

**CEMENT AND CONCRETE REFERENCE LABORATORY**  
**PROFICIENCY SAMPLE PROGRAM**

**Final Report**  
**Blended Cement Proficiency Samples**  
**Number 59 and Number 60**

May 2007

# CEMENT AND CONCRETE REFERENCE LABORATORY

AT THE  
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY  
GAITHERSBURG, MARYLAND 20899  
(301) 975-6704

SPONSORED BY  
COMMITTEE C-1 ON CEMENT  
COMMITTEE C-9 ON CONCRETE AND  
CONCRETE AGGREGATES  
AMERICAN SOCIETY FOR TESTING AND MATERIALS

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May 18, 2007

**To: Participants in the CCRL Blended Cement Proficiency Sample Program**

**SUBJECT: Final Report on Blended Cement Proficiency Samples No. 59 and No. 60**

Following is the final report for the current pair of CCRL **Blended Cement** Proficiency Samples which were distributed in February 2007. Both cements were an ASTM C595 Blended Hydraulic Cement. Sample No 59 and No. 60 were a Type IS. Blended Cement No. 50 contained approximately 40% slag and Blended Cement No. 60 contained approximately 50% slag.

This report consists of a statistical Summary of Results, a set of general Scatter Diagrams, and associated detailed information. The Table of Results with individualized information for participating laboratories can be downloaded at our website located at: <http://ccrl.us/>.

**Sulfur Trioxide (SO<sub>3</sub>) determination** - The sulfur trioxide determinations for this pair of samples exhibit two distinct groups of data. The "SO<sub>3</sub> high" group of data may contain total sulfur test results and not just SO<sub>3</sub> results.

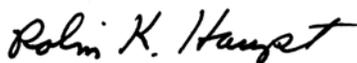
This pair of cements contains slag which contain SO<sub>3</sub> and sulfide sulfur. ASTM C595 has chemical requirements for both SO<sub>3</sub> and sulfide sulfur for cements containing slag, therefore both of these components should have been determined. As described in section 4.1.2 of C114 most instrumental methods determine total sulfur which includes SO<sub>3</sub> and sulfide sulfur. It is recommended that you review your analysis of sulfur to ensure that the SO<sub>3</sub> reported value does not include and sulfide sulfur. Individual laboratory ratings for sulfur trioxide have been suppressed for this pair of samples.

The CCRL Proficiency Sample Programs are intended for internal use by the laboratory as a tool to identify potential problems in laboratory procedures or test equipment and to initiate remedial actions. These programs are designed to complement the CCRL Laboratory Inspection Program as part of a total quality system. Care should be taken when using this program for any other purpose.

**Additional samples of these two cements and other CCRL samples are available for purchase.** These samples may be useful for equipment verification, technician training, and research. Contact CCRL for availability and price.

It is presently anticipated that the next Blended Cement Proficiency Samples will be distributed in February 2008.

Sincerely,



Robin K. Haupt  
Supervisor, Proficiency Sample Programs  
Cement and Concrete Reference Laboratory

Enclosure

**TO: Participants in the CCRL Blended Cement Proficiency Sample Program**

**FROM: Robin K. Haupt, Supervisor, PSP**

**SUBJECT: Explanation of Final Report on Results of Tests for Blended Cement Proficiency Samples No. 59 and No. 60**

This letter, and the material included with it, constitute a portion of the final report for the current pair of Blended Cement Proficiency Samples distributed in February 2007. This material includes a statistical Summary of Results, and a set of general Scatter Diagrams. If your laboratory was a participant in this program a Table of Laboratory Results (lab ratings) for your laboratory data can be viewed and printed on the CCRL website

An explanation of the program is contained in the paper: "Statistical Evaluation of Interlaboratory Cement Tests" by J. R. Crandall and R. L. Blaine [View document](#), and "Statistical Aspects of the Cement Testing Program" by W.J. Youden [View document](#), which can be found in Volume 59, Proceedings of the 62<sup>nd</sup> Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.

### **Table of Laboratory Results**

Each laboratory receives an individualized Table of Laboratory Results. Your unique laboratory number is displayed at the top of the Table of Laboratory Results. This table shows the, test title, and the reporting unit in the first two columns. After that it lists in order, the laboratory's results for the odd and even numbered samples, overall averages for the odd and even numbered samples, and the laboratory's ratings for the odd and even samples.

Laboratory ratings, shown in the Table of Results for the individual laboratory, were determined in the manner described by Crandall and Blaine using a rating scale of 1 to 5 instead of 0 to 4. The ratings have no valid standing beyond showing the difference between the individual laboratory result and the average for a particular test.

The following table details the relationship between the ratings and the averages.

<b>Ratings</b>	<b>Range (Number of Standard Deviations)</b>	<b>Number (Per 100) of Laboratories achieving the rating <sup>1</sup></b>
5	Less than 1	69
4	1 to 1.5	18
3	1.5 to 2	9
2	2 to 2.5	3
1	Greater than 2.5	1

The sign of the rating merely shows whether the result reported was greater or less than the average obtained.

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<sup>1</sup>Youden, W.J., "Statistical Aspects of the Cement Testing Program", Volume 59, *Proceedings of the 62<sup>nd</sup> Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.*

Participants subscribing to the chemical analysis portion of this report should note that the statistics were calculated using data obtained by wet methods, and rapid methods of chemical analysis.

Please note that individual laboratory ratings were not given for the flow of air content mortar (test no. 190) and compressive strength mortar (test no. 230). Air content flows in the range of  $87.5 \pm 7.5$  are satisfactory. Similarly, the compressive strength flows in the range of  $110 \pm 5$  are satisfactory. Labs with flow values outside these ranges will be flagged as a "Labs Eliminated" on the scatter diagram. Averages, standard deviations, and a scatter diagram are provided for your information. This information may be a helpful indicator of a problem with flow table apparatus or mortar mixing procedures. Flow values of 151 were assigned to laboratories reporting a mortar flow off the flow table top.

In cases where some laboratories' results are eliminated, averages, standard deviations, coefficients of variation, and the ratings of the other laboratories' results, are recalculated using the data remaining after the elimination. Since the laboratory ratings given are the results from this one series of tests, you need not attach too much significance to a single low rating, or pair of ratings, from this one series. A continuing tendency to get low ratings on several pairs of samples should lead a laboratory to consider the types of error, systematic and random, contribute to ratings that are low. Systematic error, which is indicated by low ratings with the same signs on each pair of samples, means a consistent error is occurring in equipment and/or test procedures. One indication of random error is low ratings on both samples with different signs. Since systematic error occurs with more regularity, its cause is generally easier to find than the cause of random error.

### **Summary of Results - General**

The Summary of Results provide the statistical summary for each test. Each line lists the test, the number of participants represented, the averages, standard deviations and coefficients of variations. When necessary the data from the test is represented in two lines, one line with all results reported, and then a second line with outlying results omitted. Sometimes two or more recalculations are required to eliminate all outliers from the test. In these cases, all of the laboratories omitted in previous recalculations are also omitted in subsequent ones. Results omitted are values that are more than three standard deviations from the mean of one or both samples. Often, elimination of these outlying results has little effect on the average, but may have a more pronounced effect on the standard deviation and coefficient of variation.

### **Scatter Diagrams**

General scatter diagrams are supplied with this report. Crandall and Blaine describe the manner of preparing scatter diagrams, and their interpretation, in the paper published in the 1959 ASTM Proceedings.

Using the results received from each laboratory, a scatter diagram is generated for each test method by plotting the value for the odd numbered samples on the X, or horizontal axis, against the value for the even numbered samples on the Y, or vertical axis. Vertical and horizontal dashed lines, which divide the diagrams into four sections or quadrants, place the average values for the odd and even numbered samples, respectively. The first line of print under the diagram includes the test number, as given on the data sheet, the test title, and the number of data points on the diagrams. The number of plotted points may not agree with the total number of data pairs included in the analysis because a few points may be off the diagram, and some points may represent several data pairs, which are identical. Laboratories whose points are off the diagram will have a rating of  $\pm 1$  for that particular test.

As described in Crandall and Blaine, a tight circular pattern of points around the intersection of the median lines is the ideal situation. Stretching out of the pattern into the first (upper right) and third (lower left) quadrants, suggests some kind of bias, or tendency for laboratories to get high or low results on both samples. Examination of the scatter diagrams indicates strong evidence of bias on many tests.

CCRL PROFICIENCY SAMPLE PROGRAM  
Blended Cement Proficiency Samples No. 59 and No. 60  
Final Report - Chemical Results  
May 18, 2007

SUMMARY OF RESULTS

Test		#Labs	Sample No. 59			Sample No. 60		
			Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide	prcnt	82	24.89	1.1	4.47	28.78	1.8	6.31
Silicon Dioxide	prcnt *	78	24.96	0.64	2.58	29.12	0.90	3.09
Aluminum Oxide	prcnt	78	7.26	0.37	5.14	8.48	0.45	5.36
Aluminum Oxide	prcnt *	74	7.27	0.27	3.73	8.55	0.34	3.97
Ferric Oxide	prcnt	81	2.31	0.26	11.3	1.84	0.25	13.4
Ferric Oxide	prcnt *	78	2.28	0.10	4.51	1.80	0.12	6.82
Calcium Oxide	prcnt	79	53.75	1.8	3.36	50.44	2.8	5.65
Calcium Oxide	prcnt *	75	53.73	0.78	1.45	50.27	1.03	2.06
Magnesium Oxide	prcnt	80	5.03	0.49	9.77	5.89	0.65	10.98
Magnesium Oxide	prcnt *	73	5.05	0.22	4.29	5.93	0.24	3.99
Sulfur Trioxide	prcnt	80	3.11	0.47	15.3	1.64	0.62	37.9
SO3 Low	prcnt	32	2.65	0.26	9.68	1.00	0.22	22.27
SO3 High	prcnt	48	3.41	0.31	9.18	2.07	0.39	19.12
Loss on Ignition	prcnt	78	1.73	0.42	24.6	0.90	0.49	54.6
Sodium Oxide	prcnt	73	0.247	0.10	40.9	0.398	0.11	28.2
Sodium Oxide	prcnt *	66	0.240	0.038	15.9	0.390	0.057	14.6
Potassium Oxide	prcnt	75	0.67	0.050	7.48	0.37	0.065	17.73
Potassium Oxide	prcnt *	73	0.67	0.034	5.03	0.37	0.049	13.25

\* ELIMINATED LABS: Data over three S.D. from the mean

Silicon Dioxide	38 47 176 375
Aluminum Oxide	176 2 38 246
Ferric Oxide	30 176 2116
Calcium Oxide	2 176 205 375
Magnesium Oxide	2 918 2116 2466 20 176 2476
Sodium Oxide	2 181 1373 1799 30 176 2463
Potassium Oxide	28 176

CCRL PROFICIENCY SAMPLE PROGRAM  
 Blended Cement Proficiency Samples No. 59 and No. 60  
 Final Report - Chemical Results  
 May 18, 2007

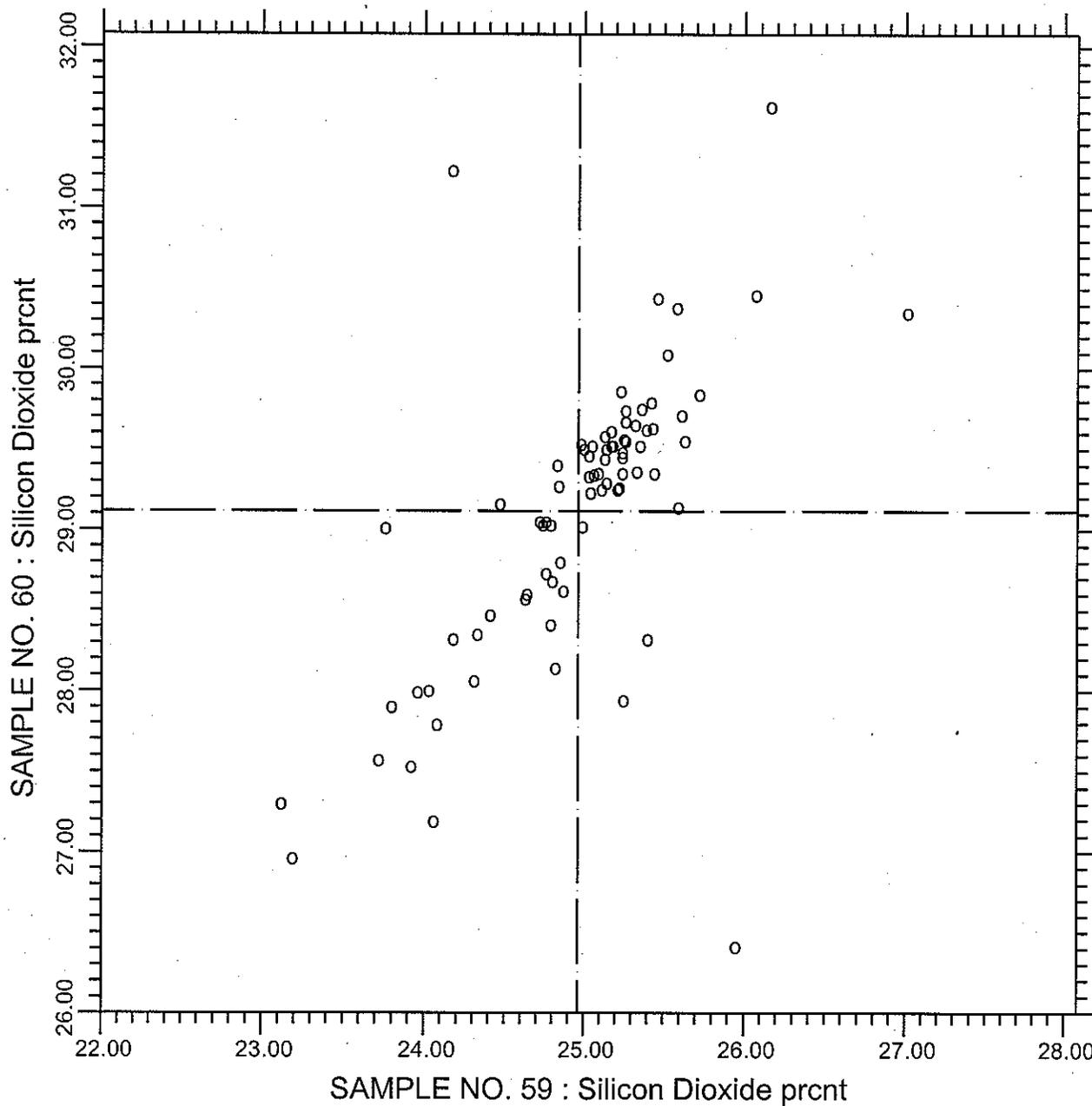
SUMMARY OF RESULTS

		Sample No. 59				Sample No. 60		
Test	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.	
Titanium Dioxide	prcnt 57	0.47	0.024	5.15	0.51	0.029	5.69	
Titanium Dioxide	prcnt * 55	0.46	0.018	4.02	0.51	0.027	5.22	
Phosphorus Pent	prcnt 53	0.081	0.012	15.3	0.057	0.015	26.8	
Phosphorus Pent	prcnt * 51	0.081	0.0099	12.1	0.056	0.0095	16.9	
Zinc Oxide	prcnt 22	0.045	0.0082	18.3	0.013	0.0033	25.6	
Zinc Oxide	prcnt * 20	0.047	0.0037	7.79	0.013	0.0026	20.12	
Manganic Oxide	prcnt 40	0.229	0.019	8.30	0.209	0.018	8.43	
Manganic Oxide	prcnt * 39	0.230	0.017	7.21	0.209	0.018	8.54	
Sulfide Sulfur	prcnt 27	0.893	1.00	112.2	0.741	0.51	69.2	
Sulfide Sulfur	prcnt * 19	0.396	0.080	20.2	0.503	0.075	14.9	
Chloride	prcnt 27	0.021	0.018	85.8	0.139	0.084	61.0	
Chloride	prcnt * 25	0.016	0.0066	40.6	0.126	0.0454	36.1	
Insoluble Residue	prcnt 72	0.32	0.19	59.2	0.31	0.17	55.8	
Insoluble Residue	prcnt * 63	0.28	0.073	26.4	0.26	0.065	24.8	
Chromium Oxide	prcnt 23	0.028	0.033	119	0.017	0.034	203	
Chromium Oxide	prcnt * 20	0.019	0.0046	23.8	0.007	0.0064	88.8	

\* ELIMINATED LABS: Data over three S.D. from the mean

Titanium Dioxide	176 1940
Phosphorous Pentoxide	1379 2463
Zinc Oxide	30 92
Manganic Oxide	2463
Sulfide Sulfur	80 246 698 2462 25 11 690 2463
Chloride	92 413
Insoluble Residue	870 2116 918 1379 1799 2466 605 695 2476
Chromium Oxide	19 40 2465

CCRL PROFICIENCY SAMPLE PROGRAM  
 Silicon Dioxide  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.10

Silicon Dioxide

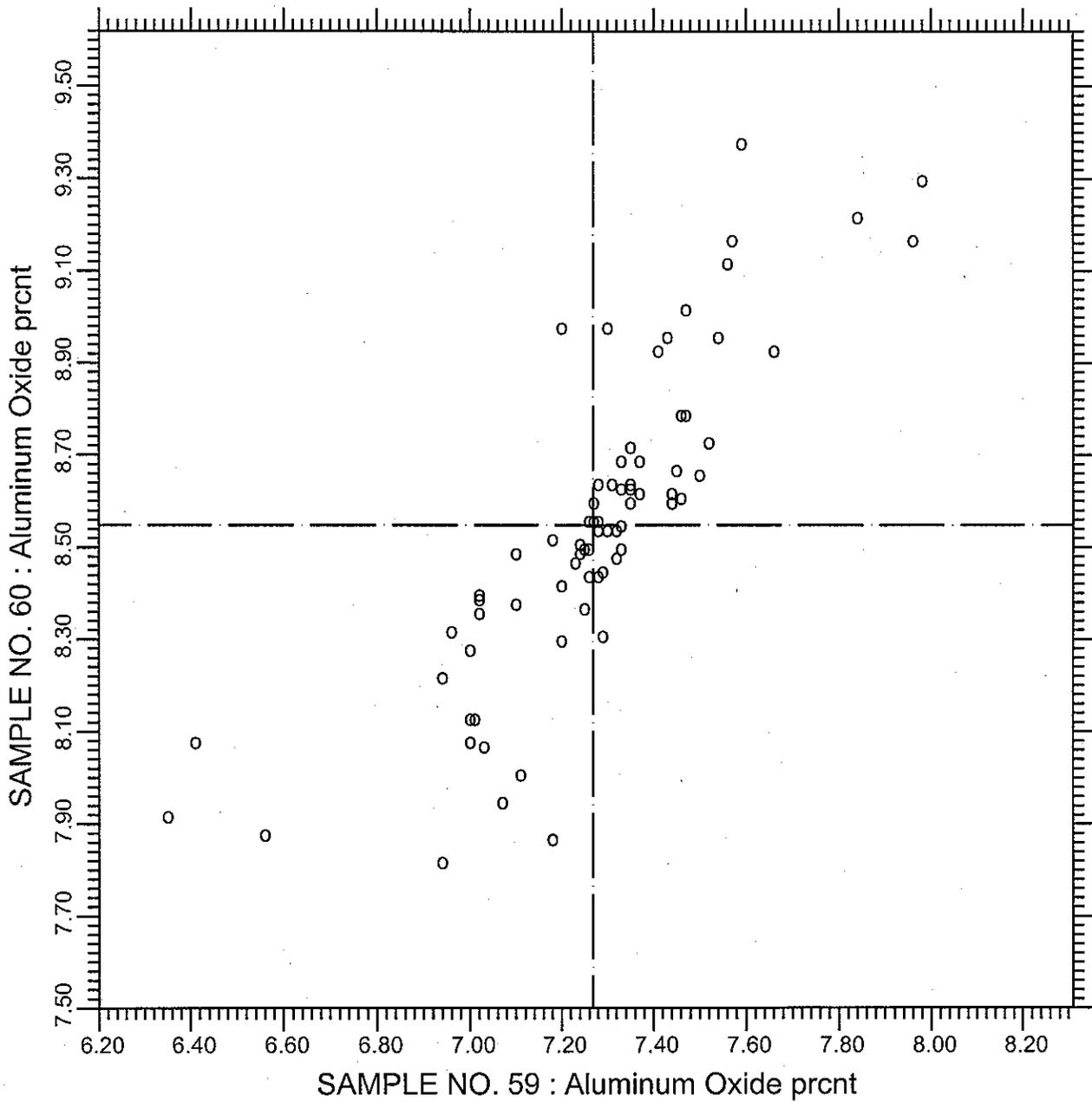
78 POINTS

SAMPLE NO. 59    AVE 24.964    S.D. 0.64    C.V. 2.58

SAMPLE NO. 60    AVE 29.116    S.D. 0.90    C.V. 3.09

LABS ELIMINATED 38 47 176 375

CCRL PROFICIENCY SAMPLE PROGRAM  
 Aluminum Oxide - wo/minor oxides  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.21

