CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

**Final Report
Pozzolan Proficiency Samples
Number 61 and Number 62**

October 2017

CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

October 31, 2017

To: Participants in the CCRL Pozzolan Proficiency Sample Program

Subject: Pozzolan Proficiency Samples No. 61 and No. 62

Following is the final report for the pair of CCRL **Pozzolan** Proficiency Samples which were distributed in August 2017. Both samples were a Class F fly ash.

This report consists of two parts and each part must be downloaded from our website located at: http://www.ccrl.us/. One part contains general information that consists of a statistical Summary of Results, a set of Scatter Diagrams, and other associated information. The second part is laboratory specific information that consists of the Table of Results containing test results and ratings for your laboratory.

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 samples 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 Pozzolan Proficiency Samples will be distributed in August 2018.

Sincerely,

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 Pozzolan Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor, PSP

SUBJECT: Explanation of Final Report on Results of Tests on Pozzolan Proficiency Samples No. 61 and No. 62

This memo and the material included with it constitute the final report and summary of results for the current pair of Pozzolan Proficiency Samples, which were distributed in August 2017. This material includes a Table of Results for individual laboratory data, a statistical Summary of Results, and a set of 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.

Laboratory Ratings

Each laboratory receives an individualized Laboratory Ratings. Each line of the ratings 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.

The ratings 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. Laboratory Ratings are calculated using the unrounded values for average and standard deviation.

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. 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

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[1]Youden, W.J., "Statistical Aspects of the Cement Testing Program", *Proceedings of the American Society for testing and Materials Volume 59*, 1959.

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

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. Elimination of these outlying results may 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 ±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
Pozzolan Proficiency Samples No. 61 and No. 62

Final Report – Chemical Results
October 31, 2017

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.61			Sample No. 62		
		Average	S.D.	C.V.	Average	S.D.	C.V.
Moisture Content (percent)							
	65	0.05	0.04	72	0.09	0.05	53
	*62	0.05	0.03	61	0.09	0.04	45
* Labs Eliminated - 148, 1930, 4220							
Silicon Dioxide (percent)							
	53	49.80	1.03	2.1	55.67	1.09	2.0
	*51	49.81	0.74	1.5	55.74	0.90	1.6
* Labs Eliminated - 24, 125							
Aluminum Oxide (minor oxides included) (percent)							
	11	17.03	0.85	5.0	20.22	0.93	4.6
No Labs Eliminated for This Test							
Aluminum Oxide (minor oxides excluded) (percent)							
	50	15.83	0.41	2.6	18.38	0.55	3.0
	*47	15.78	0.35	2.2	18.34	0.37	2.0
* Labs Eliminated - 14, 50, 2522							
Ferric Oxide (percent)							
	54	6.53	0.18	2.8	11.31	0.43	3.8
	*51	6.52	0.16	2.4	11.30	0.33	3.0
* Labs Eliminated - 1, 58, 1251							
Calcium Oxide (minor oxides included) (percent)							
	14	15.76	0.69	4.4	6.57	1.09	16.6
	*13	15.67	0.63	4.0	6.30	0.45	7.2
* Labs Eliminated - 1							
Calcium Oxide (minor oxides excluded) (percent)							
	46	15.33	0.40	2.6	6.11	0.31	5.0
	*42	15.35	0.26	1.7	6.06	0.17	2.8
* Labs Eliminated - 3, 4, 58, 2522							

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficiency Samples No. 61 and No. 62

Final Report – Chemical Results
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SUMMARY OF RESULTS

		Sample No.61			Sample No. 62		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Magnesium Oxide (percent)							
	57	4.61	0.31	6.7	1.58	0.22	14.0
	*50	4.67	0.13	2.9	1.54	0.11	7.3
* Labs Eliminated - 9, 14, 50, 58, 125, 126, 975							
Sulfur Trioxide (percent)							
	63	0.78	0.09	11.9	0.91	0.15	16.9
	*57	0.76	0.05	7.0	0.89	0.06	6.8
* Labs Eliminated - 1, 43, 58, 125, 2253, 2437							
Loss on Ignition (percent)							
	74	0.14	0.07	51	0.48	0.10	21
	*69	0.13	0.05	43	0.47	0.09	18
* Labs Eliminated - 43, 2417, 2522, 2938, 4221							
Sodium Oxide (percent)							
	57	2.59	1.26	48.4	1.19	0.16	13.3
	*53	2.46	0.19	7.6	1.18	0.12	10.1
* Labs Eliminated - 20, 25, 34, 2437							
Potassium Oxide (percent)							
	57	2.13	0.10	4.5	2.62	0.13	5.0
	*55	2.13	0.08	3.8	2.62	0.11	4.4
* Labs Eliminated - 126, 2253							
Available Sodium Oxide (percent)							
	22	0.90	0.22	24	0.38	0.15	40
No Labs Eliminated for This Test							
Available Potassium Oxide (percent)							
	22	0.60	0.17	28	0.68	0.18	27
	*21	0.57	0.11	19	0.66	0.16	25
* Labs Eliminated - 2938							

Final Report – Chemical Results
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SUMMARY OF RESULTS

		Sample No.61			Sample No. 62			
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.	

Available Alkali (**percent**)

	23	1.52	0.77	50	1.02	0.62	61	
	*21	1.30	0.28	22	0.85	0.22	26	

    * Labs Eliminated - 4, 38

CCRL Proficiency Sample Program
Moisture Content
POZZOLAN Samples No. 61 and No. 62
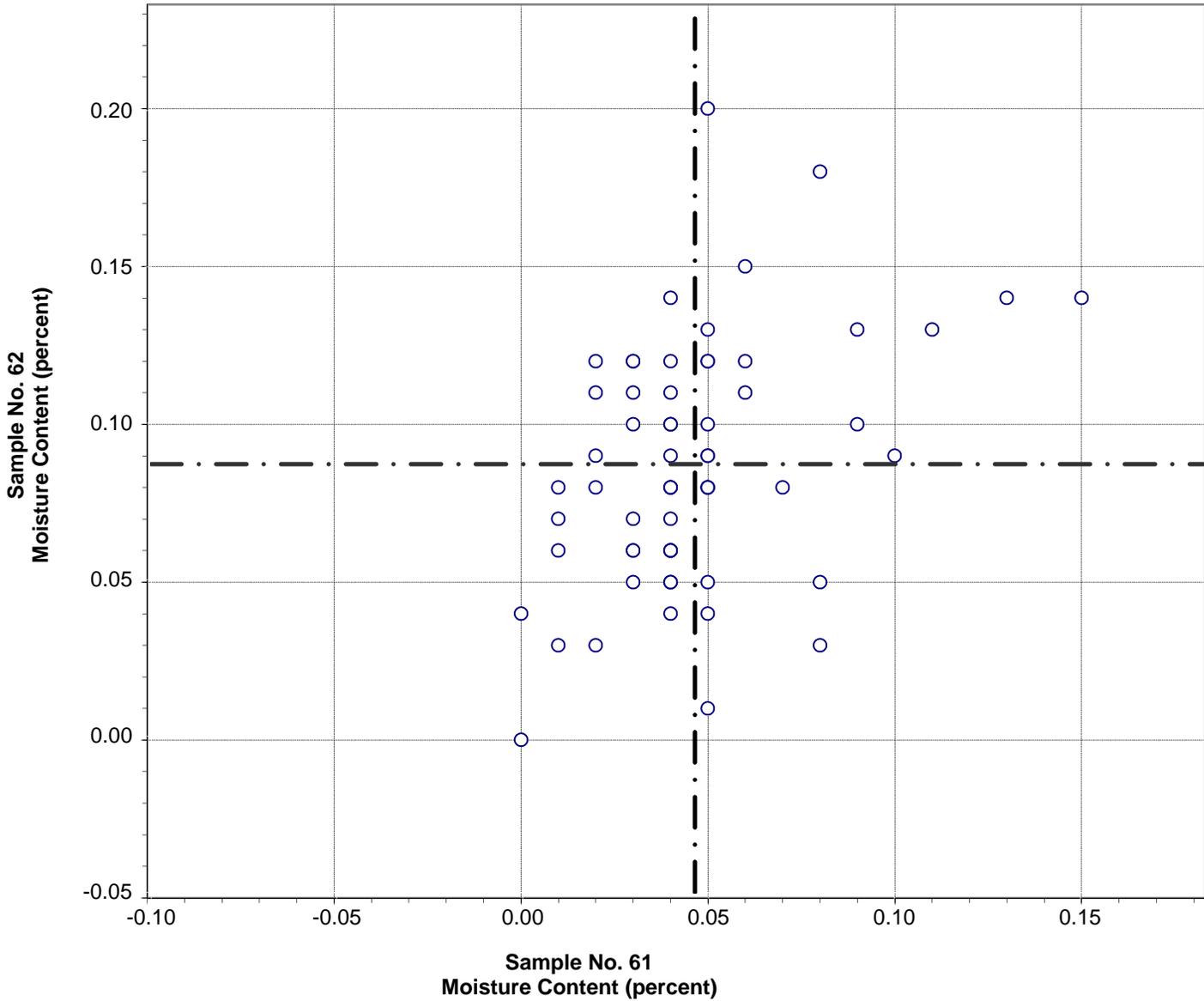
Test No. 5   Moisture Content   62 Points

Sample No. 61   Ave 0.05   S.D. 0.03   C.V. 61
Sample No. 62   Ave 0.09   S.D. 0.04   C.V. 45

Labs Eliminated: 148, 1930, 4220

CCRL Proficiency Sample Program
Silicon Dioxide
POZZOLAN Samples No. 61 and No. 62
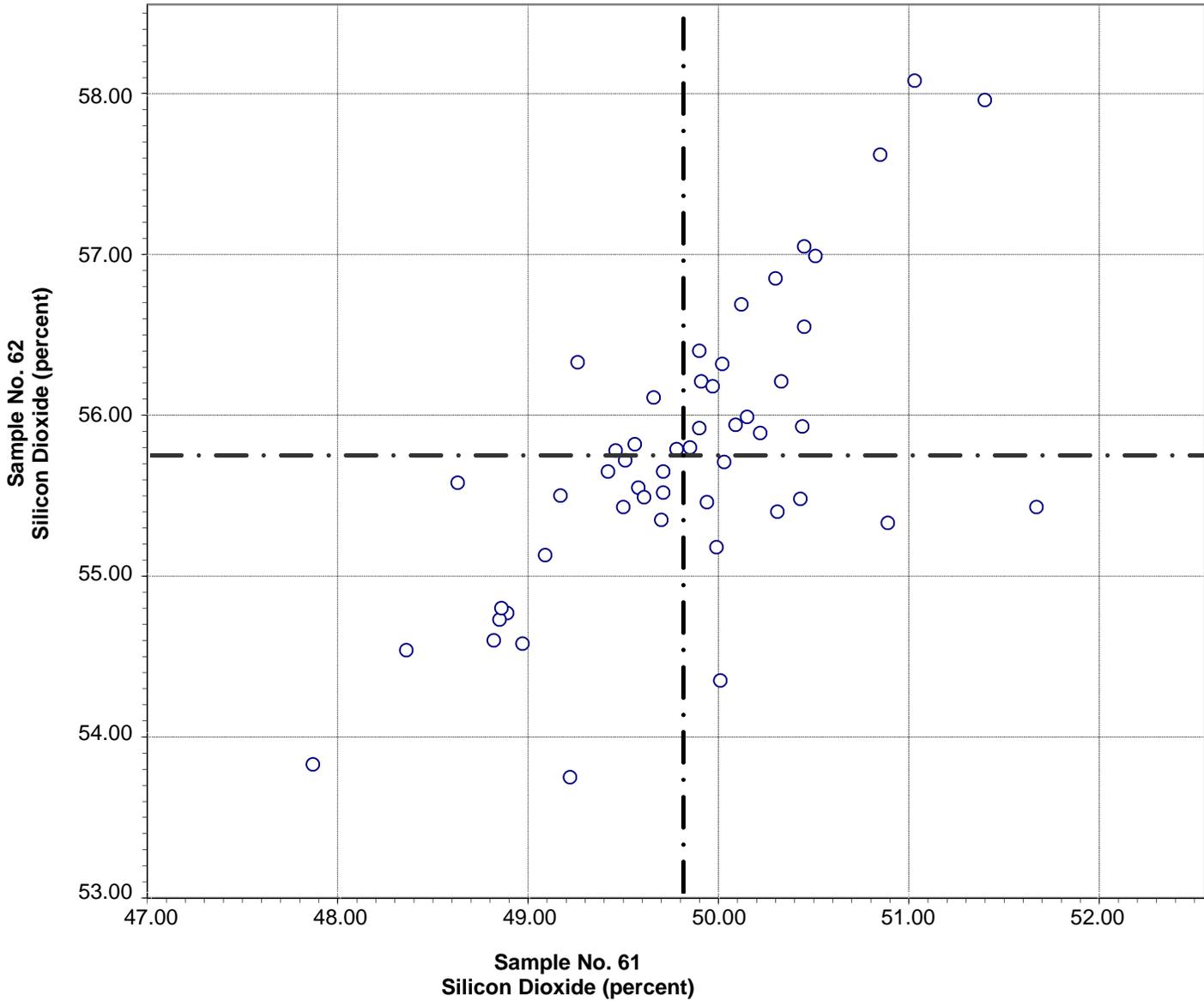
Test No. 10   Silicon Dioxide   51 Points

Sample No. 61   Ave 49.81   S.D. 0.74   C.V. 1.5
Sample No. 62   Ave 55.74   S.D. 0.90   C.V. 1.6

