TRACE EVIDENCE UNIT

QUALITY MANUAL

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1 SCOPE

This manual follows the requirements specified by ANSI-ASQ National Accreditation Board (ANAB), which is based on the ISO/IEC 17025:2017 standards and the 2017 ANAB ISO/IEC 17025:2017 — Forensic Science Testing and Calibration Laboratories Accreditation Requirements (AR 3125).

The *Trace Evidence Unit Quality Manual* follows the outline of the *ASCL Quality Manual* (ASCL-DOC-01) but is written specifically for the analysts working in the Trace Evidence Unit.

The Trace Evidence Unit examines evidence in the Gunshot Residue, Fire Debris (Ignitable Liquids Analysis), and Materials (Trace) areas.

1.1 INTERNATIONAL STANDARD: GENERAL REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

1.2 INTERNATIONAL STANDARD: SCOPE

See *ASCL-DOC-01 Quality Manual*.

1.2.1 ANAB PROGRAM

See *ASCL-DOC-01 Quality Manual*.

2 NORMATIVE REFERENCES

The Trace Evidence Unit follows the applicable references listed in *ASCL-DOC-01 Quality Manual*.

When available, the Trace Evidence Unit adheres to documents on the OSAC Registry of approved documents and ASTM Guidelines.

- ASTM E1386 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction
- ASTM E1412 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration With Activated Charcoal
- ASTM E1618 Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry
- ASTM E2451 Standard Practice for Preserving Ignitable Liquids and Ignitable Liquid Residue Extracts from Fire Debris Samples
- ASTM E1588 Standard Guide for Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-Ray Spectrometry

3 TERMS AND DEFINITIONS

See *ASCL-DOC-01 Quality Manual*. Additions to the *ASCL-DOC-01 Quality Manual* are listed below.

Fire Debris

ACCELERANT

Any material used to initiate or promote the spread of a fire. The most common accelerants are ignitable liquids. Whether a substance is an accelerant depends not on its chemical structure but on its use.

IGNITABLE LIQUID

Any liquid or the liquid phase of any material that is capable of fueling a fire, including a flammable liquid, combustible liquid, or any other material that can be liquefied and burned.

FIRE DEBRIS

A generic term used to describe material of interest collected at a fire scene by an investigator as evidence to analyze.

FIRE DEBRIS ANALYSIS

The science related to the examination of fire debris samples performed to detect and identify ignitable liquid residues.

Gunshot Residue

GUNSHOT RESIDUE

The inorganic and metallic residues largely originating from the ammunition that has been discharged but may include contributions from the firearm and previous ammunitions discharged from the firearm.

PRIMER GUNSHOT RESIDUE

See Gunshot Residue

Materials (Hair Identification)

ANAGEN

The active growth phase of a hair follicle in the hair growth cycle. The root from a pulled anagen hair is elongated, may be covered with a root sheath, and is usually fully pigmented.

ANCESTRAL GROUP

Populations differentiated by the morphological and microscopic characteristics representative of individuals originating from geographically separated regions of the world such as Asia, Africa, and Europe.

Discussion: The racial terms Caucasoid, Mongoloid, and Negroid should not be used as these terms are no longer accepted in the field of anthropology (from which these designations originated).

CATAGEN

The transitional phase of the hair follicle between the active growth phase and the resting phase in the hair growth cycle.

CUTICLE

The outermost region of a hair composed of layers of overlapping scales.

DISTAL END

The end of the hair farthest away from the root.

MEDULLA

The core of the hair shaft that is composed of vacuoles and cells that can be air- or fluid-filled.

MITOCHONDRIAL DNA

A small, circular DNA molecule located in eukaryotic mitochondria that is typically maternally inherited; the resistance to degradation and presence of multiple copies of mitochondrial DNA (mtDNA) in each cell makes it useful with samples originating from limited or damaged biological material.

POSTMORTEM BANDING

The appearance of an opaque band near the proximal end of a hair in anagen or catagen hairs that have been removed from a decomposing body.

PROXIMAL END

The portion of the hair closest to, and including, the root.

SOMATIC

An area of the body, such as head, pubic, or facial.

TELOGEN

The resting phase in the hair growth cycle when the hair has stopped growing and the root becomes keratinized and bulbous in shape.

COMMONLY USED ABBREVIATIONS

General

MIP – Marked in part

STC – Said to contain

Fire Debris

ILA – Ignitable liquids analysis
HPD – Heavy Petroleum Distillate
LPD – Light Petroleum Distillate
MPD – Medium Petroleum Distillate
GC-MS – Gas Chromatography – Mass Spectrometry (Note: GCMS or GC/MS are also acceptable)

Gunshot Residue

GSR – Gunshot residue
pGSR – Primer gunshot residue
SEM – Scanning Electron Microscope
EDS – Energy Dispersive X-ray Spectrometry

Materials (Hair Analysis)

HH – Head hair
PH – Pubic hair
PLM – Polarized light microscopy
mtDNA – Mitochondrial DNA
nDNA – Nuclear DNA

4 GENERAL REQUIREMENTS

4.1 IMPARTIALITY

See *ASCL-DOC-01 Quality Manual*.

Cases are typically worked in chronological order based on date submitted to the laboratory. However, some cases may be worked out of chronological order when Trace evidence must be collected before analysis by another section. Trace evidence cases may also be prioritized based on the availability of instrumentation, pending court dates, or by special request of the supervisor or administration.

4.2 CONFIDENTIALITY

See *ASCL-DOC-01 Quality Manual*.

5 STRUCTURAL REQUIREMENTS

5.1 ESTABLISHMENT

See *ASCL-DOC-01 Quality Manual*.

5.2 MANAGEMENT

The Arkansas State Crime Laboratory is managed by the Director, who has overall responsibility for the laboratory.

See *ASCL-DOC-01 Quality Manual* (ASCL-DOC-01) for general information regarding labwide management.

5.2.1 TRACE EVIDENCE UNIT STAFF

5.2.1.1 PHYSICAL EVIDENCE SECTION CHIEF

QUALIFICATIONS

The position requires a minimum of a baccalaureate degree in a chemical, physical, biological, or forensic science plus five years of experience in a forensic laboratory. Other job-related education or experience may be substituted upon approval of the Assistant Director. The Physical Evidence Section Chief or designee (Quality Manager or Technical Leader) will have the appropriate technical training and experience in all disciplines encompassed by the section.

AUTHORITIES AND RESPONSIBILITIES

- Coordinates unit activities by reviewing, prioritizing, and assigning new cases.
- Reviews case to become familiar with details of the crime and examines items of evidence to determine the appropriate testing methods.
- Performs analysis, prepares reports, and testifies in court.
- Consults with law enforcement officials, attorneys, and other public officials on crime scene investigations and methods of collecting, transporting and preserving evidence to ensure its integrity.
- Completes administrative duties by preparing activity reports, inventory reports, employee documentation, and other duties as assigned.
- Ensures compliance with ANAB requirements.
- Researches scientific literature and exchanges information with peers in other states or countries in order to stay abreast of the latest scientific advances.
- Maintains instruments and equipment used for the examination of evidence.

- Responsible for the technical operations and the provision of the resources needed to ensure the quality of laboratory operations.
- Reviews manuals annually.

5.2.1.2 CRIMINALIST

QUALIFICATIONS

The position requires a baccalaureate degree in chemistry or a closely related field.

AUTHORITIES AND RESPONSIBILITIES

- Reviews case to become familiar with details of the crime and examines items of evidence to determine the appropriate testing methods.
- Performs analysis, prepares reports, and testifies in court.
- Consults with law enforcement officials, attorneys, and other public officials on crime scene investigations and methods of collecting, transporting and preserving evidence to ensure its integrity.
- Researches scientific literature and exchanges information with peers in other states or countries in order to stay abreast of the latest scientific advances.
- Maintains instruments and equipment used for the examination of evidence.

5.2.1.3 UNIT QUALITY MANAGER

QUALIFICATIONS

The Section Chief will appoint one of the Criminalists to fulfill the role of Unit Quality Manager. This person should be qualified to conduct the majority of analyses performed within the unit.

AUTHORITIES AND RESPONSIBILITIES

- Ensures quality assurance practices are being followed.
- Checks logbooks to make sure documentation procedures are being followed.
- Maintains the key log for the unit.
- Edits and revises manuals.
- Maintains list of chemicals in the unit.
- Oversees validation of new instruments, methods, or procedures.
- Coordinates laboratory training of employees.
- Creates proficiency schedule plan.

5.2.1.4 UNIT SAFETY OFFICER

QUALIFICATIONS

The Section Chief will appoint one of the Criminalists to fulfill the role of Unit Safety Officer. In shared laboratory areas, this role may be fulfilled by a safety officer from another section.

AUTHORITIES AND RESPONSIBILITIES

- Performs monthly checks of showers, eyewashes, and fire extinguishers located within the unit.
- Maintains the SDS for the unit.
- Fills out monthly reports to be sent to the Laboratory Health and Safety Officer.
- Observes physical area for safety issues.
- Keeps emergency contact information up-to-date.

5.3 SCOPE OF LABORATORY ACTIVITIES

See *ASCL-DOC-01 Quality Manual*.

5.4 NORMATIVE DOCUMENTS

See *ASCL-DOC-01 Quality Manual*.

5.5 LABORATORY OPERATIONS

See *ASCL-DOC-01 Quality Manual*.

Each analyst shall be accountable to only one immediate supervisor for each category of testing.

The ASCL Quality Manual and the Trace Evidence Quality Manual are available on Qualtrax® to all analysts. Trace Evidence analysts are responsible for knowing and using these policies and procedures.

5.6 QUALITY MANAGEMENT

See *ASCL-DOC-01 Quality Manual*.

5.7 MANAGEMENT SYSTEM COMMUNICATION AND INTEGRITY

See *ASCL-DOC-01 Quality Manual*

Information concerning the laboratory will be conveyed to the unit by routine meetings, e-mails, or personal conversations.

6 RESOURCE REQUIREMENTS

6.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.2 PERSONNEL

6.2.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.2.2 COMPETENCE REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

6.2.2.1 ANALYST/EXAMINER EDUCATIONAL REQUIREMENTS

Personnel who authorize results, opinions, or interpretations in the Trace Evidence Unit shall have, at minimum, a baccalaureate degree in chemistry (preferred) or other natural science. An advanced degree in chemistry, forensic science, or other natural science is acceptable.

6.2.2.2 TRAINING PROGRAM

See *TR-DOC-02 Trace Evidence Training Manual* and *ASCL-DOC-03 ASCL New Analyst/Technician Training Manual*.

Each category of testing within the Trace Evidence Unit has a section within the training manual. Basic training on laboratory procedures and a moot court are required with the completion of the first category of testing. As an analyst trains in more areas within the unit, it will be up to the unit quality manager and supervisor to determine if additional moot courts are needed.

Records of competency training will be kept in the employee's training binder. Records of authorizations will be maintained in the Personnel tab in Qualtrax®.

EMPLOYEE DEVELOPMENT PROGRAM

In addition to initial training, employees are encouraged to improve their knowledge and skills by participating in continuing education. This training may include professional meetings, staff development seminars, technical training courses, in-house technical meetings, courses, seminars, and ASCL sponsored seminars and conferences. Travel procedures are detailed in § 3.21 & § 5.3 of

the *ASCL Personnel Handbook* (ASCL-DOC-02) and in DPS Policy 203 *DPS Travel and Reimbursement Policy*. This training shall be documented in Qualtrax®.

LITERATURE

Trace Evidence Analysts are encouraged to review and stay current on literature. The Literature Review log is kept in the Personnel Tab in Qualtrax®.

6.2.3 COMPETENCE OF STAFF

See *ASCL-DOC-01 Quality Manual* and *TR-DOC-02 Trace Evidence Training Manual.*

6.2.4 DUTIES, RESPONSIBILITIES, AND AUTHORITIES

The duties, responsibilities, and authorities of each position in the Trace Evidence Unit are contained in § 5.2.1 of this manual.

6.2.5 PERSONNEL REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

6.2.6 AUTHORIZATIONS

See *ASCL-DOC-01 Quality Manual*.

6.3 FACILITIES AND ENVIRONMENTAL CONDITIONS

6.3.1 GENERAL

The Trace Evidence Unit performs laboratory activities at the Main Laboratory: 3 Natural Resources Drive, Little Rock AR 72205.

6.3.2 DOCUMENTATION

The Trace Evidence Unit will have access to vented hoods for analysis of evidence and use of chemicals. The laboratory area should be separated from areas where firearms are discharged. The scanning electron microscope must be in a stable room to reduce vibrations. The GCMS should be vented to prevent the chemicals used from entering the environment.

6.3.3 MONITORING RECORDS

See *ASCL-DOC-01 Quality Manual*.

6.3.4 CONTROL OF FACILITIES

See *ASCL-DOC-01 Quality Manual*.

6.3.4.1 ACCESS

TRACE EVIDENCE UNIT

The Trace Evidence Unit laboratory areas are locked at all times and require a physical key or fob or an escort to enter the area. Only the following are allowed unescorted access to the section:

- Management Personnel:
  - Director
  - Assistant Director
  - Quality Assurance Manager
  - Health and Safety Manager
- Technical Personnel – other sections who have keys or fob access to the area
  - Forensic Drug Personnel and supervisors
  - Toxicology Personnel and supervisors
  - IT Section
- Other personnel deemed necessary by the Director

The Trace Evidence Unit has a key box containing cabinet, hood, and other storage area keys. The key to the section key box is kept by the Physical Evidence Section Chief. A log is kept recording when keys are added to or removed from the section key box and the keys in the possession of each analyst.

