

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 187 and Number 188

March 2013





March 19, 2013

To: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 187 and No. 188

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in January 2013. Portland Cement Samples No. 187 was an ASTM C150 meeting the specifications of Type I and Type II with limestone addition. Portland Cement No. 188 was an ASTM C150 meeting the specifications of Type I with limestone addition..

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 2013.

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. 187 and No. 188

This letter, and the material included with it, constitute the final report, and summary of results for the current pair of Portland Cement Proficiency Samples, which were distributed in January 2013. 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.

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.*

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 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. 187 and No. 188

Final Report – Primary Chemical Results
 March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (percent)							
	237	20.05	0.31	1.6	18.81	0.33	1.8
	*231	20.04	0.25	1.2	18.78	0.25	1.3
* Labs Eliminated - 50, 52, 93, 116, 206, 1799							
Aluminum Oxide (percent)							
	235	3.98	0.89	22.4	5.49	0.88	16.0
	*219	3.90	0.09	2.3	5.45	0.13	2.3
* Labs Eliminated - 24, 43, 50, 52, 116, 206, 222, 1483, 1525, 1526, 1799, 1956, 2292, 2308, 2437, 3787							
Ferric Oxide (percent)							
	235	2.81	0.30	10.5	2.17	0.33	15.3
	*220	2.80	0.05	1.6	2.14	0.03	1.6
* Labs Eliminated - 24, 52, 95, 116, 126, 131, 206, 840, 1526, 1799, 2039, 2491, 3661, 3662, 3787							
Calcium Oxide (percent)							
	234	61.93	0.69	1.12	62.26	0.68	1.09
	*229	61.98	0.47	0.75	62.27	0.47	0.75
* Labs Eliminated - 206, 222, 840, 1594, 2464							
Magnesium Oxide (percent)							
	235	3.03	0.18	5.9	2.39	0.16	6.7
	*220	3.04	0.07	2.4	2.39	0.07	3.0
* Labs Eliminated - 52, 95, 116, 159, 206, 982, 1525, 1526, 1799, 1956, 2464, 2491, 3233, 3661, 3662							
Sulfur Trioxide (percent)							
	237	3.93	0.16	4.1	4.13	0.19	4.6
	*229	3.92	0.12	3.0	4.11	0.13	3.1
* Labs Eliminated - 43, 125, 244, 690, 1525, 2437, 3443, 3819							
Loss on Ignition (percent)							
	237	2.45	0.12	4.8	2.76	0.15	5.5
	*223	2.44	0.08	3.2	2.75	0.07	2.7
* Labs Eliminated - 3, 56, 64, 116, 137, 176, 493, 557, 690, 840, 881, 1799, 2435, 2621							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Primary Chemical Results
 March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Sodium Oxide (percent)							
	225	0.322	0.065	20	0.240	0.047	20
	*211	0.325	0.036	11	0.244	0.037	15
* Labs Eliminated - 125, 354, 1940, 2305, 2352, 2463, 2464, 2490, 2955, 3233, 3235, 3279, 3606, 3705							
Potassium Oxide (percent)							
	229	1.267	0.145	11.5	1.226	0.155	12.6
	*220	1.285	0.032	2.5	1.240	0.029	2.4
* Labs Eliminated - 52, 98, 116, 413, 1079, 1956, 2305, 2491, 3791							
Titanium Dioxide (percent)							
	192	0.23	0.039	17.0	0.25	0.192	77.0
	*183	0.23	0.009	3.9	0.23	0.009	3.7
* Labs Eliminated - 4, 27, 156, 206, 491, 494, 698, 1483, 2484							
Phosphorus Pentoxide (percent)							
	193	0.074	0.100	134.1	0.253	0.030	11.7
	*171	0.064	0.007	10.6	0.255	0.009	3.5
* Labs Eliminated - 22, 27, 34, 93, 116, 124, 132, 178, 254, 687, 1466, 1483, 1524, 1799, 2462, 2463, 2484, 2491, 3233, 3235, 3607, 3663							
Zinc Oxide (percent)							
	101	0.027	0.024	89.9	0.005	0.008	159.1
	*94	0.024	0.002	10.3	0.004	0.002	57.0
* Labs Eliminated - 95, 116, 416, 2296, 2491, 3663, 3752							
Manganic Oxide (percent)							
	148	0.051	0.033	65.4	0.061	0.018	29.1
	*134	0.047	0.003	6.4	0.060	0.003	4.4
* Labs Eliminated - 10, 24, 116, 162, 203, 354, 413, 457, 768, 932, 2462, 2466, 2491, 3807							
Chloride (percent)							
	120	0.008	0.012	143	0.010	0.010	109

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Primary Chemical Results
March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
	*114	0.006	0.003	51	0.008	0.004	49
	* Labs Eliminated - 18, 129, 206, 886, 2491, 3607						
Insoluble Residue (percent)							
	214	0.32	0.17	53	0.60	0.20	34
	*200	0.29	0.09	32	0.58	0.10	17
	* Labs Eliminated - 206, 246, 247, 493, 886, 1190, 1526, 1799, 2435, 3233, 3235, 3297, 3605, 3791						
Free Lime (percent)							
	181	1.42	0.39	27	0.48	0.29	61
	*170	1.42	0.26	18	0.45	0.18	39
	* Labs Eliminated - 78, 132, 203, 222, 289, 415, 690, 2435, 2955, 3607, 3658						
Carbon Dioxide (percent)							
	198	1.50	0.37	24.8	2.00	0.34	16.8
	*178	1.49	0.18	12.2	2.01	0.11	5.4
	* Labs Eliminated - 8, 94, 162, 219, 222, 254, 255, 415, 840, 881, 883, 886, 932, 1483, 1657, 1956, 2463, 2466, 2955, 3235						
Limestone Content (percent)							
	195	3.6	0.9	24.5	4.7	0.8	17.7
	*172	3.6	0.4	12.4	4.7	0.3	5.4
	* Labs Eliminated - 8, 78, 94, 139, 162, 219, 222, 254, 255, 415, 840, 881, 883, 886, 932, 1483, 1657, 1956, 2463, 2466, 2955, 3235, 3607						
Chromium Oxide (percent)							
	93	0.008	0.004	51	0.008	0.005	66
	*87	0.008	0.003	36	0.006	0.003	40
	* Labs Eliminated - 10, 24, 203, 415, 768, 2462						
Tricalcium Silicate (percent)							
	202	54.4	4.0	7.4	52.3	4.6	8.8
	*198	54.5	3.4	6.2	52.4	4.1	7.9
	* Labs Eliminated - 93, 840, 886, 1525						

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Primary Chemical Results
 March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

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

201	15.8	3.5	22	13.9	3.8	27
*196	15.7	2.9	19	13.8	3.3	24

* Labs Eliminated - 50, 93, 840, 886, 1525

Tricalcium Aluminate (percent)

202	5.6	0.6	11.2	10.7	0.7	6.3
*193	5.5	0.3	5.2	10.7	0.4	3.6

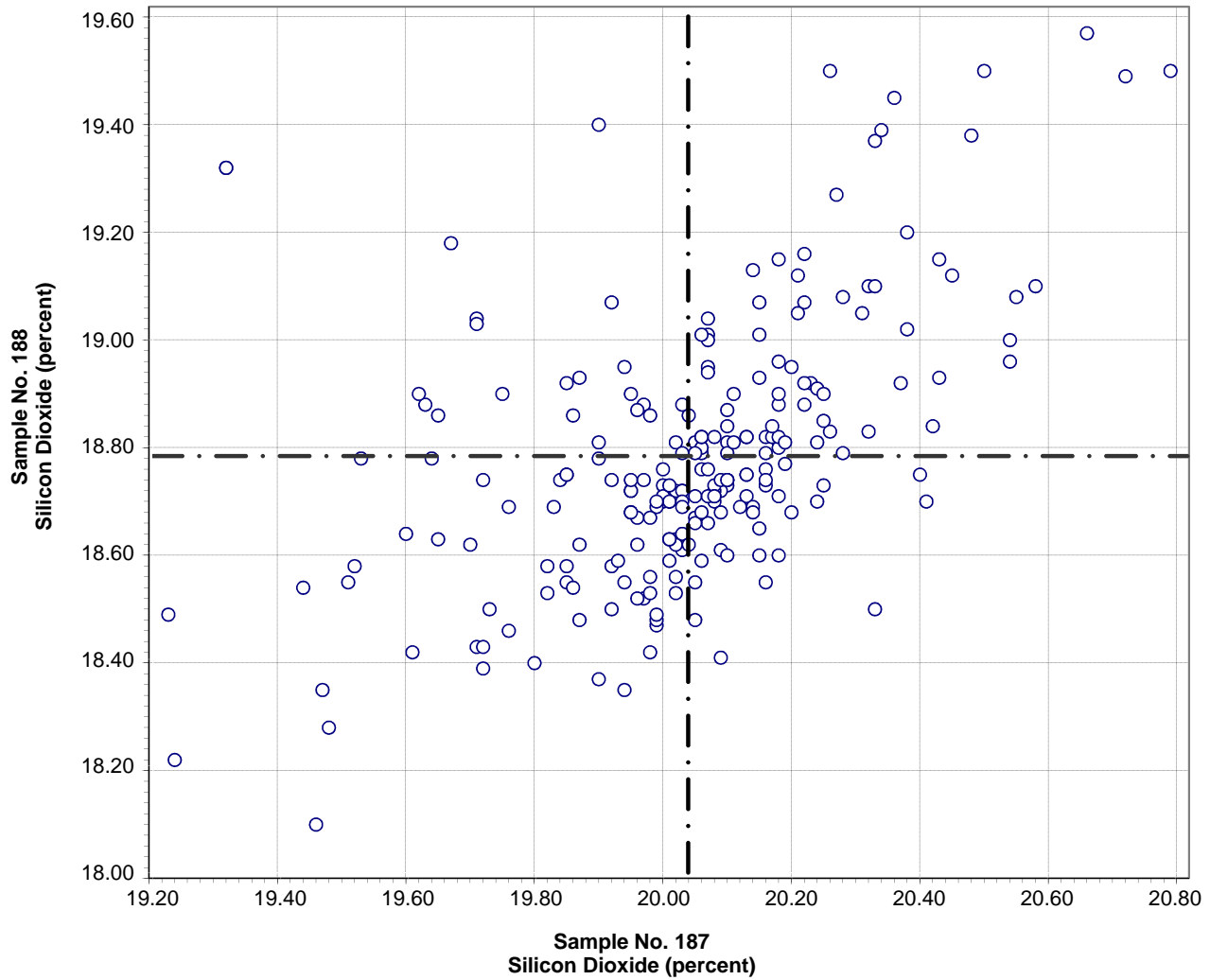
* Labs Eliminated - 24, 43, 222, 840, 1525, 1526, 1799, 1956, 2292

Tetracalcium Aluminoferrite (percent)

202	8.4	0.2	2.9	6.5	0.5	7.8
*190	8.4	0.2	1.9	6.5	0.1	2.1

* Labs Eliminated - 10, 24, 95, 126, 131, 142, 206, 840, 1526, 1799, 2491, 3661

**CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 10 Silicon Dioxide 230 Points

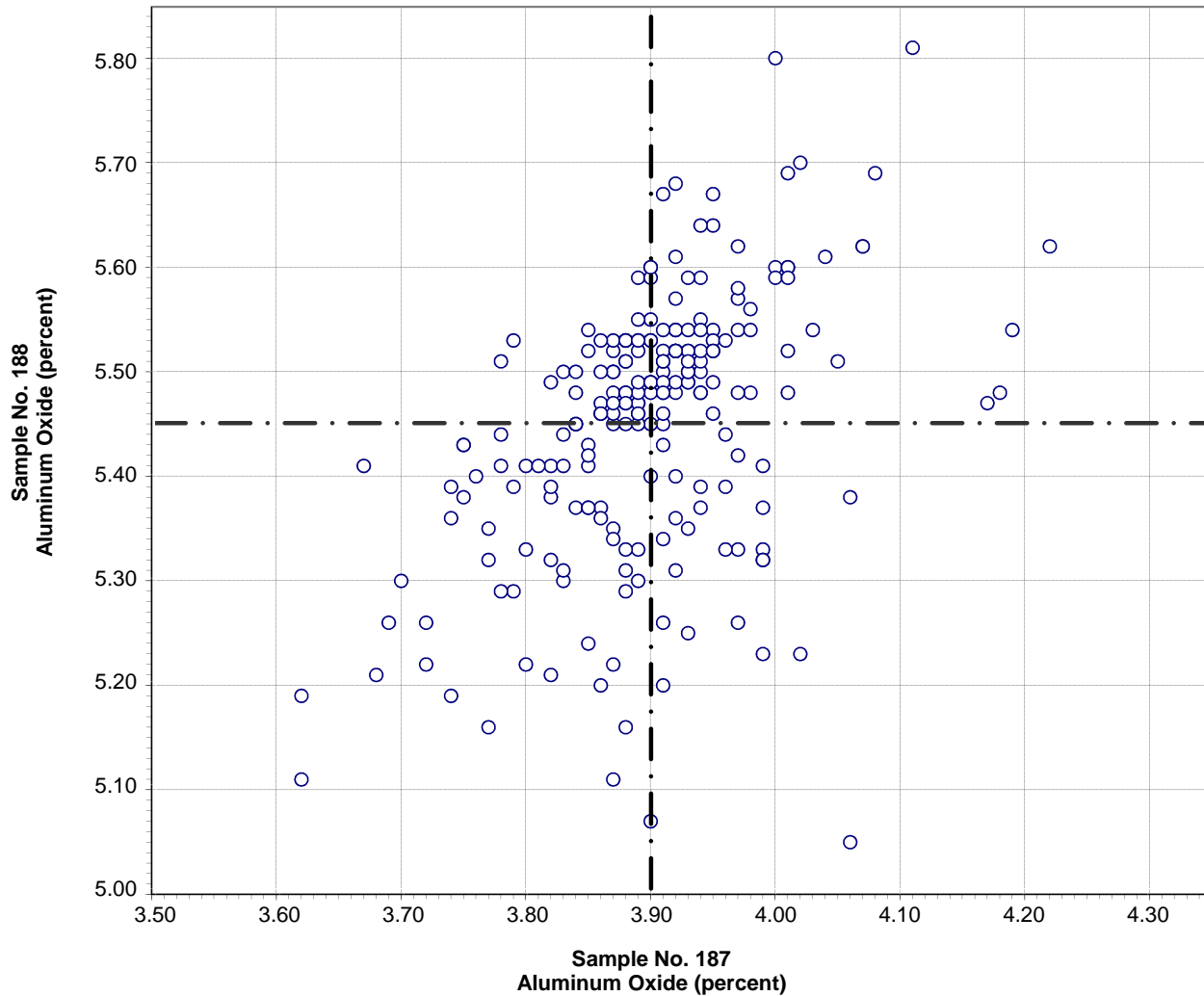
Sample No. 187 Ave 20.04 S.D. 0.25 C.V. 1.2

Sample No. 188 Ave 18.78 S.D. 0.25 C.V. 1.3

Labs Eliminated: 50, 52, 93, 116, 206, 1799

Labs off Diagram: 38

**CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



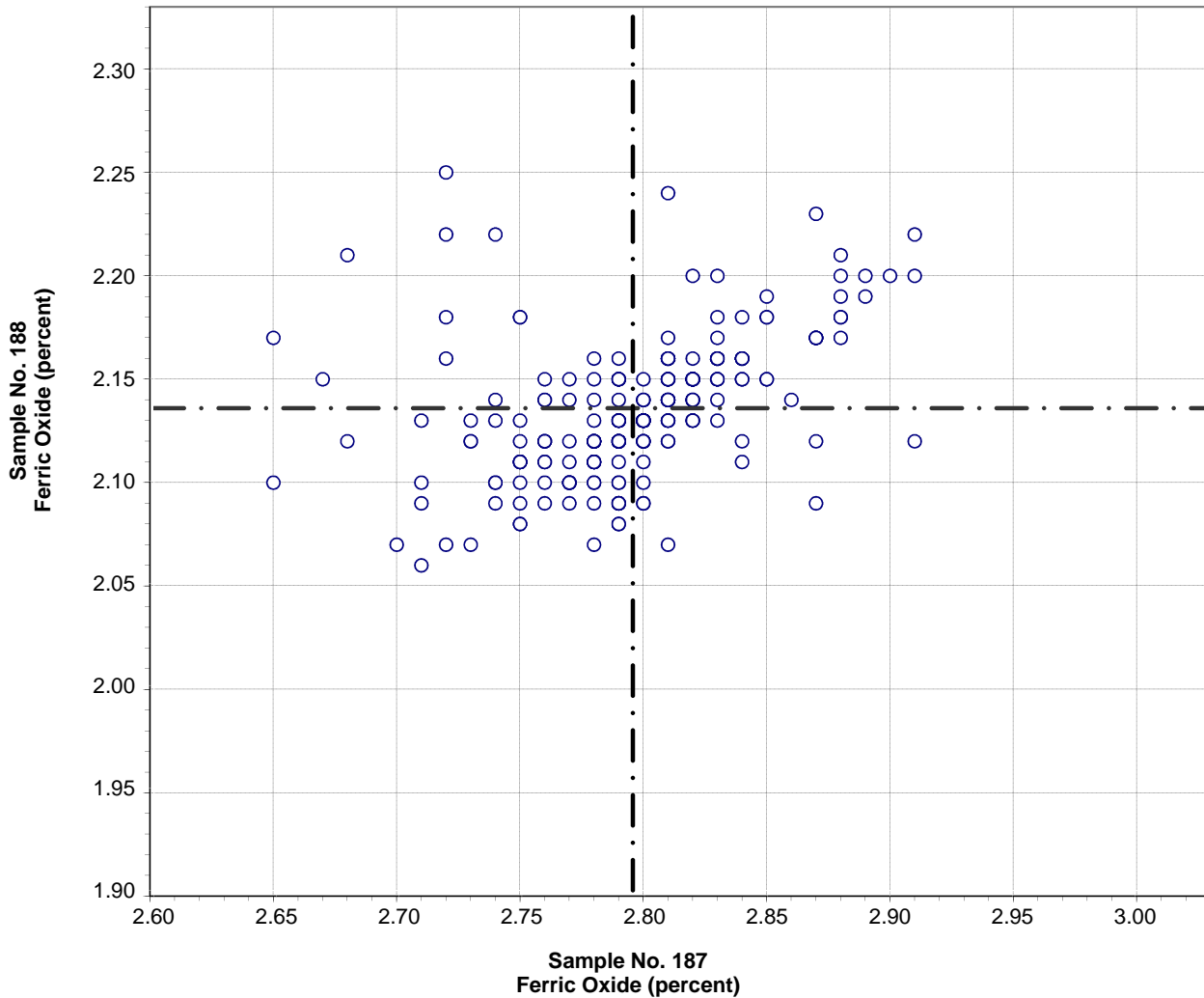
Test No. 21 Aluminum Oxide 219 Points

Sample No. 187 Ave 3.90 S.D. 0.09 C.V. 2.3

Sample No. 188 Ave 5.45 S.D. 0.13 C.V. 2.3

Labs Eliminated: 24, 43, 50, 52, 116, 206, 222, 1483, 1525, 1526, 1799, 1956,
2292, 2308, 2437, 3787

CCRL Proficiency Sample Program
Ferric Oxide
PORTLAND CEMENT Samples No. 187 and No. 188

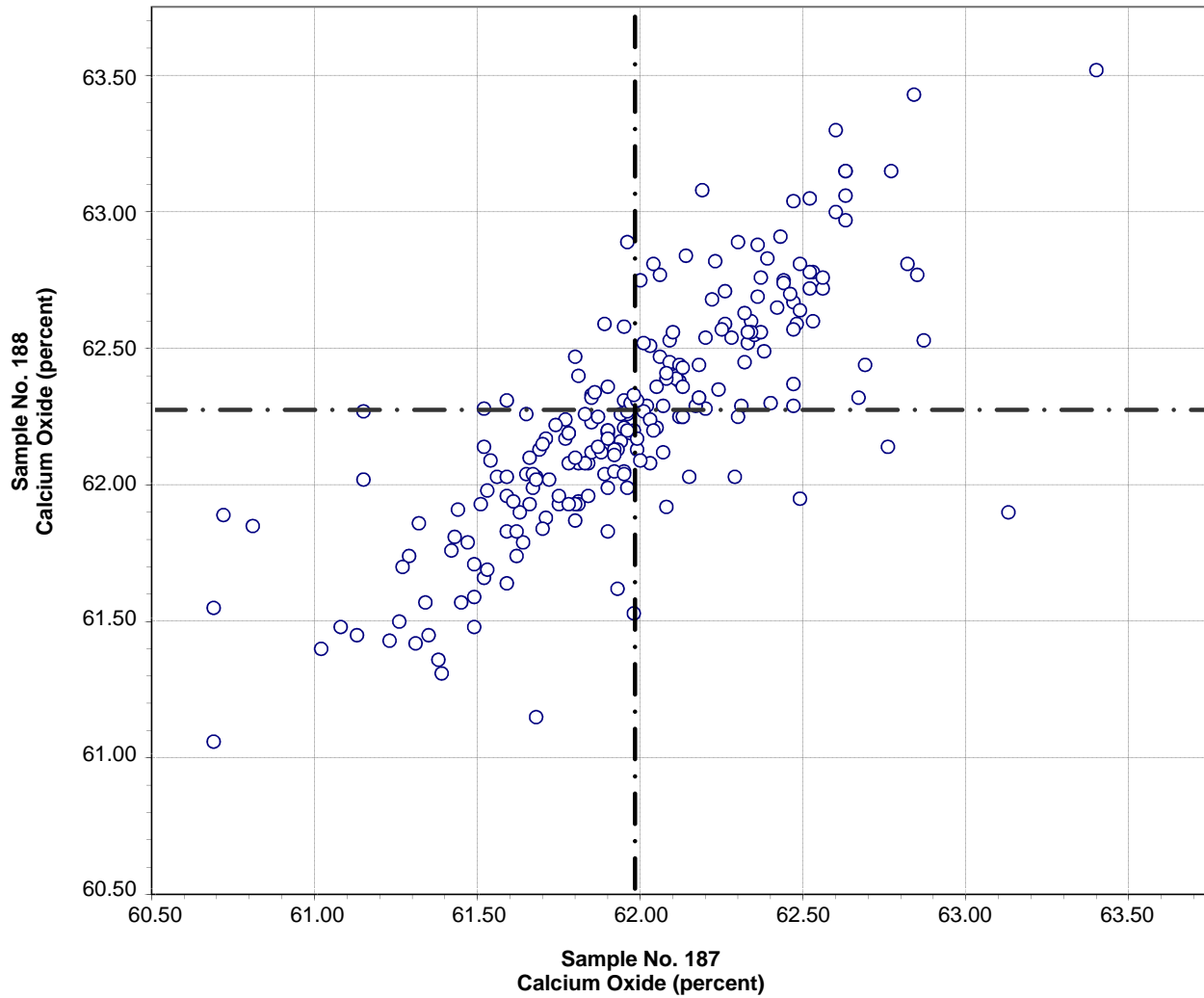


Test No. 30 Ferric Oxide 220 Points

Sample No. 187 Ave 2.80 S.D. 0.05 C.V. 1.6
Sample No. 188 Ave 2.14 S.D. 0.03 C.V. 1.6

Labs Eliminated: 24, 52, 95, 116, 126, 131, 206, 840, 1526, 1799, 2039, 2491,
3661, 3662, 3787

**CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 40 Calcium Oxide 225 Points

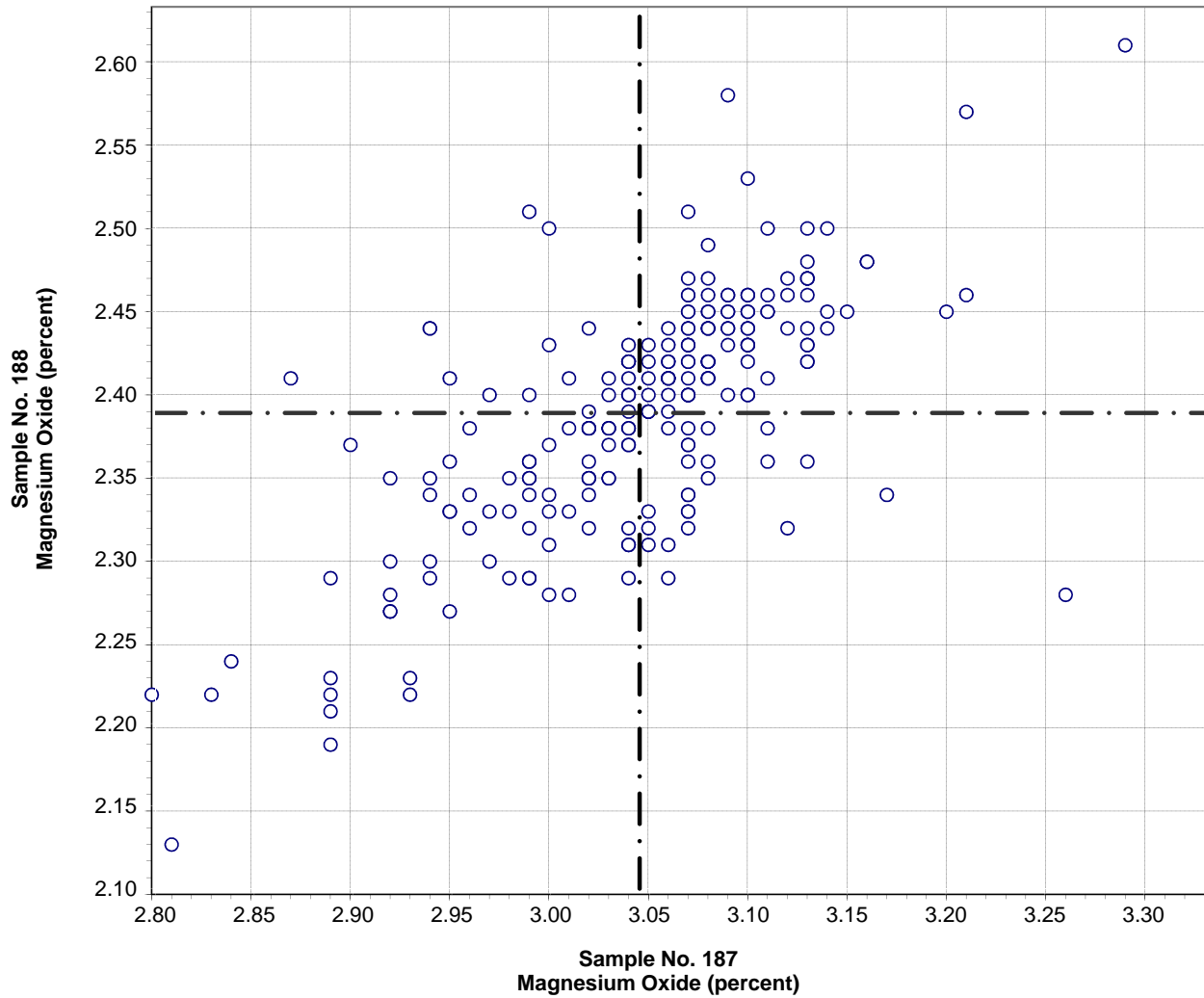
Sample No. 187 Ave 61.98 S.D. 0.47 C.V. 0.75

