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FORENSIC TESTING PROGRAM

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Paint Analysis
Test No. 26-5451 Summary Report

Each participant received a sample pack containing one known paint chip sample and two sets of questioned paint chips which they were asked to examine using their existing protocols. Data were returned from 72 participants and are compiled into the following tables:

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

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

Manufacturer's Information

Each sample pack contained known paint chip sample(s) and questioned paint chip sample(s). Participants were asked to examine the questioned paint chip sample(s) and determine if it could have originated from the known paint chip(s).

SAMPLE PREPARATION: The substrate used for this test were inspected for defects, and the areas containing defects were not used. 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.

KNOWN ITEMS: One plank sample, approximately 1" x 2.5" in size, was selected and deposited into a glassine bag and then placed into a pre-labeled item envelope and sealed.

QUESTIONED ITEMS: Two paint chip samplings, approximately ¼" x ¼" 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 envelope 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: Stereomicroscopy, Polarized Light Microscopy, Comparison Microscopy, Fluorescence, FTIR, SEM/EDX, XRS/XRF, UV, and Solubility/Chemical.

Item	Known/ Questioned	Association/ Elimination	Substrate	Primer	Color
1	Known	--	Poplar Wood	Kilz® Original All Weather Oil-Based	HGTV® by Home Sherwin Williams Showcase Semi-Gloss Cool Beige
2	Questioned	Association	Poplar Wood	Kilz® Original All Weather Oil-Based	HGTV® by Home Sherwin Williams Showcase Semi-Gloss Cool Beige
3	Questioned	Elimination	Poplar Wood	HGTV® Home by Sherwin Williams Mold & Mildew Primer Int/Ext Water-Based	HGTV® by Home Sherwin Williams Showcase Semi-Gloss Cool Beige

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. Participants were supplied with one known paint chip sample (Item 1) and two sets of questioned paint chips (Items 2 and 3). Items 1 and 2 were prepared from the same source of painted wood plank. Item 3 was prepared from a different source of painted wood plank than that of Items 1 and 2. Refer to the Manufacturer's Information for preparation details.

All 72 reporting participants associated Item 2 and eliminated 3 as having originated from the same source as the Item 1 known paint sample.

The most commonly reported examination procedures included: FTIR (100%), Stereomicroscopy (99%), and SEM/EDX (65%).

Examination Results

Could either of the questioned paint chips recovered from the suspect (Item 2 and Item 3) have originated from the damaged area of the side door trim?

TABLE 1

WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
22V9EY	Yes	No	ETJDWM	Yes	No
26WEPX	Yes	No	EZHVDK	Yes	No
2EHHWX	Yes	No	G4UP3F	Yes	No
3B38JU	Yes	No	G9NJZG	Yes	No
3YQZMU	Yes	No	GAV2YD	Yes	No
4338JR	Yes	No	GKVPUF	Yes	No
43E4PW	Yes	No	GMMENA	Yes	No
47G34V	Yes	No	GULAZE	Yes	No
6DHEZT	Yes	No	HKB9ED	Yes	No
6FMAEP	Yes	No	JDB9FB	Yes	No
77QT4Q	Yes	No	JLPUNF	Yes	No
7DCJUR	Yes	No	KG4QUE	Yes	No
7FKWBT	Yes	No	KWEF49	Yes	No
8EMYMJ	Yes	No	LFL6UC	Yes	No
8GBGGP	Yes	No	LYLRKB	Yes	No
8GTBET	Yes	No	MPQC9C	Yes	No
8NTQ7L	Yes	No	MQ2CAC	Yes	No
98E27Q	Yes	No	MQLRL9	Yes	No
9KMR4R	Yes	No	MZCDQ8	Yes	No
9MTA3N	Yes	No	N66ZV6	Yes	No
AN2G9M	Yes	No	NB6JXA	Yes	No
C23X8M	Yes	No	NCZYA8	Yes	No
CRUB7E	Yes	No	NQGWF8	Yes	No
CUJUZK	Yes	No	P36JX9	Yes	No
CVUM2E	Yes	No	P83XP4	Yes	No
CXH6WK	Yes	No	QDKPA3	Yes	No
DGPW8L	Yes	No	QHFJ84	Yes	No
E4V3BH	Yes	No	QLYBJ7	Yes	No
ED76WJ	Yes	No	QWKD78	Yes	No

TABLE 1

WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
RGK273	Yes	No			
RLTER8	Yes	No			
RTF6E3	Yes	No			
V2CGWZ	Yes	No			
V2FZJ4	Yes	No			
VNQ4H6	Yes	No			
W4XK4X	Yes	No			
WJBT62	Yes	No			
WQC62X	Yes	No			
WTFZK2	Yes	No			
XY4ULT	Yes	No			
Y8RB6U	Yes	No			
YZQY9W	Yes	No			
Z6FVBT	Yes	No			

Examination Response Summary **Participants: 72**

Could either of the questioned paint chips recovered from the suspect (Item 2 and Item 3) have originated from the damaged area of the side door trim?

	Item 2	Item 3
Yes:	**72** *(100%)*	**0** *(0%)*
No:	**0** *(0%)*	**72** *(100%)*
Inc:	**0** *(0%)*	**0** *(0%)*

Examination Procedures

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
22V9EY	✓	✓	✓	✓	✓				✓	
26WEPX	✓				✓			✓	✓	
2EHHWX	✓			✓	✓					
3B38JU	✓				✓				✓	
3YQZMU	✓		✓		✓	✓			✓	
4338JR	✓				✓					
43E4PW	✓	✓			✓		✓		✓	RAMAN
47G34V	✓	✓	✓	✓	✓				✓	XRD
6DHEZT	✓			✓	✓	✓			✓	
6FMAEP	✓	✓	✓		✓					
77QT4Q	✓	✓			✓			✓	✓	
7DCJUR	✓		✓	✓	✓	✓				
7FKWBT	✓				✓	✓			✓	
8EMYMJ	✓				✓				✓	
8GBGGP	✓	✓	✓		✓			✓	✓	
8GTBET	✓	✓			✓	✓			✓	Pyrolysis GC/MS
8NTQ7L	✓		✓		✓	✓		✓		
98E27Q	✓				✓				✓	Cross-section
9KMR4R	✓				✓				✓	Raman
9MTA3N	✓				✓			✓	✓	
AN2G9M	✓				✓			✓		
C23X8M	✓			✓	✓				✓	
CRUB7E	✓				✓				✓	
CUJUZK	✓	✓	✓		✓		✓	✓		
CVUM2E	✓				✓				✓	
CXH6WK	✓		✓		✓	✓			✓	
DGPW8L	✓				✓				✓	

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
E4V3BH	✓				✓	✓			✓	
ED76WJ	✓				✓	✓			✓	
ETJDWM	✓				✓	✓			✓	
EZHVDK	✓	✓		✓	✓	✓			✓	
G4UP3F	✓				✓					
G9NJZG	✓				✓				✓	
GAV2YD	✓		✓		✓					RAMAN
GKVPUF	✓		✓	✓	✓	✓				Microscopic Examination/Comparison (200x)
GMMENA	✓				✓				✓	Comparison microscope
GULAZE	✓				✓				✓	
HKB9ED	✓				✓				✓	
JDB9FB	✓	✓			✓					
JLPUNF	✓	✓	✓	✓	✓		✓		✓	Raman
KG4QUE	✓				✓		✓		✓	Pyrolysis GC-MS
KWEF49	✓	✓	✓		✓					Raman, XRD
LFL6UC	✓				✓				✓	
LYLRKB	✓			✓	✓				✓	
MPQC9C	✓				✓			✓		
MQ2CAC	✓				✓					
MQLRL9	✓	✓			✓				✓	
MZCDQ8	✓			✓	✓		✓		✓	
N66ZV6	✓		✓		✓				✓	
NB6JXA	✓				✓				✓	Raman spectroscopy
NCZYA8	✓				✓					
NQGWF8	✓				✓				✓	
P36JX9	✓				✓					
P83XP4	✓			✓	✓	✓		✓		high power microscopy
QDKPA3	✓				✓					

