



Glass Analysis

Test No. 26-5481 Summary Report

Each participant received a sample pack consisting of known glass samplings and questioned glass fragments which they were asked to examine using their existing protocols. Data were returned from 59 participants and are compiled into the following tables:

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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 pack contained two sets of known glass samplings and two sets of questioned glass fragments. Participants were asked to examine the questioned fragments and determine if either could have originated from the same source as the recovered known glass samplings.

SAMPLE PREPARATION: The glass was examined for defects and then broken, utilizing glass tools to remove edges and unwanted areas. Association items were selected at the same time and within close spatial proximity to one another prior to item packaging and maintained together as association batches during sample pack assembly. Elimination items were prepared separately from other items to prevent contamination.

KNOWN ITEMS: Two glass fragments, approximately 1/8" x 1/8" in size, were selected and deposited into a glassine bag and then placed into a pre-labeled item envelope and sealed.

QUESTIONED ITEMS: Two glass fragments, approximately 1/16" x 1/16" in size, were selected and deposited into a glassine bag and then placed into a pre-labeled item envelope and sealed.

SAMPLE PACK ASSEMBLY: All items were placed into a pre-labeled sample pack and sealed. This process was repeated until all of the sample packs were prepared.

VERIFICATION: Predistribution results were consistent with each other and the manufacturer's preparation information. The following procedures were used to examine the items: Color, Thickness, nD Refractive Index, Short and Long UV Fluorescence, XRS/XRF, and SEM/EDS. The average refractive indices for the glass as reported by predistribution laboratories are as follows: Item 1 RI = 1.52160, Item 2 RI = 1.51989, Item 3 RI = 1.51989, and Item 4 RI = 1.51797.

Item	Known/ Questioned	Association/ Elimination	Source
1	Known	--	Miscellaneous Glass
3	Questioned	Elimination	Window Glass
4	Questioned	Elimination	Picture Frame Glass

Item	Known/ Questioned	Association/ Elimination	Source
2	Known	--	Window Glass
3	Questioned	Association	Window Glass
4	Questioned	Elimination	Picture Frame Glass

Summary Comments

This test was designed to allow participants to assess their proficiency in the examination, comparison, and interpretation of glass samples. Participants were supplied with two sets of known glass samplings (Item 1 and Item 2) and two sets of questioned glass fragments (Item 3 and Item 4). Items 2 and 3 were prepared from the same source of glass. Items 1 and 4 were each prepared from different sources from one another and from that of Items 2 and 3. Refer to the Manufacturer's Information for preparation details.

Data were returned from 59 participants.

For Item 3, all but four participants (93%) eliminated the item as having originated from the Item 1 known glass. The remaining participants either associated or were inconclusive. All but two participants (96%) associated the item as having originated from the Item 2 known glass. The remaining participants eliminated.

For Item 4, all participants eliminated the item as having originated from the Item 2 known glass.

The most commonly reported examination procedures include: Thickness, Short UV Fluorescence, nD Refractive Index, and Color.

Examination Results

Could the questioned glass fragments recovered from the suspect (Item 3 and Item 4) have originated from either the side door and/or kitchen cabinet as represented by Item 1 and Item 2?

TABLE 1

<u>Item 1</u>					<u>Item 2</u>				
WebCode	Item 3	Item 4	Item 3	Item 4	WebCode	Item 3	Item 4	Item 3	Item 4
22QLBM	No	No	Yes	No	HL22NY	No	No	Yes	No
37ZYT	No	No	Yes	No	JX7MN3	No	No	Yes	No
38WE6H	No	No	Yes	No	KBT983	No	No	Yes	No
3KGU9H	Yes	No	Yes	No	KEC3BV	No	No	Yes	No
3NWLWP	No	No	Yes	No	KYV8UY	No	No	Yes	No
3YHQ6P	No	No	Yes	No	KZQQWZ	No	No	Yes	No
4PM84L	No	No	Yes	No	LFFHWR	No	No	Yes	No
6FC6HK	No	No	Yes	No	LQZRHZ	No	No	Yes	No
78FP7L	No	No	Yes	No	LRGNBY	No	No	Yes	No
7KMHYJ	No	No	Yes	No	MBND23	No	No	Yes	No
7RNUVG	No	No	Yes	No	MXEXUW	No	No	Yes	No
88W7ZE	No	No	Yes	No	N9EKL	No	No	Yes	No
8CQ3MK	No	No	No	No	NG67RR	Inc	No	Yes	No
8FPDJK	No	No	Yes	No	NPYEBX	No	No	Yes	No
9XL4EE	No	No	Yes	No	NTYMGT	No	No	Yes	No
9XNTJB	No	No	Yes	No	NW3HZW	No	No	Yes	No
AE79ZD	No	No	Yes	No	PD2UAX	No	No	Yes	No
BCYDUE	No	No	Yes	No	PD4KDU	No	No	Yes	No
D4UD94	Yes	No	No	No	PHYEBV	No	No	Yes	No
ECNLR9	No	No	Yes	No	PUTRBR	No	No	Yes	No
F4R6FA	No	No	Yes	No	PYYL6N	Yes	No	Yes	No
FKDTP6	No	No	Yes	No	RGDGW2	No	No	Yes	No
G7QZE3	No	No	Yes	No	RVDHBN	No	No	Yes	No
GTZ73A	No	No	Yes	No	RYCU8M	No	No	Yes	No

TABLE 1

WebCode	<u>Item 1</u>		<u>Item 2</u>		WebCode	<u>Item 1</u>		<u>Item 2</u>	
	Item 3	Item 4	Item 3	Item 4		Item 3	Item 4	Item 3	Item 4
TXVZ4R	No	No	Yes	No					
UHX8WW	No	No	Yes	No					
UXE3CT	No	No	Yes	No					
V6PPZM	No	No	Yes	No					
VAY3HL	No	No	Yes	No					
VNJMZU	No	No	Yes	No					
WJ4AXL	No	No	Yes	No					
WKEE9N	No	No	Yes	No					
X4L4YR	No	No	Yes	No					
Y6F9TQ	No	No	Yes	No					
ZVPMMR	No	No	Yes	No					

Examination Response Summary				Participants: 59	
<i>Could the questioned glass fragments recovered from the suspect (Item 3 and Item 4) have originated from either the side door and/or kitchen cabinet as represented by Item 1 and Item 2?</i>					
Item 1			Item 2		
	Item 3	Item 4		Item 3	Item 4
Yes:	3 (5.1%)	0 (0.0%)		57 (96.6%)	0 (0.0%)
No:	55 (93.2%)	59 (100.0%)		2 (3.4%)	59 (100.0%)
Inconclusive:	1 (1.7%)	0 (0.0%)		0 (0.0%)	0 (0.0%)