Labs Eliminated: 24, 125

CCRL Proficiency Sample Program
Aluminum Oxide (minor oxides included)
POZZOLAN Samples No. 61 and No. 62
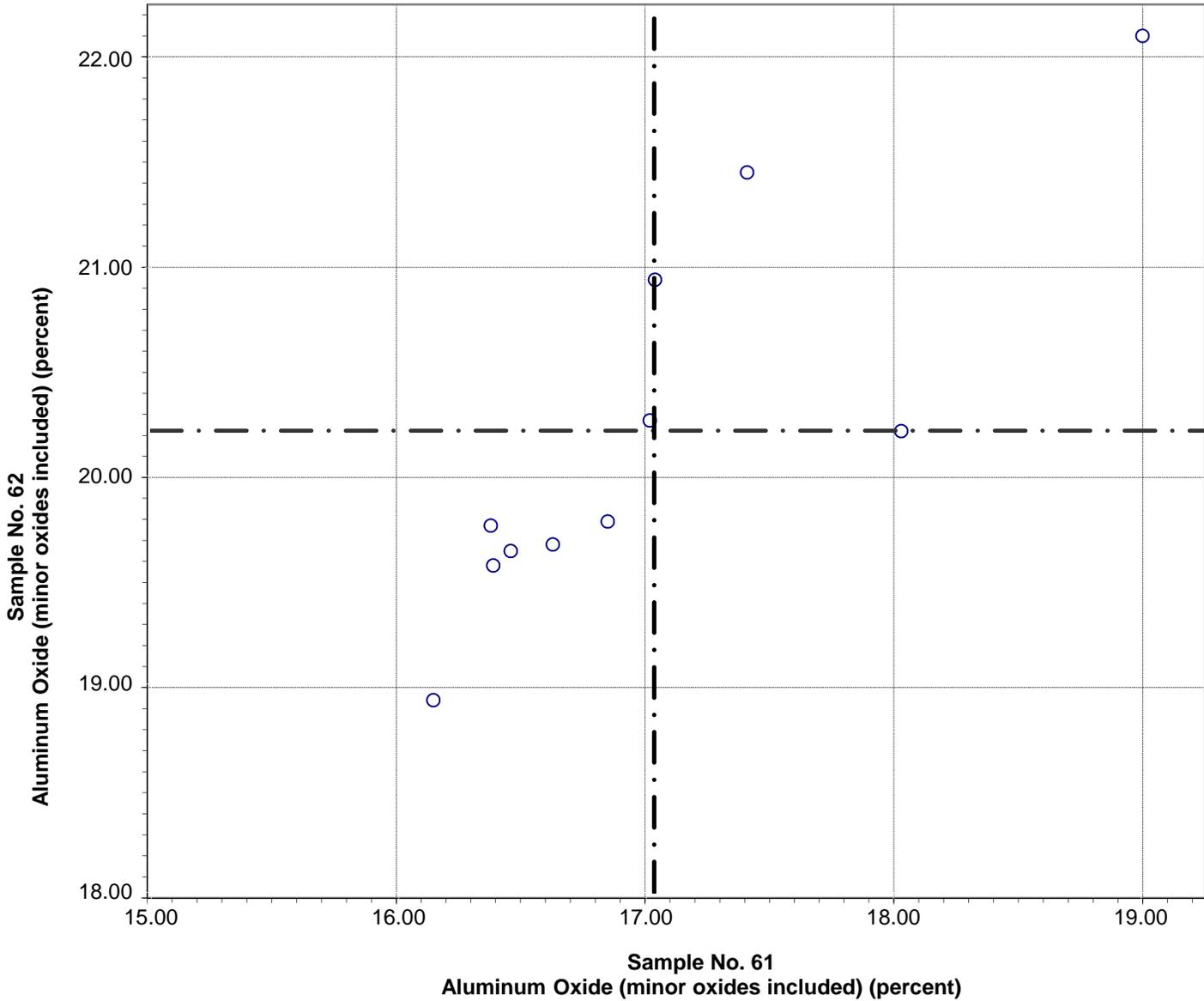
Test No. 20   Aluminum Oxide (minor oxides included)   11 Points

Sample No. 61   Ave 17.03   S.D. 0.85   C.V. 5.0
Sample No. 62   Ave 20.22   S.D. 0.93   C.V. 4.6

CCRL Proficiency Sample Program
Aluminum Oxide (minor oxides excluded)
POZZOLAN Samples No. 61 and No. 62
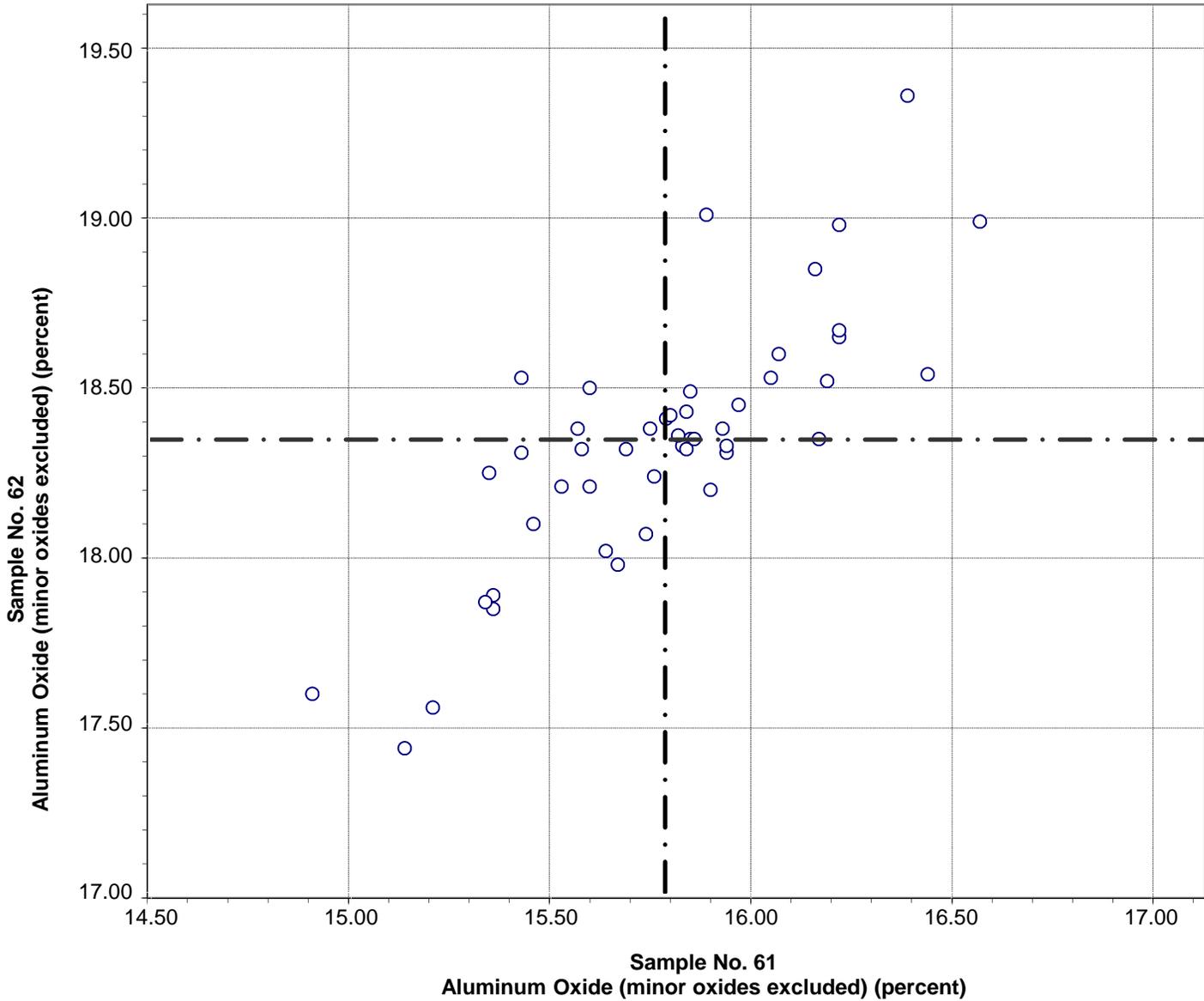
Test No. 21   Aluminum Oxide (minor oxides excluded)   47 Points

Sample No. 61   Ave 15.78   S.D. 0.35   C.V. 2.2
Sample No. 62   Ave 18.34   S.D. 0.37   C.V. 2.0

Labs Eliminated: 14, 50, 2522

CCRL Proficiency Sample Program
Ferric Oxide
POZZOLAN Samples No. 61 and No. 62
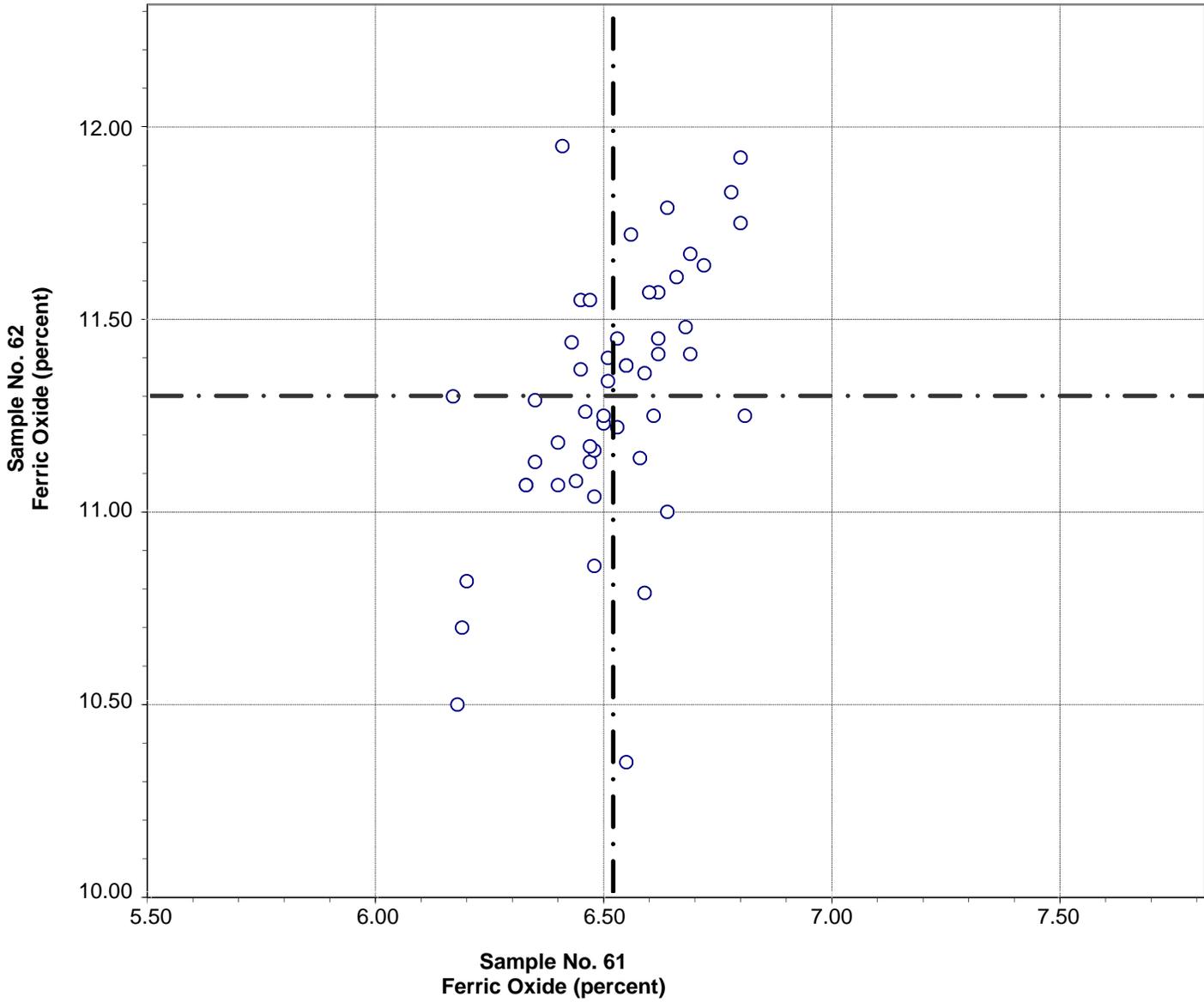
Test No. 30   Ferric Oxide   51 Points

Sample No. 61   Ave 6.52   S.D. 0.16   C.V. 2.4
Sample No. 62   Ave 11.30   S.D. 0.33   C.V. 3.0

