Explosives Quality Assurance and Operations Manual

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1 GENERAL

1.1 Forensic Examinations and Services

The Explosives Unit (EU) provides forensic-based technical and operational support for the examination of evidence associated with bombing matters through application of case experience, education, specialized training, and research.

Personnel in the EU may be qualified in one or more of the following subdisciplines: Explosives Chemistry, Fire Debris and Ignitable Liquid Analysis, or Explosives & Hazardous Devices.

1.2 Quality System

This document sets forth explosives quality assurance and operation procedures that supplement the FBI Laboratory Quality System Documents.

1.3 Externally Provided Products and Services that Affect EU Activities

Products and services that affect laboratory activities are listed in the applicable EU technical procedures with relevant specifications (when applicable). EU personnel requesting these products or services will ensure conformance with applicable specifications prior to approval by the UC. Demonstrated conformance may be maintained in various records to include, but not limited to, validation files, relevant logs (e.g., instrument performance checks, mobile phase, reagents), or other suitable technical records.

2 DOCUMENT CONTROL

EU personnel will have access to controlled copies of instrument Performance Monitoring and Maintenance protocols (PMMs) on CHEMNET.

Level 2 quality documents within the EU will be approved for adequacy by the applicable Technical Leader(s) and Unit Chief (UC).

Level 3 documents (e.g., externally produced equipment manuals) are not controlled by the EU.

Level 4 documents within the EU will be controlled and maintained electronically by the EU Quality Assurance Program Manager, applicable Technical Leader(s), or UC.

3 DEVIATIONS

All case-related minor deviations will be recorded (request and approval) within the applicable Case Record Communication Log in the Laboratory Information Management System (LIMS). All other minor deviations will be recorded on the applicable subdiscipline's Minor Deviation Log, and the applicable email approvals will be retained.

4 PERSONNEL

4.1 Training for EU Personnel

Resources that supplement the training, competency, and evaluation of EU personnel will be controlled and maintained electronically by the EU Training Program Manager, applicable Technical Leader(s), or UC.

4.2 Continuing Education

A minimum of eight hours of continuing education is required each fiscal year. For analysts and examiners, at least four of the eight hours should be technical in nature and relate to job performance. These requirements may be met by attending an in-person or virtual training, conference, or seminar, completing web-based training, reading a book, participating in a workshop, attending a course provided by an instrument or equipment manufacturer, visiting an explosive manufacturing plant or other forensic laboratory, or any other option approved by the UC or an immediate Supervisor.

4.3 Continued Competency Monitoring after Extended Leave

When EU personnel who perform laboratory activities return from extended leave, continued competence will be monitored via competency testing, proficiency/intralaboratory testing, and/or other method(s) at the discretion of the applicable Technical Leader (TL).

5 VALIDATION

5.1 Method Development (Pre-Validation)

Validation starts after a method is acquired and/or developed. If a method needs to be developed in the EU (including the modification of an acquired method), the method development will be a planned activity. The Explosives Method Development Plan and Review Form (EXPL-008) will be approved by the applicable Technical Leader (TL) prior to starting the method development. Any changes to the method development plan will be communicated to all personnel involved in the method development.

5.2 Validation Plan

A validation plan will be recorded, reviewed, and approved on the Explosives Validation Plan and Review Form (EXPL-009). The plan must be approved by the applicable TL prior to starting the validation.

5.2.1 Scope

The scope will declare the targeted matrices and analyte(s), specific equipment, and analytical method(s). The intended application of the method or procedure will be stated in the scope. The scope will generally fall into the following categories:

- Measurement of a physical property
- Screening for the presence or absence of a specified analyte or class of analytes

- Qualitative identification of a specified analyte or class of analytes

5.2.2 Performance Characteristics

The performance characteristics will vary depending on the scope. This decision requires professional judgment. For example, some performance characteristics are not relevant to particular sample types, but when applicable and appropriate, the following performance characteristics will be evaluated.

5.2.2.1 Measurement of a Physical Property

- Accuracy

5.2.2.2 Qualitative Identification or Screening for the Presence or Absence of a Specified Analyte or Class of Analytes

- Accuracy
- Carryover
- Matrix Effects/Interferences (Selectivity)
- Ionization Suppression/Enhancement
- Limit of Detection
- Processed Sample Stability
- Repeatability/Ruggedness

5.3 Conduct Validation Experiments

The following experiments are not necessarily in procedural order. Some validation experiments may be conducted concurrently. The validation plan will contain details with regards to the required number of replicates, number of runs, pre-defined acceptable limits, etc.

5.3.1 Accuracy

Accuracy (also referred to as bias) is the closeness of a measured value to the known, or "true" value and is typically reported as a percent difference. The accuracy of an analytical method can be estimated by measuring materials of known concentration or amount and comparing the result(s) with the known value(s). Matrix-matched reference materials are preferred for estimating accuracy. When practicable, these samples are obtained from an independent source rather than produced by the same person performing the validation.

$$Accuracy = \left[\frac{Measured\ Value - Known\ Value}{Known\ Value}\right] \cdot 100$$

5.3.2 Carryover

Carryover is the appearance of an analyte signal in samples after the analysis of a positive sample. Carryover will be evaluated during method development and its source investigated. This can be accomplished by running matrix blank samples immediately after a high

concentration sample or standard. If possible, the analytical procedure will be modified to remove any carryover. In cases when it is not possible to eliminate the carryover, the technical procedure and/or a guidelines procedure must address how carryover will be assessed (e.g., the signal in a case sample must be ten times greater than the signal in a blank sample immediately preceding the case sample).

5.3.3 Ionization Suppression/Ionization Enhancement

The enhancement or suppression of analyte ionization resulting from the presence of co-eluting matrix components is a phenomenon commonly encountered in liquid chromatography/mass spectrometry (LC/MS). Ionization suppression/enhancement experiments may be performed during the method development phase to ensure extraction and instrumental conditions are optimized. It can be further evaluated during the validation phase using either of the following approaches.

5.3.3.1 Post-Column Infusion

Post-column infusion provides information on retention times where ionization suppression/enhancement occurs. A solution of the analyte is constantly infused with a syringe pump into the mobile phase from the column via a post-column tee-connection and a constant, baseline signal for the analyte of interest is collected. Extracted matrix blanks are injected into the LC/MS. If there is any considerable suppression or enhancement (>25%) of the infused analyte signal at the retention time of the analyte, then modification of the chromatographic system or the sample preparation may be required to minimize the ionization suppression/enhancement.

5.3.3.2 Post-Extraction Addition

Post-extraction addition yields a quantitative estimation of ionization suppression/enhancement. Two different sets of samples are prepared, and the analyte peak areas are compared between sets to evaluate the ionization suppression/enhancement. The first set consists of the neat standards at both low and high concentrations.

Set two consists of samples extracted from different matrix sources. The extracts are then fortified with the neat standard at either the low or high concentrations.

