NBSIR 77-1321

MCCA

MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

COLLABORATIVE REFERENCE PROGRAM
COLOR AND APPEARANCE

ASTM 60° GLOSS
REPORT NO. 21

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBS COLLABORATIVE REFERENCE PROGRAMS

TAPPI Paper and Board (6 times per year)

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

FKBG-API Containerboard (48 times per year)

- Mullen burst of linerboard
- Concora test of medium

MCCA Color and Appearance (4 times per year)

- Gloss at 60°
- Color and color difference
- Retroreflectivity

Rubber (4 times per year)

- Tensile strength, ultimate elongation and tensile stress
- Hardness
- Mooney viscosity
- Vulcanization properties

ASTM Textiles (3 times per year)

- Flammability (FF3-71 and FF5-74)

ASTM Cement (2 times per year)

- Chemical (11 chemical components)
- Physical (8 characteristics)

AASHTO Bituminous

- Asphalt cement (2 times per year)
- Cutbacks (once a year)

Collaborative Reference Programs
B360 Polymer Building
National Bureau of Standards
Washington, D.C. 20234

Rev. 4/77

MANUFACTURERS COUNCIL ON
COLOR AND APPEARANCE

COLLABORATIVE REFERENCE PROGRAM FOR COLOR AND APPEARANCE

ASTM 60° Gloss

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U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBSIR 77-1321

INTRODUCTION

This Collaborative Reference Program is sponsored jointly by the Manufacturers Council on Color and Appearance and the National Bureau of Standards. Four times per year, gloss chip samples are distributed to each participating laboratory. After the data has been returned to and analyzed by NBS, two reports are sent to each participant. The first, the "preliminary" report, is an individualized report comparing a laboratory's results with the mean of all the results received by the data due date. The second, the "final" report, is a longer report (as illustrated by this report) showing the data from all participants.

A key to the tables and graphs is given on the following pages. Please make special note of the explanation of the "best values" given on page 2 of this report.

If there are any questions on the notes, the analyses, or the reports in general, contact Jeffrey Horlick or Jeffrey Stevenson or Edwin B. Randall on (301) 921-2946.

December 1, 1977

KEY TO TABLES AND GRAPHS

MEAN - The average of individual TEST DETERMINATIONS. The number of TEST DETERMINATIONS in the mean is given in the upper right corner of the first table (TEST D.) and again at the bottom of this table.

GRAND MEAN - (GR. MEAN) The average of the individual laboratory MEANS, excluding laboratories flagged (see column F) with an X or # .

DEV - The DEViation of difference of the laboratory MEAN from the GRAND MEAN.

N. DEV - The Normal DEViate or ratio of the DEV to the SD OF MEANS; an indication of the degree of divergence of the laboratory MEAN from the GRAND MEAN.

INST CODE - Code for instrument type or variation in condition, see second table.

F - Flag, with following meaning:

- # - Excluded because data were not understood or because analysis indicates extreme performance values or non-compliance with required test procedures.
- X - Excluded because plotted point would fall outside of the 99% error ellipse, (see below for explanation of Graph).
- * - Included in grand means but plotted point would fall outside of the 95% error ellipse.
- 0 - Included in grand mean and inside 95% error ellipse.

