

NBS 1279-  
1373

# INTERLABORATORY PROGRAMS FOR RUBBER

ANALYSES NO. 38  
OCTOBER - DECEMBER 1978



U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

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)

**Let  
saad**

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

# INTERLABORATORY PROGRAMS FOR RUBBER

Analyses No. 38  
October - December 1978

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U. S. DEPARTMENT OF COMMERCE  
National Bureau of Standards

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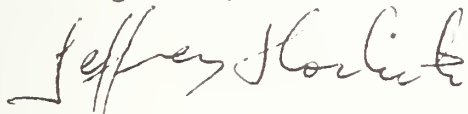


## INTRODUCTION

This report summarizes the test results for the fourth 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 Jeffrey Horlick at (301) 921-2946.

A handwritten signature in cursive script that reads "Jeffrey Horlick". The signature is written in dark ink and is positioned above the typed name and title.

Jeffrey Horlick, Administrator  
NBS Collaborative Reference Programs  
Office of Testing Laboratory Evaluation Technology

June 4, 1979



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## 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.

TENSILE STRENGTH, ULTIMATE ELONGATION, AND STRESS AT 300% ELONGATION

NOTES

Materials D81 and D82 were sheets of the same vulcanized rubber. Similarly, materials D83 and D84 were alike.

V100 results were obtained at NBS using a pendulum tester.

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

- V070 used ASTM Die B
- V126 used Die 2 in BS903
- V213 and V225 used ASTM Die D
- V208 did not specify a Die

INSTRUMENTS

Tester Used	Number of Labs	Percent of Labs
Electronic Manual	20	32%
Electronic Automatic	24	38%
Pendulum Manual	17	27%
Pendulum Automatic	2	3%
	63	100%

REPORTED RELATIVE HUMIDITY

RH	Number of Labs	Percent of Labs
Above 55%	13	21%
Below 45%	14	22%
45% - 55%	28	44%
Not Reported	8	13%
	63	100%

SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS			UNITS
					LABS	SHEETS	REPL	
TENSILE STRENGTH	D81-D82	61	3	2736.	89.	43.	70.	POUNDS PER SQUARE INCH
	D83-D84	61	3	2706.	86.	62.	63.	POUNDS PER SQUARE INCH
TENSILE STRENGTH	D81-D82	62	2	18.87	.61	.29	.48	MEGAPASCALS
	D83-D84	62	2	18.66	.59	.43	.43	MEGAPASCALS
ULTIMATE ELONGATION	D81-D82	60	4	619.	18.	5.	15.	PERCENT
	D83-D84	60	4	614.	18.	6.	16.	PERCENT
STRESS AT 300% ELONGATION	D81-D82	63	1	1167.	74.	18.	25.	POUNDS PER SQUARE INCH
	D83-D84	63	1	1152.	77.	13.	28.	POUNDS PER SQUARE INCH
STRESS AT 300% ELONGATION	D81-D82	63	1	8.049	.511	.156	.175	MEGAPASCALS
	D83-D84	63	1	7.946	.532	.164	.191	MEGAPASCALS

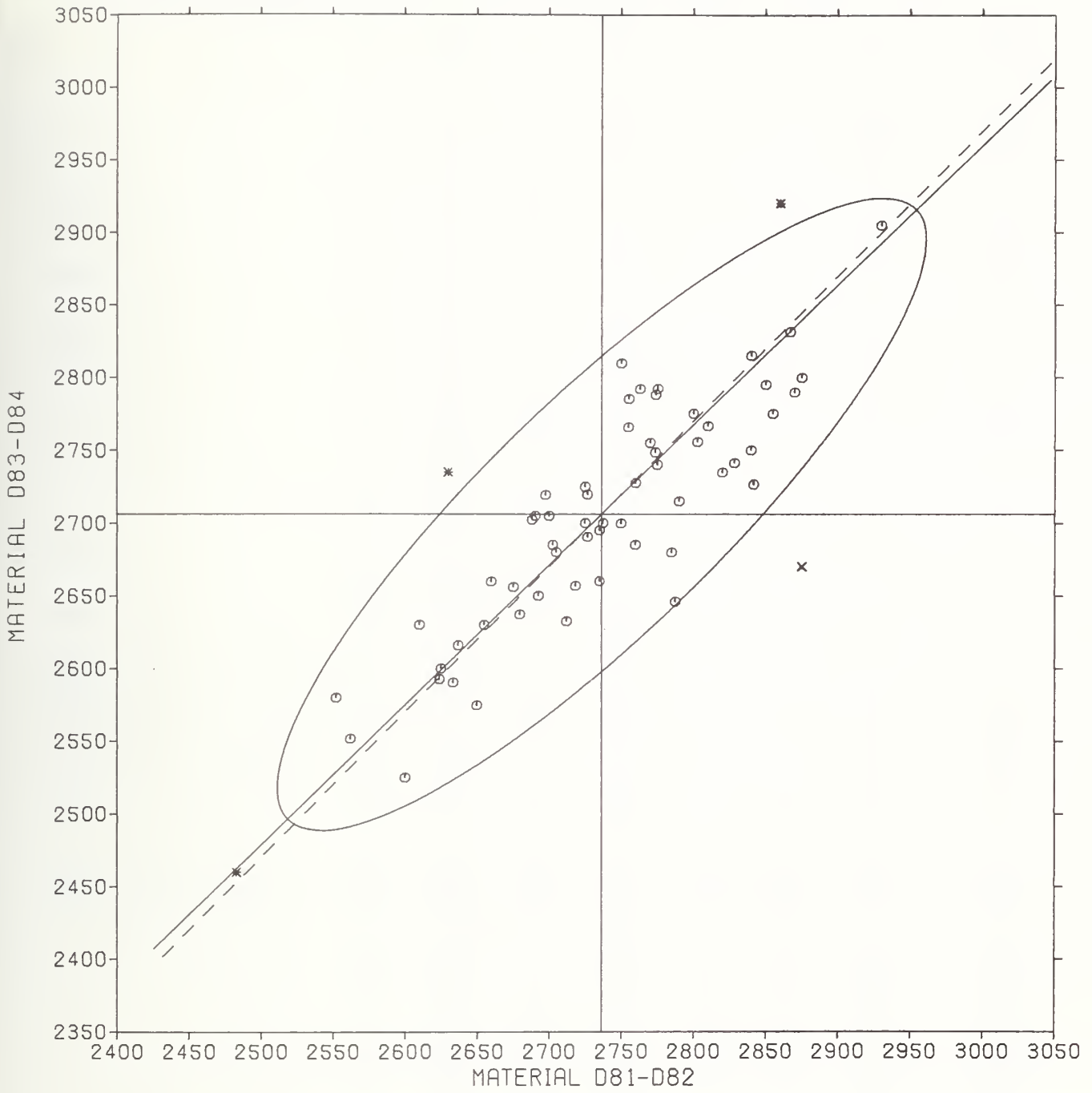
PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
TENSILE STRENGTH	D81-D82	5	5	2736.	194.	246.	PSI	7.1	9.0
	D83-D84	5	5	2706.	175.	238.	PSI	6.4	8.8
TENSILE STRENGTH	D81-D82	5	5	18.87	1.34	1.70	MEGAPA	7.1	9.0
	D83-D84	5	5	18.66	1.20	1.64	MEGAPA	6.4	8.8
ULTIMATE ELONGATION	D81-D82	5	5	619.	42.	50.	%	6.7	8.1
	D83-D84	5	5	614.	43.	51.	%	7.1	8.2
STRESS AT 300% ELONGATION	D81-D82	5	5	1167.	70.	205.	PSI	6.0	17.6
	D83-D84	5	5	1152.	77.	214.	PSI	6.6	18.6
STRESS AT 300% ELONGATION	D81-D82	5	5	8.049	.485	1.416	MEGAPA	6.0	17.6
	D83-D84	5	5	7.946	.528	1.474	MEGAPA	6.6	18.6

LAB CODE	F	MATERIAL D81-D82 COMMERCIAL TIRE TREAD				MATERIAL D83-D84 SBR					INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN PSI	MEAN MEGAPPA	% DEV	REL SDR	MEAN PSI	MEAN MEGAPPA	% DEV	REL SDR	VAR CODE	
V0066	X	2875.	19.83	5.1	1.98X	2670.	18.41	-1.3	1.99	C1	
V0067		2600.	17.93	-5.0	.36	2525.	17.41	-6.7	1.04	C1	
V0069		2750.	18.97	.5	1.88	2809.	19.38	3.8	1.75	C1	
V0070		2840.	19.59	3.8	.97	2815.	19.41	4.0	.73	C1	
V0071		2637.	18.19	-3.6	.74	2616.	18.04	-3.3	.79	C1	
V0072	*	2860.	19.72	4.5	1.74	2920.	20.14	7.0	1.21	C1	
V0076		2855.	19.65	4.3	.77	2775.	19.14	2.5	1.02	C1	
V0078		2562.	17.67	-6.3	.68	2552.	17.60	-5.7	1.05	C1	
V0081		2763.	19.05	1.0	1.32	2792.	19.25	3.2	.61	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0083		2655.	18.31	-3.0	.59	2630.	18.14	-2.8	.99	C1	
V0084		2610.	18.00	-4.6	.77	2630.	18.14	-2.8	1.07	C1	
V0085		2727.	18.80	-.3	1.63	2690.	18.55	-.6	.81	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0087		2700.	18.62	-1.3	.87	2705.	18.66	-.0	1.38	C1	
V0088	*	2483.	17.12	-9.3	1.01	2460.	16.57	-9.1	2.10X	C1	
V0092		2625.	18.10	-4.1	1.07	2600.	17.93	-3.9	1.08	C1	
V0095		2530.	20.21	7.1	1.19	2905.	20.03	7.3	1.38	C1	
V0096		2624.	18.10	-4.1	.30	2592.	17.88	-4.2	.52	C1	
V0100		2790.	19.24	2.0	.94	2715.	18.72	.3	1.08	C1	
V0102		2650.	18.28	-3.2	.84	2575.	17.76	-4.8	.89	C1	
V0111		2820.	19.45	3.1	.95	2735.	18.86	1.1	.75	C1	
V0117		2725.	18.79	-.4	.44	2700.	18.62	-.2	.63	C1	
V0120		2760.	19.03	.9	.98	2727.	18.81	.8	1.30	C1	
V0122		2552.	17.60	-6.7	.87	2580.	17.79	-4.7	1.97X	C1	
V0123		2800.	19.31	2.3	.78	2775.	19.14	2.5	.57	C1	
V0126		2826.	19.51	3.4	.77	2741.	18.90	1.3	.91	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0128		2785.	19.21	1.8	1.09	2680.	18.48	-1.0	1.31	C1	
V0141		2773.	19.13	1.4	.86	2748.	18.96	1.6	1.22	C1	
V0144		2850.	19.66	4.2	.79	2795.	19.28	3.3	.44	C1	
V0144B		2870.	19.79	4.9	.96	2790.	19.24	3.1	1.18	C1	
V0146		2841.	19.60	3.8	1.07	2726.	18.80	.8	.88	C1	
V0148		2875.	19.83	5.1	1.24	2800.	19.31	3.5	2.60X	C1	
V0149		2810.	19.38	2.7	1.37	2766.	19.08	2.2	2.38X	C1	
V0150		2735.	18.86	-.0	.78	2660.	18.34	-1.7	1.88	C1	
V0152	*	2630.	18.14	-3.9	1.85	2735.	18.86	1.1	.70	C1	
V0153		2633.	18.16	-3.8	.88	2590.	17.87	-4.3	1.62	C1	
V0154		2840.	19.59	3.8	1.61	2750.	18.97	1.6	1.12	C1	
V0156		2755.	19.00	.7	.97	2785.	19.21	2.9	2.76X	C1	
V0158		2775.	19.14	1.4	1.29	2792.	19.25	3.2	.86	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0160		2712.	18.70	-.9	1.24	2632.	18.15	-2.7	1.13	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0166		2867.	19.77	4.8	.81	2831.	19.53	4.6	1.32	C1	
V0168		2802.	19.33	2.4	1.17	2755.	19.00	1.8	1.71	C1	
V0169		2690.	18.55	-1.7	1.38	2705.	18.65	-.0	1.45	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0176		2705.	18.66	-1.1	.56	2680.	18.48	-1.0	.56	C1	
V0177		2735.	18.86	-.0	1.08	2695.	18.59	-.4	.71	C1	
V0184		2755.	19.00	.7	.95	2760.	19.08	2.2	.86	C1	
V0190		2675.	18.45	-2.2	1.04	2656.	18.32	-1.9	1.48	C1	
V0199		2760.	19.03	.9	1.13	2685.	18.52	-.8	.56	C1	
V0207		2750.	18.97	.5	.40	2700.	18.62	-.2	.43	C1	
V0208		2698.	18.60	-1.4	1.41	2719.	18.75	.5	.95	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0213	X	1906.	13.15	-30.3	.63	1920.	13.24	-29.0	.65	*60	DATA NOT UNDERSTOOD
V0214		2727.	18.80	-.3	1.06	2719.	18.75	.5	.90	C0	ORIGINAL IN MEGANEWTONS PER SQ. METER
V0220		2737.	18.88	.0	1.08	2700.	18.62	-.2	1.42	C1	
V0223		2702.	18.64	-1.2	.90	2685.	18.52	-.8	.90	C1	
V0224		2775.	19.14	1.4	.89	2740.	18.90	1.3	1.19	C1	
V0225		2718.	18.75	-.6	1.27	2657.	18.32	-1.8	.55	C1	
V0232		2680.	18.48	-2.1	.75	2637.	18.19	-2.5	.98	C1	
V0233		2787.	19.22	1.9	.87	2646.	18.25	-2.2	.99	C1	
V0235	X	2177.	15.02	-20.4	.73	2252.	15.53	-16.8	1.06	C1	
V0238		2770.	19.10	1.2	.88	2755.	19.00	1.8	.57	C1	
V0243		2692.	18.57	-1.6	1.01	2650.	18.28	-2.1	1.39	C1	
V0244		2688.	18.54	-1.8	.81	2702.	18.64	-.1	.41	C1	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A		2774.	19.13	1.4	.83	2788.	19.23	3.0	1.18	C1	
V0245B		2660.	18.34	-2.8	1.09	2660.	18.34	-1.7	.66	C1	
V0250		2725.	18.79	-.4	.81	2725.	18.79	.7	.56	C1	
2736.		18.87			GR. MEAN	2706.	18.66				5 TEST DETERMINATIONS
89.		.61			SD MEANS	86.	.59				61 LABORATORIES IN GRAND MEANS
70.		.48			AVER SDR	63.	.43				64 LABORATORIES REPORTING
PSI		MEGAPPA			UNIT	PSI	MEGAPPA				

