Module 4G

Forensic Examination of Glass

Forensic Science Teacher Professional Development

Part 7 Forensic Examination of Glass

A glass sample is another piece of commonly seen trace evidence, especially in hit-and-run or burglary cases. There are many types of glass including the following.

- Containers: bottles, jars
- Flat glass: architecture, transport glazing
- Glass fiber: reinforcement, insulation
- Domestic glass: kitchen, tableware
- Technical glass: scientific and industrial use

Part 7 Forensic Examination of Glass

Glass is a product of fusion that has cooled to a rigid state without crystallization. Glass is amorphous or non-crystalline in structure and is also known as supercooled liquid. The main constituent of glass is silica (SiO_2) sand. There might be different additives (modifiers) present in the glass for different purposes. Examples include the following.

- Sodium oxide – to reduce melting temperature of glass
- Calcium oxide (limestone, soda-lime-silicate), aluminium oxide (alumina, alumino-silicate) – to improve durability of glass
- Boric oxide (borosilicate) – to improve glass's properties of temperature and thermal shock resistance
- Lead oxide (lead silicate) – to make optical, crystal, and electrical glasses

Part 7 Forensic Examination of Glass

Glass types can be classified according to their composition.

- Fused silica - Silica can be melted and cooled to form a glass. This type of glass is popular in scientific and industrial applications.
- Soda lime silicate glasses - The principal constituents of this type of glass are silica (SiO_2), soda (sodium oxide, Na_2O), and lime (CaO). This type of glass is popular as container, flat, and domestic glassware.

Part 7 Forensic Examination of Glass

Glass types, continued:

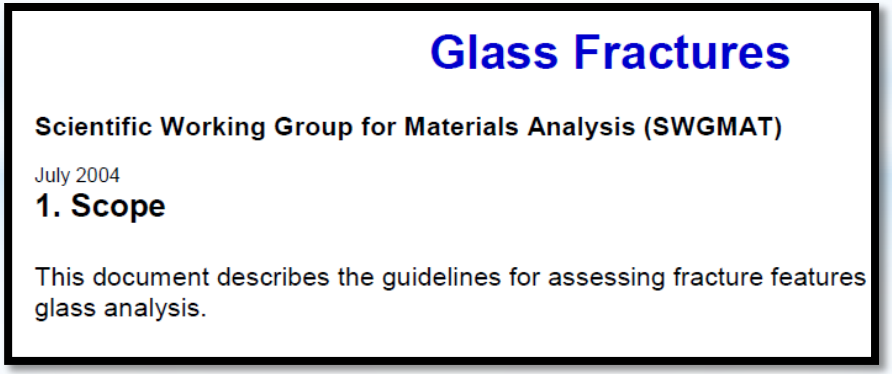
- Borosilicate glasses - The principal constituents of this type of glass are silica and boric oxide, B_2O_3, together with smaller amounts of alkalis and aluminium oxide. This type of glass is mostly in used for industrial purposes, home kitchenware, and in laboratories and hospitals glassware.
- Lead glasses - Any glass containing at least 24 percent PbO can legitimately be described as lead crystal. This type of glass is often used in optical and electrical equipment.

Part 7 Forensic Examination of Glass

Forensic examination of glass samples involves physical and chemical methods:

- Physical methods - Physical match of cracks and the determination of refractive index and dispersion of glass samples
- Chemical methods - Determine the elemental signature of a specimen of glass.

A good source to see physical fractures of glass can be found here:



http://www.swgmat.org/Glass%20Fractures.pdf

Part 7 Forensic Examination of Glass

The chemical method for the determination of glass compositions involves the use of analytical instruments, such as the following.

- AA (atomic absorption spectroscopy)
- AES (atomic emission spectroscopy)
- ICP-AA, ICP-AES
- ICP-MS (inductively coupled plasma mass spectrometry)
- LA-ICP-MS (laser ablation inductively coupled plasma mass spectrometry)
- SEM-EDS (scanning electron microscope - energy dispersive X-ray spectrometry)
- XRF (X-ray fluorescence)
- LIBS (laser-induced breakdown spectroscopy)
- NAA (neutron activation analysis)

