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FORENSIC TESTING PROGRAM

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# Glass Analysis Test No. 20-5481 Summary Report

Each participant received a sample set consisting of one set of known glass fragments (Item 1) and two sets of questioned glass particles (Items 2 and 3). Participants were requested to analyze and compare these and report their findings. Data were returned from 71 participants and are compiled into the following tables:



This report contains the data received from the participants in this test. Since these participants are located in many countries around the world, and it is their option how the samples are to be used (e.g., training exercise, known or blind proficiency testing, research and development of new techniques, etc.), the results compiled in the Summary Report are not intended to be an overview of the quality of work performed in the profession and cannot be interpreted as such. The Summary Comments are included for the benefit of participants to assist with maintaining or enhancing the quality of their results. These comments are not intended to reflect the general state of the art within the profession.

Participant results are reported using a randomly assigned "WebCode". This code maintains participant's anonymity, provides linking of the various report sections, and will change with every report.

# Manufacturer's Information

Each sample set consisted of three samples of glass, one Known (Item 1) and two Questioned (Items 2 and 3). Items 1, 2, and 3 were collected from the same glass fish tank. Examiners were instructed to examine the questioned glass particles and determine if any could have originated from the same source as the known recovered glass fragments (Item 1).

SAMPLE PREPARATION - The fish tank glass used for this test was wiped down, checked for defects and edges were avoided.

ITEMS 1, 2, and 3 (IDENTIFICATION): For the Known Item 1 samples, two glass fragments approximately 1/8" x 1/8" in size were selected and packaged in a glassine bag and then a pre-labeled Item 1 coin envelope. For the questioned Item 2 and Item 3 samples, two glass particles approximately 1/16" x 1/16" in size were selected and packaged in each glassine bag and then into a prelabeled Item 2 or Item 3 coin envelope. Items 1, 2, and 3 samples were taken in close spatial proximity to one another and were kept together as an identification group and packaged into the sample set as described below.

SAMPLE SET ASSEMBLY: For each sample set, an Item 1, Item 2, and Item 3 from the same identification group were placed in a pre-labeled envelope. The sample pack was sealed with invisible tape. Once verification was completed, all sample packs were further sealed with a piece of evidence tape and initialed "CTS."

The average refractive indices for the glass as reported by predistribution laboratories are as follows: Item 1 RI =1.51877, Item 2 RI =1.51873, and Item 3 RI =1.51876.

VERIFICATION - All three predistribution laboratories reported the expected associations. The methods employed by the predistribution laboratories included Color, Refractive Index nD, SEM/EDS, Thickness, UV Fluorescence Short and Long, and XRS/XRF.

 

# Summary Comments

This test was designed to allow participants to assess their proficiency in the examination, comparison, and interpretation of glass samples. Each sample set consisted of three samples of glass, one known (Item 1) and two questioned (Items 2 and 3). Items 1, 2 and 3 were from the same glass aquarium. Participants were instructed to examine the questioned samples and determine if either set could have come from the known source. (Refer to the Manufacturer's Information for preparation details.)

Of the 71 participants that reported results, 69 (97.2%) reported that the Item 2 and Item 3 glass particles could have originated from the Item 1 known glass sample. One participant was inconclusive as to whether Item 2 originated from the known sample and also reported that Item 3 did not originate from the Item 1 known glass sample. The remaining participant reported "inconclusive" for both Items 2 and 3.

The most commonly reported methods of analysis were thickness (96%), refractive index (nD) (79%), short UV (75%) and color (73%).

 

# Examination Results

*Could the questioned glass particles in Items 2 and/or 3 have originated from the broken aquarium as represented by Item 1?*

TABLE 1

| WebCode | Item 2 | Item 3 | WebCode | Item 2 | Item 3 |
|---|---|---|---|---|---|
| 2UDBNZ | Yes | Yes | DUTTBU | Yes | Yes |
| 34X2NX | Yes | Yes | E9RXEL | Yes | Yes |
| 3EEL8U | Yes | Yes | EQNM9U | Yes | Yes |
| 3HX3ZY | Yes | Yes | EY3AJH | Yes | Yes |
| 3V4WUW | Yes | Yes | F8FHKK | Yes | Yes |
| 3ZXQRX | Yes | Yes | GDFG9E | Yes | Yes |
| 4FNALQ | Inc | Inc | H47EME | Yes | Yes |
| 4YHTZY | Yes | Yes | H4QRCR | Yes | Yes |
| 6637ER | Yes | Yes | H6FGAD | Yes | Yes |
| 694A7E | Yes | Yes | H7UQMJ | Yes | Yes |
| 6JMN7V | Yes | Yes | HGFUUJ | Yes | Yes |
| 6RHTZW | Yes | Yes | HKBJBQ | Yes | Yes |
| 7H2UJQ | Yes | Yes | HW9MEK | Yes | Yes |
| 7U4VHP | Yes | Yes | J9VBMP | Yes | Yes |
| 7UFRNU | Yes | Yes | JK9BJH | Yes | Yes |
| 7UHGUC | Yes | Yes | JV7ENC | Yes | Yes |
| 7W9MB3 | Yes | Yes | JZZ9LD | Yes | Yes |
| 8AC9DR | Yes | Yes | LKHYXE | Yes | Yes |
| 8DBJ9R | Yes | Yes | LPTDFD | Yes | Yes |
| 98EETT | Yes | Yes | LUN4NA | Yes | Yes |
| 9HF3KP | Yes | Yes | M49VM8 | Yes | Yes |
| 9MVB9P | Yes | Yes | MT964K | Yes | Yes |
| 9ZVCLQ | Yes | Yes | NH8WZ9 | Yes | Yes |
| A7GL9U | Yes | Yes | NYRMY9 | Yes | Yes |
| AQPN7Y | Yes | Yes | P9CDY6 | Yes | Yes |
| AWQ3UL | Yes | Yes | PRRMZ7 | Yes | Yes |
| B4TAAN | Yes | Yes | PUVHJ9 | Yes | Yes |
| B6K9MM | Yes | Yes | QEGGMH | Yes | Yes |
| BX3ZYQ | Yes | Yes | R3KPG6 | Yes | Yes |
| C7EDGL | Yes | Yes | UA9K6D | Yes | Yes |
| CTMRBQ | Yes | Yes | UNT3Y3 | Yes | Yes |
| CUXTXP | Yes | Yes | WFC682 | Yes | Yes |
| D44VVV | Yes | Yes | WHFZQ4 | Inc | No |

TABLE 1

| WebCode | Item 2 | Item 3 | WebCode | Item 2 | Item 3 |
|---|---|---|---|---|---|
| XMQD93 | Yes | Yes | | | |
| Y4RDWW | Yes | Yes | | | |
| YJL6GX | Yes | Yes | | | |
| Z2Y4ZZ | Yes | Yes | | | |
| ZAA7L2 | Yes | Yes | | | |