Labs Eliminated: 1, 58, 1251

CCRL Proficiency Sample Program
Calcium Oxide (minor oxides included)
POZZOLAN Samples No. 61 and No. 62
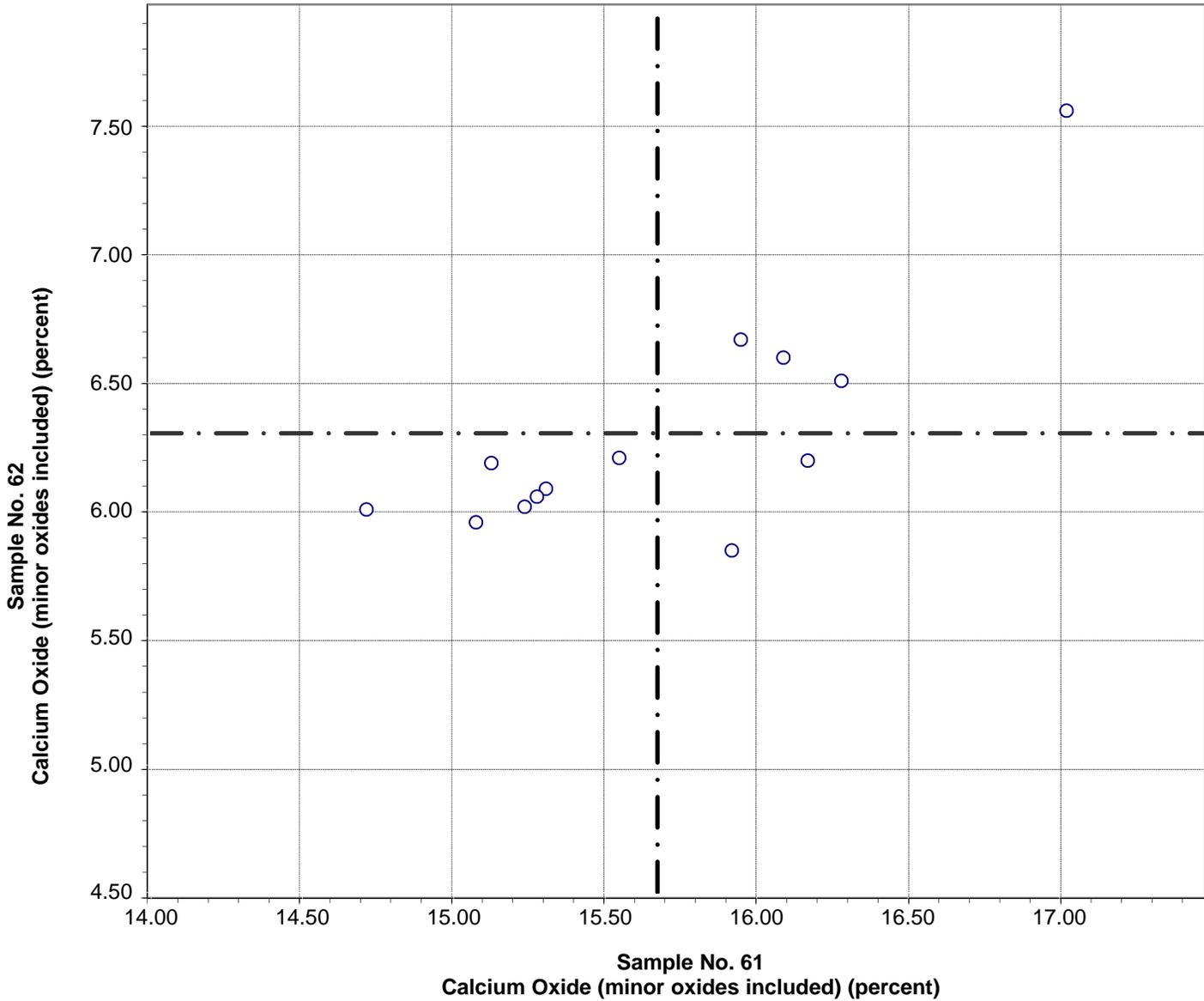
Test No. 40   Calcium Oxide (minor oxides included)   13 Points

Sample No. 61   Ave 15.67   S.D. 0.63   C.V. 4.0
Sample No. 62   Ave 6.30   S.D. 0.45   C.V. 7.2

Labs Eliminated: 1

CCRL Proficiency Sample Program
Calcium Oxide (minor oxides excluded)
POZZOLAN Samples No. 61 and No. 62
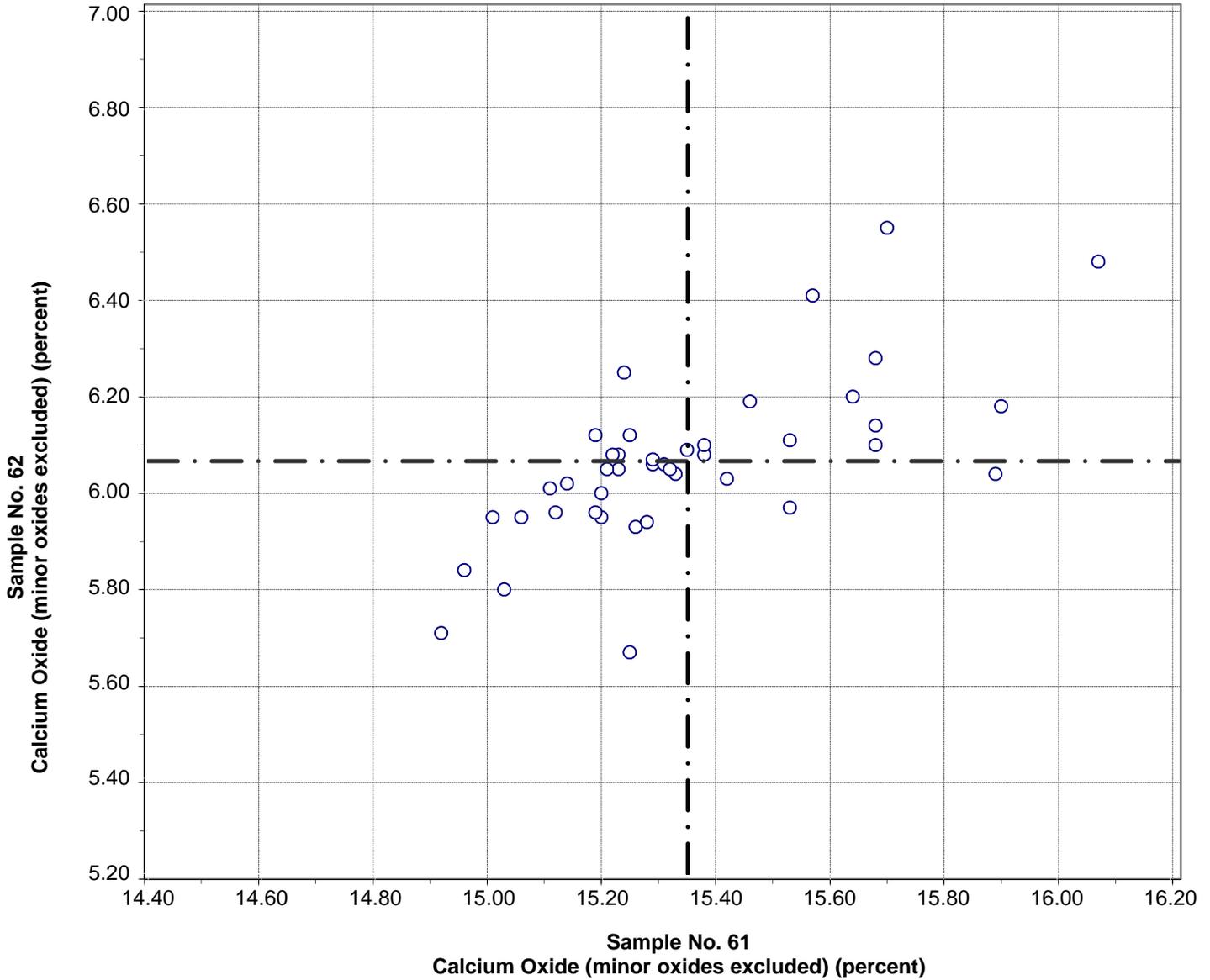
Test No. 42   Calcium Oxide (minor oxides excluded)   42 Points

Sample No. 61   Ave 15.35   S.D. 0.26   C.V. 1.7
Sample No. 62   Ave 6.06   S.D. 0.17   C.V. 2.8

Labs Eliminated: 3, 4, 58, 2522

CCRL Proficiency Sample Program
Magnesium Oxide
POZZOLAN Samples No. 61 and No. 62
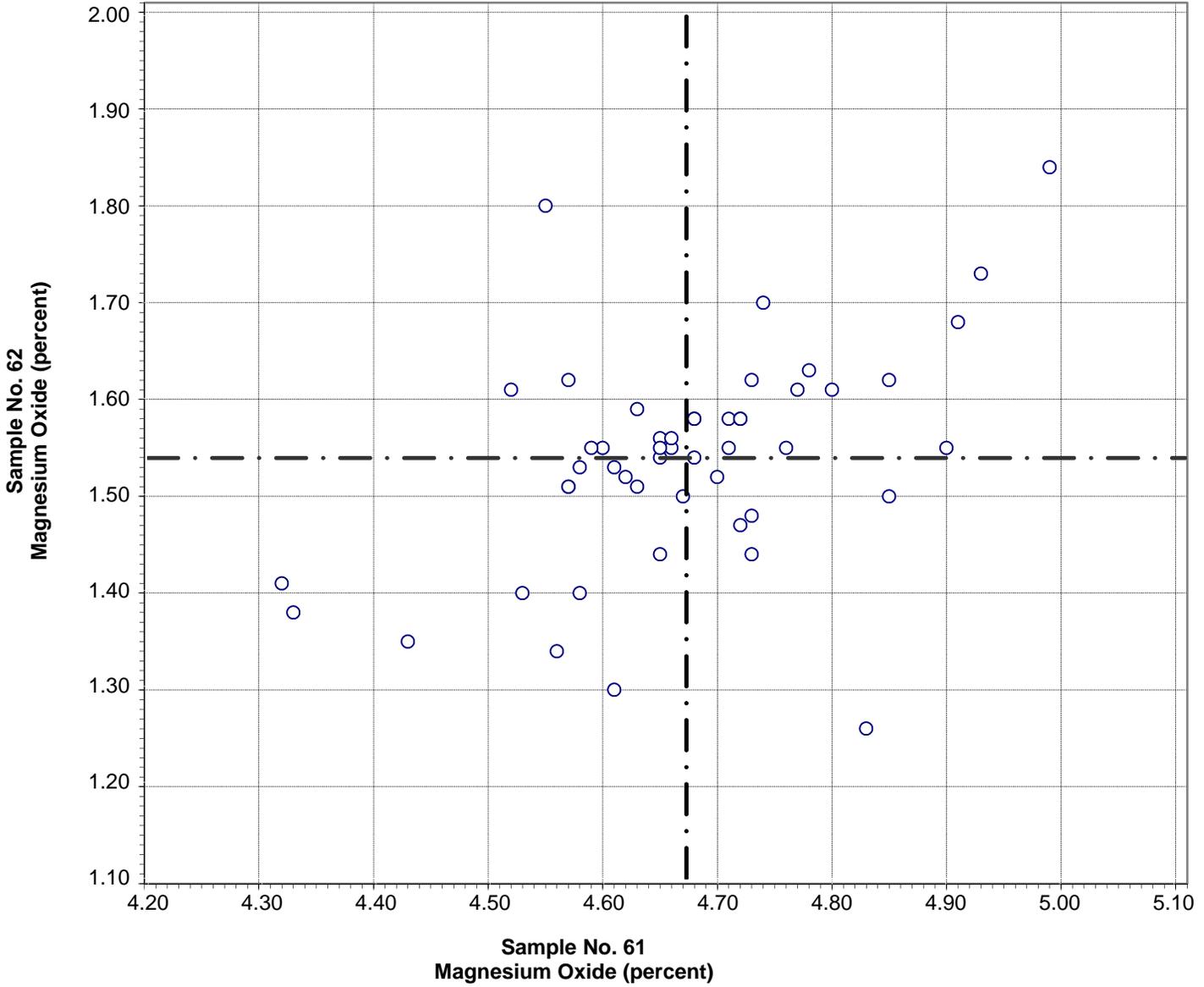
Test No. 50   Magnesium Oxide   50 Points

Sample No. 61   Ave 4.67   S.D. 0.13   C.V. 2.9
Sample No. 62   Ave 1.54   S.D. 0.11   C.V. 7.3

