INTERLABORATORY PROGRAMS FOR RUBBER

ANALYSES NO. 35
JANUARY - MARCH 1978

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

Rev. 4/77

INTERLABORATORY PROGRAMS FOR RUBBER

Analyses No. 35
January - March 1978

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

J. F. Stevenson, T. L. Cummings, Research Associates,
Collaborative Testing Services, Inc.

G. W. Bullman
Polymers Science and Standards Division
Center for Materials Research
National Measurement Laboratory

U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBSIR 78-1339

INTRODUCTION

This report summarizes the test results for the first quarter of 1978. The tests cover the four areas in the NBS Collaborative Reference Programs for Rubber: Tensile Properties, Hardness, Mooney Viscosity, and Vulcanization Properties.

For each of the four areas, there is a set of summary tables followed by a table of data and analysis by laboratory and a graphical presentation of the data and analysis. Where applicable, the tables of data have the English and Metric expressions side-by-side. Additional details are given in the section "Key to Tables and Graphs."

If there are questions or comments on the notes, the analyses, or the reports in general, contact Edwin B. Randall, Jr., Jeffrey Horlick, or Jeffrey Stevenson, (301) 921-2946.

Edwin B. Randall, Jr., Administrator
NBS Collaborative Reference Programs
Office of Testing Laboratory Evaluation Technology

June 12, 1978

TABLE OF CONTENTS

KEY TO TABLES AND GRAPHS

LAB CODE Confidential laboratory identification number known only to the participant and the Collaborative Reference Program staff.

F A flag identifying results that are extreme in comparison with the other results.

- **X** - The plotted point for the indicated laboratory lies outside of the 99% error ellipse (not shown); ie, assuming normal distribution, 99% of laboratories similar to those participating in the program will be represented by points lying within the 99% ellipse.
- ***** - The plotted point for the indicated laboratory lies outside of the 95% error ellipse shown on graphs, but inside the 99% ellipse.

MEAN The arithmetic average of the two median values for the two sheets or samples of the same material.

% DEV The deviation or difference of the laboratory MEAN from the GR. MEAN (see below), expressed as a percent of the GR. MEAN.

REL SDR The ratio of the SDR (standard deviation of replicate measurements within a laboratory) to the AVER SDR (see below). Extreme values, ie, values that are likely to occur by chance less than one time in a hundred as determined by the chi-square test, are marked with an "X".

VAR CODE A code number designating a particular test instrument, set of environmental conditons, procedure, unit used, or other variation. The code "01" designates the instrument, conditions and procedure specified at the top of the page either explicitly or in the cited ASTM Standard, and the unit of test shown at the top of the first column of data. A '+' in front of the VAR CODE indicates that the data has been excluded from the grand means due to a non-standard variation of the possibilities mentioned above, or the data is extreme.

GR MEAN The arithmetic average (grand mean) of all the laboratory MEAN values, excluding those flagged (F) with an "X".

SD MEANS The standard deviation among the laboratory MEAN values included in the GR. MEAN.

AVER SDR The arithmetic average of all the standard deviations of within laboratory replication, excluding those excluded from the GR. MEAN and excluding any additional ones for which the REL SDR has been flagged.

GRAPH

For each laboratory the MEAN for the second material is plotted against the MEAN for the first material, with each point representing a laboratory. The horizontal and vertical lines are the GR. MEAN values. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the 45° line, is the major axis of the ellipse. The ellipse is drawn so that, on the average, it will include 95% of the points representing the laboratories. The plotted symbols X and * used to represent results falling outside the ellipse are explained under "F" above. Laboratories inside the ellipse (no flag in the F column) are plotted as an O.

The graph is plotted with an ellipse when there are 20 or more laboratories in the analysis. When there are 10 through 19 laboratories in the analysis, the graph is plotted but the ellipse is omitted. When there are fewer than 10 laboratories retained in the Grand Mean the graph is not plotted.

For development of the theory, see the paper by J. Mandel and T.W. Lashof, Interpretation and Generalization of Youden's Two-Sample Diagram, J. of Quality Technology, Vol. 6, pp 22-36, Jan. 1974.

SUMMARY OF ANALYSES

LABS INCL Number of laboratories included in the GR. MEANs.

LABS OMIT Number of laboratories reporting data but excluded from the GR. MEANs.

STANDARD DEVIATIONS

LABS Same as the SD MEANs (see above)

SHEETS Standard deviation between the two sheets or samples of the same material.

REPL Same as AVER SDR (see above)

PRECISION OF METHODS

REPL CRP The number of replicate measurements per sheet or sample, as specified in the Collaborative Reference Program.

REPL ASTM The number of replicate measurements specified for a test result in the designated ASTM Standard.

REPEAT The repeatability, a measure of the within laboratory precision, i.e., of the ability of the test technician to repeat his test result: two test results obtained by the same technician on the same homogeneous sample of material may be expected 95% of the time to agree within the repeatability.

REPROD The reproducibility, a measure of the between laboratory precision: two test results obtained in different laboratories may be expected 95% of the time to agree within the reproducibility.

ABSOLUTE Values of REPEAT and REPROD expressed in the units of measurement.

PERCENT Values of REPEAT and REPROD expressed as a percent of the GR. MEANs.

NOTES

Materials A81 and A82 were sheets of the same vulcanized rubber. Similarly, materials A83 and A84 were alike.

V200 results were obtained at NBS using an electronic tester, V100 results were obtained at NBS using an pendulum tester.

All participants used Die C in ASTM D412 with the following exceptions:

V120 used ASTM Die B
V126 used Die 2 in BS903
V208 did not specify a Die
V213 used ASTM Die D

Electronic testers were used by 39 (64%) of the 61 participants; pendulum testers were used by 19 participants; 3 participants did not specify either type. Elongation measurements were made by automatic devices by 22 (36%) participants and manually by the rest. There were 9 (15%) reported relative humidities above 55% and 27 (44%) reported relative humidities below 45%.

SUMMARY OF ANALYSES

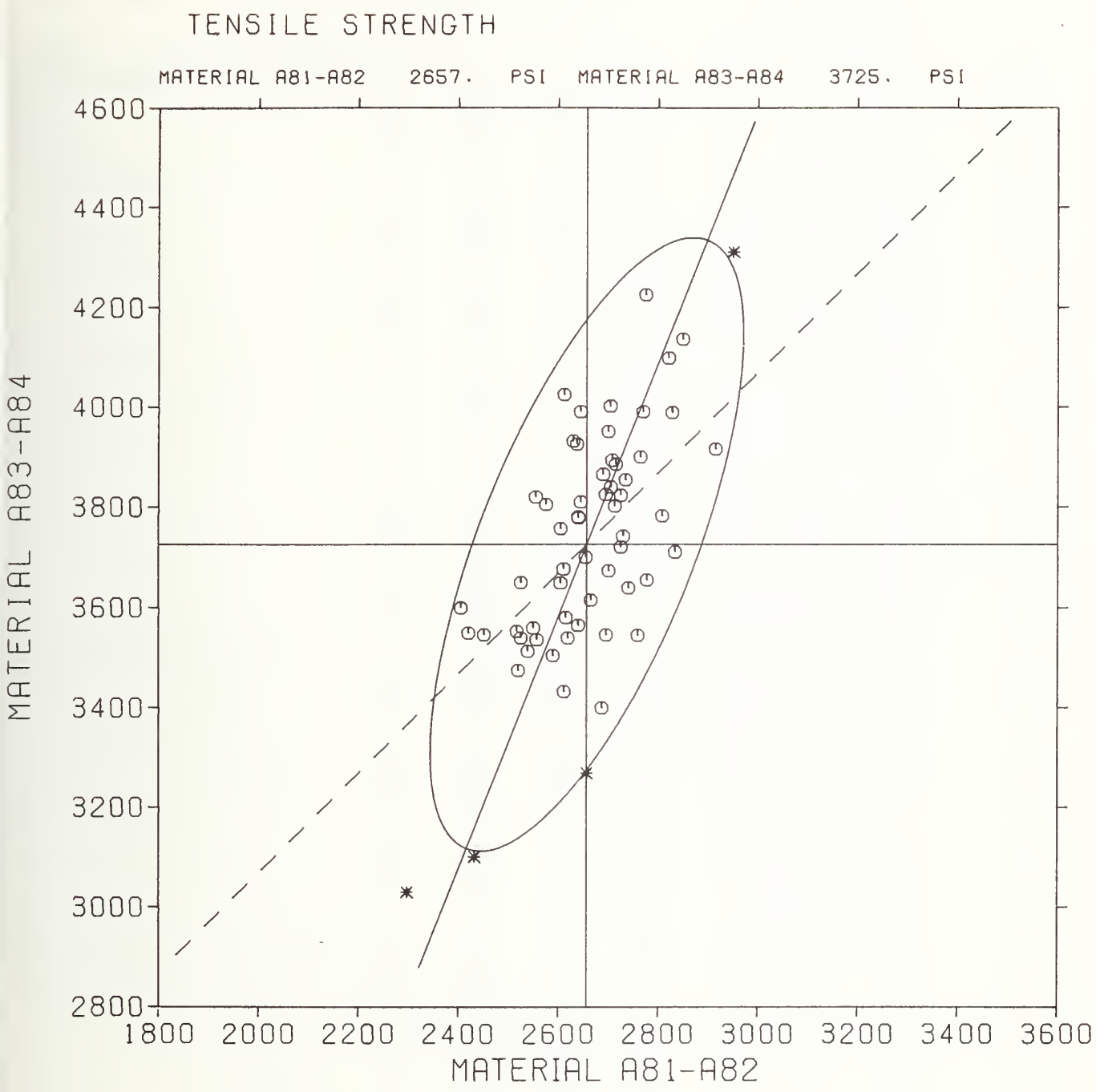
PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
TENSILE STRENGTH	A81-A82	60	1	2657.	124.	59.	72.	POUNDS PER SQUARE INCH
	A83-A84	60	1	3725.	242.	155.	286.	POUNDS PER SQUARE INCH
TENSILE STRENGTH	A81-A82	60	1	18.32	.85	.41	.50	MEGAPASCALS
	A83-A84	60	1	25.69	1.67	1.13	1.97	MEGAPASCALS
ULTIMATE ELONGATION	A81-A82	58	3	621.	22.	10.	17.	PERCENT
	A83-A84	58	3	681.	25.	13.	32.	PERCENT
STRESS AT 300% ELONGATION	A81-A82	59	2	1148.	62.	16.	26.	POUNDS PER SQUARE INCH
	A83-A84	59	2	1013.	61.	20.	30.	POUNDS PER SQUARE INCH
STRESS AT 300% ELONGATION	A81-A82	59	2	7.916	.429	.111	.178	MEGAPASCALS
	A83-A84	59	2	6.989	.419	.135	.210	MEGAPASCALS

