CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 175 and Number 176

March 2010

CCRL CEMENT AND CONCRETE REFERENCE LABORATORY

March 24, 2010

TO: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 175 and No. 176

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in January 2010. Portland Cement Sample No. 175 was an ASTM C150 Type III without limestone additions and No. 176 was an ASTM C150 Type III without limestone additions. Some of the properties of Sample No.175 were unusual. This cement was received directly from the manufacturer and the properties were not altered by CCRL.

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

Compressive Strength: These cements were C150 Type III cements, therefore compressive strength specimens were tested at the ages of 1, 3, and 7 day rather than 3, 7, and 28 day.

C1702 Heat of Hydration by Isothermal Conduction Calorimetry: No laboratory ratings were assigned for this test method. Ratings might be assigned for future samples.

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 July 2010.

Sincerely,

Robin K. Haupt

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. 175 and No. 176

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 2010. 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

[1]Youden, 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.*

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. 175 and No. 176
Final Report - Chemical Results
March 26, 2010

SUMMARY OF RESULTS

			Sample No. 175			Sample No. 176		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide	%	240	17.70	0.43	2.4	19.00	0.91	4.8
Silicon Dioxide	%	* 234	17.68	0.33	1.9	19.05	0.22	1.2
Aluminum Oxide	%	237	5.30	0.20	3.7	5.71	0.14	2.5
Aluminum Oxide	%	* 227	5.29	0.15	2.8	5.71	0.10	1.8
Ferric Oxide	%	239	2.39	0.07	3.0	2.71	0.09	3.2
Ferric Oxide	%	* 231	2.39	0.06	2.4	2.70	0.05	1.7
Calcium Oxide	%	237	61.37	1.06	1.7	61.93	0.57	0.9
Calcium Oxide	%	* 227	61.31	0.94	1.5	61.92	0.37	0.6
Magnesium Oxide	%	238	3.75	0.15	4.0	2.49	0.15	6.0
Magnesium Oxide	%	* 227	3.74	0.13	3.4	2.48	0.06	2.5
Sulfur Trioxide	%	245	2.89	0.18	6.1	4.38	0.31	7.1
Sulfur Trioxide	%	* 232	2.88	0.09	3.1	4.35	0.11	2.5
Loss on Ignition	%	243	5.73	0.55	9.5	1.67	0.22	13.0
Loss on Ignition	%	* 227	5.80	0.09	1.5	1.70	0.09	5.4
Sodium Oxide	%	225	0.322	0.060	18.7	0.308	0.059	19.1
Sodium Oxide	%	* 210	0.329	0.026	7.9	0.315	0.029	9.1

* ELIMINATED LABS: Data over three S.D. from the mean

Silicon Dioxide 51 93 207 696 2477 3454

Aluminum Oxide 48 125 206 416 457 696 768 975 3422 3454

Ferric Oxide 10 110 206 407 768 2464 2621 3454

Calcium Oxide 20 50 2621 3422 502 696 1054 1715 3233 3457

Magnesium Oxide 25 2464 3422 53 502 690 768 1956 2466 3428 3454

Sulfur trioxide 51 53 110 736 501 504 1715 2305 2464 2476 2490 3279 3422

Loss on Ignition 36 53 1644 2763 3415 3422 206 684 1940 2435 2437 2464 2466 2621 3127 3457

Sodium Oxide 98 110 2463 2464 2466 2621 3057 4 53 222 494 1251 1799 1956 3422

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 175 and No. 176
Final Report - Chemical Results
March 26, 2010

SUMMARY OF RESULTS

			Sample No. 175			Sample No. 176		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Potassium Oxide	%	230	0.805	0.053	6.6	1.008	0.069	6.9
Potassium Oxide	%	* 221	0.807	0.024	3.0	1.011	0.025	2.4
Titan Dioxide	%	185	0.30	0.039	12.7	0.25	0.032	12.8
Titan Dioxide	%	* 166	0.31	0.010	3.3	0.25	0.007	2.8
Phosphorus Pent	%	183	0.224	0.029	13.2	0.252	0.032	12.6
Phosphorus Pent	%	* 168	0.227	0.009	4.2	0.255	0.010	3.9
Zinc Oxide	%	82	0.011	0.007	58.5	0.074	0.010	13.6
Zinc Oxide	%	* 72	0.010	0.001	14.7	0.074	0.003	3.6
Manganic Oxide	%	142	0.092	0.015	16.3	0.079	0.009	11.8
Manganic Oxide	%	* 132	0.093	0.006	5.9	0.080	0.004	4.8
Chloride	%	115	0.026	0.019	73.8	0.017	0.019	114.8
Chloride	%	* 109	0.024	0.010	41.7	0.014	0.006	44.3
Insoluble Residue	%	222	0.42	0.38	91.5	0.24	0.20	83.3
Insoluble Residue	%	* 210	0.38	0.09	25.1	0.21	0.09	43.1
Free Lime	%	184	0.94	0.26	28.3	0.51	0.29	56.0
Free Lime	%	* 182	0.93	0.23	24.5	0.49	0.21	42.8