## Response Summary

**Total Participants: 71**

*Could the questioned glass particles in Items 2 and/or 3 have originated from the broken aquarium as represented by Item 1?*

| Response | | Item 2 | | Item 3 | |
|---|---|---|---|---|---|
| | Yes | 69 | *(97.2%)* | 69 | *(97.2%)* |
| | No | 0 | *(0.0%)* | 1 | *(1.4%)* |
| | Inconclusive | 2 | *(2.8%)* | 1 | *(1.4%)* |

# Examination Procedures

TABLE 2

| | Refractive Index | | | | | | | Elemental | | UV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WebCode | nD | nF | nC | ΔRI | Color | Density | Thickness | SEM/ EDS | XRS/ XRF | Long | Short | Other |
| 2UDBNZ | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| 34X2NX | ✓ | ✓ | ✓ | | ✓ | | ✓ | | | ✓ | ✓ | |
| 3EEL8U | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | | |
| 3HX3ZY | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | |
| 3V4WUW | ✓ | | | | ✓ | | ✓ | ✓ | | | ✓ | |
| 3ZXQRX | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | PLM |
| 4FNALQ | ✓ | | | | | | ✓ | | | ✓ | ✓ | |
| 4YHTZY | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | |
| 6637ER | ✓ | | | ✓ | | | ✓ | | | | ✓ | |
| 694A7E | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | PLM, micro-XRF (qualitative analysis only) |
| 6JMN7V | | | | | | ✓ | | | ✓ | | | LIBS |
| 6RHTZW | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| 7H2UJQ | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | |
| 7U4VHP | ✓ | | | | | | ✓ | | | | | |
| 7UFRNU | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | |
| 7UHGUC | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| 7W9MB3 | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | ✓ | |
| 8AC9DR | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | | ✓ | |
| 8DBJ9R | ✓ | | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | Raman |
| 98EETT | ✓ | | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | |
| 9HF3KP | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 9MVB9P | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | Elemental Analysis by ICP-OES |
| 9ZVCLQ | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| A7GL9U | | | | | ✓ | | ✓ | | | | | LA-ICPMS |
| AQPN7Y | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| AWQ3UL | ✓ | | | | ✓ | | ✓ | | | | | |

# TABLE 2

| | Refractive Index | | | | | | | Elemental | | UV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WebCode | nD | nF | nC | ΔRI | Color | Density | Thickness | SEM/ EDS | XRS/ XRF | Long | Short | Other |
| B4TAAN | | | | | | | ✓ | | ✓ | | | |
| B6K9MM | | | | ✓ | ✓ | | ✓ | | ✓ | | ✓ | |
| BX3ZYQ | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | XRF is down at this time at the lab. |
| C7EDGL | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| CTMRBQ | ✓ | | | | | | ✓ | | ✓ | ✓ | ✓ | |
| CUXTXP | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | LA-ICP-MS, LIBS |
| D44VVV | ✓ | | | | ✓ | | ✓ | ✓ | | | ✓ | |
| DUTTBU | ✓ | | | ✓ | | | ✓ | | | ✓ | ✓ | |
| E9RXEL | | | | ✓ | ✓ | | ✓ | | | | | |
| EQNM9U | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| EY3AJH | ✓ | | | ✓ | | | ✓ | | | | ✓ | |
| F8FHKK | | | | | | | ✓ | ✓ | | | | FTIR |
| GDFG9E | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | |
| H47EME | ✓ | | | | ✓ | ✓ | ✓ | | | | | |
| H4QRCR | ✓ | | | ✓ | ✓ | | ✓ | | | | ✓ | |
| H6FGAD | | | | | | | | | | | | ICP-MS |
| H7UQMJ | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | |
| HGFUUJ | ✓ | | | ✓ | ✓ | | ✓ | | | | ✓ | |
| HKBJBQ | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | |
| HW9MEK | ✓ | | | | | | ✓ | | ✓ | ✓ | ✓ | |
| J9VBMP | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | | ✓ | |
| JK9BJH | ✓ | | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | Stereomicroscopy of morphological characteristics, such as fractures. |
| JV7ENC | ✓ | | | | | | ✓ | ✓ | | ✓ | ✓ | |
| JZZ9LD | ✓ | | | | ✓ | | ✓ | | ✓ | | | |
| LKHYXE | ✓ | | | | ✓ | | ✓ | ✓ | | | ✓ | |
| LPTDFD | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| LUN4NA | ✓ | | | ✓ | ✓ | | ✓ | | | | ✓ | |

# TABLE 2

| | Refractive Index | | | | | | | Elemental | | UV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WebCode | nD | nF | nC | ΔRI | Color | Density | Thickness | SEM/ EDS | XRS/ XRF | Long | Short | Other |
| M49VM8 | ✓ | | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| MT964K | ✓ | | | | ✓ | | ✓ | | | | ✓ | LA-ICPMS |
| NH8WZ9 | ✓ | | | | ✓ | | ✓ | | ✓ | | | |
| NYRMY9 | ✓ | | | | | | ✓ | | ✓ | | ✓ | |
| P9CDY6 | ✓ | | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| PRRMZ7 | | | | | | | ✓ | | ✓ | | | LA-ICP-MS |
| PUVHJ9 | | | | ✓ | | | | | | | | |
| QEGGMH | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| R3KPG6 | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| UA9K6D | | | | ✓ | | | ✓ | | ✓ | | ✓ | |
| UNT3Y3 | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | LA-ICP-MS |
| WFC682 | ✓ | ✓ | ✓ | | ✓ | | ✓ | | | | ✓ | ICP-OES |
| WHFZQ4 | | | | ✓ | | | ✓ | | | | | |
| XMQD93 | ✓ | | | | | | ✓ | ✓ | | ✓ | ✓ | |
| Y4RDWW | ✓ | | | ✓ | ✓ | | ✓ | | ✓ | | | |
| YJL6GX | | | | | | | ✓ | ✓ | | | | |
| Z2Y4ZZ | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | LIBS |
| ZAA7L2 | ✓ | | | ✓ | ✓ | | ✓ | | | | ✓ | |

## Response Summary

| | Refractive Index | | | | | | | Elemental | | UV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Participants | nD | nF | nC | ΔRI | Color | Density | Thickness | SEM/ EDS | XRS/ XRF | Long | Short | |
| 71 | 56 | 3 | 3 | 20 | 52 | 6 | 68 | 17 | 29 | 30 | 53 | |
| *Percent* | *79%* | *4%* | *4%* | *28%* | *73%* | *8%* | *96%* | *24%* | *41%* | *42%* | *75%* | |

