CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Blended Cement Proficiency Samples
Number 69 and Number 70

May 2012

CCRL CEMENT AN D CONCRETE REFERENCE LABORATORY

CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

May 4, 2012

TO: Participants in the CCRL Blended Cement Proficiency Sample Program

SUBJECT: Final Report on Blended Cement Proficiency Samples No. 69 and No. 70

Following is the final report for the current pair of CCRL **Blended Cement** Proficiency Samples which were distributed in February 2011. Both cements were an ASTM C595 Blended Hydraulic Cement. Sample No 69 was a Type IS (20) and No. 68 was a Type IS (20).

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/.

Note on SO_3 and Loss on Ignition (LOI) test results: For Type IS cement SO_3 and LOI results should be corrected for Sulfide Sulfur (S). Ratings for **uncorrected** SO_3 and LOI were not assigned.

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 of CCRL EXTRA Samples.

It is presently anticipated that the next Blended Cement Proficiency Samples will be distributed in February 2013.

Sincerely,

Robin K. Haupt

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

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Sponsored by Committees C-1 and C-9 of ASTM International

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. 69 and No. 70

This letter, and the material included with it, constitutes the final report and summary of results for the current pair of Blended Cement Proficiency Samples, which were distributed in February 2012. This material includes a Table of Results for individual laboratory data, a statistical Summary of Results, and a set of general Scatter Diagrams. Your unique laboratory number is displayed at the top of the individual Table of Results.

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 62nd Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.

Each laboratory receives an individualized Table of Results. The Table of Results 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.

Ratings	Range (Number of Standard Deviations)	Number (Per 100) of Laboratories achieving the rating [1]
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.

Participants subscribing to the primary 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. Participants in the secondary chemical analysis should note that laboratory ratings are assigned using primary chemical statistics.

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

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 ± 7.5 are satisfactory, labs with flow values outside this range will be flagged as a "Labs Eliminated" or "Labs Off Diagram" 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.

Sulfur Trioxide and Loss on Ignition - C595 and C114 require that sulfur trioxide (SO_3) and loss on ignition (LOI) be corrected for sulfur (S) when the cement being analyzed contains slag. For this pair of samples, SO_3 and LOI were reported as corrected or uncorrected. Uncorrected test results were not assigned ratings.

Summary of Results

Usually, averages, standard deviations, and coefficients of variation are given with all results reported, and then with one or more outlying results omitted. Sometimes, two or more recalculations with laboratories omitted, have been done for the same 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. Each laboratory will receive a complete set of diagrams according to their subscription to the given program.

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. To find your point, just plot as you would when plotting any scatter diagram. 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 ±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. 69 and No. 70

Final Report – Chemical Results
May 4, 2012

SUMMARY OF RESULTS

		Sample No.69			Sample No. 70		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (**percent**)							
	86	22.19	0.35	1.6	22.26	0.36	1.6
	*78	22.20	0.21	1.0	22.27	0.21	0.9
* Labs Eliminated - 38, 52, 54, 124, 284, 2463, 3059, 3297							
Aluminum Oxide (**percent**)							
	86	5.54	0.11	2.1	6.10	0.16	2.7
	*84	5.55	0.10	1.9	6.11	0.15	2.5
* Labs Eliminated - 1, 126							
Ferric Oxide (**percent**)							
	88	2.76	0.12	4.5	2.89	0.12	4.0
	*85	2.76	0.07	2.6	2.89	0.08	2.9
* Labs Eliminated - 958, 3297, 3431							
Calcium Oxide (**percent**)							
	86	59.66	0.65	1.09	58.33	0.82	1.41
	*84	59.64	0.41	0.69	58.28	0.60	1.04
* Labs Eliminated - 42, 52							
Magnesium Oxide (**percent**)							
	87	4.01	0.26	6.5	4.43	0.29	6.5
	*81	3.99	0.12	3.0	4.44	0.12	2.7
* Labs Eliminated - 982, 1956, 3233, 3250, 3287, 3431							
Sulfur Trioxide - Corrected for S (**percent**)							
	41	3.18	0.40	13	2.57	0.37	14
	*37	3.22	0.26	8	2.60	0.29	11
* Labs Eliminated - 207, 2251, 2466, 3235							
Sulfur Trioxide - Uncorrected for S (**percent**)							
	81	3.45	0.20	6	2.87	0.22	8
	*77	3.46	0.17	5	2.87	0.22	8
* Labs Eliminated - 975, 2251, 2466, 3235							

CCRL PROFICIENCY SAMPLE PROGRAM

Blended Cement Proficiency Samples No. 69 and No. 70

Final Report – Chemical Results
May 4, 2012

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.69 Average	S.D.	C.V.	Sample No. 70 Average	S.D.	C.V.
Loss on Ignition - Corrected for S (percent)							
	45	0.95	0.25	26	2.24	0.21	9
	*41	0.93	0.19	20	2.24	0.21	10
* Labs Eliminated - 2251, 2464, 2466, 3235							
Loss on Ignition - Uncorrected for S (percent)							
	79	0.74	0.16	21.1	1.97	0.15	7.6
	*73	0.72	0.14	19.0	1.96	0.12	6.2
* Labs Eliminated - 38, 605, 2251, 2464, 2466, 3235							
Sodium Oxide (percent)							
	80	0.135	0.134	99	0.204	0.117	57
	*68	0.120	0.021	17	0.194	0.019	10
* Labs Eliminated - 354, 690, 1251, 2251, 2360, 2363, 2463, 2464, 2477, 2490, 3233, 3297							
Potassium Oxide (percent)							
	83	0.70	0.04	5.5	0.46	0.07	14.3
	*78	0.70	0.02	3.0	0.46	0.02	3.5
* Labs Eliminated - 50, 126, 1956, 2463, 3297							
Titanium Dioxide (percent)							
	64	0.32	0.323	100.3	0.38	0.236	62.4
	*61	0.28	0.009	3.2	0.35	0.012	3.3
* Labs Eliminated - 2490, 3233, 3297							
Phosphorus Pentoxide (percent)							
	67	0.114	0.019	16.6	0.132	0.027	20.1
	*63	0.114	0.006	5.4	0.130	0.007	5.2
* Labs Eliminated - 246, 1799, 2463, 3233							
Zinc Oxide (percent)							
	29	0.011	0.017	150.0	0.034	0.004	10.8
	*27	0.008	0.002	20.8	0.033	0.004	10.6
* Labs Eliminated - 542, 695							

CCRL PROFICIENCY SAMPLE PROGRAM

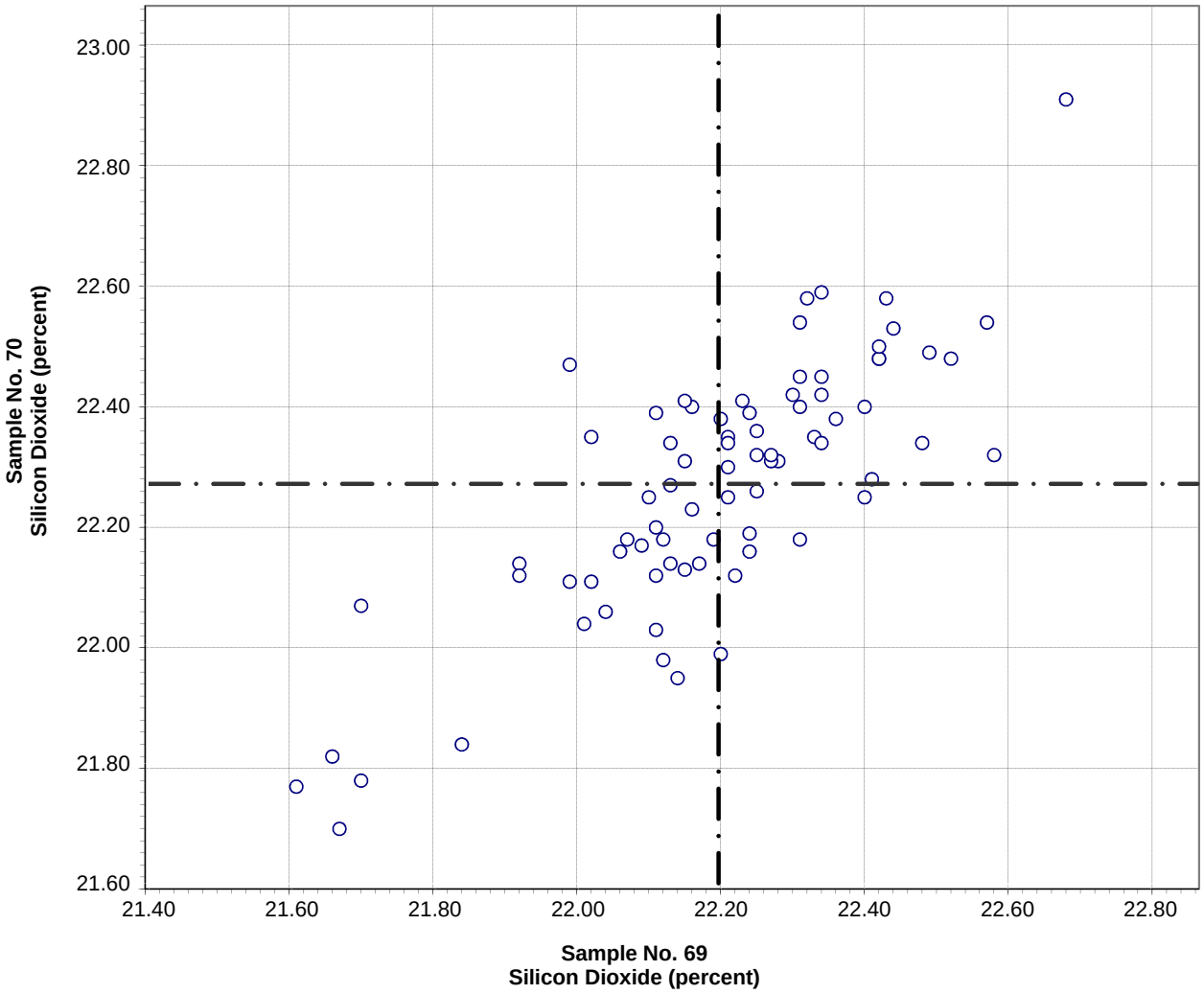
Blended Cement Proficiency Samples No. 69 and No. 70

Final Report – Chemical Results
May 4, 2012

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.69 Average	S.D.	C.V.	Sample No. 70 Average	S.D.	C.V.
Manganic Oxide (**percent**)							
	51	0.522	0.030	5.7	0.110	0.013	11.8
	*48	0.522	0.021	4.1	0.108	0.007	6.7
* Labs Eliminated - 124, 2463, 3297							
Sulfide Sulfur (**percent**)							
	30	0.207	0.260	126	0.249	0.214	86
	*25	0.134	0.046	34	0.188	0.042	23
* Labs Eliminated - 74, 101, 126, 2464, 3235							
Chloride (**percent**)							
	33	0.025	0.016	65	0.020	0.022	111
	*29	0.021	0.007	35	0.013	0.005	34
* Labs Eliminated - 126, 158, 255, 497							
Insoluble Residue (**percent**)							
	79	0.20	0.13	66	0.52	0.14	26
	*75	0.19	0.12	61	0.54	0.11	20
* Labs Eliminated - 51, 695, 1715, 3059							
Chromium Oxide (**percent**)							
	30	0.016	0.007	42	0.013	0.007	52
	*25	0.015	0.002	15	0.011	0.002	17
* Labs Eliminated - 10, 126, 958, 2462, 2463							

CCRL Proficiency Sample Program
Silicon Dioxide
BLENDED CEMENT Samples No. 69 and No. 70

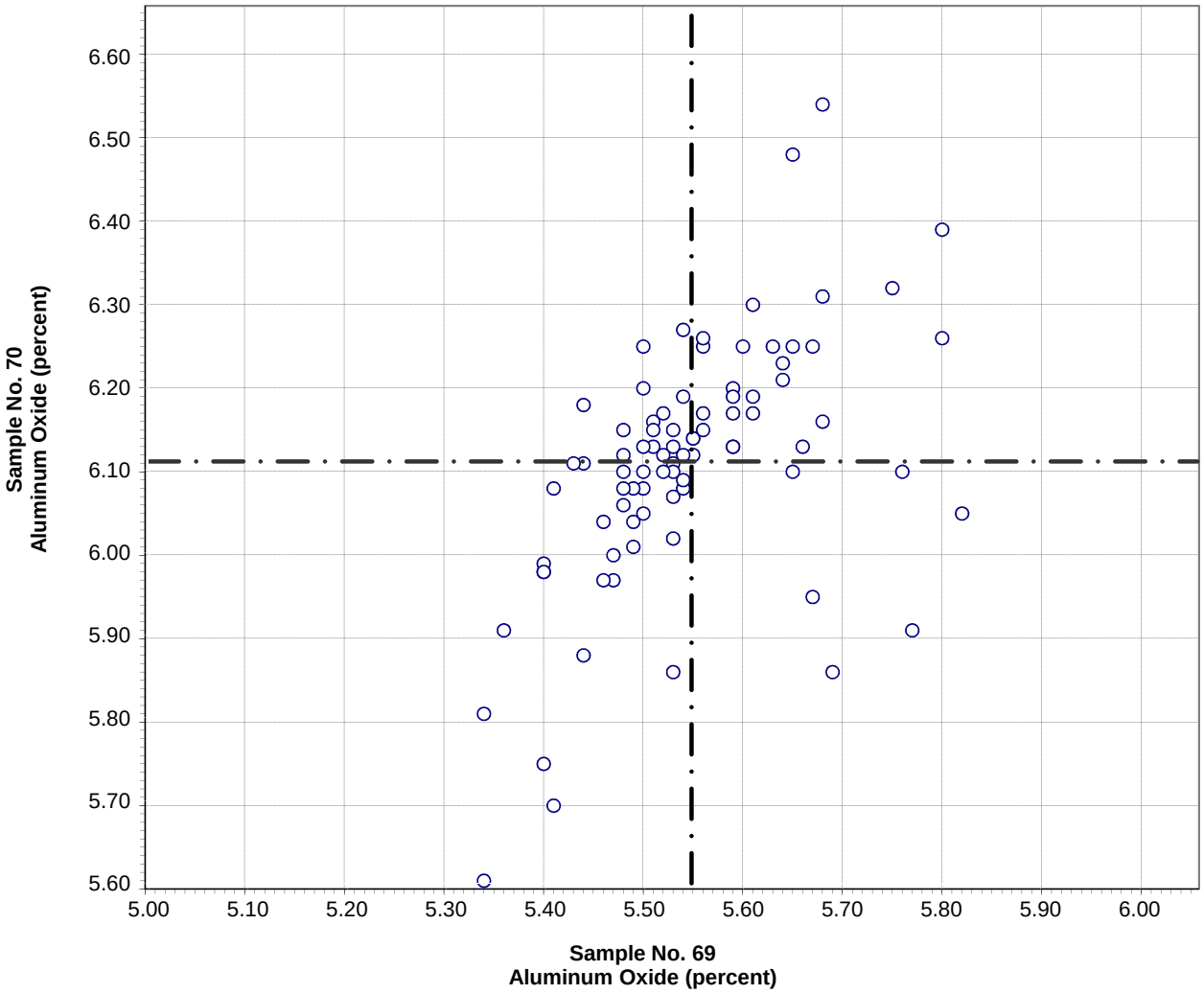


Test No. 10 Silicon Dioxide 78 Points

Sample No. 69	Ave	22.20	S.D.	0.21	C.V. 1.0
Sample No. 70	Ave	22.27	S.D.	0.21	C.V. 0.9

Labs Eliminated: 38, 52, 54, 124, 284, 2463, 3059, 3297

CCRL Proficiency Sample Program
Aluminum Oxide
BLENDED CEMENT Samples No. 69 and No. 70

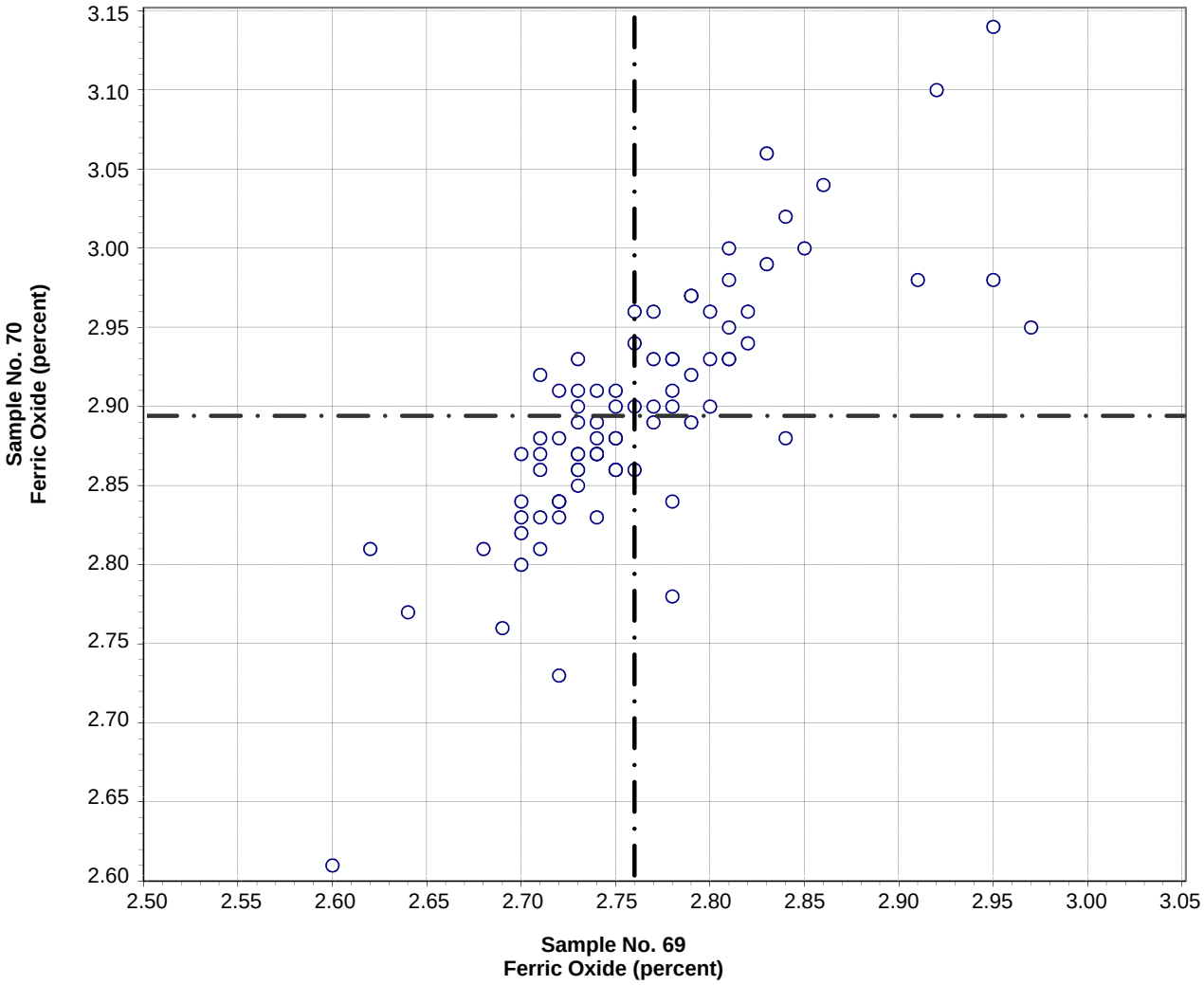


Test No. 21 Aluminum Oxide 84 Points

Sample No. 69	Ave	5.55	S.D.	0.10	C.V. 1.9
Sample No. 70	Ave	6.11	S.D.	0.15	C.V. 2.5

Labs Eliminated: 1, 126

CCRL Proficiency Sample Program
Ferric Oxide
BLENDED CEMENT Samples No. 69 and No. 70



