LABORATORY PROFICIENCY TESTING PROGRAM

REPORT NO. 16

PAINT EXAMINATION

THE FORENSIC SCIENCES FOUNDATION, INC.
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FOREWORD

The analysis summarized in this report is the sixteenth 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 different samples of physical evidence similar in nature to the types of evidence normally submitted to them for analysis.

The results for Test Number sixteen 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.

February 1977

BACKGROUND

This laboratory proficiency testing research project, one phase 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. Information is being collected for research and statistical purposes only. Such information will not be revealed or used for any other purpose. Information furnished by any person or agency identifiable to any specific person or laboratory will not be revealed or used for any purposes, other than the research and statistical purposes for which it was obtained.

Participation in the program is voluntary. Accordingly, invitations have been extended to 238 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".

Additional evaluations of individual tests will be published in a separate report.

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 Collaborative Testing Service, Inc., Vienna, Virginia in the area of statistical presentation.

SUMMARY

In this test, each of 188 laboratories were sent three paint samples which were referred to as Items A, B, and C. Participants were asked: (1) Could Items A or C have common origin with B? (2) What information did you develop to arrive at your conclusions in Question 1? (3) What methods and instruments were used:

Of the 188 laboratories, 102 laboratories responded with data, 5 indicated they do not perform paint analysis, 79 did not respond, and 2 were unable to complete the test. This represents a participation rate of 56%.

The information contained in the six tables consisted of the following:

Table 1 - Supplier's Characteristics
Table 2 - Referee Laboratory Results
Table 3 - Responses to Question 1
Table 4 - Frequency of Reported Methods
Tables 5a and 5b - Comparison of Item B to Items A and C
Table 6 - Summary of Laboratory Results

LAB CODE _____

ANNEX A

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

DATE RECEIVED IN LAB _____

DATE PROCESSED IN LAB _____

DATA SHEET
PROFICIENCY TESTING PROGRAM

TEST # 16
PAINT EXAMINATION

Item B represents a paint sample removed from the door jamb of a burglarized building. Items A and C represent samples found on the clothing of two different suspects.

1. Could Items A or C have common origin with B?

	ITEM A	ITEM C
YES	☐	☐
NO	☐	☐
INCONCLUSIVE	☐	☐

2. What information (qualitative and quantitative) did you develop to arrive at your conclusions in Question 1? Please check all appropriate boxes and provide values where applicable.

In the left hand column indicate the sequence (1,2,3 etc.) in which the tests were run. Indicate with an asterisk (*) the point where a conclusion was reached, even though subsequent tests were performed for confirmatory purposes.

Sequence of Testing		ITEM A	ITEM B	ITEM C
_____	DENSITY STUDIES			
_____	EMISSION SPECTROSCOPY (Specify Elements Identified)			
_____	FLUORESCENT STUDIES			
_____	INFRARED ANALYSIS			
_____	MACROSCOPIC EXAMINATION			
_____	MICROSCOPIC EXAMINATION			
_____	PYROLYSIS G-C			
_____	SOLUBILITY TESTS (Specify Solvents Used)			
_____	THIN LAYER CHROMATOGRAPHY			
_____	UV SPECTROPHOTOMETRY			
_____	X-RAY DIFFRACTION			
_____	X-RAY FLUORESCENCE (Count Ratio)			
_____	OTHER (SPECIFY)			

3. Please specify the information developed with each of the methods and instruments checked in Question 2. (Example: Solubility tests using HCl, H_2SO_4, Acetone and HNO_3). Please provide specific and complete responses. Attach additional sheets if necessary.

Method:

Method:

Method:

4. Additional Comments:

DATA SHEETS MUST BE RECEIVED AT THE FOUNDATION OFFICE BY AUGUST 9,1976

Table 1

Supplier's Characterization of Samples

The paints were drawn at six mils wet film on glass to yield approximately 120 square inches for each sample. The three samples consist of the following:

Content	Sample A	Sample B	Sample C
TiO_2	3.0 lbs.	3.0 lbs.	2.0 lbs.
ZnO			1.0 lbs.
Solids Soya Alkyd		3.6 lbs.	3.6 lbs.
Solids Acrylic Alkyd	3.6 lbs.		

All have traces of Iron, Zinc, Lead and Cobalt.

Samples A, B, and C could not have common origin with each other.

Table 2

RESULTS OF THE REFEREE LABORATORY

I. Response to Question 1

No for Item A
No for Item C

II. Methods and Results

1. Macroscopic Examination - A, B, C similar in color

2. Microscopic Examination - A, B and C are all single layer, but A is more brittle than B or C

3. Solubility Tests - Unable to detect any significant differences between samples A, B and C
   A. H_2SO_4 - Turns deep golden yellow; entire pigment dissolves
   B. Acetone, DMSO, DMF, $ChCl_3$, HNO_3, M-cresol, butyrolactone, Benzyl alcohol, $MeCl_2$ - Yellow pigment dissolves; residue grayish in color

4.* Pyrolysis G-C - Test samples B and C very similar. One high boiling compound present in A in 2-3 times the quantity as a compound having the same retention time in samples B and C.

