



## **Paint Analysis Test No. 17-545 Summary Report**

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This test was sent to 104 participants. Each sample set consisted of one item containing a "known" paint sample and two items containing "questioned" paint chips. Participants were requested to compare the items and report their findings. Data were returned from 82 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 set contained three items consisting of automotive paint samples. Item 1 was a known paint sample representative of the damaged area of the suspect's vehicle. Items 2 and 3 were sets of questioned paint chips recovered from the fire hydrant and stop sign, respectively. Participants were requested to examine the questioned paint chips and determine if either could have originated from the damaged area of the suspect's vehicle.

The paint samples in Items 1, 2, and 3 were prepared from the same automotive paint panel. The test panel was described by the supplier as a gray coil coated aluminum substrate panel with the following coating layering system applied to it: gray primer, Hydro Blue basecoat, and clear coat.

### **SAMPLE PREPARATION-**

The panel used for this test were inspected for defects, and the areas containing defects were not used.

ITEMS 1, 2 and 3 (ASSOCIATION): For the known Item 1, the paint panel was cut into approximately 1/2" x 1/2" wide pieces and one piece was packaged into a glassine bag and a pre-labeled Item 1 coin envelope. For the associated Item 2 and 3 samples, paint chips were cut into approximately 1/4" x 1/4" wide pieces. Two of these pieces were packaged into a glassine bag and then a pre-labeled coin envelope for each Item. This process was repeated until all of the Items were created. Items 1, 2, and 3 were taken in close spatial proximity to one another, within four inches, and were kept together as an identification group and packaged into the sample pack as described below.

SAMPLE SET ASSEMBLY: For each sample set, Items 1, 2, and 3 were placed in a pre-labeled envelope. The sample pack was 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 a piece of evidence tape and initialed "CTS".

VERIFICATION: The expected association results were confirmed by predistribution laboratories who used the following combined list of techniques: Stereomicroscopy, high power comparison microscopy, polarized light microscopy, FTIR, Pyrolysis GC, SEM/EDX, and microspectrophotometry.

June 27, 2017 - Revised to include additional information on the automotive paint panel.

## **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 automotive paint samples. Each test sample set consisted of one item containing a known paint sample (Item 1) and two items containing questioned paint chips (Items 2 and 3). The paint samples in Items 1, 2 and 3 were cut from the same automotive panel. (Refer to Manufacturer's Information for preparation details.)

Of the 82 participants that reported results in Table 1, 80 (97.6%) reported that the questioned paint chips in Item 2 and Item 3 could have originated from the same source as the known paint sample in Item 1. Of the remaining participants, one reported that Item 2 could not have originated from the same source as the known paint sample in Item 1, explaining in their conclusions that the chemical composition differed in layer 2. This participant reported the consensus result for the comparison of Item 3 with Item 1. The final participant reported the consensus result for the comparison of Item 2 with Item 1 and reported inconclusive in response to the comparison of Item 3 with Item 1. This participant noted a minor difference in the chemistries of the base coat layer between Item 1 and Item 3.

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

# Examination Results

*Could the questioned paint chips (Items 2 and/or 3) have originated from the damaged area of the suspect vehicle represented by Item 1?*

TABLE 1

<u>WebCode</u>	<u>Item 2</u>	<u>Item 3</u>	<u>WebCode</u>	<u>Item 2</u>	<u>Item 3</u>
2284FL	Yes	Yes	E8TFYW	Yes	Yes
39PUFL	Yes	Yes	EJAXVA	Yes	Yes
3FAVXK	Yes	Yes	ELETB7	Yes	Yes
3HBXML	Yes	Yes	FDFMUA	Yes	Yes
3HEFPQ	Yes	Yes	FE8L99	Yes	Yes
3TAUKG	Yes	Yes	FUMHTB	Yes	Yes
46KNDL	Yes	Yes	G2EGF3	Yes	Yes
4F6TPR	Yes	Yes	GL343B	Yes	Yes
4TRZMT	Yes	Yes	HAPXR9	Yes	Yes
63BXNH	Yes	Yes	HFG928	Yes	Yes
6B3EE8	Yes	Yes	HKPVB3	Yes	Yes
6QGKNK	Yes	Yes	HNLH26	Yes	Yes
72D68P	Yes	Yes	HNQWE7	Yes	Yes
7EKQVN	Yes	Yes	K4B3Z4	Yes	Yes
8ED7GJ	Yes	Yes	K733YZ	Yes	Yes
8G4ACC	Yes	Yes	KAJTZP	Yes	Yes
8PFL7N	Yes	Yes	KF8BJ8	Yes	Yes
8XTFGK	Yes	Yes	KQRGFB	Yes	Yes
998REE	Yes	Yes	LFPJ82	Yes	Yes
9M7VGK	Yes	Yes	LQKUF9	Yes	Yes
9NYUQC	Yes	Yes	LVDWJ9	Yes	Yes
9ZT3DL	Yes	Yes	MXXZR7	Yes	Yes
AB8JJX	Yes	Yes	NP2PRU	Yes	Yes
ABP96Y	Yes	Yes	NTJPAV	Yes	Yes
ACMJ3M	Yes	Yes	NUWLEZ	Yes	Yes
AFJB8D	Yes	Yes	NWKVQL	Yes	Yes
AHRMNE	Yes	Yes	P33LN2	Yes	Yes
BGCF6H	Yes	Yes	P6UJ3Z	Yes	Yes
CRQVMB	Yes	Yes	PA7K4X	Yes	Yes
CUR3MF	Yes	Inc	PJULGL	Yes	Yes

TABLE 1

WebCode	Item 2	Item 3	WebCode	Item 2	Item 3
PVLABZ	Yes	Yes			
QWYYFX	Yes	Yes			
RAT8AH	Yes	Yes			
RRXCXU	Yes	Yes			
RX39LZ	Yes	Yes			
TFX4V3	Yes	Yes			
TRC4NQ	Yes	Yes			
TW8T7H	No	Yes			
U39N4M	Yes	Yes			
U82TWR	Yes	Yes			
UFFE8G	Yes	Yes			
UKRF7T	Yes	Yes			
ULHJYZ	Yes	Yes			
W2MW6M	Yes	Yes			
W8CA9W	Yes	Yes			
WG3TPP	Yes	Yes			
WLWPCV	Yes	Yes			
WQ3MHE	Yes	Yes			
XCZECK	Yes	Yes			
YL6NGN	Yes	Yes			
YLL2KR	Yes	Yes			
ZN77WV	Yes	Yes			

Response Summary				
		Item 2	Item 3	
<b>Responses</b>	Yes	<b>81</b> (98.8%)	<b>81</b> (98.8%)	
	No	<b>1</b> (1.2%)	<b>0</b> (0 %)	
	Inc	<b>0</b> (0 %)	<b>1</b> (1.2%)	
<b>Participants: 82</b>				

# Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRF/XRF	SEM/EDX	Microspectrophotometry	Other
2284FL	✓	✓			✓	✓		✓		
39PUFL	✓				✓					
3FAVXK	✓				✓					Raman spectroscopy
3HBXML	✓				✓					
3HEFPQ	✓				✓		✓			PyGC/MS
3TAUKG	✓	✓	✓		✓		✓			
46KNDL	✓		✓		✓	✓	✓	✓		Cross sections
4F6TPR	✓				✓					
4TRZMT	✓				✓	✓	✓			digital microscope (photographing only)
63BXNH	✓	✓			✓		✓	✓		
6B3EE8	✓	✓			✓	✓				
6QGKNK	✓			✓	✓					Bevel cross-sections
72D68P	✓				✓	✓				Fluorescence
7EKQVN	✓				✓	✓		✓	✓	
8ED7GJ	✓				✓	✓				
8G4ACC	✓				✓	✓		✓		
8PFL7N	✓				✓			✓		
8XTFGK	✓				✓			✓		
998REE	✓		✓		✓			✓		
9M7VGK	✓	✓			✓	✓		✓		Pyrolysis GC/MS
9NYUQC	✓				✓					RAMAN
9ZT3DL	✓				✓					
AB8JJX	✓	✓	✓	✓	✓		✓	✓	✓	
ABP96Y	✓				✓			✓	✓	

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
ACMJ3M	✓			✓	✓					Raman spectroscopy
AFJB8D	✓		✓		✓			✓		
AHRMNE	✓	✓		✓	✓	✓	✓			Light box
BGCF6H	✓	✓	✓		✓			✓		Raman spectroscopy
CRQVMB	✓				✓					Raman Microscope
CUR3MF	✓				✓			✓		
E8TFYW	✓				✓			✓		
EJAXVA					✓			✓		
ELETB7	✓				✓			✓		
FDFMUA	✓	✓			✓			✓	✓	
FE8L99	✓	✓			✓	✓		✓		
FUMHTB	✓				✓			✓		Raman
G2EGF3	✓	✓			✓	✓				
GL343B	✓				✓	✓	✓			
HAPXR9	✓				✓			✓		RAMAN
HFG928	✓				✓					
HKPVB3	✓			✓	✓					
HNLH26	✓		✓		✓	✓				Pyrolysis GC/MS
HNQWE7	✓				✓					
K4B3Z4	✓				✓	✓				
K733YZ	✓				✓			✓		
KAJZP	✓	✓	✓		✓			✓	✓	Pyrolysis GC-MS
KF8BJ8	✓	✓		✓	✓			✓		
KQRGFB	✓				✓			✓		
LFPJ82	✓				✓					

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRSXRF	SEMEDX	Microspectrophotometry	Other
LQKUF9	✓				✓					
LVDWJ9	✓	✓		✓	✓					
MXZR7	✓			✓	✓			✓		
NP2PRU	✓	✓	✓		✓			✓	✓	
NTJPAV	✓	✓	✓		✓	✓				✓
NUWLEZ	✓	✓			✓				✓	Comparison Microscope
NWKVQL	✓	✓			✓			✓	✓	
P33LN2	✓		✓		✓	✓		✓		
P6UJ3Z	✓	✓		✓	✓	✓	✓	✓		
PA7K4X	✓		✓		✓	✓				Comparison Microscopy
PJULGL	✓	✓		✓	✓			✓		
PVLABZ	✓		✓		✓	✓		✓		
QWYYFX	✓					✓				
RAT8AH	✓				✓			✓		
RRXCXU	✓				✓			✓		RAMAN
RX39LZ	✓	✓		✓	✓			✓	✓	Comparison Microscopy
TFX4V3	✓				✓	✓	✓			
TRC4NQ	✓	✓			✓			✓	✓	Comparison microscope
TW8T7H	✓				✓			✓		
U39N4M	✓			✓	✓					high power comparison microscopy
U82TWR	✓	✓	✓		✓	✓				
UFFE8G	✓	✓			✓			✓		
UKRF7T	✓	✓	✓		✓					
ULHJYZ	✓				✓					
W2MW6M	✓				✓	✓		✓		



TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
W8CA9W	✓	✓	✓		✓			✓		
WG3TPP	✓				✓					
WLWPCV	✓	✓		✓	✓			✓		
WQ3MHE	✓	✓	✓		✓	✓		✓		
XCZECK	✓	✓	✓		✓			✓	✓	
YL6NGN	✓	✓	✓		✓	✓		✓		Comparison Microscope
YLL2KR	✓		✓	✓	✓			✓	✓	
ZN77WV	✓	✓		✓	✓			✓		Raman spectroscopy

Response Summary										
Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	
82	81	31	20	15	81	17	11	52	15	
Percent	99%	38%	24%	18%	99%	21%	13%	63%	18%	

# Conclusions

TABLE 3

WebCode	Conclusions
2284FL	Examination of Lab Items #1, 2, and 3 revealed the presence of blue paint chips with reflective flake and the following layer structure: Clear, Blue with Reflective Flake, and Dark Gray on a metal substrate. The blue paint chips collected from the fire hydrant (Lab Item #2) and the stop sign (Lab Item #3) were found to be physically and chemically consistent with the blue paint chip collected from the damaged area of suspect vehicle (Lab Item #1). Therefore, the blue paint chips from Lab Items #2 and 3 could have originated from the same source as the blue paint chip from Lab Item #1.
39PUFL	The three-layer paint sampled from items 1 (Known - damaged area of suspect vehicle), 2 (Questioned - fire hydrant), and 3 (Questioned - stop sign) were found to be similar in appearance (Stereomicroscope), color (comparison microscope), microscopic characteristics (compound microscope), and organic composition (FTIR). The damaged portion of the suspect vehicle (or another surface with a similar paint composition) cannot be excluded as a possible source of the paint found on the fire hydrant and the stop sign.
3FAVXK	No differences were found between all three layers of paint from Item 1, Item 2, Item 3 (using FTIR and Raman 514nm, 633nm, 785nm). It is highly possible that paint chips (Item 2 and Item 3) have originated from the damaged area of the suspect vehicle (Item 1).
3HBXML	Exhibit P1, Item 1 consisted of a blue three-layer paint sample. Microscopical examination revealed the following layer structure: clear coat / blue base coat with effect pigments / gray primer. Exhibit P1, Item 2 consisted of two blue three-layer paint chips. Microscopical examination revealed the following layer structure: clear coat / blue base coat with effect pigments / gray primer. Exhibit P1, Item 3 consisted of two blue three-layer paint chips. Microscopical examination revealed the following layer structure: clear coat / blue base coat with effect pigments / gray primer. The paint in exhibit P1, Item 2 demonstrates similar physical characteristics and chemical composition upon comparison to the paint in exhibit P1, Item 1. Accordingly, exhibit P1, Item 2 could have originated from the same source as exhibit P1, Item 1 or another source with the same physical characteristics and chemical composition. The paint in exhibit P1, Item 3 demonstrates similar physical characteristics and chemical composition upon comparison to the paint in exhibit P1, Item 1. Accordingly, exhibit P1, Item 3 could have originated from the same source as exhibit P1, Item 1 or another source with the same physical characteristics and chemical composition.
3HEFPQ	Physical and chemical examinations indicate that Items 1 through 3 are indistinguishable from one another. Therefore, Items 2 and 3 originated from the vehicle represented by Item 1 or from another vehicle painted in the same manner (Type III Association). This conclusion was reached because other vehicles produced at the same manufacturing plant, with the same specifications would have paint applied in the same manner, and would therefore also be indistinguishable. The following descriptions are meant to provide context to the conclusions reached in this report. Every type of conclusion may not be applicable in every case nor for every material. Type I Association: Physical/Fracture Match – The compared items exhibit physical features that demonstrate they were once part of the same object. Associations of Evidence with Class Characteristics: Class characteristics are physical and/or chemical properties that place an item within a particular group of items. Associations of class evidence can have varying degrees of significance. As the size of the class decreases, the significance of the association between items in that class increases. A class association does not definitively establish that the items came from the same source. Type II Association: Association with