Aluminum Oxide

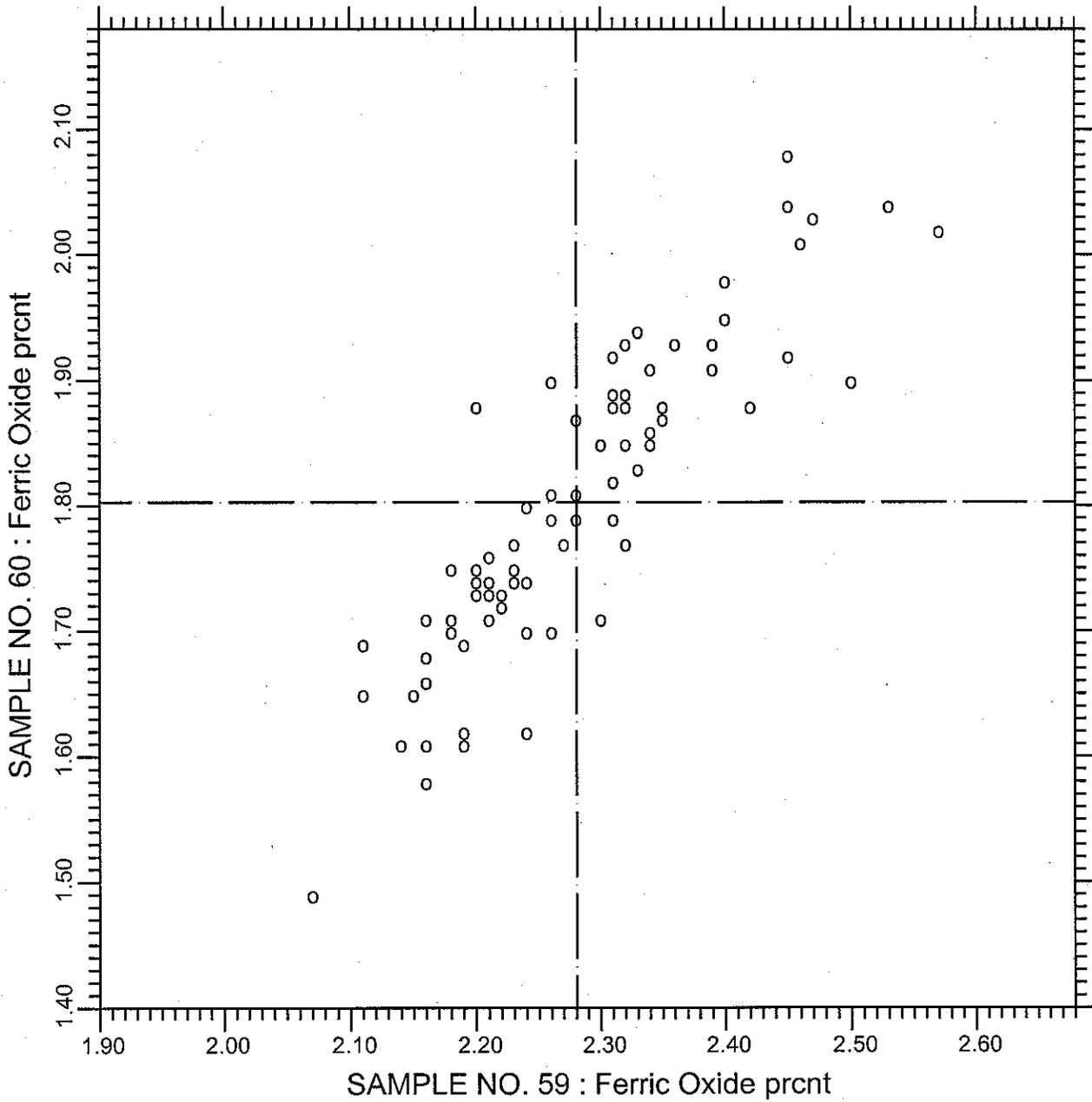
74 POINTS

SAMPLE NO. 59 AVE 7.269 S.D. 0.27 C.V. 3.73

SAMPLE NO. 60 AVE 8.548 S.D. 0.34 C.V. 3.97

LABS ELIMINATED 176 2 38 246

CCRL PROFICIENCY SAMPLE PROGRAM  
 Ferric Oxide  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.30

Ferric Oxide

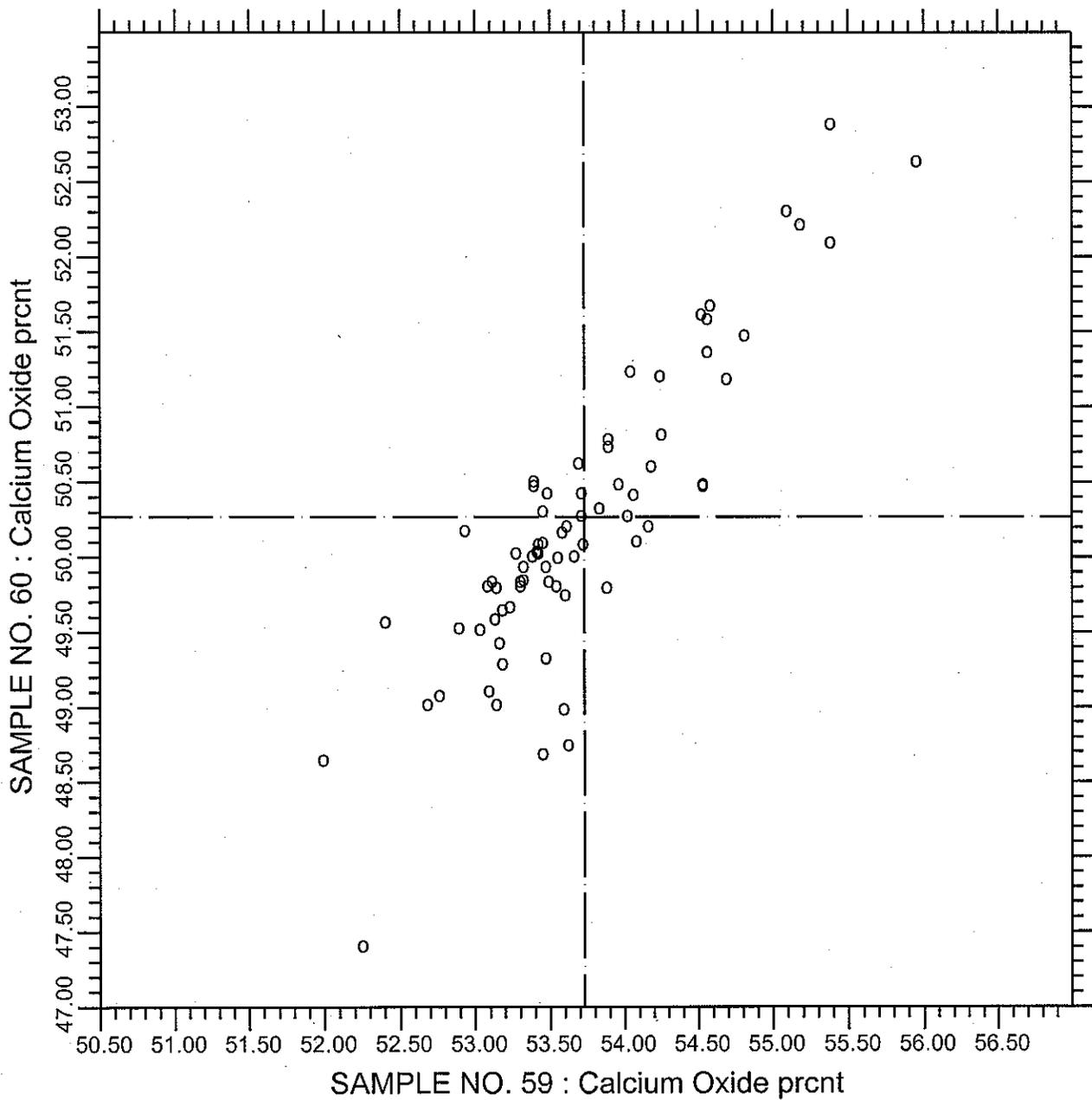
78 POINTS

SAMPLE NO. 59 AVE 2.280 S.D. 0.10 C.V. 4.51

SAMPLE NO. 60 AVE 1.803 S.D. 0.12 C.V. 6.82

LABS ELIMINATED 30 176 2116

CCRL PROFICIENCY SAMPLE PROGRAM  
 Calcium Oxide  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.40

Calcium Oxide

74 POINTS

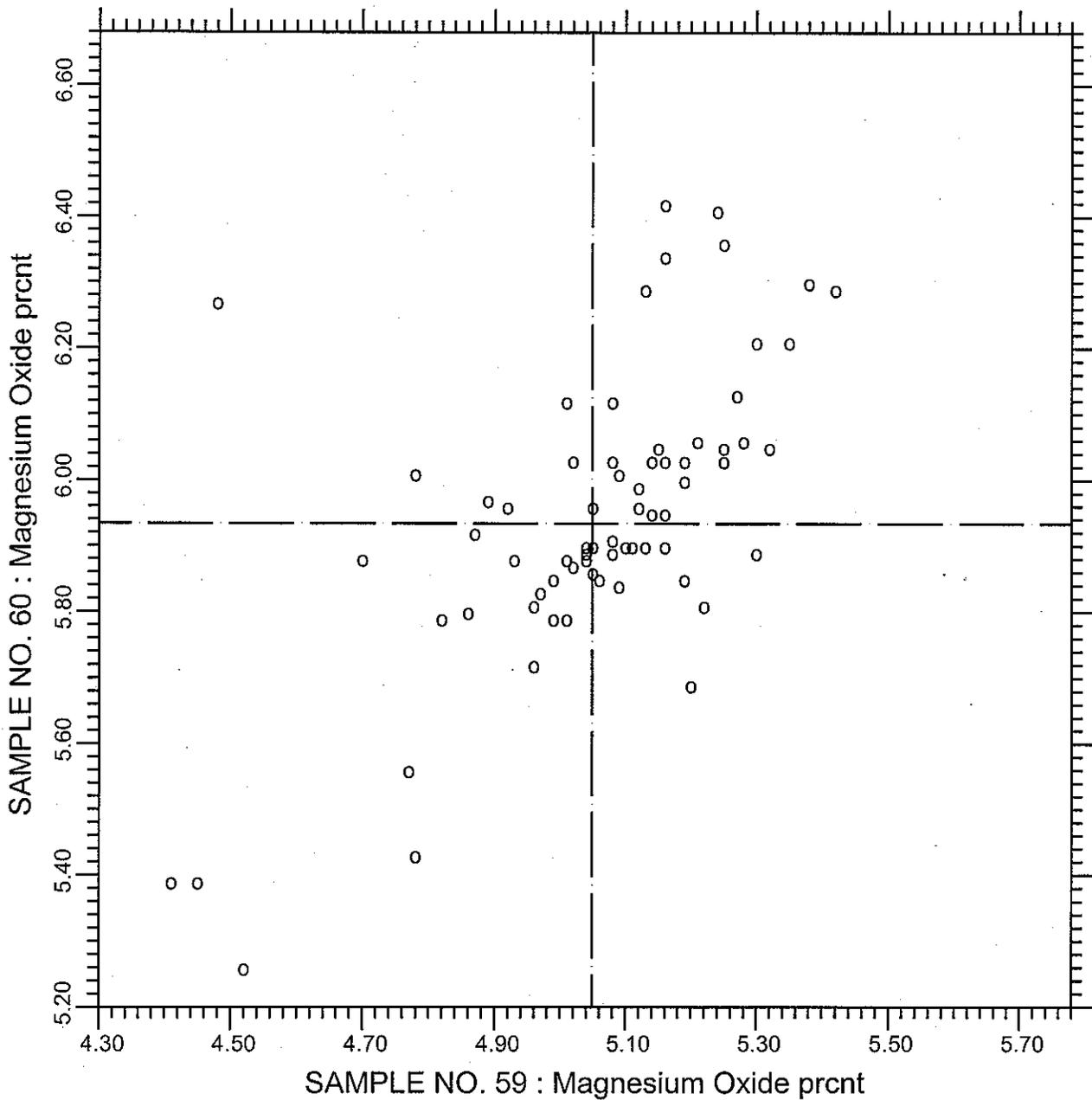
SAMPLE NO. 59 AVE 53.729 S.D. 0.78 C.V. 1.45

SAMPLE NO. 60 AVE 50.268 S.D. 1.03 C.V. 2.06

LABS ELIMINATED 2 176 205 375

LABS OFF DIAGRAM 1940

CCRL PROFICIENCY SAMPLE PROGRAM  
 Magnesium Oxide  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.50

Magnesium Oxide

72 POINTS

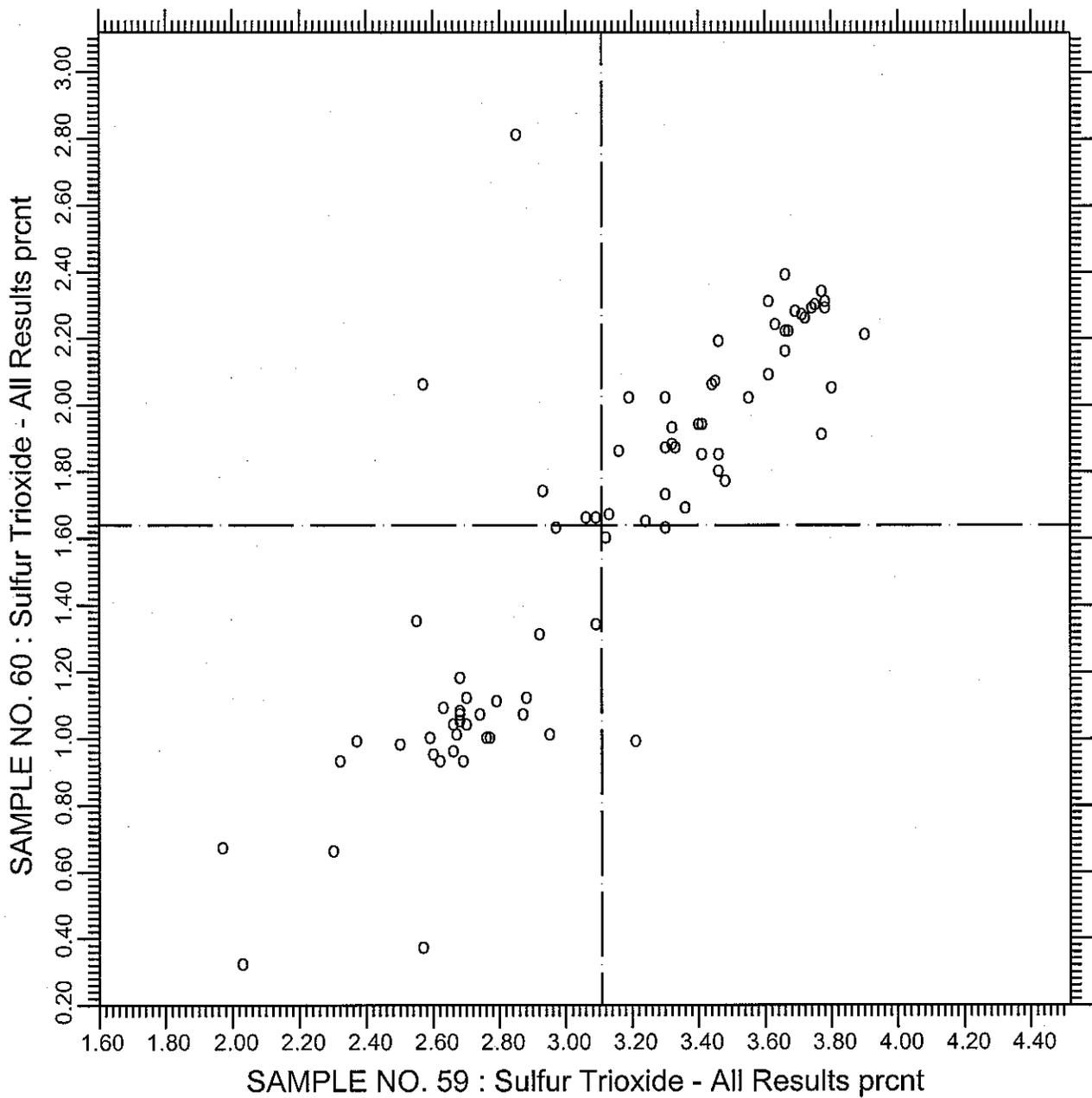
SAMPLE NO. 59 AVE 5.049 S.D. 0.22 C.V. 4.29

SAMPLE NO. 60 AVE 5.934 S.D. 0.24 C.V. 3.99

LABS ELIMINATED 2 918 2116 2466 20 176 2476

LABS OFF DIAGRAM 201

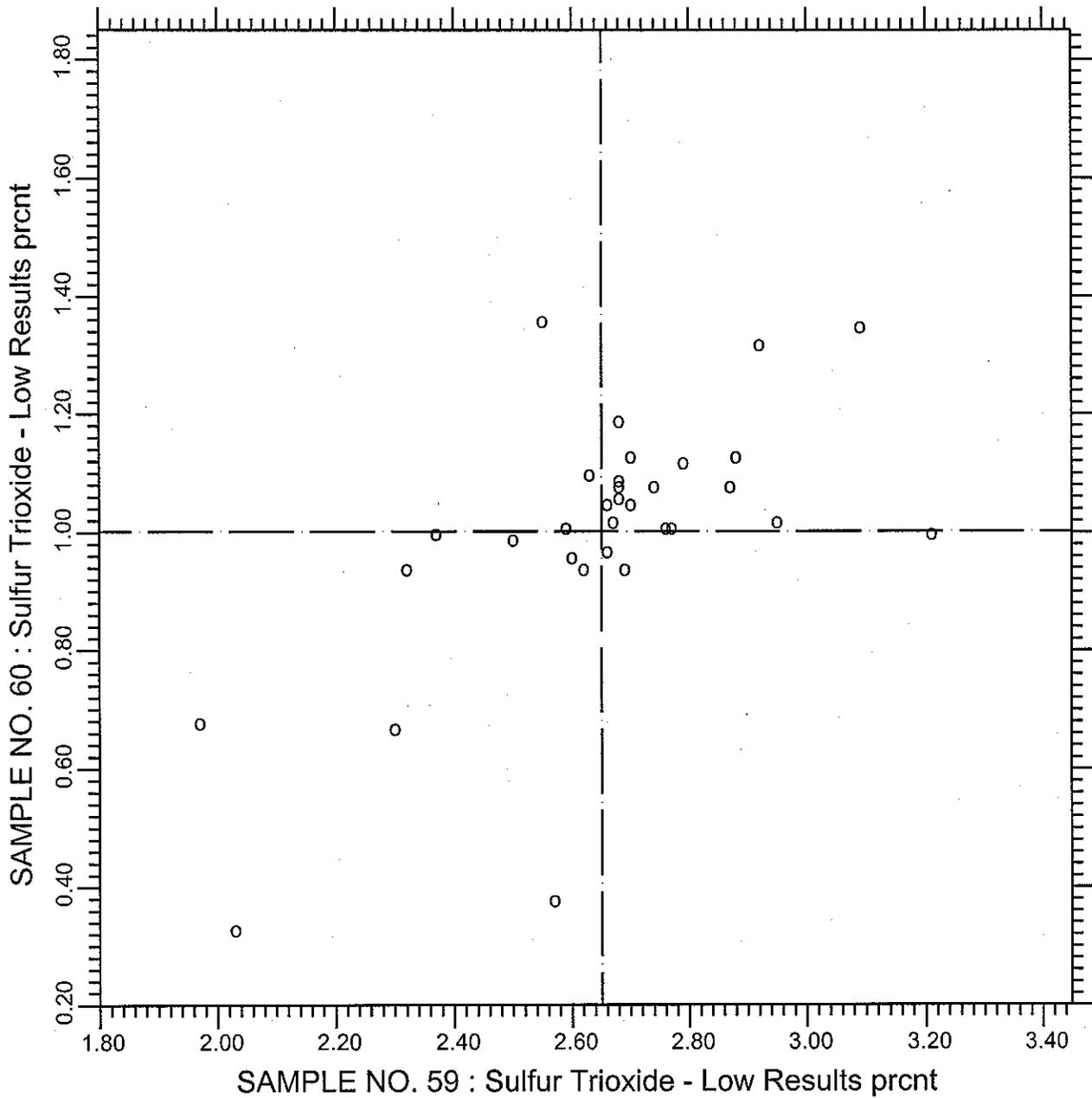
CCRL PROFICIENCY SAMPLE PROGRAM  
 Sulfur Trioxide - All Results  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.60      Sulfur Trioxide - All Results      79 POINTS

SAMPLE NO. 59	AVE	3.108	S.D.	0.47	C.V.	15.3
SAMPLE NO. 60	AVE	1.640	S.D.	0.62	C.V.	37.9

CCRL PROFICIENCY SAMPLE PROGRAM  
 Sulfur Trioxide - Low Range  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60

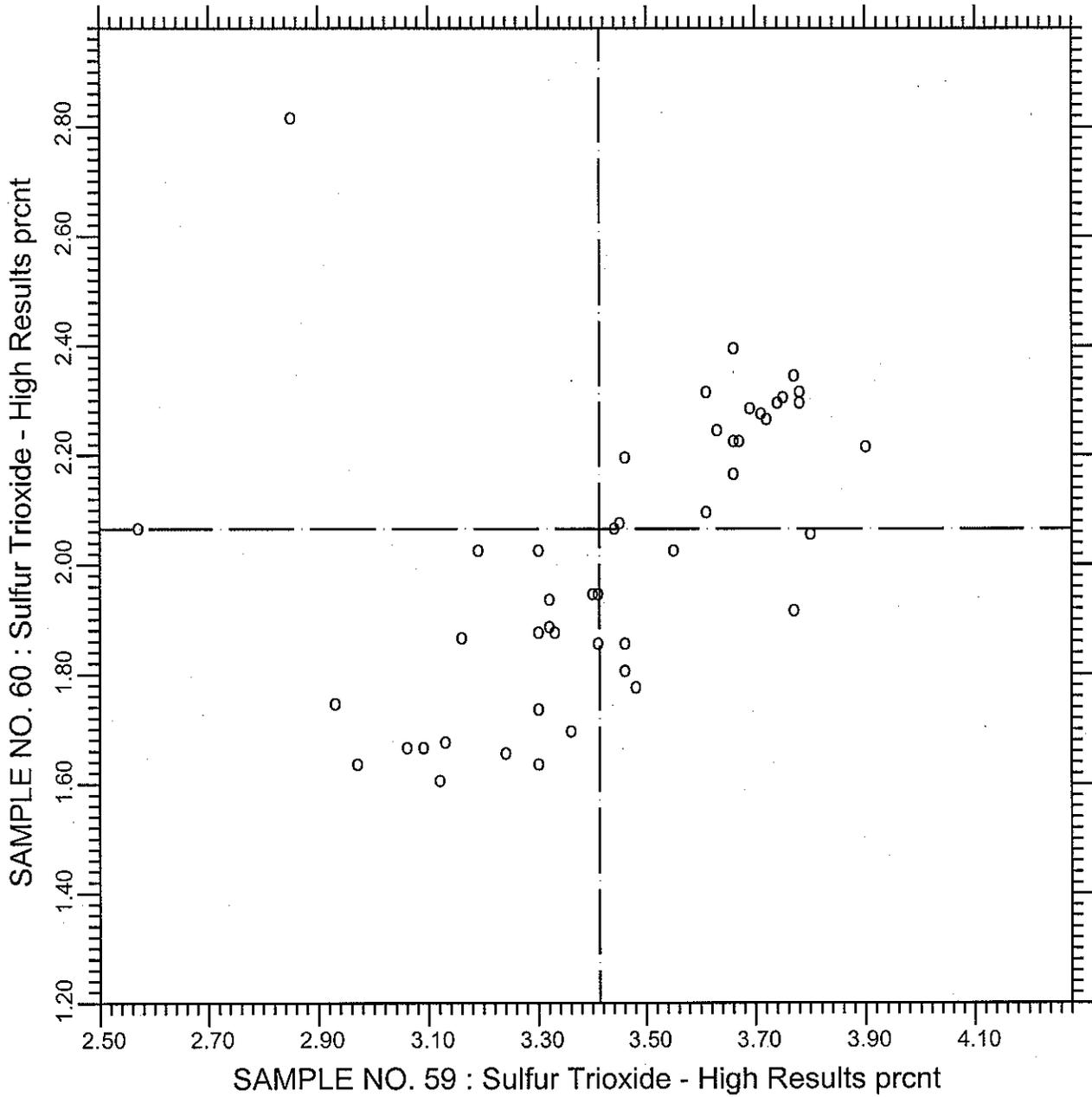


TEST NO.61      Sulfur Trioxide - Low Results      32 POINTS

SAMPLE NO. 59    AVE 2.651    S.D. 0.26    C.V. 9.68

SAMPLE NO. 60    AVE 1.002    S.D. 0.22    C.V. 22.27

CCRL PROFICIENCY SAMPLE PROGRAM  
 Sulfur Trioxide - High Range  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



