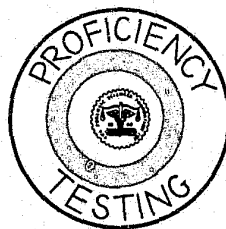


LABORATORY PROFICIENCY TESTING PROGRAM



47526



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LABORATORY PROFICIENCY TESTING PROGRAM

REPORT NO. 5

AUTO PAINT EXAMINATION

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Prepared for the Department of Justice, Law Enforcement Assistance
Administration, National Institute of Law Enforcement and Criminal
Justice, under Grant 74-NI-99-0048.

Points of view or opinions stated in this document are those of the
authors and do not necessarily represent the official position or
policies of the U.S. Department of Justice.

FOREWORD

The analysis summarized in this report is the fifth of a series that will be made in conjunction with this proficiency testing research project.

In the course of this testing program participating laboratories will have analyzed and identified ten different samples of physical evidence similar in nature to the types of evidence normally submitted to them for analysis.

The results of Test Number Five are reflected in the charts and graphs which follow.

The citing of any product or method in this report is done solely for reporting purposes and does not constitute an endorsement by the project sponsors.

Comments or suggestions relating to any portion of this report or of the program in general will be appreciated.

September 1975

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BACKGROUND

This laboratory proficiency testing research project, one phase of which is summarized in this report, was initiated in the fall of 1974.

This is a research study of how to prepare and distribute specific samples; how to analyze laboratory results; and how to report those results in a meaningful manner. The research will be conducted in two cycles, each of which will include five samples: a controlled substance; firearms evidence; blood; glass; and paint.

Participation in the program is voluntary. Accordingly, invitations have been extended to 235 laboratories to share in the research. It is recognized that all laboratories do not perform analyses of all possible types of physical evidence. Thus, in the data summaries included in this report, space opposite some Code Numbers (representing specific laboratories) may be blank, or marked "No Data Returned."

A final project report including additional findings based on information reported here will be prepared at the conclusion of Cycle II.

The Project is under the direct control of the Project Advisory Committee whose members' names are listed on the Title Page. Each is a nationally known criminalistic laboratory authority.

Supporting the Project Advisory Committee in their efforts is the Forensic Sciences Foundation with additional support from the National Bureau of Standards in the areas of sample evaluation and data analysis and interpretation.

SUMMARY

Test Sample #5 consisted of auto paint samples A, B and C packaged in a plastic box. The samples were mailed on May 16, 1975 with instructions to handle the sample in a manner similar to like evidence submitted for analysis.

Test Sample #5 was sent to 232 laboratories. Three of those laboratories served as referees, reducing the actual number to 229.

In the accompanying data summaries, 117 laboratories responded with completed data sheets, 51 laboratories responded that they did not do auto paint and no response was received from 64 laboratories. This represents a participation rate of 66%.

No effort was made in this report to highlight areas wherein laboratory improvements might be instigated.

ANNEX A

FIGURE 1.

3.

LAB CODE A- _____

☐

CHECK HERE (AND RETURN) IF YOU DO NOT PERFORM AUTO PAINT EXAMINATION

DATE RECEIVED IN LAB _____

DATE PROCESSED IN LAB _____

DATA SHEET

PROFICIENCY TESTING PROGRAM

TEST #5 AUTO PAINT EXAMINATION

Item A represents a paint specimen recovered from the clothing of a dead victim found at roadside--an apparent hit-and-run victim. (Disregard metal base plate.)

Items B and C were taken from two separate suspect vehicles. (Disregard metal base plate.)

1. Item A could have common origin with:

☐

B

☐

C

☐

Both

☐

Neither

2. What information (quantitative and qualitative) did you develop to arrive at your conclusion in No. 1?

Item A

Item B

Item C

3. Method(s) and instrument(s) used: _____

ANNEX B

National Bureau of Standards Analysis

LABORATORY TESTING PROGRAM

Test No. 5 - Automotive Paint

In this test, 232 laboratories were each sent 3 paint samples which were referred to as Items A, B, and C. Participants were asked: (1) Item A could have a common origin with Item B, Item C, Both, or Neither? (2) What information was developed to answer question 1? (3) What methods and instruments were used?

Of the 232 laboratories, 117 laboratories responded with data, 51 indicated they do not perform paint analysis, and 64 did not respond. Table 1 lists the codes for laboratories in each of these last two categories.

According to the supplier of the samples, Items A and C were prepared with the same paint from a U.S. vender, and had a top coat over two primer layers as used in the American Motors U.S. plants. Item B, on the other hand, was prepared with a paint from a Canadian vender, and had a top coat over two primer layers as used by the American Motors Canadian plant. The responses from 3 referee laboratories, shown in Table 2, are consistent with the sample supplier's statement.

Table 3 shows the responses to question 1 given by each participating laboratory, and summarizes these results. A "C" response is consistent with the supplier and referee statements.

Table 4 shows the relative frequencies of the methods reported by participating laboratories. Additional information concerning the performance of the 10 most frequently reported methods is given in Table 5.

On the average, 3.5 methods per laboratory were reported for question 3. The average number of reported methods for laboratories giving a "C" response to question 1 is only slightly greater than the average number of reported methods for laboratories giving a "Both" response (3.6 compared to 3.0); thus those laboratories whose response to question 1 is consistent with the responses from the referee laboratories were--on the average--only slightly more persistent than those which did not agree with the referee laboratories.

Solubility tests results reported for the 12 most frequently used solvents are shown in Table 6. Table 7 shows the responses to question 2 and 3 from each laboratory.

This annex was prepared by the Law Enforcement Standards Laboratory (LESL) of NBS. The anonymous test results reported by the participating forensic laboratories were analyzed and tabulated by James McLeod and Charles Leete of the NBS Laboratory Evaluation Technology Section, Alvin Lewis of the NBS Hazards Analysis Section and Robert Mills of LESL. This work was supported by the National Institute of Law Enforcement and Criminal Justice, Department of Justice.