PRECISION OF METHODS

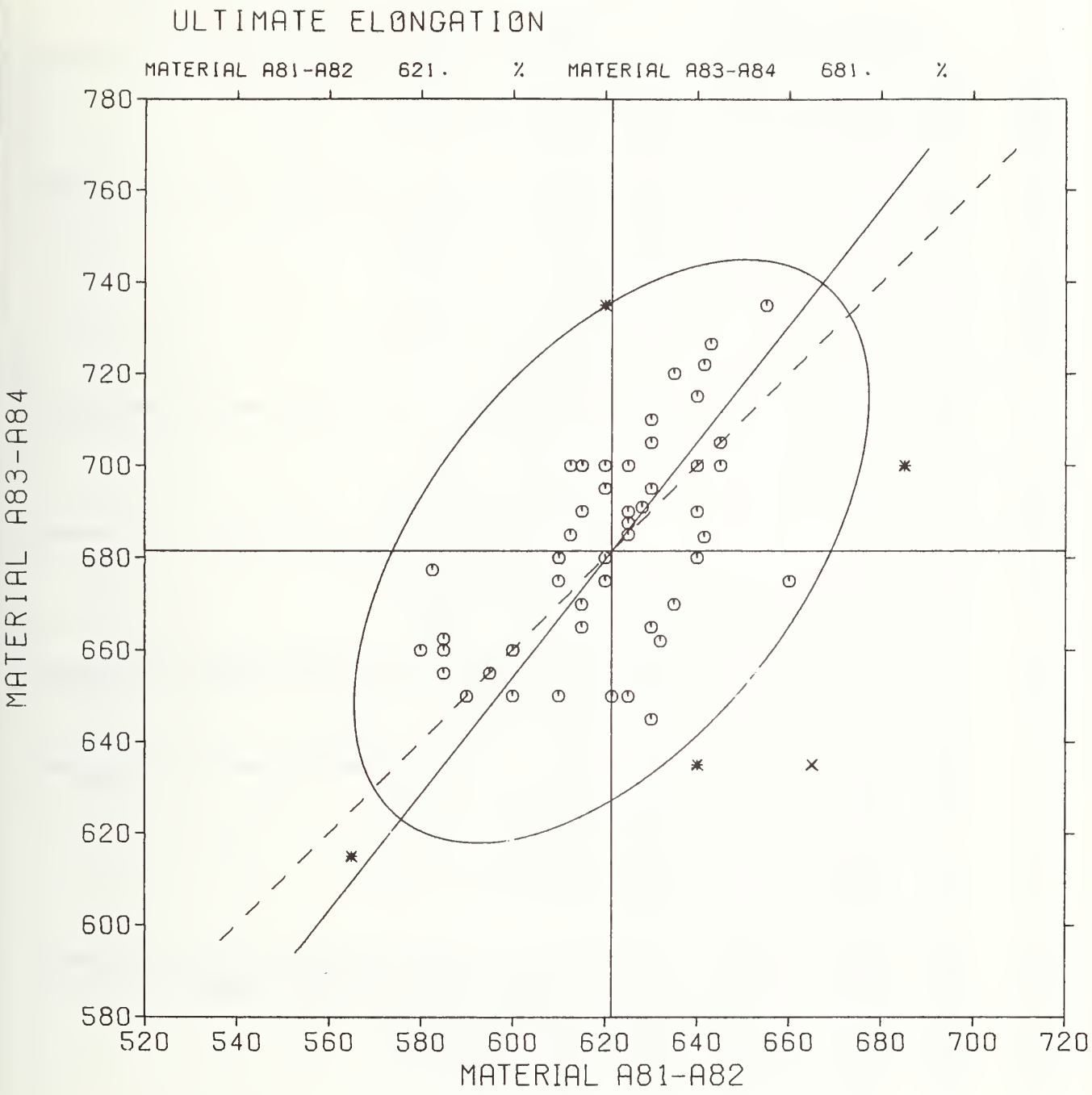
PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
TENSILE STRENGTH	A81-A82	5	5	2657.	200.	343.	PSI	7.5	12.9
	A83-A84	5	5	3725.	792.	671.	PSI	21.3	18.0
TENSILE STRENGTH	A81-A82	5	5	18.32	1.38	2.36	MEGAPA	7.5	12.9
	A83-A84	5	5	25.69	5.46	4.62	MEGAPA	21.3	18.0
ULTIMATE ELONGATION	A81-A82	5	5	621.	47.	61.	%	7.6	9.8
	A83-A84	5	5	681.	88.	69.	%	13.0	10.2
STRESS AT 300% ELONGATION	A81-A82	5	5	1148.	71.	172.	PSI	6.2	15.0
	A83-A84	5	5	1013.	84.	168.	PSI	8.3	16.6
STRESS AT 300% ELONGATION	A81-A82	5	5	7.916	.493	1.187	MEGAPA	6.2	15.0
	A83-A84	5	5	6.989	.582	1.160	MEGAPA	8.3	16.6

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
TENSILE STRENGTH - POUNDS PER SQUARE INCH

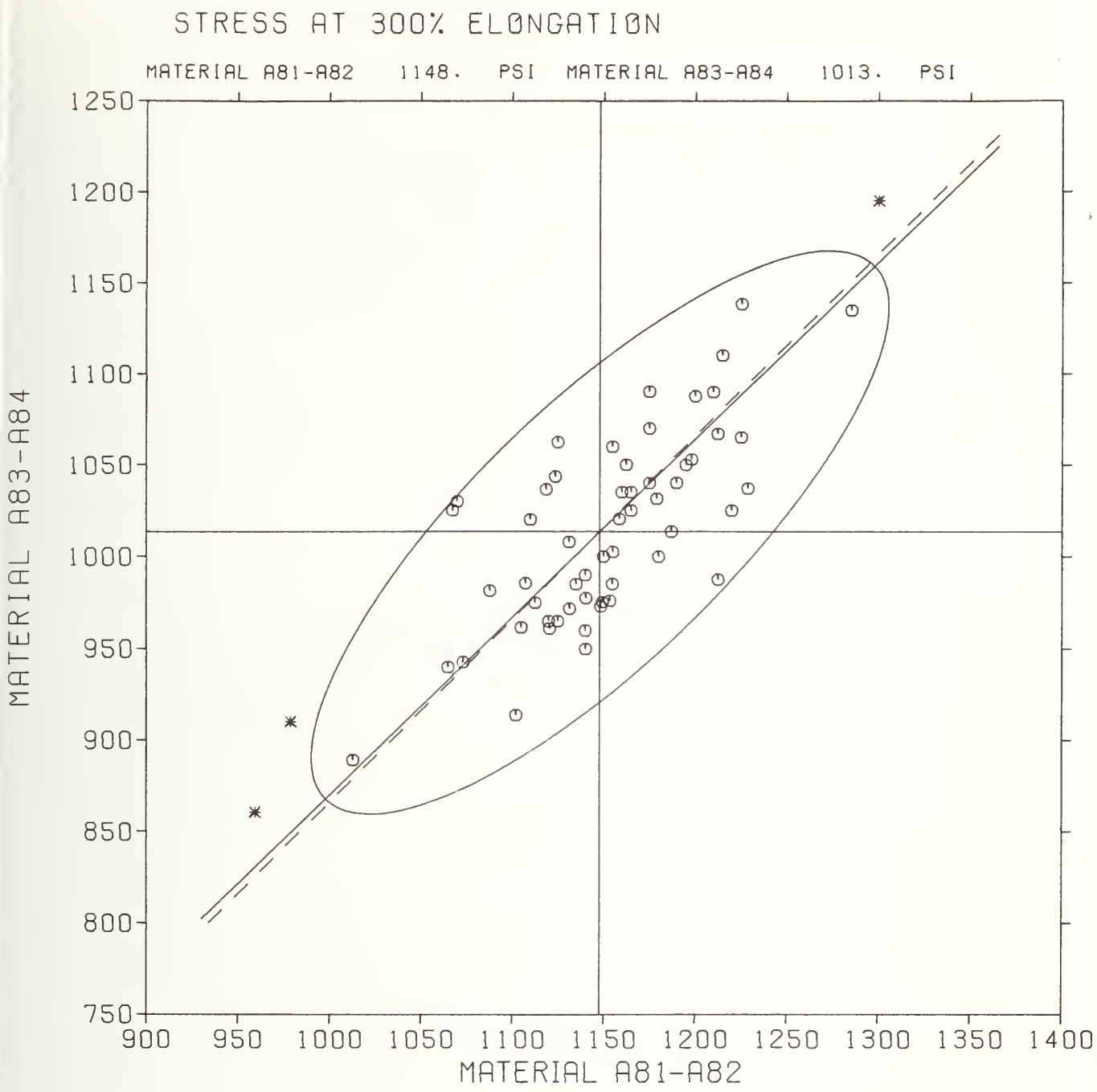
		MATERIAL A81-A82 COMMERCIAL TIRE TREAD				MATERIAL A83-A84 SBR					
LAB CODE	F	MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0076		2740.	18.90	3.1	1.04	3640.	25.10	-2.3	1.40	01	
V0078		2615.	18.03	-1.6	.63	3580.	24.69	-3.9	1.48	01	
V0081		2612.	18.02	-1.7	1.43	4025.	27.76	8.0	.87	01	
V0083		2525.	17.41	-5.0	.64	3650.	25.17	-2.0	.57	01	
V0084		2695.	18.59	1.4	.59	3825.	26.38	2.7	.72	01	
V0085		2611.	18.00	-1.7	.71	3677.	25.36	-1.3	1.38	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		2590.	17.86	-2.5	1.11	3505.	24.17	-5.9	1.45	01	
V0088		2420.	16.69	-8.9	.76	3550.	24.48	-4.7	.96	01	
V0092		2620.	18.07	-1.4	1.32	3540.	24.41	-5.0	1.32	01	
V0095		2700.	18.62	1.6	1.00	3950.	27.24	6.0	1.28	01	
V0096		2612.	18.01	-1.7	.83	3432.	23.67	-7.9	1.01	01	
V0100		2690.	18.55	1.2	1.21	3865.	26.66	3.7	.90	01	
V0111		2770.	19.10	4.3	1.04	3990.	27.52	7.1	.64	01	
V0117		2645.	18.24	-.5	1.24	3990.	27.52	7.1	.98	01	
V0120	*	2657.	18.32	.0	.85	3268.	22.54	-12.3	.93	01	
V0122		2405.	16.59	-9.5	1.01	3600.	24.83	-3.4	1.71	01	
V0123		2735.	18.86	2.9	1.05	3855.	26.59	3.5	.34	01	
V0126		2821.	19.46	6.2	.94	4097.	28.26	10.0	.49	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		2665.	18.38	.3	.89	3615.	24.93	-3.0	.82	01	
V0141		2808.	19.37	5.7	1.52	3782.	26.09	1.5	1.08	01	
V0144A		2915.	20.10	9.7	.56	3915.	27.00	5.1	1.21	01	
V01448		2655.	18.31	-.1	.93	3700.	25.52	-.7	1.28	01	
V0145		2517.	17.36	-5.3	.60	3553.	24.51	-4.6	1.17	01	
V0148		2775.	19.14	4.4	2.14X	4225.	29.14	13.4	1.19	01	
V0149		2730.	18.82	2.7	.93	3742.	25.81	.4	1.31	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0150		2705.	18.66	1.8	.90	3840.	26.48	3.1	.94	01	
V0151		2604.	17.96	-2.0	.90	3649.	25.17	-2.1	1.49	01	
V0152		2850.	19.66	7.3	1.80	4135.	28.52	11.0	1.17	01	
V0153		2555.	17.62	-3.8	1.36	3820.	26.34	2.5	.83	01	
V0154		2520.	17.38	-5.2	.72	3475.	23.97	-6.7	1.12	01	
V0156		2765.	19.07	4.1	1.20	3900.	26.90	4.7	.87	01	
V0158		2777.	19.15	4.5	1.15	3655.	25.21	-1.9	1.66	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0159		2525.	17.41	-5.0	1.27	3540.	24.41	-5.0	.69	01	
V0160		2640.	18.21	-.6	.82	3555.	24.59	-4.3	.76	01	
V0166		2713.	18.71	2.1	.36	3802.	26.22	2.1	1.57	01	
V0168		2834.	19.54	6.7	2.71X	3710.	25.59	-.4	1.01	01	
V0169		2451.	16.90	-7.7	.56	3546.	24.46	-4.8	.90	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176		2645.	18.24	-.5	.75	3810.	26.28	2.3	.84	01	
V0177		2760.	19.03	3.9	1.29	3545.	24.45	-4.8	1.11	01	
V0178		2715.	18.72	2.2	2.36X	3885.	26.79	4.3	.83	01	
V0184		2630.	18.14	-1.0	.51	3931.	27.11	5.5	.63	01	
V0190		2640.	18.21	-.6	1.01	3778.	26.06	1.4	.62	01	
V0199		2696.	18.60	1.5	1.67	3546.	24.46	-4.8	.78	01	
V0200		2704.	18.65	1.8	1.75	4001.	27.60	7.4	.76	01	
V0206		2550.	17.59	-4.0	.86	3550.	24.55	-4.4	.40	01	
V0207	*	2950.	20.34	11.0	1.18	4310.	29.72	15.7	.82	01	
V0208		2828.	19.51	6.4	.72	3989.	27.51	7.1	.91	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0213		2700.	18.62	1.6	1.16	3673.	25.33	-1.4	.67	01	
V0214		2725.	18.79	2.6	1.28	3823.	26.37	2.6	1.13	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220	X	2800.	19.31	5.4	.72					01	
V0223		2725.	18.79	2.6	1.56	3720.	25.66	-.1	1.29	01	
V0224		2605.	17.97	-2.0	2.36X	3757.	25.91	.9	1.01	01	
V0232		2640.	18.21	-.6	1.05	3780.	26.07	1.5	.73	01	
V0233		2708.	18.68	1.9	.56	3893.	26.85	4.5	.98	01	
V0235		2575.	17.76	-3.1	.55	3805.	26.24	2.1	.97	01	
V0238		2637.	18.19	-.7	.87	3925.	27.07	5.4	1.77	01	
V0243		2557.	17.63	-3.8	1.01	3536.	24.39	-5.1	1.08	01	
V0244		2539.	17.51	-4.4	1.01	3513.	24.23	-5.7	.70	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A	*	2432.	16.77	-8.5	1.99X	3100.	21.38	-16.8	.78	01	
V02458	*	2297.	15.84	-13.5	.98	3029.	20.89	-18.7	.71	01	
V0250		2687.	18.53	1.1	1.40	3400.	23.45	-8.7	1.97X	01	
		2657.	18.32	- GR. MEAN -		3725.	25.69				5 TEST DETERMINATIONS
		124.	.85	- SD MEANS -		242.	1.67				60 LABORATORIES IN GRAND MEANS
		72.	.50	- AVER SDR -		286.	1.97				61 LABORATORIES REPORTING
		PSI	MEGAPA	- UNIT -		PSI	MEGAPA				