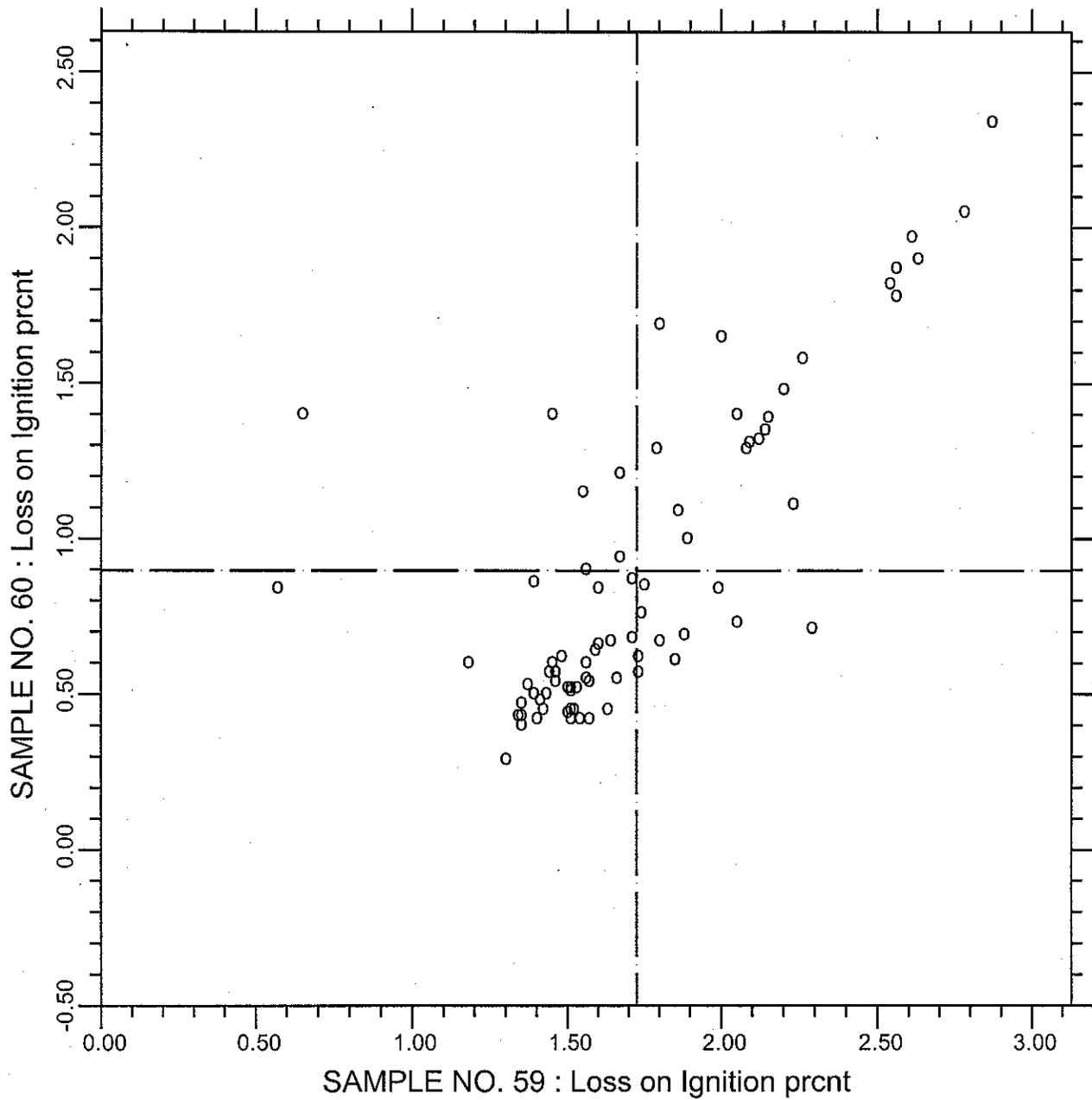
TEST NO.62      Sulfur Trioxide - High Results      47 POINTS

SAMPLE NO. 59    AVE 3.413    S.D. 0.31    C.V. 9.18

SAMPLE NO. 60    AVE 2.066    S.D. 0.39    C.V. 19.12

LABS OFF DIAGRAM 176

CCRL PROFICIENCY SAMPLE PROGRAM  
 Loss on Ignition  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



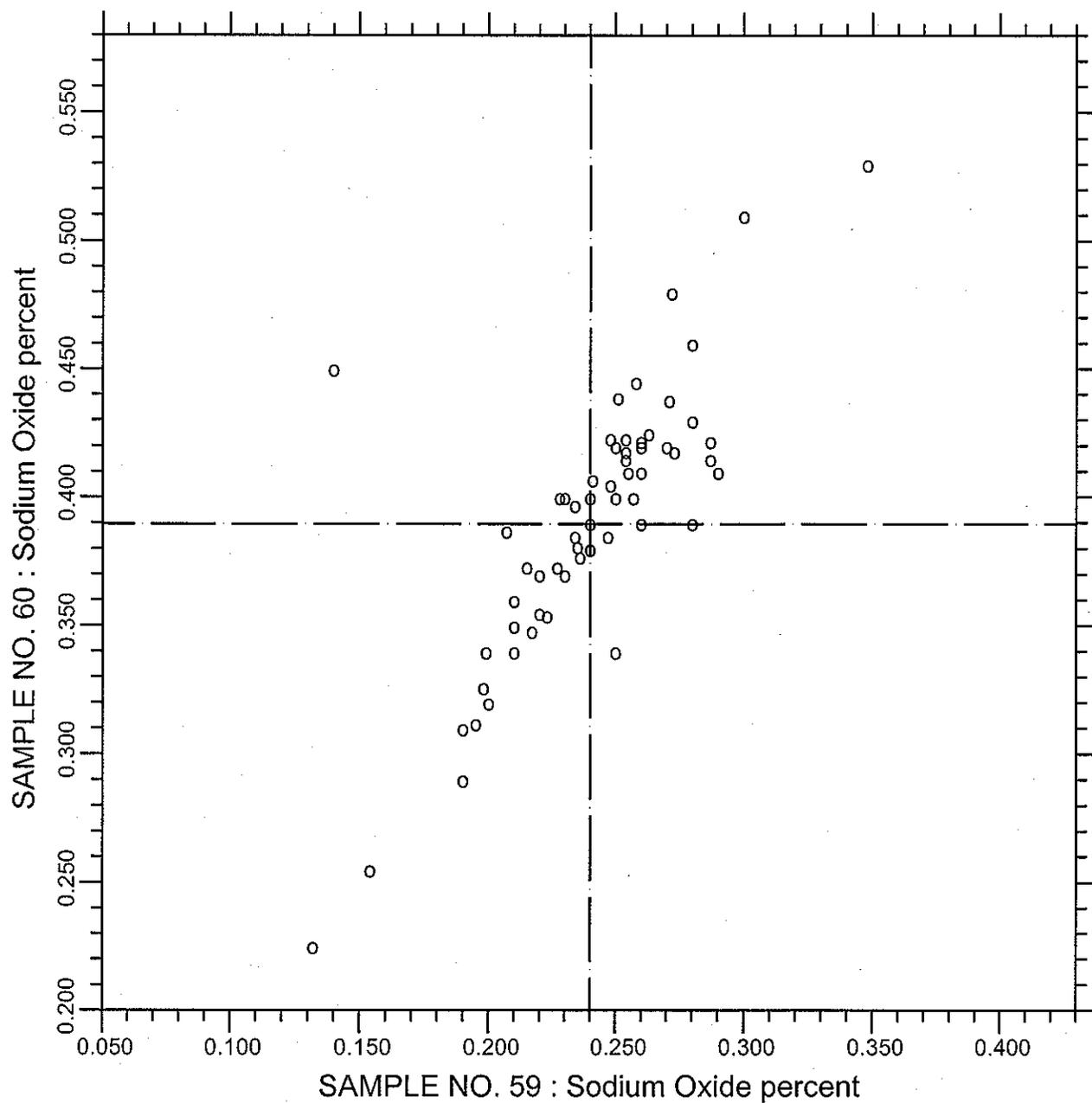
TEST NO.70

Loss on Ignition

78 POINTS

SAMPLE NO. 59	AVE	1.725	S.D.	0.42	C.V.	24.6
SAMPLE NO. 60	AVE	0.896	S.D.	0.49	C.V.	54.6

CCRL PROFICIENCY SAMPLE PROGRAM  
 Sodium Oxide  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.90

Sodium Oxide

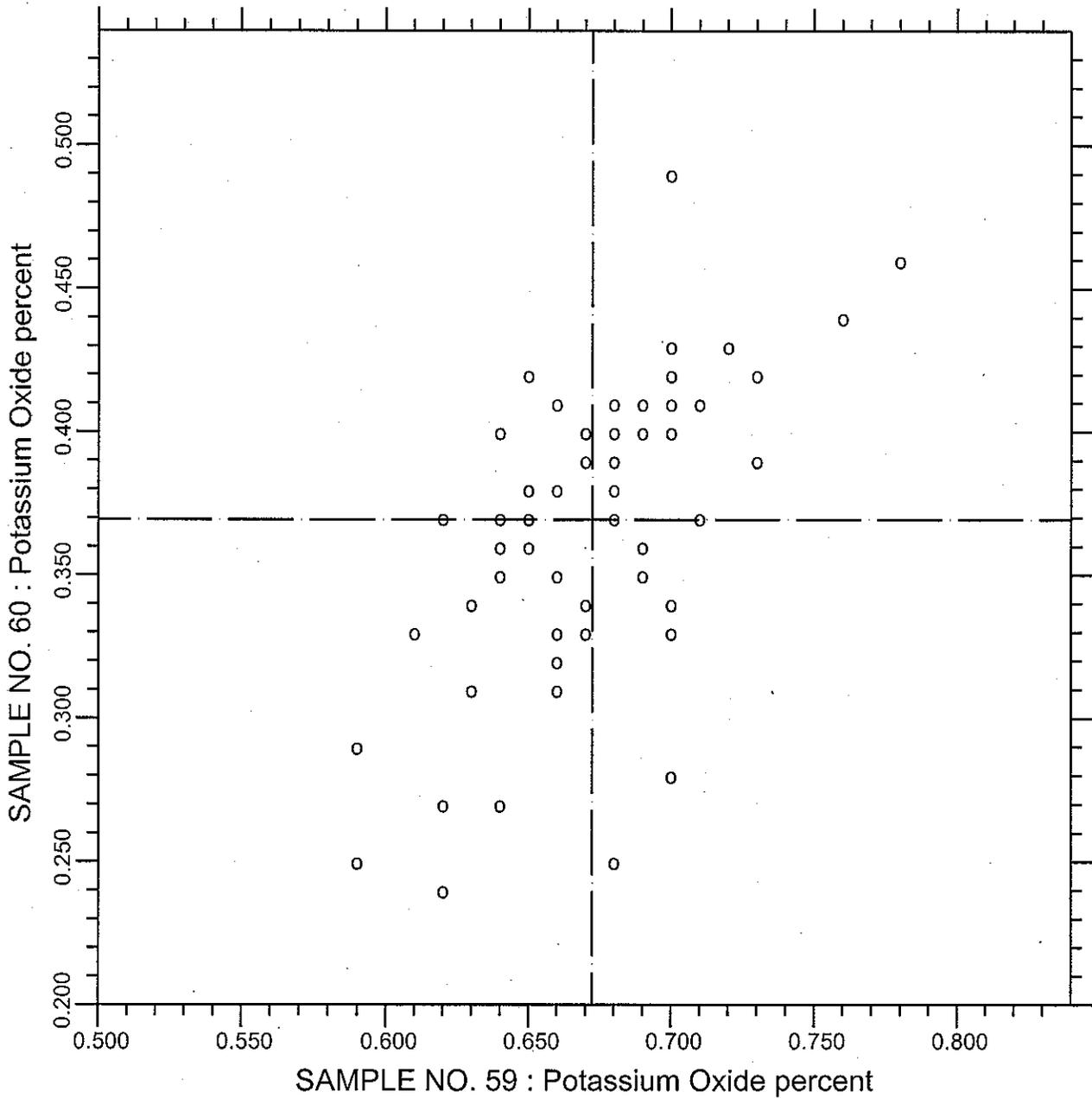
65 POINTS

SAMPLE NO. 59 AVE 0.2400 S.D. 0.038 C.V. 15.9

SAMPLE NO. 60 AVE 0.3895 S.D. 0.057 C.V. 14.6

LABS ELIMINATED 2 181 1373 1799 30 176 2463

CCRL PROFICIENCY SAMPLE PROGRAM  
 Potassium Oxide  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.100

Potassium Oxide

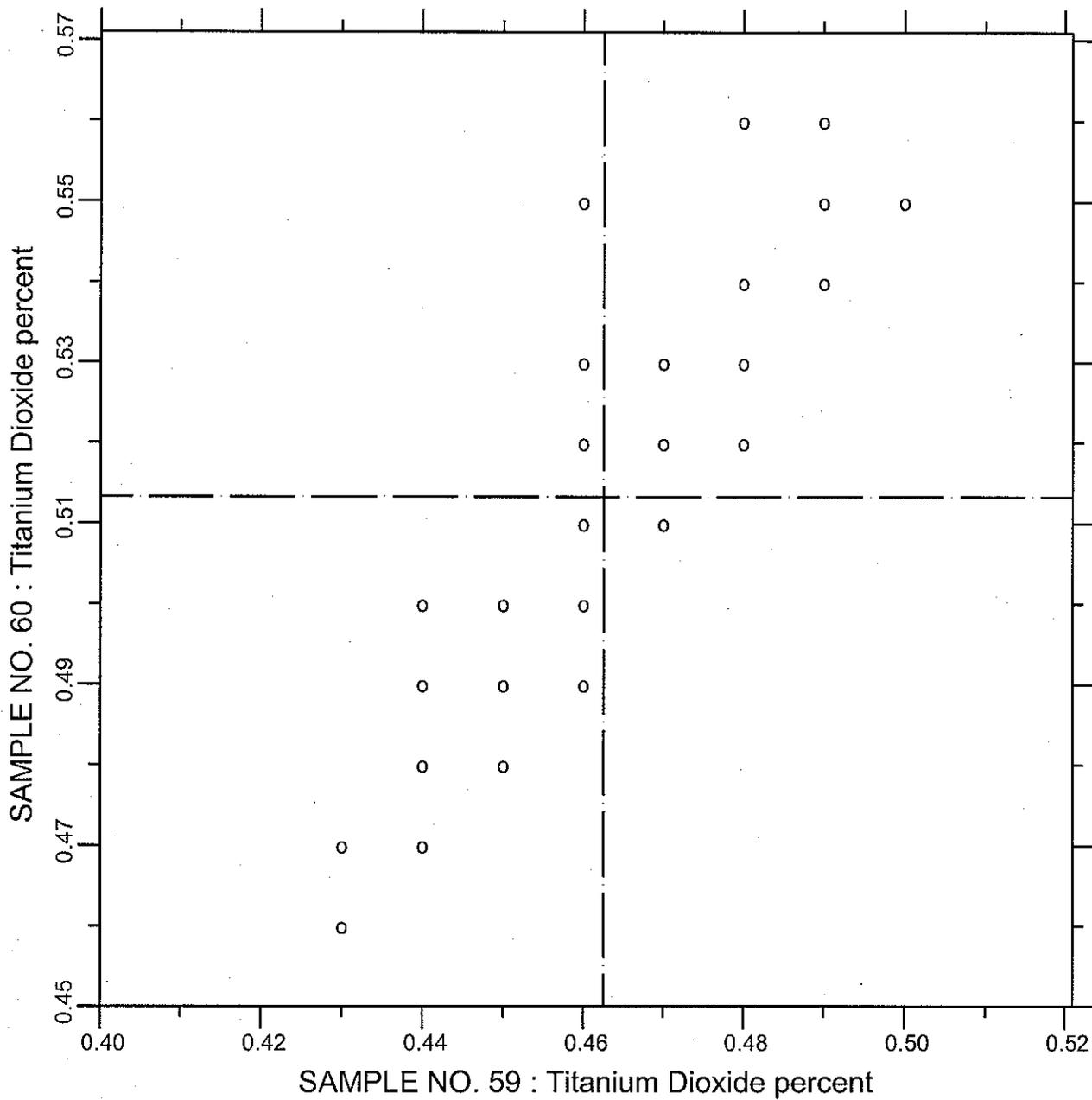
73 POINTS

SAMPLE NO. 59 AVE 0.6723 S.D. 0.034 C.V. 5.03

SAMPLE NO. 60 AVE 0.3693 S.D. 0.049 C.V. 13.25

LABS ELIMINATED 28 176

CCRL PROFICIENCY SAMPLE PROGRAM  
Titanium Dioxide  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.103

Titanium Dioxide

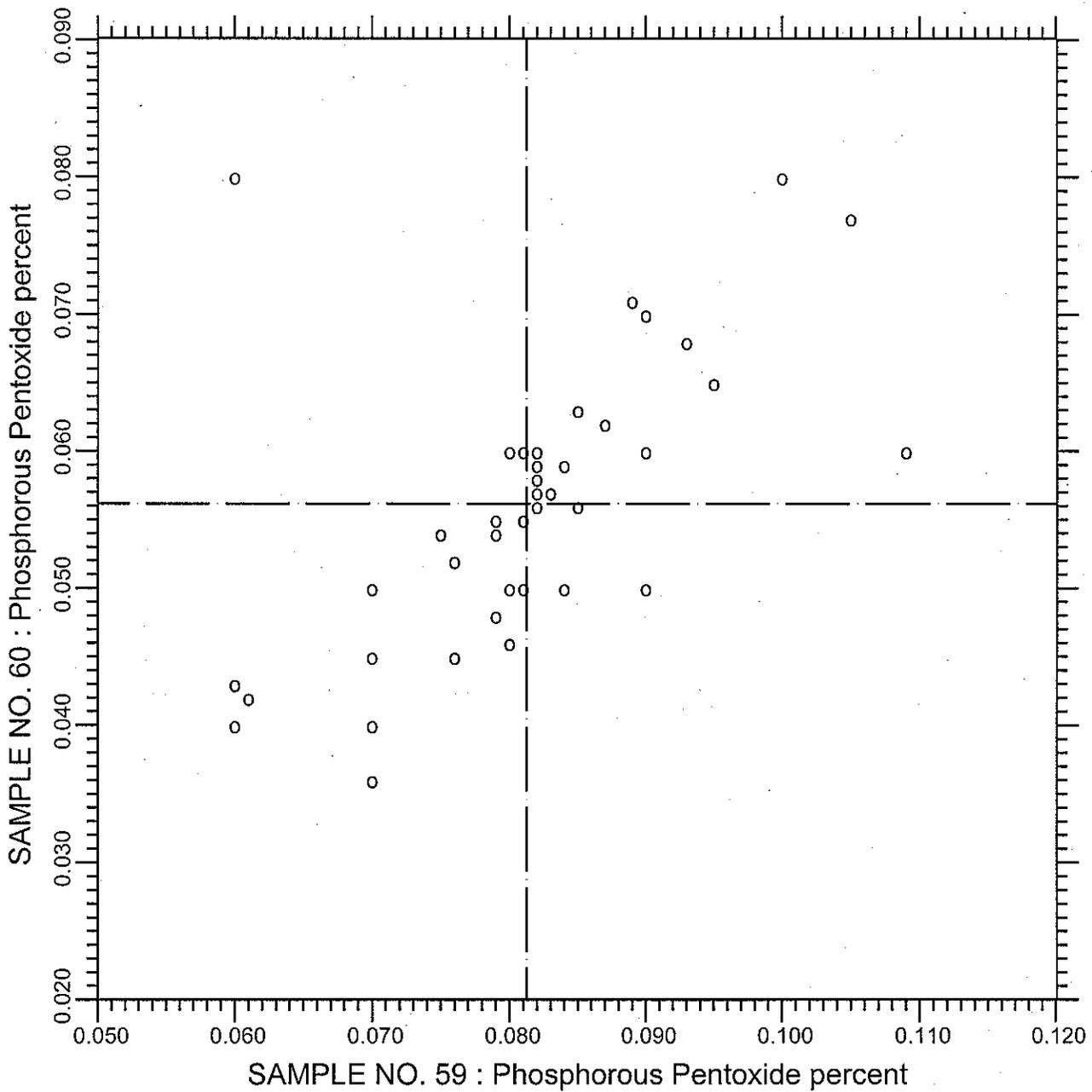
55 POINTS

SAMPLE NO. 59 AVE 0.4625 S.D. 0.018 C.V. 4.02

SAMPLE NO. 60 AVE 0.5133 S.D. 0.027 C.V. 5.22

LABS ELIMINATED 176 1940

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Phosphorus Pentoxide**  
**BLENDED CEMENT SAMPLES NO. 59 & NO. 60**