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
QHFJ84	✓		✓		✓			✓		
QLYBJ7	✓				✓				✓	
QWKD78	✓	✓	✓	✓	✓	✓				
RGK273	✓				✓					
RLTER8	✓				✓		✓		✓	
RTF6E3	✓	✓	✓		✓				✓	
V2CGWZ	✓				✓		✓	✓		
V2FZJ4	✓				✓			✓		microtome, Raman microscopy
VNQ4H6	✓	✓	✓		✓		✓		✓	LIBS
W4XK4X					✓					
WJBT62	✓				✓					
WQC62X	✓			✓	✓				✓	Raman spectroscopy
WTFZK2	✓			✓	✓				✓	
XY4ULT	✓		✓	✓	✓				✓	
Y8RB6U	✓	✓	✓		✓		✓		✓	
YZQY9W	✓	✓	✓		✓				✓	Comparison Microscopy
Z6FVBT	✓	✓	✓		✓				✓	

Response Summary **Participants: 72**

	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	Microspectrophotometry	XRF/XRS	SEM/EDX
Participants	71	19	22	16	72	14	9	12	47
Percent	*99%*	*26%*	*31%*	*22%*	*100%*	*19%*	*13%*	*17%*	*65%*

Conclusions

TABLE 3

WebCode	Conclusions
22V9EY	1. Comparative examinations of Exhibit 1 (item 1) with Exhibit 2 (item 2) disclosed them to be consistent with respect to their physical characteristics and chemical composition. As a result of these findings, Exhibit 2 originated from the same door trim as Exhibit 1 or from another source of architectural paint having the same characteristics (LEVEL 3 ASSOCIATION – Discriminating Characteristics). This type of association was reached because Exhibits 1 and 2 are comprised of a two-layer (i.e., tan and white) architectural paint with numerous features for evaluation. 2. Comparative examinations of Exhibit 1 (item 1) with Exhibit 3 (item 3) disclosed exclusionary differences with respect to physical characteristics. As a result of these findings, Exhibit 3 did not originate from the door trim as represented by Exhibit 1 (EXCLUSION). Further comparisons can be performed if additional known samples are submitted. Please contact Forensic Case Management at the email listed above to coordinate additional examinations. APPENDIX The following categories and their descriptions are meant to provide context to the conclusions reached in this report. Every type of conclusion may not be applicable in every case nor for every material type. LEVEL 1 ASSOCIATION – Physical Fit Present This is the highest degree of association between items. The items display physical characteristics along the separation boundary that realign in a manner that is not expected to be replicated, supporting the conclusion that the items once formed a contiguous unit. ASSOCIATIONS OF EVIDENCE WITH CLASS CHARACTERISTICS: Class characteristics are physical 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 items came from the same source. LEVEL 2 ASSOCIATION – Highly Discriminating Characteristics The items could not be differentiated based on the examinations conducted. Other items may have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. However, the items share specific characteristics that would not be expected to be encountered in the relevant population. LEVEL 3 ASSOCIATION – Discriminating Characteristics The items could not be differentiated based on the examinations conducted. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. LEVEL 4 ASSOCIATION – Limitations The items could not be differentiated based on the examinations conducted. 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 explainable variations were observed in the data. INCONCLUSIVE: No opinion could be reached regarding an association or an exclusion between the items. PHYSICAL FIT ABSENT: The items display physical characteristics along the separation boundary which do not align, or which realign in a manner that is expected to be replicated. This does not imply whether the compared items originated from the same source or from different sources. Additional comparison of class characteristics may be warranted. EXCLUSION: The items exhibit exclusionary differences in class characteristics, supporting the opinion that the items did not originate from the same source.
26WEPX	RESULTS OF EXAMINATION 1. Layer Structure Determination: a. Microscopic examination of known paint K1 disclosed the following layer structure: i. K1 – light brown coat (layer 1) / granular and crumbly white coat (layer 2) / tan wood substrate b. Microscopic examination of questioned paints Q1-Q2 disclosed the following layer structures: i. Q1 (two pieces) – light brown coat (layer 1) / granular and crumbly white coat (layer 2) / tan wood substrate ii. Q2 (two pieces) – light brown coat (layer 1) / pliable white coat (layer 2) / tan wood substrate 2. Comparison Result: a. One of the questioned paint samples Q1 (designated as Q1a) was

TABLE 3

WebCode	Conclusions
	instrumentally analyzed and compared to known paint K1. Q1a and K1 are consistent and no exclusionary differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. b. One of the Q2 questioned paint samples (designated as Q2a) was instrumentally analyzed and compared to the known paint K1. Questioned paint Q2a and the known paint K1 are different with respect to chemical type and texture (white coats). c. The remaining particles from Q1 and Q2 were designated as Q1b and Q2b, respectively. No further analysis was performed on these particles; therefore, no conclusions can be made. INTERPRETATION OF RESULTS 1. 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. 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.
2EHHWX	The questioned paint chips recovered from the suspect (item 2) and the known paint sample representative of the damaged area of the victim's side door trim (item 1) were consistent on color, layering and chemical composition and could have originated from the same source. The questioned paint chips recovered from the suspect (item 3) and the known paint sample representative of the damaged area of the victim's side door trim (item 1) were inconsistent on the 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.
3B38JU	The paint chips are composed of two layers, and the composition of the white layer differs in Item3. Item2 has a similar composition to Item1, while Item3 is different.
3YQZMU	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 light brown paint on one side. The light brown paint had the following layer structure: light brown, white. QUESTIONED SAMPLES: Examination of Item 2 revealed the presence of light brown paint chips with the following layer structure: light brown, white. Each paint chip was on a wood substrate. The questioned paint chips recovered from the suspect (Item 2) were physically and chemically consistent with the known paint sample representative of the damaged area of the victim's side door trim (Item 1). Therefore, the paint from Item 2 could have originated from the same source as the paint in Item 1. Examination of Item 3 revealed the presence of light brown paint chips with the following layer structure: light brown, white. Each paint chip was on a wood substrate. The questioned paint chips recovered from the suspect (Item 3), were not consistent with the known paint sample representative of the damaged area of the victim's side door trim (Item 1). Therefore, the paint in Item 3 did not originate from the same source as the paint in Item 1.
4338JR	Item 2 could have originated from the same source as Item 1. Item 3 could not have originated from the same source as Item 1.
43E4PW	After analyzing the 3 items, we conclude that items 1 and 2 are similar in all the studied parametres and we could find that items 1 and 3 were not completely similar between them.
47G34V	Exhibits 1 through 3 contained layered paint, each consisting of at least two layers, including beige paint over white paint on a wooden substrate. The exhibits were examined and compared to each other. The paint in Exhibit 3, though visibly similar in color, was different in chemical composition from the known paint in Exhibit 1. Therefore, the paint in Exhibit 3 did not come from the same source as the Exhibit 1 paint (Exclusion). The paint in Exhibits 1 and 2 were consistent in physical and microscopical characteristics, chemical composition, and elemental composition. Therefore, the Exhibit 2 paint could have come from the same source as the Exhibit 1 paint or another source with the same characteristics (Type III Inclusion). This

