



## **Paint Analysis Test No. 15-546 Summary Report**

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This test was sent to 101 participants. Each sample set consisted of two items containing a "known" paint sample and one item containing "questioned" paint chips. Participants were requested to compare the items and report their findings. Data were returned from 81 participants (80.2% 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 set consisted of three items with layered paint and primer: two known samples (Items 1 and 2) and one questioned sample (Item 3) were cut from painted pine wood plank substrates. Items 2 and 3 came from a plank with the same primer and topcoat. Item 1 was prepared with the same primer, but a different topcoat from what was used for Items 2 and 3. Participants 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-

All planks used for this test were selected based on their limited defects and were wiped down to remove dust before painting. For the following preparations, each primer coat was allowed to dry a minimum of 6 hours and each topcoat was allowed to dry overnight before applying the next coat.

ITEM 1 (ELIMINATION): The known Item 1 samples were prepared by applying two coats of primer (Behr Premium Plus® exterior water-based Multisurface Primer and Sealer, 436, white) to several pine wood planks (each 6' x 3" x 1"). Then two layers of topcoat (Glidden High Gloss Acrylic Latex Paint, Base 3, GL7113, Red Delicious (color code-00YR 08/409)) were applied. The questioned Item 1 planks were cut into one inch wide strips using a miter saw. One 1" piece was packaged into a glassine bag and then a pre-labeled Item 1 envelope.

ITEMS 2 and 3 (IDENTIFICATION): Items 2 and 3 were prepared by applying two coats of primer (Behr Premium Plus® exterior water-based Multisurface Primer and Sealer, 436, white) to several pine wood planks (each 6' x 3" x 1"). Then two layers of topcoat (Glidden High Gloss Trim Door & Furniture Oil Paint, GL302, National Red) were applied. The planks were cut into one inch wide pieces using a miter saw and kept in their original order after cutting. One 1" piece was packaged into a glassine bag and then a pre-labeled Item 2 envelope. For the matching Item 3 sample, a 1" piece was chosen approximately every three inches and several paint chips were scored 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. Items 2 and 3 were taken in close spatial proximity to one another, within three inches, and were kept together as an identification group and packaged into the sample sets as described below.

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

### VERIFICATION-

The expected association and elimination results were confirmed by predistribution laboratories, who used the following combined list of techniques: Stereomicroscopy, fluorescence, polarized light, solubility/chemical, Pyrolysis GC, FTIR, XRS/XRF, and microspectrophotography.

## **Summary Comments**

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

All 81 participants reported that the questioned paint chips in Item 3 could have originated from the same source as the known paint sample in Item 2, but could not have originated from the same source as the known paint sample in Item 1.

# Examination Results

*Could the questioned paint chips from the shoe of the suspect (Item 3) have originated from either of the damaged front doors as represented by Items 1 or 2?*

TABLE 1

WebCode	Item 1	Item 2	WebCode	Item 1	Item 2
26Q8ZE	No	Yes	FXHMUW	No	Yes
29MUU3	No	Yes	GRALAT	No	Yes
2A37FE	No	Yes	GW3MDR	No	Yes
2BTG88	No	Yes	H4JCV2	No	Yes
3ECEP8	No	Yes	HDBRLQ	No	Yes
3TN8ZF	No	Yes	HV6MWT	No	Yes
42KGUB	No	Yes	J6R6QR	No	Yes
4L4JPB	No	Yes	JB9QPX	No	Yes
4MY6GF	No	Yes	JJMEPQ	No	Yes
4QHJY9	No	Yes	JKLHEV	No	Yes
63Q7P8	No	Yes	JPEJHV	No	Yes
6FWJLY	No	Yes	JPRB9Q	No	Yes
6KR4VA	No	Yes	K4U4FT	No	Yes
6NTABF	No	Yes	KFMNWK	No	Yes
6YBUUC	No	Yes	KPALMP	No	Yes
73PLK6	No	Yes	LNA4XT	No	Yes
88RC32	No	Yes	M6HBWV	No	Yes
9HTYTC	No	Yes	M9HJ4R	No	Yes
B3R6B3	No	Yes	MMT77U	No	Yes
BDCEWB	No	Yes	MVRPRX	No	Yes
D8RAUX	No	Yes	MXUKCL	No	Yes
DEFQT3	No	Yes	NBEM9J	No	Yes
EC4HV3	No	Yes	NNKMXG	No	Yes
EM4478	No	Yes	PMR76K	No	Yes
EQKFZ3	No	Yes	QGXDGF	No	Yes
F2KGYT	No	Yes	QHABUF	No	Yes
F3FYZU	No	Yes	QL9HJJ	No	Yes
FHL9WN	No	Yes	QWRZTH	No	Yes
FKVBQY	No	Yes	QYYEKG	No	Yes
FRG43Y	No	Yes	RAXAGR	No	Yes

TABLE 1

WebCode	Item 1	Item 2	WebCode	Item 1	Item 2
RNPBNH	No	Yes			
TANYTJ	No	Yes			
UG6UAE	No	Yes			
UTEKVM	No	Yes			
VNXPKG	No	Yes			
W2JCDF	No	Yes			
W7UAYG	No	Yes			
WAXXMJ	No	Yes			
WBTJDP	No	Yes			
WHCTJD	No	Yes			
WJ8EAJ	No	Yes			
WRHQBM	No	Yes			
WTRWNC	No	Yes			
X6G3BE	No	Yes			
XL7A9C	No	Yes			
XMZVZH	No	Yes			
XW3DC7	No	Yes			
YCGU49	No	Yes			
YZKQYE	No	Yes			
ZD4RUC	No	Yes			
ZQBPU7	No	Yes			

Response Summary				
		Item 1	Item 2	
<b>Responses</b>	Yes	<b>0</b> (0 %)	<b>81</b> (100.0%)	
	No	<b>81</b> (100.0%)	<b>0</b> (0 %)	
	Inc	<b>0</b> (0 %)	<b>0</b> (0 %)	
<b>Participants: 81</b>				

# Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRF/XRF	SEM/EDX	Microspectrophotometry	Other
26Q8ZE	✓				✓	✓				Fluorescence (UV light)
29MUU3	✓				✓					
2A37FE	✓				✓	✓				
2BTG88	✓				✓					
3ECPE8	✓	✓			✓		✓	✓		Comparison Microscope
3TN8ZF	✓				✓		✓			
42KGUB	✓				✓	✓	✓	✓		Pyrolysis GC/MS
4L4JPB	✓	✓			✓		✓			
4MY6GF	✓	✓	✓		✓		✓			
4QHYJ9	✓		✓		✓		✓			
63Q7P8	✓	✓			✓	✓	✓			
6FWJLY	✓				✓					
6KR4VA	✓	✓			✓	✓	✓			Pyrolysis GC/MS
6NTABF	✓				✓		✓			
6YBUUC	✓				✓					Digital microscope
73PLK6	✓	✓			✓					Alternate Light Source (fluorescence)
88RC32	✓		✓		✓					
9HTYTC	✓	✓	✓		✓	✓	✓			
B3R6B3	✓				✓		✓			
BDCEWB	✓	✓	✓	✓	✓		✓	✓		
D8RAUX	✓				✓					
DEFQT3	✓		✓		✓					
EC4HV3	✓				✓	✓				
EM4478	✓	✓			✓		✓			
EQKFZ3	✓	✓	✓		✓				✓	

