



Paint Analysis

Test No. 21-5451 Summary Report

Each participant received a sample set consisting of one known paint sample (Item 1) and two questioned paint samples (Items 2 and 3). Participants were requested to analyze and compare these samples and report their findings. Data were returned from 67 participants 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

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 stop sign and telephone pole. 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.

SAMPLE PREPARATION-

The panels 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 Item 2 and Item 3 coin envelope. 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: ALS/Fluorescence, Comparison Microscope, FTIR, Polarized Light, Stereomicroscopy, 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 automotive 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, 2, and 3 came from the same automotive paint panel with the same basecoat, primer, and clear coat (Refer to Manufacturer's Information for preparation details).

Of the 67 participants that reported examination results in Table 1, a total of 63 (94%) reported all expected associations between the known and questioned items. Specifically, 63 participants (94%) reported that Item 2 questioned paint chips could have originated from the same source as the Item 1 known paint sample. The remaining 4 participants (6%) reported that Item 2 did not originate from Item 1. For questioned Item 3, 65 participants (97%) reported that Item 3 questioned paint chips could have originated from the same source as the Item 1 known paint sample. The remaining two participants (3%) reported that Item 3 did not originate from Item 1.

The most commonly reported methods of analysis were FTIR (97%), Stereomicroscope (96%), and SEM/EDX (52%).

Examination Results

Could the questioned paint chips recovered from the stop sign (Item 2) and/or telephone pole (Item 3) have originated from the damaged area of the suspect's vehicle as represented by Item 1?

TABLE 1

<u>WebCode</u>	<u>Item 1</u>		<u>WebCode</u>	<u>Item 1</u>	
	<u>Item 2</u>	<u>Item 3</u>		<u>Item 2</u>	<u>Item 3</u>
2V7P2U	No	No	EWKD4G	Yes	Yes
34GA26	Yes	Yes	EXA24N	Yes	Yes
3H2N64	Yes	Yes	G4UG8L	Yes	Yes
3L2Z24	Yes	Yes	G8UR4L	Yes	Yes
42QRWP	Yes	Yes	GCNU3E	Yes	Yes
4PVGQ3	Yes	Yes	GLUTGM	Yes	Yes
4VLQZ2	Yes	Yes	H7RGKN	Yes	Yes
6HP46P	Yes	Yes	HCYBEJ	Yes	Yes
7EBNFY	Yes	Yes	HQ48XL	Yes	Yes
8JCGMY	Yes	Yes	HRDFLC	Yes	Yes
9EY4FK	Yes	Yes	J8798D	Yes	Yes
9MU28T	Yes	Yes	KXCH4H	Yes	Yes
BF7XCW	Yes	Yes	KY798B	Yes	Yes
BHW4TM	Yes	Yes	LMMFW7	Yes	Yes
BLCR8R	Yes	Yes	MBB79G	Yes	Yes
BM3XMH	Yes	Yes	MC6WCA	Yes	Yes
BNFMQU	Yes	Yes	N3B7AE	Yes	Yes
BQ8L6T	Yes	Yes	NADCNH	Yes	Yes
BYHMQU	Yes	Yes	NTNA48	Yes	Yes
C7BFBT	Yes	Yes	PB36W7	Yes	Yes
C92LRJ	No	Yes	PFXYU8	Yes	Yes
CQM6NQ	No	Yes	PWJHRE	Yes	Yes
DDPKJJ	Yes	Yes	QD8TEG	Yes	Yes
E6VUFN	Yes	Yes	R6MCCY	Yes	Yes
ECN8BG	Yes	Yes	R73FT4	Yes	Yes
ED7W2N	Yes	Yes	RN3LZC	Yes	Yes

TABLE 1

WebCode	Item 1		WebCode	Item 1	
	Item 2	Item 3		Item 2	Item 3
RNNYQB	Yes	Yes			
RYHDL2	Yes	Yes			
TDXXHZ	Yes	Yes			
U22A6C	Yes	Yes			
UEPD92	Yes	Yes			
UUEGTC	Yes	Yes			
UW6M93	Yes	Yes			
VAQG38	Yes	Yes			
VKCLA8	Yes	Yes			
W2A6KZ	Yes	Yes			
X6UCL9	No	No			
X7JH3Y	Yes	Yes			
XX9GGX	Yes	Yes			
YNEQD3	Yes	Yes			
Z3C3L7	Yes	Yes			

Examination Response Summary				Participants: 67
Responses		Item 1		
		Item 2	Item 3	
Yes		63 (94.0%)	65 (97.0%)	
No		4 (6.0%)	2 (3.0%)	
Inc		0 (0%)	0 (0%)	

Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
2V7P2U	✓				✓					
34GA26	✓				✓					
3H2N64	✓				✓					
3L2Z24	✓	✓	✓		✓					
42QRWP	✓		✓	✓	✓			✓		
4PVGQ3	✓				✓					
4VLQZ2	✓				✓					
6HP46P	✓				✓				✓	Comparison Microscopy
7EBNfy	✓				✓					
8JCGMY	✓				✓	✓				
9EY4FK	✓				✓			✓		
9MU28T	✓				✓					optical microscopy
BF7XCW					✓					
BHW4TM	✓	✓		✓	✓	✓		✓		
BLCR8R	✓				✓			✓		
BM3XMH	✓		✓	✓				✓		
BNFMQU	✓			✓	✓					
BQ8L6T	✓			✓	✓			✓		
BYHMQU	✓		✓		✓			✓		
C7BFBT	✓				✓					Raman Microscope
C92LRJ	✓				✓					
CQM6NQ	✓	✓	✓		✓			✓		
DDPKJJ	✓		✓		✓	✓		✓		
E6VUFN					✓			✓		
ECN8BG	✓	✓	✓	✓	✓	✓		✓		Raman
ED7W2N					✓			✓		

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
EWKD4G	✓				✓	✓			✓	
EXA24N	✓	✓	✓		✓		✓		✓	
G4UG8L	✓	✓	✓		✓				✓	Raman Spectroscopy
G8UR4L	✓			✓	✓	✓				MLP
GCNU3E	✓	✓			✓				✓	
GLUTGM	✓				✓		✓			
H7RGKN	✓				✓				✓	
HCYBEJ	✓				✓	✓				Fluorescence
HQ48XL	✓	✓		✓	✓					
HRDFLC	✓		✓	✓	✓					
J8798D	✓				✓		✓		✓	pyrolysis-GC/MS
KXCH4H	✓				✓				✓	
KY798B	✓				✓			✓		
LMMFW7	✓				✓		✓		✓	
MBB79G	✓				✓				✓	
MC6WCA	✓	✓		✓	✓				✓	
N3B7AE	✓				✓				✓	
NADCNH	✓				✓					
NTNA48	✓		✓		✓					Dark and brightfield microscopy
PB36W7	✓	✓		✓	✓					
PFXYU8	✓	✓			✓	✓			✓	
PWJHRE	✓				✓				✓	Raman Spectroscopy
QD8TEG	✓		✓		✓				✓	
R6MICYC	✓	✓			✓		✓			
R73FT4	✓	✓	✓	✓	✓					
RN3LZC	✓			✓	✓				✓	
RNNYQB	✓				✓				✓	

