



## **Paint Analysis Test No. 19-546 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 68 participants and are compiled in the following tables:

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

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

## Manufacturer's Information

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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 3 came from a section of drywall with the same primer and topcoat. Item 2 was prepared with a different primer and topcoat from what was used for Items 1 and 3. 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 3 (ASSOCIATION):** The known Item 1 and questioned Item 3 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 (Valspar Simplicity, Mountain River Blue) were applied. For Item 1, paint samples were scored into squares that were approximately 1/2" x 1/2" and removed. One 1/2" x 1/2" piece was packaged into a glassine bag and then a pre-labeled Item 1 coin envelope. For Item 3, paint samples were scored into squares that were approximately 1/4" x 1/4" and removed. Two 1/4" x 1/4" pieces were packaged into a glassine bag and then a pre-labeled Item 3 coin envelope. Items 1 and 3 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 2 (ELIMINATION):** The questioned Item 2 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 (Sherwin Williams Showcase Paint & Primer, Mountain River Blue) were applied. Paint samples were scored into squares that were approximately 1/4" x 1/4" and removed. Two 1/4" x 1/4" pieces were packaged into a glassine bag and then a pre-labeled Item 2 coin envelope.

**SAMPLE SET ASSEMBLY:** For each sample pack, an Item 1 and an Item 3 from the same association group along with an Item 2 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, fluorescence microscopy, FTIR, solubility/chemical, and SEM/EDX.

## **Summary Comments**

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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 drywall substrates. Items 1 and 3 originated from a drywall substrate with the same primer and topcoat. Item 2 originated from a second drywall substrate that was prepared with a different primer and topcoat than what was used for Items 1 and 3. (Refer to Manufacturer's Information for preparation details.)

Of the 68 participants that reported examination results in Table 1, 68 (100%) reported that the Item 3 questioned paint chips could have originated from the same source as the Item 1 known paint sample and 67 (98.5%) reported that the Item 2 paint chips could not have originated from the same source as the Item 1 known paint sample. The final participant reported that the questioned paint chips for Item 2 were inconclusive when compared to the Item 1 known paint sample.

The most common methods utilized include FTIR, Stereomicroscope, and SEM/EDX.

# Examination Results

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

TABLE 1

| <u>Item 1</u>  |               |               | <u>Item 1</u>  |               |               | <u>Item 1</u>  |               |               |
|----------------|---------------|---------------|----------------|---------------|---------------|----------------|---------------|---------------|
| <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> | <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> | <u>WebCode</u> | <u>Item 2</u> | <u>Item 3</u> |
| 2DQKBV         | No            | Yes           | BYFZ3N         | No            | Yes           | PUBC6D         | No            | Yes           |
| 2LHYE2         | No            | Yes           | CA93JM         | No            | Yes           | Q9RMBF         | No            | Yes           |
| 2PGAA2         | No            | Yes           | DMWEMK         | No            | Yes           | QPK3VE         | No            | Yes           |
| 2UC9H6         | No            | Yes           | DVTZ3Y         | No            | Yes           | RYGKPE         | No            | Yes           |
| 2W6X68         | No            | Yes           | EAN4JU         | No            | Yes           | TJMFWB         | No            | Yes           |
| 2ZX2U6         | No            | Yes           | FF8QPK         | No            | Yes           | U2ZJR2         | No            | Yes           |
| 3WY3Y7         | No            | Yes           | FMQUWM         | No            | Yes           | UFDUHA         | No            | Yes           |
| 48DJ3W         | No            | Yes           | GDVBVJ         | No            | Yes           | UFFG29         | No            | Yes           |
| 4EWP2P         | No            | Yes           | GGVGEV         | No            | Yes           | V39QWF         | Inc           | Yes           |
| 4WRHLM         | No            | Yes           | GQ8GBR         | No            | Yes           | VFBJ2X         | No            | Yes           |
| 4ZC87Z         | No            | Yes           | H3CWRG         | No            | Yes           | VLKDK9         | No            | Yes           |
| 6BDUXW         | No            | Yes           | HELW2E         | No            | Yes           | VRAXL4         | No            | Yes           |
| 6DUEHQ         | No            | Yes           | HK9LLP         | No            | Yes           | VT23W3         | No            | Yes           |
| 6GWDTJ         | No            | Yes           | HLMXLW         | No            | Yes           | W2R279         | No            | Yes           |
| 6Q7KXZ         | No            | Yes           | J2BPFE         | No            | Yes           | WFTTRD         | No            | Yes           |
| 73RGAH         | No            | Yes           | K69JXG         | No            | Yes           | WPJDXB         | No            | Yes           |
| 7TQTHK         | No            | Yes           | KPEU7Q         | No            | Yes           | WUD8VC         | No            | Yes           |
| 99VYNZ         | No            | Yes           | KQTBDC         | No            | Yes           | X7GX94         | No            | Yes           |
| 9MTBUJ         | No            | Yes           | MAFRHH         | No            | Yes           | XCNJZ8         | No            | Yes           |
| AN2JYX         | No            | Yes           | MYVHQ3         | No            | Yes           | ZA878V         | No            | Yes           |
| B2LKUU         | No            | Yes           | N3XJRZ         | No            | Yes           |                |               |               |
| BF7ZXU         | No            | Yes           | NT6B7A         | No            | Yes           |                |               |               |
| BNVVVN         | No            | Yes           | NYWHPH         | No            | Yes           |                |               |               |
| BRWWYR         | No            | Yes           | PGQW3D         | No            | Yes           |                |               |               |

| Examination Response Summary |     | Participants: 68  |                  |
|------------------------------|-----|-------------------|------------------|
|                              |     | Item 1            |                  |
|                              |     | Item 2            | Item 3           |
| <b>Responses</b>             | Yes | <b>0</b> (0%)     | <b>68</b> (100%) |
|                              | No  | <b>67</b> (98.5%) | <b>0</b> (0%)    |
|                              | Inc | <b>1</b> (1.5%)   | <b>0</b> (0%)    |

# Examination Methods

TABLE 2

| WebCode | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTR | Solubility/ Chemical | XRF/XRF | SEM/EDX | Microspectrophotometry | Other                           |
|---------|------------------|-----------------|--------------|--------------|-----|----------------------|---------|---------|------------------------|---------------------------------|
| 2DQKBV  | ✓                | ✓               |              | ✓            | ✓   |                      |         | ✓       |                        |                                 |
| 2LHYE2  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        |                                 |
| 2PGAA2  | ✓                | ✓               | ✓            |              | ✓   |                      |         | ✓       |                        |                                 |
| 2UC9H6  | ✓                |                 | ✓            |              | ✓   |                      |         |         |                        | ALS                             |
| 2W6X68  | ✓                |                 |              |              | ✓   |                      |         |         |                        |                                 |
| 2ZX2U6  | ✓                |                 | ✓            |              | ✓   |                      |         | ✓       |                        |                                 |
| 3WY3Y7  | ✓                |                 |              |              | ✓   |                      |         | ✓       |                        |                                 |
| 48DJ3W  | ✓                | ✓               | ✓            | ✓            | ✓   |                      |         | ✓       |                        |                                 |
| 4EWP2P  | ✓                |                 | ✓            |              | ✓   |                      |         | ✓       |                        | Raman                           |
| 4WRHLM  | ✓                |                 |              |              | ✓   |                      |         | ✓       |                        |                                 |
| 4ZC87Z  | ✓                |                 |              |              | ✓   |                      |         | ✓       |                        | Raman                           |
| 6BDUXW  | ✓                |                 |              | ✓            | ✓   | ✓                    |         |         |                        | Cross-section                   |
| 6DUEHQ  | ✓                |                 |              |              | ✓   |                      |         | ✓       |                        |                                 |
| 6GWDTJ  | ✓                | ✓               | ✓            |              | ✓   |                      |         | ✓       |                        |                                 |
| 6Q7KXZ  | ✓                |                 |              |              | ✓   |                      |         |         |                        | X-Ray Diffraction, Raman        |
| 73RGAH  | ✓                | ✓               | ✓            | ✓            | ✓   |                      |         | ✓       | ✓                      | Raman                           |
| 7TQTHK  | ✓                |                 |              |              | ✓   |                      |         | ✓       | ✓                      |                                 |
| 99VYNZ  | ✓                |                 |              | ✓            | ✓   |                      |         | ✓       |                        |                                 |
| 9MTBUJ  | ✓                |                 |              |              | ✓   |                      |         | ✓       | ✓                      |                                 |
| AN2JYX  | ✓                |                 |              |              | ✓   |                      |         | ✓       |                        | RAMAN-Spectroscopy              |
| B2LKUU  | ✓                | ✓               |              |              | ✓   |                      |         |         | ✓                      | RAMAN AND COMPARISON MICROSCOPE |
| BF7ZXU  | ✓                |                 |              |              | ✓   |                      |         |         |                        |                                 |
| BNVVVN  | ✓                |                 | ✓            |              | ✓   |                      |         |         |                        | microtoming                     |
| BRWWYR  | ✓                |                 |              |              | ✓   | ✓                    |         |         | ✓                      |                                 |
| BYFZ3N  | ✓                |                 |              |              | ✓   |                      |         | ✓       | ✓                      |                                 |
| CA93JM  | ✓                | ✓               | ✓            |              | ✓   |                      |         | ✓       |                        | microscopy Raman                |
| DMWEMK  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        |                                 |
| DVTZ3Y  | ✓                |                 |              | ✓            | ✓   |                      |         |         |                        | Visual                          |