Table 1

Code Numbers of Non-responding LaboratoriesTHE FOLLOWING LABS INDICATED THEY DO NOT DO PAINT ANALYSIS:

706	749	788	828	913	998
711	750	791	841	918	
720	755	793	844	920	
721	758	803	845	932	
726	759	807	850	935	
727	761	810	862	950	
734	764	812	875	951	
735	767	816	877	953	
741	775	824	886	983	
743	785	826	891	992	

Total Labs = 51

THE FOLLOWING LABS DID NOT RESPOND:

707	736	780	829	871	914	972
708	737	782	830	874	917	984
709	738	783	831	879	924	985
710	744	792	834	880	931	988
713	762	795	836	887	937	
723	770	811	858	898	938	
724	772	817	864	900	942	
728	773	820	865	902	946	
732	774	822	867	905	964	
733	779	825	869	912	966	

Total Labs = 64

Table 2

RESULTS OF THE THREE REFEREE LABORATORIESLABORATORY 1:

Microscopic examination revealed each item has similar color layer structure and texture. No fluorescence under UV light. No reaction of the orange layer to methylethyl ketone and CH_2Cl_2 . Items A and C show slight pigment dissolution in diphenylamine in sulfuric acid while B does not. Dissimilarity not great enough to differentiate.

Determined inorganic elemental composition of all three layers using energy dispersive x-ray analysis on the scanning electron microscope:

<u>Item A</u>		<u>Item B</u>		<u>Item C</u>	
Al	15.06%	Al	19.45%	Al	15.88%
Si	25.88%	Si	25.72%	Si	26.55%
S	30.51%	S	32.03%	S	30.59%
Ti and/or Ba	16.34%	Ti and/or Ba	12.60%	Ti and/or Ba	15.66%
Cr	6.58%	Cr	5.56%	Cr	6.42%
Fe	5.63%	Fe	4.64%	Fe	4.91%

Percentages and elements do not appear to vary enough to differentiate Items A, B, and C.

Infrared spectrophotometer spectra of Items A and C similar but different from Item B. Spectra of A similar to that of C, but shows a different peak than B. A and C have a peak at 540 cm^{-1} whereas B shows a peak at 400 cm^{-1} . Significant enough to call Items A and C similar and dissimilar from Item B and to say they could not have a common origin.

Pyrolysis gas chromatography showed Items A and C similar and radically different from Item B.

Color comparison to LEAA book, Standard Reference Collection of Automotive Paint Colors showed that color was similar to AMC Sienna Orange, 74G0019. Pyrolysis gas chromatography showed Item A and C similar to AMC Sienna Orange color panels.

Table 2 Continued

LABORATORY 2:

All three items have the same color sequence, but first primer layer is considerably darker in Item B than in Items A and C.

Items A, B, and C are not soluble in acetone and are acrylic enamels. Surface coat of all items containing molybdate orange or sienna red. Pyrolysis gas chromatograph of primer layer is similar for Items A, B, and C. Pyrolysis gas chromatograph of surface layer is similar for Items A and C but different from Item B. Trace elements in surface coat (spectrograph similar for Items A and C but different from Item B) show more Mg and Sb in Item B than in Items A and C. A small amount of Ni was detected in items A and C, but no Ni was detected in Item B.

LABORATORY 3:

The layer structure of the paints of Items A, B, and C are:

1. Medium orange acrylic enamel
2. Medium gray primer
3. Dark gray primer

Microscopically, Items A, B, and C matched in colors and textures. However, under quantitative and qualitative analysis, it was determined that the inorganic and organic constituent of the medium orange acrylic enamel layers of A and C matched and were different from B. Items A and C contained nickel and no antimony. Item B contained antimony and no nickel. The pyrolysis products of the organic portions of Items A and C matched and were significantly different from Item B.

Table 3

TABULATION OF RESPONSES TO QUESTION 1:

ITEM A could have common origin with:

POSSIBLE ANSWERS: B, C, Both, Neither

LAB CODE	RESPONSE	LAB CODE	RESPONSE	LAB CODE	RESPONSE
703	C	796	C	884	Both
705	C	797	Both	885	C
712	C	798	C	888	C
715	C	799	C	889	Both
717	C	805	C	892	C
718	C	806	C	894	C
719	C	809	Both	895	C
722	C	813	C	897	C
729	Both	814	C	899	C
730	C	815	C	903	C
731	Both	818	C	904	Both
739	C	821	C	907	C
740	C	827	C	908	C
742	C	832	C	915	C
745	C	833	C	921	C
746	C	835	C	923	C
747	Both	837	C	925	C
748	C	838	C	926	Both
751	C	839	C	927	Both
752	C	842	C	944	Both
753	Both	843	C	948	Both
754	C	847	Both	958	C
756	C	848	C	960	C
757	C	849	Neither	961	C
760	Both	852	C	962	C
763	C	853	C	969	C
765	C	854	C	970	C
766	C	855	C	973	C
768	C	856	C	974	C
769	Both	859	C	975	C
777	Both	860	C	978	C
778	C	861	C	979	C
781	Inconclusive	863	Both	980	C
784	C	866	C	986	C
786	C	868	C	987	C
787	Both	870	C	989	Both
789	C	872	C	994	C
790	Both	873	Both	995	C
794	C	876	C	999	C

Total Labs Responding = 117

Number of "B" Responses = 0

Number of "C" Responses = 93 (79%)

Number of "Both" Responses = 22 (19%)

Number of "Neither" Responses = 1

Number of "Inconclusive" Responses = 1

Table 4

Relative Frequencies of the Reported Methods

<u>INSTRUMENTS OR METHODS USED</u>	<u>NUMBER OF LABORATORIES</u>
1. Microscope	98
2. Solubility tests	88
3. Infrared analysis	51
4. Emission spectroscopy	41
5. Pyrolysis gas chromatography	40
6. X-ray fluorescence	22
7. Reference collection of automotive paint colors	14
8. Ultraviolet spectrophotometry	14
9. Visual	11
10. X-ray diffraction	10
11. Thin layer chromatography	3
12. Density test	3
13. Fluorescent studies	3
14. Filters, Wratten and dichroic	1
15. Pyrolysis IR	1
16. Photographic color densitometer	1
17. Microcrystal	1
18. Spot plates	1
19. Quantitative elemental analysis	1
20. Reflectance spectrum	1
21. None listed	1

Since most laboratories indicated more than one method, the total number is greater than the total number of laboratories reporting.

