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NBS
PUBLICATIONS

MCCA

MANUFACTURERS COUNCIL ON COLOR AND APPEARANCE

**COLLABORATIVE REFERENCE PROGRAM
COLOR AND APPEARANCE**

ASTM 60° GLOSS

REPORT NO. 26 -



**U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards**

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79-1378
1979
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NBS COLLABORATIVE REFERENCE PROGRAMS

TAPPI Paper and Board (6 times per year)

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

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**MANUFACTURERS COUNCIL ON
COLOR AND APPEARANCE**

**COLLABORATIVE REFERENCE PROGRAM
FOR
COLOR AND APPEARANCE**

ASTM 60° Gloss

**J. Horlick
Office of Testing Laboratory Evaluation Technology
Office of Engineering Standards
National Engineering Laboratory**

**T. L. Cummings
CTS-NBS Research Associate**

**U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards**

NBSIR 79-1378



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.

June 13, 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 ± 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.

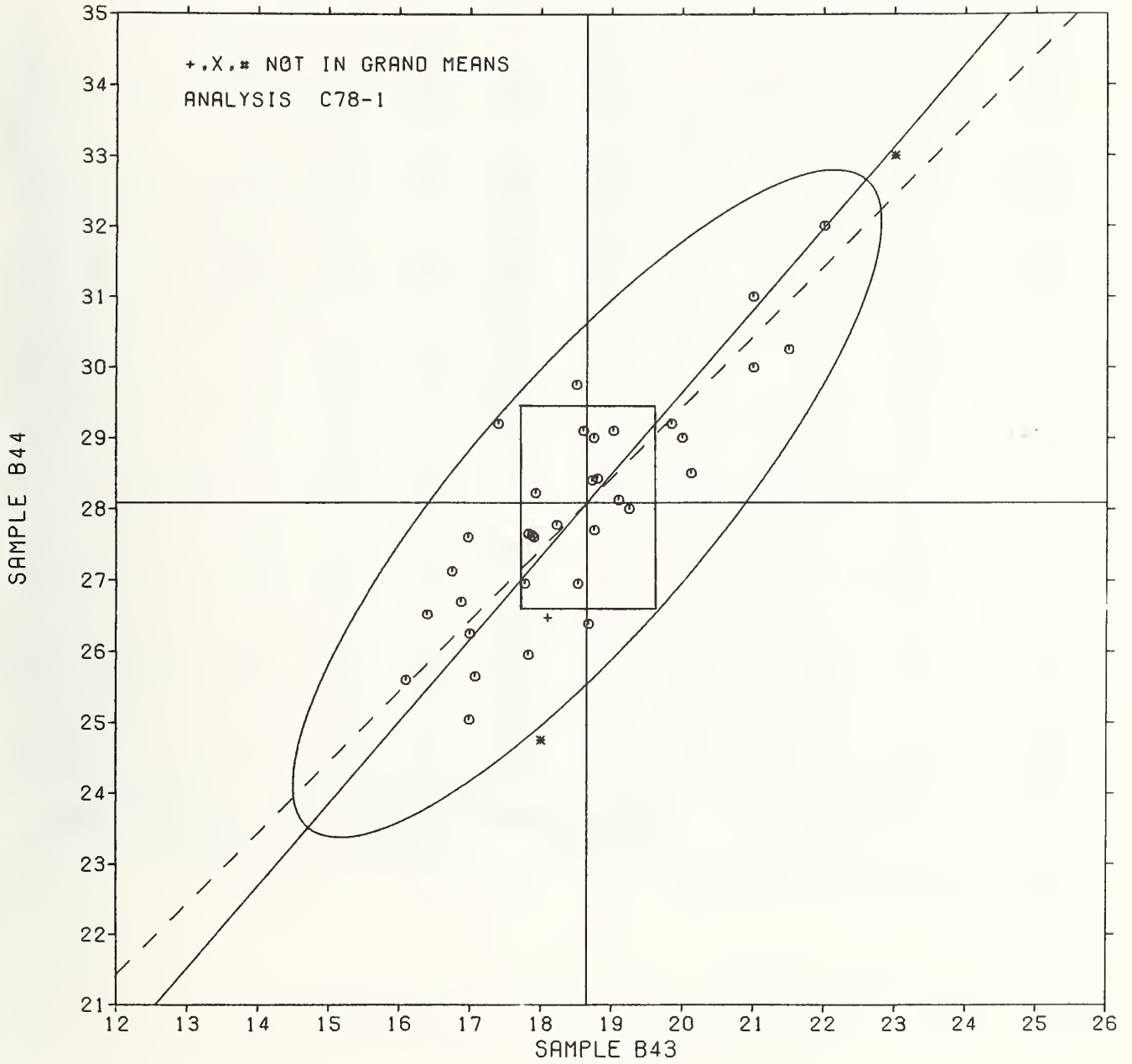
Note: Graphs are plotted with an ellipse when there are 20 or more instruments in the analysis. When there are 10 through 19 instruments in the analysis, the graph will be plotted but ellipses will be omitted. When there are fewer than 10 instruments retained in the analysis, the graph will not be plotted.

