



Paint Analysis Test No. 17-546 Summary Report

Each sample set consisted of one item containing a "known" paint sample and two items containing "questioned" paint chips. Participants were requested to compare the items and report their findings. Data were returned from 73 participants and are compiled into the following tables:

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

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

Manufacturer's Information

Each sample set consisted of three items with layered paint and primer: one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from a painted section of drywall. Items 1 and 2 came from a section of drywall with the same primer and topcoat. Item 3 was prepared with the same topcoat, but a different primer from what was used for Items 1 and 2. Examiners were instructed to examine the samples and determine if either questioned sample could have originated from the same source as the known paint sample.

SAMPLE PREPARATION: The drywall substrate was wiped down to remove dust before painting. For the following preparations, each coat was allowed to dry overnight before applying the next coat.

ITEMS 1 and 2 (ASSOCIATION): The known Item 1 and questioned Item 2 samples were prepared by applying two coats of primer (Zinsser Cover Stain Oil-Base Interior/Exterior Primer, white) to a drywall substrate. Then two layers of topcoat (Behr Marquee Interior Eggshell Enamel Paint & Primer, Purple Gladiola (MQ4-59)) were applied. For Item 1, paint samples were scored into squares that were approximately $\frac{1}{2}$ " x $\frac{1}{2}$ " and removed. One $\frac{1}{2}$ " x $\frac{1}{2}$ " piece was packaged into a glassine bag and then a pre-labeled Item 1 coin envelope. For Item 2, paint samples were scored into squares that were approximately $\frac{1}{4}$ " x $\frac{1}{4}$ " and removed. Two $\frac{1}{4}$ " x $\frac{1}{4}$ " pieces were packaged into a glassine bag and then a pre-labeled Item 2 coin envelope. Items 1 and 2 were taken in close spatial proximity to one another and were kept together as an association group and packaged into the sample sets as described below.

ITEM 3 (ELIMINATION): The questioned Item 3 samples were prepared by applying two coats of primer (Behr Premium Plus® All-in-One Primer & Sealer, white) to a drywall substrate. Then two layers of topcoat (Behr Marquee Interior Eggshell Enamel Paint & Primer, Purple Gladiola (MQ4-59)) were applied. Paint samples were scored into squares that were approximately $\frac{1}{4}$ " x $\frac{1}{4}$ " and removed. Two $\frac{1}{4}$ " x $\frac{1}{4}$ " pieces were packaged into a glassine bag and then a pre-labeled Item 3 coin envelope.

SAMPLE SET ASSEMBLY: For each sample pack, an Item 1 and an Item 2 from the same association group along with an Item 3 were placed into a pre-labeled envelope and sealed with invisible tape. This process was repeated until all of the sample sets were prepared. Once verification was completed, all sample sets were further sealed with evidence tape and initialed "CTS."

VERIFICATION: All three laboratories that conducted the predistribution examination of the completed sample sets reported the expected association and elimination results. The methods that were employed by the predistribution laboratories included: stereomicroscopy, polarized light microscopy, fluorescence microscopy, pyrolysis GC/MS, FTIR, solubility/chemical, XRS/XRF, SEM/EDX, and microspectrophotometry.

Summary Comments

This test was designed to allow participants to assess their proficiency in the examination, comparison and interpretation of multi-layered architectural paint samples. Each sample set consisted of three items with layered paint and primer: one known sample (Item 1) and two questioned samples (Items 2 and 3) were cut from painted pieces of drywall. Items 1 and 2 came from a single piece of drywall with the same primer and topcoat. Item 3 was prepared with the same topcoat, but a different primer than what was used to create Items 1 and 2. (Refer to Manufacturer's Information for preparation details.)

Of the 73 participants that reported results in Table 1, 67 (91.8%) reported that the Item 2 questioned paint chips could have originated from the same source as the Item 1 known paint sample and the Item 3 questioned paint chips could not have originated from the same source as the Item 1 known paint sample. Of the remaining participants, five reported that the Item 2 and Item 3 questioned paint chips could have originated from the same source as the Item 1 known paint sample. The final participant reported that the questioned paint chips in Item 2 could have originated from the same source as the Item 1 known paint sample, but did not report a result for the Item 3 questioned paint chips.

The most common examination methods utilized include stereomicroscopy and FTIR.

Examination Results

Could the questioned paint chips recovered from the victim's hair (Item 2) and/or shoe (Item 3) have originated from the damaged area of the suspect's living room wall as represented by Item 1?

TABLE 1

| <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> | <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> |
|----------------|---------------|---------------|----------------|---------------|---------------|
| 2ADNYR | Yes | No | DXFPEP | Yes | No |
| 38YQYF | Yes | No | F9AKPP | Yes | No |
| 472QGV | Yes | No | F9RW4N | Yes | No |
| 4EJ2UV | Yes | No | GLRYY3 | Yes | Yes |
| 4JAC4U | Yes | | GXNXVE | Yes | No |
| 4QV86X | Yes | No | H67QL6 | Yes | No |
| 6B264X | Yes | No | HAZQXE | Yes | No |
| 6JTH2Y | Yes | No | HKVWRD | Yes | No |
| 7B84DJ | Yes | No | JM2J6G | Yes | No |
| 7CM3VN | Yes | No | JQ3MW4 | Yes | No |
| 7QLAMX | Yes | No | JQZXQL | Yes | Yes |
| 7RVGPQ | Yes | No | JV9FNE | Yes | No |
| 89HU4H | Yes | No | K7QJAJ | Yes | No |
| 8GC6CT | Yes | No | LEXD4C | Yes | No |
| 8M4A8H | Yes | No | LK4AMC | Yes | No |
| 8TLM2B | Yes | No | LVLNTY | Yes | No |
| 8UEQEH | Yes | No | M2UC7Z | Yes | No |
| 9HH4LR | Yes | No | MCPNE8 | Yes | No |
| 9MR8Q9 | Yes | No | MQNRFD | Yes | No |
| AEZ47C | Yes | No | N22BDE | Yes | No |
| ALXWCK | Yes | No | N4DNHB | Yes | No |
| AMVAWR | Yes | No | NLVMMA | Yes | No |
| B3YZEN | Yes | No | P3RUU7 | Yes | No |
| BCMWFN | Yes | No | PCGKGY | Yes | No |
| BDZN7K | Yes | No | PYEUYZ | Yes | Yes |
| BLR4VN | Yes | No | Q8ZFH4 | Yes | No |
| C3JY8F | Yes | No | RAN76U | Yes | No |
| CXMCER | Yes | No | RG7HHV | Yes | No |
| DJZMUF | Yes | No | RM9NXX | Yes | No |
| DRTW3P | Yes | No | RR8697 | Yes | No |

TABLE 1

| <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> | <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> |
|----------------|---------------|---------------|----------------|---------------|---------------|
| TNLHCC | Yes | No | | | |
| TXQPTX | Yes | No | | | |
| TYM66V | Yes | No | | | |
| UCZVG3 | Yes | No | | | |
| UHTZB7 | Yes | No | | | |
| V9KPJ8 | Yes | No | | | |
| VMZNN8 | Yes | No | | | |
| VZ3JDM | Yes | Yes | | | |
| W77M4L | Yes | Yes | | | |
| WFG2UU | Yes | No | | | |
| X38LMP | Yes | No | | | |
| XFAC6M | Yes | No | | | |
| XVKXQY | Yes | No | | | |

| Response Summary | | | | |
|-------------------------|-----|---------------|----------|-------------------|
| | | <u>Item 2</u> | | <u>Item 3</u> |
| Responses | Yes | 73 | (100.0%) | 5 (6.8%) |
| | No | 0 | (0 %) | 67 (91.8%) |
| | Inc | 0 | (0 %) | 0 (0 %) |
| Participants: 73 | | | | |