Examination Procedures

TABLE 2

	Refractive Index				Color	Density	Thickness	Elemental		UV		
	nD	nF	nC	ΔRI				SEM/ EDS	XRS/ XRF	Long	Short	Other
22QLBM	✓				✓		✓		✓	✓	✓	
37ZYTl	✓				✓		✓		✓	✓	✓	PLM
38WE6H							✓		✓			LA-ICP/MS
3KGU9H							✓					Laser Induced Breakdown Spectroscopy
3NWLWP	✓				✓		✓	✓			✓	
3YHQ6P	✓				✓		✓		✓	✓	✓	
4PM84L	✓				✓		✓		✓	✓	✓	PLM
6FC6HK	✓						✓	✓			✓	
78FP7L	✓									✓	✓	
7KMHYJ	✓				✓		✓		✓		✓	
7RNUVG	✓				✓		✓		✓	✓	✓	LA-ICP-MS
88W7ZE							✓	✓				
8CQ3MK					✓		✓	✓	✓	✓	✓	
8FPDJK	✓				✓		✓		✓		✓	
9XL4EE	✓				✓		✓			✓	✓	
9XNTJB	✓			✓	✓		✓		✓			LA-ICP-MS
AE79ZD	✓				✓		✓		✓	✓	✓	
BCYDUE	✓				✓		✓	✓		✓	✓	
D4UD94					✓		✓	✓	✓			
ECNLR9				✓	✓		✓	✓	✓	✓	✓	
F4R6FA	✓				✓		✓			✓	✓	
FKDTP6	✓						✓					
G7QZE3	✓						✓		✓	✓	✓	
GTZ73A	✓						✓	✓			✓	
HL22NY	✓				✓		✓				✓	LA-ICP-MS
JX7MN3					✓		✓				✓	Elemental analysis with LA-ICP-MS

TABLE 2

	Refractive Index					Density	Thickness	Elemental		UV		
	nD	nF	nC	ΔRI	Color			SEM/ EDS	XRS/ XRF	Long	Short	Other
KBT983	✓				✓		✓	✓	✓	✓	✓	
KEC3BV	✓				✓		✓		✓			
KYV8UY	✓				✓		✓		✓			
KZQQWZ	✓			✓	✓		✓			✓	✓	
LFFHWR	✓			✓	✓		✓	✓			✓	
LQZRHZ	✓			✓	✓		✓					Surface analysis - interferometry
LRGNBY				✓	✓		✓	✓			✓	
MBND23	✓						✓		✓	✓	✓	
MXEXUW												ICP-MS
N9EKL	✓				✓		✓		✓		✓	
NG67RR							✓		✓			
NPYEBX	✓				✓		✓		✓		✓	
NTYMG	✓				✓		✓			✓	✓	
NW3HZW							✓	✓		✓	✓	
PD2UAX	✓						✓		✓			LA-ICP-TOFMS
PD4KDU	✓			✓			✓				✓	Surface interferometry
PHYEBV	✓						✓	✓		✓	✓	
PUTRBR										✓	✓	GRIMM
PYYL6N	✓				✓	✓	✓		✓	✓		
RGDGW2	✓				✓		✓	✓			✓	
RVDHBN				✓			✓	✓		✓	✓	
RYCU8M	✓			✓	✓		✓	✓			✓	
TXVZ4R				✓		✓	✓	✓			✓	
UHX8WW				✓	✓		✓	✓			✓	
UXE3CT	✓				✓		✓			✓	✓	LA-ICP-MS
V6PPZM								✓				FTIR
VAY3HL	✓				✓		✓				✓	LA-ICP-MS
VNJMZU	✓				✓		✓			✓	✓	ICP-MS

TABLE 2

	Refractive Index							Elemental		UV		
	nD	nF	nC	Δ RI	Color	Density	Thickness	SEM/ EDS	XRS/ XRF	Long	Short	Other
WJ4AXL						✓						LIBS, μ XRF
WKEE9N	✓				✓		✓		✓		✓	
X4L4YR							✓		✓	✓	✓	
Y6F9TQ	✓				✓		✓			✓	✓	ICP/MS
ZVPMMR	✓				✓		✓		✓		✓	

Response Summary										Participants: 59	
	Refractive Index							Elemental		UV	
	nD	nF	nC	Δ RI	Color	Density	Thickness	SEM/ EDS	XRS/ XRF	Long	Short
Total	41	0	0	11	38	3	54	19	26	26	44
Percent	69%	0%	0%	19%	64%	5%	92%	32%	44%	44%	75%

Conclusions

TABLE 3

WebCode	Conclusions
22QLBM	1. Comparative examinations of Exhibit 2 (glass recovered from a kitchen cabinet) with Exhibit 3 (glass from the subject) disclosed them to be consistent in their physical characteristics, elemental compositions, and refractive indices. As a result of these findings, Exhibit 3 could have originated from Exhibit 2 or another source with the same characteristics. 2. A glass association is not a means of positive identification and the number of possible sources for a specific glass is unknown. 3. Comparative examinations of Exhibit 2 with Exhibit 4 (glass from the subject) and comparative examinations of Exhibit 1 (glass from the side door) with Exhibits 3 and 4 disclosed them to be inconsistent in their physical characteristics, elemental compositions, and refractive indices. As a result of these findings, Exhibit 4 could not have originated from Exhibits 1 or 2 and Exhibit 3 could not have originated from Exhibit 1.
37ZYL	Examination of Item 3 revealed the presence of approximately two (2) broken glass fragments. It was found to be consistent in physical properties with the known glass standards in Items 1 and 2. Further analysis found Item 3 to be consistent in elemental composition, and refractive index with the known standard of Item 2, but was not consistent in elemental composition with the known standard in Item 1. Therefore, glass in Item 3 could have originated from the same source as the known standard in Item 2, or another source of broken glass with the same physical properties, elemental composition, and refractive index. Examination of Item 4 revealed the presence of approximately two (2) broken glass fragments. It was found to be not consistent in elemental composition with the known glass standards in Items 1 and 2. Therefore, this fragment could not have originated from the same source as the known standards in Items 1 and 2. No further analysis was performed on this item.
38WE6H	The thickness measurements for items 1, 2, 3 were 2.23 mm and 1.94 mm for item 4. Micro XRF analysis revealed that Si, Ca and Al were detected in all four items. However, the elemental concentration ratios were consistent only between item 2 and 3, whereas item 1 and 4 showed variations. LA-ICP/MS analysis detected variations elements including Al, Ti, Zr and Ba and similarly yielded matching results only between items 2 and 3.
3KGU9H	Item 3 was found to be similar in composition and thickness to Item 1 and Item 2. Item 4 was found to be not similar to Item 1 and Item 2
3NWLWP	The glass from the side door (Item 1) and the kitchen cabinet (Item 2), consisted of pieces of colourless, flat, float, toughened glass that were indistinguishable in thickness but distinguishable in refractive index. The questioned glass (Item 3) recovered from the suspect, consisted of two pieces of colourless, flat, float, toughened glass. This glass was indistinguishable from the glass from the kitchen cabinet (Item 2) with respect to their thickness, refractive indices and elemental compositions. Therefore, the questioned glass in Item 3 could have originated from the glass from the kitchen cabinet (Item 2) but could not have originated from the glass from the side door (Item 1). The questioned glass (Item 4) that was also recovered from the suspect, consisted of two pieces of colourless, flat, float, toughened glass that were distinguishable from the glass from both the side door (Item 1) and kitchen cabinet (Item 2) with respect to thickness and refractive index. Therefore, the questioned glass in Item 4 could not have originated from the glass from either the side door (Item 1) or kitchen cabinet (Item 2).
3YHQ6P	CONCLUSIONS: Two glass fragments identified as recovered from the suspect (Item 3) either originated from the kitchen cabinet (Item 2) or another source of broken glass possessing the same distinct physical, optical, and chemical characteristics. These two glass fragments identified as recovered from the suspect (Item 3) did not originate from the side door (Item 1). Two glass fragments identified as recovered from the suspect (Item 4) did not originate from