TABLE 2

| WebCode | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTR | Solubility/ Chemical | XRS/XRF | SEM/EDX | Microspectrophotometry | Other        |
|---------|------------------|-----------------|--------------|--------------|-----|----------------------|---------|---------|------------------------|--------------|
| EAN4JU  |                  |                 |              |              | ✓   |                      |         |         |                        |              |
| FF8QPK  | ✓                | ✓               |              |              | ✓   |                      | ✓       | ✓       |                        |              |
| FMQUWM  | ✓                |                 | ✓            | ✓            | ✓   | ✓                    |         |         |                        |              |
| GDVBVJ  | ✓                | ✓               |              |              | ✓   |                      | ✓       |         |                        |              |
| GGVGEV  | ✓                | ✓               | ✓            |              | ✓   | ✓                    |         |         |                        |              |
| GQ8GBR  | ✓                |                 | ✓            |              | ✓   |                      | ✓       | ✓       |                        | Raman        |
| H3CWRG  | ✓                | ✓               | ✓            |              | ✓   |                      | ✓       | ✓       |                        |              |
| HELW2E  | ✓                | ✓               |              |              | ✓   |                      | ✓       | ✓       |                        |              |
| HK9LLP  | ✓                | ✓               |              |              | ✓   |                      |         |         |                        | RAMAN        |
| HLMXLW  | ✓                | ✓               |              |              | ✓   |                      |         |         | ✓                      |              |
| J2BPFE  | ✓                |                 |              |              | ✓   | ✓                    |         |         | ✓                      |              |
| K69JXG  | ✓                |                 |              |              | ✓   |                      | ✓       | ✓       |                        |              |
| KPEU7Q  | ✓                | ✓               | ✓            | ✓            | ✓   | ✓                    |         |         |                        |              |
| KQTBDC  | ✓                |                 |              | ✓            | ✓   |                      | ✓       |         |                        |              |
| MAFRHH  | ✓                |                 | ✓            |              | ✓   |                      |         |         |                        |              |
| MYVHQ3  | ✓                |                 | ✓            | ✓            | ✓   | ✓                    |         |         |                        |              |
| N3XJRZ  | ✓                | ✓               |              | ✓            | ✓   | ✓                    | ✓       |         |                        |              |
| NT6B7A  | ✓                | ✓               |              | ✓            | ✓   | ✓                    | ✓       | ✓       |                        |              |
| NYWHPH  | ✓                |                 |              |              | ✓   |                      | ✓       |         |                        |              |
| PGQW3D  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        |              |
| PUBC6D  | ✓                | ✓               | ✓            | ✓            | ✓   |                      |         |         |                        |              |
| Q9RMBF  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        | fluorescence |
| QPK3VE  | ✓                |                 |              |              | ✓   |                      |         |         |                        | Micro-Raman  |
| RYGKPE  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        | UV light     |
| TJMFWB  | ✓                | ✓               | ✓            |              | ✓   |                      | ✓       |         |                        |              |
| U2ZJR2  | ✓                |                 |              | ✓            | ✓   |                      | ✓       | ✓       |                        |              |
| UFDUHA  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        | Raman        |
| UFFG29  | ✓                |                 |              |              | ✓   | ✓                    |         |         |                        |              |
| V39QWF  | ✓                | ✓               | ✓            |              |     | ✓                    |         |         |                        |              |

TABLE 2

| WebCode | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTIR | Solubility/ Chemical | XRF/XRS | SEM/EDX | Microspectrophotometry | Other     |
|---------|------------------|-----------------|--------------|--------------|------|----------------------|---------|---------|------------------------|-----------|
| VFBJ2X  | ✓                | ✓               | ✓            |              | ✓    | ✓                    | ✓       | ✓       |                        |           |
| VLKDK9  | ✓                |                 |              |              | ✓    |                      |         |         |                        |           |
| VRAXL4  | ✓                |                 | ✓            |              | ✓    |                      | ✓       |         |                        | LA-ICP-MS |
| VT23W3  | ✓                |                 | ✓            |              | ✓    | ✓                    | ✓       | ✓       |                        | XRD       |
| W2R279  | ✓                |                 |              |              | ✓    | ✓                    |         |         |                        |           |
| WFTTRD  | ✓                |                 |              | ✓            | ✓    |                      |         |         |                        |           |
| WPJDXB  | ✓                |                 |              |              | ✓    |                      | ✓       | ✓       |                        |           |
| WUD8VC  |                  |                 |              |              | ✓    |                      | ✓       |         |                        |           |
| X7GX94  | ✓                | ✓               |              |              | ✓    | ✓                    |         |         | ✓                      |           |
| XCNJZ8  | ✓                | ✓               | ✓            |              | ✓    | ✓                    | ✓       |         |                        | Raman     |
| ZA878V  | ✓                |                 |              |              | ✓    |                      | ✓       |         |                        |           |

| Response Summary |                  |                 |              |              |      |                      |                        |         |         | Total Participants: 68 |
|------------------|------------------|-----------------|--------------|--------------|------|----------------------|------------------------|---------|---------|------------------------|
|                  | Stereomicroscope | Polarized Light | Fluorescence | Pyrolysis GC | FTIR | Solubility/ Chemical | Microspectrophotometry | XRF/XRS | SEM/EDX |                        |
| Participants     | 66               | 23              | 23           | 15           | 67   | 15                   | 16                     | 10      | 36      |                        |
| Percent          | 97%              | 34%             | 34%          | 22%          | 99%  | 22%                  | 24%                    | 15%     | 53%     |                        |



