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FORENSIC TESTING PROGRAM

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Paint Analysis Test No. 19-545 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 67 participants and are compiled in the following tables:

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 vehicle. Items 2 and 3 were sets of questioned paint chips recovered from the damaged area of the child's bike and the curb, respectively. Participants were requested to examine the questioned paint chips and determine if either could have originated from the damaged area of the 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. The panel which made up Item 3 was made with the same basecoat and primer, but contained a different clear coat.

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 ½" x ½" 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 ¼" x ¼" 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 ¼" x ¼" 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, XRS/XRF, 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 basecoat, primer, and clear coat. Item 3 was prepared with the same basecoat and primer, but contained a different clear coat. (Refer to Manufacturer's Information for preparation details).

Of the 67 participants that reported examination results in Table 1, 67 (100%) reported that the Item 2 questioned paint chips could have originated from the same source as the item 1 known paint sample and 65 (97%) reported that the Item 3 paint chips could not have originated from the same source as the Item 1 known paint sample. The two remaining participants reported that Item 3 could have originated from the same source as the Item 1 known paint sample.

The most common 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 vehicle represented by Item 1?

TABLE 1

WebCode	Item 1 Item 2	Item 1 Item 3	WebCode	Item 1 Item 2	Item 1 Item 3	WebCode	Item 1 Item 2	Item 1 Item 3
2UMJ36	Yes	No	CLVVN4	Yes	No	PULMQD	Yes	No
36V9AT	Yes	No	CUP7T8	Yes	No	QEKMYL	Yes	No
3ARHCK	Yes	No	CVEEUV	Yes	No	QKCRTQ	Yes	No
46XLL9	Yes	No	CYDV7P	Yes	No	QL3ZUE	Yes	No
47NUMW	Yes	No	CZFBR3	Yes	No	QUWYRE	Yes	No
4AN6JW	Yes	No	DKD7YV	Yes	No	QZ4CPD	Yes	No
4HFB6P	Yes	No	F7MQTG	Yes	No	RATDPN	Yes	No
7BEVR9	Yes	No	FHZ9J6	Yes	No	RL3DYL	Yes	No
7JNCB2	Yes	No	FY8BFR	Yes	No	RT2X6N	Yes	No
7VL7R6	Yes	No	GC8HNT	Yes	No	TJQVJM	Yes	No
824XGA	Yes	No	HPQKJQ	Yes	No	V6LG8H	Yes	No
82KAYF	Yes	No	J7EB3Q	Yes	No	W7R9T4	Yes	No
83G6PR	Yes	No	J8BZFE	Yes	No	W7VLMR	Yes	No
83U7HY	Yes	No	JDFMYM	Yes	No	WH37QZ	Yes	Yes
8ENM8Y	Yes	No	KGBBZA	Yes	No	WMXKBL	Yes	No
8MHTZZ	Yes	No	KPQF7U	Yes	No	X8Z8G6	Yes	No
AAMB96	Yes	No	KVCCTV	Yes	No	XARPRJ	Yes	No
AN73NY	Yes	No	KXFHEB	Yes	Yes	ZBBMU8	Yes	No
B9BUT7	Yes	No	LMD32W	Yes	No	ZJ4X7M	Yes	No
BPDHXQ	Yes	No	LNMYKF	Yes	No			
BYMHKT	Yes	No	NUN3CQ	Yes	No			
C947PX	Yes	No	P7C497	Yes	No			
CAKADX	Yes	No	PKHYR9	Yes	No			
CEBKMV	Yes	No	PT8BUT	Yes	No			

Examination Response Summary

Participants: 67

Responses	Item 1 / Item 2	Item 1 / Item 3
Yes	**67** *(100%)*	**2** *(3.0%)*
No	**0** *(0%)*	**65** *(97.0%)*
Inc	**0** *(0%)*	**0** *(0%)*

Examination Methods

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
2UMJ36	✓				✓	✓				
36V9AT	✓				✓	✓				
3ARHCK	✓				✓					raman
46XLL9	✓	✓			✓			✓	✓	
47NUMW	✓	✓			✓					
4AN6JW	✓				✓		✓	✓		
4HFB6P	✓				✓		✓			Raman spectroscopy
7BEVR9	✓	✓	✓		✓	✓				
7JNCB2	✓				✓					
7VL7R6	✓				✓			✓	✓	
824XGA	✓	✓		✓	✓					
82KAYF	✓		✓		✓			✓	✓	RAMAN
83G6PR	✓				✓					
83U7HY	✓				✓					
8ENM8Y	✓				✓			✓		
8MHTZZ	✓				✓		✓			
AAMB96	✓		✓		✓	✓		✓		
AN73NY	✓			✓	✓					
B9BUT7	✓	✓	✓		✓		✓		✓	
BPDHXQ	✓				✓			✓		
BYMHKT	✓				✓					Raman Microscope
C947PX	✓				✓			✓		comparison microscopy
CAKADX				✓	✓					
CEBKMV	✓				✓			✓		
CLVVN4	✓	✓	✓		✓		✓		✓	
CUP7T8	✓				✓					
CVEEUV	✓				✓					
CYDV7P	✓	✓	✓		✓		✓	✓		Raman spectroscopy