5.* X-ray Fluorescence - Sample C has a very high concentration of zinc whereas A and B have none. Also, C has a slightly higher amount of lead where A and B display only a trace of lead.

Table 3

SUMMARY OF RESPONSES TO QUESTION 1

Response	Number of Labs Giving Response	% of Total Labs
No for Items A and C	67	65.6%
Yes for Item A and No for Item C	11	10.7%
No for Item A and Yes for Item C	11	10.7%
Yes for Items A and C	3	2.9%
Inconclusive for Item A and No for Item C	3	2.9%
No for Item A and Inconclusive for Item C	5	4.9%
Inconclusive for Items A and C	2	2.0%

Table 4

FREQUENCY OF REPORTED METHOD USED TO ANSWER QUESTION 2

Question 2: What information did you develop to arrive at your conclusion?

Method	Number of Reported Uses of This Method	% of Responding Labs Using This Method
Microscopic Examination	95	93.1%
Macroscopic Examination	88	86.3%
Solubility Tests	87	85.3%
Pyrolysis G-C	61	59.8%
Infrared Analysis	48	47.1%
Emission Spectroscopy	35	34.3%
Fluorescent Studies	31	30.4%
X-ray Fluorescence	22	21.6%
X-ray Diffraction	14	13.7%
Thin Layer Chromatography	14	13.7%
UV Spectrophotometry	8	7.8%
Density Studies	4	3.9%
Visible Spectrophotometry	2	2.0%
Microchemical	2	2.0%
EDAX	1	1.0%
Energy Dispersive Spectroscopy	1	1.0%
Thermogravimetric Analysis	1	1.0%
Polarizing Microscopy	1	1.0%
Scanning Electron Microscope	1	1.0%
Spectral Reflectance	1	1.0%
GC of Binder Extract	1	1.0%

Table 5a

Comparison of Item A and Item B
by the Eight Most Frequently Reported Methods

Method	Total Number of Labs Reporting Comparison of Item A and Item B by This Method.	Number of Labs Reporting They Could Differentiate Item A and Item B by This Method.	Number of Labs Reporting They Could Not Differentiate Item A and Item B by This Method.
Macroscopic Exam	73	12	61
Microscopic Exam	85	11	74
Solubility Tests	75	24	51
Pyrolysis G-C	53	50	3
Infrared Analysis	42	22	20
Emission Spectroscopy	27	6	21
Fluorescent Studies	25	0	25
X-ray Fluorescence	17	8	9

Table 5b

Comparison of Item B and Item C
by the Eight Most Frequently Reported Methods

Method	Total Number of Labs Reporting Comparison of Item B and Item C by This Method.	Number of Labs Reporting They Could Differentiate Item B and Item C by This Method.	Number of Labs Reporting They Could Not Differentiate Item B and Item C by This Method.
Macroscopic Exam	73	5	68
Microscopic Exam	82	10	82
Solubility Tests	69	14	55
Pyrolysis G-C	49	17	32
Infrared Analysis	34	9	25
Emission Spectroscopy	32	31	1
Fluorescent Studies	25	12	13
X-ray Fluorescence	20	20	0

