MCCA

MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

COLLABORATIVE REFERENCE PROGRAM
COLOR AND APPEARANCE

ASTM 60° GLOSS

REPORT NO. 23

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)

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- Hardness
- Mooney viscosity
- Vulcanization properties

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- 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

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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 78-1343

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.

July 6, 1978

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.

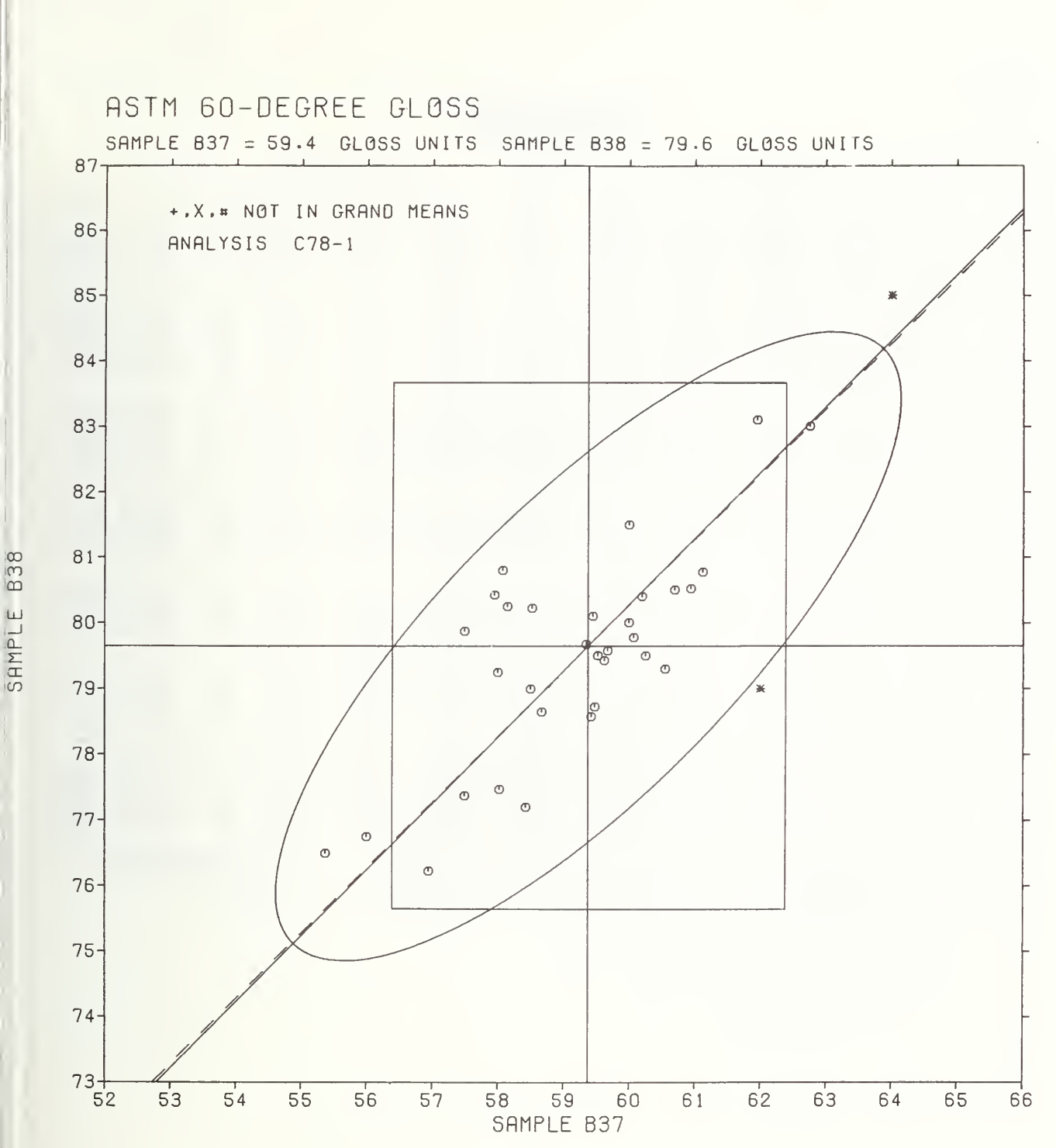
Graph - For each laboratory the MEAN for the second sample is plotted against the MEAN for the first sample, with each point representing a laboratory. The horizontal and vertical lines are the GRAND MEANS. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the 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 ± 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 (±) limits, which are shown along with the best values.


