Collaborative Testing Services, Inc
FORENSIC TESTING PROGRAM

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Paint Analysis
Test No. 23-5452 Summary Report

Each sample set contained two known paint samples (Item 1 and Item 2) and one questioned sample (Item 3) containing paint chips. Participants were requested to compare the items and report their findings. Data were returned from 50 participants and are compiled in the following tables:

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

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

Manufacturer's Information

Each sample set contained three items with layered paint and primer where samples were cut from painted drywall panels: two known samples (Item 1 and Item 2) and one questioned sample (Item 3). The known Item 1 consisted of paint chips representative of the damaged area of wall A. The known Item 2 and questioned Item 3 consisted of paint chips representative of the damaged area of wall B. Participants were instructed to examine the questioned samples and determine if they could have originated from either of the damaged walls at the scene.

SAMPLE PREPARATION: The drywall panels used for this test were inspected for defects, and the areas containing defects were not used. The Item 1 paint sample was prepared using Kilz® oil-based primer, Zinsser® water-based primer, and HGTV Home® by Sherwin Williams Showcase Interior Eggshell paint. The Items 2 and 3 paint samples were prepared using Zinsser® water-based primer and Valspar® Signature Interior Eggshell paint.

ITEM 1 (ELIMINATION): For the known Item 1, the painted drywall panel was scored into approximately ½" x ½" wide pieces. One piece was deposited and folded into a glassine bag, then placed into a pre-labeled envelope and sealed.

ITEMS 2 AND 3 (ASSOCIATION): For the known Item 2 and questioned Item 3, the painted drywall panel was scored into approximately ½" x ½" wide pieces and ¼" x ¼" wide pieces respectively. These items were taken within a four-inch spatial proximity to one another and were kept together as an identification group. One larger piece was deposited and folded into a glassine bag for Item 2 and two smaller pieces were deposited and folded into a glassine bag for Item 3. Each bag was then placed into a separate pre-labeled envelope and sealed.

SAMPLE SET ASSEMBLY: For each sample set, Items 1, 2, and 3 were placed into a pre-labeled envelope and sealed. This process was repeated until all of the sample sets were prepared.

VERIFICATION: All predistribution laboratories reported the expected responses and used the following combined list of procedures: Stereomicroscopy, Polarized Light Microscopy, Microspectrophotometry, Fluorescence, FTIR, SEM/EDX, and Solubility/Chemical.

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 contained three items with layered paint and primer where samples were cut from painted drywall panels: two known samples (Item 1 and Item 2) and one questioned sample (Item 3). The known Item 1 consisted of paint chips representative of the damaged area of wall A. The known Item 2 and questioned Item 3 consisted of paint chips representative of the damaged area of wall B. (Refer to Manufacturer's Information for preparation details.)

Of the 50 responding participants, 48 (96%) eliminated Item 1 and identified Item 2 as having been the originating source to the Item 3 questioned paint chips. Of the remaining two participants, one participant eliminated Item 1 and were inconclusive for Item 2 as having been the originating source to the Item 3 questioned paint chips and the last participant identified Item 1 and eliminated Item 2 as having been the originating source to the Item 3 questioned paint chips.

The most commonly reported examination procedures included: Stereomicroscopy (96%) and FTIR (94%).

Examination Results

Could the questioned paint chips recovered from the suspect (Item 3) have originated from the damaged area of either wall A or B as represented by Items 1 and 2, respectively?

TABLE 1

WebCode	Item 1	Item 2	WebCode	Item 1	Item 2
3QG7GX	No	Yes	HYZK2E	No	Yes
3ZNNEV	No	Yes	KVPG49	No	Yes
4WJFMQ	No	Yes	LATYXG	No	Yes
6QQUUU	No	Yes	LJCG8F	No	Yes
7ZWYKP	No	Yes	M3YPHF	No	Yes
89KA8Q	No	Yes	MUP26G	No	Yes
8VVAGN	No	Yes	P2Z2EB	No	Yes
A3ATXT	No	Yes	P6YDBB	No	Yes
AJCFET	No	Yes	PMJ4AA	No	Yes
BDJUNH	No	Yes	PTRKQB	No	Yes
BV4NCM	No	Yes	Q2J6MB	No	Yes
BZYFKJ	No	Yes	Q3J3EJ	No	Yes
CVJ8WJ	No	Yes	QFZBHB	No	Yes
D3WFXL	No	Yes	QH4VLA	No	Yes
DF2Y9L	No	Yes	RBFVH3	No	Yes
F6DJHN	No	Yes	THLHDG	No	Yes
F7NL6M	No	Yes	U7ZWA7	No	Yes
GKYLEH	No	Yes	UAY977	No	Yes
GKZJND	No	Yes	UTEH88	No	Yes
GPVDLE	No	Yes	UZ8YD3	No	Yes
HKE6XF	No	Yes	VAGQF6	No	Yes

TABLE 1

WebCode	Item 1	Item 2	WebCode	Item 1	Item 2
VETPV6	No	Inc			
VWRRP3	No	Yes			
WMGP43	No	Yes			
X8MJBY	No	Yes			
YEFCVX	No	Yes			
YG8AAW	No	Yes			
YHEMRX	No	Yes			
YUTKW2	Yes	No			

Examination Response Summary **Participants: 50**

Could the questioned paint chips recovered from the suspect (Item 3) have originated from the damaged area of either wall A or B as represented by Items 1 and 2, respectively?