TABLE 3

WebCode	Conclusions
	the side door (Item 1) or the kitchen cabinet (Item 2). RESULTS: Questioned glass fragments identified as recovered from the suspect (Items 3 and 4) were examined for the purpose of determining whether or not there is any glass present like the known glass standards from the side door (Item 1) or the kitchen cabinet (Item 2). The known glass standard from the side door (Item 1) is colorless non-tempered float sheet glass. The known glass standard from the kitchen cabinet (Item 2) is colorless non-tempered float sheet glass. Examination of the questioned glass identified as recovered from the suspect (Item 3) revealed two full thickness glass fragments. Examination and comparison of these two questioned glass fragments with the known glass standard from the kitchen cabinet (Item 2) revealed they are alike with respect to physical, optical, and chemical characteristics. It is therefore concluded these two questioned glass fragments either originated from the kitchen cabinet (Item 2) or another source of broken glass possessing the same distinct physical, optical, and chemical characteristics. Examination and comparison of the two questioned glass fragments recovered from the suspect (Item 3) with the known glass standard from the side door (Item 1) revealed they are dissimilar with respect to chemical characteristics. It is therefore concluded these two questioned glass fragments did not originate from the side door (Item 1). Examination of the questioned glass identified as recovered from the suspect (Item 4) revealed two full thickness glass fragments. Examination and comparison of these two questioned glass fragments with the known glass standards from the side door (Item 1) and the kitchen cabinet (Item 2) revealed they are dissimilar with respect to physical characteristics. It is therefore concluded these two questioned glass fragments did not originate from the side door (Item 1) or the kitchen cabinet (Item 2). METHODS OF ANALYSIS: Examinations were performed visually, by stereo microscopy, polarized light microscopy, ultraviolet fluorescence, micrometry, refractive index determination, and x-ray fluorescence spectroscopy.
4PM84L	Examination of Item 3 revealed the presence of two broken glass fragments. These fragments were not consistent in physical properties and elemental composition with the glass standard in Item 1. Therefore, these items could not have shared a common origin. These fragments were consistent in physical properties and elemental composition with the glass standard in Item 2. Further analysis of one of the fragments also found it to be consistent in refractive index with the glass standard in Item 2. Therefore, this glass fragment could have originated from the same source as the known standard in Item 2, or from another source of broken glass with the same physical properties, elemental composition, and refractive index. No further analysis was performed on this item. Examination of Item 4 revealed the presence of two broken glass fragments. These fragments were not consistent in physical properties and elemental composition with the glass standard in Item 1. Therefore, these items could not have shared a common origin. These fragments were not consistent in physical properties and elemental composition with the glass standard in Item 2. Therefore, these items could not have shared a common origin. No further analysis was performed on this item.
6FC6HK	The fragments in items 1, 2, 3 and 4 were identified as glass. The glass in item 3 was inconsistent with the side door glass from item 1 with respect to refractive index. This indicates that the glass in item 3 did not originate from the side door glass in item 1. The glass in item 3 was visually, microscopically and instrumentally (refractive index and elemental composition) consistent with the kitchen cabinet glass in item 2. This indicates that the glass in item 3 could have originated from the kitchen cabinet glass in item 2 or any other glass with the same physical and chemical characteristics. The glass in item 4 was inconsistent with the side door glass in item 1 and the kitchen cabinet glass in item 2 with respect to thickness. This indicates that the glass in item 4 did not originate from the side door glass in item 1 or the kitchen cabinet glass in item 2.
78FP7L	I formed the opinion based on the techniques used, that the glass fragments recovered from

TABLE 3

WebCode	Conclusions
	the suspect (item 3) had the same appearance, thickness and refractive index as the control glass collected from the kitchen cabinet (item 2) and could have originated from it. I also formed the opinion based on the techniques used, that the glass fragments recovered from the suspect (item 3) had a different refractive index as the control glass collected from the side door (item 1) and could not have originated from it. I further formed the opinion based on the technique used, that the glass fragments recovered from the suspect (item 4) had a different thickness as the two control glass samples collected from the side door (item 1) and kitchen cabinet (item 2) and could not have originated from them.
7KMHYJ	The questioned glass, Item 4, exhibited different physical and chemical characteristics when compared to the known glasses, Items 1 and 2. This questioned glass did not originate from same sources as the known glasses. The questioned glass, Item 3, and the known glass, item 1, exhibited differences in chemical composition. These items did not originate from the same source. The questioned glass, Item 3, and the known glass, Item 2, exhibited similarities in physical and chemical composition and refractive index. The questioned glass could have originated from the same source as the glass in Item 2, or another glass source of similar composition.
7RNUVG	The questioned glass fragments recovered from the suspect (Item 4) don't come from the known glass fragments recovered from the side door and a kitchen cabinet (Item 1 and Item 2). The questioned glass fragments recovered from the suspect (Item 3) don't come from the known glass fragments recovered from the side door (Item 1). The questioned glass fragments recovered from the suspect (Item 3) can come from the known glass fragments recovered from a kitchen cabinet (Item 2) or from another glass material with the same characteristics.
88W7ZE	Based on applied methods, the evidence (elemental composition of glass samples as well as the thickness measurements) provides support for the proposition that questioned glass fragments recovered from the suspect described as Item 3 could have originated from the from a kitchen cabinet (Item 2) while questioned glass fragments recovered from the suspect described as Item 4 could have not originated from both known glass fragments, i.e. the side door (Item 1) and a kitchen cabinet (Item 2).
8CQ3MK	The questioned glass fragments recovered from the suspect (Items 3 and 4) were examined and compared to known glass standards from the side door (Item 1) and the kitchen cabinet (Item 2) to determine if they could have originated from any of those sources. Item 1 was opened and found to contain two (2) colorless glass fragments with characteristics consistent with non-tempered float sheet glass. Both fragments have their complete thickness. These fragments were used as standards for comparison purposes. Item 2 was opened and found to contain two (2) colorless glass fragments with characteristics consistent with non-tempered float sheet glass. Both fragments have their complete thickness. These fragments were used as standards for comparison purposes. Item 3 was examined for the presence of glass and two (2) colorless glass fragments were found. These fragments had characteristics consistent with non-tempered float sheet glass. Macroscopic and microscopic examinations and comparisons revealed exclusionary differences between the questioned glass in Item 3 and the glass from the side door (Item 1) and kitchen cabinet (Item 2), with respect to their chemical composition. It is therefore concluded that the glass fragments recovered from the suspect in Item 3 could not have originated from the side door (Item 1) or kitchen cabinet (Item 2) as represented by the standard. Item 4 was examined for the presence of glass and two (2) colorless glass fragments were found. These fragments had characteristics consistent with non-tempered float sheet glass. Macroscopic and microscopic examinations and comparisons revealed exclusionary differences between the questioned glass in Item 4 and the glass from the side door (Item 1) and kitchen cabinet (Item 2), with respect to their thickness. It is therefore concluded that the glass fragments recovered from the suspect in Item 4 could not have

