



Trace Analysis Section
Quality Assurance Overview
Forensic Analysis Division



1. Quality Assurance Overview

1.1. Introduction

- 1.1.1. This document describes an overview of the quality assurance practices of the HFSC Trace Analysis Section which is in compliance with the HFSC Quality Manual. Trace evidence analyses incorporate the physical and chemical characterization of materials transferred between objects. Usually the quantities transferred are small, hence the term “trace evidence”.
- 1.1.2. Examination of trace evidence involves the characterization, comparison, and identification of materials.

1.2. Trace Sub-disciplines

- 1.2.1. Ignitable Liquid/Fire Debris
- 1.2.2. Hair Characterization/DNA Suitability
- 1.2.3. All sub-disciplines in the Trace Section are proficiency tested as per the Quality Manual.

1.3. Safety

- 1.3.1. The Safety Data Sheets (SDS) of chemicals, standards, controls, reagents, solvents, and reference materials are available in the Trace Section and may be accessed electronically.
- 1.3.2. Refer to individual Trace SOP(s) for sub-discipline specific safety practices.

1.4. Evidence Handling, Retention, and Supporting Documentation

- 1.4.1. Evidence received should be appropriately labeled, packaged, and sealed as per the HFSC Quality Manual.
 - 1.4.1.1. If received evidence does not meet the criteria listed in 1.4.1, the discrepancy is noted in the case record.
 - 1.4.1.2. Some circumstances may lead to case rejection:
 - 1.4.1.2.1. If there are evidence discrepancies and the client fails to correct them in a timely fashion, the evidence is returned unanalyzed.
 - 1.4.1.2.2. Improperly packaged evidence such that the analysis of evidence is no longer appropriate.
 - 1.4.1.2.3. If a case is rejected, the evidence will be returned unanalyzed and a report will be issued stating the reasons for the rejection.
- 1.4.2. The sampling process is varied and non-statistical for trace evidence. An item that is submitted is examined except when:
 - 1.4.2.1. After a discussion with the client it is determined that the evidence does not need to be examined.
 - 1.4.2.2. If evidence is not examined as requested, a report is issued and the reason is documented in the case record.
- 1.4.3. A chain of custody is maintained per the HFSC Quality Manual for all evidence submitted to the trace section.
- 1.4.4. Samples recovered from evidence are portioned when applicable. When a sample is portioned, the unanalyzed portion is returned to the client. These samples are properly



marked, sealed, and kept with the original evidence. If portioning is not possible the appropriate personnel (submitting officer, prosecuting attorney, and/or defense attorney) are consulted and written permission obtained before the evidence is consumed.

- 1.4.4.1. Some trace samples recovered from evidence are examined in such a manner as to leave their physical state unchanged. These items are returned in their entirety.
- 1.4.4.2. Supporting documentation such as photographs is placed in the case record when applicable.
- 1.4.4.3. Refer to the HFSC Evidence Handling Guidelines and the HFSC Quality Manual for other evidence control practices.

2. Standards and Reference Materials

- 2.1. Standards are used in fire debris analysis and other trace sub-disciplines. The classification or identity of a standard must be verified before it can be used. Documentation of the confirmation of classification or identity, lot number, supply source, analyst initials, and supporting documentation is maintained.
- 2.2. Certified standards (reference materials) are used for the identification of many types of unknown materials. Certificates of Analysis (COAs) for reference material are maintained.
- 2.3. Some types of evidence, such as ignitable liquids, fibers, and paints, are characterized by comparison to commercial products obtained from retail stores or other known sources. Commercial reference products are characterized by the same analytical technique as the sample(s) they are being compared to and the data placed in the case record. A copy of the data is also maintained by the Trace Section. Details regarding commercial reference material batch or lot numbers, supply sources, and dates obtained are documented when available.

3. Ignitable Liquid Test Mixture

- 3.1. Ignitable Liquid Test Mixture
- 3.2. The ignitable liquid test mixture may also be referred to as a Resolution Mixture or Standard Test Mixture.
- 3.3. The ASTM International standard E1618 recommends the following mixture of compounds for checking the GC-MS instrument sensitivity for ignitable liquids:
 - Even-numbered alkanes from n-octane to n-eicosane
 - Toluene
 - 1,4-dimethyl benzene (p-xylene)
 - 1-methyl-2-ethyl benzene (o-ethyltoluene)
 - 1-methyl-3-ethylbenzene (m-ethyltoluene)
 - 1,2,4-trimehtylbenzene (psuedocumene)
- 3.4. Other compounds may be added to the test mixture as deemed necessary. Commercial test mixtures containing these components are available. Commercial test mixtures may contain additional compounds.
- 3.5. The laboratory may also use a mixture of equal parts of gasoline, kerosene, and diesel to evaluate instrument performance.



- 3.6. A purchased test mixture may be used with a concentration of each component purchased or diluted to 0.05 $\mu\text{L}/\text{mL}$ (0.005% V/V).

