Collaborative Testing Services, Inc
FORENSIC TESTING PROGRAM

Paint Analysis Test No. 18-545 Summary Report

Each sample set consisted of two items 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 71 participants and are compiled into the following tables:

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

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

Manufacturer's Information

Each sample set consisted of four items with layered paint and primer: two known samples (Items 1 and 2) and two questioned samples (Items 3 and 4) were cut from painted poplar wood plank substrates. Items 1 and 3 came from a plank with the same primer and topcoat. Item 2 was prepared with a different primer and topcoat than what was used for Items 1 and 3. Item 4 had the same primer that was used for Items 1 and 3 and the same topcoat that was used for Item 2. Participants were instructed to examine the questioned samples and determine if they could have originated from the same source as either of the known paint samples.

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 3 (ASSOCIATION): The known Item 1 and questioned Item 3 samples were prepared by applying two coats of primer (Valspar All-weather Exterior Primer/Sealer, latex) to several poplar wood planks. Then two layers of topcoat (Sherwin Williams Ovation Paint & Primer, Steely Gray (color code-HGSW1453)) were applied. The known Item 1 planks were cut into 1" x 3" x 1/4" pieces. One piece was packaged into a glassine bag and then a pre-labeled Item 1 envelope. For Item 3, 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 a pre-labeled Item 3 envelope. Items 1 and 3 were taken in close spatial proximity to one another, kept together as a group, and packaged into the sample sets as described below.

ITEM 2 (ELIMINATION): Item 2 was prepared by applying two coats of primer (Kilz Original Primer/Sealer/Stain Blocker, interior oil-based) to several poplar wood planks. Then two layers of topcoat (Valspar Signature High-Hiding Paint & Primer, Drizzling Mist (color code- 4006-1C)) were applied. The known Item 2 planks were cut into 1" x 3" x 1/4" pieces. One piece was packaged into a glassine bag and then a pre-labeled Item 2 envelope.

ITEM 4 (ELIMINATION): Item 4 was prepared by applying two coats of primer (Valspar All-weather Exterior Primer/Sealer, latex) to several poplar wood planks. Then two layers of topcoat (Valspar Signature High-Hiding Paint & Primer, Drizzling Mist (color code- 4006-1C)) were applied. 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 a pre-labeled Item 4 envelope.

SAMPLE SET ASSEMBLY: For each sample pack, an Item 1 and an Item 3 from the same identification group along with an Item 2 and Item 4 were placed into a pre-labeled envelope and sealed with invisible tape. This process was repeated until all of the sample sets were prepared. Once verification was completed, all sample sets were further sealed with evidence tape and initialed "CTS."

VERIFICATION-
The expected association and elimination results were confirmed by predistribution laboratories, who used the following combined list of techniques: stereomicroscopy, pyrolysis GC, FTIR, and SEM-EDX.

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 four items with layered paint and primer: two known samples (Items 1 and 2) and two questioned samples (Items 3 and 4) were cut from painted wood plank substrates. Items 1 and 3 came from a plank with the same primer and topcoat. Item 2 was prepared with a different primer and topcoat than what was used for Items 1 and 3. Item 4 had the same primer that was used for Items 1 and 3 and the same topcoat that was used for Item 2. (Refer to Manufacturer's Information for preparation details.)

In Table 1, a consensus was determined by the responding participants that Item 3 could have originated from the same source as Item 1, but not from the same source as Item 2. In addition, there was a consensus that Item 4 could not have originated from the same source as either Item 1 or Item 2. Of the 71 participants that reported results, 12 (16.9%) had at least one response that was inconsistent with the consensus results. Based on the participants' conclusions and discussions with a field expert, it is speculated that some of the inconsistent responses could be due to differences in the interpretation of the inorganic quantitative results.

The most common examination methods utilized include stereomicroscopy, FTIR, and SEM/EDX.

Examination Results

Could the questioned paint chips recovered from the duffel bag (Item 3) or knitted hat (Item 4) have originated from the damaged area of the window frame or office door as represented by Item 1 and Item 2, respectively?

TABLE 1

WebCode	Item 1		Item 2		WebCode	Item 1		Item 2	
	Item 3	Item 4	Item 3	Item 4		Item 3	Item 4	Item 3	Item 4
2GZV3H	No	No	No	No	HWUFNF	Yes	No	No	No
2NUCKR	Yes	No	No	No	JD2YYD	Yes	No	No	No
3FZQRY	Yes	No	No	No	JE8NT9	Inc	No	No	No
3RBM7H	Yes	No	No	No	JU3D8D	Yes		No	No
3XE79U	Yes	No	No	No	KCYNGE	Yes	No	No	No
44MCGT	Yes	No	No	No	KJGZUF	Yes	No	No	No
4ADNJG	Yes	No	No	Yes	KPHFW9	Yes	No	No	No
4EHK3G	Yes	Yes	No	No	L446FC	Yes	No	No	No
62WZ9R	Yes	Inc	No	No	LCXLFW	Yes	No	No	No
7A2Y7E	Yes	No	No	No	LELPY9	Yes	No	No	No
829ERL	Yes	No	No	No	LPLTBC	Yes	No	No	No
83UHYH	Yes	No	No	No	M2QXR9	Yes	Yes	No	No
88PGMA	Yes	No	No	No	MRNFG7	Yes	No	No	No
893QGM	Yes	No	No	No	N24WD6	Yes	No	No	No
8W9UD9	Yes	No	No	No	NAZQC4	Yes	No	No	No
93AYRQ	Yes	No	No	No	NTUTMT	Yes	No	No	Yes
99KLG9	Yes	No	No	No	PD2ENR	Yes	No	No	No
9AQ73M	Yes	No	No	No	PF7MV4	Yes	No	No	No
A8MYPH	Yes	No	No	No	PJ447C	Yes	No	No	No
ABHYHJ	Yes	Yes	No	No	PT8DC3	Yes	No	No	No
AJVEK9	Yes	Yes	No	Yes	PUKQED	Yes	No	No	No
ANAJ8M	Yes	No	No	No	Q3CMG7	Yes	No	No	No
CDX9KF	Yes	No	No	No	TMBF93	Yes	No	No	No
DC3ZXH	Yes	No	No	No	TNMV33	Yes	No	No	No
EKDU27	Yes	Yes	No	No	UEGZB3	Yes	No	No	No
EKTDL4	Yes	Yes	No	No	VFZJKY	Yes	No	No	No
F82BGF	Yes	No	No	No	VL9XCV	Yes	No	No	No
G374NC	Yes	Yes	No	No	VRG7UZ	Yes	No	No	No
GQPGEB	Yes	No	No	No	VYGF96	Yes	No	No	No
HLDTEE	Yes	No	No	No	VZRRZ3	Yes	No	No	No

TABLE 1

WebCode	Item 1		Item 2		WebCode	Item 1		Item 2	
	Item 3	Item 4	Item 3	Item 4		Item 3	Item 4	Item 3	Item 4
W23KG3	Yes	No	No	No					
W38GGX	Yes	No	No	No					
WBRB4V	Yes	No	No	No					
WRUAP4	Yes	No	No	No					
XGQE7Y	Yes	No	No	No					
Y2C76V	Yes	No	No	No					
YB2WQ2	Yes	No	No	No					
YHYRNZ	Yes	No	No	No					
YXQVLV	Yes	No	No	No					
ZAKAKR	Yes	No	No	No					
ZF7P9J	Yes	No	No	No					

Response Summary

		Item 1		Item 2	
		Item 3	Item 4	Item 3	Item 4
Responses	Yes	**69** *(97.2%)*	**7** *(9.9%)*	**0** *(0%)*	**3** *(4.0%)*
	No	**1** *(1.4%)*	**62** *(87.3%)*	**71** *(100%)*	**68** *(95.8%)*
	Inc	**1** *(1.4%)*	**1** *(1.4%)*	**0** *(0%)*	**0** *(0%)*

