

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 193 and Number 194

September 2014



CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

September 3, 2014

To: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 193 and No. 194

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in June 2014. Portland Cement Samples No. 193 was an ASTM C150 meeting the specifications of Type V and. Portland Cement No. 194 was an ASTM C150 meeting the specifications of Type II.

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 January 2015.

Sincerely,

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

To: Participants in the CCRL Portland Cement Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor PSP

SUBJECT: Explanation of Final Report on Results of Tests for Portland Cement Proficiency Samples No. 193 and No. 194

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 June 2014. 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 a "Labs Eliminated" or "Labs Off Diagram" on the scatter diagram. Averages, standard deviations, and a scatter diagram are provided for your information. This information may be a helpful indicator of a problem with flow table apparatus or

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.*

mortar mixing procedures. Flow values of 151 were assigned to laboratories reporting a mortar flow off the flow table top.

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

Summary of Results

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. 193 and No. 194

Final Report – Chemical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (percent)							
	219	21.12	0.31	1.47	19.76	0.34	1.70
	*204	21.11	0.17	0.80	19.73	0.18	0.89
* Labs Eliminated - 18, 20, 26, 51, 52, 93, 98, 206, 819, 1942, 2437, 2477, 3938, 3966, 3976							
Aluminum Oxide (percent)							
	216	3.61	0.20	5.6	4.58	0.14	3.0
	*202	3.60	0.09	2.6	4.58	0.08	1.7
* Labs Eliminated - 10, 23, 50, 206, 219, 975, 1025, 1942, 2477, 3297, 3807, 3966, 3970, 3976							
Ferric Oxide (percent)							
	217	4.46	0.35	7.8	3.36	0.26	7.6
	*203	4.47	0.06	1.4	3.35	0.05	1.4
* Labs Eliminated - 10, 51, 52, 255, 354, 1025, 1251, 1594, 2477, 3661, 3807, 3966, 3970, 3976							
Calcium Oxide (percent)							
	215	63.16	0.52	0.82	62.13	0.44	0.71
	*209	63.18	0.39	0.62	62.14	0.39	0.62
* Labs Eliminated - 1, 20, 98, 3938, 3966, 3976							
Magnesium Oxide (percent)							
	217	3.03	0.14	4.6	2.99	0.19	6.5
	*204	3.04	0.08	2.5	3.01	0.07	2.3
* Labs Eliminated - 5, 50, 52, 95, 125, 176, 413, 1799, 2477, 2491, 3807, 3966, 3976							
Sulfur Trioxide (percent)							
	224	2.03	0.14	6.9	3.70	0.20	5.4
	*207	2.02	0.08	3.9	3.72	0.09	2.3
* Labs Eliminated - 8, 50, 51, 95, 134, 203, 354, 431, 494, 2437, 2477, 2934, 3057, 3938, 3966, 3970, 3976							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Chemical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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Loss on Ignition (percent)

224	1.47	0.13	9.1	1.19	0.23	19.7
*210	1.48	0.11	7.2	1.16	0.13	11.3

* Labs Eliminated - 4, 48, 51, 74, 95, 142, 169, 203, 1025, 1054, 1435, 3057, 3966, 3976

Sodium Oxide (percent)

206	0.061	0.031	51	0.279	0.056	20
*191	0.058	0.023	40	0.287	0.034	12

* Labs Eliminated - 95, 284, 354, 504, 1054, 1644, 1956, 2293, 2477, 2490, 2955, 3057, 3948, 3966, 3976

Potassium Oxide (percent)

212	0.532	0.098	18.4	0.924	0.075	8.1
*196	0.528	0.015	2.9	0.936	0.021	2.2

* Labs Eliminated - 15, 110, 156, 1799, 1956, 2293, 2412, 2477, 2491, 2621, 3279, 3606, 3661, 3807, 3966, 3976

Titanium Dioxide (percent)

171	0.22	0.015	6.8	0.21	0.016	7.5
*164	0.22	0.009	4.2	0.21	0.009	4.6

* Labs Eliminated - 175, 203, 494, 2477, 2621, 3966, 3976

Phosphorus Pentoxide (percent)

166	0.100	0.033	33.2	0.183	0.030	16.3
*140	0.096	0.005	4.8	0.181	0.006	3.2

* Labs Eliminated - 3, 8, 10, 18, 34, 94, 101, 125, 132, 137, 139, 152, 416, 450, 494, 667, 692, 1799, 1940, 2477, 2491, 3279, 3695, 3807, 3966, 3976

Zinc Oxide (percent)

87	0.025	0.029	113.8	0.124	0.028	22.2
*73	0.020	0.002	9.5	0.127	0.005	3.7

* Labs Eliminated - 15, 40, 44, 142, 206, 255, 413, 768, 1054, 2296, 2477, 2483, 2522, 3607

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Chemical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Manganic Oxide (percent)							
	140	0.243	0.029	12.1	0.213	0.027	12.5
	*129	0.243	0.009	3.5	0.214	0.007	3.5
* Labs Eliminated - 18, 205, 221, 255, 768, 2477, 3238, 3607, 3807, 3966, 3976							
Chloride (percent)							
	111	0.015	0.038	248	0.018	0.040	224
	*101	0.009	0.004	48	0.013	0.005	41
* Labs Eliminated - 493, 667, 1644, 1657, 2293, 2296, 2522, 3607, 3966, 3976							
Insoluble Residue (percent)							
	208	0.20	0.10	50	0.19	0.10	53
	*197	0.19	0.08	45	0.17	0.08	47
* Labs Eliminated - 4, 40, 92, 93, 94, 222, 309, 493, 687, 1025, 2490							
Free Lime (percent)							
	170	0.87	0.25	29	0.56	0.19	34
	*165	0.89	0.21	24	0.57	0.18	31
* Labs Eliminated - 126, 169, 203, 206, 494							
Chromium Oxide (percent)							
	82	0.035	0.022	63	0.034	0.013	38
	*74	0.034	0.005	15	0.034	0.005	15
* Labs Eliminated - 54, 157, 254, 2296, 2477, 2522, 3057, 3752							
Tricalcium Silicate (percent)							
	194	60.3	3.1	5.1	56.9	3.1	5.4
	*180	60.4	2.0	3.2	56.9	2.0	3.4
* Labs Eliminated - 8, 176, 206, 289, 1644, 1942, 2296, 2437, 2477, 3695, 3938, 3966, 3970, 3976							
Dicalcium Silicate (percent)							
	194	15.1	2.7	18.1	13.8	2.9	21.4
	*180	15.0	1.8	11.8	13.7	1.8	12.9
* Labs Eliminated - 8, 18, 176, 206, 289, 1644, 1942, 1956, 2296, 2437, 3695, 3938, 3966, 3976							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Chemical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

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

194	2.1	0.7	36.2	6.5	0.7	11.1
*184	2.0	0.3	14.8	6.5	0.2	3.8

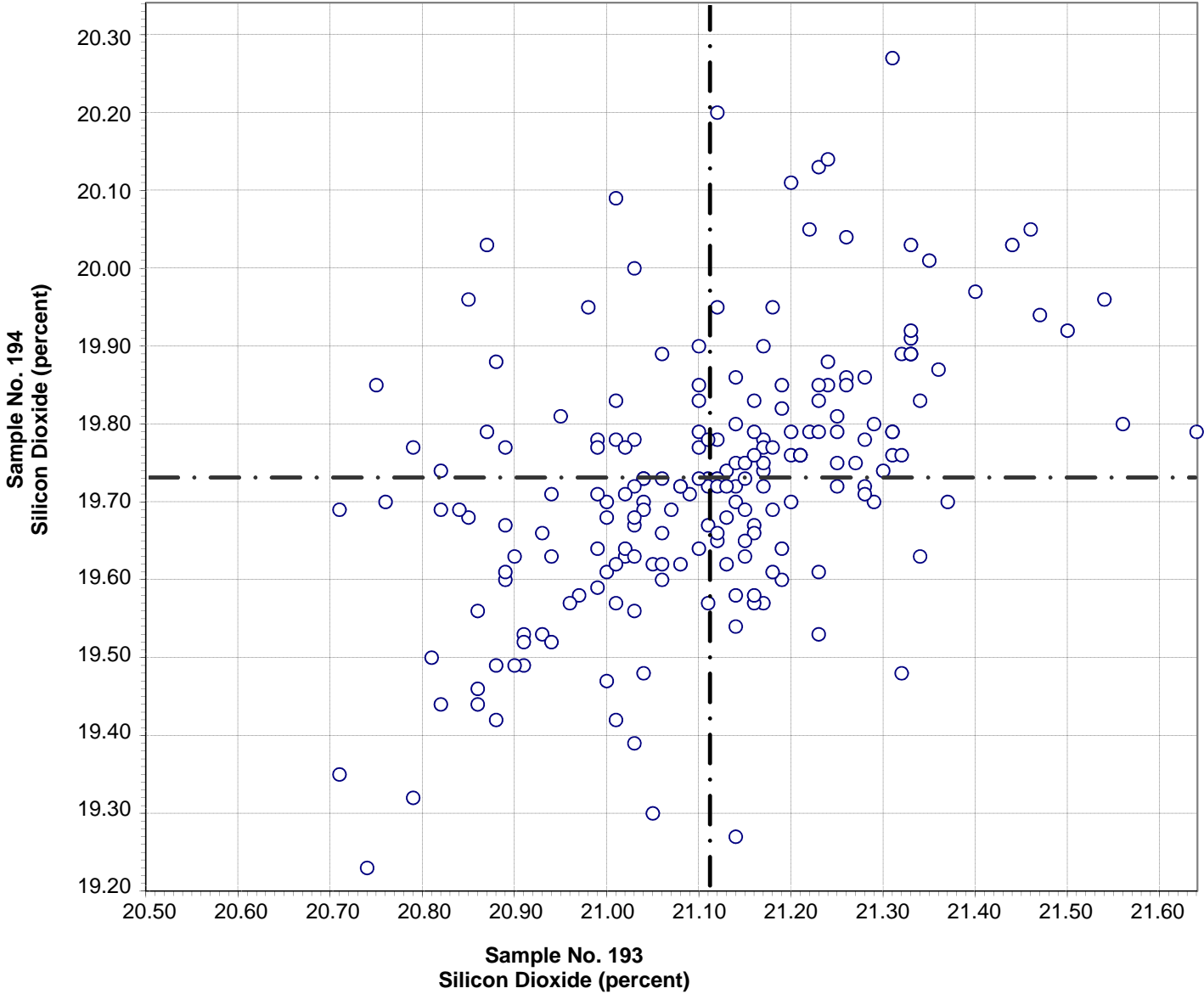
* Labs Eliminated - 50, 60, 252, 975, 1942, 2477, 3297, 3415, 3966, 3976

Tetracalcium Aluminoferrite (percent)

194	13.5	0.8	6.1	10.2	0.5	5.2
*182	13.6	0.2	1.5	10.2	0.2	1.5

* Labs Eliminated - 60, 255, 354, 1251, 2477, 2934, 3279, 3415, 3661, 3966, 3970, 3976

**CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 10 Silicon Dioxide 202 Points

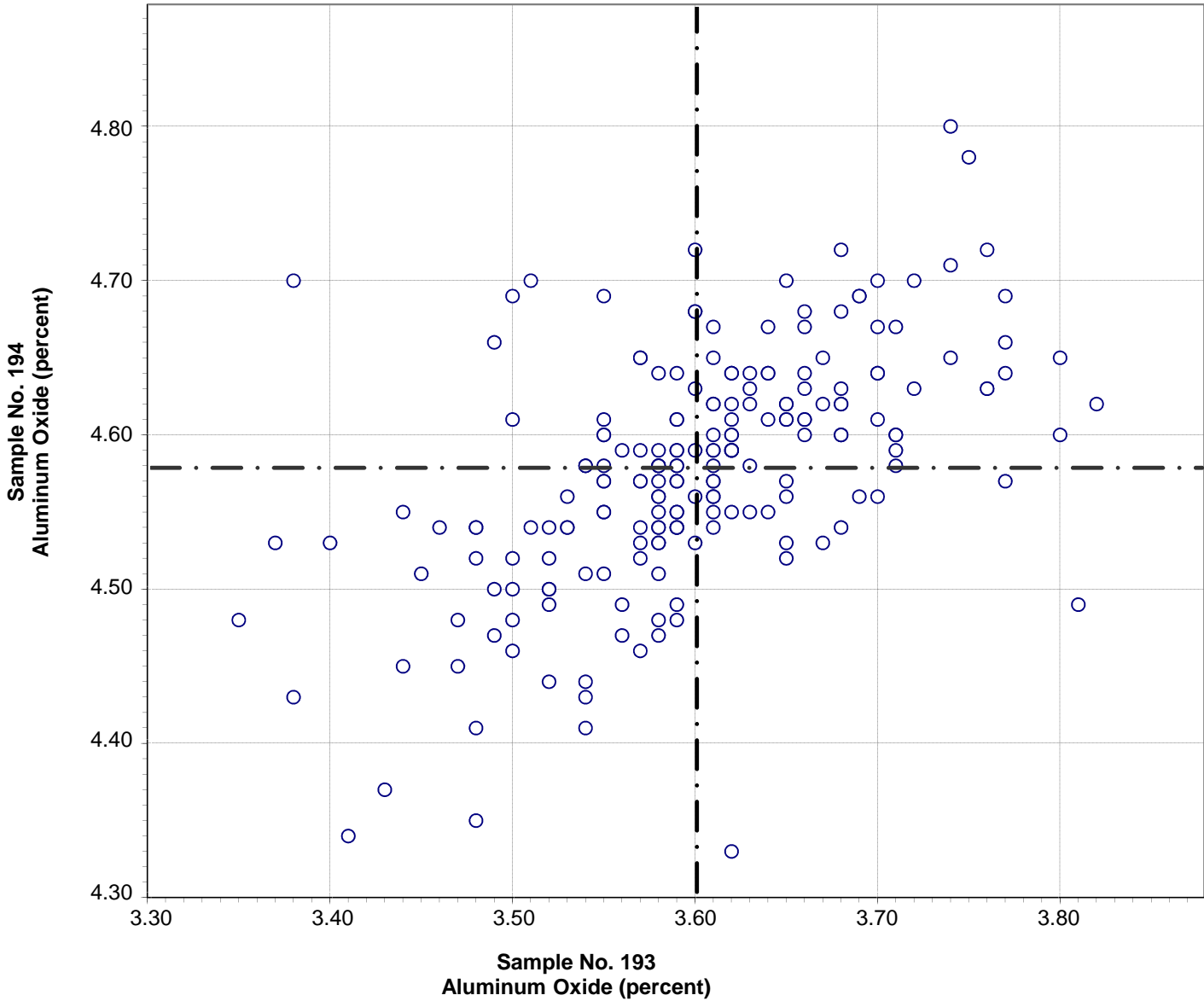
Sample No. 193 Ave 21.11 S.D. 0.17 C.V. 0.80

Sample No. 194 Ave 19.73 S.D. 0.18 C.V. 0.89

Labs Eliminated: 18, 20, 26, 51, 52, 93, 98, 206, 819, 1942, 2437, 2477, 3938, 3966, 3976

Labs off Diagram: 1644, 3695

**CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 21 Aluminum Oxide 200 Points

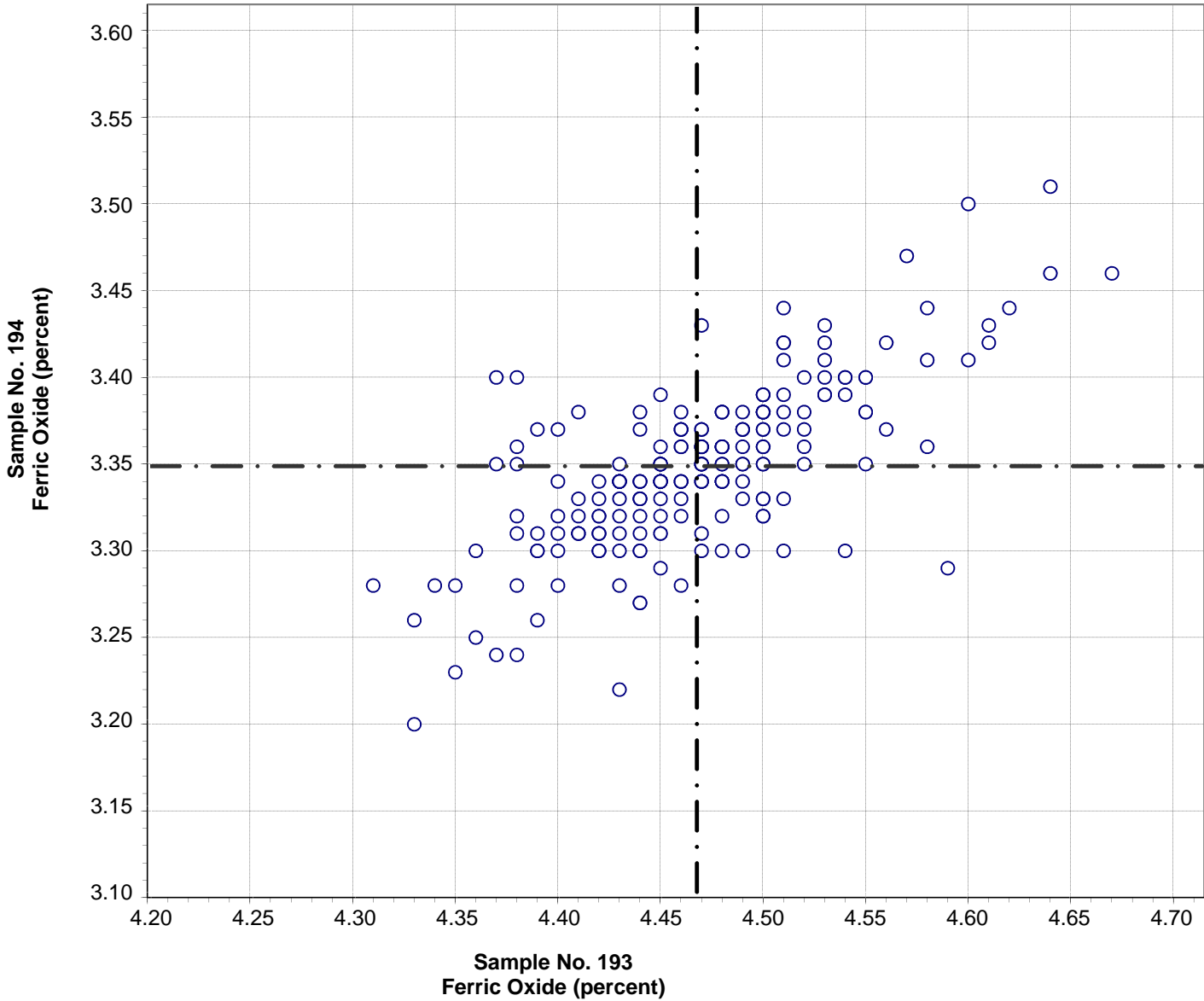
Sample No. 193 Ave 3.60 S.D. 0.09 C.V. 2.6

Sample No. 194 Ave 4.58 S.D. 0.08 C.V. 1.7

Labs Eliminated: 10, 23, 50, 206, 219, 975, 1025, 1942, 2477, 3297, 3807, 3966, 3970, 3976

Labs off Diagram: 205, 3938

**CCRL Proficiency Sample Program
Ferric Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**

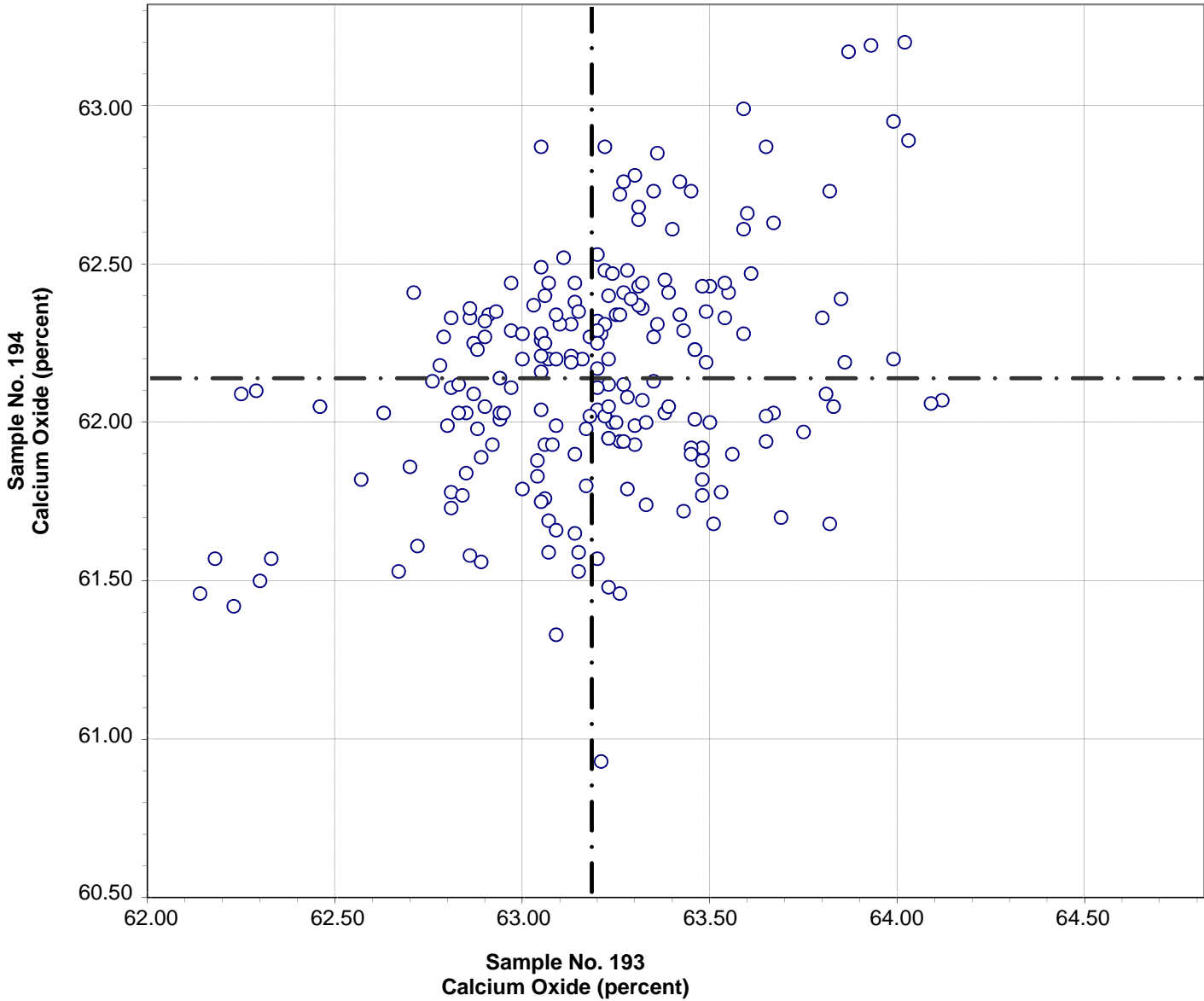


Test No. 30 Ferric Oxide 203 Points

Sample No. 193	Ave 4.47	S.D. 0.06	C.V. 1.4
Sample No. 194	Ave 3.35	S.D. 0.05	C.V. 1.4

Labs Eliminated: 10, 51, 52, 255, 354, 1025, 1251, 1594, 2477, 3661, 3807, 3966, 3970, 3976

**CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 40 Calcium Oxide 206 Points

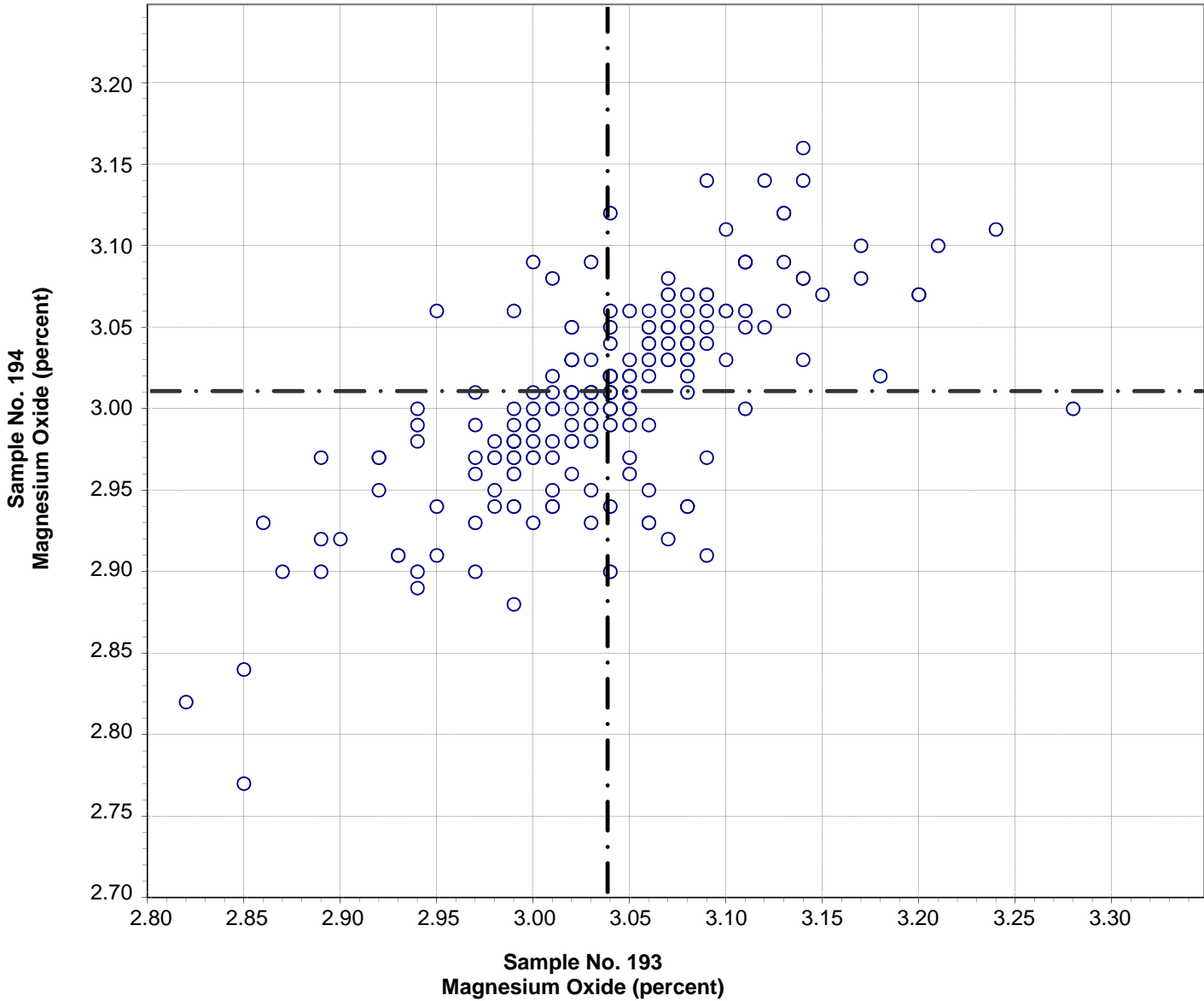
Sample No. 193 Ave 63.18 S.D. 0.39 C.V. 0.62