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
F2KGYT	✓	✓			✓		✓		✓	
F3FYZU	✓		✓		✓	✓				
FHL9WN	✓			✓	✓			✓		
FKVBQY	✓		✓		✓	✓		✓	✓	Alternate Light Source
FRG43Y	✓				✓			✓		UV
FXHMUW	✓				✓			✓		
GRALAT	✓				✓			✓		
GW3MDR	✓				✓		✓		✓	
H4JCV2	✓				✓			✓	✓	
HDBRLQ	✓				✓			✓		
HV6MWT	✓			✓	✓					
J6R6QR	✓	✓			✓				✓	
JB9QPX	✓				✓		✓	✓		
JJMEPQ	✓	✓	✓		✓					
JKLHEV	✓				✓		✓			
JPEJHV	✓				✓					
JPRB9Q	✓		✓		✓					
K4U4FT	✓		✓		✓		✓			RAMAN
KFMNWK	✓				✓			✓		
KPALMP	✓				✓					
LNA4XT	✓				✓	✓				
M6HBWV	✓				✓			✓	✓	
M9HJ4R	✓	✓			✓	✓	✓		✓	
MMT77U	✓				✓	✓				Fluorescence
MVRPRX	✓	✓			✓			✓		Pyrolysis GC-MS
MXUKCL	✓	✓			✓		✓		✓	
NBEM9J	✓				✓			✓		

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
NNKMXG	✓				✓				✓	
PMR76K	✓				✓		✓			Pyrolysis GC/MS
QGXGDF	✓				✓	✓				
QHABUF	✓				✓		✓			
QL9HJJ	✓					✓	✓			
QWRZTH	✓				✓					
QYYEKG	✓	✓	✓	✓	✓		✓			
RAXAGR					✓		✓			Comparison microscope
RNPBNH	✓					✓				
TANYTJ	✓				✓	✓				
UG6UAE	✓				✓				✓	
UTEKVM	✓	✓		✓	✓		✓	✓		
VNXPKG	✓				✓	✓				
W2JCDF	✓	✓		✓	✓	✓	✓			
W7UAYG	✓				✓		✓			
WAXXMJ	✓				✓	✓				
WBTJDP	✓	✓		✓	✓	✓	✓			
WHCTJD	✓			✓	✓		✓			
WJ8EAJ	✓	✓	✓		✓	✓	✓			
WRHQBM	✓				✓		✓	✓		
WTRWNC	✓				✓		✓	✓		
X6G3BE	✓				✓		✓			
XL7A9C	✓				✓					
XMZVZH	✓			✓	✓		✓			
XW3DC7	✓				✓	✓				RAMAN SPECTROSCOPY
YCGU49	✓	✓	✓	✓	✓	✓				



TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
YZKQYE	✓		✓	✓	✓		✓		✓	
ZD4RUC	✓	✓	✓		✓			✓		
ZQBPU7	✓				✓	✓				

Response Summary										
	Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry
	81	80	23	17	11	79	21	11	41	18
Percent		99%	28%	21%	14%	98%	26%	14%	51%	22%

# Conclusions

TABLE 3

WebCode	Conclusions
26Q8ZE	The paint in item 3 is similar in color and layer structure to the paint in item 1, however, it is dissimilar in infra-red absorbance spectra. Therefore the paint in items 1 and 3 could not have originated from the same source. The paint in item 3 is similar in color, layer structure, solubility, fluorescence and infra-red absorbance spectra to the paint in item 2. Therefore the paint in items 2 & 3 could have originated from the same source.
29MUU3	The questioned paint chip (item 3) and item (2) came from the same source.
2A37FE	Examination of the paint samples in Submissions 1a, 1b and 1c revealed the following layer structure: red, white. The paint from Submission 1c was found to be different from the paint standard in Submission 1a with respect to tint and composition. Therefore, this paint in Submission 1c did not originate from the same source as the paint standard of Submission 1a. The paint from Submission 1c was tested and found to correspond to the paint standard of Submission 1b with respect to color, tint, texture, layer structure, chemical solubility and composition. Therefore, this paint in Submission 1c is consistent with originating from the same source as the paint standard of Submission 1b or another source with these same characteristics. The evidence is available for pickup.
2BTG88	Items 3 and 1 are distinguishable in chemical composition. It was concluded that the questioned paint chips (Item 3) could not have come from the damaged front doors as represented by Item 1. Items 3 and 2 are indistinguishable in color and chemical composition. It was concluded that the questioned paint chips (Item 3) could have come from the damaged front doors as represented by Item 2.
3ECEP8	Item 3 could not have originated from the source represented by Item 1. Item 3 could have originated from Item 2, as represented by the known submitted exemplar, or from another source exhibiting all of the same analyzed/measured characteristics.
3TN8ZF	The red layer of item 1 was compositionally not consistent with that of Item 3 (nor Item 2); therefore, Item 1 could not have been a source for Item 3. Both, the red layer and the white layer of Item 2 were determined to be compositionally similar with both the red and white layers of Item 3; therefore, Item 2 could have been the source of Item 3.
42KGUB	The dark red paint in Item 3 is identical to the dark red paint in Item 2 in color, type, texture, layer structure, and elemental composition. This means that the paint chips recovered from the shoe of the suspect could have come from the damaged area of the front door of house #2. The dark red paint in Item 3 is different from the dark red paint in Item 1. This means that the paint chips recovered from the shoe of the suspect could not have come from the damaged area of the front door of house #1.
4L4JPB	The questioned paint chips recovered from the suspect shoe (Item 3) each consist of a layer of glossy red paint over a layer of white paint/primer on a wooden substrate. The Item 3 paint was compared to the submitted known paint samples from the front doors of houses #1 and #2 (Items 1 and 2 respectively) which both also consist of red/white paint layers on wooden substrates. The Item 3 paint was found to be consistent in color, layering, microscopic characteristics, elemental composition and chemical composition to the known paint from house #2 (Item 2). Accordingly, the questioned paint could have originated from the front door of house #2 or from another source that is coated with red/white layers of paint which share all of the same characteristics. The Item 3 paint was found to be dissimilar in microscopic characteristics and elemental composition to the known paint from house #1 (Item 1); and, accordingly is not consistent with having originated from that door.

TABLE 3

WebCode	Conclusions
4MY6GF	The results of the examination support that the paint chips, Item 3, originate from the front door of house #2, Item 2, (Level +2). The results of the examination extremely strongly support that the paint chips, Item 3, doesn't originate from the damaged area of the front door of house #1, Item 1, (Level -4).
4QHYJ9	The paint chips of the damaged area of the front door of house #1 (Item 1) was found to be different from the paint chip recovered from the shoe of the suspect (Item 3). Opposing to Item 1 the paint chip of the area of the front door of house #2 (Item 2) showed no differences to Item 3. The examined criteria were: colour of paint layer; fluorescence behaviour; elemental composition (SEM/EDX); chemical properties observed by IR-spectroscopy. The red layer of Item 1 differs from the red layer of Item 3 in surface structure, chemical properties as observed in IR-spectroscopy, and the elemental distribution. The white layers of Item 1, Item 2, and Item 3 were indistinguishable. The results lead to the conclusion that the questioned paint chips from the shoe (Item 3) could have originated from the damaged area of the front door of house #2 (Item 2).
63Q7P8	The paint chips recovered from the suspect's shoe could not have originated from the front door of house #1, as represented by item 1. On the basis of the results of the comparisons undertaken the paint chips recovered from the suspect's shoe could have originated from the front door of house #2, as represented by item 2. In my opinion there is strong support for the view that the recovered paint chips have originated from this location.
6FWJLY	It was found that item 2 could have originated from item 3, item 1 could not have originated from item 3.
6KR4VA	Each of the paint samples in Exhibits 1, 2 and 3 were comprised of a red layer of paint over a white layer of paint. The questioned paint chips in Exhibit 3 had the same physical characteristics and chemical composition as the sample of paint submitted in Exhibit 2. The paint chips in Exhibit 3 could have originated from Exhibit 2 or from any other paint source with the same physical characteristics and chemical composition. The questioned paint chips in Exhibit 3 had different physical characteristics and chemical composition than the sample of paint submitted in Exhibit 1. Exhibit 3 could not have originated from the same source as Exhibit 1.
6NTABF	Each of the known paint samples in item 1 and item 2 from house #1 and house #2 respectively comprised a double layered red paint fragment, having a top red paint layer and a second white paint layer. Questioned paint sample item 3 recovered from the shoe of the suspect comprised 2 double layered red paint fragments, each having a top red paint layer and a second white paint layer. The recovered paint sample in item 3 was found to agree in colour and chemical compositions with the respective red and white paint layers of the known paint sample item 2. However, there was a discrepancy in chemical composition between the respective paint layers of the recovered paint sample item 3 and the known paint sample item 1. The above finding suggested that the recovered paint fragments from the shoe of the suspect in item 3 could have come from the damaged front door of house #2 from which the known paint sample item 2 was collected, but did not originate from the damaged front door of house #1 from which the known paint sample item 1 was collected.
6YBUUC	The paint shavings in Item 3 demonstrate similar physical characteristics upon comparison to the paint sample comprising Item 1; however, further analysis revealed differences in chemical composition. Accordingly, Item 1 is excluded as a source of the paint shavings in Item 3. The paint shavings in Item 3 demonstrate the same physical characteristics and chemical composition as the paint sample comprising Item 2. Accordingly, the paint shavings in Item 3 could have originated from the same source as Item 2, or another source with the same