The average area of each set ($\bar{X}$) is used to estimate the ionization suppression/enhancement effect at each concentration as follows:

$$Effect = \left[\frac{\bar{X}(extracted)}{\bar{X}(neat)} - 1\right] \cdot 100$$

A negative value is indicative of ionization suppression, while a positive value is indicative of ionization enhancement. In instances when it is not possible to eliminate ionization suppression/enhancement during method development, the technical procedure should address how it will be managed.

5.3.4 Limit of Detection (LOD)

The LOD is an estimate of the lowest concentration (or amount) of an analyte that can be reliably differentiated from the analyte-free matrix and/or the background noise. In some instances, it may not be necessary to establish the absolute LOD provided it is shown to be less than the lowest concentration required by the method. Because a method's LOD incorporates the instrumental performance as well as the sample matrix and inherent procedural limitations, it may be important to assess LOD over multiple days. The LOD may be estimated by one or more of the following approaches.

5.3.4.1 Estimating LOD for Screening Methods

This approach is used for non-instrumental screening methods (e.g., chemical color tests). Blank matrix sources are fortified with decreasing concentrations of the specified analyte. The matrix-matched samples are then analyzed. Multiple analysts should be involved in assessing the results if there is subjectivity involved in the screening method. The lowest concentration of analyte that yields a positive result on all runs and confirmed by all participating analysts is considered the LOD.

5.3.4.2 Estimating LOD Using Background Noise

The following approaches may be used for determining the LOD of methods that demonstrate equipment-related background noise.

5.3.4.2.1 Estimating LOD Using Reference Materials

Matrix-matched reference materials at known concentrations are analyzed. The LOD is defined as the lowest concentration (or amount) of an analyte that reproducibly yields a signal greater than or equal to 3.3 times the noise level of the background signal.

5.3.5 Processed Sample Stability

Circumstances may arise in which samples that have undergone routine preparation cannot be immediately analyzed. In these instances, it is important to evaluate the length of time a prepared sample can be maintained before it undergoes changes, which may prevent reliable detection.

Matrix-matched reference materials are processed and used for stability determinations. It is important to ensure that sufficient quantity is prepared to complete this evaluation, keeping in mind that it may be necessary to split the sample into multiple portions. For example, samples in different autosampler vials may be analyzed every 8 hours up to 72 hours. The average responses for analytes of interest and any internal standards are used to evaluate any significant changes over the duration of the study.

5.3.6 Matrix Effects/Interferences (Selectivity)

Interference studies are used to assess the selectivity of a method. Selectivity is the extent to which an analytical procedure is free from interferences arising from non-analytes, including matrix components which may be expected to be present. Selectivity can often be improved by

modifying sample preparation or instrumental parameters (e.g., using a different column in chromatography).

The use of an alternate analytical procedure for verification of analytical findings is an additional assessment of selectivity. Whenever possible, orthogonal analytical techniques will be employed to respond to different properties of a particular analyte. For example, Fourier Transform Infrared Spectroscopy (FTIR) and mass spectrometry are orthogonal to each other, while FTIR and Raman spectroscopy are complementary, but non-orthogonal.

5.3.6.1 Matrix Effects

Matrix effects are usually sample specific and will be addressed on a matrix-by-matrix basis. When applicable, analyze matrix blanks from different sources to demonstrate the absence of interferences in the matrix.

5.3.6.2 Other Interferences

In certain instances, it is necessary to check for possible interferences from other analytes which may be expected to be present in authentic samples. For example, a method for analyzing soil samples for TNT must be evaluated for interferences caused by the soil matrix, but also evaluated for other organic explosives (e.g., RDX). This is accomplished by analyzing a negative matrix spiked with the potential interference(s) at appropriate concentration(s). Alternatively, neat standards of potentially interfering compounds can also be injected for this evaluation.

5.3.7 Repeatability/Ruggedness

The newly developed method will be completed at least three times by a single analyst. This does not have to be done in consecutive days. In addition, the newly developed method will be completed by at least two analysts. The results from the multiple day study and multiple analyst study will be compared to determine any deficiencies from the previous validation results. If deficiencies are observed, the source of the deficiencies will be investigated and recorded in the validation file. The method will be amended, including repeating any relevant performance characteristics, to address any noted deficiencies. If the method is not able to address a deficiency, this will be noted as a limitation in the method.

5.4 Modifications of Validated Procedures

Modifications to a validated procedure require verification that the changes do not have an adverse effect. The decision regarding which performance characteristics require additional validation will be based on logical consideration of the specific parameters likely to be affected by the change(s). These changes may include, but are not limited to:

- Analytical conditions
- Equipment
- Sample processing
- Data software

5.5 Validation Summary

A validation summary will be completed for each validation study. The individual that led the validation study will complete the form and provide it to the applicable TL. If the TL led the validation study, then another individual qualified in the applicable subdiscipline will review and approve the validation summary. The summary will briefly describe the performance characteristics that were evaluated to include the values that were obtained for the performance characteristics, if applicable. Other details may be included in the summary. An abstract for a scientific article is a basic model that may be considered when composing the summary.

5.6 Technical Review of Validation Records

The technical review(s) will be recorded on the first page of the validation records.

5.7 Validation of New Instruments

Newly installed instrumentation with pre-existing methods will be validated by conducting a performance check over three days according to the applicable PMM. The three days do not have to be consecutive. Successful completion of the overall instrument validation will simultaneously verify that the instrument software is working as expected. Validations of this type do not need to be approved by the TL.

6 EQUIPMENT CALIBRATION/MAINTENANCE

Approximate measurements of physical characteristics (e.g., mass, length, diameter) serve as descriptors and may be reported without measurement uncertainty.

Although infrequent, the specific mass of a crude material may be requested by the contributor. When requested, the crude material will be weighed by Chemistry Unit (CU) personnel using a traceable balance with known measurement uncertainty. All associated examination records, including measurement uncertainty and applicable calculations, will be provided by the CU for inclusion in the case file.

6.1 Calibration

The following equipment utilized by EU personnel requires calibration:

Equipment	Calibration Interval
Balances	Annually
Calipers and micrometers	Annually
Pipettes	Annually

Calibrations are performed to manufacturer's specifications by a service provider that is ISO/IEC 17025 accredited for the specific calibration type, to include field calibrations, as appropriate.

6.2 Maintenance

The following equipment maintenance is performed on a predetermined schedule:

Equipment	Maintenance Interval
Microscopes	Annually

Some microscopes used by the EU contain digital cameras with measuring capabilities. Each microscope used to take measurements will be verified using a ruler or stage micrometer after each annual maintenance service.

Maintenance of explosives chemistry instrumentation is described in the appropriate PMM. Routine software updates for EU equipment will be completed as suggested by the manufacturer and is considered maintenance.

6.3 Portable Equipment

Portable equipment for field examinations will be stored and transported in suitable protective and secured containers.