Participants: 71

Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
2GZV3H	✓				✓	✓				
2NUCKR	✓	✓		✓	✓					
3FZQRY	✓			✓	✓					
3RBM7H	✓				✓	✓				
3XE79U	✓				✓			✓		RAMAN
44MCGT	✓				✓					
4ADNJG	✓				✓					Visual
4EHK3G	✓				✓	✓				
62WZ9R	✓				✓			✓	✓	
7A2Y7E	✓	✓	✓		✓					
829ERL	✓				✓			✓		
83UHYH	✓	✓			✓					
88PGMA	✓				✓		✓	✓		Raman
893QGM	✓				✓			✓		
8W9UD9	✓				✓			✓		Pyrolysis GC/MS, Colorimetry
93AYRQ	✓				✓		✓			
99KLG9	✓				✓			✓		
9AQ73M	✓				✓			✓		
A8MYPH	✓				✓			✓		UV (short wave and long wave)
ABHYHJ	✓				✓	✓				
AJVEK9	✓				✓	✓				
ANAJ8M	✓		✓		✓	✓		✓		
CDX9KF	✓				✓		✓			
DC3ZXH	✓	✓	✓		✓			✓		
EKDU27	✓				✓	✓				
EKTDL4	✓				✓	✓				

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
F82BGF	✓			✓	✓			✓		
G374NC	✓				✓			✓		Raman spectroscopy
GQPGEB	✓	✓			✓			✓		Pyrolysis GC-MS
HLDTEE	✓	✓		✓	✓	✓				
HWUFNF	✓	✓	✓	✓	✓					
JD2YYD	✓	✓	✓		✓			✓	✓	
JE8NT9	✓	✓	✓		✓		✓	✓		
JU3D8D					✓		✓			
KCYNGE	✓				✓					
KJGZUF	✓		✓		✓	✓		✓		
KPHFW9	✓		✓		✓			✓		
L446FC	✓	✓		✓	✓					Cross Section
LCXLFW	✓			✓	✓			✓		
LELPY9	✓		✓	✓	✓		✓			
LPLTBC	✓				✓			✓		
M2QXR9	✓				✓	✓		✓		
MRNFG7	✓				✓			✓		Raman Spectroscopy
N24WD6	✓		✓		✓					RAMAN (785 & 514 nm)
NAZQC4	✓				✓		✓			
NTUTMT	✓				✓					Raman Microscope and XRD
PD2ENR	✓				✓			✓		RAMAN
PF7MV4	✓	✓	✓		✓			✓		
PJ447C	✓			✓	✓					Raman
PT8DC3	✓				✓	✓				Fluorescence
PUKQED	✓				✓			✓		
Q3CMG7	✓	✓			✓			✓	✓	Macroscopic (visual) examination
TMBF93	✓				✓			✓		
TNMV33	✓				✓					

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
UEGZB3	✓	✓	✓		✓	✓		✓		
VFZJKY	✓				✓					Raman spectroscopy
VL9XCV	✓				✓		✓	✓		Light box
VRG7UZ	✓	✓			✓					
VYGF96	✓		✓		✓	✓		✓		
VZRRZ3	✓				✓			✓		
W23KG3	✓			✓	✓			✓		
W38GGX	✓			✓	✓					
WBRB4V	✓	✓			✓					
WRUAP4	✓				✓			✓		
XGQE7Y	✓	✓			✓		✓			
Y2C76V	✓				✓			✓		cross-section
YB2WQ2	✓		✓		✓	✓		✓		
YHYRNZ	✓				✓			✓		
YXQVLV	✓		✓		✓			✓		
ZAKAKR	✓				✓	✓	✓			SEM (only - no EDX), Alternate light source
ZF7P9J	✓				✓					

Response Summary

	Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry
	71	70	16	15	11	71	16	10	37	3
Percent		*99%*	*23%*	*21%*	*15%*	*100%*	*23%*	*14%*	*52%*	*4%*

Conclusions

TABLE 3

WebCode	Conclusions
2GZV3H	The questioned paint chips from the suspect's duffel bag (Item 3) and the questioned paint chips from the suspect's knitted hat (Item 4) did not originate from the damaged area of the window frame (Item 1). The questioned paint chips from the suspect's duffel bag (Item 3) and the questioned paint chips from the suspect's knitted hat (Item 4) did not originate from the damaged area of the office door (Item 2).
2NUCKR	The questioned paint chip (Item 3) could have originated from the damaged area of the window frame (Item 1). The Item 4 could not have originated from the Item 1 or the Item 2.
3FZQRY	The questioned gray paint chips from the suspect's duffel bag(Item3) comes from the damaged area of the window frame. The gray chips from the suspect's knitted hat doesn't come from the damaged area of the window frame or the office door.
3RBM7H	1) The paint chips recovered from the suspect's duffel bag (Item 3) was found to be similar with the known paint sample representative of the damaged area of the window frame (Item 1). Hence, Item 3 could have originated from the damaged area of window frame. 2) The paint chips recovered from the suspect's knitted hat (Item 4) was different from the known paint sample Item 1 and Item 2. Hence Item 4 could have not originated from the damaged area of window frame and office door.
3XE79U	Microscopic analysis conducted on the four items revealed that item 1 and item 3 are similar in their layer structure and layer color. Each item consists of paint with two layers: one bright grey layer and another one white layer. Item 2 and 4 also have similar morphology with two paint layers: one matt grey layer and a second one white layer The organic analysis (FTIR) made upon grey layers of the four items, showed that item 1 and item 3 have similar IR spectra which are different from the spectra of item 2 and item 4. FTIR analysis of white layer from the four items showed that items 1, 3 and 4 had similar spectra, but item 2 had white layer spectra different from the other ones. The inorganic analysis (SEM-EDX) made upon grey and white layers of the items 1 and 3 showed no differences. The pigment analysis (RAMAN) made upon grey and white layers of the items 1 and 3 showed no differences. According to the microscopic and analytical results, questioned paint chips recovered from the suspect’s knitted hat (item 4) couldn’t have originated neither from the window frame nor from the office door. Questioned paint chip recovered from the suspect’s duffel bag (item 3) couldn’t have originated from the office door, but it can't be excluded that could have originated from the window frame
44MCGT	The source of the exemplar paint chips in item 1 is included as a possible source of the unknown paint chips in item 3, based on class characteristics. The source of the exemplar paint chips in item 2 is excluded as a possible source of the unknown paint chips in item 3, based on class characteristics. The sources of the exemplar paint chips in items 1 and 2 are excluded as a possible sources of the unknown paint chips in item 4, based on class characteristics.
4ADNJG	Based on the infrared spectrum produced of each sample, samples 1 and 3 are most likely consistent, and samples 2 and 4 are most likely consistent. Also, visually, samples 1 and 3 are similar in color, as are samples 2 and 4.
4EHK3G	On analysis, I found that the questioned paint chips recovered from suspect's duffel bag (Item 3) and the questioned paint chips recovered from suspect's knitted hat (Item 4) were similar to