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility / Chemical	Microspectrophotometry	XRF / XRS	SEM / EDX	Other
RYHDL2	✓				✓			✓		
TDXXHZ	✓	✓			✓			✓		
U22A6C	✓				✓					
UEPD92	✓	✓		✓	✓			✓		
UUEGTC	✓				✓					
UW6M93	✓	✓			✓					
VAQG38	✓	✓	✓		✓	✓		✓		
VKCLA8	✓				✓					✓
W2A6KZ	✓				✓		✓			
X6UCL9	✓				✓	✓				
X7JH3Y	✓	✓			✓			✓		PGC/MS
XX9GGX	✓	✓		✓	✓	✓		✓		
YNEQD3	✓	✓			✓		✓	✓		
Z3C3L7	✓					✓				

Response Summary										Total Participants: 67
	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	Microspectrophotometry	XRF/XRS	SEM/EDX	
Participants	64	19	15	15	65	9	7	6	35	
Percent	96%	28%	22%	22%	97%	13%	10%	9%	52%	

Conclusions

TABLE 3

WebCode	Conclusions
2V7P2U	The chemistries of the layers as found in FTIR-ATR imaging revealed that the paint systems represented by Items #2A and #3A could have originated from the same source. The chemistries of the layers as found in FTIR-ATR imaging revealed that the paint system represented by Item #1 likely originated from a different source as that represented by Items #2A and #3A.
34GA26	Results and Conclusions: 1. Item 1 consisted of one piece of painted metal having the paint layer sequence: clear / medium brown pearlescent metallic / medium grey / dark grey. 2. Items 2 and 3 each consisted of two pieces of painted metal having the paint layer sequence: clear / medium brown pearlescent metallic / medium grey / dark grey that were indistinguishable in physical characteristics and chemical composition from the paint sample, Item 1. The paint samples, Items 2 and 3, originated either from the source of the paint sample, Item 1, or from another source of paint indistinguishable in physical characteristics and chemical composition (see Result 3). 3. In a laboratory database of 1,117 paint layer sequences observed in casework, paint having the layer sequence: clear / brown metallic / grey / grey occurs with a frequency of approximately 0.2% (1 in 558 samples). It should be noted that each layer colour includes a variety of shades of colour and chemical compositions of paint. In this same database, none of the 1,117 paint layer sequences had the paint layer sequence: clear / brown pearlescent metallic / grey / grey.
3H2N64	The paint system from item 1 was consistent with the paint systems on items 2 and 3. This indicates that they are the same paints and originated from the same area.
3L2Z24	In my opinion, my findings provide very strong support for the proposition that both item 2 and item 3 (from the stop sign and the telephone pole respectively) originated from the suspect's vehicle represented by item 1.
42QRWP	1. I have considered the following propositions to evaluate my findings: a. The paint chips recovered from the stop sign and/or telephone pole originated from the damaged area of the suspect's vehicle. b. The paint chips recovered from the stop sign and/or telephone 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, that is, the paint chips recovered from the from the stop sign and telephone pole 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 findings provide strong support for the proposition that the paint chips recovered from the stop sign (Item 2) and telephone pole (Item 3) originated from the damaged area of the suspect's vehicle (Item 1).
4PVGQ3	Results: 1. Exhibit 1 consisted of one light brown pearlescent metallic paint chip having the layer sequence: clear / light brown pearlescent metallic / light grey / medium grey / metal. 2. Exhibits 2 and 3 each consisted of two light brown pearlescent metallic paint chips having the layer sequence: clear / light brown pearlescent metallic / light grey / medium grey / metal. The paint layers in these exhibits were physically and chemically indistinguishable from the corresponding paint layers in Exhibit 1. 3. In a laboratory database of 1117 vehicular paint samples encountered in casework, paint having the layer sequence clear / brown metallic / grey / grey occurred with a frequency of approximately 0.2% (1 in 558 samples). No samples in the database had the paint layer sequence: clear / brown pearlescent metallic / grey / grey. This database does not distinguish among different shades of colour or chemical composition. Conclusions: The light brown pearlescent metallic paint chips in Exhibits 2 and 3 originated either from the source of Exhibit 1, or from another source of paint having indistinguishable physical and chemical characteristics(see Result 3).