TABLE 3

WebCode	Conclusions
	type of conclusion was reached because paints are mass-produced and other paints manufactured to the same specifications as Exhibit 1 and Exhibit 2 would also be indistinguishable. The techniques utilized in this comparative analysis can typically distinguish most paint products. Further comparisons can be performed if additional known samples are submitted. See the Appendix of this report for further context regarding the conclusions listed above. The following techniques were used in the examination of one or more of the exhibits described above: visual, microscopical, and physical examinations; scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS); x-ray diffraction (XRD); Fourier transform infrared spectroscopy (FTIR); pyrolysis gas chromatography-mass spectroscopy (PGC-MS).
6DHEZT	Item 1 compared to Item 2: Items 1 and 2 were found to be indistinguishable from one another. Based on the analyses performed, items 1 and 2 are the same distinct type of paint with respect to their layer structure, appearance, and chemical composition. Item 2 could have originated from item 1 or another source of paint having the same characteristics. Item 1 compared to Item 3: Item 1 and 3 differed in physical characteristics (finish/texturing) and chemical composition. Item 1 is eliminated as a possible source of item 3.
6FMAEP	In my opinion, the findings provide strong support that the fragments contained in item 2, recovered from the suspect, originated from the side door trim of the victim's property, as represented by item 1, as opposed to not.
77QT4Q	Results of Examination 1. Layer Structure Determination a. Microscopic examination of questioned paints Q1 and Q2 disclosed the following layer structures: i. Q1 (two particles) - Beige non-uniform coat (layer 1) / white non-uniform coat (layer 2) / light brown wood substrate ii. Q2 (two particles) - Beige non-uniform coat (layer 1) / white non-uniform coat, granular appearance (layer 2) / light brown wood substrate. The particles appear dimpled. b. Microscopic examination of known paint K1 disclosed the following layer structure: i. K1 - Beige non-uniform coat (layer 1) / white non-uniform coat (layer 2) / light brown wood substrate 2. Comparison Results a. One of the particles comprising Q1 and one of the particles comprising Q2 were designated Q1a and Q2a respectively and analyzed instrumentally. b. Questioned paint Q1a and known paint K1 are consistent and no exclusionary differences were observed with respect to their color, layer structure, appearance, chemical type, and elemental composition. c. Questioned paint Q2a and the known paint K1 are consistent with respect to their color, layer structure and the appearance of layer 1 (beige coat), but are different with respect to the appearance and chemical type of layer 2 (white coat). d. The remaining particle from questioned paint Q1 and the remaining particle from questioned paint Q2 were designated Q1b and Q2b respectively. No further analysis was performed on these particles, therefore no conclusions can be made at this time. Interpretation of Results 1. 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. 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.
7DCJUR	Item 1 - This item was used for comparison purposes. Item 2 - The questioned paint chips are similar in visual color to the known paint sample from the victim 's side door trim (Item 1). One of these paint chips was selected for further analysis and is similar in layer sequence, fluorescence, chemical solubility, paint type, and paint composition to the known paint from the victim's side door trim (Item 1). It is my opinion that the questioned paint could have come from the victim's side door trim (Item 1) or any other item with similar paint characteristics. No analysis was performed on the remaining paint chip. Item 3 - The questioned paint chips are similar in visual color to the known paint sample from the victim 's side door trim (Item 1). One

TABLE 3

WebCode	Conclusions
	of these paint chips was selected for further analysis and is similar in layer sequence, but dissimilar in fluorescence, chemical solubility, and paint type to the known paint from the victim's side door trim (Item 1). It is my opinion that the questioned paint did not originate from the victim's side door trim (Item 1). No analysis was performed on the remaining paint chip.
7FKWBT	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, FTIR, and SEM-EDX. KNOWN STANDARD: Examination of Lab Item #1 revealed the presence of one large textured tan paint chip with the following layer structure: tan and white on a wood substrate. QUESTIONED SAMPLES: Examination of Lab Items #2 and #3 each revealed the presence of two small textured tan paint chips with the following layer structure: tan and white on a wood substrate. The paint chips recovered from the suspect (Lab Item #2) were physically and chemically consistent with the paint from the damaged area of the victim's side door trim (Lab Item #1). Therefore, the paint from Lab Item #2 could have originated from the same source as the paint from Lab Item #1. The paint chips recovered from the suspect (Lab Item #3) were not consistent with the paint from the damaged area of the victim's side door trim (Lab Item #1). Therefore, the paint from Lab Item #3 did not originate from the same source as the paint from Lab Item #1.
8EMYMJ	The paint from the side door trim (item 1), paint recovered from the suspect (item 2) and paint recovered from the suspect (item 3) each consisted of a taupe coloured top coat and white undercoat. In relation to colour, chemical composition and elemental composition, the taupe top coat and white undercoat recovered from the suspect (item 2) were found to be indistinguishable to the corresponding coats from the side door trim (item 1). Therefore the paint from these items may share a common origin. The undercoat recovered from the suspect (item 3) was found to have a different chemical composition to the undercoat from the side door trim (item 1). Therefore the paint recovered from the suspect could not have originated from the side door trim.
8GBGGP	The paint in items 2 and 1 are similar in examined microscopic characteristics, chemical composition, and elemental composition. Item 2 could have originated from the same source as item 1 or a source of similar manufacturing. The paint in 3 was dissimilar in layer structure and microscopic characteristics to item 1. Item 3 could not have originated from item 1 as represented by the submitted items.
8GTBET	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 Item 1.
8NTQ7L	Items #01.01 and #01.02-microscopic (stereo & fluorescence) and instrumental (micro-FTIR & XRF) analysis of one (1) of the questioned paint particles, item #01.02, and the known paint, item #01.01, revealed that they are consistent with respect to color, type, texture, layer structure, optical properties and elemental composition. Therefore, the questioned paint could have originated from the source represented by item #01.01 or another architectural paint source exhibiting the same characteristics. Items #01.01 and #01.03- microscopic (stereo & fluorescence) and instrumental (micro-FTIR) analysis of one (1) of the questioned paint particles, item #01.03, and the known paint, item #01.01, revealed that they are dissimilar with respect to type (layer 2) and optical properties. Therefore, the questioned paint from item #01.03 could NOT have come from the source represented by item #01.01.
98E27Q	Conclusions: When the Questioned Exhibit 2 paint sample was compared to the Known Exhibit 1 paint sample, it was concluded that the Questioned Exhibit 2 paint sample could have originated from the source represented by the Known Exhibit 1 paint sample. When the Questioned Exhibit 3 paint sample was compared to the Known Exhibit 1 paint sample, it was

TABLE 3

WebCode	Conclusions
	concluded that the Questioned Exhibit 3 paint sample did not originate from the source represented by the Known Exhibit 1 paint sample.
9KMR4R	Based on the assessment of the findings the paint chips of item 2 and the paint sample of item 1 match to each other. Item 2 and item 1 can be from the same origin. The paint chips of item 3 and the paint sample of item 1 do not match to each other.
9MTA3N	D) RESULTS OF EXAMINATION 1. Layer Structure Determination: a. Microscopic examination of questioned particles Q1 and Q2 disclosed the following layer structures: i. Q1 (two particles): uneven flexible and porous beige coat (Layer 1) / uneven crumbly white coat (Layer 2) / wooden substrate ii. Q2 (two particles): uneven flexible and porous beige coat (Layer 1) / uneven spongey white coat (Layer 2) / wooden substrate b. Microscopic examination of known paint K1 disclosed the following layer structure: i. K1: uneven flexible and porous beige coat (Layer 1) / uneven crumbly white coat (Layer 2) / wooden substrate 2. Comparison Result: a. One particle was selected from Q1 for instrumental analysis and designated Q1a. Questioned particle Q1a and known paint K1 are consistent and no exclusionary differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. b. The remaining particle from Q1 was designated Q1b. No further analysis was performed on this particle, therefore no conclusions can be made. c. Both particles from Q2 were instrumentally analyzed and designated Q2a and Q2b, respectively. Questioned particles Q2a and Q2b and the known paint K1 are different with respect to chemical type. E) INTERPRETATION OF RESULTS 1. It is the opinion of the undersigned that questioned particle 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. No conclusions can be made regarding questioned particle Q1b because instrumental analysis was not performed at this time. 3. It is the opinion of the undersigned that questioned particles Q2 could not have originated from the same source as represented by the known paint K1 submitted.
AN2G9M	The door trim, as represented by Exhibit 1, could be the source of the Exhibit 2 paint chips. Architectural paint is mass produced; therefore, another wood object with a similar paint scheme could also be the source of Exhibit 2. The door trim, as represented by Exhibit 1, cannot be the source of the paint chips from Exhibit 3.
C23X8M	Results of Examination and Interpretation The known paint sample in Item 1 from the damaged area of the victim's side door trim comprised a 2-layered paint chip, having a beige first layer and a white second layer. 2-layered paint chips, having a beige first layer and a white second layer were found from Item 2 recovered from the suspect. The recovered paint chips in Item 2 were found to agree in colour, chemical composition and layer sequence with the corresponding layers of the known paint sample in Item 1, indicating that the recovered paint chips from Item 2 could have originated from the same source as the known paint sample in Item 1. 2-layered paint chips, having a beige first layer and a white second layer were found from Item 3 recovered from the suspect. The white second layer of the recovered paint chips in Item 3 were found to agree in colour but differ in chemical compositions with the white second layer of the known paint sample in Item 1, indicating that they did not originate from the same source. Conclusion In view of the above laboratory findings, the recovered paint chips in Item 2 could have acquired from the damaged area of the victim's side door trim.
CRUB7E	Item 1 comprised a paint sample with the layer sequence: light brown topcoat/white undercoat. The light brown topcoat was identified as an acrylic-type paint containing titanium dioxide. The bulk elemental composition of the topcoat principally comprised titanium, silicon, aluminium and iron. The white undercoat was tentatively identified as an alkyd-type paint containing styrene, talc and calcium carbonate. The bulk elemental composition of the undercoat principally comprised silicon, magnesium, calcium, titanium and aluminium. Item 2