Sample No. 188 Ave 62.27 S.D. 0.47 C.V. 0.75

Labs Eliminated: 206, 222, 840, 1594, 2464

Labs off Diagram: 4, 667, 1054, 2621

**CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



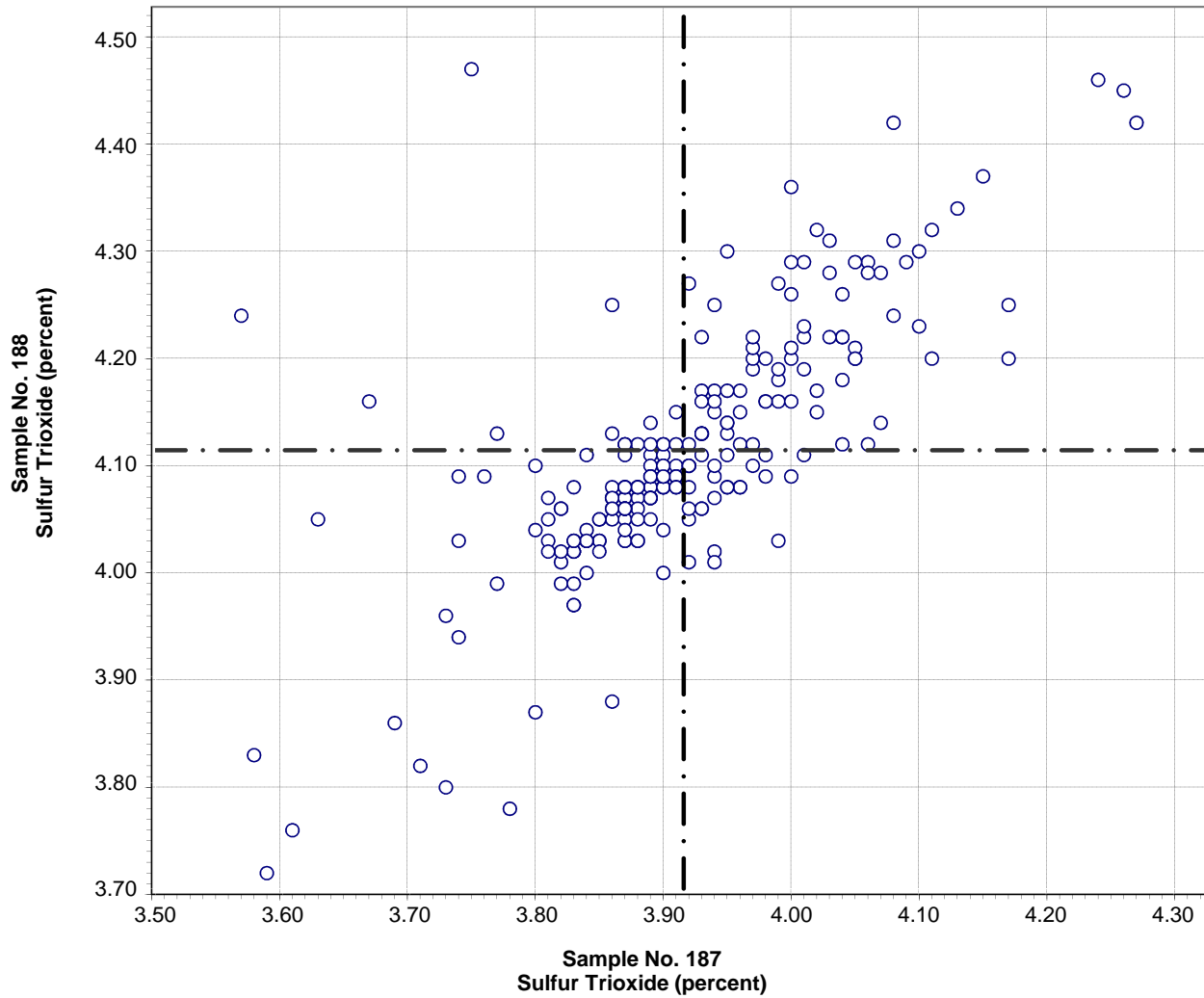
Test No. 50 Magnesium Oxide 220 Points

Sample No. 187 Ave 3.04 S.D. 0.07 C.V. 2.4

Sample No. 188 Ave 2.39 S.D. 0.07 C.V. 3.0

Labs Eliminated: 52, 95, 116, 159, 206, 982, 1525, 1526, 1799, 1956, 2464, 2491,
3233, 3661, 3662

CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 187 and No. 188



Test No. 60 Sulfur Trioxide 225 Points

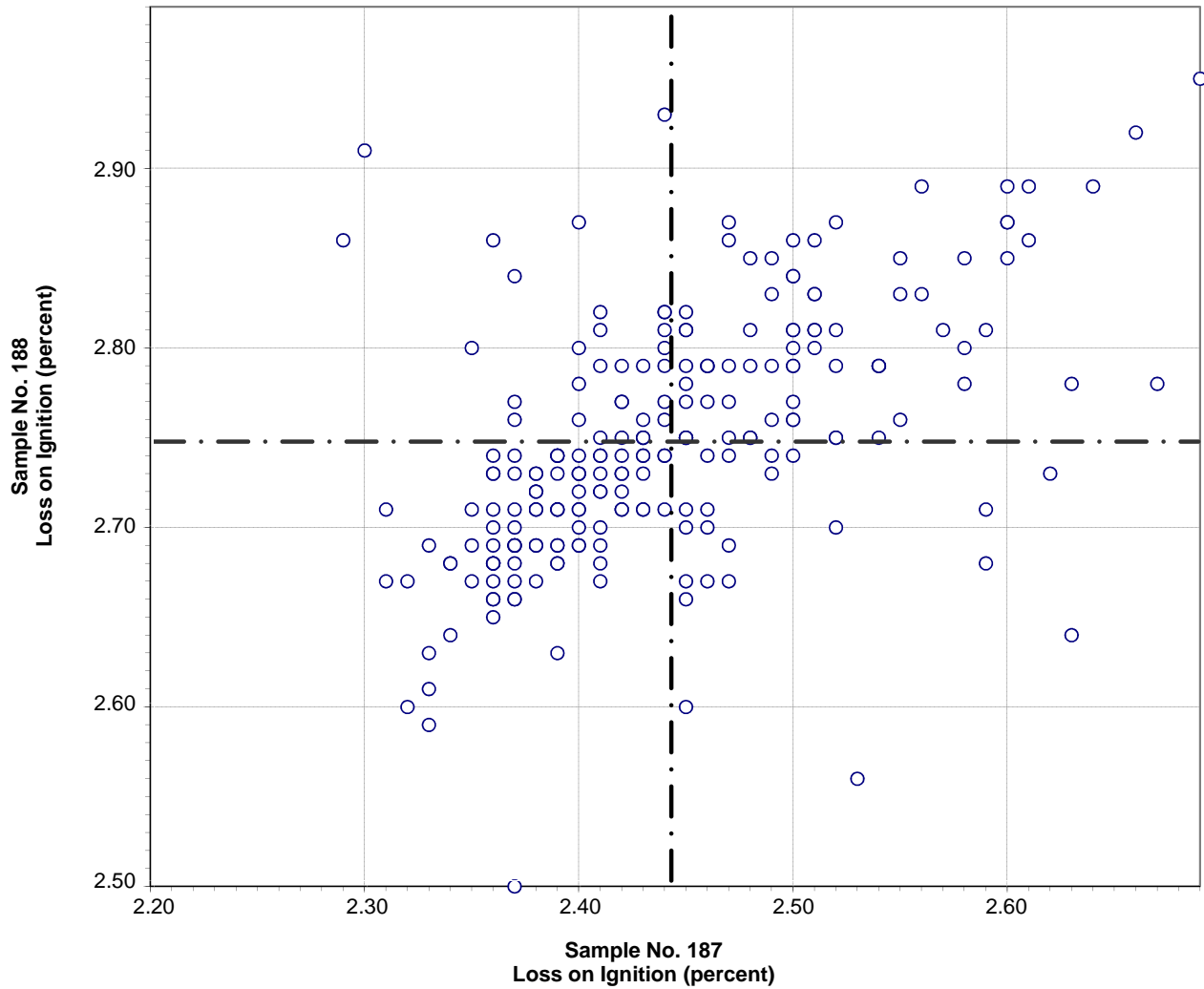
Sample No. 187 Ave 3.92 S.D. 0.12 C.V. 3.0

Sample No. 188 Ave 4.11 S.D. 0.13 C.V. 3.1

Labs Eliminated: 43, 125, 244, 690, 1525, 2437, 3443, 3819

Labs off Diagram: 50, 152, 203, 2305

CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 187 and No. 188



Test No. 70 Loss on Ignition 221 Points

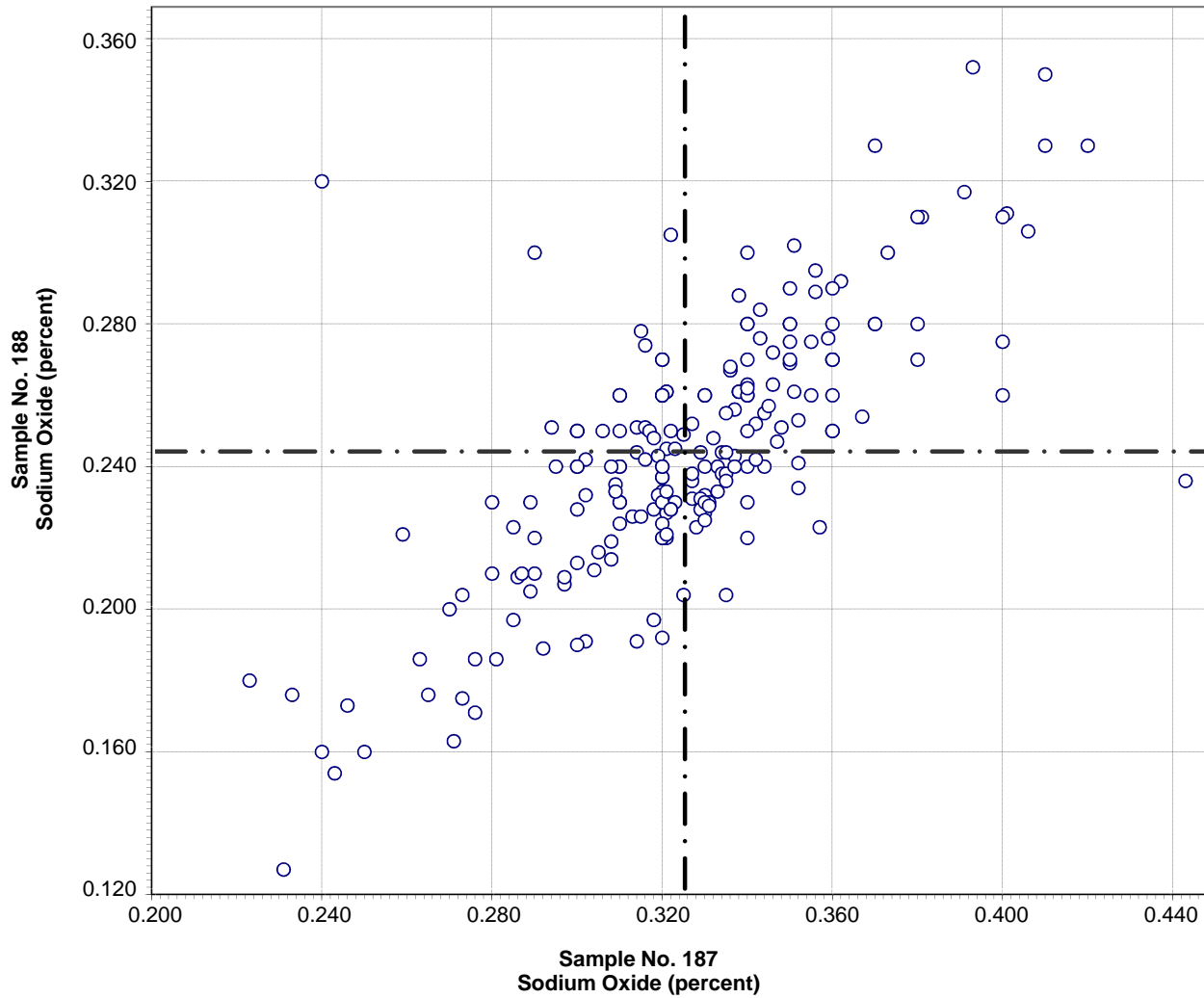
Sample No. 187 Ave 2.44 S.D. 0.08 C.V. 3.2

Sample No. 188 Ave 2.75 S.D. 0.07 C.V. 2.7

Labs Eliminated: 3, 56, 64, 116, 137, 176, 493, 557, 690, 840, 881, 1799, 2435,
2621

Labs off Diagram: 207, 1525

CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 187 and No. 188



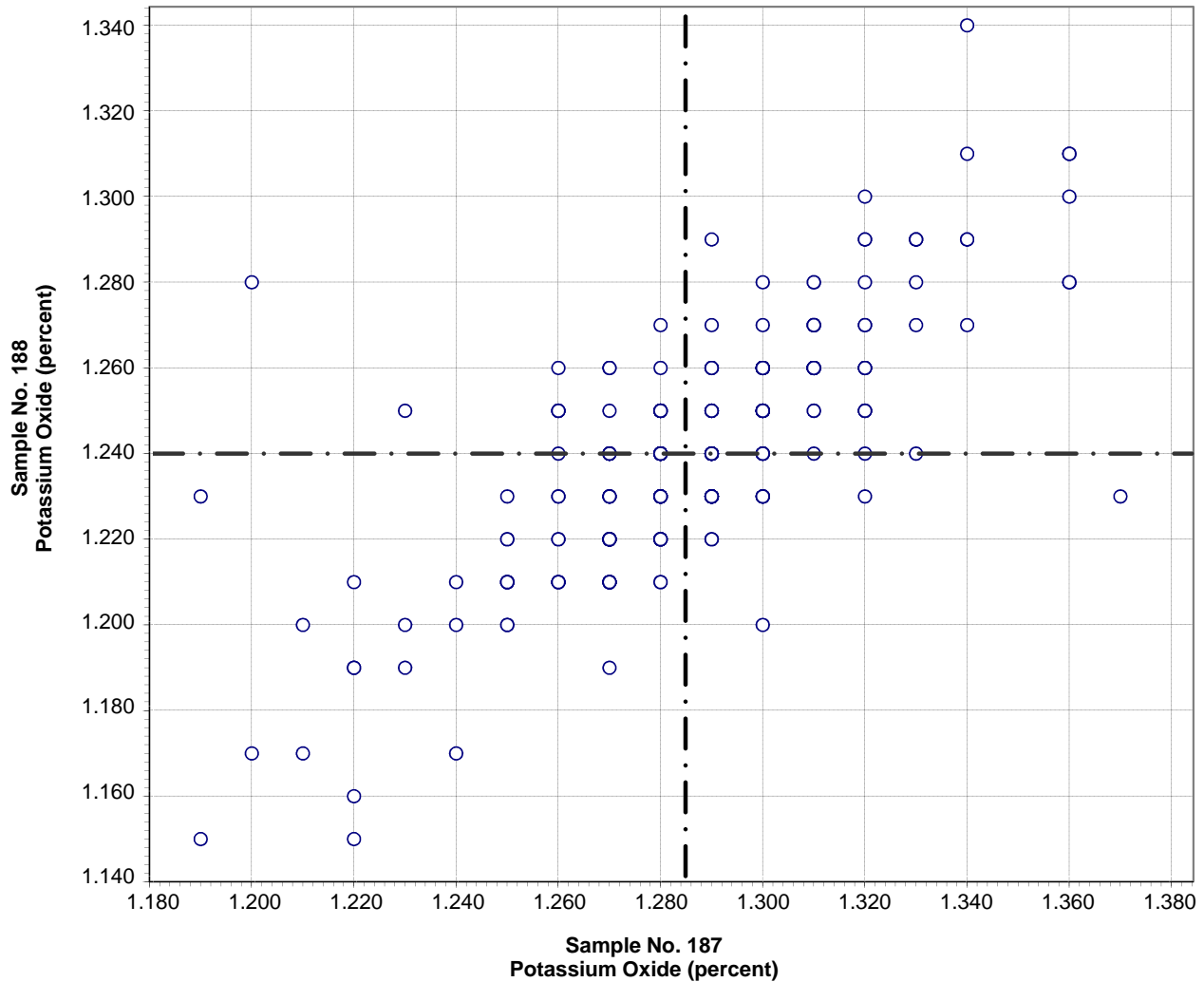
Test No. 90 Sodium Oxide 210 Points

Sample No. 187 Ave 0.325 S.D. 0.036 C.V. 11
Sample No. 188 Ave 0.244 S.D. 0.037 C.V. 15

Labs Eliminated: 125, 354, 1940, 2305, 2352, 2463, 2464, 2490, 2955, 3233,
3235, 3279, 3606, 3705

Labs off Diagram: 3368

**CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 100 Potassium Oxide 219 Points

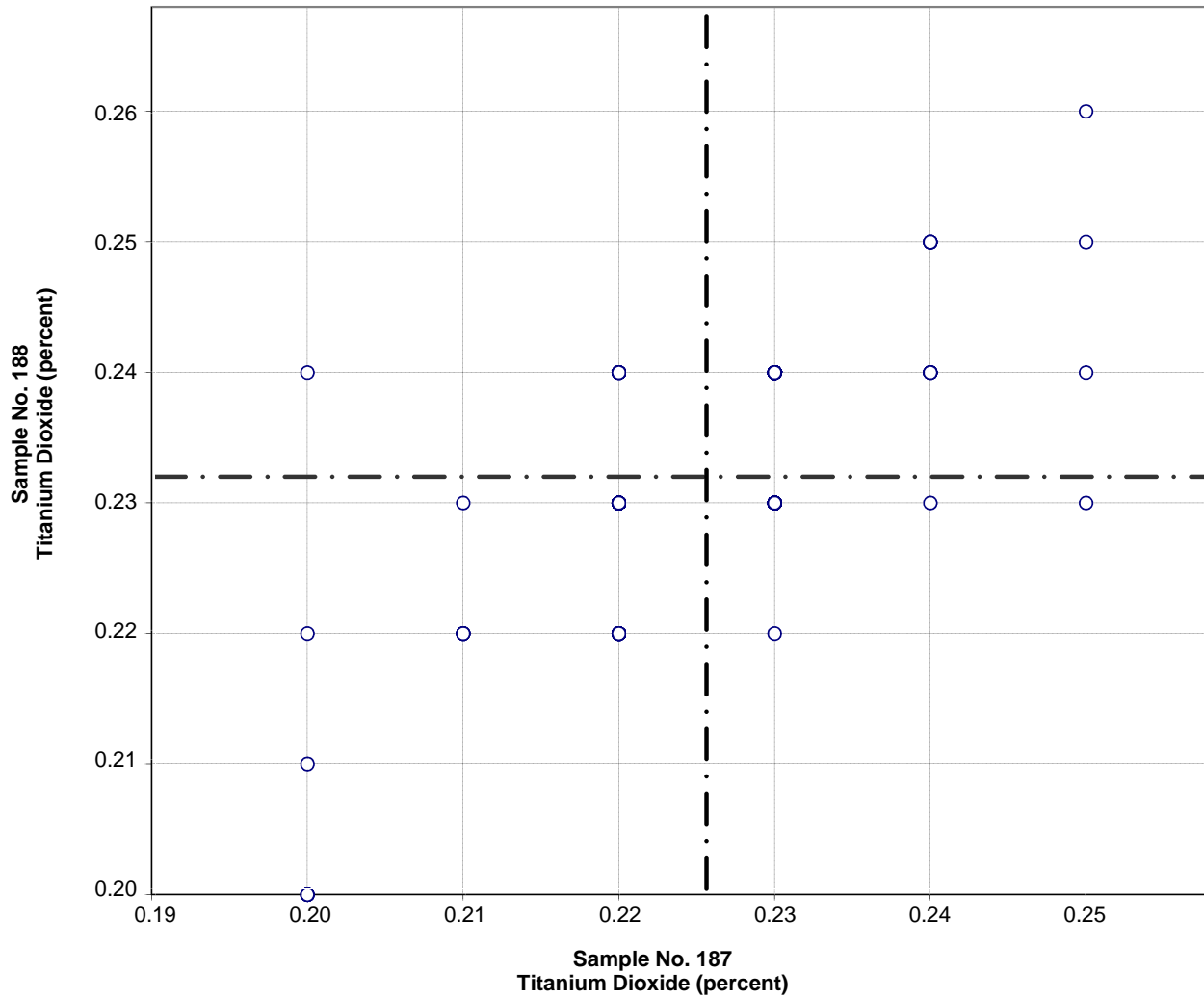
Sample No. 187 Ave 1.285 S.D. 0.032 C.V. 2.5

Sample No. 188 Ave 1.240 S.D. 0.029 C.V. 2.4

Labs Eliminated: 52, 98, 116, 413, 1079, 1956, 2305, 2491, 3791

Labs off Diagram: 3607

**CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 187 and No. 188**



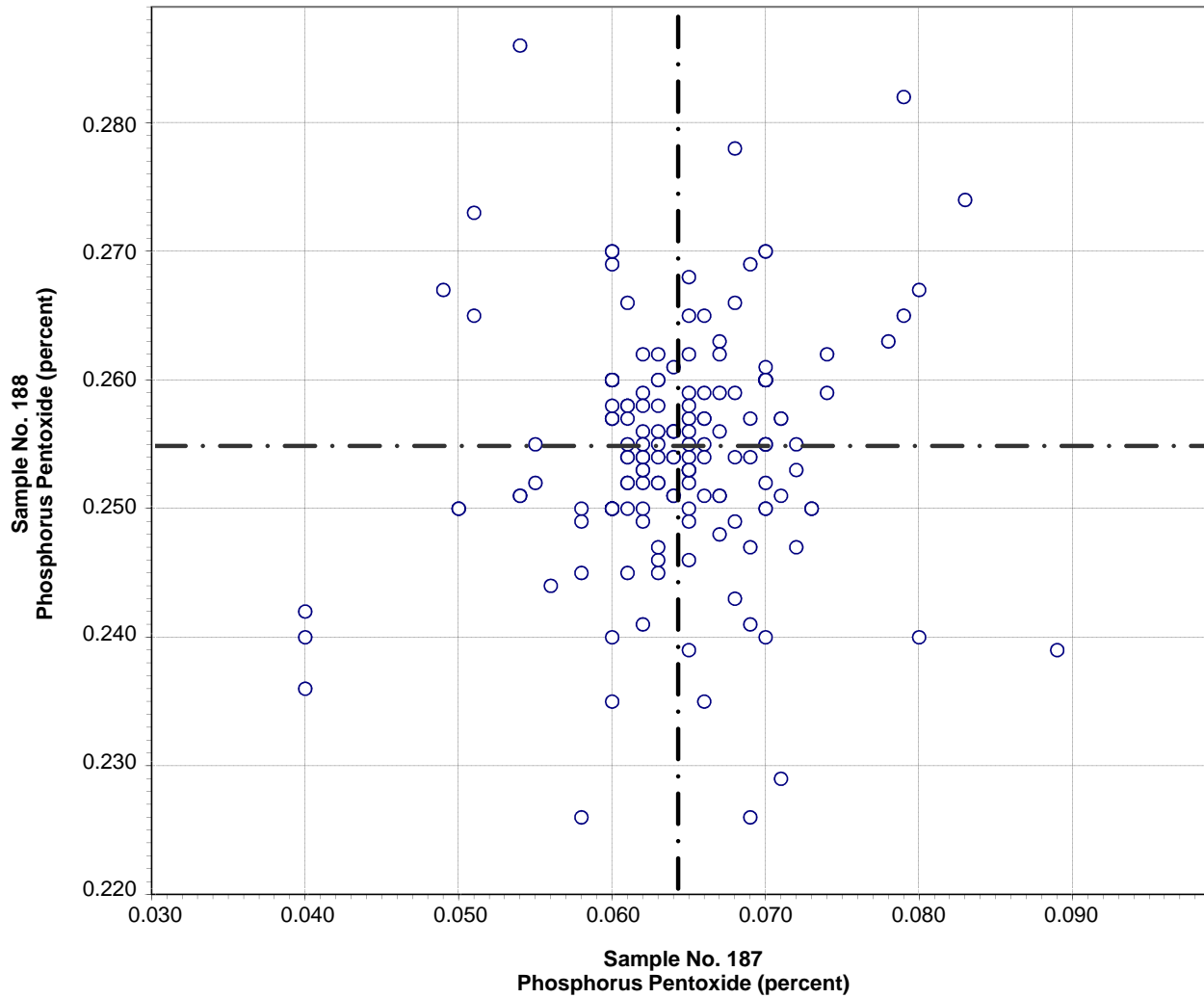
Test No. 103 Titanium Dioxide 183 Points

Sample No. 187 Ave 0.23 S.D. 0.009 C.V. 3.9

Sample No. 188 Ave 0.23 S.D. 0.009 C.V. 3.7

Labs Eliminated: 4, 27, 156, 206, 491, 494, 698, 1483, 2484

**CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 187 and No. 188**



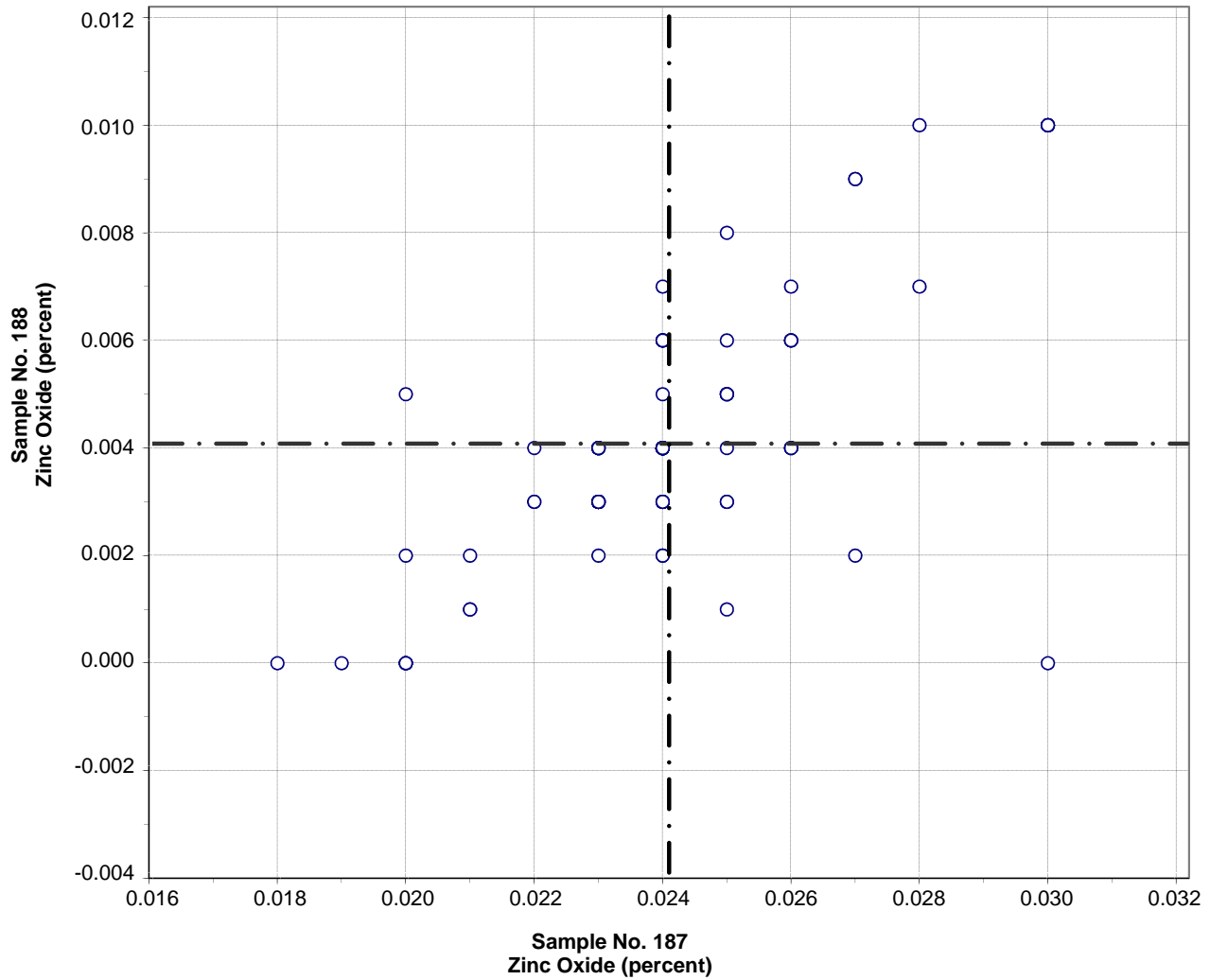
Test No. 102 Phosphorus Pentoxide 171 Points

