Technical Procedure for Microscopic Hair Analysis

1.0 Purpose – This technical procedure shall be followed for the microscopic examination of hair evidence.

2.0 Scope – This procedure applies to microscopic hair analysis cases in the Trace Evidence Section. Microscopic hair analysis is a general term that encompasses many different methods of examination including, but not limited to, the microscopic analysis of questioned human hairs compared to known standards, animal classification, and somatic origin classification. The method(s) of examination used in a microscopic hair analysis is dependent upon the case information and evidence available.

3.0 Definitions – N/A

4.0 Equipment, Materials, and Reagents

4.1 Equipment

- Stereomicroscope
- Compound or Polarized Light Microscope
- Comparison microscope

4.2 Materials

- Glass microscope slides and cover slips
- Forceps
- Scalpel and blades
- Scribe
- Fingerprint lifting tape
- Pasteur Pipettes
- Probes

4.3 Reagents

- Cytoseal 280
- Permount
- Xylene
- Xylene substitute
- Ethanol (anhydrous) 200 proof
- Deionized water
- Norland Optical Adhesive
- Clear nail polish
- 10 % bleach solution

5.0 Procedure

5.1 Analytical Approach

5.1.1 Review the request for analysis.

5.1.2 Evaluate the submitted evidence and determine the type(s) of microscopic examination required based on the request made by the agency. See **Types of Microscopic Hair Analysis.**

5.1.2.1 If necessary, contact the submitting agency to obtain additional evidence and/or case information.

5.1.2.2 If necessary, contact the submitting agency to request known hair standards following the Laboratory Procedure for Obtaining Evidentiary Standards. If standards are not submitted, the evidence may be returned.

5.1.3 Open evidence container and describe the evidence present.

5.1.4 Process the item to remove any hair evidence adhering to the item following the Trace Evidence Section Technical Procedure for the Collection and Preservation of Evidence.

5.1.5 If no questioned hair is present, the examination shall conclude.

5.1.6 If questioned hair evidence is present, the examination shall continue following the applicable **Examination Procedures**.

5.1.7 Once all visual and microscopic examinations have been completed, the Forensic Scientist shall issue a report stating his or her findings using the **Guidelines for Hair Examination Results Statements.**

5.1.7.1 All results shall be based on the Forensic Scientist's knowledge and expertise and the case being examined. Results shall be in agreement with the technical review.

5.2 Types of Microscopic Hair Analysis

5.2.1 Hair Comparison.

5.2.1.1 Compare questioned human hairs to the known hair standards submitted.

5.2.1.2 A hair comparison can only be performed on head hairs and pubic hairs.

5.2.2 Animal Classification.

5.2.2.1 Determine if the hair is human or animal.

5.2.2.2 If requested, the family/genus/species of animal may be determined.

5.2.3 Somatic Origin Classification.

5.2.3.1 If possible, the somatic origin (head, pubic or other body area) shall be determined.

5.2.3.2 If somatic origin cannot be determined based on microscopic characteristics, the hair may be deemed not suitable for comparison with the submitted standards.

5.2.4 Racial Classification.

5.2.4.1 If possible, the racial classification of the submitted human hair shall be determined.

5.2.4.2 No comparison is required in these cases.

5.2.5 Force Determination.

5.2.5.1 If possible, the Forensic Scientist may determine if a hair was forcibly removed.

5.2.5.2 No comparison is required in these cases.

5.2.6 Other

5.2.6.1 There may be times when an agency requests a variation on the above listed types of analysis. If the request falls within the scope of the technical procedures, the analysis may be permitted.

5.3 Hair Characteristics

5.3.1 The following is a list of characteristics that may be used for classification and comparison of hairs. The characteristics listed below are not all-inclusive and may or may not be present in every hair.

