

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 207 and Number 208

March 2018



CCRL
Cement and Concrete
Reference Laboratory

www.crl.us



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Reference Laboratory

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March 22, 2018

To: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 207 and No. 208

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in January 2018. Portland Cement Sample No. 207 was an ASTM C150 meeting the specifications of Type I and Type II, and contained limestone additions. Portland Cement Sample No. 208 was an ASTM C150 meeting the specifications of Type I, and contained limestone additions.

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://www.ccrl.us/>. Additional information is provided in the following pages.

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 Portland Cement Proficiency Samples will be distributed in June 2018.

Sincerely,

Kent Niedzielski
Program Manager, Proficiency Sample Programs
Cement and Concrete Reference Laboratory

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To: Participants in the CCRL Portland Cement Proficiency Sample Program

FROM: Kent Niedzielski, Program Manager PSP

SUBJECT: Explanation of Final Report on Results of Tests for Portland Cement Proficiency Samples No. 207 and No. 208

This letter, and the material included with it, constitutes the final report, and summary of results for the current pair of Portland Cement Proficiency Samples, which were distributed in January 2018. 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.

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 "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

¹Youden, 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.*

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

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
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (percent)							
	223	20.62	0.27	1.30	19.47	0.24	1.23
	*215	20.62	0.20	0.95	19.45	0.17	0.89
* Labs Eliminated - 15, 50, 206, 284, 416, 694, 1644, 4297							
Aluminum Oxide (percent)							
	221	3.64	0.15	4.1	5.31	0.23	4.2
	*217	3.63	0.09	2.6	5.33	0.12	2.2
* Labs Eliminated - 416, 779, 4099, 4155							
Ferric Oxide (percent)							
	222	3.14	0.08	2.6	2.60	0.06	2.4
	*214	3.15	0.04	1.4	2.59	0.03	1.3
* Labs Eliminated - 43, 125, 407, 416, 694, 4099, 4137, 4312							
Calcium Oxide (percent)							
	223	62.12	0.52	0.84	62.26	0.54	0.86
	*213	62.08	0.41	0.66	62.23	0.38	0.62
* Labs Eliminated - 1, 42, 48, 129, 247, 698, 1054, 2308, 2437, 4312							
Magnesium Oxide (percent)							
	224	3.50	0.12	3.4	2.50	0.15	6.1
	*211	3.50	0.07	2.1	2.47	0.06	2.2
* Labs Eliminated - 125, 142, 284, 413, 416, 667, 1644, 2466, 3707, 4050, 4080, 4099, 4251							
Sulfur Trioxide (percent)							
	226	3.30	0.09	2.7	3.62	0.09	2.4
	*217	3.29	0.07	2.1	3.62	0.08	2.1
* Labs Eliminated - 43, 50, 93, 125, 203, 416, 1435, 2308, 2437							
Loss on Ignition (percent)							
	227	1.97	0.11	5.5	2.13	0.16	7.6
	*211	1.96	0.07	3.6	2.13	0.07	3.1
* Labs Eliminated - 126, 137, 176, 206, 222, 413, 431, 1053, 1054, 1251, 1594, 2683, 2938, 3279, 4051, 4080							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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Sodium Oxide (percent)

214	0.343	0.074	22	0.241	0.075	31
*199	0.345	0.034	10	0.237	0.027	11

* Labs Eliminated - 99, 125, 219, 354, 407, 416, 687, 779, 2308, 2360, 2466, 3238, 4050, 4099, 4316

Potassium Oxide (percent)

219	1.104	0.054	4.9	1.191	0.085	7.1
*214	1.106	0.032	2.9	1.200	0.034	2.8

* Labs Eliminated - 169, 2462, 4099, 4131, 4155

Strontium Oxide (percent)

111	0.047	0.042	88	0.211	0.041	19
*104	0.040	0.003	8	0.215	0.008	4

* Labs Eliminated - 94, 309, 416, 438, 491, 494, 4099

Titanium Dioxide (percent)

176	0.20	0.018	8.7	0.25	0.158	64.5
*169	0.20	0.008	3.7	0.23	0.013	5.4

* Labs Eliminated - 43, 175, 416, 491, 667, 2308, 2466

Phosphorus Pentoxide (percent)

172	0.055	0.027	49.9	0.251	0.038	15.2
*157	0.053	0.007	12.9	0.258	0.010	4.0

* Labs Eliminated - 90, 125, 162, 206, 219, 284, 416, 494, 504, 698, 2360, 2466, 2491, 3279, 4099

Zinc Oxide (percent)

106	0.058	0.013	21.4	0.006	0.009	150.8
*96	0.059	0.004	7.1	0.004	0.002	36.4

* Labs Eliminated - 7, 35, 78, 94, 206, 309, 413, 416, 491, 2463

Manganic Oxide (percent)

148	0.049	0.010	20.6	0.073	0.018	25.2
*133	0.049	0.003	6.8	0.073	0.004	5.5

* Labs Eliminated - 8, 10, 129, 206, 354, 413, 416, 667, 932, 2463, 2466, 2477, 2491, 3297, 4297

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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Chloride (percent)

140	0.008	0.018	222	0.009	0.025	272
*132	0.007	0.003	52	0.007	0.004	51

* Labs Eliminated - 15, 90, 94, 129, 219, 982, 3250, 3658

Insoluble Residue (percent)

208	0.42	0.25	59	0.43	0.19	44
*195	0.38	0.07	19	0.41	0.09	21

* Labs Eliminated - 4, 94, 98, 121, 175, 246, 413, 1053, 1079, 1251, 2477, 3415, 4050

Free Lime (percent)

171	0.52	0.19	37	0.53	0.20	37
*164	0.50	0.15	31	0.51	0.18	35

* Labs Eliminated - 121, 132, 137, 246, 416, 768, 2466

Carbon Dioxide (percent)

197	1.30	0.26	19.9	1.05	0.24	22.7
*178	1.34	0.11	7.9	1.07	0.10	9.0

* Labs Eliminated - 42, 78, 84, 137, 206, 247, 289, 413, 698, 1644, 1657, 2522, 2934, 3249, 4051, 4092, 4131, 4155, 4251

Limestone Content (percent)

191	3.3	0.6	19.4	2.6	0.5	19.9
*175	3.3	0.3	8.3	2.6	0.2	9.4

* Labs Eliminated - 42, 137, 206, 247, 289, 413, 698, 1644, 1657, 2522, 3249, 3368, 3752, 4051, 4131, 4251

Chromium Oxide (percent)

100	0.011	0.022	199	0.007	0.003	50
*96	0.009	0.003	32	0.006	0.003	41

* Labs Eliminated - 93, 415, 457, 2477

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

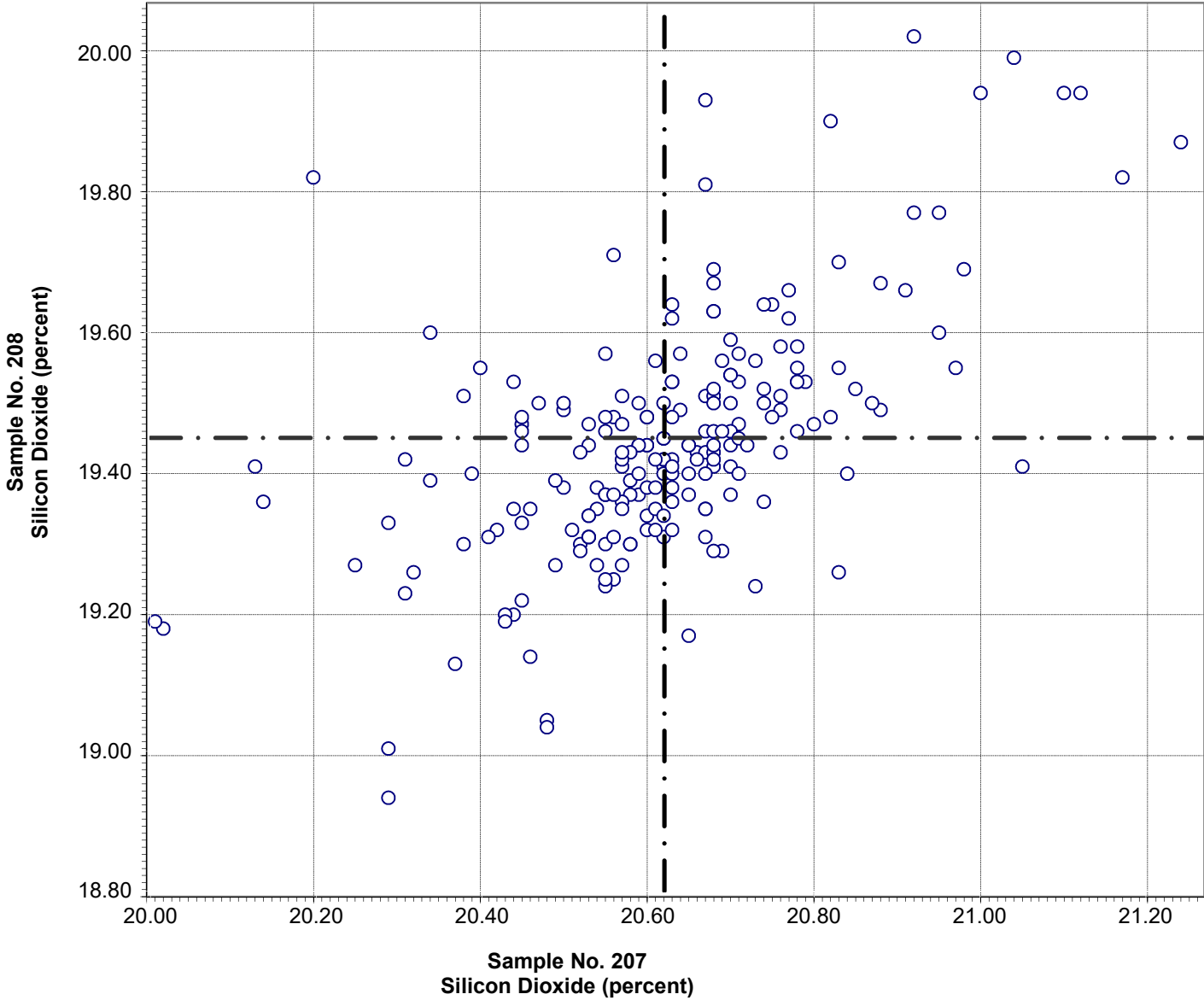
SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Tricalcium Silicate (percent)							
	192	53.6	3.8	7.0	52.5	4.0	7.6
	*185	53.4	2.7	5.1	52.2	2.9	5.6
* Labs Eliminated - 8, 42, 50, 206, 416, 4099, 4312							
Dicalcium Silicate (percent)							
	192	18.2	3.3	17.9	15.9	3.3	20.8
	*181	18.4	2.2	11.8	16.1	2.3	14.2
* Labs Eliminated - 8, 42, 50, 206, 416, 694, 1054, 1644, 2437, 4099, 4312							
Tricalcium Aluminate (percent)							
	192	4.3	0.5	11.8	9.6	0.6	6.6
	*182	4.3	0.2	5.3	9.7	0.2	2.6
* Labs Eliminated - 15, 42, 206, 416, 975, 3238, 4099, 4155, 4297, 4312							
Tetracalcium Aluminoferrite (percent)							
	192	9.4	0.3	2.9	7.9	0.3	4.0
	*187	9.5	0.2	1.7	7.9	0.2	2.0
* Labs Eliminated - 42, 43, 416, 694, 4099							

**CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 207 and No. 208**



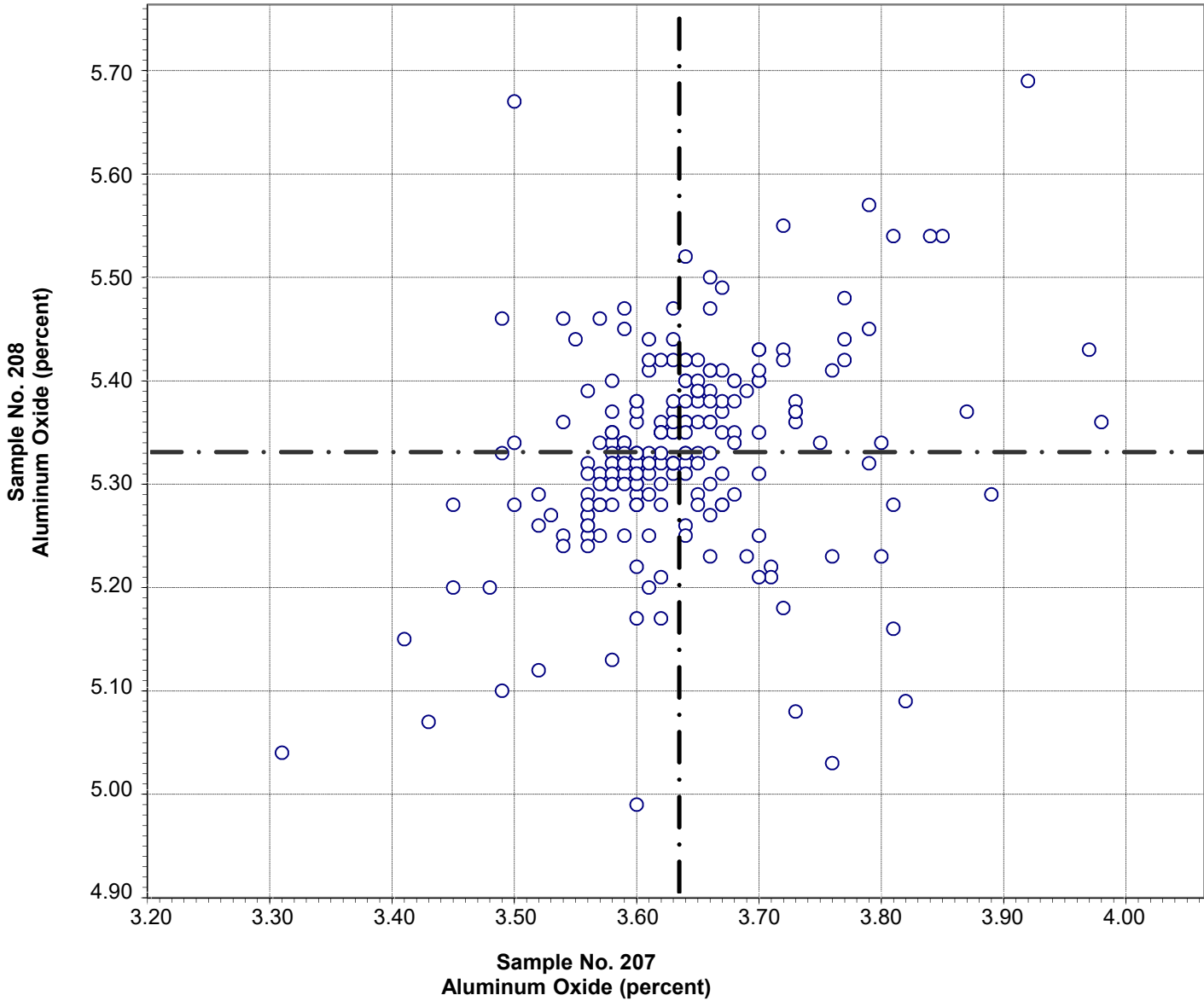
Test No. 10 Silicon Dioxide 212 Points

Sample No. 207	Ave 20.62	S.D. 0.20	C.V. 0.95
Sample No. 208	Ave 19.45	S.D. 0.17	C.V. 0.89

Labs Eliminated: 15, 50, 206, 284, 416, 694, 1644, 4297

Labs off Diagram: 125, 159, 819

**CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**



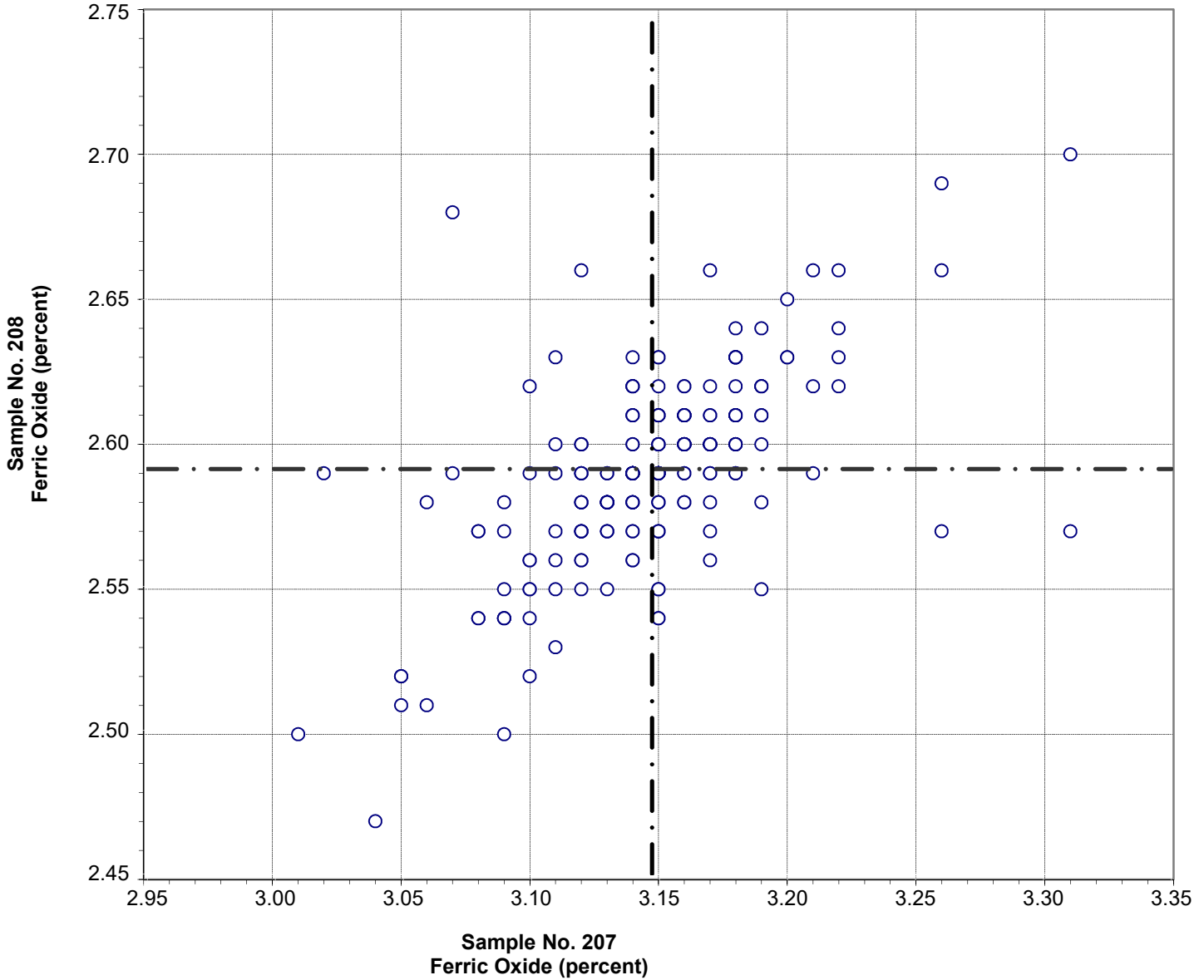
Test No. 21 Aluminum Oxide 214 Points

Sample No. 207	Ave 3.63	S.D. 0.09	C.V. 2.6
Sample No. 208	Ave 5.33	S.D. 0.12	C.V. 2.2

Labs Eliminated: 416, 779, 4099, 4155

Labs off Diagram: 125, 4297, 4312

**CCRL Proficiency Sample Program
 Ferric Oxide
 PORTLAND CEMENT Samples No. 207 and No. 208**



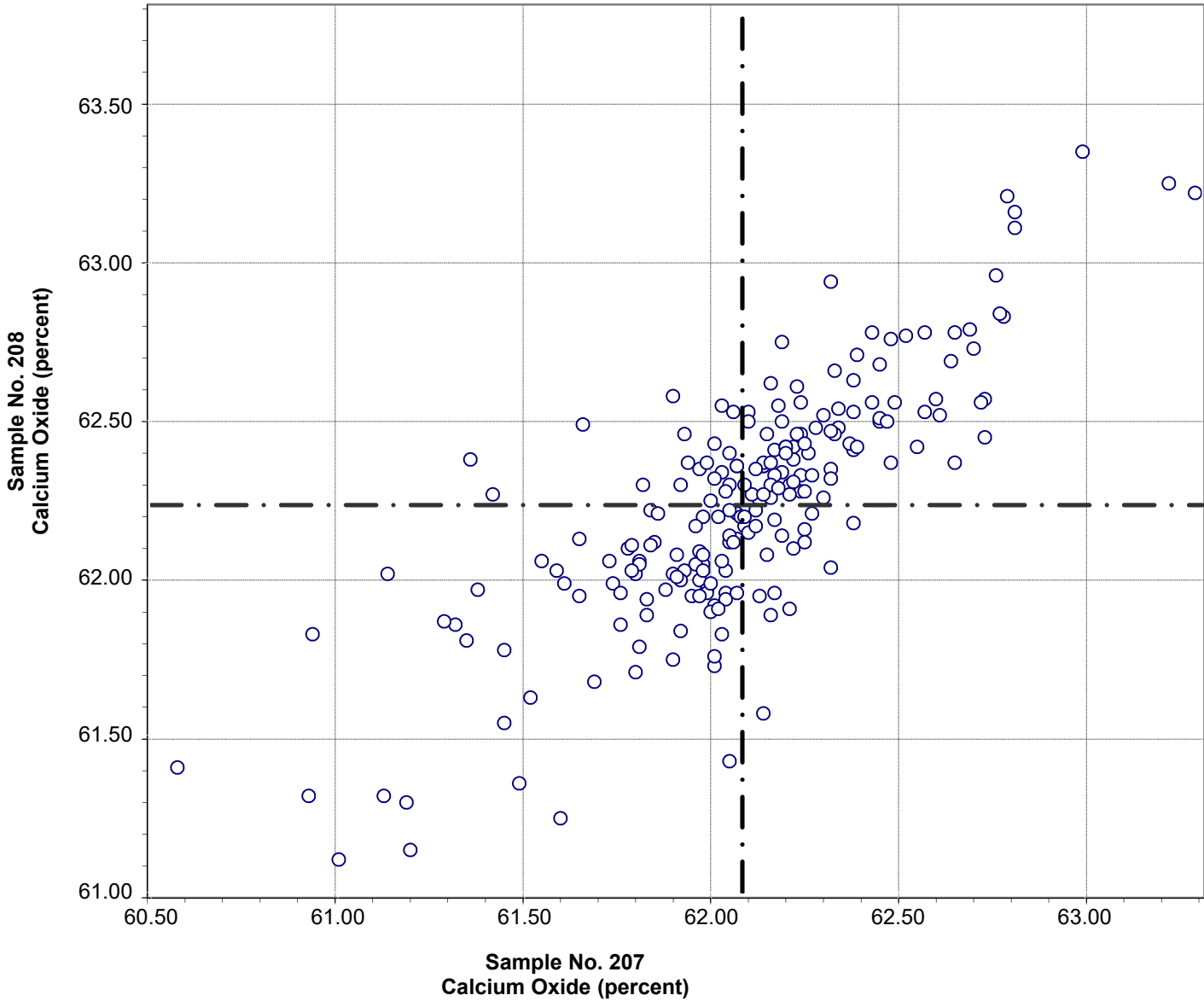
Test No. 30 Ferric Oxide 213 Points

Sample No. 207	Ave 3.15	S.D. 0.04	C.V. 1.4
Sample No. 208	Ave 2.59	S.D. 0.03	C.V. 1.3

Labs Eliminated: 43, 125, 407, 416, 694, 4099, 4137, 4312

Labs off Diagram: 93

**CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**



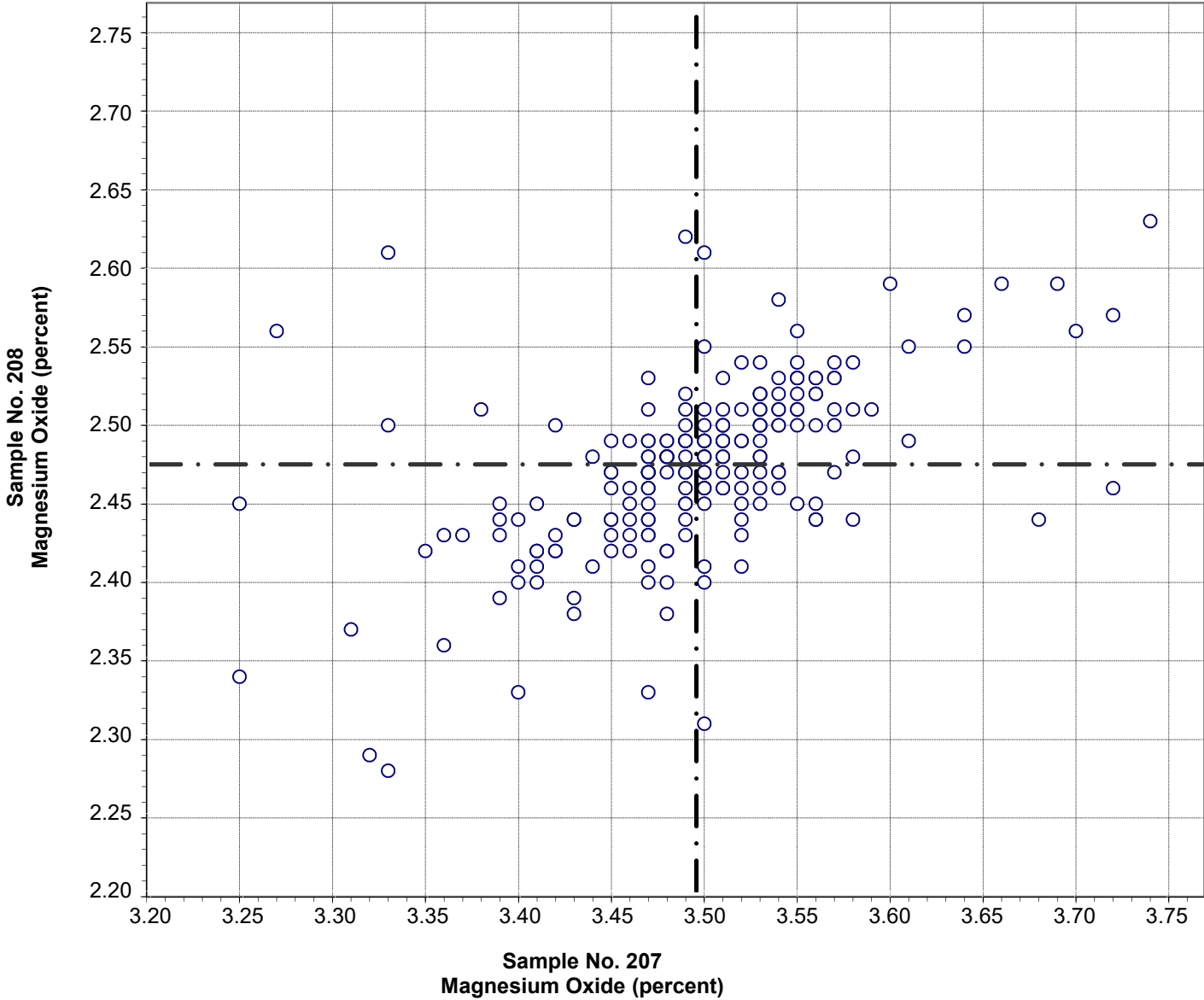
Test No. 40 Calcium Oxide 211 Points

Sample No. 207	Ave 62.08	S.D. 0.41	C.V. 0.66
Sample No. 208	Ave 62.23	S.D. 0.38	C.V. 0.62