TABLE 3

WebCode	Conclusions
	the known paint sample representative of the damaged area of the window frame (Item 1) and dissimilar to the known paint sample representative of the damaged area of the office door (Item 2). Hence, I am of opinion that the questioned paint chips recovered from suspect's duffel bag (Item 3) and questioned paint chips recovered from suspect's knitted hat (Item 4) could have originated from same source as the known paint sample representative of the damaged area of the window frame (Item 1).
62WZ9R	The following instruments were used in the analysis of items in this case: Stereomicroscope, Fourier Transform Infrared Microscope (FTIR), Scanning Electron Microscope with Energy Dispersive Spectrometer (SEM/ EDS), and Microspectrophotometer (MSP). Items 1, 2, 3, and 4 consisted of two layers of architectural paint, one gray and one white. Item 1 was consistent in color, texture and chemical composition as compared to item 3. Item 3 could have originated from item 1 or another source of paint of the same color, texture, and chemical composition. Item 1 had some minor differences with regard to color and chemical composition as compared to item 4. Additionally, there was a slight difference regarding surface texture. The results of this comparison are considered inconclusive. Items 3 and 4 could not have originated from item 2 due to differences in chemical composition.
7A2Y7E	In my opinion, my findings provide very strong support for the proposition that the paint from the duffel bag (Item 3) originated from the damaged window frame (Item 1). In my opinion, my findings provide conclusive support for the proposition that the paint from the knitted hat (Item 4) did not originate from either the damaged window frame (Item 1) nor the damaged office door (Item 2).
829ERL	FTIR (instrumental) analysis and comparison of layers 1 and 2 from #1Z1-1 and #1-4Z1A disclosed differences in chemical composition. FTIR (instrumental) analysis and comparison of layer 2 from #1Z2-1 and #1-3Z1A disclosed differences in chemical composition. FTIR (instrumental) analysis and comparison of layer 2 from #1Z2-1 and #1-4Z1A disclosed differences in chemical composition. Microscopic examination and instrumental analysis (FTIR and SEM/EDS) disclosed that the known paint #1-1Z1 from submission #1-1 (known paint from damaged area of window frame) is similar in color, texture, layer structure, chemical type and elemental composition to the questioned paint sample #1-3Z1A from submission #1-3 (Questioned paint chips from suspects duffel bag).
83UHYH	The two-layer paint (gray color coat over white primer) sampled from items 1 (Known - window frame) and 3 (Questioned - suspect's duffel bag) were found to be similar in appearance / consistency (stereomicroscope), microscopic characteristics (polarized light microscope), and organic composition (FTIR). The damaged portion of the window frame (or another surface with a similar paint composition) cannot be excluded as a possible source of the paint recovered from the suspect's duffel bag. The gray top paint layers sampled from items 1 (K - window frame) and 4 (Q - suspect's knitted hat) were found to be dissimilar in appearance / consistency (stereomicroscope), microscopic characteristics (polarized light microscope), and organic composition (FTIR). Although the white primer layers sampled from these items were found to be similar, the damaged portion of the window frame is not the source of the paint recovered from the suspect's knitted hat. The two-layer paint (gray color coat over white primer) sampled from items 2 (K - office door) and 3 (Q - suspect's duffel bag) were found to be dissimilar in appearance / consistency (stereomicroscope), microscopic characteristics (polarized light microscope), and organic composition (FTIR). The damaged portion of the office door is not the source of the paint recovered from the suspect's duffel bag. The white primer layers sampled from items 2 (K - office door) and 4 (Q - suspect's knitted hat) were found to be dissimilar in appearance / consistency (stereomicroscope),

TABLE 3

WebCode	Conclusions
	microscopic characteristics (polarized light microscope), and organic composition (FTIR). Although the gray top paint layers sampled from these items were found to be similar, the damaged portion of the office door is not the source of the paint recovered from the suspect's knitted hat.
88PGMA	ITEM 1 and ITEM 4 were physically not comparable. Therefore ITEM 4 could not have originated from the source as represented by ITEM 1. ITEM 1 and ITEM 3 were physically and chemically comparable, therefore ITEM 3 could have originated from the source as represented by ITEM 1. ITEM 2 and ITEM 3 were physically not comparable. Therefore ITEM 3 could not have originated from the source as represented by ITEM 2. ITEM 2 and ITEM 4 were physically comparable, however layer 2 of ITEM 4 was chemically not comparable with ITEM 2. Therefore ITEM 4 could not have originated from the source as represented by ITEM 2.
893QGM	1. The questioned grey paint chips marked as Item 3, recovered from the duffel bag: a) could have originated from the same source as the grey paint chip collected from the damaged area of the window frame marked as Item 1, or another source of paint with similar characteristics b) did not originate from the same source as the grey paint chip collected from the damaged area of the office door marked as Item 2. 2. The questioned grey paint chips marked as Item 4, recovered from the knitted hat, did not originate from the same source as the grey paint chip collected from the damaged area of the window frame and office door marked as Item 1 and Item 2 respectively.
8W9UD9	Item 3 could not be differentiated from Item 1. Therefore, Item 3 originated from the source represented by Item 1, or another source painted in the same manner (Type III Association). This level of association was reached because other objects painted with the same paint formulations and in the same layer sequence as Item 1 would also be indistinguishable from Item 1. Item 4 differs from both Item 1 and Item 2. Therefore, it could not have originated from the sources represented by Item 1 or Item 2 (Elimination).
93AYRQ	The white layer of Exhibit 2 was found to be chemically dissimilar to the white layers of both Exhibits 3 and 4. Therefore, Exhibit 2 (paint from office door) is excluded as the source of Exhibit 3 (paint recovered from suspect’s duffel bag) and Exhibit 4 (paint recovered from suspect’s knitted hat). The grey layers of Exhibit 1 and Exhibit 4 were found to be elementally dissimilar. Therefore, Exhibit 1 (paint from window frame) is excluded as the source of Exhibit 4 (paint recovered from suspect’s knitted hat). Exhibit 1 and Exhibit 3 were found to be visually, chemically and elementally consistent. Therefore, Exhibit 3 (paint recovered from suspect's duffel bag) could have originated from the source as represented by Exhibit 1 (paint from window frame), or paint with the same visual, chemical, and elemental properties.
99KLG9	The composition of Item 3 is consistent with the composition of Item 1 but not Item 2. The composition of Item 4 is unlike the compositions of Item 1 and Item 2.
9AQ73M	The questioned paint chips recovered from the suspect's duffel bag (item 3) may be originated from the damaged area of the window frame (item 1), but may not be originated from the damaged area of the office door (item 2). The questioned paint chips recovered from the suspect's knitted hat (item 4) may not be originated from the damaged area of the window frame (item 1) nor the damaged area of the office door (item 2).
A8MYPH	Item 1, Item 2, Item 3 and Item 4 are each composed of a 2 layer architectural paint system. The top layer is a gray color coat and the second layer is a white primer. The questioned gray paint chips recovered from the suspect’s duffel bag (Item 3) are similar in color, physical appearance, layer structure, chemistry and elemental composition in comparison to the gray

TABLE 3

WebCode	Conclusions
	paint sample representative of the damaged area of the window frame (Item 1). The gray paint from Item 3 could have come from the same paint source as Item 1, or any other gray paint source that is similar in color, physical appearance, layer structure, chemistry and elemental composition. The questioned gray paint chips recovered from the suspect's duffel bag (Item 3) are similar in color and layer structure but different in physical appearance, chemistry and elemental composition in comparison to the gray paint sample representative of the damaged area of the office door (Item 2). The gray paint from Item 3 could not have come from the same paint source as Item 2. The questioned paint chips recovered from the suspect's knitted hat (Item 4) are similar in color, physical appearance and layer structure but different in chemistry and elemental composition in comparison to the gray paint sample representative of the damaged area of the office door (Item 2). The gray paint from Item 4 could not have come from the same paint source as Item 2. The questioned paint chips recovered from the suspect's knitted hat (Item 4) are similar in color and layer structure but different in physical appearance, chemistry and elemental composition in comparison to the gray paint sample representative of the damaged area of the window frame (Item 1). The gray paint from Item 4 could not have come from the same paint source as Item 1.
ABHYHJ	Upon analysis, I found: i)Both the grey and white paints on Item 3 and 4 are similar respectively to the grey and white paints on Item 1. ii)Only the grey paints on Item 3 and Item 4 are similar to the grey paint on Item 2 whereas the white paints are not similar. Based on the findings, I am of the opinion that Item 3 and Item 4 could have originated from the window frame and not the office door.
AJVEK9	Upon analysis, the paints chips recovered from suspect's duffel bag (Item 3) and the paints chips recovered from suspect's knitted hat (Item 4) could have originated from the damaged area of the window frame (Item 1) respectively. The paints chips recovered from suspect's knitted hat (Item 4) also could have originated from the damaged area of the office door (Item 2).
ANAJ8M	Items 1, 2, 3 and 4 were examined visually and using stereomicroscopy, fluorescence microscopy and Fourier Transform Infrared Spectrophotometry (FTIR). Items 1 and 3 were further examined using microsolubility tests, microchemical tests, and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The two-layered gray paint particles in Items 1 and 3 were consistent in colors, textures, types, layer sequence, and chemical compositions. It was concluded that the paints in Items 1 and 3 either originated from the same source or different sources painted in the same manner. The two-layered gray paint particles in Item 4 could not be associated with the Item 1 or 2 two-layered gray paint due to differences in fluorescence and chemical composition. The two-layered gray paint particles in Item 3 could not be associated with the Item 2 two-layered gray paint due to differences in fluorescence and chemical composition.
CDX9KF	Laboratory item 3 and Laboratory item 1 are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type and elemental composition. Laboratory item 3 and Laboratory item 4 are different form Laboratory item 2 with respect to the texture and chemical type of layer 2. Laboratory item 4 and Laboratory item 1 are different with respect to the appearance and elemental composition of layer 1. It is opinion of the undersigned that Laboratory item 3 could have originated from the same source as represented by the known paint submitted, Laboratory item 1 or from another source exhibiting all of the same analyzed characteristics. It is opinion of the undersigned that Laboratory item 3 and Laboratory item 4 could not have originated from the same source as represented by the known paint submitted, Laboratory item 2. It is opinion of the undersigned