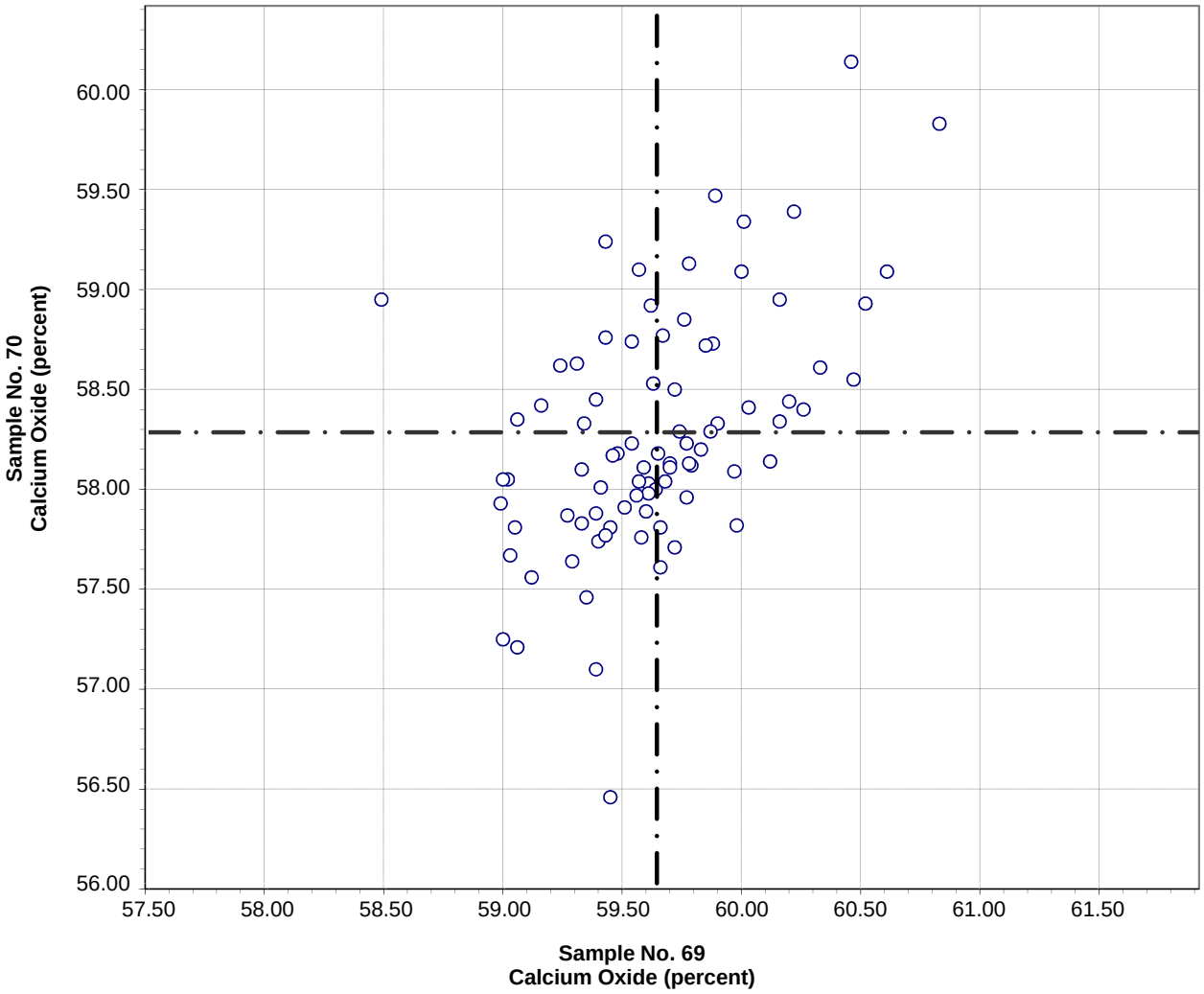
Test No. 30 Ferric Oxide 84 Points

Sample No. 69	Ave	2.76	S.D.	0.07	C.V. 2.6
Sample No. 70	Ave	2.89	S.D.	0.08	C.V. 2.9

Labs Eliminated: 958, 3297, 3431

Labs off Diagram: 3135

CCRL Proficiency Sample Program
Calcium Oxide
BLENDED CEMENT Samples No. 69 and No. 70

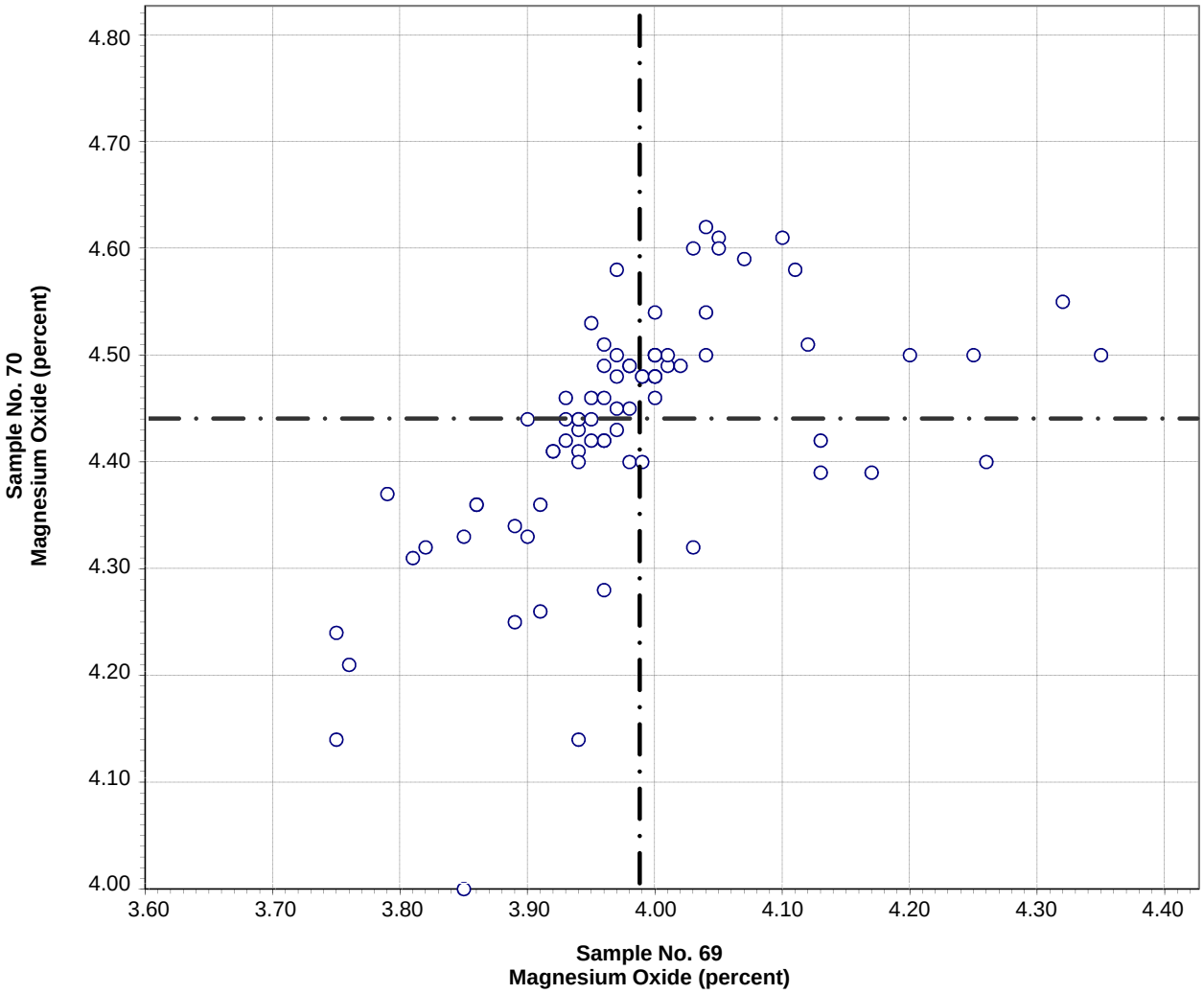


Test No. 40 Calcium Oxide 84 Points

Sample No. 69	Ave	59.64	S.D.	0.41	C.V.	0.69
Sample No. 70	Ave	58.28	S.D.	0.60	C.V.	1.04

Labs Eliminated: 42, 52

CCRL Proficiency Sample Program
Magnesium Oxide
BLENDED CEMENT Samples No. 69 and No. 70



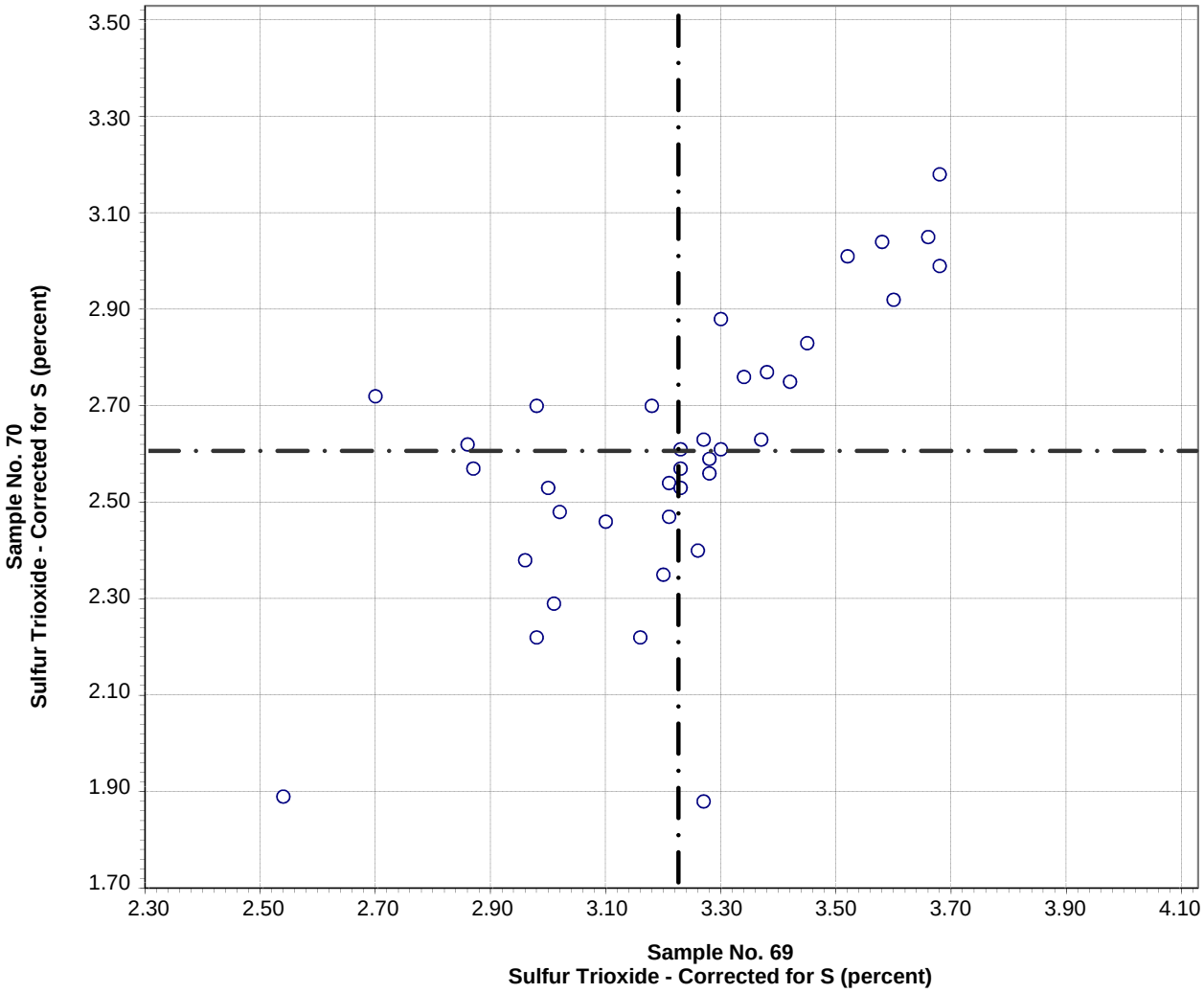
Test No. 50 Magnesium Oxide 80 Points

Sample No. 69	Ave	3.99	S.D.	0.12	C.V. 3.0
Sample No. 70	Ave	4.44	S.D.	0.12	C.V. 2.7

Labs Eliminated: 982, 1956, 3233, 3250, 3287, 3431

Labs off Diagram: 52

CCRL Proficiency Sample Program
Sulfur Trioxide - Corrected for S
BLENDED CEMENT Samples No. 69 and No. 70

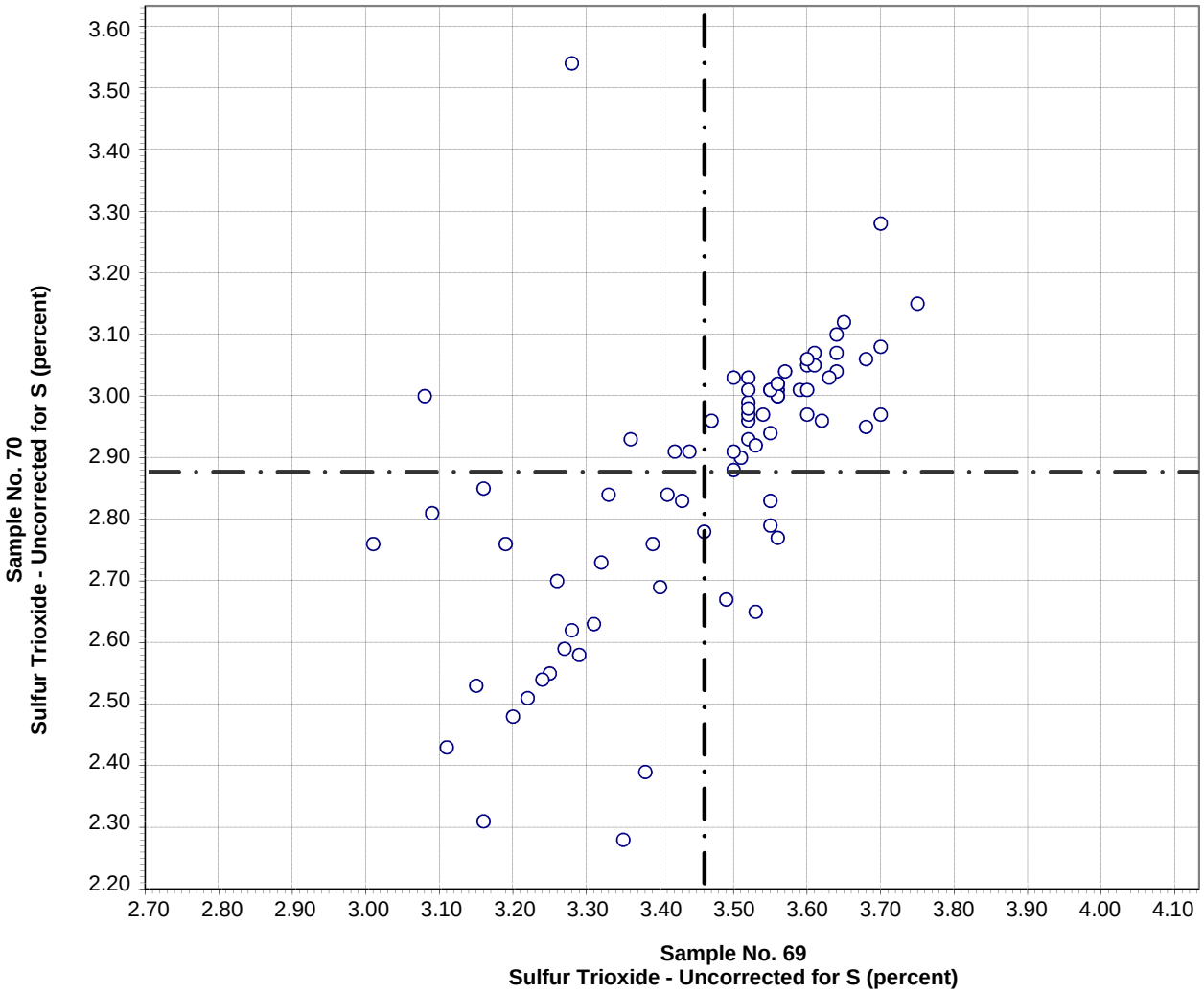


Test No. 61 Sulfur Trioxide - Corrected for S 37 Points

Sample No. 69	Ave	3.22	S.D.	0.26	C.V. 8
Sample No. 70	Ave	2.60	S.D.	0.29	C.V. 11

Labs Eliminated: 207, 2251, 2466, 3235

CCRL Proficiency Sample Program
Sulfur Trioxide - Uncorrected for S
BLENDED CEMENT Samples No. 69 and No. 70

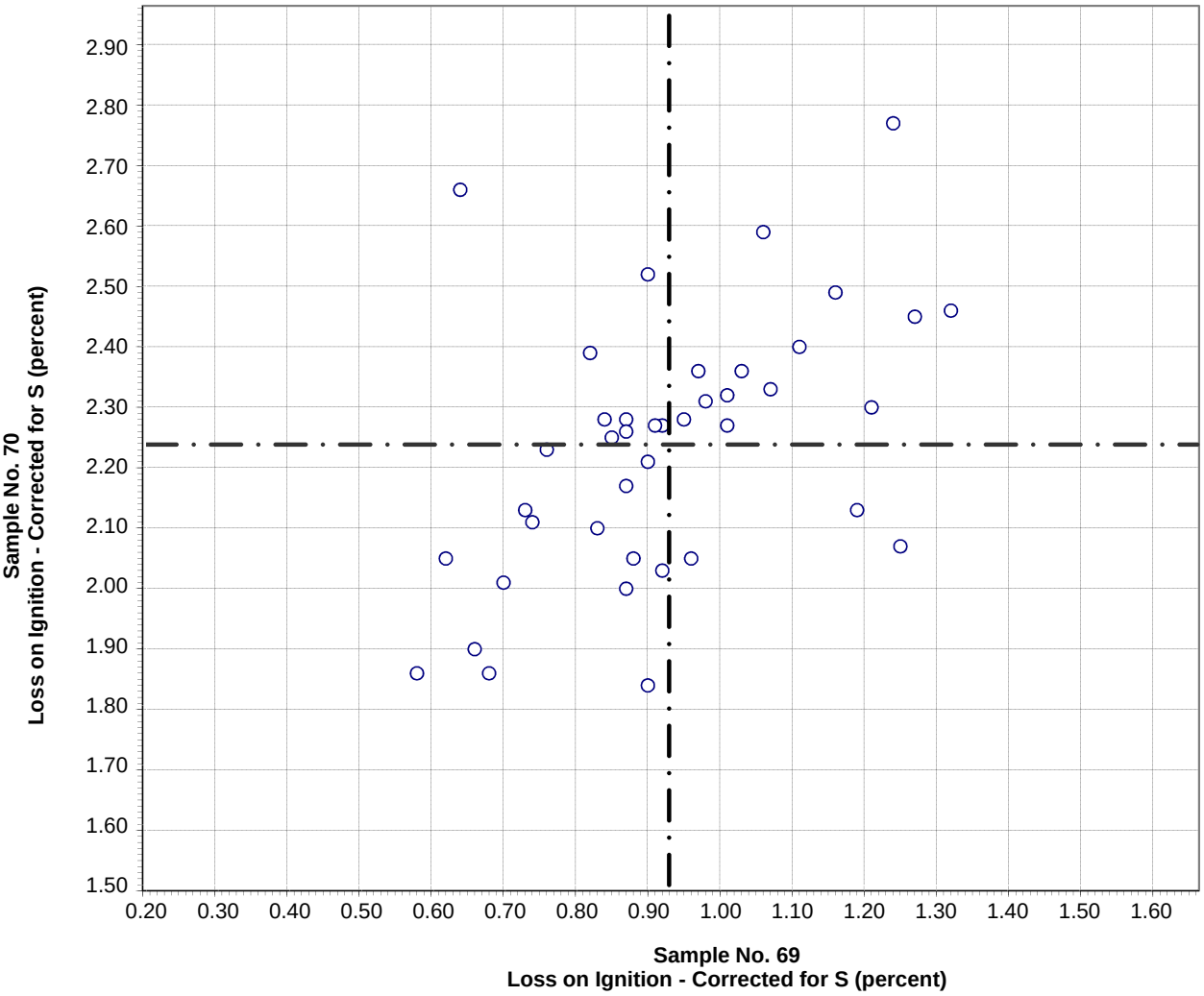


Test No. 62 Sulfur Trioxide - Uncorrected for S 77 Points

Sample No. 69	Ave	3.46	S.D.	0.17	C.V. 5
Sample No. 70	Ave	2.87	S.D.	0.22	C.V. 8

Labs Eliminated: 975, 2251, 2466, 3235

CCRL Proficiency Sample Program
Loss on Ignition - Corrected for S
BLENDED CEMENT Samples No. 69 and No. 70

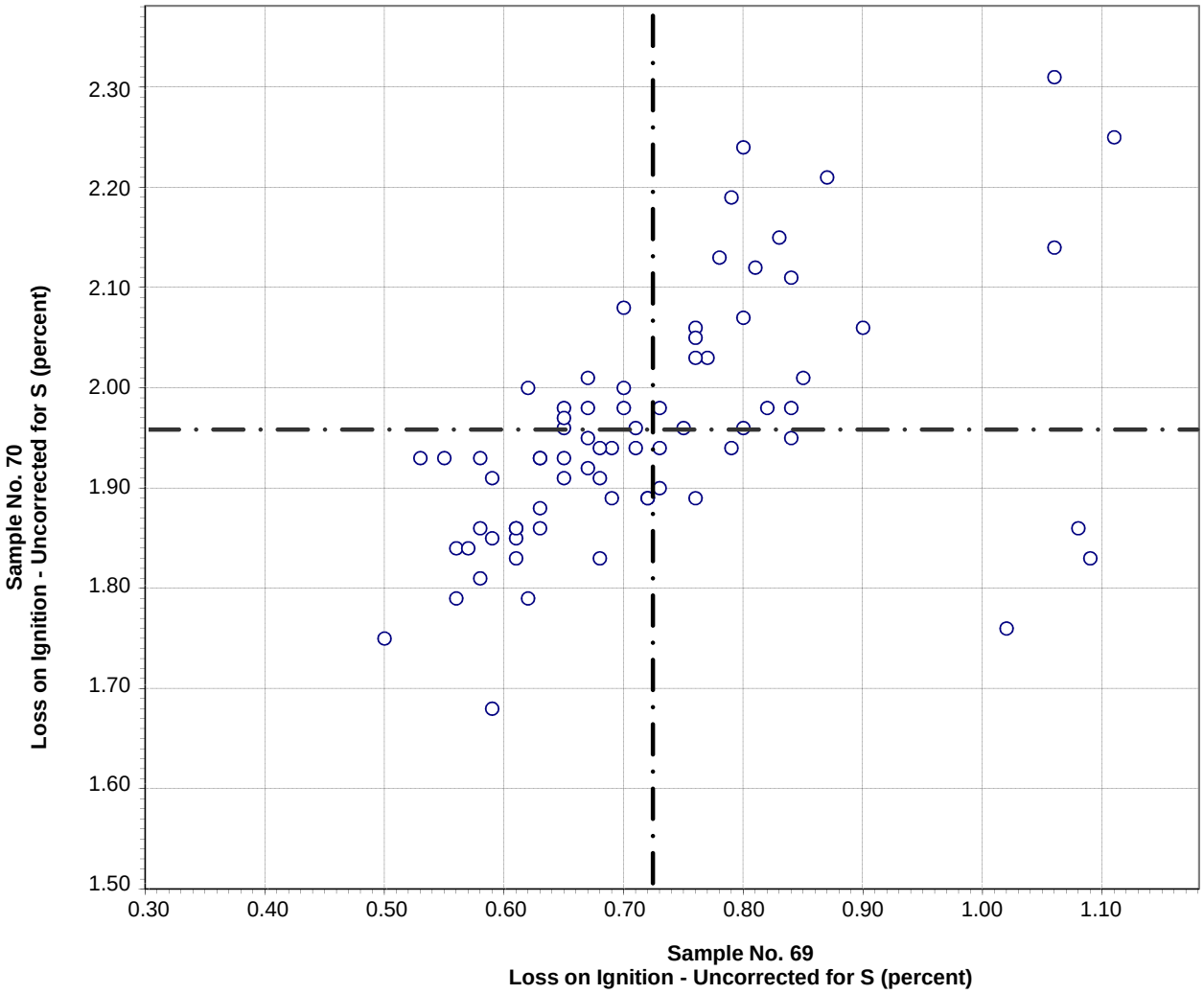


Test No. 71 Loss on Ignition - Corrected for S 41 Points

Sample No. 69	Ave	0.93	S.D.	0.19	C.V.	20
Sample No. 70	Ave	2.24	S.D.	0.21	C.V.	10