TABLE 3

WebCode	Conclusions
4VLQZ2	The items 02 and 03 may have the same source than item 01.
6HP46P	Item 1: One, four layer, light brown metallic paint standard was analyzed for comparison to item 2 and item 3. Item 2: Two, light brown metallic paint chips were found and one, four layer, light brown metallic paint chip was analyzed. In the sample analyzed, the unknown light brown metallic paint chip "recovered from the stop sign" and the standard paint "representative of the damaged area of the suspect's vehicle" (item 1) are the same in physical and chemical characteristics. The unknown paint "recovered from the stop sign" either originated from the standard or another source of paint possessing the same distinct physical and chemical characteristics. Item 3: Two, light brown metallic paint chips were found and one, four layer, light brown metallic paint chip was analyzed. In the sample analyzed, the unknown light brown metallic paint chip "recovered from the telephone pole" and the standard paint "representative of the damaged area of the suspect's vehicle" (item 1) are the same in physical and chemical characteristics. The unknown paint "recovered from the telephone pole" either originated from the standard or another source of paint possessing the same distinct physical and chemical characteristics.
7EBNFY	Item 1 (known paint sample from the damaged area of the suspect's vehicle): This paint chip consists of 4 paint layers, clearcoat, tan effectcolor, bright grey primer surfacer and dark grey first primer. Optically the effectcolor contains many glitters with different colors, light blue, dark blue, silver, orange, green and red. Item 2 (questioned paint chip from the stop sign): This paint chip consists of 4 paint layers, clearcoat, tan effectcolor, bright grey primer surfacer and dark grey first primer. No visible differences could be determined visually comparing each layer with the paint chip of sample 1. Also the colors of the glitters were similar. Item 3 (questioned paint chip from the telephone pole): This paint chip consists of 4 paint layers, clearcoat, tan effectcolor, bright grey primer surfacer and dark grey first primer. No visible differences could be determined visually comparing each layer with the paint chip of sample 1. Also the colors of the glitters were similar. The paint chips in question from the stop sign (Item 2) and the questioned paint chips from the telephone pole (Item 3) could probably have originated from the same source as the damaged area of the suspect's vehicle (Item 1).
8JCGMY	Examination of questioned Item 2 and known Item 1 revealed both paint chips with the following four (4) layer structures: Clear topcoat/ pearlescent black and brown basecoat/ light grey primer/ dark grey primer applied to silver metal substrate. The questioned paint chip recovered from the stop sign (Item 2) were found to be consistent with respect to layer structure, colour, coating thickness and chemical composition to the known paint sample from the damaged area of the suspect's vehicle (Item 1). Examination of questioned Item 3 and known Item 1 revealed both paint chips with the following four (4) layer structures: Clear topcoat/ pearlescent black and brown basecoat/ light grey primer/ dark grey primer applied to silver metal substrate. The questioned paint chip recovered from the telephone pole (Item 3) were found to be consistent with respect to layer structure, colour, coating thickness and chemical composition to the known paint sample from the damaged area of the suspect's vehicle (Item 1). Based on the above findings, in my professional opinion, questioned Items 2 and 3 could have originated from the same source represented by known Item 1.
9EY4FK	Examination of the paint chip recovered from the damaged area of the vehicle (Item 1): Item 1 comprised a paint sample with layer sequence: clear/tan metallic/light grey/grey. The clear layer was identified as a melamine-modified acrylic type paint. The tan layer was identified as a melamine-modified acrylic type paint containing metallic flake. The bulk elemental composition of the tan layer principally comprised aluminium, titanium, iron, potassium and sulfur. The light grey layer was identified as a melamine-modified isophthalic alkyd type paint. The bulk elemental composition of the light grey layer principally comprised titanium, aluminium and silicon. The grey layer was identified as a melamine-modified isophthalic alkyd type paint. The

TABLE 3

WebCode	Conclusions
	<p>bulk elemental composition of the grey layer principally comprised titanium, silicon, aluminium and sulfur. Examination of the paint chip recovered from the stop sign (Item 2): Item 2 comprised a paint sample with layer sequence: clear/tan/light grey/grey. The item corresponded in layer sequence, appearance and composition to Item 1. Examination of the paint chip recovered from the telephone pole (Item 3): Item 3 comprised a paint sample with layer sequence: clear/tan/light grey/grey. The item corresponded in layer sequence, appearance and composition to Item 1. Conclusion: The paint chips recovered from the stop sign and telephone pole (Items 2 and 3 respectively) are consistent in appearance and composition to the known paint sample taken from the damaged area of the suspect's vehicle (Item 1). These results support the proposition that contact occurred between the suspect's vehicle and the stop sign; and the suspect's vehicle and the telephone pole. The frequency of vehicles with paint systems indistinguishable from Item 1 is unknown.</p>
9MU28T	<p>The content of Item n° 1, Item n° 2, and Item n° 3 have been analyzed. Item n° 1 contains a multilayer chip representative of the damaged area of the suspect's vehicle. Item n° 2 contains multilayer paint chips recovered from the stop sign. Item n° 3 contains multilayer paint chips recovered from the telephone pole. The four layers of each sample are visually indistinguishable from each other. Hte comparative analyzes of the infrared absorption bands show that the infrared spectra of the paint systems contained in Item n° 1, Item n° 2, and Item n° 3 are indistinguishable. The paint chips recovered from the stop sign and the telephone pole could have hence originated from the damaged area of the suspect's vehicle.</p>
BF7XCW	<p>items 1, 2 and 3 could have been originated from the same source.</p>
BHW4TM	<p>The Exhibit 1 paint consisted of a four-layered automotive paint on a metal substrate. The layering sequence consisted of a clear/colorless top layer followed by a tan colored layer, a gray primer layer, and a dark gray primer layer. The paint from Exhibits 2 and 3 was analyzed and compared to the paint in Exhibit 1. Both the Exhibit 2 and 3 paints consisted of a four-layered automotive paint on a metal substrate. The Exhibit 2 and Exhibit 3 paints are consistent in physical and microscopical characteristics (including layer construction and color)and in elemental and chemical composition with each other and with the Exhibit 1 paint. The Exhibit 2 and Exhibit 3 paints could have originated from the same vehicle as the Exhibit 1 paint or from another source of paint with the same physical and microscopical characteristics and elemental and chemical composition. It should be noted that the analytical techniques used allow for a high degree of discrimination between different paints, however, other automotive paints may be manufactured to the same specifications that would be indistinguishable from the submitted evidence.</p>
BLCR8R	<p>The questioned paint chips, as represented by Item 2, from the stop sign may have been originated from the damaged area of the suspect's vehicle as represented by Item 1. The questioned paint chips, as represented by Item 3, from the telephone pole may have been originated from the damaged area of the suspect's vehicle as represented by Item 1.</p>
BM3XMH	<p>Based on the techniques used, the questioned paint chips collected from the stop sign (item 2) had the same appearance and chemical and elemental composition as the known paint chip collected from the damaged area of the suspect vehicle (item 1) and could have originated from it. Also,based on the techniques used, the questioned paint chips collected from the telephone pole (item 3) had the same appearance and chemical and elemental composition as the known paint chip collected from the damaged area of the suspect vehicle (item 1) and could have originated from it.</p>
BNFMQU	<p>Through physical study and chemical analysis practiced to the submitted evidence, it was determined for Item1, Item 2, and Item 3: - Do not have physical match with each other. - Consists of four layers (clear, light gold flakes, gray and dark gray) which are consistent in</p>