Table 5

Ten Most Frequently Reported Methods

Method	Total Number of Labs Reporting Use Of This Method	Number of Labs Reporting They Could Distinguish Item B from A and C By This Method	Number of Labs Reporting They Could Not Distinguish Item B from A and C By This Method	Number of Labs Reporting Use Of This Method Without Reporting Their Findings for The Method
1. Microscope	98	19	54	25
2. Solubility Tests	88	41	25	22
3. Infrared Analysis	51	2	37	12
4. Emission Spectroscopy	41	18	14	9
5. Pyrolysis Gas Chromatography	40	27	1	12
6. X-Ray Fluorescence	22	21	1	0
7. Reference Collection of Automotive Paint Colors	14	1	11	2
8. Ultraviolet Spectrophotometry	14	1	6	7
9. Visual	11	3	6	2
10. X-Ray Diffraction	10	1	7	2

Table 6
Most Frequently Reported Solvents

	Total Number of Labs Reporting Use Of This Solvent	Number of Labs Reporting They Could Distinguish Item B from A and C Using This Solvent	Number of Labs Reporting They Could Not Distinguish Item B from A and C Using This Solvent	Number of Labs Reporting Use Of This Solvent Without Reporting Their Findings For This Solvent
1. Acetone	48	1	33	14
2. Sulfuric acid	47	34	6	7
3. Chloroform	34	1	25	8
4. Hydrochloric acid	23	3	12	8
5. Ethyl acetate	17	0	14	3
6. Sodium hydroxide	14	0	8	6
7. Nitric acid	15	7	3	5
8. Diphenylamine	14	5	3	6
9. Benzene	9	0	8	2
10. Methylene chloride	8	0	6	2
11. Methanol	5	0	4	1
12. Dimethylformamine	6	1	4	1

Table 7

13.

Responses to Questions 2 and 3 From Each Laboratory

QUESTION 2: What information was developed to answer question 1?			
Item A	Item B	Item C	
703 Pyrolysis spectrum consistent with Item C. Soluble in concentrated H_2SO_4 .	Pyrolysis spectrum different from Items A and C. Insoluble in concentrated H_2SO_4 .	Pyrolysis spectrum consistent with Item A. Soluble in concentrated H_2SO_4 .	1,2,3,5,8
705 Has identical x-ray dispersion spectrum as item C. Has identical pyrogram as item C. Has identical color change in conc. H_2SO_4 as item C.	Has identical x-ray dispersion spectrum except the element nickel (Ni) is absent. Has identical pyrogram with exception of one peak. Gives different color reaction in conc. H_2SO_4 .	Assumed or restated	1,2,5,6
712 Microscopic examination showed similar layer sequence of items A, B, and C.			1,2,5
Has identical color change in H_2SO_4 as item C. Pyrolysis chromatogram matches item C chromatogram.	Has different color in H_2SO_4 than items A and C. Pyrolysis chromatogram different from item A chromatogram.	Has identical color change in H_2SO_4 . Pyrolysis chromatogram matches item A chromatogram.	
715 Stereomicroscopic appearance showed identical appearance of items A, B, and C.			1,4
Multiple elements base spectrum showed Ni as a constituent.	Multiple elements base spectrum showed Ni absent.	Multiple elements base spectrum showed Ni as a constituent.	
717 Visual inspection shows items A, B, and C similar in color to Automotive paint.			2,4,5
Gas Chromatography--Pyrolysis indicates same organic composition as item C. Reaction to conc. sulfuric acid similar to item A.	No reaction with conc. sulfuric acid. Evidence of the element Calcium in this paint while none noted in items A and C.	Gas Chromatography--Pyrolysis indicates same organic composition as item A. Reaction to conc. sulfuric acid similar to item A.	
718 IR same for items A, B, and C. Items A, B, and C insoluble in chloroform, benzene, acetone, hydrochloric acid or sodium hydroxide			
Visually similar in color and shading with item C. Reacts the same in sulfuric acid as item C	Visually distinguishable from items A and C. Reacts differently in sulfuric acid than items A and C.	Visually similar in color and shading with item A. Reacts the same in sulfuric acid as item A.	1,2,3
719 Has very small, densely populated pigment particles of orange-brown color similar to item C. Contains Pb, Ti, Ni in concentrations similar to item C.	Has larger size of pigment and less densely populated pigment particles. Contains Pb, Ti, and no detectable Ni.	Has very small, densely populated pigment particles similar to item A. Contain Pb, Ti, and Ni in concentrations similar to item A.	1,2,6,13
722 Microscopic examinations of base primer coat brown-black similar to item C. Reaction to conc. H_2SO_4 same as item C. Laser Microprobe Spectroscopic analysis did not observe zirconium; observed magnesium in lower concentration than item B; approximately equal to item C.	Microscopic examination of base primer coat-black color. Reaction to conc. H_2SO_4 different than items A and C. Laser Microprobe Spectroscopic Analysis observed zirconium; observed magnesium in higher concentration than in items A and C.	Microscopic examination of base primer coat brown-black similar to item A. Reaction to conc. H_2SO_4 same as item A. Laser Microprobe Spectroscopic Analysis did not observe zirconium; observed magnesium in lower concentration than item B; approximately equal to item A.	1,2,4
729 All gave similar reactions and had similar appearance.			1,2,3
730 Observation of paint layers and primer same in Items A, B, and C. Emission spectrum shows no Ni, Y, V for item B.			4,7
731 Color sequence same and paint thickness similar for items A, B, and C. Infrared spectroscopy indicates same elements present in the same approximate abundance in items A, B, and C.			1,3,4,9
739 Reaction to 60% sulfuric acid similar to item C. Gas-Chromatography Pyrolysis similar to item C. Emission Spectra similar to item C.	Reaction to 60% sulfuric acid dissimilar to Items A and C. Gas-Chromatography Pyrolysis dissimilar to Items A and C. Emission spectra dissimilar with Items A and C.	Reaction to 60% sulfuric acid similar to item A. Gas-Chromatography Pyrolysis similar to item A. Emission Spectra similar to item A.	1,2,4,5,12
740 Consistent with Item C in solubility tests. Microscopic examination appeared same as Item C	Item B could be excluded based on energy dispersive X-ray analysis. Solubility test in conc. nitric acid excludes Item B. Primer layer appeared slightly darker than Items A and C.	Consistent with Item A in solubility tests. Microscopic examination appeared same as Item A.	1,2,6
742 Visual observation showed base primer layer red-brown primer. X-ray emission spectroscopy showed same elemental composition including nickel as item C. Pyrolysis gas-chromatography showed same pyrogram as item C.	Visual observation showed base primer layer black primer. X-ray emission spectroscopy revealed absence of nickel. Pyrolysis gas-chromatography revealed dissimilar pyrogram from Items A and C.	Visual observation showed base primer layer red-brown layer. X-ray emission spectroscopy showed same elemental composition, including nickel, as item A. Pyrolysis Gas-Chromatography showed same pyrogram as item A.	1,5,6
745 Items A, B, and C have indistinguishable colors and layers. Solubility tests on orange layers in conc. HCl, Acetone, conc. H_2SO_4 , $(C_6H_5)_2NH/H_2SO_4$, $CHCl_3$, CH_2Cl_2 , DMF, Xylene, 1% KOH and conc. KOH.			1,2,3
746 IR spectra identical for Items A, B, and C. Items A, B, and C have apparent visual matching colors. Same results from TLC for Items A, B, and C.			2,3,4,7,9,11
Same reaction to conc. nitric acid and diphenylamine in conc. sulfuric acid as item C. Identical emission spectrograph as item C. Same color in dichloroethane as item C.	Different reaction to conc. nitric acid and diphenylamine in conc. sulfuric acid than Items A and C. Different emission spectrograph than Items A and C. Colorless in dichloroethane.	Same reaction to conc. nitric acid and diphenylamine in conc. sulfuric acid as item A. Identical emission spectrograph as item A. Same color in dichloroethane as item A.	
747 Visual comparison identical for Items A, B, and C. Texture, thickness and microchemical reactions of layers similar for Items A, B, and C. Pyrolysis gas-chromatogram and X-ray diffraction patterns similar for Items A, B, and C.			1,2,5,10