Labs Eliminated: 2251, 2464, 2466, 3235

CCRL Proficiency Sample Program
Loss on Ignition - Uncorrected for S
BLENDED CEMENT Samples No. 69 and No. 70

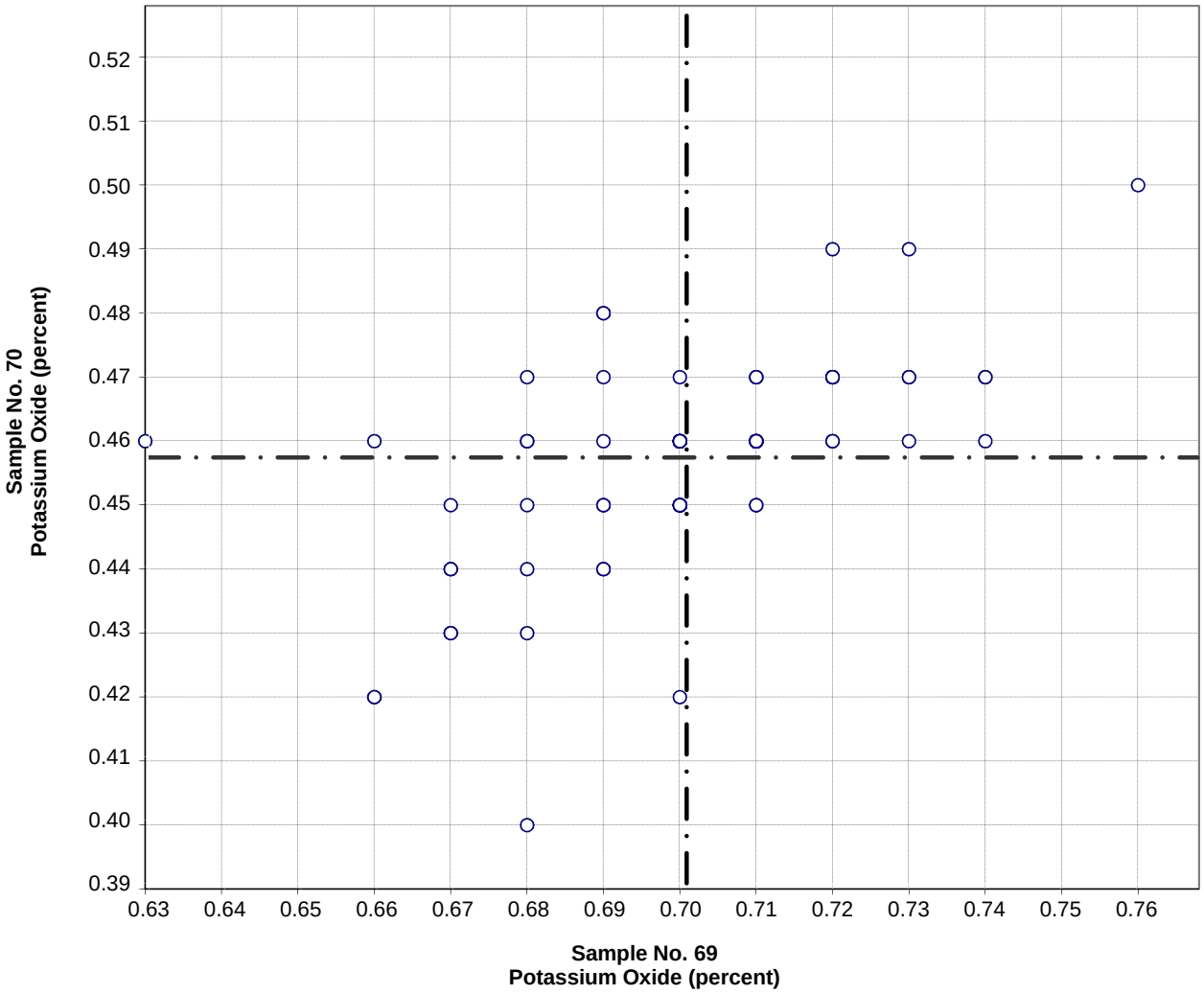


Test No. 72 Loss on Ignition - Uncorrected for S 73 Points

Sample No. 69	Ave	0.72	S.D.	0.14	C.V. 19.0
Sample No. 70	Ave	1.96	S.D.	0.12	C.V. 6.2

Labs Eliminated: 38, 605, 2251, 2464, 2466, 3235

CCRL Proficiency Sample Program
Potassium Oxide
BLENDED CEMENT Samples No. 69 and No. 70

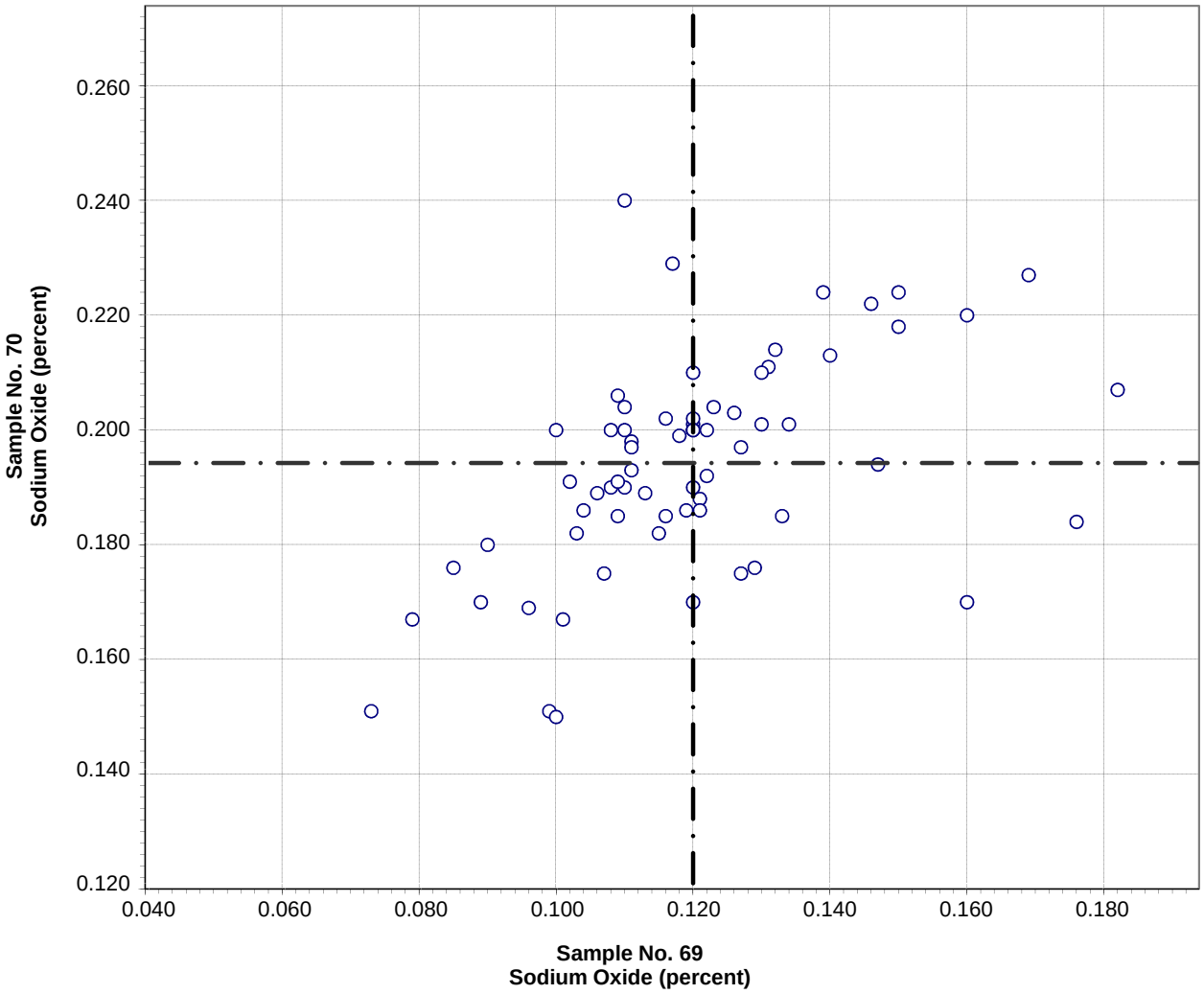


Test No. 100 Potassium Oxide 78 Points

Sample No. 69 Ave 0.70 S.D. 0.02 C.V. 3.0
Sample No. 70 Ave 0.46 S.D. 0.02 C.V. 3.5

Labs Eliminated: 50, 126, 1956, 2463, 3297

CCRL Proficiency Sample Program
Sodium Oxide
BLENDED CEMENT Samples No. 69 and No. 70

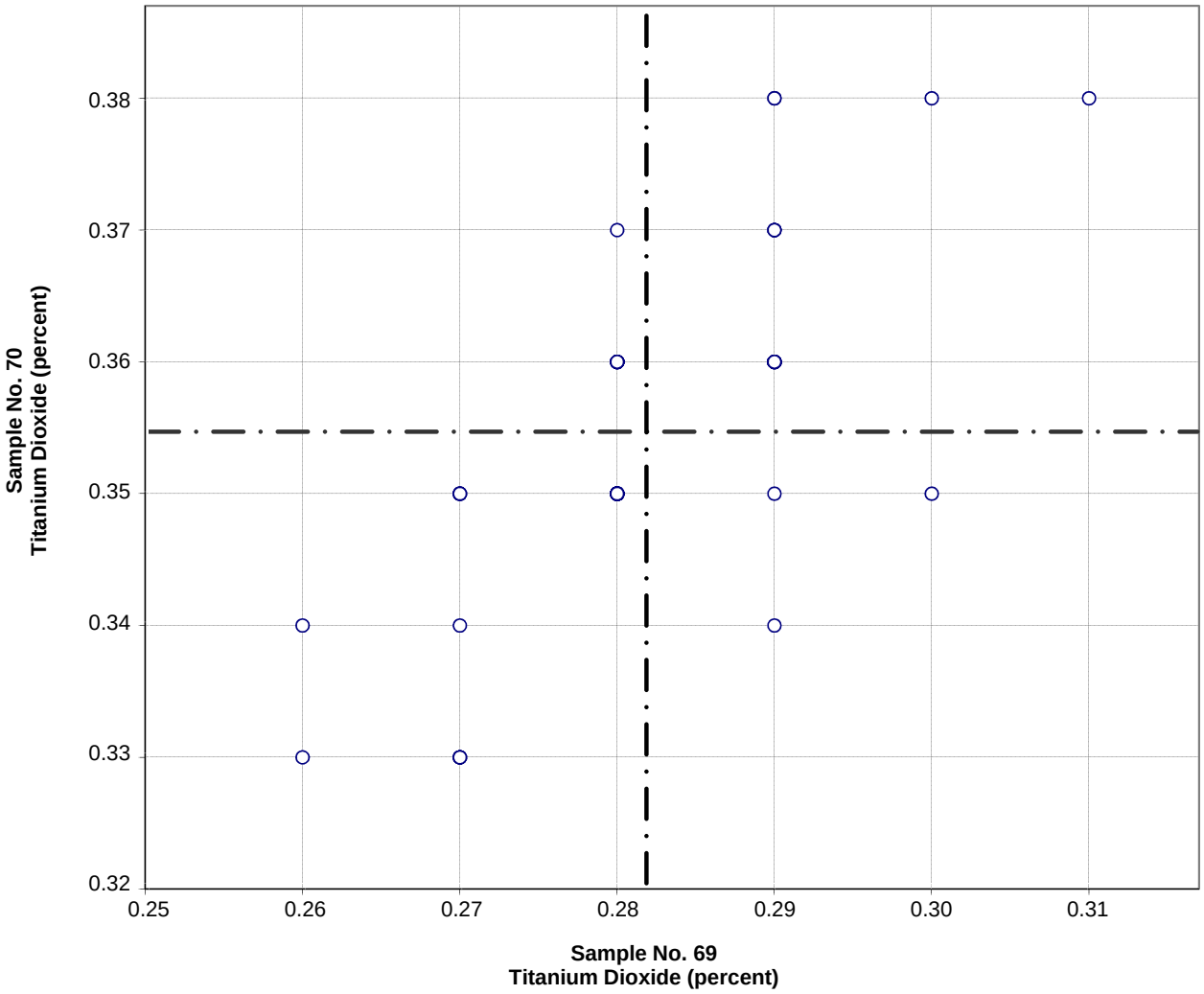


Test No. 90 Sodium Oxide 68 Points

Sample No. 69 Ave 0.120 S.D. 0.021 C.V. 17
Sample No. 70 Ave 0.194 S.D. 0.019 C.V. 10

Labs Eliminated: 354, 690, 1251, 2251, 2360, 2363, 2463, 2464, 2477, 2490, 3233, 3297

CCRL Proficiency Sample Program
Titanium Dioxide
BLENDED CEMENT Samples No. 69 and No. 70

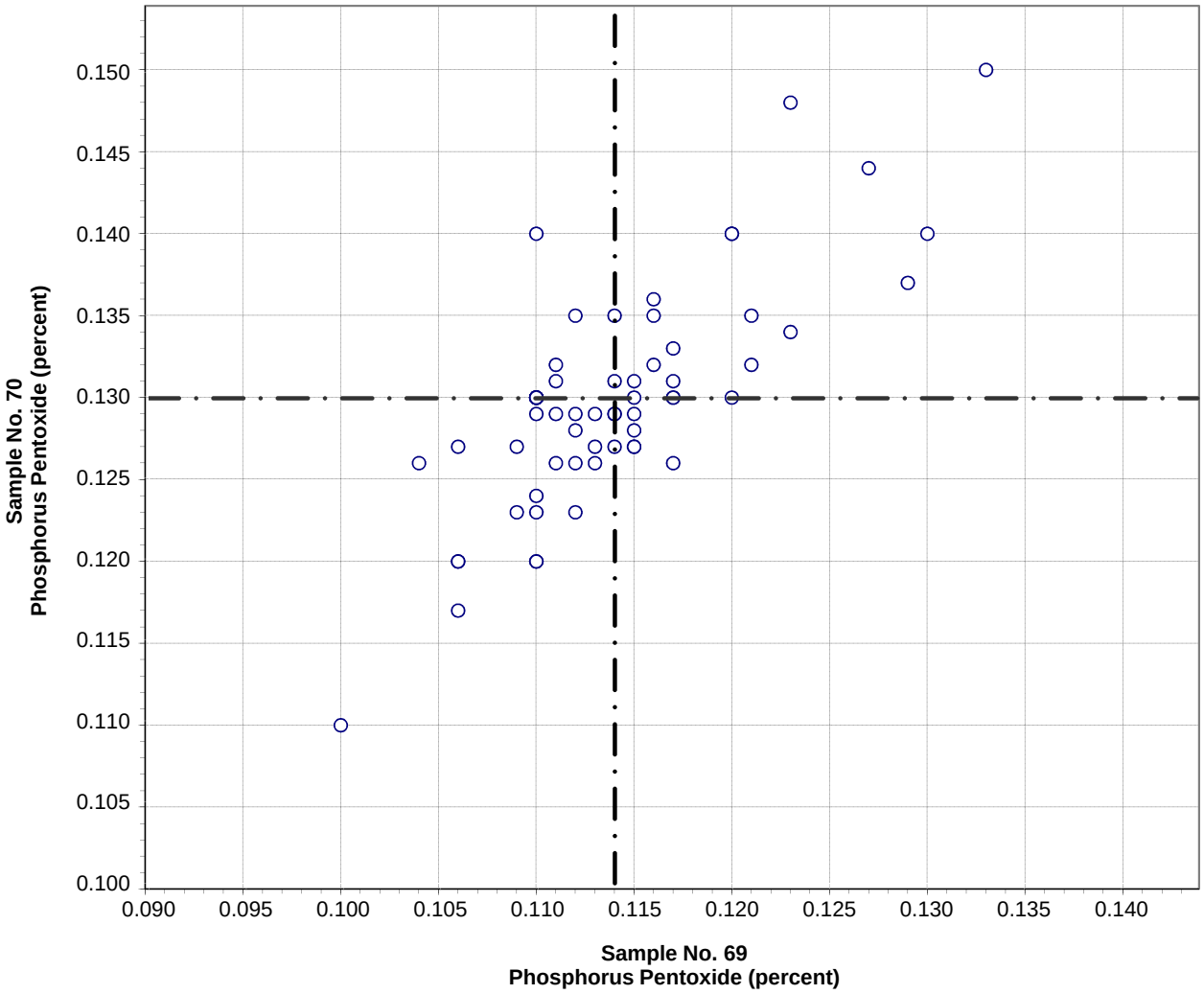


Test No. 103 Titanium Dioxide 61 Points

Sample No. 69	Ave	0.28	S.D.	0.009	C.V.	3.2
Sample No. 70	Ave	0.35	S.D.	0.012	C.V.	3.3

Labs Eliminated: 2490, 3233, 3297

CCRL Proficiency Sample Program
Phosphorus Pentoxide
BLENDED CEMENT Samples No. 69 and No. 70

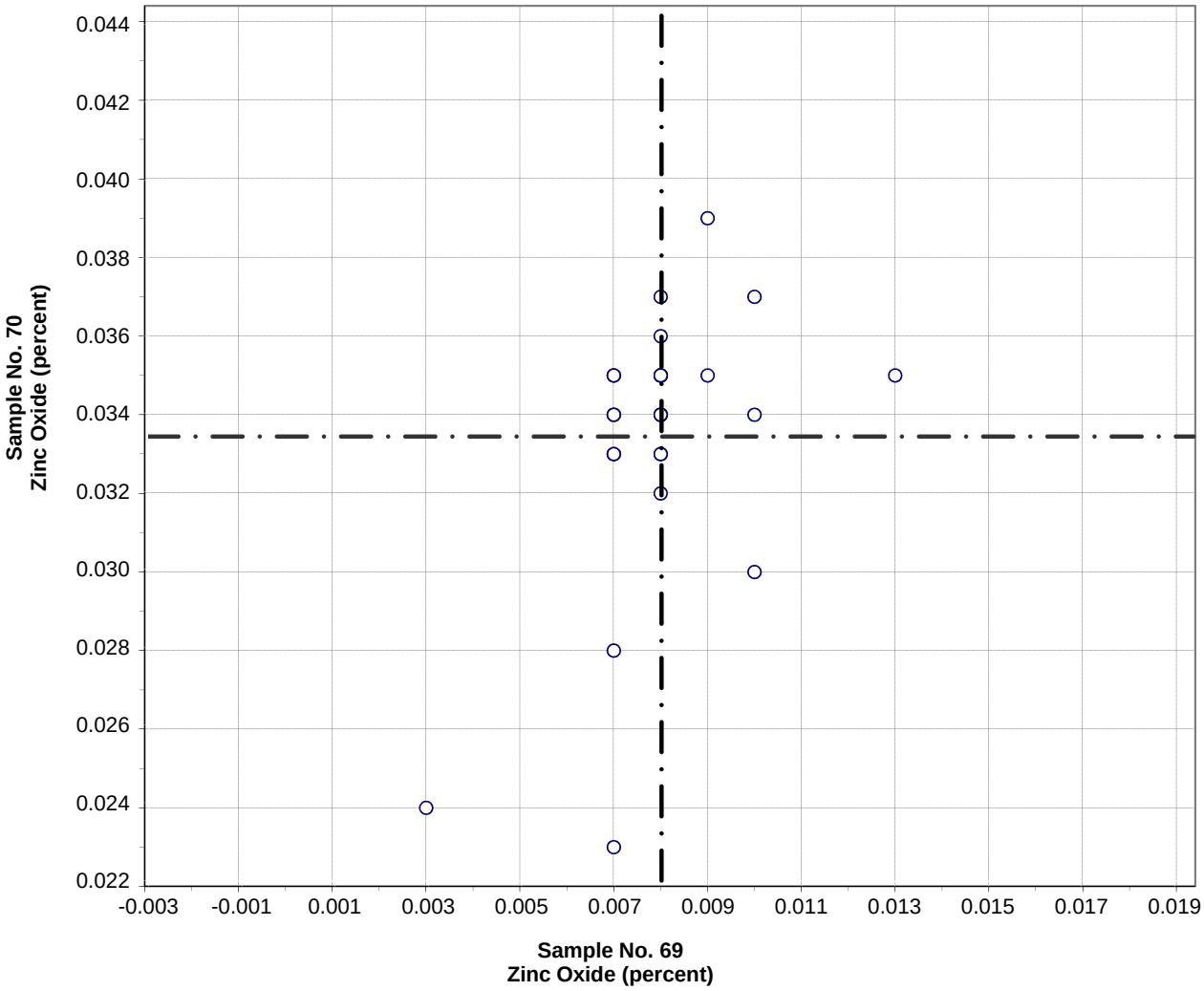


Test No. 102 Phosphorus Pentoxide 63 Points

Sample No. 69	Ave	0.114	S.D.	0.006	C.V.	5.4
Sample No. 70	Ave	0.130	S.D.	0.007	C.V.	5.2

