



Paint Analysis Test No. 16-545 Summary Report

This test was sent to 90 participants. Each sample set consisted of one item containing a "known" paint sample and two items containing "questioned" paint chips. Participants were requested to compare the items and report their findings. Data were returned from 77 participants (86% response rate) and are compiled into the following tables:

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

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

Manufacturer's Information

Each sample set consisted of three items with layered paint and primer: one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from a painted section of drywall. Items 1, 2, and 3 came from a single drywall section with the same primer and topcoat. Examiners were instructed to examine the samples and determine if either questioned sample could have originated from the same source as the known paint sample.

SAMPLE PREPARATION-

The drywall substrate was 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, 2, and 3 (ASSOCIATION): The known Item 1, questioned Item 2, and questioned Item 3 samples were prepared by applying two coats of primer (Zinsser Bulls Eye 1-2-3 water based primer) to a drywall substrate. Then two layers of topcoat (Behr Premium Plus®, Spirited Yellow (P290-4) acrylic paint) were applied. For Item 1, paint samples were scored into squares that were approximately 1/2" x 1/2" and chiseled out using a utility knife. One 1/2" x 1/2" piece was packaged into a glassine bag and then a pre-labeled Item 1 coin envelope. For Items 2 and 3, paint samples were scored into squares that were approximately 1/4" x 1/4" and chiseled out using a utility knife. Two 1/4" x 1/4" pieces were packaged into a glassine bag and then a pre-labeled coin envelope for each of Items 2 and 3. This process was repeated until all of the items were created. Items 1, 2, and 3 were taken in close spatial proximity to one another and were kept together as an association group and packaged into the sample sets as described below.

SAMPLE SET ASSEMBLY: For each sample pack, an Item 1, Item 2, and Item 3 from the same association group 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 methods that were employed by the predistribution laboratories included: stereomicroscopy, polarized light microscopy, fluorescence microscopy, pyrolysis GC, FTIR, SEM/EDX, and microspectrophotometry. Two of the three laboratories that conducted the predistribution examination of the completed sample sets reported the expected association results. The third laboratory eliminated both questioned samples due to slight differences in Mg and Si concentrations as determined by SEM/EDX. However, as reported in forensic paint analysis literature and as discussed with an independent advisor, slight differences in elemental concentration are expected due to the heterogeneous nature of paint. It was therefore determined that the test was suitable for distribution.

Summary Comments

This test was designed to allow participants to assess their proficiency in the examination, comparison and interpretation of multi-layered architectural paint chips. Each sample set consisted of three items with layered paint and primer: one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from a painted piece of drywall. Items 1, 2, and 3 came from a single piece of drywall with the same primer and topcoat. (Refer to the Manufacturer's Information for preparation details.)

Of the 77 participants that reported results in Table 1, 70 (90.9%) reported that the questioned paint chips in Item 2 and Item 3 could have originated from the same source as the known paint sample in Item 1. Of the remaining participants, five reported that the questioned paint chips in Item 2 could not have originated from the same source as the known paint sample in Item 1, but the questioned paint chips in Item 3 could have originated from Item 1. The two remaining participants reported that questioned paint chips in Item 2 and Item 3 could not have originated from the same source as the known paint sample in Item 1.

Seventy-five (97.4%) of the 77 participants reported utilizing a stereomicroscope as part of their examination procedure. FTIR was utilized by 75 (97.4%) and SEM/EDX by 45 (58.4%) of the 77 participants.

Examination Results

Could the questioned paint chips recovered from the suspect's hat (Item 2) and/or jacket (Item 3) have originated from the damaged area of the victim's bedroom wall as represented by Item 1?

TABLE 1

WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
28RVDR	Yes	Yes	H8U9RY	Yes	Yes
2AHR48	Yes	Yes	HLWKNX	Yes	Yes
36JZ8U	Yes	Yes	JDZ6CY	Yes	Yes
3C29VQ	Yes	Yes	KE793R	Yes	Yes
3DC9U7	Yes	Yes	KVBF9	Yes	Yes
3E8QV8	Yes	Yes	L4493T	Yes	Yes
4GQ6XM	Yes	Yes	LGPM48	Yes	Yes
4TKLN9	Yes	Yes	LW22L6	Yes	Yes
66VC34	Yes	Yes	MAK4HM	Yes	Yes
6KN7CA	No	Yes	MWV7E4	Yes	Yes
8HRCQP	Yes	Yes	MWZND3	Yes	Yes
8LAUMZ	Yes	Yes	NU8RQU	Yes	Yes
8LQNLN	Yes	Yes	P2NM7N	Yes	Yes
8PTNLL	Yes	Yes	PAXCKM	Yes	Yes
8UNFW4	Yes	Yes	PM4824	Yes	Yes
8XJARK	Yes	Yes	QKVCWQ	Yes	Yes
97C2F6	Yes	Yes	QWVZPN	Yes	Yes
9JWGH4	Yes	Yes	RB4GBF	Yes	Yes
9REQ7Z	Yes	Yes	RFB8DL	Yes	Yes
BHZMWJ	Yes	Yes	RQWBKL	Yes	Yes
DAF7GE	Yes	Yes	RZ8D7L	Yes	Yes
DAUTQG	Yes	Yes	T28ZYG	Yes	Yes
E2JQ6F	Yes	Yes	T4WA7W	Yes	Yes
E7U4ME	No	Yes	TJD8CX	No	No
EC36A4	Yes	Yes	TW36FG	Yes	Yes
FATEHE	Yes	Yes	U4FDEX	Yes	Yes
FFUPQR	Yes	Yes	U6QEZW	Yes	Yes
FGQ8TU	Yes	Yes	UM7N4H	Yes	Yes
G8Y9FT	No	No	UQ7ZYH	Yes	Yes
GTDTCU	Yes	Yes	UV2TUX	Yes	Yes

TABLE 1

WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
VTPEZW	Yes	Yes			
VUKW3Y	Yes	Yes			
WWLEFK	Yes	Yes			
X9X4UF	Yes	Yes			
XRU8XC	No	Yes			
XW6KEB	Yes	Yes			
XWZ4GC	Yes	Yes			
Y2QWPW	Yes	Yes			
Y7LNZE	Yes	Yes			
YBGHW	Yes	Yes			
YG49JB	Yes	Yes			
YHYRLD	No	Yes			
YM964B	Yes	Yes			
Z4CYAB	Yes	Yes			
Z98T8C	Yes	Yes			
ZEX3HB	Yes	Yes			
ZFMCPQ	No	Yes			

Response Summary				
		Item 2	Item 3	
Responses	Yes	70 (90.9%)	75 (97.4%)	
	No	7 (9.1%)	2 (2.6%)	
	Inc	0 (0 %)	0 (0 %)	
Participants: 77				

Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRF/XRF	SEM/EDX	Microspectrophotometry	Other
28RVDR	✓				✓	✓				
2AHR48	✓				✓					
36JZ8U	✓	✓	✓		✓		✓			
3C29VQ	✓				✓		✓	✓		
3DC9U7	✓	✓	✓		✓		✓	✓		
3E8QV8	✓				✓					Raman
4GQ6XM	✓	✓	✓		✓	✓	✓			
4TKLN9	✓				✓		✓	✓		
66VC34	✓				✓		✓			PyGC/MS
6KN7CA	✓			✓	✓	✓				
8HRCQP	✓						✓			RAMAN, spectrophotometry
8LAUMZ	✓	✓	✓		✓		✓	✓		
8LQNLN	✓	✓	✓		✓		✓			RAMAN
8PTNLL	✓				✓					
8UNFW4	✓	✓		✓	✓	✓				
8XJARK	✓				✓					
97C2F6	✓	✓		✓	✓	✓	✓			
9JWGH4	✓			✓	✓		✓			
9REQ7Z		✓	✓		✓	✓				Raman (785nm)
BHZMWJ	✓				✓					
DAF7GE	✓				✓					
DAUTQG	✓				✓			✓		
E2JQ6F					✓					
E7U4ME	✓				✓					

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
EC36A4	✓				✓			✓		Raman Spectroscopy
FATEHE	✓				✓			✓		
FFUPQR	✓		✓	✓	✓	✓		✓		
FGQ8TU	✓				✓	✓				
G8Y9FT	✓	✓	✓	✓	✓			✓		
GTDTCU	✓				✓			✓		
H8U9RY	✓		✓	✓	✓			✓		
HLWKNX	✓				✓					
JDZ6CY	✓		✓	✓	✓			✓		
KE793R	✓	✓	✓		✓	✓		✓		Pyrolysis GC/MS
KVBFE9	✓				✓		✓	✓		
L4493T	✓	✓			✓	✓		✓		Pyrolysis GC/MS
LGPM48	✓				✓	✓				
LW22L6	✓	✓	✓		✓					
MAK4HM	✓	✓	✓	✓	✓					
MWV7E4	✓		✓		✓			✓		
MWZND3	✓				✓			✓		
NU8RQU	✓		✓		✓			✓	✓	XRD
P2NM7N	✓	✓			✓					Comparison Microscope
PAXCKM	✓	✓			✓			✓		
PM4824	✓			✓	✓	✓				
QKVCWQ	✓	✓		✓	✓			✓	✓	
QVWZPN	✓				✓	✓				
RB4GBF	✓	✓	✓		✓			✓		
RFB8DL	✓				✓	✓				

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
RQWBKL	✓				✓	✓	✓			Alternative Light Source
RZ8D7L	✓	✓			✓		✓			
T28ZYG	✓	✓			✓	✓	✓			
T4WA7W	✓				✓		✓			RAMAN
TJD8CX	✓				✓					
TW36FG	✓			✓	✓					
U4FDEX	✓			✓	✓		✓			Raman
U6QEZW	✓	✓				✓				
UM7N4H	✓				✓	✓	✓			
UQ7ZYH	✓				✓	✓	✓			
UV2TUX	✓	✓			✓		✓			
VTPEZW	✓				✓		✓			Raman Spectroscopy
VUKW3Y	✓				✓		✓			
WWLEFK	✓				✓		✓			
X9X4UF	✓				✓		✓			
XRU8XC	✓	✓			✓		✓			Raman spectroscopy
XW6KEB	✓	✓			✓		✓	✓		
XWZ4GC	✓				✓		✓			
Y2QWPW	✓			✓	✓					
Y7LNZE	✓				✓		✓			
YBGHV	✓				✓					
YG49JB	✓	✓		✓	✓	✓				
YHYRLD	✓	✓			✓					Laser ablation - ICP-MS
YM964B	✓	✓			✓			✓		
Z4CYAB	✓	✓	✓		✓		✓			Comparison Microscopy

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
Z98T8C	✓			✓	✓	✓	✓			
ZEX3HB	✓	✓		✓				✓	✓	
ZFMCPQ	✓				✓	✓				

Response Summary										
Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	
77	75	23	22	16	75	17	7	45	10	
Percent	97%	30%	29%	21%	97%	22%	9%	58%	13%	

Conclusions

TABLE 3

WebCode	Conclusions
28RVDR	<p>Questioned paint samples recovered from lab items #2 and #3 were submitted to the [Laboratory] for paint analysis and comparison to the known paint sample from the damaged area of bedroom's wall (lab item #1). Visual and microscopic examination of lab items #1, 2, and 3 disclosed the following layer structure on all three items: K, Q1, Q2 - yellow coat (layer 1, rubber-like texture)/white coat (layer 2, rubber-like texture)/beige fibrous porous substrate with dark colored specks (possible drywall)/brown cardboard. Visual and microscopic examination of questioned paints Q1 and Q2 and comparison to known paint K disclosed that they are consistent and no discriminating differences were observed with respect to their color, texture, and layer structures. Fourier Transform Infrared Spectroscopy instrumental analysis (FTIR) was performed on layers 1 and 2 of one of the Q1 particles (designated to be Q1A), on one of the Q2 particles (designated to be Q2A), and on K. X-Ray Fluorescence Spectrometry instrumental analysis (XRF) was performed on layers 1 and 2 of Q1A, Q2A, and K. Instrumental analyses (FTIR and XRF) of layers 1 and 2 of questioned chips Q1A and Q2A and comparison to known paint K disclosed that they are consistent and no discriminating differences were observed with respect to their chemical type and elemental composition. It is the opinion of the undersigned that the questioned paints, Q1A and Q2A, could have originated from the same source as represented by the known submitted exemplar, K, or from another source exhibiting all of the same analyzed characteristics. Q1 and Q2 particles that were not instrumentally analyzed were designated to be Q1B and Q2B. No further conclusions can be reached about Q1B and Q2B.</p>
2AHR48	<p>Microscopic analysis conducted on the three items revealed that the three items are similar in their layer structure and layer colours. Each item consists of paint with two layers: a yellow layer and a white layer. The organic (FTIR) analysis made upon yellow and white layer of the three items, showed no differences among the three items. The pigment analysis (RAMAN) made upon yellow and white layer of the three items showed no differences. According to the microscopic and analytical results, questioned paint chips recovered from the suspect's hat and from the suspect's jacket were undistinguishable in colour, pigment and organic composition from sample recovered on the damaged area of the victim's bedroom wall. Therefore, it can't be excluded that samples recovered from the suspect's hat and jacket come from the victim's bedroom wall.</p>
36JZ8U	<p>The yellow two layer paint sample labeled "questioned paint chips recovered from the suspect's hat", (item 2), is consistent in color, physical characteristics, chemical composition, and elemental composition as compared to the yellow two layer paint sample labeled "known paint sample representative of the damaged area of the victim's bedroom wall", (item 1). Level III association. The yellow two layer paint sample labeled "questioned paint chips recovered from the suspect's jacket", (item 3), is consistent in color, physical characteristics, chemical composition, and elemental composition as compared to the yellow two layer paint sample labeled "known paint sample representative of the damaged area of the victim's bedroom wall", (item 1). Level III association.</p>
3C29VQ	<p>Item 1, 2 and 3 are indistinguishable in their color and chemical composition. It was concluded that the questioned paint chips (Item 2 and 3) could have originated from the damaged area of the victim's bedroom.</p>
3DC9U7	<p>The known yellow paint (Item 1) was observed to have a layering system of yellow over white. Each of the questioned yellow paints (Items 2 and 3) were observed to have similar layering systems to the known. Samples of each layer of all three items were analyzed and compared by polarized light microscopy, fluorescence microscopy, infrared spectroscopy, and scanning</p>