# Conclusions

TABLE 3

| WebCode | Conclusions  |
|---------|--|
| 2DQKBV  | <p>1. Exhibit 1 (known paint standard from the damaged area of the victim's living room wall) consists of one multi-layered paint chip. The paint layer system consists of a blue topcoat over a white primer. 2. Exhibit 2 (questioned paint from the suspect's shoe) consists of two multi-layered paint chips. The paint layer system consists of a blue topcoat over a white primer. 3. Exhibit 3 (questioned paint from the suspect's floor) consists of two multi-layered paint chips. The paint layer system consists of a blue topcoat over a white primer. 4. Comparative examinations of Exhibit 2 with Exhibit 1 disclosed them to be inconsistent in their physical characteristics and chemical compositions. As a result of these findings, the paint from the suspect's shoe could not have originated from the damaged living room wall. 5. Comparative examinations of Exhibit 3 with Exhibit 1 disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the paint from the suspect's floor could have originated from the damaged living room wall, or another source with the same characteristics. 6. A paint association is not a means of positive identification and the number of possible sources for a specific paint is unknown.</p> |
| 2LHYE2  | <p>1. The questioned paint chips recovered from the suspect's floor (Item 3) was found to be similar with the known paint sample representative of the damaged area of the victim's living room wall (Item 1). Hence, Item 3 could have originated from the damaged area of the victim's living room wall. 2. The questioned paint chips recovered from the suspect's shoe (Item 2) was different from the known paint sample representative of the damaged area of the victim's living room wall (Item 1). Hence, Item 2 could have not originated from the damaged area of the victim's living room wall.</p>  |
| 2PGAA2  | <p>The findings give strong support to the proposition that Item1 and Item3 have the same origin. The findings give strong support to the proposition that Item1 and Item2 do not have the same origin,</p>  |
| 2UC9H6  | <p>Questioned item #3 could have originated from item #1 or from another source exhibiting all of the same analyzed characteristics. Questioned item #2 could not have originated from item #1.</p>  |
| 2W6X68  | <p>firstly we investigated physical appearance of dyes. all of them is nearly same color. after that we used FTIR with ATR. we determined that item 1 and item 3 are same compound. item 2 is different structure</p>  |
| 2ZX2U6  | <p>The known paint sample (Item 1) as well as the questioned paint samples (Item 2 and Item 3) show a blue top paint layer and a white paint layer. All samples cannot be differentiated by means of microscopy, but Item 2 can be differentiated by means of infrared spectroscopy and by their elemental composition. Regarding to the methods used, the questioned paint chips from the suspect's floor (Item 3) could have originated from the damaged area of the victim's living room wall.</p>  |
| 3WY3Y7  | <p>All three items are shown by SEM to be composed of two layers. SEM/EDS analysis shows the elemental composition of both layers of Item 2 (suspect's shoe) differ from those of Item 1 (victim's living room wall). On this basis Item 2 can be excluded as having originated from Item 1. This is corroborated by the FTIR results which show differences in chemical composition between these two items. Comparison by both FTIR and SEM/EDS show no significant differences in texture or chemical composition which could exclude Item 3 (suspect's floor) as having originated from item 1 (victim's living room wall). We therefore conclude that Item 3 (suspect's floor) cannot be excluded as having originated from Item 1 (victim's living room</p>  |

TABLE 3

| WebCode | Conclusions   |
|---------|---|
|         | wall), but Item 2 (suspect's shoe) can be excluded as having originated from Item 1 (victim's living room wall).  |
| 48DJ3W  | The multi-layered paint chip in item 1.2 (recovered from the shoe) was found to be chemically different than item 1.1 (from the damaged area of the living room wall) and did not originate from that source. The multi-layered paint chip in item 1.3 (recovered from the floor) is the same distinct type of paint as that represented by item 1.1 (from the damaged area of the living room wall) and originated from that source or another source of paint having the same characteristics.  |
| 4EWP2P  | The questioned paint sample recovered from the suspects shoe (Item 2) was chemically different from the paint collected from the victims living room wall (Item 1), and therefore could not share a common origin. This conclusion assumes the paint sample contained in Item 1 is representative of all types of paint on the victims living room wall. The questioned paint sample recovered from the suspects floor (Item 3) and the known paint sample collected from the victims living room wall (Item 1) were similar in colour, layer sequence, chemical and elemental composition. Therefore the blue paint chips found on the suspects floor (Item 3) could have come from the damaged area of the victims wall (as represented by Item 1), or from another source with the same layer sequence and chemical properties.  |
| 4WRHLM  | Conclusions: I formed the opinion based on the techniques used, that the questioned paint fragments recovered from the suspect's shoe (item 2), had a different chemical and elemental composition to the control paint fragments collected from the victim'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 questioned paint fragments recovered from the suspects floor (item 3), had the same appearance, chemical and elemental composition as the control paint collected from the victim's living room wall (item 1) and could have come from it.  |
| 4ZC87Z  | The examined blue paint chips marked "Item 2" did not originate from the same source as the examined blue paint chip marked "Item 1". The examined blue paint chips marked "Item 3" could have originated from the same source as the examined blue paint chip marked "Item 1", or another source of paint with similar characteristics.  |
| 6BDUXW  | Item 1 (01-01-AA): This item was used for comparison purposes. Item 2 (01-02-AA): This item contains two architectural paint chips. The questioned paint chips are similar in visual color and layer sequence to the known paint from the victim's living room wall (01-01-AA). A portion of one of these chips was further analyzed and is different in chemical solubility and paint type from the known paint from the victim's living room wall (01-01-AA). It is my opinion that the questioned paint chips did not originate from the victim's living room wall (Category 5). No analysis was performed on the remaining paint chip. Item 3 (01-03-AA): This item contains two architectural paint chips. The questioned paint chips are similar in visual color and layer sequence to the known paint from the victim's living room wall (01-01-AA). A portion of one of these chips was further analyzed and is similar in chemical solubility, paint type, and paint composition to the known paint from the victim's living room wall (01-01-AA). It is my opinion that the questioned paint chips could have come from the victim's living room wall or any other surface with similar paint characteristics (Category 2B). No analysis was performed on the remaining paint chip. |
| 6DUEHQ  | The paint evidence in Item 3 (paint chips recovered from floor) is a two-layer non-automotive paint that is similar in layer color, layer sequence, and layer chemistry to the paint evidence in Item 1 (damaged area of living room wall). Item 3 could have originated from the same source as Item 1 or from another paint source with similar paint. The paint evidence in Item 2 (paint chips recovered from shoe) is a two-layer non-automotive paint that is similar in color  |

TABLE 3

| WebCode | Conclusions   |
|---------|---|
|         | and layer sequence but is different in chemistry to the paint evidence in Item 1 (damaged area of living room wall). The paint from Item 2 could not have originated from the same source of paint as Item 1. Items 1, 2 and 3 were examined visually and using stereomicroscopy and Fourier transformed infrared spectroscopy (FTIR). Items 1 and 3 were also examined using scanning electron microscopy/energy dispersive X-ray spectroscopy (SEM/EDS).  |
| 6GWDTJ  | The results of the examination support that the paint chips, Item 3, originate from the living room wall, from which Item 1 is collected (Level +2). The results of the examination extremely strongly support that the paint chips, Item 2, does not originate from the damaged area on the living room wall, from which Item 1 is collected (Level -4).   |
| 6Q7KXZ  | The paint chips from the suspects floor (Item 3) were found to be a good match with the known paint sample from the damaged area of the victim's living room wall (Item 1). It is possible that the paint chips recovered from the suspect's floor could have originated from the victim's living room wall. The paint chips from the suspect's shoe (Item 2) could not have originated from the damaged area of the victim's living room wall.   |
| 73RGAH  | I compared the questioned sample, item 001-2, recovered from the suspect's shoe and the questioned sample, item 001-3, recovered from the suspect's floor to the known paint sample, item 001-1, from the damaged area of the victim's living room wall. I used stereo microscopy, polarized light microscopy, and fluorescence microscopy, infrared microspectrophotometry, scanning electron microscopy with energy dispersive spectrometry, raman microspectrophotometry, visible microspectrophotometry, and pyrolysis gas chromatography mass spectrometry in this examination. All items have a blue paint layer over a white paint layer on a paper backing. I found that items 001-3 and 001-1 were indistinguishable in all aspects of this examination. These two paint samples could have come from the same source or another source of paint with the same physical and chemical properties as items 001-1 and 001-3. I found that items 001-2 and 001-1 were different in microscopical appearance and chemical composition. These two paints did not come from the same source of paint.   |
| 7TQTHK  | Examination of the known paint sample representative of the damaged area of the victim's living room wall (Item 1): Item 1 comprised a paint sample with the layer sequence: blue topcoat/white undercoat. The blue topcoat was identified as an acrylic-polyvinyl acetate type paint. Bulk elemental composition of the topcoat principally comprised calcium, silicon, titanium, aluminium and magnesium. The white undercoat layer was identified as an acrylic type paint. Bulk elemental composition of the topcoat principally comprised calcium, silicon, magnesium, titanium and aluminium. Examination of the questioned paint chips recovered from the suspect's shoe (Item 2): Item 2 comprised a paint sample with the layer sequence: blue topcoat/white undercoat. The blue topcoat was identified as an acrylic type paint with kaolinite. The composition of the blue topcoat did not correspond to the composition of the blue topcoat from item 1. Therefore the results do not support the proposition that the paint recovered from the suspect's shoe (Item 2) originated from the damaged area of the victim's living room (Item 1). Examination of the questioned paint chips recovered from the suspect's floor (Item 3): Item 3 comprised a paint sample with the layer sequence: blue topcoat/white undercoat. The blue topcoat was identified as an acrylic-polyvinyl acetate type paint. Bulk elemental composition of the topcoat principally comprised calcium, silicon, titanium, aluminium and magnesium. The white undercoat layer was identified as an acrylic type paint. Bulk elemental composition of the topcoat principally comprised calcium, silicon, magnesium, titanium and aluminium. The appearance and composition of Item 3 corresponds with the appearance and composition of Item 1. Therefore the results support the proposition that the paint recovered from the suspect's floor (Item 3) originated from the damaged area of the victim's living room (Item 1). |