Examination Methods

TABLE 2

| WebCode | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTR | Solubility/ Chemical | XRF/XRF | SEM/EDX | Microspectrophotometry | Other |
|---------|------------------|-----------------|--------------|--------------|-----|----------------------|---------|---------|------------------------|------------------------------|
| 2ADNYR | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 38YQYF | ✓ | | | | ✓ | ✓ | | | | Raman Spectroscopy |
| 472QGV | ✓ | | ✓ | | ✓ | | ✓ | | | |
| 4EJ2UV | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| 4JAC4U | ✓ | | | | ✓ | | | | | |
| 4QV86X | ✓ | | | ✓ | ✓ | | ✓ | | | |
| 6B264X | ✓ | ✓ | | | ✓ | | ✓ | | | |
| 6JTH2Y | ✓ | | | | ✓ | ✓ | | | | fluorescence |
| 7B84DJ | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | |
| 7CM3VN | ✓ | ✓ | | | ✓ | | ✓ | ✓ | | |
| 7QLAMX | ✓ | | | | ✓ | | | | | Raman spectroscopy |
| 7RVGPQ | ✓ | | | ✓ | ✓ | | ✓ | | | |
| 89HU4H | ✓ | | ✓ | | ✓ | | | | | Comparison microscopy |
| 8GC6CT | ✓ | | | | ✓ | | | | | |
| 8M4A8H | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| 8TLM2B | ✓ | | | | ✓ | | ✓ | | | RAMAN |
| 8UEQEH | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | | |
| 9HH4LR | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | Raman spectroscopy |
| 9MR8Q9 | ✓ | | | | ✓ | | ✓ | | | Raman |
| AEZ47C | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| ALXWCK | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | raman microspectrophotometry |
| AMVAWR | ✓ | ✓ | | | ✓ | | | | | ALS examination |
| B3YZEN | ✓ | | | | ✓ | | | | | |
| BCMWFN | ✓ | | ✓ | | ✓ | | ✓ | | | |
| BDZN7K | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | |
| BLR4VN | ✓ | | | | ✓ | | | | | |

TABLE 2

| WebCode | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTR | Solubility/ Chemical | XRS/XRF | SEM/EDX | Microspectrophotometry | Other |
|---------|------------------|-----------------|--------------|--------------|-----|----------------------|---------|---------|------------------------|--------------------|
| C3JY8F | ✓ | | | ✓ | ✓ | | | ✓ | | |
| CXMCER | ✓ | | | | ✓ | | ✓ | | | |
| DJZMUF | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | |
| DRTW3P | ✓ | | | | ✓ | | ✓ | | | |
| DXFPEP | ✓ | | | ✓ | ✓ | | | | | |
| F9AKPP | ✓ | | | | ✓ | | ✓ | | | SEM (imaging only) |
| F9RW4N | ✓ | ✓ | ✓ | | ✓ | | | ✓ | ✓ | |
| GLRYY3 | ✓ | | | | ✓ | | ✓ | | ✓ | |
| GXNXVE | ✓ | | | | ✓ | | | | | |
| H67QL6 | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | XRD |
| HAZQXE | ✓ | | | ✓ | ✓ | | | | | |
| HKVWRD | ✓ | | | | | ✓ | | | | |
| JM2J6G | ✓ | | | | ✓ | | | | | visual |
| JQ3MW4 | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | Pyrolysis-GC/MS |
| JQZXQL | ✓ | | | | ✓ | | | | ✓ | RAMAN |
| JV9FNE | ✓ | | | | ✓ | | | ✓ | | |
| K7QJAJ | ✓ | ✓ | | ✓ | ✓ | | | | | |
| LEXD4C | ✓ | | ✓ | | ✓ | | | | | |
| LK4AMC | ✓ | | | | ✓ | | | | | |
| LVLNTY | ✓ | | | | ✓ | | | ✓ | | |
| M2UC7Z | ✓ | | | | ✓ | | | | | |
| MCPNE8 | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | Pyrolysis GC-MS |
| MQNRFD | ✓ | ✓ | ✓ | | ✓ | | ✓ | | | Raman (785nm) |
| N22BDE | ✓ | | | | ✓ | ✓ | | | | |
| N4DNHB | ✓ | | | | ✓ | | | | ✓ | |
| NLVMMA | ✓ | | | | ✓ | | | ✓ | ✓ | |
| P3RUU7 | ✓ | | | | ✓ | | | | | |
| PCGKGY | ✓ | ✓ | | | ✓ | | | ✓ | ✓ | Pyrolysis GC-MS |

TABLE 2

| WebCode | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTIR | Solubility/ Chemical | XRS/XRF | SEM/EDX | Microspectrophotometry | Other |
|---------|------------------|-----------------|--------------|--------------|------|----------------------|---------|---------|------------------------|--------------------|
| PYEUYZ | ✓ | ✓ | | | ✓ | | | ✓ | | |
| Q8ZFH4 | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | |
| RAN76U | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | |
| RG7HHV | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | |
| RM9NXX | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | Raman spectroscopy |
| RR8697 | ✓ | | | ✓ | ✓ | | | ✓ | | |
| TNLHCC | ✓ | ✓ | | | ✓ | | | | | |
| TXQPTX | ✓ | ✓ | | | ✓ | | | ✓ | | Pyrolysis GC-MS |
| TYM66V | ✓ | | ✓ | | ✓ | | | ✓ | | LA-ICP-MS |
| UCZVG3 | ✓ | | | | ✓ | ✓ | | | | |
| UHTZB7 | ✓ | | | | ✓ | ✓ | | | | |
| V9KPJ8 | ✓ | | ✓ | | ✓ | | | ✓ | | |
| VMZNN8 | ✓ | | | | ✓ | | | ✓ | | |
| VZ3JDM | | | | | ✓ | | | | ✓ | |
| W77M4L | | | | | ✓ | | | | | |
| WFG2UU | ✓ | | | | ✓ | | | ✓ | | |
| X38LMP | ✓ | | | | ✓ | | | | | |
| XFAC6M | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | |
| XVKXQY | ✓ | | | | ✓ | ✓ | | | | |

Response Summary

| Participants | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTIR | Solubility/ Chemical | XRS/XRF | SEM/EDX | Microspectrophotometry |
|--------------|------------------|-----------------|--------------|--------------|------|----------------------|---------|---------|------------------------|
| 73 | 71 | 25 | 21 | 15 | 72 | 14 | 12 | 33 | 15 |
| Percent | 97% | 34% | 29% | 21% | 99% | 19% | 16% | 45% | 21% |

Conclusions

TABLE 3

| WebCode | Conclusions |
|---------|--|
| 2ADNYR | The two layer light purple/white(pale yellow) paints in Item 2Q and Item 1K, could have originated from the same source. The two layer light purple/white(pale yellow) paint in Item 3Q, did not originate from the same source as the paint in Item 1K. |
| 38YQYF | Each of Item 1 to Item 3 was found to consist of two layers of architectural paint on a wooden substrate: a top pinkish purple layer and a lower white 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, texture and chemical composition, indicating that the questioned paint chips recovered from the victim's hair (Item 2) could have originated from the damaged area of the suspect's living room wall (Item 1), or from another source of paint with similar characteristics. (b) The white layers in Item 1 and Item 3 were found to be different in terms of their appearance and chemical composition, indicating that the questioned paint chips recovered from the victim's shoe (Item 3) did not originate from the damaged area of the suspect's living room wall (Item 1). |
| 472QGV | The topest layer of the paint samples (Item 1, 2 and 3) have same chemical compound. But the middle layer of the Item 2 could have originated from Item 1, Item 3 could not have originated from Item 1. |
| 4EJ2UV | The questioned paint chips recovered from the victim's hair (Item 2) could have originated from the damaged area of the suspect's living room wall as represented by Item 1 because of similarities in number of layers, physical properties and chemical compositions. The questioned paint chips recovered from the victim's shoe (Item 3) could not have originated from the damaged area of the suspect's living room wall as represented by Item 1 because of differences in chemical compositions. |
| 4JAC4U | The questioned paint chips from the victim's hair(Item 2)could come from the damaged area of the suspect's living room. |
| 4QV86X | Results of Examinations: The Item 2 and Item 3 questioned paint samples were examined and compared to the Item 1 known paint sample. Based on the examinations conducted, Items 1 and 2 are alike with respect to color, layer structure, and chemical composition of the corresponding layers. Therefore, Item 2 originated from the same source as Item 1 or another source painted in the same manner (Type II Association - see Interpretation scale). This type of conclusion was reached due to the complexity of the layer structure and the expected rarity of the colors of the paint layers (sequence from the top: purple, yellow, and white). Item 3 differs in underlying layer structure from Item 1 in that it has no yellow layer. Therefore, the source of Item 1 is not the source of Item 3 (Elimination). The following analytical techniques were used in the examination of these items of evidence: visual and stereomicroscopical examinations, Fourier transform infrared spectroscopy, scanning electron microscopy with backscatter electron imaging and energy dispersive spectroscopy, and pyrolysis - gas chromatography/mass spectrometry. Interpretation: The following descriptions are meant to provide context to the conclusions reached in this report. Every type of conclusion may not be applicable in every case nor for every material. Type I Association: Physical/Fracture Match – The compared items exhibit physical features that demonstrate they were once part of the same object. Associations of Evidence with Class Characteristics (Types II-IV): Class characteristics are physical and/or chemical properties that place an item within a particular group of items. Associations of class evidence can have varying degrees of significance. As the size of the class decreases, the significance of the association between items in that class |