TABLE 3

WebCode	Conclusions
	<p>atypical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Further, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III Association: Association with typical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV Association: Association with limited characteristics/examinations – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value as a result of items that are more commonly encountered in the relevant population, the inability to perform a complete analysis, or minor variations observed in the data. Inconclusive - No conclusion could be reached regarding an association or an elimination between the items. Elimination/Exclusion – The compared items exhibit differences in observed and/or measured properties and/or chemical composition that demonstrate they did not originate from the same source.</p>
3TAUKG	<p>The paint samples in Items 2 and 3 are each similar in color, layer sequence, and chemical composition to the paint sample in Item 1. Therefore, it was concluded that the paint samples in Items 2 and 3 either originated from the same source as the paint sample in Item 1, or from a different source painted in a similar manner.</p>
46KNDL	<p>The questioned paint chips recovered from the fire hydrant (Item 2) and the questioned paint chips recovered from the stop sign (Item 3) could have originated from the damaged area of suspect vehicle (Item 1) or from another source of the same paint and layer structure.</p>
4F6TPR	<p>The source of item 1 is included as a possible source of items 2 and 3, based on class characteristics.</p>
4TRZMT	<p>B) Examination Requested: 1. Comparison of paint samples. C)Methods Used: 1. Visual examination: Laboratory items #1, 2A, 2B, 3A, and 3B 2. Microscopic examination: Laboratory items #1, 2A, 2B, 3A, and 3B. 3. Layer structure determination: Laboratory items #1, 2A, and 3A. 4. Instrumental analysis: a. Fourier Transform Infrared Spectroscopy (FTIR): Laboratory items #1, 2A, and 3A. b. X-Ray Fluorescence Spectrometry (XRF): Laboratory items #1, 2A, and 3A. c. Scanning Electron Microscopy/Energy Dispersive Spectrometry (SEM/EDS): Laboratory items #1, 2A, and 3A. D) Results of examination: 1. Observed paint particles: a. Examination of Laboratory items #1, 2A, 2B, 3A, and 3B disclosed that all five particles appear to be blue metallic in color. 2. Layer Structure Determination: a. Microscopic examination of Laboratory items #1, 2A, and 3A disclosed the following layer structure: clearcoat (layer 1)/blue coat with silver colored metallic flakes (layer 2)/grey primer (layer 3) 3. Comparison Result: a. Laboratory items #1 and #2A are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. b. Laboratory items #1 and #3A are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. E) Interpretation of Results: 1. It is the opinion of the undersigned that Laboratory item #2A ("from the fire hydrant") could have originated from the same source as represented by the Laboratory item #1 (from "the suspect vehicle") or from</p>

TABLE 3

WebCode	Conclusions
	<p>another source exhibiting all of the same analyzed characteristics. 2. It is the opinion of the undersigned that Laboratory item #3A ("from the stop sign") could have originated from the same source as represented by the Laboratory item #1 (from "the suspect vehicle") or from another source exhibiting all of the same analyzed characteristics. 3. Laboratory items #2B and #3B were not analyzed further and no further conclusions can be reached about those items.</p>
63BXNH	<p>Paint comparisons were performed on the following items: Item 1: Known sample from suspect vehicle consisting of blue metallic effect automobile paint. Item 2: Questioned sample from fire hydrant consisting of blue metallic effect automobile paint. Item 3: Questioned sample from stop sign consisting of blue metallic effect automobile paint. The blue metallic effect paint sampled from Item #1 is similar in layer structure, chemical composition and color to the blue metallic effect paint sampled from Item #2. Therefore, the blue metallic effect paint sampled from Item #2 could originate from the same source as the blue metallic effect paint sampled from Item #1 (Type III association). The blue metallic effect paint sampled from Item #1 is similar in layer structure, chemical composition and color to the blue metallic effect paint sampled from Item #3. Therefore, the blue metallic effect paint sampled from Item #3 could originate from the same source as the blue metallic effect paint sampled from Item #1 (Type III association). Analysis was performed using light microscopy, Fourier Transform infrared spectroscopy, scanning electron microscopy with energy dispersive x-ray spectrometry and microspectrophotometry. The following descriptions are meant to provide context to the levels of opinions reached in this report. Every level of conclusion may not be applicable in every case nor for every material type: Type I Association: A physical match; the item physically fits together with the known sample meaning that they are pieces of the same source material. All measured properties are indistinguishable. Type II Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and share atypical characteristic(s) that would not be expected to be readily available in the population of this evidence type. Type III Association: An association 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 individual source cannot be determined. Type IV Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. As compared to a Level III association, items categorized within a Level IV share characteristics that are more common amongst these types of manufactured products. Alternatively, an association between items would be characterized as Level IV if limited analysis was performed due to the characteristics or size of the specimen(s). Type V Association: An association in which items are consistent in some, but not all, physical properties and/or chemical composition. Some minor variation(s) exist between the known and the questioned items and could be due to factors such as sample heterogeneity, contamination of the sample(s), or having a sample of insufficient size to adequately assess the homogeneity of the entity from which it was derived. Elimination: The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source. Inconclusive: No conclusion could be reached regarding and association/elimination between the items.</p>
6B3EE8	<p>Item #2 and Item #3 exhibit similar microscopic characteristics, chemical composition, and elemental composition to Item #1. Item #2 and Item #3 could have originated from the same source as Item #1.</p>

