

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 191 and Number 192

March 2014





March 21, 2014

To: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 191 and No. 192

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in January 2014. Portland Cement Samples No. 191 was an ASTM C150 meeting the specifications of Type I and Type II. Portland Cement No. 192 was an ASTM C150 meeting the specifications of Type I.

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.

False Set (paste method) – No ratings were assigned for Sample No. 191. Sample No. 191 showed early stiffening tendencies. Upon reviewing the test data many laboratories reported percent final penetration. However some laboratories because the cement's early stiffening tendencies may have reported a remix value in mm or as a percent. Our reporting form allows only one test value to be entered for False Set. This value would normally be the percent final penetration. A remix value is not requested as this procedure is performed "at the option of the tester".

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 2014.

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. 191 and No. 192

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 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. 191 and No. 192

Final Report – Primary Chemical Results
March 21, 2014

SUMMARY OF RESULTS

Sample No.191

Sample No. 192

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (percent)							
	233	21.31	0.41	1.93	20.82	0.34	1.63
	*219	21.34	0.25	1.19	20.86	0.19	0.93
* Labs Eliminated - 3, 10, 28, 38, 43, 50, 51, 54, 86, 116, 698, 2296, 2305, 2352							
Aluminum Oxide (percent)							
	229	4.06	0.18	4.4	4.76	0.10	2.1
	*221	4.05	0.09	2.2	4.77	0.08	1.7
* Labs Eliminated - 28, 50, 74, 116, 126, 687, 1594, 3807							
Ferric Oxide (percent)							
	231	3.56	0.08	2.2	2.06	0.07	3.4
	*227	3.56	0.06	1.7	2.05	0.04	2.2
* Labs Eliminated - 51, 54, 116, 1594							
Calcium Oxide (percent)							
	230	60.45	0.56	0.93	64.20	0.44	0.68
	*222	60.44	0.48	0.79	64.20	0.34	0.53
* Labs Eliminated - 66, 90, 107, 116, 124, 1466, 3297, 3819							
Magnesium Oxide (percent)							
	231	4.06	0.16	4.0	3.08	0.11	3.5
	*218	4.07	0.11	2.6	3.09	0.07	2.2
* Labs Eliminated - 50, 54, 95, 116, 203, 1644, 1799, 2437, 2464, 2955, 3185, 3663, 3752							
Sulfur Trioxide (percent)							
	234	3.43	0.13	3.7	2.82	0.10	3.5
	*227	3.43	0.09	2.6	2.81	0.08	2.8
* Labs Eliminated - 14, 51, 690, 975, 2437, 3791, 3819							
Loss on Ignition (percent)							
	235	2.14	0.20	9.5	1.14	0.14	12.5
	*223	2.15	0.08	3.7	1.13	0.09	8.0
* Labs Eliminated - 10, 48, 74, 152, 157, 203, 840, 3297, 3605, 3695, 3791, 3807							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Primary Chemical Results
 March 21, 2014

SUMMARY OF RESULTS

Sample No.191

Sample No. 192

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

224	0.200	0.057	28	0.184	0.045	24
*204	0.198	0.021	11	0.185	0.023	12

* Labs Eliminated - 28, 116, 222, 289, 354, 494, 687, 1956, 2305, 2352, 2466, 2490, 3057, 3235, 3297, 3606, 3695, 3705, 3779, 3791

Potassium Oxide (percent)

228	0.649	0.052	8.0	0.420	0.027	6.5
*212	0.654	0.016	2.5	0.422	0.014	3.4

* Labs Eliminated - 40, 52, 54, 90, 110, 557, 611, 840, 2466, 2491, 3235, 3606, 3607, 3752, 3819, 3859

Titanium Dioxide (percent)

186	0.21	0.017	7.8	0.36	0.020	5.5
*177	0.21	0.007	3.5	0.36	0.014	3.8

* Labs Eliminated - 60, 64, 95, 98, 137, 219, 494, 1644, 1723

Phosphorus Pentoxide (percent)

178	0.056	0.017	31.0	0.099	0.025	24.9
*160	0.054	0.005	9.9	0.097	0.006	6.0

* Labs Eliminated - 8, 90, 98, 139, 178, 457, 493, 494, 1466, 1799, 1940, 2305, 2412, 2463, 2955, 3235, 3368, 3695

Zinc Oxide (percent)

98	0.029	0.008	26.2	0.018	0.018	97.9
*90	0.029	0.004	12.4	0.016	0.003	21.0

* Labs Eliminated - 54, 129, 142, 219, 416, 497, 2296, 2491

Manganic Oxide (percent)

151	0.033	0.006	19.7	0.076	0.009	12.3
*142	0.033	0.003	9.8	0.077	0.003	4.5

* Labs Eliminated - 354, 413, 416, 457, 768, 2462, 2466, 2491, 3662

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Primary Chemical Results
 March 21, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.191				Sample No. 192		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Chloride (percent)							
	121	0.015	0.009	62	0.033	0.019	57
	*114	0.013	0.006	42	0.031	0.014	44
	* Labs Eliminated - 18, 90, 493, 692, 1466, 2296, 2463						
Insoluble Residue (percent)							
	218	0.45	0.15	33	0.22	0.12	53
	*205	0.43	0.09	20	0.20	0.08	40
	* Labs Eliminated - 36, 52, 130, 206, 289, 354, 413, 494, 1799, 2491, 3297, 3413, 3663						
Free Lime (percent)							
	177	1.62	0.39	24	0.87	0.27	31
	*172	1.64	0.33	20	0.87	0.20	23
	* Labs Eliminated - 110, 206, 1942, 3185, 3695						
Chromium Oxide (percent)							
	93	0.010	0.006	63	0.015	0.008	51
	*88	0.009	0.004	41	0.014	0.004	30
	* Labs Eliminated - 95, 203, 416, 438, 3057						
Tricalcium Silicate (percent)							
	203	42.3	4.7	11.1	60.1	5.0	8.3
	*196	42.1	3.2	7.5	60.0	2.5	4.2
	* Labs Eliminated - 3, 19, 28, 38, 74, 2296, 3368						
Dicalcium Silicate (percent)							
	201	29.0	3.7	12.8	14.2	3.0	21.4
	*191	29.3	2.9	9.8	14.5	2.0	14.1
	* Labs Eliminated - 3, 19, 38, 54, 74, 78, 206, 2296, 3368, 3607						
Tricalcium Aluminate (percent)							
	202	4.7	0.3	7.2	9.1	0.6	6.0
	*193	4.7	0.3	5.5	9.2	0.2	2.6
	* Labs Eliminated - 4, 19, 28, 50, 74, 78, 126, 687, 3607						

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Primary Chemical Results
 March 21, 2014

SUMMARY OF RESULTS

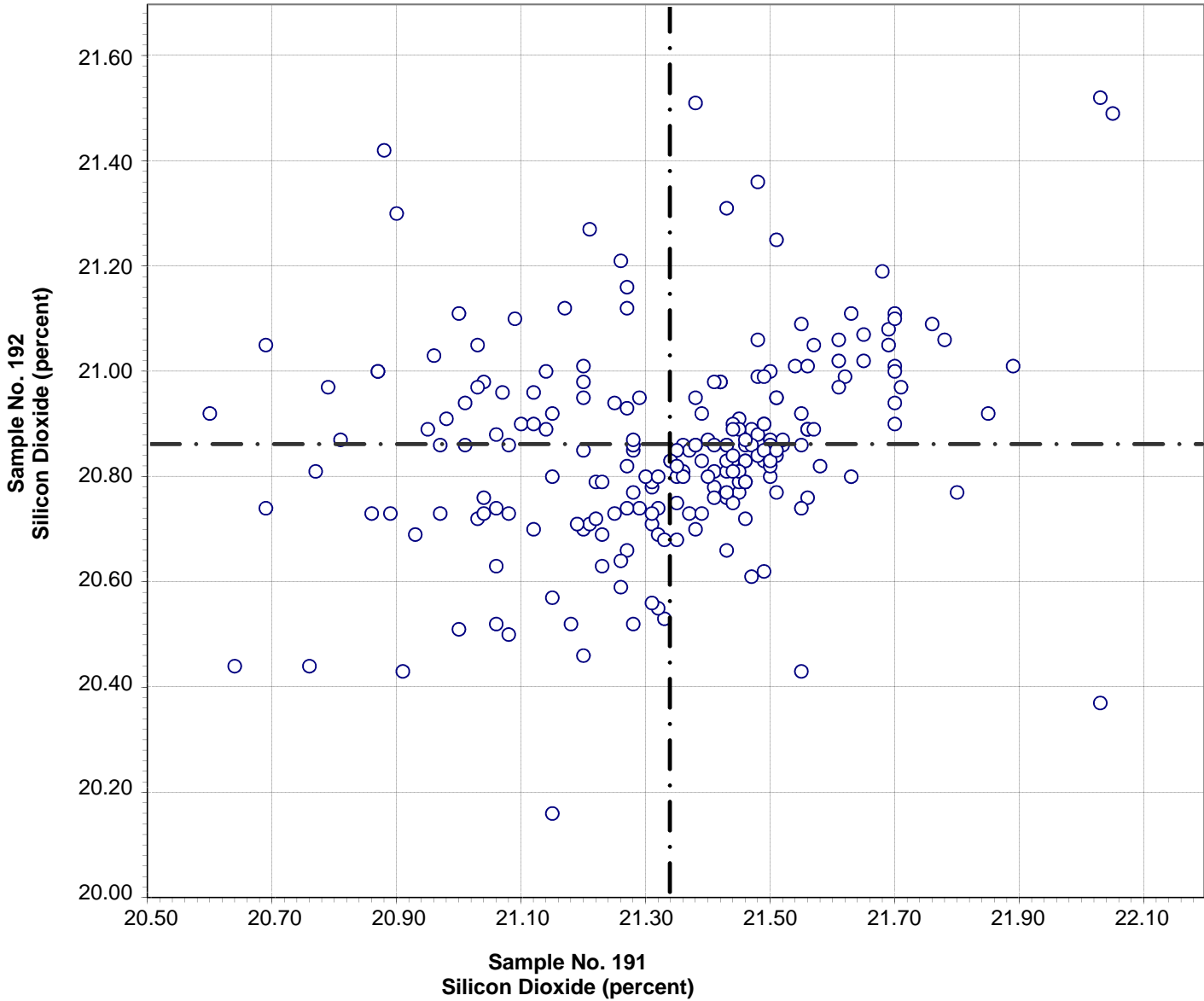
Sample No.191

Sample No. 192

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Tetracalcium Aluminoferrite (percent)							
	203	10.9	0.2	2.0	6.3	0.6	9.3
	*194	10.9	0.2	1.7	6.2	0.1	1.9

* Labs Eliminated - 10, 41, 54, 221, 222, 438, 692, 1644, 3663

**CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 191 and No. 192**



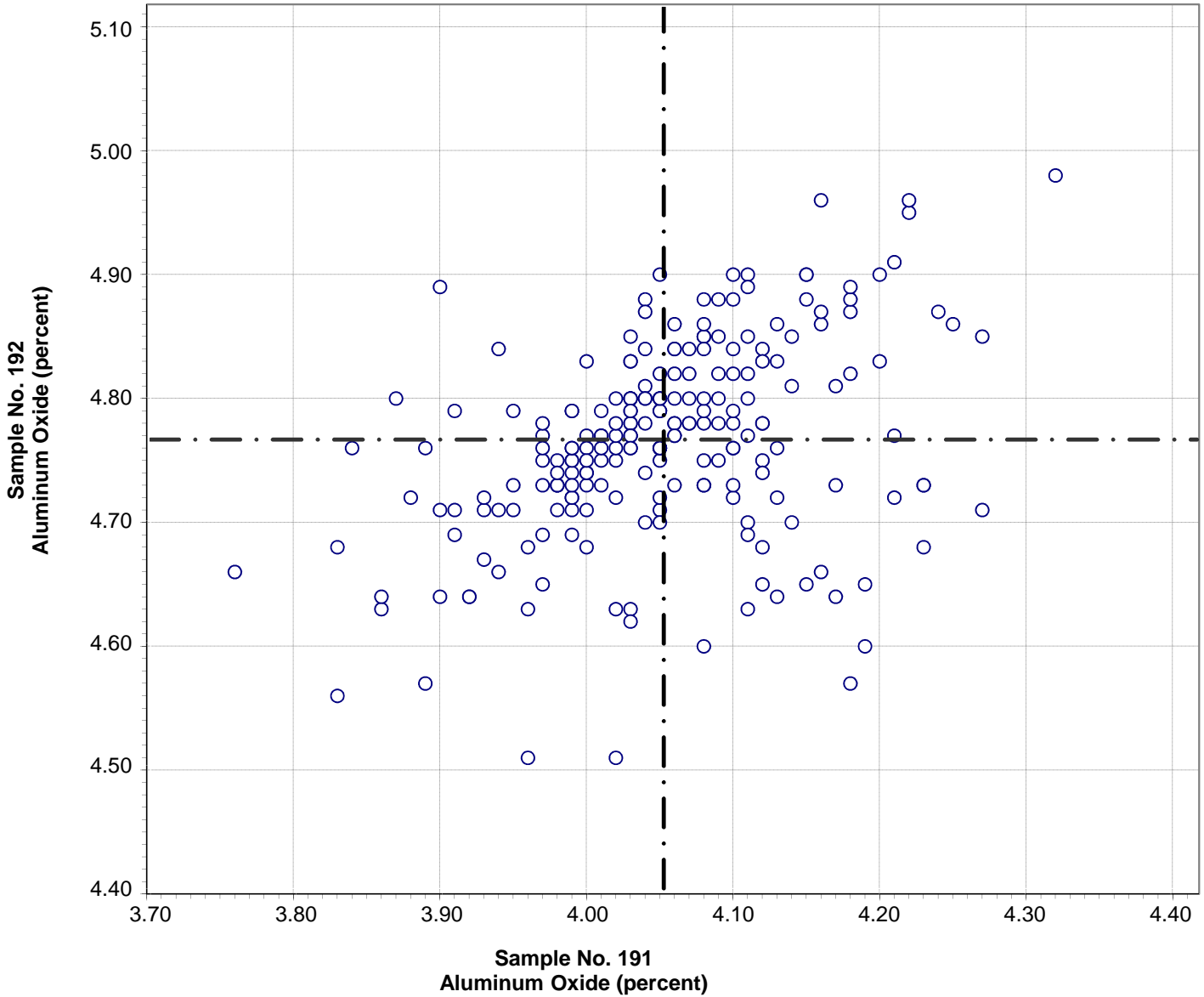
Test No. 10 Silicon Dioxide 219 Points

Sample No. 191 Ave 21.34 S.D. 0.25 C.V. 1.19

Sample No. 192 Ave 20.86 S.D. 0.19 C.V. 0.93

Labs Eliminated: 3, 10, 28, 38, 43, 50, 51, 54, 86, 116, 698, 2296, 2305, 2352

**CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**



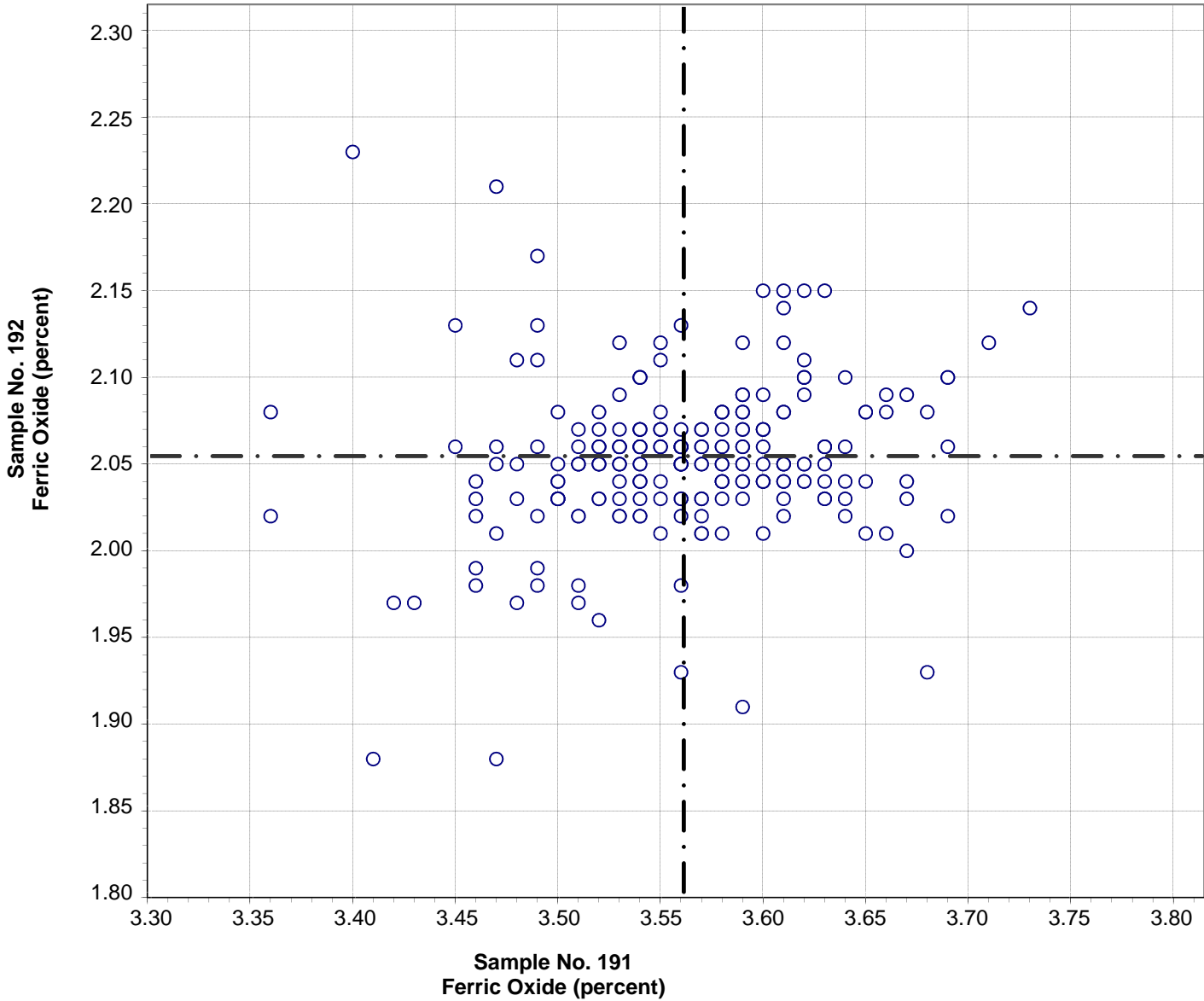
Test No. 21 Aluminum Oxide 221 Points

Sample No. 191 Ave 4.05 S.D. 0.09 C.V. 2.2

Sample No. 192 Ave 4.77 S.D. 0.08 C.V. 1.7

Labs Eliminated: 28, 50, 74, 116, 126, 687, 1594, 3807

**CCRL Proficiency Sample Program
Ferric Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**

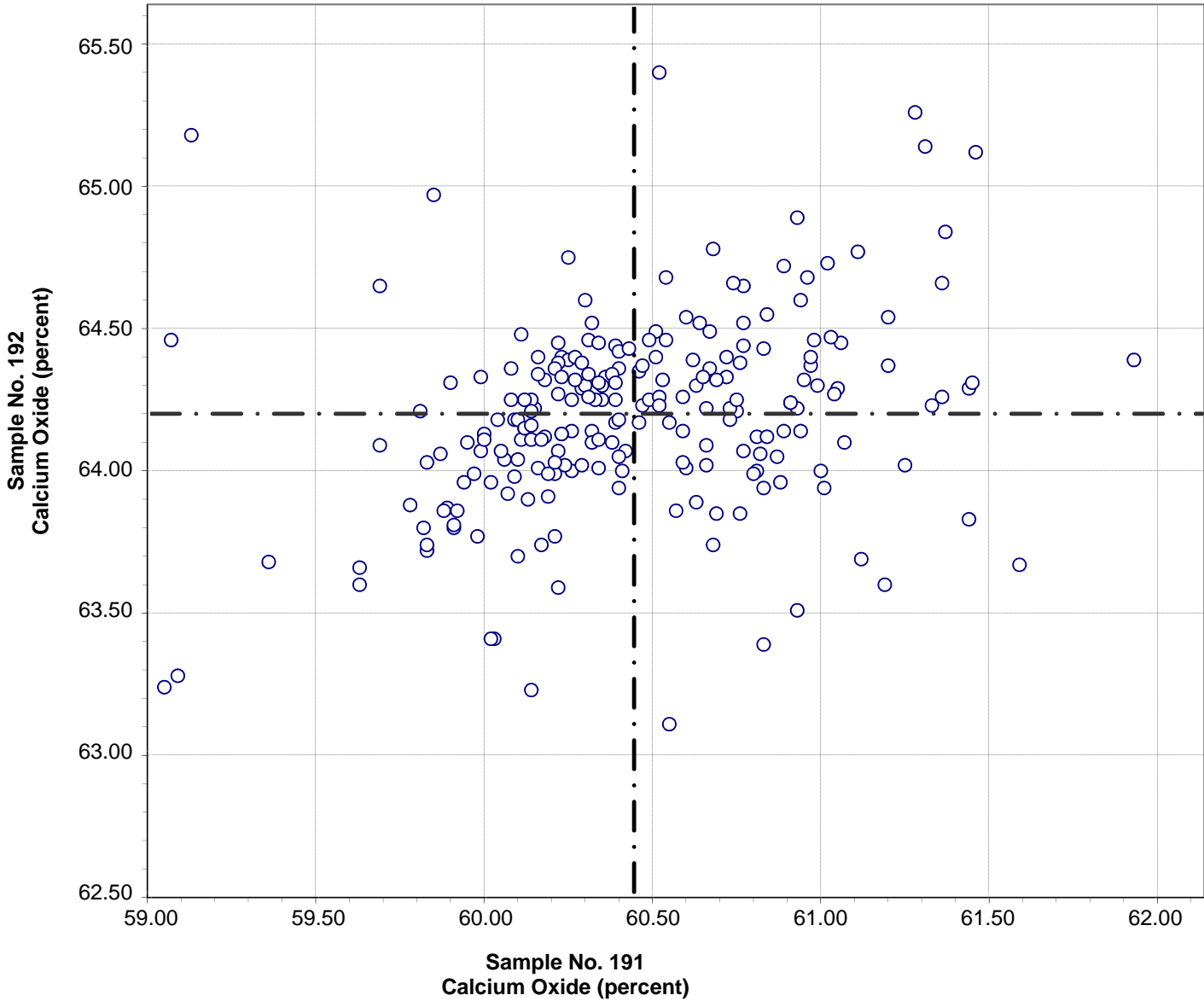


Test No. 30 Ferric Oxide 227 Points

Sample No. 191	Ave 3.56	S.D. 0.06	C.V. 1.7
Sample No. 192	Ave 2.05	S.D. 0.04	C.V. 2.2

Labs Eliminated: 51, 54, 116, 1594

**CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 40 Calcium Oxide 221 Points

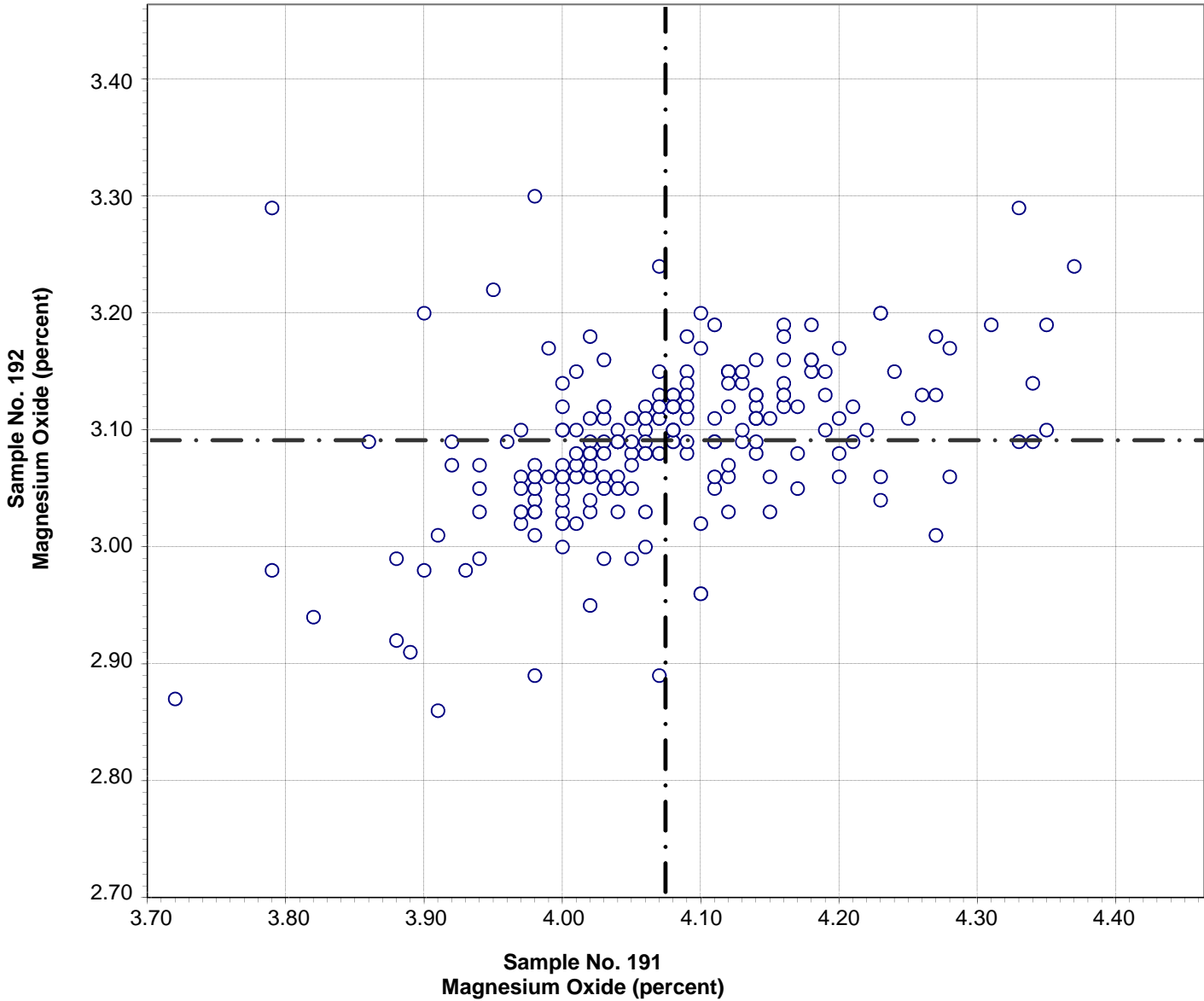
Sample No. 191 Ave 60.44 S.D. 0.48 C.V. 0.79