# TENSILE STRENGTH

MATERIAL D81-D82 2736. PSI MATERIAL D83-D84 2706. PSI



LAB CODE	F	MATERIAL D81-D82 COMMERCIAL TIRE TREAD			MATERIAL D83-D84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN %	% DEV	REL SDR	MEAN %	% DEV	REL SDR		
V0066		610.	-1.4	1.00	610.	-0.7	1.068	01	
V0067		600.	-3.1	0.42	587.	-4.4	0.93	01	
V0069		615.	-0.6	1.70	620.	0.9	1.05	01	
V0070		612.	-1.0	0.54	612.	-0.3	0.65	01	
V0071		596.	-3.7	0.85	603.	-1.8	0.91	01	
V0072		635.	2.6	1.07	625.	1.7	1.037	01	
V0076		600.	-3.1	1.15	585.	-4.8	0.96	01	
V0078		605.	-2.3	0.99	565.	-3.1	0.68	01	
V0081		631.	2.0	1.23	629.	2.5	0.95	01	
V0083		622.	0.6	1.00	612.	-0.3	1.009	01	
V0084		580.	-6.3	0.63	585.	-4.8	0.84	01	
V0085		640.	3.4	1.54	635.	3.4	1.06	01	
V0087	*	569.	-8.0	1.07	568.	-7.5	1.14	01	
V0088		602.	-2.7	1.41	598.	-2.6	1.73	01	
V0092		635.	2.6	1.07	620.	0.9	1.11	01	
V0095		620.	0.2	1.22	615.	0.1	1.31	01	
V0096		609.	-1.5	0.52	606.	-1.3	0.44	01	
V0100		615.	-0.6	0.74	615.	0.1	0.90	01	
V0102		625.	1.0	0.43	615.	0.1	0.87	01	
V0111		579.	-6.4	3.16X	577.	-6.0	1.25	01	
V0117		630.	1.8	0.38	625.	1.7	0.43	01	
V0120		630.	1.8	1.15	630.	2.6	1.69	01	
V0122		630.	1.8	1.03	630.	2.6	1.70	01	
V0123		630.	1.8	0.75	630.	2.6	0.85	01	
V0126		638.	3.1	1.05	630.	2.6	0.76	01	
V0128		630.	1.8	0.99	615.	0.1	0.96	01	
V0141		620.	0.2	0.83	635.	3.4	0.72	01	
V0144		620.	0.2	1.29	635.	3.4	0.57	01	
V0144B		615.	-0.6	1.13	615.	0.1	0.82	01	
V0146	*	660.	0.6	1.21	637.	3.8	0.47	01	
V0148	*	612.	-1.0	0.98	587.	-4.4	2.46X	01	
V0149		612.	-1.0	1.02	602.	-1.9	2.01X	01	
V0150		610.	-1.4	0.66	600.	-2.3	1.89	01	
V0152	X	570.	-7.9	1.43	612.	-0.3	0.64	01	
V0153		610.	-1.4	1.00	610.	-0.7	1.48	01	
V0154		605.	-2.3	1.32	550.	-4.0	1.05	01	
V0156		615.	-0.6	1.21	610.	-0.7	2.56X	01	
V0158		635.	2.6	1.37	635.	3.4	0.92	01	
V0160		605.	-2.3	1.03	600.	-2.3	1.10	01	
V0166		620.	0.2	0.66	605.	-1.5	1.09	01	
V0168		625.	1.0	0.61	620.	0.9	1.01	01	
V0169		627.	1.4	1.45	630.	2.6	1.04	01	
V0176		640.	3.4	0.70	620.	0.9	1.29	01	
V0177		645.	4.2	1.07	640.	4.2	1.10	01	
V0184		630.	1.8	1.55	625.	1.7	1.19	01	
V0190		630.	1.8	1.27	635.	3.4	1.07	01	
V0199	X	770.	24.4	2.97X	775.	26.2	3.56X	01	
V0207	X	632.	2.2	0.32	690.	12.3	0.35	01	
V0208		600.	-3.1	1.17	590.	-4.0	1.12	01	
V0213		608.	-1.8	0.84	616.	0.3	0.95	01	
V0214		635.	2.6	1.10	635.	3.4	0.93	01	
V0220		615.	-0.6	0.98	615.	0.1	1.00	01	
V0223		605.	-2.3	0.95	610.	-0.7	0.57	01	
V0224		620.	0.2	1.00	620.	0.9	1.35	01	
V0225		587.	-5.1	1.06	580.	-5.6	0.94	01	
V0232		647.	4.6	0.70	637.	3.8	2.15X	01	
V0233		605.	-2.3	1.26	590.	-4.0	0.68	01	
V0235	X	490.	-20.8	0.54	490.	-20.2	0.90	01	
V0238		615.	-0.6	0.88	610.	-0.7	0.78	01	
V0243		625.	1.0	1.32	620.	0.9	1.16	01	
V0244		610.	-1.4	0.46	615.	0.1	0.46	01	
V0245A		650.	5.0	0.78	655.	6.6	0.75	01	
V0245B		655.	5.8	0.93	640.	4.2	0.82	01	
V0250		630.	1.8	0.72	615.	0.1	0.32	01	

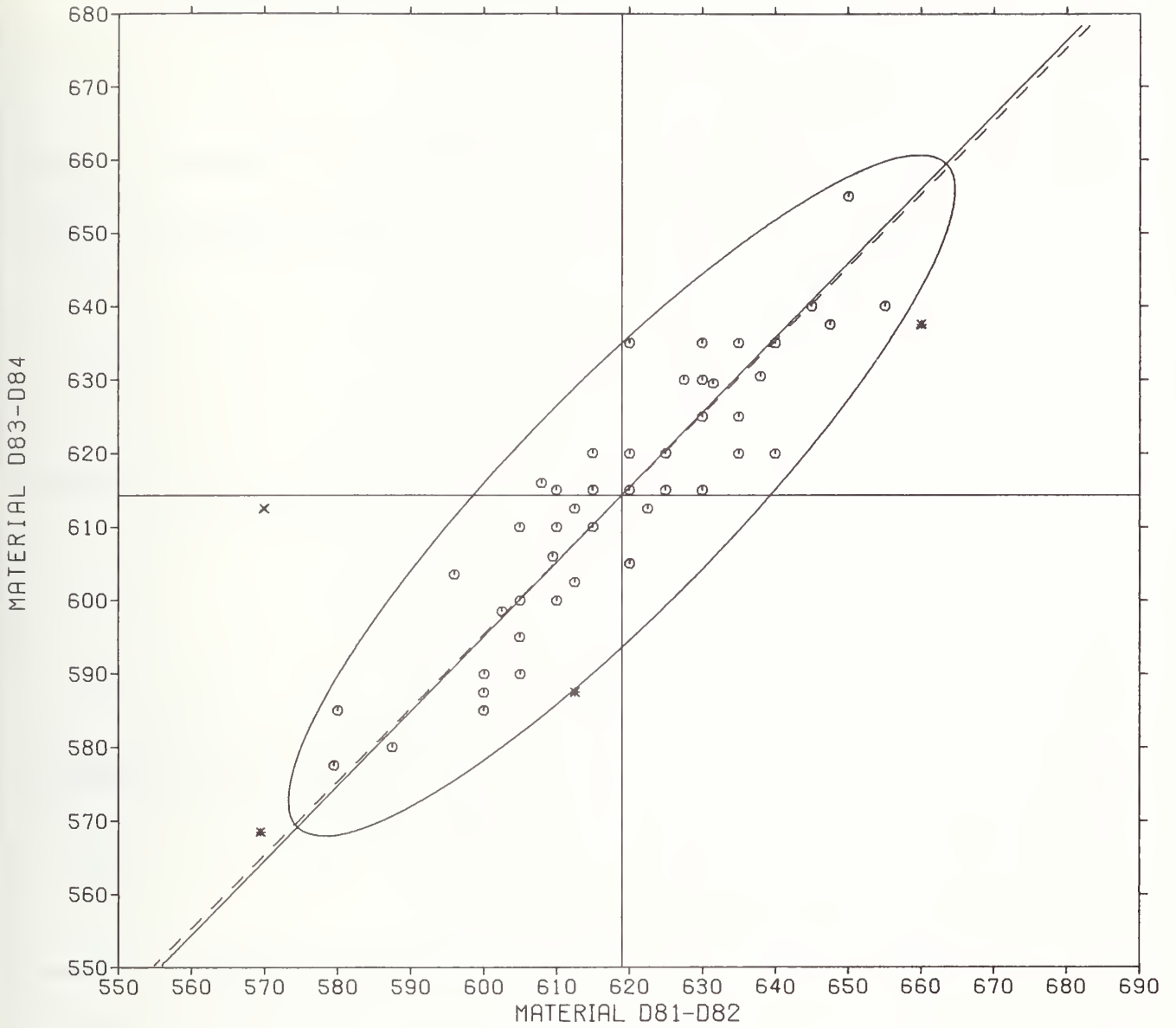
619. = GR. MEAN =  
18. = SD MEANS =  
1.0 = AVER SDR =  
% = UNIT =

