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**MCCA**

MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

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**COLLABORATIVE REFERENCE PROGRAM  
COLOR AND APPEARANCE**

**COLOR AND COLOR DIFFERENCE**

**REPORT NO. 31**

NBSIR 80-1830



**U.S. DEPARTMENT OF COMMERCE**

**National Bureau of Standards**

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TAPPI Paper and Board (6 times per year)

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Tearing strength	Surface pick strength
Tensile breaking strength	K & N ink absorption
Elongation to break	Moisture content
Tensile energy absorption	Opacity
Folding endurance	Blue reflectance (brightness)
Stiffness	Specular gloss, 75°
Air resistance	Thickness
Grammage	Concora (flat crush)
	Ring crush

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Concora test of medium

MCCA Color and Appearance (4 times per year)

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Color and color difference

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Hardness  
Mooney viscosity  
Vulcanization properties

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Physical (15 characteristics)

AASHTO Bituminous

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**MANUFACTURERS COUNCIL ON  
COLOR AND APPEARANCE**

**COLLABORATIVE REFERENCE PROGRAM  
FOR  
COLOR AND APPEARANCE**

**COLOR AND COLOR DIFFERENCE**

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**U. S. DEPARTMENT OF COMMERCE  
National Bureau of Standards**

**NBSIR 80-1830**

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## INTRODUCTION

The NBS-MCCA Collaborative Reference Program for Color and Appearance is sponsored by the Manufacturers Council on Color and Appearance and the National Bureau of Standards. Four times per year, paint chip samples and near white paper samples, along with a white calibration check sample, are distributed to participating laboratories. Participants in the paint chip test receive two pairs of color samples (from the full color spectrum) along with a white calibration sample. Participants in the near white paper test receive two sets of eight near white papers along with a white calibration sample. Laboratories can participate in either or both tests. The samples are tested by the laboratories and the data is returned to NBS for analysis.

Each test is analyzed in both X,Y,Z and L,a,b color spaces. The X,Y,Z space analysis is primarily for spectrophotometers while the L,a,b space analysis is primarily for colorimeters. A laboratory must specify in which space it wishes to receive its analyses.

Data from each laboratory is processed in a "normal" and an "adjusted" analysis. In the "normal" analysis, the laboratory's data is used as reported. In the "adjusted" analysis, the laboratory's data is first adjusted using a correction factor generated from the laboratory's white calibration sample data (see Explanation of Data For White Sample).

For comparison purposes, reflectance values for single specimens of the paint chip samples at 40 wavelengths ranging from 380 to 770 nm and colorimetric data for 45/0 reflectance factor have been provided by NBS.

Also for comparison purposes, a plot of the spectrophotometric curves of single paint chip specimens was provided by Hemmendinger Color Laboratory, Belvedere, New Jersey.

If there are any questions on the notes, analyses, or the report in general, contact Jeffrey Horlick on (301) 921-2946 or Thomas L. Cummings on (703) 442-0433.





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## KEY TO TABLES

- MEAN - The average of individual test determinations.
- GRAND MEAN - (GR. MEAN) The average of the individual laboratory MEANS, excluding laboratories flagged (see column F) with an X, #, or +.
- SD OF MEANS - The standard deviation of the laboratory MEANS about the GRAND MEAN: an index of the among-laboratory precision.
- INST CODE - Code for instrument type and color space used to report measurements, see Table of Instrument Codes
- F - Flag, is based on  $\Delta E$  column with the following meaning:
- 0 - Included in grand mean analysis.
  - \* - Included in grand means but results are between two and three standard deviations. The participants should take this as a warning to reexamine testing procedures.
  - X - Excluded from all calculations because  $\Delta E$  is beyond (3) standard deviations.
  - + - Excluded from all grand mean calculations because lab is using a nonstandard instrument or test method.
  - # - Excluded from all grand mean calculations because data were not understood, data were extreme, late, or insufficient information was supplied concerning instrument and test method used.

Note: In addition to flag (F) based on delta E column, it is also possible to have either an X or an \* on individual MEANS as follows:

- X - following a MEAN signifies that the mean is greater than 3 SD of MEANS from the Grand Mean. The values for this laboratory have been omitted in the calculations involving the MEAN for the column.
- \* - following any of the MEANS signifies that the quantity is greater than 2 but less than 3 of the appropriate standard deviations from the corresponding average. The participant should take this as a warning to reexamine his testing procedures.

$\Delta E$  - Total color difference between two samples. In X, Y, Z analysis it is calculated in MacAdams (FMC II) units. For L, a, b analysis it is calculated in Hunter units.

## ΔE Calculation

ΔE is calculated in the Color and Color Difference Collaborative Reference Program by the FMC2\* equations (X, Y, Z analysis) as follows:

The yellow-blue chromatic difference is

$$\Delta C_1 = K_1 S(P\Delta P + Q\Delta Q)/bD^2 - K_1 \Delta S/b;$$

the lightness difference is

$$\Delta L = 0.279K_2(P\Delta P + Q\Delta Q)/aD;$$

and the red-green chromatic difference is

$$\Delta C_3 = K_1(Q\Delta P - P\Delta Q)/aD.$$

The quantity, D, is an abbreviation,

$$D = (P^2 + Q^2)^{1/2}.$$

$$K_1 = 0.55669 + 0.049434 Y - 0.82575 \cdot 10^{-3} Y^2 + \\ 0.79172 \cdot 10^{-5} Y^3 - 0.30087 \cdot 10^{-7} Y^4,$$

$$K_2 = 0.17548 + 0.027556 Y - 0.57262 \cdot 10^{-3} Y^2 + \\ 0.63893 \cdot 10^{-5} Y^3 - 0.26731 \cdot 10^{-7} Y^4,$$

$$a^2 = 17.3 \cdot 10^{-6} (P^2 + Q^2) / [1 + 2.73 P^2 Q^2 / (P^4 + Q^4)],$$

$$b^2 = 3.098 \cdot 10^{-4} (S^2 + 0.2015 Y^2)$$

$$P = 0.724 X + 0.382 Y - 0.098 Z,$$

$$Q = -0.48 X + 1.37 Y + 0.1276 Z,$$

$$S = 0.686 Z,$$

$$\Delta E = [(\Delta C_1)^2 + (\Delta L)^2 + (\Delta C_3)^2]^{1/2}$$

\*Friele-MacAdam-Chickering metric

TEST METHOD CODES

FOR PAINT CHIPS AND NEAR WHITE PAPERS

INSTRUMENT CODE	INSTRUMENT	COLOR SPACE	DATA CODE
C70AC	C71AC ACS SPECTRA SENSOR	X Y Z	9014
C70BL	C71BL E-L 505 SPECTROPHOTOMETER	X Y Z	9014
C70CA	C71CA CARY 14	X Y Z	9014
C70CB	C71CE CARY 17	X Y Z	9014
C70CD	C71CD C61CF EYE SMALL SPHERE	X Y Z	9014
C70CE	C71CE C61CF EYE SMALL SPHERE	XX <sup>1</sup> Y <sup>2</sup> ,4V	9016
C70CF	C71CF C61CF EYE SMALL SPHERE	XY <sup>2</sup> ,EaSc <sup>4</sup>	9017
C70CG	C71CG C61CF EYE SMALL SPHERE	XX <sup>1</sup> Y <sup>2</sup> ,Ea	9018
C70CH	C71CF C61CF EYE SMALL SPHERE	XY <sup>2</sup> ,3V	9011
C70CL	C71CL C61CF EYE LARGE SPHERE	XX <sup>1</sup> Y <sup>2</sup> ,4V	9016
C70CM	C71CM C61CF EYE LARGE SPHERE	XX <sup>1</sup> Y <sup>2</sup> ,Ea	9018
C70CN	C71CN C61CF EYE LARGE SPHERE	XY <sup>2</sup> ,EaSc <sup>4</sup>	9017
C70DC	C71DC DIANE CEFEMASCAN SPECTROPHOTOMETER	X Y Z	9014
C70DH	C71DH DIANE MATCH SCAN SPECTROPHOTOMETER	X Y Z	9014
C70DE	C71DE DIANE/ISCE AUTOMATE	XY <sup>2</sup> ,EaSc <sup>4</sup>	9017
C70DL	C71DL DIANE/ISCE AUTOMATE	XY <sup>2</sup> ,3V,4F	9019
C70DM	C71DM DIANE/ISCE AUTOMATE	XX <sup>1</sup> Y <sup>2</sup> ,4V	9016
C70DS	C71DS DIANE/SSCE AUTOMATE	XX <sup>1</sup> Y <sup>2</sup> ,Ea	9018
C70DT	C71DT DIANE/SSCE AUTOMATE	XY <sup>2</sup> ,EaSc <sup>4</sup>	9017
C70GA	C71GA GARDNER AUTC AC2/AC3	L a b	9013
C70GB	C71GB GARDNER AUTC AC2/AC3	X Y Z	9014
C70GC	C71GC GARDNER XL-20/XL-30 SERIES	X Y Z	9014
C70GD	C71GD GARDNER XL-20/XL-30 SERIES	L a b	9013
C70GE	C71GE GE/DIANE/HARDY AUTOMATE SPECTRO	X Y Z	9014
C70GK	C71GK GARDNER XL-70	X Y Z	9014
C70GL	C71GL GARDNER XL-70	L a b	9013
C70GM	C71GM GARDNER MULTIPURPOSE REFLECTOMETER	X Y Z	9014
C70GP	C71GP GARDNER XL-200 SERIES	L a b	9013
C70GX	C71GX GARDNER XL-10	L a b	9013
C70GY	C71GY GARDNER XL-10	X Y Z	9014
C70HA	C71HA HUNTER D2SA (DA,D1A,D2A)	L a b	9013
C70HB	C71HE HUNTER D2SA (DA,D1A,D2A)	X Y Z	9014
C70HC	C71HC HUNTER D2SA (DA,D1A,D2A)	RE A E	9012
C70HF	C71HF HUNTER D2SAA	L a b	9013
C70HG	C71HG HUNTER D2SAA	X Y Z	9014
C70HM	C71HM HUNTER D2SW (DM,D1M,D2M)	L a b	9013
C70HN	C71HN HUNTER D2SW (DM,D1M,D2M)	X Y Z	9014
C70HE	C71HE HUNTER D2SW (DM,D1M,D2M)	RE A E	9012
C70HP	C71HF HUNTER D2SF (DP,D1P,D2P)	X Y Z	9014
C70HQ	C71HC HUNTER D2SF (DP,D1P,D2P)	L a b	9013
C70HR	C71HF HUNTER D2SF (DA,D1A,D2A)	Fd a b	9012
C70HT	C71HT HUNTER D54 SPECTROPHOTOMETER	X Y Z	9014
C70HU	C71HU HUNTER D54 SPECTROPHOTOMETER	L a b	9013
C70IC	C71IC IHM SPECTROPHOTOMETER	L A E	9013
C70IH	C71IE IHM SPECTROPHOTOMETER	X Y Z	9014
C70KC	C71EC ECS-18	XX <sup>1</sup> Y <sup>2</sup> ,4V	9016
C70KD	C71KD ECS-18	XX <sup>1</sup> Y <sup>2</sup> ,Ea	9018
C70KS	C71ES ECS-18	X Y Z	9014
C70KT	C71ET ECS-40	X Y Z	9014
C70LS	C71LS LERES TRIIAC	X Y Z	9014
C70LT	C71LI LERES TRIIAC	XY <sup>2</sup> ,3V	9011
C70MD	C71MD MACHETH MS2000 SPECTROPHOTOMETER	X Y Z	9014
C70ME	C71ME MACHETH MS2000 SPECTROPHOTOMETER	L a b	9013
C70MG	C71MG MACHETE MC1010	L a b	9013
C70MH	C71ME MACHETE MC1010	X Y Z	9014
C70MS	C71MS MARTIN SWEETS	X Y Z	9014
C70MT	C71MT MARTIN SWEETS	XX <sup>1</sup> Y <sup>2</sup> ,Ea	9018
C70ND	C71ND NEPTEC 220 DU COLOR	R G E	9015
C70NE	C71NE NEPTEC 220 DU COLOR	X Y Z	9014
C70SA	C71SA SPECIAL INSTRUMENT - INCLUDED	X Y Z	9014
C70SB	C71SE SPECIAL INSTRUMENT - INCLUDED	Fd a b	9012
C70SC	C71SC SPECIAL INSTRUMENT - INCLUDED	L a b	9013
C70SL	C71SL SPECIAL INSTRUMENT - INCLUDED	R G E	9015
C70SP	C71SP SPECIAL INSTRUMENT - EXCLUDED	X Y Z	9014
C70SQ	C71SQ SPECIAL INSTRUMENT - EXCLUDED	Fd a b	9012
C70SR	C71SR SPECIAL INSTRUMENT - EXCLUDED	L a b	9013
C70SS	C71SS SPECIAL INSTRUMENT - EXCLUDED	R G E	9015
C70ZD	C71ZD ZEISS DMC25	X Y Z	9014
C70ZA	C71ZA ZEISS DMC26	X Y Z	9014
C70ZE	C71ZE ZEISS ELREFH0	X Y Z	9014
C70ZF	C71ZF ZEISS ELREFH0	R G E	9015
C70ZB	C71ZE ZEISS RFC3	X Y Z	9014
C70XX	C71XX GIVE INSTRUMENT MAKE AND MODEL	NOT SPECIFIED	9020

FORMAT OF COLORIMETRIC (INPUT) DATA

DATA CODE	COLOR SCALE
9011	X,Y,Z 3 FUNCTION VITRELITE CORRECTION
9012	Fd,a,b
9013	L,a,b HUNTER
9014	X,Y,Z
9015	R,G,E
9016	X,X <sup>1</sup> ,Y,Z 4 FUNCTION VITRELITE CORRECTION
9017	X,Y,Z, HaSc <sup>4</sup> CORRECTION
9018	X,X <sup>1</sup> ,Y,Z BaSc <sup>4</sup> CORRECTION
9019	X,Y,Z 4 FUNCTION VITRELITE CORRECTION
9020	(NON-STD. INST. SCALE SPECIFIED WITH DATA)



Notes on Specific Laboratory Results for Paint Chips

- C223 - Submitted insufficient data to be analyzed in this report
- C253, C655 - Data included in body of report, but received too late for checking and therefore not included in statistical computation
- C514A, C514B, C612  
C662, C717A, C717B  
C720A, C720B - Used illuminant D65
- C705, C707, C750 - Apparent reporting or measurement problem on all five samples
- C708B - Used illuminant A
- C725 - Reported extreme values compared to other labs on sample D19
- C742 - Apparent reporting or measurement problem on samples D19 and D20



MCCA COLLABORATIVE REFERENCE PROGRAM  
 X, Y, Z SPACE ANALYSIS, NORMAL DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR PAINT CHIPS

