Collaborative Testing Services, Inc.

COLLABORATIVE REFERENCE PROGRAM FOR RUBBER

ANALYSES NO. 41
JULY - SEPTEMBER 1979

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

CTS Rubber (4 times per year)

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

CTS Thermal Insulation Materials (2 times per year)

19 test methods for thermal insulation materials covering: thermal properties; strength properties; dimensions, stability, and density properties; fire properties; and properties of vapor barriers

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)

NBS Collaborative Reference Programs
A05 Technology Building
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Washington, DC 20234

Rev. 3/79

INTERLABORATORY PROGRAMS FOR RUBBER

Analyses No. 41
July - September 1979

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U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBSIR 79-1811

INTRODUCTION

This report summarizes the test results for the third quarter of 1979. 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 or Jeffrey Horlick at (301) 921-2946.

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

September 27, 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 C91 and C92 were sheets of the same vulcanized rubber.
Similarly, materials C93 and C94 were alike.

V100 results were obtained at NBS using a pendulum tester.

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

V126 used Die 2 in BS903
V070, V158, V208 and V220 did not specify a Die
V225 used ASTM Die D
V166 reported tensile properties for samples C91, C92, C93, and C94 to be invalid.

INSTRUMENTS

Instrument	Number of Labs	Percent
Electronic Manual	21	34%
Electronic Automatic	19	31%
Pendulum Manual	18	29%
Pendulum Automatic	2	3%
Not Specified	2	3%
	62	100%

RELATIVE HUMIDITY

Relative Humidity	Number of Labs	Percent
Below 45%	9	14%
Above 55%	24	39%
45% - 55%	18	29%
Not Specified	11	18%
	62	100%

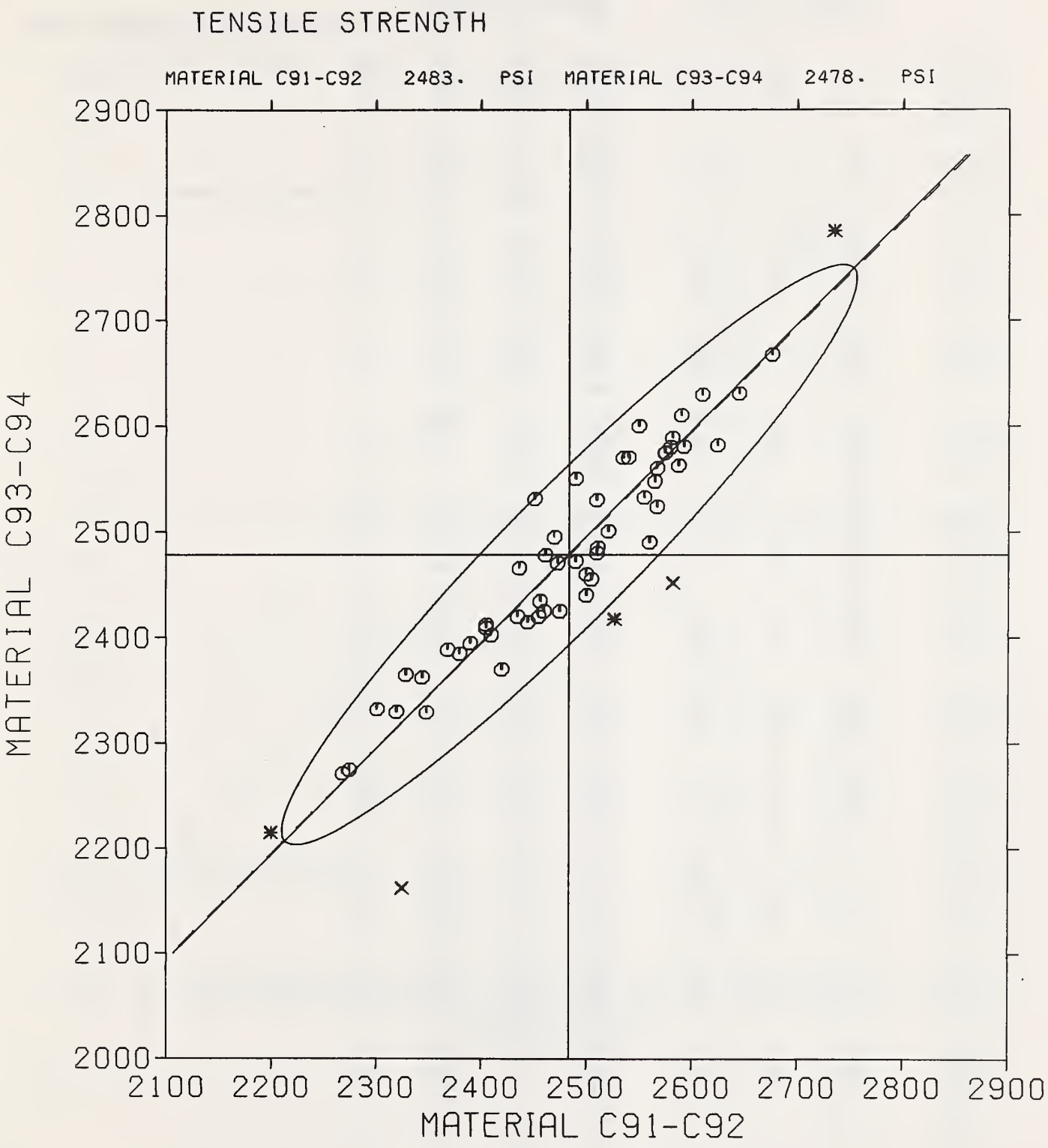
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	STD DEVIATIONS SHEETS	STD DEVIATIONS REPL	UNITS
TENSILE STRENGTH	C91-C92	56	6	2483.	108.	37.	52.	POUNDS PER SQUARE INCH
	C93-C94	56	6	2478.	108.	40.	56.	POUNDS PER SQUARE INCH
TENSILE STRENGTH	C91-C92	56	6	17.125	.742	.255	.358	MEGAPASCALS
	C93-C94	56	6	17.090	.745	.273	.383	MEGAPASCALS
ULTIMATE ELONGATION	C91-C92	56	6	602.	20.	7.	16.	PERCENT
	C93-C94	56	6	589.	19.	7.	16.	PERCENT
STRESS AT 300% ELONGATION	C91-C92	57	5	1166.	57.	11.	25.	POUNDS PER SQUARE INCH
	C93-C94	57	5	1175.	59.	11.	25.	POUNDS PER SQUARE INCH
STRESS AT 300% ELONGATION	C91-C92	57	5	8.043	.392	.100	.174	MEGAPASCALS
	C93-C94	57	5	8.105	.406	.098	.171	MEGAPASCALS

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	ABSOLUTE REPROD	UNITS	PERCENT REPEAT	PERCENT REPROD
TENSILE STRENGTH	C91-C92	5	5	2483.	144.	298.	PSI	5.8	12.0
	C93-C94	5	5	2478.	154.	299.	PSI	6.2	12.1
TENSILE STRENGTH	C91-C92	5	5	17.125	.993	2.054	MEGAPA	5.8	12.0
	C93-C94	5	5	17.090	1.061	2.065	MEGAPA	6.2	12.1
ULTIMATE ELONGATION	C91-C92	5	5	602.	44.	55.	%	7.3	9.2
	C93-C94	5	5	589.	44.	54.	%	7.5	9.2
STRESS AT 300% ELONGATION	C91-C92	5	5	1166.	70.	157.	PSI	6.0	13.5
	C93-C94	5	5	1175.	69.	163.	PSI	5.8	13.9
STRESS AT 300% ELONGATION	C91-C92	5	5	8.043	.483	1.085	MEGAPA	6.0	13.5
	C93-C94	5	5	8.105	.473	1.125	MEGAPA	5.8	13.9

