



Paint Analysis Test No. 18-546 Summary Report

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 71 participants and are compiled in the following tables:

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

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

Manufacturer's Information

Each sample set 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 victim's car and the utility pole, 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 and 2 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, Solid Black basecoat, and clear coat. The panel which made up Item 3 was made with the same basecoat and clear coat, but contained a different primer.

SAMPLE PREPARATION-

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

ITEMS 1 and 2 (ASSOCIATION): For the known Item 1, the paint panel was cut into approximately $\frac{1}{2}$ " x $\frac{1}{2}$ " wide pieces and one piece was packaged into a glassine bag and a pre-labeled Item 1 coin envelope. For the associated Item 2 samples, paint chips were cut into approximately $\frac{1}{4}$ " x $\frac{1}{4}$ " wide pieces. Two of these pieces were packaged into a glassine bag and then a pre-labeled Item 2 coin envelope. This process was repeated until all of the Items were created. Items 1 and 2 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.

ITEM 3 (ELIMINATION): For Item 3, the appropriate paint panel was cut into approximately $\frac{1}{4}$ " x $\frac{1}{4}$ " wide pieces. Two of these pieces were packaged into a glassine bag and then a pre-labeled Item 3 coin envelope. Item 3 was 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, FTIR, polarized light, and SEM/EDX.

Summary Comments

This test was designed to allow participants to assess their proficiency in the examination, comparison and interpretation of multi-layered automobile paint samples. Each sample set consisted of 3 items with layered paint and primer: one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from aluminum substrate panels. Items 1 and 2 came from the same automotive paint panel with the same gray primer, solid black basecoat, and clear coat. Item 3 was prepared with the same basecoat and clear coat, but contained a different primer. (Refer to Manufacturer's Information for preparation details.)

Of the 71 participants that reported results in Table 1, 67(94.4%) reported that the Item 2 questioned paint chips could have originated from the same source as the Item 1 known paint sample and the Item 3 paint chips could not have originated from the same source as the item 1 known paint sample. Of the remaining participants, three reported that the Item 2 and Item 3 questioned paint chips could not have originated from the same source as the Item 1 known paint sample. The final participant reported that the questioned paint chips for Item 2 were inconclusive when compared to the Item 1 known paint sample.

The most common examination methods utilized include FTIR, stereomicroscope, 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

WebCode	Item 1		WebCode	Item 1		WebCode	Item 1	
	Item 2	Item 3		Item 2	Item 3		Item 2	Item 3
233LRE	Yes	No	FTDNV8	Yes	No	VC9CUF	Yes	No
234DN2	Yes	No	GKDQJN	Yes	No	VT4T68	Yes	No
24ZVNH	Yes	No	HFY938	Yes	No	WCCCG2	Yes	No
3BWYFL	Yes	No	HMXURL	Yes	No	WDX3FK	Yes	No
67WUCR	Yes	No	HQVEV6	Yes	No	WDZRJH	Yes	No
6DD6QR	Yes	No	J8YBQN	Yes	No	WEUF3D	Yes	No
6JKVTX	Yes	No	JAK4GX	Yes	No	WFATTV	Yes	No
77CA6Y	Yes	No	JX9Vfq	Yes	No	WJPM88	Yes	No
7H3BDT	Yes	No	K4U2YJ	Yes	No	Wnk4XF	No	No
8GMBT4	Yes	No	KKZDJG	Yes	No	WZBVHK	Yes	No
8YMCUG	Yes	No	KMRA7P	Yes	No	X8EBRT	Yes	No
97J8RF	Yes	No	L3XXWV	Yes	No	Y3WJTB	Yes	No
98DV9P	Yes	No	LAZXHJ	Yes	No	YWQMAB	Yes	No
9A2D3V	Yes	No	MH9VGM	Yes	No	Z7AGYC	Yes	No
9DJQRP	Yes	No	MQFVQN	Yes	No	Z9TV4X	Yes	No
9GH83X	Yes	No	NANGQM	Yes	No			
9PZFQU	Yes	No	NWLQAN	Yes	No			
9TYUBY	Yes	No	PLWKPP	Yes	No			
A4P6YW	Yes	No	RGEYUN	Yes	No			
AF4ZGG	Yes	No	T7FBQX	Yes	No			
AQMEGX	Yes	No	TJ6D76	Yes	No			
AYJAFW	Yes	No	TMH69Q	No	No			
B8PKY8	Yes	No	TNR8WB	Yes	No			
BBLAHZ	Inc	No	TPNPWQ	No	No			
BHRVFU	Yes	No	U4KEE9	Yes	No			
E4VTGL	Yes	No	UNQPHC	Yes	No			
EG3U2H	Yes	No	UXFG66	Yes	No			
ENJEZM	Yes	No	VA4XAV	Yes	No			

Examination Response Summary		Participants: 71	
		Item 1	
		Item 2	Item 3
Responses	Yes	67 (94.4%)	0 (0%)
	No	3 (4.2%)	71 (100%)
	Inc	1 (1.4%)	0 (0%)

Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRF/XRF	SEM/EDX	Microspectrophotometry	Other
233LRE	✓		✓	✓				✓		
234DN2					✓					
24ZVNH	✓				✓	✓				
3BWYFL	✓	✓			✓			✓		
67WUCR	✓				✓					
6DD6QR	✓			✓	✓					
6JKVTX	✓				✓					
77CA6Y	✓	✓		✓	✓			✓		
7H3BDT	✓				✓			✓		
8GMBT4	✓	✓	✓		✓					RAMAN
8YMCUG	✓	✓	✓		✓			✓		Raman
97J8RF	✓		✓		✓	✓				
98DV9P	✓			✓	✓			✓		
9A2D3V	✓	✓			✓			✓		
9DJQRP	✓		✓		✓			✓		Raman
9GH83X	✓	✓			✓	✓				
9PZFQU	✓				✓					
9TYUBY	✓	✓			✓			✓		
A4P6YW	✓	✓		✓	✓			✓	✓	raman microspectrophotometry
AF4ZGG	✓	✓	✓	✓	✓			✓		
AQMEGX	✓	✓	✓		✓			✓		
AYJAFW	✓	✓						✓		FTIR Microscope
B8PKY8	✓		✓		✓	✓				
BBLAHZ	✓				✓			✓		
BHRVFU	✓	✓	✓	✓	✓		✓	✓		
E4VTGL	✓				✓			✓		

