Final Report
(December 2018)

Proficiencytesting@forensicfoundations

Automotive Paint Examination and Analysis
2018-1A

This report replaces Report 2018-1.
Please destroy all copies of Report 2018-1.

Authorised by Dale Parsell, Quality Manager, Forensic Foundations, 11/12/2018.

Suite10/12 Maroondah Hwy, Ringwood, VIC, 3134 PO Box 2279, Ringwood North VIC 3134	Office: 03 9018 8919 Mobile: 0429 966 012
quality@forensicfoundations.com.au www.forensicfoundations.com.au	ABN 23 839 112 155 ACN 130 236 618

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Contents

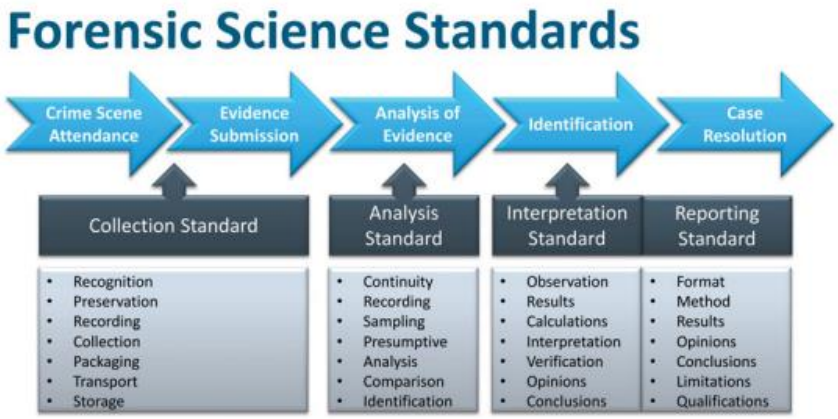
Introduction

Design

Forensic Foundations' Proficiency Tests are designed to address the following points

- Relevance to forensic science laboratories;
- Limitation of any potential context information;
- Knowledge of the 'ground truth' of samples;
- Importance of consistency between tests; and
- Cost affordability for the laboratories.

An additional feature of Forensic Foundations' Proficiency Tests is that they test the end-to-end forensic examination process. The AS 5388 Forensic Analysis series of Standards describes the forensic examination process from collection to reporting. The following figure[1] illustrates the inter-relatedness of all steps in this process and was used as the basis of the Standards' development. The figure is also used as the basis in the development of Forensic Foundations' Proficiency Tests. Thus, all Forensic Foundations' Proficiency Tests commence with item collection and/or receipt and all the subsequent examination / analysis steps, culminating in the reporting reflects actual forensic casework. NATA states 'PT samples/items should be handled in the same way as routine casework as far as practicable. The facility's routine test procedures must be used.'[2]



All Forensic Foundations' Proficiency Tests are ISO 17043 compliant. These requirements include a mechanism for participating laboratories to request a review and/or lodge an appeal regarding the evaluation of their performance. With respect to this test, a request for review:

- from Australian laboratories should be forwarded to ANZPAA|NIFS for transmission to Forensic Foundations; or
- From all other laboratories should be forwarded directly to Forensic Foundations.

The Final Report of this 2018 round of Proficiency Tests will be publicly available via Forensic Foundations web site. Participating laboratories may use the report as outlined in their respective laboratory policies.

[1] James Robertson, Karl Kent & Linzi Wilson-Wilde (2013) The Development of a Core Forensic Standards Framework for Australia, Forensic Science Policy & Management: An International Journal, 4:3-4, 59-67

[2] NATA (2018) ISO/IEC 17025 Application Document. Legal (including Forensic Science) - Appendix

Automotive Paint Interpretation 2018-1

Two laboratories were involved in this round of proficiency testing. The report also includes the results from the previous challenge test which used the same sample set. The small number of participants is insufficient for Forensic Foundations to formulate statistical analysis on the performance of the participants.

The manufacture, distribution, assessment and reporting of this proficiency test and the previously conducted challenge test has provided, and will provide, the basis for continuous improvement for both Forensic Foundations and the participating laboratories.

In addition to interpreting the results from examining known and unknown paint samples, testing generic issues such as receipt, triage and continuity of items for examination also formed part of the overall process.

In order to remove other sources of uncertainty and variability, the participants were not required to carry out the initial steps of a forensic examination (searching, identification of suitable samples) and were provided with samples from known sources. In order to remove any contextual bias in the interpretation, the participants were told only that the samples were collected from two workplaces.

Laboratory Responses

Continuity, receipt and description of items

Laboratory D gave a full description of the packaging, item description upon initial receipt and throughout the various stages of their testing.
For example:

> "Received a "SECURITY & TRANSIT" sealed and secure clear plastic bag….."Test D" ……C2017000182 PV 14/06/2017"
> Opened and found to contain 4 x white translucent paper envelopes, secured w/ sticky tape, holding apparent paint samples.

The report includes a detailed description of each item and when necessary a sketch with dimensions.

The description provided by Laboratory D concurs with the packaging, labelling and samples as distributed.

Laboratory 65278 gave a limited description of the packaging; however, it was noted that a photographic record had been made.

For example:

> "The Proficiency Test package was received on June 12. Firstly, the original photo of the external package was taken and the package was opened. Inside the package, one big plastic bag was sealed. Four small plastic bags were sealed and packed in the big one. Then the big and small plastic bags were opened for examination."

The report includes a detailed description of each item and when necessary a photograph with a ruler.

The description provided by Laboratory 65278 concurs with the packaging, and samples as distributed except that the small bags were paper envelopes.

Laboratory 16473 did not provide a description of the samples as received. However, each item was given a unique laboratory reference number.

Case Analysis, Interpretation and Conclusions (please include the wording you would use in your report)

Laboratory D:

The automotive paint samples appear OEM with 4-layers, clear, colour coat, undercoat 1, undercoat 2.
The following methods were used for analysis:

- Visual; Fluoresence; FTIR; MSP; uXTF; SEM; Pyrolysis GCMS.

The following results were obtained:

	Item 1 (PB A)	Item 2 (PB B)	Item 3 (PB B)	Item 4 (PB B)	Comments
Microscopy	Clear / red / light grey / dark grey / metal substrate	Clear / red / light grey / dark grey	Clear / red / light grey / dark grey	Clear / red / light grey / dark grey / metal substrate	Metal substrate in Item 1 is **different** in appearance to that in Item 4 (see photo).
Fluorescence microscopy	NOS	In agreement with Item 1	In agreement with Item 1	Clear layer– slight difference under blue filter.	Chamfered corners and manually sampled cross-sections viewed under B, UV and G filters. No significant differences noted. Further analysis required.
FTIR	Clear - Red – Light grey – Dark grey -	All layers in good agreement with Item 1	All layers in good agreement with Item 1	Red layer is **different** to Items 1, 2 & 3	Item 4 is **different** in chemical composition. Items 1, 2 and 3 require further analysis.
MSP	Red only	Red layer: In agreement with the red Item 1	Red layer: In agreement with the red in Item 1	N/A	Red layer was smeared (revealing a range in intensity of the red colour). Further analysis required for Items 1, 2 & 3.
XRF	Clear – NOS (tape b/ground?) Red – NOS (tape b/ground?) Light grey – Ti, Ba, S dominant (Ba – contamination from red layer, see SEM results) Dark grey – S, Al, Si dominant Metal substrate - Fe	Clear – NOS (tape b/ground?) Red – NOS (tape b/ground?) Light grey – Ti, S dominant Dark grey – S, Al, Si, Ti dominant	Clear – NOS (tape b/ground?) Red – NOS (tape b/ground?) Light grey – Ti, S dominant Dark grey – S, Al, Si, Ti dominant	Metal substrate only - Fe	No significant differences between Items 1, 2 & 3. Further analysis required.
SEM	Clear – Cl dominant Red – Ba, Ti dominant Light grey – Si, Al dominant Dark grey – Zn dominant	Clear – Cl dominant Red – Ba, Ti dominant Light grey – Si, Al dominant Dark grey – Zn dominant	Clear – Cl dominant Red – Ba, Ti dominant Light grey – Si, Al dominant Dark grey – Si dominant	N/A	No significant differences between Items 1, 2 & 3. Further analysis required.
Py-GCMS	Cross section of sample (excluding metal substrate)	In good agreement with Item 1	In good agreement with Item 1	N/A	There is the presence of alkanes after 21mins (possibly stuck to the wire). This is not seen in the blank sample before the Item samples are analysed. These alkanes are also observed in both the standards run at the beginning and at the end of the sequence.

