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Collaborative Testing Services, Inc.

COLLABORATIVE REFERENCE PROGRAM FOR RUBBER

ANALYSES NO. 43
JANUARY - MARCH 1980

NBSIR 80-1835

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

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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
- Moisture content
- 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

CTS Rubber (4 times per year)

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

ASTM Cement (2 times per year)

- Chemical (11 chemical components)
- Physical (15 characteristics)

AASHTO Bituminous

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

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A05 Technology Building
National Bureau of Standards
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INTERLABORATORY PROGRAMS FOR RUBBER

Analyses No. 43
January - March 1980

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U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards

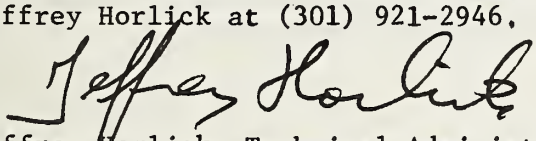
NBSIR 80-1835

INTRODUCTION

This report summarizes the test results for the first quarter of 1980. The tests cover the four areas in the NBS Collaborative Reference Programs for Rubber: Tensile Properties, Hardness, Mooney Viscosity, and Vulcanization Properties. The program is maintained and operated by Collaborative Testing Services, Inc. (CTS). CTS is a non-profit organization of associations that offers CRP's to a wide range of industries.

For each of the four areas, there is a set of summary tables followed by a table of data and analysis by laboratory and graphical presentation of the data and analysis. Where applicable, the tables of data have the English and Metric expressions side-by-side. Also, shown in the tables are notes concerning specific laboratory results and instrument, unit or other variations. 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 Thomas Cummings at (703) 442-0433 or Jeffrey Horlick at (301) 921-2946.



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

May 14, 1980

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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 A01 and A02 were sheets of the same vulcanized rubber. Similary, materials A03 and A04 were alike

V100 results were obtained at NBS using a pendulum tester.

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

V178 did not specify a Die
V225 used ASTM Die D
V171 used ASTM Die B
V249 used ASTM Die A

INSTRUMENTS

Instrument	Number of Labs	Percent
Electronic Manual	20	31%
Electronic Automatic	20	31%
Pendulum Manual	20	31%
Pendulum Automatic	2	3.5%
Not Specified	2	3.5%
	64	100%

RELATIVE HUMIDITY

Relative Humidity	Number of Labs	Percent
Below 45%	29	45%
Above 55%	10	16%
45% - 55%	15	23%
Not Specified	10	16%
	64	100%

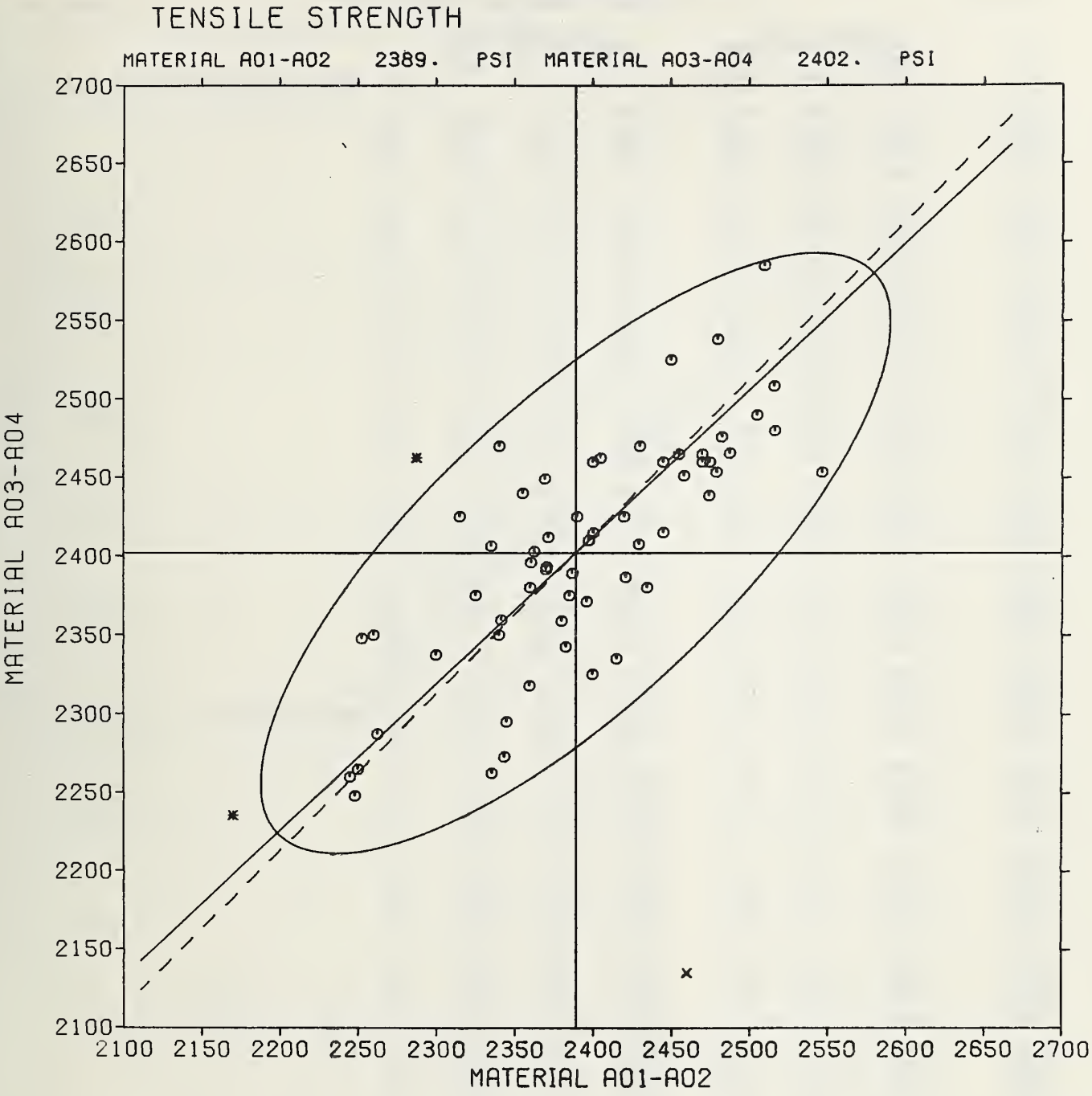
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
TENSILE STRENGTH	A01-A02	62	2	2389.	80.	63.	56.	POUNDS PER SQUARE INCH
	A03-A04	62	2	2402.	75.	44.	57.	POUNDS PER SQUARE INCH
TENSILE STRENGTH	A01-A02	62	2	16.475	.549	.436	.389	MEGAPASCALS
	A03-A04	62	2	16.565	.520	.306	.396	MEGAPASCALS
ULTIMATE ELONGATION	A01-A02	62	2	561.	23.	8.	15.	PERCENT
	A03-A04	62	2	560.	19.	9.	15.	PERCENT
STRESS AT 300% ELONGATION	A01-A02	62	2	1228.	72.	29.	21.	POUNDS PER SQUARE INCH
	A03-A04	62	2	1217.	74.	21.	22.	POUNDS PER SQUARE INCH
STRESS AT 300% ELONGATION	A01-A02	62	2	8.472	.494	.198	.141	MEGAPASCALS
	A03-A04	62	2	8.390	.510	.145	.153	MEGAPASCALS

PRECISION OF METHODS

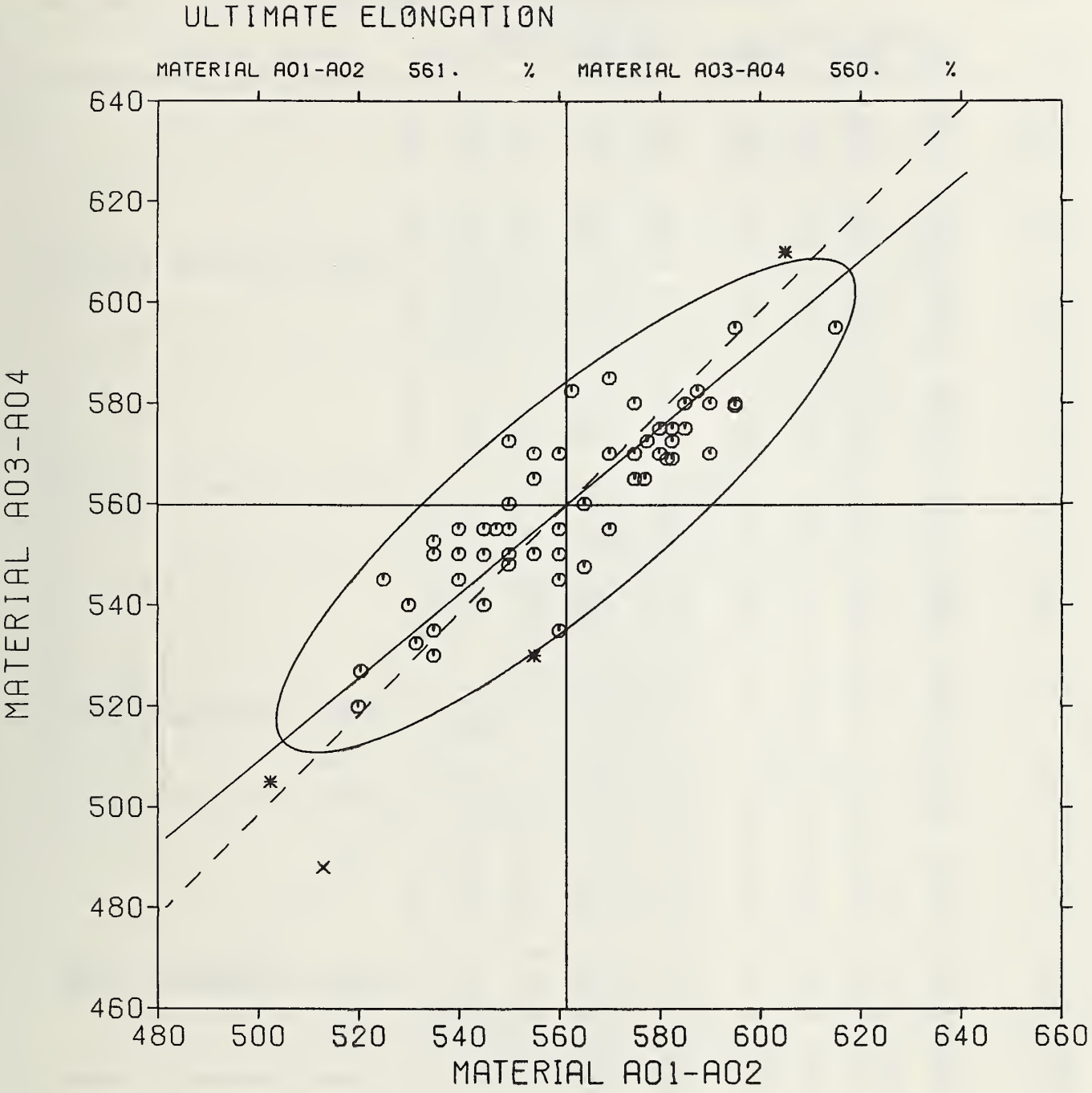
PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
TENSILE STRENGTH	A01-A02	5	5	2389.	156.	220.	PSI	6.5	9.2
	A03-A04	5	5	2402.	159.	209.	PSI	6.6	8.7
TENSILE STRENGTH	A01-A02	5	5	16.475	1.077	1.519	MEGAPA	6.5	9.2
	A03-A04	5	5	16.565	1.098	1.441	MEGAPA	6.6	8.7
ULTIMATE ELONGATION	A01-A02	5	5	561.	41.	63.	%	7.2	11.2
	A03-A04	5	5	560.	43.	54.	%	7.6	9.6
STRESS AT 300% ELONGATION	A01-A02	5	5	1228.	57.	198.	PSI	4.6	16.1
	A03-A04	5	5	1217.	61.	205.	PSI	5.1	16.8
STRESS AT 300% ELONGATION	A01-A02	5	5	8.472	.392	1.368	MEGAPA	4.6	16.1
	A03-A04	5	5	8.390	.424	1.411	MEGAPA	5.1	16.8