TABLE 3

WebCode	Conclusions
6QGKNK	<p>Item 1 - Known paint from suspect vehicle. This item was used for comparison purposes. Item 2 - Questioned paint chips from the fire hydrant. This item consists of royal blue with effect automotive paint chips which are similar in visual color to the known paint from the suspect vehicle (01-01-AA). A portion of the questioned paint chips were further analyzed and are similar in layer sequence, paint type, and paint composition to the known paint from the suspect vehicle. It is my opinion that the questioned paint chips could have come from the suspect vehicle or any other vehicle with similar paint characteristics (Category 2B). No analysis was performed on the remaining paint chips. Item 3 - Questioned paint chips from the stop sign. This item consists of royal blue with effect automotive paint chips which are similar in visual color to the known paint from the suspect vehicle (01-01-AA). A portion of the questioned paint chips were further analyzed and are similar in layer sequence, paint type, and paint composition to the known paint from the suspect vehicle. It is my opinion that the questioned paint chips could have come from the suspect vehicle or any other vehicle with similar paint characteristics (Category 2B). No analysis was performed on the remaining paint chips.</p>
72D68P	<p>The paint in items 2 and 3 is similar in color, layer structure, solubility, fluorescence and infra-red absorbance spectra to the paint in item 1. Therefore the paint in items 1, 2 and 3 could have originated from the same source.</p>
7EKQVN	<p>The known reference sample from the suspect's vehicle (Item #1) has the following layer structure: 1 – Clear Coat. 2 – Cerulean Blue Metallic Base Coat. 3 – Charcoal Grey Primer. The paint chips recovered from the fire hydrant (Item #2) have the following layer structure: 1 – Clear Coat. 2 – Cerulean Blue Metallic Base Coat. 3 – Charcoal Grey Primer. The paint chips recovered from the stop sign (Item #3) have the following layer structure: 1 – Clear Coat. 2 – Cerulean Blue Metallic Base Coat. 3 – Charcoal Grey Primer. One of the paint chips from Item #2 was analyzed and compared to Item #1. Based on the examinations conducted, the layers comprising the analyzed paint chip from Item #2 are comparable in color, texture, relative thickness, and chemical composition to the corresponding layers of Item #1. Accordingly, the analyzed paint chip from Item #2 and Item #1 originated from the same vehicle or from different vehicles painted in the same manner (Type III Association). This level of association was reached because vehicles produced at the same manufacturing plant as the source of Item #1, which were painted with the same color code and same paint formulations, would also be indistinguishable from the source of the analyzed paint chip from Item #2. One of the paint chips from Item #3 was analyzed and compared to Item #1. Based on the examinations conducted, the layers comprising the analyzed paint chip from Item #3 are comparable in color, texture, and relative thickness to the corresponding layers of Item #1, but have minor variations within their chemical composition. Accordingly, the analyzed paint chip from Item #3 and Item #1 could have originated from the same vehicle or from different vehicles painted in the same manner, and the minor chemical differences may be attributed to factors such as sample heterogeneity (Type V Association). This level of association was reached because vehicles produced at the same manufacturing plant as the source of Item #1, which were painted with the same color code and same paint formulations, would also be indistinguishable from the source of the analyzed paint chip from Item #3.</p>
8ED7GJ	<p>Exhibit 1 is chemically and elementally consistent with both Exhibit 2 and Exhibit 3; therefore the suspect vehicle as represented by Exhibit 1 could be the source of the paint recovered from the fire hydrant (Exhibit 2) and the stop sign (Exhibit 3). Alternatively, a different object painted with the same three-layer paint system could be the source.</p>

TABLE 3

WebCode	Conclusions
8G4ACC	Known paint (Item 1), reportedly from the suspect vehicle was found to be consistent with the questioned paint (Items 2 and 3) reportedly from the fire hydrant and stop sign respectively with respect to color, texture, layer sequence, chemical and physical properties and composition. Based upon these observations, it is the opinion of this analyst that the known paint (Item 1) and the questioned paint (Items 2 and 3) are of the same type and could have a common origin. This analyst recognizes that other sources of paint with properties consistent with the above paint exist.
8PFL7N	Item 1 was composed of a clear top coat, a blue pigmented layer and a gray black primer on a metal substrate. Items 2 and 3 were consistent in color and appearance with item 1. Cross sections of Items 1, 2 and 3 were similar in size and appearance. FTIR spectra of the clear coat and the blue pigmented layer in all three samples were consistent with acrylic melamine polymer. No significant differences were observed in the three samples. The EDS analysis of the clear coat from each sample indicated that they were composed of carbon and oxygen with minor nitrogen and trace amounts of aluminum and silicon. The EDS analysis of the blue pigmented layer in each sample showed major amounts of carbon and oxygen, minor nitrogen, minor to trace copper and aluminum-rich flakes. No elemental differences were observed in the samples. Items 2 and 3 were consistent with Item 1 and Item 1 is a possible source for Items 2 and 3.
8XTFGK	Microscopic examination of the paint in Items 1, 2, and 3 revealed a three-layered paint system consisting of a clearcoat, a blue metallic basecoat, and a gray primer. Microscopic and instrumental analysis and comparison of Item 2 (paint recovered from fire hydrant) and Item 3 (paint recovered from stop sign) to Item 1 (paint from suspect's vehicle) revealed them to be consistent with respect to color, texture, type, layering sequence, binder composition, and pigment composition. Therefore, the paint recovered from the fire hydrant and the paint recovered from the stop sign came from the area of the vehicle represented by the paint from the suspect's vehicle or another vehicle with the same paint history.
998REE	The compositions of Items 2 and 3 are consistent with the composition of Item 1.
9M7VGK	The paint in Item 2 is similar in color, layer sequence, and chemical composition to the paint in Item 1; therefore, the paint in Item 2 could have originated from the same area as the paint in Item 1. The paint in Item 3 is similar in color, layer sequence, and chemical composition to the paint in Item 1; therefore, the paint in Item 3 could have originated from the same area as the paint in Item 1.
9NYUQC	In the limit of our analytical techniques, the Item n° 2 and n° 3 are both indistinguishable from the Item n° 1. To conclude, Items n° 2 and n° 3 could be originated from the car on which Item n° 1 has been sampled.
9ZT3DL	[No Conclusions Reported.]
AB8JJX	The paint flakes in Item 2 and Item 3 were in very good agreement with the known sample, Item 1, in all aspects tested. I would not expect to find paint in this colour and with this number of layers on an item selected at random and hence consider the findings to be far more probable if the paint flakes from the fire hydrant and stop sign originated from the vehicle in question rather than another unknown source.