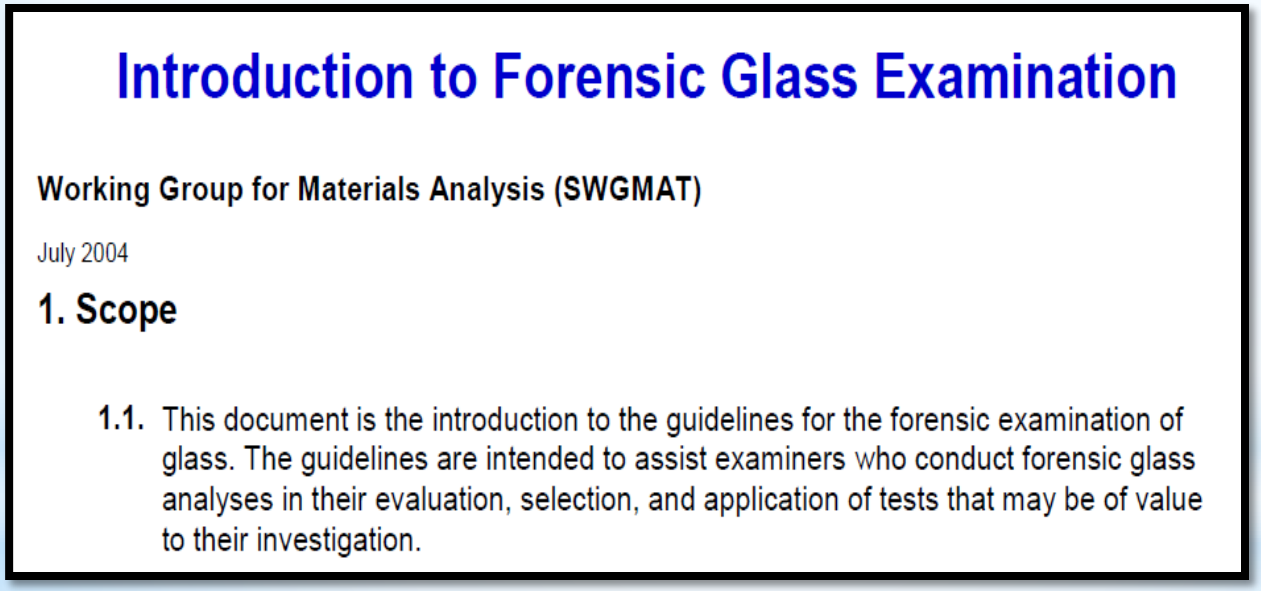
Part 7 Forensic Examination of Glass

Major, minor, and trace amounts of elements in glass samples are examined. The elemental composition of each glass sample can be compared to one another. Standard protocols for glass sample analysis can also be found from ASTM, such as the following.

- ASTM E1967 - 98(2003) Standard Test Method for the Automated Determination of Refractive Index of Glass Samples Using the Oil Immersion Method and a Phase Contrast Microscope.
- ASTM E2330 - 04 Standard Test Method for Determination of Trace Elements in Glass Samples Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

Part 7 Forensic Examination of Glass

A good introduction for glass sample analysis can also be found from the Glass Subgroup of the Scientific Working Group on Materials Analysis (SWGMAT).



Introduction to Forensic Glass Examination

Working Group for Materials Analysis (SWGMAT)

July 2004

1. Scope

1.1. This document is the introduction to the guidelines for the forensic examination of glass. The guidelines are intended to assist examiners who conduct forensic glass analyses in their evaluation, selection, and application of tests that may be of value to their investigation.

Introduction to Forensic Glass Examination:

http://www.swgmat.org/Introduction%20to%20Forensic%20Glass%20Examination.pdf

Module 4: Conclusion

Since the early 1990s, the FBI Laboratory has sponsored Scientific Working Groups (SWG's) to improve discipline practices and create recommended guidelines among federal, state, and local forensic community partners. In 2004, there were nine working groups established in different forensic disciplines:

- SWGDAM - DNA Analysis
- SWGDE - Digital Evidence
- SWGDOC - Questioned Documents
- SWGDRUG - Analysis of Seized Drugs
- SWGFAST - Latent Fingerprints
- SWGGUN - Firearms and Toolmarks
- SWGIT - Imaging Technology
- SWGMAT - Materials (Trace Evidence)
- SWGSTAIN - Bloodstain Pattern Analysis
- FISWG - Facial Identification and Recognition

Each SWG is made up of members from within the focus field.

Module 4: Conclusion

The SWGs have a common working framework that is based on the Scientific Working Group Bylaws.

The American Society of Crime Laboratory Directors (ASCLD) publishes the ASCLD NEWS newsletter in April, August, and December every year. This newsletter contains updates from each SWG. Each SWG serves as a common voice for its scientific discipline. SWG members will meet at least once a year to discuss issues of concern and reach consensus on those documents drafted throughout the year.

Module 4: Conclusion

SWGMAT is the SWG that creates, prepares, and publishes standards and guidelines in trace evidence examination. These documents provide crime laboratories a solid basis for operational guidelines. Enforcement of the guidelines is left to the appropriate governing agency and each group's internal policies. The documents are published in peer-reviewed scientific journals in the group's discipline. Forensic Science Communications, the FBI Laboratory's online scientific journal, publishes SWG standards and guidelines in virtually every quarterly issue.

Module 4: Conclusion

SWGMAT currently provides the guidelines and best practices pertaining to fibers, glass, paint, and tape. We expect more guidelines in the field of trace evidence will be prepared in the future. Every trace analyst should regularly visit the primary website of SWGMAT for updated protocols and standards for trace evidence examination. http://www.swgmat.org/

Module 4: Conclusion

Other important websites for high school teachers when they prepare forensic science curriculum:

1. American Academy of Forensic Sciences (AAFS): http://www.aafs.org/

2. International Association for Identification (IAI): http://www.theiai.org/

End of Module 4

Forensic Science Teacher Professional Development