ASTM E2520 - 15

Standard Practice for Measuring and Scoring Performance of Trace Explosive Chemical Detectors

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STANDARD REFERENCES

Significance and Use

5.1 The practice may be used to accomplish several ends: to establish a worldwide frame of reference for terminology, metrics, and procedures for reliably determining trace detection performance of ETDs; to give developers tangible benchmarks designed to improve detection performance of next-generation ETDs; as a demonstration by the vendor that the equipment is operating properly to a specified performance score; for a periodic verification by the user of

detector performance after purchase; and as a generally-acceptable template adaptable by international agencies to specify performance requirements, analytes and dosing levels, background challenges, and operations.

5.2 It is expected that current ETD systems will exhibit wide ranges of performance across the diverse explosive types and compounds considered. As in previous versions, this practice establishes the minimum performance that is required for a detector to be considered effective in the detection of trace explosives. An explosives detector is considered to have "minimum acceptable performance" when it has attained a test score of at least 80.

5.3 It is not recommended to use scores exclusively to compare different ETD systems in order to make procurement or deployment decisions. The scores themselves signify ratings based on general detection performance, but do not necessarily reflect capabilities with specific analytes or BCMs, nor do scores consider many factors that users may also consider important: procurement and operating costs, robustness and dependability, training requirements, ease of use, security features, size and weight constraints, network capabilities and interoperability, and radioactive material management.

1. Scope

1.1 This practice may be used for measuring, scoring, and improving the overall performance of detectors that alarm on traces of explosives on swabs. These explosive trace detectors (ETDs) may be based on, but are not limited to, chemical detection technologies such as ion mobility spectrometry (IMS) and mass spectrometry (MS). Technologies that use thermodynamic or optical detection are not specifically addressed, but may be adapted into future versions of this practice.

1.2 This practice considers instrumental (post-sampling) trace detection performance, involving specific chemical analytes across eight types of explosive formulations in the presence of a standard background challenge material. This practice adapts Test Method E2677 for the evaluation of limit of detection, a combined metric of measurement sensitivity and repeatability, which requires ETDs to have numerical responses.

1.3 This practice considers the effective detection throughput of an ETD by factoring in the sampling rate, interrogated swab area, and estimated maintenance requirements during a typical eight hour shift.

1.4 This practice does not require, but places extra value on, the specific identification of targeted compounds and explosive formulations.

1.5 This practice requires the use of a single set of ETD operational settings for calculating a system test score based on the factors described in 1.2, 1.3, and 1.4. A minimum acceptable score is derived from criteria established in Practice E2520–07.

1.6 Intended Users—ETD developers and manufacturers, testing laboratories, and international agencies responsible for enabling effective deterrents to terrorism.

1.7 Actual explosives as test samples would be preferable, but standard explosive formulations are not widely available, nor are methods for depositing these quantitatively and realistically on swabs. This practice considers sixteen compounds that are available from commercial suppliers. This does not imply that only these sixteen are important to trace detection. Most ETDs are able to detect many other compounds, but these are either chemically similar (hence redundant) to the ones considered, or are unavailable from commercial suppliers for reasons of stability and safety. Under typical laboratory practices, the sixteen compounds considered are safe to handle in the quantities used.

1.8 This practice is not intended to replace any current standard procedure employed by agencies to test performance of ETDs for specific applications. Those procedures may be more rigorous, use different compounds or actual explosive formulations, employ different or more realistic background challenges, and consider environmental sampling procedures and other operational variables.

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1.9 This practice recommends one method for preparation of test swabs, pipetting, because this method is simple, reproducible, quantitative, documented, and applicable to most current detection technologies. Other methods, such as inkjet printing and dry transfer, may generate more realistic analyte distributions and particle sizes, but these methods are not widely available and less familiar. They may be used if the procedures are validated and documented properly.

1.10 With any deposition method, some compounds are difficult to present to the ETD inlet quantitatively due to volatility and loss during the swab preparation process. Problematic issues pertinent to this practice are identified along with recommended instructions. The user should be aware of the possibility that untested scenarios may lead to failure in the determination of reliable test scores.

1.11 Units—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.12 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

Keywords

Amines - Aromatic Nitro Compounds - Cbrne Sensors And Detectors - Cyclotrimethylenetrinitramine - Ion Mobility Spectrometry - Pentaerythritol Tetranitrate - Quaternary Ammonium Compounds - Spectroscopy - Trace Explosive Detectors - Trinitrotoluene

ICS Code

ICS Number Code 13.230 (Explosion protection)

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