Sample No. 187 Ave 0.064 S.D. 0.007 C.V. 10.6

Sample No. 188 Ave 0.255 S.D. 0.009 C.V. 3.5

Labs Eliminated: 22, 27, 34, 93, 116, 124, 132, 178, 254, 687, 1466, 1483, 1524,
1799, 2462, 2463, 2484, 2491, 3233, 3235, 3607, 3663

**CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 99 Zinc Oxide 93 Points

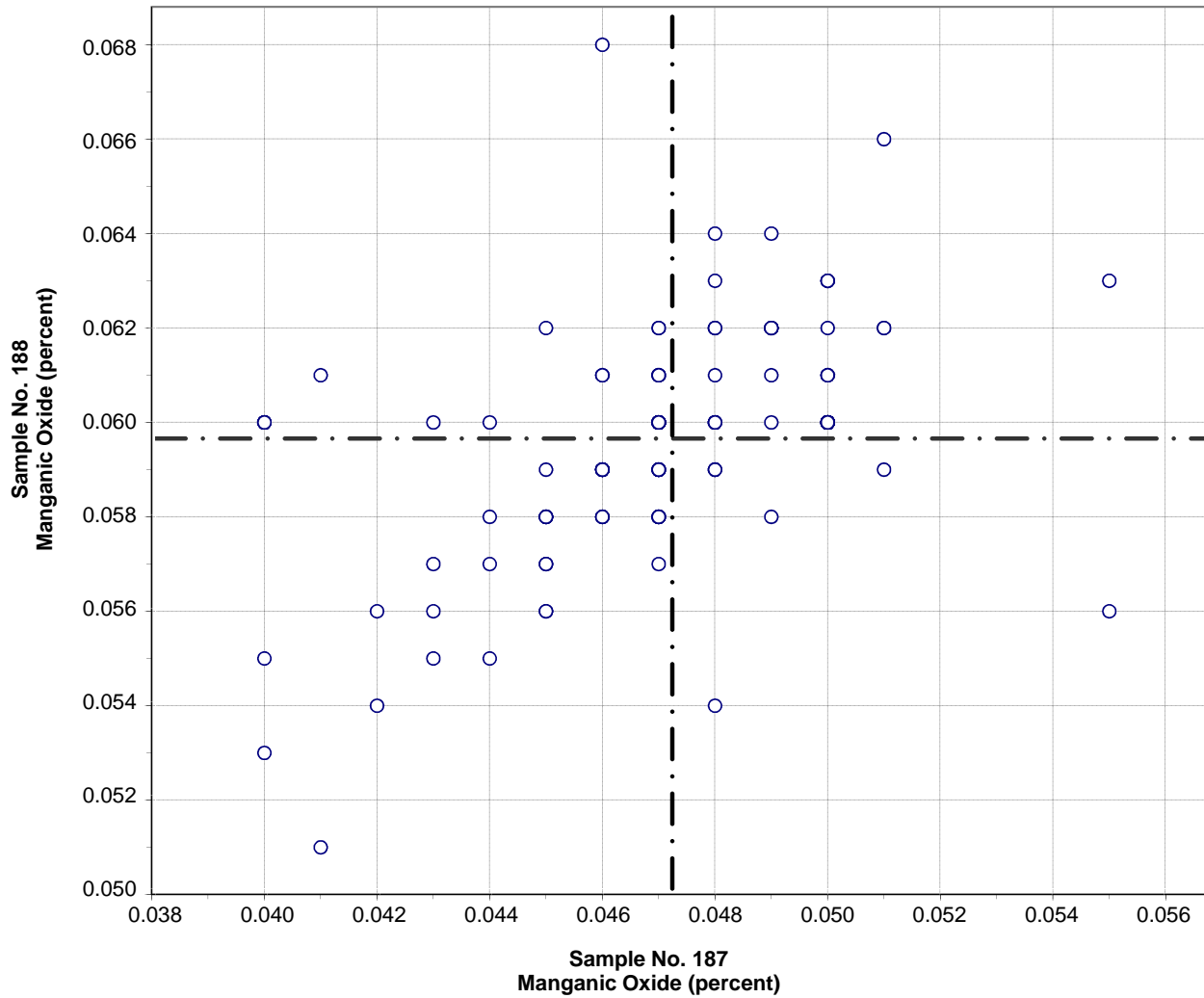
Sample No. 187 Ave 0.024 S.D. 0.002 C.V. 10.3

Sample No. 188 Ave 0.004 S.D. 0.002 C.V. 57.0

Labs Eliminated: 95, 116, 416, 2296, 2491, 3663, 3752

Labs off Diagram: 2484

**CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



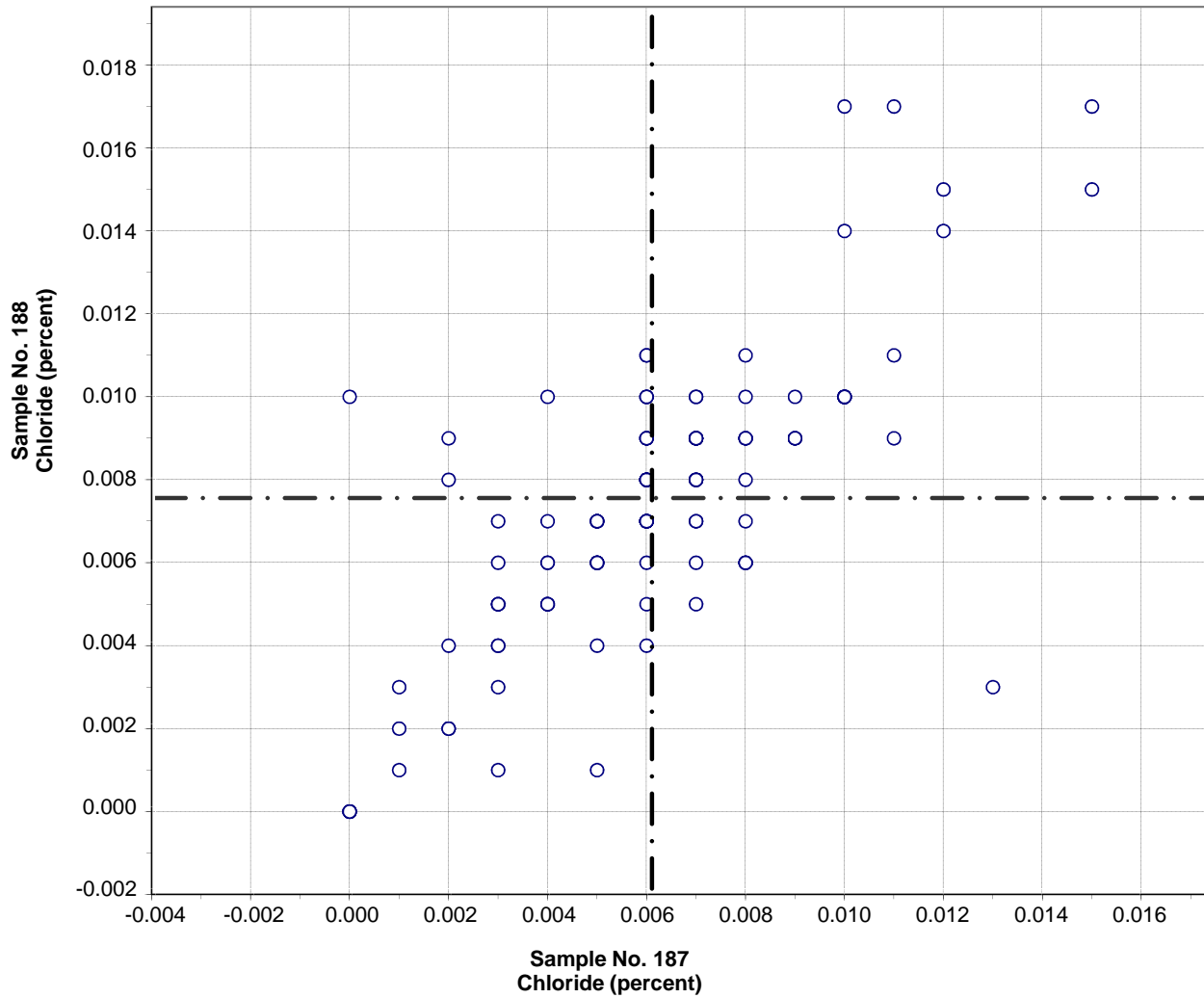
Test No. 101 Manganic Oxide 132 Points

Sample No. 187 Ave 0.047 S.D. 0.003 C.V. 6.4
 Sample No. 188 Ave 0.060 S.D. 0.003 C.V. 4.4

Labs Eliminated: 10, 24, 116, 162, 203, 354, 413, 457, 768, 932, 2462, 2466,
 2491, 3807

Labs off Diagram: 75, 2484

CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 187 and No. 188



Test No. 104 Chloride 113 Points

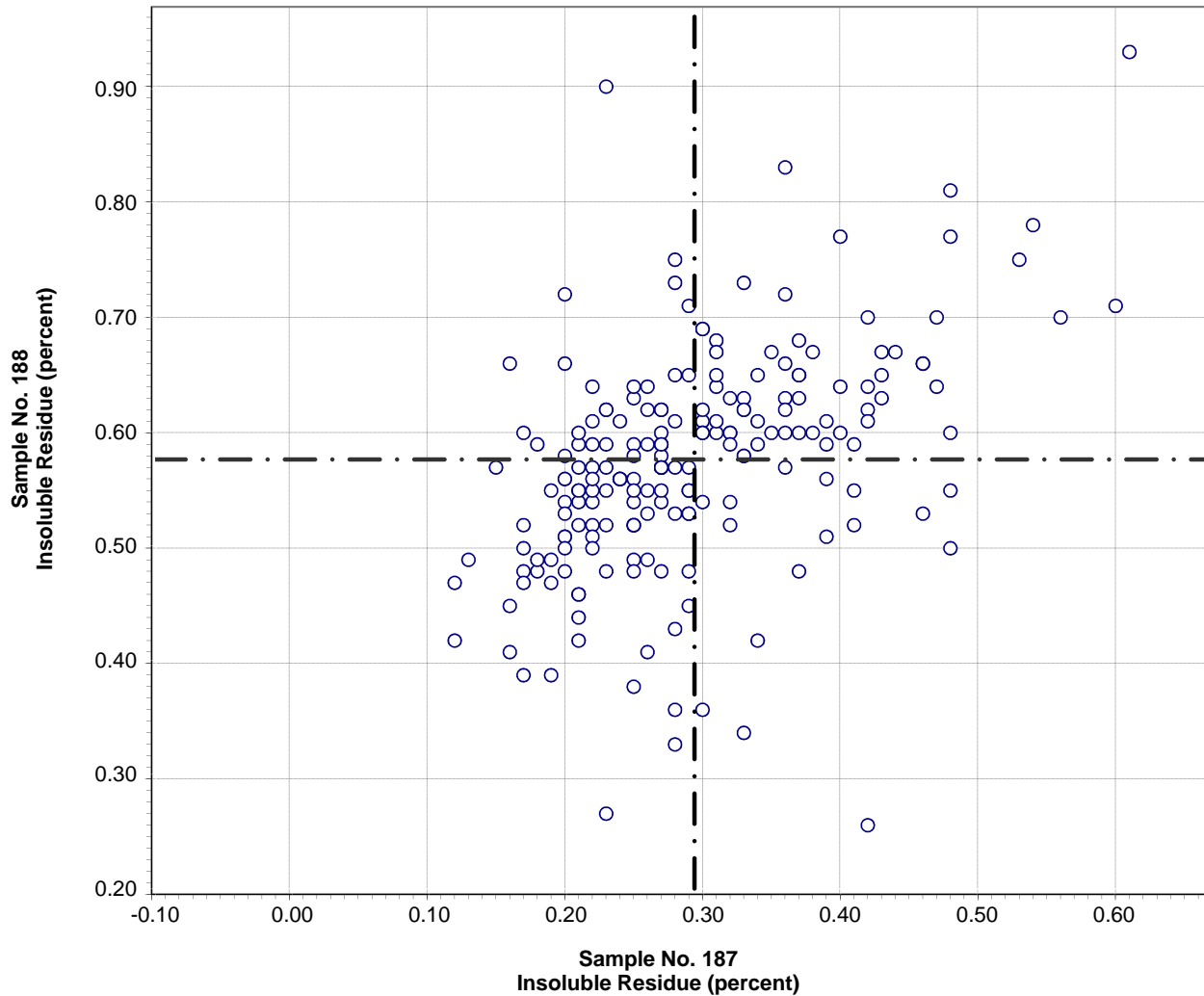
Sample No. 187 Ave 0.006 S.D. 0.003 C.V. 51

Sample No. 188 Ave 0.008 S.D. 0.004 C.V. 49

Labs Eliminated: 18, 129, 206, 886, 2491, 3607

Labs off Diagram: 2463

**CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 187 and No. 188**



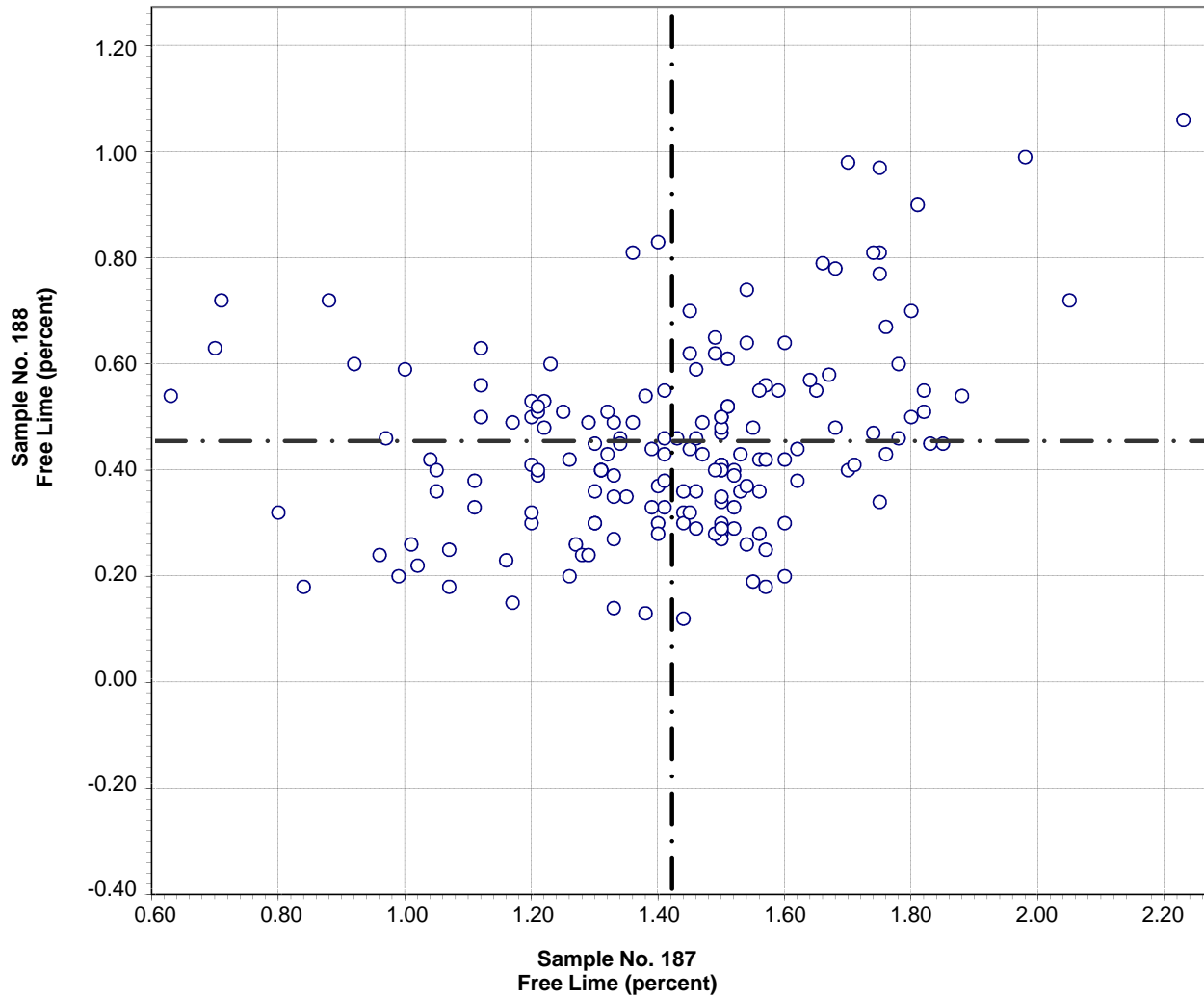
Test No. 80 Insoluble Residue 200 Points

Sample No. 187 Ave 0.29 S.D. 0.09 C.V. 32

Sample No. 188 Ave 0.58 S.D. 0.10 C.V. 17

Labs Eliminated: 206, 246, 247, 493, 886, 1190, 1526, 1799, 2435, 3233, 3235,
3297, 3605, 3791

CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 187 and No. 188

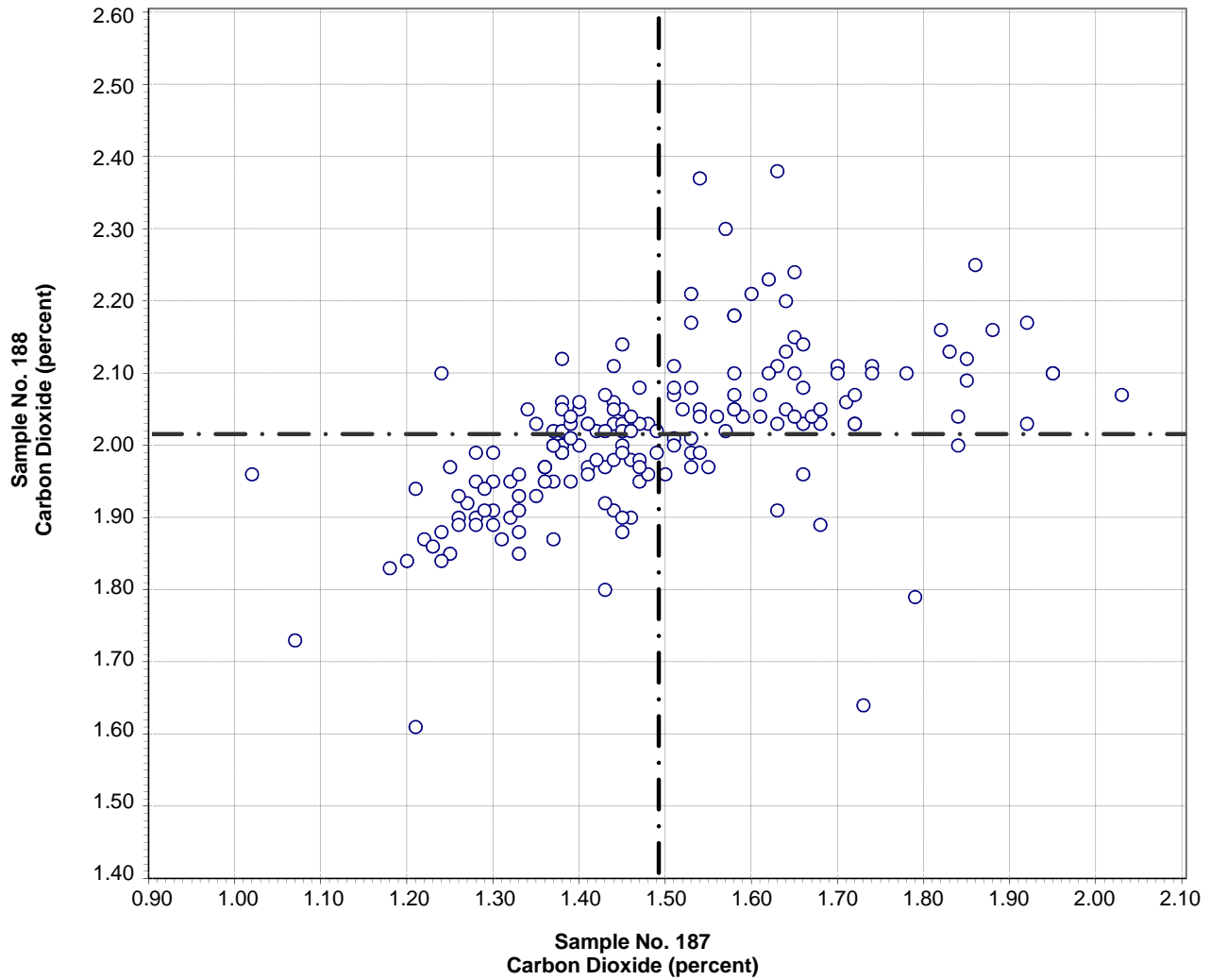


Test No. 41 Free Lime 170 Points

Sample No. 187 Ave 1.42 S.D. 0.26 C.V. 18
Sample No. 188 Ave 0.45 S.D. 0.18 C.V. 39

Labs Eliminated: 78, 132, 203, 222, 289, 415, 690, 2435, 2955, 3607, 3658

**CCRL Proficiency Sample Program
Carbon Dioxide
PORTLAND CEMENT Samples No. 187 and No. 188**



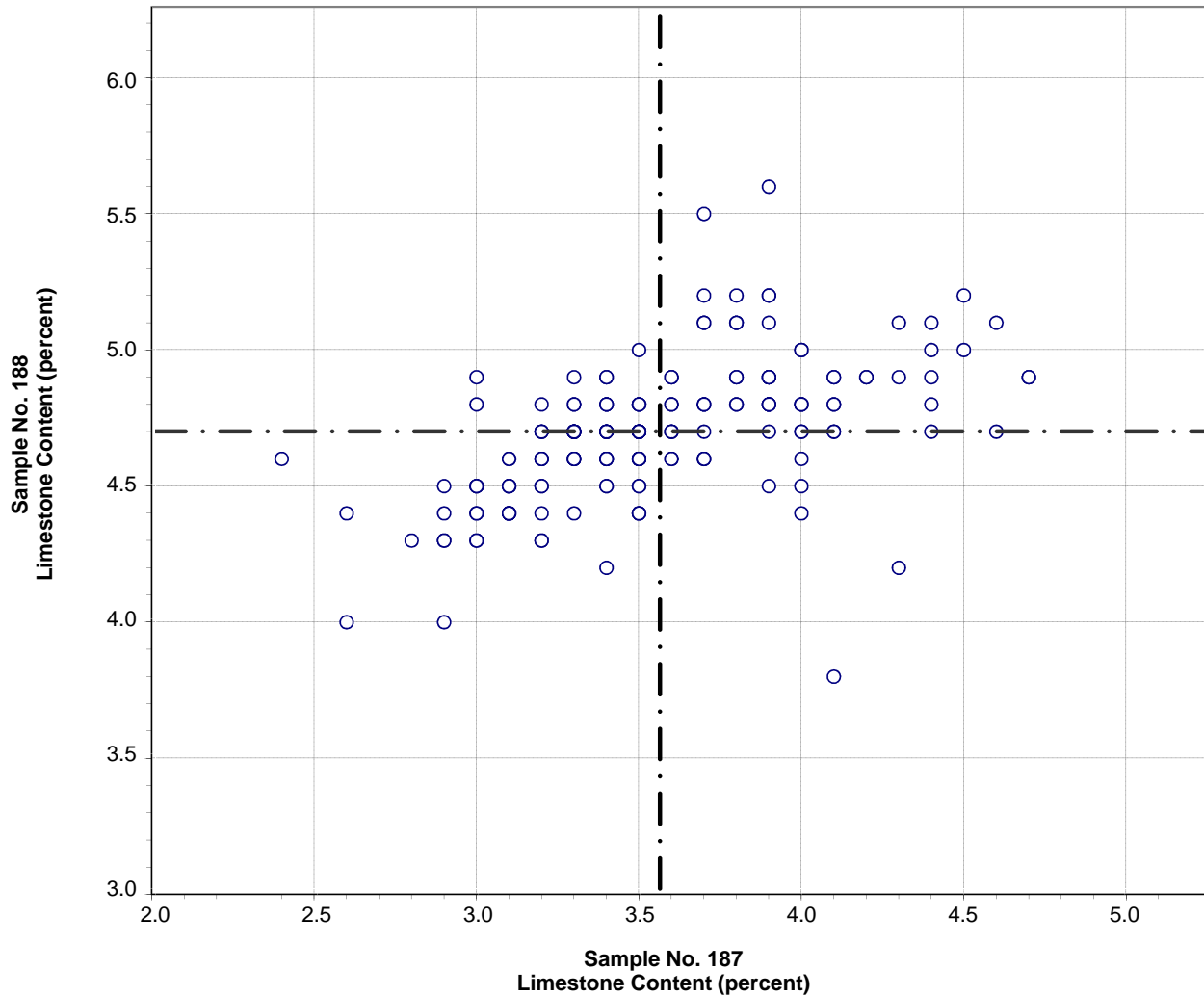
Test No. 97 Carbon Dioxide 178 Points

Sample No. 187 Ave 1.49 S.D. 0.18 C.V. 12.2

Sample No. 188 Ave 2.01 S.D. 0.11 C.V. 5.4

Labs Eliminated: 8, 94, 162, 219, 222, 254, 255, 415, 840, 881, 883, 886, 932,
1483, 1657, 1956, 2463, 2466, 2955, 3235