QUESTION 3:
What methods and
instruments were used?
Numbers listed below
refer to the methods
listed in Table 4

Table 7 Continued

Item A	Item B	Item C	
748 Microscopic, other solvent tests, infrared spectra, and spectrograph same for all three items.			1,2,3,4
Top layer slightly soluble in conc. sulfuric acid.	Top layer insoluble in conc. sulfuric acid.	Top layer slightly soluble in conc. sulfuric acid.	
751 Microscopic observation identical with Item C. Reaction to conc. H_2SO_4 same as Item C.	Microscopic observation different from Items A and C. Reaction to conc. H_2SO_4 different than Items A and C.	Microscopic observation identical with Item A. Reactions to conc. H_2SO_4 same as Item A.	1,2
752 Visual comparison of paint and layers same for Items A, B, and C. Crystalline pigment present in 3 layers for Items A, B, and C.			1,5,10
Organic components compare with Item C.	Organic components do not compare with Items A and C.	Organic components compare with Item A.	
753 Comparison of Items A, B and C identical by physical, microscopic, microchemical and infrared characteristics.			1,2,3
754 Microscopic comparison led to suspicion that Item B was different from Items A and C.			1,2,3,4,5
Reaction in H_2SO_4 like Item C. Gas-Chromatographic Pyrolysis pyrogram like Item C.	Reaction to H_2SO_4 unlike Items A and C. Gas-chromatographic Pyrolysis pyrogram unlike Items A and C.	Reaction to H_2SO_4 like Item A. Gas-Chromatographic Pyrolysis pyrogram like Item A.	
IR showed no differences in Items A, B, and C. Emission spectroscopy showed no differences in Items A, B, and C.			
756 Microscopic examination led to conclusion that Items A, B and C were similar. Chemical Solubility tests led to conclusion that Items A, B, and C were similar.			1,2,5,7
Gas-Chromatographic Pyrolysis pyrogram similar to Item C.	Gas-Chromatographic Pyrolysis pyrogram not similar to Items A and C.	Gas-Chromatographic Pyrolysis pyrogram similar to Item A.	
757 IR spectrum shows similar spectrum for Items A, B, and C. Microscopic examination show similar observations for Items A, B, and C.			1,3,6
Elemental profiles shows absence of Zr, presence of Ni, same as Item C.	Elemental profiles shows presence of Zr, absence of Ni unlike Items A and C.	Elemental profile shows absence of Zr, presence of Ni same as Item Z.	
760 Visual observation shows similar appearance of Items A, B, and C. Elemental composition of Items A, B, and C same.			1,2,4
763 None listed			1,2
765 Microscopic comparison showed no differentiation between Items A, B, and C.			1,2,3
Reaction to conc. sulfuric acid similar to Item C. IR spectra between 600-300 cm^{-1} same as Item C.	Reaction to conc. sulfuric acid different than Items A and C. IR spectra between 600-300 cm^{-1} different from Items A and C.	Reaction to conc. sulfuric acid similar to Item A. IR spectra between 600-300 cm^{-1} same as Item A.	
766 Reaction to conc. H_2SO_4 same as Item C.	Reaction to conc. H_2SO_4 different than Items A and C.	Reactions to conc. H_2SO_4 same as Item A.	1,2
768 IR spectrophotometric analysis failed to show significant differences between Items A and C. Simple solubility tests failed to distinguish Items A and C.			2,3,6,9
Presence of Ni. All elements in Item A are present in same proportions as Item C.	Absence of Ni.	Presence of Ni. All elements in Item C are present in same proportions as Item A.	
769 All items were of same color under visible and UV light. All items were of the same number, order, thickness, and texture of layering. All top layers were an enamel paint. All top layers had the same IR spectrum. All top layers and samples of the three layers of paint had the same emission spectrum. Paint color similar to paint used on 1974 AMC Motor Cars.			1,2,3,4,7,8
777 Visual comparison shows no differentiation between Items A, B, and C. Reaction to Benzene and Ethyl Acetate same for Items A, B, and C. Elemental contents same for Items A, B, and C.			2,4,9
778 Elemental analysis shows presence of Ni same as Item C. Reaction to H_2SO_4 same as Item C.	Elemental analysis shows absence of Ni unlike Item A and C. Reaction to H_2SO_4 different from Items A and C.	Elemental analysis shows presence of Ni, same as Item A. Reaction to H_2SO_4 , same as Item A.	1,2,6
781 Findings inconclusive			21
784 Microchemical properties identical for Items A, B, and C. IR spectrum same for Items A, B, and C.			2,3,5,6
Elemental analysis shows presence of Ni like Item C. Pyrogram identical to Item C.	Elemental analysis different than Items A and C. Pyrogram different and C.	Elemental analysis identical to Item A. Pyrogram identical to Item A.	
786 Pyphysical and UV examination showed no detectable differences between Items A, B, and C.			4,8
No Zr detected	Zr detected	No Zr detected	
787 Layering of samples same for Items A, B, and C.			1
789 Visual examination shows Item B different from Items A and C. All items insoluble in acetone.			1,2
790 Microscopy of layer structure same for Items A, B, and C. IR Spectrophotometric analysis same for Items A, B, and C. Pyrolysis analysis same for Items A, B, and C.			1,3,5
794 Visual comparison shows similar appearance of Items A, B, and C. Visual color and microscopic comparison same for Items A, B, and C. Multiple Internal Reflectance same for Items A, B, and C.			1,2,3,7
Reaction to diphenylamine in H_2SO_4 and reaction to conc. HNO_3 same as Item C.	Reaction to diphenylamine in H_2SO_4 and reaction to conc. HNO_3 different from Items A and C.	Reaction to diphenylamine in H_2SO_4 and reaction to conc. HNO_3 same as Item A.	