TABLE 3

| WebCode | Conclusions   |
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| 99VYNZ  | Microscopic examination: All of them (Item 1, 2, 3) are contained two layers, which is blue and white coat (from top to bottom). Item 1 and Item 3 were found to be consistent in color, layer sequence, microscopic appearance and instrumental analysis. However, Item 1 and item 2 were found to be different in instrumental analysis. Accordingly, item 3 has originated from item 1, but item 2 hasn't.   |
| 9MTBUJ  | The paint samples from the 'damaged area of the 'victim's living room wall' (Item 1) and the questioned paint chips from the 'suspect's shoe' (Item 2) and the 'suspect's floor' (Item 3) each consisted of a blue top coat and a white 2nd layer. No significant differences in appearance and chemical composition were detected between the paint chips from the 'suspect's floor' (Item 3) and the paint from the 'damaged area of the victim's living room wall' (Item 1). In my opinion, the paint from the 'suspect's floor' (Item 3) could have originated from the same source as the paint from the 'damaged area of the victim's living room wall' (Item 1). Significant differences in chemical composition were detected between the blue top coat and white 2nd layer of the paint chips from the 'suspect's shoe' (Item 2) and the corresponding paint layers from the 'damaged area of the 'victim's living room wall' (Item 1). In my opinion, the paint from the 'suspect's shoe' (Item 2) did not originate from the same source as the paint from the 'damaged area of the victim's living room wall' (Item 1).   |
| AN2JYX  | Item 1 (sample of the damaged area of the victim's living room wall) and item 3 fit together. Item 1 and item 3 belong together in color, chemical (the same binder system) and elementary composition. Item 2 is different to item 1 and item 3.   |
| B2LKUU  | The evidences 1 and 3 have the same morphology, chemical composition and color, but evidence 2 is different   |
| BF7ZXU  | The paint chip recovered from suspect's floor are originated from the damaged area of the victim's living room wall.  |
| BNVVVN  | The paint from the floor matched the paint from the wall with respect to appearance, colour, layer sequence and chemical composition of the blue and white layers. The paint from the floor could have come from the wall. The paint from the shoe had a similar appearance, colour and layer sequence but different chemical compositions of the paint layers to the paint from the wall. The paint from the floor did not come from the wall.   |
| BRWWYR  | 1. The known paint sample representative of the damage area of the victim's living room wall (item 1), the questioned paint chips recovered from the suspect's shoe (item 2) and the questioned paint chips recovered from the suspect's floor (item 3), consist of two layers paint system with the following layer structure: For items 1 and 3: 1. grayish blue PVA-acrylic latex paint with calcium carbonate and 2. White ortho phthalic alkyd enamel with talc and calcium carbonate. For item 2: 1. grayish blue acrylic latex paint with china clay and 2. White acrylic latex paint with styrene modified and calcium carbonate. 2. The two layered paint chips in items 1 and 3 matches in all properties investigated, particularly in colors, textures, types, layer sequence 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 depend on whether or not, the suspect could have obtained a paint transfer from another wall presents the same layer sequence, same thickness, porosity, color and chemical composition. 3. The two layered paint chips in item 2 and 1 match in the physical and microscopic properties studied, particularly in color and layer sequence, but don't match regarding the chemical composition of the two layers. It was concluded that the paint in these items don't have a common origin. |
| BYFZ3N  | Item 3 could have originated from the wall (as represented by Item 1, the submitted exemplar) or from another source with paint exhibiting all of the same analyzed characteristics. Item 2   |

TABLE 3

| WebCode | Conclusions   |
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|         | could not have originated from the wall represented by the Item 1 submitted exemplar.   |
| CA93JM  | Item 1, a known paint sample representative of the damaged area of the victim's living room wall, had two paint layers. Questioned paint chips recovered from the suspect's floor (Item 3) matched in colour, layer structure and elemental and chemical composition with Item 1, the known paint sample. Thus the questioned paint chips in Item 3 could have originated from the known paint sample, Item 1. Questioned paint chips recovered from the suspect's shoe (Item 2) were inconsistent with the known paint sample, Item 1.   |
| DMWEMK  | Item 3 similar to item 1. Item 2 different from item 1  |
| DVTZ3Y  | 1) Exhibit 3 originated either from the source of Exhibit 1 or from another source of paint having color, structure, texture and chemical characteristics indistinguishable from Exhibit 1. 2) Exhibit 2 did not originate from the source of Exhibit 1.  |
| EAN4JU  | Item #3 and item # 1 are confirmed to be related and can be originated from the same source while item #2 cannot be confirmed to be related due to different layers chemistry and physical properties.  |
| FF8QPK  | Layers 1 and 2 of the selected paint chips in item 3 are similar in layer structure, layer sequence, microscopic characteristics, and chemical composition to layers 1 and 2 of the known paint sample. Therefore, the paint in item 3 could have originated from the paint in item 1 or any source with paint that has similar class characteristics. Layers 1 and 2 of the selected paint chips in item 2 are similar in layer structure, layer sequence, and microscopic characteristics to layers 1 and 2 of the known paint sample. There are differences in the chemical composition between layers 1 and 2 in item 2 and layers 1 and 2 in item 1; therefore, the paint in item 2 could not have originated from the paint in item 1.  |
| FMQUWM  | Item 1: Known paint sample representative of the damaged area of the victim's living room wall- This item was used as a comparison standard. Item 2: Questioned paint chips recovered from suspect's shoe- The questioned paint chips recovered from the suspect's shoe are dissimilar in paint type to the known paint sample from the victim's living room wall (Item 1). It is our opinion that these questioned paint chips did not come from the victim's living room wall. Item 3: Questioned paint chips recovered from suspect's floor- The questioned paint chips recovered from the suspect's floor are similar in color, layer sequence, paint type, and paint composition to the known paint sample from the victim's living room wall (Item 1). It is our opinion that these questioned paint chips could have come from the victim's living room wall or any other source with similar characteristics. |
| GDVBVJ  | The Questioned Paint(Blue/White) analyzed in Item 2(Test No. 19-546 Item 2) is not consistent with the Known Paint(Blue/White) analyzed in Item 1(Test No. 19-546 Item 1) on the basis of organic composition and elemental composition. The Questioned Paint(Blue/White) analyzed in Item 3(Test No. 19-546 Item 3) is consistent with the Known Paint(Blue/White) analyzed in Item 1 on the basis of color, layer structure, organic composition, and elemental composition.  |
| GGVGEV  | In my opinion, the findings provide strong support for the proposition that the paint chips in item 3 originated from the damaged living room wall, as opposed to not. In my opinion, the findings provide conclusive support for the proposition that the paint chips in item 2 did not originate from the damaged living room wall, and instead originated from a different source of paint.  |
| GQ8GBR  | According to the results of above mentioned examination and analysis procedures, the questioned paint chips recovered from the suspect's shoe (Item 2) could not have originated from the damaged area of the victim's living room wall as represented by Item 1, the   |

