MCCA

MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

COLLABORATIVE REFERENCE PROGRAM
COLOR AND APPEARANCE

ASTM 60° GLOSS

REPORT NO. 29

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
- Moisture content
- 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

CTS Rubber (4 times per year)

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

ASTM Cement (2 times per year)

- Chemical (11 chemical components)
- Physical (15 characteristics)

AASHTO Bituminous

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

NBS Collaborative Reference Programs
A05 Technology Building
National Bureau of Standards
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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 79-1815

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 on (301) 921-2946.

November 30, 1979

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:

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

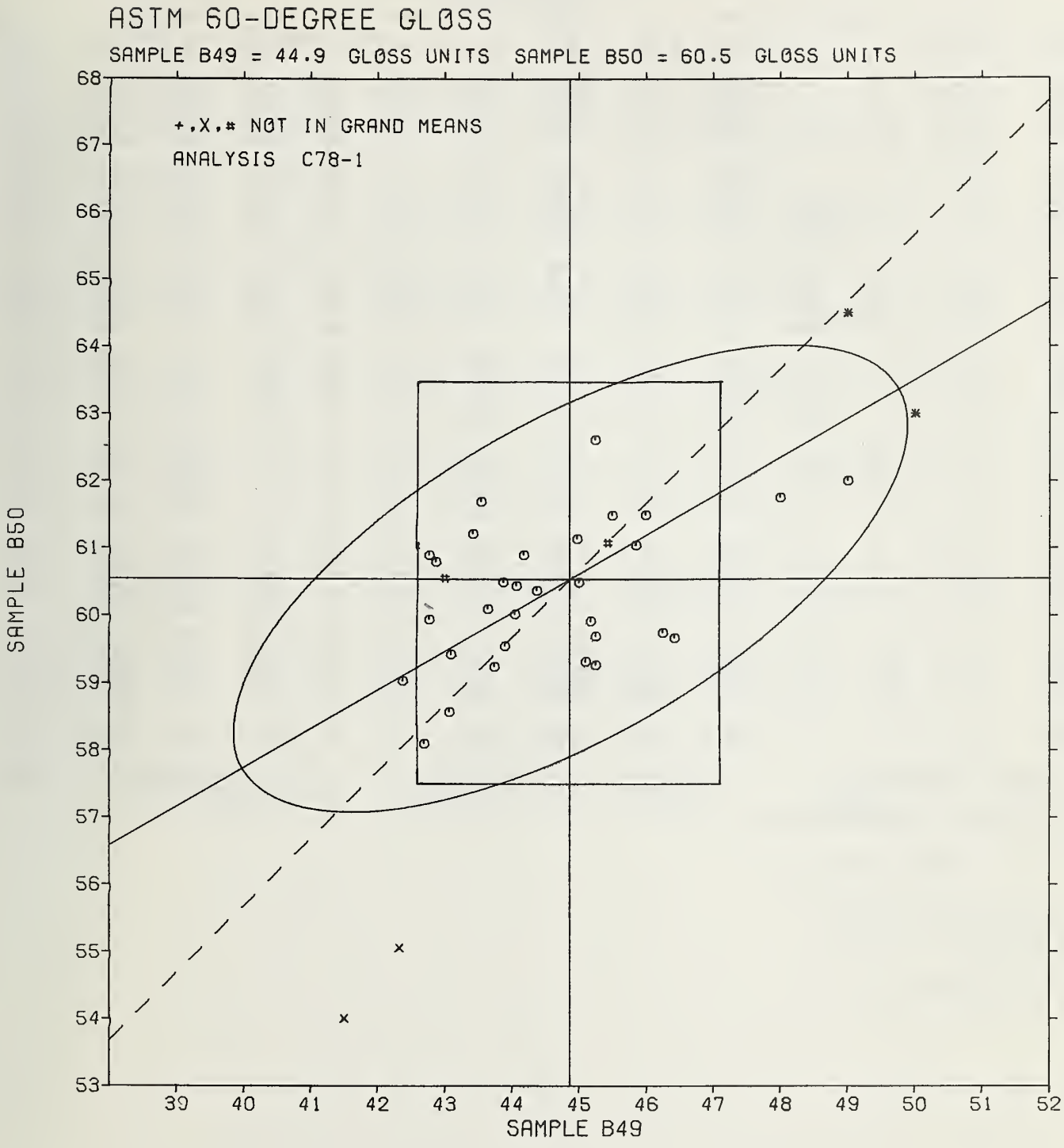
Graph - For each laboratory the MEAN for the second sample is plotted against the MEAN for the first sample, with each point representing a laboratory. The horizontal and vertical lines are the GRAND MEANS. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the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