Table 6

Detailed Summary of Laboratory Responses

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
003	1	Macroscopic Exam	A slightly more brittle than B and C		
NN	2	Microscopic Exam	No discernible differences between A, B, C		
	3	Solubility Tests	7 reagents used, A different from B and C by HNO_3 reaction		
	4	Fluorescent Studies	No differences between A, B, C		
	5*	X-ray Fluorescence	Pb/Fe = .31 Cl/Tu = .46 A different from B	Pb/Fe = .21 Cl/Ti = .37	Ti/Fn = .85 C different from A and B
009	1	Macroscopic Exam	No differences observed		
NN	2	Microscopic Exam	Shiny	Dull	Dull
	3	Solubility Tests	H_2SO_4 Darker Brown than B or C		Diphenyl benzidene C-Turns purple A and B do not
	4	Pyrolysis G-C	Does not match B		Does not match B
	5	X-ray Fluorescence			
013	1	Macroscopic Exam			
NN	2	Microscopic Exam			
	3	Solubility Tests			
	4	TLC			
	5	UV Spectrophotometry			
	6	Pyrolysis G-C			
	7*	IR			
020	1	Macroscopic Exam	A slightly darker than B or C		
NI	2	Microscopic Exam	A, B, C indistinguishable		
	3	Pyrolysis G-C			
046	1)	Macroscopic Exam	A, B, C	light green	
NN	2)	Microscopic Exam	slight striations	no striations	Multiple layers appears to have been on wood
	3*	Solubility Tests	4 reagents KOH - insol. HNO_3 - insol.	 KOH - sol. HNO_3 - sl. sol.	 KOH - Sol. KNO_3 - sl. sol.
	4*	Infrared Analysis	slightly different than B		Similar to B
	5*	Emission Spectroscopy	No Fe		Fe present
050	1	Solubility Tests	A, B, C similar		
NN	2	Macroscopic Exam	A, B, C similar		
	3	Microscopic Exam	A, B, C similar		
	4	H_2SO_4	Black upon heating	Yellow solution	Black upon heating
056	1	Macroscopic Exam	A similar to B		C similar to B
IN	2	Microscopic Exam	Similar to B		Slight difference from B
	3*	X-ray Fluorescence	Cl:Ti = .46 Pb:Fe = .31 Zn:Ce = .07	Cl:Ti = .37 Pb:Fe = .21 Zn:Cl = .12	 Ti:Zn = .85
	4	Solubility Tests	A similar to B		C different rate of rx. w/HNO_3
061	1	Macroscopic Exam			
NN	2	Microscopic Exam	A, B, C single-layered		yellowish green
	3	Solubility Tests	A, B, C similar		
	4*	Infrared Analysis	A different from B and C		
	5*	X-ray Fluorescence		B different from C	

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
068	1	Macroscopic Exam	A, B, C similar, gold color		
NN	2	Microscopic Exam	A, B, C 4 layers of gold		
	3	Solubility Tests	A not completely sol. in Alc-KOH	Sol. In. KOH	Sol. In. KOH
	4	Infrared Anaylsis	A, B, C similar		
	5*	Emission Spectroscopy			Zn present in C
072	1	Macroscopic Exam			
YN	2	Microscopic Exam			
	3	Solubility Tests			
	4*	Emission Spectroscopy			
080	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C different		
	4*	Pyrolysis G-C	A, B, C different		
	5*	X-ray Diffraction	A and B similar		C different
	6	TLC	A, B, C similar		
	7	Emission Spectroscopy	A and B similar		C different
	8	Fluorescent Studies	A, B, C similar		
122	1	Macroscopic Exam	A, B, C green paint		
NN	2	Microscopic Exam	A, B, C single layers		
	3	Solubility Tests	A, B, C similar		
	4*	Pyrolysis G-C	A different	B and C match	
	5*	X-ray Fluorescence	Ti/Zn = .90	.54	.4
			Ti/Cu = .63	.42	.31
			Ti/Mn = .70	.60	.52
128	1	Macroscopic Exam	A, B, C olive yellow color		
NN	2	Microscopic Exam	A, B, C single layer		
	3	Solubility Tests	A, B, C similar		
	4*	Infrared Analysis	A, B, C different		
	5.	X-ray Fluorescence			
134	1*	Macroscopic Exam	A, B, C different		
NN	2	Microscopic Exam	A different	B and C similar	
	3	Solubility Tests	A, B, C different		
	4	Fluorescent Studies	A, B, C similar		
	5	UV Spectrophotometry	A, B, C different		
167	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4	UV Spectrophotometry	A, B, C have same max.		
	5	Infrared Analysis	A different	B and C similar	
	6*	Emission Spectroscopy		No Zn	Zn Present
	7*	Pyrolysis G-C	A different	B and C similar	
	8	Thermogravimetric Analysis	A, B, C similar		
170	1	Macroscopic Exam			
NY	2	Microscopic Exam			
	3	UV Light			
	4	Solubility Tests			
	5*	Pyrolysis G-C	A different	B and C are the same	
178	1	Macroscopic Exam	A, B, C similar in color		
NN	2	Microscopic Exam	A, B, C similar in color		
	3	Solubility Tests	A different	B and C similar	
	4*	Pyrolysis G-C	A different	C slightly different from	
	5*	Emission Spectroscopy	Ti, Fe, Si, Al, Mg, Mn for A and B		C contains elements for A and B + Zn
	6	X-ray Fluorescence	A similar to B		C similar to B but with Zn