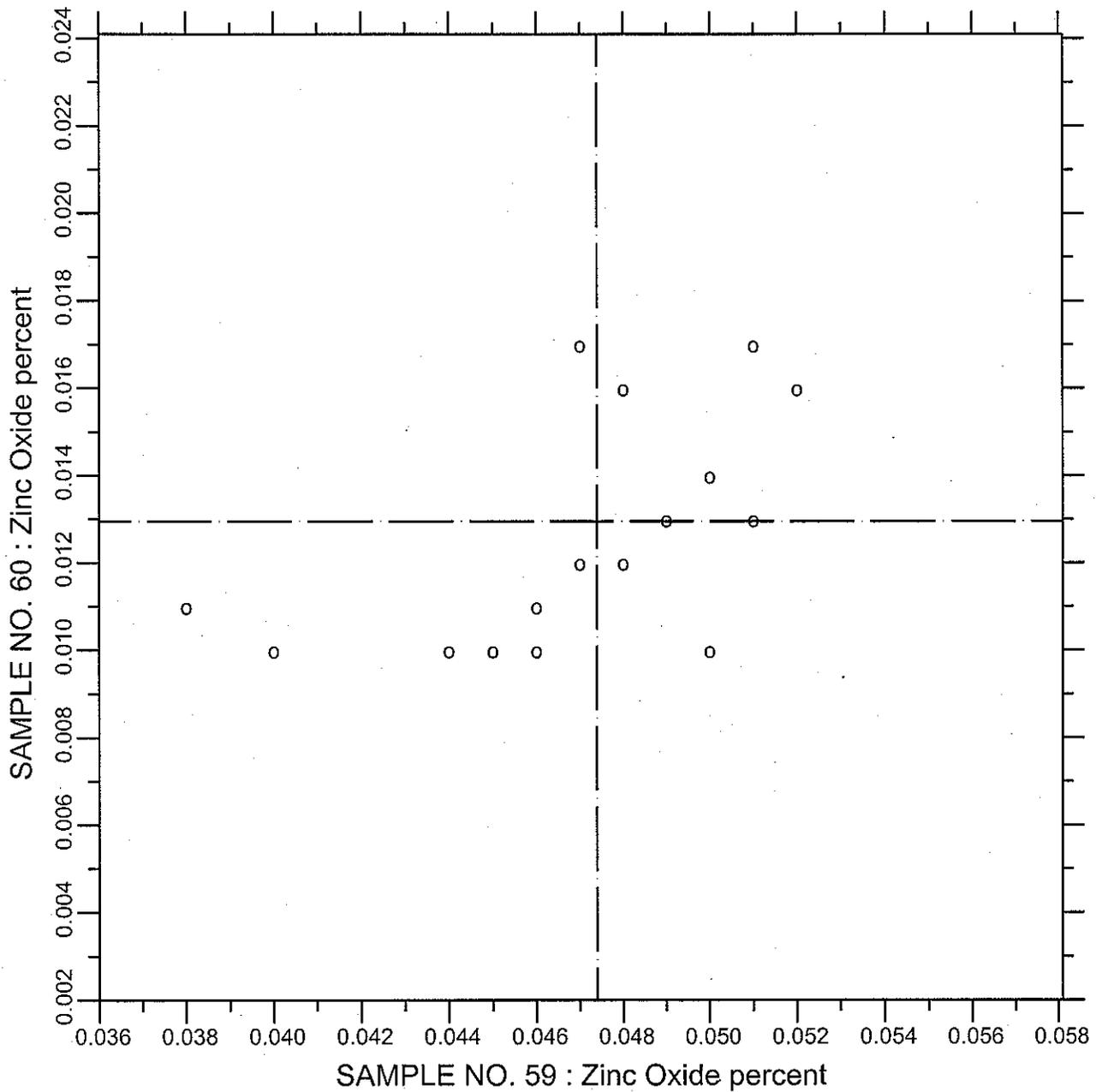
TEST NO.102      Phosphorous Pentoxide      51 POINTS

SAMPLE NO. 59    AVE 0.0812    S.D. 0.0099    C.V. 12.1

SAMPLE NO. 60    AVE 0.0562    S.D. 0.0095    C.V. 16.9

LABS ELIMINATED 1379 2463

CCRL PROFICIENCY SAMPLE PROGRAM  
Zinc Oxide  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.99

Zinc Oxide

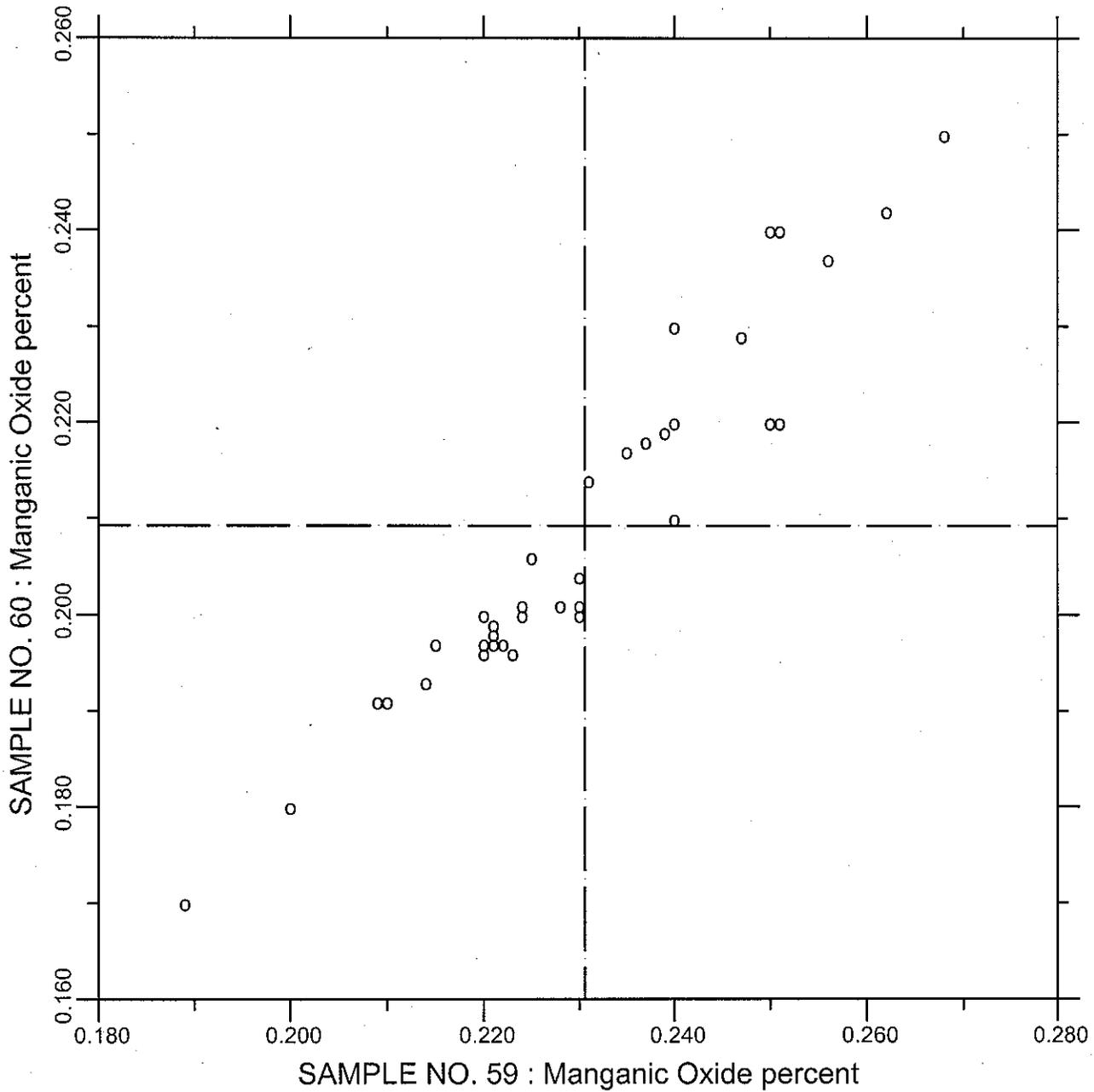
20 POINTS

SAMPLE NO. 59 AVE 0.04740 S.D. 0.0037 C.V. 7.79

SAMPLE NO. 60 AVE 0.01295 S.D. 0.0026 C.V. 20.12

LABS ELIMINATED 30 92

CCRL PROFICIENCY SAMPLE PROGRAM  
Manganic Oxide  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.101

Manganic Oxide

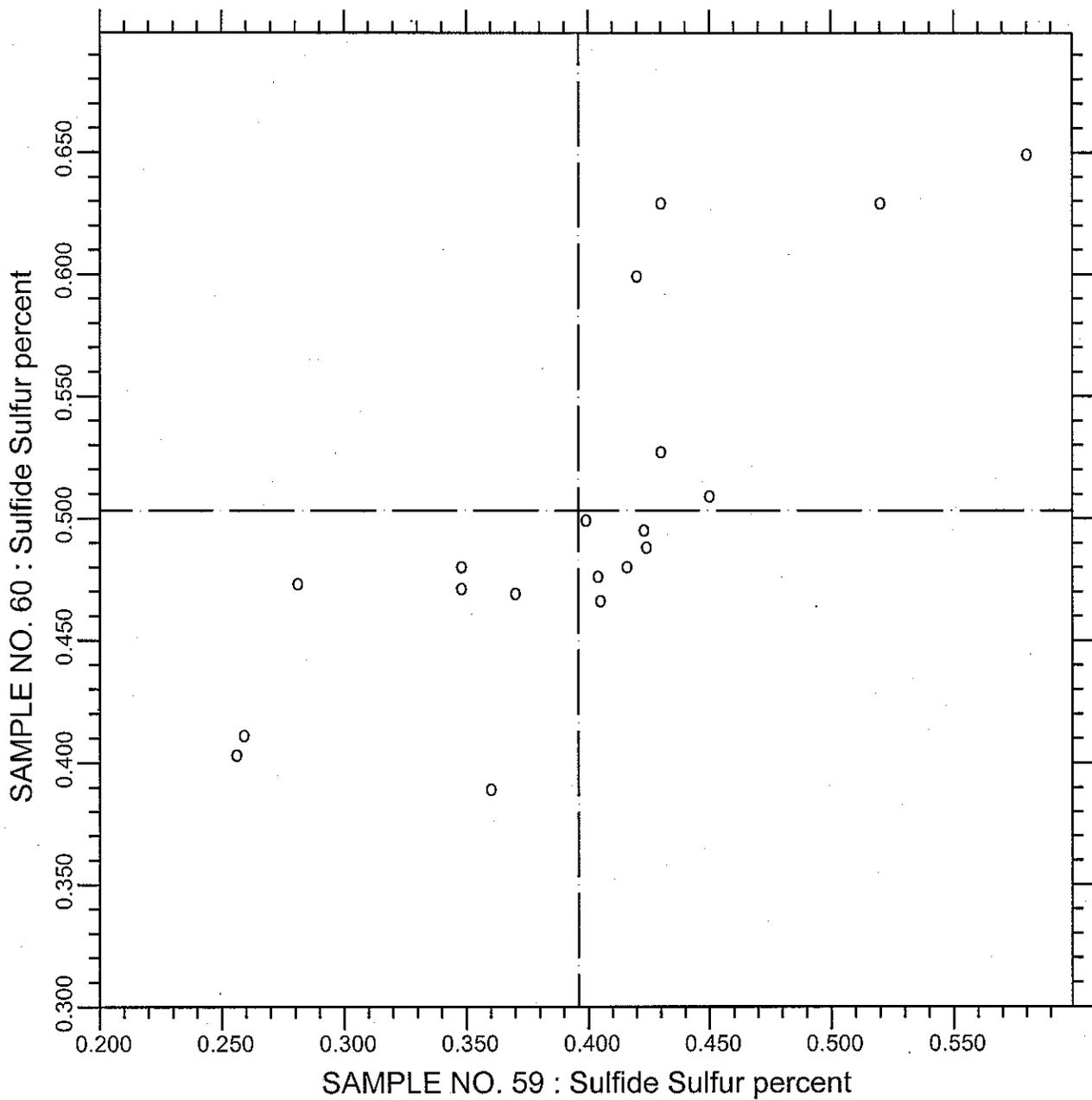
39 POINTS

SAMPLE NO. 59 AVE 0.2306 S.D. 0.017 C.V. 7.21

SAMPLE NO. 60 AVE 0.2092 S.D. 0.018 C.V. 8.54

LABS ELIMINATED 2463

CCRL PROFICIENCY SAMPLE PROGRAM  
 Sulfide Sulfur  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.65

Sulfide Sulfur

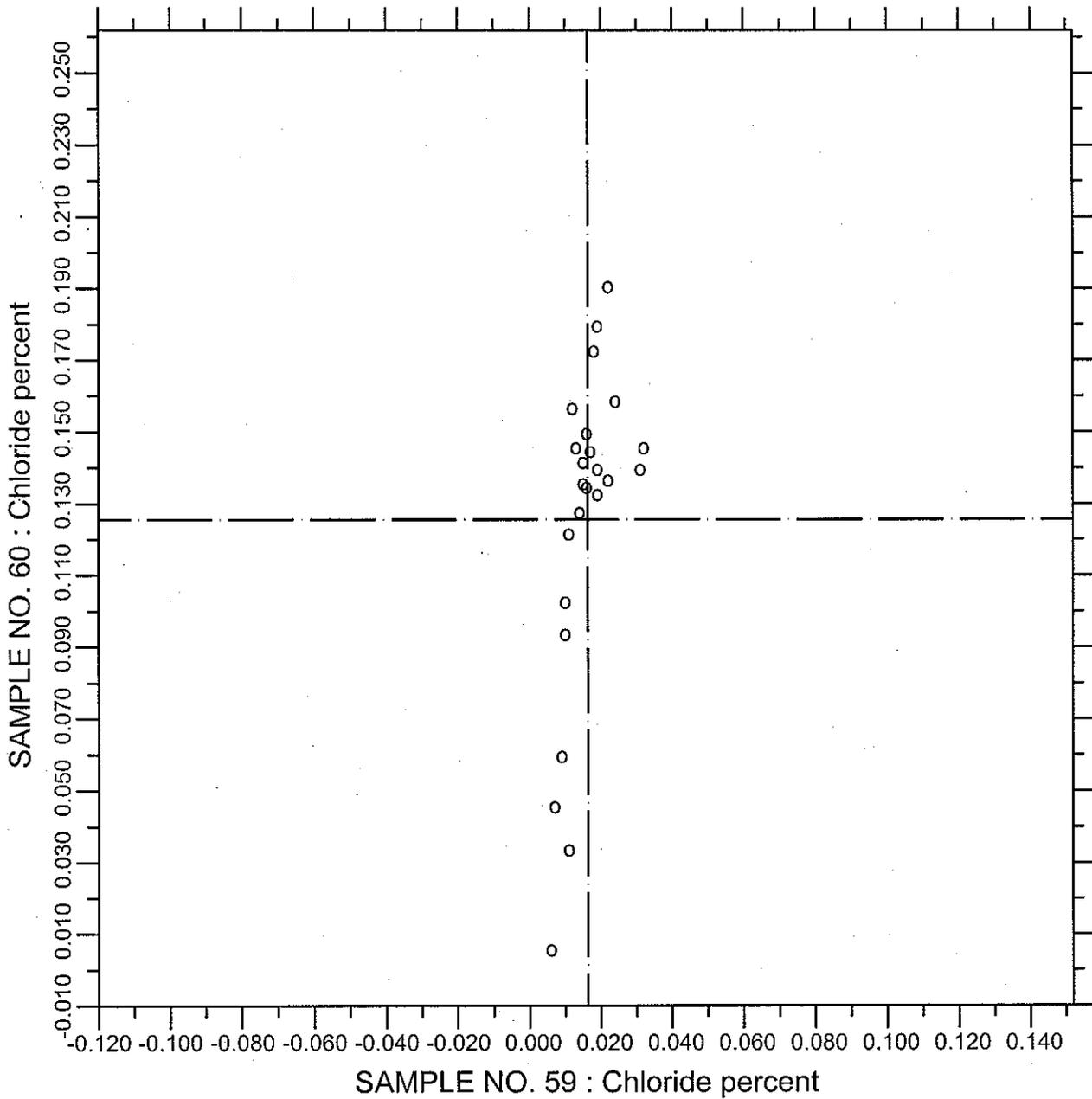
19 POINTS

SAMPLE NO. 59 AVE 0.396 S.D. 0.080 C.V. 20.2

SAMPLE NO. 60 AVE 0.503 S.D. 0.075 C.V. 14.9

LABS ELIMINATED 80 246 698 2462 25 11 690 2463

CCRL PROFICIENCY SAMPLE PROGRAM  
Chloride  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.104

Chloride

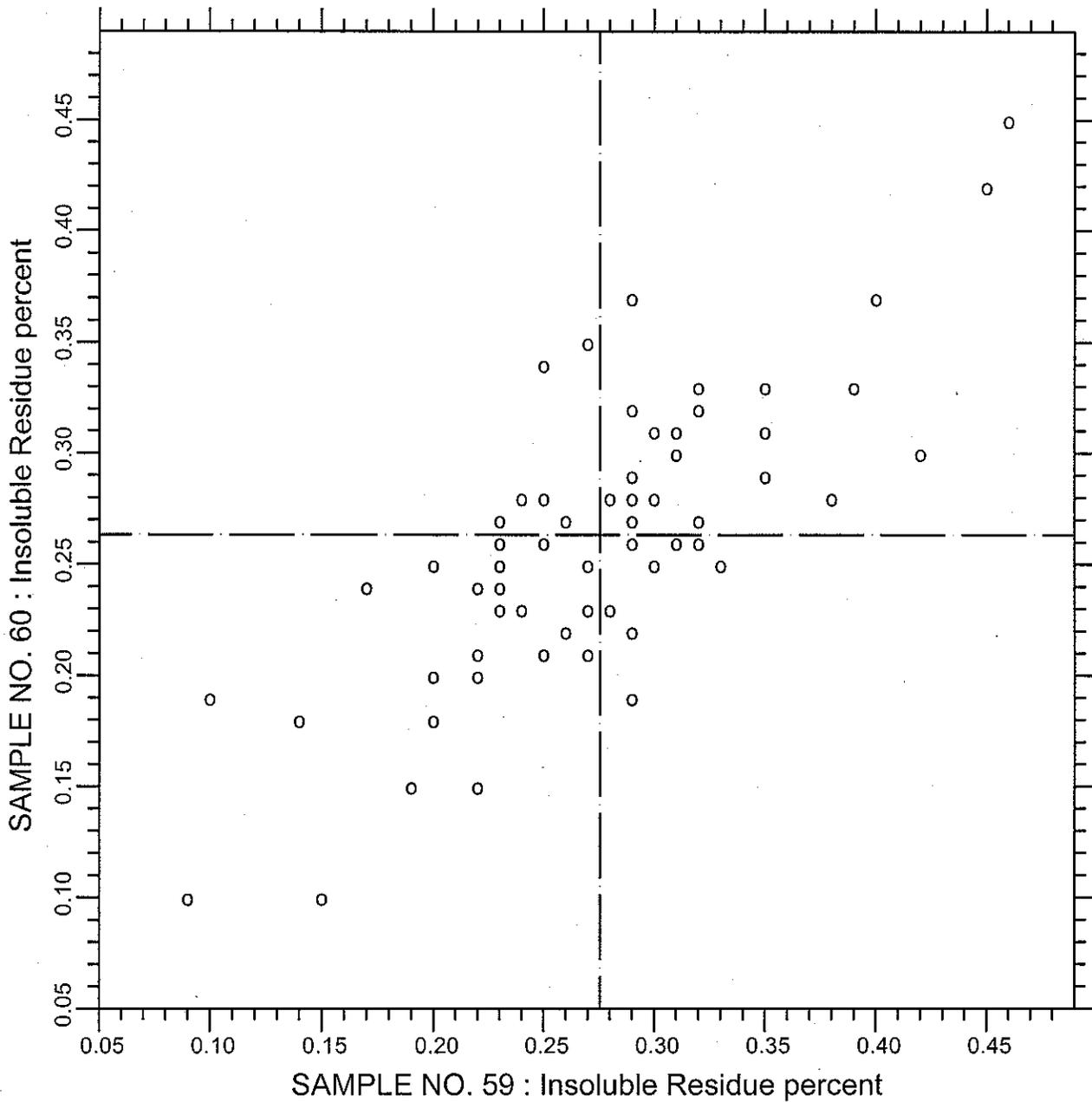
25 POINTS

SAMPLE NO. 59 AVE 0.0164 S.D. 0.0066 C.V. 40.6

SAMPLE NO. 60 AVE 0.1256 S.D. 0.0454 C.V. 36.1

LABS ELIMINATED 92 413

CCRL PROFICIENCY SAMPLE PROGRAM  
 Insoluble Residue  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.80