ASTM 60-DEGREE GLOSS
SAMPLE B37 = 59.4 GLOSS UNITS SAMPLE B38 = 79.6 GLOSS UNITS
+,X,* NOT IN GRAND MEANS
ANALYSIS C78-1
SAMPLE B38
SAMPLE B37
87
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66

ANALYSIS C78-1 TABLE 1
60-DEGREE GLOSS
ASTM METHOD D523

LAB CODE	SAMPLE B37 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	SAMPLE B38 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	TEST D.• 4 VAR	P	LAB
C200	60.70	1.33	.73	.35	.46	80.50	.85	.46	.00	.00	78S	ó	C200
C251	58.00	-1.37	-.75	.71	.93	79.25	-.40	-.22	.96	2.12	78H	ó	C251
C253	59.47	.10	.06	.22	.29	78.72	-.92	-.50	.51	1.14	78H	ó	C253
C256	59.67	.30	.16	.25	.33	79.57	-.07	-.04	.26	.58	78E	ó	C256
C281	58.15	-1.22	-.67	.30	.40	80.25	.60	.33	.47	1.03	78D	ó	C281
C410A	58.50	-.87	-.48	.58	.76	79.00	-.65	-.35	.00	.00	78H	ó	C410A
C410B	62.00	2.63	1.44	.00	.00	79.00	-.65	-.35	.00	.00	78H	*	C410B
C410C	68.00	8.63	4.72	1.15	1.53	91.00	11.35	6.17	.00	.00	78H	X	C410C
C410D	64.00	4.63	2.53	.00	.00	85.00	5.35	2.91	.00	.00	78H	*	C410D
C417	59.42	.05	.03	.82	1.08	78.57	-1.07	-.58	.56	1.25	78F	ó	C417
C418	57.50	-1.87	-1.03	1.47	1.94	77.37	-2.27	-1.23	1.70	3.77	78C	ó	C418
C420	60.07	.70	.38	.84	1.11	79.77	.13	.07	.72	1.59	78F	ó	C420
C422	56.94	-2.43	-1.33	1.26	1.66	76.23	-3.42	-1.86	.29	.64	78S	ó	C422
C426	58.02	-1.35	-.74	.26	.35	77.47	-2.17	-1.18	.21	.46	78E	ó	C426
C437	59.52	.15	.08	.57	.75	79.50	-.15	-.08	.12	.26	78D	ó	C437
C440	61.12	1.75	.96	.32	.42	80.77	1.13	.61	.29	.64	78F	ó	C440
C443	56.00	-3.37	-1.85	1.83	2.41	76.75	-2.90	-1.57	.96	2.12	78C	ó	C443
C444	58.42	-.95	-.52	.39	.51	77.20	-2.45	-1.33	.64	1.41	78H	ó	C444
C445	59.35	-.02	-.01	.24	.31	79.67	.03	.02	.15	.33	78F	ó	C445
C446	57.95	-1.42	-.78	.52	.69	80.42	.78	.42	.15	.33	78S	ó	C446
C454	60.94	1.57	.86	.20	.27	80.52	.88	.48	.48	1.07	78E	ó	C454
C455	58.07	-1.30	-.71	2.16	2.85	80.80	1.15	.63	.32	.70	78F	ó	C455
C462	60.20	.83	.45	.98	1.30	80.40	.75	.41	.12	.26	78F	ó	C462
C475	60.00	.63	.34	.82	1.08	81.50	1.85	1.01	.58	1.28	78B	ó	C475
C477	61.95	2.58	1.41	.24	.31	83.10	3.45	1.88	.14	.31	78F	ó	C477
C479	55.37	-4.00	-2.19	1.03	1.36	76.50	-3.15	-1.71	.41	.91	78B	ó	C479
C494	62.75	3.38	1.85	.50	.66	83.00	3.35	1.82	.00	.00	78C	ó	C494
C504	57.50	-1.87	-1.03	.41	.54	79.87	.23	.12	.25	.55	78S	ó	C504
C506	58.52	-.85	-.46	1.42	1.87	80.22	.58	.31	.26	.58	78E	ó	C506
C510	60.00	.63	.34	1.15	1.53	80.00	.35	.19	.82	1.81	78K	ó	C510
C517	60.55	1.18	.64	.61	.81	79.30	-.35	-.19	.73	1.63	78F	ó	C517
C538	60.25	.88	.48	2.22	2.93	79.50	-.15	-.08	1.29	2.86	78H	ó	C538
C543	59.62	.25	.14	.19	.25	79.42	-.22	-.12	.26	.58	78I	ó	C543
C576	59.45	.08	.04	.65	.85	80.10	.45	.25	.56	1.24	78F	ó	C576
C612	58.67	-.70	-.38	.74	.98	78.65	-1.00	-.54	.24	.53	78D	ó	C612