Labs Eliminated: 1, 42, 48, 129, 247, 698, 1054, 2308, 2437, 4312

Labs off Diagram: 38, 206

**CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**

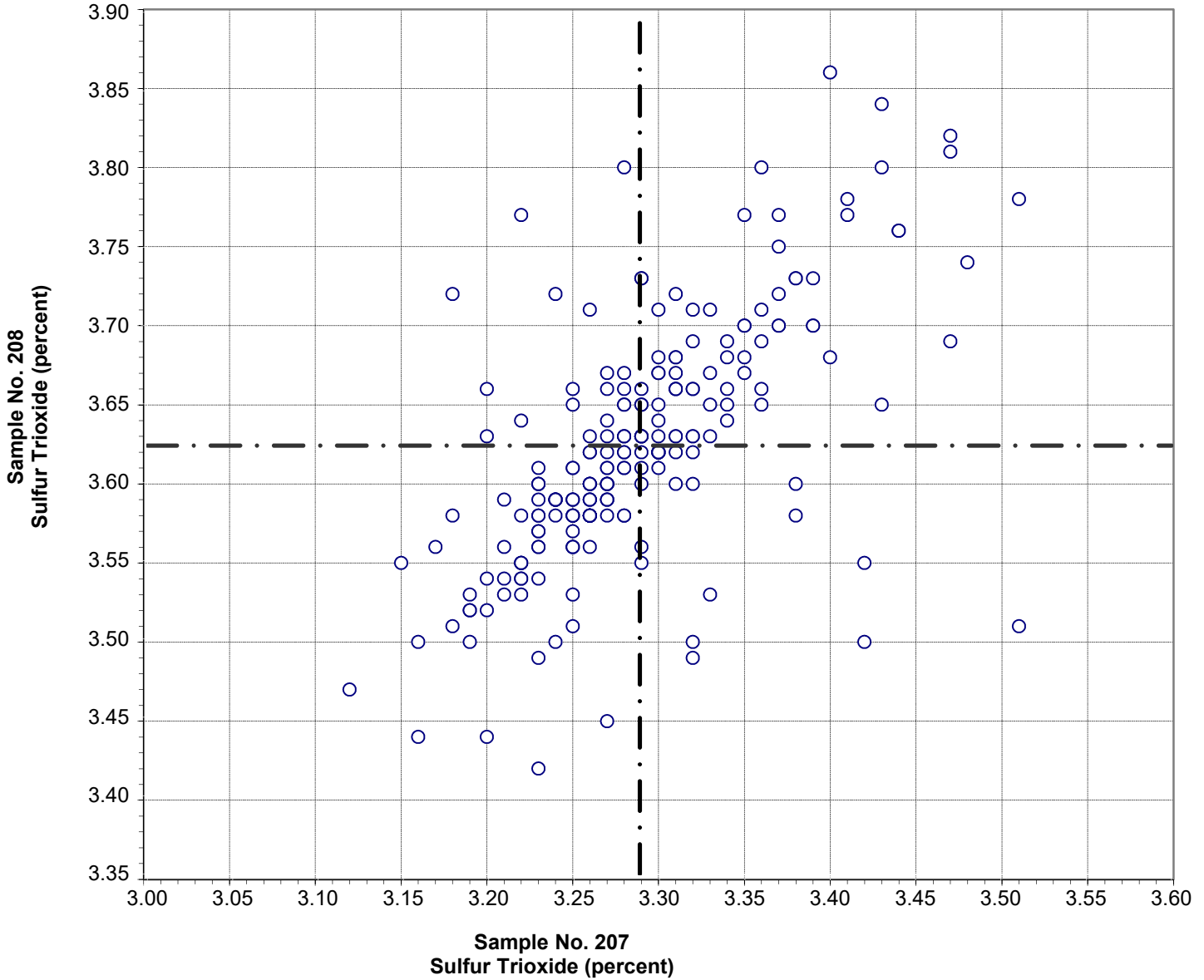


Test No. 50 Magnesium Oxide 211 Points

Sample No. 207	Ave 3.50	S.D. 0.07	C.V. 2.1
Sample No. 208	Ave 2.47	S.D. 0.06	C.V. 2.2

Labs Eliminated: 125, 142, 284, 413, 416, 667, 1644, 2466, 3707, 4050, 4080, 4099, 4251

**CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 207 and No. 208**

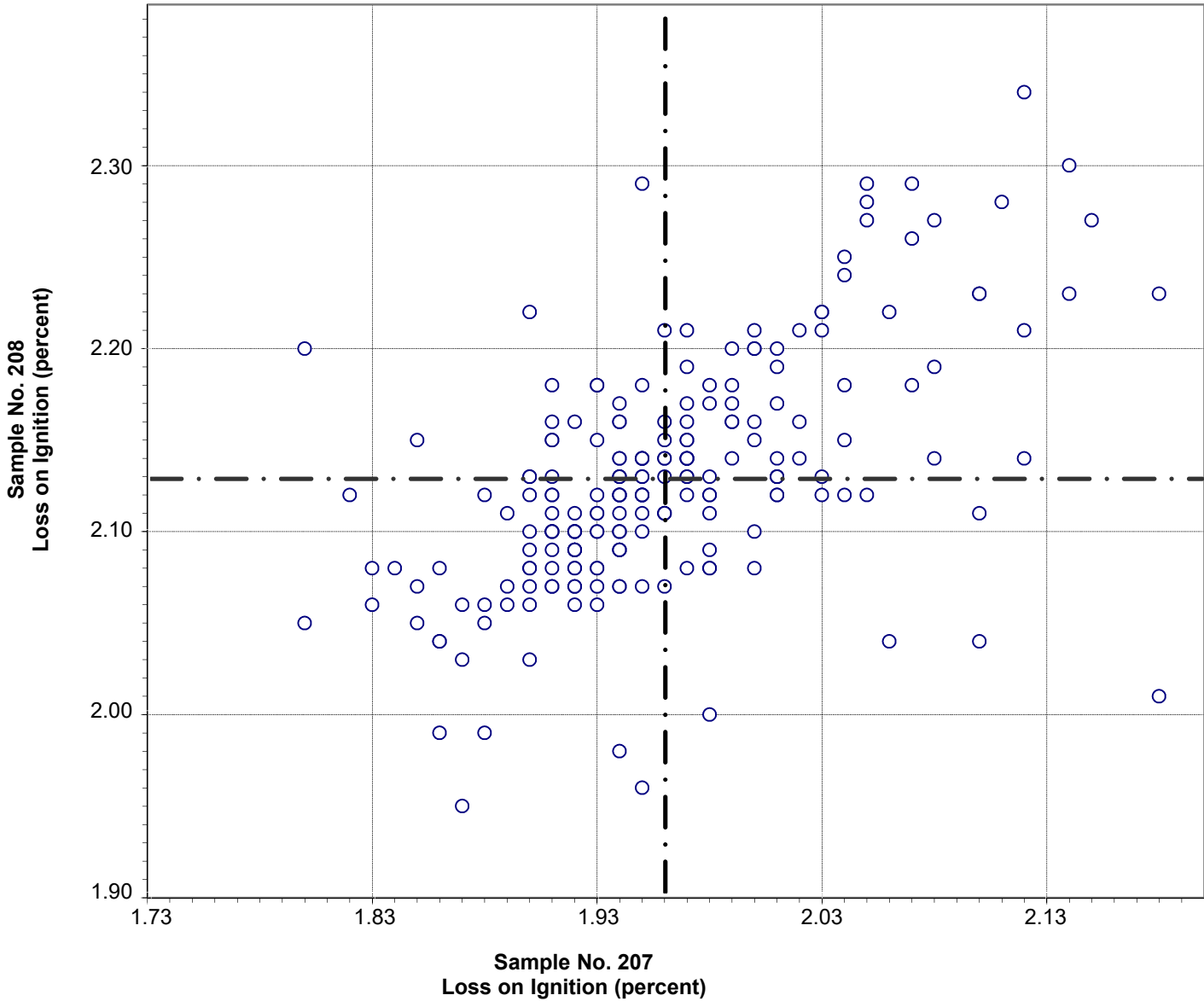


Test No. 60 Sulfur Trioxide 217 Points

Sample No. 207	Ave 3.29	S.D. 0.07	C.V. 2.1
Sample No. 208	Ave 3.62	S.D. 0.08	C.V. 2.1

Labs Eliminated: 43, 50, 93, 125, 203, 416, 1435, 2308, 2437

**CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 207 and No. 208**



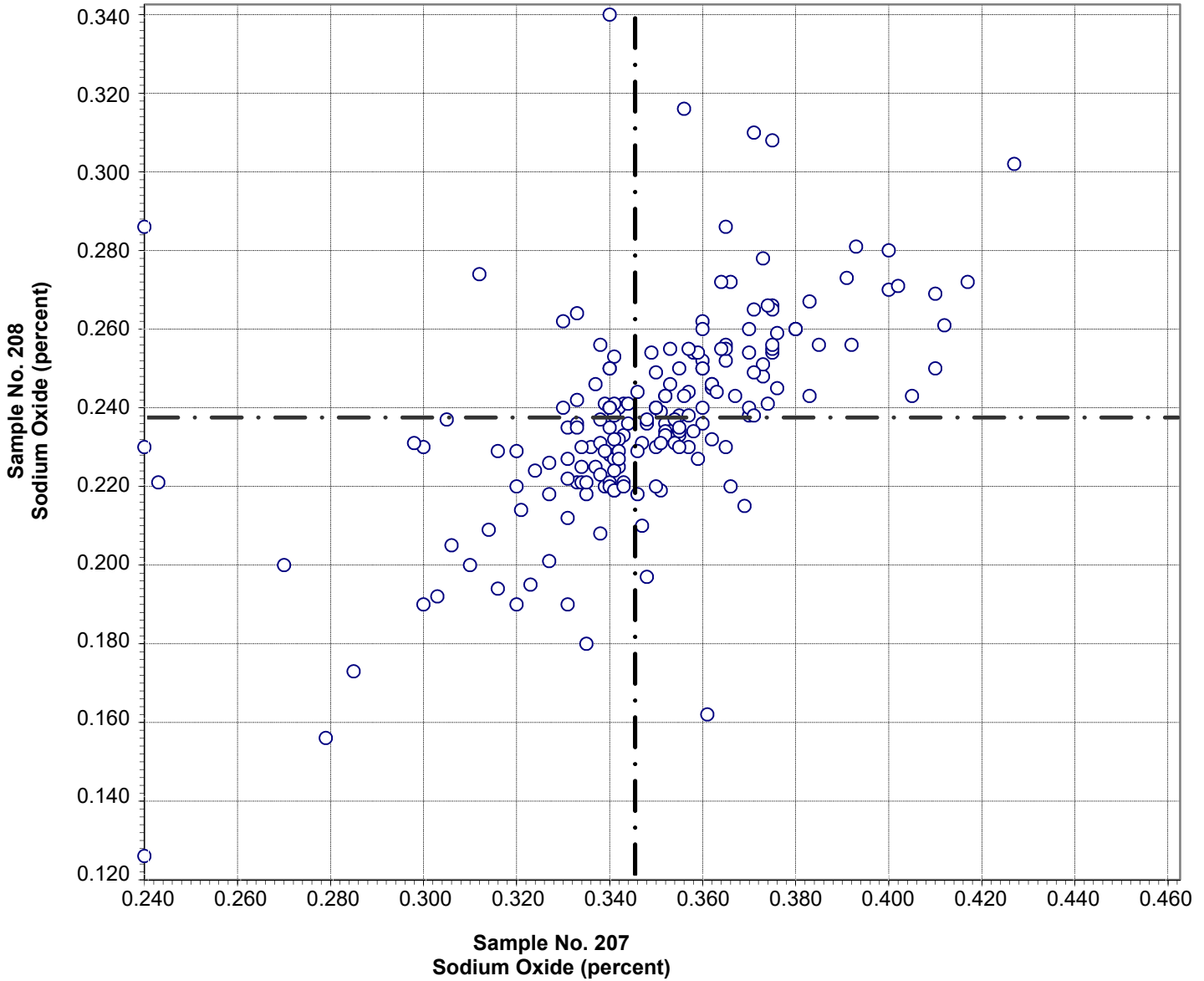
Test No. 70 Loss on Ignition 210 Points

Sample No. 207	Ave 1.96	S.D. 0.07	C.V. 3.6
Sample No. 208	Ave 2.13	S.D. 0.07	C.V. 3.1

Labs Eliminated: 126, 137, 176, 206, 222, 413, 431, 1053, 1054, 1251, 1594, 2683, 2938, 3279, 4051, 4080

Labs off Diagram: 4050

**CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**



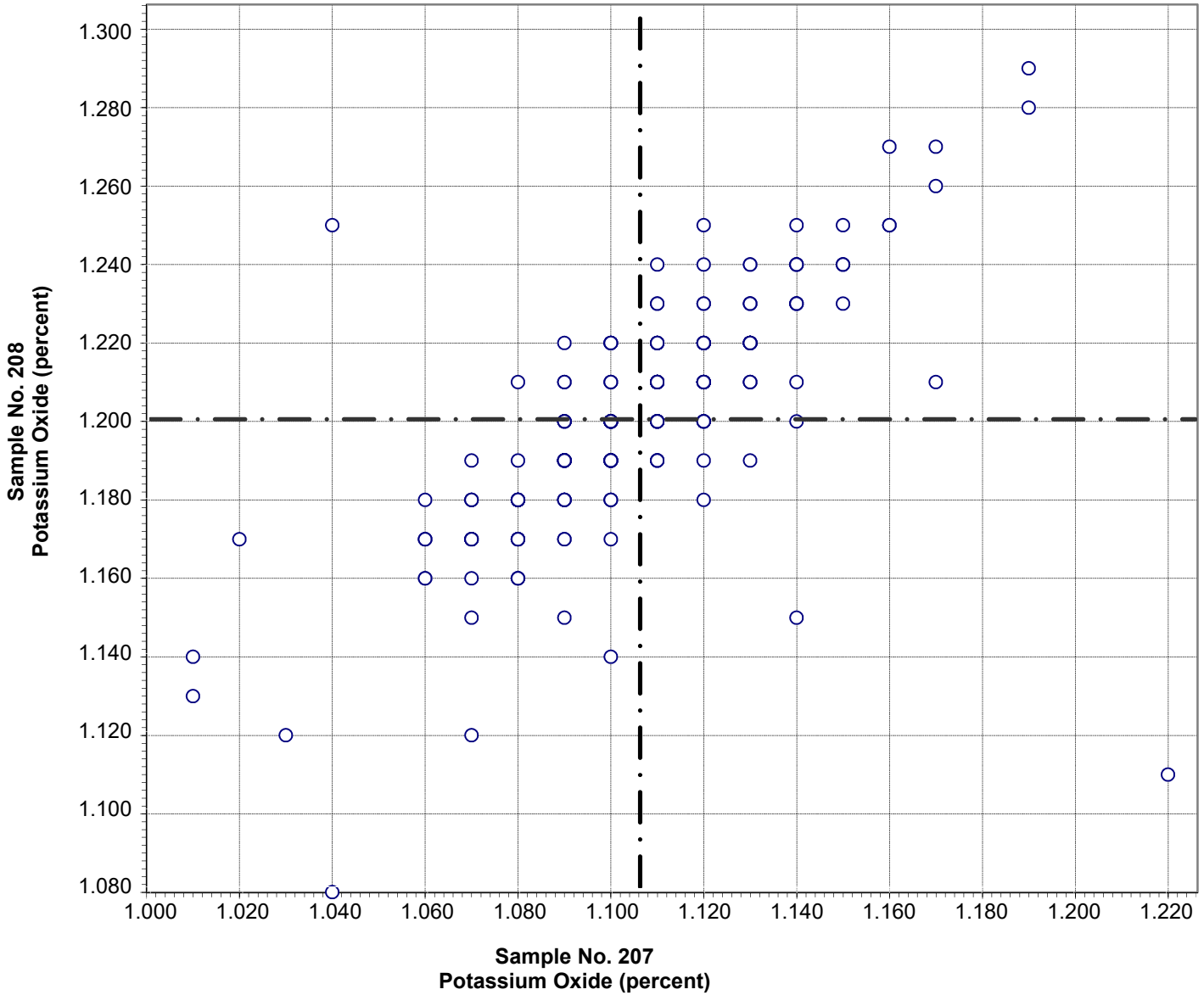
Test No. 90 Sodium Oxide 194 Points

Sample No. 207	Ave 0.345	S.D. 0.034	C.V. 10
Sample No. 208	Ave 0.237	S.D. 0.027	C.V. 11

Labs Eliminated: 99, 125, 219, 354, 407, 416, 687, 779, 2308, 2360, 2466, 3238, 4050, 4099, 4316

Labs off Diagram: 35, 284, 289, 1644, 4314

**CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**



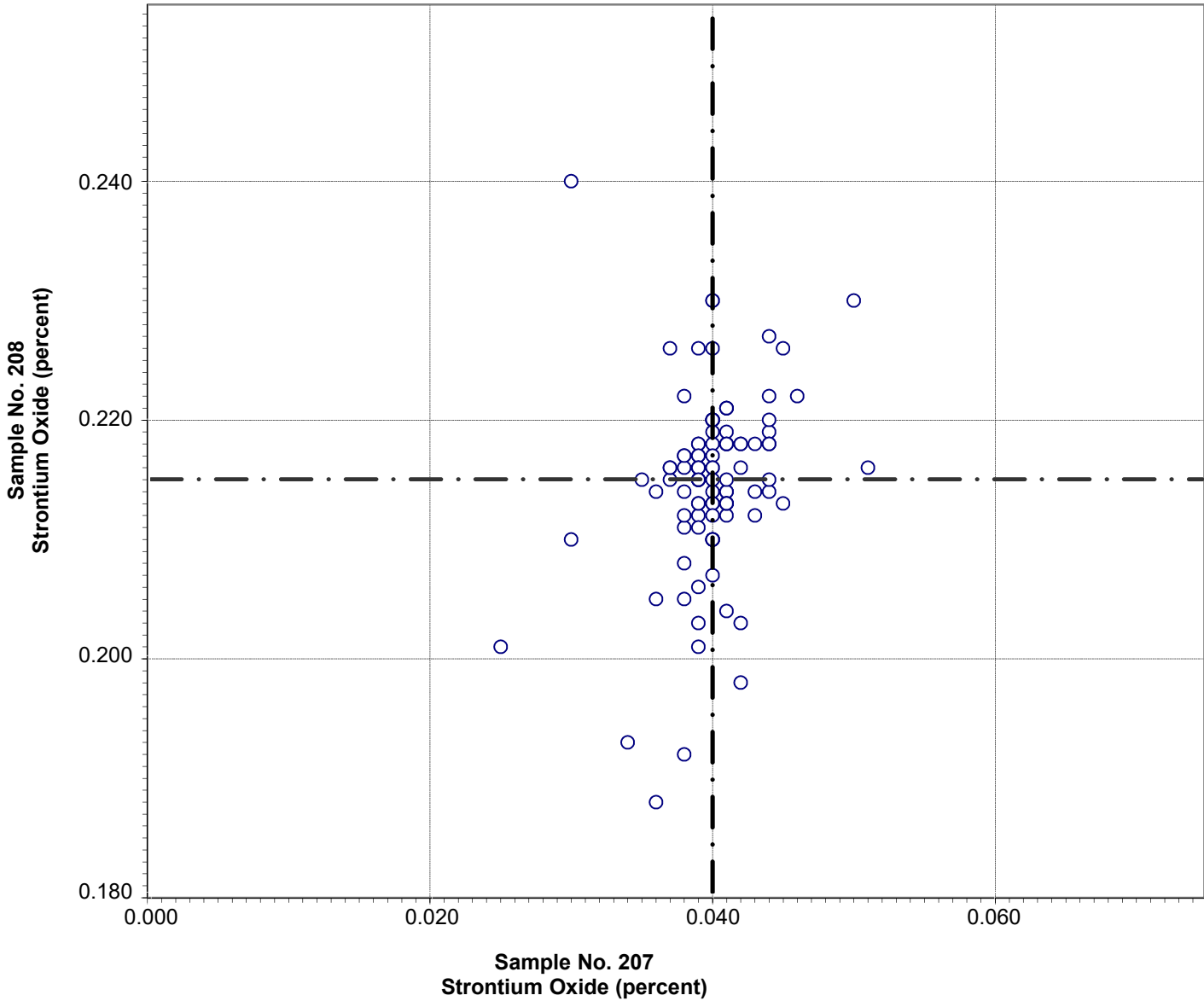
Test No. 100 Potassium Oxide 210 Points

Sample No. 207	Ave 1.106	S.D. 0.032	C.V. 2.9
Sample No. 208	Ave 1.200	S.D. 0.034	C.V. 2.8

Labs Eliminated: 169, 2462, 4099, 4131, 4155

Labs off Diagram: 36, 78, 125, 4312

**CCRL Proficiency Sample Program
Strontium Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**

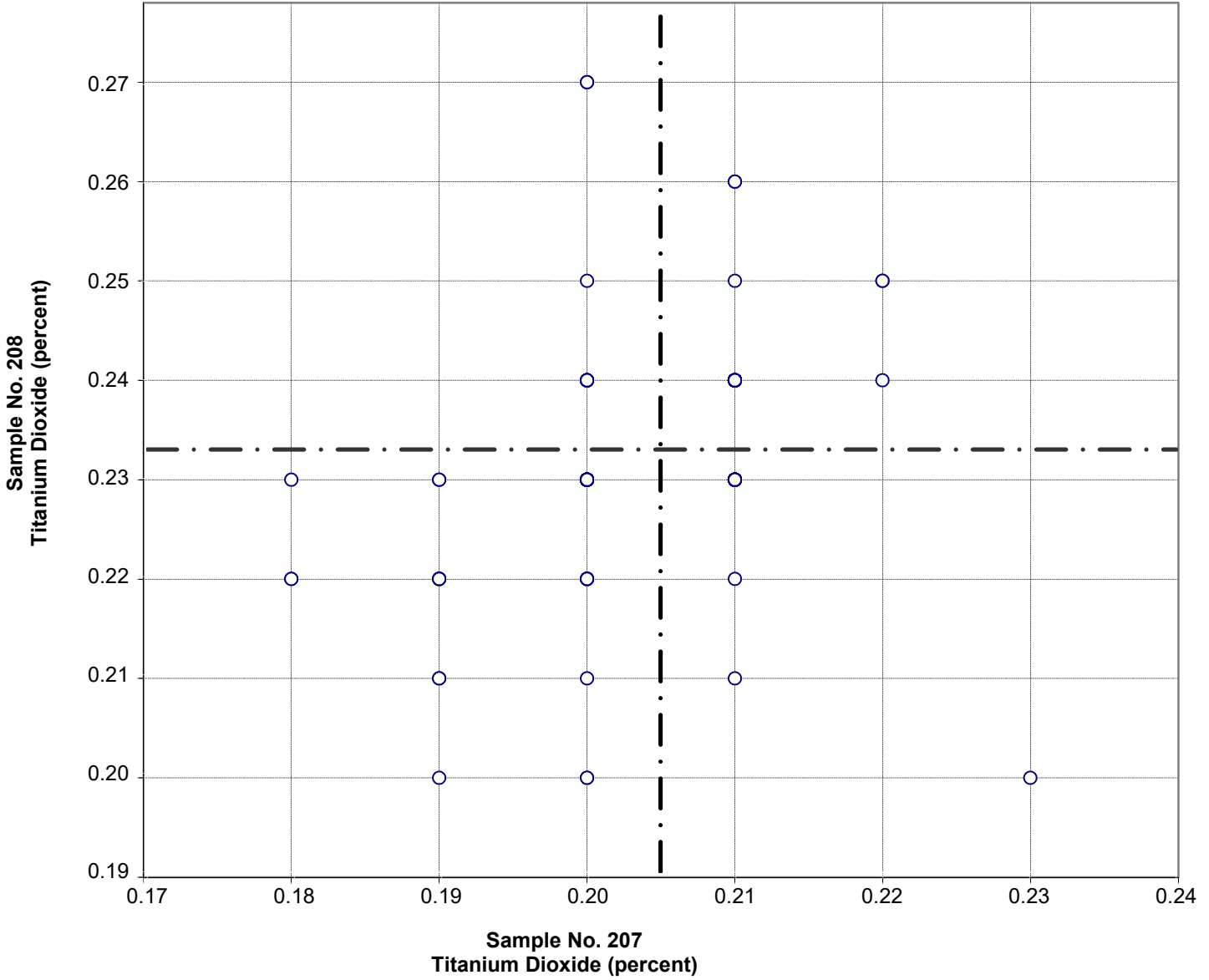


Test No. 92 Strontium Oxide 104 Points

Sample No. 207	Ave 0.040	S.D. 0.003	C.V. 8
Sample No. 208	Ave 0.215	S.D. 0.008	C.V. 4