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 B43 = 18.7 GLOSS UNITS SAMPLE B44 = 28.1 GLOSS UNITS



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

LAB CODE	SAMPLE B43 GLOSS SPECIMENS					SAMPLE B44 GLOSS SPECIMENS					TEST D. - 4			
	MEAN	DEV	N. DEV	SDR	R. SDR	MEAN	DEV	N. DEV	SDR	R. SDR	VAR	F	LAB	
C251	16.75	-1.90	-1.19	.65	1.62	27.12	-.96	-.53	.63	.98	78H	Ø	C251	
C253	16.87	-1.78	-1.11	.33	.83	26.70	-1.38	-.76	.52	.82	78H	Ø	C253	
C256	18.75	.10	.06	.52	1.30	27.70	-.38	-.21	.58	.90	78E	Ø	C256	
C281	16.97	-1.68	-1.05	.13	.32	27.60	-.48	-.27	.41	.64	78D	Ø	C281	
C410A	20.00	1.35	.84	.00	.00	29.00	.92	.50	.00	.00	78H	Ø	C410A	
C410B	22.00	3.35	2.09	.00	.00	32.00	3.92	2.16	.00	.00	78H	Ø	C410B	
C410C	21.00	2.35	1.47	.00	.00	31.00	2.92	1.60	.00	.00	78H	Ø	C410C	
C410D	23.00	4.35	2.71	.00	.00	33.00	4.92	2.71	.00	.00	78H	*	C410D	
C410E	21.00	2.35	1.47	.00	.00	30.00	1.92	1.05	.82	1.27	78H	Ø	C410E	
C417	19.10	.45	.28	.12	.29	28.12	.04	.02	.50	.78	78F	Ø	C417	
C418	17.87	-.78	-.48	.25	.63	27.62	-.46	-.25	.75	1.17	78C	Ø	C418	
C420	37.97	19.32	12.06	.05	.13	45.10	17.02	9.36	.18	.28	78F	X	C420	
C422	16.99	-1.66	-1.04	1.16	2.92	25.04	-3.05	-1.68	.52	.81	78S	Ø	C422	
C427	18.22	-.43	-.27	.10	.24	27.77	-.31	-.17	.25	.39	78F	Ø	C427	
C437	17.92	-.73	-.45	2.15	5.38	28.22	.14	.08	2.46	3.83	78D	Ø	C437	
C440	18.80	.15	.09	.29	.74	28.42	.34	.19	.46	.71	78F	Ø	C440	
C443	19.25	.60	.37	.50	1.25	28.00	-.08	-.05	.00	.00	78C	Ø	C443	
C444	19.85	1.20	.75	.50	1.25	29.20	1.12	.61	.86	1.34	78C	Ø	C444	
C445	17.82	-.83	-.52	.33	.83	25.95	-2.13	-1.17	.51	.79	78F	Ø	C445	
C446	17.07	-1.58	-.98	1.01	2.54	25.65	-2.43	-1.34	.75	1.17	78S	Ø	C446	
C454	18.67	.02	.01	.39	.98	26.39	-1.69	-.93	.84	1.31	78E	Ø	C454	
C455	17.77	-.88	-.55	.38	.95	26.95	-1.13	-.62	.49	.77	78F	Ø	C455	
C462	52.15	33.50	20.91	.82	2.05	81.10	53.02	29.18	.93	1.45	78F	X	C462	
C475	18.00	-.65	-.41	.00	.00	24.75	-3.33	-1.83	.50	.78	78B	*	C475	
C477,	18.72	.07	.05	.32	.80	28.40	.32	.17	.76	1.19	78F	Ø	C477	
C479	17.90	-.75	-.47	.27	.68	27.60	-.48	-.27	.38	.60	78H	Ø	C479	
C484	18.50	-.15	-.09	.58	1.45	29.75	1.67	.92	.50	.78	78B	Ø	C484	
C494	18.75	.10	.06	.06	.14	29.00	.92	.50	.59	.93	78B	Ø	C494	
C495	17.00	-1.65	-1.03	.41	1.02	26.25	-1.83	-1.01	.96	1.49	78H	Ø	C495	
C506	17.40	-1.25	-.78	.58	1.46	29.20	1.12	.61	.84	1.31	78E	Ø	C506	
C508	18.52	-.13	-.08	.21	.52	26.95	-1.13	-.62	.10	.16	78F	Ø	C508	
C517	17.82	-.83	-.52	.44	1.11	27.65	-.43	-.24	.52	.81	78F	Ø	C517	
C520	19.02	.37	.23	.22	.56	29.10	1.02	.56	.55	.85	78K	Ø	C520	
C538	21.50	2.85	1.78	.58	1.45	30.25	2.17	1.19	.50	.78	78H	Ø	C538	
C543	18.60	-.05	-.03	.00	.00	29.10	1.02	.56	1.39	2.16	78I	Ø	C543	
C574	16.40	-2.25	-1.40	.48	1.19	26.52	-1.56	-.86	.96	1.50	78D	Ø	C574	
C612	16.10	-2.55	-1.59	.36	.89	25.60	-2.48	-1.37	2.08	3.25	78D	Ø	C612	
C659	20.12	1.47	.92	.25	.63	28.50	.42	.23	.58	.90	78S	Ø	C659	
C690	20.00	1.35	.84	.41	1.02	29.00	.92	.50	.41	.64	78C	Ø	C690	
GR. MEAN =	18.65	GLOSS UNITS				GRAND MEAN =	28.08	GLOSS UNITS				TEST DETERMINATIONS =		
SD MEANS =	1.60	GLOSS UNITS				SD OF MEANS =	1.82	GLOSS UNITS				37 LABS IN GRAND MEANS		
		AVERAGE SDR =				.40	GLOSS UNITS				AVERAGE SDR =			
											.64			
C504	18.10	-.55	-.34	.23	.58	26.47	-1.61	-.89	.61	.96	78L	*	C504	
TOTAL NUMBER OF LABORATORIES REPORTING = 40														