NOS – Nothing of significance PB – Panel Beater

Conclusion:
The initial likelihood ratio calculations (1568, strong support) do not take into consideration the shades of colours that can be seen in the paint layers. If these are considered, then very strong support (approx. LR=42,300) would be more appropriate for the proposition that the four-layer paint sample recovered from panel beater A did share a common origin with two of the three four-layer paint samples recovered from panel beater B.

These results concur with the pretesting and test set up.

Laboratory 65278

1 and 4 were paint layers on metal fragment. Item 2 and 3 were paint layers. It can be seen under the stereomicroscope that all items have 4 paint layers. The colour of each layer was transparent (first layer, the clear coat), red (second layer, the base coat), grey (third layer, the primer surfacer), and deep grey (fourth layer, the primer). There was no essential difference in the colour of each layer among the four samples.

The following methods were used for analysis:

- Visual; FT-IR; SEM/EDS.

The following results were obtained:

Item 1

Method	Results
FT-IR	The FT-IR spectra showed characteristic absorption peaks at 701, 761, 815, 1157, 1455, 1492, 1551 cm^{-1}, etc. (the clear coat)
	The FT-IR spectra showed characteristic absorption peaks at 730, 817, 843, 1552, 1606, 1643 cm^{-1}, etc. (the base coat)
	The FT-IR spectra showed characteristic absorption peaks at 815, 1180, 1550 cm^{-1}, etc. (the primer surfacer)
	The FT-IR spectra showed characteristic absorption peaks at 830, 1183, 1510, 1607 cm^{-1}, etc.(the primer)
SEM/EDS	C, O (the clear coat)
	C, O, P, Cl, Ti (the base coat)
	C, O, Al, Si, P, S, Cl, Ca, Ti, Ba, Fe, Zn (the primer surfacer)
	C, O, Al, Si, Sn, Ti (the primer)
	C, O, Al, Si, P, Sn, Ti, Mn, Fe, Zn (the phosphate coat)

Item 2

Method	Results
FT-IR	The FT-IR spectra showed characteristic absorption peaks at 701, 761, 816, 1158, 1456, 1492, 1553 cm^{-1}, etc. (the clear coat)
	The FT-IR spectra showed characteristic absorption peaks at 732, 818, 843, 1552, 1606, 1644 cm^{-1}, etc. (the base coat)
	The FT-IR spectra showed characteristic absorption peaks at 815, 1179, 1550 cm^{-1}, etc. (the primer surfacer)
	The FT-IR spectra showed characteristic absorption peaks at 830, 1183, 1510, 1607 cm^{-1}, etc.(the primer)
SEM/EDS	C, O (the clear coat)
	C, O, P, Cl, Ti (the base coat)
	C, O, Al, Si, P, S, Cl, Ca, Ti, Ba, Fe, Zn (the primer surfacer)
	C, O, Al, Si, Sn, Ti (the primer)
	C, O, Al, Si, P, Sn, Ti, Mn, Fe, Zn (the phosphate coat)

Item 3

Method	Results
FT-IR	The FT-IR spectra showed characteristic absorption peaks at 701, 761, 816, 1157, 1455, 1492, 1552 cm^{-1}, etc. (the clear coat)
	The FT-IR spectra showed characteristic absorption peaks at 730, 818, 844, 1552, 1607, 1643 cm^{-1}, etc. (the base coat)
	The FT-IR spectra showed characteristic absorption peaks at 815, 1180, 1550 cm^{-1}, etc. (the primer surfacer)
	The FT-IR spectra showed characteristic absorption peaks at 830, 1183, 1510, 1607 cm^{-1}, etc.(the primer)
SEM/EDS	C, O (the clear coat)
	C, O, P, Cl, Ti (the base coat)
	C, O, Al, Si, P, S, Cl, Ca, Ti, Ba, Fe, Zn (the primer surfacer)
	C, O, Al, Si, Sn, Ti (the primer)
	C, O, Al, Si, P, Sn, Ti, Mn, Fe, Zn (the phosphate coat)

Item 4

Method	Results
FT-IR	The FT-IR spectra showed characteristic absorption peaks at 701, 761, 815, 1155, 1455, 1491, 1551 cm^{-1}, etc. (the clear coat)
	The FT-IR spectra showed characteristic absorption peaks at 821, 843, 1551, 1607, 1644 cm^{-1}, etc. (the base coat)
	The FT-IR spectra showed characteristic absorption peaks at 815, 1181, 1550 cm^{-1}(the primer surfacer)
	The FT-IR spectra showed characteristic absorption peaks at 830, 1183, 1510, 1607 cm^{-1}(the primer)
SEM/EDS	C, O (the clear coat)
	C, O, Al, Si, S, Cl, Ti (the base coat)
	C, O, Al, Si, P, S, Cl, Ca, Ti, Ba, Fe, Zn (the primer surfacer)
	C, O, Al, Si, Sn, Ti (the primer)
	C, O, Al, Si, P, Sn, Ti, Mn, Fe, Zn (the phosphate coat)

Items 1, 2 and 3 have four paint layers. There was no essential difference in the colour, elemental composition and resin type of corresponding layer among item 1, 2 and 3. Item 4 has also four paint layers. However, it was examined that there was difference in the colour, elemental composition and resin type of base coat between item 4 and other samples.

Therefore, item 1, 2 and 3 could have the same source, they could have originated from the stolen red 2014 Ford Ranger. Item 4 has a different source with item 1, 2 and 3. It could have not originated from the stolen red 2014 Ford Ranger.

These results concur with the pretesting and test set up.

Laboratory 16473

The methods used by this laboratory included a Hazmat instrument and GC-MSD

The following results were obtained:

1. Using the HazMat ID instrument:
   a) Item 1: Alizarin blue acid (dye) (attached)
   b) Item 2: Doxylamine succinate (attached)
   c) Item 3: Violamine (attached)
   d) Item 4: Doxylamine succinate (attached)

2. Using the GC-MSD Type 5975 C instrument:
   a) Item 1: non identical with items 2, 3 and 4 (attached)
   b) Item 2: non identical with items 1, 3 and 4 (attached)
   c) Item 3: non identical with items 1, 2 and 4 (attached)
   d) Item 4: non identical with items 1, 2 and 3 (attached)

Conclusion

1. Using the HazMat ID instrument, the following result is obtained:
   Item 2 is identical with item 4.
2. Using the GC-MSD instrument, the following result is obtained:
   Item 1 is non-identical with items 2,3, and 4

These results DO NOT concur with the pretesting and test set up.