Responses	Item 1	Item 2
Yes	**1** *(2.0%)*	**48** *(96.0%)*
No	**49** *(98.0%)*	**1** *(2.0%)*
Inc	**0** *(0%)*	**1** *(2.0%)*

Examination Procedures

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
3QG7GX	✓		✓		✓					
3ZNNEV	✓		✓		✓				✓	Raman spectroscopy
4WJFMQ	✓		✓		✓					Comparison microscope
6QQUUU					✓				✓	
7ZWYKP	✓	✓	✓		✓	✓				
89KA8Q	✓				✓					Raman
8VVAGN	✓		✓		✓				✓	
A3ATXT	✓	✓	✓	✓	✓		✓		✓	
AJCFET	✓				✓		✓	✓		
BDJUNH	✓				✓					
BV4NCM	✓				✓				✓	
BZYFKJ	✓				✓					Raman Spectroscopy
CVJ8WJ	✓	✓			✓	✓				
D3WFXL	✓			✓	✓					RAMAN
DF2Y9L	✓				✓	✓				
F6DJHN	✓				✓				✓	
F7NL6M	✓			✓	✓				✓	
GKYLEH	✓				✓		✓			
GKZJND	✓				✓		✓	✓		
GPVDLE	✓	✓	✓		✓		✓		✓	
HKE6XF	✓				✓				✓	Raman (514.5 nm, 785 nm)
HYZK2E	✓									
KVPG49	✓	✓	✓		✓					Raman
LATYXG	✓	✓	✓	✓	✓		✓		✓	
LJCG8F	✓	✓	✓	✓	✓					
M3YPHF	✓	✓			✓	✓				
MUP26G	✓	✓	✓		✓				✓	
P2Z2EB	✓				✓				✓	
P6YDBB	✓				✓					
PMJ4AA	✓			✓	✓				✓	

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
PTRKQB	✓	✓	✓	✓	✓				✓	
Q2J6MB	✓				✓					
Q3J3EJ	✓				✓					
QFZBHB	✓	✓	✓		✓	✓		✓		
QH4VLA	✓				✓	✓				
RBFVH3	✓	✓			✓		✓		✓	
THLHDG	✓				✓					
U7ZWA7	✓	✓	✓	✓	✓				✓	
UAY977	✓	✓		✓	✓	✓		✓	✓	
UTEH88	✓				✓		✓		✓	Pyrolysis GC-MS
UZ8YD3	✓		✓		✓					
VAGQF6	✓				✓					
VETPV6	✓		✓				✓			Cross-sections, ALS, high intensity lighting
VWRRP3	✓				✓	✓				
WMGP43	✓				✓	✓	✓		✓	
X8MJBY	✓				✓				✓	
YEFCVX	✓			✓	✓				✓	
YG8AAW	✓		✓		✓				✓	
YHEMRX	✓		✓		✓					
YUTKW2										Breakdown Spectroscopy (LiBS) and Comparison Macroscope

Response Summary **Total Participants: 50**

	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	Microspectrophotometry	XRF/XRS	SEM/EDX
Participants	48	14	18	10	47	9	10	4	22
Percent	*96%*	*28%*	*36%*	*20%*	*94%*	*18%*	*20%*	*8%*	*44%*

Conclusions

TABLE 3

WebCode	Conclusions
3QG7GX	In my opinion, the paint evidence provides strong support for a proposition that the paint chips recovered from the suspect originated from the damaged area of Wall B, rather than not. The paint evidence shows conclusively that the paint chips recovered from the suspect did NOT originate from the damaged area of Wall A.
3ZNNEV	Based on visual observations with (stereo)microscopy and the analytical results from infrared spectroscopy ITEM 3 can be distinguished from ITEM 1. The results support extremely strong the proposition that the paint chips recovered from the suspect (ITEM 3) originate from an unknown painted object or wall rather than that these traces originate from the damaged area of wall A (ITEM 1). Based on visual observations with (stereo)microscopy and the analytical results from infrared spectroscopy, Raman spectroscopy and SEM-EDX ITEM 2 cannot be distinguished from ITEM 3. Small differences observed in the Raman signal from item 2 compared to item 3 can be explained by the inhomogeneity of the samples. The results support the proposition that the paint chips recovered from the suspect (ITEM 3) originate from the damaged area of wall B (ITEM 2) rather than that these traces originate from an unknown painted object or wall.
4WJFMQ	The known paint sample representative of the damaged area of wall A (Item 1) consisted of an orange solid paint with the following layer sequence: Orange/White. The known paint sample representative of the damaged area of wall B (Item 2) consisted of an orange solid paint with the following layer sequence: Orange/White. Item 3 consisted of 2 matching paint chips recovered from the suspect. The paint chips consisted of an orange solid paint with the following layer sequence: Orange/White. The paint chips recovered from the suspect (Item 3) matched the known paint from wall A (Item 1) in layer sequence (Orange/White), however the orange layers differed in both microscopic appearance and in chemical composition. The paint chips recovered from the suspect (Item 3) matched the known paint from wall B (Item 2) in microscopic appearance, layer sequence and in chemical composition.
6QQUUU	Based on the SEM imaging and EDS analysis of the three samples, the questioned paint chip recovered from the suspect (item 3) could not have originated from the damaged area of wall A (item 1) but cannot be excluded from having originated from the damaged area of wall B (item 2). These conclusions are supported by the FTIR analysis of the top layer of paint of all three items, where differences in the spectrum were observed between item 3 and item 1 but no significant differences were observed between item 3 and item 2.
7ZWYKP	Item 1: Known paint sample representative of the damaged area of wall A This item was used for comparison purposes. Item 2: Known paint sample representative of the damaged area of wall B This item was used for comparison purposes. Item 3: Questioned paint chips recovered from the suspect The questioned paint chips are similar in visual color to the known paint sample representative of the damaged area of wall B (Item 2). One of these paint chips was selected for further analysis and is similar in layer sequence, chemical solubility, fluorescence, and paint type to the known paint sample representative of the damaged area of wall B (Item 2). Please note that paint composition analysis and/or comparison cannot be performed by our laboratory at this time. It is our opinion that the questioned paint could have come from the damaged area of wall B or any other source with similar paint characteristics. No analysis was performed on the remaining paint chip. The questioned paint chips are dissimilar in visual color and texture to the known paint sample representative of the damaged area of wall A (Item 1). It is our opinion that the questioned paint chips did not come from the damaged area of wall A.
89KA8Q	The paint from item-3 (questioned paint chips recovered from the suspect) and item-2 (known paint sample representative of the damaged area of wall B) were consistent on color, layering