TABLE 3

WebCode	Conclusions
	color, width and sequence. -Item 1 have similar infrared spectra with Item 2 and Item3. -Item 1 have similar pyrograms with Item 2 and Item 3. -Item 1 was used as a control sample. -Item 1, Item 2 and Item 3 are consistent with a common origin.
BQ8L6T	The questioned paint chips recovered from the stop sign (item 2), the questioned paint chips recovered from the telephone pole (item 3) and the known paint sample representative of the damaged area of the suspect's vehicle (item 1) were consistent on color, layering and chemical composition and could have originated from the same source.
BYHMQU	The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show the same paint layers: clearcoat, grey effect basecoat, a bright-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 stop sign) and Item 3 (the sample from the telephone pole) cannot be differentiated from Item 1 by the used methods. The questioned paint samples Item 2 and Item 3 could have originated from the damaged area of the suspect's vehicle (Item 1).
C7BFBT	The submitted items were examined and analyzed by Stereo Microscope, FT-IR spectrometer and raman microscope. Item 1, 2 and 3 are all metallic paint and similar in physical appearance. The binder and pigment composition of Item 1, 2 and 3 are same type and same chemical structure, so Item 2 and 3 could have originated from Item 1.
C92LRJ	There are no optically discernible features of the three submitted paint systems. The source of the paint system representative of Item #2 is excluded from those representative of Items #1 and #3 owing to differences in the chemistries of the basecoat. The paint systems representative of Items #1 and #3 consist of four layers: a clear coat, a silver finish coat with decorative flake and two primers. The number, colors, and chemistries of the layers of the paint chips submitted for comparison from Item #1 and Item #3 are consistent with each other and cannot be excluded from originating from the same source, as represented by the items submitted.
CQM6NQ	The brown paint sample labeled "questioned paint chips from the stop sign", (item 2), displays differences in chemical composition as compared to the brown paint sample labeled "known paint sample from the suspect's vehicle", (item 1). Elimination. The brown paint sample labeled "questioned paint chips recovered from the telephone pole", (item 3), is consistent in color, physical characteristics, chemical composition, and elemental composition as compared to the brown paint sample labeled "known paint sample from the suspect's vehicle", (item 1). Level III association.
DDPKJJ	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, fluorescence, FTIR, and SEM-EDX. KNOWN STANDARD: Examination of the paint sample from the damaged area of the suspect vehicle (Item 1) revealed a piece of metal painted rose-gold reflective with the following layer structure: Clear, Rose-gold reflective, Light grey, Dark grey. QUESTIONED SAMPLES: Examination of the paint chips from the stop sign (Item 2) revealed two pieces of metal painted rose-gold reflective with the following layer structure: Clear, Rose-gold reflective, Light grey, Dark grey. The rose-gold reflective paint from the stop sign (Item 2) was visually and chemically consistent with the rose-gold reflective paint from the damaged area of the suspect vehicle (Item 1). Therefore, the rose-gold reflective paint from the stop sign (Item 2) could have originated from the same source as the rose-gold reflective paint from the damaged area of the suspect vehicle (Item 1). Examination of the paint chips from the telephone pole (Item 3) revealed two pieces of metal painted rose-gold reflective with the following layer structure: Clear, Rose-gold reflective, Light grey, Dark grey. The rose-gold reflective paint from the telephone pole (Item 3) was visually and chemically consistent with the rose-gold reflective paint from the damaged area of the

TABLE 3

WebCode	Conclusions
	suspect vehicle (Item 1). Therefore, the rose-gold reflective paint from the telephone pole (Item 3) could have originated from the same source as the rose-gold reflective paint from the damaged area of the suspect vehicle (Item 1).
E6VUFN	Conclusion: paint chips recovered from item 2 and item 3 have originated from the damaged area of the suspect's vehicle as represented by item 1.
ECN8BG	The questioned paint samples (Items 001-2 and 001-3) recovered from the stop sign and from the telephone pole were indistinguishable from the known paint sample (Item 001-1) recovered from the damaged area of the suspect's vehicle. Therefore, 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.
ED7W2N	1. Color : no reportable color difference in Item1, Item2, and Item3. 2. FT-IR analysis : Item1, Item2, and Item3 are composed with enamel acrylic in metallic layer and lacquer acrylic in gray layer.
EWKD4G	Items 1 through 3 were examined visually, microscopically, by chemical spot tests, by scanning electron microscopy with energy dispersive x-ray analysis and by infrared spectroscopy. Known paint (Item 1), reportedly from the suspect's vehicle, was examined and found to have the following layer sequence: clear over brown metallic over gray over dark gray. Questioned paints (Items 2 and 3), reportedly from the stop sign and telephone pole respectively, were examined and found to have the following layer sequence: clear over brown metallic over gray over dark gray. Known paint (Item 1), reportedly from the suspect's vehicle was found to be consistent with the questioned paints (Items 2 and 3) reportedly from the stop sign and telephone pole respectively, with respect to color, 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 paints (Items 2 and 3) are of the same type and could have come from the same source or any source exhibiting the same analyzed characteristics.
EXA24N	Questioned metallic tan paint chips reportedly collected from a stop sign (Item 2) and a telephone pole (Item 3) were compared to known metallic tan automotive paint reportedly collected from a suspect's vehicle (Item 1). Known and questioned paint chips were all observed to have a layering sequence of clear/metallic tan/light gray/dark gray. Samples of each layer of each item were analyzed and compared using one or more of the following methods: microscopy, fluorescence, infrared spectroscopy, microspectrophotometry, and scanning electron microscopy-energy dispersive spectroscopy. Each layer of the questioned paint chips was similar in all examinations performed to the respective layers of the known paint; therefore, Items 2 and 3 originated either from the vehicle as represented by Item 1 or another paint source indistinguishable from it (Level 3 - Association). Because other items have been manufactured that would be indistinguishable from Item 1, an individual source cannot be determined.
G4UG8L	The paint chips recovered from the stop sign (Item 2) and telephone pole (Item 3) could have originated from the damaged area of the suspect's vehicle as represented by Item 1.
G8UR4L	The Items 2 and 3 are consistent with Item 1.
GCNU3E	The Questioned Paint(Clear/Silver/Grey) analyzed in Item 2 and Item 3 is consistent with the Known Paint in Item 1 on the basis of color, layer structure, organic composition, and elemental composition.
GLUTGM	It was determined utilizing stereomicroscopic, comparison microscopic, Fourier Transform Infrared Spectroscopy and X-Ray Fluorescence Spectroscopy that the clearcoat layer, metallic champagne basecoat, light grey primer and dark grey primer layers from questioned paint