TABLE 3

| WebCode | Conclusions  |
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|         | questioned paint chips recovered from the suspect's floor (Item 3) could have originated from the damaged area of the victim's living room wall as represented by Item 1.  |
| H3CWGR  | Item 1 is a two-layer paint sample with a blue topcoat and a white primer layer on a drywall substrate. Item 2 is a two-layer paint sample with a blue topcoat and a white primer layer on a drywall substrate. Item 2 has a different chemical composition than item 1; therefore, item 2 could not have originated from item 1. Item 3 is a two-layer paint sample with a blue topcoat and a white primer layer on a drywall substrate. Item 3 is similar in microscopic characteristics and chemical composition to item 1; therefore, item 3 could have originated from item 1 or another paint source with the same class characteristics.  |
| HELW2E  | Comparative examinations of the paint from Exhibit 1 (known paint sample representative of the damaged area of victim's living room wall) with the paint from Exhibit 2 (questioned paint chips recovered from the suspect's shoe) disclosed them to be inconsistent in their organic and elemental compositions. As a result of these findings, the paint recovered from the suspect's shoe could not have originated from the damaged area of the victim's living room wall as represented by the paint in Exhibit 1. Comparative examinations of the paint from Exhibit 1 (known paint sample representative of the damaged area of victim's living room wall) with the paint from Exhibit 3 (questioned paint chips recovered from the suspect's floor) disclosed them to be consistent in their physical characteristics, organic compositions, and elemental compositions. As a result of these findings, the paint recovered from the suspect's floor could have originated from the damaged area of the victim's living room wall or another source with similar characteristics. 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.  |
| HK9LLP  | 3) Microscopic analysis conducted on the three items revealed that they are similar in their layer structure and layer colors. Each item consists of paint with two layers: a blue layer and a white layer. The organic analysis (FTIR) and the pigment analysis (RAMAN) made upon the two layers of the items 1 and 3, showed no differences between them. The organic analysis (FTIR) made upon blue and white layers of items 1 and 2 produced different spectra. According to the microscopic and analytical results, questioned paint chips recovered from the suspect's shoe (item 2) can't come from the damaged area of the victim's living room wall (item 1). Nevertheless, questioned paint chips recovered from the suspect's floor (item 3) were undistinguishable in color, pigment and organic composition from samples recovered on from the damaged area of the victim's living room wall (item 1). Therefore, it can't be excluded than samples recovered from the suspect's floor (item 3) come from the damaged area of the victim's living room wall (item 1).  |
| HLMXLW  | One of the two exhibits from Item 2 was examined microscopically and found to be consistent in layer structure with Item 1. It was further examined using polarized light microscopy and fourier transform infrared spectroscopy (FTIR, blue layer only) and compared to Item 1. The FTIR results reveal discriminating differences between the blue layers of Item 2 and Item 1. Thus, Item 2 could not have originated from Item 1 as represented by the examined samples in Items 2 and Item 1. No further analysis was performed on the remaining exhibit in Item 2. Therefore, no conclusions can be reached on this sample. The submitted Item 1 was examined and compared to one of the two exhibits in Item 3 using polarized light microscopy, visible microscopy, microspectrophotometry (blue layers only) and fourier transform infrared spectroscopy (FTIR). The examined exhibits from Items 3 and 1 each consist of 2 layers. The 2 layers are consistent in appearance, microscopic and chemical properties. Thus, Item 3 could have originated from Item 1 as represented by the examined samples in Items 3 and 1 or another paint source exhibiting the same analyzed characteristics and layer structure. No analysis was performed on the remaining exhibit in Item 3. Therefore, no conclusions can be |

TABLE 3

| WebCode | Conclusions  |
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|         | reached on this sample.  |
| J2BPFE  | Physical and chemical examinations indicate that: Item 2 differed in chemical composition from item 1. Therefore, item 2 (questioned paint chips recovered from suspect's shoe) did not originate from item 1 (known paint sample representative of the damaged area of the victim's living room wall). Item 1 and 3 are indistinguishable from one another and have the same physical and chemical properties. Therefore, item 3 (questioned paint chips recovered from the suspect's floor) could have originated from item 1 (known paint sample representative of the damaged area of the victim's living room wall).  |
| K69JXG  | Microscopic and instrumental examination and comparison of the questioned (Item 3) and known (Item 1) paints reveals sufficient similarities such that it can be concluded that the questioned paint could have originated from the same source as the known paint. Microscopic and instrumental examination and comparison of the questioned (Item 2) and known (Item 1) paints reveals sufficient dissimilarities such that it can be concluded that the questioned paint could not have originated from the same source as the known paint.   |
| KPEU7Q  | The questioned paint chips recovered from suspect's floor (item 3) could have originated from the damaged area of the victim's living room wall (item 1), because of the similarities of their physical properties and chemical compositions. The questioned paint chips recovered from suspect's shoe (item 2) could NOT have originated from the damaged area of the victim's living room wall (item 1), because of the differences of their physical properties and chemical compositions.  |
| KQTBDC  | <p>Results of Examinations: The Item 1 known paint chip from the victim's living room wall was examined and compared to the Item 2 questioned paint chips recovered from the suspect's shoe and the Item 3 questioned paint chips recovered from the suspect's floor. Based on the examinations conducted, the two layers of paint comprising Item 1 could not be distinguished in sequence, color, texture, and chemical composition to the corresponding layers of paint in Item 3. Accordingly, Item 1 and Item 3 originated from the same source or from different sources painted in the same manner (Type III Association – see Interpretation scale). This type of association was reached because other surfaces painted with the same colors and formulations in the same sequence as the source of Item 1 would also be indistinguishable. Item 1 was different from Item 2 in chemical composition. Therefore, Item 1 and Item 2 do not share a common source (Elimination). The following analytical techniques were used in the examinations of these items of evidence: visual and stereomicroscopical examinations, Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy with energy dispersive spectroscopy (SEM/EDS), and pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS).</p> <p>Interpretation: The following descriptions are meant to provide context to the conclusions reached in this report. Every type of conclusion may not be applicable in every case nor for every material. Type I Association: Physical/Fracture Match – The items exhibit physical features that demonstrate they were once part of the same object. Associations of Evidence with Class Characteristics – Class characteristics are physical and/or chemical properties that place an item within a particular group of items. Associations of evidence with class characteristics can have varying degrees of significance. In general, the smaller the size of the group relative to the relevant population, the more significant the association. A class association cannot definitively establish that the items came from the same source. Type II: Association with Highly Discriminating Characteristics – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. Additionally, the items share unusual characteristics that would not be expected to be encountered in the relevant population. Type III: Association with Discriminating Characteristics – An association in which items could not be differentiated.</p> |