6.3.1 Validation of Portable Instrumentation

After initial acquisition, and prior to being placed into service, the portable instrumentation will be validated over three days using the manufacturer-recommended verification sample (e.g., polystyrene). The three days do not have to be consecutive. Validations of this type do not need to be approved by the TL.

Each instrument will pass the validation process if the verification sample successfully matches the internal library according to the instrument. If the instrument does not identify the appropriate match, it will be reanalyzed up to three times. If the instrument continues to fail to identify the appropriate material, then troubleshooting will be conducted or the manufacturer will be contacted for troubleshooting assistance. Successful completion of the overall instrument validation will simultaneously verify that the instrument software is working as expected.

Infrared and Raman systems will also be evaluated by analyzing two explosives-related compounds (e.g., ammonium nitrate and TNT) at least once.

The validation data will be placed in the validation file and labeled with the instrument's unique serial/identification number and results.

6.3.2 Field Use of Portable Instrumentation

Prior to being used in the field for casework purposes by EU personnel, portable instrumentation will undergo a performance check to ensure that the instrument works as expected on the day of use. The performance check will be conducted using the manufacturer-recommended verification sample (e.g., polystyrene).

Upon return from field use or deployment, the performance check data will be printed and maintained in the portable instrumentation binder. If the instrument was not utilized in the field, the performance check data does not need to be printed.

Portable instrumentation usage is strictly for presumptive screening purposes only to determine hazard classification to ensure proper storage, handling, and shipping requirements

are met. However, if the presumptive results are used for sampling of items to be sent to the FBI Laboratory for examination, then the unique identifier of the instrument (e.g., serial number) will be recorded in the case file.

6.3.3 Field Use of Other Portable Equipment

Micrometers, calipers, and microscopes are not presumptive screening tools and do not need to be performance checked prior to being placed into service or used in the field. However, only calibrated EU equipment (e.g., calipers, micrometers) will be used for examinations at a non-FBI Laboratory controlled space. The examinations performed and the unique identifier of the equipment used will be recorded in the case file.

7 EQUIPMENT

7.1 Reagents

7.1.1 Verification of Reagent Reliability

The reliability of a reagent will be verified prior to, or in concurrence with casework. This may be done in any of the following ways:

- When available, follow the reagent verification instructions given in the applicable technical procedure.
- Perform the analysis using suitable reference materials, known materials, controls, and/or blanks and evaluate the outcome.
- Conduct a measurement of a chemical property (e.g., pH, presence of peroxide).

Reagent verification data will be kept within the instrumentation or mobile phase log.

For mobile phases, at the time of preparation or upon first use, a testmix and a blank are analyzed using the new mobile phase. The new mobile phase should give the expected results. A copy of the testmix analysis will be initialed and placed in the instrument Quality Assurance/Quality Control (QA/QC) log.

When a new mobile phase does not give the desired results upon the analysis of a testmix and a blank, refer to the specific instrument's PMM to troubleshoot the system. After troubleshooting, if it appears the instrument is performing within acceptable parameters, re-analyze the testmix and the blank.

7.1.2 Internally-Prepared Mobile Phases

Mobile phases prepared and used by chemists will be recorded in a mobile phase or reagent preparation log. The log will contain the following information:

- Reagent name
- Preparation date
- Initials of preparer
- Name, manufacturer, and lot number of each component
- Expiration date, if applicable

- Initials of tester
- Whether the mobile phase worked as expected

Refills of mobile phase reservoirs containing deionized water only (e.g., ion chromatographs) do not need to be logged.

The following information will be placed on stock containers of prepared mobile phase:

- Reagent name
- Preparation date
- Initials of preparer
- Expiration date, if applicable

7.1.3 Solvents

Upon opening a solvent for the first time, the date and initials of the opener will be recorded on the bottle. Solvents will be continuously evaluated for contaminants concurrent with casework (blanks), and the data will be maintained in the case file. If a solvent is determined to be contaminated, it will be properly discarded.

7.1.4 Expiration

The expiration date for reagents and solvents is determined by the expiration date provided by the manufacturer or determined by the individual PMM or technical procedure describing its preparation. Reagents and solvents may be used past their expiration dates provided that the reagent reliability is verified. This may be accomplished by the analysis of blanks, controls, and/or standards.

7.1.5 Labeling of Reagent Containers

7.1.5.1 Purchased Reagents

Purchased reagents will have the following information recorded on the container:

- Date received
- Date opened

7.2 Reference Materials

7.2.1 Definitions

A reference material is a material with known origin, sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.

A certified reference material (CRM) is a reference material, characterized by a metrologically valid procedure for one or more specified properties, accompanied by a reference material certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability

7.2.2 Reference Material Verification

All chemical reference materials must have their identities verified prior to, or in concurrence with, use in casework. A CRM does not require identity verification. However, it is good laboratory practice to verify dilutions and/or prepared mixtures of CRMs (e.g., testmixes).

For all other reference materials, only one sample per manufacturer's lot number must be verified. Subsequent reference materials from the same lot will be considered as having the same verification as the original. Verification will be achieved by at least two orthogonal techniques, when practicable. If two orthogonal techniques do not exist, the analysis results from one structural elucidation technique must be compared to a referenced literature source. Results must compare favorably with a previously analyzed reference material, reference data, or literature, as necessary.

When the identity verification is complete, the data will be maintained on the respective instruments, in the case file, or be printed and filed in the validation file.

7.2.2.1 Discrepancies in Identity

Discrepancies in the structural identity of a reference material following qualitative testing will be discussed with the manufacturer and, if necessary, actions will be taken to obtain another reference material. If the material is retained, the container will be labeled with information indicating the discrepancy.

7.2.3 Synthesis of a Reference Material

When a reference material is not available from a vendor, it may be necessary to synthesize it (e.g., peroxide-based explosives). The following information will be recorded and maintained in the validation file:

- Name of synthesized reference material
- Procedure or notes used to synthesize the material
- Date of synthesis
- Initials of the person who synthesized the material
- Lot number, if applicable
- Storage instructions, if applicable
- Verification of identity data

7.2.4 Use of Reference Materials Beyond Their Expiration Date

The expiration date for reference materials is determined by the expiration date provided by the manufacturer or by the individual technical procedure (or other applicable document) describing its preparation. A reference material may be used past its expiration date provided that the reference material is verified.

7.2.5 Use of Reference Materials

Reference materials may be used for analysis or comparison in casework and/or evaluation of equipment. At the time of use, include the relevant information from the label or cite the database's unique identifier in the examination records.

When using synthesized reference materials in casework, cite the database's unique identifier or record the following information in the examination records for the case in which it was used:

- Name of synthesized reference material
- Date of synthesis
- Lot number, if applicable

Note that detailed synthesis procedures, notes, and/or recipes of explosives may be considered "Law Enforcement Sensitive." Refer to applicable classification guides for proper marking of this information.

