NBS PUBLICATIONS





MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

# COLLABORATIVE REFERENCE PROGRAM COLOR AND APPEARANCE

ASTM 60° GLOSS REPORT NO. 27



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)

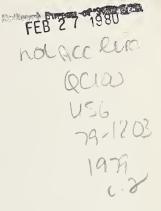
# AASHTO Bituminous

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



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

# MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE



# FOR COLOR AND APPEARANCE

ASTM 60° Gloss

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Office of Engineering Standards
National Engineering Laboratory

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U. S. DEPARTMENT OF COMMERCE National Bureau of Standards



#### 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.

July 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:

# -

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 reexamine 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.



78D # C612

# C659

₱ C690

785

78B

#### MCCA COLLABORATIVE REFERENCE PROGRAM ANALYSIS C78-1 TABLE 1 60-DEGREE GLOSS ASTM METHOD D523

SAMPLE GLESS SPECIMENS SAMPLE GLOSS SPECIMENS TEST Do = 4 LAB B45 B46 DEV VAR F LAB CODE MEAN DEV N. DEV SDR R. SDR MEAN N. DEV SDR R. SDR .76 1.17 81.70 C200 67,20 1.06 .53 .08 78S 6 C200 .66 m 46 .12 .67 . 47 .41 81.00 o36 .18 1.47 78H Ø C251 C251 66.50 . 27 2.08 . 90 C256 67.02 1.00 .56 o55 79.60 -1.04 -. 52 1.16 1.63 78E ₫ C256 66,97 .95 .53 . 42 .69 80.10 -027 1.65 78D 6 C281 C281 -.54 1.17 .00 69.00 2.97 1.67 .00 79.75 3,53 78 H # C410A C410A -.89 -. 45 2.50 C410B 67,50 1.47 . 83 .58 . 95 78**.7**5 -1.89 78H 6 C410B -0 94 . 50 67.00 . 97 •55 .00 00 81.00 .18 781 Ø C410C C410C 。36 .00 .00 .00 .00 C410D 67.00 • 97 • **5**5 78,50 -2.14 -1<sub>c</sub> 07 3,00 4 0 2 3 78H e C410D .00 .00 C410E 66.50 .47 .27 1.00 1.64 81.00 .36 .18 78H 6 C410E 049 .48 . 98 C418 65, 37 -.65 -.37 .79 81.62 . 48 .68 78C 6 C418 .42 .69 .58 C420 65.65 **-.**38 -.21 79.90 **-.74 -.**37 .82 78F 6 C420 C422 64.56 -1.47 -.83 1.24 20 04 80.19 -,46 -<sub>0</sub> 23 .50 .70 785 6 C422 . 56 6 C427 C427 67.85 1.82 1.03 o34 82.65 2.01 1.00 .33 047 78F .85 1.70 78D 6 C437 C437 66.87 .48 .67 1.09 80.10 -.54 **-**₀ 27 1,21 .34 .24 CAAO 65.57 -.45 -, 25 1.14 1.88 82,85 2.21 1.10 78F 6 C440 78C # C443 61.00 -5.03 -2.83 75.00 -2-81 3, 05 C443 1.41 2.32 -5.64 2.16 78H 。51 。71 78.57 6 C444 C444 65.82 -. 20 -.11 . 84 -2.07 -1.03 1.73 2.44 .71 1.01 6 C445 1.17 78F C445 65,50 81.82 1.18 -.53 -.30 。59 6 C446 .27 1.05 81.75 C446 1.72 1.08 785 66.50 .47 1.11 • 55 .77 Ø C454 1.00 .77 78E C454 66,38 -35 a 20 .61 83.00 2.36 1.18 1.08 C455 66,12 . 10 。05 .69 1.13 81.07 .43 。22 .59 .83 78F 6 C455 C462 67.45 1.42 .80 042 .69 81.32 .68 .34 · 26 .37 78G Ø C462 . 45 C467 65,80 **⇔**₀ 23 -.13 .64 1.05 81.72 1.08 . 54 .32 78D 6 C467 1.57 C475 64,25 -1.78 -1.00 .96 80,50 -. 07 . 58 .81 78B 6 C475 -014 C477 66,80 .77 .44 .59 . 97 81.75 1.11 **.** 55 . 44 。63 78F 6 C477 -.07 C479 78D e C479 65,90 -.13 o 52 .86 82<sub>0</sub>20 1.56 .78 o 42 .60 C484 65,00 -1.03 -,58 .82 1.34 81.50 .86 .43 1.00 1 . 41 78B 6 C484 4.97 .91 78Ħ # C495 C495 71.00 2.80 2.94 4.84 93,50 12,86 60 41 1.29 C494 .17 78B F C494 64.50 -1.53 -. 86 .39 . 64 80,52 -.12 -. 06 。24 C5C4 。33 .75 78L € C504 66.07 。05 。03 . 54 80,40 -<sub>0</sub> 12 .53 -2098 1.40 1.98 C506 61,22 -4.80 -2.70 1.00 1.65 74.67 -5.97 785 # C506 <sub>6</sub>55 .59 . 83 C508 67,00 。97 .18 .30 81.17 。53 。27 78F 6 C508 C5 1.0 66<sub>0</sub> 25 。22 .13 96 1.57 81.00 。36 。18 1 . 4 1 1.99 78K e c510 .58 e C520 C520 66,25 .22 o13 o 95 80<sub>0</sub>65 .01 .00 .86 1.21 78 K o 43 .58 .81 6 C538 C538 66,75 .72 .41 1.89 3,11 81.50 .86 78H .37 C576 2,57 .53 78F \* C576 70.30 4-27 2.41 062 1.01 85,80 5.16

