



## **Paint Analysis Test No. 11-546 Summary Report**

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This test was sent to 114 participants. Each sample set consisted of two "known" paint samples and a "questioned" paint chip. Participants were requested to compare the items and report their findings. Data were returned from 90 participants (79% 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

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Each sample pack consisted of three items of layered paint and primer: two known samples (Items 1 and 2) and one questioned sample (Item 3) were cut from painted sections of drywall. Items 1 and 3 came from a single panel with the same primer and topcoat. Item 2 was prepared with the same primer as, but a different topcoat from, what was used for Items 1 and 3. Examiners were instructed to examine the questioned sample and determine if it could have originated from the same source as either of the known paint samples.

## 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. The painted drywall panels were then stored at room temperature in a controlled humidity environment for several days.

ITEM 2 (ELIMINATION): The known Item 2 samples were prepared by applying two coats of primer (Kilz 2® Latex Interior/Exterior Water-base primer-sealer-stain blocker, White Tintable) to a drywall substrate. Then two layers of topcoat (Glidden® Interior Premium Paint Flat Base 1 GLN9011 (color code -10BB 62/010)) were applied. The painted drywall was 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 2 coin envelope. This process was repeated until all of the items were created. Item 2 was packaged into the sample sets as described below.

ITEMS 1 and 3 (IDENTIFICATION): The known Item 1 and questioned Item 3 samples were prepared by applying two coats of primer (Kilz 2® Latex Interior/Exterior Water-base primer-sealer-stain blocker, White Tintable) to a drywall substrate. Then two layers of topcoat (Behr Premium Plus® Interior Flat Ultra Pure White® No.1050, Silver Screen (770E-2)) 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 Item 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 Item 3 coin envelope. This process was repeated until all of the items were created. Items 1 and 3 were taken in close spatial proximity to one another and were kept together as an identification group and packaged into the sample sets as described below.

SAMPLE PACK ASSEMBLY: For each sample pack, an Item 1 and an Item 3 from the same identification group along with an Item 2 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 packs were further sealed with evidence tape and initialed "CTS".

## VERIFICATION-

The expected identification and elimination results were confirmed by predistribution laboratories, who used the following combined list of techniques: Microscopic Examinations, FTIR, and SEM/EDX.

## **Summary Comments**

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

Of the 90 participants that reported results, 88 (98%) reported that the Item 3 paint chips could have originated from the same source as the Item 1 known paint sample ("the damaged area of wall location A") and did not originate from the same source as the Item 2 known paint sample ("the damaged area of wall location B"). One participant reported "inconclusive" for the comparison between Item 3 and Item 1 and eliminated Item 2. The remaining participant associated Item 3 with both Items 1 and 2.

# Examination Results

*Could the questioned paint chips recovered from the suspect's clothing (Item 3) have originated from either of the damaged walls of the museum as represented by Items 1 or 2?*

TABLE 1

WebCode	Item 1	Item 2	WebCode	Item 1	Item 2
2U9PFA	Yes	No	EC3TFY	Yes	No
3FZBPW	Yes	No	ECKV9T	Yes	No
3MDDKC	Yes	No	EEQZ2G	Yes	No
3P4ENE	Yes	No	EJHLFW	Yes	No
3V8JFY	Yes	No	ENGL8E	Yes	No
3Z8VL7	Yes	No	EQ6D2W	Yes	No
47LV9M	Yes	No	ET3REL	Yes	No
4B2EHG	Yes	No	F2ANWX	Yes	Yes
4CXLV3	Yes	No	F4G7VT	Yes	No
4KRNZY	Yes	No	F6WUGN	Yes	No
4XEZC9	Yes	No	FCHCYW	Yes	No
67L3Z7	Yes	No	FQ2WJP	Yes	No
67PL94	Yes	No	GEXE7T	Yes	No
6C8A8D	Yes	No	HEDY8G	Yes	No
6KLWLN	Yes	No	HEYDXF	Yes	No
7GMQR4	Yes	No	HFPE2H	Yes	No
7PX7KX	Yes	No	JDHJUK	Yes	No
8CHQJH	Yes	No	JXY8RP	Yes	No
93TD74	Yes	No	KPLFY7	Yes	No
93VWEZ	Yes	No	KQGY6E	Yes	No
94ME8V	Yes	No	KWK3TR	Yes	No
96XXWP	Yes	No	L8LMVJ	Yes	No
9J6RPM	Yes	No	LH73QY	Yes	No
9TMHX8	Yes	No	MD87GY	Yes	No
9X3XGW	Yes	No	N263YH	Yes	No
9YFNQ2	Yes	No	NDC8MP	Yes	No
BAKJPV	Yes	No	NNG4Y8	Yes	No
BRNHYT	Yes	No	NZDZVF	Yes	No
BZFHEW	Yes	No	PCZRTN	Yes	No
CEAFRR	Yes	No	PLCP32	Yes	No
DFP2AU	Yes	No	Q89LAK	Yes	No
E7E9AX	Yes	No	RFV33T	Yes	No
E93FWF	Yes	No	RGQNTY	Yes	No

TABLE 1

WebCode	Item 1	Item 2	WebCode	Item 1	Item 2
RHFCT7	Yes	No			
UBVTNW	Yes	No			
UNHZJD	Yes	No			
UTB6CG	Yes	No			
UVJ7NF	Yes	No			
UVZ98A	Inc	No			
UWWZ4F	Yes	No			
V87L3E	Yes	No			
V8B7PH	Yes	No			
VL6Q77	Yes	No			
VU6YZD	Yes	No			
WKBDA6	Yes	No			
WWP8P6	Yes	No			
X36LDU	Yes	No			
X6EFMZ	Yes	No			
XUAJCH	Yes	No			
XW468U	Yes	No			
XWYN7B	Yes	No			
XZ4GZA	Yes	No			
YCUFH4	Yes	No			
YTX4HG	Yes	No			
YVM9CA	Yes	No			
ZWQKA2	Yes	No			
ZYGP6U	Yes	No			

**Response Summary**

		Item 1	Item 2
<b>Responses</b>	Yes	<b>89</b>	<b>1</b>
	No	<b>0</b>	<b>89</b>
	Inc	<b>1</b>	<b>0</b>
<b>Participants: 90</b>			

# Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRF/XRF	SEM/EDX	Microspectrophotometry	Other
2U9PFA	✓				✓			✓		Comparison microscopy of cross-sectioned samples
3FZBPW	✓	✓			✓		✓			Physical Characteristics/texture
3MDDKC	✓				✓		✓			
3P4ENE	✓				✓	✓				
3V8JFY	✓	✓	✓		✓					macroscopic examination
3Z8VL7					✓			✓		
47LV9M	✓				✓	✓	✓	✓		
4B2EHG	✓	✓			✓			✓		LIBS
4CXLV3	✓			✓	✓					
4KRNZY	✓			✓	✓					
4XEZC9	✓				✓			✓		
67L3Z7	✓	✓	✓		✓	✓		✓		Pyrolysis GC/MS
67PL94	✓	✓	✓		✓			✓		
6C8A8D	✓				✓	✓		✓		
6KLWLN	✓		✓			✓				
7GMQR4	✓	✓	✓	✓	✓	✓		✓		
7PX7KX	✓				✓			✓		
8CHQJH	✓				✓					
93TD74	✓	✓	✓	✓	✓	✓		✓		
93VWEZ	✓	✓	✓		✓			✓		
94ME8V	✓			✓	✓			✓		
96XXWP	✓	✓			✓	✓		✓		
9J6RPM	✓			✓	✓					
9TMHX8	✓			✓	✓					
9X3XGW	✓				✓	✓		✓		Pyrolysis GC/MS
9YFNQ2	✓		✓	✓	✓	✓	✓			
BAKJPV	✓	✓	✓		✓		✓	✓		
BRNHYT	✓	✓			✓		✓			Pyrolysis GC/MS, morphology of the surface