TABLE 3

| WebCode | Conclusions |
|---------|--|
| | <p>increases. A class association does not definitively establish that the items came from the same source. Type II Association: Association with atypical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Further, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III Association: Association with typical characteristics – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV Association: Association with limited characteristics/examinations – An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value as a result of items that are more commonly encountered in the relevant population, the inability to perform a complete analysis, or minor variations observed in the data. Inconclusive – No conclusion could be reached regarding an association or an elimination between the items. Elimination/Exclusion – The compared items exhibit differences in observed and/or measured properties and/or chemical composition that demonstrate they did not originate from the same source.</p> |
| 6B264X | <p>Items #1, 2 and 3 each consisted of paint chips with a layering of purple over off-white. The paint samples were examined via stereomicroscopy, polarized light microscopy (PLM), infrared spectroscopy (FTIR) and scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDS). One paint chip from Item 2 was examined. The examined questioned paint chip from Item #2 was consistent in color, layering, chemical and elemental composition with the known paint chip from Item #1 and could have originated from the same source (Level III association). The off-white layer of the two questioned paint chips from Item #3 were inconsistent in chemical composition with the off-white layer of the known paint chip from Item #1 and did not originate from the same source (Elimination). Terminology Key for Associative Evidence: The following descriptions are meant to provide context to the levels of opinions reached in this report. Every level of conclusion may not be applicable in every case nor for every material type. Level I Association: A positive identification; an association in which items share individual characteristics that show that the items were once from the same source. Level II Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and share atypical characteristic(s) that would not be expected to be readily available in the population of this evidence type. Level III Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined. Level IV Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. As compared to a Level III association, items categorized within a Level IV share characteristics that are more common amongst these kinds of manufactured products. Alternatively, an association between items would be categorized as a Level IV if a limited analysis was performed due to characteristics or size of the specimen(s). Level V Association: An association in which items are consistent in some, but not all, physical properties and/or chemical composition. Some minor variation(s) exists between the known and questioned items and</p> |

TABLE 3

| WebCode | Conclusions |
|---------|--|
| | could be due to factors such as sample heterogeneity, contamination of the sample(s), or having a sample of insufficient size to adequately assess homogeneity of the entity from which it was derived. Inconclusive: No conclusion could be reached regarding an association/elimination between the items. Elimination: The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source. |
| 6JTH2Y | The paint in item 2 is similar in color, layer structure, solubility, fluorescence and infra-red absorbance spectra to the paint in item 1. Therefore the paint in items 1 and 2 could have originated from the same source. The paint in item 3 is similar in color, layer structure, solubility, and fluorescence to the paint in item 1, however, it is dissimilar in infra-red absorbance. Therefore the paint in items 1 and 3 could not have originated from the same source. |
| 7B84DJ | Item 1 could have been the source of the recovered paint in item 2 as they could not be distinguished by their physical appearance or chemical composition as determined by infrared spectroscopy, pyrolysis gas chromatography-mass spectrometry and elemental. Item 1 was not the source of the recovered paint in item 3 as, although the topcoats were of similar physical appearance and chemical composition, the undercoats were dissimilar. |
| 7CM3VN | The examined portions of the two purple paint chips from the trace item – question paint chips recovered from the victim’s hair (Item 1-2) were found to be consistent in color, layer sequence, microscopic appearance and instrumental properties with the examined portion of the purple paint chip from the trace item – known paint sample representative of the damaged area of the suspect’s living room wall (Item 1-1). Accordingly, the examined portions of the two purple paint chips from the trace item – question paint chips recovered from the victim’s hair could have originated from the examined portion of the purple paint chip from the trace item – known paint sample representative of the damaged area of the suspect’s living room wall or another damaged source with similar characteristics. The examined portion of one purple paint chip from the trace item – question paint chips recovered from the victim’s shoe (Item 1-3) was found to be different in instrumental properties from the examined portion of the purple paint chip from the trace item – known paint sample representative of the damaged area of the suspect’s living room wall (Item 1-1). Accordingly, the examined portion of the one purple paint chip from the trace item – question paint chips recovered from the victim’s shoe could not have originated from the examined portion of the purple paint chip from the trace item – known paint sample representative of the damaged area of the suspect’s living room wall. |
| 7QLAMX | The questioned paint chips from the victim's hair(Item2)could come from the damaged area of the suspect's living room. |
| 7RVGPQ | The piant in item2 was found to be similar to item1 in microscopic appearance,layer structure and chemical composition. Therefore,item2 could have originated from the same source as item1 or another similiary painted source. Item3 was found to be different from item1 in chemical composition. |
| 89HU4H | The known paint sample from the damaged area of the suspect's living room wall (Item 1) was pink with a single white underlayer. The two chips recovered from the victim's hair (Item 2) consisted of pink paint with a single white underlayer. Both layers matched Item 1 in colour, microscopic appearance and chemical composition. The two chips recovered from the victim's shoe (Item 3) consisted of pink paint with a single white underlayer. The pink layer matched |

TABLE 3

| WebCode | Conclusions |
|---------|--|
| | the corresponding pink layer in Item 1 in colour, microscopic appearance and chemical composition. While the white layer was similar to the corresponding white layer in colour and microscopic appearance, it differed in chemical composition. |
| 8GC6CT | Results and Conclusions: 1. Exhibit 1 consisted of one piece of paper having the paint layer sequence: light purple / white. The surface of the white paint layer adjacent to the light purple paint layer had a light yellow colour. 2. Exhibit 2 consisted of two pieces of paper having the paint layer sequence: light purple / white. The surface of the white paint layer adjacent to the light purple paint layer had a light yellow colour. The light purple and white paint layers of Exhibit 2 are physically and chemically indistinguishable from the corresponding paint layers of Exhibit 1. The painted pieces of paper in Exhibit 2 originated either from the source of Exhibit 1, or from another source of paint having indistinguishable physical and chemical characteristics. 3. Exhibit 3 consisted of two pieces of paper having the paint layer sequence: light purple / white. The light purple paint layer of Exhibit 3 is physically and chemically indistinguishable from the light purple paint layer of Exhibit 1. The white paint layer of Exhibit 3 is physically and chemically different from the white paint layer of Exhibit 1. The painted pieces of paper in Exhibit 3 did not originate from the source of Exhibit 1. (see Remark 1) [Table 4 - Additional Comments] |
| 8M4A8H | Items 1, 2, and 3 all consist of two layers of architectural paint on an apparent cardboard substrate. The top layer of paint is purple and the bottom layer of paint is white. Item 2 is the same in all examined characteristics to Item 1 and thus could have originated from Item 1 or a similarly painted source. The white layer of paint on Item 3 is different from the white layer of paint on Item 1 and thus could not have originated from the same source as Item 1 as represented by the submitted sample. |
| 8TLM2B | Item 1 and Item 2 were physically and chemically comparable. Item 2 could have originated from Item 1. Item 1 and Item 3 were chemically distinguishable and therefore Item 3 could not have originated from Item 1. |
| 8UEQEH | Item 3 was found to be different to Item 1, and could not have originated from the suspect's living room wall. Item 2 was found to be in very good agreement with Item 1 in terms of their colour and appearance, elemental and chemical composition. It is my opinion, the findings: a. Show that the recovered paint from the victim's shoe (Item 3) can be excluded from having originated from the damaged area of the suspect's living room wall (Item 1). b. Provide strong support for the proposition that paint recovered from the victim's hair (Item 2) originated from the damaged area of the suspect's living room wall (Item 1). |
| 9HH4LR | 1. Item 2 paint chips could have originated from the damaged area of the suspect's living room wall as represented by Item 1. 2. Item 3 paint chips couldn't have originated from the damaged area of the suspect's living room wall as represented by Item 1. |
| 9MR8Q9 | Item 2 was physically and chemically comparable with item 1 therefore Item 2 could have originated from the source represented by item 1. Item 3 was physically comparable with Item 1 however the second layers of Items 3 and 1 were chemically not comparable therefore Item 3 could not have originated from the source represented by Item 1. |
| AEZ47C | Results of Laboratory Examination: The Item 1 known architectural paint was compared to the questioned paints in Items 2 and 3. The Item 1 known paint was similar to the Items 2 and 3 questioned paints in color and layer structure (light purple and white) and visible spectra (MSP). However, the Item 3 questioned paint was found to be different from the Item 1 paint in |