TABLE 3

WebCode	Conclusions
	originated from the side door (Item 1) or kitchen cabinet (Item 2) as represented by the standard.
8FPDJK	The glass fragments recovered from the suspect (Item 3) could not have originated from the side door. Item 3 was chemically different than item 1. The glass fragments recovered from the suspect (Item 3) could have originated from the kitchen cabinet or another source of broken glass with the same physical, optical, and chemical properties. Item 3 was indistinguishable from item 2 in color, thickness, refractive index, and elemental composition. The glass fragments recovered from the suspect (Item 4) could not have originated from the side door or kitchen cabinet. Item 4 had a different thickness than Items 1 and 2.
9XL4EE	The glass from Item-3 (Questioned glass fragments recovered from the suspect) and the Item-1 (Known glass fragments recovered from the side door) were inconsistent and could not have originated from the same source. The glass from Item-3 (Questioned glass fragments recovered from the suspect) and the Item-2 (Known glass fragments recovered from a kitchen cabinet) were consistent and could have originated from the same source. The glass from Item-4 (Questioned glass fragments recovered from the suspect) and the Item-1 (Known glass fragments recovered from the side door) were inconsistent and could not have originated from the same source. The glass from Item-4 (Questioned glass fragments recovered from the suspect) and the Item-2 (Known glass fragments recovered from a kitchen cabinet) were inconsistent and could not have originated from the same source.
9XNTJB	The fragments of the known samples Item 1 and Item 2 differ from each other based on their elemental composition measured by micro-XRF and LA-ICP-MS, and on the RI values measured before and after annealing, as well. The questioned fragments of Item 3 – based on type, color, thickness, elemental composition measured by micro-XRF and LA-ICP-MS, and based on the RI values measured before and after annealing, as well – can most likely originate from the glass represented by known sample Item 2. The questioned fragments of Item 3 – based on elemental composition measured by micro-XRF and LA-ICP-MS, and based on the RI values measured before and after annealing, as well – cannot originate from the glass represented by known sample Item 1. The questioned fragments of Item 4 – based on elemental composition measured by micro-XRF and LA-ICP-MS, and based on the RI values measured before and after annealing, as well – cannot originate from either the glass represented by known sample Item 1, or the glass represented by known sample Item 2.
AE79ZD	There is a very high probability that item 3 has originated from the broken kitchen cabinet (item 2) which was damaged at the crime scene.
BCYDUE	Item 1: Two broken fragments of clear/colorless glass were analyzed for comparison to Items 3 and 4. Item 2: Two broken fragments of clear/colorless glass were analyzed for comparison to Items 3 and 4. Item 3: Two broken fragments of clear/colorless glass were found. The unknown glass (Item 3) either originated from the standard glass (Item 2) from the "kitchen cabinet" or another source of broken glass possessing the same distinct physical, optical, and chemical characteristics. The unknown glass (Item 3) and the standard glass (Item 1) from the "side door" are not the same in optical characteristics (refractive index). The unknown glass could not have originated from the standard glass from the "side door". Item 4: Two broken fragments of clear/colorless glass were found. The unknown glass (Item 4) and the standard glasses (Items 1 and 2) are not the same in physical characteristics (thickness). The unknown glass (Item 4) could not have originated from the standards.
D4UD94	[No Conclusions Reported.]
ECNLR9	On analysis, I found: i) The refractive index of the questioned glass fragments recovered from the suspect (Item 3) to be similar to the refractive index of the known glass fragments recovered from a kitchen cabinet (Item 2) but to be dissimilar to the refractive index of the known glass

TABLE 3

WebCode	Conclusions
	fragments recovered from the side door (Item 1). ii) The refractive index of the questioned glass fragments recovered from the suspect (Item 4) to be dissimilar to the refractive index of the known glass fragments recovered from the side door (Item 1) and the refractive index of the known glass fragments recovered from a kitchen cabinet (Item 2). Therefore, I am of the opinion that: i) The questioned glass fragments recovered from the suspect (Item 3) could have originated from the kitchen cabinet (Item 2) but did not originate from the side door (Item 1). ii) The questioned glass fragments recovered from the suspect (Item 4) did not originate from the side door (Item 1) and the kitchen cabinet (Item 2).
F4R6FA	METHODS: Items 1, 2, 3, and 4 were examined visually and using a digital caliper and ultraviolet light. Items 1, 2, and 3 were further examined using the Glass Refractive Index Measurement system (GRIM3). It should be noted that this examination did not include elemental analysis. RESULTS AND INTERPRETATIONS: The Item 3 glass fragments were consistent with the Item 2 glass in color, thickness, temper, type, and refractive index. Based on the fragments examined, it was concluded that these fragments originated from either the broken glass source represented by Item 2 or another source of broken glass with the same properties (Level III – Association with Discriminating Characteristics). This type of conclusion was reached because other glass sheets or products produced with the same properties would also be indistinguishable. Despite the utilization of discriminating techniques, the chance of finding coincidental associations is higher when no elemental analysis is performed. Based on the fragments examined, the Item 3 glass fragments could not be associated with the Item 1 glass due to differences in refractive index (Exclusion/Elimination). Based on the fragments examined, the Item 4 glass fragments could not be associated with the Item 1 or 2 glass due to differences in thickness (Exclusion/Elimination). Date(s) of testing: 6/11/2026 - 6/12/2026.
FKDTP6	The fragments recovered from the suspect (Item 3) show the same results in all the analyses performed (RI and Thickness) than the known glass fragments recovered from the broken kitchen cabinet (Item 2). The fragments recovered from the suspect (Item 4) show different results in all the analyses performed (RI and Thickness) than the known glass fragments recovered from the broken side door and kitchen cabinet (Item 1 and 2).
G7QZE3	Results of examination/analysis 1. Visual/Microscopic Examination for Characteristics of Glass a. All eight fragments from Laboratory items #1 through 4 were observed to have two parallel original surfaces. b. All eight fragments from Laboratory items #1 through 4 were probed for hardness using metal tweezers and examined for isotropism while mounted in a drop of water. c. All eight fragments from Laboratory items #1 through 4 were found to be hard, isotropic, insoluble in water, and exhibited conchoidal fractures, which are all class characteristics of glass. 2. Comparison a. Examination of Laboratory item #3 (Q1A and Q1B) and comparison to Laboratory item #2 (K2A and K2B) disclosed that they are consistent and no exclusionary differences were observed with respect to color, appearance, thickness, response to UV light, elemental composition, and refractive index. b. Examination of Laboratory item #3 (Q1A and Q1B) and comparison to Laboratory item #1 (K1A and K1B) disclosed that they are different with respect to response to UV light and elemental composition. c. Examination of Laboratory item #4 (Q2A and Q2B) and comparison to Laboratory item #1 (K1A and K1B) disclosed that they are different with respect to thickness and elemental composition. d. Examination of Laboratory item #4 (Q2A and Q2B) and comparison to Laboratory item #2 (K2A and K2B) disclosed that they are different with respect to thickness, response to UV light, and elemental composition. Interpretation of results 1. It is the opinion of the undersigned that Laboratory item #3 (Q1A and Q1B) could have originated from the same source as represented by Laboratory item #2 (K2A and K2B) or from another source exhibiting all of the same analyzed characteristics. 2. It is the opinion of the undersigned that Laboratory item #3 (Q1A and Q1B) could not have originated from the source represented by Laboratory item #1 (K1A and K1B).