GR. MEAN = 59.37 GLOSS UNITS — GRAND MEAN = 79.65 GLOSS UNITS — TEST DETERMINATIONS = 4
SD MEANS = 1.83 GLOSS UNITS — SD OF MEANS = 1.84 GLOSS UNITS — 34 LABS IN GRAND MEANS
AVERAGE SDR = .76 GLOSS UNITS — AVERAGE SDR = .45 GLOSS UNITS
TOTAL NUMBER OF LABORATORIES REPORTING = 35

Best Values: B37 59.3 ± 3.0 gloss units
B38 80.5 ± 3.0 gloss units

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

LAB CODE	P	MEANS B37	MEANS B38	COORDINATES MAJOR	COORDINATES MINOR	AVG R.SDR	VAR	PROPERTY---TEST INSTRUMENT---CONDITIONS
C479	G	55.37	76.50	-5.05	.63	1.13	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C443	G	56.00	76.75	-4.43	.36	2.27	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C422	G	56.94	76.23	-4.14	-.68	1.15	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C504	G	57.50	79.87	-1.16	1.49	.55	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C418	G	57.50	77.37	-2.93	-.27	2.86	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C446	G	57.95	80.42	-.45	1.56	.51	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C251	G	58.00	79.25	-1.25	.70	1.53	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C426	G	58.02	77.47	-2.49	-.57	.40	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C455	G	58.07	80.80	-.09	1.74	1.77	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C281	G	58.15	80.25	-.43	1.29	.71	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C444	G	58.42	77.20	-2.41	-1.05	.96	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C410A	G	58.50	79.00	-1.07	.17	.38	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C506	G	58.52	80.22	-.19	1.01	1.23	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C612	G	58.67	78.65	-1.20	-.20	.75	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C445	G	59.35	79.67	.00	.04	.32	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C417	G	59.42	78.57	-.72	-.79	1.16	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C576	G	59.45	80.10	.38	.27	1.05	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C253	G	59.47	78.72	-.58	-.72	.71	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C437	G	59.52	79.50	.00	-.21	.50	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C543	G	59.62	79.42	.02	-.33	.42	78I	GLOSS, 60 DEGREE, LOCKWOOD-MCLORIE GLOSSMETER
C256	G	59.67	79.57	.16	-.26	.46	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C510	G	60.00	80.00	.69	-.20	1.67	78K	GLOSS, 60 DEGREE, BYK-MALLINKRODT MULTIGLOSS
C475	G	60.00	81.50	1.76	.86	1.18	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C420	G	60.07	79.77	.59	-.41	1.35	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C462	G	60.20	80.40	1.12	-.06	.78	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C538	G	60.25	79.50	.51	-.72	2.90	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C517	G	60.55	79.30	.58	-1.08	1.22	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C200	G	60.70	80.50	1.54	-.34	.23	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C454	G	60.94	80.52	1.73	-.50	.67	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C440	G	61.12	80.77	2.03	-.45	.53	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C477	G	61.95	83.10	4.27	.60	.31	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C410B	*	62.00	79.00	1.39	-2.32	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C494	G	62.75	83.00	4.76	-.04	.33	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C410D	*	64.00	85.00	7.06	.48	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C410C	X	68.00	91.00	14.14	1.86	.76	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
GMEANS:		59.37	79.65			1.00		
		95% ELLIPSE:		6.38	2.22	WITH GAMMA = 45 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)*

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