TABLE 3

| WebCode | Conclusions |
|---------|--|
| | <p>chemical composition (FTIR). Therefore, the Item 3 paint can be eliminated as coming from the same source as the Item 1 paint (Elimination). The Item 1 known paint and the Item 2 questioned paint were also found to be similar in microscopic characteristics (PLM), chemical composition (FTIR), elemental composition (SEM/EDS), and chemical solubilities. Therefore, these two paints could have come from a common source (Type III Association). It should be noted that since similar items may have been manufactured which would be indistinguishable from the submitted evidence, an individual source cannot be determined. KEY for instrument acronyms: FTIR – Fourier Transform Infrared Spectroscopy; PLM – Polarized Light Microscopy; MSP – Microspectrophotometry; SEM/EDS – Scanning Electron Microscopy/Energy Dispersive Spectroscopy. Interpretation: The following descriptions are meant to provide context to the opinions reached in this report. Every type of conclusion may not be applicable in every case or for every material type. Type I Association: Identification: An association in which items share individual characteristics and/or physically fit together that demonstrate the items were once from the same source. Type II Association: Association with distinct characteristics: An association in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and share distinctive characteristic(s) that would not be expected to be found in the population of this evidence type. The distinctive characteristics were not sufficient for a Type I Association. Type III Association: Association with conventional characteristics: An association in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and could have originated from the same source. Because it is possible for another sample to be indistinguishable from the submitted evidence, an individual source cannot be determined. Type IV Association: Association with limitations: An association in which items could not be differentiated based on observed and/or measured properties and/or chemical composition. As compared to the categories above, this type of association has decreased evidential value as a result of items that are more commonly encountered in the relevant population, the inability to perform a complete analysis, limited information, or minor variations observed in the data. Inconclusive: No conclusion could be reached regarding an association or an elimination between the items. Dissimilar: The items were dissimilar in physical properties and/or chemical composition, indicating that the items may not have originated from the same source. However, these dissimilarities were insufficient for a definitive Elimination. Elimination: Items exhibit dissimilarities in one or more of the following: physical properties, chemical composition or microscopic characteristics and, therefore, conclusively did not originate from the same source.</p> |
| ALXWCK | <p>The paint chips, items 001-1, 001-2, and 001-3, each consist of a purple paint layer over a white layer on paper. I compared these paint chips using stereo microscopy, polarized light microscopy, fluorescence microscopy, infrared microspectrophotometry, raman microspectrophotometry, scanning electron microscopy with energy dispersive spectrometry, reflected visible microspectrophotometry, and pyrolysis gas chromatography mass spectrometry. I found that both the purple and white layers of the reference paint, item 001-1, and the purple and white layers of the questioned paint, item 001-2, were similar in color, texture, layer structure, fluorescence, organic composition and inorganic composition. I found that the purple layer of questioned paint, item 001-3, and the reference paint, item 001-1, were similar in color, texture, fluorescence, organic composition and inorganic composition but the white layer of item 001-3 was different in texture, fluorescence, organic and inorganic composition when compared to the white layer of the reference paint item 001-1. CONCLUSION The questioned paint chip, item 001-2, is indistinguishable from the reference paint chip, item 001-1, in physical and chemical properties. The paint chip, item 001-2, could have originated from the same source of paint as the reference paint chip, item 001-1, or</p> |

TABLE 3

| WebCode | Conclusions |
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| | another source painted with a similar purple paint over a similar white substrate material. The questioned paint chip, item 001-3, is distinguishable from the reference paint chip, item 001-1, in that the white layer under the purple layer is different in texture and chemical composition. The paint chip, item 001-3, did not originate from the same source as the reference paint chip. |
| AMVAWR | The questioned sample #2 could have originated from item #1 or another source exhibiting all the same analyzed characteristics. Item #3 could not have originated from item #1 |
| B3YZEN | Item 2 recovered from the victim's hair could have originated from the damaged area of the suspect's living room wall. Item 3 recovered from victim's shoe could not have originated from the damaged area of the suspect's living room. |
| BCMWFN | Samples 1 and 2 were indistinguishable in terms of layer structure, microscopic appearance, chemical composition and elemental analysis. Sample 3 could be differentiated from samples 1 and 2 in these respects. |
| BDZN7K | In my opinion, the findings provide conclusive support for the proposition that the paint fragments recovered from the sole of the victim's shoe did not originate from the damaged living room wall. Furthermore, the findings provide strong support for the proposition that the paint fragments recovered from the victim's hair originated from the damaged living room wall, rather than from some other source. |
| BLR4VN | Item#2 and Item#1 are confirmed to be related, and can be originated from the same source. Item#3 can not be confirmed to be related to Item#1 due to different layers chemistry and physical properties. |
| C3JY8F | I formed the opinion based on the techniques used, that the questioned paint chip recovered from the victim's shoe (item 3) had a different texture and different chemical and elemental composition to the paint chip representing the damaged area of the suspect's living room wall (item 1) and could not have come from it. I also formed the opinion based on the techniques used, that the appearance, texture and chemical and elemental composition of the questioned paint chip recovered from the victim's hair (item 2) was indistinguishable to the paint chip representing the damaged area of the suspect's living room wall (item 1) and could have come from it. |
| CXM CER | The paint chips of all three samples consist of two layers: purple and a white layer. The paint chips from the victim's hair and from the damaged area of the suspect's living room wall show similar IR- spectra in both layers and they have the same inorganic elements. The IR- spectras from the white layer of sample 3 are different from the other white layers. It is highly probable that the questioned paint chips from the victim's hair originated from the damaged area of the suspect's living room wall. |
| DJZMUF | 1. Comparative examinations of the paint chip from Exhibit 1 (known paint form damaged area of subject's living room wall) with the paint chip from Exhibit 2 (questioned paint recovered from victim's hair) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the paint chip recovered from the victim's hair could have originated from the damaged area of the subject's living room wall, or another source with the same characteristics. 2. Comparative examinations of the paint chip from Exhibit 1 (known paint form damaged area of subject's living room wall) with the paint chip from Exhibit 3 (questioned paint recovered from victim's |