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
194	1	Microscopic Exam	A, B, C yellowgreen		
NN	2	Solubility Tests			
	3	Infrared Analysis	Inconclusive		
	4*	Density Studies	Bromoform-Benzene		
			6.0-4.0	5.5-4.5	5.0-5.0
			A, B, C different		
199	1	Macroscopic Exam			
NN	2	Microscopic Exam	A, B, C single layer, mustard color		
	3	X-ray Fluorescence	Ti/Pb = 13.65	Ti/Pb = 22.51	Zu/Pb = 23.66
				Zn/Pb = .56	
	4*	Pyrolysis G-C	A and B different		
212	1	Macroscopic Exam	Brittle flake	Pliable Flake	Pliable Flake
			A, B, C gold color		
	2	Microscopic Exam	A, B, C similar		
	3	Fluorescent Studies	A, B, C similar		
	4	Solubility Tests	A, B, C similar		
	5*	Emission Spectroscopy	A and B similar		C contains Zu
	6*	Density Studies	A and B different		B and C similar
228	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A possibly different from B and C		
	3	Solubility Tests	A, B, C similar		
	4	Pyrolysis G-C	A different from B		
	5*	Emission Spectroscopy		B different from C	
247	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4*	Infrared Analysis	A, B, C different		
	5	Pyrolysis G-C	A different from B		B and C similar
	6	Emission Spectroscopy	A and B similar	Mg, Ti, Si, Mn, Pb, Fe, Ca, Ae	C also contains Zn C different
251	1	Macroscopic Exam	Fine splintered chips	B and C large regular piece	
NY	2	Microscopic Exam	A = B = C		
	3	Micro chemical	A ≠ B = C		
	4	Solubility Test	A ≠ B = C		
	5	TLC	A = B = C		
	6	UV Spectrophotometry	A = B = C		
	7	Infrared Analysis	A ≠ B = C		
254	1	Macroscopic Exam			
NN	2	Microscopic Exam			
	3	Solubility Tests			
	4*	Emission Spectroscopy			
266	1	Microscopic Exam	A, B, C dissimilar		
NY	2	Solubility Tests	A, B, C similar		
	3	Pyrolysis G-C	A different	B and C similar	
272	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	Inconclusive		
	4*	Fluorescent Studies	Absorbs	Absorbs	Yellow Fluores-
	5*	Pyrolysis G-C	A different from	B and C	cence
278	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4	Emission Spectroscopy	A, B, C different		

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
289	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C Similar		
	4*	Pyrolysis G-C	A, B, C different		
	5	Emission Spectroscopy	A and B similar		C different
297	1	Microscopic Exam	A, B, C similar		
NN	2	Pyrolysis G-C	Acrylic	Alkyd	Alkyd
	3*	X-ray Diffraction	TiO_2	TiO_2	TiO_2 and ZnO
	4	Infrared Analysis	Acrylic	Alkyd	Alkyd
	5	Emission Spectroscopy	A and B contain	Mn,Pb,Mg,Si, Fe,Al,Ca,Ti	C also contains Zn
301		Unable to complete test			
305		Unable to complete test			
308	1	Macroscopic Exam	Inconclusive		
NN	2	Microscopic Exam	Inconclusive		
	3*	X-ray Fluorescence	A and B trace Zn		C - Zn major element
317	1	Macroscopic Exam			
NN	2	Microscopic Exam			
	3	Fluorescent Studies			
	4*	Emission Spectroscopy			C different in Zn content
	5*	Pyrolysis G-C	A different from B		
	6	Solubility Tests	A different from B		
330	1	Macroscopic Exam			
NN	2	Microscopic Exam			
	3*	Pyrolysis G-C			
	4	Solubility Tests			
	5	Infrared Analysis			
	6*	X-ray Fluorescence			
333	1	Macroscopic Exam	A, B, C similar		
YY	2	Microscopic Exam	A, B, C similar		
	3	Fluorescent Studies	A, B, C all absorbed		
	4	Solubility Tests	No differentiation between A, B, C		
	5*	Infrared Analysis	No differentiation between A, B, C		
344	1	Macroscopic Exam	A, B, C contain greenish particles		
NN	2	Fluorescent Studies	A and B dark purple		No fluorescence
	3	Microscopic Exam	A, B, C similar		
	4	Solubility Tests	Very soluble	Least Soluble	Soluble
	5*	Density Studies	Level-bottom	Level-middle	Level-Top
	6	Emission Spectroscopy	A and B have no Zn		Zn present in C
345	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4*	Infrared Analysis	A, B, C all have differences; definitely C $\neq$ B		
	5.	TLC	A, B, C similar		
	6*	Pyrolysis G-C	A $\neq$ B		
347	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4	Pyrolysis G-C	A, B, C all different		
	5	Infrared Analysis	A, B, C different		
	6	Fluorescent Studies	A, B, C similar		
	7	TLC	A, B, C similar		