5.3.1.1 Macroscopic Properties

- Color
- Form
- Shaft length
- Overall shaft thickness
- Presence/Absence of a root

5.3.1.2 Microscopic Properties

5.3.1.2.1 Cuticle

- Colors
- Scale Patterns
- Damage
- Banding

5.3.1.2.2 Cortex

- Pigment characteristics (e.g., color, size, shape, distribution)
- Ovoid bodies
- Cortical fusi
- Chemical treatment (e.g., dyes, bleaching)

5.3.1.2.3 Medulla

- Presence/Absence
- Patterns
- Cellular size

5.3.1.2.4 Shaft

- Size
- Cross sectional shape
- Attached debris
- Parasites
- Disease

5.3.1.2.5 Root

- Pigments
- Cortical fusi
- Presence of follicular tissue
- Growth stage
- Shape
- Force determination
- Putrid

5.3.1.2.6 Tip

- Shape (e.g., frayed, cut, split, natural taper, singed)

5.4 Examination Procedures

5.4.1 Hair Comparison

5.4.1.1 The known standards are opened and an initial visual evaluation and macroscopic examination is performed. See **Evaluation of Known Standards** and **Hair Characteristics**.

5.4.1.2 The questioned hair evidence is screened using a stereomicroscope and any hair(s) that appear to be macroscopically similar to the known hair standards are mounted on microscope slides. See **Sample Selection Guidelines** and **Sample Preparation**. No further analysis will be performed on hairs that are found to

be macroscopically different from the known hair standards.

5.4.1.3 Mount a representative sample of hair from the known standard(s) using the same non-temporary mounting medium that was chosen for the questioned hairs.

5.4.1.4 Using a comparison microscope, the Forensic Scientist examines the microscopic characteristics of the questioned hairs. If possible, the Forensic Scientist determines if the hair is human, the racial classification, and somatic origin. See **Hair Characteristics**. The known standards are then evaluated, if necessary.

5.4.1.5 If the hair is human head or pubic hair and is suitable for microscopic comparison, based on the analyst's training and experience, then it shall be compared to the known standards.

5.4.1.5.1 The comparison process involves a direct comparison of the questioned hair and the known standard along the entire hair, utilizing all of the microscopic characteristics that are present in the hair.

5.4.1.5.2 If there are no hairs suitable for microscopic comparison, the examination shall conclude.

5.4.1.6 If the Forensic Scientist finds questioned and known hairs to be microscopically consistent, or to have similarities with slight differences, and the hairs may establish an association (e.g. victim to suspect; victim to scene), then:

5.4.1.6.1 A second Forensic Scientist, who is qualified in hair comparisons, shall confirm these microscopic comparisons. A verification review shall be completed in FA and the microscope slides shall be initialed and dated by the verifying Forensic Scientist. The verifying Forensic Scientist will also note in FA the contents of all slides verified.

5.4.1.6.2 A representative sample of the associative hairs shall be sent for DNA analysis. See Technical Procedure for Screen for DNA Analysis**.** Additional hairs may be recommended for DNA analysis.

5.4.1.6.3 Hairs found to be microscopically consistent, or to have similarities with slight differences, that do not establish an association (e.g. victim on victim; suspect on suspect), require no additional analysis.

5.4.2 Animal Classification

5.4.2.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is of human or animal origin.

5.4.2.1.1 No further analysis shall be performed on hairs determined to be of animal origin, without prior approval from the Technical Leader, Forensic Scientist Supervisor, or the Forensic Scientist Manager.

5.4.2.2 If specifically requested and approved by the Technical Leader, Forensic Scientist Supervisor, or the Forensic Scientist Manager, additional characterization of the hair as to family/genus/species may be done.

5.4.2.2.1 The type of hair shall be determined (guard or fur).

5.4.2.2.1.1 Guard hairs with the root and tip intact provide the most information during analysis.

5.4.2.2.2 The scale pattern can be determined either by using the microscope or by scale casting.

5.4.2.2.2.1 When making scale casts, the Forensic Scientist shall note the root end and tip end of the hair.

5.4.2.2.2.2 There are numerous ways to make scale casts, some of which are listed below. This list is not all inclusive and the Forensic Scientist may employ other techniques if they are not destructive, the hair can be retrieved from the casting medium, and a successful scale cast has been achieved on positive controls.