LAB CODE	F	SAMPLE D17			SAMPLE D18			DIFFERENCE D18 - D17			ΔE	INST CODE	LAB
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ			
C157	θ	39.67	30.78	28.01	39.11	30.03	27.80	-0.56	-0.75	-0.21	3.31	70GE	C157
C162	θ	41.37*	32.00*	27.51	40.87*	31.30*	27.44	-0.49	-0.70	-0.07	3.21	70DC	C162
C251	θ	35.68	29.80	26.81	39.02	29.00	26.57	-0.66	-0.80	-0.24	3.30	70ZE	C251
C253	#	38.48	29.40	26.85	37.90	28.70	26.77	-0.58	-0.70	-0.09	2.77	70SA	C253
C278	θ	38.40	30.35	26.10	37.60	29.50	25.85	-0.80	-0.85	-0.25	2.60	70NE	C278
C407	θ	40.09	31.1E	28.36	39.54	30.43	28.24	-0.55	-0.72	-0.12	3.00	70BI	C407
C414	θ	35.2E	30.1E	26.44	38.85	29.58	26.41	-0.43	-0.60	-0.03	2.77	70MD	C414
C416A	θ	36.61X	29.29	27.36	35.89X	28.52	27.23	-0.72	-0.77	-0.13	2.40	70IE	C416A
C416B	θ	35.89X	28.77*	27.60	35.17X	27.95θ	27.40	-0.72	-0.82	-0.20	2.85	70GE	C416B
C417B	θ	3E 60	29.65	26.84	37.99	28.89	26.70	-0.61	-0.76	-0.14	3.12	70BN	C417B
C41E	θ	38.66	30.04	27.17	38.13	29.35	27.02	-0.54	-0.69	-0.15	2.8E	70CE	C41E
C422	θ	3E 06	28.98	26.25	37.55	28.32	26.19	-0.51	-0.65	-0.06	2.84	70GC	C422
C424	θ	39 3E	30.63	28.14	38.84	29.92	28.03	-0.54	-0.72	-0.11	3.04	70CA	C424
C42E	θ	39 46	30.25	27.25	38.89	29.55	27.20	-0.57	-0.70	-0.05	2.76	70BE	C42E
C443	θ	40.14	30.94	27.55	40.01	30.5E	27.80	-0.13 X	-0.3E X	0.25 *	2.73	70CM	C443
C444	θ	39.43	30.4E	27.66	39.24	30.11	27.90	-0.18 X	-0.37 X	0.24 *	2.14*	70GE	C444
C446	θ	39.00	30.07	28.04	38.83	29.70	28.19	-0.18 X	-0.37 X	0.15	2.23*	70GE	C446
C451	θ	40.46	31.00	26.67	40.11	30.49	26.79	-0.34 *	-0.52 *	0.12	2.4E	70AC	C451
C453	θ	40.03	30.66	27.21	39.72	30.1E	27.34	-0.30 *	-0.4E *	0.13	2.47	70BT	C453
C459	θ	3E 76	29.96	27.33	38.25	29.26	27.23	-0.51	-0.70	-0.11	3.20	70GE	C459
C460	θ	39.05	30.13	27.05	38.22	29.15	26.66	-0.83	-0.9E *	-0.39	3.74	70GE	C460
C462A	θ	39 05	30.05	27.10	38.55	29.45	27.10	-0.50	-0.60	0.00	2.30	70BE	C462A
C463	θ	40.00	30.66	27.11	39.50	30.04	27.13	-0.50	-0.62	-0.02	2.46	70DC	C463
C467A	θ	38.91	30.16	29.39*	38.41	29.53	29.34*	-0.49	-0.63	-0.05	2.55	70GE	C467A
C467B	θ	38.86	29.88	26.90	38.3E	29.26	26.92	-0.48	-0.63	0.02	2.66	70BN	C467B
C469	θ	39.81	30.84	28.24	39.34	30.17	28.18	-0.47	-0.67	-0.06	3.11	70GE	C469
C470	θ	40.03	31.04	28.01	39.51	30.32	27.91	-0.52	-0.72	-0.11	3.23	70DB	C470
C472	θ	40.95*	31.97*	28.16	40.47*	31.26*	28.08	-0.48	-0.71	-0.08	3.3E	70ZL	C472
C473	θ	39.8E	30.65	27.09	39.32	29.94	26.99	-0.57	-0.71	-0.10	2.83	70CB	C473
C474	θ	39 08	30.33	28.24	38.42	29.52	27.99	-0.66	-0.81	-0.25	3.17	70GE	C474
C476	θ	39.07	29.79	26.64	38.44	29.02	26.50	-0.63	-0.7E	-0.14	3.1E	70SA	C476
C479B	θ	39.74	30.61	27.69	39.12	29.84	27.54	-0.62	-0.77	-0.1E	3.12	70CE	C479B
C480	θ	37.7E	29.0E	25.35	37.14	28.33	25.19	-0.64	-0.75	-0.16	2.87	70BE	C480
C481	θ	38.70	29.9E	26.90	38.05	29.20	26.80	-0.65	-0.7E	-0.10	2.70	70BE	C481
C482	θ	38.41	29.31	26.30	37.79	28.51	26.09	-0.63	-0.80	-0.20	3.50	70GC	C482
C483	θ	38.69	29.20	26.69	38.12	28.50	26.57	-0.57	-0.70	-0.12	2.91	70ZF	C483
C499C	θ	39.17	30.14	29.75*	38.65	29.48	29.59*	-0.53	-0.66	-0.16	2.69	70BI	C499C
C503	θ	39.35	30.41	28.11	38.81	29.70	27.94	-0.55	-0.71	-0.17	3.0E	70GE	C503
C50E	θ	39.8E	30.86	28.31	39.32	30.12	28.10	-0.56	-0.74	-0.21	3.2E	70GE	C50E
C511	θ	39.63	30.50	27.07	39.06	29.76	26.94	-0.57	-0.74	-0.13	3.1E	70CB	C511
C512	θ	40.46	31.13	26.61	39.8E	30.3E	26.50	-0.58	-0.7E	-0.11	3.13	70AC	C512
C514B	*	3E.77	30.56	26.20	38.21	29.82	26.05	-0.57	-0.73	-0.15	3.0E	70SF	C514B
C521A	θ	39.69	30.51	28.11	39.02	29.73	27.89	-0.66	-0.7E	-0.22	2.95	70CA	C521A
C521B	θ	39.73	30.54	27.32	38.65	29.39	26.71	-1.09 X	-1.1E X	-0.61 X	3.7E	70SA	C521B
C526	θ	36.14X	29.13	27.41	35.41X	28.30	27.13	-0.74	-0.83	-0.2E	2.7E	70CB	C526
C52E	θ	39.85	30.74	27.00	39.14	29.87	26.63	-0.71	-0.88	-0.3E	3.60	70MD	C52E
C529	θ	3E.60	30.12	24.79*	37.97	29.33	24.59*	-0.64	-0.79	-0.20	3.2E	70DB	C529
C532	θ	40.21	31.57	30.51X	39.61	30.79	30.2E X	-0.60	-0.78	-0.23	3.19	70GE	C532
C534	θ	40.47	31.05	26.94	39.89	30.33	26.84	-0.57	-0.72	-0.10	2.89	70MD	C534
C536	θ	38.21	30.40	24.79*	37.45	29.56	24.51*	-0.77	-0.84	-0.29	2.67	70AC	C536
C540	θ	39.67	30.79	28.63	38.91	29.89	28.21	-0.76	-0.90	-0.42	3.4E	70GE	C540
C545	θ	37.91	29.33	26.59	37.22	28.48	26.25	-0.68	-0.85	-0.33	3.53	70GE	C545
C549	θ	40.16	30.82	26.94	39.84	30.33	27.15	-0.32 *	-0.49 *	-0.21 *	2.41	70DB	C549
C552	θ	38.61	29.74	26.96	38.04	29.04	26.87	-0.57	-0.70	-0.09	2.79	70BN	C552
C612	*	36.22X	28.83	24.63*	35.60X	28.14	24.53*	-0.62	-0.69	-0.10	2.29	70SF	C612
C613	θ	40.43	31.42	25.90	39.5E	30.40	25.36	-0.86 *	-1.02 *	-0.54 *	4.05*	70MD	C613
C627	θ	39.55	30.5E	27.59	38.87	29.79	27.37	-0.68	-0.84	-0.21	3.11	70ZE	C627
C630	θ	39.17	30.17	27.08	38.59	29.43	26.93	-0.58	-0.74	-0.15	3.10	70ES	C630
C631	θ	39.94	30.71	26.83	39.39	30.02	26.76	-0.55	-0.69	-0.0E	2.7E	70AC	C631
C632	θ	40.06	30.76	26.73	39.71	30.2E	26.95	-0.35 *	-0.4E *	0.22 *	2.17*	70AC	C632
C638	θ	38.70	29.20	27.10	37.90	28.30	26.85	-0.80	-0.90	-0.25	3.31	70SA	C638
C639	θ	40.16	31.01	26.75	39.51	30.22	26.59	-0.66	-0.79	-0.16	3.01	70DB	C639
C644	θ	39.60	30.33	26.58	38.82	29.43	26.23	-0.78	-0.90	-0.35	3.43	70AC	C644
C645	θ	40.21	30.85	26.93	39.53	30.04	26.76	-0.68	-0.81	-0.17	3.06	70MC	C645
C656	θ	39.1E	30.20	26.72	38.77	29.57	26.70	-0.41	-0.63	-0.02	3.20	70SA	C656

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LAB CODE	F	SAMPLE D17			SAMPLE D18			DIFFERENCE D18 - D17			INCL CODE	LAE
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ		
C657		38.75	30.37	24.63*	38.16	29.64	24.51*	-0.59	-0.73	-0.13	2.87	7CAC C657
C662		38.35	29.89	24.82*	37.79	29.19	24.73*	-0.55	-0.70	-0.10	2.82	70SF C662
C670	θ	38.70	29.70	26.70	38.00	28.85	26.50	-0.70	-0.85	-0.20	3.39	70CC C672
C675	θ	39.80	30.61	26.84	39.12	29.80	26.60	-0.68	-0.81	-0.24	3.15	7CAC C675
C683	θ	37.79	28.47*	25.12	37.05*	27.63*	24.92	-0.73	-0.84	-0.20	3.23	70CC C683
C691	θ	38.68	29.17	26.61	37.98	28.42	26.42	-0.70	-0.75	-0.18	2.63	70ZE C691
C700	θ	38.46	30.37	26.85	38.85	29.61	26.66	-0.61	-0.76	-0.15	3.10	70CB C700
C705	#	30.13X	0.40X	0.31X	29.29X	0.40X	0.31X	0.84	0.00 X	0.00	86X	70BF C705
C707	#	27.92X	20.97X	18.46X	27.53X	20.49X	18.38X	-0.39	-0.48 *	-0.08	2.54	70SA C707
C708A	θ	42.26X	32.87X	27.44	41.77X	32.19X	27.43	-0.49	-0.68	-0.01	2.89	70BT C708A
C708B	*	0.44X	0.79X	0.92X	0.44X	0.80X	0.92X	0.00 X	0.01 X	0.00	67X	70SS C708B
C709	θ	39.15	30.01	26.77	38.52	29.25	26.63	-0.63	-0.76	-0.14	3.01	70ES C709
C716	θ	37.81	29.70	26.80	37.26	29.00	26.81	-0.55	-0.70	-0.01	2.83	70ZE C716
C717A	*	39.06	30.52	24.87*	38.56	29.85	24.79	-0.50	-0.67	-0.08	2.96	70SF C717A
C717B	*	39.03	30.51	25.10	38.41	29.73	24.91	-0.63	-0.78	-0.15	3.14	70SF C717B
C718A	θ	39.16	30.71	24.79*	38.42	29.85	24.55*	-0.74	-0.86	-0.24	3.18	70AC C718A
C718B	θ	38.96	30.51	24.67*	38.26	29.67	24.46*	-0.70	-0.84	-0.21	3.20	70AC C718B
C719C	θ	37.70*	28.64*	26.26	37.11	27.92*	26.15	-0.60	-0.73	-0.11	2.97	70XC C719C
C720A	*	38.74	30.23	25.01	37.98	29.33	24.69*	-0.76	-0.89	-0.32	3.38	70SF C720A
C720B	*	38.72	30.22	24.94*	37.98	29.34	24.64*	-0.74	-0.88	-0.30	3.41	70SF C720B
C723	θ	39.59	30.45	26.46	38.86	29.58	26.18	-0.73	-0.87	-0.28	3.37	70MD C723
C724	θ	39.42	30.52	27.93	38.71	29.66	27.64	-0.70	-0.86	-0.25	3.40	70ZA C724
C725	θ	38.57	29.82	26.31	38.09	29.11	26.58	-0.48	-0.71	0.27 *	3.40	70KS C725
C726	θ	41.22*	31.72*	27.99	40.61*	30.92	27.87	-0.61	-0.80	-0.13	3.31	70SA C726
C727A	*	38.57	30.08	24.75*	38.16	29.51	24.81	-0.41	-0.58	0.06	2.62	70SF C727A
C727B	*	38.56	30.09	24.81*	38.08	29.44	24.79	-0.48	-0.65	-0.03	2.87	70SF C727B
C741	θ	39.29	30.12	27.32	38.77	29.43	28.28	-0.53	-0.69	0.96 X	4.04*	70CB C741
C742	#	39.34	30.47	24.63*	38.86	29.84	24.62*	-0.48	-0.63	-0.01	2.68	70CB C742
C748	θ	39.01	30.01	27.19	38.39	29.27	27.07	-0.63	-0.74	-0.12	2.74	70BE C748
C749	θ	39.06	30.59	24.77*	38.20	29.62	24.38*	-0.86 *	-0.97 *	-0.35	3.44	70AC C749
C752A	θ	39.18	30.37	27.33	38.52	29.55	27.06	-0.67	-0.82	-0.27	3.30	70CB C752A
C752B	θ	38.82	29.90	26.86	38.14	29.12	26.70	-0.68	-0.78	-0.16	2.82	70BN C752B
GRAND MEANS												
		39.33	30.29	27.01	38.74	29.54	26.88	-0.61	-0.75	-0.13	3.03	
SD OF MEANS												
		0.78	0.71	0.99	0.82	0.73	1.03	0.12	0.10	0.15	0.39	
INCLUDED LABS FOR THIS MEAN												
		79	82	82	79	82	82	79	79	81	83	



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LAB CODE	F	SAMPLE D19			SAMPLE D20			DIFFERENCE D20 - D19			INST CODE	LAB
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ		
C157	θ	7.51	7.68	9.68	6.65	6.77	8.57	-0.86	-0.91	-1.11	4.36	70GE C157
C162	θ	7.89*	8.03*	9.74	7.18*	7.31*	8.88	-0.70	-0.72	-0.86	3.34	70IC C162
C251	θ	7.23	7.30	9.09	6.43	6.50	8.03	-0.80	-0.80	-1.06	3.95	70ZE C251
C253	#	6.91	7.13	8.72	6.15	6.36	7.76	-0.76	-0.78	-0.96	3.86	70SA C253
C27E	θ	7.05	7.35	8.85	6.30	6.55	7.85	-0.75	-0.80	-1.00	3.95	70NE C27E
C407	θ	7.59	7.70	9.51	6.96	7.06	8.74	-0.63	-0.64	-0.77	3.02	70EI C407
C414	θ	6.94	7.08	8.63	6.32	6.45	7.86	-0.62	-0.64	-0.77	3.17	70MD C414
C416A	θ	7.21	7.36	8.85	6.44	6.57	7.89	-0.78	-0.75	-0.96	3.86	70IE C416A
C416B	θ	6.74	6.89*	8.51	6.08	6.21	7.67	-0.66	-0.68	-0.84	3.45	70GE C416B
C417B	θ	7.04	7.13	8.94	6.36	6.44	8.08	-0.65	-0.65	-0.87	3.43	70BN C417B
C418	θ	7.67	7.79	9.60	6.86	6.95	8.54	-0.81	-0.83	-1.06	3.97	70CE C418
C422	θ	6.87	7.01	8.52	6.20	6.31	7.68	-0.67	-0.70	-0.84	3.52	70GC C422
C424	θ	7.49	7.63	9.43	6.87	6.99	8.66	-0.62	-0.64	-0.77	3.04	70CA C424
C428	θ	7.08	7.21	8.88	6.55	6.67	8.24	-0.53 *	-0.54 *	-0.64 *	2.67	70BE C428
C443	θ	7.45	7.58	9.45	6.73	6.79	8.52	-0.76	-0.75	-0.97	3.84	70CM C443
C444	θ	7.49	7.62	9.48	6.71	6.84	8.48	-0.78	-0.75	-1.00	3.76	70GE C444
C446	θ	7.42	7.55	9.34	6.88	6.80	8.39	-0.74	-0.75	-0.95	3.64	70GE C446
C451	θ	7.31	7.45	9.12	6.64	6.77	8.28	-0.67	-0.68	-0.85	3.32	70AC C451
C453	θ	7.44	7.58	9.41	6.61	6.73	8.36	-0.83	-0.85	-1.05	4.08	70BT C453
C459	θ	7.36	7.49	9.27	6.45	6.60	8.17	-0.87	-0.89	-1.10	4.25	70GE C459
C460	θ	6.95	7.09	8.81	6.05	6.17	7.64	-0.90	-0.92	-1.17	4.55	70GE C460
C462A	θ	7.15	7.35	9.05	6.35	6.50	8.05	-0.80	-0.85	-1.00	4.17	70BE C462A
C463	θ	7.40	7.54	9.25	6.59	6.71	8.22	-0.81	-0.83	-1.03	4.01	70IC C463
C467A	θ	7.60	7.76	9.64	6.81	6.95	8.63	-0.79	-0.81	-1.01	3.86	70GE C467A
C467B	θ	7.10	7.24	8.97	6.32	6.44	7.97	-0.78	-0.80	-1.00	3.95	70BN C467B
C469	θ	7.68	7.81	9.80	6.85	6.96	8.74	-0.83	-0.85	-1.06	3.95	70GE C469
C470	θ	7.41	7.54	9.37	6.59	6.70	8.33	-0.82	-0.83	-1.04	4.02	70EB C470
C472	θ	7.56	7.68	9.47	6.82	6.94	8.50	-0.74	-0.75	-0.97	3.57	70ZE C472
C473	θ	7.32	7.44	9.15	6.55	6.66	8.21	-0.77	-0.78	-0.98	3.75	70EB C473
C474	θ	7.74	7.89	9.95*	6.94	7.07	8.96*	-0.80	-0.82	-0.95	3.84	70GE C474
C476	θ	7.13	7.24	9.34	6.21	6.30	8.18	-0.92 *	-0.95	-1.17	4.65	70SA C476
C479B	θ	7.32	7.44	9.25	6.62	6.74	8.31	-0.70	-0.70	-0.94	3.42	70CE C479B
C480	θ	7.21	7.38	8.99	6.41	6.55	7.98	-0.81	-0.83	-1.00	4.07	70BE C480
C481	θ	7.35	7.25	9.10	6.40	6.30	7.90	-0.95 *	-0.95	-1.20 *	4.70*	70BE C481
C482	θ	6.82	6.97	8.51	6.00*	6.12*	7.46	-0.82	-0.85	-1.05	4.30	70GC C482
C483	θ	7.60	7.50	9.45	6.76	6.60	8.39	-0.84	-0.90	-1.06	4.57	70ZF C483
C499C	θ	7.89*	8.01*	9.95*	6.86	6.98	8.64	-1.03 X	-1.03 *	-1.31 *	4.80*	70EI C499C
C503	θ	7.34	7.46	9.33	6.69	6.79	8.49	-0.64	-0.66	-0.84	3.23	70GE C503
C508	θ	7.21	7.35	9.17	6.65	6.77	8.47	-0.56	-0.58	-0.70	2.83	70GE C508
C511	θ	7.35	7.48	9.24	6.71	6.83	8.42	-0.63	-0.65	-0.82	3.15	70EB C511
C512	θ	7.30	7.45	9.10	6.68	6.81	8.30	-0.62	-0.63	-0.75	3.05	70AC C512
C514B	*	7.02	7.38	8.47	6.42	6.75	7.72	-0.60	-0.63	-0.75	3.05	70SF C514B
C521A	θ	7.44	7.55	9.46	6.74	6.84	8.54	-0.70	-0.70	-0.92	3.40	70CA C521A
C521B	θ	6.87	7.01	8.81	6.41	6.52	8.25	-0.46 *	-0.45 *	-0.57 *	2.47*	70SA C521B
C526	θ	7.22	7.37	9.02	6.62	6.76	8.26	-0.60	-0.61	-0.76	3.01	70EB C526
C528	θ	7.15	7.34	9.00	6.50	6.63	8.14	-0.69	-0.71	-0.86	3.45	70ME C528
C529	θ	7.05	7.36	8.42	6.37	6.64	7.60	-0.68	-0.71	-0.82	3.45	70EB C529
C532	θ	7.08	7.23	8.92	6.42	6.55	8.11	-0.66	-0.68	-0.81	3.35	70GE C532
C534	θ	7.31	7.29	8.92	6.59	6.53	7.97	-0.73	-0.77	-0.95	3.92	70ME C534
C536	θ	7.07	7.46	8.32	6.37	6.72	7.48	-0.71	-0.74	-0.84	3.60	70AC C536
C540	θ	8.03*	8.15X	10.08*	7.20*	7.34*	9.04*	-0.83	-0.84	-1.04	3.88	70GE C540
C545	θ	6.80	6.94	8.66	6.23	6.35	7.90	-0.57	-0.59	-0.75	2.95	70GE C545
C549	θ	7.21	7.33	9.06	6.47	6.57	8.13	-0.74	-0.76	-0.93	3.72	70EB C549
C552	θ	7.02	7.15	8.66	6.30	6.41	7.95	-0.72	-0.74	-0.91	3.67	70BN C552
C612	*	6.37X	6.73*	7.63X	5.63X	5.95*	6.78X	-0.74	-0.75	-0.85	4.03	70SF C612
C613	θ	6.33X	7.13	6.83X	5.57X	6.34	7.87X	-0.75	-0.79	-0.96	4.14	70ME C613
C627	θ	7.47	7.61	9.45	6.65	6.77	8.40	-0.82	-0.84	-1.05	4.03	70ZE C627
C630	θ	7.45	7.58	9.42	6.71	6.82	8.50	-0.74	-0.76	-0.93	3.65	70BE C630
C631	θ	7.31	7.44	9.15	6.49	6.61	8.10	-0.82	-0.83	-1.04	4.03	70AC C631
C632	θ	7.37	7.51	9.23	6.67	6.80	8.35	-0.70	-0.71	-0.88	3.45	70AC C632
C638	θ	7.20	7.40	9.00	6.50	6.60	8.10	-0.70	-0.80	-0.90	4.22	70SA C638
C639	θ	7.25	7.42	9.17	6.66	6.77	8.38	-0.63	-0.65	-0.75	3.16	70DB C639
C644	θ	6.88	6.94	8.40	6.38	6.43	7.77	-0.50 *	-0.51 *	-0.63 *	2.55*	70ME C644
C645	θ	7.30	7.44	9.11	6.65	6.76	8.28	-0.66	-0.68	-0.83	3.28	70AC C645
C656	θ	6.86	6.95	8.60	6.12	6.23	7.65	-0.74	-0.76	-0.95	3.83	70SA C656