TABLE 3

| WebCode | Conclusions |
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| | shoe) disclosed them to be inconsistent in their organic compositions. As a result of these findings, the paint chip recovered from the victim's shoe could not have originated from the damaged area of the subject's living room wall as represented in Exhibit 1. 3. It should be noted that a paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown. |
| DRTW3P | It was determined utilizing Stereomicroscopic, Fourier Transform Infrared Spectroscopy, and X-Ray Fluorescence Spectroscopy techniques of analysis revealed the purple top coat layer and white primer layer from item 1 and item 2 exhibit consistent characteristics. Therefore, the item 1 paint sample cannot be eliminated as being the source of the item 2 questioned paint sample. It was determined utilizing Stereomicroscopic, Fourier Transform Infrared Spectroscopy, and X-Ray Fluorescence Spectroscopy techniques of analysis revealed the white primer layer from item 1 and item 3 exhibit dissimilar characteristics. Therefore, the item 1 paint sample can be eliminated as being the source of the item 3 questioned paint sample. |
| DXFPEP | The paint from item-2 (Questioned paint chips recovered from the victim's hair) and item-1 (Known paint sample representative of the damaged area of the suspect's living room wall) were consistent on color, layering and chemical composition and could have the same source. The paint from item-3 (Questioned paint chips recovered from the victim's shoe) and item-1 (Known paint sample representative of the damaged area of the suspect's living room wall) were inconsistent on chemical composition and could not have the same source. |
| F9AKPP | Questioned paint Q1a (item 2) and known paint K (item 3) are consistent and no discriminating differences were observed with respect to their color, texture, layer structure, chemical type, and elemental composition. Q1b was not instrumentally analyzed. No further conclusions can be made regarding this particle. It is the opinion of the undersigned that questioned paint Q1a (item 2) could have originated from the same source as represented by the known submitted exemplar K (item 1) or from another source exhibiting all of the same analyzed characteristics. Questioned paint Q2a and Q2b (item 3) and the known paint K (item 1) are different with respect to the texture and chemical type of layer 2. It is the opinion of the undersigned that questioned paint Q2a and Q2b (item 3) could not have originated from the same source as represented by the known paint K (item 1) submitted. |
| F9RW4N | Representative paint layers in Item 1 were examined and compared with the paint layers in Item 2 visually, microscopically, and instrumentally, and Item 3 visually and microscopically. Items 1 and 2 were consistent in all measured physical, microscopic, chemical, elemental, and color characteristics. They could have come from the same source, or any other source with the same physical, chemical, and elemental compositions. Items 1 and 3 were found to be inconsistent in microscopic characteristics and could not have come from the same source. |
| GLRYY3 | the results obtained by the different techniques used previously show that the paint samples of the seals P2-01, P2-02 and P2-03 have the same physico-chemical properties. |
| GXNXVE | The paint recovered from the victim's hair and shoe contained two coating layers. The paint from the wall also had two coating layers. The IR spectra of the top coat of the shoe and hair samples matched the spectrum of the top coat of the wall. However, the IR spectrum of the primer of the shoe coating sample did not match the primer of the wall sample. The primer spectra of the hair coating sample was consistent with the primer spectrum of the wall sample. It is likely the paint recovered from the hair originated from the living room wall paint. |
| H67QL6 | Exhibit 2 and Exhibit 3 each contained two paint chips consisting of a two-layered paint on a |

TABLE 3

| WebCode | Conclusions |
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| | brown drywall substrate. The top layer for both exhibits was light purple in color with a slight glossy and textured appearance over a white primer layer. The paints from these exhibits were examined and compared to each other as well as to the submitted known paint, Exhibit 1, which also consisted of a two-layered paint on a brown drywall substrate. The top layer was light purple in color with a slight glossy and textured appearance over a white primer layer. The paint of Exhibit 2 is comparable in physical characteristics, including layer construction and color, as well as in chemical and elemental composition to Exhibit 1, the known paint sample. The paint on Exhibit 2 could have originated from the same source as Exhibit 1 or from any other paint source with the same physical characteristics and chemical and elemental composition. The top layer of Exhibit 3 is comparable in physical characteristics as well as in chemical and elemental composition to the top layer of Exhibits 1 and 2, but displays dissimilarities in the bottom primer layer in chemical and elemental composition to both submitted paint samples, Exhibit 1 and Exhibit 2. The paint on Exhibit 3 is not consistent with having originated from the same source as either of the other submitted exhibits. |
| HAZQXE | [No Conclusions Reported.] |
| HKVWRD | The questioned paint chips recovered from the victim's hair (item 2) could have a common origin with the damaged area of the suspect's living room wall (item 1). The questioned paint chips recovered from the victim's shoe (item 3) did not originate from the damaged area of the suspect's living room wall (item 1). |
| JM2J6G | 1) Exhibit 2 originated either from the source of Exhibit 1 or from another source having paint layers with color, structure, texture and chemical characteristics indistinguishable from Exhibit 1. 2) Exhibit 3 did not originate from the source of Exhibit 1. |
| JQ3MW4 | The paint chips from the victim's hair in Item 2 either originated from the suspect's living room wall represented by the standard in Item 1 or from another source of architectural paint with the same optical, physical, chemical and elemental properties (Level III Association). The paint chips from the victim's shoes in Item 3 could not have originated from the suspect's living room wall represented by the standard in Item 1 (Elimination). |
| JQZXQL | Item 1 is not differentiated of Item 2 and Item 3. It was completed a visual examination, and FTIR, RAMAN and Microspectrophotometry (MSP-U/Vis) analysis. Item 1 has the same chemical structure than others (Item 2 and Item 3) by F-TIR and RAMAN. And using MSP-U/vis, item 1, 2 and 3 had the same spectrums (Abs/cm-1). |
| JV9FNE | Summary for Test 17-546: Paint Analysis (Our Web Code: JV9FNE): All three items are composed of two separate layers: a lower white layer and an upper purple layer. The upper layer of Item 1 (wall) showed a very similar chemical composition to that of Items 2 and 3 (victim's hair and victim's shoe respectively) by both FTIR and SEM/EDS analysis. However, when the lower layer of paint was analysed by SEM/EDS and FTIR, it was clearly shown that the chemical composition of Item 3 (victim's shoe) differed significantly from that of both Item 1 (wall) and Item 2 (victim's shoe), which matched each other quite closely. It is concluded that Item 1 cannot be excluded as a possible source for Item 2, but it can be excluded as a possible source for Item 3. |
| K7QJAJ | The known paint sample representative of the damaged area of the suspect's living room wall (Item 1), the questioned paint chips recovered from the victim's hair (Item 2) and the questioned paint chips recovered from the victim's shoe (Item 3) show the same layers with purple and white layer. All layers of three samples were analyzed by stereomicroscopy, Fourier |

TABLE 3

| WebCode | Conclusions |
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| | transform-infrared-spectroscopy and Pyrolysis Gas chromatography-mass spectrometry. Both purple and white layers from Item 2 were similar with Item 1. White layers from Item 3 can be differentiated from Item 1, while purple layers can be similar with Item 1. Accordingly, the questioned paint samples such as Item 2 could have originated from the suspect's living room wall (Item 1), but Item 3 could not have originated from the suspect's living room wall (Item 1). |
| LEXD4C | The paint samples in Items 1 and 2 were found to show agreement in topcoat colour, layer structure and chemical properties such that they could have had a common origin. The paint samples in Items 1 and 3 were found to show agreement in topcoat colour, however there were differences in layer structure and chemical properties such that they could not have had a common origin |
| LK4AMC | FTIR and microscopy results are consistent with Item 1 and Item 2 having a common origin, whereas Item 1 and Item 3 are were found to be different. |
| LVLNTY | Physical, microscopic, and instrumental analysis and comparison of the purple and white layers from Item 2 with the purple and white layers from Item 1 revealed them to be consistent with respect to color, texture, type, layer structure, binder composition, and pigment composition. Therefore, the paint recovered from the victim's hair could have originated from the damaged area of the suspect's living room wall or another paint source with these same properties. Physical, microscopic, and instrumental analysis and comparison of the purple and white layers from Item 3 with the purple and white layers from Item 1 revealed the white layers to be inconsistent with respect to binder composition and pigment composition. Therefore, the paint recovered from the victim's shoe could not have originated from the damaged area of the suspect's living room wall. |
| M2UC7Z | The paint sample identified as Item 2 demonstrates similar physical characteristics and chemical composition as the paint sample comprising Item 1. Accordingly, Item 1, or another source with the same physical characteristics and chemical composition, cannot be excluded as the source of the paint sample in Item 2. The paint sample identified as Item 3 demonstrates similar physical characteristics as the paint sample comprising Item 1; however, further analysis revealed differences in chemical composition. Accordingly, Item 1 is excluded as the source of the paint sample in Item 3. |
| MCPNE8 | The paint chips in Items 2 and 3 were examined and compared to the known paint sample in Item 1 in an attempt to determine whether or not either of the questioned paint samples recovered from the victim's body could have originated from the suspect's living room wall. Item 1 consists of one (1) paint chip having the following layer structure: 1. Light purple acrylic enamel paint layer; 2. White alkyd enamel primer layer; Substrate. The layers comprising this paint chip exhibit characteristics consistent with structural/architectural coatings, and the paint chip was used as a standard for comparison purposes. Item 2, questioned paint chips recovered from the victim's hair, consists of two (2) paint chips having the following layer structure: 1. Light purple acrylic enamel paint layer; 2. White alkyd enamel primer layer; Substrate. The layers comprising these paint chips exhibit characteristics consistent with structural/architectural coatings. Microscopical, microchemical and instrumental examinations and comparisons between the paint chips in Item 2 and the paint chip in Item 1 revealed that they are like one another with respect to layer colors, layer textures, layer sequence, and the microchemical reactivities, binder characteristics, and elemental composition of their respective layers. It is therefore concluded that the paint chips recovered from the victim's hair could have originated from the suspect's living room wall as represented in Item 1. Item 3, questioned paint chips recovered from the victim's shoe, consists of two (2) paint chips having |