Sample No. 192 Ave 64.20 S.D. 0.34 C.V. 0.53

Labs Eliminated: 66, 90, 107, 116, 124, 1466, 3297, 3819

Labs off Diagram: 222

**CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**



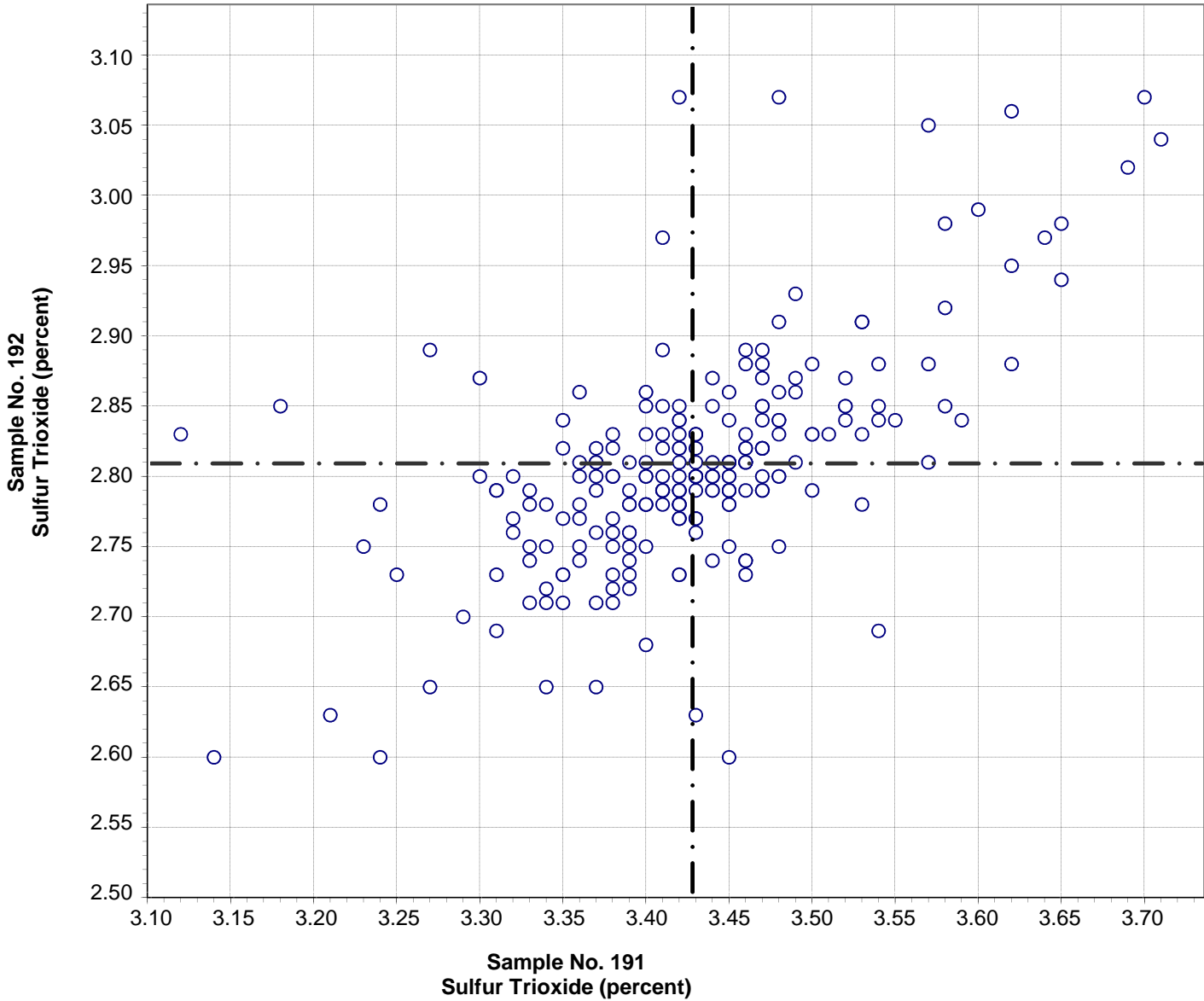
Test No. 50 Magnesium Oxide 218 Points

Sample No. 191 Ave 4.07 S.D. 0.11 C.V. 2.6

Sample No. 192 Ave 3.09 S.D. 0.07 C.V. 2.2

Labs Eliminated: 50, 54, 95, 116, 203, 1644, 1799, 2437, 2464, 2955, 3185, 3663, 3752

**CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 191 and No. 192**



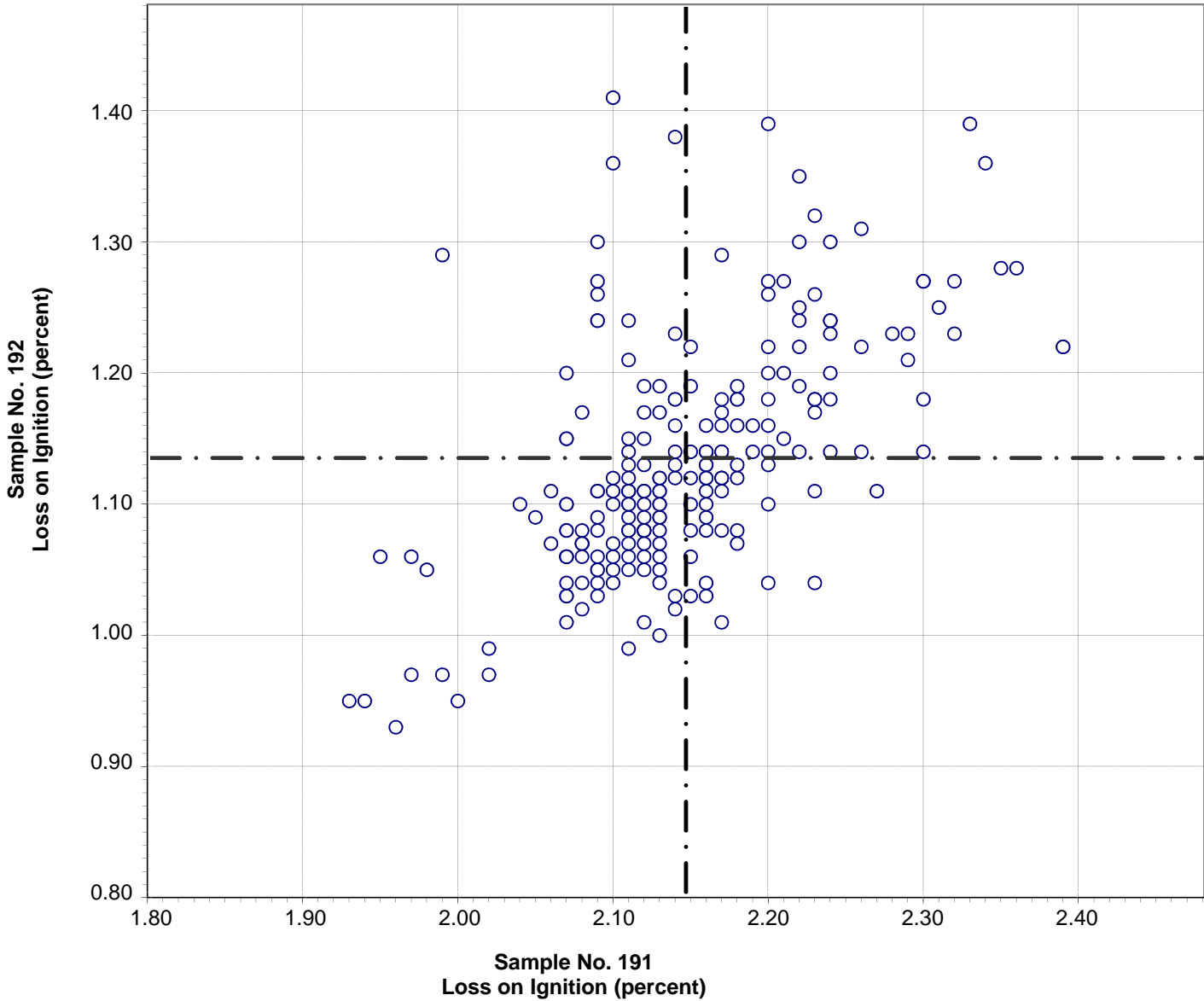
Test No. 60 Sulfur Trioxide 227 Points

Sample No. 191 Ave 3.43 S.D. 0.09 C.V. 2.6

Sample No. 192 Ave 2.81 S.D. 0.08 C.V. 2.8

Labs Eliminated: 14, 51, 690, 975, 2437, 3791, 3819

**CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 191 and No. 192**



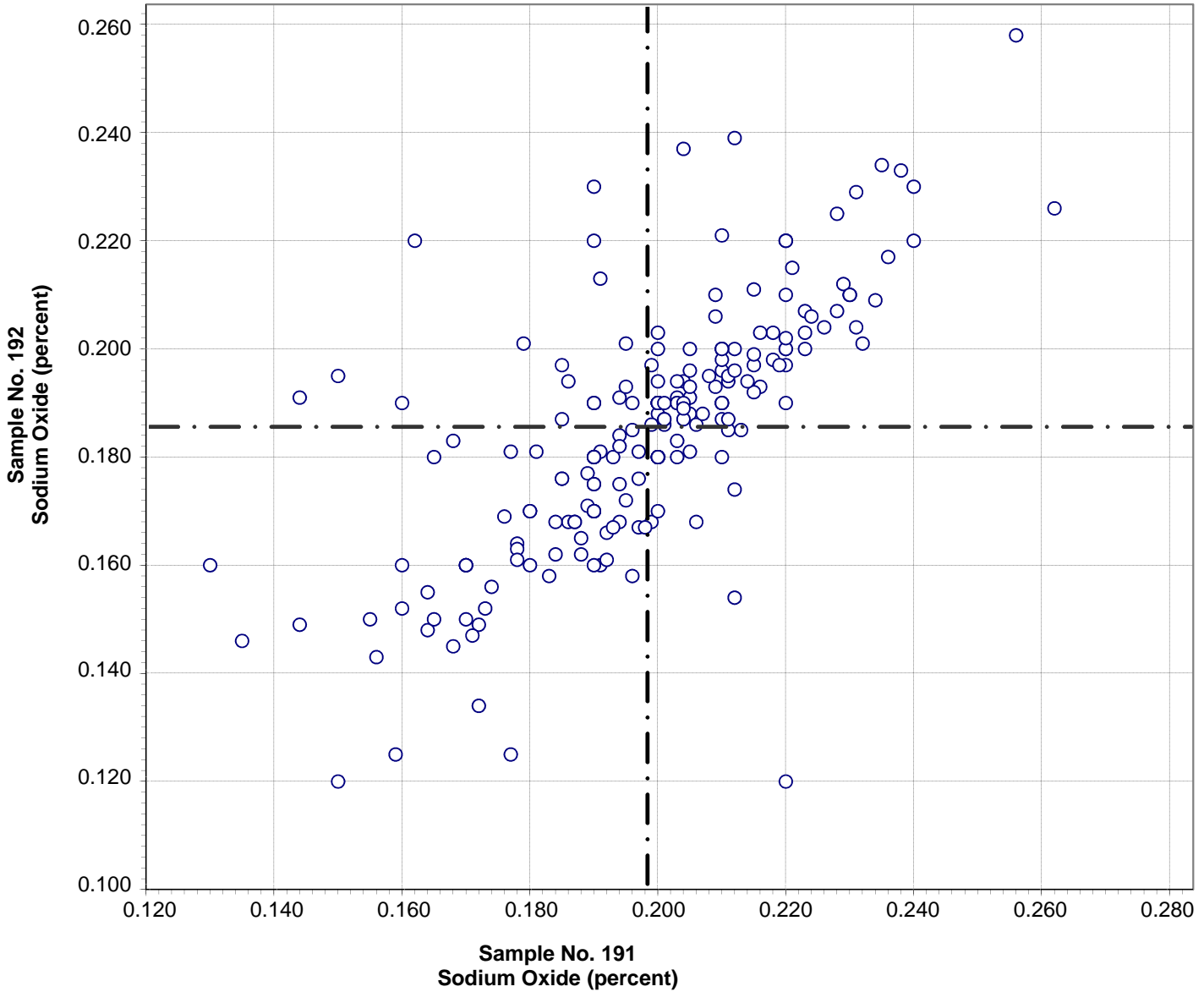
Test No. 70 Loss on Ignition 223 Points

Sample No. 191 Ave 2.15 S.D. 0.08 C.V. 3.7

Sample No. 192 Ave 1.13 S.D. 0.09 C.V. 8.0

Labs Eliminated: 10, 48, 74, 152, 157, 203, 840, 3297, 3605, 3695, 3791, 3807

**CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**

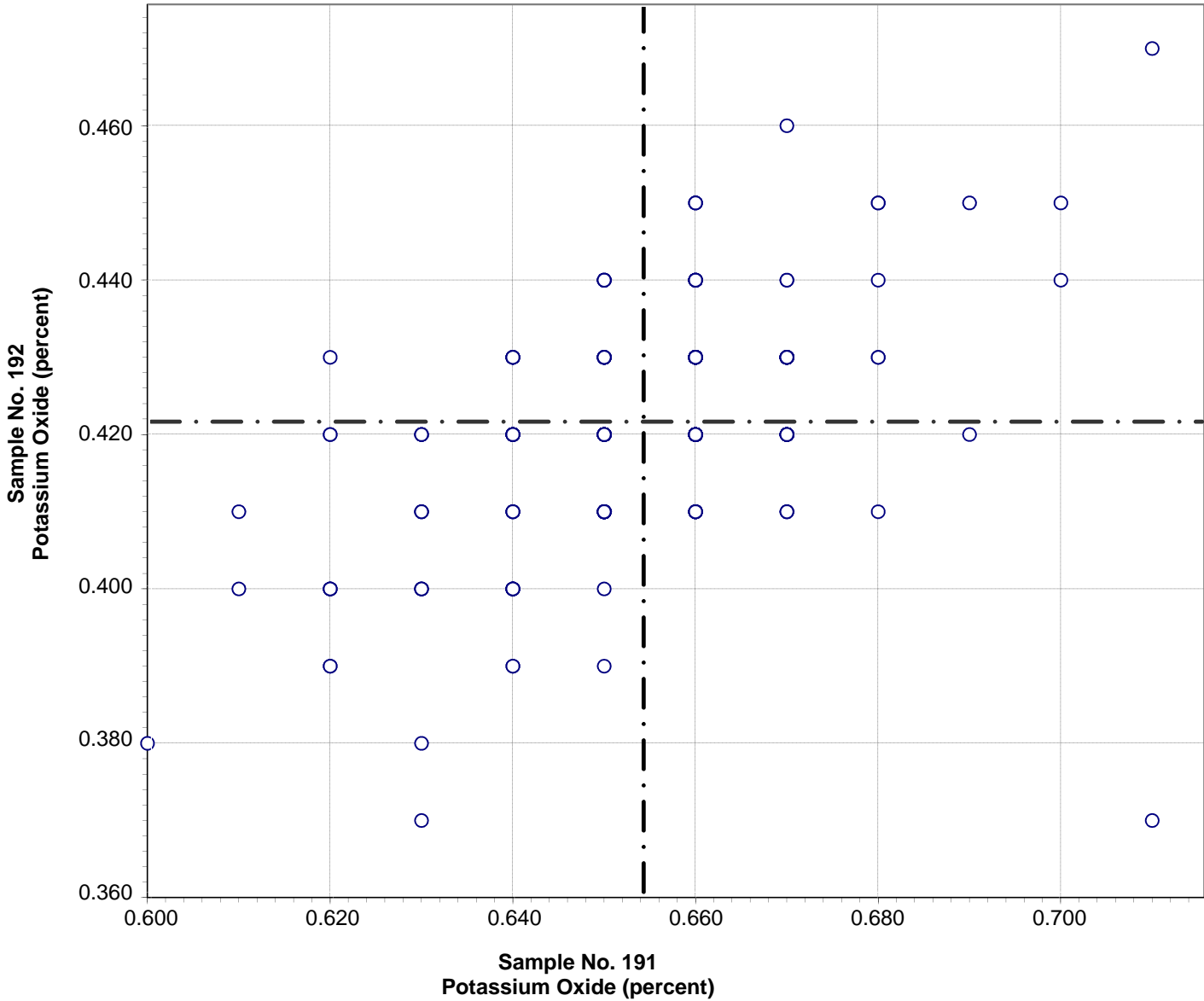


Test No. 90 Sodium Oxide 204 Points

Sample No. 191	Ave 0.198	S.D. 0.021	C.V. 11
Sample No. 192	Ave 0.185	S.D. 0.023	C.V. 12

Labs Eliminated: 28, 116, 222, 289, 354, 494, 687, 1956, 2305, 2352, 2466, 2490, 3057, 3235, 3297, 3606, 3695, 3705, 3779, 3791

**CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**



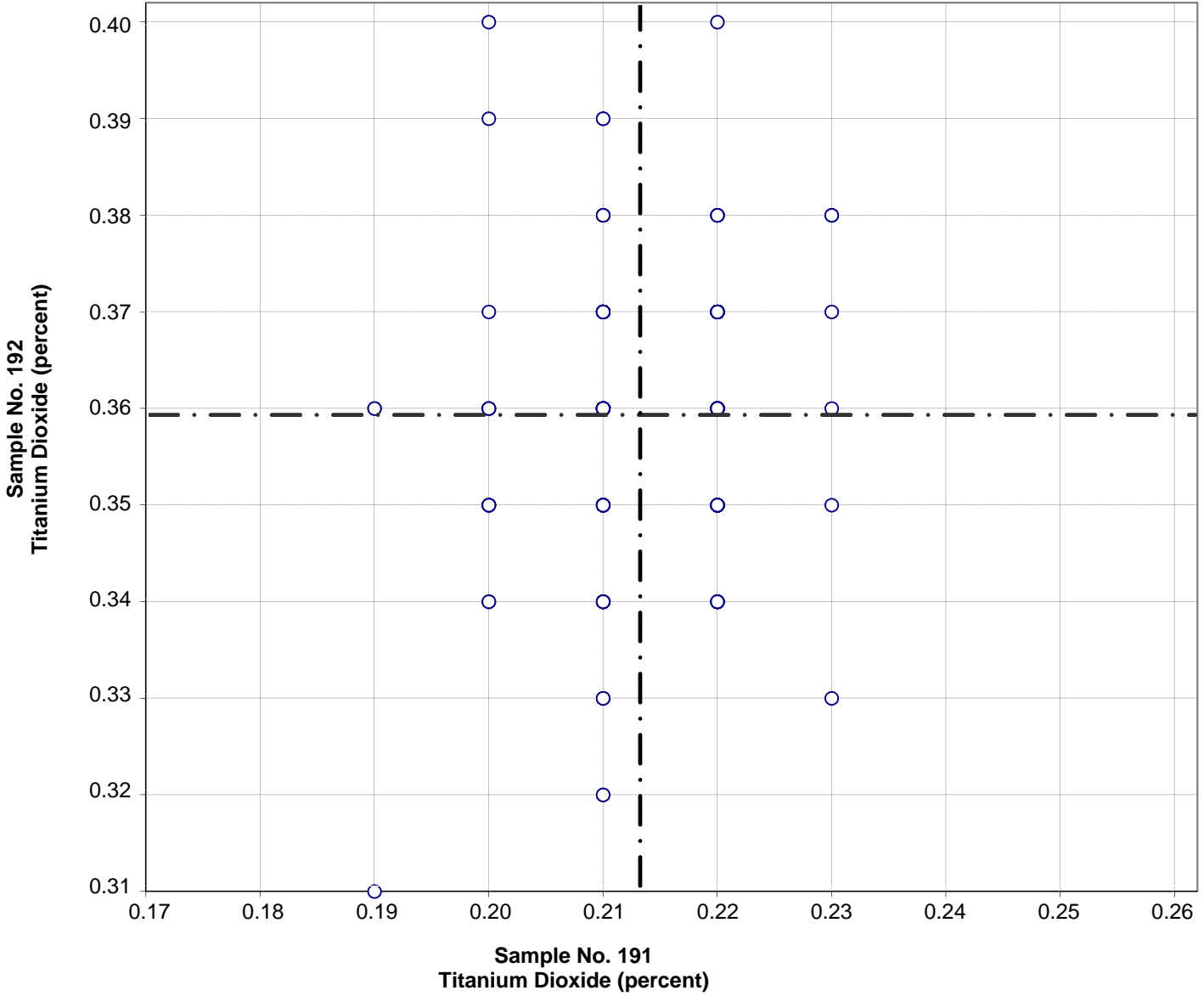
Test No. 100 Potassium Oxide 212 Points

Sample No. 191 Ave 0.654 S.D. 0.016 C.V. 2.5

Sample No. 192 Ave 0.422 S.D. 0.014 C.V. 3.4

Labs Eliminated: 40, 52, 54, 90, 110, 557, 611, 840, 2466, 2491, 3235, 3606, 3607, 3752, 3819, 3859

**CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 191 and No. 192**



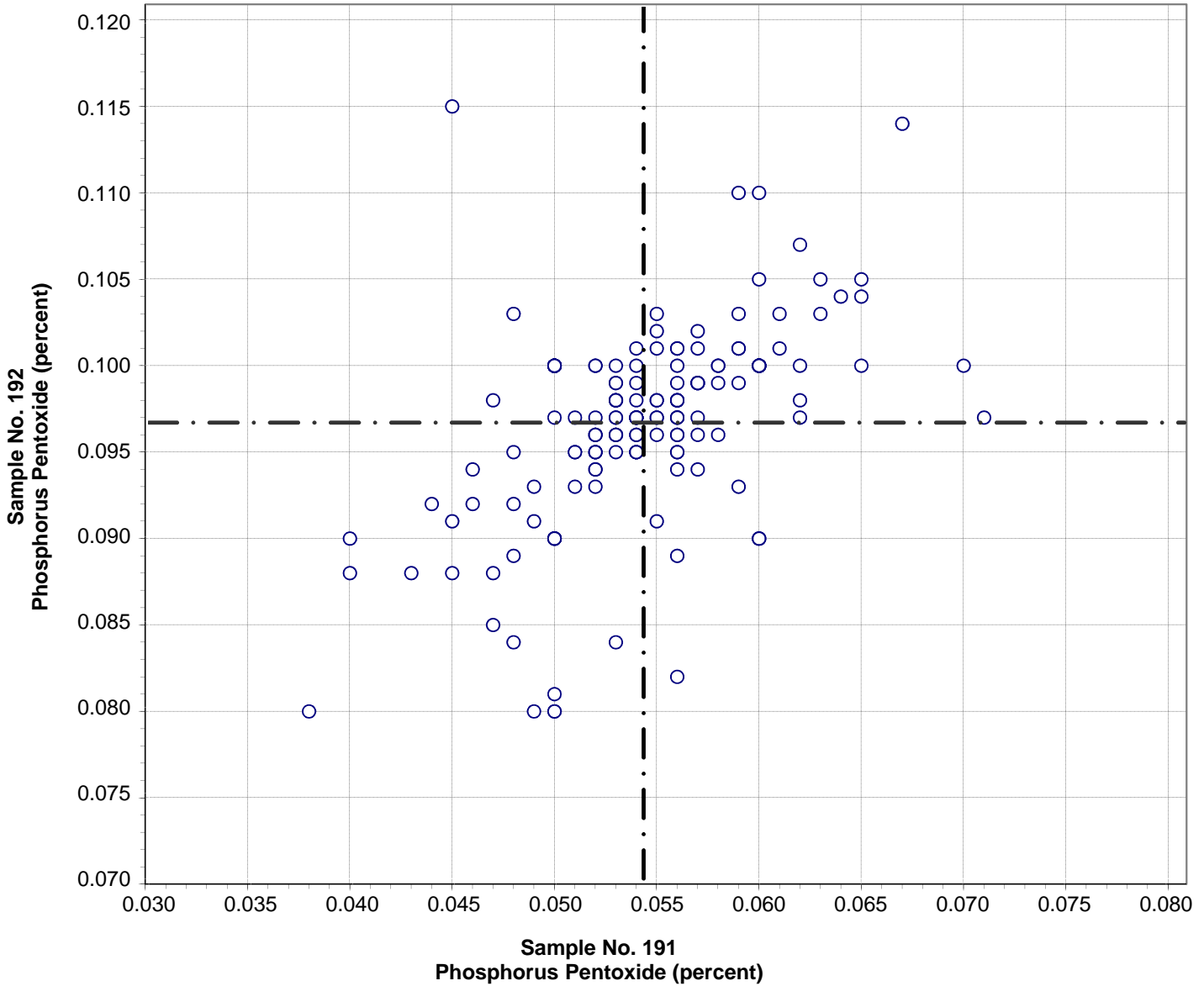
Test No. 103 Titanium Dioxide 177 Points