If a fob or key is misplaced by a staff member, their supervisor will be notified immediately if the fob or key location is completely unknown, or within 48 hours if the fob or key is expected to be recovered (e.g. it has been misplaced in their home).

Evidence stored in the Trace Evidence Unit should be protected from loss, deterioration, or contamination. Evidence stored in laboratory areas accessed by a key does not require further locked storage. The Trace Secure Storage cabinet contains items retained for possible future analysis and is kept locked. Trace Evidence analysts have access to the keyed cabinet.

6.3.4.2 PREVENTION OF ADVERSE INFLUENCES

The Trace Evidence Unit has multiple measures in place to prevent contamination, cross-contamination, interference, or adverse influences on laboratory activities. These include, but are not limited to:

- Examining one item of evidence at a time.

- Working items recovered from suspect and victim or from different crime scenes in different rooms or workspaces or on different days.
- Wearing personal protection equipment.
- Changing personal protection equipment and paper between items and areas.
- Cleaning examination areas and tools between samples or cases.

6.3.4.3 SEPARATION

TRACE EVIDENCE UNIT

The Trace Evidence Unit area is designed to ensure effective separation between the Firearms Section. Firearms employees are also not allowed to wear their lab coats in the Trace Evidence or Forensic Serology Unit areas where primer gunshot residue sampling occurs.

6.3.5 EXTERNAL ACTIVITIES

When Trace Evidence analysts perform laboratory activities at sites or facilities outside its permanent control, it shall ensure that the requirements related to facilities and environmental conditions of this document are met.

6.4 EQUIPMENT

6.4.1 ACCESS

The Trace Evidence Unit has adequate equipment to perform all necessary testing. Details of specific quality control measures on equipment that has a significant effect on the quality of test results will be outlined in this manual.

6.4.2 OUTSIDE EQUIPMENT

See *ASCL-DOC-01 Quality Manual*.

6.4.3 PROPER FUNCTIONING

The Section Chief shall authorize personnel to operate equipment (documented on *Analyst & Technician Competency Authorization Documentation, ASCL-FORM-62*). This authorization documentation is maintained in Qualtrax®. New employees shall be trained on the appropriate equipment during their training program as detailed in each Discipline Training Manual. Only individuals who have been trained in the proper use of the equipment shall operate it.

When new equipment requires a validation, appropriate personnel will be trained in its use. This training will be documented and maintained in Qualtrax®. Performance verifications may be

conducted on upgraded equipment. If the upgrades to methodologies are significant, supplemental training should be conducted and documented in Qualtrax®.

Up-to-date instructions on the use and maintenance of the equipment shall be readily available (Qualtrax®).

Following is a list of equipment used in the Trace Evidence Unit:

(1) GAS CHROMATOGRAPH–MASS SPECTROMETER (GC–MS)

USE

- The GC-MS is used in the analysis of ignitable liquids and identification of chemical compounds.

SAFETY CONSIDERATIONS

- The injector port may be hot. Caution should be taken when changing the septum or liner.
- The oven should be cooled before changing the column.

MAINTENANCE

Routine

- The septum should be replaced before the next run after reaching 150 injections.
- The compressed gas cylinder providing helium to the system will be changed as needed.

Non-routine

- The injection liner should be replaced if needed. Ignitable liquid samples are fairly clean and do not need to be changed often. The liners may be packed with glass wool but it is not necessary.
- The source should be cleaned.
- Used filaments should be replaced.
- Diffusion pump oil should be inspected and replaced if necessary.
- Rough pump oil should be checked and filled or replaced if necessary.

PERFORMANCE CHECKS

Daily prior to use

- Perform standard Autotune (PFTBA internal standard used to optimize parameters) and check autotune report:
    - If any m/z peaks below 69 m/z are above 10% relative abundance to the 69 m/z, it is an indication of a leak. The instrument should be removed from service until it is repaired or has passed the performance check.

- Electron Multiplier (EM) Voltage maximum is 3000. Normal ranges vary from instrument to instrument. If the EM voltage is between 2500 and 3000, the instrument should be removed from service until it is repaired or has passed the performance check.
- Iso Ratio for masses 69:219:512 should be approximately 1:4:10.

- A copy of the autotune is printed to Indexer and saved to a JusticeTrax® case file. Checking the autotune box on the GC/MS log signifies that the parameters above were checked by the analyst.

QUALITY CONTROL

- Quality control samples required by type of analysis should be recorded on the GC/MS log or in the case notes. (e.g. AGKD and ASTM Sensitivity).
  - A copy of the check sample should be placed in the QC folder on the GC-MS or for non-routine samples, in the case notes.
- Blanks shall be run between sample injections. The extraction blank may be used as a blank that is run between samples.
- The blank, standard, and samples must be run under the same chromatographic conditions and data acquisition parameters.
- For a single compound identification, a mass spectrum should be included in the case file.
- For identification of a compound or substance, no rigid mass spectral probability based match criteria are defined. Flexibility is given to the experienced analyst. The identification will be based on a number of factors which may include retention time, extracted ions, ion abundance, and literature references.
- When case samples are weak, the samples may be concentrated and sampled in a microvial insert. It may be useful to also inject a larger volume and examine the sample using selected ion monitoring (SIM). It is necessary to know the major ions of interest for SIM monitoring.
- The Standby01 method is loaded to save He gas flow when the instrument is not in use.
- A method should be loaded after a power outage or when turning the computer on.

EMERGENCY SHUTDOWN PROCEDURES

- Turn off the buttons on the bottom front of the mass spectrometer and the bottom front of the gas chromatograph.
- Shut down the computer.
- If the instrument needs to be vented (will take approximately one hour)
  - Will not normally need to be vented for basic shutdown or power outage.
  - From the software, select Vacuum Control/Vent/OK (A time frame will be given on how long it will take to cool the filament.)
  - A prompt will appear with notification that the instrument may be turned off.
  - Turn off mass spectrometer, gas chromatograph, then computer.

(2) SCANNING ELECTRON MICROSCOPE–ENERGY DISPERSIVE X-RAY SPECTROMETER (SEM–EDS)

USE

- The SEM-EDS is used for the imaging of particle morphology and for elemental analysis of gunshot residue or other small particles.

SAFETY CONSIDERATIONS

- Care should be taken when removing the Wehnelt cap from the instrument. If the filament has been in operation, it may be hot.
- Do not open the SEM chamber door without first turning off the vacuum.

MAINTENANCE

- Records of all maintenance and performance checks are recorded in the SEM-EDS logbook located next to the instrument
- Preventative Maintenance includes:
    - The Scanning Electron Microscope preventative maintenance occurs annually.
        - Pump oil is replaced
        - Apertures are cleaned or replaced
        - Magnification is verified
    - The Energy Dispersive X-Ray Spectrometer preventative maintenance occurs annually.
        - Brightness/Contrast correlation between EDS and SEM is checked.
        - Field overlap is checked.
- When a filament burns out, the Wehnelt cap is cleaned and the filament is replaced in the instrument.
    - Cleaning the Wehnelt cap:
        - Sonicate in an approximate 10% solution of Micro 90 and water; rinse well. (optional)
        - Polish with metal polish; rub clean.
        - Sonicate in ethanol.
        - Sonicate in acetone.
        - Allow to dry.
        - Place a new or re-tipped filament assembly in cap.
        - Using stereomicroscope, align filament.
        - Store wrapped in foil until ready for use.
    - Replacing the filament:
        - Place a clean Wehnelt cap into the instrument and turn on the vacuum.
        - Ensure that the lid has a proper vacuum seal.
        - Allow the instrument vacuum to pump down for at least 10 minutes.

        - Make sure the gun load current has been turned down.
        - Turn the filament (HT) ON.
        - Slowly raise the load current to the mark and then gradually increase to the orange bar. This should be done over a 10 minute to 2 hour period.
        - Allow the filament to warm up for a minimum of 30 minutes.
    - Align the filament:
        - Saturate the filament by adjusting load current, tilt, shift, and spotsize.
        - Obtain an image by aligning the filament using the SEM controls for spotsize, shift, and tilt.
        - Set the Bias.
        - Adjust the wobble.
        - Adjust the astigmatism (STIG).
- The stage may be initialized (or re-initialized) any time the computer is restarted, after a power outage, or a shift in stage coordinates is observed.
    - To initialize stage:
        - Remove the stage holder from the chamber. The vacuum does not need to be on.
        - In the SEM software, go to Setup→Fundamental Setup→Stage Setup→Start

PERFORMANCE CHECKS

Yearly after Preventative Maintenance

- The B-Fed 4 QC stub will be analyzed prior to use.
    - Results are considered passing if at least 10 characteristic particles are found for HV and at least 8 characteristic particles are found for LV.
    - The number of characteristic particles found is documented in the logbook and on the QC report generated by the EDS program.

Daily prior to use

- The detector's resolution should be measured and recorded in the log book each time the instrument is used.
    - This is performed by measuring the fwhm (full width at half max) of the Cobalt peak collected on the calibration stub at 20 keV. The EDS software calculates this value under the Microscope Setup "Optimize" setting by performing the Energy Calibration.
    - The Beam Measurement of Co is measured at least twice.
    - The QC report contains the value of the resolution for the energy calibration of Co which is recorded in the logbook.
    - The value should not exceed 150 eV.
- When running the automated gunshot residue program, the EDS threshold levels should be set using the highZ / low Z standard stub of cobalt and gold.
    - The brightness and contrast are adjusted to optimize the gray levels at 16384 and 32767.

- A known sample is tested prior to use.
    - The detected features from a known reference area (Spike) are collected.
    - A spectrum is then acquired from each of the detected features.
    - Results are considered passing if at least 12 characteristic particles are found for HV and at least 10 characteristic particles are found for LV.
    - The number of detected features and characteristic particles found is documented in the logbook and on the QC report generated by the EDS program.
- Before running the automated gunshot residue program, the recipe, parameters, and focus should be checked for each stub that has been placed in the holder.

QUALITY CONTROL

- Before testing, each stub is marked on the bottom with the item number or the pre-stamped number is recorded on the gunshot residue worksheet.
- Each stub is marked and placed in the stub holder to align the mark on the stub with the mark on the holder. If the stub is removed, it may be returned to the same position to locate particles.
- Only stubs from one individual at a time are placed in the chamber for gunshot residue analysis.
- A blank stub is tested with each automated gunshot residue run.
    - If characteristic or bi-component gunshot residue particles are found, then the results for the automated run must be discarded.
        - Replace the blank and rerun the samples.
        - If the blank still has characteristic or bi-component particles, immediately cease case work. The problem must be corrected before resuming case work.
    - If other indicative particles are found, the blank will be replaced with a new blank stub.
- During the automated gunshot residue run, the threshold (highZ / low Z) is checked every 60 minutes. If the check does not pass, the programmed run will stop.

EMERGENCY SHUTDOWN PROCEDURES

For normal shutdown, vacuum pump should be left on (omit last step).

- Turn filament (HT) OFF.
- Close computer software programs.
- Shut down both computers.
- Turn key on front of SEM to OFF.

(3) MICROSCOPES

USES

- Stereomicroscopes are used for slightly increasing the magnification and visualization of evidence with a greater working distance. Samples do not need to be mounted on slides.
- The compound light microscope is used for increased magnification and visualization of evidence mounted on slides.
- The comparison polarized light microscope is used for the observation and imaging of hairs, fibers, and other small particles.

SAFETY CONSIDERATIONS

- Do not look directly into microscopes with lamp on highest setting.
- The lamps can get hot. Caution should be taken when replacing a bulb that has recently burned out.

MAINTENANCE

- Records of all maintenance and performance checks are recorded in the logbook located next to each compound or comparison microscope. Stereomicroscopes do not have logbooks.
- Microscopes should be cleaned to remove dust.
- Light bulbs may need to be changed if a change in illumination is detected or if the bulb burns out.
- Lenses (eyepiece, objective, condenser, etc.) should be cleaned as needed with lens paper.

PERFORMANCE CHECKS (DOES NOT APPLY TO STEREOMICROSCOPES)

Daily prior to use

- Confirm that the microscope is set for proper Köhler illumination.

Monthly prior to use

- Set the microscope up for Köhler illumination.
- Record in logbook.

QUALITY CONTROL (DOES NOT APPLY TO STEREOMICROSCOPES OR COMPOUND MICROSCOPE)

- Recalculation of the eyepiece micrometer may be performed as needed for each objective using a stage micrometer. Document the conversion from units to micrometers in the logbook.

EMERGENCY SHUTDOWN PROCEDURES

- Turn lamp brightness down.
- Turn microscope off

(4) REFRIGERATOR

USE

- The refrigerator is used for storing standards, reagents, and reference materials.

SAFETY CONSIDERATIONS

- Ensure the refrigerator is on a stable countertop.

MAINTENANCE

- Defrost if a large amount of ice accumulates on the freezer compartment.
- Change the light bulb if it burns out.
- Record any maintenance or repair on the log sheet.

PERFORMANCE CHECK

- Record the temperature of the refrigerator in the logbook before removing any standards, reagents, or reference materials. The temperature should be between 0° and 10° C.