TABLE 3

WebCode	Conclusions
	<p>electron microscopy/energy dispersive spectroscopy. Additionally, the yellow layer of each item was analyzed and compared by microspectrophotometry. Each layer of the questioned paint was similar in all examinations performed to the known paint; therefore, Items 2 and 3 could have originated from the source as represented by Item 1 (Level 3 - Association). Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined.</p>
3E8QV8	<p>The FTIR (650-4000 cm⁻¹) and Raman (lasers: 514nm, 785 nm; 200-3000 cm⁻¹) analysis of two paint layers for each item were carried out. No significant differences were found between first (yellow) and second (white) layer of paint on all three Items. Therefore, it is highly possible that the paint coating in Item 2 and 3 originates from the same source as the paint coating in Item 1.</p>
4GQ6XM	<p>Each sample present in the items comprised two layers of architectural paint of yellow topcoat on white undercoat (on substrate). The yellow topcoats in items 2 and 3 were indistinguishable from the yellow topcoat in item 1. The white undercoats in items 2 and 3 were indistinguishable from the white undercoat in item 1. In my opinion the findings provide moderately strong support for the proposition that the paint samples in items 2 and 3 originated from the same source as the control sample (item 1) rather than not.</p>
4TKLN9	<p>The following instrumentation was utilized for analysis: Fourier Transform Infrared Microscope (FTIR), Stereo Microscope, Microspectrophotometer (MSP) and Scanning Electron Microscope with Energy Dispersive Spectrometer (SEM/EDS). Items 1B (2) and 1C (3) were compared to item 1A (1). Each sample was consistent in physical, chemical and elemental composition as well as color. Items 1B and 1C both could have originated from item 1A or another source having the same physical, chemical, elemental and color composition.</p>
66VC34	<p>The Item 2 and 3 paint chips from the articles of clothing were examined and compared to the Item 1 known paint sample from the damaged area of the bedroom wall. Using a combination of analytical techniques that afford a high degree of discrimination, neither Items 2 nor 3 could be differentiated from Item 1 with respect to layer structure (i.e., layer colors, texture, sequence) or chemical composition. Therefore, Items 2 and 3 originated from the same paint source as Item 1 or from physically and chemically indistinguishable paints manufactured and then applied in the same manner (Type III Association). This conclusion was reached because other paints produced at the same manufacturing plant(s), or with the same specifications, and applied in the same manner would also be indistinguishable. The following 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 I Association: Physical/Fracture Match – The compared 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 class evidence can have varying degrees of significance. As the size of the class decreases, the significance of the association between items in that class increases. A class association does not definitively establish that the items came from the same source. Type II Association: Association with atypical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Further, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III Association: Association with typical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been</p>

TABLE 3

WebCode	Conclusions
	<p>manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV Association: Association with limited characteristics/examinations – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. 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 as a result of items that are more commonly encountered in the relevant population, the inability to perform a complete analysis, or minor variations observed in the data. Inconclusive - No conclusion could be reached regarding an association or an elimination between the items.</p> <p>Elimination/Exclusion – The compared items exhibit differences in observed and/or measured properties and/or chemical composition that demonstrate they did not originate from the same source.</p>
6KN7CA	<p>Paint Examination and Comparison: Comparative examinations of the Known paint (Item #1) to the Questioned paint (Item #3) gave consistent microscopic, chemical and instrumental (Fourier Transform InfraRed, Pyrolysis Gas Chromatography) results. Therefore, in the opinion of examiner, the Questioned paint from the suspect's jacket (Item #3) could have originated from the Known paint from the victim's bedroom as represented by Item #1 or from another source exhibiting all of the same analyzed characteristics. Comparative examinations of the Known paint (Item #1) to the Questioned paint (Item #2) gave consistent microscopic results, however, different chemical and instrumental (Fourier Transform InfraRed, Pyrolysis Gas Chromatography) results were obtained. Therefore, in the opinion of examiner, the Questioned paint from the suspect's hat (Item #2) could not have come from the Known paint from the victim's bedroom as represented by Item #1.</p>
8HRCQP	<p>We didn't find differences between Item 1, Item 2 and Item 3 with the analytical methods. So it could be originated from the damaged area of the victim's bedroom wall.</p>
8LAUMZ	<p>Samples of the questioned paint in Items 2 and 3 were compared to samples of the known paint in Item 1 using the following techniques: microscopy, fluorescence, infrared spectroscopy, and scanning electron microscopy - energy dispersive spectroscopy (SEM-EDS). The sampled paint in all three items had a layer system of yellow over white. Samples from the yellow layer of Items 2 and 3 were also compared to samples of the yellow layer of Item 1 using microspectrophotometry. Each layer of questioned paint was similar in all tests performed to the respective layer of known paint. The victim's bedroom wall, as represented by the known paint chip, is a possible source of the questioned paint chips recovered from the suspect's hat and jacket (Level 3 - Association). Because similar items or structures may have been painted with paint that would be indistinguishable from the submitted evidence, an individual source cannot be determined.</p>
8LQNLP	<p>The questioned paint chips from the suspect's hat (Item2) and jacket (Item3) cannot be differentiated from the damaged area of the victim's bedroom wall represented by Item1. Thus, both samples (Item2 and Item3) could have originated from the damaged area of the victim's bedroom wall represented by Item1.</p>
8PTNLL	<p>The source of the exemplar paint chip in item 1 is included as a possible source of the unknown paint chips in items 2 and 3, based on class characteristics.</p>
8UNFW4	<p>Items 1-3 are consistent in color, appearance, layer sequence and chemical composition. The questioned paint chips recovered from the suspect's hat (Item 2) and from the suspect's jacket (Item 3) could have originated from the damaged area of the victim's bedroom wall (Item 1) or from another damaged area coated with paint exhibiting all of the same analyzed/measured characteristics.</p>