Best values: B43 68.30 ± 3 gloss units
B44 102.60 ± 3 gloss units

MCCA COLLABORATIVE REFERENCE PROGRAM
 ANALYSIS C78-1 TABLE 2
 60-DEGREE GLÖSS
 ASTM METHOD D523

LAB CODE	F	MEANS		COORDINATES		AVG R, SDR VAR	PROPERTY---TEST	INSTRUMENT---CONDITIONS
		B43	B44	MAJOR	MINOR			
C612	Ø	16.10	25.60	-3.55	.31	2.07	78D GLÖSS, 60 DEGREE,	GARDNER PRECISION GLÖSSMETER
C574	Ø	16.40	26.52	-2.65	.69	1.35	78D GLÖSS, 60 DEGREE,	GARDNER PRECISION GLÖSSMETER
C251	Ø	16.75	27.12	-1.97	.81	1.30	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C253	Ø	16.87	26.70	-2.21	.44	.82	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C281	Ø	16.97	27.60	-1.46	.95	.48	78D GLÖSS, 60 DEGREE,	GARDNER PRECISION GLÖSSMETER
C422	Ø	16.99	25.04	-3.39	-.73	1.86	78S GLÖSS, 60 DEGREE,	SPECIAL INSTRUMENT
C495	Ø	17.00	26.25	-2.47	.05	1.26	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C446	Ø	17.07	25.65	-2.87	-.39	1.86	78S GLÖSS, 60 DEGREE,	SPECIAL INSTRUMENT
C506	Ø	17.40	29.20	.03	1.68	1.39	78E GLÖSS, 60 DEGREE,	HUNTER D16 GLÖSSMETER
C455	Ø	17.77	26.95	-1.43	-.08	.86	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C517	Ø	17.82	27.65	-.87	.34	.96	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C445	Ø	17.82	25.95	-2.16	-.77	.81	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C418	Ø	17.87	27.62	-.85	.29	.90	78C GLÖSS, 60 DEGREE,	GARDNER PORTABLE GLÖSSMETER
C479	Ø	17.90	27.60	-.86	.25	.64	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C437	Ø	17.92	28.22	-.37	.64	4.61	78D GLÖSS, 60 DEGREE,	GARDNER PRECISION GLÖSSMETER
C475	*	18.00	24.75	-2.95	-1.68	.39	78B GLÖSS, 60 DEGREE,	GARDNER MULTIANGLE GLÖSSMETER
C504	*	18.10	26.47	-1.58	-.63	.77	78L GLÖSS, 60 DEGREE,	SHEEN DIGITAL
C427	Ø	18.22	27.77	-.51	.12	.31	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C484	Ø	18.50	29.75	1.16	1.20	1.11	78B GLÖSS, 60 DEGREE,	GARDNER MULTIANGLE GLÖSSMETER
C508	Ø	18.52	26.95	-.94	-.64	.34	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C543	Ø	18.60	29.10	.74	.70	1.08	78I GLÖSS, 60 DEGREE,	LÖCKWÖD*MCLÖRIE GLÖSSMETER
C454	Ø	18.67	26.39	-1.27	-1.12	1.14	78E GLÖSS, 60 DEGREE,	HUNTER D16 GLÖSSMETER
C477	Ø	18.72	28.40	.29	.15	1.00	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C256	Ø	18.75	27.70	-.23	-.33	1.10	78E GLÖSS, 60 DEGREE,	HUNTER D16 GLÖSSMETER
C494	Ø	18.75	29.00	.76	.52	.54	78B GLÖSS, 60 DEGREE,	GARDNER MULTIANGLE GLÖSSMETER
C440	Ø	18.80	28.42	.36	.11	.73	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C520	Ø	19.02	29.10	1.01	.38	.71	78K GLÖSS, 60 DEGREE,	BYK-MALLINKRÖDT MULTI GLÖSS