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility Chemical	XRF/XRF	SEM/EDX	Microspectrophotometry	Other
BZFHEW	✓	✓		✓	✓			✓		
CEAFRR	✓				✓		✓		✓	
DFP2AU	✓	✓	✓	✓	✓		✓			
E7E9AX	✓				✓					
E93FWF	✓			✓	✓	✓				
EC3TFY	✓				✓	✓		✓		Alternate Light Source
ECKV9T	✓	✓	✓		✓			✓		
EEQZ2G	✓			✓	✓					
EJHLFW	✓		✓		✓		✓			
ENGL8E	✓	✓		✓	✓					
EQ6D2W	✓	✓			✓			✓		Pyrolysis GC/MS
ET3REL		✓		✓	✓					Pyrolyzed GC/MSD
F2ANWX	✓				✓		✓			
F4G7VT	✓	✓			✓			✓		PGC/MS
F6WUGN	✓				✓	✓				
FCHCYW	✓	✓		✓	✓			✓		
FQ2WJP	✓	✓	✓	✓	✓					
GEXE7T	✓				✓			✓		
HEDY8G	✓	✓	✓		✓	✓		✓		
HEYDXF	✓				✓			✓		
HFPE2H	✓				✓	✓		✓		
JDHJUK	✓	✓		✓	✓		✓			
JXY8RP	✓		✓		✓					
KPLFY7	✓				✓					
KQGY6E	✓	✓			✓			✓		
KWK3TR				✓	✓		✓			Raman spectroscopy
L8LMVJ	✓	✓	✓		✓			✓	✓	
LH73QY	✓	✓	✓		✓			✓		Pyrolysis GC/MS
MD87GY	✓		✓		✓					Comparison Microscope

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
N263YH	✓				✓					
NDC8MP	✓		✓		✓			✓		
NNG4Y8	✓			✓	✓			✓		
NZDZVF	✓				✓	✓				
PCZRTN	✓	✓			✓					
PLCP32	✓	✓			✓					
Q89LAK	✓				✓			✓		
RFV33T	✓				✓			✓		py-GC/MS
RGQNTY	✓				✓	✓		✓		Ultraviolet lamp
RHFCT7	✓	✓	✓		✓	✓				
UBVTNW	✓				✓					
UNHZJD	✓			✓	✓					
UTB6CG	✓				✓			✓		Raman Spectroscopy
UVJ7NF	✓			✓	✓			✓		
UVZ98A	✓	✓			✓			✓		
UWWZ4F	✓				✓			✓		
V87L3E	✓	✓	✓		✓					
V8B7PH	✓			✓	✓			✓		
VL6Q77	✓		✓		✓			✓		
VU6YZD	✓	✓	✓	✓	✓	✓				UV
WKBDA6	✓		✓		✓	✓		✓		Colorimetry
WWP8P6	✓		✓		✓	✓		✓		compound microscopy, Colorimetry
X36LDU	✓			✓	✓	✓				
X6EFMZ	✓	✓			✓			✓		
XUAJCH	✓	✓			✓			✓		Raman
XW468U	✓	✓	✓					✓		
XWYN7B	✓			✓	✓			✓		
XZ4GZA	✓			✓	✓					
YCUFH4	✓		✓		✓	✓		✓		Colorimetry

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
YTX4HG	✓	✓			✓					
YVM9CA					✓			✓		
ZWQKA2	✓			✓	✓					
ZYGP6U	✓	✓		✓	✓			✓		FT-Raman , UV

Response Summary										
Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	
90	86	36	27	28	88	22	13	49	2	
Percent	96%	40%	30%	31%	98%	24%	14%	54%	2%	

# Conclusions

TABLE 3

WebCode	Conclusions
2U9PFA	The paint samples from the wall contained a grey layer on a white paint layer. The grey paint from location A (item 1) was different to the grey paint of location B (item 2). The paint sample (item 3) recovered from the suspect's clothing contained a grey paint layer on a white paint layer. I compared the paint of item 3 with the paint of items 1 and 2 by their visual appearance, elemental composition and chemical composition. The grey layer of item 3 had a different chemical composition to the grey paint layer of item 2. Therefore the paint recovered from the suspect's clothing (item 3) could not be from the same source of paint as the paint from location B (item 2). I was unable to distinguish the paint layers of item 3 from the paint layers of item 2[sic]. The respective paint layers had the same colour, appearance[sic], elemental and chemical compositions. Therefore the paint recovered from the suspect's clothing (item 3) could be from the same source of paint as the paint from location A (item 1).
3FZBPW	Items 1, 2 and 3 contain architectural paint samples. All three samples have a light grey-colored top layer and a second white layer. The texture and chemical composition of the light grey top layer of the control paint sample in Item 2 is dissimilar to that of questioned paint sample in Item 3. Therefore, the questioned paint sample in Item 3, recovered from the suspect's clothing, did not originate from the paint of the wall location B (Item 2). The control paint sample in Item 1 is similar to the questioned paint sample in Item 3 in all examined properties, including color, texture, microscopic characteristics, chemical composition, and elemental composition. Therefore, the questioned paint sample in Item 3, recovered from the suspect's clothing, could have originated from the paint of the wall location A (Item 1) or another source with similar physical and chemical characteristics.
3MDDKC	It was determined utilizing stereomicroscopic examination, Fourier Transform Infrared Spectroscopy, and X-Ray Fluorescence Spectroscopy that the white paint samples detected in item 001 and item 003 exhibit consistent characteristics. Therefore, the known sample from item 001 cannot be eliminated as being the possible source of the questioned sample from item 003. It was determined utilizing stereomicroscopic examination, Fourier Transform Infrared Spectroscopy, and X-Ray Fluorescence Spectroscopy that the white paint samples detected in item 002 and item 003 exhibit different characteristics. Therefore, the known sample from item 002 can be eliminated as being the possible source of the questioned sample from item 003.
3P4ENE	The paint in item 3 is similar in color, layer structure, solubility and infra-red absorbance spectra to the paint in item 3. Therefore the paint in item 1 and 3 could have originated from the same source. The paint in item 3 is similar in color and layer structure to the paint in item 2, however, it is dissimilar in infrared absorbance spectra. Therefore the paint in items 2 and 3 could not have originated from the same source.
3V8JFY	1. Macroscopic Examination: Item 1 and Item 3 are similar in their surface roughness, while Item 2 has more smooth surface than Item 1 and 3. 2. Microscopic Examination: Item 1, Item 2 and Item 3 are indistinguishable in their microscopic characters. They all have two layers of same colors. 3. FT-IR Analysis: Chemical compositions of layers of Item 1 are similar to those of Item 3. But they differ from those of Item 2.
3Z8VL7	The lower layer of the paint in the evidence sample (Item 3) appeared consistent with those from both locations A and B (Items 1 and 2 respectively) and so neither location could be excluded on this basis. However, the top coat of Item 2 showed a different chemical composition to those of Items 1 and 3, which were very similar. The FTIR spectrum of Item 2 was different to that of Items 1 and 3, including the absence of detectable talc. Quantitative EDS analysis showed, in particular, that the concentrations for aluminium (Al) and phosphorus (P) are markedly higher in the paint from Items 1 and 3 than in the paint from Item 2. It could therefore be concluded that the evidence sample (Item 3) could originate from the damaged area of wall at Location A (Item