LAB CODE	F	MATERIAL A01-A02 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL A03-A04 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062		2245	15.483	-6.0	.81	2260	15.586	-5.9	1.06	01	
V0063		2369	16.341	-.8	.69	2449	16.890	2.0	1.13	01	
V0070		2387	16.462	-.1	1.33	2389	16.476	-.5	1.55	01	
V0071		2421	16.697	1.3	.76	2386	16.459	-.6	.95	01	
V0072		2470	17.034	3.4	.72	2465	17.000	2.6	.55	01	
V0073		2325	16.034	-2.7	.78	2375	16.379	-1.1	.71	01	
V0076		2430	16.755	1.7	.93	2470	17.034	2.8	1.20	01	
V0083		2390	16.483	.0	.69	2425	16.724	1.0	.40	01	
V0084		2420	16.690	1.3	2.15X	2425	16.724	1.0	1.00	01	
V0085		2429	16.754	1.7	.60	2408	16.604	.2	1.23	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0087		2400	16.552	.5	.98	2460	16.966	2.4	1.11	01	
V0088	*	2170	14.966	-9.2	1.17	2235	15.417	-6.9	1.70	01	
V0092		2340	16.138	-2.0	1.01	2350	16.207	-2.2	.91	01	
V0095		2397	16.534	.4	1.22	2410	16.621	.3	2.00X	01	
V0100		2445	16.862	2.3	2.07X	2415	16.655	.5	.85	01	
V0102		2315	15.966	-3.1	2.23X	2425	16.724	1.0	.95	01	
V0111		2385	16.448	-.2	1.00	2375	16.379	-1.1	1.50	01	
V0117		2300	15.862	-3.7	.41	2337	16.121	-2.7	2.03X	01	
V0120		2482	17.121	3.9	1.16	2476	17.076	3.1	1.05	01	
V0123		2340	16.138	-2.0	.84	2470	17.034	2.8	1.07	01	
V0126		2516	17.355	5.3	.89	2480	17.104	3.3	1.33	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0128		2470	17.034	3.4	.91	2460	16.966	2.4	.78	01	
V0141		2359	16.272	-1.2	.50	2318	15.986	-3.5	1.09	01	
V0144		2510	17.310	5.1	1.12	2585	17.828	7.6	.80	01	
V0144B	X	2460	16.966	3.0	3.81X	2135	14.724	-11.1	5.01X	01	
V0146		2370	16.345	.8	1.22	2391	16.493	-.4	1.23	01	
V0149		2371	16.355	-.7	1.37	2412	16.634	.4	.84	01	
V0150		2400	16.552	.5	1.19	2325	16.034	-3.2	1.29	01	
V0152		2435	16.793	1.9	.86	2380	16.414	-.9	1.04	01	
V0153		2341	16.148	-2.0	1.58	2359	16.272	-1.8	1.36	01	
V0154		2455	16.931	2.8	1.48	2465	17.000	2.6	.69	01	
V0156		2345	16.172	-1.8	1.08	2295	15.828	-4.5	.75	01	
V0158		2484	17.134	4.0	1.53	2414	16.649	.5	1.62	.72	ORIGINAL IN MEGAPASCAL RECEIVED LATE
V0160		2458	16.954	2.9	1.11	2451	16.904	2.0	1.24	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0164		2474	17.066	3.6	.65	2438	16.817	1.5	1.58	01	
V0166		2396	16.524	.3	.64	2371	16.352	-1.3	1.17	01	
V0168		2516	17.352	5.3	.85	2508	17.300	4.4	.62	01	
V0169		2487	17.154	4.1	1.44	2466	17.004	2.7	.92	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0171		2505	17.276	4.9	.95	2490	17.172	3.7	1.36	01	
V0176		2355	16.241	-1.4	1.22	2440	16.828	1.6	.36	01	
V0178		2360	16.276	-1.2	.70	2380	16.414	-.9	.78	01	
V0184		2260	15.586	-5.4	.92	2350	16.207	-2.2	.74	01	
V0190		2479	17.097	3.8	1.03	2453	16.921	2.1	1.82	01	
V0199		2415	16.655	1.1	1.49	2335	16.103	-2.8	1.21	01	
V0206		2475	17.069	3.6	1.74	2460	16.966	2.4	.94	01	
V0207		2250	15.517	-5.8	.53	2265	15.621	-5.7	.40	01	
V0213		2371	16.349	-.8	1.17	2393	16.504	-.4	.80	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0214		2400	16.554	.5	.63	2415	16.654	.5	.81	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0220		2405	16.586	.7	1.10	2462	16.983	2.5	1.21	01	
V0223		2445	16.862	2.3	1.07	2460	16.966	2.4	.92	01	
V0224		2382	16.431	-.3	1.26	2342	16.155	-2.5	1.39	01	
V0225		2362	16.293	-1.1	.56	2403	16.572	.0	.72	01	
V0232		2480	17.104	3.8	1.17	2538	17.505	5.7	1.76	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0233		2335	16.103	-2.3	1.32	2406	16.597	.2	1.10	01	
V0235		2343	16.162	-1.9	.93	2272	15.672	-5.4	.93	01	
V0238		2262	15.603	-5.3	1.07	2287	15.776	-4.8	1.49	01	
V0243		2380	16.414	-.4	1.02	2359	16.269	-1.8	1.20	01	
V0244		2248	15.504	-5.9	.67	2248	15.504	-6.4	.50	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0245A		2360	16.279	-1.2	1.28	2396	16.524	-.2	.52	01	
V0245B		2546	17.562	6.6	.52	2453	16.921	2.1	.50	01	
V0249		2450	16.897	2.6	.81	2525	17.414	5.1	.24	01	
V0250	*	2287	15.776	-4.2	1.91	2462	16.983	2.5	.90	01	
V0252		2335	16.103	-2.3	.78	2262	15.603	-5.8	.97	01	
V0253		2252	15.534	-5.7	1.11	2348	16.193	-2.2	.77	01	
		2389	16.479	* GR. MEAN *		2402	16.565				5 TEST DETERMINATIONS
		80	.548	* SD MEANS *		75	.520				62 LABORATORIES IN GRAND MEANS
		56	.389	* AVER SDR *		57	.396				64 LABORATORIES REPORTING
		PSI	MEGAPA	* UNIT *		PSI	MEGAPA				


TENSILE STRENGTH
MATERIAL A01-A02 2389. PSI MATERIAL A03-A04 2402. PSI
MATERIAL A03-A04
MATERIAL A01-A02
2700
2650
2600
2550
2500
2450
2400
2350
2300
2250
2200
2150
2100
2100 2150 2200 2250 2300 2350 2400 2450 2500 2550 2600 2650 2700

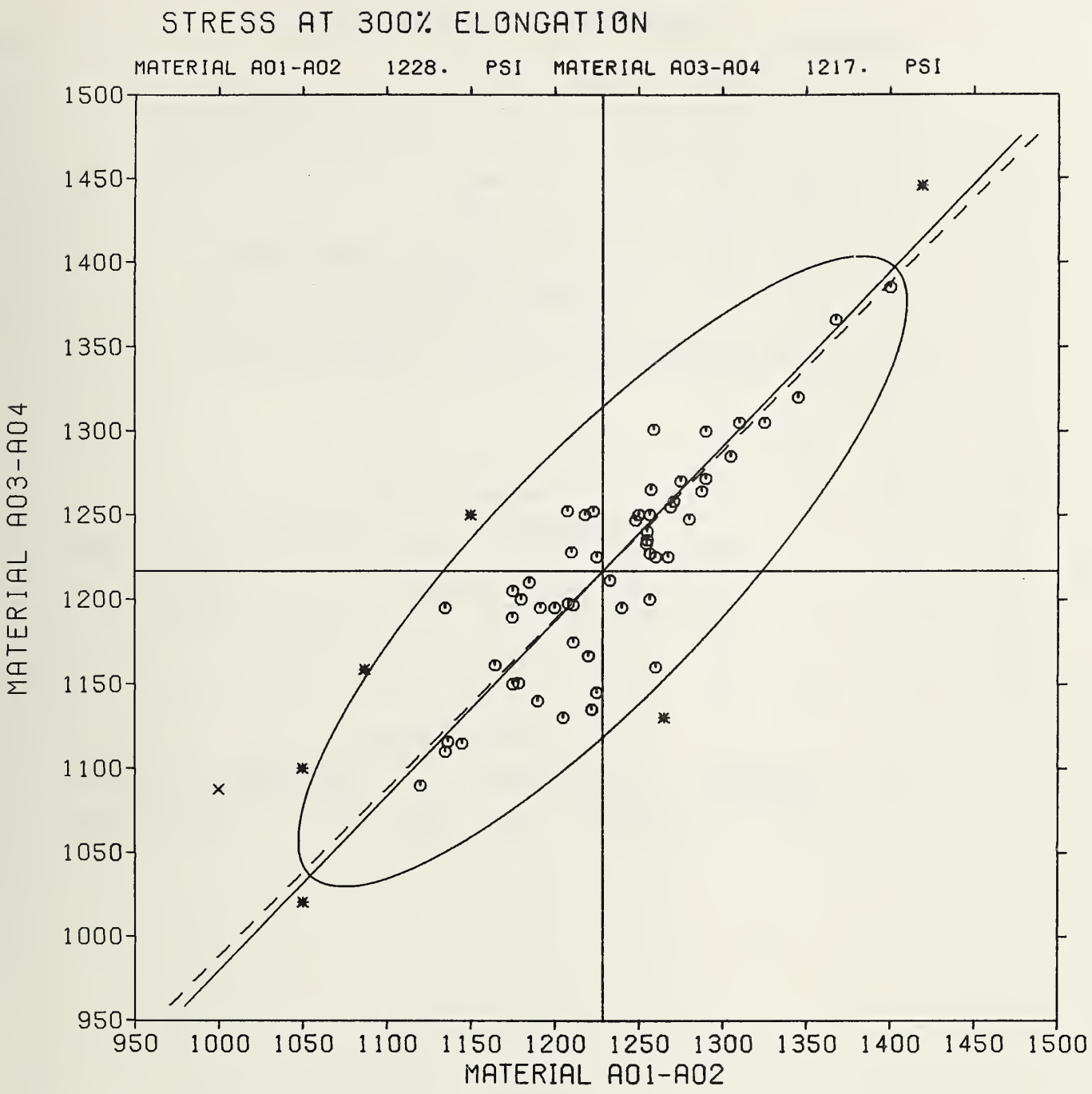
INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
ULTIMATE ELONGATION - PERCENT