Labs Eliminated: 246, 1799, 2463, 3233

CCRL Proficiency Sample Program
Zinc Oxide
BLENDED CEMENT Samples No. 69 and No. 70

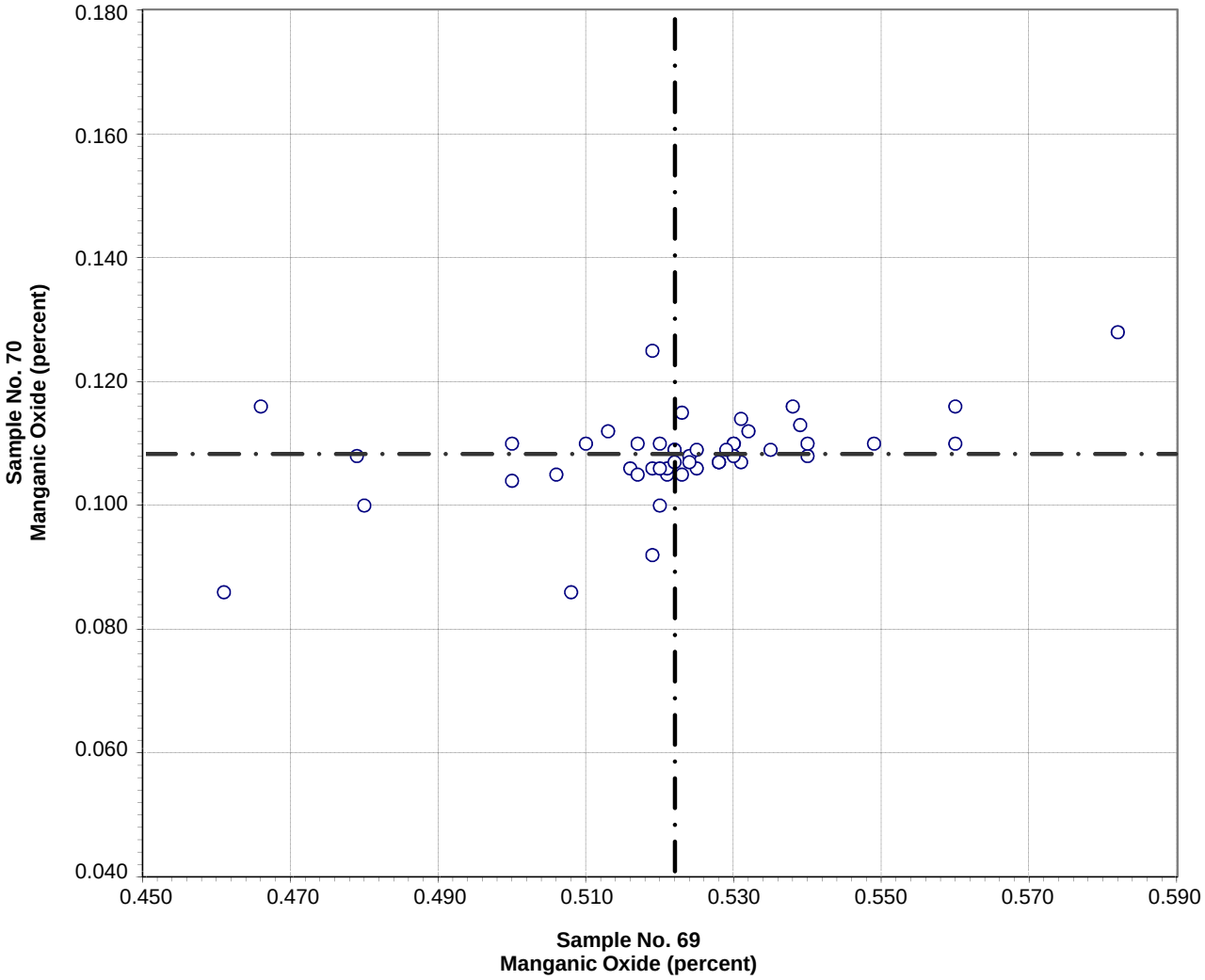


Test No. 99 Zinc Oxide 27 Points

Sample No. 69	Ave	0.008	S.D.	0.002	C.V.	20.8
Sample No. 70	Ave	0.033	S.D.	0.004	C.V.	10.6

Labs Eliminated: 542, 695

CCRL Proficiency Sample Program
Manganic Oxide
BLENDED CEMENT Samples No. 69 and No. 70

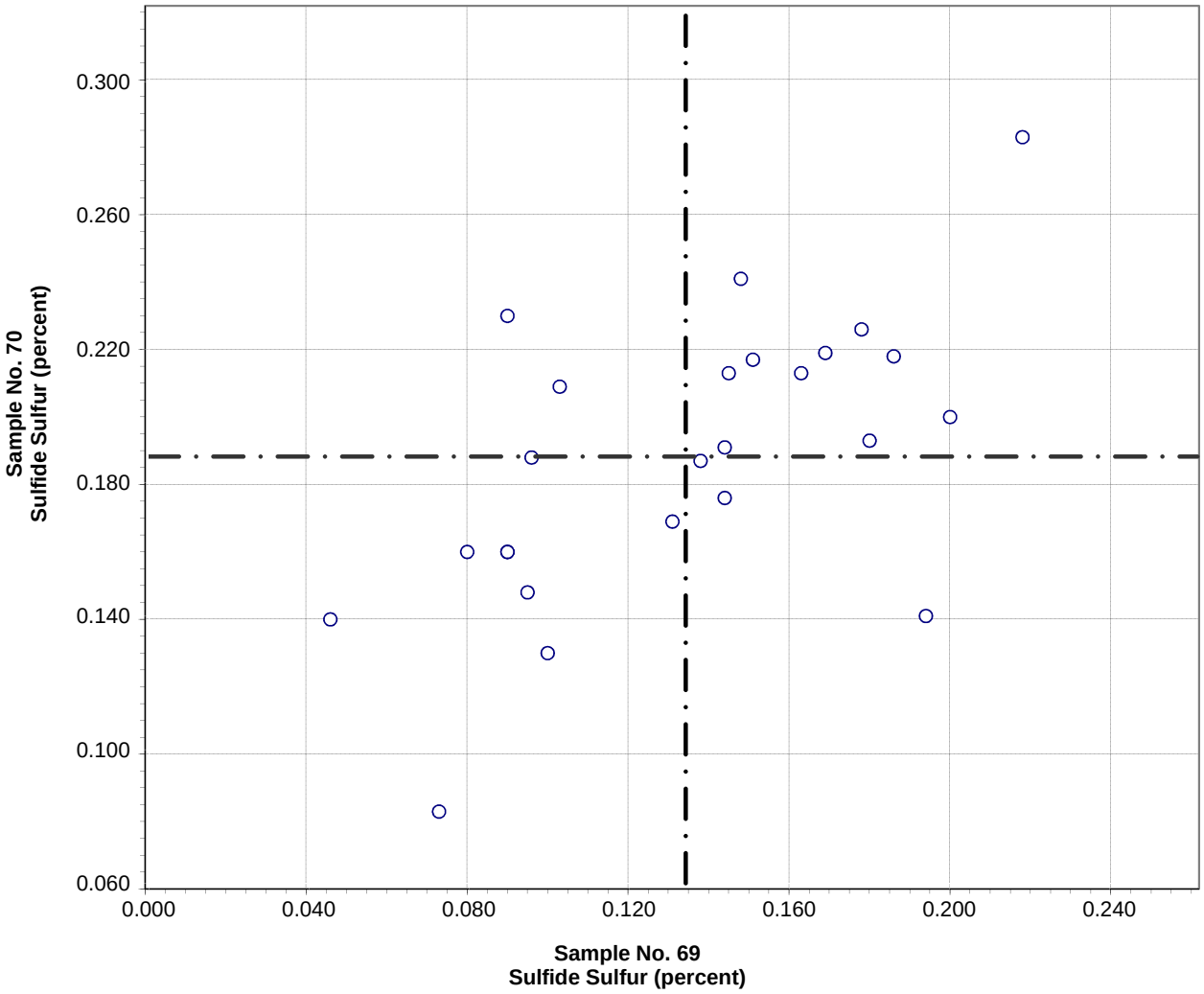


Test No. 101 Manganic Oxide 48 Points

Sample No. 69	Ave	0.522	S.D.	0.021	C.V.	4.1
Sample No. 70	Ave	0.108	S.D.	0.007	C.V.	6.7

Labs Eliminated: 124, 2463, 3297

CCRL Proficiency Sample Program
Sulfide Sulfur
BLENDED CEMENT Samples No. 69 and No. 70

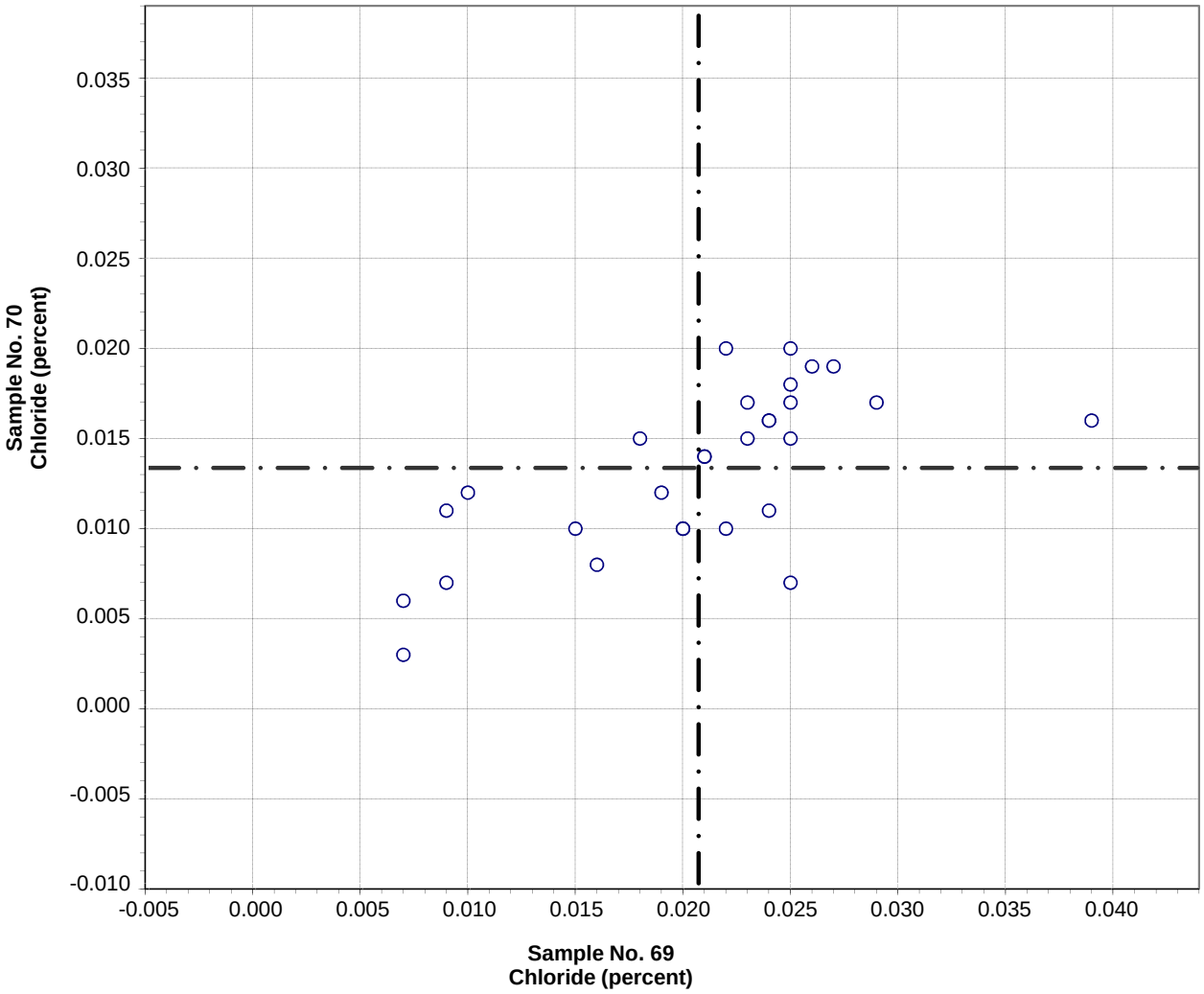


Test No. 65 Sulfide Sulfur 25 Points

Sample No. 69	Ave	0.134	S.D.	0.046	C.V.	34
Sample No. 70	Ave	0.188	S.D.	0.042	C.V.	23

Labs Eliminated: 74, 101, 126, 2464, 3235

CCRL Proficiency Sample Program
Chloride
BLENDED CEMENT Samples No. 69 and No. 70

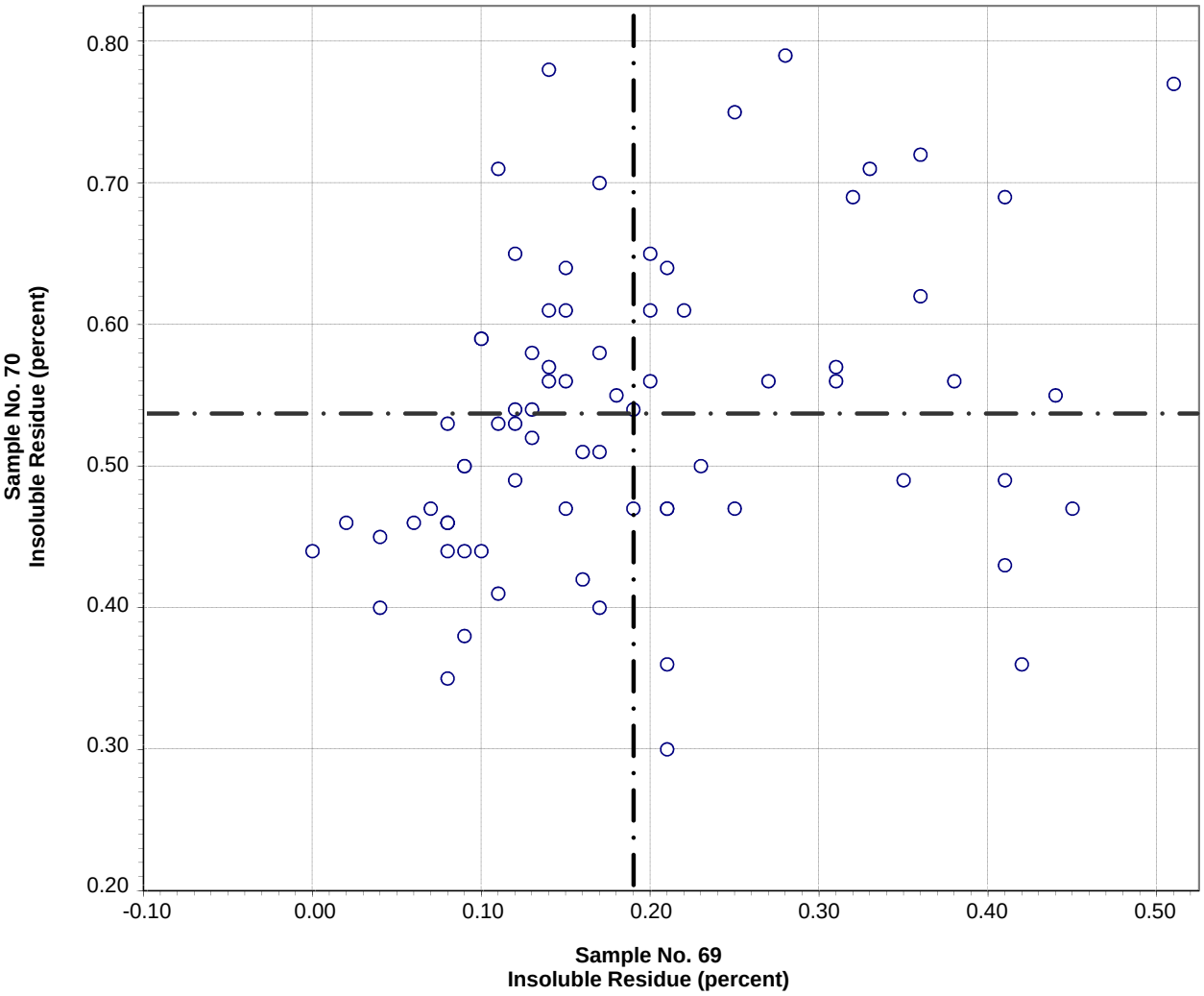


Test No. 104 Chloride 29 Points

Sample No. 69	Ave	0.021	S.D.	0.007	C.V. 35
Sample No. 70	Ave	0.013	S.D.	0.005	C.V. 34

Labs Eliminated: 126, 158, 255, 497

CCRL Proficiency Sample Program
Insoluble Residue
BLENDED CEMENT Samples No. 69 and No. 70

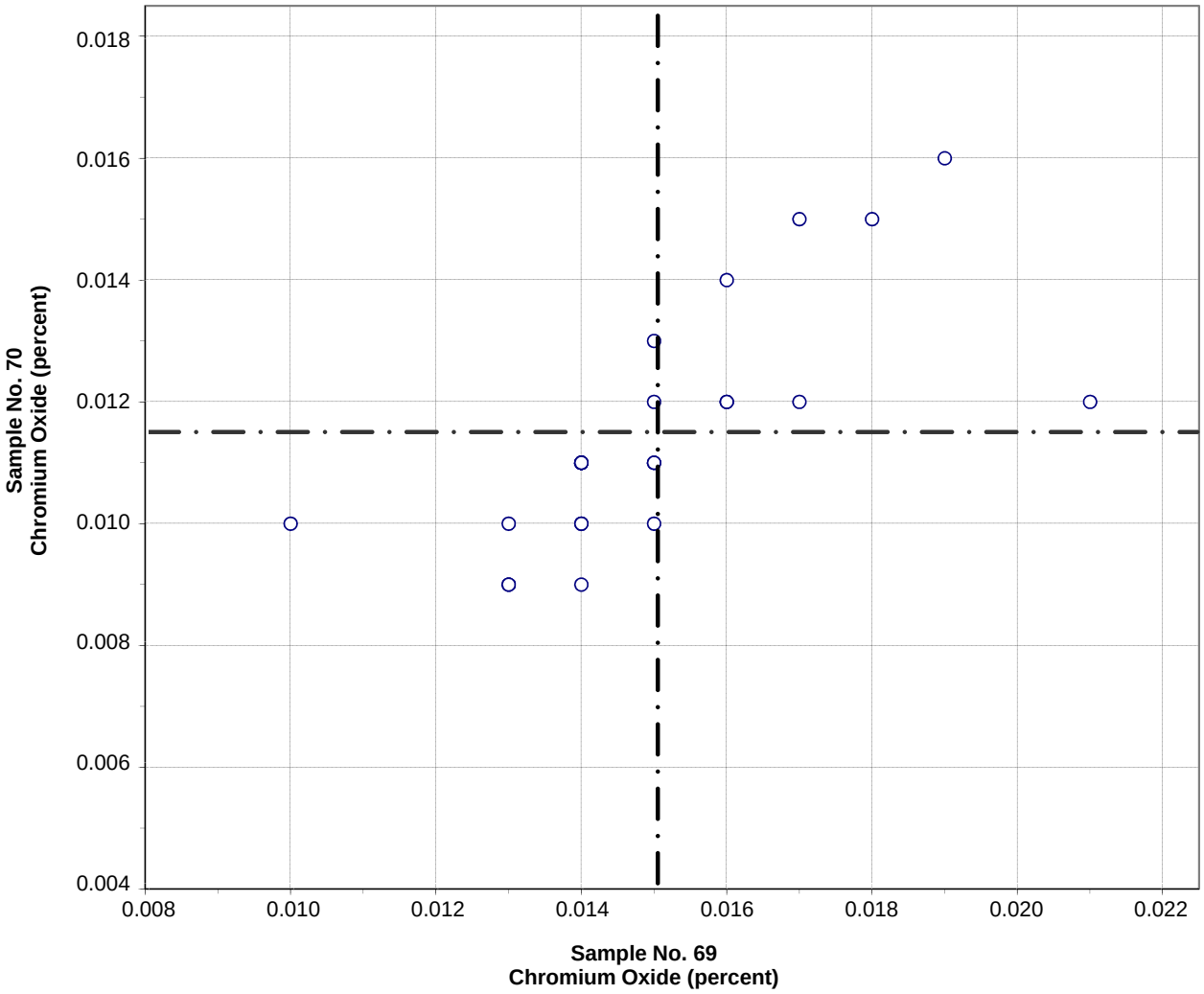


Test No. 80 Insoluble Residue 75 Points

Sample No. 69	Ave	0.19	S.D.	0.12	C.V. 61
Sample No. 70	Ave	0.54	S.D.	0.11	C.V. 20

Labs Eliminated: 51, 695, 1715, 3059

CCRL Proficiency Sample Program
Chromium Oxide
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 105 Chromium Oxide 25 Points

Sample No. 69	Ave	0.015	S.D.	0.002	C.V.	15
Sample No. 70	Ave	0.011	S.D.	0.002	C.V.	17