TENSILE STRENGTH
MATERIAL A81-A82 2657. PSI MATERIAL A83-A84 3725. PSI
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
MATERIAL A83-A84
1800 2000 2200 2400 2600 2800 3000 3200 3400 3600
MATERIAL A81-A82

LAB CODE	F	MATERIAL A81-A82 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	MATERIAL A83-A84 SBR MEAN %	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0076		625.	.6	1.20	650.	-4.6	1.51	01	
V0078		590.	-5.0	.93	650.	-4.6	1.81	01	
V0081		580.	-6.7	1.51	660.	-3.1	.77	01	
V0083		582.	-6.3	.65	677.	-.6	.73	01	
V0084		610.	-1.8	.41	680.	-.2	.82	01	
V0085		630.	1.4	.62	710.	4.2	1.43	01	
V0087		632.	1.7	1.80	662.	-2.9	1.59	01	
V0088		630.	1.4	1.34	665.	-2.4	.94	01	
V0092	*	565.	-9.1	1.13	615.	-9.7	1.17	01	
V0095		630.	1.4	1.15	695.	2.0	1.49	01	
V0096		621.	.0	1.27	650.	-4.6	1.22	01	
V0100		615.	-1.0	.92	700.	2.7	.49	01	
V0111		643.	3.5	1.28	726.	6.6	.77	01	
V0117		635.	2.2	.85	720.	5.7	1.15	01	
V0120	*	640.	3.0	.71	635.	-6.8	1.14	01	
V0122		640.	3.0	1.07	700.	2.7	1.89	01	
V0123		625.	.6	1.21	690.	1.3	.47	01	
V0126		641.	3.2	.81	722.	6.0	.46	01	
V0128		610.	-1.8	1.51	675.	-.9	.67	01	
V0141		635.	2.2	1.29	670.	-1.7	.89	01	
V0144A		640.	3.0	.75	690.	1.3	1.14	01	
V0144B		620.	-.2	.95	695.	2.0	.81	01	
V0146		645.	3.8	.85	705.	3.5	1.32	01	
V0148		625.	.6	1.13	700.	2.7	.55	01	
V0149		585.	-5.9	.98	662.	-2.8	.74	01	
V0150	X	625.	.6	.93	785.	15.2	1.27	01	
V0151		655.	5.4	1.64	735.	7.9	2.01X	01	
V0152		612.	-1.4	1.27	685.	.5	1.16	01	
V0153		612.	-1.4	1.46	700.	2.7	.78	01	
V0154		595.	-4.2	.59	655.	-3.9	1.18	01	
V0156		600.	-3.4	1.50	650.	-4.6	.60	01	
V0158	*	685.	10.2	1.01	700.	2.7	1.71	01	
V0159		615.	-1.0	1.45	665.	-2.4	.76	01	
V0160		610.	-1.8	.89	650.	-4.6	.63	01	
V0166		620.	-.2	.26	700.	2.7	1.76	01	
V0168		630.	1.4	2.41X	645.	-5.3	.83	01	
V0169		585.	-5.9	.45	660.	-3.1	.87	01	
V0176		615.	-1.0	.93	670.	-1.7	.88	01	
V0177		660.	6.2	.91	675.	-.9	1.19	01	
V0178		628.	1.1	2.40X	691.	1.4	.76	01	
V0184		620.	-.2	.63	675.	-.9	.87	01	
V0190		645.	3.8	.57	700.	2.7	.65	01	
V0199		660.	6.2	2.10X	675.	-.9	1.07	01	
V0200		615.	-1.0	1.27	700.	2.7	.49	01	
V0206		640.	3.0	1.06	680.	-.2	1.13	01	
V0207		615.	-1.0	.60	700.	2.7	.45	01	
V0208		600.	-3.4	.49	660.	-3.1	.78	01	
V0213		641.	3.2	1.22	684.	.4	.79	01	
V0214		640.	3.0	1.33	715.	4.9	1.52	01	
V0220	X	655.	5.4	.87				01	
V0223		620.	-.2	1.22	680.	-.2	1.37	01	
V0224	*	620.	-.2	2.64X	735.	7.9	1.04	01	
V0232		615.	-1.0	.81	690.	1.3	.90	01	
V0233		600.	-3.4	.49	660.	-3.1	.82	01	
V0235		585.	-5.9	.58	655.	-3.9	.58	01	
V0238		625.	.6	.73	688.	.9	1.63	01	
V0243		625.	.6	.72	685.	.5	.88	01	
V0244		610.	-1.8	.71	680.	-.2	.70	01	
V0245A		615.	-1.0	1.90	670.	-1.7	1.13	01	
V0245B		630.	1.4	1.00	705.	3.5	1.08	01	
V0250	X	665.	7.0	.21	635.	-6.8	1.99X	01	
		621.	- GR. MEAN -		681.				5 TEST DETERMINATIONS
		22.	- SD MEANS -		25.				58 LABORATORIES IN GRAND MEANS
		17.	- AVER SDR -		32.				61 LABORATORIES REPORTING
		%	- UNIT -		%				


ULTIMATE ELONGATION
MATERIAL A81-A82 621. %
MATERIAL A83-A84 681. %
780
760
740
720
700
680
660
640
620
600
580
MATERIAL A83-A84
520
540
560
580
600
620
640
660
680
700
720
MATERIAL A81-A82

LAB CODE	F	MATERIAL A81-A82 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL A83-A84 SBR MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0076		1175.	8.103	2.4	.67	1040.	7.172	2.6	.65	01	
V0078		1179.	8.131	2.7	1.10	1031.	7.114	1.8	1.10	01	
V0081		1125.	7.759	-2.0	.75	1062.	7.328	4.8	.83	01	
V0083		1162.	8.017	1.3	.70	1050.	7.241	3.6	.85	01	
V0084		1165.	8.034	1.5	.60	1025.	7.069	1.1	.70	01	
V0085		1131.	7.802	-1.4	.39	972.	6.702	-4.1	.91	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		1155.	7.966	.6	.90	1060.	7.310	4.6	.96	01	
V0088		1070.	7.379	-6.8	2.06X	1030.	7.103	1.6	1.69	01	
V0092		1285.	8.862	12.0	1.23	1135.	7.828	12.0	1.05	01	
V0095		1175.	8.103	2.4	1.13	1090.	7.517	7.6	.93	01	
V0096		1158.	7.990	.9	1.09	1020.	7.038	.7	.83	01	
V0100		1140.	7.862	-.7	.98	990.	6.828	-2.3	1.26	01	
V0111		1165.	8.034	1.5	.67	1035.	7.138	2.1	.66	01	
V0117		1120.	7.724	-2.4	1.38	965.	6.655	-4.8	1.61	01	
V0120		1118.	7.714	-2.6	.56	1036.	7.148	2.3	1.49	01	
V0122	X	862.	5.948	-24.9	1.25	825.	5.690	-18.6	1.03	01	
V0123		1195.	8.241	4.1	.87	1050.	7.241	3.6	1.01	01	
V0126		1149.	7.927	.1	1.00	975.	6.727	-3.8	.74	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		1190.	8.207	3.7	.55	1040.	7.172	2.6	1.12	01	
V0141		1229.	8.476	7.1	.43	1037.	7.152	2.3	.49	01	
V0144A		1140.	7.862	-.7	1.39	950.	6.552	-6.3	.76	01	
V0144B		1140.	7.862	-.7	1.72	960.	6.621	-5.3	.85	01	
V0146	*	979.	6.752	-14.7	1.16	910.	6.276	-10.2	1.16	01	
V0148		1200.	8.276	4.5	.43	1087.	7.500	7.3	1.08	01	
V0149		1198.	8.262	4.4	.70	1053.	7.262	3.9	1.20	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0150		1125.	7.759	-2.0	.39	965.	6.655	-4.8	.53	01	
V0151		1105.	7.621	-3.7	2.34X	961.	6.631	-5.1	2.37X	01	
V0152		1210.	8.345	5.4	.38	1090.	7.517	7.6	.68	01	
V0153		1120.	7.728	-2.4	1.78	961.	6.628	-5.2	1.74	01	
V0154		1160.	8.000	1.1	.47	1035.	7.138	2.1	.81	01	
V0156		1225.	8.448	6.7	1.49	1065.	7.345	5.1	1.18	01	
V0158		1073.	7.402	-6.5	.98	943.	6.502	-7.0	.32	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0159		1110.	7.655	-3.3	1.00	1020.	7.034	.6	1.17	01	
V0160		1175.	8.103	2.4	.93	1070.	7.379	5.6	1.13	01	
V0166		1148.	7.921	.1	.78	973.	6.710	-4.0	.59	01	
V0168		1187.	8.186	3.4	1.30	1013.	6.990	.0	.90	01	
V0169		1131.	7.802	-1.4	1.13	1008.	6.952	-.5	1.17	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0175		1155.	7.966	.6	1.75	985.	6.793	-2.8	1.39	01	
V0177		1065.	7.345	-7.2	.74	940.	6.483	-7.2	1.20	01	
V0178		1135.	7.828	-1.1	.74	985.	6.793	-2.8	.63	01	
V0184		1067.	7.362	-7.0	.84	1025.	7.069	1.1	.47	01	
V0190		1153.	7.955	.5	1.55	976.	6.731	-3.7	1.04	01	
V0199		1123.	7.748	-2.1	1.77	1043.	7.197	3.0	1.86	01	
V0200		1107.	7.638	-3.5	.94	985.	6.797	-2.8	.54	01	
V0206		1110.	7.655	-3.3	1.37	1020.	7.034	.5	1.62	01	
V0207	*	1300.	8.966	13.3	1.81	1195.	8.241	17.9	1.09	01	
V0208		1226.	8.452	6.8	2.37X	1139.	7.852	12.3	2.11X	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0213		1140.	7.866	-.6	1.65	977.	6.741	-3.5	1.44	01	
V0214		1102.	7.602	-4.0	.56	914.	6.302	-9.8	1.00	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		1150.	7.931	.2	.75	1000.	6.897	-1.3	.70	01	
V0223		1220.	8.414	6.3	.43	1025.	7.069	1.1	.97	01	
V0224		1180.	8.138	2.8	1.43	1000.	6.897	-1.3	1.08	01	
V0232		1155.	7.966	.6	1.16	1002.	6.914	-1.1	.89	01	
V0233		1212.	8.362	5.6	1.03	1067.	7.359	5.3	1.10	01	
V0235		1215.	8.379	5.9	.78	1110.	7.655	9.5	1.10	01	
V0238		1112.	7.672	-3.1	1.07	975.	6.724	-3.8	.63	01	
V0243		1013.	6.986	-11.7	.56	889.	6.131	-12.3	.72	01	
V0244		1088.	7.504	-5.2	1.50	981.	6.768	-3.2	1.21	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A	*	959.	6.617	-16.4	1.54	860.	5.934	-15.1	1.35	01	
V0245B	X	925.	6.379	-19.4	1.04	718.	4.955	-29.1	1.75	01	
V0250		1212.	8.362	5.6	.97	987.	6.810	-2.6	.82	01	
		1148.	7.916	- GR. MEAN -		1013.	6.989				5 TEST DETERMINATIONS
		62.	.429	- SD MEANS -		61.	.419				59 LABORATORIES IN GRAND MEANS
		26.	.178	- AVER SDR -		30.	.210				61 LABORATORIES REPORTING
		PSI	MEGAPA	- UNIT -		PSI	MEGAPA				


STRESS AT 300% ELONGATION
MATERIAL A81-A82 1148. PSI MATERIAL A83-A84 1013. PSI
MATERIAL A83-A84
MATERIAL A81-A82
1250
1200
1150
1100
1050
1000
950
900
850
800
750
900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400

HARDNESS

NOTES

Materials A81 and A82 were sheets of the same vulcanized rubber. Similarly, materials A83 and A84 were alike.