7.3 Known Materials

A known material is an item acquired for method development, validation, and/or comparison with an evidentiary sample (e.g., commercial products, items received directly from manufacturers or distributors).

Known materials can be used during the examination of energetic materials and explosive and hazardous device components (such as, but not limited to, detonators, detonating cord, and batteries). Known materials do not have to be verified. The same analytical examinations will be performed on all items, regardless of the source.

Known materials used by EU personnel usually fall into one of the following categories:

- Commercial products: Items that can be purchased by the general public (e.g., pyrotechnics, batteries, clocks).
- Manufacturer's or distributor's samples: Samples that are acquired directly from the manufacturer or distributor (e.g., detonators, detonating cord).
- Other sources: Samples acquired from sources (e.g., other government agencies, other laboratories).
- Database samples: Samples from the above sources for reference collections/databases established by an FBI Laboratory unit(s) (e.g., Smokeless Powder Database, Detonator Database).

7.3.1 Records for Known Materials

Most commercial products have a trade name, the name of the manufacturer, the product size (e.g., 100-foot roll, 2.5 oz.), and possibly a lot number and expiration date on the label. Retain the original label with the product when possible. Retain any related product literature, data specification sheets, or hazard information sheets provided by the manufacturer or distributor of the material, as appropriate.

The following information (if available) will appear either on the outer storage container, on a tag/label attached to the product, or recorded in the Explosives Reference Tool (EXPeRT) database or the Explosives Reference File (ERF) (or equivalent). A unique identifier will relate a product to a database entry.

- Full name of product

- Name of manufacturer/distributor/source
- Size of product and type of container (e.g., 12 oz. can, 16 oz. bottle)
- Lot number
- Expiration date, if applicable

7.3.2 Use of Known Materials

At the time of use, include the relevant information from the label or cite the database's unique identifier in the case notes.

7.4 Storage

Reagents, solvents, reference materials, and known materials will be stored according to manufacturer recommendations. Reference materials that have been diluted in a solvent will be stored in a refrigerator unless indicated otherwise by the manufacturer or PMM.

8 MONITORING

All qualified EU examiners and analysts will complete a minimum of one proficiency test, interlaboratory comparison, intralaboratory comparison, or observation-based performance monitoring per calendar year. Personnel who conduct examinations in more than one EU subdiscipline will participate in performance monitoring in each subdiscipline.

EU examiners and analysts will complete the following performance monitoring:

Subdiscipline	Performance Monitoring Type
Explosives Chemistry	Proficiency Test
Fire Debris & Ignitable Liquids	Proficiency Test
Explosives & Hazardous Devices	Intralaboratory Test

8.1 Distribution

The EU Proficiency Test Representative (PTR) will distribute, evaluate, and record proficiency and intralaboratory tests for the unit. The PTR will email the test participant when the proficiency or intralaboratory test is available, and this email will be retained within the test file for the participant.

The time limit for proficiency tests will be determined by the provider. Intralaboratory tests will have a time limit of ten weeks. Extensions to the due date for internal tests may be granted by the PTR or the UC and will be documented in the test records.

8.2 Proficiency Testing

Each analyst will perform the examination portion of his/her proficiency test that is commensurate with his/her training. The analyst will furnish an examiner with all the notes and data that pertain to the examinations performed. The examiner will complete the external provider's results form based on the results of the analyst's examinations and complete the review and test submission processes.

Each examiner will complete all examinations and sections of the external provider's results forms for proficiency tests conducted by that examiner.

All proficiency tests will be administratively and technically reviewed in the same manner as casework. If the reviewer is participating in the same test distribution, the reviewer must complete his/her portion of the test prior to performing a review.

8.3 Intralaboratory Testing

Each analyst will perform the examination portion of his/her intralaboratory test that is commensurate with his/her training. The analyst will furnish an examiner with all notes and related records that pertain to the examinations performed. The examiner will evaluate this material and will upload a document containing the results of the examinations into the Case Record Object Repository with all relevant information (e.g., laboratory number, date, initials).

Each examiner will complete all examinations and draft the results for intralaboratory tests conducted by that examiner.

The examination process will include inventory and sorting of specimens, photography, evidence examination, taking examination notes, and case records. Each examiner/analyst will contribute to the final product by conducting one or more of the described tasks which are performed as a part of routine casework.

When an examiner and analyst are working together, each person must record his/her participation by placing his/her initials on each page of the laboratory notes. If multiple analysts are working together on an intralaboratory test, the analyst responsible for memorializing the analysis of the evidence in the laboratory notes will provide the first set of initials in a series of initials. Analysts who participate in functions other than note preparation will initial after the note preparer analyst's initials. The second set of initials indicates that all analysts working on the intralaboratory test have reviewed the notes and agree with their accuracy (e.g., ABC/DEF, where ABC prepared the notes and DEF inventoried, sorted, and photographed the evidence). To indicate review and concurrence with the data memorialized in the notes, the examiner will initial each page in an area separate from the analyst(s).

8.3.1 Preparation of Intralaboratory Tests

An intralaboratory test plan will be approved by the applicable TL and will contain relevant details such as test identification number, subdiscipline, preparation method(s), sample identifiers, and expected results. The test will be prepared by an individual qualified in the subdiscipline unless the individual is participating in the same test distribution. The applicable TL may authorize someone not qualified in the subdiscipline to prepare the test. All preparation, validation, and approval records will be maintained by the PTR.

8.4 Evaluations of Monitoring

All proficiency and intralaboratory tests will be evaluated by the PTR and recorded in the test records. If the PTR is being tested, the UC or applicable TL will perform the evaluation of the

PTR's results. Upon completion of the evaluation, the test participant will be notified to review the evaluation.

Any monitoring discrepancy identified by the PTR, UC, or TL will be reported in writing, at the time of detection, to the FBI Laboratory Proficiency Test Program Manager (PTPM). Each participant must respond in writing to any discrepancy identified by the PTR, UC, or affected TL(s) as noted in the evaluation. These comments, including any suggested corrective action(s), are to be included in the permanent monitoring file for the participant.

9 EVIDENCE HANDLING

9.1 Personal Protective Equipment (PPE)

Appropriate personal protective equipment (PPE) (e.g., laboratory coat, disposable gloves, safety glasses) will be worn by personnel during all evidentiary processes to include, but not limited to, evidence inventory, examinations, and cleaning of laboratory spaces.

9.2 Evidence Storage

Evidence will be stored in an Evidence Storage Room (ESR). Evidence being inventoried, processed, and/or reviewed is considered under active examination and will be secured by placing an "Evidence Do Not Disturb" sign (or similar) near the evidence and locking the door to the room (where possible).

All drug and valuable evidence, at the end of each working day, will be sealed and stored in a specifically-designated safe.

9.3 Explosives Evidence Storage

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10 EXAMINATION PROCESS

Appendix A contains a list of abbreviations that are specific to the EU. Any other abbreviations will be defined upon first use within each case file.