TABLE 3

WebCode	Conclusions
	1), but not from Location B (Item 2).
47LV9M	It was found that item 3 could have originated from item 1. Item 3 could not have originated from item 2.
4B2EHG	The questioned paint sample 3 is consistent with the know[sic] paint in sample 1 on the basis of color, layer structure, organic and elemental composition. The questioned paint in sample 3 is not consistent with the known paint in sample 2 on the basis of organic composition.
4CXLV3	It was determined, after Physical and Chemical analysis to the evidence, that: a. Samples Item 1 (damaged area of wall location A) and Item 3 (recovered from the suspect's clothing) show similar physical properties and chemical composition among them. B. Samples Item 2 (damaged area of wall location B) and Item 3 (recovered from the suspect's clothing) show different physical properties and chemical composition among them.
4KRNZY	The questioned paint chips recovered from the suspect's clothing (Item 3) could have come from the damaged area of wall location A (Item 1) but could not have come from the damaged area of wall location B (Item 2).
4XEZC9	According to our experimental data, items on suspect's clothes could not come from the wall B. Our experimental data sustain more the hypothes[e] that the wall A is the origin of items found on suspect's clothes, in comparison to other hypotheses (i.e. that the wall B is the origin of such an item).
67L3Z7	The questioned paint chips recovered from the suspect's clothing (Exhibit 3) have the same physical characteristics and chemical composition as the known paint sample from the damaged area of wall location A (Exhibit 1). The questioned paint chips from the suspect's clothing (Exhibit 3) could have originated from the damaged area of wall location A (Exhibit 1) or from any other paint with the same physical characteristics and chemical composition. The questioned paint chips recovered from the suspect's clothing (Exhibit 3) do not have the same chemical composition as the known paint sample from the damaged area of wall location B (Exhibit 2). The questioned paint chips from the suspect's clothing (Exhibit 3) could not have originated from the damaged area of the wall location B (Exhibit 2).
67PL94	The results of the examination support that the paint chips, item 3, from the clothes, originate from the wall, where item 1 was taken (level +2). The results of the examination extremely strongly support that the paint chips, item 3, from the clothes, do not originate from the wall, where item 2 was taken (level -4).
6C8A8D	On analysis, I found that the questioned paint chips in Item 3 are similar to the known paint sample in Item 1. Therefore, I am of the opinion that Item 3 and Item 1 could have come from the same source.
6KLWLN	The paint chips (item 3) from the suspect's clothing differed in microscopic appearance from the paint from the damaged wall in location B (Item 2) and hence the paint chips from his clothing have not originated from the damaged wall at this location. The paint chips were however found to be microscopically indistinguishable under a range of lighting conditions and by simple chemical tests from the paint from the damaged wall at location A (item 1). This combination of tests is capable of discriminating between paint samples from many different sources and it is my view unlikely that such a level of correspondence between the paint chips from the clothing and the damaged wall at location A would have been found coincidentally had the paint not originated from this wall. There is therefore in my opinion moderately strong evidence to support the view that the paint flakes from the suspect's clothing (Item 3) have originated from the damaged wall at location A (Item 1). [sic]
7GMQR4	The questioned white paint recovered from the suspect's clothing, Item 3, corresponded in color, layer structure, chemical solubility, chemical composition (FTIR, PGC), and elemental

TABLE 3

WebCode	Conclusions
	<p>composition (SEM-EDS) to the known paint submitted as Item 1, the representative sample of the damaged area of the wall location A. Therefore, Item 3 and Item 1 could have a common source (Level 3 Association). The Item 1 paint sample is not unique and other similar painted items may exist which would be indistinguishable from the submitted evidence. The chemical composition (FTIR, PGC) of the questioned white paint from the suspect's clothing Item 3, is different than the known white paint submitted as Item 2, the representative sample of the damaged area of wall location B. Therefore, Item 3 did not originate from Item 2 (Elimination). Key for instrument acronyms: FTIR - Fourier Transform Infrared Spectroscopy; PGC - Pyrolysis Gas Chromatography; SEM/EDS - Scanning Electron Microscopy/Energy Dispersive Spectroscopy.</p>
7PX7KX	<p>The two layered paint chips #3 recovered from the suspect's clothing were not discriminated from the known paint sample #1 on the basis of physical appearance, colour layer sequence and composition (as determined by FTIR and SEM/EDX). Therefore the paint chips #3 could have originated from the damaged area of the wall location 'A' as represented by the known paint sample #1, although an alternative source for these paint chips cannot be excluded. However the damaged area of the wall location "B" can be excluded as a source for the paint chips #3 on the suspect's clothing based on the difference in the composition (as determined by FTIR) of the grey top coat of the paint chips #3 compared to that of the known paint #2.</p>
8CHQJH	<p>1) Exhibit 3 originated either from the source of Exhibit 1 or from another source of paint having color, texture, surface features and chemical characteristics indistinguishable from Exhibit 1. In a laboratory survey of non-automotive paint from scenes of crime, 5 of the 1721 samples (i. e., 0.3%) had a gray over white paint layer sequence. The survey did not distinguish among different shades of color or the chemical composition of the paint layers. 2) Exhibit 3 did not originate from the source of Exhibit 2.</p>
93TD74	<p>The Item 3 questioned paint chips corresponded in color and layer structure (gray, white), chemical solubility (LeRosen's) microscopic characteristics (stereomicroscope, PLM and fluorescence), chemical composition (FTIR and PGC), and elemental composition (SEM/EDS) to the known paint from Item 1. Therefore, Items 1 and 3 could have a common source (Level 3 Association). It should be noted that since similar items may have been manufactured which would be indistinguishable from the submitted evidence, an individual source cannot be determined. The Item 3 questioned paint chips displayed a different texture, chemical solubility results (LeRosen's), and chemical composition (FTIR) than the known paint from Item 2. Therefore, the unknown paint did not come from the Item 2 known sample (Elimination). Key for instrument acronyms: FTIR - Fourier Transform Infrared Spectroscopy; PLM - Polarized Light Microscopy; PGC - Pyrolysis Gas Chromatography; SEM/EDS - Scanning Electron Microscopy/Energy Dispersive Spectroscopy. [Participant submitted an "Interpretation" section that could not be reproduced for this report.]</p>
93VWEZ	<p>1. Two layers of paint (gray/white), on a paper-like substrate, were located in submission #3 (Questioned paint chip recovered from suspect's clothing). This paint sample (submission #3) exhibited similar microscopic and instrumental characteristics to the layers of paint (gray/white) located in submission #1 (Known paint sample representative of the damaged area of the wall location A). This paint sample (submission #3) exhibited dissimilar characteristics to the two layers of paint (gray/white) located in submission #2 (Known paint sample representative of the damaged area of the wall location B).</p>
94ME8V	<p>According to the results of above mentioned examination and analysis procedures, the questioned paint chips recovered from the suspect's clothing (Item 3) could have originated from known paint sample representative of the damaged area of wall location A (Item 1), could not have originated from known paint sample representative of the damaged area of wall location B (Item 2).</p>