V100 results were obtained at NBS using ASTM D2240. V200 results were obtained at NBS using ASTM D1415.

Four of the 26 participants reporting used ASTM D1415 (Wallace) for the hardness determintation. All others used ASTM D2240 (Type A Durometer).

SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
HARDNESS	A81-A82	26	0	56.26	1.72	.18	.40	IRHD
	A83-A84	26	0	56.14	1.82	.20	.41	IRHD

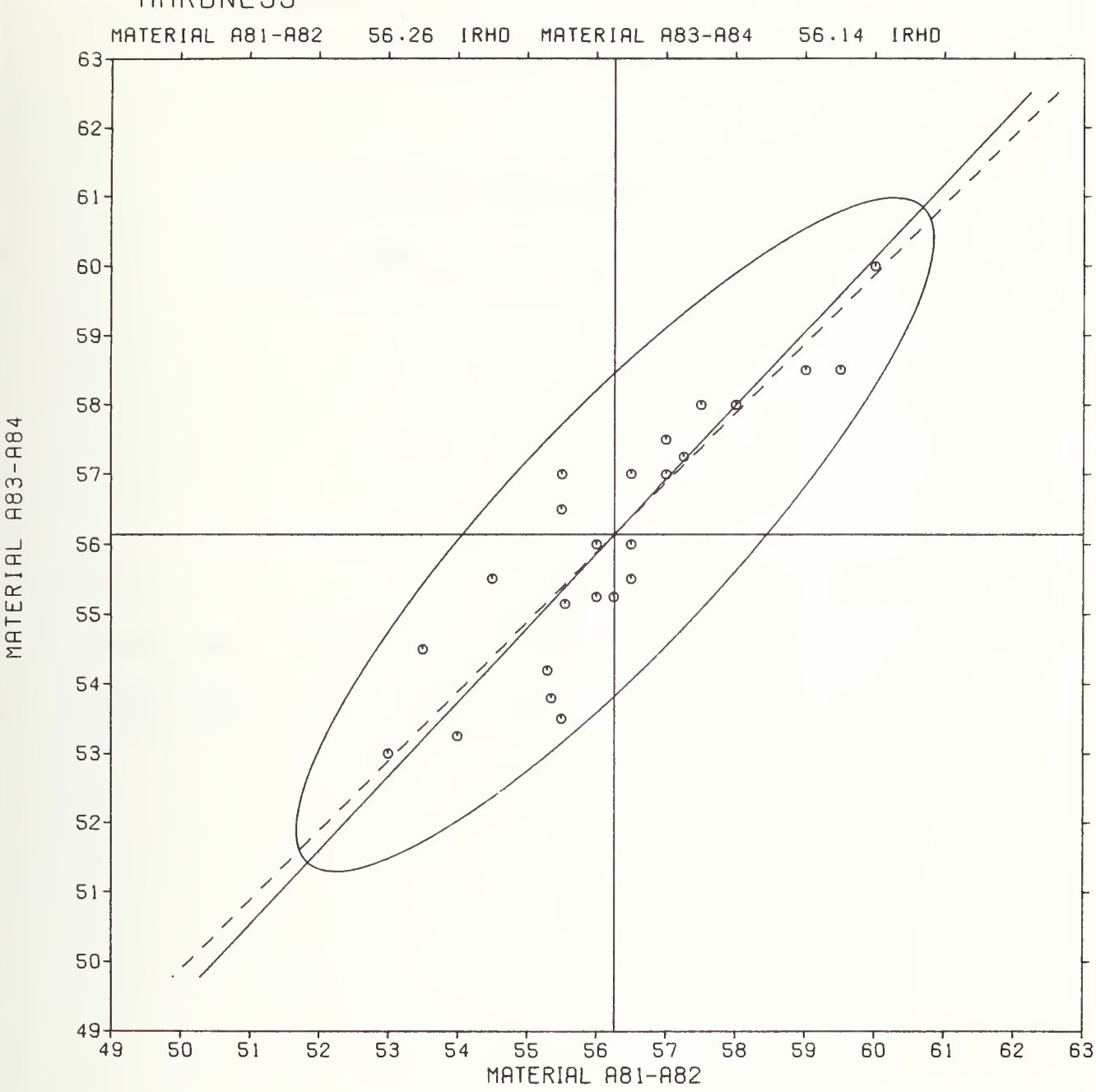
PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
HARDNESS	A81-A82	5	5	56.26	1.11	4.77	IRHD	2.0	8.5
	A83-A84	5	5	56.14	1.13	5.04	IRHD	2.0	9.0

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 35 - 2 HARDNESS - IRHD JANUARY 1978

LAB CODE	F	MATERIAL A81-A82 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	MATERIAL A83-A84 SBR MEAN IRHD	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0081		57.00	1.3	1.25	57.00	1.5	1.54	01	
V0084		57.50	2.2	.56	58.00	3.3	1.34	01	
V0085		55.35	-1.6	.48	53.80	-4.2	.59	01	
V0087		60.00	6.7	.56	60.00	6.9	.67	01	
V0088		55.50	-1.3	2.10X	57.00	1.5	1.10	01	
V0092		53.50	-4.9	1.37	54.50	-2.9	1.10	01	
V0095		55.50	-1.3	1.68	53.50	-4.7	1.22	01	
V0100		55.50	-1.3	.69	56.50	.6	1.22	01	
V0111		57.50	2.2	.69	58.00	3.3	1.10	01	
V0122		56.00	-.5	.62	55.25	-1.6	.95	01	
V0128		54.50	-3.1	1.37	55.50	-1.1	1.22	01	
V0141		53.00	-5.8	1.25	53.00	-5.6	.67	01	
V0144		59.50	5.8	1.61	58.50	4.2	2.41X	01	
V0144B		59.00	4.9	1.12	58.50	4.2	1.10	01	
V0168		57.25	1.8	.62	57.25	2.0	.77	01	
V0169		58.00	3.1	.56	58.00	3.3	.55	01	
V0176		56.50	.4	1.57	55.50	-1.1	1.34	01	
V0190		56.00	-.5	1.45	55.00	-.3	1.22	01	
V0200		54.00	-4.0	.51	53.25	-5.1	.53	01	
V0208		55.30	-1.7	1.28	54.20	-3.5	.67	01	
V0214		55.55	-1.3	2.91X	55.15	-1.8	1.12	01	
V0224		54.50	-3.1	1.25	55.50	-1.1	1.22	01	
V0232		57.00	1.3	.00	57.50	2.4	1.22	01	
V0235		56.25	-.0	.28	55.25	-1.6	.77	01	
V0243		56.50	.4	1.12	55.00	-.3	.67	01	
V0244		56.50	.4	1.12	57.00	1.5	1.10	01	
		56.26	- GR. MEAN -		55.14				5 TEST DETERMINATIONS
		1.72	- SD MEANS -		1.82				26 LABORATORIES IN GRAND MEANS
		.40	- AVER SDR -		.41				26 LABORATORIES REPORTING
		IRHD	- UNIT -		IRHD				


HARDNESS
MATERIAL A81-A82 56.26 IRHD MATERIAL A83-A84 56.14 IRHD
MATERIAL A83-A84
MATERIAL A81-A82
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
49 50 51 52 53 54 55 56 57 58 59 60 61 62 63

MOONEY VISCOSITY

NOTES

Materials R81 and R82 were the same rubber. Similarly, materials R83 and R84 were the same rubber. No sample preparation was required fpr materials R81 and R82 whereas, mill massing was required for materials R83 and R84.

V100 results were obtained at NBS on the manually closed viscometer used for determining the Mooney viscosities of the standard rubbers.

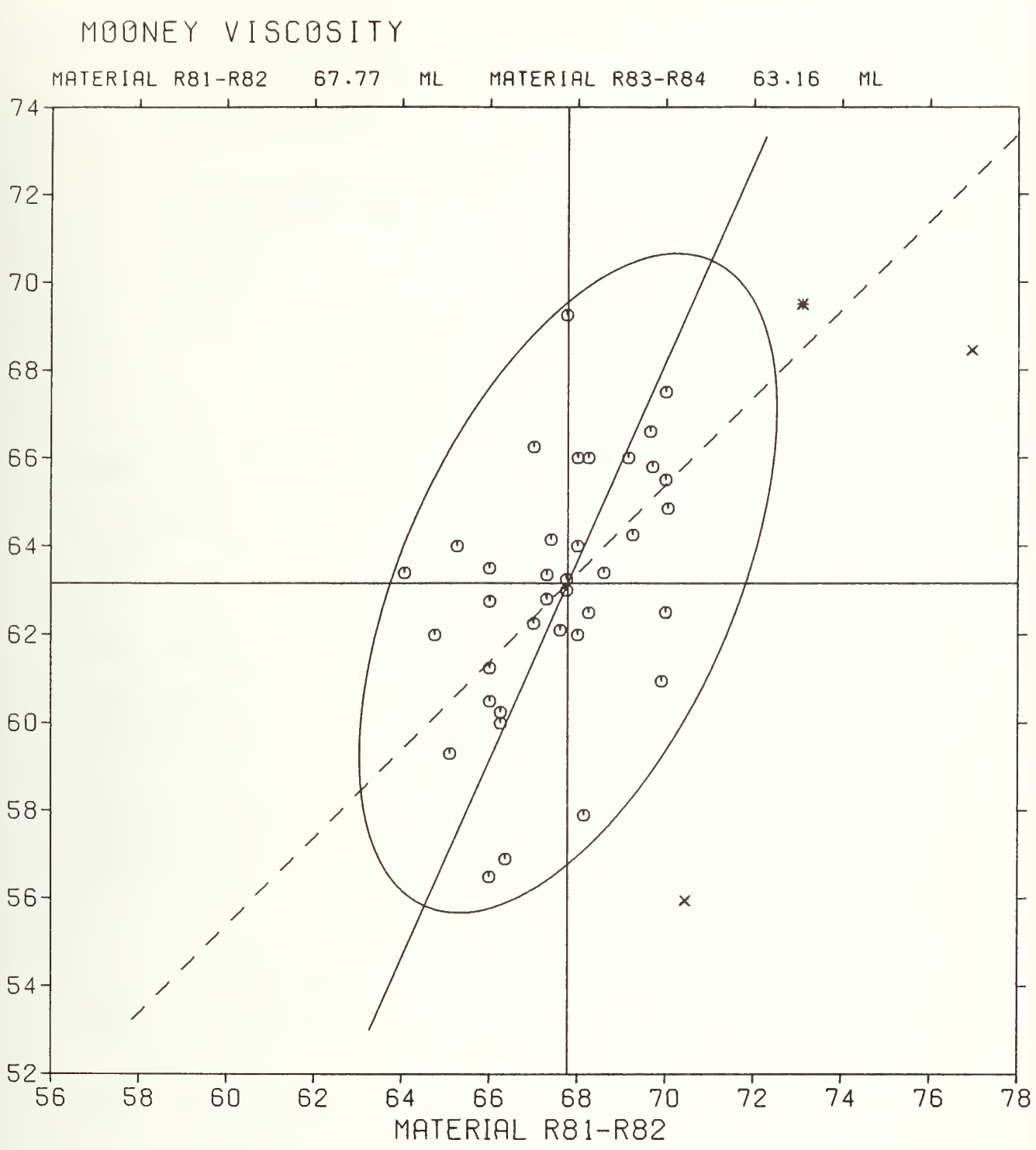
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR.MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
MOONEY	R81-R82	40	3	67.77	1.84	.17	.35	ML
VISCOSITY	R83-R84	40	3	63.16	2.90	.53	.45	ML