QUALITY CONTROL

- Adjust the control knob if the refrigerator temperature is outside of the range.
    - If the adjustment does not bring the temperature into the expected range, remove all contents to another refrigerator until repairs are made.

EMERGENCY SHUTDOWN PROCEDURES

- Unplug refrigerator.

(5) OVEN

USE

- The oven is used for fire debris samples.

SAFETY CONSIDERATIONS

- Ensure the oven is on a stable, heat-resistant countertop.
- Use thermal resistant gloves to remove hot samples from the oven.

MAINTENANCE

- Clean out any debris which may accumulate in the oven.
- Record any maintenance or repair on the log sheet.

PERFORMANCE CHECK

- Record the temperature of the oven in the logbook before placing or removing any evidence. The temperature should be between 60° and 70° C.

QUALITY CONTROL

- Adjust the thermostat if the oven temperature is outside of the range.
  - If the adjustment does not bring the temperature into the expected range, remove the oven from service until repaired.

EMERGENCY SHUTDOWN PROCEDURES

- Unplug oven.

(6) REFERENCE MATERIALS

USE

- Reference materials are used for checking the performance of the SEM-EDS, GC-MS, and microscopes.

SAFETY CONSIDERATIONS

- Handle reference materials in such a manner to prevent breakage or contamination.
- Label the reference materials.
- Transport reference materials in a safe manner for the size and type of container and contents.

STORAGE

- Reference materials are stored in cabinets, refrigerators, or on counters in such a way that reduces the chances of breakage.
- Reference materials which are mounted on stubs and used frequently may stay in the chamber of the SEM.

PERFORMANCE CHECKS

- Reference materials will be replaced when they fail to perform adequately under controlled conditions.

QUALITY CONTROLS

- Reference materials are verified prior to use.
- Some reference materials may have a certificate of traceability which should be maintained in the reference materials log beside the instrument.

(7) CHEMICALS, REAGENTS, AND GASES

For more on chemicals and reagents, see §6.4.3.1.

USES

- Chemicals and reagents are used for chemical and micro-chemical testing.
- Commercial products are also used for comparison purposes.
- Some chemicals are used during the cleaning processes for instrumentation.
- pH test strip may be used to test a liquid to determine if it is acidic or basic.
- Gases are used for instrumentation.

SAFETY CONSIDERATIONS

- Wear personal protective equipment when handling chemicals and reagents.
- Label the contents of any containers in accordance with laboratory guidelines in Section 6.4.3.1.
- Transport chemicals and reagents in a safe manner for the size and type of container and contents.
- Transport gas tanks on a cylinder cart with safety chain in place.

STORAGE

- Flammable chemicals or products should be stored in a flammables cabinet.
- Other chemicals or reagents are stored in cabinets, refrigerators, or on counters in such a way that reduces the chances of breakage.
- Chain gas tanks to the wall for storage.

PERFORMANCE CHECKS

- Dispose of chemicals and reagents when they fail to perform adequately under controlled conditions.
- Check pH test strips with the water (if used to dilute sample).

QUALITY CONTROL

- Chemicals and reagents are tested with known samples and blanks. Details are in Section 9.
- Logbooks are kept with directions of preparation, chemical(s) used, lot number (when applicable), and initials of analyst.

6.4.3.1 REAGENT RECORDS AND LABELING

GENERAL

- Mark all purchased solvents, chemicals, reagents, and reference materials when received with the date and initials of the person receiving them. Upon opening, mark the container with the date and initials of the individual opening the item.
    - Working bottles of chemicals or reagents should be labeled at a minimum with the name of the chemical or reagent, lot number, expiration date, and initials of the analyst

- The quality of all chemicals purchased for use in the Trace Evidence Unit will be adequate for their intended use. Generally, this will mean that solvents, acids, bases, organic and inorganic compounds will be of ACS Reagent Grade or better.
    - Ensure that the reference materials, controls, reagents, or chemicals used are of satisfactory quality.
    - Dispose of and replace reference materials, controls, reagents, or chemicals when they fail to perform adequately under controlled conditions.
- Items with a manufacturer-specified expiration date may not be used after that date without documentation to support continued reliability.
    - For items without a manufacturer-specified expiration date, dates will be based on experience, industry standard, or scientific consensus.
- Logs are maintained for reagents chemicals and reference materials used and contain preparation (and verification, if needed) instructions.
    - Recipes may be scaled up or down depending on need.
    - Test the reliability before use or, if appropriate, concurrent with the test.
    - Test non-routine reagents prepared for one time use with known samples and blank and record in the case notes. Discard any excess reagent after use.
    - Mark containers for prepared reagents and chemicals with the identity, date of preparation, date of expiration, initials of the analyst, and lot number (if needed).
- Test strips are checked with appropriate standards and results are recorded in the case notes.
    - Test strips may continue to be used past their stated expiration date as long as they pass the quality control check.
- Use deionized (DI) or reverse osmosis (RO) water for reagent preparation or as an extraction solvent.
- Glassware used for preparation shall be appropriate and clean.

6.4.3.2 REFERENCE COLLECTION RECORDS

Reference collection of items in the Trace Evidence Unit are documented on the S: drive . Each item in a collection is given a unique identifier and kept in storage within the unit. Other collections within the unit are used for training purposes but not for comparisons to casework.

Spectral libraries used as reference are maintained on the instrument. Each has a library listing of the contents and a unique identifier.

6.4.4 PERFORMANCE VERIFICATION

Before equipment is placed into service or returned into service, complete a performance verification. This ensures that the equipment meets all specified requirements.

GC-MS

- Add routine methods.
- Run each routine method with the ASTM 1618 Test Mix.
- Evaluate the chromatography, fragmentation patterns, and library matching capabilities to ensure quality performance of the instrument and software.
- Retain this data and information in the cabinet above the instrument.

SEM-EDS

- Test the Spike sample.
  - Confirm the elemental content and morphology of the particles detected.
  - Retain this data from the project on the instrument.
- Test the B-Fed 4 sample after preventative maintenance or as needed.
  - Confirm the elemental content and morphology of the particles detected.
  - Retain this data from the project on the instrument.

Microscopes

- Ensure the microscope is in proper alignment.

Reference Materials

- Attain a Certificate of Analysis from an ISO 17025 approved vendor, if possible
- Analyze the sample via SEM-EDS or GC-MS and retain verification information next to the instrument.

Refrigerators and Ovens

- Ensure proper temperature has been achieved before returning to service.

6.4.5 FITNESS FOR SERVICE

All equipment should be fit for service. Clearly mark any equipment that is not in service. See §6.4.8.

6.4.6 CALIBRATION REQUIREMENT

The Trace Evidence Unit does not have equipment requiring calibration.

6.4.7 CALIBRATION PROGRAM

The Trace Evidence Unit does not have equipment requiring calibration.

6.4.8 LABELLING

See *ASCL Quality Manual* (ASCL-DOC-01) for general information regarding labelling of calibrated equipment or equipment that has a defined period of validity.

6.4.9 OUT OF SERVICE

Remove from service any equipment which has been subjected to overloading or mishandling, gives questionable results, or has been shown to be defective or outside specified requirements.

Label the equipment as "Out of Service" to prevent its use. It will only be returned to service after it has been verified to perform correctly.

When equipment is removed from service due to a problem that occurred during case work, a *Quality Assurance Concern* workflow is initiated in Qualtrax®. The ASCL will examine any effect that the deviation may have had on its activities. See section 7.10 for lab policies regarding nonconforming work.

6.4.10 INTERMEDIATE CHECKS

See *ASCL Quality Manual* (ASCL-DOC-01).

The gunshot residue program in the Oxford AZtec system is automated to check the threshold standard every sixty minutes. This ensures the stability of the tungsten filament. If the threshold check fails, the automated run is stopped. The filament can be adjusted or replaced.

6.4.11 CORRECTION FACTORS

The reference materials used in Trace Evidence do not require correction factors.

6.4.12 EQUIPMENT ADJUSTMENT

If unintended adjustments of equipment may influence testing results, the Trace Evidence Unit will take precautions (when practicable) to prevent these unintended adjustments.

6.4.13 EQUIPMENT RECORDS

Records are retained for equipment that influences laboratory activities. These records include the Trace Evidence Equipment Log, Certificates, Reagent Logbooks, and instrument logbooks.

6.5 METROLOGICAL TRACEABILITY

See *ASCL-DOC-01 Quality Manual*.

6.6 EXTERNALLY-PROVIDED PRODUCTS AND SERVICES

6.6.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.6.2 RECORDS

See *ASCL-DOC-01 Quality Manual*.

6.6.3 COMMUNICATION

See *ASCL-DOC-01 Quality Manual*.

7 PROCESS REQUIREMENTS

7.1 REVIEW OF REQUESTS, TENDERS, AND CONTRACTS

7.1.1 GENERAL

The Trace Evidence Unit processes evidence submitted by external agencies and the Medical Examiner's Office of the Arkansas State Crime Laboratory using the methods and procedures documented in the Trace Evidence Quality Manual. Contracts (submission sheets) from agencies are reviewed by the Section Chief or Trace Evidence analysts to assess the requests and to determine if the laboratory has the capability and resources to perform the services requested (i.e. adequate standards, controls, and approved test methods). Requests from the medical examiner's office (Evidence Report in JusticeTrax®) should be added to the case file.

Case related discussions are documented on an *Agency Contact Form* (ASCL-FORM-06), e-mail, or other document and recorded in the case file.

Requests for non-routine work must be reviewed by the appropriate Section Chief. The Section Chief must initial and date the *ASCL Evidence Submission Form* [ASCL-FORM-12 and ASCL-FORM-63) next to the request.

See *ASCL-DOC-01 Quality Manual* for additional information regarding subcontracting.

7.1.2 INAPPROPRIATE REQUESTS

The Trace Evidence Unit makes all decisions regarding analytical processing and choice of methods, which is agreed to by the customer as part of the submission process. If the customer requests testing which is inappropriate or out-of-date, they are informed as part of the review of the request.

7.1.3 STATEMENTS OF CONFORMITY

The ASCL does not issue reports containing statements of conformity.

7.1.4 RESOLUTION OF DIFFERENCES

Any difference between the request or tender and the contract shall be resolved before any work commences. Each contract shall be acceptable both to the ASCL and the customer.

7.1.5 DEVIATION FROM THE CONTRACT

When the customer agrees to the contract, the customer agrees that the ASCL may make deviations as deemed necessary. However, the customer will be notified (e.g., iResults, phone call, e-mail) if the Trace Evidence Unit goes outside its scope of testing.

7.1.6 AMENDEMENT OF THE CONTRACT

If the contract needs to be amended after work has begun, the contract shall be reviewed (as stated above) by the discipline making the amendment, and all affected personnel shall be notified.

7.1.7 COOPERATION WITH CUSTOMERS

See *ASCL Quality Manual* (ASCL-DOC-01) for general information regarding cooperation with customers.

7.1.8 RECORDS OF REVIEW

See *ASCL Quality Manual* (ASCL-DOC-01) for information regarding records of review.

7.1.9 DATABASE SEARCH EXTENT

See *ASCL Quality Manual* (ASCL-DOC-01) for information regarding database search.

7.2 SELECTION, VERIFICATION, AND VALIDATION OF METHODS

7.2.1 SELECTION AND VERIFICATION OF METHODS

Test methods for Trace Evidence are listed in §9 of this manual.

See *ASCL-DOC-01 Quality Manual* for general information regarding:

- Selection of Methods
  - Test Methods
  - Comparison of Knowns and Unknowns
  - Calibration Method Selection
- Method Availability
- Method Version
- Method Selection
- Method Verification
- Method Development
- Deviation from Method

7.2.2 VALIDATION OF METHODS

See *ASCL-DOC-01 Quality Manual* for general information regarding:

- Validation of Methods
  - Extent of Validation
- Validation Procedure
- Changes to Validated Methods
- Relevance to Needs
- Validation Records

7.3 SAMPLING

7.3.1 GENERAL

The sampling plans are recorded in § 9 under the specific type of analysis, if appropriate. The sampling plan used in routine casework, as documented in the Trace Evidence Quality Manual, is not required to be recorded in the case notes. It may be recorded on one of the worksheets. Any deviations or elaborations shall be approved in writing by the Section Chief and maintained in the case record. The Section Chief will keep a log of deviations.

See *ASCL-DOC-01 Quality Manual* for additional information on Sampling, Sampling Method, and Sampling Records.

7.4 HANDLING OF TEST ITEMS

7.4.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

7.4.1.1 HANDLING PROCEDURES

7.4.1.1.1 STORAGE

The Trace Evidence Unit work area is secured by key and magnetic locks accessed only by laboratory personnel listed in §6.3.4.1 of this manual. Evidence may be left in this secure area. Each analyst also has a set of locked storage areas within their work area. The analyst shall take reasonable precautions to protect all evidence from loss, cross-transfer, contamination, and deleterious change.

Evidence collected and retained will be stored in the Trace Evidence Secure Storage lockers or

transferred to another analyst or secure storage location (i.e. PE Secure Storage or FD Secure Storage).

7.4.1.1.2 PACKAGING AND SEALING

If an entire originally submitted item is retained (for example a hair or tape lift), the original packaging should also be kept with the item, when practical.