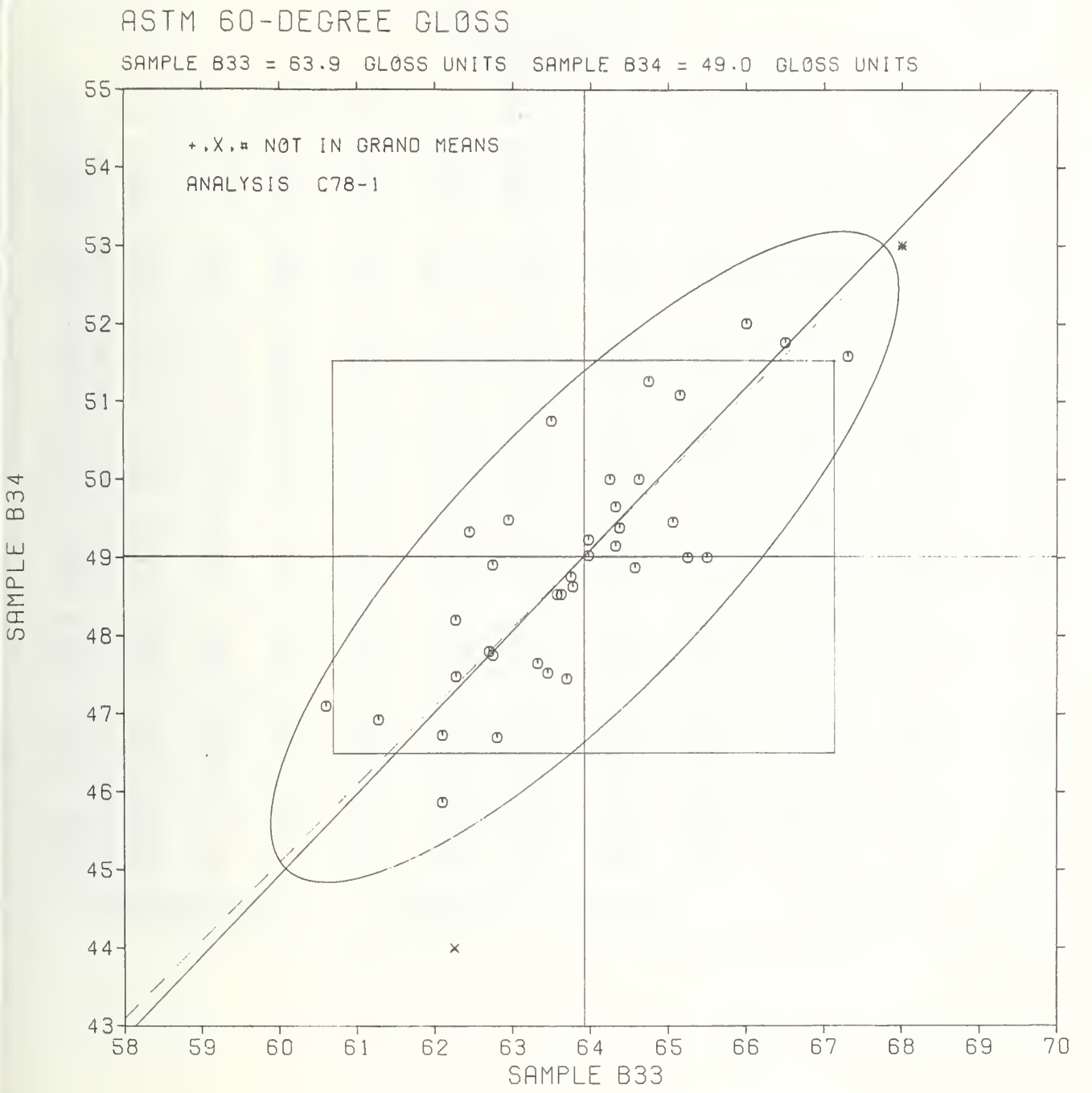
Graph - For each laboratory the MEAN for the second sample is plotted against the MEAN for the first sample, with each point representing a laboratory. The horizontal and vertical lines are the GRAND MEANS. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the 45° line, is along the major axis of the error ellipse. The ellipse is drawn so that, on the average, it will include 95% of the points representing the laboratories.

The rectangular area represents the $\pm$ 5 percent of magnitude of reading which is the ASTM precision statement for reproducibility for 60° gloss.

Plotted symbols are as explained above (under F). A participant whose plotted point falls outside of the ellipse or the rectangular area should carefully re-examine the testing procedure he is following.

Note: Graphs are plotted with an ellipse when there are 20 or more instruments in the analysis. When there are 10 through 19 instruments in the analysis, the graph will be plotted but ellipses will be omitted. When there are fewer than 10 instruments retained in the analysis, the graph will not be plotted.

Best values - Given at the end of Table 1 for 60° gloss. These values are based on the results obtained by the National Bureau of Standards and the National Research Council of Canada. All participants using equipment that is standard for the analysis should be able to achieve results within the plus-minus ($\pm$) limits, which are shown along with the best values.


ASTM 60-DEGREE GLOSS
SAMPLE B33 = 63.9 GLOSS UNITS SAMPLE B34 = 49.0 GLOSS UNITS
+,X,* NOT IN GRAND MEANS
ANALYSIS C78-1
SAMPLE B34
SAMPLE B33
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ANALYSIS C78-1 TABLE 1
60-DEGREE GLOSS
ASTM METHOD D523

