Collection, Handling, and Identification of Glass

Scientific Working Group for Materials Analysis (SWGMAT)

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1. Scope

This document outlines the methods intended for use by forensic glass examiners for the collection, handling, and identification of glass. The particular methods employed by each examiner and/or laboratory will depend upon sample size, sample suitability, laboratory equipment, and the purpose of the examination.

2. Reference Documents

2.1. Scientific Working Group for Materials Analysis Documents

Quality assurance guidelines
Trace evidence recovery guidelines

2.2. American Society for Testing and Materials Standards

D1395 *Standard Definitions of Terms Relating to Glass*
E1492 Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Laboratory

3. Terminology

Anisotropy is the property of having different refractive indices depending on the vibration direction of light.

A *conchoidal* type of fracture is observed when glass breaks to give irregularly curved and usually striated surfaces.

Extinction is the condition that occurs when the vibration directions of the specimen are parallel to the direction of either of the two crossed polars. At extinction, the specimen will appear dark.

Glass is an inorganic product of fusion that has cooled to a rigid condition without crystallizing.

Interference colors are colors produced by the interference of rays of white light that are out of phase.

Isotropy is the property of having the same refractive index regardless of the direction of vibration of light passing through the material. An isotropic particle will exhibit extinction at all orientations between crossed polars.

Known sample is a subset of a larger population or sample originating from an identifiable source, collected as being representative of that larger grouping (e.g., fragments removed from a broken window at the scene of a crime).

Polarized light microscope (PLM) is a microscope equipped with two polarizing elements, one (polarizer) located between the light source and the sample and the other (analyzer) between the sample and the observer.

Questioned sample is material of an unknown source collected from a known location either as, or from, items of evidence (e.g., fragments recovered from a suspect's clothing).

Stereomicroscope is a microscope containing two separate optical paths, resulting in a three-dimensional view of a specimen.

4. Summary of Guideline

This guideline covers the collection and handling of glass specimens, the recovery of questioned particles from suspect items such as clothing and tools, the cleaning of questioned particles, and procedures for the identification of glass particles.

5. Significance and Use

Glass samples should be collected in a manner consistent with generally recognized and accepted practices such that they are adequate for analysis and interpretation of results within the context of an investigation. All of the sampling techniques listed below are acceptable. However, one may be more appropriate than another depending on circumstances, such as the nature of the crime scene or analytical methodologies to be employed. For additional information see to the *Scientific Working Group for Materials Analysis Trace Evidence Recovery Guidelines.*

6. Sample Handling

6.1. Considerations for Collection of a Glass Sample

6.1.1. The collector must consider that fragments within a questioned sample may have multiple origins. If possible, the collector should attempt an initial separation based on physical properties.

6.1.2. The collector must consider the possibility there may be a physical match to a known sample (e.g., a piece of glass to a fractured vehicle headlamp). When an attempt to make a physical match is made at the site of collection, the collector should take precautions to avoid mixing of the known and questioned samples.

6.1.3. Any glass samples collected should be documented, marked (if necessary), packaged, and labeled as recommended in the *Scientific Working Group for Materials Analysis Trace Evidence Recovery Guidelines.*

6.2. Considerations for Receiving Glass Evidence

6.2.1. Check the evidence packaging for the presence of damage (i.e., tears, cuts) and make a notation of any damage detected.

6.2.2. Maintain a separation of all known and unknown samples, avoiding contamination at all steps of collection and examination.

6.3. Collecting the Sample

6.3.1. The glass sample should consist of the largest amount that can be practically collected from each broken object and packaged separately. The sample should be removed from the structure (e.g., window frame, light assembly). The inside and outside surfaces of the known sample should be labeled if a determination of direction of breakage or reconstruction of the pane is desired. If multiple

panes are sampled, a diagram to show relative positions from which samples are taken can be helpful.

6.3.2. When multiple broken glass sources are identified, it is necessary to sample all sources. For instance, when multiple vehicle windows are involved, a sample from each of the windows should be collected (e.g., both sides of a laminated windshield, each side window, mirrors, and headlights).