Evidence will be sealed so that the contents cannot readily escape, and that opening the container would result in obvious damage or alteration to the container or its tape seal. All evidence must bear a proper seal, including the initials (or other identifier) of the person sealing the evidence across the seal.

Whenever practical, the original seal will be left intact when opening a container. This is not possible when opening containers submitted for ignitable liquids analysis.

If reusing the original container is impractical, a new evidence container may be used. It shall be marked and sealed according to the above procedures and the original evidence packaging shall be kept inside the second evidence container. If the original packaging cannot be kept, complete documentation and a picture of original packaging must be retained in the case record. Documentation of the change in packaging (with full description) must be included in the case record for future reference.

Items with an expectation of frequent analysis may be considered "evidence in the process of examination" and may be stored unsealed in a limited access area as long as the evidence is protected from loss, cross-transfer, contamination, and deleterious change. Cases no longer in the process of examination shall be closed and the evidence properly sealed until analysis resumes or a new service request is received.

Evidence collected by trace evidence analysts from a crime scene or vehicle should be protected from loss, cross transfer, contamination, or other change during transport to the ASCL. The evidence should be appropriately identified, packaged, and entered into the LIMS as soon as practical.

Evidence categorized as Trace Evidence but which is no longer tested at the Arkansas State Crime Laboratory (e.g. paint, tape, glass, fibers) may be collected and preserved to prevent loss or contamination.

7.4.1.1.3 CHAIN OF CUSTODY

Evidence[1] within the Trace Evidence Unit is tracked by the LIMS. Sub-items shall be tracked through the chain of custody to the same extent as original items.

The LIMS database contains electronic signatures and initials for all analysts. In older cases, a combination of written and electronic chain of custody is used.

INTRA-LABORATORY TRANSFER

Cases may be transferred within the ASCL System as necessary in order to minimize the turn-around time and to provide the best overall service to our customers.

INTER-LABORATORY TRANSFER

Refer to *ASCL-DOC-01 Quality Manual* §6.6.2.

EVIDENCE RETENTION AND RETURN

At times, evidence items or samples from evidence items may be retained at the laboratory. When items are retained, the submitting agency will be notified, typically via analysis report.

Evidence collected and retained in the Trace Evidence Secure Storage location is periodically returned to the agency. The items are usually retained for at least 5 years. If the case is active, they may be kept for a longer duration.

7.4.1.1.4 CUSTOMER NOTIFICATION

See *ASCL-DOC-01 Quality Manual*.

7.4.2 ITEM IDENTIFICATION

Each exterior container is labeled with a unique barcode. Analysts document the packaging description in their notes and mark the containers with the case number, item number, and the initials of the analyst. Agency evidence numbers will be used to identify the evidence whenever practical.

Evidence collected from or removed from items of evidence (SEM stubs, hairs, tape lifts, etc.) will be labeled with a unique identifier and itemized in JusticeTrax®. This allows for the tracking of each sub-item and the identification of its origin.

All evidence will be marked or identified with the laboratory case number (e.g., YYYY-######), item number, and initials of the analyst. When the evidence does not lend itself to marking, a tag may be attached. If the item is unsuitable for marking (e.g. too small, to be tested for latent prints,

[1] This includes both items that are received by the laboratory as well as items that are collected or created and preserved for future testing (e.g. GSR stubs, tape lifts, hairs)

irregular appearance), mark the proximal container with the laboratory case number, item number, and initials of the analyst.

7.4.3 DEVIATIONS

See *ASCL-DOC-01 Quality Manual*.

If a packaging deficiency is not apparent until the case is checked out by an analyst, the analyst may correct the deficiency. If there is any concern that the packaging deficiency has affected the integrity or identity of the test item, the Physical Evidence Section Chief and the customer agency shall be advised and consulted for further instructions.

If the analyst discovers a significant inconsistency between the stated and actual contents of a package, or if there is doubt about the suitability of an evidence item for testing, then the analyst shall attempt to contact the customer before proceeding. All contacts will be documented in the case record (e.g. *Agency Contact Form* ASCL-FORM-06, email). For minor inconsistencies, the analyst shall use their judgment on whether to contact the customer, but must make a note of the discrepancy in the case file.

All remedial actions taken to correct packaging or evidence deficiencies shall be noted in the case record (e.g. on the submission form or in analytical notes).

If the customer requires testing after acknowledging a deviation from specified conditions, a disclaimer will be included in the report indicating which results may be affected by the deviation.

7.4.4 ENVIRONMENTAL CONDITIONS

See *ASCL-DOC-01 Quality Manual*.

7.5 TECHNICAL RECORDS

7.5.1 GENERAL

Each case record will contain enough information to enable reanalysis to be conducted under conditions as close as possible to the original and to identify factors affecting uncertainty.

Record the starting date in the notes. Record observations, data, and calculations at the time they are made and make them identifiable to the specific task. This may be in the notes or on spectra. The ending date for the work will be the “draft complete” date recorded in JusticeTrax®.

Record operating parameters used during instrumental analysis in the examination records or as a method on the spectra. A more in depth method description may be found in § 9 of this Quality Manual.

The unique ASCL case number (e.g. YYYY-######, either handwritten or electronically generated) and the analyst's handwritten initials or signature (or secure electronic equivalent) must be on all examination records in the case file.

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding technical records.

7.5.1.1 TECHNICAL RECORD RETENTION

Examination records are any records generated by the analyst for a case file (e.g. notes, worksheets, photographs, spectra, printouts, charts, and other data). Examination records that are essential for the evaluation and interpretation of the data must be stored in the appropriate folder within the "Request" folder in the LIMS case file. When it is not feasible to incorporate the examination records in the LIMS case file, these records may be stored external to the LIMS case file. Large data files (such as those generated by the SEM/EDS during gunshot residue analysis) or extra spectra (GC-MS, SEM/EDS) will be stored by case number on the instrument on which it is collected. Periodically, these files will be backed up and may be stored externally.

All other records contained in the case file will be considered administrative records and will normally be stored in the "Case Images" folder in the LIMS case file.

7.5.1.2 ABBREVIATIONS

Abbreviations may be used in examination records. Trace Evidence abbreviations are located in §3 of this manual. Commonly understood abbreviations (e.g. etc., mL, pos.) are not required to be included in this legend.

7.5.1.3 TECHNICAL RECORD SUFFICIENCY

Technical records to support a report[2] shall be such that, in the absence of the analyst, another competent reviewer could evaluate what was done and interpret the data. See §9 of this manual.

7.5.1.4 TECHNICAL RECORD PERMANENCY

Records are created or maintained in a permanent manner. Handwritten notes and observations must be in ink. However, pencil may be appropriate for diagrams or making tracings. No handwritten information will be obliterated or erased.

A sticky note containing case information (e.g., case notes, reviewer notes, an item's identifier) shall not be used. Sticky notes used only to flag a location in the case record, and which contain no case information, may be used.

[2] Including results, opinions, and interpretations

7.5.1.5 REJECTION

If data, an observation, or a calculation is rejected, the following information will be recorded in the technical record:

- The reason for the rejection
- The identity of the person rejecting
- The date of the rejection

This includes both rejection by a reviewer/verifier and rejection of data by the analyst/examiner.

7.5.1.6 CALIBRATION DATA

The Trace Evidence Unit does not use equipment requiring calibration.

7.5.2 AMENDMENTS TO TECHNICAL RECORDS

Amendments[3] to technical records must be trackable to previous versions or to original observations. Both the original and amended data will be retained, including:

- The date of alteration
- An indication of the altered aspect(s)
- The initials of the analyst who made the alteration(s)

Any corrections made to existing hardcopy technical records will be made by an initialed and dated single strikeout (so that what is stricken can still be read) by the person making the change. All additions will be initialed and dated. Correction fluid or correction tape may not be used.

Changes made to electronic documents must allow the reviewer to track what changes were made to the document, who made the change, and when. If a correction is made, the original version will be maintained[4].

Contemporaneous[5] revisions to technical records are not considered to be amendments.

When the analyst has completed a request, set the milestone(s) in JusticeTrax® to draft complete. Examination records for a request will be considered completed at this time. If a change is subsequently made to the examination record, the original record will remain in the electronic case file and the changed record will be stored with a different name (e.g. amended notes). There shall be sufficient information to determine what was changed.

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[3] Including additions, deletions, changes, interlineations, or any other modification to the original information
[4] A second copy of the document is not necessary if it has not yet been placed into JusticeTrax®; the correction can be made on the original notes.
[5] Contemporaneous means at the same time. Amendments made after moving on to the next item/task are not considered to be contemporaneous.

If a report is changed after it has been draft completed (but before release), place a copy of the original report in Case Images (Scanned or Indexed individually or scanned with the Review Sheet) with an indication that it is not the final copy.

7.6 EVALUATION OF MEASUREMENT UNCERTAINTY

Trace Evidence does not record measurements in external reports.

7.7 ENSURING THE VALIDITY OF RESULTS

7.7.1 GENERAL

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding ensuring the validity of results

This manual contains quality control procedures to monitor and ensure the validity of test results. See §6.4.3 for instrumentation and §9 for categories of testing.

Work on the case only proceeds if quality control measures are acceptable. If the quality control data is outside the acceptable criteria, case work is not initiated or continued. The problem should be determined and corrected with passing quality control before case work proceeds.

7.7.1.1 VERIFICATION

The Trace Evidence Unit does not require verification of analysis before the case is complete.

7.7.1.2 CASE REVIEW

All cases will be technically and administratively reviewed prior to the release of the report. The review process must confirm that electronic versions of all necessary documentation are in the imaging module of LIMS or in the *Reviewer Notes* field in the related request in JusticeTrax®.

The *Trace Evidence Case Review Form TR-FORM-01A* is used for cases in which one analyst will be reviewing the case. If the case involves multiple categories of testing which require more than one analyst to review, *Trace Evidence Case Review Form TR-FORM-01B* may be used. Alternatively, the review may be documented in *Reviewer Notes* field in the related request in JusticeTrax®.

If a reviewer discovers an error in the case record, the reviewer must document the error (using a case review form or the *Reviewer Notes* field) and inform the analyst. If the analyst and the reviewer cannot reach consensus, then both the analyst and reviewer must meet with the Section Chief (or designee) for resolution.

All non-conforming work identified during review will be handled according to § 8.7 (Corrective Action).

The successful completion of technical and administrative reviews is recorded by the setting of the appropriate milestone(s) in JusticeTrax®.

7.7.1.2.1 TECHNICAL REVIEW

The technical review will include a thorough review of the analyst's examination records to ensure that the records support the reported results.

At a minimum, the technical review shall include a review of all examination records and the report to ensure that:

- All necessary analyses are performed and documented according to established guidelines
- The case data supports the results and/or conclusions in the report
- The report is accurate
- Associations and results are properly qualified in the report
- The report contains all required information

The technical review includes, but is not necessarily limited to: bench notes, spectra, graphs, external telephone conversation records, investigative reports, sketches, diagrams, and laboratory reports. The records must provide an adequate basis for any reported conclusions.

The technical review does not shift the responsibility for the forensic findings to the reviewer, but the reviewer has the responsibility of ensuring that the case record provides an adequate basis for the conclusion.

It is the responsibility of the technical reviewer to report serious or repetitive deficiencies to the Section Chief. If the technical reviewer discovers a problem that raises an immediate concern regarding the overall quality of the analyst's work, the technical reviewer must promptly notify the Section Chief. The Section Chief will consult with the Quality Assurance Manager and Assistant Director to determine whether a Corrective Action Request is warranted.

Technical reviews must be conducted by individuals competency tested and authorized by the Physical Evidence Section Chief to perform the testing work that is being reviewed[6]. This authorization shall be documented on the *Analyst & Technician Competency Authorization Documentation* form (ASCL-FORM-62).

An individual conducting technical review does not have to be an active examiner or undergo proficiency testing. The reviewer must have sufficient knowledge of the discipline to verify compliance with the laboratory's technical procedures and that the reported conclusions are supported by the examination documentation. For those individuals not currently competent in the reviewed discipline, the Section Chief shall write an authorization memo or letter which will be maintained in Qualtrax®.

[6] The reviewer need not be an ASCL employee, currently proficiency tested, or currently performing the work

If the review is conducted by a qualified analyst who is not an employee of the Arkansas State Crime Laboratory, the reviewer must be from an accredited laboratory. The accreditation certificate for the laboratory and a CV for the individual conducting the review will be maintained on file (S:\Technical Reviewers).

Administrative reviews may be conducted by any laboratory analyst or other qualified individual. The administrative reviewer of a case that has been technically reviewed by an outside agency will push the technical review in the LIMS before proceeding with the administrative review. The administrative reviewer will ensure that the completed review form has been scanned into the case file.

Technical review of an examination record or report shall not be conducted by the author or co-author.

Verification of a critical finding does not constitute authorship, and does not disqualify the verifier from performing technical review.

7.7.1.2.2 ADMINISTRATIVE REVIEW

Administrative review includes a review of spelling and grammar, markings[7], descriptions of evidence and seals, and other appropriate documentation.

Administrative review may be conducted by any individual qualified to perform technical review. Administrative review shall not be conducted by the author of the report.

At a minimum, the administrative review shall include:

- A review of the report to ensure consistency with laboratory policy and editorial correctness
- A review of all administrative and examination records to ensure that they contain the unique ASCL case number and are stored properly in LIMS
- A review of the examination records to ensure dates are recorded to indicate when the work was performed, and
- A review of examination records to ensure that all corrections in the case file are made consistent with laboratory policy

7.7.1.2.3 TESTIMONY REVIEW

See *ASCL Quality Manual* (ASCL-DOC-01).