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
EG3U2H	✓				✓			✓		Raman Spectroscopy
ENJEZM	✓				✓	✓			✓	
FTDNV8	✓		✓		✓			✓		
GKDQJN	✓	✓		✓	✓	✓	✓	✓		
HFY938	✓		✓		✓					microtome
HMXURL	✓				✓			✓		
HQVEV6	✓				✓					
J8YBQN	✓			✓	✓			✓		
JAK4GX	✓		✓		✓					
JX9VFQ	✓				✓	✓				UV light
K4U2YJ	✓	✓			✓		✓		✓	
KKZDJG					✓	✓				
KMRA7P	✓	✓	✓		✓			✓		
L3XXWV	✓		✓		✓			✓		
LAZXHJ	✓				✓			✓	✓	
MH9VGM	✓			✓	✓			✓		
MQFVQN	✓				✓		✓	✓		
NANGQM	✓				✓	✓				UV Light
NWLQAN	✓	✓	✓		✓			✓		
PLWKPP					✓			✓		
RGEYUN	✓				✓					
T7FBQX	✓	✓			✓			✓		
TJ6D76	✓		✓		✓					comparison microscope
TMH69Q	✓				✓	✓				
TNR8WB	✓	✓			✓			✓		
TPNPWQ					✓					
U4KEE9	✓				✓			✓		
UNQPHC	✓	✓		✓	✓	✓		✓		

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
UXFG66	✓				✓			✓		
VA4XAV	✓	✓		✓	✓					
VC9CUF	✓				✓	✓	✓			
VT4T68	✓				✓					
WCCCG2	✓		✓	✓	✓	✓				
WDX3FK	✓	✓	✓	✓	✓	✓				
WDZRJH	✓				✓				✓	
WEUF3D	✓		✓		✓					
WFATTV	✓				✓					
WJPM88	✓	✓		✓	✓					
WNK4XF	✓				✓	✓		✓		
WZBVHK					✓					
X8EBRT	✓				✓			✓		
Y3WJTB	✓				✓					
YWQMAB	✓	✓	✓		✓			✓		
Z7AGYC	✓	✓	✓		✓					
Z9TV4X	✓			✓	✓			✓		Backscatter Imaging

Response Summary										
Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
71	66	24	20	16	70	9	10	38	5	
Percent	93%	34%	28%	23%	99%	13%	14%	54%	7%	

Conclusions

TABLE 3

WebCode	Conclusions
233LRE	Microscopic examination: All of them(item1.2.3) are contained four layers, which is clear,black,light gray and dark gray coat(from top to bottom). The examined portions of item1 and item2 were found to be consistent in color,layer sequence,microscopic appearance and instrumental analysis. However, the examined portions of item1 and item3 were found to be different in instrumental analysis. Accordingly, item2 has originated from item1, but item3 hasn't.
234DN2	[No Conclusions Reported.]
24ZVNH	1) The known paint sample representative of the damaged area of suspect vehicle (item 1), the questioned paint chips recovered from the victim's car (item 2), and the questioned paint chips recovered from the utility pole (item 3) consist of a four layers paint system with the following layer structure: Item 1: 1. Colorless acrylic-urethane enamel clear coat, 2. Black urethane modified isophthalic polyester-melamine enamel base coat, 3. Light gray terephthalic-polyester-epoxy enamel primer, and 4. Dark gray polyester-melamine enamel primer. Item 2: 1. Colorless acrylic-urethane enamel clear coat, 2. Black urethane modified isophthalic polyester-melamine enamel base coat, 3. Light gray terephthalic-polyester-epoxy enamel primer, and 4. Dark gray polyester-melamine enamel primer. Item 3: 1. Colorless acrylic-urethane enamel clear coat, 2. Black urethane modified isophthalic polyester-melamine enamel base coat, 3. Light gray isophthalic-polyester-melamine enamel primer, and 4. Dark gray polyester-melamine enamel primer. 2) The four layered paint chips in item 1 and 2 match in all properties investigated, particularly in colors, textures, types, layer sequence and chemical composition. It was concluded that the paint in this items could have a common origin. The possibility that they don't share a common origin depend on the presence, in the crime scene, of another vehicle with the same finish (along with the damage in an external place) and that it comes from the same factory lot as the currently questioned vehicle. 3) The four layered paint chips 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 and thickness of light gray primer layer. It was concluded that the paint in these items don't have a common origin.
3BWYFL	The questioned paint from Item 2 could have originated from the vehicle (as represented by the Item 1 exemplar) or from another source with paint exhibiting all of the same analyzed characteristics. The questioned paint from Item 3 could not have originated from the vehicle (as represented by the Item 1 exemplar).
67WUCR	The paint chips of all three samples consist of four layers: clear coat, black coloured coat, grey surfacer and a dark grey first primer. The paint chip of the suspect vehicle 1 and from the victim's car show similar IR-spectra in all 4 layers. The grey surfacer from item 3 is thinner than the surfacers from the other items and shows different IR- spectra. It is highly probable that the questioned paint chips from the victim's car originated from the damaged area of the suspect vehicle 1.
6DD6QR	The paint from item-2 (questioned paint chips recovered from the victim's car) and item-1 (known paint sample representative of the damaged area of suspect vehicle) were consistent on color, layering and chemical composition and could have the same source. The paint from item-3 (questioned paint chips recovered from the utility pole) and item-1 (known paint sample representative of the damaged area of suspect vehicle) were inconsistent on chemical composition and could not have the same source.
6JKVTX	Item 2 demonstrates the same physical characteristics and chemical properties as the paint

TABLE 3

WebCode	Conclusions
	comprising Item 1. Accordingly, Item 2 could have originated from the same source as Item 1 or another source with the same physical characteristics and chemical properties. Item 3 demonstrates differences in physical characteristics and chemical properties upon comparison to the paint comprising Item 1. Accordingly, Item 1 is excluded as the source of the paint in Item 3.
77CA6Y	1. Exhibit 1 (known paint standard from damaged area of suspect's vehicle) consists of one multi-layered paint chip. The paint layer system consists of a colorless clearcoat, black basecoat, medium grey primer, and dark grey primer. 2. Exhibit 2 (questioned paint from victim's car) consists of two multi-layered paint chips. The paint layer system consists of a colorless clearcoat, black basecoat, medium grey primer, and dark grey primer. 3. Exhibit 3 (questioned paint from utility pole) consists of two multi-layered paint chips. The paint layer system consists of a colorless clearcoat, black basecoat, light grey primer, and dark grey primer. 4. Comparative examinations of Exhibit 1 with Exhibit 2 disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the questioned paint from the victim's car (Exhibit 2) could have originated from the damaged area of the suspect's vehicle (Exhibit 1) or another source with the same characteristics. 5. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown. 6. Comparative examinations of Exhibit 1 with Exhibit 3 disclosed them to be inconsistent in the physical characteristics and chemical compositions of their layer three primers. As a result of these findings, the questioned paint from the utility pole (Exhibit 3) could not have originated from the damaged area of the suspect's vehicle as represented by Exhibit 1.
7H3BDT	Item 1 and Item 2 were physically and chemically comparable. Item 2 could have originated from the same origin as Item 1. Item 1 and Item 3 were chemically distinguishable and therefore Item 3 could not have originated from Item 1.
8GMBT4	ITEM 2 was originated from paint's car. It has equal layers and same width. The chemicals compositions(F-TIR and RAMAN)are coincident between layers. ITEM 3 wasn't originated from paint's car. There is a different kind of chemical composition for the first one layer. Although it has the same chemical composition for topcoat and clearcoat layers.
8YMCUG	Questioned paint chips recovered from the victim's car (Item #2) were four layer paint chips, which matched in colour, layer structure and elemental and chemical composition with Item #1, the known paint sample representative of the damaged area of suspect vehicle. Thus the questioned paint chips in Item #2 could have originated from the known paint sample, Item #1. Questioned paint chips recovered from the utility pole (Item #3) were inconsistent with the known paint sample, Item #1.
97J8RF	Microscopic examination and Instrumental analysis (Micro-FTIR and XRF) of the paint chips from Items #01.01 through #01.03 yielded the following results: Items #01.01(K) and #01.02(Q)- revealed that they are consistent with respect to color, texture, type and layer structure. Therefore, the questioned paint from #01.02 could have originated from the known source represented by #01.01 or another vehicular paint source exhibiting the same characteristics. Items #01.01(K) and #01.03(Q)- revealed that they are dissimilar with respect to type (layer 3). Therefore, the questioned paint from #01.03 could not have come from the source represented by #01.01.
98DV9P	I formed the opinion based on the techniques used, that the appearance and chemical and elemental composition of item 2, the questioned paint fragment recovered from the victim's car was indistinguishable to item 1, the paint fragment representative of the damaged area of the suspect vehicle and could have come from it. I also formed the opinion based on the