614.  
18.  
16.  
%

5 TEST DETERMINATIONS  
60 LABORATORIES IN GRAND MEANS  
64 LABORATORIES REPORTING

# ULTIMATE ELONGATION

MATERIAL D81-D82 619. % MATERIAL D83-D84 614. %

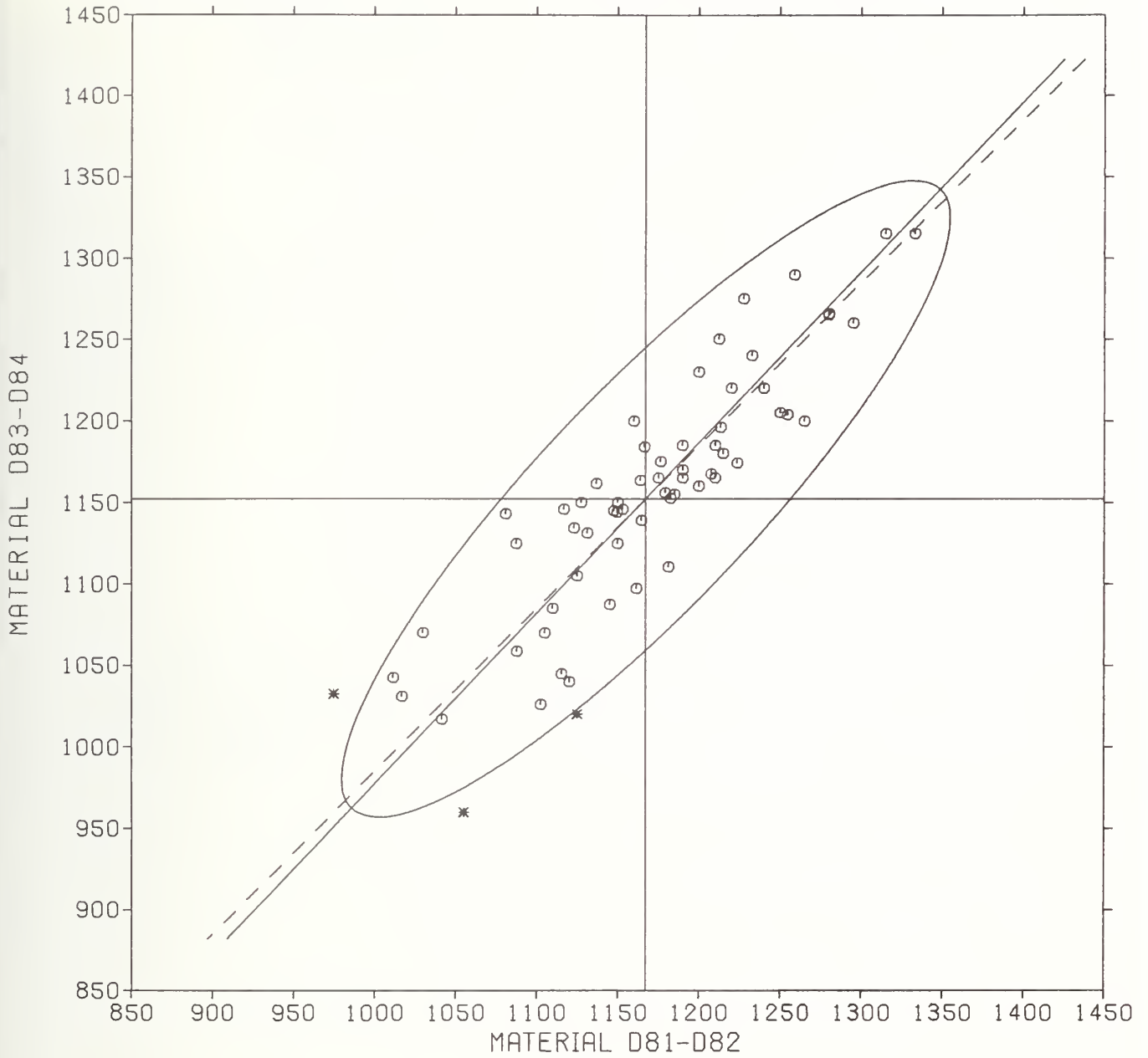


IAB CODE	F	MATERIAL D81-D82 COMMERCIAL TIRE TREAD				MATERIAL D83-D84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MEAN PSI	MEAN MEGAPA	% DEV	REL SDR		
V0066		1185.	8.172	1.5	1.73	1155.	7.966	.2	1.22	01	
V0067		1150.	7.931	-1.5	.70	1150.	7.931	-.2	.40	01	
V0069		1137.	7.841	-2.6	1.18	1161.	8.010	.8	1.28	01	
V0070		1190.	8.207	2.0	1.29	1170.	8.069	1.5	.58	01	
V0071		1223.	8.438	4.8	1.14	1174.	8.097	1.9	1.20	01	
V0072		1160.	8.000	-.6	.74	1200.	8.276	4.1	1.24	01	
V0076		1280.	8.828	9.7	1.08	1265.	8.724	9.0	.40	01	
V0078		1081.	7.455	-7.4	1.33	1143.	7.883	-.8	1.46	01	
V0081		1131.	7.802	-3.1	.83	1131.	7.802	-1.8	1.74	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0083		1175.	8.103	.7	.70	1165.	8.034	1.1	.68	01	
V0084		1190.	8.207	2.0	.66	1165.	8.034	1.1	.60	01	
V0085		1117.	7.702	-4.3	.98	1146.	7.902	-.6	.76	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		1315.	9.069	12.7	1.50	1315.	9.069	14.1	1.11	01	
V0088		1011.	6.976	-13.3	1.32	1042.	7.150	-9.5	1.02	01	
V0092		1030.	7.103	-11.8	1.88	1070.	7.379	-7.1	1.91	01	
V0095		1240.	8.552	6.2	.84	1220.	8.414	5.9	.97	01	
V0096		1149.	7.928	-1.5	.84	1144.	7.890	-.7	.79	01	
V0100		1190.	8.207	2.0	1.17	1185.	8.172	2.8	.74	01	
V0102		1115.	7.690	-4.5	.42	1045.	7.207	-9.3	.99	01	
V0111		1295.	8.931	11.0	.71	1260.	8.690	9.4	1.13	01	
V0117		1150.	7.931	-1.5	.97	1125.	7.759	-2.4	.87	01	
V0120		1176.	8.114	.8	.39	1175.	8.103	2.0	1.13	01	
V0122	*	975.	6.724	-16.5	.86	1032.	7.121	-10.4	.89	01	
V0123		1200.	8.276	2.8	.42	1160.	8.000	.7	.43	01	
V0126		1162.	8.012	-.5	1.00	1097.	7.567	-4.8	1.16	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		1215.	8.375	4.1	1.29	1180.	8.138	2.4	.46	01	
V0141		1181.	8.148	1.2	1.17	1110.	7.659	-3.6	.83	01	
V0144		1110.	7.655	-4.9	1.05	1085.	7.483	-5.8	1.10	01	
V0144B		1250.	8.621	7.1	1.17	1205.	8.310	4.6	1.26	01	
V0146		1123.	7.745	-3.8	.56	1134.	7.824	-1.5	.91	01	
V0148		1212.	8.362	3.9	1.46	1250.	8.621	8.5	1.28	01	
V0149		1213.	8.369	4.0	.79	1190.	8.248	3.8	1.02	01	
V0150		1210.	8.345	3.7	1.58	1185.	8.172	2.8	1.39	01	
V0152		1210.	8.345	3.7	.30	1165.	8.034	1.1	.68	01	
V0153		1164.	8.031	-.2	1.12	1139.	7.855	-1.1	1.50	01	
V0154		1265.	8.724	8.4	1.01	1200.	8.276	4.1	.83	01	
V0156		1200.	8.276	2.8	.81	1230.	8.483	6.7	.89	01	
V0158		1179.	8.132	1.0	.28	1156.	7.972	.3	.89	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0160		1255.	8.652	7.5	.69	1204.	8.302	4.5	.56	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0166		1166.	8.045	-.1	.86	1184.	8.166	2.8	.55	01	
V0168		1127.	7.776	-3.4	.70	1150.	7.931	-.2	2.52X	01	
V0169		1088.	7.502	-6.8	1.42	1059.	7.302	-8.1	.97	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176		1125.	7.759	-3.6	1.88	1105.	7.621	-4.1	1.33	01	
V0177		1120.	7.724	-4.0	.77	1040.	7.172	-9.7	.64	01	
V0184		1207.	8.328	3.5	.65	1167.	8.052	1.3	1.43	01	
V0190		1164.	8.028	-.3	.87	1163.	8.024	1.0	1.46	01	
V0199	*	1125.	7.759	-3.6	1.42	1020.	7.034	-11.5	1.33	01	
V0207	*	1055.	7.276	-9.6	1.65	960.	6.621	-16.7	1.91	01	
V0208		1233.	8.502	5.6	1.76	1240.	8.552	7.6	2.43X	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0213	X	852.	5.876	-27.0	.75	839.	5.790	-27.1	.66	+60	DATA NOT UNDERSTOOD
V0214		1153.	7.952	-1.2	.26	1146.	7.902	-.6	.00	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		1145.	7.897	-1.9	.76	1087.	7.500	-5.6	.54	01	
V0223		1182.	8.155	1.3	.81	1152.	7.948	.0	.94	01	
V0224		1227.	8.466	5.2	2.42X	1275.	8.793	10.7	.84	01	
V0225		1333.	9.193	14.2	1.21	1315.	9.069	14.1	1.45	01	
V0232		1105.	7.621	-5.3	.82	1070.	7.379	-7.1	.54	01	
V0233		1220.	8.414	4.5	.81	1220.	8.414	5.9	.77	01	
V0235		1259.	8.683	7.9	1.03	1289.	8.893	11.9	1.14	01	
V0238		1147.	7.914	-1.7	1.14	1145.	7.897	-.6	.66	01	
V0243		1102.	7.603	-5.5	1.22	1026.	7.076	-11.0	1.47	01	
V0244		1280.	8.828	9.7	1.62	1266.	8.730	9.9	1.06	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A		1041.	7.183	-10.8	.80	1017.	7.014	-11.7	1.22	01	
V0245B		1017.	7.014	-12.9	.82	1031.	7.110	-10.5	.68	01	
V0250		1087.	7.500	-6.8	.79	1125.	7.759	-2.4	.70	01	
1167.		8.049				1152.	7.946				5 TEST DETERMINATIONS
.511						77.	.532				63 LABORATORIES IN GRAND MEANS
.25.		.175				28.	.191				64 LABORATORIES REPORTING
PSI		MEGAPA				PSI	MEGAPA				



# STRESS AT 300% ELONGATION

MATERIAL D81-D82    1167.    PSI    MATERIAL D83-D84    1152.    PSI





## HARDNESS

## NOTES

Materials D81 and D82 were sheets of the same vulcanized rubber. Similarly, materials D83 and D84 were alike.

V200 results were obtained at NBS using ASTM D2240.

Three of the 30 participants reporting used ASTM D1415 (Wallace) for the hardness determination. One participant did not report the instrument used. All others used ASTM D2240 (Type A Durometer).

## SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS			UNITS
					LABS	SHEETS	REPL	
HARDNESS	D81-D82	31	0	58.14	1.94	.18	.42	IRHD
	D83-D84	31	0	57.90	1.83	.14	.44	IRHD

## PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
HARDNESS	D81-D82	5	5	58.14	1.17	5.37	IRHD	2.0	9.2
	D83-D84	5	5	57.90	1.21	5.07	IRHD	2.1	8.8

LAB CODE	F	MATERIAL D81-D82 COMMERCIAL TIRE TREAD			MATERIAL D83-D84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN IRHD	% DEV	REL SDR	MEAN IRHD	% DEV	REL SDR		
V0065		57.50	-1.1	1.17	57.00	-1.6	1.47	01	
V0070		58.00	-0.2	1.48	58.50	1.0	1.58	01	
V0071		58.00	-0.2	1.17	58.00	0.2	1.25	01	
V0072		56.50	-2.8	1.52	57.00	-1.6	1.25	01	
V0078		57.00	-2.0	0.00	57.00	-1.6	1.14	01	
V0081		59.50	2.3	1.18	60.00	3.6	0.51	01	
V0084		59.00	1.5	0.65	58.00	0.2	1.14	01	
V0085		60.00	3.2	0.65	58.65	1.3	0.64	01	
V0087		61.50	5.8	0.53	61.50	6.2	0.00	01	
V0088		57.50	-1.1	1.17	57.50	-0.7	1.14	01	
V0092		57.50	-1.1	1.17	57.50	-0.7	1.25	01	
V0095		56.00	-3.7	0.53	56.00	-3.3	0.00	01	
V0102		62.00	6.6	1.58	62.00	7.1	0.63	01	
V0111		59.50	2.3	1.29	59.50	2.8	0.63	01	
V0122		58.00	-0.2	0.00	57.50	-0.7	0.63	01	
V0128		55.50	-4.5	1.29	56.50	-2.4	1.02	01	
V0141		54.50	-6.3	1.17	54.50	-5.9	1.14	01	
V0144		61.50	5.8	0.53	61.00	5.3	1.25	01	
V0144B	*	61.50	5.8	1.17	59.50	2.8	1.14	01	
V0168		59.00	1.5	0.59	58.75	1.5	0.63	01	
V0169		57.00	-2.0	0.53	57.00	-1.6	0.51	01	
V0176		56.50	-2.8	1.06	56.50	-2.4	1.02	01	
V0190		60.00	3.2	1.17	59.50	2.8	0.63	01	
V0200		56.50	-2.8	0.59	56.00	-3.3	0.47	01	
V0208		58.65	0.9	1.10	57.85	-0.1	1.06	01	
V0214		57.50	-1.1	3.28X	57.30	-1.0	3.16X	01	
V0224		58.50	0.6	0.53	58.00	0.2	1.54	01	
V0233		59.50	2.3	1.06	60.00	3.6	1.14	01	
V0235		57.25	-1.5	0.82	56.50	-2.4	0.72	01	
V0243		56.00	-3.7	0.00	55.50	-4.2	0.00	01	
V0244		55.50	-4.5	1.29	55.00	-5.0	1.47	01	
58.14			GR. MEAN		57.90				5 TEST DETERMINATIONS
1.94			SD MEANS		1.83				31 LABORATORIES IN GRAND MEANS
0.42			AVER SDR		0.44				31 LABORATORIES REPORTING
IRHD			UNIT		IRHD				

# HARDNESS

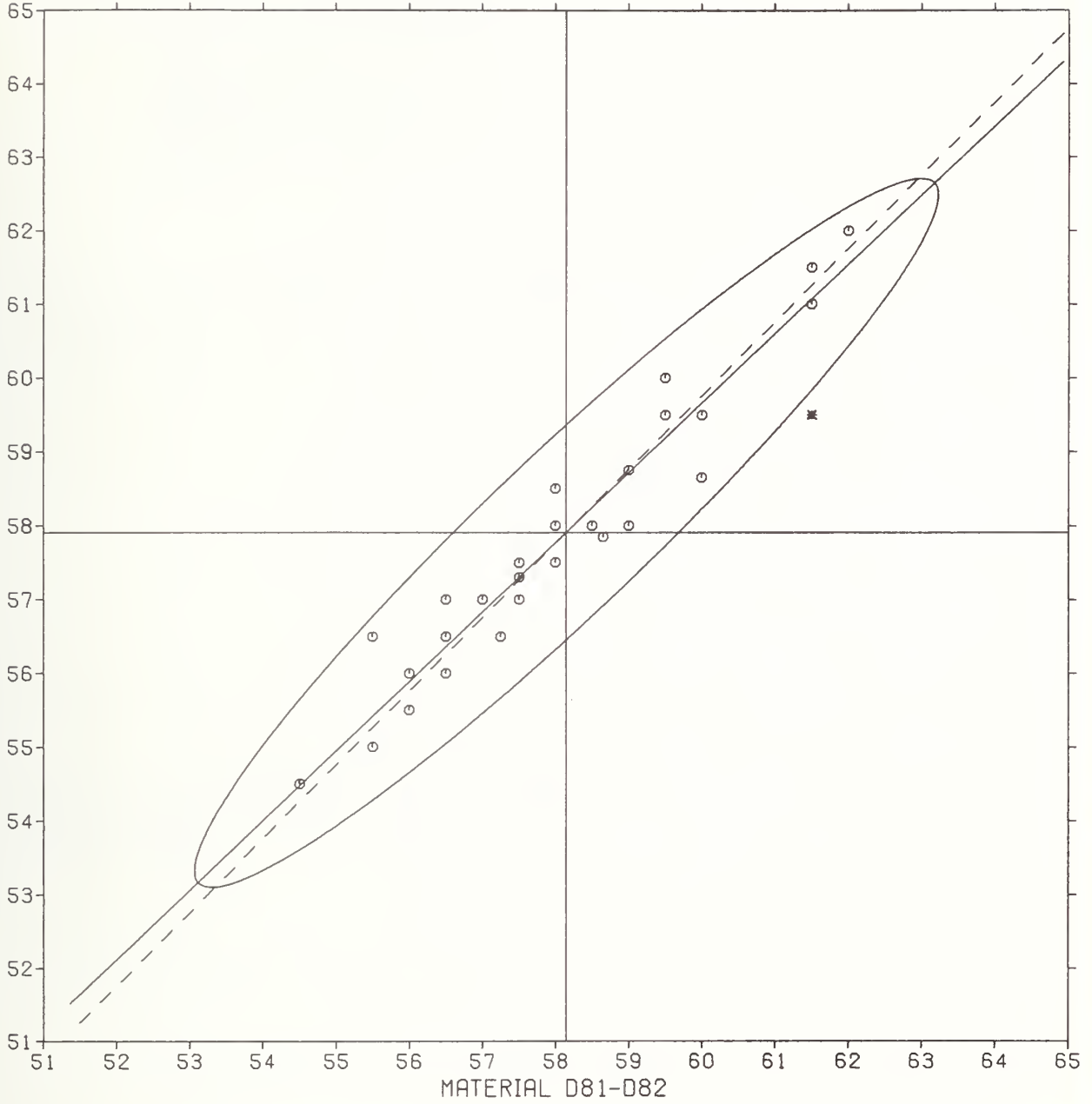
MATERIAL D81-D82

58.14 IRHD

MATERIAL D83-D84

57.90 IRHD

MATERIAL D83-D84





## MOONEY VISCOSITY

## NOTES

Materials U81 and U82 were the same rubber. Similarly, materials U83 and U84 were the same rubber. No sample preparation was required for materials U81 and U82 whereas, mill massing was required for materials U83 and U84.

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			UNITS
					LABS	SHEETS	REPL	
MOONEY	U81-U82	43	2	68.27	2.07	.13	.36	ML
VISCOSITY	U83-U84	43	2	64.03	2.25	.31	.51	ML

## PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
MOONEY	U81-U82	3	3	68.27	1.00	5.73	ML	1.5	8.4
VISCOSITY	U83-U84	3	3	64.03	1.41	6.24	ML	2.2	9.7

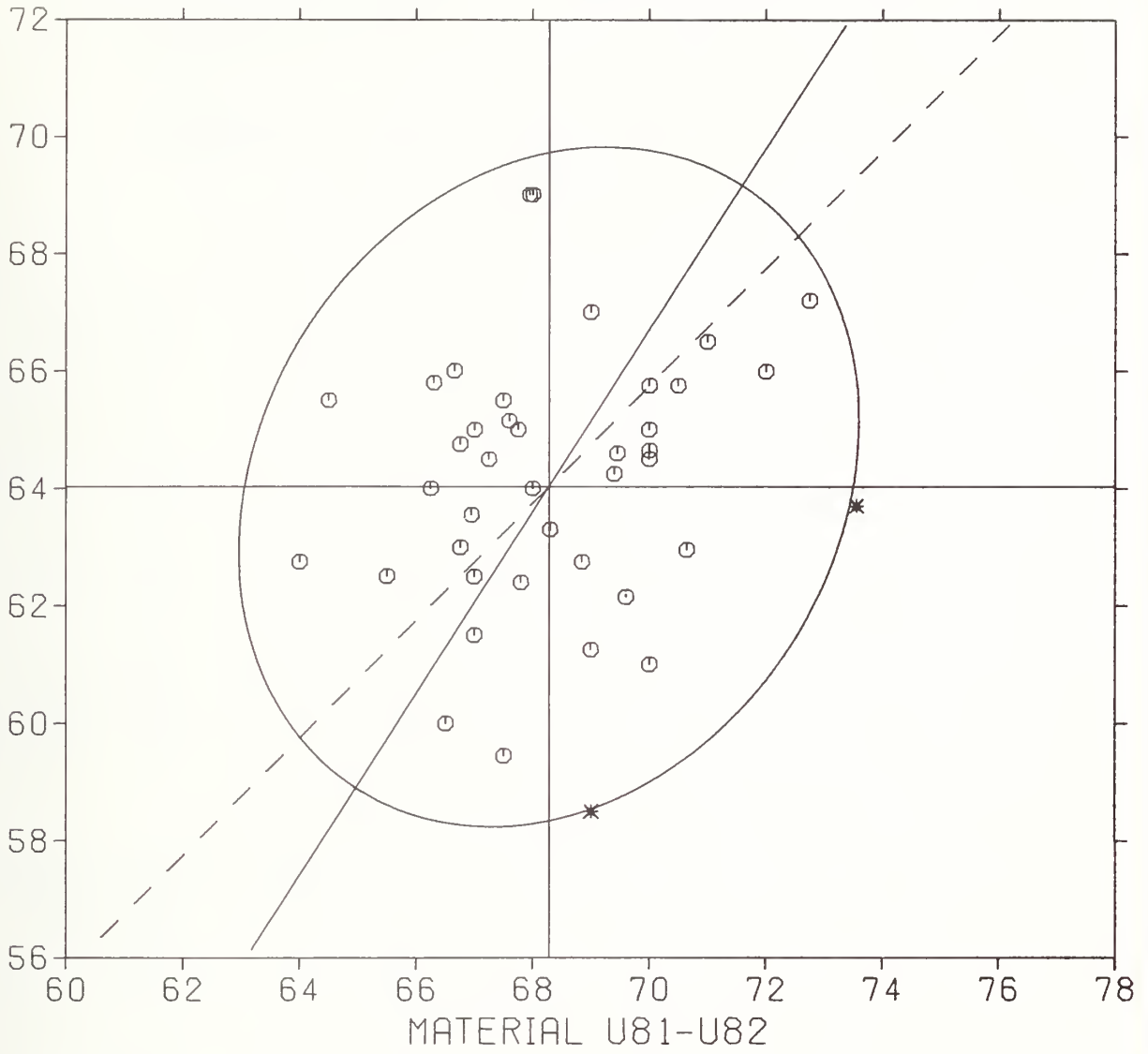
LAB CODE	F	MATERIAL U81-U82 BUTYL RUBBER			MATERIAL U83-U84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN ML	% DEV	REL SDR	MEAN ML	% DEV	REL SDR		
V0068		64.50	-5.5	2.77X	65.50	2.3	4.57X	01	
V0071		67.60	-1.0	.61	65.15	1.8	.53	01	
V0072		70.00	2.5	4.23X	61.00	-4.7	1.97	01	
V0073		65.50	-4.1	.80	62.50	-2.4	1.27	01	
V0077		68.30	.0	.42	63.30	-1.1	.36	01	
VC078	X	62.15	-5.0	1.83	55.10	-15.9	.55	01	
V0079		69.60	1.9	.53	62.15	-2.9	1.23	01	
V0080		65.45	1.7	1.84	64.60	.9	1.14	01	
V0083		70.00	2.5	.88	64.65	1.0	.68	01	
V0085		72.75	6.6	.50	67.20	5.0	.66	01	
VC090		69.00	1.1	.80	61.25	-4.3	1.06	01	
V0092		68.00	-.4	1.60	69.00	7.8	1.14	01	
V0095		66.75	-2.2	1.20	63.00	-1.6	.49	01	
V0100		68.85	.8	.29	62.75	-2.0	.85	01	
V0111	X	57.90	-15.2	.83	54.85	-14.3	.95	01	
V0117		65.50	-4.1	2.00	62.50	-2.4	2.07	01	
V0122		66.25	-3.0	.40	64.00	-.0	.57	01	
V0128		69.00	1.1	1.60	67.00	4.6	.57	01	
V0144		70.00	2.5	.40	64.50	.7	.57	01	
V0146		67.00	-1.9	.80	65.00	1.5	.00	01	
VC148		66.50	-2.6	2.40X	60.00	-6.3	2.64X	01	
V0149		67.95	-.5	.91	69.00	7.8	1.16	01	
V0150	*	73.55	7.7	1.43	63.70	-.5	2.54X	01	
V0156		66.75	-2.2	1.09	64.75	1.1	.78	01	
V0166		67.50	-1.1	.80	65.50	2.3	.57	01	
V0169		67.80	-.7	.21	62.40	-2.5	.25	01	
V0177		66.30	-2.9	3.97X	65.80	2.8	1.27	01	
V0178		66.95	-1.9	.87	63.55	-.7	.55	01	
V0182		67.25	-1.5	1.38	64.50	.7	1.50	01	
V0190		70.65	3.5	1.37	62.95	-1.7	1.71	01	
VC207		65.40	1.6	.44	64.25	.3	.84	01	
V0208		72.00	5.5	.80	66.00	3.1	.57	01	
V0211		67.00	-1.9	.40	62.50	-2.4	.57	01	
V0213		70.50	3.3	.80	65.75	2.7	.78	01	
V0214		66.75	-2.2	2.11	63.00	-1.6	.28	01	
VC217		64.00	-6.3	.00	62.75	-2.0	.28	01	
V0218		68.00	-.4	.80	64.00	-.0	.85	01	
V0220		67.50	-1.1	1.83	59.45	-7.1	.51	01	
V0221		70.00	2.5	.69	65.75	2.7	.57	01	
V0223		67.75	-.8	1.20	65.00	1.5	.98	01	
V0236		71.00	4.0	.80	66.50	3.9	1.97	01	
V0238	*	69.00	1.1	1.60	58.50	-8.6	2.12	01	
V0244		67.00	-1.9	3.50X	61.50	-3.9	2.12	01	
V0250		70.00	2.5	1.60	65.00	1.5	2.07	01	
V0251		66.65	-2.4	1.21	66.00	3.1	1.56	01	
68.27			GR. MEAN		64.03				3 TEST DETERMINATIONS
2.07			SD MEANS		2.25				43 LABORATORIES IN GRAND MEANS
.36			AVER SDR		.51				45 LABORATORIES REPORTING
ML			UNIT		4L				