Sample No. 194 Ave 62.14 S.D. 0.39 C.V. 0.62

Labs Eliminated: 1, 20, 98, 3938, 3966, 3976

Labs off Diagram: 125, 2477, 3859

**CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 50 Magnesium Oxide 200 Points

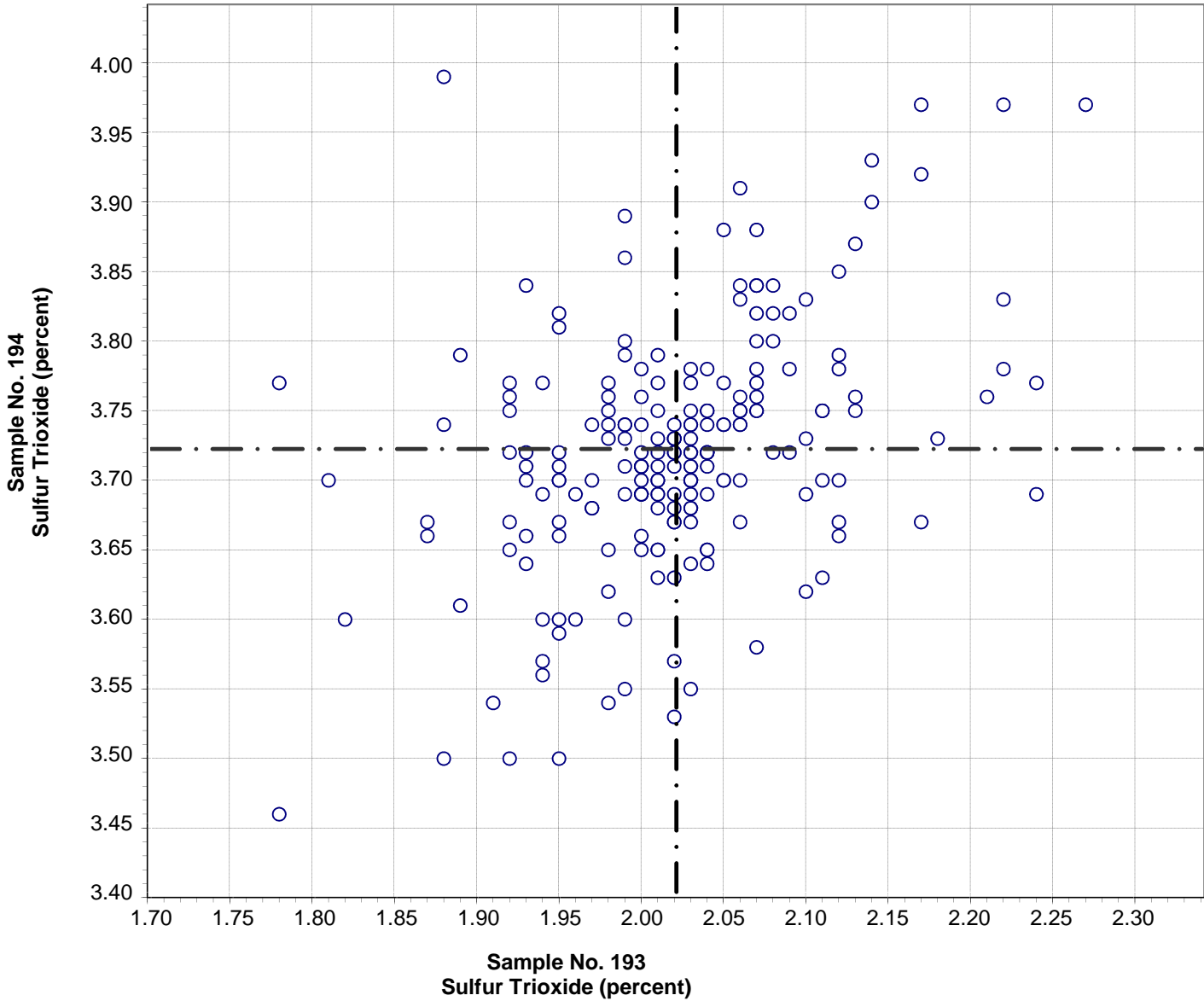
Sample No. 193 Ave 3.04 S.D. 0.08 C.V. 2.5

Sample No. 194 Ave 3.01 S.D. 0.07 C.V. 2.3

Labs Eliminated: 5, 50, 52, 95, 125, 176, 413, 1799, 2477, 2491, 3807, 3966, 3976

Labs off Diagram: 1, 3127, 3663, 3695

**CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 193 and No. 194**



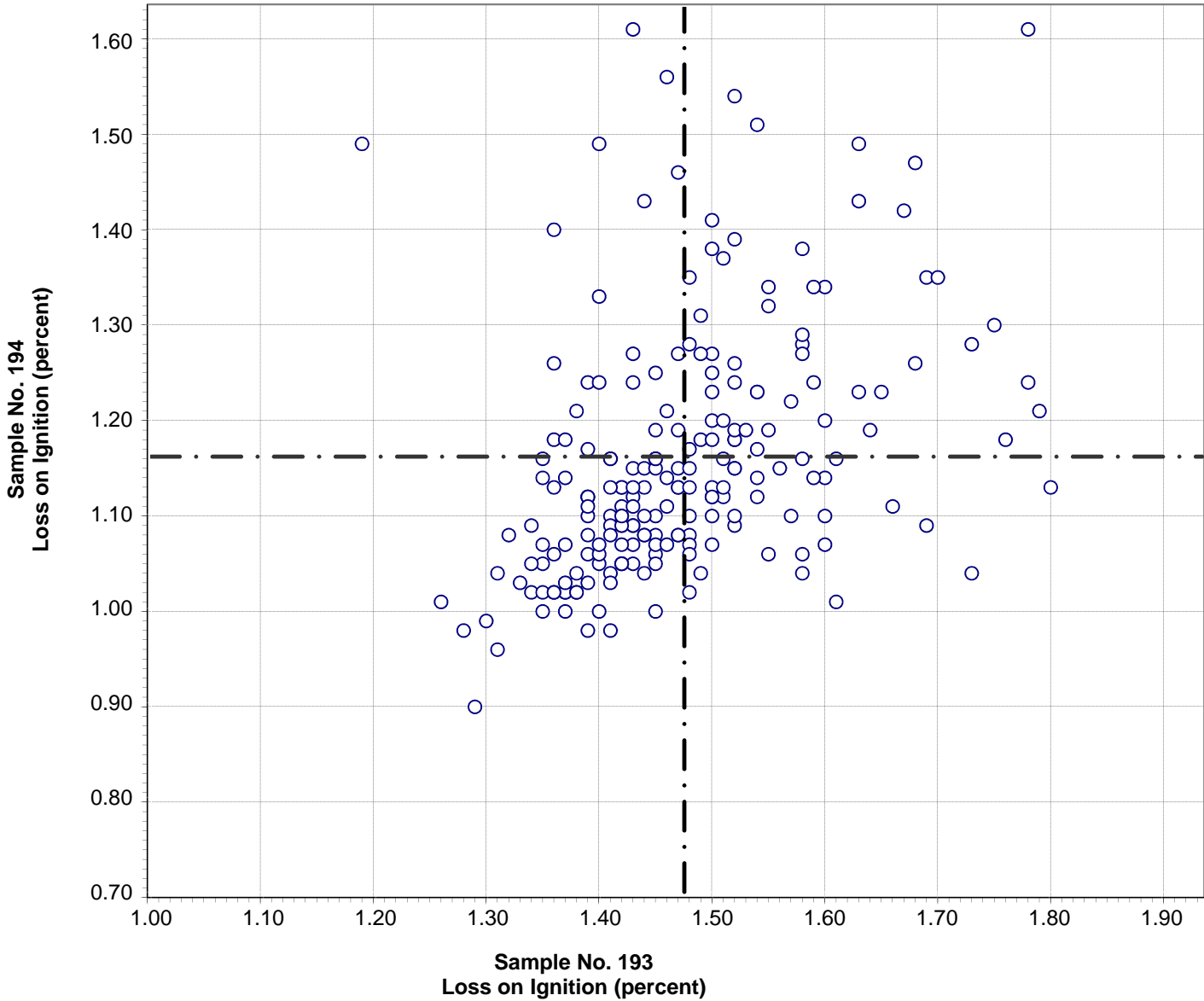
Test No. 60 Sulfur Trioxide 207 Points

Sample No. 193 Ave 2.02 S.D. 0.08 C.V. 3.9

Sample No. 194 Ave 3.72 S.D. 0.09 C.V. 2.3

Labs Eliminated: 8, 50, 51, 95, 134, 203, 354, 431, 494, 2437, 2477, 2934, 3057, 3938, 3966, 3970, 3976

**CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 193 and No. 194**

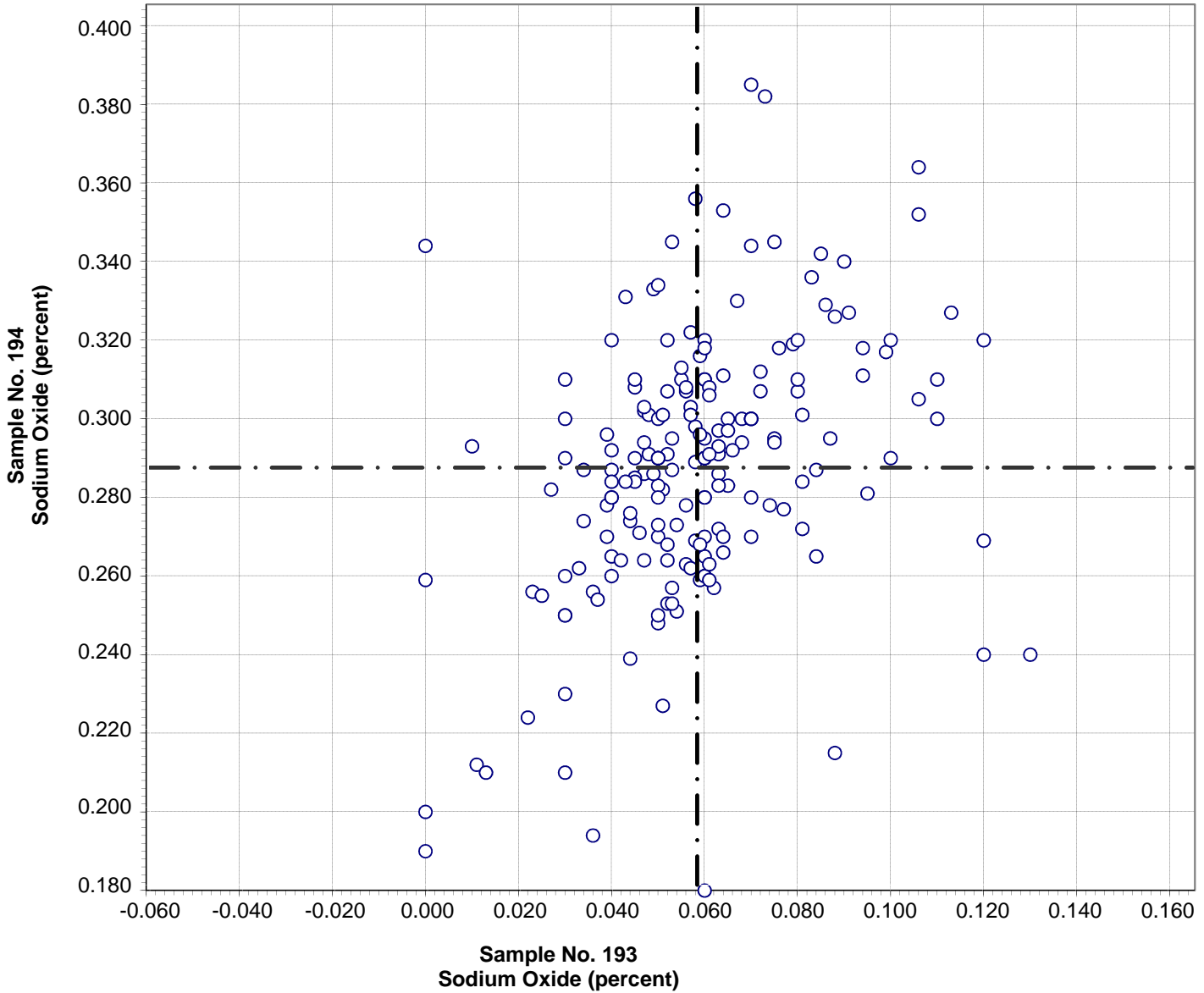


Test No. 70 Loss on Ignition 210 Points

Sample No. 193 Ave 1.48 S.D. 0.11 C.V. 7.2
Sample No. 194 Ave 1.16 S.D. 0.13 C.V. 11.3

Labs Eliminated: 4, 48, 51, 74, 95, 142, 169, 203, 1025, 1054, 1435, 3057, 3966, 3976

**CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



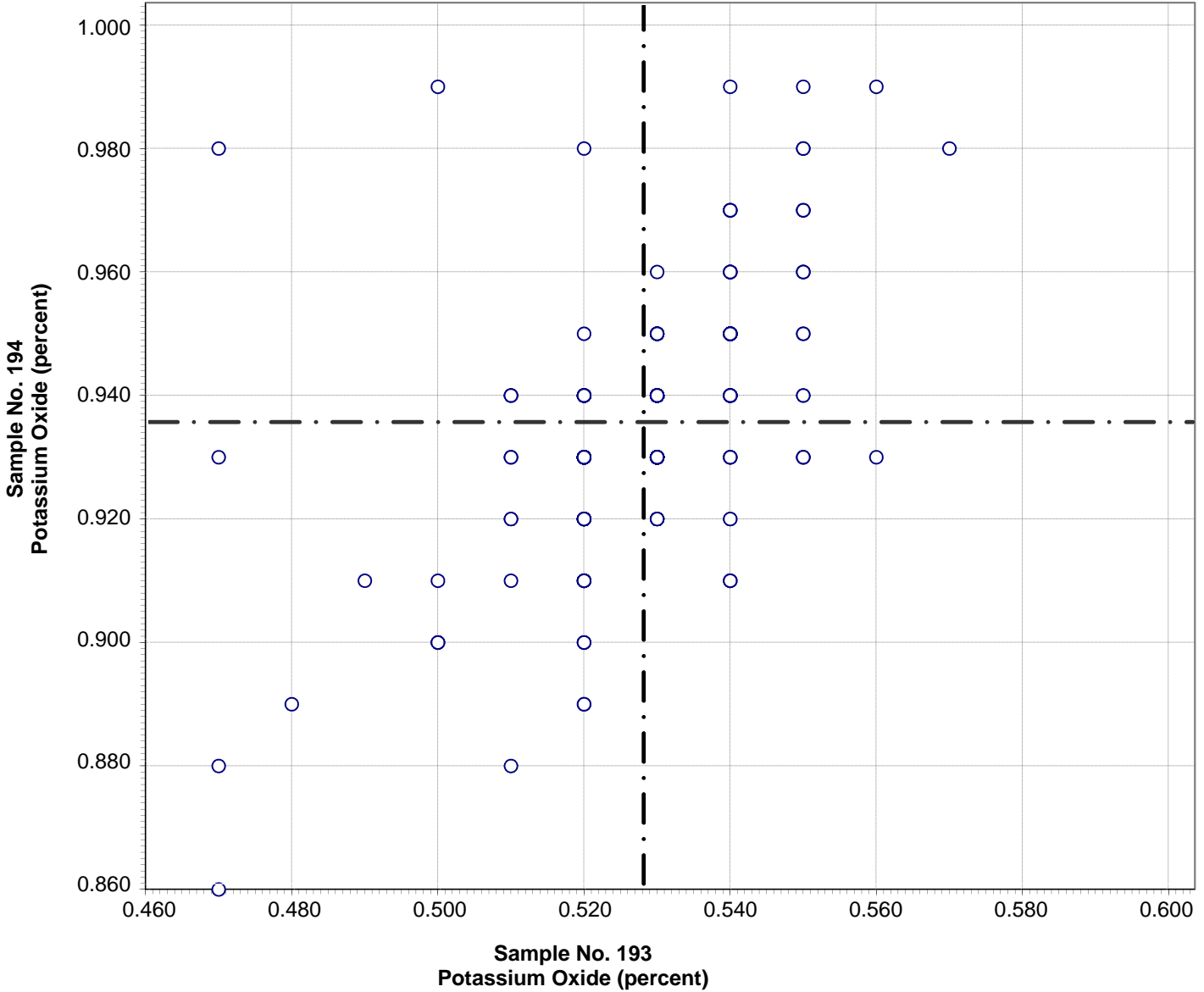
Test No. 90 Sodium Oxide 190 Points

Sample No. 193	Ave 0.058	S.D. 0.023	C.V. 40
Sample No. 194	Ave 0.287	S.D. 0.034	C.V. 12

Labs Eliminated: 95, 284, 354, 504, 1054, 1644, 1956, 2293, 2477, 2490, 2955, 3057, 3948, 3966, 3976

Labs off Diagram: 3695

**CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



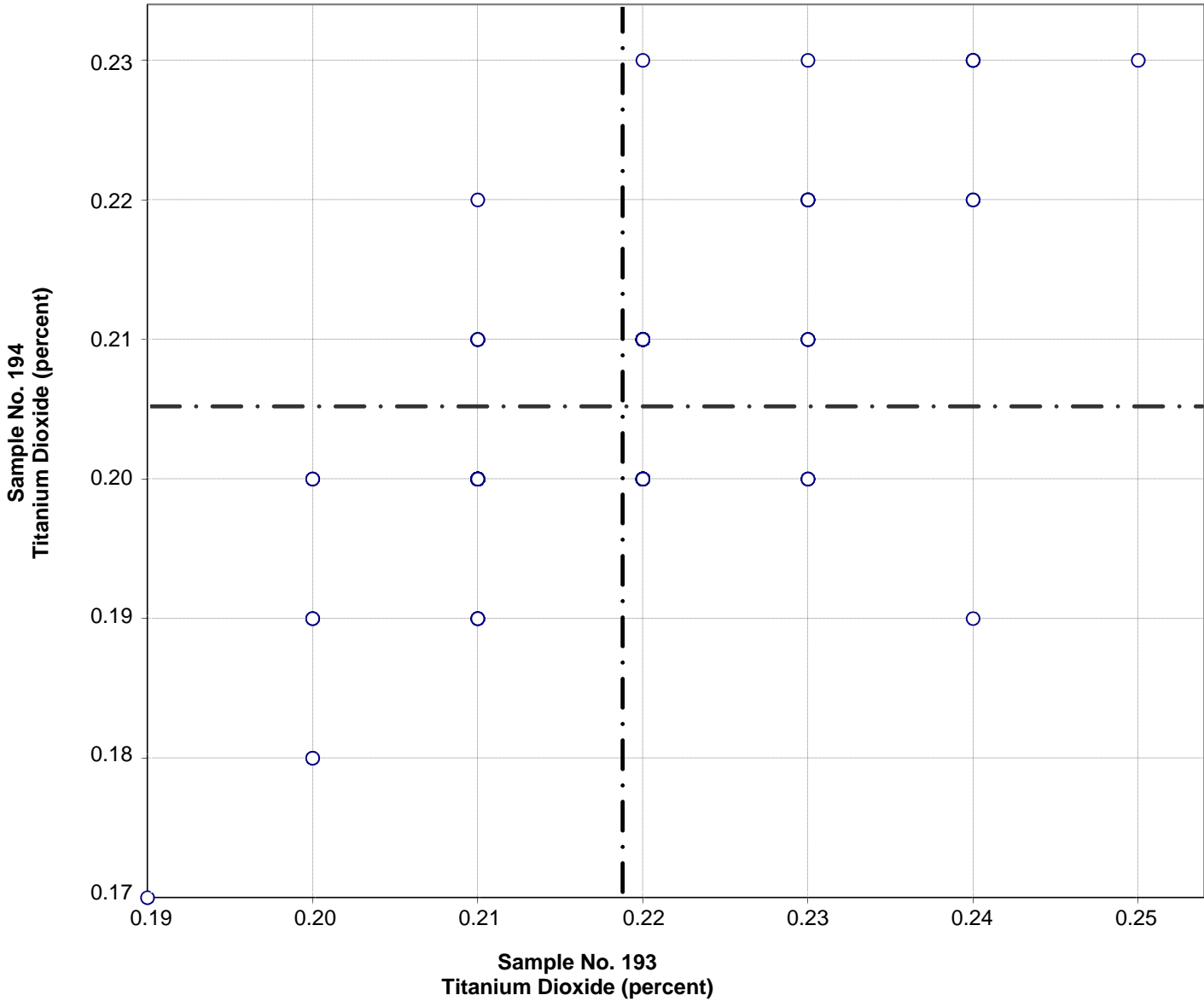
Test No. 100 Potassium Oxide 196 Points

Sample No. 193 Ave 0.528 S.D. 0.015 C.V. 2.9

Sample No. 194 Ave 0.936 S.D. 0.021 C.V. 2.2

Labs Eliminated: 15, 110, 156, 1799, 1956, 2293, 2412, 2477, 2491, 2621, 3279, 3606, 3661, 3807, 3966, 3976

**CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 103 Titanium Dioxide 163 Points

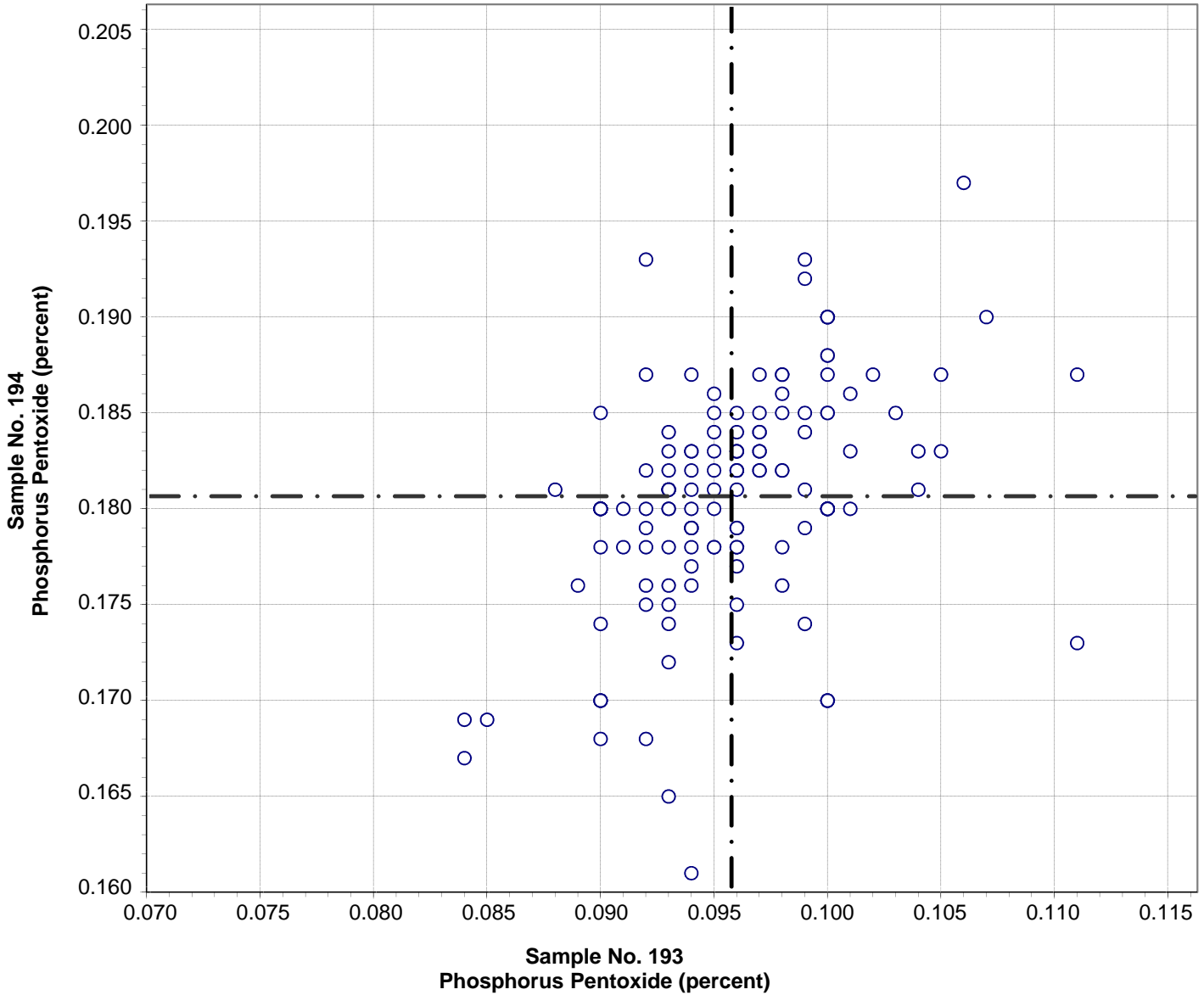
Sample No. 193 Ave 0.22 S.D. 0.009 C.V. 4.2