TABLE 3

WebCode	Conclusions
ABP96Y	<p>Examination of the paint chip recovered from the damaged area of the vehicle (Item 1): Item 1 comprised a paint sample with layer sequence: clearcoat/blue metallic topcoat/grey undercoat. The clearcoat was identified as an acrylic/melamine type paint. The inorganic elemental composition of the clearcoat principally comprised silicon and sulfur. The blue topcoat was identified as an acrylic/melamine type paint containing aluminium flake. The inorganic elemental composition of the topcoat principally comprised aluminium, copper, sulfur, phosphorous and chlorine. The grey undercoat was identified as an isophthalic alkyd/melamine type paint. The inorganic elemental composition of the light grey layer principally comprised titanium, silicon, aluminium and iron. Examination of the paint chip recovered from the fire hydrant (Item 2): Item 2 comprised a paint sample with layer sequence: clearcoat/blue metallic topcoat/grey undercoat. The layer colour, layer sequence and composition of Item 2 was found to correspond with Item 1. Therefore the results support the proposition that the paint recovered from the fire hydrant (Item 2) originated from the damaged area of the vehicle (Item 1). Examination of the paint chip recovered from the stop sign (Item 3): Item 3 comprised a paint sample with layer sequence: clearcoat/blue metallic topcoat/grey undercoat. The layer colour, layer sequence and composition of Item 3 was found to correspond with Item 1. Therefore the results support the proposition that the paint recovered from the stop sign (Item 3) originated from the damaged area of the vehicle (Item 1).</p>
ACMJ3M	<p>Each layer of all items shows exactly same pattern in FT-IR, Pyro-GC/MS and Raman spectroscopy, respectively. Therefore, all paint chips are same.</p>
AFJB8D	<p>The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show the same paint layers: clearcoat, blue effect basecoat and a dark-grey layer. All samples cannot be differentiated by means of microscopy, infrared spectroscopy and by their elemental composition. Regarding to the methods used, the questioned paint chips from the fire hydrant (Item 2) and from the stop sign (Item 3) could have originated from the damaged area of suspect vehicle.</p>
AHRMNE	<p>1. Examinations of Exhibit 1 (known paint from damaged area of suspect vehicle), Exhibit 2 (questioned paint chips recovered from the fire hydrant), and Exhibit 3 (questioned paint chips recovered from the stop sign) disclosed the presence of a three-layer paint system with the following color and layer sequence: clear coat/metallic blue/gray primer. 2. Comparative examinations of Exhibit 1 with Exhibit 2 and Exhibit 3 disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, Exhibits 2 and 3 could have originated from Exhibit 1 or another source with the exact same characteristics. 3. Instrumentation used for analysis was microscopy, x-ray micro fluorescence, pyrolysis gas chromatography-mass spectrometry, scanning electron microscopy electron dispersive spectroscopy and Fourier transform infrared spectroscopy. 4. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.</p>
BGCF6H	<p>The paint layers of Item 1. have the same optical, morphological, chemical and elemental features as Item 2. and Item 3.</p>
CRQVMB	<p>1. Visual and microscopic examinations – Item 1, Item 2 and Item 3 are the metallic paint distinguishable in their appearance; microscope examinations all three Items have similar in physical appearance. 2. Chemical analysis and comparisons – The paint compositions (binder and pigment) of Item 2 and 3 are same type with Item 1 in FTIR and Raman technique</p>

TABLE 3

WebCode	Conclusions
	respectively. 3. Conclusions – Item 2 and 3 could have originated from known paint sample Item 1.
CUR3MF	Each paint system represented by Items #1, #2A, and #3B consisted of three layers: a clear coat; a blue base coat with decorative flake, and a white primer coat of approximately the same thicknesses. The comparison of the chemistries of the layers represented by Items #1 and #2A are not distinguishable from each other. The item #2A paint system could have originated from a source represented by Item #1. There is a minor difference in the chemistries of the base coat layers in Items #1 and #3B. It is inconclusive that the source of the Item #3B paint sample could have originated from a source represented by Item #1.
E8TFYW	The paint chips recovered from the fire hydrant in Item 2 and from the stop sign in Item 3, and the known paint sample from the suspect vehicle in Item 1, each comprised of four layers, viz., Layer 1 - colourless; Layer 2 - blue metallic; Layer 3 - grey and Layer 4 - metal substrate. Items 2 and 3 were found to agree with each other, as well as with Item 1, pertaining to colours, chemical compositions of the constitute paint layers, and their sequence, indicating that Items 2 and 3 could have originated from the same source as Item 1.
EJAXVA	Both questioned paint chips (#2 and #3) match the known source (#1) for clearcoat, color coat and primer layers. No differences were observed between all three samples.
ELETB7	On analysis, I found the questioned paint chips Item 2 and Item 3 to be similar to the known paint sample Item 1. Therefore, I am of the opinion that the questioned paint chips Item 2 and Item 3 could have originated from the same source as the known paint sample Item 1.
FDFMUA	Items 2 and 3 originated from the same source as Item 1 or a source with similar characteristics.
FE8L99	Items 1, 2, and 3 are blue metallic automotive paint on a metal substrate. There are three layers of paint on the metal substrate from Items 1, 2, and 3: a clear coat, a blue metallic color coat, and a gray primer. The blue metallic paint chips from Items 2 and 3 are similar in color, physical characteristics, and chemistry to the blue metallic paint from the standard, Item 1. The paint from Items 2 and 3 could have come from Item 1 or any other blue metallic automotive paint source that is similar in color, physical characteristics, and chemistry. 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.
FUMHTB	item 1, item 2 and item 3 consisted of the same original binder system and same elemental composition. no chemical distinction could be made between item 1, item 2 and item 3. Therefore item 2 and item 3 could have originated from item 1.
G2EGF3	The paint samples from items 2 and 3 are similar in all examined characteristics to the paint sample from item 1. Therefore, the paint from the fire hydrant (item 2) and the paint from the stop sign (item 3) could have originated from the damaged area of the suspect vehicle (item 1) or another vehicle of similar manufacture.
GL343B	Questioned paint samples Q1A and Q2A (laboratory item#s 2 and 3 respectively) and known paint K (laboratory item 1) are consistent and no discriminating differences were observed with



TABLE 3

WebCode	Conclusions
	respect to their color, texture, layer structure, chemical type, and elemental composition. It is the opinion of the undersigned that questioned paint samples Q1A (laboratory item # 2) and Q2A (laboratory item # 3) could have originated from the same source as represented by the known submitted paint exemplar K (laboratory item # 1) or from another source exhibiting all of the same analyzed characteristics.
HAPXR9	Items 2 and 3 were physically and chemically comparable to Item 1 and could therefore have originated from the same source as Item 1.
HFG928	The infrared spectra of the grey primer, blue mid-coat, and translucent topcoat were all similar and could be considered the same paint.
HKPVB3	The questioned paint chips (Item 2), the questioned paint chips (Item 3) and the known paint sample (Item 1) are each composed of three paint layers. Each of the three layers in the questioned paint chips (Item 2) and the questioned paint chips (Item 3) cannot be distinguished from the corresponding layers in the known paint sample (Item 1). Therefore, the questioned paint chips recovered from the fire hydrant (Item 2) and the questioned paint chips recovered from the stop sign (Item 3) could have come from the damaged area of suspect vehicle (Item 1).
HNLH26	Paint Analysis and Comparison: Comparative examinations of the Questioned paint from the fire hydrant (Item #2) and the stop sign (Item #3) to the Known paint from the suspect vehicle (Item #1) gave consistent microscopic, chemical and instrumental (Fourier Transform InfraRed, Pyrolysis Gas Chromatography/Mass Selective Detection) results. Therefore, in the opinion of this examiner, Items #2 and #3 could have originated from the source represented by the Known submitted exemplar (Item #1) or from another source exhibiting all the same analyzed characteristics.
HNQWE7	Item 2, Questioned paint chips recovered from the fire hydrant, could have originated from the same source as Item 1, Known paint sample representative of the damaged area of suspect vehicle. Item 3, Questioned paint chips recovered from the stop sign, could have originated from the same source as Item 1, Known paint sample representative of the damaged area of suspect vehicle.
K4B3Z4	On analysis, I found that the questioned paint chips recovered from the fire hydrant (Item 2) and the questioned paint chips recovered from the stop sign (Item 3) to be similar to known paint sample representative of the damaged area of suspect vehicle (Item 1). Hence, I am of the opinion that the questioned paint chips recovered from the fire hydrant (Item 2) and the questioned paint chips recovered from the stop sign (Item 3) could have originated from the damaged area of the suspect vehicle (Item 1).
K733YZ	The questioned blue paint fragments from the exhibit "Item 2" recovered from the fire hydrant, and the questioned blue paint fragments from the exhibit "Item 3" recovered from the stop sign, could have originated from the same source as the known blue paint fragment "Item 1" collected from the damaged area of the suspect vehicle, or another source of paint with similar characteristics.
KAJTZP	The known paint sample (Item 001-1) recovered from the damaged area of the suspect's vehicle was similar to the questioned paint sample (Item 001-2) recovered from the fire hydrant and to the questioned paint sample (Item 001-3) recovered from the stop sign.