Labs Eliminated: 94, 309, 416, 438, 491, 494, 4099

**CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 207 and No. 208**



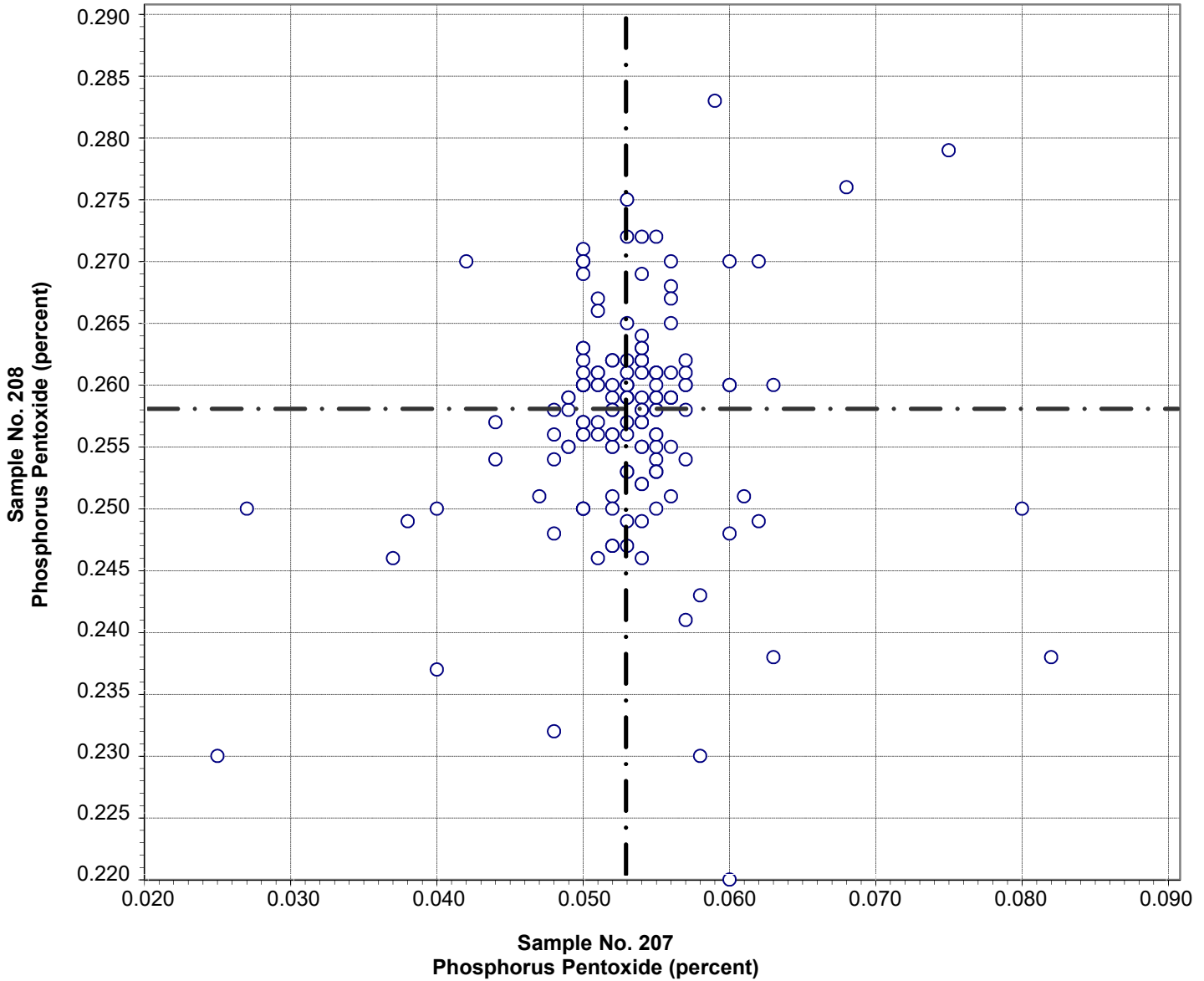
Test No. 103 Titanium Dioxide 166 Points

Sample No. 207	Ave 0.20	S.D. 0.008	C.V. 3.7
Sample No. 208	Ave 0.23	S.D. 0.013	C.V. 5.4

Labs Eliminated: 43, 175, 416, 491, 667, 2308, 2466

Labs off Diagram: 35, 246, 4297

**CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 207 and No. 208**



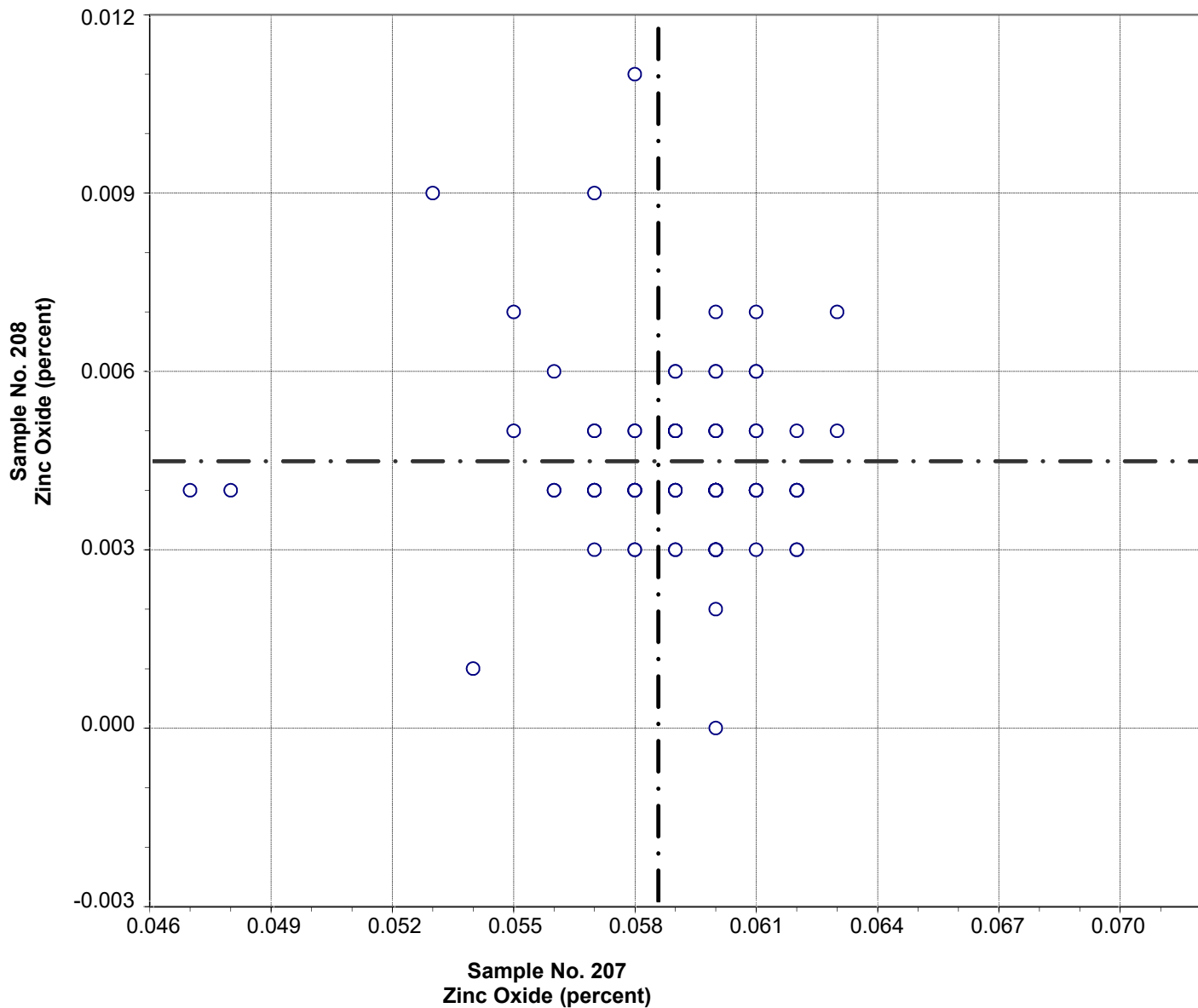
Test No. 102 Phosphorus Pentoxide 154 Points

Sample No. 207	Ave 0.053	S.D. 0.007	C.V. 12.9
Sample No. 208	Ave 0.258	S.D. 0.010	C.V. 4.0

Labs Eliminated: 90, 125, 162, 206, 219, 284, 416, 494, 504, 698, 2360, 2466, 2491, 3279, 4099

Labs off Diagram: 8, 1079, 4131

**CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**



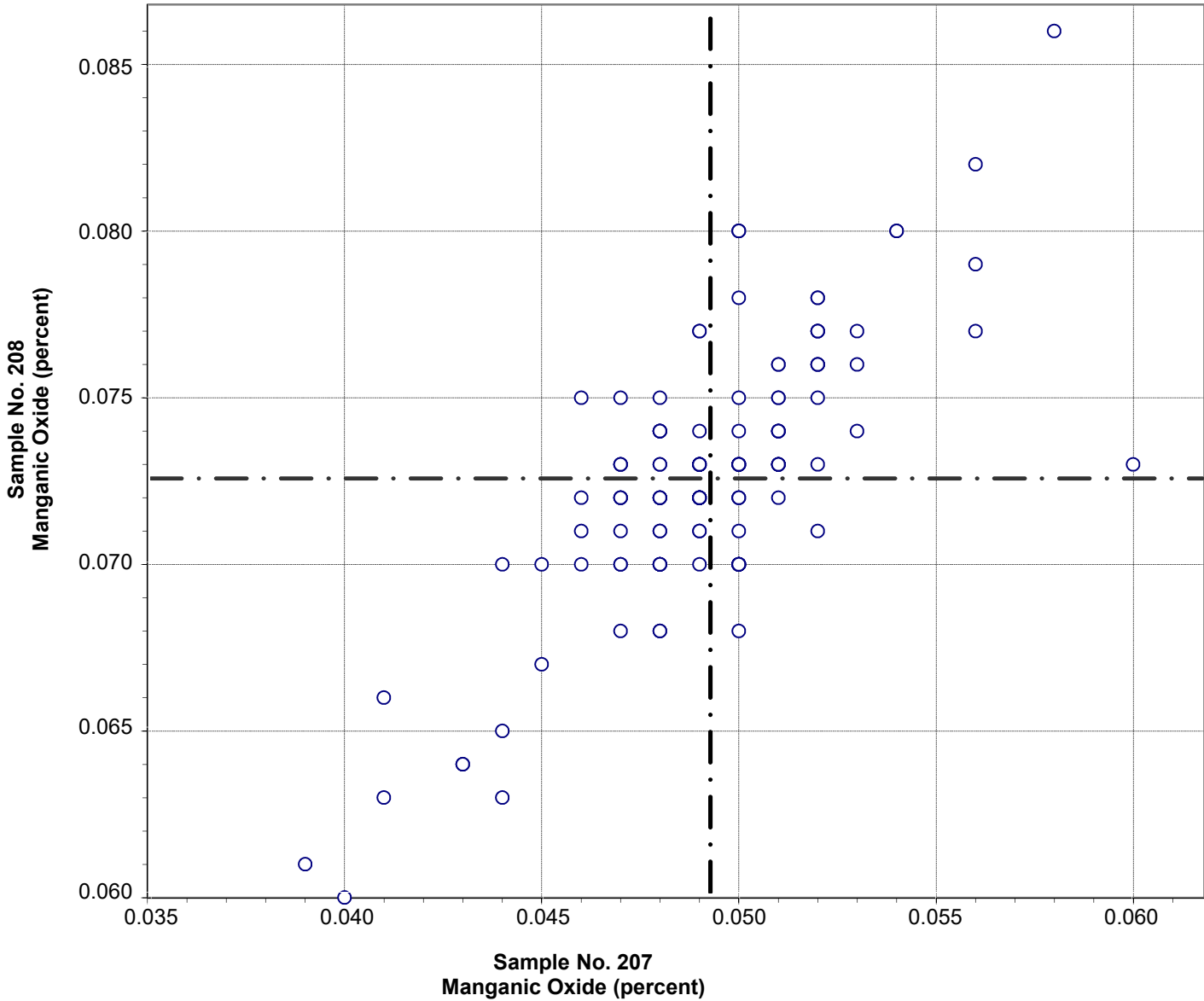
Test No. 99 Zinc Oxide 91 Points

Sample No. 207	Ave 0.059	S.D. 0.004	C.V. 7.1
Sample No. 208	Ave 0.004	S.D. 0.002	C.V. 36.4

Labs Eliminated: 7, 35, 78, 94, 206, 309, 413, 416, 491, 2463

Labs off Diagram: 502, 768, 1916, 4099, 4297

**CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**



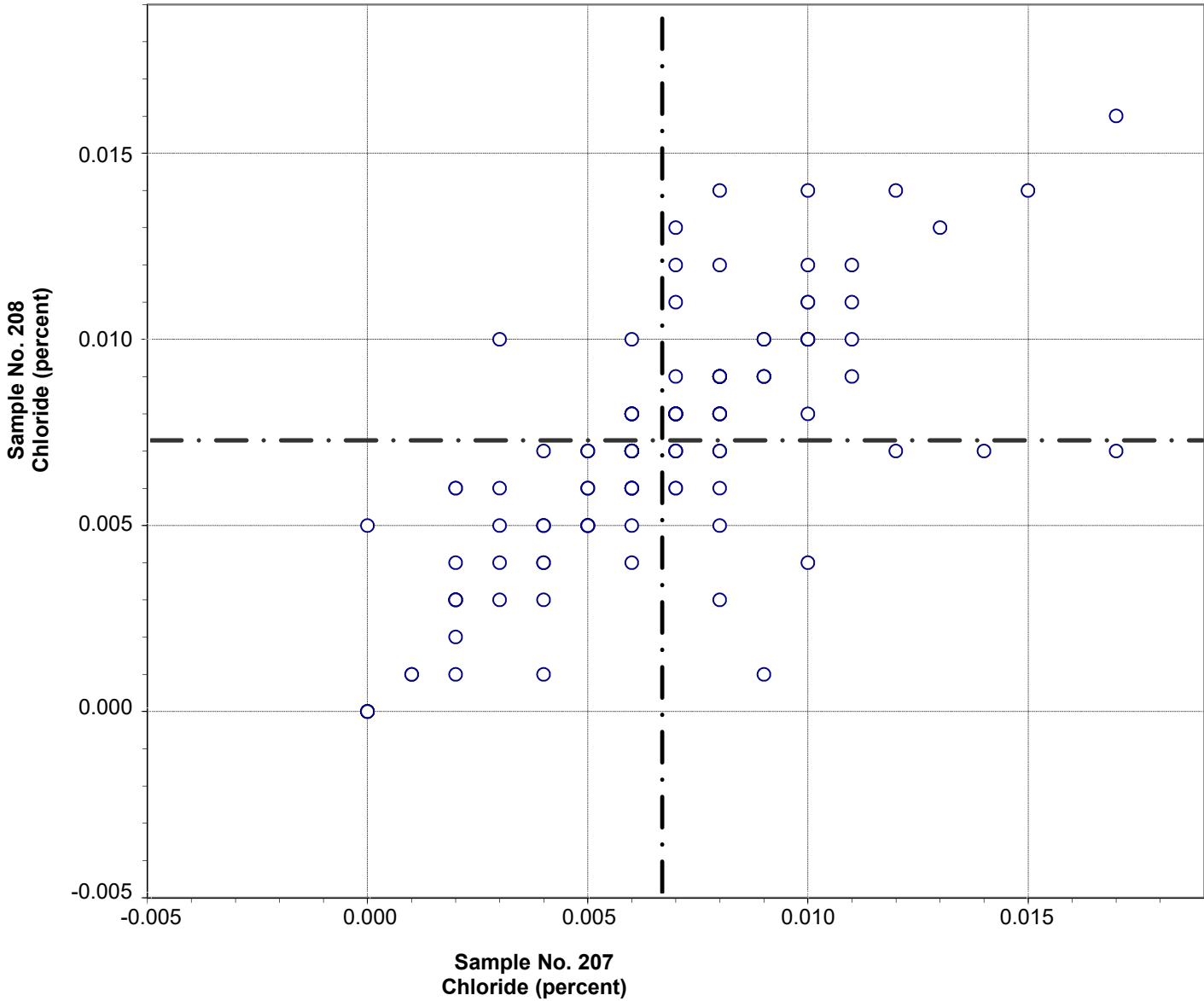
Test No. 101 Manganic Oxide 131 Points

Sample No. 207	Ave 0.049	S.D. 0.003	C.V. 6.8
Sample No. 208	Ave 0.073	S.D. 0.004	C.V. 5.5

Labs Eliminated: 8, 10, 129, 206, 354, 413, 416, 667, 932, 2463, 2466, 2477, 2491, 3297, 4297

Labs off Diagram: 84, 768

**CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 207 and No. 208**



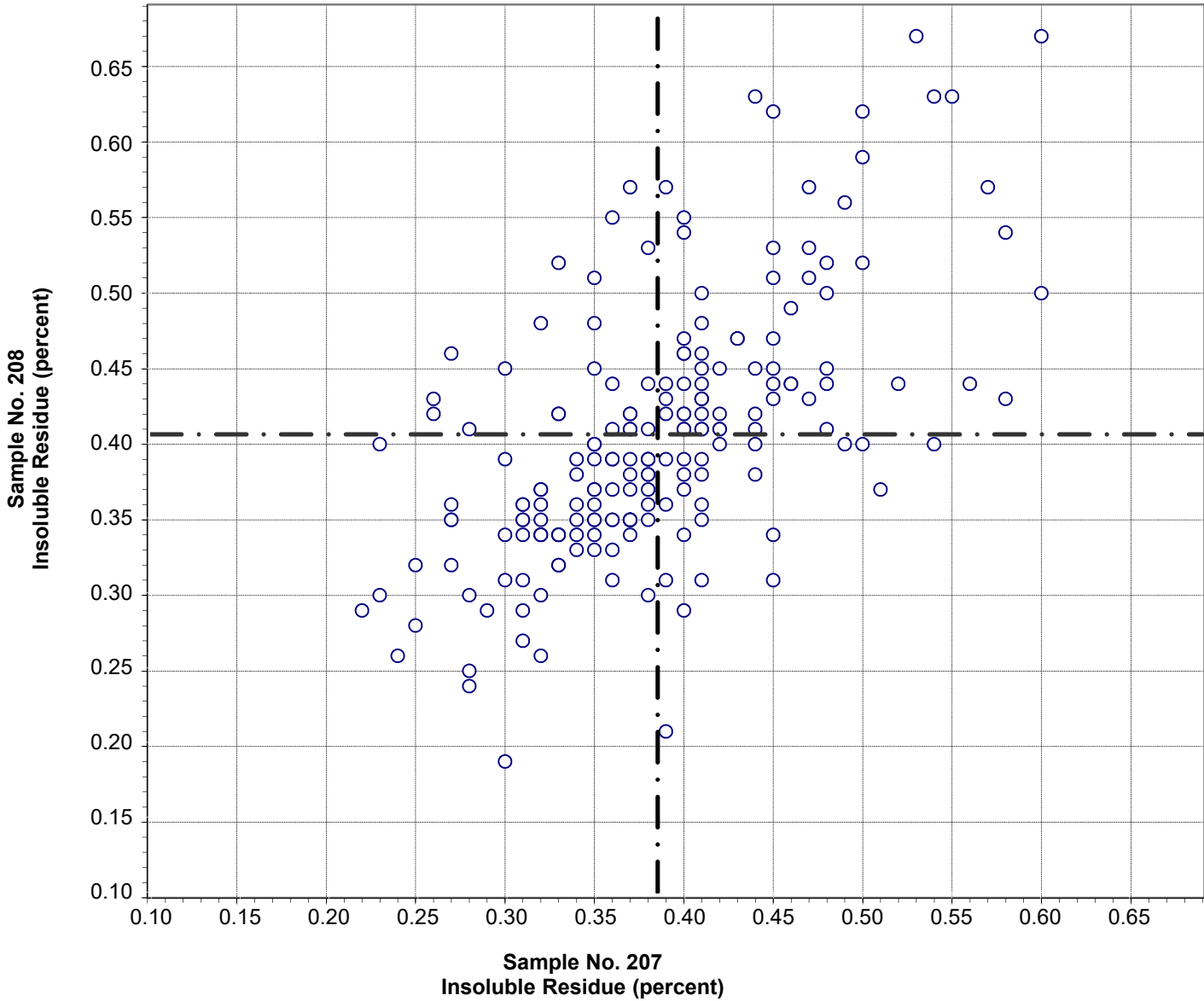
Test No. 104 Chloride 130 Points

Sample No. 207	Ave 0.007	S.D. 0.003	C.V. 52
Sample No. 208	Ave 0.007	S.D. 0.004	C.V. 51

Labs Eliminated: 15, 90, 94, 129, 219, 982, 3250, 3658

Labs off Diagram: 413, 491

**CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 207 and No. 208**

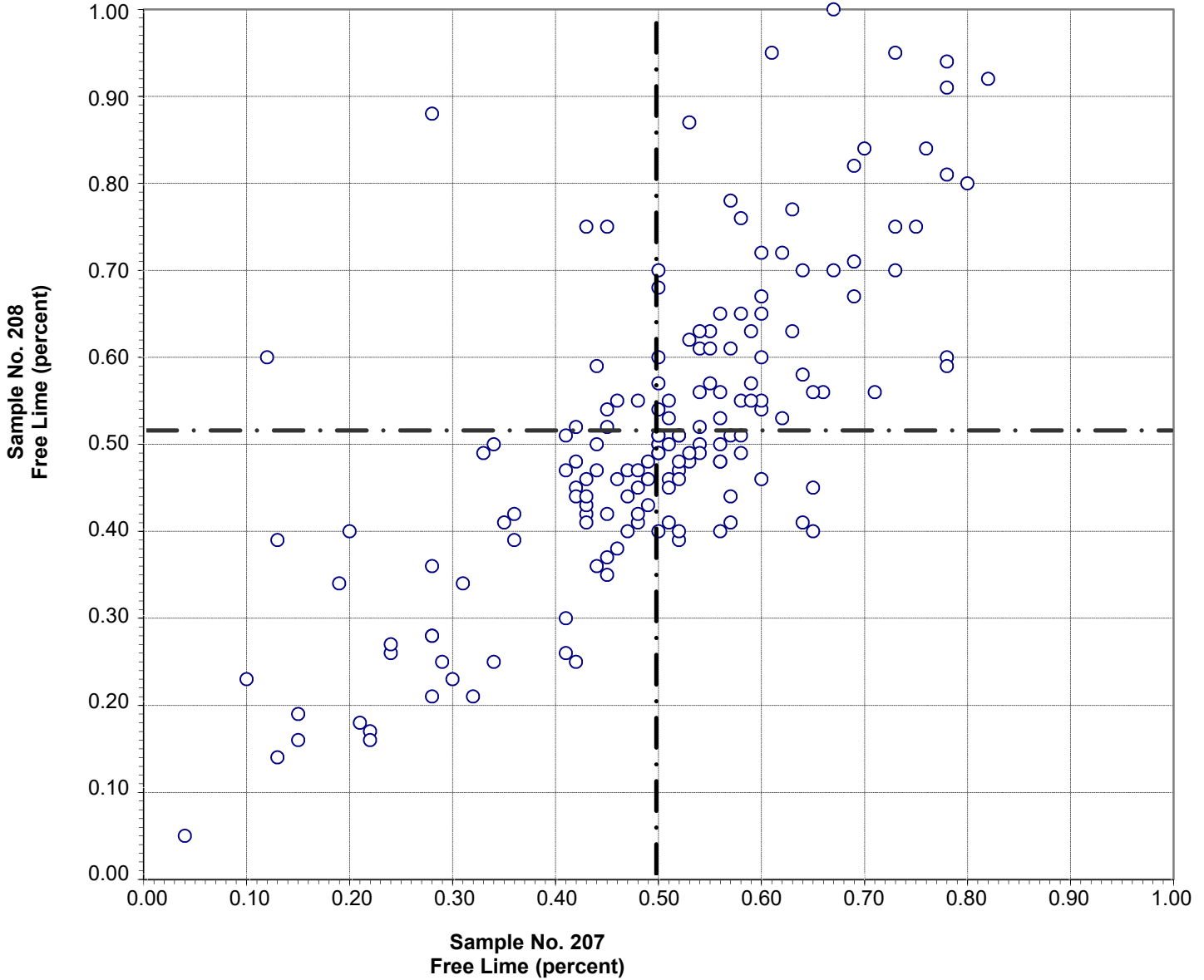


Test No. 80 Insoluble Residue 195 Points

Sample No. 207	Ave 0.38	S.D. 0.07	C.V. 19
Sample No. 208	Ave 0.41	S.D. 0.09	C.V. 21

Labs Eliminated: 4, 94, 98, 121, 175, 246, 413, 1053, 1079, 1251, 2477, 3415, 4050

**CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 207 and No. 208**

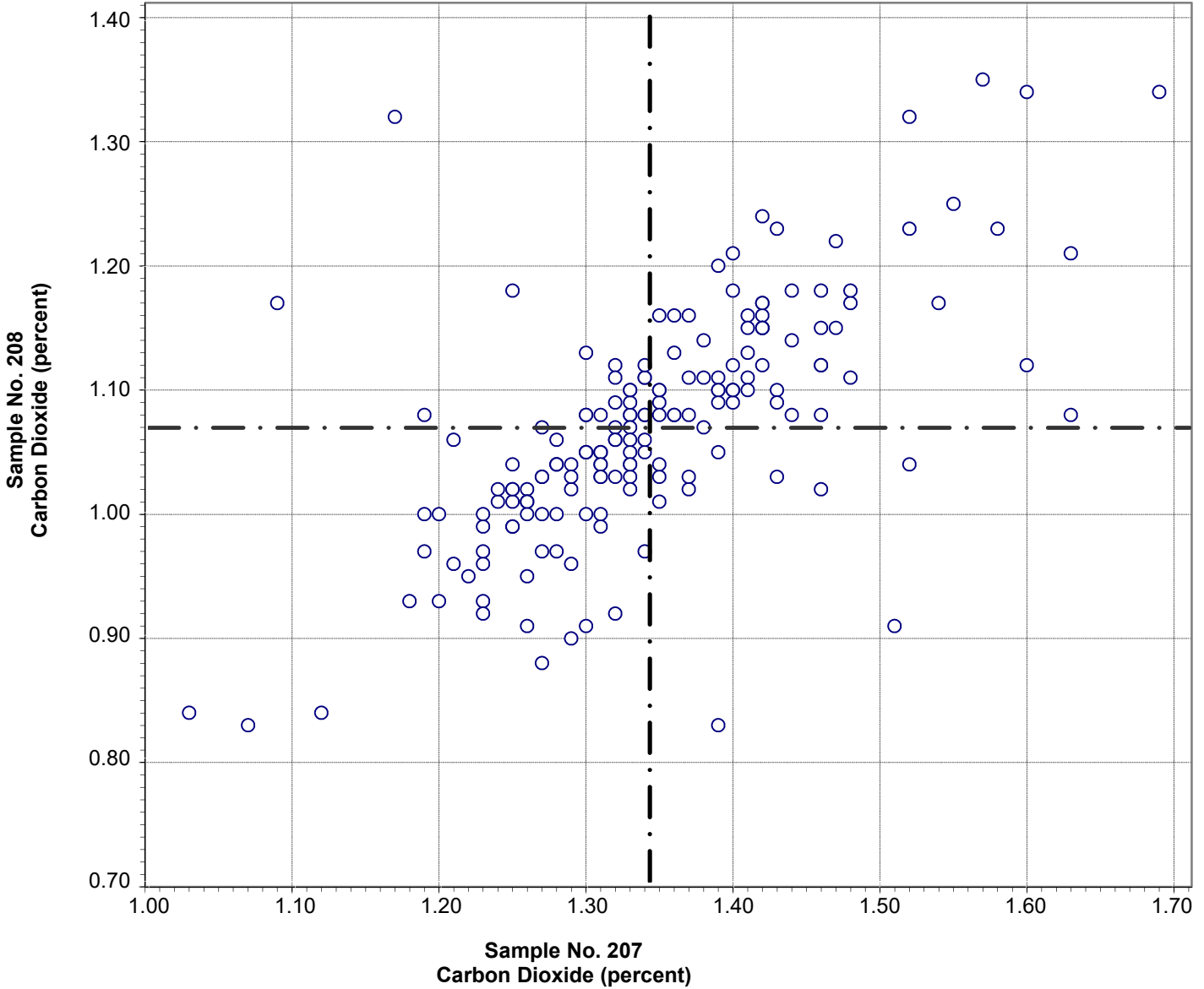


Test No. 41 Free Lime 164 Points

Sample No. 207	Ave 0.50	S.D. 0.15	C.V. 31
Sample No. 208	Ave 0.51	S.D. 0.18	C.V. 35

Labs Eliminated: 121, 132, 137, 246, 416, 768, 2466

**CCRL Proficiency Sample Program
Carbon Dioxide
PORTLAND CEMENT Samples No. 207 and No. 208**



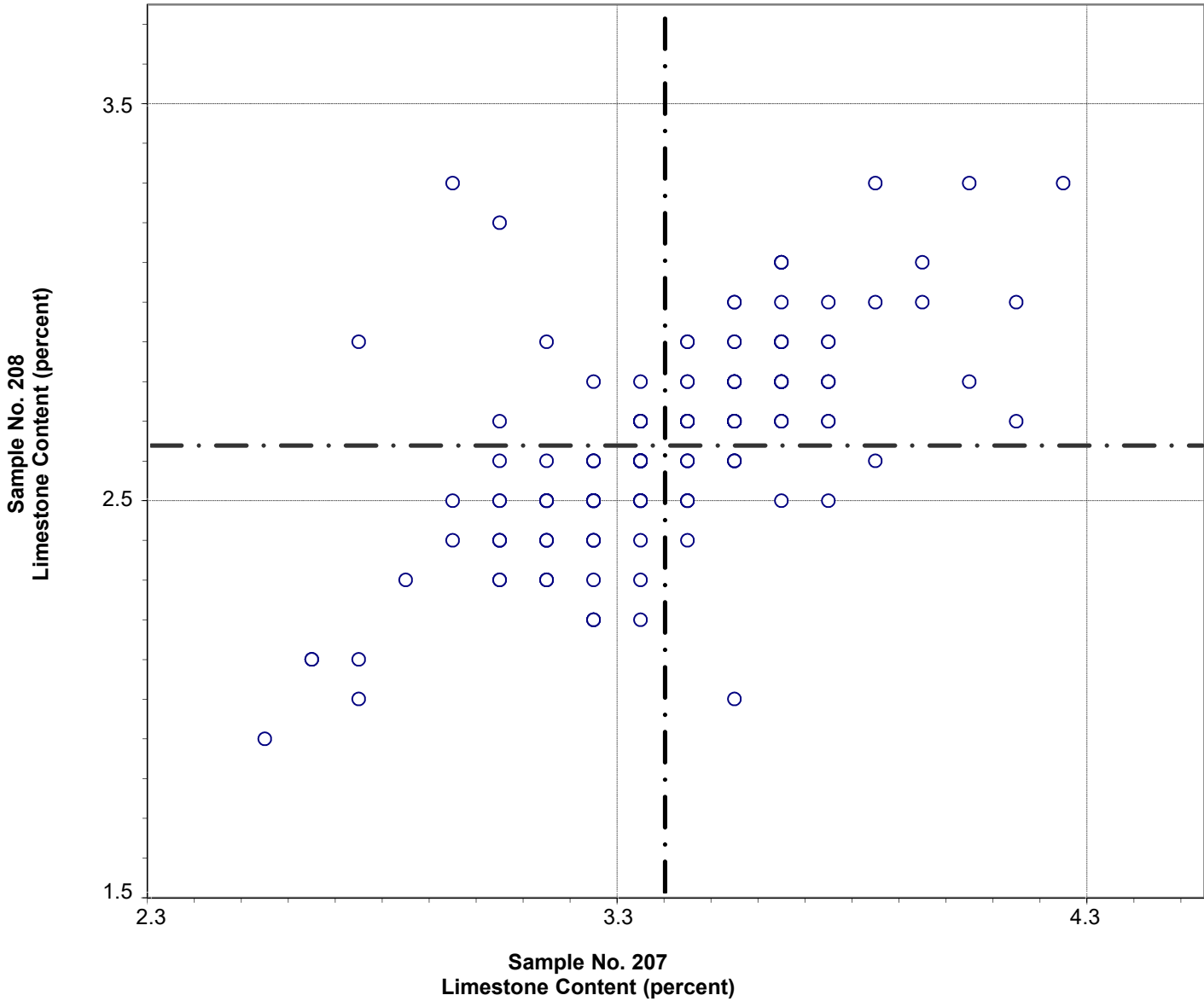
Test No. 97 Carbon Dioxide 177 Points

Sample No. 207	Ave 1.34	S.D. 0.11	C.V. 7.9
Sample No. 208	Ave 1.07	S.D. 0.10	C.V. 9.0

Labs Eliminated: 42, 78, 84, 137, 206, 247, 289, 413, 698, 1644, 1657, 2522, 2934, 3249, 4051, 4092, 4131, 4155, 4251

Labs off Diagram: 1054

**CCRL Proficiency Sample Program
Limestone Content
PORTLAND CEMENT Samples No. 207 and No. 208**

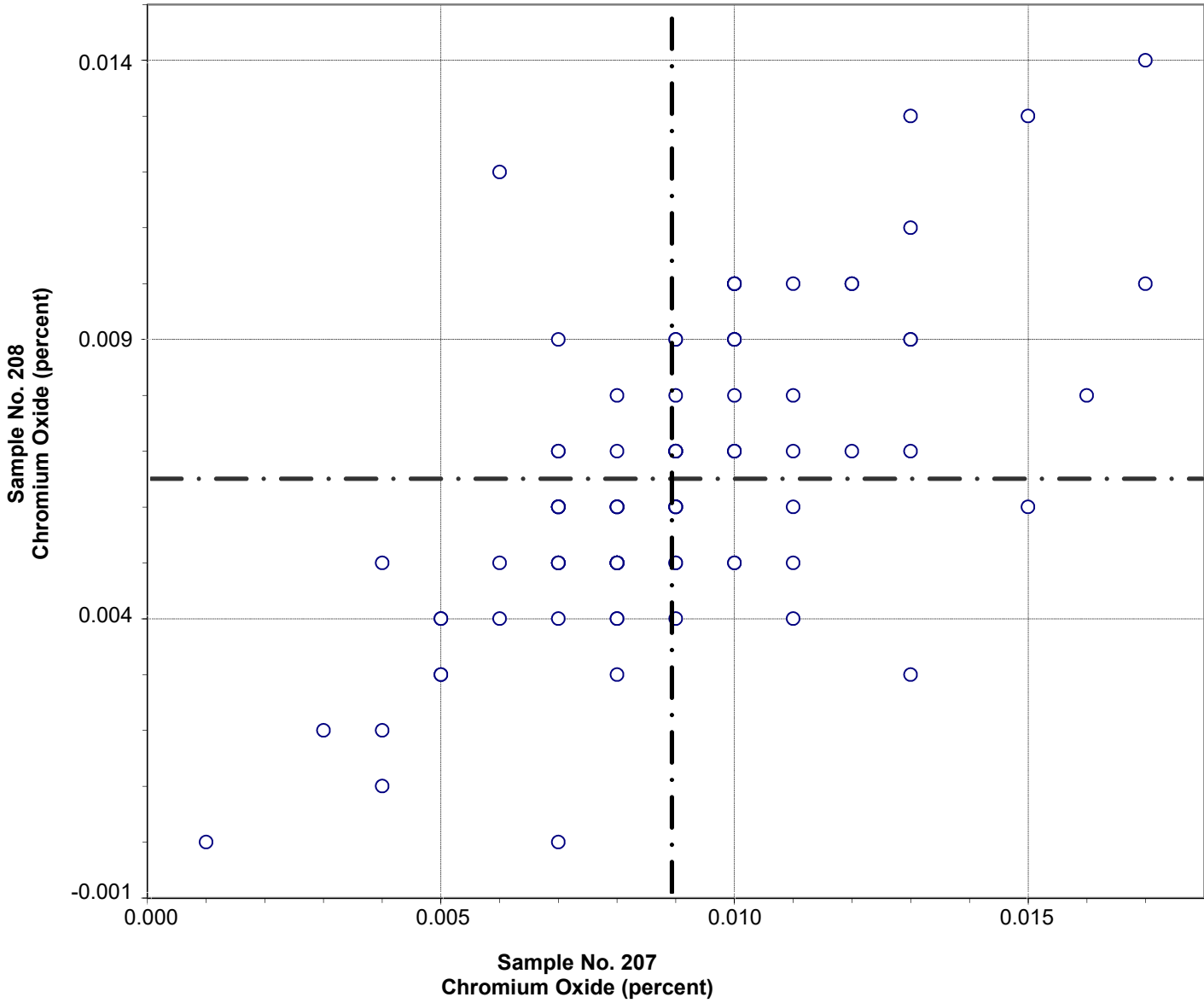


Test No. 98 Limestone Content 175 Points

Sample No. 207	Ave 3.3	S.D. 0.3	C.V. 8.3
Sample No. 208	Ave 2.6	S.D. 0.2	C.V. 9.4

Labs Eliminated: 42, 137, 206, 247, 289, 413, 698, 1644, 1657, 2522, 3249, 3368, 3752, 4051, 4131, 4251

**CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 207 and No. 208**

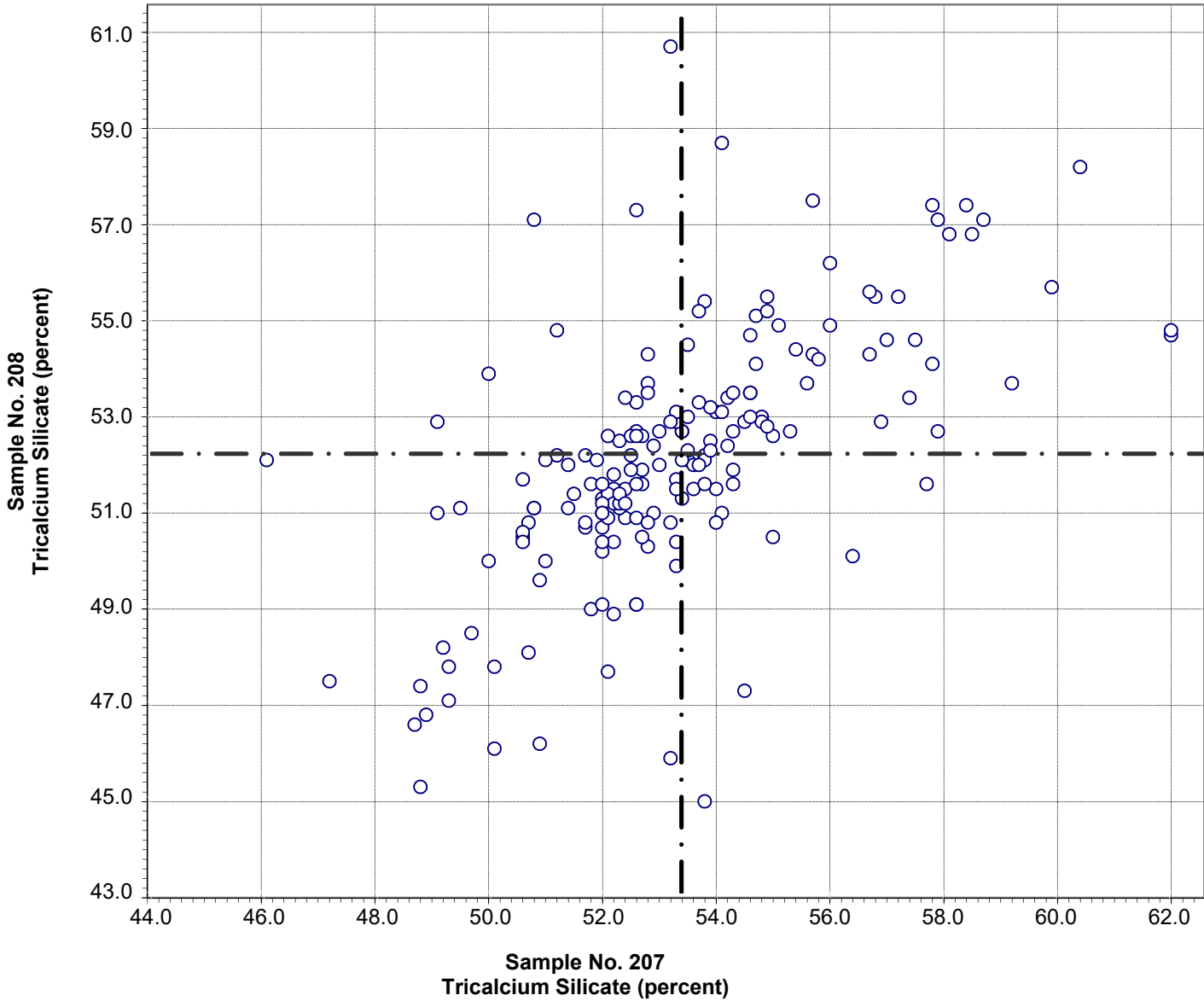


Test No. 105 Chromium Oxide 96 Points

Sample No. 207	Ave 0.009	S.D. 0.003	C.V. 32
Sample No. 208	Ave 0.006	S.D. 0.003	C.V. 41

Labs Eliminated: 93, 415, 457, 2477

**CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 207 and No. 208**



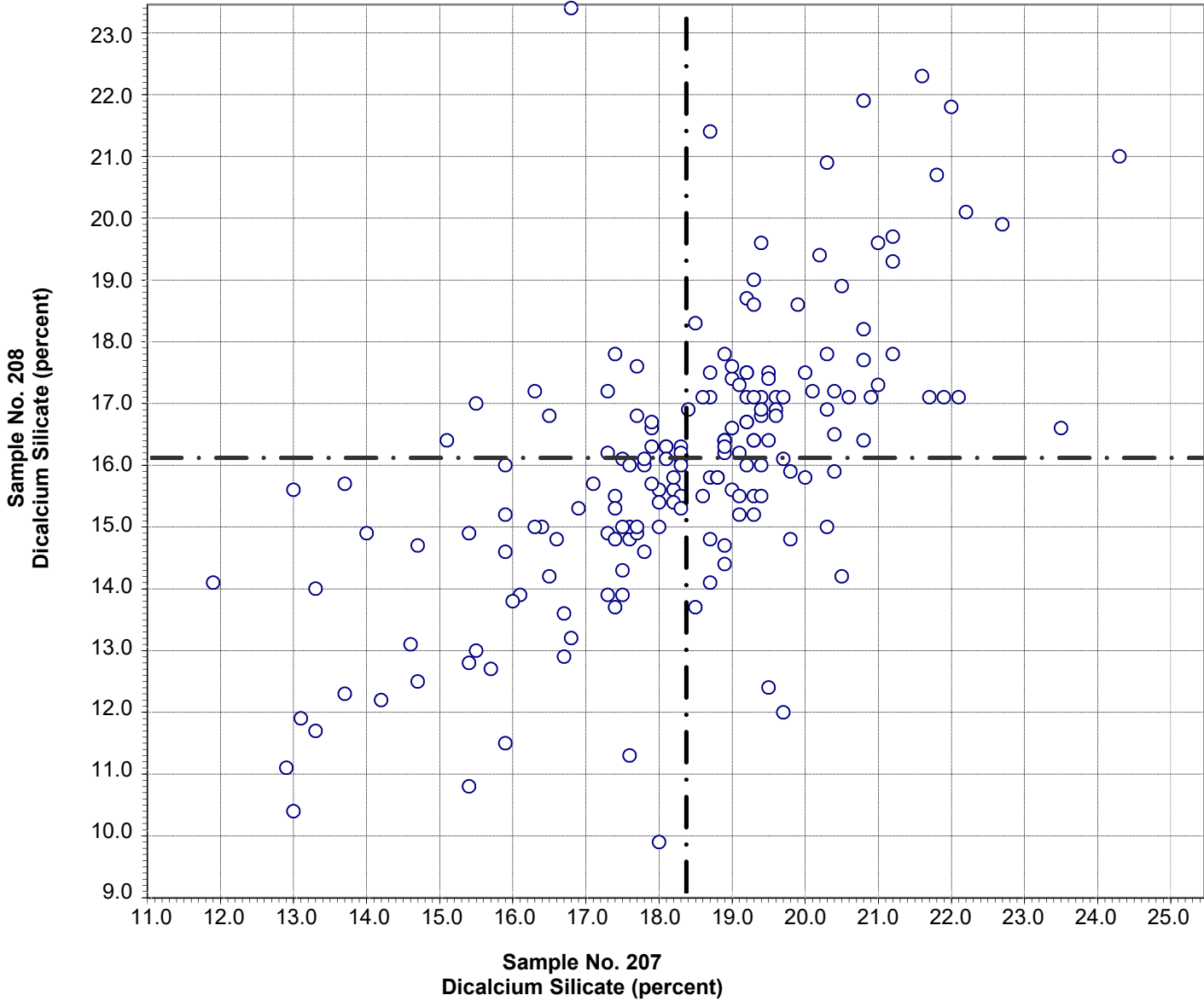
Test No. 106 Tricalcium Silicate 182 Points

Sample No. 207	Ave 53.4	S.D. 2.7	C.V. 5.1
Sample No. 208	Ave 52.2	S.D. 2.9	C.V. 5.6

Labs Eliminated: 8, 42, 50, 206, 416, 4099, 4312

Labs off Diagram: 1054, 2437, 3238

**CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 207 and No. 208**



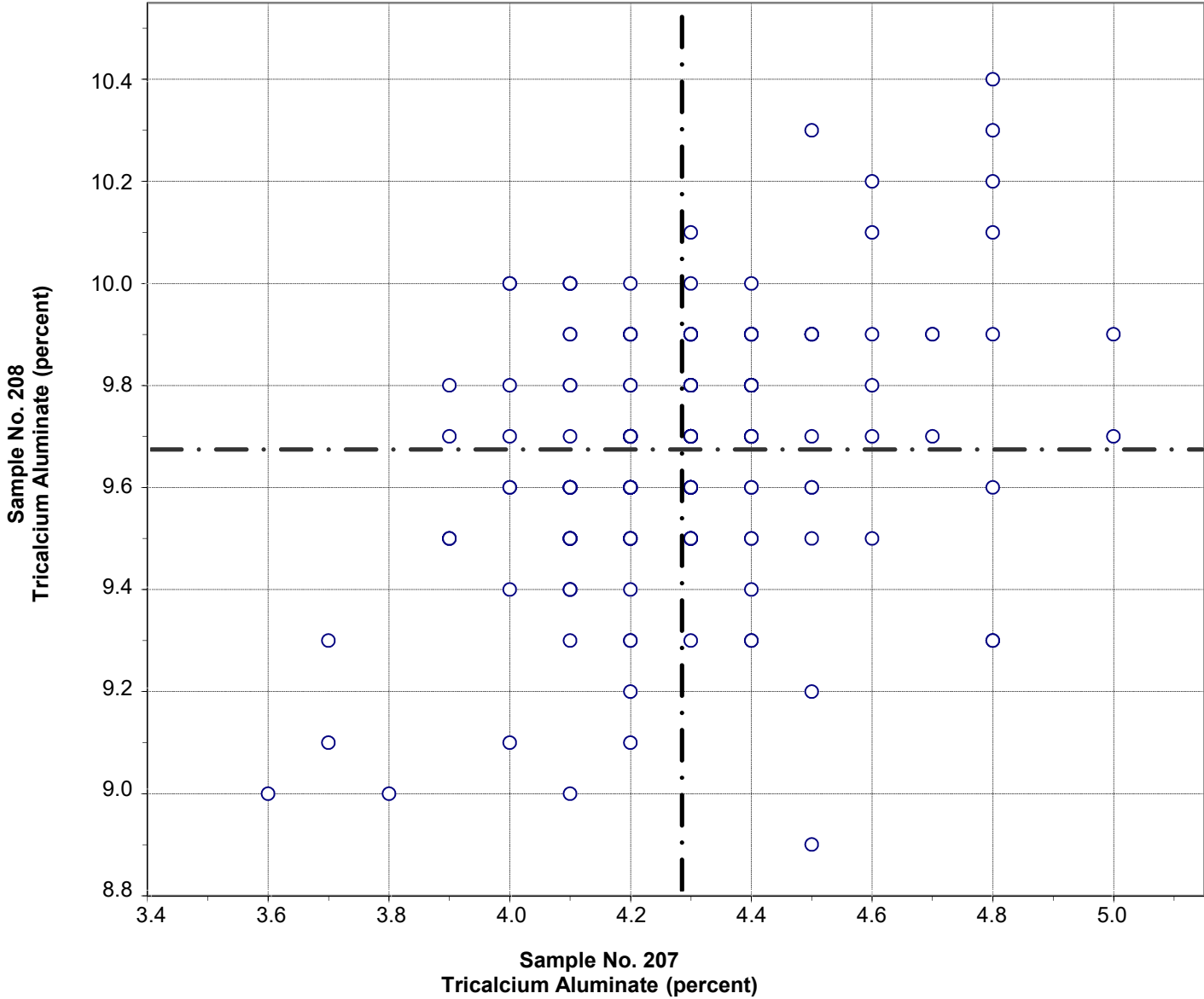
Test No. 107 Dicalcium Silicate 180 Points

Sample No. 207	Ave 18.4	S.D. 2.2	C.V. 11.8
Sample No. 208	Ave 16.1	S.D. 2.3	C.V. 14.2

Labs Eliminated: 8, 42, 50, 206, 416, 694, 1054, 1644, 2437, 4099, 4312

Labs off Diagram: 4297

**CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 207 and No. 208**

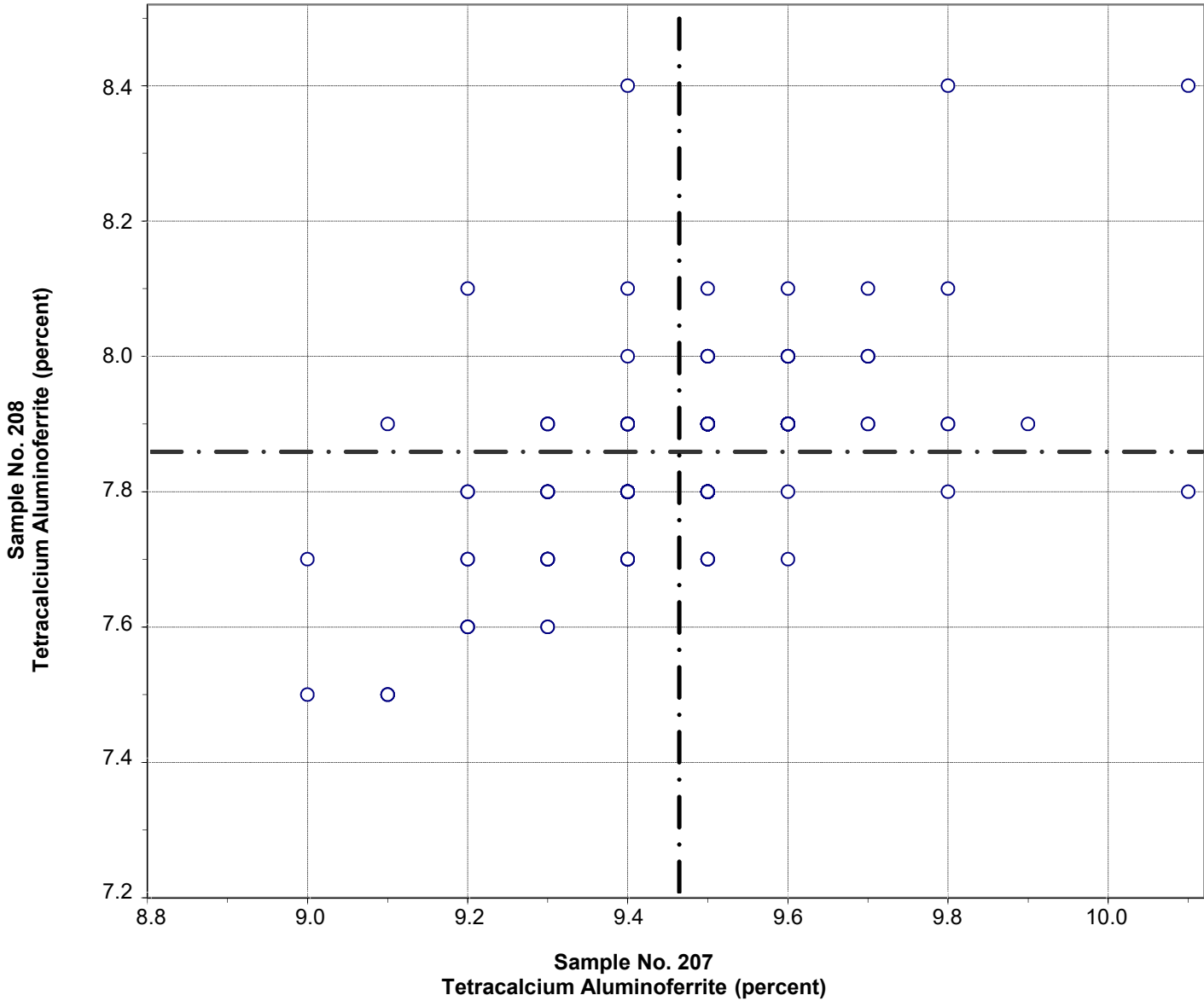


Test No. 108 Tricalcium Aluminate 182 Points

Sample No. 207	Ave 4.3	S.D. 0.2	C.V. 5.3
Sample No. 208	Ave 9.7	S.D. 0.2	C.V. 2.6