Labs Eliminated: 10, 126, 958, 2462, 2463

CCRL PROFICIENCY SAMPLE PROGRAM

Blended Cement Proficiency Samples No. 69 and No. 70

Final Report – Physical Results
May 4, 2012

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.69 Average	S.D.	C.V.	Sample No. 70 Average	S.D.	C.V.
Normal Consistency - % Water (percent)							
	94	25.5	0.6	2.4	25.4	0.5	1.9
	*93	25.6	0.5	2.0	25.5	0.4	1.4
* Labs Eliminated - 2352							
Vicat Time of Set - Initial (min)							
	93	87	17	19.9	104	17	16.7
	*90	85	14	16.5	102	13	12.5
* Labs Eliminated - 34, 2465, 3431							
Vicat Time of Set - Final (min)							
	89	184	32	17	198	31	16
	*86	182	30	16	195	26	13
* Labs Eliminated - 92, 2975, 3431							
Autoclave Expansion (percent)							
	86	0.03	0.02	53	0.02	0.05	209
	*80	0.03	0.01	32	0.02	0.01	75
* Labs Eliminated - 34, 45, 124, 691, 2462, 2477							
Air Content % (percent)							
	74	8.0	1.5	18	7.8	1.5	19
	*71	8.1	1.1	13	7.9	1.3	16
* Labs Eliminated - 497, 1251, 3245							
Air Content - % Water (percent)							
	73	72.1	21.5	29.8	71.8	21.5	30.0
	*70	69.6	2.2	3.2	69.3	2.3	3.3
* Labs Eliminated - 51, 105, 413							
Air Content - Flow (percent)							
	74	87	3.6	4.2	87	3.2	3.7
No Labs Eliminated for This Test							

CCRL PROFICIENCY SAMPLE PROGRAM

Blended Cement Proficiency Samples No. 69 and No. 70

Final Report – Physical Results
May 4, 2012

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.69 Average	S.D.	C.V.	Sample No. 70 Average	S.D.	C.V.
Specific Gravity							
	75	3.12	0.05	1.6	3.07	0.05	1.7
	*70	3.12	0.03	1.1	3.07	0.04	1.3
* Labs Eliminated - 24, 148, 413, 691, 1956							
Compressive Strength - 3 day (psi)							
	95	3481	297	8.5	3601	291	8.1
	*93	3502	259	7.4	3620	262	7.2
* Labs Eliminated - 46, 51							
Compressive Strength - 7 day (psi)							
	95	4603	381	8.3	4669	382	8.2
	*94	4624	319	6.9	4685	352	7.5
* Labs Eliminated - 51							
Compressive Strength - 28 day (psi)							
	91	6207	535	8.6	6194	530	8.6
No Labs Eliminated for This Test							
Compressive Strength - % Water (percent)							
	92	48.7	3.1	6.4	48.5	3.1	6.5
	*88	48.4	1.1	2.3	48.3	1.0	2.1
* Labs Eliminated - 105, 309, 2360, 2477							
Compressive Strength - Flow (percent)							
	94	109	4.8	4.4	110	3.9	3.6
	*91	110	2.9	2.6	110	2.6	2.4
* Labs Eliminated - 34, 47, 3287							
Fineness - Air Permeability (cm^2/g)							
	90	4139	246	5.9	4969	421	8.5
	*86	4175	165	3.9	5033	281	5.6
* Labs Eliminated - 51, 982, 1251, 1455							

CCRL PROFICIENCY SAMPLE PROGRAM

Blended Cement Proficiency Samples No. 69 and No. 70

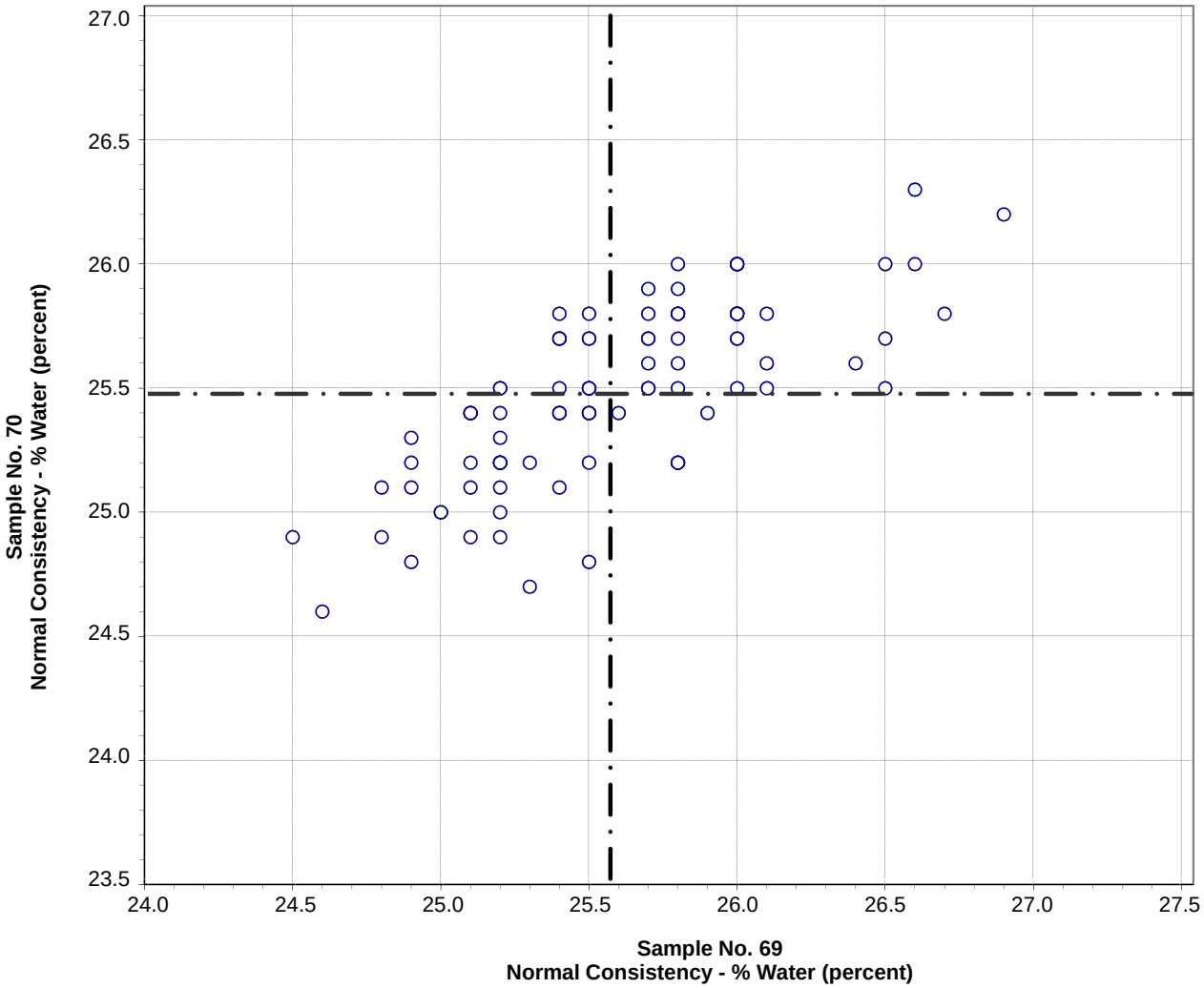
Final Report – Physical Results
May 4, 2012

SUMMARY OF RESULTS

		Sample No.69			Sample No. 70		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Fineness - 45µm % Passing (**percent**)							
	90	93.63	0.94	1.00	93.35	1.18	1.26
	*89	93.67	0.82	0.88	93.42	0.93	1.00

* Labs Eliminated - 50

CCRL Proficiency Sample Program
Normal Consistency - % Water
BLENDED CEMENT Samples No. 69 and No. 70



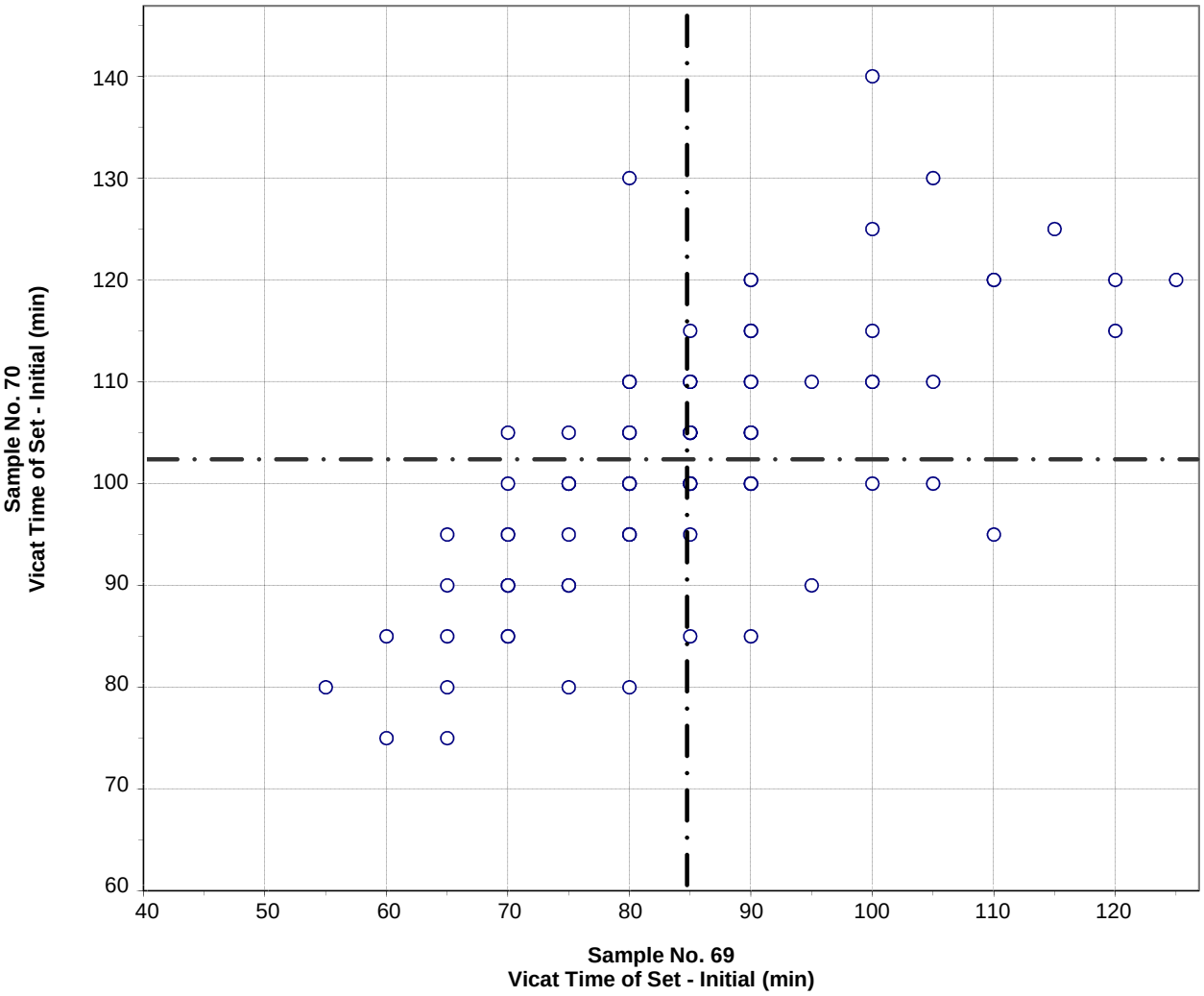
Test No. 110 Normal Consistency - % Water 92 Points

Sample No. 69	Ave	25.6	S.D.	0.5	C.V. 2.0
Sample No. 70	Ave	25.5	S.D.	0.4	C.V. 1.4

Labs Eliminated: 2352

Labs off Diagram: 1455

CCRL Proficiency Sample Program
Vicat Time of Set - Initial
BLENDED CEMENT Samples No. 69 and No. 70

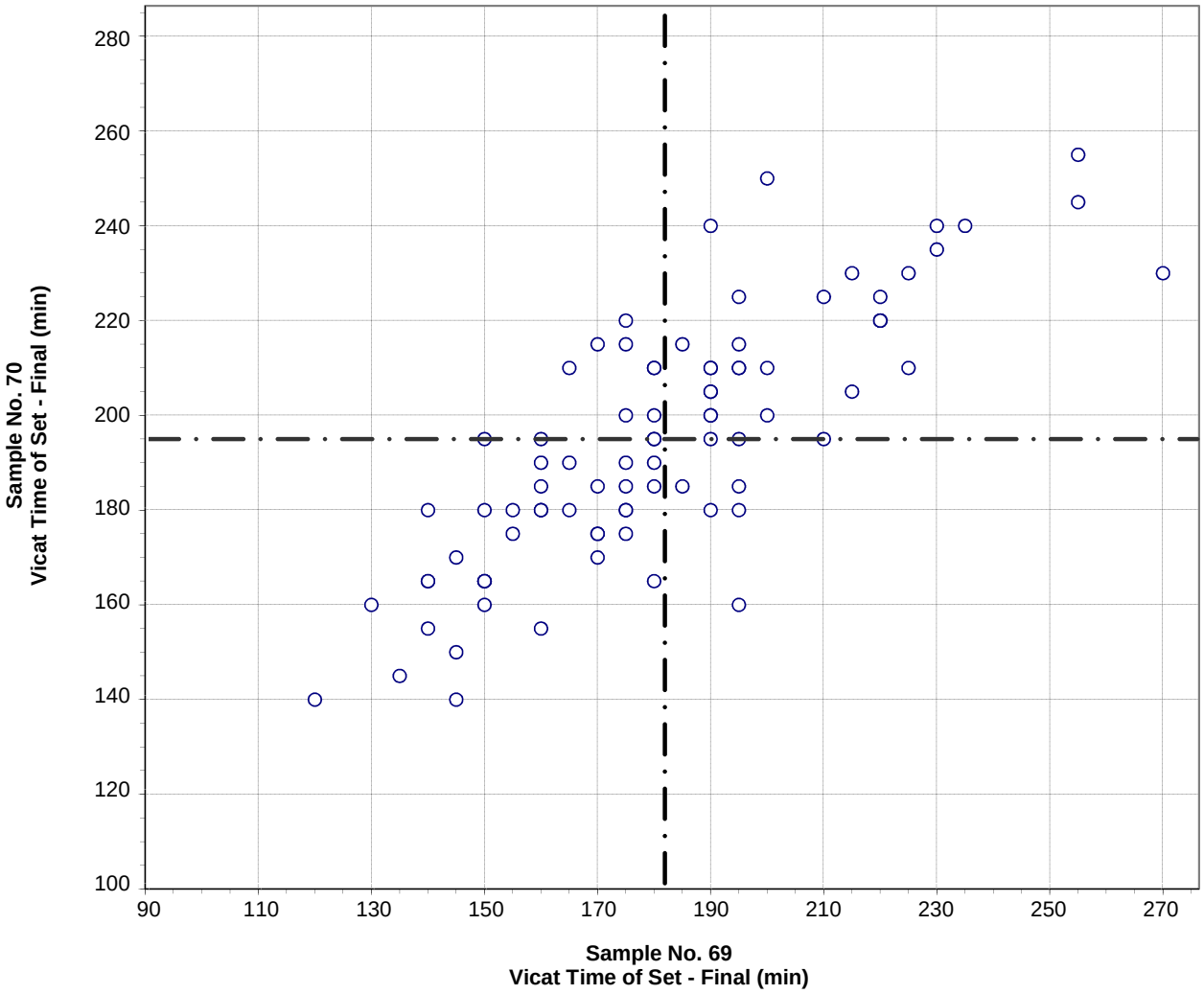


Test No. 120 Vicat Time of Set - Initial 90 Points

Sample No. 69 Ave 85 S.D. 14 C.V. 16.5
Sample No. 70 Ave 102 S.D. 13 C.V. 12.5

Labs Eliminated: 34, 2465, 3431

CCRL Proficiency Sample Program
Vicat Time of Set - Final
BLENDED CEMENT Samples No. 69 and No. 70

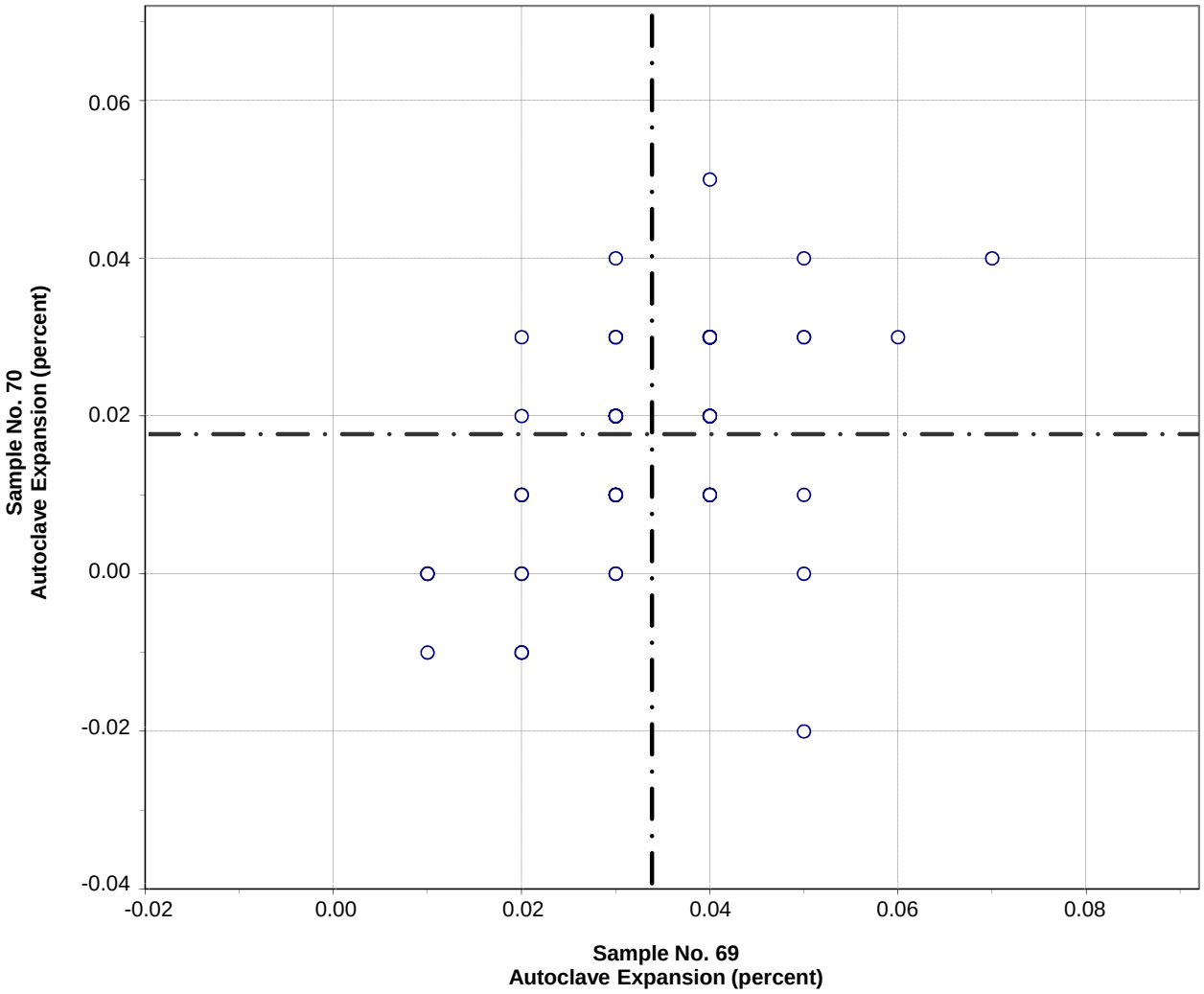


Test No. 121 Vicat Time of Set - Final 86 Points

Sample No. 69	Ave	182	S.D.	30	C.V. 16
Sample No. 70	Ave	195	S.D.	26	C.V. 13

Labs Eliminated: 92, 2975, 3431

CCRL Proficiency Sample Program
Autoclave Expansion
BLENDED CEMENT Samples No. 69 and No. 70