TABLE 3

WebCode	Conclusions
	<p>samples item 2 and item 3 are consistent to the clearcoat layer, metallic champagne basecoat, light grey primer and dark grey primer layer from the known paint sample, item 1. Therefore, the known paint sample item 1 cannot be eliminated as being the source of the questioned paint samples from item 2 and item 3.</p>
H7RGKN	<p>Known paint sample contained four apparent layers: clearcoat, metallic, light primer and dark primer. The same four layers were observed in both item #2 and item #3. No differences were observed between the known paint sample and either questioned sample.</p>
HCYBEJ	<p>The paint in items 2 and 3 is similar in color, layer structure, solubility, fluorescence, and infrared 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>
HQ48XL	<p>Items 2 and 3 were compared to Item 1. All three are OEM (original equipment manufacturer) paints with the following colored layer structure: clear coat/ tan metallic color coat/ gray primer/ dark gray primer. They are consistent in their physical characteristics, including color and layer structure, and chemical composition. Therefore, the questioned paint chips Items 2 and 3 either originated from the suspect's vehicle, as represented by Item 1, or another source of damaged automotive paint with the same analyzed characteristics.</p>
HRDFLC	<p>Item 1: Known paint sample representative of the damaged area of the suspect's vehicle; This item was used as a comparison standard. Item 2: Questioned paint chips recovered from the stop sign; The questioned paint chips recovered from the stop sign are similar in visual color, layer sequence, paint type, and paint composition to the known paint sample from the suspect's vehicle (Item 1). It is our opinion that these questioned paint chips could have come from the suspect's vehicle or any other source with similar characteristics. Item 3: Questioned paint chips recovered from the telephone pole; The questioned paint chips recovered from the telephone pole are similar in visual color, layer sequence, paint type, and paint composition to the known paint sample from the suspect's vehicle (Item 1). It is our opinion that these questioned paint chips could have come from the suspect's vehicle or any other source with similar characteristics.</p>
J8798D	<p>The metallic bronze paint in Items 2 and 3 was indistinguishable from the metallic bronze paint in Item 1 in color, polymer type, texture, layer structure, and elemental composition (Type 3 Association). This means that the unknown paint chips recovered from the stop sign and the telephone pole could have come from the suspect's vehicle. Trace Interpretation Scale Type 1 Association: Physical Match—The compared items exhibit physical features that demonstrate they were once part of the same object. Type 2 Association: Association with Distinctive characteristics—Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. The items further share distinctive characteristics that would not be typically encountered in the relevant population. Type 3 Association: Association with Conventional characteristics—Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. Because other items have been manufactured or are naturally occurring that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Type 4 Association: Association with limited characteristics and/or examination (1) Items are consistent in all measured and observed physical properties, chemical composition and/or microscopic characteristics, and therefore could have originated from the same source. This type of evidence may be commonly encountered in the environment or may have limited comparative value. Or (2) The comparison between items may be categorized as a Type 4 Association if the association is limited by the inability to perform a complete analysis or if minor variations are observed in the examination results. Inconclusive—No conclusion could be reached regarding an association or an elimination between the items.</p>

TABLE 3

WebCode	Conclusions
	Elimination—Items exhibit differences in one or more of the following: physical properties, chemical composition, or microscopic characteristics and therefore did not originate from the same source. Non-Association—The items were different in physical properties, chemical composition, and/or microscopic characteristics, indicating that the items did not originate from the same source. However, these differences were insufficient for a definitive elimination.
KXCH4H	The paint on Item 1 (Vehicle), Item 2 (Sign), and Item 3 (Pole) were analyzed using optical microscopy, IR microspectrometry, and SEM-EDS. Optical micrographs of the cross sections of each sample show that they are grossly similar in the number of layers, the visual appearance of the layers, and their order of application (dark gray base coat, light gray second coat, dark red third coat, and transparent colorless top coat). IR microspectrometry found that the chemistry of each layer of Item 2 and Item 3 was grossly similar to the chemistry of the corresponding layer in Item 1 (base coat/second coat was polyester-melamine primer with titanium dioxide, dark red coat was an acrylic melamine enamel, and the transparent colorless top coat was melamine enamel). SEM-EDS confirmed the presence of four layers in all three Items, and determined that the compositions were similar (Gray base coat was organic rich in titanium; gray second coat was organic rich in titanium; dark red coat was heterogeneous organic with nitrogen and platy inclusions rich in aluminum, silicon, iron, and titanium; transparent colorless top coat was homogeneous organic with nitrogen). The minor and trace substituents were also consistent across samples, with all observed variations consistent with typical microscopic variations in heterogeneous materials such as paint. In conclusion, Item 1 cannot be excluded as a possible source for Item 2 or for Item 3.
KY798B	Items 1, 2, and 3 all consist of a three layer automotive paint system with a clearcoat, tan metallic basecoat, and gray primer layer on a metal substrate. The paint systems on Items 2 and 3 are consistent in all examined characteristics to the paint system on Item 1. Therefore, Items 2 and 3 could have originated from the same source as Item 1 or a similarly painted source.
LMMFW7	The multilayered paint fragments from the 'damaged area on the suspect's vehicle' (Item 1) and the questioned paint fragments recovered from the 'stop sign' (Item 2) and the 'telephone pole (Item 3) each consisted of a clear top coat, a brown/red metallic 2nd layer, a grey undercoat 3rd layer and a dark grey undercoat 4th layer. No significant differences in the appearance and the chemical and elemental composition were detected between the paint fragments from the 'damaged area on the suspect's vehicle' (Item 1) and the questioned paint fragments recovered from the 'stop sign' (Item 2) and the 'telephone pole (Item 3). In my opinion, the paint fragments recovered from the 'stop sign' (Item 2) and the 'telephone' pole (Item 3) could have originated from the same source as the paint from the 'damaged area on the suspect's vehicle' (Item 1). However, I could not exclude the possibility that the paint fragments recovered from the 'stop sign' (Item 2) and the 'telephone pole (Item 3), originated from another vehicle with the same paint layer sequence and composition.
MBB79G	The analysis revealed that the measured physical and chemical properties of the recovered paint samples (Item #2 and Item #3) are similar to the physical and chemical properties of the paint from the suspect's vehicle (Item #1). The paint from the suspect's vehicle cannot be excluded as the source of the recovered paint samples.
MC6WCA	The questioned paint from Exhibits 2 and 3 corresponded to the known paint in Exhibit 1 in layer structure (clear, bronze/tan, light grey, dark grey), microscopic characteristics (PLM), chemical composition (FTIR and PGC-MS), and elemental composition (SEM-EDS). Therefore, the paint in Exhibits 2 and 3 could have come from the same source as Exhibit 1. It should be noted that the analytical techniques used allow for a high degree of discrimination between different paint; however, other paint may have been manufactured to the same specifications that would be indistinguishable from the submitted evidence.