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
357	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Polarizing Microscope	A, B, C similar		
	4	Solubility Tests	A, B, C similar		
	5	Infrared Analysis	A, B, C similar		
	6	X-ray Diffraction	TiO_2	TiO_2	TiO_2 and ZnO
	7	Emission Spectroscopy	A and B contain	Mn, Mg, Si, Ti, Co, Al, Ca, Fe, Pb, Cu	C contain Zn in addition
	8*	Pyrolysis G-C	A, B, C different		
370	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A different	B and C similar	
	4	Pyrolysis G-C	A different	B and C similar	
	5*	X-ray Fluorescence		B contains more Zn then C- C also contains Mn	
375	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3*	Solubility Tests	A, B, C different		
	4	Infrared Analysis	A different from B and C		B and C distinquishable
386	1	Macroscopic Exam	A = B = C		
NN	2	Microscopic Exam	A = B = C		
	3*	Pyrolysis G-C	A different		B=C
	4*	Emission Spectroscopy		B and C different	
395	1	Macroscopic Exam			
NY	2	Microscopic Exam			
	3	Solubility Tests	A, B, C similar		
	4*	Infrared Analysis	A different	B and C similar	
	5*	Pyrolysis G-C	A different	B and C similar	
399	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3*	Pyrolysis G-C	Gross differences in A, B, C		
	4	Solubility Tests	B different from A or C		
	5	Infrared Analysis	A, B, C different		
	6	UV Spectrophotometry	A, B, C different		
	7	Fluorescent Studies	A, B, C no fluorescence		
401	1	Macroscopic Exam	A, B, C lemon yellow		
IN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	Inconclusive		
	4	Infrared Analysis	A, B, C similar		
	5*	Emission Spectroscopy	A and B inconclusive		C different
409	1	Macroscopic Exam	A, B, C yellow-green		
NN	2	Microscopic Exam	A, B, C single layer		
	3*	Pyrolysis G-C	A different	B and C similar	
	4	Infrared Analysis	A, B, C alkyd enamel, TiO_2 present		
	5*	X-ray Fluorescence	Trace Cu No Zn	No Cu Trace Zn	No Cu High conc. Zn
415	1	Macroscopic Exam	A, B, C similar		
NN	2	Solubility Tests	A, B, C similar		
	3*	EDAX	A and B similar		High Zn concentration
	4*	Pyrolysis G-C	A different	B and C similar	
420	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Fluorescent Studies	A and B do not fluoresces		C fluoresces
	4	X-ray Diffraction	Slight difference in A and B		
	5	Solubility Tests	A different from B		

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
430	1	Macroscopic Exam	Inconclusive		
YN	2	Microscopic Exam	A, B, C similar		
	3*	Fluorescent Studies	Absorbs	Absorbs	Yellow
	4*	Solubility Tests			
	5	Pyrolysis G-C			
	6	Infrared Analysis			
448	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3*	Solubility Tests	A different from B		
	4*	Emission Spectroscopy	A and B contain Mu, Mg, Al, Si, Ti, Ca		C also contains Zn
	5	Infrared Analysis	A, B, C similar		
	6	Fluorescent Studies	No fluorescence in A, B, C		
457	1*	Macroscopic Exam	A more brittle than B or C		
NN	2	Microscopic Exam	A slightly different than B or C		
	3	Solubility Tests	A, B, C similar		
	4	Pyrolysis G-C	A different from B or C		
	5*	Emission Spectroscopy	A and B contain Mg, Al, Fe, Si Pb, Mn, Ti		C also contains Zn
	6	Scanning Electron Microscope	A and B similar		C contains Zn not in A, B
461					
II					
475	1	Macroscopic Exam	B slightly different than A and C		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4*	Pyrolysis G-C	A different	B and C similar	
	5*	X-ray Diffraction	A and B similar		C different
	6	Emission Spectroscopy	A and B contain Al, Ca, Mg, Pb, Si, Ti		C also contains Zn
496	1	Macroscopic Exam			
NI	2	Microscopic Exam			
	3	Fluorescent Studies			
	4	Solubility Tests			
	5	Pyrolysis G-C	A and B slightly soluble in HNO_3		
	6	Density Studies			
504	1	Macroscopic Exam	A, B, C same		
YY	2	Microscopic Exam	A, B, C same		
	3*	Solubility Tests	A, B, C same - used H_2SO_4, NH_4ON, $CHCR_3$, Dioxane Ethyl Acetate, Methyl Ethyl Ketone		
507	1	Macroscopic Exam	A, B, C pea-green enamel		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4	Pyrolysis G-C			
	5*	Energy Dispersive Spectroscopy	Zn, Al, Si, S Ti Major, Fe	Mg, Al, Si, Ti Major, Fe	Mg, Si, Ti Major, Fe
513	1	Microscopic Exam			
NN	2	Fluorescent Studies	A and B have no fluorescence		C fluoresces slightly
	3	X-ray Fluorescence	A and B similar		C different in Zn
	4	Infrared Analysis	A and B similar		
	5	Pyrolysis G-C	A and B different		
523	1	Microscopic Exam	A, B, C indistinguishable		
NN	2	Solubility Tests	A, B, C similar		
	3	Infrared Analysis	Small difference between A and B		B and C similar
	4	Pyrolysis G-C	A different		B and C similar
	5	Emission Spectroscopy	A and B contain Ti, Si, Mg, Mn, Pb, Cu		C also contains Zn