**CCRL Proficiency Sample Program
Limestone Content
PORTLAND CEMENT Samples No. 187 and No. 188**



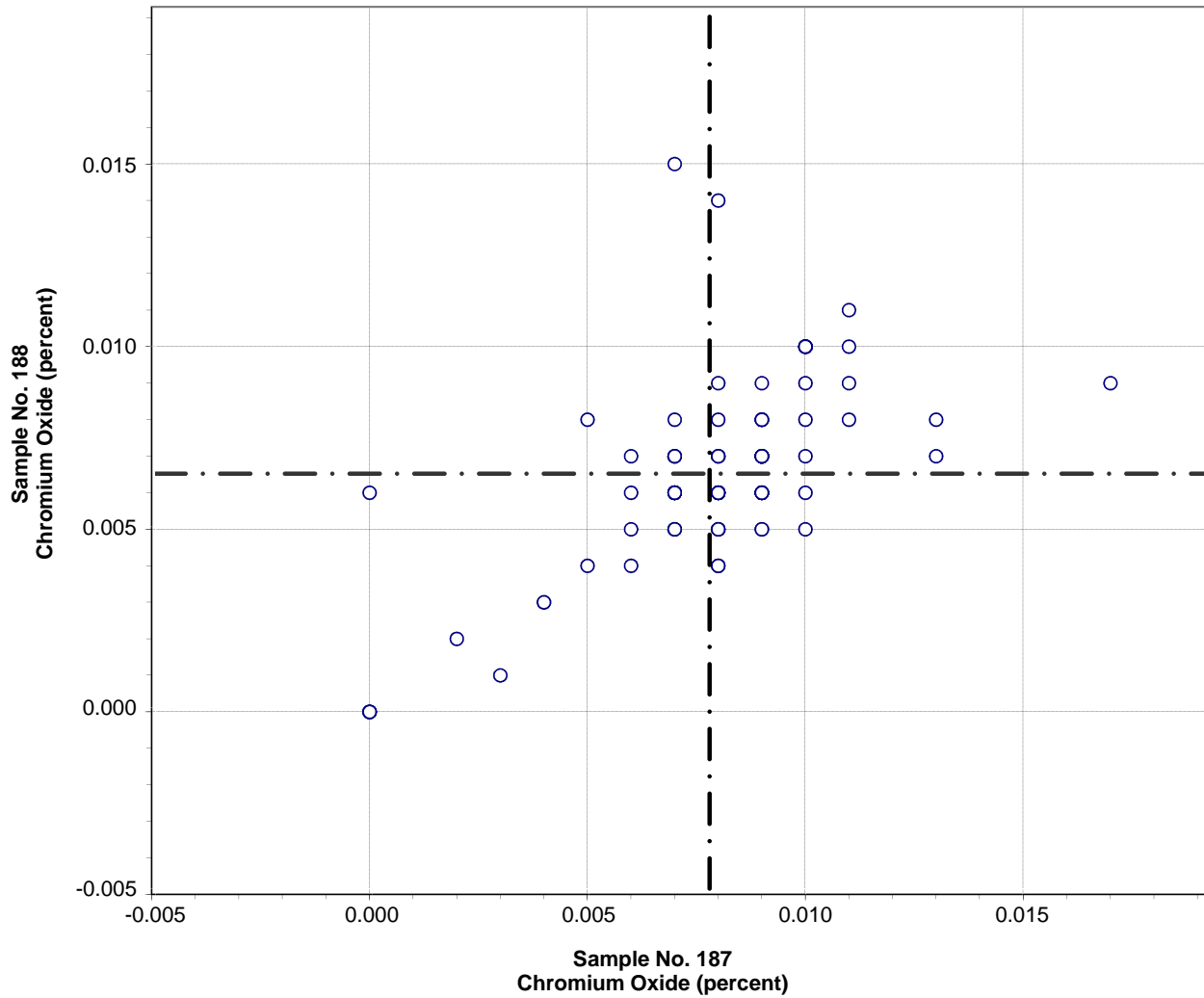
Test No. 98 Limestone Content 172 Points

Sample No. 187 Ave 3.6 S.D. 0.4 C.V. 12.4

Sample No. 188 Ave 4.7 S.D. 0.3 C.V. 5.4

Labs Eliminated: 8, 78, 94, 139, 162, 219, 222, 254, 255, 415, 840, 881, 883, 886, 932, 1483, 1657, 1956, 2463, 2466, 2955, 3235, 3607

**CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 187 and No. 188**



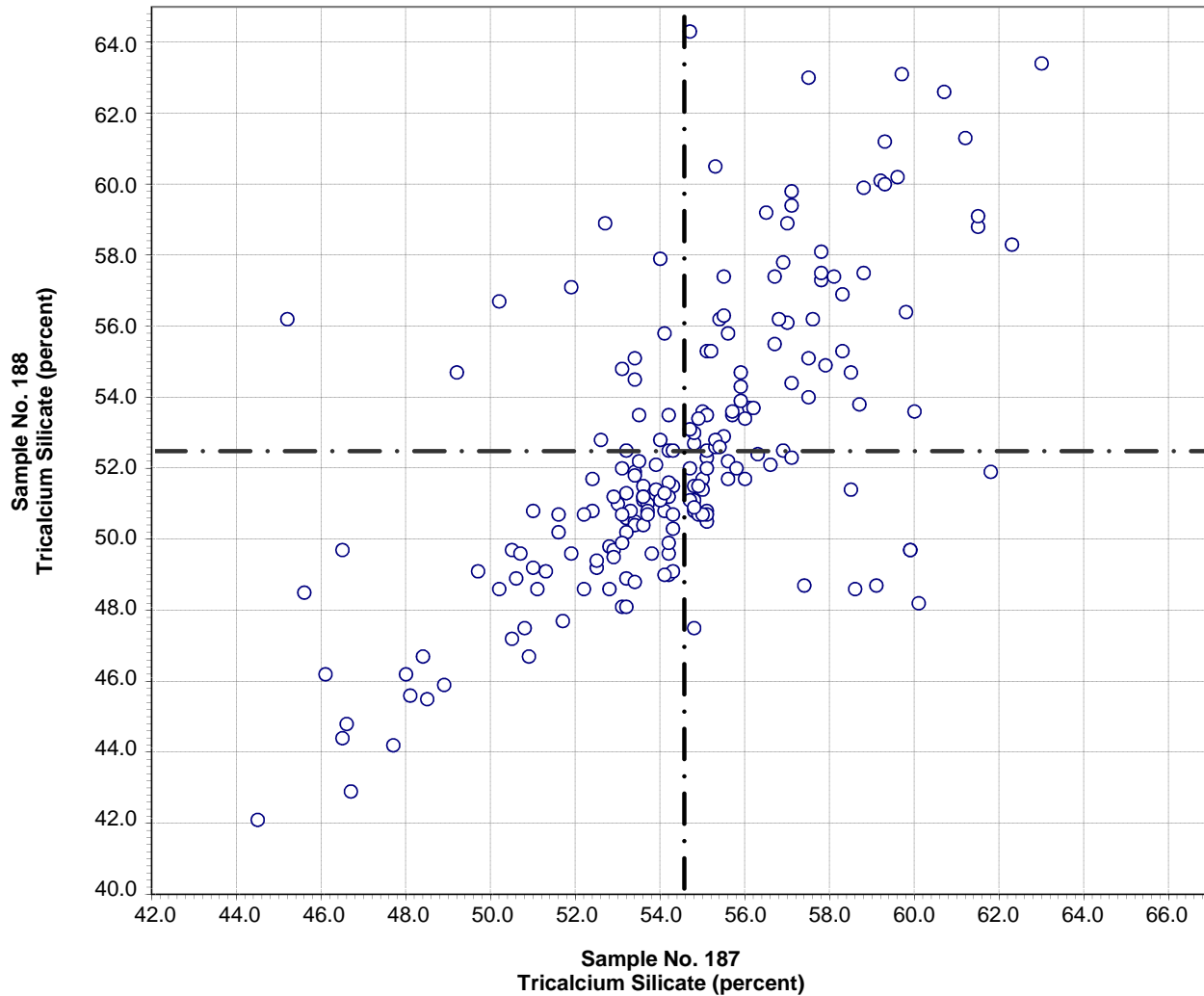
Test No. 105 Chromium Oxide 87 Points

Sample No. 187 Ave 0.008 S.D. 0.003 C.V. 36

Sample No. 188 Ave 0.006 S.D. 0.003 C.V. 40

Labs Eliminated: 10, 24, 203, 415, 768, 2462

**CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 106 Tricalcium Silicate 197 Points

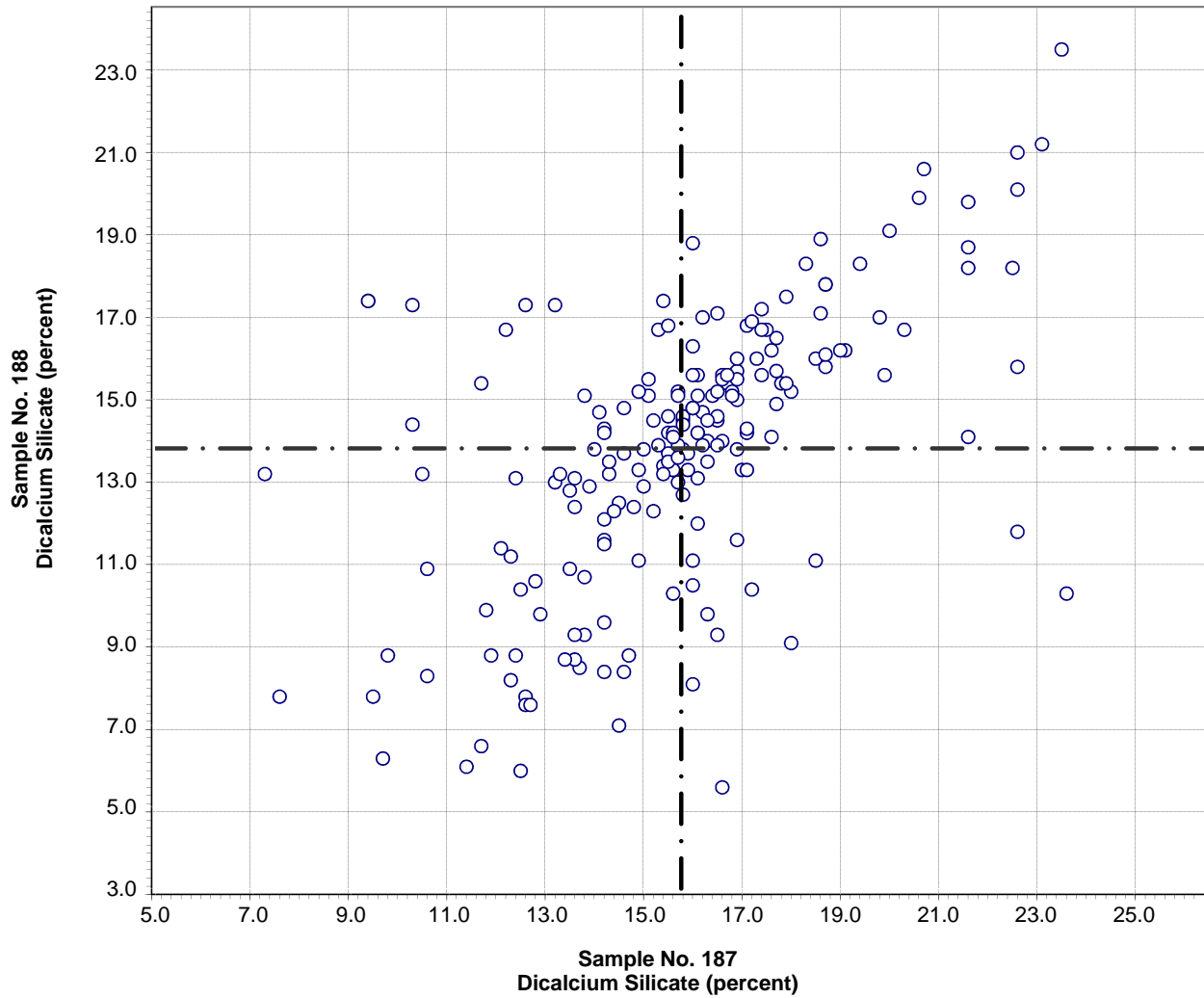
Sample No. 187 Ave 54.5 S.D. 3.4 C.V. 6.2

Sample No. 188 Ave 52.4 S.D. 4.1 C.V. 7.9

Labs Eliminated: 93, 840, 886, 1525

Labs off Diagram: 50

**CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 187 and No. 188**

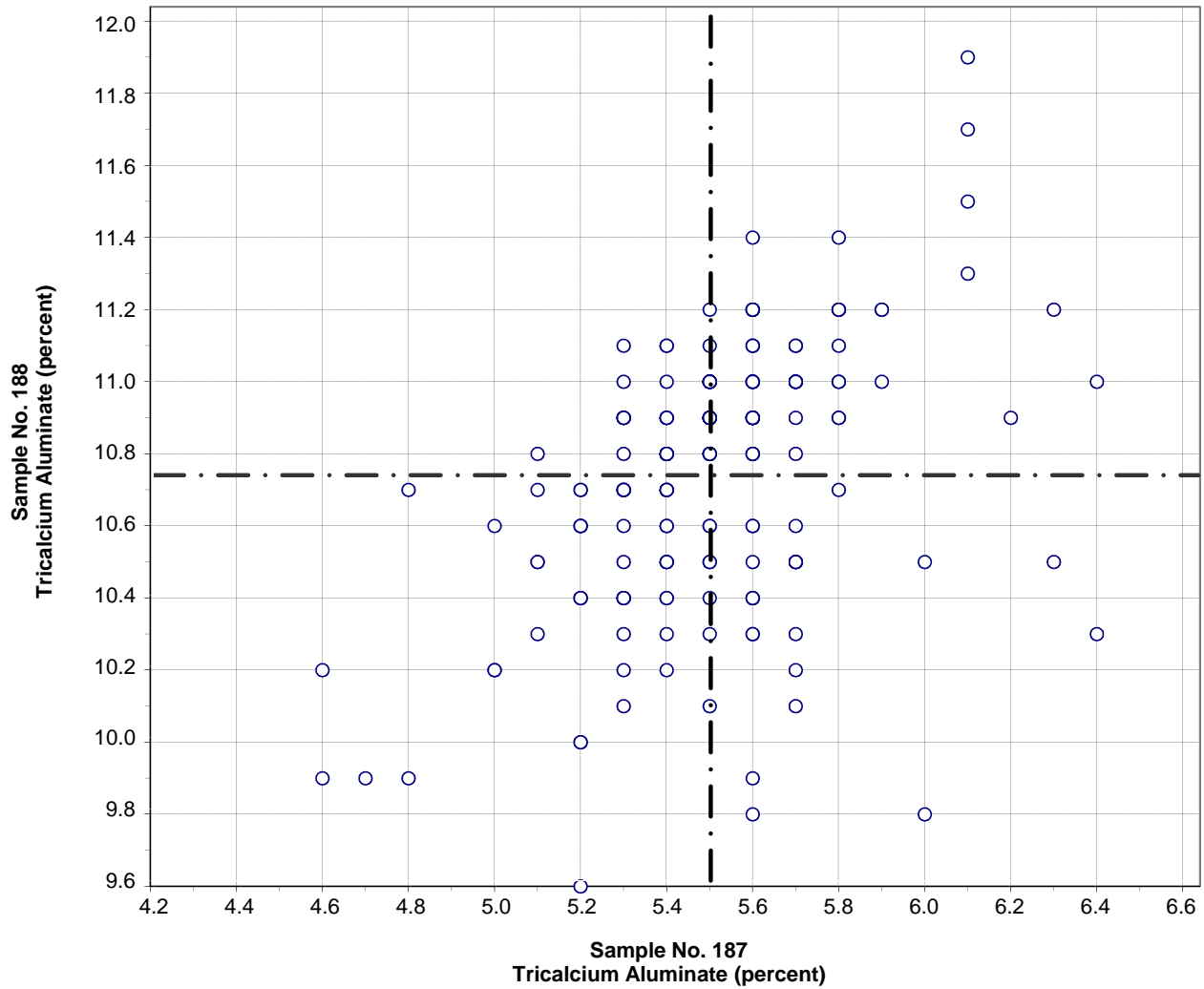


Test No. 107 Dicalcium Silicate 196 Points

Sample No. 187 Ave 15.7 S.D. 2.9 C.V. 19
Sample No. 188 Ave 13.8 S.D. 3.3 C.V. 24

Labs Eliminated: 50, 93, 840, 886, 1525

**CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 108 Tricalcium Aluminate 191 Points

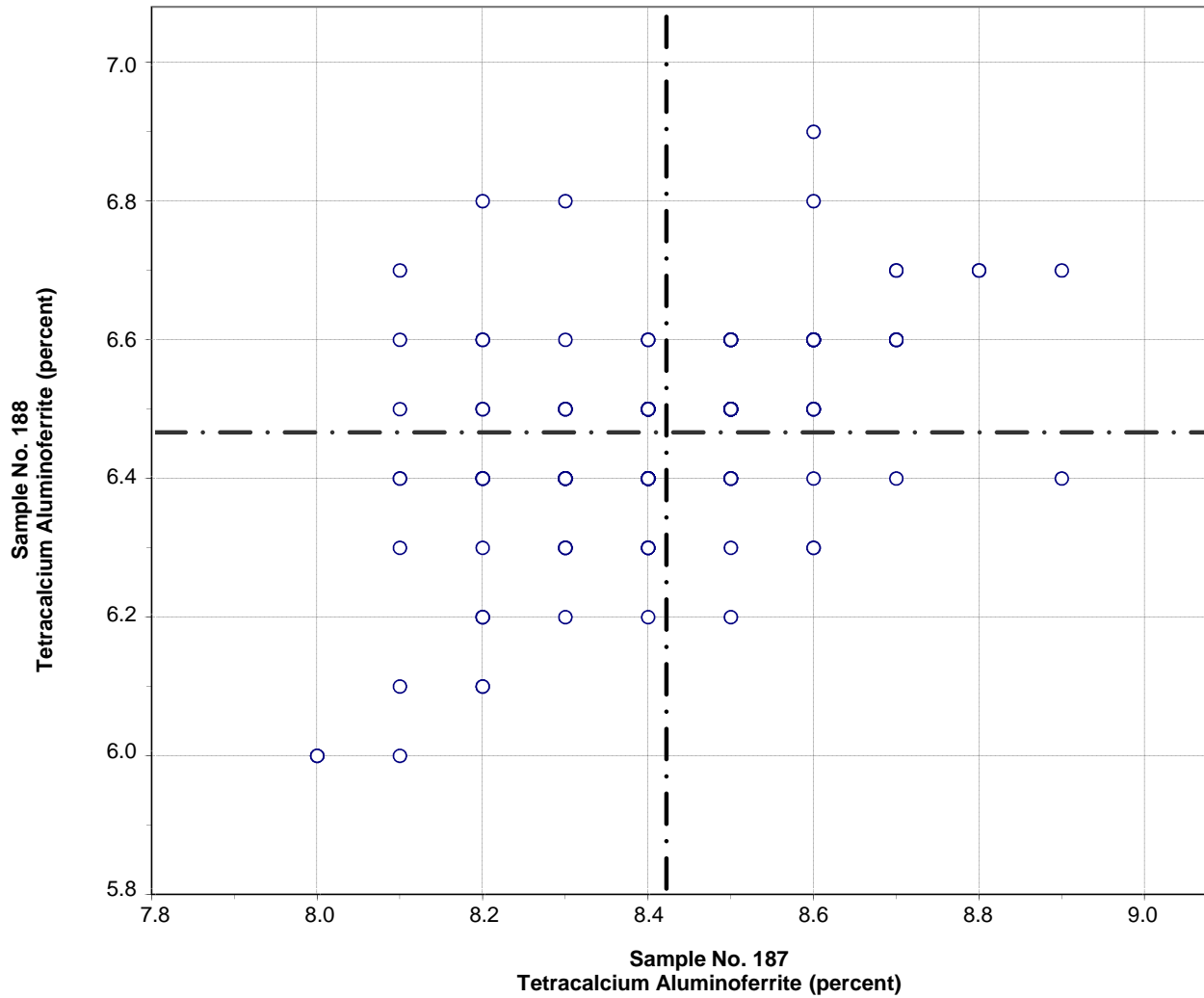
Sample No. 187 Ave 5.5 S.D. 0.3 C.V. 5.2

Sample No. 188 Ave 10.7 S.D. 0.4 C.V. 3.6

Labs Eliminated: 24, 43, 222, 840, 1525, 1526, 1799, 1956, 2292

Labs off Diagram: 221, 1483

**CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 109 Tetracalcium Aluminoferrite 190 Points

Sample No. 187 Ave 8.4 S.D. 0.2 C.V. 1.9

Sample No. 188 Ave 6.5 S.D. 0.1 C.V. 2.1

Labs Eliminated: 10, 24, 95, 126, 131, 142, 206, 840, 1526, 1799, 2491, 3661

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Physical Results
 March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Normal Consistency - % Water (percent)							
	249	27.3	0.88	3.2	27.1	0.86	3.2
	*244	27.2	0.49	1.8	27.1	0.46	1.7
* Labs Eliminated - 8, 51, 1940, 2412, 3819							
Vicat Time of Set - Initial (minutes)							
	243	128	13	10.1	139	15	10.6
	*236	127	11	9.0	138	13	9.2
* Labs Eliminated - 25, 38, 93, 565, 1483, 3245, 3819							
Vicat Time of Set - Final (minutes)							
	235	234	32	14	248	31	12
	*230	234	29	13	248	29	12
* Labs Eliminated - 90, 124, 165, 2296, 3819							
Gillmore Time of Set - Initial (minutes)							
	151	166	23	14	179	29	16
	*143	164	19	12	176	22	12
* Labs Eliminated - 23, 38, 40, 94, 116, 1956, 2490, 3245							
Gillmore Time of Set - Final (minutes)							
	151	269	39	14	286	38	13
	*146	267	37	14	284	35	12
* Labs Eliminated - 116, 176, 1956, 2296, 2490							
False Set - Paste Method (percent)							
	188	77	9.2	12	72	10.2	14
	*186	77	8.6	11	73	9.8	13
* Labs Eliminated - 103, 2463							
Autoclave Expansion (percent)							
	224	0.04	0.069	156	0.04	0.060	157
	*210	0.04	0.019	45	0.04	0.016	45
* Labs Eliminated - 26, 95, 116, 360, 431, 605, 687, 1524, 2296, 2462, 2466, 2490, 3658, 3663							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Physical Results
 March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content % (percent)							
	215	9.4	1.3	14	7.8	1.3	16
	*209	9.3	1.1	12	7.7	1.2	15
* Labs Eliminated - 134, 1483, 1956, 2296, 2490, 3245							
Air Content - % Water (percent)							
	210	68.3	8.5	12.4	69.0	8.3	12.0
	*200	69.6	2.3	3.3	70.1	2.2	3.2
* Labs Eliminated - 49, 124, 134, 222, 438, 565, 605, 2296, 2464, 2490							
Air Content - Flow (percent)							
	212	87	4.1	4.7	86	3.7	4.3
	*208	87	3.6	4.1	86	3.3	3.9
* Labs Eliminated - 26, 438, 2490, 3144							
Compressive Strength - 3 day (psi)							
	250	3867	304	7.9	4622	368	8.0
	*244	3882	259	6.7	4647	329	7.1
* Labs Eliminated - 51, 52, 116, 1525, 1526, 3057							
Compressive Strength - 7 day (psi)							
	246	4629	309	6.7	5266	369	7.0
	*242	4646	282	6.1	5283	345	6.5
* Labs Eliminated - 52, 1525, 1526, 2463							
Compressive Strength - 28 day (psi)							
	224	5625	392	7.0	6117	452	7.4
	*221	5645	353	6.2	6137	416	6.8
* Labs Eliminated - 40, 1525, 2080							
Compressive Strength - Flow (percent)							
	224	104	9	9.1	103	9	9.0
	*222	104	9	8.7	103	9	8.8
* Labs Eliminated - 9, 1466							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Physical Results
 March 19, 2013

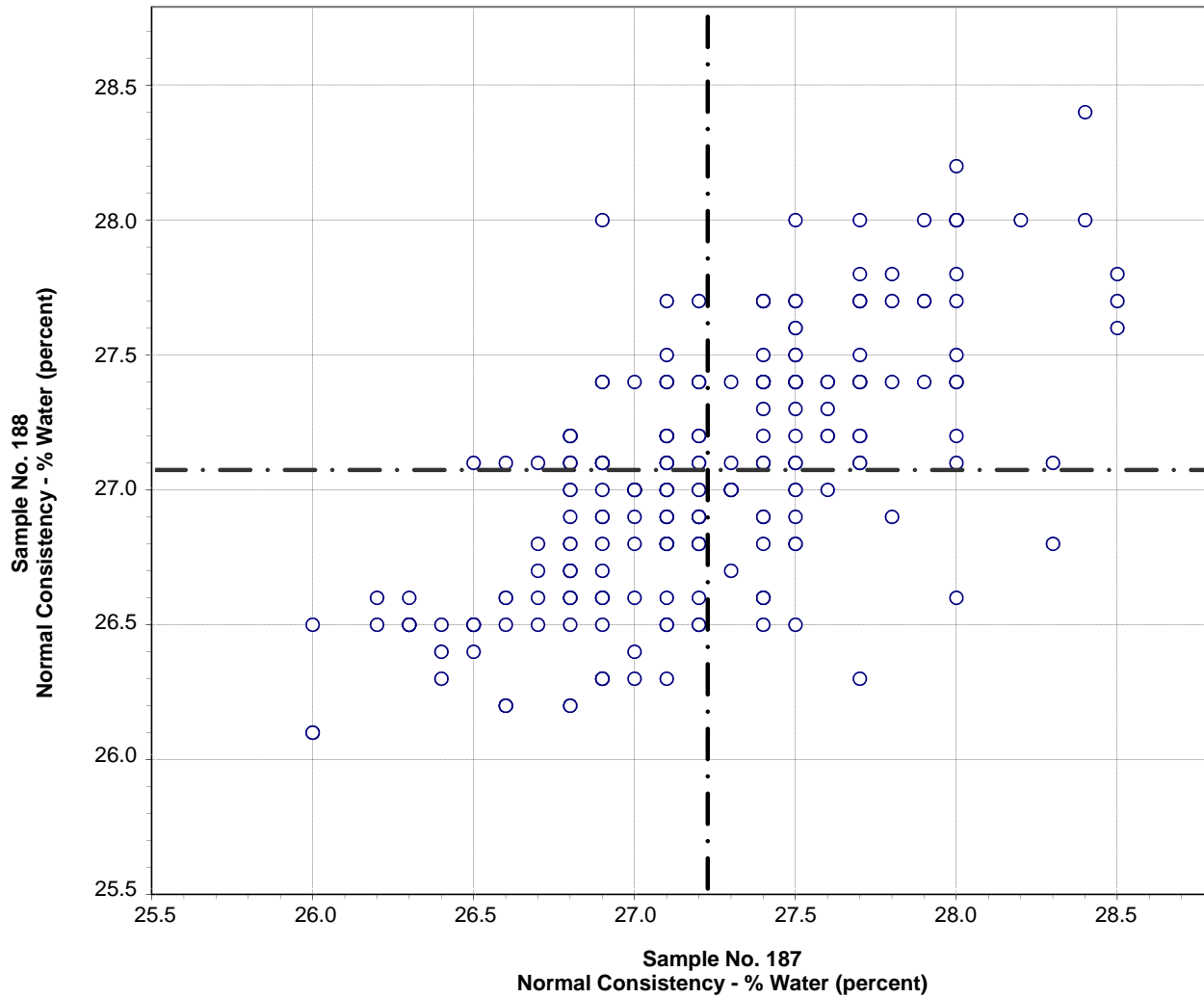
SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Fineness - Air Permeability (m²/kg)							
	245	390	15	3.8	410	15	3.8
	*237	391	11	2.9	410	12	2.9
* Labs Eliminated - 34, 605, 886, 1525, 1594, 2296, 3297, 3819							
Fineness - Wagner Turbidimeter (m²/kg)							
	5	209	19	9.2	209	22	10.5
No Labs Eliminated for This Test							
Fineness - 45µm Sieve (percent)							
	232	97.93	0.55	0.57	95.56	1.03	1.08
	*218	98.02	0.36	0.37	95.68	0.65	0.68
* Labs Eliminated - 23, 29, 47, 49, 51, 95, 222, 413, 515, 684, 840, 1799, 2412, 3511							
C1038 Mortar Bar Expansion (percent)							
	148	0.011	0.010	89	0.008	0.009	116
	*136	0.010	0.004	43	0.007	0.003	49
* Labs Eliminated - 84, 441, 493, 494, 565, 1054, 1956, 2462, 2463, 2490, 3607, 3752							
C1038 Mortar - Water (ml)							
	146	248	18	7.4	247	18	7.4
	*138	247	6	2.5	247	6	2.3
* Labs Eliminated - 84, 151, 184, 207, 440, 1956, 2412, 2490							
C1038 Mortar - Flow (percent)							
	146	108	7	6.4	108	7	6.0
	*134	109	2	2.2	109	2	2.2
* Labs Eliminated - 6, 46, 75, 151, 667, 690, 691, 996, 1251, 1956, 2490, 3663							

**CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 187 and No. 188**



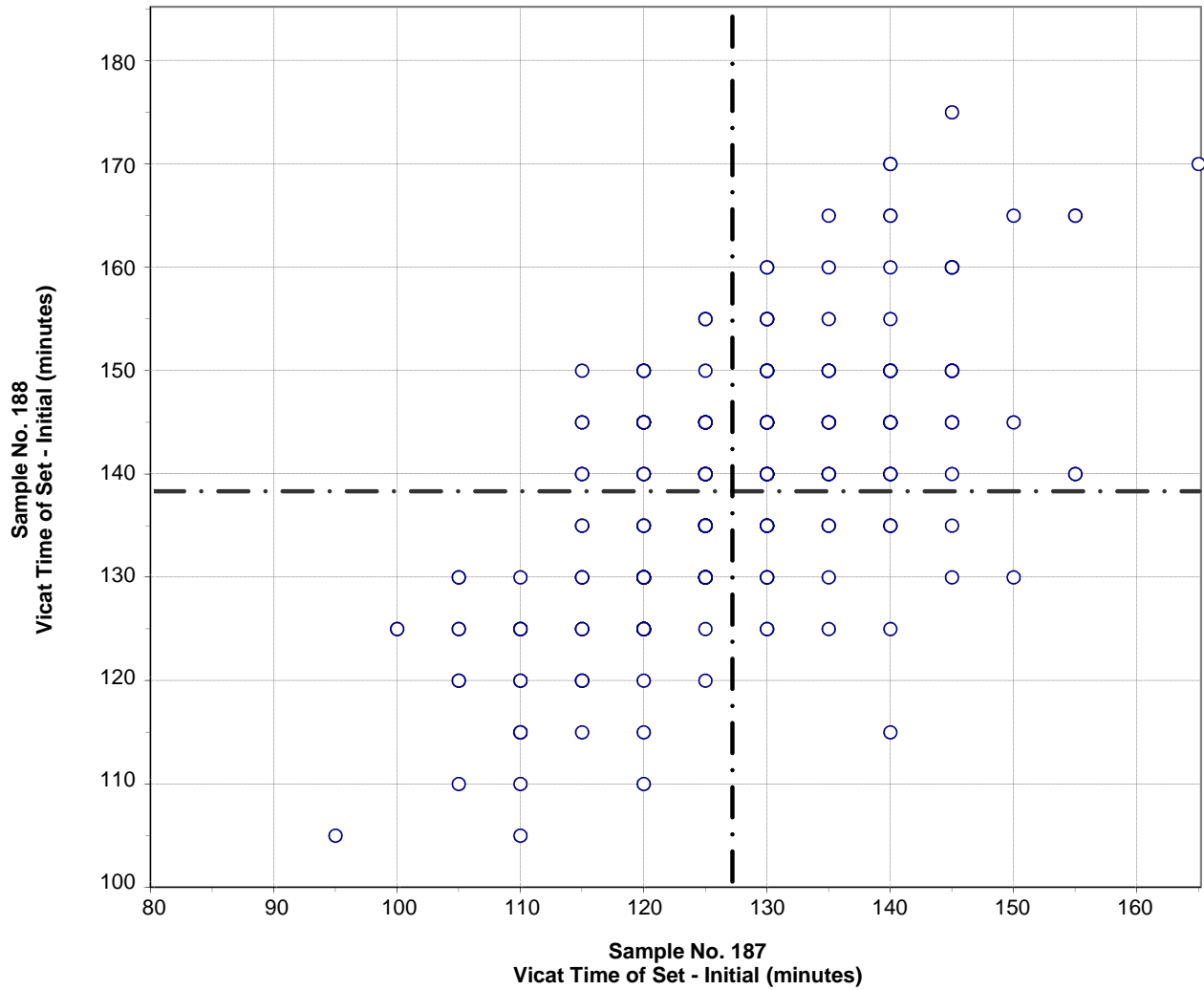
Test No. 110 Normal Consistency - % Water 244 Points

Sample No. 187 Ave 27.2 S.D. 0.49 C.V. 1.8

Sample No. 188 Ave 27.1 S.D. 0.46 C.V. 1.7

Labs Eliminated: 8, 51, 1940, 2412, 3819

**CCRL Proficiency Sample Program
 Vicat Time of Set - Initial
 PORTLAND CEMENT Samples No. 187 and No. 188**



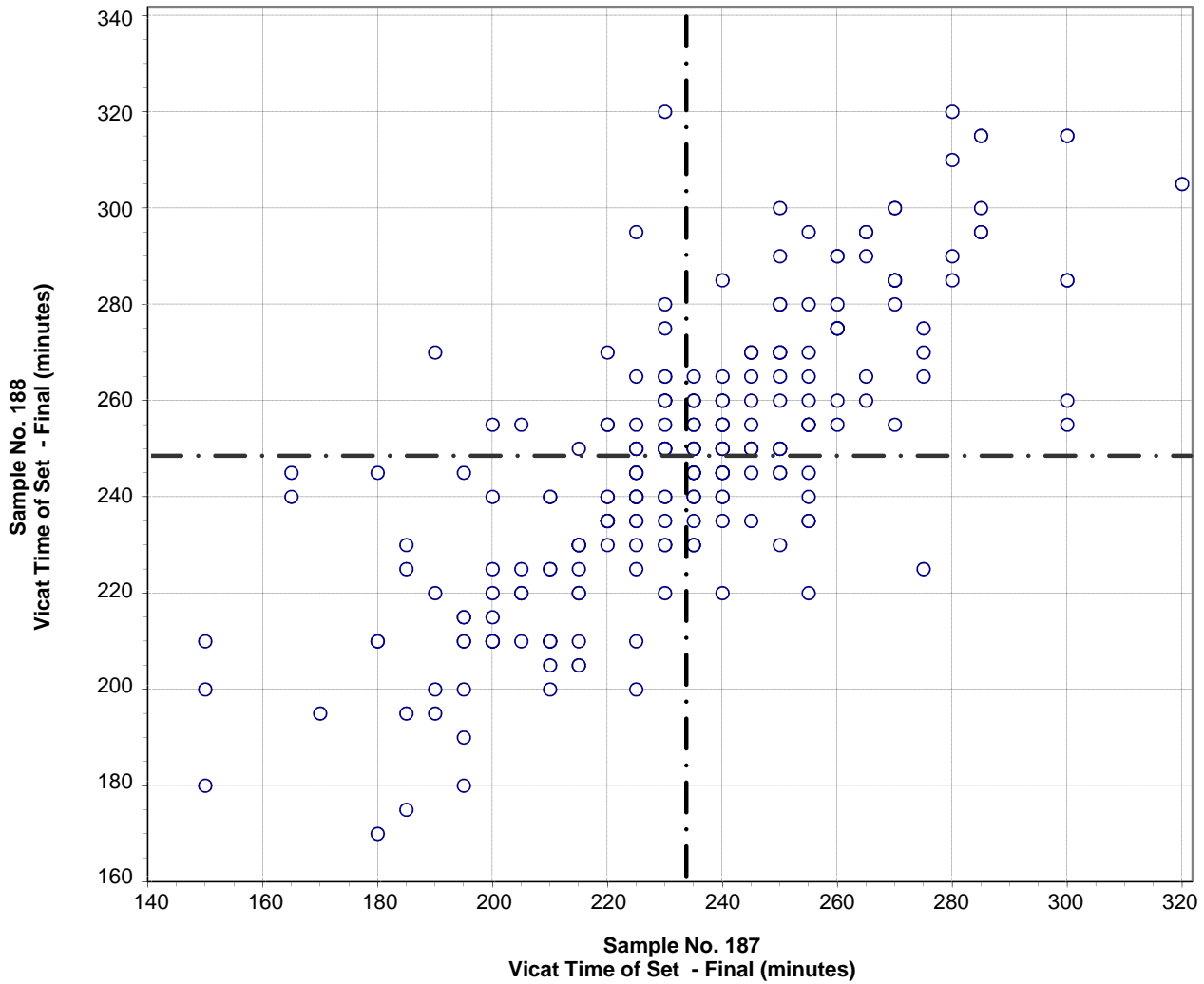
Test No. 120 Vicat Time of Set - Initial 236 Points

Sample No. 187 Ave 127 S.D. 11 C.V. 9.0

Sample No. 188 Ave 138 S.D. 13 C.V. 9.2

Labs Eliminated: 25, 38, 93, 565, 1483, 3245, 3819

**CCRL Proficiency Sample Program
 Vicat Time of Set - Final
 PORTLAND CEMENT Samples No. 187 and No. 188**



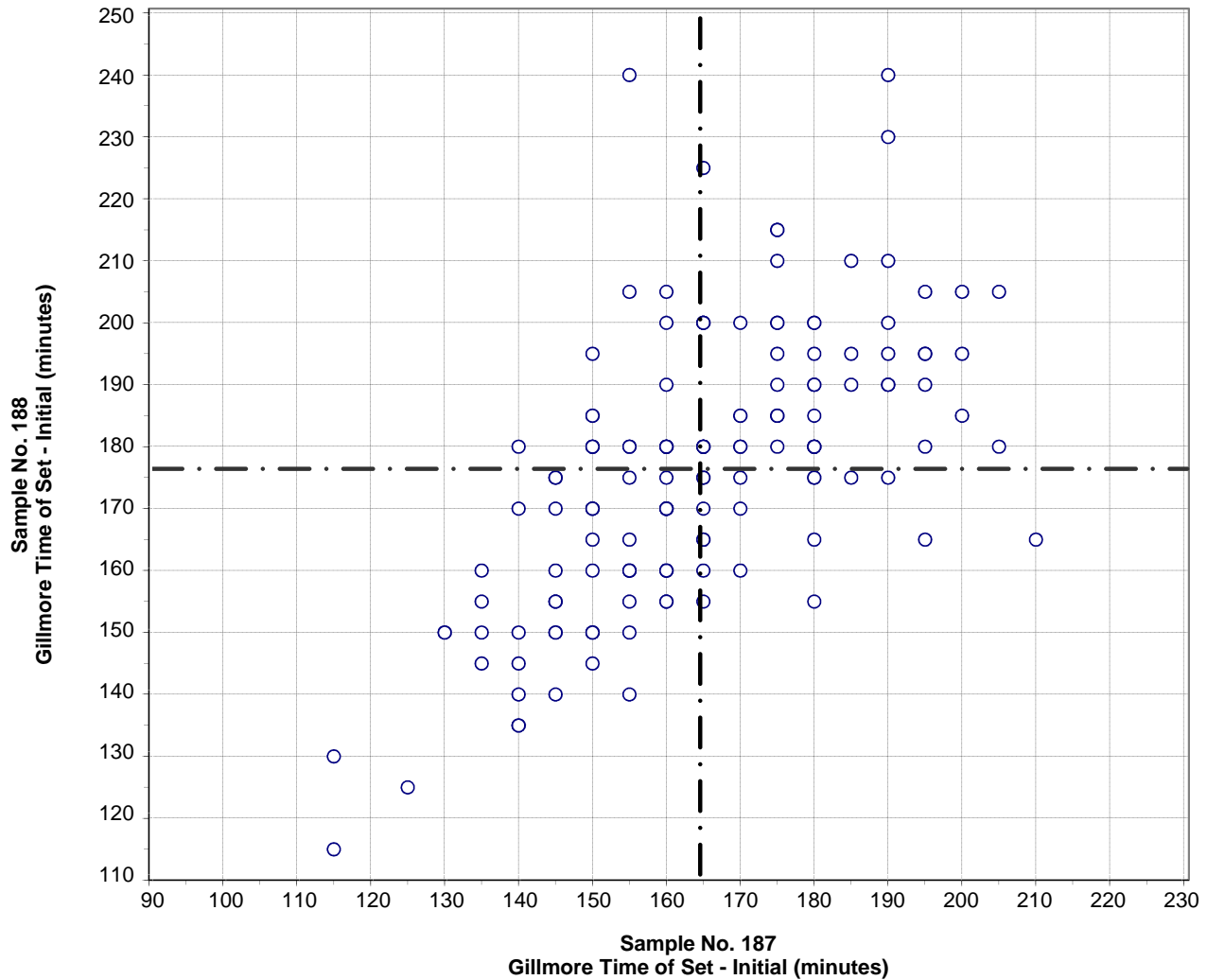
Test No. 121 Vicat Time of Set - Final 230 Points

Sample No. 187 Ave 234 S.D. 29 C.V. 13

Sample No. 188 Ave 248 S.D. 29 C.V. 12

Labs Eliminated: 90, 124, 165, 2296, 3819

**CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 187 and No. 188**



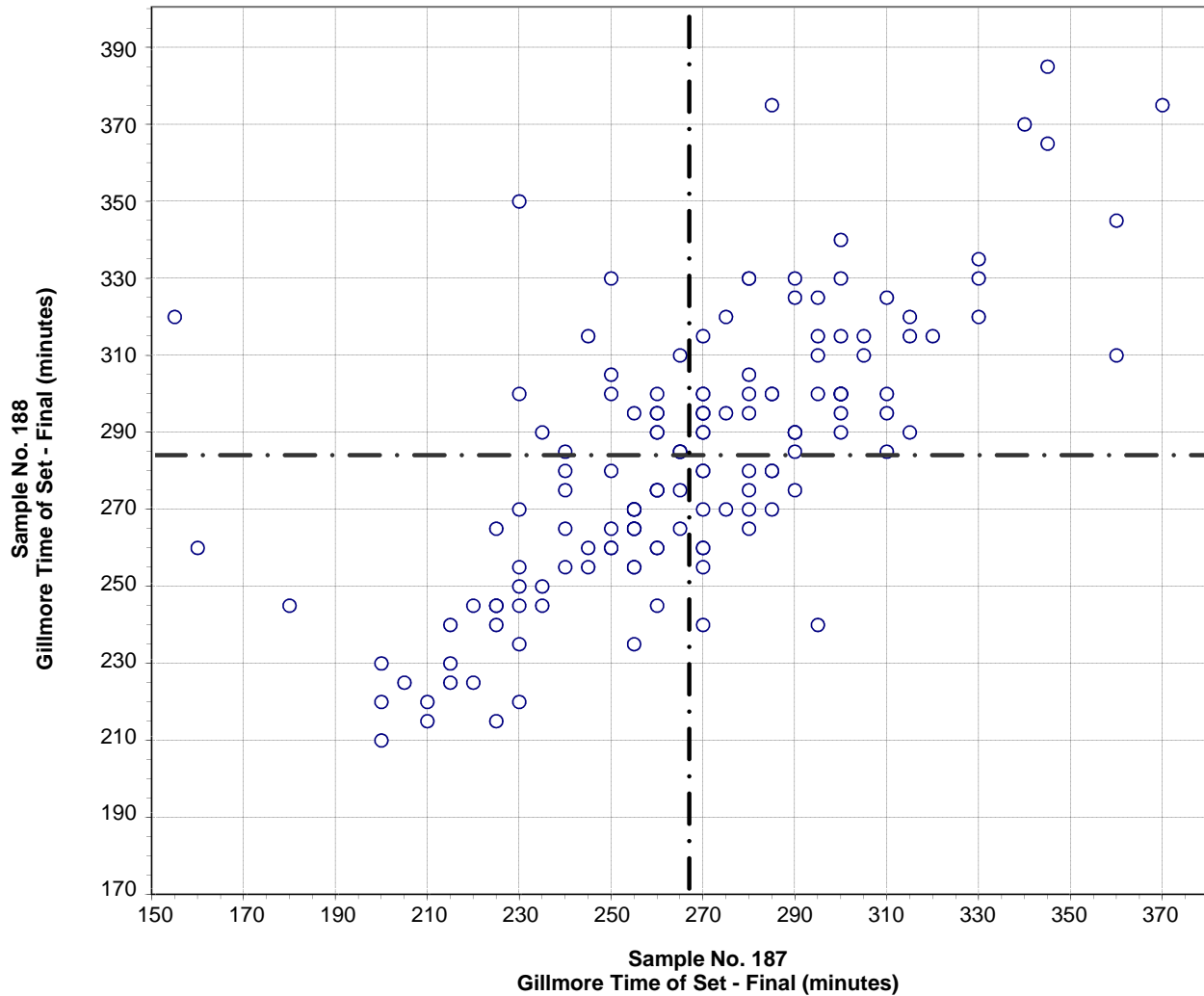
Test No. 130 Gillmore Time of Set - Initial 143 Points

Sample No. 187 Ave 164 S.D. 19 C.V. 12

Sample No. 188 Ave 176 S.D. 22 C.V. 12

Labs Eliminated: 23, 38, 40, 94, 116, 1956, 2490, 3245

**CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 187 and No. 188**



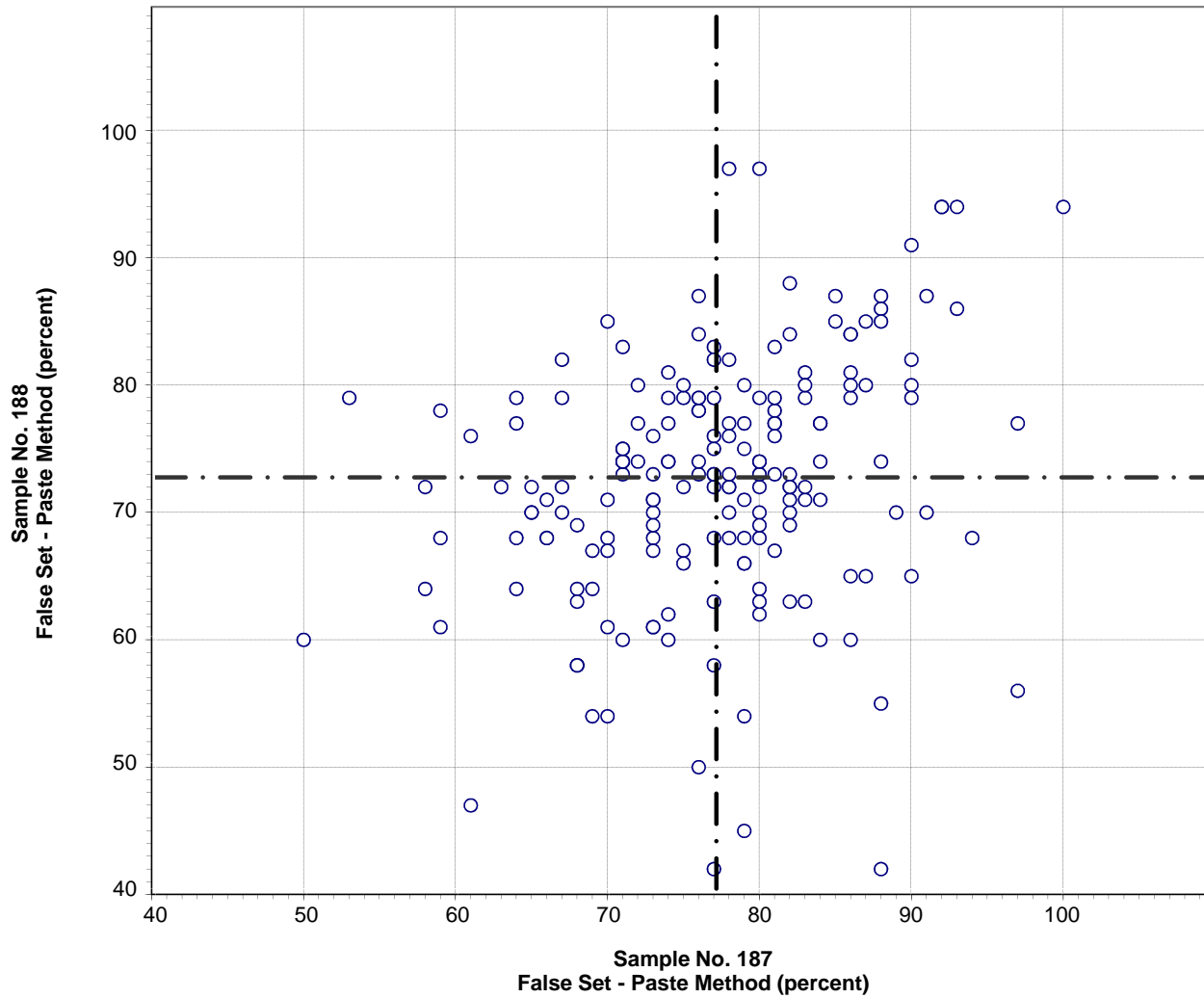
Test No. 140 Gillmore Time of Set - Final 146 Points

Sample No. 187 Ave 267 S.D. 37 C.V. 14

Sample No. 188 Ave 284 S.D. 35 C.V. 12

Labs Eliminated: 116, 176, 1956, 2296, 2490

**CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 187 and No. 188**

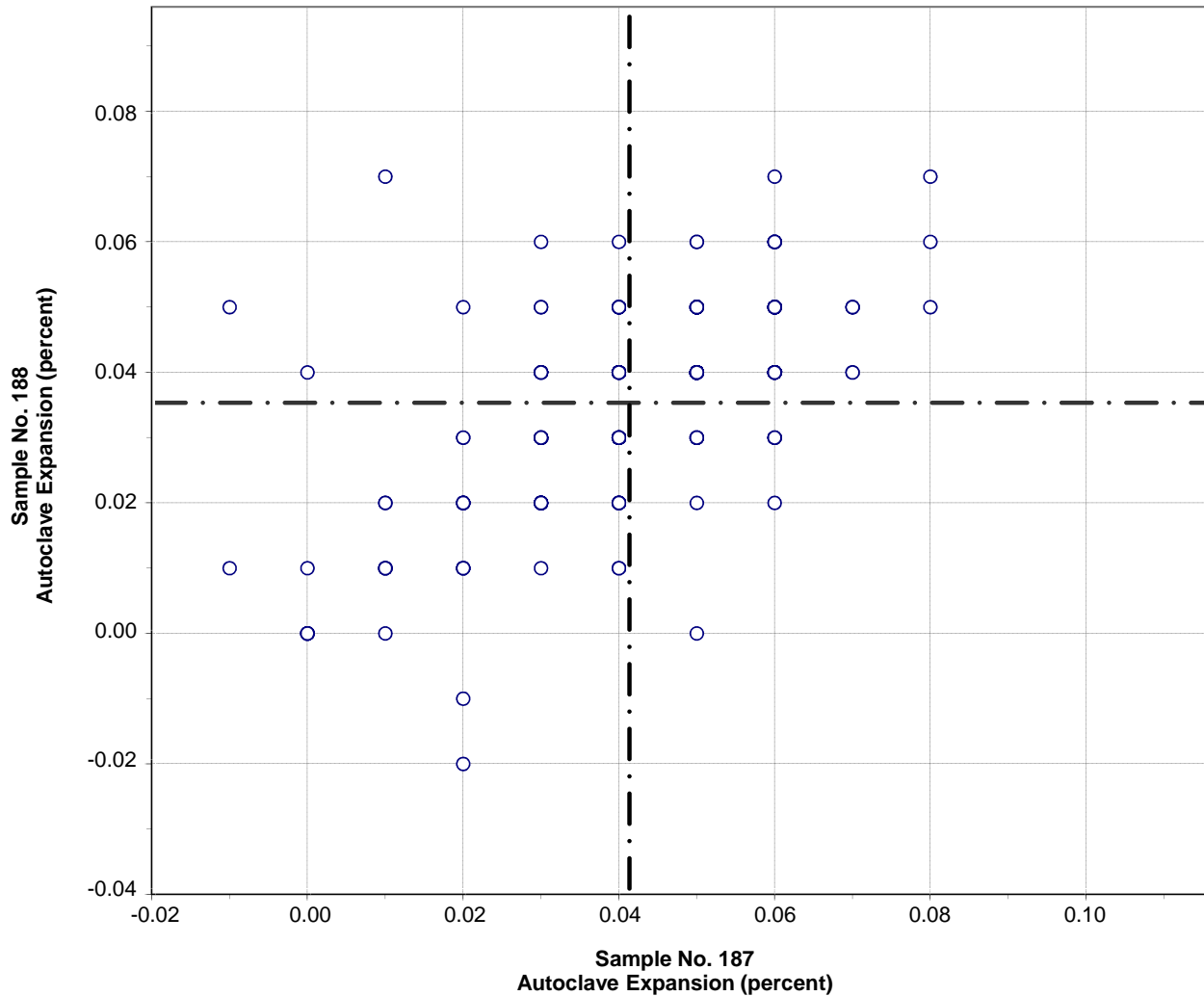


Test No. 150 False Set - Paste Method 186 Points

Sample No. 187	Ave 77	S.D. 8.6	C.V. 11
Sample No. 188	Ave 73	S.D. 9.8	C.V. 13

Labs Eliminated: 103, 2463

**CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 160 Autoclave Expansion 208 Points

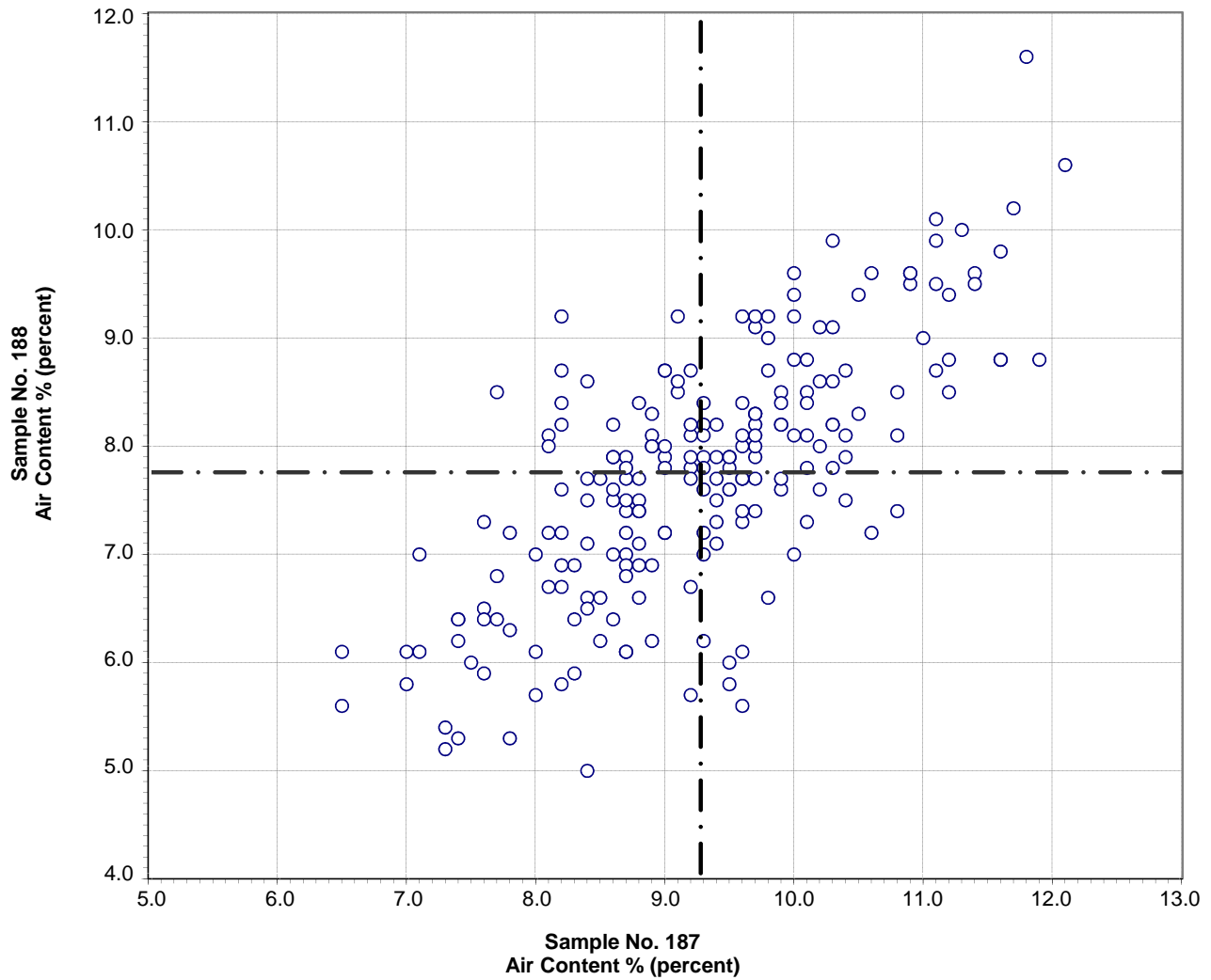
Sample No. 187 Ave 0.04 S.D. 0.019 C.V. 45