TABLE 3

WebCode	Conclusions
	that Laboratory item 4 could not have originated from the same source as represented by the known paint submitted, Laboratory item 1.
DC3ZXH	The known two-layer (gray over white) paint samples (Items 1 and 2) were submitted for comparison to questioned two-layer (gray over white) paint samples (Items 3 and 4). Samples of each item were analyzed and compared using one or more of the following techniques: stereomicroscopy, polarized light microscopy, fluorescence, infrared spectroscopy (IR), scanning electron microscopy - energy dispersive spectroscopy (SEM-EDS). Each layer of the questioned paint in Item 3 was similar to the respective layers of the known paint in Item 1 in all tests performed. The questioned paint reportedly recovered from the duffel bag could have originated from the damaged area of the window frame (Level 3 - Association; see Association Scale below). Because other objects or areas may have been painted with paint that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. The two layers of questioned paint in Item 3 were dissimilar in chemistry by IR to the respective layers of known paint in Item 2. The questioned paint reportedly recovered from the duffel bag did not originate from the damaged area of the office door, as represented by the submitted known paint sample (Elimination/Non-association). The white layer of questioned paint in Item 4 was similar in chemistry by IR to the white layer of known paint in Item 1; however, their gray layers were discriminated by IR. Conversely, the gray layer of questioned paint in Item 4 was similar in chemistry by IR to the gray layer of known paint in Item 2, but their white layers were discriminated by IR. The questioned paint reportedly recovered from the knitted hat did not originate from the damaged area of the window frame or the damaged area of the office door, as represented by the submitted known paint samples (Elimination/Non-association). Additional known paint samples may be submitted for comparison to the questioned paint recovered from the knitted hat (Item 4), if desired.
EKDU27	Questioned paint chip Item 3 and Item 4 were similar with window frame paint Item 1. Hence, I am of the opinion that the questioned paint chip Item 3 and Item 4 were originated from the window frame paint Item 1. Questioned paint chip Item 3 and Item 4 were dissimilar with office door paint Item 2.
EKTDL4	On analysis, I found that Item 3 and Item 4 were similar to Item 1. Hence, I am of the opinion that questioned paint chips recovered from the suspect's duffel bag (Item 3) and questioned paint chips recovered from the suspect's knitted hat (Item 4) could have originated from the damaged area of the window frame (Item 1).
F82BGF	The questioned gray paint chips from the suspect's duffel bag(Item 3) comes from the damaged area of the window frame. The gray chips from the suspect's knitted hat doesn't come from the damaged area of the window frame and the office door.
G374NC	Examination of the known paint sample from the damaged area of the window frame (Item 1). Item 1 comprised a paint sample with layer sequence: grey topcoat/white undercoat. The grey topcoat was identified as a acrylic type paint. The inorganic elemental composition of the grey topcoat principally comprised titanium, silicon, aluminium and zinc. The white undercoat was identified as a acrylic type paint. The inorganic elemental composition of the white undercoat principally comprised titanium, zinc, silicon, magnesium and aluminium. Examination of the known paint sample from the damaged area of the office door (Item 2). Item 2 comprised a paint sample with layer sequence: grey topcoat/white undercoat. The grey topcoat was identified as a acrylic type paint. The inorganic elemental composition of the grey topcoat principally comprised titanium, silicon and aluminium. The white undercoat was identified as a acrylic type paint. The inorganic elemental composition of the white undercoat principally

TABLE 3

WebCode	Conclusions
	comprised calcium, silicon, titanium, aluminium and magnesium. Examination of the questioned paint chips recovered from the suspect's duffel bag (Item 3). Item 3 comprised a paint sample with layer sequence: grey topcoat/white undercoat. The grey topcoat was identified as a acrylic type paint. The inorganic elemental composition of the grey topcoat principally comprised titanium, silicon, aluminium and zinc. The white undercoat was identified as a acrylic type paint. The inorganic elemental composition of the white undercoat principally comprised titanium, zinc, silicon, magnesium and aluminium. The layer colour, layer sequence and composition of Item 3 correspond with Item 1. Therefore the results support the proposition that the paint recovered from the suspect's duffel bag (Item 3) originated from the damaged area of the window frame (Item 1). Examination of the questioned paint chips recovered from the suspect's knitted hat (Item 4). Item 4 comprised a paint sample with layer sequence: grey topcoat/white undercoat. The grey topcoat was identified as a acrylic type paint. The inorganic elemental composition of the grey topcoat principally comprised titanium, silicon, aluminium and zinc. The white undercoat was identified as a acrylic type paint. The inorganic elemental composition of the white undercoat principally comprised titanium, zinc, silicon, magnesium and aluminium. The layer colour, layer sequence and composition of Item 4 correspond with Item 1. Therefore the results support the proposition that the paint recovered from the suspect's knitted hat (Item 4) originated from the damaged area of the window frame (Item 1).
GQPGEB	The known paint sample (item 1) from the window frame cannot be eliminated as a possible source of the paint (item 3) from the suspect's duffel bag. The paint from the suspect's duffel bag has either come from the window frame, or from another damaged object that is also coated with paint that is indistinguishable in layer sequence, colour, microscopic appearance and chemical composition. While paint is a distinctive material it is expected that other objects coated with paint that is indistinguishable from this paint exists since paint is a mass-manufactured material. The known paint sample (item 1) from the window frame is eliminated as a possible source of the paint (item 4) from the suspect's knitted hat. The known paint sample (item 2) from the office door is eliminated as a possible source of the paint (item 3) from the suspect's duffel bag and the paint (item 4) from the suspect's knitted hat.
HLDTEE	Items 1 and 2 consist of two layer grey paint which were used for comparison. Item 3: The paint from the suspect's duffle bag was determined to be a two layer light grey paint which is similar in layer sequence, paint type, and paint composition to the know light grey paint from the window frame (Item 1). It is our opinion that this paint could have come from the window frame, or any other item of similar construction. Additionally, this paint from the suspect's duffle bag is dissimilar in paint type to the paint from the office door (Item 2). It is our opinion that this paint did not come from the office door. Please note, different areas of a painted item may exhibit different paint systems. Item 4: The paint from the suspect's knitted hat was determined to be a two layer light grey paint which is dissimilar in paint type to the known light grey paint from the window frame (Item 1) and the office door (Item 2). It is our opinion that this paint did not come from the window frame or the office door. Please note, different areas of a painted item may exhibit different paint systems.
HWUFNF	The questioned chips from the suspect's duffel bag (Item 3) consist of medium grey and white architectural paint which are similar in visual color, optical properties, layer sequence, paint type, and paint composition to the paint standard from the window frame (Item 1). It is my opinion that the questioned chips from the suspect's duffel bag (Item 3) could have originated from the window frame or any other similarly painted item. Additionally, the questioned chips from the suspect's duffel bag (Item 3) are dissimilar in visual color and paint type to the paint standard from the office door (Item 2). It is my opinion that the questioned chips from the

