CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Pozzolan Proficiency Samples
Number 59 and Number 60

October 2016

CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

October 18, 2016

TO: Participants in the CCRL Pozzolan Proficiency Sample Program

SUBJECT: Pozzolan Proficiency Samples No. 59 and No. 60

Following is the final report for the pair of CCRL **Pozzolan** Proficiency Samples which were distributed in August 2016. Both samples were a Class C 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 2017.

Sincerely,

Robin K. Haupt

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

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. 59 and No. 60

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 2016. 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

[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. 59 and No. 60

Final Report – Chemical Results
October 18, 2016

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.59 Average	S.D.	C.V.	Sample No. 60 Average	S.D.	C.V.
Moisture Content (**percent**)							
	64	0.06	0.04	63	0.07	0.03	48
	*63	0.06	0.03	59	0.07	0.03	48
* Labs Eliminated - 619							
Silicon Dioxide (**percent**)							
	57	37.36	0.74	2.0	33.68	0.83	2.5
	*53	37.32	0.46	1.2	33.53	0.47	1.4
* Labs Eliminated - 34, 58, 126, 975							
Aluminum Oxide (minor oxides included) (**percent**)							
	16	18.45	1.23	6.7	21.25	1.37	6.4
No Labs Eliminated for This Test							
Aluminum Oxide (minor oxides excluded) (**percent**)							
	53	16.43	0.39	2.4	19.08	0.42	2.2
	*52	16.40	0.32	2.0	19.04	0.32	1.7
* Labs Eliminated - 50							
Ferric Oxide (**percent**)							
	57	6.92	0.53	7.7	5.41	0.28	5.1
	*56	6.86	0.25	3.7	5.39	0.22	4.1
* Labs Eliminated - 176							
Calcium Oxide (minor oxides included) (**percent**)							
	18	25.55	1.61	6.3	28.59	1.42	5.0
	*17	25.22	0.80	3.2	28.28	0.58	2.1
* Labs Eliminated - 4							
Calcium Oxide (minor oxides excluded) (**percent**)							
	49	24.58	1.10	4.5	27.98	1.00	3.6
	*43	24.44	0.29	1.2	27.83	0.28	1.0
* Labs Eliminated - 4, 25, 34, 38, 126, 975							

CCRL PROFICIENCY SAMPLE PROGRAM

Pozzolan Proficiency Samples No. 59 and No. 60

Final Report – Chemical Results
October 18, 2016

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.59 Average	S.D.	C.V.	Sample No. 60 Average	S.D.	C.V.
Magnesium Oxide (**percent**)							
	61	5.14	0.34	6.6	5.53	0.41	7.3
	*57	5.19	0.17	3.2	5.59	0.12	2.2
* Labs Eliminated - 42, 50, 126, 2308							
Sulfur Trioxide (**percent**)							
	66	2.05	0.18	8.9	1.68	0.13	7.9
	*64	2.04	0.14	6.8	1.67	0.10	5.8
* Labs Eliminated - 42, 176							
Loss on Ignition (**percent**)							
	74	0.41	0.09	21	0.45	0.09	20
No Labs Eliminated for This Test							
Sodium Oxide (**percent**)							
	61	2.57	0.33	12.9	1.53	0.15	9.8
	*57	2.58	0.13	5.0	1.54	0.09	5.6
* Labs Eliminated - 50, 126, 975, 2253							
Potassium Oxide (**percent**)							
	61	0.68	0.05	7.8	0.43	0.03	6.2
	*56	0.68	0.02	3.6	0.43	0.01	3.4
* Labs Eliminated - 1, 34, 50, 975, 2253							
Available Sodium Oxide (**percent**)							
	20	1.55	0.41	26	0.96	0.35	36
	*19	1.61	0.29	18	1.00	0.31	31
* Labs Eliminated - 41							
Available Potassium Oxide (**percent**)							
	20	0.43	0.26	59	0.28	0.14	50
	*19	0.38	0.10	27	0.25	0.08	33
* Labs Eliminated - 41							

CCRL PROFICIENCY SAMPLE PROGRAM

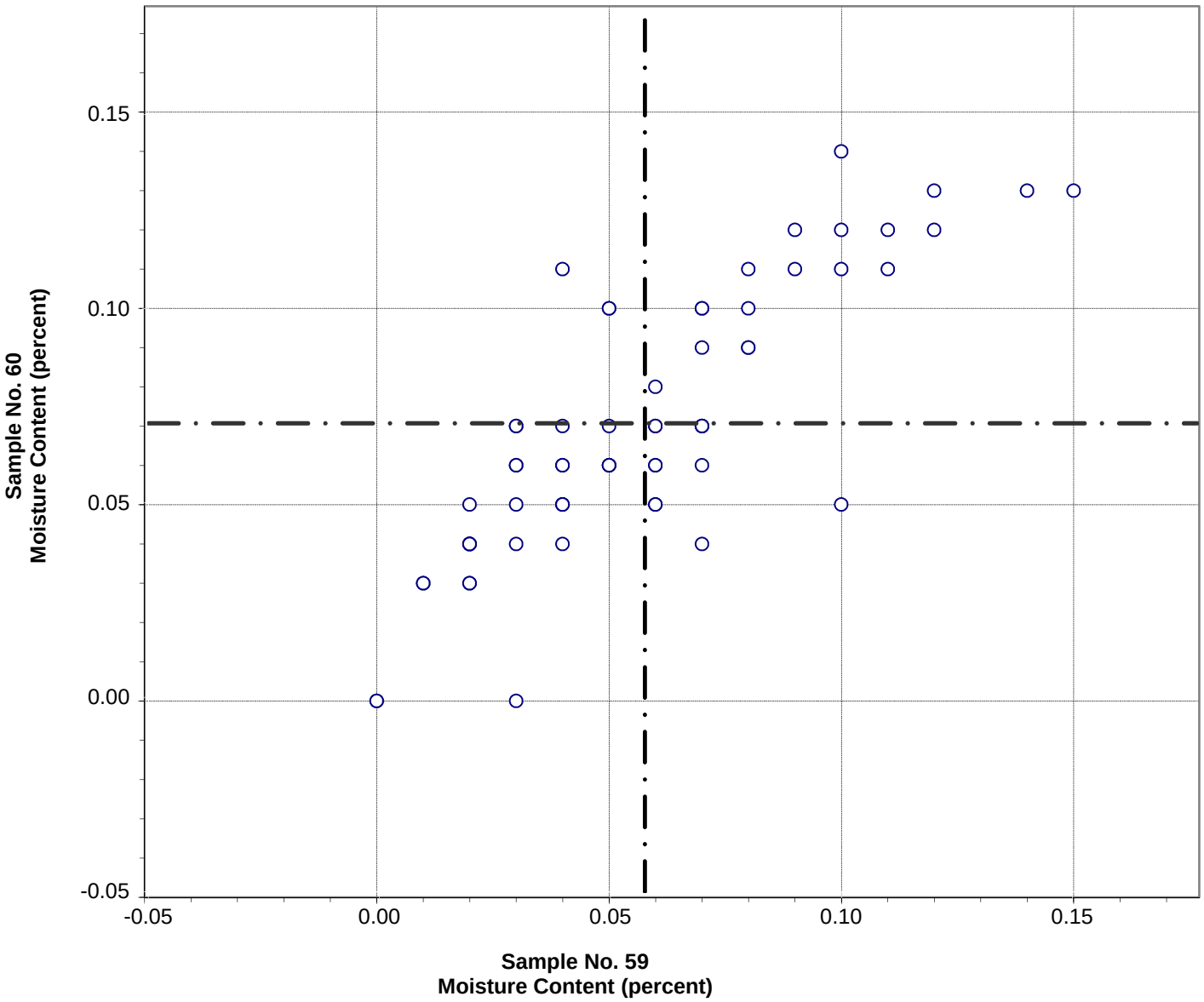
Pozzolan Proficiency Samples No. 59 and No. 60

Final Report – Chemical Results
October 18, 2016

SUMMARY OF RESULTS

		Sample No.59			Sample No. 60		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Available Alkali (**percent**)							
	21	1.89	0.44	23	1.17	0.38	33
No Labs Eliminated for This Test							

CCRL Proficiency Sample Program
Moisture Content
POZZOLAN Samples No. 59 and No. 60

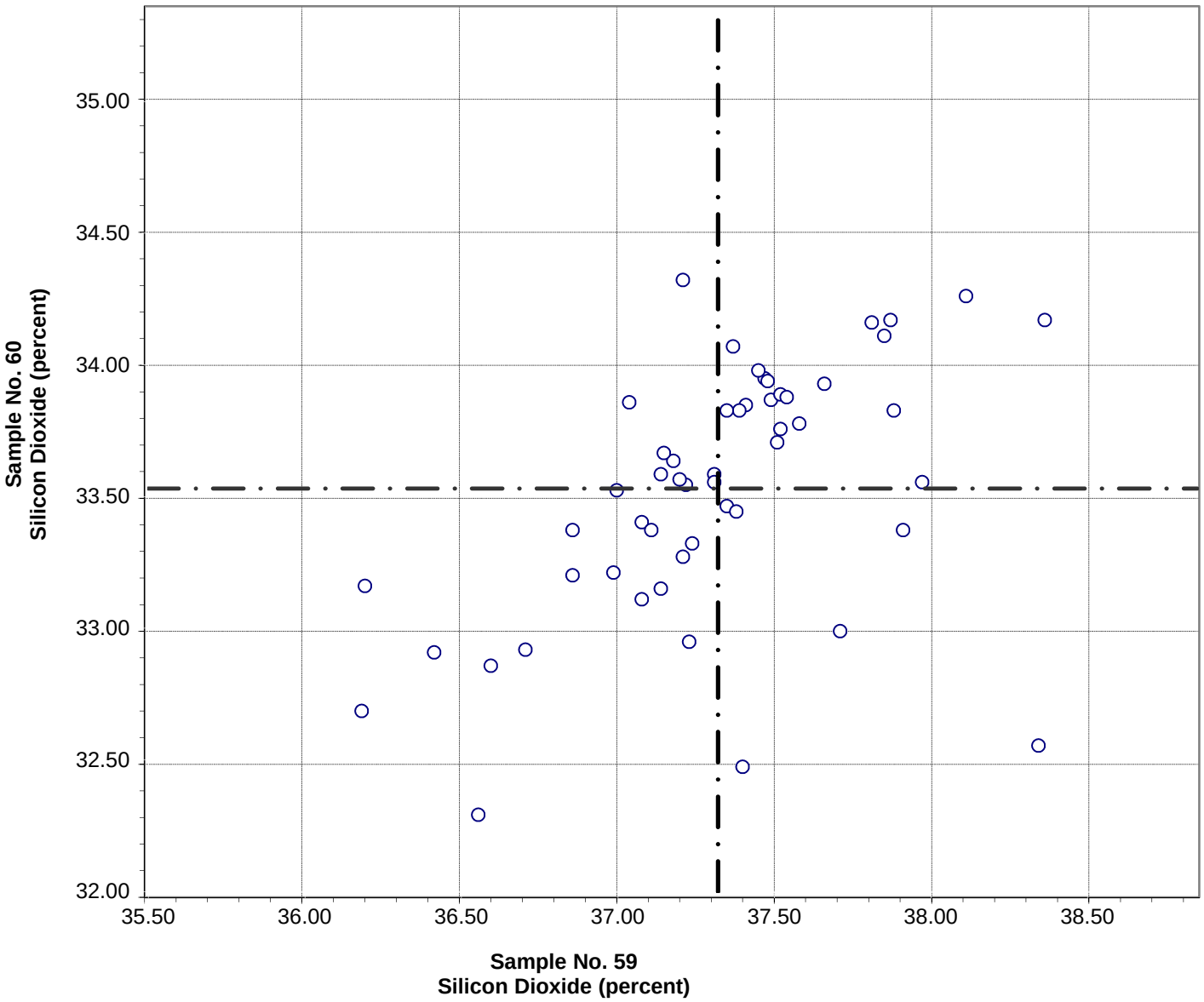


Test No. 5 Moisture Content 63 Points

Sample No. 59	Ave	0.06	S.D.	0.03	C.V.	59
Sample No. 60	Ave	0.07	S.D.	0.03	C.V.	48

Labs Eliminated: 619

CCRL Proficiency Sample Program
Silicon Dioxide
POZZOLAN Samples No. 59 and No. 60