TABLE 3

WebCode	Conclusions
	and chemical composition and could have originated from the same source. The paint from item-3 (questioned paint chips recovered from the suspect) and item-1 (known paint sample representative of the damaged area of wall A) were inconsistent on layering and chemical composition and could not have originated from the same source.
8VVAGN	1. One, three-layer orange paint chip was analyzed for comparison to item #3. 2. One, two-layer orange paint chip was analyzed for comparison to item #3. 3. Two, two-layer orange paint chips were found. The unknown paint from the suspect and the standard paint from the "damaged area of wall A" (item #1) are not the same in physical characteristics (texture, layer structure and fluorescence). The unknown paint could not have originated from the standard paint from the "damaged area of wall A" (item #1). The unknown paint from the suspect and the standard paint from the "damaged area of wall B" (item #2) are the same in physical characteristics (color, texture, layer structure and fluorescence) and chemical characteristics. The unknown paint either originated from the standard paint from the "damaged area of wall B" (item #2) or another source of paint possessing the same distinct physical and chemical characteristics.
A3ATXT	The paint from Wall A and Wall B were each comprised of two layers, with an orange top layer and a white base layer. Item 3 originated from Wall B (item 2), or another source with paint that has the same physical, microscopic, optical and chemical properties. The paint from item 3 is comprised of two layers, with both layers physically, microscopically, optically, and chemically indistinguishable from the corresponding layers of paint from Wall B (item 2). Item 3 could not have originated from Wall A (item 1). The two layers of paint from item 1 were physically and microscopically different from the corresponding layers of paint from Wall A (item 1).
AJCFET	Physical and chemical examinations indicate that : Item 1 is distinguishable from item 3 in physical proprieties and chemical composition. Therefore, item 3 (Questioned paint chips recovered from the suspect) did not originated from item 1 (Known paint sample representative of the damaged area of wall A). Item 2 and 3 are indistinguishable from each other. Therefore, item 3 (Questioned paint chips recovered from the suspect) could have originated from item 2 (Known paint sample representative of the damaged area of wall B).
BDJUNH	We propose two hypotheses to evaluate the obtained results Hypothesis 1: The questioned paint recovered from the suspect (sample 3) originates from the wall. Hypothesis 2: The questioned paint recovered from the suspect (sample 3) originates from an arbitrary other painted object. With respect to sample 1 we conclude: The differences found between the samples exclude hypothesis 1. The questioned paint recovered originates from an arbitrary other painted object. With respect to sample 2 we conclude: The correspondence between samples 2 and 3 form a strong support for hypothesis 1. Hypothesis 2 cannot be excluded as paints are mass produced and an accidental match is unlikely, but possible. The results strongly support hypothesis 1.
BV4NCM	Microscopic and instrumental (Micro-FTIR, SEM/EDS) analysis of the paint from items #01.03(Q) and #01.02(K) revealed that they are consistent with respect to color, texture, chemical type, elemental composition, and layer structure. Therefore, the questioned paint particles from the suspect, item #01.03, could have originated from the known source, wall B, as represented by item #01.02 or another architectural paint source or painted surface exhibiting the same characteristics (color, texture, chemical type, elemental composition, and layer structure). Microscopic and instrumental (Micro-FTIR) analysis of the paint from Items #01.03(Q) and #01.01(K) revealed that they are dissimilar with respect to layer structure and chemical type (layer 1, orange). Therefore, the questioned paint particles from the suspect, item #01.03, could not have come from the known source, wall A, as represented by item #01.01.