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
CZFBR3	✓		✓		✓			✓		
DKD7YV	✓		✓	✓	✓		✓			
F7MQTG	✓				✓					
FHZ9J6	✓	✓	✓		✓					
FY8BFR	✓				✓			✓		
GC8HNT	✓				✓					
HPQKJQ	✓			✓	✓					
J7EB3Q	✓	✓		✓	✓			✓		
J8BZFE	✓				✓					
JDFMYM	✓				✓			✓		Raman
KGBBZA	✓		✓	✓	✓		✓	✓		
KPQF7U	✓		✓		✓			✓		
KVCCTV	✓	✓		✓	✓					
KXFHEB	✓		✓		✓			✓		
LMD32W	✓		✓		✓	✓		✓		Raman Microscopy
LNMYKF	✓	✓		✓	✓	✓				
NUN3CQ	✓				✓			✓		Raman spectroscopy
P7C497					✓					
PKHYR9					✓	✓				
PT8BUT	✓				✓					
PULMQD	✓	✓	✓		✓			✓		
QEKMYL	✓				✓					Comparison Compound Microscopy
QKCRTQ	✓		✓		✓	✓		✓		
QL3ZUE	✓				✓	✓				
QUWYRE	✓		✓		✓			✓		
QZ4CPD	✓				✓	✓				
RATDPN	✓		✓		✓	✓		✓		Compound Microscopy
RL3DYL	✓		✓		✓			✓	✓	Pyrolysis GC/MS
RT2X6N	✓	✓			✓			✓	✓	Comparison Microscope

TABLE 2

WebCode	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry	Other
TJQVJM	✓				✓			✓		RAMAN
V6LG8H	✓			✓	✓		✓	✓		
W7R9T4	✓		✓		✓	✓				
W7VLMR	✓				✓			✓		
WH37QZ	✓			✓	✓					
WMXKBL	✓			✓	✓					high power microscopy
X8Z8G6	✓			✓	✓			✓		colorimetry
XARPRJ	✓	✓	✓		✓		✓		✓	
ZBBMU8	✓	✓		✓	✓			✓		
ZJ4X7M	✓				✓		✓			

Response Summary

	Participants	Stereomicroscope	Polarized Light	Fluorescence	Pyrolysis GC	FTIR	Solubility/ Chemical	XRS/XRF	SEM/EDX	Microspectrophotometry
	67	64	15	20	14	67	12	11	30	8
Percent		*96%*	*22%*	*30%*	*21%*	*100%*	*18%*	*16%*	*45%*	*12%*

Conclusions

TABLE 3

WebCode	Conclusions
2UMJ36	On analysis, I found the questioned paint chips recovered from the damaged area of the child's bike "Item 2" was similar with the known paint sample representative of the damaged area of the vehicle "Item 1". I also found that the questioned paint chips recovered from the curb "Item 3" was not similar with the known paint sample representative of the damaged area of the vehicle "Item 1".
36V9AT	On analysis, I found that Item 2 was similar to Item 1. Hence, I am of the opinion that the questioned paint chips recovered from the damaged area of the child's bike (Item 2) could have originated from the damaged area of the vehicle(Item 1).
3ARHCK	The questioned paint chips recovered from the damaged area of the child's bike (Item 2) and the known paint sample representative of the damaged area of the vehicle (Item 1) were consistent on color, layering and chemical composition and could have the same source. The questioned paint chips recovered from the curb (Item 3) and the known paint sample (Item 1) were inconsistent on chemical composition and could not have the same source.
46XLL9	The Item 1.1 paint standard is a four-layer paint consisting of a clear coat, green metallic color coat, white primer, and gray primer. The 1.1 paint standard was compared to the Items 1.2 paint transfer and 1.3 paint transfer. The Item 1.2 paint standard is a four-layer paint consisting of a clear coat, green metallic color coat, white primer, and gray primer. The 1.2 paint transfer is similar in color, layer structure, and chemical composition to the 1.1 paint standard. Therefore, the 1.2 paint transfer could have originated from the 1.1 paint standard or another source with the same color, layer structure, and chemical composition. This is a Type III association as described in the Association Scale included in this report. The Item 1.3 paint standard is a four-layer paint consisting of a clear coat, green metallic color coat, white primer, and gray primer. The 1.3 paint transfer is different in chemical composition to the 1.1 paint standard. Therefore, the 1.3 paint transfer could not have originated from the 1.1 paint standard. This is an elimination. [Attachment not provided by participant.]
47NUMW	1. Envelope containing known paint sample representative of the damaged area of the vehicle -multi-layer paint: grey, white, green with decorative flake and clearcoat 2. Envelope containing questioned paint chips recovered from the damaged area of the child's bike - multi-layer paint: grey, white, green with decorative flake and clearcoat 3. Envelope containing questioned paint chips recovered from the curb - multi-layer paint: grey, white, green with decorative flake and clearcoat Item Description Finding Conclusion #2 Questioned paint Same color, texture, microscopical characteristics, layer structure and chemical composition as Item #1 Could have originated from the same source1 #3 Questioned paint Different chemical composition from Item #1 Exclusion 1This association is not exclusive; other manufactured items with the same characteristics may exist. Remarks The evidence is being returned to your department. Digital images are being retained at [laboratory]. Analytical Detail These findings were determined using microscopical examination techniques and instrumental analyses. [Participant submitted manually formatted data that was not transferrable into the final report, therefore, data is presented as is.]
4AN6JW	Comparison Result: a. Questioned paint Q1a and known paint K1 are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. b. Q1b was not instrumentally analyzed, therefore no conclusions can be made regarding this particle. c. Questioned paint Q2 (layer 1) and the known paint K1 (layer 1) are different with respect to chemical type as determined by FTIR instrumental analysis. Interpretation of Results: 1. It is the opinion of the undersigned that

