MCCA

MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

COLLABORATIVE REFERENCE PROGRAM COLOR AND APPEARANCE

ASTM 60° GLOSS

REPORT NO. 24

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

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

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

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- Flammability (FF3-71 and FF5-74)

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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 78-1349

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.

September 7, 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.

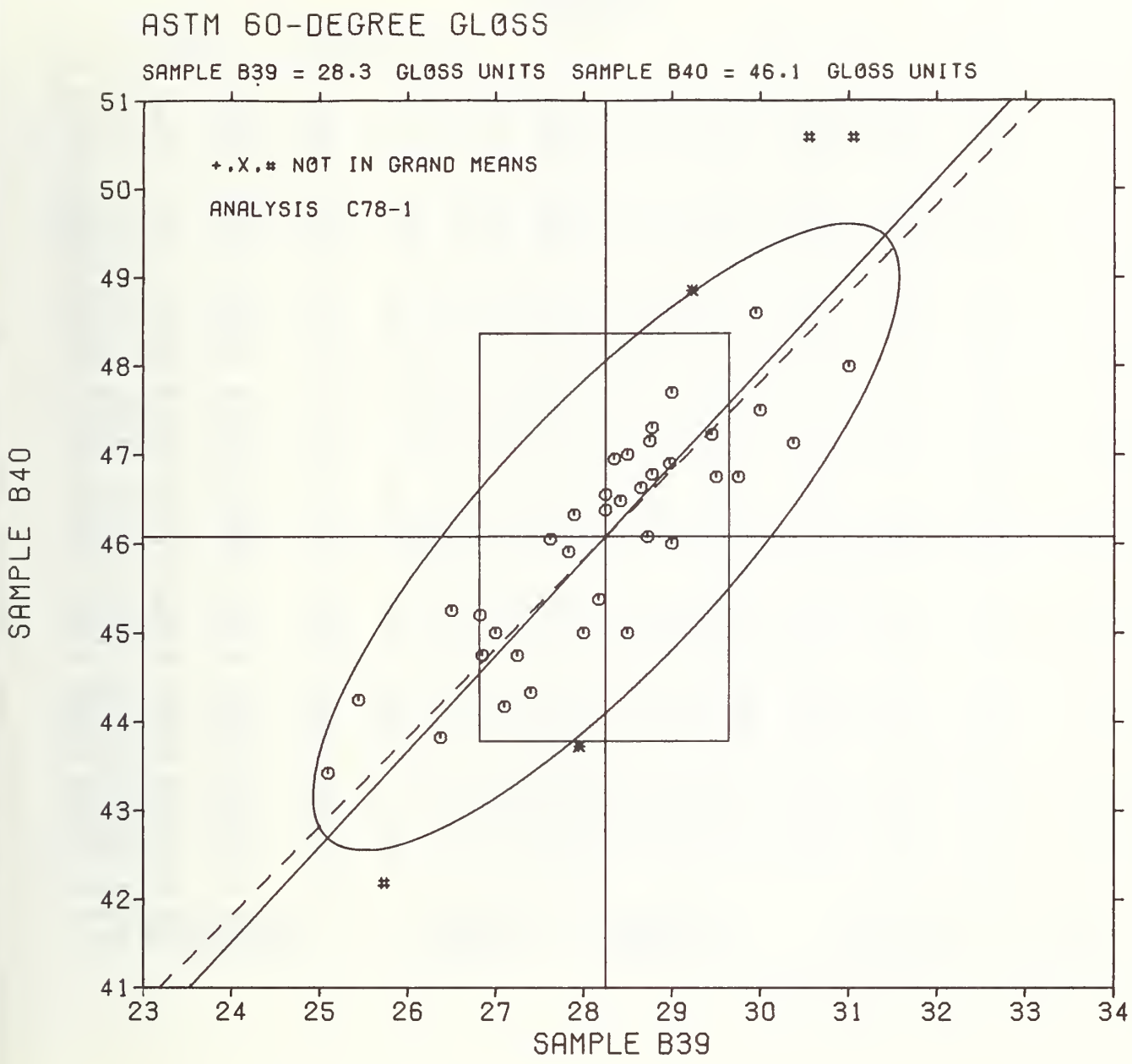
Graph - For each laboratory the MEAN for the second sample is plotted against the MEAN for the first sample, with each point representing a laboratory. The horizontal and vertical lines are the GRAND MEANS. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the 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 $\pm$ 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 B39 = 28.3 GLOSS UNITS SAMPLE B40 = 46.1 GLOSS UNITS
+,X,* NOT IN GRAND MEANS
ANALYSIS C78-1
SAMPLE B40
SAMPLE B39
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ANALYSIS C78-1 TABLE 1
60-DEGREE GLOSS
ASTM METHOD D523