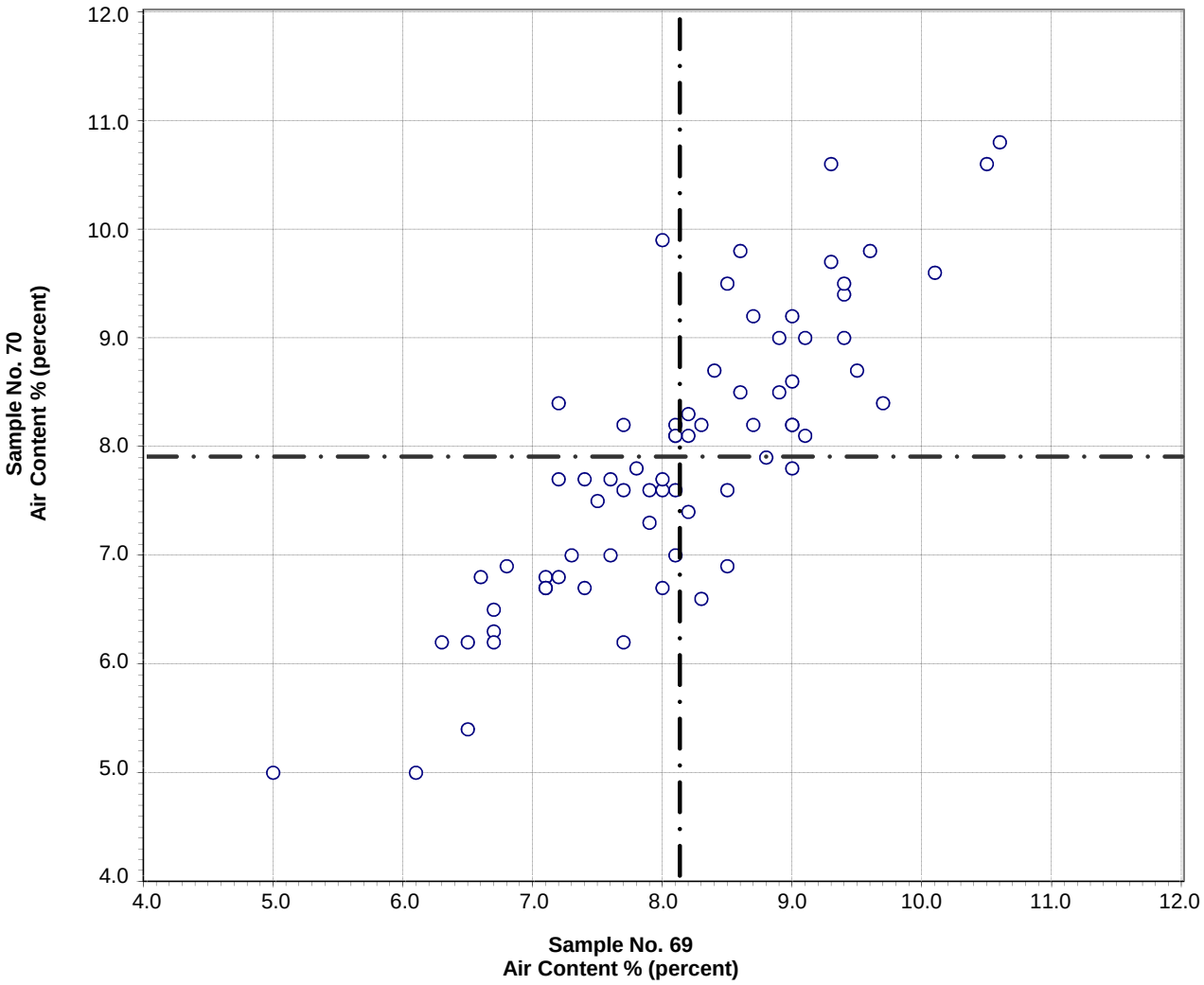


Test No. 160 Autoclave Expansion 80 Points

Sample No. 69	Ave	0.03	S.D.	0.01	C.V. 32
Sample No. 70	Ave	0.02	S.D.	0.01	C.V. 75

Labs Eliminated: 34, 45, 124, 691, 2462, 2477

CCRL Proficiency Sample Program
Air Content %
BLENDED CEMENT Samples No. 69 and No. 70

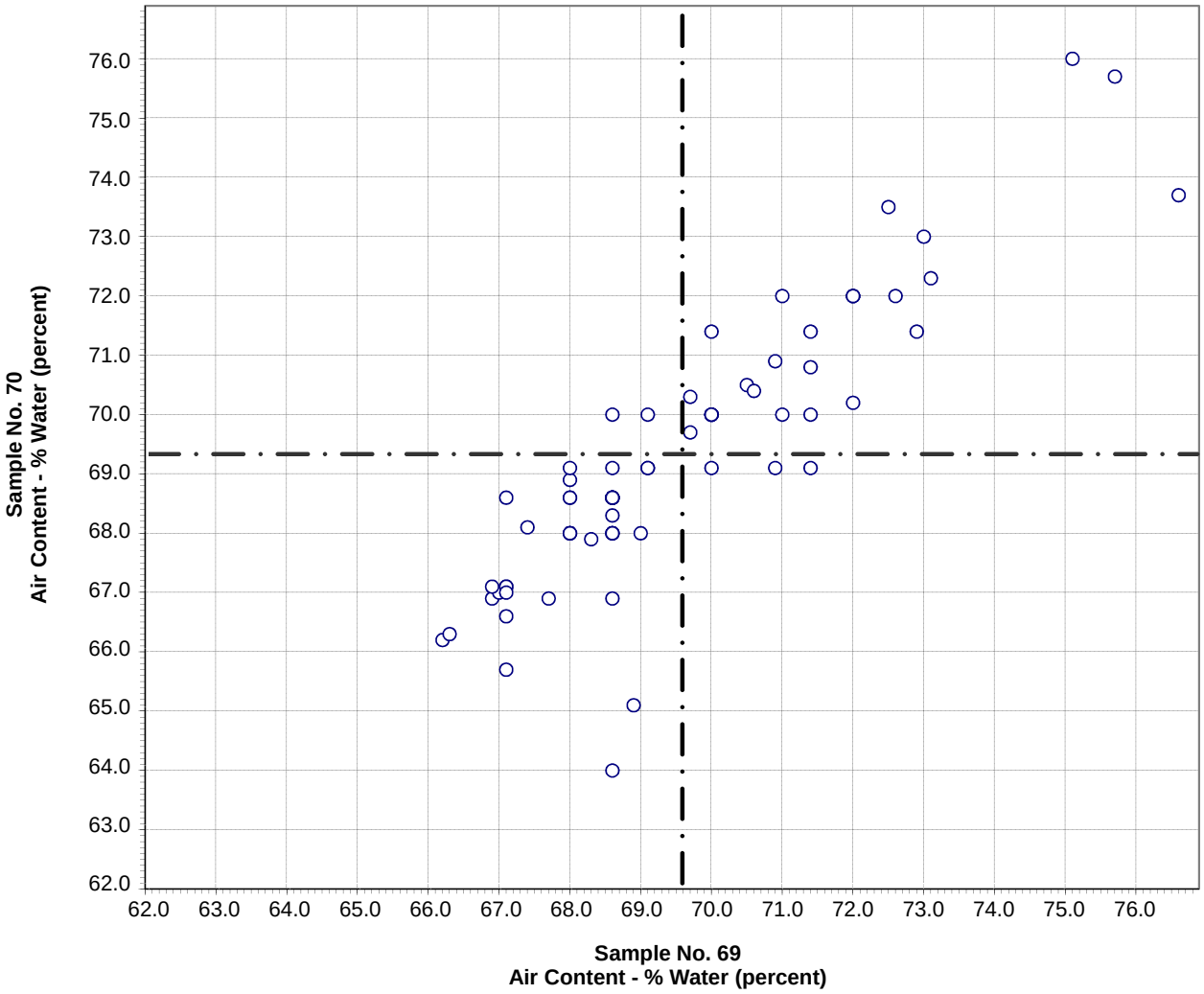


Test No. 170 Air Content % 71 Points

Sample No. 69	Ave	8.1	S.D.	1.1	C.V. 13
Sample No. 70	Ave	7.9	S.D.	1.3	C.V. 16

Labs Eliminated: 497, 1251, 3245

CCRL Proficiency Sample Program
Air Content - % Water
BLENDED CEMENT Samples No. 69 and No. 70

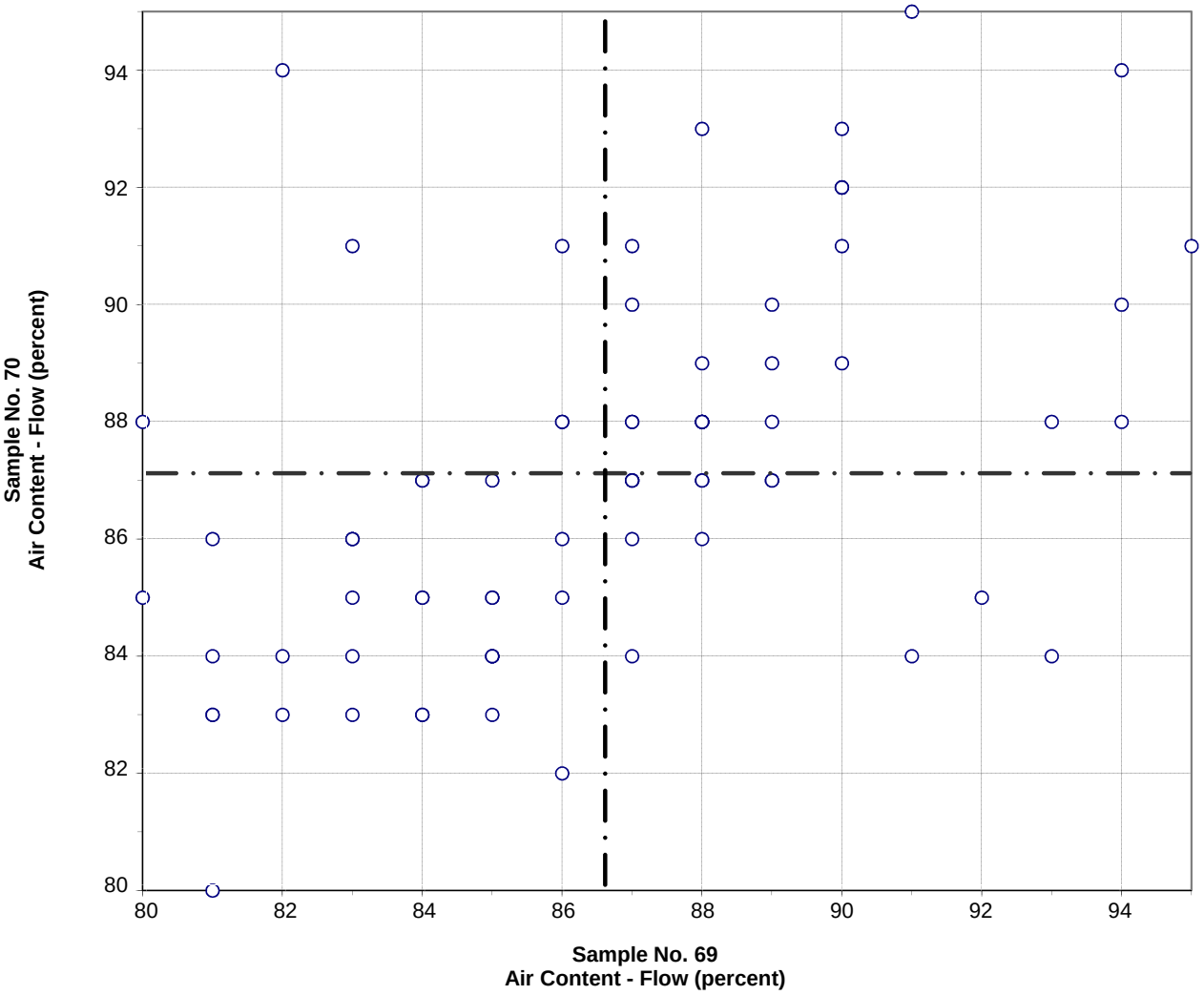


Test No. 180 Air Content - % Water 70 Points

Sample No. 69	Ave	69.6	S.D.	2.2	C.V. 3.2
Sample No. 70	Ave	69.3	S.D.	2.3	C.V. 3.3

Labs Eliminated: 51, 105, 413

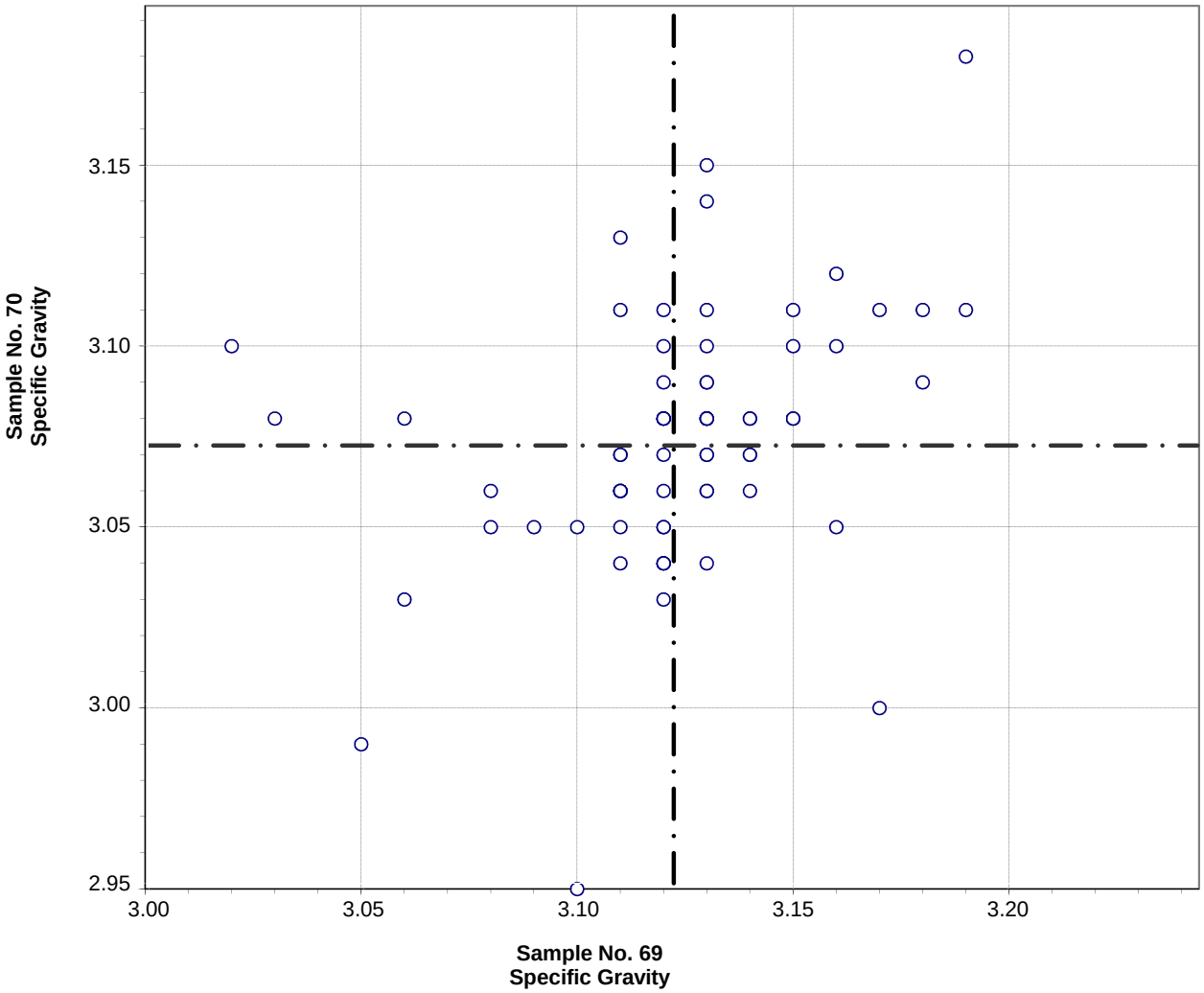
CCRL Proficiency Sample Program
Air Content - Flow
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 190 Air Content - Flow 74 Points

Sample No. 69	Ave	87	S.D.	3.6	C.V. 4.2
Sample No. 70	Ave	87	S.D.	3.2	C.V. 3.7

CCRL Proficiency Sample Program
Specific Gravity
BLENDED CEMENT Samples No. 69 and No. 70



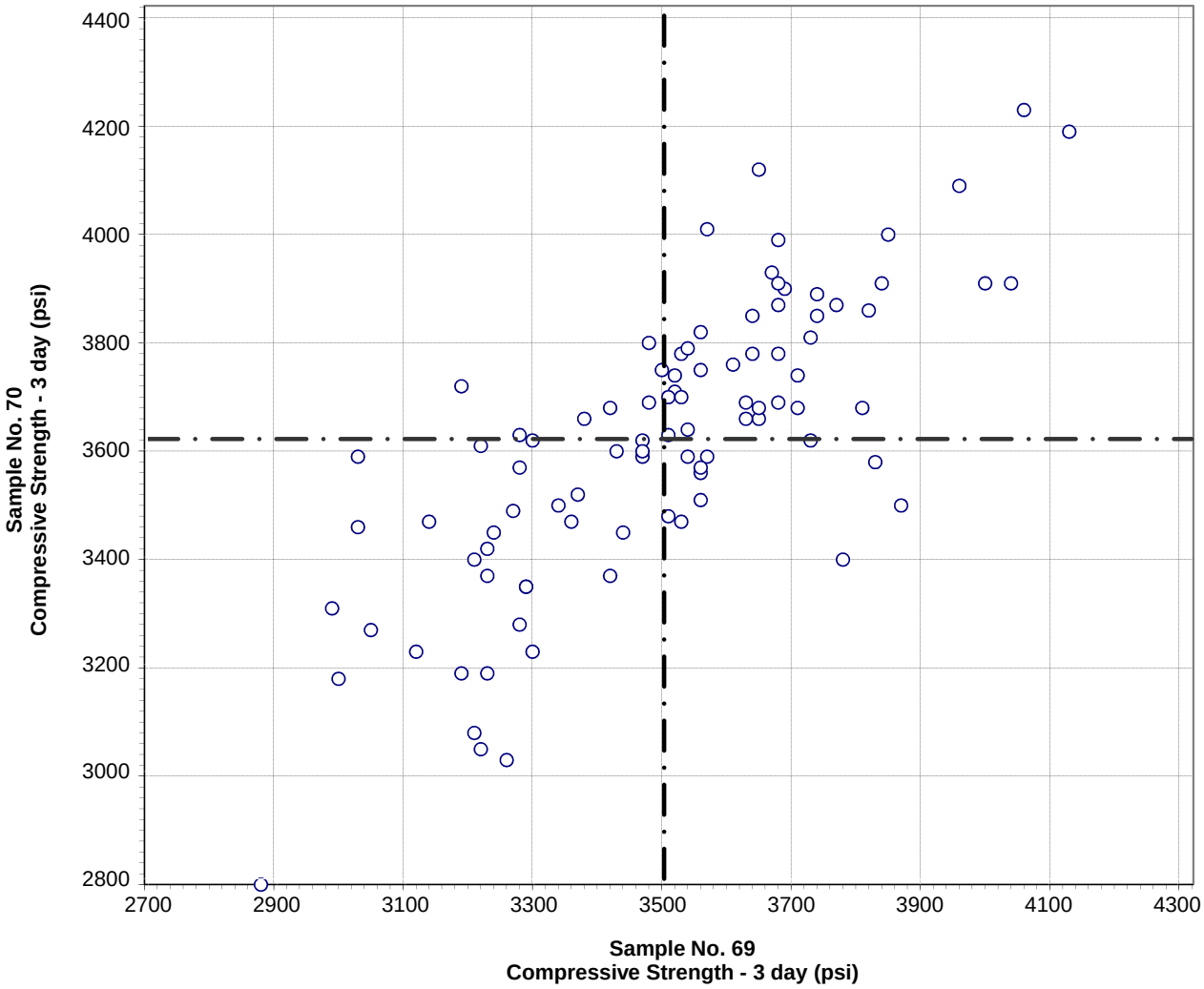
Test No. 310 Specific Gravity 69 Points

Sample No. 69	Ave	3.12	S.D.	0.03	C.V. 1.1
Sample No. 70	Ave	3.07	S.D.	0.04	C.V. 1.3

Labs Eliminated: 24, 148, 413, 691, 1956

Labs off Diagram: 497

CCRL Proficiency Sample Program
Compressive Strength - 3 day
BLENDED CEMENT Samples No. 69 and No. 70

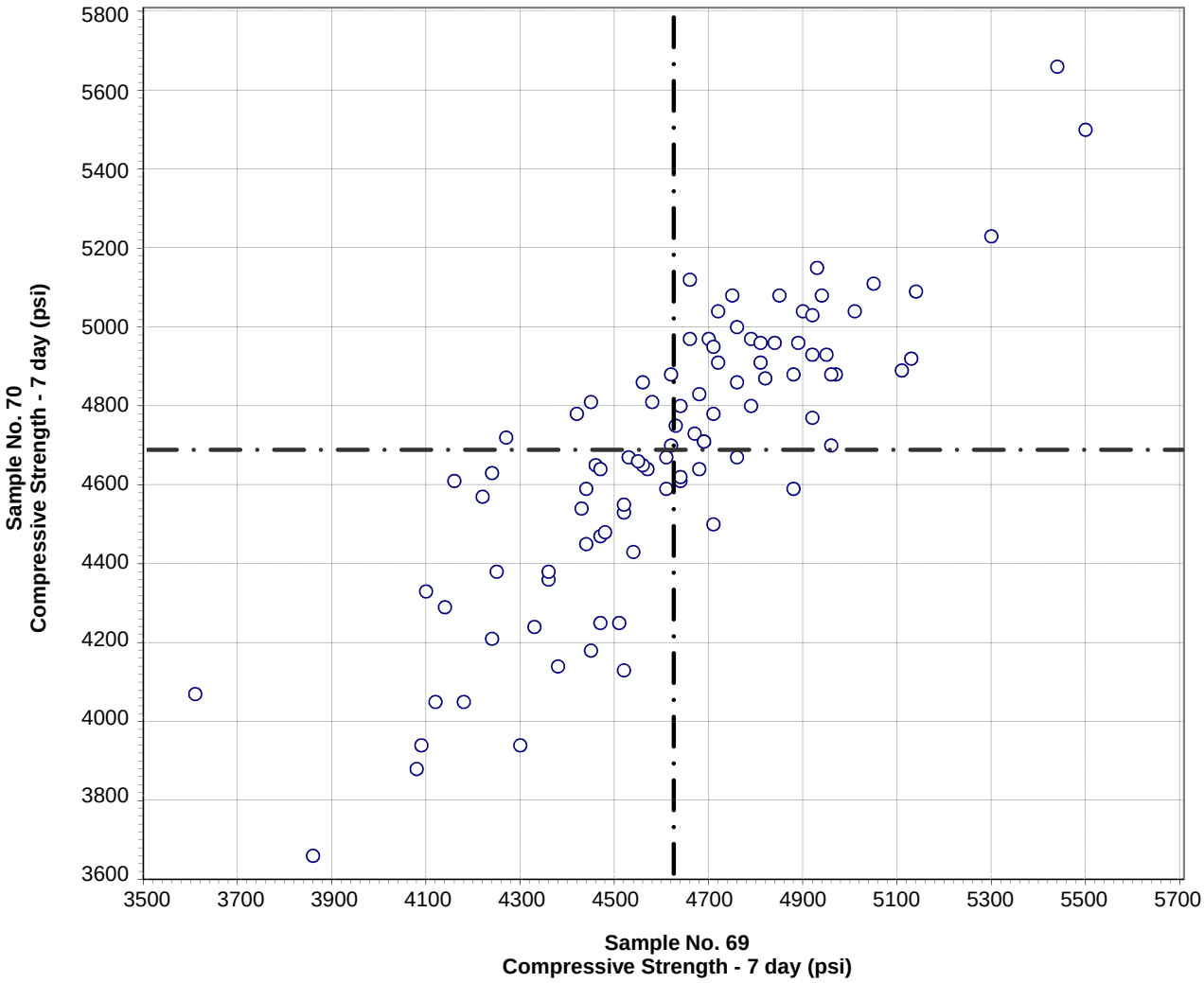


Test No. 200 Compressive Strength - 3 day 93 Points

Sample No. 69	Ave	3502	S.D.	259	C.V. 7.4
Sample No. 70	Ave	3620	S.D.	262	C.V. 7.2