TABLE 3

WebCode	Conclusions
N3B7AE	Therefore, it is plausible to conclude that the questioned paint chips recovered from the stop sign (Item 2) and telephone pole (Item 3) have originated from the damaged area of the suspect's vehicle as represented by Item 1.
NADCNH	The source of item 1 is included as a possible source of items 2 and 3, based on class characteristics including physical and chemical properties.
NTNA48	Paint from the suspect's vehicle (Item #1) consists of four layers. These are consistent with a regular car paint system (primer, surfacer, effect layer, clearcoat). The paint system was examined microscopically. In addition, the paint layers were isolated manually and analyzed individually using FTIR. Paint from the suspect's vehicle (Item #1) was compared to the traces recovered from the stop sign (Item #2) and the telephone pole (Item #3) using microscopy and infrared spectrometry. The results indicate that Item #2 and Item #3 cannot be discriminated from each other nor from item #1. Two hypotheses were defined to evaluate these results: Hypothesis 1: The suspect's vehicle is the source of the of the questioned paint samples (items #2 and #3). Hypothesis 2: An arbitrary other tan car is the source of the of the questioned paint samples (items #2 and #3). In these hypotheses, both questioned samples (items #2 and #3) are evaluated together, as the results show that they cannot be discriminated. The results strongly support the hypothesis that the vehicle (item #1) is the source of the paint samples recovered from the stop sign (item #2) and the telephone pole (item #3).
PB36W7	Item 1 (01-01-AA): This item was used for comparison purposes. Item 2 (01-02-AA): This item contains two automotive paint chips. The questioned paint chips are similar in visual color to the known paint from the suspect vehicle (01-01-AA). A portion of one of these paint chips was further analyzed and is similar in layer sequence, paint type, and paint composition to the known paint from the suspect vehicle (01-01-AA). It is my opinion that the questioned paint could have come from the suspect vehicle or any other surface with similar paint characteristics (Category 2B). No further analysis was performed on the remaining paint chip. Item 3 (01-03-AA): This item contains two automotive paint chips. The questioned paint chips are similar in visual color to the known paint from the suspect vehicle (01-01-AA). A portion of one of these paint chips was further analyzed and is similar in layer sequence, paint type, and paint composition to the known paint from the suspect vehicle (01-01-AA). It is my opinion that the questioned paint could have come from the suspect vehicle or any other surface with similar paint characteristics (Category 2B). No further analysis was performed on the remaining paint chip.
PFXYU8	The following methodologies were used in the examination of this case: visual examination, microscopy, solubility and chemical tests, FTIR, and SEM-EDX. KNOWN STANDARD: Examination of Lab Item #1 revealed the presence of a tan reflective paint chip with the following layer structure: clear, tan with reflective flake, light gray, and dark gray on a metal substrate. QUESTIONED SAMPLES: Examination of Lab Items #2 and 3 revealed the presence of tan reflective paint chips with the following layer structure: clear, tan with reflective flake, light gray, and dark gray on a metal substrate. The tan reflective paint chips recovered from the stop sign (Lab Item #2) and the telephone pole (Lab Item #3) were found to be physically and chemically consistent with the tan reflective paint chip collected from the damaged area of the suspect's vehicle (Lab Item #1). Therefore, the tan reflective paint chips from Lab Items #2 and 3 could have originated from the same source as the tan reflective paint chip from Lab Item #1.
PWJHRE	The questioned paint chips marked "Item 2" and "Item 3", recovered from the stop sign and telephone pole respectively, could have originated from the same source as the paint sample marked "Item 1", collected from the damaged area of the suspect's vehicle, or another source of paint with similar characteristics.

TABLE 3

WebCode	Conclusions
QD8TEG	The chemical and physical compositions of the paint layers in Items 2 and 3 are consistent with the compositions of the paint layers in Item 1.
R6MCYC	The submitted paint from item 1 was examined and compared to 1 of the exhibits from items 2 and 3 using polarized light microscopy, visible microscopy, microspectrophotometry and fourier transform infrared spectroscopy (FTIR). The examined exhibits from items 2 and 3 and item 1 each consist of 4 layers. The 4 layers of items 2 and 3 and item 1 are consistent in appearance, microscopic and chemical properties. Thus, items 2 and 3 could have originated from item 1 as represented by the examined samples in items 2 and 3 and item 1 or another paint source exhibiting the same analyzed characteristics and layer structure. No analysis was performed on the remaining exhibits in items 2 and 3. Therefore, no conclusions can be reached on these samples.
R73FT4	01: 3x6 yellow envelope ->01-01: Question paint recovered from the stop sign (Item 2) ->The paint recovered from the stop sign is similar in physical characteristics, paint type, and paint composition to the known paint from the suspect's vehicle (01-03). It is our opinion that the paint could have come from the suspect's vehicle or any other vehicle with similar paint characteristics. (Category 2B) ->01-02: Question paint recovered from the telephone pole (Item 3) ->The paint recovered from the telephone pole is similar in physical characteristics, paint type, and paint composition to the known paint from the suspect's vehicle (01-03). It is our opinion that the paint could have come from the suspect's vehicle or any other vehicle with similar paint characteristics. (Category 2B) ->01-03: Known paint from the suspect's vehicle (Item 1) ->This item was used for comparison purposes.
RN3LZC	Physical and chemical examinations indicate that Items 1, 2 and 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 categories and their descriptions are meant to provide context to the conclusions reached in this report. Every category may not be applicable in every case nor for every 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. Elimination – The items exhibit exclusionary differences that demonstrate they