Labs Eliminated: 15, 42, 206, 416, 975, 3238, 4099, 4155, 4297, 4312

**CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 207 and No. 208**



Test No. 109 Tetracalcium Aluminoferrite 185 Points

Sample No. 207	Ave 9.5	S.D. 0.2	C.V. 1.7
Sample No. 208	Ave 7.9	S.D. 0.2	C.V. 2.0

Labs Eliminated: 42, 43, 416, 694, 4099

Labs off Diagram: 407, 4312

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Normal Consistency - % Water (percent)							
	246	25.8	1.73	6.70	28.2	2.58	9.10
	*241	25.9	0.50	1.90	28.5	0.58	2.00
* Labs Eliminated - 457, 2462, 2490, 3605, 3834							
Vicat Time of Set - Initial (minutes)							
	242	166	14	8	125	16	13
	*237	167	12	7	125	14	11
* Labs Eliminated - 51, 246, 2466, 3606, 3834							
Vicat Time of Set - Final (minutes)							
	233	269	32	12	238	34	14
	*227	269	28	10	237	30	13
* Labs Eliminated - 17, 50, 98, 309, 2466, 3658							
Gillmore Time of Set - Initial (minutes)							
	131	190	20	10	166	24	14
	*130	189	19	10	166	23	14
* Labs Eliminated - 246							
Gillmore Time of Set - Final (minutes)							
	131	294	33	11	279	42	15
	*130	294	33	11	277	38	14
* Labs Eliminated - 32							
False Set - Paste Method (percent)							
	188	80	8.8	11.0	63	12.3	19.6
	*185	81	7.8	9.7	63	11.8	18.8
* Labs Eliminated - 23, 493, 3834							
Autoclave Expansion (percent)							
	231	0.03	0.035	134	0.08	0.042	52
	*217	0.03	0.015	55	0.09	0.032	37
* Labs Eliminated - 17, 93, 103, 159, 205, 221, 431, 551, 698, 2466, 2683, 3297, 3658, 3834							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content % (percent)							
	233	9.1	1.3	14	8.7	1.2	14
	*228	9.1	1.1	13	8.7	1.1	13
* Labs Eliminated - 416, 515, 1644, 3297, 3834							
Air Content - % Water (percent)							
	224	68.6	4.4	6.4	70.2	4.5	6.5
	*220	69.0	2.1	3.1	70.5	2.3	3.2
* Labs Eliminated - 94, 1644, 3834, 4137							
Air Content - Flow (percent)							
	227	88	4.1	4.7	87	4.2	4.8
	*225	87	3.6	4.1	87	3.8	4.4
* Labs Eliminated - 883, 3834							
Compressive Strength - 3 day (psi)							
	253	3576	423	11.8	4355	421	9.7
	*246	3545	251	7.1	4342	295	6.8
* Labs Eliminated - 33, 48, 52, 687, 3834, 4097, 4137							
Compressive Strength - 7 day (psi)							
	251	4329	442	10.2	5030	455	9.1
	*250	4310	323	7.5	5012	357	7.1
* Labs Eliminated - 33							
Compressive Strength - 28 day (psi)							
	240	5340	473	8.9	5954	507	8.5
	*239	5320	357	6.7	5932	384	6.5
* Labs Eliminated - 33							
Compressive Strength - Flow (percent)							
	225	117	11	9.4	103	11	10.6
	*224	117	11	9.2	103	11	10.5
* Labs Eliminated - 3							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

Final Report – March 22, 2018

SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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Fineness - Air Permeability (m²/kg)

244	357	15	4.1	435	20	4.5
*229	355	10	2.7	436	12	2.8

* Labs Eliminated - 4, 41, 180, 247, 360, 440, 491, 515, 736, 840, 1054, 1644, 3297, 3834, 4097

Fineness - 45µm Sieve (percent)

231	96.50	0.88	0.91	96.99	1.33	1.37
*224	96.57	0.66	0.68	97.15	0.84	0.87

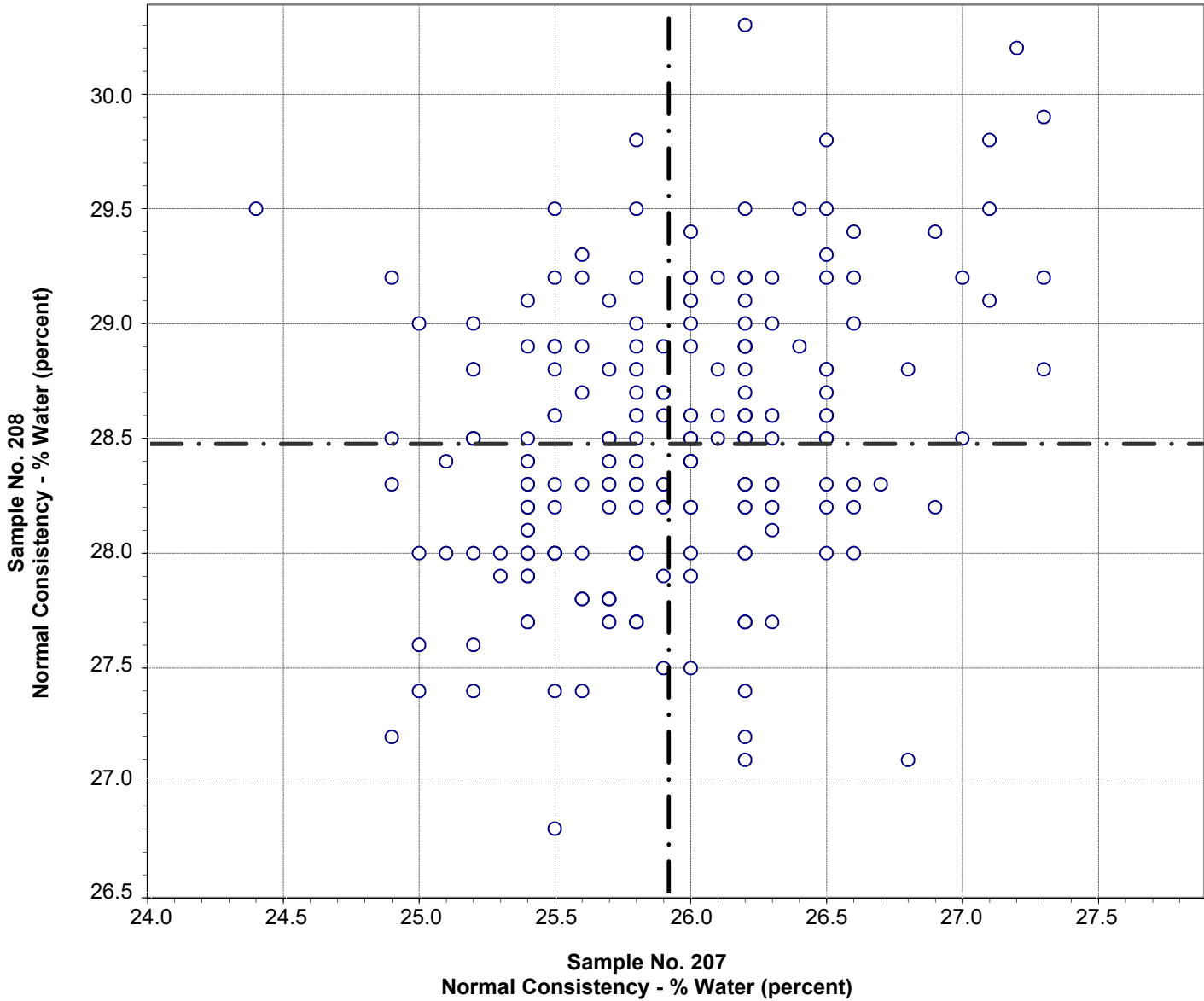
* Labs Eliminated - 52, 95, 116, 206, 515, 932, 3003

C1038 Mortar Bar Expansion (percent)

166	0.008	0.008	96	0.007	0.009	139
*157	0.008	0.004	51	0.006	0.003	53

* Labs Eliminated - 205, 416, 457, 493, 1251, 3368, 3607, 4296, 4314

**CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 207 and No. 208**

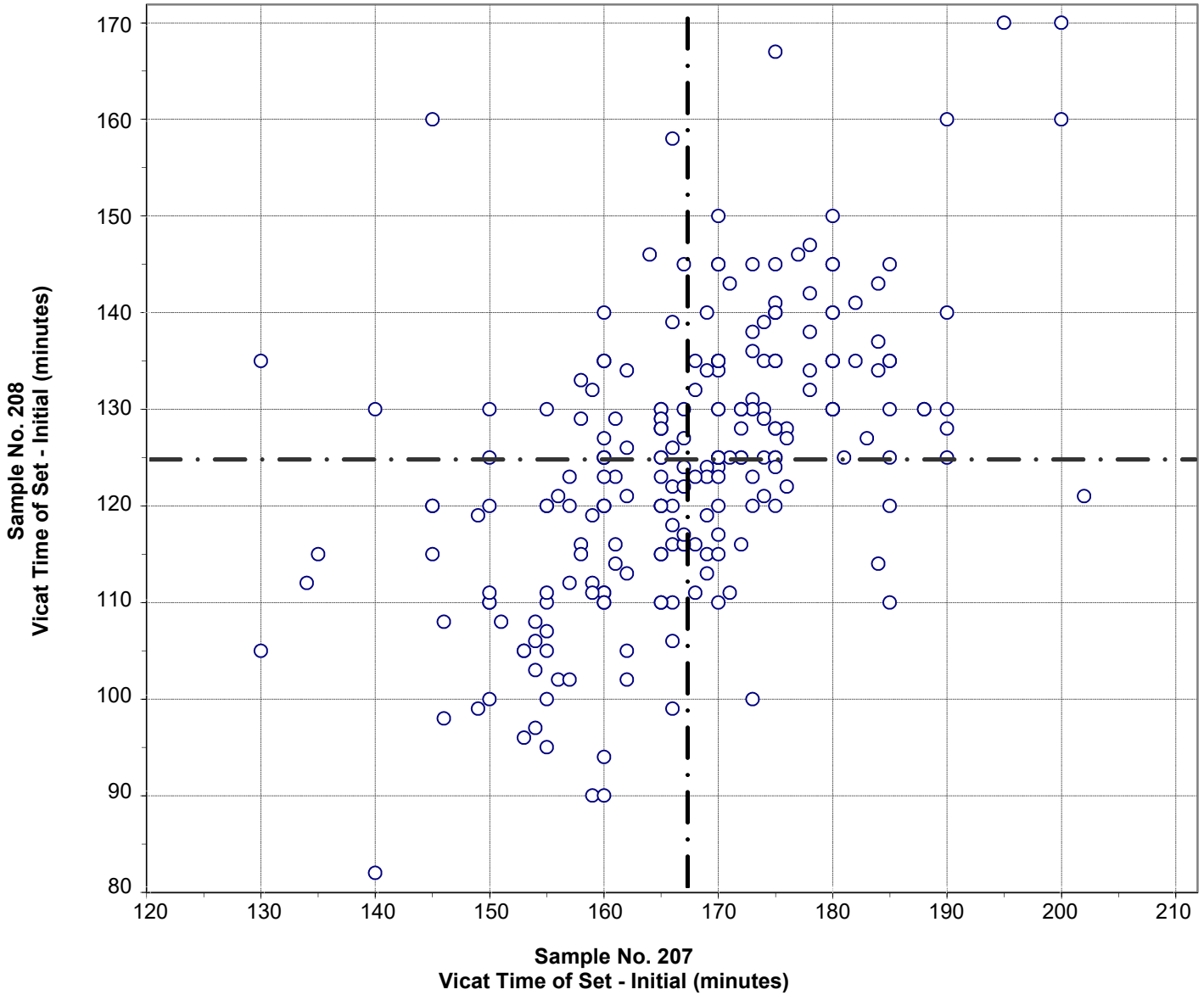


Test No. 110 Normal Consistency - % Water 241 Points

Sample No. 207	Ave 25.9	S.D. 0.50	C.V. 1.90
Sample No. 208	Ave 28.5	S.D. 0.58	C.V. 2.00

Labs Eliminated: 457, 2462, 2490, 3605, 3834

**CCRL Proficiency Sample Program
 Vicat Time of Set - Initial
 PORTLAND CEMENT Samples No. 207 and No. 208**

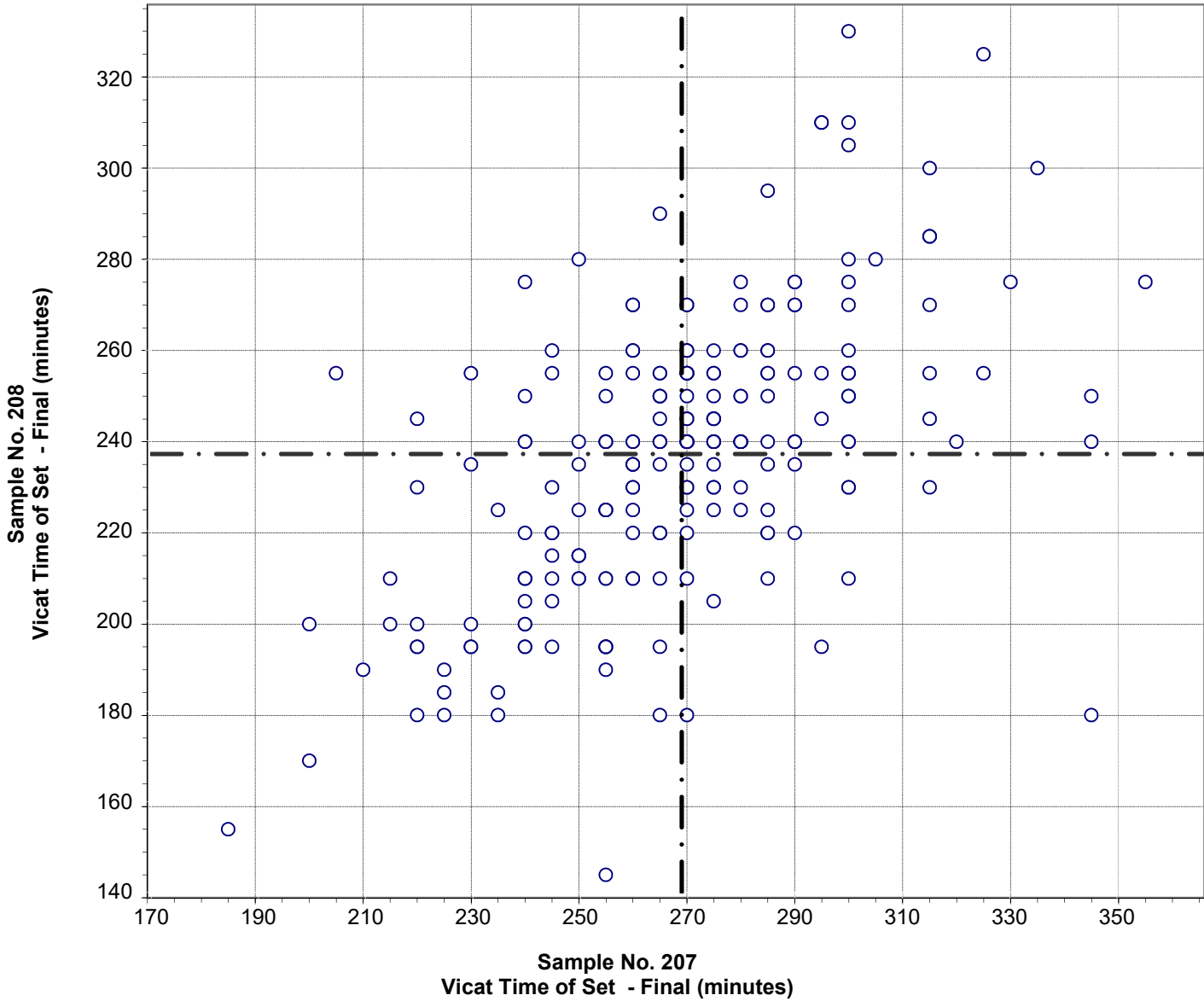


Test No. 120 Vicat Time of Set - Initial 237 Points

Sample No. 207	Ave 167	S.D. 12	C.V. 7
Sample No. 208	Ave 125	S.D. 14	C.V. 11

Labs Eliminated: 51, 246, 2466, 3606, 3834

CCRL Proficiency Sample Program
Vicat Time of Set - Final
PORTLAND CEMENT Samples No. 207 and No. 208

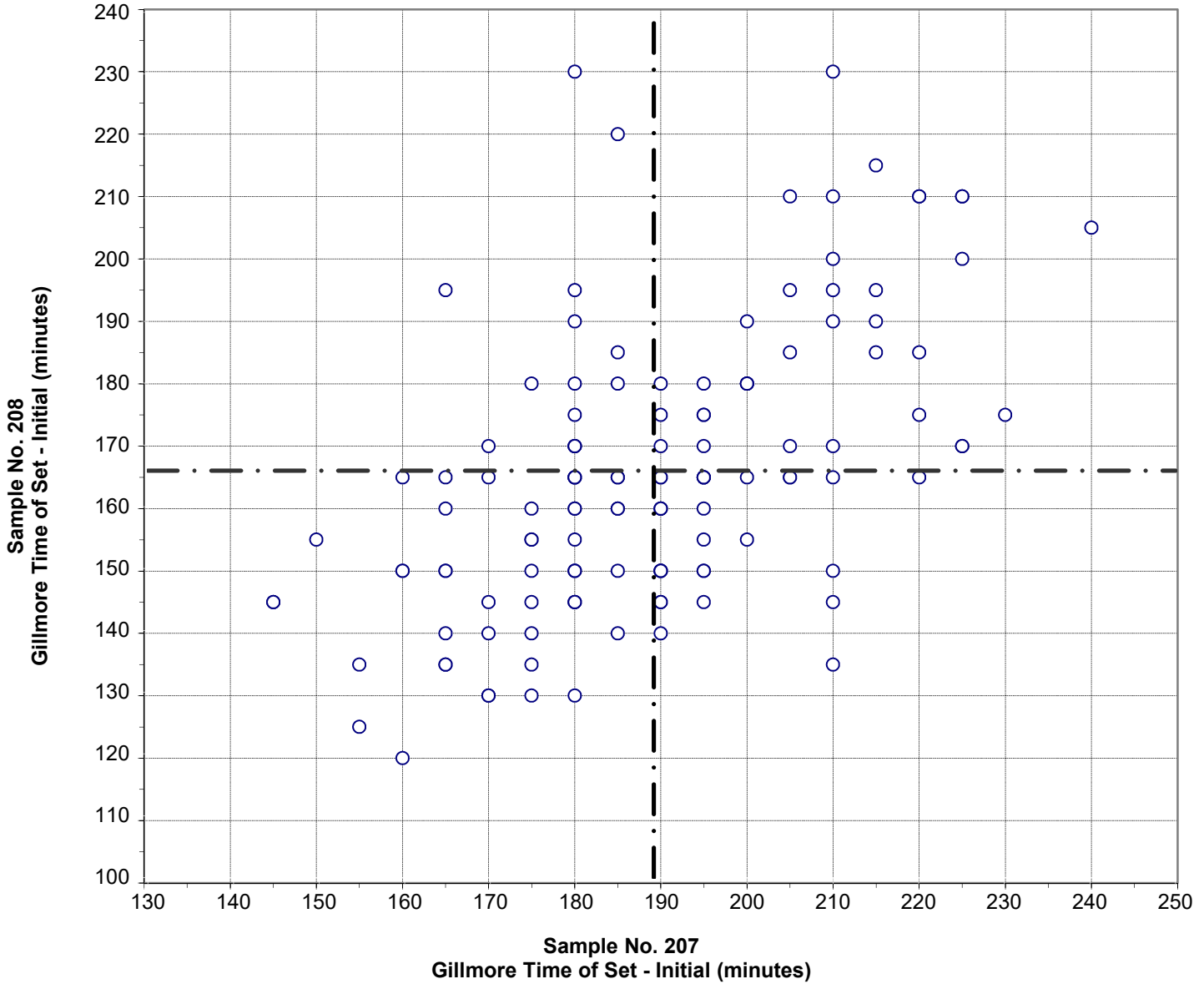


Test No. 121 Vicat Time of Set - Final 227 Points

Sample No. 207	Ave 269	S.D. 28	C.V. 10
Sample No. 208	Ave 237	S.D. 30	C.V. 13

Labs Eliminated: 17, 50, 98, 309, 2466, 3658

**CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 207 and No. 208**

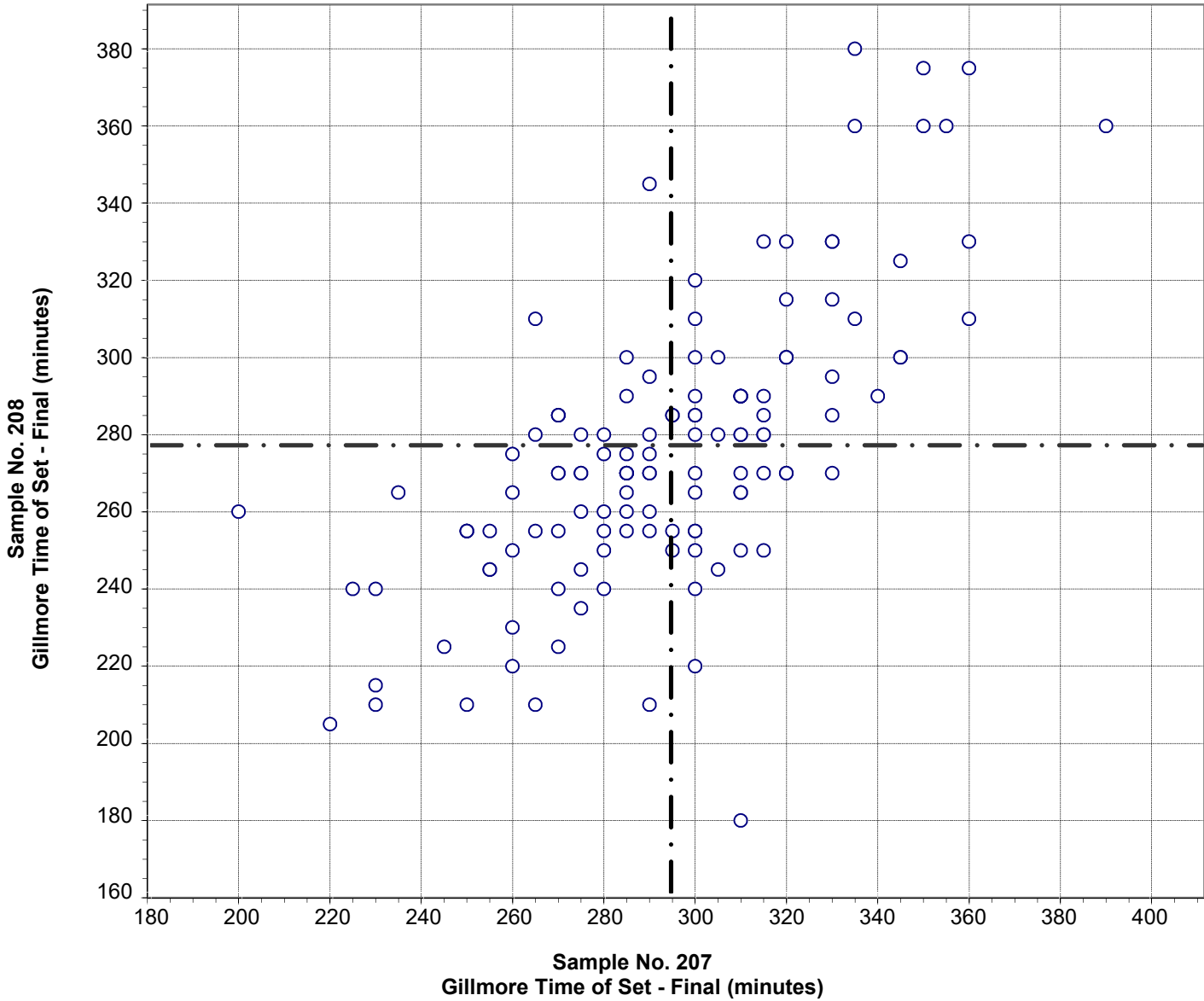


Test No. 130 Gillmore Time of Set - Initial 130 Points

Sample No. 207	Ave 189	S.D. 19	C.V. 10
Sample No. 208	Ave 166	S.D. 23	C.V. 14

Labs Eliminated: 246

**CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 207 and No. 208**



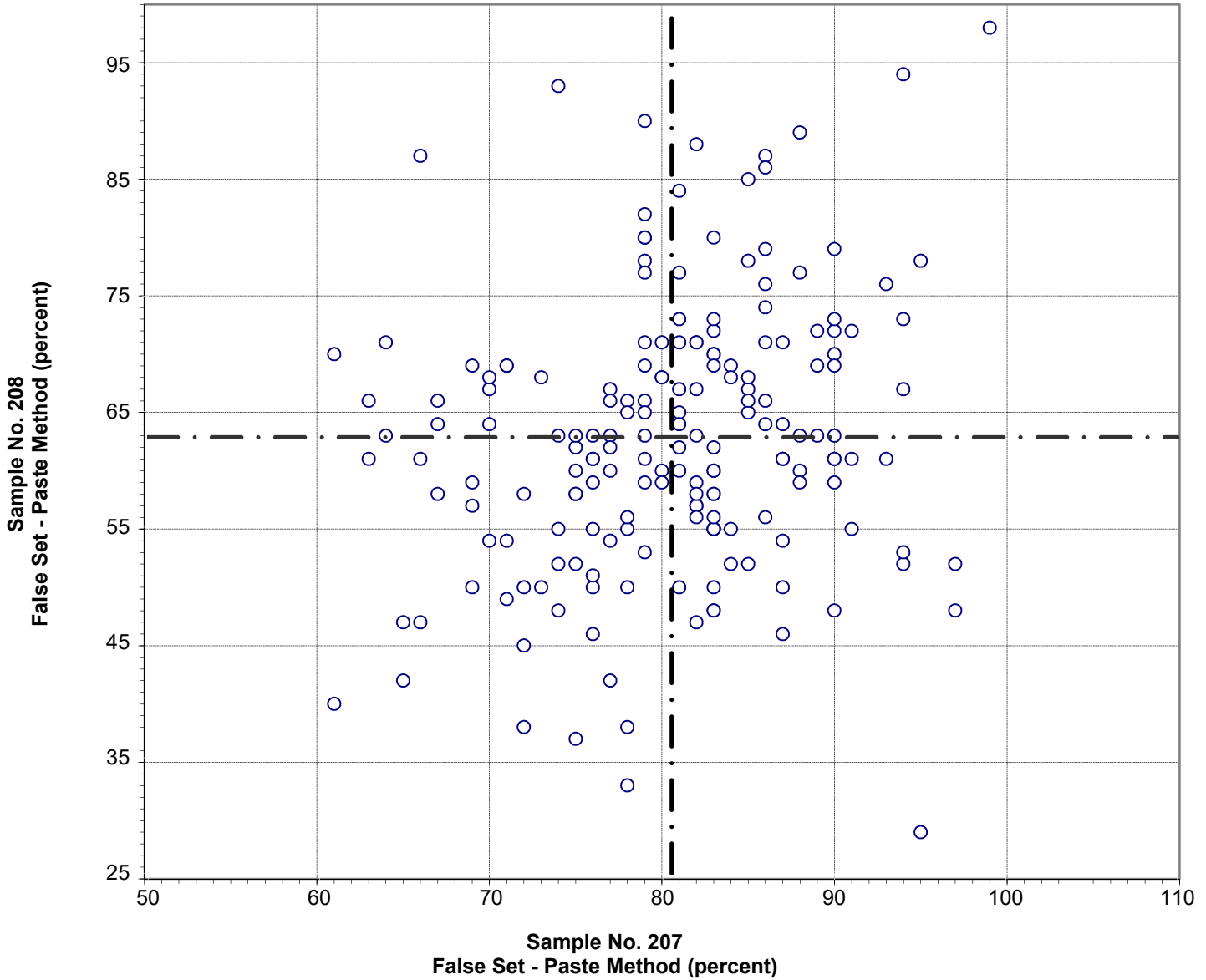
Test No. 140 Gillmore Time of Set - Final 129 Points