TABLE 3

WebCode	Conclusions
	physical characteristics and chemical composition.
73PLK6	Questioned paint sample #3 could have originated from known paint sample #2 or another source exhibiting all of the same analyzed characteristics. Item #3 could not have originated from known paint sample #1.
88RC32	Item 3 could have originated from the front door of house no. 2 (Item 2). Item 3 did not originate from the front door of house no. 1 (Item 1).
9HTYTC	The known paint sample (item 1) from the damaged area of the front door of house #1 and the known paint sample (item 2) from the damaged area of the front door of house #2 were received on two relatively large wooden block. Two small questioned paint chips (item 3) were recovered from the suspect's shoe and submitted for comparison to the known paint samples. The submitted samples were analyzed using stereomicroscopy, polarized light microscopy, fluorescence/comparison microscopy, xray fluorescence spectrometry, scanning electron microscopy, energy dispersive spectrometry, and infrared spectrometry. Questioned paint chips (item 3) from the suspect's shoe could have come from the damaged area of the front door of house #2. Because paint is mass-produced, the paint from the suspect's shoe could also share sources with other paints that have similar visual and chemical properties. Questioned paint chips (item 3) from the suspect's shoe did not come from the front door of house #1.
B3R6B3	Items 1, 2, and 3 are two layer architectural paint consisting of a red color coat and a white primer. The red paint chips from Item 3 are similar in color, physical characteristics, and chemistry to the paint sample from Item 2. The red paint from Item 3 could have come from Item 2 or any other red paint source that is similar in color, physical characteristics, and chemistry. Item 3 is not similar in physical characteristics or chemistry to the paint sample from Item 1. Item 3 could not have come from the same source of paint as Item 1. Chemical analysis includes: Fourier Transform Infrared Spectroscopy (FTIR), and Scanning Electron Microscopy – Energy Dispersive Spectroscopy (SEM-EDS). Samples collected and analyzed during examination and analysis of the items in this case were returned to and retained with the original item.
BDCEWB	The questioned paint recovered from the suspect's shoe (Item 3) was similar to the known paint sample collected from the damaged area of the front door of house #2 (Item 2). Therefore, the questioned paint chips (Item 3) could have come from the damaged area of the front door of house #2 (Item 2) or from another source of paint with the same physical and chemical characteristics. The questioned paint chips (Item 3) did not come from the damaged area of the front door of house #1 (Item 1).
D8RAUX	The visual appearance, texture, and infrared spectra of the topcoat of Item 1 were not consistent with those of Item 3; therefore, the chips from Item 3 could not have originated from Item 1. Items 2 and 3 had similar surface textures and the same number of coating layers. The infrared spectra produced of both the red topcoats and the white bottom coats were chemically consistent. Therefore, Item 3 could have originated from Item 2.
DEFQT3	The red paint chips collected from the suspect's shoe (Item 3) and the red paint sample from the door of house #2 (Item 2) were determined to be microscopically and chemically (infrared spectroscopy) indistinguishable and; therefore, may have a common origin. The red paint chips collected from suspect's shoe (Item 3) were determined to be microscopically and chemically (infrared spectroscopy) different from the red paint samples collected from the door of house #1 (Item 1). Therefore, red paint from the door of house #1 (Item 1) was excluded as the source of the red paint chips collected from suspect's shoe (Item 3).

TABLE 3

WebCode	Conclusions
EC4HV3	Questioned paint Q1A, Q1B and known paint K2 were visually and stereoscopically examined and instrumentally analyzed using Fourier Transform Infrared Spectroscopy (FT-IR) and X-Ray Fluorescence (XRF). These analyses disclosed that questioned paint Q1A and Q1B(lab item 3) and known paint K2 (lab item 2) are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. It is the opinion of the undersigned that the questioned paint, Q1A and Q1B, could have originated from the same source as represented by the known submitted exemplar, K2, or from another source exhibiting all of the same analyzed characteristics. Known paint K1 was visually and stereoscopically examined and instrumentally analyzed using Fourier Transform Infrared Spectroscopy (FT-IR).These analyses disclosed that the questioned paint, Q1A, Q1B (lab item 3) and the known paint, K1 (lab item 1, are different with respect to their chemical type. It is the opinion of the undersigned that the questioned paint Q1A, Q1B could not have originated from the source represented by the known paint K1.
EM4478	The paint from the suspect's shoe (item 3) could have come from the front door of house #2 (item 2), or any other source with paint that is visually, microscopically, and chemically similar to the paint in item 3. The paint from item 1 is dissimilar in visual and chemical properties of layer 1 to layer 1 from items 2 and 3. The paint from the suspect's shoe (item 3) could not have come from the front door of house #1 (item 1).
EQKFZ3	Representative paint layers in Items 1 and 2 were examined and compared with the paint layers in Item 3 visually, microscopically, and instrumentally. Items 2 and 3 were consistent in all measured physical, microscopic, chemical, and color characteristics. They could have come from the same source, or any other source with the same physical and chemical compositions. Items 1 and 3 were found to be inconsistent in microscopic characteristics and chemical composition and could not have come from the same source.
F2KGYT	Items 1 and 3 are dissimilar to each other by visual, stereomicroscopy, and comparison polarization microscopy. Therefore the paint chips from item 3 could not have originated from the door of house #1 as represented by the paint sample from item 1. Items 2 and 3 are similar to each other by visual, stereomicroscopy, comparison polarization microscopy, microspectrophotometry, Fourier transform infra-red spectroscopy, and micro x-ray fluorescence spectroscopy. Therefore the paint chips from item 3 could have originated from the door of house #2 as represented by the paint sample from item 2.
F3FYZU	Item #1 contains known paint exhibiting the following layer structure: 1. red non-metallic top coat; 2. white primer. Item #2 contains known paint exhibiting the following layer structure: 1. red non-metallic top coat; 2. white primer. Item #3 contains questioned paint exhibiting the following layer structure: 1. red non-metallic top coat; 2. white primer. Microscopic, microchemical, and instrumental analysis (micro-FTIR) of the known paint (items #1 and 2) and the questioned paint (item #3) yielded the following results and conclusions: Item #3 (questioned paint) and item #1 (known paint) are dissimilar[sic] with respect to type. Therefore the questioned paint (#3) did not originate from the source represented by the known paint, item #1. Item #3 (questioned paint) and item #2 (known paint) are consistent with respect to color, texture, type, and layer structure. Therefore the questioned paint (#3) could have originated from the source represented by the known paint (#2) or another painted surface with paint exhibiting the same characteristics (color, texture, layer structure, and type).
FHL9WN	Microscopic Exam: All of them (Item 1,2,3) are contained three layers, which are red layer, white layer and wood (from top to bottom). Chemical Analysis: According to FTIR, Pyrolysis GC and SEM/EDS result, the chemical compositions of the Item 3 is similar to those of the