GR. MEAN = 66.03 GLØSS UNITS GRAND MEAN = 80.64 GLØSS UNITS TEST DETERMINATIONS = 4
SD MEANS = 1.78 GLØSS UNITS SD ØF MEANS = 2.01 GLØSS UNITS 37 LABS IN GRAND MEANS

AVERAGE SDR = .61 GLØSS UNITS AVERAGE SDR = .61 GLØSS UNITS

TOTAL NUMBER = 4F LABGRATØRIES REPØRTING = 39

81, 25

90.37

77.87

.29

.48

. 65

041

.68

。92

.30

4.85

-1.38

.61

9,73

-2.77

.08

. 85

-44

o 13

.72

1.40

-.75

3,57

-1.79

Best values: B45 66.85  $\pm$  3 gloss units B46 81.73  $\pm$  3 gloss units

-1.33

6.35

-3.18

64.70

72,37

62,85

C612

C659

C690

#### MCCA COLLABORATIVE REFERENCE PROGRAN ANALYSIS C78-1 TABLE 2 60-DEGREE GLOSS ASTN METHOD D523

LAB		MEANS		COORDINATES		AVG					
CODE	F	B45	B46	MAJOR	MINGR	R. SDR	VAR	PROPERTYTEST		YTEST	INSTRUMENT CANDITIONS
	-										
C443	*	61.00	75.00	<b>-7.55</b>	. 25	2.69	78C	GT.ESS.	60	DEGREE.	GARDNER RORTABLE GLOSSWETER
	*	-	740 67	-7.66	14						HUNTER DIG GLESSMETER
	ø		77.87	-4.16	67						GARDNER MULTIANGLE GLESSMETER
C475	ĕ	-	80.50	-1.25	1.27						GARDNER MULTIANGLE GLASSNETER
C494				-1.07	1.10						GARDNER MULTIANGLE GLOSSNETER
C494		04.50	00, 32	-1001	1.10		, 01	ODOGG,	-	DEGREE,	OARDNER MOD! TANGED GEO! SRETER
C422	a	64.56	90.10	-1.29	.84	1.37	705	CTACC	60	DECREE	SRECIAL INSTRUMENT
		-	81.25	38	1.41						GARDNER PRECISION GLOSSMETER
C484	e		81.50	00	1.34						GARDNER MULTIANGLE GLØSSMETER
			_	-	-						GARDNER RORTABLE GLOSSMETER
		_	-	. 34	1.13						
C445	61	65,50	81.82	• 57	1.16	1009	/8F	GLess,	60	DEGREE,	HUNTER D48 GLOSSMETER
							=			DEGE==	WINDOWS DAY OF GROWERS
		65.57	82.85	1.40	1.76						HUNTER DAS GLOSSMETER
C420				81	19						HUNTER D48 GLOSSMETER
C467	M		81.72	. 69	. 87						GARDNER PRECISION GLOSSMETER
C444				-1.72	-1.17						GARDNER GLESSGARD-60