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR.MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
MOONEY	R81-R82	3	3	67.77	.97	5.09	ML	1.4	7.5
VISCOSITY	R83-R84	3	3	63.16	1.25	8.04	ML	2.0	12.7

LAB CODE	P	MATERIAL R81-R82 BUTYL RUBBER MEAN ML	% DEV	REL SDR	MATERIAL R83-R84 SBR MEAN ML	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0077		66.00	-2.6	.72	56.50	-10.5	.87	01	
V0078	X	65.90	-2.8	1.62	50.50	-20.0	.96	01	
V0079	X	76.95	13.5	.82	68.45	8.4	4.21X	01	
V0080	X	70.45	4.0	1.37	55.95	-11.4	2.32	01	
V0083		69.25	2.2	.41	64.25	1.7	.64	01	
V0085		67.60	-.3	.16	62.10	-1.7	1.34	01	
V0090		69.15	2.0	.66	66.00	4.5	3.87X	01	
V0092		68.00	.3	1.64	66.00	4.5	1.28	01	
V0095		66.00	-2.6	1.83	62.75	-.7	1.43	01	
V0100		68.25	.7	.36	62.50	-1.0	.00	01	
V0111		65.10	-3.9	.65	59.30	-6.1	.34	01	
V0117		67.00	-1.1	1.12	62.25	-1.4	1.40	01	
V0122		64.75	-4.5	1.12	62.00	-1.8	.96	01	
V0128		66.00	-2.6	.82	63.50	.5	.64	01	
V0144		69.70	2.8	1.23	65.80	4.2	.39	01	
V0146		70.00	3.3	2.46X	67.50	6.9	.32	01	
V0148	*	73.10	7.9	.87	69.50	10.0	1.16	01	
V0149		70.05	3.4	.92	64.85	2.7	.65	01	
V0150		69.90	3.1	.38	60.95	-3.5	1.62	01	
V0156		66.00	-2.6	2.17	61.25	-3.0	.85	01	
V0166		67.00	-1.1	1.91	66.25	4.9	1.84	01	
V0169		70.00	3.3	1.64	62.50	-1.0	1.28	01	
V0177		64.05	-5.5	1.17	63.40	.4	.36	01	
V0178		67.30	-.7	.30	62.80	-.6	.50	01	
V0182		67.75	-.0	.41	63.25	.1	1.17	01	
V0190		68.15	.6	.38	57.90	-8.3	.65	01	
V0206		66.25	-2.2	1.23	60.00	-5.0	2.25	01	
V0207		67.40	-.5	1.47	64.15	1.6	.89	01	
V0208		70.00	3.3	1.64	65.50	3.7	1.28	01	
V0211		68.00	.3	.41	62.00	-1.8	.00	01	
V0213		66.25	-2.2	.00	60.25	-4.6	.32	01	
V0214		65.25	-3.7	1.50	64.00	1.3	2.58X	01	
V0217		68.25	.7	.41	66.00	4.5	.00	01	
V0218		67.75	-.0	.41	63.00	-.3	.64	01	
V0220		69.65	2.8	1.08	66.60	5.4	1.33	01	
V0221		68.60	1.2	.76	63.40	.4	1.10	01	
V0223		67.75	-.0	.41	69.25	9.6	.64	01	
V0230		66.35	-2.1	1.80	56.90	-9.9	.96	01	
V0236		70.00	3.3	.00	62.50	-1.0	1.28	01	
V0238		66.00	-2.6	.82	60.50	-4.2	3.58X	01	
V0244		68.00	.3	3.06X	64.00	1.3	1.11	01	
V0250		68.00	.3	1.64	62.00	-1.8	.64	01	
V0251		67.30	-.7	1.57	63.35	.3	1.84	01	
		67.77	• GR. MEAN •		63.16				3 TEST DETERMINATIONS
		1.84	• SD MEANS •		2.90				40 LABORATORIES IN GRAND MEANS
		.35	• AVER SDR •		.45				43 LABORATORIES REPORTING
		ML	• UNIT •		ML				


MOONEY VISCOSITY
MATERIAL R81-R82 67.77 ML
MATERIAL R83-R84 63.16 ML
74
72
70
68
66
64
62
60
58
56
54
52
56 58 60 62 64 66 68 70 72 74 76 78
MATERIAL R81-R82

VULCANIZATION CHARACTERISTICS USING OSCILLATING DISK CURE METER

NOTES

Materials W81 and W82 werethe same rubber formulation. Similarly, materials W83 and W84 were alike.

V100 results were obtained at NBS using a Model TM-100 Monsanto Rheometer with a disk oscillating at $\pm 1^{\circ}$ amplitude and 1.7 hertz frequency.

All participants used Monsanto Rheometers operated at one degree amplitude and 1.7 hertz frequency.

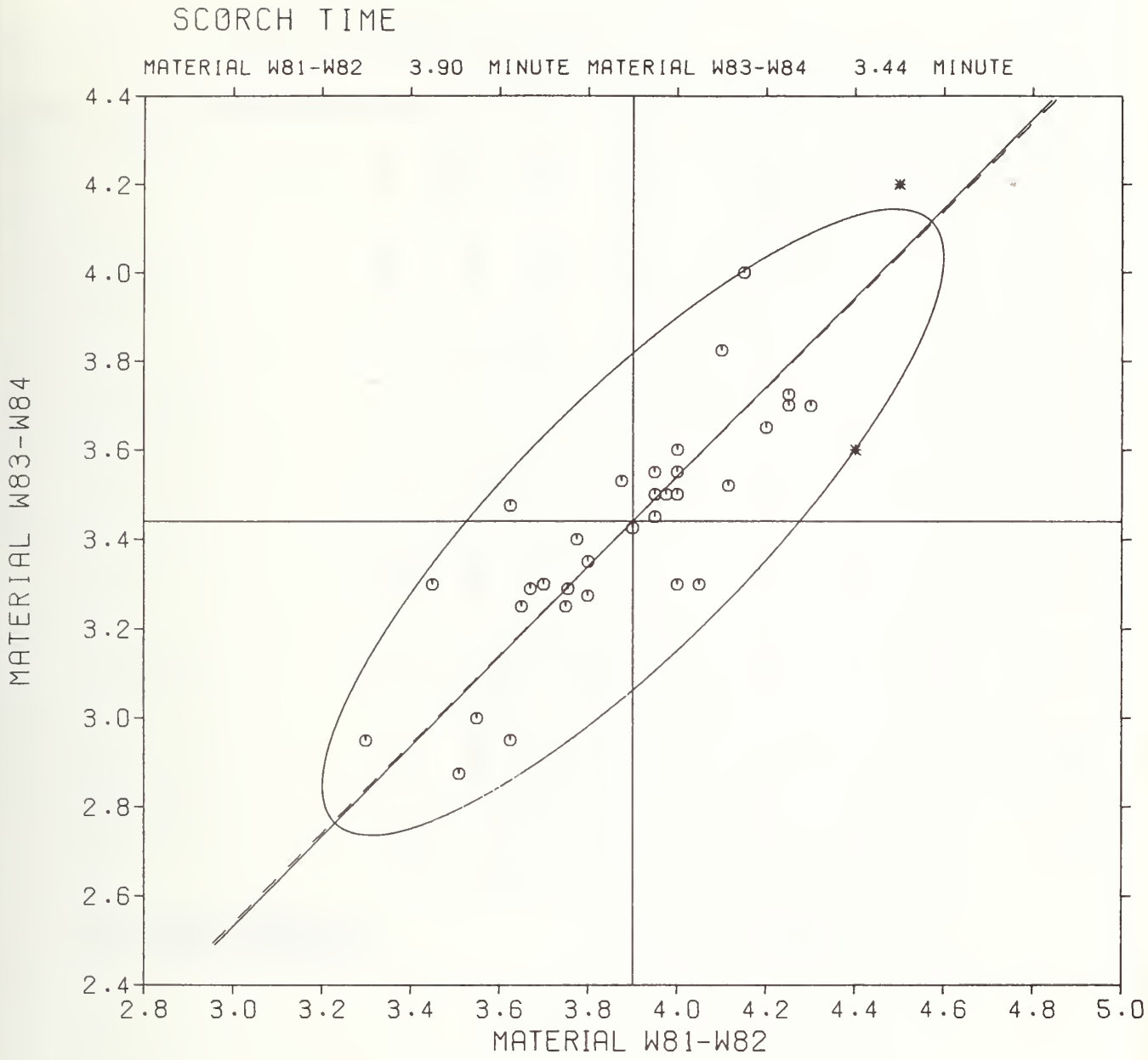
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
SCORCH TIME	W81-W82	37	2	3.90	.27	.03	.06	MINUTES
	W83-W84	37	2	3.44	.27	.02	.06	MINUTES
CURE TIME (50% MH)	W81-W82	36	3	6.28	.33	.03	.08	MINUTES
	W83-W84	36	3	7.31	.46	.05	.06	MINUTES
CURE TIME (90% MH)	W81-W82	36	3	10.53	.51	.05	.13	MINUTES
	W83-W84	36	3	14.83	.96	.09	.13	MINUTES
MINIMUM TORQUE	W81-W82	33	6	5.11	.37	.03	.07	POUND-INCHES
	W83-W84	33	6	6.44	.41	.04	.07	POUND-INCHES
MINIMUM TORQUE	W81-W82	33	6	.5778	.0416	.0038	.0075	NEWTON-METERS
	W83-W84	33	6	.7275	.0468	.0046	.0084	NEWTON-METERS
MAXIMUM TORQUE	W81-W82	38	1	24.09	1.04	.08	.16	POUND-INCHES
	W83-W84	38	1	30.70	1.22	.18	.09	POUND-INCHES
MAXIMUM TORQUE	W81-W82	38	1	2.7217	.1173	.0088	.0177	NEWTON-METERS
	W83-W84	38	1	3.4684	.1378	.0203	.0105	NEWTON-METERS