6.3.3. A sample should be collected from various locations throughout the broken portion of the object in order to be as representative as possible.

6.3.4. The sample should be collected with consideration being given to the presence of other types of evidence on that sample (e.g., fibers, blood).

6.4. Collecting Glass Samples from Garments, Footwear, and Other Items of Evidence

6.4.1. The evidentiary item to be examined is removed from its packaging and transferred to a clean surface.

6.4.2. The packaging that contained the item should be examined for the presence of glass or other trace evidence.

6.4.3. Garments and other textile products should be examined and their condition noted. Particular attention should be paid to damage such as tears and cuts. Any cuts or holes in the soles of footwear should be probed for the presence of glass. Any glass fragments that are found should be documented with their locations and recovered, if appropriate. Cuffs or pockets should be examined and turned out to free any glass that may be present. The item can then be tugged, shaken, or scraped over the collection surface. Other sample collection techniques may be employed, as appropriate. Anything detected on the collection surface should be recovered as recommended in the *Scientific Working Group for Materials Analysis Trace Evidence Recovery Guidelines.*

6.4.4. Items such as tools or bats should be examined microscopically, giving special consideration to any damaged area or powdered substance. Any glass fragments that are found should be noted and recovered, if appropriate.

6.4.5. The area from which any sample is collected should be documented as specifically as possible.

6.5. Cleaning Glass Samples

6.5.1. The condition of the glass should be noted, as well as consideration given to the fact that any material removed from the glass may have its own evidentiary value. The fragment must be cleaned to remove dirt, grease, and other debris that may have an effect on any analytical procedure to be performed on the fragment.

6.5.2. The fragments can be cleaned manually using an appropriate solvent. The fragment can also be cleaned using detergent in an ultrasonicator, then rinsed, and dried.

6.6. Crushing Glass

6.6.1. If crushing the fragment is required, it should be in a manner that will allow for the maximum recovery and minimum introduction of foreign materials. Consideration should be given to obtaining crushed samples of specific interest (e.g., near surface, bulk fragments from known samples) and maintaining the evidentially significant features of the original fragment (e.g., original surfaces on

questioned fragments).

6.6.2. It may be necessary to fracture the original fragment to remove a sufficient piece for further crushing in order to obtain particles of proper dimension.

6.6.3. If the sample is limited, nondestructive methods should be used before subjecting the sample to any destructive testing.

6.6.4. Unless the sample is consumed during analysis, the examiner should retain a portion of every sample analyzed and return it to the submitter or preserve it, as appropriate.

6.6.5. If the entire sample is required for analysis, attempts should be made to maintain the sample in its tested state.

7. Analysis

7.1. Characterizing Particles as Glass

7.1.1. Glass fragments can be distinguished from plastic by their relative hardness. If the careful application of pressure from a needle causes deformation of a particle, it is not glass.

7.1.2. Some plastics are soluble in some organic solvents. If the questioned particle exhibits this characteristic, it is not glass.

7.1.3. Because glass is an amorphous material, it breaks in a random manner. Some glass fragments can be recognized by their conchoidal fracture.

7.1.4. Glass is an isotropic material. An examiner can determine if an unstrained particle is isotropic by placing or mounting it on a glass microscope slide and observing it with a polarized light microscope.

7.1.4.1. Insert the analyzer (cross the polars). If the particle is unstrained glass, it should appear extinct. Rotate the microscope stage 360 degrees. If the particle remains extinct at all orientations, the particle is isotropic. If interference colors are observed, either the particle is anistropic and therefore not glass, or it is glass that has been subjected to mechanical or thermal stress.

7.1.4.2. A stereomicroscope with a polarizing attachment may also be used without mounting a particle in an immersion medium. This is an extremely useful technique for screening a large number of samples.

7.2. Upon the completion of the initial screening, separation, and cleaning, the samples can then be analyzed or retained for later analysis.

8. Considerations

The number of glass fragments recovered from a questioned source may be important to the findings in a case. The number, or approximate number, of fragments recovered should be noted. The location of a recovered fragment of glass may also be relevant to the findings and, as such, should be noted when possible and applicable.

9. Bibliography

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