TABLE 3

WebCode	Conclusions
8XJARK	The questioned paint chips recovered from the suspect's hat (Item 2) and the questioned paint chips recovered from the suspect's jacket (Item 3) are similar to the known paint sample representative of the damaged area of the victim's bedroom wall (Item 1). In conclusion, the paint chips marked as Item 2 and Item 3 could have originated from the damaged area of the victim's bedroom wall as represented by Item 1.
97C2F6	The questioned paint recovered from the suspect's hat (item 2) is the same distinct type of paint as the known paint on the victim's bedroom wall (item 1) and originated either from that source or another source of paint having the same distinct characteristics. The questioned paint recovered from the suspect's jacket (item 3) is the same distinct type of paint as the known paint on the victim's bedroom wall (item 1) and originated either from that source or another source of paint having the same distinct characteristics.
9JWGH4	Results of Laboratory Examination: The questioned paint in Items 2 and 3 corresponded in color and layer structure (pale yellow top layer, white bottom layer), chemical composition (FTIR, PGCMS), and elemental composition (SEM/EDS) to the known paint in Item 1. Therefore, Items 1, 2, and 3 could have a common source (Type 3 Association). It should be noted that since similar items may have been manufactured that would be indistinguishable from the submitted evidence, an individual source cannot be determined. KEY for instrument acronyms: FTIR – Fourier Transform Infrared Spectroscopy, PGCMS – Pyrolysis Gas Chromatography with Mass Spectrometry, SEM/EDS – Scanning Electron Microscopy/Energy Dispersive Spectroscopy. Interpretation: The following descriptions are meant to provide context to the opinions reached in this report. Every type of conclusion may not be applicable in every case or for every material type. Type 1 Association: Identification - An association in which items share individual characteristics and/or physically fit together that demonstrate the items were once from the same source. Type 2 Association: Highly likely - An association in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and share distinctive characteristic(s) that would not be expected to be found in the population of this evidence type. The distinctive characteristics were not sufficient for a Type 1 Association. Type 3 Association: Could have - An association in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and could have originated from the same source. Because it is possible for another sample to be indistinguishable from the submitted evidence, an individual source cannot be determined. Type 4 Association: Cannot eliminate - An association in which items correspond in some but possibly not all measured physical properties, chemical composition and/or microscopic characteristics and cannot be eliminated as coming from the same source. This type of evidence may be commonly encountered in the environment, may have limited comparative value and/or there may be factor(s) limiting the comparison. Inconclusive: No conclusion could be reached regarding an association between the items. Elimination: Items exhibit dissimilarities in one or more of the following: physical properties, chemical composition or microscopic characteristics and, therefore, conclusively did not originate from the same source. Non-Association: Items exhibit dissimilarities but certain details or features are not sufficient for an Elimination.
9REQ7Z	In the limit of our analytical techniques, both item 2 and 3 could have the same origin than the item 1.
BHZMWJ	The questioned paint chips from the suspect's hat(Item 2) and jacket(Item 3) could come from the damaged area of the victim's bedroom wall.
DAF7GE	The paint in Exhibits 2 and 3 originated either from the source of Exhibit 1, or from another source of paint having indistinguishable physical and chemical properties.

TABLE 3

WebCode	Conclusions
DAUTQG	All items are 2 layers-paint chips(yellow and white). FT-IR results show that each layer of all items is same. yellow layer of all items gives identical spectrum by microspectrophotometry. The paint chips recovered from the suspect's hat(item 2) and the suspect's jacket(item 3) have came from the damaged area of the victim's bedroom wall(item 1).
E2JQ6F	Top layer(yellow layer) of item 1 is similar with item 2 and item 3(top layer) by FT-IR spectroscopy. Moreover, 2rd layer(white layer) of item 1 is similar with item 2(2rd layer) and item 3(2rd layer).
E7U4ME	Item 2 could not have originated from the same source as Item 1. Item 3 could have originated from the same source as Item 1.
EC36A4	Item 1 (Control) from the damaged area comprised a white acrylic/styrene undercoat with a yellow acrylic topcoat. The white undercoat contained the elements Ca, Ti, Si, Al, Mg and Zn. The yellow topcoat contained the elements Ti, Al, Si, Ca and K. Item 2 recovered from the hat comprised a white acrylic/styrene undercoat with a yellow acrylic topcoat. Item 3 from the jacket comprised a white acrylic/styrene undercoat with a yellow acrylic topcoat. Item 2 and Item 3 corresponded in composition, appearance and layer sequence with Item 1. These results support the proposition that Items 2 and 3 originated from the damaged area of the victims bedroom wall (Item 1).
FATEHE	Questioned items 2 and 3 are indistinguishable from each other and from reference item 1. This conclusion is based on paint binders of the top yellow layers and the underlying white layers of each sample. Analyses were carried out using FTIR and SEM-EDX.
FFUPQR	The examination revealed that the physical and chemical characteristics of the paint chips recovered from the hat (Item 2) and the jacket (Item 3) are consistent with the physical and chemical characteristics of the paint recovered from the wall (Item 1). It is therefore concluded that the paint chips from the suspect's hat and jacket are of the same type of paint as from the victim's bedroom wall, and could have originated from that source or from another source of paint having the same characteristics.
FGQ8TU	On analysis, I found that the questioned paint chips recovered from the suspect's hat (Item 2) and the questioned paint chips recovered from the suspect's jacket (Item 3) to be similar with the known paint sample representative of the damaged area of the victim's bedroom wall (Item 1). Hence, I am of the opinion that the questioned paint chips recovered from the suspect's hat (Item 2) and the questioned paint chips recovered from the suspect's jacket (Item 3) could have originated from the known paint sample representative of the damaged area of the victim's bedroom wall (Item 1).
G8Y9FT	Item 2 (multi-layered paint chips from the suspect's hat) did not originate from the source represented by Item 1 (multi-layered paint chip from the victim's bedroom wall). Item 3 (multi-layered paint chips from the suspect's jacket) did not originate from the source represented by Item 1 (multi-layered paint chip from the victim's bedroom wall).
GTDTCU	Microscopic examination of Items 1, 2, and 3 revealed architectural paint samples with the following layer structure: a yellow paint layer and a white paint layer. Physical, microscopic, and instrumental analysis and comparison of the paint from Item 2 with the paint from Item 1 revealed them to be consistent with respect to color, texture, type, layering sequence, binder composition, and pigment composition. Therefore, the paint from the suspect's hat could have originated from the damaged area of the victim's bedroom wall or another object with the same paint history. Physical, microscopic, and instrumental analysis and comparison of the paint from Item 3 with the paint from Item 1 revealed them to be consistent with respect to color, texture, type, layering sequence, binder composition, and pigment composition.