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LAB CODE	F	SAMPLE D19			SAMPLE D20			DIFFERENCE D20 - D19			ΔE	INST CODE	LAE
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ			
C6	0	7.13	7.50	8.47	6.32	6.64	7.49	-0.81	-0.66	-0.98	4.15	7CAC C657	
C6	*	6.99	7.30	8.36	6.32	6.59	7.56	-0.67	-0.71	-0.80	3.45	7CSF C662	
C72	0	6.90	7.05	8.60	6.20	6.30	7.70	-0.70	-0.75	-0.90	3.83	70GC C672	
C675	0	7.25	7.38	9.04	6.82	6.74	8.25	-0.63	-0.64	-0.79	3.12	70AC C675	
C623	0	6.65*	6.97	8.52	5.97*	6.27	7.65	-0.68	-0.70	-0.87	3.55	70GC C683	
C691	0	7.23	7.30	8.30	6.61	6.70	7.56	-0.62	-0.61	-0.74	3.01	70ZE C691	
C700	0	7.14	7.27	8.95	6.55	6.66	8.21	-0.59	-0.61	-0.74	3.00	70EB C700	
C705	#	7.20	0.31X	0.31X	6.54	0.31X	0.31X	-0.66	0.00 X	0.00 X	3.24	70BF C705	
C707	#	4.99X	5.07X	6.39X	4.54X	4.61X	5.82X	-0.45 *	-0.46 *	-0.57 *	2.81	70SA C707	
C708A	0	7.60	7.75	9.52	6.84	6.97	8.55	-0.76	-0.79	-0.97	3.72	70B1 C708A	
C708B	*	1.20X	1.22X	1.43X	1.25X	1.27X	1.48X	0.05 X	0.05 X	0.05 X	90X	70SS C708B	
C709	0	7.60	7.73	9.50	6.84	6.95	8.54	-0.76	-0.78	-0.97	3.62	70ES C709	
C716	0	7.33	7.40	9.21	6.55	6.60	8.27	-0.78	-0.80	-0.94	3.89	70ZE C716	
C717A	*	7.18	7.50	8.57	6.39	6.67	7.61	-0.79	-0.82	-0.96	3.92	70SF C717A	
C717B	*	7.25	7.57	8.69	6.46	6.74	7.73	-0.79	-0.82	-0.95	3.96	70SF C717B	
C718A	0	7.13	7.49	8.44	6.42	6.74	7.59	-0.71	-0.75	-0.85	3.62	70AC C718A	
C718B	0	6.98	7.34	8.27	6.33	6.64	7.50	-0.66	-0.70	-0.77	3.42	70AC C718B	
C719C	0	7.10	7.21	8.56	6.40	6.50	8.07	-0.70	-0.71	-0.89	3.51	70KC C719C	
C72CA	*	7.04	7.36	8.42	6.49	6.78	7.78	-0.55	-0.58	-0.64 *	2.83	70CF C720A	
C720B	*	7.01	7.33	8.40	6.47	6.76	7.77	-0.54	-0.57	-0.63 *	2.72	70SF C720B	
C723	0	7.07	7.21	8.87	6.26	6.38	7.84	-0.82	-0.83	-1.03	4.10	70MD C723	
C724	0	7.33	7.45	9.20	6.51	6.61	8.17	-0.82	-0.84	-1.04	4.07	70ZA C724	
C725	X	8.34X	7.46	9.34	6.52	6.66	8.22	-1.82 X	-0.81	-1.12	23.13X	70ES C725	
C726	0	7.54	7.66	9.57	6.95	7.06	8.81	-0.59	-0.59	-0.75	2.84	70SA C726	
C727A	*	7.12	7.44	8.53	6.33	6.61	7.57	-0.79	-0.83	-0.96	4.02	70SF C727A	
C727B	*	7.12	7.44	8.54	6.41	6.69	7.66	-0.71	-0.75	-0.82	3.67	70SF C727B	
C741	0	7.56	7.67	9.74	6.81	6.91	8.76	-0.75	-0.76	-0.92	3.65	70CE C741	
C742	#	105.19X	110.33X	120.45X	94.16X	98.69X	107.65X	-11.03 X	-11.64 X	-12.80 X	9.32X	70DE C742	
C748	0	7.22	7.39	9.14	6.60	6.76	8.35	-0.63	-0.63	-0.79	3.09	70BE C748	
C749	0	7.30	7.67	8.67	6.49	6.82	7.70	-0.82	-0.86	-0.97	4.07	70AC C749	
C752A	0	7.20	7.33	9.05	6.51	6.62	8.18	-0.70	-0.71	-0.87	3.47	70DE C752A	
C752B	0	7.01	7.14	8.83	6.26	6.37	7.88	-0.75	-0.76	-0.95	3.80	70BN C752B	
GRAND MEANS													
		7.27	7.41	9.10	6.54	6.67	8.18	-0.72	-0.75	-0.92	3.66		
SD OF MEANS													
		.27	.25	.41	.25	.25	.38	.10	.10	.13	.50		
INCLUDED LAES FOR THIS MEAN													
		81	81	81	81	82	81	81	82	82	82		

MCCA COLLABORATIVE REFERENCE PROGRAM  
 L, a, b SPACE ANALYSIS, NORMAL DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR PAINT CHIPS

LAB CODE	F	SAMPLE D17			SAMPLE D18			DIFFERENCE D18 - D17			INST CODE	LAB
		MEAN L	MEAN A	MEAN B	MEAN L	MEAN A	MEAN B	$\Delta L$	$\Delta A$	$\Delta B$		
C121	0	53.65	31.90	10.20X	52.85*	32.70	10.20X	-0.80 *	0.20	-0.60 *	1.22	70BA C121
C148	0	54.90	31.75	9.00	54.20	32.45	8.25	-0.70	0.70	-0.75	1.24	70BF C148
C152	0	55.25	30.75	9.10	54.65	31.45	8.40	-0.60	0.70	-0.70	1.16	70BA C152
C166	0	55.00	30.95	9.05	54.30	31.65	8.35	-0.70	0.70	-0.70	1.21	70BA C166
C183	0	54.40	31.65	9.20	53.70	32.35	8.50	-0.70	0.70	-0.70	1.21	70BA C183
C241	0	55.25	30.90	9.40	54.55	31.55	8.75	-0.70	0.65	-0.65	1.16	70BF C241
C255	0	55.20	30.35	9.25	54.45	31.05	8.40	-0.75	0.70	-0.85 *	1.33*	70BA C255
C256A	0	54.66	31.14	9.02	54.02	31.29	8.33	-0.64	0.74	-0.65	1.20	70SC C256A
C256B	0	55.49	31.47	10.15*	54.75	32.34	9.53*	-0.70	0.27	-0.62	1.21	70BC C256E
C282	0	54.70	31.40	9.20	54.00	32.10	8.50	-0.70	0.70	-0.70	1.21	70BM C282
C291	0	54.70	31.25	8.65	54.00	31.95	7.95	-0.70	0.70	-0.70	1.21	70BA C291
C317	0	54.30	31.10	8.90	53.70	31.20	8.10	-0.60	0.70	-0.20	1.22	70BM C317
C325	0	54.59	30.59	8.29	53.85	31.27	7.71	-0.74	0.67	-0.68	1.21	70BC C325
C356	0	53.49*	31.26	8.29	52.86*	31.93	7.59	-0.63	0.67	-0.65	1.15	70IC C356
C380	0	55.00	31.95	9.20	54.35	32.25	8.50	-0.65	0.90 *	-0.70	1.31	70BA C380
C382	0	55.00	30.70	9.20	54.25	31.45	8.55	-0.75	0.75	-0.65	1.24	70BA C382
C390	0	54.50	31.85	8.70	54.30	32.60	7.95	-0.60	0.75	-0.75	1.22	70BF C390
C402	0	54.71	30.99	8.77	54.13	31.69	8.03	-0.58	0.70	-0.74	1.18	70BA C402
C420A	0	54.50	31.50	8.70	53.80	32.25	8.00	-0.70	0.75	-0.70	1.24	70BF C420A
C420B	0	54.45	31.65	8.80	53.90	32.25	8.00	-0.55 *	0.60	-0.20	1.14	70BF C420E
C427	0	55.10	31.60	9.20	54.40	32.45	8.60	-0.70	0.25	-0.70	1.30	70BA C427
C437	0	54.35	32.65	8.22	53.72	33.44	8.20	-0.63	0.75	-0.68	1.20	70GI C437
C440	0	54.58	31.44	9.14	54.32	32.10	8.43	-0.66	0.66	-0.71	1.17	70BA C440
C442	0	54.20	30.80	9.30	54.10	31.50	8.60	-0.70	0.70	-0.70	1.21	70BM C442
C454	0	53.99	30.72	7.97*	53.27	31.36	7.25*	-0.72	0.52	-0.72	1.17	70BA C454
C452	0	54.27	31.43	9.39	54.24	32.13	8.66	-0.63	0.70	-0.73	1.19	70BM C452
C475	0	54.34	31.82	8.47	53.77	32.60	7.71	-0.57	0.72	-0.76	1.23	70BA C475
C477	0	54.46	32.46	8.97	53.81	33.15	8.26	-0.65	0.69	-0.71	1.18	70BA C477
C494	0	55.35	31.20	9.55	54.70	31.80	8.80	-0.65	0.60	-0.75	1.16	70BA C494
C496B	0	53.25	32.00	10.55X	53.20	32.75	9.80*	-0.65	0.75	-0.75	1.24	70GF C496E
C499A	X	54.65	32.20	8.55	54.10	32.05	7.85	-0.55 *	-0.15 X	-0.70	1.90X	70BA C499A
C499B	0	54.80	31.15	8.90	54.10	31.85	8.15	-0.70	0.70	-0.75	1.24	70BA C499E
C506	0	55.00	31.55	9.00	54.30	32.20	8.25	-0.70	0.65	-0.65	1.16	70BA C506
C514A	*	54.92	32.80	9.66	54.31	33.63	9.13	-0.67	0.23	-0.73	1.30	70SF C514A
C517	0	55.00	30.20	9.40	54.30	31.00	8.70	-0.70	0.20	-0.70	1.27	70BC C517
C532	X	56.00*	34.20*	8.40	55.20*	35.10X	7.70	-0.80	0.90 *	-0.70	1.35X	70GX C532
C541	X	53.90	31.25	8.05*	53.05	32.75	7.30	-0.85 *	0.90 *	-0.75	1.45X	70GF C541
C546A	0	54.20	31.40	9.00	53.50	32.10	7.90	-0.70	0.70	-0.70	1.21	70BM C546A
C546B	0	53.90	32.00	9.00	53.20	32.60	8.30	-0.70	0.60	-0.70	1.16	70BC C546E
C547	0	53.27*	33.36*	9.17	52.73*	34.19*	8.46	-0.54 *	0.23	-0.72	1.22	70BC C547
C574	0	54.90	33.80*	9.40	54.20	34.50*	8.70	-0.70	0.70	-0.70	1.21	70BC C574
C576	0	54.53	31.22	8.25	53.85	32.02	8.13	-0.68	0.20	-0.76	1.30	70BE C576
C600	0	54.40	33.90*	8.60	53.80	34.75*	7.85	-0.60	0.25	-0.75	1.22	70GI C600
C615	0	54.10	33.30*	9.00	53.40	34.00	8.40	-0.70	0.70	-0.60 *	1.16	70BC C615
C620	0	53.71	31.64	10.21*	53.02	32.51	9.54*	-0.69	0.27	-0.67	1.30	70MG C620
C633	X	54.80	31.02	8.76	54.32	31.60	8.01	-0.42 X	0.52	-0.75	1.05X	70BA C633
C655	0	55.55	32.04	10.30*	54.83	32.25	9.64*	-0.72	0.20	-0.66	1.27	70BT C655
C677	0	55.40	32.02	8.20	54.62	32.79	8.09	-0.78	0.74	-0.72	1.25	70SC C677
C690	X	55.15	30.09	8.60	53.80	31.65	8.10	-1.35 X	1.56 X	-0.50 X	2.13X	70BM C690
C719A	0	54.95	30.00	8.50	54.20	30.20	8.30	-0.75	0.20	-0.60 *	1.22	70BA C719A
C719B	0	55.05	30.85	8.95	54.30	31.55	8.25	-0.75	0.70	-0.70	1.24	70BA C719E
C750	#	59.36X	29.72*	2.68X	58.57X	30.47	1.85X	-0.79	0.74	-0.24 *	1.37*	70IC C750
GRAND MEANS												
		54.64	31.55	9.05	53.97	32.22	8.37	-0.68	0.73	-0.71	1.22	
SD OF MEANS												
		0.54	0.86	0.46	0.53	0.28	0.52	0.06	0.22	0.05	0.25	
INCLUDED LABS FOR THIS MEAN												
		45	45	43	45	45	44	45	45	45	45	



MCCA COLLABORATIVE REFERENCE PROGRAM  
 L, a, b SPACE ANALYSIS, NORMAL DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR PAINT CHIPS