TABLE 3

WebCode	Conclusions
	suspect's duffel bag (Item 3) did not originate from the area sampled from the office door. The questioned chips from the suspect's knitted hat (Item 4) are dissimilar in visual color and/or paint type to the paint standards from the window frame (Item 1) and office door (Item 2). It is my opinion that the questioned chips from the suspect's knitted hat (Item 4) did not originate from the areas sampled from the window frame or office door. Please note, other areas of a painted item may exhibit different paint systems.
JD2YYD	The known gray paint chips (Items 1 and 2) were observed to have a layering system of gray over white. Each of the questioned gray paint chips (Items 3 and 4) was observed to have a similar layering system to the known paint chips. Samples of each layer of all four items were analyzed and compared using one or more of the following methods: polarized light microscopy, fluorescence microscopy, infrared spectroscopy, microspectrophotometry, and scanning electron microscopy/energy dispersive spectroscopy. Layers of Items 3 and 4 were dissimilar in chemistry to layers of Item 2. Additionally, layers of Item 4 were dissimilar in chemistry to layers of Item 1. Therefore, paint chips recovered from the suspect's duffel bag and knitted hat (Items 3 and 4, respectively) did not originate from the office door as represented by Item 2 (Elimination). Paint chips recovered from the suspect's knitted hat also did not originate from the window frame as represented by Item 1 (Elimination). Layers of Item 3 were similar in all examinations performed to Item 1. Paint chips recovered from the suspect's duffel bag (Item 3) could have originated from the window frame as represented by Item 1 (Level 3 - Association). Because similar items have been manufactured that would be indistinguishable from the submitted evidence, an individual source cannot be determined.
JE8NT9	None of the questioned paint chips recovered from the suspect’s duffel bag (item3) and knitted hat (item4) can be originated from the damaged area of the office door (Item2). The questioned paint chip recovered from the suspect’s knitted hat (item4) can not be originated from the damaged area of the window frame (Item1). However several properties of the Item3 and Item1 paints are the same, there is no conclusive analytical evidence which confirm that the questioned paint chip recovered from the suspect’s duffel bag (Item3) originates from the damaged area of the window frame (Item1). Relations between Item1 and Item 3 paint chips: Our lab’s RAMAN is out of order, temporarily it is under repair. Without this analytical method we cannot give a conclusion that the questioned paint chip recovered from the suspect’s duffel bag (Item3) originates from the damaged area of the window frame (Item1). The topcoats of the paints Item1 and Item3 can not be distinguished. However the elemental composition of the primer coats differs slightly, but this significant difference can be detected by μXRF only (for example in the Zn/Ti ratio). Based on this difference only, the categorical elimination of the Item1 paint as the origin of the Item3 paint chip is not valid.
JU3D8D	[No Conclusions Reported.]
KCYNGE	The paint in exhibit P1, Item 3 demonstrates similar physical characteristics and chemical composition upon comparison to the paint in exhibit P1, Item 1. Accordingly, exhibit P1, Item 3 could have originated from the same source as exhibit P1, Item 1 or another source with the same physical characteristics and chemical composition. The paint in exhibit P1, Item 4 demonstrates different physical characteristics and chemical composition than either the paint in exhibit P1, Item 1 or exhibit P1, Item 2. Accordingly, the sources of the paints in exhibit P1, Item 1 and exhibit P1, Item 2 are excluded as the source of the paint in exhibit P1, Item 4.
KJGZUF	KNOWN STANDARDS: Examination of Item 1 and Item 2 each revealed the presence of rectangular piece of wood with grey paint on one side. The grey paint had the following layer structure: Grey and White. QUESTIONED SAMPLES: Examination of Item 3 revealed the

TABLE 3

WebCode	Conclusions
	presence of grey paint chips with the following layer structure: Grey and White. The grey paint chips recovered from the suspect's duffel bag (Item 3) were physically and chemically consistent with the known paint sample representative of the damaged area of the window frame (Item 1). Therefore, the grey paint chips recovered from the suspect's duffel bag (Item 3) could have originated from the same source as the known paint sample representative of the damaged area of the window frame (Item 1). The grey paint chips recovered from the suspect's duffel bag (Item 3) were not consistent with the known paint sample representative of the damaged area of the office door (Item 2). Therefore, the grey paint chips from Item 3 did not originate from the same source as the paint in Item 2. Examination of Item 4 revealed the presence of grey paint chips with the following layer structure: Grey and White. The grey paint chips recovered from the suspect's knitted hat (Item 4) were not consistent with the known paint sample representative of the damaged area of the window frame (Item 1) and were not consistent with the known paint sample representative of the damaged area of the office door (Item 2). Therefore, the grey paint chips from Item 4 did not originate from the same source as the paint in Item 1 and Item 2.
KPHFW9	Item 3 (paint chips recovered from a duffel bag) cannot be discriminated from Item 1 (paint of window frame) and can therefore originate therefrom. This item has no connection to item 2 (paint of office door). Item 4 (paint chips recovered from a knitted hat) are different from both item 1 and item 2 and can therefore not originate from the sampled reference areas.
L446FC	Item 1 consists of a dark gray paint chip and was used for comparisons. Item 2 consists of a gray paint chip and was used for comparisons. Item 3 consists of two dark gray paint chips. Both of these dark gray paint chips are different in visual color to the submitted known paint from the office door (Item 2). It is my opinion these dark gray paint chips did not originate from the office door [Category 5]. These dark gray paint chips are similar in visual color to the submitted known paint from the window frame (Item 1). One of these dark gray paint chips (Item 3) was further analyzed and found to be similar in layer sequence, paint type, and paint composition to the submitted known paint from the window frame (Item 1). It is my opinion this dark gray paint chip from the suspect's duffel bag (Item 3) could have originated from the window frame or another paint source with similar characteristics (Category 2B). No further analysis was done with the remaining dark gray paint chip (Item 3). Item 4 consists of two gray paint chips. Both of these gray paint chips are different in visual color to the submitted known paint from the window frame (Item 1). It is my opinion these gray paint chips did not originate from the window frame (Category 5). These gray paint chips are similar in visual color to the submitted known paint from the office door (Item 2). One of these gray paint chips (Item 4) was further analyzed and found to be similar in layer sequence, but different in paint type to the submitted known paint from the office door (Item 2). It is my opinion this gray paint chip from the suspect's knitted hat (Item 4) did not originate from the office door (Category 5). No further analysis was done with the remaining gray paint chip (Item 4).
LCXLFW	According to the results of above mentioned examination and analysis procedures, the questioned paint chips recovered from the suspect's duffel bag (Item 3) could have originated from the known paint sample representative of the damaged area of the window frame (Item 1) , and could not have originated from the known paint sample representative of the damaged area of the office door (Item 2) . The questioned paint chips recovered from the suspect's knitted hat (Item 4) could not have originated from the known paint sample representative of the damaged area of the window frame (Item 1) , and could not have originated from the known paint sample representative of the damaged area of the office door (Item 2) .

TABLE 3

WebCode	Conclusions
LELPY9	In my opinion the findings provide strong support for the proposition that Item 3 originated from Item 1; Item 3 could not have originated from Item 2 based on differences in fluorescence and chemical composition of the paint layers. Item 4 could not have originated from either Item 1 or Item 2 based on differences in chemical and elemental composition of the paint layers.
LPLTBC	Item 2 was excluded. Because the white paint layer of item 2 is different from counterpart of item 1, 3 and 4 based on FT/IR result. Item 4 was excluded. Because the gray paint layer of item 4 is different from counterpart of item 1 and 3 based on SEM/EDX result. So, item 1 and 3 are same.
M2QXR9	The paint fragments examined from Item #1, Item #3, and Item #4 were alike with respect to their color, texture, layer structure, chemical solubilities, inorganic composition, and organic composition. It was concluded that the Item #3 and the Item #4 paint could have had a common origin with the Item #1 paint or another source painted in the same manner. The paint fragments examined from Item #2 could not be associated to those examined from Item #3 and Item #4 due to differences in the organic and inorganic compositions of the white layer.
MRNFG7	Each of the known samples and questioned paint chips consisted of a grey top layer sandwiching a white middle layer coated onto a strip of wood. The general appearance of the respective paint layers in both the known and questioned paint samples agreed with each other. Instrumental analysis revealed that the chemical and elemental composition of the questioned paint chips in Item 3 agreed with those of the known sample in Item 1 only but not with Item 2. On the other hand, the chemical and elemental composition of questioned paint chips in both Items 3 and 4 were found not to agree with the known sample in Item 2. Therefore, the questioned paint chips recovered from the suspect's duffel bag Item 3 could have originated from the window frame in Item 1 but not from the office door in Item 2. No association could be established between the questioned paint chips recovered from the suspect's knitted hat Item 4 with either known samples Items 1 and 2.
N24WD6	Item 1, 2, 3 and 4 have been examinated. The recovered paint ship item 4 does neither originated from the damaged area of the window frame nor the office door. In the limit of the used analytical techniques, it is possible that the recovered paint ship Item 3 could come from the damaged area of the window frame (item 1) and not from from the damaged area of the office door (item 2)
NAZQC4	Comparison Result: a. Questioned paint Q1a and known paint K1 are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. b. Questioned paint Q1 and the known paint K2 are different with respect to texture and finish. c. Questioned paint Q2 and the known paint K1 are different with respect to elemental composition. d. Questioned paint Q2 and the known paint K2 are different with respect to texture and finish. e. The unanalyzed particle from Q1 was designated Q1b. No conclusions can be made regarding this particle. 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 Q1 could not have originated from the same source as represented by the known paint K2 submitted. 3. It is the opinion of the undersigned that questioned paint Q2 could not have originated from the same source as represented by the known paints K1 and K2 submitted.