- Norland Optical Adhesive method
- Nail Polish method

5.4.2.2.3 By examining the guard hair, the animal's family and sometimes genus can be determined. *Microscopy of Hairs: A Practical Guide and Manual* may be used to determine the family and possible genus according to the following features:

- Root
- Medulla
- Tip
- Color
- Banding patterns
- Scale pattern

5.4.3 Somatic Origin Classification

5.4.3.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.4.3.2 If possible, the somatic origin (head, pubic or other body area) of the hair shall be classified (see **Appendix 3**). Factors that may be used to aid in the determination of the somatic origin of the hair include, but are not limited to:

- Length
- Macroscopic form
- Medulla
- Diameter
- Chemical treatment

5.4.3.3 If the hair has a root that may be suitable for DNA analysis, the hair root or the entire hair may be sent to the Forensic Biology Section for further testing. See Technical Procedure for Screen for DNA Analysis.

5.4.4 Racial Classification

5.4.4.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.4.4.2 If possible, the racial classification of the hair shall be determined (see **Appendix 2**). Factors that may be used to aid in the determination of the racial classification of the hair include, but are not limited to:

- Cross sectional shape
- Pigment pattern
- Macroscopic form

5.4.4.3 If the hair has a root that may be suitable for DNA analysis, the hair root or the entire hair may be sent to the Forensic Biology Section for further testing. See Technical Procedure for Screen for DNA Analysis.

5.4.5 Force Determination

5.4.5.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.4.5.2 By examining the growth phase and structure of the hair root, the Forensic Scientist determines if the hair could have been forcibly removed.

5.4.5.3 If there is no root present, a force determination cannot be performed.

5.4.5.4 If the hair has a root that may be suitable for DNA analysis, the hair root or the entire hair may be sent to the Forensic Biology Section for further testing. See Technical Procedure for Screen for DNA Analysis.

5.5 Evaluation of Known Standards

5.5.1 It is requested that a known head and/or pubic hair standard be submitted from all parties involved in each case.

5.5.1.1 A known head and/or pubic hair standard consists of 50 full-length (plucked, if possible) hairs from all around the region of interest, and should include a sample of any weave/wig fibers or braids/dreadlocks that may be present.

5.5.1.2 A standard may consist of fewer than 50 hairs if the analyst documents enough properties to differentiate between individuals. These properties may include macroscopic and/or microscopic characteristics.

5.5.2 In addition, the submitted standards may be deemed inadequate for comparison. Some of these factors may include:

5.5.2.1 An insufficient quantity and/or variety of hairs submitted;

5.5.2.2 Hairs where too much time has elapsed such that the standard does not adequately represent the hair at the time of incident; or

5.5.2.3 Standards that are comprised solely of bland and/or gray hairs.

5.6 Sample Preparation

5.6.1 Place the hair on a clean microscope slide and apply a thin film of an appropriate mounting medium, such that the hair is totally covered. Place a glass cover slip on top of the hair and mounting medium.

5.6.1.1 It is permissible to mount hairs in a temporary mounting medium, such as water or xylene, or a non-temporary mounting medium, such as Cytoseal or Permount. A non-temporary mounting medium shall be used for hairs mounted for a microscopic comparison.

5.6.1.2 If a temporary mounting medium is used, the hairs shall be retrieved and placed into the original packaging after the examination is complete.

5.6.1.3 A mounting medium, such as Cytoseal or Permount, may be used so long as, based on the Forensic Scientist's training and experience, it flows properly and has not yellowed.

5.7 Guidelines for Hair Examination Result Statements

5.7.1 A methodology statement shall be added to all reports.

5.7.1.1 Example: The following methodologies were used in the examination of this case: visual examination and microscopy.

5.7.2 The wording of the results shall accurately describe the evidence at hand.

5.7.3 The report shall address all unknown hairs present in a case, whether microscopically compared or not.

5.7.4 In cases where there are multiple victims/suspects listed and standards are not provided for all of the individuals, a statement shall be added at the beginning of the report which informs the reader what comparisons were made.

5.7.4.1 Example: Items A, B, and C were examined for the presence of hairs that could be associated with the submitted standards from ___ only. A hair standard was not provided from _____.