TABLE 3

WebCode	Conclusions
FKVBQY	Item 2. However, the Item 3 is dissimilar to the Item 1 because of different chemical composition.
FKVBQY	There were significant differences in the physical, chemical and elemental properties in Items 1 and 3 therefore the questioned paint chips recovered from the shoe of the suspect did not originate from the damaged area of the front door of house #1. There were no significant differences in the physical, chemical and elemental properties in Items 2 and 3 therefore the questioned paint chips recovered from the shoe of the suspect may have originated from the damaged area of the front door of house #2 or from another surface with the same paint.
FRG43Y	Examinations of Item 1 (known paint from house #1), Item 2 (known paint from house #2) and Item 3 (questioned paint chips) disclosed the presence of a two- layer paint system with the following color and layer sequence: red topcoat/white basecoat. Comparative examinations of Item 2 with Item 3 disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, Item 3 could have originated from Item 2. Comparative examinations of Item 1 with Item 3 disclosed them to be different in their physical characteristics. Therefore, Item 3 could not have originated from Item 1.
FXHMUW	The red paint layer of item 3 was chemically incomparable with the red paint layer of item 1 and therefore item 3 could not have originated from the source represented by item 1. Items 2 and 3 consisted of the same number of paint layers that were physically and chemically comparable. Therefore item 3 could have originated from the source represented by item 2.
GRALAT	The known paint sample representative of the damaged area of the front door of house #1 (Item 1), the known paint sample representative of the damaged area of the front door of house #2 (Item 2) and the questioned paint chips recovered from the shoe of the suspect (Item 3) are all two-layer paints. The first layer is red coat and the second layer is white coat. Comprehensive examination results of microscopy, FT-IR and SEM/EDS demonstrated that Item 3 is consistent with Item 2, while Item 3 is different from Item 1 in the chemical composition of the red coat. Therefore, the questioned chips recovered from the shoe of the suspect (Item 3) could originate from the damaged area of the front door of house #2 (Item 2) but couldn't originate from the damaged area of the front door of house #1 (Item 1).
GW3MDR	1. Microscopic Examination - Item1, Item2 and Item3 are indistinguishable in their appearance; They all have two layers of red and white. 2. Microspectrophotometry - Red layer of Item3 shows similar absorption spectrum to that of Item2 while it is different from that of Item1. 3. FT-IR and XRF Analysis - Chemical compositions of layers of Item3 are similar to those of Item2. But Item3 differs from Item1 in red layer.
H4JCV2	The questioned paint chip #3 was different to the paint from the damaged area of the house #1. The questioned paint chip #3 was indistinguishable to the paint from the damaged area of the house #2 by visual appearance, infrared analysis, inorganic analysis and UV-visible micro spectrophotometry. Therefore a source for the paint chip from the suspects shoes could be the front door of the house #2. This evidence provides a level 3 association between the house #2 and the questioned paint chip #3. A level 3 association is one in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, and[sic] individual source cannot be determined.
HDBRLQ	Examination of Items 1, 2, and 3 revealed a two-layered paint system consisting of a red topcoat and a white primer. Microscopic and instrumental analysis and comparison of Item 3, paint from shoes, with Item 1, paint from front door of house #1, revealed them to be

TABLE 3

WebCode	Conclusions
HV6MWT	<p>inconsistent with respect to binder and pigment composition. Therefore, the paint from the shoes did not share a common origin with the paint from the front door of house #1. Microscopic and instrumental analysis and comparison of Item 3, paint from shoes, with Item 2, paint from front door of house #2, revealed them to be consistent with respect to color, texture, type, layering sequence, binder composition, and pigment composition. Therefore, the paint from the shoes came from the front door of house #2 or another object with the same paint history.</p>
HV6MWT	<p>The know paint sample item 1 (representative of the damage area of the front door of house Number 1), the know paint sample item 2 (representative of the damage area of the front door of house Number 2) and the questioned paint chips item 3 (recovered from the shoe of the suspect) are each recovered of two paint layers. The questioned paint chips (item 3) are distinguishable from the know paint sample (item 1). The questioned paint chip recovered from the shoe of the suspect (item 3) could not have come from the damage area of the front door of house Number 1 (item 1). Both layers in the questioned paint chips (item 3) cannot be distinguished from those layers in the know paint sample (item 2). The questioned paint chip recovered from the shoe of the suspect (item 3) could have come from the damage area of the front door of house Number 2 (item 2). [sic]</p>
J6R6QR	<p>Each of the submitted paint chips from item 3 was visually examined. One of the paint chips from Item 3 was examined and compared to Item 2 using polarized light microscopy, visible microscopy, fourier transform infrared spectroscopy (FTIR), and microspectrophotometry. The one examined paint chip from Item 3 and Item 2 were found to each consist of 2 layers. The 2 layers of Item 3 and Item 2 are consistent in appearance, microscopic and chemical properties. Thus, Item 3 could have originated from Item 2 as represented by the examined samples in Items 3 and 2 or another paint source exhibiting the same analyzed characteristics and layer structure. The FTIR results reveal discriminating differences between the red layers of Item 3 and Item 1. Thus Item 3 could not have come from Item 1 as represented by the examined samples in item 3 and Item 1. No further analysis was performed on the remaining sample from item 3. Therefore, no conclusion can be reached on that sample.</p>
JB9QPX	<p>Item #3 could not have originated from the same source as represented by item #1. Item #3 could have originated from the same source as item #2, or from another source exhibiting the same analyzed characteristics.</p>
JJMEPQ	<p>In my opinion, the findings provide strong support for the proposition that the two paint chips, recovered from the shoe of the suspect, have originated from the damaged area on the front door of house #2. In my opinion, the findings show conclusively that the two paint chips, recovered from the shoe of the suspect, have not originated from the damaged area on the front door of house #1.</p>
JKLHEV	<p>After the infrared spectroscopic analysis of the red layers from the three samples we can say item 2 and item 3 had the same organic matrix. In addition the compositions of the inorganic elements of the red samples from item 2 and 3 are the same. After the FTIR and XRF the white layer from item 1 is not the same as the white layer from item 2 and item 3. We can notify that it is probable that the paint chips from the suspect are from the front door of house 2.</p>
JPEJHV	<p>It was determined utilizing stereomicroscopic and Fourier Transform Infrared Spectroscopy that the paint sample from item 2 and item 3 exhibit consistent characteristics. Therefore, the known paint item 2 cannot be eliminated as being the source of the questioned paint sample. It was determined utilizing stereomicroscopic and Fourier Transform Infrared Spectroscopy that the paint sample from item 1 and item 3 exhibit dissimilar characteristics. Therefore, the known paint item 1 can be eliminated as being the source of the questioned paint sample.</p>