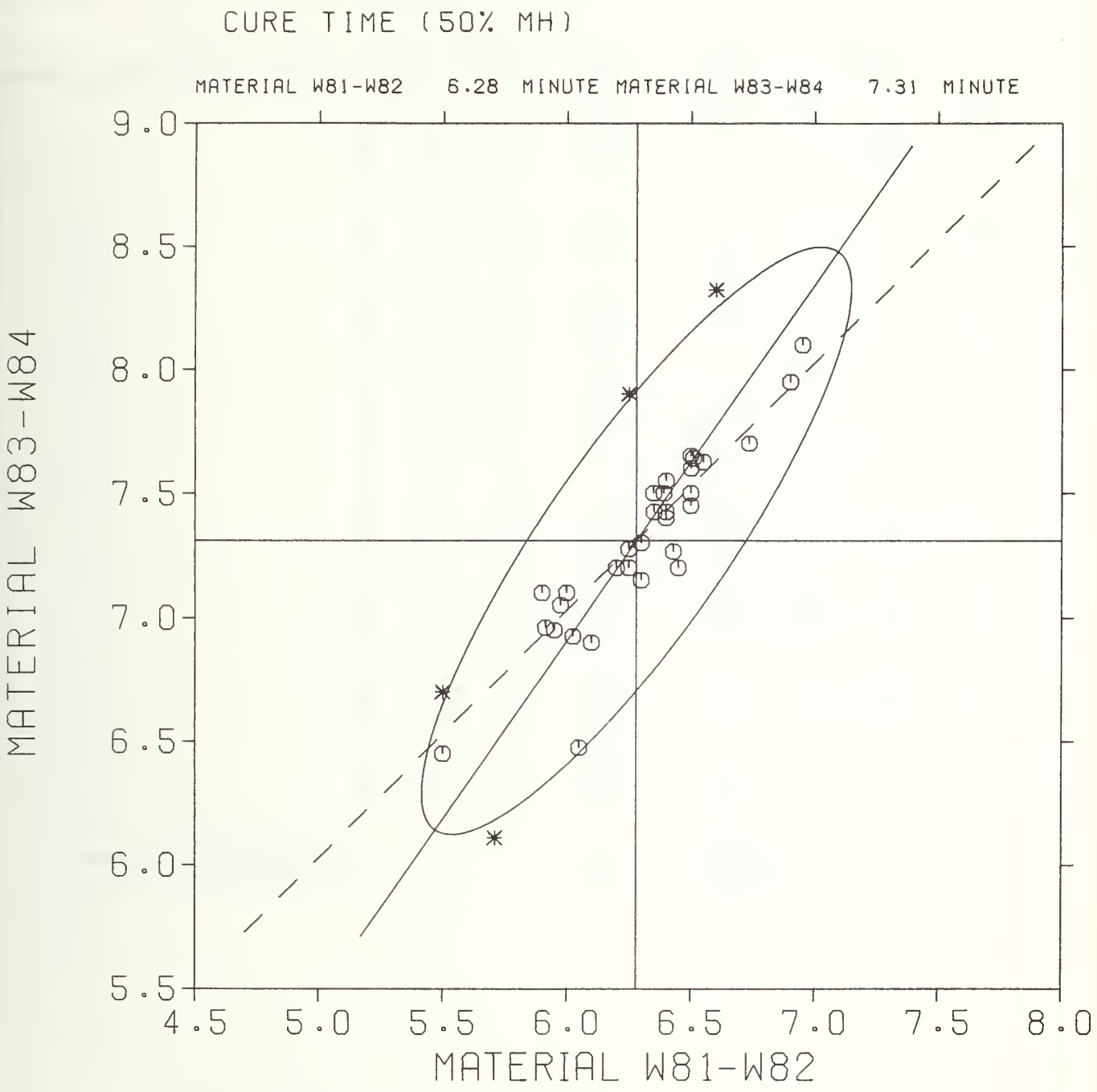
PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
SCORCH TIME	W81-W82	3	3	3.90	.16	.75	MINUTE	4.2	19.1
	W83-W84	3	3	3.44	.17	.75	MINUTE	4.9	21.9
CURE TIME (50% MH)	W81-W82	3	3	6.28	.21	.92	MINUTE	3.4	14.7
	W83-W84	3	3	7.31	.16	1.27	MINUTE	2.1	17.3
CURE TIME (90% MH)	W81-W82	3	3	10.53	.37	1.42	MINUTE	3.5	13.4
	W83-W84	3	3	14.83	.36	2.67	MINUTE	2.4	18.0
MINIMUM TORQUE	W81-W82	3	3	5.11	.18	1.02	LB-IN.	3.6	19.9
	W83-W84	3	3	6.44	.21	1.15	LB-IN.	3.2	17.8
MINIMUM TORQUE	W81-W82	3	3	.5778	.0207	.1151	N-M	3.6	19.9
	W83-W84	3	3	.7275	.0232	.1296	N-M	3.2	17.8
MAXIMUM TORQUE	W81-W82	3	3	24.09	.43	2.87	LB-IN.	1.8	11.9
	W83-W84	3	3	30.70	.26	3.38	LB-IN.	.8	11.0
MAXIMUM TORQUE	W81-W82	3	3	2.7217	.0491	.3248	N-M	1.8	11.9
	W83-W84	3	3	3.4684	.0292	.3816	N-M	.8	11.0

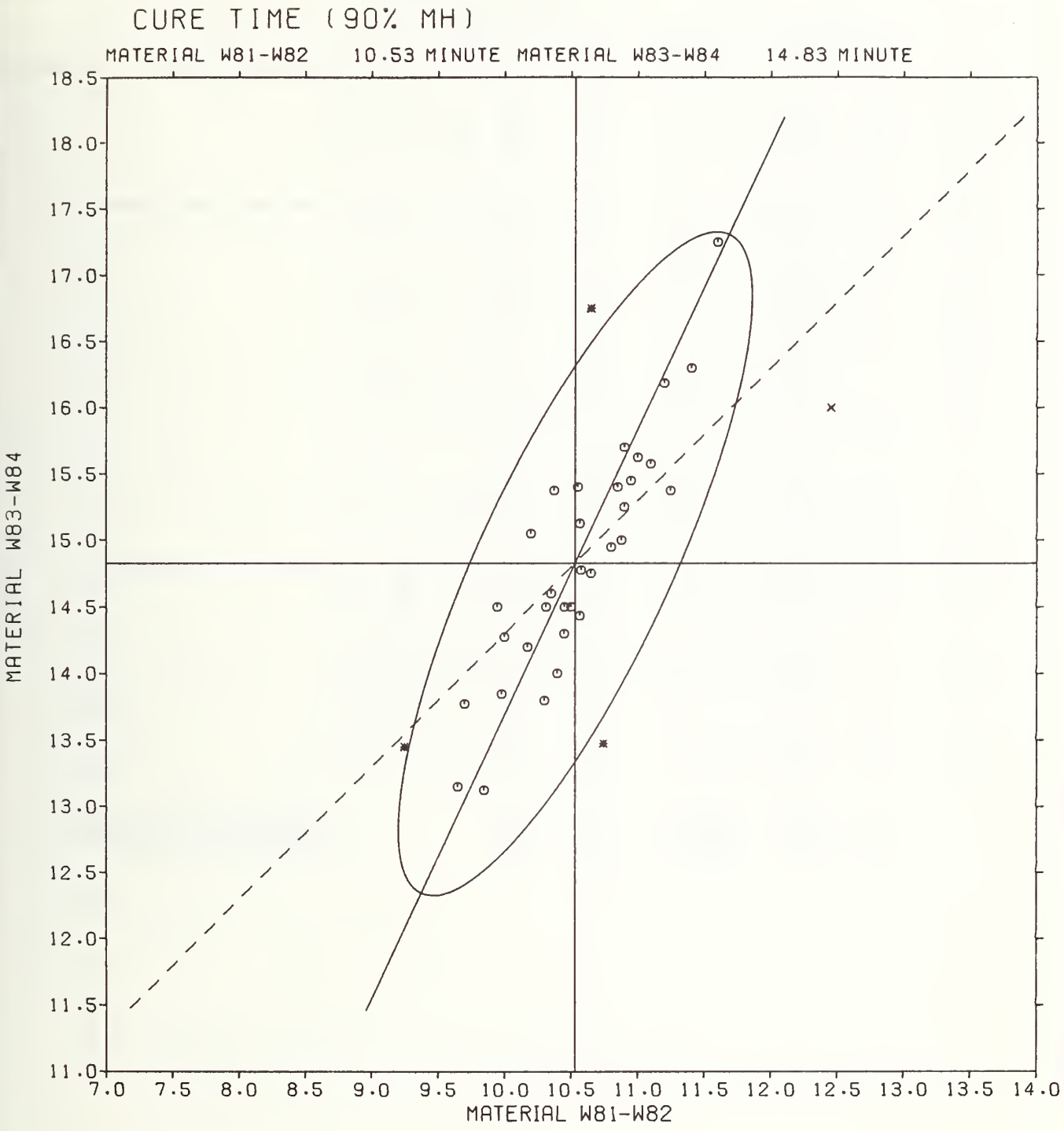
LAB CODE	F	MATERIAL W81-W82 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL W83-W84 SBR MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0074A		3.51	-10.0	3.24X	2.87	-16.4	.00	01	
V0074B		3.77	-3.2	2.22	3.40	-1.2	1.02	01	
V0077		3.90	.0	1.61	3.42	-.4	1.40	01	
V0078		4.30	10.3	.49	3.70	7.6	.94	01	
V0079		4.10	5.1	3.10X	3.82	11.2	.00	01	
V0083		4.25	9.0	.98	3.70	7.6	2.50X	01	
V0085		3.62	-7.1	.98	2.95	-14.2	.47	01	
V0090		4.25	9.0	.49	3.72	8.3	.38	01	
V0092		3.77	-3.2	.00	3.40	-1.2	1.18	01	
V0095	*	4.40	12.8	2.25	3.60	4.7	1.89	01	
V0100		4.00	2.6	.49	3.30	-4.1	.94	01	
V0117		3.75	-3.8	1.34	3.25	-5.5	.00	01	
V0120		4.11	5.5	3.04X	3.52	2.3	3.71X	01	
V0122		3.55	-9.0	.85	3.00	-12.8	1.29	01	
V0128		4.20	7.7	.85	3.65	6.1	.47	01	
V0144		3.67	-5.9	.34	3.29	-4.4	.62	01	
V0146		4.00	2.6	1.22	3.50	1.7	.94	01	
V0148	X	1.50	-61.5	.49	1.30	-62.2	.24	01	
V0149		3.97	1.9	1.31	3.50	1.7	.47	01	
V0150		3.45	-11.5	.98	3.30	-4.1	2.06	01	
V0152		3.80	-2.6	.00	3.35	-2.6	.00	01	
V0154		3.95	1.3	.49	3.45	.3	.82	01	
V0156		3.95	1.3	.49	3.50	1.7	1.49	01	
V0158		3.80	-2.6	1.22	3.27	-4.8	.94	01	
V0161		3.70	-5.1	.98	3.30	-4.1	.47	01	
V0166		4.00	2.6	.98	3.55	3.2	.94	01	
V0169		3.65	-6.4	.98	3.25	-5.5	.82	01	
V0182		3.70	-5.1	.24	3.30	-4.1	.65	01	
V0207	*	4.50	15.4	.85	4.20	22.1	1.42	01	
V0208		3.75	-3.7	1.39	3.29	-4.4	.71	01	
V0211		3.95	1.3	.98	3.55	3.2	.94	01	
V0213		3.62	-7.1	1.96	3.47	1.0	1.08	01	
V0214	X	.90	-76.9	2.67X	.80	-76.7	1.89	01	
V0217		4.15	6.4	2.94X	4.00	16.3	.00	01	
V0218		3.95	1.3	.49	3.50	1.7	1.29	01	
V0220		3.30	-15.4	2.61X	2.95	-14.2	1.29	01	
V0221		4.00	2.6	.49	3.60	4.7	1.42	01	
V0238		4.05	3.8	2.61X	3.30	-4.1	.00	01	
V0243		3.87	-.6	1.06	3.53	2.6	.63	01	
		3.90	- GR. MEAN -		3.44				3 TEST DETERMINATIONS
		.27	- SD MEANS -		.27				37 LABORATORIES IN GRAND MEANS
		.06	- AVER SDR -		.06				39 LABORATORIES REPORTING
		MINUTE	- UNIT -		MINUTE				


SCORCH TIME
MATERIAL W81-W82 3.90 MINUTE MATERIAL W83-W84 3.44 MINUTE
MATERIAL W83-W84
MATERIAL W81-W82
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.8
3.0
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0