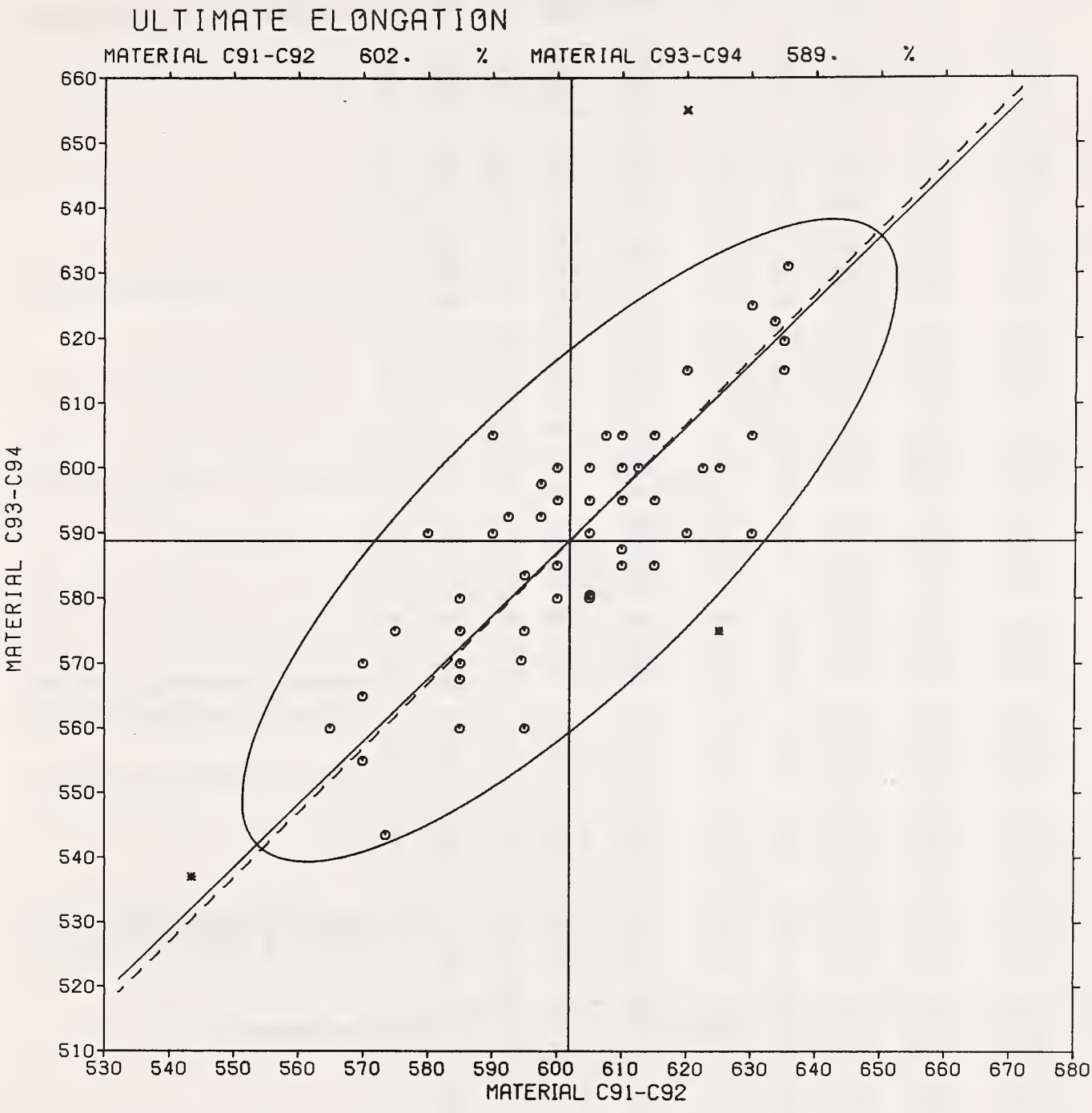
LAB CODE	F	MATERIAL C91-C92 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL C93-C94 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062		2329.	16.062	-6.2	.88	2365.	16.310	-4.6	1.03	01	
V0063		2521.	17.386	1.5	1.46	2500.	17.245	.9	.93	01	
V0066		2565.	17.690	3.3	1.08	2547.	17.569	2.8	1.08	01	
V0067		2410.	16.621	-2.9	1.13	2402.	16.569	-3.1	.59	01	
V0069		2676.	18.455	7.8	1.26	2667.	18.397	7.6	1.23	01	
V0070		2348.	16.197	-5.4	.94	2329.	16.066	-6.0	.79	01	
V0071		2456.	16.941	-1.1	1.13	2434.	16.790	-1.8	2.16X	01	
V0072	*	2735.	18.862	10.1	1.20	2785.	19.207	12.4	.79	01	
V0073		2475.	17.069	-.3	.70	2425.	16.724	-2.1	.95	01	
V0076		2610.	18.000	5.1	.85	2630.	18.138	6.1	.46	01	
V0078		2405.	16.586	-3.1	.58	2409.	16.617	-2.8	.84	01	
V0083		2505.	17.276	.9	.46	2455.	16.931	-.9	.94	01	
V0084		2500.	17.241	.7	.83	2460.	16.966	-.7	1.08	01	
V0085		2451.	16.904	-1.3	1.89	2531.	17.455	2.1	1.11	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		2455.	16.931	-1.1	.99	2420.	16.690	-2.3	1.10	01	
V0088		2268.	15.645	-8.6	1.75	2271.	15.666	-8.3	.80	01	
V0092		2540.	17.517	2.3	1.83	2570.	17.724	3.7	1.56	01	
V0095		2500.	17.241	.7	1.22	2440.	16.828	-1.5	.87	01	
V0100		2490.	17.172	.3	1.30	2550.	17.586	2.9	1.29	01	
V0102		2420.	16.690	-2.5	1.22	2370.	16.345	-4.4	1.66	01	
V0111		2470.	17.034	-.5	1.42	2495.	17.207	.7	1.05	01	
V0117		2390.	16.483	-3.8	.59	2395.	16.517	-3.4	.73	01	
V0123		2460.	16.966	-.9	.55	2425.	16.724	-2.1	.96	01	
V0126		2582.	17.805	4.0	1.00	2589.	17.855	4.5	.92	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		2590.	17.862	4.3	.83	2610.	18.000	5.3	1.28	01	
V0144		2510.	17.310	1.1	1.25	2480.	17.103	.1	1.61	01	
V0144B		2580.	17.793	3.9	.87	2580.	17.793	4.1	1.18	01	
V0146		2473.	17.055	-.4	.54	2470.	17.038	-.3	.63	01	
V0149		2511.	17.317	1.1	1.02	2485.	17.138	.3	.99	01	
V0150		2405.	16.586	-3.1	1.08	2412.	16.638	-2.6	.95	01	
V0152		2560.	17.655	3.1	.93	2490.	17.172	.5	1.08	01	
V0153		2368.	16.334	-4.6	.96	2389.	16.476	-3.6	1.19	01	
V0154		2575.	17.759	3.7	.79	2575.	17.759	3.9	1.57	01	
V0156		2435.	16.793	-1.9	.99	2420.	16.690	-2.3	1.10	01	
V0158		2624.	18.100	5.7	1.07	2582.	17.805	4.2	.95	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0160		2437.	16.804	-1.9	1.43	2466.	17.004	-.5	.90	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0164	X	1677.	11.569	-32.4	.53	1654.	11.410	-33.2	1.85	01	
V0166	X	1997.	13.776	-19.6	.90	2027.	13.983	-18.2	.99	01	
V0168		2592.	17.875	4.4	.75	2580.	17.797	4.1	1.15	01	
V0169		2574.	17.755	3.7	.53	2574.	17.755	3.9	1.54	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176	*	2200.	15.172	-11.4	.64	2215.	15.276	-10.6	.52	01	
V0184		2380.	16.414	-4.2	.94	2385.	16.448	-3.8	.78	01	
V0190		2490.	17.172	.3	.78	2472.	17.048	-.2	.81	01	
V0199		2275.	15.690	-8.4	.59	2275.	15.690	-8.2	.91	01	
V0206		2320.	16.000	-6.6	1.23	2330.	16.069	-6.0	1.30	01	
V0207		2535.	17.483	2.1	.97	2570.	17.724	3.7	.65	01	
V0208	*	2553.	17.605	2.8	.81	2458.	16.954	-.8	1.59	+72	ORIGINAL IN MEGAPASCAL RECEIVED LATE
V0213	*	2527.	17.425	1.7	1.34	2418.	16.674	-2.4	2.11X	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0214		2445.	16.859	-1.6	.68	2415.	16.654	-2.6	.63	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		2550.	17.586	2.7	1.48	2600.	17.931	4.9	.51	01	
V0223		2510.	17.310	1.1	1.42	2530.	17.448	2.1	1.81	01	
V0224		2555.	17.621	2.9	1.18	2532.	17.466	2.2	2.99X	01	
V0225		2257.	15.566	-9.1	1.84	2238.	15.434	-9.7	1.04	+70	DATA RECEIVED LATE
V0232		2301.	15.872	-7.3	.97	2332.	16.086	-5.9	.98	01	
V0233		2344.	16.169	-5.6	.37	2362.	16.293	-4.7	1.38	01	
V0235		2461.	16.976	-.9	.64	2478.	17.090	-.0	.51	01	
V0238	X	2325.	16.034	-6.4	1.97X	2162.	14.914	-12.7	1.88	01	
V0243	X	2582.	17.807	4.0	1.15	2451.	16.907	-1.1	1.29	01	
V0244		2567.	17.705	3.4	.90	2524.	17.405	1.8	.66	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0245A		2645.	18.241	6.5	.79	2631.	18.145	6.2	1.18	01	
V0245B		2567.	17.703	3.4	1.03	2560.	17.655	3.3	.62	01	
V0250		2587.	17.845	4.2	.79	2562.	17.672	3.4	.88	01	
		2483.	17.125	= GR. MEAN =		2478.	17.090				5 TEST DETERMINATIONS
		108.	.742	= SD MEANS =		108.	.745				56 LABORATORIES IN GRAND MEANS
		52.	.358	= AVER SDR =		56.	.383				62 LABORATORIES REPORTING
		PSI	MEGAPA	= UNIT =		PSI	MEGAPA				


TENSILE STRENGTH
MATERIAL C91-C92 2483. PSI MATERIAL C93-C94 2478. PSI
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
MATERIAL C93-C94
2100 2200 2300 2400 2500 2600 2700 2800 2900
MATERIAL C91-C92

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 41 - 1 ULTIMATE ELONGATION - PERCENT JULY 1979

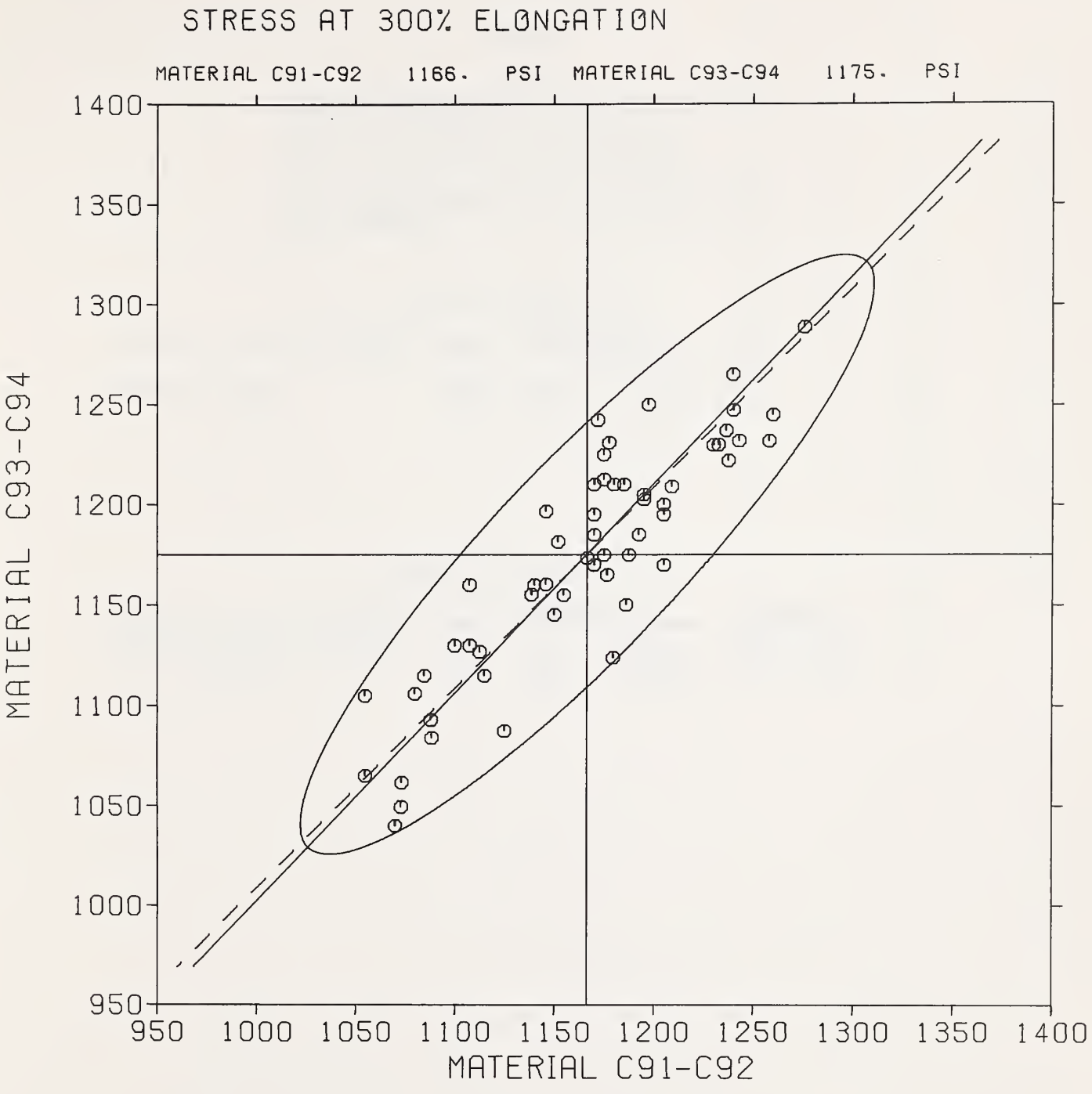
LAB CODE	F	MATERIAL C91-C92 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	MATERIAL C93-C94 COMMERCIAL TIRE TREAD MEAN %	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062	*	543.	-9.7	.89	537.	-8.8	1.00	01	
V0063	X	620.	3.0	.99	655.	11.3	.81	01	
V0066		612.	1.8	.43	600.	1.9	.70	01	
V0067		585.	-2.8	.91	567.	-3.6	.68	01	
V0069		615.	2.2	1.39	585.	-.6	1.49	01	
V0070	X	710.	18.0	1.64	660.	12.1	1.09	01	
V0071		595.	-1.1	1.46	583.	-.9	2.05X	01	
V0072		605.	.5	.76	600.	1.9	.82	01	
V0073	X	61.	-89.9	.09	61.	-89.6	.09	+98	EXTREME TEST RESULTS
V0076		610.	1.3	1.12	595.	1.1	.58	01	
V0078		570.	-5.3	.50	565.	-4.0	.82	01	
V0083		610.	1.3	.50	587.	-.2	.96	01	
V0084		595.	-1.1	1.09	560.	-4.9	.85	01	
V0085		610.	1.3	1.40	605.	2.8	1.11	01	
V0087		605.	.5	.72	580.	-1.4	2.61X	01	
V0088		594.	-1.2	1.76	570.	-3.1	1.01	01	
V0092		630.	4.7	1.21	625.	6.2	.82	01	
V0095		605.	.5	1.00	595.	1.1	.77	01	
V0100		600.	-.3	.57	595.	1.1	1.33	01	
V0102		600.	-.3	.66	585.	-.6	.74	01	
V0111		635.	5.6	1.65	631.	7.2	2.00X	01	
V0117		630.	4.7	.61	605.	2.8	.48	01	
V0123		620.	3.0	.75	590.	.2	.49	01	
V0126		635.	5.5	.93	619.	5.2	.79	01	
V0128		605.	.5	.93	590.	.2	.91	01	
V0144		585.	-2.8	1.33	560.	-4.9	1.48	01	
V0144E		615.	2.2	1.28	605.	2.8	.81	01	
V0146		600.	-.3	1.24	600.	1.9	.78	01	
V0149		615.	2.2	1.20	595.	1.1	1.13	01	
V0150		565.	-6.1	.89	560.	-4.9	.69	01	
V0152		595.	-1.1	.53	575.	-2.3	.54	01	
V0153		570.	-5.3	.14	570.	-3.2	.14	01	
V0154		600.	-.3	.81	580.	-1.5	1.21	01	
V0156		570.	-5.3	1.28	555.	-5.7	.92	01	
V0158		605.	.5	1.32	600.	1.9	.81	01	
V0160		580.	-3.6	1.06	590.	.2	1.20	01	
V0164		597.	-.7	1.12	597.	1.5	1.77	01	
V0166		585.	-2.8	.79	580.	-1.5	.82	01	
V0168		600.	-.3	.64	600.	1.9	1.01	01	
V0169		620.	3.0	.72	615.	4.5	1.47	01	
V0176		590.	-2.0	.83	605.	2.8	.87	01	
V0184		605.	.5	1.26	580.	-1.5	1.35	01	
V0190		600.	-.3	.76	600.	1.9	.97	01	
V0199		625.	3.8	1.22	600.	1.9	1.76	01	
V0206		575.	-4.5	1.05	575.	-2.3	.94	01	
V0207		592.	-1.6	.16	592.	.6	.07	01	
V0208	X	555.	-7.8	1.98X	500.	-15.1	3.08X	+70	DATA RECEIVED LATE
V0213		573.	-4.7	1.00	543.	-7.7	1.56	01	
V0214		610.	1.3	1.27	585.	-.6	1.50	01	
V0220		590.	-2.0	1.22	590.	.2	1.04	01	
V0223		585.	-2.8	1.66	570.	-3.2	1.41	01	
V0224		622.	3.4	1.13	600.	1.9	2.67X	01	
V0225	X	540.	-10.3	.67	515.	-12.5	.56	+70	DATA RECEIVED LATE
V0232		607.	.9	.98	605.	2.8	.94	01	
V0233		585.	-2.8	.53	575.	-2.3	1.32	01	
V0235		633.	5.3	1.05	622.	5.7	.69	01	
V0238	X	560.	-7.0	1.70	515.	-12.5	1.66	01	
V0243		630.	4.7	.70	590.	.2	1.39	01	
V0244		635.	5.5	1.22	615.	4.5	.42	01	
V0245A		610.	1.3	.69	600.	1.9	1.18	01	
V0245E		597.	-.7	1.02	592.	.6	.73	01	
V0250	*	625.	3.8	.94	575.	-2.3	.96	01	
		602.	= GR. MEAN =		589.				5 TEST DETERMINATIONS
		20.	= SD MEANS =		19.				56 LABORATORIES IN GRAND MEANS
		16.	= AVER SDR =		16.				62 LABORATORIES REPORTING
		%	= UNIT =		%				