Conclusion and Summary of the Test

The aim of this test was to examine the end-to-end forensic examination and analysis process. To minimise extraneous elements influencing the interpretation, limited contextual information was provided to the participating laboratories.

The test items comprised 2 pieces of multi-layered automotive paint and 2 pieces of metal decorated with multi-layered automotive paint. One of the pieces of painted metal, named ITEM#1 and both of the pieces of multi-layer paint (ITEM#2 and ITEM#3) were prepared using the same paints and application technique. ITEM#4 differed to the other 3; the red basecoat in ITEM#4 was a water-based paint whereas the red basecoat in the other items was solvent-based. In all other respects, the four items were prepared identically.

The individual test items were sealed in paper envelopes, labelled ‘ITEM 1’, ‘ITEM 2’, ‘ITEM 3’ and ‘ITEM 4’ respectively. These envelopes were then sealed in a tamper evident plastic bag.

The expected response to the test proposition “that there is an association between ITEM#1 and the other three items” was that ITEMS#1, #2 and #3 could share a common origin but ITEM#4 was not associated with any of the other 3.

The test provider verified that infrared microspectrometry and scanning electron microscopy – energy dispersive X-ray microspectrometry were effective at discriminating the basecoat in ITEM#4 from the basecoat in the other 3 items.

COMMENTS TO TEST RECIPIENT

The test D and 65278 recipients correctly recorded the packaging in a manner that traceability could be achieved.

The test D and 65278 recipients correctly determined that ITEM#4 was not related to the other 3 items and correctly determined that the other 3 items were related to each other. Furthermore, the test D recipient arrived at that determination using techniques that the test provider has demonstrated is capable of supporting that determination (i.e., infrared microspectrometry and scanning electron microscopy – energy dispersive X-ray microspectrometry).

The test D and 65278 recipients correctly characterized the test items with regards to their physical make-up, including their packaging and other chain of custody details.

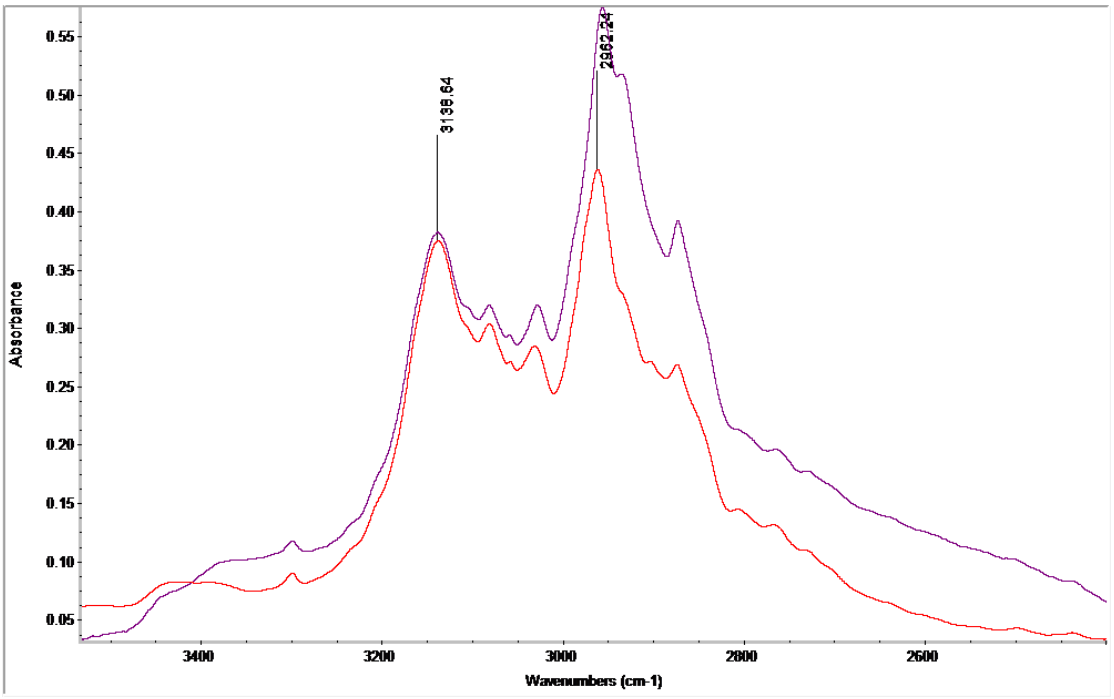
The 16473 recipient did not correctly identify the relationship between the items and appears to have used a technique which is unsuitable for identifying or differentiating between the paint layers from the samples provided. The facility appears to have used instrumentation which is more suitable to identifying drugs and is not suitable for identifying/differentiating multi-layered paint products.

Pre-test analytical results (undertaken by Flinders University.)

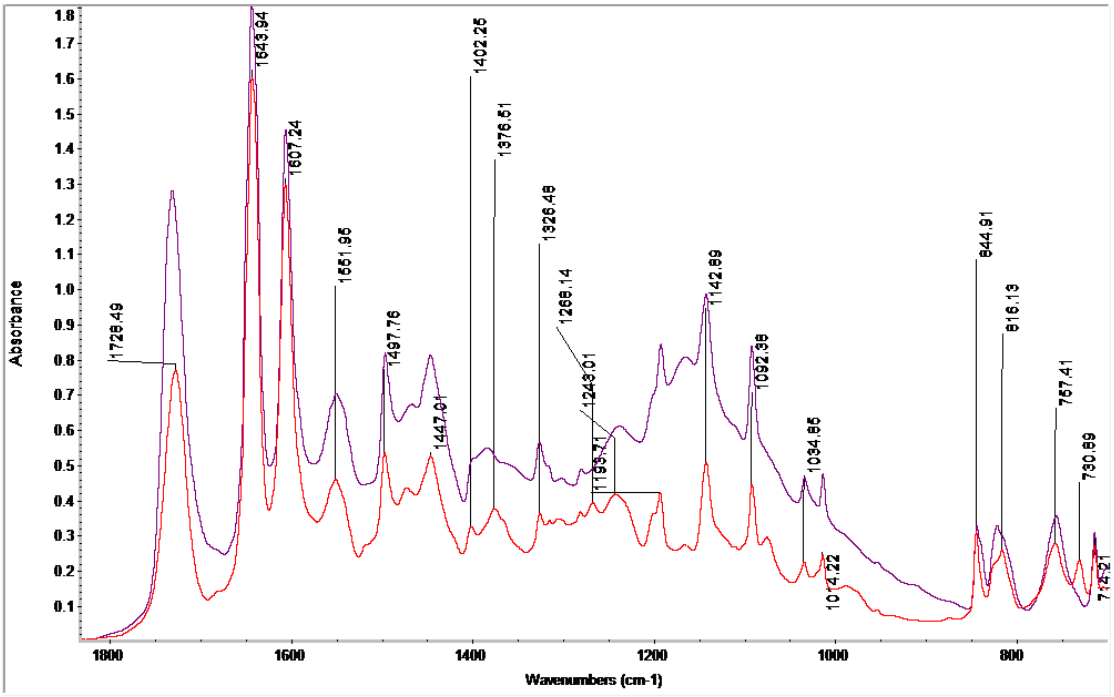
Infrared microspectrometry

Spectra below were acquired using a Nicolet Nexus FTIR equipped with a continuum microscope, narrow band MCT detector and wide range KBr beam splitter. Spectra were acquired at 4cm^{-1} resolution with 100 scans using transmission mode, except for the electrocoat, which was acquired using a diamond ATR accessory (some residual diamond background is evident in the electrocoat exemplar spectrum).