LAB CODE	SAMPLE B39 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	SAMPLE B40 MEAN	GLOSS SPECIMENS DEV	N.DEV	SDR	R.SDR	TEST D.* 4 VAR	F	LAB
C200	28.75	.50	.39	.17	.48	47.15	1.07	.79	.06	.15	78S	6	C200
C251	26.50	-1.75	-1.36	.41	1.12	45.25	-.83	-.61	.29	.73	78H	6	C251
C253	25.45	-2.80	-2.18	.31	.86	44.25	-1.83	-1.34	.58	1.46	78H	6	C253
C256	29.45	1.20	.93	.48	1.32	47.22	1.15	.84	.13	.32	78F	6	C256
C281	26.82	-1.43	-1.11	.21	.57	45.20	-.88	-.65	.08	.21	78D	6	C281
C410A	27.00	-1.25	-.97	.00	.00	45.00	-1.08	-.79	.00	.00	78H	6	C410A
C410B	30.50	2.25	1.75	.58	1.59	50.50	4.42	3.25	.58	1.46	78H	#	C410B
C410C	31.00	2.75	2.14	.00	.00	50.50	4.42	3.25	.58	1.46	78H	#	C410C
C410D	29.00	.75	.58	.00	.00	46.00	-.08	-.06	.00	.00	78H	6	C410D
C410E	28.00	-.25	-.19	.00	.00	45.00	-1.08	-.79	.00	.00	78H	6	C410E
C417	29.95	1.70	1.32	.35	.97	48.60	2.52	1.85	.22	.55	78F	6	C417
C418	27.25	-1.00	-.78	.96	2.63	44.75	-1.33	-.98	.50	1.26	78C	6	C418
C420	28.97	.72	.56	.15	.41	46.90	.82	.60	.08	.21	78F	6	C420
C422	27.83	-.42	-.32	.28	.77	45.91	-.17	-.12	.32	.80	78C	6	C422
C426	28.17	-.08	-.06	.43	1.20	45.37	-.70	-.52	.17	.43	78E	6	C426
C427	29.22	.97	.76	.46	1.28	48.85	2.77	2.03	.13	.33	78F	*	C427
C437	27.10	-1.15	-.90	.18	.50	44.17	-1.90	-1.40	.61	1.55	78D	6	C437
C440	28.35	.10	.08	.19	.53	46.95	.87	.64	.06	.15	78F	6	C440
C443	28.50	.25	.19	1.29	3.55	45.00	-1.08	-.79	.82	2.06	78C	6	C443
C444	29.00	.75	.58	.26	.71	47.70	1.62	1.19	.27	.68	78H	6	C444
C445	28.42	.17	.14	.25	.69	46.47	.40	.29	.59	1.49	78F	6	C445
C446	27.62	-.63	-.49	.51	1.39	46.05	-.03	-.02	.48	1.21	78S	6	C446
C454	27.40	-.85	-.66	.68	1.86	44.33	-1.75	-1.28	.95	2.41	78E	6	C454
C455	25.67	-2.58	-2.01	.61	1.69	42.10	-3.98	-2.92	.49	1.24	78P	#	C455
C462	28.25	-.00	-.00	.06	.16	46.55	.47	.35	.40	1.02	78F	6	C462
C467	26.85	-1.40	-1.09	.13	.36	44.75	-1.33	-.98	.53	1.33	78D	6	C467
C475	30.00	1.75	1.36	.00	.00	47.50	1.42	1.04	.58	1.46	78B	6	C475
C477	28.72	.47	.37	.94	2.59	46.07	-.00	-.00	1.02	2.58	78F	6	C477
C479	27.90	-.35	-.27	.52	1.44	46.32	.25	.18	.37	.93	78D	6	C479
C484	29.50	1.25	.97	.58	1.59	46.75	.67	.49	.96	2.42	78B	0	C484
C504	28.25	-.00	-.00	.29	.79	46.37	.30	.22	.48	1.21	78S	6	C504
C506	27.95	-.30	-.23	.40	1.11	43.72	-2.35	-1.73	.40	1.02	78E	*	C506
C510	30.37	2.12	1.65	.48	1.32	47.12	1.05	.77	.25	.63	78K	6	C510
C517	28.65	.40	.31	.24	.65	46.62	.55	.40	.15	.38	78F	6	C517
C520	28.77	.52	.41	.13	.35	46.77	.70	.51	.71	1.80	78K	6	C520
C531	25.10	-3.15	-2.45	.35	.95	43.42	-2.65	-1.95	.05	.13	78H	6	C531
C538	28.50	.25	.19	.58	1.59	47.00	.92	.68	.82	2.06	78H	6	C538
C543	31.00	2.75	2.14	.00	.00	48.00	1.92	1.41	.00	.00	78I	6	C543
C574	29.75	1.50	1.17	.96	2.63	46.75	.67	.49	.96	2.42	78D	6	C574
C576	28.77	.52	.41	.13	.35	47.30	1.22	.90	.58	1.47	78F	6	C576
C612	26.37	-1.88	-1.46	.61	1.67	43.82	-2.25	-1.66	.21	.52	78D	6	C612