TABLE 3

WebCode	Conclusions
	3. It is the opinion of the undersigned that Laboratory item #4 (Q2A and Q2B) could not have originated from the source represented by Laboratory item #1 (K1A and K1B). 4. It is the opinion of the undersigned that Laboratory item #4 (Q2A and Q2B) could not have originated from the source represented by Laboratory item #2 (K2A and K2B). Remarks 1. Evidence was photographed during analysis. 2. No trace materials were observed/collected. 3. Evidence listed on invoice Q201612 was returned to the Evidence Control Section for storage.
GTZ73A	Item 1 (control glass from side door) comprised two fragments of clear, colourless float glass, with original surfaces and an average thickness of 2.23 mm. Item 2 (control glass from kitchen cabinet) comprised two fragments of clear, colourless float glass, with original surfaces and an average thickness of 2.23 mm. Item 3 (recovered from the suspect) comprised two fragments of clear, colourless float glass, with original surfaces and an average thickness of 2.23mm. The fragments corresponded in apparent colour, thickness, average refractive index, and bulk elemental composition to Item 2 and therefore could have originated from the control glass from the kitchen cabinet, as represented by Item 2. The glass fragments in Item 3 differed in refractive index to those of Item 1 and therefore could not have originated from the control glass from the side door, as represented by Item 1. Item 4 (recovered from the suspect) comprised two fragments of clear, colourless float glass, with original surfaces and an average thickness of 1.94 mm. The fragments differed in thickness to those of Item 1 and Item 2 and therefore could not have originated from either of the control glass sources, as represented by Item 1 and Item 2.
HL22NY	Glass recovered from the suspect (Item 3) is indistinguishable from glass from the kitchen cabinet (Item 2). Consequently, the glass from the suspect (Item 3) either originated from the kitchen cabinet (Item 2) or from another source of broken glass indistinguishable in all of the measured or observed physical properties, refractive index, and elemental composition. Glass recovered from the suspect (Item 3) is different from the glass from the side door (Item 1). Consequently, the glass from the suspect (Item 3) did not originate from the same source as the glass from the side door (Item 1). Glass recovered from the suspect (Item 4) is different from the glass from the side door (Item 1) and the kitchen cabinet (Item 2). Consequently, the glass from the suspect (Item 4) did not originate from the same source as the glass from the side door (Item 1) or the kitchen cabinet (Item 2).
JX7MN3	Hypothesis 1: one or more floatglass fragments originate from the broken glass panes Hypothesis 2: all floatglass fragments originate from other broken glass panes The results of the examination are much more likely (approximately 10000) if Hypothesis 1 is true than if hypothesis 2 is true.
KBT983	The questioned glass fragments in Exhibits 3 and 4 (recovered from the suspect) were compared to the known glass fragments in Exhibit 1 (known glass from the side door) and Exhibit 2 (known glass from the kitchen cabinet). The glass fragments in Exhibit 2 and the glass fragments in Exhibit 3 are clear, colorless glass. No physical fit was found between these glass fragments, however, comparative examinations by visual and microscopical techniques, refractive index, and elemental composition determined that they could not be differentiated. Therefore, the questioned glass from the suspect in Exhibit 3 originated from the same source as the glass fragments from the kitchen cabinet in Exhibit 2 or another source of broken glass indistinguishable in the measured properties (Type III Inclusion). This type of association was reached because these combined techniques have shown to be discriminating between glass sources. It should be noted that glass fragments can only originate from broken objects and not intact ones. The glass fragments in Exhibit 3 differ in physical characteristics and elemental composition from the glass in Exhibit 1. Therefore, the glass source represented as Exhibit 1 is not the source of Exhibit 3 (Exclusion). The glass fragments in Exhibit 4 differ in physical

TABLE 3

WebCode	Conclusions
	characteristics and elemental composition from the glass in Exhibits 1 and 2. Therefore, the glass sources represented as Exhibit 1 and Exhibit 2 are not the source of Exhibit 4 (Exclusion).
KEC3BV	It is possible that item 3 originated from the kitchen cabinet (item 2), since we cannot distinguish these two kinds of glass based on refractive index and elemental analysis. Based on the analysis we have carried out, it can be definitively ruled out that item 4 could have originated from item 1 or 2.
KYV8UY	The glass fragments were examined by using refractive index measurement and elemental analysis (Micro-XRF - Bruker M4). Item 3, recovered from the suspect is in its refractive index and its elemental composition not distinguishable from the Item 2, recovered from the kitchen cabinet. Therefore, it is very likely that the glass fragments Item 2 and Item 3 have their origin in the same body of glass. Item 4, recovered from the suspect is in its refractive index and its elemental composition clearly distinguishable from the Item 1 and Item 2, both recovered from the crime scene. Therefore, Item 4 can't share the same origin with Item 1 respective Item 2
KZQQWZ	1. In my opinion, the pieces of glass 'Item 3' recovered from the suspect could have originated from the kitchen cabinet 'Item 2'. For these pieces of glass to have originated from a different source, this alternative source would have to be similar in terms of appearance, manufacturing process, thickness, refractive index and thermal history, to the control glass sample taken from the kitchen cabinet 'Item 2'. 2. The pieces of glass 'Item 3' recovered from the suspect could not have originated from the side door 'Item 1'. 3. The pieces of glass 'Item 4' recovered from the suspect could not have originated from either the side door 'Item 1' or the kitchen cabinet 'Item 2'.
LFFHWR	The results give support for the hypothesis that the two pieces of glass in Item 3, from the suspect, originate from the broken kitchen cabinet represented by Item 2 (Level +2). The results give extremely strong support for the hypothesis that the two pieces of glass in Item 3, from the suspect, do not originate from the broken door represented by Item 1 (Level -4). The two pieces of glass in Item 4 do not originate from the broken door represented by Item 1 nor from the broken kitchen cabinet represented by Item 2 (exclusion).
LQZRHZ	The glass findings provide moderately strong support for the view that the matching glass recovered from the suspect (Item 3) originated from the kitchen cabinet (Item 2), rather than it originated from another source. No inference on the activity that led to the presence of glass can be made. The questioned glass fragments from Item 4 did not originate from Item 1 or Item 2. These fragments originated from at least one other source.
LRGNBY	In my opinion, the findings show that item 1, glass from the side door, and item 2, glass from the kitchen cabinet, were distinguishable to each other in refractive index values. In relation to Item 3 - In my opinion, the findings provide strong support for the proposition that the glass under consideration originated from the broken kitchen cabinet. In relation to Item 4 - In my opinion, the findings show that the glass under consideration did not originate from the broken kitchen cabinet or broken side door.
MBND23	The glass from Item 3 was found to be similar in thickness, elemental composition, and refractive index in comparison to the glass from Item 2 (standard) and could have originated from the same source of glass as Item 2 or from any other source of glass with similar thickness, elemental composition, and refractive index. The glass from Item 3 was found to be similar in thickness but different in elemental composition in comparison to the glass from Item 1 (standard) and could not have originated from the same source of glass as Item 1. The glass from Item 4 was found to be different in thickness and elemental composition in comparison to the glass from Item 1 (standard) and Item 2 (standard) and could not have originated from the same source of glass as Item 1 and Item 2. Items 1, 2, 3, and 4 were examined visually and using stereomicroscopy, UV fluorescence, Polarized Light Microscopy (PLM), a digital caliper,