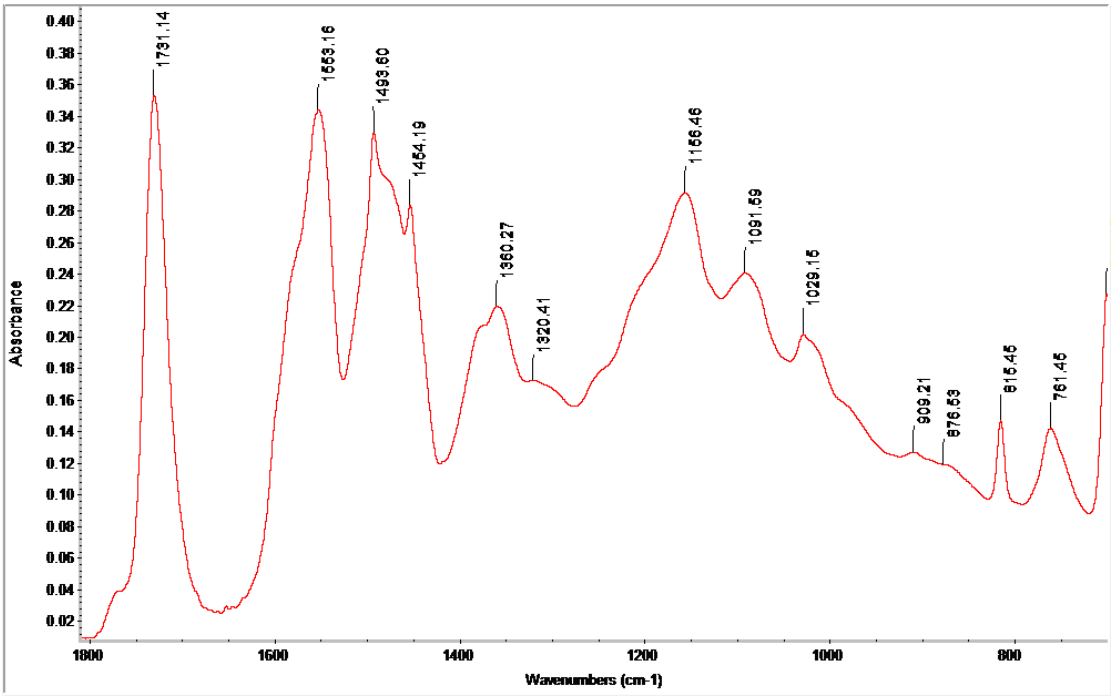
ITEMS 1, 2, and 3 can be discriminated from Item 4 on the basis of the red basecoat compositions. Overlaid expanded comparisons of the two basecoats employed in this test are provided below. As clearcoat, primer and electrocoat are identical across all ITEMS, only one exemplar spectrum is provided for each layer (expanded regions for the clearcoat).



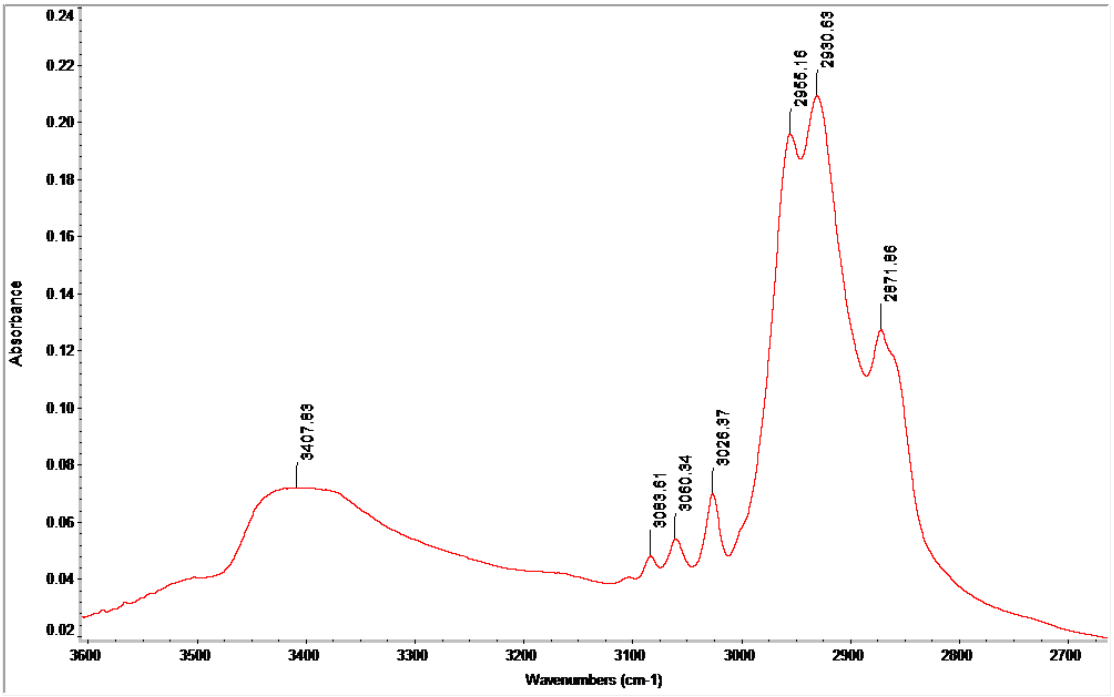
Exemplar spectra, high frequency region: basecoats for Items 1, 2 and 3, in RED- basecoat for ITEM 4 in BLUE. Transmission spectra.



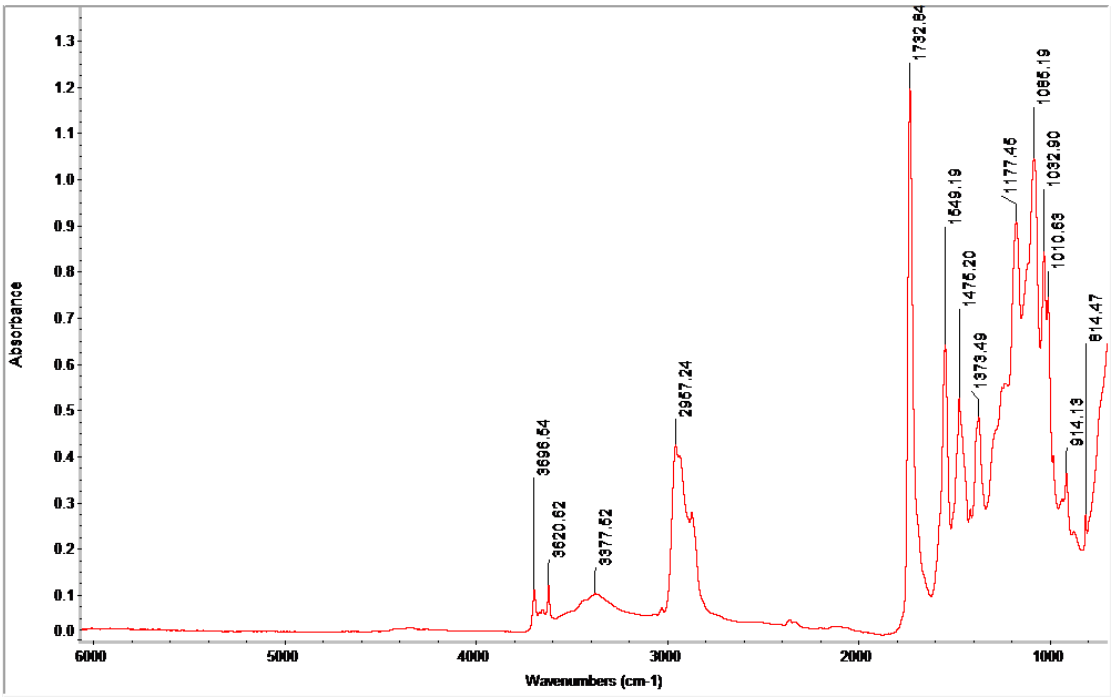
Exemplar spectra, low frequency region: basecoats for ITEMS 1, 2 and 3, in RED-basecoat for ITEM 4 in BLUE. Transmission spectra.