TABLE 3

WebCode	Conclusions
NTUTMT	The submitted items were examined using Stereo Microscope, FT-IR Spectrometer, Raman Microscope and X-Ray Diffractometer. The founded in Item#1, #2, #3 and #4 are solid paint which composed of Acrylic resin and Titanium dioxide: Rutile. The founded in Item#3 exhibit as same microscopic appearance, chemical characteristic and founded 1,3 carbon-based black pigment as Item#1. Therefore, these questioned paint chips recovered from the suspect's duffel bag could have originated from the known paint sample representative of the damage area of the window frame. The founded in Item#4 exhibit as same microscopic appearance and chemical characteristic as Item#2. Therefore, these questioned paint chips recovered from the suspect's knitted hat could have originated from the known paint sample representative of the damaged area of the office door.
PD2ENR	Item 3 is physical and chemical comparable to Item 1 and could have originated from the source as represented by Item 1. Item 4 is not comparable to either Item 1 or Item 2 and could therefore not have originated from the sources as represented by Items 1 or 2. Item 3 is not comparable with Item 2.
PF7MV4	Item 3, the gray two-layer architectural paint sample labeled "questioned paint from the suspect's duffel bag", is consistent in color, physical characteristics, chemical composition, and elemental composition as compared to item 1, the gray two layer architectural paint sample labeled "known paint sample from the damaged area of the window frame". Level III association. Item 3, the gray two layer architectural paint sample labeled "questioned paint from the suspect's duffel bag", displays differences in physical characteristics, chemical composition and elemental composition as compared to item 2, the gray two layer architectural paint sample labeled "known paint sample from the damaged area of the office door". Elimination. Item 4, the gray two layer architectural paint sample labeled "questioned paint from the suspect's knitted hat", displays differences in chemical composition and elemental composition as compared to item 1, the gray two layer architectural paint sample labeled "known paint sample from the damaged area of the window frame". Elimination. Item 4, the gray two layer architectural paint sample labeled "questioned paint from the suspect's knitted hat", displays differences in physical characteristics, chemical composition and elemental composition as compared to item 2, the gray two layer architectural paint sample labeled "known paint sample from the damaged area of the office door". Elimination.
PJ447C	Item 1 and Item 3 are indistinguishable in their color and chemical composition. It was concluded that the questioned paint chips(Item 3) could have originated from the damaged area of the window frame Item 1. Item 1 and Item 4 are distinguishable in their chemical composition. Item 2 and Item 3, 4 are distinguishable in their chemical composition, respectively.
PT8DC3	The paint in item 3 is similar in color, layer structure, solubility, fluorescence, and infra-red absorbance spectra to the paint in item 1. Therefore the paint in items 1 and 3 could have originated from the same source. The paint in item 4 is similar in layer structure to the paint in item 1, however, it is dissimilar in color and infra-red absorbance spectra. Therefore the paint in items 1 and 4 could not have originated from the same source. The paint in items 3 and 4 were similar in layer structure to the paint in item 2, however, it is dissimilar in infra-red absorbance spectra. Therefore the paint in items 2, 3, and 4 could not have originated from the same source.
PUKQED	The paint in sample 3 was consistent in color, layer structure and chemical composition with the paint in Sample 1 and could have come from the same source. The paint in sample 3 could not have come from the source represented by sample 2. The paint in sample 4 could

TABLE 3

WebCode	Conclusions
	not have come from either of the sources represented by samples 1 and 2.
Q3CMG7	The paint on item 3 could have originated from item 1, as represented by the known submitted exemplar, or from another source of paint exhibiting all the same analyzed/measured characteristics. The paint on item 3 could not have originated from the source represented by item 2. The paint on item 4 could not have originated from the sources represented by items 1 and 2. Because paint is mass produced, it is not possible to state that a paint chip originated from a particular source of paint to the exclusion of all other sources with paint that exhibits the same physical, microscopic and chemical properties.
TMBF93	Results were based on analyses of the finish coat and primers for all four samples.
TNMV33	Item 3, paint chips recovered from the suspect's duffel bag, could have originated from Item 1, known paint sample from the window frame. Item 3 could not have originated fro Item 2, known paint sample from the office door. Item 4, paint chips recovered from the suspect's knitted hat, could not have originated from either Item 1 or Item 2.
UEGZB3	Items 1,2,3 and 4 were examined using stereomicroscopy, microsolubility tests, microchemical tests, fluorescence microscopy, polarized light microscopy (PLM), Fourier Transform Infrared Spectrophotometry (FTIR), and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The two-layered grey over white paint particles in Items 1 and 3 were consistent in colors, textures, types, layer sequence and chemical compositions. It was concluded that the Item 3 paint could have had a common origin with Item 1 or another source of paint with the same colors, textures, types, layer sequence, and chemical compositions. The two-layered grey over white paint particles in Items 1 and 4 could not be associated due to differences in color and chemical composition. The two-layered grey over white paint particles in Items 3 and 4 could not be associated with the two-layered grey over white paint particle in Items 2 due to differences in color, texture, and/or chemical composition.
VFZJKY	All 4 items consist of two layers: first layer (grey) and second layer (white). Two layers of each item were examined using IR and Raman spectroscopy. Based on IR spectra obtained for first layer of each item acrylic resin was identified as a binder whereas talc and titanium dioxide were identified as main pigments. Items 2 and 4 are different from items 1 and 3 taking into account the band shape in the range of 1100 – 1200 cm-1 as well as the presence of additional peak at 3026 cm-1. White layer of items 1, 3, 4 contain methacrylic resin, talc, kaolinite and titanium dioxide and show no differences. White layers of item 1, 3, 4 are different from white layer of item 2 which does not contain kaolinite and shows additionally the presence of calcium carbonate. Raman spectra of grey layer of all items are very similar and show no significant differences. Raman analysis proved that white layer in item 2 has different chemical composition in comparison to white layer in items 1, 3, 4. To sum up it is highly possible that paint chips recovered from the suspect's duffel bag (item 3) originate from the damaged area of the window frame (item 1), whereas paint chips recovered from suspect's knitted hat (item 4) do not originate from window frame (item 1) and office door (item 2).
VL9XCV	1. Examinations of Exhibit 1 (known paint sample representative of the damaged area of the window frame), Exhibit 2 (known paint sample representative of the damaged area of the office door), Exhibit 3 (questioned paint chips recovered from the suspect's duffel bag), and Exhibit 4 (questioned paint chips recovered from the suspect's knitted hat) each disclosed the presence of a two-layer paint system with the following color and layer sequence: gray topcoat/white primer. 2. Comparative examinations of Exhibit 1 with Exhibit 3 disclosed them

