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FORENSIC TESTING PROGRAM

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Paint Analysis
Test No. 22-5451 Summary Report

Each sample set consisted of one item containing a known paint sample and two items containing questioned paint chips. Participants were requested to compare the items and report their findings. Data were returned from 69 participants and are compiled in 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 items with layered paint and primer: one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from painted poplar wood plank substrates. Items 1 and 2 came from a plank with the same primer and topcoat. Item 3 was prepared with a different primer but the same topcoat as Items 1 and 2. Participants were instructed to examine the questioned samples and determine if they could have originated from the known paint sample.

SAMPLE PREPARATION:
All planks used for this test were selected based on their limited defects and were wiped down to remove dust before painting. For the following preparations, each coat was allowed to dry overnight before applying the next coat.

ITEMS 1 and 2 (ASSOCIATION): The known Item 1 and questioned Item 2 samples were prepared by applying two coats of primer (KILZ® Original Oil-Based Interior Primer, white) to several poplar wood planks. Then two layers of topcoat (Glidden™ Premium Satin Interior Paint and Primer, Silver Charm) were applied. The known Item 1 planks were cut into 1" x 2.5" pieces using a miter saw. One of these pieces was packaged into a glassine bag and then into a pre-labeled Item 1 envelope. For Item 2, paint samples were scored into squares that were approximately ¼" x ¼" and removed. Two ¼" x ¼" pieces were packaged into a glassine bag and then into a pre-labeled Item 2 envelope. Items 1 and 2 were taken in close spatial proximity to one another, kept together as a group, and packaged into the sample sets as described below.

ITEM 3 (ELIMINATION): Item 3 was prepared by applying two coats of primer (Behr® Interior/Exterior Multi-Surface Water-Based Primer, White) to one poplar wood plank. Then two layers of topcoat (Glidden™ Premium Satin Interior Paint and Primer, Silver Charm) were applied. The plank was scored into squares that were approximately ¼" x ¼"and were removed using a utility knife. Two ¼" x ¼" pieces were packaged into a glassine bag and then into a pre-labeled Item 3 envelope.

SAMPLE SET ASSEMBLY: For each sample set, Items 1 and 2 were taken from the same batch and placed in a pre-labeled envelope along with an Item 3 sample. The sample pack was sealed with invisible tape and this process was repeated until all of the sample sets were prepared. Once verification was completed, all sample packs were further sealed with a piece of evidence tape and initialed "CTS".

VERIFICATION:
The expected association results were confirmed by predistribution laboratories who used the following combined list of techniques: FTIR, Solubility/Chemical, Fluorescence, XRS/XRF, PGC/MS, and Stereomicroscope.

Summary Comments

This test was designed to allow participants to assess their proficiency in the examination, comparison, and interpretation of multi-layered architectural paint samples. Each sample set consisted of three items with layered paint and primer; one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from painted poplar wood plank substrates. Items 1 and 2 originated from a poplar wood plank substrate with the same primer and topcoat. Item 3 originated from a second poplar wood plank substrate that was prepared with the same topcoat used to prepare Items 1 and 2 but a different primer. (Refer to Manufacturer's Information for preparation details.)

Of the 69 participants that reported examination results in Table 1, 67 (97%) reported that the Item 2 questioned paint chips could have originated from the same source as the Item 1 known paint sample, and the remaining two participants reported that Item 2 could not have originated from the Item 1 known paint sample. For the Item 3 questioned paint chips, 68 (98%) participants reported that Item 3 could not have originated from the same source as the Item 1 known paint sample, and the last participant reported it could have originated from Item 1.

The most commonly reported methods of analysis were Stereomicroscope (100%), FTIR (99%), and SEM/EDX (59%).

Examination Results

Could the questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) and/or inside the trunk of the suspect's car (Item 3) have originated from the damaged area of the victim's back door as represented by Item 1?

TABLE 1

	Item 1			Item 1	
WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
32CUBD	Yes	No	AQMBW7	No	No
3G2YJ8	Yes	No	AZUB78	Yes	No
3LWTG9	Yes	No	B22MPU	Yes	No
3TX6C6	Yes	No	BFKBX8	Yes	No
4R4GUA	Yes	No	BJJNKW	Yes	No
6DW7JT	Yes	No	BTQL4U	Yes	No
84JXQW	Yes	No	CPLF3T	Yes	No
8NNFZX	Yes	No	E34P24	Yes	No
8ZHUYA	Yes	No	E7JGTW	Yes	No
94YG99	No	No	EFRUAZ	Yes	No
9GH4H7	Yes	No	EK6U7R	Yes	No
9RGYF2	Yes	No	FMRNPD	Yes	No
9UTEA3	Yes	No	G86X4G	Yes	No
A96CR9	Yes	No	GJ3JNU	Yes	No

TABLE 1

Item 1			Item 1		
WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
GQ4TZD	Yes	No	QFA2ZQ	Yes	No
HN77EZ	Yes	No	QLDXR4	Yes	No
JJXXVB	Yes	No	R98CYD	Yes	No
K29GXR	Yes	No	RBULE7	Yes	No
KAMWAA	Yes	No	RF3ALF	Yes	No
KFPAMY	Yes	No	RLRR2C	Yes	No
KJPKHY	Yes	No	RQQ444	Yes	No
L982ZM	Yes	No	RVJ8QG	Yes	No
LZU629	Yes	No	TDCB8G	Yes	No
METG4K	Yes	No	V2XUDG	Yes	No
MXLAVA	Yes	No	VTK3NJ	Yes	No
PBHC6T	Yes	No	W2RZ8G	Yes	Yes
PT29KM	Yes	No	W3LNQC	Yes	No
PT6NZ9	Yes	No	W9TGHL	Yes	No
Q99P7F	Yes	No	WHH6FA	Yes	No
Q9CCJM	Yes	No	WLGGBA	Yes	No

TABLE 1

	Item 1	
WebCode	Item 2	Item 3
X4TMZB	Yes	No
XCLXA7	Yes	No
XKYRP9	Yes	No
XU32UD	Yes	No
Y3EDTW	Yes	No
YETF7G	Yes	No
YRUB6A	Yes	No
ZFG9JC	Yes	No
ZYC24A	Yes	No

	Item 1	
WebCode	Item 2	Item 3

Examination Response Summary **Participants: 69**

Responses	Item 1 Item 2	Item 1 Item 3
Yes	**67** *(97.1%)*	**1** *(1.4%)*
No	**2** *(2.9%)*	**68** *(98.6%)*
Inc	**0** *(0%)*	**0** *(0%)*

Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
32CUBD	✓				✓	✓				
3G2YJ8	✓			✓	✓					
3LWTG9	✓				✓				✓	
3TX6C6	✓				✓	✓			✓	
4R4GUA	✓	✓			✓	✓			✓	Pyrolysis GC/MS
6DW7JT	✓			✓	✓				✓	
84JXQW	✓		✓		✓				✓	
8NNFZX	✓				✓			✓		
8ZHUYA	✓			✓	✓					
94YG99	✓				✓					
9GH4H7	✓				✓				✓	
9RGYF2	✓				✓				✓	
9UTEA3	✓				✓					
A96CR9	✓	✓	✓		✓					
AQMBW7	✓									
AZUB78	✓				✓	✓				
B22MPU	✓	✓	✓		✓				✓	
BFKBX8	✓	✓	✓	✓	✓					
BJJNKW	✓				✓					
BTQL4U	✓	✓			✓		✓		✓	
CPLF3T	✓				✓				✓	Raman (780 nm laser)
E34P24	✓				✓	✓				
E7JGTW	✓				✓					
EFRUAZ	✓				✓			✓	✓	
EK6U7R	✓			✓	✓					
FMRNPD	✓		✓		✓	✓		✓		