TABLE 3

WebCode	Conclusions
96XXWP	Neither of the two paint chips in Item 3 originated from the same source as the paint in Item 2. The two paint chips in Item 3 could have originated from the same source as the paint in Item 1 or another source having the same color, layering sequence and chemical composition.
9J6RPM	The gray paint chips recovered from the suspect's clothing (Item 3) are similar in layer sequence, paint type, and paint composition to the known gray paint chips from the damaged area of wall location A (Item 1) and dissimilar in paint type and paint composition to the known gray paint chips from the damaged area of wall location B (Item 2). It is my opinion that the gray paint chips recovered from the suspect's clothing could have originated from the damaged area of wall location A or any other source with the same characteristics.
9TMHX8	Item 1 (wall location A) and Item 3 (questioned paint chip) are indistinguishable[sic] in color and chemical composition. So, Item 3 could have come from the wall location A (item 1). Item 2 (wall location B) and Item 3 (questioned paint chip) are indistinguishable[sic] in color but are different in chemical composition. So, Item 3 could not have come from the wall location B (item 2).
9X3XGW	The white paint in Item 3 was identical to the white paint in Item 1 in color, type, texture, layer structure, and elemental composition. This means that the paint recovered from the suspect's clothing could have come from the damaged area of the wall in location A. The white paint in Item 3 was different from the white paint in Item 2. This means that the paint recovered from the suspect's clothing did not originate from the damaged area of the wall in location B.
9YFNQ2	The paint sample in Item 1 (from location A) and the paint sample in Item 3 (from the suspect's clothing) were found to be indistinguishable from each other in all aspects tested. The paint chip from the clothing could therefore have originated from location A. The paint chip from the suspect's clothing, Item 3, was different to the paint sample from location B, Item 2.
BAKJPV	The known paint sample representative of the damaged area of wall location A (Item 1) consists of two layers. The first layer is off white and the second layer is white. The known paint sample representative of the damaged area of wall location B (Item 2) and questioned paint chips recovered from the suspect's clothing (Item 3) both have a similar two layers structure to Item 1. Item 1 and Item 3 have the same surface texture, polarized and fluorescent characteristics, while Item 2 shows different features. FTIR analysis results showed that the spectra of the second layer of the three items are the same. Item 1 and Item 3 produced almost identical spectra of the first layer, but Item 2 produced a different one. Micro-XRF could not detect elemental composition difference among the three items, however SEM/EDX analysis indicated that the detected elements of the first layer of Item 2 were a little different from those of Item 1 and Item 3. As a result, Item 3 is consistent with Item 1 in macroscopic characteristics, layer sequence, infrared spectrum properties and elemental composition. Therefore, Item 3 is the same kind of paint with Item 1 instead of Item 2.
BRNHYT	The data of Item 3 (chips recovered from the suspect's clothing) was shown to have[sic] similar to those obtained from the Item 1 (wall location A) in physical characters: colors, polarizing effect and morphology of the surface and the instrumental data obtained with FT-IR (similar to acrylic paint), py-GC/MS and XRF. However, most data, except polarizing effect, of Item 3 were different from those of Item 2. So we concluded that the paint chips of Item 3 have originated from the damaged wall of museum as represented by Item 1.
BZFHEW	1. Exhibits 1, 2, and 3 consist of multilayered paint chips with layer sequence of off-white top coat and a white primer base coat. 2. The top coat in Exhibit 3 (questioned paint chips recovered from the suspect's clothing) is dissimilar in physical appearance and chemical composition to the top coat in Exhibit 2 (known paint sample representative of the damaged area of wall location B). Therefore, Exhibit 3 did not originate from the damaged area of wall location B as represented by the paint sample in Exhibit 2. 3. Exhibit 3 (questioned paint chips

TABLE 3

WebCode	Conclusions
	recovered from the suspect's clothing) is similar in layer sequence, microscopic characteristics, organic composition, and elemental composition to Exhibit 1 (known paint sample from the damaged area of wall location A). Therefore, it is this examiner's opinion that the questioned paint chips recovered from the suspect's clothing could have originated from the damaged area of wall location A.
CEAFRR	1. Microscopic Analysis: Item 1, Item 2 and Item 3 have same white and grey color layers. 2. FT-IR Analysis: The white layers of Item 1, Item 2 and Item 3 are all of the same component. The grey layers of Item 3 and Item 1 have the same component but Item 2 is different from Item 1 and Item 3. 3. result: Item 3 and Item 1 are the same.
DFP2AU	Item 3 could have come from the damaged area of the wall in location 'A' represented by Item 1, or from any other source containing similar paint. Item 3 could not have come from the damaged area of the wall in location 'B' represented by Item 2.
E7E9AX	Item 3 is similar to Item 1 in appearance and chemical composition. Item 3 is dissimilar to Item 2 in appearance and chemical composition.
E93FWF	The questioned paint chips recovered from the suspect's clothing exhibit the same color, layer sequence and paint type as the known paint sample collected from the damaged area of wall location A. The paint chips recovered from the suspect's clothing could have originated from the sample area of wall location A. The questioned paint chips recovered from the suspect's clothing exhibits a different paint type when compared to the known paint sample collected from the damaged area of wall location B. This difference in paint types indicates that the paint chips recovered from the suspect's clothing did not originate from the sampled area of wall location B.
EC3TFY	No significant differences were found in the microscopic, chemical and elemental analyses of Items 1 and 3. The questioned paint chips recovered from the suspect's clothing could have originated from the damaged area of wall location A or from another wall with the same paint layer structure, color, chemical and elemental composition. There were significant differences in the gray paint layers of items 2 and 3 therefore the questioned paint chips recovered from the suspect's clothing can be excluded as originating from the damaged area of wall location B.
ECKV9T	The questioned paint chips recovered from the suspect's clothing (Item 3) were microscopically and analytically similar to the known paint sample from the damaged area of wall location A (Item 1). The questioned paint chips recovered from the suspect's clothing (Item 3) were dissimilar to the known paint sample from the damaged area of wall location B (Item 2). It is noted that paint cannot be positively identified as originating from a particular source to the exclusion of other similar sources.
EEQZ2G	They grey colored paint chip recovered from the suspect's clothing (item 3) is similar in color, layer sequence and type of paint to the grey colored paint chip of the damaged area of wall location A (item #1). It is my opinion that the grey colored paint chip recovered from the suspect's clothing could have come from the damaged area of wall location A. The grey colored paint chip recovered from the suspect's clothing (item 3) is dissimilar in type of paint to the grey colored paint chip of the damaged area of wall location B (item #2).
EJHLFW	Due to the microscopic investigation every sample consists of one layer of brown cardboard, one layer of white and one layer of grey paint. The thickness and optical appearance of each of the layers give the same impression and thus are indistinguishable by means of microscopy. After inspection with the aid of UV light (365/395/450nm), it was not possible to differentiate the samples. By investigating the three samples by x-ray fluorescence in the white and grey layers the same inorganic elements were detected in comparable amounts. Due to this two paint layers of the three samples were indistinguishable from each other. After infrared spectroscopic analysis the three samples were indistinguishable by means of the white layers. But it was possible to differentiate the grey layers of item 3 and 1 from the grey layer of item 2. On the

TABLE 3

WebCode	Conclusions
	basis of conducted investigations we notify that item 1 and the two samples of item 3 cannot be distinguished from each other. It was possible to differentiate the item 2 from the other samples.
ENGL8E	Both known paint samples (Item 1 & 2) consisted of a gray top coat and a white base coat. The questioned paint chips recovered from the suspect's clothing (Item 3) are similar in color, layer sequence, texture, microscopic characteristics, composition, and type of paint to the known paint from the damaged area of wall at location A (Item 1). It is this examiner's opinion that the questioned paint chips recovered from the suspect's clothing (Item 3) could have come from the damaged area of wall at location A (Item 1). The gray top coat of questioned paint chips (Item 3) is dissimilar in texture, microscopic characteristics, and type of paint to known paint from the damaged area of wall at location B (Item 2). It is this examiner's opinion that the questioned paint chips recovered from the suspect's clothing (Item 3) did not originate from the damage[sic] area of wall at location B (Item 2).
EQ6D2W	The paint from the damaged Museum wall, location B, as represented by Item 2, is not the source of the paint from the suspect's clothing, Item 3. The paint from the damaged Museum wall, location A, as represented by Item 1, cannot be excluded as a possible source of the paint from the suspect's clothing, Item 3. The paint from the suspect's clothing, Item 3, either came from the damaged Museum wall, location A, as represented by Item 1, or from another source of damaged paint indistinguishable in layer sequence, colour, microscopic appearance and chemical composition. Other sources of paint indistinguishable from Item 3 would include other items with two layers of paint of the same manufacturer's formulations and colours.
ET3REL	Three paint samples (Item 1, Item 2 and Item 3) were similar in colour and morphology. Item 2 sample was different with Item 3 from the result of FT-IR spectrum and pyrolyzed GC chromatogram.
F2ANWX	The paint in Item 1 & 2 and the paint in Item 3 are consistent in microscopic characteristics and chemical composition and could have come from the same source.
F4G7VT	The damaged wall in location B, as represented by item 2, can be eliminated as a possible source of the paint chips recovered from the suspect's clothing, item 3. The damaged wall in location A, as represented by item 1, cannot be eliminated as a possible source of the paint chips recovered from the suspect's clothing, item 3. Thus these chips either came from this damaged location of the wall, or from another source of damaged two-layered paint that is indistinguishable in colour, layer sequence, microscopic appearance and chemical composition. Paint is a mass manufactured material, thus it is expected that other objects painted with the same layer sequence using paint of the same colour and manufacturer exist. The combination of two layers increases the significance of this finding.
F6WUGN	1) The known paint sample representative of the damaged area of wall location A (item 1), the known paint sample representative of the damaged area of wall location B (item 2), and questioned paint chips recovered from the suspect's clothing (item 3), consist of a two layers paint system with the following layer structure: 1. Light gray acrylic latex paint (items 1 and 3) and light gray PVA-acrylic latex paint (item 2), and 2. White styrened acrylic latex paint with calcium carbonate. This sequence exhibits typical characteristics of two layers of architectonic paint. 2) The two layered paint chips in items 1 and 3 matches in all properties investigated, particularly 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 don't share a common origin depends 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. 3) The two layered paint chips in item 2 and 3 match in the physical and microscopic properties studied, particularly in color and layer sequence, but don't match regarding the chemical composition of layer 1 (light gray). It was concluded that the paint in these items don't have a common origin.

