GLASS EXAMINATION INFORMATION

INTRODUCTION

Glass has many uses in everyday life; examples include windows, doors, automotive glass, and bottles. Due to its brittleness, when glass is broken, fragments may be transferred onto persons or objects in close proximity, for example, onto clothing and footwear, as well as tools etc. used to break the glass. Studies have shown that finding glass on a person's outer clothing or the upper portion of their shoes indicates recent exposure to broken glass. The persistence of glass fragments on an item will depend on the type of surface and the activity occurring after deposition. Broken glass encountered in hit-and-run investigations may provide information regarding damage to the vehicle involved (e.g. broken windshield, side/rear window, mirror, headlight). It is important to note that glass pieces encountered in forensic casework have come from a source of **broken** glass.

EXAMINATION FOR GLASS

Items are examined visually and/or microscopically to determine whether or not glass is present. Debris may be recovered by shaking and/or scraping the items over paper. This debris is searched for glass and a portion of the fragments are selected for further examination. The physical properties that can be determined for the recovered glass fragments are then compared to those of the glass source that has been submitted for comparison. The properties used to discriminate glass sources include colour, thickness, surface features, refractive index, and thermal history. In a given case, the properties used for comparison will depend on the size and features of the recovered glass fragments. Due to the brittle nature of glass, a recovered fragment, if large enough, may form a physical match with glass from the source.

INTERPRETATION

Since glass is a mass-produced material, it cannot be concluded that a recovered glass fragment has come from a specific source of broken glass to the exclusion of all other possible sources. If in all examinations performed, the properties of the recovered glass fragment cannot be differentiated from those of the source glass submitted (i.e. they are **indistinguishable** from each other), it will be reported that the questioned glass fragment came from **either** the known source of glass **or** from another source of broken glass sharing the indistinguishable physical and chemical properties that were examined. To indicate the significance of these findings, the report will include a statement regarding the number of glass samples examined previously at CFS, which are indistinguishable in the compared properties of the known glass source. The presence of a physical match between a recovered glass fragment and glass from the known source may provide stronger association of a shared source. When any of the properties examined **differ** for glass fragments, it will be reported that the fragments did not come from the same source of broken glass.

GLOSSARY

Annealed glass: See thermal history.

Colour: Chemicals may be added to glass during its manufacture to impart colour, which is known as tinting. Glass without tinting is referred to as colourless glass. Small fragments may appear colourless even though they originated from a source of coloured glass.

Container Glass: Glass products such as bottles, jars, bowls, drinking glasses are referred to as container glass. Most container glasses are made from the same ingredients as flat glass, however colouring agents may be added during manufacturing. Container glass is usually annealed (non-tempered) glass.

Float glass: 'Float refers to a glass manufacturing process where the molten glass floats on a bath of molten tin, which produces high quality flat glass without grinding or polishing. The surface of glass that had been in contact with the tin will fluoresce under ultraviolet light, enabling float glass to be identified. The surface not in contact with the tin will be flat, but will not fluoresce. Most flat glass produced today is manufactured using the float process.

Glass: Glass is a brittle, non-crystalline, transparent or translucent material that is generally formed by the melting of sand (silica) with soda ash and limestone.

Heat-strengthened glass: See thermal history.

Laminated glass: This is a type of safety glass with a sandwich construction, having a plastic sheet heat-sealed between two panes of glass. The most common application of laminated glass is in vehicle windshields.

Physical match: This term is used to describe a realignment of two or more broken pieces sharing sufficient corresponding random characteristics that indicates they once formed a single item. A physical match is confirmed when the fracture edges of the broken pieces have matching individual characteristics, such as matching ridges, curvature and surface features. Microscopic techniques are used to examine and realign the fracture edges of the broken pieces. Due to the small size of glass pieces encountered in casework, physical matches are rarely observed.

Refractive index: The refractive index of glass can be regarded as a measure of the bending of light as it passes from air into glass. This physical property is measured accurately using an instrument known as GRIM (Glass Refractive Index Measurement). Microscopic sized glass particles are placed in a drop of oil on a microscope slide for analysis with GRIM, which exploits differences in the optical properties of oil and glass to measure refractive index. The instrument requires calibration with glass standards of known refractive indices.

Surface features: Some glasses may have intentional or incidental features on the surface. Examples of this include coatings, frosting, patterns, mold marks, rouge pits, scratches or tin from the float process. Frosted glass and some patterned glasses will not be clear (i.e. not see-through).

Tempered glass: See thermal history.

Thermal history: The heating and cooling of glass both during and after manufacturing will affect the physical properties of the glass. This is referred to as the thermal history of the glass. Annealing, heat-strengthening and tempering will change the refractive index of the glass. This change can be assessed by re-annealing the glass in the laboratory, enabling the scientist to classify the glass as annealed/non-tempered, heat-strengthened or tempered.

> **Annealed glass:** Gradual cooling during the manufacturing process of glass in order to reduce stress is called ’annealing‘ and the product is known as annealed glass (also referred to as non-tempered glass).
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> **Heat-strengthened glass:** A type of glass that has been ’strengthened' using a process similar to tempering. This glass is stronger than annealed glass but not quite as strong as tempered glass. It is sometimes used for architectural purposes. Vehicle windshields may exhibit the properties of heat-strengthened glass.
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> **Tempered glass:** A type of glass which has been heated until close to its softening point, and then cooled rapidly with air jets. The resulting product has enhanced impact resistance and when broken, characteristically "dices" into small cubes with few splinters or sharp edges, and thus is considered a type of safety glass. It is most often used for side and rear windows of motor vehicles, as well as in shower stalls, patio doors and doors to commercial buildings.

Thickness: Thickness can be measured on pieces of flat glass if both original surfaces are present. A calibrated micrometer is used to measure thickness accurately. Thickness cannot be measured accurately on non-flat surfaces such as bottle glass.

Wired glass: An annealed glass rolled flat with a wire mesh completely embedded in it. Wired glass may display surface features from the polishing process, such as rouge pits. It is commonly used as safety glass in schools and institutions.