GR. MEAN = 28.25 GLOSS UNITS GRAND MEAN = 46.08 GLOSS UNITS TEST DETERMINATIONS = 4
SD MEANS = 1.28 GLOSS UNITS SD OF MEANS = 1.36 GLOSS UNITS 38 LABS IN GRAND MEANS
AVERAGE SDR = .36 GLOSS UNITS AVERAGE SDR = .40 GLOSS UNITS
TOTAL NUMBER OF LABORATORIES REPORTING = 41

Best Values: B39 28.2 ± 3.0 gloss units
B40 46.6 ± 3.0 gloss units

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

LAB CODE	F	MEANS B39	MEANS B40	COORDINATES MAJOR	COORDINATES MINOR	AVG R.SDR	VAR	PROPERTY---TEST INSTRUMENT---CONDITIONS
C531	6	25.10	43.42	-4.09	.50	.54	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C253	6	25.43	44.25	-3.25	.80	1.16	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C455	#	25.67	42.10	-4.67	-.83	1.46	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C612	6	26.37	43.82	-2.93	-.16	1.10	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C251	6	26.50	45.25	-1.80	.72	.93	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C281	6	26.82	45.20	-1.61	.44	.39	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C467	6	26.85	44.75	-1.93	.12	.84	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C410A	6	27.00	45.00	-1.64	.18	.00	78E	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C437	6	27.10	44.17	-2.18	-.46	1.02	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C418	6	27.25	44.75	-1.65	-.17	1.95	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C454	6	27.40	44.33	-1.86	-.57	2.14	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C446	6	27.62	46.05	-.45	.44	1.30	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C422	6	27.83	45.91	-.41	.19	.79	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C479	6	27.90	46.32	-.06	.42	1.18	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C506	*	27.95	43.72	-1.93	-1.38	1.06	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C410E	6	28.00	45.00	-.96	-.55	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C426	6	28.17	45.37	-.57	-.42	.81	78E	GLOSS, 60 DEGREE, HUNTER D16 GLOSSMETER
C504	6	28.25	46.37	.22	.20	1.00	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C462	6	28.25	46.55	.34	.32	.59	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C440	6	28.35	46.95	.71	.52	.34	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C445	6	28.42	46.47	.41	.14	1.09	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C538	6	28.50	47.00	.84	.44	1.82	78E	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C443	6	28.50	45.00	-.62	-.92	2.81	78C	GLOSS, 60 DEGREE, GARDNER PORTABLE GLOSSMETER
C517	6	28.65	46.62	.67	.08	.52	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C477	6	28.72	46.07	.32	-.35	2.59	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C200	6	28.75	47.15	1.12	.36	.31	78S	GLOSS, 60 DEGREE, SPECIAL INSTRUMENT
C576	6	28.77	47.30	1.25	.45	.91	78F	GLOSS, 60 DEGREE, BUNTER D48 GLOSSMETER
C520	6	28.77	46.77	.87	.09	1.07	78K	GLOSS, 60 DEGREE, BYK-MALLINKRODT MULTIGLOSS
C420	6	28.97	46.90	1.09	.03	.31	78P	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C444	6	29.00	47.70	1.70	.56	.70	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C410D	6	29.00	46.00	.45	-.60	.00	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C427	*	29.22	48.85	2.69	1.18	.80	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C256	6	29.45	47.22	1.66	-.10	.82	78F	GLOSS, 60 DEGREE, HUNTER D48 GLOSSMETER
C484	6	29.50	46.75	1.34	-.46	2.00	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C574	6	29.75	46.75	1.51	-.64	2.53	78D	GLOSS, 60 DEGREE, GARDNER PRECISION GLOSSMETER
C417	6	29.95	48.60	3.00	.47	.76	78F	GLOSS, 60 DEGREE, BUNTER D48 GLOSSMETER
C475	6	30.00	47.50	2.23	-.31	.73	78B	GLOSS, 60 DEGREE, GARDNER MULTIANGLE GLOSSMETER
C510	6	30.37	47.12	2.21	-.84	.97	78K	GLOSS, 60 DEGREE, BYK-MALLINKRODT MULTIGLOSS
C410B	#	30.50	50.50	4.77	1.37	1.52	78E	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
C543	6	31.00	48.00	3.28	-.70	.00	78I	GLOSS, 60 DEGREE, LOCKWOOD-MCLORIE GLOSSMETER
C410C	#	31.00	50.50	5.11	1.00	.73	78H	GLOSS, 60 DEGREE, GARDNER GLOSSGARD-60
GMEANS:		28.25	46.08			1.00		
95% ELLIPSE:				4.63	1.42	WITH GAMMA = 47 DEGREES		

NBS-114A (REV. 7-73)

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15. SUPPLEMENTARY NOTES

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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