TABLE 3

WebCode	Conclusions
	<p>techniques used, that the chemical and elemental composition of item 3, the questioned paint fragment recovered from the utility pole was different to and could not share a common origin with item 1, the known paint fragment representative of the damaged area of the suspect vehicle.</p>
9A2D3V	<p>The questioned paint from Item #2 was consistent in color, layering, chemical composition and elemental composition with the known paint from Item #1 and could have originated from the same source (Level III association). The questioned paint from Item #3 was inconsistent in layering and chemical composition with the known paint from Item #1 and did not originate from the same source (Elimination). Terminology Key for Associative Evidence: 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. Level I Association: A physical match; items physically fit back to one another, indicating that the items were once from the same source. Level 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. Level 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, an individual source cannot be determined. Level 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 kinds of manufactured products. Alternatively, an association between items would be categorized as a Level IV if a limited analysis was performed due to characteristics or size of the specimen(s). Level V Association: An association in which items are consistent in some, but not all, physical properties and/or chemical composition. Some minor variation(s) exists 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. Inconclusive: No conclusion could be reached regarding an association/elimination between the items. Elimination: The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source.</p>
9DJQRP	<p>The questioned paint chips recovered from the victim's car (Item 2) and the known paint sample from the damaged area of the suspect vehicle (Item 1) were similar in colour, layer sequence, chemical composition and elemental composition. Therefore, the black paint chips from the victim's car (labelled as Item 2) could have come from the damaged area of the suspect vehicle (as represented by Item 1) or from another source of paint displaying the same layer sequence and chemical properties. The paint chips recovered from the utility pole (Item 3) were chemically different from the paint on the suspect vehicle (Item 1) and therefore could not share a common origin. This conclusion assumes the paint sample in Item 1 is representative of all the paint types on the suspect vehicle</p>
9GH83X	<p>Item #2 exhibited similar microscopic characteristics, chemical composition, and elemental composition to Item #1. Item #1 and Item #2 could have originated from the same source. Item #3 exhibited different microscopic characteristics and chemical composition to Item #1. Item #3 could not have originated from the same source as Item #1.</p>
9PZFQU	<p>The paint chips from Item #1, 2 and 3 were examined using optical microscopy, Fourier Transform Infra-red spectroscopy (FTIR) using attenuated total reflectance on exposed surfaces,</p>

TABLE 3

WebCode	Conclusions
	and FTIR imaging using attenuated total reflectance on all layers. The number, colors, and chemistries of the layers of Item #1 known paint sample from damaged area of suspect vehicle and Item #2 from victim's car are consistent with each other and cannot be excluded from originating from the same source, as represented by the items submitted. The chemistries of the layers of Item #1 Known paint sample from damaged area of suspect vehicle are inconsistent with Item #3 from utility pole. The submitted paint chips originated from different sources, as represented by the items submitted.
9TYUBY	The black paint from the victim's car (Item 2) was consistent in color, layer structure, chemical composition and elemental composition with the known black paint from the suspect vehicle (Item 1). Item 2 could have originated from the known paint represented by Item 1 or any source with similar characteristics. The black paint from the utility pole (Item 3) was dissimilar to the known black paint from the suspect vehicle (Item 1) in color and layer structure. The samples were examined by stereomicroscopy, comparison polarized light microscopy, Fourier transform infrared spectroscopy, and scanning electron microscopy with energy dispersive spectrometry.
A4P6YW	I compared the two questioned paint chips, items 001-2 and 001-3, to the reference paint sample, item 001-1, using stereo microscopy, polarized light microscopy, infrared microspectrophotometry, raman microspectrophotometry, ultraviolet and visible microspectrophotometry, scanning electron microscopy with energy dispersive spectrometry, and pyrolysis gas chromatography mass spectrometry. I found that the questioned paint sample, item 001-2, was indistinguishable from the reference paint sample, item 001-1, in physical appearance such as color, layer sequence, layer thickness, organic and inorganic composition. The paint sample, item 001-2, and the reference paint sample, item 001-1, could have originated from the same source of paint or another source of paint that is indistinguishable from item 001-1. I found that the questioned paint sample, item 001-3, was different from the reference paint sample, item 001-1, in the primer layers' thicknesses and composition. The questioned paint sample, item 001-3, did not come from the same source as the reference paint, item 001-1.
AF4ZGG	The multi-layered paint chip in item 1.2 (recovered from the victim's car) is the same distinct type of paint as that represented by Item 1.1 (from the damaged area of the suspect's vehicle) and originated from that source or another source of paint having the same characteristics. The multi-layered paint chip in item 1.3 (recovered from the utility pole) was found to be chemically different than item 1.1 and did not originate from that source.
AQMEGX	The results of the examination support that the paint chips Item 2 originate from the suspect vehicle (Item 1) (Level +2). The results of the examination extremely strongly support that the paint chips Item 3 does not originate from the damaged area of the suspect vehicle (Item 1) (Level -4).
AYJAFW	Items 2 and 3 were examined to determine if they are consistent with and could have originated from Item 1. Items 2 and 3 were compared visually, stereoscopically, microscopically and instrumentally to Item 1. A Zeiss stereoscope, an Olympus polarizing microscope, a Thermo Fisher Scientific FT-IR microscope and an ASPEX scanning electron microscope with energy dispersive X-ray analyzer were used to perform these analyses. Item 2 was observed and sampled for comparison to Item 1. Item 2 is consistent in color, layer structure, chemical and elemental composition to Item 1. Therefore, this analyst concludes that Item 2 could have originated from Item 1 or a source of similar origin. Item 3 was observed and sampled for comparison to Item 1. Item 3 is consistent in color and layer structure but is inconsistent in chemical and elemental composition to Item 1. Therefore, Item 3 was excluded from originating from Item 1.