Labs Eliminated: 9, 14, 50, 58, 125, 126, 975

CCRL Proficiency Sample Program
Sulfur Trioxide
POZZOLAN Samples No. 61 and No. 62
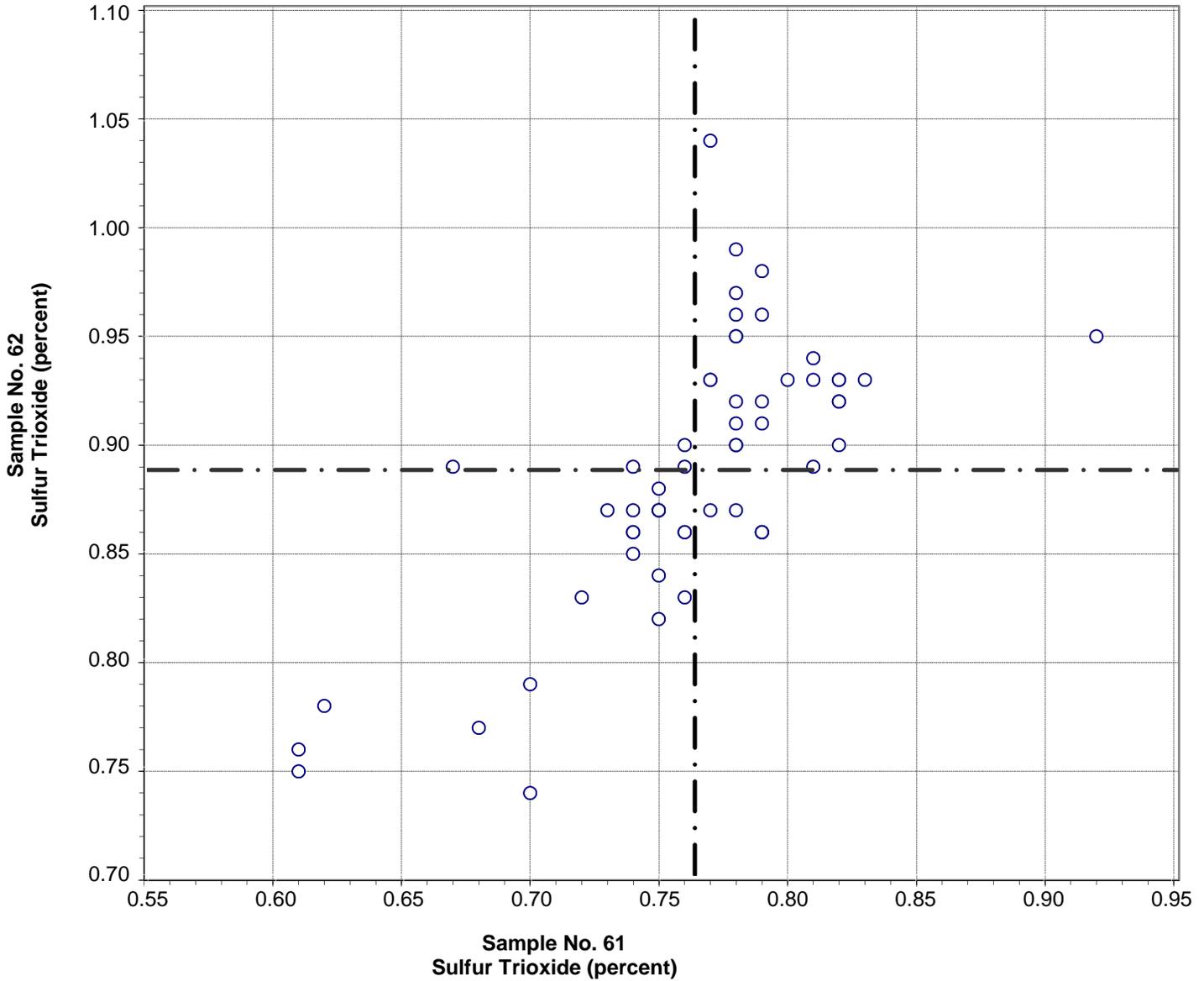
Test No. 60   Sulfur Trioxide   57 Points

Sample No. 61   Ave 0.76   S.D. 0.05   C.V. 7.0
Sample No. 62   Ave 0.89   S.D. 0.06   C.V. 6.8

Labs Eliminated: 1, 43, 58, 125, 2253, 2437

CCRL Proficiency Sample Program
Loss on Ignition
POZZOLAN Samples No. 61 and No. 62
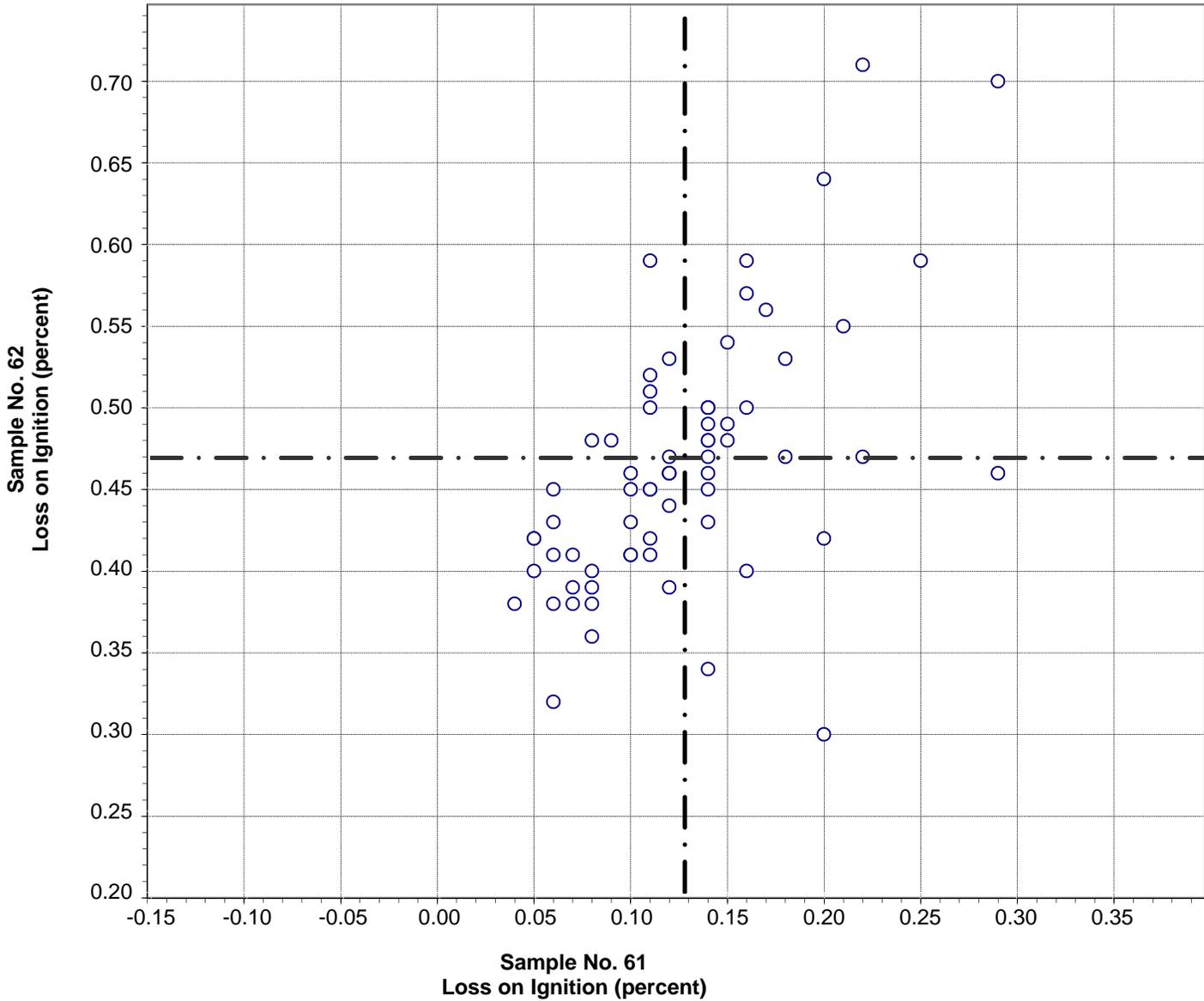
Test No. 70   Loss on Ignition   68 Points

Sample No. 61   Ave 0.13   S.D. 0.05   C.V. 43
Sample No. 62   Ave 0.47   S.D. 0.09   C.V. 18

Labs Eliminated: 43, 2417, 2522, 2938, 4221

Labs off Diagram: 34

CCRL Proficiency Sample Program
Sodium Oxide
POZZOLAN Samples No. 61 and No. 62
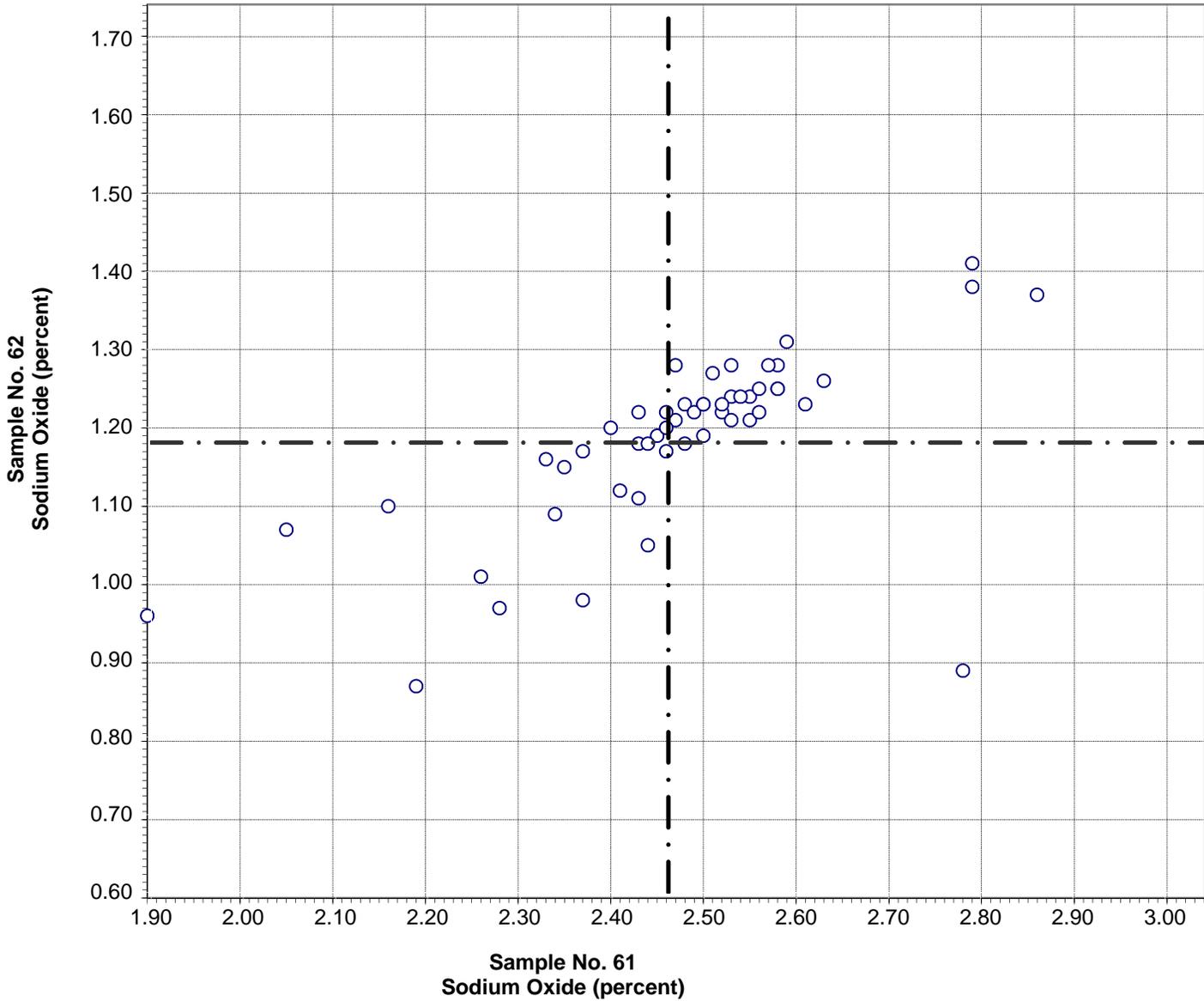
Test No. 90   Sodium Oxide   52 Points

Sample No. 61   Ave 2.46   S.D. 0.19   C.V. 7.6
Sample No. 62   Ave 1.18   S.D. 0.12   C.V. 10.1

Labs Eliminated: 20, 25, 34, 2437

Labs off Diagram: 8

CCRL Proficiency Sample Program
Potassium Oxide
POZZOLAN Samples No. 61 and No. 62
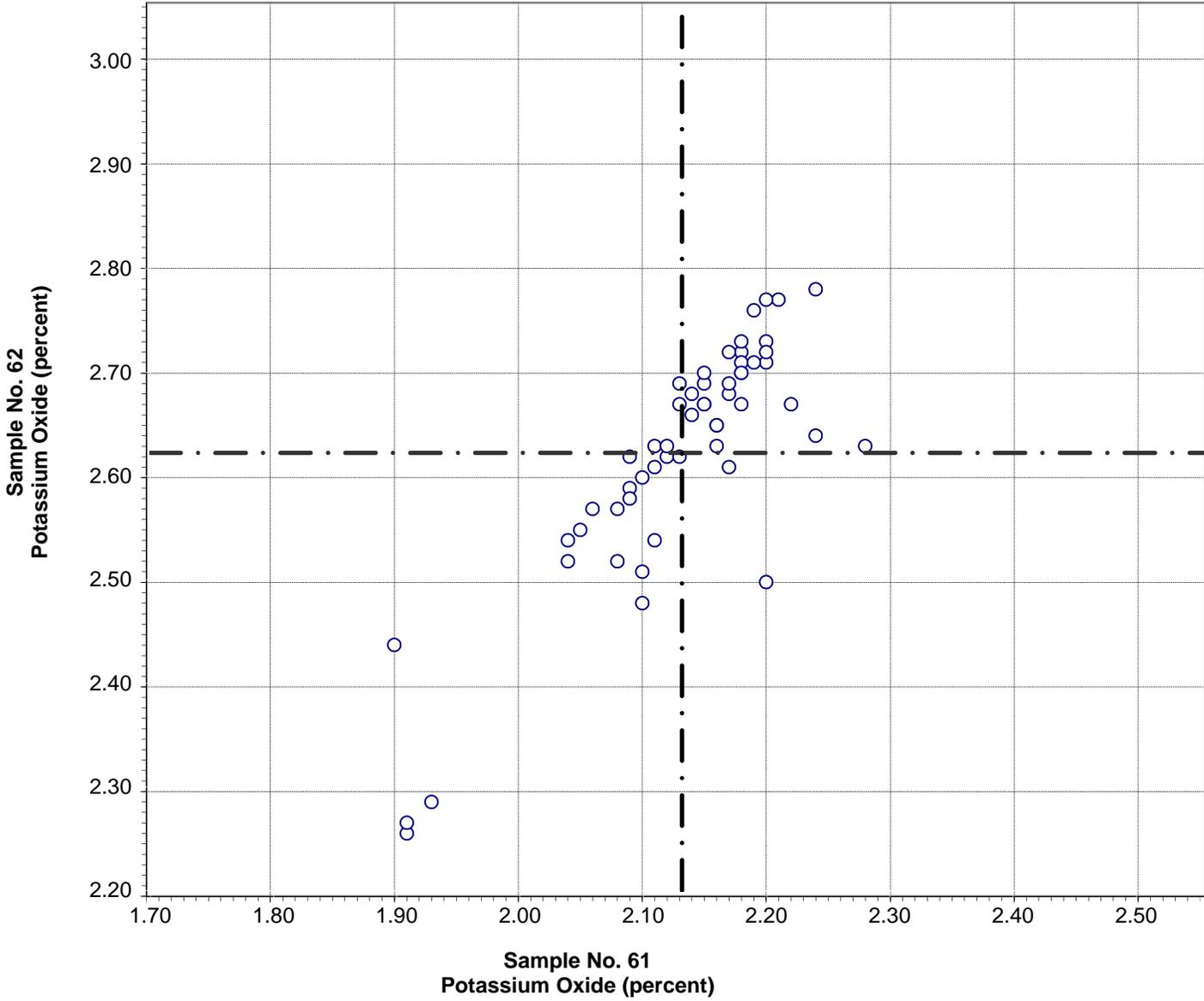
Test No. 100   Potassium Oxide   55 Points