TABLE 3

WebCode	Conclusions
FCHCYW	The questioned paint chips recovered from the suspect's clothing (Item #3) consisted of two layers; a matte white-gray layer over a white layer. These were compared to the known paint sample from the damaged area of wall location A (Item #1) and found to be consistent in color, layering, chemical composition and elemental composition. Accordingly, the paint chips from Item #3 could have originated from the same location as Item #1 or from another source which is painted with a two layer paint having the same color, layering, chemical and elemental composition. The known paint from the damaged area of the wall location B (Item #2) is a one layer gray-white paint with a shiny finish which is visually dissimilar to the paint from the suspect's clothing (Item #3); therefore the paint from Item #3 did not originate from the same location as Item #2.
FQ2WJP	The multi-layer white paint chips collected from the suspect's clothing, item 3, and the multi-layer white paint sample from location A on the damaged wall, item 1, were determined to be microscopically and chemically (infrared spectroscopy and pyrolysis gas chromatography) indistinguishable and; therefore, may have a common origin. The multi-layer white paint sample collected from location B on the damaged wall, item 2, were[sic] determined to be microscopically and chemically (spectroscopy and pyrolysis gas chromatography) different from the multi-layer white paint chips collected from the suspects clothes, item 3, and; therefore, were excluded as having a common origin.
GEXE7T	The paint fragments recovered from the suspect's clothing (item 3) were found to consist of a pale grey top coat and a white undercoat. The known paint sample from the damaged area of wall location A (item 1) also consisted of a pale grey top coat and a white undercoat. The corresponding paint layers from wall location A (item 1) were found to be indistinguishable in relation to colour, chemical composition and elemental composition from the paint fragment recovered from the suspects clothing (item 3). Therefore these two paint samples may share a common origin. The known paint sample from the damaged area of wall location B (item 2) also consisted of a pale grey top coat and a white undercoat. The pale grey top coat was found to have a different chemical composition and appearance to the paint fragment recovered from the suspects clothing (item 3). Therefore the paint recovered from the suspects clothing could not have originated from the damaged area of wall location B.
HEDY8G	The known paints (items 1 and 2) and the questioned paint (item 3) were examined and were found to have the following layer sequence: smooth gray on crystalline white. The questioned paint (item 3) was found to be consistent with the known paint (item 1) regarding its color, texture, layer sequence, chemical properties and gross elemental composition. Based on these findings, the questioned paint (item 3) could have a common origin with the known paint (item 1). This analyst recognizes that other sources of paint with properties consistent with the above paint do exist. The questioned paint (item 3) differed from the known paint (item 2) regarding their chemical properties and gross elemental composition. Based on these findings, the questioned paint (item 3) could not have a common origin with the known paint (item 2).
HEYDXF	Microscopic examination of Items 1, 2, and 3 each revealed a white architectural paint system. Comparison of the paint in Item 3, paint chips from suspect's clothing, with the paint from Item 1, known paint from location A of the damaged wall, 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 clothing came from location A of the damaged wall or another source with these same properties. Comparison of the paint in Item 3, paint chips from suspect's clothing, with the paint from Item 2, known paint from location B of the damaged wall, revealed them to be inconsistent with respect to binder composition. Therefore, the paint from the suspect's clothing did not come from location B of the damaged wall.
HFPE2H	Known paint (Item 1), reportedly from the damaged area of wall location A, was examined and found to have the following layer sequence: grayish white over white. Known paint (Item 2),

TABLE 3

WebCode	Conclusions
	<p>reportedly from the damaged area of wall location B, was examined and found to have the following layer sequence: grayish white over white. Questioned paint (Item 3), reportedly from the suspect's clothing, was examined and found to have the following layer sequence: grayish white over white. Known paint (Item 1), reportedly from wall location A, was examined and found to be consistent with the questioned paint (Item 3), reportedly from the suspect's clothing, with respect to color, texture, layer sequence, 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 (Item 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. Known paint (Item 2), reportedly from wall location B, was examined and found to be inconsistent with the questioned paint (Item 3), reportedly from the suspect's clothing, with respect to chemical properties and composition.</p>
JDHJUK	<p>Item 1 contained a single paint chip. The chip contained a gray acrylic upper paint layer and a lower white acrylic paint layer. Item 2 contained a single paint chip. The chip contained a gray polyvinyl acetate upper paint layer and a lower white acrylic paint layer. Item 3 contained paint chips. Both chips contained a gray acrylic upper paint layer and a lower white acrylic paint layer. The two questioned paint chips from the Item 3 and the known paint standard from item 1 have indistinguishable chemical, elemental, and microscopic compositions. Therefore, the paint collected from the suspect's clothing (item 3) could have come from the damaged area of the wall (location A, item 1) or any other source with paint containing indistinguishable chemical, elemental, and microscopic compositions. The two questioned paint chips from Item 3 and the known paint standard from item 2 have significant chemical differences. Therefore, the paint collected from the suspect's clothing (item 3) did not come from the damaged area of the wall (location B, Item 2).</p>
JXY8RP	<p>The paint chips associated with item 3 were indistinguishable, by the tests undertaken, from the control paint sample Item 1. Therefore in my opinion there is moderate scientific support for the proposition that the paint chips associated with Item 3 have originated from the damaged wall area at location A. The paint chips associated with item 3 were distinguishable, by the tests undertaken, from the control paint sample item 2. Therefore in my opinion the paint chips from item 3 could not have originated from the damaged wall area at location B.</p>
KPLFY7	<p>The known paint samples (Item 1 and Item 2) and the questioned paint chips (Item 3) consist each of two paint layers. Each of the two layers in the known paint sample (Item 1) cannot be distinguished from the corresponding layers in the questioned paint chips (Item 3). The questioned paint chips (Item 3) could therefore have come from the damaged area of wall location A (Item 1). The top layer in the known paint sample (Item 2) is distinguishable from the top layer in the questioned paint chips (Item 3). Therefore the questioned paint chips (Item 3) could not have come from the damaged area of wall location B (Item 2).</p>
KQGY6E	<p>Examination of Item 1 and Item 3 revealed they are like one another with respect to their layer structures, layer colors, layer textures, binder characteristics of their respective layers, and pigment characteristics of their respective layers. Accordingly, these samples could have originated from the same source, or from another source of paint having the same characteristics. Examination of item 2 and item 3 showed that the samples were not consistent with one another and therefore could not have originated from the same source.</p>
KWK3TR	<p>Items 1 to 3 have been examined. Within the range of each analysis method according to our comparison process used, our conclusions are: Macroscopic examinations could not show any differences between the 3 samples (Items 1 to 3). Micro-FTIR spectroscopy analysis could not show any differences between Items 1 and 3. There are differences between Item 3 and item 2. X-Ray Microfluorescence analysis could not show any difference between Items 1 and 3. Raman spectroscopy could not show any differences between Items 1 and 3. Pyrolysis GC could not</p>