4. Quality Control Documentation

- 4.1. A logbook of instrument quality checks is maintained. For the GC-MS, the logbook contains air and water checks, autotunes, tune evaluations, and test mixtures.
- 4.2. A logbook documenting the preparation of the E1618 test mixture and other standards is maintained in the Trace Section and contains dilution records, preparation dates, and the analyst's initials.
- 4.3. Logbooks for reference materials and standards are maintained. Logbooks contain applicable certificates of analysis (COAs) or a worksheet listing the source of the reference material and the lot number when present.
- 4.4. Logbooks for in house quality checks of solvents, charcoals strips, process blanks, and environmental conditions are maintained. Log sheet records for the oven and refrigerator in the Trace Section are also maintained.
- 4.5. If a test mixture, standard, or reference material has expired, the analyst may do the following:
- 4.5.1. Analyze the material and compare the data to the data from the initial verification. If the data are comparable, the material can be used. If the data is not comparable, the material is discarded.
- 4.6. Logbooks may be binders, bound notebooks, or in an electronic format.

5. Method/Instrument Validation

5.1. Practice

- 5.1.1. Prior to use, every analytical method is properly validated or verified.
- 5.1.1.1. Proposed validation or verification procedures shall be approved by the FAD director or designee.
- 5.1.1.2. Data from the validation procedure are compiled, a summary report written and submitted to the FAD director or designee and Quality Division for approval.
- 5.1.1.2.1. The report includes a statement that the method is fit for purpose and intended use in case work.
- 5.1.2. Each instrument used in the analysis of trace evidence is validated or performance verified prior to use.
- 5.1.2.1. Proposed validation or verification procedures shall be approved by the FAD director or designee.
- 5.1.2.2. Data from the validation or verification procedure is compiled, a summary report is written and submitted to the FAD director or designee and the Quality Division for approval.
- 5.1.2.3. Each new instrument providing a new capability or technology is validated through an appropriate method validation prior to use.
- 5.1.2.4. Each new or replacement instrument whose technology is already proven to the HFSC Trace Analysis Section is performance verified prior to use.



- 5.1.3. New instrument methods designed to analyze a new material or that are part of an analytical method are properly validated prior to use in case work. If a previously published method is being adopted, it must be performance checked prior to use in case work.

6. Maintenance and Calibration of Laboratory Instrumentation and Equipment

6.1. General Requirements for Analytical Instrumentation

- 6.1.1. All instruments are periodically maintained and their performance verified in accordance with the manufacturer's recommendations and specifications and HFSC laboratory policy. All instruments' performance is re-verified if they are moved or if a major repair is performed. This information is kept in a logbook.
- 6.1.2. If an instrument fails the calibration check or a performance problem is detected during routine **operations or during** maintenance, it must be removed from service until it is demonstrated to be functioning properly. The Forensic Analysis Division Director and Quality Director should be notified and the problem recorded in the logbook.
- 6.1.3. A record of all repairs and routine maintenance **procedures is kept** in an appropriate logbook.
- 6.1.4. **Quality assurance procedures for analytical instruments used for the characterization and identification of trace evidence are covered in their respective SOPs.**

6.2. General Requirements for Laboratory Equipment

6.2.1. Pipettors

- 6.2.1.1. Pipettors are used for transfer of volume in trace analysis. Critical volume measurements are not used. Before use, pipettors are visually inspected and cleaned as needed.
- 6.2.1.2. Pipettors are tested, **at a minimum**, annually to ensure that they are functioning properly. If the performance check does not pass, then the pipettor is not used for casework purposes until deemed acceptable or replaced.

6.2.2. Balances

- 6.2.2.1. **The Trace Analysis Section (Trace) has one top loading balance designated TB21. The balance originally belonged to Controlled Substances and records prior to 2016 are kept by that section. Care should be taken not to overload the balance with too much weight. Analytical and bulky balances are available for use by the Trace Section in the Controlled Substances laboratory.**
- 6.2.2.2. **Trace Section does not perform measurements requiring an uncertainty of measurement study.**
- 6.2.2.3. **Inspect the balance for cleanliness and check the level frequently.**
- 6.2.2.4. **It is the analyst's responsibility to verify that the necessary checks have been performed in the recommended time period for any balances or weights used.**
- 6.2.2.5. **Balances will be calibrated by an external vendor at least once a year.**
- 6.2.2.6. **Reference weights and secondary weights used by the Trace Section are kept in the Controlled Substances lab area and will be re-certified at least every three years by**



an external vendor. Secondary weights will be checked in-house by the Controlled Substances section following their sectional SOP.

6.2.2.7. Balances will be checked using secondary weights. Balances must be checked monthly, whenever they are moved from one location to another, or as needed.

6.2.2.8. To perform regular balance checks, the following procedure will be followed:

6.2.2.8.1. Place the appropriate weight on the balance.

6.2.2.8.2. Listed below are the acceptable ranges for each balance along with its corresponding check weight(s):

Balance	Weights	Readability	Acceptable range*
TB21	2 kg	2000.0 g	±0.5 g
	100 g – 1 g	1.0 g	±0.5 g

* The acceptable range is determined from the vendor's calibration records.

6.2.2.8.3. If a result from the check is outside of the acceptable range, first ensure that the balance is level and clean and that the weight is centered on the pan prior to rechecking.