Sample No. 61   Ave 2.13   S.D. 0.08   C.V. 3.8
Sample No. 62   Ave 2.62   S.D. 0.11   C.V. 4.4

Labs Eliminated: 126, 2253

CCRL Proficiency Sample Program
Available Sodium Oxide
POZZOLAN Samples No. 61 and No. 62
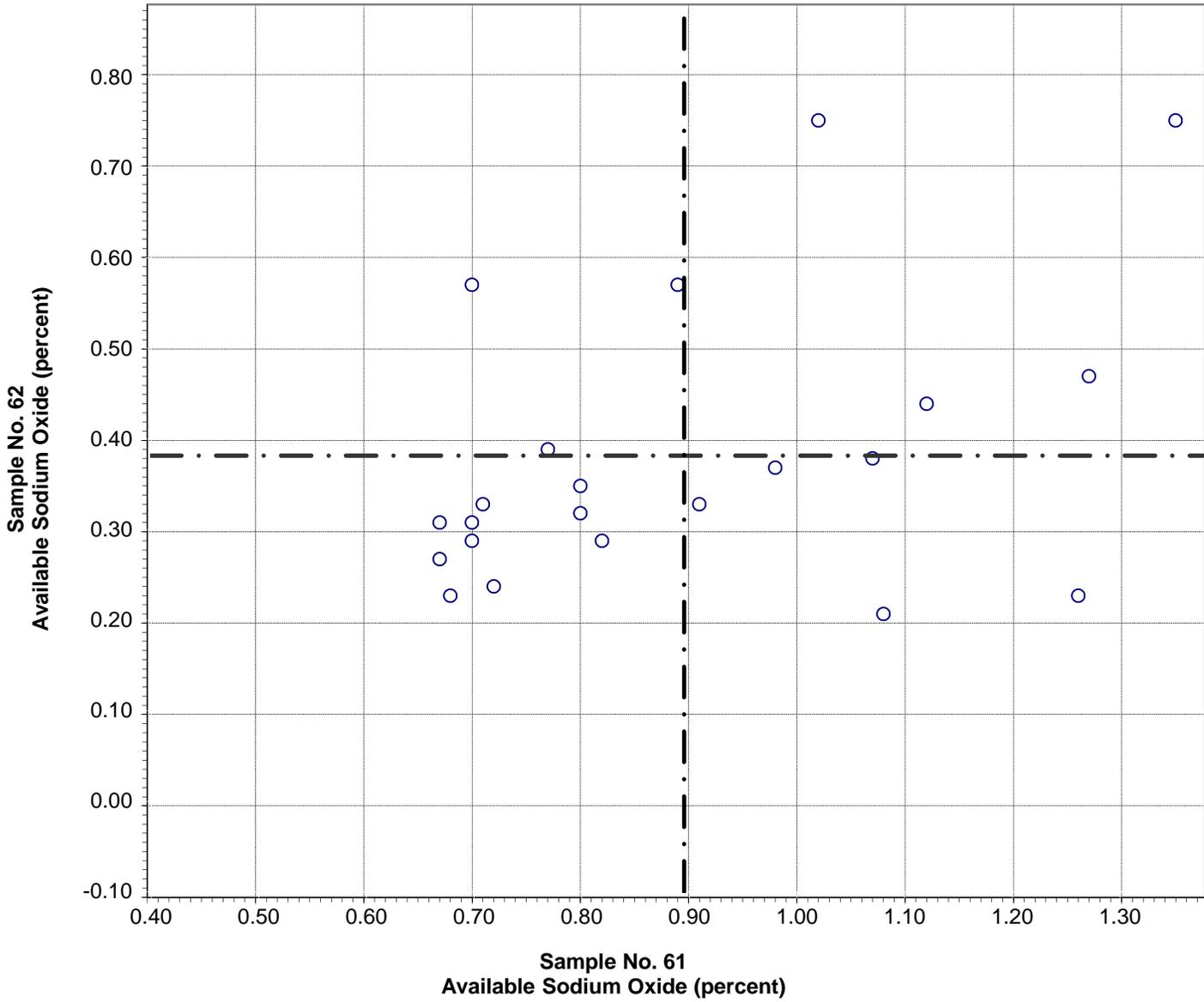
Test No. 91   Available Sodium Oxide   22 Points

Sample No. 61   Ave 0.90   S.D. 0.22   C.V. 24
Sample No. 62   Ave 0.38   S.D. 0.15   C.V. 40

CCRL Proficiency Sample Program
Available Potassium Oxide
POZZOLAN Samples No. 61 and No. 62
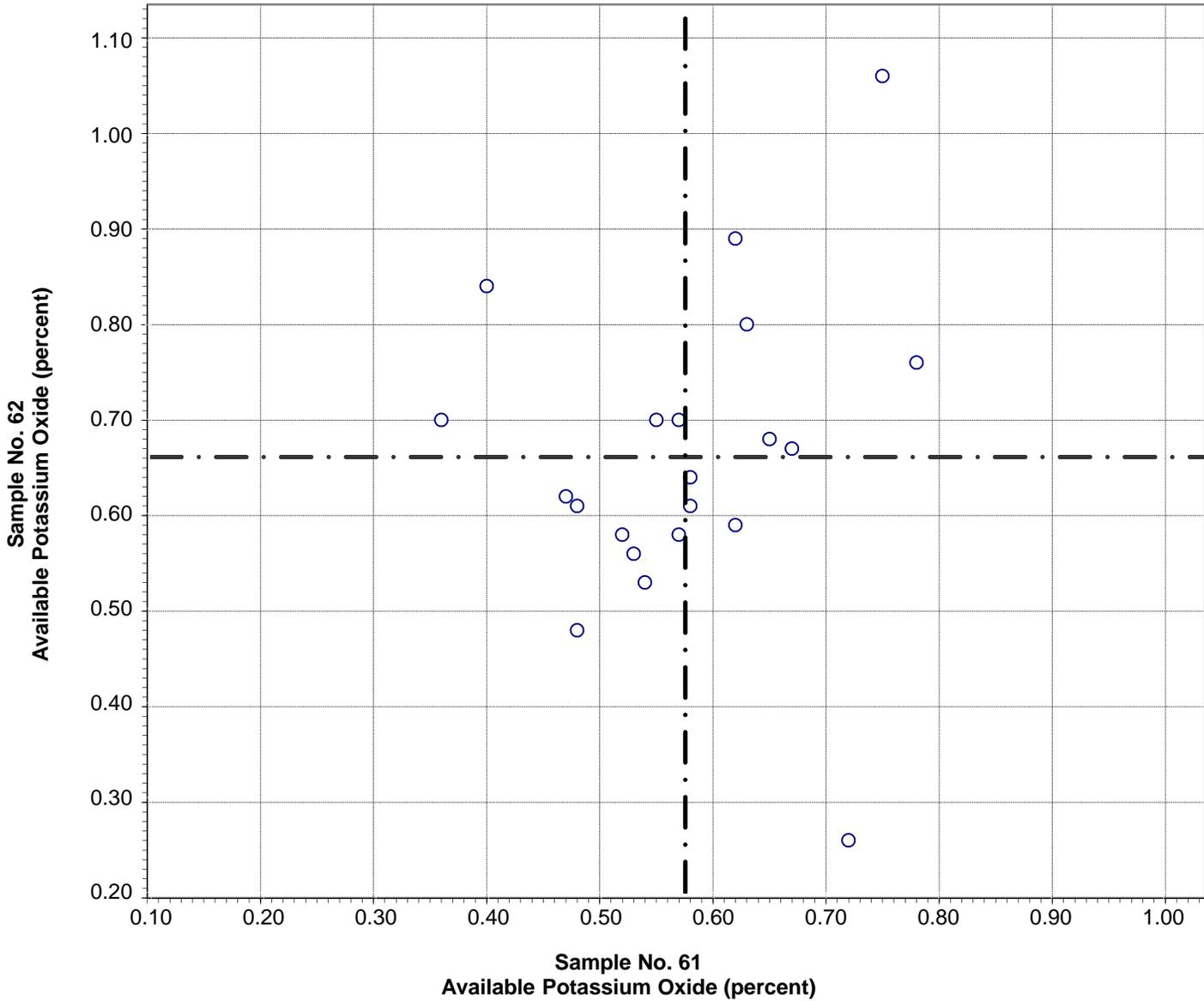
Test No. 93   Available Potassium Oxide   21 Points

Sample No. 61   Ave 0.57   S.D. 0.11   C.V. 19
Sample No. 62   Ave 0.66   S.D. 0.16   C.V. 25

Labs Eliminated: 2938

CCRL Proficiency Sample Program
Available Alkali
POZZOLAN Samples No. 61 and No. 62
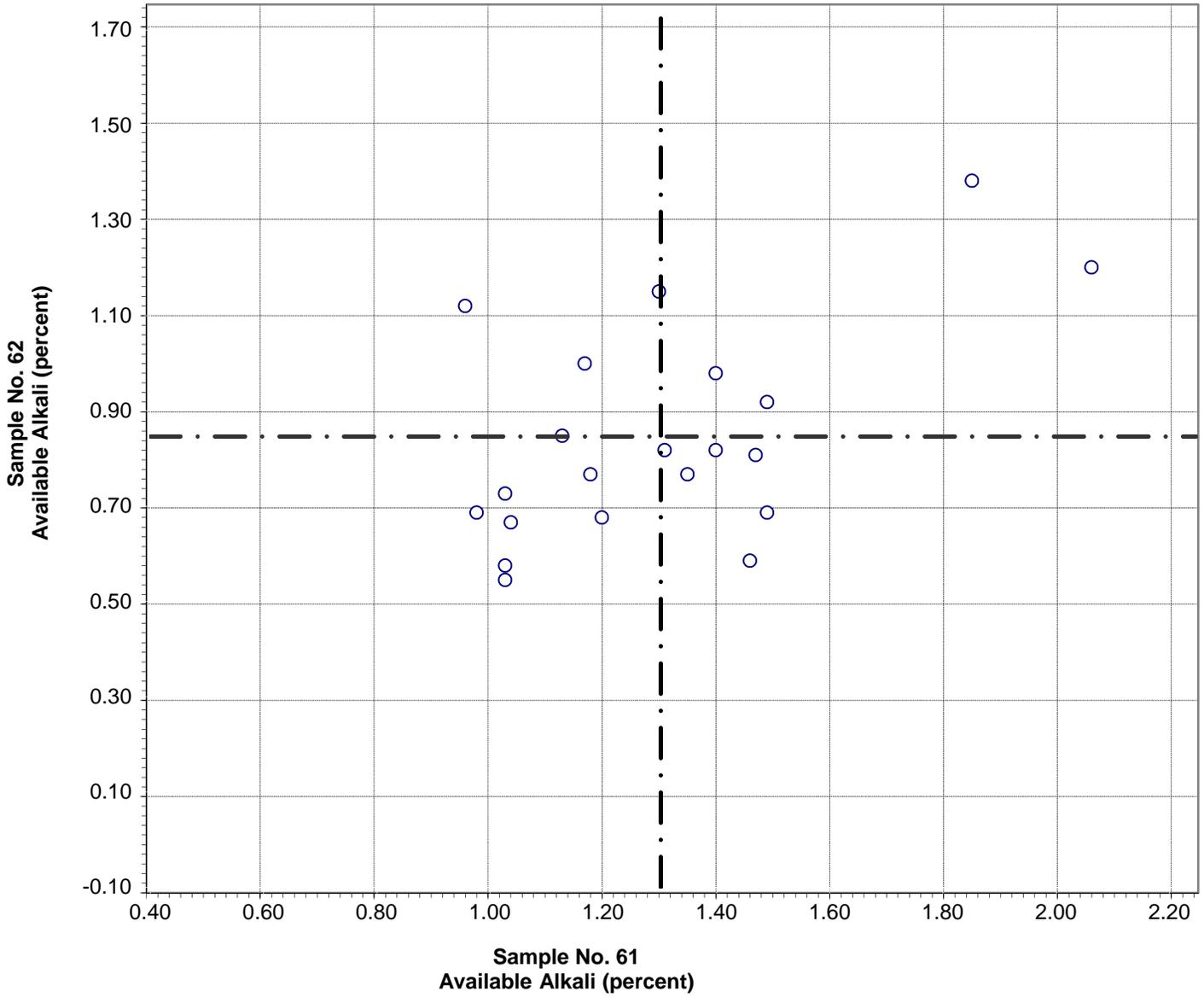
Test No. 95   Available Alkali   21 Points

Sample No. 61   Ave 1.30   S.D. 0.28   C.V. 22
Sample No. 62   Ave 0.85   S.D. 0.22   C.V. 26

Labs Eliminated: 4, 38

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficiency Samples No. 61 and No. 62

Final Report – Physical Results
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SUMMARY OF RESULTS

|		Sample No.61			Sample No. 62		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.