Testimony review of each testifying analyst or examiner shall occur at least once per accreditation cycle, when practicable. If this review is not practicable, a memorandum will be generated detailing the reason(s). This documentation will be maintained in Qualtrax on the Personnel tab.

[7] For example, case number, date, and initials on appropriate pages

Frequency of testimony review may be increased in some situations. Examples may include: if an analyst is found to have had any serious or repetitive deficiencies in the technical aspects of testimony; if an analyst's testimony has raised immediate concern regarding the overall quality of the analyst's work; or if the analyst has limited testimony experience.

TESTIMONY REVIEW SCHEDULE

- First testimony as a new analyst or in a new discipline (when practicable) - Reviewed by Trace Evidence Quality Manager, if possible.
- One testimony review per testifying analyst per accreditation cycle (4 years).

7.7.2 INTERLABORATORY COMPARISONS

The Trace Evidence Unit monitors its performance by participating in proficiency testing as a form of interlaboratory comparison. This assists the Trace Evidence Unit in the evaluation of individual technical expertise and the monitoring of training needs and procedural weaknesses for individual analysts and disciplines within the laboratory.

7.7.2.1 EXTERNAL PROFICIENCY TESTING

For each calendar year[8], the Trace Evidence Unit participates in at least one external proficiency test for each discipline in which accredited services are provided. The providers of these tests must be authorized to release the test results to ANAB.

7.7.3 MONITORING ACTIVITY ANALYSIS

The data from monitoring activities is evaluated as part of the quality control system of the laboratory. Data that is monitored within the Trace Evidence Unit includes but is not limited to evaluating quality control results, proficiency testing, and the technical and administrative review process. When data or procedures are found to be outside acceptable criteria, action is taken to correct the problem and to prevent incorrect results from being reported. The initiation of the corrective action process may be necessary (see § 8.7).

7.7.4 INDIVIDUAL PERFORMANCE MONITORING

Each Trace Evidence analyst engaged in testing activities or the authorization of results shall successfully complete at least one internal or external proficiency test per calendar year[9] in each discipline in which they perform that work. The disciplines covered by the Trace Evidence unit include Fire Debris and Materials (Hair Identification and Gunshot Residue).

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[8] For proficiency tests conducted at the end of the calendar year, the evaluation may take place in the next calendar year

[9] For proficiency tests conducted at the end of the calendar year, the evaluation may take place in the next calendar year

If an analyst is solely performing case reviews, they will also complete a proficiency test covering the reviews for the discipline.

Proficiency test assignments should be varied so that personnel are evaluated on all aspects of their job function over time.

Successfully completing a proficiency test means either obtaining the correct response or successfully completing corrective action(s) resulting from an incorrect response (see § 8.7).

7.7.5 PERFORMANCE MONITORING REQUIREMENTS

Analysis, technical review, and administrative review policies are employed during proficiency testing as they are normally applied to casework. All parts of a proficiency test provided by an approved test provider shall be examined as completely as the discipline's procedures allow.

A case will be created in JusticeTrax® LIMS-plus for all proficiency tests. Under the "Offense" tab, "Proficiency Test" shall be selected. For external proficiency tests, the analyst shall complete the test and submit the results by the due date.

Some external proficiency tests (e.g. Gunshot residue, Hair Identification) may be taken independently by more than one analyst. The first analyst taking the test will submit the results to the external provider before the succeeding analyst receives the test. This will be considered an External Proficiency Test. The remaining analyst will independently take the exam by the proficiency due date. These tests will be considered Internal Proficiency Tests. Precautions are taken to prevent the initial results from influencing the subsequent examiner (e.g. each proficiency case record is restricted in JusticeTrax® so that the other analysts taking the test cannot access it or perform the technical or administrative review).

The criterion for successful completion of proficiency testing in the Trace Evidence Unit is obtaining the expected results from the proficiency provider. More specific criteria may be documented in the Proficiency Test workflow.

For intra-laboratory monitoring events (i.e. internal proficiency tests), the quality of the comparison will be evaluated prior to the monitoring activity. This is typically achieved by pre-distribution testing or examination by another analyst and recorded on the proficiency test workflow. Documentation of this evaluation will be maintained.

The evaluation of all intra-laboratory monitoring events will include comparison to results obtained by another analyst/examiner at the laboratory. This may include pre-distribution testing or the results of other analysts being monitored.

Nonconformities identified at any point in the testing will be handled in accordance with § 7.10 (Nonconforming Testing) and § 8.7 (Corrective Action).

Each Section Chief (or supervisor) is responsible for comparing the analytical results to the expected results, determining if the analytical results are acceptable, and reviewing these results with the analyst.

The following criteria shall be used for evaluating proficiency test results:

- No analyst may evaluate their own proficiency test.
- All tests are graded as satisfactory or unsatisfactory.
  - A satisfactory grade is attained when the experimental results match the expected results
- If there is a discrepancy between the expected results and the experimental results, the Section Chief must notify the Quality Assurance Manager
- Minor discrepancies may be deemed satisfactory, based on the following factors, with approval of the Quality Assurance Manager:
  - Discipline interpretation guidelines
  - Consensus results

If the results are deemed to be unsatisfactory, a Quality Assurance Concern workflow must be initiated.

7.7.6 PERFORMANCE MONITORING SCHEDULE

The Trace Evidence Unit maintains a documented schedule of proficiency testing on the S: drive and in Qualtrax®

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding performance monitoring schedule.

7.7.7 PROFICIENCY TEST SOURCING

See *ASCL Quality Manual* (ASCL-DOC-01).

7.7.8 PERFORMANCE MONITORING RECORDS

See *ASCL Quality Manual* (ASCL-DOC-01).

7.8 REPORTING AND TESTIMONY

7.8.1 GENERAL

7.8.1.1 REVIEW AND AUTHORIZATION OF RESULTS

All results will be reviewed and authorized before release.

7.8.1.1.1 DOCUMENTATION

Both the review of results and the authorization of results are performed by the author of the report and are documented by the setting of the draft complete milestone.

Trace Evidence analysts issuing a report based on examination records generated by another analyst shall complete and document a review of all relevant pages of documentation in the case record (e.g. initialing each page of the examination record or by using a review checklist or statement).

Trace Evidence analysts offering testimony based on examination records generated by another individual shall complete a *Court Case Review Form* (ASCL-FORM-57) before testifying. This form should be added to the JusticeTrax® case file.

7.8.1.2 REPORTS

When analytical conclusions or opinions are generated, a "Report of Laboratory Analysis" will be issued to the investigating agency (including to the ASCL Medical Examiner's Office). The results shall be reported accurately, clearly, unambiguously, and objectively, and in accordance with any specific instructions in the test methods. Each analyst proofreads and signs their reports to indicate that the report is accurate and error-free. The LIMS allows the analyst to sign their reports electronically.

A laboratory report is not required if an internal request is made to determine if a hair is suitable for DNA. However, if the examination results in gaining additional probative information or additional samples are needed, a report should be issued.

See *ASCL-DOC-01 Quality Manual* for additional exceptions and reporting information.

7.8.1.3 SIMPLIFIED REPORTING

The ASCL, in agreement with its customers, reports in a simplified way. This agreement is documented on the submission form by the customer's signature.

7.8.1.4 REPORT ELEMENTS

See *ASCL Quality Manual* (ASCL-DOC-01).

7.8.2 COMMON REQUIREMENTS FOR REPORTS

7.8.2.1 REPORT ELEMENTS

The elements which are included and not included in each report is maintained on the ASCL website. A link to where this list is located on the website is included on the *Evidence Submission Form* (ASCL-FORM-12_WD or ASCL-FORM-63).

See *ASCL-DOC-01 Quality Manual* for a listing of report elements.

7.8.3 SPECIFIC REQUIREMENTS FOR TEST REPORTS

See *ASCL-DOC-01 Quality Manual* for specific requirements. The Trace Evidence Unit does not report measurements.

7.8.4 SPECIFIC REQUIREMENTS FOR CALIBRATION CERTIFICATES

The ASCL does not perform calibration or issue calibration certificates.

7.8.5 REPORTING SAMPLING—SPECIFIC REQUIREMENTS

See *ASCL-DOC-01 Quality Manual.*

7.8.6 REPORTING STATEMENTS OF CONFORMITY

The ASCL does not issue statements of conformity.

7.8.7 REPORTING OPINIONS AND INTERPRETATIONS

7.8.7.1 AUTHORIZATION

Only personnel authorized by the ASCL to express opinions and interpretations in reports may do so, and only for the types of testing for which they have been authorized. The case record shall support the basis for any interpretation or opinion.

7.8.7.2 SCOPE OF OPINIONS/INTERPRETATIONS

The following (or equivalent) statement will appear on all laboratory reports:

"The results stated below relate only to the items tested and represent the interpretations/opinions of the undersigned analyst."

7.8.7.3 DIALOGUE

When opinions or interpretations are directly communicated by dialogue to a customer, a record of the communication will be retained[10] in the case record.

7.8.8 AMENDMENTS TO REPORTS

7.8.8.1 IDENTIFYING THE CHANGE(S)

An amended report is necessary if an error is found on issued report (including reports uploaded to iResults). An "amended request" will be created in the LIMS and all administrative and examination records for the amended analysis will be added to the electronic case record. Administrative and technical reviews are required before an amended report is issued. When an amended report is necessitated by a change in analytical results, then the Section Chief or Section Quality Manager will perform the technical review on the amended request. Documentation of this review will be incorporated into the original case file.

The original report and all original records will be kept in the case record.

An amended report is generally not needed when an agency revises or corrects administrative information that they provided at the time of submission[11] after a report has already been issued. Exceptions can be made for individual cases, when appropriate.

The amended report is intended to replace the original report, and will contain all of the unchanged results from the original report, as well as the newly-amended results. Any change of information will be clearly identified. Where appropriate, the reason for the change will be included in the report.

The disclaimer will normally be contained in a note at the bottom of the report, but may be alternately listed in the result text if this makes the reason for the amendment clearer to the customer.

7.8.8.2 STYLE OF AMENDMENT

Any amendments to an issued report are made by issuing a complete new report.

[10] For example, using an *Agency Contact Form* (ASCL-FORM-06)
[11] For example, correcting the spelling of a name, or changing an incorrect agency case number

7.8.8.3 IDENTIFYING THE AMENDED REPORT

The statement "*AMENDED REPORT TO ORIGINAL [TYPE] REPORT ON [DATE]*" (or equivalent) will appear below the header information and above the listing of the evidence and the results[12]. The amended report will contain all of the items on the original report and any amendments.

The original report must be stored in the JusticeTrax® case record.

7.8.9 SUPPLEMENTAL REPORTS

A supplemental report is necessary when additional evidence is received after the original report has been issued, additional requests for analysis are made, or other additional testing is required in a case[13]. A "supplemental request" will be created in the LIMS, and all administrative and examination records for the additional evidence will be added to the electronic case record. Administrative and technical reviews are required before a supplemental report is issued. The statement "SUPPLEMENTAL REPORT TO ORIGINAL [TYPE] REPORT ON [DATE]" (or equivalent) will appear below the header information and above the listing of the evidence and the results[14]. The supplemental report will contain the updated information from the additional analysis.

All original records will remain in the case record.

7.8.10 REPORTING GUIDELINES

- For reporting guidelines for specific test methods, refer to § 9 of this manual.

7.8.11 TESTIMONY GUIDELINES

- An analyst shall make no assumption as to how an item or substance (e.g. GSR particle, ignitable liquid, hair, etc.) was transferred to the evidence.
- If an identification is made in casework (e.g. GSR particle, ignitable liquid, hair, etc.), an analyst shall make no assumption as to how long that substance has been present in/on the evidence.
    - In the instance of GSR kits collected from a person's hands, an analyst may provide a *general* timeframe of persistence of GSR on skin.
- An analyst may assert that the ability to detect a substance is in part based on the integrity of the packaging at the time of receipt at the lab; test results may be influenced by packaging.

[12] The date of the original report must be entered in the "additional data" tab of the amended request.
[13] When additional evidence is received on a case that has not been completed, the additional evidence may be analyzed and included in the original report
[14] The date of the original report must be entered in the "additional data" tab of the supplemental request

- An analyst shall make no assumptions or suggestions that a hair originated from a particular individual.
- An analyst shall not assert that examinations conducted in Trace Evidence are infallible or have a zero error rate.
- An analyst shall not provide a conclusion that includes a statistic or numerical degree of probability except when based on relevant and appropriate data.
- An analyst shall not cite the number of Trace Evidence examinations or cases worked in his or her career as a direct measure for the accuracy of a proffered conclusion. An analyst may cite the number of examinations or cases worked in the Trace Evidence discipline for the purpose of establishing, defending, or describing his or her qualifications or experience.
- An analyst shall not use the expressions 'reasonable degree of scientific certainty,' 'reasonable scientific certainty,' or similar assertions of reasonable certainty in either reports or testimony.

7.9 COMPLAINTS

7.9.1 GENERAL

The ASCL processes all complaints using the *Quality Assurance Concern* (QAC) workflow in Qualtrax®.

See *ASCL-DOC-01 Quality Manual*.