LAB CODE	SAMPLE B33 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	SAMPLE B34 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	TEST D.* 4 VAR	F	LAB
C200	64.62	.71	.45	.38	.63	50.00	.99	.61	.92	1.68	78S	O	C200
C251	65.25	1.33	.85	.50	.84	49.00	-.01	-.01	1.15	2.10	78H	O	C251
C253A	62.75	-1.17	-.75	.61	1.03	48.90	-.11	-.07	.58	1.05	78D	O	C253A
C253B	63.70	-.22	-.14	.20	.34	47.45	-1.56	-.97	.10	.18	78H	O	C253B
C256	63.97	.06	.04	.44	.74	49.22	.21	.13	.61	1.10	78E	O	C256
C281	63.62	-.29	-.19	.66	1.10	48.52	-.49	-.30	.19	.34	78S	O	C281
C410A	66.00	2.08	1.34	.00	.00	52.00	2.99	1.86	.00	.00	78H	O	C410A
C410B	68.00	4.08	2.62	.00	.00	53.00	3.99	2.48	.00	.00	78H	*	C410B
C410C	65.25	1.33	.85	.50	.84	49.00	-.01	-.01	.00	.00	78H	O	C410C
C417	64.32	.41	.26	.54	.90	49.65	.64	.40	.52	.94	78E	O	C417
C418	63.75	-.17	-.11	.50	.84	48.75	-.26	-.16	.96	1.74	78C	O	C418
C420	62.95	-.97	-.62	.13	.22	49.47	.46	.29	.10	.17	78F	O	C420
C422	62.09	-1.82	-1.17	.90	1.52	45.87	-3.14	-1.95	.48	.88	78S	O	C422
C426	62.45	-1.47	-.94	.66	1.11	49.32	.31	.19	1.09	1.98	78E	O	C426
C427	64.32	.41	.26	.87	1.45	49.15	.14	.09	1.58	2.87	78F	O	C427
C437	61.27	-2.64	-1.70	1.30	2.19	46.92	-2.09	-1.30	.60	1.09	78D	O	C437
C440	63.57	-.34	-.22	.42	.70	48.52	-.49	-.30	.39	.70	78F	O	C440
C444	62.80	-1.12	-.72	.29	.49	46.70	-2.31	-1.44	.58	1.06	78E	O	C444
C445	63.77	-.14	-.09	.32	.54	48.62	-.39	-.24	1.23	2.24	78F	O	C445
C446	64.57	.66	.42	.61	1.02	48.87	-.14	-.08	.35	.64	78S	O	C446
C454	65.06	1.14	.73	.22	.37	49.45	.44	.27	.58	1.06	78E	O	C454
C455	63.32	-.59	-.38	.25	.42	47.65	-1.36	-.85	.26	.48	78F	O	C455
C462	63.97	.06	.04	.28	.46	49.02	.01	.01	.10	.17	78F	O	C462
C467	62.27	-1.64	-1.05	1.19	1.99	47.47	-1.54	-.95	.95	1.73	78D	O	C467
C475	63.50	-.42	-.27	1.00	1.68	50.75	1.74	1.08	.50	.91	78B	O	C475
C477	65.15	1.23	.79	.31	.52	51.07	2.06	1.28	.22	.40	78F	O	C477
C479A	62.27	-1.64	-1.05	.22	.37	48.20	-.81	-.50	.45	.83	78D	O	C479A
C479B	62.70	-1.22	-.78	.36	.60	47.80	-1.21	-.75	.22	.39	78B	O	C479B
C484	65.50	1.58	1.01	.58	.97	49.00	-.01	-.01	.00	.00	78B	O	C484
C494	62.75	-1.17	-.75	1.71	2.87	47.75	-1.26	-.78	.96	1.74	78C	O	C494
C504	64.37	.46	.29	.25	.42	49.37	.36	.23	.75	1.36	78S	O	C504
C506	60.60	-3.32	-2.13	.85	1.42	47.10	-1.91	-1.19	.69	1.25	78E	O	C506
C510	64.75	.83	.53	.96	1.61	51.25	2.24	1.39	.50	.91	78K	O	C510
C517	63.45	-.47	-.30	1.03	1.73	47.52	-1.49	-.92	1.43	2.60	78F	O	C517
C520	53.75	-10.17	-6.52	.87	1.45	42.12	-6.89	-4.28	.48	.87	78K	X	C520
C531	62.25	-1.67	-1.07	.50	.84	44.00	-5.01	-3.11	2.16	3.93	78C	X	C531
C538	66.50	2.58	1.66	1.29	2.17	51.75	2.74	1.70	.50	.91	78H	O	C538
C543	64.25	.33	.21	.50	.84	50.00	.99	.61	.00	.00	78I	O	C543
C574	62.10	-1.82	-1.17	.90	1.51	46.72	-2.29	-1.42	.56	1.01	78D	O	C574
C576	67.30	3.38	2.17	.32	.53	51.57	2.56	1.59	.25	.45	78F	O	C576