C479	M	65,90	82.20	1.11	1.10	73 ه	78D	GL#SS,	60	DEGREE,	GARDNER RRECISION GLOSSMETER
C504		_	80.40	16	19						SHEEN DIGITAL
		66.12	81.07	.39	•20						HUNTER D48 GLESSMETER
C520			80.65	.15	17						BYK-MALLINKRODT WULTIGLOSS
	Ø			e 42	.06						BYK-MALLINKRODT MULTIGLOSS
C454	Ħ	66.38	83.00	2.04	1.24	1.04	78E	GLESS,	60	DEGREE,	HUNTER DIG GLASSMETER
C446		66.50	81.75	1.15	。35						SRECIAL INSTRUMENT
C251			81.00	<sub>e</sub> 58	13						GARDNER GLASSGARD-60
C41 0E		66.50	81.00	<sub>e</sub> 58	13						GARDNER GLASSGARD-60
C538			81.50	1.12	01	1.96	78 H	GLASS,	60	DEGREE,	GARDNER GLESSGARD-60
C477	Ø	66.80	81.75	1.35	.12	.80	78F	GLASS,	60	DEGREE,	HUNTER D48 GLGSSMETER
C437	đ	66.87	80.10	• 13	<b>~1.00</b>						GARDNER PRECISION GLOSSMETER
C281	ศ	66.97	80.10	. 19	-1.08	1.17	78D	GLASS,	60	DEGREE,	GARDNER RRECISION GLASSMETER
C508	A	67.00	81.17	1.03	41	o 57	78F	GLESS,	60	DEGREE,	HUNTER D48 GL6SSMETER
C410C	e e	67.00	81.00	.90	<b>-</b> ₀ 52	.00	78 H	GLASS.	60	DEGREE.	GAPDNER GLESSGARD-60
C41 0D	6	67.00	78.50	-1.02	-2.12	2,12	78H	GLESS,	60	DEGREE,	GARDNER GLASSGARD-60
C256	Ø	67.02	79.60	16	-1.43	1.27	78E	GLASS,	60	DEGREE,	HUNTER DIG GLESSMETER
C200	e	67.20	81.70	1,56	22	. 44	78S	GLOSS.	60	DEGREE.	SPECIAL INSTRUMENT
C462	e	67.45	81.32	1.44	66						RHCTOVOLT NODEL 670
C410B	e	67.50	78.75	51	-2.34						GARDNER GLASSGARD-60
C427	6	67.85	82.65	2.71	11						HUNTER DAS GLASSMETER
					•	•					
C41 0A	*	69,00	79.75	1.22	-2.85	1.76	78H	GLESS.	60	DEGREE.	GARDNEP GLESSCAPD-60
C576		70,30	85.80	6,70	.02						HUNTER DAS GLØSSMETER
C495	#	_	93.50	13, 06	4.42						GARDNER GLASSGARD-60
		72.37	_	11.54	1.36						SPECIAL INSTRUMENT
			•					,	-	,	
GYEANS	:	66.03	80.64			1.00					
		-	LLIPSE:	6,35	2.80		GAMA	(A = 50	DEC	REES	
				-05	-400		J	30			

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