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
545	1	Macroscopic Exam	Fine thin chips	One irregular chip	Small thin
			Yellow-green	Yellow-green	Yellow-green
YN	2	Microscopic Exam	A and B one layer, smooth surfaces	yellow-green,	Same as A and B except has prominent ridges
	3*	Fluorescent Studies	A and B different from C		
	4	Solubility Tests	Some differences in A, B, C		
	5	TLC	A, B, C similar		
	6	Emission Spectroscopy	A and B contain Si, Mg, Mn, Ti, Pb		C also contains Zn
	7	Infrared Analysis	A and B similar		
	8*	UV Spectrophotometry	A and B same		
564	1	Macroscopic Exam			
NN	2	Microscopic Exam			
	3	Solubility Tests			
	4	Fluorescent Studies			
	5*	X-ray Fluorescence	Definite differences in Zn content		
584	1	Macroscopic Exam	A, B, C similar, A slightly different		
NN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C - no differences		
	4	Pyrolysis G-C	A different	B and C similar	
	5*	X-ray Diffraction	A and B similar		C different
594	1	Macroscopic Exam	A, B, C yellow-green paint		
NN	2	Microscopic Exam	A, B, C 1-layer		
	3	Solubility Tests			
	4*	Pyrolysis G-C	A different from B		C different from B in quantity
597	1	Macroscopic Exam	B flat, A and C shiny		
NN	2	Microscopic Exam	B flat, A and C shiny		
	3*	Solubility Tests	B different from A and C w.r.t. color eluted		
	4	Infrared Analysis	Inconclusive		
	5	TLC	Inconclusive		
	6	Emission Spectroscopy	B different from A and C		
599	1	Fluorescent Studies	A, B, C negative		
YN	2	Macroscopic Exam	A, B, C similar		
	3	Microscopic Exam	A, B, C single layer		
	4	Solubility Tests	A and B different from C in acetone		
	5	Emission Spectroscopy	A and B contain Pb, Mg, Al, Fe		C also contains Zn
608	1	Macroscopic Exam	A, B, C similar in color		
NN	2	Microscopic Exam	No differences noted		
	3*	Solubility Tests	A different	B and C slightly different	
	4	Pyrolysis G-C			
	5	Emission Spectroscopy	A and B contain no Zn		C containZn
	6	Infrared Analysis	A, B, C similar		
626	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C non metallic, similar		
	3	Fluorescent Studies	A, B, C have no fluorescence		
	4	Spectral Reflectance	A, B, C similar		
	5*	Infrared Analysis	A, B, C different		
	6	Pyrolysis G-C	A, B, C different		
632	1	Macroscopic Exam	A, B, C similar		
NN	2*	X-ray Fluorescence	Ti/Pb = 4.4	Ti/Pb = 7.5	C contains more Zn than A or B
	3	Solubility Tests	A and B similar		
	4	Infrared Analysis	A and B similar		

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
637	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3	Fluorescent Studies	A, B, C same		
	4	Solubility Tests	A, B, C similar		
	5*	Pyrolysis G-C	A different from B		C slightly different from B
	6	X-ray Diffraction	A, B, C similar		
646	1	Miscroscopic Exam	A, B, C similar		
NI	2*	Solubility Tests	A different	B and C similar	
	3*	Pyrolysis G-C	A different	C slightly different from B	
648	1	Macroscopic Exam			
NN	2	Microscopic Exam			
	3*	Solubility Tests	A and B different from C		
	4	Fluorescent Studies			C different from A, B
	5	Emission Spectroscopy	A and B different		
	6	Infrared Analysis	A different from B		
652	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3*	Fluorescent Studies	A and B similar		C dissimilar
	4*	Infrared Analysis	A, B, C different		
	5	X-ray Diffraction	TiO_2	TiO_2	TiO_2 & ZnO
	6*	Pyrolysis G-C	A, B, C different		
	7	Solubility Tests	A, B, C similar		
	8	Emission Spectroscopy	A and B similar		C has conc. of Zn
655	1	Macroscopic Exam			
NI	2	Microscopic Exam	A, B, C indistinguishable		
	3	Solubility Tests	A, B, C similar		
	4	Pyrolysis G-C	A different	B and C similar	
	5	TLC	A, B, C similar		
675	1	Macroscopic Exam	A, B, C same		
YY	2*	Solubility Tests	A, B, C same		
677	1	Macroscopic Exam	Fractures in splinters		B and C not in splinters
NY	2	Microscopic Exam	A, B, C similar		
	3*	Solubility Tests	A insol. H_2SO_4	B and C sol. H_2SO_4	
	4	TLC	A, B, C similar		
	5	Infrared Analysis	A, B, C modified Alkyd		
700	1	Macroscopic Exam			
YN	2	Fluorescent Studies	A and B dark Aks.		C- weak yellow fluorescence
	3	Solubility Tests	A and B similar		C slightly different
	4*	Emission Spectroscopy	A and B contain Ti, Mg, Si, Fe, Pb, Al		C contains Zn also
702	1	Macroscopic Exam	A, B, C yellow - A long, thin fragments, B and C flexible		
	2	Microscopic Exam	A, B, C single layer		C wrinkled surface
	3	Solubility Tests	A, B, C similar		
	4*	Infrared Analysis	$A \neq B = C$		
	5	TLC	$A = B = C$		
	6	UV Spectrophotometry	$A \neq B = C$		
706	1	Macroscopic Exam	A, B, C same		
YN	2*	Microscopic Exam	A and B same		C different
	3	Solubility Tests	A and B same		C different