C417	Ø	19.10	28.12	.32	-.31	.53	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C443	Ø	19.25	28.00	.33	-.51	.63	78C GLÖSS, 60 DEGREE,	GARDNER PORTABLE GLÖSSMETER
C444	Ø	19.85	29.20	1.63	-.18	1.30	78C GLÖSS, 60 DEGREE,	GARDNER PORTABLE GLÖSSMETER
C690	Ø	20.00	29.00	1.57	-.42	.83	78C GLÖSS, 60 DEGREE,	GARDNER PORTABLE GLÖSSMETER
C410A	Ø	20.00	29.00	1.57	-.42	.00	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C659	Ø	20.12	28.50	1.28	-.85	.76	78S GLÖSS, 60 DEGREE,	SPECIAL INSTRUMENT
C410C	Ø	21.00	31.00	3.74	.12	.00	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C410E	Ø	21.00	30.00	2.98	-.53	.64	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C538	Ø	21.50	30.25	3.50	-.74	1.11	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C410B	Ø	22.00	32.00	5.15	.02	.00	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C410D	*	23.00	33.00	6.56	-.09	.00	78H GLÖSS, 60 DEGREE,	GARDNER GLÖSSGARD-60
C420	X	37.97	45.10	25.50	-3.54	.21	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
C462	X	52.15	81.10	62.03	9.22	1.75	78F GLÖSS, 60 DEGREE,	HUNTER D48 GLÖSSMETER
GMEANS:		18.65	28.08			1.00		
		95% ELLIPSE:		6.03	1.75		WITH GAMMA = 49 DEGREES	

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. MCCA Gloss CRP 26	2. Gov't. Accession No.	3. Recipient's Accession No.
4. TITLE AND SUBTITLE Manufacturers Council on Color and Appearance COLLABORATIVE REFERENCE PROGRAM, COLOR AND APPEARANCE ASTM 60°, Report No. 26		5. Publication Date June 13, 1979	6. Performing Organization Code
7. AUTHOR(S) J. Horlick, T. L. Cummings	8. Performing Organ. Report No. NBSIR 79-1378		
9. PERFORMING ORGANIZATION NAME AND ADDRESS NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, DC 20234		10. Project/Task/Work Unit No.	11. Contract/Grant No.
12. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (Street, City, State, ZIP) Collaborative Testing Services, Inc., 9241 Wood Glade Drive, Great Falls, Virginia 22066; and Manufacturers Council on Color and Appearance		13. Type of Report & Period Covered Final	14. Sponsoring Agency Code
15. SUPPLEMENTARY NOTES <input type="checkbox"/> 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 <input type="checkbox"/> Unlimited <input checked="" type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input type="checkbox"/> Order From Sup. of Doc., U.S. Government Printing Office, Washington, DC 20402, SD Stock No. SN003-003- <input type="checkbox"/> Order From National Technical Information Service (NTIS), Springfield, VA, 22161		19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED	21. NO. OF PRINTED PAGES 9
		20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED	22. Price