If a trainee is taking notes on behalf of a qualified analyst or examiner, then the relevant notes section(s) will include the initials of the trainee and the qualified individual. This may include the analyst and/or the assigned examiner.

10.1 Case Assignment

The UC will ensure that the submission information is reviewed and that cases are assigned to the appropriate examiners based on the subdiscipline (e.g., Explosives Chemistry, Fire Debris and Ignitable Liquids Analysis, Explosives and Hazardous Devices) involved in the request.

10.2 Receiving Evidence

Evidence for the EU is generally delivered to an Evidence Storage Room (ESR) or via hand-to-hand transfer. All transfers will be recorded on appropriate chain-of-custody log and will include a specific Evidence Interim Storage Locker (EISL), specific evidence storage locker (ESL), refrigerator, or freezer when applicable. Drug and valuable evidence will be directly transferred to caseworking personnel for storage in the drug and valuable safe. If a piece of evidence is too bulky, or there are too many items to be stored in an ESL, the evidence may be placed in an examination room and properly secured.

At times, evidence is received directly from the field. Evidence transfers occurring in the field will be recorded on a Chain-of-Custody Log (7-243) or other appropriate form.

An appropriately trained employee (typically evidence management personnel) will receive the evidence and initiate a submission to obtain a Laboratory number.

10.3 Evidence Inventory

After a case is assigned and the evidence is delivered, the evidence container(s) and/or packaging will be opened, when practicable, and the contents inventoried. Check-in notes will be prepared upon inventory of the evidence and will be retained in the FBI Laboratory file.

The evidence received will be compared against the itemized listing in the request for examination. If anything is missing or if items are present which are not listed as being delivered, it will be brought to the attention of evidence management personnel.

If any evidence container(s) and/or packaging is damaged or in an unsealed condition, it will be recorded in the check-in notes or case notes. The decision to proceed with evidence processing and analysis will be dependent on the circumstances of the case, the nature of the packaging, and determined by the assigned examiner. If examinations will not be conducted, evidence management personnel will be notified.

Check-in notes will be prepared to record the type and nature of the packaging of the submitted item(s). If the primary packaging is not sealed but examinations will still be conducted, the lack of a seal(s) will be noted in the check-in notes or case notes and the packaging will be sealed upon completion of examinations.

10.3.1 Inventory of Evidence for Explosives Residues or Trace Evidence

Items to be examined for explosives residues or trace evidence will only be photographed outside of its original packaging after the completion of all appropriate chemical or trace analyses unless there are unusual circumstances precluding this requirement. If photographs must be taken before explosives residue or trace evidence examinations are conducted, the camera and the area around it must be thoroughly cleaned and appropriate control samples will be taken before the items are removed for photography.

When it is determined that explosives residue examinations are to be conducted on an item, the following procedures will be used to prevent contamination:

- If the primary evidence container is not opened, the item(s) should remain in this packaging and be taken to the explosives chemistry examiner. If inventory, safety check, or multi-discipline visual exam needs to be conducted where the container must be opened, this should be performed with the explosives chemistry examiner and/or chemist in the explosives trace room, when possible. Otherwise, the handling of the evidence should be recorded (e.g., check-in notes, case notes, Communication Log) to allow for the identification of potential sources of contamination.
- If an item(s) is removed from the original container for repackaging, the specimens must be transferred to an appropriate new container (e.g., glass vial, heat-sealable bag, metal can). During the transfer, clean disposable gloves must be worn and the evidence will be placed directly into the clean container without coming in contact with any other surfaces.

10.3.2 Safety Check

Redacted

10.4 Evidence Preservation

EU personnel will at all times be aware of the need to protect the evidence for examinations that may be conducted by analysts or examiners of other units and to preserve the integrity of each item by protecting it from loss, cross-transfer, contamination, or deleterious change. These individuals, through their training, will be knowledgeable of the proper sequence in which examinations need to be conducted. If an analyst or examiner receives evidence that should be examined by another discipline/subdiscipline first, or receives evidence after being processed by another discipline/subdiscipline that prevents an examination from being conducted, evidence management personnel will be notified.

The following evidence preservation procedures will be performed by EU personnel when applicable to the evidence received:

Redacted

- Temperature Monitoring: Digital thermometers are connected to all refrigerators and freezers which store evidence. These thermometers are monitored by an

electronic temperature monitoring system managed by FBI Laboratory instrument operations personnel. The electronic temperature monitoring system collects and maintains temperature information, and appropriate personnel are notified if a temperature reading is outside of typical refrigerator/freezer settings. These personnel determine the cause of the fluctuation and will coordinate maintenance or replacement of the refrigerator/freezer as necessary. Manual monitoring may be performed if the electronic temperature monitoring system is unavailable.

- Trace Evidence: Appropriately trained trace evidence personnel will open and collect appropriate trace evidence prior to other examinations being conducted.
- Firearms: FBI-qualified firearms instructors may render firearms safe. If one is not available to perform this task, the assistance of appropriately trained Laboratory personnel will be requested.
- Documents: If indented writing examinations will be conducted, personnel will protect the evidence from any action that might impart (or transfer) impressions onto the evidence, including the use of initials to place the evidence under proper seal. If necessary, the evidence should be placed into an additional container to protect it from impressions.

Redacted

- DNA Evidence: Evidence to be examined for DNA will be handled carefully to prevent additional and/or loss of DNA. The use of appropriate PPE (e.g., lab coat, gloves, mask) minimizes the chance of transferring DNA to the evidence. For items to be heated during examinations, DNA personnel should be contacted to have the item swabbed prior to heating.

10.5 Explosives Contamination Prevention

As with all trace analysis, the importance of taking preventative measures to ensure that contamination does not occur is critical with explosives examinations. These measures need to be followed in cases involving both explosives residues as well as bulk materials. Every circumstance is unique and requires expert judgment. Several measures are employed to ensure that transfer and contamination do not occur in casework.

Submissions from multiple locations (e.g., a post-blast crime scene and the subsequent search of a subject's residence) will be physically separated from each other until after the explosives residue examinations and other trace evidence examinations (e.g., hairs, fibers) have been completed. If items from searches of multiple locations are submitted to the FBI Laboratory in a single container, an evaluation will be made by the explosives chemistry and/or explosives and hazardous devices examiner, in consultation with the trace evidence examiner(s), regarding the manner in which to proceed and any subsequent limitations regarding the significance of the analytical results.

10.5.1 Preparation of Laboratory Work Surfaces

Clean the work surfaces with isopropyl alcohol (IPA). A new disposable paper towel will be used to wipe the surface.

Cover the work surfaces with a disposable material such as kraft paper. The work surface covering will be replaced, at minimum, upon completion of the evidence inventory process for each submission. This procedure will be used for each new submission. At no time should explosive residues evidence be placed upon an improperly prepared work surface.