# MOONEY VISCOSITY

MATERIAL U81-U82 68.27 ML MATERIAL U83-U84 64.03 ML

MATERIAL U83-U84





VULCANIZATION CHARACTERISTICS USING OSCILLATING DISK CURE METER

NOTES

Materials Z81 and Z82 were the same rubber formulation. Similarly, materials Z83 and Z84 were alike.

VI00 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.

One participant used a Monsanto Rheometer operated at  $10^\circ$  amplitude and 1.7 hertz frequency. All others 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			UNITS
					LABS	SHEETS	REPL	
SCORCH TIME	Z81-Z82	36	3	4.44	.25	.03	.08	MINUTES
	Z83-Z84	36	3	3.47	.22	.03	.07	MINUTES
CURE TIME (50% MH)	Z81-Z82	39	0	6.38	.32	.02	.06	MINUTES
	Z83-Z84	39	0	6.20	.34	.03	.07	MINUTES
CURE TIME (90% MH)	Z81-Z82	37	2	9.44	.53	.03	.12	MINUTES
	Z83-Z84	37	2	11.34	.67	.03	.14	MINUTES
MINIMUM TORQUE	Z81-Z82	36	3	4.74	.81	.03	.10	POUND-INCHES
	Z83-Z84	36	3	5.62	.85	.03	.08	POUND-INCHES
MINIMUM TORQUE	Z81-Z82	36	3	.5350	.0913	.0050	.0112	NEWTON-METERS
	Z83-Z84	36	3	.6350	.0956	.0047	.0085	NEWTON-METERS
MAXIMUM TORQUE	Z81-Z82	36	3	22.14	1.21	.04	.11	POUND-INCHES
	Z83-Z84	36	3	25.90	1.20	.05	.09	POUND-INCHES
MAXIMUM TORQUE	Z81-Z82	36	3	2.5011	.1371	.0047	.0123	NEWTON-METERS
	Z83-Z84	36	3	2.9264	.1355	.0052	.0105	NEWTON-METERS

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
SCORCH TIME	Z81-Z82	3	3	4.44	.22	.68	MINUTE	4.9	15.3
	Z83-Z84	3	3	3.47	.18	.62	MINUTE	5.2	17.8
CURE TIME (50% MH)	Z81-Z82	3	3	6.38	.17	.89	MINUTE	2.6	14.0
	Z83-Z84	3	3	6.20	.21	.94	MINUTE	3.3	15.1
CURE TIME (90% MH)	Z81-Z82	3	3	9.44	.32	1.47	MINUTE	3.4	15.6
	Z83-Z84	3	3	11.34	.39	1.85	MINUTE	3.4	16.3
MINIMUM TORQUE	Z81-Z82	3	3	4.74	.27	2.24	LB-IN.	5.8	47.3
	Z83-Z84	3	3	5.62	.21	2.34	LB-IN.	3.7	41.7
MINIMUM TORQUE	Z81-Z82	3	3	.5350	.0309	.2530	N-M	5.8	47.3
	Z83-Z84	3	3	.6350	.0235	.2649	N-M	3.7	41.7
MAXIMUM TORQUE	Z81-Z82	3	3	22.14	.30	3.36	LB-IN.	1.4	15.2
	Z83-Z84	3	3	25.90	.26	3.32	LB-IN.	1.0	12.8
MAXIMUM TORQUE	Z81-Z82	3	3	2.5011	.0342	.3798	N-M	1.4	15.2
	Z83-Z84	3	3	2.9264	.0290	.3755	N-M	1.0	12.8

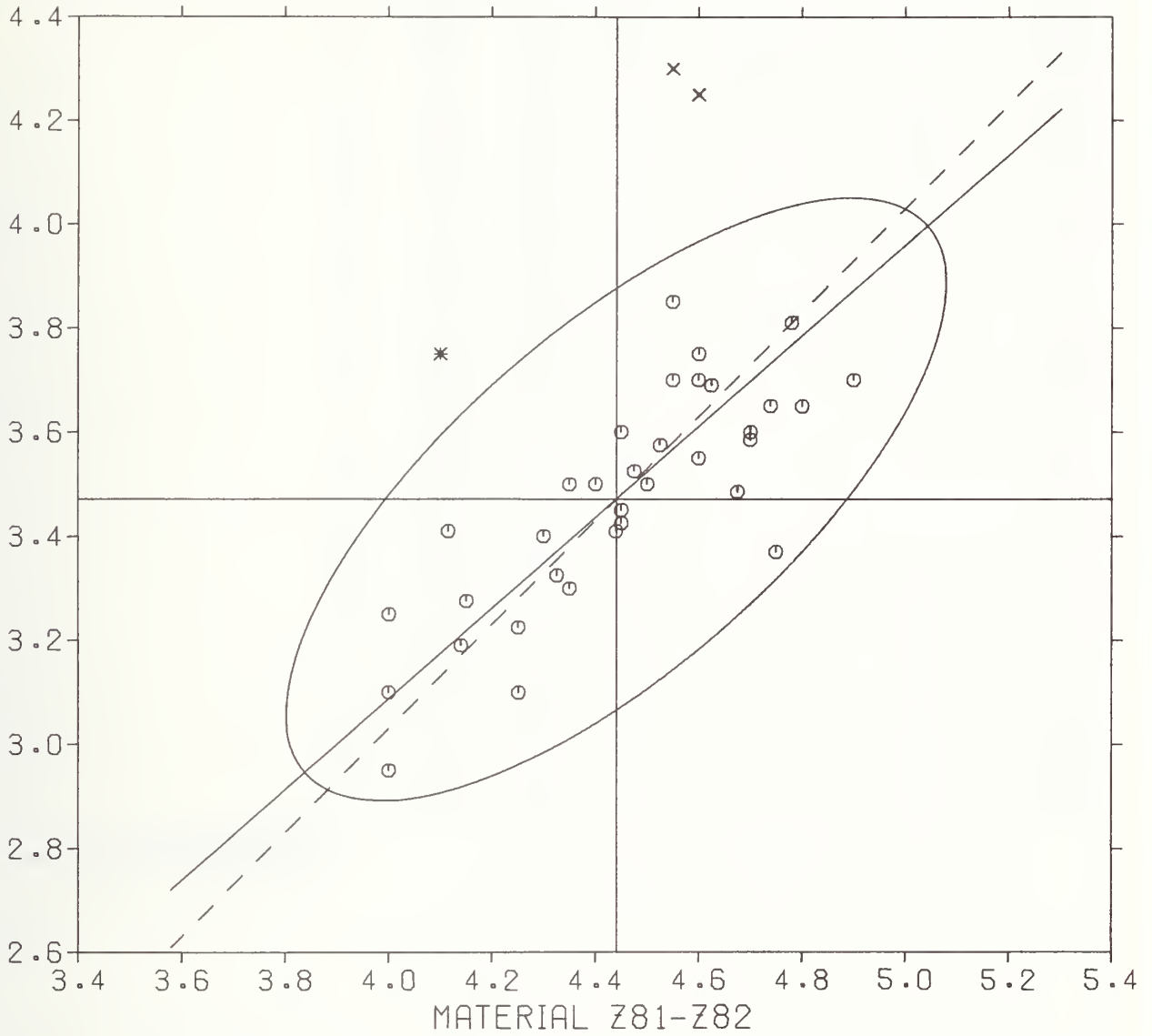
MATERIAL Z81-Z82 COMMERCIAL TIRE TREAD				MATERIAL Z83-Z84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
LAB CODE	F	MEAN MINUTE	% DEV	REL SDR	MEAN MINUTE	% DEV	REL SDR		
V0071		4.40	.9	.64	3.50	.8	1.33	01	
V0074A		4.70	5.9	.74	3.58	3.3	.84	01	
V0074B		4.67	5.3	1.41	3.48	.4	.97	01	
V0077		4.74	6.8	1.68	3.65	5.2	1.11	01	
V0078		4.47	.8	2.61X	3.52	1.6	1.67	01	
V0079		4.75	7.0	.55	3.37	-2.9	.00	01	
V0063		4.70	5.9	2.02	3.60	3.7	.89	01	
V0085		4.45	.2	.00	3.42	-1.3	.00	01	
V0086		4.55	2.5	1.38	3.70	6.6	.00	01	
V0090		4.62	4.2	.77	3.69	6.3	.69	01	
V0092		4.32	-2.6	.55	3.32	-4.2	.44	01	
V0095	X	4.55	2.5	.00	4.30	23.9	.00	01	
V0100		4.45	.2	.64	3.60	3.7	.77	01	
V0117		4.25	-4.3	1.34	3.10	-10.7	1.21	01	
V0120		4.11	-7.3	2.17	3.41	-1.8	1.02	01	
V0122		4.14	-6.8	.41	3.19	-8.1	.58	01	
V0128	X	4.20	-5.4	.37	5.15	48.4	.44	01	
V0144		4.35	-2.0	.29	3.50	.8	.58	01	
V0146		4.90	10.4	1.84	3.70	6.6	1.65	01	
V0148		4.50	1.4	.44	3.50	.8	.31	01	
V0149		4.45	.2	1.11	3.45	-.6	1.33	01	
V0150		4.55	2.5	1.70	3.85	10.9	1.65	01	
V0152		4.60	3.6	.00	3.70	6.6	.00	01	
V0156		4.52	1.9	.55	3.57	3.0	.44	01	
V0158		4.15	-6.5	.32	3.27	-5.6	.22	01	
V0161		4.35	-2.0	.37	3.30	-4.9	1.33	01	
V0166		4.30	-3.2	1.28	3.40	-2.0	.44	01	
V0169	*	4.00	-7.7	1.48	3.75	8.0	1.33	01	
V0178		4.00	-9.9	1.71	3.10	-10.7	1.21	01	
V0207	X	4.60	3.6	1.01	4.25	22.4	1.21	01	
V0208		4.78	7.7	.63	3.81	9.8	.90	01	
V0211		4.25	-4.3	.37	3.22	-7.1	1.55	01	
V0213		4.25	-4.3	2.58X	3.10	-10.7	.89	01	
V0214		4.80	8.1	.74	3.65	5.2	1.21	01	
V0217		4.60	3.6	.00	3.75	8.0	.00	01	
V0218		4.60	3.6	.74	3.55	2.3	.00	01	
V0220		4.00	-9.9	1.70	2.95	-15.0	1.33	01	
V0238		4.00	-9.9	.92	3.05	-6.4	1.45	01	
V0243		4.44	.0	.52	3.41	-1.8	.64	01	
4.44			GR. MEAN		4.47				
.25			SD MEANS		.22				
.08			AVER SDR		.07				
MINUTE			UNIT		MINUTE				