Sample No. 191 Ave 0.21 S.D. 0.007 C.V. 3.5

Sample No. 192 Ave 0.36 S.D. 0.014 C.V. 3.8

Labs Eliminated: 60, 64, 95, 98, 137, 219, 494, 1644, 1723

**CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 191 and No. 192**



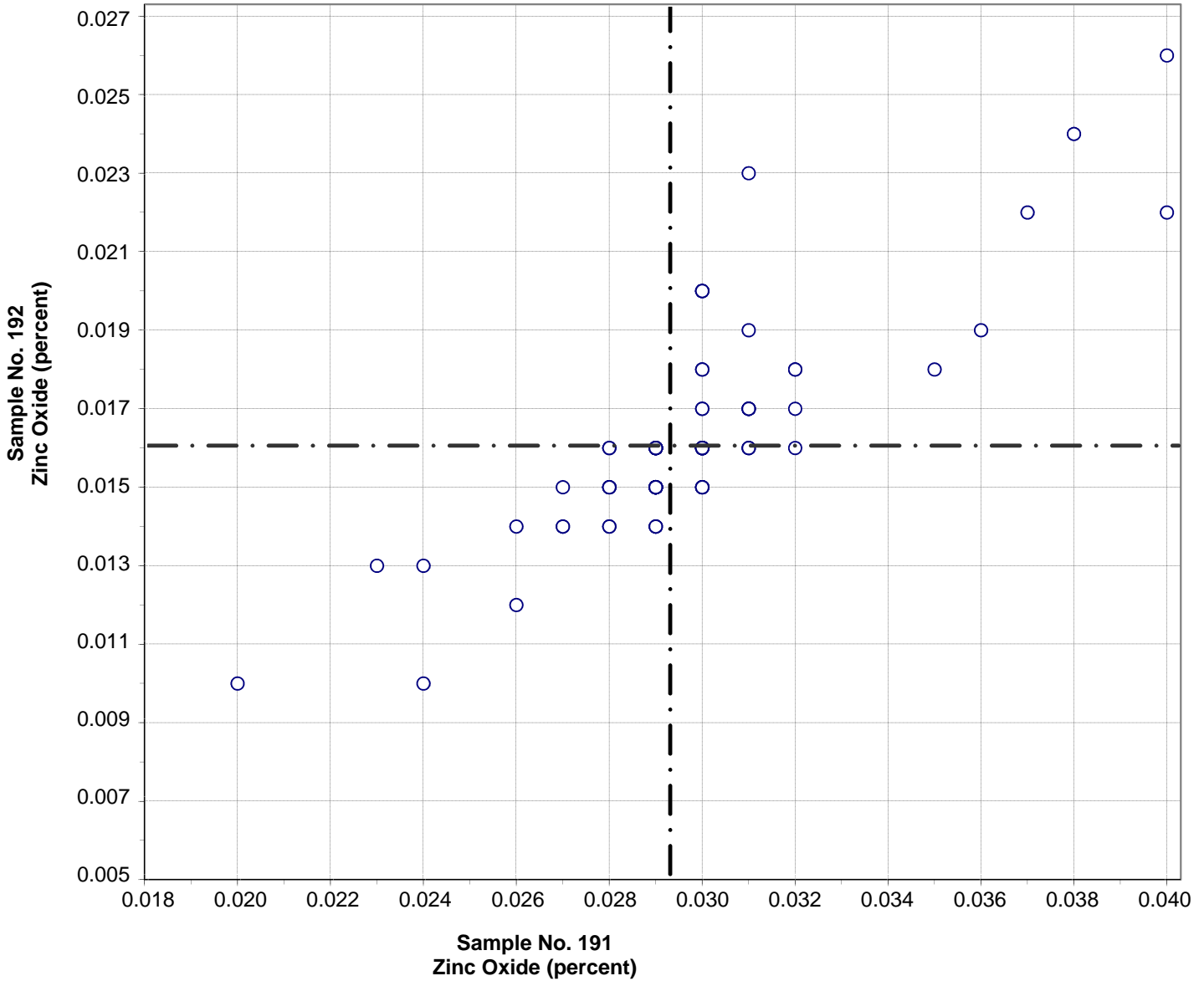
Test No. 102 Phosphorus Pentoxide 160 Points

Sample No. 191 Ave 0.054 S.D. 0.005 C.V. 9.9

Sample No. 192 Ave 0.097 S.D. 0.006 C.V. 6.0

Labs Eliminated: 8, 90, 98, 139, 178, 457, 493, 494, 1466, 1799, 1940, 2305,
2412, 2463, 2955, 3235, 3368, 3695

**CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 99 Zinc Oxide 86 Points

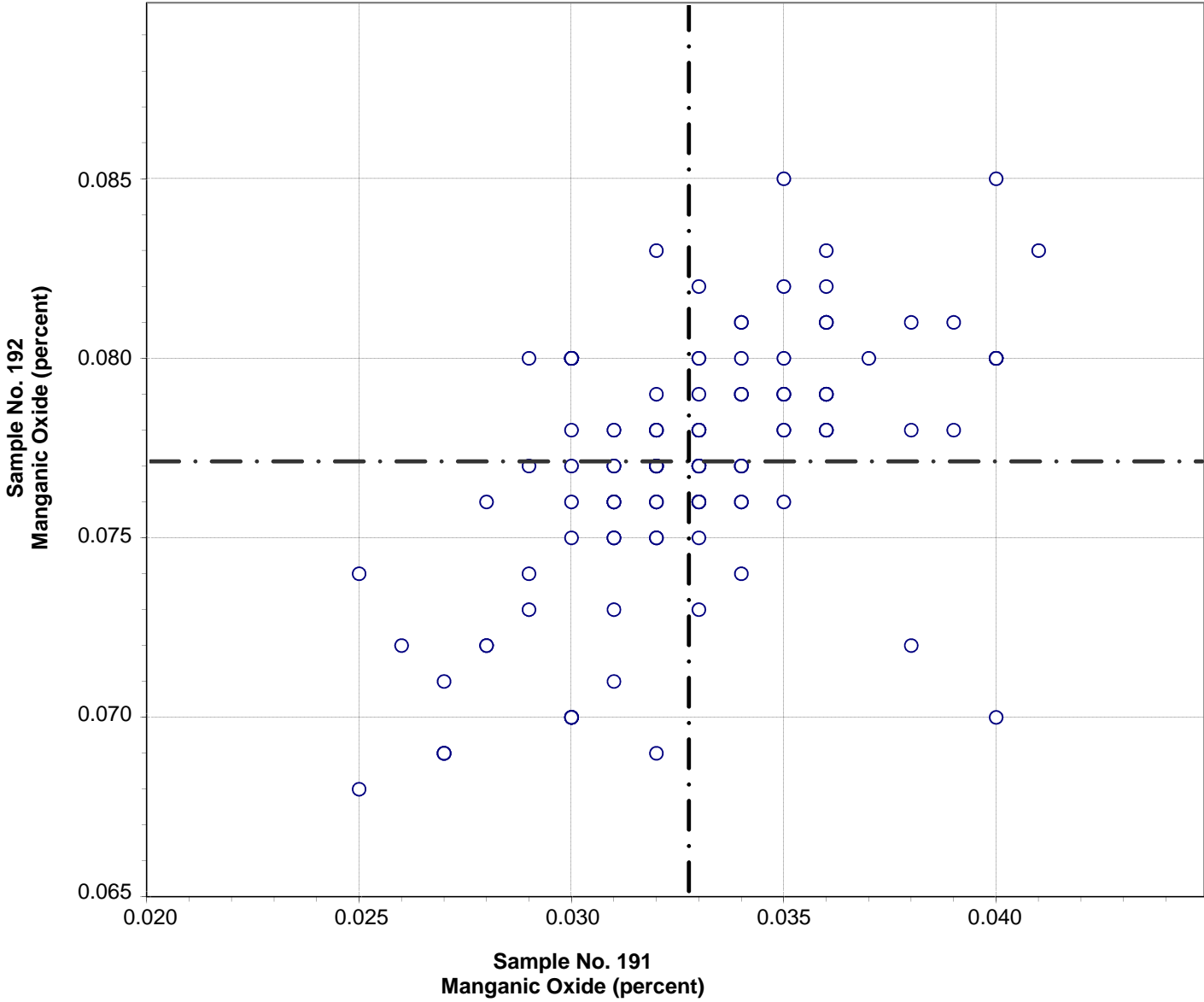
Sample No. 191 Ave 0.029 S.D. 0.004 C.V. 12.4

Sample No. 192 Ave 0.016 S.D. 0.003 C.V. 21.0

Labs Eliminated: 54, 129, 142, 219, 416, 497, 2296, 2491

Labs off Diagram: 7, 75, 95, 768

**CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**



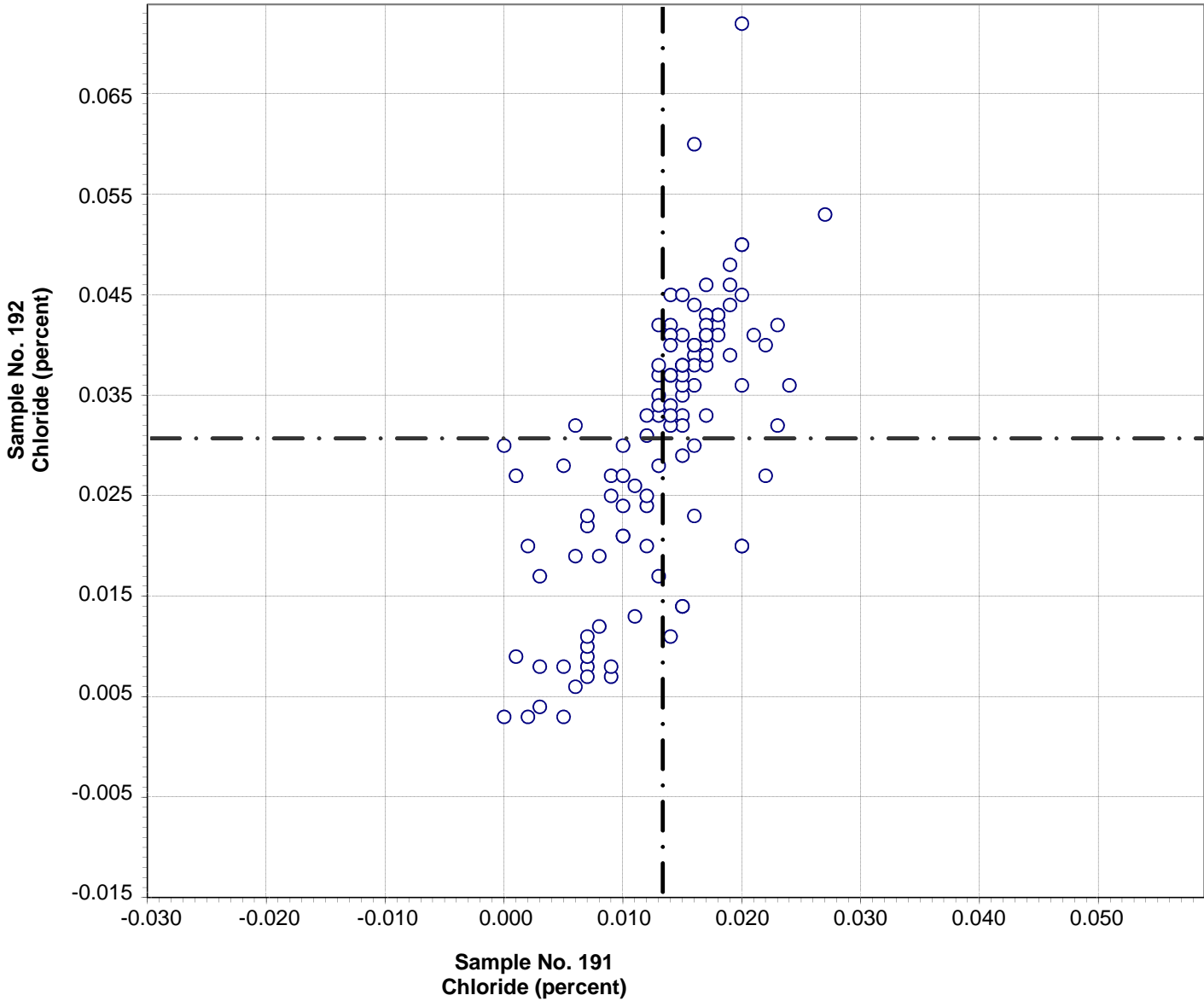
Test No. 101 Manganic Oxide 142 Points

Sample No. 191 Ave 0.033 S.D. 0.003 C.V. 9.8

Sample No. 192 Ave 0.077 S.D. 0.003 C.V. 4.5

Labs Eliminated: 354, 413, 416, 457, 768, 2462, 2466, 2491, 3662

**CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 191 and No. 192**

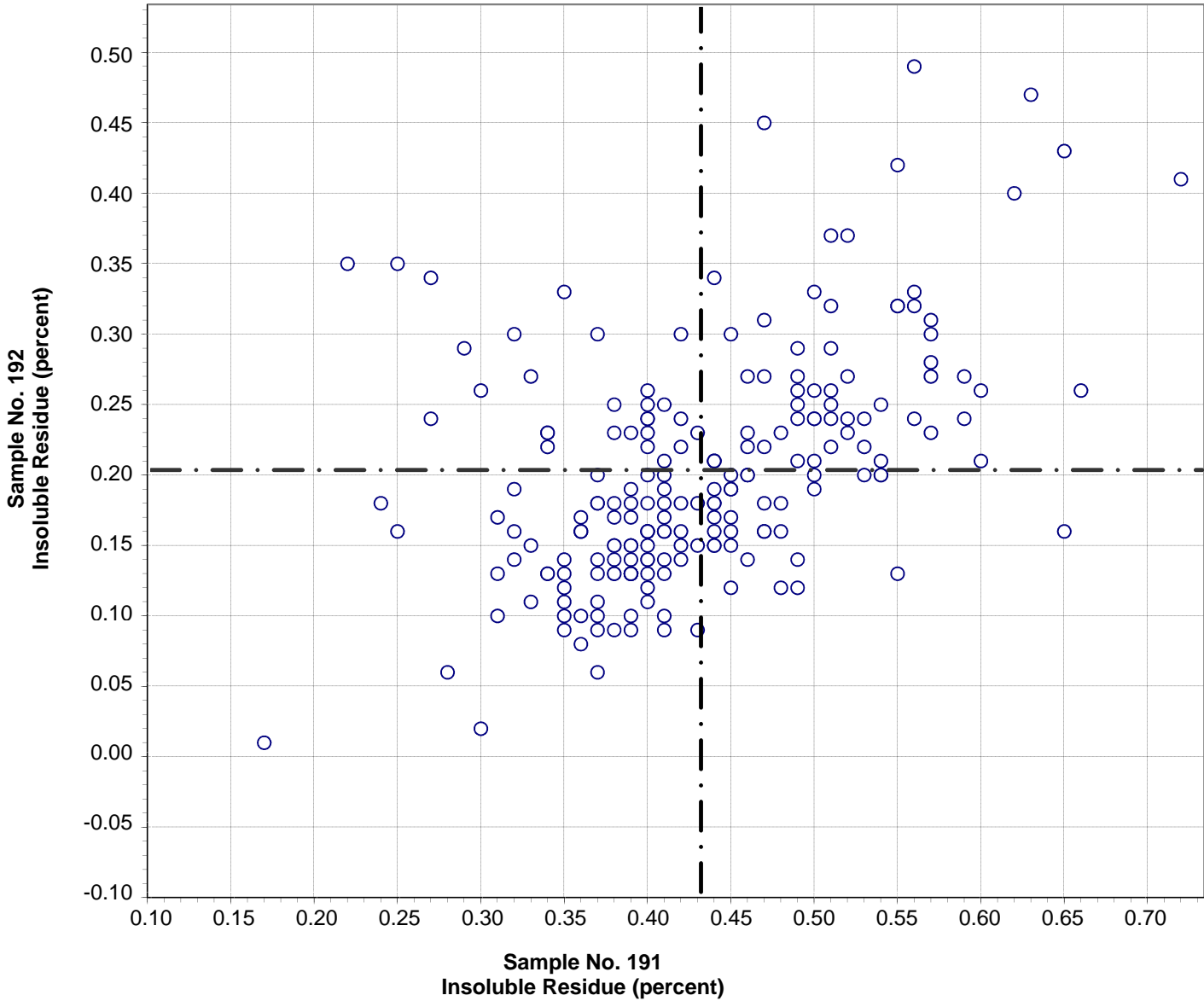


Test No. 104 Chloride 114 Points

Sample No. 191	Ave 0.013	S.D. 0.006	C.V. 42
Sample No. 192	Ave 0.031	S.D. 0.014	C.V. 44

Labs Eliminated: 18, 90, 493, 692, 1466, 2296, 2463

**CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 191 and No. 192**



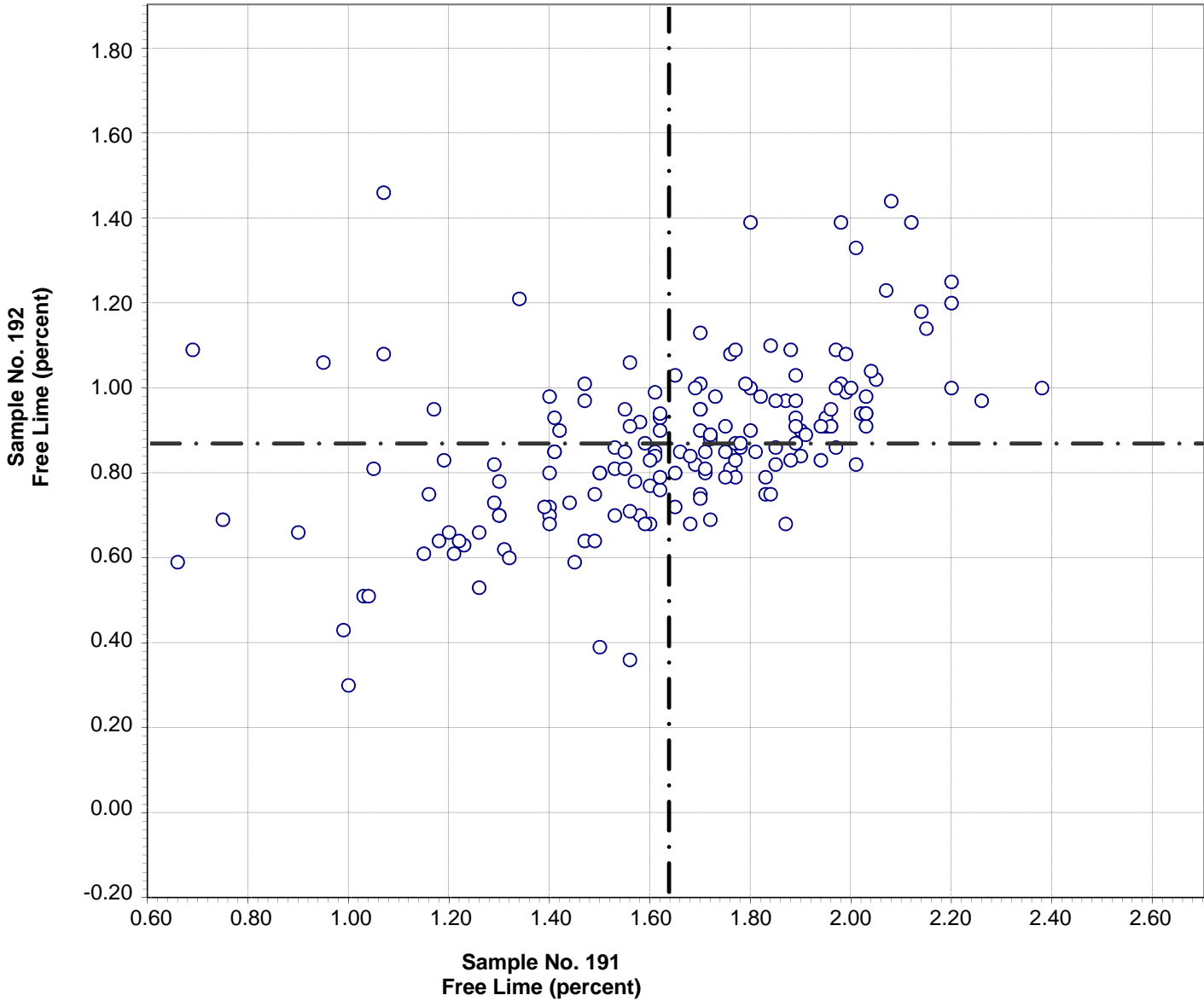
Test No. 80 Insoluble Residue 205 Points

Sample No. 191 Ave 0.43 S.D. 0.09 C.V. 20

Sample No. 192 Ave 0.20 S.D. 0.08 C.V. 40

Labs Eliminated: 36, 52, 130, 206, 289, 354, 413, 494, 1799, 2491, 3297, 3413, 3663

CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 191 and No. 192



Test No. 41 Free Lime 171 Points

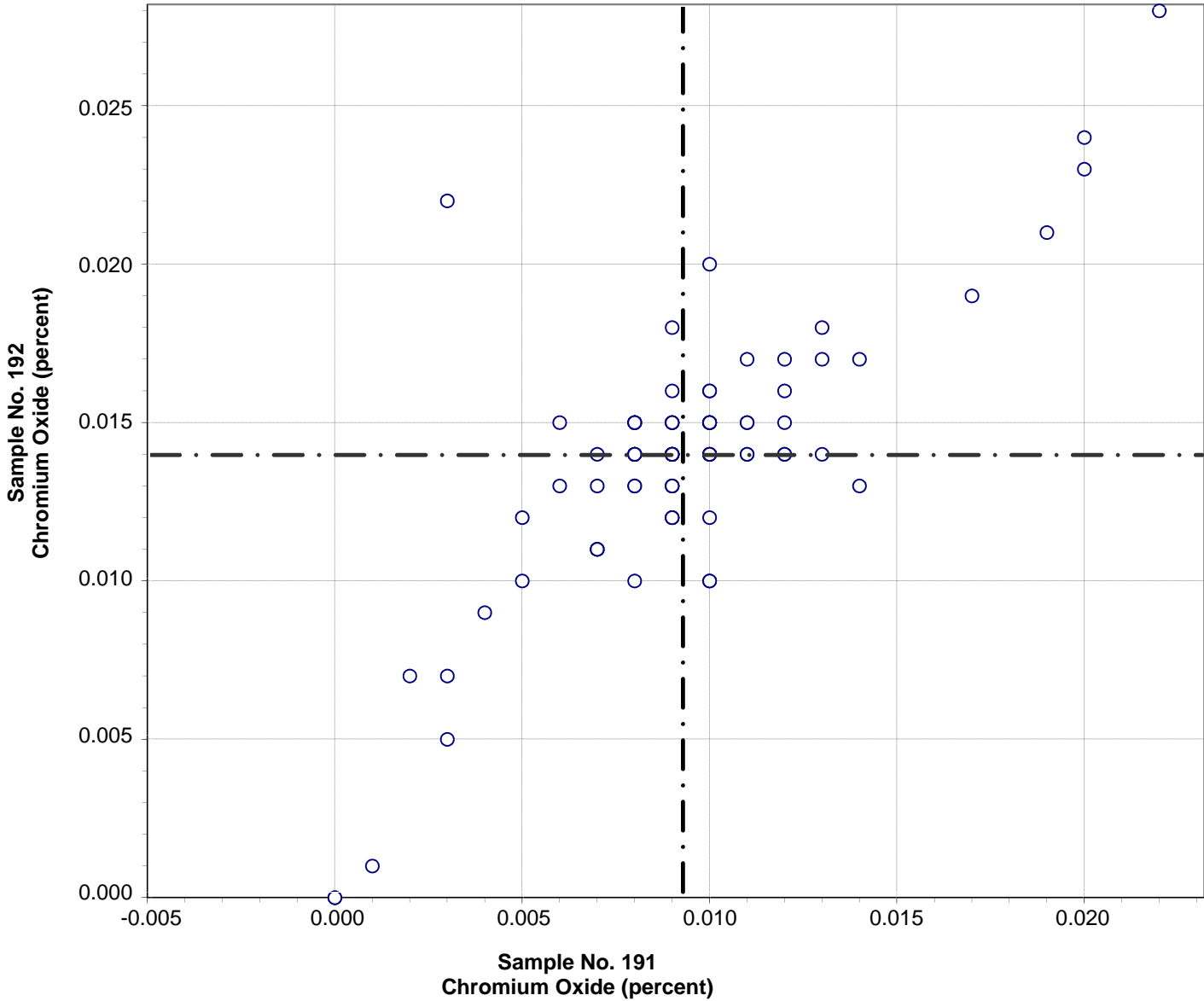
Sample No. 191 Ave 1.64 S.D. 0.33 C.V. 20

Sample No. 192 Ave 0.87 S.D. 0.20 C.V. 23

Labs Eliminated: 110, 206, 1942, 3185, 3695

Labs off Diagram: 159

**CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 191 and No. 192**

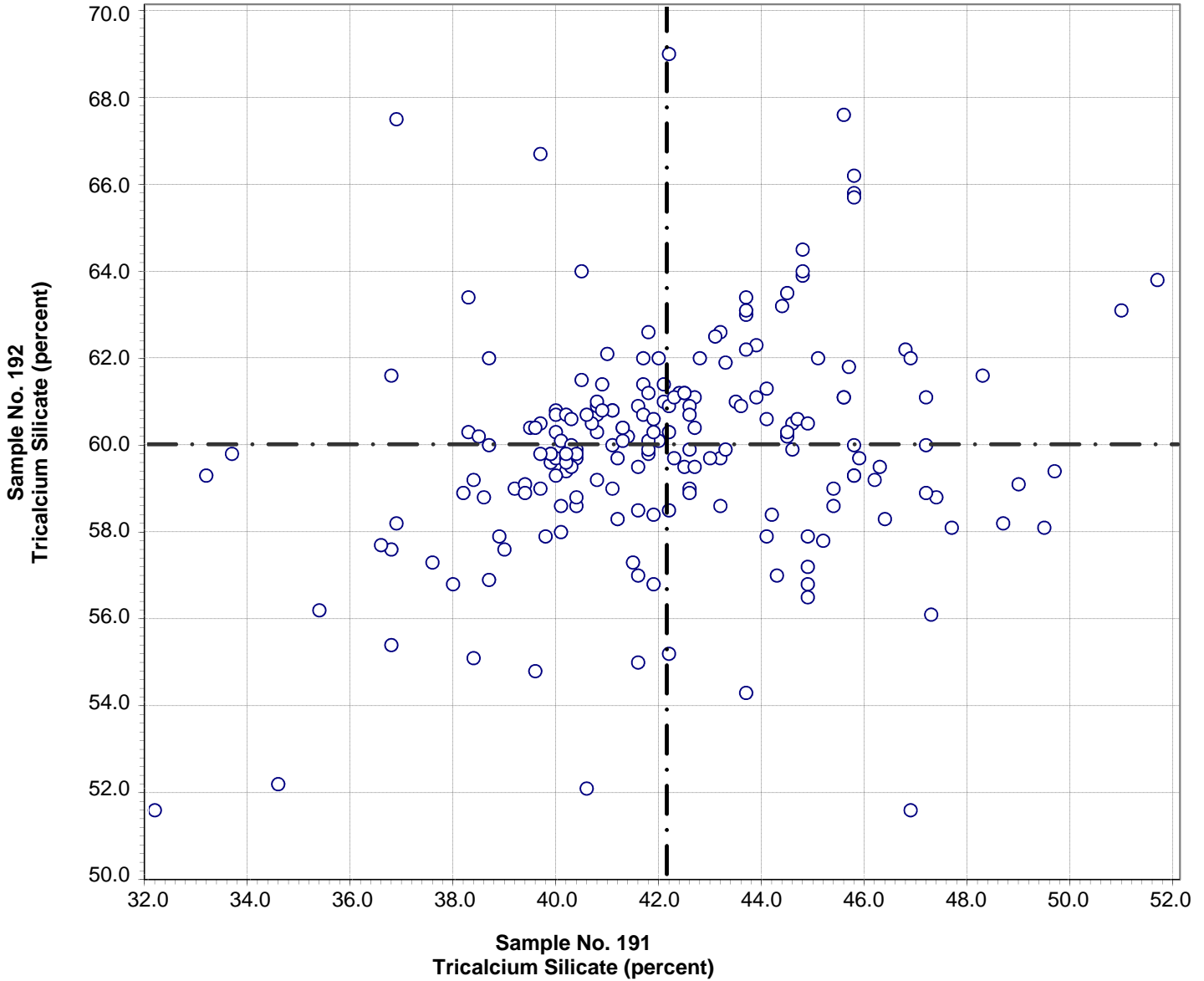


Test No. 105 Chromium Oxide 88 Points

Sample No. 191	Ave 0.009	S.D. 0.004	C.V. 41
Sample No. 192	Ave 0.014	S.D. 0.004	C.V. 30