7.9.2 TRANSPARENCY OF PROCESS

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding transparency of process.

7.9.3 COMPLAINT PROCESS

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding the complaint process.

7.9.4 RESPONSIBILITY

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding responsibility.

7.9.5 COMMUNICATION

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding communication.

7.9.6 INDEPENDENT EVALUATION

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding independent evaluation.

7.9.7 NOTICE OF COMPLETION

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding notice of completion.

7.10 NONCONFORMING WORK

7.10.1 GENERAL

Nonconforming testing is testing in which ASCL procedures are not followed or the agreed-upon requirements of the customer (e.g., testing of standards and controls, test precision and accuracy, the care and handling of evidence, instrument performance) are not met. All laboratory staff, including analysts and supervisory personnel, must be vigilant for any indication of nonconforming testing.

See *ASCL-DOC-01 Quality Manual for further information regarding nonconforming work*.

7.11 CONTROL OF DATA AND INFORMATION MANAGEMENT

See *ASCL Quality Manual* (ASCL-DOC-01).

8 MANAGEMENT SYSTEM REQUIREMENTS

8.1 OPTIONS

See *ASCL-DOC-01 Quality Manual*.

8.2 MANAGEMENT SYSTEM DOCUMENTATION (OPTION A)

8.2.1 POLICIES AND OBJECTIVES

The Trace Evidence Quality Manual (TR-DOC-01) is a compilation of policies and procedures for use in the Trace Evidence Unit. This manual is available on Qualtrax®. Trace Evidence Analysts (Criminalists) are responsible for the familiarization and utilization of these policies and procedures. The Trace Evidence Quality Manual and Training Manual are reviewed annually by the Section Chief. Updates are made as needed to reflect changing organizational, technical, and procedural information. Reviews will be conducted on Qualtrax®.

See *ASCL Quality Manual* (ASCL-DOC-01) for further information regarding policies and objectives.

8.2.2 MISSION AND QUALITY POLICY STATEMENTS

The mission of the Trace Evidence Unit is to utilize scientific methodologies and instrumentation to examine physical evidence for the presence of ignitable liquids and primer gunshot residue and to perform hair identifications including the determination of suitability for DNA analysis. The Trace Evidence Unit is dedicated to collecting and preserving evidence for future analysis.

The Trace Evidence Training Manual (TR-DOC-02) may be found on Qualtrax®.

8.2.3 COMMITMENT TO MANAGEMENT SYSTEM

See *ASCL Quality Manual* (ASCL-DOC-01).

8.2.4 DOCUMENTATION

See *ASCL Quality Manual* (ASCL-DOC-01).

8.2.5 ACCESSIBILITY

Trace Evidence Analysts have access to the ASCL and Trace Evidence quality manuals at all locations where operations essential to the effective functioning of the laboratory are performed through the Qualtrax® document control system. If performing work off-site, quality manuals are available on the ASCL website.

8.3 CONTROL OF MANAGEMENT SYSTEM DOCUMENTS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.4 CONTROL OF RECORDS (OPTION A)

8.4.1 RECORDS

All records shall be legible, readily retrievable, and maintained in a manner that prevents damage, deterioration, or loss of the records. The storage location of physical records must be secure and have limited-access.

Records include both quality and technical records. This policy provides procedures and practices for the identification, collection, organization, accessibility, filing, indexing, access, storage, maintenance, and disposal of records.

TECHNICAL RECORDS

Trace Evidence case files will be retained by the Arkansas State Crime Laboratory in either physical or electronic form. The Arkansas State Crime Laboratory uses the JusticeTrax® LIMS-plus software program. All case documentation will be stored electronically. Once reviewed, this electronic version is considered the official case record.

Historical non-electronic case files for the Little Rock laboratory are stored in the Trace Evidence section, the evidence storage area in Evidence Receiving, or the laboratory annex.

QUALITY RECORDS

Trace Evidence quality records such as reagent and chemical QC logs, instruments logs, and training records will be stored in the unit library, by the instruments, or in the office of the Section Chief.

8.4.2 RECORD POLICIES AND PROCEDURES

See *ASCL Quality Manual* (ASCL-DOC-01).

8.5 ACTIONS TO ADDRESS RISKS AND OPPORTUNITIES (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.6 IMPROVEMENT (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.7 CORRECTIVE ACTIONS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.8 INTERNAL AUDITS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.9 MANAGEMENT REVIEWS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

9 CATEGORIES OF TESTING

Personnel who authorize results or express opinions or interpretations in the Trace Evidence Unit will meet the educational requirements listed in §5.2.9 and §6.2.2.1 of this manual.

The following is a guide to the types of analysis conducted in the Trace Evidence Unit.

9.1 FIRE DEBRIS ANALYSIS (OR IGNITABLE LIQUIDS ANALYSIS)

9.1.1 SCOPE

Evidence may be submitted for the detection of ignitable liquids. The evidence is examined, residues are extracted, and samples are analyzed by gas chromatography – mass spectrometry.

The evidence must be submitted in an airtight container to protect the integrity of the evidence and the validity of the result.

9.1.2 ANALYTICAL APPROACH

- Briefly open each container, make a visual inspection, and record a description of the contents on the GC-MS Worksheet.
- Do not intentionally smell the contents but make a notation of any noticeable odor. Samples with a strong odor may be tested at ambient temperature.
- Liquid samples may be tested for the pH level using pH test strips. Strong acids and bases should not be directly injected to the GC-MS.
- If a non-aqueous liquid is present, it may be tested "neat". See direct injection procedure.
- If an aqueous liquid is present or for most debris samples, the sample will be collected by Passive Adsorption-Elution. See procedure below.
- Solvent extraction may be the best testing method for some types of evidence (e.g. a dried liquid on glass or swabs).
- If a latent print examination is requested on a container, remove contents of the container to a clean airtight jar for further analysis. If no liquid is present, a solvent extraction of the interior of the container may be conducted or the item may be tested at ambient temperature.
- The samples are examined by GC-MS. See procedure in § 9.1.6.
- The GC-MS Total Ion Chromatogram (TIC) and extracted ion chromatography (EIC) for case samples are compared to known reference samples.
- Any sample extract vials generated during the analysis are returned in the original container.

- If a known ignitable liquid is submitted in a case, comparisons between the known(s) and other questioned samples are not conducted. Each sample is tested independently. No conclusions are drawn as to the origin or source of the sample.
- Data from questioned samples will be analyzed before any known samples in order to limit any potential bias.

9.1.3 SAFETY CONSIDERATIONS

- Intentional inhalation of fumes may be harmful. Avoid direct inhalation.
- Carbon disulfide should be used in the hood.
- Samples which have been in the oven may be very hot. Caution should be taken when removing these items.

9.1.4 MINIMUM STANDARDS AND CONTROLS

- Each new bottle of carbon disulfide must be tested prior to use in casework. Approximately 2 mL of carbon disulfide is placed in a vial and a sample is injected. It must be free of any significant peaks which would interfere with the analysis. The data files for the date the bottle was opened are kept in the QC folder on the GC-MS with the lot number recorded.
- Each new package of carbon strips should be tested prior to use in casework. A strip will be placed in a vial with carbon disulfide and tested. It must be free of any significant peaks which would interfere with the analysis. The data files for the date the package was opened are kept in the QC folder on the GC-MS with the lot number recorded.
- A sensitivity standard (ASTM E1618) will be run with each sequence to ensure minimum detection limits and reproducibility of retention times. The data files are kept in the QC folder on the GC-MS.
    - The retention time for three peaks (toluene, decane, and hexadecane) will be recorded in a chart on the GC-MS desktop. If the retention time varies by more than 0.05 minutes from the previously recorded peak retention time, maintenance should be performed.
- A sample of alcohols, gasoline, kerosene, and diesel fuel (AGKD) will be run at the beginning of each sequence to ensure the reproducibility of chromatographic patterns. If the sequence runs longer than the work day or overnight, then the AGKD sample should be included at the end of the sequence. The spectrum should be examined for the presence of the alcohol peaks prior to the solvent delay and for the gasoline, kerosene, and diesel pattern after the delay. The data files are kept in the QC folder on the GC-MS.
- There must be at least one blank between each case sample injected. The blank is solvent only and must be the same solvent used on the other samples in the case. A blank for each item is included in the case file.
- Reagents used will be at least reagent grade.
- Clean tweezers used to remove carbon strips from paper clip in carbon disulfide between each sample.

- A reference collection of ignitable liquids is maintained for classification and comparison purposes.

9.1.5 SAMPLING TECHNIQUES

9.1.5.1 PASSIVE ADSORPTION–ELUTION

This technique is used for most samples and is a non-statistical sampling method. It is a headspace concentration method also known as the charcoal strip method in which volatile ignitable liquids are removed from the static headspace above the sample and trapped on a charcoal strip then eluted with a solvent and analyzed.

- A charcoal strip attached to a bent paper clip is placed in the container by a string.
- For heated passive adsorption, the container is resealed and placed into an oven with temperature between 60º C and 70º C for a minimum of four hours. The container may be left overnight.
- For ambient passive adsorption, the container is resealed and left at room temperature for a minimum of sixteen hours.
- If heated, the container is removed from the oven and allowed to cool.
- The charcoal strip is removed and placed in an injection vial.
- The charcoal strip is eluted with a small amount of carbon disulfide.
- The eluent is analyzed by gas chromatography-mass spectrometry (GC-MS).

9.1.5.2 DIRECT SAMPLING

This technique is used for non-aqueous liquid samples and is a non-statistical sampling method. Non-aqueous samples may also be examined with passive adsorption-elution. The whole liquid is tested. Samples which are strong acid or bases should not be directly injected to the GC-MS. A test of the pH using a pH test strip should be performed if the liquid could be strongly acid or basic. Record pH lot number used in notes.

- Neat liquid samples are diluted with carbon disulfide and analyzed via gas chromatography-mass spectrometry.
- A solvent blank must be included.

9.1.5.3 SOLVENT WASH OR SOLVENT EXTRACTION

This is a sensitive technique which can be useful for the extraction of petroleum products from non-porous surfaces, debris, or very small samples. It is a non-statistical sampling method.

- Place as much of the sample as is practical into a clean beaker.
  - If possible select a representative portion of the sample.
  - If only a representative portion is extracted, include which portion in notes.
- Pour a small amount of pentane or carbon disulfide over the sample.
- Decant the solvent into a separate clean beaker.

- Evaporate the solvent to a small volume to concentrate any ignitable liquid residues that may be present.
- The solvent blank shall be treated in the same manner as the sample.
- Analyze by gas chromatography-mass spectrometry.

9.1.6 TESTING TECHNIQUE

See Gas Chromatography-Mass Spectrometry §6.4.3 (1).
Samples are analyzed by GC-MS which provides a total ion chromatogram (TIC) and extracted ion chromatograms (EIC) for groups of specific ions.

9.1.6.1 ANALYTICAL PROCEDURES

- An autotune must be performed and checked prior to testing case samples.
- Each day the GC-MS is used for case samples, the AGKD sample and the Sensitivity sample must be injected prior to case samples. This will serve to check the resolution and sensitivity of the instrument.
  - Compare to previous sample to verify consistency.
  - Verify mass spectra of specific peaks.
- Inject case samples.
  - The autosampler may be used. Blanks must be injected between each case sample.

9.1.6.2 METHODS

- The parameters for the method used during GC-MS analysis are printed at the bottom of the GC-MS worksheet.
  - The method typically used in fire debris analysis is ILAV10.
  - The method ILAV10PLUS is identical to ILAV10 but with 10 additional minutes added to the end. This method may be useful for samples suspected to contain heavy petroleum distillates or oily residues.

9.1.7 INTERPRETATION OF RESULTS

All peaks used to determine the presence or absence of an ignitable liquid should be identified by their mass spectrum. This may be done by pattern-matching the extracted ion chromatograph for selected ions with that of a known primary standard of an ignitable liquid or by identifying specific compounds by their mass spectrum and comparing these to that of a known primary standard.

Characterization of ignitable liquids by class should be done in accordance with the ASTM Ignitable Liquid Classification Scheme (ASTM E1618).

Compound Class	Ions of Interest for Petroleum Distillates

Alkane	43, 57, 85, 99
Aromatic	91, 105, 119
Cycloparaffin	55, 69, 83
Naphthalene	128, 142, 156

Compound Class		Ions of Interest for Gasoline
Alkane		43, 57, 71, 85
Aromatic	Alkylbenzene	91
	C_2 Benzenes	106
	C_3 Benzenes	120
	C_4 Benzenes	134
Naphthalene	Naphthalene	128
	Methylnaphthalene	142

- A chromatogram with no significant peaks may be reported as negative given that all QC checks were acceptable.
- A chromatogram with significant peaks which may be attributed to the sample matrix but that do not match that of an ignitable liquid may be reported as negative given that all QC checks were acceptable.
- A chromatogram with significant peaks that match that of an ignitable liquid that are not attributed to the sample matrix may be reported as positive for that class of ignitable liquid given that all QC checks were acceptable.

9.1.8 REPORT WORDING SUGGESTIONS

- The report should include a brief description of the sampling technique and analytical technique used.
  - (example) The samples were extracted by passive adsorption-elution techniques and examined by gas chromatography and mass spectrometry.

- Negative
  - No ignitable liquid residues were detected in item ____.
  - Ignitable liquids may evaporate or can be totally consumed during a fire. A negative result does not preclude the presence of an ignitable liquid during a fire.