LAB CODE	F	MATERIAL A01-A02 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	MATERIAL A03-A04 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062		531	-5.3	.98	532	-4.9	1.04	01	
V0063		595	6.0	.56	595	6.3	.88	01	
V0070		545	-2.9	1.22	550	-1.7	1.34	01	
V0071	X	513	-8.6	.61	488	-12.9	1.21	01	
V0072		530	-5.6	.75	540	-3.5	1.31	01	
V0073		585	4.2	.61	580	3.6	.52	01	
V0076		540	-3.8	1.28	545	-2.6	1.01	01	
V0083		547	-2.5	.95	555	-.8	.43	01	
V0084		535	-4.7	2.01X	550	-1.7	1.10	01	
V0085		575	2.4	.88	565	.9	1.26	01	
V0087		520	-7.3	.99	527	-5.8	1.01	01	
V0088		563	.2	2.32X	582	4.1	2.62X	01	
V0092		550	-2.0	.86	555	-.8	.73	01	
V0095		535	-4.7	1.05	535	-4.4	1.91	01	
V0100		560	-.2	2.01X	545	-2.6	1.28	01	
V0102		540	-3.8	1.87	555	-.8	.90	01	
V0111		582	3.8	1.44	569	1.7	.95	01	
V0117		615	9.6	.47	595	6.3	2.18X	01	
V0120		560	-.2	.86	555	-.8	.76	01	
V0123		575	2.4	.70	580	3.6	.93	01	
V0126		595	6.0	.98	579	3.5	1.29	01	
V0128		585	4.2	.98	575	2.7	.50	01	
V0141		575	2.4	.44	570	1.8	.79	01	
V0144		555	-1.1	1.16	570	1.8	.60	01	
V0144B		565	.6	1.43	560	.1	1.40	01	
V0146		582	3.8	1.21	572	2.3	1.12	01	
V0149		550	-2.0	1.28	572	2.3	.70	01	
V0150		560	-.2	1.19	570	1.8	1.43	01	
V0152		555	-1.1	.61	565	.9	.92	01	
V0153		550	-2.0	1.00	550	-1.7	.90	01	
V0154		545	-2.9	1.67	540	-3.5	.88	01	
V0156		570	1.5	1.08	570	1.8	.56	01	
V0158		590	5.1	1.37	570	1.8	1.43	+70	DATA RECEIVED LATE
V0160		590	5.1	1.45	580	3.6	1.22	01	
V0164		565	.6	.26	547	-2.2	.95	01	
V0166		560	-.2	.46	550	-1.7	1.31	01	
V0168		550	-2.0	.69	560	.1	.93	01	
V0169		582	3.8	1.37	575	2.7	1.02	01	
V0171		555	-1.1	1.11	550	-1.7	1.67	01	
V0176		570	1.5	1.27	585	4.5	.81	01	
V0178		581	3.6	.50	569	1.7	.77	01	
V0184		540	-3.8	1.12	550	-1.7	.79	01	
V0190		577	2.9	.83	572	2.3	1.88	01	
V0199		590	5.1	1.33	570	1.8	1.31	01	
V0206		535	-4.7	1.34	552	-1.3	.85	01	
V0207	*	605	7.8	.37	610	5.0	.66	01	
V0213		550	-2.0	1.30	548	-2.1	1.08	01	
V0214		580	3.3	1.22	575	2.7	.76	01	
V0220	*	502	-10.5	.65	505	-9.8	.28	01	
V0223		560	-.2	1.15	555	-.8	.88	01	
V0224		595	6.0	.97	580	3.6	1.07	01	
V0225		535	-4.7	.81	530	-5.3	1.01	01	
V0232		587	4.7	1.29	582	4.1	1.72	01	
V0233		525	-6.5	.93	545	-2.6	1.14	01	
V0235		577	2.8	.89	565	.9	.73	01	
V0239		575	2.4	.81	565	.9	1.50	01	
V0243		565	.6	.99	560	.1	1.05	01	
V0244		520	-7.4	.70	520	-7.1	.44	01	
V0245A	*	555	-1.1	1.05	530	-5.3	1.78	01	
V0245B		560	-.2	.89	535	-4.4	1.00	01	
V0249		580	3.3	.47	570	1.8	.47	01	
V0250		550	-2.0	1.75	550	-1.7	.82	01	
V0252		570	1.5	1.35	555	-.8	1.06	01	
V0253		545	-2.9	.97	555	-.8	.65	01	
		561	• GR. MEAN •		560				5 TEST DETERMINATIONS
		23	• SD MEANS •		19				62 LABORATORIES IN GRAND MEANS
		15	• AVER SDR •		15				64 LABORATORIES REPORTING
		%	• UNIT •		%				


ULTIMATE ELONGATION
MATERIAL A01-A02 561. %
MATERIAL A03-A04 560. %
640
620
600
580
560
540
520
500
480
460
480 500 520 540 560 580 600 620 640 660
MATERIAL A01-A02
MATERIAL A03-A04

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
STRESS AT 300% ELONGATION - POUNDS PER SQUARE INCH

LAB CODE	F	MATERIAL A01-A02 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL A03-A04 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062		1225.	8.448	-.3	1.31	1225.	8.448	.7	.94	01	
V0063	*	1087.	7.497	-11.5	.43	1158.	7.990	-4.8	.43	01	
V0070		1257.	8.667	2.3	1.57	1227.	8.462	.9	1.29	01	
V0071	*	1419.	9.786	15.5	2.08X	1445.	9.969	18.8	1.06	01	
V0072		1310.	9.034	6.6	2.06X	1305.	9.000	7.3	1.44	01	
V0073		1175.	8.103	-4.4	1.18	1150.	7.931	-5.5	.95	01	
V0076		1325.	9.138	7.9	.56	1305.	9.000	7.3	.55	01	
V0083		1280.	8.828	4.2	.64	1247.	8.603	2.5	.78	01	
V0084		1275.	8.793	3.8	1.07	1270.	8.759	4.4	1.17	01	
V0085		1255.	8.652	2.1	1.38	1233.	8.502	1.3	1.64	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0087		1400.	9.655	14.0	1.50	1385.	9.552	13.8	1.05	01	
V0088		1120.	7.724	-8.8	.67	1090.	7.517	-10.4	1.45	01	
V0092		1190.	8.207	-3.1	1.30	1140.	7.862	-6.3	.81	01	
V0095		1260.	8.690	2.6	2.22X	1225.	8.448	.7	2.00X	01	
V0100		1240.	8.552	.9	1.40	1195.	8.241	-1.8	1.07	01	
V0102		1185.	8.172	-3.5	.99	1210.	8.345	-.5	.82	01	
V0111		1200.	8.276	-2.3	1.12	1195.	8.241	-1.8	1.05	01	
V0117	X	1000.	6.897	-18.6	.84	1087.	7.500	-10.6	.98	01	
V0120		1290.	8.897	5.0	.75	1271.	8.769	4.5	1.02	01	
V0123		1135.	7.828	-7.6	.74	1195.	8.241	-1.8	.52	01	
V0126		1191.	8.217	-3.0	1.28	1195.	8.242	-1.8	.47	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0128		1255.	8.655	2.2	.85	1235.	8.517	1.5	.84	01	
V0141		1210.	8.345	-1.5	.58	1228.	8.469	.9	.51	01	
V0144		1250.	8.621	1.8	.80	1250.	8.621	2.8	1.29	01	
V0144B	*	1265.	8.724	3.0	6.81X	1130.	7.793	-7.1	4.68X	01	
V0146		1136.	7.838	-7.5	1.04	1116.	7.697	-8.3	1.27	01	
V0149		1222.	8.428	-.5	.74	1135.	7.828	-6.7	.70	01	
V0150		1225.	8.448	-.3	.79	1145.	7.897	-5.9	.36	01	
V0152		1260.	8.690	2.6	.67	1160.	8.000	-4.6	.48	01	
V0153		1256.	8.666	2.3	2.52X	1200.	8.276	-1.4	2.11X	01	
V0154		1290.	8.897	5.0	.98	1300.	8.966	6.9	.73	01	
V0156		1205.	8.310	-1.9	.47	1130.	7.793	-7.1	.94	01	
V0158		1218.	8.402	-.8	1.70	1204.	8.302	-1.0	1.89	*72	ORIGINAL IN MEGAPASCAL RECEIVED LATE
V0160		1269.	8.752	3.3	1.27	1255.	8.652	3.1	.85	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0164		1256.	8.666	2.3	1.33	1250.	8.621	2.8	.94	01	
V0166		1208.	8.331	-1.7	1.17	1197.	8.259	-1.6	1.43	01	
V0168		1271.	8.766	3.5	1.42	1258.	8.676	3.4	1.05	01	
V0169		1233.	8.502	.4	.80	1211.	8.352	-.4	.73	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0171		1305.	9.000	6.2	.22	1285.	8.862	5.6	1.74	01	
V0176		1180.	8.138	-3.9	1.42	1200.	8.276	-1.4	1.57	01	
V0178		1175.	8.103	-4.4	1.02	1205.	8.310	-.9	1.85	01	
V0184		1207.	8.328	-1.7	.84	1252.	8.638	3.0	.73	01	
V0190		1257.	8.672	2.4	.49	1265.	8.724	4.0	.52	01	
V0199		1220.	8.414	-.7	1.68	1166.	8.045	-4.1	1.82	01	
V0206		1345.	9.276	9.5	1.17	1320.	9.103	8.5	1.14	01	
V0207	*	1050.	7.241	-14.5	1.70	1020.	7.034	-16.2	1.16	01	
V0213		1248.	8.607	1.6	.64	1247.	8.597	2.5	.91	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0214		1211.	8.352	-1.4	.16	1175.	8.102	-3.4	.18	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0220		1267.	8.741	3.2	.92	1225.	8.448	.7	.64	01	
V0223		1255.	8.655	2.2	.72	1240.	8.552	1.9	1.07	01	
V0224		1145.	7.897	-6.8	.25	1115.	7.690	-8.3	1.38	01	
V0225		1367.	9.431	11.3	1.10	1366.	9.421	12.3	1.38	01	
V0232		1211.	8.352	-1.4	1.12	1197.	8.252	-1.6	1.10	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0233		1287.	8.879	4.8	1.37	1264.	8.717	3.9	.95	01	
V0235		1178.	8.128	-4.1	.78	1150.	7.934	-5.4	1.28	01	
V0238	*	1050.	7.241	-14.5	.27	1100.	7.586	-9.6	.00	01	
V0243		1164.	8.031	-5.2	.46	1161.	8.007	-4.6	1.22	01	
V0244		1175.	8.102	-4.4	1.81	1189.	8.202	-2.2	.63	20	ORIGINAL IN MEGANEWTONS PER SQ METER
V0245A		1223.	8.434	-.4	2.28X	1252.	8.634	2.9	2.66X	01	
V0245B		1259.	8.683	2.5	2.26X	1301.	8.972	6.9	2.91X	01	
V0249		1250.	8.621	1.8	1.53	1250.	8.621	2.8	.50	01	
V0250	*	1150.	7.931	-6.4	2.20X	1250.	8.621	2.8	1.09	01	
V0252		1135.	7.828	-7.6	1.14	1110.	7.655	-8.8	1.05	01	
V0253		1218.	8.400	-.9	.80	1250.	8.621	2.8	.55	01	
		1228.	8.472	* GR. MEAN *		1217.	8.390			5 TEST DETERMINATIONS	
		72.	.494	* SD MEANS *		74.	.510			62 LABORATORIES IN GRAND MEANS	
		21.	.141	* AVER SDR *		22.	.153			64 LABORATORIES REPORTING	
		PSI	MEGAPA	* UNIT *		PSI	MEGAPA				


STRESS AT 300% ELONGATION
MATERIAL A01-A02 1228. PSI
MATERIAL A03-A04 1217. PSI
MATERIAL A03-A04
MATERIAL A01-A02
1500
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
950 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450 1500

HARDNESS

NOTES

Materials A01 and A02 were sheets of the same vulcanized rubber.
Similarly, materials A03 and A04 were alike.