TABLE 3

WebCode	Conclusions
BZYFKJ	Considering the number and color of layers, no significant visual differences were observed between Item 1 and Item 3. However, the analysis performed by FTIR and Raman spectroscopy determined that both samples have different composition. According to these results, Item 1 and Item 3 have different origins. Considering the number and color of layers, no significant visual differences were observed between Item 2 and Item 3. The analysis performed by FTIR and Raman spectroscopy determined that both samples are indistinguishable with the techniques used. Therefore, Item 2 and Item 3 could have the same origin.
CVJ8WJ	Item 1: This item was used for comparison purposes. Item 2: This item was used for comparison purposes. Item 3: This item contains two architectural paint chips. The questioned paint chips are similar in visual color to the known paint from wall A (Item 1) and wall B (Item 2). A portion of one of these paint chips was further analyzed and is different in chemical solubility from the known paint from wall A (Item 1). It is my opinion that the questioned paint did not come from wall A (Category 5). This same questioned paint chip is similar in layer sequence, chemical solubility, and paint type to the known paint from wall B (Item 2). It is my opinion that the questioned paint could have come from wall B or any other item with similar paint characteristics (Category 2B). No analysis was performed on the remaining paint chip.
D3WFXL	The content of all the items has been studied to answer the question. Our analyses show that the spectra of the paint representative of the damaged area of the wall A (Item 1) is different from the one of the one of the paint chip recovered from the suspect (Item 3). The results of our three comparative analyses show that the spectra of the paint representative of the damaged area of wall B (Item 2) cannot be differentiated from the one of the paint chip recovered from the suspect (Item 3). Consequently, the result of our observations and our analyses show that it is probable that the paint representative of the damaged area of wall B (Item 2) and the paint of the chip recovered from the suspect (Item 3) have the same origin, due to a contact of any type (tearing, rubbing, or impact) between the suspect and the damaged area of wall B.
DF2Y9L	On analysis, I found that Item 3 is similar to Item 2. Hence, I am of the opinion that the questioned paint chips recovered from the suspect (Item 3) could have originated from the known paint sample representative of the damaged area of wall B (Item 2).
F6DJHN	Item 3 shows similar FT-IR and SEM/EDS results to item 2, suggesting that the paint chips recovered from the suspect likely originated from wall B. The upper surface color and FT-IR spectrum of item 1 exhibit slight differences from item 3, along with disparities in the EDS elemental composition.
F7NL6M	Results of Examinations: The Item 3 questioned paint chips recovered from the suspect were examined and compared to the Item 1 known paint from wall A and Item 2 known paint from wall B. Based on the examinations conducted, the two layers of paint (orange over white) comprising Item 3 could not be distinguished in sequence, color, texture, and chemical composition to the corresponding layers of paint in Item 2. Accordingly, Item 3 originated from the same source as Item 2 or from a different source painted in the same manner (Type III Association – see Interpretation section). This type of association was reached because other surfaces painted with the same colors and formulations in the same sequence would also be indistinguishable. Item 1 and Item 3 differ in layer structure and chemical composition, and therefore, Item 3 did not originate from the same source as Item 1 (Elimination). The following analytical techniques were used in the examination of these items: visual and stereomicroscopical examinations, Fourier transform infrared spectroscopy, scanning electron microscopy (SEM) with backscattered electron imaging and energy dispersive X-ray spectroscopy, and pyrolysis-gas chromatography/mass spectrometry. Interpretation: The following categories and their descriptions are meant to provide context to the conclusions reached in this report. Every category may not be applicable in every case nor for every

TABLE 3

WebCode	Conclusions
	material. Type I Association: Physical Fit – The items exhibit physical features that demonstrate they were once part of the same object. Associations of Evidence with Class Characteristics: Class characteristics are physical and/or chemical properties that place an item within a particular group of items. Associations of evidence with class characteristics can have varying degrees of significance. In general, the smaller the size of the group relative to the relevant population, the more significant the association. A class association cannot definitively establish that the items came from the same source. Type II: Association with Highly Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Additionally, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III: Association with Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV: Association with Limitations – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value. For example, the items are more commonly encountered in the relevant population, a complete analysis was not performed due to limited characteristics or a limited analytical scheme, or minor variations were observed in the data. Inconclusive – No conclusion could be reached. Elimination – The items exhibit exclusionary differences that demonstrate they did not originate from the same source.
GKYLEH	The questioned paint chips recovered from the suspect (Item 3) were found to be consistent in layer structure and UV reaction to those of the known paint sample representative of the damaged area of wall A (Item 1). However, the surface texture, coating thickness, colour and chemical composition in Item 3 were inconsistent to those of the Item 1. The questioned paint chips recovered from the suspect (Item 3) were found to be consistent in layer structure, UV reaction, surface texture, coating thickness, colour, and chemical composition to those of the known paint sample representative of the damaged area of wall B (Item 2). Based on the above findings, in my professional opinion, (i) Item 3 could have originated from Item 2. (ii) Item 3 could not have originated from Item 1.
GKZJND	Exhibit 1 was found to have more than one layer of white paint, while exhibits 2 and 3 were found to only have one layer of white. The orange layer on exhibit 1 is differentiated from exhibit 3 by chemical and elemental composition. A comparison of each layer using the methods and techniques described above cannot differentiate exhibit 2 from exhibit 3. Therefore, wall B (exhibit 2) could be the source of the paint chips recovered from the suspect (exhibit 3). It is the opinion of this examiner that the presence of multiple layers of corresponding paint adds strength to this association. However, another object painted with the same paint scheme could also be the source.
GPVDLE	Examination and comparison of representative paint layers from Items 3 and 1 were found to be dissimilar in all measured chemical composition for the top orangish-red layer. They could not have come from the same source. Examination and comparison of representative paint layers from Items 3 and 2 were found to be similar in all measured microscopic, chemical, elemental, and color properties. They could have come from the same source or any other source with the same properties.
HKE6XF	Questioned paint chips recovered from the suspect (Item 3) could not have orginated from the damaged area of wall A (Item 1). Questioned paint chips recovered from the suspect (Item 3) could have orginated from the damaged area of wall B (Item 2).
HYZK2E	Item 1 has a different primer pigment - talc. The topcoat is a questionable match.