6.2.2.8.4. If applicable, use the internal calibration function of the balance prior to rechecking.

6.2.2.8.5. Re-check the weight that was found to be outside the acceptable range.

6.2.2.8.6. If a result of the re-check is outside of the acceptable range after performing the actions above, then the balance shall be immediately taken out of service until maintenance and/or calibration are performed by an external vendor.

6.2.3. Records documenting the results of the balance checks, weight checks, maintenance, and calibrations will be maintained either by Trace or Controlled Substances.

7. Case Documentation, Review, and Report Modification

7.1. Practice

7.1.1. Case Documentation

7.1.1.1. The case **record** includes the chain of custody, worksheet or case notes, reports, technical review sheets, and instrumental data from blanks, samples, and, when appropriate, standards, reference products, and/or reference materials. Other information that may be present include court related documents and communication documents. This information may be in paper or electronic form.

7.1.1.2. Worksheets, case notes, and instrumental data are initialed by the examiner.

7.1.1.3. Each packet of instrumental data includes the date acquired, the instrument name, and the method.

7.1.1.4. The total number of internally generated **technical** pages is documented **on the evidence inventory sheet**.



7.1.1.5. All changes and corrections are delineated by a single strike-out and initialed by the examiner.

7.1.2. Technical Review

7.1.2.1. Technical reviews are performed by an individual other than the author of the report on all cases that are subjected to analytical examination. Cases are sent to an outside agency for a technical review when there is not another qualified analyst at HSFC to perform a technical review. A technical review **form (which may be electronic)** covering the scope of the review requirements are filled out by the reviewer and **kept with** the case **record**.

7.1.2.2. The technical review includes the following:

7.1.2.2.1. Verify that the information listed on the report header is correct.

7.1.2.2.2. Verify that the conclusions are supported **by appropriate documentation**.

7.1.2.2.3. Verify that the lab/item number is listed on the data.

7.1.2.2.4. **Where applicable**, the date data was acquired and the instrument name are present on each packet of data. The analyst's initials appear on each page of data.

7.1.2.3. The reviewer(s) must have sufficient knowledge of the particular trace evidence sub-discipline and instrumentation used to verify compliance with the laboratory's technical procedures to ensure that the conclusions are supported by the examination documentation.

7.1.3. Administrative Review

7.1.3.1. Administrative reviews are performed on all cases by an individual other than the author of the report. Unless approved in advance by the Forensic Analysis Division Director or designee, the technical and administrative reviews are not conducted by the same individual. An administrative review **form (which may be electronic)** covering the scope of the review is filled out by the reviewer and **kept with** the case **record**. The administrative review follows the HFSC Quality Manual.

7.2. Report Modification

7.2.1. It is sometimes necessary to modify a report after it has been issued in order to correct an error, to document additional analyses, or for various other reasons.

7.2.2. The new report is clearly labeled as a modified or amended report, references the original report, and clearly states why an amended report is being issued. The original report is maintained in the case record.



8. Abbreviations

8.1. The following is a list of abbreviations commonly used in the Trace Analysis Section:

Table 1. Abbreviations Used by the Trace Analysis Section

Abbreviation	Description
c	Containing (may be used with a bar across the top of the 'c')
env	Envelope
evid	Evidence
NR	No reaction
IS	Internal standard
HS	Headspace
LPD	Light petroleum distillates
HPD	Heavy petroleum distillates
MPD	Medium petroleum distillates
Res	Resolution
F	Frozen
Inc/I	Inconclusive
W	Weak
ND	Not Done
NEV	Nothing of evidentiary value
QNS	Quantity not sufficient
C-Strip	Charcoal strip
amb	Ambient
gal	Gallon
qt	Quart
pt	Pint
HFSC	Houston Forensic Science Center
CS ₂	Carbon disulfide
inj	Injection
BP	Base peak
ILR	Ignitable liquid residue
k-count	1 Thousand (1000) counts (measurement of abundance)
mega counts	1 Million (1,000,000) counts (measurement of abundance)
TMB	Trimethylbenzene
ETOH	Ethanol
MeOH	Methanol
Cyclo	Cyclic structure
Subt	Substituted
ACS	Activated charcoal strip
TIC	Total ion chromatogram



RIC	Reconstructed ion chromatogram (Varian)
GC-MS	Gas chromatogram-mass spectrophotometry
PB	Polymer bag
OTWE	Over the weekend
ON	Over night
EXT	Extract
Pent	Pentane
PD	Petroleum distillate
ALS	Automated liquid sampler
Oxy	Oxygenate
Misc	Miscellaneous
NA	Normal alkane
NP	Naphthenic/paraffinic
Isopar	Isoparaffinic
FTIR	Fourier Transform Infrared Spectroscopy
SDS	Safety Data Sheets
PPE	Personal Protective Equipment

9. References

- 9.1. Saferstein, R. Criminalistics An Introduction to Forensic Science, 11th Edition, Pearson Education, Inc., 2015
- 9.2. Pasadena Police Department Regional Crime Laboratory Standard Operating Procedures Trace Evidence TE-01-01 Version 5, effective date March 18, 2013