TABLE 3

WebCode	Conclusions
	Therefore, the paint from the suspect's jacket could have originated from the damaged area of the victim's bedroom wall or another object with the same paint history.
H8U9RY	The known paint sample in Item 1 from the damaged area of the victim's bedroom wall comprised one two-layered paint fragment, having a yellow first layer and a white second layer. The questioned paint chips in Item 2 from the suspect's hat were found to contain two two-layered paint chips, each having a yellow first layer and a white second layer. The yellow and white paints in the questioned paint chips item 2 agreed in colour and chemical composition with the respective paints of the known paint sample in Item 1, suggesting that they could have originated from the same source. The questioned paint chips in Item 3 from the suspect's jacket were found to contain two two-layered paint chips, each having a yellow first layer and a white second layer. The yellow and white paints in the questioned paint chips Item 3 agreed in colour and chemical composition with the respective paints of the known paint sample in Item 1, suggesting that they could have originated from the same source.
HLWKNX	The paint chips in Item 2 demonstrate similar physical characteristics and chemical composition as the paint sample comprising Item 1. Accordingly, the paint chips in Item 2 could have originated from the same source as Item 1, or another source with the same physical characteristics and chemical composition. The paint chips in Item 3 demonstrate similar physical characteristics and chemical composition as the paint sample comprising Item 1. Accordingly, the paint chips in Item 3 could have originated from the same source as Item 1, or another source with the same physical characteristics and chemical composition.
JDZ6CY	Based on the techniques used, I formed the opinion that the paint chips recovered from the suspect's[<i>sic</i>] hat, item 2 had a chemical and elemental composition indistinguishable to the control paint from the victim's bedroom wall and could have originated from it. Based on the techniques used, I also formed the opinion that the paint chips recovered from the suspect's jacket, item 3 had a chemical and elemental composition indistinguishable to the control paint from the victim's bedroom wall and could have originated from it.
KE793R	Examination of Items #2 and #3 each revealed the presence of two paint chips with the following layer structure: yellow and white. Examination of Item #1 revealed the presence of a single yellow paint chip with the following layer structure: yellow and white. The yellow paint chips from Items #2 and #3 were compared to the yellow paint chip from Item #1 and were found to be physically and chemically consistent with the yellow paint chip from Item #1. Therefore, the yellow paint chips from Items #2 and #3 could have originated from the same source as the yellow paint chip in Item #1.
KVBF9E	Questioned paints Q1A, Q1B, Q2A, Q2B and known paint K1 were stereoscopically examined and instrumentally analyzed using Fourier Transform Infrared Spectroscopy (FT-IR) and X-Ray Fluorescence Spectrometry (XRF). These analyses disclosed that questioned paints Q1A, Q1B, Q2A, Q2B 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. It is the opinion of the undersigned that the questioned paints Q1A, Q1B, Q2A and Q2B could have originated from the same source as represented by the known paint, K1, or from another source exhibiting all of the same analyzed characteristics.
L4493T	Examination of Items #1, 2, & 3 revealed the presence of yellow paint chips with the following layer structure: yellow & white. The paint chips recovered from the suspect's hat (Item #2) and the suspect's jacket (Item #3) were physically and chemically consistent with the paint from the damaged area of the victim's bedroom wall (Item #1). Therefore, the paint from Items #2 & 3 could have originated from the same source as the paint from Item #1.
LGPM48	The paint in items 2 and 3 is similar in color, layer structure, solubility, fluorescence and

TABLE 3

WebCode	Conclusions
	infra-red absorbance spectra to the paint in item 1. Therefore the paint in items 1, 2 and 3 could have originated from the same source.
LW22L6	In my opinion, the findings provide strong support for the proposition that the two paint fragments recovered from the suspect's hat (item 2) and jacket (item 3) have originated from the damaged area of the victim's bedroom wall (as represented by item 1).
MAK4HM	The questioned paint chips from the suspect's hat (Item 2) and suspect's jacket (Item 3) are similar in visual color, layer sequence, microscopic characteristics, polymer type, and paint composition to the known paint from the damaged area of the victim's bedroom wall (Item 1). It is my opinion that the questioned paint from the suspect's hat and jacket could have come from the damaged area of the victim's bedroom wall or another source with similar characteristics.
MWV7E4	Items 2 and 3 are very similar in composition to each other and to Item 1. Item 1 could represent the source for Items 2 and 3.
MWZND3	"ITEM 1" was physically and chemically comparable to "ITEM 2" and "ITEM 3" and therefore they could have originated from the source.
NU8RQU	The paint sample (Item 1) from the damaged area of the bedroom wall and the recovered paint chips from the suspect's hat (Item 2) and jacket (Item 3) consisted of a pale yellow satin-finish topcoat and white undercoat applied to a card surface. The color, appearance and texture of the respective yellow topcoats and white undercoats associated with these paints (items 1, 2 & 3) were indistinguishable. No significant differences were detected between the compositions of the corresponding yellow topcoats and white undercoats of these paints. Consequently, it is my opinion that the paint chips recovered from the suspect's hat (Item 2) and jacket (Item 3) could have originated from the damaged area of the bedroom wall (Item 1). However, I cannot exclude the possibility that the paint chips recovered from the suspect's hat (Item 2) and jacket (Item 3) could have originated from another card surface painted using paints manufactured to the same specification as the yellow topcoat and white undercoat.
P2NM7N	The two-layer paint sampled from items 1 (Known - victim's bedroom wall), 2 (Questioned - suspect's hat), and 3 (Questioned - suspect's jacket) were found to be similar in appearance (Stereomicroscope), color (Comparison Microscope), microscopic characteristics (PLM), and organic composition (FTIR). The damaged portion of the wall (or another surface with a similar paint composition) cannot be excluded as a possible source of the paint found on both the suspect's hat and jacket.
PAXCKM	The questioned paint flakes in Item 2(Paint from suspect's hat) and Item 3(Paint from suspects's[sic] jacket) are consistent with the known paint in Item 1(Paint from victim's wall) on the basis of color, texture, organic and elemental composition. Therefore the paint in Items 2 and 3 could have originated from the known paint in Item 1.
PM4824	[No conclusions reported]
QKVCWQ	I compared these three paint samples using stereo microscopy, polarizing light microscopy, an alternate light source, infrared microspectrophotometry, raman microspectrophotometry, visible light microspectrophotometry, pyrolysis gas chromatography, and scanning electron microscopy with energy dispersive spectrometry. Both questioned paint chips, items 001-2 and 001-3, were indistinguishable in physical properties, microscopical properties, and chemical composition from the known paint chip, item 001-1, as determined using the above listed instrumentation. The questioned paint samples, item 001-2 and 001-3, could have come from the same source of paint as the known paint sample, item 001-1, or another paint