10.5.2 Explosives Trace Room

Separate areas have been designated for residue and bulk explosives chemistry examinations. An area with limited access has been dedicated for residue analysis (explosives trace room). Sticky mats have been placed at the threshold of these rooms to minimize the possibility of contamination. Personnel utilizing these areas must sign a logbook to record the date and laboratory number associated with the evidence being analyzed within the room.

Evidence submitted from multiple post-blast scenes will be examined separately in the explosives trace room. The room will be thoroughly cleaned in between scenes, and new PPE and supplies will be used for each.

Collect appropriate negative control samples as referenced in the Explosives Residue Analysis procedure. Wear a new disposable laboratory coat (Tyvek or equivalent) and clean disposable gloves (clean room gloves preferable when handling evidence) prior to examining evidence items. Disposable supplies such as glassware/plasticware, syringes, and filters will be used when available and appropriate. Change laboratory coat and gloves and clean work surfaces between examinations, as necessary.

10.5.3 Personal Hygiene

Personnel conducting examinations within laboratory space are expected to wear clothing free of explosive(s). In particular, clothing must be changed after performing work on the explosives range and before entering any areas in the laboratory in which evidence containing explosives residue is stored, processed, and/or examined. It may also be necessary for personnel to shower or bathe in order to remove any potential contamination from hair or skin and wash other items such as glasses, watches.

Firearms will not be worn while working in the explosives trace room.

10.6 Secondary Evidence

Secondary evidence is a material derived from an examination process on an item of evidence (e.g., prepared microscope slides, pill boxes containing scraped debris, vials containing extracts or c-strips). It is not an individual item submitted by a contributor and could not have been assigned an item identifier through the evidence inventory process.

When secondary evidence is created, a new item identifier will be generated and recorded on the Explosives Secondary Evidence Log (EXPL-007). The secondary evidence item description

will include the name of the unit and the number and type of secondary evidence (e.g., "Explosives Unit Secondary Evidence [2 glass vials]").

10.7 Sampling

Physical evidence submitted to explosives chemistry and explosives and hazardous devices personnel for analysis routinely consists of bulk materials. Bulk materials can commonly be further categorized as either liquid or solid.

Sampling is defined as the selection of a sample for testing according to a procedure. The approach to sampling can be either non-statistical or statistical.

Non-statistical sampling may be conducted on homogenous or heterogeneous items. If an item is determined to be homogenous, the portion analyzed can be representative of the whole item. If an item is determined to be heterogeneous, a portion of each component present in the item will be analyzed to be representative of the item as a whole, as practicable.

Statistical sampling may be conducted on several items to make an inference on a larger group of items (e.g., analyzing 20 out of 100 like items). If this is done, the specific statistical sampling method will be stated and the corresponding calculations retained.

Samples within manufacturer-sealed containers will not be opened and analyzed unless a technical, practical, or safety reason is stated.

10.7.1 Liquids

It is important to stir liquid samples adequately to ensure proper mixing. If the item appears to be homogeneous, remove an appropriate quantity of sample for analysis.

If the item appears to consist of two or more immiscible liquids, remove an appropriate quantity of each liquid and analyze the components separately.

10.7.2 Solids

If visual examinations (to include microscopic examinations) indicate that the item is homogenous, remove an appropriate quantity of sample for analysis.

If visual examinations (to include microscopic examinations) indicate that the item is heterogeneous, attempt to separate and remove appropriate quantities of the individual components to analyze separately. A heterogeneous sample may also be analyzed according to specific extraction procedures. Refer to the appropriate explosives analysis procedure that best categorizes the sample to be analyzed.

When smaller amounts of a non-homogeneous, bulk material are submitted for analysis, the sample may be homogenized with a mortar and pestle, as applicable.

10.7.3 Limitations

If inconsistent results are obtained during the analysis of the samples, further portions may need to be analyzed. Individual component analyses of complex, heterogeneous mixtures may not be representative of the item as a whole.

11 REPORTING OF RESULTS

11.1 Case Records

A case file consists of the administrative and examination records for a case. It is a compilation of case records, requests for examinations, photographs, technical records, and other pertinent communications and information. These records (physical or electronic) will be retained in the case file.

11.2 *Laboratory Report* Reviews

The review of EU case records encompasses three forms of review: verification of identifications and associations, technical review, and administrative review.

11.2.1 Verifications of Identifications and Associations

Verification of identifications and associations is defined as a comparison of physical and/or chemical traits that results in repeatable similarities between the items with a coexistent lack of meaningful differences.

11.2.2 Technical Review

Technical reviews and verification of identifications and associations, if applicable, will be conducted when a *Laboratory Report* contains examination results. The technical review and verification of identifications and associations will be combined into a single review process. The technical review and verification of identifications and associations will be conducted by a technical reviewer who is authorized in the subdiscipline being reviewed.

11.2.3 Administrative Review

All *Laboratory Reports* will be administratively reviewed. This review may be conducted in conjunction with the technical review.

An administrative review will be conducted by the issuing examiner's UC, appropriate TL, or any EU-qualified examiner.

11.2.4 Expedited Results

Expedited results are considered preliminary and may be disseminated via email to the contributor without a technical review prior to issuing a *Laboratory Report.* Expedited results must reference the pertinent items and will state that the results are preliminary in nature and subject to change upon review. If expedited results are provided verbally, the examiner will also send an email containing the results and necessary information.

11.3 Multiple Examiner *Laboratory Reports*

When a *Laboratory Report* in the subdiscipline of Explosives and Hazardous Devices is being issued and results from another examiner(s) must be included, the explosives and hazardous devices examiner will identify each examiner's results and include a statement that includes the

FBI Laboratory number and Case Record number of the other examiner's report, the examiner's name, and the date of his/her report.

11.3.1 Exception – Multiple Examiner Reports

A multiple examiner *Laboratory Report* may be issued without Sentinel approval by the cited EU examiner if the report must be issued due to external time constraints (e.g., investigative actions, trial dates, deployments) and the cited examiner is unavailable to come to the office. Verbal or written approval by the cited examiner will be recorded in the Case Record Communication Log by the Explosives and Hazardous Devices examiner. The applicable TL will ensure that the cited results accurately reflect the results in the cited examiner's standalone report and will approve in Sentinel in lieu of the cited examiner. [Exception to LAB-200, Section 3.1.8.2.C]

11.4 Intelligence, Information, and/or Investigative Leads (i3) Products

11.4.1 Informal Requests for Information

The EU routinely receives informal questions or requests for information from FBI and external contributors. Such requests:

- May be received over the phone or via email
- May result in a negative response (e.g., no information is provided)
- Could include general evidence packaging and/or submission information
- Commonly require general subject matter expertise

Responses to these requests are not considered i3 products and will not be tracked or retained. Through consultation with the contributor, if it is determined that a formal reporting product (not a *Laboratory Report*) is needed, then an EU i3 product will be provided.