TABLE 3

WebCode	Conclusions
	questioned paint Q1a could have originated from the same source as represented by the known submitted exemplar K1 or from another source exhibiting all of the same analyzed characteristics. 2. It is the opinion of the undersigned that questioned paint Q2 could not have originated from the same source as represented by the known paint K1 submitted.
4HFB6P	Each of Item 1 to Item 3 was found to consist of four layers of automotive coating on a metal substrate: a top clear layer, a second green metallic layer, a third white layer and a fourth grey layer. (a) The corresponding layers in Item 1 and Item 2 were compared with each other and found to be indistinguishable in terms of their layer sequence, colour and chemical composition, indicating that the two questioned paint chips recovered from the damaged area of the child's bike (Item 2) could have originated from the damaged area of the suspect's vehicle (Item 1), or from another source of paint with similar characteristics. (b) The clear layers in Item 1 and Item 3 were found to be different in terms of their chemical composition, indicating that the two questioned paint chips recovered from the curb (Item 3) did not originate from the damaged area of the suspect's vehicle (Item 1).
7BEVR9	Item #1 consists of a known paint chip with the following layer structure: 1. clear coat top coat 2. green metallic color coat 3. white primer 4. grey primer; Item #2 consists of two(2)questioned paint chips with the following layer structure: 1. clear coat top coat 2. green metallic color coat 3. white primer 4. grey primer; Item #3 consists of two(2)questioned paint chips with the following layer structure: 1. clear coat top coat 2. green metallic color coat 3. white primer 4. grey primer; Microscopic, microchemical, and instrumental analysis (micro-FTIR) of the known paint chip (item#1), one(1) of the questioned paint chips from item#2, and one(1) of the questioned paint chips from item#3 yielded the following results and conclusions: the known paint chip (item#1) and the questioned paint chip from item#2 are consistent with respect to color, texture, type, and layer structure. Therefore, the questioned paint chip from item#2 could have originated from the source represented by item#1, or another vehicular paint exhibiting the same characteristics (color, texture, type, and layer structure). the known paint chip and the questioned paint chip from item #3 are dissimilar with respect to type. Therefore, the questioned paint chip did not originate from the painted surface represented by item#1.
7JNCB2	The source of item 1 is included as a possible source of item 2, based on class characteristics including color, layer structure and chemical composition. For another item to be included as a possible source of item 2, it must display the same class characteristics including color, layer structure and chemical composition. The source of item 1 is excluded as a possible source of item 3, based on class characteristics including chemical composition.
7VL7R6	The paint chip in Item 2 corresponded in color and layer structure (clear, green, white, grey), chemical composition (FTIR), visible spectra (MSP), and elemental composition (SEM/EDS) to the known paint in Item 1. 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 paint chips in Item 3, though visibly similar in color and layer structure, are 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. Instrument and Equipment Acronyms: FTIR – Fourier Transform Infrared Spectroscopy, MSP – Microspectrophotometry, SEM/EDS – Scanning Electron Microscopy/Energy Dispersive Spectroscopy. Interpretation: The following descriptions are

TABLE 3

WebCode	Conclusions
	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.
824XGA	The paint recovered from the victim's bike (Item 2) is similar in visual color, layer sequence, paint type, and composition to the paint from the suspect's vehicle (Item 1). It is my opinion that this paint could have originated from the suspect's vehicle or any other vehicle with similar paint. The paint recovered from the curb (Item 3) is dissimilar in paint type to the paint from the suspect's vehicle (Item 1). It is my opinion that this paint did not originate from the sampled area of the suspect's vehicle. Please note that different areas of a vehicle can exhibit different paint layer systems.
82KAYF	Item 2 could not be distinguished from Item 1. Item 3 could be distinguished from Item 1 by the composition of the clearcoat.
83G6PR	The spectra of the three coating layers of item 2 were consistent with the spectra of item 1. The top coat spectrum of item 3 was not consistent with the spectrum of the top coat of item 1. The coating from item 2 likely originated from the damaged area of the vehicle represented by item 1. The coating from item 3 did not match the coating from item 1.
83U7HY	Item 2, questioned paint chips from the damaged area of the child's bike, could have originated from the damaged area of the vehicle represented in Item 1. Item 3, questioned paint chips recovered from the curb, could not have originated from the damaged area of the vehicle represented in Item 1.
8ENM8Y	The questioned paint chips recovered from the damaged area of the child's bike (Item 2) may be originated from the damaged area of the the vehicle (Item 1). The questioned paint chips recovered from the curb (Item 3) may not be originated from the damaged area of the vehicle (Item 1).
8MHTZZ	The infrared absorption spectra of the first and second paint layers are identical to each other, and the contained metal components are similar. On the other hand, the infrared absorption

TABLE 3

WebCode	Conclusions
	spectra of the first and third paint layers are different from each other, and the contained metal components also differ.
AAMB96	Items 1, 2, and 3 were examined visually and using stereomicroscopy, fluorescence microscopy, and Fourier Transform Infrared Spectrophotometry (FTIR). Items 1 and 2 were further examined using microsolubility tests, a microchemical test and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The Item 1 and 2 multilayered green paint particles with decorative flake were consistent in colors, textures, types, layer sequence, and chemical compositions. Based on the samples analyzed, it was concluded that the Item 1 and 2 green paint particles either originated from the same source or different sources painted in the same manner. The multilayered green paint particles with decorative flake in Items 1 and 3 could not be associated due to differences in chemical composition. Date(s) of testing: 03/15/2019 - 04/08/2019. Supporting examination documentation is maintained in the case file. The above listed methods are those approved for use at the time of analysis.
AN73NY	[No Conclusions Reported.]
B9BUT7	The known four-layer paint sample (Item 1) was submitted for comparison to questioned four-layer paint samples (Items 2 and 3). Each sample had a layer sequence of clear/dark green 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, micro X-ray fluorescence (XRF). Each layer of the questioned paint in Item 2 was similar to the respective layer of the known paint in Item 1 in all tests performed. The questioned paint reportedly recovered from the damaged area of the bicycle originated from either the vehicle as represented by Item 1 or from another paint source with indistinguishable properties (Level 3 - Association; see Association Scale below [Table 4- Additional Comments]). 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. The upper two layers of the questioned paint in Item 3 were dissimilar in chemistry by IR to the respective layers of the known paint in Item 1. The questioned paint reportedly recovered from the curb did not originate from the vehicle as represented by the known paint sample in Item 1 (Elimination/Non-association). Additional known paint samples may be submitted for comparison to the questioned paint recovered from the curb (Item 3), if desired.
BPDHXQ	Sample 2 is consistent with Sample 1 by IR and EDX, and Sample 1 is a potential source of Sample 2. The top two layers of paint material in Sample 3 are distinguishable from the corresponding layers of Sample 1 by IR. Thus, Sample 1 could not be a source of Sample 3.
BYMHKT	1.Visual and microscopic examinations – Item 1, Item 2 and Item 3 are the metallic paint distinguishable in their appearance; microscope examinations all three Items have similar in physical appearance. 2.Chemical analysis and comparisons: 2.1 The pigment and primer compositions of Item 2 and 3 are same type with Item 1 in Raman and FTIR technique respectively. 2.2 The binder composition of all Item in FTIR technique are same type but difference in chemical structure, by Item 1 and Item 2 are same type but not same as Item 3. 3.Conclusions – Item 2 could have originated from known paint sample Item 1.
C947PX	Item 1: In the sample analyzed, a four layer metallic green paint standard was analyzed for comparison to Items 2 and 3. Item 2: A four layer metallic green paint chip was found. In the sample analyzed, the unknown paint (Item 2 "recovered from the damaged area of the child's bike") and the standard paint (Item 1 "representative of the damaged area of the vehicle") are the same in physical and chemical characteristics. The unknown paint (Item 2) either