Sample No. 207	Ave 294	S.D. 33	C.V. 11
Sample No. 208	Ave 277	S.D. 38	C.V. 14

Labs Eliminated: 32

Labs off Diagram: 309

**CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 207 and No. 208**

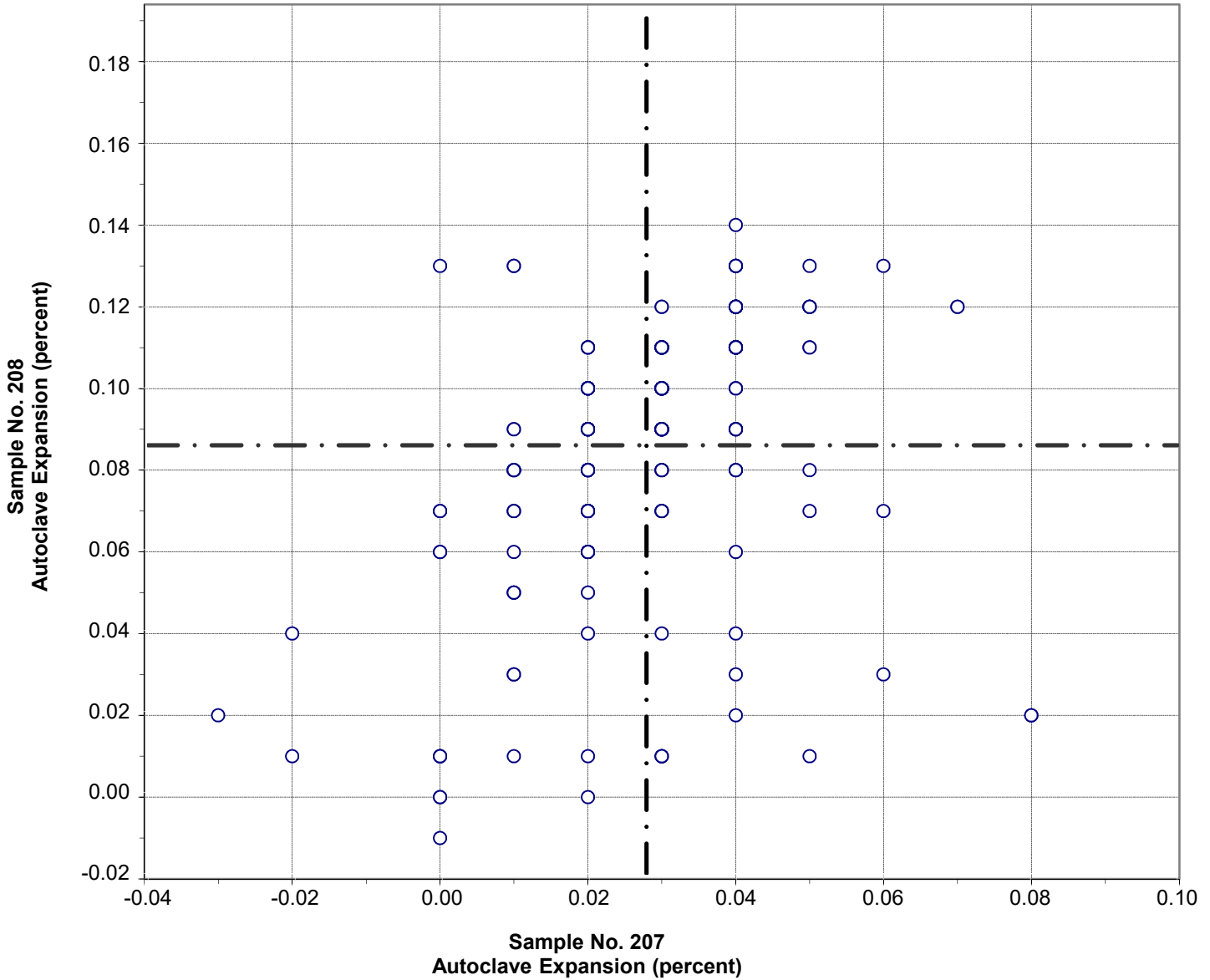


Test No. 150 False Set - Paste Method 185 Points

Sample No. 207	Ave 81	S.D. 7.8	C.V. 9.7
Sample No. 208	Ave 63	S.D. 11.8	C.V. 18.8

Labs Eliminated: 23, 493, 3834

**CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 207 and No. 208**

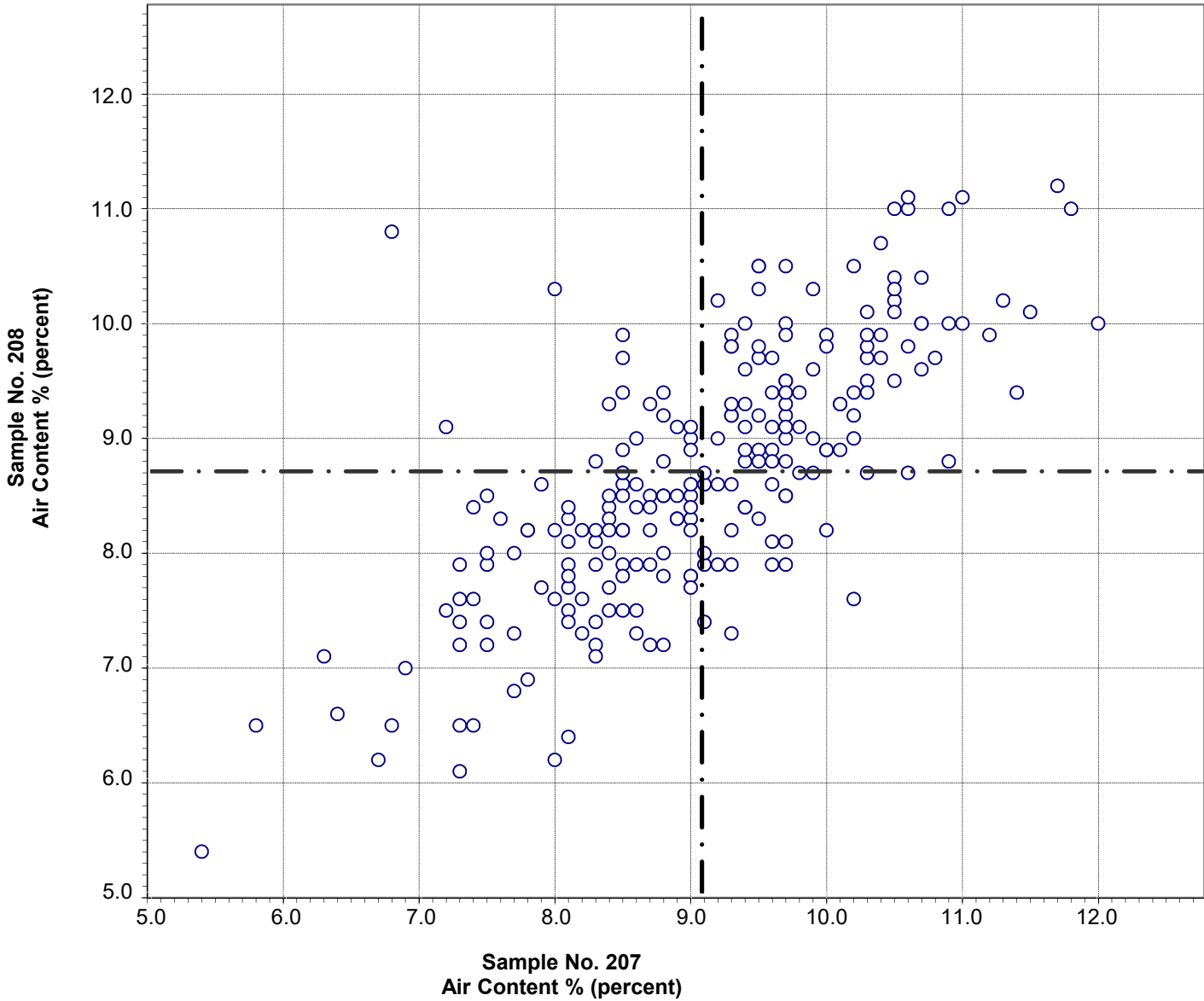


Test No. 160 Autoclave Expansion 217 Points

Sample No. 207	Ave 0.03	S.D. 0.015	C.V. 55
Sample No. 208	Ave 0.09	S.D. 0.032	C.V. 37

Labs Eliminated: 17, 93, 103, 159, 205, 221, 431, 551, 698, 2466, 2683, 3297, 3658, 3834

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 207 and No. 208

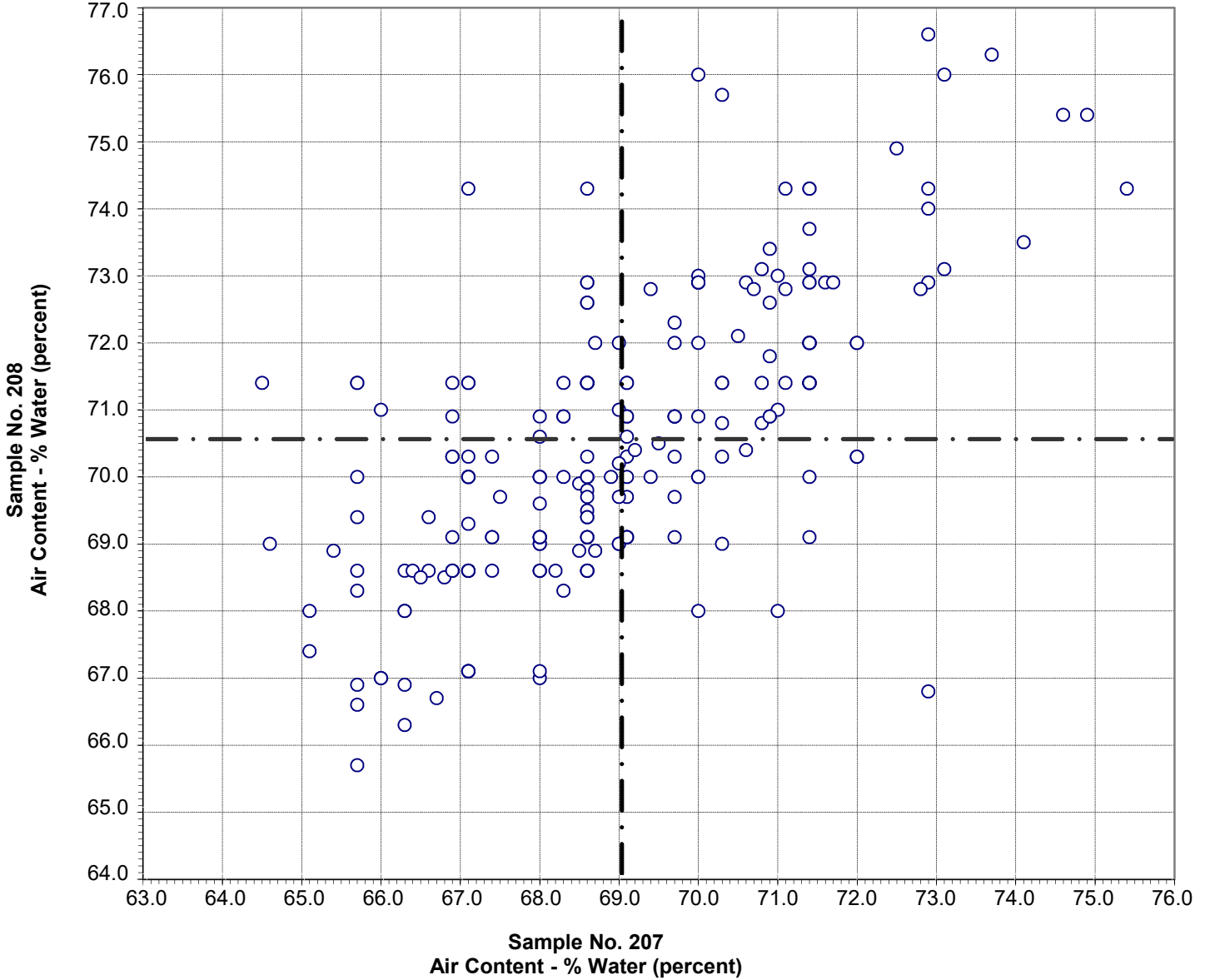


Test No. 170 Air Content % 228 Points

Sample No. 207	Ave 9.1	S.D. 1.1	C.V. 13
Sample No. 208	Ave 8.7	S.D. 1.1	C.V. 13

Labs Eliminated: 416, 515, 1644, 3297, 3834

CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 207 and No. 208



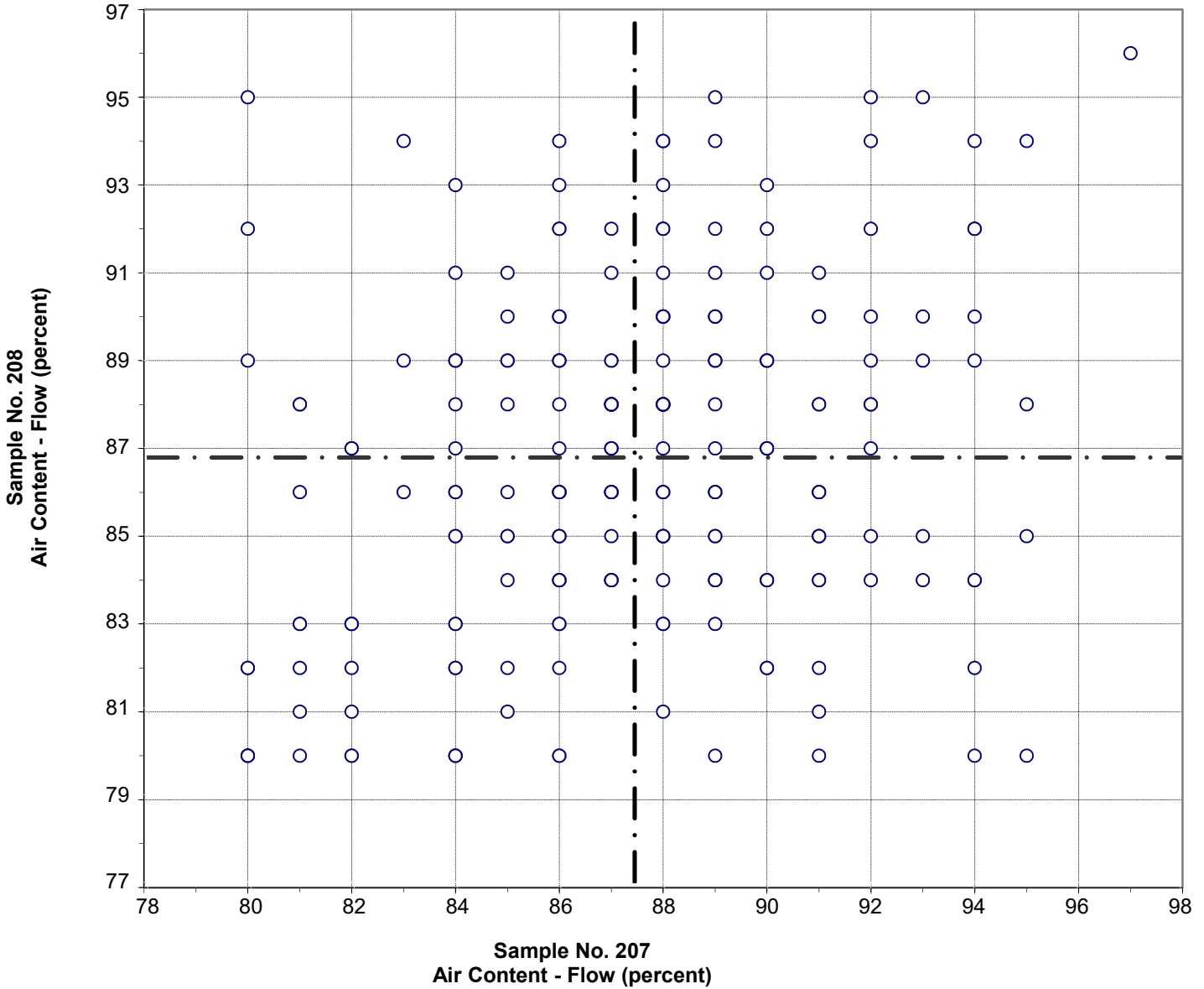
Test No. 180 Air Content - % Water 218 Points

Sample No. 207	Ave 69.0	S.D. 2.1	C.V. 3.1
Sample No. 208	Ave 70.5	S.D. 2.3	C.V. 3.2

Labs Eliminated: 94, 1644, 3834, 4137

Labs off Diagram: 95, 203

CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 207 and No. 208

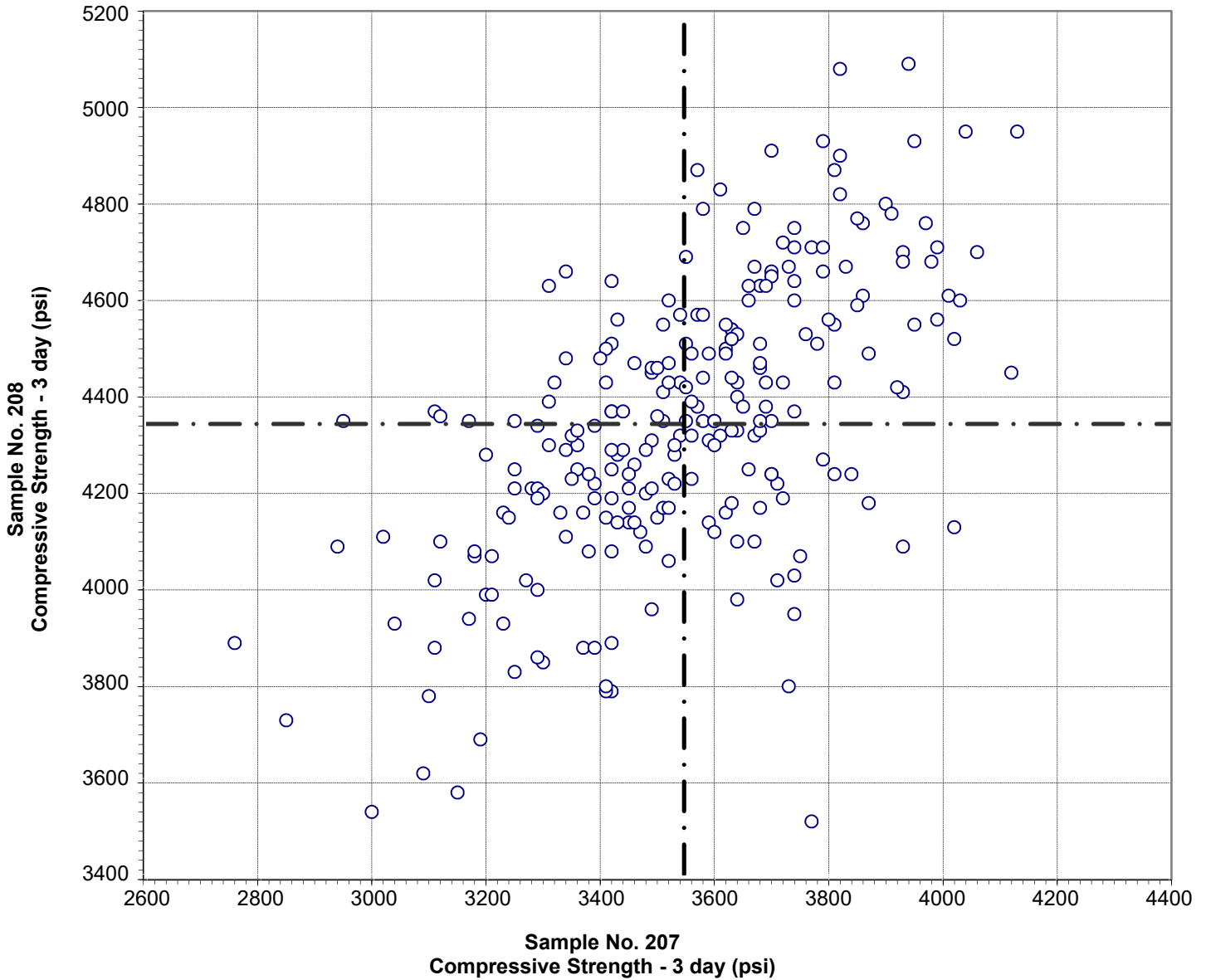


Test No. 190 Air Content - Flow 225 Points

Sample No. 207	Ave 87	S.D. 3.6	C.V. 4.1
Sample No. 208	Ave 87	S.D. 3.8	C.V. 4.4

Labs Eliminated: 883, 3834

**CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 207 and No. 208**



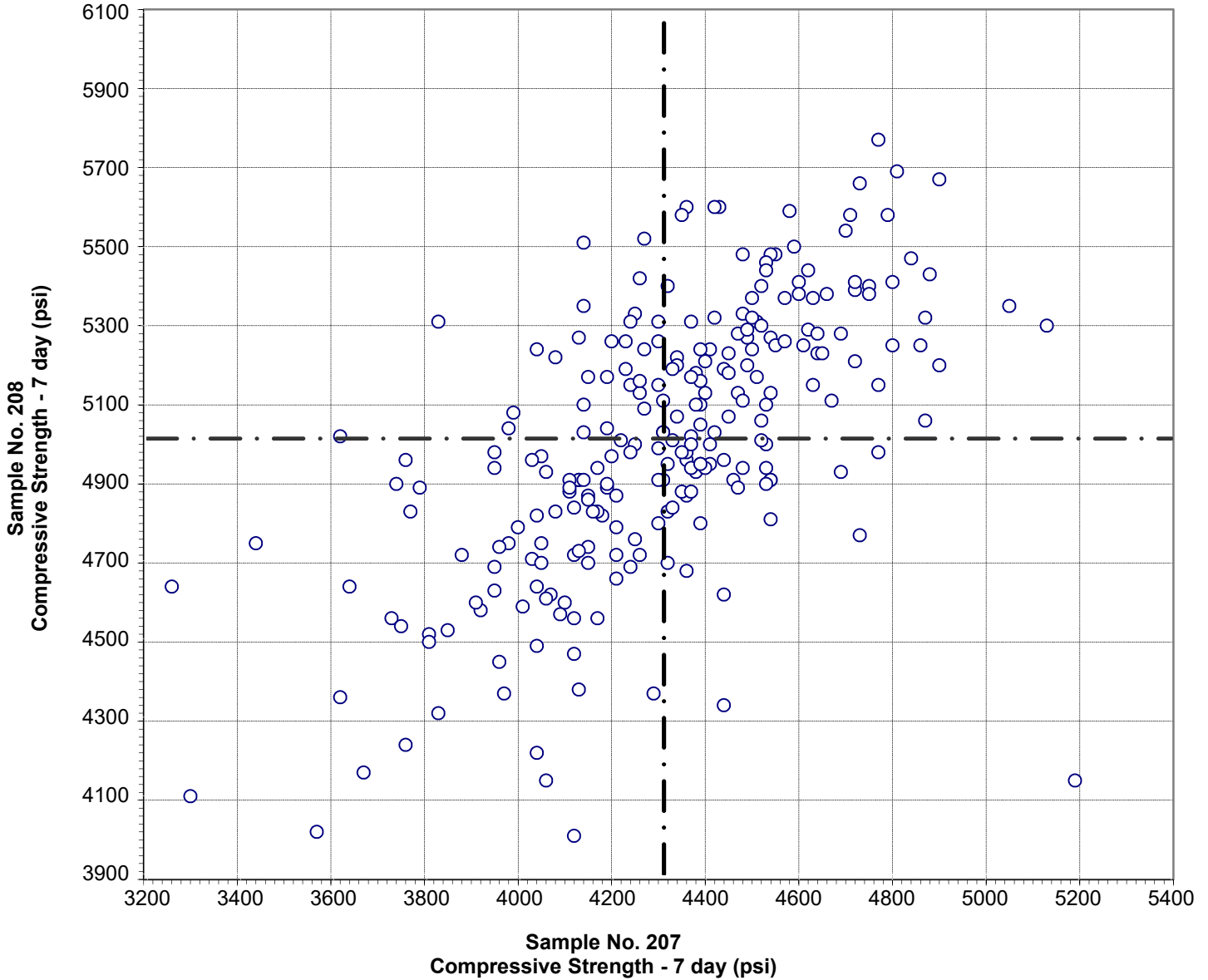
Test No. 200 Compressive Strength - 3 day 245 Points