LAB CODE	F	SAMPLE D19			SAMPLE D20			DIFFERENCE D20 - D19			INST CODE	LAB
		MEAN L	MEAN A	MEAN B	MEAN L	MEAN A	MEAN B	ΔL	ΔA	ΔB		
C121	θ	26.45	.90*	1.10X	25.10	1.20X	1.80X	-1.35	.30 X	.70 X	1.55	7CBA C121
C148	θ	27.05	-.00	-.90	25.80	-.00	-.80	-1.25	-.00	.10	1.25	7CBF C148
C152	θ	25.85X	.10	-.70	27.60X	.10	-.70	1.75 X	.00	-.00	1.75	70BA C152
C166	θ	27.20	-.10	-.90	25.80	-.05	-.80	-1.40	.05	.10	1.40	7CBA C166
C183	θ	27.05	-.50	-.90	25.55	-.50*	-.90	-1.50	.00	.00	1.50	70BA C183
C241	θ	27.10	.25	-.70	25.45	.30	-.60	-1.65	.05	.10	1.65	7CBF C241
C255	θ	27.10	.10	-.65	25.50	.10	-.80	-1.60	-.00	.05	1.60	70BA C255
C256A	θ	26.71	.08	-.95	25.07	.11	-.87	-1.65	.04	.08	1.65	7CSC C256A
C256B	θ	27.30	.05	-.86	26.03	.05	-.83	-1.27	.00	.02	1.27	70BT C256B
C28E	θ	26.50	.30	-.20	25.10	.40	-.80	-1.40	.10 *	-.00	1.40	7CBM C28E
C291	θ	26.95	.55	-.80	25.70	.10	-.80	-1.25	-.45 X	.00	1.33	70BA C291
C317	θ	26.60	.10	-.80	25.30	.10	-.80	-1.30	-.00	-.00	1.30	7CBM C317
C325	θ	26.74	.30	-.87	25.59	.30	-.87	-1.15	.00	.00	1.15	7CBC C325
C356	θ	26.02X	.05	-1.09	24.73*	.07	-1.04	-1.29	.02	.04	1.29	70IC C356
C380	θ	27.05	-.00	-.85	25.75	-.00	-.80	-1.30	-.00	.05	1.30	70BA C380
C382	θ	27.05	-.00	-.65	25.90	-.05	-.60	-1.15	-.05	.05	1.15	7CBA C382
C390	θ	27.50	.60	-1.10	26.20	.65*	-1.10	-1.30	.05	.00	1.30	70BF C390
C402	θ	27.19	-.00	-.74	25.77	.01	-.69	-1.42	.01	.04	1.42	7CBA C402
C420A	θ	26.90	-1.75X	-1.30*	25.45	-1.80X	-1.25*	-1.45	-.05	.05	1.45	70BF C420A
C420B	θ	26.85	-1.50X	-1.20*	25.45	-1.55X	-1.20*	-1.40	-.05	.00	1.40	7CBF C420B
C427	θ	27.10	1.00*	-.20	25.80	1.10X	-.80	-1.30	.10 *	.00	1.30	70BA C427
C437	X	26.84	-.00	-.58	26.67*	-.00	-.59	-.17 X	-.00	-.01	1.17X	7CGE C437
C440	θ	27.22	.13	-.46*	25.77	.12	-.44*	-1.45	-.01	.03	1.45	7CBA C440
C442	θ	26.50	.30	-.80	25.10	.30	-.80	-1.40	.00	-.00	1.40	70BM C442
C454	θ	27.34	-.00	-.03X	25.85	-.00	.00X	-1.49	-.00	.03	1.49	7CBA C454
C45E	θ	27.11	.16	-.65	25.37	.20	-.59	-1.74 *	.04	.07	1.75	70BM C45E
C475	θ	27.17	-.00	-.78	25.71	-.00	-.71	-1.45	-.00	.07	1.46	70BA C475
C477	θ	27.40	.12	-.62	26.01	.14	-.56	-1.39	.02	.07	1.40	7CBA C477
C494	θ	27.45	-.20	-.70	25.90	-.05	-.65	-1.55	.15 X	.05	1.56	7CBA C494
C496B	θ	26.90	-1.20X	1.40X	25.40	-1.25X	1.60X	-1.50	-.05	.20 X	1.51	7CGF C496B
C499A	θ	27.35	.10	-1.05	25.50	.10	-1.00	-1.85 *	-.00	.05	1.85*	7CBA C499A
C499B	θ	27.20	-.10	-.50	26.00	-.05	-.90	-1.20	.05	.00	1.20	70BA C499B
C506	θ	27.10	.10	-.50	25.90	.10	-.80	-1.20	.00	.10	1.20	7CBA C506
C514A	*	27.19	.05	-.83	26.03	.12	-.78	-1.16	.03	.05	1.16	70SF C514A
C517	θ	27.10	-.40	-.60	26.05	-.40	-.55	-1.05	.00	.05	1.05	70BC C517
C53E	θ	27.20*	1.70X	-2.00X	26.50*	1.60X	-2.05X	-1.30	-.10 X	-.05 *	1.30	7CGX C53E
C541	θ	26.55	-.40	-.65	25.20	-.40	-.90	-1.35	-.00	.05	1.35	70GF C541
C546A	θ	26.50	.30	-1.00	25.60	.30	-.90	-1.30	.00	.10	1.30	7CBM C546A
C546B	θ	26.75	.30	-.90	25.00	.30	-.90	-1.75 *	.00	-.00	1.75	70BC C546B
C547	θ	24.93X	.23	-.54	23.58X	.25	-.95	-1.35	.02	-.01	1.35	7CBC C547
C574	θ	27.40	.75*	-.50	25.90	-.00	-.80	-1.50	-.75 X	.10	1.6E	70BC C574
C576	θ	26.80	.22	-.84	25.37	.26	-.80	-1.43	.04	.04	1.43	7CBC C576
C600	θ	27.45	-.50	-.30X	25.90	-.50*	-.30*	-1.55	-.00	-.00	1.55	70GE C600
C615	θ	26.80	.40	-1.00	25.30	.40	-.90	-1.50	-.00	.10	1.50	70BC C615
C620	θ	25.63X	.05	-.72	24.15X	.14	-.69	-1.47	.05	.03	1.48	70MG C620
C633	θ	27.12	-.06	-.65	25.78	-.02	-.82	-1.33	.03	.03	1.34	70BA C633
C655	θ	27.05	.06	-.83	25.74	.07	-.80	-1.31	.01	.03	1.31	70BT C655
C677	θ	26.55	-.11	-1.60X	25.37	-.13	-1.49X	-1.18	-.02	.11	1.19	70SC C677
C690	X	26.50	.20	-1.00	26.48*	.57	-1.00	-.02 X	.37 X	.00	3.7X	70BM C690
C715A	θ	26.50	-.20	-.75	25.75	-.45*	-.80	-1.15	-.25 X	-.05 *	1.18	70BA C715A
C719B	θ	26.95	-.05	-.50	25.85	-.00	-.90	-1.10	.05	.00	1.10	7CBA C719B
C750	#	29.91X	-1.25X	-6.23X	28.10X	-1.14X	-6.13X	-1.81 *	.11 *	.21 X	1.82*	70IC C750
GRAND MEANS												
		27.03	.11	-.65	25.62	.06	-.80	-1.39	.01	.04	1.41	
SD OF MEANS												
		.30	.32	.16	.35	.24	.18	.17	.03	.04	.18	
INCLUDED LABS FOR THIS MEAN												
		44	44	42	45	42	43	47	42	46	4E	



## EXPLANATION OF DATA FOR WHITE SAMPLE FOR PAINT CHIPS

Specimens of a white calibration sample (Paint Chips) were distributed to the participants along with the usual two pairs of colored specimens, and each participant was asked to return measurement data for the white calibration sample (Paint Chips), reporting results in the same manner as for the colored specimens.

As a first step, three laboratories were selected to serve as "reference" laboratories for the purposes of this analysis and the average of their X, Y, Z values for the white sample were computed. Next, the ratios of the participants data to the combined reference laboratory values were calculated for each participant (transformed to X, Y, Z space if necessary). These ratios are shown in the White Sample Analysis tables.

Two observations can be made about the data in the White Sample Analysis tables. First, the participants as a whole tend to be high compared with the combined average values obtained by the selected reference laboratories. Second, a few participants had noticeably extreme values for one or more of the components and these participants especially should look to the cause.

Next, the ratios in the White Sample Analysis tables were used to "adjust" the data of the normal data tables to obtain the adjusted data table values. The adjustment consisted of dividing the X, Y, Z values of the normal data tables by the respective ratios in the White Sample Analysis tables.

The significant change in the adjusted data tables is in the SD OF MEANS. Comparison of these among-laboratory standard deviations with those in the normal data tables, shows considerable reduction for X, Y, Z. Thus part, at least, of the disagreement among participants is due to errors in standardization that could be corrected through use of an agreed-upon white standard. There is no similar significant change for  $\Delta X$ ,  $\Delta Y$ , and  $\Delta Z$ .

LAB RATIO--(LAB/COMBINED)  
 CODE X Y Z

INST PERCENTY FROM COMBINED  
 CODE X Y Z

C157	1.0114	1.0091	1.0174
C162	1.0128	1.0109	1.0154
C251	1.0075	1.0043	1.0106
C283	1.0041	1.0035	1.0030
C278	1.0257	1.0270	1.0236
C407	1.0118	1.0100	1.0152
C414	1.0085	1.0007	1.0067
C416A	1.0446	1.0464	1.0055
C416B	1.0142	1.0190	1.0023
C417B	1.0045	1.0027	1.0056
C418	1.0007	1.0073	1.0002
C422	1.0040	1.0035	1.0051
C424	1.0061	1.0068	1.0082
C428	1.0075	1.0061	1.0111
C443	1.0189	1.0147	1.0313
C444	1.0127	1.0140	1.0121
C446	1.0091	1.0084	1.0010
C451	1.0058	1.0108	1.0062
C453	1.0053	1.0090	1.0078
C455	1.0008	1.0015	1.0088
C460	1.0045	1.0055	1.0081
C462A	1.0024	1.0010	1.0106
C463	1.0101	1.0080	1.0186
C467A	1.0067	1.0088	1.0100
C467B	1.0025	1.0015	1.0054
C469	1.0161	1.0181	1.0309
C470	1.0110	1.0110	1.0188
C472	1.0063	1.0058	1.0045
C473	1.0041	1.0032	1.0034
C474	1.0010	1.0014	1.0046
C476	1.0058	1.0052	1.0085
C479B	1.0175	1.0182	1.0228
C480	1.0061	1.0042	1.0130
C481	1.0234	1.0055	1.0053
C482	1.0043	1.0022	1.0057
C483	1.0025	1.0022	1.0079
C490C	1.0276	1.0280	1.0302
C503	1.0171	1.0161	1.0241
C508	1.0044	1.0048	1.0062
C511	1.0028	1.0025	1.0066
C512	1.0109	1.0116	1.0021
C514B	1.0028	1.0156	1.0282
C521A	1.0170	1.0165	1.0323
C521B	1.0222	1.0211	1.0324
C526	1.0000	1.0046	1.0051
C528	1.0037	1.0051	1.0078
C529	1.0085	1.0022	1.0055
C532	1.0054	1.0105	1.0181
C534	1.0012	1.0056	1.0021
C536	1.0053	1.0079	1.0063
C540	1.0161	1.0160	1.0150
C545	1.0076	1.0082	1.0030
C549	1.0073	1.0054	1.0091
C552	1.0069	1.0051	1.0045
C612	1.0026	1.0060	1.0154
C613	1.0198	1.0205	1.0221
C627	1.0043	1.0023	1.0043
C630	1.0027	1.0012	1.0057
C631	1.0108	1.0104	1.0075
C632	1.0050	1.0085	1.0050
C638	1.0044	1.0042	1.0052
C639	1.0044	1.0035	1.0067
C644	1.0014	1.0030	1.0066
C645	1.0109	1.0107	1.0061
C656	1.0093	1.0079	1.0113
C657	1.0021	1.0054	1.0246
C662	1.0014	1.0062	1.0238
C672	1.0035	1.0010	1.0071
C675	1.0113	1.0112	1.0076
C683	1.0168	1.0151	1.0060
C684	1.0044	1.0022	1.0066
C700	1.0069	1.0066	1.0059
C705	1.0026	1.0034	1.0031
C707	1.0042	1.0027	1.0045
C708A	1.0045	1.0041	1.0027
C708B	1.0024	1.0025	1.0027
C705	1.0025	1.0024	1.0038
C716	1.0001	1.0077	1.0049
C717A	1.0058	1.0004	1.0056
C717B	1.0055	1.0097	1.0030
C718A	1.0000	1.0109	1.0273
C718B	1.0022	1.0100	1.0284
C715C	1.0017	1.0063	1.0010
C72CA	1.0027	1.0070	1.0270
C72CB	1.0055	1.0052	1.0264
C723	1.0061	1.0071	1.0070
C724	1.0041	1.0027	1.0063
C725	1.0054	1.0088	1.0052
C726	1.0148	1.0125	1.0225
C727A	1.0027	1.0072	1.0273
C727B	1.0015	1.0057	1.0263
C741	1.0061	1.0072	1.0086
C742	1.0070	1.0023	1.0221
C748	1.0024	1.0023	1.0116
C749	1.0054	1.0060	1.0234
C752A	1.0078	1.0076	1.0024
C752B	1.0023	1.0016	1.0072

700E	1.14	1.01	1.074
700C	1.038	1.005	1.054
702E	1.075	1.043	1.006
708A	1.085	1.068	1.062
708E	2.037	2.070	2.036
708I	1.10	1.00	1.092
708D	-1.15	-0.92	-1.033
708B	4.46	4.94	4.85
700E	1.42	1.096	1.023
708H	-0.85	-0.62	-0.81
700E	-1.93	-2.27	-0.02
700C	-0.60	-0.65	-1.009
700A	-0.15	-0.12	-0.16
708B	0.75	0.61	1.011
708M	1.85	1.47	3.013
700E	1.27	1.40	1.021
700E	-0.05	-0.16	0.10
704C	-0.52	1.002	0.62
708I	-0.53	0.50	0.78
700E	-0.02	0.15	-0.12
700E	-0.45	0.55	0.51
708B	-0.24	0.10	1.006
700C	1.01	0.60	1.056
700E	-0.07	0.85	1.000
708H	-0.25	0.15	0.54
700E	1.91	1.81	3.005
708D	1.10	1.10	1.088
702D	-0.02	-0.02	0.45
708D	-0.41	0.32	0.34
700E	-1.0	0.14	0.46
708A	-0.58	0.52	0.85
708B	1.76	1.62	2.028
708E	0.61	0.42	1.030
708B	2.34	-2.45	0.53
700C	-0.57	-0.62	-1.003
702F	-1.05	-1.78	-1.021
708I	2.76	2.80	3.002
700E	1.71	1.61	2.041
700E	-0.44	0.48	0.62
708D	-0.38	0.35	0.66
704C	1.09	1.18	0.21
708P	-1.62	1.52	-0.18
700A	1.70	1.65	3.033
708A	2.22	2.11	3.034
708D	-1.00	-0.54	-2.009
708D	-1.03	-1.45	-2.22
708D	-3.15	-0.78	-7.045
700E	-0.54	1.005	1.061
708D	-1.88	-1.44	-1.079
704C	-2.47	0.75	-9.037
700E	1.61	1.60	1.090
700E	-3.24	-3.18	-2.070
708D	-0.73	0.54	0.51
708H	-0.31	-0.45	0.45
708P	-2.64	0.60	-8.046
708D	1.58	2.00	2.21
702B	-0.57	-0.67	-0.55
708E	-0.27	0.12	0.67
704C	1.08	1.04	0.75
704C	0.90	0.85	0.50
708A	-0.56	-0.87	-0.48
708D	-0.56	-0.65	-0.33
708D	-0.14	0.30	-0.34
704C	1.09	1.07	0.61
708A	-0.52	0.75	1.13
704C	-2.15	0.94	-7.54
708P	-2.86	-0.38	-7.62
700C	-0.25	0.10	-0.25
704C	1.13	1.12	0.78
700C	1.66	1.51	0.50
702B	-0.36	-0.76	-0.04
708D	-0.31	-0.32	-0.41
708P	2.26	-59.66	-59.66
708A	-15.57	-19.63	-16.55
708I	-1.81	-0.56	-1.73
708S	-55.76	-55.75	-95.73
708E	0.25	0.24	0.28
702E	-0.01	-0.23	0.45
708P	-2.42	0.04	-7.002
708P	-2.45	-0.02	-6.054
704C	-2.00	1.05	-7.27
704C	-1.58	1.00	-7.16
708C	-2.82	-3.07	-1.50
708P	-2.72	-0.30	-7.20
708P	-2.51	-0.46	-7.26
708D	-1.35	-1.25	-2.20
702A	0.41	0.27	0.63
708E	-1.44	-1.32	-1.08
708A	1.48	1.35	2.028
708P	-2.72	-0.27	-7.027
708F	-2.85	-0.42	-7.27
708E	-0.81	0.72	0.86
708D	-2.56	-0.67	-7.065
708E	0.34	0.23	1.16
704C	-2.46	0.60	-7.66
708D	-0.22	-0.24	0.26
708H	-0.22	0.10	0.72



LAB CODE	RATIO--(LAB/COMBINED)			INST CODE	PERCENT FROM COMBINED		
	X	Y	Z		X	Y	Z
C121	.9897	.9870	.9978	70HA	-1.03	-1.30	-.22
C148	.9958	.9943	1.0022	70HF	-.42	-.57	.22
C152	.9982	.9964	1.0066	70HA	-.18	-.36	.66
C166	.9903	.9891	1.0038	70HA	-.97	-1.09	.38
C183	.9864	.9845	.9919	70HA	-1.36	-1.51	-.81
C241	.9922	.9901	1.0025	70HF	-.78	-.99	.25
C255	.9930	.9911	.9958	70HA	-.70	-.89	-.02
C256A	.9854	.9832	.9938	70SC	-1.46	-1.68	-.62
C256B	.9883	.9877	.9897	70HU	-1.17	-1.23	-1.03
C288	.9867	.9849	.9949	70HM	-1.33	-1.51	-.51
C291	.9897	.9891	.9969	70HA	-1.03	-1.09	-.31
C317	.9821	.9797	.9881	70HM	-1.79	-2.03	-1.19
C325	.9957	.9925	1.0017	70HC	-.43	-.75	.17
C356	1.0099	1.0104	1.0117	70IC	-.99	1.04	1.17
C380	.9888	.9870	.9963	70HA	-1.12	-1.30	-.37
C382	.9903	.9891	.9976	70HA	-.97	-1.09	-.24
C390	.9946	.9922	1.0016	70HF	-.54	-.78	.16
C402	.9886	.9870	.9961	70HA	-1.14	-1.30	-.39
C420A	.9963	.9932	.9956	70HF	-.37	-.68	-.04
C420B	.9924	.9953	1.0017	70HF	-.16	-.47	.17
C427	.9925	.9901	.9933	70HA	-.75	-.99	-.67
C437	.9819	.9810	.9824	70GD	-1.81	-1.99	-1.76
C440	1.0030	.9998	1.0075	70HA	.30	-.02	.75
C442	.9861	.9845	.9949	70HM	-1.39	-1.51	-.51
C454	1.0023	.9991	1.0116	70HA	.23	-.09	1.16
C458	.9878	.9854	.9969	70HM	-1.22	-1.46	-.31
C475	.9978	.9941	1.0072	70HA	-.22	-.59	.72
C477	.9901	.9427	.9293	70HA	-4.99	-5.73	-7.07
C494	.9901	.9427	.9293	70HA	-4.99	-5.73	-7.07
C496B	1.0056	1.0089	1.0117	70GF	.96	.89	1.17
C499A	.9940	.9922	1.0021	70HA	-.60	-.78	.31
C499B	.9940	.9922	1.0001	70HA	-.60	-.78	.01
C506	.9955	.9943	1.0053	70HA	-.45	-.57	.53
C514A	.9800	.9789	.9815	70SE	-2.00	-2.11	-1.85
C517	1.0194	1.0163	1.0215	70HQ	1.94	1.63	2.15
C538	.9695	.9725	.9739	70GX	-3.05	-2.75	-2.61
C541	.9934	1.0026	1.0076	70GF	-.66	.26	.76
C546A	.9852	.9828	.9943	70HM	-1.48	-1.72	-.57
C546B	.9919	.9901	.9941	70HQ	-.81	-.99	-.59
C547	.9880	.9856	.9931	70HQ	-1.20	-1.44	-.69
C574	1.0470	1.0322	1.0385	70HQ	4.70	3.22	3.85
C576	.9799	.9777	.9918	70HE	-2.01	-2.23	-.82
C600	.9894	.9870	.9940	70GD	-1.06	-1.30	-.60
C619	.9991	.9932	.9988	70HQ	-.49	-.68	-.12
C620	.9426	.9435	.9352	70MG	-5.74	-5.65	-6.48
C633	.9902	.9884	.9998	70HA	-.98	-1.16	-.02
C655	.9962	.9956	.9925	70HU	-.38	-.44	-.75
C677	1.0333	1.0305	1.0444	70SC	3.33	3.05	4.44
C690	.9860	.9839	.9923	70HM	-1.40	-1.61	-.77
C719A	1.0102	1.0089	1.0272	70HA	1.02	.89	2.72
C719B	.9982	.9922	1.0085	70HA	-.48	-.78	.85
C750	.9737	.9932	1.01702	70IC	-2.63	-.68	17.02