ULTIMATE ELONGATION
MATERIAL C91-C92 602. %
MATERIAL C93-C94 589. %
MATERIAL C93-C94
MATERIAL C91-C92
660
650
640
630
620
610
600
590
580
570
560
550
540
530
520
510
530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 41 - 1 STRESS AT 300% ELONGATION - POUNDS PER SQUARE INCH JULY 1979

LAB CODE	F	MATERIAL C91-C92 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MATERIAL C93-C94 COMMERCIAL TIRE TREAD MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0062		1232.	8.500	5.7	1.88	1230.	8.483	4.7	1.12	01	
V0063		1186.	8.179	1.7	.68	1150.	7.931	-2.1	.50	01	
V0066		1107.	7.638	-5.0	1.21	1130.	7.793	-3.8	1.17	01	
V0067		1192.	8.224	2.3	.66	1185.	8.172	.8	1.07	01	
V0069		1177.	8.121	1.0	.71	1231.	8.490	4.7	1.15	01	
V0070	X	854.	5.893	-26.7	1.35	865.	5.966	-26.4	.79	01	
V0071		1176.	8.114	.9	1.14	1165.	8.034	-.9	1.47	01	
V0072		1170.	8.069	.3	1.56	1210.	8.345	3.0	.94	01	
V0073		1125.	7.759	-3.5	1.39	1087.	7.500	-7.5	.87	01	
V0076		1240.	8.552	6.3	.55	1265.	8.724	7.6	.87	01	
V0078		1237.	8.534	6.1	1.20	1222.	8.428	4.0	.86	01	
V0083		1205.	8.310	3.3	.83	1170.	8.069	-.4	.90	01	
V0084		1170.	8.069	.3	1.01	1185.	8.172	.8	1.02	01	
V0085		1146.	7.902	-1.8	.89	1197.	8.252	1.8	1.34	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		1205.	8.310	3.3	.78	1195.	8.241	1.7	1.20	01	
V0088		1073.	7.400	-8.0	5.99X	1049.	7.238	-10.7	1.58	01	
V0092		1115.	7.690	-4.4	1.03	1115.	7.690	-5.1	2.14X	01	
V0095		1140.	7.862	-2.2	1.40	1160.	8.000	-1.3	1.32	01	
V0100		1180.	8.138	1.2	2.05X	1210.	8.345	3.0	.68	01	
V0102		1055.	7.276	-9.5	.53	1065.	7.345	-9.4	1.17	01	
V0111		1085.	7.483	-7.0	.61	1115.	7.690	-5.1	.39	01	
V0117		1055.	7.276	-9.5	.77	1105.	7.621	-6.0	.53	01	
V0123		1100.	7.586	-5.7	1.12	1130.	7.793	-3.8	1.55	01	
V0126		1139.	7.852	-2.4	.53	1155.	7.967	-1.7	.59	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		1230.	8.483	5.5	.82	1230.	8.483	4.7	1.13	01	
V0144		1240.	8.552	6.3	2.55X	1265.	8.724	7.6	.93	01	
V0144E		1150.	7.931	-1.4	1.39	1145.	7.897	-2.6	1.70	01	
V0146		1179.	8.134	1.1	1.98X	1124.	7.752	-4.4	1.66	01	
V0149		1170.	8.069	.3	1.12	1170.	8.069	-.4	.67	01	
V0150		1155.	7.966	-1.0	1.25	1155.	7.966	-1.7	.85	01	
V0152		1195.	8.241	2.5	.86	1205.	8.310	2.5	.56	01	
V0153		1152.	7.945	-1.2	2.13X	1181.	8.148	.5	1.11	01	
V0154		1175.	8.103	.8	1.38	1225.	8.448	4.2	.96	01	
V0156		1205.	8.310	3.3	.94	1200.	8.276	2.1	1.10	01	
V0158		1243.	8.572	6.6	2.66X	1232.	8.497	4.8	1.37	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0160		1240.	8.552	6.3	1.32	1247.	8.602	6.1	.89	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0164	X	725.	5.000	-37.8	3.51X	677.	4.669	-42.4	1.26	01	
V0166	X	932.	6.428	-20.1	.56	963.	6.645	-18.0	.41	01	
V0168		1195.	8.241	2.5	.81	1202.	8.293	2.3	.55	01	
V0169		1146.	7.902	-1.8	.94	1160.	8.002	-1.3	.58	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176		1070.	7.379	-8.3	.73	1040.	7.172	-11.5	.94	01	
V0184		1107.	7.638	-5.0	.79	1160.	8.000	-1.3	.65	01	
V0190		1258.	8.676	7.9	1.13	1232.	8.497	4.8	1.18	01	
V0199		1088.	7.503	-6.7	.98	1093.	7.538	-7.0	.94	01	
V0206		1170.	8.069	.3	1.07	1195.	8.241	1.7	.56	01	
V0207		1260.	8.690	8.0	1.64	1245.	8.586	5.9	2.11X	01	
V0208	X	1400.	9.653	20.0	3.09X	1421.	9.803	20.9	6.66X	*72	ORIGINAL IN MEGAPASCAL RECEIVED LATE
V0213		1276.	8.797	9.4	.83	1289.	8.887	9.7	1.15	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0214		1172.	8.082	.5	.37	1242.	8.567	5.7	.56	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		1187.	8.190	1.8	.53	1175.	8.103	-.0	1.21	01	
V0223		1185.	8.172	1.6	1.12	1210.	8.345	3.0	.74	01	
V0224		1197.	8.259	2.7	1.23	1250.	8.621	6.4	1.16	01	
V0225		1222.	8.431	4.8	5.14X	1257.	8.669	7.0	2.03X	*70	DATA RECEIVED LATE
V0232		1073.	7.403	-8.0	.99	1061.	7.321	-9.7	1.00	01	
V0233		1112.	7.672	-4.6	1.17	1127.	7.772	-4.1	1.21	01	
V0235		1080.	7.448	-7.4	1.01	1106.	7.628	-5.9	.78	01	
V0238		1175.	8.103	.8	.54	1175.	8.103	-.0	1.15	01	
V0243		1088.	7.507	-6.7	1.03	1084.	7.476	-7.8	1.26	01	
V0244		1236.	8.527	6.0	1.20	1237.	8.532	5.3	.80	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0245A		1209.	8.338	3.7	1.10	1209.	8.338	2.9	1.57	01	
V0245B		1166.	8.045	.0	.82	1173.	8.093	-.1	.90	01	
V0250		1175.	8.103	.8	1.39	1212.	8.362	3.2	.84	01	
		1166.	8.043	= GR. MEAN =		1175.	8.105				5 TEST DETERMINATIONS
		57.	.392	= SD MEANS =		59.	.406				57 LABORATORIES IN GRAND MEANS
		25.	.174	= AVER SDR =		25.	.171				62 LABORATORIES REPORTING
		PSI	MEGAPA	= UNIT =		PSI	MEGAPA				


STRESS AT 300% ELONGATION
MATERIAL C91-C92 1166. PSI MATERIAL C93-C94 1175. PSI
MATERIAL C93-C94
MATERIAL C91-C92
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
950 1000 1050 1100 1150 1200 1250 1300 1350 1400

HARDNESS

NOTES

Materials C9I and C92 were sheets of the same vulcanized rubber. Similarly, materials C93 and C94 were alike.