# Conclusions

TABLE 3

| WebCode | Conclusions |
|---|---|
| 2UDBNZ | The glass fragments in Items 2 and 3 were found to be indistinguishable from the reference glass in Item 1 in macroscopic properties, refractive index, and elemental composition. The glass fragments in Items 2 and 3 could have originated from the broken aquarium (Item 1) or another glass with the same macroscopic properties, refractive index, and elemental composition. |
| 34X2NX | Glass fragments from Items 2 and 3 corresponded in general appearance, thickness, fluorescence, and refractive index (GRIM- 656nm, 589nm and 488 nm) to the known glass in Item 1. Therefore, Items 1, 2 and 3 could have come from a common source; however, more sensitive testing methods could allow for greater discrimination, which limits this association (Type IV Association). Other glass may have been manufactured to the same specifications that would be indistinguishable from the submitted evidence. Instrument and Equipment Acronyms: GRIM- Glass Refractive Index Measurement, VSC- Video Spectral Comparator. Interpretation: The following descriptions are meant to provide context to the opinions reached in this report. Not every type of conclusion may be applicable in every case or for every material type. Type I Association: Identification Source identification is reached when the discernible class and individual characteristics have corresponding detail and the examiner would not expect to see the same arrangement of details repeated in another source. This includes when two Items fit or realign together in a manner that is not expected to be replicated. Type II Association: Association with distinct characteristics: Items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and share distinctive characteristic(s). Although the examiner would not expect to see these distinctive characteristic(s) repeated in another source, it lacked sufficient characteristics for a source identification. Type III Association: Association with conventional characteristics: Items correspond in all measured physical properties, chemical composition and/or microscopic characteristics. However, it is possible for another sample to be indistinguishable from the submitted evidence; therefore, an individual source cannot be determined. Type IV Association: Association with limitations: An association of decreased evidential value in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics, but there is a limitation to the exam. Limitations could include items commonly encountered in the relevant population, the inability to perform a complete analysis, or limited information. Inconclusive No conclusion could be reached regarding an association or an exclusion between the items. Exclusion with Limitations: The item exhibits differences to the comparison sample that suggests that it did not originate from the same source. However, there are limiting factors, such as possible natural or manufactured source variations. Exclusion: The items exhibit differences in physical properties and/or chemical composition to the comparison sample that demonstrate they did not originate from the same source. |
| 3EEL8U | Microscopic and instrumental analysis (GRIM and XRF) of one (1) piece of questioned glass from each of the Items #01.02 and #01.03, and the known glass from Item #01.01 revealed that they are consistent with respect to color, thickness, surface characteristics, isotropism, Refractive Index and elemental composition. Therefore, the piece of questioned glass from Item #01.02 and #01.03 could have originated from the source represented by the known glass, Item #01.01, or another glass source that exhibits the same physical properties, optical properties, elemental composition and is damaged. |
| 3HX3ZY | The glass pieces from Items 2 and 3 are similar to each other and to Item 1 in physical characteristics, elemental composition and refractive indices. The glass pieces from Items 2 and 3 could have originated from the same source as the submitted standard (Item 1) or from a different source of broken glass with the same physical characteristics, elemental composition |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | and refractive index. Items 1, 2, and 3 were examined visually and using stereomicroscopy, polarized light microscopy (PLM), a digital caliper, X-Ray fluorescence spectroscopy (XRF), and Glass Refractive Index Measurement System (GRIM3). Samples collected and analyzed during the examination of the items in this case (ex. pillboxes and glass slides) have been returned to and retained with the original items. |
| 3V4WUW | In my opinion, the findings provide moderately strong support for the view that items 2 + 3 originated from the same source as item 1. |
| 3ZXQRX | Examination showed the glass in Item #2 is consistent in physical properties, refractive index, and elemental composition with the glass in Item #1. These fragments could have shared a common origin. Examination showed the glass in Item #3 is consistent in physical properties, refractive index, and elemental composition with the glass in Item #1. These fragments could have shared a common origin. |
| 4FNALQ | In this particular case, it was not possible to make a clear difference between the samples based on their refractive indexes. More analysis should be carried out which are not available in this laboratory at the moment. |
| 4YHTZY | Comparative examinations of Exhibit 1 (known glass standard from the broken aquarium) with Exhibit 2 (questioned glass fragments recovered from the suspect's sweater) and Exhibit 3 (questioned glass fragments recovered from the suspect's trunk) disclosed them to be consistent in their physical characteristics, refractive indices, and elemental compositions. As a result of these findings, the questioned glass fragments from Exhibits 2 and 3 could have originated from the broken aquarium (Exhibit 1) or another source with the same characteristics. A glass association is not a means of positive identification and the number of possible sources for a specific glass is unknown. |
| 6637ER | The glass samples recovered as Test Item 2 and Test Item 3 were found to show agreement in physical characteristics, Refractive Index and thermal history with the control Test Item 1 such that, in our opinion, they could all have had a common origin. |
| 694A7E | FINDINGS AND OPINIONS: Item 1 consists of two fragments of faint blue glass, one of which was analyzed and used for comparison to Items 2 and 3. Item 2 consists of two small fragments of faint blue glass, one of which was analyzed and determined to be similar in color, glass type, ultraviolet fluorescence properties, thickness, refractive index, and bulk elemental chemical composition to the glass in Item 1. Therefore, the analyzed glass fragment in Item 2 could have originated from the known glass source represented by Item 1, or from another broken glass source with similar physical characteristics, refractive index values, and bulk elemental chemical composition. Item 3 consists of two small fragments of faint blue glass, one of which was analyzed and determined to be similar in color, glass type, ultraviolet fluorescence properties, thickness, refractive index, and bulk elemental chemical composition to the glass in Item 1. Therefore, the analyzed glass fragment in Item 3 could have originated from the known glass source represented by Item 1, or from another broken glass source with similar physical characteristics, refractive index values, and bulk elemental chemical composition. REMARKS: Trace elemental chemical composition was not performed on the glass in Items 1, 2, or 3. The chance of finding coincidentally indistinguishable glass is higher when trace elemental chemical composition analysis is not performed than when trace elemental chemical composition analysis is performed. |
| 6JMN7V | The chemical composition of all three samples was determined with LIBS and μXRF. The comparison of the chemical compositions of the samples showed a good congruence between all three Items. Additionalle, the density of the samples was determined. All three Items have an identical density value. Conclusion: Item 2 as well as Item 3 originate from the same object as |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | Item 1. |