TABLE 3

WebCode	Conclusions
	source with the same color, layer sequence, and microscopical and chemical properties.
QVWZPN	The white and yellow paint layers of Exhibits 1, 2 and 3 were examined visually and with the aid of a stereomicroscope. They are consistent with one another in color, texture and layer structure. Each white and yellow paint layer was analyzed for chemical composition via Fourier-Transform Infrared Spectroscopy (FTIR) and for elemental composition via X-ray Fluorescence Spectroscopy (XRF). The paints in Exhibits 2 and 3 are not differentiated from the corresponding layers in the Exhibit 1 standard by these techniques. Therefore, the chips located on the suspect (Exhibits 2 and 3) could have originated from the bedroom wall as represented by Exhibit 1, or from another painted surface with yellow and white paints with the same appearance, chemical composition and elemental properties.
RB4GBF	The known paint sample (Item 1) as well as the questioned samples (Item 2 and Item 3) show a yellow top paint layer and a white paint layer. All samples can not be differentiated by means of microscopy, infrared spectroscopy, and by their elemental composition. Regarding to the methods used, the questioned paint chips from the suspect's hat (Item 2), and from the jacket (Item 3) could have originated from the damaged area of the victim's bedroom.
RFB8DL	The yellow and white layers of Exhibit 2 and 3 were found to be visually, chemically, and elementally consistent with the yellow and white layers of Exhibit 1. Therefore, the paint chips recovered from the Suspect's hat (Exhibit 2) and jacket (Exhibit 3) could have come from the Victim's bedroom wall (Exhibit 1), or a source painted with the same layer structure exhibiting the same chemical and elemental properties.
RQWBKL	Item 1, Item 2 and Item 3 are each composed of a 2 layer architectural paint system. The top layer is a yellow color coat and the second layer is a white primer. The questioned yellow paint chips recovered from the suspect's hat (Item 2) and questioned paint chips recovered from the suspect's jacket (Item 3) are similar in color, physical appearance, chemistry and elemental composition in comparison to the yellow paint sample representative of the damaged area of the victim's bedroom wall (Item 1). The yellow paint from Item 2 and Item 3 could have come from Item 1, or any other yellow paint source that is similar in color, physical appearance, chemistry and elemental composition.
RZ8D7L	Comparative examinations of the paint sample in Exhibit 1 (known paint sample representative of the damaged area of the victim's bedroom wall) with the paint chips in Exhibit 2 (questioned paint chips recovered from the suspect's hat) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, the questioned paint chips recovered from the suspect's hat could have had a common source of origin with the known paint sample representative of the victim's bedroom wall. Comparative examinations of the paint sample in Exhibit 1 (known paint sample representative of the damaged area of the victim's bedroom wall) with the paint chips in Exhibit 3 (questioned paint chips recovered from the suspect's jacket) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, the questioned paint chips recovered from the suspect's jacket could have had a common source of origin with the known paint sample representative of the victim's bedroom wall.
T28ZYG	Items 1, 2 and 3 were examined visually and using stereomicroscopy, fluorescence microscopy, microsolubility tests, microchemical tests, Fourier Transform Infrared Spectrophotometry (FTIR) and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The two-layered yellow paint particles in Items 1, 2 and 3 were consistent in colors, textures, types, layer sequence, and chemical compositions. It was concluded that the paints in Items 1, 2 and 3 either originated from the same source or different sources painted in the same manner.

TABLE 3

WebCode	Conclusions
T4WA7W	The questioned paint chips from the suspect's hat (Item 2) and jacket (Item 3) could have originated from the damaged area of the victim's bedroom wall as represented by Item 1.
TJD8CX	Microscopic examination revealed each Item had two coating layers: a white primer and a yellow topcoat. The thickness and color of the layers of each Item appeared to be similar. However, the infrared spectrum of the primer of Item 1 was similar but not the same as that of Items 2 and 3. Likewise, the infrared spectrum of the yellow topcoat of Item 1 was similar but not the same as that of Items 2 and 3.
TW36FG	The known paint sample item 1 (representative of the damaged area of the victim's bedroom wall), the questioned paint chips item 2 (recovered from the suspect's hat) and the questioned paint chips item 3 (recovered from the suspect's jacket) are each composed of two paint layers: a white paint layer underneath and a yellow paint layer on top. The two layers in both questioned paint chips (item 2 and item 3) cannot be differentiated from the corresponding layers in the known paint sample (item 1). The questioned paint chip recovered from the hat of the suspect (item 2) and the questioned paint chip recovered from the jacket of the suspect (item 3) could have originated from the damage area of the victim's bedroom wall (item 1).
U4FDEX	According to the results of above mentioned examination and analysis procedures, both of the questioned paint chips recovered from the suspect's hat (Item 2) and jacket (Item 3) could have originated from the known paint sample representative of the damaged area of the victim's bedroom wall (Item 1).
U6QEZW	Item 2, questioned paint chips recovered from the suspect's hat and item 3, questioned paint chips recovered from the suspect's jacket may have had a common origin with item 1, the known paint sample representative of the damaged area of the victim's bedroom wall.
UM7N4H	The paint fragments examined from item #1, item #2 and item #3 were alike with respect to their color, texture, layer structure, chemical solubilities, inorganic composition, and organic composition. It was concluded that the paint examined from item #2 and item #3 could have had a common origin with item #1 or another source painted in the same manner.
UQ7ZYH	The questioned paint (items 2 and 3) were subsequently found to be consistent with the known paint (item 1) regarding color, texture, microchemical and physical properties and gross elemental composition. Based upon these observations, it is the opinion of this analyst that the known paint (item 1) and the questioned paint (items 2 and 3) are of the same type and could have come from the same source. This analyst recognizes that another source of paint with properties consistent with the above paint exists.
UV2TUX	Examination of Items 1, 2 and 3 using a low power stereomicroscope showed all three to have similar layer structures. Each was seen to consist of a light yellow non-metallic topcoat and a white primer layer. Thin shavings of the yellow and white layers from each sample were dispersed in 1.600 refractive index liquid and examined using polarized light microscopy (PLM). All three samples were consistent in appearance. The yellow layers all contained TiO ₂ , a yellow pigment and a small amount of a birefringent filler. The white layers contained TiO ₂ and calcium carbonate. Micro infrared spectroscopic analysis of thin shavings taken from both layers of each of the three samples showed no significant differences between them. Scanning electron microscopy with energy dispersive X-ray spectrometry (SEM/EDS) showed the yellow and white layers in Items 2 and 3 to have elemental compositions consistent with the yellow and white layers in Item 1. Major elements identified were consistent with identification of TiO ₂ and calcium carbonate by PLM. Results of all analyses show the questioned paint chips (Items 2 and 3) to be consistent with Item 1. The questioned paint chips from the suspect's hat and jacket could have originated from the damaged area of the victim's bedroom wall.