Labs Eliminated: 95, 203, 416, 438, 3057

**CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 191 and No. 192**



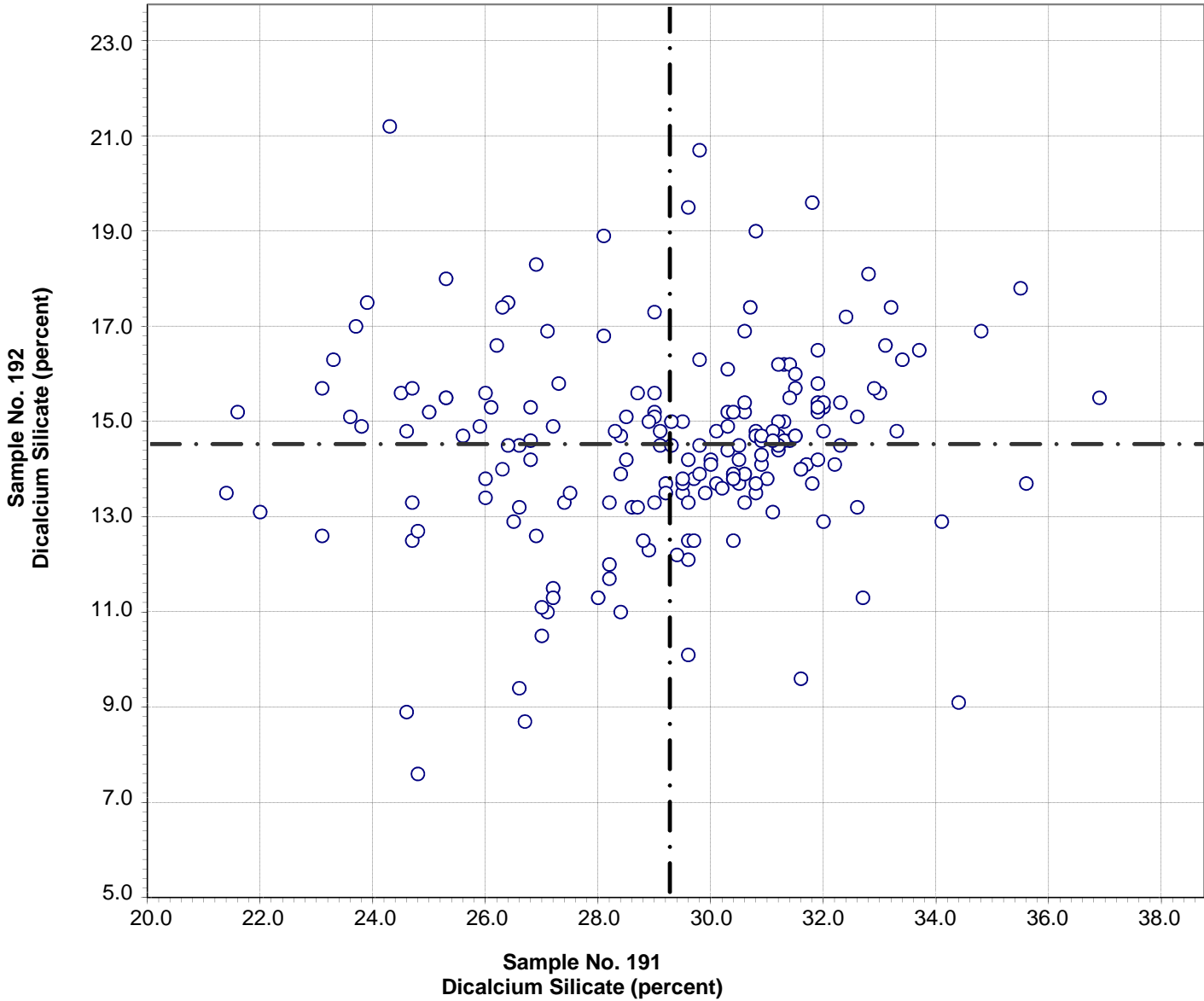
Test No. 106 Tricalcium Silicate 196 Points

Sample No. 191 Ave 42.1 S.D. 3.2 C.V. 7.5

Sample No. 192 Ave 60.0 S.D. 2.5 C.V. 4.2

Labs Eliminated: 3, 19, 28, 38, 74, 2296, 3368

**CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 191 and No. 192**

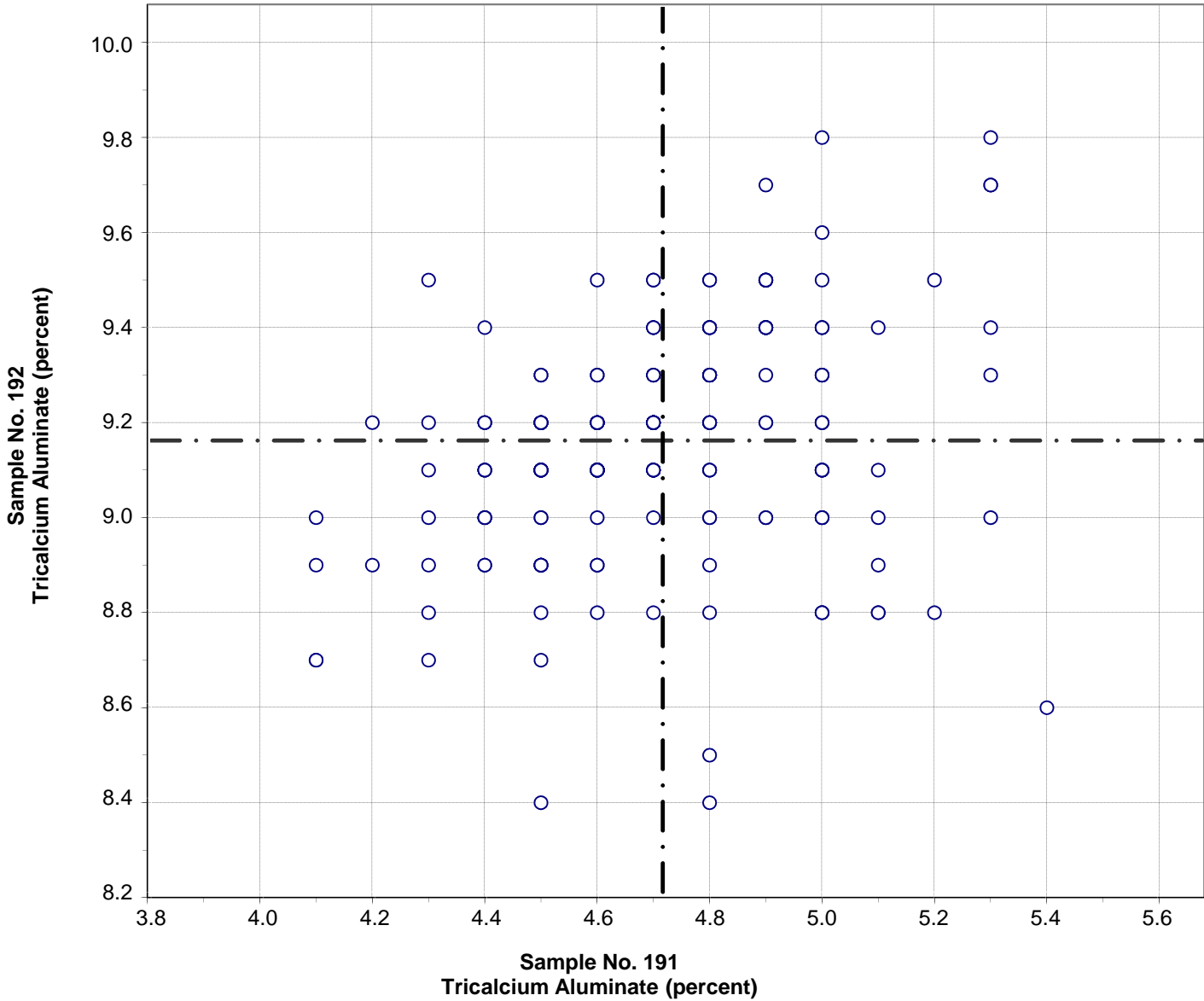


Test No. 107 Dicalcium Silicate 191 Points

Sample No. 191	Ave 29.3	S.D. 2.9	C.V. 9.8
Sample No. 192	Ave 14.5	S.D. 2.0	C.V. 14.1

Labs Eliminated: 3, 19, 38, 54, 74, 78, 206, 2296, 3368, 3607

**CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 191 and No. 192**



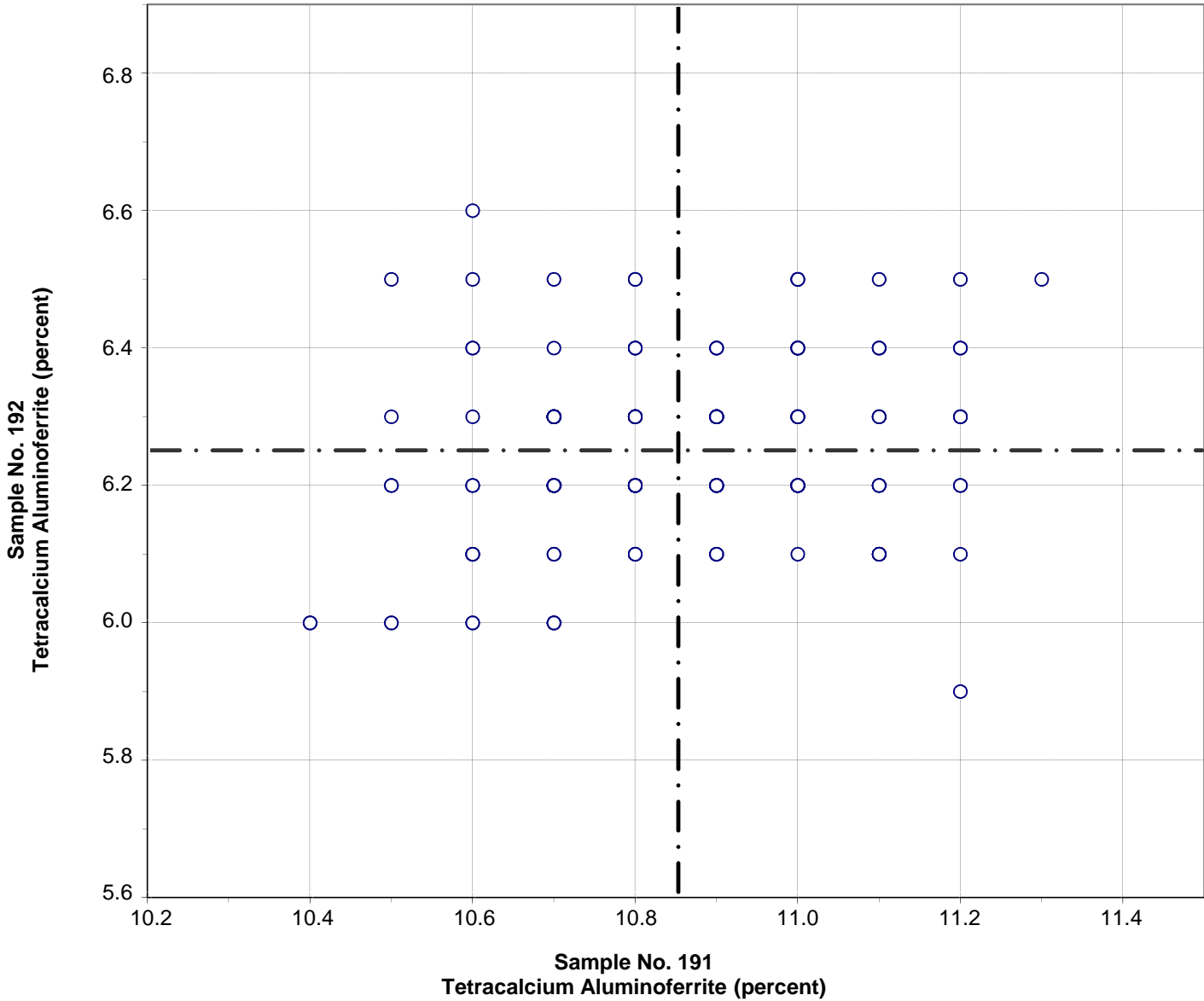
Test No. 108 Tricalcium Aluminate 193 Points

Sample No. 191 Ave 4.7 S.D. 0.3 C.V. 5.5

Sample No. 192 Ave 9.2 S.D. 0.2 C.V. 2.6

Labs Eliminated: 4, 19, 28, 50, 74, 78, 126, 687, 3607

**CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 109 Tetracalcium Aluminoferrite 194 Points

Sample No. 191 Ave 10.9 S.D. 0.2 C.V. 1.7

Sample No. 192 Ave 6.2 S.D. 0.1 C.V. 1.9

Labs Eliminated: 10, 41, 54, 221, 222, 438, 692, 1644, 3663

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Physical Results
 March 21, 2014

SUMMARY OF RESULTS

Sample No.191

Sample No. 192

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Normal Consistency - % Water (percent)							
	245	25.1	1.63	6.50	25.9	1.81	7.00
	*239	25.0	0.54	2.10	25.8	0.66	2.60
* Labs Eliminated - 7, 157, 1940, 2305, 2465, 3859							
Vicat Time of Set - Initial (minutes)							
	239	104	32	31	143	15	11
	*234	105	31	30	142	14	10
* Labs Eliminated - 44, 694, 1435, 2116, 2763							
Vicat Time of Set - Final (minutes)							
	232	232	36	16	244	28	11
	*228	231	34	15	243	26	11
* Labs Eliminated - 3, 165, 502, 3658							
Gillmore Time of Set - Initial (minutes)							
	145	143	41	29	175	24	14
	*144	144	41	29	174	23	13
* Labs Eliminated - 54							
Gillmore Time of Set - Final (minutes)							
	145	262	36	14	274	32	12
	*144	262	34	13	274	31	11
* Labs Eliminated - 1435							
False Set - Paste Method (percent)							
	184	19	29.1	150.3	81	11.1	13.7
	*181	19	28.9	153.7	82	9.5	11.6
* Labs Eliminated - 116, 491, 3893							
Autoclave Expansion (percent)							
	228	0.12	0.076	65	0.13	0.078	61
	*213	0.12	0.039	32	0.14	0.047	33
* Labs Eliminated - 23, 26, 38, 103, 116, 515, 958, 1053, 1054, 1940, 2360, 2462, 2463, 2481, 3819							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Physical Results
 March 21, 2014

SUMMARY OF RESULTS

Sample No.191

Sample No. 192

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content % (percent)							
	225	9.0	1.0	11	8.8	1.1	13
	*224	9.0	1.0	11	8.8	1.1	13
* Labs Eliminated - 36							
Air Content - % Water (percent)							
	218	69.5	5.4	7.8	70.1	5.5	7.9
	*213	69.8	2.1	3.0	70.4	2.1	3.0
* Labs Eliminated - 18, 159, 3279, 3662, 3893							
Air Content - Flow (percent)							
	220	86	3.8	4.4	86	4.3	5.0
	*217	86	3.3	3.8	86	3.3	3.9
* Labs Eliminated - 667, 2296, 3893							
Compressive Strength - 3 day (psi)							
	251	2431	245	10.1	3759	308	8.2
	*244	2418	184	7.6	3756	263	7.0
* Labs Eliminated - 38, 46, 143, 252, 502, 1222, 3859							
Compressive Strength - 7 day (psi)							
	250	3312	330	10.0	4781	340	7.1
	*242	3291	245	7.4	4776	282	5.9
* Labs Eliminated - 29, 38, 42, 46, 116, 143, 252, 823							
Compressive Strength - 28 day (psi)							
	237	5511	406	7.4	5958	404	6.8
	*233	5540	343	6.2	5981	363	6.1
* Labs Eliminated - 823, 1222, 2080, 3779							
Compressive Strength - Flow (percent)							
	227	107	9	8.0	104	9	8.2
	*222	107	8	7.1	104	8	7.4
* Labs Eliminated - 26, 95, 2080, 2296, 3893							

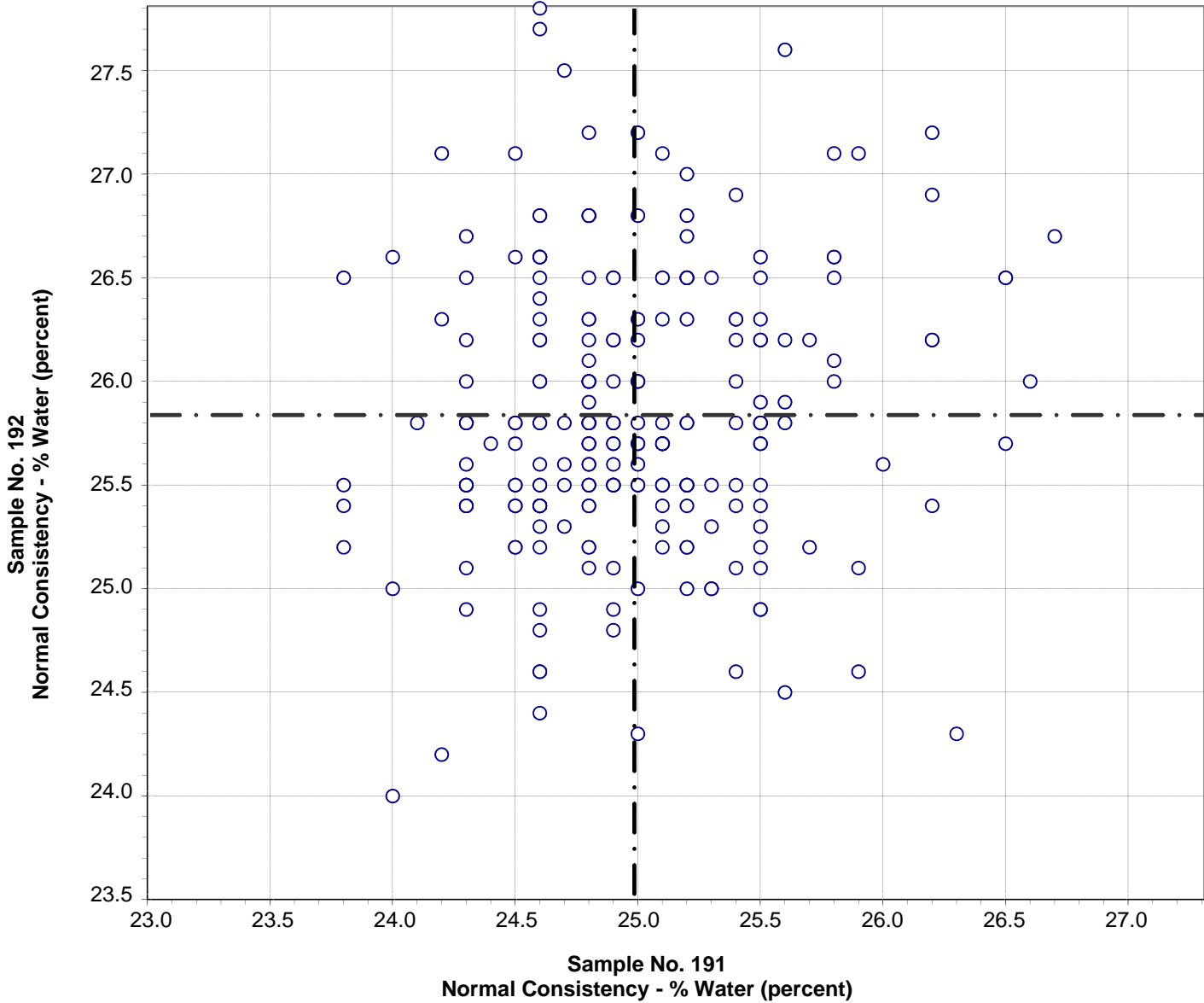
CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Physical Results
 March 21, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.191				Sample No. 192		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Fineness - Air Permeability (m²/kg)							
	242	439	21	4.7	401	16	4.0
	*234	440	15	3.4	401	13	3.2
	* Labs Eliminated - 26, 40, 47, 116, 143, 284, 360, 840						
Fineness - Wagner Turbidimeter (m²/kg)							
	5	220	18	8.3	216	15	6.8
	No Labs Eliminated for This Test						
Fineness - 45µm Sieve (percent)							
	232	92.83	1.27	1.36	92.90	1.18	1.27
	*227	92.91	0.98	1.05	92.97	0.93	1.00
	* Labs Eliminated - 26, 50, 116, 840, 2484						
C1038 Mortar Bar Expansion (percent)							
	155	0.008	0.008	100	0.007	0.008	118
	*148	0.007	0.004	52	0.007	0.004	55
	* Labs Eliminated - 15, 178, 246, 691, 768, 2462, 3662						
C1038 Mortar - Water (ml)							
	153	244	23	9.3	246	23	9.4
	*147	243	5	1.9	245	6	2.3
	* Labs Eliminated - 26, 84, 157, 1466, 2490, 3413						
C1038 Mortar - Flow (percent)							
	151	109	6	5.3	109	6	5.4
	*144	109	3	2.5	109	2	2.2
	* Labs Eliminated - 26, 84, 243, 565, 691, 2463, 3605						

**CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 191 and No. 192**



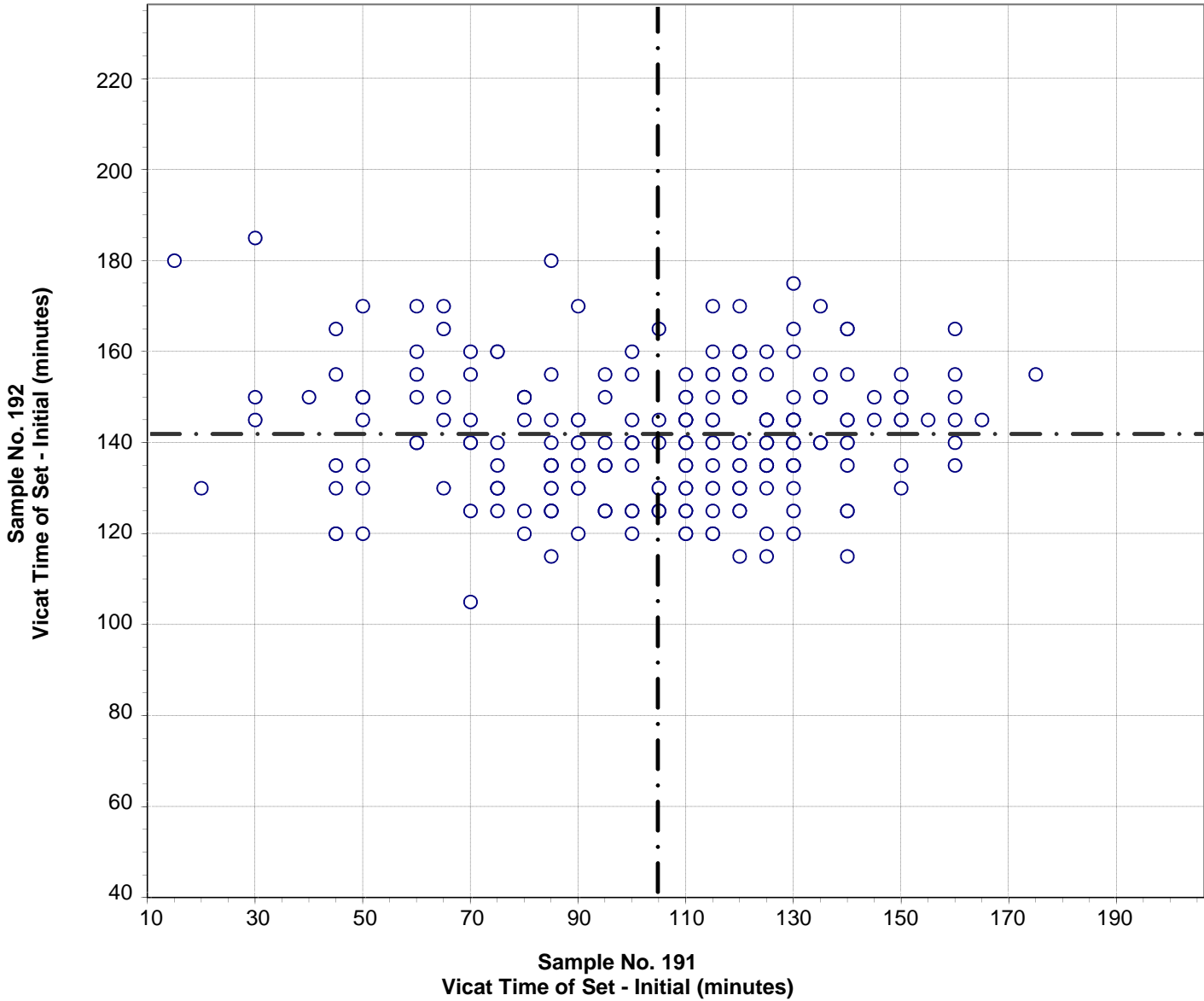
Test No. 110 Normal Consistency - % Water 239 Points