TABLE 3

| WebCode | Conclusions  |
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|         | <p>Therefore, the possibility that the items came from the same source cannot be eliminated. Other items have been manufactured that would also be indistinguishable from the submitted items and could be encountered in the relevant population. Type IV: Association with Limitations – An association in which items could not be differentiated. Therefore, the possibility that the items came from the same source cannot be eliminated. As compared to the categories above, this type of association has decreased evidential value. For example, the items are more commonly encountered in the relevant population, a complete analysis was not performed due to limited characteristics or a limited analytical scheme, or minor variations were observed in the data. Inconclusive – No conclusion could be reached regarding an association or an elimination between the items. Elimination – The items exhibit meaningful differences that demonstrate they did not originate from the same source.</p>  |
| MAFRHH  | <p>The paint sample recovered from the suspect's floor (ITEM 3) was found to show agreement in colour, cross-sectional layer structure and chemical properties/composition with the control paint sample (ITEM 1) such that, in our opinion, these samples could have had a common origin. The paint sample recovered from the suspect's shoe (ITEM 2) was found to be different from the control paint sample (ITEM 1).</p>   |
| MYVHQ3  | <p>In my opinion the paint in Item 2 (from the shoe) could not have originated from the wall (Item 1) based on differences in fluorescent properties and chemical composition. In my opinion the findings provide strong support for the proposition that the paint in Item 3 (from the floor) originated from the wall (Item 1) based on agreement in the physical and chemical properties.</p>   |
| N3XJRZ  | <p>The paint chips recovered from the subject's shoe in Item 2 could not have originated from the wall as represented by the standard. The paint chips recovered from the subject's floor in Item 3 could have originated from the victim's wall as represented by the standard.</p>   |
| NT6B7A  | <p><b>CONCLUSIONS:</b> The questioned paint recovered from the suspect's floor (item 3) is the same distinct type of paint as the known paint from the victim's living room wall (item 1) and originated either from that source or another source of architectural paint having the same distinct characteristics. The questioned paint recovered from the suspect's shoe (item 2) did not originate from the area of the wall represented by item 1. <b>RESULTS:</b> The paint from the suspect's shoe (item 2) and the paint from the suspect's floor (item 3) were examined for the purpose of determining whether or not there is any paint present like that on the victim's living room wall (item 1). The paint standard from the wall (item 1) has the following layer structure: 1. Medium blue polyvinyl acetate-acrylic latex top coat; 2. White alkyd enamel primer; 3. Drywall substrate. This paint exhibits characteristics typical of an architectural finish and was used for comparison with questioned paint recovered from the suspect's shoe (item 2) and from the suspect's floor (item 3). The questioned paint recovered from the floor (item 3) has the same layer structure as the known paint from the victim's wall (item 1). Examination and comparison of the questioned paint from the floor (item 3) with item 1 revealed they are alike with respect to layer structure, layer colors, layer textures, microchemical reactivities, binder characteristics, and pigment characteristics. It is therefore concluded that the questioned paint recovered from the suspect's floor (item 3) is the same distinct type of paint as that on the victim's living room wall (item 1) and originated either from that source, or from another source of architectural paint having the same distinct characteristics. The questioned paint from the suspect's shoe (item 2) has the following layer structure: 1. Medium blue acrylic latex top coat; 2. White acrylic enamel primer; 3. Drywall substrate. Examination and comparison of the questioned paint from the shoe (item 2) with item 1 revealed they are dissimilar with respect to layer textures, general binder types and pigment characteristics. It is therefore concluded that the questioned paint recovered from the suspect's shoe (item 2) did not originate from the area of the victim's wall represented by item 1.</p> |



TABLE 3

| WebCode | Conclusions   |
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| NYWHPH  | <p>ITEMS: 1: a sealed manila envelope identified as "2019 CTS Forensic Testing Program TEST NO. 19-546: Paint Analysis" containing: 1-1: a paint chip sealed in a small manila envelope identified as "Test No. 19-546 Item 1". 1-2: two paint chips sealed in a small manila envelope identified as "Test No. 19-546 Item 2". 1-3: two paint chips sealed in a small manila envelope identified as "Test No. 19-546 Item 3". RESULTS: The paint chip in item #1-1 consisted of two (2) layers in the following order: textured blue/white. The paint chips in item #1-2 each consisted of two (2) layers in the following order: textured blue/white. The paint chips in item #1-3 each consisted of two (2) layers in the following order: textured blue/white. The paint chips in items #1-1, #1-2, and #1-3 were examined using stereomicroscopy, Fourier Transform Infrared Spectroscopy (FTIR), and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectroscopy (SEM-EDS). The paint in item #1-2 was consistent in color and layer sequence to the known paint sample in item #1-1. The paint in item #1-2 was dissimilar to the known paint sample in item #1-1 in texture and chemical composition. The paint in item #1-3 was consistent in color, texture, layer sequence, and chemical composition to the known paint sample in item #1-1. OPINION: The paint from item #1-3 could have come from the known paint sample, item #1-1, or any other source exhibiting similar characteristics. This is a Type III Association. See Association Key below. [Table 4 - Additional Comments] The paint in item #1-2 was dissimilar to the paint from the known paint sample, item #1-1. This is an Elimination. See Association Key below. [Table 4 - Additional Comments]</p> |
| PGQW3D  | <p>The paint chips of all 3 samples consist of two layers: blue and a white layer. The paint chips from the damaged area of the victim's living room wall and from the suspect's floor show similar IR- spectra in both layers and they have the same inorganic elements. The IR- spectras from both layers of sample 2 are different from the other layers. It is highly probable that the questioned paint chips from the suspect's floor originated from the damaged area of the victim's living room.</p>   |
| PUBC6D  | <p>Item 1: Known paint sample representative of the damaged area of the victim's living room wall. Conclusion: This item consists of a blue paint and was used for comparison purposes. Item 2: Questioned paint chips recovered from the suspect's shoe. Conclusion: This item consists of two pieces of blue paint. One of the pieces was further analyzed and determined to be dissimilar in paint type to the paint from the victim's living room wall (Item 1). It is our opinion that this paint did not come from the victim's living room wall. No further analysis was performed on the second piece of blue paint. Item 3: Questioned paint chips recovered from the suspect's floor. Conclusion: This item consists of two pieces of blue paint. One of the pieces was further analyzed and determined to be similar in visual color, layer sequence, paint type, and paint composition to the paint from the victim's living room wall (Item 1). It is our opinion that this paint could have come from the victim's living room wall or any other paint with similar characteristics. No further analysis was performed on the second piece of blue paint.</p>   |
| Q9RMBF  | <p>The paint in item 3 is similar in color, layer structure, solubility, fluorescence and infrared absorbance spectra to the paint in item 1. Therefore the paint in items 1 and 3 could have originated from the same source. The paint in item 2 is similar in color, layer structure, and fluorescence to the paint in item 1; however, it is dissimilar in infrared absorbance spectra. Therefore the paint in items 1 and 2 could not have originated from the same source.</p>  |
| QPK3VE  | <p>The questioned paint chips recovered from the suspect's floor (item 3) and the known paint sample representative of the damaged area of the victim's living room wall (item 1) were consistent on color, layering and chemical composition and could have originated from the same source. The questioned paint chip recovered from the suspect's shoe (item 2) and the known paint sample (item 1) were inconsistent on chemical composition. The item 2 could not</p>  |

TABLE 3

| WebCode | Conclusions  |
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|         | have originated from the same source as represented by the item 1.   |
| RYGKPE  | The paint in item 3 is similar in color, layer structure, solubility, fluorescence and infrared absorbance spectra to the paint in item 1. Therefore the paint in items 1 and 3 could have originated from the same source. The paint in item 2 is similar in color, layer structure and fluorescence to the paint in item 1; however, it is dissimilar in infrared absorbance spectra. Therefore the paint in items 1 and 2 could not have originated from the same source.   |
| TJMFWB  | Representative paint samples from Items 1 and 3 were consistent in all measured physical, microscopic, chemical, and elemental properties. They could have come from the same source, or any other source with the same physical, chemical, and elemental compositions. Representative paint samples from Items 1 and 2 were found to be inconsistent in chemical composition and could not have come from the same source.  |
| U2ZJR2  | Items 1, 2, and 3 were examined by stereomicroscopy and infrared spectroscopy. Items 1 and 3 were further examined by microspectrophotometry, scanning electron microscopy/energy-dispersive x-ray spectrometry, and pyrolysis gas chromatography/mass spectrometry. The slate-blue paint in Item 3 was indistinguishable from the slate-blue paint in Item 1 in color, polymer type, layer structure, texture, and elemental composition (Type 2 Association). This means the paint recovered from the suspect's floor could have come from the damaged area of the victim's living room wall. The slate-blue paint in Item 2 was different from the slate-blue paint in Item 1 (Elimination). This means the paint recovered from the suspect's shoe did not come from the damaged area of the victim's living room wall.  |
| UFDUHA  | Item 1, Item 2, and Item 3 have been analysed. Within the limits of the used analytical methods, we do not differentiate Item 1 and Item 3 while Item 1 and Item 2 are different. So, we conclude that : the recovered paint chips from the suspect's floor (Item 3) could have originated from the damaged area of the victim's living room wall (Item 1). the recovered paint chips from the suspect's shoe (Item 2) doesn't come from the damaged area of the victim's living room wall (Item 2).   |
| UFFG29  | 1) The known paint sample representative of the damaged area of the victim's living room wall (item 1), the questioned paint chips recovered from the suspect's shoe (item 2), and the questioned paint chips recovered from the suspect's floor (item 3) consist of a two layers paint system with the following layer structure: Items 1 and 3: dark blue topcoat layer, polyvinyl acetate - acrylic latex; and white undercoat layer, orthophthalic alkyd enamel with calcium carbonate and talc. Items 2: dark blue topcoat layer, acrylic latex with china clay; and white undercoat layer, styrene acrylic latex with calcium carbonate. 2) The two layered paint samples in items 1 and 3 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 transfers detected to the suspect coming from another surface (building or house) that particularly has the same type of finish (same layer sequence, physical properties and chemical composition). 3) The two layered paint chips in item 1 and 2 match in the physical properties studied, particularly in color and layer sequence, but don't match regarding the chemical composition of dark blue topcoat layer and white undercoat layer. It was concluded that the paint in these items don't have a common origin. |
| V39QWF  | We compared items 2 and 3 to item 1 by using the methods mentioned before. As chemical test, we used the test of Rosen. Item 3 could not be differentiated from item 1 by the methods used. Item 2 showed very subtle differences in microscopy, uv-light and during the chemical test. But these differences could also be caused by the substrate, which is clearly not the same as in item 1 and 3.   |