Insoluble Residue

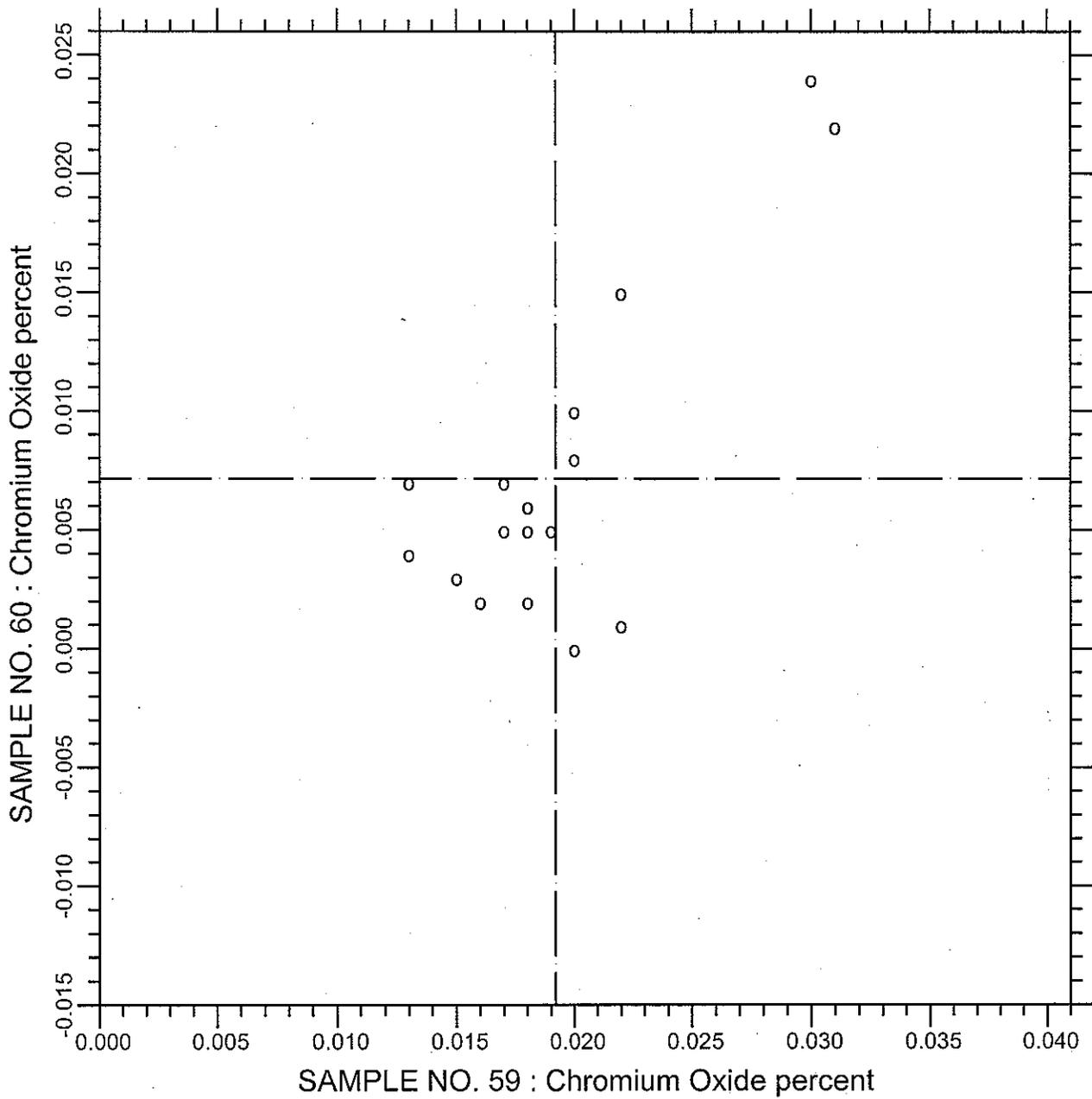
63 POINTS

SAMPLE NO. 59 AVE 0.2756 S.D. 0.073 C.V. 26.4

SAMPLE NO. 60 AVE 0.2633 S.D. 0.065 C.V. 24.8

LABS ELIMINATED 870 2116 918 1379 1799 2466 605 695 2476

CCRL PROFICIENCY SAMPLE PROGRAM  
Chromium Oxide  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.105

Chromium Oxide

20 POINTS

SAMPLE NO. 59 AVE 0.0192 S.D. 0.0046 C.V. 23.8

SAMPLE NO. 60 AVE 0.0072 S.D. 0.0064 C.V. 88.8

LABS ELIMINATED 19 40 2465

CCRL PROFICIENCY SAMPLE PROGRAM  
 Blended Cement Proficiency Samples No. 59 and No. 60  
 Final Report - Physical Results  
 May 18, 2007

SUMMARY OF RESULTS

Test		#Labs	Sample No. 59			Sample No. 60		
			Average	S.D.	C.V.	Average	S.D.	C.V.
N.C. Water	prcnt	90	27.06	2.3	8.40	29.43	2.2	7.51
N.C. Water	prcnt	* 89	26.829	0.44	1.66	29.208	0.63	2.17
Vicat TS Initial	min	88	137.3	17.4	12.6	159.5	23.0	14.4
Vicat TS Initial	min	* 86	136.4	16.3	11.9	157.6	16.3	10.3
Vicat TS Final	min	83	251.0	48.5	19.3	285.7	48.8	17.1
Vicat TS Final	min	* 80	244.8	35.6	14.5	280.8	42.2	15.0
Autoclave Expan	prcnt	82	0.0368	0.070	189	0.0482	0.080	165
Autoclave Expan	prcnt	* 79	0.0308	0.019	61.3	0.0426	0.024	56.9
Air Content	prcnt	74	9.33	1.4	15.2	7.77	1.3	17.1
AC Mix Water	prcnt	74	67.93	2.6	3.91	68.42	2.8	4.09
AC Mix Water	prcnt	* 70	67.73	2.0	2.98	68.23	2.2	3.16
AC Flow	prcnt	74	88.72	3.2	3.61	87.82	3.1	3.57
Specific Gravity		68	3.005	0.11	3.71	2.964	0.10	3.40
Specific Gravity		* 62	3.0147	0.036	1.20	2.9729	0.031	1.05

CONTINUED ON NEXT PAGE

\* ELIMINATED LABS: Data over three S.D. from the mean

Normal Consistency,	35
Vicat TS Intial	2 413
Vicat TS Final	23 47 698
Autoclave Expansion	691 2463 2476
Air Content, Mix Water	918 44 51 2975
Specific Gravity	36 51 44 691 2295 2476

CCRL PROFICIENCY SAMPLE PROGRAM  
Blended Cement Proficiency Samples No. 59 and No. 60  
Final Report - Physical Results  
May 18, 2007

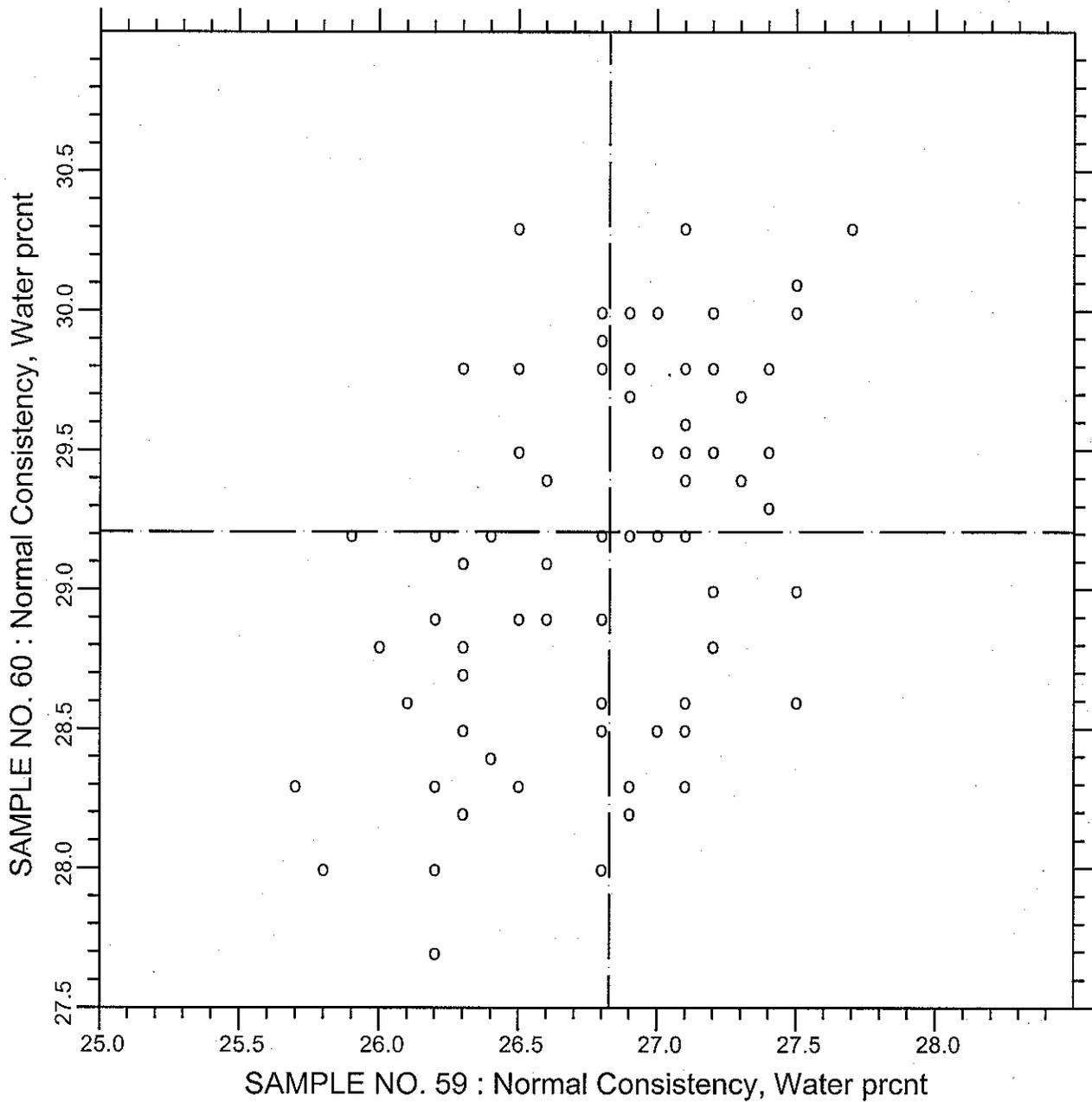
SUMMARY OF RESULTS

Test		#Labs	Sample No. 59			Sample No. 60		
			Average	S.D.	C.V.	Average	S.D.	C.V.
Comp Str, 3 day	psi	90	2641.0	196.0	7.42	2316.0	260.9	11.26
Comp Str, 3 day	psi	* 86	2634.8	173.1	6.57	2294.4	191.3	8.34
Comp Str, 7 day	psi	91	3794.9	295.7	7.79	4108.5	398.3	9.69
Comp Str, 7 day	psi	* 86	3799.1	235.5	6.20	4124.2	291.4	7.07
Comp Str, 28 day	psi	83	5716.3	391.9	6.86	6640.2	581.3	8.75
CS Mix Water	prcnt	84	47.91	2.9	6.09	48.13	2.9	6.11
CS Mix Water	prcnt	* 82	48.12	1.1	2.35	48.35	1.1	2.27
Com Str Flow	prcnt	88	110.25	3.3	3.00	109.82	3.4	3.13
Com Str Flow	prcnt	* 82	110.39	2.8	2.58	110.13	2.8	2.54
Fineness AP	cm <sup>2</sup> /g	82	4637.8	332.2	7.16	4755.7	435.7	9.16
45µm Sieve	prcnt	81	96.744	0.69	0.712	98.068	1.13	1.149
45µm Sieve	prcnt	* 75	96.771	0.47	0.484	98.228	0.34	0.342

\* ELIMINATED LABS: Data over three S.D. from the mean

Comp Strength, 3 day      2 413 34 450  
 Comp Strength, 7 day    51 413 450 34 2295  
 Comp Strength, Water    10 148  
 Comp Strength, Flow    3 44 695 698 1323 2477  
 Fineness, 45µm Sieve   34 80 958 36 1323 2466

CCRL PROFICIENCY SAMPLE PROGRAM  
 Normal Consistency - % Water  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



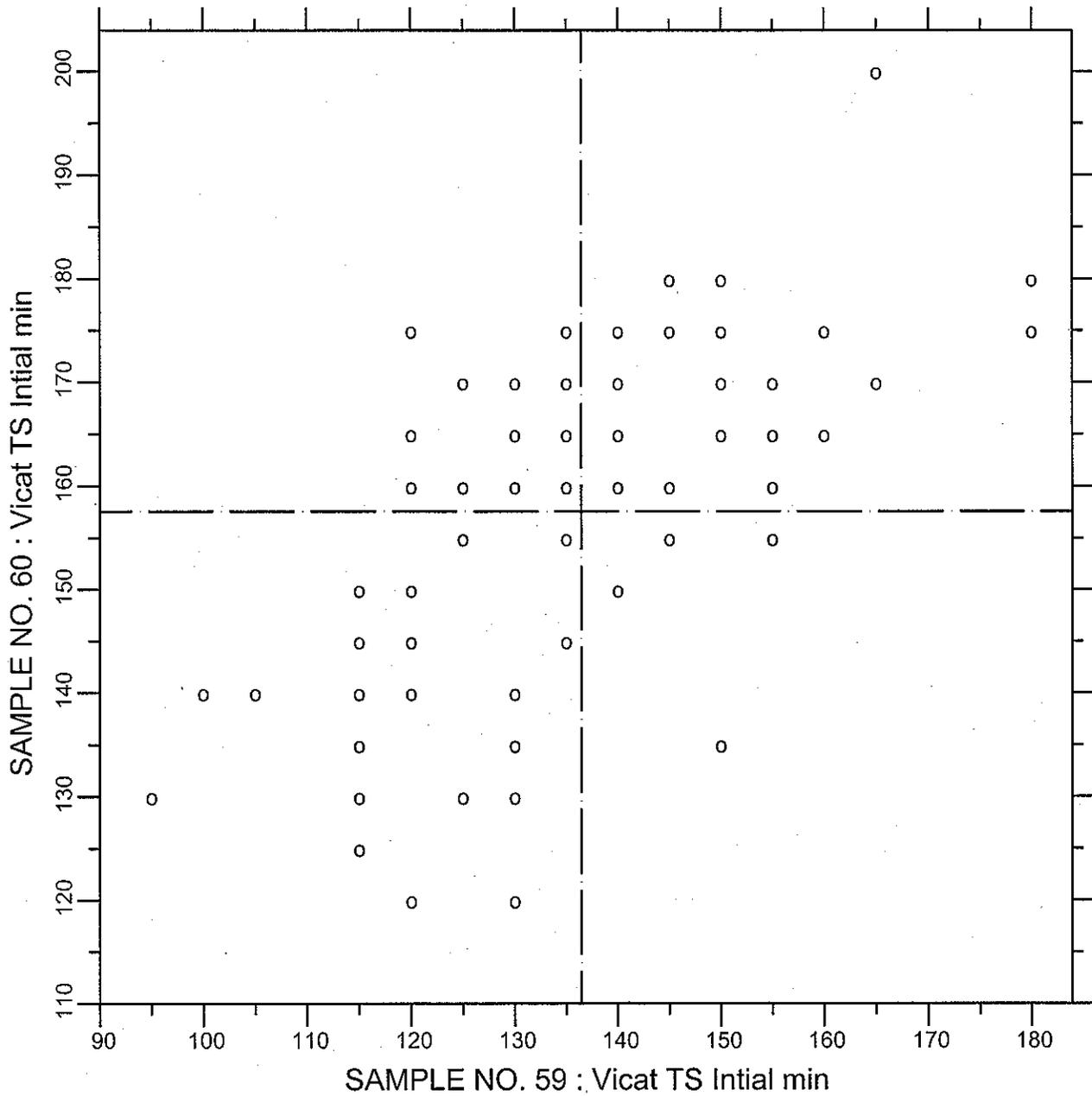
TEST NO.110      Normal Consistency, Water      89 POINTS

SAMPLE NO. 59    AVE 26.829    S.D. 0.44    C.V. 1.66

SAMPLE NO. 60    AVE 29.208    S.D. 0.63    C.V. 2.17

LABS ELIMINATED 35

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Vicat Time of Set - Initial**  
**BLENDED CEMENT SAMPLES NO. 59 & NO. 60**



TEST NO.120

Vicat TS Intial

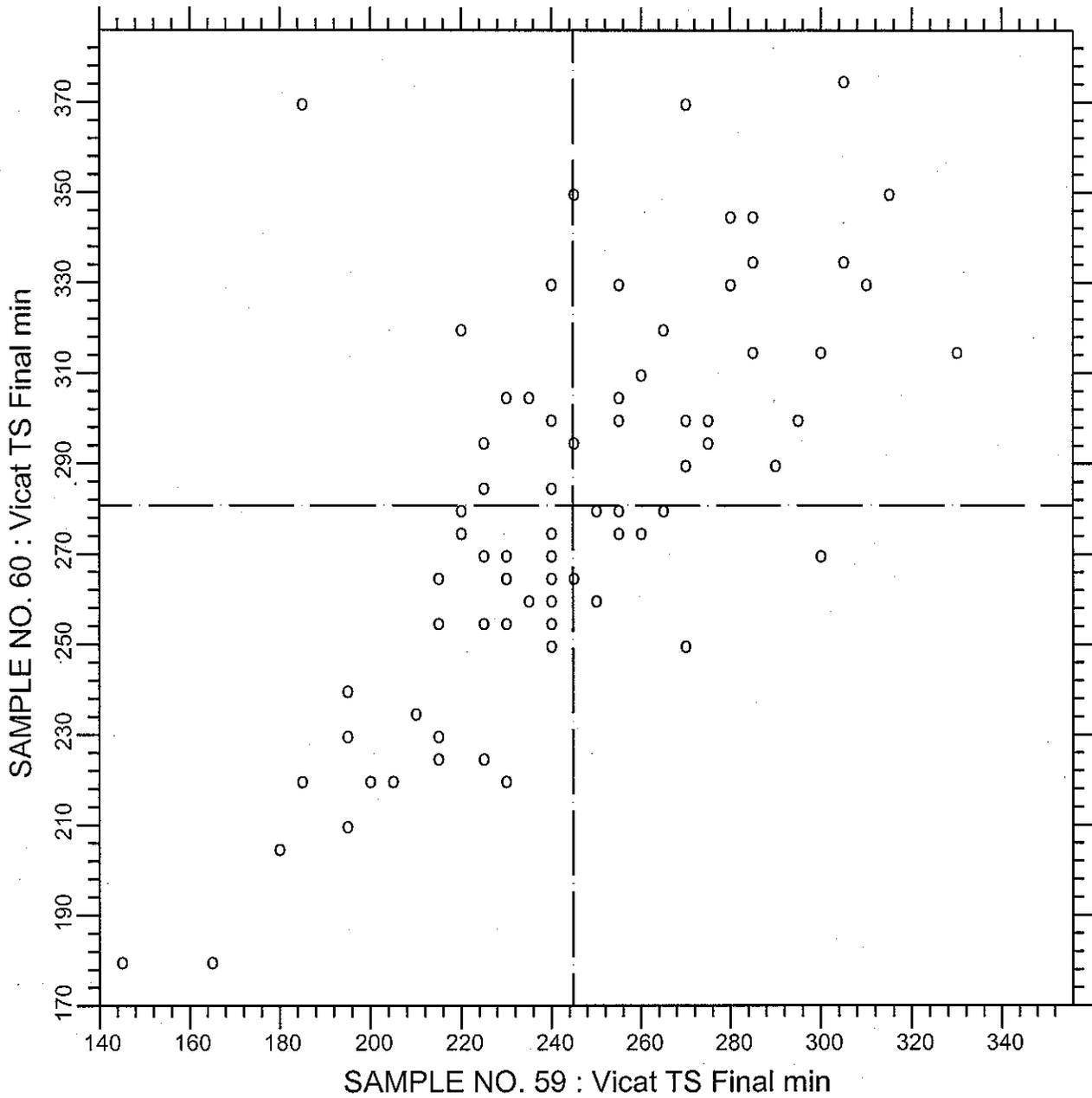
86 POINTS

SAMPLE NO. 59 AVE 136.4 S.D. 16.3 C.V. 11.9

SAMPLE NO. 60 AVE 157.6 S.D. 16.3 C.V. 10.3

LABS ELIMINATED 2 413

CCRL PROFICIENCY SAMPLE PROGRAM  
 Vicat Time of Set - Final  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.121