Table 7 Continued

15.

Item A	Item B	Item C	
796 Elemental analysis similar to Item C. Organically similar to Items B and C.	Elemental analysis different from Items A and C (Low Ti, high Cr, no Ni, high Fe, high Pb, lower Si). Organically similar to A and C.	Elemental analysis similar to Item A. Organically similar to Items A and B.	1,6
797 Visual observation same for Items A, B, and C. IR of first layer same for Items A, B, and C.			1,3
798 Microscopic comparison and solubility characteristics same as Item C.	Microscopic comparison and solubility characteristics different than Items A and C.	Microscopic comparison and solubility characteristics same as Item A.	1,2,8
799 Color and layer observations same for Items A, B, and C. IR-ATR Analysis identical for Items A, B, and C. All items insoluble in organic solvents.			1,2,3,7,8
Microscopic examination identical to Item C. Reaction to conc. H ₂ SO ₄ same as Item C.	Microscopic examination different from Items A and C. Reaction to conc. H ₂ SO ₄ different than Items A and C.	Microscopic examination identical to Item A. Reaction to conc. H ₂ SO ₄ same as Item A.	
805 Microscopic examination shows Items A, B, and C indistinguishable. Volatile components of Items A, B, and C found to be indistinguishable. Crystalline diffraction patterns of Items A, B, and C found to be indistinguishable.			1,2,4,5,10
Chemical reactivity indistinguishable from Item C. Contains Ni and lower concentration of Mg. Elemental analysis shows qualitatively matching to Item C.	Chemical reactivity shows Item B dissimilar to Items A and C. Does not contain Ni and high concentration of Mg.	Chemical reactivity indistinguishable from Item A. Contains Ni and lower concentration of Mg. Elemental analysis shows qualitatively matching to Item A.	
806 Physical appearance and solubility of Items A, B, and C similar.			1,2,5
Pyrogram compares with Item C.	Pyrogram does not compare with Items A and C.	Pyrogram compares with Item A.	
809 Microscopic examination of layers, solubility analysis of layers and emission spectrograph same for Items A, B, and C.			1,2,4
813 Visual observations same for Items A, B, and C.			1,3,6
X-ray relative intensities similar to Item C. IR same as Item C. Contains no Zr unlike Item B.	X-ray relative intensities different from Items A and C. Contains no Ni, unlike Items A and C. IR different than Items A and C. Contains trace Zr.	X-ray relative intensities similar to Item A. IR same as Item A. Contains no Zr unlike Item B.	
814 Reaction to H ₂ SO ₄ and HCl same as Item C.	Reaction to H ₂ SO ₄ and HCl different than Items A and C.	Reaction to H ₂ SO ₄ and HCl same as Item A.	1,2,7
815 Similarities with "C" color, layer sequence and thickness, texture, solubility, IR spectra, x-ray diffraction patterns, layer fluorescence under broad spectrum UV lights and spectrographic elemental analysis.	Dissimilarities: Fluorescence of dark gray layer under short-wave UV light, presence of antimony which was not found in samples A and C. Differences in quantities of Mg and Ni, and slight difference in IR spectra.		1,2,3,4,6,10,14
818 Microscopic surface analysis same as Item C. X-ray dispersive energy analysis same as Item C.	Microscopic surface analysis different than Items A and C. X-ray dispersive energy analysis different than Item A and C.	Microscopic surface analysis same as Item A. X-ray dispersive energy analysis same as Item A.	1,2,6,9
821 Microscopic and microchemical comparisons failed to reveal significant differences between Items A, B, and C.			2,5,17
Pyrolysis chromatogram identical to Item C.	Pyrolysis chromatogram different from Items A and C.	Pyrolysis chromatogram identical to Item A.	
827 Microscopic examination, UV fluorescence, solubility in four solvents: CH ₃ COCH ₃ , CHCl ₃ , HCl, H ₂ SO ₄ , Gas Chromatography Pyrolysis, atomic emission. Item B eliminated by solubility tests			1,2,4,5,8
832 Microscopic examination same for Items A, B, and C. UV and IR luminescence same for Items A, B, and C.			1,3,6,8
Ni present	No Ni present	Ni present	
833 Microscopic examination could not distinguish between Items A, B, and C. Visible reaction to short and long wave UV light, IR light and various colored light could not distinguish between Items A, B, and C. Solubility tests could not differentiate between Items A, B, and C.			1,2,3,8,11,20
Reflectance spectrum same as Item B. Reaction to conc. sulfuric acid, conc. nitric acid and LaRosen test same as Item C.	Reflectance spectrum same as Item A. Reaction to conc. sulfuric acid, conc. nitric acid and LaRose test different than Items A and C.	Reflectance spectrum different from Items A and B. Reaction to conc. sulfuric acid, conc. nitric acid and LaRosen test same as Item A.	
835 IR, X-ray diffraction and spectrograph could not distinguish between Items A, B, and C. Visual examination of color, number, and sequence of layers same for Items A, B, and C.			1,2,3,4,5,9,10
Appeared to have smooth surface like Item C. Reaction to sulfuric acid same as Item C. Pyrogram matched American Motors as Item C, Sienna Orange.	Appeared to have crinkled surface unlike Items A and C. Reaction to sulfuric acid different than Items A and C. Minor differences noted in IR absorption. Pyrogram significantly different from Items A and C.	Appeared to have smooth surface like Item A. Reaction to sulfuric acid same as Item A. Pyrogram same as Item A, matched American Motors Sienna Orange.	
837 Microscopically similar to Item C. Pyrogram consistent with Item C.	Microscopically different than Items A and C.	Microscopically similar to Item A. Pyrogram consistent with Item A.	1,5,9
838 Visual, IR and UV observations indistinguishable for Items A, B, and C.			1,2,3,8
Reaction to conc. H ₂ SO ₄ similar to Item C.	Reaction to conc. H ₂ SO ₄ different than Items A and C.	Reaction to conc. H ₂ SO ₄ similar to Item A.	
839 All information is qualitative, only distinction found was in the polymer film A=C≠B found by Pyrolysis GC and IR.			2,3,4,5,10
842 Gross visual observation same for Items A, B, and C.			1,2,3,4,5,7,8,9