3 TEST DETERMINATIONS  
36 LABORATORIES IN GRAND MEANS  
39 LABORATORIES REPORTING

SCORCH TIME

MATERIAL Z81-Z82 4.44 MINUTE MATERIAL Z83-Z84 3.47 MINUTE

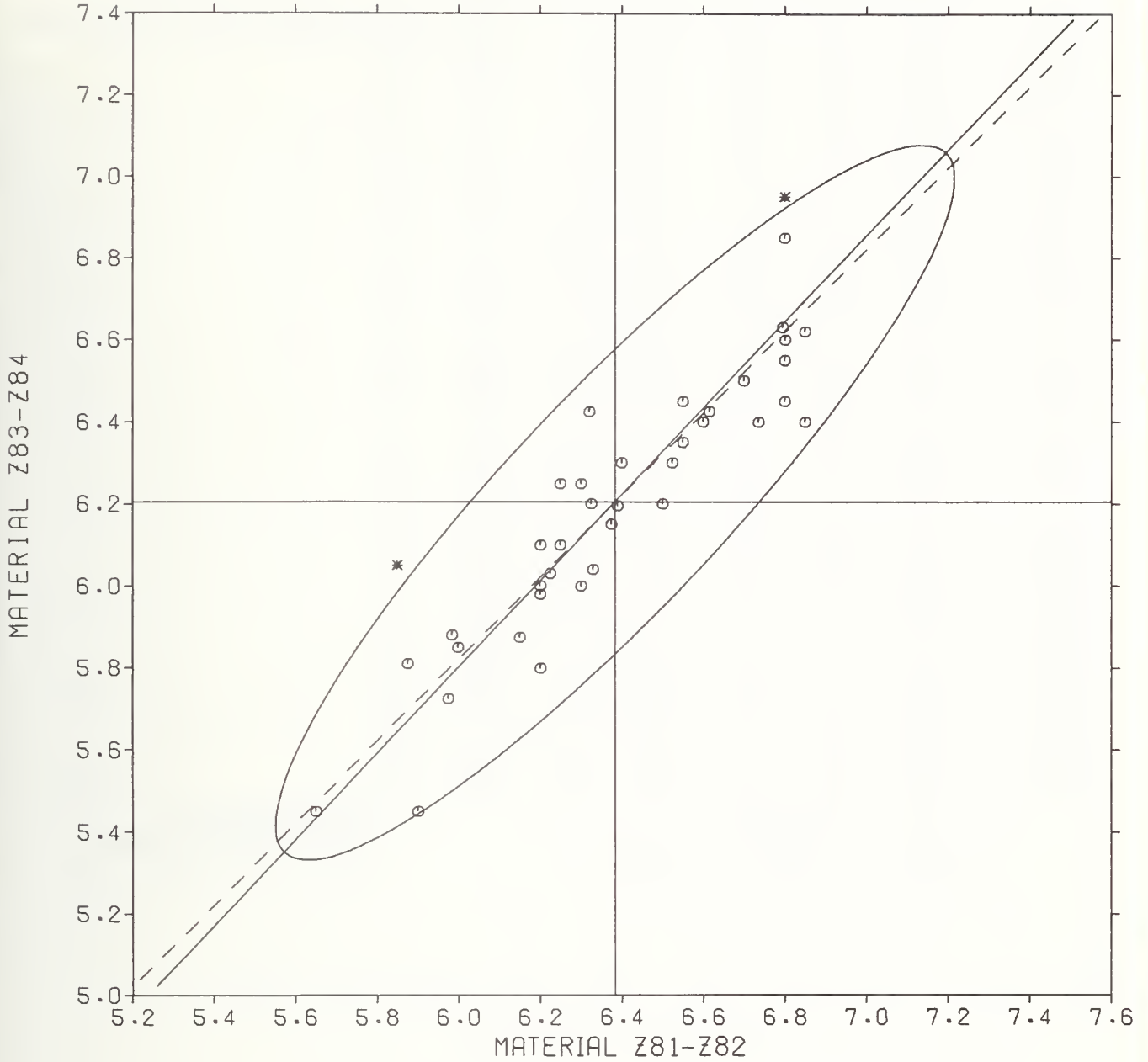
MATERIAL Z83-Z84



MATERIAL Z81-Z82 COMMERCIAL TIRE TREAD				MATERIAL Z83-Z84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
LAB CODE	F	MEAN MINUTE	% DEV	REL SDR	MEAN MINUTE	% DEV	REL SDR		
V0071		6.30	-1.3	.96	6.25	.7	1.16	01	
V0074A		6.85	7.3	1.42	6.62	6.7	.62	01	
V0074B		6.73	5.5	2.82X	6.40	3.1	1.25	01	
V0077		6.79	6.5	1.66	6.63	6.9	.61	01	
V0078		6.32	-0.9	3.49X	6.20	-0.1	1.40	01	
V0079	*	5.85	-8.3	.48	6.05	-2.5	.00	01	
V0083		6.80	6.5	2.14	6.60	6.4	1.06	01	
V0085		6.50	1.8	.83	6.20	-0.1	1.16	01	
V0086		6.80	6.5	3.16X	6.85	10.4	1.69	01	
V0090		6.61	3.6	.73	6.42	3.5	.57	01	
V0092		6.15	-3.6	.72	5.87	-5.3	.19	01	
V0095		6.80	6.5	.00	6.55	5.6	.00	01	
V0100		6.25	-2.1	.96	6.25	.7	.77	01	
V0117		6.25	-2.1	1.66	6.10	-1.7	1.06	01	
V0120		5.98	-6.2	3.06X	5.88	-5.2	1.48	01	
V0122		6.22	-2.5	1.27	6.03	-2.8	1.34	01	
V0128		6.20	-2.9	.83	6.10	-1.7	.00	01	
V0144		6.33	-0.8	.48	6.04	-2.7	.30	01	
V0146		6.70	5.0	1.31	6.50	4.8	1.16	01	
V0148		6.32	-1.0	.79	6.42	3.5	2.66X	01	
V0149		6.37	-0.1	.88	6.15	-0.9	1.06	01	
V0150		6.40	.3	1.44	6.30	1.5	1.55	01	
V0152		6.60	3.4	.96	6.40	3.1	.39	01	
V0156		6.52	2.2	.48	6.30	1.5	.72	01	
V0158		5.97	-6.4	.48	5.72	-7.7	.58	01	
V0161		6.20	-2.9	.96	5.80	-6.5	1.16	01	
V0166		6.20	-2.9	.48	6.00	-3.3	.39	01	
V0169		6.00	-6.0	1.75	5.85	-5.7	.39	01	
V0178		5.65	-11.5	2.71X	5.45	-12.2	1.41	01	
V0207	*	6.80	6.5	3.05X	6.95	12.0	1.69	01	
V0208		6.39	.1	.70	6.19	-0.2	.12	01	
V0211		6.30	-1.3	.48	6.00	-3.3	1.41	01	
V0213		6.80	6.5	.72	6.45	4.0	2.07	01	
V0214		6.85	7.3	1.44	6.40	3.1	2.16	01	
V0217		6.55	2.6	.48	6.45	4.0	.39	01	
V0218		6.55	2.6	.96	6.35	2.3	.00	01	
V0220		5.90	-7.6	1.31	5.45	-12.2	.77	01	
V0238		5.87	-8.0	1.83	5.81	-6.4	1.43	01	
V0243		6.20	-2.9	.38	5.98	-3.6	.49	01	
		6.38		GR. MEAN	6.20			3 TEST DETERMINATIONS	
		.32		SD MEANS	.34			39 LABORATORIES IN GRAND MEANS	
		.06		AVER SDR	.07			39 LABORATORIES REPORTING	
		MINUTE		UNIT	MINUTE				

CURE TIME (50% MH)