Sample No. 191 Ave 25.0 S.D. 0.54 C.V. 2.10

Sample No. 192 Ave 25.8 S.D. 0.66 C.V. 2.60

Labs Eliminated: 7, 157, 1940, 2305, 2465, 3859

**CCRL Proficiency Sample Program
 Vicat Time of Set - Initial
 PORTLAND CEMENT Samples No. 191 and No. 192**



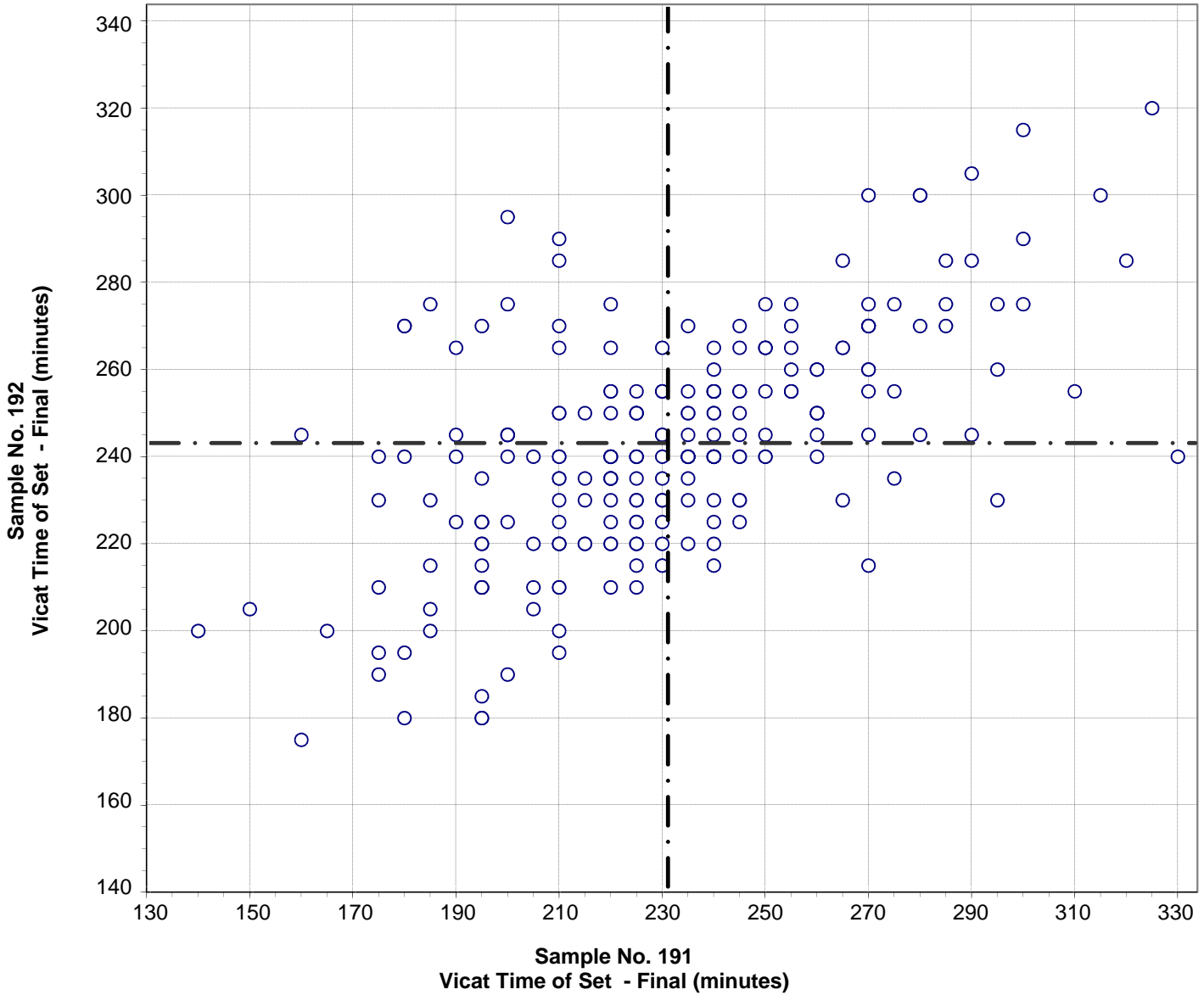
Test No. 120 Vicat Time of Set - Initial 234 Points

Sample No. 191 Ave 105 S.D. 31 C.V. 30

Sample No. 192 Ave 142 S.D. 14 C.V. 10

Labs Eliminated: 44, 694, 1435, 2116, 2763

CCRL Proficiency Sample Program
Vicat Time of Set - Final
PORTLAND CEMENT Samples No. 191 and No. 192

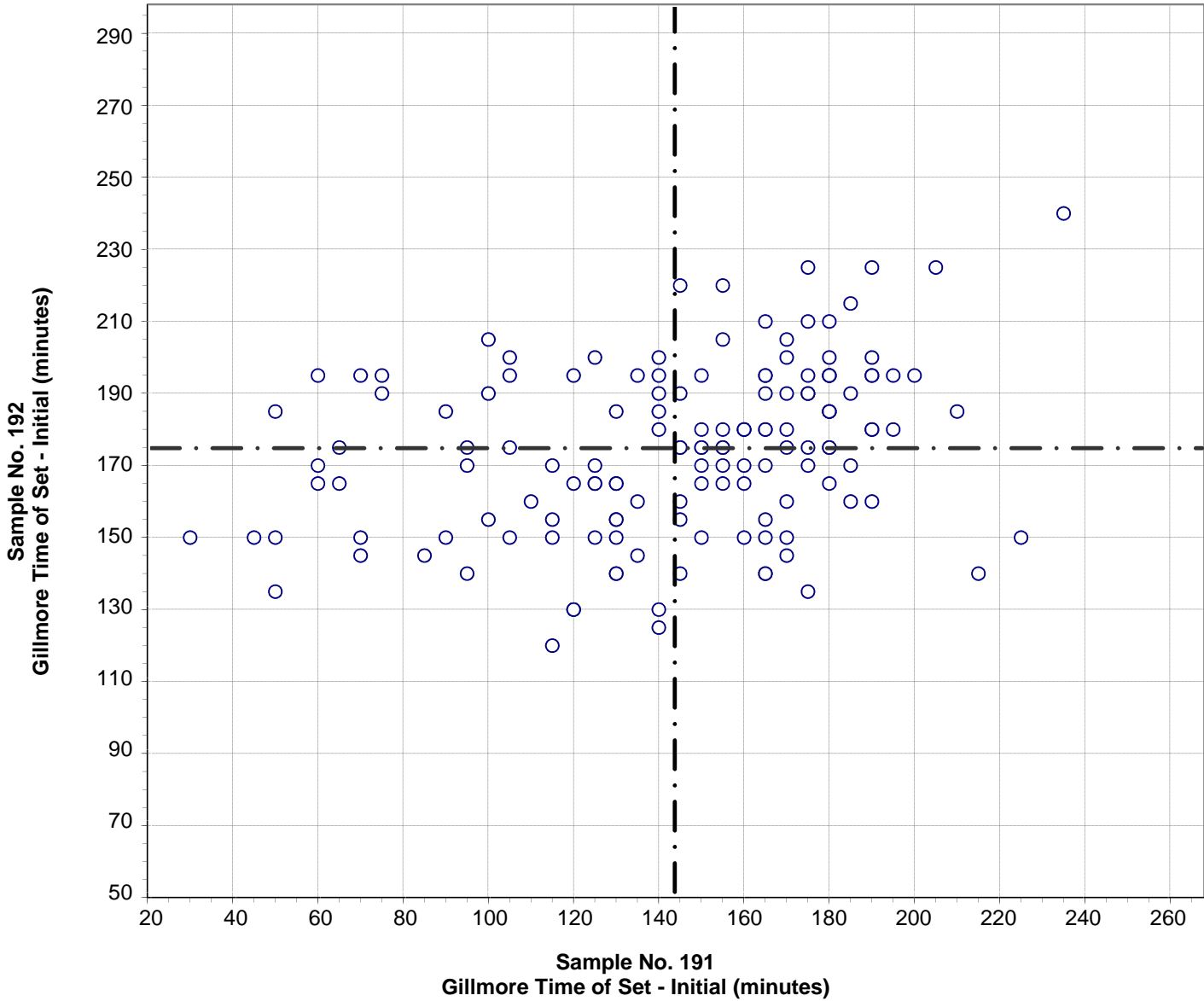


Test No. 121 Vicat Time of Set - Final 228 Points

Sample No. 191	Ave 231	S.D. 34	C.V. 15
Sample No. 192	Ave 243	S.D. 26	C.V. 11

Labs Eliminated: 3, 165, 502, 3658

**CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 191 and No. 192**

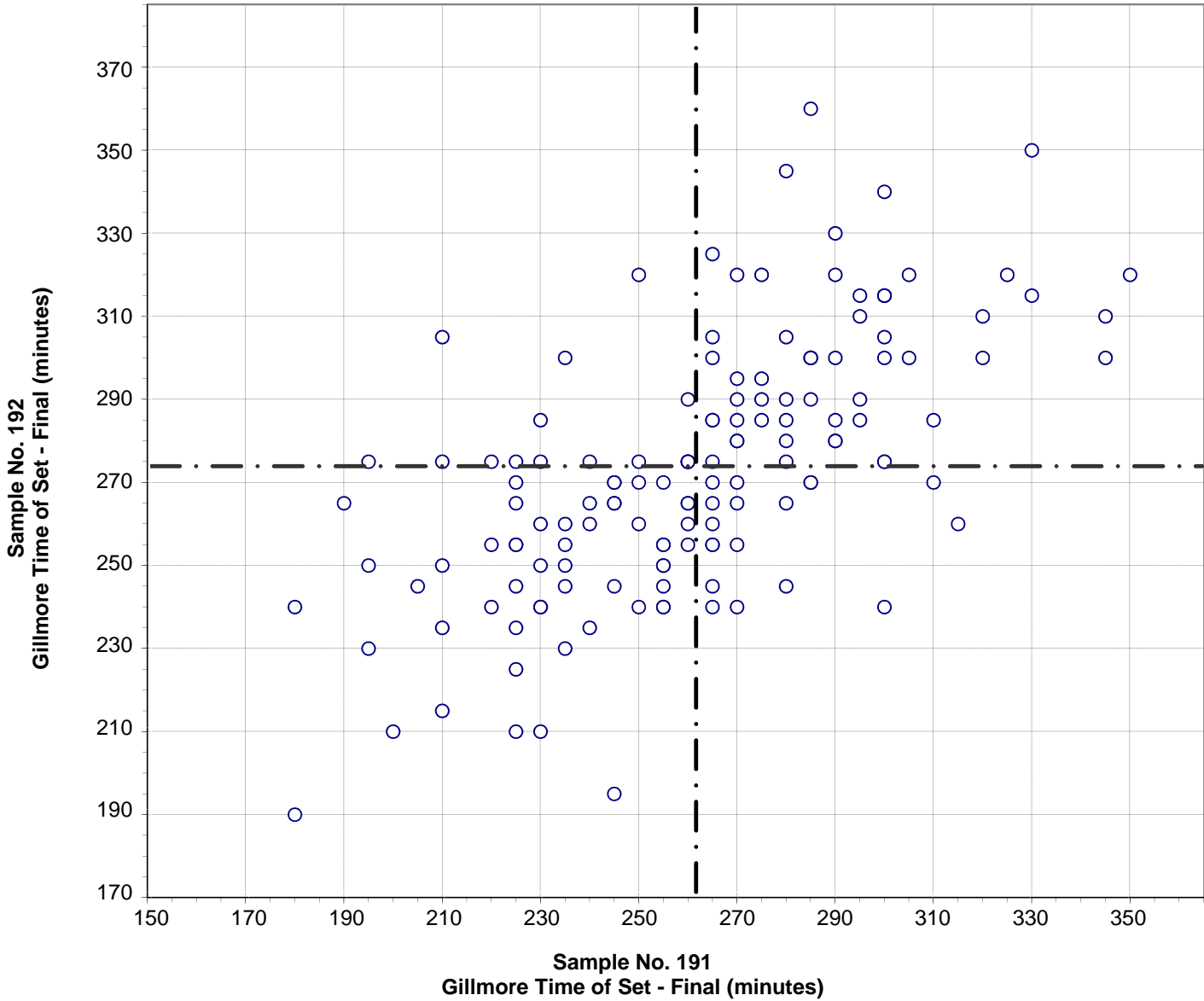


Test No. 130 Gillmore Time of Set - Initial 144 Points

Sample No. 191	Ave 144	S.D. 41	C.V. 29
Sample No. 192	Ave 174	S.D. 23	C.V. 13

Labs Eliminated: 54

**CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 191 and No. 192**

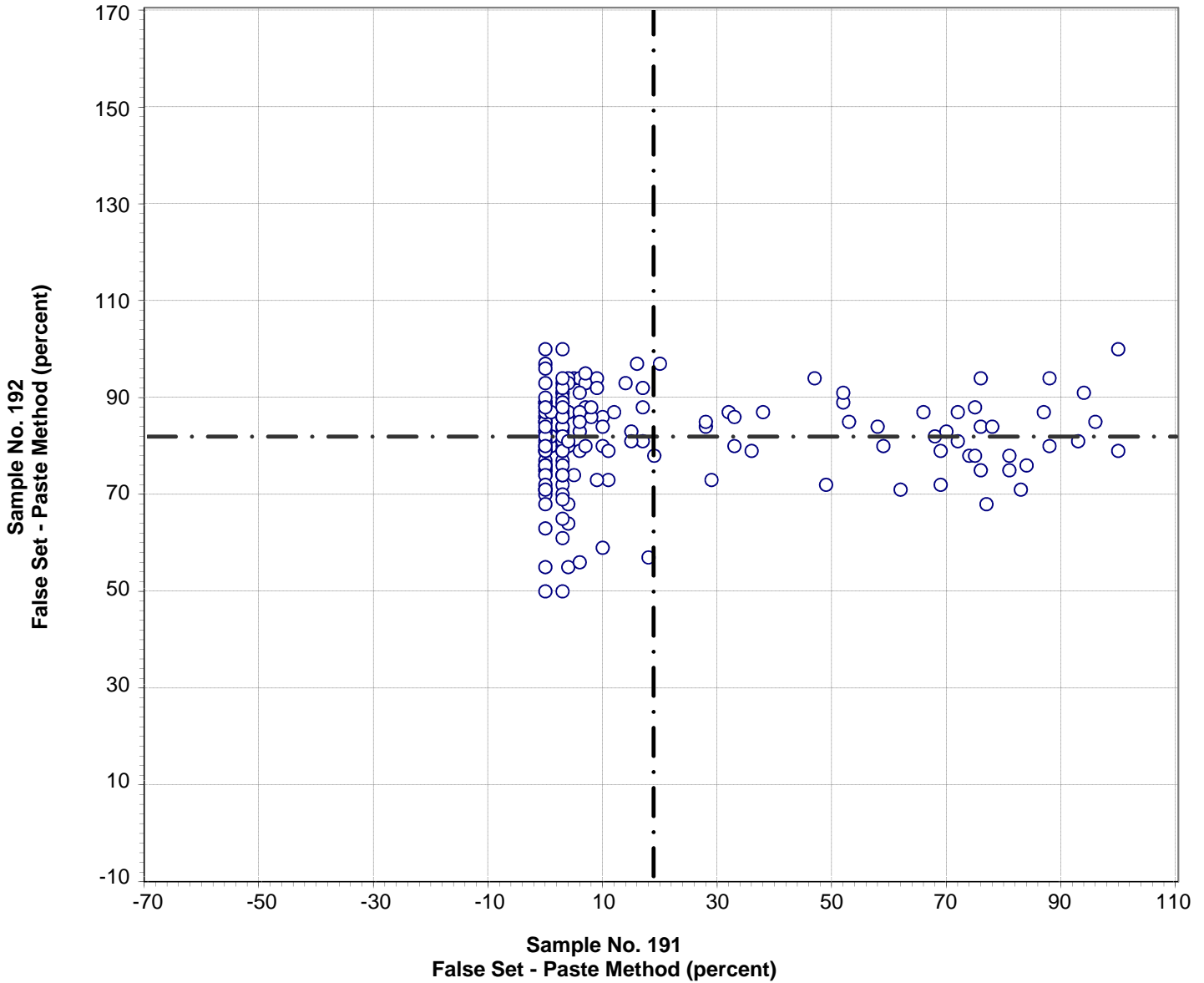


Test No. 140 Gillmore Time of Set - Final 144 Points

Sample No. 191	Ave 262	S.D. 34	C.V. 13
Sample No. 192	Ave 274	S.D. 31	C.V. 11

Labs Eliminated: 1435

**CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 191 and No. 192**



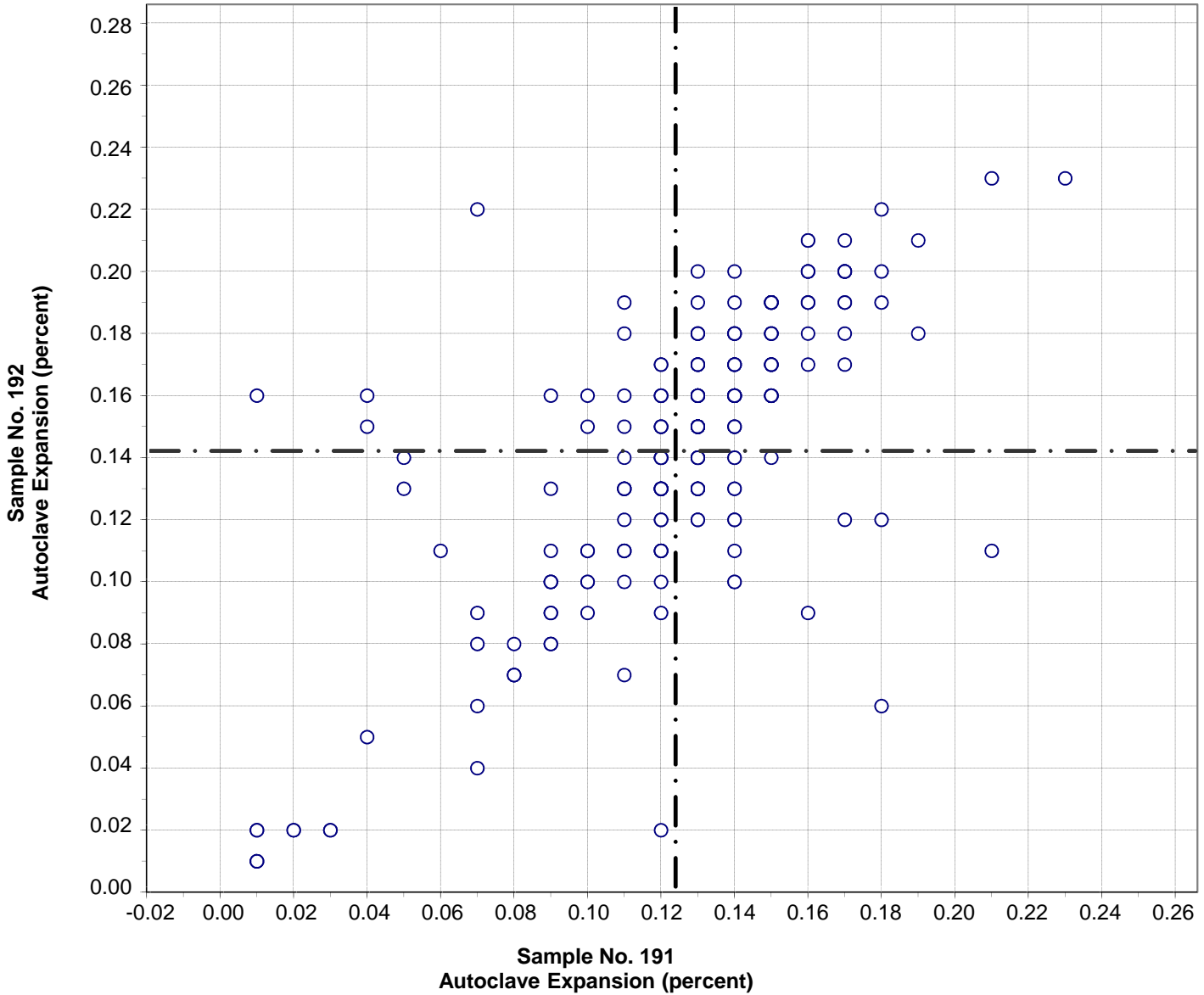
Test No. 150 False Set - Paste Method 181 Points

Sample No. 191 Ave 19 S.D. 28.9 C.V. 153.7

Sample No. 192 Ave 82 S.D. 9.5 C.V. 11.6

Labs Eliminated: 116, 491, 3893

**CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 160 Autoclave Expansion 212 Points

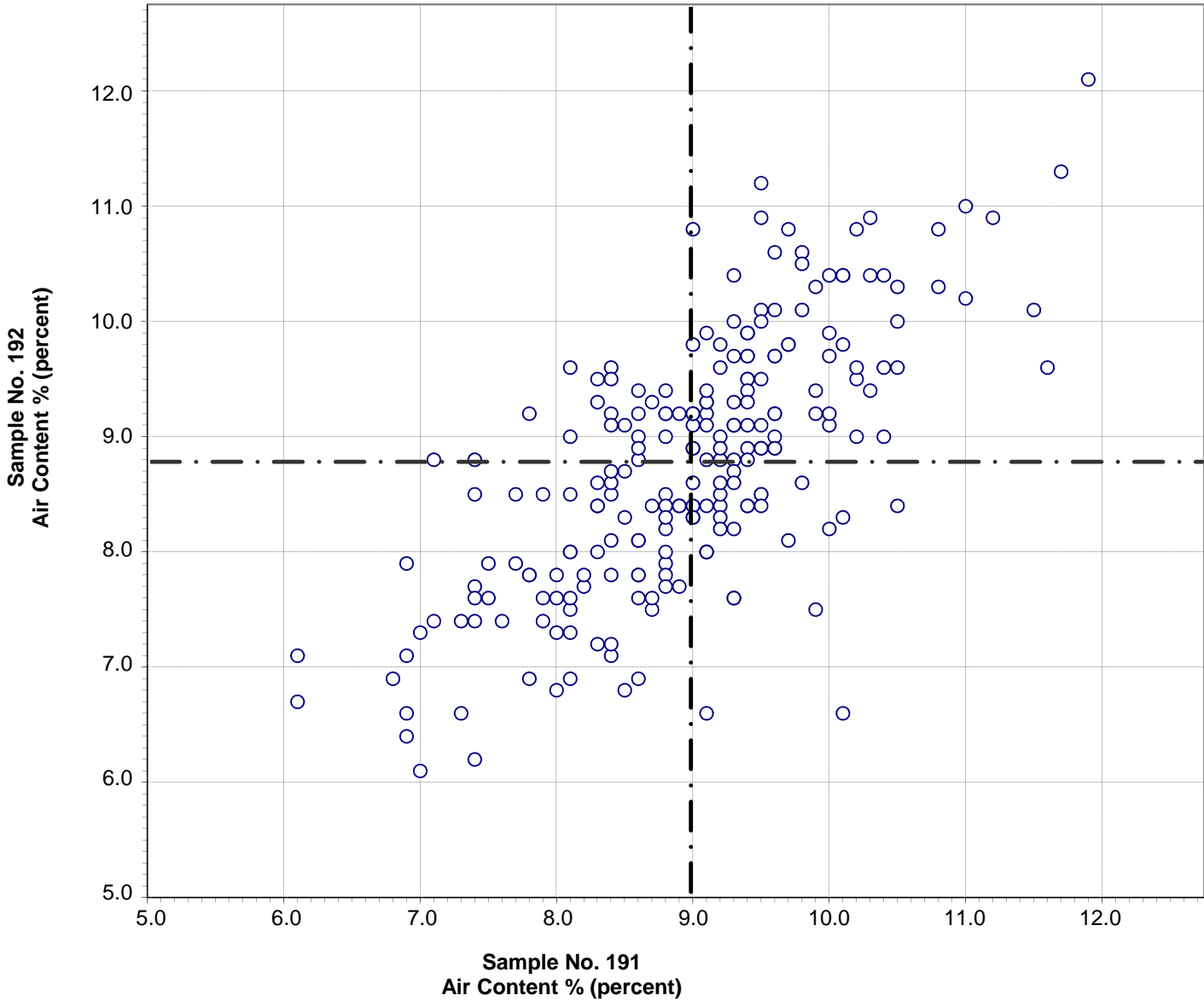
Sample No. 191 Ave 0.12 S.D. 0.039 C.V. 32

Sample No. 192 Ave 0.14 S.D. 0.047 C.V. 33

Labs Eliminated: 23, 26, 38, 103, 116, 515, 958, 1053, 1054, 1940, 2360, 2462, 2463, 2481, 3819