* ELIMINATED LABS: Data over three S.D. from the mean

Potassium Oxide 8 36 137 692 975 2491 3279 3422 3454

Titanium Dioxide 48 2296 3422 125 247 695 975 2305 2363 2462 2483 2621 3279 53 75 207 3235 3368 3454

Phosphorus Pentoxide 93 98 696 2462 2466 9 137 139 2363 2465 2476 3279 3368 3428 3454

Zinc Oxide 23 619 768 206 219 501 2476 413 2522 3454

Manganic Oxide 48 413 691 2296 3368 408 2462 2463 2476 3454

Chloride 66 354 2484 1466 2491 3454

Insoluble Residue 206 1526 2491 99 175 458 493 1251 1799 3127 3422 3454

Free Lime 3297 3454

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 175 and No. 176
Final Report - Chemical Results
March 26, 2010

SUMMARY OF RESULTS

			Sample No. 175			Sample No. 176		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Chromium Oxide	%	82	0.012	0.006	49.5	0.010	0.006	62.0
Chromium Oxide	%	* 79	0.011	0.004	34.2	0.009	0.003	36.5
Tricalcium Silicate	%	193	67.3	6.4	9.5	52.6	3.2	6.0
Tricalcium Silicate	%	* 176	68.0	4.0	5.9	52.4	2.0	3.8
Dicalcium Silicate	%	185	0.5	4.9	1030	15.1	2.8	18.8
Dicalcium Silicate	%	* 169	-0.2	3.1	1604	15.1	1.9	12.3
Tricalc Aluminate	%	198	9.9	0.9	8.7	10.5	0.5	5.0
Tricalc Aluminate	%	* 190	9.9	0.4	4.4	10.5	0.3	2.9
Tetracalc Alumino	%	196	7.3	0.6	8.5	8.3	0.7	8.2
Tetracalc Alumino	%	* 187	7.3	0.2	2.4	8.2	0.1	1.7

* ELIMINATED LABS: Data over three S.D. from the mean

Chromium Oxide 10 48 98

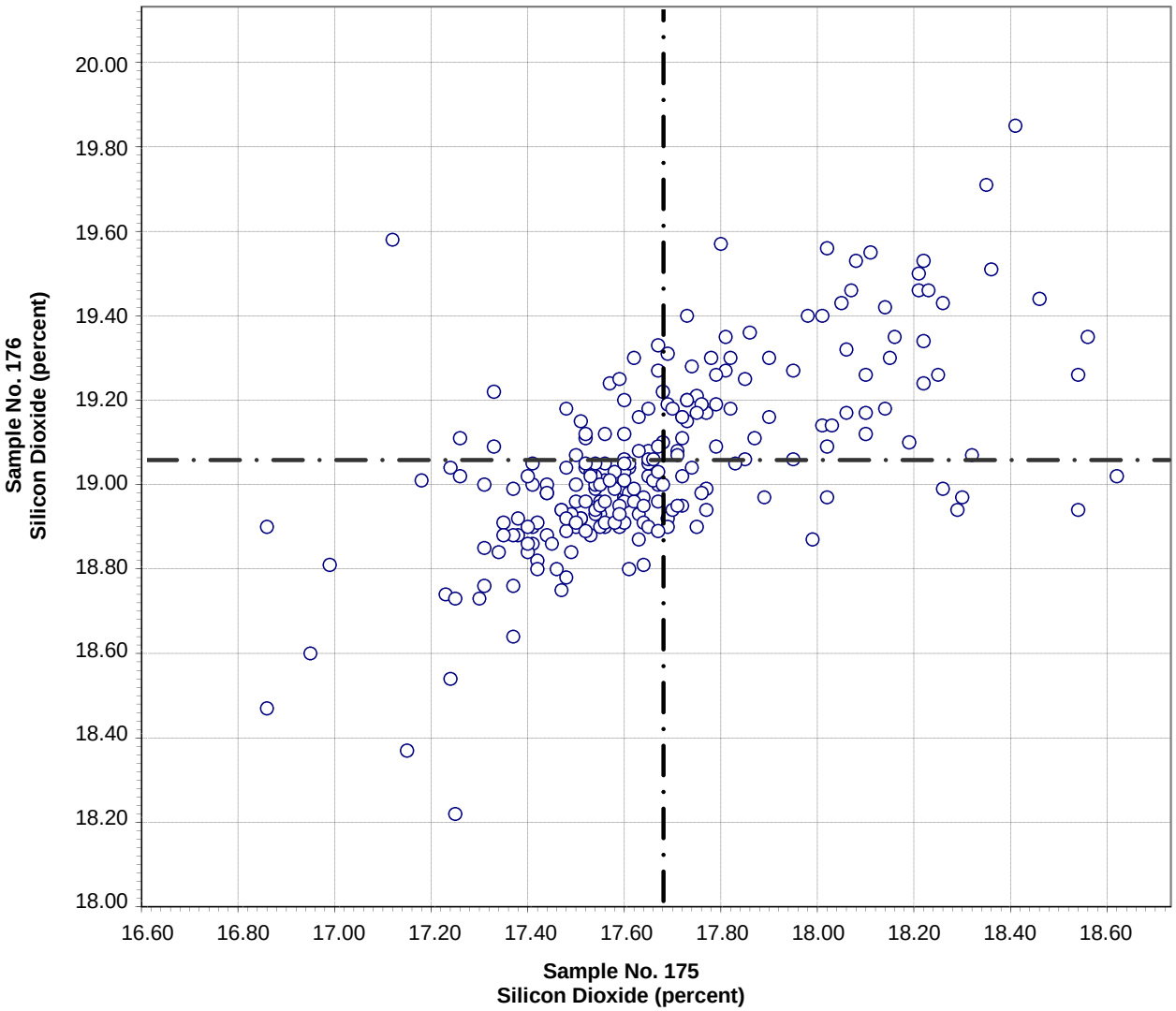
Tricalcium Silicate 50 491 779 1715 1799 2254 2296 2463 2491 2621 8 24 48 246 416 1483 3454