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

Three of the 30 participants reporting used ASTM D1415 (Wallace) for the hardness determination. All others used ASTM D2240 (Type A Durometer).

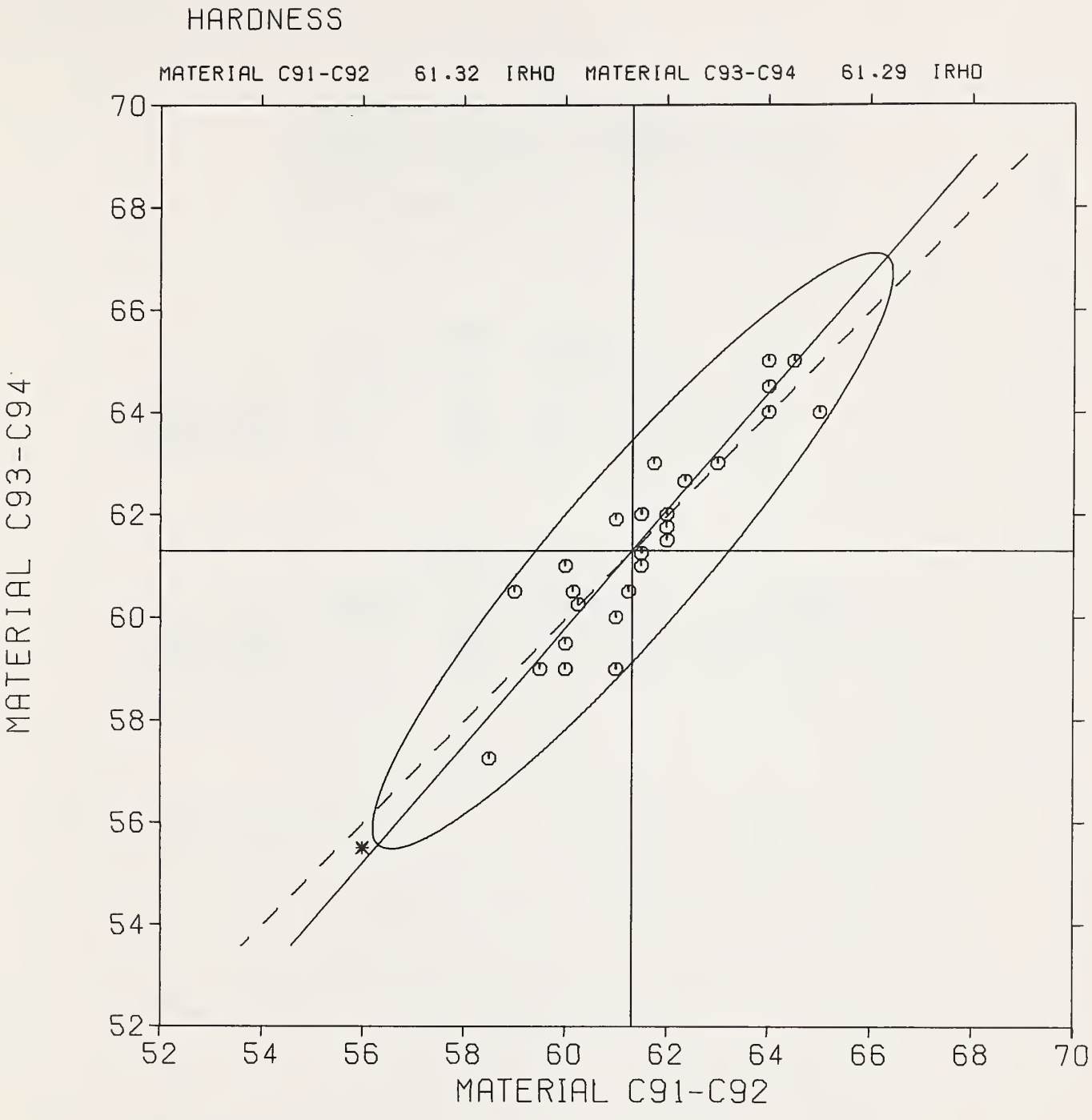
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
HARDNESS	C91-C92	29	1	61.32	1.94	.18	.45	IRHD
	C93-C94	29	1	61.29	2.20	.12	.45	IRHD

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
HARDNESS	C91-C92	5	5	61.32	1.25	5.38	IRHD	2.0	8.8
	C93-C94	5	5	61.29	1.26	6.11	IRHD	2.0	10.0

LAB CODE	F	MATERIAL C91-C92 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	MATERIAL C93-C94 COMMERCIAL TIRE TREAD MEAN IRHD	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR STEER VARIATION
V0062		61.50	.3	1.56	61.25	-.1	1.04	01	
V0069	*	56.00	-8.7	.76	55.50	-9.5	.49	01	
V0070		61.75	.7	1.56	63.00	2.8	.99	01	
V0071		64.00	4.4	1.28	64.00	4.4	1.10	01	
V0072		64.00	4.4	1.21	64.50	5.2	1.53	01	
V0078		65.00	6.0	.49	64.00	4.4	.99	01	
V0084		62.00	1.1	1.10	61.50	.3	1.10	01	
V0085		61.00	-.5	.96	61.90	1.0	.80	01	
V0087		61.50	.3	.00	62.00	1.2	.00	01	
V0088		59.50	-3.0	1.10	59.00	-3.7	.49	01	
V0092		61.00	-.5	1.91X	59.00	-3.7	2.25X	01	
V0095		61.50	.3	.61	62.00	1.2	.00	01	
V0100		60.15	-1.9	.79	60.50	-1.3	.81	01	
V0102		64.00	4.4	1.48	65.00	6.0	.49	01	
V0111		64.50	5.2	.99	65.00	6.0	.99	01	
V0128		59.00	-3.8	.99	60.50	-1.3	.99	01	
V0144		62.00	1.1	.61	62.00	1.2	1.27	01	
V0168		62.00	1.1	.55	61.75	.7	.49	01	
V0169		60.00	-2.2	.49	59.50	-2.9	.00	01	
V0176		60.00	-2.2	1.14	59.00	-3.7	1.12	01	
V0190		63.00	2.7	1.21	63.00	2.8	1.21	01	
V0200		60.25	-1.7	.92	60.25	-1.7	.85	01	
V0206		58.50	-4.6	1.02	57.25	-6.6	1.37	01	
V0208		61.75	.7	1.33	61.60	.5	2.68X	+70	DATA RECEIVED LATE
V0214		62.35	1.7	1.23	62.65	2.2	.71	01	
V0224		60.00	-2.2	.92	61.00	-.5	1.10	01	
V0233		60.00	-2.2	.49	61.00	-.5	1.71	01	
V0235		61.25	-.1	.99	60.50	-1.3	.98	01	
V0243		61.00	-.5	.00	60.00	-2.1	.00	01	
V0244		61.50	.3	1.53	61.00	-.5	1.38	01	
		61.32	= GR. MEAN =		61.29			5	TEST DETERMINATIONS
		1.94	= SD MEANS =		2.20			29	LABORATORIES IN GRAND MEANS
		.45	= AVER SDR =		.45			30	LABORATORIES REPORTING
		IRHD	= UNIT =		IRHD				


HARDNESS
MATERIAL C91-C92 61.32 IRHO MATERIAL C93-C94 61.29 IRHO
MATERIAL C93-C94
MATERIAL C91-C92
70
68
66
64
62
60
58
56
54
52
52
54
56
58
60
62
64
66
68
70

MOONEY VISCOSITY

NOTES

Materials T91 and T92 were the same rubber. Similarly, materials T93 and T94 were the same rubber. No sample preparation was required for materials T91 and T92 whereas, mill massing was required for materials T93 and T94.

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

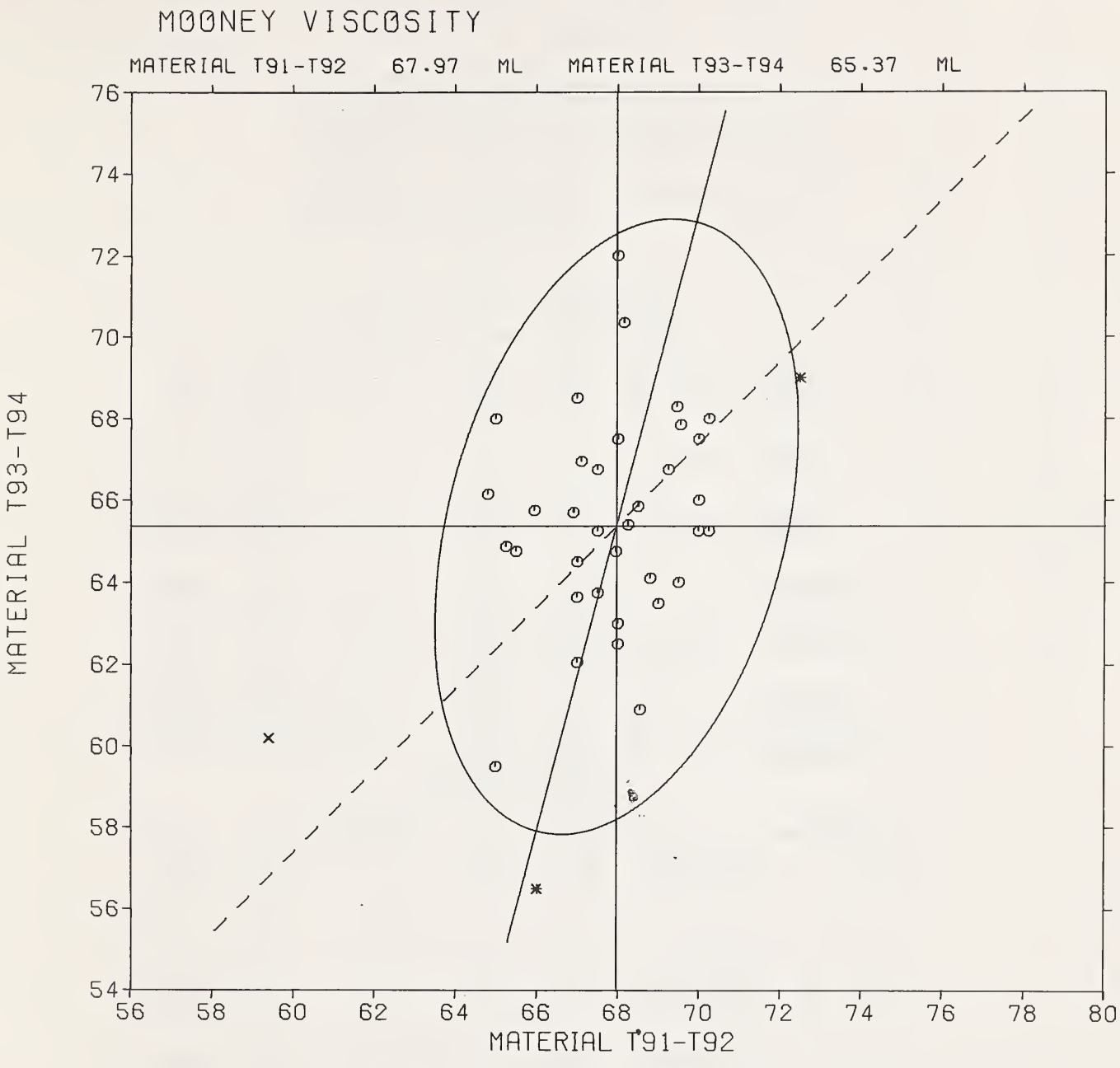
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
MOONEY	T91-T92	38	2	67.97	1.73	.12	.34	ML
VISCOSITY	T93-T94	38	2	65.37	2.91	.53	.52	ML