Sample No. 188 Ave 0.04 S.D. 0.016 C.V. 45

Labs Eliminated: 26, 95, 116, 360, 431, 605, 687, 1524, 2296, 2462, 2466, 2490, 3658, 3663

Labs off Diagram: 1435, 2464

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 187 and No. 188



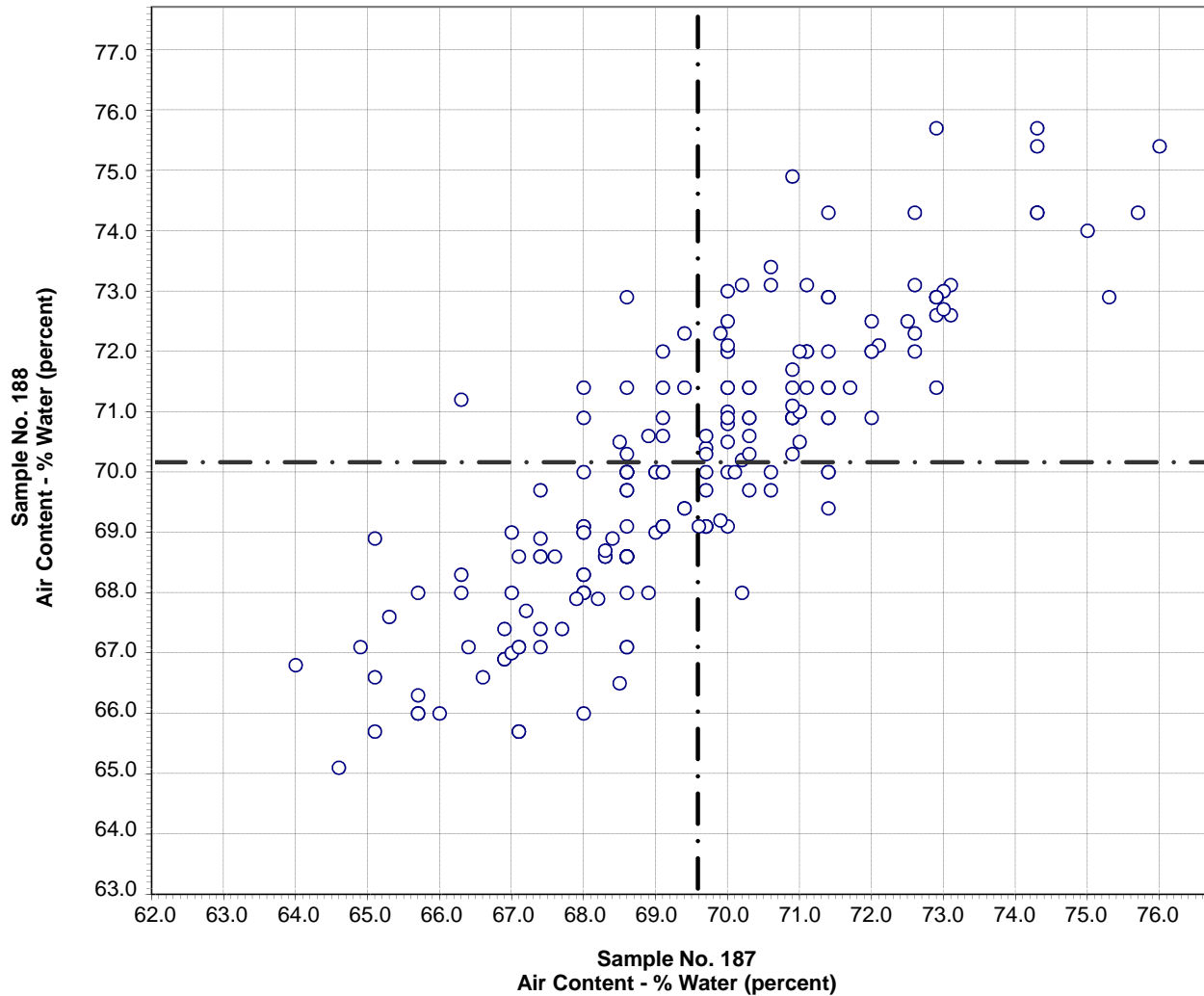
Test No. 170 Air Content % 209 Points

Sample No. 187 Ave 9.3 S.D. 1.1 C.V. 12

Sample No. 188 Ave 7.7 S.D. 1.2 C.V. 15

Labs Eliminated: 134, 1483, 1956, 2296, 2490, 3245

**CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 180 Air Content - % Water 199 Points

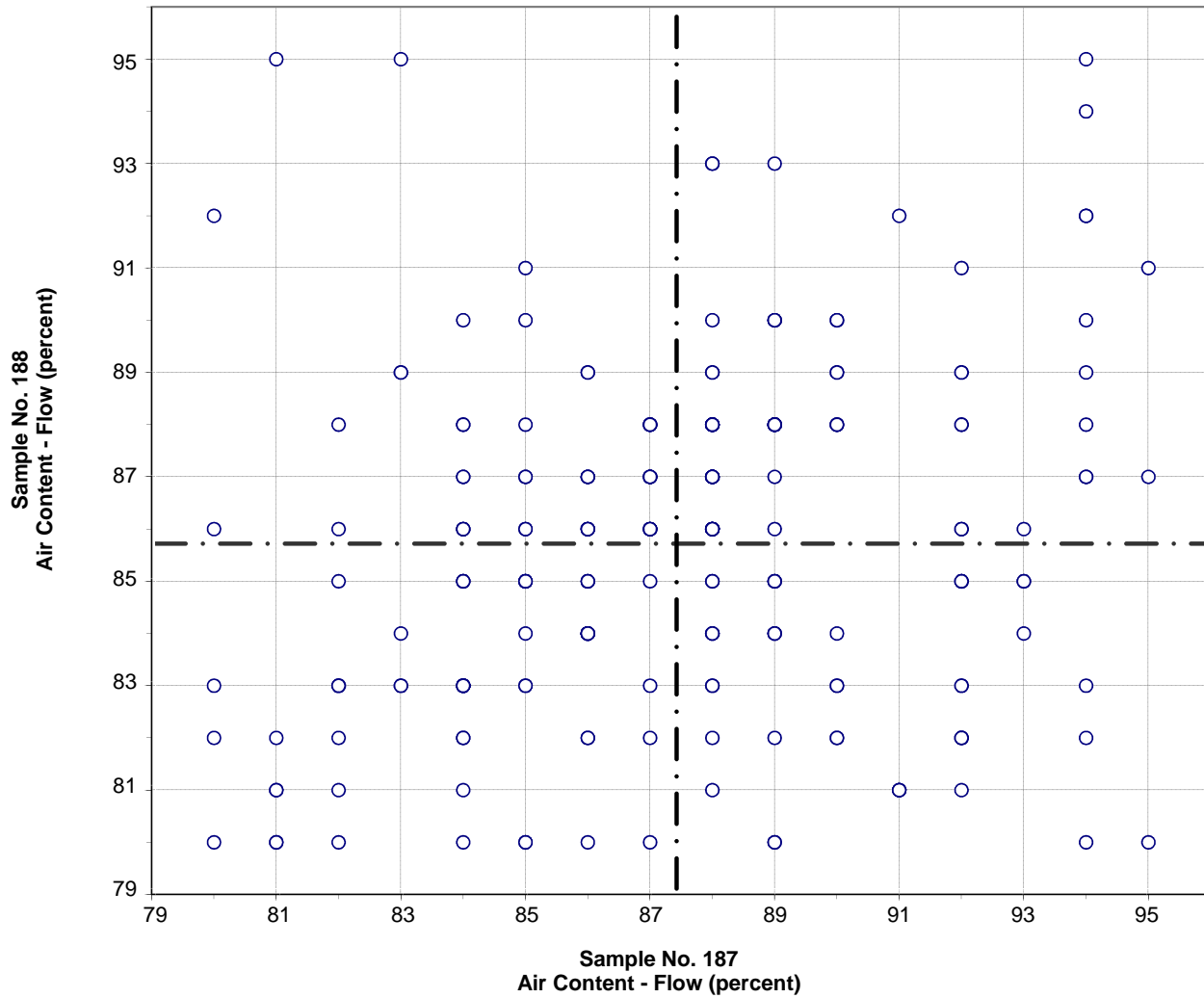
Sample No. 187 Ave 69.6 S.D. 2.3 C.V. 3.3

Sample No. 188 Ave 70.1 S.D. 2.2 C.V. 3.2

Labs Eliminated: 49, 124, 134, 222, 438, 565, 605, 2296, 2464, 2490

Labs off Diagram: 247

**CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 187 and No. 188**

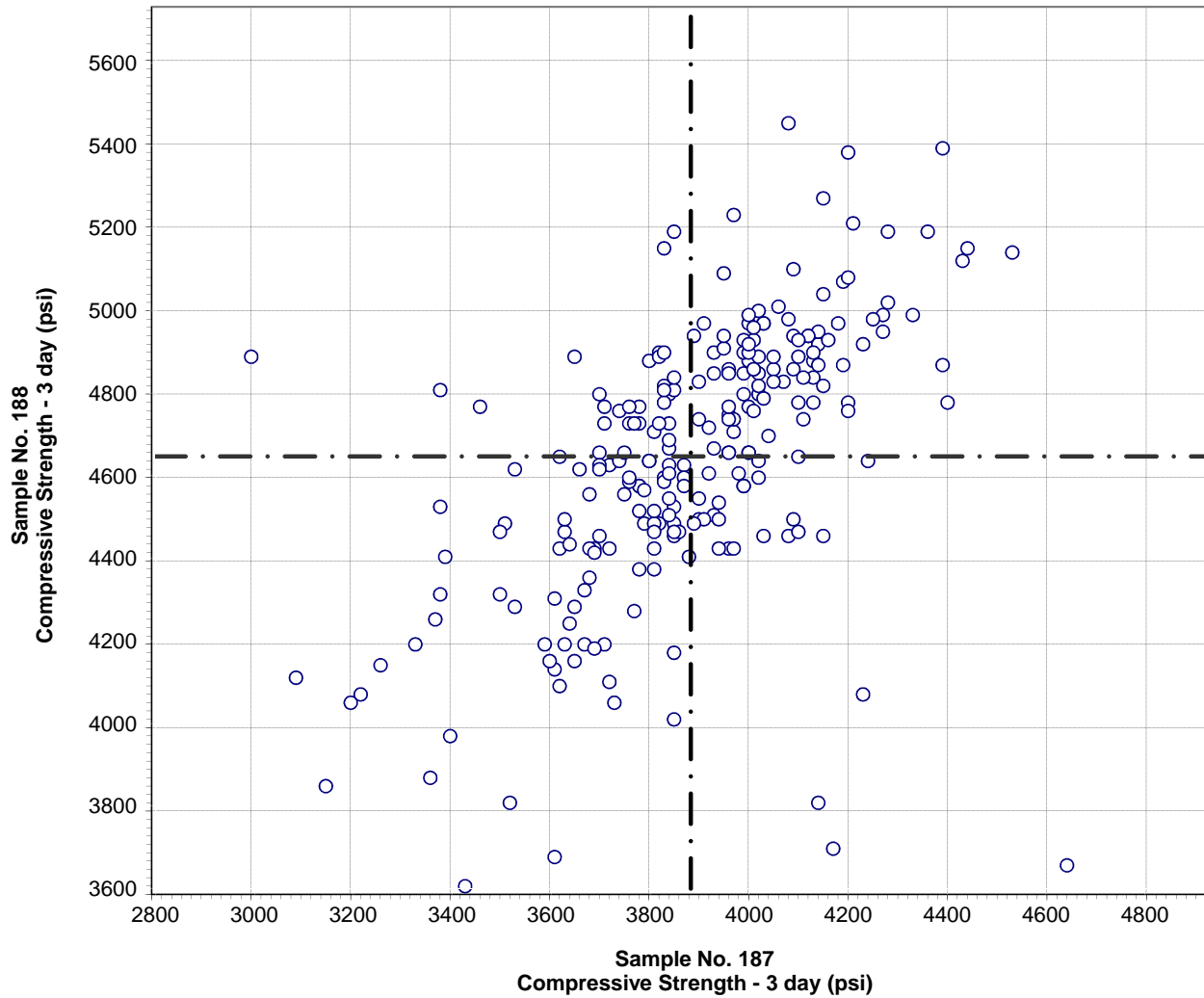


Test No. 190 Air Content - Flow 208 Points

Sample No. 187 Ave 87 S.D. 3.6 C.V. 4.1
 Sample No. 188 Ave 86 S.D. 3.3 C.V. 3.9

Labs Eliminated: 26, 438, 2490, 3144

**CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 200 Compressive Strength - 3 day 243 Points

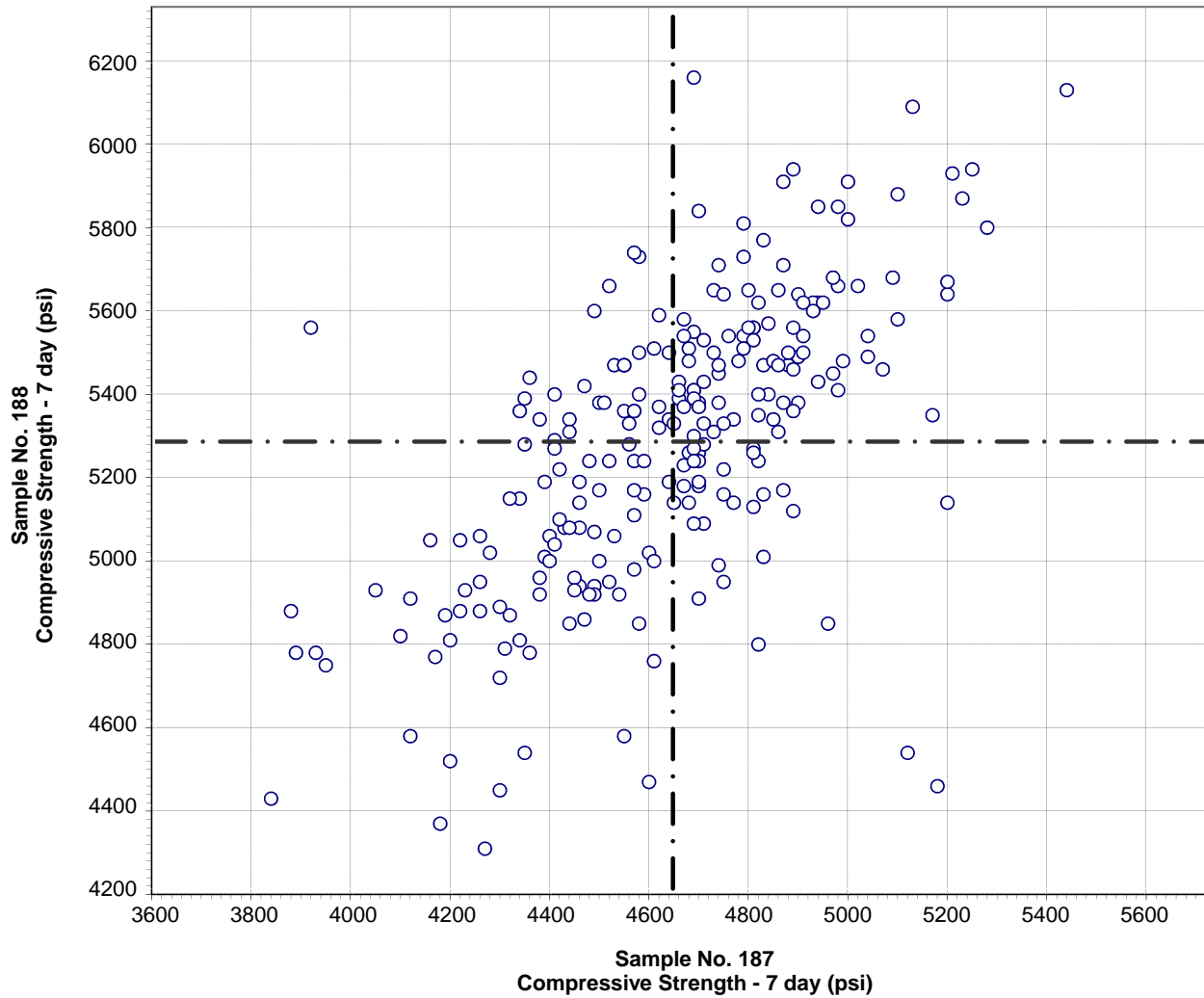
Sample No. 187 Ave 3882 S.D. 259 C.V. 6.7

Sample No. 188 Ave 4647 S.D. 329 C.V. 7.1

Labs Eliminated: 51, 52, 116, 1525, 1526, 3057

Labs off Diagram: 1435

**CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 187 and No. 188**

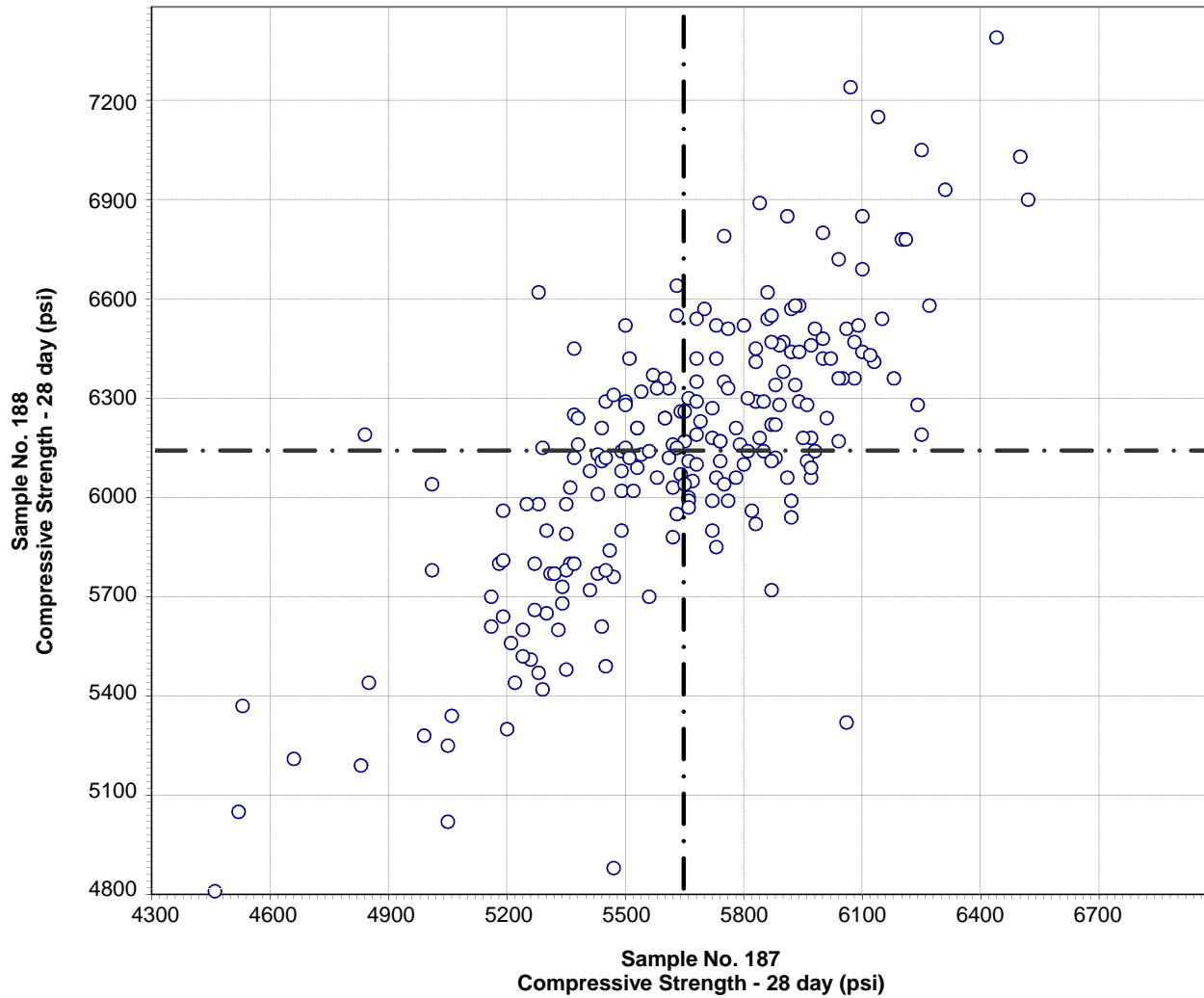


Test No. 210 Compressive Strength - 7 day 242 Points

Sample No. 187	Ave 4646	S.D. 282	C.V. 6.1
Sample No. 188	Ave 5283	S.D. 345	C.V. 6.5

Labs Eliminated: 52, 1525, 1526, 2463

**CCRL Proficiency Sample Program
Compressive Strength - 28 day
PORTLAND CEMENT Samples No. 187 and No. 188**

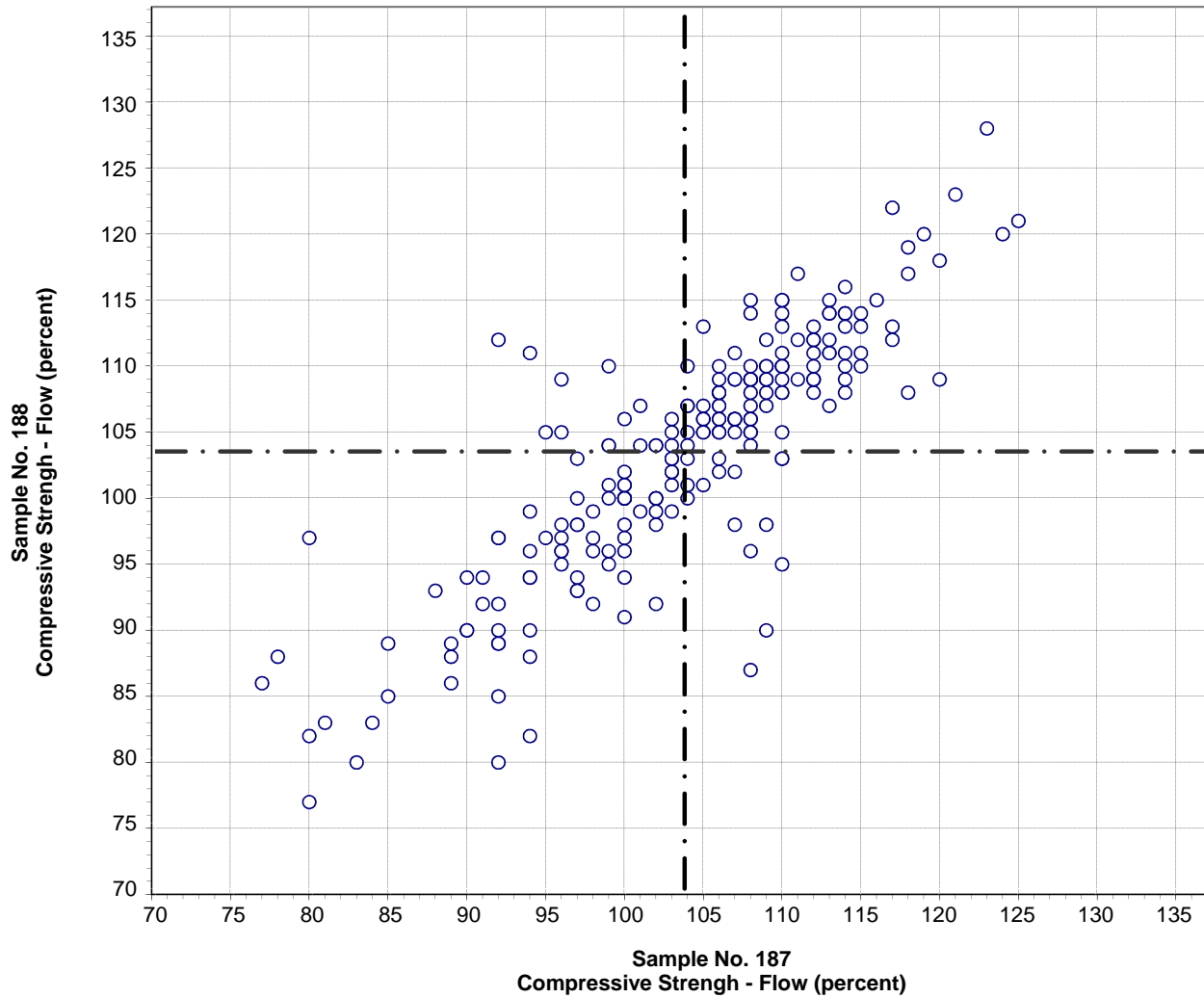


Test No. 211 Compressive Strength - 28 day 221 Points

Sample No. 187	Ave 5645	S.D. 353	C.V. 6.2
Sample No. 188	Ave 6137	S.D. 416	C.V. 6.8