Dicalcium Silicate 50 491 779 1715 1799 2254 2296 2463 2491 2621 24 48 93 246 1483 3454

Tricalcium Aluminate 151 48 125 206 416 457 975 2464

Tetracalcium Aluminoferrite 209 10 19 110 206 407 2464 2621 3454

CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 175 and No. 176



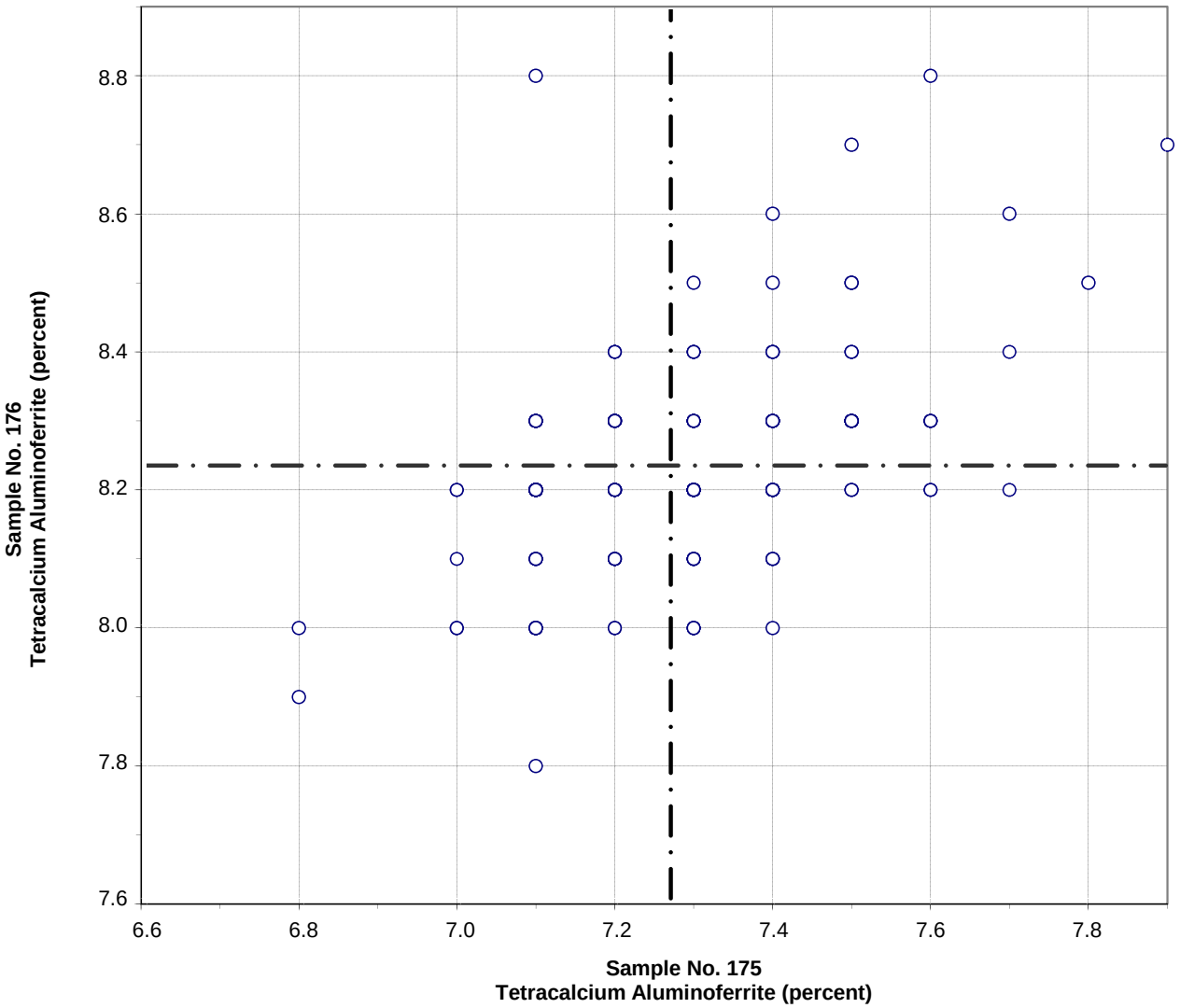
Test No. 10 Silicon Dioxide 232 Points

Sample No. 175	Ave	17.68	S.D.	0.33	C.V.	1.9
Sample No. 176	Ave	19.05	S.D.	0.22	C.V.	1.2