Sample No. 194 Ave 0.21 S.D. 0.009 C.V. 4.6

Labs Eliminated: 175, 203, 494, 2477, 2621, 3966, 3976

Labs off Diagram: 95

**CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 193 and No. 194**



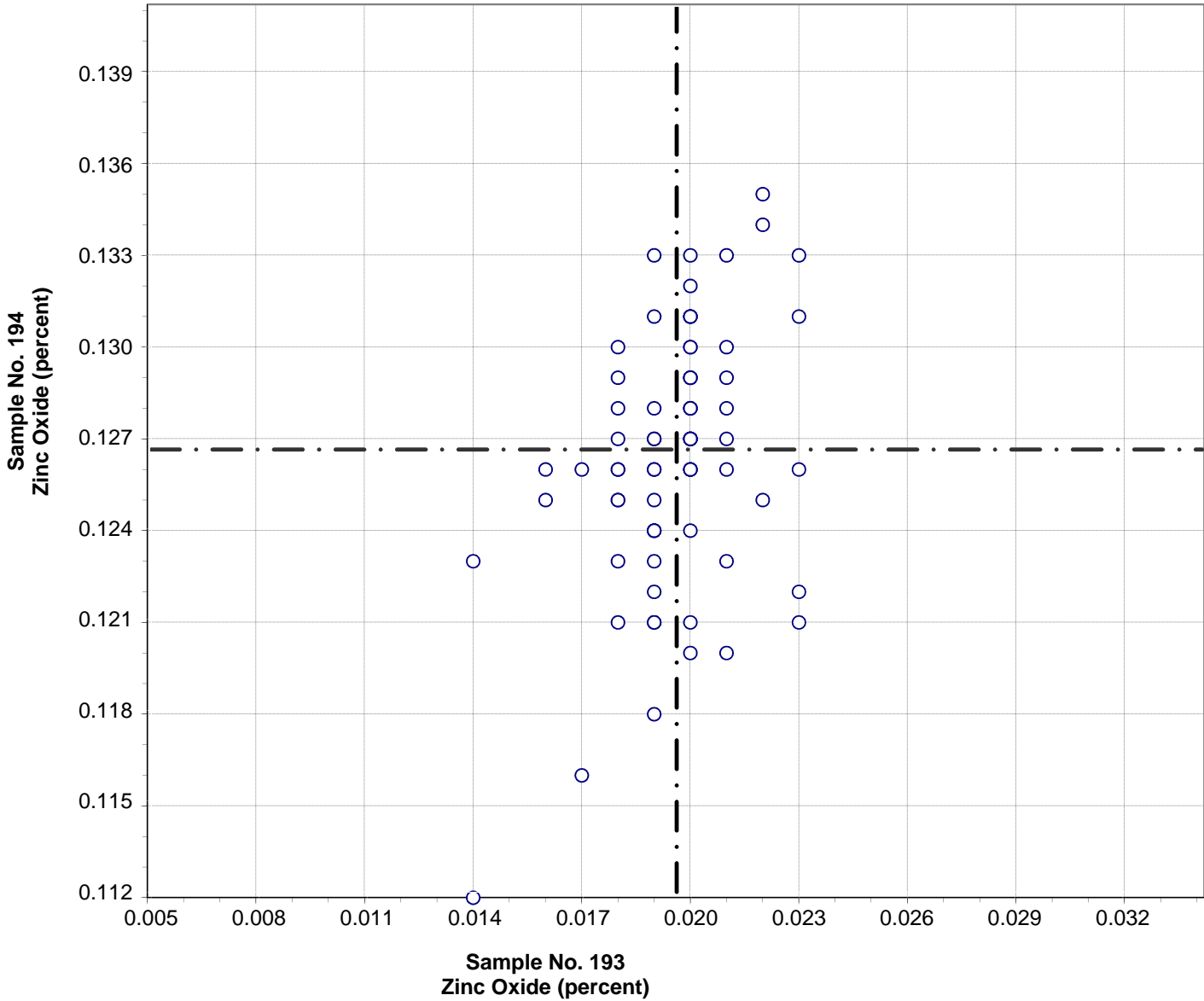
Test No. 102 Phosphorus Pentoxide 140 Points

Sample No. 193 Ave 0.096 S.D. 0.005 C.V. 4.8

Sample No. 194 Ave 0.181 S.D. 0.006 C.V. 3.2

Labs Eliminated: 3, 8, 10, 18, 34, 94, 101, 125, 132, 137, 139, 152, 416, 450, 494,
667, 692, 1799, 1940, 2477, 2491, 3279, 3695, 3807, 3966, 3976

**CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



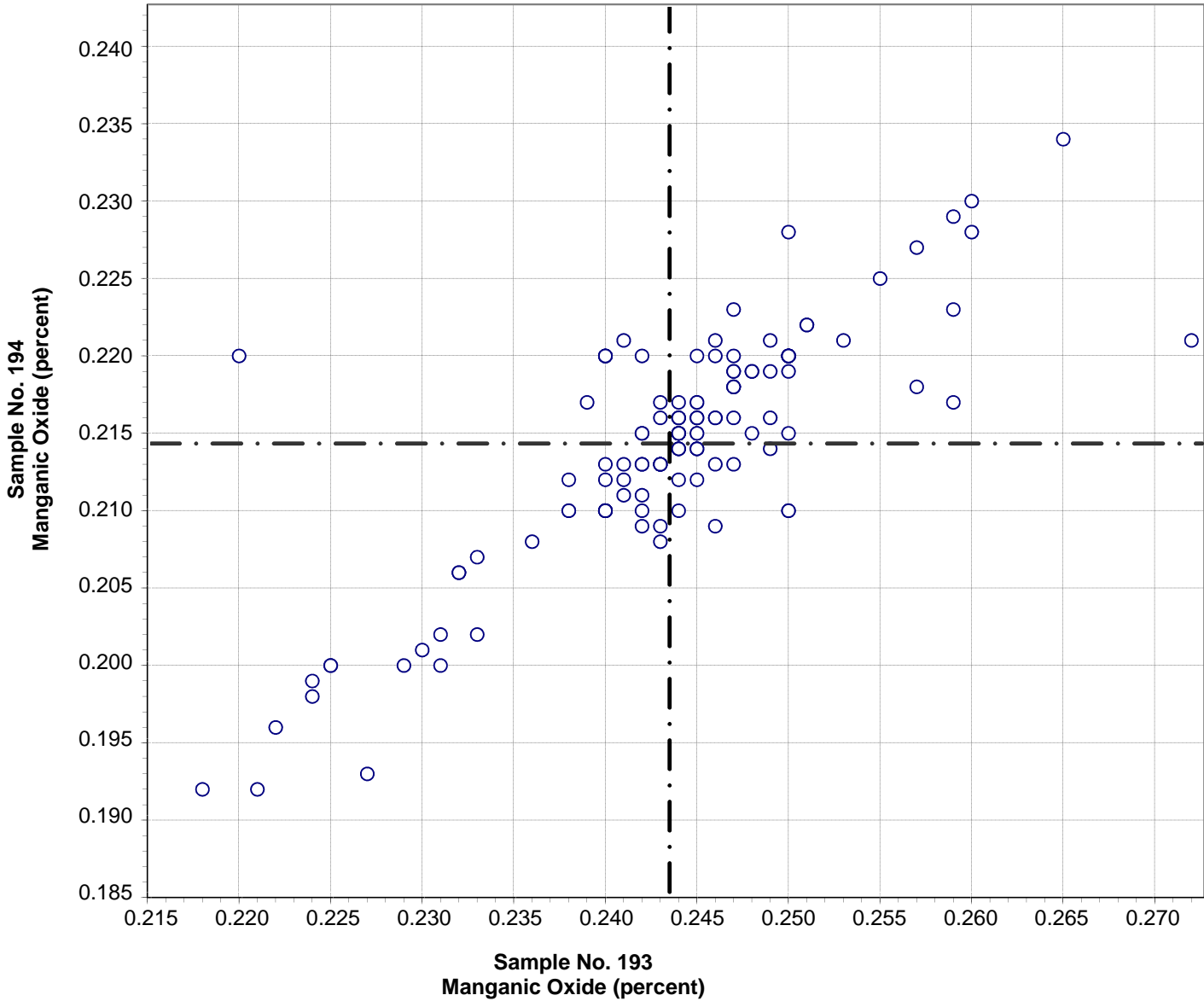
Test No. 99 Zinc Oxide 72 Points

Sample No. 193 Ave 0.020 S.D. 0.002 C.V. 9.5
 Sample No. 194 Ave 0.127 S.D. 0.005 C.V. 3.7

Labs Eliminated: 15, 40, 44, 142, 206, 255, 413, 768, 1054, 2296, 2477, 2483,
 2522, 3607

Labs off Diagram: 3752

**CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



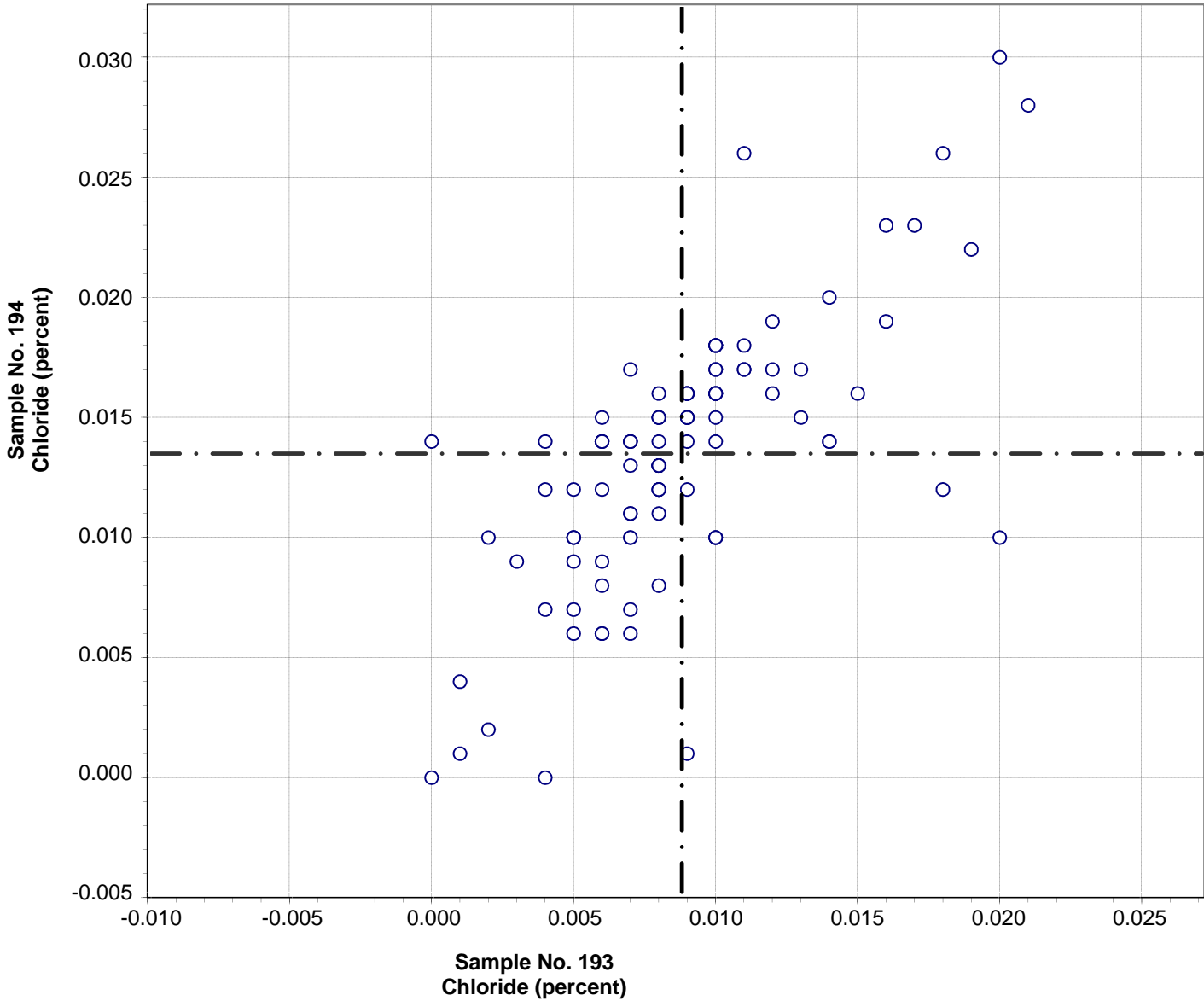
Test No. 101 Manganic Oxide 129 Points

Sample No. 193 Ave 0.243 S.D. 0.009 C.V. 3.5

Sample No. 194 Ave 0.214 S.D. 0.007 C.V. 3.5

Labs Eliminated: 18, 205, 221, 255, 768, 2477, 3238, 3607, 3807, 3966, 3976

**CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 193 and No. 194**



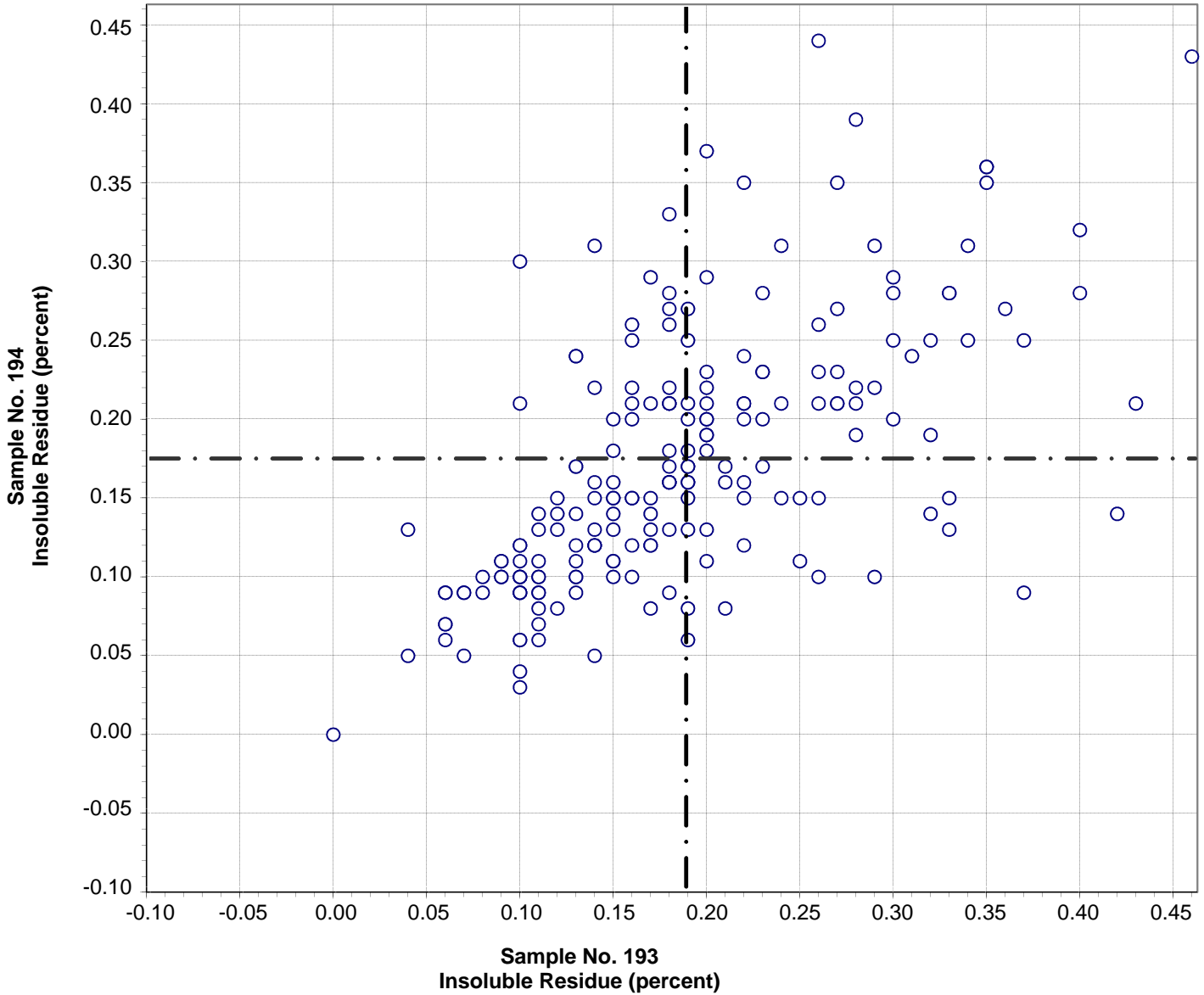
Test No. 104 Chloride 101 Points

Sample No. 193 Ave 0.009 S.D. 0.004 C.V. 48

Sample No. 194 Ave 0.013 S.D. 0.005 C.V. 41

Labs Eliminated: 493, 667, 1644, 1657, 2293, 2296, 2522, 3607, 3966, 3976

**CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 193 and No. 194**



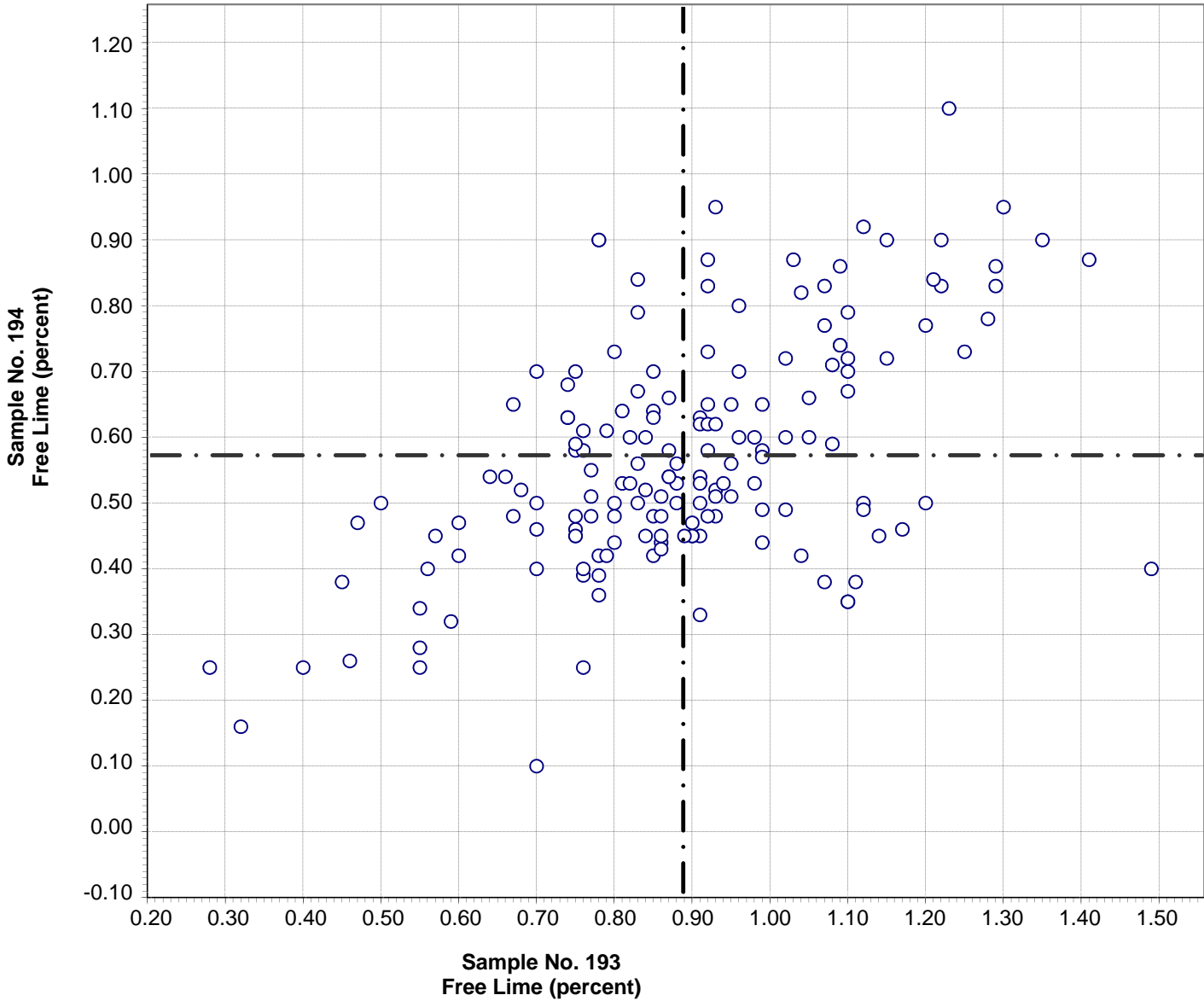
Test No. 80 Insoluble Residue 197 Points

Sample No. 193 Ave 0.19 S.D. 0.08 C.V. 45

Sample No. 194 Ave 0.17 S.D. 0.08 C.V. 47

Labs Eliminated: 4, 40, 92, 93, 94, 222, 309, 493, 687, 1025, 2490

**CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 193 and No. 194**



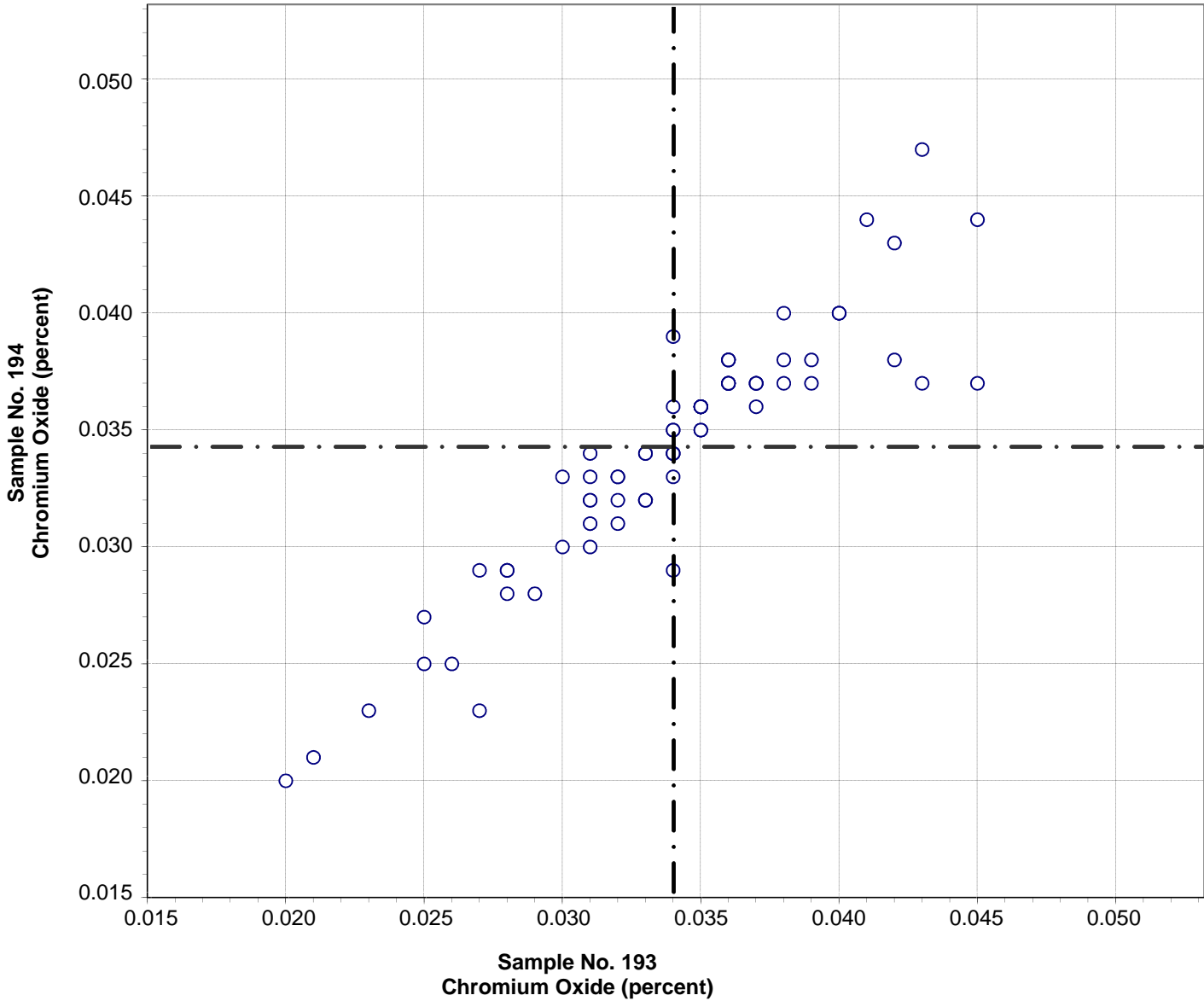
Test No. 41 Free Lime 164 Points

Sample No. 193	Ave 0.89	S.D. 0.21	C.V. 24
Sample No. 194	Ave 0.57	S.D. 0.18	C.V. 31