Vicat TS Final

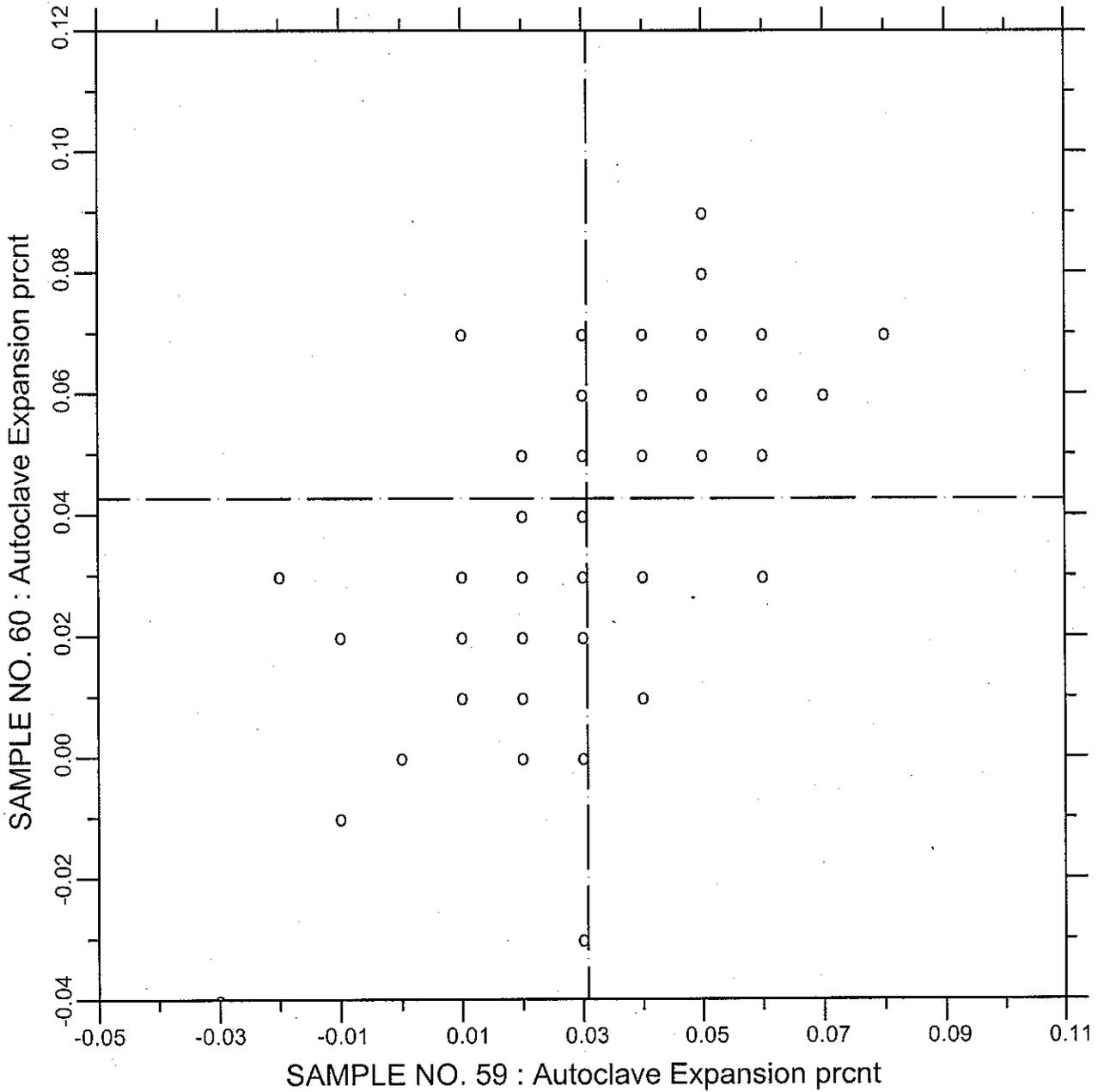
80 POINTS

SAMPLE NO. 59 AVE 244.8 S.D. 35.6 C.V. 14.5

SAMPLE NO. 60 AVE 280.8 S.D. 42.2 C.V. 15.0

LABS ELIMINATED 23 47 698

CCRL PROFICIENCY SAMPLE PROGRAM  
 Autoclave Expansion  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60

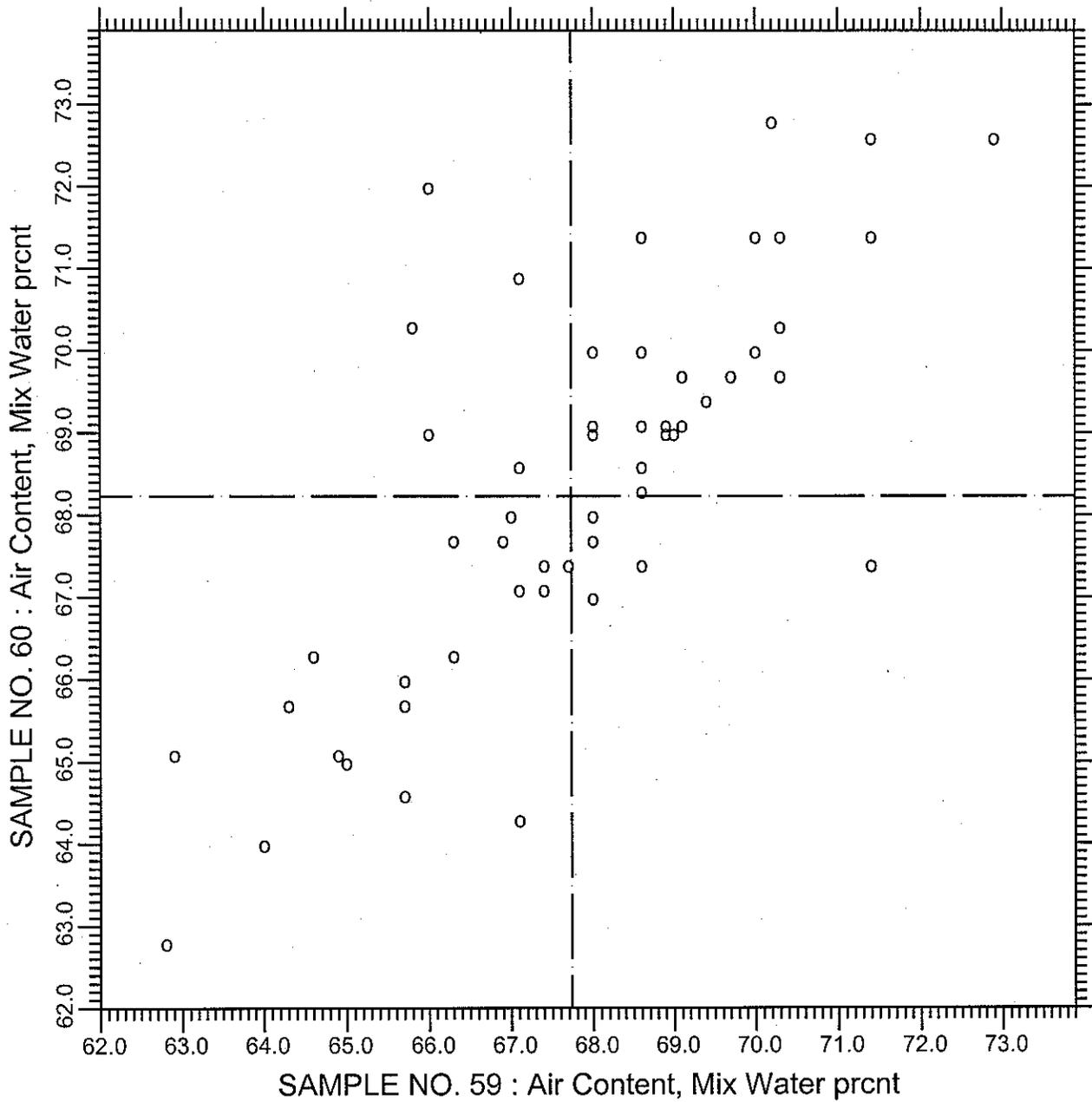


TEST NO.160                      Autoclave Expansion                      79 POINTS

SAMPLE NO. 59    AVE 0.0308    S.D. 0.019    C.V. 61.3  
 SAMPLE NO. 60    AVE 0.0426    S.D. 0.024    C.V. 56.9  
 LABS ELIMINATED 691 2463 2476



**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Air Content - % Water  
**BLENDED CEMENT SAMPLES NO. 59 & NO. 60**



TEST NO.180

Air Content, Mix Water

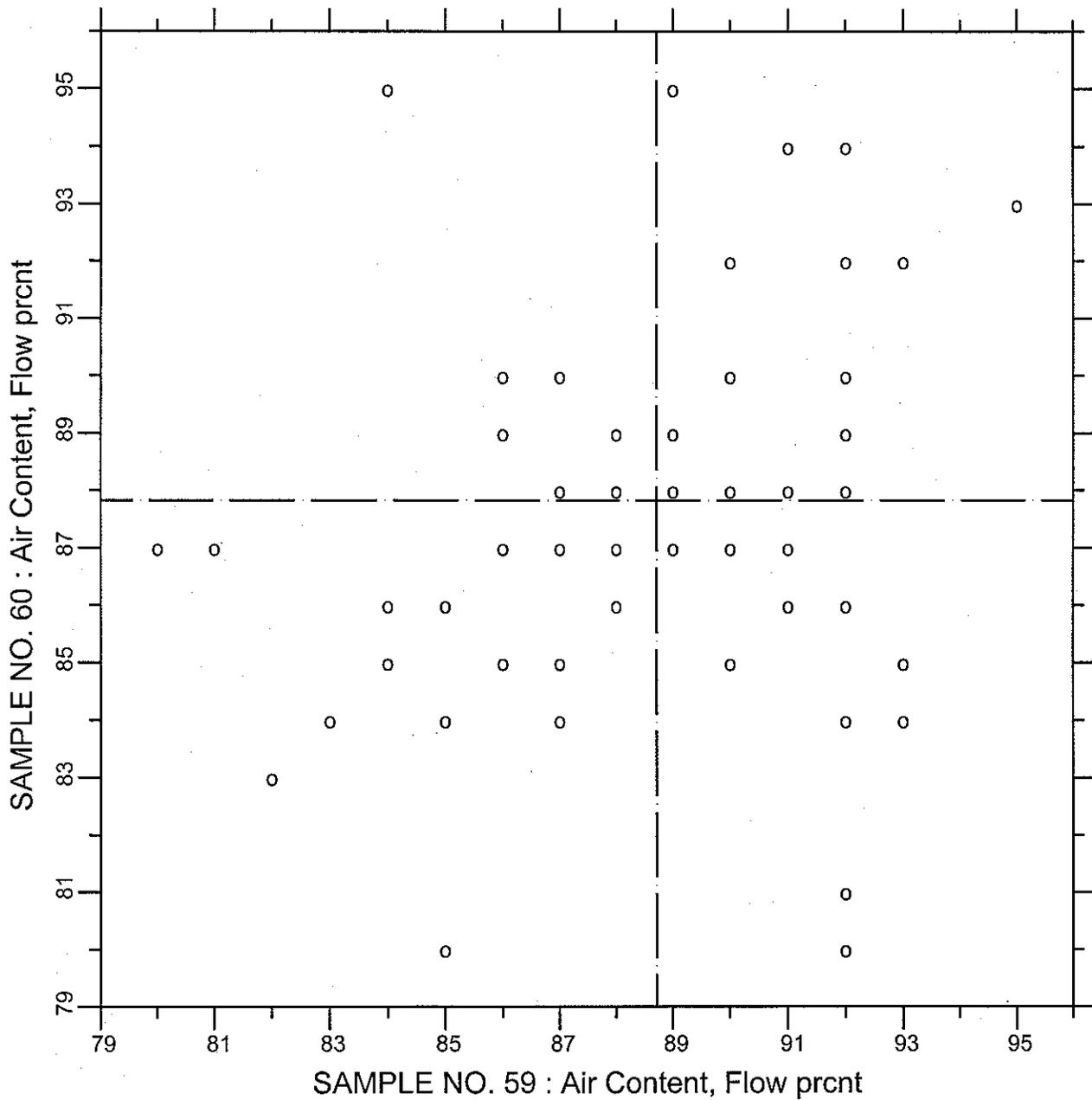
70 POINTS

SAMPLE NO. 59 AVE 67.73 S.D. 2.0 C.V. 2.98

SAMPLE NO. 60 AVE 68.23 S.D. 2.2 C.V. 3.16

LABS ELIMINATED 918 44 51 2975

CCRL PROFICIENCY SAMPLE PROGRAM  
Air Content - Flow  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.190

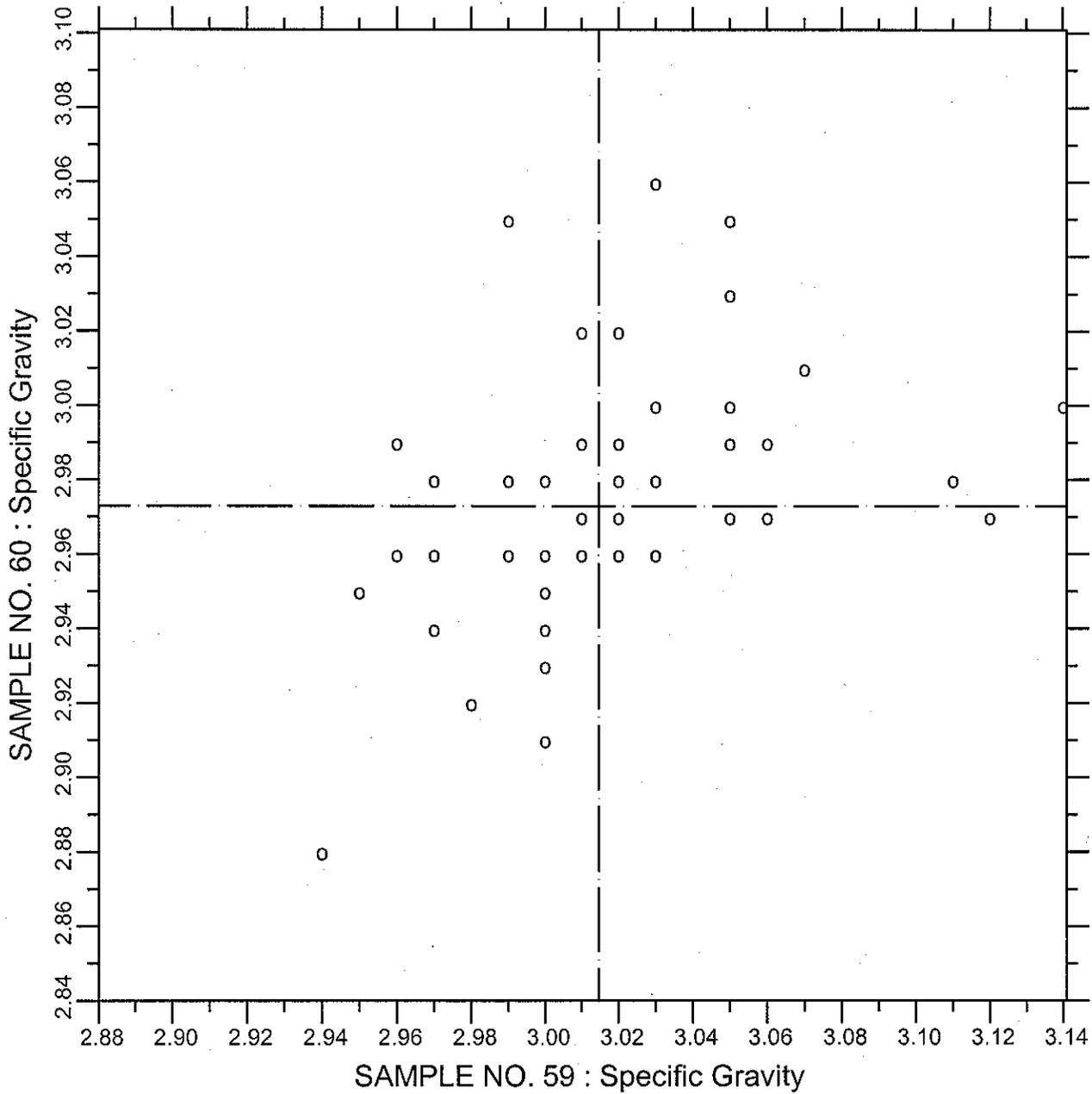
Air Content, Flow

74 POINTS

SAMPLE NO. 59 AVE 88.72 S.D. 3.2 C.V. 3.61

SAMPLE NO. 60 AVE 87.82 S.D. 3.1 C.V. 3.57

CCRL PROFICIENCY SAMPLE PROGRAM  
Specific Gravity  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.310

Specific Gravity

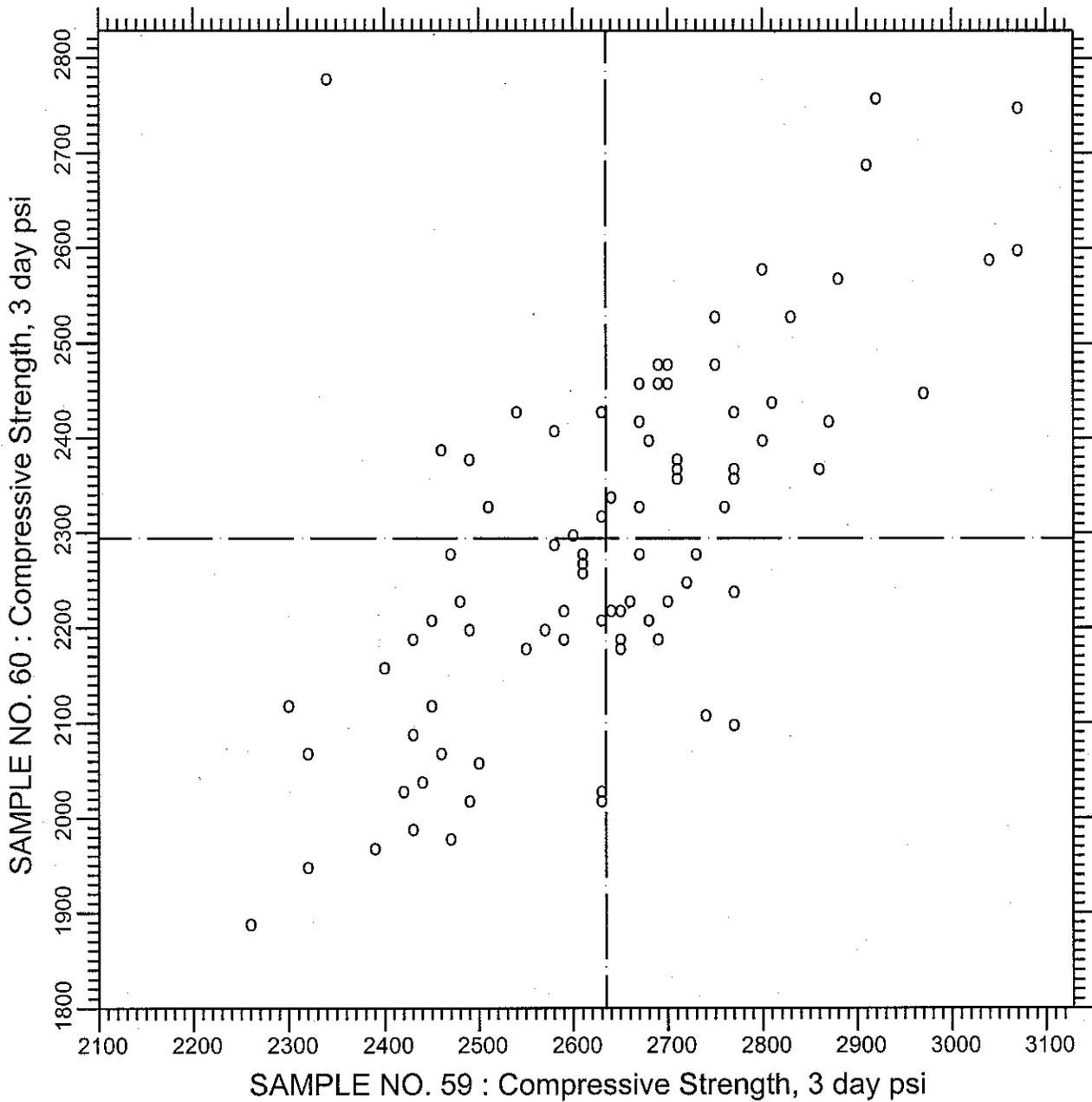
62 POINTS

SAMPLE NO. 59 AVE 3.0147 S.D. 0.036 C.V. 1.20

SAMPLE NO. 60 AVE 2.9729 S.D. 0.031 C.V. 1.05

LABS ELIMINATED 36 51 44 691 2295 2476

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Compressive Strength - 3 day  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



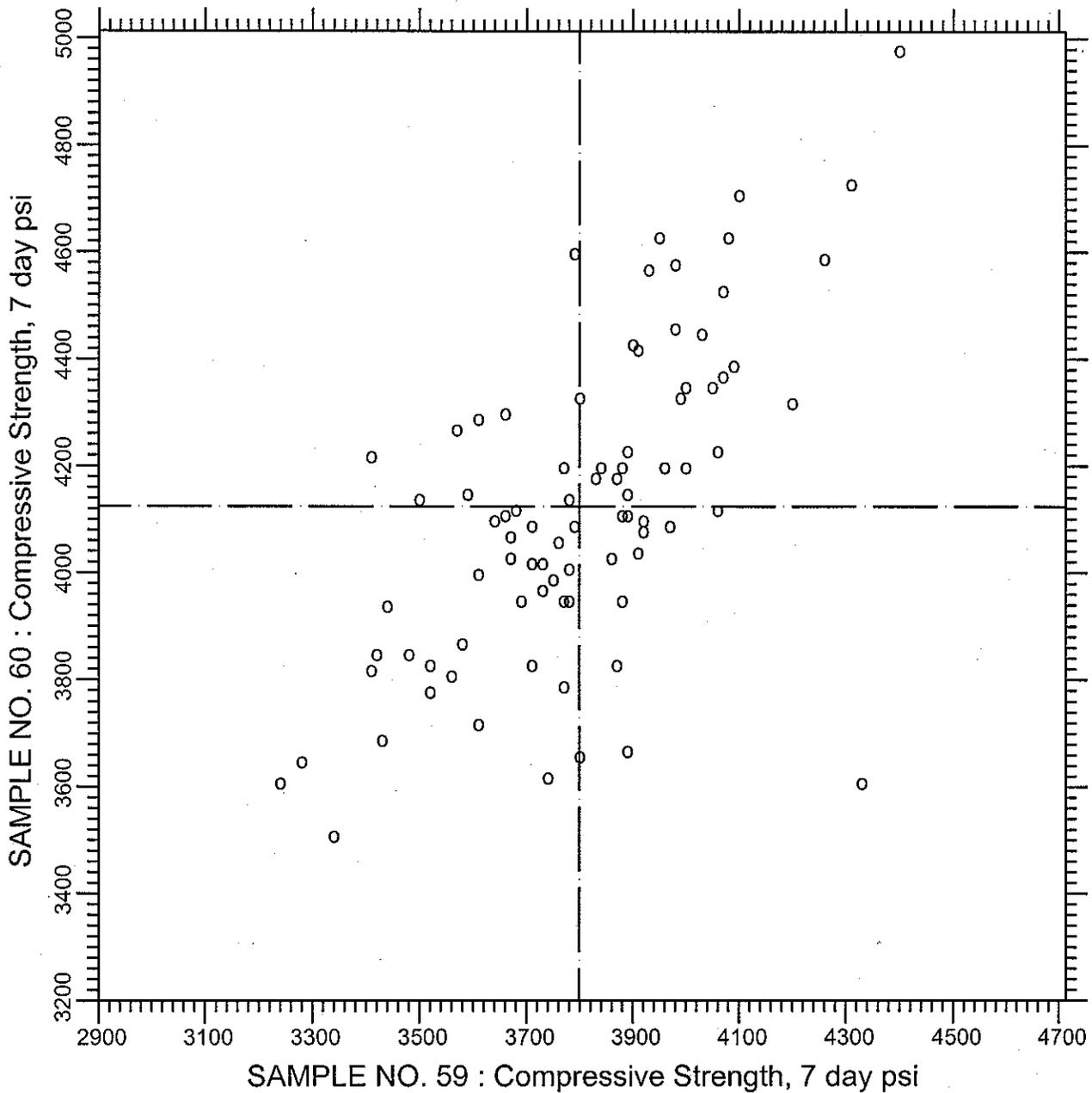
TEST NO.200      Compressive Strength, 3 day      86 POINTS