MATERIAL Z81-Z82 6.38 MINUTE MATERIAL Z83-Z84 6.20 MINUTE



MATERIAL Z81-Z82 COMMERCIAL TIRE TREAD				MATERIAL Z83-Z84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
LAB CODE	F	MEAN MINUTE	% DEV	REL SDR	MEAN MINUTE	% DEV	REL SDR		
V0071		9.50	.6	1.03	11.60	2.3	.82	01	
V0074A		10.35	9.6	.76	12.44	9.7	1.20	01	
V0074B		10.12	7.2	2.20X	12.00	5.8	.37	01	
V0077		9.88	4.6	.92	12.15	7.2	.78	01	
V0078		9.25	-2.0	1.15	11.25	-0.8	.80	01	
V0079	X	8.70	-7.9	.12	11.97	5.6	.00	01	
V0083		10.05	6.4	1.57	12.50	10.2	1.03	01	
V0085		9.50	.6	.43	10.85	-4.3	.62	01	
V0086		9.75	3.3	.75	11.50	1.4	1.60	01	
V0090		9.81	3.9	1.97	11.76	3.8	1.19	01	
V0092		9.00	-4.7	.00	10.72	-5.4	.18	01	
V0095	X	11.45	21.3	.00	11.15	-1.7	.60	01	
V0100		9.50	.6	.68	11.55	1.9	.90	01	
V0117		9.15	-3.1	2.16	11.40	.5	.71	01	
V0120		8.85	-6.3	2.16	11.05	-2.5	1.18	01	
V0122		9.62	1.9	1.71	11.82	4.3	1.83	01	
V0128		9.10	-3.6	.75	11.10	-2.1	.00	01	
V0144		9.18	-2.7	.43	10.96	-3.3	1.82	01	
V0146		9.85	4.3	1.25	11.50	1.4	1.36	01	
V0148		9.42	-0.2	.78	11.34	.1	.98	01	
V0149		9.60	1.7	1.08	11.30	-0.3	.82	01	
V0150		9.15	-3.1	.50	11.00	-3.0	2.18	01	
V0152		9.70	2.7	.50	11.70	3.2	.21	01	
V0156		9.70	2.7	.34	11.50	1.4	.54	01	
V0158		8.52	-9.7	.00	10.25	-9.6	1.08	01	
V0161		8.80	-6.8	.50	10.45	-7.8	.90	01	
V0166		8.95	-5.2	.25	10.85	-4.3	.56	01	
V0169		8.85	-6.3	1.16	10.85	-4.3	.90	01	
V0178		8.30	-12.1	1.90	9.75	-14.0	.41	01	
V0207	*	11.00	16.5	1.73	13.25	16.9	1.80	01	
V0208		9.48	.4	.66	11.39	.5	3.75X	01	
V0211		9.27	-1.8	1.12	11.00	-3.0	1.34	01	
V0213		9.75	3.3	.75	11.35	.1	1.27	01	
V0214		10.15	7.5	1.40	12.05	6.3	1.83	01	
V0217		9.50	.6	.00	11.50	1.4	.62	01	
V0218		9.60	1.7	.50	11.60	2.3	.41	01	
V0220		8.90	-5.7	.68	10.35	-8.7	1.09	01	
V0238		9.00	-4.7	1.25	10.87	-4.1	2.43X	01	
V0243		9.23	-2.2	.16	11.01	-2.9	.68	01	
9.44			GR. MEAN		11.34				
.53			SD MEANS		.67				
.12			AVEE SDR		.14				
MINUTE			UNIT		MINUTE				

3 TEST DETERMINATIONS  
37 LABORATORIES IN GRAND MEANS  
39 LABORATORIES REPORTING



CURE TIME (90% MH)