TABLE 3

WebCode	Conclusions
	comprised a paint sample with the layer sequence: light brown topcoat/white undercoat. The layer sequence, appearance and composition of Item 2 was indistinguishable from that of Item 1. Therefore, these results support the proposition that the paint recovered from the suspect (Item 2) originated from the side door trim (Item 1), rather than an alternative source. Item 3 comprised a paint sample with the layer sequence: light brown topcoat/white undercoat. The composition of the white undercoat from Item 3 differed from that of Item 1. Therefore, the results do not support the proposition that the paint recovered from the suspect (Item 3) originated from the side door trim (Item 1). Difficulties in analysis may include low quantity of recovered material, smeared layers, or materials that contain components that obscure the presence of other components (such as a large proportion of filler/extender). Tentative identifications are reported where individual components cannot be unequivocally identified.
CUJUZK	The paint from item 2 is similar to the paint from item 1 in all examined characteristics, including layer structure (layer order, textures, thicknesses, and colors), fluorescence characteristics, and chemical composition. The paint from item 2 could have originated from the same source as the paint from item 1 or another source of paint with the same layer structure and chemical composition. The paint from item 3 differs from the paint from item 1 in fluorescence characteristics and chemical composition. Item 1 is eliminated as the source of item 3, as represented by the sample submitted for item 1.
CVUM2E	Items 1, 2 and 3 consisted of a light brown layer, a white layer and a wooden substrate, respectively. Microscopic examination revealed that the color and morphology of each layer in items 1, 2 and 3 were similar. Analysis of each layer using FT-IR and SEM-EDS showed that both the light brown and white layers of item 2 had chemical compositions similar to those of item 1. Consequently, item 2 was determined to have originated from the same source as item 1. However, the white paint layer of item 3 was found to be distinct from that of item 1. Since it was identified as a different type of resin, item 3 was determined to be from a different source.
CXH6WK	The two-layered beige paints 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 paints in Items 1 and 2 originated from either the same source or different sources painted in the same manner (Level II – Association with Highly Discriminating Characteristics). This type of conclusion was reached because Items 1 and 2 both exhibit architectural paint systems with two layers of varying colors and chemistries. The layer structure of architectural paint is dictated by a number of factors (color choice, price, desired properties, etc.) that are unlikely, though not impossible, to be reproduced in another viable source of paint. It should be noted that the techniques used in this comparative analysis can typically distinguish architectural paint systems/layers with differing colors and/or chemistries. Based on the particles examined, the two-layered beige paint in Items 1 and 3 could not be associated due to differences in chemical composition (Exclusion/Elimination).
DGPW8L	The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show the same paint layers: a bright brown layer and a white layer. All layers of all samples were analyzed by microscopy, infrared spectroscopy and SEM/EDX. 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 SEM/EDX. Based on the results, the questioned paint chips from the suspect (Item 2) could have originated from the damaged area of the victim's side door trim (Item 1).
E4V3BH	After analysis (i) Known sample marked "Item 1" is similar to recovered paint chips marked "Item 2" (ii) Known sample marked "Item 1" is dissimilar to recovered paint chips marked "Item 3".
ED76WJ	On analysis, I found that: (i) The questioned paint chips recovered from the suspect (Item 2) is similar to the known paint sample representative of the damaged area of the victim's side door

TABLE 3

WebCode	Conclusions
	trim (Item 1). (ii) The questioned paint chips recovered from the suspect (Item 3) is dissimilar to the known paint sample representative of the damaged area of the victim's side door trim (Item 1). Hence, I am of the opinion that: (i) The questioned paint chips recovered from the suspect (Item 2) could have originated from the same source as the known paint sample representative of the damaged area of the victim's side door trim (Item 1). (ii) The questioned paint chips recovered from the suspect (Item 3) could have originated from the different sources as the known paint sample representative of the damaged area of the victim's side door trim (Item 1).
ETJDWM	On analysis, I found: i) The questioned paint chips recovered from the suspect (Item 2) to be similar to the known paint sample representative of the damaged area of the victim's side door trim (Item 1). ii) The questioned paint chips recovered from the suspect (Item 3) to be dissimilar to the known paint sample representative of the damaged area of the victim's side door trim (Item 1). Based on the findings, I am of the opinion that: i) The questioned paint chips recovered from the suspect (Item 2) and the known paint sample representative of the damaged area of the victim's side door trim (Item 1) could have come from the same source. ii) The questioned paint chips recovered from the suspect (Item 3) and the known paint sample representative of the damaged area of the victim's side door trim (Item 1) did not come from the same source.
EZHVDK	CONCLUSIONS: The questioned paint recovered from the suspect (item 2) is the same distinct type of paint as the known paint on the victim's side door trim (item 1) and originated either from that source or another source of architectural paint having the same distinct characteristics. The questioned paint recovered from the suspect (item 3) did not originate from the area/panel of the victim's side door trim represented by item 1. RESULTS: Questioned paint chips recovered from the suspect (items 2 and 3) were examined for the purpose of determining whether or not there is any paint present like that on the victim's side door trim (item 1). The paint standard from the victim's side door trim (item 1) has the following layer structure: 1. Light brown acrylic enamel topcoat 2. White alkyd enamel primer This paint exhibits characteristics typical of an architectural finish and was used for comparison with questioned paint recovered from the suspect (items 2 and 3). The questioned paint recovered from the suspect (item 2) has the same layer structure as the known paint from the victim's side door trim (item 1). Examination and comparison of the questioned paint (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 recovered from the suspect (item 2) is the same distinct type of paint as that on the victim's side door trim (item 1) and originated either from that door, or from another source of architectural paint having the same distinct characteristics. The questioned paint recovered from the suspect (item 3) has the following layer structure: 1. Light brown acrylic enamel topcoat 2. White acrylic enamel primer Examination and comparison of the questioned paint (item 3) with item 1 revealed they are dissimilar with respect to layer textures, binder characteristics, and general binder types. It is therefore concluded that the questioned paint recovered from the suspect (item 3) did not originate from the area/panel 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.
G4UP3F	A. Visual Examination 1. Item 1 is a wooden fragment coated on top with a light brown layer and a white layer. 2. Item 2 and 3 are two square wood chips, respectively, each coated sequentially with a brown layer and a white layer. B. Component Analysis 1. The light brown and white layers identified in Item 1 show infrared absorption spectra patterns similar to those of the light brown and white layers identified in Item 2. 2. The light brown layer identified in Item 1 shows an infrared absorption spectrum pattern similar to that of the light brown layer