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
G86X4G	✓		✓		✓			✓		
GJ3JNU	✓	✓	✓		✓					
GQ4TZD	✓	✓		✓	✓				✓	
HN77EZ	✓				✓	✓	✓			
JJXXVB	✓	✓			✓				✓	
K29GXR	✓				✓			✓	✓	Raman Spectroscopy, LIBS
KAMWAA	✓			✓	✓				✓	
KFPAMY	✓				✓					
KJPKHY	✓				✓					
L982ZM	✓		✓		✓	✓			✓	
LZU629	✓				✓				✓	
METG4K	✓		✓		✓	✓			✓	
MXLAVA	✓				✓		✓		✓	
PBHC6T	✓				✓				✓	
PT29KM	✓			✓	✓				✓	
PT6NZ9	✓				✓				✓	
Q99P7F	✓				✓	✓				
Q9CCJM	✓				✓			✓	✓	
QFA2ZQ	✓				✓					
QLDXR4	✓	✓	✓	✓	✓		✓		✓	
R98CYD	✓	✓	✓		✓				✓	
RBULE7	✓		✓	✓	✓				✓	
RF3ALF	✓				✓		✓		✓	
RLRR2C	✓	✓			✓					
RQQ444	✓				✓				✓	Raman
RVJ8QG	✓	✓			✓	✓				
TDCB8G	✓			✓	✓				✓	

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
V2XUDG	✓			✓	✓	✓			✓	
VTK3NJ	✓			✓	✓				✓	
W2RZ8G	✓	✓	✓		✓					RAMAN
W3LNQC	✓		✓		✓	✓			✓	
W9TGHL	✓				✓					
WHH6FA	✓		✓		✓	✓			✓	
WLGGBA	✓	✓			✓	✓			✓	
X4TMZB	✓			✓	✓				✓	
XCLXA7	✓				✓			✓		
XKYRP9	✓				✓				✓	
XU32UD	✓			✓	✓				✓	
Y3EDTW	✓	✓		✓	✓	✓			✓	
YETF7G	✓	✓			✓					
YRUB6A	✓		✓	✓	✓				✓	
ZFG9JC	✓				✓				✓	
ZYC24A	✓			✓	✓		✓		✓	

Response Summary **Total Participants: 69**

	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	Microspectrophotometry	XRF/XRS	SEM/EDX
Participants	69	16	16	18	68	16	6	7	41
Percent	*100%*	*23%*	*23%*	*26%*	*99%*	*23%*	*9%*	*10%*	*59%*

Conclusions

TABLE 3

WebCode	Conclusions
32CUBD	On analysis, I found the questioned paint chips recovered from the suspect's hooded sweatshirt 'Item 2', is similar to known sample representative of the damaged area of the victim's back door 'Item 1'. I also found that the questioned paint chips recovered from the inside of the suspect's car trunk 'Item 3' is not similar to known sample representative of the damaged area of the victim's back door 'Item 1'.
3G2YJ8	All items are consisted with gray-top and white-bottom layer. FT-IR and Pyrolysis GC-MS shows that gray layers of each item are same. FT-IR and Pyrolysis GC-MS shows that white layers from item 1 and item 2 are same. But white layer of item 1 and item 3 are different. Item 2 is originated from item 1. The layer structure and composition of item 1 paint is the same as item 2. item 3 differs from item 1 in some constituent.
3LWTG9	All layers of item 2 matched item 1. The primer layer of item 3 did not match item 1. Top layers matched.
3TX6C6	Items 1, 2, and 3 were examined visually and microscopically and were observed to have the following layer sequence: gray over white. The known paint from the door (item 1), the questioned paint from the suspect's hooded sweatshirt (item 2), and the questioned paint from the suspect's car (item 3) were then examined by solubility/microchemical tests, infrared spectroscopy, and scanning electron microscopy with energy dispersive x-ray analysis. The known paint (item 1) and the questioned paint from the suspect's hooded sweatshirt (item 2) were found to be consistent with respect to color, layer, sequence, physical and chemical properties and composition. Based on these findings, items 1 and 2 could have originated from the same source or any other source exhibiting the same analyzed characteristics. The known paint (item 1) and the questioned paint from the suspect's car (item 3) were found to differ with respect to physical and chemical properties and composition. Based on these findings, items 1 and 3 could not have originated from the same source.
4R4GUA	Item 1 was used for comparison to Items 2 and 3. The paint in Item 2 is similar in color, layer sequence, and chemical composition to the paint in Item 1; therefore, the paint in Item 2 could have originated from the same source as the paint in Item 1. The paint in Item 3 is similar in color and layer sequence but dissimilar in chemical composition to the paint in Item 1; therefore, the paint in Item 3 did not originate from the same source as the paint in Item 1.
6DW7JT	The sample of paint from the victim's damaged back door (item 1), the sample of paint from the suspect's hooded sweatshirt (item 2) and the sample of paint from inside the trunk of the suspect's car (item 3), all consisted of a grey paint layer on a white paint layer. I have compared the paint samples by their elemental and chemical compositions. The elemental compositions of the paint samples were determined using a scanning electron microscope with an energy dispersive x-ray detector. The chemical compositions of the paint samples were determined using Fourier transform infrared spectroscopy and pyrolysis gas chromatography with a mass spectrometer detector. Using these instrumental techniques, I was unable to exclude the paint sample from the suspect's hooded sweatshirt (item 2) as coming from the victim's damaged back door (item 1). Therefore, the sample of paint from the suspect's hooded sweatshirt could have come from the victim's damaged back door or from another source of this type of two-layered grey and white paint. The white paint layer in the sample of paint from inside the trunk of the suspect's car (item 3) had a different chemical composition to the white paint layer in the sample of paint from victim's back door (item 1). Therefore, the sample of paint from inside the trunk of the suspect's car could not have come from the area sampled from victim's damaged back door.
84JXQW	The physical and chemical properties of items #2 and #3 were compared to item #1. It is