TABLE 3

| WebCode | Conclusions  |
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| VFBJ2X  | <p>Results of Laboratory Examination: The paint chips in Item 3 were examined microscopically (PLM) and corresponded in color and layer structure (blue/white), chemical composition (FTIR, chemical solubilities), visible spectra (MSP), and elemental composition (SEM/EDS) to the known paint in Item 1. Therefore, the Item 3 paint could have come from the same source as Item 1 or another source with the same characteristics (Type III Association). It should be noted that the analytical techniques used allow for a high degree of discrimination between different paints, however, other items may have paint manufactured to the same specifications that would be indistinguishable from the submitted evidence. The paint chips in Item 2, though visibly similar in color and layer structure (blue/white), differ in chemical composition (FTIR) to the known paint in Item 1. Therefore, the Item 2 paint did not come from the same source as the Item 1 known paint (Exclusion). Instrument and Equipment Acronyms: FTIR - Fourier Transform Infrared Spectroscopy. PLM - Polarized Light Microscopy. MSP - Microspectrophotometry. VSC - Video Spectral Comparator. SEM/EDS - Scanning Electron Microscopy/Energy Dispersive Spectroscopy. Interpretation: The following descriptions are meant to provide context to the opinions reached in this report. Not every type of conclusion may be applicable in every case or for every material type. Type I Association: Identification: Source identification is reached when the discernable class and individual characteristics have corresponding detail and the examiner would not expect to see the same arrangement of details repeated in another source. This includes when two Items fit or realign together in a manner that is not expected to be replicated. Type II Association: Association with distinct characteristics: Items correspond in all measured physical properties, chemical composition and/or microscopic characteristics and share distinctive characteristic(s). Although the examiner would not expect to see these distinctive characteristic(s) repeated in another source, it lacked sufficient characteristics for a source identification. Type III Association: Association with conventional characteristics: Items correspond in all measured physical properties, chemical composition and/or microscopic characteristics. However, it is possible for another sample to be indistinguishable from the submitted evidence; therefore, an individual source cannot be determined. Type IV Association: Association with limitations: An association of decreased evidential value in which items correspond in all measured physical properties, chemical composition and/or microscopic characteristics, but there is a limitation to the exam. Limitations could include items commonly encountered in the relevant population, the inability to perform a complete analysis, or limited information. Inconclusive: No conclusion could be reached regarding an association or an exclusion between the items. Exclusion with Limitations: The item exhibits differences to the comparison sample that suggests that it did not originate from the same source. However, there are limiting factors, such as possible natural or manufactured source variations. Exclusion: The items exhibit differences in physical properties and/or chemical composition to the comparison sample that demonstrate they did not originate from the same source.</p> |
| VLKDK9  | <p>By analyzing the paint chips with FTIR, spectra produced of the topcoats of items 1 and 3 were consistent and can be considered a match. However, spectra obtained of the topcoat of item 2 was not consistent with item 1 and cannot be considered a match.</p>  |
| VRAXL4  | <p>The known source (item #1) was investigated microscopically and contains 2 paint layers, a blue top layer on a white layer. Both layers were isolated using a surgical knife and investigated by FTIR, LA ICPMS and SEM-EDX. The blue top layer contains a polyvinyl acetate binder, calcium carbonate and titanium dioxide. The white layer contains calcium carbonate, magnesium silicate as well as small amounts of aluminum silicate and titanium dioxide. No binder could be identified in the white layer as the infrared spectrum is dominated by these fillers. The received traces (items #2 and #3) were compared to item #1. Item #3 was found to match in all characteristics (visual, FTIR, LA ICPMS and SEM-EDX). Item #2 does not match</p>   |

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|         | to the known source (item #1), using FTIR, and was not further investigated using the other techniques. Two hypotheses H1 and H2 are proposed to evaluate these results: H1: The trace originates from the victim's living room wall. H2: The trace originates from an arbitrary other painted object. With respect to item #2, our conclusion is: H1 is excluded. Item #2 originates from another painted object than the victim's living room wall. With respect to item #3, our conclusion is: The results are much more likely if item #3 originates from the victim's living room wall than if it originates from another painted object.  |
| VT23W3  | It was determined that Item-1 and Item-3 were similar in terms of physical and chemical properties. It was determined that Item-1 and Item-2 were different in terms of physical and chemical properties.   |
| W2R279  | On analysis I found that:- i. The questioned paint chips recovered from the suspect's floor (Item 3) to be similar with the known paint sample representative of the damaged area of the victim's living room wall (Item 1). ii.The questioned paint chips recovered from the suspect's shoe (Item 2) to be dissimilar with known paint sample representative of the damaged area of the victim's living room wall (Item 1). Thus I am of the opinion that:- i.The questioned paint chips (Item 3) could have originated from the known paint sample(Item 1) ii.The questioned paint chips (Item 2) did not originated from the known paint sample(Item 1)  |
| WFTTRD  | Results and Conclusions: 1. Exhibit 1 contained one piece of paper having the paint layer sequence medium grey-blue / white. 2. Exhibit 2 contained two pieces of paper having the paint layer sequence medium grey-blue / white. The medium grey-blue and white paint layers of Exhibit 2 are physically (texture and appearance) and chemically different from the corresponding paint layers of Exhibit 1. The paint in Exhibit 2 did not originate from the same source as the paint in Exhibit 1. 3. Exhibit 3 contained two pieces of paper having the paint layer sequence medium grey-blue / white. The medium grey-blue and white paint layers of Exhibit 3 are physically and chemically indistinguishable from the corresponding paint layers of Exhibit 1. The paint in Exhibit 3 originated either from the same source as the paint in Exhibit 1, or from another source of paint having indistinguishable physical and chemical characteristics. |
| WPJDXB  | One of the paint chips from the suspect's floor (Item #3) was analyzed and compared to the known reference paint sample from the victim's living room wall (Item #1). Based on the examinations conducted, the layers comprising the analyzed paint chip from Item #3 are comparable in color, texture, relative thickness, and chemical composition to the corresponding layers of Item #1. Accordingly, the analyzed paint chip from Item #3 and Item #1 originated from the same source or from different sources painted in the same manner (Type IV Association). This level of association was reached due to the limited layer structure of the submitted samples. The paint from the suspect's shoe (Item #2) does not compare to the known reference paint sample from the victim's living room wall (Item #1). No further analysis at this time.  |
| WUD8VC  | Item 3 could have originated from item 1. Item 2 could not have originated from item 1.   |
| X7GX94  | The questioned paint in item 2 exhibits significant differences from the known paint in item 1 and did not originate from the same source as represented by item 1. The questioned paint in item 3 is similar in all examined characteristics to the known paint in item 1 and could have originated from the same source as item 1 or another paint source with the same characteristics.  |
| XCNJZ8  | The physical and chemical properties of paint Item 1.- by the examined and measured features - correspond with the same properties of paint Item 3., and don't correspond with the  |