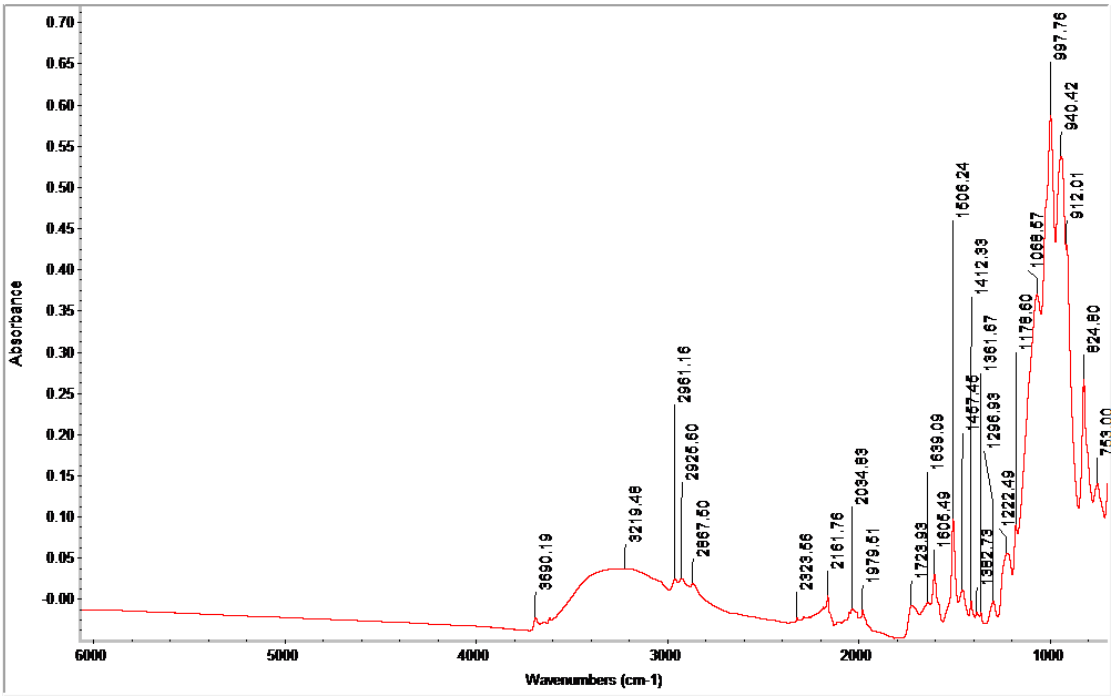
Exemplar low frequency spectrum for all ITEMS, clearcoat.



Exemplar high frequency spectrum for all ITEMS, clearcoat.



Exemplar spectrum for all ITEMS, primer.

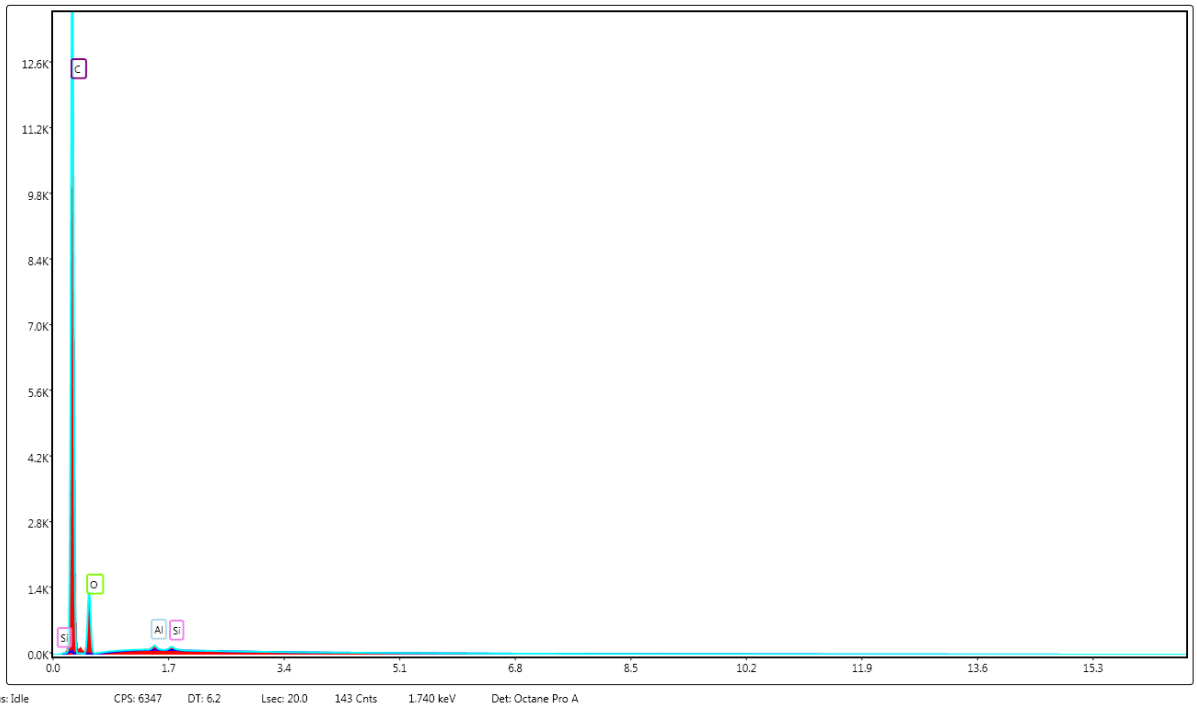


Exemplar spectrum for all ITEMS, electrocoat (ATR).