TABLE 3

WebCode	Conclusions
	concluded that the paint recovered from inside the trunk of the suspect's car (Item 3) could not have originated from the damaged area of the victim's back door. It is further concluded that the paint recovered from the suspect's hooded sweatshirt (Item 2) can not be eliminated from sharing a common source with the paint from the damaged area of the victim's back door.
8NNFZX	Item 1 (known paint sample representative of the damaged area of the victim`s backdoor): This paint chip consists of 2 paint layers, bright grey and white on a wooden ground. Item 2 (questioned paint chip recovered from the suspect`s hooded sweatshirt): These paint chips consist of 2 paint layers, bright grey and white on a wooden ground. No visible differences could be determined visually comparing each layer with the paint chip of sample 1. Item 3 (questioned paint chip recovered from inside the trunk of the suspect`s car): These paint chips consist of 2 paint layers, bright grey and white on a wooden ground. No visible differences could be determined visually comparing each layer with the paint chip of sample 1. The paint chips in question recovered from the suspect`s hooded sweatshirt (Item 2) could probably have originated from the same source as the damaged area of the victim`s backdoor as represented by Item 1. The paint chips in question recovered from inside the trunk of the suspect`s car (Item 3) could definitely not have originated from the same source as the damaged area of the victim`s backdoor as represented by Item 1.
8ZHUYA	Through a physical study and chemical analysis performed on the submitted evidence, it was determined that: Items 1, 2 and 3 do not present physical matching and are made up of two layers, one light gray and the other white, which are consistent in color, texture and sequence. Items 1 and 2 have a similar chemical composition (Infrared Spectra, FTIR and Gas chromatography with pyrolysis, GC/FID/PY), so they are consistent with a common origin. Items 1 and 3 do not have a similar chemical composition (FTIR and GC/FID/PY), so they are not consistent with a common origin. Item 1 was use as reference sample.
94YG99	The topcoat materials matched item #1, but the primer on item #2 looked different under magnification (2 layers of primer compared to one layer in item #1), and the bottom white layer on item #3 produced a different FTIR spectrum than the same layer from item #1.
9GH4H7	The layer sequence and color of "Item 2" were consistent with those of "Item 1". "Item 1" and "Item 2" consisted of the same binder systems and elemental composition; therefore "Item 2" could have originated from the same source as represented by "Item 1" . "Item 3" was physically and chemically not comparable with "Item 1"; therefore "Item 3" could not have originated from the same source as represented by "Item 1".
9RGYF2	The questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) could have originated from the damaged area of the victim's back door as represented by Item 1. The questioned paint chips recovered inside the trunk of the suspect's car (Item 3) could not have originated from the damaged area of the victim's back door as represented by Item 1.
9UTEA3	The source of item 1 is included as a possible source of item 2. The source of item 1 is excluded as a possible source of item 3.
A96CR9	1) In my opinion, there is strong support for the proposition that the questioned paint chips recovered from the suspect's hooded sweatshirt (item 2) have originated from the victim's back door (represented by item 1). 2) In my opinion, there is conclusive support for the proposition that the questioned paint chips recovered from inside the trunk of the suspect's car (item 3) have not originated from the victim's back door (represented by item 1). This is based upon the assumption that 'item1' is fully representative of all the paint on the damaged door.
AQMBW7	After the study of the three samples, and because of the diferent width of the two layers that conform the samples (white and grey), the results are consistent with the fact that Item 1, 2 and 3 have different origins.

TABLE 3

WebCode	Conclusions
AZUB78	On analysis, I found the questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) was similar to the known paint sample representative of the damaged area of the victim's back door (Item 1). I also found that the questioned paint chips recovered from inside the trunk of the suspect's car (Item 3) was not similar with the known paint sample representative of the damaged area of the victim's back door (Item 1).
B22MPU	Questioned paint chips reportedly recovered from a sweatshirt (Item 2) and questioned paint chips reportedly recovered from a trunk (Item 3) were examined and compared to known paint from a door (Item 1) using the following techniques: visual examination, stereomicroscopy, polarized light microscopy, fluorescence microscopy, infrared spectroscopy (IR), and scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS). Each sample contained a gray paint layer and a white paint layer. Comparison of Items 1 and 2: Each layer of Item 2 corresponded in all tests performed to the respective layer of Item 1. Therefore, the questioned paint from Item 2 originated either from the door represented by Item 1 or from another source with indistinguishable properties. Because other paint has been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. (Level 3-Association). Comparison of Items 1 and 3: The white layer of Item 3 differed in microscopic characteristics and in chemistry from the white layer of Item 1. Therefore, the questioned paint from Item 3 did not originate from the door represented by Item 1. (Elimination).
BFKBX8	The Questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) could have been originated from paint sample of the damaged area of the victim's back door (Item 1), because of the similarities on their physical properties and chemical compositions. The Questioned paint chips recovered from inside the trunk of the suspect's car (Item 3) could NOT be originated from damaged area of the victim's back door (Item 1), because of the differences on their physical properties and chemical compositions.
BJJNKW	The two-layer paint (gray over white primer) sampled from Item 1 (Known from back door) and Item 2 (Questioned from suspect's hooded sweatshirt) were found to be similar in appearance and chemical composition (FTIR). The damaged area of the victim's back door cannot be excluded as a possible source of the paint chips recovered from the suspect's hooded sweatshirt. The white primer layers sampled from Item 1 (1W - Known from back door) and Item 3 (3W - Questioned from trunk of suspect's car) were found to be dissimilar in chemical composition (FTIR). The damaged area of the victim's back door is not the source of the paint chips recovered from inside the trunk of the suspect's car.
BTQL4U	Item 2 could have originated from the door, as represented by Item 1, or from another source with paint exhibiting all of the same analyzed characteristics. Item 3 could not have originated from the door as represented by Item 1.
CPLF3T	a). The questioned paint chips recovered from the suspect's hooded sweatshirt, marked “Item 2”, could have originated from the same source as the control paint collected from the damaged area of the victim's back door, marked “Item 1”, or another source of paint with similar characteristics. b). The questioned paint chips recovered from the inside of the trunk of the suspect's car, marked “Item 3” did not originate from the same source as the control paint collected from the damaged area of the victim's back door, marked “Item 1”.
E34P24	The questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) could have originated from the damaged area of the victim's back door (Item 1). The questioned paint chips recovered from inside the trunk of the suspect's car (Item 3) did not originate from the damaged area of the victim's back door (Item 1).
E7JGTW	The paint layer of item 1 is identical with the paint layer of item 2. The paint layer of item 1 is not identical with the paint layer of item 3.

TABLE 3

WebCode	Conclusions
EFRUAZ	1. One of the Q1 questioned paint samples (designated as Q1a) was instrumentally analyzed and compared to known paint K1. Q1a and K1 are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. It is the opinion of the undersigned that questioned paint Q1a could have originated from the same source as represented by the known submitted exemplar K1 or from another source exhibiting all of the same analyzed characteristics. 2. One of the Q2 questioned paint samples (designated as Q2a) was instrumentally analyzed and compared to known paint K1. Questioned paint Q2a and the known paint K1 are consistent with respect to their color, layer structure and chemical type for layer 1; however, Q2a and K1 are different with respect to texture and chemical type for layer 2. It is the opinion of the undersigned that questioned paint Q2a could not have originated from the same source as represented by the known paint K1 submitted.
EK6U7R	The questioned paint chips recovered from the suspect's hooded sweatshirt (item 2) and the known paint sample representative of the damaged area of the victim's back door (item 1) were consistent on color, layering and chemical composition and could have originated from the same source. The questioned paint chip recovered inside the trunk of the suspect's car (item 3) and the known paint sample (item 1) were inconsistent on chemical composition for the second paint layer (white layer). The item 3 could not have originated from the same source as represented by the item 1.
FMRNPD	Item 1 and Item 2 exhibit the same microscopic characteristics and consists of the same chemical and elemental components; therefore, these two paint samples could have originated from the same source. Item 1 and Item 3 exhibit different microscopic characteristics and have different chemical and elemental components; therefore, these two paint samples did not originate from the same source.
G86X4G	I have considered the following propositions to evaluate my findings: a). The paint recovered from the suspect’s hooded sweatshirt and/or the trunk of the suspect’s car originated from the paint of the victim’s back door. b). The paint recovered from the suspect’s hooded sweatshirt and/or the trunk of the suspect’s car did not originate from the paint of the victim’s back door but came from an unrelated source. Given the above, I consider the findings to be more probable if the first proposition is true in regards to the paint recovered from the suspect’s hooded sweatshirt, that is, the paint recovered from the hooded sweatshirt originated from the damaged area of the victim’s back door rather than the second that the paint came from an unrelated source. Consequently it is my opinion that the findings provide moderate support for the proposition that paint recovered from the suspect’s hooded sweatshirt (Item 2) originated from the damaged area of the victim’s back door (Item 1). The recovered paint from inside the trunk of the suspect’s car (Item 3) can be excluded from having originated from the damaged area of the victim’s back door based on differences observed in the analysis.
GJ3JNU	The paint chips recovered from the suspect's hooded sweatshirt (Item 2) are consistent with the paint layers from the damaged area of the victim's back door (Item 1) and the possibility exists they originated from the victim's back door. However, the paint chips from inside the suspect's car (Item 3) did not match the paint chips from the victim's back door.
GQ4TZD	The questioned paint chips from the suspect’s environment (Exhibits 2 and 3) were examined and compared to the submitted known paint sample from the victim’s back door (Exhibit 1). All of the submitted paint samples correspond in color and layer structure (a gray layer, over a white layer, on a wooden substrate). Samples from the gray and white paint layers from Exhibits 1 through 3 were analyzed further with the following results: Exhibits 1 and 2 correspond in microscopic characteristics, chemical composition, and elemental composition. Therefore, the Exhibit 2 paint chips could have come from the damaged area of the victim’s back door, or from another source with the same characteristics (Type III Inclusion). This type of conclusion