Labs eliminated: 51, 93, 207, 696, 2477, 3454

Labs off Diagram: 20, 53

CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 175 and No. 176

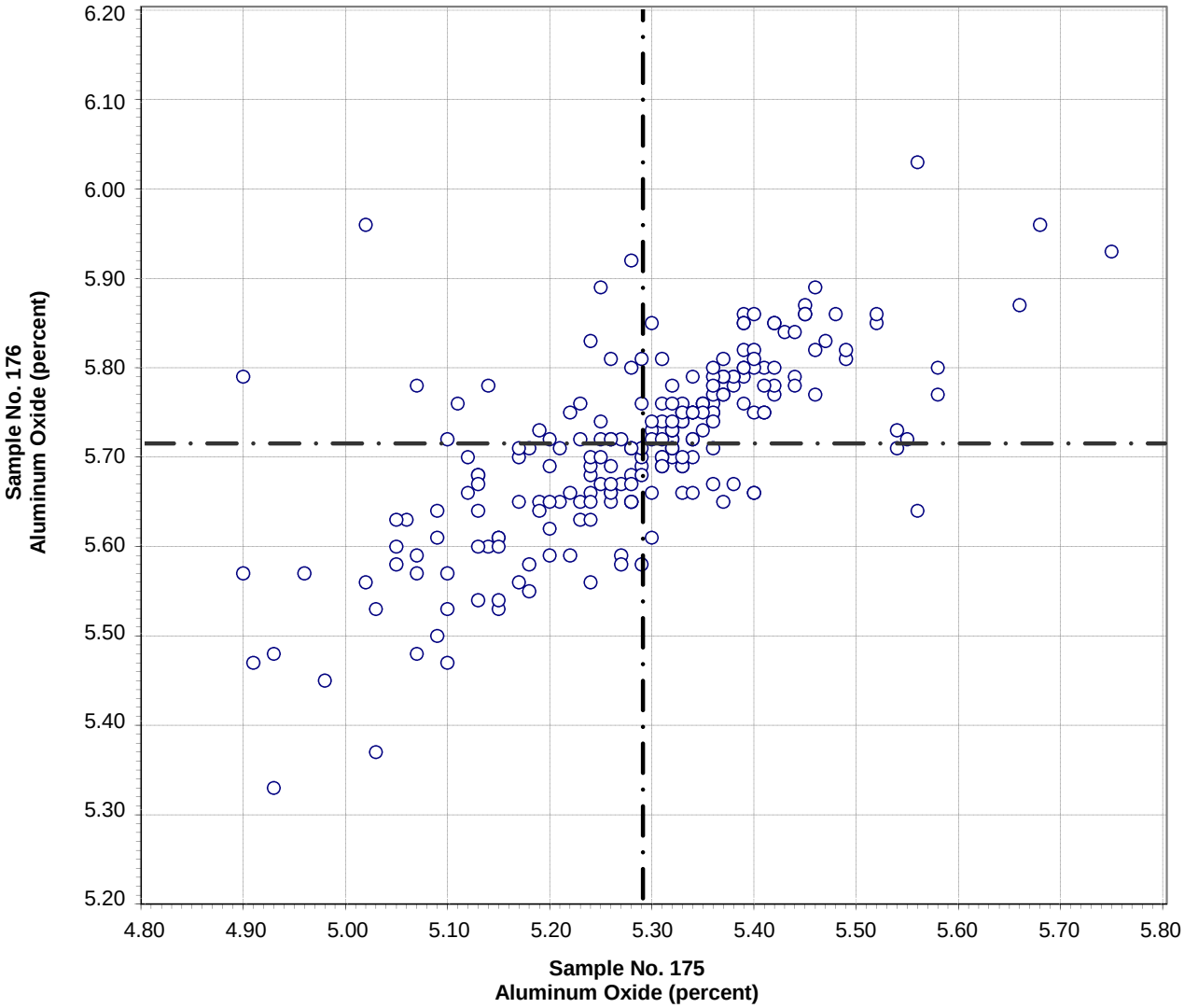


Test No. 109 Tetracalcium Aluminoferrite 187 Points

Sample No. 175	Ave	7.3	S.D.	0.2	C.V.	2.4
Sample No. 176	Ave	8.2	S.D.	0.1	C.V.	1.7