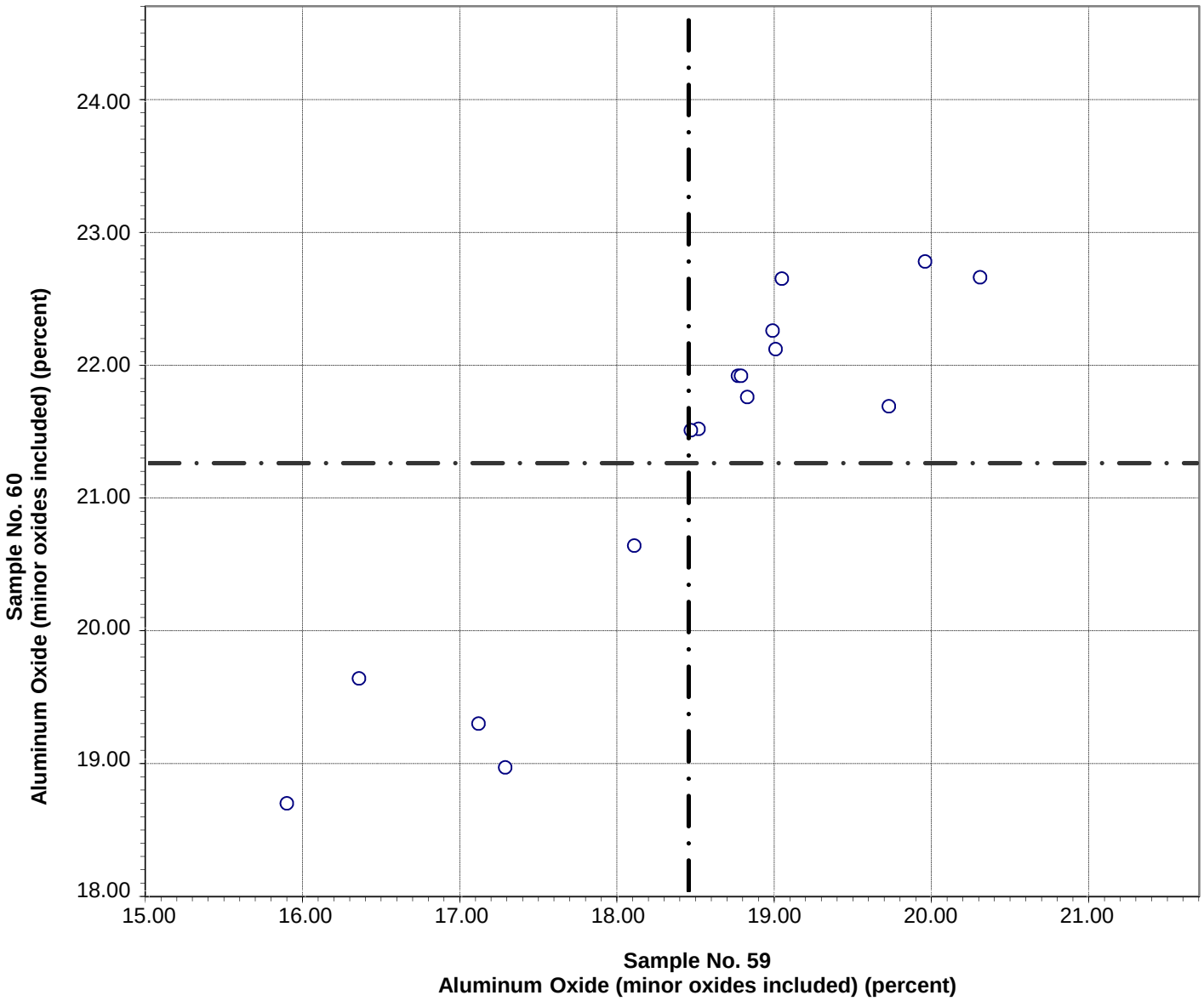


Test No. 10 Silicon Dioxide 53 Points

Sample No. 59	Ave	37.32	S.D.	0.46	C.V. 1.2
Sample No. 60	Ave	33.53	S.D.	0.47	C.V. 1.4

Labs Eliminated: 34, 58, 126, 975

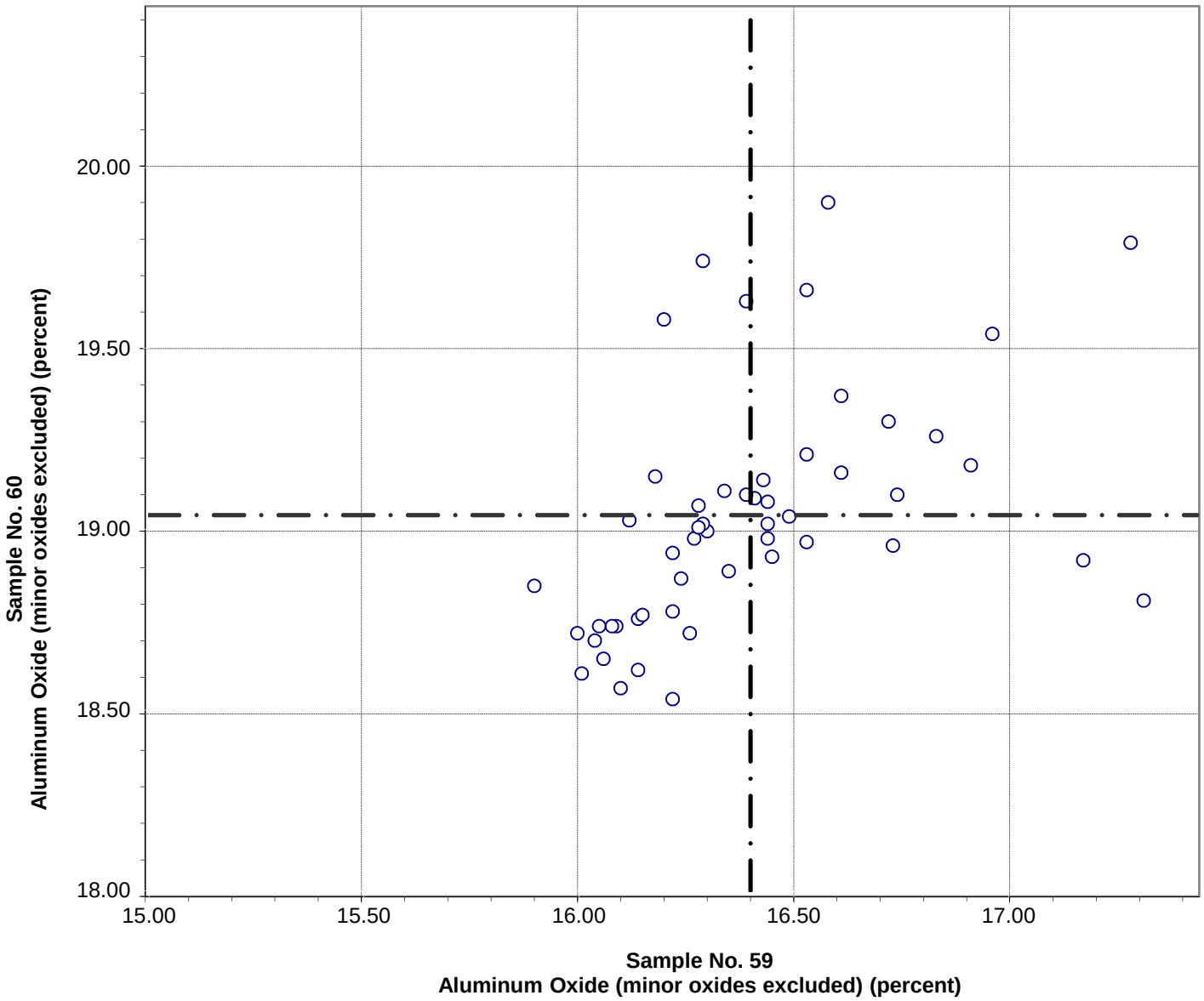
CCRL Proficiency Sample Program
Aluminum Oxide (minor oxides included)
POZZOLAN Samples No. 59 and No. 60



Test No. 20 Aluminum Oxide (minor oxides included) 16 Points

Sample No. 59	Ave	18.45	S.D.	1.23	C.V.	6.7
Sample No. 60	Ave	21.25	S.D.	1.37	C.V.	6.4

CCRL Proficiency Sample Program
Aluminum Oxide (minor oxides excluded)
POZZOLAN Samples No. 59 and No. 60

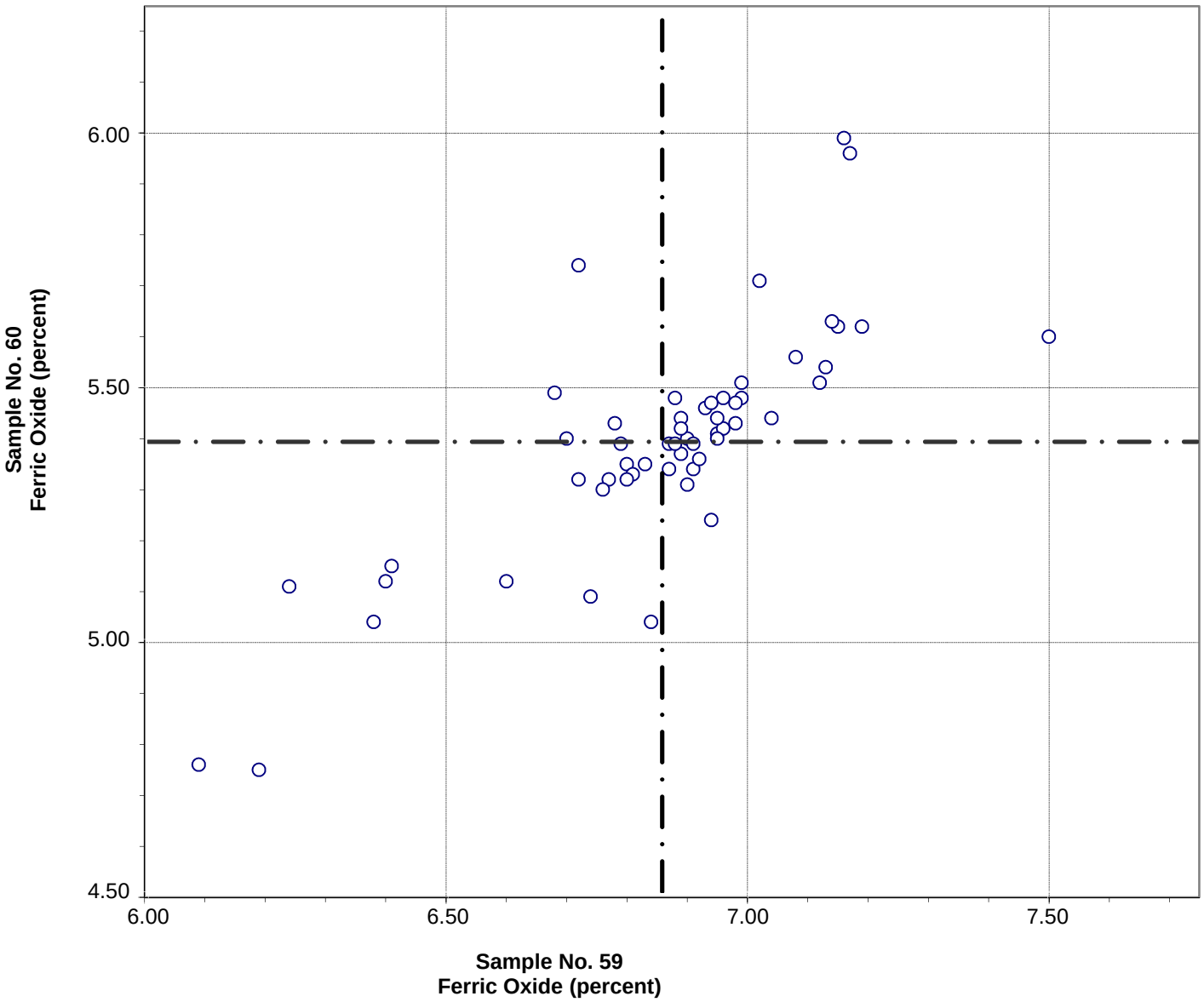


Test No. 21 Aluminum Oxide (minor oxides excluded) 52 Points

Sample No. 59	Ave	16.40	S.D.	0.32	C.V.	2.0
Sample No. 60	Ave	19.04	S.D.	0.32	C.V.	1.7

Labs Eliminated: 50

CCRL Proficiency Sample Program
Ferric Oxide
POZZOLAN Samples No. 59 and No. 60

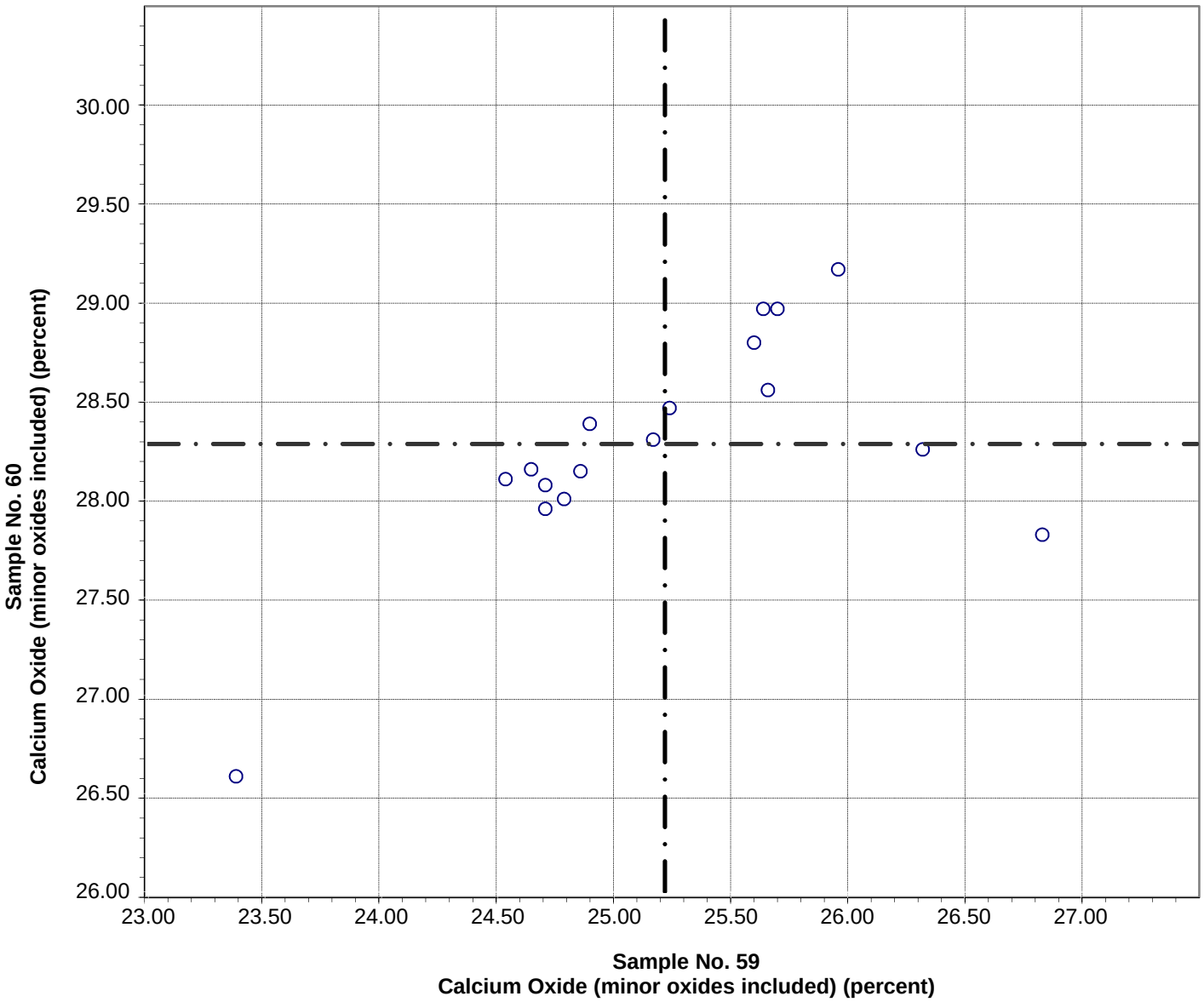


Test No. 30 Ferric Oxide 56 Points

Sample No. 59	Ave	6.86	S.D.	0.25	C.V.	3.7
Sample No. 60	Ave	5.39	S.D.	0.22	C.V.	4.1