Density (g/cm³)

	53	2.49	0.05	2.2	2.35	0.07	2.8
	*50	2.50	0.03	1.1	2.34	0.02	1.0

* Labs Eliminated - 25, 50, 823

Fineness - 45 µm Sieve Retained (percent)

	74	23.52	4.99	21.2	26.46	5.55	21.0
	*70	24.39	1.36	5.6	27.44	1.48	5.4

* Labs Eliminated - 565, 975, 2116, 4221

Drying Shrinkage (percent)

	16	0.038	0.157	408	-0.020	0.067	-348
	*15	0.000	0.006	773	-0.002	0.006	213

* Labs Eliminated - 840

Autoclave Expansion (percent)

	48	0.05	0.03	54	0.04	0.02	68
	*44	0.06	0.01	22	0.04	0.01	34

* Labs Eliminated - 15, 41, 47, 1038

Normal Consistency Water (percent)

	51	24.4	4.5	18.4	24.8	4.5	18.2
	*49	23.5	0.4	1.6	23.9	0.4	1.7

* Labs Eliminated - 169, 1221

Air Entrainment – Vinsol Resin (percent)

	9	0.020	0.010	51	0.022	0.013	60

No Labs Eliminated for This Test

Strength Activity Index - 7 day (percent)

	55	84	6.3	7.5	81	5.0	6.1
	*51	83	3.9	4.7	80	3.2	4.0

* Labs Eliminated - 4, 26, 34, 46

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficiency Samples No. 61 and No. 62

Final Report – Physical Results
October 31, 2017

SUMMARY OF RESULTS

		Sample No.61			Sample No. 62			
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.	

Strength Activity Index - 28 day (percent)

	54	91	4.7	5.2	86	5.1	6.0	
	*51	91	3.9	4.3	85	3.9	4.6	

* Labs Eliminated - 4, 46, 1859

SAI Water Requirement (percent)

	55	92	8.7	9.5	92	8.8	9.5	
	*52	93	1.4	1.5	94	1.6	1.7	

* Labs Eliminated - 34, 36, 2116

Alkali-Silica Reaction - Reduction of Expansion (percent)

	11	43	14	33	50	11	22	

No Labs Eliminated for This Test

CCRL Proficiency Sample Program
Density
POZZOLAN Samples No. 61 and No. 62
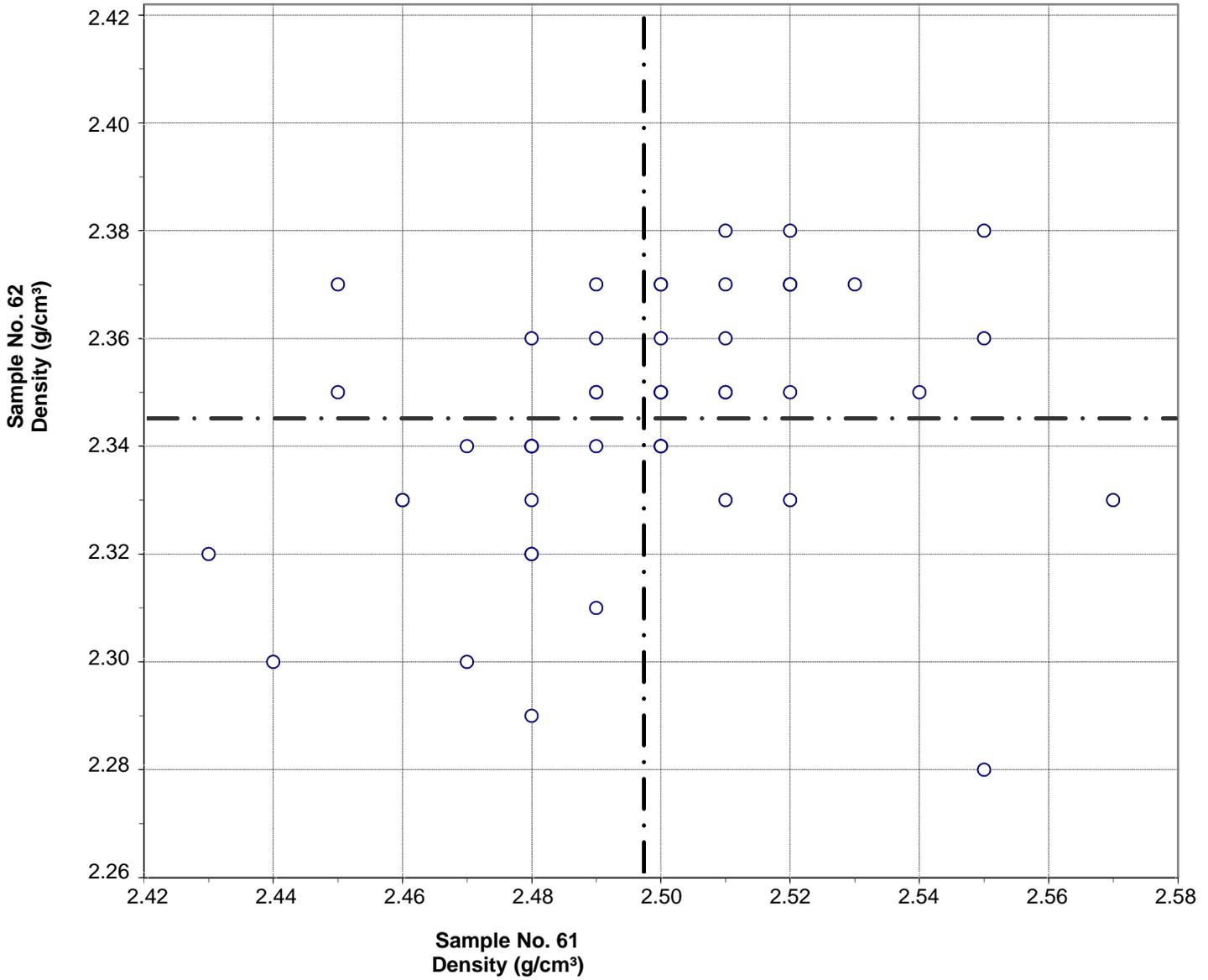
Test No. 310   Density   50 Points

Sample No. 61   Ave 2.50   S.D. 0.03   C.V. 1.1
Sample No. 62   Ave 2.34   S.D. 0.02   C.V. 1.0

Labs Eliminated: 25, 50, 823

CCRL Proficiency Sample Program
Fineness - 45 µm Sieve Retained
POZZOLAN Samples No. 61 and No. 62
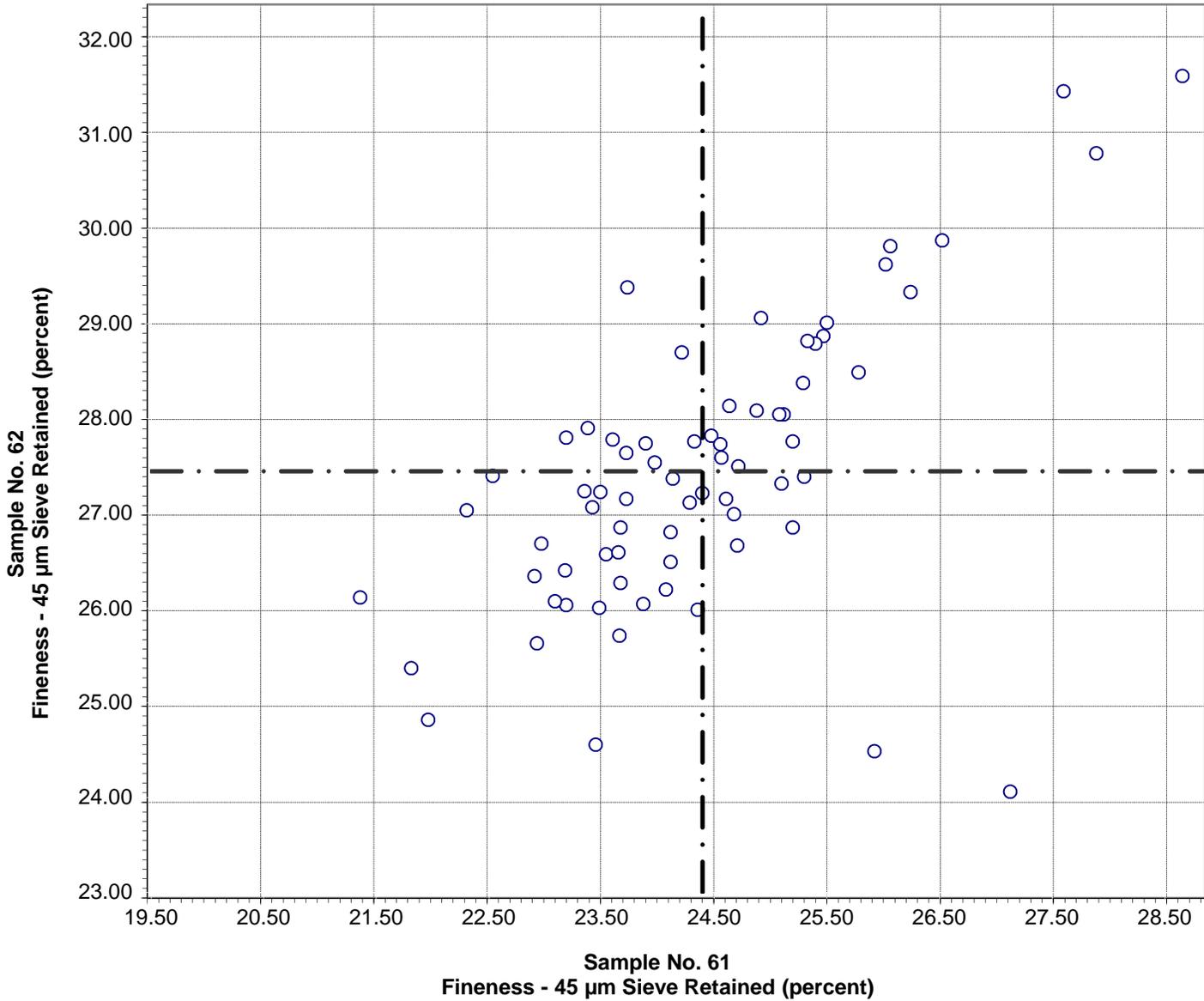
Test No. 281   Fineness - 45 µm Sieve Retained   70 Points

Sample No. 61   Ave 24.39   S.D. 1.36   C.V. 5.6
Sample No. 62   Ave 27.44   S.D. 1.48   C.V. 5.4

Labs Eliminated: 565, 975, 2116, 4221

CCRL Proficiency Sample Program
Drying Shrinkage
**POZZOLAN Samples No. 61 and No. 62**
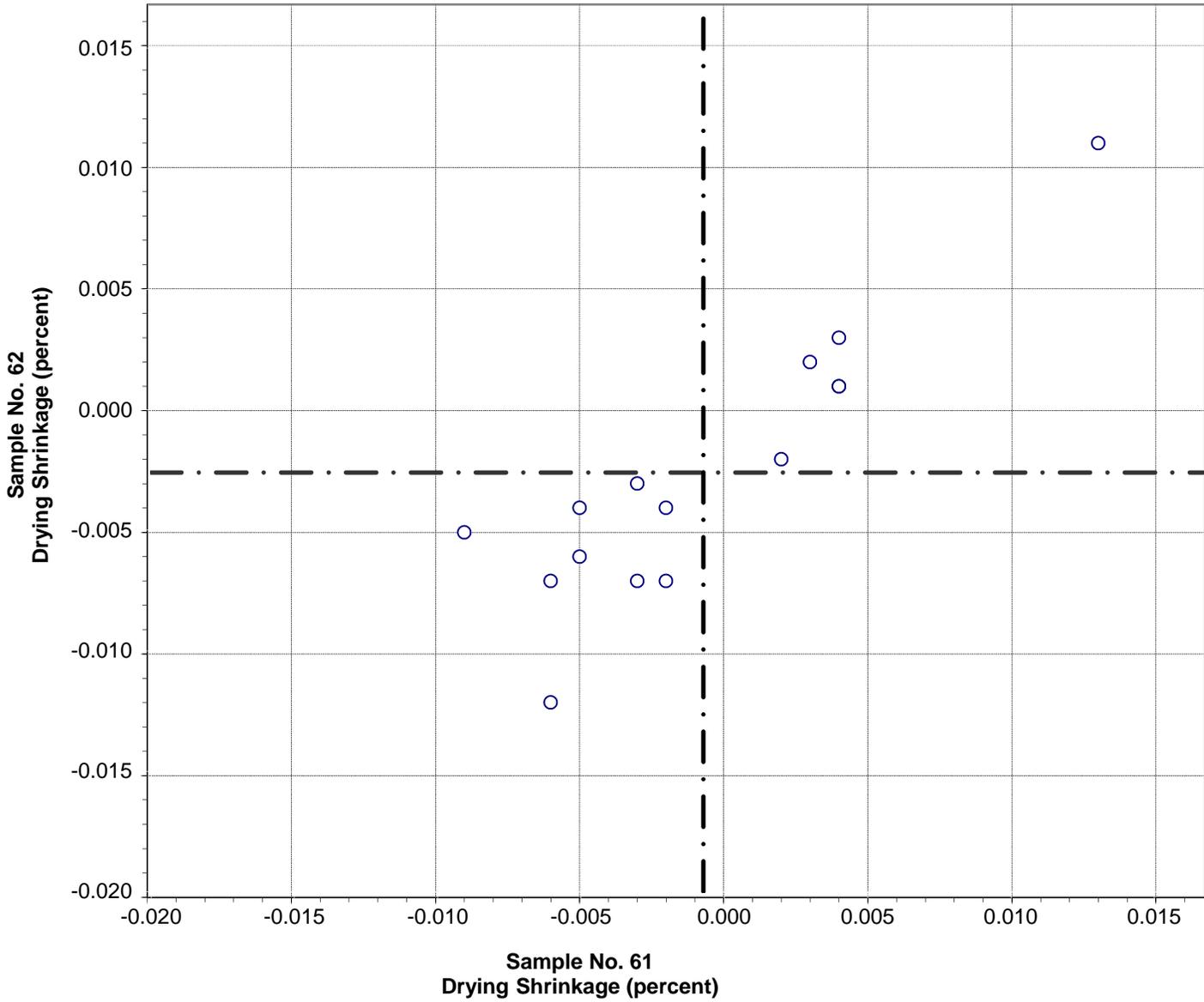
Test No. 340   Drying Shrinkage   15 Points