Labs eliminated: 209, 10, 19, 110, 206, 407, 2464, 2621, 3454

CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 175 and No. 176



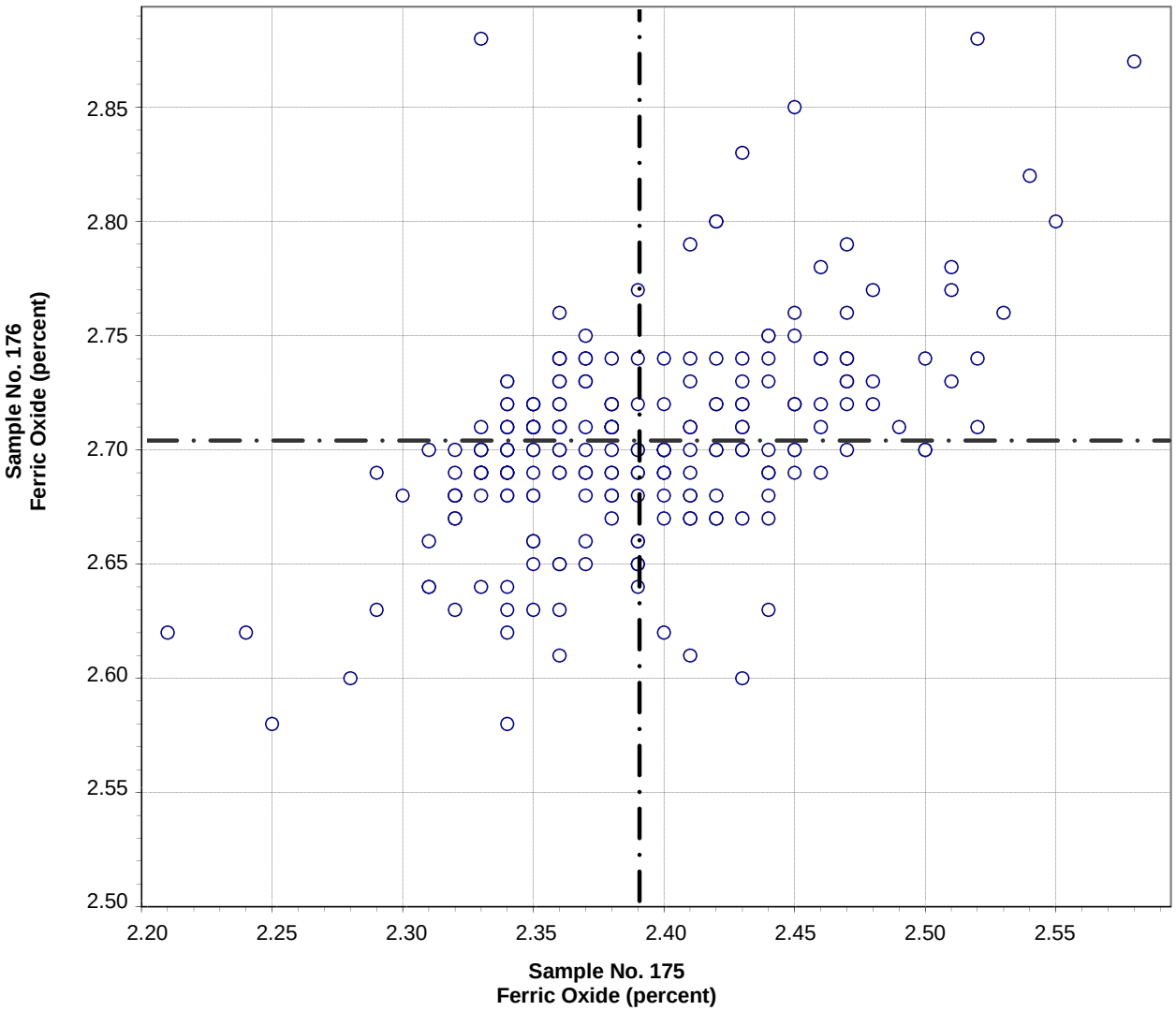
Test No. 21 Aluminum Oxide 226 Points

Sample No. 175 Ave 5.29 S.D. 0.15 C.V. 2.8
Sample No. 176 Ave 5.71 S.D. 0.10 C.V. 1.8

Labs eliminated: 48, 125, 206, 416, 457, 696, 768, 975, 3422, 3454

Labs off Diagram: 687

CCRL Proficiency Sample Program
Ferric Oxide
PORTLAND CEMENT Samples No. 175 and No. 176