| 6RHTZW | Visual, stereomicroscopic, and instrumental examination and comparison reveals similarities in color, thickness, elemental composition and refractive index such that it can be concluded that the analyzed questioned glass samples in Items 2 and 3 could have originated from the same source as the glass in Item 1. |
| 7H2UJQ | The two particles of questioned glass recovered from the suspect's sweater (Item 2) and the two particles of questioned glass from the suspect's trunk (Item 3) can come from the broken aquarium as represented by Item 1 or from another glass material with the same characteristics. |
| 7U4VHP | The fragments taken from the broken aquarium (known fragments, ITEM 1) and the fragments recovered from the suspect´s sweater (questioned, ITEM 2) and from the suspect´s trunk (questioned, ITEM 3, show the same results in all the analyses performed (physical propierties) |
| 7UFRNU | The apparent glass pieces from the suspect's sweater and from the trunk of the suspect's car were determined to be four glass pieces which are similar in color, thickness, fluorescence, and refractive index to the known glass pieces from the broken aquarium (01-01). Trace elemental comparison between this item and the known glass pieces from the broken aquarium cannot be performed by our laboratory at this time. It is our opinion that these glass pieces could have come from the known glass pieces from the broken aquarium or any other source of broken glass with similar characteristics. |
| 7UHGUC | Questioned glass fragments (Items 2 and 3) and known glass (Item 1) were compared using physical characteristics, UV fluorescence, refractive index measurements, and elemental analysis by X-Ray Fluorescence. The tested questioned glass fragments (Items 2 and 3) were similar in color, thickness, type (float glass), UV fluorescence, refractive index, and elemental composition to the known glass (Item 1). The questioned glass fragments originated either from the aquarium or from another broken glass source with indistinguishable properties(Level 3— Association). Because similar glass has been manufactured that would be indistinguishable from the submitted evidence, an individual source cannot be determined. |
| 7W9MB3 | Glass fragments from the suspect’s sweater (item 2) and the vehicle’s trunk (item 3) could not be eliminated as having come from the broken aquarium (item 1). As such, items 2 and 3 came from either item 1 or another source or sources of broken, clear, colourless, annealed float glass, indistinguishable from item 1 with respect to thickness and refractive index. |
| 8AC9DR | In my opinion, the findings provide strong support for the proposition that the two fragments of glass in item 2 and the two fragments of glass in item 3 originated from the source of broken glass (item 1) at the scene, rather than not. |
| 8DBJ9R | Two particles of questioned glass recovered from the suspect’s sweater (Item 2) and two particles of questioned glass recovered from the suspect’s trunk (Item 3) are consistent with two fragments of known glass taken from the broken aquarium (Item 1) in color, thickness, UV fluorescence, refractive index, elemental composition and Raman spectrum. Item 2 and item 3 could have originated from the broken aquarium. |
| 98EETT | CONCLUSIONS: Two glass fragments recovered from the suspect's sweater (Item 2) and two glass fragments recovered from the suspect's trunk (Item 3) either originated from the broken aquarium (Item 1) or another source of broken glass possessing the same distinct physical, optical, and chemical characteristics. RESULTS: Two glass fragments recovered from the suspect's sweater (Item 2) and two glass fragments recovered from the suspect's trunk (Item 3) were examined for the purpose of determining whether or not there is any glass present like the known glass standard from the broken aquarium (Item 1). The known glass standard from the aquarium (Item 1) is colorless non-tempered float sheet glass. Examination and comparison of |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | the four questioned glass fragments (Items 2 and 3) with the known glass standard from the aquarium (Item 1) reveals they are alike with respect to physical, optical, and chemical characteristics. It is therefore concluded that these four questioned glass fragments recovered from the suspect's sweater (Item 2) and the suspect's trunk (Item 3) either originated from the aquarium (Item 1) or another source of broken glass possessing the same distinct physical, optical, and chemical characteristics. METHODS OF ANALYSIS: Examinations were performed visually, by stereo microscopy, polarized light microscopy, ultraviolet fluorescence, micrometry, refractive index determination, and x-ray fluorescence spectroscopy. |
| 9HF3KP | The particles of questioned glass recovered from the suspect's sweater (Item 2) and suspect's trunk (Item 3) both could have been originated from the broken aquarium (Item 1) because of their similarities of their physical properties & chemical composition. |
| 9MVB9P | Glass recovered from the suspect's sweater and trunk (Items 2 and 3) is indistinguishable from the broken glass aquarium as represented by Item 1. Consequently, the glass recovered from the suspect's sweater and trunk (Items 2 and 3) either originated from the broken glass aquarium (Item 1) or from another source of broken glass indistinguishable in all of the measured or observed physical properties, refractive index, and elemental composition (an inclusion, see the interpretation section, below). [Table 4 - Additional Comments] |
| 9ZVCLQ | The two particles of glass recovered from the suspect's sweater (item 2) and the two particles of glass recovered from the suspect's trunk (item 3) match with the two fragments of known glass taken from the broken aquarium (item 1) in all investigated features. That means, it may be assumed that the two particles of glass recovered from the suspect's sweater (item 2) and the two particles of glass recovered from the suspect's trunk (item 3) originated from the same source like the two fragments of glass taken from the broken aquarium (item 1). But note: It is not totally impossible that the fragments of item 2 and the fragments of item 3 originated from another glass sources with the same features as the fragments of known glass taken from the broken aquarium (item 1). |
| A7GL9U | The results of the examination are much more likely when hypothesis 1 is true than if hypothesis 2 is true. H1: one or more glass fragments from the examined items originate from the aquarium. H2: all glass fragments originate from another glass pane. |
| AQPN7Y | The known glass taken from the broken aquarium (item 1) and the questioned glass from the suspect’s sweater (item 2) and the suspect’s trunk (item 3) exhibit the same physical, optical and chemical properties. Therefore, the known glass taken from the broken aquarium and the questioned glass from the from the suspect’s sweater and the suspect’s trunk originated from the same source of glass or another glass with the same physical, optical and chemical properties. |
| AWQ3UL | The results gives strong support to the hypothesis that the two particles of questioned glass recovered from the suspect's sweater (Item 2) originates from the aquarium (Item 1). The results gives strong support to the hypothesis that the two particles of questioned glass recovered from the suspect's trunk (Item 3) originates from the aquarium (Item 1). |
| B4TAAN | On the basis of the results obtained, due to the similarities in the elemental composition and thickness between Items 1, 2 and 3, it was considered that all Items originated from the same source. |
| B6K9MM | All fragments of all 3 items had both original glass-surfaces and showed the same thickness of 4.65±0.01mm. All fragments appeared like tempered glass. Also all of them showed a white fluorescence under UV-light at a wavelength of 254nm on one of the surfaces, which is typical for floatglass. All fragments of all items had the same inorganic composition and couldn´t be differentiated by their refractive index or color. It is probable that item 2 (recovered from the |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | suspect´s sweater) and item 3 (recovered from the suspect´s trunk) originated from the broken aquarium from the victims residence. A thickness of 4.65mm is untypical for plate-glass in [Country]. |