TABLE 3

WebCode	Conclusions
	did not originate from the same source.
RNNYQB	Item 1, 2, and 3 consist of multiple layers including clear coat, metallic coat, and base coat. Each layer from Item 1, 2, and 3 showed similar chemical composition as results of chemical analysis. Therefore, Item 2 and Item 3 could have originated from the same source as Item 1.
RYHDL2	The known paint sample from the damaged area of the suspect's car (item 1) was found to consist of a clear top layer, a silver tan metallic second layer, a light grey third layer and a dark grey fourth layer. The paint chips recovered from the stop sign (item 2) were also found to consist of a clear top layer, a silver tan metallic second layer, a light grey third layer and a dark grey fourth layer. In relation colour, chemical composition and elemental composition all four layers of the paint recovered from the stop sign (item 2) were found to be indistinguishable to corresponding layers of the paint from the suspect's car (item 1). Therefore these two paint samples may share a common origin. The paint chips recovered from the telephone pole (item 3) were also found to consist of a clear top layer, a silver tan metallic second layer, a light grey third layer and a dark grey fourth layer. In relation colour, chemical composition and elemental composition all four layers of the paint recovered from the telephone pole (item 3) were found to be indistinguishable to corresponding layers of the paint from the suspect's car (item 1). Therefore these two paint samples may share a common origin.
TDXXHZ	The known paint sample item 1 from the damaged area of the suspect's vehicle comprised a 4-layered paint chip, with a colourless topcoat, a metallic brown second layer, a light grey third layer and a dark grey fourth layer. The questioned paint chips item 2 and item 3 recovered from the stop sign & the telephone pole respectively, were both found to comprise 4-layered paint chips with colour, layer structure and chemical composition agreeing with the known paint sample item 1. Therefore, both the questioned paint chips in item 2 and item 3 could have come from the same source as item 1.
U22A6C	Based on the analyses performed, Item 2 could have originated from the same source as Item 1 or from another paint source with the same physical and chemical characteristics. Based on the analyses performed, Item 3 could have originated from the same source as Item 1 or from another paint source with the same physical and chemical characteristics.
UEPD92	1. Exhibit 1 (known paint standard from damaged area of suspect's vehicle), Exhibit 2 (questioned paint chips from the stop sign), and Exhibit 3 (questioned paint chips from the telephone pole) each consist of multi-layered paint chip(s) on an apparent metal substrate. The following layer structure was observed in each Exhibit: a. Layer 1: Colorless clearcoat, b. Layer 2: Medium brown basecoat with effect pigment, c. Layer 3: Medium blue-grey primer, d. Layer 4: Dark grey primer. 2. Comparative examinations of Exhibits 2 and 3 (questioned paint samples) with Exhibit 1 (known paint standard) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the questioned paint chips in Exhibits 2 and 3 could have originated from the suspect's vehicle as represented by Exhibit 1, or another source of automotive paint with the same characteristics. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.
UUEGTC	Item 2 and Item 3 could have originated from Item 1.
UW6M93	The four-layer automotive type paint sampled from Items 1 (Known - suspect's vehicle), 2 (Questioned - stop sign), and 3 (Questioned - telephone pole) were found to be similar in appearance, microscopic characteristics, and organic composition (FTIR). The damaged area of the suspect's vehicle cannot be excluded as a possible source of the foreign paint found on the stop sign and telephone pole.
VAQG38	The known four-layer paint sample (Item 1) was submitted for comparison to questioned

TABLE 3

WebCode	Conclusions
	<p>four-layer paint samples (Items 2 and 3). Each item had a paint layer sequence of clear/brown-gray metallic/light gray/dark gray. Samples of each item were analyzed and compared using one or more of the following techniques: stereomicroscopy, polarized light microscopy, fluorescence, infrared spectroscopy (IR), microspectrophotometry, scanning electron microscopy - energy dispersive spectroscopy (SEM-EDS). Each layer of the sampled questioned paint in Items 2 and 3 was similar to the respective layer of the sampled known paint in Item 1 in all tests performed. The questioned paints reportedly recovered from the stop sign and telephone pole originated either from the vehicle as represented by Item 1 or from another paint source with indistinguishable properties. Because other vehicles or items may have been painted with paint that would also be indistinguishable from the submitted evidence, an individual source cannot be determined.</p>
VKCLA8	<p>According to the result of forensic analysis, the components and color of item1, item2, and item3 are similar each other. Thus, we speculate that item2 and item3 originally came from item1.</p>
W2A6KZ	<p>Observations, Analysis, and Conclusions: The paint samples submitted in Exhibits 1, 2, and 3 were examined visually and with the aid of a stereomicroscope to compare their layer structures and visual appearance. In all respects, these features were indistinguishable between the three exhibits. The chemical compositions of the corresponding paint layers in Exhibit 1-3 were assessed and compared using Fourier-Transform Infrared Spectroscopy and were also found to be indistinguishable. The pigmented layers were further examined using X-ray Fluorescence Spectroscopy to assess elemental composition; no exclusionary differences were detected. Therefore, the vehicle represented by Exhibit 1, or another damaged vehicle with an applied paint system with all the same visual, chemical and elemental characteristics, could be the source of both paints collected at the scene (Exhibits 2 and 3).</p>
X6UCL9	<p>The questioned paint chips represented by item 2 and item 3 could not have originated from the damaged area of the suspect vehicle represented by item 1.</p>
X7JH3Y	<p>Examinations and comparisons were performed in order to determine if there is evidence of an association between the damaged area of the suspect's vehicle, the stop sign and/or the telephone pole. Item 1: Item 1, which was collected from the damaged area of the suspect's vehicle, contains one (1) paint chip with the following layer structure: 1. Clear colorless topcoat, 2. Gold metallic and pearlescent acrylic-melamine-styrene finishcoat, 3. Light gray polyester-melamine primer, 4. Dark gray polyester-melamine primer. This paint chip was found to exhibit characteristics consistent with an original automotive paint layer system, and it was used as a standard sample for comparison purposes. Item 2: Item 2 consists of two (2) paint chips having the following layer structure: 1. Clear colorless topcoat, 2. Gold metallic and pearlescent acrylic-melamine-styrene finishcoat, 3. Light gray polyester-melamine primer, 4. Dark gray polyester-melamine primer. Further instrumental examinations were performed on both of the Item 2 paint chips. These paint chips exhibit characteristics consistent with an original automotive paint layer system. Microscopical and instrumental examinations and comparisons between the Item 2 paint chips and the Item 1 standard paint sample revealed that they are alike with respect to the layer colors, layer textures, layer sequences, decorative flake content of Layer 2, detailed binder characteristics and elemental composition of the respective layers. It is therefore concluded that the Item 2 paint chips recovered from the stop sign originated from the damaged area of the suspect's vehicle or another source having these same characteristics. Item 3: Item 3 consists of two (2) paint chips having the following layer structure: 1. Clear colorless topcoat, 2. Gold metallic and pearlescent acrylic-melamine-styrene finishcoat, 3. Light gray polyester-melamine primer, 4. Dark gray polyester-melamine primer. Further instrumental examinations were performed on both of the Item 3 paint chips. These paint chips exhibit characteristics consistent with an original automotive paint layer system.</p>