Labs off Diagram: 51

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 191 and No. 192

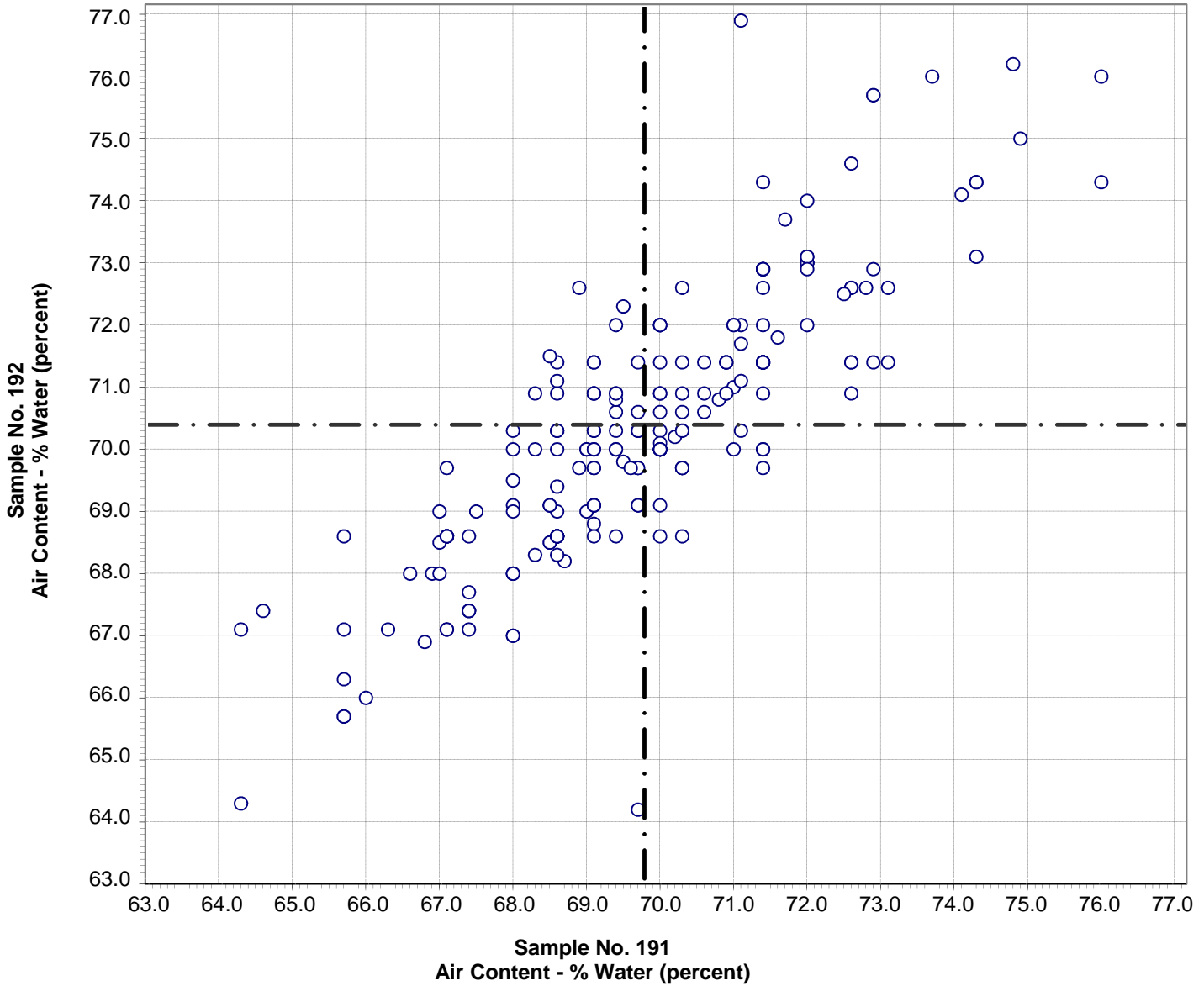


Test No. 170 Air Content % 224 Points

Sample No. 191	Ave 9.0	S.D. 1.0	C.V. 11
Sample No. 192	Ave 8.8	S.D. 1.1	C.V. 13

Labs Eliminated: 36

CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 191 and No. 192



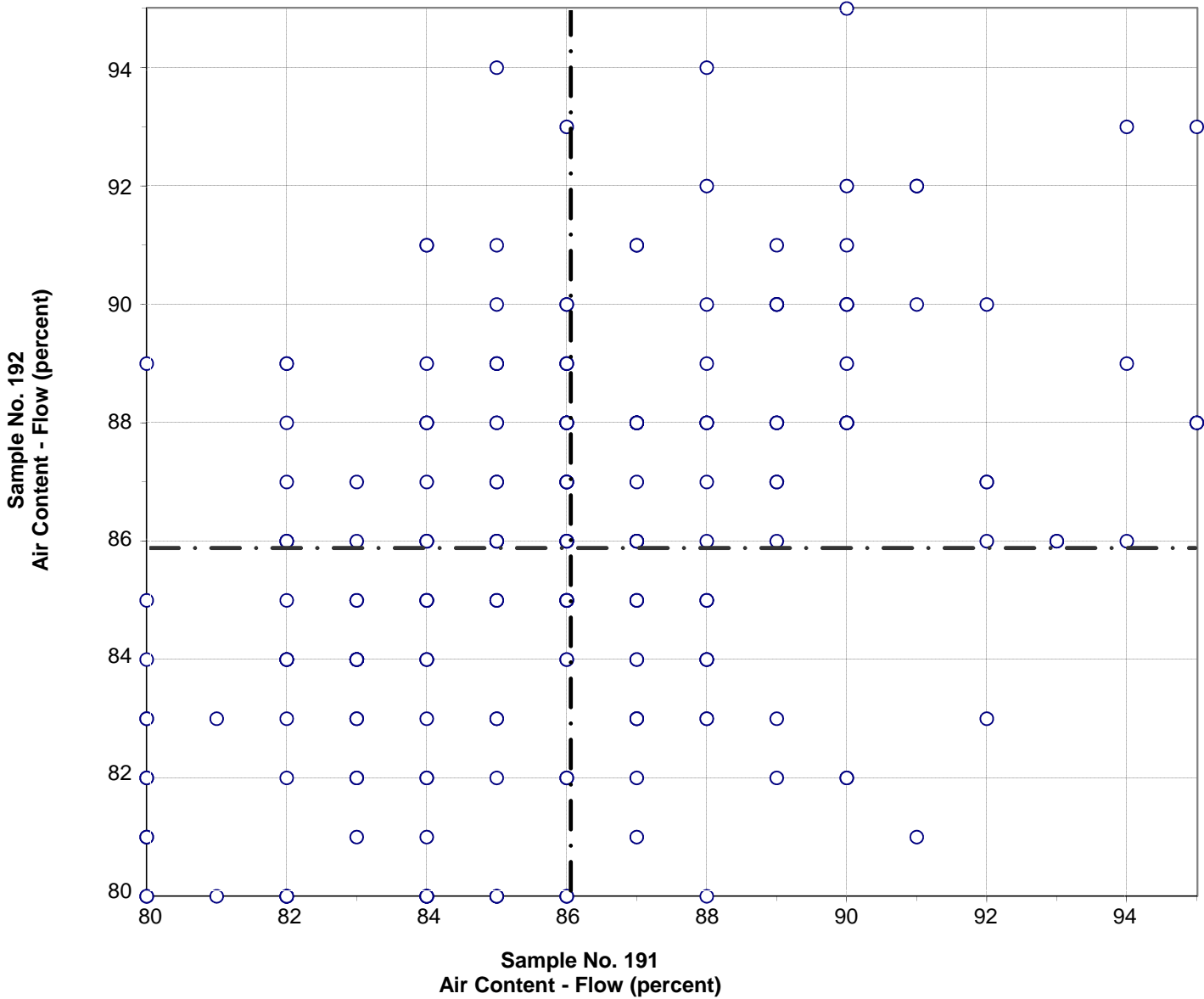
Test No. 180 Air Content - % Water 213 Points

Sample No. 191 Ave 69.8 S.D. 2.1 C.V. 3.0

Sample No. 192 Ave 70.4 S.D. 2.1 C.V. 3.0

Labs Eliminated: 18, 159, 3279, 3662, 3893

CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 191 and No. 192

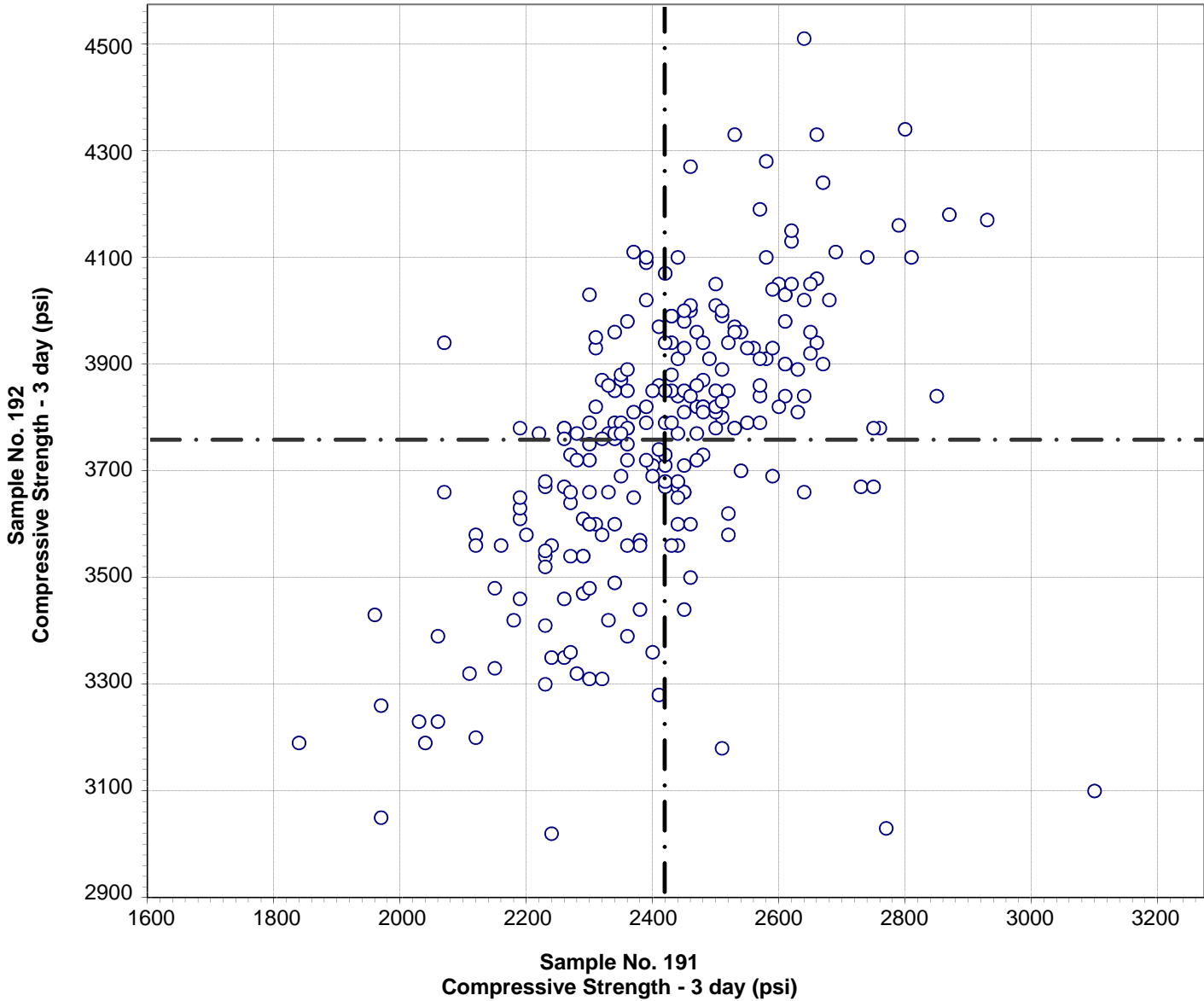


Test No. 190 Air Content - Flow 217 Points

Sample No. 191	Ave 86	S.D. 3.3	C.V. 3.8
Sample No. 192	Ave 86	S.D. 3.3	C.V. 3.9

Labs Eliminated: 667, 2296, 3893

**CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 200 Compressive Strength - 3 day 243 Points

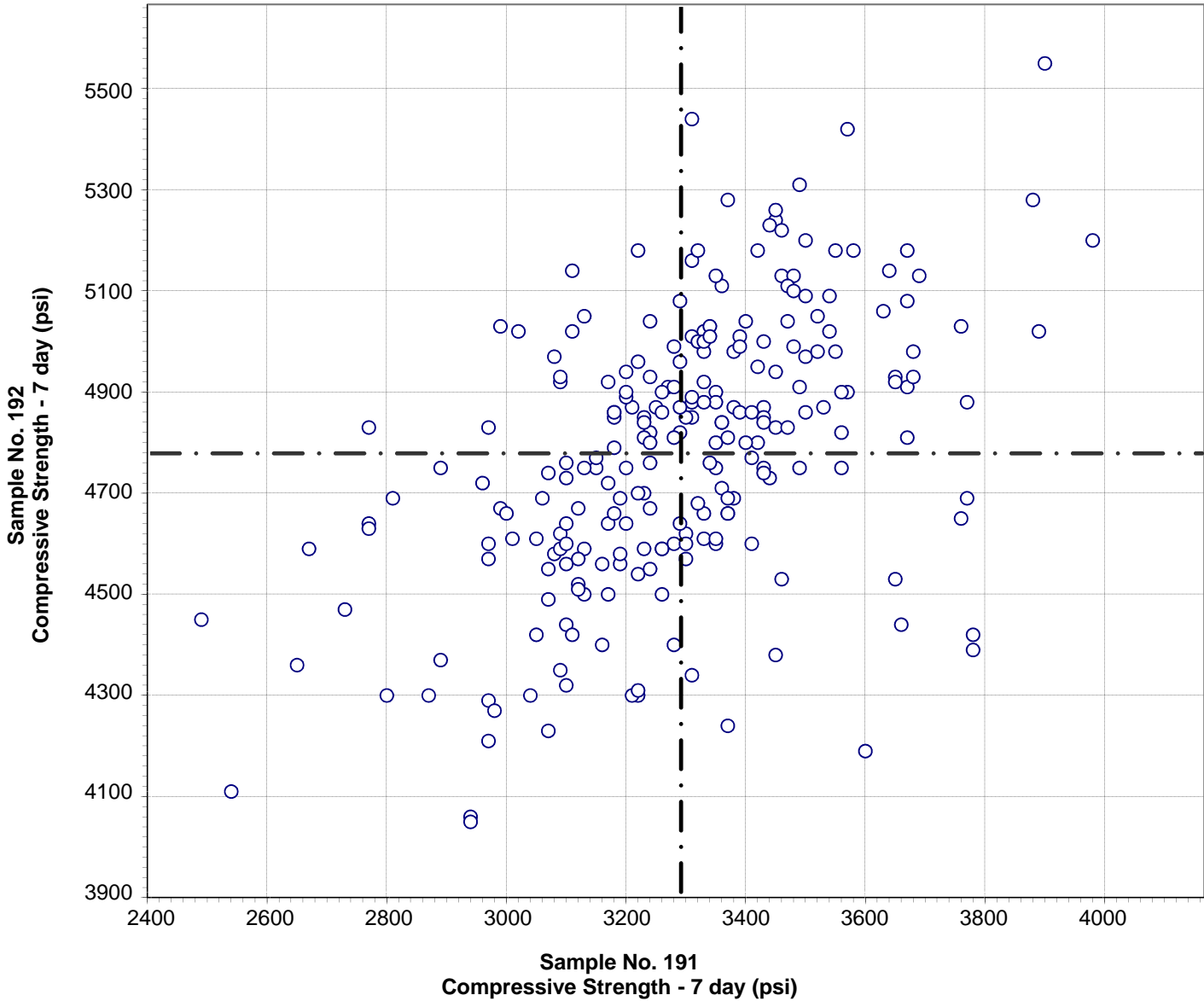
Sample No. 191 Ave 2418 S.D. 184 C.V. 7.6

Sample No. 192 Ave 3756 S.D. 263 C.V. 7.0

Labs Eliminated: 38, 46, 143, 252, 502, 1222, 3859

Labs off Diagram: 3

**CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 210 Compressive Strength - 7 day 240 Points

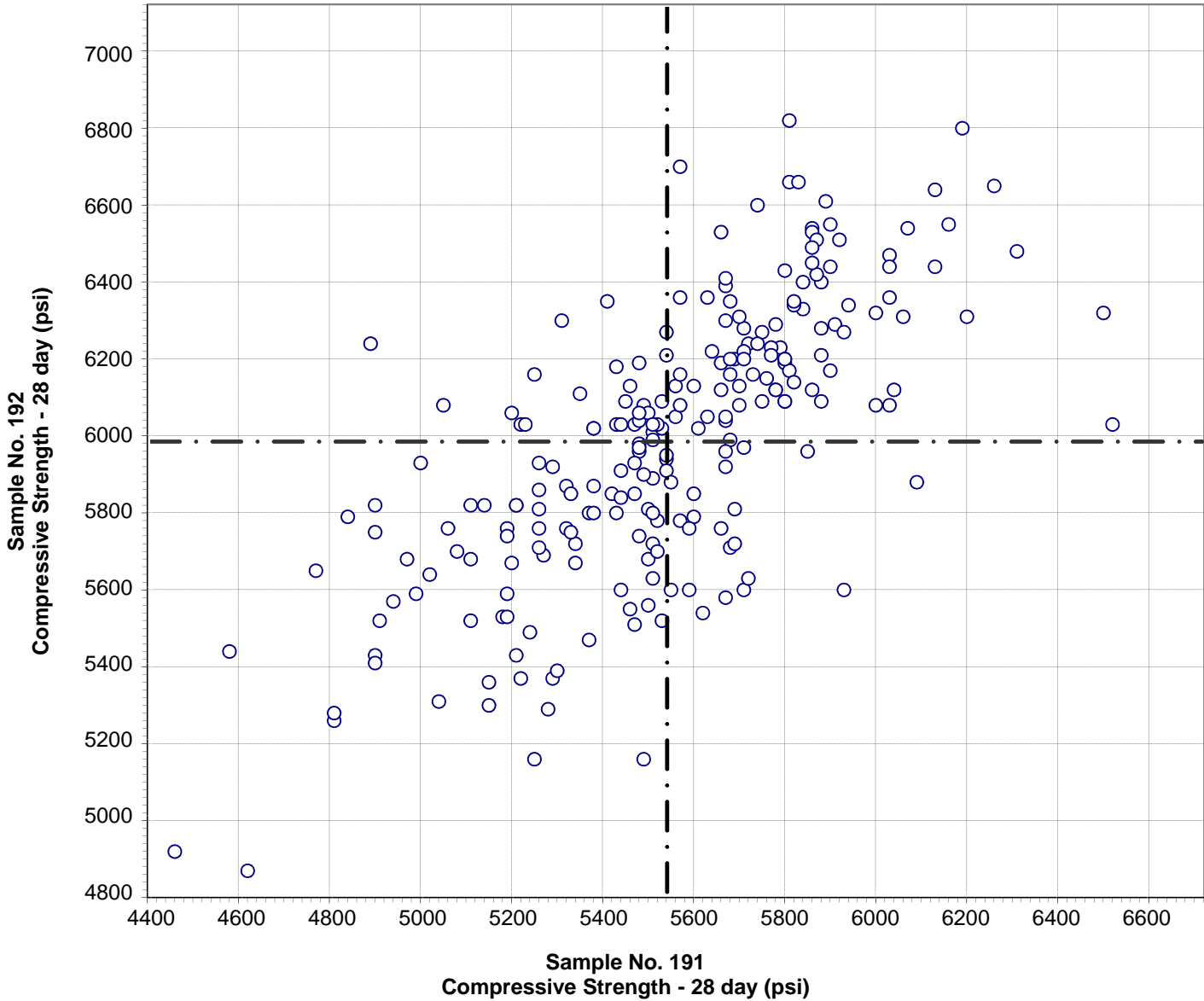
Sample No. 191 Ave 3291 S.D. 245 C.V. 7.4

Sample No. 192 Ave 4776 S.D. 282 C.V. 5.9

Labs Eliminated: 29, 38, 42, 46, 116, 143, 252, 823

Labs off Diagram: 51, 1222

**CCRL Proficiency Sample Program
Compressive Strength - 28 day
PORTLAND CEMENT Samples No. 191 and No. 192**



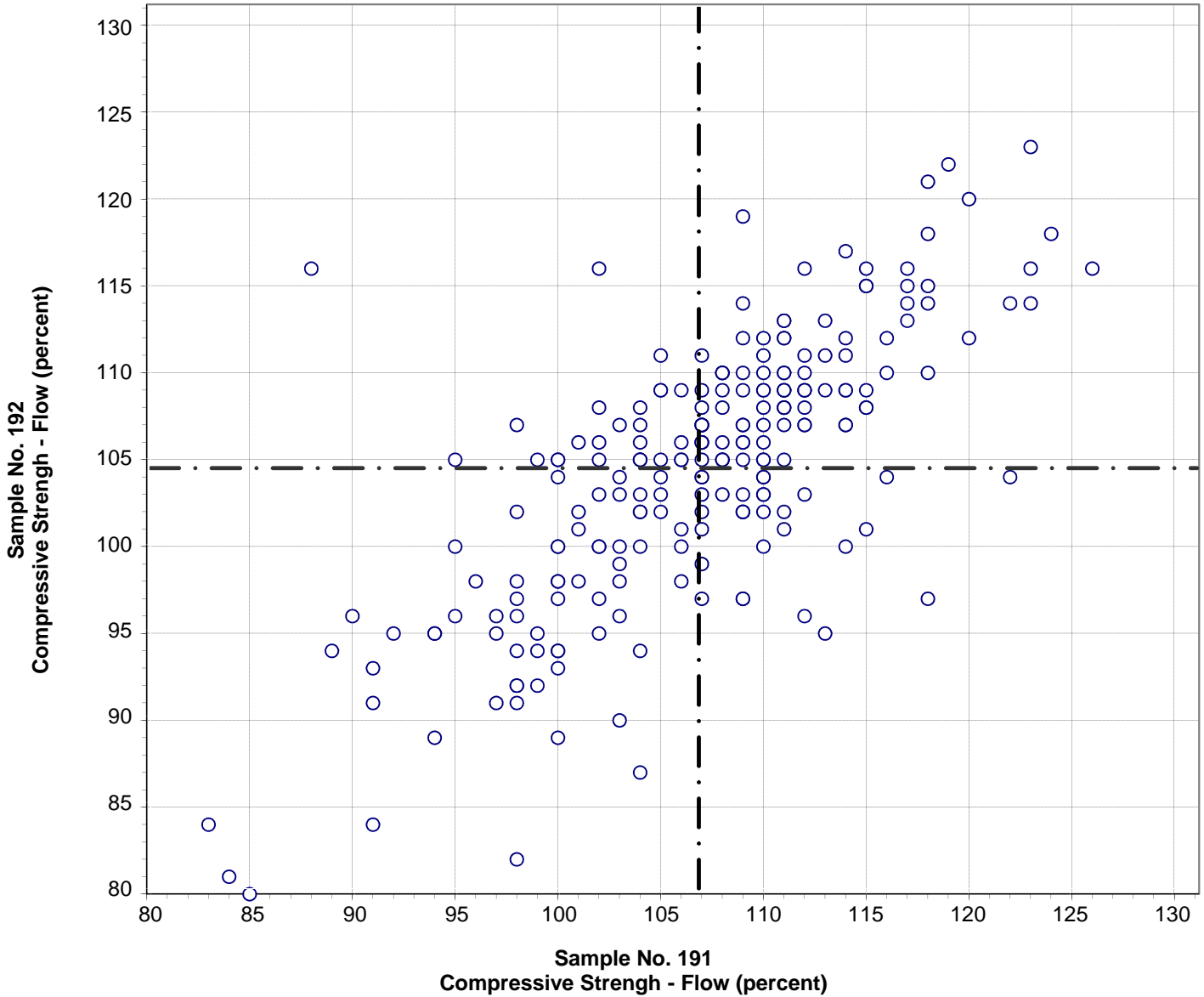
Test No. 211 Compressive Strength - 28 day 232 Points

Sample No. 191	Ave 5540	S.D. 343	C.V. 6.2
Sample No. 192	Ave 5981	S.D. 363	C.V. 6.1

Labs Eliminated: 823, 1222, 2080, 3779

Labs off Diagram: 51

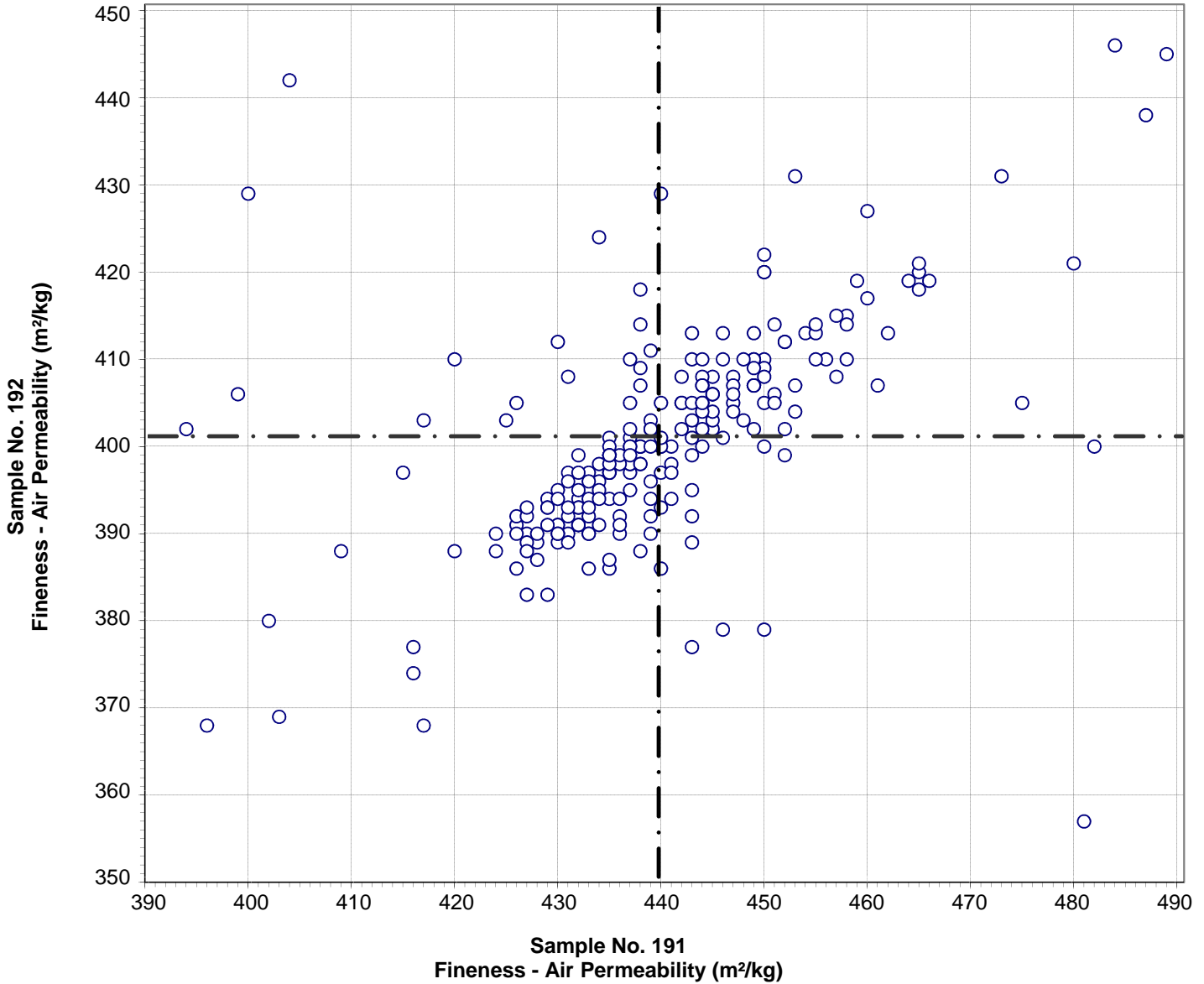
**CCRL Proficiency Sample Program
Compressive Strength - Flow
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 230 Compressive Strength - Flow 222 Points