TABLE 3

WebCode	Conclusions
	identified in Item 3. However, the white layer of Item 1 shows a different infrared absorption spectrum pattern compared to Item 3. Conclusion A. The light brown and white layers identified in Item 1 and 2 are similar in both color and composition. B. The light brown layer identified in Item 1 and 3 are similar in composition; however, the white layers are different in composition. Based on the analytical results, Item 2 is likely to have originated from Item 1 whereas 3 is unlikely to have originated from Item 1.
G9NJZG	1. The questioned paint chips Item 2 recovered from the suspect might have been originated from the damaged area of the side door trim. 2. The questioned paint chips Item 3 recovered from the suspect could not have been originated from the damaged area of the side door trim.
GAV2YD	The Questioned paint chips recovered from the suspect (Item 2) could have originated from paint sample of the damaged area of the victim's side door trim (Item 1), because of the similarities of their physical properties and chemical compositions. Questioned paint chips recovered from the suspect (Item 3) could NOT have originated from damaged area of the victim's side door trim (Item 1), because of the differences of their physical properties and chemical compositions.
GKVPUF	Item 1 - Known Paint Sample from Damaged Area of Victim's Side Door Trim: This item was used for comparison purposes. Item 2 - Questioned Paint Chips from Suspect: This item is comprised of two architectural paint chips. The questioned paint chips are similar in visual color to the known paint sample from the damaged area of the victim's side door trim (Item 1). One of these paint chips was selected for further analysis and is similar in layer sequence, fluorescence, chemical solubility, paint type, and paint composition to the known paint sample (Item 1). It is our opinion that the questioned paint could have come from the damaged area of the victim's side door trim, or any other source with similar paint characteristics. No analysis was performed on the remaining paint chip. Item 3 - Questioned Paint Chips from Suspect: This item is comprised of two architectural paint chips. One of these paint chips was selected for further analysis and is dissimilar in paint type to the known paint sample from the damaged area of the victim's side door trim (Item 1). It is our opinion that the questioned paint did not come from the damaged area of the victim's side door trim. No analysis was performed on the remaining paint chip.
GMMENA	The paint sample from the damaged area of the victim's side door trim (item 1) and the two paint samples from the suspect (items 2 and 3) consisted of a light brown paint layer on a white paint layer. The chemical composition of each paint layer from these samples were determined using Fourier transform infrared spectroscopy. The elemental compositions of the paint layers from item 1 and item 2 were determined using scanning electron microscopy with an energy dispersive X-ray detector. Using these techniques, the paint sample recovered from the suspect (item 2) could not be excluded as coming from the damaged area of the victim's side door trim (item 1). Therefore, item 2 could have come from the damaged area of the victim's side door trim or from a different source of this type of two-layered paint. In subjectively interpreting the examination results of item 1 and item 2, I have considered the probability of obtaining these results given item 2 has come from the victim's side door trim. Conversely, I have also considered the probability of these results given item 2 has not come from the victim's side door trim. In my opinion, I would expect to obtain these results if item 2 had come from the victim's side door trim. Conversely, given there are a large number of paint colours, as well as different chemical and elemental paint compositions, I would expect to observe a difference in these results if item 2 came from another source of this type of paint. However, I did not observe any such differences. Therefore in my opinion, the results of the paint analysis provide strong support for the proposition that the paint sample, item 2, came from the damaged area of the victim's side trim as opposed to a different source of this type of two-layered paint. I have chosen the term "strong support" from the following range of

TABLE 3

WebCode	Conclusions
	conclusions: neutral, slight support, moderate support, strong support, very strong support and extremely strong support. This scale can be used to indicate the level of support the evidence provides for either of the propositions. The chemical composition of the white paint layer in the paint sample recovered from the suspect (item 3) was different to the chemical composition of the white paint layer in the paint sample from the damaged area of the victim's side door trim (item 1). Therefore in my opinion, the paint sample, item 3, could not have come from the damaged area sampled of the victim's side door trim (item 1).
GULAZE	Item 1: A two-layer tan paint standard was analyzed for comparison to unknown Items 2 and 3. Item 2: Two small pieces of a two-layer tan paint chip were found. In the sample analyzed, the unknown paint (Item 2) and the standard paint (Item 1) are the same in physical and chemical characteristics. The unknown paint (Item 2) either originated from the standard (Item 1) or another source of paint possessing the same distinct physical and chemical characteristics. Item 3: Two small pieces of a two-layer tan paint chip were found. In the sample analyzed, the unknown paint (Item 3) and the standard paint (Item 1) are not the same in chemical characteristics. The unknown paint (Item 3) could not have originated from the standard (Item 1).
HKB9ED	Microscopic and instrumental analysis and comparison of Item 2 to Item 1 revealed an association with discriminating characteristics. The paint from the subject was consistent with respect to color, texture, type, layering sequence, binder composition, and elemental composition. Therefore, Item 2 came from the door or another source with these same properties. Microscopic and instrumental analysis and comparison of Item 3 to Item 1 revealed them to be inconsistent with respect to primer binder composition. Therefore, the paint from the subject in Item 3 did not originate from the door in Item 1.
JDB9FB	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: tan 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. Note: Because paint is mass produced, it is not possible to state that a paint chip originated from a particular source to the exclusion of all other materials that exhibit the same appearance, microscopic and chemical properties.
JLPUNF	The questioned paint samples (Item 001-2) recovered from the suspect was indistinguishable from the known paint sample (Item 001-1) representative of the damaged area of the victim’s side door. Therefore, the questioned paint samples (Items 001-2) could have come from the damaged area of the victim’s side door (Item 001-1) or from another source of paint with the same physical and chemical properties. The other questioned paint samples (Item 001-3) recovered from the suspect was distinguishable from the known paint sample (Item 001-1) representative of the damaged area of the victim’s side door. Therefore, the questioned paint samples (Items 001-3) did not come from the sampled area of the known paint sample (Item 001-1) representative of the damaged area of the victim’s side door.
KG4QUE	Light brown paint in Item 2 was indistinguishable from light brown paint in Item 1 in color, type, layer structure, texture, and elemental composition (Type 2 Association: Association with Distinctive characteristics). This means that the questioned paint chips recovered from the

TABLE 3

WebCode	Conclusions
	suspect could have originated from the damaged area of the victim's side door trim. Item 3 was different from Item 1 (Elimination). This means that the questioned paint chips recovered from the suspect did not originate from the damaged area of the victim's side door trim. Trace Interpretation Scale Type 1 Association: Physical Fit—The compared items exhibit physical features that demonstrate they were once part of the same object. Type 2 Association: Association with Distinctive characteristics—Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. The items further share distinctive characteristics that would not be typically encountered in the relevant population. Type 3 Association: Association with Conventional characteristics—Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. Because other items have been manufactured or are naturally occurring that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Type 4 Association: Association with limited characteristics and/or examination (1) Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. This type of evidence may be commonly encountered in the environment or may have limited comparative value. Or (2) The comparison between items may be categorized as a Type 4 Association if the association is limited by the inability to perform a complete analysis or if minor variations are observed in the examination results. Inconclusive—No conclusion could be reached regarding an association or an elimination between the items. Elimination—Items exhibit differences in one or more of the following: physical properties, chemical composition, or microscopic characteristics and therefore did not originate from the same source. Non-Association—The items were different in physical properties, chemical composition, and/or microscopic characteristics, indicating that the items did not originate from the same source. However, these differences were insufficient for a definitive elimination.
KWEF49	The individual layers of paint on item 2 cannot be distinguished from the damaged area (item 1) by means of the used methods. In contrast, the white paint layer of item 3 can be clearly distinguished from the corresponding paint layer from item 1. It is therefore possible that item 2 could originate from item 1, whereas item 3 cannot originate from item 1.
LFL6UC	The known paint sample representative of the damaged area of the victim's side door trim (Item 1), the questioned paint chips recovered from the suspect (Item 2) and the questioned paint chips recovered from the suspect (Item 3) show the same layers with light brown and white layer. All layers of three samples were analyzed by stereomicroscopy, Fourier transform-infrared-spectroscopy and Scanning electron microscopy-energy-dispersive X-ray spectroscopy. As a result, the questioned paint samples such as Item 2 could have originated from the damaged area of the victim's side door trim (Item 1), Item 3 could not have originated from Item 1.
LYLRKB	All samples consist of a gray layer and a white layer. FT-IR analysis shows that binders of gray layers of all samples are acrylic. Binders of white layers of ITEM 1 and ITEM 2 are alkyd, while that of ITEM 3 is acrylic. Pyrogram pattern of ITEM 2 is identical to that of ITEM 1, where as different from that of ITEM 3. Therefore ITEM 1 & 2 could have originated from the same source. Additionally, in the SEM/EDX analysis, the Ca was observed in ITEM 1 and ITEM 2, but not in ITEM 3.
MPQC9C	The paint chips of all three samples consist of two layers: beige and a white layer. The paint chips from the damaged area of the victim´s side door trim and the paint chips from item 2 show similar IR- spectra in both layers and they have the same inorganic elements. The IR-spectra from the white layer of sample 3 are different from the other white layers. It is highly