Labs Eliminated: 176

CCRL Proficiency Sample Program
Calcium Oxide (minor oxides included)
POZZOLAN Samples No. 59 and No. 60

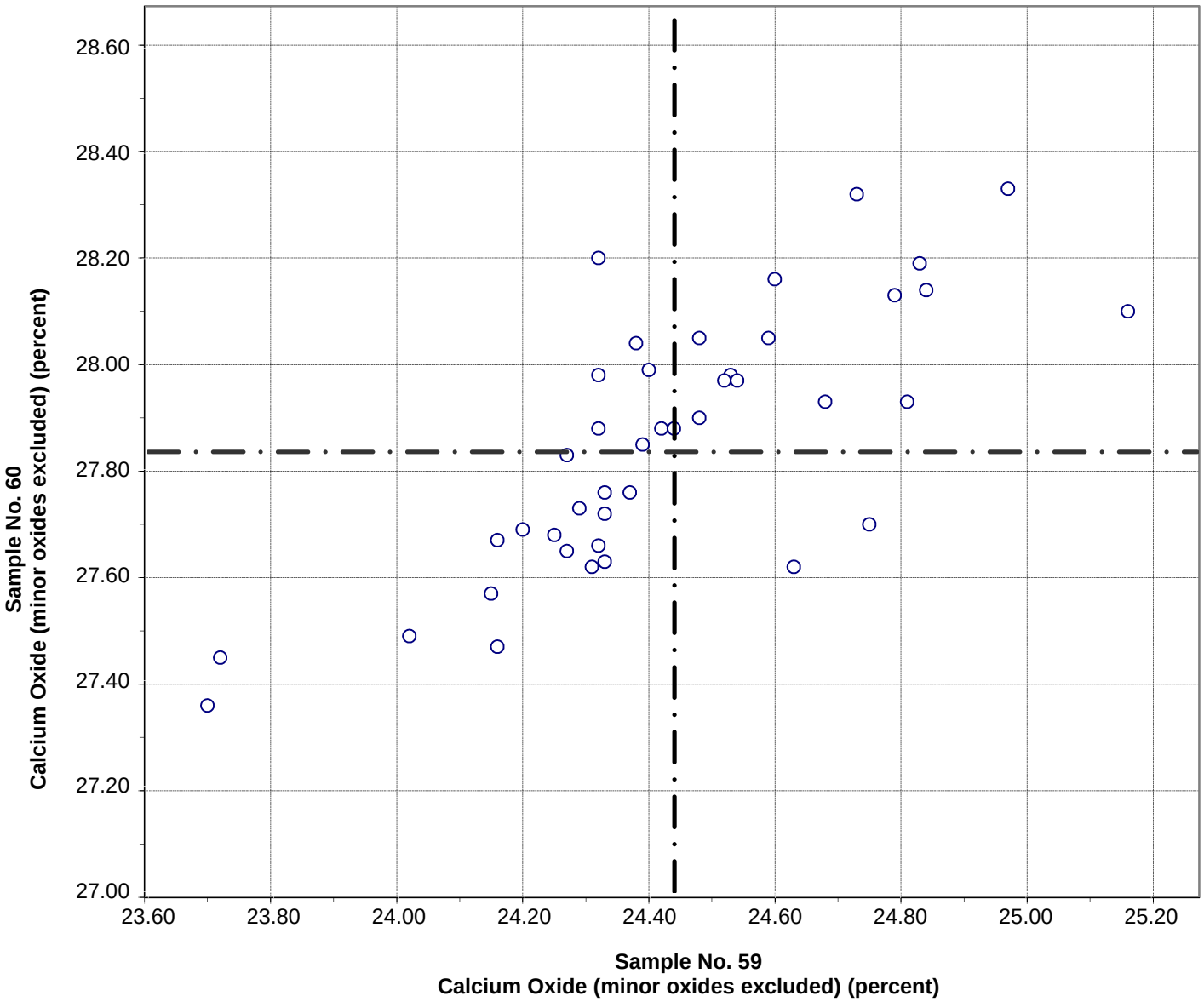


Test No. 40 Calcium Oxide (minor oxides included) 17 Points

Sample No. 59	Ave	25.22	S.D.	0.80	C.V.	3.2
Sample No. 60	Ave	28.28	S.D.	0.58	C.V.	2.1

Labs Eliminated: 4

CCRL Proficiency Sample Program
Calcium Oxide (minor oxides excluded)
POZZOLAN Samples No. 59 and No. 60



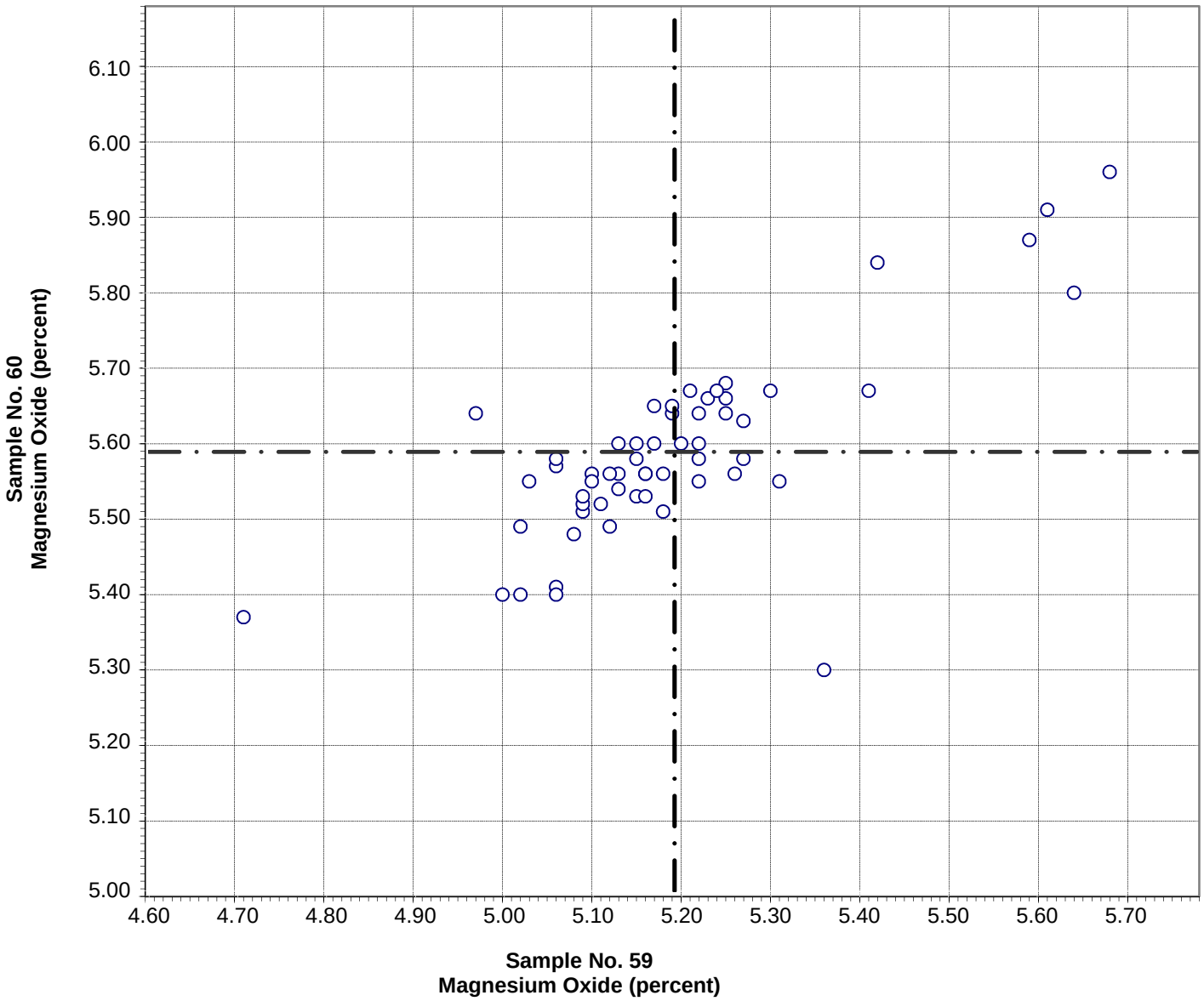
Test No. 42 Calcium Oxide (minor oxides excluded) 42 Points

Sample No. 59	Ave	24.44	S.D.	0.29	C.V. 1.2
Sample No. 60	Ave	27.83	S.D.	0.28	C.V. 1.0

Labs Eliminated: 4, 25, 34, 38, 126, 975

Labs off Diagram: 58

CCRL Proficiency Sample Program
Magnesium Oxide
POZZOLAN Samples No. 59 and No. 60

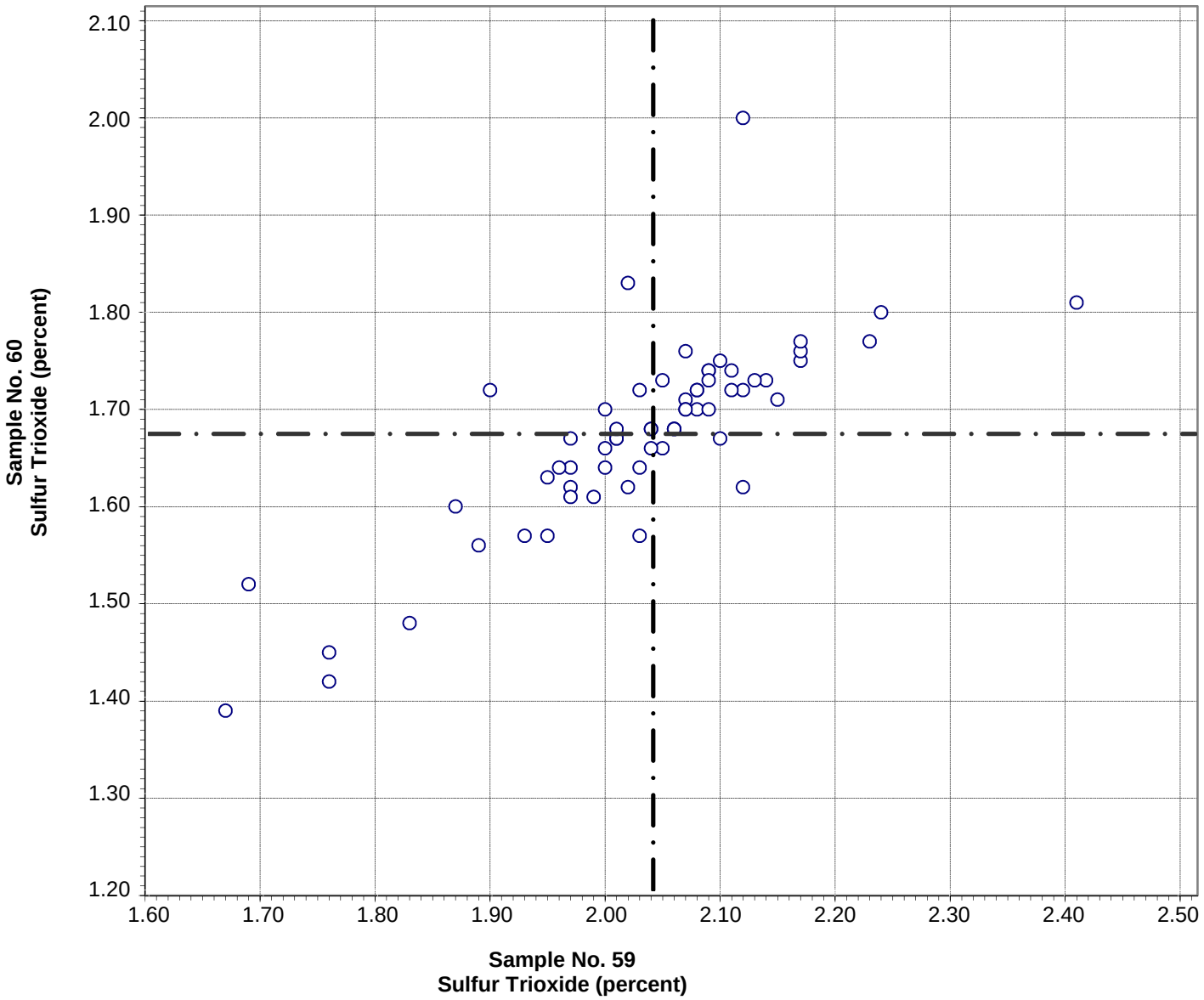


Test No. 50 Magnesium Oxide 57 Points

Sample No. 59	Ave	5.19	S.D.	0.17	C.V.	3.2
Sample No. 60	Ave	5.59	S.D.	0.12	C.V.	2.2

Labs Eliminated: 42, 50, 126, 2308

CCRL Proficiency Sample Program
Sulfur Trioxide
POZZOLAN Samples No. 59 and No. 60