Sample No. 207	Ave 3545	S.D. 251	C.V. 7.1
Sample No. 208	Ave 4342	S.D. 295	C.V. 6.8

Labs Eliminated: 33, 48, 52, 687, 3834, 4097, 4137

Labs off Diagram: 9

**CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 207 and No. 208**



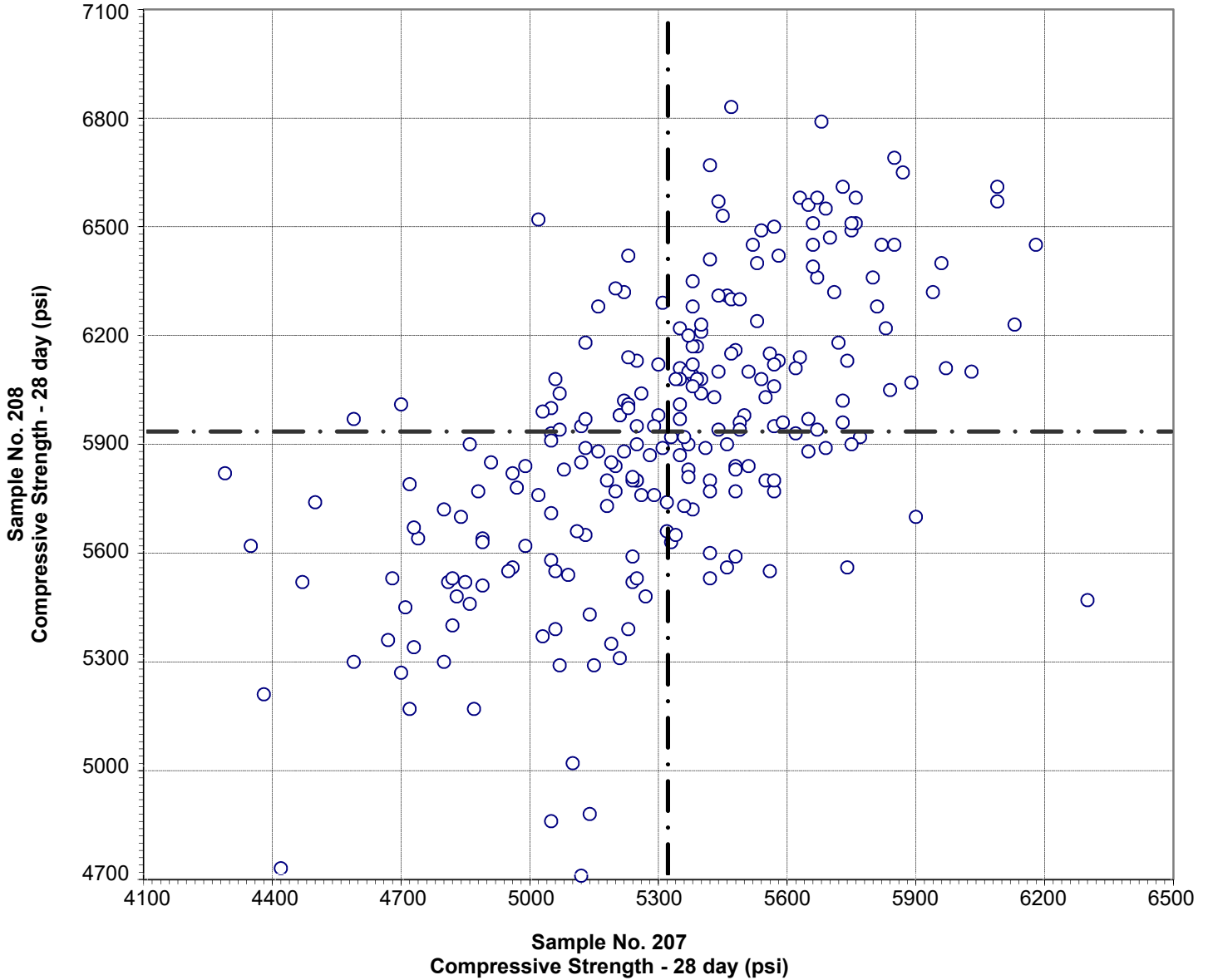
Test No. 210 Compressive Strength - 7 day 248 Points

Sample No. 207	Ave 4310	S.D. 323	C.V. 7.5
Sample No. 208	Ave 5012	S.D. 357	C.V. 7.1

Labs Eliminated: 33

Labs off Diagram: 48, 4137

**CCRL Proficiency Sample Program
Compressive Strength - 28 day
PORTLAND CEMENT Samples No. 207 and No. 208**

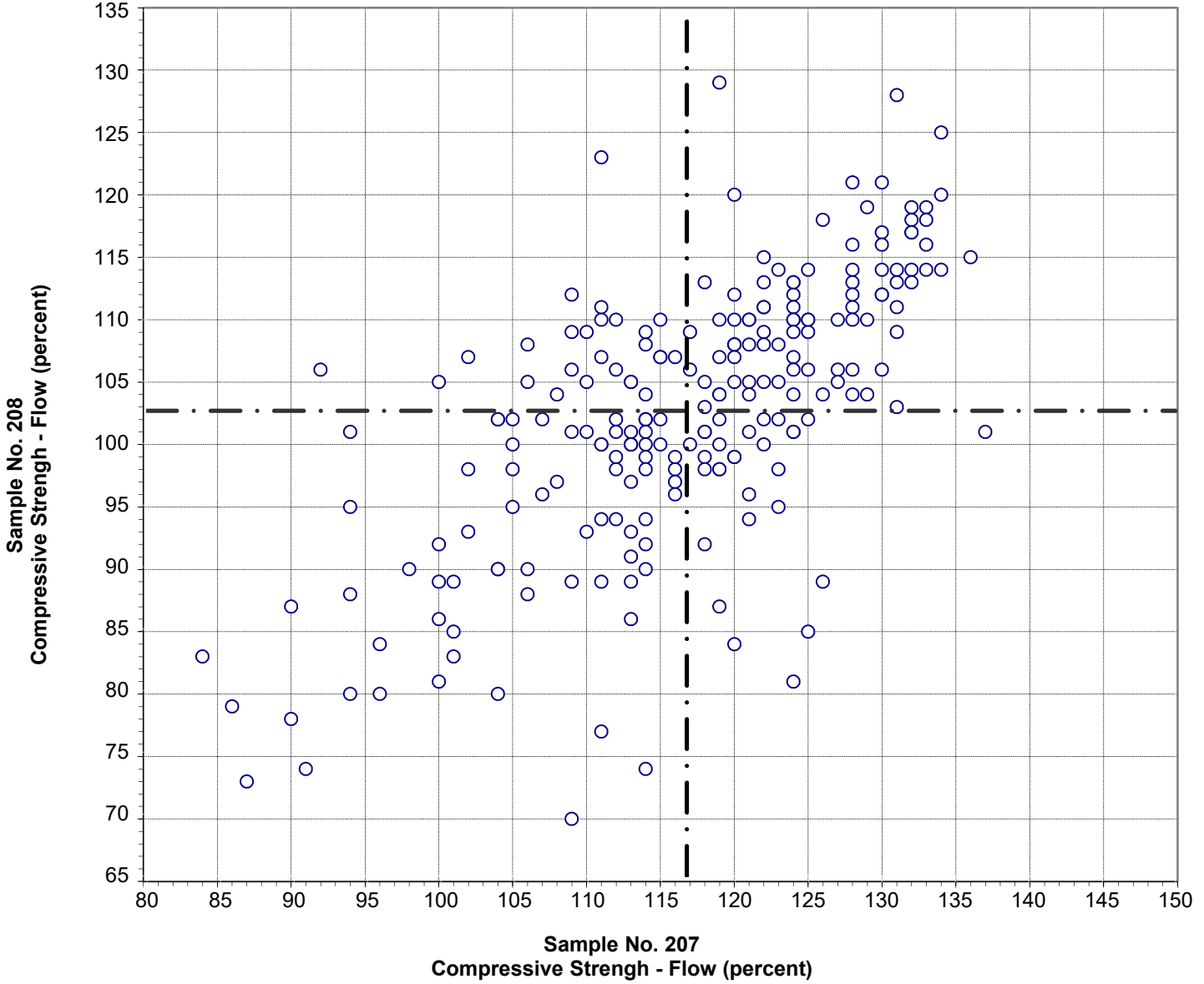


Test No. 211 Compressive Strength - 28 day 239 Points

Sample No. 207	Ave 5320	S.D. 357	C.V. 6.7
Sample No. 208	Ave 5932	S.D. 384	C.V. 6.5

Labs Eliminated: 33

**CCRL Proficiency Sample Program
Compressive Strength - Flow
PORTLAND CEMENT Samples No. 207 and No. 208**

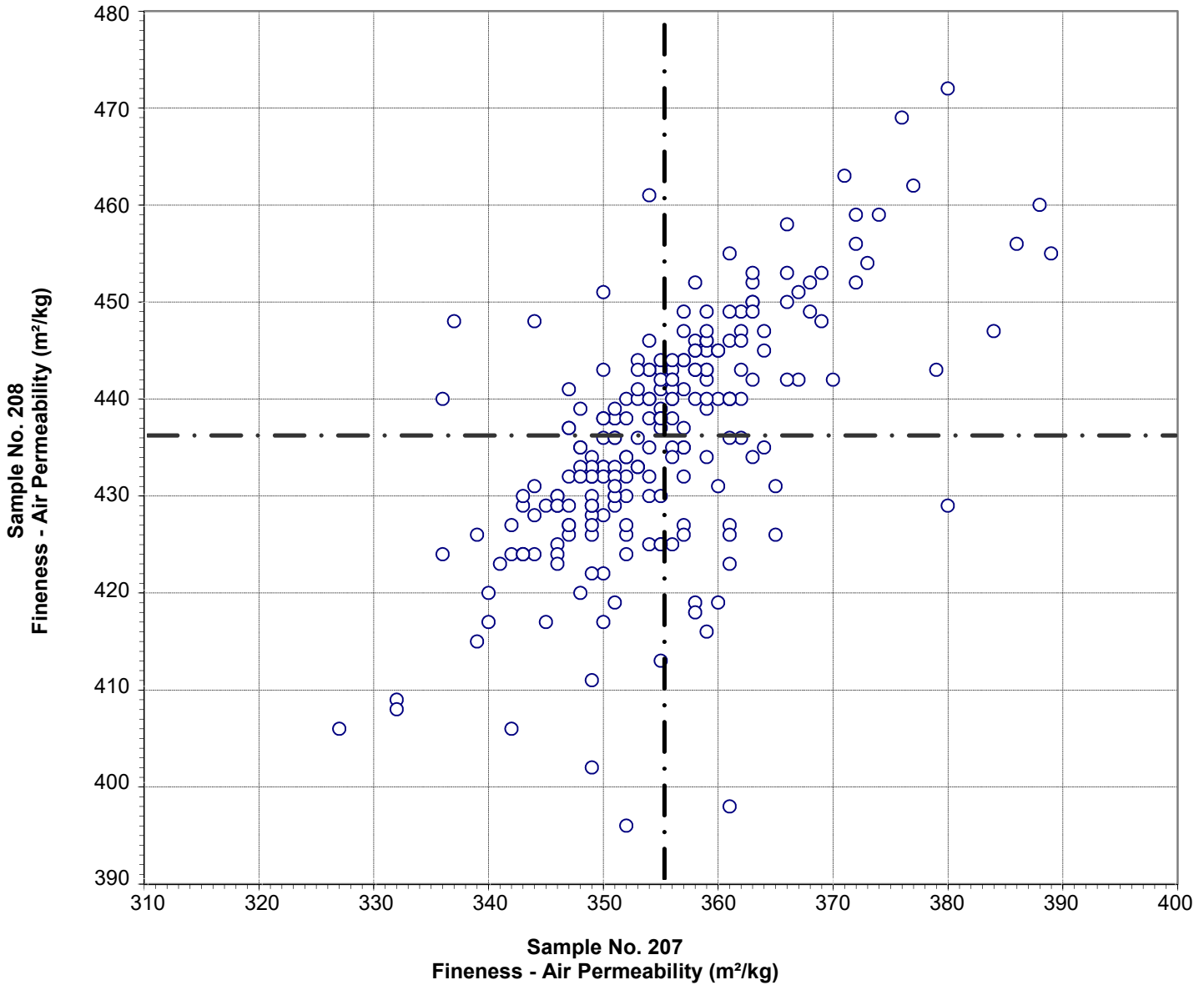


Test No. 230 Compressive Strength - Flow 224 Points

Sample No. 207	Ave 117	S.D. 11	C.V. 9.2
Sample No. 208	Ave 103	S.D. 11	C.V. 10.5

Labs Eliminated: 3

**CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 207 and No. 208**

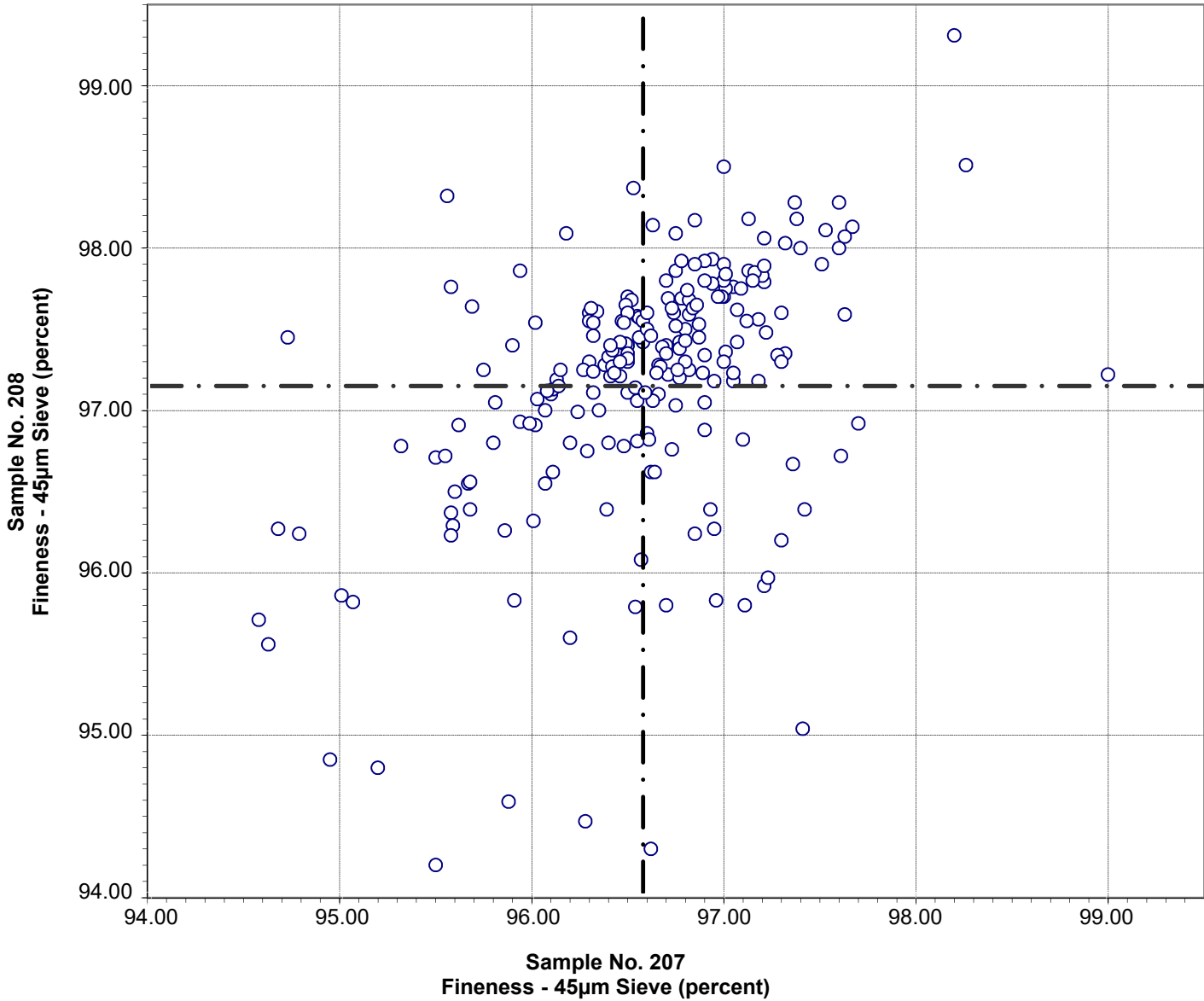


Test No. 270 Fineness - Air Permeability 229 Points

Sample No. 207	Ave 355	S.D. 10	C.V. 2.7
Sample No. 208	Ave 436	S.D. 12	C.V. 2.8

Labs Eliminated: 4, 41, 180, 247, 360, 440, 491, 515, 736, 840, 1054, 1644, 3297, 3834, 4097

**CCRL Proficiency Sample Program
Fineness - 45µm Sieve
PORTLAND CEMENT Samples No. 207 and No. 208**



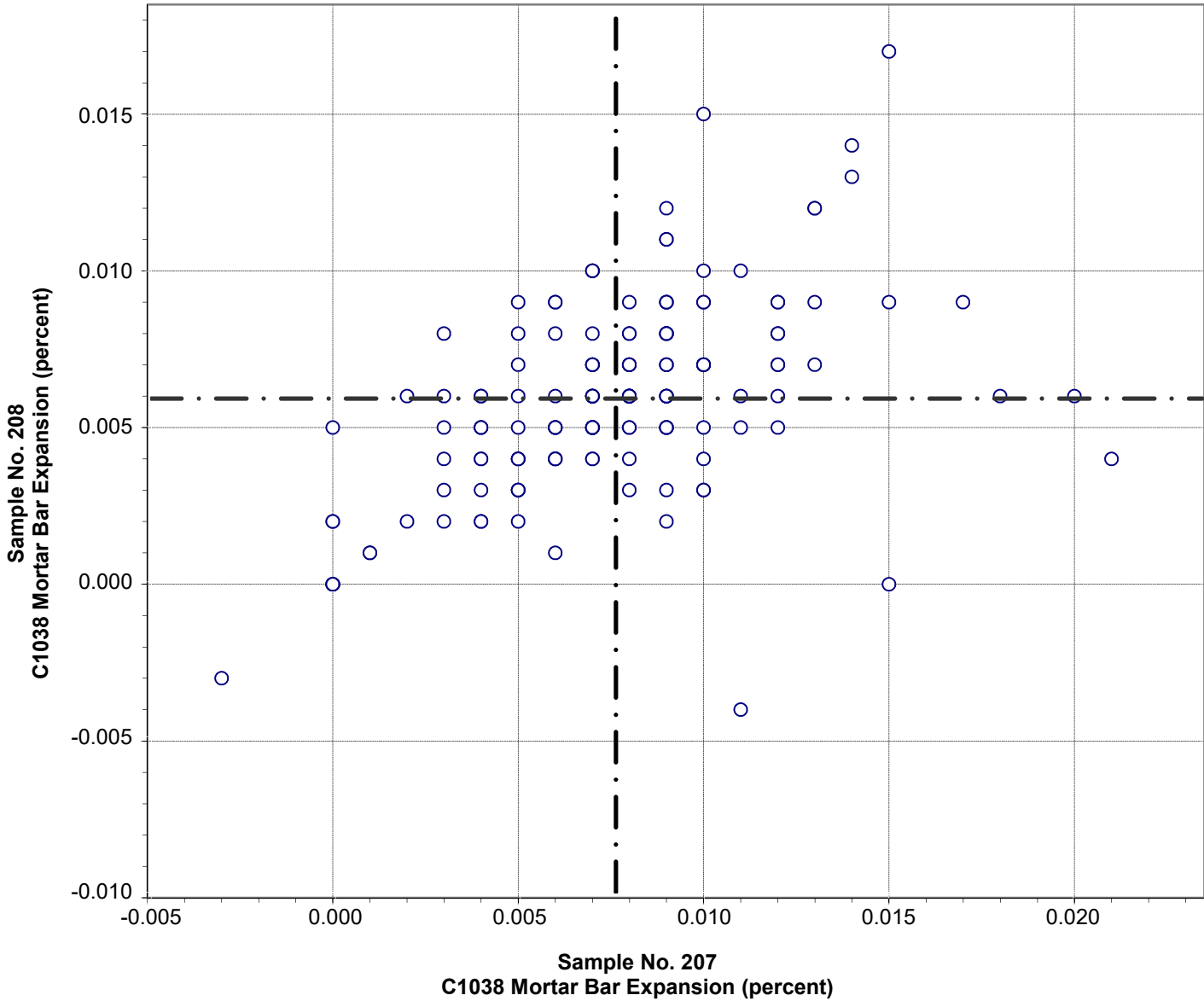
Test No. 281 Fineness - 45µm Sieve 222 Points

Sample No. 207	Ave 96.57	S.D. 0.66	C.V. 0.68
Sample No. 208	Ave 97.15	S.D. 0.84	C.V. 0.87

Labs Eliminated: 52, 95, 116, 206, 515, 932, 3003

Labs off Diagram: 8, 132

**CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 207 and No. 208**



Test No. 400 C1038 Mortar Bar Expansion 157 Points

Sample No. 207	Ave 0.008	S.D. 0.004	C.V. 51
Sample No. 208	Ave 0.006	S.D. 0.003	C.V. 53

Labs Eliminated: 205, 416, 457, 493, 1251, 3368, 3607, 4296, 4314

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 207 and No. 208

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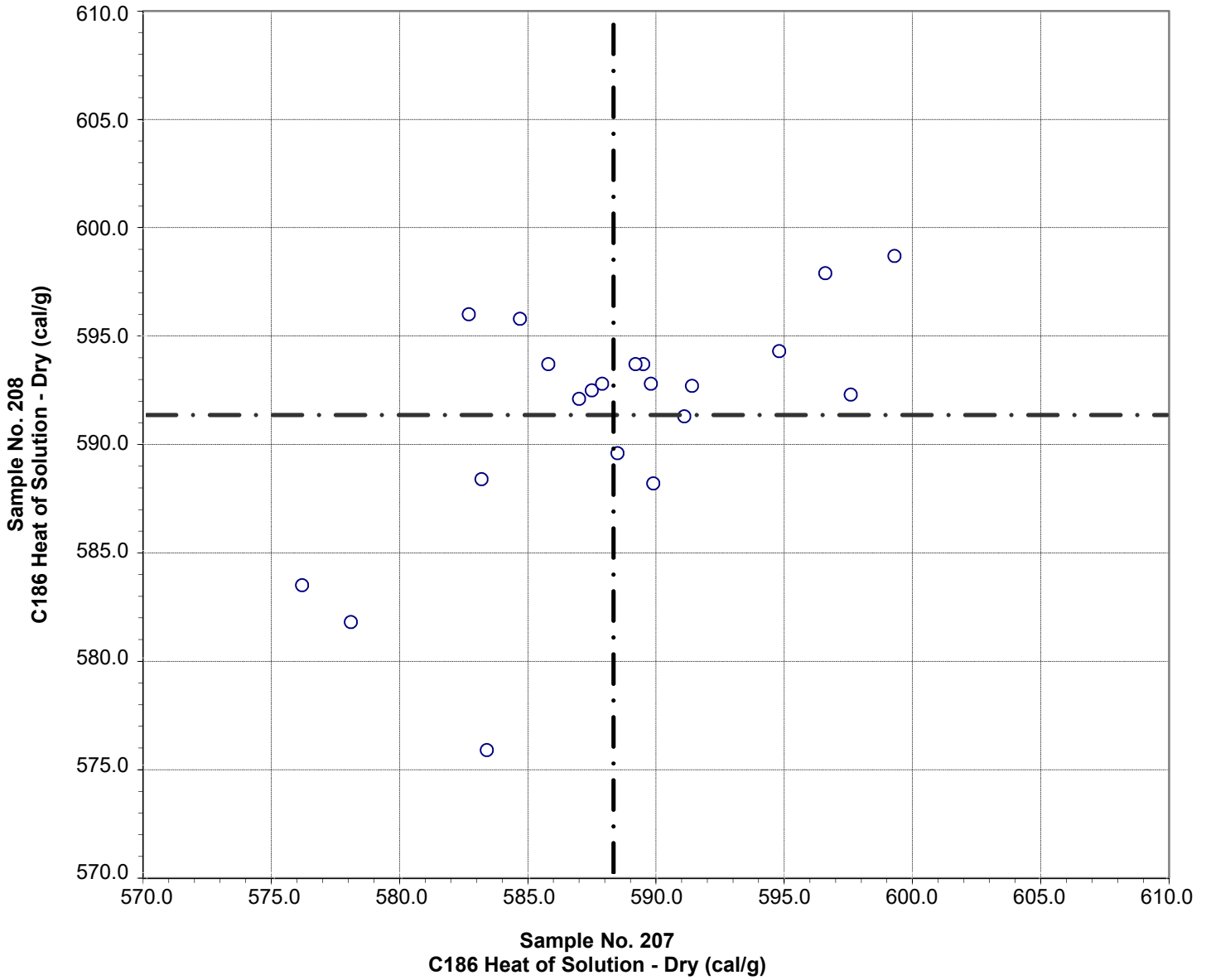
SUMMARY OF RESULTS