- Gasoline
  - Gasoline was identified in item ___. (for liquid samples)
  - A residue of gasoline was detected in item ____.

- Note that the examples provided below are not intended to be all-inclusive. Many of the examples are in more than one category based upon the chemical composition. The active ingredient of insecticides is not typically flammable but the solvent and propellants used in some products may be categorized as ignitable liquids. See ASTM E1618 for further information and clarification.

- Petroleum Distillates
  - A residue of a light petroleum distillate was detected in item _____.
  - Note: may be designated as light, medium, or heavy range.
  - Examples of petroleum distillates include:
    - Light: camping fuels, cigarette lighter fluids, naphtha, and petroleum ether.
    - Medium: charcoal starters, paint thinners, dry cleaning solvents, mineral spirits, automotive parts cleaners, spray lubricants, lamp oils, deck sealers, varnishes, kerosene, and insecticides.
    - Heavy: kerosene, Diesel fuel, charcoal starters, aviation fuels, insecticides, fuel additives, lamp oils, and automotive parts cleaners.

- Isoparaffinic Products
  - A residue of an isoparaffinic product was detected in item _____.
  - Note: may be designated as light, medium, or heavy range.
  - Examples of isoparaffinic products include:
    - Light: aviation gasolines, lighter fluids, and charcoal starters.
    - Medium: charcoal starters, paint thinners, copier toners, mineral spirits, solvents, cleaners, kerosene, lamp oils, and gun oils.
    - Heavy: spot cleaners, penetrating oils, and insecticides.

- Aromatic Products
  - A residue of an aromatic product was detected in item _____.
  - Note: may be designated as light, medium, or heavy range.
  - Examples of aromatic products include:
    - Light: automotive parts cleaners, solvent cleaners, xylenes, toluene-based products, and lacquer thinners.
    - Medium: automotive parts cleaners, specialty cleaning solvents, insecticides, and brush cleaners.
    - Heavy: insecticides and adhesives.

- Naphthenic-Paraffinic Products
  - A residue of a naphthenic-paraffinic product was detected in item _____.
  - Note: may be designated as light, medium, or heavy range.
  - Examples of naphthenic-paraffinic products include:
    - Light: cyclohexane based solvents or products

        - Medium: charcoal starters, insecticides, lamp oils, mineral spirits, and automotive parts cleaners.
        - Heavy: Insecticides and lamp oils.

- Normal Alkane Products
    - A residue of a normal alkane product was detected in item ____.
    - Note: may be designated as light, medium, or heavy range; light is less common.
    - Examples of normal alkane products include:
        - Medium: candle oils, copier toners, lamp oils, and wax cleaners
        - Heavy: candle oils, lamp oil, carbonless forms, and copier toners.

- Oxygenated Solvents
    - A residue of an oxygenated solvent was detected in item _____.
    - Note: may be designated as light, medium, or heavy range.
    - Examples of oxygenated solvents include:
        - Light: alcohols, ketones, lacquer thinners, fuel additives, surface preparations, solvents, automotive parts cleaners, spray adhesives, and brush cleaners.
        - Medium: metal cleaners, gloss removers, degreasers, furniture strippers, cleaning solvents, and insecticides.
        - Heavy: biodiesels, fuel additives, floor finishes, and insecticides.

- Others - Miscellaneous
    - Item _____ contained residues consistent with a miscellaneous class of ignitable liquids.
    - Note: may be designated as light, medium, or heavy range.
    - Examples of miscellaneous class products include:
        - Light: single component products enamel reducers, lacquer thinners, aviation gasolines, racing gasolines.
        - Medium: turpentine products, mineral spirits, fuel additives, spray lubricants, brush cleaners, paint thinners, citrus cleaners, and charcoal starters.
        - Heavy: lamp oils, insecticides, citrus cleaners, automotive parts cleaners, kerosene, and fuel additives.

- Terpenes
    - Terpenes were identified in item _____. Terpenes consistent with those detected are essential components of turpentine and are naturally occurring in some types of wood.

- Not airtight
    - Items _____ were not tested for ignitable liquids. Samples submitted for ignitable liquid testing should be packaged in airtight containers such as canning jars or paint cans at the time of collection.

9.1.9 REFERENCES

- ASTM E1618 Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry
- ASTM E1386 Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction
- ASTM E1387 Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography
- ASTM E1412 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration with Activated Charcoal

9.2 GUNSHOT RESIDUE ANALYSIS

9.2.1 SCOPE

This procedure is for the analysis of primer gunshot residue by scanning electron microscopy coupled with energy dispersive X-ray spectrometry. The residue may be collected by the officer in pre-packaged gunshot residue collection kits or by the analyst in the laboratory. The analysis of primer gunshot residue can determine if particles characteristic to gunshot residue are present. However, the analysis of primer gunshot residue cannot determine who fired a weapon.

Gunshot residue collection kits and clothing from suspects may be tested.

Clothing collected from a pile, laundry basket, or discarded may not be tested. The items should be associated with an individual.

Other objects which have been sampled using a collection kit or are sent in for analysis may also be tested but should be associated with an individual.

Shoes and inner garments will not routinely be tested.

Gunshot residue collection kits and clothing from a recipient of a gunshot wound will not be tested for primer gunshot residue.

Kits collected more than six hours after the time of the shooting will not be tested.

Kits or clothing collected from individuals with a firearm in their possession, who admit being in the vicinity of a firearm at the time of discharge, who admit or were allowed to wash their hands, or who admit to firing a weapon will not be tested.

Kits containing only swabs will not be tested for primer gunshot residue.

9.2.2 QUALITY ASSURANCE

- Separation is maintained between the Firearms Section work areas and the Trace Evidence GSR processing areas.
- Items of clothing should be opened one at a time and labeled.
- All items should be examined on a clean sheet of white butcher paper.
- All bench areas should be cleaned between each case.
- Items to be examined for blood or tape lift collection should have the gunshot residue collected before any other analysis.
- Each stub should be labeled with the item number and area sampled or the pre-stamped number from the manufacturer should be recorded on the worksheet. The stub holder should also include the case number, item number, and sampled areas.
- Each stub should be marked so that it can be returned to the same position in the holder if removed.

- Samples from different suspects are not placed in the chamber together. Only one gunshot residue case is placed in the chamber for analysis.
- Gloves and lab coats should be changed between items from different suspects.

9.2.3 SAMPLE COLLECTION AND PREPARATION

9.2.3.1 SUSPECT CLOTHING OR OTHER ITEMS

- Place the item to be examined on a clean white sheet of paper, if possible.
- Label stub.
- Press carbon-coated adhesive stub on area to be tested. Store stubs in holders labeled with case number, item number, and area sampled.
- Record information in notes.

9.2.3.2 GUNSHOT RESIDUE KITS

- Open gunshot residue kits one at a time.
- Inspect gunshot residue kits for the type used. Record this information in notes.
- Label each plastic stub holder. Label the stub or record the unique ID number.
- Record name of person sampled from information sheet. Scan the information sheet into the case file.

9.2.4 TESTING TECHNIQUES

See Scanning Electron Microscopy/Energy Dispersive X-ray Spectrometry §6.4.3 (2).

9.2.4.1 STANDARDS AND CONTROLS

- A blank stub is run with each batch of stubs.
- The internal "energy calibration" is established by examination of the Cobalt standard.
- The "threshold" is established by examination of the Cobalt and Gold standard.
- Performance is checked before use by examination of an area on the Spike standard.
- Performance is checked by analysis of B-Fed 4 quality control stub after preventative maintenance of the instrument occurs.

9.2.4.2 AUTOMATED ANALYSIS

- Place stubs in the sample holder of the SEM.
- Close sample compartment and obtain a vacuum.
  - "HV" or high vacuum mode may be used for most samples with carbon coated adhesive stubs.

- "LV" or low vacuum mode should be used for samples that do not have carbon adhesive or which contain a large number of particles (such as fibers) that may produce excessive charging.
- Optimize the SEM conditions for Energy Dispersive X-ray Spectrometry (EDS) collection.
- Enter case information in the EDS system.
- Use the cobalt and gold standard stub to set the threshold levels of the backscatter detector.
- Test detected features and acquire features on known area of control (spike) stub.
- Start automated gunshot analysis.

9.2.4.3 CONFIRMATION OF PARTICLES

- Potential GSR particles detected by automated analysis are relocated and confirmed manually by acquiring an x-ray spectrum from the particle.
- If no GSR-related particles are detected on a sample, the analyst should ensure that the focus and general operating conditions have not varied and are correct. If changes to the operating conditions have occurred, the automated analysis should be performed again.
- Include summary of instrument results in case record.
- Include spectra and images of confirmed GSR particles in case record.
- Raw data files are very large and are stored on the hard drive of the EDS computer.

9.2.4.4 SAMPLES FROM AMMUNITION

- In some cases, it may be relevant to establish whether the particles detected were consistent with the ammunition that was used. This may be especially helpful in cases where the ammunition does not contain one of the three main elements commonly found in gunshot residue.
- Collect particles from cartridge case.
  - Using a wooden applicator stick, transfer particles from the fired case to a collection stub.
  - Cover the opening of the cartridge case with the collection stub and firmly tap the base of the cartridge case.
  - Ensure that the particles are firmly attached to the carbon adhesive.
- Run these samples for comparison.
- Almost all GSR classified as characteristic in elemental composition is derived from ammunition primers based on the "Sinoxid" formulation which contains lead styphnate (possible with other lead components), antimony sulfide, and barium nitrate. The particles from this type of primer must contain lead, antimony, and barium. Other additional components may be present from the primer composition, other ammunition components, or from the firearm.

- Older ammunition or specialty ammunition may not contain one or more of the three typical elements.

9.2.5 INTERPRETATION OF DATA

Individual particles may be classified as characteristic of, consistent with, or commonly associated with GSR based on their elemental composition and morphology. The morphology of GSR related particles should indicate formation at highly elevated temperatures.

At least 95% of a stub should be analyzed to be reported. However, if characteristic particles have been identified on the stub, it does not have to run to completion.

9.2.5.1 CHARACTERISTIC

- Particles classified as characteristic of GSR have elemental compositions rarely found in particles from any other source.
- Characteristic particles from Sinoxid-type primers must contain lead, antimony, and barium.
- Characteristic particles from calcium silicide based primers with tin foil (older Sellier & Bellot) must contain lead, barium, calcium, silicon, and tin.

9.2.5.2 CONSISTENT

- Particles classified as consistent with GSR have compositions that are also found in particles from a number of relatively common, non-firearm sources.
- Particles consistent with gunshot residue contain a combination of two of the three elements (lead, antimony, and barium).
- Some ammunition (e.g. non-Sinoxid primers or "lead-free" ammunition) will not generate characteristic lead-antimony-barium particles. Consequently, the following elemental profiles are considered to be consistent with GSR:
  - Barium, calcium, silicon
  - Antimony, barium
  - Lead, antimony (levels higher than trace amounts)
  - Barium, aluminum
  - Lead, barium
  - Lead, barium, calcium, silicon
  - Titanium, zinc
  - Strontium
- Consistent particles are not usually reported unless there is an indication that the ammunition used may not generate characteristic particles.

9.2.5.3 NEGATIVE

- No characteristic particles were identified.
- The absence of particles may be from many factors:
  - The person did not discharge a firearm.
  - Hands or clothing were washed.
  - Hands were wiped.
  - Gloves were worn.
  - Sweating profusely.
  - Environmental factors including wind or rain.
  - Excessive blood or debris on the hands
  - Normal physical activity within 4 to 6 hours passing between firing and sampling.
  - The weapon did not produce primer residue when discharged.
  - Physical barrier preventing discharge or deposition of gunshot residue.

9.2.6 REPORTING SUGGESTIONS

- The instrumentation and criteria should be included in the report:
  - The clothing from _____ was sampled for gunshot residue.
  - The samples (or kit) were examined by scanning electron microscopy with energy dispersive x-ray spectrometry and analyzed for morphology and elemental composition of gunshot residue particles.

- Characteristic particles
  - Particles characteristic of gunshot residue were present on the sample from _____.
  - One particle characteristic of gunshot residue was present on the sample from ____.

- A disclaimer should be included on items containing characteristic particles:
  - The presence of these particles may be the result of discharging a firearm, handling a firearm, being in the proximity of a firearm at the time of discharge, or coming into contact with an object bearing gunshot residue.
  - The presence of these particles is consistent with the item having been in the vicinity of a firearm when it was discharged or having come into contact with another item bearing gunshot residue.

- Consistent particles with indication of ammunition that does not produce characteristic particles:
  - Particles consistent with gunshot residue were present on the samples from ___. These particles are found in gunshot residue but may also originate from other sources.

- If gunshot residue results are negative:

- No characteristic gunshot residue particles were identified. The absence of gunshot residue does not eliminate that person from having discharged a firearm.

- If comparison to known ammunition is conducted:
  - The elemental composition of the particles from item ___ corresponded to the elemental composition of the particles from the cartridge case. This proportion, however, could be found in other ammunition.