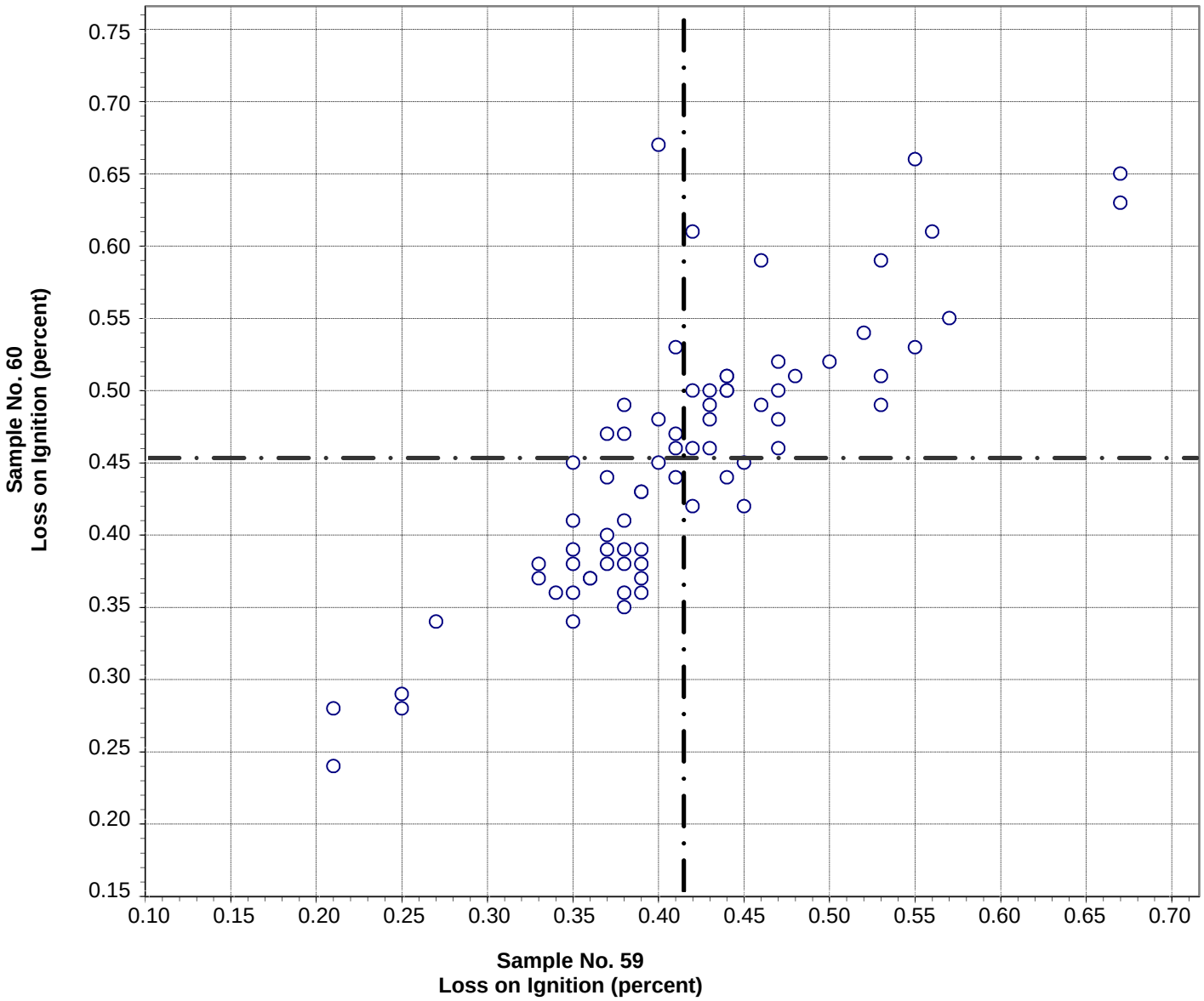
Test No. 60 Sulfur Trioxide 63 Points

Sample No. 59	Ave	2.04	S.D.	0.14	C.V.	6.8
Sample No. 60	Ave	1.67	S.D.	0.10	C.V.	5.8

Labs Eliminated: 42, 176

Labs off Diagram: 34

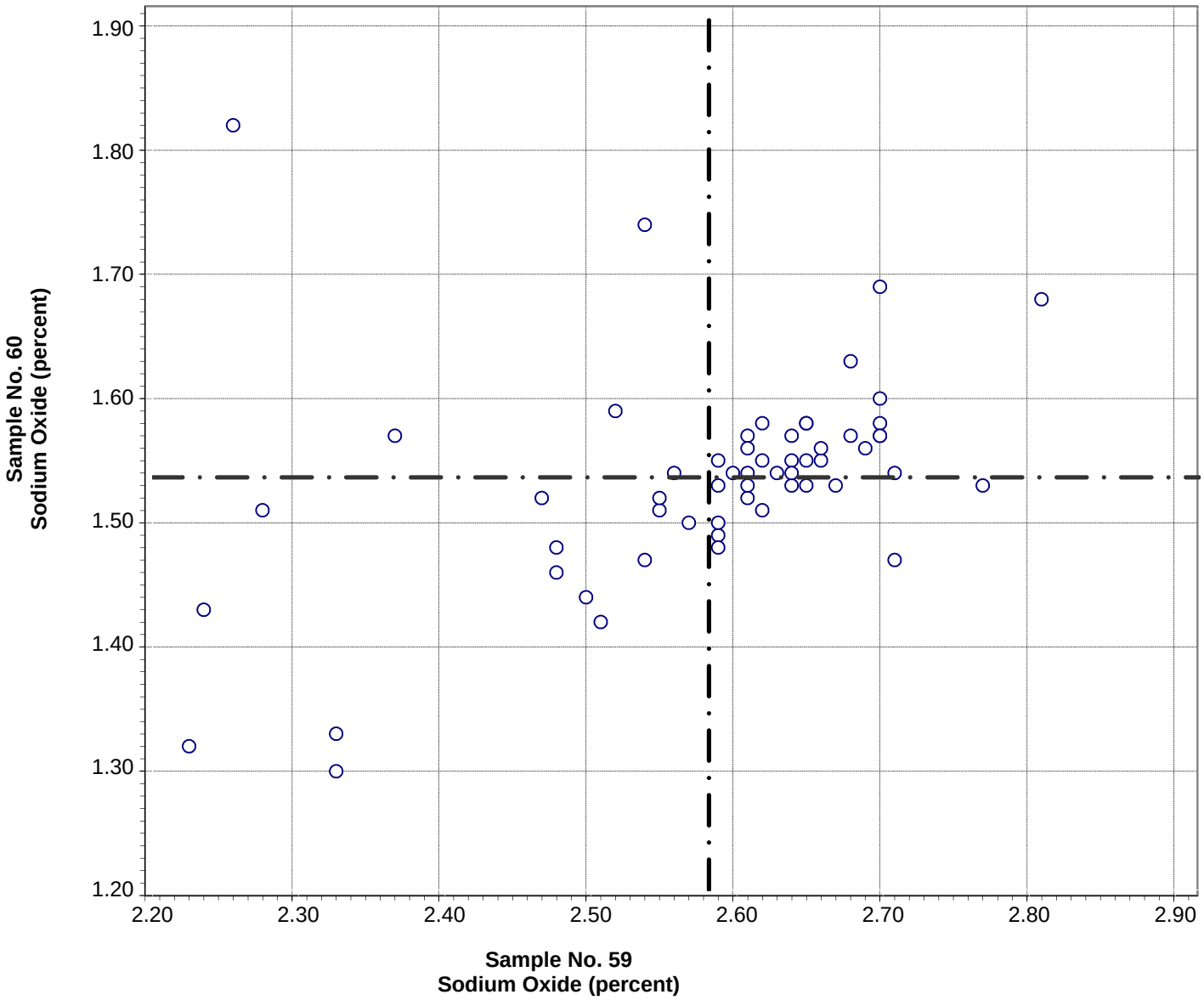
CCRL Proficiency Sample Program
Loss on Ignition
POZZOLAN Samples No. 59 and No. 60



Test No. 70 Loss on Ignition 74 Points

Sample No. 59	Ave	0.41	S.D.	0.09	C.V.	21
Sample No. 60	Ave	0.45	S.D.	0.09	C.V.	20

CCRL Proficiency Sample Program
Sodium Oxide
POZZOLAN Samples No. 59 and No. 60

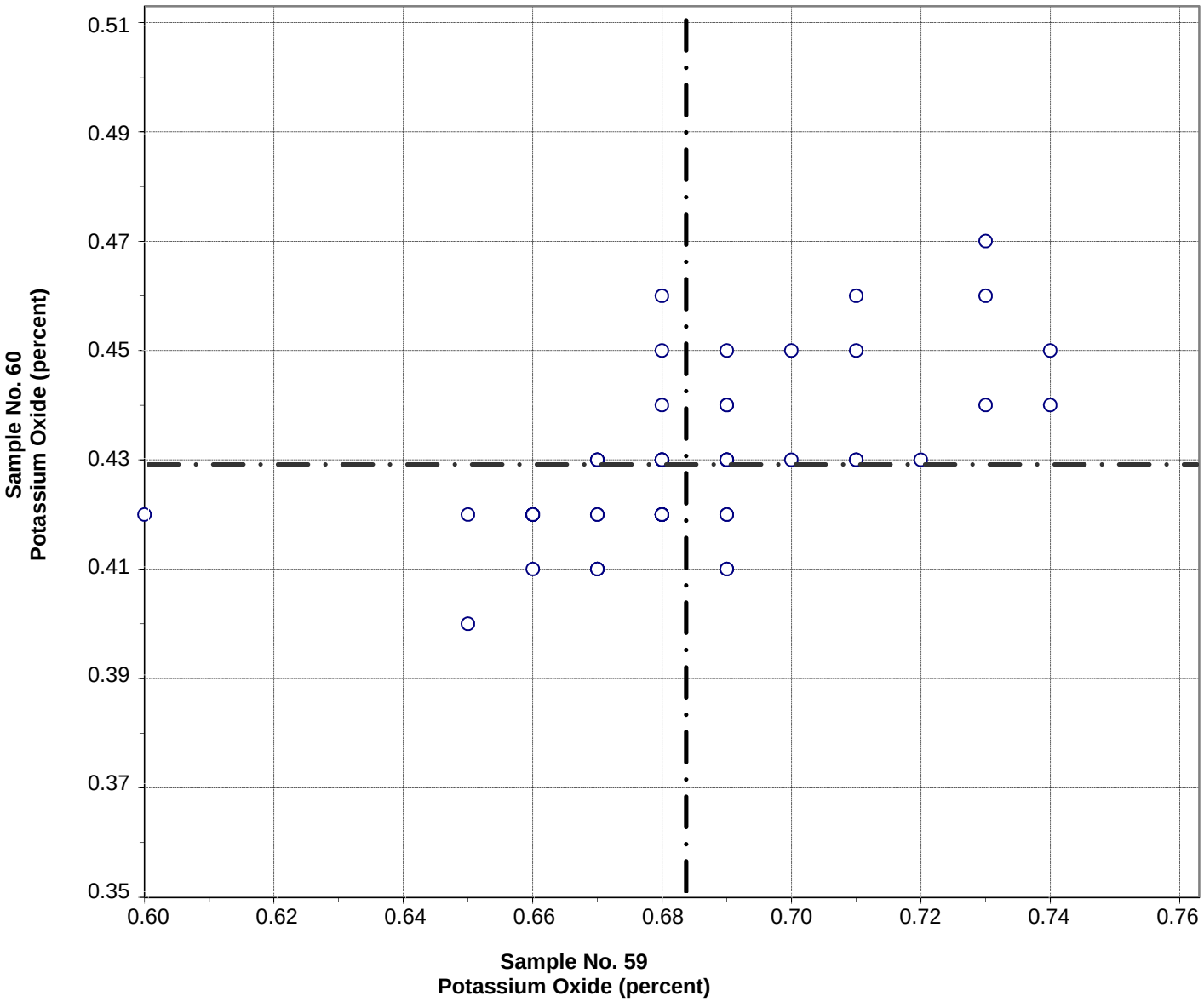


Test No. 90 Sodium Oxide 57 Points

Sample No. 59	Ave	2.58	S.D.	0.13	C.V. 5.0
Sample No. 60	Ave	1.54	S.D.	0.09	C.V. 5.6

Labs Eliminated: 50, 126, 975, 2253

CCRL Proficiency Sample Program
Potassium Oxide
POZZOLAN Samples No. 59 and No. 60