MCCA COLLABORATIVE REFERENCE PROGRAM  
 X, Y, Z SPACE ANALYSIS, ADJUSTED DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR PAINT CHIPS

LAB CODE	F	SAMPLE D17			SAMPLE D18			DIFFERENCE D18 - D17			ΔE	INST CODE	LAB
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ			
C157	θ	39.22	30.50	27.53	38.67	29.76	27.33	-0.55	-0.74	-0.21	3.30	70GE C157	
C162	θ	40.81*	31.66*	26.59	40.32*	30.96*	26.92	-0.49	-0.70	-0.07	3.20	70DC C162	
C251	θ	39.38	29.67	26.53	38.73	28.88	26.29	-0.66	-0.80	-0.24	3.30	70ZE C251	
C253	#	38.71	29.59	27.02	38.13	28.89	26.94	-0.58	-0.70	-0.09	2.77	70SA C253	
C278	θ	37.44*	29.55	25.50X	36.66*	28.72	25.25X	-0.78	-0.83	-0.24	2.57	70NE C278	
C407	θ	39.63	30.85	27.83	39.09	30.13	27.71	-0.54	-0.71	-0.11	2.59	70EI C407	
C414	θ	39.74	30.46	26.60	39.30	29.86	26.77	-0.43	-0.61	-0.03	2.78	70MI C414	
C416A	θ	39.05X	27.91X	27.21	34.36X	27.18X	27.09	-0.69	-0.73	-0.12	2.35	70IE C416A	
C416B	θ	39.39X	28.22X	27.54	34.68X	27.41X	27.34	-0.71	-0.81	-0.19	2.82	70GE C416B	
C417B	θ	38.82	29.84	26.90	38.20	29.08	26.76	-0.61	-0.76	-0.14	3.13	70BN C417B	
C418	θ	39.43	30.74	27.17	38.88	30.03	27.02	-0.55	-0.70	-0.15	2.91	70CE C418	
C422	θ	38.29	29.17	26.54	37.78	28.51	26.48	-0.51	-0.66	-0.06	2.85	70GC C422	
C424	θ	39.45	30.67	28.20*	38.91	29.95	28.08*	-0.54	-0.72	-0.11	3.04	70CA C424	
C428	θ	39.17	30.07	26.56	38.60	29.38	26.91	-0.57	-0.70	-0.05	2.76	70BE C428	
C443	θ	39.39	30.49	26.71	39.27	30.11	26.96	-0.12 X	-0.38 X	0.25 *	2.72	70CM C443	
C444	θ	38.93	30.06	27.33	38.75	29.70	27.57	-0.18 X	-0.36 X	0.24 *	2.13*	70GE C444	
C446	θ	39.04	30.12	28.01	38.87	29.75	28.17*	-0.18 X	-0.37 X	0.15	2.23*	70GE C446	
C451	θ	40.07	30.68	26.51	39.72	30.17	26.63	-0.34 *	-0.51 *	0.11	2.47	70AC C451	
C453	θ	39.66	30.39	27.00	39.36	29.91	27.13	-0.30 *	-0.48 *	0.13	2.46	70BT C453	
C455	θ	38.73	29.92	27.36	38.22	29.22	27.26	-0.51	-0.70	-0.11	3.20	70GE C455	
C460	θ	38.88	29.97	26.91	38.05	29.00	26.53	-0.83	-0.57 *	-0.39	3.73	70GE C460	
C462A	θ	38.56	30.02	26.82	38.46	29.42	26.82	-0.50	-0.60	0.00	2.30	70BE C462A	
C463	θ	39.60	30.42	26.70	39.11	29.80	26.71	-0.50	-0.62	0.01	2.45	70DC C463	
C467A	θ	38.65	29.91	29.10X	38.16	29.29	29.05X	-0.49	-0.62	-0.05	2.54	70GE C467A	
C467B	θ	38.75	29.83	26.65	38.27	29.20	26.67	-0.48	-0.62	0.02	2.66	70BN C467B	
C469	θ	39.07	30.30	27.40	38.60	29.63	27.34	-0.47	-0.66	-0.06	3.09	70GE C469	
C470	θ	39.60	30.71	27.50	39.08	29.99	27.40	-0.51	-0.71	-0.10	3.22	70BE C470	
C472	θ	40.94*	31.98X	28.02	40.46*	31.27X	27.94	-0.48	-0.72	-0.08	3.38	70ZI C472	
C473	θ	39.72	30.55	27.00	39.16	29.85	26.90	-0.56	-0.70	-0.09	2.83	70DB C473	
C474	θ	39.05	30.29	28.11*	38.36	29.48	27.86	-0.66	-0.81	-0.25	3.17	70GE C474	
C476	θ	38.85	29.64	26.41	38.22	28.87	26.27	-0.63	-0.77	-0.14	3.15	70SA C476	
C479B	θ	39.04	30.07	27.08	38.44	29.31	26.93	-0.61	-0.76	-0.15	3.10	70CE C479B	
C480	θ	37.56*	28.96*	25.03X	36.92*	28.22*	24.87X	-0.64	-0.75	-0.16	2.86	70BE C480	
C481	θ	37.81	30.70	26.76	37.18	29.93	26.66	-0.64	-0.77	-0.10	2.74	70BE C481	
C482	θ	38.63	29.51	26.57	38.01	28.71	26.37	-0.63	-0.81	-0.21	3.51	70GC C482	
C483	θ	39.34	29.73	27.02	38.76	29.02	26.90	-0.58	-0.71	-0.12	2.94	70ZF C483	
C499C	θ	38.12	29.32	28.88X	37.61	28.68	28.73X	-0.51	-0.64	-0.16	2.67	70EI C499C	
C503	θ	38.69	29.93	27.45	38.16	29.23	27.29	-0.54	-0.70	-0.16	3.07	70GE C503	
C508	θ	39.71	30.72	28.14*	39.15	29.98	27.93	-0.56	-0.74	-0.20	3.26	70GE C508	
C511	θ	39.49	30.38	26.89	38.92	29.64	26.76	-0.57	-0.74	-0.13	3.15	70EB C511	
C512	θ	40.03	30.77	26.53	39.45	30.03	26.42	-0.57	-0.74	-0.10	3.12	70AC C512	
C514B	*	39.41	30.09	27.93	38.84	29.37	27.77	-0.57	-0.72	-0.16	3.02	70SF C514B	
C521A	θ	39.02	30.02	27.21	38.37	29.25	26.99	-0.65	-0.77	-0.22	2.94	70CA C521A	
C521B	θ	38.87	29.91	26.44	37.81	28.78	25.85*	-1.06 X	-1.13 X	-0.59 *	3.75	70SA C521B	
C526	θ	36.51X	29.29	28.00	35.77X	28.46	27.72	-0.74	-0.83	-0.28	2.78	70EB C526	
C528	θ	40.52	31.21	27.62	39.79	30.32	27.23	-0.72	-0.89	-0.38	3.62	70MI C528	
C529	θ	39.86	30.36	26.79	39.20	29.56	26.57	-0.66	-0.80	-0.22	3.24	70DB C529	
C532	θ	39.83	31.24	30.03X	39.24	30.47	29.80X	-0.59	-0.77	-0.23	3.18	70GE C532	
C534	θ	41.24*	31.51*	27.44	40.66*	30.78*	27.33	-0.59	-0.73	-0.10	2.91	70MI C534	
C536	θ	39.18	30.16	27.36	38.40	29.33	27.04	-0.78	-0.83	-0.31	2.63	70AC C536	
C540	θ	39.04	30.31	28.10*	38.30	29.43	27.69	-0.74	-0.89	-0.41	3.46	70GE C540	
C545	θ	39.18	30.29	27.33	38.47	29.42	26.98	-0.71	-0.87	-0.34	3.58	70GE C545	
C549	θ	39.87	30.65	26.70	39.56	30.17	26.91	-0.31 *	-0.48 *	0.21 *	2.40	70EB C549	
C552	θ	38.73	29.89	26.84	38.16	29.19	26.75	-0.57	-0.70	-0.09	2.79	70BN C552	
C612	*	37.20*	28.66*	26.91	36.56*	27.98*	26.80	-0.64	-0.88	-0.11	2.26	70SP C612	
C613	θ	39.65	30.79	25.34X	38.81	29.79	24.82X	-0.84	-1.00 *	-0.53 *	4.02*	70MI C613	
C627	θ	39.78	30.79	27.74	39.09	29.53	27.53	-0.69	-0.85	-0.22	3.32	70ZE C627	
C630	θ	39.06	30.13	26.82	38.49	29.39	26.87	-0.58	-0.74	-0.15	3.10	70KS C630	
C631	θ	39.52	30.39	26.63	38.97	29.71	26.56	-0.54	-0.68	-0.07	2.77	70AC C631	
C632	θ	39.76	30.50	26.60	39.36	30.03	26.82	-0.34 *	-0.47 *	0.22 *	2.16*	70AC C632	
C638	θ	38.92	29.37	27.23	38.11	28.46	26.98	-0.80	-0.91	-0.25	3.32	70SA C638	
C639	θ	40.39	31.22	26.84	39.73	30.42	26.68	-0.66	-0.80	-0.17	3.02	70DB C639	
C644	θ	39.54	30.24	26.68	38.76	29.34	26.32	-0.78	-0.90	-0.35	3.42	70MI C644	
C645	θ	39.78	30.53	26.77	39.11	29.73	26.60	-0.67	-0.80	-0.16	3.05	70AC C645	
C656	θ	38.82	29.96	26.42	38.41	29.34	26.40	-0.41	-0.63	-0.02	3.19	70SA C656	

NCCA COLLABORATIVE REFERENCE PROGRAM  
 X, Y, Z SPACE ANALYSIS, ADJUSTED DATA  
 COLOR + COLOR DIFFERENCE  
 FOR PAINT CHIPS

LAB CODE	F	SAMPLE D17			SAMPLE D18			DIFFERENCE D18 - D17			ΔE	INST CODE	LAB
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ			
C657	0	39.62	30.09	26.65	39.01	29.37	26.51	-0.60	-0.72	-0.14	2.84	70AC	C657
C662	+	35.48	30.00	26.87	38.91	29.31	26.77	-0.57	-0.70	-0.10	2.80	70SF	C662
C672	0	38.56	29.67	26.78	37.87	28.82	26.58	-0.70	-0.85	-0.20	3.35	70CC	C672
C675	0	35.36	30.28	26.64	38.68	29.47	26.40	-0.67	-0.81	-0.24	3.14	70AC	C675
C683	0	37.16*	28.05X	24.50X	36.44*	27.22X	24.70X	-0.72	-0.83	-0.20	3.21	70CC	C683
C691	0	38.82	29.40	26.62	38.12	28.64	26.44	-0.70	-0.76	-0.19	2.64	70ZE	C691
C700	0	39.59	30.47	26.56	38.92	29.70	26.77	-0.61	-0.76	-0.19	3.10	70DB	C700
C705	#	29.18X	116.40X	100.41X	28.37X	116.40X	100.41X	-0.81	0.00 X	0.00	2.35	70BF	C705
C707	#	34.71X	26.10X	22.55X	34.23X	25.49X	22.85X	-0.48	-0.60	-0.10	2.76	70SA	C707
C708A	0	42.91X	33.40X	27.53	42.41X	32.71X	27.91	-0.50	-0.65	-0.02	2.51	70BT	C708A
C708B	+	187.60X	311.81X	336.86X	187.60X	315.74X	336.86X	0.00 X	3.92 X	0.00	****X	70SS	C708B
C705	0	39.05	29.94	26.67	38.43	29.18	26.53	-0.62	-0.76	-0.14	3.00	70KS	C705
C716	0	37.81	29.77	26.67	37.26	29.07	26.68	-0.55	-0.70	0.00	2.84	70ZE	C716
C717A	+	40.03	30.51	26.75	39.52	29.84	26.67	-0.51	-0.67	-0.08	2.54	70SF	C717A
C717B	+	40.02	30.52	26.58	39.32	29.74	26.77	-0.64	-0.72	-0.20	3.12	70SF	C717B
C718A	0	39.96	30.38	26.73	39.21	29.53	26.48	-0.75	-0.86	-0.26	3.14	70AC	C718A
C718B	0	39.75	30.19	26.57	39.03	29.35	26.35	-0.72	-0.84	-0.23	3.16	70AC	C718B
C719C	0	38.80	29.55	26.77	38.19	28.80	26.66	-0.62	-0.75	-0.11	3.00	70CC	C719C
C720A	+	35.83	30.32	26.58	39.05	29.42	26.64	-0.78	-0.50	-0.34	3.36	70SF	C720A
C720B	+	35.88	30.37	26.92	39.12	29.48	26.60	-0.76	-0.82	-0.32	3.35	70SF	C720B
C723	0	40.15	30.88	27.06	39.41	29.57	26.77	-0.74	-0.82	-0.25	3.35	70ME	C723
C724	0	39.26	30.41	27.76	38.56	29.55	27.47	-0.70	-0.86	-0.25	3.35	70ZA	C724
C725	0	35.14	30.22	26.71	38.65	29.50	26.98	-0.49	-0.71	0.27 *	3.42	70KS	C725
C726	0	40.62	31.30	27.38	40.02	30.51	27.26	-0.60	-0.72	-0.12	3.30	70SA	C726
C727A	+	35.65	30.17	26.69	39.23	29.59	26.75	-0.42	-0.58	0.06	2.61	70SF	C727A
C727B	+	35.69	30.22	26.75	39.20	29.57	26.76	-0.49	-0.65	-0.03	2.88	70SF	C727B
C741	0	38.92	29.90	27.09	38.46	29.22	28.04*	-0.52	-0.68	0.55 X	4.03*	70CE	C741
C742	#	40.55	30.68	26.69	40.06	30.05	26.68	-0.49	-0.63	-0.01	2.67	70DB	C742
C748	0	38.82	29.54	26.82	38.26	29.20	26.77	-0.62	-0.74	-0.12	2.75	70BE	C748
C749	0	40.05	30.41	26.83	39.17	29.45	26.41	-0.88 *	-0.56 *	-0.42	3.41	70AC	C749
C752A	0	39.27	30.44	27.26	38.60	29.62	26.99	-0.67	-0.82	-0.27	3.31	70DB	C752A
C752B	0	38.73	29.86	26.67	38.05	29.08	26.51	-0.68	-0.78	-0.15	2.82	70EN	C752B
GRAND MEANS													
		39.26	30.24	27.07	38.67	29.50	26.95	-0.60	-0.75	-0.14	3.02		
SD OF MEANS													
		0.74	0.54	0.48	0.77	0.55	0.50	0.12	0.10	0.16	0.35		
INCLUDED LABS FOR THIS MEAN													
		75	78	76	79	78	76	79	75	82	83		