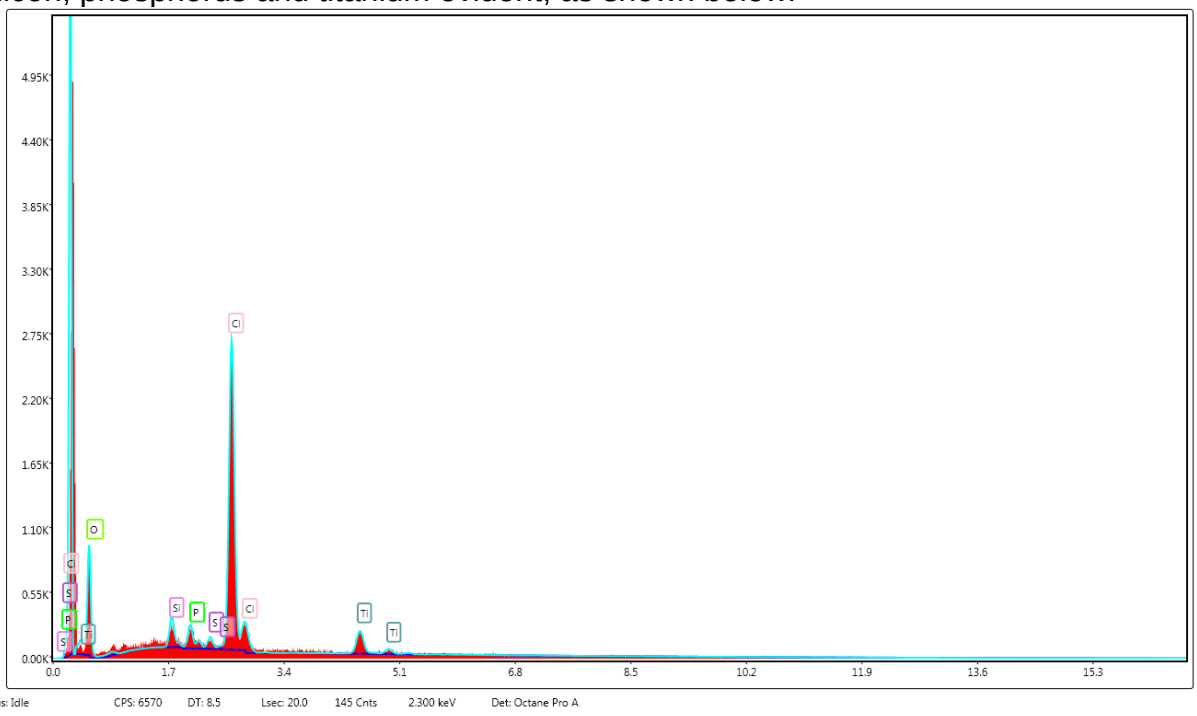
Scanning electron microscopy – energy dispersive X-ray spectrometry

Transverse cross-sections were prepared by suspending chips of ITEM 1 and ITEM 4 in UV-cure resin in channels cut in cured polyester resin and then polishing them flat using sub-micron diamond paste. The cross-sections were coated with carbon and then analysed using a scanning electron microscope (FEI Inspect 50) equipped with an energy dispersive X-ray analyser (Octane Pro by EDAX). Spectra were acquired using a spot size of 5 and a beam energy of 25 kV.

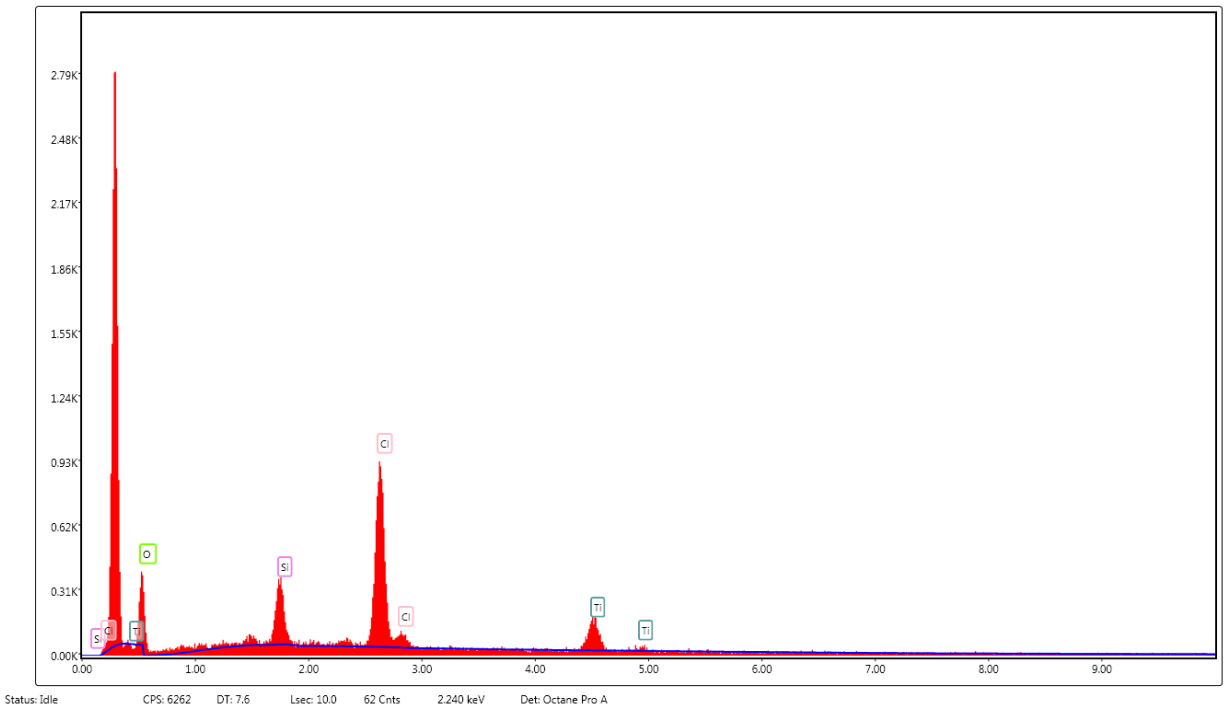
Clearcoats for both ITEMS could not be differentiated using EDS; they produced spectra as shown below.



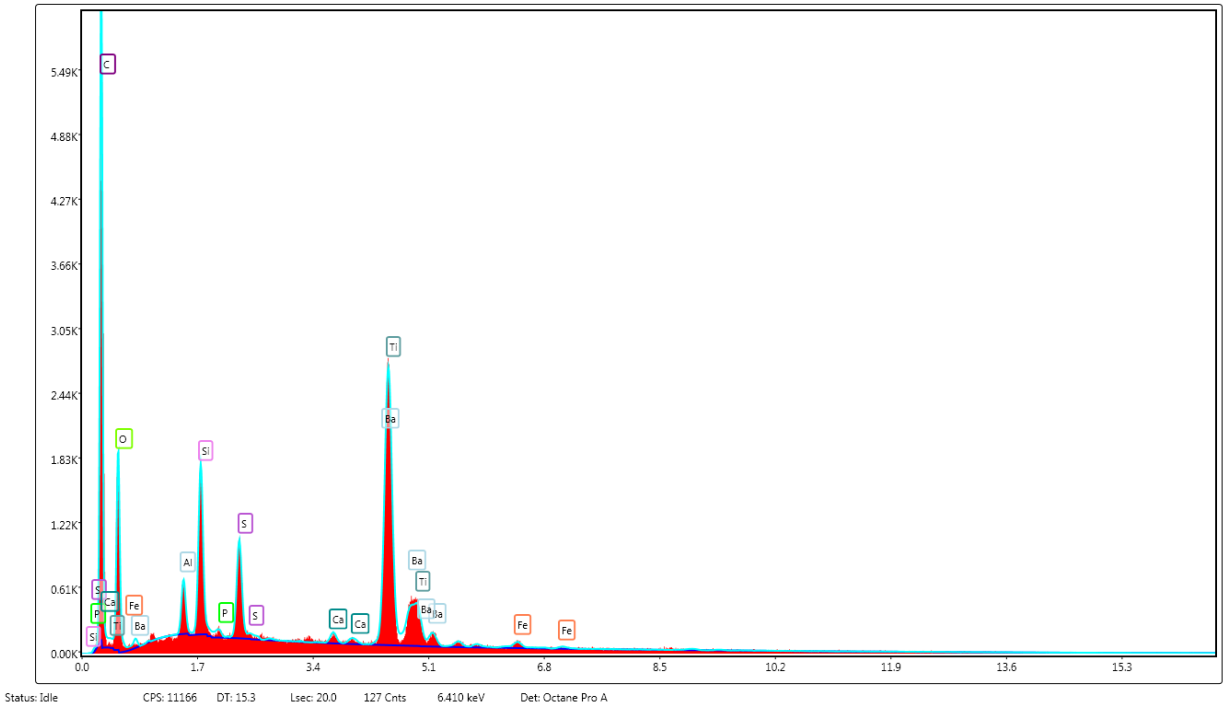
The basecoat for ITEMS 1, 2 and 3 showed an abundance of chlorine with traces of silicon, phosphorus and titanium evident, as shown below.