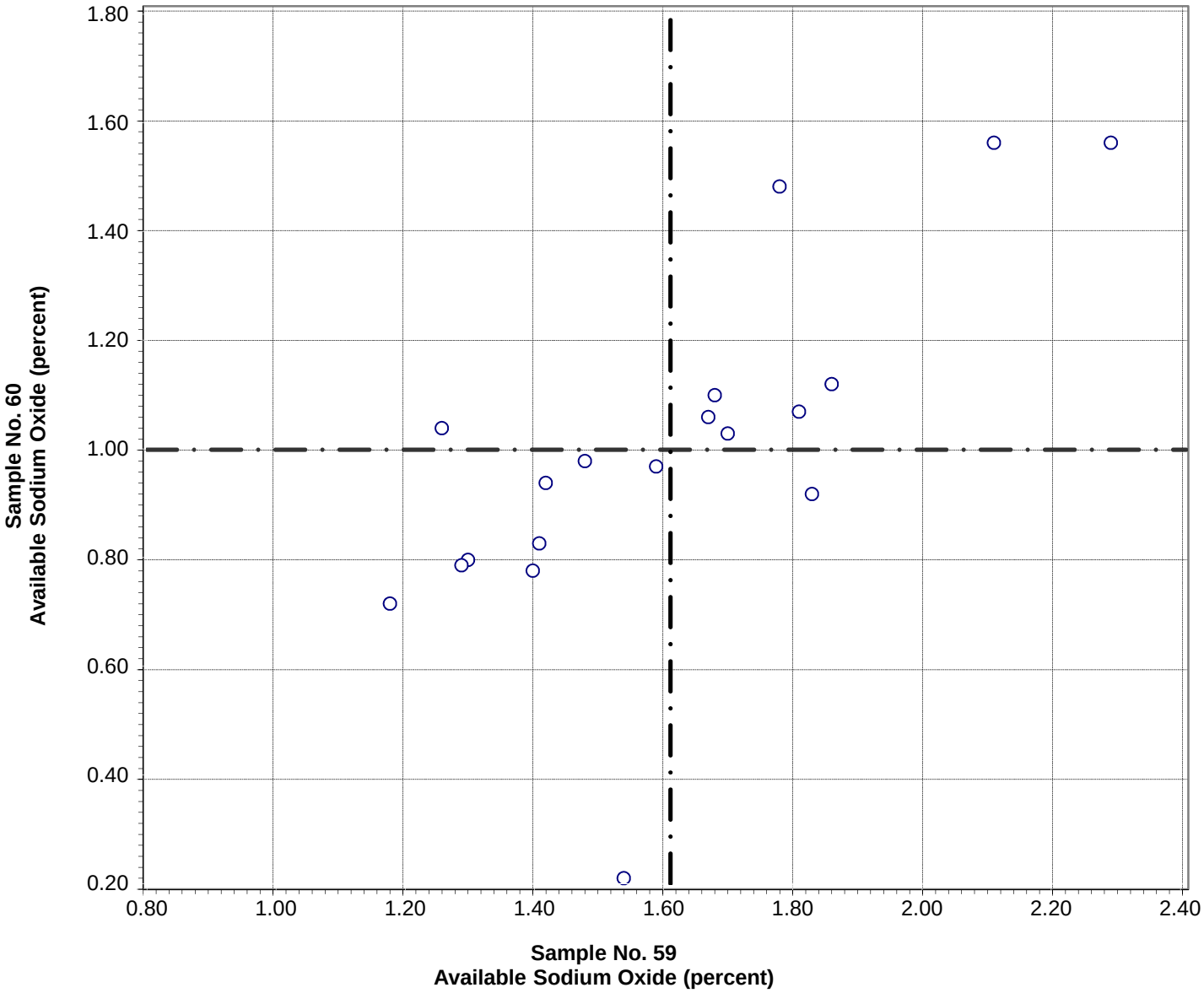


Test No. 100 Potassium Oxide 56 Points

Sample No. 59	Ave	0.68	S.D.	0.02	C.V.	3.6
Sample No. 60	Ave	0.43	S.D.	0.01	C.V.	3.4

Labs Eliminated: 1, 34, 50, 975, 2253

CCRL Proficiency Sample Program
Available Sodium Oxide
POZZOLAN Samples No. 59 and No. 60

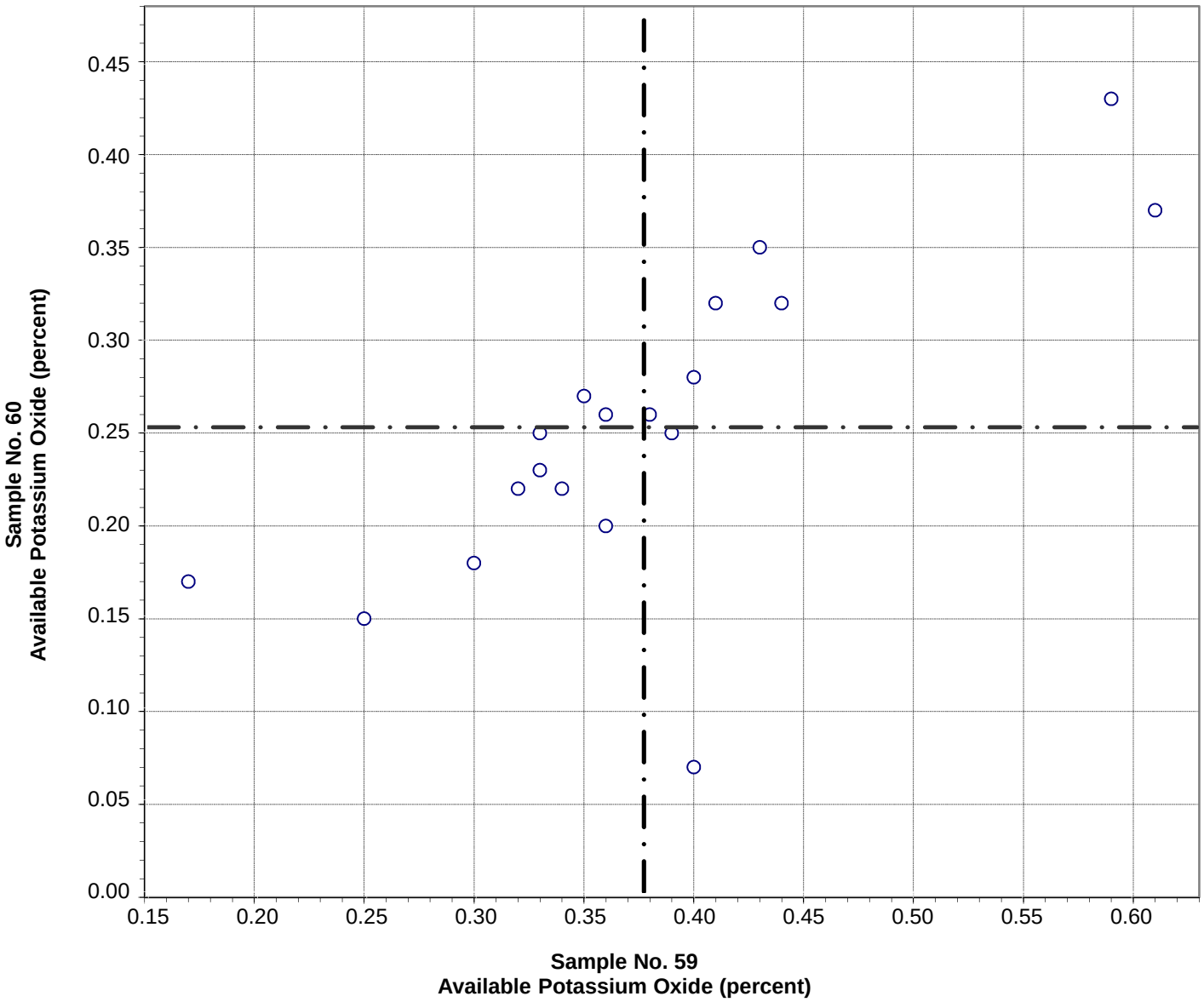


Test No. 91 Available Sodium Oxide 19 Points

Sample No. 59	Ave	1.61	S.D.	0.29	C.V. 18
Sample No. 60	Ave	1.00	S.D.	0.31	C.V. 31

Labs Eliminated: 41

CCRL Proficiency Sample Program
Available Potassium Oxide
POZZOLAN Samples No. 59 and No. 60

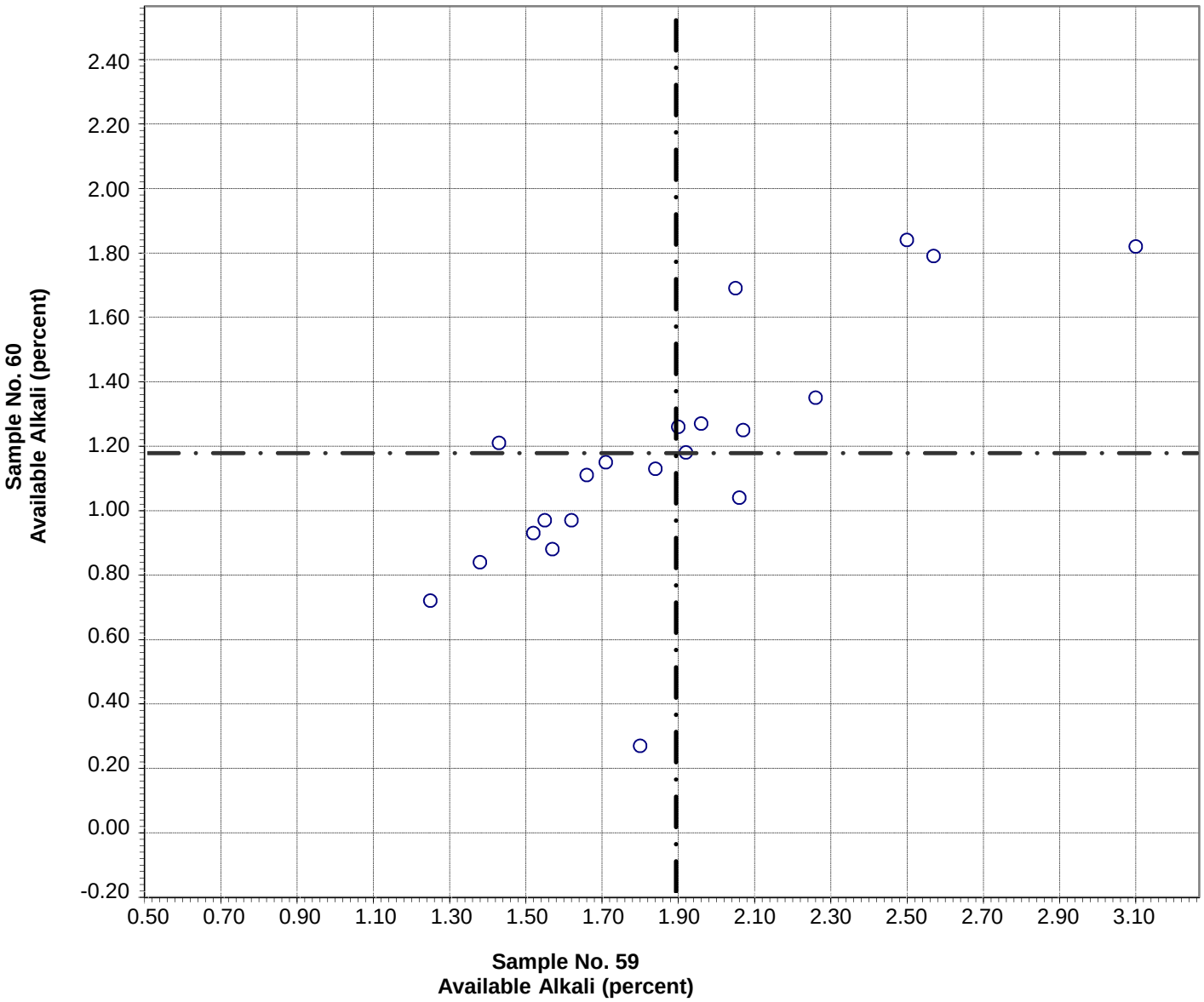


Test No. 93 Available Potassium Oxide 19 Points

Sample No. 59	Ave	0.38	S.D.	0.10	C.V.	27
Sample No. 60	Ave	0.25	S.D.	0.08	C.V.	33

Labs Eliminated: 41

CCRL Proficiency Sample Program
Available Alkali
POZZOLAN Samples No. 59 and No. 60



Test No. 95 Available Alkali 21 Points

Sample No. 59	Ave	1.89	S.D.	0.44	C.V.	23
Sample No. 60	Ave	1.17	S.D.	0.38	C.V.	33

CCRL PROFICIENCY SAMPLE PROGRAM

Pozzolan Proficiency Samples No. 59 and No. 60

Final Report – Physical Results
October 18, 2016

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.59 Average	S.D.	C.V.	Sample No. 60 Average	S.D.	C.V.
Density (**g/cm³**)							
	59	2.72	0.14	5.0	2.70	0.09	3.4
	*55	2.70	0.03	1.2	2.69	0.03	1.1
* Labs Eliminated - 26, 42, 1221, 2292							
Fineness - 45 µm Sieve Retained (**percent**)							
	75	11.84	2.81	23.7	9.32	2.04	21.9
	*70	12.18	0.85	6.9	9.59	0.72	7.5
* Labs Eliminated - 7, 25, 34, 823, 1059							
Drying Shrinkage (**percent**)							
	19	0.009	0.033	375	-0.012	0.115	-1027
	*18	0.014	0.026	184	0.015	0.026	182
* Labs Eliminated - 840							
Autoclave Expansion (**percent**)							
	53	0.02	0.06	329	0.01	0.02	208
	*48	0.01	0.01	105	0.01	0.01	132
* Labs Eliminated - 15, 19, 20, 26, 823							
Normal Consistency Water (**percent**)							
	55	24.9	2.8	11.3	25.0	2.8	11.3
	*53	24.6	0.4	1.6	24.6	0.4	1.8
* Labs Eliminated - 46, 169							
Air Entrainment (**percent**)							
	10	0.027	0.024	87	0.029	0.031	109
No Labs Eliminated for This Test							
Strength Activity Index - 7 day (**percent**)							
	59	97	5.3	5.4	102	6.6	6.5
No Labs Eliminated for This Test							