LAB CODE	F	SAMPLE D19			SAMPLE D20			DIFFERENCE D20 - D19			ΔE	INST CODE	IAE
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ			
C157	♂	7.43	7.61	9.51	6.58	6.71	8.42	-0.85	-0.50	-1.09	4.34	70GE C157	
C162	♂	7.78	7.94*	9.56	7.09*	7.23*	8.72	-0.70	-0.71	-0.84	3.33	70FC C162	
C251	♂	7.18	7.27	8.99	6.38	6.47	7.95	-0.79	-0.80	-1.05	3.94	70ZE C251	
C253	#	6.95	7.18	8.77	6.19	6.40	7.81	-0.76	-0.76	-0.97	3.87	70SA C253	
C278	♂	6.87	7.16	8.65	6.14	6.38	7.67	-0.73	-0.78	-0.98	3.91	70NE C278	
C407	♂	7.50	7.62	9.33	6.88	6.99	8.58	-0.62	-0.63	-0.76	3.01	70EI C407	
C414	♂	7.02	7.15	8.75	6.39	6.51	7.97	-0.63	-0.64	-0.78	3.18	70MI C414	
C416A	♂	6.91	7.02	8.81	6.17	6.27	7.85	-0.74	-0.75	-0.95	3.78	70IE C416A	
C416B	♂	6.65*	6.76*	8.50	5.99*	6.09*	7.66	-0.65	-0.67	-0.84	3.42	70GE C416B	
C417B	♂	7.08	7.17	8.96	6.39	6.48	8.10	-0.65	-0.65	-0.87	3.44	70BN C417B	
C418	♂	7.82*	7.97*	9.60	6.99	7.11	8.53	-0.83	-0.85	-1.06	4.01	70CE C418	
C422	♂	6.92	7.06	8.62	6.24	6.35	7.77	-0.68	-0.68	-0.85	3.53	70CC C422	
C424	♂	7.50	7.64	9.45	6.88	7.00	8.68	-0.62	-0.64	-0.77	3.04	70CA C424	
C428	♂	7.03	7.17	8.79	6.51	6.63	8.15	-0.53	-0.54	-0.64	2.66*	70BE C428	
C442	♂	7.35	7.48	9.20	6.60	6.69	8.26	-0.75	-0.75	-0.94	3.81	70CM C442	
C444	♂	7.40	7.52	9.37	6.63	6.75	8.38	-0.77	-0.77	-0.99	3.74	70GE C444	
C446	♂	7.43	7.57	9.34	6.69	6.81	8.39	-0.74	-0.76	-0.95	3.64	70GE C446	
C451	♂	7.24	7.38	9.07	6.58	6.70	8.23	-0.66	-0.68	-0.84	3.31	70AC C451	
C453	♂	7.37	7.51	9.34	6.55	6.67	8.30	-0.82	-0.84	-1.04	4.06	70BI C453	
C455	♂	7.35	7.48	9.28	6.48	6.60	8.18	-0.87	-0.85	-1.10	4.29	70GE C455	
C460	♂	6.92	7.06	8.77	6.02*	6.14*	7.61	-0.90	-0.91	-1.16	4.58	70GE C460	
C462A	♂	7.13	7.34	8.95	6.33	6.49	7.97	-0.80	-0.85	-0.99	4.16	70BE C462A	
C463	♂	7.33	7.48	9.11	6.53	6.66	8.10	-0.80	-0.82	-1.01	3.99	70IC C463	
C467A	♂	7.55	7.70	9.55	6.77	6.89	8.54	-0.78	-0.81	-1.00	3.85	70GE C467A	
C467B	♂	7.08	7.23	8.89	6.31	6.43	7.90	-0.78	-0.80	-1.00	3.94	70BN C467B	
C469	♂	7.54	7.67	9.51	6.73	6.84	8.48	-0.81	-0.83	-1.03	3.96	70GE C469	
C470	♂	7.33	7.46	9.20	6.52	6.63	8.18	-0.81	-0.83	-1.02	4.00	70BE C470	
C472	♂	7.56	7.69	9.42	6.82	6.94	8.46	-0.74	-0.75	-0.97	3.57	70ZL C472	
C473	♂	7.29	7.42	9.16	6.53	6.64	8.18	-0.77	-0.78	-0.98	3.78	70BE C473	
C474	♂	7.74	7.88	9.90*	6.94	7.06	8.92*	-0.80	-0.82	-0.99	3.84	70GE C474	
C476	♂	7.09	7.21	9.26	6.17	6.27	8.11	-0.91	-0.94	-1.15	4.64	70SA C476	
C479B	♂	7.19	7.31	9.04	6.50	6.62	8.13	-0.69	-0.69	-0.92	3.39	70CE C479B	
C480	♂	7.17	7.35	8.87	6.37	6.52	7.88	-0.80	-0.83	-0.99	4.06	70BE C480	
C481	♂	7.18	7.43	9.05	6.25	6.46	7.86	-0.93	-0.97	-1.19	4.73	70BE C481	
C482	♂	6.86	7.02	8.60	6.03*	6.16	7.54*	-0.82	-0.86	-1.06	4.31	70GC C482	
C483	♂	7.73	7.64	9.56	6.88	6.72	8.49	-0.86	-0.92	-1.08	4.60	70ZF C483	
C495C	♂	7.68	7.79	9.66	6.68	6.79	8.39	-1.00	-1.00	-1.27	4.74*	70EI C495C	
C503	♂	7.22	7.34	9.11	6.58	6.69	8.29	-0.63	-0.65	-0.82	3.21	70GE C503	
C508	♂	7.18	7.31	9.11	6.62	6.74	8.42	-0.56	-0.58	-0.70	2.83	70GE C508	
C511	♂	7.32	7.46	9.18	6.69	6.81	8.37	-0.63	-0.65	-0.81	3.14	70IB C511	
C512	♂	7.23	7.36	9.07	6.61	6.74	8.28	-0.61	-0.63	-0.79	3.07	70AC C512	
C514B	*	7.14	7.27	9.03	6.53	6.65	8.23	-0.61	-0.62	-0.79	3.02	70SF C514B	
C521A	♂	7.32	7.43	9.16	6.63	6.73	8.27	-0.69	-0.69	-0.89	3.38	70CA C521A	
C521B	♂	6.72*	6.87*	8.53	6.27	6.39	7.98	-0.45	-0.48	-0.55	2.45*	70SA C521B	
C526	♂	7.29	7.42	9.21	6.65	6.80	8.44	-0.60	-0.62	-0.78	3.01	70EB C526	
C528	♂	7.31	7.46	9.21	6.61	6.73	8.33	-0.71	-0.73	-0.88	3.51	70MI C528	
C529	♂	7.28	7.42	9.10	6.58	6.70	8.22	-0.70	-0.72	-0.89	3.50	70IB C529	
C532	♂	7.02	7.16	8.78	6.36	6.49	7.99	-0.65	-0.67	-0.79	3.04	70GE C532	
C534	♂	7.45	7.40	9.08	6.72	6.63	8.12	-0.74	-0.78	-0.96	3.94	70ME C534	
C536	♂	7.25	7.41	9.18	6.53	6.67	8.26	-0.72	-0.74	-0.92	3.59	70AC C536	
C54C	♂	7.90*	8.06*	9.89*	7.09*	7.23*	8.87*	-0.82	-0.83	-1.02	3.86	70GE C54C	
C545	♂	7.03	7.17	8.90	6.44	6.56	8.12	-0.59	-0.61	-0.78	3.04	70GE C545	
C546	♂	7.16	7.30	8.98	6.43	6.54	8.06	-0.73	-0.76	-0.92	3.71	70BE C546	
C552	♂	7.04	7.19	8.83	6.32	6.44	7.92	-0.72	-0.74	-0.91	3.68	70BN C552	
C612	*	6.55*	6.69*	8.34*	5.75*	5.91*	7.41*	-0.76	-0.78	-0.93	4.03	70SF C612	
C613	♂	6.21X	6.59	6.65X	5.47X	6.22	5.74X	-0.74	-0.77	-0.94	4.11	70MI C613	
C627	♂	7.51	7.67	9.50	6.69	6.82	8.45	-0.82	-0.85	-1.06	4.04	70CE C627	
C630	♂	7.43	7.58	9.33	6.70	6.82	8.42	-0.73	-0.76	-0.92	3.64	70BE C630	
C631	♂	7.24	7.37	9.08	6.43	6.55	8.04	-0.81	-0.82	-1.04	4.01	70AC C631	
C632	♂	7.31	7.45	9.19	6.61	6.74	8.31	-0.70	-0.71	-0.88	3.44	70AC C632	
C638	♂	7.24	7.44	9.04	6.54	6.64	8.14	-0.70	-0.80	-0.90	4.23	70SA C638	
C639	♂	7.34	7.47	9.21	6.70	6.82	8.41	-0.63	-0.65	-0.80	3.17	70IB C639	
C644	♂	6.87	6.92	8.43*	6.37	6.41	7.80	-0.50	-0.51	-0.63	2.58*	70ME C644	
C645	♂	7.23	7.36	9.05	6.58	6.69	8.23	-0.65	-0.67	-0.82	3.26	70AC C645	
C656	♂	6.80	6.94	8.50	6.06	6.18	7.56*	-0.73	-0.75	-0.94	3.82	70SA C656	

MCCA COLLABORATIVE REFERENCE PROGRAM  
 X, Y, Z SPACE ANALYSIS, ADJUSTED DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR PAINT CHIPS

LAB CODE	F	SAMPLE D19			SAMPLE D20			DIFFERENCE D20 - D19			INST	
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ	ΔE	CODE IAE
C657	θ	7.29	7.43	9.16	6.46	6.58	8.11	-0.83	-0.85	-1.05	4.14	70AC C657
C662	*	7.20	7.33	9.06	6.51	6.62	8.19	-0.69	-0.71	-0.87	3.46	70SF C662
C672	θ	6.88	7.04	8.62	6.18	6.29	7.72	-0.70	-0.75	-0.90	3.83	70GC C672
C675	θ	7.17	7.30	8.97	6.55	6.67	8.15	-0.62	-0.63	-0.78	3.11	70AC C675
C683	θ	6.54*	6.87*	8.44	5.87*	6.18	7.58	-0.67	-0.65	-0.86	3.52	70GC C683
C691	θ	7.26	7.36	8.31*	6.64	6.75	7.57*	-0.62	-0.61	-0.74	3.02	70ZE C691
C700	θ	7.16	7.29	8.99	6.57	6.68	8.25	-0.59	-0.61	-0.74	3.00	70LE C700
C705	#	6.97	90.21X	100.41X	6.33	90.21X	100.41X	-0.64	0.00 X	0.00 X	2.07X	70BF C705
C707	#	6.20X	6.31X	7.95X	5.64X	5.74X	7.23X	-0.56	-0.57	-0.71	3.06	70SA C707
C708A	θ	7.72	7.88	9.65	6.94	7.08	8.70	-0.78	-0.80	-0.95	3.75	70BI C708A
C708B	*	508.85X	478.51X	522.57X	528.77X	498.12X	539.84X	19.92 X	16.61 X	17.28 X	****X	70SE C708B
C709	θ	7.58	7.71	9.47	6.82	6.94	8.51	-0.76	-0.77	-0.96	3.68	70KE C709
C716	θ	7.33	7.42	9.16	6.55	6.62	8.23	-0.78	-0.80	-0.94	3.50	70ZE C716
C717A	*	7.36	7.50	9.22	6.55	6.67	8.19	-0.81	-0.82	-1.03	3.99	70SF C717A
C717B	*	7.43	7.57	9.34	6.62	6.75	8.31	-0.81	-0.83	-1.03	3.97	70SF C717B
C718A	θ	7.28	7.41	9.11	6.56	6.67	8.19	-0.72	-0.74	-0.92	3.61	70AC C718A
C718B	θ	7.13	7.27	8.91	6.46	6.57	8.08	-0.67	-0.65	-0.83	3.41	70AC C718B
C719C	θ	7.30	7.44	9.13	6.59	6.70	8.23	-0.72	-0.73	-0.90	3.55	70CF C719C
C720A	*	7.24	7.38	9.08	6.68	6.80	8.39	-0.57	-0.58	-0.69	2.83	70SF C720A
C720B	*	7.23	7.37	9.07	6.67	6.80	8.39	-0.56	-0.57	-0.68	2.75	70SF C720B
C723	θ	7.17	7.31	9.07	6.35	6.47	8.02	-0.83	-0.84	-1.05	4.12	70ME C723
C724	θ	7.30	7.43	9.15	6.48	6.59	8.12	-0.82	-0.84	-1.03	4.07	70ZA C724
C725	X	8.47X	7.56	9.48	6.62	6.75	8.34	-1.85 X	-0.82	-1.14	23.25X	70SE C725
C726	θ	7.43	7.56	9.36	6.85	6.97	8.62	-0.58	-0.59	-0.74	2.83	70SA C726
C727A	*	7.32	7.46	9.20	6.51	6.63	8.17	-0.81	-0.83	-1.04	4.03	70SF C727A
C727B	*	7.33	7.48	9.22	6.60	6.72	8.27	-0.74	-0.76	-0.95	3.68	70SF C727B
C741	θ	7.50	7.62	9.66	6.76	6.86	8.69	-0.74	-0.76	-0.97	3.64	70CE C741
C742	#	108.42X	111.07X	130.48X	97.05X	99.36X	116.62X	-11.37 X	-11.71 X	-13.86 X	9.31X	70EB C742
C748	θ	7.20	7.38	9.04	6.58	6.74	8.26	-0.62	-0.63	-0.78	3.09	70BE C748
C749	θ	7.49	7.63	9.39	6.65	6.78	8.34	-0.84	-0.85	-1.05	4.07	70AC C749
C752A	θ	7.22	7.35	9.03	6.52	6.64	8.16	-0.70	-0.71	-0.87	3.48	70DE C752A
C752B	θ	7.00	7.13	8.77	6.25	6.36	7.82	-0.75	-0.76	-0.94	3.80	70BN C752B
GRAND MEANS												
		7.26	7.39	9.11	6.53	6.64	8.19	-0.73	-0.75	-0.92	3.66	
SD OF MEANS												
		.27	.26	.34	.25	.24	.31	.10	.10	.13	.50	
INCLUDED LAES FOR THIS MEAN												
		81	82	81	81	82	81	82	82	82	82	

LAB CODE	F	SAMPLE D17			SAMPLE D18			DIFFERENCE D18 - D17			INCL CODE LAB	
		MEAN L	MEAN A	MEAN B	MEAN L	MEAN A	MEAN B	ΔL	ΔA	ΔB	ΔE	
C121	θ	54.00	31.76	11.16X	53.20	32.57	10.56X	-0.81 *	0.81	-0.60 *	1.25	70BA C121
C14E	θ	55.06	31.64	9.26	54.36	32.35	8.51	-0.70	0.70	-0.75	1.24	70BF C14E
C152	θ	55.35	30.57	9.42	54.75	31.27	8.72	-0.60	0.70	-0.70	1.16	70BA C152
C166	θ	55.30	30.96	9.53	54.60	31.67	8.83	-0.70	0.70	-0.70	1.22	70BA C166
C182	θ	54.82	31.70	9.47	54.11	32.40	8.77	-0.71	0.71	-0.70	1.22	70BA C182
C241	θ	55.53	30.78	9.81	54.82	31.43	9.16	-0.70	0.65	-0.65	1.16	70BF C241
C255	θ	55.45	30.25	9.55	54.69	30.95	8.69	-0.75	0.70	-0.85 *	1.34*	70BA C255
C256A	θ	55.13	31.14	9.40	54.48	31.89	8.71	-0.65	0.75	-0.65	1.21	70SC C256A
C256B	θ	55.84	31.58	10.27*	55.13	32.46	9.64*	-0.70	0.88	-0.62	1.25	70BT C256B
C28E	θ	55.12	31.40	9.57	54.41	32.11	8.86	-0.71	0.71	-0.70	1.22	70BT C28E
C291	θ	55.00	31.34	8.93	54.30	32.04	8.23	-0.70	0.70	-0.70	1.22	70BA C291
C317	θ	54.86	31.11	9.24	54.25	31.82	8.44	-0.61	0.71	-0.80	1.23	70BM C317
C325	θ	54.80	30.30	8.70	54.06	30.98	8.02	-0.74	0.68	-0.68	1.21	70BC C325
C356	θ	53.21*	31.17	8.28*	52.55*	31.83	7.55*	-0.63	0.66	-0.69	1.14	70IC C356
C380	θ	55.36	31.92	9.54	54.71	32.83	8.83	-0.65	0.91 *	-0.70	1.32	70BA C380
C382	θ	55.30	30.71	9.50	54.55	31.47	8.85	-0.75	0.75	-0.65	1.25	70BA C382
C390	θ	55.12	31.66	9.01	54.51	32.41	8.26	-0.60	0.75	-0.75	1.22	70BF C390
C4C2	θ	55.07	30.98	9.10	54.48	31.69	8.35	-0.59	0.71	-0.75	1.15	70BA C402
C420A	θ	54.65	31.22	8.92	53.98	31.97	8.22	-0.70	0.75	-0.70	1.25	70BF C420A
C420B	θ	54.58	31.34	9.01	54.03	31.94	8.21	-0.55 *	0.60	-0.80	1.14	70BF C420B
C427	θ	55.37	31.44	9.44	54.67	32.30	8.74	-0.70	0.86	-0.70	1.31	70BA C427
C437	θ	54.87	32.88	9.01	54.23	33.64	8.32	-0.64	0.76	-0.69	1.21	70GE C437
C440	θ	54.98	31.04	9.37	54.32	31.70	8.66	-0.66	0.66	-0.71	1.17	70BA C440
C442	θ	55.22	30.88	9.67	54.51	31.58	8.96	-0.71	0.71	-0.70	1.22	70HM C442
C454	θ	54.02	30.40	8.34*	53.29	30.98	7.62*	-0.72	0.58	-0.72	1.17	70BA C454
C45E	θ	55.27	31.36	9.79	54.64	32.07	9.06	-0.63	0.71	-0.73	1.20	70HM C45E
C475	θ	54.50	31.44	8.88	53.93	32.23	8.12	-0.58	0.78	-0.76	1.23	70BA C475
C477	θ	56.05*	32.42	8.80	55.42*	33.13	8.07	-0.67	0.71	-0.74	1.22	70BA C477
C494	θ	57.01X	31.11	9.40	56.34X	31.74	8.63	-0.67	0.62	-0.78	1.20	70BA C494
C496B	θ	53.61*	31.77	10.55*	52.96*	32.52	9.83*	-0.65	0.75	-0.75	1.24	70GF C496B
C495A	X	54.86	32.89	8.91	54.31	31.94	8.21	-0.55 *	-0.15 X	-0.70	1.90X	70BA C495A
C495B	θ	55.02	31.04	9.17	54.31	31.74	8.42	-0.70	0.70	-0.75	1.25	70BA C495B
C506	θ	55.16	31.48	9.25	54.46	32.13	8.60	-0.70	0.65	-0.65	1.16	70BA C506
C514A	*	55.57	33.01	10.04	54.89	33.85*	9.30	-0.68	0.84	-0.74	1.31	70CF C514A
C517	θ	54.56	29.57*	9.47	53.86	30.37*	8.78	-0.69	0.79	-0.69	1.26	70BC C517
C53E	X	56.79X	35.09X	8.56	55.98*	36.00X	7.85	-0.81 *	0.91 *	-0.71	1.41X	70GX C53E
C541	X	53.83	32.98	8.19*	52.98	33.88*	7.44*	-0.85 *	0.89	-0.75	1.44X	70GF C541
C546A	θ	54.67	31.36	9.82	53.97	32.07	8.31	-0.71	0.71	-0.70	1.22	70HM C546A
C546B	θ	54.17	31.93	9.16	53.47	32.53	8.46	-0.70	0.60	-0.70	1.16	70BC C546B
C547	θ	53.66*	33.30*	9.45	53.11	34.13*	8.73	-0.54 *	0.84	-0.72	1.23	70BC C547
C574	θ	54.04	31.46	9.43	53.35	32.16	8.74	-0.69	0.70	-0.69	1.20	70BC C574
C576	θ	55.15	31.29	9.41	54.46	32.10	8.64	-0.69	0.81	-0.76	1.31	70BE C576
C600	θ	54.76	33.81*	8.87	54.15	34.66X	8.11	-0.60	0.86	-0.75	1.25	70GE C600
C615	θ	54.28	33.18*	9.19	53.58	33.88*	8.59	-0.70	0.70	-0.60 *	1.16	70BC C615
C620	θ	55.30	32.71	10.26*	54.58	33.61	9.57*	-0.72	0.90 *	-0.69	1.34*	70MG C620
C633	X	55.12	30.97	9.15	54.69	31.56	8.40	-0.43 X	0.59	-0.75	1.05X	70BA C633
C655	θ	55.67	32.05	10.24	54.95	32.85	9.57*	-0.72	0.81	-0.67	1.27	70BT C655
C677	θ	54.57	31.22	9.07	53.80	31.95	8.36	-0.77	0.73	-0.71	1.27	70SC C677
C690	X	55.60	30.06	8.93	54.24	31.64	8.42	-1.36 X	1.58 X	-0.50 X	2.15X	70BM C690
C719A	θ	54.71	29.71	9.38	53.96	30.50	8.79	-0.75	0.80	-0.60 *	1.24	70BA C719A
C719B	θ	55.27	30.58	9.47	54.51	31.29	8.77	-0.75	0.70	-0.70	1.25	70BA C719B
C750	#	55.56X	32.51	8.59	58.77X	33.24	7.79	-0.79	0.73	-0.80	1.34*	70IC C750
GRAND MEANS												
		54.87	31.40	9.33	54.19	32.07	8.62	-0.68	0.73	-0.71	1.23	
SD OF MEANS												
		0.60	0.86	0.46	0.59	0.81	0.47	0.06	0.08	0.05	0.05	
INCLUDED LABS FOR THIS MEAN												
		44	45	44	44	44	44	45	45	45	45	