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	INdicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
711	1	Microscopic Exam	A, B, C gold color		
NY	2	Solubility Tests	A, B, C similar		
	3	TLC			
	4*	Pyrolysis G-C	A different from B and C		
717	1	Macroscopic Exam			
NY	2	Microscopic Exam			
	3	Solubility Tests			
	4*	Pyrolysis G-C			
719	1	Microscopic Exam			
NY	2	Solubility Tests	A, B, C similar		
	3*	Pyrolysis G-C	A different from B and C		
	4	Infrared Analysis			
730	1	Macroscopic Exam			
NI	2	Microscopic Exam			
	3	Solubility Tests			
	4*	Pyrolysis G-C	inconclusive on B and C		
	5	Infrared Analysis			
747	1	Macroscopic Exam	A, B, C same color		
IN	2	Microscopic Exam	A, B, C same color, layer structure		
	3	Fluorescent Studies	A, B, C have no fluorescence		
	4	Solubility Tests	No significant differences		
	5*	X-ray Fluorescence	Low - Zn High - Ti	Low - Zn High - Ti	High - Zn Low - Ti
	6	GC of Binder Extract	Minor differences between A and B		B and C same
761	1	Macroscopic Exam	A and B gold		C greenish-gold
YN	2*	Fluorescent Studies	A and B no fluorescence		C slight fluorescence
	3	Microscopic Exam	A and B single layer enamel		
	4	Solubility Tests	A and B same		
	5*	Infrared Analysis	A and B same		
	6	TLC	A and B match		
763	1	Macroscopic Exams	A, B, C green		
NN	2	Microscopic Exam	A, B, C green, single layer		
	3*	Solubility Tests	A different Ø2NH in H_2SO_4	B and C same	
	4*	X-ray Diffraction	A and B similar		C different
	5	Emission Spectroscopy	Ti	Ti	Ti & Zn
	6	Pyrolysis G-C	A different	B and C similar	
	7	Infrared Analysis	A, B, C similar		
768	1	Macroscopic Exam	A, B, C similar		
YN	2	Microscopic Exam	A, B, C similar		
	3	Solubility Tests	A, B, C similar		
	4*	Emission Spectroscopy	A and B same		C different
	5	Infrared Analysis	A, B, C similar		
	6	UV Spectrophotometry	A, B, C similar		
	7	Pyrolysis G-C	Inconclusive		
775	1	Microscopic Exam	No differences noted		
YN	2*	X-ray Fluorescence	A and B contain Ti, Pb, Fe, Zn, Mn		C contains Zn, Ti, Fe, Pb
	3	Solubility Tests	No changes in H_2SO_4, HNO_3 for A, B, C		
	4	Infrared Analysis	A and B same		
	5	X-ray Diffraction	A and B rutile		
793	1	Microscopic Exam	A and B single layer, yellow-green		C two layers, yellow-green
NN	2	Infrared Analysis	A, B, C different		
	3*	Pyrolysis G-C	A, B, C different		