CCRL PROFICIENCY SAMPLE PROGRAM

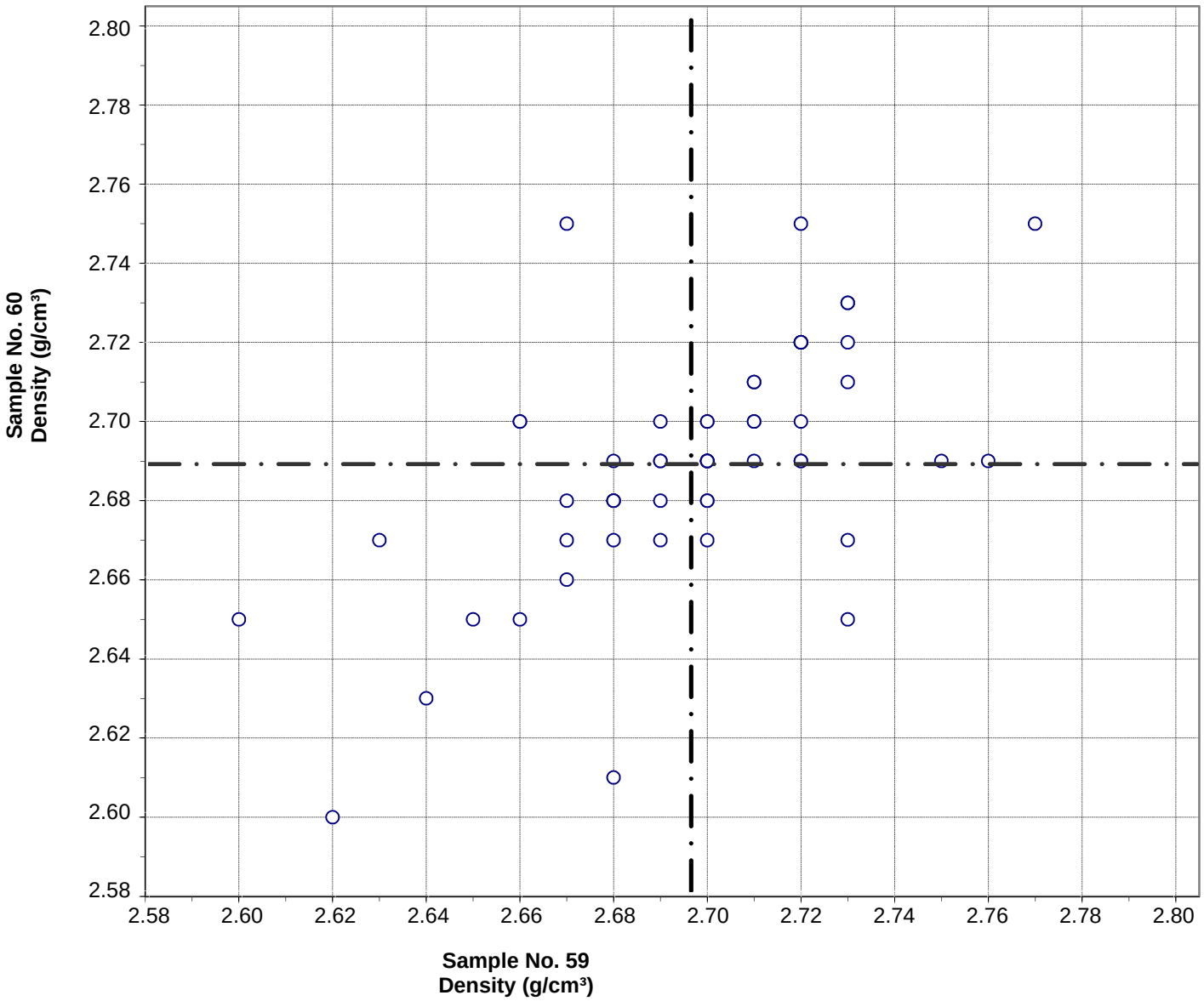
Pozzolan Proficiency Samples No. 59 and No. 60

Final Report – Physical Results
October 18, 2016

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.59 Average	S.D.	C.V.	Sample No. 60 Average	S.D.	C.V.
Strength Activity Index - 28 day (**percent**)							
	57	104	7.1	6.8	109	7.6	6.9
	*55	104	5.6	5.4	109	5.9	5.4
* Labs Eliminated - 14, 34							
SAI Water Requirement (**percent**)							
	57	94	6.7	7.1	94	6.7	7.1
	*53	94	1.1	1.2	94	1.3	1.3
* Labs Eliminated - 3, 34, 125, 823							
Alkali-Silica Reaction - Reduction of Expansion (**percent**)							
	11	-12	31	-281	3	24	903
No Labs Eliminated for This Test							

CCRL Proficiency Sample Program
Density
POZZOLAN Samples No. 59 and No. 60

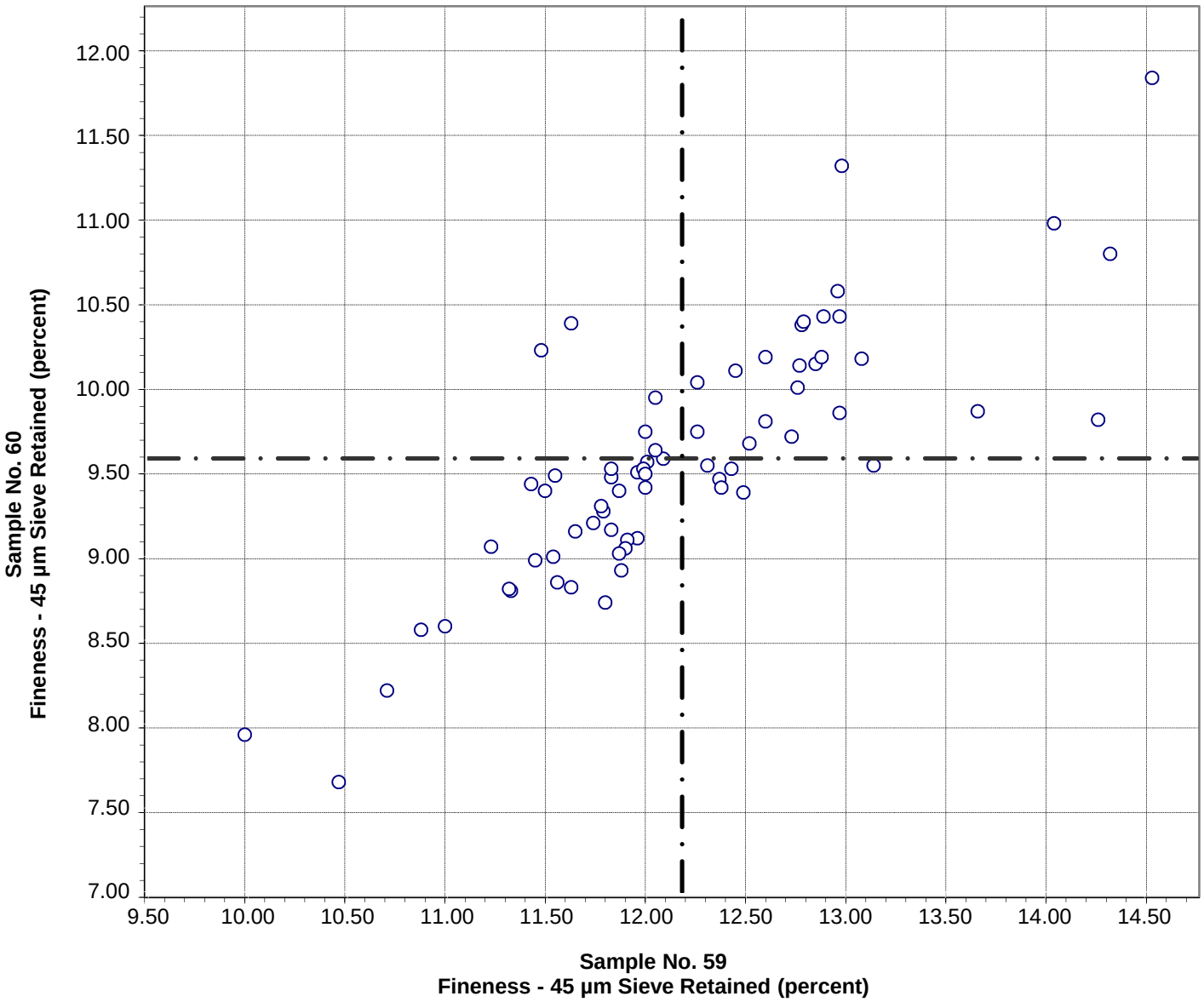


Test No. 310 Density 55 Points

Sample No. 59	Ave	2.70	S.D.	0.03	C.V. 1.2
Sample No. 60	Ave	2.69	S.D.	0.03	C.V. 1.1

Labs Eliminated: 26, 42, 1221, 2292

CCRL Proficiency Sample Program
Fineness - 45 µm Sieve Retained
POZZOLAN Samples No. 59 and No. 60

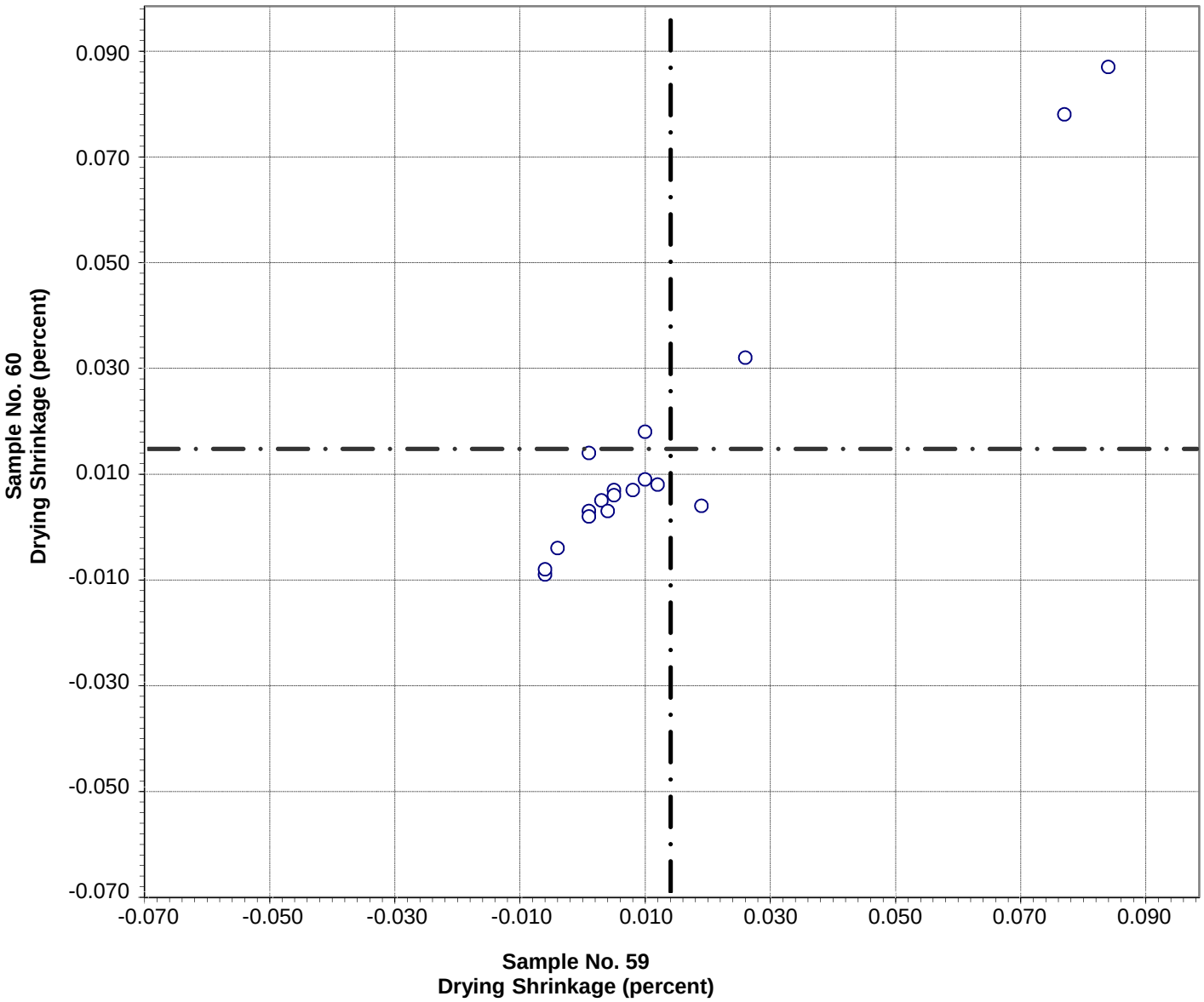


Test No. 281 Fineness - 45 µm Sieve Retained 70 Points

Sample No. 59 Ave 12.18 S.D. 0.85 C.V. 6.9
Sample No. 60 Ave 9.59 S.D. 0.72 C.V. 7.5

Labs Eliminated: 7, 25, 34, 823, 1059

CCRL Proficiency Sample Program
Drying Shrinkage
POZZOLAN Samples No. 59 and No. 60