Labs Eliminated: 46, 51

CCRL Proficiency Sample Program
Compressive Strength - 7 day
BLENDED CEMENT Samples No. 69 and No. 70

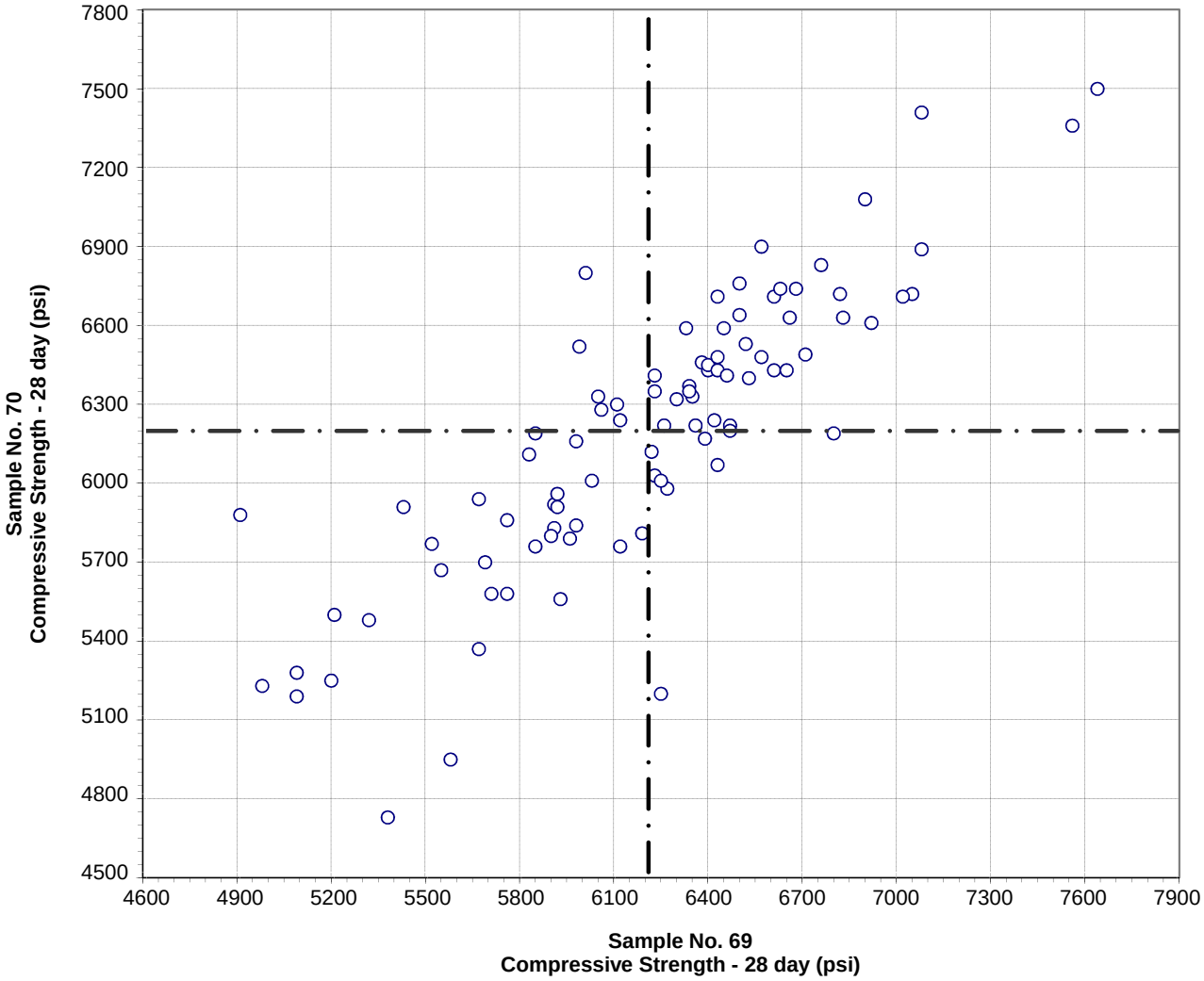


Test No. 210 Compressive Strength - 7 day 94 Points

Sample No. 69 Ave 4624 S.D. 319 C.V. 6.9
Sample No. 70 Ave 4685 S.D. 352 C.V. 7.5

Labs Eliminated: 51

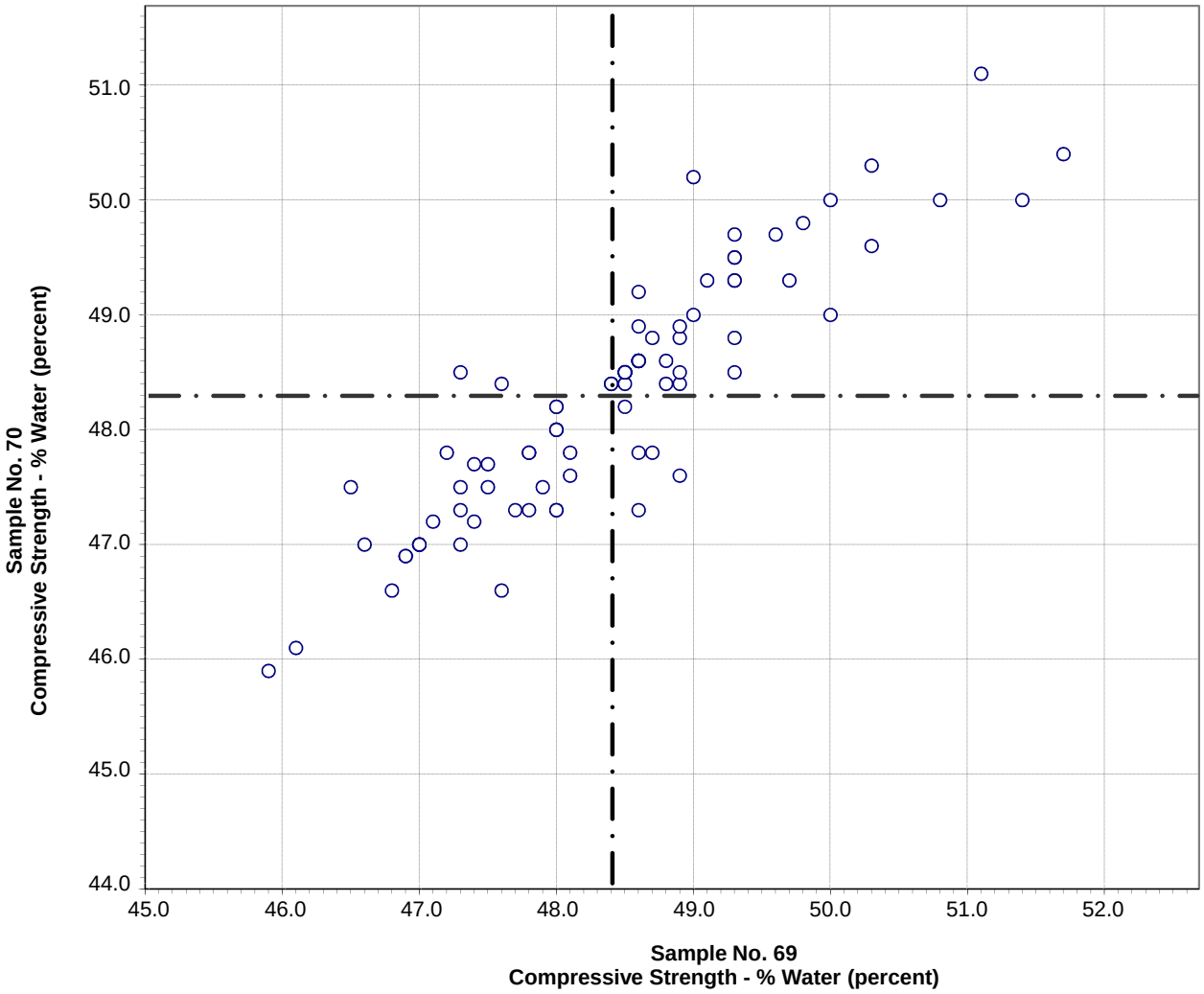
CCRL Proficiency Sample Program
Compressive Strength - 28 day
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 211 Compressive Strength - 28 day 91 Points

Sample No. 69	Ave	6207	S.D.	535	C.V.	8.6
Sample No. 70	Ave	6194	S.D.	530	C.V.	8.6

CCRL Proficiency Sample Program
Compressive Strength - % Water
BLENDED CEMENT Samples No. 69 and No. 70

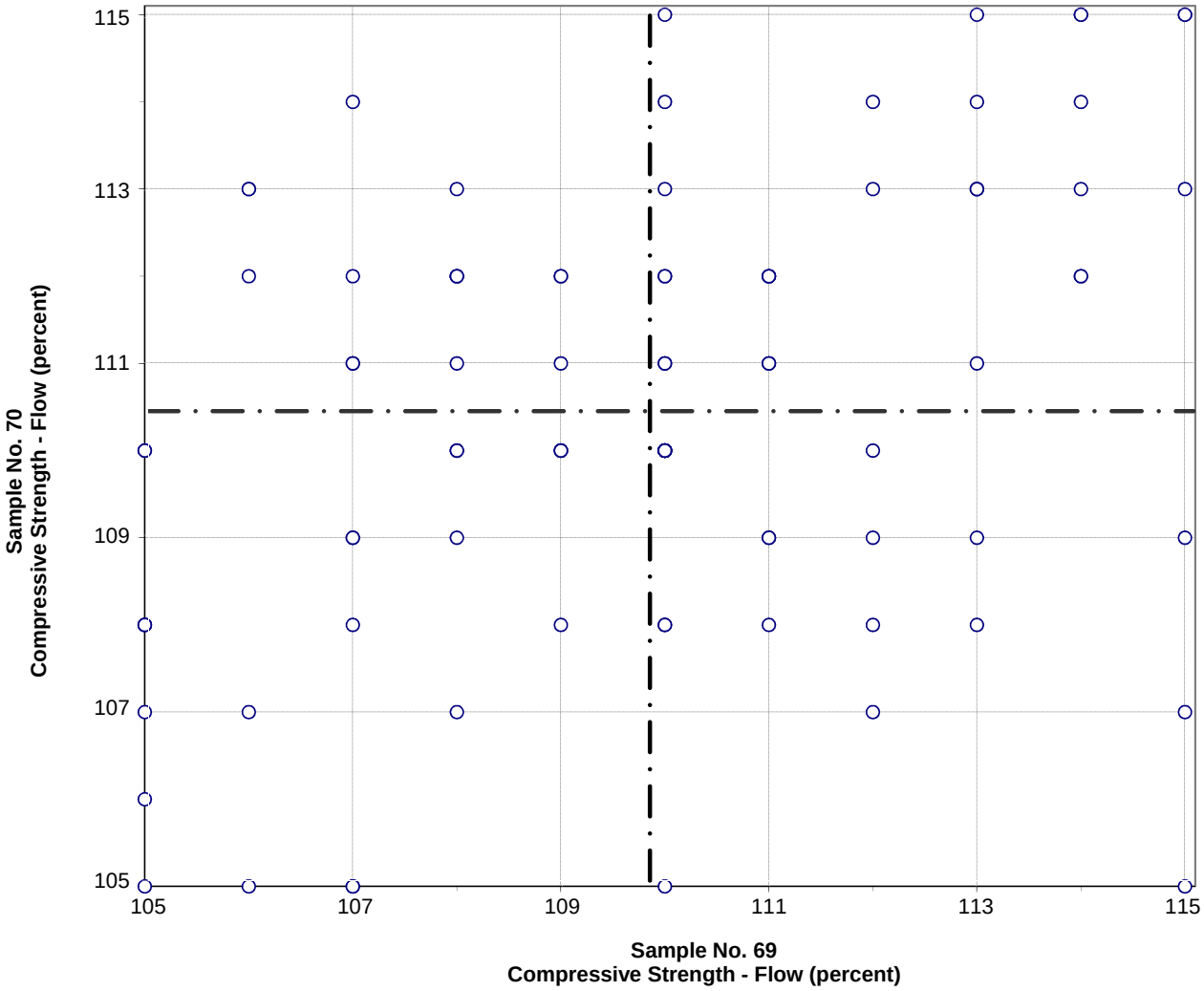


Test No. 220 Compressive Strength - % Water 88 Points

Sample No. 69	Ave	48.4	S.D.	1.1	C.V. 2.3
Sample No. 70	Ave	48.3	S.D.	1.0	C.V. 2.1

Labs Eliminated: 105, 309, 2360, 2477

CCRL Proficiency Sample Program
Compressive Strength - Flow
BLENDED CEMENT Samples No. 69 and No. 70

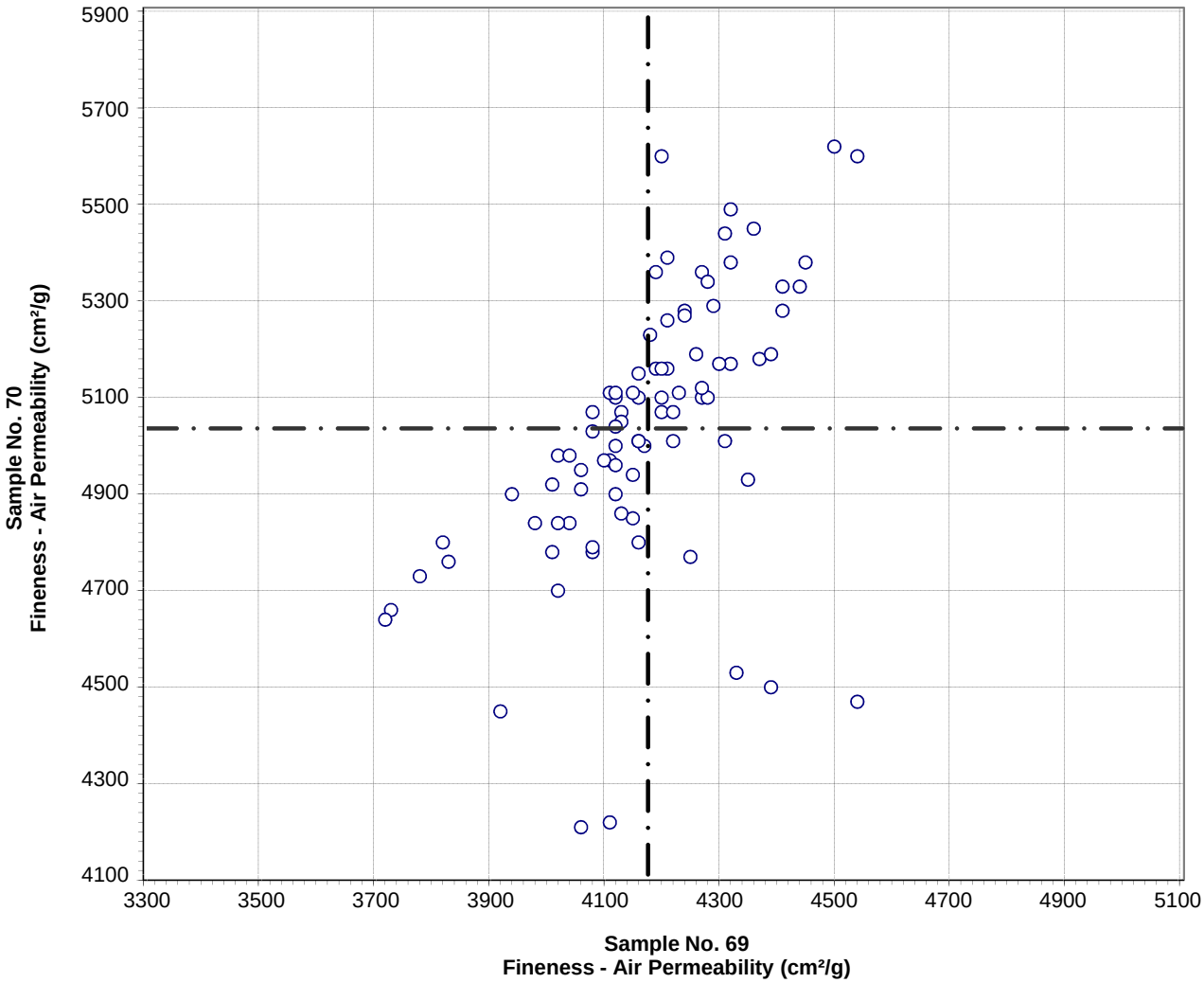


Test No. 230 Compressive Strength - Flow 91 Points

Sample No. 69	Ave	110	S.D.	2.9	C.V. 2.6
Sample No. 70	Ave	110	S.D.	2.6	C.V. 2.4

Labs Eliminated: 34, 47, 3287

CCRL Proficiency Sample Program
Fineness - Air Permeability
BLENDED CEMENT Samples No. 69 and No. 70

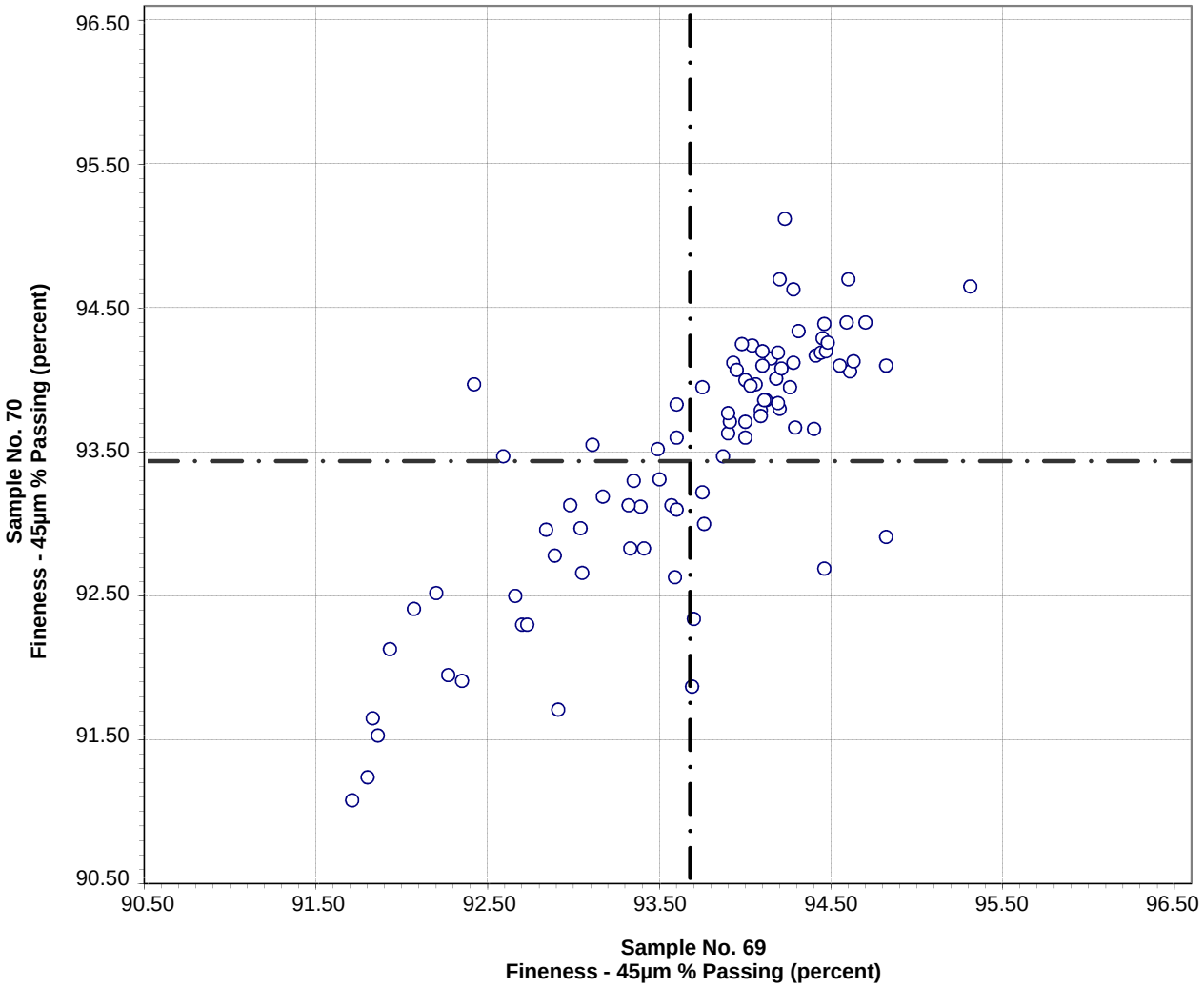


Test No. 270 Fineness - Air Permeability 86 Points

Sample No. 69	Ave	4175	S.D.	165	C.V. 3.9
Sample No. 70	Ave	5033	S.D.	281	C.V. 5.6