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
803	1	Microscopic Exam	A, B, C yellow green; B not glossy, A and C glossy		
NN	2	Fluorescence	A, B, C no fluorescence		
	3*	Pyrolysis G-C	A different from B		B and C same Contains Zn
	4	X-ray Fluorescence	A and B same	B and C different	
836	1	Macroscopic Exam	A, B, C yellow paint, glossy finish		
NN	2	Microscopic Exam	A, B, C single layer		
	3	Solubility Tests	A, B, C react the same		
	4	TLC	A, B, C same		
	5*	X-ray Fluorescence	Zn/Pb = .053	Zn/Pb = .232	Zn/Pb = 14.2
	6	Infrared Analysis	A, B, C similar		
	7*	Pyrolysis G-C	A different	B and C same	
849	1	Macroscopic Exam	A, B, C same color		
NY	2	Microscopic Exam	A different flaking pattern from B and C		
	3	Solubility Tests	A, B, C similar		
	4*	Visible Spectrophotometry	A different from B		
	5	TLC	A different from B and C		
	6	Infrared Analysis	A different from B		
	7	Pyrolysis G-C	A different from B		B and C similar
855	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A, B, C similar		
	3*	Solubility Tests	A different from B in alc - KOH		C and B similar
	4*	Emission Spectrophotometry		B - no Zn	C - contains Zn
857	1	Macroscopic Exam	A, B, C similar		
NN	2	Microscopic Exam	A and B pliable		C brittle
	3*	Infrared Analysis	A, B, C all different		
	4	Solubility Tests			
872	1	Macroscopic Exam	A, B, C similar in color		
NN	2	Microscopic Exam	A, B, C similar		
	3*	Pyrolysis G-C	A different from B and C		
	4	Infrared Analysis	A different from B		B similar to C
	5*	Emission Spectroscopy	Mg, Pb, Si, Al, Cu,	Mg, Pb, Mn, Si, Fe, Al, Ti, Ca	Mg, Pb, Mn, Si, Fe, Al, Cu, Fn, Na, Ti, Ca
877	1	Macroscopic Exam	A, B, C similar in color		
YN	2	Microscopic Exam	A, B, C similar in layer number and texture		
	3	Pyrolysis G-C	A, B, C consistent		
	4*	Fluorescent Studies	A and B - no fluorescence		C - yellow fluorescence
	5	Solubility Tests	A and B similar		
	6*	Infrared Analysis	A and B similar		
895	1	Macroscopic Exam	A, B, C yellow paint		
NN	2	Microscopic Exam	A, B, C yellow paint		
	3	X-ray Fluorescence	High in Zn	Low in Zn	Contains more Zn than A
902	1	Infrared Analysis	A = B = C		
II	2	Pyrolysis G-C	Insufficient sample for conclusion		
910	1	Macroscopic Exam	A, B, C same appearance		
NY	2	Microscopic Exam	A - smooth surface	B and C - rough surface	
	3*	Solubility Tests	A different from B		B and C same
	4	Fluorescent Studies	No fluorescence in A, B, C		
	5*	Pyrolysis G-C	A different from B		B and C same

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

Table 6 (continued)

Lab Code	Sequence of Testing	Test	Item A	Item B	Item C
917	1	Macroscopic Exam	No significant differences		
NN	2	Microscopic Exam	No significant differences		
	3	Solubility Tests	No significant differences		
	4*	Pyrolysis G-C	A different from B		Slight difference in B & C
	5*	Emission Spectroscopy	A and B TiO_2		C TiO_2 and ZnO
	6	X-ray Diffraction			
	7	Visible Spectrophotometry	A, B, C similar		
927	1	Macroscopic Exam	A, B, C green		
NN	2	Microscopic Exam	A, B, C single layer		
	3	Solubility Tests	A, B, C similar		
	4*	Pyrolysis G-C	A different from B		B and C similar
	5*	X-ray Fluorescence	A and B - Ti, Pb, Fe, Ti/Zn > 1 Zn (trace)		C - Ti, Fe, Pb Zn (strong) Ti/Zn < 1
928	1	Macroscopic Exam	A, B, C similar color		
NN	2	Microscopic Exam	A, B, C similar color		
	3*	Pyrolysis G-C	A different from B		B similar to C
	4*	X-ray Diffraction	TiO_2	TiO_2	TiO_2 + ZnO
	5	Solubility Tests	A, B, C similar		
936	1	Microscopic Exam	A, B, C similar		
NN	2*	Infrared Analysis	A different from B		B and C same
	3	Pyrolysis G-C	A different from B		B and C same
	4*	X-ray Fluorescence			B and C different
942	1	Macroscopic Exam	A, B, C similar		
YN	2	Fluorescent Studies	A and B no fluorescence		C fluorescent
	3	Microscopic Exam	A and B similar		
	4	Infrared Analysis	A and B same		
967	1	Macroscopic Exam	A, B, C similar		
NN	2	Solubility Tests	A and C compare to B		
	3*	Pyrolysis G-C	A different from B		B and C compare
	4*	Emission Spectroscopy	A and B similar (No Zn)		C - Zn present
	5	X-ray Diffraction	A different from B		B and C similar
972	1	Macroscopic Exam	A, B, C yellow paint		
NN	2	Microscopic Exam	A, B, C shiny surface		
	3	Solubility Tests	A, B, C similar		
	4*	Pyrolysis G-C	A grossly different from B		B and C different

* indicates the point where a conclusion was reached

NOTE:

NN	Indicates No for A and No for C
NY	Indicates No for A and Yes for C
YN	Indicates Yes for A and No for C
YY	Indicates Yes for A and Yes for C
IN	Indicates Inconclusive for A and No for C
NI	Indicates No for A and Inconclusive for C

END