| BX3ZYQ | Two particles of glass recovered from the suspect's sweater (further labeled Q1 and Q2) are similar in visual color, thickness, fluorescence, and refractive index to the fragments of glass taken from the broken aquarium. Please note trace elemental comparison between the glass recovered from the suspect's sweater and the glass taken from the broken aquarium cannot be performed by our laboratory at this time. It is our opinion that these particles of glass could share a common origin to the fragments of glass taken from the broken aquarium. Two particles of glass recovered from the suspect's trunk (further labeled Q3 and Q4) are similar in visual color, thickness, fluorescence, and refractive index to the fragments of glass taken from the broken aquarium. Please note trace elemental comparison between the glass recovered from the suspect's trunk and the glass taken from the broken aquarium cannot be performed by our laboratory at this time. It is our opinion that these particles of glass could share a common origin to the fragments of glass taken from the broken aquarium. Fragments of Known Glass Taken from the Broken Aquarium: This item was used as a comparison standard. |
| C7EDGL | The glass recovered from the suspect's sweater Item2 and the glass recovered from the suspect's trunk Item3 are indistinguishable in physical and chemical properties (Thickness, colour, UV Fluorescence, refractive index and elemental composition) to the glass taken from the broken aquarium Item1, therefore, the glass recovered from the suspect's sweater Item2 and the glass recovered from the suspect's trunk Item3, could have originated from the broken aquarium Item1 or from another source exhibiting the same physical and chemical properties. |
| CTMRBQ | METHODS: Items 1, 2, and 3 were examined by refractive index determination, X-ray fluorescence spectroscopy, ultra-violet fluorescence, and micrometry. RESULTS AND CONCLUSIONS: The glass in Items 2 and 3 was indistinguishable from the glass in Item 1 in optical, physical, and elemental properties (Type 3 Association). This means that the glass recovered from the suspect's sweater and the glass recovered from the suspect's trunk could have originated from the aquarium. Trace Interpretation Scale Type 1 Association: Physical Match— The compared items exhibit physical features that demonstrate they were once part of the same object. Type 2 Association: Association with Distinctive characteristics— Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. The items further share distinctive characteristics that would not be typically encountered in the relevant population. Type 3 Association: Association with Conventional characteristics— Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. Because other items have been manufactured or are naturally occurring that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Type 4 Association: Association with limited characteristics and/or examination (1) Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. This type of evidence may be commonly encountered in the environment or may have limited comparative value. Or (2) The comparison between items may be categorized as a Type 4 Association if the association is limited by the inability to perform a complete analysis or if minor variations are observed in the examination results. Inconclusive— No conclusion could be reached regarding an association or an elimination between the items. Elimination— Items exhibit differences in one or more of the following: physical properties, chemical composition, or microscopic characteristics and therefore did not originate from the same source. Non-Association— The items were different in physical properties, chemical composition, and/or microscopic characteristics, indicating that the |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | items did not originate from the same source. However, these differences were insufficient for a definitive elimination. |
| CUXTXP | The glass (Item 001-2) recovered from the suspect's sweater and the glass (Item 001-3) recovered from the suspect's trunk was indistinguishable in physical appearance, refractive index and elemental composition from the glass (Item 001-1) taken from the broken aquarium. Therefore, the glass recovered from the suspect's sweater and from the suspect's trunk could have originated from the broken aquarium or from another source of glass produced by the same glass manufacturer exhibiting the same physical and chemical properties. |
| D44VVV | Item 1 comprised two full thickness fragments of colourless float glass collected from the broken aquarium (control glass). The fragments were found to have an average thickness of 4.68mm, an average refractive index of 1.5189 and were principally composed of silicon, sodium, calcium, and magnesium. Item 2 comprised two full thickness fragments of colourless float glass recovered from the suspect's sweater. The fragments were found to have an average thickness of 4.67mm, had an average refractive index of 1.5189 and were principally composed of silicon, sodium, calcium, and magnesium. Item 3 comprised two full thickness fragments of colourless float glass recovered from the suspect's trunk. The fragments were found to have an average thickness of 4.675mm, had an average refractive index of 1.5189 and were principally composed of silicon, sodium, calcium, and magnesium. The two recovered samples (Items 2 and 3) statistically corresponded in average refractive index and corresponded in appearance, thickness and gross elemental composition to the control (Item 1). Based on these results, the recovered fragments (Items 2 and 3) could not be excluded from originating from the control (Item 1). This result would not normally be reported without confirmation of trace elemental composition via laser ablation inductively coupled plasma mass spectrometry, however our instrument is currently undergoing repairs. |
| DUTTBU | Conclusions I formed the opinion based on the techniques used, that item 2, the particles of questioned glass recovered from the suspect's sweater had the same appearance and refractive index as item 1, the known glass fragments taken from the broken aquarium and could have come from it. I also formed the opinion based on the techniques used, that item 3, the particles of questioned glass recovered from the suspect's trunk had the same appearance and refractive index as item 1, the known glass fragments taken from the broken aquarium and could have come from it. |
| E9RXEL | Examination on the questioned glass fragments recovered from the suspect's sweater (Item 2) were consistent with known glass taken from the broken aquarium (Item 1) in colour and refractive index. Examination on the questioned glass fragments recovered from the suspect's trunk (Item 3) were consistent with known glass taken from the broken aquarium (Item 1) in colour and refractive index. Based on the above findings, in my professional opinion, questioned glass fragments (Item 2 and Item 3) could have originated from the same source represented by known Item 1. |
| EQNM9U | The glass fragments recovered from the suspect's sweater and trunk (items 2 and 3) could have originated from the broken glass aquarium, or another source of broken glass with the same physical, optical, and chemical properties. Item 2 and Item 3 are indistinguishable from item 1 in color, thickness, refractive index, and elemental composition. |
| EY3AJH | The questioned glass particles in items 2 & 3 could have originated from the broken aquarium as represented by item 1. |
| F8FHKK | Elemental compositions from the EDS analysis conclude that Item 2 (suspect's sweater) and Item 3 (suspect's trunk) could have originated from the broken aquarium (Item 1). The FTIR analysis results and the fact that all three items are of the same thickness (4.68 mm) further support that |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | neither Item 2 nor Item 3 can be excluded as originating from Item 1. We therefore conclude that both Item 2 (suspect's sweater) and Item 3 (suspect's trunk) could have originated from the broken aquarium (Item 1). |