TABLE 3

WebCode	Conclusions
	show any differences between Items 1 and 3. The questioned paint chips[sic] recovered from the suspect's clothing (Item 3) could come from the damaged area of wall location A (Item 1) or from any wall with the same paint. The questioned paint chips[sic] recovered from the suspect's clothing (Item 3) could not come from the damaged area of wall location B (Item 2).
L8LMVJ	Representative paint layers in Items 1 and 2 were examined and compared with the paint layers in Item 3 visually, microscopically, and instrumentally. Items 1 and 3 were found to [sic] consistent in all measured physical, microscopic, chemical and elemental compositions. They could have come from the same source, or any other source with the same physical and chemical compositions. Items 1 and 2 were found to be inconsistent in measured chemical compositions. They could not have come from the same source.
LH73QY	Item 3, questioned paint chips recovered from the suspect's clothing, were two layer paint chips, which matched in colour, layer structure and chemical composition with Item 1, known paint sample representative of the damaged area of wall location A. Thus the questioned paint chips, Item 3, could have a common origin with the known paint sample, Item 1. Item 3 was inconsistent with Item 2, the known paint sample representative of the damaged area of wall location B.
MD87GY	The findings provide moderate support for the view that that questioned paint chips, item 3, came from the damaged area of wall location A (Item 1), rather than originating from another source.
N263YH	Both Items 1 and 3 consist of three coating layers in the same color order, and each layer is of comparable thickness. The ATR spectra obtained of the topcoats are identical indicating that the topcoats are the same. The ATR spectra obtained of the respective mid-coat and primer layers are the same, as well. Item 2 consists of only two coating layers, and the ATR spectrum of Items 2's topcoat is not the same as those obtained of Items 1 and 3. The spectrum obtained of the primer of Item 2 also differs from the spectra obtained of the primer of Items 1 and 3.
NDC8MP	The questioned paint chips from the suspect's clothing (Item 3) and the known paint chip (Item 1) taken from location A at the damaged wall are indistinguishable in the examined criteria. The examined criteria were number, sequence and colour of paint layers, surface structure, fluorescence behaviour, elemental composition and chemical properties observed by infrared spectroscopy. The known paint chip (Item 2) taken from location B at the damaged wall and the questioned paint chips Item 3 were found to be different in the structure of surfaces and the chemical properties of the light grey paint layer observed by infrared spectroscopy. The result admits the conclusion that the questioned paint chips Item 3 could have originated from the location A at the damaged wall as represented by the known paint chips Item 1.
NNG4Y8	Item: 1 results: Two layer white paint standard. Item: 2 results: Two layer white paint standard. Item: 3 results: A two layer white paint chip was found. The unknown paint (Item #3) and the standard paint (Item #1) are the same in physical and chemical characteristics. The standard can be considered as a possible source of the unknown paint. The unknown paint (Item #3) and the standard paint (Item #2) are not the same. The unknown paint could not have originated from the standard.
NZDZVF	The paint in Item 3 is similar in color, layer structure, solubility and infra-red absorbance spectra to the paint in Item 1. Therefore the paint in Items 3 and 1 could have originated from the same source. The paint in Item 3 is similar color and layer structure to the paint in Item 2, however, it is dissimilar in infra-red absorbance spectra. Therefore the paint in Items 3 and 2 could not have originated from the same source.
PCZRTN	Item 3 was examined and compared to Item 1 and Item 2 using polarized light microscopy, visible microscopy and fourier transform infrared spectroscopy (FTIR). A representative sample from Items 1, 2 and 3 were chosen and found to consist of 2 layers. The 2 layers of Item 1 and

TABLE 3

WebCode	Conclusions
	Item 3 are indistinguishable in appearance, microscopic and chemical properties. Thus Item 3 could have come from Item 1 or another paint source exhibiting the same analyzed characteristics and layer structure. FTIR results revealed distinguishable differences between Item 2 and Item 3. Thus Item 3 could not have come from Item 2 as represented by that received in Item 2.
PLCP32	Item 1 and 3 could not be differentiated with all used methods. Item 2 showed some differences in the infrared spectra from Item 1 and item 3. Therefore, questioned paint recovered from the suspect's clothing (Item 3) could have originated from the damaged area of wall location A (Item 1).
Q89LAK	Item 1 comprised one paint chip with two layers (grey topcoat and white undercoat). The grey topcoat was identified as an acrylic type paint. Bulk elemental analysis of the grey topcoat indicated the elements titanium, silicon, aluminium, potassium, sodium, phosphorus and calcium. The white undercoat was identified as a high calcite paint of unknown type. Bulk elemental analysis of the white undercoat indicated the elements calcium, titanium, silicon, aluminium, sodium, potassium, magnesium and phosphorus. Item 2 comprised one paint chip with two layers (grey topcoat and white undercoat). The grey topcoat contained a binder of unknown type. Bulk elemental analysis of the grey topcoat indicated the elements titanium, silicon, aluminium, potassium, sodium, sulphur and calcium. The white undercoat was identified as a high calcite paint of unknown type. Bulk elemental analysis of the white undercoat indicated the elements calcium, titanium, silicon, aluminium, sodium, potassium, magnesium and phosphorus. Item 3 comprised two paint chips each with two layers (grey topcoat and white undercoat). The grey topcoat for both chips were[sic] identified as an acrylic type paint and the bulk elemental analysis indicated the elements titanium, silicon, aluminium, potassium, sodium, phosphorus and calcium. Both paint chips from Item 3 corresponded in appearance, composition and colour to Item 1. The grey topcoat from both paint chips from Item 3 differed in composition to the grey topcoat from Item 2, and therefore could not share a common origin. The results support the proposition that the questioned paint chips from the suspect's clothing (Item 3) share a common origin with representative paint from the damaged wall location A (Item 1).
RFV33T	Items 1 through 3 are architectural paint samples that consist of two layers each. The two layers of paint comprising item 3 are comparable in sequence, color, texture, and chemical composition to the corresponding layer of paint in item 1. Accordingly, item 3 originated from the source represented by item 1, or from a source painted in the same manner (Level III Association). This level of association was reached because the possibility that other substrates may be painted in the same manner cannot be eliminated. The top layer of paint in item 2 differs chemically from the corresponding layer in item 3. Therefore, item 3 did not originate from the source represented by item 2 (Elimination).
RGQNTY	Item 1 consists of a grey two-layered paint chip from the "damaged area of wall location A". Item 2 consists of a grey two-layered paint chip from the "damaged area of wall location B". Item 3 consists of grey two-layered paint chips recovered from the "clothing of suspect." The grey two-layered paint chips in items 1 and 3 are similar in colors, textures, types, layers structure and chemical composition. It was concluded that the paint chips in Items 1 and 3 either originated from the same source or different sources painted in a similar manner. The Item 3 grey two-layered paint chips could not be associated to the Item 2 grey two-layered paint chip due to differences in textures and chemical composition. The above-referenced paint particles were examined and compared using a microscopic examination (stereoscope), an ultraviolet lamp, microchemical testing, a Fourier-transform infrared spectrometer (FT-IR), and a scanning electron microscope with energy dispersive X-ray analyzer (SEM-EDAX).
RHFCT7	The paint chip submitted as Item 3 was indistinguishable from the known paint sample submitted