TABLE 3

WebCode	Conclusions
B8PKY8	<p>The paint sample (item 3), recovered from the utility pole, was found to be distinguishable in microscopic appearance from the paint sample (item 1), from the damaged area of the suspect vehicle. In my opinion the paint recovered from the utility pole could not have originated from the damaged area of the suspect vehicle. The paint sample (item 2), recovered from the victim's car, was found to be indistinguishable in the results of the tests performed from the paint sample (item 1), from the damaged area of the suspect vehicle. In my opinion the paint recovered from the victim's vehicle could have originated from the damaged area of the suspect vehicle. The examinations undertaken in this instance provide a sensitive means of discriminating between samples of paint that have originated from different sources. In my opinion the likelihood of encountering flakes of paint on the victim's car that correspond with the paint from the suspect vehicle to the degree encountered, purely by chance, is very low. Therefore, in my opinion the findings provide strong support for the view that the paint recovered from the victim's car has originated from the suspect's vehicle.</p>
BBLAHZ	<p>Paints are extremely heterogeneous coatings, and to successfully match them one must identify each component in the paint, which normally include pigments, resins, and fillers. Additionally, they are multilayered, so this needs to be done for each observed layer. Since this can be a massive undertaking, it is often safer and more practical to identify clear differences and eliminating the possibility of a match. This was done for item 3, in which it was found through IR that the bottommost layer of the paint had a different polymer resin than that of item 1. EDS also revealed that this same layer had a different filler than that of item 1 (titania rather than barite). These observations rule out the possibility of item 3 originating from item 1. A similar demonstration cannot be made in comparison of items 1 and 2. Utilizing both FTIR and EDS on each layer of paint, we were unable to identify any clear differences between these items. However, we are not comfortable in asserting that they are a match due to the known and expected heterogeneity of paints.</p>
BHRVFU	<p>1. Comparative examinations of the paint chip from Exhibit 1 (known paint sample representative of the damaged area of suspect's vehicle) with the paint chip from Exhibit 2 (questioned paint chips recovered from the victim's car) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the paint chip recovered from the victim's car could have originated from the damaged area of the suspect's vehicle, or another source with the same characteristics. 2. Comparative examinations of the paint chip from Exhibit 1 (known paint sample representative of the damaged area of suspect's vehicle) with the paint chip from Exhibit 3 (questioned paint chip recovered from the utility pole) disclosed them to be inconsistent in their physical characteristics and elemental compositions. As a result of these findings, the paint chip recovered from the utility pole could not have originated from the damaged area of the suspect's vehicle as represented in Exhibit 1. 3. It should be noted that a paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.</p>
E4VTGL	<p>3.1 Items 1, 2 and 3 consisted of clear, black, light gray and dark gray paint layers; 3.2 Items 1 and 2 were physically and chemically comparable therefore item 2 could have originated from a source represented by item 1. 3.3 The third paint layer of item 3 was physically and chemically incomparable with the third layer of item 1 therefore item 3 could not have originated from a source represented by item 1.</p>
EG3U2H	<p>The questioned black paint chips marked "Item 2", recovered from the victim's car, could have originated from the same source as the paint chips marked "Item 1", collected from the damaged area of the suspected vehicle, or another source of paint with similar characteristics. The questioned black paint chips marked "Item 3", recovered from the utility pole, did not</p>

TABLE 3

WebCode	Conclusions
	originate from the same source as the paint chips marked "Item 1", collected from the damaged area of the suspected vehicle.
ENJEZM	the results obtained by the different techniques used previously show that the paint of the Item 1 and Item 2 have the same physico-chemical properties but the paint of the Item 3 is different the paint of the Item 1.
FTDNV8	The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show the same paint layers: clearcoat, black basecoat, a grey layer and a dark-grey layer. All layers of all samples were analyzed by microscopy, light microscopy, infrared spectroscopy and SEM/EDX. Item 2 (the sample from the victim's car) cannot be differentiated from Item 1 by the used methods. Item 3 (the sample from the utility pole) shows differences to Item 1 in the thickness of the grey layer, in the IR-spectra and in the elemental composition of this grey layer. The questioned paint sample Item 2 could have originated from the damaged area of suspect vehicle (Item 1).
GKDJQN	The questioned paint recovered from the victim's car (item 1B, CTS item 2) is the same distinct type of paint as the known paint on the suspect vehicle (item 1A, CTS item 1) and originated either from that source or another source of automotive paint having the same distinct characteristics. The questioned paint recovered from the utility pole (item 1C, CTS item 3) did not originate from the area/panel of the vehicle represented by item 1A (CTS item 1). RESULTS: The questioned paint from the victim's car (item 1B, CTS item 2) and the questioned paint from the utility pole (item 1C, CTS item 3) were examined for the purpose of determining whether or not there is any paint present like that on the suspect vehicle (item 1A, CTS item 1). The paint standard from the suspect vehicle (item 1A, CTS item 1) has the following layer structure: 1. Colorless acrylic-urethane enamel clearcoat, 2. Black polyester-melamine-urethane enamel basecoat, 3. Light gray polyester-epoxy enamel primer, 4. Dark gray polyester-epoxy-melamine enamel primer. This paint exhibits characteristics typical of an original automotive finish and was used for comparison with questioned paint recovered from the victim's car (item 1B, CTS item 2) and from the utility pole (item 1C, CTS item 3). The questioned paint recovered from the victim's car (item 1B, CTS item 2) has the same layer structure as the known paint from the suspect vehicle (item 1A, CTS item 1). Examination and comparison of this questioned paint (item 1B, CTS item 2) with item 1A (CTS item 1) revealed they are alike with respect to layer structure, layer colors, layer textures, microchemical reactivities, binder characteristics, and pigment characteristics. It is therefore concluded that the questioned paint recovered from the victim's car (item 1B, CTS item 2) is the same distinct type of paint as that on the suspect vehicle (item 1A, 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 utility pole (item 1C, CTS item 3) has the following layer structure: 1. Colorless acrylic-urethane enamel clearcoat, 2. Black polyester-melamine-urethane enamel basecoat, 3. Light gray polyester-melamine enamel primer, 4. Dark gray polyester-melamine enamel primer. Examination and comparison of this questioned paint (item 1C, CTS item 3) with item 1A (CTS item 1) revealed they are dissimilar with respect to layer texture of layer 3 and general binder types of layers 3 and 4. It is therefore concluded that the questioned paint recovered from the utility pole (item 1C, CTS item 3) did not originate from the area/panel of the vehicle represented by item 1A (CTS item 1).
HFY938	The four layer paint on the victim's car (item 2) matches the four layer paint from the suspect's vehicle with respect to the colour, layer sequence and the chemical composition of the paint layers. The four layer paint from the pole (item 3) does not match the paint from the suspect vehicle with respect to the layer sequence or the chemical composition of some of the paint