TABLE 3

| WebCode | Conclusions |
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| | the following layer structure: 1. Light purple paint layer; 2. White undercoat layer; Substrate. The layers comprising these paint chips exhibit characteristics consistent with structural/architectural coatings. Microscopical and microchemical examinations and comparisons between the paint chips in Item 3 and the paint chip in Item 1 revealed significant differences with respect to the texture and microchemical reactivity of layer 2. It is therefore concluded that the paint chips recovered from the victim's shoe did not originate from the suspect's living room wall as represented in Item 1. |
| MQNRFD | Item 1, Item 2 and Item 3 have been examined. In the limits of the used analytical techniques, it is possible to conclude that : Purple paint chip which was found in the victim's hair (Item 2) could come from the damaged area of the suspect's living room wall (Item 1). Purple paint chip wich was found on the bottom of the shoe's victim (Item 3) doesn't come from the damaged area of the suspect's living room wall (Item 1). |
| N22BDE | The paint in item 2 is similar in color, layer structure, solubility, and infra-red absorbance spectra to the paint in item 1. Therefore the paint in items 1 and 2 could have originated from the same source. The paint in item 3 is similar in layer structure to the paint in item 1 however it is dissimilar in color, solubility, and infra-red absorbance spectra. Therefore the paint in items 1 and 3 could not have originated from the same source. |
| N4DNHB | The known paint sample (Item 1) from the damaged area of the suspect's living room wall and the recovered paint chips from the victim's hair (Item 2) and shoe (Item 3) consisted of two layers: a light pinkish-purple topcoat / a white primer applied to a cardboard surface. The questioned paint chips recovered from the victim's hair (Item 2) were similar in color, texture, coating thickness, paint type, layering sequence and chemical composition to the known paint sample from the suspect's living room wall (Item 1). Meanwhile, the white primer in Item 3 was found to be similar in color but different in thickness and chemical composition to the white primer in Item 1. Therefore, I am of the opinion that the questioned paint chips recovered from the victim's hair (Item 2) could have come from the damaged area of the suspect's living room wall (Item 1). |
| NLVMMMA | Each item is two-layer paint chip. All have purple layer as 1st layer and white layer as 2nd layer. FT-IR, SEM-EDX and MSP shows that purple layers of each item are same. FT-IR SEM-EDX shows that white layers from item 1 and item 2 are same. But white layer of item 1 and item 3 are different. |
| P3RUU7 | [No Conclusions Reported.] |
| PCGKGY | The questioned paint chips from Item 2 could have originated from the living room wall (as represented by Item 1) or from another source exhibiting all of the same analyzed characteristics. The questioned paint chips from Item 3 could not have originated from the living room wall as represented by Item 1. |
| PYEUYZ | Examinations Performed: Visual, Stereomicroscopy, Polarized Light Microscopy, Scanning Electron Microscopy with Energy Dispersive X-ray Analyzer, and Fourier Transform Infrared Spectroscopy. The questioned paint in CTS17-546 Item 2("Questioned paint chips recovered from the victim's hair.") and CTS17-546 Item 3("Questioned paint chips recovered from the victim's shoe.") are found to be consistent with the known paint in CTS17-546 Item 1("Known paint sample representative of the damaged area of the suspect's living room wall.") on the basis of color, texture, layer structure, elemental composition, and organic composition. The known paint in CTS17-546 Item 1("Known paint sample representative of the damaged area |

TABLE 3

| WebCode | Conclusions |
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| | of the suspect's living room wall.") could be a possible source of the questioned paint in CTS17-546 Item 2("Questioned paint chips recovered from the victim's hair.") and CTS17-546 Item 3("Questioned paint chips recovered from the victim's shoe."). |
| Q8ZFH4 | The results of the examination strongly support that the paint chips, Item 2, originate from the living room wall, from which Item 1 is collected (Level +3). The results of the examination extremely strongly support that the paint chips, Item 3, does not originate from the damaged area on the living room wall, from which Item 1 is collected (Level -4). |
| RAN76U | 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, microchemical tests and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectrometry (SEM-EDS). The two-layered light purple paint particles in Items 1 and 2 were consistent in colors, textures, types, layer sequence and chemical compositions. It was concluded that the Item 2 paint could have had a common origin with Item 1 or another source of paint with the same colors, textures, types, layer sequence and chemical compositions. The light purple paint particles in Item 3 could not be associated with the Item 1 paint due to differences in texture, fluorescence and chemical composition. |
| RG7HHV | The multi-layered paint chip in Item 2 (recovered from the victim's hair) is the same distinct type of paint as that represented by Item 1 (damaged area of the suspect's living room wall) and originated from that source or another source of paint having the same characteristics. The multi-layered paint chip in Item 3 (recovered from the victim's shoe) was found to be chemically different from Item 1 and did not originate from that source. |
| RM9NXX | Questioned paint chips recovered from the victim' hair (Item #2) were two layer paint chips, which matched in colour, layer structure and elemental and chemical composition with Item #1, the known paint sample representative of the damaged area of the suspect's living room wall. Thus the questioned paint chips in Item #2 could have originated from the known paint sample, Item #1. Questioned paint chips recovered from the victim' shoe (Item #3) were inconsistent with the known paint sample, Item #1. |
| RR8697 | Microscopic examination: All of them(Item1,2,3)are contained two layers,which is purple and white coat(from top to bottom). Chemical composition of Item2 is similar to those of Item1.However,Item3 is dissimilar to Item1 because of different chemical composition. |
| TNLHCC | Item 2: Description - Questioned paint chips. Finding - Same color, texture, layer structure, microscopic characteristics, and chemical composition as the known paint (Item #1). Conclusion - Could have originated from the same source, but not exclusively since other manufactured paint in this class may be indistinguishable from the submitted evidence. Item 3: Description - Questioned paint chips. Finding - White layer of paint is different from the known paint (Item #1) with respect to texture and chemical composition. Conclusion - Excluded. Remarks: The paint chips in Items #1 - #3 are each two layer paint chips consisting of a purple color top layer and a white color 2nd layer. Though the white color 2nd layers of the questioned paint chips (Item #3) and the known paint chip (Item #1) are different with respect to texture and chemical composition, the purple color top layers of these paint chips are the same with respect to color, texture, microscopic characteristics, and chemical composition. The evidence is being returned to your department. Analytical Detail: The above findings were determined using microscopic examination techniques and instrumental analyses. |