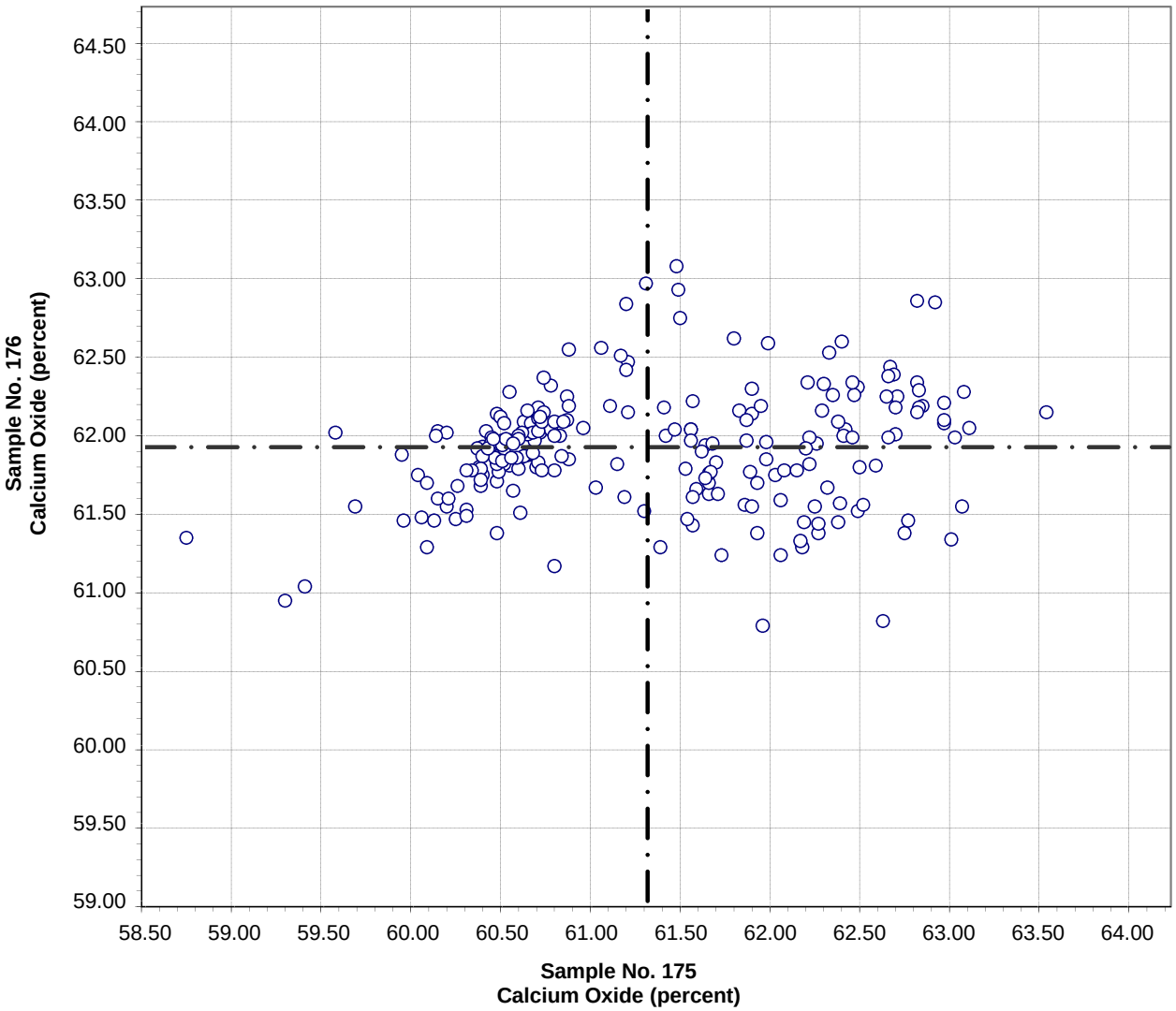


Test No. 30 Ferric Oxide 231 Points

Sample No. 175	Ave	2.39	S.D.	0.06	C.V.	2.4
Sample No. 176	Ave	2.70	S.D.	0.05	C.V.	1.7