SAMPLE NO. 59    AVE 2634.8    S.D. 173.1    C.V. 6.57

SAMPLE NO. 60    AVE 2294.4    S.D. 191.3    C.V. 8.34

LABS ELIMINATED 2 413 34 450

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Compressive Strength - 7 day  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



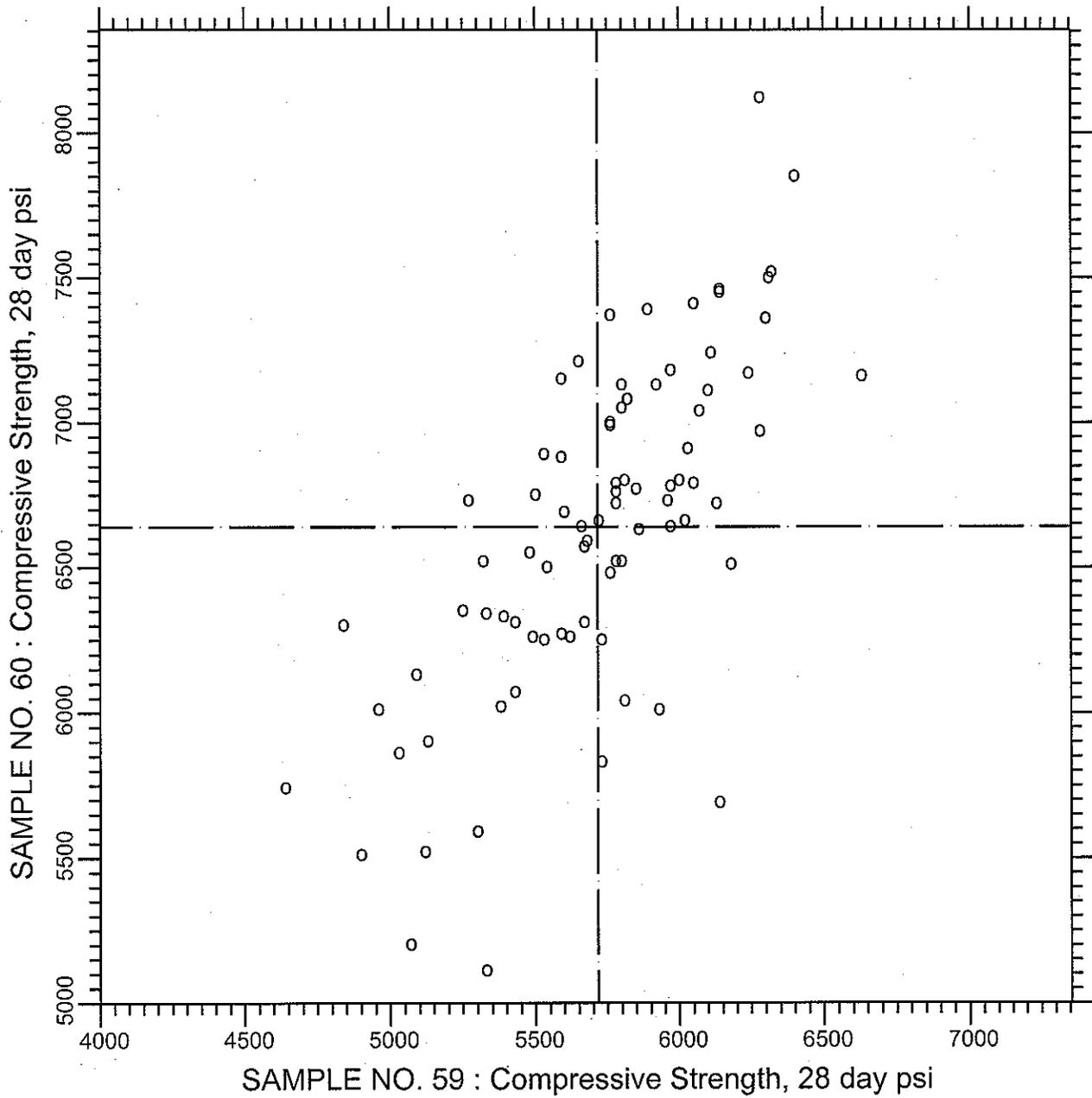
TEST NO.210    Compressive Strength, 7 day    86 POINTS

SAMPLE NO. 59    AVE 3799.1    S.D. 235.5    C.V. 6.20

SAMPLE NO. 60    AVE 4124.2    S.D. 291.4    C.V. 7.07

LABS ELIMINATED 51 413 450 34 2295

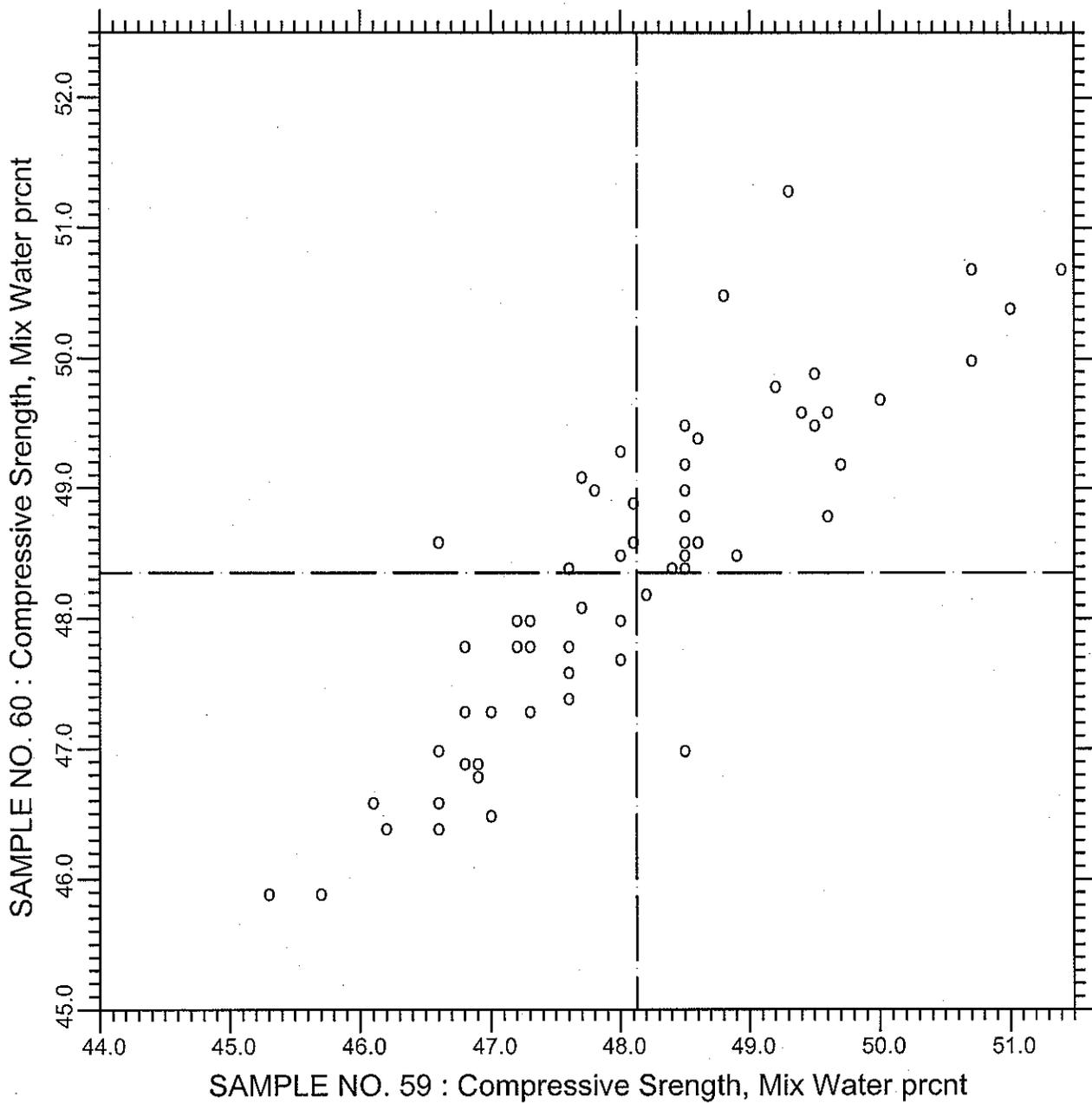
CCRL PROFICIENCY SAMPLE PROGRAM  
 Compressive Strength - 28 day  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.211    Compressive Strength, 28 day    83 POINTS

SAMPLE NO. 59	AVE	5716.3	S.D.	391.9	C.V.	6.86
SAMPLE NO. 60	AVE	6640.2	S.D.	581.3	C.V.	8.75

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Compressive Strength - % Water  
**BLENDED CEMENT SAMPLES NO. 59 & NO. 60**



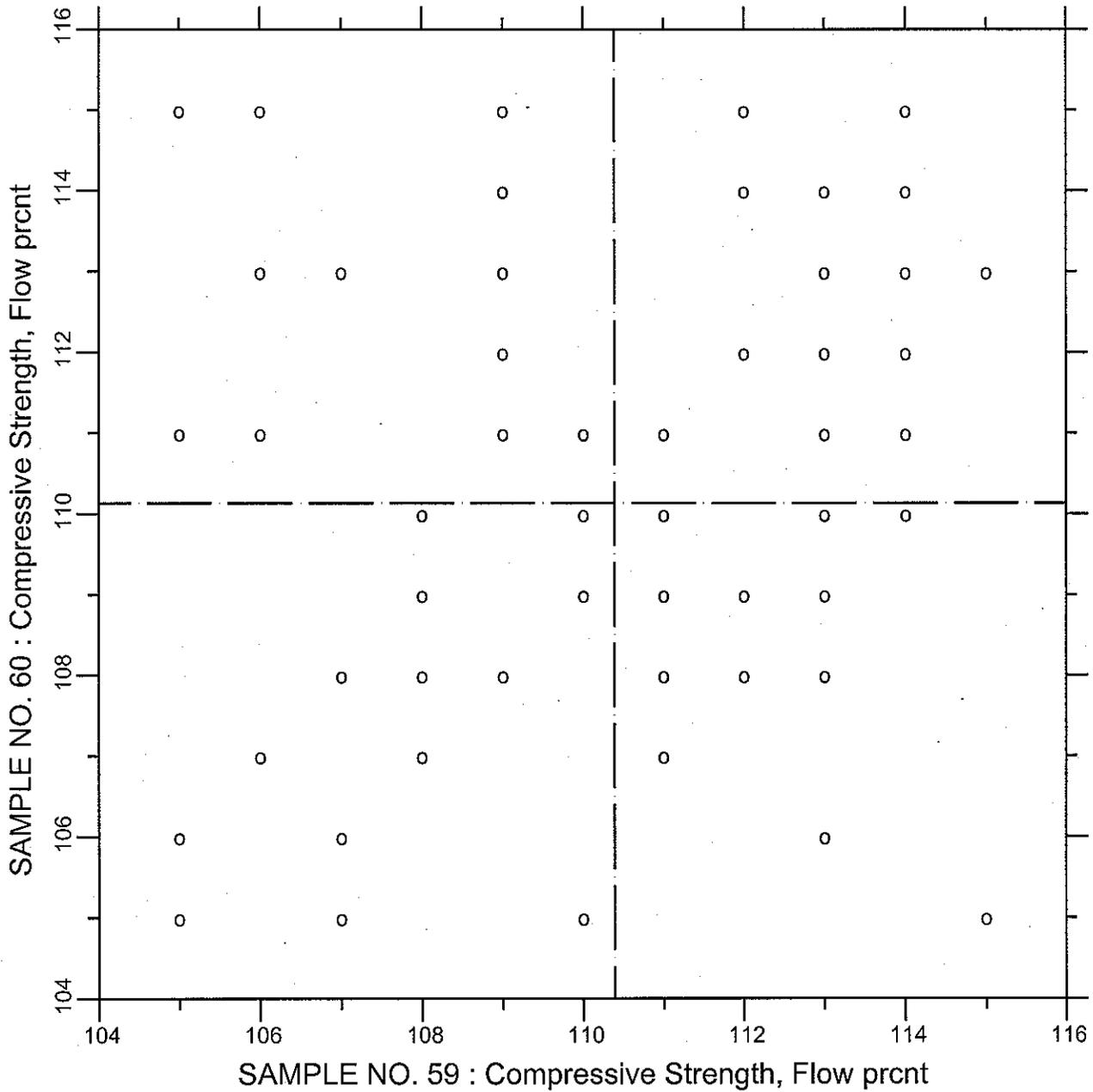
**TEST NO.220 Compressive Srength, Mix Water 82 POINTS**

SAMPLE NO. 59 AVE 48.12 S.D. 1.1 C.V. 2.35

SAMPLE NO. 60 AVE 48.35 S.D. 1.1 C.V. 2.27

LABS ELIMINATED 10 148

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Compressive Strength - Flow**  
**BLENDED CEMENT SAMPLES NO. 59 & NO. 60**



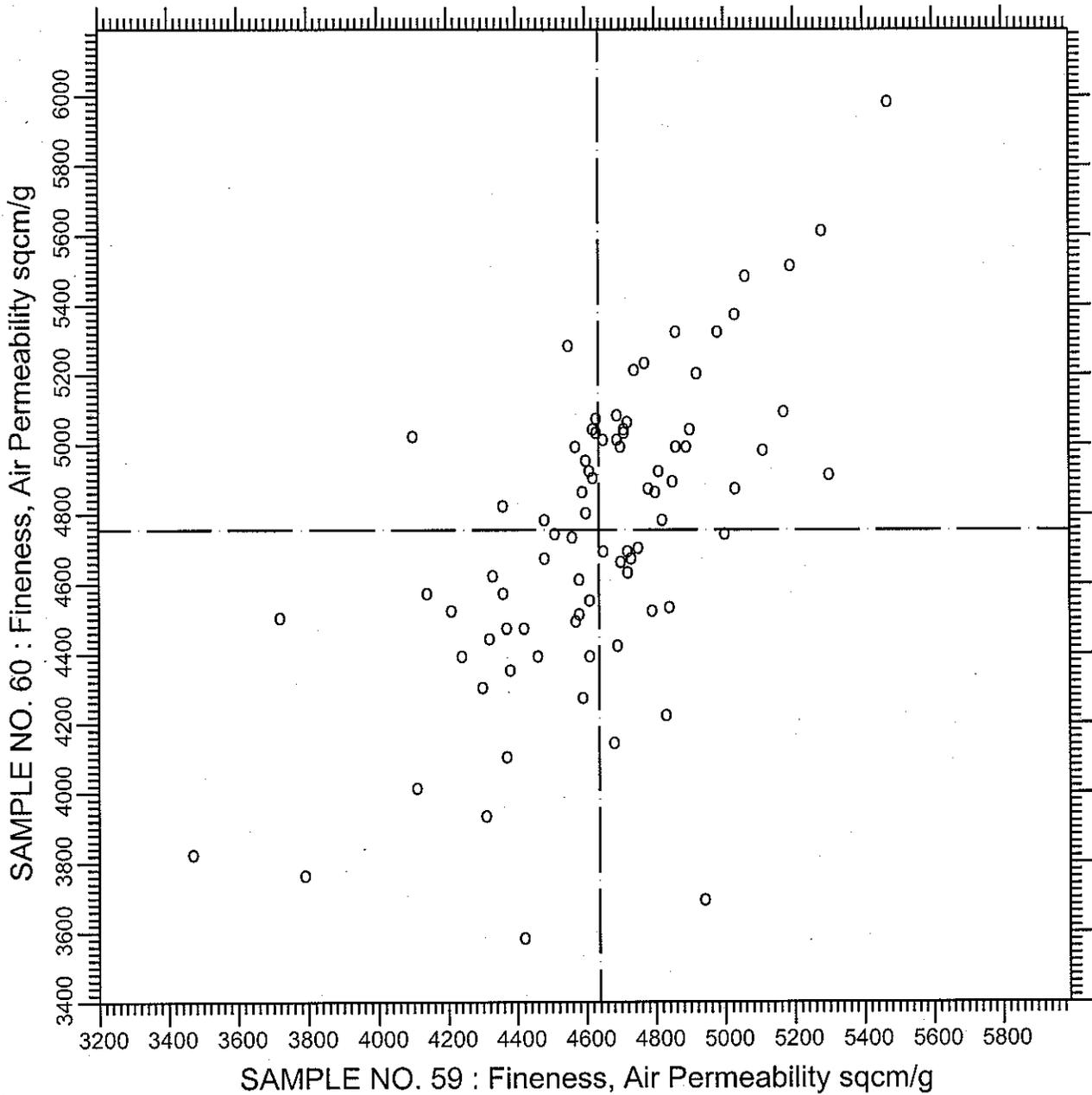
**TEST NO.230      Compressive Strength, Flow      82 POINTS**

SAMPLE NO. 59    AVE 110.39    S.D. 2.8    C.V. 2.58

SAMPLE NO. 60    AVE 110.13    S.D. 2.8    C.V. 2.54

LABS ELIMINATED 3 44 695 698 1323 2477

CCRL PROFICIENCY SAMPLE PROGRAM  
 Fineness - Air Permeability  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60

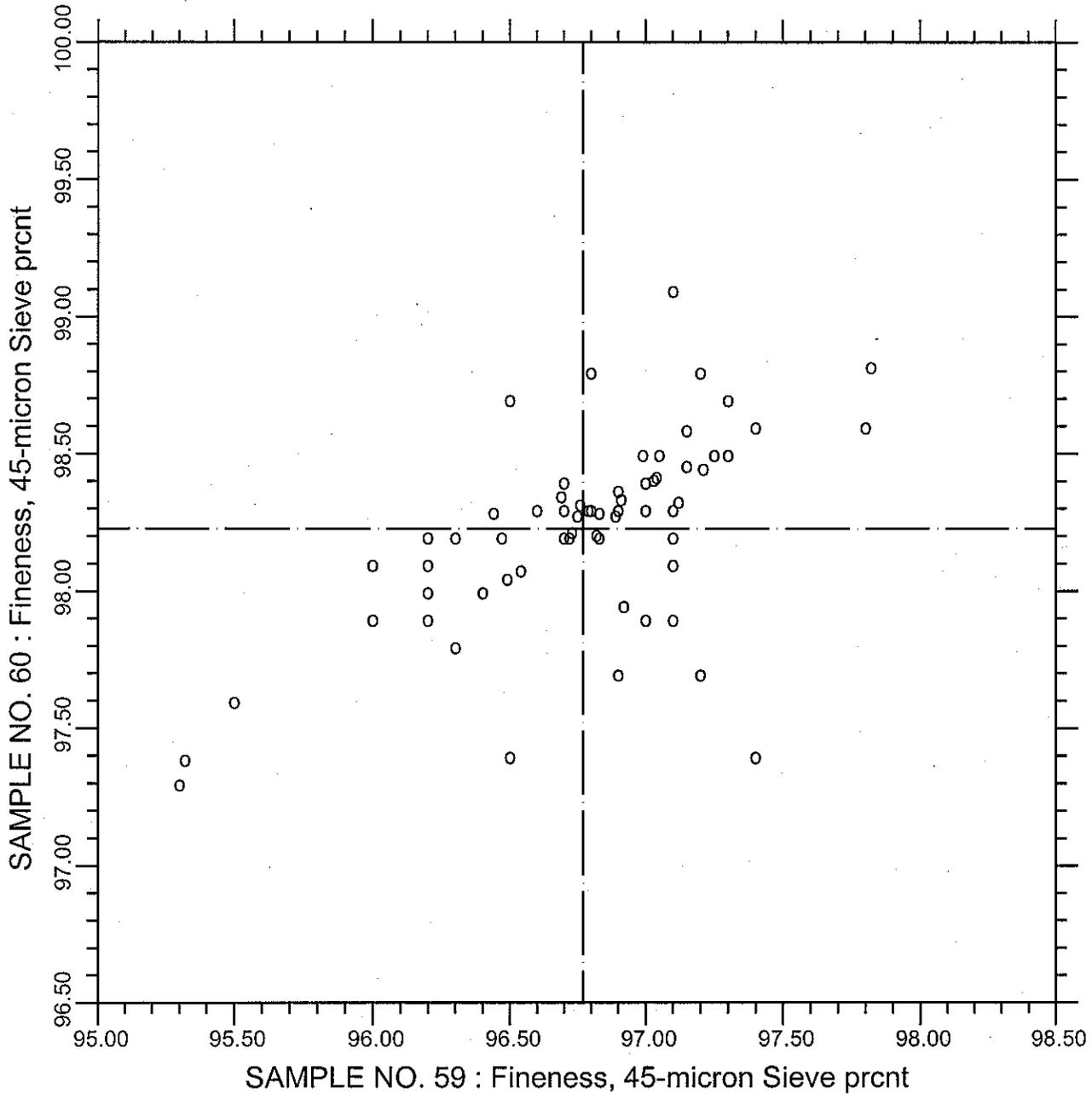


TEST NO.270      Fineness, Air Permeability      82 POINTS

SAMPLE NO. 59    AVE 4637.8    S.D. 332.2    C.V. 7.16

SAMPLE NO. 60    AVE 4755.7    S.D. 435.7    C.V. 9.16

CCRL PROFICIENCY SAMPLE PROGRAM  
 45-micron Sieve - % Passing  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.281      Fineness, 45-micron Sieve      75 POINTS