| GDFG9E | The glass from questioned "item 2" and "item 3" was found to be consistent with the known glass "item 1". Therefore, the glass from the "item 2" and the "item 3" could have come from the same source as the glass from "item 1". |
| H47EME | ITEMS: 1 a small sealed manila envelope identified as "2020 CTS Forensic Testing Program TEST NO. 20-5481: GLASS ANALYSIS" containing: 1-1: two (2) pieces of glass sealed in a small manila envelope identified as "Test No. 20-5481 Item 1". 1-2: two (2) pieces of glass sealed in a small manila envelope identified as "Test No. 20-5481 Item 2". 1-3: two (2) pieces of glass sealed in a small manila envelope identified as "Test No. 20-5481 Item 3". RESULTS: Items #1-1, #1-2, and #1-3 were examined for average thickness, density properties, and refractive index using the glass refractive index measurement system. The analyzed glass fragment recovered from the sweater in item #1-2 corresponded in color, thickness, density, and refractive index with the known glass sample from the aquarium, item #1-1. The analyzed glass fragment recovered from the car trunk in item #1-3 corresponded in color, thickness, density, and refractive index with the known glass sample from the aquarium, item #1-1. OPINION: The glass fragment from item #1-2 could have originated from the broken glass represented by the known glass, item #1-1, or another source of broken glass with the same properties. This is a Type III Association. See Association Key below. [Attachment not provided by participant] The glass fragment from item #1-3 could have originated from the broken glass represented by the known glass, item #1-1, or another source of broken glass with the same properties. This is a Type III Association. See Association Key below. [Attachment not provided by participant] |
| H4QRCR | The two glass fragments from the broken aquarium (item 1) consisted of clear, colourless, toughened float glass. The two glass fragments recovered from the suspect's sweater (item 2) consisted of clear, colourless, toughened float glass. In relation to colour, thickness and refractive index these fragments were found to be indistinguishable from the broken aquarium glass (item 1). Therefore the glass recovered from the suspect's sweater and broken aquarium glass may share a common origin. The two glass fragments recovered from the suspect's trunk (item 3) consisted of clear, colourless, toughened float glass. In relation to colour, thickness and refractive index these fragments were found to be indistinguishable from the broken aquarium glass (item 1). Therefore, the glass recovered from the suspect's trunk and broken aquarium glass may share a common origin. |
| H6FGAD | Based on the analysis of triplicate 2-6 mg portions of ground glass fragments by Inductively Coupled Plasma – Mass Spectrometry, the concentration of 51 elements in Items 2 and 3 were not distinguishable from the concentration of those elements in Item 1. Distinguishability is based on the sample average and 4 x the standard deviation. These criteria have been used in the published literature to provide the lowest combination of type 1 and 2 error rates [Table 4 - Additional Comments]. Elemental concentrations are considered indistinguishable if the range generated by their average concentration ± 4[standard deviation] (above the MQL) overlap. Opinions/Interpretations: Based on the results Items 2 and 3 could have originated from Item 1 |
| H7UQMJ | The fragments of items 1, 2, and 3 were found to be indistinguishable based on macroscopic properties, refractive index, and elemental composition. The glass from the suspect's sweater (item 2) and the glass from the suspect's trunk (item 3) could have originated from the broken aquarium (item 1) or another source of glass with the same microscopic properties, refractive index, and elemental composition. |
| HGFUUJ | The findings provide strong support for the view that the glass from the suspect's sweater and the |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | glass from the trunk of her vehicle came from the glass aquarium rather than the view that they came from a different source. |
| HKBJBQ | Based on visual examination, RI (using the T-test), and bulk elemental composition, the recovered glass from Item 2 (Suspect's Sweater) could not be differentiated from the control glass contained within Item 1 (Reference glass taken from the broken aquarium). Therefore, the recovered glass from Item 2 could have come from the same source as Item 1. However, other sources with similar physical and elemental characteristics cannot be excluded. In my opinion, the glass evidence strongly supports the proposition that the clothing believed to belong to the POI (Sweater), was in the immediate vicinity of the sampled glass from the broken aquarium, at the time that it was breaking. Based on visual examination, RI (using the T-test), and bulk elemental composition, the recovered glass from Item 3 (Suspect's Trunk) could not be differentiated from the control glass contained within Item 1 (Reference glass taken from the broken aquarium). Therefore, the recovered glass from Item 3 could have come from the same source as Item 1. However, other sources with similar physical and elemental characteristics cannot be excluded. In my opinion, the glass evidence strongly supports the proposition that the sampled broken glass from the aquarium (Item 1), came into contact with the trunk of the car believed to belong to the POI, sometime after the glass was broken. |
| HW9MEK | Items 1, 2, and 3 were examined by stereomicroscopy, ultraviolet light fluorescence, micrometry, X-ray fluorescence spectroscopy, and refractive index determination. The glass in Items 2 and 3 was indistinguishable from the glass in Item 1 in optical, physical, and elemental properties (Type 3 Association). This means the glass recovered from the suspect's sweater and the glass recovered from the suspect's trunk could have come from the broken aquarium. |
| J9VBMP | The results of the examination give support for the hypothesis that the glass particles in Item 2 originate from the broken aquarium represented by Item 1 (Level +2). The results of the examination give support for the hypothesis that the glass particles in Item 3 originate from the broken aquarium represented by Item 1 (Level +2). |
| JK9BJH | The sample in Item 1 consists of two colorless glass fragments that exhibit characteristics consistent with non-tempered float sheet (window) glass. These fragments have their full thickness. They were used as standards for comparison to the glass in Items 2 and 3. Items 2 and 3 each consist of two colorless glass fragments that have their full thickness and exhibit characteristics consistent with non-tempered float sheet (window) glass. Macroscopic, microscopic and instrumental examinations and comparisons of Items 1, 2 and 3 revealed that the four questioned glass fragments are like the glass standard in Item 1 with respect to their color, thickness, refractive index values and chemical characteristics. It is therefore concluded that the glass fragments represented as having been recovered from the subject's sweater and vehicle trunk originated either from the broken aquarium or from another source of broken non-tempered float sheet glass having these same characteristics. |
| JV7ENC | Examination and comparison of Items 1, 2 and 3 revealed the items to be glass that were similar in all measured physical, microscopic and optical properties and elemental composition. Items 1, 2, and 3 could have come from the same source or from other glass with the same properties. |
| JZZ9LD | The sample of glass from Item 1.2 has similar physical properties, optical properties, and trace elemental content with the sample of glass from Item 1.1. These two samples of glass could have come from the same original source. The sample of glass from Item 1.3 has similar physical properties, optical properties, and trace elemental content with the sample of glass from Item 1.1. These two samples of glass could have come from the same original source. |