TABLE 3

WebCode	Conclusions
KVPG49	The paint in questioned Item 3 is different from the paint in known sample Item 1 regarding the physical and chemical properties of the paint layers. The paint in questioned Item 3 is similar to the paint in known sample Item 2 regarding the physical and chemical properties of the paint layers.
LATYXG	The two layers of questioned paint from the suspect (item 3) exhibit the same physical, chemical and optical properties as the two layers of known paint from wall B (item 2); therefore, the questioned paint from the suspect originated from the paint from wall B or another paint source exhibiting the same physical, chemical and optical properties. Physical and microscopic differences were observed between the two layers of known paint from wall A (item 1) and the two layers of questioned paint from the suspect (item 3); therefore, the questioned paint from the suspect and the known paint from wall A do not share the same source.
LJCG8F	The questioned paint chip recovered from the suspect (Item 3) could have originated from the damaged area of wall B (Items 2), because of the similarities of their physical properties and chemical compositions. The questioned paint chip recovered from the suspect (Item 3) could NOT have originated from the damaged area of wall A (Items 1), because of the differences of their physical properties and chemical compositions.
M3YPHF	The orange paint from the suspect (item 3) is similar in color, surface texture, microscopic features, solubility and chemical composition to the paint from wall B (item 2). The orange paint from the suspect (item 3) could have come from wall B or any other source with paint having similar physical and chemical properties. The orange paint from the suspect (item 3) differs from the orange paint from wall A (item 1) in color, surface texture, solubility and chemical composition. The paint from item 3 is not consistent with having come from wall A (item 1).
MUP26G	The results support that the examined paint chip, recovered from the suspect Item 3, originate from wall B, represented by Item 2 (Level +2). The results extremely strongly support that the examined paint chip, recovered from the suspect Item 3, does not originate from the damaged area of wall A, represented by Item 1 (Level -4).
P2Z2EB	[No Conclusions Reported.]
P6YDBB	Questioned paint sample item (3) could have originated from damaged area of wall B represented by item (2). Questioned paint sample item (3) could not have originated from damaged area of wall A represented by item (1).
PMJ4AA	Microscopic examination: All of them (Item1, 2, 3) contain two layers, which are orange and white coats from top to bottom. Item3 and Item2 were found to be consistent in instrumental analysis. However, Item3 and Item1 were found to be different. Accordingly, Item3 could originate from Item2, and couldn't from Item1.
PTRKQB	Comparative examinations of Exhibit 3 (questioned paint chips recovered from the suspect) with the paint from Exhibit 2 (known paint sample representative of the damaged area of wall B) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, Exhibit 3 could have originated from Exhibit 2 or another source with the same characteristics. Comparative examinations of Exhibit 3 (questioned paint chips recovered from the suspect) with the paint from Exhibit 1 (known paint sample representative of the damaged area of wall A) disclosed them to be inconsistent in their physical characteristics and organic compositions. Therefore, Exhibit 3 could not have originated from Exhibit 1. It should be noted that a paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.
Q2J6MB	1) The know paint sample representative of the damage area of wall B (item 2), the questioned paint chips recovered from the suspect (item 3), consist to two layers paint system with the

TABLE 3

WebCode	Conclusions
	following layer structure: 1. orange acrylic latex paint with china clay and 2. white acrylic latex with calcium carbonate and china clay. 2) The know paint sample representative of the damage area of wall A (item 1) consist to three layers paint system with the following layer structure: 1. orange acrylic latex paint with china clay, 2. white acrylic latex with calcium carbonate and china clay and 3. ligth yellow orthopthalic alkyd enamels with talc and calcium carbonate. 3) The two layered paint chips in items 2 and 3 matches in all properties investigated, particulary in colors, textures, types, layer sequence and chemical composition. It was concluded that the paint in these items could have a common origin. The possibility that they dont't share a common origin depend on whether or not, the suspect could have obtained a paint transfer from another wall that presents the same layer sequence, same thickness, porosity, color and chemical composition. 4) The two most external paint layers that constitute part of the sequence of item 1 and 3 respectively, present a high similarity between them, in microscopic, physical and chemical characteristics, however, item 1 presents a third very light yellow layer that is not present in item 3, so they cannot be associated with each other.
Q3J3EJ	Layer 1 of “Item 1”, exhibited a dark glossy orange colour with a rough texture. In contrast, Layer 1 “Item 3” displayed an orange shade with a matte texture. The chemical analysis indicated distinguishable characteristics between layer 1 of “Item 1” and “Item 3”, signifying the presence of distinct binder systems in these exhibits, therefore “Item 3” could not have originated from “Item 1”. Layer 1 of both “Item 2” and “Item 3” displayed an orange shade with a matte texture. The chemical analysis indicated that the chemical composition of layer 1 and layer 2 of "Item 2" and "Item 3" were comparable. The physical and chemical characteristics of "Item 2" and "Item 3" were indistinguishable therefore these exhibits could have originated from the same source.
QFZBHB	Item 3 compared to Item 1: There are significant differences in macroscopic characteristics, microscopic characteristics, chemical composition, and elemental composition between the questioned paint chips (Item 3) and the known paint sample from the damaged area of wall A (Item 1). These differences exclude the damaged area of wall A as a source of the questioned paint chips. Item 3 compared to Item 2: No significant differences in macroscopic characteristics, microscopic characteristics, chemical composition, or elemental composition were observed between the questioned paint chips (Item 3) and the known paint sample from the damaged area of wall B (Item 2). The questioned paint chips could have originated from the damaged area of Wall B, or any other source with the same class characteristics.
QH4VLA	a) The questioned paint chip recovered from the suspect (Item 3) did not originate from the damaged area of Wall A (Item 1). b) The questioned paint chip recovered from the suspect (Item 3) may have originated from the damaged area of Wall B (Item 2).
RBFVH3	Based on the exclusionary differences in layer structure between items 1 and 3, the questioned paint chip (item 3) could not have originated from the same source as represented by the known submitted exemplar (item 1). No exclusionary difference in stereomicroscopic properties, color (by visible MSP), chemical composition (by FTIR), and elemental composition (by SEM-EDS) were observed between items 2 and 3. Therefore, the questioned paint (item 3) could have originated from the same source as represented by the known submitted exemplar (item 2) or from another source of paint exhibiting all of the same analyzed/measured characteristics.
THLHDG	The layer sequence and colour of “Item 3” 3.3 were consistent with those of “Item 2”. “Item 3” and “Item 2” consisted of the same binder systems; therefore “Item 3” could have originated from the same source as represented by “Item 2”. “Item 3” was physically and chemically not comparable with “Item 2”; therefore “Item 3” could not have originated from the same source as represented by “Item 2”.
U7ZWA7	1. Comparative examinations of Exhibit 3 (item 3) with Exhibit 1 (item 1) disclosed them to be