ASTM 60-DEGREE GLOSS
SAMPLE B49 = 44.9 GLOSS UNITS SAMPLE B50 = 60.5 GLOSS UNITS
+,X,* NOT IN GRAND MEANS
ANALYSIS C78-1
SAMPLE B50
SAMPLE B49
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MCCA COLLABORATIVE REFERENCE PROGRAM
ANALYSIS C78-1 TABLE 1
60-DEGREE GLOSS
ASTM METHOD D523

LAB CODE	SAMPLE B49 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	SAMPLE B50 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	TEST D.= 4 VAR	F	LAB
C200	45.25	.39	.20	1.04	1.43	59.70	-.85	-.64	.12	.19	78S	C	C200
C206	45.25	.39	.20	.31	.43	59.27	-1.27	-.96	.45	.72	78F	O	C206
C251	45.37	.51	.27	.25	.34	61.00	.45	.34	.41	.66	78H	#	C251
C253	42.77	-2.09	-1.09	.56	.77	60.90	.35	.26	.39	.63	78H	O	C253
C256	44.07	-.79	-.41	1.30	1.79	60.45	-.10	-.07	.58	.93	78F	O	C256
C281	45.10	.24	.12	.42	.58	59.32	-1.22	-.92	.33	.53	78D	O	C281
C410A	46.00	1.14	.59	.00	.00	61.50	.95	.72	.58	.93	78H	O	C410A
C410B	48.00	3.14	1.63	1.15	1.59	61.75	1.20	.90	.96	1.54	78H	O	C410B
C410C	50.00	5.14	2.67	.00	.00	63.00	2.45	1.84	.00	.00	78H	*	C410C
C410D	49.00	4.14	2.15	.00	.00	62.00	1.45	1.09	1.15	1.86	78H	O	C410D
C410E	49.00	4.14	2.15	.00	.00	64.50	3.95	2.97	1.73	2.79	78H	*	C410E
C417	43.90	-.96	-.50	.96	1.32	59.55	-1.00	-.75	.13	.21	78F	O	C417
C418	43.87	-.99	-.51	.25	.34	60.50	-.05	-.04	.41	.66	78C	O	C418
C420	46.42	1.56	.81	.49	.68	59.67	-.87	-.66	1.26	2.02	78F	O	C420
C422	42.38	-2.48	-1.29	.90	1.24	59.03	-1.52	-1.14	.52	.83	78S	O	C422
C427	44.97	.11	.06	.42	.58	61.15	.60	.45	.31	.50	78F	O	C427
C437	43.07	-1.79	-.93	.15	.21	58.57	-1.97	-1.48	.67	1.07	78D	O	C437
C440	43.42	-1.44	-.75	.30	.41	61.22	.68	.51	.75	1.21	78F	O	C440
C444	45.85	.99	.51	1.98	2.72	61.05	.50	.38	.93	1.50	78C	O	C444
C446	42.77	-2.09	-1.09	.26	.36	59.95	-.60	-.45	.30	.48	78S	O	C446
C454	44.18	-.68	-.35	.95	1.31	60.90	.36	.27	.38	.62	78E	O	C454
C455	43.55	-1.31	-.68	.77	1.06	61.70	1.15	.87	.32	.51	78F	O	C455
C462	43.65	-1.21	-.63	.58	.80	60.10	-.45	-.34	1.15	1.86	78F	O	C462
C467	44.37	-.49	-.25	1.76	2.43	60.37	-.17	-.13	.50	.80	78C	O	C467
C475	43.75	-1.11	-.58	1.50	2.07	59.25	-1.30	-.98	.50	.80	78B	O	C475
C484	45.00	.14	.07	.82	1.12	60.50	-.05	-.04	.58	.93	78B	O	C484
C494	44.05	-.81	-.42	.51	.70	60.02	-.52	-.39	1.22	1.96	78B	O	C494
C495	45.25	.39	.20	1.26	1.73	62.62	2.08	1.56	.75	1.21	78H	O	C495
C506	42.32	-2.54	-1.32	.88	1.22	55.05	-5.50	-4.13	1.00	1.61	78E	X	C506
C508	45.17	.31	.16	1.17	1.61	59.92	-.62	-.47	.30	.48	78F	O	C508
C517	43.10	-1.76	-.92	.22	.30	59.42	-1.12	-.84	1.07	1.72	78F	O	C517
C520	42.95	-1.91	-1.00	.66	.91	60.47	-.07	-.05	.64	1.03	78K	#	C520
C538	46.25	1.39	.72	.50	.69	59.75	-.80	-.60	.96	1.54	78H	O	C538
C543	42.70	-2.16	-1.13	.32	.44	58.10	-2.45	-1.84	.42	.68	78I	O	C543
C574	42.87	-1.99	-1.03	1.10	1.52	60.80	.25	.19	.71	1.15	78S	C	C574
C705	41.50	-3.36	-1.75	.58	.79	54.00	-6.55	-4.92	.82	1.31	78H	X	C705
C709	45.50	.64	.33	.58	.79	61.50	.95	.72	.58	.93	78C	O	C709