TABLE 3

WebCode	Conclusions
	possible that the questioned paint chips from the suspect (Item 2) originated from the damaged area of the victim´s side door trim.
MQ2CAC	The two-layer paint (beige over white primer) sampled from Item 1 (Known from victim's door) and Item 2 (Questioned from suspect - first) were found to be similar in chemical composition (FTIR). The damaged area of the victim's side door trim cannot be excluded as a possible source of this first questioned paint sample recovered from the suspect. The two-layer paint (beige over white primer) sampled from Item 1 (Known from victim's door) and Item 3 (Questioned from suspect - second) were found to be dissimilar in chemical composition (FTIR). The damaged area of the victim's side door trim is not the source of this second questioned paint sample recovered from the suspect.
MQLRL9	The questioned paint from Items 1,2 and 3 each consisted of a beige layer over a white layer. The questioned paint from Item 2 was consistent in color, microscopic characteristics, layering, chemical composition and elemental composition with the known paint from Item 1 and could have originated from that source (Association with Discriminating Characteristics). The questioned paint from Item 3 was inconsistent in chemical composition with the known paint from Item 1 and did not originate from that source (elimination). APPENDIX 1: STANDARD GUIDE FOR INTERPRETATION AND REPORTING IN FORENSIC COMPARISONS OF TRACE MATERIALS (FROM ASTM E3462-25) This guide focuses on a qualitative approach to communicate the significance of an association or exclusion, based on (1) the validated methodology used for the comparison of the items, (2) discrimination capabilities of the analytical scheme, and (3) existing knowledge of how discriminating the compared characteristics are based on survey studies, reference collections, or databases. While the significance of each association is assessed independently, cross-transfers or multiple transfers, when they occur, are examples of factors that could further increase the significance of findings. The interpretation scale is an example of descriptions for the interpretation categories and the respective opinions for forensic comparisons of trace materials. The following descriptions are meant to provide context to the interpretation categories selected within a report. Physical Fit—Physical Fit is the highest degree of association between items. It is the opinion that the observations provide the strongest support for the proposition that the items were once joined together to form a single object as opposed to originating from different sources. Physical Fit is reached when the items that have been broken, torn, or separated exhibit physical features that correspond or re-align in a manner that is not expected to be replicated. 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 occur in the relevant population. This type of association provides very strong to extremely strong support for the proposition that the items originated from the same source as opposed to different sources. This is the highest degree of association that can be determined in the absence of a Physical Fit. 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. This type of association provides moderately strong to strong support for the proposition that the items originated from the same source as opposed to different sources. The analytical techniques used in the analysis of these items can provide high levels of discrimination among natural and manufactured materials and therefore this is considered a strong association. 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. This type of association provides slight to

TABLE 3

WebCode	Conclusions
	moderate support for the proposition that the items originated from the same source as opposed to different sources. As compared to the categories above, this type of association has decreased evidential value. 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 explainable variations were observed in the data. Inconclusive—No opinion could be reached regarding an association or an exclusion between the items. This provides an indeterminate support for the propositions that the items originated from either the same source or different sources. 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; however, limiting factors prevented an Exclusion (Elimination) from being reached. This provides slight to strong support for the proposition that the items originated from different sources as opposed to the same source. Exclusion (Elimination)—The items exhibit differences that provide the strongest support that the items originated from different sources as opposed to the same source.
MZCDQ8	Microscopic examination: All of them (Item1, 2, 3) contain two layers, which are light brown and white coats from top to bottom. Item 2 and Item 1 were found to be consistent in instrumental analysis. However, Item 3 and Item 1 were found to be different.
N66ZV6	The paint from item two was found to be similar in colour, chemical properties and chemical composition with the paint in item one. The paint from item two, recovered from the suspect, could have originated from the same source as item one (paint from the damaged area of the victim's side door trim). The paint from item three was found to be similar in colour but different in chemical properties with the paint in item one. The paint from item three, recovered from the suspect, could not have originated from the same source as item one (paint from the damaged area of the victim's side door trim).
NB6JXA	The questioned paint chips recovered from the suspect, marked “Item 2”, could have originated from the same source as the known paint sample representative of the damaged area of the victim's side door trim marked “Item 1”, or another source of paint with similar characteristics. The questioned paint chips recovered from the suspect, marked “Item 3”, did not originate from the same source as the known paint sample representative of the damaged area of the victim's side door trim marked “Item 1”.
NCZYA8	Items 01 and 02 have two (2) layers of paint that match both in their arrangement and composition, so both samples are COMPATABLE. Therefore, the paint in item 02 may have the same origin as that in item 01. Items 01 and 03, despite having the same arrangement and number of paint layers and being the finish layer of the same composition, differ in the composition of the primer, so both samples ARE NOT COMPATIBLE. Therefore, the paint fragments of item 03 do not have the same origin as that of item 01.
NQGWF8	All items are composed of two layers, a beige upper layer and a white lower layer. - Beige colored and white colored layers of item 1 and item 2 are similar in both color and chemical composition. - As observed in FT-IR and SEM/EDX analyses, beige colored layers of item 1 and item 3 are similar, whereas white layers are different in chemical composition. In conclusion, item 2 is considered to have originated from item 1, whereas item 3 is not considered to have originated from item 1.
P36JX9	All items are composed of two paint layers: a beige upper layer and a white lower layer. Similar FTIR spectra for acrylic paint were obtained from the beige upper layers of all items. In case of white paints, Item 2 showed an alkyd spectrum similar to that of Item 1; however an acrylic spectrum was confirmed for Item 3.
P83XP4	Items 1, 2 and 3 are consistent in layer color and layer structure. All items are two-layer architectural paint with tan top layer and white bottom layer. Items 1 and 2 are consistent in