Sample No. 61   Ave 0.000   S.D. 0.006   C.V. 773
Sample No. 62   Ave -0.002   S.D. 0.006   C.V. 213

Labs Eliminated: 840

CCRL Proficiency Sample Program
Autoclave Expansion
POZZOLAN Samples No. 61 and No. 62
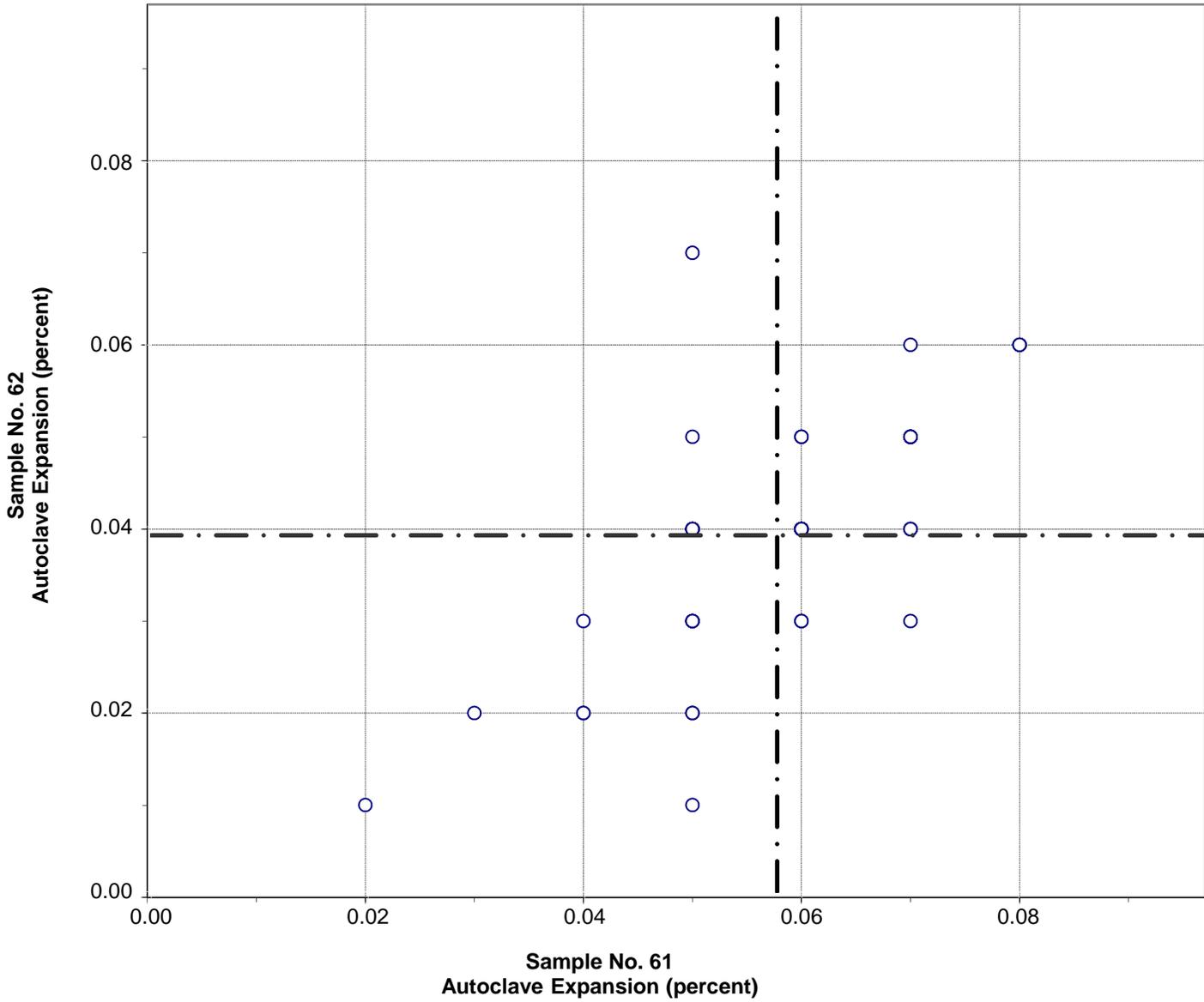
Test No. 160   Autoclave Expansion   44 Points

Sample No. 61   Ave 0.06   S.D. 0.01   C.V. 22
Sample No. 62   Ave 0.04   S.D. 0.01   C.V. 34

Labs Eliminated: 15, 41, 47, 1038

CCRL Proficiency Sample Program
Normal Consistency Water
POZZOLAN Samples No. 61 and No. 62
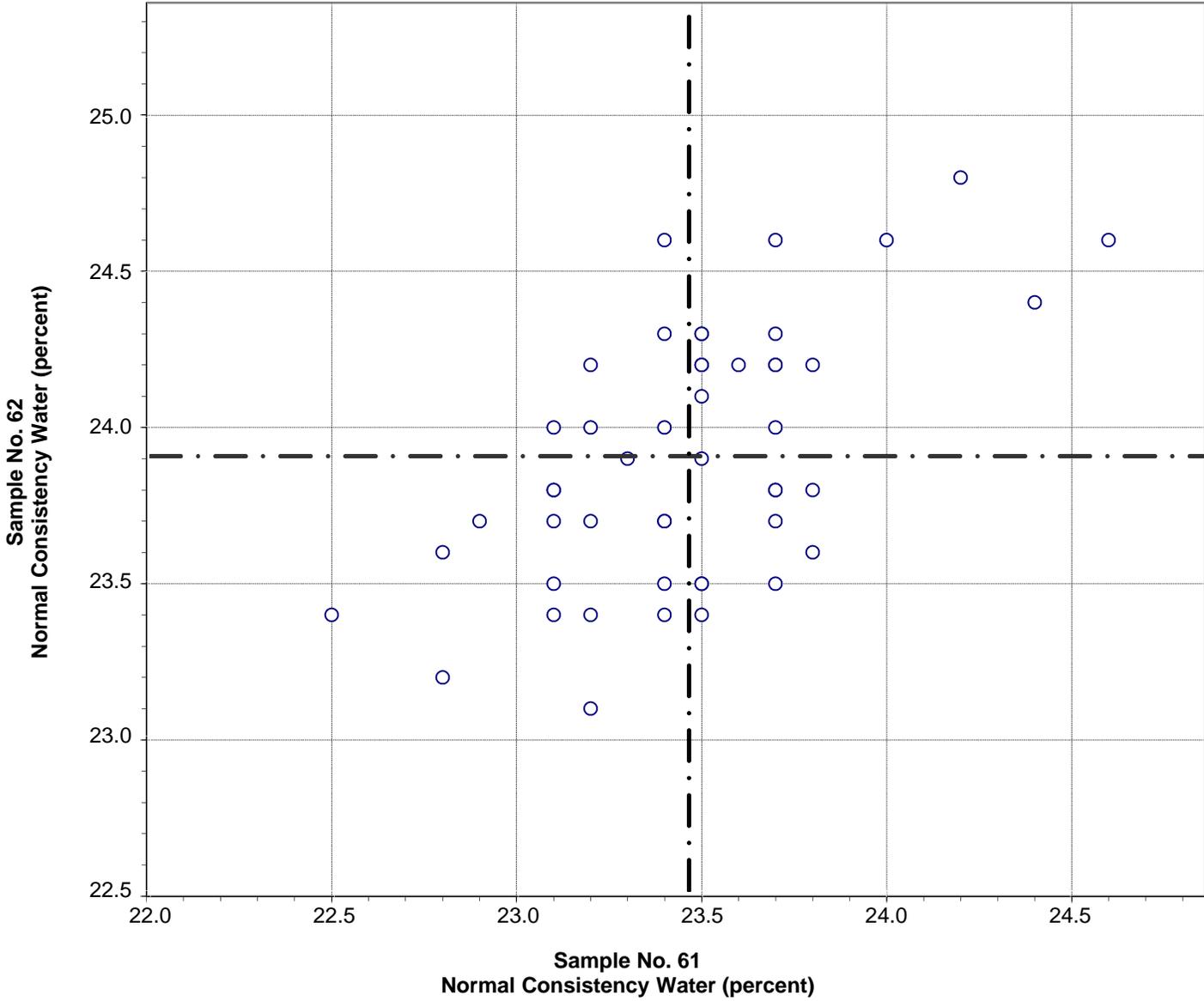
Test No. 110   Normal Consistency Water   49 Points

Sample No. 61   Ave 23.5   S.D. 0.4   C.V. 1.6
Sample No. 62   Ave 23.9   S.D. 0.4   C.V. 1.7

Labs Eliminated: 169, 1221

CCRL Proficiency Sample Program
Air Entrainment - Vinsol Resin
POZZOLAN Samples No. 61 and No. 62
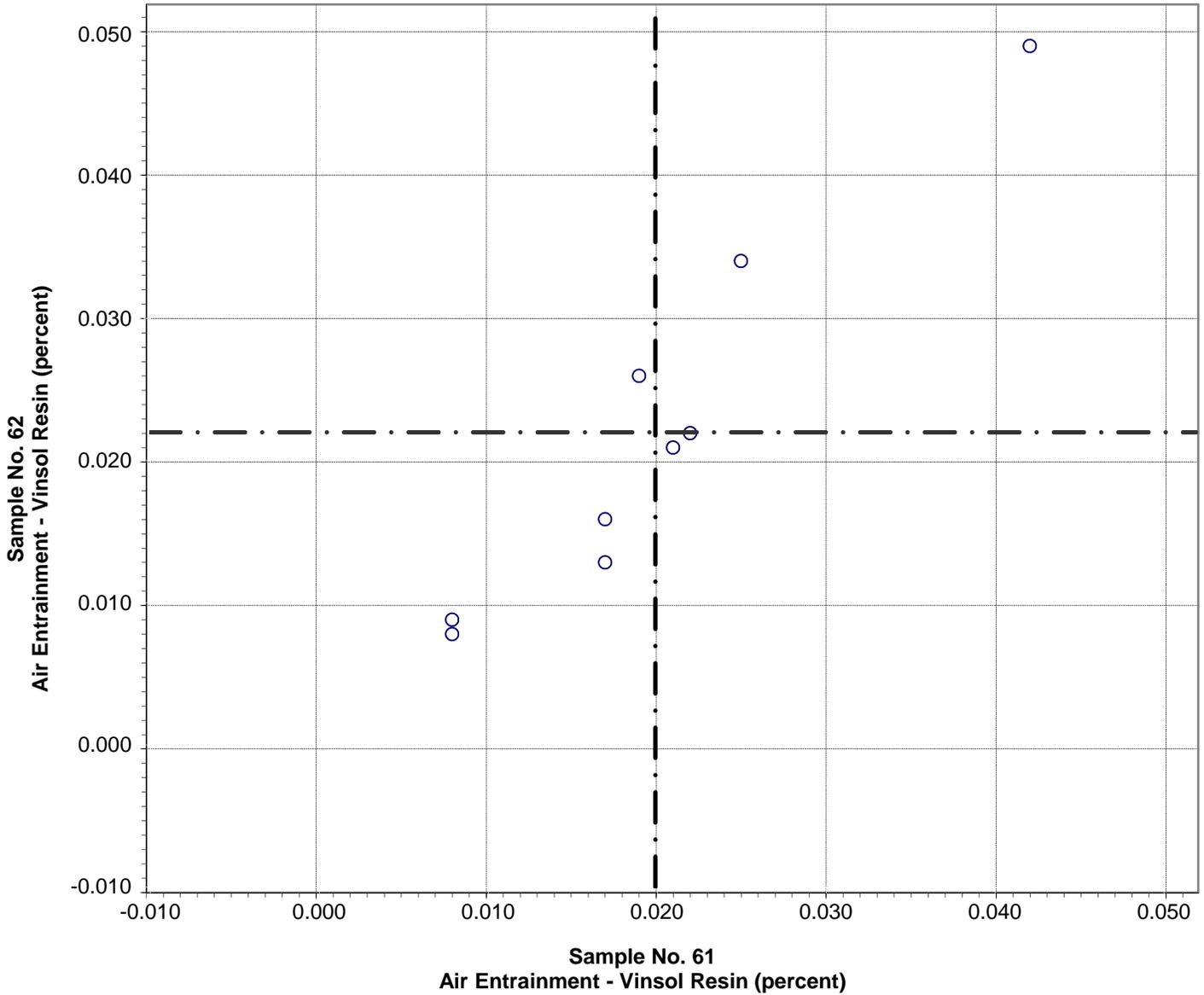
Test No. 350   Air Entrainment - Vinsol Resin   9 Points