Sample No. 191 Ave 107 S.D. 8 C.V. 7.1
 Sample No. 192 Ave 104 S.D. 8 C.V. 7.4
 Labs Eliminated: 26, 95, 2080, 2296, 3893

**CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 270 Fineness - Air Permeability 233 Points

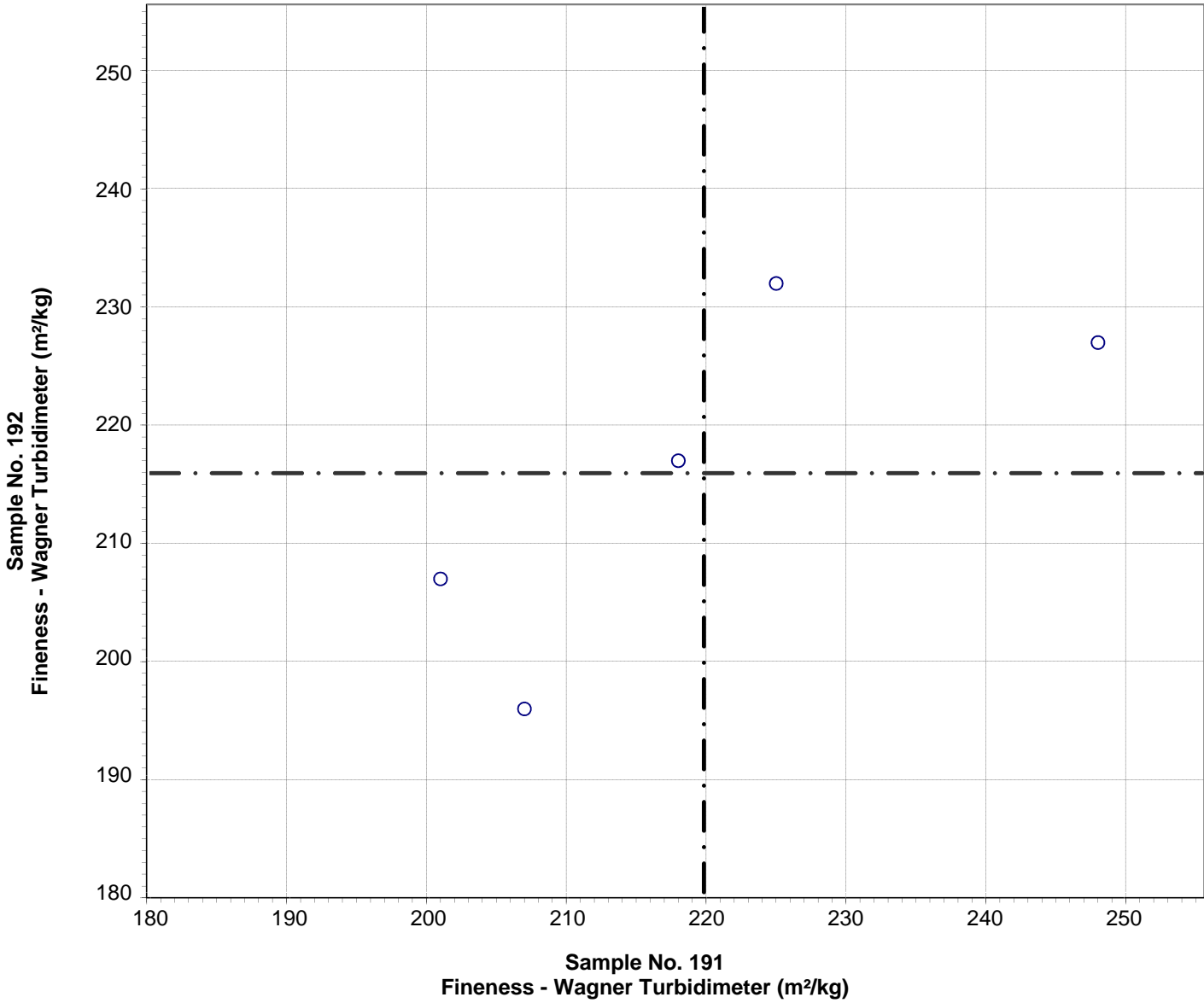
Sample No. 191 Ave 440 S.D. 15 C.V. 3.4

Sample No. 192 Ave 401 S.D. 13 C.V. 3.2

Labs Eliminated: 26, 40, 47, 116, 143, 284, 360, 840

Labs off Diagram: 206

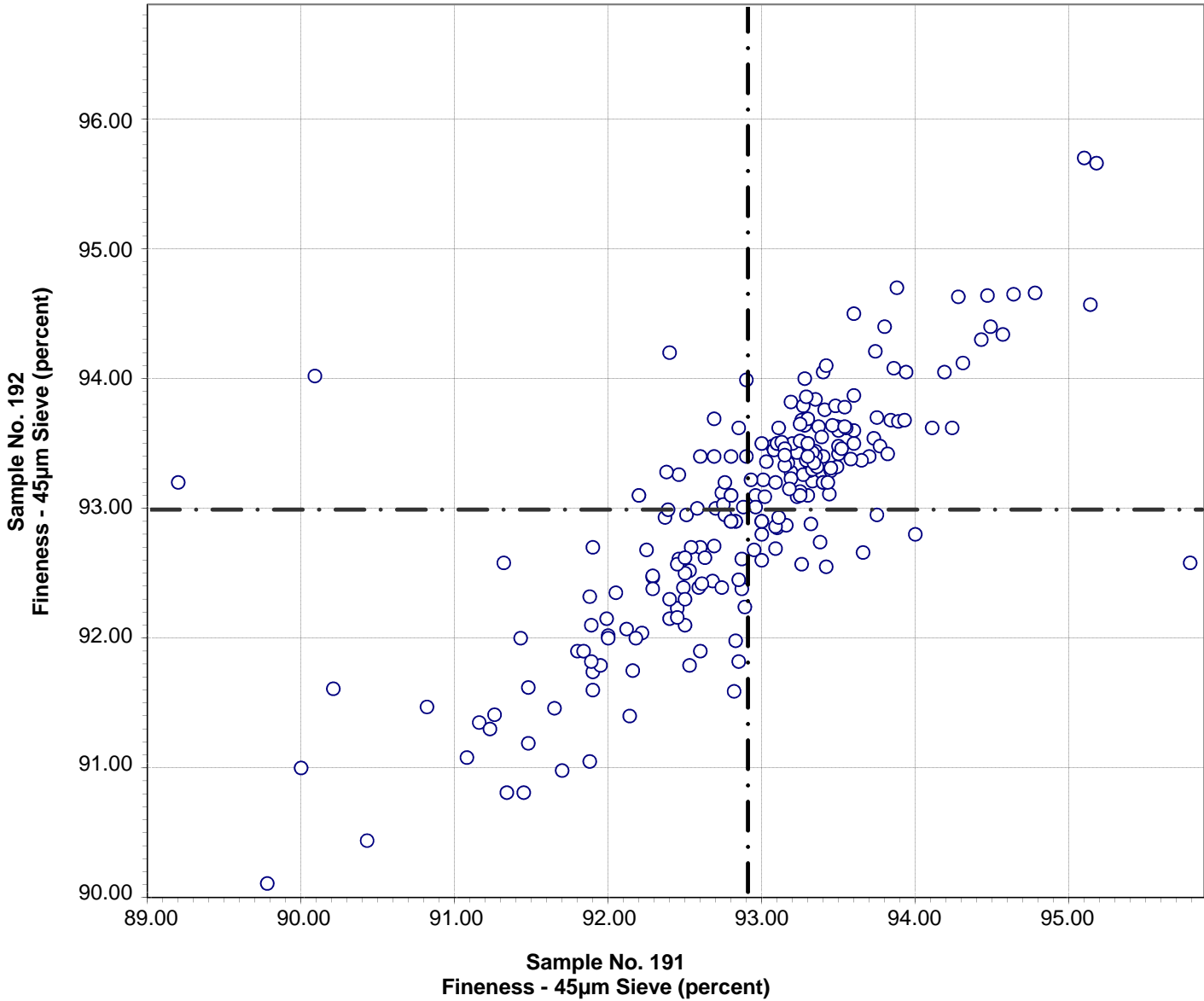
**CCRL Proficiency Sample Program
Fineness - Wagner Turbidimeter
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 280 Fineness - Wagner Turbidimeter 5 Points

Sample No. 191	Ave 220	S.D. 18	C.V. 8.3
Sample No. 192	Ave 216	S.D. 15	C.V. 6.8

**CCRL Proficiency Sample Program
Fineness - 45µm Sieve
PORTLAND CEMENT Samples No. 191 and No. 192**



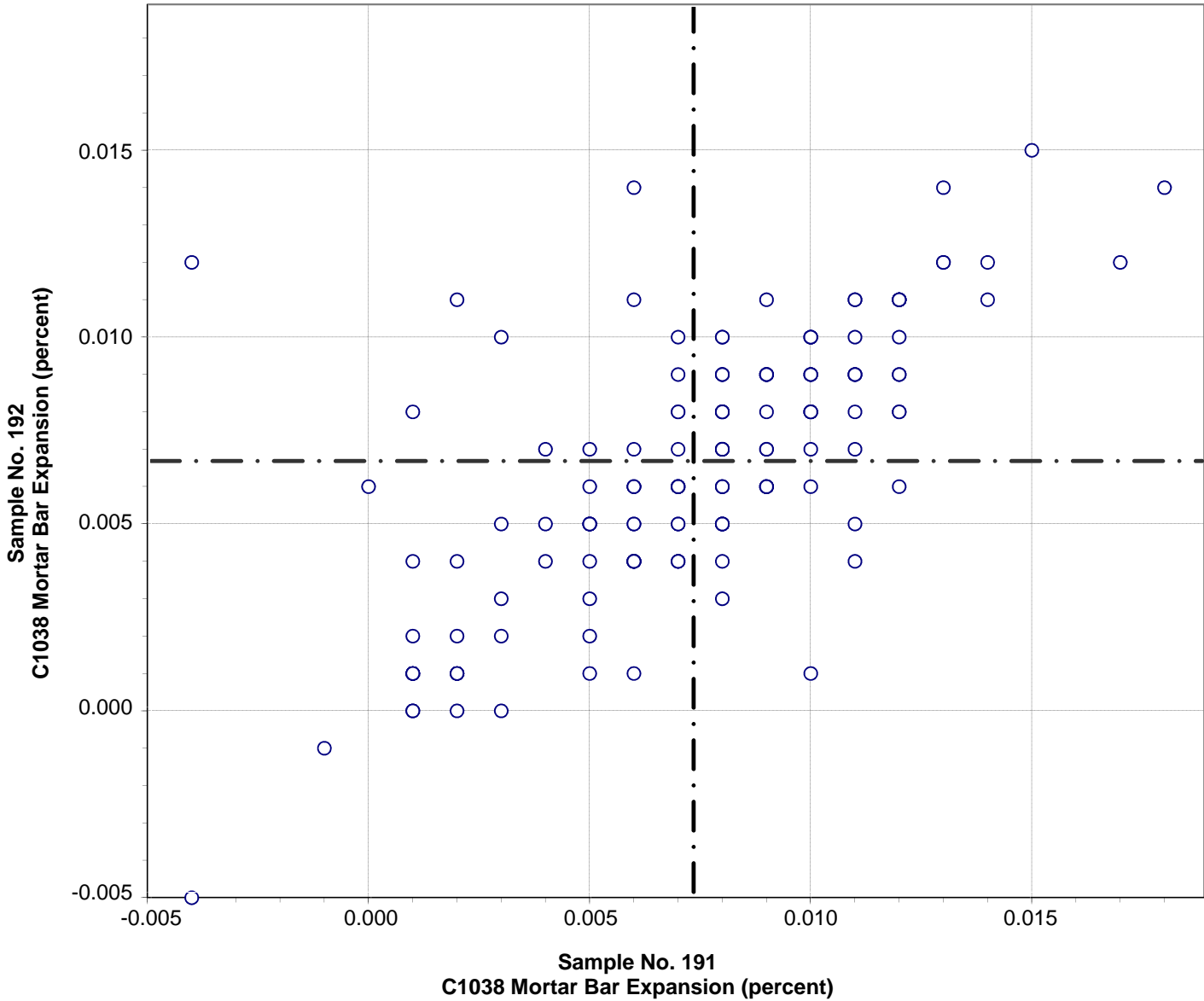
Test No. 281 Fineness - 45µm Sieve 224 Points

Sample No. 191	Ave 92.91	S.D. 0.98	C.V. 1.05
Sample No. 192	Ave 92.97	S.D. 0.93	C.V. 1.00

Labs Eliminated: 26, 50, 116, 840, 2484

Labs off Diagram: 51, 413, 494

**CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 400 C1038 Mortar Bar Expansion 147 Points

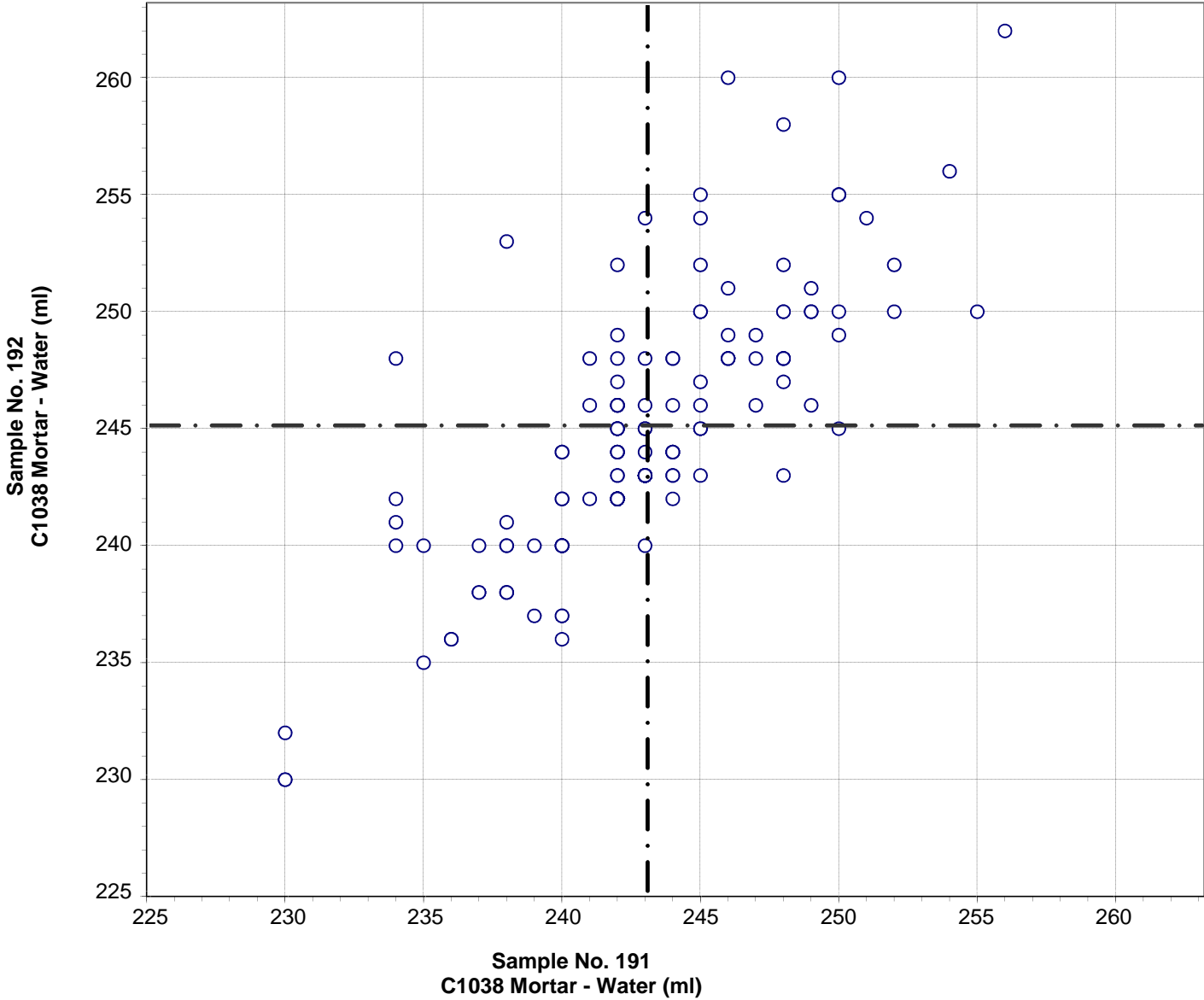
Sample No. 191 Ave 0.007 S.D. 0.004 C.V. 52

Sample No. 192 Ave 0.007 S.D. 0.004 C.V. 55

Labs Eliminated: 15, 178, 246, 691, 768, 2462, 3662

Labs off Diagram: 413

**CCRL Proficiency Sample Program
C1038 Mortar - Water
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 401 C1038 Mortar - Water 146 Points

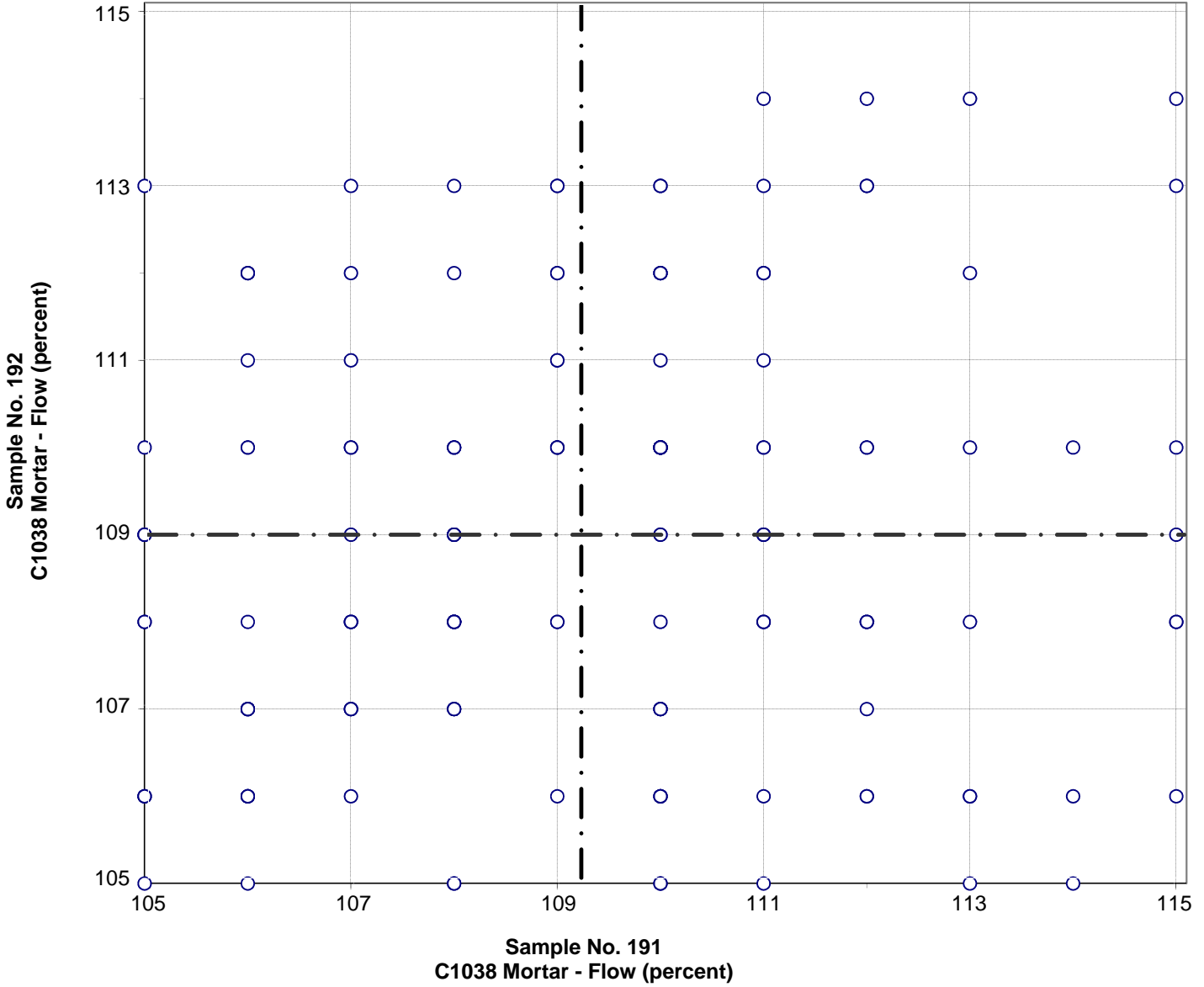
Sample No. 191 Ave 243 S.D. 5 C.V. 1.9

Sample No. 192 Ave 245 S.D. 6 C.V. 2.3

Labs Eliminated: 26, 84, 157, 1466, 2490, 3413

Labs off Diagram: 69

**CCRL Proficiency Sample Program
C1038 Mortar - Flow
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 402 C1038 Mortar - Flow 144 Points

Sample No. 191 Ave 109 S.D. 3 C.V. 2.5

Sample No. 192 Ave 109 S.D. 2 C.V. 2.2

Labs Eliminated: 26, 84, 243, 565, 691, 2463, 3605

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 191 and No. 192

Final Report – Heat of Hydration Results
 March 21, 2014

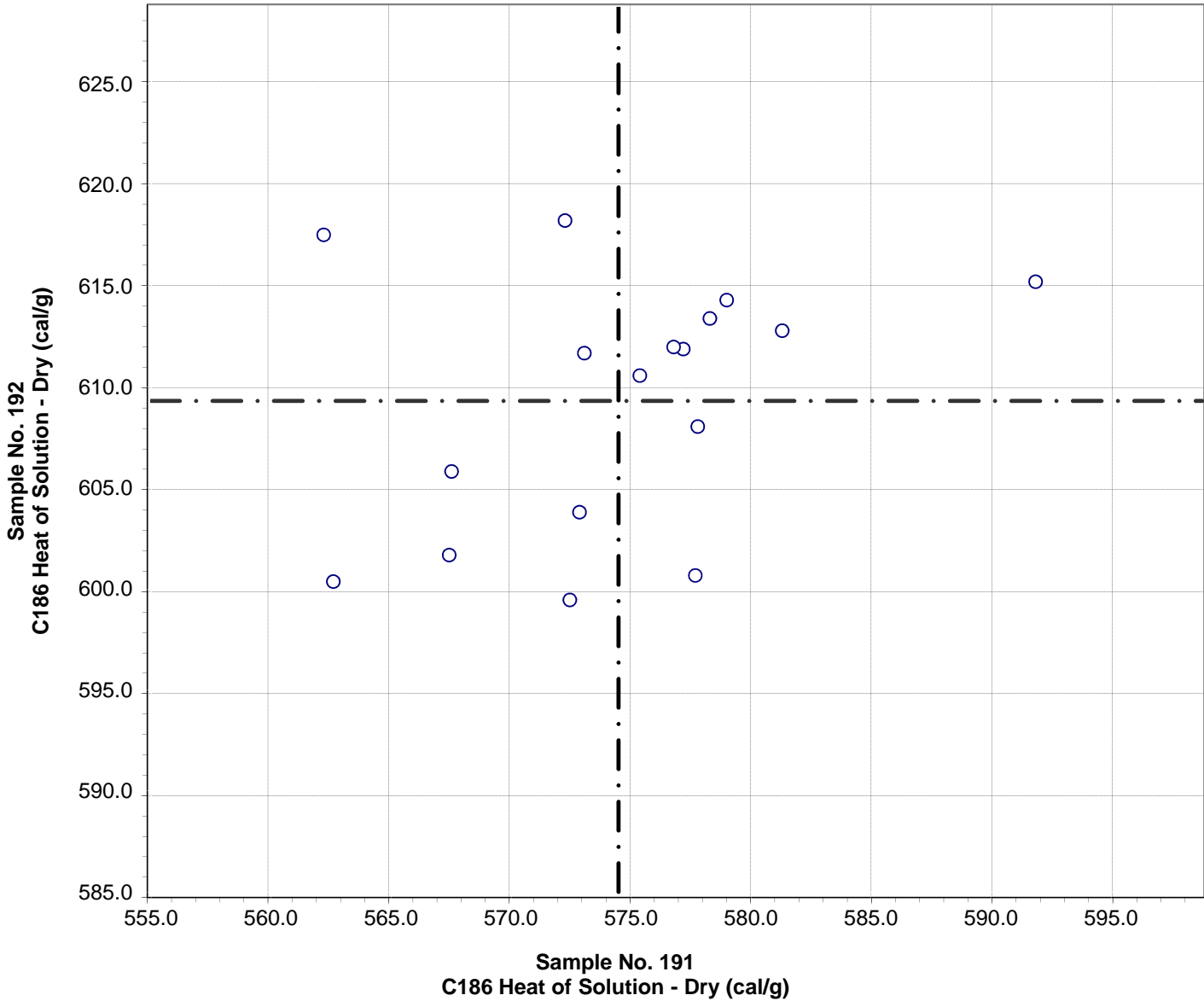
SUMMARY OF RESULTS

Sample No.191

Sample No. 192

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C186 Heat of Solution - Dry (cal/g)							
	20	566.0	71.4	12.6	610.0	16.0	2.6
	*17	574.0	7.1	1.2	609.0	6.1	1.0
* Labs Eliminated - 491, 1715, 3605							
C186 Heat of Solution - 7 day (cal/g)							
	20	515.5	25.3	4.9	527.3	15.2	2.9
	*19	510.1	7.2	1.4	524.5	8.7	1.7
* Labs Eliminated - 491							
C186 Heat of Solution 28 day (cal/g)							
	16	500.4	6.9	1.4	512.9	8.2	1.6
No Labs Eliminated for This Test							
C186 Heat of Hydration - 7 day (cal/g)							
	22	66.4	9.7	14.6	84.6	5.7	6.7
No Labs Eliminated for This Test							
C186 Heat of Hydration - 28 day (cal/g)							
	18	74.0	10.3	13.9	94.5	3.9	4.1
No Labs Eliminated for This Test							
C1702 Heat of Hydration - 3 day (J/g)							
	6	225	23	10.2	310	39	12.4
No Labs Eliminated for This Test							
C1702 Heat of Hydration - 7 day (J/g)							
	7	284	40	14.0	371	24	6.4
No Labs Eliminated for This Test							

**CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 191 and No. 192**

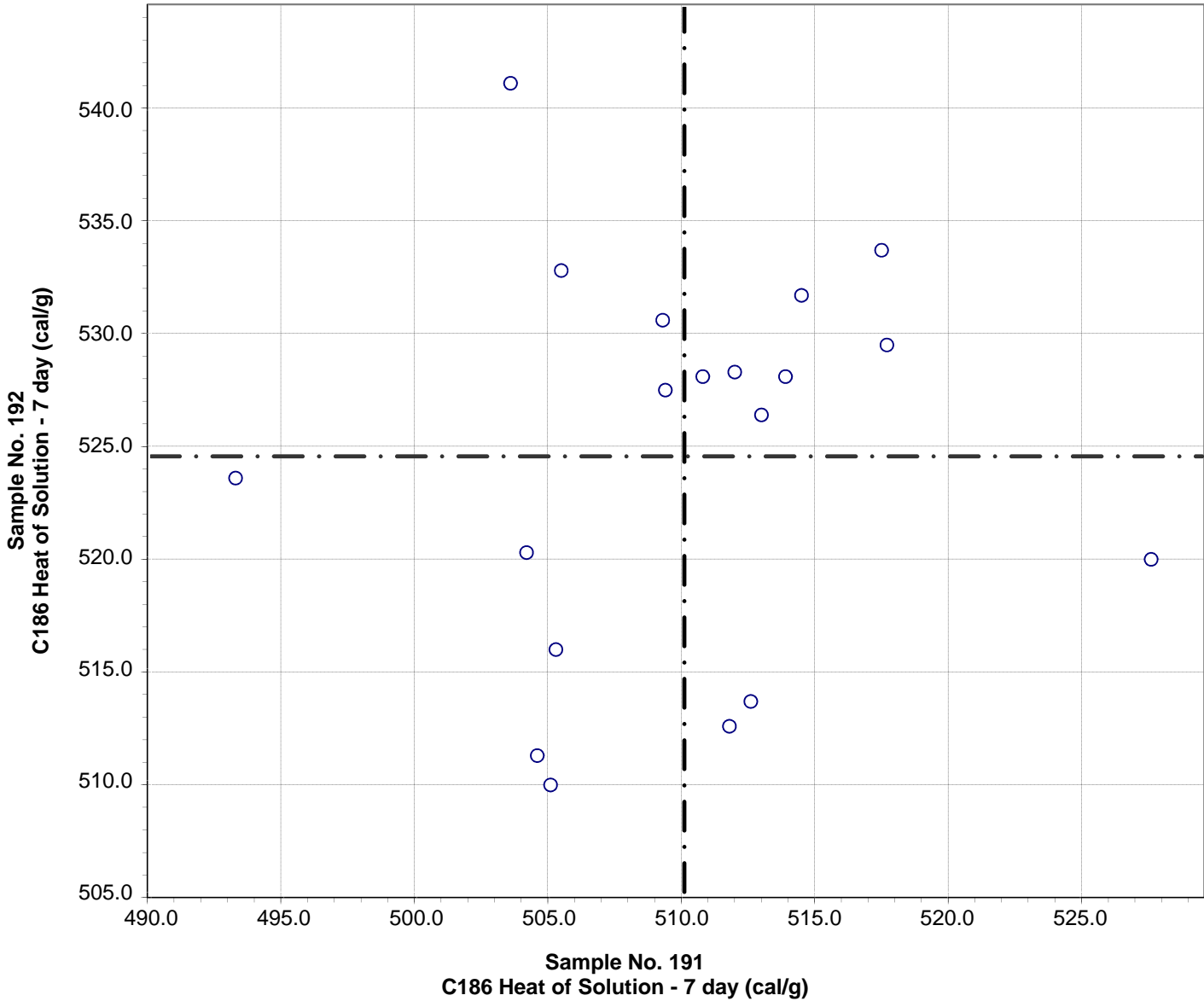


Test No. 291 C186 Heat of Solution - Dry 17 Points

Sample No. 191	Ave 574.0	S.D. 7.1	C.V. 1.2
Sample No. 192	Ave 609.0	S.D. 6.1	C.V. 1.0

Labs Eliminated: 491, 1715, 3605

**CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 191 and No. 192**

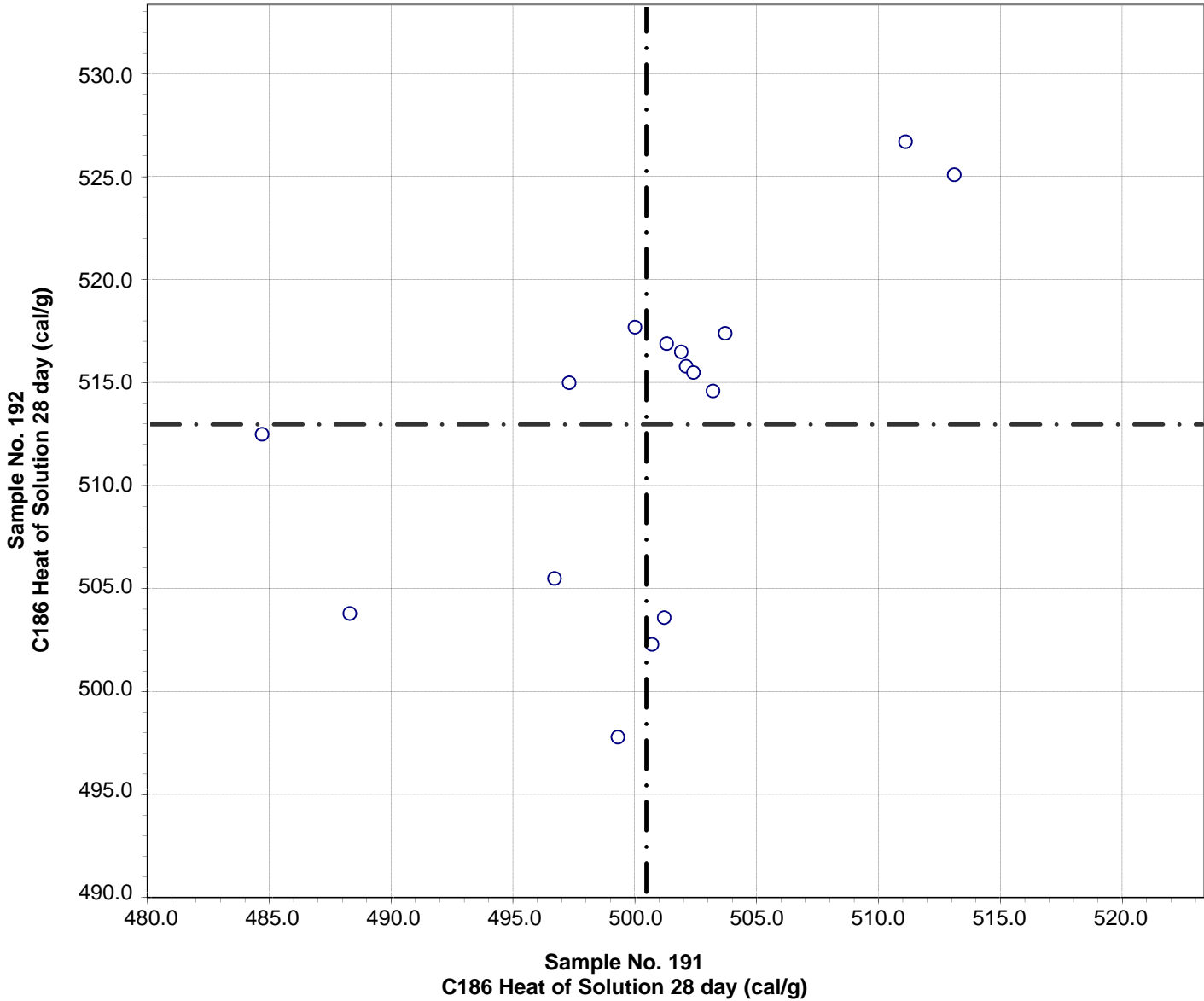


Test No. 292 C186 Heat of Solution - 7 day 19 Points

Sample No. 191	Ave 510.1	S.D. 7.2	C.V. 1.4
Sample No. 192	Ave 524.5	S.D. 8.7	C.V. 1.7

Labs Eliminated: 491

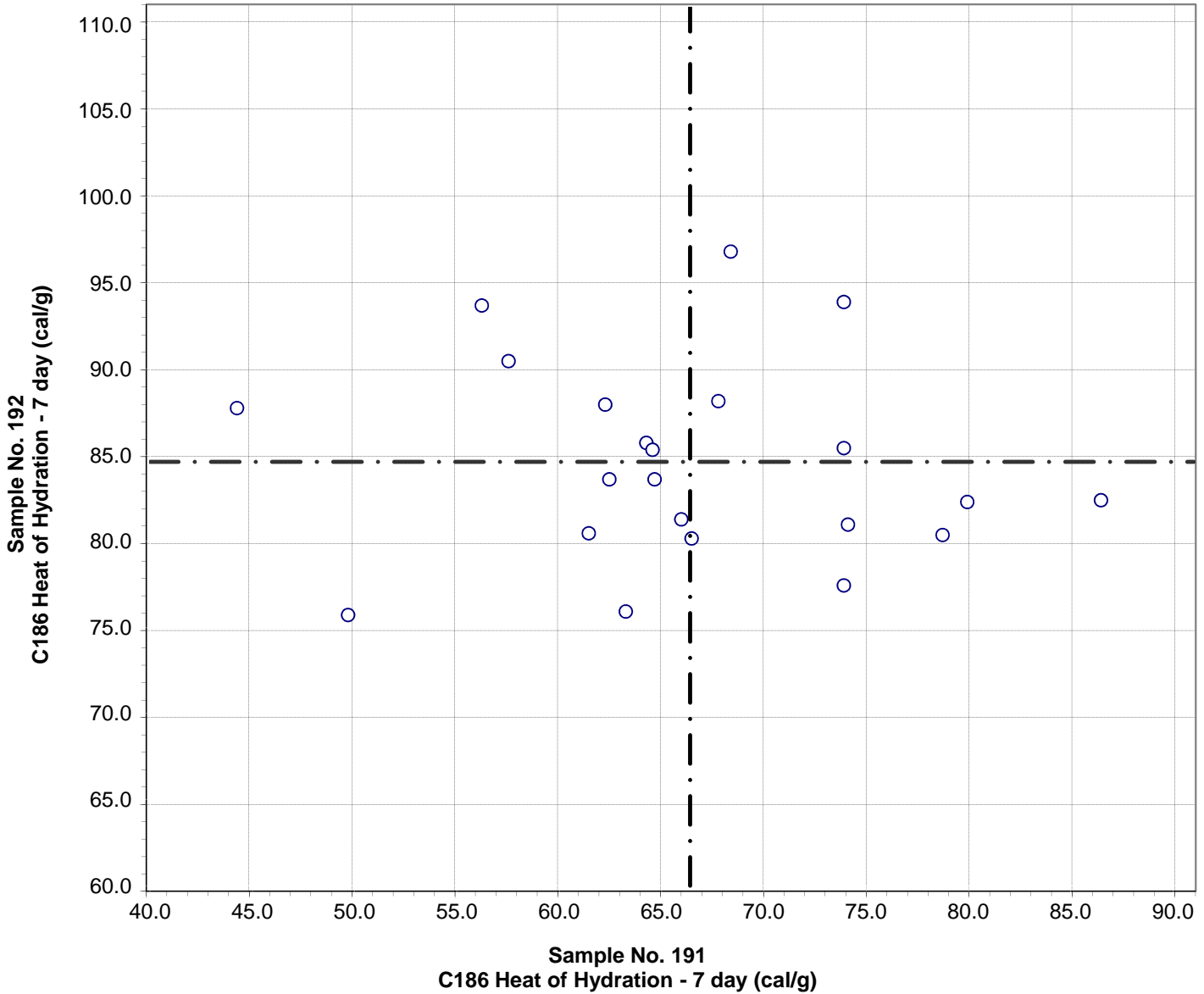
**CCRL Proficiency Sample Program
C186 Heat of Solution 28 day
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 301 C186 Heat of Solution 28 day 16 Points

Sample No. 191	Ave 500.4	S.D. 6.9	C.V. 1.4
Sample No. 192	Ave 512.9	S.D. 8.2	C.V. 1.6

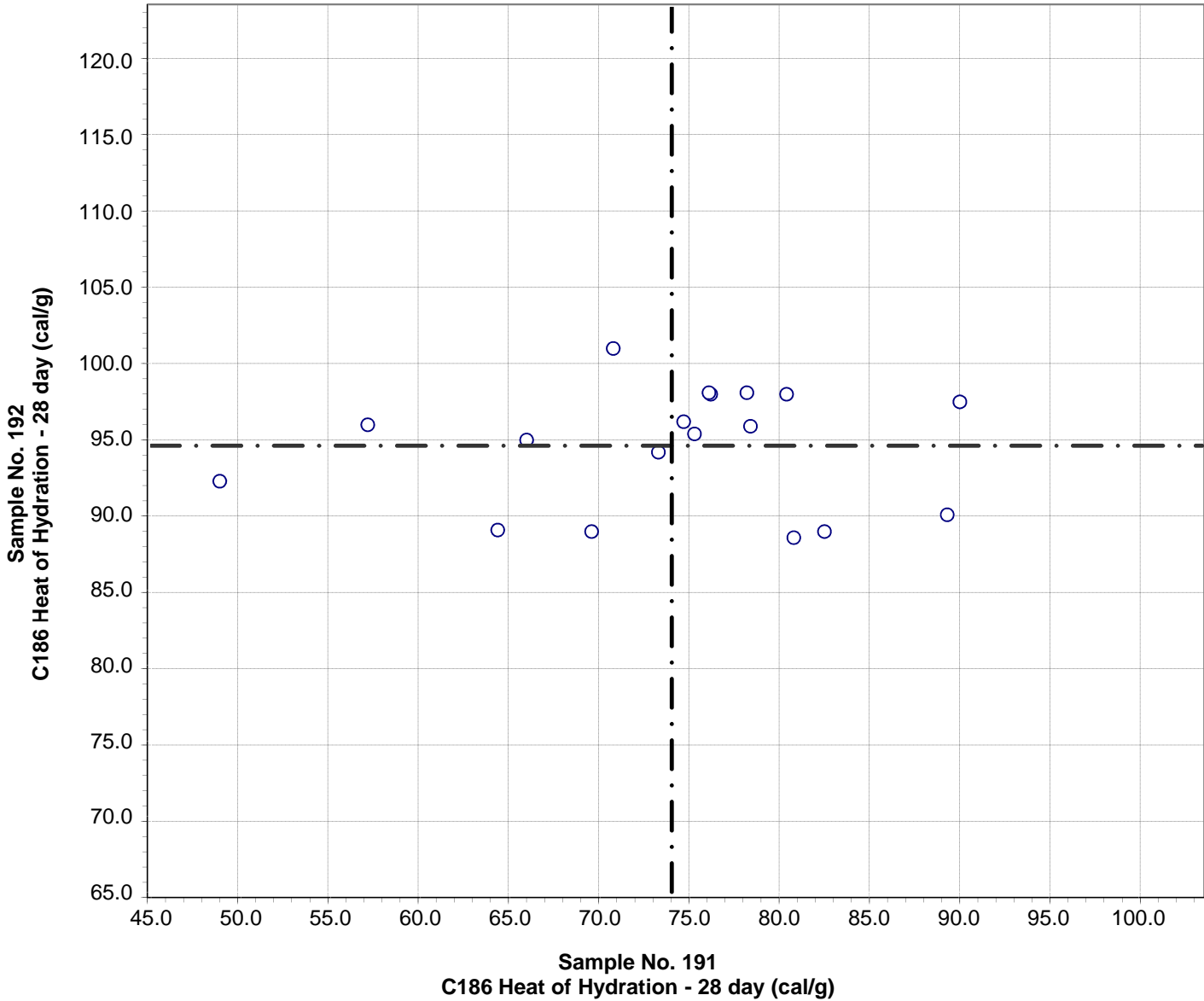
**CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 290 C186 Heat of Hydration - 7 day 22 Points

Sample No. 191	Ave 66.4	S.D. 9.7	C.V. 14.6
Sample No. 192	Ave 84.6	S.D. 5.7	C.V. 6.7

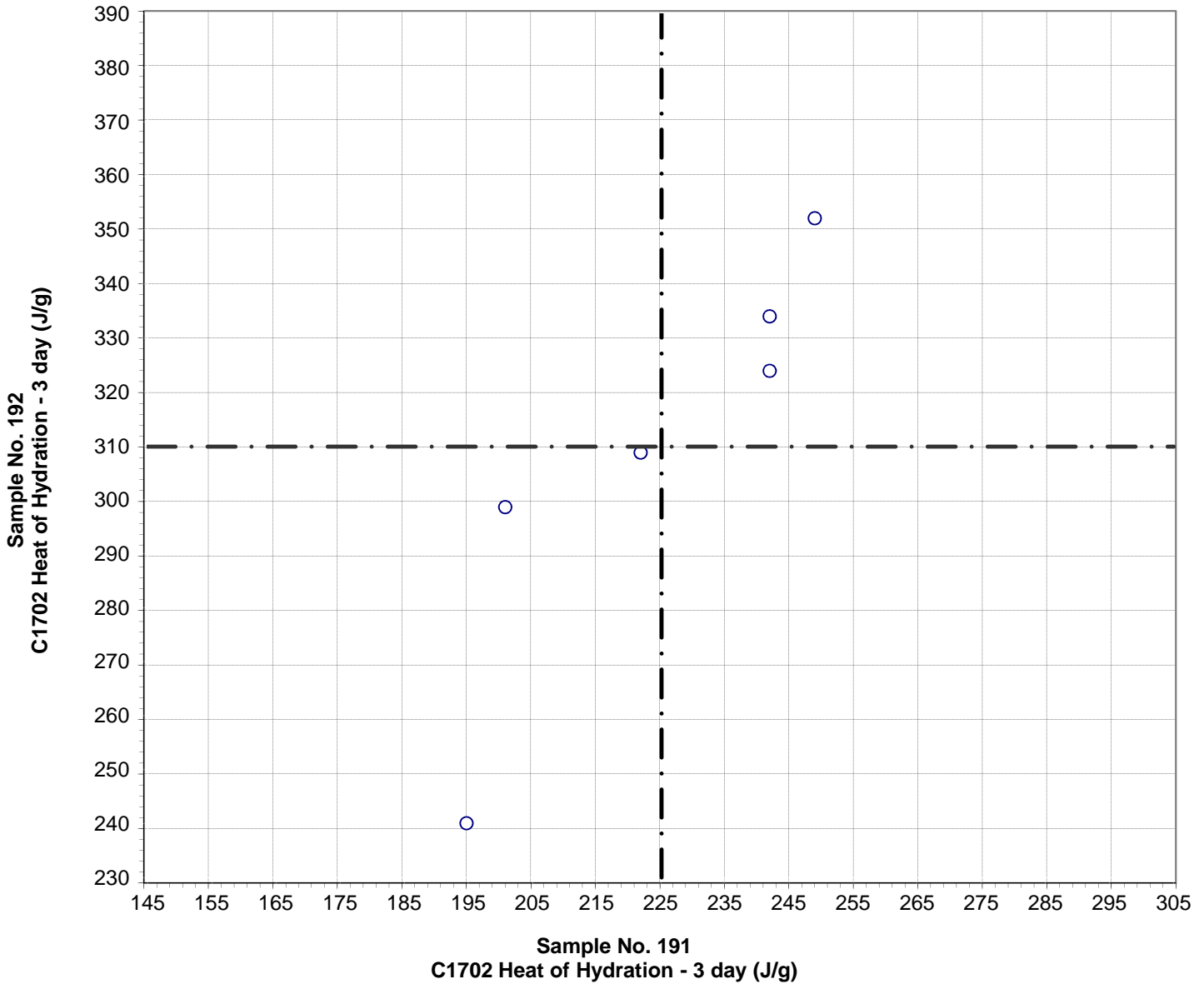
**CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 191 and No. 192**



Test No. 300 C186 Heat of Hydration - 28 day 18 Points

Sample No. 191	Ave 74.0	S.D. 10.3	C.V. 13.9
Sample No. 192	Ave 94.5	S.D. 3.9	C.V. 4.1

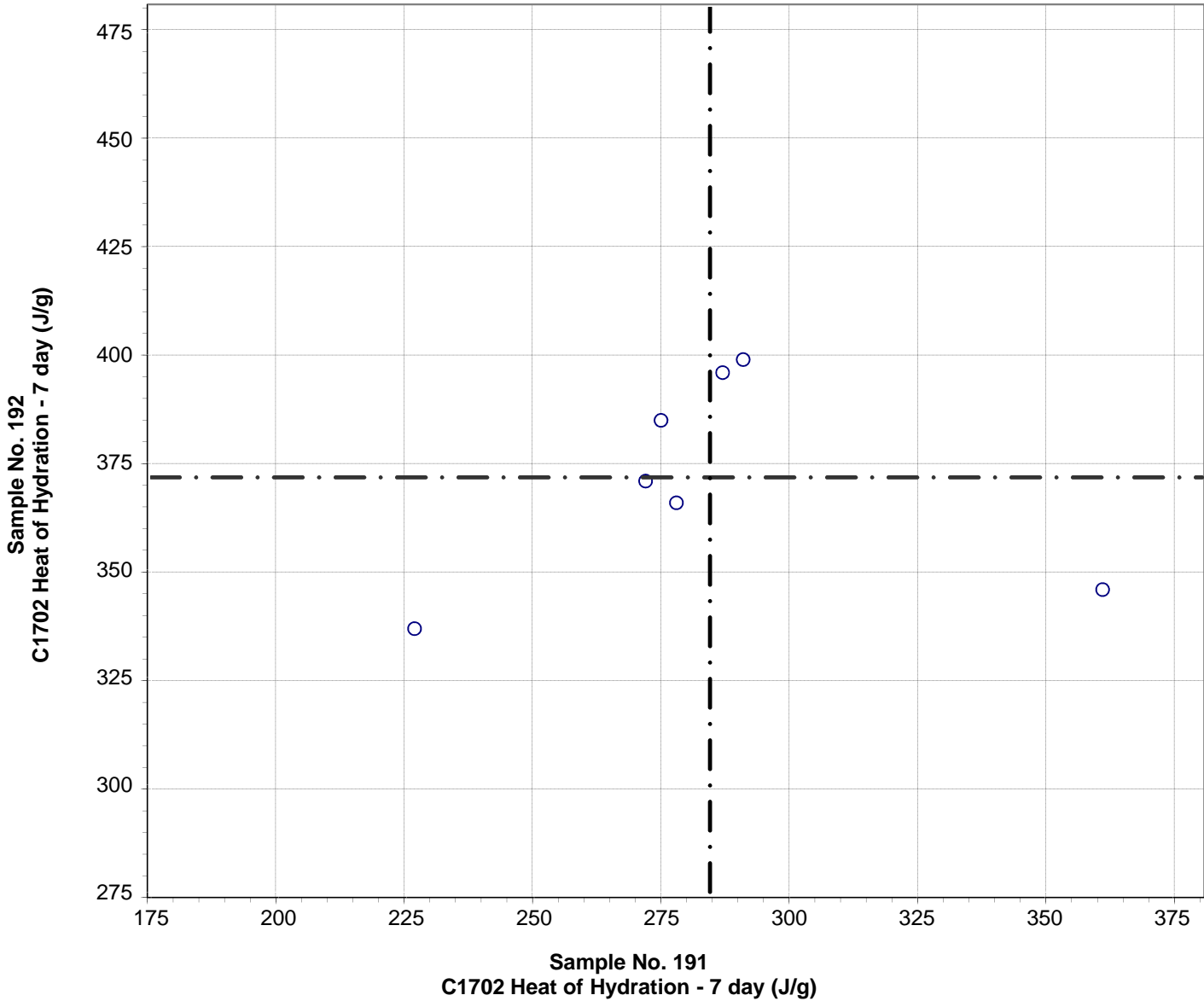
CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 191 and No. 192



Test No. 500 C1702 Heat of Hydration - 3 day 6 Points

Sample No. 191	Ave 225	S.D. 23	C.V. 10.2
Sample No. 192	Ave 310	S.D. 39	C.V. 12.4

CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 191 and No. 192



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

Sample No. 191	Ave 284	S.D. 40	C.V. 14.0
Sample No. 192	Ave 371	S.D. 24	C.V. 6.4