TABLE 3

WebCode	Conclusions
	was reached because paints are mass-produced, and other paints manufactured to the same specifications would also be indistinguishable. The techniques utilized in this comparative analysis can typically distinguish most paint products. Exhibits 1 and 3 are different in chemical and elemental composition. Therefore, the Exhibit 3 paint chips did not originate from the damaged area of the victim's back door (Exclusion).
HN77EZ	Comparative examination of the paint layers from Item 1 and Item 2 by optical microscopy and FTIR found no significant differences in physical or chemical composition. The findings are consistent with Item 1 and Item 2 having a common origin. Comparative examination of the paint layers from Item 1 and Item 3 found significant differences in the chemical composition of the lower paint layers. Item 3 and Item 1 do not have a common origin.
JJXXVB	1. Exhibit 1 (known paint standard from the damaged area of the victim's back door), Exhibit 2 (questioned paint chips from the suspect's hooded sweatshirt), and Exhibit 3 (questioned paint chips from inside the trunk of the suspect's car) each consist of dual-layered paint samples on an apparent wood substrate. The following layer structure was observed in each Exhibit: a. Layer 1: medium grey topcoat. b. Layer 2: white primer. 2. Comparative examination of Exhibit 2 (questioned paint sample) with Exhibit 1 (known paint standard) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the questioned paint chips in Exhibit 2 could have originated from the damaged door as represented by Exhibit 1, or another source of architectural paint with the same characteristics. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown. 3. Comparative examination of Exhibit 3 (questioned paint sample) with Exhibit 1 (known paint standard) disclosed them to be inconsistent in their chemical characteristics. As a result of these findings, the questioned paint chips in Exhibit 3 could not have originated from the damaged door as represented by Exhibit 1.
K29GXR	The questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) could have originated from the damaged area of the victim's back door as represented by Item 1. The questioned paint chips recovered from inside the trunk of the suspect's car (Item 3) could not have originated from the damaged area of the victim's back door as represented by Item 1.
KAMWAA	Items 1, 2, and 3 were examined by stereomicroscopy and scanning electron microscopy/energy-dispersive x-ray spectroscopy. Items 1 and 2 were additionally examined by infrared spectroscopy and pyrolysis gas chromatography/mass spectrometry. The lavender-gray paint in Item 2 was indistinguishable from the lavender-gray paint in Item 1 in color, texture, layer structure, chemical composition, and elemental composition (Type 2 Association). This means the paint recovered from the suspect's hooded sweatshirt could have come from the damaged area of the victim's back door. The lavender-gray paint in Item 3 was different from the lavender-gray paint in Item 1 (Elimination). This means the paint recovered from inside the trunk of the suspect's car did not come from the damaged area of the victim's back door.
KFPAMY	Item one and item two could have been orginated from the same source.
KJPKHY	1. The paint in Exhibit 2 originated either from the source of Exhibit 1, or from another source of painted wood having indistinguishable physical and chemical properties. 2. The paint in Exhibit 3 did not originate from the source of Exhibit 1.
L982ZM	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, fluorescence, FTIR, and SEM-EDX. KNOWN STANDARD: The known paint standard from the damaged area of the victim's back door (Item 1) revealed the presence of a piece of wood painted grey with the following layer structure: Grey, white. QUESTIONED SAMPLES: The questioned paint sample from the suspect's hooded sweatshirt (Item 2) revealed the presence of two small pieces of wood painted grey with the

TABLE 3

WebCode	Conclusions
	following layer structure: Grey, white. The questioned paint sample from the suspect's hooded sweatshirt (Item 2) was physically and chemically consistent with the known paint standard from the damaged area of the victim's back door (Item 1). Therefore, the questioned paint sample from the suspect's hooded sweatshirt (Item 2) could have originated from the same source as the known paint standard from the damaged area of the victim's back door (Item 1). The questioned paint sample from inside the trunk of the suspect's car (Item 3) revealed the presence of two small pieces of wood painted grey with the following layer structure: Grey, white. The questioned paint sample from inside the trunk of the suspect's car (Item 3) was not consistent with the known paint standard from the damaged area of the victim's back door (Item 1). Therefore, the questioned paint sample from inside the trunk of the suspect's car (Item 3) did not originate from the same source as the known standard from the damaged area of the victim's back door (Item 1).
LZU629	The known paint sample and both questioned paint chips consisted of 2-layered paint structures, with a grey upper layer and a white lower layer on a wooden substrate. The questioned paint chips in item 2 were found to agree in colour and chemical composition with the corresponding layers of the known paint sample in item 1. This finding indicated that the questioned paint chips in item 2 from the suspect's hooded sweatshirt could have originated from the damaged area of the victim's back door from which the known paint sample item 1 was taken. The grey upper layer of the questioned paint chips in item 3 were found to agree in colour and chemical composition with the grey upper layer of the known paint sample in item 1. The white lower layer of the questioned paint chips in item 3 were found to agree in colour but differ in chemical composition from the white lower layer of the known paint sample in item 1. This finding indicated that the questioned paint chips in item 3 from inside the trunk of the suspect's car did not originate from the damaged area of the victim's back door from which the known paint sample item 1 was taken.
METG4K	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, fluorescence, FTIR, and SEM-EDX. Examination of the known paint sample representative of the damaged area of the victim's back door (Item #1) revealed the presence of a piece of wood painted gray on one side with the following layer structure: gray and white. Examination of the questioned paint chips recovered from the suspect's hooded sweatshirt (Item #2) and the questioned paint chips recovered from inside the trunk of the suspect's car (Item #3) each revealed the presence of two small pieces of wood painted gray on one side with the following layer structure: gray and white. The gray paint from the questioned paint chips recovered from the suspect's hooded sweatshirt (Item #2) was physically and chemically consistent with the gray paint from the known paint sample representative of the damaged area of the victim's back door (Item #1). Therefore, the gray paint in Item #2 could have originated from the same source as the gray paint in Item #1. The gray paint from the questioned paint chips recovered from inside the trunk of the suspect's car (Item #3) was not consistent with the gray paint from the known paint sample representative of the damaged area of the victim's back door (Item #1). Therefore, the gray paint in Item #3 did not originate from the same source as the gray paint in Item #1.
MXLAVA	The paint sample from the 'damaged area of the victim's back door' (Item 1) consisted of a piece of wood with a light grey topcoat and a white 2nd layer applied to one surface. The paint chips from the 'suspect's hooded sweatshirt' (Item 2) and from 'inside the trunk of the suspect's car' (Item 3) both consisted of small pieces of wood with a light grey topcoat and a white 2nd layer applied to the surface. The light grey topcoat and the white 2nd layer of the paint chips from the 'suspect's hooded sweatshirt' (Item 2) were indistinguishable from the respective light grey topcoat and the white 2nd layer of the paint sample from the 'victim's back door' (Item 1) with respect to their appearance, colour, chemical and elemental composition. In my opinion,