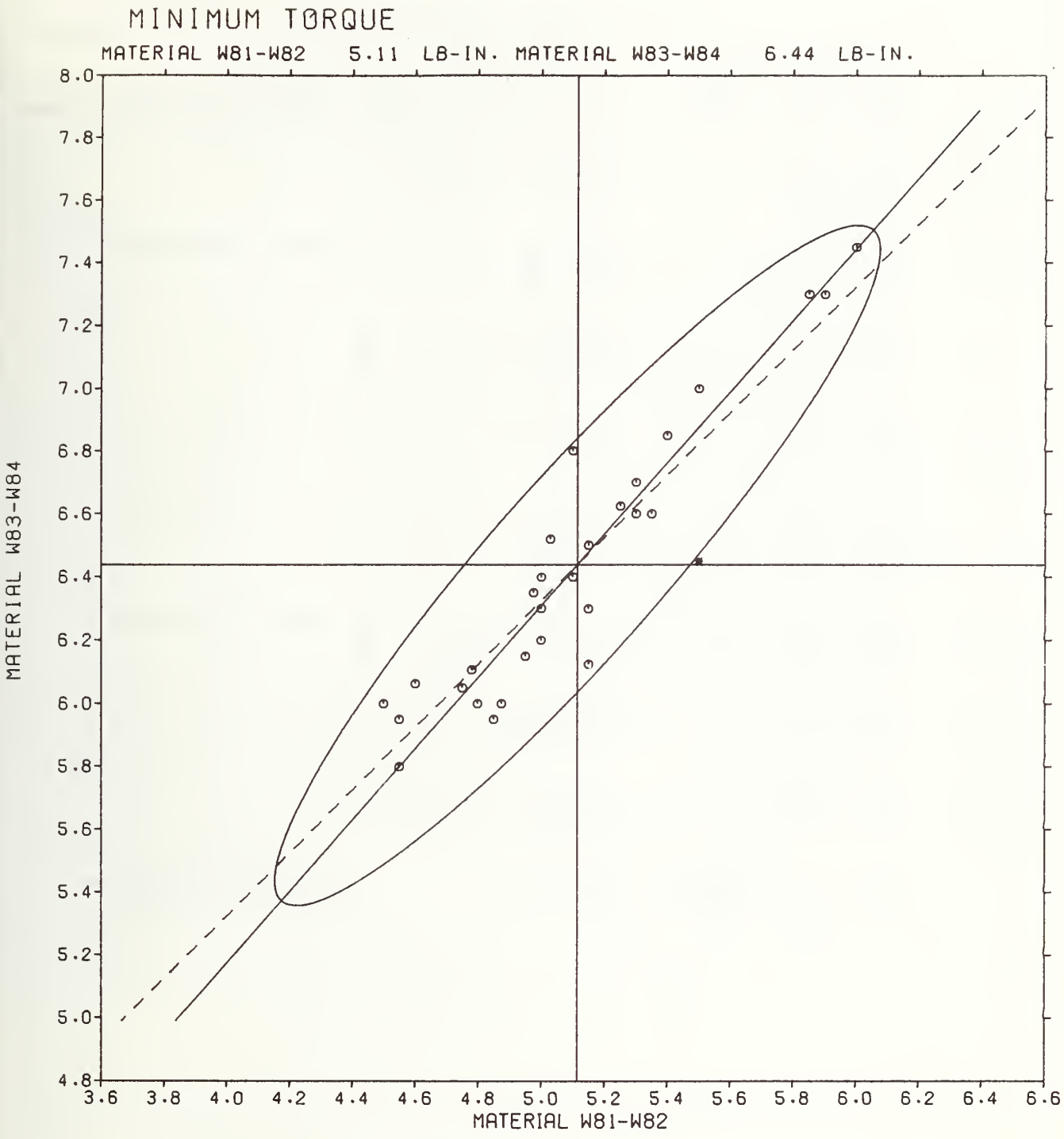
LAB CODE	P	MATERIAL W81-W82 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL W83-W84 SBR MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0074A	*	5.71	-9.1	2.30	6.11	-16.4	2.59X	01	
V0074B		6.35	1.1	1.69	7.42	1.6	.93	01	
V0077		6.39	1.7	1.25	7.50	2.6	1.25	01	
V0078	X	23.75	99.9	1.52	29.55	99.9	1.02	01	
V0079	*	6.60	5.1	2.66X	8.32	13.9	.77	01	
V0083		6.90	9.9	2.03	7.95	8.8	3.89X	01	
V0085		6.05	-3.7	1.51	6.47	-11.4	.26	01	
V0090		6.73	7.2	.23	7.70	5.3	.51	01	
V0092		6.25	-.5	.19	7.27	-.5	.51	01	
V0095		6.45	2.7	.38	7.20	-1.5	1.35	01	
V0100		6.30	.3	1.52	7.15	-2.2	1.02	01	
V0117		5.90	-6.1	.66	7.10	-2.9	.51	01	
V0120		6.51	3.7	3.41X	7.64	4.5	10.51X	01	
V0122		5.95	-5.3	.76	6.95	-4.9	1.53	01	
V0128		6.35	1.1	.38	7.50	2.6	.51	01	
V0144		5.91	-5.8	.87	6.96	-4.8	1.26	01	
V0146		6.50	3.5	1.04	7.45	1.9	1.02	01	
V0148	X	15.35	99.9	3.81X	19.27	99.9	1.14	01	
V0149		6.55	4.3	2.01	7.62	4.3	1.02	01	
V0150	*	5.50	-12.4	2.03	6.70	-8.3	2.85X	01	
V0152		6.20	-1.3	.76	7.20	-1.5	.00	01	
V0154		6.40	1.9	.38	7.42	1.6	.51	01	
V0156		6.40	1.9	.00	7.40	1.2	.89	01	
V0158		6.02	-4.1	.95	6.92	-5.3	1.02	01	
V0161		6.10	-2.9	.76	6.90	-5.6	1.02	01	
V0166		6.50	3.5	.76	7.50	2.6	1.40	01	
V0169		6.00	-4.5	1.14	7.10	-2.9	2.85X	01	
V0182		5.97	-4.9	.33	7.05	-3.6	1.02	01	
V0207	*	6.25	-.5	3.31X	7.90	8.1	4.50X	01	
V0208		6.43	2.4	.59	7.26	-.6	1.07	01	
V0211		6.25	-.5	.76	7.20	-1.5	1.91	01	
V0213		6.50	3.5	.38	7.65	4.7	1.14	01	
V0214	X	16.95	99.9	.38	20.70	99.9	8.69X	01	
V0217		6.95	10.7	1.14	8.10	10.8	1.02	01	
V0218		6.40	1.9	1.04	7.55	3.3	1.40	01	
V0220		5.50	-12.4	1.14	6.45	-11.8	1.40	01	
V0221		6.50	3.5	.38	7.60	4.0	1.40	01	
V0238		6.50	3.5	1.71	7.60	4.0	.51	01	
V0243		6.30	.3	.95	7.30	-.1	.82	01	
		6.28	- GR. MEAN -		7.31				3 TEST DETERMINATIONS
		.33	- SD MEANS -		.46				36 LABORATORIES IN GRAND MEANS
		.08	- AVER SDR -		.06				39 LABORATORIES REPORTING
		MINUTE	- UNIT -		MINUTE				


CURE TIME (50% MH)
MATERIAL W81-W82 6.28 MINUTE MATERIAL W83-W84 7.31 MINUTE
MATERIAL W83-W84
MATERIAL W81-W82
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0

LAB CODE	F	MATERIAL W81-W82 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL W83-W84 SBR MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0074A		9.70	-7.9	6.39X	13.77	-7.1	1.75	01	
V0074B		10.87	3.3	1.50	15.00	1.2	.22	01	
V0077		10.56	.3	.72	15.12	2.0	1.30	01	
V0078	X	12.45	18.3	.43	16.00	7.9	.39	01	
V0079	*	10.65	1.2	3.24X	16.75	13.0	1.12	01	
V0083		11.40	8.3	3.68X	16.30	9.9	2.83X	01	
V0085		9.85	-6.4	1.31	13.12	-11.5	.75	01	
V0090		11.25	6.9	.92	15.37	3.7	.99	01	
V0092		10.31	-2.0	.66	14.50	-2.2	1.12	01	
V0095		10.40	-1.2	.99	14.00	-5.6	.67	01	
V0100		10.45	-.7	1.62	14.30	-3.5	.45	01	
V0117		10.35	-1.7	.99	14.60	-1.5	1.57	01	
V0120		11.20	6.4	2.60X	16.18	9.2	13.57X	01	
V0122		10.55	.2	.37	15.40	3.9	1.79	01	
V0128		10.20	-3.1	.43	15.05	1.5	.22	01	
V0144		9.98	-5.2	.38	13.85	-6.6	.29	01	
V0146		10.65	1.2	1.50	14.75	-.5	.00	01	
V0148	X	23.85	99.9	3.34X	29.41	98.4	.25	01	
V0149		11.10	5.4	.96	15.57	5.1	1.25	01	
V0150		9.65	-8.3	1.83	13.15	-11.3	2.02	01	
V0152		10.50	-.3	.21	14.50	-2.2	.00	01	
V0154		10.90	3.5	.89	15.70	5.9	.79	01	
V0155		10.57	.4	.19	14.77	-.3	.92	01	
V0158		10.17	-3.4	1.26	14.20	-4.2	.78	01	
V0161		10.30	-2.2	.43	13.80	-6.9	1.20	01	
V0166		10.80	2.6	1.17	14.95	.8	.90	01	
V0169		9.95	-5.5	1.55	14.50	-2.2	1.43	01	
V0182		10.00	-5.0	1.02	14.27	-3.7	.49	01	
V0207		11.60	10.2	1.72	17.25	16.4	1.40	01	
V0208	*	10.74	2.1	2.43X	13.47	-9.1	3.78X	01	
V0211		10.45	-.7	.43	14.50	-2.2	.90	01	
V0213		10.37	-1.5	.96	15.37	3.7	.97	01	
V0214	X	24.25	99.9	.21	29.95	99.9	1.12	01	
V0217		10.90	3.5	1.71	15.25	2.9	.00	01	
V0218		10.95	4.0	1.41	15.45	4.2	1.12	01	
V0220	*	9.25	-12.1	1.41	13.45	-9.3	.82	01	
V0221		10.85	3.1	.00	15.40	3.9	.45	01	
V0238		11.00	4.5	1.07	15.62	5.4	1.53	01	
V0243		10.56	.3	.38	14.43	-2.6	.80	01	
		10.53	- GR. MEAN -		14.83				3 TEST DETERMINATIONS
		.51	- SD MEANS -		.96				36 LABORATORIES IN GRAND MEANS
		.13	- AVER SDR -		.13				39 LABORATORIES REPORTING
		MINUTE	- UNIT -		MINUTE				

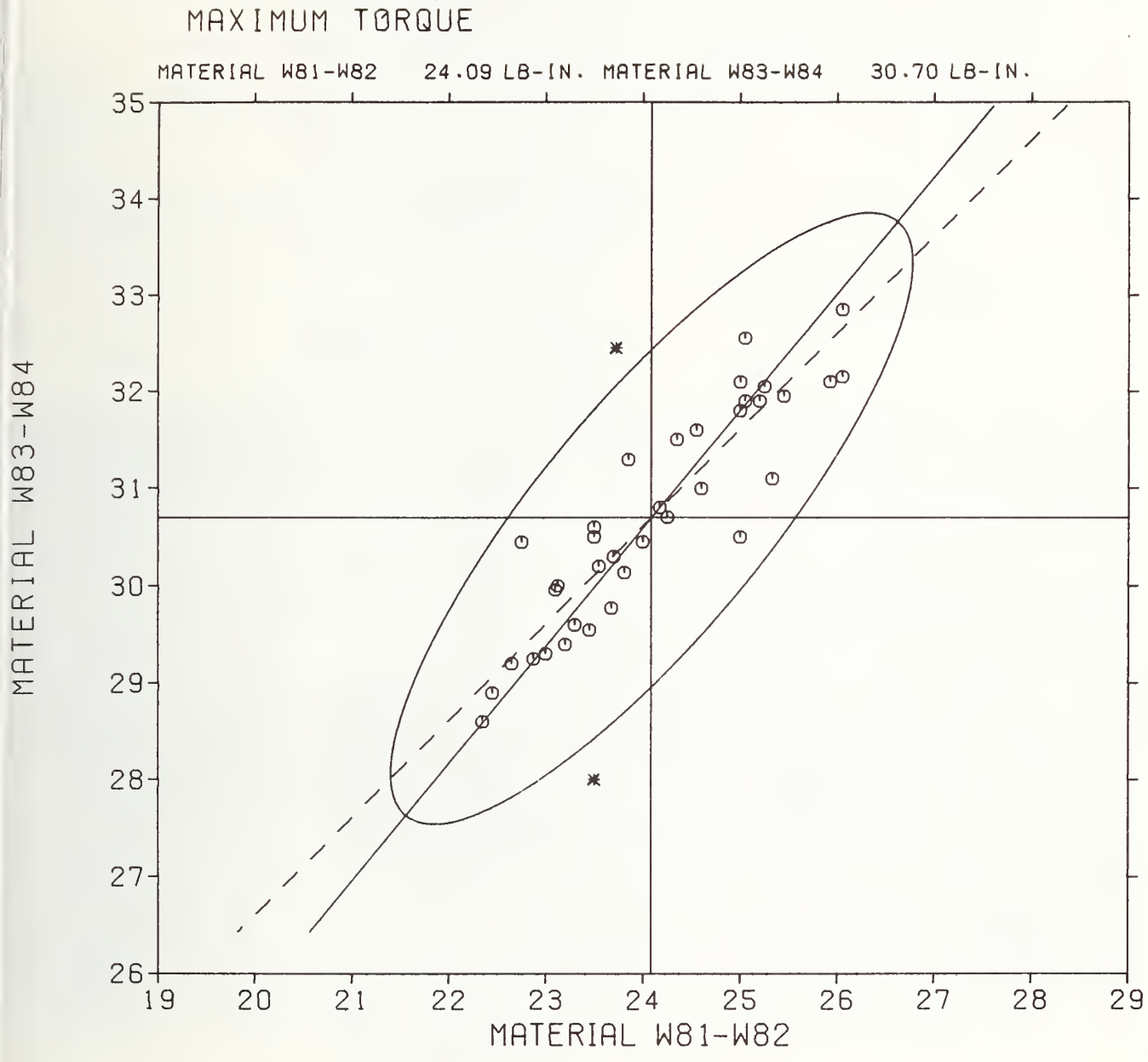

CURE TIME (90% MH)
MATERIAL W81-W82 10.53 MINUTE MATERIAL W83-W84 14.83 MINUTE
MATERIAL W83-W84
MATERIAL W81-W82
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0
13.5
14.0