TABLE 3

WebCode	Conclusions
	<p>layers.</p> <p>Results of Laboratory Examination: The questioned paint chips from the Item 2 and the known paint in Item 1 were similar in layer structure (four layers of similar thickness), color (clear, black, light grey, and dark grey), chemical composition (FTIR), and elemental composition (SEM-EDS). Therefore, the questioned paint from Item 2 could have come from a common source as the known paint in Item 1 (Type III Association). It should be noted that the analytical techniques used allow for a high degree of discrimination. However, other vehicles may have a paint system, made to the same specifications, that would be indistinguishable from these paint systems. The questioned paint chips from Item 3 and known paint in Item 1 had four layers that were similar in color (clear, black, light grey, and dark grey). However, the light grey layer in Item 3 was much thicker than the one observed in Item 1. These light grey layers were further examined using FTIR and were found to also differ in chemical composition. Therefore, the paint from Item 3 did not come from the same source as the Item 1 known sample (Elimination). It should be noted that vehicles may have different paint systems on different panels of the same vehicle. Further comparisons can be performed if additional known samples are submitted. KEY for instrument acronyms: FTIR – Fourier Transform Infrared Spectroscopy, SEM/EDS – Scanning Electron Microscopy/Energy Dispersive Spectroscopy: Located at [University]. 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 I 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 II Association: Association with distinct characteristics: 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 I Association. Type III Association: Association with conventional characteristics: 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 IV Association: Association with limitations: An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. 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, limited information, or minor variations observed in the data. Inconclusive: No conclusion could be reached regarding an association or an elimination between the items. Dissimilar: The items were dissimilar in physical properties and/or chemical composition, indicating that the items may not have originated from the same source. However, these dissimilarities were insufficient for a definitive Elimination. 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.</p>
HMXURL	<p>The known paint sample (Item 1) and the two questioned paint chips (Item 2 and Item 3) consist each of four paint layers. The four layers of the known paint sample (Item 1) cannot be distinguished from the corresponding layers of the questioned paint chip (Item 2) recovered from the victim's car. Therefore this questioned paint chip (Item 2) could have originated from the damaged area of the suspect vehicle as represented by Item 1. Therefore, the results strongly support the hypothesis that Item 2 originated from the suspect's vehicle. The lower two layers of the known paint sample (Item 1) differ from the lower two layers of the questioned</p>
HQVEV6	

TABLE 3

WebCode	Conclusions
	paint chip (Item 3) recovered from the utility pole. Therefore this questioned paint chip (Item 3) cannot have come from the damaged area of the suspect vehicle as represented by Item 1.
J8YBQN	The suspect's vehicle, as represented by item 1, cannot be eliminated as a possible source of the paint chips recovered from the victim's car, item 2. The black paint chips, item 2, either came from the suspect's vehicle, as represented by item 1 or from another source of damaged black paint indistinguishable with respect to the properties listed in the results. The suspect's vehicle, as represented by item 1, was eliminated as a possible source of the paint chips recovered from the utility pole, item 3.
JAK4GX	1. The paint, Exhibit 2, originated either from the same source as Exhibit 1 or from another source bearing paint physically and chemically indistinguishable from the paint of Exhibit 1. In a laboratory database of 1042 vehicular paint samples encountered in casework, 6 samples (less than 1%) had the paint layer sequence: clear\black\grey\grey. This database does not distinguish among different shades of colour or chemical composition. 2. The paint, Exhibit 3, did not originate from the same source as Exhibit 1.
JX9Vfq	The paint in item 2 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 and 2 could have originated from the same source. The paint in item 3 is similar in color to the paint in item 1, however, it is dissimilar in layer structure and fluorescence. Therefore the paint in items 1 and 3 could not have originated from the same source.
K4U2YJ	Conclusion: The paint sample from the victim's car (Item 2) is associated to the paint standard from the suspect vehicle (Item 1) upon comparison of optical, physical, chemical, and elemental properties and either originated from the suspect vehicle or from another vehicle with the same characteristics (Level III Association). The paint sample from the utility pole (Item 3) is disassociated from the paint standard from the suspect vehicle (Item 1) due to differences in chemical and elemental properties and is eliminated as having originated from the suspect vehicle (Elimination).
KKZDJG	[No Conclusions Reported.]
KMRA7P	The paint layers from a representative paint chip in Item 2 and the paint layers in Item 1 were examined and compared visually, microscopically and instrumentally and were found to be consistent in all measured microscopic, chemical and elemental compositions. They could have come from the same source or any other source with the same compositions. The paint layers from a representative paint chip in Item 3 and the paint layers in Item 1 were examined and compared visually, microscopically and instrumentally and the gray/black layers were found to be inconsistent in all measured microscopic and chemical compositions. They could not have come from the same source.
L3XXWV	The topst layer of the paint samples (Item 1, 2 and 3) have same chemical compound. But the grey layer of the Item 2 could have originated from Item 1, Item 3 could not have originated from Item 1
LAZXHJ	The questioned paint chip in Item 2 (from the victim's car) was examined and corresponded in color and layer structure (clear, black, medium grey, dark grey), chemical composition (FTIR), visible spectra of black layer (MSP), and elemental composition (SEM/EDS) to the known paint in Item 1 (from the suspect vehicle). Therefore, the Item 2 paint could have come from the same source as Item 1 or another source with the same characteristics (Type III Association). It should be noted that the analytical techniques used allow for a high degree of discrimination between different paints, however, other cars may have paint systems manufactured to the same specifications that would be indistinguishable from the submitted evidence. The

TABLE 3

WebCode	Conclusions
	<p>questioned paint chip in Item 3, though visibly similar in color and layer structure, is different in chemical composition (FTIR) from the known paint in Item 1. Therefore, the paint in Item 3 did not come from the same source as the Item 1 known paint (Elimination). Different panels on the same vehicle may have different paint systems. Further comparisons can be performed if additional known samples are submitted. KEY for instrument acronyms: FTIR – Fourier Transform Infrared Spectroscopy, 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 I 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 II Association: Association with distinct characteristics: 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 I Association. Type III Association: Association with conventional characteristics: 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 IV Association: Association with limitations: An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. 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, limited information, or minor variations observed in the data. Inconclusive: No conclusion could be reached regarding an association or an elimination between the items. Dissimilar: The items were dissimilar in physical properties and/or chemical composition, indicating that the items may not have originated from the same source. However, these dissimilarities were insufficient for a definitive Elimination. 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.</p>
MH9VGM	<p>Physical and chemical examinations indicate that Items 1 and 2 are indistinguishable from one another. Therefore, Item 2 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. Item 3 differed in chemical composition from Item 1 in one (or more) layers. Therefore, Item 3 did not originate from the vehicle represented by Item 1 (Elimination). 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. Type II Association: Association with atypical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Further, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III Association: Association with typical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be</p>