GR. MEAN = 63.92 GLOSS UNITS GRAND MEAN = 49.01 GLOSS UNITS TEST DETERMINATIONS = 4
SD MEANS = 1.56 GLOSS UNITS SD OF MEANS = 1.61 GLOSS UNITS 38 LABS IN GRAND MEANS
AVERAGE SDR = .60 GLOSS UNITS AVERAGE SDR = .55 GLOSS UNITS
TOTAL NUMBER OF LABORATORIES REPORTING = 40

Best Values: B33 64.60 ± 3 gloss units
B34 49.44 ± 3 gloss units

ANALYSIS C78-1 TAHLE 2
60-DEGREE GLOSS
ASTM METHOD D523

LAH CODE	F	MEANS H33	H34	COORDINATES MAJOR	MINOR	AVG R.SDR	VAR	PROPERTY---TEST INSTRUMENT---CONDITIONS
C520	X	53.75	42.12	-12.01	2.56	1.16	78K	GLOSS, 60 DEGREE, HYK-MALLINKRODT MULTIGLOSS
C506	O	60.60	47.10	-3.68	1.07	1.34	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C437	O	61.27	46.92	-3.34	.46	1.64	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C422	O	62.09	45.87	-3.53	-.86	1.20	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C574	O	62.10	46.72	-2.91	-.27	1.26	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C531	X	62.25	44.00	-4.77	-2.27	2.38	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C479A	O	62.27	48.20	-1.72	.62	.60	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C467	O	62.27	47.47	-2.25	.12	1.86	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C426	O	62.45	49.32	-.79	1.28	1.54	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C479H	O	62.70	47.80	-1.72	.04	.50	78H	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C253A	O	62.75	48.90	-.89	.77	1.04	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C494	O	62.75	47.75	-1.72	-.03	2.30	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C444	O	62.80	46.70	-2.44	-.79	.78	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C420	O	62.95	49.47	-.34	1.02	.20	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C455	O	63.32	47.65	-1.39	-.52	.45	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C517	O	63.45	47.52	-1.40	-.69	2.16	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C475	O	63.50	50.75	.96	1.51	1.29	78H	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C440	O	63.57	48.52	-.59	-.09	.70	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C281	O	63.62	48.52	-.55	-.13	.72	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C253B	O	63.70	47.45	-1.28	-.92	.26	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C418	O	63.75	48.75	-.31	-.06	1.29	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C445	O	63.77	48.62	-.38	-.16	1.39	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C256	O	63.97	49.22	.19	.11	.92	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C462	O	63.97	49.02	.05	-.03	.32	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C543	O	64.25	50.00	.94	.45	.42	78I	GLOSS, 60 DEGREE, LOCKWOOD+MCLORIE GLOSSMETER
C427	O	64.32	49.15	.38	-.20	2.16	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C417	O	64.32	49.65	.74	.15	.92	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C504	O	64.37	49.37	.58	-.08	.89	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C446	O	64.57	48.87	.36	-.57	.83	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C200	O	64.62	50.00	1.20	.18	1.16	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C510	O	64.75	51.25	2.19	.95	1.26	78K	GLOSS, 60 DEGREE, HYK-MALLINKRODT MULTIGLOSS
C454	O	65.06	49.45	1.11	-.52	.72	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C477	O	65.15	51.07	2.34	.54	.46	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C410C	O	65.25	49.00	.91	-.97	.42	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C251	O	65.25	49.00	.91	-.97	1.47	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C484	O	65.50	49.00	1.09	-1.15	.48	78H	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C410A	O	66.00	52.00	3.60	.57	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C538	O	66.50	51.75	3.76	.04	1.54	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C576	O	67.30	51.57	4.19	-.66	.49	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C410B	*	68.00	53.00	5.70	-.18	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
GMEANS:		63.92	49.01			1.00		
		95% ELLIPSE:		5.54	1.73	WITH GAMMA = 46 DEGREES		

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16. ABSTRACT (*A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.*)

Collaborative Reference Programs provide participating laboratories with the means for checking periodically the level and uniformity of their testing in comparison with that of other participating laboratories. An important by-product of the programs is the provision of realistic pictures of the state of the testing art. This is one of the periodic reports showing averages for each participant, within and between laboratory variability, and other information for participants and standards committees.

17. KEY WORDS (*six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons*)

Collaborative reference program; Gloss; Laboratory evaluation; Precision; Reference samples; Testing calibration

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