Labs Eliminated: 40, 1525, 2080

**CCRL Proficiency Sample Program
Compressive Strength - Flow
PORTLAND CEMENT Samples No. 187 and No. 188**



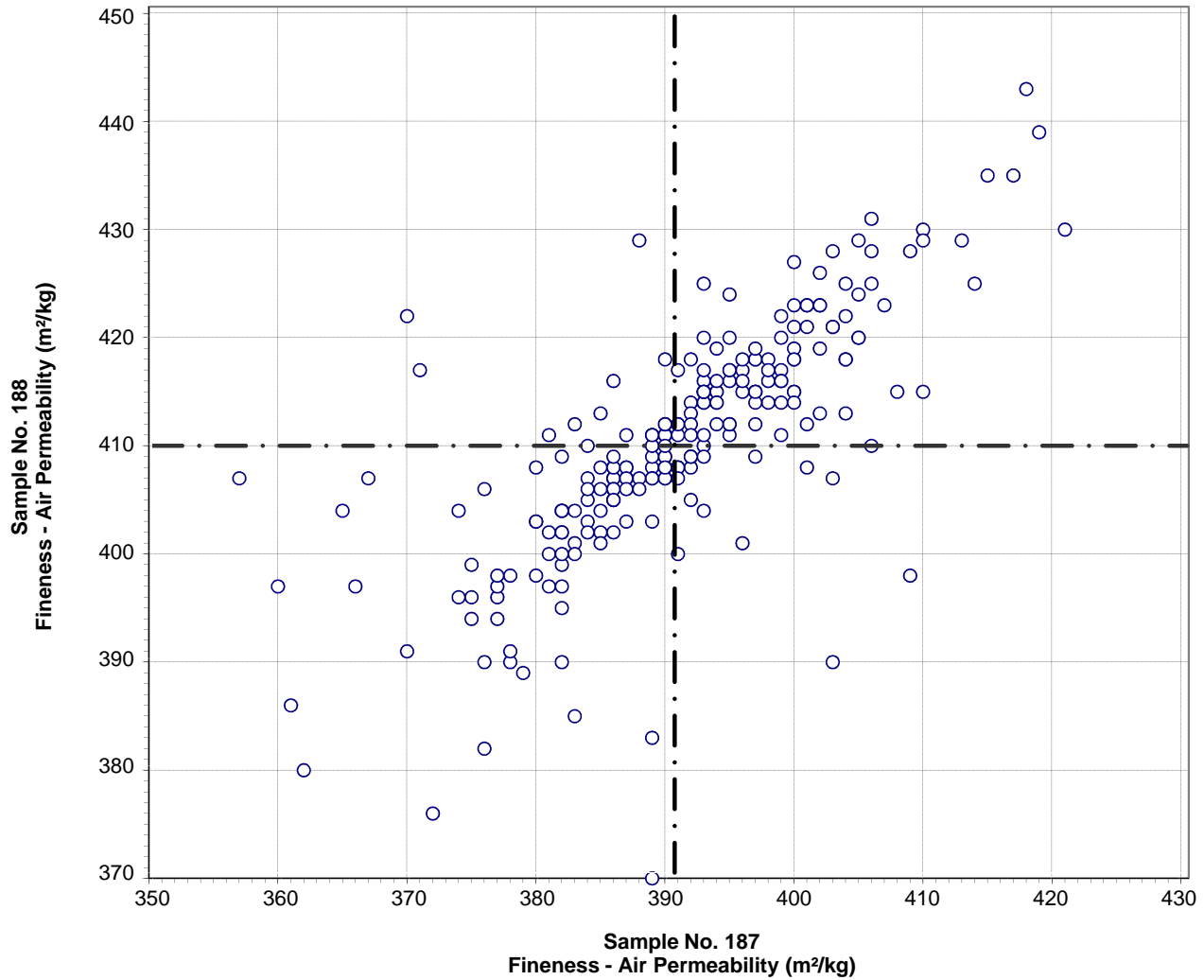
Test No. 230 Compressive Strength - Flow 222 Points

Sample No. 187 Ave 104 S.D. 9 C.V. 8.7

Sample No. 188 Ave 103 S.D. 9 C.V. 8.8

Labs Eliminated: 9, 1466

CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 187 and No. 188



Test No. 270 Fineness - Air Permeability 234 Points

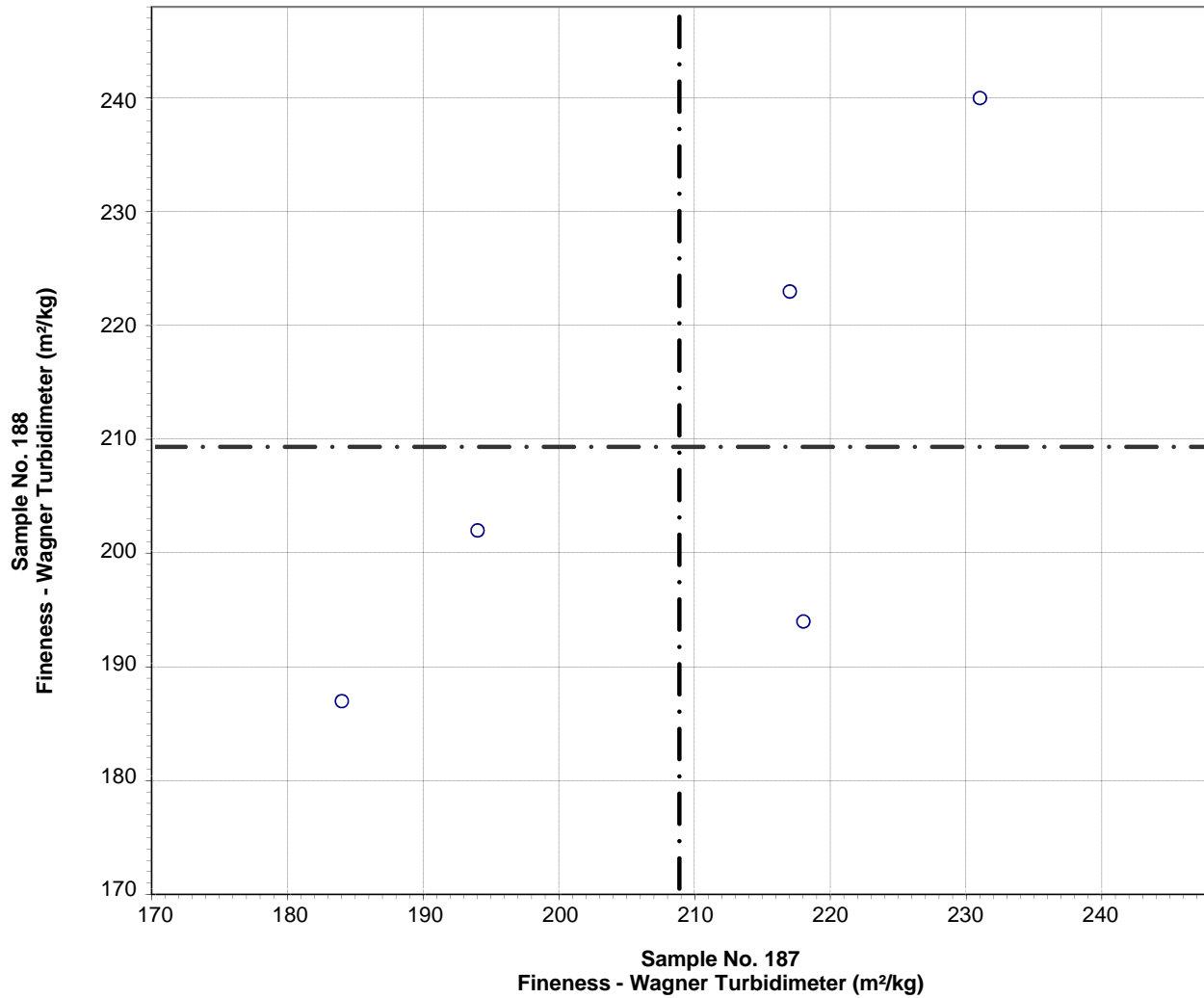
Sample No. 187 Ave 391 S.D. 11 C.V. 2.9

Sample No. 188 Ave 410 S.D. 12 C.V. 2.9

Labs Eliminated: 34, 605, 886, 1525, 1594, 2296, 3297, 3819

Labs off Diagram: 47, 103, 2491

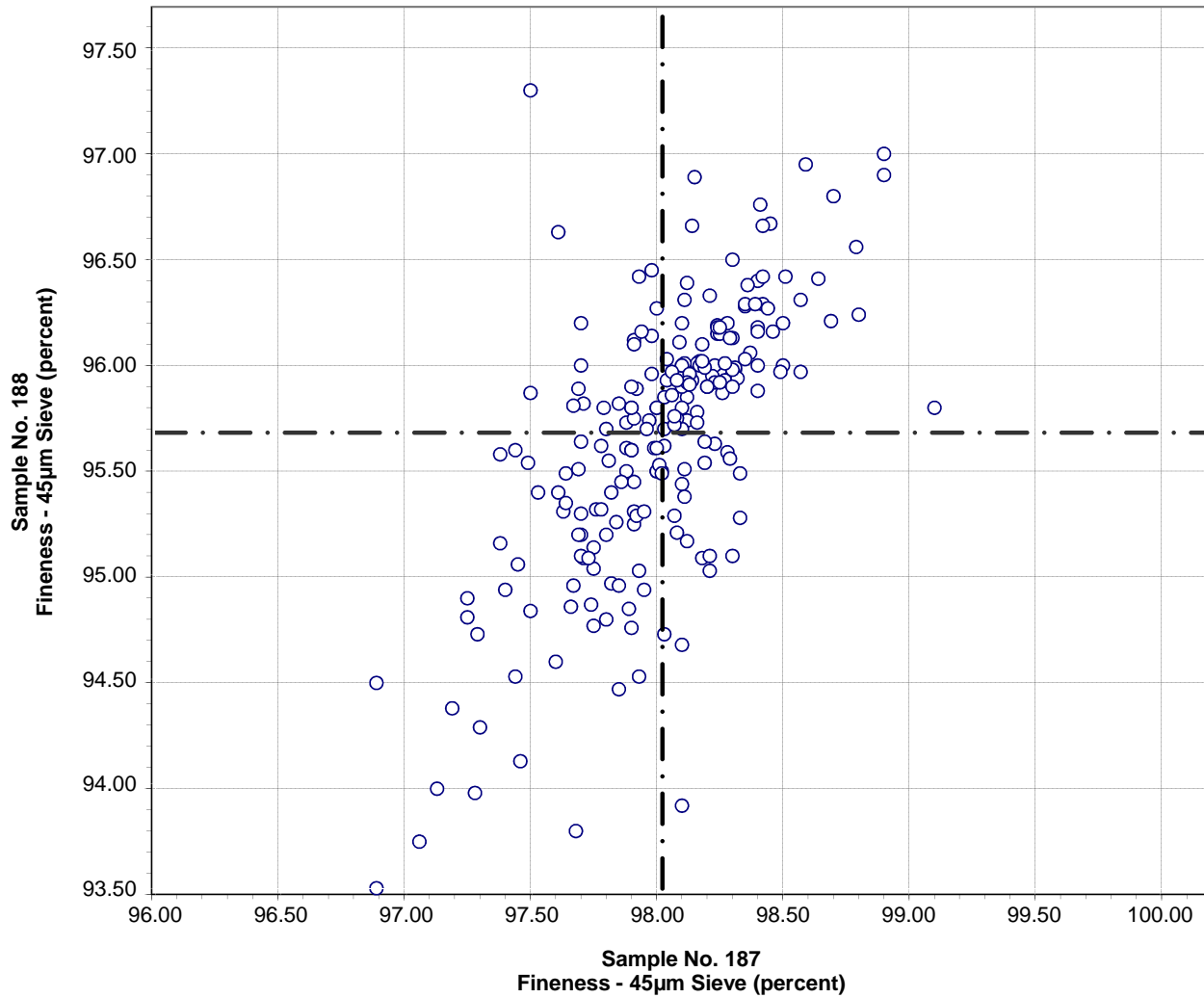
CCRL Proficiency Sample Program
Fineness - Wagner Turbidimeter
PORTLAND CEMENT Samples No. 187 and No. 188



Test No. 280 Fineness - Wagner Turbidimeter 5 Points

Sample No. 187	Ave 209	S.D. 19	C.V. 9.2
Sample No. 188	Ave 209	S.D. 22	C.V. 10.5

**CCRL Proficiency Sample Program
Fineness - 45µm Sieve
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 281 Fineness - 45µm Sieve 217 Points

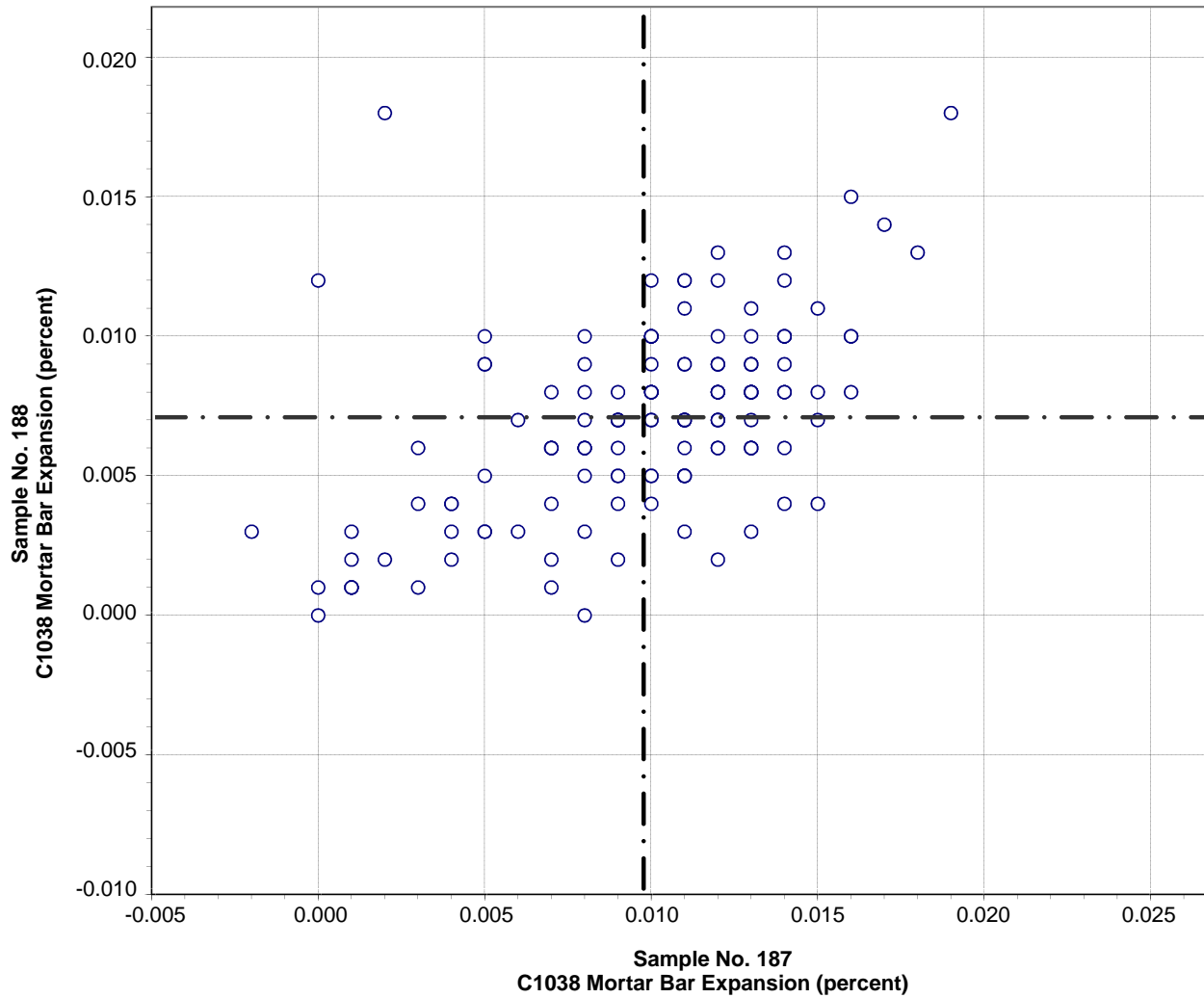
Sample No. 187 Ave 98.02 S.D. 0.36 C.V. 0.37

Sample No. 188 Ave 95.68 S.D. 0.65 C.V. 0.68

Labs Eliminated: 23, 29, 47, 49, 51, 95, 222, 413, 515, 684, 840, 1799, 2412, 3511

Labs off Diagram: 66

CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 187 and No. 188



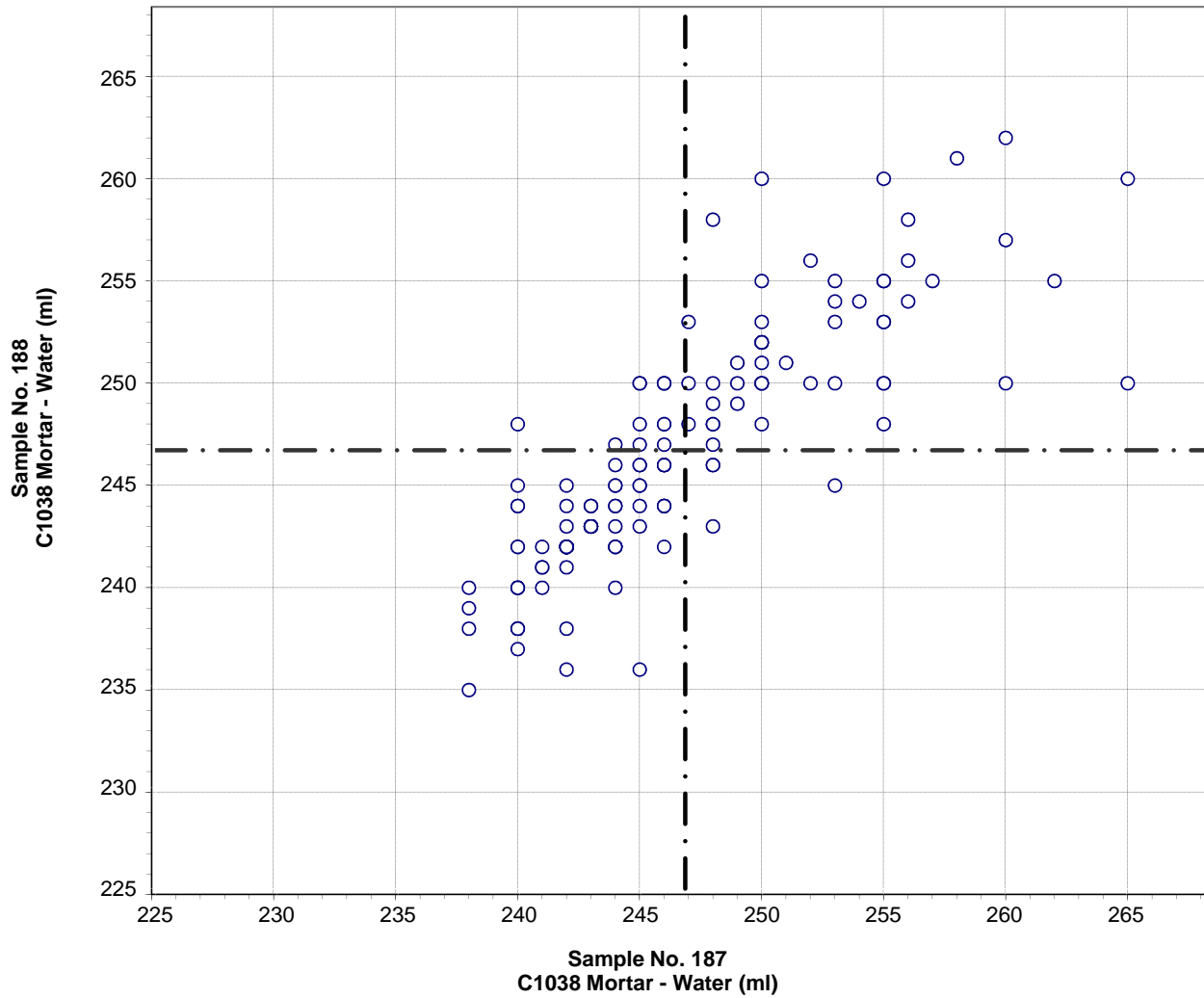
Test No. 400 C1038 Mortar Bar Expansion 136 Points

Sample No. 187 Ave 0.010 S.D. 0.004 C.V. 43

Sample No. 188 Ave 0.007 S.D. 0.003 C.V. 49

Labs Eliminated: 84, 441, 493, 494, 565, 1054, 1956, 2462, 2463, 2490, 3607, 3752

**CCRL Proficiency Sample Program
C1038 Mortar - Water
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 401 C1038 Mortar - Water 137 Points

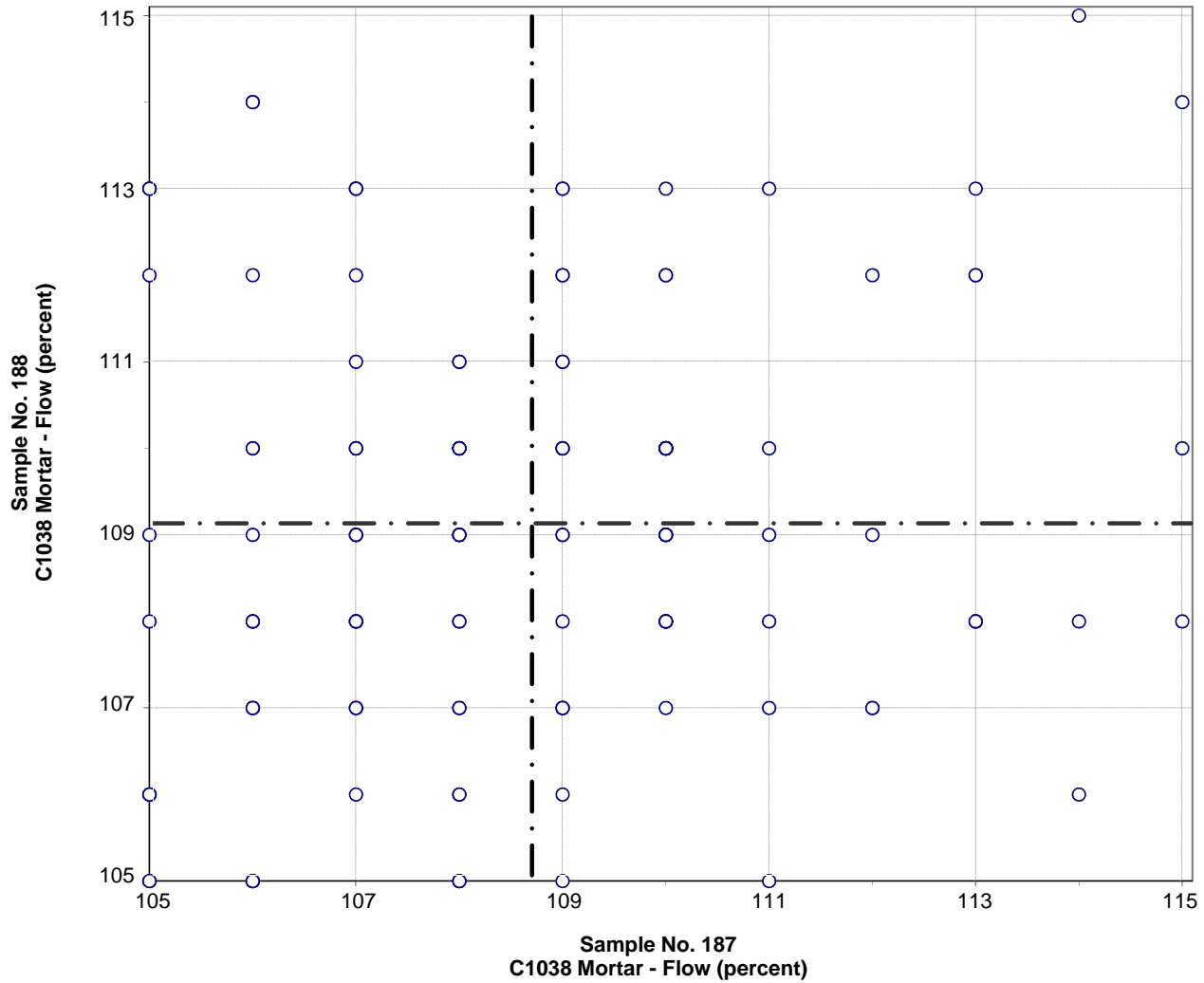
Sample No. 187 Ave 247 S.D. 6 C.V. 2.5

Sample No. 188 Ave 247 S.D. 6 C.V. 2.3

Labs Eliminated: 84, 151, 184, 207, 440, 1956, 2412, 2490

Labs off Diagram: 690

**CCRL Proficiency Sample Program
C1038 Mortar - Flow
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 402 C1038 Mortar - Flow 134 Points

Sample No. 187 Ave 109 S.D. 2 C.V. 2.2

Sample No. 188 Ave 109 S.D. 2 C.V. 2.2

Labs Eliminated: 6, 46, 75, 151, 667, 690, 691, 996, 1251, 1956, 2490, 3663

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Heat of Hydration Results
 March 19, 2013

SUMMARY OF RESULTS

Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C186 Heat of Solution - Dry (cal/g)							
	22	584.0	7.1	1.2	585.0	5.9	1.0
	*20	584.0	7.1	1.2	585.0	5.9	1.0
* Labs Eliminated - 1956, 2490							
C186 Heat of Solution - 7 day (cal/g)							
	22	503.9	5.7	1.1	500.6	7.6	1.5
	*19	503.0	4.0	0.8	499.5	6.1	1.2
* Labs Eliminated - 1956, 2490, 3250							
C186 Heat of Solution 28 day (cal/g)							
	18	496.8	6.5	1.3	493.0	7.6	1.5
	*16	496.8	6.5	1.3	493.0	7.6	1.5
* Labs Eliminated - 1956, 2490							
C186 Heat of Hydration - 7 day (cal/g)							
	23	79.9	7.5	9.3	84.6	6.8	8.1
	*21	79.9	7.5	9.3	84.6	6.8	8.1
* Labs Eliminated - 1956, 2490							
C186 Heat of Hydration - 28 day (cal/g)							
	19	87.0	4.2	4.8	92.4	7.0	7.6
	*17	87.0	4.2	4.8	92.4	7.0	7.6
* Labs Eliminated - 1956, 2490							
C1702 Heat of Hydration - 3 day (J/g)							
	8	320	11	3.5	350	11	3.0
	*6	320	11	3.5	350	11	3.0
* Labs Eliminated - 1956, 2490							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 187 and No. 188