TABLE 3

WebCode	Conclusions
	Therefore, both of the questioned paint samples (Items 001-2 and 001-3) could have come from the damaged area of the suspect's vehicle (Item 001-1) or from another source of paint with the same physical and chemical characteristics.
KF8BJ8	The paint in Items 2 and 3 is similar in color, layer sequence, and chemical composition to the paint in Item 1. The paint in Items 2 and 3 could have originated from the immediate vicinity of the same source as the paint in Item 1.
KQRGFB	The questioned paint chips (Items 2 and 3) may have been originated from the damaged area of the suspect vehicle represented by Item 1
LFPJ82	The paint recovered from the suspect car and the questioned paint chips recovered (item 2&3) could be related and can come from the same source, or the source of all paints can be cars manufactured and painted at the same factory plant.
LQKUF9	[No Conclusions Reported.]
LVDWJ9	Items 2 and 3 are consistent with Item 1
MXXZR7	Items 2 and 3 are similar in color, layer sequence, and chemical composition to Item 1; therefore, the paint chips in Items 2 and 3 could have originated from the same source as the paint in Item 1.
NP2PRU	Questioned multiple-layer paint chips recovered from the fire hydrant (Item 2) and recovered from the stop sign (Item 3) were compared to known multiple-layer paint chips from the vehicle (Item 1) using microscopy, fluorescence, infrared spectroscopy, microspectrophotometry (MSP), and scanning electron microscopy - energy dispersive spectroscopy (SEM-EDS). Each item consisted of three layers of paint over a metal substrate: clear over blue metallic over gray. Each layer of questioned paint from Item 2 and from Item 3 was similar in all tests performed to the respective layer of known paint from Item 1. The questioned paint from the fire hydrant and the questioned paint from the stop sign originated from either the vehicle represented by Item 1 or another source of paint with similar characteristics.
NTJPAV	Items 2 and 3 could have originated from the damaged area of the suspect vehicle as represented by item 1, or another vehicle having a similar layer sequence and chemistry.
NUWLEZ	Portions of one of the blue paint chips from the questioned paint chips recovered from the fire hydrant (Item 1-2) were examined microscopically and analyzed instrumentally and were found to be consistent in color, sequence of layers, microscopic appearance and instrumental properties with the examined portions of the blue paint chip from the known paint sample representative of the damaged area of the suspect vehicle (Item 1-1). Accordingly, the examined portions of the blue paint chip from the questioned paint chips recovered from the fire hydrant could have originated from the examined portions of the blue paint chip from the known paint sample representative of the damaged area of the suspect vehicle or from another damaged source with similar characteristics. Portions of one of the blue paint chips from the questioned paint chips recovered from the stop sign (Item 1-3) were examined microscopically and analyzed instrumentally and were found to be consistent in color, sequence of layers, microscopic appearance and instrumental properties with the examined portions of the blue paint chip from the known paint sample representative of the damaged

TABLE 3

WebCode	Conclusions
	area of the suspect vehicle (Item 1-1). Accordingly, the examined portions of the blue paint chip from the questioned paint chips recovered from the stop sign could have originated from the examined portions of the blue paint chip from the known paint sample representative of the damaged area of the suspect vehicle or from another damaged source with similar characteristics.
NWKVQL	Items 1, 2 and 3 are each three-layer paint systems. The paint chips recovered from the fire hydrant (item 2) and the stop sign (item 3) exhibit the same physical and chemical properties as the known paint sample representative of the damaged area of suspect vehicle (item 1). Therefore, the paint chips recovered from the fire hydrant and the stop sign could have originated from the suspect vehicle or another source exhibiting the same physical and chemical properties.
P33LN2	Items 1, 2, and 3 were examined using stereomicroscopy, compound microscopy, fluorescence microscopy, Fourier Transform Infrared Spectrophotometry (FTIR), microsolubility tests, microchemical tests, and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The three-layered blue paint particles with decorative flake in Items 1, 2, and 3 were consistent in colors, textures, types, layer sequence, and chemical compositions. It was concluded that the paints in Items 1, 2, and 3 either originated from the same source or different sources painted in the same manner.
P6UJ3Z	The questioned paint recovered from the fire hydrant (CTS Item 2) is the same distinct type of paint as the known paint on the subject's vehicle (CTS Item 1) and originated either from that vehicle or from another source of automotive paint having the same distinct characteristics. The questioned paint recovered from the stop sign (CTS Item 3) is the same distinct type of paint as the known paint on the subject's vehicle (CTS Item 1) and originated either from that vehicle or from another source of automotive paint having the same distinct characteristics.
PA7K4X	Paint samples from the fire hydrant (Item 2) and stop sign (Item 3) are similar to the paint from the vehicle (Item 1). Therefore, Items 2 and 3 could have come from the vehicle or other source of similar paint.
PJULGL	The suspect vehicle (as represented by item 1) cannot be excluded as a possible source of the paints recovered from the fire hydrant (item 2) and stop sign (item 3). The paints recovered from the fire hydrant and stop sign (items 2 and 3, respectively) either came from the suspect vehicle or from another source of damaged paint indistinguishable in colour, layer sequence, microscopic appearance and chemical composition. Other sources of indistinguishable paint would include vehicles manufactured at the same plant when this paint formulation was in use.
PVLABZ	Items 1, 2 and 3 were examined visually and using stereomicroscopy, fluorescence microscopy, microsolubility tests, microchemical tests, Fourier Transform Infrared Spectrophotometry (FTIR) and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The multilayered blue paint particles with decorative flake in Items 1, 2 and 3 were consistent in colors, textures, types, layer sequence, and chemical compositions. It was concluded that the paints in Items 1, 2 and 3 either originated from the same source or different sources painted in the same manner.
QWYYFX	The questioned paint chips recovered from the fire hydrant (Item 2) and the stop sign (Item 3) was found to be physically and chemically consistent with the paint sample from the damaged