Labs Eliminated: 126, 169, 203, 206, 494

Labs off Diagram: 881

**CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 193 and No. 194**



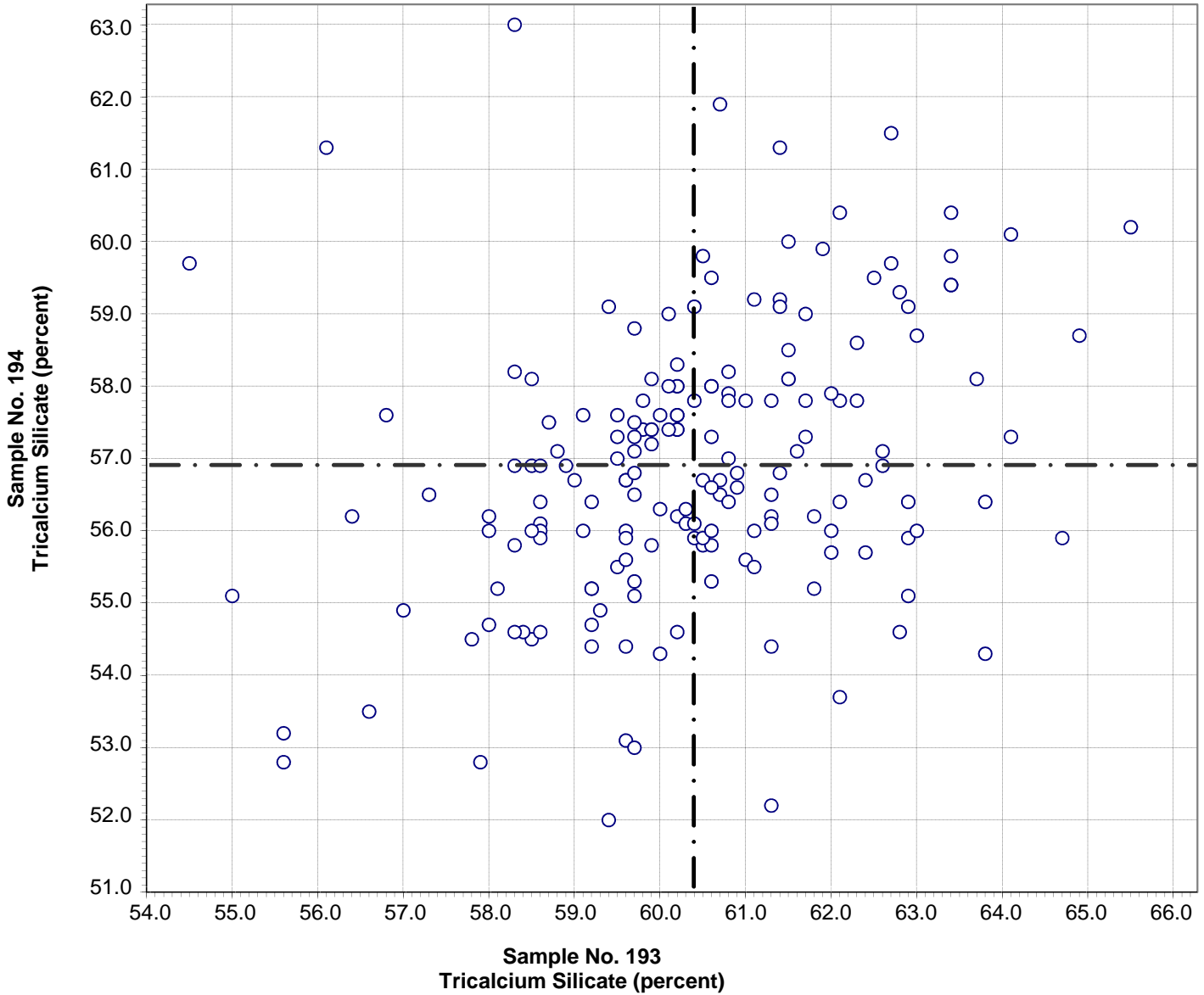
Test No. 105 Chromium Oxide 74 Points

Sample No. 193 Ave 0.034 S.D. 0.005 C.V. 15

Sample No. 194 Ave 0.034 S.D. 0.005 C.V. 15

Labs Eliminated: 54, 157, 254, 2296, 2477, 2522, 3057, 3752

**CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 106 Tricalcium Silicate 178 Points

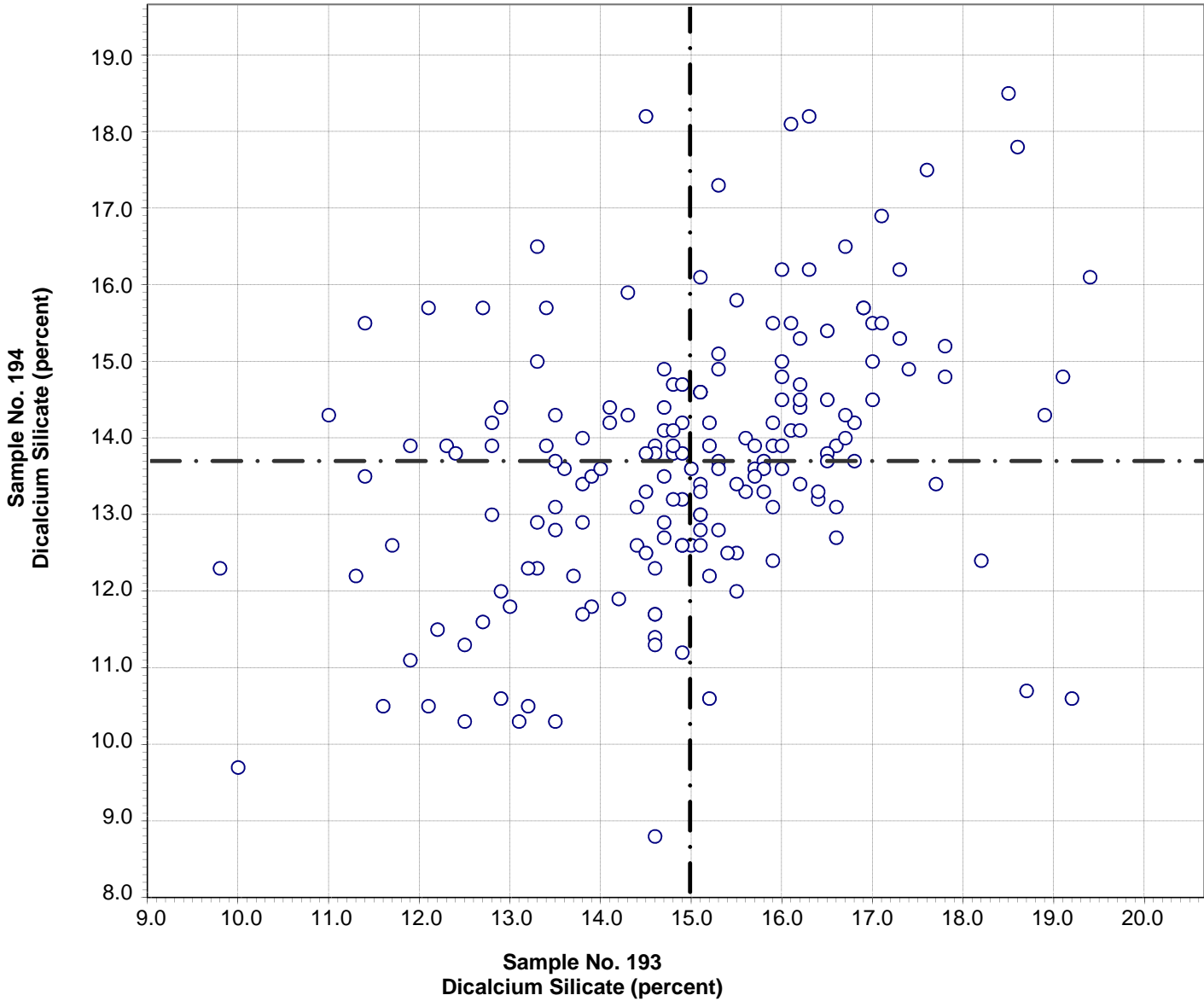
Sample No. 193 Ave 60.4 S.D. 2.0 C.V. 3.2

Sample No. 194 Ave 56.9 S.D. 2.0 C.V. 3.4

Labs Eliminated: 8, 176, 206, 289, 1644, 1942, 2296, 2437, 2477, 3695, 3938, 3966, 3970, 3976

Labs off Diagram: 99, 3297

**CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 107 Dicalcium Silicate 179 Points

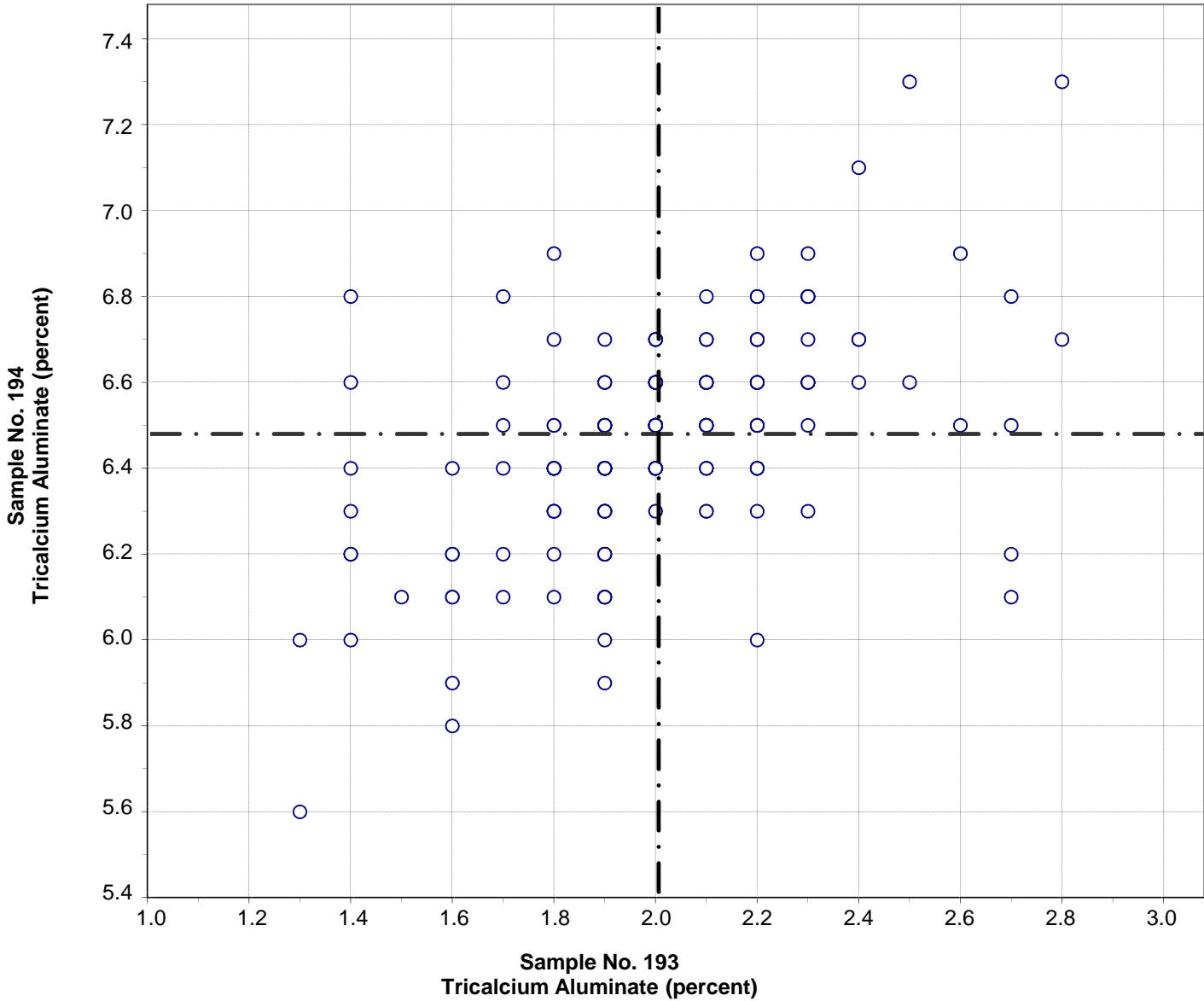
Sample No. 193 Ave 15.0 S.D. 1.8 C.V. 11.8

Sample No. 194 Ave 13.7 S.D. 1.8 C.V. 12.9

Labs Eliminated: 8, 18, 176, 206, 289, 1644, 1942, 1956, 2296, 2437, 3695, 3938, 3966, 3976

Labs off Diagram: 3859

**CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 108 Tricalcium Aluminate 182 Points

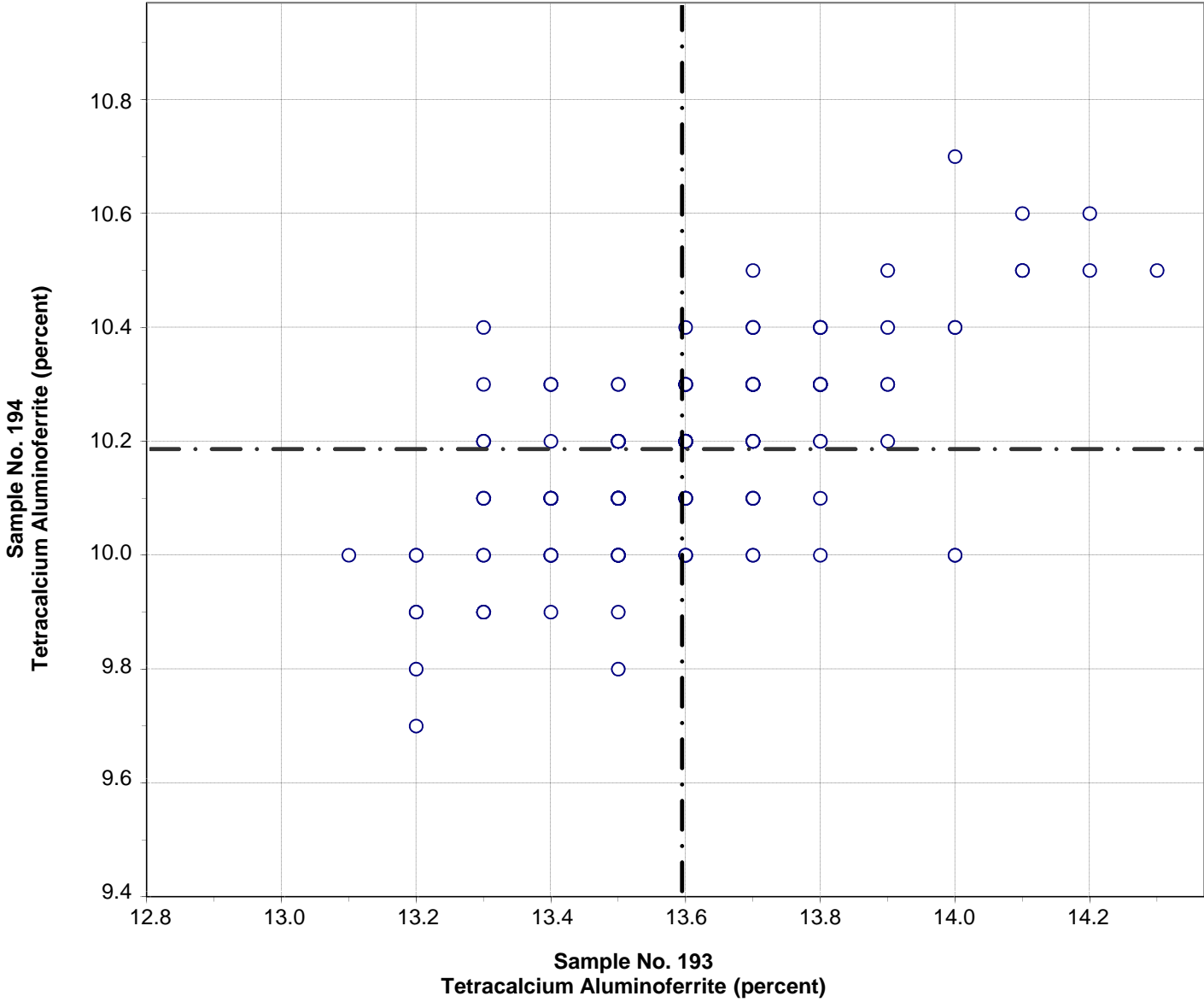
Sample No. 193 Ave 2.0 S.D. 0.3 C.V. 14.8

Sample No. 194 Ave 6.5 S.D. 0.2 C.V. 3.8

Labs Eliminated: 50, 60, 252, 975, 1942, 2477, 3297, 3415, 3966, 3976

Labs off Diagram: 1251, 3938

**CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 109 Tetracalcium Aluminoferrite 182 Points

Sample No. 193 Ave 13.6 S.D. 0.2 C.V. 1.5

Sample No. 194 Ave 10.2 S.D. 0.2 C.V. 1.5

Labs Eliminated: 60, 255, 354, 1251, 2477, 2934, 3279, 3415, 3661, 3966, 3970, 3976

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Physical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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Normal Consistency - % Water (percent)

237	24.0	0.64	2.70	25.6	0.61	2.40
*233	24.0	0.48	2.00	25.6	0.45	1.70

* Labs Eliminated - 9, 1079, 3966, 3976

Vicat Time of Set - Initial (minutes)

235	188	22	12	131	21	16
*224	188	21	11	129	14	11

* Labs Eliminated - 37, 38, 49, 69, 126, 180, 1079, 2254, 3297, 3368, 3779

Vicat Time of Set - Final (minutes)

228	301	41	14	248	35	14
*222	301	36	12	247	32	13

* Labs Eliminated - 3, 51, 255, 3297, 3859, 3973

Gillmore Time of Set - Initial (minutes)

145	219	31	14	170	27	16
*143	218	31	14	169	25	15

* Labs Eliminated - 94, 176

Gillmore Time of Set - Final (minutes)

145	332	42	13	287	44	15
*142	332	39	12	285	41	14

* Labs Eliminated - 3, 86, 3779

False Set - Paste Method (percent)

189	78	9.5	12.2	69	11.9	17.4
*188	78	9.2	11.8	69	12.0	17.4

* Labs Eliminated - 284

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Physical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Autoclave Expansion (percent)							
	218	0.02	0.021	100	0.03	0.026	90
	*202	0.02	0.013	57	0.03	0.015	51
* Labs Eliminated - 94, 103, 130, 159, 176, 407, 415, 497, 692, 1054, 1466, 2296, 3059, 3661, 3662, 3779							
Air Content % (percent)							
	224	8.5	1.7	20	9.0	1.8	20
	*220	8.5	1.3	15	9.0	1.3	14
* Labs Eliminated - 34, 180, 698, 3970							
Air Content - % Water (percent)							
	219	66.5	9.1	13.7	67.7	9.4	13.9
	*208	68.0	2.6	3.9	69.1	2.4	3.5
* Labs Eliminated - 26, 49, 60, 151, 176, 667, 690, 1054, 2412, 3297, 3970							
Air Content - Flow (percent)							
	219	88	4.1	4.7	87	3.3	3.8
	*217	88	3.7	4.2	87	3.3	3.7
* Labs Eliminated - 93, 360							
Compressive Strength - 3 day (psi)							
	242	2980	245	8.2	4060	317	7.8
	*237	2969	201	6.8	4066	269	6.6
* Labs Eliminated - 38, 151, 823, 3966, 3976							
Compressive Strength - 7 day (psi)							
	241	3659	302	8.3	4800	308	6.4
	*237	3646	243	6.7	4798	271	5.7
* Labs Eliminated - 38, 691, 1222, 2412							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Physical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Compressive Strength - 28 day (psi)							
	233	5328	530	9.9	5689	538	9.5
	*230	5347	359	6.7	5714	377	6.6
* Labs Eliminated - 38, 180, 3057							
Compressive Strength - Flow (percent)							
	216	124	11	8.9	115	11	9.6
	*208	125	9	7.2	116	8	7.3
* Labs Eliminated - 5, 24, 48, 175, 180, 247, 2296, 3970							
Fineness - Air Permeability (m²/kg)							
	230	378	14	3.7	376	14	3.8
	*222	377	10	2.6	375	9	2.5
* Labs Eliminated - 15, 26, 40, 51, 116, 148, 360, 690							
Fineness - Wagner Turbidimeter (m²/kg)							
	4	212	18	8.3	204	16	8.0
No Labs Eliminated for This Test							
Fineness - 45µm Sieve (percent)							
	218	95.51	1.02	1.07	93.89	1.15	1.23
	*203	95.66	0.66	0.69	94.01	0.71	0.75
* Labs Eliminated - 3, 40, 50, 51, 54, 116, 180, 181, 413, 415, 565, 823, 2484, 3236, 3752							
C1038 Mortar Bar Expansion (percent)							
	159	0.007	0.004	60	0.005	0.009	173
	*151	0.007	0.003	45	0.005	0.003	54
* Labs Eliminated - 34, 99, 413, 438, 497, 823, 1251, 3976							
C1038 Mortar - Water (ml)							
	154	234	17	7.3	239	19	7.9
	*147	233	7	3.1	239	5	2.2
* Labs Eliminated - 26, 440, 450, 691, 840, 3059, 3970							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Physical Results
 September 3, 2014

SUMMARY OF RESULTS

Sample No.193

Sample No. 194

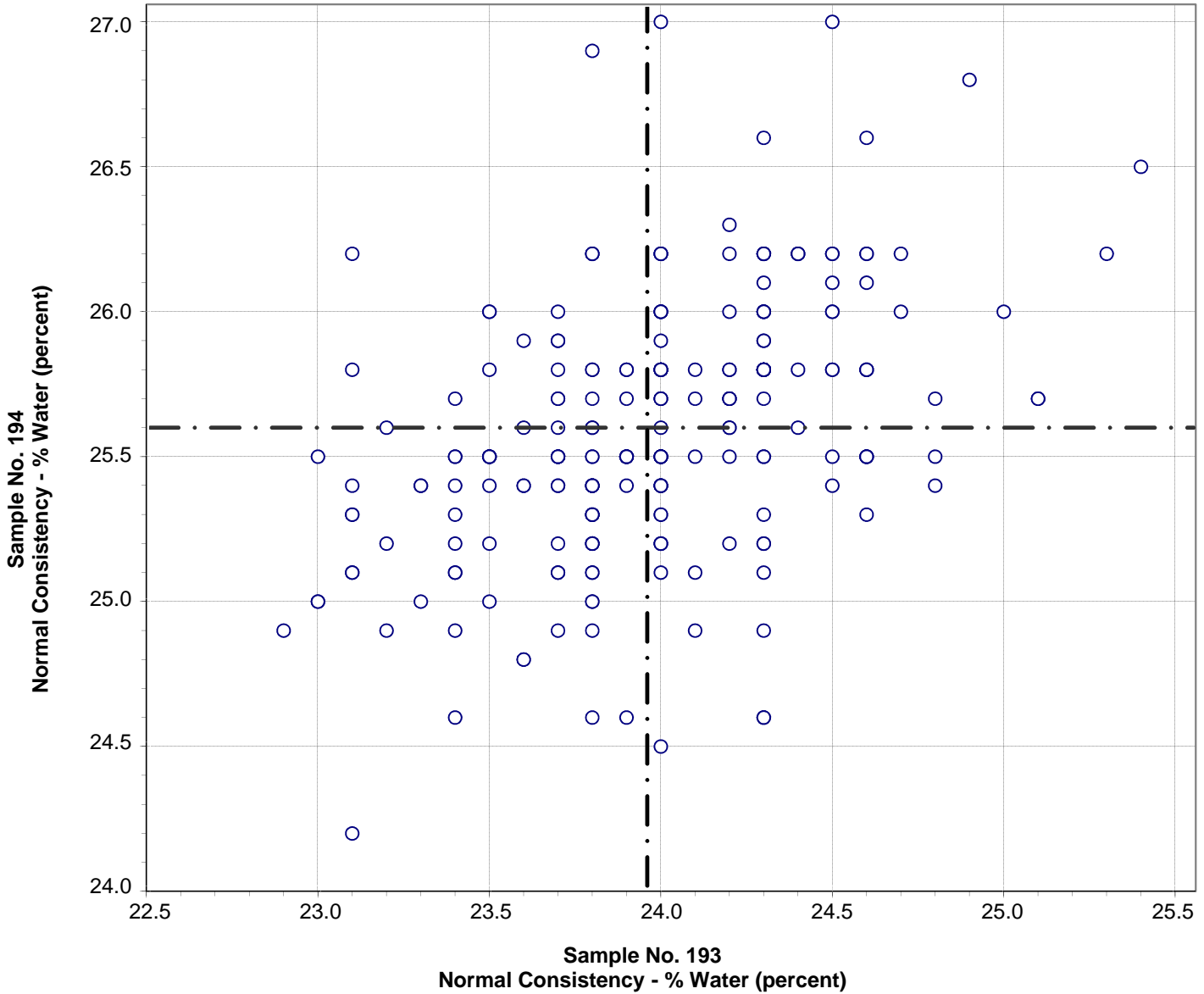
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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C1038 Mortar - Flow (percent)

	154	110	6	5.4	109	6	5.2
	*147	110	3	2.5	109	3	2.4

* Labs Eliminated - 26, 66, 134, 442, 996, 3662, 3966

CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 193 and No. 194



Test No. 110 Normal Consistency - % Water 230 Points

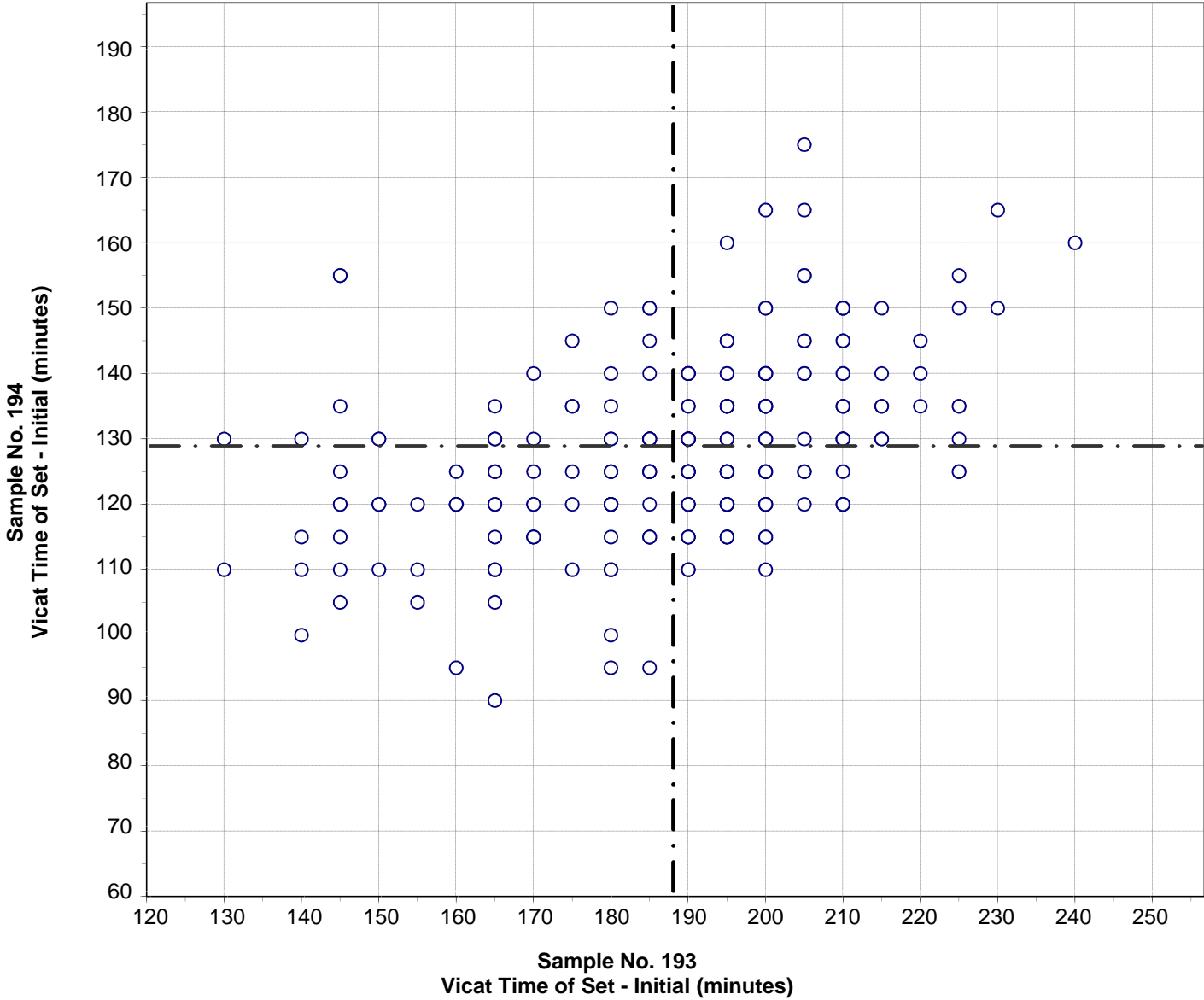
Sample No. 193 Ave 24.0 S.D. 0.48 C.V. 2.00