TABLE 3

WebCode	Conclusions
VTPEZW	Items 2 and 3 do not show significant reproducible differences from Item 1 and thus Item 2 and/or Item 3 could have originated from Item 1.
VUKW3Y	The questioned paint chips from the suspect's hat (Item 2) could have originated from the damaged area of the victim's bedroom wall as represented by Item 1. The questioned paint chips from the suspect's jacket (Item 3) have originated from the damaged area of the victim's bedroom wall as represented by Item 1.
WWLEFK	CONCLUSIONS: The victim's bedroom wall (as represented by the paint in Item 1) cannot be excluded as a possible source of the paint chips (Item 2) recovered from the suspect's hat and paint chips (Item 3) recovered from the suspect's jacket. Either the yellow paint recovered from the suspect's hat and jacket came from the victim's bedroom wall or from another source or sources of paint that is indistinguishable in layer sequence, microscopic appearance, and chemical composition. Other sources of indistinguishable paint include other architectural paints of the same manufacture's formulation and colour.
X9X4UF	Item 1: One light yellow paint chip with a textured surface was analyzed as a standard for comparison to items 2 and 3. Item 2: Two light yellow paint chips with textured surfaces were found. In the sample analyzed, the unknown light yellow paint chip "from the suspect's hat" and the standard light yellow paint chip from "the damaged area of the victim's bedroom wall" are the same in physical and chemical characteristics. The unknown paint "from the suspect's hat" either originated from the standard paint from "the damaged area of the victim's bedroom wall" or another source of paint possessing the same distinct physical and chemical characteristics. Item 3: Two light yellow paint chips with textured surfaces were found. In the sample analyzed, the unknown light yellow paint chip "from the suspect's jacket" and the standard light yellow paint chip from "the damaged area of the victim's bedroom wall" are the same in physical and chemical characteristics. The unknown paint "from the suspect's jacket" either originated from the standard paint from "the damaged area of the victim's bedroom wall" or another source of paint possessing the same distinct physical and chemical characteristics.
XRU8XC	All paint chips consisted of two layers on a substrate: a white layer and a yellow layer at the surface. The yellow layers of both questioned paint chips (Item 2 and Item 3) could not be distinguished from the yellow layer of the known paint sample by the methods used. The white layer of questioned paint from the suspect's jacket (Item 3) could not be distinguished from the white layer of the known paint sample. Item 3 can therefore originate from the damaged area of the bedroom wall. The white layer of the questioned paint from the suspect's hat however (Item 2) presented a higher filler loading compared to the known paint sample, as was detected both in microscopic examination and elemental composition. Item 2 is therefore different from the known paint and cannot have originated from the damaged area of the bedroom wall.
XW6KEB	The questioned samples (Items 2 and 3) could have originated from the paint from the bedroom wall, as represented by the known submitted exemplar (Item 1), or from another source of paint exhibiting all of the same analyzed characteristics.
XWZ4GC	The questioned paint chips marked "Item 2" and "Item 3" could have originated from the same source as the control paint chip marked "Item 1", or another source of paint with similar characteristics.
Y2QWPW	The items 2 (hat) and 3 (jacket) dont have differences with the item 1 (damage area of the victims bedroom). Then, they could have originated from item 1.
Y7LNZE	1. Two layer yellow paint standard. 2. A two layer yellow paint chip was found. The unknown

TABLE 3

WebCode	Conclusions
	<p>paint and the paint standard from the victim's bedroom wall (item #1) are the same in physical and chemical characteristics. The unknown paint recovered from the suspect's hat either originated from the standard (item #1) or from another source of paint possessing the same distinct physical and chemical characteristics. 3. A two layer yellow paint chip was found. The unknown paint and the paint standard from the victim's bedroom wall (item #1) are the same in physical and chemical characteristics. The unknown paint recovered from the suspect's jacket either originated from the standard (item #1) or from another source of paint possessing the same distinct physical and chemical characteristics.</p>
YBGHW	[No conclusions reported]
YG49JB	<p>The yellow paint chips recovered from the suspect's hat (Item 2) and jacket (Item 3) are similar in visual color, layer sequence, chemical properties, paint type and composition to the known yellow paint from the victim's bedroom wall (Item 1). It is our opinion that the yellow paint chips recovered from the suspect's hat (Item 2) and jacket (Item 3) could have originated from the victim's bedroom wall (Item 1) or any other item with similar characteristics.</p>
YHYRLD	<p>The samples obtained (numbered 1-3) were found to contain 4 layers of materials. Two of these layers, a brown paper layer and a gray layer consisting of cellulose are attributed to the drywall substrate and will not be taken into account. Two paint layers were found -a yellow top layer, consisting of a.o. acrylate and titanium dioxide; -a white bottom layer, consisting of a.o. acrylate, styrene, calcium carbonate and titanium dioxide. The yellow paint layers from samples 1, 2, and 3 are identical on all analysed properties. The white paint layers from samples 1 and 3 are identical on all analysed properties. The white paint layer of sample 2 is very similar to these layers, but can be discriminated by its elemental composition. We formulate two hypotheses to evaluate these results: h1: the wall, represented by sample 1 is the source of sample 2 (or 3). h2: an arbitrary other object coloured with yellow paint is the source of sample 2(or 3). Our conclusion for sample 2 is: The wall (represented by sample 1) has to be excluded as the source of sample 2. This conclusion is based on the assumption that the samples obtained are representative. See also additional comments. Our conclusion for sample 3 is: The results strongly support the hypothesis that the wall (represented by sample 1) is the source of sample 3.</p>
YM964B	<p>The yellow paint chips found in items 2 and 3 exhibit the same chemical composition as the yellow paint sample recovered from the victim's bedroom wall found in item 1. Therefore, the paint chips from items 2 and 3 could share a common origin with the paint sample in item 1.</p>
Z4CYAB	<p>Items 1, 2, and 3 each consist of two layer (yellow/white) architectural paint samples. The two layer (yellow/white) paint samples recovered from the suspect in Items 2 and 3 are similar in color, type, layer structure, and chemical composition to the known two layer (yellow/white) paint from the victim's bedroom wall in Item 1. It was concluded that these paint samples either originated from the same source or a different source coated using paint with a similar composition. Items 1, 2, and 3 were analyzed using stereomicroscopy, comparison microscopy with polarized light, fluorescence microscopy, scanning electron microscopy with energy dispersive x-ray spectrometry, and Fourier transform infrared micro-spectrometry.</p>
Z98T8C	<p>The yellow paint chips in Items 2 and 3 were identical to the yellow paint in Item 1 in color, type, texture, layer structure, and elemental composition. This means the paint chips recovered from the suspect's hat and jacket could have come from the damaged area of the victim's bedroom wall.</p>
ZEX3HB	<p>The paint fragments found in items 1, 2 and 3 were examined by stereomicroscopy, Fourier Transform Infrared Spectrometry (FTIR), Microspectrophotometry (MSP) and scanning electron microscopy with energy dispersive x-ray analysis (SEM/EDX). The yellow paint fragments found</p>