MATERIAL Z81-Z82

9.44

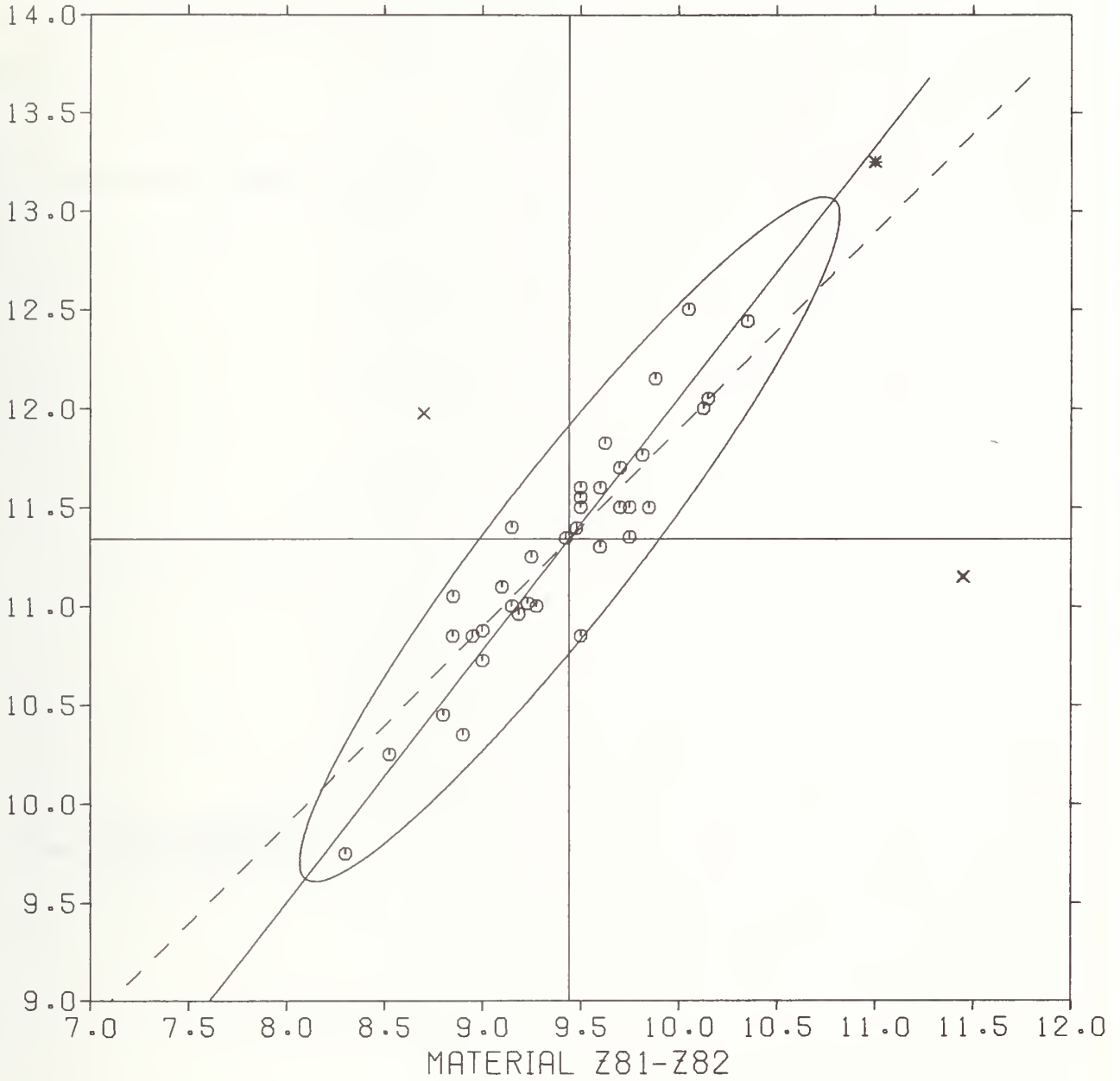
MINUTE

MATERIAL Z83-Z84

11.34

MINUTE

MATERIAL Z83-Z84

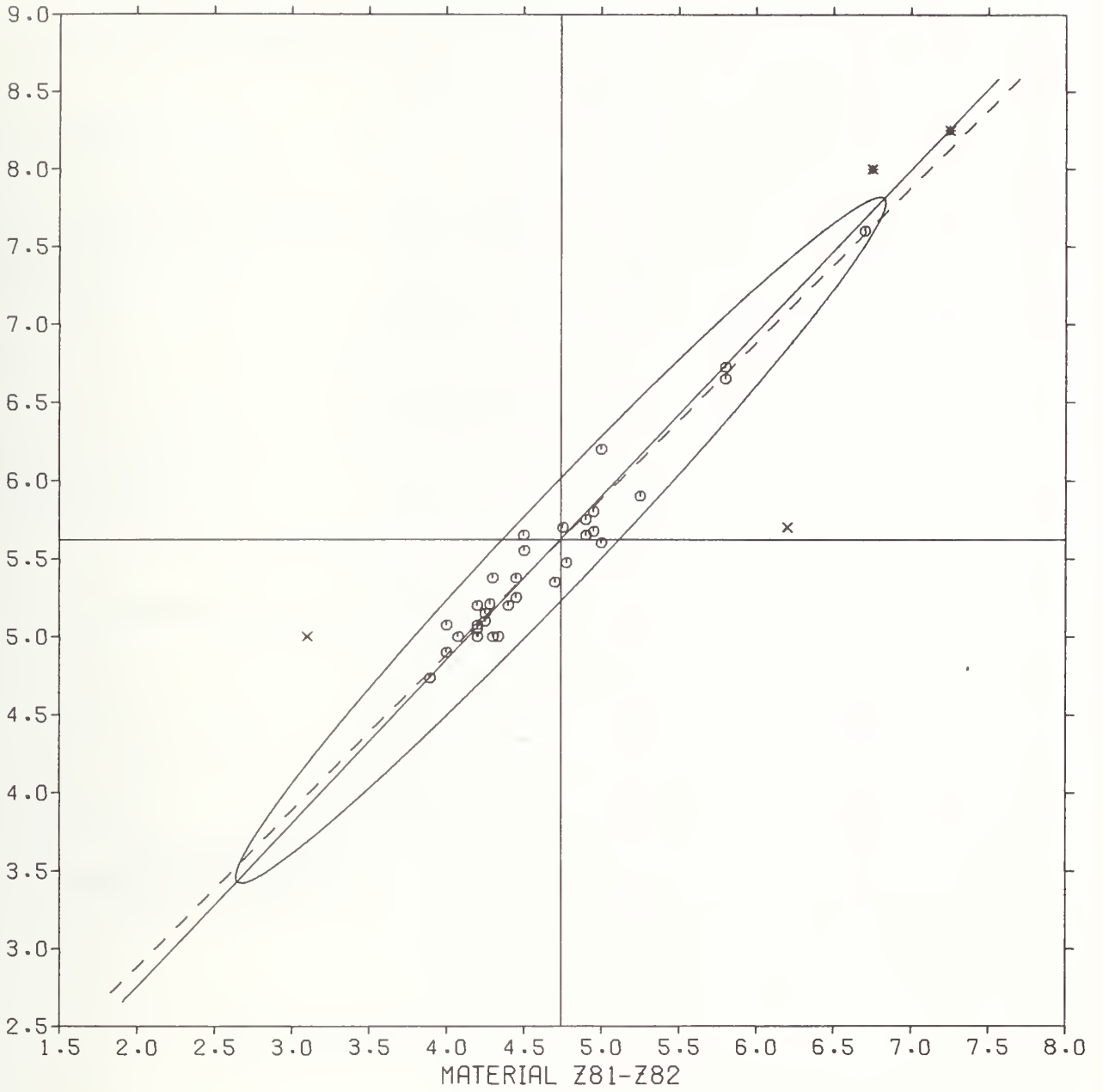


LAB CODE	F	MATERIAL Z81-Z82 COMMERCIAL TIRE TREAD				MATERIAL Z83-Z84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MEAN LB-IN.	MEAN N-M	% DEV	REL SDR		
V0071		4.20	.4746	-11.3	.80	5.05	.5706	-10.1	.77	01	
V0074A		4.30	.4859	-9.2	1.41	5.37	.6073	-4.4	.89	01	
V0074B		4.20	.4746	-11.3	1.32	5.07	.5734	-9.7	.38	01	
V0077		4.07	.4604	-13.9	.25	5.00	.5649	-11.0	.51	01	
V0078		4.25	.4802	-10.2	1.07	5.10	.5762	-9.3	.77	01	
V0079	X	3.10	.3503	-34.5	.88	5.00	.5649	-11.0	.00	01	
V0083		5.80	.6553	22.5	.58	6.65	.7514	16.3	1.33	01	
V0085		3.89	.4400	-17.8	.00	4.74	.5350	-15.7	.00	40	ORIGINAL IN NEWTON-METER
V0086		4.30	.4859	-9.2	1.17	5.00	.5649	-11.0	.38	01	
V0090		4.77	.5395	.8	1.70	5.47	.6186	-2.6	3.17X	01	
V0092		4.45	.5028	-6.0	.00	5.25	.5932	-6.6	.77	01	
V0095	X	6.20	.7005	30.9	.00	5.70	.6440	1.4	.00	01	
V0100		4.40	.4972	-7.1	.58	5.20	.5875	-7.5	.00	01	
V0117		4.90	.5537	3.5	1.83	5.75	.6497	2.3	1.68	01	
V0120		5.00	.5649	5.6	1.01	6.20	.7005	10.3	2.05	01	
V0122		5.00	.5649	5.6	2.18X	5.60	.6327	-.4	3.15X	01	
V0128		4.25	.4802	-10.2	.00	5.15	.5819	-8.4	.38	01	
V0144		4.00	.4520	-15.5	.00	4.90	.5537	-12.8	.38	01	
V0146		4.95	.5593	4.5	1.09	5.80	.6553	3.2	2.30	01	
V0148		5.80	.6553	22.5	1.90	6.72	.7599	19.7	1.34	01	
V0149		4.50	.5085	-5.0	.58	5.55	.6271	-1.2	1.43	01	
V0150	*	6.75	.7627	42.6	3.99X	8.00	.9039	42.3	.00	01	
V0152		4.20	.4746	-11.3	.00	5.00	.5649	-11.0	.00	01	
V0156		4.70	.5311	-.7	.51	5.35	.6045	-4.8	1.15	01	
V0158		4.00	.4520	-15.5	.00	5.07	.5734	-9.7	1.83	01	
V0161		4.00	.4520	-15.5	.80	4.90	.5537	-12.8	.77	01	
V0166		4.20	.4746	-11.3	.00	5.20	.5875	-7.5	.00	01	
V0169		4.34	.4900	-8.4	1.34	5.00	.5650	-11.0	.34	40	ORIGINAL IN NEWTON-METER
V0178		4.50	.5085	-5.0	1.55	5.65	.6384	.5	.38	01	
V0207	X	8.30	.9378	75.3	3.05X	8.75	.9887	55.7	2.78X	01	
V0208		4.28	.4836	-9.6	.56	5.21	.5887	-7.3	.69	01	
V0211		4.45	.5028	-6.0	.53	5.37	.6073	-4.4	1.26	01	
V0213		5.25	.5932	10.9	.88	5.90	.6666	5.0	.77	01	
V0214		6.70	.7570	41.5	1.56	7.60	.8587	35.2	.77	01	
V0217		4.20	.4746	-11.3	.00	5.20	.5875	-7.5	.00	01	
V0218		4.90	.5537	3.5	.58	5.65	.6384	.5	1.54	01	
V0220		4.75	.5367	.3	.80	5.70	.6440	1.4	1.15	01	
V0238	*	7.25	.8192	53.1	2.73X	8.25	.9322	46.8	3.50X	01	
V0243		4.95	.5593	4.5	.58	5.67	.6412	1.0	.96	01	
		4.74	.5350	GR. MEAN		5.62	.6350				3 TEST DETERMINATIONS
		.81	.0913	SD MEANS		.85	.0956				36 LABORATORIES IN GRAND MEANS
		.10	.0112	AVER SDR		.08	.0085				39 LABORATORIES REPORTING
		LB-IN.	N-M	UNIT		LB-IN.	N-M				

# MINIMUM TORQUE

MATERIAL Z81-Z82 4.74 LB-IN. MATERIAL Z83-Z84 5.62 LB-IN.

MATERIAL Z83-Z84



LAB CODE	F	MATERIAL Z81-Z82 COMMERCIAL TIRE TREAD				MATERIAL Z83-Z84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MEAN LB-IN.	MEAN N-M	% DEV	REL SDR		
V0071		21.60	2.4406	-2.4	1.32	25.00	2.8248	-3.5	.62	01	
VC074A		22.22	2.5112	.4	1.49	26.25	2.9660	1.4	2.86X	01	
V0074B		22.20	2.5084	.3	1.00	25.97	2.9349	.3	.16	01	
V0077		21.10	2.3841	-4.7	.48	25.02	2.8276	-3.4	.74	01	
V0078		21.55	2.4349	-2.6	1.22	25.30	2.8586	-2.3	.85	01	
VC079	X	16.20	1.8304	-26.8	1.59	25.05	2.8304	-3.3	.00	01	
V0083		23.80	2.6892	7.5	.53	28.00	3.1637	8.1	1.87	01	
V0085		19.87	2.2451	-10.2	.41	23.41	2.6451	-9.6	1.10	40	ORIGINAL IN NEWTON-METER
V0086		20.80	2.3502	-6.0	.79	24.15	2.7287	-6.8	.82	01	
VC090		22.37	2.5282	1.1	.23	25.47	2.8784	-1.6	3.66X	01	
VC092		22.80	2.5762	3.0	.26	26.30	2.9716	1.5	.00	01	
V0095	X	22.80	2.5762	3.0	.00	22.30	2.5197	-13.9	.00	01	
V0100		22.00	2.4858	-.6	.00	26.15	2.9547	1.0	.00	01	
VC117	*	21.80	2.4632	-1.5	7.39X	26.85	3.0338	3.7	2.80X	01	
V0120		23.60	2.6666	6.6	2.10	27.35	3.0903	5.6	1.56	01	
V0122		23.10	2.6101	4.4	2.17	26.50	2.9942	2.3	6.58X	01	
V0128		20.45	2.3106	-7.6	1.32	24.25	2.7400	-6.4	.93	01	
V0144		21.00	2.3728	-5.1	.26	24.80	2.8022	-4.2	2.69X	01	
V0146		22.00	2.4858	-.6	1.06	25.50	2.8812	-1.5	1.65	01	
V0148		24.22	2.7372	9.4	1.27	27.50	3.1072	6.2	2.18	01	
VC149		21.70	2.4519	-2.0	1.94	25.50	2.8812	-1.5	1.36	01	
V0150	*	24.50	2.7683	10.7	3.96X	29.00	3.2767	12.0	.00	01	
V0152		21.45	2.4236	-3.1	.53	25.50	2.8812	-1.5	.31	01	
V0156		21.60	2.4406	-2.4	1.06	24.55	2.7739	-5.2	.31	01	
VC158		21.15	2.3897	-4.5	1.06	25.07	2.8332	-3.2	1.63	01	
V0161		20.45	2.3106	-7.6	.96	24.60	2.7796	-5.0	1.24	01	
V0166		21.15	2.3897	-4.5	.46	25.55	2.8869	-1.4	.54	01	
VC169		21.11	2.3651	-4.6	2.47X	24.65	2.7851	-4.8	.83	40	ORIGINAL IN NEWTON-METER
V0178		21.15	2.3897	-4.5	1.49	25.25	2.8530	-2.5	1.13	01	
V0207	X	27.85	3.1468	25.8	2.55X	31.00	3.5027	19.7	1.66	01	
V0208		23.00	2.5988	3.9	3.09X	26.63	3.0089	2.8	5.38X	01	
V0211		22.67	2.5620	2.4	1.01	26.60	3.0055	2.7	1.36	01	
V0213		23.35	2.6383	5.5	1.32	27.25	3.0790	5.2	1.56	01	
V0214		24.15	2.7287	9.1	.96	27.25	3.0790	5.2	.62	01	
V0217		21.20	2.3954	-4.2	1.06	25.00	2.8248	-3.5	.00	01	
V0218		22.50	2.5423	1.6	.53	26.50	2.9942	2.3	1.24	01	
V0220		22.50	2.5423	1.6	.92	26.45	2.9886	2.1	.31	01	
V0238	*	24.75	2.7965	11.8	3.87X	27.25	3.0790	5.2	.78	01	
V0243		22.00	2.4858	-.6	.79	26.00	2.9377	.4	.31	01	
		22.14	2.5011		GR. MEAN	25.90	2.9264				3 TEST DETERMINATIONS
		1.21	.1371		SD MEANS	1.20	.1355				36 LABORATORIES IN GRAND MEANS
		.11	.0123		AVER SDR	.09	.0105				39 LABORATORIES REPORTING
		LB-IN.	N-M		UNIT	LB-IN.	N-M				

# MAXIMUM TORQUE

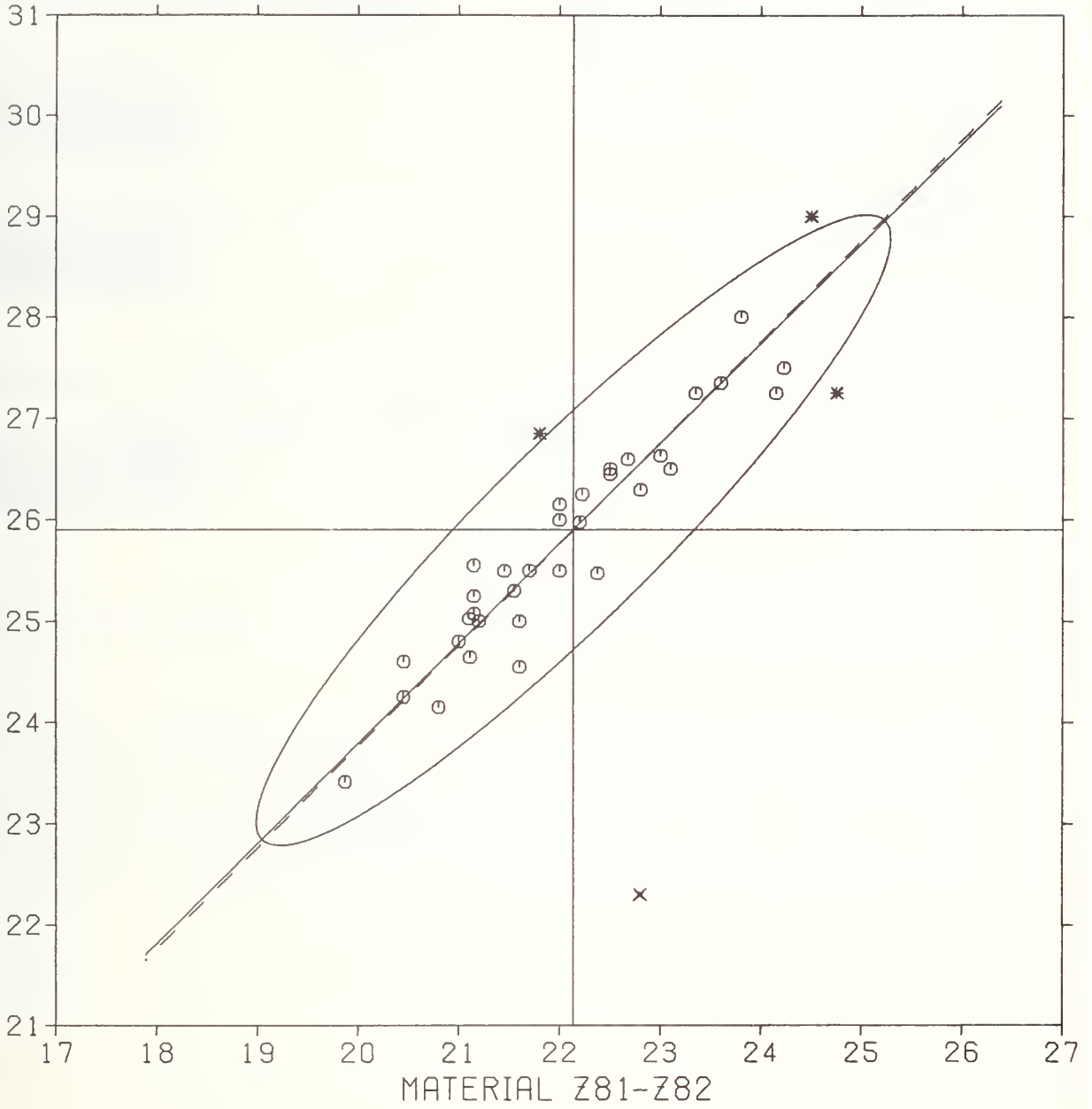
MATERIAL Z81-Z82

22.14 LB-IN.

MATERIAL Z83-Z84

25.90 LB-IN.

MATERIAL Z83-Z84



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