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

Four of the 31 participants reporting used ASTM D1415 (Wallace)
for hardness determination. 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	A01-A02	31	0	61.63	2.45	.15	.46	IRHD
	A03-A04	31	0	61.34	2.44	.20	.41	IRHD

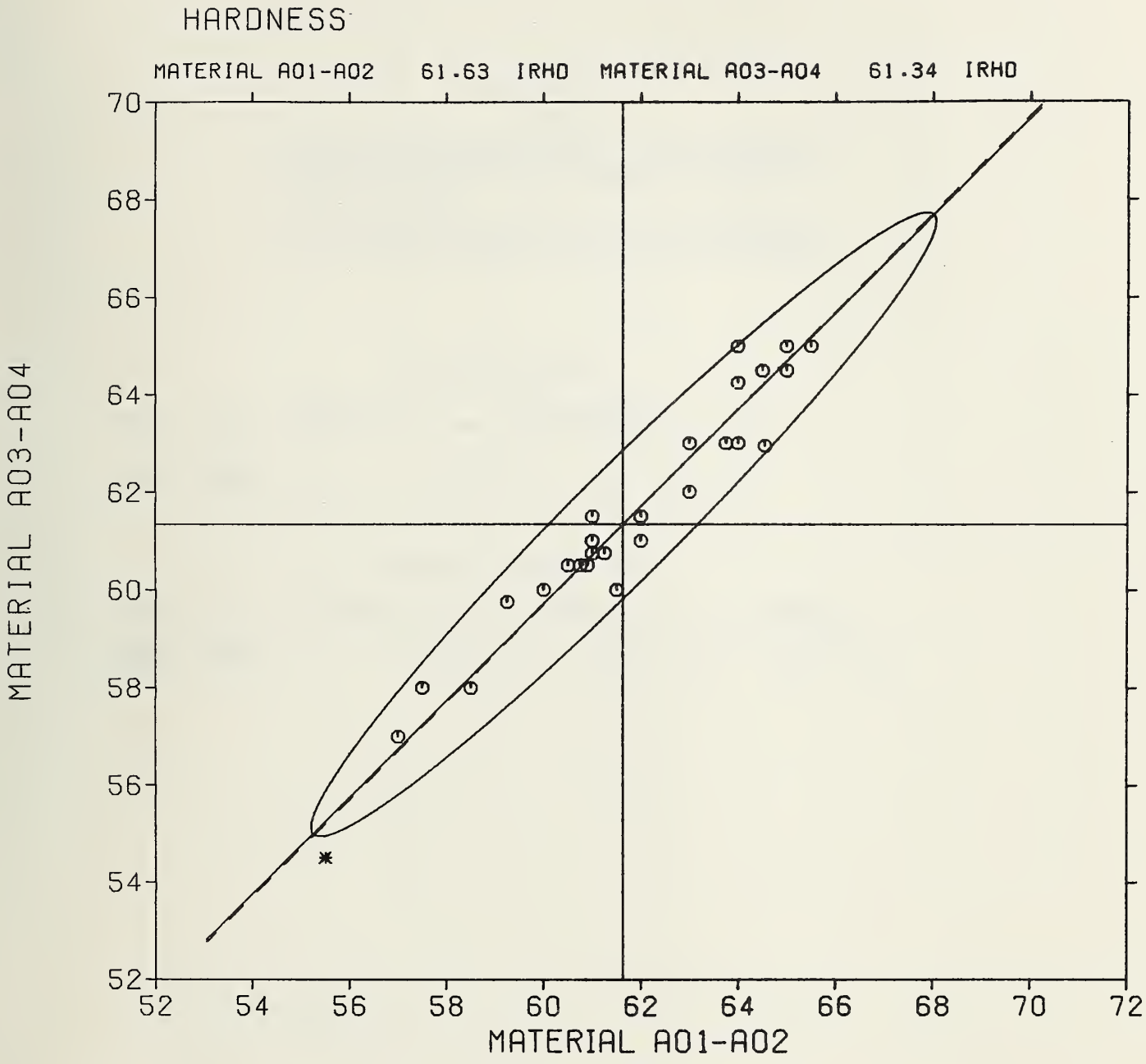
PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
HARDNESS	A01-A02	5	5	61.63	1.27	6.75	IRHD	2.1	11.0
	A03-A04	5	5	61.34	1.14	6.75	IRHD	1.9	11.0

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 43 - 2 HARDNESS - IRHD JANUARY 1980

LAB CODE	F	MATERIAL A01-A02 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	MATERIAL A03-A04 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062		60.75	-1.4	1.57	60.50	-1.4	1.20	01	
V0070		64.00	3.8	1.20	65.00	6.0	1.75	01	
V0071		61.00	-1.0	1.55	61.00	-.5	2.40X	01	
V0072		63.00	2.2	1.20	62.00	1.1	1.21	01	
V0084		62.00	.6	.98	61.50	.3	.54	01	
V0085		64.00	3.8	1.17	64.25	4.7	.62	01	
V0088		60.50	-1.8	1.75	60.50	-1.4	2.03X	01	
V0087		60.00	-2.6	1.89X	60.00	-2.2	1.52	01	
V0092		65.00	5.5	1.83	65.00	6.0	2.34X	01	
V0095		63.00	2.2	.00	63.00	2.7	.00	01	
V0100		60.90	-1.2	1.58	60.50	-1.4	1.48	01	
V0102		65.50	6.3	1.09	65.00	6.0	.66	01	
V0111		64.00	3.8	1.09	63.00	2.7	1.08	01	
V0128		58.50	-5.1	.49	58.00	-5.4	.54	01	
V0141	*	55.50	-9.9	1.40	54.50	-11.1	2.30X	01	
V0144		65.00	5.5	.60	64.50	5.2	1.21	01	
V0144B		64.50	4.7	1.20	64.50	5.2	1.08	01	
V0168		63.75	3.4	.49	63.00	2.7	.54	01	
V0169		61.00	-1.0	.49	61.00	-.5	1.08	01	
V0171		62.00	.6	.98	61.00	-.5	.66	01	
V0176		61.00	-1.0	.84	60.75	-1.0	.94	01	
V0190		62.00	.6	.49	61.50	.3	1.21	01	
V0200		61.25	-.6	.76	60.75	-1.0	1.12	01	
V0206		59.25	-3.9	1.39	59.75	-2.6	2.10X	01	
V0214		64.55	4.7	.23	62.95	2.6	.17	01	
V0224		61.00	-1.0	.49	61.50	.3	.66	01	
V0233		57.00	-7.5	1.09	57.00	-7.1	.00	01	
V0235		61.50	-.2	1.09	60.00	-2.2	1.33	01	
V0243		60.50	-1.8	.49	60.50	-1.4	.00	01	
V0244		57.50	-6.7	.49	58.00	-5.4	.54	01	
V0253		61.00	-1.0	.00	61.00	-.5	.00	01	
		61.63	* GR. MEAN *		61.34				5 TEST DETERMINATIONS
		2.45	* SD MEANS *		2.44				31 LABORATORIES IN GRAND MEANS
		.46	* AVER SDR *		.41				31 LABORATORIES REPORTING
		IRHD	* UNIT *		IRHD				


HARDNESS
MATERIAL A01-A02 61.63 IRHD MATERIAL A03-A04 61.34 IRHD
MATERIAL A03-A04
MATERIAL A01-A02
70
68
66
64
62
60
58
56
54
52
52
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56
58
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64
66
68
70
72

MOONEY VISCOSITY

NOTES

Materials R01 and R02 were the same rubber. Similarly, materials R03 and R04 were the same rubber. No sample preparation was required for materials R91 and R92 whereas, mill massing was required for materials R03 and R04.

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	R01-R02	39	7	67.86	2.29	.14	.35	ML
VISCOSITY	R03-R04	39	7	65.43	3.03	.68	.53	ML

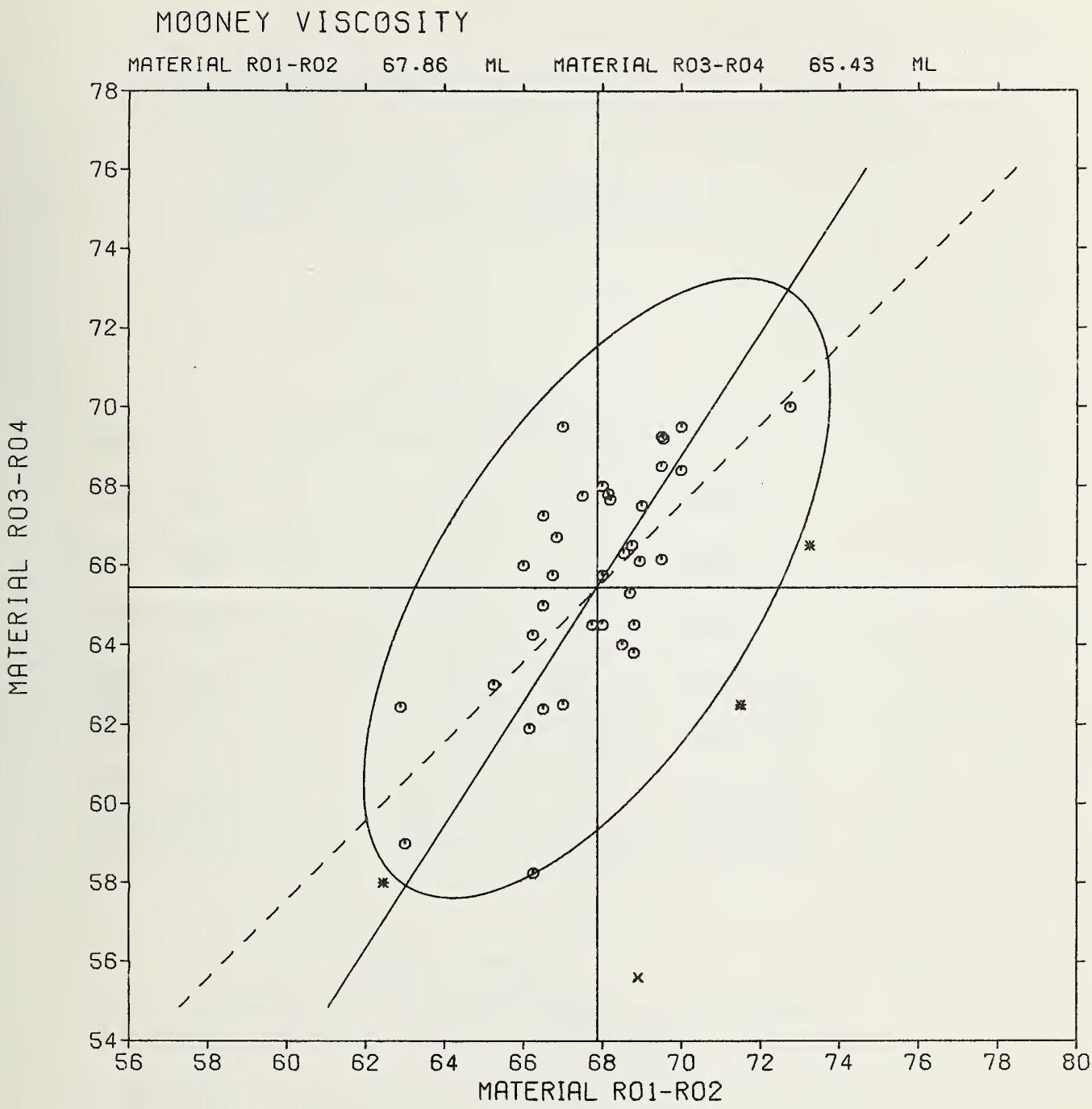
PRECISION OF METHODS

PROPERTY	MATERIAL	REPT CRP	REPT ASTM	GR. MEAN	ABSOLUTE REPEAT	REPRD	UNITS	PERCENT REPEAT	REPRD
MOONEY	R01-R02	3	3	67.86	.97	6.33	ML	1.4	9.3
VISCOSITY	R03-R04	3	3	65.43	1.46	8.38	ML	2.2	12.8