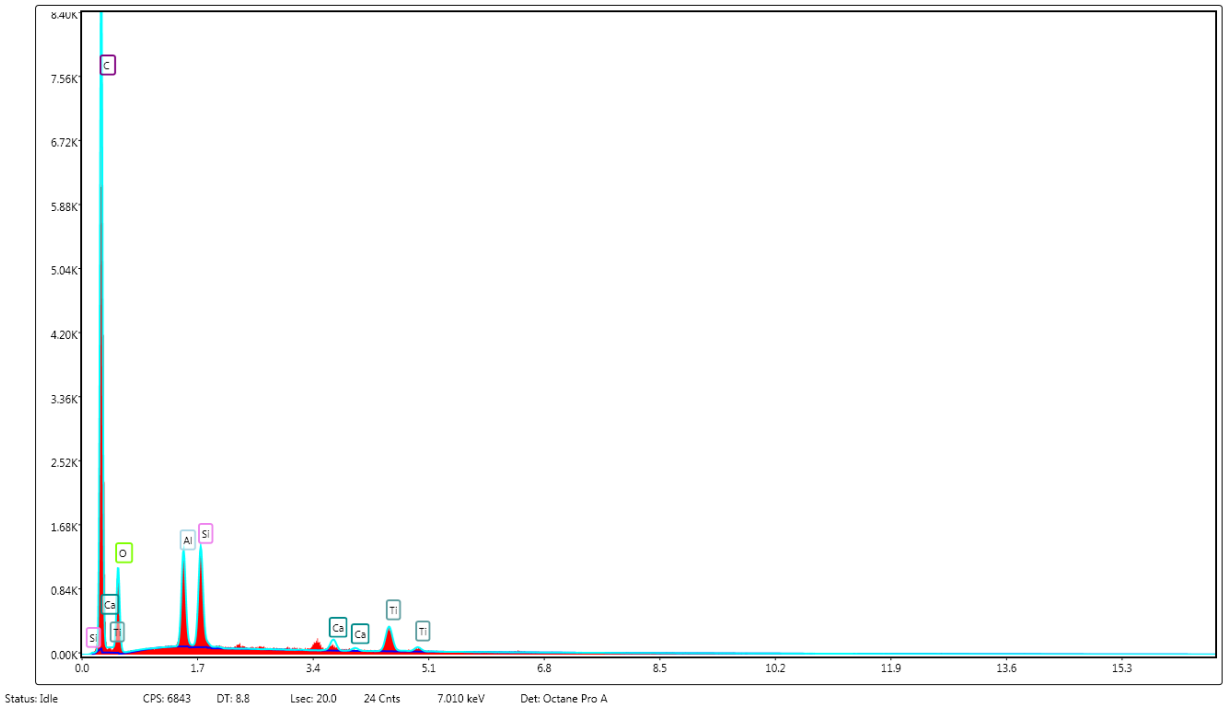
The basecoat for ITEM 4 (spectrum shown below), however, could be differentiated from the basecoat of ITEM 1 on the basis of phosphorus, which appeared to be absent in ITEM 4, and the relative abundance of chlorine.



Surfacer layers for ITEMS 1, 2, 3 and 4 could not be differentiated nor could the primer layers. Exemplar spectra are provided below.



ITEM 1, 2 and 3 surface?



ITEM 1, 2, and 3 primer

Appendix A

Form No: WEF-03-A

Proficiencytesting@forensicfoundations

PROGRAM PLAN

Program	Automotive Paint	
Round	2018-1	
Advisory Group		
Program Coordinator /Technical Manager	Mrs Anna Davey Director Forensic Foundations PO Box 2279 North Ringwood, 3134	
Discipline specific expert(s)	Prof K. Paul Kirkbride Professor of Forensic Science School of Chemical and Physical Sciences Flinders University GPO Box 2100 Adelaide, SA 5001	
Supplier(s)	Initial sample collection & test production. Results interpretation.	Paint Panel production
	Forensic Foundations PO Box 2279 North Ringwood, Victoria 3134	PPG Australia 14 McNaughton Rd Clayton South Vic 3169
Aims/Objectives	The aim of the program is to assess the laboratories' ability to competently analyze, compare and interpret samples of automotive paints used in Australia.	
Purpose	To assist the laboratories by ensuring their methods/procedures are performing adequately.	
Program Design		
Tests	>5	
Number of samples	4	
Type of sample	Samples are either: • excised from electrocoated steel panels to which primer, paint and clear coat had been applied; or • flakes of dried paint from the above panel produced by bending the panels.	
Levels	The thickness of each layer will be industry standard. Only one sample will be provided per item and paint chips will be of a size slightly larger than that typically encountered in casework in order to ensure that sample preparation is not the most challenging aspect of the trial.	
Range of values/assigned values	The expected answers are binary – match or no match. It is not feasible for participants to arrive at chemical composition more detailed than the broad classification of the paint (e.g., melamine acrylic) and pigment (e.g., organic).	

	The match/non-match of items was set by the paint application process carried out by the manufacturer and verified at duplicate positions on panels using infrared microspectrometry at Flinders University.
Traceability/origin of assigned values	See above
Methods	Machine and hand application of layer, followed by baking. Samples to be prepared as described above. Match/non-match was determined using infrared microspectrometry.
Design	Primer, paint and clear coat to be selected from existing PPG products.
Selection Criteria	Products to be selected include those which are chemically distinguishable but look very similar to the naked eye.
Potential Major Sources of Error	Failure to distinguish between non-matching samples.
Participants	Chemical Criminalistic laboratories
Reporting Criteria, Accuracy	NA
Analysis	Correctly identify chemical composition of layers in all samples and interpret similarities/differences. .

Pre-testing	
Homogeneity Testing	Uniform spraying of initial panels as far as is possible. Duplicate samples from panels were pretested, additional samples retained, for subsequent homogeneity/repeatability checking if required.
Stability Testing	NA – Automotive paint is designed to be stable
Homogeneity/Stability Acceptance Criteria	NA
Technical Review (internal)	
Participant Instructions	Provide copy of Instructions and evidence of Technical Review
Results Sheet	Provide copy of Results Sheet and evidence of Technical Review
Report	Include copy of Report and evidence of Technical Review

Sample Preparation	
Storage requirements	Room Temperature
Distribution requirements	Distributed via Forensic Foundations
Sample checks	NA
Program Dates	
Invitation letter	1st February 2018
Sample distribution	First week June 2018
Results due	3rd August 2018
Manufacturing Information to be sent	September 2018
Final report due date	First week October 2018
Statistical Analysis	
Homogeneity Testing	NA

Stability Testing	NA
Data Entry	Include evidence of data entry checks in file
Normality	NA
Review by Statistician	NA
Reporting	
Report No:	1/2018
Master copy	Reports folder
Availability	Website

Program Coordinator signature:

Date: 31/1/2018

Samples packed by: KAD 8/6/18

Checked by: BJD 8/6/18

Result data input by: DGP

Data checked by: KAD

Statistics and report collated by: Prof. K. Paul Kirkbride and Dale Parsell

Report checked by: KAD

Appendix B

forensic FOUNDATIONS™
ISO 9001 certified

Proficiency@forensicfoundations

Automotive Paint Examination
1/2018

Thank you for participating in this Proficiency Test. We hope that you find this test useful and welcome any feedback on the design of further tests.