TABLE 3

WebCode	Conclusions
	originated from the standard (Item 1) or another source of paint possessing the same distinct physical and chemical characteristics. Item 3: A four layer metallic green paint chip was found. In the sample analyzed, the unknown paint (Item 3 "recovered from the curb") and the standard paint (Item 1 "representative of the damaged area of the vehicle") are not the same in physical and chemical characteristics. The unknown paint (Item 3) could not have originated from the standard (Item 1).
CAKADX	[No Conclusions Reported.]
CEBKMV	Clearcoat and pigment layers of Item #2 are consistent with the reference paint #1. Clearcoat and pigment layers of Item #3 are not consistent with the reference paint #1.
CLWN4	Questioned multiple-layer paint chips recovered from a bike (Item 2) and from a curb (Item 3) were compared to a known multiple-layer paint chip from a vehicle (Item 1) using microscopy, fluorescence, infrared spectroscopy, and microspectrophotometry (MSP). The questioned paint from Item 2 was also compared to the known paint from Item 1 using X-ray fluorescence. Each item consisted of four layers of paint over a metal substrate: clear over green over light gray over gray. Each layer of questioned paint from Item 2 was similar in all tests performed to the respective layer of known paint from Item 1. Therefore, the questioned paint from the bike (Item 2) originated either from the vehicle represented by Item 1 or another source of paint with similar characteristics. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. The clear and green layers of questioned paint from Item 3 differed in chemistry from the respective layers of known paint from Item 1. Therefore, the questioned paint from the curb (Item 3) did not originate from the area of the vehicle represented by Item 1.
CUP7T8	EXAMINATION INFORMATION: Items #1, #2 and #3 were examined using optical microscopy and Fourier Transform Infrared Spectroscopy (FTIR) using attenuated total reflectance on the exposed surfaces. Items #1 and #2 were further examined using infrared microscopic imaging using attenuated total reflectance. RESULTS AND INTERPRETATION: There are no optically discernible features of the three submitted paint systems. The source of the paint system representative of Item #3 is excluded from those representative of Items #1 and #2 owing to differences in the chemistries of the clear coat (topcoat). The paint systems representative of Items #1 and #2 consist of four layers: a clear coat, a green finish coat with decorative flake and two primers. The number, colors, and chemistries of the layers of the paint systems submitted for comparison from Item #1 and Item #2 are consistent with each other and cannot be excluded from originating from the same source, as represented by the items submitted.
CVEEUV	[No Conclusions Reported.]
CYDV7P	Paint chips Item 2. can originate from the damaged area of vehicle represented by paint sample Item 1. Paint chips Item 3. can not originate from the damaged area of vehicle represented by paint sample Item 1.
CZFBR3	The paint chips from the curb (item 3) were found to be different from the known paint sample of the damaged area of the vehicle (item 1). Differences were found in the chemical properties of the clear coats (observed by infrared spectroscopy) and slightly in those of the green effect coat layers. The paint chips from the childs bike (item 2) could not be differenciated from the known paint sample of the damaged area of the vehicle (item 1) using infrared spectroscopy, stereomicroscopy, fluorescence and SEM/EDX.
DKD7YV	In my opinion the findings provide very strong support for the proposition that Item 2 (Questioned sample from the damaged area of the bike) originated from Item 1 (Known from