TABLE 3

WebCode	Conclusions
	area of the suspect vehicle (Item 1). Therefore the questioned paint chips (Items 2 and 3) could have originated from the damaged area of the suspect vehicle represented by Item 1.
RAT8AH	Results and Interpretations: No significant differences were observed between the paint sample from the suspect vehicle and the paint chips recovered from the fire hydrant and the stop sign. Therefore, the paint chips from the fire hydrant and the stop sign may have come from the suspect vehicle or a similarly painted vehicle.
RRXCXU	3) Microscopic analysis conducted on the three items revealed that the three items are similar in their layer structure and layer colours. Each item consists of paint with three layers: a grey layer, a metallic blue layer and a colorless layer. The organic analysis (FTIR) made upon grey, blue and and colorless layers of the three items, showed no differences among the three items. The pigment analysis (RAMAN) made upon grey, blue and and colorless layers of the three items showed no differences. The inorganic analysis (SEM-EDX) made upon the three layers of the three items showed no differences. According to the microscopic and analytical results, questioned paint chips recovered from the fire hydrant and from the stop sign were undistinguishable in colour, pigment, organic and inorganic composition from sample recovered on the damaged area of the suspect vehicle. Therefore, it can't be excluded that samples recovered from the fire hydrant and from the stop sign come from the the suspect vehicle.
RX39LZ	The Item 1.1 known paint sample representative of the damaged area of suspect vehicle is a three-layer paint consisting of a clear coat, blue metallic color coat, and gray primer. The Item 1.1 known paint was compared to the Items 1.2 questioned paint chips recovered from the firehydrant and 1.3 questioned paint chips recovered from the stop sign. The Item 1.2 questioned paint from the fire hydrant is a three-layer paint consisting of a clear coat, blue metallic color coat, and gray primer. The three layers present in the 1.2 questioned paint are similar in color, layer structure, and chemical composition to their respective layers in the Item 1.1 known paint. Therefore, the 1.2 questioned paint could have originated from the 1.1 known paint or another source with the same color, layer structure, and chemical composition. This is a Class III association as described in the Association Scale included in this report [Association Scale not submitted]. The Item 1.3 questioned paint from the stop sign is a three-layer paint consisting of a clear coat, blue metallic color coat, and gray primer. The three layers present in the 1.3 questioned paint are similar in color, layer structure, and chemical composition to their respective layers in the Item 1.1 known paint. Therefore, the 1.3 questioned paint could have originated from the 1.1 known paint or another source with the same color, layer structure, and chemical composition. This is a Class III association as described in the Association Scale included in this report [Association Scale not submitted].
TFX4V3	Questioned paint Q1A (from item #2) and known paint K1 (item #1) are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. Questioned paint Q2A (from item #3) and known paint K1 (item #1) 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 questioned paints Q1A and Q2A could have originated from the same source as represented by the known submitted exemplar, K1, or from another source exhibiting all of the same analyzed characteristics.
TRC4NQ	Items 2 and 3 could have originated from Item 1 as represented by the known submitted exemplar or from another source of paint exhibiting all of the same analyzed/measured

TABLE 3

WebCode	Conclusions
	characteristics.
TW8T7H	FTIR (instrumental) analysis and comparison of layer 2 from #1-1Z1 and #1-2Z1A disclosed differences in chemical composition. Microscopic examination and instrumental analysis (FTIR and SEM/EDS) disclosed that the known paint #1-1Z1 from submission #1-1 (damaged area of suspect vehicle) is similar in color, texture, layer structure, chemical type and elemental composition to the questioned paint sample #1-3Z1A from submission #1-3 (stop sign).
U39N4M	Items 1 - 3 are consistent in color, appearance, layer sequence and chemical composition. The questioned paint chips recovered from the fire hydrant (item 2) and from the stop sign (item 3) could have originated from the damaged area of suspect vehicle (item 1) or from another damaged vehicle with paint exhibiting all of the same analyzed/measured characteristics.
U82TWR	Item #1 - Contains a Known paint chip exhibiting the following layer structure: 1. clear coat top coat, 2. medium blue metallic color coat, 3. medium gray primer. Item #2 - contains questioned paint chips (2) exhibiting the following layer structure: 1. clear coat top coat, 2. medium blue metallic color coat, 3. medium gray primer. Item #3 - contains questioned paint chips (2) exhibiting the following layer structure: 1. clear coat top coat, 2. medium blue metallic color coat, 3. medium gray primer. Microscopic and instrumental analysis (micro FTIR) of Items #1, 2, and 3 disclosed that they are consistent with respect to color, texture, type, and layer structure. Therefore the questioned paint chips (items #2 and #3) could have originated from the source represented by the Known paint (item #1) or from another vehicle with a painted surface exhibiting the same characteristics (color, texture, type, and layer structure).
UFFE8G	Items 2 and 3 were examined to determine if they are consistent with and could have originated from Item 1. Items 1, 2 and 3 were compared visually, stereoscopically, microscopically and instrumentally. A Wild stereoscope, a Zeiss polarizing microscope, a Perkin Elmer FT-IR microscope and an ASPEX scanning electron microscope with energy dispersive X-ray analyzer were used to perform these analyses. Item 2 and Item 3 are consistent in color, layer structure, and chemical composition to Item 1. This analyst concludes that material from Item 2 and Item 3 could have originated from Item 1 or a source of similar origin. After completion of the examination, the evidence was repackaged and placed in storage. If further analysis is required please contact the laboratory at the below listed number.
UKRF7T	In my opinion, my findings provide very strong support for the proposition that the paint chips recovered from both the fire hydrant (represented by item 2) and the stop sign (represented by item 3), originated from the damaged area of the suspect vehicle (represented by item 1).
ULHJYZ	All items are consisted with clear-top, blue-metallic-middle and gray-bottom layer. Each layer of all items show exactly same pattern in FT-IR spectrum, respectively. So, all paint chips are same.
W2MW6M	The paint fragments examined from Item #1, Item #2, and Item #3 were alike with respect to their color, texture, layer structure, chemical solubilities, inorganic composition, and organic composition. It was concluded that the paint from Item #2 and Item #3 could have had a common origin with the paint from Item #1 or another source painted in the same manner.
W8CA9W	Item 2, the paint sample labeled "questioned paint chips recovered from the fire hydrant" is a