LAB CODE	F	SAMPLE D19			SAMPLE D20			DIFFERENCE D20 - D19			INST CODE LAB	
		MEAN L	MEAN A	MEAN B	MEAN L	MEAN A	MEAN B	ΔL	ΔA	ΔB	ΔE	
C121	θ	26.62	.78*	1.30X	25.26	1.02X	1.98X	-1.36	.31 X	.69 X	1.55	7CHA C121
C148	θ	27.13	-.07	-.75	25.87	-.07	-.65	-1.25	.00	.09	1.26	7CHF C148
C152	θ	25.90*	.02	-.51	27.65X	.01	-.50	1.75 X	-.01	.01	1.75	7CHA C152
C166	θ	27.35	-.16	-.61	25.94	-.11	-.53	-1.41	.05	.02	1.41	7CHA C166
C183	θ	27.26	-.58*	-.77	25.75	-.57*	-.77	-1.51	.00	-.01	1.51	7CHA C183
C241	θ	27.24	.15	-.46	25.58	.20	-.37	-1.66	.06	.08	1.66	7CHF C241
C255	θ	27.22	.01	-.68	25.61	.02	-.64	-1.61	.01	.04	1.61	7CHA C255
C256A	θ	26.94	-.03	-.74	25.28	.02	-.68	-1.66	.05	.06	1.67	7CSC C256A
C256B	θ	27.47	.02	-.82	26.19	.03	-.80	-1.28	.00	.02	1.28	7CST C256B
C288	θ	26.70	.22	-.61	25.29	.32	-.62	-1.41	.11 *	-.01	1.41	7CHM C288
C291	θ	27.10	.52	-.65	25.84	.07	-.66	-1.26	-.45 X	-.01	1.33	7CHA C291
C317	θ	26.87	-.01	-.64	25.56	-.01	-.65	-1.31	.01	-.01	1.31	7CHM C317
C325	θ	26.84	.15	-.70	25.69	.15	-.70	-1.15	.01	-.01	1.15	7CHC C325
C356	θ	25.88*	.08	-1.06	24.60*	.10	-1.02	-1.28	.02	.04	1.28	7CIC C356
C380	θ	27.23	-.09	-.67	25.92	-.08	-.63	-1.31	.00	.04	1.31	7CHA C380
C382	θ	27.20	-.06	-.48	26.04	-.11	-.44	-1.16	-.05	.04	1.16	7CHA C382
C390	θ	27.61	.48	-.91	26.30	.54*	-.92	-1.31	.06	-.01	1.31	7CHF C390
C402	θ	27.36	-.08	-.56	25.93	-.06	-.53	-1.43	.02	.04	1.43	7CHA C402
C420A	θ	26.99	-1.89X	-1.18*	25.54	-1.94X	-1.13*	-1.46	-.04	.01	1.46	7CHF C420A
C420B	θ	26.91	-1.64X	-1.07	25.51	-1.69X	-1.08	-1.40	-.04	-.01	1.40	7CFE C420B
C427	θ	27.24	.89X	-.74	25.93	.99X	-.74	-1.31	.11 *	-.00	1.31	7CHA C427
C437	X	27.10	-.05	-.56	26.93*	-.05	-.57	-.17 X	.00	-.01	1.17X	7CGD C437
C440	θ	27.22	-.02	-.32	25.77	-.02	-.30	-1.45	-.00	.02	1.45	7CHA C440
C442	θ	26.70	.24	-.61	25.29	.25	-.62	-1.41	.00	-.01	1.41	7CHM C442
C454	θ	27.35	-.15	.21X	25.86	-.14	.23X	-1.49	.01	.02	1.49	7CHA C454
C456	θ	27.31	.05	-.43	25.55	.09	-.38	-1.76 *	.04	.05	1.76	7CHM C456
C475	θ	27.25	-.18	-.52	25.79	-.17	-.47	-1.46	.01	.06	1.46	7CHA C475
C477	θ	28.22*	-.26	-.94	26.78*	-.22	-.86	-1.44	.03	.02	1.44	7CHA C477
C494	θ	28.27*	-.59*	-1.02	26.66*	-.41	-.95	-1.60	.17 X	.07	1.61	7CHA C494
C496B	θ	26.78	-1.23X	1.44X	25.29	-1.27X	1.64X	-1.49	-.05	.20 X	1.51	7CGF C496B
C499A	θ	27.46	.01	-.83	25.60	.02	-.80	-1.86 *	.01	.04	1.86*	7CHA C499A
C499B	θ	27.31	-.19	-.75	26.10	-.13	-.75	-1.20	.05	-.01	1.21	7CHA C499B
C506	θ	27.18	.04	-.68	25.97	.04	-.69	-1.20	.00	.09	1.21	7CHA C506
C514A	*	27.48	.04	-.79	26.31	.02	-.74	-1.17	.03	.05	1.17	7CST C514A
C517	θ	26.88	-.54	-.50	25.84	-.53	-.45	-1.04	.01	.05	1.04	7CHC C517
C538	θ	28.19*	1.82X	-2.00X	26.87*	1.77X	-2.05X	-1.32	-.11 X	-.05 *	1.32	7CGX C538
C541	θ	26.52	.03	-.85	25.17	.01	-.81	-1.35	-.02	.05	1.35	7CGF C541
C546A	θ	27.13	.19	-.78	25.82	.19	-.69	-1.31	.01	.09	1.31	7CFM C546A
C546B	θ	26.88	.21	-.83	25.12	.22	-.83	-1.76 *	.01	-.00	1.76	7CHC C546B
C547	θ	25.11X	.13	-.81	23.75X	.16	-.82	-1.36	.03	-.02	1.36	7CHC C547
C574	θ	26.97	.06	-.77	25.49	-.63*	-.67	-1.48	-.69 X	.09	1.63	7CHC C574
C576	θ	27.10	.11	-.57	25.65	.16	-.54	-1.44	.05	.03	1.45	7CHC C576
C600	θ	27.63	-.62*	-.16*	26.07	-.61*	-.17*	-1.56	.01	-.01	1.56	7CGE C600
C619	θ	26.89	.31	-.89	25.39	.32	-.80	-1.51	.00	.09	1.51	7CHC C619
C620	θ	26.38	.15	-.91	24.86	.19	-.87	-1.52	.05	.04	1.52	7CMG C620
C633	θ	27.27	-.14	-.63	25.93	-.10	-.61	-1.34	.04	.02	1.34	7CHA C633
C655	θ	27.11	.03	-.89	25.80	.05	-.87	-1.31	.02	.03	1.31	7CHM C655
C677	θ	26.15	-.23	-1.31*	24.99	-.24	-1.21*	-1.16	-.01	.10	1.17	7CSC C677
C690	X	26.72	.10	-.84	26.70*	.47	-.84	-.02 X	.37 X	.00	3.7X	7CHM C690
C719A	θ	26.78	-.26	-.40	25.64	-.50	-.46	-1.15	-.25 X	-.06 *	1.17	7CHA C719A
C719B	θ	27.06	-.19	-.58	25.95	-.14	-.59	-1.10	.06	-.01	1.11	7CHA C719B
C750	#	30.01X	-.22	-2.21X	28.20X	-.12	-2.23X	-1.81 *	.05	-.02	1.81*	7CIC C750
GRAND MEANS												
		27.09	-.01	-.72	25.72	-.04	-.69	-1.40	.02	.03	1.41	
SD OF MEANS												
		.49	.22	.23	.45	.26	.22	.18	.03	.04	.15	
INCLUDED LABS FOR THIS MEAN												
		47	43	44	46	42	44	47	42	46	48	



## NOTES ON NBS REFLECTANCE VALUES

The tables on page 23 of this report contain absolute reflectance values measured at 40 wavelengths (380-770 nm) and tristimulus values for three of the five samples covered by this report. The measurements were performed by the Radiometric Physics Division of the National Bureau of Standards.

These values represent state-of-the-art color measurements on a single specimen of each sample. Thus the results give an accurate picture of the values for single specimens and are not an accurate measure of the whole sample population. Participants should be aware of this concept when comparing their measurements to these NBS values.

NBS VALUES FOR SPECTRAL REFLECTANCE

45/0 REFLECTANCE FACTOR

Samples D17, D19, W20

WAVELENGTH (nm)	D17	D19	W20
380	.1129	.0581	.1511
390	.1727	.0663	.2254
400	.2409	.0744	.4391
410	.2605	.0766	.7034
420	.2520	.0767	.8433
430	.2423	.0765	.8778
440	.2384	.0763	.8859
450	.2337	.0760	.8910
460	.2304	.0756	.8961
470	.2312	.0751	.8996
480	.2242	.0748	.9051
490	.2074	.0744	.9064
500	.1981	.0741	.9093
510	.1976	.0737	.9112
520	.1884	.0735	.9126
530	.1772	.0731	.9143
540	.1802	.0729	.9153
550	.2067	.0727	.9157
560	.2398	.0727	.9159
570	.2611	.0729	.9165
580	.3318	.0731	.9172
590	.4586	.0730	.9175
600	.5554	.0728	.9168
610	.5984	.0724	.9164
620	.6138	.0721	.9164
630	.6188	.0717	.9181
640	.6196	.0712	.9156
650	.6191	.0709	.9164
660	.6180	.0705	.9147
670	.6168	.0702	.9104
680	.6155	.0698	.9119
690	.6142	.0695	.9166
700	.6130	.0693	.9149
710	.6116	.0689	.9178
720	.6098	.0686	.9145
730	.6085	.0683	.9145
740	.6075	.0679	.9141
750	.6061	.0677	.9137
760	.6049	.0675	.9154
770	.6034	.0672	.9158

SAMPLES D17, D19, W20

X, Y, Z SPACE

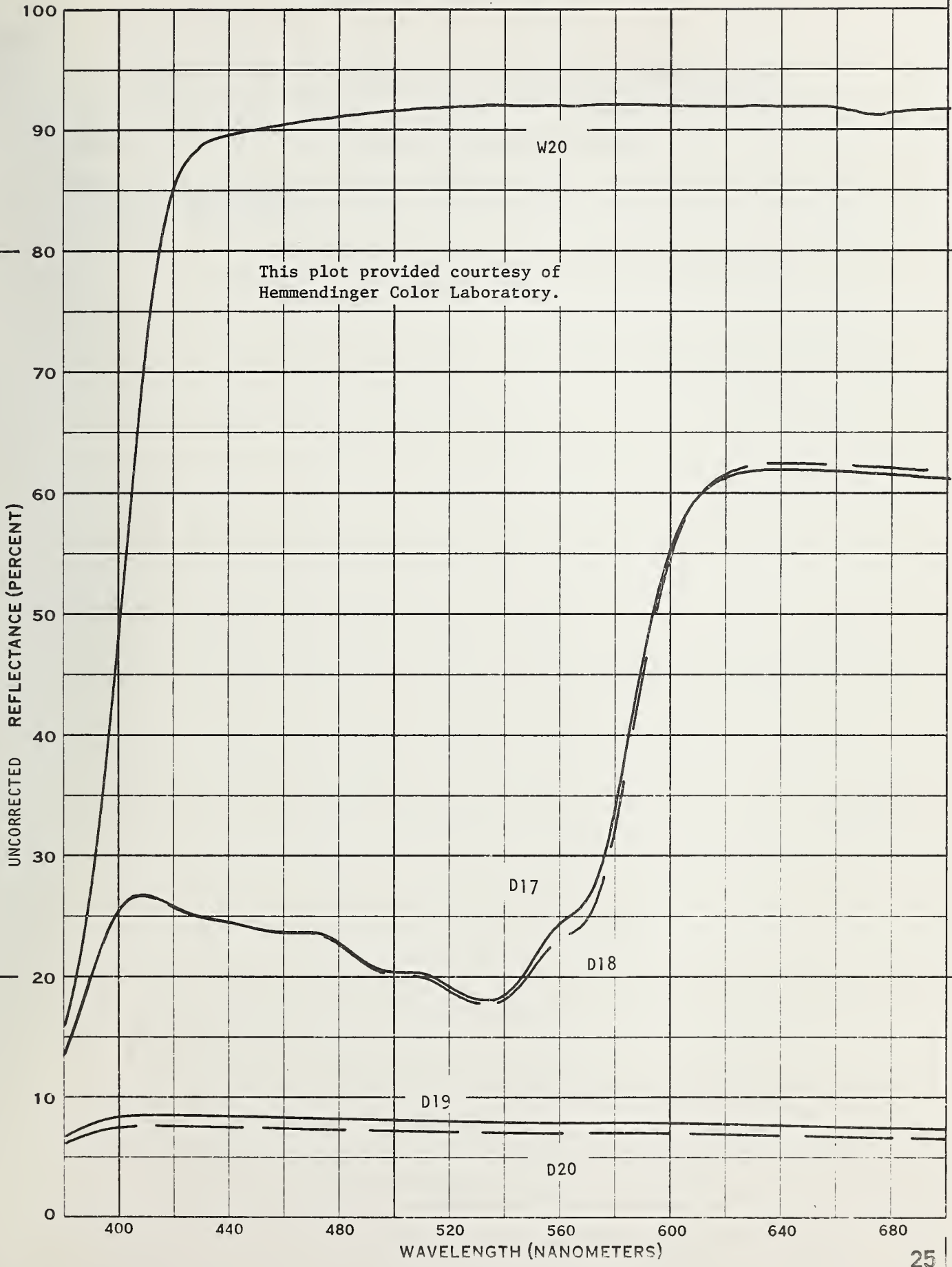
	D17	D19	W20
X	39.59	7.12	89.16
Y	30.55	7.25	91.44
Z	27.32	8.88	104.65

L, a, b SPACE

	D17	D19	W20
L	55.27	26.93	95.62
a	31.13	.08	-.91
b	9.38	-.71	2.05



SPECTROPHOTOMETRIC CURVES OF COLOR AND COLOR  
DIFFERENCE FOR PAINT CHIPS NO. 31 SAMPLES



GERS SERIAL NO. 4092225



Notes on Specific Laboratory Results for Near White Papers

C285 - Specular component excluded

C662, C717A, C717B, - Used illuminant D65  
C720A, C720B, C727A  
C727B

MCCA COLLABORATIVE REFERENCE PROGRAM  
 X, Y, Z SPACE ANALYSIS, NORMAL DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR NEAR WHITE PAPERS