TABLE 3

WebCode	Conclusions
	damaged area of the vehicle). Item 3 (Questioned sample from the curb) could not have originated from Item 1 based on different chemical compositions of the clear and green layers.
F7MQTG	1. Item 1 consisted of one piece of painted metal having the paint layer sequence: clear / dark green metallic / light grey / dark grey. 2. Item 2 consisted of two pieces of painted metal having the paint layer sequence: clear / dark green metallic / light grey / dark grey that were indistinguishable in physical characteristics and chemical composition from the paint sample, Item 1. The paint sample, Item 2, originated either from the source of Item 1 or from another source of paint indistinguishable in physical characteristics and chemical composition (see Result 4). 3. Item 3 consisted of two pieces of painted metal having the paint layer sequence: clear / dark green metallic / light grey / dark grey. The clear paint layer was different in physical characteristics and chemical composition from the clear paint layer of Item 1. The dark green metallic paint layer was indistinguishable in physical characteristics, but different in chemical composition, from the dark green metallic paint layer of Item 1. The light grey and dark grey paint layers were indistinguishable in physical characteristics and chemical composition from the corresponding paint layers of Item 1. The paint sample, Item 3, did not originate from the source of Item 1 (see Remark 1). 4. In a laboratory database of paint layer sequences observed in casework, 10 of the 1,060 automotive paint entries (approximately 1 in 106 samples) have the paint layer sequence: clear / green metallic / grey / grey. It should be noted that each layer colour includes several shades of colour and chemical compositions of paint. Remarks: 1. The term “source” refers to the particular area of the vehicle from which the paint sample was taken.
FHZ9J6	All the three samples labelled item 1, item 2 and item 3 have been analyzed. Within the limits of the used analatycal methods, we conclude that: the paint chips recovered from the damaged area of the child's bike (item 2) could have originated from the damaged area of the vehicle (item1). the paint chips recovered from the curb (item 3) doesn't come from the damaged area of the vehicle (item 1).
FY8BFR	The multi-layered paint from the damaged area of the vehicle (item 1) consisted of a clear top coat, green metallic second coat, off-white to very light grey third coat and grey fourth coat. The paint recovered from the damaged area of the child's bike (item 2)consisted of a clear top coat, green metallic second coat, off-white to very light grey third coat and grey fourth coat. In relation to colour, chemical composition and elemental composition these layers were found to be indistinguishable from the corresponding layers from the vehicle (item 1). Therefore the paint from these items may share a common origin. The paint recovered from the curb (item 3)consisted of a clear top coat, green metallic second coat, off-white to very light grey third coat and grey fourth coat.The chemical composition of the clear top coat and green metallic second coat were different to the corresponding coats from the vehicle (item 1) and therefore the paint from the curb could not have originated from the vehicle.
GC8HNT	Item 1 is originated from item 2. The layer structure and composition of item 1 paint is the same as item 2. Item 3 differs from Item 1 in some constituent.
HPQKJQ	Item 1, 2, and 3 were examined using stereommicroscopy, Fourier Transform Infrared Spectrophotometry(FTIR), and pyrolisys gas chromatography mass spectrometry (py-GC/MS). The green paint chips in Item 1 and 2 were consistent in colors and chemical compositions. Based upon the results, it was concluded that the paint chips in Item 1 and 2 could have originated from the same source.
J7EB3Q	The green metallic paint in item 2 was visually, microscopically, and instrumentally consistent with the green metallic paint in item 1. This indicates that the green metallic paints in items 1 and 2 could share a common origin. The green metallic paint in item 3 was instrumentally

TABLE 3

WebCode	Conclusions
	different from the green metallic paint in item 1. This indicates that the green metallic paints in items 1 and 3 do not share a common origin.
J8BZFE	After analysis, I found: i) question paint chips Item 2 is similar to known paint sample item 1. ii) question paint chips Item 3 is not similar to known paint sample item 1. In view of the above findings, I am of the opinion that the questioned paint chips Item 2 is originated from the damaged area of the suspect's vehicle.
JDFMYM	Examination of the known paint sample representative of the damaged area of the vehicle (Item 1). Item 1 comprised a paint sample with layer sequence: clearcoat/green metallic/light grey/dark grey. The clearcoat was identified as a polyurethane modified acrylic containing melamine and styrene type paint. Bulk elemental composition of the clearcoat principally comprised silicon and sulfur. The green metallic layer was identified as an acrylic/polyurethane/melamine/styrene type paint. Bulk elemental composition of the green metallic layer principally comprised barium, titanium, sulfur, silicon, aluminium, potassium and bromine. The light grey layer was identified as isophthalic alkyd type paint containing melamine. Bulk elemental composition of the light grey layer principally comprised barium, titanium, sulfur, silicon and aluminium. The dark grey layer was identified as isophthalic alkyd type paint containing melamine. Bulk elemental composition of the dark grey layer principally comprised titanium, silicon, aluminium and iron. Examination of the questioned paint chips recovered from the damaged area of the child's bike (Item 2). Item 2 comprised a paint sample with layer sequence: clearcoat/green metallic/light grey/dark grey. The layer colour, layer sequence and composition of Item 2 correspond with Item 1. Therefore, the results support the proposition that the paint recovered from the child's bike (Item 2) originated from the damaged area of vehicle (Item 1). Examination of the questioned paint chips recovered from the curb (Item 3). Item 3 comprised a paint sample with layer sequence: clearcoat/green metallic/light grey/dark grey. The composition of clear layer from Item 3 did not correspond with the composition of the clear layer from Item 1. Therefore, the results do not support the proposition that the paint recovered from the curb (Item 3) originated from the damaged area of vehicle (Item 1).
KGBBZA	Item 2, questioned paint chips recovered from the damaged area of the child's bike, could have come from the damaged area of the vehicle (known paint sample; item 1). As paint is mass produced, item 2 could have come from other vehicles that were painted using a similar paint system. Item 3, paint chips recovered from the curb, did not come from the damaged area of the vehicle.
KPQF7U	Item 2 and Item 3 were analyzed and compared to Item 1. Analysis of Item 2 revealed that the microscopic and chemical characteristics are like those of Item 1. It is concluded that Item 2 is of the same distinct type of paint as Item 1 and originated from the same source or from another source of paint having the same characteristics. Analysis of Item 3 revealed that the chemical characteristics are dissimilar from those of Item 1. It is concluded that Item 3 could not have originated from Item 1.
KVCCTV	The apparent paint recovered from the victim's bicycle (Item 2) was determined to be paint that is similar in color, layer sequence, paint type, and paint composition to the known paint from the damaged area of the vehicle (Item 1). It is our opinion that this paint (Item 2) could have come from the damaged area of the vehicle (Item 1) or any paint with similar characteristics. The apparent paint recovered from the crime scene (Item 3) was determined to be paint that is similar in color and layer sequence, but dissimilar in paint type and paint composition to the known paint from the damaged area of the vehicle (Item 1). It is our opinion that this paint (Item 3) did not originate from the damaged area of the vehicle (Item 1).