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
MOONEY	T91-T92	3	3	67.97	.93	4.80	ML	1.4	7.1
VISCOSITY	T93-T94	3	3	65.37	1.44	8.06	ML	2.2	12.3

LAB CODE	F	MATERIAL T91-T92 BUTYL RUBBER MEAN ML	% DEV	REL SDR	MATERIAL T93-T94 SBR MEAN ML	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0060		69.25	1.9	.74	66.75	2.1	1.01	01	
V0061		67.10	-1.3	.90	66.95	2.4	.70	01	
V0071		68.80	1.2	1.04	64.10	-1.9	1.05	01	
V0072		68.00	.0	3.75X	63.00	-3.6	1.52	01	
V0073	*	66.00	-2.9	.00	56.50	-13.6	1.52	01	
V0077		67.00	-1.4	.69	62.05	-5.1	1.62	01	
V0078	X	63.70	-6.3	1.79	51.65	-21.0	2.46X	01	
V0079		64.80	-4.7	.61	66.15	1.2	1.65	01	
V0080		67.00	-1.4	1.43	63.65	-2.6	3.79X	01	
V0083		69.45	2.2	.98	68.30	4.5	.90	01	
V0085	*	72.50	6.7	1.17	69.00	5.6	.83	01	
V0090		70.00	3.0	.43	65.25	-.2	.28	01	
V0092		67.00	-1.4	1.71	68.50	4.8	1.52	01	
V0095		69.00	1.5	.86	63.50	-2.9	1.01	01	
V0100		68.50	.8	.83	65.85	.7	.77	01	
V0111	X	59.40	-12.6	.79	60.20	-7.9	.58	01	
V0117		67.50	-.7	2.83X	65.25	-.2	1.79	01	
V0128		68.00	.0	3.94X	72.00	10.2	2.97X	01	
V0144		69.50	2.2	.00	64.00	-2.1	1.11	01	
V0146		65.00	-4.4	.86	68.00	4.0	.56	01	
V0149		68.15	.3	.82	70.35	7.6	1.63	01	
V0150		69.00	1.5	1.71	63.50	-2.9	3.39X	01	
V0156		65.25	-4.0	1.83	64.87	-.7	1.12	01	
V0166		68.00	.0	1.17	67.50	3.3	1.39	01	
V0169		70.00	3.0	.00	66.00	1.0	.00	01	
V0177		65.95	-3.0	.99	65.75	.6	.59	01	
V0182		70.25	3.4	.43	65.25	-.2	.56	01	
V0190		68.55	.8	.62	60.90	-6.8	.30	01	
V0207		67.95	-.0	1.28	64.75	-.9	1.20	01	
V0208		68.00	.0	1.71	62.50	-4.4	.56	01	
V0211		67.50	-.7	.86	63.75	-2.5	.56	01	
V0213		67.50	-.7	.86	66.75	2.1	.28	01	
V0214		67.00	-1.4	.43	64.50	-1.3	1.39	01	
V0220		66.90	-1.6	1.12	65.70	.5	.84	01	
V0221		70.25	3.4	.86	68.00	4.0	.83	01	
V0223		65.50	-3.6	.43	64.75	-.9	.76	01	
V0236		70.00	3.0	.00	67.50	3.3	1.11	01	
V0238		65.00	-4.4	1.71	59.50	-9.0	1.11	01	
V0250		69.55	2.3	.48	67.85	3.8	1.31	01	
V0251		68.25	.4	1.47	65.40	.1	.65	01	
		67.97	* GRO MEAN *		65.37				3 TEST DETERMINATIONS
		1.73	* SD MEANS *		2.91				38 LABORATORIES IN GRAND MEANS
		.34	* AVER SDR *		.52				40 LABORATORIES REPORTING
		ML	* UNIT *		ML				


MOONEY VISCOSITY
MATERIAL T91-T92 67.97 ML
MATERIAL T93-T94 65.37 ML
MATERIAL T93-T94
MATERIAL T91-T92
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 Y91 and Y92 were the same rubber formulation. Similarly, materials Y93 and Y94 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.

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

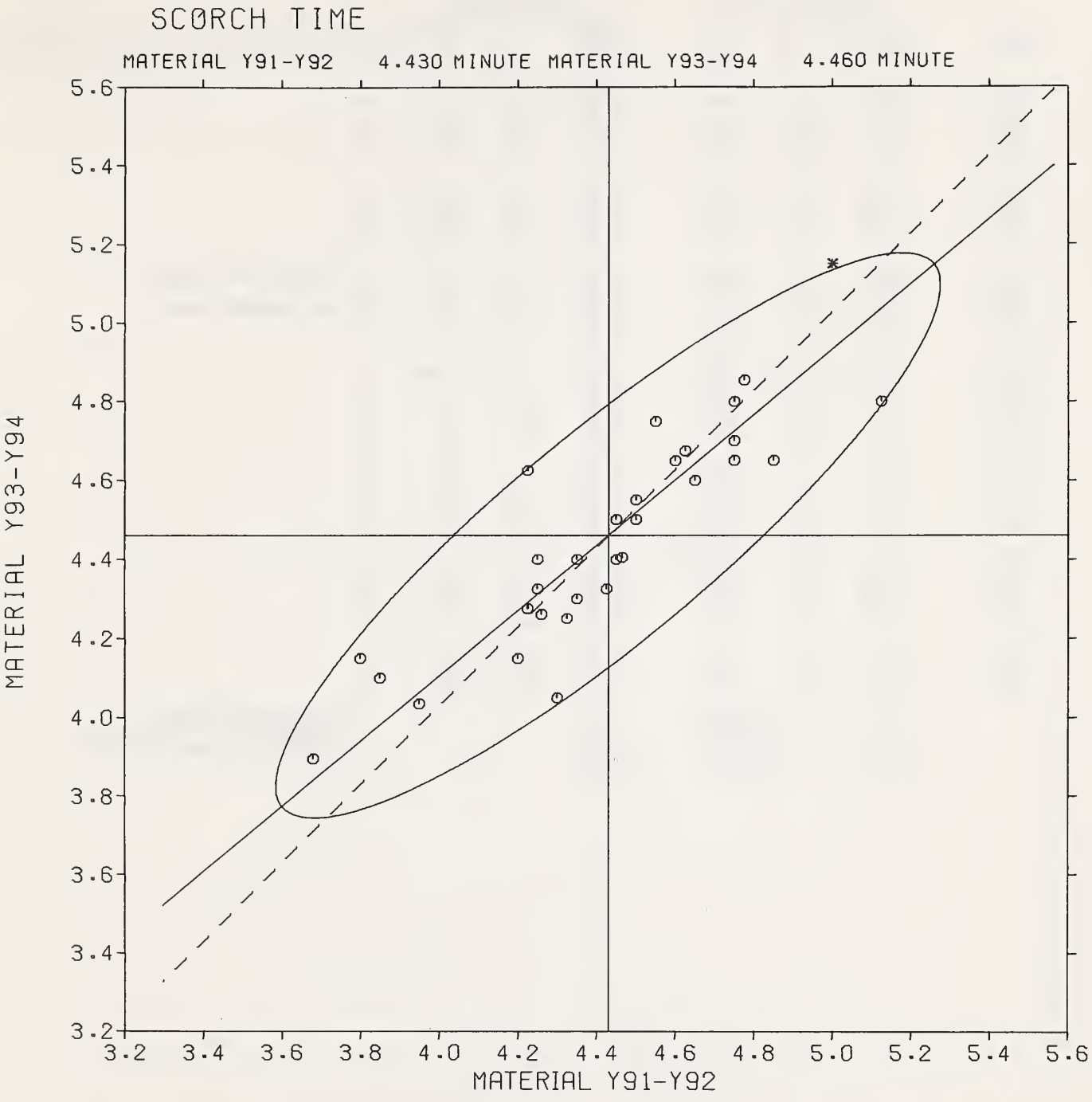
SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS LABS	SHEETS	REPL	UNITS
SCORCH TIME	Y91-Y92	33	0	4.430	.324	.048	.071	MINUTES
	Y93-Y94	33	0	4.460	.274	.025	.052	MINUTES
CURE TIME (50% MH)	Y91-Y92	29	4	6.50	.28	.01	.07	MINUTES
	Y93-Y94	29	4	6.53	.26	.02	.06	MINUTES
CURE TIME (90% MH)	Y91-Y92	32	1	10.01	.55	.04	.09	MINUTES
	Y93-Y94	32	1	10.06	.44	.05	.09	MINUTES
MINIMUM TORQUE	Y91-Y92	29	4	5.15	.60	.02	.06	POUND-INCHES
	Y93-Y94	29	4	5.17	.63	.02	.08	POUND-INCHES
MINIMUM TORQUE	Y91-Y92	29	4	.5824	.0673	.0036	.0072	NEWTON-METERS
	Y93-Y94	29	4	.5847	.0707	.0027	.0088	NEWTON-METERS
MAXIMUM TORQUE	Y91-Y92	32	1	23.53	1.46	.05	.16	POUND-INCHES
	Y93-Y94	32	1	23.52	1.43	.05	.10	POUND-INCHES
MAXIMUM TORQUE	Y91-Y92	32	1	2.6590	.1653	.0071	.0185	NEWTON-METERS
	Y93-Y94	32	1	2.6580	.1616	.0072	.0115	NEWTON-METERS