TABLE 3

WebCode	Conclusions
	inconsistent in their physical characteristics. As a result of these findings, Exhibit 3 could not have originated from Exhibit 1. 2. Comparative examinations of Exhibit 3 (item 3) with Exhibit 2 (item 2) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, Exhibit 3 could have originated from Exhibit 2, or another source with the same characteristics. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.
UAY977	CONCLUSIONS: The questioned paint identified as recovered from the suspect (item 3) is the same distinct type of paint as the known paint on wall B (item 2) and originated either from that source or another source of architectural paint having the same distinct characteristics. The questioned paint identified as recovered from the suspect (item 3) did not originate from the area of wall A represented by item 1. RESULTS: Questioned paint chips identified as recovered from the suspect (item 3) were examined for the purpose of determining whether or not they are like the known paint identified as from wall A (item 1) and wall B (item 2). The paint standard from wall B (item 2) has the following layer structure: 1. Medium orange acrylic-based enamel topcoat 2. White acrylic-based enamel primer 3. Drywall substrate This paint exhibits characteristics typical of an architectural finish and was used for comparison with questioned paint identified as recovered from the suspect (item 3). Examination and comparison of the questioned paint (item 3) with item 2 revealed they are alike with respect to layer structure, layer colors, layer textures, microchemical reactivities, binder characteristics, and pigment characteristics. It is therefore concluded that the questioned paint identified as recovered from the suspect (item 3) is the same distinct type of paint as that on wall B (item 2) and originated either from that wall, or from another source of architectural paint having the same distinct characteristics. The paint standard from wall A (item 1) has the following layer structure: 1. Medium orange topcoat 2. White primer 3. Drywall substrate Examination and comparison of the questioned paint identified as from the suspect (item 3) with item 1 revealed layer 1 is dissimilar with respect to color and optical properties. It is therefore concluded that the questioned paint identified as recovered from the suspect (item 3) did not originate from the area of wall A represented by item 1. METHODS OF ANALYSIS: Examinations were performed visually, by stereo microscopy, brightfield/polarized light comparison microscopy, microchemical tests, Fourier transform infrared microspectroscopy, pyrolysis gas chromatography, scanning electron microscopy/energy dispersive x-ray analysis and x-ray fluorescence spectroscopy.
UTEH88	Items 1, 2, and 3 were examined using stereomicroscopy, infra-red spectroscopy, scanning electron microscopy/energy-dispersive x-ray spectrometry, and pyrolysis gas chromatography - mass spectrometry. Items 2 and 3 were additionally examined using microspectrophotometry. Orange paint in Item 3 was indistinguishable from orange paint in Item 2 in color, type, layer structure, texture, and elemental composition (Type 2 Association). This means that the questioned paint chips recovered from the suspect could have originated from the damaged area of wall B. Orange paint in Item 3 was different from orange paint in Item 1 (Elimination). This means that the questioned paint chips recovered from the suspect did not originate from the damaged area of wall A. Trace Interpretation Scale Type 1 Association: Physical Match-The compared items exhibit physical features that demonstrate they were once part of the same object. Type 2 Association: Association with Distinctive characteristics- Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. The items further share distinctive characteristics that would not be typically encountered in the relevant population. Type 3 Association: Association with Conventional characteristics- Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. Because other items have been manufactured or are naturally occurring that would also be