TABLE 3

WebCode	Conclusions
KXFHEB	The compositions of the paint chips in Items 2 and 3 are consistent with the composition of the paint sample in Item 1.
LMD32W	The paint in Item 2 is similar in color, layer sequence, and chemical composition to the paint in Item 1; therefore, the paint in Item 2 could have originated from the same area of the same paint source represented by the paint sample in Item 1, or an identically painted object. The paint in Item 3 is dissimilar in chemical composition to the paint in Item 1; therefore, the paint in Item 3 did not originate from the same area of the same paint source represented by the paint sample in Item 1.
LNMYKF	Item 2 is consistent with Item 1. The questioned paint chips recovered from the child's bike could have originated from the damanged area of the vehicle. Item 3 is not consistent with Item 1. The questioned paint chips recovered from the curb did not originate from the damanged area of the vehicle.
NUN3CQ	All items consist of 4 layers: 1- clear coat, 2- green metallic layer, 3- white, 4- gray. The composition of layer 3 and 4 in each item is similar. Item 1 and 2 differ significantly from item 3 in respect of chemical composition of polymer binder. Item 1 and 2 contain similar polymers and pigments in layers 1 and 2.
P7C497	Based on FTIR spectra, Item 1 and Item 2 may share a common origin. Item 1 and Item 3 do not share a common origin.
PKHYR9	On analysis, I found that Item 2 sample have originated from Item 1, meanwhile Item 3 sample not originated from Item 1.
PT8BUT	EXAMINATION INFORMATION: Items #1, #2 and #3 were examined using optical microscopy and Fourier Transform Infrared Spectroscopy (FTIR) using attenuated total reflectance on the exposed surfaces. Items #1 and #2 were further examined using infrared microscopic imaging using attenuated total reflectance. RESULTS AND INTERPRETATION: There are no optically discernible features of the three submitted paint systems. The source of the paint system representative of Item #3 is excluded from those representative of Items #1 and #2 owing to differences in the chemistries of the clear coat (topcoat). The paint systems representative of Items #1 and #2 consist of four layers: a clear coat, a green finish coat with decorative flake and two primers. The number, colors, and chemistries of the layers of the paint systems submitted for comparison from Item #1 and Item #2 are consistent with each other and cannot be excluded from originating from the same source, as represented by the items submitted.
PULMQD	Item 1 Examined by stereomicroscopy. The paint sample labeled “known paint sample from the vehicle” is a green, decorative flake paint sample. 1.1 Portion of paint sample prepared for microscopic examination. Examined by light microscopy, reflected light microscopy, polarized light microscopy, fluorescence microscopy, and comparison microscopy. 1.2 Portion of paint sample prepared for infra-red examination. Examined by Fourier Transform infra-red spectroscopy. 1.3 Portion of paint sample prepared for elemental examination. Examined by scanning electron microscopy / energy dispersive X-ray detection. Item 2 Examined by stereomicroscopy. The paint sample labeled “questioned paint chips recovered from the bicycle” is a green, decorative flake, paint sample. 2.1 Portion of paint sample prepared for microscopic examination. Examined by light microscopy, reflected light microscopy, polarized light microscopy, fluorescence microscopy, and comparison microscopy. 2.2 Portion of paint sample prepared for infra-red examination. Examined by Fourier Transform infra-red spectroscopy. 2.3 Portion of paint sample prepared for elemental examination. Examined by scanning electron microscopy / energy dispersive X-ray detection. The green paint sample

TABLE 3

WebCode	Conclusions
	labeled “questioned paint chips recovered from the bicycle”, (item 2), is consistent in physical characteristics, chemical composition, and elemental composition as compared to the green paint sample labeled “known paint sample from the vehicle”, (item 1). Level III association. Item 3 Examined by stereomicroscopy. The paint sample labeled “questioned paint chips recovered from the curb” is a green, decorative flake, paint sample. 3.1 Portion of paint sample prepared for microscopic examination. Examined by light microscopy, reflected light microscopy, polarized light microscopy, fluorescence microscopy, and comparison microscopy. 3.2 Portion of paint sample prepared for infra-red examination. Examined by Fourier Transform infra-red spectroscopy. 3.3 Portion of paint sample prepared for elemental examination. Examined by scanning electron microscopy / energy dispersive X-ray detection. The green paint sample labeled “questioned paint chips from the curb”, (item 3), displays differences in chemical composition and elemental composition as compared to the green paint sample labeled “known paint sample from the vehicle”, (item 1). Elimination.
QEKMYL	The four-layer paint sampled from items 1 (Known from vehicle) and 2 (Questioned from bike) were found to be similar in appearance (stereomicroscope), color (comparison microscope), microscopic characteristics (compound microscope), and organic chemical composition (FTIR). The damaged portion of the vehicle (or another surface with similar paint composition) cannot be excluded as a possible source of the paint found on the child's bike. The clear top paint layers and the green metallic base coat layers sampled from items 1 (Known from vehicle) and 3 (Questioned from curb) were found to be dissimilar in organic chemical composition (FTIR). The damaged portion of the vehicle is not the source of the paint found on the curb.
QKCRTQ	Items 1, 2, and 3 were examined using stereomicroscopy, compound microscopy, fluorescence microscopy, Fourier Transform Infrared Spectrophotometry (FTIR). Items 1 and 2 were further examined using microsolubility tests, microchemical tests, and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The multilayered dark green paint particles with decorative flake in Items 1 and 2 were consistent in colors, textures, types, layer sequence, and chemical compositions. Based upon the particles examined, it was concluded that the paints in Items 1 and 2 either originated from the same source or different sources painted in the same manner. Based upon the particles examined, the dark green paint particles with decorative flake in Items 1 and 3 could not be associated due to differences in chemical composition.
QL3ZUE	On analysis, I found that: (a) The questioned paint chips recovered from the damaged area of the child's bike (Item 2) to be similar to known paint sample representative of the damaged area of the vehicle (Item 1). (b) The questioned paint chips recovered from the curb (Item 3) to be dissimilar to known paint sample representative of the damaged area of the vehicle (Item 1). Hence, I am of the opinion that the questioned paint chips recovered from the damaged area of the child's bike (Item 2) could have originated from the damaged area of the vehicle (Item 1).
QUWYRE	The known paint sample Item 1 comprised 4 layers. From the top layer to the bottom layer were colourless, green, white and grey respectively. The appearance, colour, layer structure and the chemical composition of the questioned paint sample Item 2 were found to agree with those of the known paint sample Item 1, suggesting that these two paint samples could have originated from the same source. The chemical composition of the first layer of the paint sample Item 3 was found to differ from that of the known paint sample Item 1, suggesting that these respective paint samples did not originate from the same source.
QZ4CPD	On analysis, I found that : 1) Questioned paint chips recovered from the damaged area of the child's bike (Item 2) to be similar with the known paint sample representative of the damaged