Sample No. 207

Sample No. 208

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C186 Heat of Solution - Dry (cal/g)							
	22	589.0	6.0	1.0	589.0	10.3	1.7
	*21	588.0	5.9	1.0	591.0	5.4	0.9
* Labs Eliminated - 3606							
C186 Heat of Solution - 7 day (cal/g)							
	22	505.7	21.0	4.2	507.6	5.0	1.0
	*21	510.1	5.4	1.1	507.9	5.0	1.0
* Labs Eliminated - 3834							
C186 Heat of Solution 28 day (cal/g)							
	15	500.5	7.9	1.6	500.9	5.5	1.1
No Labs Eliminated for This Test							
C186 Heat of Hydration - 7 day (cal/g)							
	25	82.2	20.7	25.2	82.4	10.6	12.9
	*23	78.1	6.6	8.4	84.1	3.5	4.2
* Labs Eliminated - 3606, 3834							
C186 Heat of Hydration - 28 day (cal/g)							
	18	88.6	8.4	9.5	88.8	11.3	12.7
	*17	88.5	8.7	9.8	91.2	5.2	5.7
* Labs Eliminated - 3606							
C1702 Heat of Hydration - 3 day (J/g)							
	17	285	43	15.1	325	49	15.1
No Labs Eliminated for This Test							
C1702 Heat of Hydration - 7 day (J/g)							
	17	315	47	14.9	358	49	13.7
No Labs Eliminated for This Test							

**CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 207 and No. 208**

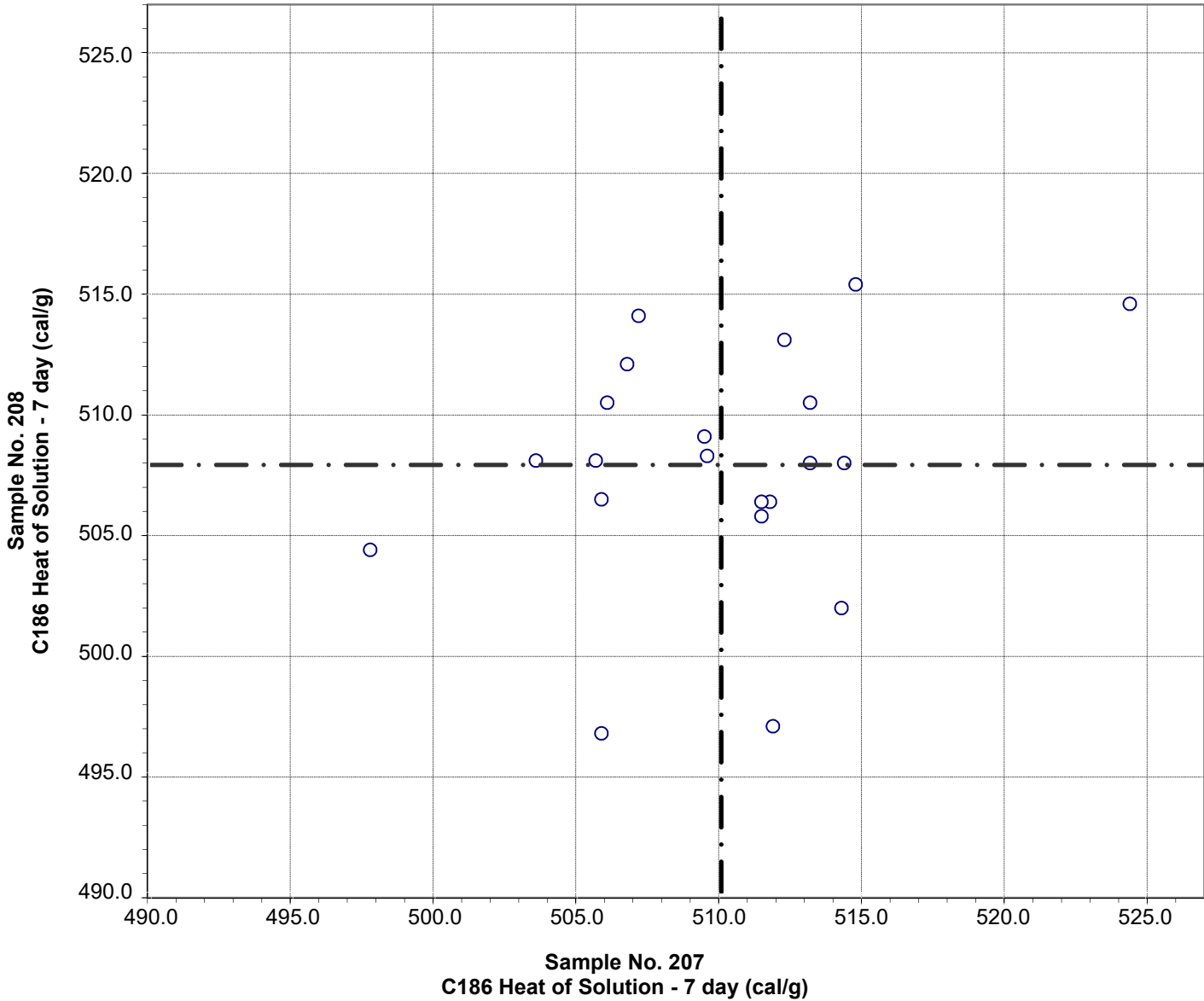


Test No. 291 C186 Heat of Solution - Dry 21 Points

Sample No. 207	Ave 588.0	S.D. 5.9	C.V. 1.0
Sample No. 208	Ave 591.0	S.D. 5.4	C.V. 0.9

Labs Eliminated: 3606

**CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 207 and No. 208**

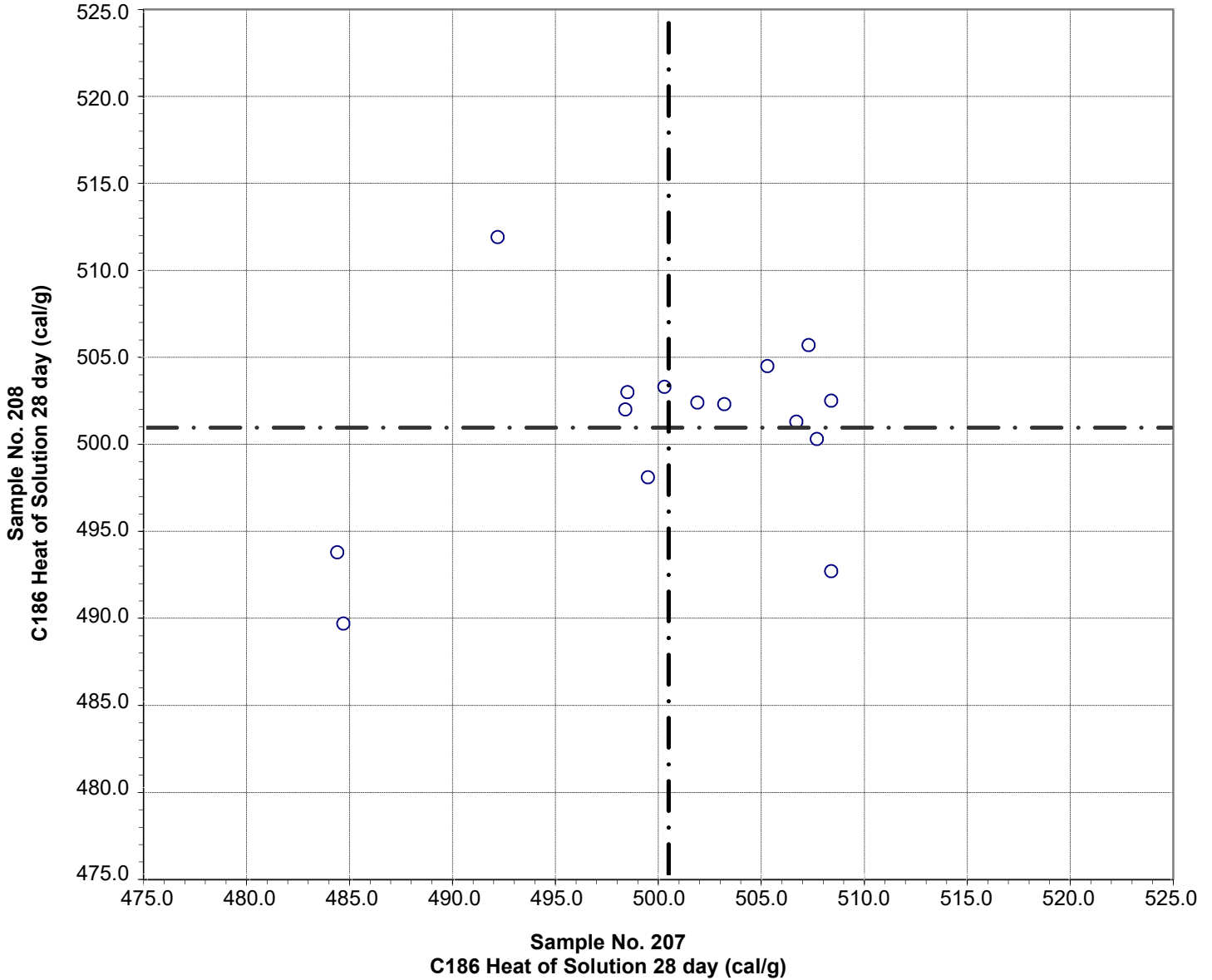


Test No. 292 C186 Heat of Solution - 7 day 21 Points

Sample No. 207	Ave 510.1	S.D. 5.4	C.V. 1.1
Sample No. 208	Ave 507.9	S.D. 5.0	C.V. 1.0

Labs Eliminated: 3834

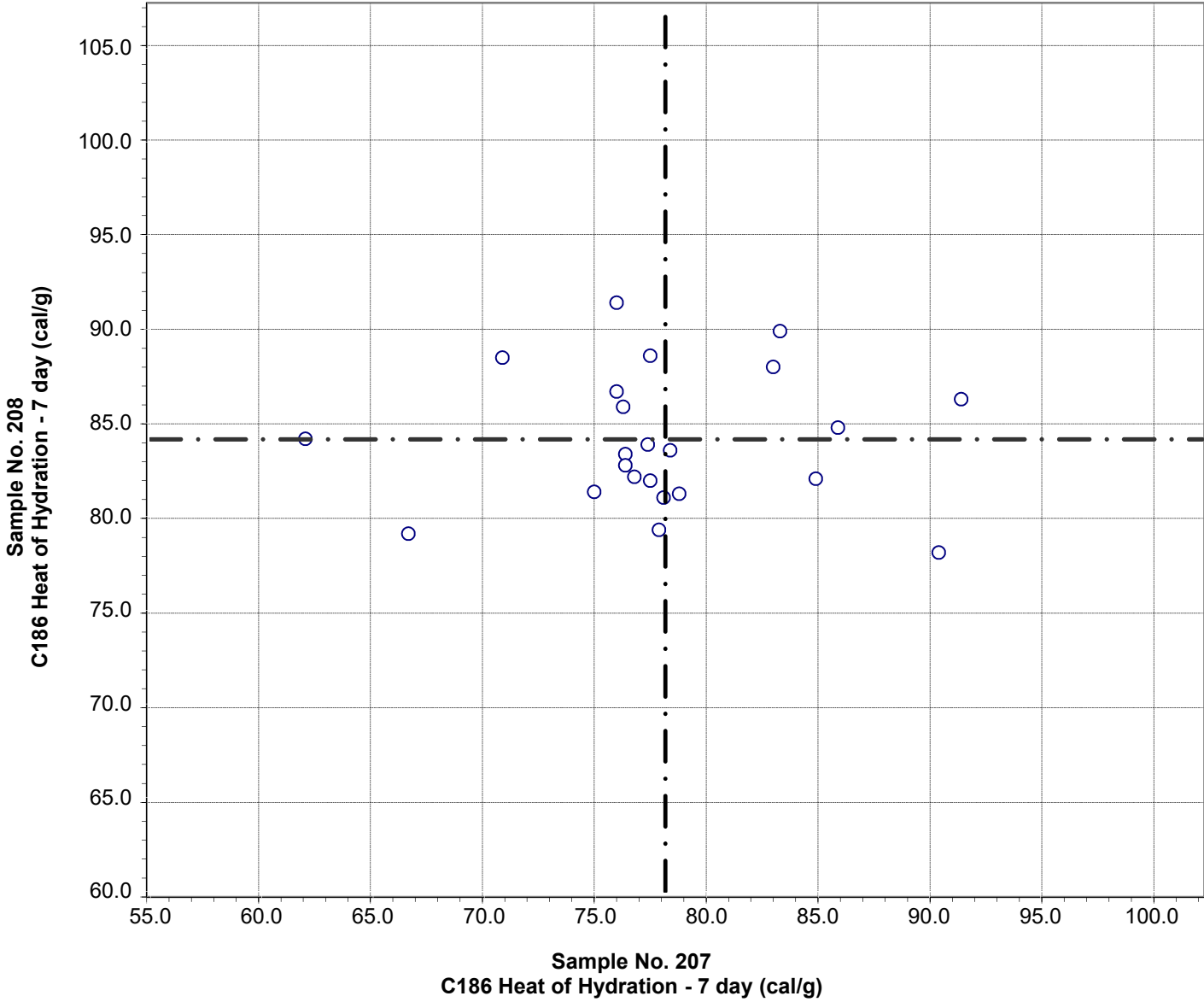
**CCRL Proficiency Sample Program
C186 Heat of Solution 28 day
PORTLAND CEMENT Samples No. 207 and No. 208**



Test No. 301 C186 Heat of Solution 28 day 15 Points

Sample No. 207	Ave 500.5	S.D. 7.9	C.V. 1.6
Sample No. 208	Ave 500.9	S.D. 5.5	C.V. 1.1

**CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 207 and No. 208**

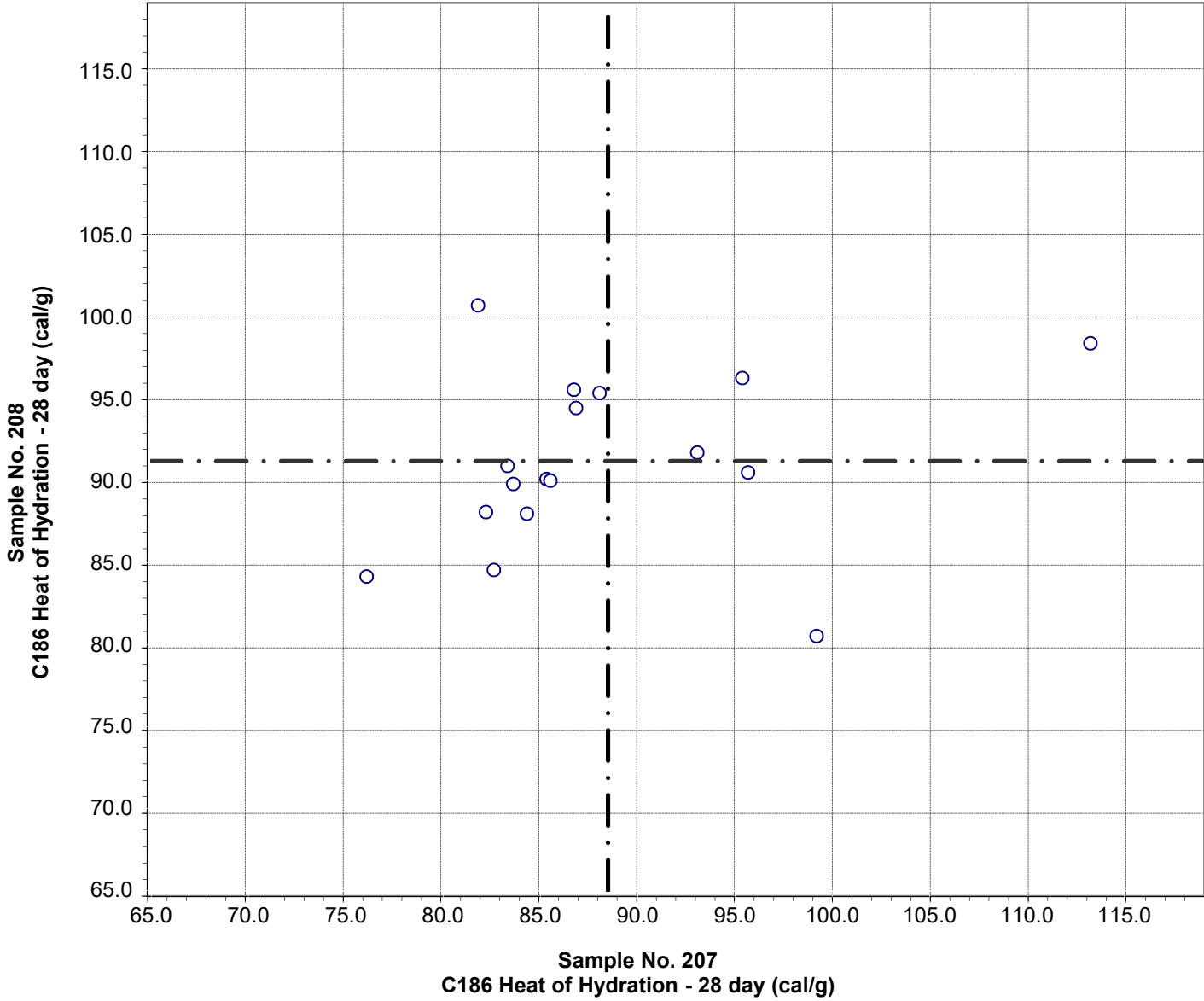


Test No. 290 C186 Heat of Hydration - 7 day 23 Points

Sample No. 207	Ave 78.1	S.D. 6.6	C.V. 8.4
Sample No. 208	Ave 84.1	S.D. 3.5	C.V. 4.2

Labs Eliminated: 3606, 3834

CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 207 and No. 208

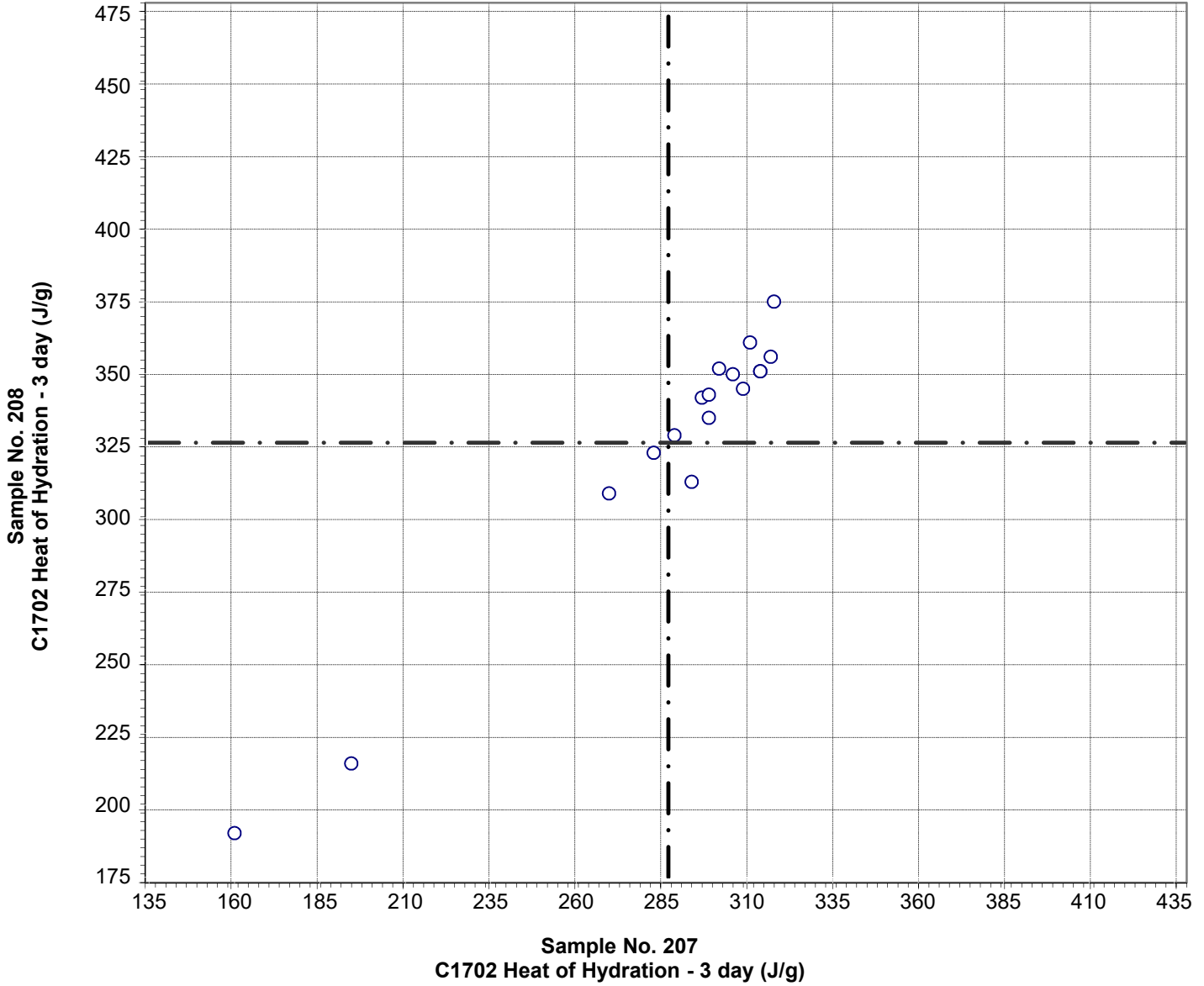


Test No. 300 C186 Heat of Hydration - 28 day 17 Points

Sample No. 207	Ave 88.5	S.D. 8.7	C.V. 9.8
Sample No. 208	Ave 91.2	S.D. 5.2	C.V. 5.7

Labs Eliminated: 3606

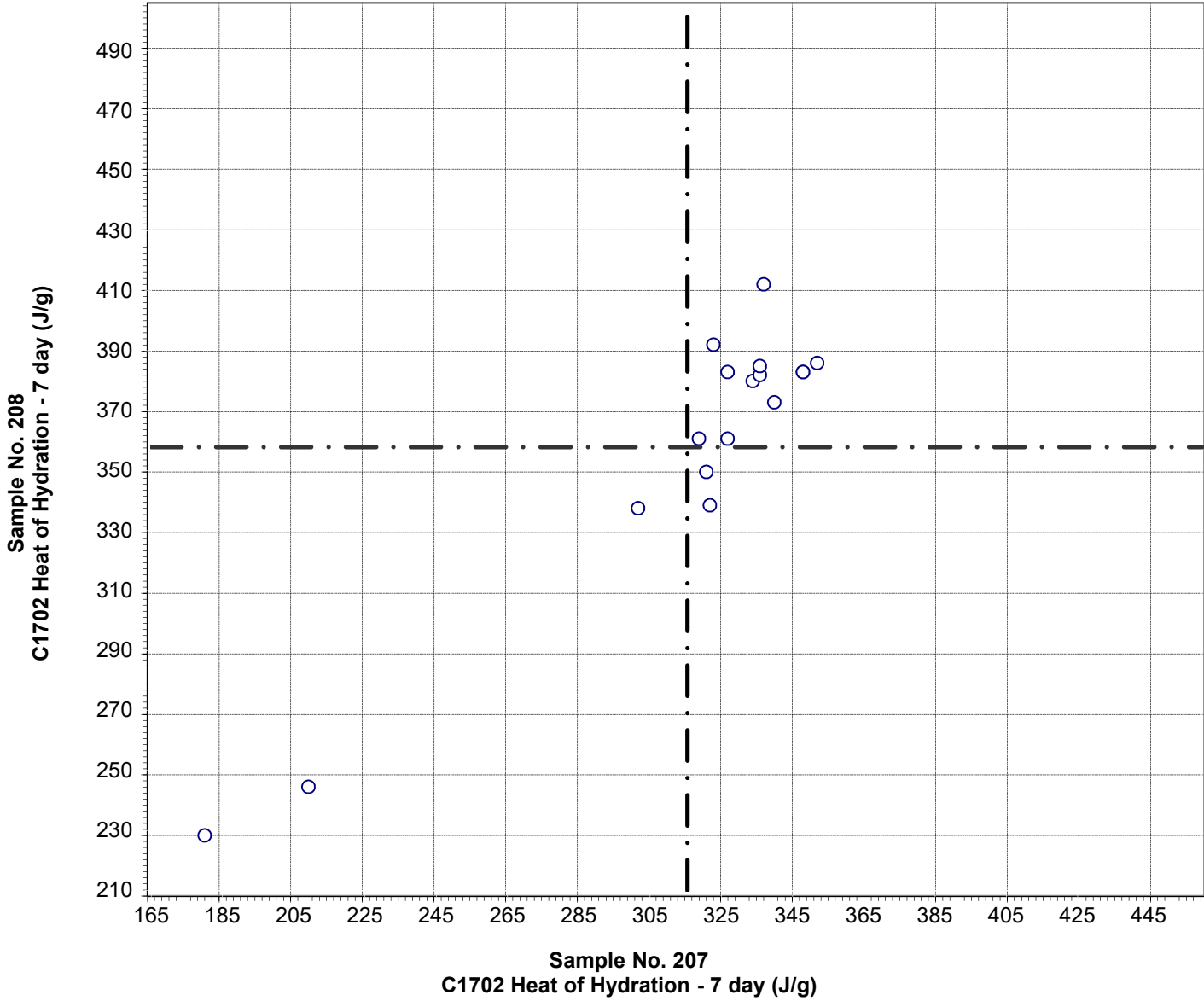
CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 207 and No. 208



Test No. 500 C1702 Heat of Hydration - 3 day 17 Points

Sample No. 207	Ave 285	S.D. 43	C.V. 15.1
Sample No. 208	Ave 325	S.D. 49	C.V. 15.1

**CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 207 and No. 208**



Test No. 510 C1702 Heat of Hydration - 7 day 17 Points

Sample No. 207	Ave 315	S.D. 47	C.V. 14.9
Sample No. 208	Ave 358	S.D. 49	C.V. 13.7