TABLE 3

WebCode	Conclusions
	this result provides moderate support for the contention that the paint chips from the 'suspect's hooded sweatshirt' (Item 2) originated from the 'damaged area of the victim's back door' (Item 1). The white 2nd layer of the paint chips from 'inside the trunk of the suspect's car' (Item 3) was distinguishable from the white 2nd layer of the paint sample from the 'victim's back door' (Item 1) with respect to their chemical and elemental composition. Therefore, in my opinion, the paint chips from 'inside the trunk of the suspect's car' (Item 3) did not originate from the 'damaged area of the victim's back door' (Item 1).
PBHC6T	The samples were examined using stereomicroscopy, Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy- Energy Dispersive X-ray Spectrometry (SEM-EDS). All paint samples consisted of a gray topcoat and a white undercoat. The questioned sample from Item #2 was consistent in color, layering, chemical composition, and elemental composition with the known paint from Item #1 and could have originated from the same source (Level III association). The white undercoat layer of the questioned sample from Item #3 was inconsistent in chemical composition with the known paint from Item #1 and did not originate from the same source (Elimination). Terminology Key for Associative Evidence: The following descriptions are meant to provide context to the levels of opinions reached in this report. Every level of conclusion may not be applicable in every case nor for every material type. Level I Association: A physical match; items physically fit back to one another, indicating that the items were once from the same source. Level II Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and share atypical characteristic(s) that would not be expected to be readily available in the population of this evidence type. Level III Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Level IV Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. As compared to a Level III association, items categorized within a Level IV share characteristics that are more common amongst these kinds of manufactured products. Alternatively, an association between items would be categorized as a Level IV if a limited analysis was performed due to characteristics or size of the specimen(s). Level V Association: An association in which items are consistent in some, but not all, physical properties and/or chemical composition. Some minor variation(s) exists between the known and questioned items and could be due to factors such as sample heterogeneity, contamination of the sample(s), or having a sample of insufficient size to adequately assess homogeneity of the entity from which it was derived. Inconclusive: No conclusion could be reached regarding an association/elimination between the items. Elimination: The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source.
PT29KM	Similar in color, layer sequence, and chemical composition to the paint in Item 1-1; therefore, the paint in Item 1-2 could have originated from the same source as the paint in Item 1-1. Similar in color and layer sequence, but dissimilar in chemical composition to the paint in Item 1-1; therefore, the paint in Item 1-3 may not have originated from the same source as the paint in Item 1-1.
PT6NZ9	The paint from the victim's back door (item 1) consisted of a grey top coat and white undercoat. The paint chips recovered from the suspect's hooded sweatshirt (item 2) consisted of a grey top coat and white undercoat. In relation to colour, chemical composition and elemental composition the grey and white coats were indistinguishable to the corresponding coats from the victim's back door. Therefore the paint from these items may share a common origin. The

TABLE 3

WebCode	Conclusions
	paint chips recovered from the trunk of the suspect's car (item 3) consisted of a grey top coat and white undercoat. The chemical composition of the white undercoat was different to the undercoat from the victim's back door and therefore the paint chips recovered from the trunk of the suspect's car could not have originated from that source.
Q99P7F	The item 2 is consistent with item 1. The item 3 is not consistent with item 1.
Q9CCJM	Laboratory items #1 and 2A are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. It is the opinion of the undersigned that Laboratory item #2A could have originated from the same source as represented by the known submitted exemplar, Laboratory item #1, or from another source exhibiting all of the same analyzed characteristics. Laboratory items #1 and 3A are different with respect to the chemical composition of layer 2. It is the opinion of the undersigned that Laboratory item #3A could not have originated from the same source as represented by the known paint, Laboratory item #1.
QFA2ZQ	The paint chips recovered from the suspect's sweatshirt, Item 2, could have originated from the damaged area of the victim's back door, Item 1, or another source of paint with the same distinct characteristics. The paint chips recovered from inside the trunk of the suspect's car, Item 3, could not have originated from the damaged area of the victim's back door, Item 1.
QLDXR4	The questioned paint sample (Items 001-2) recovered from the suspect’s hooded sweatshirt was indistinguishable from the known paint sample (Item 001-1) recovered from the damaged area of the victim’s back door. Therefore, the questioned paint sample (Items 001-2) could have come from the damaged area of the victim’s back door (Item 001-1) or from another source of paint with the same physical and chemical characteristics. The questioned paint sample (Items 001-3) recovered from inside the trunk of the suspect’s car was distinguishable from the known paint sample (Item 001-1) recovered from the damaged area of the victim’s back door. Therefore, the questioned paint sample (Items 001-3) did not come from the damaged area of the victim’s back door (Item 001-1).
R98CYD	Questioned gray paint chips, reportedly recovered from the suspect's hooded sweatshirt (Item 2) and inside the trunk of the suspect's car (Item 3), were examined and compared to the known gray paint chip, reportedly representative of the damaged area of the victim's back door (Item 1). Paint chips in all three items were observed to have two layers: gray over white. Samples of each layer of Items 1, 2, and 3 were analyzed and compared using one or more of the following methods: microscopy, fluorescence, infrared spectroscopy, and scanning electron microscopy-energy dispersive spectroscopy. The gray layer of Items 1 and 3 was similar in chemistry to one another, but the white layer of Items 1 and 3 was not. The gray questioned paint chips from inside the trunk of the suspect's car (Item 3) did not originate from the victim's back door as represented by Item 1 (Elimination). Layers of Item 2 were similar in all examinations performed to the respective layers of Item 1; therefore, the gray questioned paint chips from the suspect's hooded sweatshirt originated from either the victim's back door as represented by Item 1 or another paint source indistinguishable from it (Level 3 - Association). Because other items have been manufactured that would be indistinguishable from Item 1, an individual source cannot be determined.
RBULE7	I formed the opinion based on the techniques used, that the questioned paint chips recovered from the suspect's hooded sweatshirt, item 2 had the same appearance, chemical and elemental composition as the known paint chips collected from near the damaged area of the victim's back door item 1 and could have come from it. I also formed the opinion based on the techniques used, that the questioned paint chips collected from the trunk of the suspect's vehicle, item 3, were different to the known paint chips collected from near the damaged area of the victim's back door, item 1 and could not have come from it.