TABLE 3

WebCode	Conclusions
	indistinguishable from the submitted evidence, an individual source cannot be determined. Type 4 Association: Association with limited characteristics and/or examination (1) Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. This type of evidence may be commonly encountered in the environment or may have limited comparative value. Or (2) The comparison between items may be categorized as a Type 4 Association if the association is limited by the inability to perform a complete analysis or if minor variations are observed in the examination results. Inconclusive- No conclusion could be reached regarding an association or an elimination between the items. Elimination- Items exhibit differences in one or more of the following: physical properties, chemical composition, or microscopic characteristics and therefore did not originate from the same source. Non-Association- The items were different in physical properties, chemical composition, and/or microscopic characteristics, indicating that the items did not originate from the same source. However, these differences were insufficient for a definitive elimination.
UZ8YD3	In my opinion, * My findings provide very strong support for the proposition that the questioned paint chip in 'item 3' recovered from the suspect originated from the damaged area of wall B represented by 'item 2'. This is based on the assumption that item 2 fully represents the surface coating of this wall. * My findings provide conclusive support for the proposition that the questioned paint chip in 'item 3' recovered from the suspect did not originate from the damaged area of wall A represented by 'item 1'. This is based on the assumption that item 1 fully represents the surface coating of this wall. The strength of the evidence in relation to either proposition considered is assessed on a verbal scale of: no support for either proposition, limited, moderate, moderately strong, strong, very strong and conclusive.
VAGQF6	1) The known paint sample representative of the damaged area of wall A (item 1), the known paint sample representative of the damaged area of wall B (item 2), and the questioned paint chips recovered from the suspect (item 3), consist of a paint system with the following layer structure: Item 1: orange topcoat layer, acrylic enamel with china clay; a white undercoat layer, styrene acrylic enamel with china clay and calcium carbonate; and white undercoat layer, orthophthalic alkyd enamel with talc and calcium carbonate. Items 2 y 3: orange topcoat layer, acrylic enamel with china clay; and white undercoat layer, styrene acrylic enamel with china clay and calcium carbonate. 2) The two layered paint samples in items 2 and 3 matched in colors, textures and chemical composition. It was concluded that the paint in these items could have a common origin. The possibility that they do not have a common origin depends on whether or not the transfers detected on the suspect come from another surface (building or house), and particularly have the same type of finish (same sequence of layers, physical properties and chemical composition). 3) Differences are detected in the sequence and chemical composition of the three layers presented by the orange fragment that constitutes item No. 1, in relation to the two layers of the fragments that constitute item No. 3. They are also detected slight microscopic physical differences in the topcoat layer of both objects. According to this, it is concluded that the paint on these articles does not have a common origin.
VETPV6	When the Questioned Exhibit 3 (Item 3) was compared to the Known Exhibit 1 (Item 1) it was concluded that the questioned sample did not originate from the source represented by the known sample. When the Questioned Exhibit 3 (Item 3) was compared to the Known Exhibit 2 (Item 2) no conclusion could be drawn due to the infrared and elemental analysis instruments being out of service.
VWRRP3	On analysis, I found: i) The known paint sample representative of the damaged area of wall B (Item 2) to be similar to the questioned paint chips recovered from the suspect (Item 3). ii) The known paint sample representative of the damaged area of wall A (Item 1) to be dissimilar to the questioned paint chips recovered from the suspect (Item 3). Based on the finding, I am of

TABLE 3

WebCode	Conclusions
	the opinion that: ii) The known paint sample representative of the damaged area of wall B (Item 2) and the questioned paint chips recovered from the suspect (Item 3) could have come from the same source. ii) The known paint sample representative of the damaged area of wall A (Item 1) and the questioned paint chips recovered from the suspect (Item 3) did not come from the same source.
WMGP43	The known paint reference from the scene – wall A (Item #1) has the following layer structure: 1 – Orange Red, 2 – White, 3 – Grey Fibrous Material, and Brown Paper Backing. The known paint reference from the scene – wall B (Item #2) has the following layer structure: 1 – Orange Red, 2 – White, 3 – Grey Fibrous Material, and Brown Paper Backing. The unknown paint chips recovered from the suspect (Item #3) have the following layer structure: 1 – Orange Red, 2 – White, 3 – Grey Fibrous Material, and Brown Paper Backing. One of the paint chips from the suspect (Item #3) was analyzed and compared to the known reference paint sample from the scene – wall B (Item #2). Based on the examinations conducted, the layers comprising the analyzed paint chip from Item #3 are comparable in color, texture, relative thickness, and chemical composition to the corresponding layers of Item #2. Accordingly, the analyzed paint chip from Item #3 and Item #2 originated from the same source or from different sources painted in the same manner (Type IV Association). This level of association was reached due to the limited layer structure of the submitted samples. The paint from the suspect (Item #3) does not compare to the known reference paint sample from the scene – wall A (Item #1). No further analysis at this time.
X8MJBY	The paint in Item 3 was consistent in color, layer structure and composition of layers with the paint in Item 2 and could have originated from the source represented by that Item. The paint in Item 3 was not consistent with the paint in Item 1 and could not have originated from the source represented by that Item.
YEFCVX	[No Conclusions Reported.]
YG8AAW	Item 1: One, three-layer, orange paint standard analyzed for comparison to item 3. Item 2: One, two-layer, orange paint standard analyzed for comparison to item 3. Item 3: Two, two-layer, orange paint samples were present. In the sample analyzed, the unknown orange paint sample “recovered from the suspect” and the standard paint “representative of the damaged area of wall A” (item 1) are not the same in physical, including fluorescence, characteristics. The unknown paint could not have originated from this orange paint standard (item 1). In the sample analyzed, the unknown orange paint sample “recovered from the suspect” and the standard paint “representative of the damaged area of wall B” (item 2) are the same in physical (color, texture, layer sequence, and fluorescence) characteristics and chemical characteristics. The unknown orange paint “recovered from the suspect” either originated from this orange paint standard (item 2) or another source of paint possessing the same distinct physical and chemical characteristics.
YHEMRX	Questioned paint 3 was compared with Known paint 2, when they were found to be similar in colour, layer sequence and chemical composition, to the extent that, in our opinion, they could have had a common origin. The results of our analysis provide moderate support that the paint chip recovered from the suspect (item 3) originated from the damaged area of wall B (item 2). Questioned paint 3 was compared with Known paint 1 when they were found to be different in colour and chemical composition. These samples do not have a common origin.
YUTKW2	Comparison macroscope of Items 1,2 and 3 revealed difference in texture of white paint undercoat for Item 2 (Wall B), therefore suspect did not collide with wall B. However the texture of white paint undercoat for Item 1 and 3 was similar, hence the suspect collided with wall A.