TABLE 3

WebCode	Conclusions
	as Item 1 by visual exam, microscopy and IR-spectroscopy. Item 3 could have originated from Item 1 or another wall with a similar paint system. Item 2 was excluded as a source of Item 3. Additional methods of analysis could provide additional information to further differentiate between the samples.
UBVTNW	Comparative examination of the paint layers from Item 1 and Item 3 by optical microscopy and FTIR found no differences in physical or chemical composition. The findings are consistent with Item 1 and Item 3 having the same origin. Comparative examination of the paint layers from Item 3 and Item 2 found differences in the chemical composition of the surface paint layer. Item 3 could not have originated from the damaged walls as represented by Item 2.
UNHZJD	Questioned paint chips of Item 3 exhibit similar physical and chemical characteristics as known paint sample of Item 3, which is consistent with a common origin. Questioned paint chips of Item 3 exhibit different physical characteristics as known paint sample of Item 2, therefore they do not come from a common origin.
UTB6CG	Items 1, 2 and 3 were found to be two-layered paint chips, each containing a top light grey layer and a second beige layer. (a) The light grey layers of Items 1 and 3 were found to be similar, but different from that of Item 2 in terms of their chemical compositions. (b) The beige layers of Items 1, 2 and 3 were found to be indistinguishable from each other in terms of their colour and chemical compositions. (c) Hence item 3 could have originated from the same source as item 1, or another source of paint with similar characteristics. Item 3 did not originate from the same source as Item 2.
UVJ7NF	Item 1: White three layer paint standard. Item 2: White three layer paint standard. Item 3: Two white three layer paint chips found. The unknown paint and standard paint from the damaged area of wall location A (Item 1) are the same in physical and chemical characteristics. The standard paint (Item 1) can be considered as a possible source of the unknown paint. The unknown paint and the standard paint from the damaged area of wall location B (Item 2) are not the same. The unknown paint could not have originated from the standard (Item 2).
UVZ98A	The paint chips in Items 1 and 2 from the known damaged wall locations designated A and B are clearly different and distinguishable. The paint chips in Item 3 from the suspect's clothing could not have come from the damaged wall location in Item 2 (location B). While it is possible that Item 3 came from the same damaged wall location in Item 1 (location A), the data show inconsistencies in the gray layer making the results inconclusive. One of the five sample preparations from Item 3 showed the presence of a strong FTIR band at 3630 cm <sup>-1</sup> that was not observed in any other preparation in this sample or in the preparations from Items 1 and 2. All other results for Item 3 were consistent with Item 1. Therefore, the finding of Item 3 matching Item 1 is inconclusive.
UWWZ4F	Items 1-3 were examined visually, microscopically and instrumentally by Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy/electron dispersive spectrometry (SEM/EDS). Item 3 (recovered from suspect) was consistent with Item 1 (wall location A). Items 1 and 3 could share a common origin. Item 3 (recovered from suspect) was not consistent with Item 2 (wall location B).
V87L3E	Moderately strong support for the proposition that the paint fragments recovered from the suspect's clothing originated from location A of the damaged wall. Conclusive support that paint on suspect's clothing did not originate from location B of the damaged wall.
V8B7PH	Two known paint samples were submitted for analysis. Items 1 and 2 represent two different areas of damaged walls. A questioned paint, Item 3, was submitted. Item 3.1 and 3.2 are two paint samples recovered from the suspect's clothing. These paints were examined stereo microscopically. The paint layers were analyzed using infrared spectroscopy (FTIR), scanning electron microscopy with energy dispersive spectroscopy (SEM/EDS), and pyrolysis gas

TABLE 3

WebCode	Conclusions
	<p>chromatography with mass spectrometry (PyGCMS). Each of the paint samples is comprised of a light gray paint layer on a white primer paint. Based on these tests the following conclusions are reached: Items 3.1 and 3.2 cannot be differentiated from each other. The primers from items 1, 2, 3.1 &amp; 3.2 cannot be differentiated from each other. Comparative analysis disclosed that the layered paint in Item 1 is consistent with the layered paints in Item 3.1 and Item 3.2. These results indicate these paints may share a common source. Comparative analysis disclosed that the top gray layer paint in Item 2 is not consistent with the top gray layer paints in Item 1, Item 3.1, and Item 3.2.</p>
VL6Q77	<p>Grey paint recovered from the suspect (item 3) and the sample representative of the damaged area of wall location A (item 1) were examined when they were found to be similar in colour, layer structure, physical appearance, chemical and elemental compositions such that, in our opinion, these samples could have had a common origin. Grey paint (item 3) was found to be different in physical appearance to grey paint from wall location B (item 2).</p>
VU6YZD	<p>1. Each of the paint samples in Items 1, 2, and 3 disclosed the presence of two layers of paint on a paper surface. The color of the top paint layer was off-white/light gray and the color of the bottom paint layer was white for all items. 2. Comparative examinations of the paint chips in Item 3 with the paint sample in Item 1 disclosed them to be consistent in their physical characteristics, elemental, and organic compositions. Therefore, the paint chips in Item 3 could have originated from the damaged area of the wall (location A) as represented by the paint sample in Item 1. 3. Although the paint sample in Item 2 and the paint chips in Item 3 were similar in their layer structure, further comparative examinations disclosed that the top paint layers were dissimilar in their physical characteristics (such as surface feature and fluorescence characteristic). Therefore, the paint chips in Item 3 could not have originated from the damaged area of the wall (location B) as represented by the paint sample in Item 2.</p>
WKBDA6	<p>Items 1 and 3 were examined visually and using stereomicroscopy, fluorescence microscopy, microchemical tests, microsolvability tests, Colorimetry, Fourier Transform Infrared Spectrophotometry (FTIR), and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). Item 2 was examined visually and using stereomicroscopy and FTIR. The two-layered light gray nonmetallic paint particles in Items 1 and 3 were consistent in colors, textures, types, layers sequence and chemical composition. It was concluded that the Item 3 paint could have had a common origin with Item 1 or another source of paint with the same colors, textures, types, layer sequence and chemical composition. The light gray nonmetallic paint particles in Items 2 and 3 could not be associated due to differences in texture and chemical composition.</p>
WWP8P6	<p>Items 1, 2, and 3 were examined using stereomicroscopy, compound microscopy, fluorescence microscopy, Colorimetry, Fourier Transform Infrared Spectrophotometry (FTIR), and Scanning Electron Microscopy- Energy Dispersive X-Ray Spectrometry (SEM-EDS). Items 1 and 3 were further examined using microsolvability and microchemical tests. The two-layered dull white nonmetallic paint particles in Items 1 and 3 were consistent in colors, textures, types, layer sequence, and chemical composition. It was concluded that the paints in Items 1 and 3 either originated from the same source or different sources painted in the same manner. The two-layered dull white nonmetallic paint particles in Items 2 and 3 could not be associated due to differences in texture and chemical composition.</p>
X36LDU	<p>Microscopic, microchemical + instrumental analysis (micro-FTIR + pyrolysis GC/MS) of the known paint #01 + #02 and the questioned paint #03 yielded the following results: #01 + #03 are consistent with respect to color, texture, type and layer structure. Therefore the questioned paint #03 could have originated from the source represented by the known paint #01. #03 can not be associated to the known paint #02.</p>
X6EFMZ	<p>Item 3 could have originated from the same source as Item 1 or a source with similar properties.</p>

TABLE 3

WebCode	Conclusions
	Item 3 did not originate from the same source as Item 2.
XUAJCH	The questioned paint chips recovered from the suspect's clothing (item 3) exhibits the same results in all tested properties: layer structures, layer colours, and chemical and elemental composition as the known paint sample representative of the damaged area of wall location A (item 1). The questioned paint chips recovered from the suspect's clothing (item 3) exhibits different results as the known paint sample representative of the damaged area of wall location B (item 2).
XW468U	The questioned paint chips from the suspect's clothing (Item 3) could not be distinguished from the known paint sample representative of the damaged area of wall location A (Item 1). Therefore, these paint chips could have originated from the damaged area of wall location A. The questioned paint chips from the suspect's clothing (Item 3) could be distinguished from the known paint sample representative of the damaged area of wall location B (Item 2). Therefore, these paint chips could not have originated from the damaged area of wall location B.
XWYN7B	Examination of known sample from the damaged area of museum wall location A (Item 1). Item 1 comprised a paint chip with a white topcoat and a brown fiber undercoat. The white topcoat was identified as an Acrylic paint containing titanium dioxide. Examination of known sample from the damaged area of museum wall location B (Item 2). Item 2 comprised a paint chip with a white topcoat and iron-grey fiber undercoat. The white topcoat was identified as an Acrylic and Polyvinyl acetate paint containing titanium dioxide. Examination of questioned paint chips recovered from the suspect's clothing (Item 3). Item 3 contains two paint chips. We named it No. 3-1 and No. 3-2. Both of No. 3-1 and No. 3-2 comprised a paint chip with a white topcoat and brown fiber undercoat. Both of the white topcoat from the No. 3-1 and No. 3-2 paint chips was identified as an Acrylic paint containing titanium dioxide.
XZ4GZA	After performing a physical study and chemical analysis on the evidences it was determined: (1) that the grey paint from the damaged area wall (location A) show similar characteristics to the paint chips recovered from the suspect's clothing, consistent with having a common origin. (2) that the grey paint from the damaged area wall (location B) don't have similar characteristics to the paint chips recovered from the suspect's clothing.
YCUFH4	Items 1, 2 and 3 were examined using stereomicroscopy, microsolvability tests, microchemical tests and Colorimetry. Additionally, Items 1 and 3 were examined using fluorescence microscopy, Fourier Transform Infrared Spectrophotometry (FTIR), and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The white nonmetallic paint particles in Items 1 and 3 were consistent in colors, textures, types, layer sequence and chemical composition. It was concluded that the Item 3 paint could have had a common origin with Item 1 or another source of paint with the same colors, textures, types, layer sequence and chemical composition. The Item 3 white nonmetallic paint could not be associated with the Item 2 white nonmetallic paint due to differences in chemical composition.
YTX4HG	Samples #1, 2 & 3 are multi layered, white paint chips. The examined features of samples #1 and #3 are similar. The morphology and IR spectra of layers of sample #2 are different from these features of samples #1 & #3.
YVM9CA	Item 3 is clearly different from Item 2 and could not originate from this location. Item 3 is similar to Item 1 and could originate from this location.
ZWQKA2	[No Conclusions Reported.]
ZYGP6U	The questioned paint chips recovered from the suspect's clothing (Item 3) could have originated from the damaged wall of the museum represented by (Item 1).