TABLE 3

WebCode	Conclusions
	chemical composition, pigment appearance and distribution. Therefore, Item 2 originated from the side door trim as represented by Item 1 or from another damaged object having paint with the same analyzed characteristics. The white layer of Item 3 is different in chemical composition from the white layer of Item 1. Therefore, Item 3 did not originate from the side door trim as represented by Item 1.
QDKPA3	item 1 and item 2 could have been originated from the same source
QHFJ84	Items 1, 2, and 3 were analyzed via Fourier transform infrared spectroscopy (FTIR), x-ray fluorescence spectroscopy (XRF), and fluorescence observation (UV and royal blue illumination) to investigate sample similarities/differences. Each was observed via optical light microscopy prior to analysis, as well. While XRF measurements of the paint layer were consistent across all 3 items, a measurable variance in potassium (K), calcium (Ca), and magnesium (Mg) was observed in the primer layer in Item 3 (primer layers on samples 1 and 2 were consistent). FTIR analysis confirmed the primer on Item 3 varied from Items 1 and 2 - showing multiple distinct spectral variances in the fingerprint region (~1600-500 cm-1). Additionally, FTIR analysis confirmed the paint coat was compositionally identical across all 3 samples. Paint chip labeled "Item 2" generally matched the reference ("Item 1"), and could have originated from the damaged area of the side door trim. Paint chip labeled "Item 3" showed distinct differences to the reference ("Item 1") in the primer layer, and did not originate from the damaged area of the side door trim.
QLYBJ7	The know paint sample (Item 1) is a possible source for Item 2 but not Item3. Each sample had two layers of paint - a gray layer and a white layer - all of similar thickness, colors, and arrangement. The gray layer was composed of the same matrix material and filler particle formulation in all three samples. The white layer in Items 1 and 2 were composed of the same matrix material and filler particle formulation, but the white layer in Item 3 had both a different matrix material and filler particle formulation than Item 1.
QWKD78	01 : 3x5.5 yellow envelope 01-01-AA : Piece of painted wood (victim's side door) This item was used for comparisons. 01-02-AA : Paint chips (from the suspect) The questioned paint chips are similar in visual color to the known paint from the victim 's side door (01-01-AA). One of these paint chips was selected for further analysis and is similar in layer sequence, chemical solubility, fluorescence, paint type, and paint composition to the known paint from the victim 's side door. It is my opinion that the questioned paint could have come from the victim 's side door or any other painted surface with similar paint characteristics (Category 2B). No analysis was performed on the remaining paint chips. No further analysis was performed. 01-03-AA : Paint chips (from the suspect) The questioned paint chips are similar in visual color but dissimilar in physical characteristics to the known paint from the victim's side door (01-01-AA). It is my opinion that the paint chips did not originate from the victim's side door (Category 5). No further analysis was performed. Investigative Leads and Requirements for Further Analysis: If additional trace evidence analysis is necessary, please contact this analyst. Disposition: The evidence is being retained.
RGK273	CONCLUSIONS: 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.
RLTER8	The paint sample from the 'damaged area of the victim's side door trim' (Item 1) consisted of a piece of wood with a light brown topcoat and a white 2nd layer applied to one surface. The paint chips 'recovered from the suspect' (Item 2 and Item 3) both consisted of small fragments of wood with a light brown topcoat and a white 2nd layer applied to the surface. The light brown topcoat and the white 2nd layer of the paint chips 'recovered from the suspect' (Item 2) were indistinguishable from the respective light brown topcoat and white 2nd layer of the paint sample from the 'damaged area of the victim's side door trim' (Item 1) with respect to their

TABLE 3

WebCode	Conclusions
	appearance, colour, chemical and elemental composition. In my opinion, this result provides moderate support for the contention that the paint chips 'recovered from the suspect (Item 2) originated from the 'damaged area of the victim's side door trim' (Item 1). The white 2nd layer of the paint chips 'recovered from the suspect' (Item 3) was distinguishable in chemical and elemental composition from the white 2nd layer of the paint sample from the 'damaged area of the victim's side door trim' (Item 1). Therefore, in my opinion, the paint chips 'recovered from the suspect' (Item 3) did not originate from the 'damaged area of the victim's side door trim' (Item 1).
RTF6E3	Examinations: Visual examination, stereomicroscopy, fluorescence microscopy, polarized light microscopy, infrared spectroscopy, scanning electron microscopy - energy dispersive spectroscopy Information: Questioned paint samples recovered from a suspect (Items 2, 3) were examined and compared to known paint reportedly collected from the damaged area of door trim (Item 1) to determine if either questioned paint sample could have originated from the door trim. The layering structure of each submitted paint sample was tan paint over white paint. Results: Each paint layer of Item 2 corresponded to the respective paint layer of Item 1 in all examinations performed. In the opinion of the examiner, the questioned paint of Item 2 originated either from the door trim as represented by Item 1 or from another paint source with indistinguishable properties. (Level 3 - Association) Items 1 and 3 differed in the chemistry of the white layer of paint. In the opinion of the examiner, Item 3 did not originate from the door trim as represented by Item 1. (Elimination)
V2CGWZ	Physical and chemical examinations indicate that: Item 2 is indistinguishable from item 1 in physical and chemical proprieties. Therefore, item 2 (Questioned paint chips recovered from the suspect) could have originated from item 1 (Known paint sample representative of the damaged area of the victim's side door trim). Item 3 is distinguishable from item 1 in chemical proprieties. Therefore, item 3 (Questioned paint chips recovered from the suspect) did not originated from item 1 (Known paint sample representative of the damaged area of the victim's side door trim).
V2FZJ4	1) Sample description All items submitted for testing were analyzed in accordance with the police inquiry. ITEM 1 : a reference paint sample representative of the damaged area on the victim's side door trim. This sample consists of two distinct layers : a beige-brown base layer and a white top layer. ITEM 2 and 3 : samples recovered from the suspect, both exhibiting a two-layer structure similar to ITEM 1. 2) Observation and analytical results Visual comparison : no morphological differences were observed between ITEM 1 and ITEM 2&3. Infrared spectroscopy : The IR spectrum of the white layer in ITEM 3 is distinct from that of ITEM 1 The IR spectra of beige-brown layers in both ITEM 2 and ITEM 3 are indistinguishable from ITEM 1 Raman Spectroscopy : The spectra for both the white and beige-brown layers of ITEM 2 are consistent with those ITEM 1. Emission line analysis : The elemental emission bands for both layers of ITEM2 are indistinguishable from those of ITEM 1. The paint contained in ITEM 3 and ITEM 1 originate from different sources. Conversely, the analytical data suggests that the paint in ITEM 2 and ITEM 1 likely share a common origin. Based on the results of observations and analyses : 1-The paint recovered from the suspect (ITEM 3) did not originate from the damaged area of the victim's side door trim. (ITEM 1) 2-The paint recovered from the suspect (ITEM 2) is highly likely to have originated from the damaged area of the victim's side door trim.
VNQ4H6	1. The questioned paint chips recovered from the suspect (Item 2) could have originated from the damaged area of the side door trim represented by Item1. 2. The questioned paint chips recovered from the suspect (Item 3) could not have originated from the damaged area of the side door trim represented by Item1.
W4XK4X	The samples all contained two layers, a white layer and a tan topcoat. Sampling for IR spectra

TABLE 3

WebCode	Conclusions
	revealed that there was a visible difference in the primer layer of Sample 3. This was confirmed by infrared spectroscopy. The spectra of the topcoats matched. The spectra of the primers on Samples 1 and 2 were the same. The spectrum of the primer from Sample 3 did not match Sample 1.
WJBT62	The comparison between the unknown tan paint sample in Item 2 and the exemplar tan paint sample in Item 1 revealed similar class characteristics including optical, physical and chemical properties. Therefore, the source of the exemplar tan paint sample in Item 1 is included as a possible source of the unknown tan paint sample in Item 2. For another exemplar paint to be included as a possible source of item 2, it would have to share the same class characteristics. The comparison between the unknown tan paint sample in Item 3 and the exemplar tan paint sample in Item 1 revealed dissimilar class characteristics including chemical properties. Therefore, the source of the exemplar tan paint sample in Item 1 is excluded as a possible source of the unknown tan paint sample in Item 3.
WQC62X	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: tan 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 in layer structure, layer colors, or layer composition. 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 Fit – 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.
WTFZK2	The questioned paint chip recovered from the suspect (Item 2) has originated from the damaged area of the side door trim.
XY4ULT	Item 3 could be differentiated to Item 1 based on differences in chemical compositions. In