TABLE 3

| WebCode | Conclusions |
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| TXQPTX | <p>1. The damaged area of the suspect's wall, as represented by item 1, cannot be eliminated as a possible source of the paint (item 2) recovered from the victim's hair. Item 2 has either come from the suspect's wall or from another painted surface that is also indistinguishable in layer sequence, colour, microscopic appearance and chemical composition. Given that paint is mass-manufactured this two-layer paint should not be regarded as unique; however, architectural paint is known to occur in a wide variety of colours and chemical compositions. Ceramic microspheres and vinyl toluene-modified alkyd binders are not commonly encountered in architectural paint; these features add to the distinctiveness of this paint. 2. The damaged area of the suspect's wall, as represented by item 1, is eliminated as a possible source of the paint (item 3) recovered from the victim's shoe</p> |
| TYM66V | <p>The obtained sample from the suspect's living room wall (sample 1) contains layers of pink and white paint. Between these layers, a thin yellow area was observed. It is not clear whether this yellow material was applied as a separate paint layer, or was formed by mixing of diffusion of material. All studied properties of the paint sample recovered from the victim's hair (sample 2) match those of paint from sample 1. The type and colour of paint are relatively rare. Therefore, the results strongly support the hypothesis that sample 2 originated from the suspect's living room wall. The properties of the paint sample recovered from the victim's shoe (sample 3) can clearly be discriminated from those of sample 1. We conclude that sample 3 did not originate from the suspect's living room wall</p> |
| UCZVG3 | <p>1) The known paint sample representative of the damaged area of the suspect's living wall (item 1), the questioned paint chips recovered from the victim's hair (item 2), and the questioned paint chips recovered from the bed of the victim's shoe (item 3) consist of a two layers paint system with the following layer structure: Items 1 and 2: purple topcoat layer, acrylic latex; and white undercoat layer, orthophthalic alkyd enamel, with calcium carbonate and talc. Items 3: purple topcoat layer, acrylic latex; and white undercoat layer, styrene acrylic latex with calcium carbonate . 2) The two layered paint samples in items 1 and 2 matched in colors, textures and chemical composition. It was concluded that the paint in these items could have a common origin. The possibility that they don't share a common origin depends on whether or not, the victim could have obtained a paint transfer from another wall that presents the same layer sequence, same physical properties and chemical composition. 3) The two layered paint chips in item 1 and 3 match in the physical properties studied, particularly in color and layer sequence, but don't match regarding the chemical composition of white undercoat layer. It was concluded that the paint in these items don't have a common origin.</p> |
| UHTZB7 | <p>On analysis, I found that : i) Questioned paint chips recovered from the victim's hair (Item 2) to be similar with the known paint sample representative of the damaged area of the suspect's living room wall (Item 1). ii) Questioned paint chips recovered from the victim's shoe (Item 3) to be dissimilar with the known paint sample representative of the damaged area of the suspect's living room wall (Item 1). Hence, I am of the opinion that :- i) The questioned paint chips recovered from the victim's hair (Item 2) could have originated from the known paint sample representative of the damaged area of the suspect's living room wall (Item 1). ii) The questioned paint chips recovered from the victim's shoe (Item 3) did not originate from the known paint sample representative of the damaged area of the suspect's living room wall (Item 1).</p> |
| V9KPJ8 | <p>The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show the same paint layers: violet layer and white layer. Both layers of all samples were analyzed by microscopy, light microscopy, infrared spectroscopy and SEM/EDX. Item 2 cannot</p> |

TABLE 3

| WebCode | Conclusions |
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| | be differentiated from Item 1 by the used methods. Item 3 shows differences to Item 1 in the IR-spectra and in the elemental composition of the white layer. The questioned paint sample Item 2 could have originated from Item 1. |
| VMZNN8 | 1. The questioned paint marked "Item 2" could have originated from the same source as the control paint marked "Item 1", or another source of paint with similar characteristics. 2. The questioned paint marked "Item 3" did not originate from the same source as the control paint marked "Item 1". |
| VZ3JDM | [No Conclusions Reported.] |
| W77M4L | [No Conclusions Reported.] |
| WFG2UU | The paint from the living room (item 1) was found to consist of a lilac coloured top coat and white undercoat. The interface between these layers exhibited a cream colouration. The paint from the victim's hair (item 2) was found to consist of a lilac coloured top coat and white undercoat. The interface between these layers exhibited a cream colouration. In relation to colour, appearance, chemical composition and elemental composition the lilac top coat and white undercoat were found to be indistinguishable from the corresponding coats from the living room paint (item 1). these items may therefore share a common origin. The paint from the victim's shoe (item 3) was found to consist of a lilac coloured top coat and white undercoat. No discolouration of the interface between these layers was evident. The white undercoat was found to have a different chemical composition to the white undercoat from the living room (item 1). Therefore these items could not share a common origin. |
| X38LMP | A two-layer paint system was observed in the paint sampled from Items 1-3. The paint systems consisted of a lavender top-layer and a white primer layer on a paperboard substrate. Each of the paint layers was analyzed visually, stereoscopically and instrumentally by Fourier transform infrared spectrometry (FTIR). The two-layer paint system from Item 1 was visually and instrumentally consistent with Item 2. This indicates the paint recovered from the victim's hair (Item 2) could have originated from the damaged area of the suspect's living room wall (Item 1). The two-layer paint system from Item 1 was not consistent with Item 3 due to chemical differences observed in the FTIR results of the white primer layers as well as a visual difference in the top-layer texture. This indicates the paint recovered from the victim's shoe (Item 3) did not originate from the damaged area of the suspect's living room wall (Item 1). |
| XFAC6M | Item 2 is a light purple paint chip which is similar in visual color, layer sequence, paint type, and paint composition to light purple paint chip submitted as Item 1. It is my opinion that this paint chip could have originated from the same source as Item 1 or any other paint with similar characteristics. Item 3 is a light purple paint chip which is dissimilar in paint type to the light purple paint chip submitted as Item 1. It is my opinion that this paint chip did not originate from the same source as Item 1. |
| XVKXQY | 1) The known paint sample representative of the damaged area of the suspect's living room wall (item 1), the questioned paint chips recovered from the victim's hair (item 2), and the questioned paint chips recovered from the victim's shoe (item 3), consist of a two layers paint system with the following layer structure: 1. lilac lighth acrylic latex paint (items 1, 2 and 3) and 2. white alkyd orthophthalic oil based paint with calcium carbonate and china clay as extenders (item 1 and 2) and acrylic latex paint with calcium carbonate an extender(item 3). This sequence exhibits typical characteristics of two layers of architectonic paint. 2) The two layers paint chips in items 1 and 2 matches in all properties investigated, particularly in colors, |

TABLE 3

| WebCode | Conclusions |
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| | <p>textures, types, layer sequence and chemical composition. It was concluded that the paint in these items could have a common origin. 3) The two layers paint chips in item 1 and 3 match in the physical and microscopic properties studied, particularly in color and layer sequence, but don't match regarding the chemical composition of layer 2 (white). It was concluded that the paint in these items don't have a common origin.</p> |

Additional Comments

TABLE 4

| WebCode | Additional Comments |
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| 2ADNYR | The paints in Item 2Q and Item 1K, are similar in color, layer sequence and chemical composition. The paints in Item 3Q and Item 1K, are dissimilar in appearance, UV fluorescence, chemical reactivity, organic and inorganic composition. |
| 4QV86X | Due to similarities between Item 3 and Items 1 and 2, I would be reaching out to the contributor to inquire about whether additional known items could be submitted for comparison to Item 3. |
| 89HU4H | In normal casework I would evaluate the findings. |
| 8GC6CT | Remarks 1. The term 'source' refers to the specific area of the wall from which the paint sample was taken. |
| ALXWCK | Uncertain how to interpret the statement "ignore the drywall substrate." Does this mean to ignore the paper and the white layer or just the paper? Didn't see a separate gypsum layer in these paints. |
| F9AKPP | The white paint seemed to absorb into the cardboard substrate creating the appearance of a discoloration in the white coat near the substrate. I feel that a less porous substrate would be better suited for these samples. |
| JQ3MW4 | <p>Association Level Definitions: Level I Association: A physical match; items physically fit and/or align one another by way of corresponding surface characteristics. The associated items were once joined together to form a single item. Level II Association: Items correspond in all observed and measured physical properties and/or chemical composition and share atypical characteristic(s) that would not be expected to be readily available in the population of this evidence type. Level III Association: Items correspond in all observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Other items have been manufactured and/or are naturally occurring that would also correspond to the submitted evidence. Level IV Association: Items correspond in all observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. The items share typical characteristics expected to be readily available in the population of this evidence type. Alternatively, an association between items could be categorized as a Level IV Association if a limited analysis is performed. The extent of limited analysis varies. Comparison Terminology Definitions: Physically Match: Associated items physically fit and/or align one another by way of corresponding surface characteristics. The associated items were once joined together to form a single item. Associated: The questioned sample is the same distinct type of material as the known standard based upon detected properties. In other words, one could not discern a questioned sample if it were to be mixed with an associated known standard. No meaningful differences are detected. Disassociated: Meaningful differences are detected upon comparison. Inconclusive: No conclusion could be reached regarding an association or an elimination. Elimination: The sample did not originate from the source represented by the known standard. Samples are disassociated from the standard due to detecting meaningful differences upon comparison. Methodology: A stereomicroscope was utilized in the general examination of evidence. A stereomicroscope with transmitted, reflected and coaxial lighting was utilized in evidence analysis. A comparison microscope with transmitted light and polarized light capabilities is utilized to compare the physical and optical characteristics of trace evidence materials side-by-side in the same optical field up to 600 times magnification. A Perkin Elmer Spectrum 100 infrared spectrometer (FTIR) with Spotlight 200 microscope accessory is utilized to analyze the chemical characteristics of materials. Microchemical tests are performed to observe the reactivity of paint samples in various</p> |