Additional Comments

TABLE 4

WebCode	Additional Comments
3QG7GX	In expressing the evidential significance of my findings, I have used the following scale: no support for either proposition, limited, moderate, moderately strong, strong, very strong and extremely strong support. It should be noted that this scale is logarithmic, rather than linear, such that each point on the scale, prior to 'extremely strong', is ten times greater than the previous one.
4WJFMQ	In normal casework I would evaluate my findings based on the following two propositions: Hp The orange paint chips recovered from the suspect came from the damaged area of wall B. Hd The orange paint chips recovered from the suspect came from a different source. Report conclusion wording: The findings of paint recovered from the suspect matching the known paint from the damaged area of wall B are expected if the paint recovered from the suspect came from the damaged area of wall B. There is a low expectation of these findings if the orange chips recovered from the suspect came from a different source. The above findings provide moderately strong support for the view that the paint chips recovered from the suspect came from the damaged area of wall B, rather than a different source. I have chosen the above phrase from the following scale: weak support, moderate support, moderately strong support, strong support, very strong support, extremely strong support. If the circumstances differ from that laid out in the background information please contact me as soon as possible as I will need to re-evaluate my conclusion.
BDJUNH	Test is very easy due to a) large samples and b) large differences between samples.
CVJ8WJ	Unable to perform MSP or PGC analysis due to instrument issues. However, both these techniques would at least be attempted following our analytical scheme.
D3WFXL	Remark: the device of our fourth analytical method is out of order, so we weren't able to use it as initially planned by our analytical strategy (event registered under the number EVT n° 163-2023 in our SAQ system).
Q2J6MB	Since the comparison was made between two layers of paintings only, the result of this analysis must be considered together with the remains of elements that the investigation of the case reveals.
VAGQF6	At the moment we don't routinely received cases with that kind of samples in our laboratory. We work routinely with automotive paint chips.
VETPV6	SEM-EDS and FTIR instruments were out of service at the time of this analysis.

-End of Report-
(Appendix may follow)

Collaborative Testing Services ~ Forensic Testing Program

Test No. 23-5452: Paint Analysis

DATA MUST BE SUBMITTED BY **Nov. 20, 2023, 11:59 p.m. EST** TO BE INCLUDED IN THE REPORT

Participant Code: U1234A WebCode: DC49BM

The Accreditation Release section can be accessed by using the "Continue to Final Submission" button above. This information can be entered at any time prior to submitting to CTS.

Scenario:
Police are investigating a case where questioned paint chips were recovered from a suspect, who was apprehended shortly after the incident. Along with the questioned paint chips, investigators are providing you with known paint samples from two damaged walls at the scene. You are asked to examine the questioned paint chips and determine if they could have originated from either of the damaged walls at the scene.

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

Items Submitted (Sample Pack P2):
Item 1: Known paint sample representative of the damaged area of wall A.
Item 2: Known paint sample representative of the damaged area of wall B.
Item 3: Questioned paint chips recovered from the suspect.

1.) Could the questioned paint chips recovered from the suspect (Item 3) have originated from the damaged area of either wall A or B as represented by Items 1 and 2, respectively?

	Item 1		
	Yes	No	Inconclusive
Item 3:	○	○	○

	Item 2		
	Yes	No	Inconclusive
Item 3:	○	○	○

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

Please check all that apply.

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

Other (specify):

Please note: *Any additional formatting applied in the free form space below will not transfer to the Summary Report and may cause your information to be illegible. This includes additional spacing and returns that present your responses in lists and tabular formats.*

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

4.) Additional Comments

Participant Code: U1234A
WebCode: DC49BM

RELEASE OF DATA TO ACCREDITATION BODIES

The Accreditation Release is accessed by pressing the "Continue to Final Submission" button online and can be completed at any time prior to submission to CTS.

CTS submits external proficiency test data directly to ASCLD/LAB, ANAB, and/or A2LA. Please select one of the following statements to ensure your data is handled appropriately.

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

Have the laboratory's designated individual complete the following steps
only if your laboratory is accredited in this testing/calibration discipline
by one or more of the following Accreditation Bodies.

Step 1: Provide the applicable Accreditation Certificate Number(s) for your laboratory

ANAB Certificate No.
(Include ASCLD/LAB Certificate here)

A2LA Certificate No.

Step 2: Complete the Laboratory Identifying Information in its entirety

Authorized Contact Person and Title

Laboratory Name

Location (City/State)