TABLE 3

WebCode	Conclusions
	to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, Exhibit 3 could have originated from Exhibit 1 or another source with the exact same characteristics. 3. Comparative examinations of Exhibit 2 with Exhibit 3 disclosed them to be inconsistent in their physical characteristics. Therefore, Exhibit 3 could not have originated from Exhibit 2. 4. Comparative examinations of Exhibits 1 and 2 with Exhibit 4 disclosed them to be inconsistent in their physical characteristics and/or elemental compositions. Therefore, Exhibit 4 could not have originated from Exhibits 1 or 2. 5. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.
VRG7UZ	Item 3: The submitted items 1 and 2 were examined and compared to 1 of the exhibits in item 3 using polarized light microscopy, visible microscopy, and fourier transform infrared spectroscopy (FTIR). The examined exhibits from item 3 and items 1 and 2 each consist of 2 layers. The 2 layers of item 3 and item 1 are consistent in appearance, microscopic and chemical properties. Thus, item 3 could have originated from item 1 as represented by the examined samples or another paint source exhibiting the same analyzed characteristics and layer structure. The FTIR results reveal discriminating differences between both layers of item 3 and item 2. Thus, item 3 could not have originated from item 2 as represented by the examined samples. No analysis was performed on the remaining exhibits in item 3. Therefore, no conclusions can be reached on these samples. Item 4: The 2 submitted exhibits in item 4 were examined microscopically and found to be consistent in layer structure with item 1 and item 2. One exhibit from item 4 was selected and analyzed using polarized light microscopy, visible microscopy, and fourier transform infrared spectroscopy (FTIR). The FTIR results reveal discriminating differences between the white layers of items 4 and 2 and between the grey layers of items 4 and 1. Thus, item 4 could not have originated from item 1 or item 2 as represented by the examined samples. No further analysis was performed on the remaining exhibits in item 4. Therefore, no conclusions can be reached on these samples.
VYGF96	The paint chips recovered from the suspect's duffel bag (Item #3) were physically and chemically consistent with the paint from the damaged area of the window frame (Item #1). Therefore, the paint from Item #3 could have originated from the same source as the paint from Item #1. The paint chips recovered from the suspect's duffel bag (Item #3) were not consistent with the paint from the damaged area of the office door (Item #2). Therefore, the paint from Item #3 did not originate from the same source as the paint from Item #2. The paint chips recovered from the suspect's knitted hat (Item #4) were not consistent with the paint from the damaged area of the window frame (Item #1) or the paint from the damaged area of the office door (Item #2). Therefore, the paint from Item #4 did not originate from the same source as the paint from Items #1 and #2.
VZRRZ3	[No Conclusions Reported.]
W23KG3	The gray paint in Item 3 was visually, microscopically and instrumentally consistent with the gray paint in Item 1. This indicates that the gray paint in Items 1 and 3 could share a common origin. The gray paint in Item 4 was visually and instrumentally different from the gray paint in Item 1. This indicates that the gray paint in Items 1 and 4 do not share a common origin. The gray paint in Item 3 was visually, microscopically and instrumentally different from the gray paint in Item 2. This indicates that the gray paint in Items 2 and 3 do not share a common origin. The gray paint in Item 4 was microscopically and instrumentally different from the gray paint in Item 2. This indicates that the gray paint in Items 2 and 4 do not share a common origin.

TABLE 3

WebCode	Conclusions
W38GGX	The questioned paint chips recovered from the suspect's duffel bag (Item 3) and the known paint sample representative of the damaged area of the window frame (Item 1) were consistent on color, layering and chemical composition and could have the same source. The questioned paint chips recovered from the suspect's knitted hat (Item 4) and both known paint samples (Item 1 and Item 2) were inconsistent on chemical composition and could not have the same source.
WBRB4V	The examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's duffel bag (Item 1-3) was found to be consistent in color and sequence of layers, microscopic appearance and instrumental properties with the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the window frame (Item 1-1). Accordingly, the examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's duffel bag could have originated from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the window frame or from another damaged source having similar characteristics. The examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's duffel bag (Item 1-3) was found to be different in instrumental properties from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the office door (Item 1-2). Accordingly, the examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's duffel bag could not have originated from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the office door. The examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's knitted hat (Item 1-4) was found to be different in instrumental properties from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the window frame (Item 1-1). Accordingly, the examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's knitted hat could not have originated from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the window frame. The examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's knitted hat (Item 1-4) was found to be different in instrumental properties from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the office door (Item 1-2). Accordingly, the examined portion of the painted side of the piece of wood-like material from the trace item – questioned paint chips recovered from the suspect's knitted hat could not have originated from the examined portion of the painted side of the piece of wood-like material from the trace item – known paint sample representative of the damaged area of the office door.
WRUAP4	The paint chip in Item 3 corresponded in color and layer structure (grey/white), chemical composition (FTIR), and elemental composition (SEM/EDS) to the known paint in Item 1. Therefore, the Item 3 paint could have come from the same source as Item 1 or another source with the same characteristics (Type III Association). It should be noted that the analytical techniques used allow for a high degree of discrimination between different paints, however, other paints may have been manufactured to the same specifications that would be

TABLE 3

WebCode	Conclusions
	indistinguishable from the submitted evidence. The paint chips in Item 4, though visibly similar in color and layer structure, and similar in chemical composition (FTIR), are different in elemental composition from the known paint in Item 1. Therefore, the paint in Item 4 did not come from the same source as the Item 1 known paint (Elimination). Though visibly similar in color and layer structure, Items 3 and 4 were different in chemical composition (FTIR) to the known paint in Item 2. Therefore, the paint in Items 3 and 4 did not come from the same source as the Item 2 known paint (Elimination).
XGQE7Y	Item 3 is similar in all examined characteristics to item 1 and could have originated from the window frame or another source of paint with the same characteristics. Item 3 did not originate from the door as represented by item 2. Item 4 did not originate from either the window frame or the door as represented by items 1 and 2.
Y2C76V	The paint sample from the damaged area of the window frame (item 1), from the damaged area of the office door (item 2), from the suspect's duffel bag (item 3) and from the suspect's knitted hat (item 4) consisted of grey paint on white paint. The paint samples from the suspect were compared to the paint samples from the window frame and from the door based on their cross-sectional appearance and on their chemical composition using Fourier transform infrared spectroscopy (FTIR). Some of the paint samples were further compared based on their elemental composition using a scanning electron microscope with an energy dispersive X-ray detector (SEM-EDX). Based on these examinations, the grey paint and white paint from the suspect's duffel bag had the same appearance, chemical composition and elemental composition as the respective paint layers of the window frame. Therefore the paint from the suspect's duffel bag could have come from the window, or from another source of this type of two-layered paint. The paint samples from the suspect had different chemical compositions to the paint from the office door. Therefore the paint samples from the suspect have not come from the damaged area of the office door. The grey paint layer from the suspect's knitted hat had a different chemical composition to the grey paint layer from the window. Therefore the paint from the suspect's knitted hat could not have come from the damaged area of the window.
YB2WQ2	Examination of Items #1 and #2 each revealed the presence of a piece of wood painted gray with the following layer structure: gray and white. Examination of Items #3 and #4 each revealed the presence of two wood fragments painted gray with the following layer structure: gray and white. The gray paint from Item #3 (questioned paint chips recovered from the suspect's duffel bag) is physically and chemically consistent with the gray paint from Item #1 (known paint sample representative of the damaged area of the window frame). Therefore, the gray paint from Item #3 could have originated from the same source as the gray paint in Item #1. The gray paint from Item #3 (questioned paint chips recovered from the suspect's duffle bag) is not consistent with the gray paint from Item #2 (known paint sample representative of the damaged area of the office door). Therefore, the gray paint from Item #3 did not originate from the same source as the gray paint in Item #2. The gray paint from Item #4 (questioned paint chips recovered from the suspect's knitted hat) is not consistent with the gray paint from Item #1 (known paint sample representative of the damaged area of the window frame) or from Item #2 (the known paint sample representative of the damaged area of the office door). Therefore, the gray paint from Item #4 did not originate from the same source as the gray paint in Items #1 or #2.
YHYRNZ	Item 1: A two layer gray paint standard was analyzed for comparison to Items 3 and 4. Item 2: A two layer gray paint standard was analyzed for comparison to Items 3 and 4. Item 3: Two, two layer gray paint chips were found. The unknown paint (Item 3) and the standard