5.7.5 Hair Comparison

5.7.5.1 Consistent

5.7.5.1.1 Only applicable to head and pubic hairs.

5.7.5.1.2 No significant differences were observed between the questioned and known hairs (i.e., characteristics exhibited by the unknown hair fit within the range of characteristics present in the known standard).

5.7.5.1.2.1 Example: The hair in Item A was found to be microscopically consistent with the hair in Item B. Microscopically consistent means characteristics exhibited by the unknown hair fit within the range of characteristics present in the known standard. Therefore, the hair in Item A could have originated from the same source as the hair in Item B.

5.7.5.2 Inconclusive

5.7.5.2.1 Questioned and known hairs exhibit similarities in characteristics, but slight differences were noted.

5.7.5.2.1.1 Example: The hair in Item A exhibited both similarities and slight differences to the hair in Item B. Similarities with slight differences means minor variations were noted between the characteristics exhibited by the unknown hair and the range of characteristics present in the submitted known standard. Accordingly, no conclusion could be reached as to whether or not the hair in Item A could have originated from the same source as Item B.

5.7.5.2.2 Questioned hair or hair standard is of a limited nature.

5.7.5.2.2.1 Example: Due to the nature/condition of Item A, no conclusion could be reached as to whether or not Item A could have originated from the same source as Item B.

5.7.5.2.3 Questioned and known hairs exhibit overlapping characteristics.

5.7.5.2.3.1 Example: The hair in Item A exhibited overlapping characteristics with the hair in Items B and C. Overlapping characteristics means characteristics exhibited by the unknown hair fit within the range of characteristics present in more than one known standard. Accordingly, no conclusion could be reached as to whether or not the hair in Item A could have originated from the same source as Item B or C.

5.7.5.3 Not Consistent

5.7.5.3.1 Numerous differences were found between the questioned and known sample (i.e., characteristics found in the questioned hair cannot be found in the known sample). These differences shall be the basis for exclusion.

5.7.5.3.1.1 Example: The hair in Item A was found to be macroscopically/microscopically different from the hair in Item B. Macroscopically/Microscopically different means distinct characteristics exhibited by the unknown hair were not noted within the range of characteristics present in the submitted known standard. Therefore, the hair in Item A could not be associated with the submitted standard from __ (Item B).

5.7.6 Racial Classification

5.7.6.1 Example: Examination of Item A revealed the presence of several hairs with Caucasian characteristics.

5.7.7 Animal Classification

5.7.7.1 Example: Examination of Item A revealed the presence of one hair found to be of animal origin and exhibiting characteristics of the deer family.

5.7.8 Force Determination

5.7.8.1 Example: The hair in Item A has characteristics that indicate it was forcibly removed. Hair roots may exhibit properties that indicate a hair has been forcibly removed. However, they type of force, amount of force, or when the force was

applied cannot be determined.

5.7.8.2 Example: It cannot be determined whether or not hairs with roots in the telogen growth phase were forcibly removed or naturally shed.

5.7.8.3 Example: Because fragments do not contain a root, a force determination is not possible and it cannot be determined whether or not this hair was forcibly removed.

5.7.9. No Analysis

5.7.9.1. No analysis is performed due to the outcome of DNA analysis.

5.7.9.1.1. DNA results correlate two items of evidence (e.g., suspect's DNA profile is identified on the victim's vaginal swabs).

5.7.9.1.1.1 Example: Based on the results of DNA analysis, the above listed evidence is being returned without analysis. If you have any questions, please contact the Forensic Scientist who issued this report.

5.7.9.1.2 An unknown DNA profile was developed on an item of evidence (e.g., vaginal swabs).

5.7.9.1.2.1 Example: Due to the fact that there is an unknown DNA profile noted in the Forensic Biology report dated *mm/dd/yy* by *analyst*, the above listed evidence is being returned without examination at this time. If you have any questions, please contact the Forensic Scientist that issued this report.

5.7.9.2 Standards Not Submitted

5.7.9.2.1 No analysis is performed because all standards have not been submitted to the laboratory.

5.7.9.2.1.1 Example: Due to the fact that no suspect/victim/elimination standards were submitted, the above listed evidence is being returned without examination. The evidence may be resubmitted for hair analysis accompanied by the suspect's/victim's/elimination's head/pubic hair standards.