TABLE 3

WebCode	Conclusions
	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.
MQFVQN	Items 3A and 3B are different from item #1 with respect to the color and chemical type of layer 3. It is the opinion of the undersigned that item #3 could not have originated from the same source as represented by item #1. 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. It is the opinion of the undersigned that item #2A could have originated from the same source as represented by item #1, or from another source exhibiting all of the same analyzed characteristics.
NANGQM	The paint in item 2 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 and 2 could have originated from the same source. The paint in item 3 is similar in color to the paint in item 1, however, it is dissimilar in fluorescence and infra-red absorbance spectra. Therefore the paint in items 1 and 3 could not have originated from the same source.
NWLQAN	The elemental composition measured with EDAX, the chemical and morphological properties of paint layers of Item 2 and Item 1. are the same. Chemical and morphological properties and elemental composition of some paint layers of Item 3. differ from some layers of Item 1.
PLWKPP	All three items are shown by SEM to be composed of multiple layers. However, Items 1 (suspect vehicle) and 2 (victim's car) both show 3 layers, whereas Item 3 (utility pole) shows 4. On this basis Item 3 can be excluded as having originated from Item 1. This is corroborated by the FTIR results which show differences in composition between these two items. Comparison by both FTIR and SEM/EDS show no significant differences in texture or chemical composition which could exclude Item 2 as having originated from item 1. We therefore conclude that Item 2 (victim's car) cannot be excluded as having originated from Item 1 (suspect vehicle), but Item 3 (utility pole) can be excluded as having originated from Item 1 (suspect vehicle).
RGEYUN	Comparative examination of the paint layers from Item 1 and Item 2 by optical microscopy and FTIR found no significant differences in physical or chemical composition. The findings are consistent with Item 1 and Item 2 having a common origin. Comparative examination of Item 1 and Item 3 found significant differences in the profile of paint layers. Item 3 and Item 1 do not have a common origin.
T7FBQX	Both Items 1 and 2 could have originated from the same source, or another source with similar manufacturing. Item 3 did not originate from the same source as Item 1 as represented by the submitted samples.
TJ6D76	The questioned paint sample #2 could have originated from item #1 (known paint sample) or from another source exhibiting all of the same analyzed characteristics. The questioned paint sample #3 could not have originated from item #1.

TABLE 3

WebCode	Conclusions
TMH69Q	Item 2- Questioned paint chips recovered from the victim's car, did not have a common origin with Item 1, known paint sample from the suspect's car. Item 3 – Questioned paint chips from the utility pole did not have a common origin with Item #1.
TNR8WB	Item 2 could have originated from item 1, but item 3 did not originated from item 1.
TPNPWQ	The translucent top coat on all samples was the same. The black layer on Item 2 does not match Item 1. The gray layer on Item 3 does not match Item 1.
U4KEE9	Microscopic and instrumental analysis and comparison of Item 2 with Item 1 revealed them to be consistent with respect to color, texture, type, layering sequence, binder composition and pigment composition. Therefore, Item 2 could have come from Item 1 or another vehicle with the same paint history. Microscopic and instrumental analysis and comparison of Item 3 with Item 1 revealed them to be inconsistent with respect to layering sequence, primer binder composition, and primer pigment composition. Therefore, Item 3 could not have come from Item 1.
UNQPHC	These exhibits were examined and compared in an attempt to determine whether or not an association exists between the recovered questioned paint chips and the suspect vehicle. Examinations of Item 1, the known paint sample from the suspect vehicle, revealed a paint chip having the following layer structure: 1. Clear colorless acrylic-urethane enamel topcoat, 2. Black melamine-polyester-urethane enamel finishcoat, 3. Medium gray alkyd-epoxy enamel primer, 4. Dark gray epoxy-melamine-polyester enamel primer. This layer structure is typical of an automotive paint layer system. Item 2, questioned paint chips recovered from the victim's car, was examined and found to contain two paint chips having the following layer structure: 1. Clear colorless acrylic-urethane enamel topcoat, 2. Black melamine-polyester-urethane enamel finishcoat, 3. Medium gray alkyd-epoxy enamel primer, 4. Dark gray epoxy-melamine-polyester enamel primer. This layer structure is typical of an automotive paint layer system. Microscopic, microchemical, and instrumental examinations and comparisons of these paint chips with the Item 1 paint chip revealed they are like one another with respect to their layer colors, layer textures, and the microchemical reactivities, binder characteristics, pigment characteristics, and elemental characteristics of their respective layers. It is therefore concluded that these paint fragments originated from the suspect vehicle or from another source of automotive paint that exhibits all of the same characteristics revealed in the series of examinations performed. Examinations of Item 3, questioned paint chips recovered from the utility pole, revealed the presence of two paint chips having the following layer structure: 1. Clear colorless topcoat, 2. Black finishcoat, 3. Medium gray melamine-polyester enamel primer, 4. Dark gray primer. This layer structure is typical of an automotive paint layer system. Microscopic, microchemical, and instrumental examinations and comparisons of these paint chips with the Item 1 paint chip revealed differences between them with respect to their relative layer thicknesses and the binder type of Layer 3. As such, these paint fragments did not originate from the suspect vehicle as it is represented by Item 1.
UXFG66	The paint samples from the damaged area of the suspect vehicle (Item 1), victim car (Item 2) and utility pole (Item 3) each consisted of a clear top coat, black 2nd layer, grey undercoat 3rd layer and grey primer 4th layer. The grey 3rd layer of the paint sample from the utility pole was significantly lighter in appearance to the corresponding 3rd layer of the paint from the suspect (Item 1) and victim's car (Item 2). No significant differences in appearance and chemical composition were detected between the paint samples from suspect vehicle (Item 1) and the victim's car (Item 2). In my opinion, the paint from the victim's car (Item 2) could have originated from the same source as the paint from suspect vehicle (Item 1). No significant differences in appearance or chemical composition were detected between the top clear coat