- Not analyzed:
  - Admits to discharging a firearm:
    - The gunshot residue kit from ____ was returned unexamined. It is the policy of the Trace Evidence Unit that gunshot residue kits collected from an individual who admits to discharging a firearm will not be analyzed. The individual was known to have been in a gunshot residue environment.
  - Admits to being near a discharging firearm:
    - The gunshot residue kit from ___ was returned unexamined. It is the policy of the Trace Evidence Unit that gunshot residue kits collected from an individual admitting to be near a firearm at the time of discharge will not be analyzed. The individual was known to have been in a gunshot residue environment.
  - Firearm in possession:
    - The gunshot residue kit from ___ was returned unexamined. It is the policy of the Trace Evidence Unit that gunshot residue kits collected from an individual with a weapon in their immediate possession will not be analyzed. The individual was known to have been in a gunshot residue environment.
  - Kit collected after 6 hours:
    - The gunshot residue kit from ____ was returned unexamined. It is the policy of the Trace Evidence Unit that gunshot residue kits collected longer than six hours after a shooting will not be analyzed.
  - Recipient of gunshot wound:
    - The gunshot residue kit from ___ was returned unexamined. It is the policy of the Trace Evidence Unit that gunshot residue kits collected from the recipient of a firearm discharge will not be analyzed. The individual was known to have been in a gunshot residue environment.
  - Swabs:
    - The gunshot residue kit from ___ was not analyzed. The laboratory does not have the capability of analyzing kits containing only swabs.
  - Clothing items not tested:
    - The clothing items from ___were not examined because characteristic gunshot residue particles were found on the kit (or another clothing items) of this individual.
    - Socks, shoes, or inner garments were not examined for gunshot residue.

- If gunshot residue samples were collected and retained in the laboratory but not analyzed, these items should be noted on the report.

9.2.7 REFERENCE

- ASTM E1588, Standard Guide for Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-Ray Spectrometry.

9.3 HAIR IDENTIFICATION

9.3.1 SCOPE

Items may be submitted to be identified as hair. This may be of human, animal, or synthetic fiber (wig) origin. The submissions may be of individually collected hairs, hairs removed from an item by the analyst, or hairs which have previously been collected on tape lifts.

Human hairs may be examined to assess their somatic origin, ancestry, and roots. Hairs with tissue present are suitable for nuclear DNA testing. Hairs not suitable for nuclear DNA testing might be considered for mitochondrial DNA testing. These hairs will be sent to an outside agency for further examination.

9.3.2 PREPARATION

- If tape lifts have previously been collected by another analyst, the items should be recovered from secure storage and transferred into the possession of the examiner.
- Determine which items are suitable for examination.
- Record the general description of the hair and approximate length.
- Either count the number of hairs present or give a general approximation on the amount of hairs present.
- Hairs may be mounted with Permount or another mounting medium for microscopic comparison.
- Hairs should be mounted in such a way to avoid frequent crossovers and bubbles. The ends of the hairs should not stick out from under the coverslip.
- Slides should be labeled with the case number, item number, analyst's initials and date the slide was mounted.

9.3.3 STANDARDS AND CONTROLS

- Permount, Meltmount, Cargille liquid, or other mounting media with a stated expiration date will not automatically be discarded after the stated date. As long as the mounting media continues to flow properly, as determined by the examiner, it may continue to be used.
- A collection of known human hair, animal hairs, and wig hairs is kept for reference.

9.3.4 TESTING TECHNIQUES

9.3.4.1 HAIR IDENTIFICATION

The purpose is to differentiate human hairs from animal hairs or to identify fibers which resemble hairs.

- The item may be examined with a stereomicroscope. Morphological features may easily be distinguished to determine the identification as human, animal, or synthetic fiber.
- The item may be temporarily or permanently mounted on a glass slide for microscopic evaluation.
    - Using a compound microscope, examine the hair.
    - Based upon microscopic observations, determine if the hair is human, animal, or a synthetic fiber. Record the observations used in the determination (e.g. color, banding, scales, medulla, root, etc.)
    - A human hair may be classified by ancestral group: European ancestry, African ancestry, or Asian or Native American ancestry. It must be understood that designation of an ancestral group is based upon an evaluation of the microscopic characteristics present in the hair and may not coincide with how a person self-identifies or with their physical appearance.
        - If a hair or hair sample cannot be easily associated with a particular ancestral group, the hairs may be described as exhibiting mixed ancestral characteristics.
    - A human hair may also be classified as to somatic origin or the region of the body from which it originated. Typically, body area determinations include head, pubic, facial, and other body hairs.
    - Animal hairs may further be classified into a family group based upon the observed features of the hair. Published classification keys may be used for identifying the family group.

9.3.4.2 EVALUATION OF ROOT FOR NUCLEAR DNA

Human hairs are evaluated for the suitability of further testing by the DNA Section. Only hairs which are in the active growth stage (anagen or catagen phase) or hairs with tissue attached may be suitable for nuclear DNA analysis.

- Recovered hairs may be screened using the stereomicroscope to determine if the item is a hair or hair fragment. If tissue is visible, additional microscopic analysis may not be needed.
- If needed, mount the hair for microscopic examination using a compound light microscope.
- If the hair is in the telogen phase with no tissue attached, it is not suitable for nuclear DNA testing.
- If tissue is present on the root or shaft of the hair, the hair may be sent to the DNA Section for further analysis.
- Package the hair for transfer.
    - If the hair was mounted in Permount, remove the hair and clean with xylene.
    - If the hair was in a temporary mounting media, clean the hair.

- Hairs may be taped to a clean glass slide with the root ends noted, folded in a tissue or piece of paper, or placed in an extraction tube provided by the DNA section. Place in an envelope.
  - Itemize the hairs with a unique tracking number.
- Notify the DNA section and transfer the evidence to FD Secure Storage or the analyst working the case.

9.3.4.3 OTHER REQUESTS

Additional information may be obtained from examining the hairs. Each case should be evaluated to determine if probative information may be gained.

- Forcibly removed
  - Hairs which have been forcibly removed exhibit a ribbon-like appearance of the root.
  - This information may be reported if it is useful in the case.
- Putrid roots
  - Hairs which remain on the body as decomposition takes place form dark bands near the root.
  - This information may be useful in identifying a hair or for determining when a questioned hair was deposited (i.e. post mortem).
- Singed hairs
  - Hairs which have been exposed to extreme heat or flames may exhibit bubbles and a darkened appearance.
  - This information may be reported if it is useful in the case.
- Mitochondrial DNA (mtDNA)
  - Hairs without tissue present may still be suitable for mitochondrial DNA testing.
  - The Arkansas State Crime Laboratory does not conduct mitochondrial DNA analysis. Hairs may be submitted by law enforcement to the FBI Laboratory or a private testing company for mtDNA analysis.

9.3.5 INTERPRETATION OF RESULTS

- Hairs may be classified as human, animal, or fibers resembling hairs based upon macro- or microscopic examination.
- Somatic origin or ancestral origin of a hair may be useful information in some cases.
- It should be determined, based on the findings and case information, if the hair should be sent for DNA analysis.

9.3.6 REPORT SUGGESTIONS

- The techniques used (i.e. stereomicroscopy, light microscopy, comparison light microscopy, polarized light microscopy, etc.) should be reported.

- Identification:
  - Animal
    - The hairs recovered from Item ____ were of animal origin.
    - The hairs recovered from Item ____ were animal hairs from the family _____.
  - Fibers
    - The hairs recovered from Item ____ were synthetic fibers resembling hairs.
    - The item submitted as a hair was a fiber of (synthetic or vegetable) origin.
  - Somatic/Ancestral Origin
    - (Head or pubic) hairs were recovered from Item ___.
    - (Head or pubic) hairs indicative of (European, African, or Asian/Native American) ancestry were recovered from Item ____. It should be noted that designation of an ancestral group is based upon an evaluation of the microscopic characteristics present in the hair and may not coincide with how a person self-identifies or with their physical appearance.
    - Body hairs were recovered from Item ____.
  - DNA
    - The (human or somatic origin) hairs recovered from Item ___ were forwarded to the DNA section for further analysis.
    - The (human or somatic origin) hairs (or hair fragments) recovered from Item ___ were not suitable for nuclear DNA analysis.
    - The (human or somatic origin) hair from Item ___ is being forward to the FBI laboratory for mitochondrial DNA analysis.

- If a hair sample (e.g. on a tape lift, single hair, several hairs) which has only been submitted to the Trace evidence unit is retained, it should be noted on the report.
  - If the sample was previously noted as retained on a serology report, no additional notation is needed.

9.3.7 REFERENCE

- "Forensic Human Hair Examination Guidelines", Scientific Working Group on Materials Analysis

9.4 COLLECTION AND PRESERVATION

9.4.1 SCOPE

Trace Evidence is collected from evidence for analysis (e.g. gunshot residue, hair identification, DNA) or for preservation. Trace Evidence no longer tested at this laboratory (e.g. fibers, paint, glass, tape) may need to be removed from an item in order to prevent loss and allow for the continued examination of the item by another section of the laboratory.

Tape lifts used for evidence collection may also be examined by the DNA section. If the tape lifts will be sent to DNA, the hairs should be removed from the tape lifts first.

Each case should be evaluated based on the circumstances.

9.4.2 PREPARATION

- Determine which items are from the victim, suspect, scene, etc. Ensure that items from different people, places, etc. are worked in different areas or on different days.
- Review the officer's request for the items to be examined.
  - If gunshot residue is requested on an item, it must be collected BEFORE tape lifts are collected from the item.
    - If the item is from the suspect, contact a Trace Evidence examiner.
    - If the item is from the victim, contact a Firearms examiner.
  - If the item is to be examined by latent prints, contact an examiner in the Latent Prints Section if they need to examine the item first.
- Items which are covered in mold, decomposed bodily fluids, or are otherwise unsuitable for tape lift analysis may be returned untested.

9.4.3 TESTING TECHNIQUES

9.4.3.1 COLLECTION FROM CLOTHING OR OTHER ITEMS

- Visually examine the item and note description of item and fabric content, if listed.
- Take care to preserve evidence that other sections may need to examine (e.g. blood stains, latent prints). It may be necessary to collect hairs with forceps and place in an envelope rather than taping the item directly.
- A section of clear adhesive tape is pressed on the item and pulled away. Hairs and other small evidence particles adhere to the tape which is then placed on a clear transparency sheet. Continue collecting with sections of tape until the entire item has been covered.
- Label the tape lifts on the transparency sheet. It should be noted if tape lifts are collected from a specific area (e.g. inside the underwear).

- Known samples of all the fiber types and colors are cut from the item and placed on the transparency sheet with clear tape or in an envelope. White cotton, denim, light-colored fabrics and smooth fabrics (such as nylon windbreakers) are not suitable target fibers.
- Place transparency sheets and any envelopes in a manila envelope and itemize.

9.4.3.2 REMOVING HAIRS FROM TAPE LIFTS

- A stereomicroscope may be useful for removing hairs.
- It may be necessary to loosen the hair from the adhesive along the length of the hair.
- Gently pick up the end of the hair with tweezers or gloved fingers and remove hair from tape.
- Place the hair in a folded piece of paper or tissue and place in a labeled coin envelope.
- Itemize the package of hairs removed from the tape lift.

9.4.3.3 PRESERVATION OF OTHER TRACE EVIDENCE

- Debris may be scraped from the clothing from victims or suspects. This debris, which may contain paint or glass fragments, should be retained in a paper fold in an envelope to prevent loss. Alternatively, larger fragments may be removed and placed in a paper fold.
- Debris, such as glass or paint, may be removed from, damaged bullets or other items and preserved in a paper fold. Paper folds should be placed in envelopes to prevent loss.
- Tape (duct, electrical, etc.) is often examined for latent prints and serology. Care should be taken to preserve the tape for possible future testing. It may be placed on clear acetate sheets for preservation.
- Soil samples may be collected by scraping (after any footwear impressions are obtained) the soil onto a piece of paper. If the soil sample is damp, it should be allowed to air dry before placing it in a container (e.g. paper fold, glass vial) to prevent loss of small particles.

9.4.4 QUALITY ASSURANCE/QUALITY CONTROL

- Examine items over clean white paper.
- Victim and suspect items should be collected in different rooms.
- Change lab coats, gloves, and other supplies between examination of items from victim and suspect.
- Maintain adhesive tape in a manner to avoid contamination.
- Examine only one item at a time.
- Cut known samples of fiber types and colors from clean areas which do not appear to contain biological stains.
- Follow biohazard procedures and practice universal safety precautions when examining evidence.

- Retaining entire envelopes said to contain hairs will reduce the risk of loss during the transfer of the items to different containers.
- Label all evidence removed from items with a unique item number. For example, "E-2TL" for tape lifts from E-2, "E-2H" for hairs from E-2, "E-2F" for known fibers from E-2 and "E-2" for debris from E-2.

9.4.5 ASSESSMENT OF EVIDENCE COLLECTED

- If additional processing needs to be completed, forward to the appropriate section or retain the evidence and notify the section chief or analyst who will continue the examination.
- If known samples were not submitted, write a report requesting known samples, if necessary.
- If tape lifts will be sent to DNA for analysis, remove the hairs from those items.

9.4.6 REPORT WRITING SUGGESTIONS

- Tape lifts (or type of debris) were collected from the items listed. They are being retained.
- (Type of debris) collected from item __ is being returned with the evidence.
- (Type of debris) collected from item ___ is being forwarded to the FBI Laboratory for further analysis.

9.4.7 REFERENCES

- "Trace Evidence Recovery Guidelines", Technical Working Group on Materials Analysis, Evidence Handling Committee.