5.7.9.2.2 Analysis has been discontinued because the requested standards have not been submitted.

5.7.9.2.2.1 Example: The hair standards previously requested by the Trace Evidence Section have not been submitted; therefore, no further analysis could be performed.

5.7.9.3 Pubic hair combings collected more than 48 hours after the incident occurred.

5.7.9.3.1 Example: Item A was not examined, as it was collected more than 48 hours after the incident occurred.

5.7.9.4 No questioned hair evidence present.

5.7.9.4.1 Example: Because no questioned hair evidence was submitted for analysis, the above listed known standards are being returned without examination. If you have any questions, please contact the Forensic Scientist who issued this report.

5.7.9.4.2 Example: Examination of Item A did not reveal the presence of any hairs.

5.7.9.5 Improper Collection of Hair Evidence.

5.7.9.5.1 Example: Item A was improperly collected/packaged and will be returned without examination.

5.7.9.5.2 Example: Because the evidence collection envelopes/victim kit paperwork indicates that the pubic hair combings were collected after the pubic hair standard, Item A was improperly collected. Therefore, Item A is being returned without examination.

5.7.9.6 Common Environment.

5.7.9.6.1 Example: Because it cannot be determined when or how a hair was deposited on an item from an environment common to both the victim and suspect, a hair analysis cannot be performed on Item A.

5.7.10 Qualifying Statements

5.7.10.1 Qualifying statements shall be included in the formal report if their inclusion further explains the conclusion or provides necessary information to the reader regarding the interpretation of the conclusion.

5.7.10.2 Qualifying Statement Regarding Passage of Time

5.7.10.2.1 Because hair is a biological material, it can change with the passage of time. A qualifying statement may be added to the report when, based on the Forensic Scientist's training and experience, a large

lapse of time has occurred between the date of the crime and the collection of the standard.

Example: Hair characteristics can change with the passage of time and [amount of time] has passed between the date of the crime and the collection of these known hair standards.

5.7.10.3 Qualifying Statement Regarding Featureless / Bland Hairs, Gray Hairs and Bleached Hairs

5.7.10.3.1 Featureless/bland hairs (excluding gray hairs) are hairs that have little pigment and may have a fine diameter, an absent medulla, etc. They are lacking many of the characteristics used in the evaluation, examination and comparison of hairs.

5.7.10.3.2 Gray hairs are hairs that have no pigment and may have an absent medulla. They are lacking most of the characteristics used in the evaluation, examination and comparison of hairs.

5.7.10.3.3 Bleached hairs are hairs that have been chemically treated. Bleaching will remove pigment from the hair and give the hair a characteristic yellow hue. A clear line of demarcation may be present and the hair shaft may appear brittle with disturbed scales.

5.7.10.3.4 Because many characteristics are absent and less information is available to make these comparisons, the Forensic Scientist shall be cautious with his/her conclusions in these circumstances. A statement qualifying any comparison conclusions made regarding featureless hairs shall be included in the formal report.

5.7.10.4 Qualifying Statement Regarding Racial Classification

5.7.10.4.1 In racial classification, the Forensic Scientist forms an opinion based on the macroscopic and microscopic properties of the hair.

5.7.10.4.2 A qualifying statement shall be added to state that the racial determination of the hair may not be indicative of the individual's outward appearance.

5.7.10.5 Qualifying Statement Regarding Force Determinations

5.7.10.5.1 When determining if a hair has been forcibly removed, it is not possible for the Forensic Scientist to determine how, when or why the hair was forcibly removed. A qualifying statement shall be added to communicate this.

5.7.10.6 Qualifying Statement Regarding Hair Comparisons and DNA Analysis

5.7.10.6.1 A statement as to the non-individualizing nature of hair examinations shall be included on the report.

Example: "The conclusions rendered in this report apply only to comparisons with the submitted standards (Item A and Item B). Should future investigation develop additional information or individuals related to the case, please contact the Forensic Scientist that issued this report.