 

# TABLE 3

| WebCode | Conclusions |
|---|---|
| LKHYXE | Item 1: Two pieces of clear, colorless glass standard were analyzed for comparison to Items 2 and 3. Item 2: Two pieces of clear, colorless glass were found. In the sample analyzed, the unknown glass (Item 2) either originated from the standard (Item 1) or another source of broken glass possessing the same distinct physical, and chemical characteristics. Item 3: Two pieces of clear, colorless glass were found. In the sample analyzed, the unknown glass (Item 3) either originated from the standard (Item 1) or another source of broken glass possessing the same distinct physical, and chemical characteristics. |
| LPTDFD | Both questioned items (2) and (3) could have originated from broken aquarium item (1). |
| LUN4NA | The glass fragments from Item 2 and Item 3 cannot be distinguished from Item 1 by looking at color, thickness, UV fluorescence, and refractive index. The questioned glass particles from the suspect's sweater (Item 2) and the questioned glass particles from the suspect's trunk (Item 3) may have originated from the broken aquarium (Item1). Note: As glass is a mass product, a matching refractive index is not an individual match, but a different refractive index proves the origin from different sources. |
| M49VM8 | The glass fragments from the broken aquarium (Item #1) compares to the glass fragments recovered from the suspect's sweater (Item #2) and the glass fragments recovered from the suspect's trunk (Item #3) by physical, elemental, and optical properties, indicating that they could have had a common origin or could have originated from another glass source with indistinguishable properties. |
| MT964K | In my opinion, the findings provide very strong support, or the evidence is at least 11600 times more likely, for the proposition that the sweater (Item 2) believed to belong to the suspect was close to the glass at the scene (Item 1) when it was broken, rather than the proposition that it was not close to the glass at the scene when it was broken. It is also my opinion that the findings provide very strong support of an association between the glass recovered from the suspect's trunk (Item 3), and the broken glass at the scene (Item 1). |
| NH8WZ9 | On analysis, I found : The refractive index of the questioned glasses from the suspect's sweater (ITEM 2) and trunk (ITEM 3) to be similar with the refractive index of the known glass taken from the broken aquarium (ITEM 1). Therefore, I am of the opinion that: The questioned glasses from the suspect's sweater (ITEM 2), trunk (ITEM 3) and the known glass taken from the broken aquarium (ITEM 1) could have come from the same source. |
| NYRMY9 | Utilizing a Stereomicroscope, Micrometer, Polarized Light Microscopy, X-Ray Fluorescence Spectroscopy (XRF), and Glass Refractive Index Measurement System (GRIM3), it was determined that the questioned glass from items 002 and 003 exhibited consistent thickness, chemical and optical properties with the known glass, item 001. Therefore, the known glass, item 001, cannot be eliminated as being the possible source of the questioned glass from items 002 and 003. Dates of Analysis: 7/6/20-7/7/20 Items 001, 002, and 003 are ready to be returned to the submitting agency. |
| P9CDY6 | The glass samples in Items 2 and 3 were consistent in color, thickness, fluorescence, refractive index and element content with the known glass in Item 1 and could have originated from that source. |
| PRRMZ7 | Two fragments of aquarium glass in Item 1, similar with Item 2 and Item 3 glass fragments. |
| PUVHJ9 | We confirm that: glass refractive index of two particles of glass recovered from the suspect's sweater (Item 2) match with both glass refractive index of glass fragments taken from the broken aquarium (Item 1) and glass refractive index of two particles of glass recovered from the suspect's trunk (Item 3) match with both glass refractive index of glass fragments taken from the |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | broken aquarium (Item 1). |
| QEGGMH | The questioned glass particles in Items 2 and 3 were each found to agree in colour, thickness, density, refractive index and elemental composition with the known glass fragments in Item 1. The findings suggested the questioned glass particles in Items 2 and 3 could have originated from the same source as the glass fragments in Item 1. |
| R3KPG6 | The Analysis revealed that the measured physical and chemical properties of Item #1, #2 and #3 are indistinguishable. The glass from Item #1 cannot be eliminated as the source of glass for Items #2 and #3. |
| UA9K6D | Conclusion: 1. I have considered the following propositions to evaluate my findings: a. The glass fragments recovered from the suspect's sweater and/or trunk originated from the broken aquarium glass. b. The glass fragments recovered from the suspect's sweater and/or trunk originated from an unrelated source and are present due to chance. 2. Given the above, I consider the findings to be more probable if the first proposition is true, that is, the glass fragments recovered from the suspect's sweater and/or trunk originated from the broken aquarium glass rather than the second that the glass was present by chance. 3. Consequently it is my opinion that the findings provide moderate support for the proposition that the recovered glass fragments from the suspect's sweater (Item 2) and trunk (Item 3) originated from the broken aquarium glass (Item 1). |
| UNT3Y3 | The questioned glass fragments from "Item 2" and "Item 3" were found to have no significant difference with the control glass fragments from "Item 1" in terms of colour, fluorescence, thickness, refractive index and trace elemental composition. Hence, the questioned glass fragments from "Item 2" and "Item 3" were very likely to have originated from the same source as the control glass fragments from "Item 1"; other sources of glass with similar characteristics are limited. |
| WFC682 | Glass recovered from the sweater (Item 2) and the trunk (Item 3) is indistinguishable from glass from the aquarium (Item 1). Consequently, the glass from the sweater (Item 2) and the trunk (Item 3) either originated from the aquarium (Item 1) or from another source of broken glass indistinguishable in all of the measured or observed physical properties, refractive index, and elemental composition. |
| WHFZQ4 | glass 1 and 3 could not be originated from the same source. it is inconclusive to say if glass 1 and glass 2 originated from the same source. |
| XMQD93 | 1.Two pieces of clear, colorless float glass were found. One piece of glass was analyzed for comparison to items 2 and 3. 2.Two pieces of clear, colorless float glass were found. One piece of glass was analyzed for comparison to item #1. The unknown glass either originated from the standard glass (item #1) or another source of broken glass possessing the same distinct physical and chemical characteristics. 3.Two pieces of clear, colorless float glass were found. One piece of glass was analyzed for comparison to item #1. The unknown glass either originated from the standard glass (item #1) or another source of broken glass possessing the same distinct physical and chemical characteristics. |
| Y4RDWW | Both Item2 and Item3 can originate with high probability from Item1. |
| YJL6GX | The evidence (elemental composition of glass samples as well as the thickness measurements) provides support for the proposition that glass fragments recovered from the suspect's sweater(Item 2)and from the suspect's trunk (Item 3) could have originated from the broken aquarium(Item 1). |
| Z2Y4ZZ | The questioned glass in Item 2(Two particles of questioned glass recovered from the suspect's |

 

TABLE 3

| WebCode | Conclusions |
|---|---|
| | sweater) and Item 3(Two particles of questioned glass recovered from the suspect's trunk) is consistent with the known glass in Item 1(Two fragment of know glass taken from the broken aquarium) on the basis of color, thickness, luminescence, refractive index, and elemental composition. Therefore, the questioned glass in Items 2 and 3 could have originated from the know glass in Item 1. It should be noted that glass does not contain enough individual chemical and microscopic characteristics to be positively identified as originating from a particular source to the exclusion of all other sources. |
| ZAA7L2 | Particles of questioned glass recovered from the suspect's sweater (Item 2) and from the suspect's trunk (Item 3) could have a common origin with glass fragments of known glass taken from the broken aquarium (Item 1). |

 