Labs Eliminated: 51, 982, 1251, 1455

CCRL Proficiency Sample Program
Fineness - 45µm % Passing
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 281 Fineness - 45µm % Passing 88 Points

Sample No. 69	Ave	93.67	S.D.	0.82	C.V. 0.88
Sample No. 70	Ave	93.42	S.D.	0.93	C.V. 1.00

Labs Eliminated: 50

Labs off Diagram: 413

CCRL PROFICIENCY SAMPLE PROGRAM

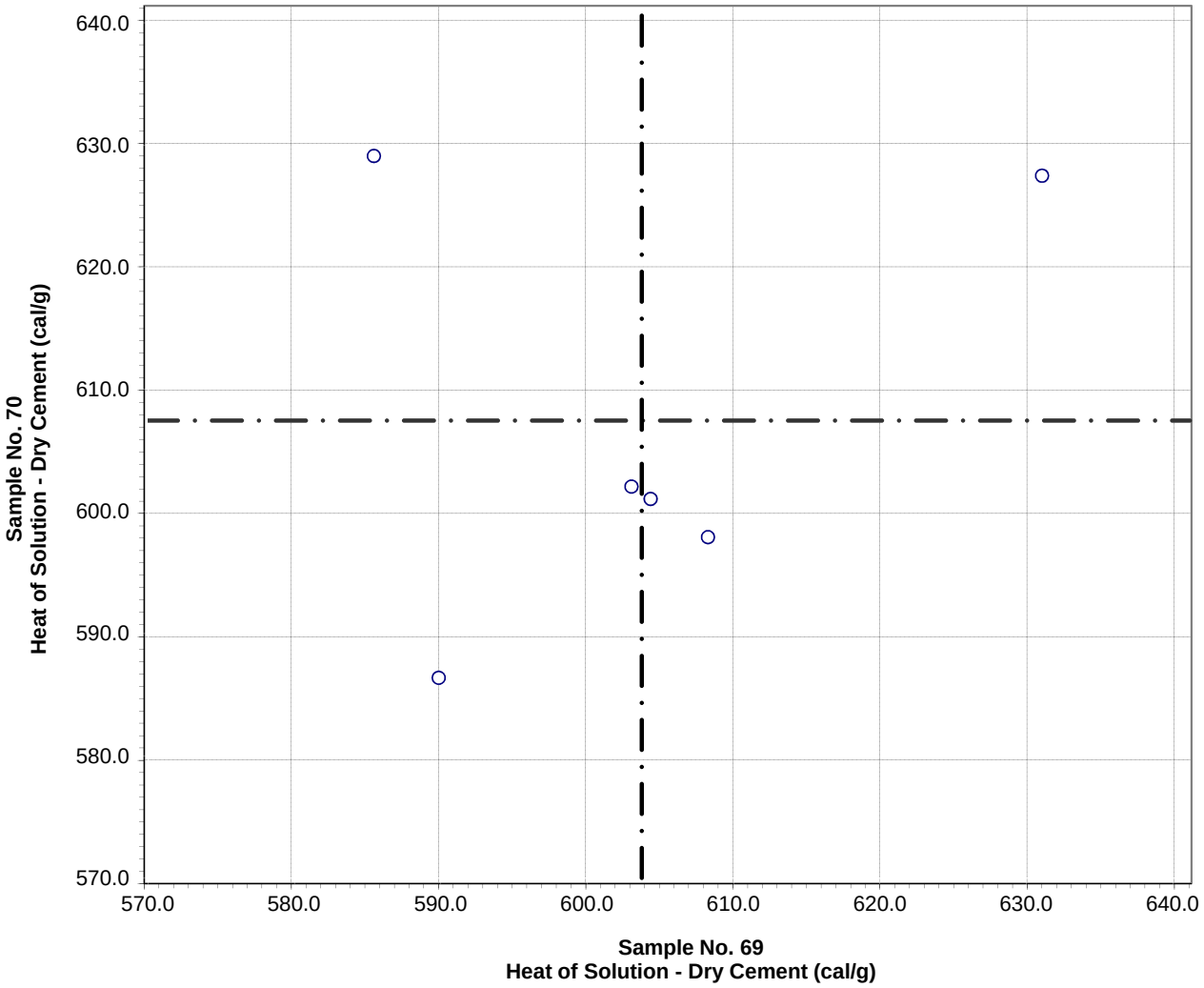
Blended Cement Proficiency Samples No. 69 and No. 70

Final Report – Heat of Hydration Results
May 4, 2012

SUMMARY OF RESULTS

		Sample No.69			Sample No. 70		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Heat of Solution - Dry Cement (**cal/g**)							
	6	603.7	16.0	2.7	607.4	17.0	2.8
No Labs Eliminated for This Test							
Heat of Solution - 7 day (**cal/g**)							
	6	532.8	31.7	5.9	525.1	14.6	2.8
No Labs Eliminated for This Test							
Heat of Solution - 28 day (**cal/g**)							
	4	512.9	14.3	2.78	513.4	20.7	4.02
No Labs Eliminated for This Test							
Heat of Hydration - 7 day (**cal/g**)							
	6	79.2	4.1	5.2	82.3	14.4	17.5
No Labs Eliminated for This Test							
Heat of Hydration - 28 day (**cal/g**)							
	4	94.0	6.6	7.1	100.7	25.9	25.7
No Labs Eliminated for This Test							

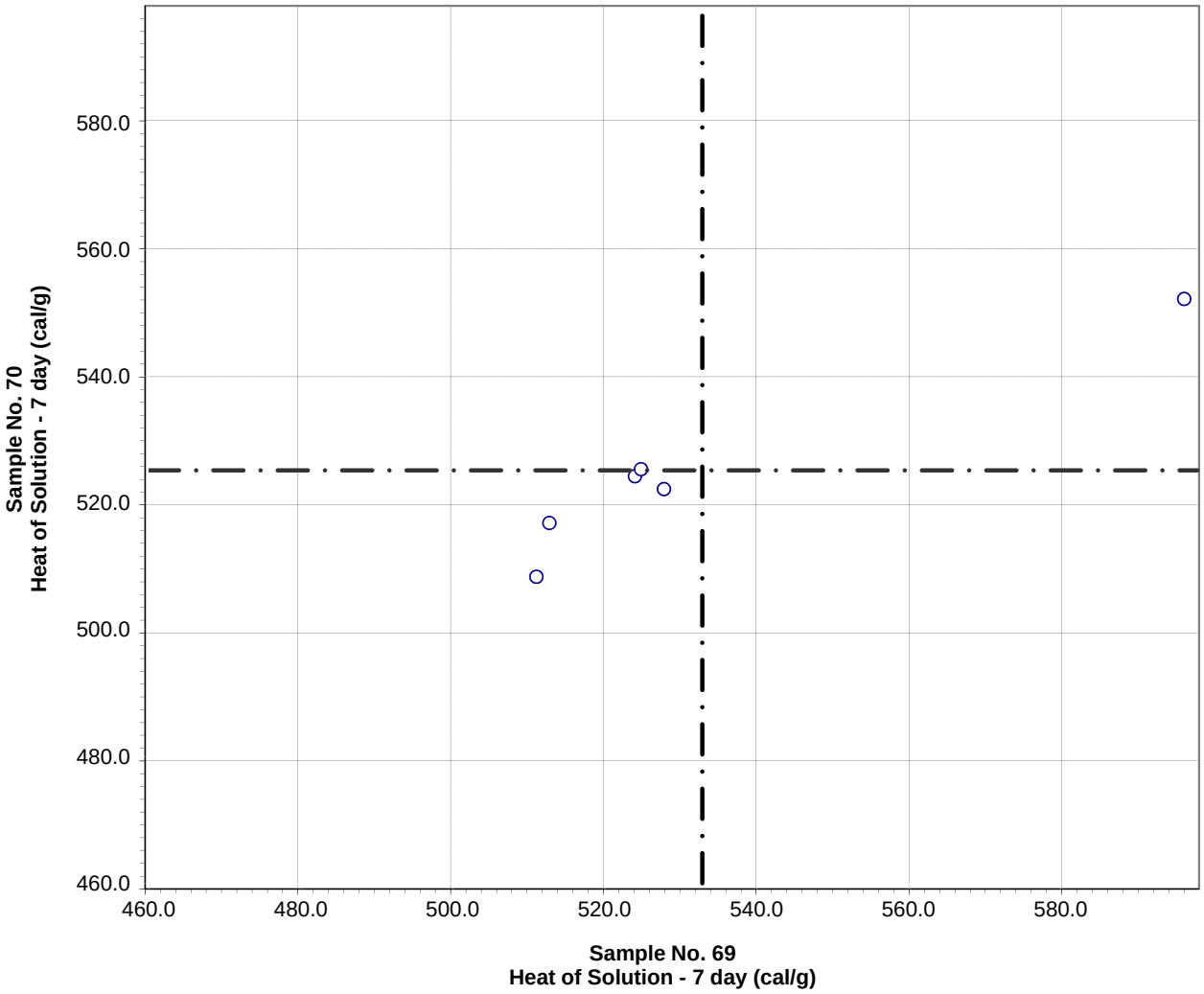
CCRL Proficiency Sample Program
Heat of Solution - Dry Cement
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 291 Heat of Solution - Dry Cement 6 Points

Sample No. 69	Ave	603.7	S.D.	16.0	C.V.	2.7
Sample No. 70	Ave	607.4	S.D.	17.0	C.V.	2.8

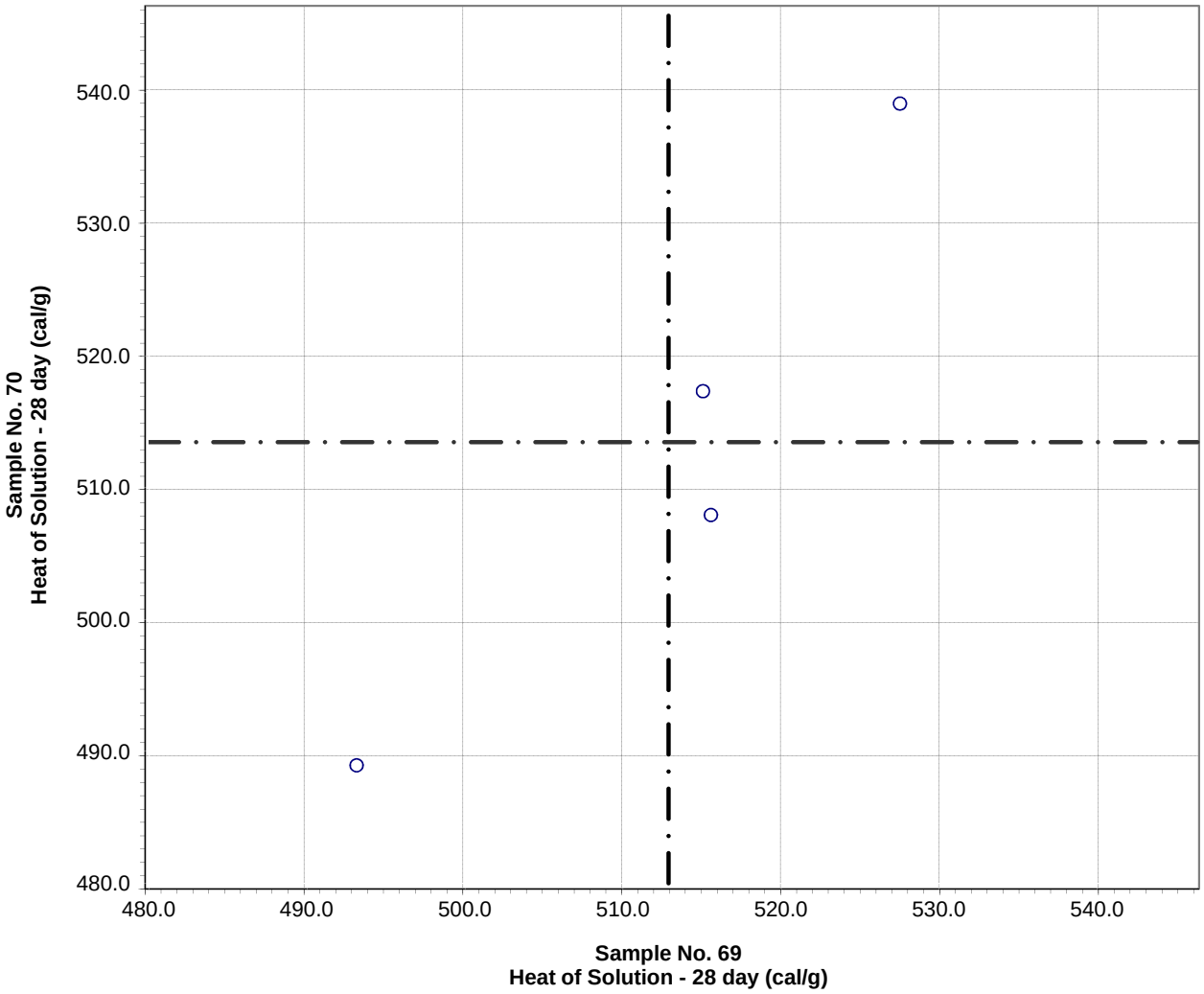
CCRL Proficiency Sample Program
Heat of Solution - 7 day
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 292 Heat of Solution - 7 day 6 Points

Sample No. 69	Ave	532.8	S.D.	31.7	C.V.	5.9
Sample No. 70	Ave	525.1	S.D.	14.6	C.V.	2.8

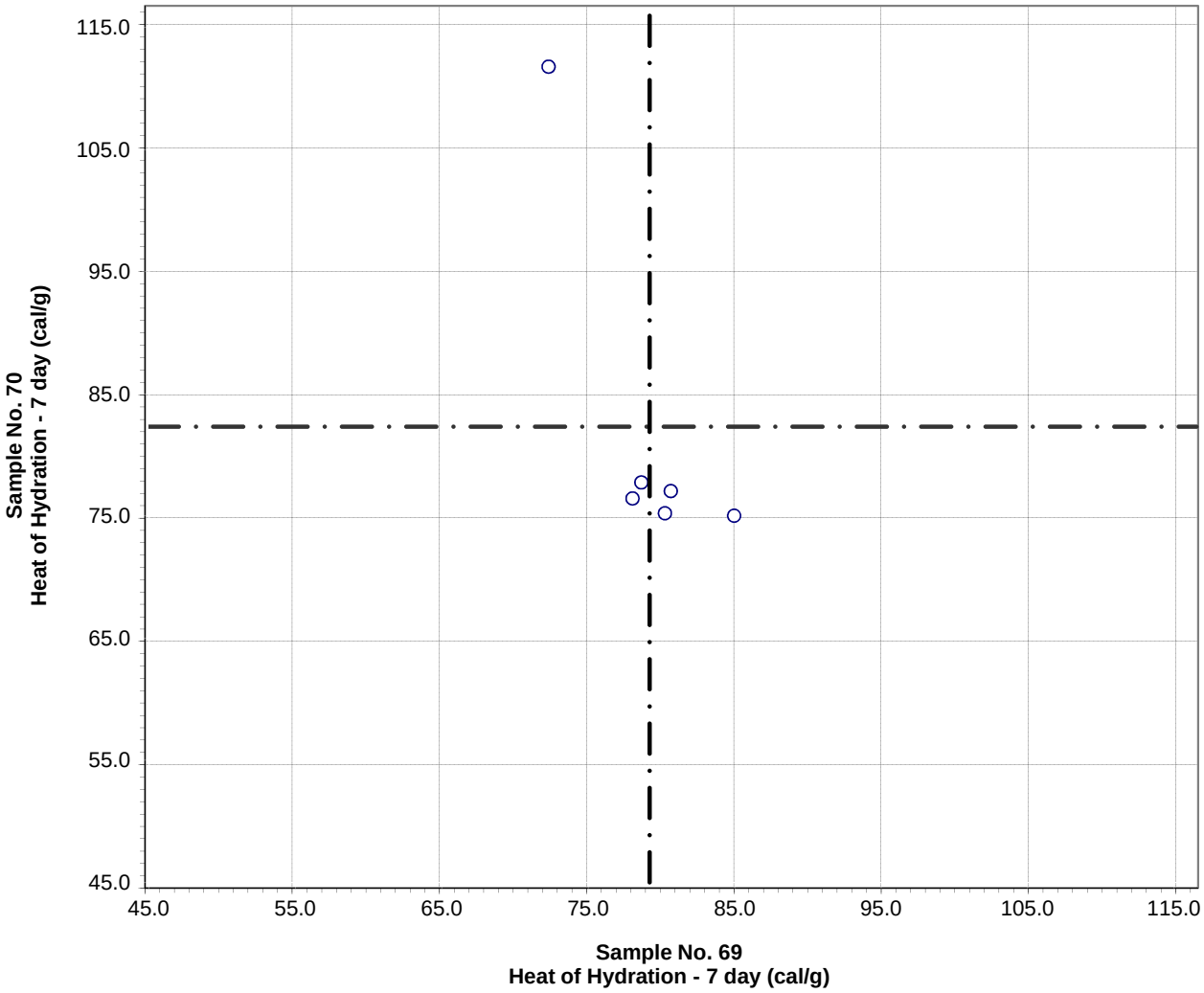
CCRL Proficiency Sample Program
Heat of Solution - 28 day
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 301 Heat of Solution - 28 day 4 Points

Sample No. 69	Ave	512.9	S.D.	14.3	C.V.	2.78
Sample No. 70	Ave	513.4	S.D.	20.7	C.V.	4.02

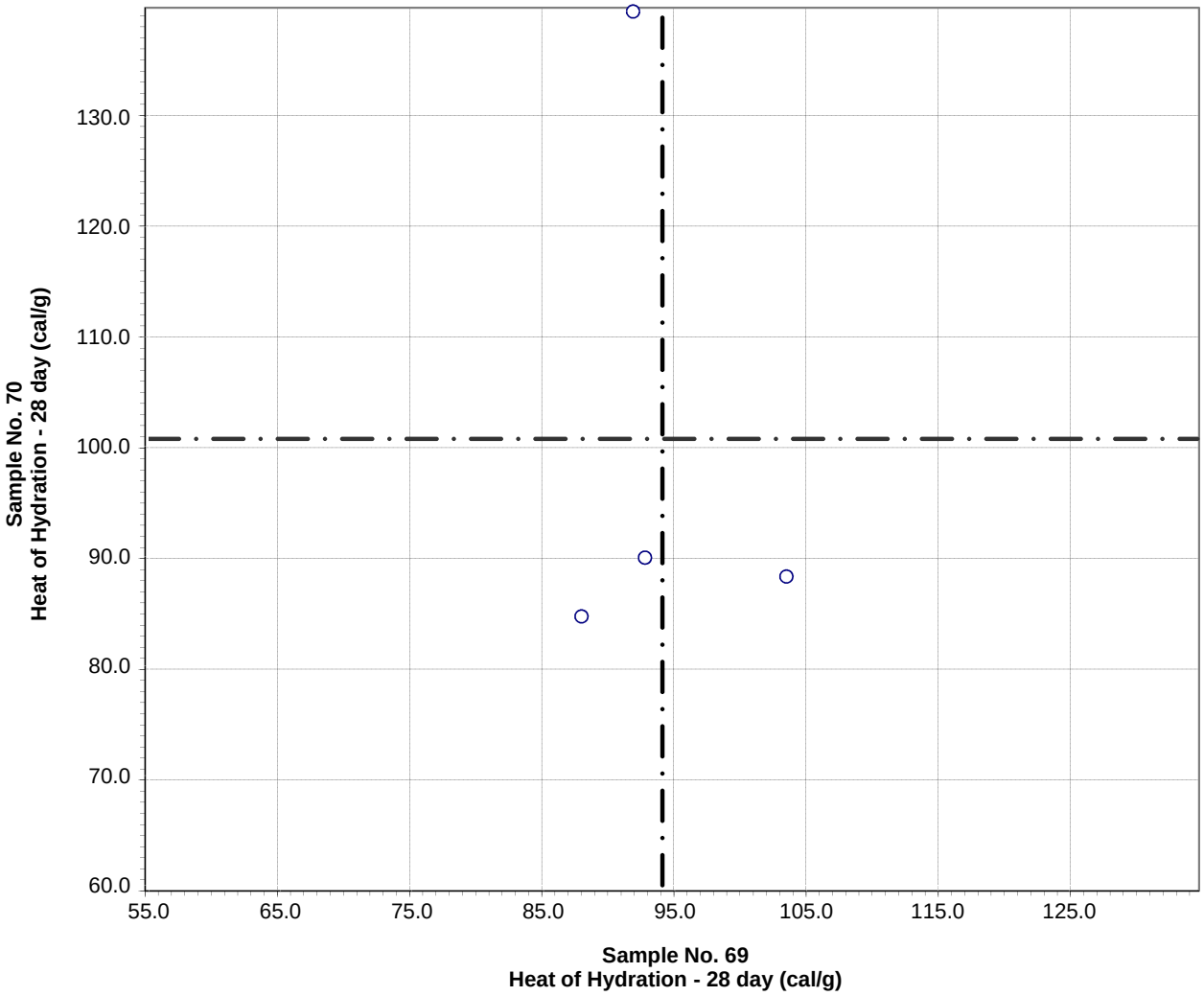
CCRL Proficiency Sample Program
Heat of Hydration - 7 day
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 290 Heat of Hydration - 7 day 6 Points

Sample No. 69	Ave	79.2	S.D.	4.1	C.V. 5.2
Sample No. 70	Ave	82.3	S.D.	14.4	C.V. 17.5

CCRL Proficiency Sample Program
Heat of Hydration - 28 day
BLENDED CEMENT Samples No. 69 and No. 70



Test No. 300 Heat of Hydration - 28 day 4 Points

Sample No. 69 Ave 94.0 S.D. 6.6 C.V. 7.1
Sample No. 70 Ave 100.7 S.D. 25.9 C.V. 25.7