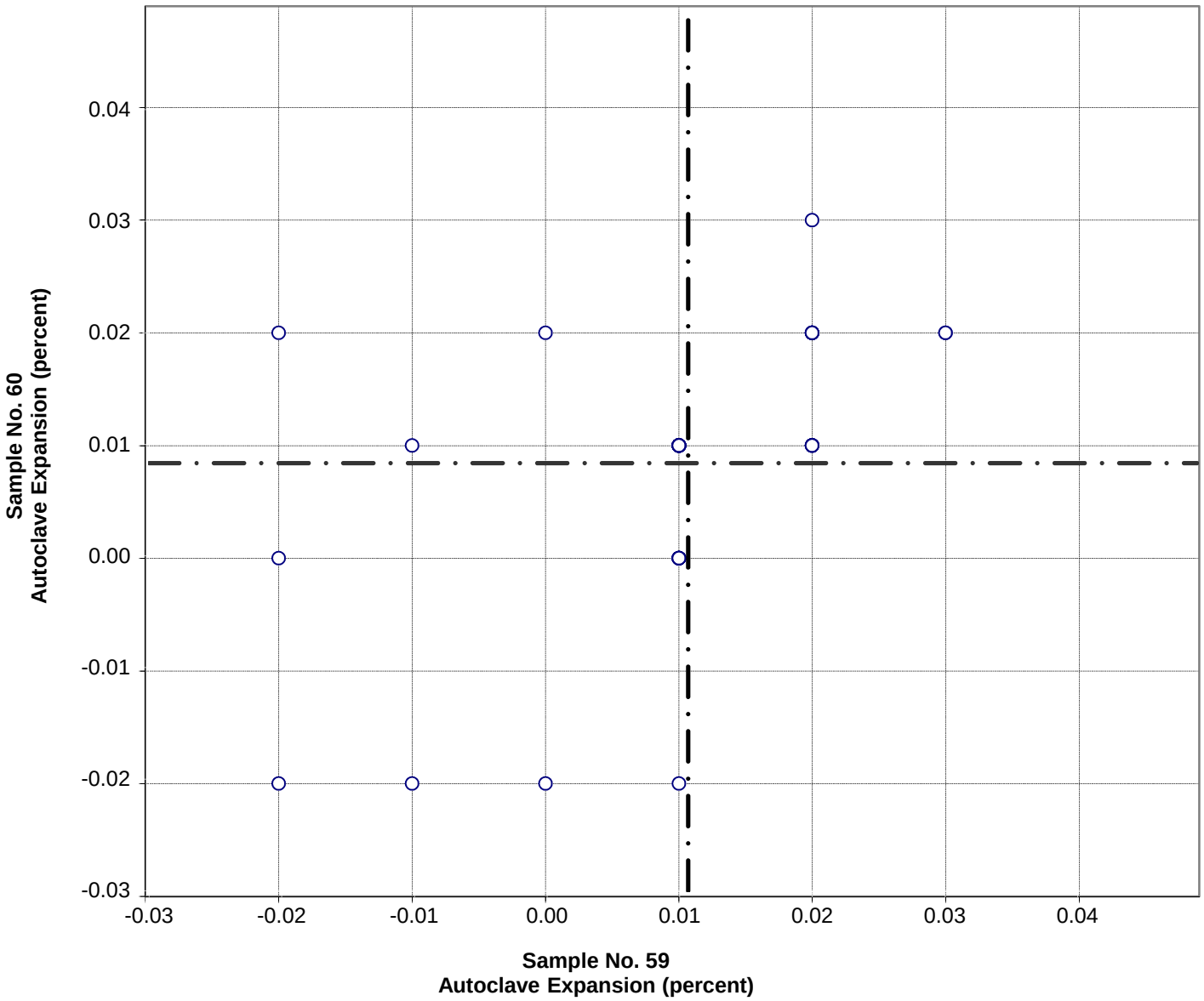


Test No. 340 Drying Shrinkage 18 Points

Sample No. 59	Ave	0.014	S.D.	0.026	C.V. 184
Sample No. 60	Ave	0.015	S.D.	0.026	C.V. 182

Labs Eliminated: 840

CCRL Proficiency Sample Program
Autoclave Expansion
POZZOLAN Samples No. 59 and No. 60

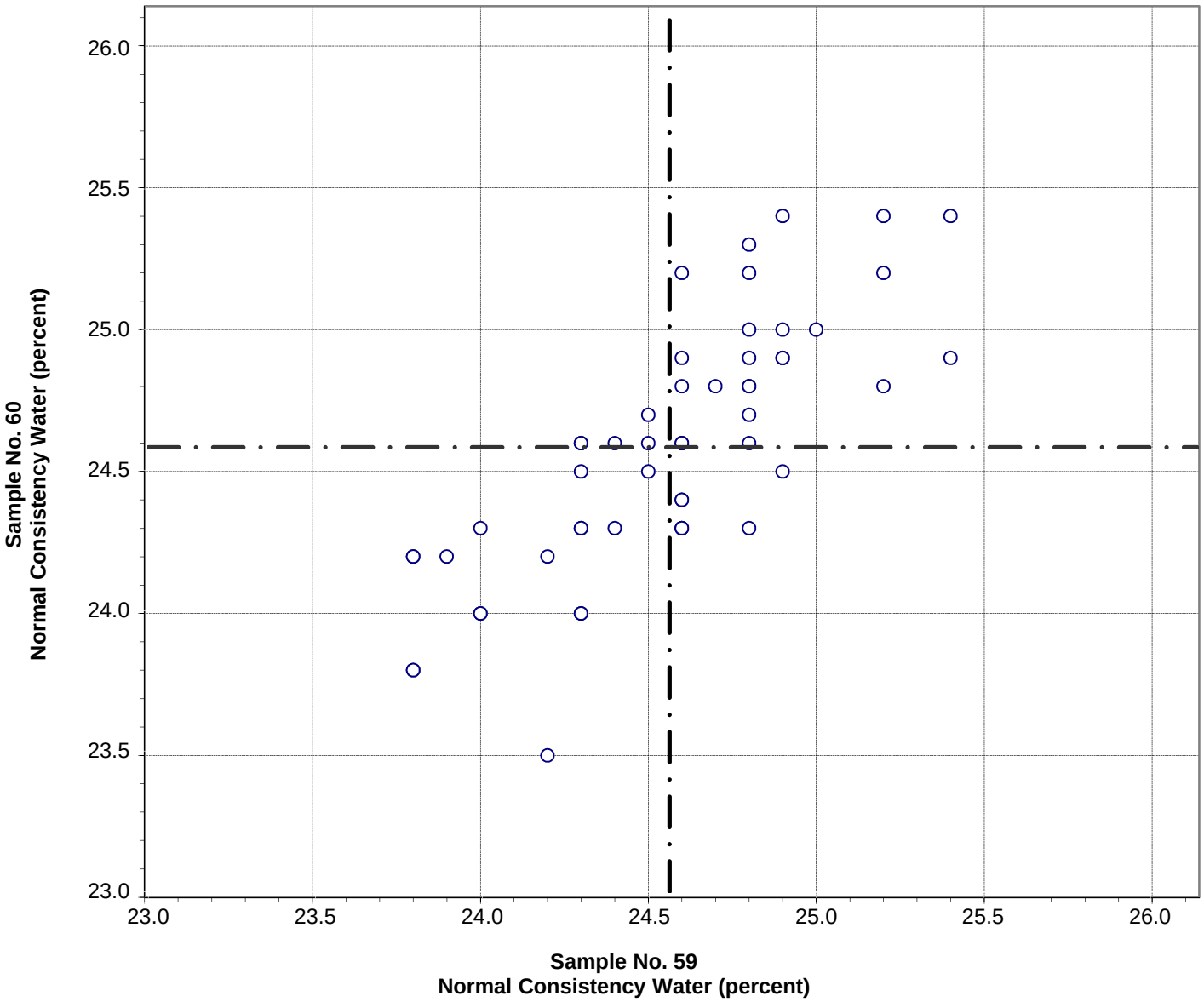


Test No. 160 Autoclave Expansion 48 Points

Sample No. 59	Ave	0.01	S.D.	0.01	C.V. 105
Sample No. 60	Ave	0.01	S.D.	0.01	C.V. 132

Labs Eliminated: 15, 19, 20, 26, 823

CCRL Proficiency Sample Program
Normal Consistency Water
POZZOLAN Samples No. 59 and No. 60

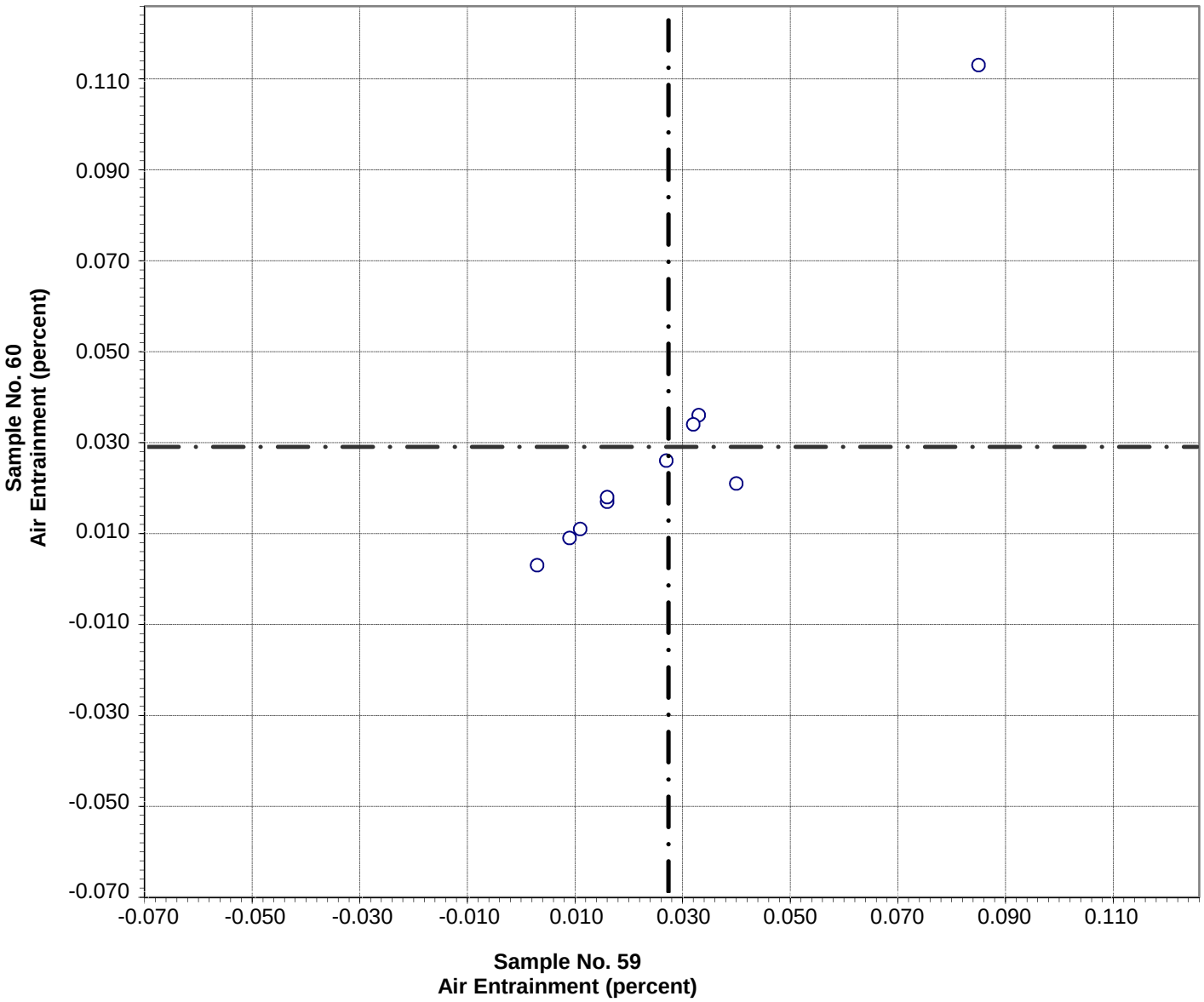


Test No. 110 Normal Consistency Water 53 Points

Sample No. 59	Ave	24.6	S.D.	0.4	C.V. 1.6
Sample No. 60	Ave	24.6	S.D.	0.4	C.V. 1.8

Labs Eliminated: 46, 169

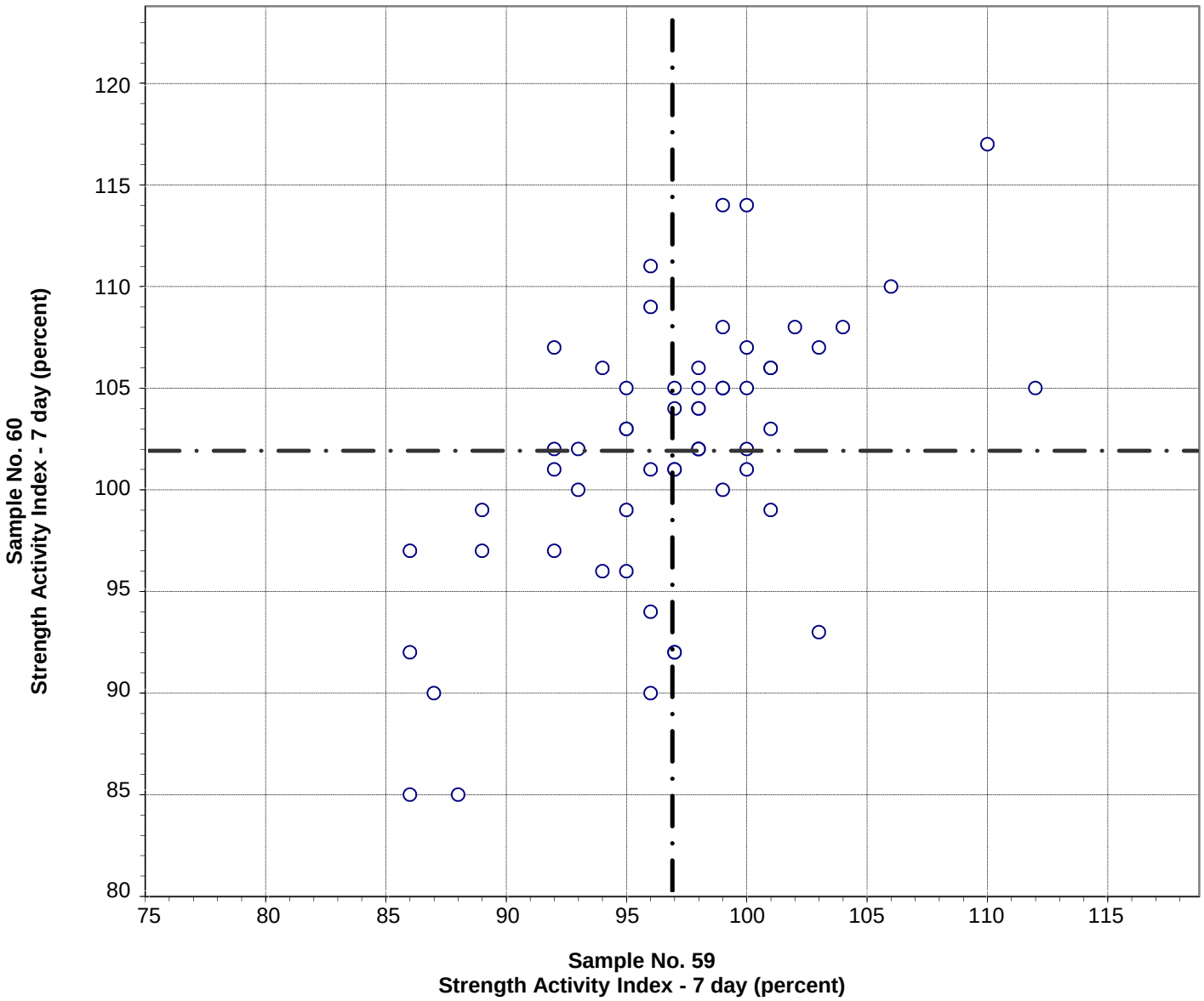
CCRL Proficiency Sample Program
Air Entrainment
POZZOLAN Samples No. 59 and No. 60