The comparison of the microscopic characteristics in hairs does not constitute a basis for absolute personal identification. The probative value of hair comparisons may be affected by the results of DNA analysis."

5.7.10.7 Qualifying Statement Regarding Mitochondrial DNA Analysis

5.7.10.7.1 A statement regarding the option of mitochondrial DNA testing shall be included on the report when the results of a hair comparison may establish an association (e.g. victim to suspect; victim to scene). Example: It is recommended that this sample be outsourced for mitochondrial DNA testing.

5.7.10.7.2 A statement regarding the option of mitochondrial DNA testing shall be included on the report when the results of a hair comparison may establish an association (e.g. victim to suspect; victim to scene) and/or a hair root is sent for DNA analysis. Example: Should DNA analysis of the hair root yield no profile, it is recommended that the remaining portion of the hair be outsourced for mitochondrial DNA testing.

5.7.10.7.3 A statement regarding the option of mitochondrial DNA testing shall be included on the report when the hair analyst has exhausted the examination capabilities of the North Carolina State Crime Laboratory and questioned hairs remain that may be suitable for mitochondrial DNA analysis.

5.8. Standards and Controls – N/A

5.9. Calibration – N/A

5.10. Maintenance – No maintenance is required in this procedure. However, the procedure does utilize instruments that require maintenance. See the individual technical procedures for the operations of those instruments.

5.11 Sampling and Sample Selection

5.11.1 No sampling is performed. When sample selection occurs, it shall be based on the Forensic Scientist's training and experience.

5.11.2 In general, each unknown hair shall be compared separately to the range of characteristics in the known standard(s) provided.

5.11.3 Sample Selection Guidelines

5.11.3.1 If a number of unknown hairs are submitted from the same location and are believed to have been deposited at the same time during the same event (e.g., a clump of hairs, dreadlock, etc.), they may be treated as a group.

5.11.3.2 If a large quantity of hairs is present in a clump, a number of the unknown hairs shall be selected by the Forensic Scientist as representative of the entire unknown sample. The selection shall be based primarily on characteristics such as length, coarseness, and color as observed by the Forensic Scientist. All hairs included in the representative unknown sample shall be compared to a known standard.

5.11.3.3 The Forensic Scientist shall choose hairs for further analysis based on an initial macroscopic examination and comparison to the known standard. If the questioned hair does not fall into the range of characteristics in the known standard (e.g., length, race) or was not recovered from a controlled location (e.g., victim's panties), it does not need to be mounted for further comparison.

5.11.3.4 Hairs found to be suitable for DNA analysis may be excluded on the basis of race if the race of the subject is known (i.e., suitable root on a Caucasian hair from a Caucasian victim's clothing does not require submission for DNA analysis if the subject is Negroid).

5.12. Calculations – N/A

5.13 Uncertainty of Measurement – N/A

6.0 Limitations

6.1 It is not possible to state that a hair originates from a particular person to the exclusion of all others based on a comparative hair examination.

6.2 Hair examinations may be limited where a considerable length of time exists between the deposition of questioned hairs and the collection of known hair samples.

6.3 Gray hairs typically have no color and are lacking many of the characteristics used to determine the racial and somatic origin of hairs. Therefore, they will be identified only as gray hairs with no conclusion as to their racial or somatic origin. In addition, these hairs are not suitable for microscopic comparison.

6.4 This Laboratory does not perform mitochondrial DNA testing; therefore, it will be recommended that samples be outsourced for mitochondrial DNA testing when the results of a hair comparison may establish an association between the victim and suspect.

6.5 This Laboratory does not perform animal hair comparisons.

7.0 Safety

7.1 Items may have blood or other body fluids present. Use protective equipment when dealing with items that may contain biohazard material. Refer to Laboratory Safety Manual: Bloodborne Pathogen Compliance Program.

7.2 Care shall be exercised when using solvents such as xylene and xylene substitute. Consult Safety Data Sheets for information on safe use for reagents listed in this procedure. Refer to Appendix 1 for Chemical Hygiene and Safety Precautions.