LAB CODE	F	SAMPLE P05			SAMPLE P06			DIFFERENCE P06 - P05			ΔE	INST CODE	LAB
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ			
C162	0	84.10*	85.58*	97.69*	83.51*	85.03*	96.46*	-0.59	-0.55	-1.23	0.95	71EC	C162
C244	0	81.37	82.95	93.54	80.58	82.22	92.32	-0.79	-0.73	-1.62	1.25	71ZE	C244
C313	0	82.16	83.65	95.07	81.24	82.71	92.72	-0.92	-0.93	-2.35	2.15	71ZF	C313
C446	0	81.57	83.39	94.37	81.00	82.83	93.48	-0.57	-0.56	-0.89	0.70	71GE	C446
C662	+	79.49	83.28	87.45*	78.98*	82.77	86.40*	-0.51	-0.50	-1.05	0.91	71SP	C662
C716	0	81.23	83.06	94.24	80.70	82.40	92.93	-0.53	-0.66	-1.31	1.55	71ZE	C716
C717A	+	79.63	83.34	87.72*	79.11*	82.86	86.53*	-0.52	-0.48	-1.19	1.02	71SP	C717A
C717B	+	79.98	83.72	88.08*	79.37	83.13	86.92	-0.62	-0.60	-1.16	0.94	71SF	C717B
C720A	+	79.60	83.38	87.42*	79.02*	82.80	86.37*	-0.58	-0.57	-1.05	0.87	71SP	C720A
C720B	+	79.40	83.16	87.33*	78.83*	82.60	86.28*	-0.57	-0.56	-1.05	0.86	71SF	C720B
C727A	+	79.48	83.30	87.36*	79.03*	82.85	86.59*	-0.44	-0.44	-0.77	0.64	71SP	C727A
C727B	+	79.51	83.32	87.52*	78.71*	82.88	86.67	-0.79	-0.43	-0.85	1.81	71SF	C727B
GRAND MEANS													
		82.09	83.73	95.06	80.88	82.54	93.58	-0.68	-0.65	-1.48	1.32		
SD OF MEANS													
		1.18	1.07	1.53	0.30	0.28	1.66	0.17	0.16	0.55	0.57		
INCLUDED LABS FOR THIS MEAN													
		5	5	5	4	4	5	5	5	5	5		



MCCA COLLABORATIVE REFERENCE PROGRAM  
 L, a, b SPACE ANALYSIS, NORMAL DATA  
 COLOR • COLOR DIFFERENCE  
 FOR NEAR WHITE PAPERS

LAB CODE	F	SAMPLE P05			SAMPLE P06			DIFFERENCE P06 - P05			INST CODE	LAB
		MEAN L	MEAN A	MEAN B	MEAN L	MEAN A	MEAN B	ΔL	ΔA	ΔB		
C105	0	91.38	-0.20	2.38	91.03	-0.30	2.85	-0.35	-0.10	0.47	0.60	71HM C105
C122	0	91.39	-0.20	2.49	91.06	-0.23	2.87	-0.32	-0.03	0.38	0.50	71SC C122
C128	0	91.10	-0.20	2.70	90.74	-0.14	2.94	-0.36	0.06	0.24	0.44	71SC C128
C148	0	92.13	-0.57	3.14*	91.79	-0.54	3.17	-0.34	0.03	0.03	0.34	71HF C148
C150	0	92.20	-0.70	2.68	92.00	-0.72	3.00	-0.20	-0.02	0.33	0.38	71BA C150
C213	0	90.70	-0.20	2.40	90.39	-0.20	2.80	-0.31	-0.00	0.40	0.51	71SC C213
C222	0	92.46*	-0.49	2.15	92.23	-0.66	2.52	-0.23	-0.17	0.37	0.47	71BA C222
C225	0	91.00	-0.20	2.40	90.66	-0.29	2.79	-0.34	-0.09	0.39	0.52	71SC C225
C226	0	91.39	-0.33	2.40	90.99	-0.36	2.83	-0.40	-0.03	0.43	0.58	71BA C226
C230	0	91.38	-0.45	2.43	90.95	-0.46	2.85	-0.44	-0.01	0.42	0.61	71BA C230
C262	0	91.42	-0.40	2.12	90.95	-0.49	2.99	-0.47	-0.09	0.87	0.99	71BC C262
C285	+	91.44	-0.68	3.25*	91.10	-0.93	4.43*	-0.35	-0.25 *	1.15	1.26	71SF C285
C301	0	91.38	-0.18	2.40	90.89	-0.29	3.53	-0.49	-0.11	1.13	1.24	71BM C301
C320	0	92.10	-0.58	2.80	92.23	-0.95	4.02*	0.13 *	-0.41 X	1.23 *	1.30	71BA C320
C324	0	91.63	-0.33	2.87	91.51	-0.39	3.35	-0.12	-0.06	0.79	0.80	71BA C324
C328	0	91.33	-0.76	2.48	90.49	-1.08	3.56	-0.84 *	-0.32 X	1.08	1.40*	71EA C328
C340	0	91.92	-0.37	2.34	91.72	-0.60	2.63	-0.20	-0.23 *	0.29	0.42	71BA C340
C352	0	92.10	-0.40	2.30	91.90	-0.48	2.62	-0.20	-0.08	0.32	0.38	71EA C352
C442	0	91.24	-0.50	2.50	90.96	-0.50	2.74	-0.28	0.00	0.24	0.37	71BM C442
C456	0	91.40	-0.35	1.98	91.00	-0.46	2.70	-0.40	-0.12	0.72	0.83	71BA C456
C571	0	91.01	-0.01	2.80	90.26	-0.15	3.84	-0.75 *	-0.15	1.04	1.30	71BA C571
C585	0	91.63	-0.10	2.31	91.39	-0.09	2.81	-0.24	0.01	0.50	0.56	71SC C585
C670	0	91.47	-1.026X	3.87X	91.23	-1.030*	3.83	-0.24	-0.04	0.27	0.36	71SC C670
C702	0	91.98	-0.03	2.60	92.68*	-0.52	3.58	0.70 X	-0.50 X	0.98	1.30	71BA C702
C706	0	91.29	-0.40	2.25	90.88	-0.40	2.61	-0.41	0.00	0.36	0.55	71BA C706
C713	0	93.87X	0.28*	2.59	93.48X	0.30*	3.02	-0.39	0.02	0.43	0.58	71BA C713
GRAND MEANS												
		91.54	-0.32	2.47	91.25	-0.45	3.06	-0.34	-0.06	0.55	0.69	
SD OF MEANS												
		0.44	0.23	0.25	0.63	0.33	0.43	0.19	0.07	0.33	0.35	
INCLUDED LABS FOR THIS MEAN												
		24	24	24	24	25	25	24	22	25	25	

## EXPLANATION OF DATA FOR WHITE SAMPLE FOR NEAR WHITE PAPERS

Specimens of a white calibration sample (Paint Chips) were distributed to the participants along with the two sets of eight near white papers, and each participant was asked to return measurement data for the white calibration sample (Paint Chips), reporting results in the same manner as for the near white papers.

As a first step, three laboratories were selected to serve as "reference" laboratories for the purposes of this analysis and the average of their X, Y, Z values for the white sample were computed. Next, the ratios of the participants data to the combined reference laboratory values were calculated for each participant (transformed to X, Y, Z space if necessary). These ratios are shown in the White Sample Analysis table.

Two observations can be made about the data in the White Sample Analysis tables. First, the participants as a whole tend to be high compared with the combined average values obtained by the selected reference laboratories. Second, a few participants have noticeably extreme values for one or more of the components and these participants especially should look to the cause.

Next, the ratios in the White Sample Analysis tables were used to "adjust" the data of the normal data tables to obtain the adjusted data tables values. The adjustment consisted of dividing the X, Y, Z values of the normal data tables by the respective ratios in the White Sample Analysis tables.

The significant change in the adjusted data tables is in the SD OF MEANS. Comparison of these among-laboratory standard deviations with those in the normal data tables, shows considerable reduction for X, Y, Z. Thus part, at least, of the disagreement among participants is due to errors in standardization that could be corrected through use of an agreed-upon white standard. There is no similar significant change for  $\Delta X$ ,  $\Delta Y$ , and  $\Delta Z$ .

LAB CODE	FA116--(LAB/COMBINED)			INST CODE	PERCENT FROM COMBINED		
	X	Y	Z		X	Y	Z
C162	1.0151	1.0126	1.0189	71DC	1.51	1.26	1.89
C244	0.9566	0.9955	0.9584	71ZE	-0.34	-0.45	-0.16
C313	1.0052	0.9999	1.0084	71ZE	0.52	-0.01	0.84
C446	0.9954	0.9527	1.0035	71GE	-0.06	-0.13	0.35
C662	0.9558	0.9956	0.9241	71SP	-4.02	-0.44	-7.59
C716	0.9262	0.9201	0.9056	71ZE	-7.32	-7.95	-9.42
C717A	0.9726	0.9963	0.9263	71SP	-2.74	-0.37	-7.37
C717H	0.9766	1.0011	0.9319	71SP	-2.34	0.11	-6.81
C72CA	0.9724	0.9967	0.9261	71SP	-2.76	-0.33	-7.39
C720H	0.9658	0.9942	0.9256	71SP	-3.02	-0.58	-7.44
C727A	0.9726	0.9570	0.9272	71SP	-2.74	-0.30	-7.28
C727H	0.9735	0.9584	0.9279	71SP	+2.61	-0.16	-7.21

WHITE SAMPLE ANALYSIS FOR NEAR WHITE PAPERS  
L, a, b LABORATORIES

LAB CODE	FA116--(LAB/COMBINED)			INST CODE	PERCENT FROM COMBINED		
	X	Y	Z		X	Y	Z
C105	0.9521	0.9891	1.0059	71HM	-0.75	-1.05	0.99
C122	0.9845	0.9828	0.9951	71SC	-1.51	-1.72	-0.45
C128	0.9852	0.9828	0.9928	71SC	-1.42	-1.72	-0.72
C148	0.9551	0.9932	1.0011	71HF	-0.45	-0.68	0.11
C150	0.9583	0.9577	1.0076	71HA	-0.17	-0.23	0.76
C213	0.9765	0.9746	0.9855	71SC	-2.31	-2.54	-1.41
C222	1.0048	1.0060	1.0180	71HA	0.48	0.60	1.80
C225	0.9836	0.9818	0.9925	71SC	-1.64	-1.82	-0.75
C226	0.9622	0.9581	0.9585	71HA	-3.72	-4.15	-4.15
C230	0.9516	0.9858	1.0034	71HA	-0.84	-1.02	0.34
C262	0.9525	0.9914	1.0042	71HC	-0.75	-0.86	0.42
C285	0.9804	0.9827	0.9760	71SR	-1.96	-1.73	-2.40
C301	0.9894	0.9270	0.9586	71HM	-1.06	-1.20	-0.14
C320	0.9456	0.9438	0.9313	71HA	-5.04	-5.62	-6.87
C324	0.9852	0.9880	0.9581	71HA	-1.02	-1.20	-0.15
C328	0.9111	0.9100	0.9000	71HA	-8.85	-9.00	-10.00
C340	0.9913	0.9907	1.0030	71HA	-0.87	-0.93	0.30
C352	0.9922	0.9964	1.00120	71HA	-0.12	-0.36	1.20
C442	0.9861	0.9845	0.9945	71HM	-1.35	-1.51	-0.51
C456	0.9907	0.9885	1.0087	71HA	-0.53	-1.15	0.87
C571	0.9356	0.9322	0.9154	71HA	-6.04	-6.72	-2.06
C585	0.9356	0.9322	0.9154	71SC	-6.04	-6.72	-2.06
C670	0.9762	0.9820	0.9725	71SC	-2.32	-1.80	-2.71
C702	0.9472	0.9418	0.9307	71HA	+5.22	-5.82	-6.53
C706	0.9746	0.9704	0.9741	71HA	-2.54	-2.96	-2.55
C713	1.0450	1.0356	1.0477	71HA	4.50	3.56	4.77

MCCA COLLABORATIVE REFERENCE PROGRAM  
 X, Y, Z SPACE ANALYSIS, ADJUSTED DATA  
 COLOR \* COLOR DIFFERENCE  
 FOR NEAR WHITE PAPERS

LAB CODE	F	SAMPLE P05			SAMPLE P06			DIFFERENCE P06 - P05			ΔE	INST	
		MEAN X	MEAN Y	MEAN Z	MEAN X	MEAN Y	MEAN Z	ΔX	ΔY	ΔZ		CODE	LAB
C162	Ø	82.85X	84.52	95.89X	82.28*	83.97	94.68	-0.58	-0.54	-1.21	0.94	71DC	C162
C244	Ø	81.64	83.33	94.09	80.85	82.60	92.47	-0.79	-0.73	-1.63	1.25	71ZE	C244
C313	Ø	81.73	83.66	94.28	80.82	82.72	91.95	-0.92	-0.94	-2.33	2.14	71ZE	C313
C446	Ø	81.63	83.50	94.04	81.05	82.94	93.16	-0.58	-0.56	-0.89	0.70	71GE	C446
C662	*	82.82	83.65	94.64	82.30	83.14	93.50	-0.53	-0.51	-1.14	0.94	71SF	C662
C716	Ø	87.65X	90.28X	104.04X	87.08X	89.56X	102.60X	-0.57	-0.72	-1.44	1.59	71ZE	C716
C717A	*	81.87	83.65	94.71	81.34	83.16	93.42	-0.53	-0.48	-1.28	1.05	71SF	C717A
C717B	*	81.90	83.64	94.51	81.27	83.04	93.27	-0.63	-0.59	-1.24	0.96	71SF	C717B
C720A	*	81.87	83.65	94.40	81.27	83.08	93.27	-0.60	-0.58	-1.13	0.89	71SF	C720A
C720B	*	81.87	83.64	94.36	81.28	83.08	93.22	-0.59	-0.56	-1.13	0.88	71SF	C720B
C727A	*	81.72	83.55	94.22	81.27	83.10	93.39	-0.46	-0.45	-0.83	0.65	71SF	C727A
C727B	*	81.64	83.45	94.32	80.82	83.01	93.40	-0.82	-0.44	-0.92	1.83	71SF	C727B
GRAND MEANS													
		81.67	83.75	94.14	81.25	83.06	93.06	-0.69	-0.70	-1.50	1.32		
SD OF MEANS													
		0.06	0.53	0.12	0.69	0.63	1.18	0.16	0.16	0.54	0.57		
INCLUDED LABS FOR THIS MEAN													
		3	4	3	4	4	4	5	5	5	5		

L, a, b SPACE ANALYSIS, ADJUSTED DATA  
 COLOR + COLOR DIFFERENCE  
 FOR NEAR WHITE PAPERS

LAB CODE	F	SAMPLE P05			SAMPLE P06			DIFFERENCE P06 - P05			INSTR CODE	LAB
		MEAN L	MEAN A	MEAN B	MEAN L	MEAN A	MEAN B	ΔL	ΔA	ΔB		
C105	0	91.88	-0.69	3.67	91.53	-0.79	4.13	-0.35	-0.10	0.46	0.59	71BM C105
C122	0	92.18	-0.55	3.28	91.86	-0.57	3.65	-0.33	-0.02	0.37	0.50	71SC C122
C128	0	91.89	-0.59	3.34	91.53	-0.53	3.58	-0.36	0.06	0.24	0.44	71SC C128
C148	0	92.44	-0.87	3.64	92.10	-0.84	3.66	-0.34	0.03	0.02	0.34	71BF C148
C150	0	92.31	-0.79	3.29	92.11	-0.81	3.61	-0.21	-0.02	0.32	0.38	71BA C150
C213	0	91.88	-0.59	3.14	91.56	-0.59	3.54	-0.31	0.00	0.40	0.51	71SC C213
C222	0	92.19	-0.30	2.88	91.96	-0.47	3.24	-0.23	-0.17	0.36	0.46	71BA C222
C225	0	91.84	-0.50	3.09	91.50	-0.55	3.48	-0.34	-0.09	0.39	0.52	71SC C225
C226	0	93.37	-1.03	2.48	92.96	-1.05	2.91	-0.41	-0.02	0.43	0.60	71BA C226
C230	0	91.85	-0.73	3.28	91.41	-0.74	3.70	-0.44	-0.01	0.42	0.61	71BA C230
C262	0	91.82	-0.58	2.96	91.35	-0.67	3.82	-0.47	-0.09	0.86	0.68	71BC C262
C285	*	92.24	-0.30	2.85	91.89	-0.55	4.06	-0.35	-0.25 *	1.21	1.28	71SF C285
C301	0	91.98	-0.57	3.14	91.49	-0.68	4.26*	-0.49	-0.11	1.12	1.23	71BM C301
C320	0	94.81	-1.59*	2.02	94.93*	-2.02X	3.30	0.13 *	-0.43 X	1.28 *	1.36	71BA C320
C324	0	92.18	-0.62	3.21	92.06	-0.69	3.99	-0.13	-0.06	0.79	0.60	71BA C324
C328	0	95.74*	-0.99	1.88	94.86	-1.32	3.04	-0.88 *	-0.33 X	1.15	1.48*	71BA C328
C340	0	92.35	-0.47	3.11	92.15	-0.70	3.40	-0.21	-0.23 *	0.29	0.42	71BA C340
C352	0	92.27	-0.80	3.27	92.07	-0.88	3.58	-0.20	-0.08	0.31	0.38	71BA C352
C442	0	91.94	-0.70	3.14	91.65	-0.70	3.38	-0.29	0.00	0.24	0.37	71BM C442
C456	0	91.93	-0.70	3.24	91.53	-0.81	3.94	-0.41	-0.11	0.70	0.82	71BA C456
C571	0	94.26	-1.30	2.02	93.48	-1.45	3.13	-0.78 *	-0.14	1.11	1.36	71BA C571
C585	0	94.60	-1.40	1.50*	94.65	-1.40	2.03X	-0.25	0.01	0.53	0.59	71SC C585
C670	0	92.30	-0.42	3.02	92.07	-0.46	3.30	-0.24	-0.04	0.27	0.36	71SC C670
C702	0	94.78	-1.08	1.62	95.50*	-1.60*	2.94	0.72 X	-0.52 X	1.02	1.35	71BA C702
C706	0	92.67	-1.09	2.82	92.25	-1.09	2.89	-0.42	0.00	0.37	0.56	71BA C706
C713	0	92.06	-0.56	3.02	91.68	-0.53	3.43	-0.38	0.02	0.41	0.56	71BA C713
GRAND MEANS												
		92.71	-0.78	2.88	92.41	-0.83	3.49	-0.35	-0.05	0.55	0.70	
SD OF MEANS												
		1.18	0.32	0.58	1.25	0.32	0.37	0.20	0.07	0.35	0.37	
INCLUDED LABS FOR THIS MEAN												
		25	25	25	25	24	24	24	22	25	25	



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