TABLE 3

WebCode	Conclusions
	X-Ray Fluorescence spectroscopy (XRF), and Glass Refractive Index Measurement system (GRIM III). Samples analyzed in this case have been returned to and retained with the original items.
MXEXUW	Results: Based on the analysis of triplicate 1-4 mg portions of glass fragments by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) the concentrations of 6 elements in Item 3 were distinguishable from the concentration of those elements in Item 1. The concentrations of 5 elements in Item 4 were distinguishable from the concentration of those elements in Item 1. Based on the analysis of triplicate 1-4 mg portions of glass fragments by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) the concentrations of 44 elements in Item 3 were not distinguishable from the concentration of those elements in Item 2. The concentrations of 6 elements in Item 4 were distinguishable from the concentration of those elements in Item 2. Opinions/Interpretations: Based on the results Item 3 could not have originated from the same source as Item 1, but could have originated from the same source as Item 2. Based on the results Item 4 could not have originated from the same source as Item 1 or 2.
N9EKL	The two fragments recovered from the suspect (item 4) did not match in all investigated features with the fragments from the side door (item 1) and with the fragments recovered from a kitchen cabinet (item 2). That means the glass fragments from item 4 and the glass fragments from the victims kitchen (item 1 and 2) do not have the same source. The questioned glass fragments recovered from the suspect (item 3) and the known glass fragments from the kitchen cabinet (item 2) matched in nD, in UV-Fluorescence, in color, in thickness and in chemical composition. It means that glass fragments from the suspect (item 3) and from the kitchen cabinet (item 2) may have the same source. The questioned glass fragments recovered from the suspect (item 3) and the known glass fragments from the side door (item 1) did not match in nD and in UV-Fluorescence. It means that glass fragments of item 3 and of item 1 may not have the same source.
NG67RR	In conclusion, the fragments from Item 1, 2, 3 and 4 were identified as fragments of clear, colourless soda-lime sheet glass. The fragments from Items 1, 2 and 3 appeared to have broken from a sheet with an original thickness of 2.20 mm. The fragments from Item 4 had an original thickness of 1.95 mm. Due to the thickness of Item 4, it wouldn't have originated from the source of Item 1 or Item 2. Item 3 is consistent with Item 1 and Item 2 in pane thickness and share similarities in elemental composition; however, Item 1 contained a higher level of magnesium and a lower level of sodium than that detected in Item 3, whereas the levels of these elements were comparable in Item 2 and Item 3. As a result, Item 2 was a more likely source of Item 3.
NPYEBX	The questioned glass fragments from Item 4 are float glasses and have a thickness of around 1.92 mm. The glass differs in its thickness, refractive index and in its elemental composition from Item 1 and from Item 2. The questioned glass fragments from Item 3 and the known glass fragments from Item 2 are both float glasses, have both a thickness of around 2.21 mm and cannot be differentiated by their refractive indices and their elemental composition. The questioned glass fragments from Item 3 could have originated from the broken kitchen cabinet, but not from the broken side door.
NTYMG	The two fragments of questioned glass recovered from the suspect (Item 3) have not the same physical properties (refractive index) to the two fragments of known glass recovered from the side door (Item 1). The two fragments of questioned glass recovered from the suspect (Item 4) have not the same physical properties (Thickness, refractive index) to the two fragments of known glass recovered from side door (Item 1). The two fragments of questioned glass recovered from the suspect (Item 3) have the same physical properties (Thickness, colour, fluorescence, refractive index) to the two fragments of known glass recovered from a kitchen

TABLE 3

WebCode	Conclusions
	cabinet (Item2), therefore, the two fragments of questioned glass recovered from the suspect (Item3) could have originated from the glass recovered from a kitchen cabinet (Item2) or from another source exhibiting the same physical properties. The two fragments of questioned glass recovered from the suspect (Item4) have not the same physical properties (Thickness, refractive index) to the two fragments of known glass recovered from a kitchen cabinet (Item2).
NW3HZW	The glass fragments from all four items look visually similar. Based on elemental composition, thickness, and response to shortwave UV light the glass fragments from Item 3 and Item 4 could not have originated from Item 1. However, Item 3 is a good match for Item 2 and the possibility exists that Item 3 could have originated from Item 2.
PD2UAX	Based on our analysis the questioned fragments from the suspect (Item 3) could not be differentiated from the reference material from the kitchen cabinet (Item 2). But item 3 can be clearly distinguished from the fragments of the side door (item 1). The questioned fragments from the suspect (Item 4) could be clearly distinguished from both reference materials (Item 1 & 2), as well as from the other fragments of the suspect (item 3). The fragments from item 4 originate from another unknown source.
PD4KDU	The questioned glass in item 3 was indistinguishable from the control glass sample in item 2 in terms of the tests employed. In my opinion, the results of this examination indicate the questioned glass in item 3 could have originated from the control source represented by item 2. The questioned glass in item 3 could not have originated from the control source represented by item 1. The questioned glass in item 4 was distinguishable from the control glass samples in items 1 and 2 in terms of the tests employed. The results of this examination indicate the questioned glass in item 4 could not have originated from the control sources represented by items 1 and 2.
PHYEBV	The Interpretations & Opinions stated below are based solely on the representative samples analyzed. Examination and comparison of representative samples in Items 2 & 3 were found to be clear glass that was similar in all measured physical, microscopic, and optical properties and elemental composition. They could have come from the same source or any other source with the same properties and composition. Examination and comparison of representative samples in Items 1, 2 & 4 were found to be clear glass that was dissimilar in physical and optical properties. They could not have come from the same source. Examination and comparison of representative samples in Items 1 & 3 were found to be clear glass that was dissimilar in physical and optical properties. They could not have come from the same source.
PUTRBR	Item 3 could have originated from Item 2 Item 4 could not have originated from Item 1 & Item 2
PYYL6N	Glass fragments from Item 3 were compared to the known glass samples from Item 1 (side door) and Item 2 (kitchen cabinet). The results indicate that the fragments in Item 3 are analytically consistent with the fragments from Item 1 and Item 2 and could have originated from the same source. Glass fragments from Item 4 were also compared to the known glass samples from Items 1 and 2. Differences were observed between Item 4 and both known glass sources. Therefore, Item 4 is excluded as having originated from either the side door (Item 1) or the kitchen cabinet (Item 2). The results provide support for the proposition that Item 3, collected from the suspect, could have originated from the same sources as Item 1 and Item 2. However, this does not rule out any other potential sources of glass with similar analytical properties. Overall, the findings indicate that the suspect may have been in contact with glass that was recovered from both the shattered side door and the broken kitchen cabinet at the crime scene.
RGDGW2	The known glass sample in Item 1 was comprised of two colourless glass fragments of identical thickness. The known glass sample in Item 2 was comprised of two colourless glass fragments