MOONEY VISCOSITY - ML

LAB CODE	F	MATERIAL R01-R02 BUTYL RUBBER MEAN ML	% DEV	REL SDR	MATERIAL R03-R04 SBR MEAN ML	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0060		69.50	2.4	.41	69.25	5.8	1.45	01	
V0061		66.85	-1.5	1.70	66.70	1.9	.74	01	
V0071		68.15	.4	.36	67.80	3.6	.11	01	
V0072		67.00	-1.3	1.24	62.50	-4.5	1.64	01	
V0073		66.25	-2.4	1.24	58.25	-11.0	1.54	01	
V0077	X	67.65	-.3	.44	53.45	-18.3	.31	01	
V0078		62.90	-7.3	2.28	62.45	-4.6	1.09	01	
V0080		68.80	1.4	2.42X	64.50	-1.4	1.93	01	
V0083		70.00	3.2	1.95	68.40	4.5	1.23	01	
V0085		72.75	7.2	1.24	70.00	7.0	.55	01	
V0087		68.00	.2	.83	64.50	-1.4	1.94	01	
V0090	X	71.00	4.6	1.81				62	DATA MISSING
V0092		67.00	-1.3	1.65	69.50	6.2	1.10	01	
V0095		67.75	-.2	1.92	64.50	-1.4	.72	01	
V0100		68.55	1.0	.47	66.30	1.3	.34	01	
V0111	*	62.45	-8.0	1.01	58.00	-11.4	.46	01	
V0117		66.50	-2.0	1.54	67.25	2.8	.75	01	
V0128		70.00	3.2	3.01X	69.50	6.2	1.50	01	
V0144		68.80	1.4	.98	63.80	-2.5	.96	01	
V0146		69.50	2.4	2.26	68.50	4.7	1.50	01	
V0149		69.55	2.5	1.24	69.20	5.8	1.74	01	
V0150		68.00	.2	.83	68.00	3.9	1.50	01	
V0156		65.25	-3.8	.00	63.00	-3.7	1.02	01	
V0166		66.25	-2.4	.00	64.25	-1.8	.27	01	
V0169	X	75.00	10.5	.83	67.75	3.5	.82	*70	DATA RECEIVED LATE
V0177		68.25	.6	1.13	63.75	-2.6	.60	*70	DATA RECEIVED LATE
V0178		69.50	2.4	.72	66.15	1.1	1.63	01	
V0182		68.75	1.3	1.13	66.50	1.6	.27	01	
V0190		66.50	-2.0	.51	62.40	-4.6	1.19	01	
V0207		68.70	1.2	.46	65.30	-.2	.71	01	
V0211		68.50	.9	.83	64.00	-2.2	.00	01	
V0213		68.00	.2	.41	65.75	.5	.27	01	
V0214		66.00	-2.7	.41	66.00	.9	.27	01	
V0217		66.75	-1.6	.21	65.75	.5	.75	01	
V0218		67.50	-.5	.83	67.75	3.5	.27	01	
V0221		66.15	-2.5	1.21	61.90	-5.4	1.40	01	
V0221	*	73.25	7.9	.41	66.50	1.6	1.37	01	
V0223		69.00	1.7	.41	67.50	3.2	.75	01	
V0230	X	68.90	1.5	1.21	55.60	-15.0	1.06	01	
V0236	*	71.50	5.4	1.65	62.50	-4.5	1.10	01	
V0238		66.50	-2.0	.83	65.00	-.7	1.64	01	
V0244		67.00	-1.3	3.81X	59.00	-9.8	1.10	*70	DATA RECEIVED LATE
V0249		65.50	-3.5	1.13	67.50	3.2	.00	*70	DATA RECEIVED LATE
V0250		68.95	1.6	.52	66.10	1.0	.58	01	
V0252		68.20	.5	.31	67.65	3.4	.69	01	
V0253		63.00	-7.2	.00	59.00	-7.8	.00	01	

67.86	= GR. MEAN =	65.43	3 TEST DETERMINATIONS
2.29	= SD MEANS =	3.03	39 LABORATORIES IN GRAND MEANS
.35	= AVER SDR =	.53	46 LABORATORIES REPORTING
ML	= UNIT =	ML	


MOONEY VISCOSITY
MATERIAL R01-R02 67.86 ML
MATERIAL R03-R04 65.43 ML
MATERIAL R03-R04
MATERIAL R01-R02
78
76
74
72
70
68
66
64
62
60
58
56
54
56
58
60
62
64
66
68
70
72
74
76
78
80

VULCANIZATION CHARACTERISTICS USING OSCILLATING DISK CURE METER

NOTES

Materials W01 and W02 were the same rubber formulation. Similarly, materials W03 and W04 were alike.

V100 results were obtained at NBS using a Model TM-100 Monsanto Rheometer with a disk oscillating at ±1° amplitude and 1.7 hertz frequency.

SUMMARY OF ANALYSES

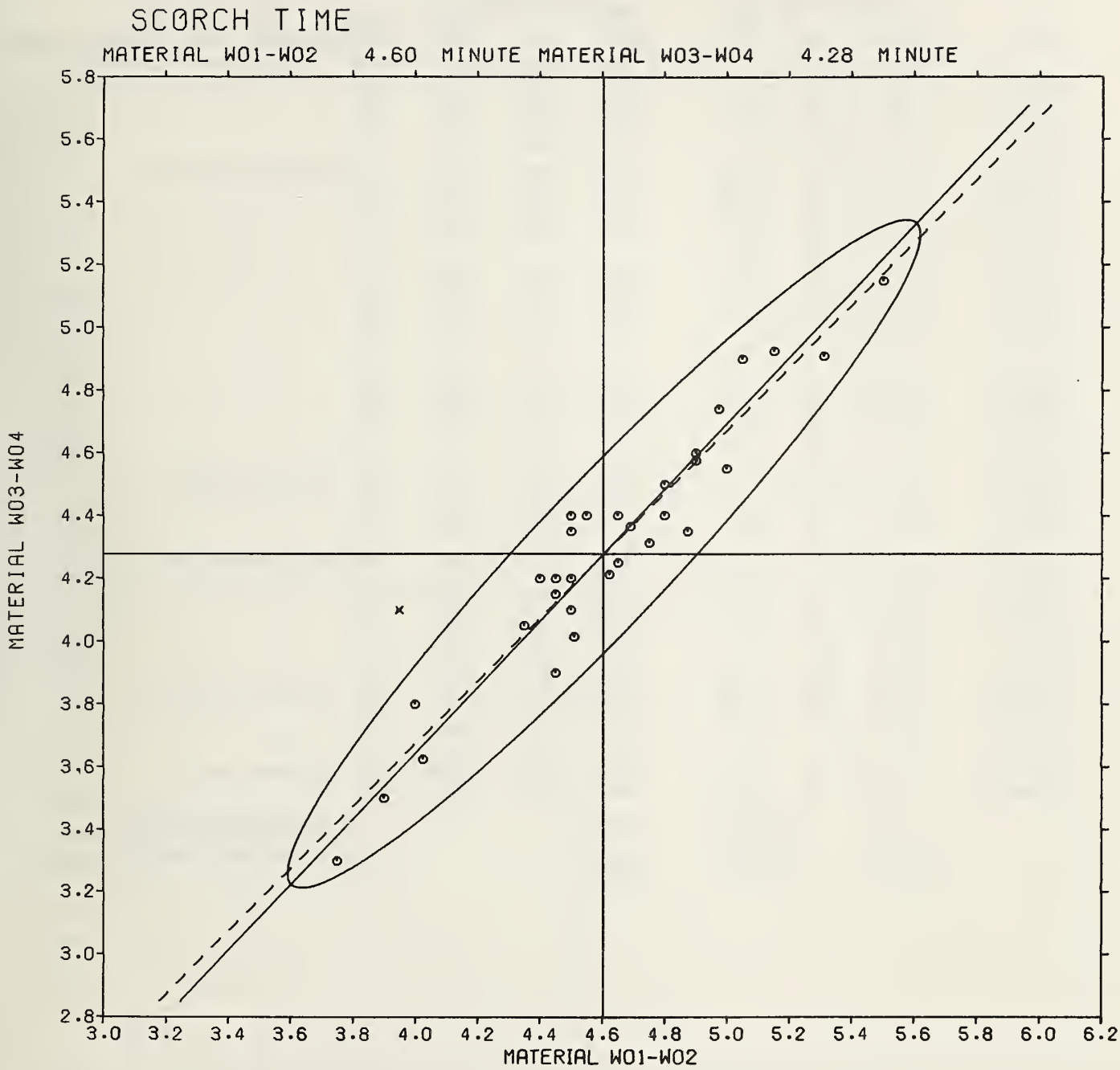
PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
SCORCH	W01-W02	34	4	4.60	.39	.04	.05	MINUTES
TIME	W03-W04	34	4	4.28	.41	.03	.05	MINUTES
CURE TIME	W01-W02	32	6	6.61	.38	.02	.06	MINUTES
(50% MH)	W03-W04	32	6	6.38	.37	.02	.05	MINUTES
CURE TIME	W01-W02	32	9	9.62	.57	.04	.11	MINUTES
(90% MH)	W03-W04	32	9	9.82	.58	.03	.10	MINUTES
MINIMUM	W01-W02	31	7	5.03	.38	.03	.08	POUND-INCHES
TORQUE	W03-W04	31	7	5.03	.36	.02	.07	POUND-INCHES
MINIMUM	W01-W02	31	7	.5682	.0431	.0034	.0091	NEWTON-METERS
TORQUE	W03-W04	31	7	.5680	.0404	.0026	.0081	NEWTON-METERS
MAXIMUM	W01-W02	34	4	23.62	1.26	.07	.13	POUND-INCHES
TORQUE	W03-W04	34	4	22.72	1.11	.05	.09	POUND-INCHES
MAXIMUM	W01-W02	34	4	2.6692	.1418	.0106	.0151	NEWTON-METERS
TORQUE	W03-W04	34	4	2.5668	.1254	.0076	.0104	NEWTON-METERS

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
SCORCH	W01-W02	3	3	4.60	.14	1.08	MINUTE	3.1	23.4
TIME	W03-W04	3	3	4.28	.14	1.13	MINUTE	3.2	26.5
CURE TIME	W01-W02	3	3	6.61	.16	1.04	MINUTE	2.4	15.8
(50% MH)	W03-W04	3	3	6.38	.14	1.04	MINUTE	2.2	16.2
CURE TIME	W01-W02	3	3	9.62	.32	1.58	MINUTE	3.3	16.4
(90% MH)	W03-W04	3	3	9.82	.27	1.60	MINUTE	2.7	16.3
MINIMUM	W01-W02	3	3	5.03	.22	1.06	LB-IN.	4.4	21.0
TORQUE	W03-W04	3	3	5.03	.20	.99	LB-IN.	3.9	19.7
MINIMUM	W01-W02	3	3	.5682	.0252	.1198	N-M	4.4	21.0
TORQUE	W03-W04	3	3	.5680	.0223	.1120	N-M	3.9	19.7
MAXIMUM	W01-W02	3	3	23.62	.37	3.48	LB-IN.	1.6	14.7
TORQUE	W03-W04	3	3	22.72	.26	3.08	LB-IN.	1.1	13.5
MAXIMUM	W01-W02	3	3	2.6692	.0419	.3928	N-M	1.6	14.7
TORQUE	W03-W04	3	3	2.5668	.0289	.3475	N-M	1.1	13.5