Table 7 Continued

Item A	Item B	Item C	
No determinable chemical differences for Item C.	Microscopic examination revealed presence of minute black specks unlike Items A and C. Trace differences in chemical composition from Items A and C.	No determinable chemical differences from Item A.	
843 Quantitative ratios of elements present appear to be the same for Items A, B, and C.			6,19
Contains comparable amount of Ni as Item C. Zr and Sb absent.	Absence of Ni. Contains significant amounts of Zr and Sb.	Contains comparable amount of Ni as Item A. Zr and Sb absent.	
847 Visual examination same for Items A, B, and C. Solvency tests same for Items A, B, and C. IR analysis same for Items A, B, and C.			2,3,9
848 Microscopic examination indistinguishable for Items A, B, and C. Micro solvent tests indistinguishable for Items A, B, and C. Emission Spec Laser Microprobe indistinguishable for Items A, B, and C			1,2,4,5
Gas Chromatographic Pyrolysis compares to Item C.	Gas Chromatographic Pyrolysis different for Items A and C.	Gas Chromatographic Pyrolysis compares to Item A.	
849 Spectrographic qualitative analysis different for Items A, B, and C.			1,2,4
852 Solubility in conc. H ₂ SO ₄ same as Item C. Observation under UV light same as Item C. Pyrolysis same as Item C.	Solubility in conc. H ₂ SO ₄ different than Items A and C. Pyrolysis different than Items A and C.	Solubility in conc. H ₂ SO ₄ same as Item A. Observation under UV light same as Item A.	1,2,3,5,8
853 Items A, B, and C insoluble in acetone, chloroform, ethyl acetate and conc. HCl.			1,2,4
Soluble in conc. H ₂ SO ₄ and conc. HNO ₃ . Major elements detected: Pb, Si.	Major elements detected: Pb, Si, Mg, Fe, and trace Sb. Color observed to be a shade darker than Items A and C.	Soluble in conc. H ₂ SO ₄ and conc. HNO ₃ . Major elements detected: Pb, Si.	
854 No difference observed under microscopic examination of Items A, B, and C. Elements present in Items A, B, and C: Ti, Cr, Fe, Cu, Zr, Ga, Pb, Sr, Mo. Items A, B, and C matched 74G0019 of American Motors.			1,6,7
Presence of Ni and traces of Zr. Ratios of elements to fixed count of Ti similar to Item C within 3% error. Matched Item C with respect to color, consistency, number of layers, layer thickness elemental composition and ratio of elemental concentrations.	Absence of Ni and presence of high concentration of Zr.	Presence of Ni and traces of Fr. Ratios of elements to fixed count of Ti similar to Item C within 3% error. Matched Item A with respect to color, consistency, number of layers, layer thickness, elemental composition and ratio of elemental concentrations.	
855 Microscopic examination similar for Items A, B, and C. Items A, B, and C could not be differentiated by microchemical tests. Items A, B, and C could not be differentiated by IR analysis.			1,2,3,4
Contains small amount of Ni.	Contains no Ni.	Contains small amount of Ni.	
856 Color, layer structure, organic solvent solubility and IR spectra consistent with Items A and C.			1,2,3,5
Reaction to conc. sulfuric acid matches Item C. Pyrolysis matches Item C.	Reaction to conc. sulfuric acid different from Items A and C. Pyrolysis different from Items A and C.	Reaction to conc. sulfuric acid matches Item A. Pyrolysis matches Item A.	
859 Microscopic examination same for Items A, B, and C. Solvent characteristics same for Items A, B, and C. IR spectra identical for Items A, B, and C. X-ray diffraction analysis revealed Items A, B, and C contain the same pigment.			1,2,3,4,5,10
Emission spectroscopy revealed presence of Ni. Pyrolysis same as Item C.	Elemental composition and pyrolysis different than Items A and C. Emission spectroscopy revealed absence of Ni. Pyrolysis different than Items A and C.	Emission spectroscopy revealed presence of Ni. Pyrolysis same as Item A.	
860 Items A, B, and C, consistent in color, number, and sequence of layers. Solubility tests in chloroform and acetone similar for Items A, B, and C. Items A, B, and C similar to paint used on 1974 American Motors Automobiles			1,2,3,5,7
Pyrolysis consistent with Item C.	Macro examination revealed Item B reflected light differently than Items A and C. Reaction to sulfuric acid different from Items A and C. IR analysis revealed very minor differences from Items A and C. Pyrolysis different from Item A and C.	Pyrolysis consistent with Item A	
861 Primary color of Items A, B, and C appears to be AMC paint.			1,4,7
Microscopic examination same as Item C.	Under microscopic examination final layer appeared different in color from Items A and C. Spectrographic analysis confirmed a slight difference from Items A and C with regard to trace elements.	Microscopic examination same as Item A.	
863 Items A, B, and C insoluble in same solvents. Elements found in Items A, B, and C same and about same intensity.			2,4
866 Layer color description same for Items A, B, and C.			1,2,4
Orange slightly soluble in acetone. Element Ni present.	Orange slightly soluble in IN NCl. Element Ni absent.	Orange slightly soluble in acetone. Element Ni present.	
868 Stereomicroscopic appearance similar for Items A, B, and C. IR examination similar for Items A, B, and C.			1,3,4
Same elements detected in same relative concentration as Item C.	Does not contain Ni like Items A and C.	Same elements detected in same relative concentration as Item A.	