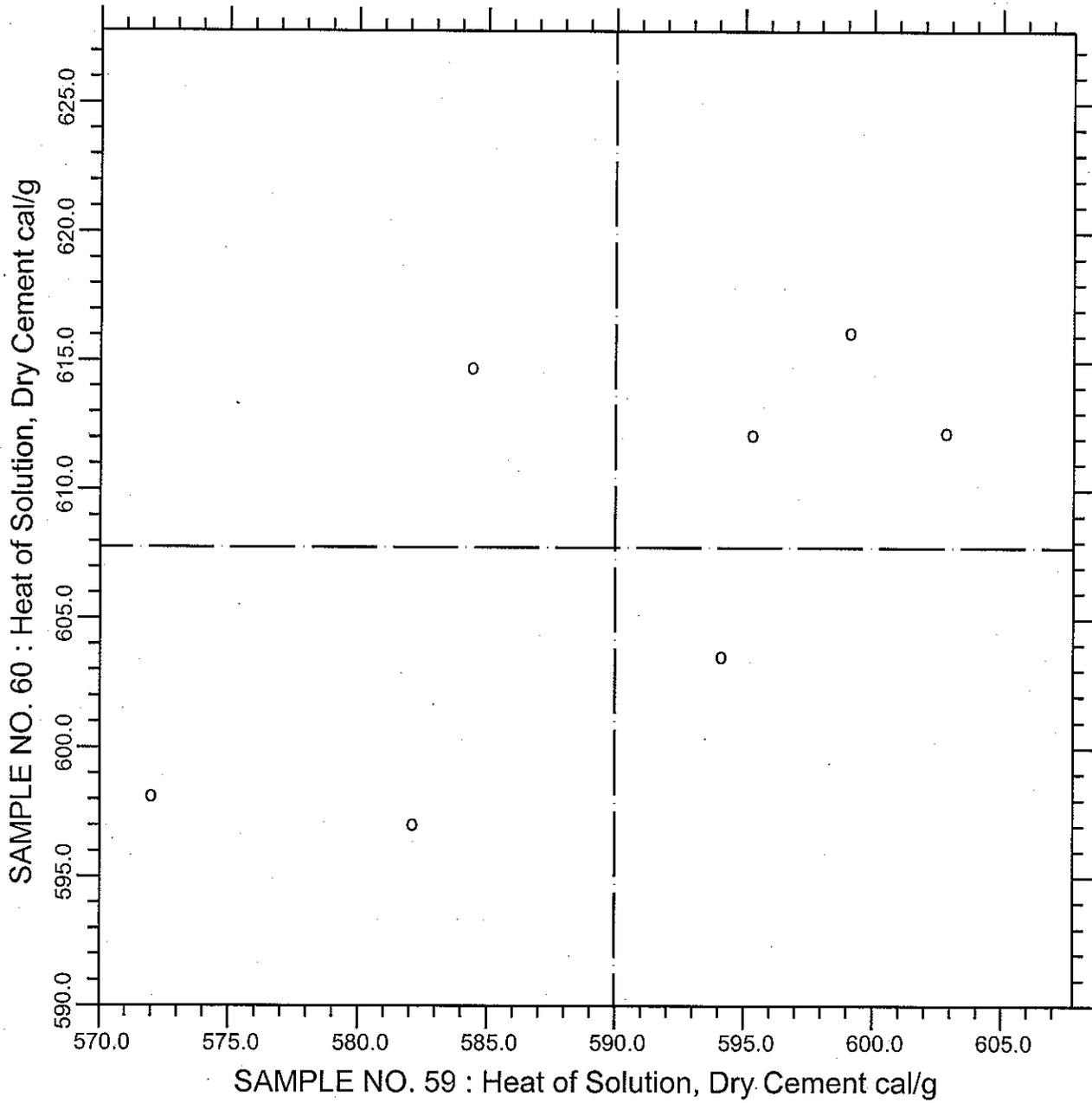
SAMPLE NO. 59	AVE	96.771	S.D.	0.47	C.V.	0.484
SAMPLE NO. 60	AVE	98.228	S.D.	0.34	C.V.	0.342
LABS ELIMINATED 34 80 958 36 1323 2466						

CCRL PROFICIENCY SAMPLE PROGRAM  
 Blended Cement Proficiency Samples No. 59 and No. 60  
 Final Report - Heat of Hydration Results  
 May 18, 2007

SUMMARY OF RESULTS

Test	#Labs	Sample No. 59			Sample No. 60		
		Average	S.D.	C.V.	Average	S.D.	C.V.
Heat Solution, Dry cal/g	7	590.0	10.9	1.84	607.8	8.0	1.32
Heat Sol, 7 day cal/g	7	520.8	11.4	2.20	543.4	8.8	1.62
Heat Sol, 28 day cal/g	6	512.4	8.4	1.63	535.0	8.6	1.61
Heat Hyd, 7 day cal/g	7	69.2	3.4	4.88	64.4	4.6	7.07
Heat Hyd, 28 day cal/g	6	78.7	6.2	7.82	73.3	4.4	6.00

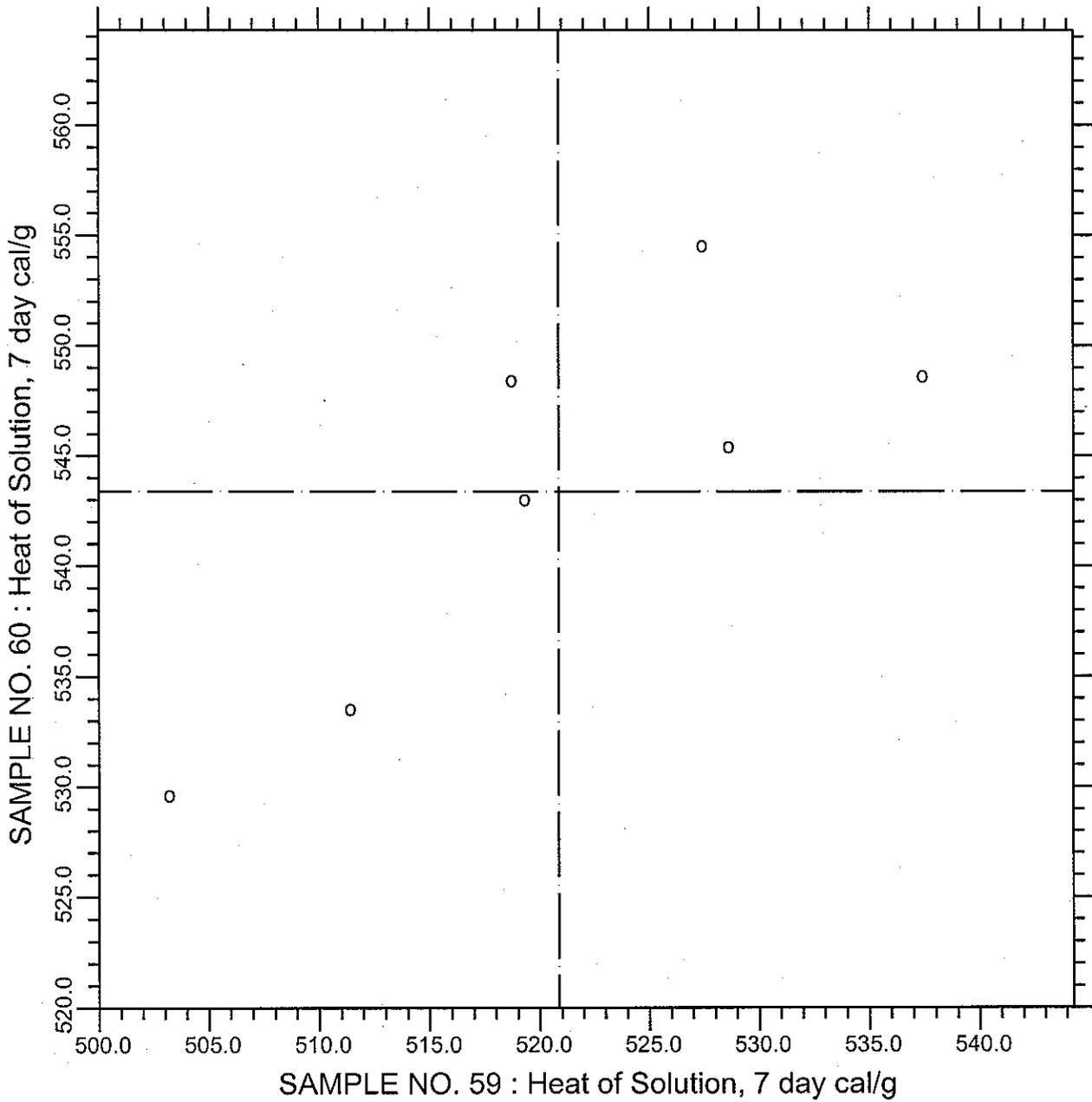
CCRL PROFICIENCY SAMPLE PROGRAM  
 Heat of Solution - Dry Cement  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.291      Heat of Solution, Dry Cement      7 POINTS

SAMPLE NO. 59    AVE 590.0    S.D. 10.9    C.V. 1.84  
 SAMPLE NO. 60    AVE 607.8    S.D. 8.0    C.V. 1.32

CCRL PROFICIENCY SAMPLE PROGRAM  
Heat of Solution - 7-day  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.292

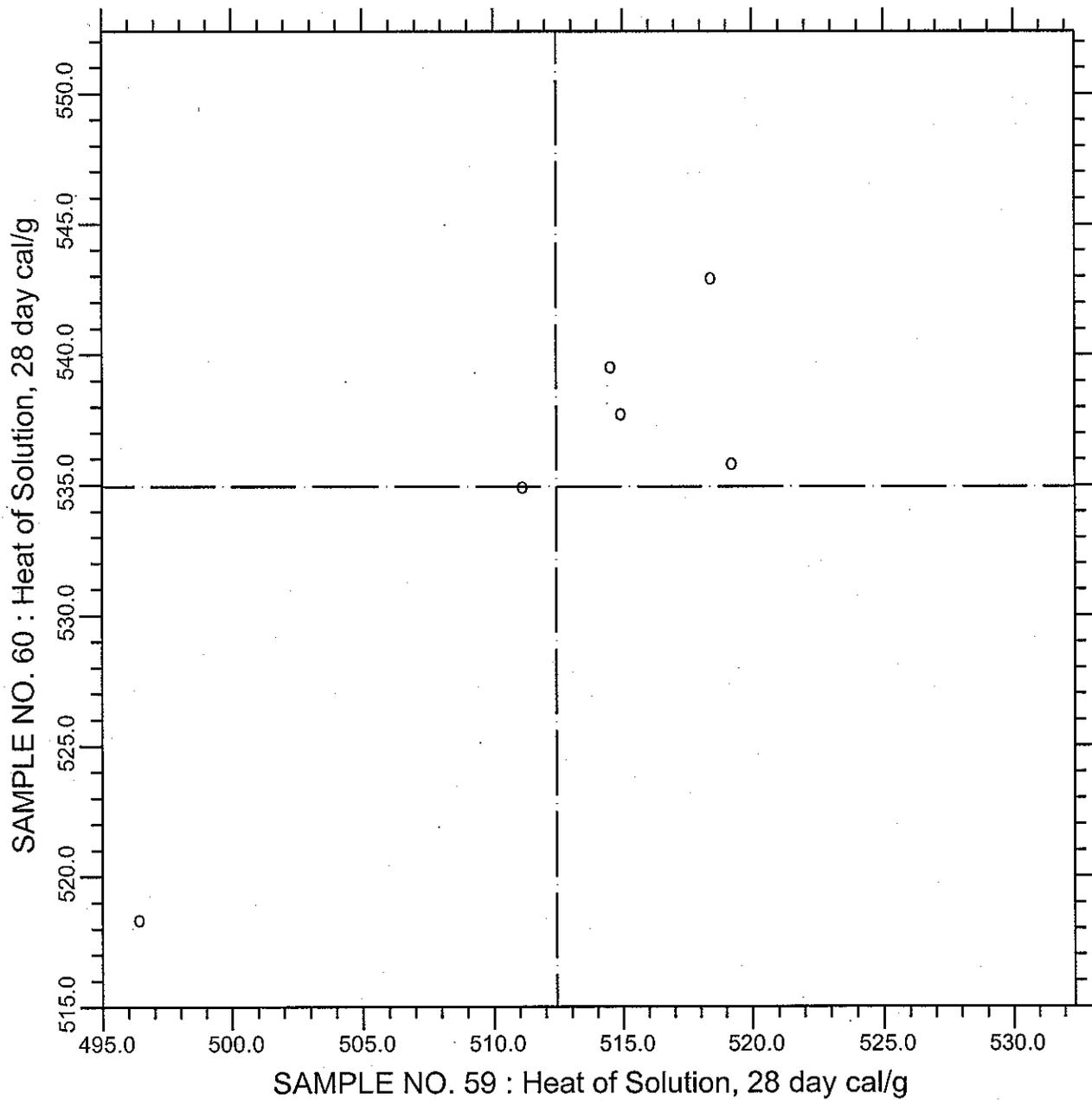
Heat of Solution, 7 day

7 POINTS

SAMPLE NO. 59 AVE 520.8 S.D. 11.4 C.V. 2.20

SAMPLE NO. 60 AVE 543.4 S.D. 8.8 C.V. 1.62

CCRL PROFICIENCY SAMPLE PROGRAM  
Heat of Solution - 28-day  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.301

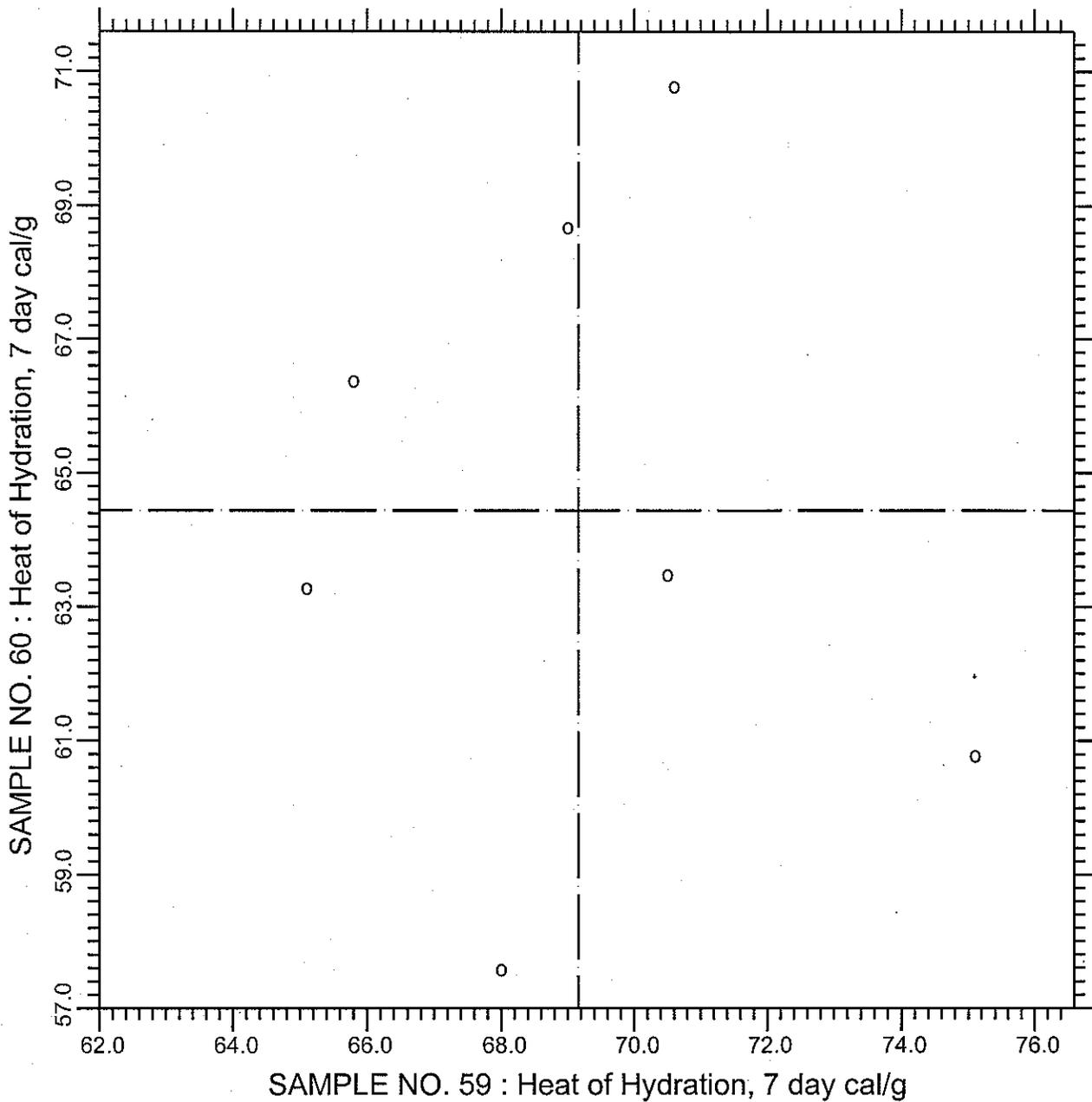
Heat of Solution, 28 day

6 POINTS

SAMPLE NO. 59 AVE 512.4 S.D. 8.4 C.V. 1.63

SAMPLE NO. 60 AVE 535.0 S.D. 8.6 C.V. 1.61

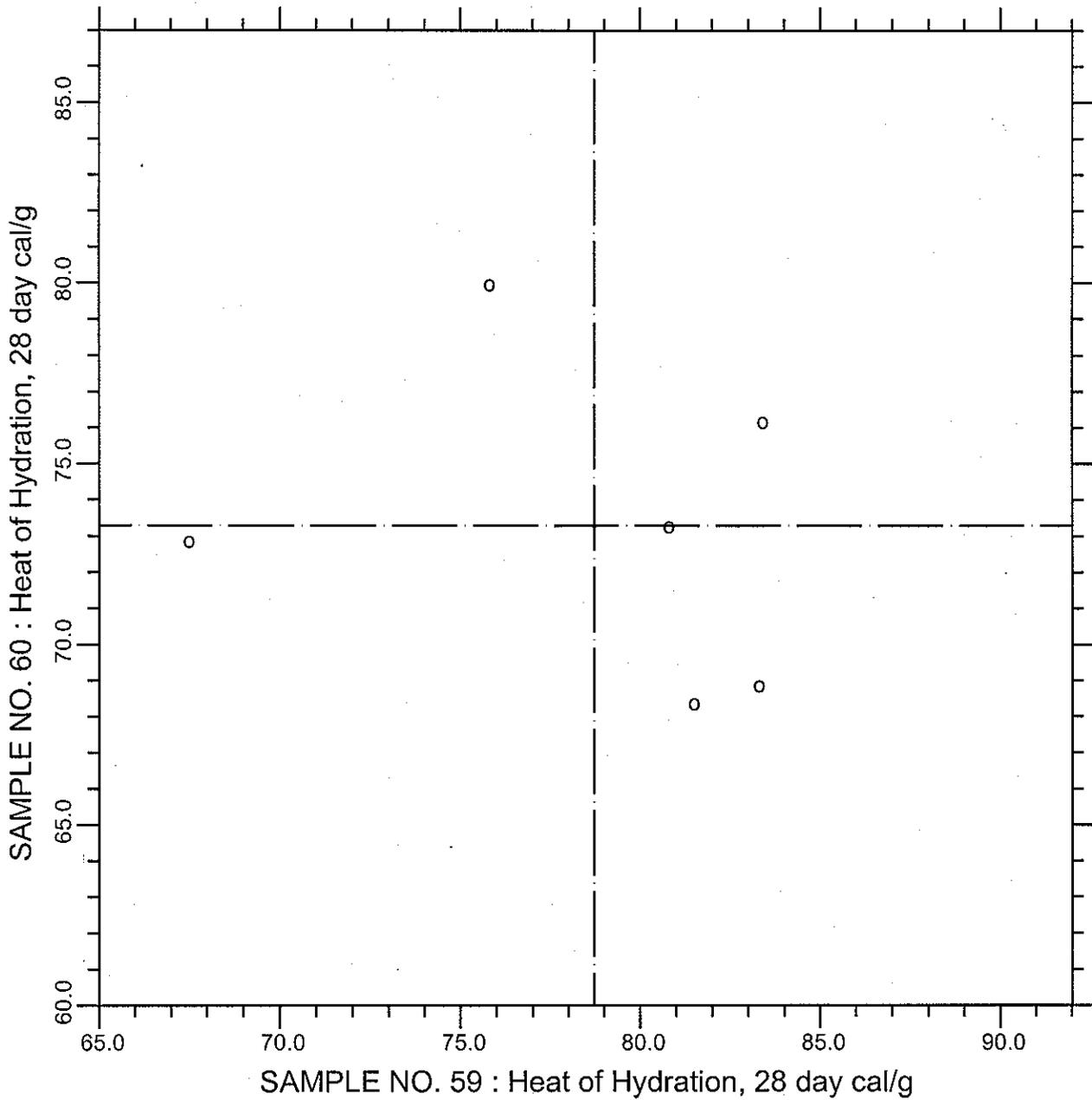
CCRL PROFICIENCY SAMPLE PROGRAM  
Heat of Hydration - 7-day  
BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.290      Heat of Hydration, 7 day      7 POINTS

SAMPLE NO. 59	AVE	69.2	S.D.	3.4	C.V.	4.88
SAMPLE NO. 60	AVE	64.4	S.D.	4.6	C.V.	7.07

CCRL PROFICIENCY SAMPLE PROGRAM  
 Heat of Hydration - 28-day  
 BLENDED CEMENT SAMPLES NO. 59 & NO. 60



TEST NO.300      Heat of Hydration, 28 day      6 POINTS

SAMPLE NO. 59	AVE	78.7	S.D.	6.2	C.V.	7.82
SAMPLE NO. 60	AVE	73.3	S.D.	4.4	C.V.	6.00