TABLE 3

WebCode	Conclusions
ZFMCPQ	<p>in items 2 and 3 exhibit the same microscopic characteristics and chemical composition as the known yellow paint found in item 1. Therefore, the yellow paint fragments found in items 2 and 3 may share a common origin with the yellow paint found in item 1.</p> <p>On analysis, T[sic] found that: i) Questioned paint chips recovered from the suspect's jacket (Item 3) to be similar to known paint sample representative of the damaged area of the victim's bedroom wall (Item 1). ii) Questioned paint chips recovered from the suspect's hat (item 2) to be dissimilar to known paint sample representative of the damaged area of the victim's bedroom wall (item 1).</p>

Additional Comments

TABLE 4

WebCode	Additional Comments
28RVDR	If the directions call to ignore drywall substrate why include a second substrate (cardboard). Real cases don't have two substrates on top of each other.
3DC9U7	A possible third, thin off-white layer was observed in all 3 items below the white layer. This layer was not consistent in appearance with paint and was therefore not included in the layering system description. IR analysis indicated the possible presence of kaolinite. The complete Association Scale used by our laboratory system cannot be included due to space availability. However the definition of the association included is below: 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.
4GQ6XM	Samples were soft and thus difficult to prepare for some of the tests conducted. The substrates also caused strong fluorescence using high power microscopy - given the soft/'fresh' nature of the samples it was not possible to remove the substrates easily.
66VC34	An Interpretation Scale is required for all paint comparison reports that are issued by this laboratory. Therefore, this report of examination should be considered incomplete if an Interpretation Scale is not included.
8LAUMZ	SEM-EDS analysis was conducted at the [Laboratory]. An Association Scale would be included in the report.
DAF7GE	RESULTS 1. Exhibit 1 consisted of a paint chip having the paint layer sequence yellow / white. 2. Exhibit 2 consisted of 2 paint chips having the paint layer sequence yellow / white. These paint layers were physically and chemically indistinguishable from corresponding paint layers in Exhibit 1. 3. Exhibit 3 consisted of 2 paint chips having the paint layer sequence yellow / white. These paint layers were physically and chemically indistinguishable from corresponding paint layers in Exhibit 1.
EC36A4	The frequency of objects with paint indistinguishable from the control is unknown.
FATEHE	Yellow layer mineral content was found to be inhomogeneous. Analysis of multiple locations of each chip demonstrated no significant differences in composition.
G8Y9FT	SEM/EDX results for items 2 and 3 differed from Item 1 in the reproducible ratios of the elements Mg and Si present in the primer layer.
JDZ6CY	The binder composition of these paints was found to be a styrene modified acrylic polyester (butylmethacrylate) formulation. No chemical or elemental evidence of pigment was detected using the techniques prescribed. While visually the lemon yellow coloured pigments present in the top coat layer of each of these three paint samples appeared to be indistinguishable, use of the technique of microspectrophotometry could further characterise each of the pigments in terms its UV-Vis absorbance properties. Microspectrophotometry is not a technique available in our laboratory and only fluorescent characterisation of these paints was undertaken.
RB4GBF	It has to be taken into account that paint is a mass product and shows only group identifiers. An individual match of these materials is not possible.
RQWBKL	Chemical Analysis performed includes: Fourier Transform Infrared Spectroscopy, Solubility/Chemical analysis and Scanning Electron Microscopy.
T4WA7W	Items 1, 2 and 3 consisted two paint layers: a yellow top paint layer and a white layer

TABLE 4

WebCode	Additional Comments
	underneath the yellow layer. Both yellow and white layers contain TiO ₂ . The white layer also contains CaCo ₃ .
XWZ4GC	"Item 1" to "Item 3" were each found to consist of an outermost yellow layer and a second white layer. Both layers of "Item 1" to "Item 3" were found to be similar in terms of colour and chemical composition.
YHYRLD	The differences between samples 1 and 2 are subtle, but significant. In case work, we would try to obtain more reference samples from the wall, as the observed differences may well be attributed to heterogeneity of the paint.
Z98T8C	Microspectrophotometry was not performed on these paint layers due to their opacity and lack of microscopic color.
ZFMCPQ	I am of the opinion that question paint chips recovered from the suspect's jacket (item 3) have originated from the damaged area of the victim's bedroom wall.

Appendix: Data Sheet

Collaborative Testing Services ~ Forensic Testing Program

Test No. 16-545: Paint Analysis

DATA MUST BE RECEIVED BY May 31, 2016 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 a sexual assault of a young woman. The victim stated that damage was rendered to her bedroom wall during the assault. The police located a suspect and a warranted search was conducted five days after the sexual assault. Yellow paint chips similar in color to the victim's bedroom wall were located on the suspect's hat and jacket. A known paint sample has been collected from the damaged area of the bedroom wall. Police are requesting that you examine the recovered paint chips from the suspect's hat and jacket, and determine if they could have originated from the victim's bedroom wall.

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 drywall 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 victim's bedroom wall.

Item 2: Questioned paint chips recovered from the suspect's hat.

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

1.) Could the questioned paint chips from the suspect's hat (Item 2) and/or jacket (Item 3) have originated from the damaged area of the victim's bedroom wall as represented by Item 1?

Item 2: Yes No Inconclusive

Item 3: Yes No Inconclusive

Please return all pages of this data sheet.

Participant Code:

WebCode:

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

Microscopic Examinations:

- | | | |
|---|--|---|
| <input type="checkbox"/> Stereomicroscope | <input type="checkbox"/> Polarized Light | <input type="checkbox"/> Fluorescence |
| <input type="checkbox"/> Pyrolysis GC | <input type="checkbox"/> FTIR | <input type="checkbox"/> Solubility/Chemical |
| <input type="checkbox"/> XRS/XRF | <input type="checkbox"/> SEM/EDX | <input type="checkbox"/> Microspectrophotometry |
| <input type="checkbox"/> 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 **May 31, 2016** 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. **16-545: Paint Analysis**

This release page must be completed and received by **May 31, 2016** 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

ASCLD/LAB Certificate No. _____

ANAB Certificate No. _____

A2LA Certificate No. _____

Step 2: Complete the Laboratory Identifying Information in its entirety

Signature and Title _____

Laboratory Name _____

Location (City/State) _____

Accreditation Release	
<u>Return Instructions</u>	
<i>Please submit the completed Accreditation Release at the same time as your full data sheet. See Data Sheet Return Instructions on the previous page.</i>	<i>Questions? Contact us 8 am-4:30 pm EST Telephone: +1-571-434-1925 email: forensics@cts-interlab.com</i>
Please return all pages of this data sheet.	