# Additional Comments

TABLE 4

| WebCode | Additional Comments |
|---|---|
| 6637ER | It was unusual to encounter cubed glass that did not exhibit a typical toughened delta RI. |
| 6JMN7V | Density Item 1 = Density Item 2 = Density Item 3 = 2.4951 g/cm3 |
| 7UFRNU | Trace elemental comparison cannot be performed by our laboratory at this time due to the XRF being currently out of service. |
| 7W9MB3 | Of the 2319 samples of broken glass collected from casework and survey samples examined at this Laboratory for which refractive index, thermal history, thickness, and float data are available, 1 (0.04%) was non-tempered, float glass, indistinguishable in refractive index and thickness from item 1. |
| 8AC9DR | In a real case scenario I would request the clothing (sweater) from the police force. I would collect the debris and examine it for the presence of glass with a freshly broken appearance. I would address the case at activity level, rather than source level, and I would consider whether or not a recent wearer of the sweater broke the glass in the aquarium. |
| 9MVB9P | The above conclusion [Table 3 - Conclusions] would not stand alone in an official report of examination. Included would be methods, interpretation and limitation sections. Text box size precludes inclusion of this information. |
| B4TAAN | Items 1 and 2 showed birefringence consistent with toughened glass. Item 3 showed weak birefringence that is also consistent with toughened glass but shows slight variation within the glass. |
| H4QRCR | Equipment required to conduct additional testing (elemental composition determination) on items 1-3 was out of service as the time of testing. |
| H6FGAD | Literature citation: Trejos, T., Koons, R., Weis, P., Becker, S., Berman, T., Dalpe, C., Duecking, M., Buscaglia, J., Eckert-Lumsdon, T., Ernst, T., Hanlon, C., Heydon, A., Mooney, K., Nelson, R., Olsson, K., Schenk, E., Palenik, C., Pollock, E., Rudell, D., Ryland, S., Tarifa, A., Valadez, M., Es, A., Zdanowicz, V., Almirall, J., J. Anal. At. Spectrom., Vol. 28, 2013, 1270-1282. |
| HGFUUJ | I have chosen the above phrase from the following scale: weak support, moderate support, moderately strong support, strong support, very strong support, extremely strong support. |
| HW9MEK | Type 3 Association: Association with Conventional Characteristics: Items are consistent in all measured and observed physical properties, chemical composition, and/or microscopic characteristics, and therefore could have originated from the same source. Because other items have been manufactured or are naturally occurring that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. I would have liked a more representative sample of the known glass for comparison. |
| MT964K | My conclusions are based on the results of my laboratory examination and the information made available to me at this time. If any aspects of the case should change (in particular the propositions) then I am prepared to review my conclusion in light of such changes. |
| UNT3Y3 | Refractive index (3SD range): Item 1: 1.5187 – 1.5189, Item 2: 1.5187 – 1.5189, Item 3: 1.5187 – 1.5190. Comparison of trace elemental composition: The match criterion for LA-ICP-MS analysis was set at 4SD range (minimum 3% RSD) around average of control sample. The elements compared are: Li7, Na23, Mg24, Al27, K39, Ca42, Ti49, Mn55, Fe57, Rb85, Sr88, Zr90, Ba137, La139, Ce140, Nd146, Hf178, Pb208. |
| WHFZQ4 | glass 1 average thickness: 4.67mm, glass 2 average thickness 4.67mm, glass 3 average thickness 4.66mm, glass 1 and 3 have slight difference in their thickness. glass 1 RI 1.51860-151863, glass 2 RI 1.51852-1.51856, glass 3 RI 1.51864-1.51865, glass 1 and 2 |

 

TABLE 4

| WebCode | Additional Comments |
|---|---|
| | have slight difference in their RI but some of the measurements were too close in order to conclude. |
| YJL6GX | Thickness of all objects (Item 1, 2 and 3) was the same.Quantitative elemental composition of glass fragments evaluated based on likelihood ratio(LR) calculation shows that hypothesis about common origin of both compared fragments was more probable than hypothesis that compared fragments originate from different sources. Based on obtained LR values it was concluded that support for hypothesis about common origin of this fragments is strong. So based on elemental composition this fragments (Item 1, 2 and 3) could not be differentiated. However during sample preparation, we find difficulties to smashed one of the recovered fragment (Item 3). So this is kind of suspicious point out that some fragments could originate from toughen glass and some not. So in next step refractive index measurements should be performed. However we do not have appropriate equipment. |

-End of Report-
(Appendix may follow)

 

**Collaborative Testing Services ~ Forensic Testing Program**

# Test No. 20-5481: Glass Analysis

DATA MUST BE SUBMITTED BY **Aug. 10, 2020, 11:59 p.m.** TO BE INCLUDED IN THE REPORT

Participant Code: U1234H WebCode: HYBKNR

The Accreditation Release section can be accessed by using the "Continue to Final Submission" button above. This information can be entered at any time prior to submitting to CTS.

**Scenario:**
Police are investigating a violent assault at a residence. A man claims his ex-wife had entered his house and attacked him with a golf club, breaking his glass aquarium. Police apprehended the suspect and recovered glass particles from the suspect's sweater, as well as, the trunk of her vehicle. Investigators are requesting that you examine and compare the glass particles recovered from the suspect's sweater and trunk with the fragments recovered from the broken aquarium found in the victim's residence.

*Please Note:*
*-Samples contained within each individual Item are from a single source.*
*-CTS will not reproduce Interpretation Scales, Scale of Conclusions or Terminology Keys in the final report, please do not submit with the participant's data sheet.*

**Items Submitted (Sample Pack GL):**
Item 1: Two fragments of known glass taken from the broken aquarium.
Item 2: Two particles of questioned glass recovered from the suspect's sweater.
Item 3: Two particles of questioned glass recovered from the suspect's trunk.

## 1.) Could the questioned glass particles in Items 2 and/or 3 have originated from the broken aquarium as represented by Item 1?

| | Yes | No | Inconclusive |
|---|---|---|---|
| **Item 2:** | ○ | ○ | ○ |
| **Item 3:** | ○ | ○ | ○ |

## 2.) Indicate the procedure used to examine the submitted items:

| Refractive Index: | | UV Fluorescence: | | |
|---|---|---|---|---|
| ☐ nD | ☐ nC | ☐ Long | ☐ Color | ☐ Thickness |
| ☐ nF | ☐ Δ RI | ☐ Short | ☐ Density | |
| | | **Elemental Analysis:** | | |
| ☐ SEM/EDS | ☐ XRS/XRF | | | |

Other:

***Please note:*** *Any additional formatting applied in the free form space below will not transfer to the Summary Report and may cause your information to be illegible. This includes additional spacing and returns that present your responses in lists and tabular formats.*

## 3.) What would be the wording of the Conclusions in your report?

## 4.) Additional Comments

# RELEASE OF DATA TO ACCREDITATION BODIES

**The Accreditation Release is accessed by pressing the "Continue to Final Submission" button online and can be completed at any time prior to submission to CTS.**

**CTS submits external proficiency test data directly to ASCLD/LAB, ANAB, and/or A2LA. Please select one of the following statements to ensure your data is handled appropriately.**

○ This participant's data is intended for submission to ASCLD/LAB, ANAB, and/or A2LA. (Accreditation Release section below must be completed.)
○ This participant's data is **not** intended for submission to ASCLD/LAB, ANAB, and/or A2LA.

Have the laboratory's designated individual complete the following steps
**only if your laboratory is accredited in this testing/calibration discipline**
by one or more of the following Accreditation Bodies.

**Step 1: Provide the applicable Accreditation Certificate Number(s) for your laboratory**

**ANAB** Certificate No.
(Include ASCLD/LAB Certificate here)

**A2LA** Certificate No.

**Step 2: Complete the Laboratory Identifying Information in its entirety**

Authorized Contact Person and Title

Laboratory Name

Location (City/State)