Item A	Item B	Item C	
870 Items A, B, and C could not be distinguished by simple microscopic examination.	Pyrogram different than Items A and C.		1,5
872 Microscopic comparison, relative solubilities, spectrographic composition.			1,2,4
873 Microscopic examination same for Items A, B, and C.			1,2,3,7
876 Items A, B, and C insoluble in acetone, ethylacetate, sulfuric acid, hydrochloric acid and chloroform.			1,2,5
Gives yellow color in sulfuric acid. Pyrogram same as Item C.	Does not give yellow color in sulfuric acid. Pyrogram different from Items A and C.	Gives yellow color in sulfuric acid. Pyrogram same as Item A.	
884 Microscopic examination similar for Items A, B, and C. Solubilities in various solvents similar for Items A, B, and C.			1,2
885 Test in conc. H_2SO_4 compared to Item C.	Elemental composition different from Items A and C. Test in conc. H_2SO_4 not comparable to Items A and C.	Test in conc. H_2SO_4 compared to Item A.	1,2,6
888 Microscopic examination same for Items A, B, and C. Solubility tests similar for Items A, B, and C.			1,2,5
Pyrogram compared with Items B and C.	Pyrogram different from Items A and C.	Pyrogram similar to Item A.	
889 Visual examination same for Items A, B, and C. Solubility reactions similar for Items A, B, and C.			1,2
892 Microscopic examination same for Items A, B, and C.			1,6
Contained relatively large amount of Ni.	Contained trace amount of Ni.	Contained relatively large amount of Ni.	
894 No quantitative data acquired for Items A, B, and C. Color identical for Items A, B, and C.			1,2,12
Liquid solubility comparisons identical to Item C. Layering identical to Item C.	Liquid solubility comparisons different from Items A and C. Layering like Item A.	Liquid solubility comparisons identical to Item A. Layering identical to Item A.	
895 Reaction to H_2SO_4 and to HNO_3 for Items A, B, and C.			1,2
897 Contains same amounts of titanium, zinc, iron and nickel as Item C. Pyrogram same as Item C. IR spectrum same as Item C.	Contains different amounts of titanium, zinc, and iron than Item A and C. Contains no nickel. Pyrogram different than Items A and C. IR spectrum different from Items A and C.	Contains same amounts of titanium, zinc, iron and nickel as Item A. IR spectra same as Item A.	3,5,6
899 IR spectra same as Item C. Elemental composition and relative ratios same as Item C.	IR spectra slightly different than Items A and C. Elemental composition distinctly different from Items A and C.	IR spectra same as Item A. Elemental composition and relative ratios same as Item A.	1,3,6
903 Slightly soluble in conc. sulfuric acid.	Not soluble in conc. sulfuric acid.	Slightly soluble in conc. sulfuric acid.	1,2,3,4,8
904 Items A, B, and C similar in color, layer composition, elemental content and solvent tests.			1,2,4
Insoluble in conc. H_2SO_4 .	Very slightly soluble in conc. H_2SO_4 .	Insoluble in conc. H_2SO_4 .	
907 Layer color description same as Item C.	Layer color description different than Items A and C.	Layer color description same as Item A.	2,3,5,16
908 Gross and microscopic examination similar for Items A, B, and C. IR similar for Items A, B, and C.			1,2,3,15
Diphenylamine and H_2SO_4 similar to Item C.		Diphenylamine and H_2SO_4 similar to Item A.	
915 Finish coat insoluble in acetone for Items A, B, and C.			1,2,4,5,7,9
Color sequence description same as Item C. Pyrogram matches Item C. Color matches 1974 AMC G-6 paint panel.	Color sequence description different from Items A and C. Pyrogram different from Items A and C.	Color sequence description same as Item A. Pyrogram matches Item A. Color matches 1974 AMC G-6 paint panel.	
921 Similar color to Item C. Insoluble in chloroform. Nickel present.	Very slightly different visual color than Items A and C. Soluble in chloroform. Nickel absent.	Similar color to Item A. Insoluble in chloroform. Nickel present.	2
923 No difference in microscopic examination for Items A, B, and C. No difference in solvent tests for Items A, B, and C.			1,2,5
Pyrogram compared favorably to Item C.	Pyrogram different from Items A and C.	Pyrogram compared favorably to Item A.	
925 IR spectra similar for Items A, B, and C. Layer color sequence same for Items A, B, and C.			1,2,3,4,6
Energy dispersive x-ray shows Items A and C equal. Emission spectroscopy shows Items A and C equal.	Contains no Ni and significantly less Ca, Al and Ba than Items A and C. Energy dispersive x-ray and emission spectroscopy shows Item B different from Items A and C.	Energy dispersive x-ray shows Item A and C equal. Emission spectroscopy shows Items A and C equal.	
926 Color similar for Items A, B, and C. Reaction to solvents similar for Items A, B, and C.			1,2,7
927 IR curves and pigment layer identical for Items A, B, and C.			3,5
Chromatogram similar to Item C.	Chromatogram dissimilar to Items A and C.	Chromatogram similar to Item A.	
944 Microscopic examination same for Items A, B, and C. IR spectrum same for Items A, B, and C.			1,3