TABLE 3

WebCode	Conclusions
RF3ALF	The following instruments were utilized in the analysis of this case: Stereomicroscope, Fourier Transform Infrared Spectrometer (FTIR), Microspectrophotometer (MSP) and Scanning Electron Microscope/Energy Dispersive Spectrometer (SEM/EDS). Item 1A and Item 1B were consistent in color, layer sequence, physical and chemical properties. The paint from Item 1A and Item 1B could have come from the same source, or from another source painted in the same manner. Item 1A and 1C could not have originated from the same source due to differences in chemical composition.
RLRR2C	All of the submitted paint from items 1, 2, and 3 was visually examined. The paint from Item 1 was examined and compared to 1 exhibit from item 2 and 1 exhibit from item 3 using polarized light microscopy, visible microscopy and fourier transform infrared spectroscopy (FTIR). The examined paint from items 1, 2, and 3 were found to each consist of 2 layers: grey and white. The 2 layers of items 2 and item 1 are consistent in appearance, microscopic and chemical properties. Thus, item 2 could have originated from item 1 as represented by the examined samples in items 1 and 2 or another paint source exhibiting the same analyzed characteristics. There are discriminating differences in the physical properties and the FTIR results of the white layer of item 3 and item 1. Thus, item 3 could not have originated from item 1 as analyzed. No further analysis was performed on the remaining samples from items 2 and 3. Therefore, no conclusion can be reached on these samples.
RQQ444	Examination of the known paint sample representative of the damage area of the victim's back door (Item 1). Item 1 comprised a paint sample with the layer sequence: grey topcoat/white undercoat. The grey layer was identified as a polyvinyl acetate/styrene type paint. The inorganic elemental composition of the grey layer principally comprised titanium, silicon, aluminium, and potassium. The white layer was identified as an acrylic/melamine/styrene type paint. The inorganic elemental composition of the white layer principally comprised silicon, titanium, calcium, magnesium, aluminium, and potassium. Examination of the questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2). Item 2 comprised a paint sample with the layer sequence: grey topcoat/white undercoat. The layer colour, layer sequence, and composition of Item 2 corresponded with that of Item 1. Therefore, the results support the proposition that the paint recovered from the suspect's hooded sweatshirt (Item 2) originated from the damaged area of the victim's back door (Item 1). Examination of the questioned paint chips recovered from inside the trunk of the suspect's car (Item 3). Item 3 comprised a paint sample with the layer sequence: grey topcoat/white undercoat. The white layer was identified as an acrylic/styrene type paint. The inorganic elemental composition of the white layer principally comprised titanium, silicon, aluminium, zinc, and potassium. The composition of the white undercoat from Item 3 did not correspond with that of Item 1. Therefore, the results do not support the proposition that the paint recovered from inside the trunk of the suspect's car (Item 3) originated from the damaged area of the victim's back door.
RVJ8QG	01-01-AA (Item 1): This item was used for comparison purposes. 01-02-AA (Item 2): Two paint chips were observed within this item. The questioned paint chips are similar in visual color to the known paint from the victim's back door (01-01-AA). One of these paint chips was selected for further analysis and is similar in layer sequence, chemical solubility, and paint type to the known paint from the victim's back door. It is my opinion that the questioned paint could have come from victim's back door or any other item with similar paint characteristics (Category 2B). No analysis was performed on the remaining paint chips. 01-03-AA (Item 3): Two paint chips were observed within this item. The questioned paint chips are similar in visual color. One paint chip was further analyzed and found to be dissimilar in chemical solubility to the known paint from the victim's back door (01-01-AA). It is my opinion that the questioned paint chips did not come from the victim's back door (Category 5). No analysis was performed on the remaining paint chips.

TABLE 3

WebCode	Conclusions
TDCB8G	Item 1, 2, and 3 were composed of two layers on the top of the wood substrate, gray and white layers. The major chemical composition of the gray layer from Item 1 was similar to Item 2 and 3. In addition, the major chemical composition of the white layer from Item 1 was also similar to Item 2. However, the chemical composition of the white layer from Item 3 was different from that of Item 1. Therefore, it is concluded that Item 2 was likely to have originated from the same source as Item 1, while Item 3 did not originate from the same source as Item 1.
V2XUDG	The paint in Item 2 is similar in color, layer sequence and chemical composition to the paint in Item 1. The paint in Item 2 could have originated from the same source as the paint in Item 1. The paint in Item 3 is similar in color and dissimilar in layer sequence and chemical composition to the paint in Item 1. Therefore, it did not originate from the same source as the paint in Item 1.
VTK3NJ	Physical examinations indicate that Items 1, 2 and 3 are indistinguishable from one another in that each consists of a two layer architectural paint system: light gray color coat over a white primer. However, the Item 3 white paint layer differs in chemical composition from the Item 1 white paint layer. Therefore, Item 3 did not originate from the same source as Item 1 (Elimination). Further, Items 1 and 2 were determined to contain no exclusionary differences and therefore Item 2 originated from the painted substrate represented by Item 1 or from another substrate painted in the same manner (Type III Association). This conclusion was reached because other substrates painted with the same materials applied in the same manner would also be indistinguishable. The following categories and their descriptions are meant to provide context to the conclusions reached in this report. Every category may not be applicable in every case nor for every material. Type I Association: Physical/Fracture Match – The items exhibit physical features that demonstrate they were once part of the same object. Associations of Evidence with Class Characteristics: Class characteristics are physical and/or chemical properties that place an item within a particular group of items. Associations of evidence with class characteristics can have varying degrees of significance. In general, the smaller the size of the group relative to the relevant population, the more significant the association. A class association cannot definitively establish that the items came from the same source. Type II: Association with Highly Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Additionally, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III: Association with Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV: Association with Limitations – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value. For example, the items are more commonly encountered in the relevant population, a complete analysis was not performed due to limited characteristics or a limited analytical scheme, or minor variations were observed in the data. Inconclusive – No conclusion could be reached. Elimination – The items exhibit exclusionary differences that demonstrate they did not originate from the same source.
W2RZ8G	Traces of gray paint recovered from the suspect's hooded sweatshirt (Item 2) and traces found inside the trunk of the vehicle (Item 3) match physical characteristics, morphology, and chemical composition with the damaged area of the door back of the victim (Item 1). So they could have a common origin.
W3LNQC	METHODS: Items 1, 2, and 3 were examined visually and using stereomicroscopy, microchemical tests, fluorescence microscopy, and Fourier Transform Infrared