11.4.2 EU Technical Assessment

The EU defines its i3 product as an EU Technical Assessment that is written in Microsoft Word. The i3 product may also be titled Technical Threat Assessment depending on the specific request. Upon completion, the Technical Assessment will be converted to a PDF for retention.

A qualified forensic examiner in the EU may state more information (e.g., additional chemical and/or physical characteristics of an explosive sample) in an i3 product than typically included in a *Laboratory Report* but will not give opinions outside of their qualifications and expertise (e.g., explosives and hazardous device examiners will not opine on the chemical analysis of explosives and explosives chemistry examiners will not opine on the hazardous device analysis of device components).

An EU Technical Assessment will be issued as an i3 product for the following types of requests:

- The contributor specifically requests an EU Technical Assessment (in lieu of a *Laboratory Report*) of non-physical items, including, but not limited to, photographs, manufacturing instructions, or lists of chemicals and/or device components.

- Laboratory examinations are requested on non-evidentiary physical items (e.g., chemical and/or physical characterization of an explosive sample).

11.4.2.1 Examinations of Non-Evidentiary Physical Items

Examinations performed for reporting in an EU Technical Assessment may only be performed using instruments and methods that have been validated according to the FBI Laboratory Quality System documents. An appropriate chain-of-custody form (e.g., 7-243, 7-243a *FBI Laboratory Chain-of-Custody Log*) may be used for tracking custody transfers of the non-evidentiary items; however, this is not required unless specifically requested by the contributor.

The issuance of an EU Technical Assessment for examinations will be up to the discretion of the examiner based on the specific request and level of effort. If the customer does not request a formal reporting product, then the data can be provided as an informal request. However, the examiner may still choose to write an EU Technical Assessment for work that requires a higher level of effort and/or involves data interpretation and opinions.

11.4.2.2 Reviewing EU Technical Assessments

All Technical Assessments will undergo an administrative review, technical review, and verification of identifications and associations (when applicable) in accordance with Section 11.2 *Laboratory Report* Reviews. The reviewer(s) will record approval of the product in the supporting records (e.g., signature, Sentinel approval, email).

11.4.2.3 Issuing EU Technical Assessments

Only qualified forensic examiners in the EU are authorized to issue Technical Assessments.

Technical Assessments will be serialized into an administrative Case File in Sentinel for tracking and retention and into the contributor's investigative Case File, when applicable. A copy may also be provided to FBI contributors via email. This email will not be retained.

Technical Assessments issued to external contributors will be provided via email. This email will not be retained.

11.4.2.4 Competency and Performance Monitoring

The Training Manual for the Explosives Unit contains i3 product training requirements for forensic examiner trainees, to include demonstrating competency. A separate competency test for issuing i3 products is not required because competency is demonstrated via real and/or simulated exercises. Performance monitoring of forensic examiners who issue i3 products will be conducted according to Section 8 Monitoring.

11.4.2.5 Retaining Records

Supporting examination records (e.g., examination notes, instrument data) will contain the date and initials of the preparer and will be serialized in Sentinel as a 1A/1C package(s) attached to the product using one of the following methods:

- Electronic records uploaded and serialized as a digital 1A package
- Physical records placed in a *Supporting Documentation Envelope(s),* serialized as a physical 1A/1C package, and retained by the unit

12 SAFETY

Safety protocols, contained within the FBI Laboratory Safety Manual, will be observed at all times. Standard precautions, including the use of PPE, will be taken for the handling of all chemicals, reagents, and standards including universal precautions for the handling of biological and potentially hazardous materials.

Explosives are inherently hazardous as they are sensitive to heat, shock, friction, impact, and/or electrostatic discharge. Personnel should work with small quantities of material (such as a few hundred milligrams) and properly store larger quantities in approved containers. Additional safety precautions on explosives and/or instruments are described in specific technical procedures.

13 REVISION HISTORY

Revision	Issue Date	Changes
00	02/22/2022	Drafted new manual. Replaces and combines some previous level 2 quality assurance documents.
01	04/17/2023	Updated section 8. Added safety check content to 10.3.2. Added manual temperature monitoring to 10.4. Added sections 4.3 and 11.3.1. Added chain-of-custody to section 11.4.2.1. Changed review requirements in section 11.4.2.2. Added new section 11.4.2.4.

APPENDIX A: ABBREVIATIONS USED IN EXPLOSIVES UNIT EXAMINATION RECORDS

à	to, into, transferred to
(-)/-	negative
(+)/+	positive
(?)	indicates uncertainty
Ø	absent
~	possible
=	consistent with, to the limit of the specific examinations performed
abs	absent
ace	acetone
ack	acknowledge, acknowledgement
Al	aluminum
amt	amount
AN	ammonium nitrate
ANFO	ammonium nitrate fuel oil
APCI	atmospheric pressure chemical ionization
API	atmospheric pressure ionization
appear	appearance
arb	arbitrary
AS	autosampler
assoc	associated
ATB	appears to be
ATR	attenuated total reflectance
AUSA	Assistant United States Attorney
ave, avg	average
AWG	American (standard) wire gauge
batt	battery(ies)
bl	blue
blk	black
bkg	background
BP	black powder
bpb	brown paper bag
BPS	black powder substitute
Br	brass
br, brn	brown
brt	bright
BSE	backscatter detector

CAN	calcium [carbonate] ammonium nitrate
CB	circuit board
CD	command detonation
CEXC	Combined Explosives Exploitation Cell
char	characteristic(s)
chem	chemical
CHP	concentrated hydrogen peroxide
CI	chemical ionization
clr	color(ed)
CND	could not determine
comp	composition
conc	concentrated
cond	conductivity
cont	continuous
cont	control
con't/cont'd	continued
conv	conversation
COTS	commercial off the shelf
CP	cordless phone
cps	counts per second
CTA	cotton tipped applicator
CTG	cartridge
CW, c/w, con/w	consistent with
D, D, Dia, diam	diameter
DADP	diacetone diperoxide
DAP, DAPh	diamyl phthalate
DB	double-base
DBP, DBPh	dibutyl phthalate
DCDA	dicyanodiamide
DEHP, DEHPh	diethylhexyl phthalate
dens	density
DEP, DEPh	diethyl phthalate
det	detonator
det [cord]	detonating [cord]
detc'd	detected
dia	diameter
DIBP, DIBPh, IBPH	diisobutyl phthalate
DIPP, DIPPh	diisopentyl phthalate
dil	diluted
discont	discontinuous
dist, distr	distribution
dk	dark
DMDNB/DMNB	dimethyldinitrobutane