Table 7 Continued

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Item A	Item B	Item C	
948 Color, layering, microscopic appearance, chemical solubility, metallic element content and IR spectra same for Items A, B, and C.			1,2,3,6
958 Solubilities same as Item C.	Solubility different than Items A and C. Same qualitative elemental content as Items A and C but much higher level of Mg.	Solubilities same as Item A.	1,2,4,10
960 Microscopy, GC-pyrolysis, density and solubility same for Items A, B, and C.			1,2,5,12
961 Items A, B, and C acrylic enamel (melamine). Paint samples consistent with having been used by AMC.			1,3,11
962 Microscopic examination same for Items A, B, and C. PMIR same for Items A, B, and C.			1,3,4,6,10
X-ray fluorescence, emission spectrograph, and x-ray diffraction same as Item C.	X-ray fluorescence, emission spectrograph and x-ray diffraction different than Items A and C.	X-ray fluorescence, emission spectrograph, and x-ray diffraction same as Item A.	
969 Items A, B, and C visually indistinguishable.			1,2,9
	Exhibited different solubility in HNO ₃ and H ₂ SO ₄ than Items A and C.		
970 Items A, B, and C macroscopically and microscopically similar.			1,4
Sb absent. Ni present.	Sb present. Ni absent.	Sb absent. Ni present.	
973 Microscopic and fluorescent light examination failed to reveal any differences between Items A, B, and C.			1,2,13
Reactions same as Item C	Reactions different from Items A and C.	Reactions same as Item A.	
974 Emission Spectrography revealed no significant differences between Items A, B, and C.			1,2,4,5
Similar color, texture, type and chemical composition to Item C.	Description of layers different than Items A and C. Different chemical composition than Items A and C.	Similar color, texture, type and chemical composition to Item A.	
975 Color, chemical solubility, Pyrolysis-Gas Chromatography.			1,2,4,5,8
978 Microscopic examination, IR absorption and Pyrolysis same for Items A, B, and C.			1,2,3,5
	Color reaction tests and solubility tests different than Items A and C.		
979 Presence of Ni in same quantity as Item C. Correlates directly with Item C in solubility and fluorescence.	Absence of Ni. Most pronounced solubility deviation with Items A and C with conc. H ₂ SO ₄ and diphenylamine in H ₂ SO ₄ .	Presence of Ni in same quantity as Item A. Correlates directly with Item C in solubility and fluorescence.	1,2,6,13
980 Number, color, and sequence of layers, solubility, vehicle comparison, pigment comparison, elemental comparison same as Item C.	Vehicle comparison. Elemental comparison.	Number, color, and sequence of layers, solubility, vehicle comparison, pigment comparison, elemental comparison same as Item A.	1,2,3,4,5,10
986 Visual description of three layers same for Items A, B, and C. Solubility tests same for Items A, B, and C.			1,2,4
Ni present. Sb absent.	Ni absent. Sb present.	Ni present. Sb absent.	
987 Solubility, change in pigment with pH, reaction to strong mineral acid same as Item C.	Different solubility than Items A and C. Different change in pigment with pH than Items A and C. Reaction with strong mineral acid different than Items A and C.	Solubility, change in pigment with pH, reaction to strong mineral acid same as Item A.	1,2,8,18
989 Items A, B, and C acrylic enamel paint. IR, solubility, emission spectra and color identically matches for Items A, B, and C.			1,2,3,4,5
994 Items A, B, and C insoluble in acetone, chloroform and ethyl alcohol. Description of layer color sequence same for Items A, B, and C. Items A, B, and C non-metallic			2
Reaction to conc. sulfuric acid same as Item C.	Reaction to conc. sulfuric acid different from Items A and C.	Reaction to conc. sulfuric acid same as Item A.	
995 Color of orange layer visually same for Items A, B, and C.			1,3,5
Layer color sequence same as Item C. IR spectrum same as Item C. Pyrogram same as Item C.	Layer color sequence different than Items A and C. IR spectrum qualitatively different from Items A and C. Pyrogram different from Items A and C.	Layer color sequence same as Item A. IR spectrum same as Item A. Pyrogram same as Item A.	
999 Solubility, IR spectra and hardness of Items A, B, and C.			1,2,3
	Much harder to scrape than Items A and C.		

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END