TABLE 3

WebCode	Conclusions
JPRB9Q	Paint sample 3 was compared with Paint Sample 2 when they were found to be similar in general characteristics and chemical properties in both layers, such that, in our opinion, at one time they could have had a common origin. Paint sample 3 was compared with Paint Sample 1 when they were found to be different.
K4U4FT	Item 1, Item 2 and Item 3 have been examined[sic]. In the limits of the analytical techniques, it is possible to conclude that : red paint chips which were found in the shoe of the suspect (Item 3) could come from the damaged area of the front door of house #2 (item 2) but couldn't come from the damaged area of the front door of house #1 (item 1).
KFMNWK	All three examined samples present two distinct layers, a red outer coat and a white undercoat in direct contact with the wood support. The outer layer of the two control samples (items 1 and 2) showed marked differences in their chemical composition, both by FTIR and SEM/EDS analysis. By FTIR they were found to consist of very different polyester paints and by EDS/SEM, Item 1 is shown to contain a filler consisting of mineral particulates (talc and barite)which is absent in item 2. Analysis of the upper layer of the questioned paint chip (item 3) showed that it had a chemical composition consistent with item 2 but not item 1. By SEM/EDS and FTIR, the white undercoat was found to be very similar in all three samples, both in terms of texture and chemical composition, and so it was not possible to exclude item 2 as a source of the paint chip. Therefore, It is our opinion that the questioned sample (item 3) could not originate from item 1 but presents sufficient similarities with control sample 2 (item 2) to conclude that it may originate from it.
KPALMP	[No Conclusions Reported.]
LNA4XT	The questioned paint chips recovered from the shoe of the suspect (Item 3) to be similar with the known paint sample representative of the damaged area of the front door of house#2 (Item 2) but to be dissimilar with the known paint sample representative of the damaged area of the front door of house#1 (Item 1). Hence, I am of the opinion that:- 1) The questioned paint chips recovered from the shoe of the suspect (Item 3) could have originated from the known paint sample representative of the damaged area of the front door of house#2 (Item 2). 2)The questioned paint chips recovered from the shoe of the suspect (Item 3) did not originate from the known paint sample representative of the damaged area of the front door of house#1 (Item 1).
M6HBWV	Item 1 from house #1 comprised a white acrylic/styrene undercoat with a red acrylic topcoat. Item 2 from house #2 comprised a white acrylic/styrene undercoat with a red alkyd topcoat. The white undercoat contained the elements Ti, Si, Al, K and Zn. The red topcoat contained the elements Fe, Ti, Si and Zn. Item 3 from the shoe of the suspect comprised a white acrylic/styrene undercoat with a red alkyd topcoat. The white undercoat contained the elements Ti, Si, Al, K and Zn. The red topcoat contained the elements Fe, Ti, Si and Zn. Item 3 corresponded in colour, composition and layer sequence with item 2. The results support the proposition that item 3 originated from house #2.
M9HJ4R	The questioned paint chips in Item 3 and the known paint in Item 2 were found to be alike in all parameters tested. Therefore, the paint in Item 3 could have originated from the same source as the paint in Item 2. The paint in Item 1 was found to be dissimilar to the paint in Item 3.
MMT77U	The paint in item 3 is similar in color, layer structure, solubility, fluorescence, and infra-red absorbance spectra to the paint in item 2. Therefore the paint in items 2 and 3 could have originated from the same source. The paint in item 3 is similar in color, layer structure, and fluorescence to the paint in item 1, however, it is dissimilar in solubility and infra-red



TABLE 3

WebCode	Conclusions
	absorbance spectra. Therefore the paint in items 1 and 3 could not have originated from the same source.
MVRPRX	CONCLUSIONS: The damaged area of the front door of house #1, as represented by item 1, is eliminated as a possible source of the paint chips recovered from the shoe of the suspect (item 3). The damaged area of the front door of house #2, as represented by item 2, cannot be eliminated as a possible source of the paint chips recovered from the shoe of the suspect (item 3). The recovered paint from the shoe of the suspect (item 3) has either come from the damaged area of the front door of house #2 or from another damaged wooden surface that is also painted with red over white paint that is indistinguishable in colour, microscopic appearance and chemical composition. Paint is a mass-manufactured material so therefore it is to be expected that other objects that are coated with the paint that is indistinguishable from the paint in item 3 exists.
MXUKCL	The paint in item 3 is similar in all examined characteristics to the paint in item 2 and could have originated from the same source or from another paint source with these same characteristics. The paint in item 3 shows significant differences from the paint in item 1 and did not originate from the same source (as represented by the submitted paint in item 1).
NBEM9J	A two layer paint system was observed in the paint sampled from Items 1-3. The paint systems consisted of a dark red top layer and a white primer layer on a wooden substrate. Each of these layers was analyzed visually, stereoscopically and instrumentally by Fourier transform infrared spectrometry (FTIR) and scanning electron microscopy/energy dispersive spectrometry (SEM/EDS). The two layer paint system from Item 1 was not consistent with Item 3 due to chemical differences observed in the FTIR and SEM/EDS results of the red paint layers as well as a visual difference in sheen. This indicates the paint recovered from the suspect's shoe (Item 3) did not originate from the damaged front door of house #1 (Item 1). The two layer paint system from Item 2 was visually and instrumentally consistent with Item 3. This indicates the paint recovered from the suspect's shoe (Item 3) could have originated from the damaged front door of house # 2 (Item 2).
NNKMXG	The known paint sample representative of the damaged area of the front door of house #1 (Item 1), the known paint sample representative of the damaged area of the front door of house #2 (Item 2) and the questioned paint chips recovered from the shoe of the suspect (Item 3) are all two-layer paints: a red top coat and a white second coat. Item 3 was found to be consistent with respect to layer structure (stereomicroscope), color (microspectrophotometry) and chemical composition (FT-IR) with Item 2. Meanwhile, the red top coat in Item 3 was found to have a different chemical composition to the red top coat in Item 1. Therefore, it was concluded that the questioned paint chips recovered from the shoe of the suspect (Item 3) could have come from the damaged area of the front door of house #2 (Item 2).
PMR76K	The paint in Exhibit 3 could have originated from the same source as the paint in Exhibit 2. The paint in Exhibit 3 did not originate from the same source as the paint in Exhibit 1.
QGXDGF	Firstly all items was put on a clean white sheet paper. Color tones and layers of dyes were looked with stereomicroscope. Item-2 and item-3 are smoother and brilliant surface than item-1. After physical test, paints were analyzed with FTIR (Fourier Transform Infrared Spectroscopy) and solubility test. On conclusion item-2 and item-3 are identically, item-1 is differently.
QHABUF	1. Each of "Item 1" to "Item 3" was found to consist of two layers of architectural paint on a wooden substrate: a top red layer and a lower white layer. 2. The corresponding layers in "Item 2" and "Item 3" were compared with each other and found to be indistinguishable in