TABLE 3

WebCode	Conclusions
	area of the vehicle (Item 1). 2) Questioned paint chips recovered from the curb (Item 3) to be dissimilar with the known paint sample representative of the damaged area of the vehicle (Item 1). Hence, I am of the opinion that, 1) Item 2 could have originated from Item 1, 2) Item 3 did not originated from Item 1
RATDPN	Items 1, 2, and 3 were examined visually and using stereomicroscopy, fluorescence microscopy, and Fourier Transform Infrared Spectrophotometry (FTIR). Items 1 and 2 were further examined using compound microscopy, microsolubility tests, microchemical tests, and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The multilayered dark green paint particles with decorative flake in Items 1 and 2 were consistent in colors, textures, types, layer sequence, and chemical compositions. Based upon the particles examined, it was concluded that the paints in Items 1 and 2 either originated from the same source or different sources painted in the same manner. Based upon the particles examined, the multilayered dark green paint particles with decorative flake in Item 3 could not be associated with the Item 1 multilayered dark green paint particles with decorative flake due to differences in chemical composition.
RL3DYL	Items 1, 2, and 3 were examined by stereomicroscopy and infra-red spectroscopy. Items 1 and 2 were additionally examined by microspectrophotometry, scanning electron microscopy/energy-dispersive x-ray spectrometry, and pyrolysis gas chromatography/mass spectrometry. The metallic dark green paint in Item 2 was indistinguishable from the metallic dark green paint in Item 1 in color, polymer type, texture, layer structure and elemental composition (Type 3 Association). This means that the paint recovered from the damaged area of the child's bike could have come from the damaged area of the vehicle. The metallic dark green paint in Item 3 was different from the metallic dark green paint in Item 1 (Elimination). This means that the questioned paint recovered from the curb did not originate from the damaged area of the 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. 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.

TABLE 3

WebCode	Conclusions
RT2X6N	The paint on item 2 could have originated from item 1 as represented by the known submitted exemplar, or from another source exhibiting all of the same analyzed/measured characteristics. The paint on item 3 could not have originated from the source represented by item 1.
TJQVJM	Microscopic analysis conducted on the three items revealed that they are similar in their layer structure and layer colors. Each item consists of paint with four layers: a colorless layer, an effect green layer, a beige layer and a black layer. The organic analysis (FTIR), the pigment analysis (RAMAN) and the inorganic analysis (SEM-EDX) made upon the four layers of the items 1 and 2, showed no differences between them. The organic analysis (FTIR) made upon clear coat and top coat layers of items 1 and 3 produced different spectra. According to the microscopic and analytical results, questioned paint chips recovered from the curb (item 3) can't come from the suspect vehicle (item 1). Nevertheless, questioned paint chips recovered from the child's bike (item 2) were undistinguishable in color, pigment, inorganic and organic composition from samples recovered on the suspect vehicle (item 1). Therefore, it can't be excluded than samples recovered from the child's bike come from the suspect vehicle or from a vehicle with a similar paint.
V6LG8H	1. Examinations of Exhibit 1 (known paint sample representative of the damaged area of the vehicle) and Exhibit 2 (questioned paint chips recovered from the damaged area of the child's bike) disclosed the presence of green metallic paint chips. The paint chips have a four-layer paint system with the following color and layer sequence: clear coat/green metallic basecoat/light gray primer/dark gray primer. Comparative examinations of Exhibit 1 with Exhibit 2 disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. Therefore, Exhibit 2 could have originated from Exhibit 1 or another source with the same characteristics. 2. Examinations of Exhibit 3 (questioned paint chips recovered from the curb) disclosed the presence of green metallic paint chips. Comparative examinations of Exhibit 1 with Exhibit 3 disclosed them to be inconsistent in their elemental compositions. Therefore, Exhibit 3 could not have originated from Exhibit 1. 3. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.
W7R9T4	The paint in item 2 is similar in color, layer structure, solubility, fluorescence and infrared 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 infrared absorbance spectra. Therefore the paint in items 1 and 3 could not have originated from the same source.
W7VLMR	The questioned dark green paint chips marked as "Item 2", recovered from the damaged area of the child's bike, could have originated from the same source as the dark green paint chips marked as "Item 1", collected from the damaged area of the vehicle, or another source of paint with similar characteristics. The questioned dark green paint chips marked as "Item 3", recovered from the curb, did not originate from the same source as the dark green paint chips marked as "Item 1", collected from the damaged area of the vehicle.
WH37QZ	Through physical study and chemical analysis practiced to the submitted evidence, it was determined: The multilayer green paint particles Item 1, Item 2 and Item 3 were consistent in color, textures, types, layer sequence and chemical composition. The Item 1 paint particle was used as control sample.
WMXKBL	Items 1 and 2 are consistent in color, appearance, layer sequence and chemical composition. Item 3 is different from Item 1 in chemical composition of clear coat. Therefore, the paint chips recovered from the damaged area of the child's bike, Item 2, could have originated from the