TABLE 3

WebCode	Conclusions
	Spectrophotometry (FTIR). Items 1 and 2 were further examined using Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). RESULTS AND INTERPRETATIONS: The two-layered gray paint particles in Items 1 and 2 were consistent in colors, textures, types, layer sequence, and chemical compositions. Based on the particles examined, it was concluded that the Item 2 paint had a common origin with either Item 1 or another source of paint with the same colors, textures, types, layer sequence, and chemical compositions (Level III - Association with Discriminating Characteristics). This type of conclusion was reached because other surfaces painted with the same types of paints would also be indistinguishable. It should be noted that the techniques used in this comparative analysis can typically distinguish different paints. Based on the particles examined, the two-layered gray paint particles in Items 1 and 3 could not be associated due to differences in texture, fluorescence and chemical composition (Exclusion/Elimination). TERMINOLOGY KEY FOR COMPARATIVE EXAMINATIONS: Level I - Physical/Fracture Match: Physical Fit is reached when the items that have been broken, torn, or separated exhibit physical features that correspond/re-align in a manner that is not expected to be replicated. Level II - Association with Highly Discriminating Characteristics: An association in which items could not be differentiated based on the examinations conducted. Therefore, the possibility that the items came from the same source cannot be eliminated. Additionally, the items share unusual characteristics that would rarely be expected to occur in the relevant population. This is the highest degree of association that can be determined in the absence of a Physical Fit. Level III - Association with Discriminating Characteristics: An association in which items could not be differentiated based on the examinations conducted. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured or could occur in nature that would also be indistinguishable from the submitted items and could be encountered in the relevant population. The analytical techniques used in the analysis of these items can provide high levels of discrimination among natural and manufactured materials. This is considered a high degree of association. Level IV - Association with Limitations: An association in which items could not be differentiated based on the examinations conducted. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value. For example, the items are more commonly encountered in the relevant population, minor variations were observed, or a complete analysis was not performed due to limited characteristics or sample size. Minor variations, for certain types of examinations, could be due to factors such as contamination of the sample(s) or having a sample of insufficient size to adequately assess heterogeneity of the entity from which it was derived. Inconclusive: No conclusion could be reached regarding an association or an elimination between the items. Exclusion with Limitations: The item exhibits differences from the comparison sample that support that it did not originate from the source, as represented by the comparison sample. An Exclusion/Elimination conclusion was not reached due to limiting factors, such as possible natural or manufactured source variations. Exclusion/Elimination: The items exhibit differences that demonstrate the items did not originate from the same source. Date(s) of testing: 01/13/2022 – 01/31/2022. Supporting examination documentation is maintained in the case file. The above listed methods are those approved for use at the time of analysis.
W9TGHL	Examination of questioned Item 2 and known Item 1 revealed both paint chips with the following two (2) layer structures: grey undercoat and white primer applied to a wood substrate. The questioned paint chip recovered from the suspect's hooded sweatshirt (Item 2) were found to be consistent with respect to colour, chemical compositions and layer structure to the known paint chips from the damaged area of the victim's door as represented by known Item 1. Examination of questioned Item 3 and known Item 1 revealed both paint chips with the following two (2) layer structures: grey undercoat and white primer applied to a wood substrate.

TABLE 3

WebCode	Conclusions
	The questioned paint chips recovered from inside trunk of the suspect's car (Item 3) were found to be consistent with respect to colour and layer structure to the known paint chips from the damaged area of the victim's door as represented by known Item 1. The chemical composition of questioned Item 3 was found to be inconsistent to that of known Item 1. Based on the above findings, in my professional opinion, (a) the questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) could have originated from the damaged area of the victim's door as represented by Item 1; (b) the questioned paint chips recovered from inside trunk of the suspect's car (Item 3) could not have originated from the damaged area of the victim's door as represented by Item 1.
WHH6FA	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, fluorescence, FTIR, and SEM-EDX. KNOWN STANDARDS: Examination of Item 1 revealed the presence of one rectangular piece of wood with grey paint on one side. The grey paint had the following layer structure: grey, white. QUESTIONED SAMPLES: Examination of Item 2 revealed the presence of grey paint chips with the following layer structure: grey, white. Each paint chip was on a wood substrate. The questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) were physically and chemically consistent with the known paint sample representative of the damaged area of the victim's back door (Item 1). Therefore, the questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) could have originated from the same source as the known paint sample representative of the damaged area of the victim's back door (Item 1). Examination of Item 3 revealed the presence of grey paint chips with the following layer structure: grey, white. Each paint chip was on a wood substrate. The questioned paint chips recovered from inside the trunk of the suspect's car (Item 3), were not consistent with the known paint sample representative of the damaged area of the victim's back door (Item 1). Therefore, the questioned paint chips recovered from inside the trunk of the suspect's car (Item 3) did not originate from the known paint sample representative of the damaged area of the victim's back door (Item 1).
WLGGBA	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, FTIR, and SEM-EDX. Examination of Lab Item #1 revealed the presence of one large textured gray paint chip with the following layer structure: gray and white on a wood substrate. Examination of Lab Items #2 and #3 each revealed the presence of two small textured gray paint chips with the following layer structure: gray and white on a wood substrate. The paint chips recovered from the suspect's hooded sweatshirt (Item #2) were physically and chemically consistent with the paint from the damaged area of the victim's back door (Item #1). Therefore, the paint from Item #2 could have originated from the same source as the paint from Item #1. The paint chips recovered from inside the trunk of the suspect's car (Item #3) were not consistent with the paint from the damaged area of the victim's back door (Item #1). Therefore, the paint from Item #3 did not originate from the same source as the paint from Item #1.
X4TMZB	Item 1, 2, and 3 were composed with two colors of paints, gray paint for surface layer and ivory paint for below layer of the gray paint. Gray paints from item 1, 2, and 3 had similar FT-IR spectrum and elemental composition. In case of ivory paint, item 1 and 2 showed similar FT-IR spectrum, pyrolysis GC-MS chromatogram, and elemental composition. However, ivory paint from item 3 presented distinct FT-IR spectrum, pyrolysis GC-MS chromatogram, and elemental distribution (no Mg and Ca) compared to the item 1.
XCLXA7	The paints in Items 1, 2 and 3 are each composed of a gray over white layer, which are consistent in layer color. Items 1 and 2 are consistent in chemical composition, pigment appearance and pigment distribution. The white layer of Item 3 is different in chemical composition from the white layer of item 1. Therefore, the paint chips recovered from the