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
SCORCH TIME - MINUTES

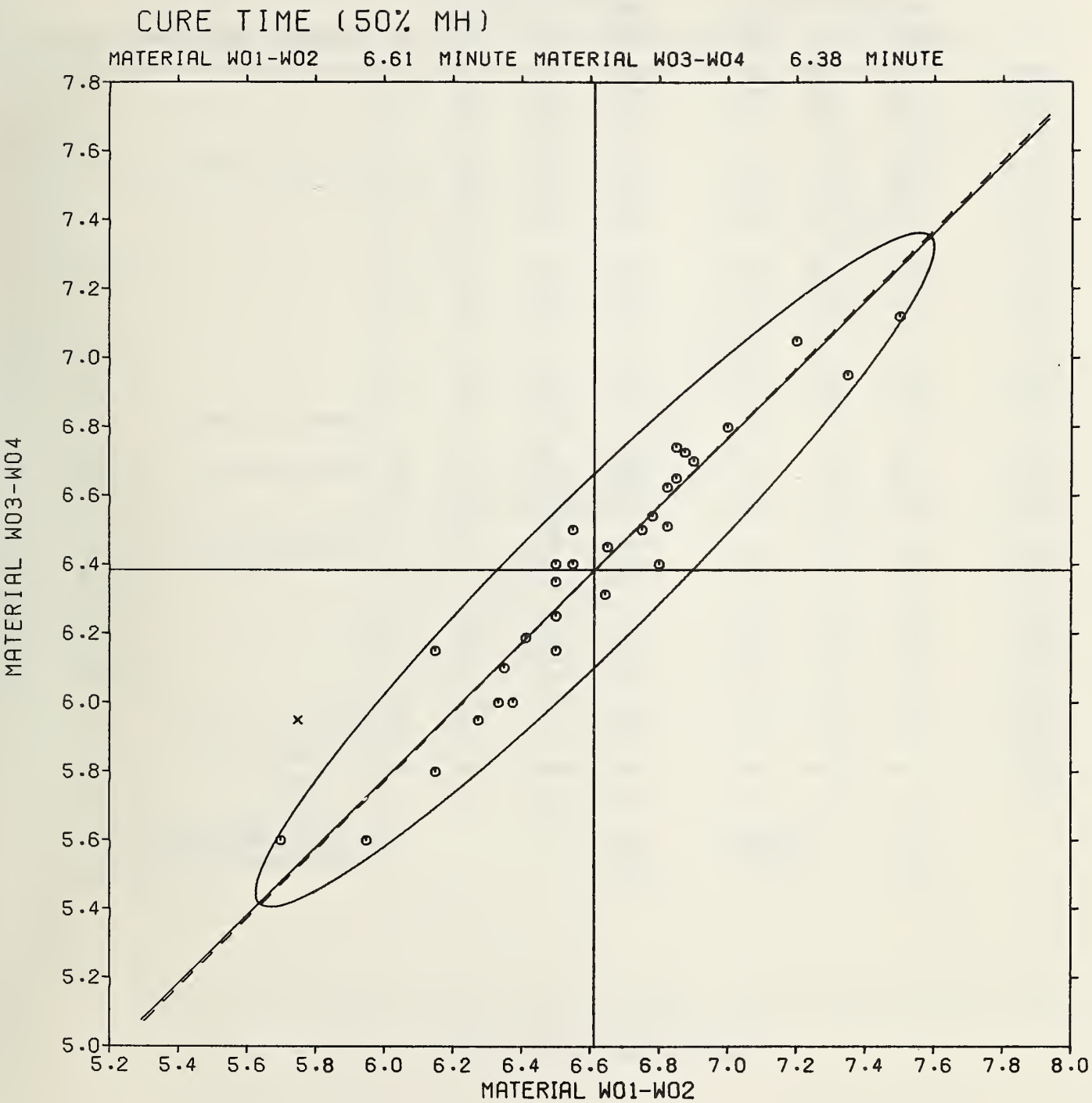
LAB CODE	F	MATERIAL W01-W02 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL W03-W04 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0061		4.80	4.2	.84	4.40	2.9	.00	01	
V0064		3.90	-18.3	1.11	3.50	-18.2	.56	01	
V0071		5.00	6.6	1.67	4.55	6.4	1.57	01	
V0074		4.00	-13.1	.56	3.80	-11.2	.00	01	
V0077		4.00	-13.1	1.11	3.80	-11.2	1.15	01	
V0078		5.50	19.4	.00	5.15	20.4	.00	01	
V0083		4.50	-2.3	3.67X	4.35	1.7	2.10	01	
V0085		4.45	-3.4	2.84X	3.90	-8.8	.50	01	
V0090		4.97	8.0	1.65	4.74	10.8	.69	01	
V0092	X	3.95	-14.2	2.44	4.10	-4.1	1.15	01	
V0095		5.05	9.7	1.67	4.90	14.6	.58	01	
V0100		4.65	1.0	.00	4.25	-.6	.58	01	
V0117		4.35	-5.5	.56	4.05	-5.3	3.05X	01	
V0128		4.65	1.0	.00	4.40	2.9	.00	01	
V0144		4.51	-2.1	.17	4.01	-6.1	.55	01	
V0146		4.55	-1.2	1.11	4.40	2.9	2.67X	01	
V0149		4.87	5.5	.76	4.35	1.7	.58	01	
V0150		4.75	3.2	.00	4.31	.8	1.44	01	
V0152		4.80	4.2	.56	4.50	5.2	1.15	01	
V0154		5.15	11.8	.76	4.92	15.1	.58	01	
V0156		4.90	6.4	.28	4.57	7.0	.58	01	
V0158		4.20	-8.8	.00	3.85	-10.0	.00	+70	DATA RECEIVED LATE
V0161		4.40	-4.4	.56	4.20	-1.8	1.57	01	
V0166		4.90	6.4	.56	4.60	7.5	1.73	01	
V0169		4.50	-2.3	1.52	4.10	-4.1	3.48X	01	
V0178		4.65	1.0	1.11	4.35	1.7	1.15	+70	DATA RECEIVED LATE
V0182		4.65	1.0	2.92X	4.40	2.9	.50	01	
V0206		4.45	-3.4	1.67	4.15	-3.0	2.10	01	
V0207		4.50	-2.3	2.90X	4.20	-1.8	4.16X	01	
V0211		4.45	-3.4	1.95	3.90	-8.8	1.00	01	
V0217		4.62	-12.6	3.42X	3.62	-15.3	4.48X	01	
V0218		4.50	-2.3	1.11	4.40	2.9	1.57	01	
V0220		3.75	-18.6	8.04X	3.30	-22.8	4.03X	01	
V0221		4.45	-3.4	1.47	4.20	-1.8	1.15	01	
V0238		5.31	15.3	.67	4.91	14.8	2.76X	01	
V0243		4.69	1.9	3.14X	4.36	2.0	.38	01	
V0249	X	3.75	-18.6	.00	3.75	-12.3	2.88X	+70	DATA RECEIVED LATE
V0252		4.62	.4	.67	4.21	-1.5	.43	01	
		4.60	* GR. MEAN *		4.28				3 TEST DETERMINATIONS
		.39	* SD MEANS *		.41				34 LABORATORIES IN GRAND MEANS
		.05	* AVER SDR *		.05				38 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				


SCORCH TIME
MATERIAL W01-W02 4.60 MINUTE MATERIAL W03-W04 4.28 MINUTE
MATERIAL W03-W04
MATERIAL W01-W02
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
3.0 3.2 3.4 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

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 43 - 5 CURE TIME (50% MH) - MINUTES MARCH 1980

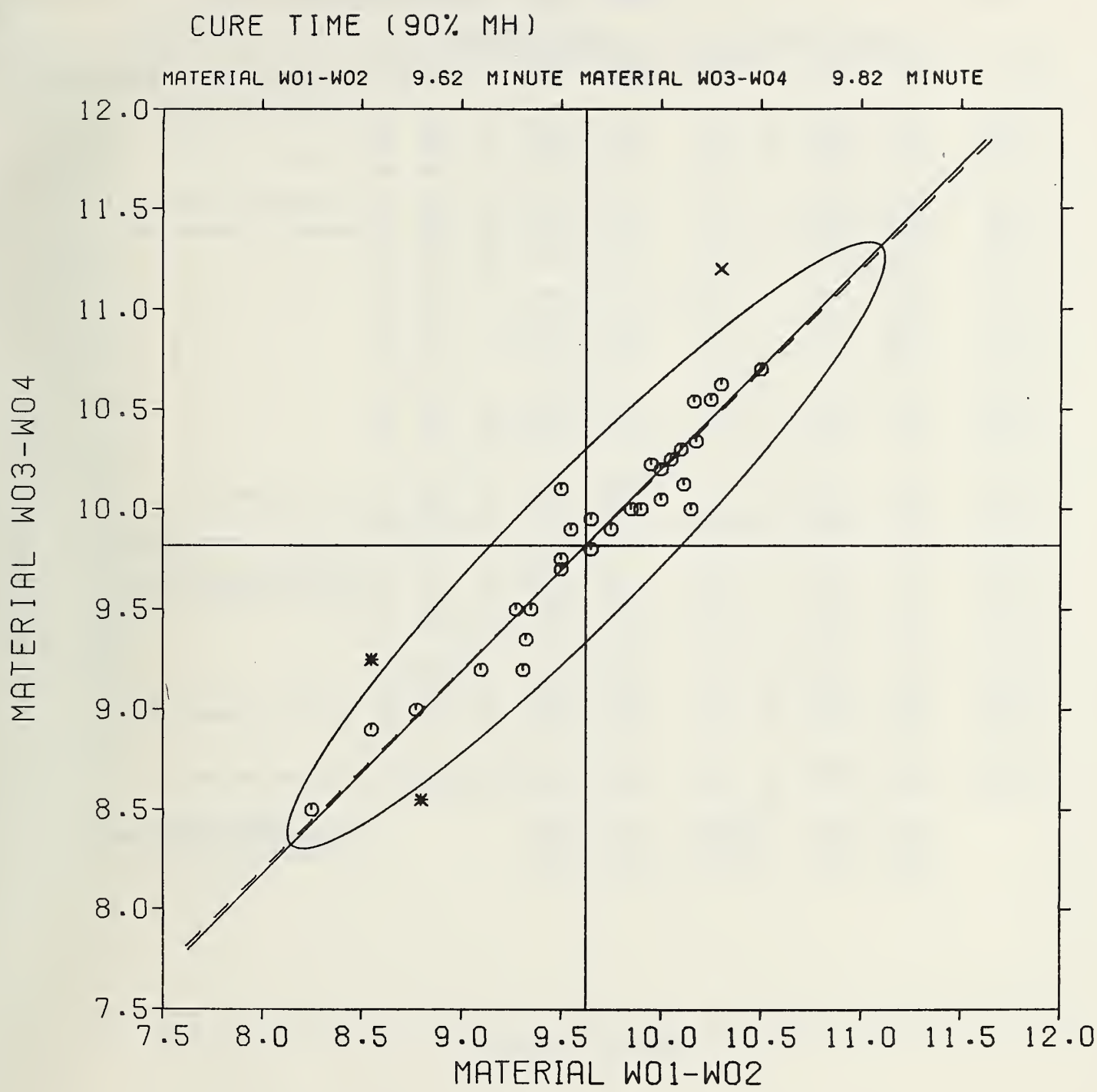
LAB CODE	F	MATERIAL W01-W02 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL W03-W04 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0061		6.82	3.2	.40	6.51	2.0	.00	01	
V0064		6.50	-1.7	1.01	6.15	-3.7	.58	01	
V0071		6.85	3.6	1.37	6.65	4.2	1.00	01	
V0074		7.00	5.9	.00	6.80	6.5	.00	01	
V0077		5.70	-13.8	.00	5.60	-12.3	1.58	01	
V0078	X	7.50	13.4	.00	7.50	17.5	.00	*98	EXTREME TEST RESULTS
V0083		6.55	-.9	3.64X	6.50	1.8	1.58	01	
V0085		6.37	-3.6	3.40X	6.00	-6.0	1.80	01	
V0090		6.85	3.6	1.78	6.74	5.6	.94	01	
V0092	X	5.75	-13.0	1.01	5.95	-6.8	1.15	01	
V0095		7.20	8.9	1.01	7.05	10.4	.58	01	
V0100		6.50	-1.7	.50	6.35	-.5	.58	01	
V0117		6.15	-7.0	1.01	5.80	-9.1	1.73	01	
V0128		6.55	-.9	.50	6.40	.3	.00	01	
V0144		6.33	-4.2	.15	6.00	-6.0	.83	01	
V0146		6.50	-1.7	.50	6.40	.3	.58	01	
V0149		6.80	2.8	1.17	6.40	.3	.58	01	
V0150		6.64	.5	.50	6.31	-1.1	2.67X	01	
V0152		6.75	2.1	.50	6.50	1.8	1.15	01	
V0154		7.35	11.2	.92	6.95	8.9	.79	01	
V0156		6.87	4.0	.25	6.72	5.4	.29	01	
V0158		5.75	-13.0	.00	5.55	-13.1	.00	*70	DATA RECEIVED LATE
V0161		6.15	-7.0	1.01	6.15	-3.7	.58	01	
V0166		6.90	4.3	.50	6.70	5.0	1.15	01	
V0169		6.50	-1.7	1.37	6.25	-2.1	1.58	01	
V0178		6.70	1.3	1.01	6.50	1.8	1.73	*70	DATA RECEIVED LATE
V0182		6.82	3.2	2.63X	6.62	3.8	.50	01	
V0206		6.35	-4.0	2.01	6.10	-4.4	4.05X	01	
V0207		6.65	.6	1.37	6.45	1.0	1.00	01	
V0211		6.27	-5.1	.66	5.95	-6.8	1.00	01	
V0217		5.95	-10.0	1.76	5.60	-12.3	1.53	01	
V0218		6.50	-1.7	.50	6.40	.3	.00	01	
V0220	X	5.70	-13.8	3.63X	5.10	-20.1	3.09X	*98	EXTREME TEST RESULTS
V0221		6.50	-1.7	1.01	6.35	-.5	1.73	01	
V0238		7.50	13.4	1.69	7.12	11.5	2.80X	01	
V0243		6.78	2.5	2.16	6.54	2.5	.86	01	
V0249		5.87	-11.2	3.77X	5.50	-13.8	5.77X	*70	DATA RECEIVED LATE
V0252		6.41	-3.0	1.39	6.19	-3.1	.50	01	
		6.61	* GR. MEAN *		6.38				3 TEST DETERMINATIONS
		.38	* SD MEANS *		.37				32 LABORATORIES IN GRAND MEANS
		.06	* AVER SDR *		.05				38 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				