LAB CODE	F	MATERIAL W81-W82 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL W83-W84 SBR MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0074A		5.00	.5649	-2.2	1.31	6.40	.7231	-.6	1.09	01	
V00748		5.25	.5932	2.7	.44	6.62	.7486	2.9	1.03	01	
V0077		4.97	.5621	-2.7	.52	6.35	.7175	-1.4	1.29	01	
V0078	X	10.65	1.2033	99.9	.44	7.15	.8079	11.1	.78	01	
V0079		4.75	.5367	-7.1	3.93X	6.05	.6836	-6.0	.85	01	
V0083		5.30	.5988	3.6	.87	6.60	.7457	2.5	.78	01	
V0085		4.60	.5200	-10.0	.39	6.06	.6850	-5.8	.00	40	ORIGINAL IN NEWTON-METER
V0090		4.80	.5424	-6.1	.87	6.00	.6779	-6.8	.00	01	
V0092	*	5.50	.6214	7.5	.00	6.45	.7288	.2	1.06	01	
V0095	X	5.75	.6497	12.4	5.56X	8.10	.9152	25.8	1.45	01	
V0100		5.10	.5762	-.3	.44	6.40	.7231	-.6	.00	01	
V0117		5.30	.5988	3.6	1.19	6.70	.7570	4.1	2.96X	01	
V0120		5.50	.6214	7.5	1.31	7.00	.7909	8.7	1.79	01	
V0122		6.00	.6779	17.3	.87	7.45	.8418	15.7	1.06	01	
V0128		5.15	.5819	.7	.44	6.50	.7344	1.0	.39	01	
V0144		5.90	.6666	15.4	1.75	7.30	.8248	13.4	2.96X	01	
V0146		4.50	.5085	-12.0	4.36X	6.00	.6779	-6.8	3.57X	01	
V0148		5.25	.5932	2.7	4.48X	6.62	.7486	2.9	2.06	01	
V0149		5.15	.5819	.7	1.41	6.12	.6921	-4.9	.39	01	
V0150	X	7.25	.8192	41.8	4.80X	9.00	1.0169	39.8	1.95	01	
V0152		4.55	.5141	-11.0	1.75	5.80	.6553	-9.9	.00	01	
V0154		5.00	.5649	-2.2	.87	6.20	.7005	-3.7	.39	01	
V0155		5.15	.5819	.7	.44	6.30	.7118	-2.1	.00	01	
V0159		5.35	.6045	4.6	1.19	6.60	.7457	2.5	1.03	01	
V0161		4.95	.5593	-3.2	1.19	6.15	.6949	-4.5	1.06	01	
V0166		5.00	.5649	-2.2	.44	6.30	.7118	-2.1	1.03	01	
V0169		4.78	.5400	-6.5	1.16	6.11	.6900	-5.1	1.19	40	ORIGINAL IN NEWTON-METER
V0182		4.85	.5480	-5.2	.87	5.95	.6723	-7.6	1.45	01	
V0207	X	7.35	.8305	43.7	1.51	8.60	.9717	33.6	1.70	01	
V0208		5.03	.5683	-1.6	.00	6.52	.7367	1.3	.00	01	
V0211		4.55	.5141	-11.0	.87	5.95	.6723	-7.6	.78	01	
V0213	X	13.30	1.5028	99.9	2.78X	15.00	1.6948	99.9	.78	01	
V0214	X	7.80	.8813	52.5	1.19	9.20	1.0395	42.9	13.04X	01	
V0217		5.10	.5762	-.3	6.00X	6.80	.7683	5.6	1.55	01	
V0218		5.15	.5819	.7	1.19	6.50	.7344	1.0	.78	01	
V0220		5.15	.5819	.7	1.19	6.50	.7344	1.0	1.17	01	
V0221		5.85	.6610	14.4	1.75	7.30	.8248	13.4	.39	01	
V0238		4.87	.5508	-4.7	1.09	6.00	.6779	-6.8	.00	01	
V0243		5.40	.6101	5.6	1.19	6.85	.7740	6.4	.39	01	
		5.11	.5778	* GR. MEAN *		6.44	.7275				3 TEST DETERMINATIONS
		.37	.0416	* SD MEANS *		.41	.0468				33 LABORATORIES IN GRAND MEANS
		.07	.0075	* AVER SDR *		.07	.0084				39 LABORATORIES REPORTING
		LB-IN.	N-M	* UNIT *		LB-IN.	N-M				


MINIMUM TORQUE
MATERIAL W81-W82 5.11 LB-IN. MATERIAL W83-W84 6.44 LB-IN.
MATERIAL W83-W84
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6
MATERIAL W81-W82

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
MAXIMUM TORQUE - POUND-INCHES

LAB CODE	F	MATERIAL W81-W82 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL W83-W84 SBR MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0074A	*	23.72	2.6807	-1.5	.88	32.45	3.6665	5.7	1.00	01	
V0074B		24.25	2.7400	.7	.48	30.70	3.4688	.0	.94	01	
V0077		23.30	2.6327	-3.3	1.14	29.60	3.3445	-3.6	1.13	01	
V0078		25.25	2.8530	4.8	.74	32.05	3.6213	4.4	.62	01	
V0079		23.12	2.6129	-4.0	3.31X	30.00	3.3897	-2.3	.00	01	
V0083		25.05	2.8304	4.0	2.05	31.90	3.6044	3.9	1.93	01	
V0085		23.10	2.6101	-4.1	.71	29.96	3.3851	-2.4	.72	40	ORIGINAL IN NEWTON-METER
V0090		23.45	2.6496	-2.6	.32	29.55	3.3389	-3.7	.15	01	
V0092		25.92	2.9293	7.6	.99	32.10	3.6270	4.6	.62	01	
V0095	*	23.50	2.6553	-2.4	4.16X	28.00	3.1637	-8.8	1.75	01	
V0100		24.55	2.7739	1.9	.18	31.60	3.5705	2.9	.00	01	
V0117		24.35	2.7513	1.1	1.21	31.50	3.5592	2.6	.93	01	
V0120		25.05	2.8304	4.0	1.00	32.55	3.6778	6.0	2.23	01	
V0122		25.20	2.8473	4.6	2.42X	31.90	3.6044	3.9	1.69	01	
V0128		22.75	2.5705	-5.6	.82	30.45	3.4405	-.8	.31	01	
V0144		25.00	2.8248	3.8	.37	31.80	3.5931	3.6	3.09X	01	
V0146		22.45	2.5366	-6.8	.50	28.90	3.2654	-5.9	.62	01	
V0148		25.45	2.8756	5.7	2.18	31.95	3.6100	4.1	.31	01	
V0149		23.67	2.6750	-1.7	1.54	29.77	3.3643	-3.0	.77	01	
V0150		25.00	2.8248	3.8	1.84	30.50	3.4462	-.6	3.09X	01	
V0152		23.00	2.5988	-4.5	.00	29.30	3.3106	-4.5	.31	01	
V0154		24.00	2.7118	-.4	.18	30.45	3.4405	-.8	.31	01	
V0156		23.20	2.6214	-3.7	.00	29.40	3.3219	-4.2	1.35	01	
V0158		24.17	2.7315	.4	.96	30.80	3.4801	.3	.54	01	
V0161		22.65	2.5592	-6.0	.81	29.20	3.2993	-4.9	1.15	01	
V0166		23.50	2.6553	-2.4	.37	30.50	3.4462	-.6	.62	01	
V0169		23.81	2.6901	-1.2	1.07	30.14	3.4051	-1.8	.82	40	ORIGINAL IN NEWTON-METER
V0182		23.85	2.6948	-1.0	1.33	31.30	3.5366	2.0	1.07	01	
V0207		26.05	2.9434	8.1	1.44	32.85	3.7117	7.0	.85	01	
V0208		25.33	2.8620	5.2	1.73	31.10	3.5140	1.3	4.61X	01	
V0211		22.35	2.5253	-7.2	.98	28.60	3.2315	-6.8	.31	01	
V0213	X	47.00	5.3105	95.1	2.39	58.75	6.6382	91.4	4.64X	01	
V0214		26.05	2.9434	8.1	.18	32.15	3.6326	4.7	1.93	01	
V0217		23.70	2.6779	-1.6	2.08	30.30	3.4236	-1.3	1.86	01	
V0218		23.50	2.6553	-2.4	.66	30.60	3.4575	-.3	1.44	01	
V0220		23.55	2.6609	-2.2	4.22X	30.20	3.4123	-1.6	2.48X	01	
V0221		25.00	2.8248	3.8	.00	32.10	3.6270	4.6	.93	01	
V0238		22.87	2.5846	-5.0	.92	29.25	3.3050	-4.7	1.55	01	
V0243		24.60	2.7796	2.1	1.33	31.00	3.5027	1.0	1.24	01	
		24.09	2.7217	* GR. MEAN *		30.70	3.4684				3 TEST DETERMINATIONS
		1.04	.1173	* SD MEANS *		1.22	.1378				38 LABORATORIES IN GRAND MEANS
		.16	.0177	* AVER SDR *		.09	.0105				39 LABORATORIES REPORTING
		LB-IN.	N-M	* UNIT *		LB-IN.	N-M				


MAXIMUM TORQUE
MATERIAL W81-W82 24.09 LB-IN. MATERIAL W83-W84 30.70 LB-IN.
MATERIAL W83-W84
MATERIAL W81-W82
35
34
33
32
31
30
29
28
27
26
19
20
21
22
23
24
25
26
27
28
29

NBS-114A (REV. 7-73)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. RUBBER CRP 35	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

INTERLABORATORY PROGRAMS FOR RUBBER

Analyses: No. 35
January - March 1978

5. Publication Date: 6/12/78

6. Performing Organization Code:

7. AUTHOR(S)
E. B. Randall, J. Horlick, J. F. Stevenson, G. W. Bullman

8. Performing Organ. Report No. NBSIR 78-1339

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No. 7825578

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, VA 22066

13. Type of Report & Period Covered: Final

14. Sponsoring Agency Code:

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; Laboratory evaluation; Precision; Reference samples; Rubber; Testing calibration.

18. AVAILABILITY

☐ Unlimited

☒ For Official Distribution. Do Not Release to NTIS

☐ Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13

☐ Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT): UNCLASSIFIED

21. NO. OF PAGES: 36

20. SECURITY CLASS (THIS PAGE): UNCLASSIFIED

22. Price:

USCOMM-DC 29042-P74