7.3 Care shall be exercised when using Cytosol 280. Consult Safety Data Sheet for information on safe use in this procedure. Refer to Appendix 1 for Chemical Hygiene and Safety Precautions.

7.4 Glass pipettes, razor blades, and probes are sharp and can be dangerous.

8.0 References

8.1 ASTM Guidelines

SWGMAT. "Forensic Human Hair Examination Guidelines." *Forensic Science Communications* 7.2 (2005).

8.2 Books

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8.3 Journal Articles

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Deedrick, D.W. and S.L. Koch. "Microscopy of Hair Part I: A Practical Guide and Manual for Human Hairs." *Forensic Science Communications* 6.1 (2004).

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9.0 Records

Laboratory Safety Manual- Chemical Hygiene Plan and Hazardous Communication Program

Laboratory Safety Manual: Bloodborne Pathogen Compliance Program

10.0 Attachments

Appendix 1: Chemical Hygiene and Safety Precautions

Appendix 2: Somatic Origin Classification

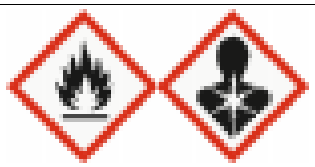
Appendix 3: Racial Classification

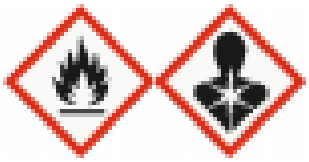
Revision History		
Effective Date	Version Number	Reason
09/21/2020	1	Original Document, Created from Technical Procedure for Hair Analysis

Appendix 1: Chemical Hygiene and Safety Precautions

Cytoseal 280 DANGER: PARTICULARLY HAZARDOUS SUBSTANCE *	
	**HEALTH 3** **FLAMMABILITY 3** **REACTIVITY 0**
Detection of Release	Colorless liquid; Aromatic Odor
Signs/Symptoms of Exposure	Skin, eye irritation; drowsiness or dizziness; Breathing difficulties. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting.
PEL	ACGIH TLV 20 ppm; OSHA PEL 100 ppm (TWA); NIOSH IDLH 500 ppm
Associated Hazards	**May be fatal if swallowed and enters airways**; Highly flammable liquid and vapor. Causes skin irritation. **Suspected of damaging fertility or the unborn child. May cause damage to organs (Central nervous system) through prolonged or repeated exposure.**
Controls	Use only under a chemical fume hood. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. Use eye protection. Handle with impervious gloves.
Safe handling, storage, disposal	Avoid contact with skin and eyes. Avoid inhalation of vapor or mist; Use explosion-proof equipment; Keep away from heat and sources of ignition; take measures to prevent the build-up of electrostatic charge. Dispose in Hazardous Chemical Waste.
Emergency Procedures	**Eye Contact:** Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention. Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Keep eye wide open while rinsing. If symptoms persist, call a physician. **Inhalation Exposure:** Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required. Move to fresh air in case of accidental inhalation of vapors. If symptoms persist, call a physician. **Ingestion:** Do not induce vomiting. Call a physician or Poison Control Center immediately. Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Consult a physician. **Skin Contact:** Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention. Call a physician immediately. SPEEDY ACTION IS

	CRITICAL, GET MEDICAL AID IMMEDIATELY.. If symptoms persist, call a physician. If skin irritation persists, call a physician. Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. **Spills:** Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Small contained spill: wearing appropriate PPE, collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container. Dispose in Hazardous Chemical Waste. Large spills: Evacuate area and call 911 (Haz Mat).

Xylene Substitute DANGER: HIGH RISK SUBSTANCE*	
	HEALTH 2 FLAMMABILITY 3 REACTIVITY 0
Detection of Release	Colorless liquid; Odorless
Signs/Symptoms of Exposure	Breathing difficulties. Skin irritation.
PEL	OSHA TWA 500 ppm
Associated Hazards	Highly flammable liquid and vapor. **May be fatal if swallowed and enters airways.**
Controls	Use under fume hood. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. Use eye protection. Handle with gloves. Wear lab coat.
Safe handling, storage, disposal	Handling: Use protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Storage: Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Dispose in Hazardous Chemical Waste.
Emergency Procedures	**Eye Contact:** Flush eyes with water as a precaution. **Inhalation Exposure:** If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician. **Ingestion:** Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician. **Skin Contact:** Wash off with soap and plenty of water. Consult a physician. **Spills:** Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Small contained spill: wearing appropriate PPE, collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container. Dispose in Hazardous Chemical Waste. Large spills: Evacuate area and call 911 (Haz Mat).