CURE TIME (50% MH)
MATERIAL W01-W02 6.61 MINUTE MATERIAL W03-W04 6.38 MINUTE
MATERIAL W03-W04
MATERIAL W01-W02
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
5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6 7.8 8.0

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 43 - 5 CURE TIME (90% MB) - MINUTES MARCH 1980

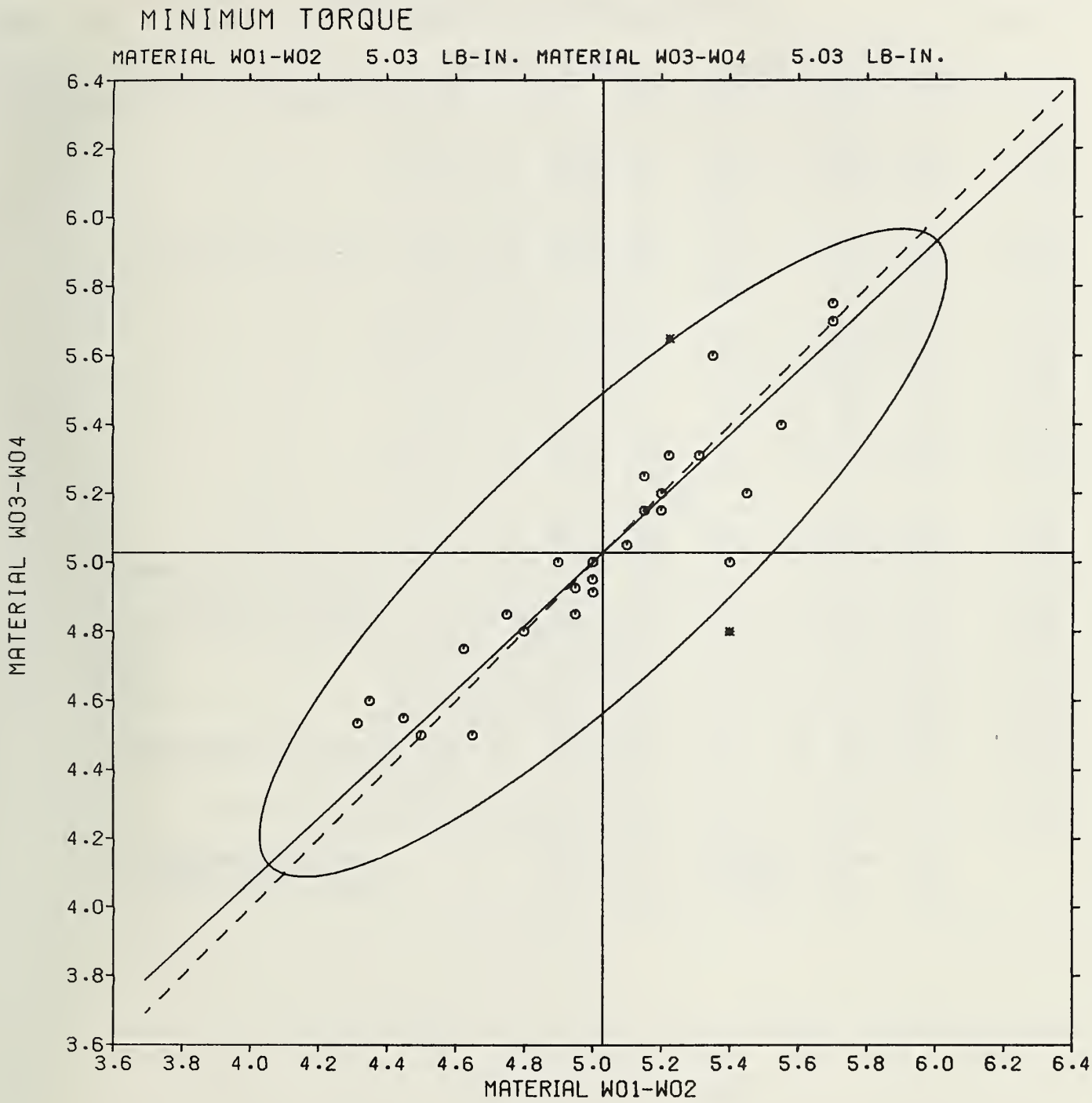
LAB CODE	F	MATERIAL W01-W02 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL WC3-W04 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0061		10.05	4.5	.25	10.25	4.4	.00	01	
V0064		9.50	-1.3	.88	9.70	-1.2	1.20	01	
V0071		10.25	6.5	1.20	10.55	7.5	.9C	01	
V0074		10.50	9.1	.00	10.70	9.0	.CC	01	
V0077		8.55	-11.1	.76	8.90	-9.3	1.64	01	
V0078	X	11.00	14.3	.00	12.25	24.8	.00	+98	EXTREME TEST RESULTS
V0083		10.00	3.9	2.74X	10.20	3.9	2.84X	01	
V0085		9.32	-3.1	1.63	9.35	-4.8	1.56	01	
V0090		10.17	5.8	2.29	10.34	5.3	.92	01	
V0092	*	8.55	-11.1	.76	9.25	-5.8	1.59	01	
VCC95	X	10.30	7.1	.88	11.20	14.1	.82	01	
V0100		9.75	1.3	.00	9.90	.8	.6C	01	
V0117		9.10	-5.4	.00	9.20	-6.3	1.04	01	
V0128		9.50	-1.3	.25	10.10	2.9	.0C	01	
V0144		9.31	-3.2	.07	9.20	-6.3	.14	01	
V0146		9.55	-.7	1.20	9.90	.8	1.39	01	
V0149		9.90	2.9	.57	10.00	1.9	.3C	01	
V0150		10.11	5.1	.97	10.12	3.1	.98	01	
V0152		10.00	3.9	.25	10.20	3.9	.3C	01	
V0154	*	11.22	16.7	.25	11.40	16.1	.41	+98	EXTREME TEST RESULTS
V0156		10.30	7.1	.22	10.62	8.2	.91	01	
V0158	*	8.50	-11.7	.25	8.34	-15.0	.0C	+70	DATA RECEIVED LATE
V0161		9.35	-2.8	.76	9.50	-3.2	1.C4	01	
V0166		10.10	5.0	.25	10.30	4.9	.0C	01	
V0169		9.85	2.4	1.01	10.00	1.9	.6C	01	
V0178	X	9.95	3.4	.51	10.40	5.9	.6C	70	DATA RECEIVED LATE
V0182		9.95	3.4	1.33	10.22	4.2	.3C	01	
V0206		9.65	.3	1.41	9.80	-.2	1.87	01	
V0207		10.15	5.5	1.41	10.00	1.9	1.80	01	
V0211		9.27	-3.6	1.14	9.50	-3.2	.6C	01	
V0217		8.77	-8.8	2.45X	9.00	-8.3	1.3C	01	
V0218		10.00	3.9	.00	10.05	2.4	.3C	01	
V0220	*	8.80	-8.5	2.58X	8.55	-12.9	2.38X	01	
V0221		9.65	.3	1.83	9.95	1.4	1.64	01	
V0238	*	11.25	16.9	1.18	11.50	17.1	.99	+98	EXTREME TEST RESULTS
V0243		10.16	5.6	1.98	10.54	7.4	.59	01	
V0249	X							70	DATA RECEIVED LATE
V0249		8.25	-14.3	1.73	8.50	-13.4	1.5C	01	
V0252		9.50	-1.3	.63	9.75	-.7	.CC	01	
		9.62	* GR. MEAN *		9.82				3 TEST DETERMINATIONS
		.57	* SD MEANS *		.58				34 LABORATORIES IN GRAND MEANS
		.11	* AVER SDR *		.10				38 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				


CURE TIME (90% MH)
MATERIAL W01-W02 9.62 MINUTE MATERIAL W03-W04 9.82 MINUTE
MATERIAL W03-W04
MATERIAL W01-W02
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 43 - S — MINIMUM TORQUE - POUND-INCHES — MARCH 1980