TABLE 3

WebCode	Conclusions
	of identical thickness. The questioned glass fragments in Item 3 were found to agree in colour, thickness, UV fluorescence, elemental composition and refractive index with the known glass fragments in Item 2, but differ in refractive index from the known glass fragments in Item 1, indicating that the questioned glass fragments in Item 3 could have originated from the same source as the known glass fragments in Item 2, but did not originate from the same source as the known glass fragments in Item 1. The questioned glass fragments in Item 4 were found to differ in thickness and refractive index with the known glass fragments in Items 1-2, indicating that the questioned glass fragments in Item 4 did not originate from the same source as the known glass fragments in Items 1-2.
RVDHBN	The questioned glass fragments recovered from suspect (item 3) could be originated from the glass fragments recovered from the kitchen cabinet. (item 2). The questioned glass fragments recovered from suspect (item 4) could not have been originated from the glass fragments recovered from the side door. (item 1). The questioned glass fragments recovered from suspect (item 4) could not have been originated from the glass fragments recovered from kitchen cabinet. (item 2).
RYCU8M	In my opinion, the findings provide no support for or against the proposition that the suspect broke the side door glass window. In my opinion, the findings provide moderately strong support for the proposition that the suspect broke the glass kitchen cabinet, rather than did not.
TXVZ4R	The analysis revealed that the measured properties of the questioned glass samples of Item 3 and Item 4 are dissimilar from the known glass of Item 1, therefore, the questioned glass of Item 3 and Item 4 could not have originated from that source. Further analysis revealed that the measured properties of the questioned glass sample of Item 4 are dissimilar from the known glass sample of Item 2, therefore, the questioned glass of Item 4 could not have originated from that source. The measured properties of the questioned glass sample of Item 3 are the same as those of the known glass of Item 2. It is concluded that Item 2 and Item 3 may share a common source.
UHX8WW	The known glass fragments from the side door (item 1) and the known glass fragments from the kitchen cabinet (item 2) were found to have different refractive indices and therefore could be differentiated based on this property. In relation to colour, thickness, refractive index, fluorescent properties and elemental composition, the questioned glass fragments recovered from the suspect (item 3) and the known glass fragments from the kitchen cabinet (item 2) were found to be indistinguishable. Therefore, these two glass samples may share a common origin. The questioned glass fragments recovered from the suspect (item 4) were found to have a different thickness and refractive index to either of the known glass samples (items 1 & 2) and therefore, could not have originated from either of those sources.
UXE3CT	The questioned glass fragments marked "Item 3", recovered from the suspect, were found: a) To have no exclusionary difference with the known glass fragments marked "Item 2", recovered from the kitchen cabinet, in terms of colour, fluorescence, thickness, refractive index and trace elemental composition. Hence, the questioned glass fragments marked "Item 3" were very likely to have originated from the same source as the known glass fragments marked "Item 2"; other sources of glass with similar characteristics are limited. b) To be different from the known glass fragments marked "Item 1", recovered from the side door, in terms of trace elemental composition and refractive index. Hence, the questioned glass fragments marked "Item 3" did not originate from the same source as the known glass fragments marked "Item 1". The questioned glass fragments marked "Item 4", recovered from the suspect, were found to be different from the known glass fragments marked "Item 1" and "Item 2", recovered from the side door and kitchen cabinet, respectively, in terms of trace elemental composition and

TABLE 3

WebCode	Conclusions
	refractive index. Hence, the questioned glass fragments marked "Item 4" did not originate from the same sources as the known glass fragments marked "Item 1" and "Item 2".
V6PPZM	Based on the SEM/EDS analysis, it is concluded that Item 3 can be excluded as having originated from item 1, but cannot be excluded as having originated from item 2, based on Na and Mg values. Item 4 can be excluded as having originated from either of items 1 or 2, as C and Na differs. FTIR analysis results were consistent with the SEM/EDS findings.
VAY3HL	Glass recovered from the suspect as represented by Item 3 is indistinguishable from glass recovered from the kitchen cabinet as represented by Item 2. Accordingly, the Item 3 glass fragments either originated from the kitchen cabinet, or from another source of broken glass indistinguishable in all of assessed physical characteristics, refractive index, and elemental composition. See "Inclusion with Elemental Composition Examination" in the Interpretation Section, below. Glass recovered from the suspect as represented by Item 3 is different from the glass recovered from the side door as represented by Item 1. Therefore, the Item 3 glass fragments are eliminated as originating from the side door as represented by Item 1. See "Exclusion" in the Interpretations section below. Glass recovered from the suspect as represented by Item 4 is different from the glass recovered from the side door as represented by Item 1 and the glass recovered from the kitchen cabinet as represented by Item 2. Therefore, the Item 4 glass fragments are eliminated as originating from the side door as represented by Item 1 and the kitchen cabinet as represented by Item 2. See "Exclusion" in the Interpretations section below.
VNJMZU	Visual and microscopic examination of exhibits Item 1, Item 2, Item 3, and Item 4 revealed the presence of multiple fragments confirmed as glass. Physical, microscopic, and instrumental analysis and comparison of the glass from Item 3 to the glass from Item 2 revealed them to be the same with respect to physical properties, optical properties, and elemental composition. This is an association with highly discriminating characteristics. Therefore, the glass recovered from the subject (Item 3) came from the broken kitchen cabinet in the victim's residence or another source of broken glass with identical physical properties, optical properties, and elemental composition. The glass from the broken kitchen cabinet in the victim's residence (Item 2) was excluded as a possible source of the glass from the subject (Item 4) based on differences in optical properties. The glass from the broken side door in the victim's residence (Item 1) was excluded as a possible source of the glass from the subject (Item 3, Item 4) based on differences in optical properties. Results were confirmed using the following instrumentation: polarized light microscope, digital calipers, glass refractive index measurement system, and inductively coupled plasma mass spectrometer.
WJ4AXL	Item 2 is only identical with Item 3. Item 1 is not identical to any other Item.
WKEE9N	The Item 4 questioned fragments from the suspect differed in thickness from the known fragments recovered from the side door and kitchen cabinet (Items 1 and 2). In the opinion of the examiner, the Item 4 questioned fragments from the suspect did not originate from the side door or kitchen cabinet as represented by Items 1 and 2. (Exclusion) The Item 3 questioned fragments from the suspect differed in elemental composition from the known fragments recovered from the side door (Item 1). In the opinion of the examiner, the Item 3 questioned fragments from the suspect did not originate from the side door represented by Item 1. (Exclusion) The Item 3 questioned fragments from the suspect were similar in all tests performed to the known glass fragments from the kitchen cabinet (Item 2). In the opinion of the examiner, the Item 3 questioned fragments from the suspect originated either from the kitchen cabinet represented by Item 2 or from another source with indistinguishable properties. (Association with Highly Discriminating Characteristics)
X4L4YR	Two glass fragments (Item 3) are similar in visual color, thickness, fluorescence, and elemental