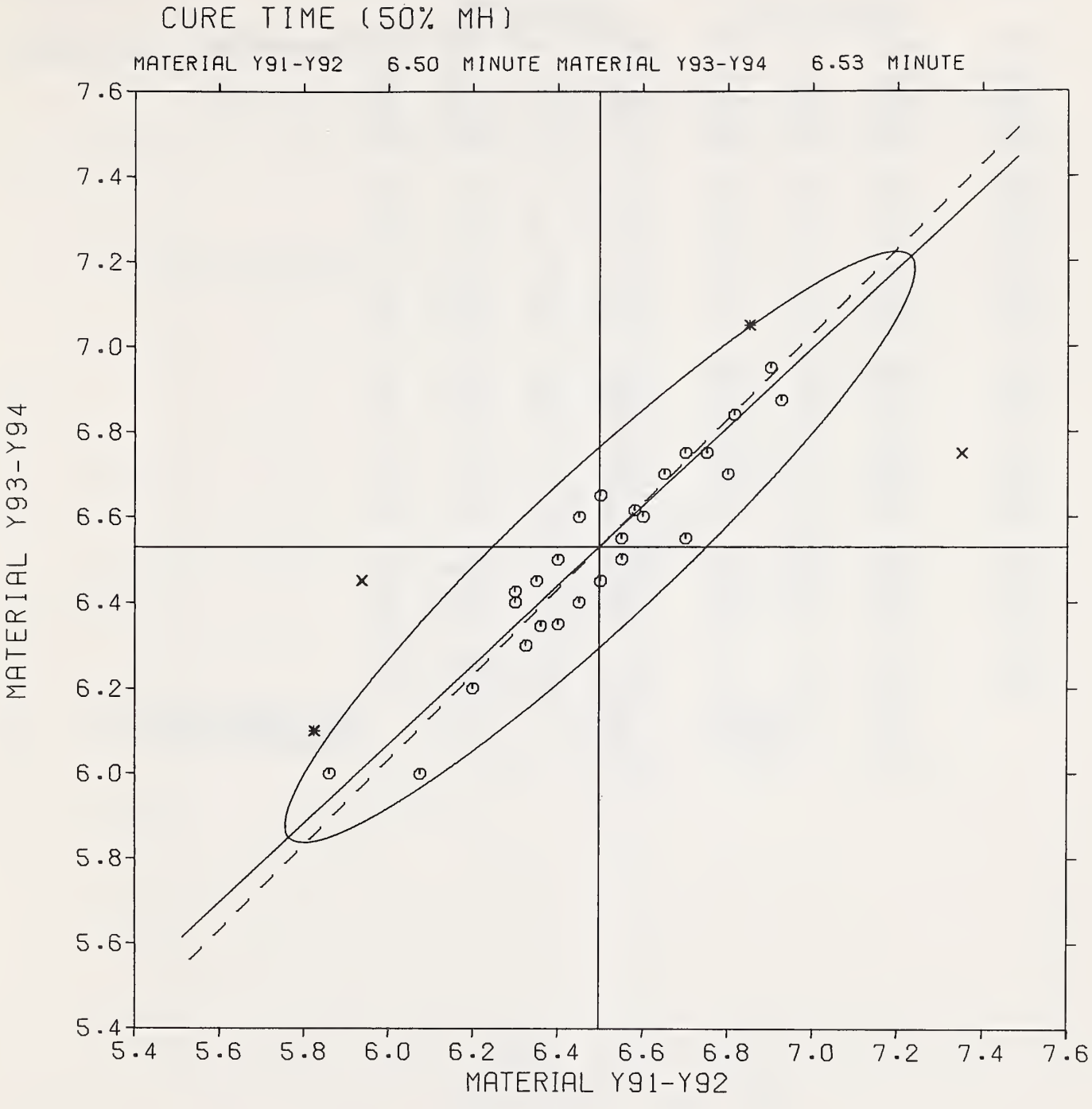
PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE REPEAT	REPROD	UNITS	PERCENT REPEAT	REPROD
SCORCH TIME	Y91-Y92	3	3	4.430	.196	.697	MINUTE	4.4	20.2
	Y93-Y94	3	3	4.460	.144	.759	MINUTE	3.2	17.0
CURE TIME (50% MH)	Y91-Y92	3	3	6.50	.20	.78	MINUTE	3.1	12.0
	Y93-Y94	3	3	6.53	.15	.73	MINUTE	2.4	11.1
CURE TIME (90% MH)	Y91-Y92	3	3	10.01	.26	1.52	MINUTE	2.6	15.2
	Y93-Y94	3	3	10.06	.26	1.23	MINUTE	2.6	12.2
MINIMUM TORQUE	Y91-Y92	3	3	5.15	.18	1.65	LB-IN.	3.4	32.0
	Y93-Y94	3	3	5.17	.22	1.73	LB-IN.	4.2	33.5
MINIMUM TORQUE	Y91-Y92	3	3	.5824	.0198	.1865	N-M	3.4	32.0
	Y93-Y94	3	3	.5847	.0245	.1959	N-M	4.2	33.5
MAXIMUM TORQUE	Y91-Y92	3	3	23.53	.45	4.05	LB-IN.	1.9	17.2
	Y93-Y94	3	3	23.52	.28	3.96	LB-IN.	1.2	16.8
MAXIMUM TORQUE	Y91-Y92	3	3	2.6590	.0513	.4579	N-M	1.9	17.2
	Y93-Y94	3	3	2.6580	.0318	.4477	N-M	1.2	16.8

LAB CODE	F	MATERIAL Y91-Y92 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL Y93-Y94 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0064		4.750	7.2	1.22	4.800	7.6	.00	01	
V0074		4.250	-4.1	1.02	4.325	-3.0	1.11	01	
V0077		3.800	-14.2	1.35	4.150	-6.9	1.51	01	
V0079		4.225	-4.6	1.94	4.625	3.7	1.39	01	
V0083		4.500	1.6	1.49	4.500	.9	.00	01	
V0090		4.775	7.8	2.02	4.855	8.9	1.13	01	
V0092		4.450	.5	.41	4.400	-1.3	.96	01	
V0095		4.850	9.5	.82	4.650	4.3	1.11	01	
V0100		4.500	1.6	.41	4.500	.9	1.66	01	
V0117		4.750	7.2	.82	4.700	5.4	.96	01	
V0120		3.850	-13.1	4.64X	4.100	-8.1	3.39X	01	
V0128		4.650	5.0	.41	4.600	3.1	.00	01	
V0144		3.950	-10.8	.08	4.035	-9.5	.67	01	
V0146		4.600	3.8	.41	4.650	4.3	.55	01	
V0149		4.300	-2.9	.00	4.050	-9.2	.00	01	
V0150	*	5.000	12.9	1.52	5.150	15.5	1.11	01	
V0152		4.550	2.7	.41	4.750	6.5	.55	01	
V0154		4.625	4.4	1.02	4.675	4.8	.76	01	
V0156		4.425	-.1	.20	4.325	-3.0	.28	01	
V0158		4.200	-5.2	.00	4.150	-6.9	.28	01	
V0161		4.350	-1.8	.82	4.400	-1.3	1.11	01	
V0166		4.750	7.2	1.22	4.650	4.3	2.07	01	
V0169		4.250	-4.1	2.04	4.400	-1.3	3.50X	01	
V0182		4.225	-4.6	.82	4.275	-4.1	.55	01	
V0190		4.500	1.6	.61	4.550	2.0	.76	01	
V0207		4.450	.5	2.18	4.500	.9	2.93X	01	
V0208		4.260	-3.8	.65	4.260	-4.5	.22	01	
V0211		4.325	-2.4	.76	4.250	-4.7	.55	01	
V0213		5.125	15.7	4.64X	4.800	7.6	1.21	01	
V0217		4.450	.5	1.11	4.500	.9	1.11	01	
V0221		4.350	-1.8	.82	4.300	-3.6	2.22	01	
V0238		3.680	-16.9	2.21	3.895	-12.7	1.54	01	
V0243		4.465	.8	.23	4.405	-1.2	.64	01	
		4.430	= GR. MEAN =		4.460				3 TEST DETERMINATIONS
		.324	= SD MEANS =		.274				33 LABORATORIES IN GRAND MEANS
		.071	= AVER SDR =		.052				33 LABORATORIES REPORTING
		MINUTE	= UNIT =		MINUTE				

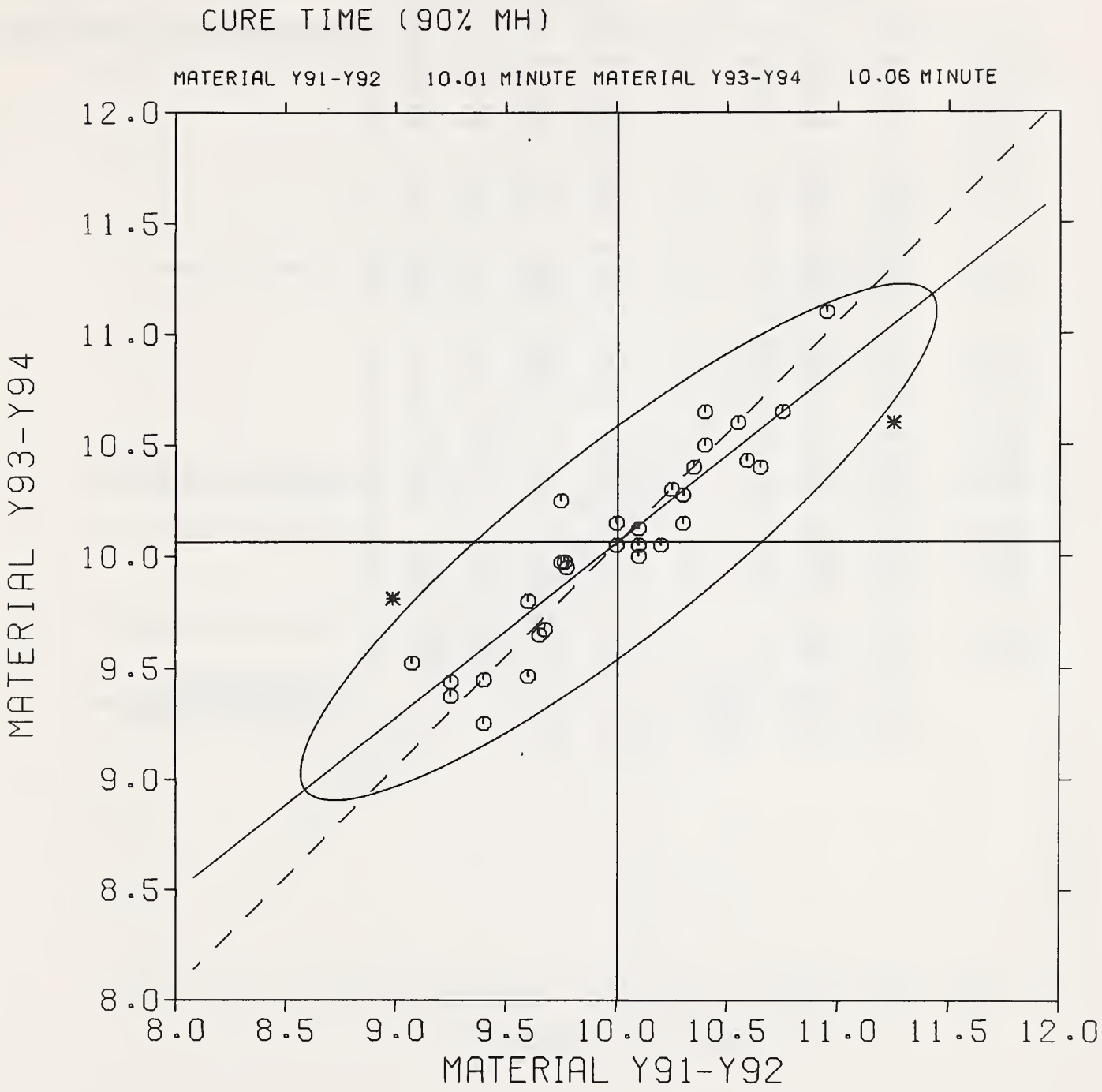

SCØRCH TIME
MATERIAL Y91-Y92 4.430 MINUTE MATERIAL Y93-Y94 4.460 MINUTE
MATERIAL Y93-Y94
MATERIAL Y91-Y92
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6