Test No. 350 Air Entrainment 10 Points

Sample No. 59	Ave	0.027	S.D.	0.024	C.V.	87
Sample No. 60	Ave	0.029	S.D.	0.031	C.V.	109

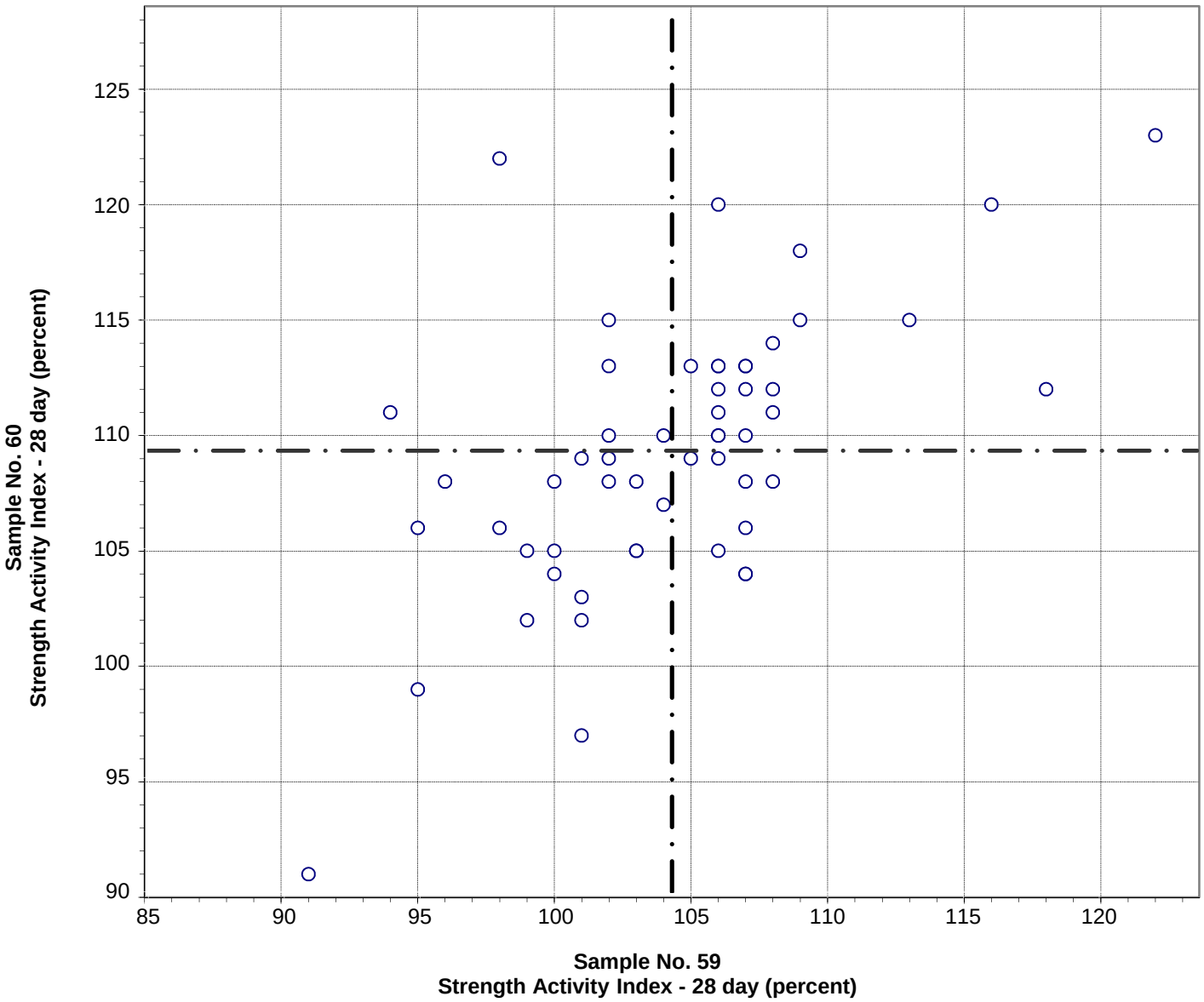
CCRL Proficiency Sample Program
Strength Activity Index - 7 day
POZZOLAN Samples No. 59 and No. 60



Test No. 359 Strength Activity Index - 7 day 59 Points

Sample No. 59	Ave 97	S.D. 5.3	C.V. 5.4
Sample No. 60	Ave 102	S.D. 6.6	C.V. 6.5

CCRL Proficiency Sample Program
Strength Activity Index - 28 day
POZZOLAN Samples No. 59 and No. 60

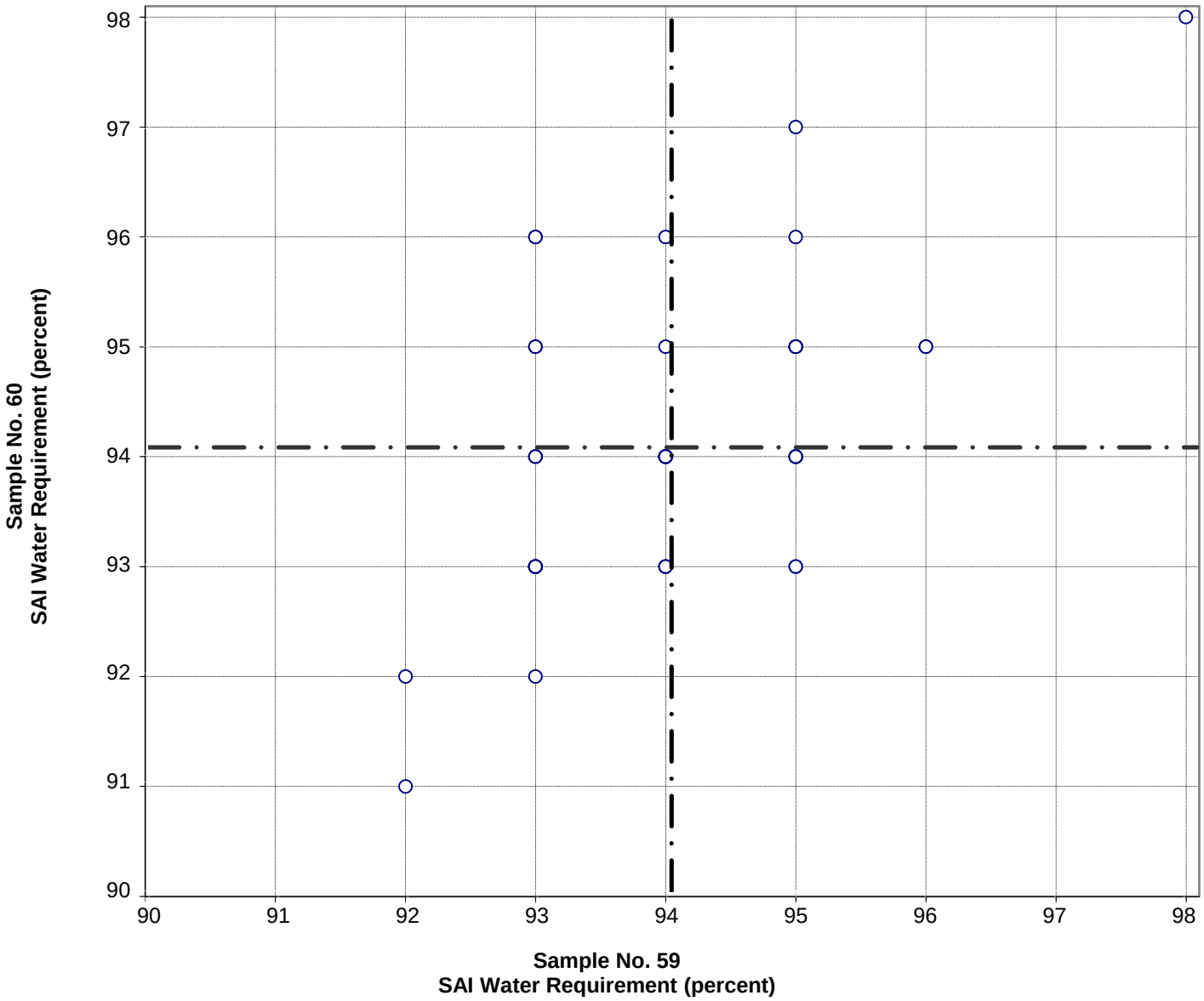


Test No. 360 Strength Activity Index - 28 day 55 Points

Sample No. 59	Ave	104	S.D.	5.6	C.V. 5.4
Sample No. 60	Ave	109	S.D.	5.9	C.V. 5.4

Labs Eliminated: 14, 34

CCRL Proficiency Sample Program
SAI Water Requirement
POZZOLAN Samples No. 59 and No. 60

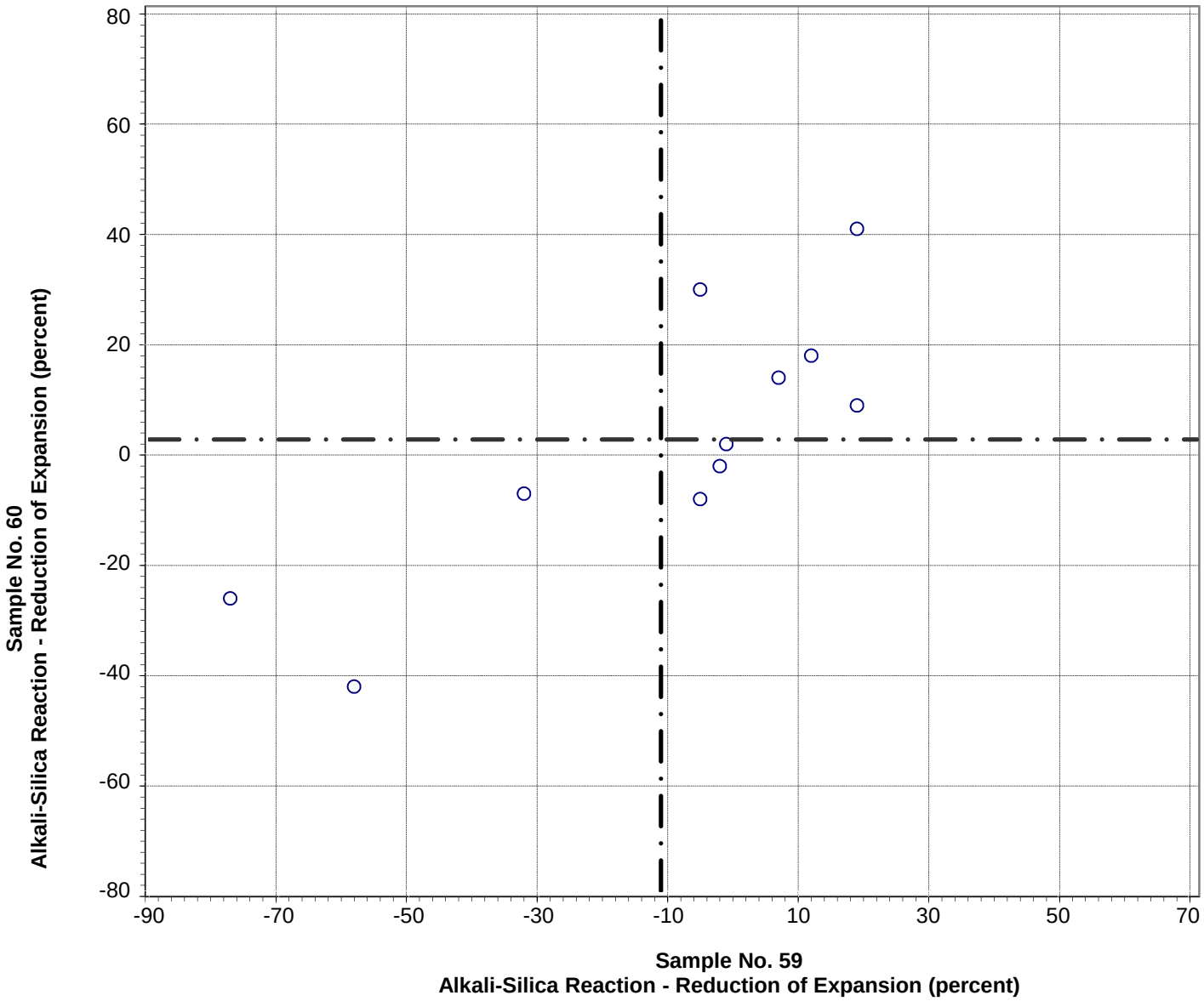


Test No. 370 SAI Water Requirement 53 Points

Sample No. 59	Ave	94	S.D.	1.1	C.V. 1.2
Sample No. 60	Ave	94	S.D.	1.3	C.V. 1.3

Labs Eliminated: 3, 34, 125, 823

CCRL Proficiency Sample Program
Alkali-Silica Reaction - Reduction of Expansion
POZZOLAN Samples No. 59 and No. 60



Test No. 390 Alkali-Silica Reaction - Reduction of Expansion 11 Points

Sample No. 59 Ave -12 S.D. 31 C.V. -281
Sample No. 60 Ave 3 S.D. 24 C.V. 903