TABLE 3

WebCode	Conclusions
	paint (Item 1) are the same in physical characteristics and chemical characteristics. The unknown paint (Item 3) either originated from the standard (Item 1) or another source of paint possessing the same distinct physical and chemical characteristics. The unknown paint (Item 3) and the standard paint (Item 2) are not the same in physical and chemical characteristics. The unknown paint (Item 3) could not have originated from the standard (Item 2). Item 4: Two, two layer gray paint chips were found. The unknown paint (Item 4) and the standard paints (Item 1 and 2) are not the same in physical and chemical characteristics. The unknown paint (Item 4) could not have originated from the standards (Item 1 and 2).
YXQVLV	The known paint samples (Item 1 and Item 2) as well as the questioned paint samples (Item 3 and Item 4) show the same paint layers: grey layer and white layer. All layers of the four samples were analyzed by microscopy, light microscopy, infrared spectroscopy and SEM/EDX. Item 3 cannot be differentiated from the Item 1 by the used methods. Item 4 shows differences to Item 1 and Item 2. The questioned paint sample Item 3 could have originated from Item 1.
ZAKAKR	1. It is the opinion of the undersigned that questioned paint 3a (paint chip from "...duffel bag") could have originated from the same source as represented by the known paint from "...window frame" or from another source exhibiting all of the same analyzed characteristics. 2. It is the opinion of the undersigned that questioned paints 3a and 3b (from "...duffel bag") could not have originated from the same source as represented by the known paint from "...office door" submitted. 3. It is the opinion of the undersigned that questioned paints 4a and 4b (from "...knitted hat") could not have originated from the same source as represented by the known paint from "...window frame" submitted. 4. It is the opinion of the undersigned that questioned paints 4a and 4b (from "...knitted hat") could not have originated from the same source as represented by the known paint from "...office door" submitted.
ZF7P9J	Conclusions: 1. The paint in Exhibit 3 originated either from the source of Exhibit 1, or from another wooden source bearing indistinguishable paint. The paint in Exhibit 3 did not originate from the source of Exhibit 2. 2. The paint in Exhibit 4 did not originate from the source of Exhibit 1 or 2

Additional Comments

TABLE 4

WebCode	Additional Comments
83UHYH	Our methods do not generally allow for the comparison of inorganic materials that may be present in paint samples.
893QGM	Each item consists of 2 layers: Outermost grey and 2nd white on a wood substrate
8W9UD9	Interpretation scale would be included in report to provide context to association.
A8MYPH	Chemical Analysis performed includes: Fourier Transform Infrared Spectroscopy and Scanning Electron Microscopy.
DC3ZXH	Association Scale for Trace 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 1 - Identification: A physical match or fracture match; items physically fit back to one another, indicating that the items were once a single object or from the same source. Level 2 - High Degree of Association: 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 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. Level 4 - Limited Association: 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 3 association, items categorized within a Level 4 share characteristics that are more common amongst these kinds of manufactured products or are commonly encountered in the environment. Alternatively, an association between items would be categorized as a Level 4 if a limited analysis was performed due to characteristics or size of the specimen(s). Level 5 - Inconclusive Association: 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. Unsuitable for comparison: No conclusion could be reached regarding an association/elimination between the items. Elimination (Non-association): The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source. Inconclusive Non-association: The items appear to exhibit some dissimilarities; however, there are significant limiting factors in the samples (such as lacking in quantity, quality and/or detail) that do not permit an elimination.
JD2YYD	The definitions of the conclusions used by our laboratory system are as follows: 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.
PD2ENR	Items 1 to 4 each consisted of a top grey layer and a white undercoat. Items 1 and 3 had the same physical appearance while Items 2 and 4 had the same physical appearance. The grey top layers of Items 2 and 4 differ from those of Items 1 and 3. The white undercoat from Item 2 contained calcium which differentiates it from the white undercoat of Item 4.

TABLE 4

WebCode	Additional Comments
YHYRNZ	Item 1 (standard) had a yellow smear on one edge of the wood block. The yellow was not found anywhere else on Item 1 and was presumed to be from a yellow saw blade cutting the sample.
ZF7P9J	Results: 1. Exhibits 1 and 2 each contained a piece of wood painted on one surface with the paint layer sequence: Exhibit 1: medium grey (1) / white (1); Exhibit 2: medium grey (2) / white (2). The medium grey (1) and medium grey (2) paint layers were physically and chemically different from one another, as were the white (1) and white (2) paint layers. 2. Exhibit 3 contained two wood shavings, each painted on one surface with the paint layer sequence: medium grey (1) / white (1). The medium grey (1) and white (1) paint layers in Exhibit 3 were physically and chemically indistinguishable from the corresponding medium grey (1) and white (1) paint layers in Exhibit 1. 3. Exhibit 4 contained two wood shavings, each painted on one surface with the paint layer sequence: medium grey (2) / white (1). The medium grey (2) and white (1) paint layers in Exhibit 4 were physically and chemically indistinguishable from the medium grey (2) paint layer in Exhibit 2 and the white (1) paint layer in Exhibit 1, respectively. However, the overall paint layer sequence of medium grey (2) / white (1) in Exhibit 4 was different from those in Exhibits 1 and 2.

Appendix: Data Sheet

Collaborative Testing Services ~ Forensic Testing Program *****

Test No. 18-545: Paint Analysis

DATA MUST BE RECEIVED BY *April 30, 2018* TO BE INCLUDED IN THE REPORT

Participant Code: WebCode:

Accreditation Release Statement

CTS submits external proficiency test data directly to ASCLD/LAB, ANAB, and 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 on the last page must be completed and submitted.)**

☐ This participant's data is NOT intended for submission to ASCLD/LAB, ANAB or A2LA.

Scenario:

Police are investigating the burglary of a business. It appears that a tool was used to pry open a window frame and interior office door, both of which were painted gray. Police located a suspect and conducted a warranted search of his house four days later. It revealed gray paint chips in a duffel bag and a knitted hat. Known paint samples have been collected from the damaged area of the window frame and office door. Police are requesting that you examine the recovered paint chips from the suspect's duffel bag and knitted hat and determine if either of them could have originated from the window frame and/or office door.

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

CTS will not reproduce Interpretation Scales, Scale of Conclusions or Terminology Keys in the final report, please do not submit with the participant's data sheet.

Items Submitted (Sample Pack P1):

Item 1: Known paint sample representative of the damaged area of the window frame.

Item 2: Known paint sample representative of the damaged area of the office door.

Item 3: Questioned paint chips recovered from the suspect's duffel bag.

Item 4: Questioned paint chips recovered from the suspect's knitted hat.

1.) Could the questioned paint chips recovered from the duffel bag (Item 3) or knitted hat (Item 4) have originated from the damaged area of the window frame or office door as represented by Item 1 and Item 2, respectively?

	Window frame (Item 1)			***Office door (Item 2)***		
Item 3	Yes ☐	No ☐	Inc ☐	Yes ☐	No ☐	Inc ☐
Item 4	Yes ☐	No ☐	Inc ☐	Yes ☐	No ☐	Inc ☐

Please return all pages of this data sheet.

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

Microscopic Examinations:

☐ 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?

4.) Additional Comments

Return Instructions: Data must be received via online data entry, fax (please include a cover sheet), or mail by *April 30, 2018* to be included in the report. Emailed data sheets are not accepted.

QUESTIONS?
TEL: +1-571-434-1925 (8 am - 4:30 pm EST)
EMAIL: forensics@cts-interlab.com
www.ctsforensics.com

Participant Code:

ONLINE DATA ENTRY: www.cts-portal.com

FAX: +1-571-434-1937

MAIL: Collaborative Testing Services, Inc.
P.O. Box 650820
Sterling, VA 20165-0820 USA

Please return all pages of this data sheet.

Collaborative Testing Services ~ Forensic Testing Program

RELEASE OF DATA TO ACCREDITATION BODIES

The following Accreditation Releases will apply only to:

Participant Code: WebCode:

for Test No. **18-545: Paint Analysis**

This release page must be completed and received by ***April 30, 2018*** to have this participant's submitted data included in the reports forwarded to the respective Accreditation Bodies.

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

Signature and Title _____

Laboratory Name _____

Location (City/State) _____

Accreditation Release

Return Instructions

Please submit the completed Accreditation Release at the same time as your full data sheet. See Data Sheet Return Instructions on the previous page.

Questions? Contact us 8 am-4:30 pm EST
Telephone: +1-571-434-1925
email: forensics@cts-interlab.com

Please return all pages of this data sheet.