TABLE 4

| WebCode | Additional Comments |
|---------|--|
| | <p>solvents and can assist in pigment and binder identification and layer discernment. Sulfuric acid and the LeRosen test were utilized in this case. A CRAIC Technologies QDI 2010 microspectrophotometer (MSP) is used to measure the relative intensities of visible and UV light that is transmitted, reflected, or fluoresced by a sample. An EDAX Orbis PC micro X-ray fluorescence spectrometer (micro-XRF) is utilized to analyze and compare the elemental characteristics of various types of trace evidence including glass, paint, tape, metals, and unknown materials. The elements sodium to berkelium on the periodic table can be detected. Glass is also amenable to semi-quantitative elemental ratio analysis and comparisons. Comparisons of glass elemental ratios increase the discrimination power of the method. Furthermore, ratios of certain elements may be utilized to classify glass as sheet or container. Py-GC/MS (pyrolysis-gas chromatography/mass spectrometry) is utilized in the analysis of various types of trace evidence including: tape, paint, fibers, polymers, lubricants, cosmetics, and unknown materials. When a substance is pyrolyzed (heated) using a CDS Analytical AS5250 pyroprobe autosampler, the chemical bonds within the substance are broken in a reproducible fashion. A pyrolysis temperature of 980C is utilized for certain lubricant types, a pyrolysis temperature series of 200C, 400C, and 800C is utilized for tapes, and a pyrolysis temperature of 800C is utilized for unknowns and most other materials. After heating, the gases are separated by an Agilent Technologies 7890B GC followed by identification/classification by an Agilent Technologies 5977A MS. Resulting data are compared either to standards, an in-house created searchable database, or an externally purchased searchable database. Py-GC/MS consumes materials upon testing.</p> |
| MCPNE8 | <p>Examination and comparison via dual-column PGC is typically employed as a technique in full-protocol forensic paint examinations in this laboratory. However, the section's PGC was unavailable for use on the test samples. Single-column PGC-MS was utilized instead of PGC to examine and compare the samples in this test.</p> |
| N22BDE | <p>The paint in items 1 and 3 differed in color of the primer layers. The top layers were similar in color.</p> |
| TNLHCC | <p>My report wording is formatted as a table in my actual report, which does not translate to the limitation of the CTS reporting format.</p> |
| TXQPTX | <p>In an actual case I would inquire about other areas of damage in the house.</p> |
| TYM66V | <p>The large size of the questioned materials (samples 2 and 3) makes this test rather unrealistic.</p> |
| UCZVG3 | <p>At the moment we don't routinely received cases with that kind of samples in our laboratory. We work routinely with automotive paint chips.</p> |
| VMZNN8 | <p>1. "Item 1" and "Item 2" were each found to consist of three layers of paint - an outermost purple layer, a second beige layer and a third white layer. "Item 3" was found to consist of two layers of paint - an outermost purple layer and a second white layer. 2. All three layers of "Item 1" and "Item 2" were found to have no significant differences in terms of colour and chemical composition. 3. The outermost purple layer of "Item 3" was found to have no significant differences in terms of colour and chemical composition when compared to the outermost purple layer of "Item 1". The second white layer of "Item 3" was found to be different from the second beige layer and third white layer of "Item 1" in terms of chemical composition.</p> |
| XVKXQY | <p>The possibility that the Item 1 and item 2 don't share a common origin depends on whether or not, the victim could have obtained a paint transfer from another area that presents the same layer sequence, same thickness, porosity, color and chemical composition. Especially considering that the paintings are finishing both samples are very commonly used in architectural finishes.</p> |

Appendix: Data Sheet

Collaborative Testing Services ~ Forensic Testing Program

Test No. 17-546: Paint Analysis

DATA MUST BE RECEIVED BY November 20, 2017 TO BE INCLUDED IN THE REPORT

Participant Code:

WebCode:

Accreditation Release Statement

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

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

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

Scenario:

Police are investigating the homicide of a woman whose body was discovered in an abandoned building. Purple paint chips were found in the victim's hair and on the bottom of her shoe. The police located a suspect and searched her house one week after the murder was suspected to have taken place. There was damage to the suspect's living room wall, which is similar in color to the paint chips found on the victim. A known paint sample has been collected from the damaged area of the wall. Police are requesting that you examine the recovered paint chips from the victim's body and determine if either of them could have originated from the suspect's living room wall.

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 drywall substrate.

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

Items Submitted (Sample Pack P2):

Item 1: Known paint sample representative of the damaged area of the suspect's living room wall.

Item 2: Questioned paint chips recovered from the victim's hair.

Item 3: Questioned paint chips recovered from the victim's shoe.

1.) Could the questioned paint chips recovered from the victim's hair (Item 2) and/or shoe (Item 3) have originated from the damaged area of the suspect's living room wall as represented by Item 1?

Item 2: Yes No Inconclusive

Item 3: Yes No Inconclusive

Please return all pages of this data sheet.

Participant Code:

WebCode:

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

Microscopic Examinations:

Stereomicroscope

Polarized Light

Fluorescence

Pyrolysis GC

FTIR

Solubility/Chemical

XRS/XRF

SEM/EDX

Microspectrophotometry

Other (specify): _____

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

4.) Additional Comments

| | |
|---|---|
| <p>Return Instructions: Data must be received via online data entry, fax (please include a cover sheet), or mail by November 20, 2017 to be included in the report. Emailed data sheets are not accepted.</p> <p>QUESTIONS? TEL: +1-571-434-1925 (8 am - 4:30 pm EST) EMAIL: forensics@cts-interlab.com www.ctsforensics.com</p> | <p>Participant Code:</p> <p>ONLINE DATA ENTRY: www.cts-portal.com</p> <p>FAX: +1-571-434-1937</p> <p>MAIL: Collaborative Testing Services, Inc. P.O. Box 650820 Sterling, VA 20165-0820 USA</p> |
|---|---|

Please return all pages of this data sheet.

Collaborative Testing Services - Forensic Testing Program

RELEASE OF DATA TO ACCREDITATION BODIES

The following Accreditation Releases will apply only to:

Participant Code:

WebCode:

for Test No. **17-546: Paint Analysis**

This release page must be completed and received by **November 20, 2017** to have this participant's submitted data included in the reports forwarded to the respective Accreditation Bodies.

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

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

ASCLD/LAB Certificate No. _____

ANAB Certificate No. _____

A2LA Certificate No. _____

Step 2: Complete the Laboratory Identifying Information in its entirety

Signature and Title _____

Laboratory Name _____

Location (City/State) _____

Accreditation Release**Return Instructions**

Please submit the completed Accreditation Release at the same time as your full data sheet. See Data Sheet Return Instructions on the previous page.

*Questions? Contact us 8 am-4:30 pm EST
Telephone: +1-571-434-1925
email: forensics@cts-interlab.com*

Please return all pages of this data sheet.

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