TABLE 3

WebCode	Conclusions
	terms of their layer sequence, color, texture and chemical composition, indicating that the 2 questioned paint chips from the suspect's shoe ("Item 3") could have originated from the damaged area of the front door of house #2 ("Item 2"), or from another source of paint with similar layer sequence, color, texture and chemical composition as "Item 2". 3. The red layers in "Item 1" and "Item 3" were found to be different in terms of color, texture and chemical composition, indicating that "Item 3" did not originate from the damaged area of the front door of house #1 ("Item 1").
QL9HJJ	The paint in Item 3 did not originate from the same area of the same paint source as the paint in Item 1. The paint in Item 3 could have originated from the same paint source as the paint in Item 2.
QWRZTH	Top layer (red layer) of item 3 is similar with item 2 (top layer), not item 1 (top layer) by FT-IR spectroscopy. Moreover, 2rd layer (white layer) of item 3 is similar with item 2 (2rd layer) and item 3 (2rd layer). [sic]
QYYEKG	Questioned paint chips recovered from the shoe of the suspect (Item #3) were two layer paint chips, which matched in colour, layer structure and chemical composition with Item #2, the known paint sample representative of the damaged area of the front door of house #2. Thus the questioned paint chips in Item #3 could share a common origin with the known paint sample, Item #2. Item #3 was inconsistent with the other known paint sample, Item #1.
RAXAGR	The paint from the suspect's shoe (item 3) consisted of a red paint layer on a white paint layer. The paint from the front door of house #1 (item 1) and house #2 (item 2) each consisted of a red paint layer on a white paint layer. The paint from the three items was compared visually and then chemically, using Fourier transform infrared spectroscopy. The red paint layer from house #1 had a different appearance and a different chemical composition to the paint found on the suspect's shoes. Therefore in my opinion, the paint on the suspect's shoe could not have come from the door of house #1. The paint on the suspect's shoe could not be excluded as having come from the front door of house #2 based on its visual appearance and chemical composition. The elemental compositions of these two samples of paint (items 2 and 3) were further compared using a scanning electron microscope with an energy dispersive x-ray detector. The sample of paint from the suspect's shoe could not be excluded as coming from the front door of house #2 based on its elemental composition. Therefore in my opinion, the paint on the suspect's shoe could have come from the front door of house #2 or from another source of this type of two-layered paint.
RNPBNH	The questioned paint chip from the shoe of the suspect (item 3) did not originate from the known paint sample from the damaged front door of house # 1 (item 1). The questioned paint chip from the shoe of the suspect (item 3) could have a common origin with the known paint sample from the damaged front door of house #2 (item 2).
TANYTJ	1) The known paint sample representative of the damaged area of the front door of house #1 (item 1), the known paint sample representative of the damaged area of the front door of house #2 (item 2), and questioned paint chips recovered from the shoe of the suspect (item 3), consist of a two layers paint system with the following layer structure: 1. red alkyd orthophthalic oil based paint (items 2 and 3) and red acrylic latex paint (item 1), and 2. White acrylic copolymerized with styrene-butadiene latex paint. This sequence exhibits typical characteristics of two layers of architectural paint. 2) The two layered paint chips in items 2 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. 3) The two layered paint chips in item 2 [sic] and 3 match in the physical and some microscopic properties studied, particularly in color and layer sequence, but don't

TABLE 3

WebCode	Conclusions
UG6UAE	<p>match regarding the chemical composition of layer 1 (red). It was concluded that the paint in these items don't have a common origin.</p> <p>All of items have 2 layer-coating on the wood. First layer has wine color and second layer has white color. After FT-IR analysis of each item's first layer (wine color), we found that item 2 and item 3 have same chemicals in the layer not item 1. Also, MSP showed that item 2 and item 3's first layer give almost same pattern in spectrum not item 1's first layer. All items' white layer showed that each FT-IR spectrum is same.</p>
UTEKVM	<p>The questioned paint from Item 3 corresponded to the Item 2 known paint in color and layer structure (red, white), general microscopic appearance (stereomicroscope and PLM), chemical composition (FTIR and PGCMS), visible spectra (MSP) and elemental composition (SEM-EDS). Therefore, these paints could have come from a common source (Type 3 Association). It should be noted that since similar items may have been manufactured which would be indistinguishable from the submitted evidence and[sic] individual source cannot be determined. The questioned paint from Item 3 was different in microscopic appearance (stereomicroscope) and chemical composition (FTIR) to the known paint in Item 1. Therefore, these paints can be eliminated as coming from a common source (Elimination). KEY for instrument acronyms: FTIR – Fourier Transform Infrared Spectroscopy. PGCMS – Pyrolysis Gas Chromatography Mass Spectrometry. PLM – Polarized Light Microscopy. MSP – Microspectrophotometry. SEM/EDS – Scanning Electron Microscopy/Energy Dispersive Spectroscopy. Interpretation: The following descriptions are meant to provide context to the opinions reached in this report. Every type of conclusion may not be applicable in every case or for every material type. Type 1 Association: Identification. An association in which items share individual characteristics and/or physically fit together that demonstrate the items were once from the same source. Type 2 Association: Highly likely. An association in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and share distinctive characteristic(s) that would not be expected to be found in the population of this evidence type. The distinctive characteristics were not sufficient for a Type 1 Association. Type 3 Association: Could have. An association in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and could have originated from the same source. Because it is possible for another sample to be indistinguishable from the submitted evidence, an individual source cannot be determined. Type 4 Association: Cannot eliminate. An association in which items correspond in some but possibly not all measured physical properties, chemical composition and/or microscopic characteristics and cannot be eliminated as coming from the same source. This type of evidence may be commonly encountered in the environment, may have limited comparative value and/or there may be factor(s) limiting the comparison. Inconclusive: No conclusion could be reached regarding an association between the items. Elimination: Items exhibit dissimilarities in one or more of the following: physical properties, chemical composition or microscopic characteristics and, therefore, conclusively did not originate from the same source. Non-Association: Items exhibit dissimilarities but certain details or features are not sufficient for an Elimination.</p>
VNXPKG	<p>1) The known paint sample representative of the damaged area of the front door of house #1 (item 1), the known paint sample representative of the damaged area of the front door of house #2 (item 2), and the questioned paint chips recovered from the shoe of the suspect (item 3) consist of a two layers paint system with the following layer structure: Items 1: red topcoat layer, acrylic lacquer; and white undercoat layer, acrylic latex. Items 2 and 3: red topcoat layer, alkyd enamel; and white undercoat layer, acrylic latex. 2) The two layered paint sample in item 1 and 3 match in the physical properties studied, particularly in color and layer sequence, but don't match regarding the chemical composition of red topcoat layer. It was</p>

TABLE 3

WebCode	Conclusions
W2JCDF	<p>concluded that the paint in these items don't have a common origin. 3) The two layered red 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 don't share a common origin depends on whether or not, the suspect could have obtained a paint transfer from another surface that presents the same layer sequence, same physical properties and chemical composition.</p> <p>CONCLUSIONS: The questioned paint recovered from the shoe of the suspect (Item 1C/CTS Item 3) did not originate from the area of the door of house #1 represented by Item 1A/CTS Item 1. The questioned paint recovered from the shoe of the suspect (Item 1C/CTS Item 3) is the same distinct type of paint as that on the door of house #2 (Item 1B/CTS Item 2) and either originated from that door, or from another source of architectural paint having the same distinct characteristics. RESULTS: The questioned paint from the shoe of the suspect (Item 1C/CTS Item 3) was examined for the purpose of determining whether or not it could have originated from either source represented by the known paint sample from the door of house #1 (Item 1A/CTS Item 1) or house #2 (Item 1B/CTS Item 2). The paint standard from the door of house #1 (Item 1A/CTS Item 1) has the following layer structure: 1. Dark red acrylic latex enamel topcoat; 2. White primer. This paint exhibits characteristics typical of an architectural paint and was used for comparison with the questioned paint recovered from the shoe of the suspect. The questioned paint recovered from the shoe of the suspect (Item 1C/CTS Item 3) has the following layer structure: 1. Dark red alkyd enamel topcoat; 2. White acrylic styrene enamel primer. Examination and comparison of the questioned paint (Item 1C/CTS Item 3) with Item 1A/CTS Item 1 revealed they are dissimilar with respect to the binder type of the red topcoats (layer one). It is therefore concluded that the questioned paint recovered from the shoe of the suspect (Item 1C/CTS Item 3) did not originate from the area of the door of house #1 represented by Item 1A/CTS Item 1. The paint standard from the door of house #2 (Item 1B/CTS Item 2) has the following layer structure: 1. Dark red alkyd enamel topcoat; 2. White acrylic styrene enamel primer. This paint exhibits characteristics typical of an architectural paint and was used for comparison with the questioned paint recovered from the suspect's shoe. Examination and comparison of the questioned paint (Item 1C/CTS Item 3) with Item 1B/CTS Item 2 revealed they are alike with respect to layer structure, layer colors, layer textures, micro chemical reactivity (solubility), binder characteristics, and pigment characteristics. It is therefore concluded that the questioned paint recovered from the shoe of the suspect (Item 1C/CTS Item 3) is the same distinct type of paint as that on the door of house #2 (Item 1B/CTS Item 2) and either originated either from that door, or from another source of architectural paint having the same distinct characteristics. METHODS OF ANALYSIS: Examinations were performed visually, by stereo microscopy, bright field/polarized light comparison microscopy, micro chemical tests, Fourier transform infrared micro spectroscopy, pyrolysis gas chromatography, pyrolysis gas chromatography/mass spectrometry, and scanning electron microscopy/energy dispersive x-ray analysis.</p>
W7UAYG	<p>The questioned red paint chips marked as Item 3, recovered from the shoe of the suspect, could have originated from the same source as the red paint sample marked as Item 2, collected from the damaged area of the front door of house #2, or another source of paint with similar characteristics. The questioned red paint chips marked as Item 3, recovered from the shoe of the suspect, did not originate from the same source as the red paint sample marked as Item 1, collected from the damaged area of the front door of house #1.</p>
WAXXMJ	<p>Examination of the paint samples in Submissions 1a, 1b and 1c revealed the following layer structure: red, white. The paint from Submission 1c was found to be different from the paint standard in Submission 1a with respect to tint and composition. Therefore, this paint in Submission 1c did not originate from the same source as the paint standard of Submission</p>