TABLE 3

WebCode	Conclusions
	<p>Microscopical and instrumental examinations and comparisons between the Item 3 paint chips and the Item 1 standard paint sample revealed that they are alike with respect to the layer colors, layer textures, layer sequences, decorative flake content of Layer 2, detailed binder characteristics and elemental composition of the respective layers. It is therefore concluded that the Item 3 paint chips recovered from the telephone pole originated from the damaged area of the suspect's vehicle or another source having these same characteristics.</p>
XX9GGX	<p>CONCLUSIONS: The questioned paint chips recovered from the stop sign (item 2) and the telephone pole (item 3) are the same distinct type of paint as the known paint on the suspect vehicle (item 1) and originated either from that source or another source of automotive paint having the same distinct characteristics. RESULTS: The questioned paint chips recovered from the stop sign (item 2) and the telephone pole (item 3) were examined for the purpose of determining whether or not there is any paint present like that on the suspect vehicle (item 1). The paint standard from the suspect vehicle (item 1) has the following layer structure: 1. Colorless acrylic-melamine enamel clearcoat, 2. Medium yellow-brown acrylic-melamine enamel basecoat with effect pigment (Gold), 3. Medium grey polyester-melamine enamel primer 4. Dark grey polyester-melamine enamel primer. This paint exhibits characteristics typical of an original automotive finish and was used for comparison with questioned paint chips recovered from the stop sign (item 2) and the telephone pole (item 3). Examination and comparison of the questioned paint chips recovered from the stop sign (item 2) and the telephone pole (item 3) with 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 chips recovered from the stop sign (item 2) and the telephone pole (item 3) are the same distinct type of paint as the known paint on the suspect vehicle (item 1) and originated either from that source or another source of automotive paint having the same distinct characteristics. METHODS OF ANALYSIS: Examinations were performed visually, by stereo microscopy, brightfield/polarized light comparison microscopy, microchemical tests, Fourier transform infrared microspectroscopy, pyrolysis gas chromatography, and scanning electron microscopy/energy dispersive x-ray analysis.</p>
YNEQD3	<p>Results of Examination 1. Layer structure determination: a. Microscopic examination of questioned paint Q1a and Q1b (item 2), questioned paint Q2a and Q2b (item 3), and known paint K (item 1) disclosed the following layer structure on all five paint samples: clearcoat (layer 1), thin brown metallic colorcoat (layer 2), grey primer (layer 3), thin dark grey primer (layer 4) metal substrate. 2. Instrumental analysis and comparison result: a. Questioned paint Q1a and known paint K are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. b. Questioned paint Q2a and known paint K are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. c. The questioned paint Q1b and Q2b were not instrumentally analyzed, therefore no further conclusions can be made at this time. Interpretation of Results: 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 K or from another source exhibiting all of the same analyzed characteristics.</p>
Z3C3L7	<p>On analysis, I found that Item 2 and Item 3 were similar to Item 1. Hence, I am of the opinion that the questioned paint chips recovered from the stop sign (Item 1) and telephone pole (Item 3) could have originated from the damaged area of the suspect's vehicle (Item 1).</p>

Additional Comments

TABLE 4

WebCode	Additional Comments
3L2Z24	If a real case, I would have requested either scene photos or a scene report regarding the type of damage to the vehicle and the type of deposits seen on the stop sign and telephone pole.
EXA24N	An Association Scale would also be included in my report. The definition of the association used in this report is the following: - 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.
GCNU3E	The Questioned Paint analyzed in Item 2 and Item 3 could share a common source with the Known Paint in Item 1. It should be noted that in the absence of a fracture match between paint flakes, paint does not possess enough individual chemical and microscopic characteristics to be positively identified as originating from a particular source to the exclusion of all other sources. The conclusions in this report only pertain to the point that was analyzed from each Submission and makes no assumptions about the entire contents of each Submission.
HQ48XL	Methods of Analysis: Paint chips were examined using visual examination, stereomicroscopy, high power comparison microscopy, polarized light microscopy (PLM), and Fourier transform infrared spectroscopy (FTIR). Clear coats were also examined using pyrolysis gas chromatography-mass spectrometry (PGC-MS).
N3B7AE	All three items are tan colored paint chips that consist of a brown enamel acrylic layer, where round, reflective glitter that contains aluminium(Al) and titanium(Ti) is mixed within, and a grey lacquer acrylic layer.
NADCNH	For another paint system to be included as a possible source of items 2 and 3, it would have to display the same physical and chemical properties as the unknown items.
PWJHRE	The paint chips marked "Item 1", "Item 2" and "Item 3" were each found to consist of an outermost clear colourless layer, a second red-brown layer with pearlescent and metallic effects, a third light grey layer and a fourth dark grey layer. The paint chips marked "Item 1" to "Item 3" were found to have no significant difference from one another in terms of colour, number and sequence of layers and chemical composition.
UUEGTC	Results from microscopic examination indicated all paint chips: Item 1, Item 2 and Item 3 contained two distinct layers with similar color and thickness. Top layer FTIR spectra of all three items were identical. The library search indicated that the material is related to acrylate polymer. Bottom layer FTIR spectra of all three items were also almost identical. The library search indicated that the material is related to alkyd resin.
UW6M93	My examinations and analyses do not focus on the detection of inorganic materials. The three paint samples may vary in their inorganic content.
VAQG38	The associations described would also include a label from the range of conclusions on the association scale that would be at the end of the report.
X6UCL9	The questioned paint chips represented by item 2 and item 3 could have originated from the same source.

-End of Report-
(Appendix may follow)

Test No. 21-5451: Paint Analysis

DATA MUST BE SUBMITTED BY **April 26, 2021, 11:59 p.m.** TO BE INCLUDED IN THE REPORT

Participant Code: U1234K

WebCode: B6MNLG

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

Scenario:

Police are investigating the robbery of a local jewelry store. Witnesses described a tan car driving erratically away from the store. When police arrived at the scene, they found damage to a near by stop sign and telephone pole. Police were able to recover paint chips from the stop sign and telephone pole. Soon after, the police acquired a suspect whose vehicle matched the witness' description and had damage to the passenger side of the vehicle. A known paint sample was taken from the damaged area of the vehicle. Police are requesting that you examine the recovered paint chips and determine if they could have originated from the damaged area of the suspect's 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 supplemental 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 the suspect's vehicle.

Item 2: Questioned paint chips recovered from the stop sign.

Item 3: Questioned paint chips recovered from the telephone pole.

1.) Could the questioned paint chips recovered from the stop sign (Item 2) and/or telephone pole (Item 3) have originated from the damaged area of the suspect's vehicle as represented by Item 1?

	Yes	No	Inconclusive
Item 2:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 3:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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

Please check all that apply.

Microscopic Exams:	<input type="checkbox"/> Stereomicroscope	<input type="checkbox"/> Polarized Light
	<input type="checkbox"/> Fluorescence	
<input type="checkbox"/> Pyrolysis GC	<input type="checkbox"/> FTIR	<input type="checkbox"/> Solubility/Chemical
<input type="checkbox"/> XRS/XRF	<input type="checkbox"/> SEM/EDX	<input type="checkbox"/> Microspectrophotometry
Other (specify): <input type="text"/>		

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

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

4.) Additional Comments

RELEASE OF DATA TO ACCREDITATION BODIES

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

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

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

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

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

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

A2LA Certificate No.

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

Authorized Contact Person and Title

Laboratory Name

Location (City/State)