Sample No. 194 Ave 25.6 S.D. 0.45 C.V. 1.70

Labs Eliminated: 9, 1079, 3966, 3976

Labs off Diagram: 1956, 3605, 3973

CCRL Proficiency Sample Program
Vicat Time of Set - Initial
PORTLAND CEMENT Samples No. 193 and No. 194



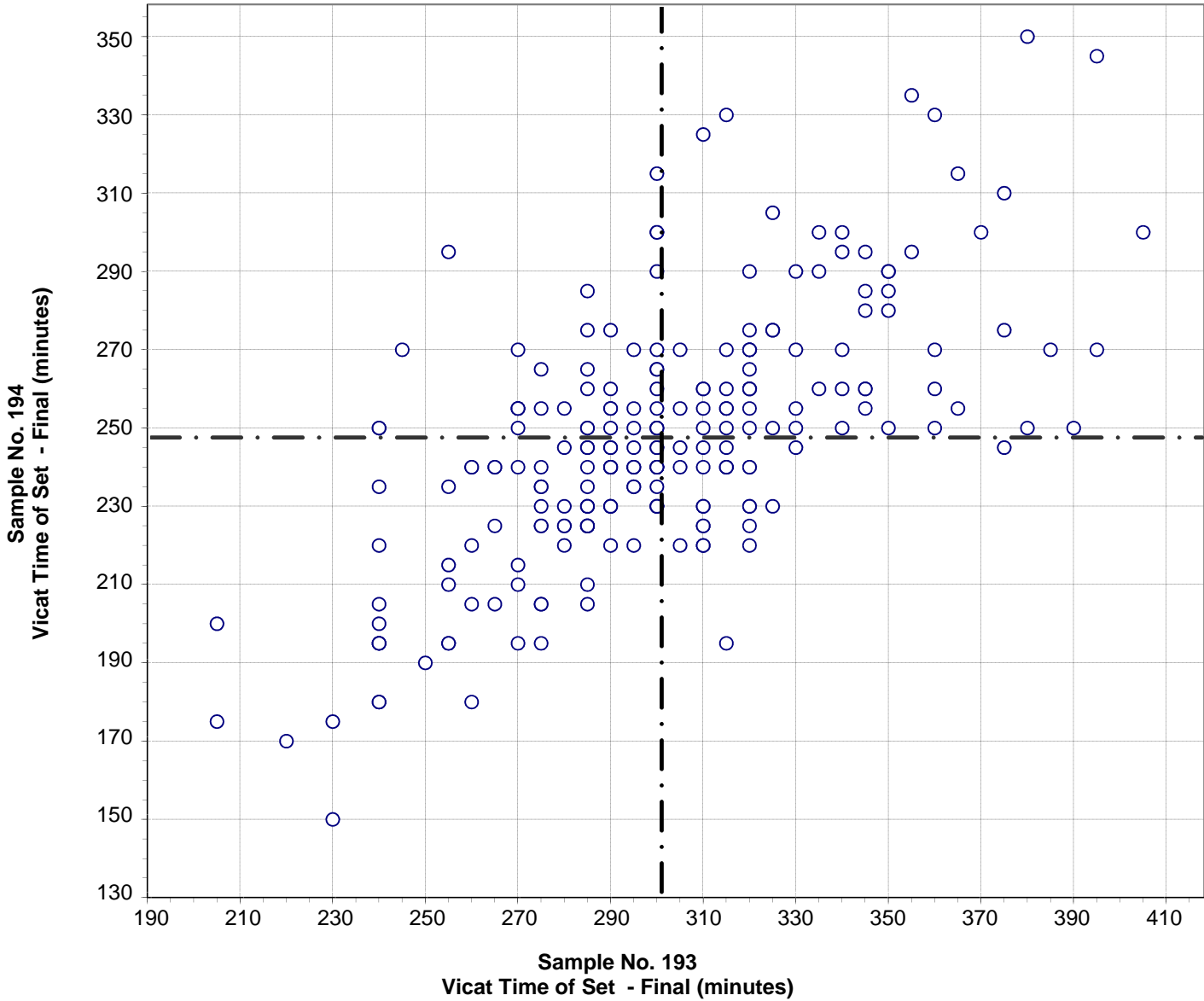
Test No. 120 Vicat Time of Set - Initial 224 Points

Sample No. 193 Ave 188 S.D. 21 C.V. 11

Sample No. 194 Ave 129 S.D. 14 C.V. 11

Labs Eliminated: 37, 38, 49, 69, 126, 180, 1079, 2254, 3297, 3368, 3779

CCRL Proficiency Sample Program
Vicat Time of Set - Final
PORTLAND CEMENT Samples No. 193 and No. 194

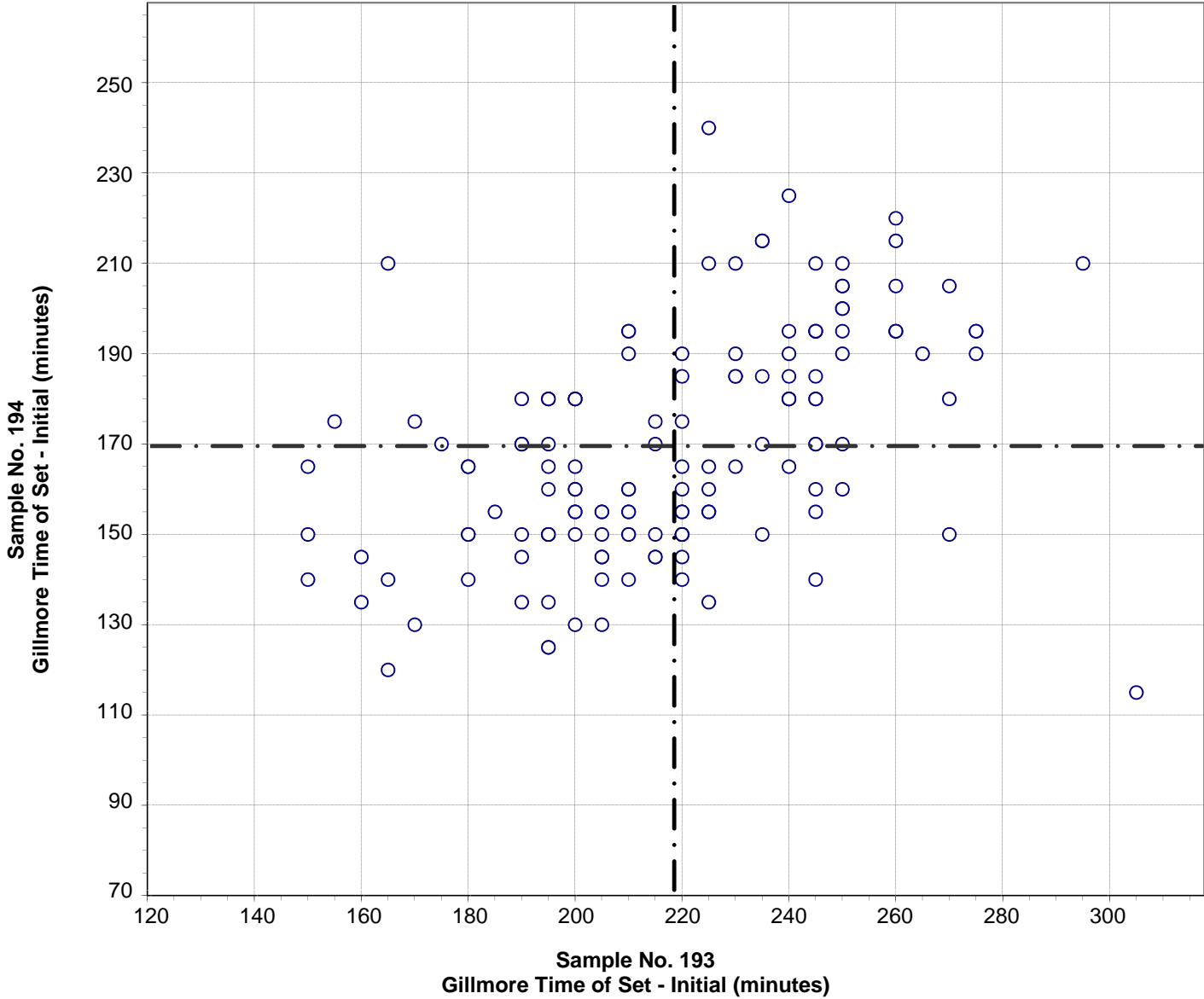


Test No. 121 Vicat Time of Set - Final 222 Points

Sample No. 193	Ave 301	S.D. 36	C.V. 12
Sample No. 194	Ave 247	S.D. 32	C.V. 13

Labs Eliminated: 3, 51, 255, 3297, 3859, 3973

**CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 193 and No. 194**

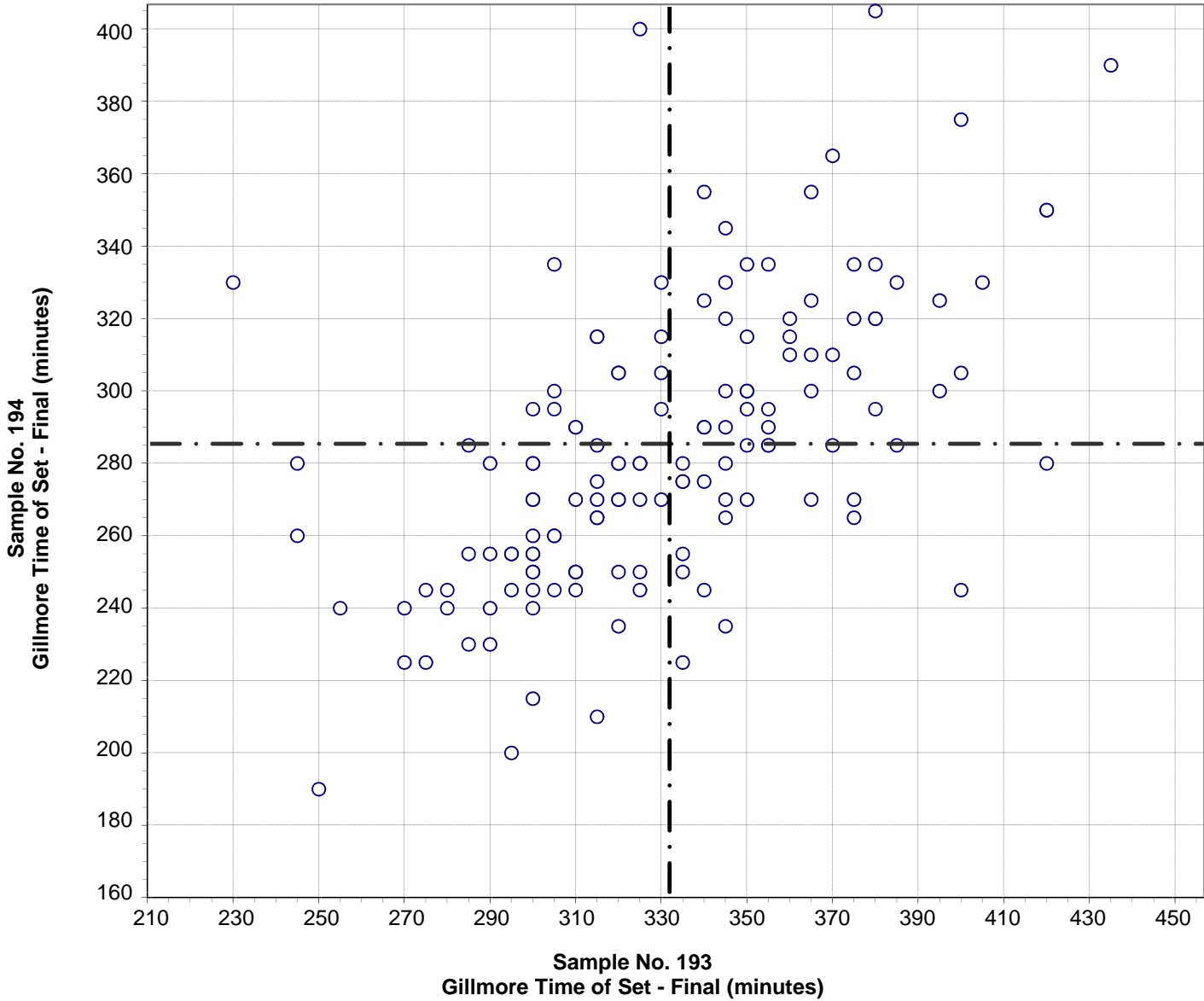


Test No. 130 Gillmore Time of Set - Initial 143 Points

Sample No. 193	Ave 218	S.D. 31	C.V. 14
Sample No. 194	Ave 169	S.D. 25	C.V. 15

Labs Eliminated: 94, 176

**CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 193 and No. 194**



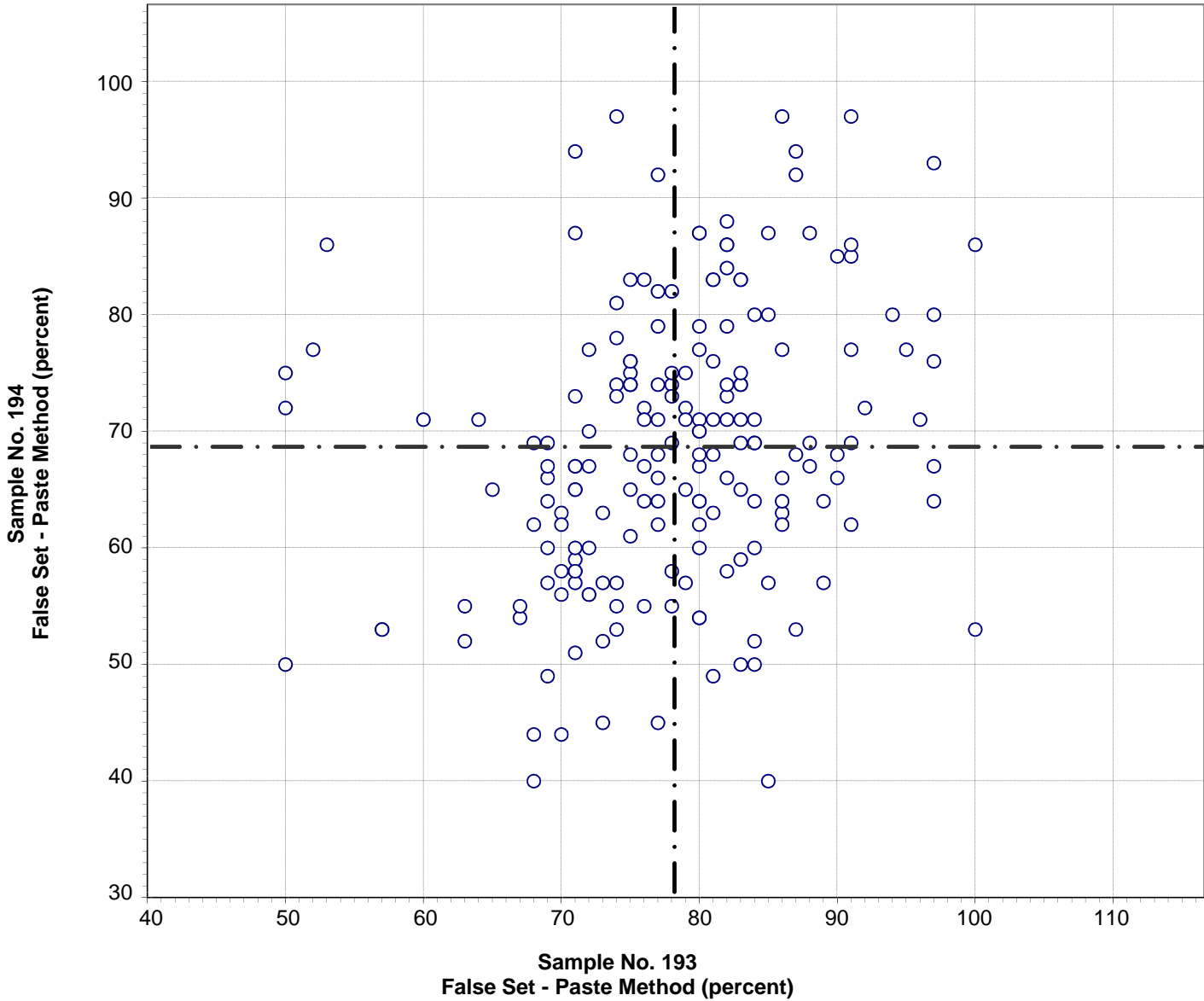
Test No. 140 Gillmore Time of Set - Final 141 Points

Sample No. 193	Ave 332	S.D. 39	C.V. 12
Sample No. 194	Ave 285	S.D. 41	C.V. 14

Labs Eliminated: 3, 86, 3779

Labs off Diagram: 18

**CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 193 and No. 194**

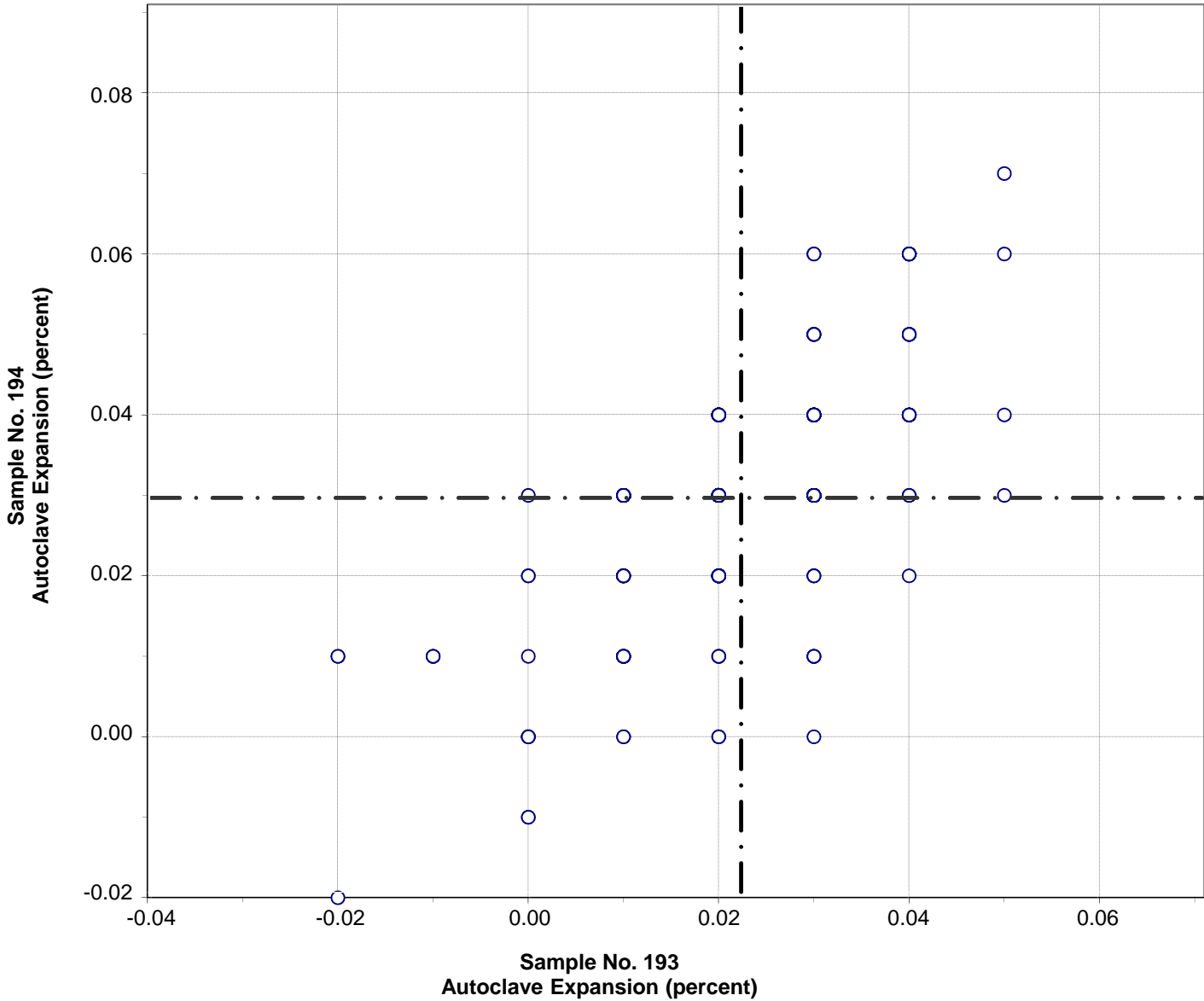


Test No. 150 False Set - Paste Method 188 Points

Sample No. 193	Ave 78	S.D. 9.2	C.V. 11.8
Sample No. 194	Ave 69	S.D. 12.0	C.V. 17.4

Labs Eliminated: 284

**CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 193 and No. 194**



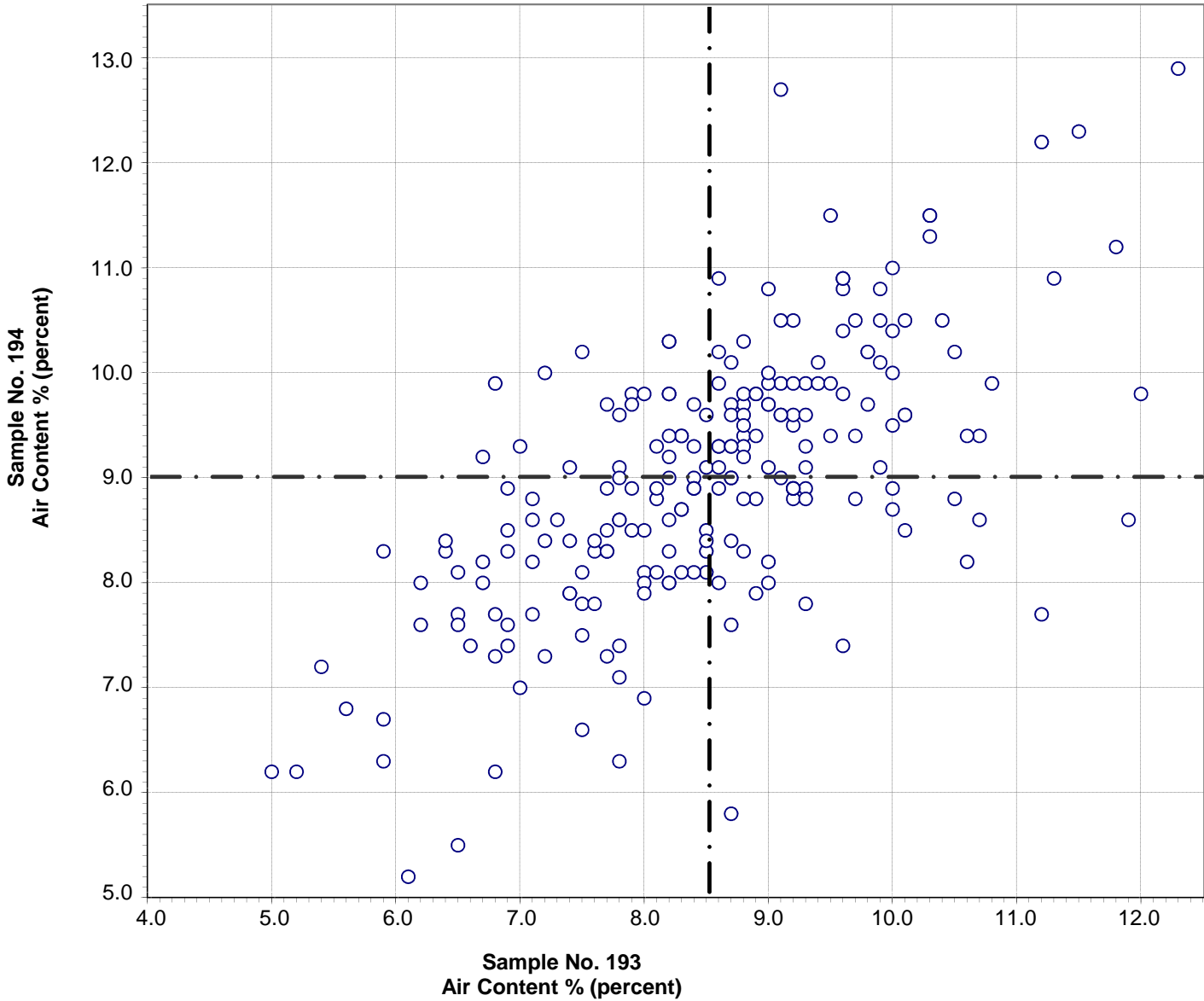
Test No. 160 Autoclave Expansion 202 Points

Sample No. 193 Ave 0.02 S.D. 0.013 C.V. 57

Sample No. 194 Ave 0.03 S.D. 0.015 C.V. 51

Labs Eliminated: 94, 103, 130, 159, 176, 407, 415, 497, 692, 1054, 1466, 2296,
3059, 3661, 3662, 3779