TABLE 3

WebCode	Conclusions
	<p>and black 2nd layer of paint from the suspect vehicle (Item 1) and utility pole (Item 3). However, significant differences in appearance and chemical composition were detected in the grey 3rd layer from suspect vehicle (Item 1) and the utility pole (Item 3). Consequently, it is my opinion that the paint samples from the utility pole (Item 3) could not have originated from the same source as the paint from suspect vehicle (Item 1).</p>
VA4XAV	<p>The questioned paint chips from the victim's car (Item 2) consisted of multilayered black paint that is similar in visual color, layer sequence, paint type, and composition to the known paint from the damaged area of the suspect vehicle (Item 1). It is my opinion that these black paint chips could have originated from the suspect vehicle, or any other source with similar paint. The questioned paint chips from the utility pole (Item 3) consisted of multilayered black paint that is dissimilar in paint type to the known paint from the damaged area of the suspect vehicle (Item 1). It is my opinion that these black paint chips did not originate from the area sampled on the suspect vehicle. Please note that different areas of a vehicle can exhibit different paint types</p>
VC9CUF	<p>Visual and microscopic examination, FTIR, XRF and SEM analyses disclosed that questioned paint Q1A and the known paint K 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 paint Q1A paint submitted as Laboratory item #2 could have originated from the same source as represented by the known submitted exemplar K, Laboratory item #1 or from another source exhibiting all of the same analyzed characteristics. Microscopic examination and FTIR analysis disclosed that questioned paint Q2A and Q2B and the known paint K are different with respect to chemical composition of their gray primer (layer 3). It is the opinion of the undersigned that questioned paints Q2A and Q2B submitted as Laboratory item #3 could not have originated from the same source as represented by the known paint K submitted as Laboratory item #1.</p>
VT4T68	<p>The paint chips from Items #1, #2 and #3 were examined using optical microscopy, Fourier Transform Infrared spectroscopy (FTIR) using attenuated total reflectance on exposed surfaces, FTIR imaging using attenuated total reflectance on all layers. The number, colors, and chemistries of the layers of Item #1 known/damaged area of suspect's vehicle and Item #2 victim's car are consistent with each other and cannot be excluded from originating from the same source, as represented by the items submitted. The physical characteristics, and chemistries of the layers, of Item #1 known/damaged area of suspect's vehicle and Item #3 utility pole are inconsistent with each other. The submitted paint chips originated from different sources, as represented by the items submitted.</p>
WCCCG2	<p>1. I have considered the following propositions to evaluate my findings: a. The paint chips recovered from the victim's vehicle and/or utility pole originated from the damaged area of the suspect's vehicle. b. The paint chips recovered from the victim's vehicle and/or utility pole originated from an unrelated source and are present due to chance. 2. Given the above, I consider the findings to be more probable if the first proposition is true in regards to the paint chips recovered from the victim's vehicle, that is, the paint chips recovered from the victim's vehicle originated from the damaged area of the suspect's vehicle rather than the second that the paint chips were present by chance. 3. Consequently it is my opinion that the recovered paint chips from the utility pole (Item 3) can be excluded from having originated from the damaged area of the suspect's vehicle based on differences observed in the analysis. The findings provide very strong support for the proposition that the paint chips recovered from the victim's vehicle (Item 2) originated from the damaged area of the suspect's vehicle (Item 1).</p>
WDX3FK	<p>The questioned paint chips recovered from the victim's car (item 2) could have been originated from the damaged area of the suspect vehicle (item 1) because of their similarities in physical</p>

TABLE 3

WebCode	Conclusions
	and chemical compositions. The questioned paint chips recovered from the utility pole (item 3) is different from the paint chips of item 1 because of the differences in their chemical compositions.
WDZRJH	The known paint sample (Item 1) from the damaged area of the suspect vehicle and the recovered paint chips from the victim's car (Item 2) consist of three layers: Clear topcoat / solid black basecoat / light grey primer applied to silver metal substrate. Meanwhile, the questioned paint chips recovered from the utility pole (Item 3) consist of four layers: Clear topcoat / solid black basecoat / light grey primer / dark grey primer applied to silver metal substrate. The questioned paint chips recovered from the victim's car (Item 2) were found to be consistent with respect to layer structure, color, texture, paint type, coating thickness and chemical composition to the known paint sample from the damaged area of the suspect vehicle (Item 1). On the other hand, the questioned paint chips recovered from the utility pole (Item 3) was found to be different with respect to layer structure, coating thickness and chemical composition (i.e. in light grey primer) to the known paint sample in Item 1. Therefore, I am of the opinion that the questioned paint chips recovered from the victim's car (Item 2) could have come from the damaged area of the suspect vehicle (Item 1).
WEUF3D	Item 1 shows agreement in top coat colour, layer structure and chemical composition of the layers to Item 2 such that, in our opinion, they could have had a common origin. Item 1 shows agreement in top coat colour with item 3 however there are significant differences in layer structure such that, in our opinion, they could not have had a common origin.
WFATTV	The number, color, and chemistries of the layers of Item #1 described as being a "Known paint sample from damaged area of suspect vehicle" and Item #2 described as originating from "victim's car" are consistent with each other and cannot be excluded from originating from the same source, as represented by the items submitted. The chemistries of the layers of Item #1 described as being a "Known paint sample from damaged area of suspect vehicle" are inconsistent with Item #3 described as originating from "utility pole". The submitted paint chips originated from different sources, as represented by the items submitted.
WJPM88	The paint samples in items 1, 2, and 3 were compared to each other microscopically and chemically for similarities and differences. The black, multi-layer paint sample collected from the suspect's car (Item 1) and the black, multi-layer paint sample from the victim's car (Item 2) were determined to be microscopically and chemically (infrared spectroscopy and pyrolysis GC) indistinguishable and; therefore, may have a common origin. The black, multi-layer, paint sample collected from utility pole (Item 3) was determined to be microscopically and chemically (infrared spectroscopy and pyrolysis GC) different from the black, multi-layer, paint sample collected from the suspect's car (Item 1). Therefore, black, multi-layer, paint sample from the suspect's car (Item 1) was excluded as the source of the black, multi-layer, paint sample collected from utility pole (Item 3).
WNK4XF	On analysis, I found that the questioned paint chips "Item 2" and "Item 3" to be dissimilar from the known paint sample "Item 1". Hence, I am of the opinion that both questioned paint chips "Item 2" and "Item 3" did not originate from the same source as the known paint sample "Item 1".
WZBVHK	The paint chips of item 2 that recovered from the victim's car was matched with the (item 1) known paint sample of the damaged area of suspect vehicle.
X8EBRT	Examination and analysis of Items 1 and 2 using a stereo microscope, infrared spectroscopy, and elemental spectroscopy reveals similarities in all corresponding layers. The paint sample in Item 2 could have originated from the same source as the paint sample in Item 1. Examination and analysis of Items 1 and 3 using a stereo microscope, infrared spectroscopy, and elemental