In addition to this exercise being a test of your laboratory procedures using controlled items, we also anticipate that it will enable participants to evaluate the quality of their analytical results against those from other laboratories and observe how other laboratories express their opinions or advice to clients. To enable this, we request that participants submit the following:

- All spectral and other analytical data collected for the items; and
- their opinion in the format that they would provide to court

Attached you will find the case 'Examination Request and Item Submission' form and the test commences with the receipt of the items followed by your routine processes - item description, examination, analysis and interpretation. The information submitted to the laboratory on the examination request form will direct what testing needs to be undertaken. Please use the attached results sheets. Additional pages may be added if required.

The attached results sheets should be returned to Forensic Foundations by 3rd August 2018.

Qualitative feedback will be provided to participants. Feedback will be both participant-specific (i.e., whether a particular laboratory "got the right answer") and group specific (e.g., which techniques seemed to perform better than others).

It is expected that there may be some differences in the analytical results depending on the instrumentation used, however the final conclusions should be consistent with the known source of items.

Following the conclusion of the testing participants will be advised which items "match". They will also be provided with all the formulation and preparation information that was available to the test provider and the pretest analytical results undertaken by Flinders University.

Appendix C

PROFICIENCYTESTING@FORENSICFOUNDATIONS	
EXAMINATION REQUEST AND ITEM SUBMISSION	forensic FOUNDATIONS™ ISO 9001 certified

OFFENCE:	Car rebirthing
DATE OF OFFENCE	20/01/2018

BRIEF STATEMENT OF FACTS

Police are investigating a number of panel beaters' premises that they believe are one operation involved in dismantling stolen cars and selling parts from them or using them in their business.

A red 2014 Ford Ranger has been reported stolen and has not been recovered.

From panel beater **A,** police have seized a red roof panel with short sections of its support pillars in place.
From panel beater **B,** police have seized two doors. They have sampled a small quantity of paint from each door and have provided them to you as well as some painted metal fragments found at the premises.

ITEMS SUBMITTED FOR EXAMINATION

Item 1 – Sample of painted metal cut from a short section of roof panel support pillar from panel beater A;
Item 2 – Sample of paint layers from passenger-side car door from panel beater B;
Item 3 – Sample of paint layers from driver-side car door from panel beater B; and
Item 4 – Painted metal fragments collected from panel beater B.

EXAMINATION REQUESTED

Police request an examination to establish whether there is any association between the paint and metal samples taken from the panel beaters. An expert's report for investigational purposes is requested

Appendix D

Suite10, 12 Maroondah Hwy, Ringwood, VIC, 3134
PO Box 2279, Ringwood North VIC 3134
Office: 03 9018 8919
Mobile: 0429 966 012
Fax: 03 9870 1308

anna.davey@forensicfoundations.com.au
www.forensicfoundations.com.au

ABN 23 839 112 155 ACN 130 236 618

PROFICIENCYTESTING@FORENSIC FOUNDATIONS
AUTOMOTIVE PAINT 1/2018

MANUFACTURER'S INFORMATION

Paint Panel Preparation

450x300mm sheets of electrocoated steel from the same source were used in the preparation of all painted panels.

Panel 4 construction:

Two electrocoated steel sheets were machine-applied with a standard PPG Australia formulation FORD Primer (30-40μm build) and baked at 140°C for 30min.

A standard PPG FORD (Vixen Red) **water-based** red basecoat was then machine-applied (15-25μm build), force air-dried for 10min at 80°C, then coated with PPG standard Ford Australia solvent-based clear coat (30-50μm) and finally baked at 140°C for 30min. In effect, the clear coat was applied wet-on-wet, despite the bake at 80°C.

The primer was a polyurethane-modified polyester with butylated melamine cross-linker.
The red basecoat was an acrylic latex-polyester formulation with butylated melamine cross-linker, a benzotriazole UV absorber, and an organic pigment.
The clear coat was a HEMA and butylated melamine cross-linked acrylic with hindered amine light stabiliser and benzotriazole UV absorber.

Panel 6 construction:

Two electrocoated steel sheets were machine-applied with a standard PPG Australia formulation FORD Primer (30-40μm build) and baked at 140°C for 30min.

A standard PPG FORD (Vixen Red) **solvent-based** red basecoat was then machine-applied (15-25μm build) then coated with PPG standard Ford Australia solvent-based clear coat (30-50μm) and finally baked at 140°C for 30min.
The clear coat was applied wet-on-wet.

The primer was a polyurethane-modified polyester with butylated melamine cross-linker.
The red basecoat was a cellulose acetate butyrate-polyester resin with butylated melamine cross-linker, no UV absorber and an organic pigment (note: NOT the same pigment as used for Panel 4).

The clear coat is a HEMA and butylated melamine cross-linked acrylic with hindered amine light stabiliser and benzotriazole UV absorber.

Sample construction

Item #1 Was a piece of painted metal 25mm x 25mm cut from Panel 6, by PPG.
Item #2 Was prepared by bending a piece of Panel 6 until the entire coating flaked off. A piece of coating approximately 10mm x 2mm was provided to participants.
Item#3 Was prepared by bending a piece of Panel 6 until the entire coating flaked off. One piece of coating approximately 10mm x 7mm was provided to participants.
Item #4 was a piece of painted metal 25mm x 25mm cut from Panel 4 by PPG.

Pretesting

Replicate sub-samples from each layer of each coating present on panels 4 and 6 were dissected and subjected to infrared microspectrometry. As expected, differences between the basecoat were observed for panel 4 and 6

Amendment Record:

Issue Date	Comments
11/12/18	Page 10. Laboratory ID No 96159 substituted for 16473 (Laboratory 96159 does not exist).

END of REPORT

Automotive Paint 2018-1 Interpretation Feedback

Forensic Foundations prides itself in providing flexible fit-for-purpose forensic programs. This Challenge Test was the second developed by Forensic Foundations and thus the second undertaken by forensic laboratories. The manufacture, distribution and assessment and reporting of this test has provided, and will provide the basis for continuous improvement for both Forensic Foundations and the forensic laboratories. To this end we would appreciate your comments to assist us to improve the tests.

Please tick the appropriate box and make any relevant comments.

	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
1. The test was too basic for our facility	□	□	□	□	□

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2. The samples supplied were suitable	□	□	□	□	□

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3. The results required were not outlined sufficiently	□	□	□	□	□

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The final report provided suitable detail □ □ □ □ □

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1. The tests involved should be more challenging	□	□	□	□	□

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Please comment briefly on the following:

6. Are there additional aspects which could be included in the test?

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7. Any additional comments

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9. Facility (optional)

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10. Would you like us to contact you to discuss your feedback?

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Forensic Foundations' Proficiency Tests are required to be fit-for purpose. To assist us to provide the relevant tests, please use the following form to suggest further tests for development.

Recommendation for Proficiency Test development

Contact	Name	
	Email	
	Phone	
Discipline/ subdiscipline		
Specific issues(s) to be addressed*. Note: The tests can be designed to be multidisciplinary.		
Suggested technical advisor (if known)		
Suggested manufacturer (if known)		

* All Proficiency Tests will include the end to end process (receipt & continuity, triage, description, examination, analysis, data generation, interpretation, reporting) but one aspect may be of particular interest/focus.

This form can be emailed to quality@forensicfoundations.com.au or you can discuss your suggestions on either 03 9018 8919 or 0429 966 012.