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 193 and No. 194

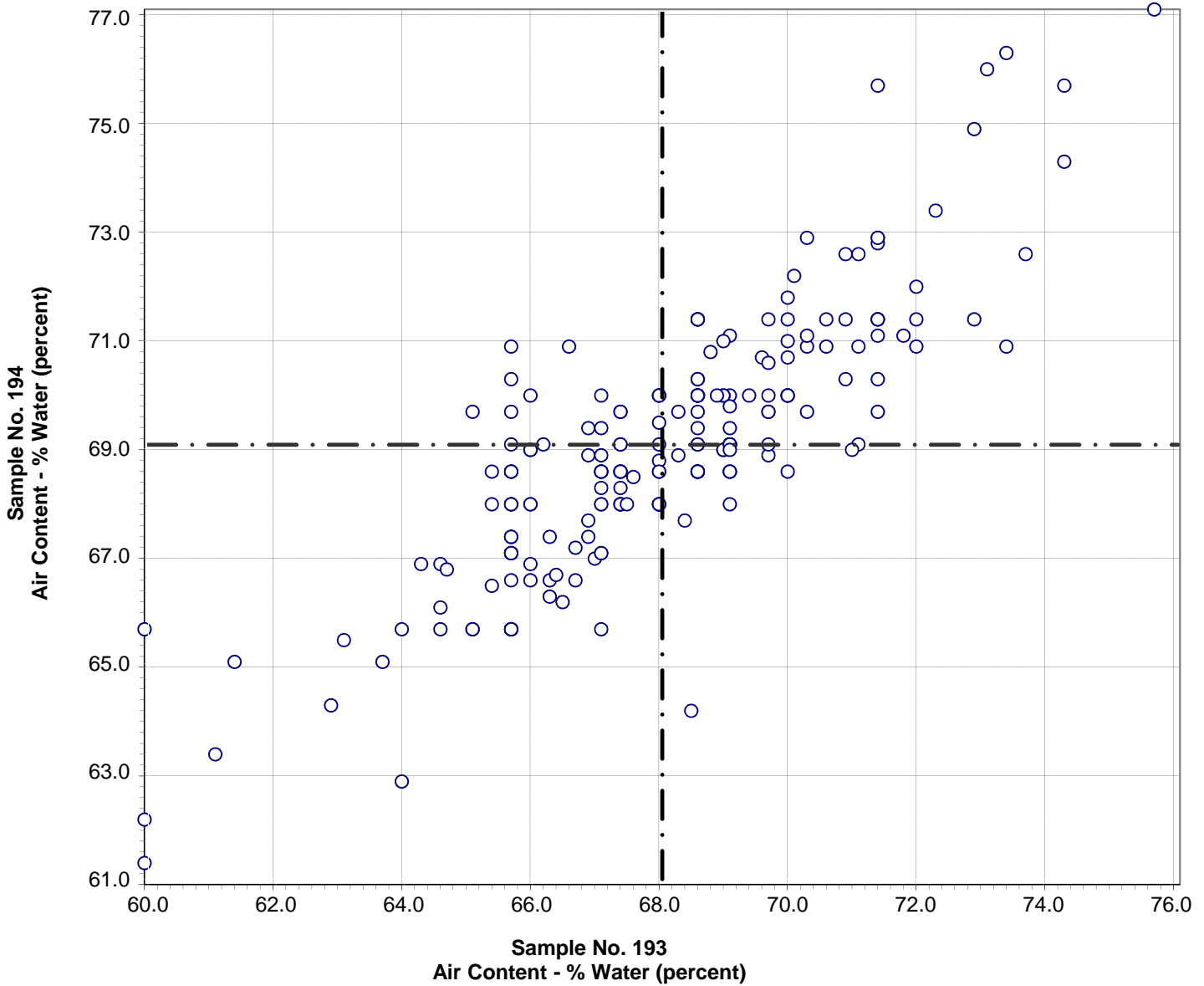


Test No. 170 Air Content % 220 Points

Sample No. 193	Ave 8.5	S.D. 1.3	C.V. 15
Sample No. 194	Ave 9.0	S.D. 1.3	C.V. 14

Labs Eliminated: 34, 180, 698, 3970

CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 193 and No. 194



Test No. 180 Air Content - % Water 207 Points

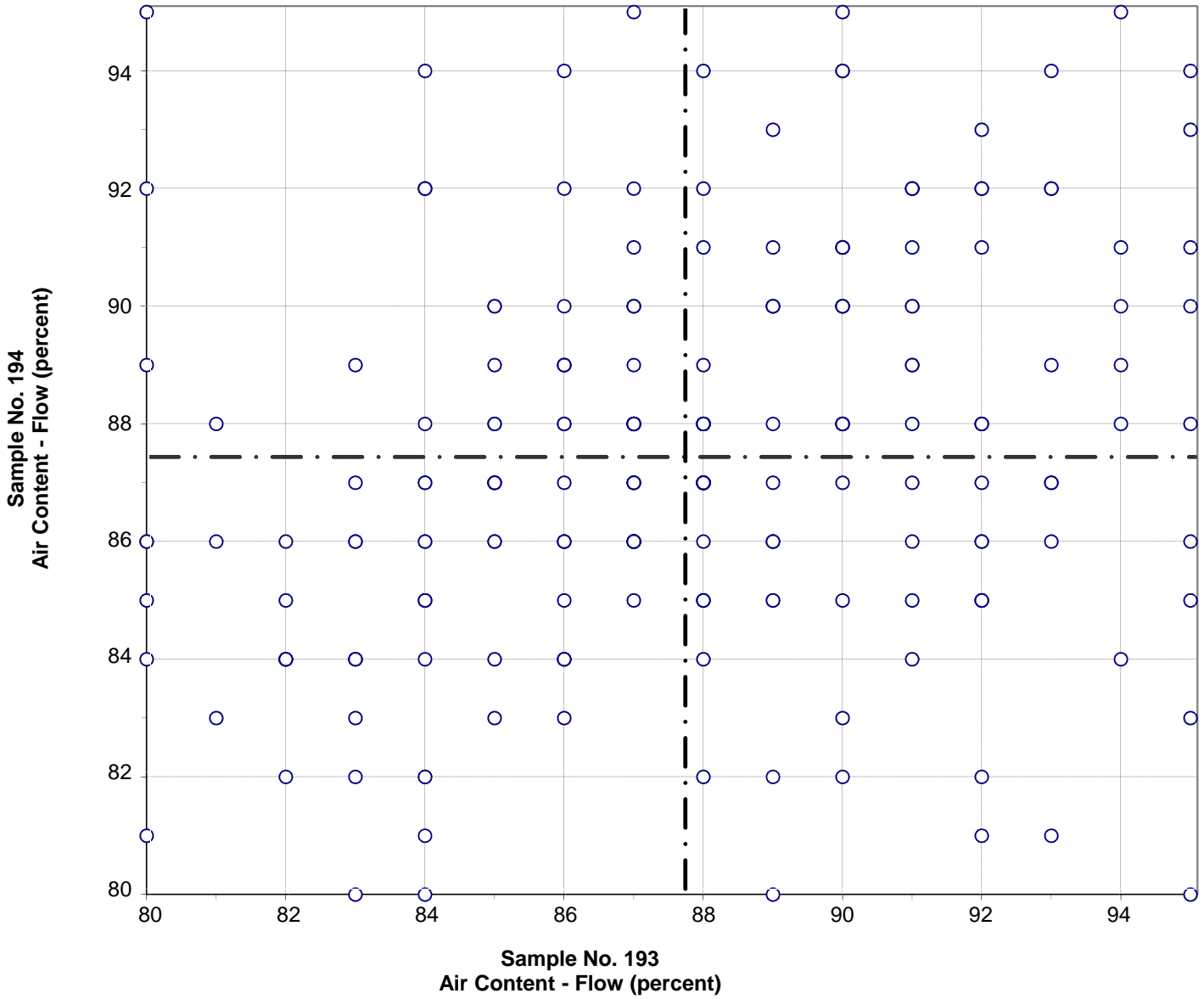
Sample No. 193 Ave 68.0 S.D. 2.6 C.V. 3.9

Sample No. 194 Ave 69.1 S.D. 2.4 C.V. 3.5

Labs Eliminated: 26, 49, 60, 151, 176, 667, 690, 1054, 2412, 3297, 3970

Labs off Diagram: 110

CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 193 and No. 194

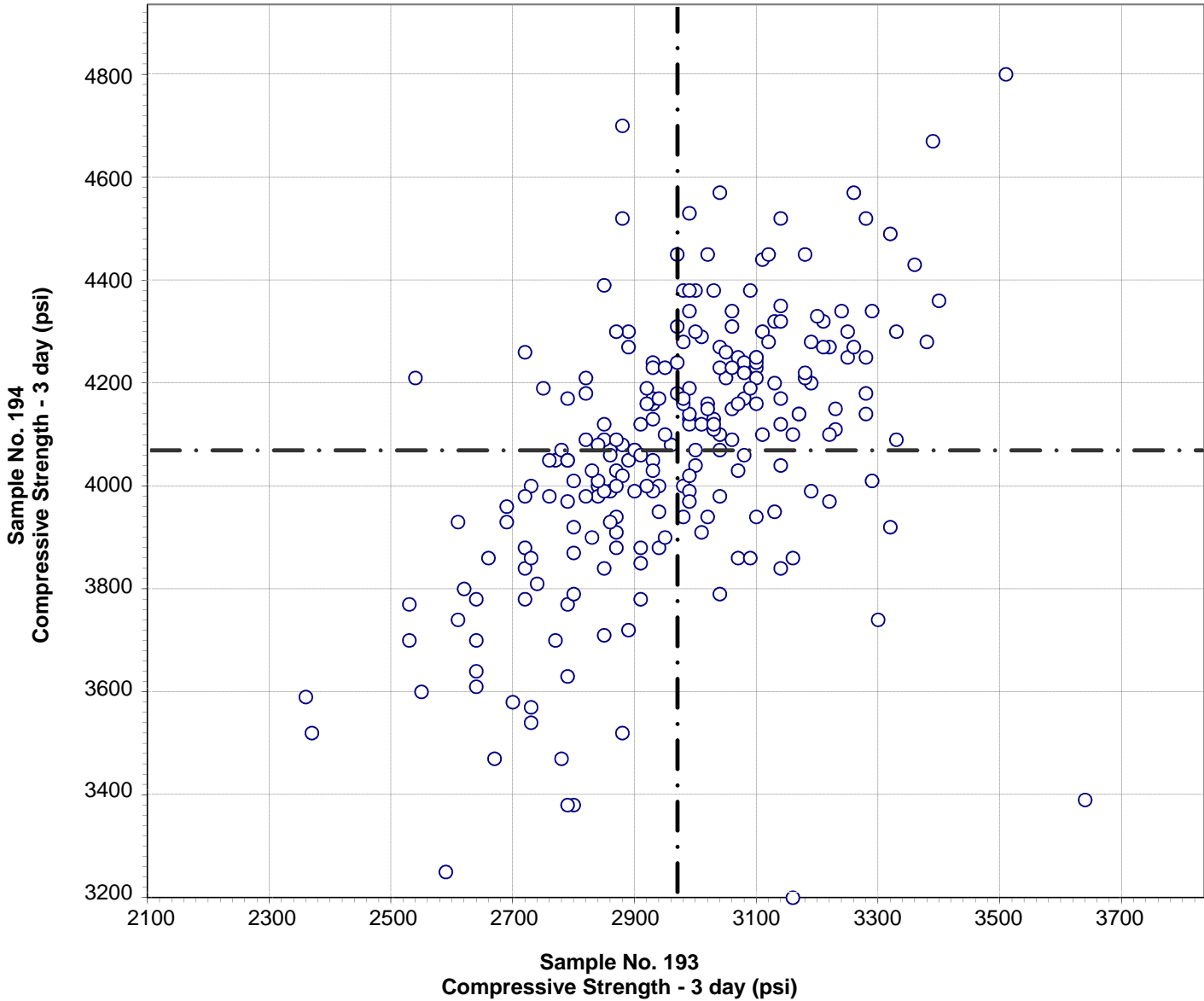


Test No. 190 Air Content - Flow 217 Points

Sample No. 193	Ave 88	S.D. 3.7	C.V. 4.2
Sample No. 194	Ave 87	S.D. 3.3	C.V. 3.7

Labs Eliminated: 93, 360

**CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 200 Compressive Strength - 3 day 235 Points

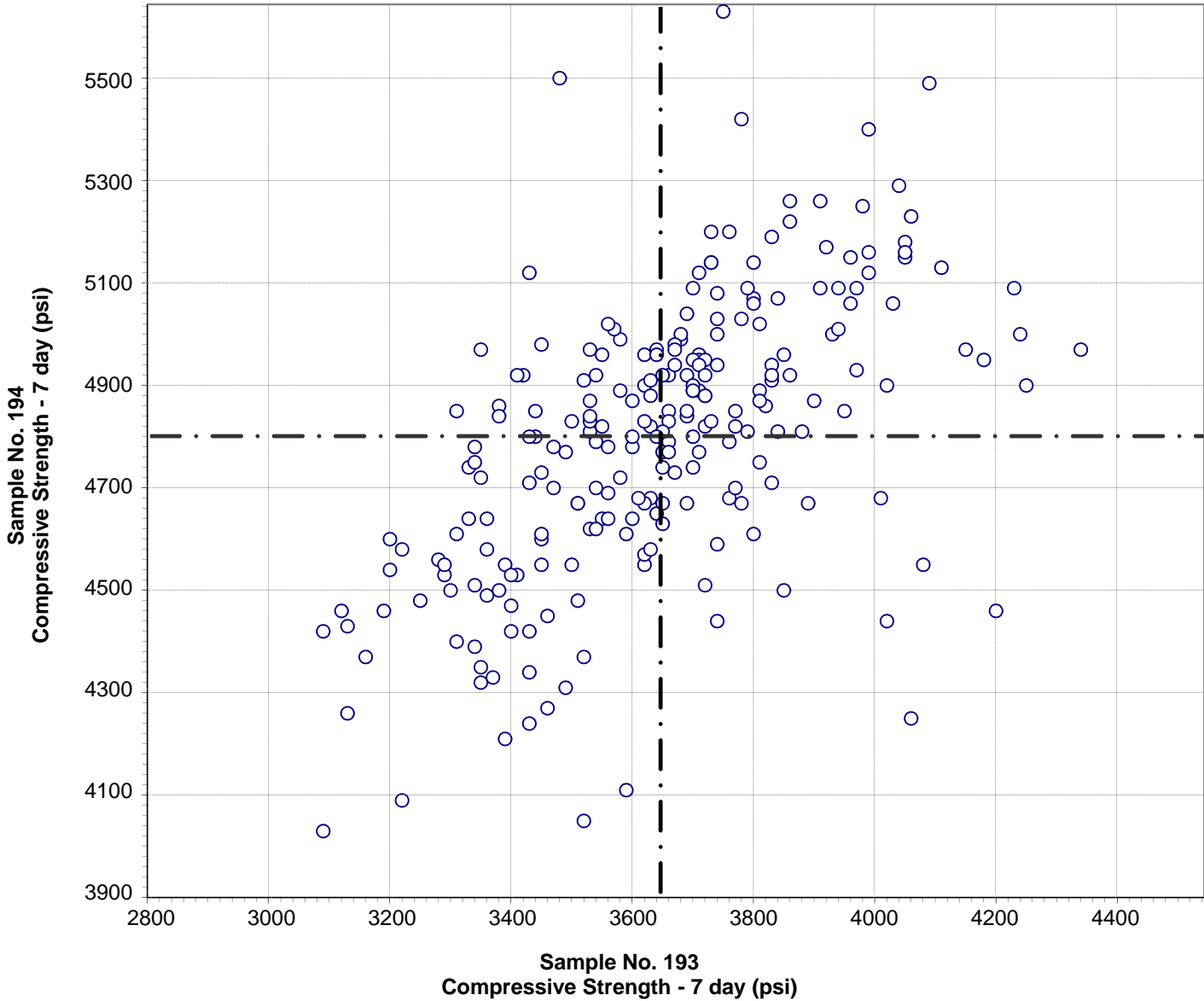
Sample No. 193 Ave 2969 S.D. 201 C.V. 6.8

Sample No. 194 Ave 4066 S.D. 269 C.V. 6.6

Labs Eliminated: 38, 151, 823, 3966, 3976

Labs off Diagram: 46, 1222

**CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 193 and No. 194**

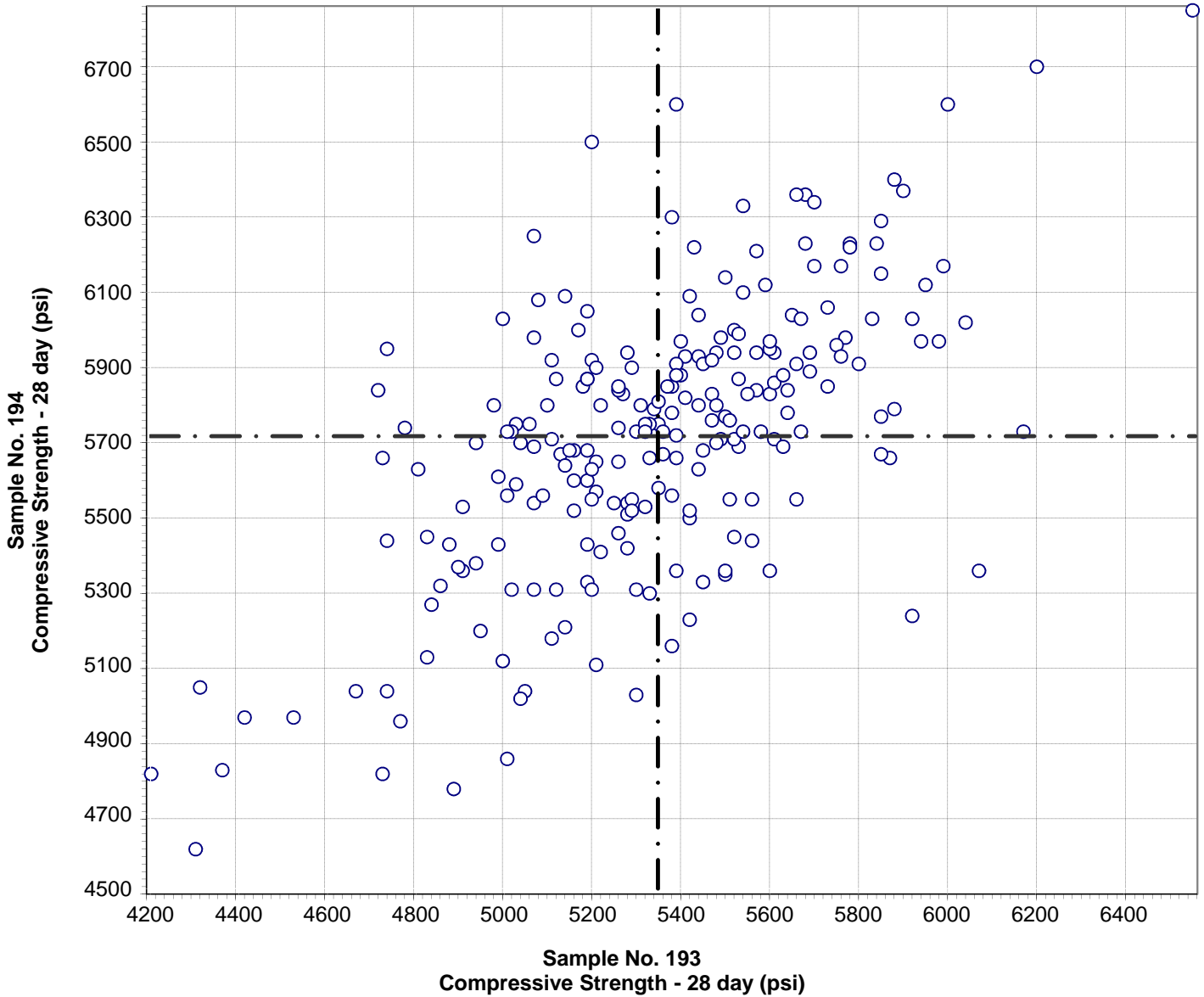


Test No. 210 Compressive Strength - 7 day 237 Points

Sample No. 193	Ave 3646	S.D. 243	C.V. 6.7
Sample No. 194	Ave 4798	S.D. 271	C.V. 5.7

Labs Eliminated: 38, 691, 1222, 2412

**CCRL Proficiency Sample Program
Compressive Strength - 28 day
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 211 Compressive Strength - 28 day 229 Points

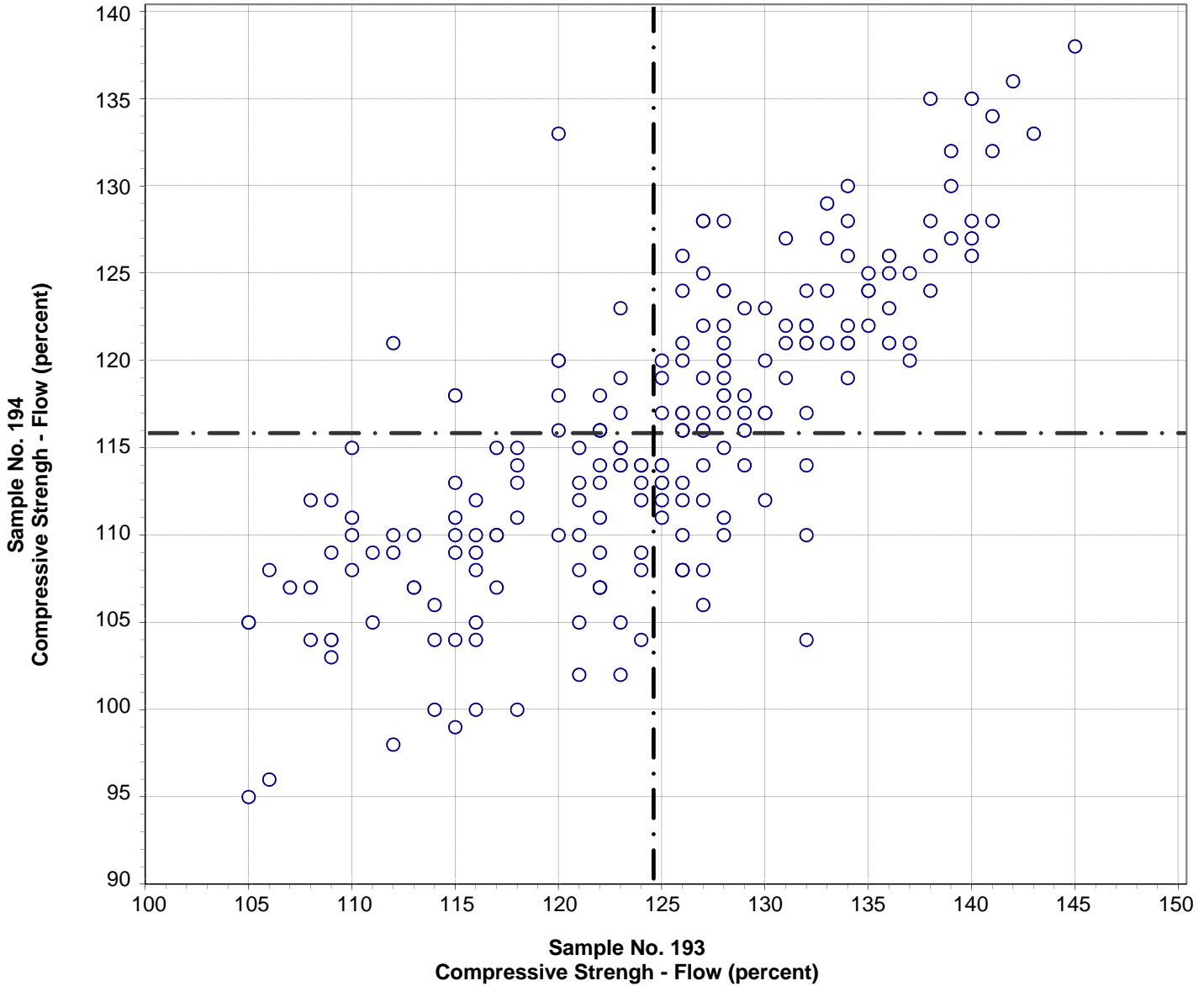
Sample No. 193 Ave 5347 S.D. 359 C.V. 6.7

Sample No. 194 Ave 5714 S.D. 377 C.V. 6.6

Labs Eliminated: 38, 180, 3057

Labs off Diagram: 2412

**CCRL Proficiency Sample Program
Compressive Strength - Flow
PORTLAND CEMENT Samples No. 193 and No. 194**



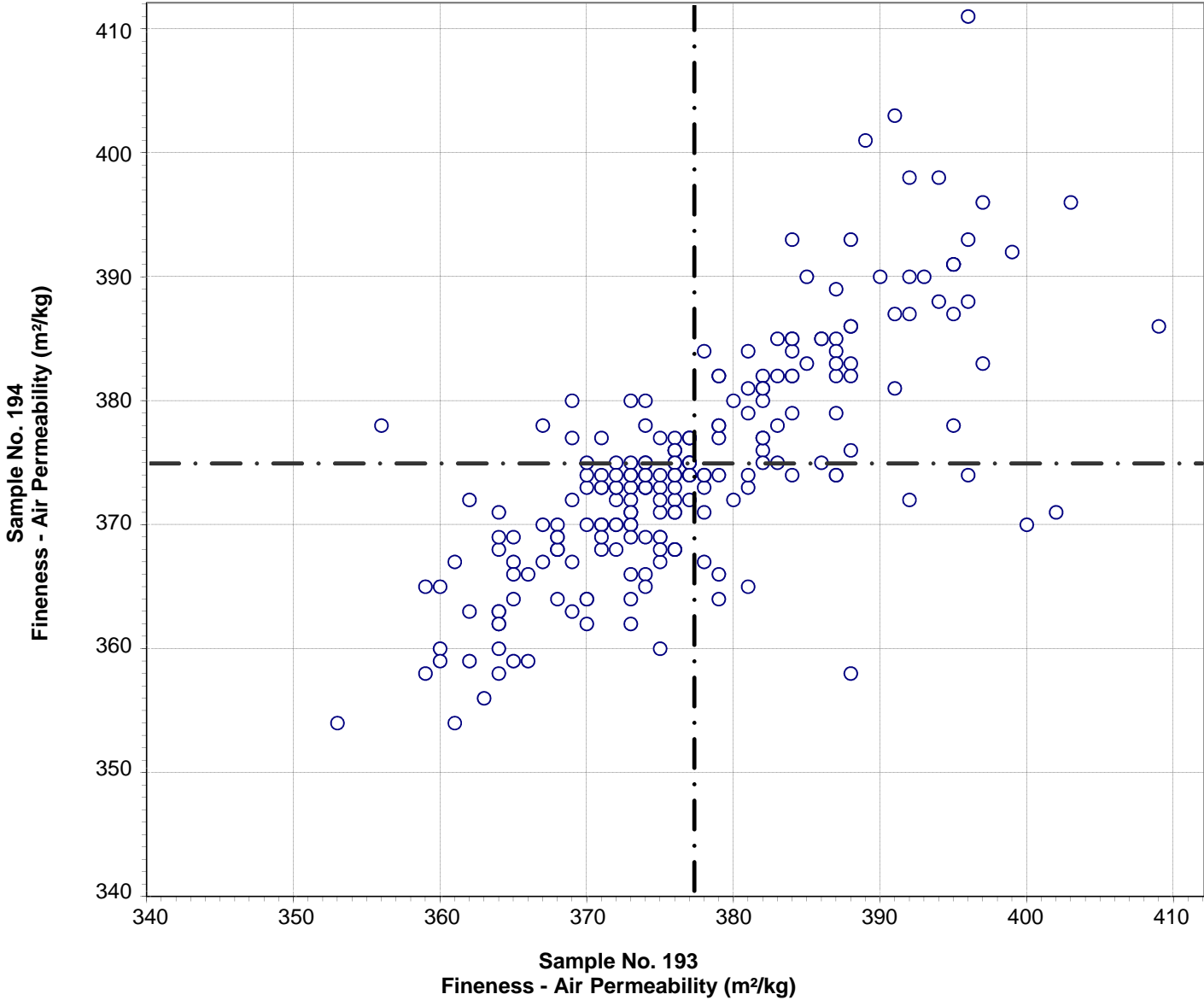
Test No. 230 Compressive Strength - Flow 208 Points