LAB CODE	F	MATERIAL W01-WC2 COMMERCIAL TIRE TREAD MEAN LB-IN	MEAN N-M	% DEV	REL SDR	MATERIAL W03-W04 COMMERCIAL TIRE TREAD MEAN LB-IN	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0061	X	6.80	.7683	35.2	.72	6.65	.7514	32.3	.00	*98	EXTREME TEST RESULTS
V0064		5.70	.6440	13.3	.62	5.75	.6497	14.4	.81	01	
V0071		5.10	.5762	1.4	.98	5.05	.5706	.5	1.48	01	
V0074	X	6.60	.7457	31.2	1.44	6.60	.7457	31.3	.00	*98	EXTREME TEST RESULTS
V0077	*	5.22	.5904	3.9	4.32X	5.65	.6384	12.4	2.43X	01	
V0078	X	6.50	.7344	29.3	.00	6.50	.7344	29.3	.00	*98	EXTREME TEST RESULTS
V0083		4.95	.5593	-1.6	1.79	4.85	.5480	-3.5	1.48	01	
V0085		5.31	.6000	5.6	.00	5.31	.6000	5.6	.72	40	ORIGINAL IN NEWTON-METER
V0090		4.62	.5226	-8.0	.96	4.75	.5367	-5.5	.76	01	
V0092		5.70	.6440	13.3	.98	5.70	.6440	13.4	1.21	01	
V0095		5.10	.5762	1.4	.98	5.05	.5706	.5	.40	01	
V0100		4.50	.5085	-10.5	.00	4.50	.5085	-10.5	.00	01	
V0117		4.75	.5367	-5.5	.98	4.85	.5480	-3.5	.40	01	
V0128		5.35	.6045	6.4	.36	5.60	.6327	11.4	.00	01	
V0144		4.35	.4915	-13.5	.72	4.60	.5198	-8.5	.81	01	
V0146		5.40	.6101	7.4	4.40X	5.00	.5649	-.5	3.64X	01	
V0149		4.95	.5593	-1.6	.49	4.92	.5565	-2.0	.40	01	
V0150		4.65	.5254	-7.5	1.08	4.50	.5085	-10.5	.00	01	
V0152		4.45	.5028	-11.5	.36	4.55	.5141	-9.5	1.11	01	
V0154		5.20	.5875	3.4	.00	5.20	.5875	3.4	.00	01	
V0156	*	5.40	.6101	7.4	2.27	4.80	.5424	-4.5	.00	01	
V0158		4.95	.5593	-1.6	.00	5.00	.5649	-.5	.40	*70	DATA RECEIVED LATE
V0161		4.45	.5028	-11.5	.72	4.55	.5141	-9.5	2.53X	01	
V0166		5.15	.5819	2.4	.36	5.15	.5819	2.4	.40	01	
V0169		5.22	.5900	3.8	.87	5.31	.6000	5.6	1.79	40	ORIGINAL IN NEWTON-METER
V0178		5.35	.6045	6.4	.95	5.40	.6101	7.4	.40	*70	DATA RECEIVED LATE
V0182		5.00	.5650	-.6	1.65	5.00	.5650	-.5	1.31	40	ORIGINAL IN NEWTON-METER
V0206		5.15	.5819	2.4	1.08	5.25	.5932	4.4	1.88	01	
V0207		5.00	.5649	-.6	.72	4.95	.5593	-1.5	.40	01	
V0211		5.55	.6271	10.4	2.01	5.40	.6101	7.4	1.21	01	
V0217	X	6.85	.7740	36.2	3.56X	9.60	1.0847	91.0	15.00X	01	
V0218		4.90	.5537	-2.6	.00	5.00	.5649	-.5	.81	01	
V0220		5.45	.6158	8.4	2.15	5.20	.5875	3.4	2.16	01	
V0221		5.00	.5650	-.6	.87	4.91	.5550	-2.3	.72	40	ORIGINAL IN NEWTON-METER
V0238		4.31	.4876	-14.2	.93	4.53	.5124	-9.8	.93	01	
V0243		5.20	.5875	3.4	.36	5.15	.5819	2.4	.00	01	
V0249	X	6.00	.6779	19.3	3.59X	6.50	.7344	29.3	4.05X	*70	DATA RECEIVED LATE
V0252		4.80	.5424	-4.6	.72	4.80	.5424	-4.5	.81	01	
		5.03	.5682	= GR. MEAN =		5.03	.5680				3 TEST DETERMINATIONS
		.38	.0431	= SD MEANS =		.36	.0404				31 LABORATORIES IN GRAND MEANS
		.08	.0091	= AVER SDR =		.07	.0081				38 LABORATORIES REPORTING
		LB-IN	N-M	= UNIT =		LB-IN	N-M				


MINIMUM TORQUE
MATERIAL W01-W02 5.03 LB-IN. MATERIAL W03-W04 5.03 LB-IN.
MATERIAL W03-W04
MATERIAL W01-W02
6.4
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5.6
5.4
5.2
5.0
4.8
4.6
4.4
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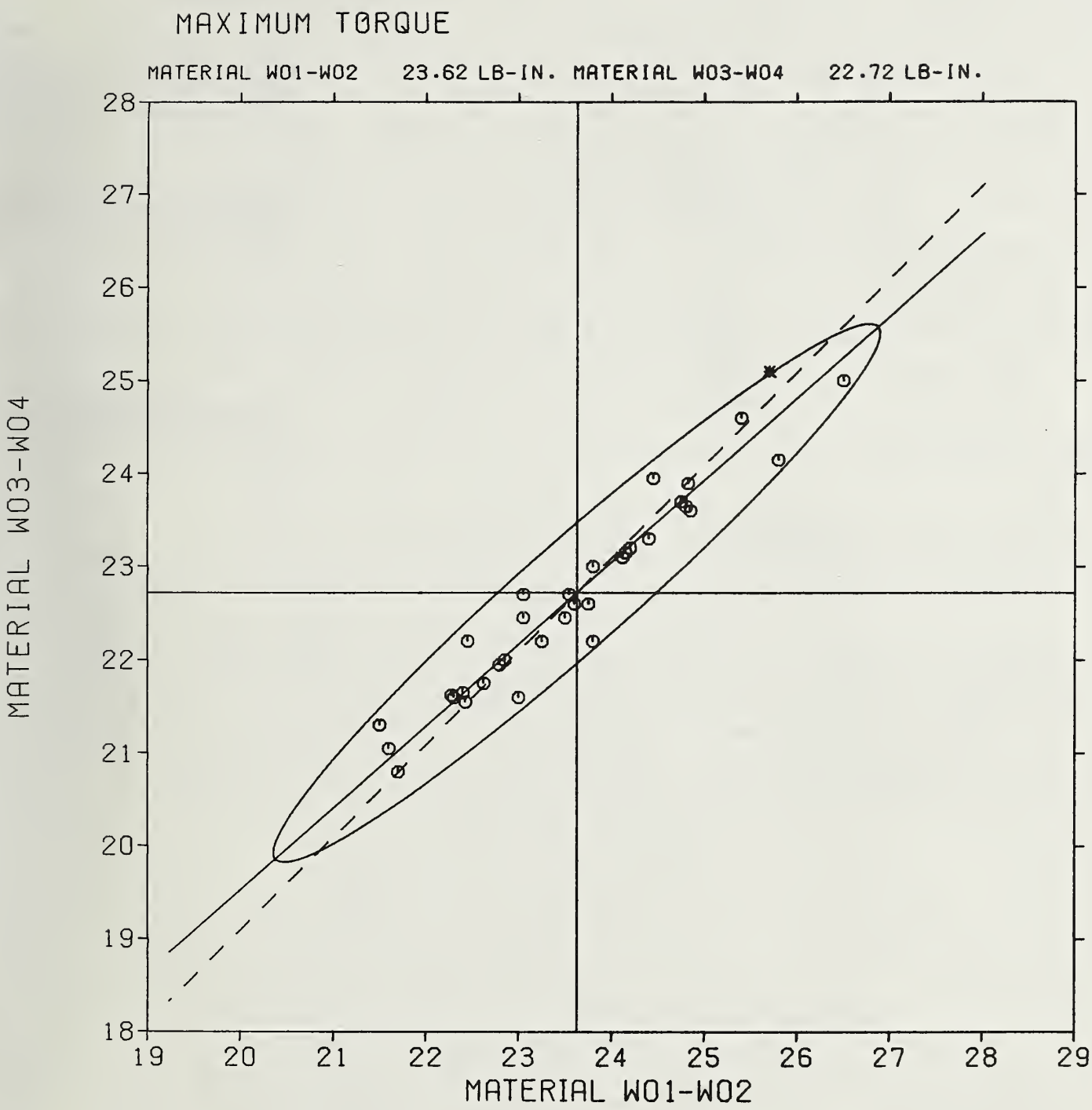
3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 43 - 5 MAXIMUM TORQUE - POUND-INCHES MARCH 1980

LAB CODE	F	MATERIAL W01-W02 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL W03-W04 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0061	#	25.70	2.9038	8.8	.57	25.10	2.8360	10.5	.00	01	
V0064		23.80	2.6892	.7	.86	23.00	2.5988	1.2	1.56	01	
V0071		23.75	2.6835	.5	1.53	22.60	2.5536	-.5	.62	01	
V0074		25.40	2.8699	7.5	.86	24.60	2.7796	8.3	.00	01	
V0077		23.05	2.6044	-2.4	2.58X	22.70	2.5649	-.1	1.91	01	
V0078		26.50	2.9942	12.2	.00	25.00	2.8248	10.1	.00	01	
V0083		24.80	2.8022	5.0	1.77	23.65	2.6722	4.1	2.99X	01	
V0085		23.54	2.6601	-.3	.33	22.70	2.5651	-.1	.55	40	ORIGINAL IN NEWTON-METER
V0090		22.42	2.5338	-5.1	2.49X	21.55	2.4349	-5.1	.47	01	
V0092		25.80	2.9151	9.2	2.85X	24.15	2.7287	6.3	1.08	01	
V0095		21.50	2.4293	-9.0	1.51	21.30	2.4067	-6.2	1.56	01	
V0100		24.40	2.7570	3.3	.00	23.30	2.6327	2.6	.54	01	
V0117		21.60	2.4406	-8.6	.59	21.05	2.3784	-7.3	.31	01	
V0128		22.45	2.5366	-5.0	.94	22.20	2.5084	-2.3	.00	01	
V0144		22.30	2.5197	-5.6	.80	21.60	2.4406	-4.9	1.17	01	
V0146		23.00	2.5988	-2.6	.65	21.60	2.4406	-4.9	2.79X	01	
V0149		22.27	2.5169	-5.7	.39	21.62	2.4434	-4.8	.43	01	
V0150		23.25	2.6270	-1.6	.78	22.20	2.5084	-2.3	1.43	01	
V0152		22.40	2.5310	-5.2	.43	21.65	2.4462	-4.7	.62	01	
V0154		23.60	2.6666	-.1	.79	22.60	2.5536	-.5	1.25	01	
V0156		23.80	2.6892	.7	1.79	22.20	2.5084	-2.3	1.56	01	
V0158		23.00	2.5988	-2.6	.22	22.35	2.5253	-1.6	.31	*70	DATA RECEIVED LATE
V0161		21.70	2.4519	-8.1	1.00	20.80	2.3502	-8.4	.62	01	
V0166		22.85	2.5818	-3.3	.79	22.00	2.4858	-3.2	.31	01	
V0169		24.83	2.8051	5.1	.38	23.90	2.7001	5.2	1.38	40	ORIGINAL IN NEWTON-METER
V0178		24.00	2.7118	1.6	.00	23.35	2.6383	2.8	.31	*70	DATA RECEIVED LATE
V0182		22.79	2.5751	-3.5	1.70	21.95	2.4801	-3.4	.83	40	ORIGINAL IN NEWTON-METER
V0206		24.15	2.7287	2.2	1.23	23.15	2.6157	1.9	1.91	01	
V0207		24.45	2.7626	3.5	1.98	23.95	2.7061	5.4	1.65	01	
V0211		24.85	2.8078	5.2	1.64	23.60	2.6666	3.9	.62	01	
V0217	X	25.70	2.9038	8.8	.94	27.75	3.1355	22.2	13.31X	01	
V0218		23.05	2.6044	-2.4	.00	22.45	2.5366	-1.2	.62	01	
V0220		24.75	2.7965	4.8	6.42X	23.70	2.6779	4.3	1.25	01	
V0221		24.12	2.7251	2.1	.57	23.10	2.6101	1.7	1.58	40	ORIGINAL IN NEWTON-METER
V0238		22.62	2.5564	-4.2	.47	21.75	2.4575	-4.3	.68	01	
V0243		24.20	2.7344	2.4	1.15	23.20	2.6214	2.1	1.14	01	
V0249		25.00	2.8247	5.8	2.94X	24.25	2.7400	6.7	4.69X	*70	DATA RECEIVED LATE
V0252		23.50	2.6553	-.5	1.51	22.45	2.5366	-1.2	.31	01	
		23.62	2.6692	= GR. MEAN =		22.72	2.5668				3 TEST DETERMINATIONS
		1.26	.1418	= SD MEANS =		1.11	.1254				34 LABORATORIES IN GRAND MEANS
		.13	.0151	= AVER SDR =		.09	.0104				38 LABORATORIES REPORTING
		LB-IN.	N-M	= UNIT =		LB-IN.	N-M				


MAXIMUM TORQUE
MATERIAL W01-W02 23.62 LB-IN. MATERIAL W03-W04 22.72 LB-IN.
MATERIAL W03-W04
MATERIAL W01-W02
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☐ 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 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

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