Final Report – Heat of Hydration Results
 March 19, 2013

SUMMARY OF RESULTS

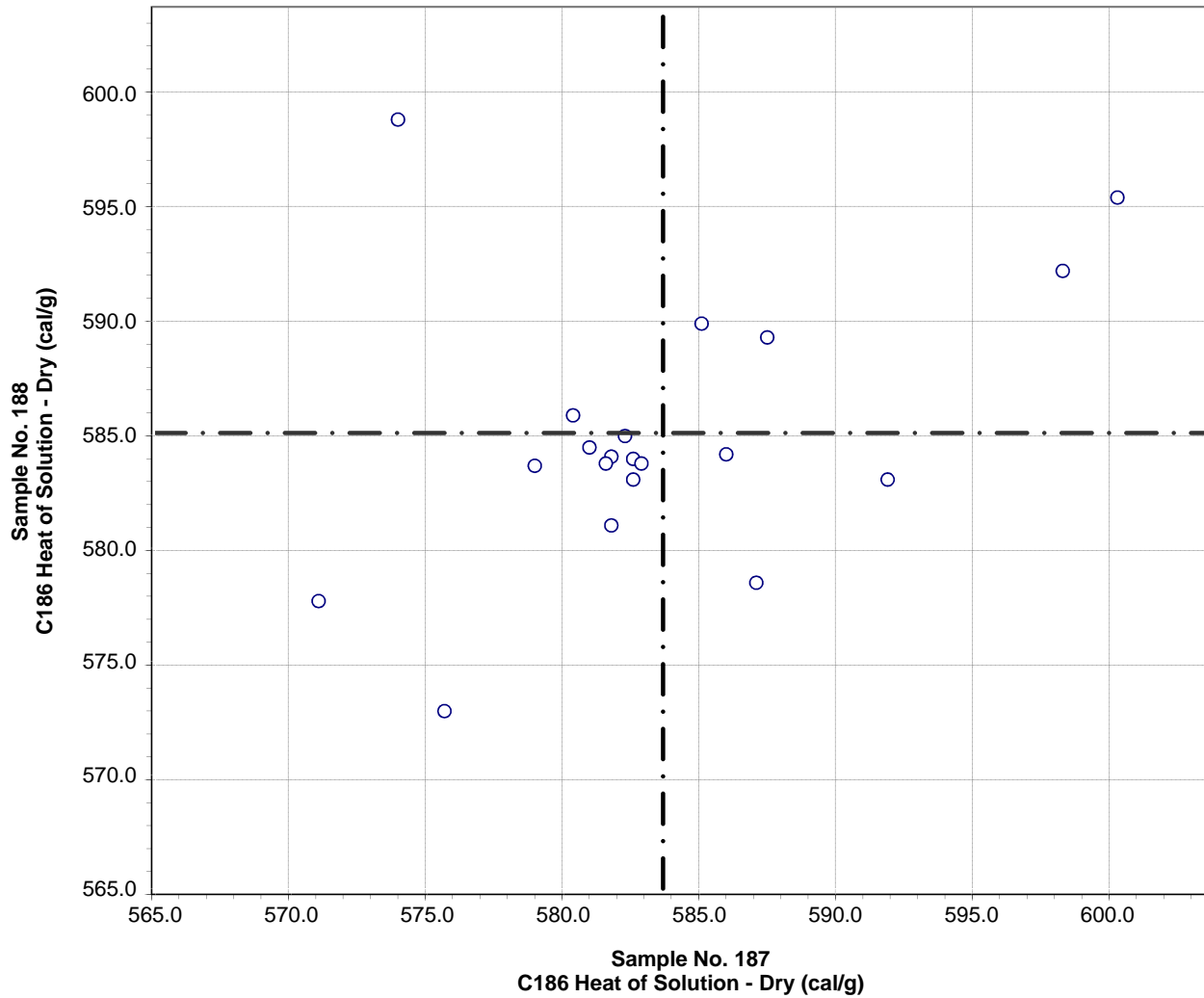
Sample No.187

Sample No. 188

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C1702 Heat of Hydration - 7 day (J/g)							
	8	362	13	3.6	393	15	3.9
	*6	362	13	3.6	393	15	3.9

* Labs Eliminated - 1956, 24

**CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 187 and No. 188**

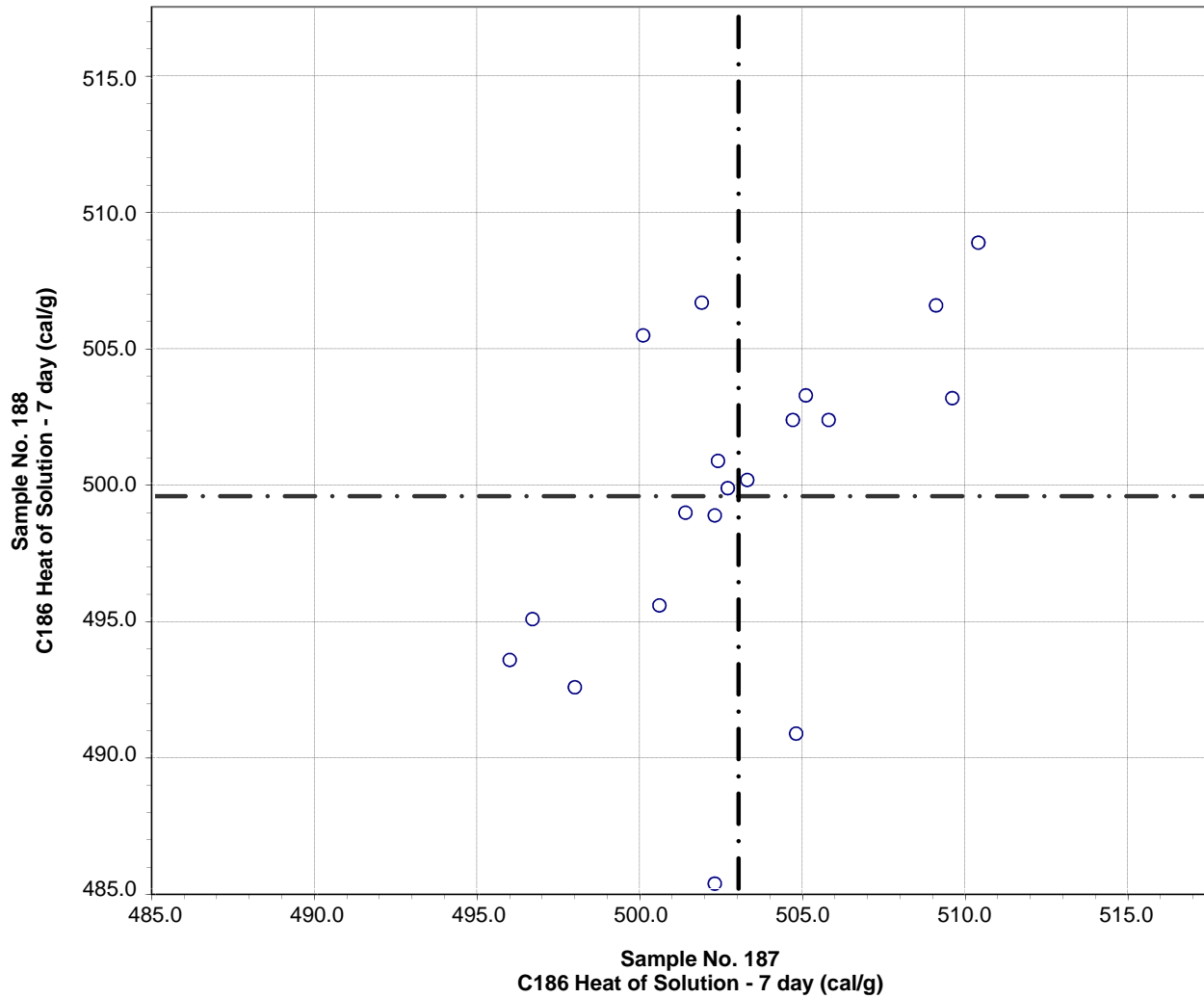


Test No. 291 C186 Heat of Solution - Dry 20 Points

Sample No. 187	Ave 584.0	S.D. 7.1	C.V. 1.2
Sample No. 188	Ave 585.0	S.D. 5.9	C.V. 1.0

Labs Eliminated: 1956, 2490

**CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 187 and No. 188**



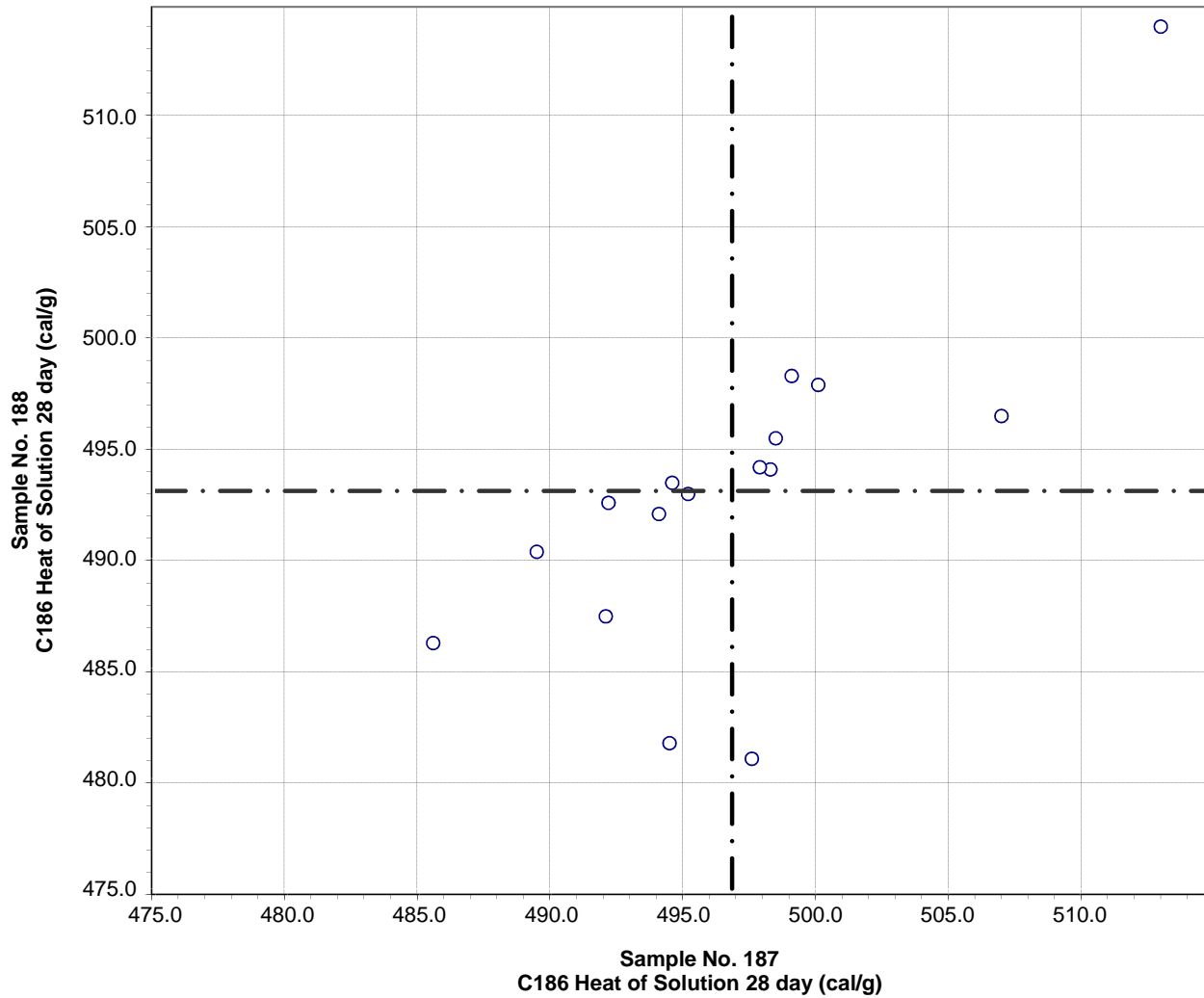
Test No. 292 C186 Heat of Solution - 7 day 19 Points

Sample No. 187 Ave 503.0 S.D. 4.0 C.V. 0.8

Sample No. 188 Ave 499.5 S.D. 6.1 C.V. 1.2

Labs Eliminated: 1956, 2490, 3250

**CCRL Proficiency Sample Program
C186 Heat of Solution 28 day
PORTLAND CEMENT Samples No. 187 and No. 188**



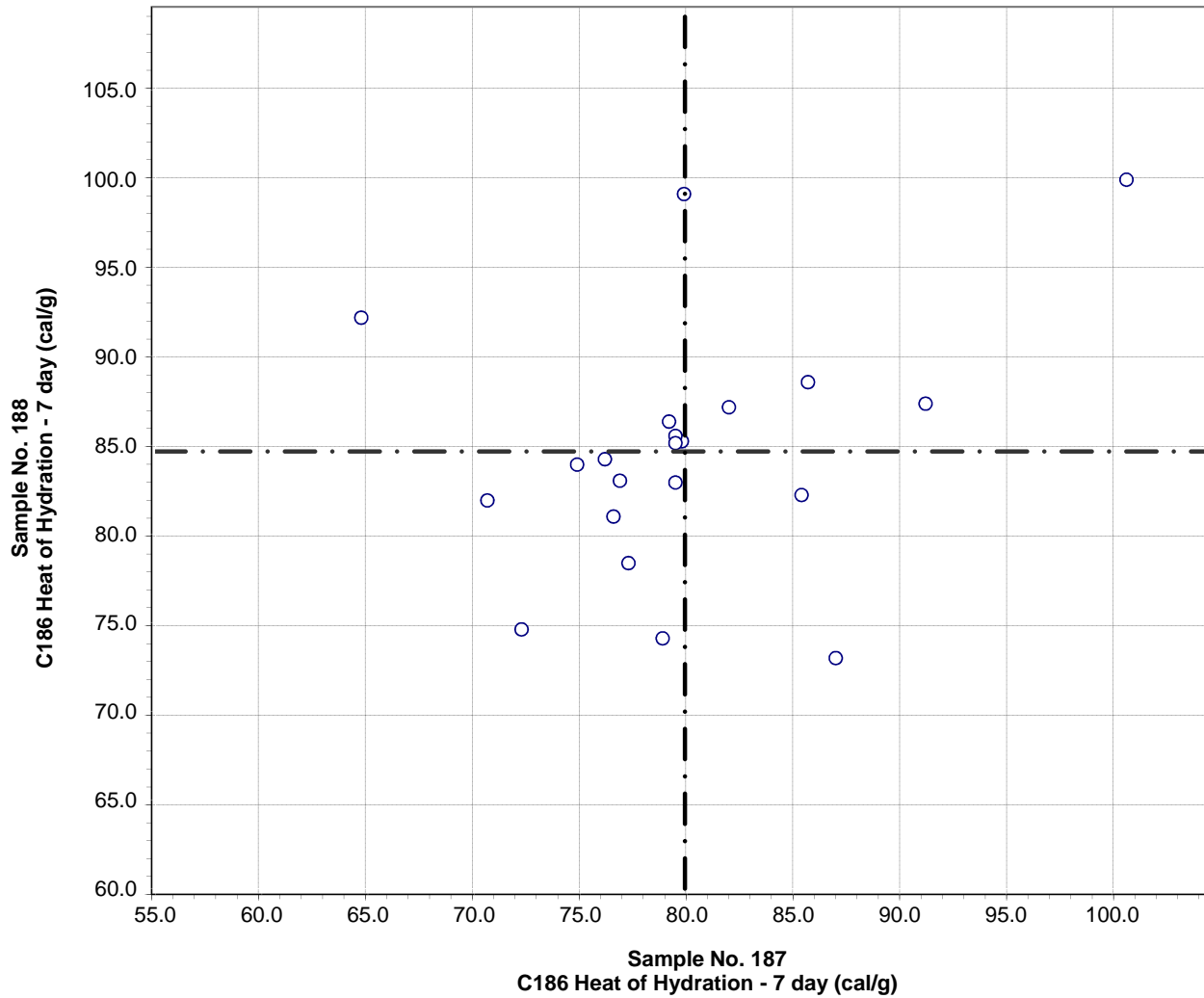
Test No. 301 C186 Heat of Solution 28 day 16 Points

Sample No. 187 Ave 496.8 S.D. 6.5 C.V. 1.3

Sample No. 188 Ave 493.0 S.D. 7.6 C.V. 1.5

Labs Eliminated: 1956, 2490

**CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 187 and No. 188**



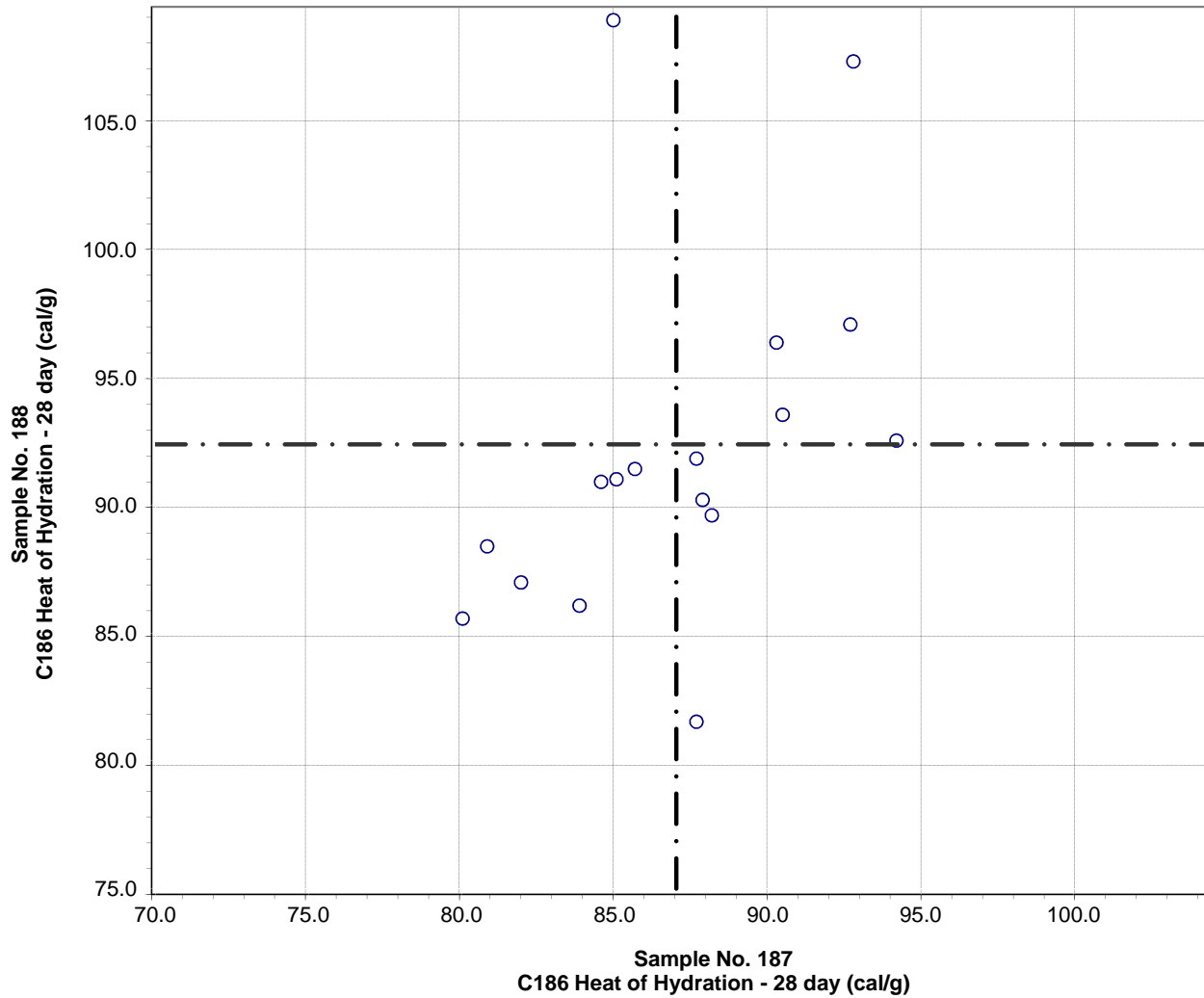
Test No. 290 C186 Heat of Hydration - 7 day 21 Points

Sample No. 187 Ave 79.9 S.D. 7.5 C.V. 9.3

Sample No. 188 Ave 84.6 S.D. 6.8 C.V. 8.1

Labs Eliminated: 1956, 2490

**CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 187 and No. 188**



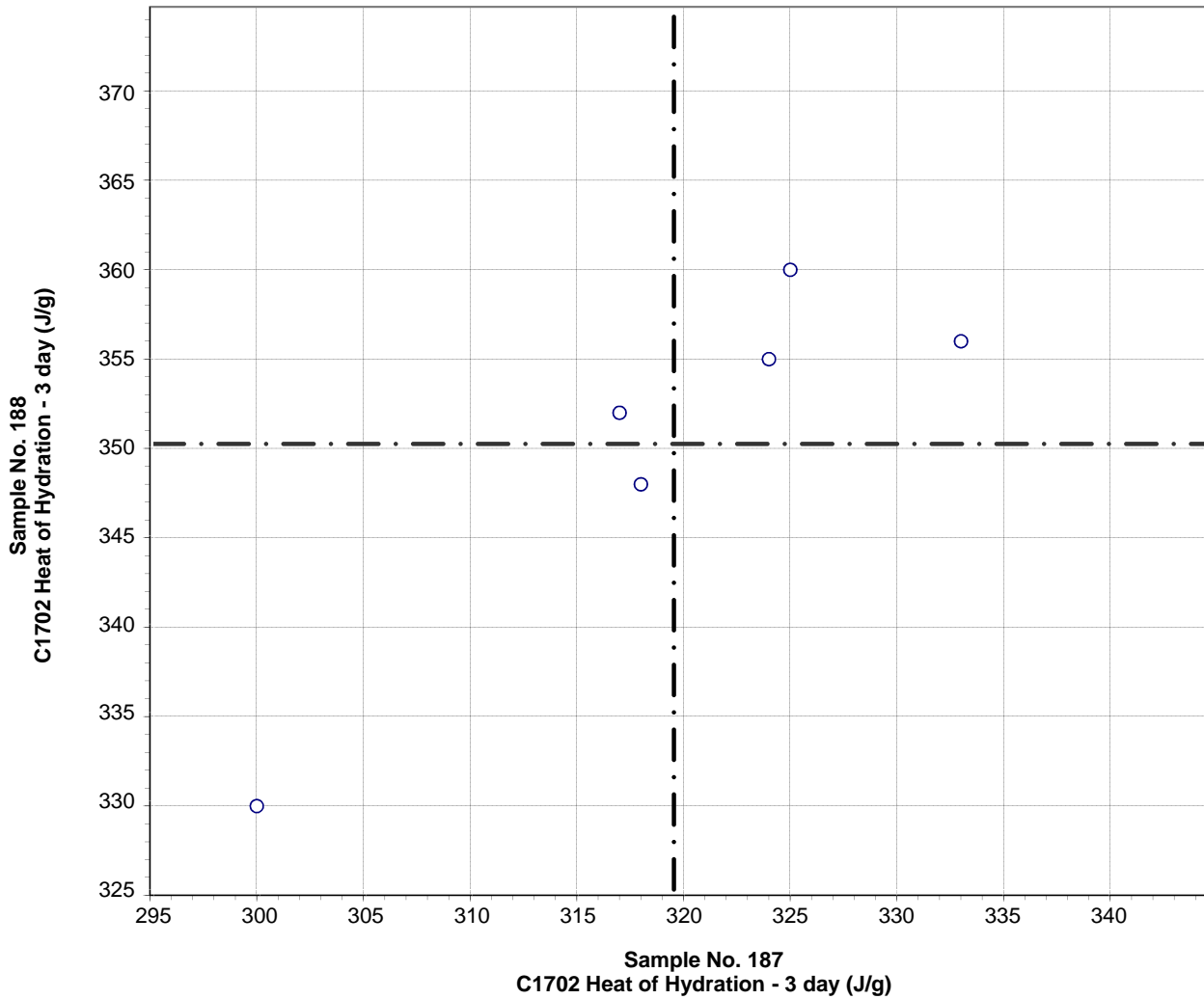
Test No. 300 C186 Heat of Hydration - 28 day 17 Points

Sample No. 187 Ave 87.0 S.D. 4.2 C.V. 4.8

Sample No. 188 Ave 92.4 S.D. 7.0 C.V. 7.6

Labs Eliminated: 1956, 2490

**CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 187 and No. 188**

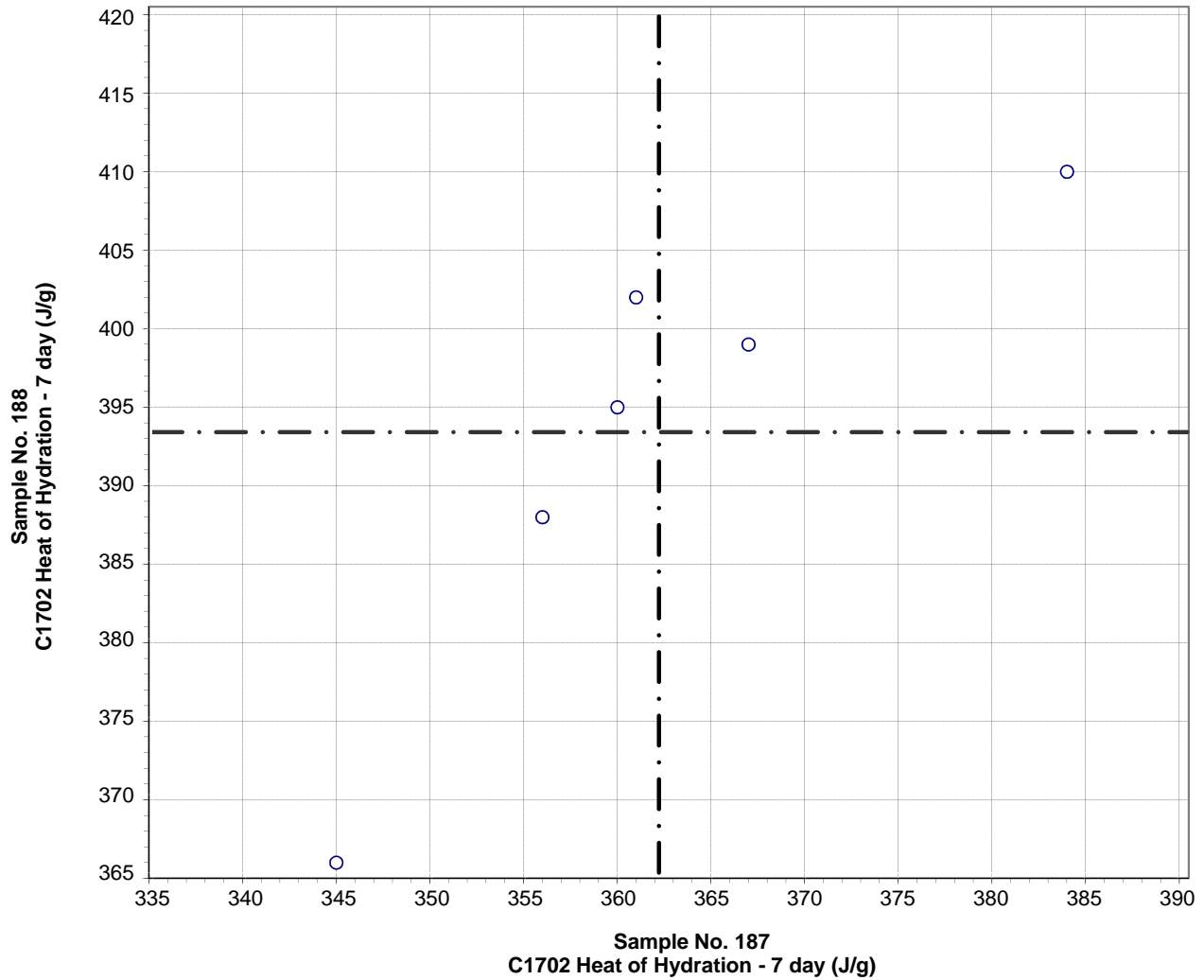


Test No. 500 C1702 Heat of Hydration - 3 day 6 Points

Sample No. 187 Ave 320 S.D. 11 C.V. 3.5
 Sample No. 188 Ave 350 S.D. 11 C.V. 3.0

Labs Eliminated: 1956, 2490

**CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 187 and No. 188**



Test No. 510 C1702 Heat of Hydration - 7 day 6 Points

Sample No. 187 Ave 362 S.D. 13 C.V. 3.6
 Sample No. 188 Ave 393 S.D. 15 C.V. 3.9

Labs Eliminated: 1956, 2490