Sample No. 193 Ave 125 S.D. 9 C.V. 7.2

Sample No. 194 Ave 116 S.D. 8 C.V. 7.3

Labs Eliminated: 5, 24, 48, 175, 180, 247, 2296, 3970

**CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 193 and No. 194**



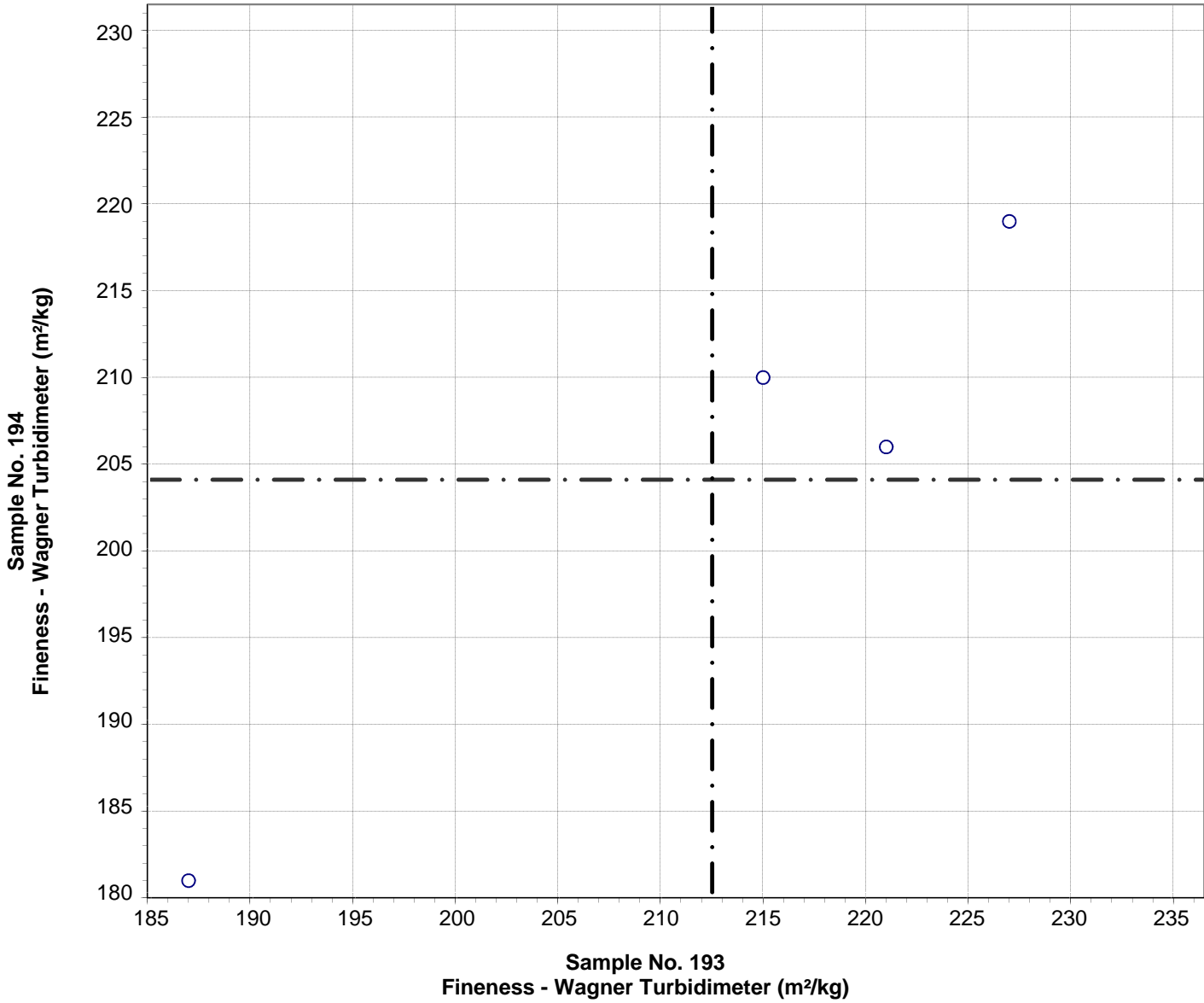
Test No. 270 Fineness - Air Permeability 222 Points

Sample No. 193 Ave 377 S.D. 10 C.V. 2.6

Sample No. 194 Ave 375 S.D. 9 C.V. 2.5

Labs Eliminated: 15, 26, 40, 51, 116, 148, 360, 690

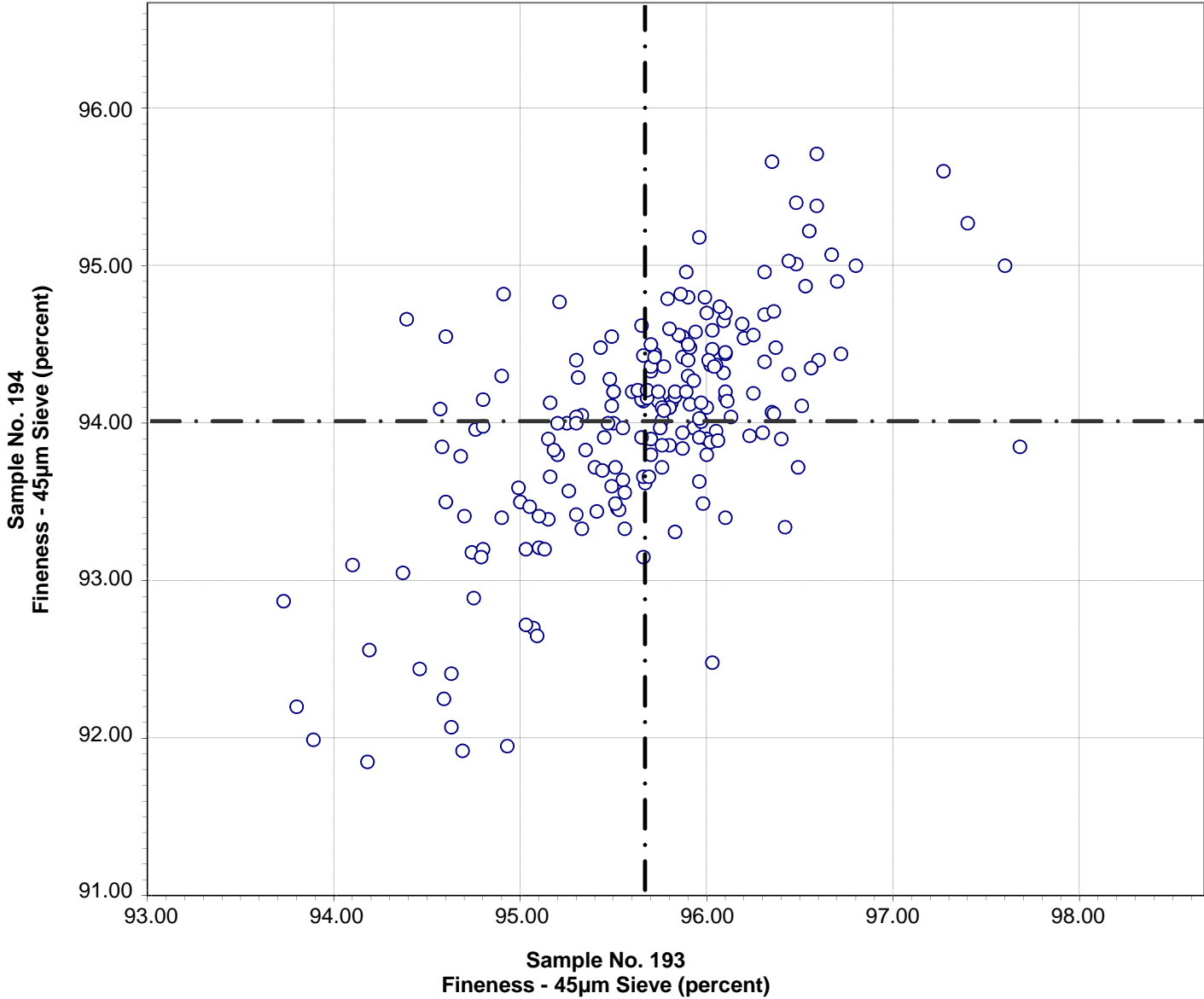
**CCRL Proficiency Sample Program
Fineness - Wagner Turbidimeter
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 280 Fineness - Wagner Turbidimeter 4 Points

Sample No. 193	Ave 212	S.D. 18	C.V. 8.3
Sample No. 194	Ave 204	S.D. 16	C.V. 8.0

**CCRL Proficiency Sample Program
Fineness - 45 μ m Sieve
PORTLAND CEMENT Samples No. 193 and No. 194**



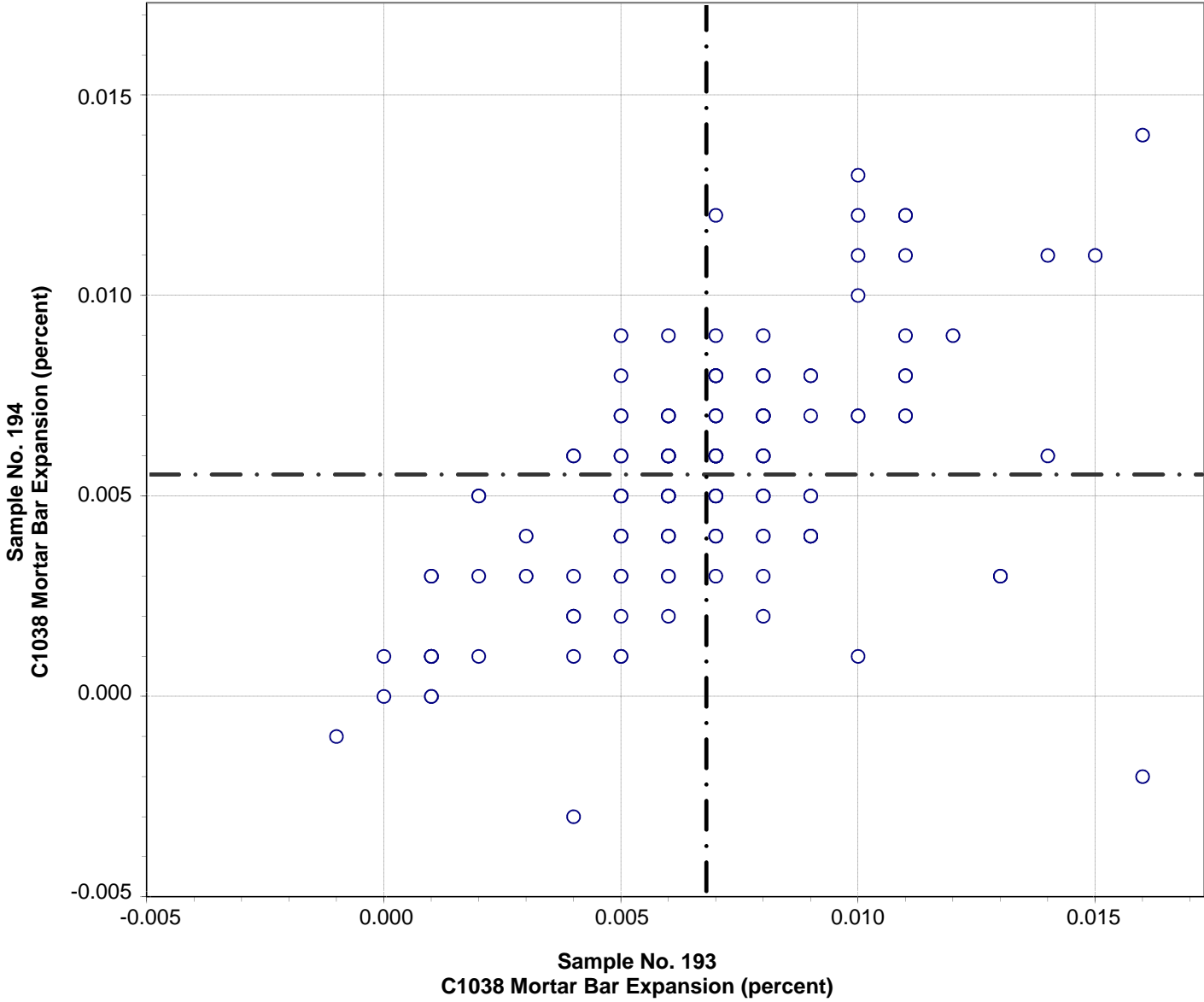
Test No. 281 Fineness - 45 μ m Sieve 203 Points

Sample No. 193 Ave 95.66 S.D. 0.66 C.V. 0.69

Sample No. 194 Ave 94.01 S.D. 0.71 C.V. 0.75

Labs Eliminated: 3, 40, 50, 51, 54, 116, 180, 181, 413, 415, 565, 823, 2484, 3236, 3752

**CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 193 and No. 194**



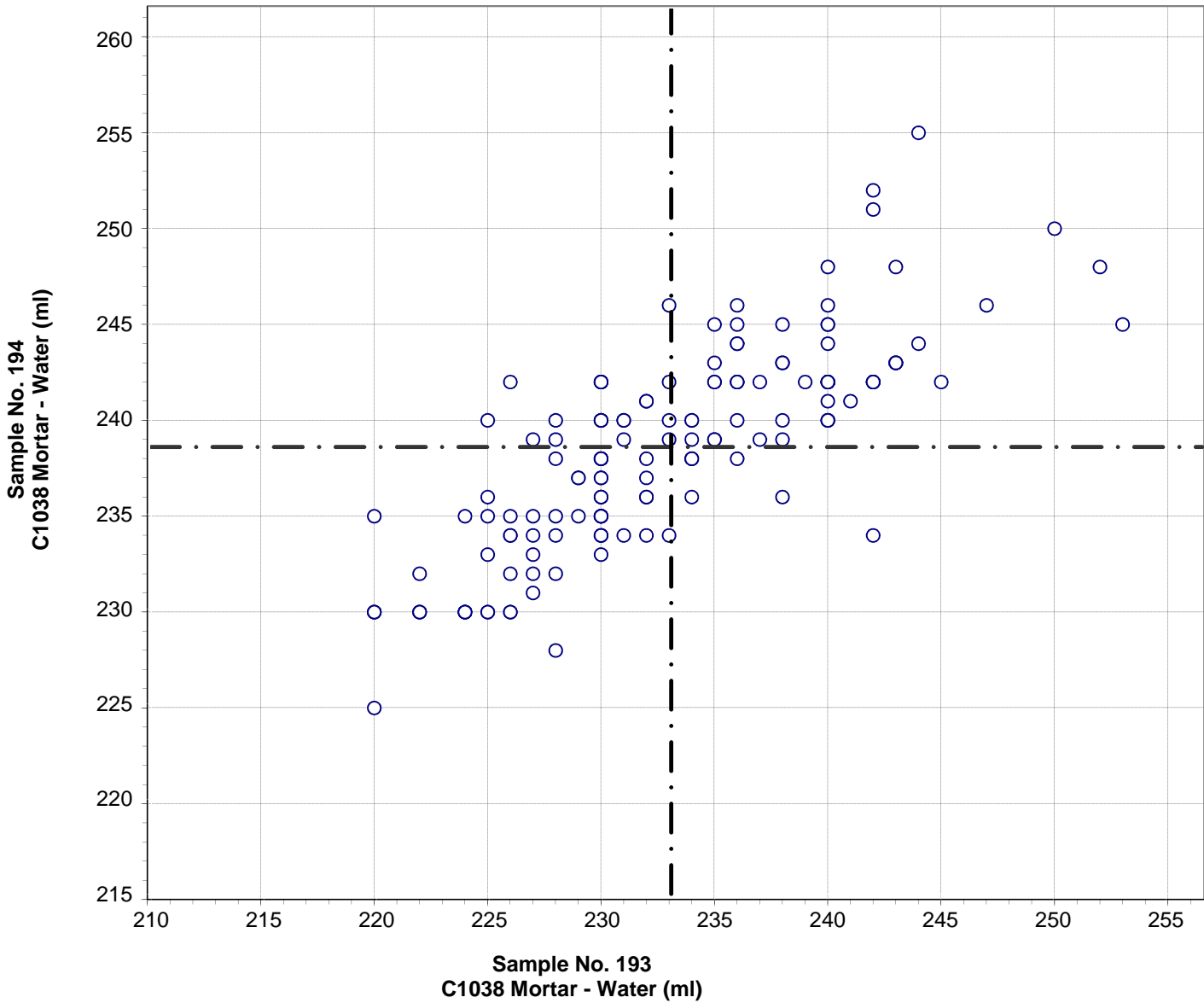
Test No. 400 C1038 Mortar Bar Expansion 151 Points

Sample No. 193 Ave 0.007 S.D. 0.003 C.V. 45

Sample No. 194 Ave 0.005 S.D. 0.003 C.V. 54

Labs Eliminated: 34, 99, 413, 438, 497, 823, 1251, 3976

**CCRL Proficiency Sample Program
C1038 Mortar - Water
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 401 C1038 Mortar - Water 146 Points

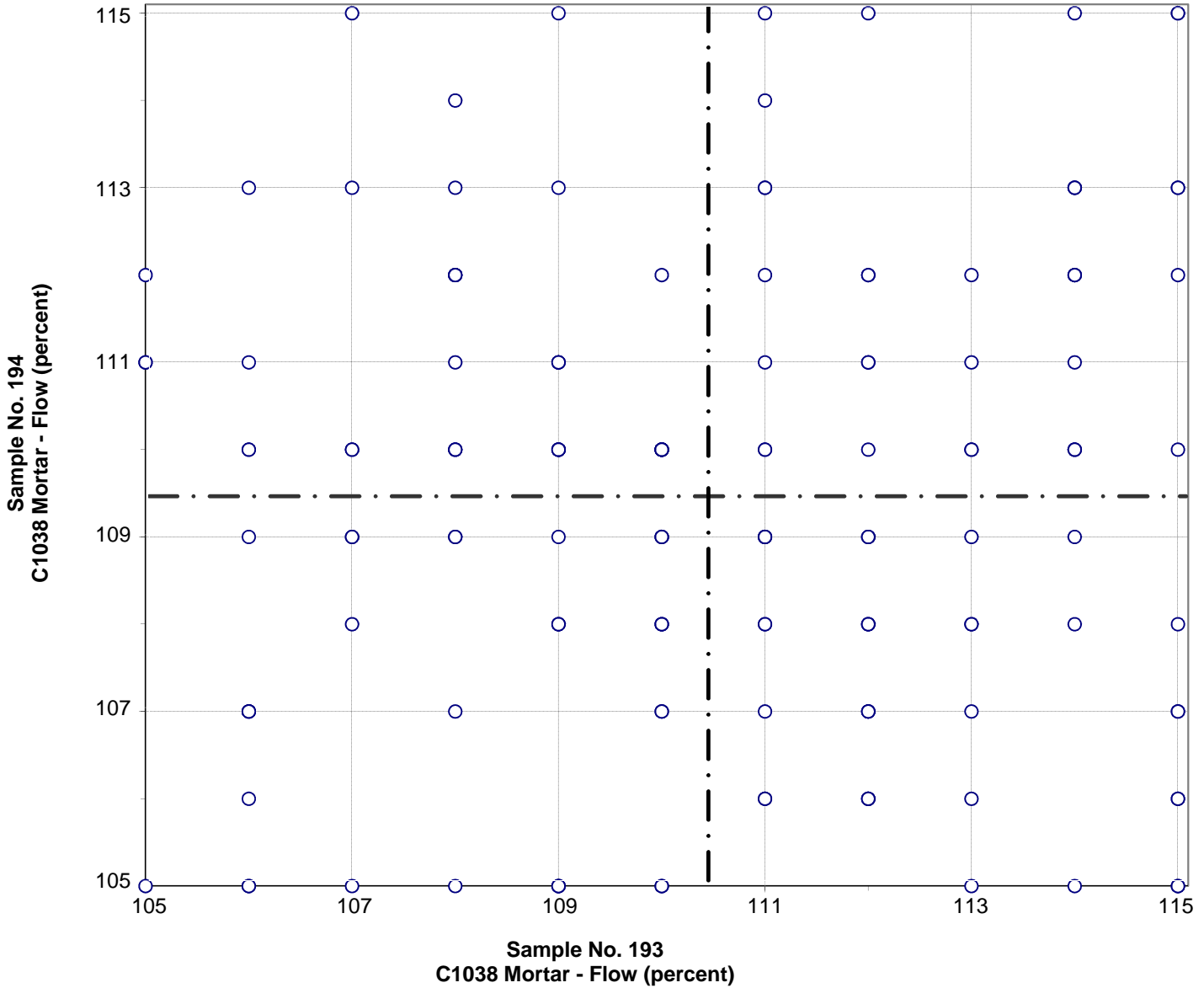
Sample No. 193 Ave 233 S.D. 7 C.V. 3.1

Sample No. 194 Ave 239 S.D. 5 C.V. 2.2

Labs Eliminated: 26, 440, 450, 691, 840, 3059, 3970

Labs off Diagram: 25

**CCRL Proficiency Sample Program
C1038 Mortar - Flow
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 402 C1038 Mortar - Flow 147 Points

Sample No. 193 Ave 110 S.D. 3 C.V. 2.5

Sample No. 194 Ave 109 S.D. 3 C.V. 2.4

Labs Eliminated: 26, 66, 134, 442, 996, 3662, 3966

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 193 and No. 194

Final Report – Heat of Hydration Results
 September 3, 2014

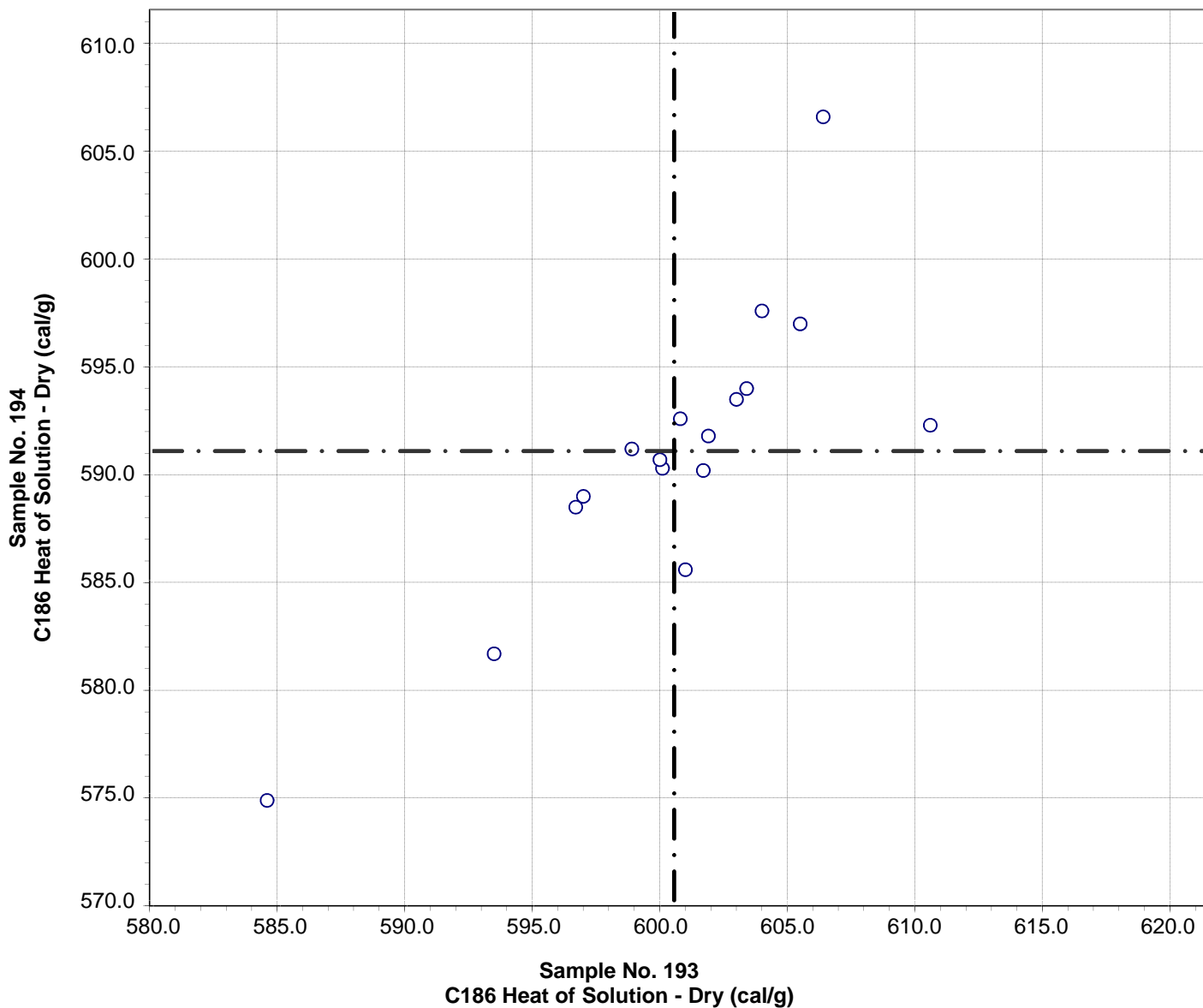
SUMMARY OF RESULTS

Sample No.193

Sample No. 194

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C186 Heat of Solution - Dry (cal/g)							
	20	587.0	37.8	6.4	580.0	35.5	6.1
	*17	601.0	5.7	1.0	591.0	6.8	1.1
* Labs Eliminated - 491, 975, 1644							
C186 Heat of Solution - 7 day (cal/g)							
	19	517.0	38.4	7.4	503.3	30.0	6.0
	*17	528.9	11.5	2.2	512.2	12.1	2.4
* Labs Eliminated - 491, 1644							
C186 Heat of Solution 28 day (cal/g)							
	14	519.8	10.4	2.0	506.0	6.6	1.3
No Labs Eliminated for This Test							
C186 Heat of Hydration - 7 day (cal/g)							
	25	70.1	7.9	11.3	77.8	14.7	18.9
	*24	69.2	6.6	9.6	75.8	10.8	14.3
* Labs Eliminated - 1799							
C186 Heat of Hydration - 28 day (cal/g)							
	17	79.3	7.0	8.9	89.2	8.0	8.9
No Labs Eliminated for This Test							
C1702 Heat of Hydration - 3 day (J/g)							
	6	230	83	35.9	285	102	35.5
	*5	265	6	2.2	325	7	2.3
* Labs Eliminated - 148							
C1702 Heat of Hydration - 7 day (J/g)							
	6	268	95	35.6	322	115	35.6
	*5	306	9	2.9	369	17	4.7
* Labs Eliminated - 148							

**CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 193 and No. 194**



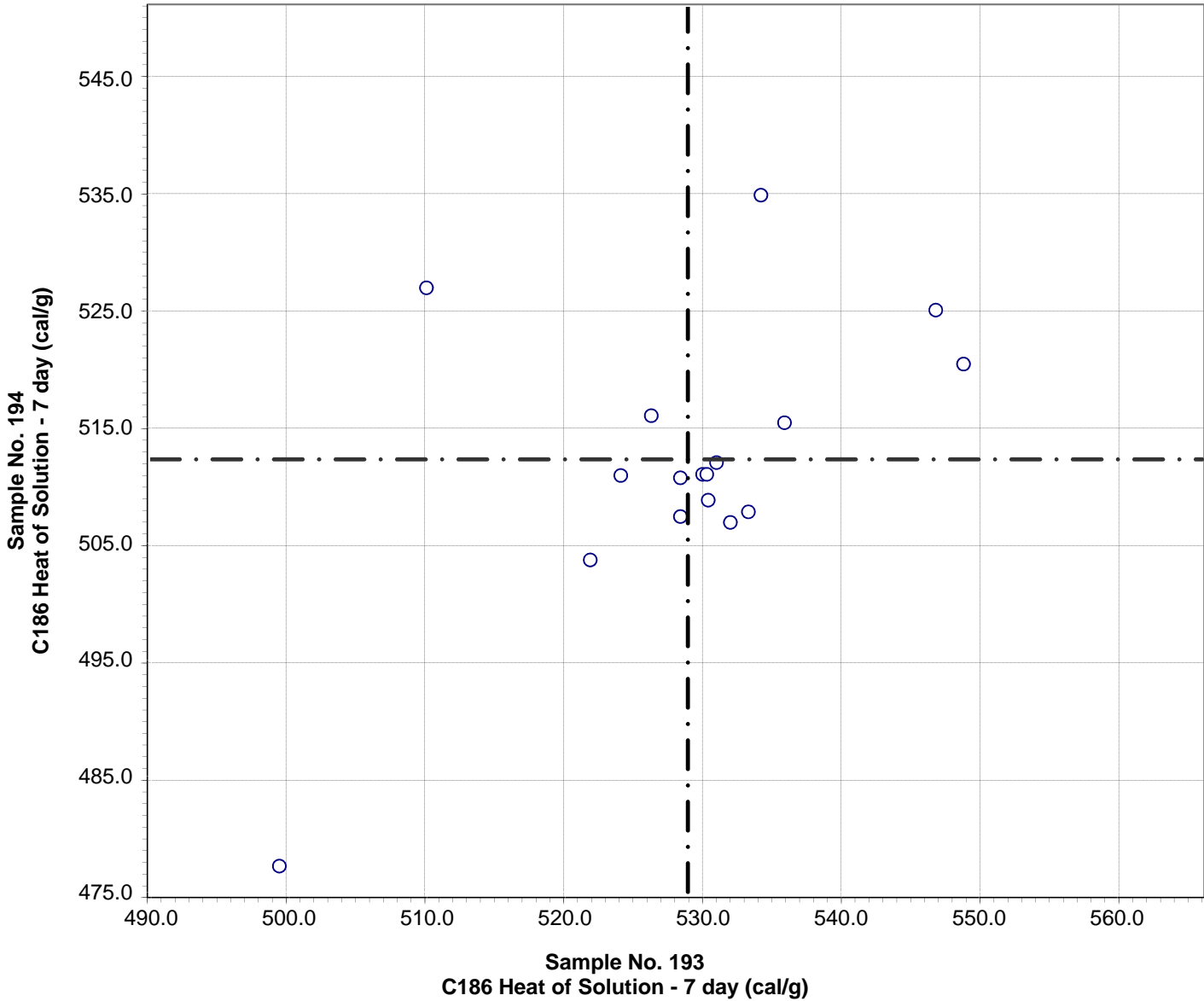
Test No. 291 C186 Heat of Solution - Dry 17 Points

Sample No. 193 Ave 601.0 S.D. 5.7 C.V. 1.0

Sample No. 194 Ave 591.0 S.D. 6.8 C.V. 1.1

Labs Eliminated: 491, 975, 1644

**CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 193 and No. 194**

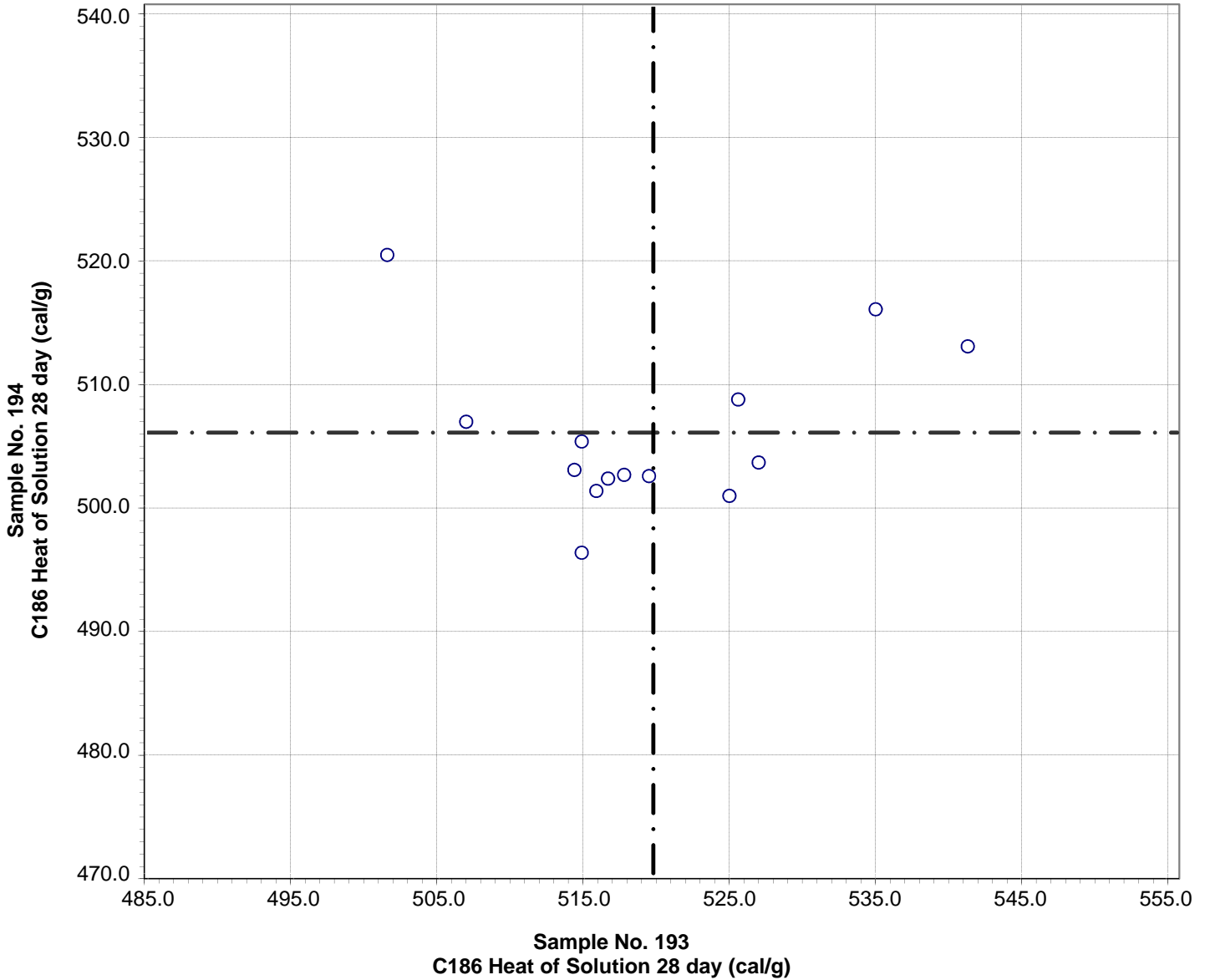


Test No. 292 C186 Heat of Solution - 7 day 17 Points

Sample No. 193	Ave 528.9	S.D. 11.5	C.V. 2.2
Sample No. 194	Ave 512.2	S.D. 12.1	C.V. 2.4

Labs Eliminated: 491, 1644

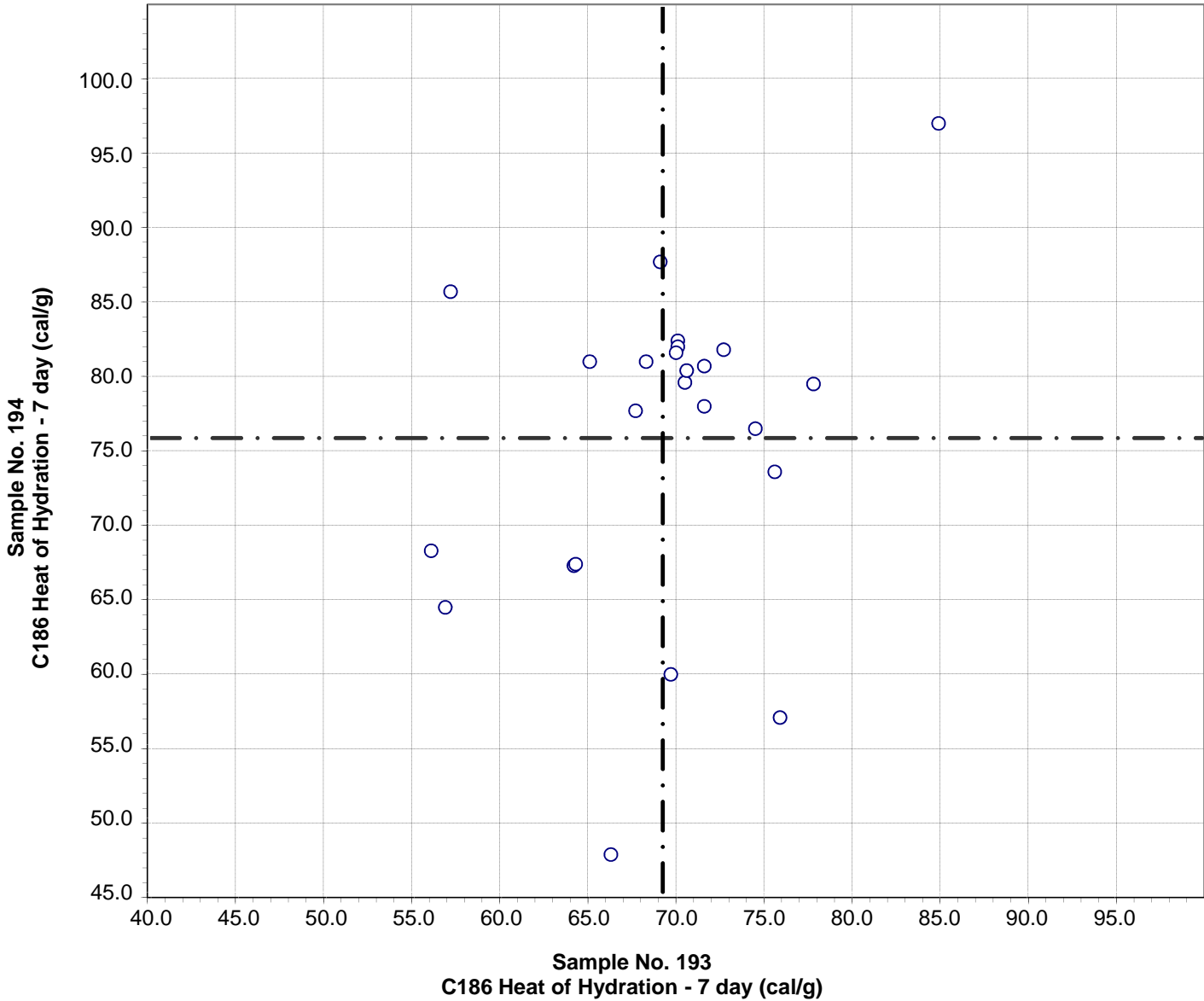
**CCRL Proficiency Sample Program
C186 Heat of Solution 28 day
PORTLAND CEMENT Samples No. 193 and No. 194**



Test No. 301 C186 Heat of Solution 28 day 14 Points

Sample No. 193	Ave 519.8	S.D. 10.4	C.V. 2.0
Sample No. 194	Ave 506.0	S.D. 6.6	C.V. 1.3

**CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 193 and No. 194**

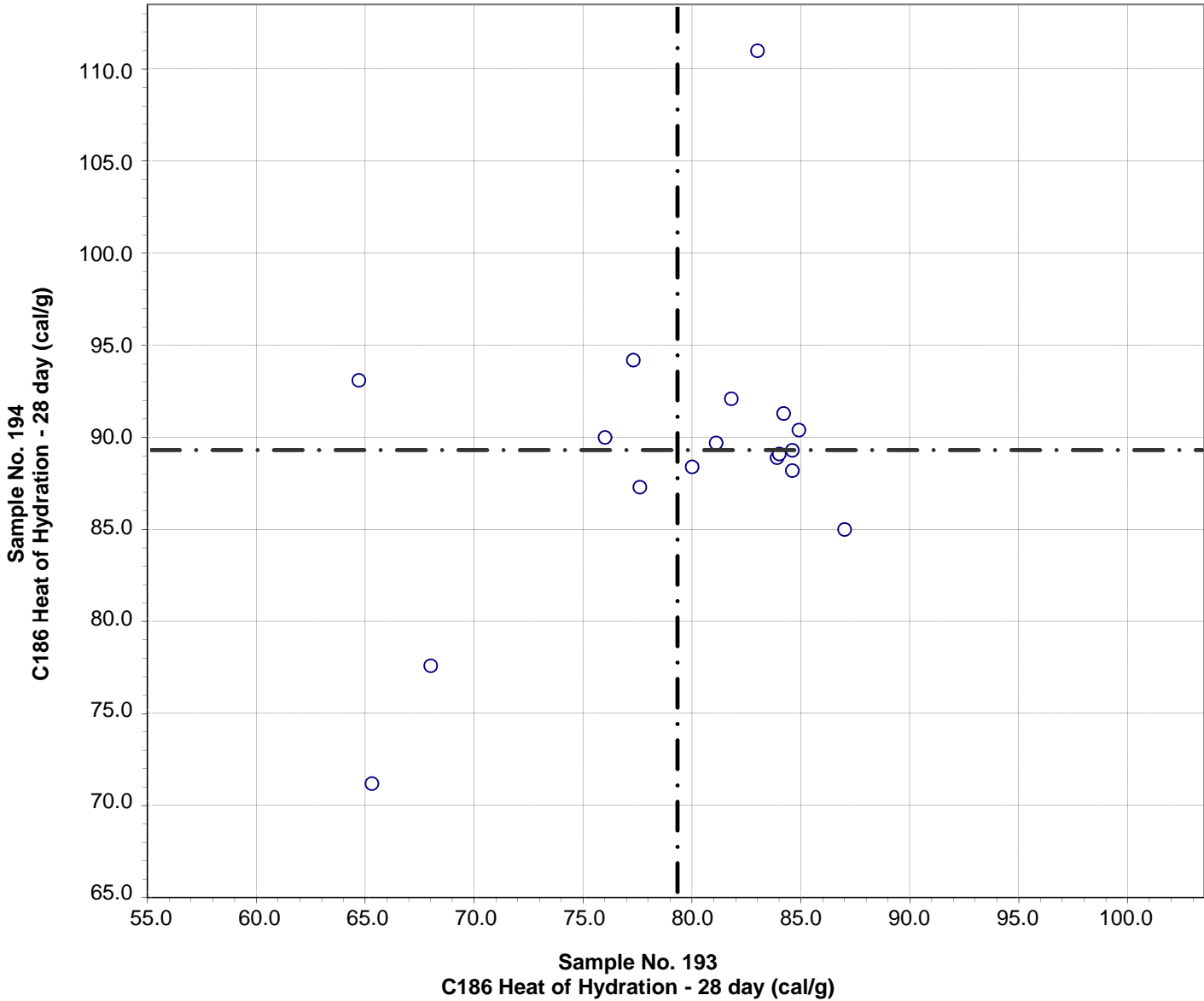


Test No. 290 C186 Heat of Hydration - 7 day 24 Points

Sample No. 193	Ave 69.2	S.D. 6.6	C.V. 9.6
Sample No. 194	Ave 75.8	S.D. 10.8	C.V. 14.3

Labs Eliminated: 1799

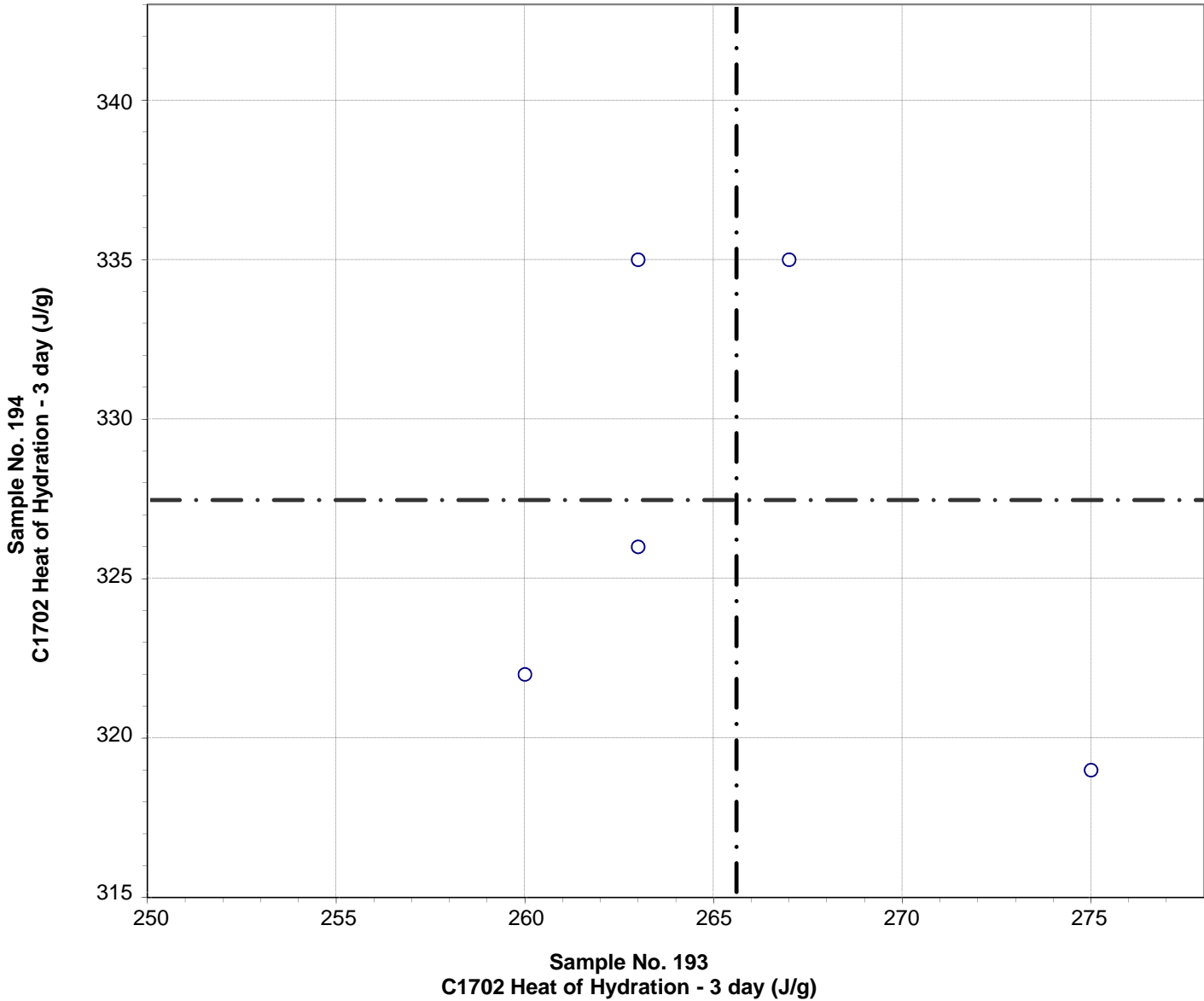
CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 193 and No. 194



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

Sample No. 193	Ave 79.3	S.D. 7.0	C.V. 8.9
Sample No. 194	Ave 89.2	S.D. 8.0	C.V. 8.9

**CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 193 and No. 194**



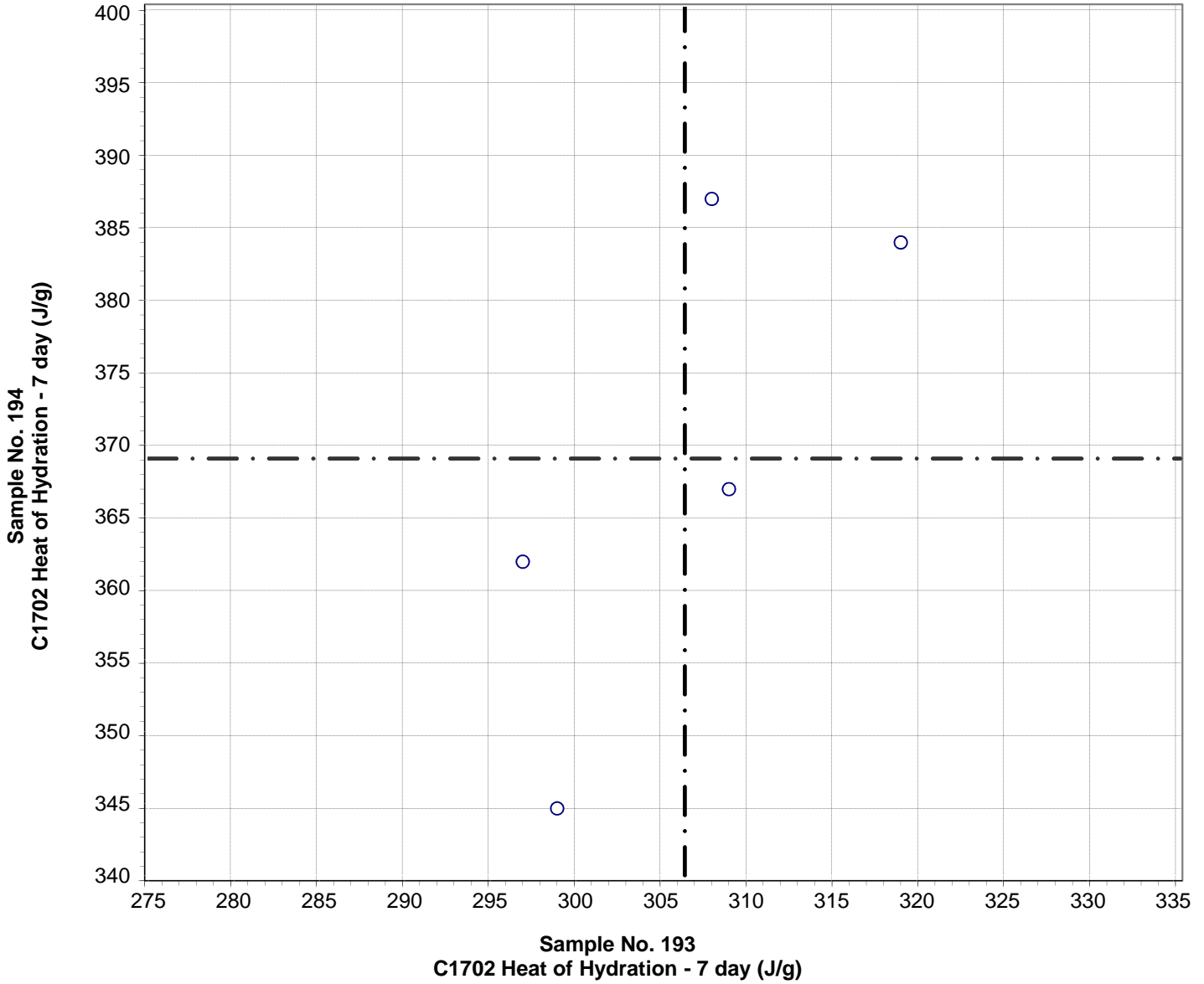
Test No. 500 C1702 Heat of Hydration - 3 day 5 Points

Sample No. 193 Ave 265 S.D. 6 C.V. 2.2

Sample No. 194 Ave 325 S.D. 7 C.V. 2.3

Labs Eliminated: 148

CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 193 and No. 194



Test No. 510 C1702 Heat of Hydration - 7 day 5 Points

Sample No. 193 Ave 306 S.D. 9 C.V. 2.9
Sample No. 194 Ave 369 S.D. 17 C.V. 4.7

Labs Eliminated: 148