Labs eliminated: 10, 110, 206, 407, 768, 2464, 2621, 3454

CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 175 and No. 176

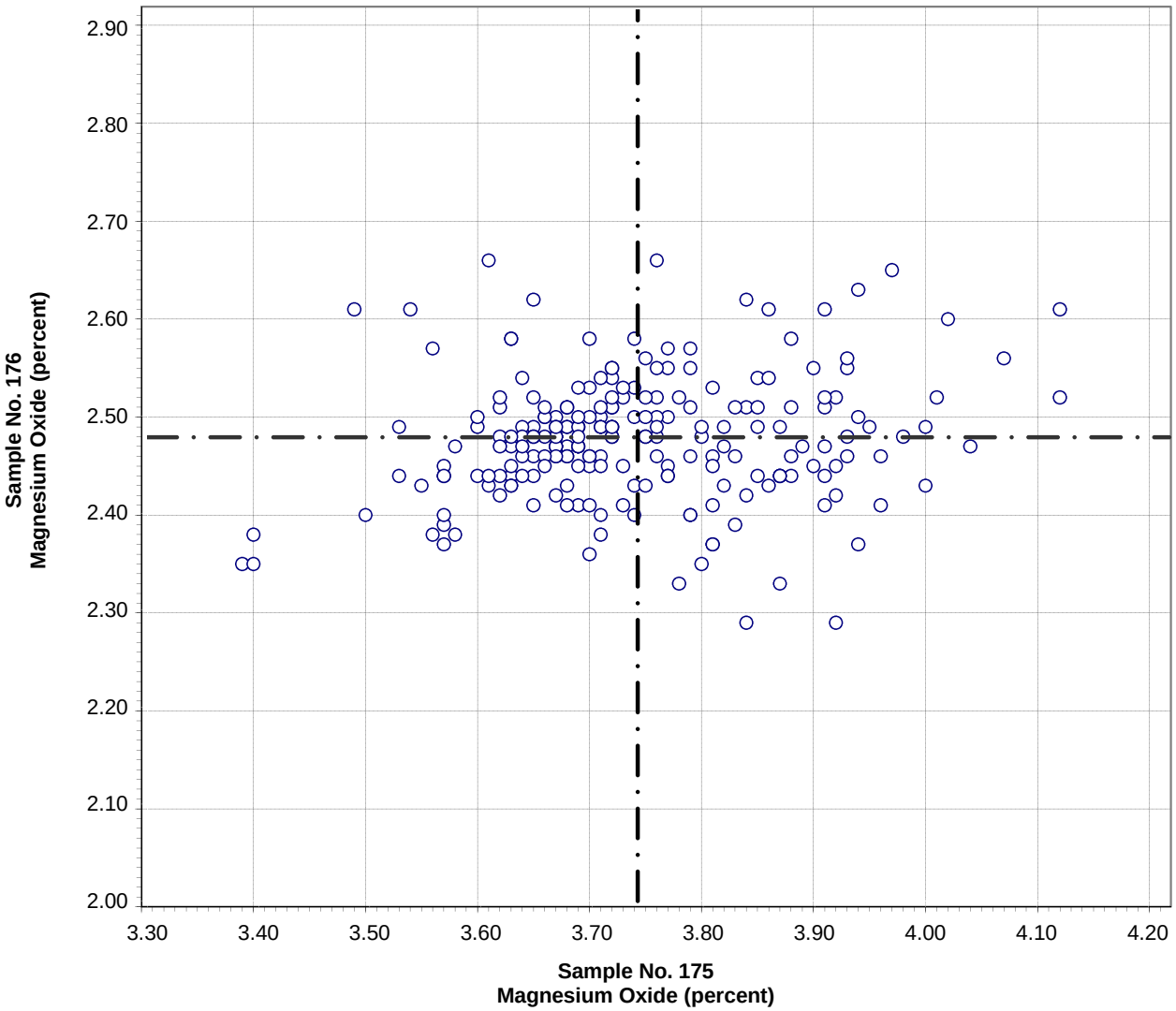


Test No. 40 Calcium Oxide 227 Points

Sample No. 175	Ave	61.31	S.D.	0.94	C.V. 1.5
Sample No. 176	Ave	61.92	S.D.	0.37	C.V. 0.6

Labs eliminated: 20, 50, 2621, 3422, 502, 696, 1054, 1715, 3233, 3457

CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 175 and No. 176

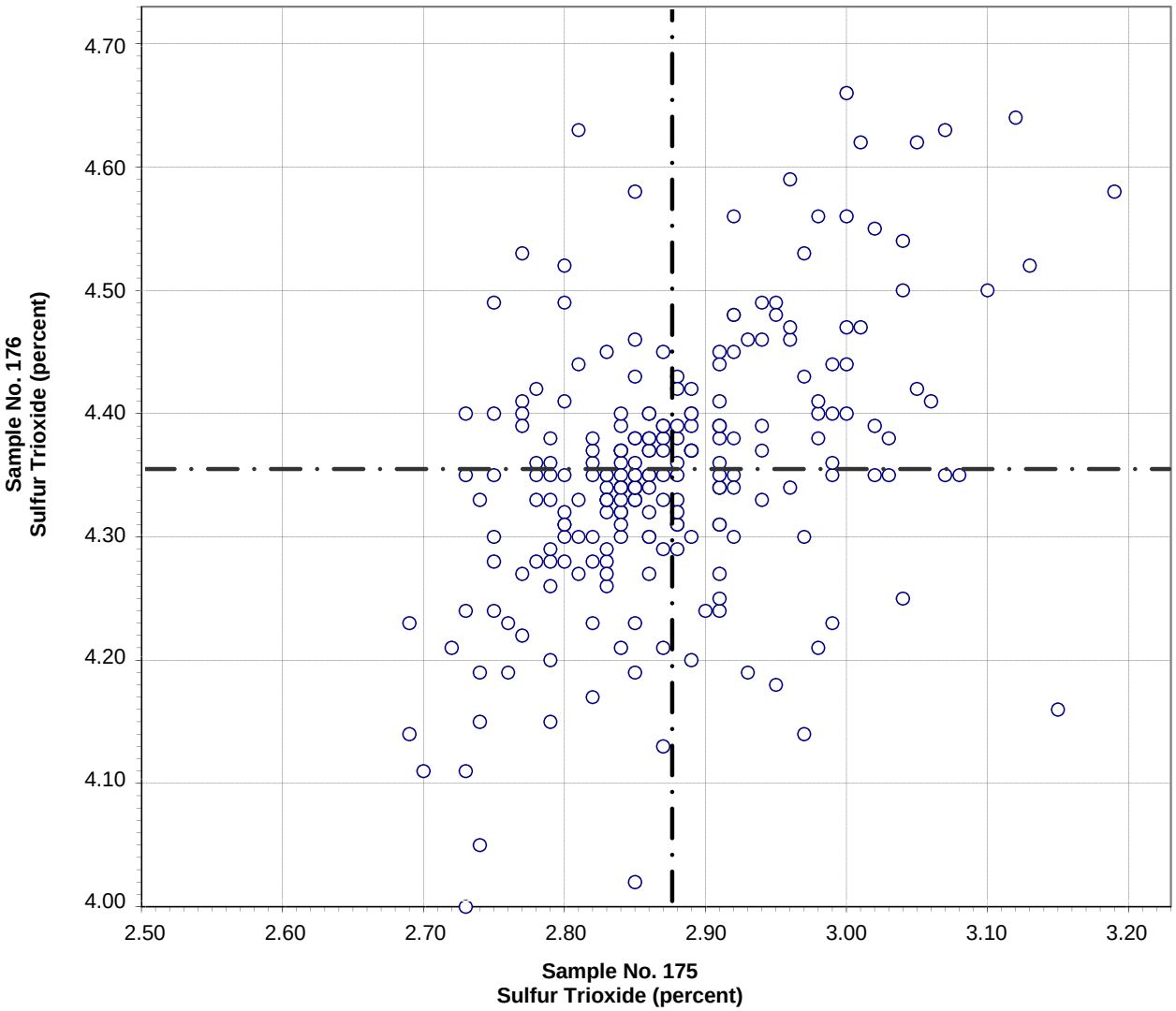


Test No. 50 Magnesium Oxide 227 Points

Sample No. 175	Ave	3.74	S.D.	0.13	C.V.	3.4
Sample No. 176	Ave	2.48	S.D.	0.06	C.V.	2.5