# Additional Comments

TABLE 4

WebCode	Additional Comments
67PL94	[Participant submitted a "Scale of Conclusions" that could not be reproduced for this report.]
7GMQR4	[Participant submitted an "Interpretation" section that could not be reproduced for this report.]
E93FWF	As instructed the samples were treated as a single source and the wall substrate was ignored.
EJHLFW	In the investigations high inhomogeneity[sic] was observed for the gray layer of each sample.
F6WUGN	In our laboratory the majority of casework received consists of automobile paint transfer, while the cases received involving architectural paint transfer, are usually frictions of one or two layers at best, where many of the resins used are very common. Therefore the possibility of finding this type of resin on a surface different from that of the crime scene is probable, thus making it hard to establish an association with a high degree of certainty, unlike the cases of automobile paint transfer where there have been cases with up to fifteen particular resin layers.
JXY8RP	The strength of evidence quoted in this matter is based on an exponential scale using the following terms: no scientific support; inconclusive; limited; moderate; moderately strong; very strong; conclusive.
MD87GY	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. The questioned paint chips (item 3) did not match the sample of the damaged area of wall location B (item 2).
NNG4Y8	A layer of paint appears to have absorbed into the substrate forming what visually appears to be an additional layer of paint blended in with the substrate. Following CTS instructions to ignore substrate, this layer was not taken into account.
RFV33T	[Participant submitted an "Interpretation" section that could not be reproduced for this report.]
UTB6CG	The elemental compositions of the top light grey layers of item 1 and 3 determined by SEM/EDX spectra were Si, Al, Ti, O with small amount/trace of Na, K, P and Fe. The elemental profile of the light grey layer of item 2 was similar to those of item 1 and 3, but with lower amount of Al.
UVJ7NF	It was noted "please ignore the wall substrate" while analyzing all items. It was, however, difficult to do this, given the type of substrate used. It appears that the first layer of paint on top of the wall board combined with pigments present in the paper. Therefore the question arises as to whether this collusion of paper and paint create a layer making the sample of three layer paint sample versus a two layer paint sample. I characterized the samples as having three layers. Discrimination of Item 3 from Item 2 and inclusion of Item 1 as possible source for Item 3 was still possible for the test; however, the physical layer structure of paint in these items was ambiguous.
UVZ98A	Item 3 is suspected to be a match to Item 1, but due to the presence of an unidentified inorganic mineral species located in one of the six preparations from Item 3 and not found in any of the preparations for Item 1, the results were deemed inconclusive. The inorganic filler particles in all of the paint layers were quite heavy and very unevenly distributed. The silicate fillers and likely the carbonate fillers were from multiple mineral species. It is possible the unidentified inorganic in Item 3 is a less abundant mineral related to either the silicate or carbonate fillers.

TABLE 4

WebCode	Additional Comments
VL6Q77	The elements detected would generally be present in the majority of widely available white/non-coloured paints.
X36LDU	Additional paint spls. would be requested from the source represented by #02.
ZYGP6U	The chemical composition (organic and inorganic components) of Item 1 paint chips is similar to the chemical composition of Item 3.

**Test No. 11-546: Paint Analysis**DATA MUST BE RECEIVED BY November 28, 2011 TO BE INCLUDED IN THE REPORT

Participant Code:

WebCode:

**Accreditation Release Statement**

CTS submits external proficiency test data directly to ASCLD/LAB and FQS-International. 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 and/or FQS-International. (Accreditation Release section on the last page must be completed and submitted.)

This participant's data is **NOT** intended for submission to ASCLD/LAB or FQS-International.

**Scenario:**

Police are investigating a break-in of a museum where items were stolen. During the break-in, investigators noticed two walls in different sections of the museum that were heavily damaged where it appeared the thief pried valuable artwork from the walls. The police have a suspect in custody and have collected paint chips from the his clothing. Police are requesting you to examine the recovered paint chips and determine if they could have originated from either of the damaged walls.

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 wall substrate.

**Items Submitted (Sample Pack P2):**

- Item 1: Known paint sample representative of the damaged area of wall location A.
- Item 2: Known paint sample representative of the damaged area of wall location B.
- Item 3: Questioned paint chips recovered from the suspect's clothing.

**1.) Could the questioned paint chips recovered from the suspect's clothing (Item 3) have originated from either of the damaged walls of the museum as represented by Items 1 or 2?**

**Item 1:** Yes  No  Inconclusive

**Item 2:** Yes  No  Inconclusive

**Please return all pages of this data sheet.**

Page 1 of 3

Participant Code:

WebCode:

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

*Microscopic Examinations:*

Stereomicroscope

Polarized Light

Fluorescence

Pyrolysis GC

FTIR

Solubility/Chemical

XRS/XRF

SEM/EDX

Microspectrophotometry

Other (specify): \_\_\_\_\_

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

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**4.) Additional Comments**

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**Return Instructions**

Participant Code:

**Data Sheets can be mailed or faxed (please include a cover sheet) and must be received by November 28, 2011 to be included in the report.**

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

FAX: +1-571-434-1937  
or Toll-Free (U.S. only): 1-866-FAX-2CTS (329-2287)  
TEL: +1-571-434-1925 (8 am - 4:30 pm EST)  
EMAIL: forensics@cts-interlab.com

www.ctsforensics.com

**Please return all pages of this data sheet.**

Page 2 of 3

## RELEASE OF DATA TO ACCREDITATION BODIES

The following Accreditation Releases will apply only to:

Participant Code:

WebCode:

for Test No. **11-546: Paint Analysis**

This release page must be completed and received by **November 28, 2011** to have this participant's submitted data included in the reports forwarded to the respective Accreditation Bodies.

### **ASCLD/LAB RELEASE**

If your lab has been accredited by ASCLD/LAB and you are submitting this data as part of their external proficiency test requirements, have the laboratory's designated individual complete the following.

**The information below must be completed in its entirety for the results to be submitted to ASCLD/LAB.**

ASCLD/LAB Legacy Certificate No. \_\_\_\_\_ ASCLD/LAB International Certificate No. \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Laboratory Name \_\_\_\_\_

Location (City/State) \_\_\_\_\_

### **FQS-INTERNATIONAL RELEASE**

If your laboratory maintains its accreditation through FQS-International, please complete the following form in its entirety to have your results forwarded.

FQS-International Certificate No. \_\_\_\_\_

Signature and Title: \_\_\_\_\_ Date \_\_\_\_\_

Laboratory Name \_\_\_\_\_

Location (City/State) \_\_\_\_\_

### Accreditation Release

#### **Return Instructions**

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

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

**Please return all pages of this data sheet.**

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