LAB CODE	F	MATERIAL Y91-Y92 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL Y93-Y94 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0064		6.90	6.2	.00	6.95	6.4	.00	01	
V0074		6.60	1.6	.39	6.60	1.1	.00	01	
V0077	*	5.82	-10.3	1.29	6.10	-6.6	1.59	01	
V0079	X	5.94	-8.6	2.17	6.45	-1.2	1.91	01	
V0083		6.75	3.9	1.07	6.75	3.4	1.04	01	
V0090		6.81	4.9	2.19	6.84	4.8	.75	01	
V0092		6.40	-1.5	1.36	6.35	-2.7	1.42	01	
V0095		6.65	2.4	1.17	6.70	2.6	.52	01	
V0100		6.50	.0	.68	6.45	-1.2	2.75X	01	
V0117		6.70	3.1	.78	6.75	3.4	.52	01	
V0120	X	15.65	99.9	3.48X	16.30	99.9	10.02X	+98	EXTREME TEST RESULTS
V0128		6.70	3.1	1.04	6.55	.3	.00	01	
V0144		5.87	-9.6	.10	5.91	-9.5	.43	+70	DATA RECEIVED LATE
V0146		6.50	.0	1.07	6.65	1.8	1.04	01	
V0149		6.80	4.7	.39	6.70	2.6	.00	01	
V0150	*	6.85	5.4	1.46	7.05	8.0	3.64X	01	
V0152		6.45	-.7	.39	6.60	1.1	.90	01	
V0154		6.92	6.6	.90	6.87	5.3	.71	01	
V0156		6.32	-2.6	.20	6.30	-3.5	.26	01	
V0158		6.07	-6.5	.00	6.00	-8.1	.00	01	
V0161		6.20	-4.6	.78	6.20	-5.0	.90	01	
V0166		6.75	3.9	1.46	6.75	3.4	.90	01	
V0169		6.55	.8	1.07	6.55	.3	1.56	01	
V0182		6.30	-3.0	1.12	6.40	-2.0	.52	01	
V0190		6.30	-3.0	1.62	6.42	-1.6	1.29	01	
V0207		6.40	-1.5	2.45X	6.50	-.4	.52	01	
V0208		6.58	1.3	.20	6.61	1.3	1.29	01	
V0211		6.55	.8	1.36	6.50	-.4	1.04	01	
V0213	X	7.35	13.1	1.73	6.75	3.4	.52	01	
V0217		6.35	-2.3	1.46	6.45	-1.2	2.08	01	
V0221		6.45	-.7	1.46	6.40	-2.0	1.42	01	
V0238		5.86	-9.8	.93	6.00	-8.1	.91	01	
V0243		6.36	-2.1	.16	6.34	-2.8	.74	01	
		6.50	* GR. MEAN *		6.53				3 TEST DETERMINATIONS
		.28	* SD MEANS *		.26				29 LABORATORIES IN GRAND MEANS
		.07	* AVER SDR *		.06				33 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				


CURE TIME (50% MH)
MATERIAL Y91-Y92 6.50 MINUTE MATERIAL Y93-Y94 6.53 MINUTE
MATERIAL Y93-Y94
MATERIAL Y91-Y92
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
CURE TIME (90% MH) - MINUTES

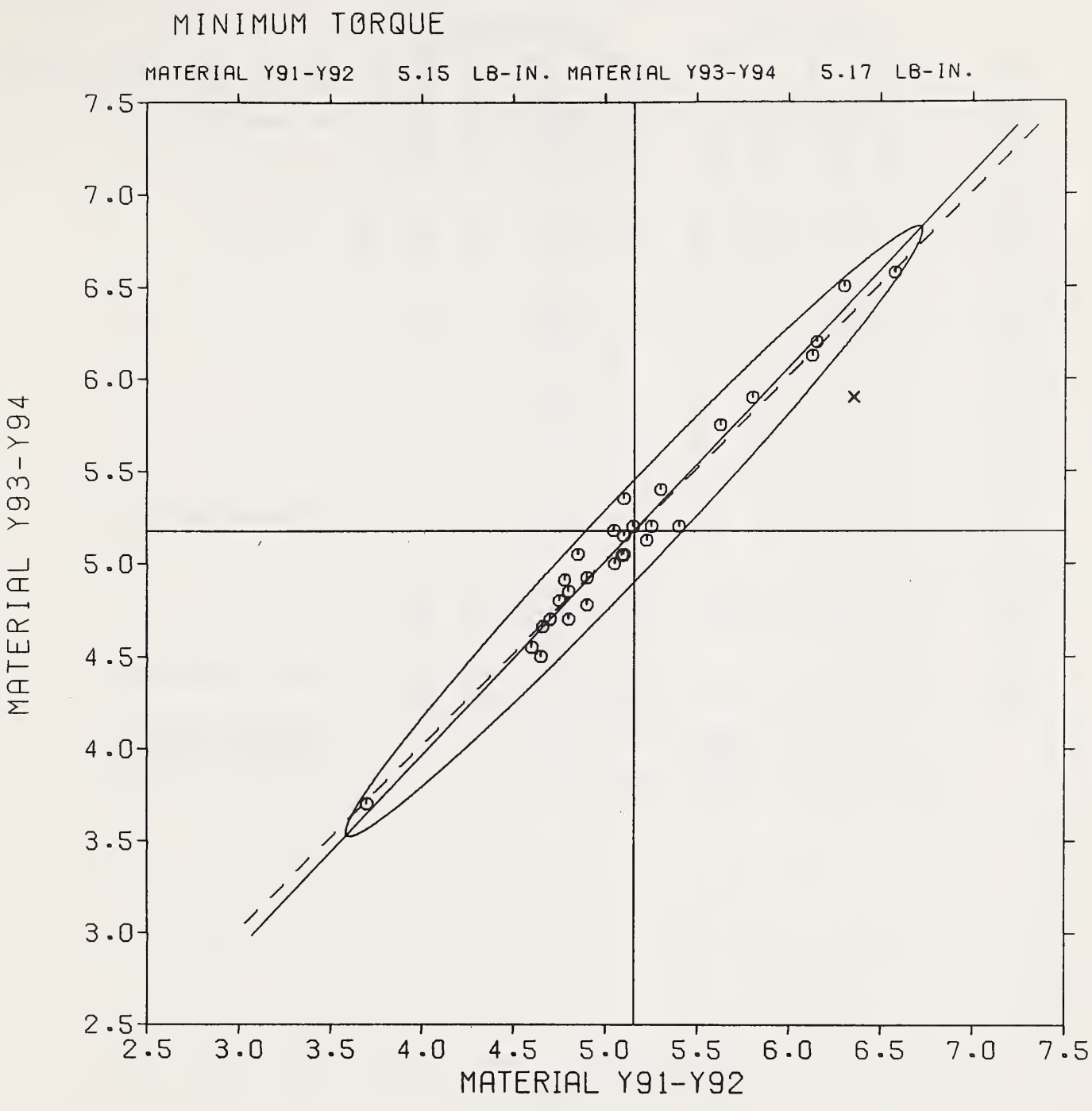
LAB CODE	F	MATERIAL Y91-Y92 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	MATERIAL Y93-Y94 COMMERCIAL TIRE TREAD MEAN MINUTE	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0064		10.40	3.9	.00	10.65	5.8	.00	01	
V0074		10.30	2.9	.00	10.27	2.1	.15	01	
V0077		9.07	-9.3	3.10X	9.52	-5.4	1.51	01	
V0079	*	8.99	-10.2	3.48X	9.81	-2.5	3.06X	01	
V0083		10.55	5.4	1.85	10.60	5.3	.84	01	
V0090		10.59	5.8	1.80	10.43	3.6	.32	01	
V0092		9.65	-3.6	.62	9.65	-4.1	1.37	01	
V0095		10.20	1.9	.62	10.05	-.1	.31	01	
V0100		10.00	-.1	.84	10.15	.8	1.34	01	
V0117		10.65	6.4	.82	10.40	3.3	.84	01	
V0120	X	22.75	99.9	9.69X	23.25	99.9	4.51X	*98	EXTREME TEST RESULTS
V0128		10.10	.9	.62	10.00	-.6	.61	01	
V0144		9.25	-7.5	.15	9.37	-6.9	.53	01	
V0146		10.10	.9	1.07	10.05	-.1	2.87X	01	
V0149		10.35	3.4	.31	10.40	3.3	.00	01	
V0150		10.40	3.9	3.04X	10.50	4.3	4.14X	01	
V0152		9.75	-2.6	.31	10.25	1.8	.61	01	
V0154		10.75	7.4	.31	10.65	5.8	.61	01	
V0156		9.67	-3.3	.46	9.67	-3.9	1.12	01	
V0158		9.40	-6.0	.00	9.25	-8.1	.00	01	
V0161		9.40	-6.0	.62	9.45	-6.1	.61	01	
V0166		10.00	-.1	1.13	10.05	-.1	.31	01	
V0169		10.30	2.9	1.46	10.15	.8	1.76	01	
V0182		9.77	-2.3	.71	9.95	-1.1	.86	01	
V0190		9.60	-4.1	.97	9.80	-2.6	.92	01	
V0207		10.95	9.4	1.13	11.10	10.3	1.91	01	
V0208		9.76	-2.4	1.49	9.97	-.9	3.46X	01	
V0211		10.10	.9	1.70	10.12	.6	1.07	01	
V0213	*	11.25	12.4	2.20	10.60	5.3	1.86	01	
V0217		9.75	-2.6	2.78X	9.97	-.9	1.47	01	
V0221		10.25	2.4	1.15	10.30	2.3	1.37	01	
V0238		9.25	-7.5	2.08	9.44	-6.2	2.51X	01	
V0243		9.60	-4.1	.59	9.46	-6.0	1.70	01	
		10.01	* GR. MEAN *		10.06				3 TEST DETERMINATIONS
		.55	* SD MEANS *		.44				32 LABORATORIES IN GRAND MEANS
		.09	* AVER SDR *		.09				33 LABORATORIES REPORTING
		MINUTE	* UNIT *		MINUTE				


CURE TIME (90% MH)
MATERIAL Y91-Y92 10.01 MINUTE MATERIAL Y93-Y94 10.06 MINUTE
MATERIAL Y93-Y94
MATERIAL Y91-Y92
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0

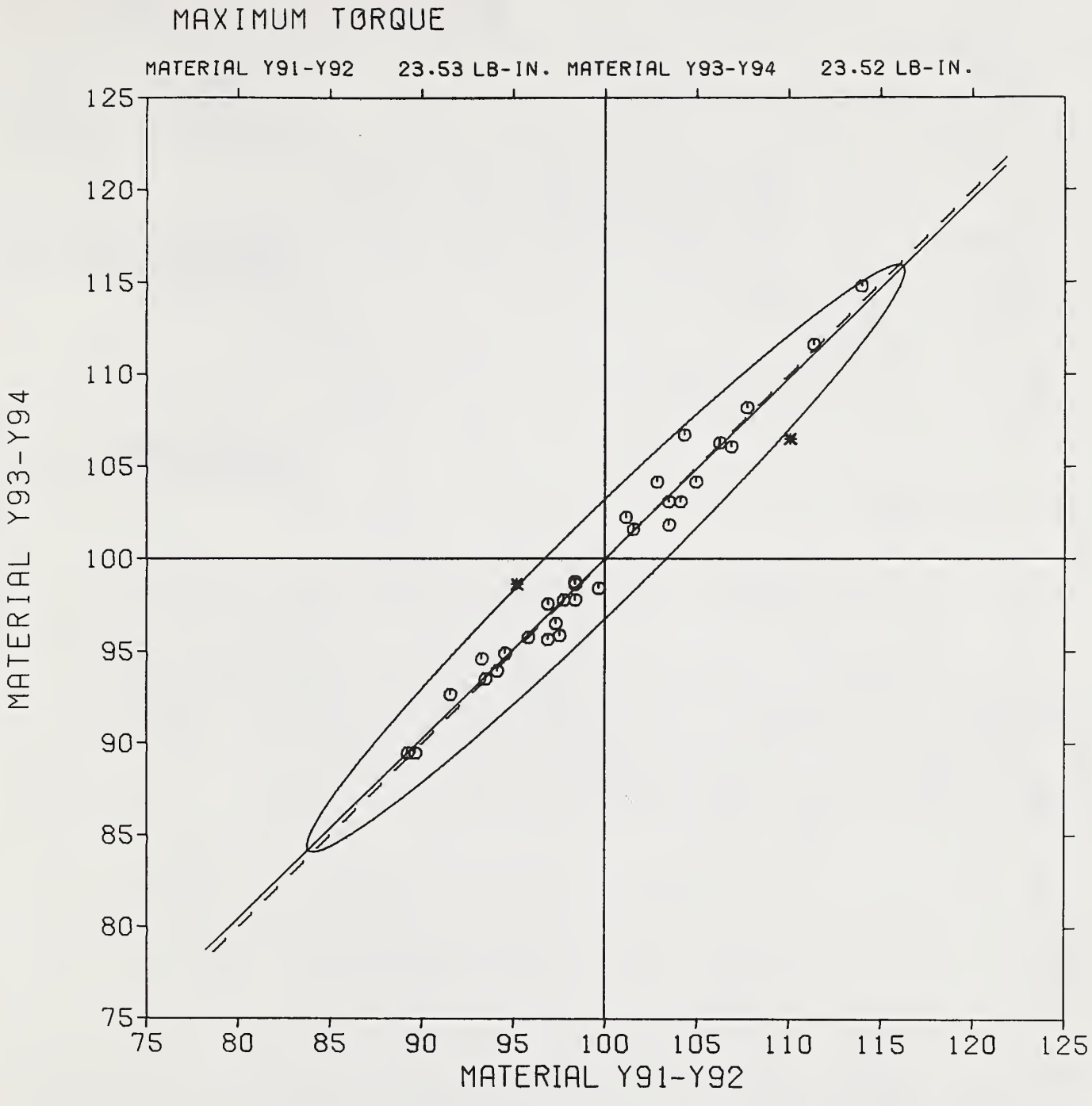
INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER

REPORT 41 - 5 MINIMUM TORQUE - POUND-INCHES AUGUST 1979

LAB CODE	F	MATERIAL Y91-Y92 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL Y93-Y94 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0064		5.30	.5988	2.8	.00	5.40	.6101	4.4	.00	01	
V0074		6.57	.7429	27.6	.23	6.57	.7429	27.1	.37	01	
V0077		4.90	.5537	-4.9	2.44X	4.92	.5565	-4.8	1.03	01	
V0079		4.85	.5480	-5.9	.46	5.05	.5706	-2.4	.00	01	
V0083		6.15	.6949	19.3	1.37	6.20	.7005	19.8	.00	01	
V0090		4.90	.5537	-4.9	1.05	4.77	.5395	-7.7	.69	01	
V0092		5.40	.6101	4.8	1.25	5.20	.5875	.5	.74	01	
V0095		4.80	.5424	-6.9	.79	4.70	.5311	-9.2	.74	01	
V0100		4.65	.5254	-9.8	.91	4.50	.5085	-13.0	.37	01	
V0117		4.80	.5424	-6.9	1.25	4.85	.5480	-6.3	1.01	01	
V0120	X	6.85	.7740	32.9	10.01X	7.50	.8474	44.9	8.00X	01	
V0128	X	7.65	.8870	52.3	.79	7.60	.8587	46.9	.00	*98	EXTREME TEST RESULTS
V0144		5.25	.5932	1.9	1.21	5.20	.5875	.5	2.26X	01	
V0146		5.15	.5819	-.1	1.37	5.20	.5875	.5	1.65	01	
V0149		5.22	.5904	1.4	.00	5.12	.5791	-1.0	.00	01	
V0150		6.30	.7118	22.2	3.63X	6.50	.7344	25.6	.00	01	
V0152		4.75	.5367	-7.8	.91	4.80	.5424	-7.2	.00	01	
V0154		5.10	.5762	-1.1	.46	5.15	.5819	-.5	.74	01	
V0156		5.80	.6553	12.5	.91	5.90	.6666	14.0	.74	01	
V0158		4.60	.5198	-10.8	.00	4.55	.5141	-12.1	.37	01	
V0161		5.05	.5706	-2.0	2.00	5.00	.5649	-3.4	.74	01	
V0166		3.70	.4181	-28.2	1.25	3.70	.4181	-28.5	1.28	01	
V0169		4.78	.5400	-7.3	1.21	4.91	.5550	-5.1	1.22	40	ORIGINAL IN NEWTON-METER
V0182		5.04	.5700	-2.1	.81	5.18	.5850	.0	1.22	41	ORIGINAL IN DECINEWTON-METER
V0190		4.70	.5311	-8.8	1.00	4.70	.5311	-9.2	.99	01	
V0207	X	8.45	.9548	63.9	1.25	8.35	.9435	61.4	.74	*98	EXTREME TEST RESULTS
V0208		4.66	.5265	-9.6	.82	4.66	.5265	-9.9	.00	01	
V0211	X	6.35	.7175	23.2	3.19X	5.90	.6666	14.0	1.48	01	
V0213		6.12	.6921	18.8	.00	6.12	.6921	18.4	1.11	01	
V0217		5.10	.5762	-1.1	.91	5.05	.5706	-2.4	2.79X	01	
V0221		5.09	.5750	-1.3	.81	5.04	.5700	-2.5	1.83	40	ORIGINAL IN NEWTON-METER
V0238		5.62	.6356	9.1	1.14	5.75	.6497	11.1	1.85	01	
V0243		5.10	.5762	-1.1	.91	5.35	.6045	3.4	1.33	01	
		5.15	.5824	= GR. MEAN =		5.17	.5847			3	TEST DETERMINATIONS
		.60	.0673	= SD MEANS =		.63	.0707			29	LABORATORIES IN GRAND MEANS
		.06	.0072	= AVER SDR =		.08	.0088			33	LABORATORIES REPORTING
		LB-IN.	N-M	= UNIT =		LB-IN.	N-M				


MINIMUM TORQUE
MATERIAL Y91-Y92 5.15 LB-IN. MATERIAL Y93-Y94 5.17 LB-IN.
MATERIAL Y93-Y94
MATERIAL Y91-Y92
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5

LAB CODE	F	MATERIAL Y91-Y92 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MATERIAL Y93-Y94 COMMERCIAL TIRE TREAD MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
V0064		22.80	2.5762	-3.1	.00	22.95	2.5931	-2.4	.00	01	
V0074		23.87	2.6976	1.5	.18	23.91	2.7022	1.7	.48	+70	DATA RECEIVED LATE
V0077		22.95	2.5931	-2.5	1.54	22.55	2.5479	-4.1	1.04	01	
V0079		21.95	2.4801	-6.7	1.67	22.25	2.5140	-5.4	.85	01	
V0083		25.00	2.8248	6.2	1.82	25.00	2.8248	6.3	.57	01	
V0090		23.45	2.6496	-.4	1.21	23.15	2.6157	-1.6	.39	01	
V0092		25.15	2.8417	6.9	.64	24.95	2.8191	6.1	1.04	01	
V0095		21.55	2.4349	-8.4	.77	21.80	2.4632	-7.3	1.24	01	
V0100		23.80	2.6892	1.1	1.41	24.05	2.7174	2.2	.28	01	
V0117		22.00	2.4858	-6.5	.00	22.00	2.4858	-6.5	.57	01	
V0120		24.55	2.7739	4.3	6.22X	25.10	2.8360	6.7	4.81X	01	
V0128		24.70	2.7909	5.0	.77	24.50	2.7683	4.1	.28	01	
V0144		24.50	2.7683	4.1	1.08	24.25	2.7400	3.1	2.27	01	
V0146		22.80	2.5762	-3.1	1.16	22.50	2.5423	-4.4	1.71	01	
V0149		22.55	2.5479	-4.2	.55	22.52	2.5451	-4.2	.00	01	
V0150		24.35	2.7513	3.5	.88	24.25	2.7400	3.1	1.71	01	
V0152		22.15	2.5027	-5.9	.35	22.10	2.4971	-6.1	.00	01	
V0154		23.15	2.6157	-1.6	.35	23.20	2.6214	-1.4	.57	01	
V0156		24.20	2.7344	2.8	.53	24.50	2.7683	4.1	.78	01	
V0158		23.15	2.6157	-1.6	.47	23.00	2.5988	-2.2	.28	01	
V0161		21.10	2.3841	-10.3	.35	21.05	2.3784	-10.5	.57	01	
V0166		21.00	2.3728	-10.8	1.06	21.05	2.3784	-10.5	.57	01	
V0169		23.14	2.6151	-1.7	1.39	23.23	2.6251	-1.2	2.00	41	ORIGINAL IN DECINEWTON-METER
V0182		25.35	2.8643	7.7	.99	25.45	2.8756	8.2	1.24	01	
V0190		22.25	2.5140	-5.5	.72	22.32	2.5225	-5.1	.25	01	
V0207		26.20	2.9603	11.3	1.61	26.25	2.9660	11.6	2.09	01	
V0208		26.81	3.0298	13.9	1.30	27.00	3.0507	14.8	2.64X	01	
V0211	*	25.90	2.9264	10.1	1.71	25.05	2.8304	6.5	.85	01	
V0213		24.35	2.7513	3.5	.84	23.95	2.7061	1.8	1.09	01	
V0217		22.90	2.5875	-2.7	.30	22.70	2.5649	-3.5	3.70X	01	
V0221		23.90	2.7001	1.5	.82	23.90	2.7001	1.6	.75	40	ORIGINAL IN NEWTON-METER
V0238		23.00	2.5988	-2.3	1.76	23.00	2.5988	-2.2	.00	01	
V0243	*	22.40	2.5310	-4.8	.93	23.20	2.6214	-1.4	2.00	01	
		23.53	2.6590	= GR. MEAN =		23.52	2.6580				3 TEST DETERMINATIONS
		1.46	.1653	= SD MEANS =		1.43	.1616				32 LABORATORIES IN GRAND MEANS
		.16	.0185	= AVER SDR =		.10	.0115				33 LABORATORIES REPORTING
		LB-IN.	N-M	= UNIT =		LB-IN.	N-M				


MAXIMUM TORQUE
MATERIAL Y91-Y92 23.53 LB-IN. MATERIAL Y93-Y94 23.52 LB-IN.
MATERIAL Y93-Y94
MATERIAL Y91-Y92
125
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NBS-114A (REV. 9-78)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. RUBBER CRP 41	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

INTERLABORATORY PROGRAMS FOR RUBBER
Analyses No. 41
July - September 1979

5. Publication Date
September 27, 1979

6. Performing Organization Code

7. AUTHOR(S)
T. L. Cummings, J. Horlick, G. W. Bullman

8. Performing Organ. Report No.
NBSIR 79-1811

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, DC 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

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

Collaborative Reference Programs provide participating laboratories with the means for checking periodically the level and uniformity of their testing in comparison with that of other participating laboratories. An important by-product of the programs is the provision of realistic pictures of the state of the testing art. This is one of the periodic reports showing averages for each participant, within and between laboratory variability, and other information for participants and standards committees.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Collaborative reference program; 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, DC 20402, SD Stock No. SN003-003-

☐ Order From National Technical Information Service (NTIS), Springfield, VA. 22161

19. SECURITY CLASS (THIS REPORT)	21. NO. OF PRINTED PAGES
UNCLASSIFIED	27
20. SECURITY CLASS (THIS PAGE)	**22. Price**
UNCLASSIFIED	

USCOMM-DC