Xylenes DANGER: HIGH RISK SUBSTANCE*	
	HEALTH 2 FLAMMABILITY 3 REACTIVITY 0
Detection of Release	Clear, colorless liquid with a sweet odor.
Signs/Symptoms of Exposure	Breathing difficulties. Respiratory irritation. Skin irritation.
PEL	OSHA PEL - 100 ppm
Associated Hazards	Highly flammable liquid and vapor. **May be fatal if swallowed and enters airways.** Causes skin irritation. May cause respiratory irritation. May cause damage to organs (Central nervous system, Liver, Kidney) through prolonged or repeated exposure if inhaled. Toxic to aquatic life.
Controls	Use under fume hood. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. Use eye protection. Wear lab coat. Handle with gloves (Nitrile breakthrough time = 35 minutes)
Safe handling, storage, disposal	Handling: Avoid contact with skin and eyes. Avoid inhalation of vapor or mist. Keep away from sources of ignition. Take measures to prevent the build-up of electrostatic charge. Storage: Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Dispose in Hazardous Chemical Waste.
Emergency Procedures	**Eye Contact:** Flush eyes with water as a precaution. **Inhalation Exposure:** If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician. **Ingestion:** Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician. **Skin Contact:** Wash off with soap and plenty of water. Consult a physician. **Spills:** Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Small contained spill: wearing appropriate PPE, collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container. Dispose in Hazardous Chemical Waste. Large spills: Evacuate area and call 911 (Haz Mat).

Appendix 2: Racial Classification

The following outline is from *Microscopy of Hair: A Practical Guide and Manual* and sets forth certain key characteristics which serve as indicators of racial origin (Caucasian, Negroid, and Mongoloid). It should be understood that these indicators are generalities and apply primarily to head hairs.

Racial Classification:

Caucasian
- Shaft diameter moderate with minimal variation
- Pigment granules sparse to moderately dense with fairly even distribution
- Oval cross-sectional shape

Negroid
- Shaft diameter moderate to fine with considerable variation
- Pigment granules densely distributed (hair shaft may be opaque) and arranged in prominent clumps
- Shaft with prominent twist and curl
- Flattened cross-sectional shape

Mongoloid
- Shaft diameter coarse and usually with little or no variation
- Pigment granules densely distributed and often arranged in large patchy clumps or streaks
- Prominent medulla (broad and continuous)
- Cuticle thick
- Round cross-sectional shape

Appendix 3: Somatic Origin Classification

The following outline is from *Microscopy of Hair: A Practical Guide and Manual* and lists features of individual hairs which serve to identify the region of the body from which they come. Again, the features listed are generalities and one must consider racial origin of the specimen when analyzing features such as the degree of diameter variation or the medullary structure.

Somatic Origin:

Head Hairs

- Long with moderate shaft diameter and diameter variation
- Medulla absent to continuous and relatively narrow when compared to its structure in hairs from other body areas
- Often with cut or split tips
- May show artificial treatment, solar bleaching, or mechanical damage, such as, caused by backcombing
- Soft texture (pliable)

Pubic Hairs

- Shaft diameter coarse with wide variations and buckling
- Medulla relatively broad and usually continuous when present
- Root frequently with follicular tags
- Tip usually rounded or abraded
- Stiff texture

Body Hairs

- Variations may occur with hairs that may make somatic origin determination difficult or impossible to determine. These particular hair specimens may be nonclassifiable due to immaturity or changes caused by artificial treatment or damage. The hairs may be transitional hairs (fringe hairs); i.e., from an areas of the body between two identifiable regions, or they may be fragmentary and not of sufficient size for an adequate examination.