TABLE 3

WebCode	Conclusions
	blue, three-layer, decorative flake paint sample. Item 2, the paint sample labeled "questioned paint chips recovered from the fire hydrant" is consistent in physical characteristics, chemical composition, and elemental composition as compared to item 1, the paint sample labeled "known paint sample representative of the damaged area of suspect vehicle". Level III association. Item 3, the paint sample labeled "questioned paint chips recovered from the stop sign" is a blue, three-layer, decorative flake paint sample. Item 3, the paint sample labeled "questioned paint chips recovered from the stop sign" is consistent in physical characteristics, chemical composition, and elemental composition as compared to item 1, the paint sample labeled "known paint sample representative of the damaged area of suspect vehicle". Level III association.
WG3TPP	On analysis, I found that Item 2 and Item 3 were similar to Item 1.
WLWPCV	For Items 1, 2, 3: Paint with layer structure of clear/ turquoise-blue reflective/ grey was observed. Item 1: This paint was used for comparison purposes. Items 2 + 3: This paint was similar in color and chemical composition to Item 1, therefore, it could have originated from the same source.
WQ3MHE	The questioned paint chips, Items 2 and 3, could have originated from the damaged area of the suspect vehicle, represented by Item 1, or from another vehicle bearing similar paint.
XCZECK	The known blue paint (Item 1) was observed to have a layering system of clear over metallic blue over gray. Each of the questioned blue paint chips (Items 2 and 3) were observed to have similar layering systems to the known. Samples of each layer of all three items were analyzed and compared by polarized light microscopy, fluorescence microscopy, infrared spectroscopy, and scanning electron microscopy/energy dispersive spectroscopy. Additionally, the metallic blue layer of each item was analyzed and compared by microspectrophotometry. Each layer of questioned paint was similar in all examinations performed to the respective layer of known paint; therefore, Items 2 and 3 could have originated from the vehicle as represented by Item 1 (Level 3 - Association). Because similar items have been manufactured that would be indistinguishable from the submitted evidence, an individual source cannot be determined.
YL6NGN	Examination of Item #1 revealed the presence of a piece of metal painted blue reflective. The blue reflective paint had the following layer structure: clear, blue reflective and dark gray. Examination of Items #2 and #3 each revealed the presence of two pieces of metal painted blue reflective. The blue reflective paint had the following layer structure: clear, blue reflective and dark gray. The blue reflective paint from Items #2 and #3 was found to be physically and chemically consistent with the blue reflective paint from Item #1. Therefore, the blue reflective paint from Items #2 and #3 could have originated from the same source as the blue reflective paint in Item #1.
YLL2KR	The paint chips in item 2 (recovered from fire hydrant) and item 3 (recovered from stop sign) were visually, microscopically and instrumentally consistent with the known paint sample in item 1. This indicates that the paints in items 1, 2 and 3 could share a common origin.
ZN77WV	The known paint sample representative of the damaged area of suspect vehicle (Item 1), the questioned paint chips recovered from the fire hydrant (Item 2) and the questioned paint chips recovered from the stop sign (Item 3) show the same layers with clearcoat, metallic blue layer and grey layer. All layers of all samples were analyzed by stereomicroscopy, Fourier transform-infrared spectroscopy, raman spectroscopy and scanning electron

TABLE 3

WebCode	Conclusions
	microscopy-energy-dispersive X-ray spectroscopy. All layers from each Item 2 and 3 can not be differentiated from Item 3. Accordingly, the questioned paint samples such as Item 2 and 3 could have originated from the suspect vehicle (Item 1).

# Additional Comments

TABLE 4

WebCode	Additional Comments
39PUFL	Our methods do not generally allow for the comparison of inorganic materials (metal flake, for example) that may be present in paint samples.
6B3EE8	There was difficulty obtaining cross sections because the top coat layers separated extremely easy from the primer layer which adhered to the substrate. Under the stereoscope you could see the layers already separated when looking at the sample on end.
7EKQVN	The following descriptions are meant to provide context to the levels of opinions reached in this report. Every type of conclusion may not be applicable in every case nor for every material type. Type I Association: A physical match; items physically fit back to one another, indicating that the items were once from the same source. Type II Association: An association in which items are consistent in all measured physical properties and/or chemical composition and share atypical characteristic(s) (e.g., repaint layers) that would not be expected to be readily available in the relevant population. Type III Association: An association in which items are consistent in all measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Type IV Association: An association in which items are consistent in all measured physical properties and/or chemical composition and, therefore, could have originated from the same source. As compared to a Type III association, items categorized as Type IV share characteristics that are more common amongst these kinds of manufactured products. Alternatively, an association between items would be categorized as a Type IV if a limited analysis was performed due to characteristics or size of the specimen(s). Type V Association: An association in which items are consistent in some, but not all physical properties and/or chemical composition. Some minor variation(s) exist(s) between the known and questioned items and could be due to factors such as sample heterogeneity, contamination of the sample(s), or having a sample of insufficient size to adequately assess homogeneity of the entity from which it was derived.
LVDWJ9	The clearcoats are carbamate/melamine while the gray primer is a polyester/melamine
NUWLEZ	It would be most helpful if microscopic photos and spectra (e.g. FTIR, UV-VIS microspectrometry, Py-GC/MS and SEM/EDS) of the test samples were included in the results for comparison purposes with in-house data.
PA7K4X	The laboratory's PGC-MS system was not operational for this test. Slight differences such as seen in paint from different batches may not have been detected.
U82TWR	It is possible that further analysis (i.e. XRS/XRF, SEM/EDX, Microspectrophotometry) could provide additional information to further associate or discriminate the compared samples.
ULHJYZ	clear-top layer: acylic melamine. blue-metallic-middle layer: polyester melamine. gray-bottom layer: acylic melamine
WLWPCV	These paint samples are not representative of vehicle paint. Paint layers delaminated, their thicknesses varied, reflective particles were unevenly distributed, and inclusions into adjoining layers were observed. It was not possible to determine if differences in samples were due to specific physical properties or to poor paint quality.
XCZECK	The definition of the association included used by our laboratory system is as follows: Level 3 - Association: Items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined.



# Appendix: Data Sheet

Collaborative Testing Services ~ Forensic Testing Program

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## Test No. 17-545: Paint Analysis

DATA MUST BE RECEIVED BY May 30, 2017 TO BE INCLUDED IN THE REPORT

Participant Code:

WebCode:

### Accreditation Release Statement

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

This participant's data is intended for submission to ASCLD/LAB, ANAB, and/or A2LA. (Accreditation Release section on the last page must be completed and submitted.)

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

#### Scenario:

Police are investigating a drive-by shooting, which resulted in the death of a young woman. Witnesses described gun shots being fired from a blue car. When driving away, the vehicle struck a fire hydrant and stop sign, sustaining damage to the passenger side. Police were able to recover paint chips from the fire hydrant and stop sign. The next day, the police seized a suspect vehicle that matched the witness' description and had damage to the passenger side. A known paint sample was taken from the damaged area of the vehicle. Police are requesting that you examine the two sets of recovered paint chips and determine if they could have originated from the damaged area of the suspect vehicle.

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 metal substrate.

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

#### Items Submitted (Sample Pack P1):

- Item 1: Known paint sample representative of the damaged area of suspect vehicle
- Item 2: Questioned paint chips recovered from the fire hydrant
- Item 3: Questioned paint chips recovered from the stop sign

#### 1.) Could the questioned paint chips (Items 2 and/or 3) have originated from the damaged area of the suspect vehicle represented by Item 1?

Item 2:    Yes                       No                       Inconclusive

Item 3:    Yes                       No                       Inconclusive

Please return all pages of this data sheet.

Participant Code:

WebCode:

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

Microscopic Examinations:

Stereomicroscope

Polarized Light

Fluorescence

Pyrolysis GC

FTIR

Solubility/Chemical

XRS/XRF

SEM/EDX

Microspectrophotometry

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

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

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

**4.) Additional Comments**

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

**Return Instructions:** Data must be received via online data entry, fax (please include a cover sheet), or mail by *May 30, 2017* 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. **17-545: Paint Analysis**

This release page must be completed and received by **May 30, 2017** to have this participant's submitted data included in the reports forwarded to the respective Accreditation Bodies.

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

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

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

ANAB Certificate No. \_\_\_\_\_

A2LA Certificate No. \_\_\_\_\_

**Step 2: Complete the Laboratory Identifying Information in its entirety**

Signature and Title \_\_\_\_\_

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

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

**Accreditation Release****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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