TABLE 3

WebCode	Conclusions
WBTJDP	<p>1a. The paint from Submission 1c was tested and found to correspond to the paint standard of Submission 1b with respect to color, tint, texture, layer structure, chemical solubility and composition. Therefore, this paint in Submission 1c is consistent with originating from the same source as the paint standard of Submission 1b or another source with these same characteristics. The evidence is available for pickup.</p> <p>The paint chips recovered from the shoe of the subject were compared to the known paint samples from the two houses to determine if they could have originated from either of the houses' damaged front doors. Item 1 consists of a block of apparent wood having the following layers of paint on its surface: 1. Medium red acrylic topcoat; 2. White acrylic-styrene undercoat. Item 2 consists of a block of apparent wood having the following layers of paint on its surface: 1. Medium red alkyd enamel topcoat; 2. White acrylic-styrene enamel undercoat. Samples of paint taken from these two items exhibit characteristics typical of architectural paint and were used as standards for comparison to the paint recovered from the shoe. Item 3 consists of two chips of an apparent wooden substrate having following layers of paint on their surfaces: 1. Medium red alkyd enamel topcoat; 2. White acrylic-styrene enamel undercoat. Samples of paint taken from these chips also exhibit characteristics typical of architectural paint. Microscopic, microchemical and instrumental examinations and comparisons revealed that the paint in Item 3 and the paint standard in Item 2 are like one another with respect to their layer sequence, layer colors and layer textures, as well as the microchemical reactivities, detailed binder characteristics and pigment characteristics of their respective layers. It is therefore concluded that the paint recovered from the subject's shoe in Item 3 could have originated from the damaged front door of house #2. Significant differences were observed between the medium red topcoats of Items 1 and 3 with respect to their microscopic characteristics and subsequently their binder types. It is therefore concluded that the paint recovered from the subject's shoe in Item 3 could not have originated from the damaged front door of house #1, as it is represented by the paint standard in Item 1.</p>
WHCTJD	<p>Item 1, 2 and 3 were found to be two-layered paint chips, each containing a top red layer and a second white layer. (a) The red layers of item 2 and 3 were found to be similar, but different from that of item 1 in terms of their chemical compositions. (b) Hence item 3 could have originated from the same source as item 2, or another source of paint with similar characteristics. Item 3 did not originate from the same source as item 1.</p>
WJ8EAJ	<p>The sample Item 3. is a two-layered paint. The morphology and chemical composition of the red paint layer of the sample Item 1. is different from the features of the red layer of the sample Item 3. The morphology and chemical composition of the layers of the sample Item 2. is equal to the features of the layers of the sample 3.</p>
WRHQBM	<p>Paint chips from the damaged areas of the front doors of house #1 and house #2 (Items 1 and 2, respectively), and from the suspect's shoe (Item 3), each comprised 2 paint layers consisting of a red topcoat and white undercoat, over what appeared to be a wooden substrate. The white undercoat from each of the items showed no significant differences one from the other, with respect to appearance and chemical composition. In addition, both the red topcoat and white undercoat from the paint chips recovered from the suspect's shoe (Item 3) showed no significant differences from the red topcoat and white undercoat, respectively, from the damaged area of the front door of house #2 (Item 2), in regard to appearance, chemical composition, colour and elemental composition. As a result, in my opinion, there is support for the contention that the paint chips recovered from the suspect's shoe (Item 3) may have originated from the damaged area of the front door of house #2 (Item 2). However, the red topcoat from the damaged area of the front door of house #1 (Item 1) showed significant differences in chemical composition from the red topcoat from both the damaged area of the</p>

TABLE 3

WebCode	Conclusions
	front door of house #2 (Item 2) and the paint chips from the suspect's shoe (Item 3). As a result, in my opinion, the paint chips from the suspect's shoe (Item 3) did not originate from the damaged area of the front door of house #1 (Item 1).
WTRWNC	Item 3 could not have originated from item 1 due to differences in chemical composition. Items 3 and 2 were consistent in color, layer sequence, physical and chemical properties. Item 3 could have originated from Item 2 or another source of paint with the same color, texture, and chemical composition.
X6G3BE	The paint from the suspect's shoe, item 3, could be conclusively excluded from having originated from the front door of house #1. The findings provide strong support for the proposition that Item 3 originated from the front door of house #2.
XL7A9C	The questioned paint chips from the shoe of the suspect (Item 3) could not come from the damaged area of the front door of house #1 (Item 1), but house #2 (Item 2).
XMZVZH	The Item 3 questioned paint chips recovered from the shoe of the suspect were examined and compared to the Item 1 known paint sample from house #1 and also to the Item 2 known paint sample from house #2. Based on the examinations conducted, Item 3 could not be differentiated from Item 2 in color, texture, layer structure, or chemical composition. Therefore, Item 3 originated from the location represented by Item 2 or from another location painted with the same sequence of paint (Type III Association). This type of association was assigned, because the items are only two-layered. However, it should be noted that color of the topcoat and the analytical techniques chosen provide for a very high degree of discrimination between architectural paint samples. Further, Item 3 differs from Item 1 in color and chemical composition. Therefore, the location as represented by Item 1 is not the source of Item 3 (Elimination).
XW3DC7	1.VISUAL AND MICROSCOPIC EXAMINATIONS-ITEM1, ITEM2 AND ITEM 3 ARE THE SOLID PAINT DISTINGUISHABLE IN THEIR APPEARANCE; ITEM1 HAVE DIFFERENT COLOR TONE FROM ITEM2 AND ITEM3. ITEM2 AND ITEM3 ARE SIMILAR AND DARKER THAN ITEM1 IN THE SAME LIGHT SOURCE. 2.CHEMICAL ANALYSIS AND COMPARISONS-ITEM1 ARE DISSIMILAR FROM ITEM2 AND ITEM3 IN FTIR AND RAMAN SPECTRA. XRF ANALYSIS ARE DETECTABLE SAME ELEMENTAL IN THE PAINT SAMPLES, THE RATIO ELEMENTALS OF ITEM2 IS SIMILAR TO ITEM3 BUT DIFFERENT FROM ITEM1. 3.CONCLUSIONS-ITEM3 COULD HAVE ORIGINATED FROM KNOWN PAINT SAMPLE ITEM2.
YCGU49	The question paint chips from the suspect's shoe (Item 3) are dissimilar in paint type to the paint standard from house #1 (Item 1). It is my opinion that these question paint chips could not have originated from house #1. Additionally, these question paint chips from the suspect's shoe (Item 3) are similar in visual color, layer sequence, paint type and paint composition to the paint standard from house #2 (Item 2). It is my opinion that these question paint chips could have originated from house #2 or any other source with the same characteristics.
YZKQYE	Lab Item 1 (1) - KNOWN PAINT FROM HOUSE #1: This item consisted of a two-layer architectural paint sample, a red layer on top of a white layer. The paint was examined and the binder systems were identified as follows: red layer: acrylic; white layer: styrene-butadiene. Lab Item 2 (2) - KNOWN PAINT FROM HOUSE #2: This item consisted of a two-layer architectural paint sample, a red layer on top of a white layer. The paint was examined and the binder systems were identified as follows: red layer: alkyd; white layer: styrene-butadiene. Lab Item 3 (3) - QUESTIONED PAINT FROM SUSPECT'S SHOE: This item consisted of a two-layer architectural paint sample, a red layer on top of a white layer. One of two visually similar paint chips was examined and the binder systems were identified as follows: red layer: alkyd; white layer: styrene-butadiene. Significant chemical differences were observed between