TABLE 3

WebCode	Conclusions
	regard to Item 2, I have considered the following propositions to evaluate my findings: 1. Paint chips recovered from the suspect (Item 2) originated from the damaged area of the door (Item 1). 2. Paint chips recovered (Item 2) from the suspect came from another source. In relation to questioned Item 2, I consider the findings to be more probable if the first proposition is true, that is, Item 2 originated from the damaged area of the victim's side door trim rather than the second. Based on the results, it is my opinion that: i. Item 3 could not have originated from Item 1 based on different chemical compositions. ii. The findings provide moderate support for the proposition that Item 2 originated from Item 1.
Y8RB6U	Examinations: Visual examination, stereomicroscopy, polarized light microscopy, fluorescence microscopy, infrared spectroscopy (IR), microspectrophotometry, scanning electron microscopy - energy dispersive spectroscopy Information: Two questioned paint samples (CTS Items 2 and 3) were submitted for comparison to a known paint sample (CTS Item 1). Each item had a paint layer sequence of beige over white. Results: Each layer of the sampled questioned paint in Item 2 corresponded to the respective layer of the sampled known paint in Item 1 in all tests performed. In the opinion of the examiner, the questioned paint in Item 2 originated either from the door frame as represented by Item 1 or from another paint source with indistinguishable properties (Level 3 - Association). Because other items may have been painted with paint that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. The sampled white layers of Item 3 and Item 1 differed in chemistry by IR. In the opinion of the examiner, the questioned paint in Item 3 did not originate from the source represented by the known paint sample in Item 1 (Elimination/Non-association).
YZQY9W	Item 1: Two-layer, grey/beige architectural paint standard analyzed for comparison to item 2 and item 3. Item 2: Two, two-layer grey/beige architectural paint samples were submitted. In the sample analyzed, the unknown grey/beige paint "recovered from the suspect" and the standard paint (item 1) are the same in physical characteristics (color, layer structure, texture, and fluorescence) and chemical characteristics (organic and elemental). The unknown paint either originated from the standard "representative of the damaged area of the victim's side door trim" or another source of paint possessing the same distinct physical and chemical characteristics. Item 3: Two, two-layer grey/beige architectural paint samples were submitted. In the sample analyzed, the unknown grey/beige paint "recovered from the suspect" and the standard paint (item 1) "representative of the damaged area of the victim's side door trim" are not the same in physical characteristics (texture, distribution of extenders/pigments in undercoat, or fluorescence). The unknown paint could not have originated from the standard.
Z6FVBT	Information: The submitted questioned paint chips (Items 2 and 3, reportedly recovered from the suspect) and known paint chip (Item 1, reportedly representative of the damaged area of the victim's side door trim) were stereoscopically examined and determined to all have the same layer sequence of tan over white paint. Layers of each item were analyzed and compared using one or more of the following methods: polarized light microscopy, fluorescence microscopy, infrared spectroscopy, and scanning electron microscopy - energy dispersive spectroscopy. Results: The respective layers of Items 1 and 2 were similar in all examinations performed. In the opinion of the examiner, Item 2 originated either from the source as represented by Item 1 or from another indistinguishable paint source (Level 3 - Association). The white layers of Items 1 and 3 were dissimilar by polarized light microscopy and fluorescence microscopy. In the opinion of the examiner, Item 3 did not originate from the source as represented by Item 1 (Elimination).

Additional Comments

TABLE 4

WebCode	Additional Comments
43E4PW	We consider very useful this kind of test.
47G34V	APPENDIX: The following descriptions are meant to provide context to the opinions reached in this report. Not every type of conclusion may be applicable in every case or for every material type. Type I Inclusion: Physical Fit – Physical Fit is the highest degree of association between items. This association provides the strongest support that the items originated from the same source as opposed to different sources. A Physical Fit is reached when the items display physical features that correspond/re-align in a manner that is not expected to be replicated. Type II Inclusion: Inclusion with Highly Discriminating Characteristics – This is the highest degree of association that can be determined in the absence of a Physical Fit. This type of association provides strong support that the items originated from the same source as opposed to different sources. The items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and share highly discriminating characteristic(s) that would rarely be expected to occur in the relevant types of materials examined. Type III Inclusion: Inclusion with Discriminating Characteristics – This type of association provides support that the items originated from the same source as opposed to different sources. The items correspond in all measured physical properties, chemical composition and/or microscopic characteristics; however, other items have been manufactured or could occur in nature that would also be indistinguishable from the examined materials. Type IV Inclusion: Inclusion with Limitations – This type of association provides limited support that the items originated from the same source as opposed to different sources. 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 due to limiting factors such as the items are more commonly encountered, a limited analytical scheme was conducted, or minor variations were observed in the data. Inconclusive – No conclusion could be reached regarding an inclusion or an exclusion between the items. Exclusion with Limitations – This conclusion provides support that the items originated from different sources as opposed to the same source due to observed differences; however, an Exclusion conclusion was not reached due to limiting factors such as possible natural or manufactured source variations, damage or contamination that cannot be removed or avoided. Exclusion – The items display differences that support that the two items did not originate from the same source.
6FMAEP	The fragments contained in item 3 were found to be different to the sample taken from the victim's property and therefore they must have originated from a different source. However, given the similarities to the paint sample taken from the scene, I would not exclude the possibility that these could have originated from a different area of the damaged door trim, which could be explored by examining more samples.
8NTQ7L	only one of the questioned paint particles were tested form each questioned sample. PY-GCMS is currently offline for paint analysis.
98E27Q	MSP and Fluorescence were not done due to the instruments being out of service.
9KMR4R	The item 1 and item 2 match in the appearence and due to the findings of the chemical analysis. At the item 1 and item 3 differences at the primer can be observed in the appearence and the chemical composition.
MQ2CAC	My examinations and analyses do not focus on the detection of inorganic materials. Items 1 and 2 may vary in their inorganic content.
NB6JXA	The conclusion levels are as follows: Identification, Very Likely, Could Have, Could Not Be

TABLE 4

WebCode	Additional Comments
	Ruled Out, Inconclusive, Unlikely and Exclusion.
RGK273	RESULTS: 1. Exhibit 1 contained a block of wood painted on one surface with the paint layer sequence: light brown / white. 2. Exhibit 2 contained two wood fragments, each painted on one surface with the paint layer sequence: light brown / white. The paint layers in Exhibit 2 were indistinguishable in color, texture and chemical composition from the corresponding paint layers in Exhibit 1. 3. Exhibit 3 contained two wood fragments, each painted on one surface with the paint layer sequence: light brown / white. The light brown paint layer in Exhibit 3 was indistinguishable in color from the light brown paint layer in Exhibit 1; however, slight variations in texture and chemical composition were observed between the light brown paint layers in Exhibits 3 and 1. While these variations could possibly be due to different degrees of drying, mixing and/or aging, this could not be confirmed; therefore, the forensic significance of these variations could not be determined. The white paint layer in Exhibit 3 was different in color, texture and chemical composition from the white paint layer in Exhibit 1.
RTF6E3	A Trace Evidence Association Scale would be included in the report.
Y8RB6U	An association scale would be included in the report.
YZQY9W	During the preparation of item 1, it appears that at least two applications of topcoat were applied to the one side of the piece of wood. The first application was allowed to dry just long enough for a separation of layers to occur and the delineation visible via PLM and SEM. The opposite side of this piece of wood does not exhibit this same phenomenon. Only one layer of paint can be observed with no clear separation between applications.
Z6FVBT	An Association Scale would be included in the report for context and to define conclusions.

-End of Report-
(Appendix may follow)

Collaborative Testing Services ~ Forensic Testing Program

Test No. 26-5451: Paint Analysis

DATA MUST BE SUBMITTED BY **April 27, 2026, 11:59 p.m. EDT** TO BE INCLUDED IN THE REPORT

Participant Code: U1234A WebCode: QPGMM3

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 where the side door trim at the victim's house was vandalized and paint damaged. A few hours later, police apprehended a suspect and recovered paint chips, similar in color to the victim's side door trim. Police are requesting you to examine the recovered paint chips and determine if they could have originated from the damaged area of the side door trim.

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 side door trim.
Item 2: Questioned paint chips recovered from the suspect.
Item 3: Questioned paint chips recovered from the suspect.

1.) Could either of the questioned paint chips recovered from the suspect (Item 2 and Item 3) have originated from the damaged area of the side door trim?

	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):

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)