DMP, DMPh	dimethyl phthalate
DNN	dinitronaphthalene
DNT	dinitrotoluene
DOT	Department of Transportation
DPA	diphenylamine
DPP, DPPh	diphenyl phthalate
DTMP	dual tone multi frequency
EC	Electronic Communication
EC	ethyl centralite
ECD	electron capture detector
EDTA	ethylenediaminetetraacetic acid
EDAX	brand name for energy dispersive X-ray spectrometer
EDX, EDS	energy dispersive X-ray spectroscopy
EFP	explosively formed projectile
EGC	eluent generator cartridge
EGDN	ethyleneglycol dinitrate
EI	electron impact
EIP, EIC	extracted ion profile/chromatogram
EISL	evidence interim storage locker
elec	electrical
elim	elimination
env	envelope
EOD	Explosives Ordnance Disposal
ESI	electrospray ionization
ESR	evidence storage room
ETN	erythritol tetranitrate
EtOH	ethanol
EU	Explosives Unit
EUC	Explosives Unit Chemistry
EUD, EUDev	Explosives Unit Devices
evap	evaporated/evaporation
evid	evidence
exp	expiration
exp, expl	explosive
EXPeRT	Explosives Reference Tool
FID	flame ionization detector
fil	filter
FPS	feet per second
frag, frg	fragment(s)
freq	frequency
FRS	family radio service
FST	flame susceptibility test

FTIR	Fourier Transform Infrared
GC	gas chromatography
gen char	general characteristics
GMRS	general mobile radio service
gr, grn	green
grad	gradual, graduated
GSM	global system for mobile communications
GWS	glass well slide
H	height
HC	homemade circuit
HCB, HMCB	homemade circuit board
HE	high explosive
Hex	hexane
H/F	Hairs/fibers
HME	homemade explosive
HMTD	hexamethylenetriperoxide diamine
HMX	cyclotetramethylene tetranitramine
HP	hydrogen peroxide
HPD	heavy petroleum distillate
HPLC	high pressure liquid chromatograph
HS	headspace
HT	high-temperature
hvy	heavy
I	item
IC	integrated chip
IC	ion chromatography
ID	identification
IE	improvised explosive
IED	improvised explosive device
IL	ignitable liquid
IL	illegible
ILR	ignitable liquid residue
inc	include
inc	inconclusive
incorp	incorporated
indust	industrial
insol	insoluble
insuff	insufficient
IP	In-processing
IPA	isopropyl alcohol
IR	infrared

IRAM	improvised rocket assisted munition
irr	irregular
IS	internal standard
JEOL	brand name for scanning electron microscope
K, kn, KN	known [item]
KES	keyless entry system
L	left
L	length
lat	lateral
LC	liquid chromatography
LE	low explosive
LED	light emitting diode
lg	large
LPD	light petroleum distillate
LRCP/T	long range cordless phone/telephone
lt	light
lim, ltd	limited
LTQ	brand name for liquid chromatograph/mass spectrometer (linear trap quadrupole)
LVFC	limited value for comparison
LVIED	large vehicle improvised explosive device
Macro	macroscopic
mag	magnification
MC	methyl centralite
MDP	medium petroleum distillate
mech timer	mechanical timer
$MeCl_2$, MeCl	methylene chloride
med	medium
MEK	methyl ethyl ketone
MEKP	methyl ethyl ketone peroxide
MeOH	methanol
MHN	mannitol hexanitrate
Micro	microscopic
min	minimum
misc	miscellaneous
mito	mitrochrondrial [DNA]
mkd	marked
mod	moderate
MS	mass spectrometry
MSA	methanesulfonic acid

MSD	mass selective detector
Msg	message
Mscope, scope	microscope
mtDNA	mitochrondrial DNA
mult, multi	multiple
m/z	mass to charge ratio
m&p	mortar and pestle
NA	not analyzed
NA, N/A	not applicable
NB	nitrobenzene
NC	negative control
NC	nitrocellulose
nDNA	nuclear DNA
NDPA	nitrodiphenylamine
neg	negative
NG	nitroglycerin
NI	negative ion
NIST	National Institute of Standards and Technology
NM	nitromethane
nom	nominal
NQ	nitroguanidine
NSFC	not suitable for comparison
NSFCP	not suitable for comparison purposes
NSFSCP	not suitable for significant comparison purposes
NT	nitrotoluene
num	number
occ	occasional(ly)
op’d	opened
or, org	orange
P	pistol
part	particle(s)
PB	pill box
pc(s)	piece(s)
PC	positive control
PC	potassium chlorate
PCB	printed circuit board
PD	police department
PETN	pentaerythritol trinitrate
PFTBA	perfluorotributylamine
pg	page
PI	positive ion

PIR	passive infrared
pkgd, pkg'd	packaged
PMR	personal mobile radio
pos	positive
PP	pressure plate
PPC	potassium perchlorate
PPT	PowerPoint
prep'd	prepared
prox	proximal
PS	polystyrene
Q	questioned [item]
RDX	cyclotrimethylene trinitramine
recv'd, rcv'd, rec'd, rec	received
R, rt	right
RC	radio controlled
rd, rnd	round
re	regarding
Ref	reference
Ref	reflective
rel	relative(ly)
ret'd	returned
RI	refractive index
R/S	representative sample
RS	rifle/shotgun
R-Salt	cyclotrimethylene trinitrosamine
RSP	render safe procedure
RT	retention time
RX	receiver
S	suspect
SAM	standard accelerant mixture
SB	single-base
SCR	silicon controlled rectifier
S/D, S&D	similarities and differences
SE	secondary evidence
sec ev, sec evid	secondary evidence
SEI	secondary electron detector
SEM	scanning electron microscopy
sev	several
SFC	suitable for comparison
Shav	shaving
SHN	sorbitol hexanitrate

sig, signif	significant
SIM	single-ion monitoring
slt	slight
sm	small
SN, S/No, S#	serial number
SNR	signal to noise ratio
sol	soluble, solubility
SP	smokeless powder
SPE	solid phase extraction
spec	specimen
SPME	solid-phase microextraction
ss	single strand
SS	spot size
ssteel	stainless steel
std	standard
TATP	triacetone triperoxide
TB	triple-base
TBEP	tributoxyethyl phosphate
TC, TELCAL	telephone call
TCR	transistor controlled relay circuit
TCU	tinned copper
TE	tamper evident [tape]
Telcal, telcall	telephone call
temp	temperature
TIC	total ion chromatogram
TM	testmix
TNT	trinitrotoluene
tpi	threads per inch
TPU	timing and power unit
TSQ	brand name for gas chromatograph/tandem MS/MS mass spectrometer (triple stage quadrupole)
TST	Thermal susceptibility test
TT	test tube
TX	transmitter
UN	urea nitrate
unID	unidentified
unk	unknown
unobs	unobserved
UPLC	ultra performance liquid chromatography, ultra-high performance liquid chromatography

v	very
V	victim
V	volt
vac	vacuum
var	variation, variable
VBIED	vehicle borne improvised explosive device
VCW	visually consistent with
VF	vacuum filter
v thn	very thin
W	width
wht	white
wrt	with regards/respect to
wt	weight
XPN	xylitol pentanitrate
XRD	X-ray diffraction
XRPD	X-ray powder diffraction
xtr	extract/extraction
ztb	zip-top bag