TABLE 3

WebCode	Conclusions
	spectroscopy reveals dissimilarities in the chemical composition of one of the primer layers. The paint sample in Item 3 did not originate from the same source as the paint sample in Item 1.
Y3WJTB	[No Conclusions Reported.]
YWQMAB	Item2 and Item1 can belong to the same class (are of same type). Item3 will by high probability not originate from the same damaged area as from where Item1 is collected at the suspect vehicle.
Z7AGYC	Item 1, Item 2 and Item 3 have been examined. In the limits of the used analytical techniques, we conclude that : Paint chips recovered from the victim's car (Item 2) could have originated from the damaged area of the suspect vehicle (Item 1), Paint chips recovered from the utility pole (Item 3) doesn't come from the damaged area of the suspect vehicle (Item 1).
Z9TV4X	Results of Examinations: The Item 1 known paint chip was examined and compared to the Item 2 questioned paint chips recovered from the victim's car and the Item 3 questioned paint chips recovered from the utility pole. Based on the examinations conducted, the four layers of paint comprising Item 1 could not be distinguished in sequence, color, texture, relative thickness, and chemical composition to the corresponding layers of paint in Item 2. Accordingly, Item 1 and Item 2 originated from the same vehicle or from different vehicles painted in the same manner (Type III Association – see Interpretation scale). This type of association was reached because other vehicles produced at the same manufacturing plant as the source of Item 1, which were painted with the same color code and paint formulations, would also be indistinguishable. On the other hand, Item 1 was differentiable from Item 3 based on layer structure and chemical composition. Therefore, the source of Item 1 is not the source of Item 3 (Elimination). Interpretation: 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 items exhibit physical features that demonstrate they were once part of the same object. Associations of Evidence with Class Characteristics – Class characteristics are physical and/or chemical properties that place an item within a particular group of items. Associations of evidence with class characteristics can have varying degrees of significance. In general, the smaller the size of the group relative to the relevant population, the more significant the association. A class association cannot definitively establish that the items came from the same source. Type II: Association with Highly Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Additionally, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III: Association with Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV: Association with Limitations – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value. For example, the items are more commonly encountered in the relevant population, a complete analysis was not performed due to limited characteristics or a limited analytical scheme, or minor variations were observed in the data. Inconclusive – No conclusion could be reached regarding an association or an elimination between the items. Elimination – The items exhibit meaningful differences that demonstrate they did not originate from the same source.

Additional Comments

TABLE 4

WebCode	Additional Comments
24ZVNH	In our laboratory the majority of casework received consists of automobile paint transfer, it is common to receive different exhibits from a real case scenario to compare with a suspect car. The typical problems are fragment size and usual refinish cars with more than 10 layers. According to our experience, this test is unusual scenario. The new for us is work only with OEM finish. This is very similar to test No. 16-546 and maybe in the future they can evaluate scenarios with transfers between several vehicles with refinish (greater number of layers), which is common in our country.
97J8RF	Pyrolysis GCMS was not on line at the time the test was being analyzed. Also, the MCT-B Detector was not operational at the time the test was being analyzed.
9DJQRP	Pyrolysis GC-MS technique was not used. This is because paint samples encountered in typical casework are often traces and/or smears that are not amenable to this technique.
B8PKY8	All three samples of paint were found to be composed of four layers (colourless ; black ; grey ; dark grey). The grey layer of item 3 was found to be distinguishable from the grey layer of item 1 in colour and microscopic appearance. The four layers of paint within item 2 were found to be indistinguishable from the respective layers within item 1 in colour, microscopic appearance and layer sequence under a range of lighting conditions, in the results of chemical analysis and in the results of simple chemical tests.
EG3U2H	The black paint chips marked "Item 1", "Item 2" and "Item 3" were each found to consist of an outermost clear colourless layer, a second black layer, a third light grey layer and a fourth grey layer. The corresponding four layers of the black paint chips marked "Item 1" and "Item 2" were found to have no significant difference from each other in terms of colour, number and sequence of layers and chemical composition. The corresponding outermost clear colourless layer and the second black layer of the paint chips marked "Item 1" and "Item 3" were found to have no significant difference with each other in terms of colour and chemical composition. The corresponding third light grey layer and the fourth grey layer of the paint chips marked "Item 1" and "Item 3" were found to be different from each other in terms of chemical composition.
HFY938	These results would be unusual since the scenario is that only one vehicle was involved and the paint samples are representative of the damaged area. In this scenario the paint on the victim's car and the pole would be expected to match each other.
HQVEV6	The large size of the questioned materials (samples 2 and 3) makes this test rather unrealistic.
J8YBQN	Technical assistance has been provided in the examination and analysis of the items discussed in this report. This report contains interpretations and opinions based on scientific data. To obtain information about sample availability for retesting or additional testing, clarification, or a copy of the documentation underlying this report, please contact the writer of this report. The following instrumental analytical techniques were used to analyze the paint in items 1 and 2: Scanning Electron Microscopy - Energy Dispersive X-ray Spectroscopy (SEM-EDX), Fourier Transform Infrared Spectroscopy (FTIR), Pyrolysis Gas Chromatograph - Mass Spectroscopy (PGC-MS)
UNQPHC	Items 1, 2, and 3 were examined visually and by stereomicroscopy, microchemical tests, and brightfield/polarized light microscopy. Further examinations of Items 1 and 2 included Fourier transform infrared microspectroscopy, pyrolysis gas chromatography, and scanning electron microscopy/energy dispersive x-ray spectroscopy. As per the test instructions, the samples contained within each individual item were considered representative of a single source and

TABLE 4

WebCode	Additional Comments
UXFG66	the metal substrate was ignored. Very slight but reproducible differences were detected in the chemical composition of the grey 4th layer from the suspect vehicle (Item 1) and victim's car (Item 2) compared to the corresponding layer from the utility pole (Item 3). This is most likely due to a wet on wet application resulting in absorption occurring between the adjacent grey 3rd layer and the grey 4th layer in Items 1 & 2.

-End of Report-
(Appendix may follow)

Appendix: Data Sheet

Collaborative Testing Services ~ Forensic Testing Program

Test No. 18-546: Paint Analysis

DATA MUST BE RECEIVED BY November 19, 2018 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 fatal hit and run incident. A witness described a black sport utility vehicle sideswiping the victim's blue car, hitting a utility pole, and then driving away. Police were able to recover black paint chips from the victim's car and utility pole. Three days later, the police located a vehicle at a repair shop that matched the witness's description and had damage to the driver's 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 P2):

- Item 1: Known paint sample representative of the damaged area of suspect vehicle
- Item 2: Questioned paint chips recovered from the victim's car
- Item 3: Questioned paint chips recovered from the utility pole

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 <input type="checkbox"/> | No <input type="checkbox"/> | Inconclusive <input type="checkbox"/> |
| Item 3: | 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?

4.) Additional Comments

Return Instructions: Data must be received via online data entry, fax (please include a cover sheet), or mail by **November 19, 2018** to be included in the report. Emailed data sheets are not accepted.

QUESTIONS?
TEL: +1-571-434-1925 (8 am - 4:30 pm EST)
EMAIL: forensics@cts-interlab.com
www.ctsforensics.com

Participant Code:

ONLINE DATA ENTRY: www.cts-portal.com

FAX: +1-571-434-1937

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

Please return all pages of this data sheet.

Collaborative Testing Services ~ Forensic Testing Program

RELEASE OF DATA TO ACCREDITATION BODIES

The following Accreditation Releases will apply only to:

Participant Code:

WebCode:

for Test No. **18-546: Paint Analysis**

This release page must be completed and received by **November 19, 2018** 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

ANAB Certificate No. _____

(Include ASCLD/LAB Certificate here)

A2LA Certificate No. _____

Step 2: Complete the Laboratory Identifying Information in its entirety

Signature and Title _____

Laboratory Name _____

Location (City/State) _____

Return Instructions**Accreditation Release**

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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