TABLE 3

WebCode	Conclusions
	<p>the red layer of Lab Item 1 and the red layer of Lab Item 3. Therefore, the Lab Item 3 paint did not come from the same source as the Lab Item 1 paint. This is an Elimination. The red and white layers of Lab Item 2 have indistinguishable physical, chemical, elemental, and microscopic characteristics from the red and white layers of Lab Item 3. Therefore, the Lab Item 3 paint could have come from the same source as the Lab Item 2 paint, or any other source of paint with indistinguishable physical, chemical, elemental, and microscopic characteristics. This is a Type III Association.</p>
ZD4RUC	<p>1. Comparative examinations of Item 3 (questioned paint chips recovered from the shoe of the suspect) with Item 1 (known paint sample representative of the damaged area of the front door of house #1) disclosed them to be dissimilar in their physical characteristics. As a result of these findings, the questioned paint chips submitted in Item 3 did not originate from the source for the known paint submitted as Item 1. 2. Comparative examinations of Item 3 (questioned paint chips recovered from the shoe of the suspect) with Item 2 (known paint sample representative of the damaged area of the front door of house #2) disclosed them to be consistent in their physical characteristics (texture, layer structure, and layer colors). In addition, these paints were found to be consistent in the organic and elemental composition of their red and white layers, respectively. Based on these results, the questioned paint chips in Item 3 originated from the source for the known paint sample in Item 2 or a source of paint with identical physical properties and composition.</p>
ZQBPU7	<p>It was found that Item 2 could have originated from Item 3, Item 1 could not have originated from Item 3.</p>

## Additional Comments

TABLE 4

WebCode	Additional Comments
63Q7P8	All paint samples found to have the following layer sequence: Red gloss top-coat ; white ; wood. Differences found between item 1 and item 3 in microscopic appearance, results of simple chemical tests, and results of chemical and elemental analysis.
88RC32	I would normally evaluate the match and give my conclusion of the strength of the match based on a scale: weak support, moderate support, moderately strong support, strong support, very strong support, extremely strong support
JJMEPQ	The controlled samples taken from doors #1 and #2 are representative of the paint on these doors.
JPRB9Q	The white layers in Paint samples 1, 2 and 3 were found to be similar in general characteristics and chemical properties to each other. However, differences were noted in the red layers of Samples 1 and 3.
QGXDGF	we have ignored the wood substrate.
TANYTJ	The possibility that the Item 2 and Item 3 don't share a common origin depends on whether or not, the suspect could have obtained a paint transfer from another door that presents the same layer sequence, same thickness, porosity, color and chemical composition. Especially considering that the paintings are finishing both samples are very commonly used in architectural finishes.
VNXPKG	At the moment we don't routinely received cases with that kind of samples in our laboratory. We work routinely with automotive paint chips. Sometimes we received tiny paint chips, lest[sic] than 2 mm, on the a tool surface for identification, but the problem is mix of different layers.
X6G3BE	Item 1 comprised one red acrylic layer and one white styrene modified acrylic layer. Item 2 comprised two identical red alkyd layers and one white styrene-acrylic layer that was similar to the white layer in item 1.
XMZVZH	A conclusion scale would be included in its entirety.



## **Appendix: Data Sheet**

Collaborative Testing Services ~ Forensic Testing Program

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### **Test No. 15-546: Paint Analysis**

DATA MUST BE RECEIVED BY November 23, 2015 TO BE INCLUDED IN THE REPORT

Participant Code:

WebCode:

#### **Accreditation Release Statement**

CTS submits external proficiency test data directly to ASCLD/LAB and ANAB. 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 ANAB.  
(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 ANAB.

#### Scenario:

Police are investigating a series of break-ins in a suburban neighborhood. A tool was used to pry open the front door, causing damage to the paint. The police investigation so far has led to a female suspect who was in possession of items similar to those taken from the houses. A warranted search of the suspect was conducted two days after the break-ins. It revealed red paint chips in her shoe that are similar in color to the front doors of two of the houses. A known paint sample has been collected from the damaged area of the front door of house #1 and house #2. Police are requesting that you examine the recovered paint chips and determine if they could have originated from the damaged area of either of the houses' front doors.

Please Note:

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

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

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

- Item 1: Known paint sample representative of the damaged area of the front door of house #1.
- Item 2: Known paint sample representative of the damaged area of the front door of house #2.
- Item 3: Questioned paint chips recovered from the shoe of the suspect.

#### **1.) Could the questioned paint chips from the shoe of the suspect (Item 3) have originated from either of the damaged front doors as represented by Items 1 or 2?**

- |                |                              |                             |                                       |
|----------------|------------------------------|-----------------------------|---------------------------------------|
| <b>Item 1:</b> | Yes <input type="checkbox"/> | No <input type="checkbox"/> | Inconclusive <input type="checkbox"/> |
| <b>Item 2:</b> | Yes <input type="checkbox"/> | No <input type="checkbox"/> | Inconclusive <input type="checkbox"/> |

**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**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Return Instructions:** Data must be received via online data entry, fax (please include a cover sheet), or mail by **November 23, 2015** to be included in the report. Emailed data sheets are not accepted.

QUESTIONS?

TEL: +1-571-434-1925 (8 am - 4:30 pm EST)

EMAIL: [forensics@cts-interlab.com](mailto:forensics@cts-interlab.com)

[www.ctsforensics.com](http://www.ctsforensics.com)

Participant Code:

ONLINE DATA ENTRY: [www.cts-portal.com](http://www.cts-portal.com)

FAX: +1-571-434-1937

MAIL: Collaborative Testing Services, Inc.

P.O. Box 650820

Sterling, VA 20165-0820 USA

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

## Collaborative Testing Services - Forensic Testing Program

**RELEASE OF DATA TO ACCREDITATION BODIES**

The following Accreditation Releases will apply only to:

Participant Code:

WebCode:

for Test No. **15-546: Paint Analysis**

This release page must be completed and received by **November 23, 2015** 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) \_\_\_\_\_

**ANAB RELEASE**

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

ANAB 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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