TABLE 3

| WebCode | Conclusions  |
|---------|--|
| ZA878V  | <p>properties of Item 2. So: The paint chips recovered from the floor (Item 3.) could have originated from the damaged area of the victim's living room wall as represented by Item 1.</p> <p>The paint from the floor (Item 3) was found to be similar in color, layer sequence, and chemistry in comparison to the paint from the living room wall (Item 1). The paint from Item 3 could have come from the same source as Item 1, or from any other source of paint with similar color, layer sequence, and chemistry. The paint from the shoe (Item 2) was found to be different in texture, layer thickness, and chemistry in comparison to the paint from the living room wall (Item 1). The paint from Item 2 could not have come from the same source as Item 1. Items 1 and 3 were examined visually and using stereomicroscopy, Fourier Transformed Infrared Spectroscopy, and Scanning Electron Microscopy. Item 2 was examined visually and using stereomicroscopy and Fourier Transformed Infrared Spectroscopy. Samples collected and analyzed during the examination and analysis of the items in this case (low e- slide, cross section slides) have been returned to and retained with the original item.</p> |

# Additional Comments

TABLE 4

| WebCode | Additional Comments   |
|---------|---|
| 2ZX2U6  | It has to be taken into account that paint is a mass product and shows only group identifiers. An individual match of these materials is not possible.  |
| 4EWP2P  | Pyrolysis GC-MS technique was not used as paint samples typically encountered during casework are often traces and/or smears that are not amenable to this technique.   |
| 4ZC87Z  | Fragments were sampled from the paint chips marked "Item 1", "Item 2" and "Item 3" and found to consist of: 1. An outermost blue layer, 2. A second white layer. There were no significant differences between the examined blue fragments sampled from the paint chips marked "Item 1" and "Item 3" in terms of colour, layer sequence and chemical composition. The examined blue fragments sampled from the paint chips marked "Item 1" and "Item 2" were found to be different in terms of chemical composition.  |
| 9MTBUJ  | Wouldn't use 'Victim' and 'Suspect' when describing samples in casework. However, used in this case for consistency with sample names provided in CTS test.   |
| B2LKUU  | It is necessary to continue with the tests  |
| BNVVN   | The findings have not been evaluated. In a case scenario it would be unusual to find samples that had the same appearance and layers from the suspect's shoe and suspect's floor and find one matching and one not matching. In a real case I would look for additional samples from the scene.   |
| BRWWYR  | In our laboratory the majority of casework received consists of automobile paint transfer, while the cases received involving architectonic paint transfer, are usually frictions of one or two layers at best, where many of the resins used are very common. Therefore the possibility of finding this type of resin on a surface different from that of the crime scene is probable, thus making it hard to establish an association with a high degree of certainty, unlike the cases of automobile paint transfer where there have been cases with up to fifteen particular resin layers.  |
| DMWEMK  | There isn't SEM/EDX in our laboratory so we analysed these paint samples by only FTIR. But that samples analyse with SEM/EDX too.   |
| FF8QPK  | It was very difficult to determine what the "drywall substrate" was in items 1 -3. This made determining which layers were to be analyzed and which layers were to be ignored challenging. The white primer layer was also very difficult to separate from the drywall substrate for analysis.  |
| GDVBJ   | The Questioned Paint analyzed in Item 3 could share a common source with the Known Paint in Item 1. It should be noted that in the absence of a fracture match between paint flakes, paint does not possess enough individual chemical and microscopic characteristics to be positively identified as originating from a particular source to the exclusion of all other sources. The conclusions in this report only pertain to the paint that was analyzed from each Submission and makes no assumptions about the entire contents of each Submission.  |
| MAFRHH  | In casework, we may have requested additional samples from the wall (ITEM 1).   |
| NYWHPH  | Terminology Key for Associative Evidence: Type I Association: A positive identification; an association in which items share individual characteristics that show that the items were once from the same source. Type II Association: An association in which items are consistent in all measured physical properties and/or chemical composition and share unusual characteristic(s) that would not be expected to be found in the population of this evidence type. Type III Association: An association in which items are consistent in all measured physical properties and/or chemical composition and could have originated from the same source. Because |

TABLE 4

| WebCode | Additional Comments   |
|---------|---|
|         | <p>similar items have been manufactured or could exist in nature and would be indistinguishable from the submitted evidence, an individual source cannot be determined. Type IV Association: An association in which items are consistent in measured physical properties and/or chemical composition. This sample type is commonly encountered in our environment and may have limited associative value. Alternatively, an association between items would be categorized as a Type IV if limited analysis was performed due to the characteristics or size of the specimen(s). Type V Association: An association in which items are consistent in some, but not all, physical properties and/or chemical composition. Some minor variation exists between the known and questioned items and could be due to factors such as sample heterogeneity, contamination of the sample(s), or the quality of the sample. Inconclusive: No conclusion could be reached regarding an association between the items. Elimination: The items were dissimilar in physical properties and/or chemical composition and did not originate from the same source.</p>   |
| U2ZJR2  | <p>Type 2 Association: Association with Distinctive characteristics--Items are consistent in all measured and observed physical properties, chemical composition, and/or microscopic characteristics, and therefore could have originated from the same source. The items further share distinctive characteristics that would not be typically encountered in the relevant population. Elimination--Items exhibit differences in one or more of the following: physical properties, chemical composition, or microscopic characteristics and therefore did not originate from the same source.</p>   |
| UFFG29  | <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>  |
| V39QWF  | <p>As there is only one layer of paint, other methods like FT-IR would be more specific and could lead to a better discrimination.</p>  |
| WPJDXB  | <p>The following descriptions are meant to provide context to the levels of opinions reached in this report. Every type of conclusion may not be applicable in every case nor for every material type. Type I Association: A physical match; items physically fit back to one another, indicating that the items were once from the same source. Type II Association: An association in which items are consistent in all measured physical properties and/or chemical composition and share atypical characteristic(s) (e.g., repaint layers) that would not be expected to be readily available in the relevant population. Type III Association: An association in which items are consistent in all 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. Type IV Association: An association in which items are consistent in all measured physical properties and/or chemical composition and, therefore, could have originated from the same source. As compared to a Type III association, items categorized as Type IV share characteristics that are more common amongst these kinds of manufactured products. Alternatively, an association between items would be categorized as a Type IV if a limited analysis was performed due to characteristics or size of the specimen(s). Type V Association: An association in which items are consistent in some, but not all physical properties and/or chemical composition. Some minor variation(s) exist(s) between the known and questioned items and could be due to factors such as sample heterogeneity, contamination of the sample(s), or having a sample of insufficient size to adequately assess homogeneity of the entity from which it was derived.</p> |

-End of Report-  
(Appendix may follow)

## Test No. 19-546: Paint Analysis

DATA MUST BE SUBMITTED BY **Nov. 18, 2019, 11:59 p.m.** TO BE INCLUDED IN THE REPORT

Participant Code: U1234J

WebCode: EVZYAD

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

### Scenario:

Police are investigating the physical assault of an elderly man. The victim stated that damage was rendered to his living room wall during the assault. The police located a suspect and a warranted search was conducted two days after the assault. Blue paint chips similar in color to the victim's living room wall were located inside the suspect's shoe and on the suspect's floor. A known paint sample has been collected from the damaged area of the living room wall. Police are requesting that you examine the recovered paint chips from the suspect's shoe and floor and determine if either of them could have originated from the victim'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 victim's living room wall.

Item 2: Questioned paint chips recovered from the suspect's shoe.

Item 3: Questioned paint chips recovered from the suspect's floor.

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

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

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

Please check all that apply.

|                                       |   |   |
|---------------------------------------|---|---|
| <b>Microscopic Exams:</b>             | <input type="checkbox"/> Stereomicroscope | <input type="checkbox"/> Polarized Light        |
|                                       | <input type="checkbox"/> Fluorescence     |   |
| <input type="checkbox"/> Pyrolysis GC | <input type="checkbox"/> FTIR             | <input type="checkbox"/> Solubility/Chemical    |
| <input type="checkbox"/> XRS/XRF      | <input type="checkbox"/> SEM/EDX          | <input type="checkbox"/> Microspectrophotometry |

Other (specify):



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

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

**4.) Additional Comments**

## RELEASE OF DATA TO ACCREDITATION BODIES

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

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

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

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

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

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

A2LA Certificate No.

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

Authorized Contact Person and Title

Laboratory Name

Location (City/State)