Sample No. 61   Ave 0.020   S.D. 0.010   C.V. 51
Sample No. 62   Ave 0.022   S.D. 0.013   C.V. 60

CCRL Proficiency Sample Program
Strength Activity Index - 7 day
**POZZOLAN Samples No. 61 and No. 62**

Sample No. 62
Strength Activity Index - 7 day (percent)

Sample No. 61
Strength Activity Index - 7 day (percent)

Test No. 359   Strength Activity Index - 7 day   51 Points

Sample No. 61   Ave 83   S.D. 3.9   C.V. 4.7
Sample No. 62   Ave 80   S.D. 3.2   C.V. 4.0

Labs Eliminated: 4, 26, 34, 46

CCRL Proficiency Sample Program
Strength Activity Index - 28 day
POZZOLAN Samples No. 61 and No. 62
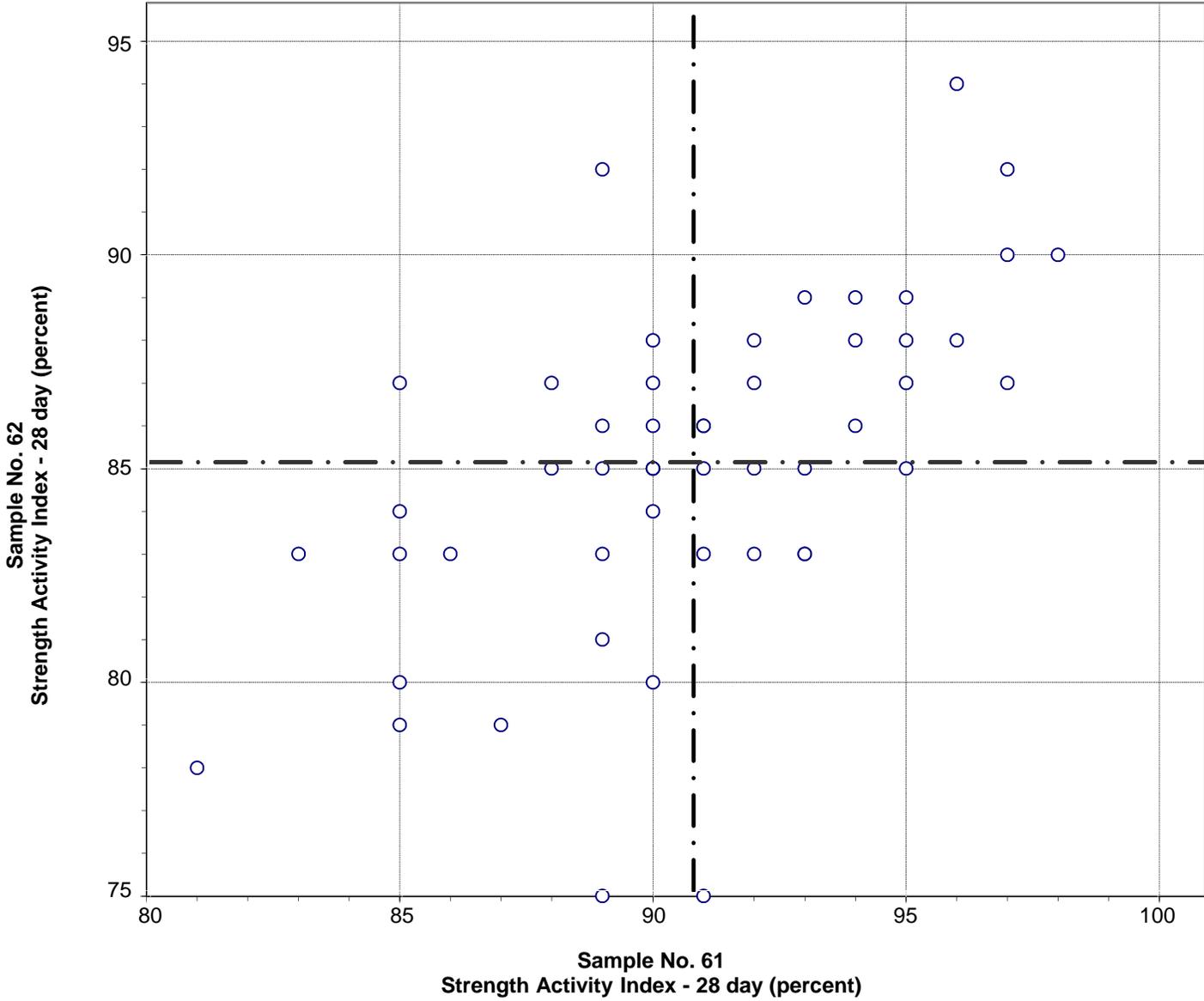
Test No. 360   Strength Activity Index - 28 day   51 Points

Sample No. 61   Ave 91   S.D. 3.9   C.V. 4.3
Sample No. 62   Ave 85   S.D. 3.9   C.V. 4.6

Labs Eliminated: 4, 46, 1859

CCRL Proficiency Sample Program
SAI Water Requirement
POZZOLAN Samples No. 61 and No. 62
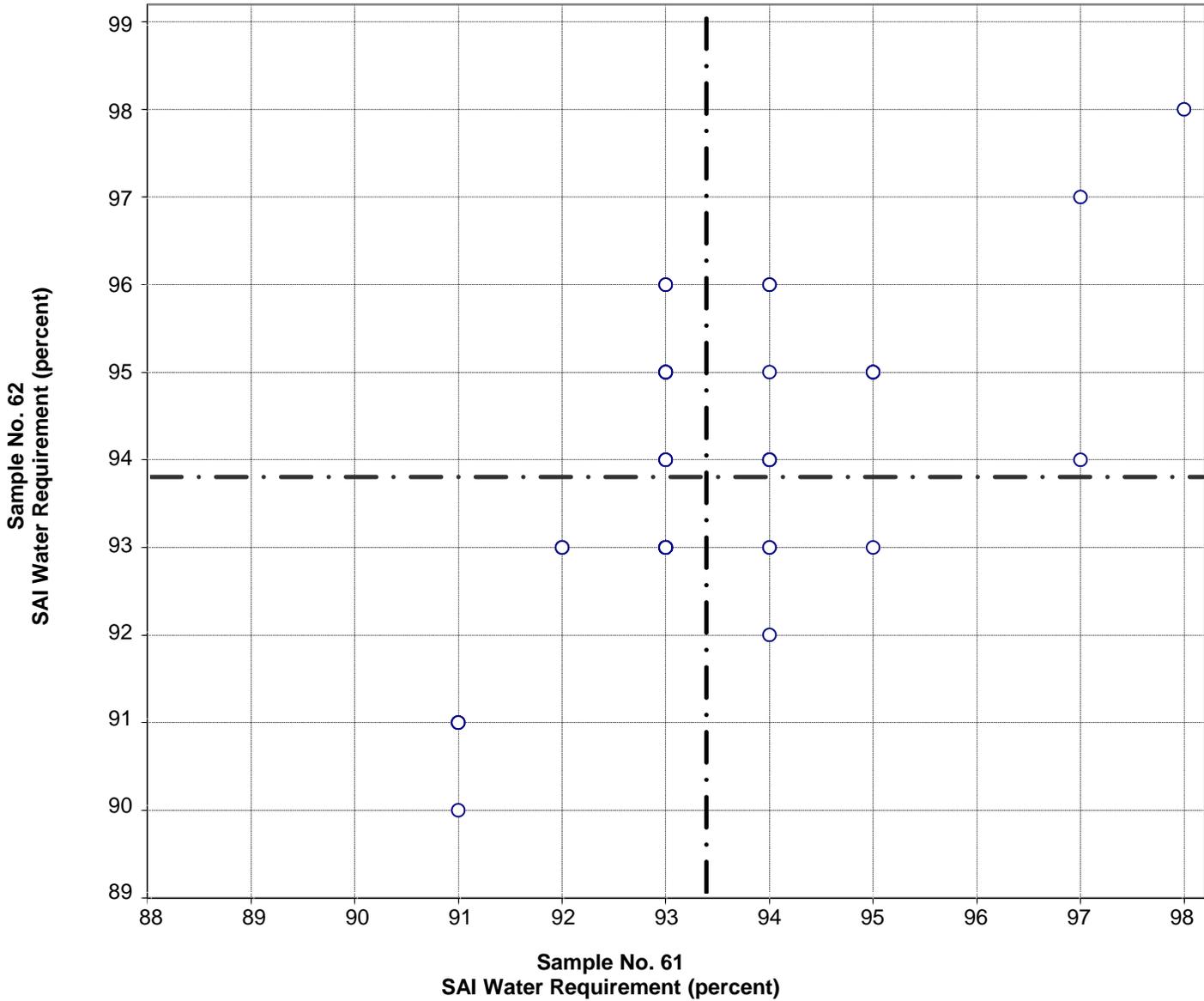
Test No. 370   SAI Water Requirement   52 Points

Sample No. 61   Ave 93   S.D. 1.4   C.V. 1.5
Sample No. 62   Ave 94   S.D. 1.6   C.V. 1.7

Labs Eliminated: 34, 36, 2116

CCRL Proficiency Sample Program
Alkali-Silica Reaction - Reduction of Expansion
POZZOLAN Samples No. 61 and No. 62
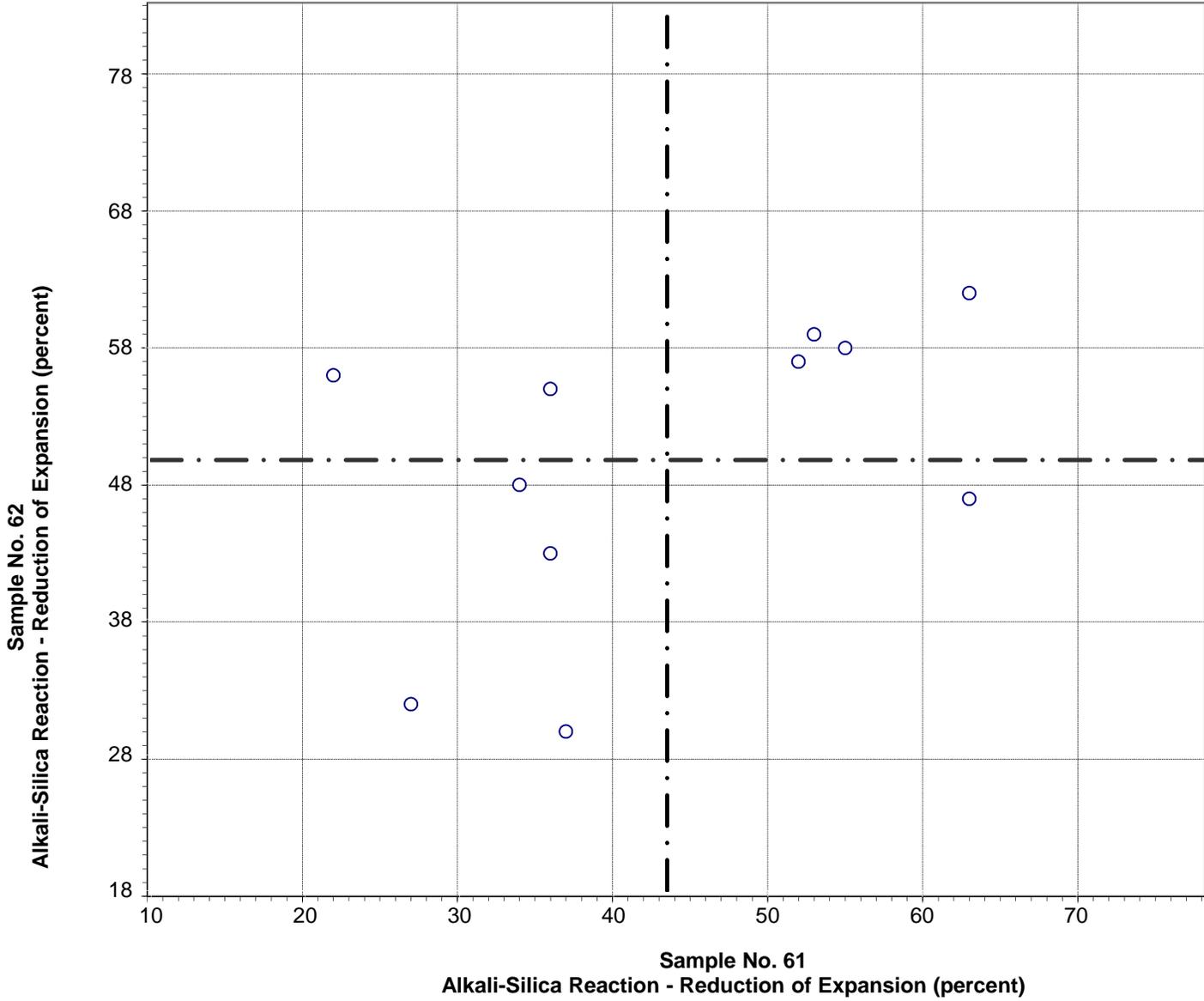
Test No. 390   Alkali-Silica Reaction - Reduction of Expansion   11 Points

Sample No. 61   Ave 43   S.D. 14   C.V. 33
Sample No. 62   Ave 50   S.D. 11   C.V. 22