TABLE 3

WebCode	Conclusions
	suspect's hooded sweatshirt, Item 2, originated from the damaged area of the victim's back door as represented by item 1 or from another damaged object having paint with the same analyzed characteristics. The paint chips from inside the trunk of the suspect's car, Item 3, did not originate from the damaged area of the victim's back door as represented by Item 1.
XKYRP9	The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show a grey top paint layer and a white paint layer. All samples cannot be differentiated by means of microscopy, but the white layer of Item 3 can be differentiated by means of infrared spectroscopy and by their elemental composition. Regarding to the methods used, the questioned paint chips from the suspect's hooded sweatshirt (Item 2) could have originated from the damaged area of the victim's back door.
XU32UD	The paint chips from the suspect's hooded sweatshirt (Item2) could have originated from the damaged area of the back door (Item1). The paint chips inside the trunk of his car (Item3) could not have originated from the damaged area of the back door (Item1).
Y3EDTW	CONCLUSIONS: The questioned paint identified as recovered from the sweatshirt (Item 2) is the same distinct type of paint as the known paint on the door (Item 1) and originated either from that source or another source of architectural paint having the same distinct characteristics. The questioned paint identified as recovered from the trunk (Item 3) did not originate from the area of the door represented by Item 1. RESULTS: Questioned paint chips identified as recovered from the sweatshirt and the trunk (Items 2 and 3) were examined for the purpose of determining whether or not they are like the known paint identified as from the damaged area of the victim's back door (Item 1). The paint standard from the door (Item 1) has the following layer structure: 1. Medium grey polyvinyl acetate latex enamel topcoat. 2. White alkyd enamel primer. 3. Wood substrate. This paint exhibits characteristics typical of an architectural finish and was used for comparison with questioned paint identified as recovered from the sweatshirt and trunk (Items 2 and 3). Examination and comparison of the questioned paint identified as from the sweatshirt (Item 2) with Item 1 revealed they are alike with respect to layer structure, layer colors, layer textures, microchemical reactivities, binder characteristics, and pigment characteristics. It is therefore concluded that the questioned paint identified as recovered from the sweatshirt (Item 2) is the same distinct type of paint as that on the door (Item 1) and originated either from that door, or from another source of architectural paint having the same distinct characteristics. The questioned paint chips identified as from the trunk (Item 3) have the following layer structure: 1. Medium grey polyvinyl acetate latex enamel topcoat. 2. White enamel primer. 3. Wood substrate. Examination and comparison of the questioned paint identified as from the trunk (Item 3) with Item 1 revealed layer 2 is dissimilar with respect to binder and pigment characteristics. It is therefore concluded that the questioned paint identified as recovered from the trunk (Item 3) did not originate from the area of the door represented by Item 1. METHODS OF ANALYSIS: Examinations were performed visually, by stereo microscopy, brightfield/polarized light comparison microscopy, microchemical tests, Fourier transform infrared microspectroscopy, pyrolysis gas chromatography, and scanning electron microscopy/energy dispersive x-ray analysis.
YETF7G	The paint from the sweatshirt (item 2) could have come from the same source as the paint from the back door (item 1) or any other source with a similar layer structure and chemistry. The paint from the trunk of the vehicle (item 3) did not come from the same source as the samples of paint from the sweatshirt and back door.
YRUB6A	The gray paint in Item 2 was visually, microscopically and instrumentally consistent with the gray paint in Item 1. This indicates that the gray paint in Item 2 could share a common origin with the gray paint in Item 1. The gray paint in Item 3 was microscopically and instrumentally different from the gray paint in Item 1 with respect to the white layer of paint. This indicates that the gray paint in Item 3 does not share a common origin with the gray paint in Item 1.

TABLE 3

WebCode	Conclusions
ZFG9JC	1. As a result of FT-IR analysis, the white layers of item 1 and item 2 were similar, but the white layer of item 3 showed different spectra. 2. As a result of SEM-EDX, the metal composition ratio of the white layer item 1 and item 2 was similar, but the metal composition ratio of the white layer item 3 was different.
ZYC24A	Item 2 could have originated from Item 1, but Item 3 could not have originated from Item 1. The composition and FT-IR spectrum which are obtained from gray topcoat of item 3 were simillar with item 1, meanwhile, those of white layer used to lower layer of item 3 are different from item 1.

Additional Comments

TABLE 4

WebCode	Additional Comments
A96CR9	If this was a real forensic submission, I would be asking the police questions in relation to obtaining further paint samples from the damaged door, just to make sure that item 1 is fully representative of the paint in the damaged areas.
B22MPU	An association scale would be included to define the terms in parentheses.
BJJNKW	My examinations and analyses do not focus on the detection of inorganic materials. Items 1 and 2 may vary in their inorganic content.
CPLF3T	a. “Item 1” to “Item 3” were each found to consist of two layers of paint - an outer grey layer, and a second white layer. b. The questioned paint chips marked “Item 2” were found to have no exclusionary differences with the control paint marked “Item 1” in terms of colour, sequence of layers and chemical composition. c. The questioned paint chips marked “Item 3” were found to be different from the control paint marked “Item 1” in terms of chemical composition.
G86X4G	Procedures state that PyGCMS would be used on the two indistinguishable paint samples. However, as the PyGCMS is not currently in service this analysis could not be performed. The above results have been released without all possible testing methods.
GQ4TZD	I would contact the agent and let them know that the gray layers are consistent to one another and that they should see if there are other damaged areas if additional exams are desired.
KAMWAA	Type 2 Association: Association with Distinct 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. 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.
KJPKHY	RESULTS: 1. Exhibit 1 contained a block of wood painted on one surface with the paint layer sequence: medium grey / white. 2. Exhibit 2 contained two wood shavings, each painted on one surface with the paint layer sequence: medium grey / white. These paint layers were indistinguishable in color, texture and chemical composition from the corresponding paint layers in Exhibit 1. 3. Exhibit 3 contained two wood shavings, each painted on one surface with the paint layer sequence: medium grey/white. The medium grey paint layer was indistinguishable in color, texture and chemical composition from the medium grey paint layer in Exhibit 1. The white paint layer was indistinguishable in color, but different in texture and chemical composition, from the white paint layer in Exhibit 1.
R98CYD	An Association Scale would also be included in the report. The definition of the associations used in the report are the following: Level 3" Association: Items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Elimination (Non-association): The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source.
W2RZ8G	It is considered opportune to continue with this type of trials.

TABLE 4

WebCode	Additional Comments
YETF7G	Samples from all three items contain a 2-layer (gray, white) paint system on a wood substrate. There was correspondence in the morphology of the samples, such as color, layer structure, and texture. The gray layers contained similar chemistry; however, the white layer from item 3 contained different chemistry from the white layers in items 1 and 2. The paint from the sweatshirt (item 2) contains chemistry and morphology that corresponds to the chemistry and morphology of the paint from the back door (item 1). NOTE: The surface texture would normally be used as a morphological feature to compare; however, it appears that both known samples (item 2 and item 3) have a different texture than item 1. More information would have been required such as a picture of where the items were sampled from. In an actual case, additional samples would have been requested in order to see the range in variation of surface texture.

-End of Report-
(Appendix may follow)

Collaborative Testing Services ~ Forensic Testing Program

Test No. 22-5451: Paint Analysis

DATA MUST BE SUBMITTED BY **April 25, 2022, 11:59 p.m.** TO BE INCLUDED IN THE REPORT

Participant Code: U1234A WebCode: Q8GMJZ

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 break-in that occurred in a residential neighborhood where several things were stolen from inside the victim's house. It appears a tool was used to pry open the back door which caused damage to the paint. The police apprehended a potential suspect two days later. They conducted a warranted search of the suspect's home and vehicle where they found paint chips, similar in color to the back door, on his hooded sweatshirt and inside the trunk of his car. Known paint samples have been collected from the damaged area of the back door. Police are requesting that you examine the recovered paint chips from the suspect's hooded sweatshirt and inside the trunk of his car and determine if either of them could have originated from the damaged area of the back door.

Please Note:
-Samples contained within each individual item are representative of a single source.
-The purpose of this test is the examination of paint; please ignore the wood substrate.

Items Submitted (Sample Pack P1):
Item 1: Known paint sample representative of the damaged area of the victim's back door.
Item 2: Questioned paint chips recovered from the suspect's hooded sweatshirt.
Item 3: Questioned paint chips recovered from inside the trunk of the suspect's car.

1.) Could the questioned paint chips recovered from the suspect's hooded sweatshirt (Item 2) and/or inside the trunk of the suspect's car (Item 3) have originated from the damaged area of the victim's back door as represented by Item 1?

	Yes	No	Inconclusive
Item 2:	○	○	○
Item 3:	○	○	○

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

Please check all that apply.

Microscopic Exams:	☐ Stereomicroscope	☐ Polarized Light
	☐ Fluorescence	
☐ Pyrolysis GC	☐ FTIR	☐ Solubility/Chemical
☐ XRS/XRF	☐ SEM/EDX	☐ Microspectrophotometry

Other (specify):

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)