TABLE 3

WebCode	Conclusions
	composition to the glass fragments from the kitchen cabinet (Item 2). It is our opinion that these glass fragments could share a common origin to the glass fragments from the kitchen cabinet. Please note refractive index comparison between the glass fragments recovered from the suspect and the glass fragments recovered from the kitchen cabinet cannot be performed by our laboratory at this time. Additionally, these glass fragments are dissimilar in thickness to the glass fragments from the side door (Item 1). It is our opinion that these glass fragments did not originate from the glass fragments from the side door. Two glass fragments (Item 4) are dissimilar in thickness to the glass fragments from the side door (Item 1) and the kitchen cabinet (Item 2). It is our opinion that these glass fragments did not originate from the glass fragments from the side door or the kitchen cabinet. Items 1 and 2 were used as a comparison standard.
Y6F9TQ	Microscopic and instrumental analysis and comparison of the glass from Item 3 to the glass from Item 2 revealed them to be the same with respect to physical properties, optical properties, and elemental composition. This is an association with highly discriminating characteristics. Therefore, the glass from Item 3 came from the source represented by the glass from Item 2 or another source of broken glass with identical physical properties, optical properties, and elemental composition. The glass from Item 2 was excluded as a possible source of the glass from Item 4 based on differences in optical properties. The glass from Item 1 was excluded as a possible source of the glass from Item 3 and Item 4 based on differences in optical properties. Results were confirmed by the following instrumentation: polarizing light microscope, digital calipers, glass refractive index measurement system, and inductively coupled plasma mass spectrometer.
ZVPMR	The known glasses and questioned glasses were examined by stereomicroscopy, glass refractive index measurement and micro X-ray fluorescence spectrometry, as appropriate. The known glass from the kitchen cabinet (item 2) and the questioned glass from the suspect (item 3) exhibit the same physical, optical, microscopic, and chemical properties. Therefore, the questioned glass from the suspect (item 3) originated from the kitchen cabinet or another broken glass with the same physical, optical, microscopic, and chemical properties. The known glass from the kitchen cabinet (item 2) and the questioned glass from the suspect (item 4) have different physical properties. Therefore, the questioned glass from the suspect (item 4) could not have originated from the kitchen cabinet. The known glass from the side door (item 1) and the questioned glass from the suspect (item 4) have different physical properties. The known glass from the side door (item 1) and the questioned glass from the suspect (item 3) have different chemical properties. Therefore, the questioned glasses from the suspect (items 3 and 4) could not have originated from the side door.

Additional Comments

TABLE 4

WebCode	Additional Comments
3KGU9H	Item 1 and Item 2 was found to be similar in composition and thickness
3NWLWP	Instead of having two 'recovered' items, the glass from the two 'questioned' items could be included in one item to more closely resemble real casework Items that can include glass from multiple sources.
78FP7L	This laboratory does not conduct elemental analysis. Further discrimination may be possible between items 1 and item 3.
88W7ZE	In routine casework involving glass microtraces, we use SEM–EDX supported by likelihood ratio (LR) analysis. If only the SEM–EDX results were considered, the LR values would indicate a common origin for Item 1 and Item 4, as well as for Item 2 and Item 3. In the CTS test, the fragments provided are sufficiently large for their thickness to be measured. We do not analyse such large glass fragments in routine casework, particularly those recovered from the suspect. The measurements showed that Item 1, Item 2 and Item 3 had similar thicknesses (ca. 2.2 mm), whereas Item 4 differed in thickness (ca. 1.9 mm). However, we do not know whether this difference is significant, or how significant it is, particularly in the case of Item 1 and Item 4, which show similarities based on the SEM–EDX results. Nevertheless, taking into account the observed difference in thickness between Item 1 and Item 4, the fact that the LR obtained from the SEM–EDX measurements provides relatively weak support for the proposition that they share a common origin, and the principle that a false-negative error is preferable to a false-positive one, it was concluded that Item 1 and Item 4 should be regarded as different.
8CQ3MK	Items 1, 2, 3 and 4 were examined macroscopically, by stereomicroscopy, ultraviolet fluorescence, a micrometer for thickness measurements, x-ray fluorescence spectrometry and scanning electron microscopy/energy dispersive x-ray spectroscopy.
KZQQWZ	1. The pieces of glass 'Item 3', recovered from the suspect were similar in terms of appearance, manufacturing process, thickness, refractive index and thermal history, to the control glass sample taken from the kitchen cabinet 'Item 2'. 2. The pieces of glass 'Item 3' recovered from the suspect were different in terms of refractive index from the control glass sample taken from the side door 'Item 1'. 3. The pieces of glass 'Item 4' recovered from the suspect were different in terms of thickness from the control glass samples taken from the side door 'Item 1' and the kitchen cabinet 'Item 2'.
LFFHWR	Item 4 was excluded due to difference in thickness.
LQZRHZ	The Control glass samples submitted did not have enough glass pieces to allow for a thorough evaluation. It would be preferable to have 4 pieces of glass for each control. As there is no timeline listed for the recovery of the suspect's clothing after the incident, nor are there details regarding the retentive properties of the clothing, the findings cannot be evaluated at activity level. A higher support level could likely have been reported if the results were evaluated at activity level rather than source level.
PD2UAX	The fragments from item 4 have a different (lower) thickness than the fragments of item 1 to 3, which have the same thickness.
RYCU8M	Strength of support decided on due to lack of information and availability of debris from clothing etc.
V6PPZM	EDS analysis noted that C ranges within the samples, but due to the samples being mounted on Carbon adhesive tab, the C is not a reliable comparison due to the influence from the underlying C-tabs.

-End of Report-
(Appendix may follow)

Test No. 26-5481: Glass Analysis

DATA MUST BE SUBMITTED BY **Aug. 03, 2026, 11:59 p.m. EDT** TO BE INCLUDED IN THE REPORT

Participant Code: U1234A

WebCode: DQQUVH

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 breaking-and-entering case. The victim claims that a man attacked him in his kitchen, where he shattered the side door and a kitchen cabinet. Later that same night, police apprehended a suspect and recovered glass fragments similar to those collected at the crime scene. Investigators are asking you to compare the glass fragments recovered from the suspect to those recovered from the shattered side door and cabinet, and to report your findings.

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: Known glass fragments recovered from the side door.

Item 2: Known glass fragments recovered from a kitchen cabinet.

Item 3: Questioned glass fragments recovered from the suspect.

Item 4: Questioned glass fragments recovered from the suspect.

1.) Could the questioned glass fragments recovered from the suspect (Item 3 and Item 4) have originated from either the side door and/or kitchen cabinet as represented by Item 1 and Item 2?

	<u>Item 1</u>		
	Yes	No	Inconclusive
Item 3:	☐	☐	☐
Item 4:	☐	☐	☐

	<u>Item 2</u>		
	Yes	No	Inconclusive
Item 3:	☐	☐	☐
Item 4:	☐	☐	☐

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

<u>Refractive Index:</u>		<u>UV Fluorescence:</u>		
☐ nD	☐ nC	☐ Long	☐ Color	☐ Thickness
☐ nF	☐ Δ RI	☐ Short	☐ Density	
<u>Elemental Analysis:</u>				
☐ SEM/EDS	☐ XRS/XRF			
Other:				

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

Note: Please use appropriate punctuation to indicate the end of sentences, sections, and statements in the free-form space below. Extra spacing and returns used for separation within your text will not transfer and may cause your information to be illegible in the Summary Report. The use of lists and tabular formats to deliver information is also cautioned against, as these do not transfer.

4.) Additional Comments

Note: Please use appropriate punctuation to indicate the end of sentences, sections, and statements in the free-form space below. Extra spacing and returns used for separation within your text will not transfer and may cause your information to be illegible in the Summary Report. The use of lists and tabular formats to deliver information is also cautioned against, as these do not transfer.

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

A2LA Certificate No.

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

Authorized Contact Person and Title

Laboratory Name

Location (City/State)