TABLE 3

WebCode	Conclusions
	damaged area of the vehicle, Item 1, or another damaged vehicle with paint having the same analyzed characteristics. The paint chips recovered from the curb, Item 3, could not have originated from the damaged area of the vehicle. Item 1.
X8Z8G6	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 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/Exclusion – The items exhibit meaningful differences that demonstrate they did not originate from the same source.
XARPRJ	Known green automotive paint (Item 1), reportedly collected from a damaged area of a vehicle, was compared to questioned green paint chips reportedly collected from the damaged area of a bike (Item 2) and from a curb (Item 3). Known and questioned paint chips were all observed to have a layering sequence of clear/green/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 X-ray fluorescence. Each layer of the questioned paint recovered from the bike (Item 2) was similar in all examinations performed to the respective layers of the known paint. Item 2 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. The clear layer of the questioned paint recovered from the curb (Item 3) was dissimilar in chemistry to the clear layer of the known paint. Item 3 did not originate from the vehicle as represented by Item 1 (Elimination). However, all other layers of Item 3 were similar in all examinations performed to

TABLE 3

WebCode	Conclusions
	the respective layers of Item 1. If additional areas of the vehicle were damaged, please submit additional known paint samples from these areas for comparison to Item 3.
ZBBMU8	The vehicle (as represented by item 1) was eliminated as a possible source of the paint recovered from the curb (item 3). Therefore, item 3 did not come from item 1. The vehicle (as represented by item 1) could not be eliminated as a possible source of the paint recovered from the child's bike (item 2). As such, item 2 either came from item 1 or from another source of paint that is indistinguishable from item 1 with respect to the properties listed in the results. Other sources of paint indistinguishable from item 1 would include other vehicles of the same colour manufactured at the same plant during the time this paint formulation was in use.
ZJ4X7M	It was determined utilizing stereomicroscopic, comparison microscopic, Fourier Transform Infrared Spectroscopy and X-Ray Fluorescence Spectroscopy that the metallic green paint from item 1 and item 2 exhibit consistent chemical and optical properties. Therefore, the known sample from item 1 cannot be eliminated as being the source of the questioned paint. It was determined utilizing stereomicroscopic, comparison microscopic, Fourier Transform Infrared Spectroscopy and X-Ray Fluorescence Spectroscopy that the metallic green paint from item 1 and item 3 exhibit dissimilar chemical properties. Therefore, the known sample from item 1 can be eliminated as being the source of the questioned paint. All items are being stored in proficiency test file.

Additional Comments

TABLE 4

WebCode	Additional Comments
B9BUT7	Note #1: Elemental analysis was conducted using micro XRF because our SEM-EDS instrument is down. Note #2, to be included in report: Association Scale for Trace 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 1 - Identification: A physical match or fracture match; items physically fit back to one another, indicating that the items were once a single object or from the same source. Level 2 - High Degree of Association: 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 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. Level 4 - Limited Association: 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 3 association, items categorized within a Level 4 share characteristics that are more common amongst these kinds of manufactured products or are commonly encountered in the environment. Alternatively, an association between items would be categorized as a Level 4 if a limited analysis was performed due to characteristics or size of the specimen(s). Level 5 - Inconclusive Association: 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. Unsuitable for comparison: No conclusion could be reached regarding an association/elimination between the items. Elimination (Non-association): The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source. Inconclusive Non-association: The items appear to exhibit some dissimilarities; however, there are significant limiting factors in the samples (such as lacking in quantity, quality and/or detail) that do not permit an elimination.
NUN3CQ	Small differences observed in IR spectra of green layer in item 1 and 2 are qualitative rather and are probably consequence of inhomogeneity of paint (it concerns BaSO4 content).
QEKMYL	Our methods do not generally allow for the comparison of inorganic materials (metal flake, for example) that may be present in paint samples.
XARPRJ	I would typically use SEM/EDS as an elemental technique instead of XRF, but our laboratory's SEM/EDS is in need of repair. An Association Scale would also be included in my report. The definitions of the associations used in this report are as follows: Level 3 - Association: Items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Elimination (Non-association): The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source.

-End of Report-
(Appendix may follow)

Collaborative Testing Services ~ Forensic Testing Program

Test No. 19-545: Paint Analysis

DATA MUST BE SUBMITTED BY **April 29, 2019, 11:59 p.m.** TO BE INCLUDED IN THE REPORT

Participant Code: U1234A WebCode: M7LRPE

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 a child abduction. A witness reported a suspect in a green vehicle running over a bike and driving off with a child. Police located the child's bike two blocks away from his home and discovered damage to the bike. Police were able to recover green paint chips from the damaged area of the child's bike. Police also recovered green paint chips from a curb located one block away from the child's bike. Police investigated local repair shops and found a vehicle resembling the witness's description, showing damage to the exterior. 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 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.

Items Submitted (Sample Pack P1):
Item 1: Known paint sample representative of the damaged area of the vehicle.
Item 2: Questioned paint chips recovered from the damaged area of the child's bike.
Item 3: Questioned paint chips recovered from the curb.

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

	Yes	No	Inconclusive
Item 2:	○	○	○
Item 3:	○	○	○

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

Please check all that apply.

Microscopic Exams:	☐ Stereomicroscope	☐ Polarized Light
	☐ Fluorescence	
☐ Pyrolysis GC	☐ FTIR	☐ Solubility/Chemical
☐ XRS/XRF	☐ SEM/EDX	☐ Microspectrophotometry

Other (specify):

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)