GR. MEAN = 44.86 GLOSS UNITS — GRAND MEAN = 60.55 GLOSS UNITS — TEST DETERMINATIONS = 4
SD MEANS = 1.92 GLOSS UNITS — SD OF MEANS = 1.33 GLOSS UNITS — 33 LABS IN GRAND MEANS
AVERAGE SDR-= .73 GLOSS UNITS — AVERAGE SDR = .62 GLOSS UNITS
TOTAL NUMBER OF LABORATORIES REPORTING = 37

Best values: B49 44.05 ± 3 gloss units
B50 59.83 ± 3 gloss units

Data from labs C251 and C520 were received late and not included in the Grand Mean.

Data from lab C612 was not received in time to appear in this report.

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

LAB CODE	F	MEANS B49	MEANS B50	COORDINATES MAJOR	COORDINATES MINOR	AVG R.SDR	VAR	PROPERTY---TEST INSTRUMENT---CONDITIONS
C705	X	41.50	54.00	-6.19	-3.99	1.05	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C506	X	42.32	55.05	-4.95	-3.49	1.41	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C422	D	42.38	59.03	-2.91	-.07	1.03	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C543	D	42.70	58.10	-3.10	-1.04	.56	78I	GLOSS, 60 DEGREE, LOCKWOOD+MCLORIE GLOSSMETER
C253	D	42.77	60.90	-1.63	1.35	.70	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C446	D	42.77	59.95	-2.11	.53	.42	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C574	D	42.87	60.80	-1.60	1.21	1.33	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C520	#	42.95	60.47	-1.69	.89	.97	78K	GLOSS, 60 DEGREE, BYK-MALLINKROOT MULTIGLOSS
C437	D	43.07	58.57	-2.54	-.81	.64	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C517	D	43.10	59.42	-2.09	-.09	1.01	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C440	D	43.42	61.22	-.91	1.31	.81	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C455	D	43.55	61.70	-.56	1.66	.78	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C462	D	43.65	60.10	-1.28	.22	1.33	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C475	D	43.75	59.25	-1.61	-.57	1.43	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C418	D	43.87	60.50	-.88	.45	.50	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C417	D	43.90	59.55	-1.33	-.38	.76	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C494	D	44.05	60.02	-.97	-.05	1.33	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C256	D	44.07	60.45	-.73	.31	1.36	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C454	D	44.18	60.90	-.41	.65	.96	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C467	D	44.37	60.37	-.51	.10	1.61	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C427	D	44.97	61.15	.40	.47	.54	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C484	D	45.00	60.50	.09	-.11	1.03	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C281	D	45.10	59.32	-.41	-1.18	.56	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C508	D	45.17	59.92	-.04	-.69	1.05	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C200	D	45.25	59.70	-.09	-.93	.81	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C206	D	45.25	59.27	-.30	-1.30	.58	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C495	D	45.25	62.62	1.37	1.61	1.47	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C251	#	45.37	61.00	.67	.14	.50	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C709	D	45.50	61.50	1.03	.51	.86	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C444	D	45.85	61.05	1.10	-.06	2.11	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C410A	D	46.00	61.50	1.46	.26	.46	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C538	D	46.25	59.75	.80	-1.38	1.11	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C420	D	46.42	59.67	.91	-1.54	1.35	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C410B	D	48.00	61.75	3.32	-.53	1.57	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C410E	*	49.00	64.50	5.56	1.35	1.39	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C410D	G	49.00	62.00	4.31	-.81	.93	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C410C	*	50.00	63.00	5.67	-.44	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
GMEANS:		44.86	60.55			1.00		
		95% ELLIPSE:		5.64	2.35	WITH GAMMA = 30 DEGREES		

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15. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

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

18. AVAILABILITY

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