Labs eliminated: 25, 2464, 3422, 53, 502, 690, 768, 1956, 2466, 3428, 3454

CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 175 and No. 176

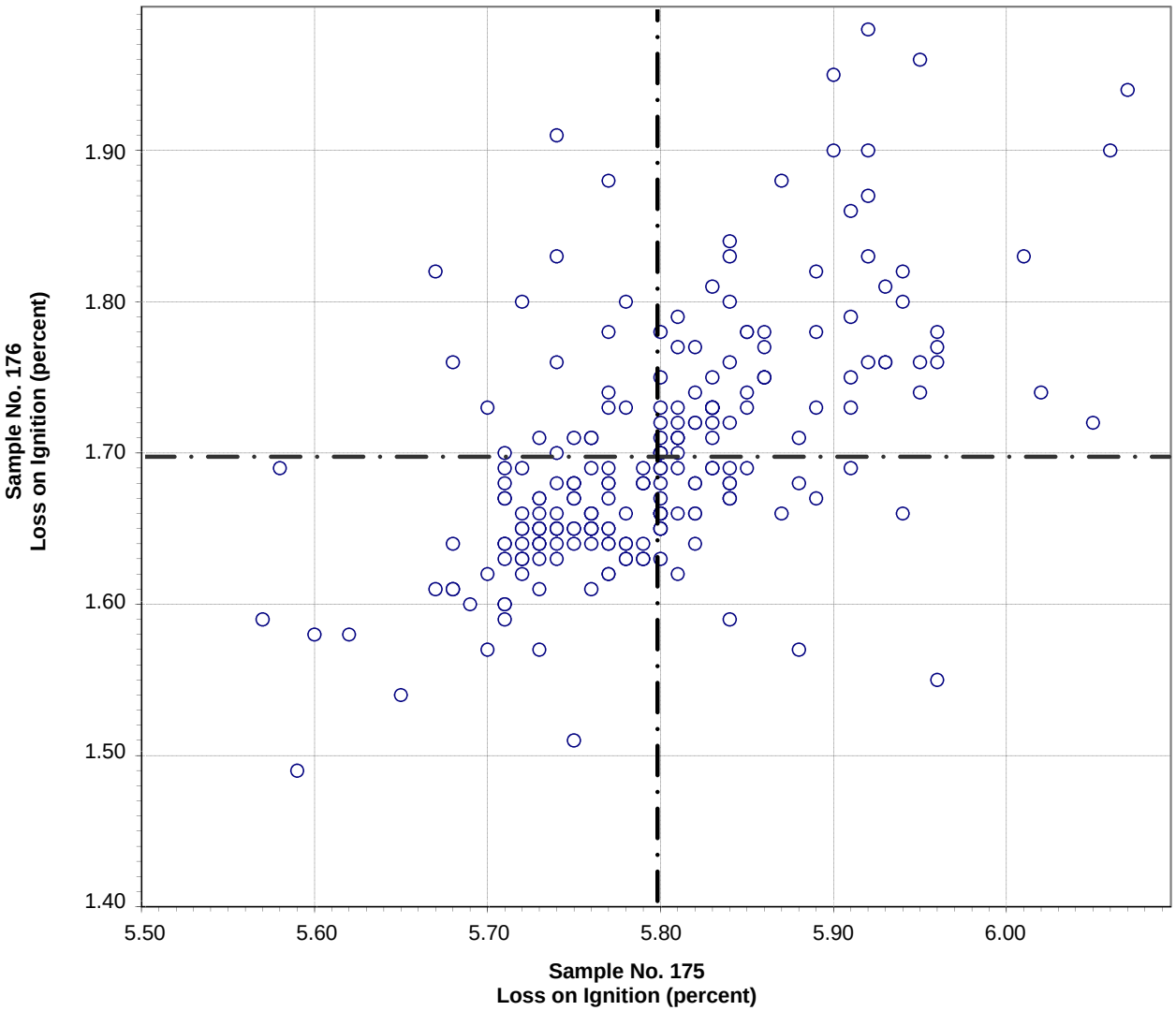


Test No. 60 Sulfur Trioxide 232 Points

Sample No. 175 Ave 2.88 S.D. 0.09 C.V. 3.1
Sample No. 176 Ave 4.35 S.D. 0.11 C.V. 2.5

Labs eliminated: 51, 53, 110, 736, 501, 504, 1715, 2305, 2464, 2476, 2490, 3279, 3422

CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 175 and No. 176



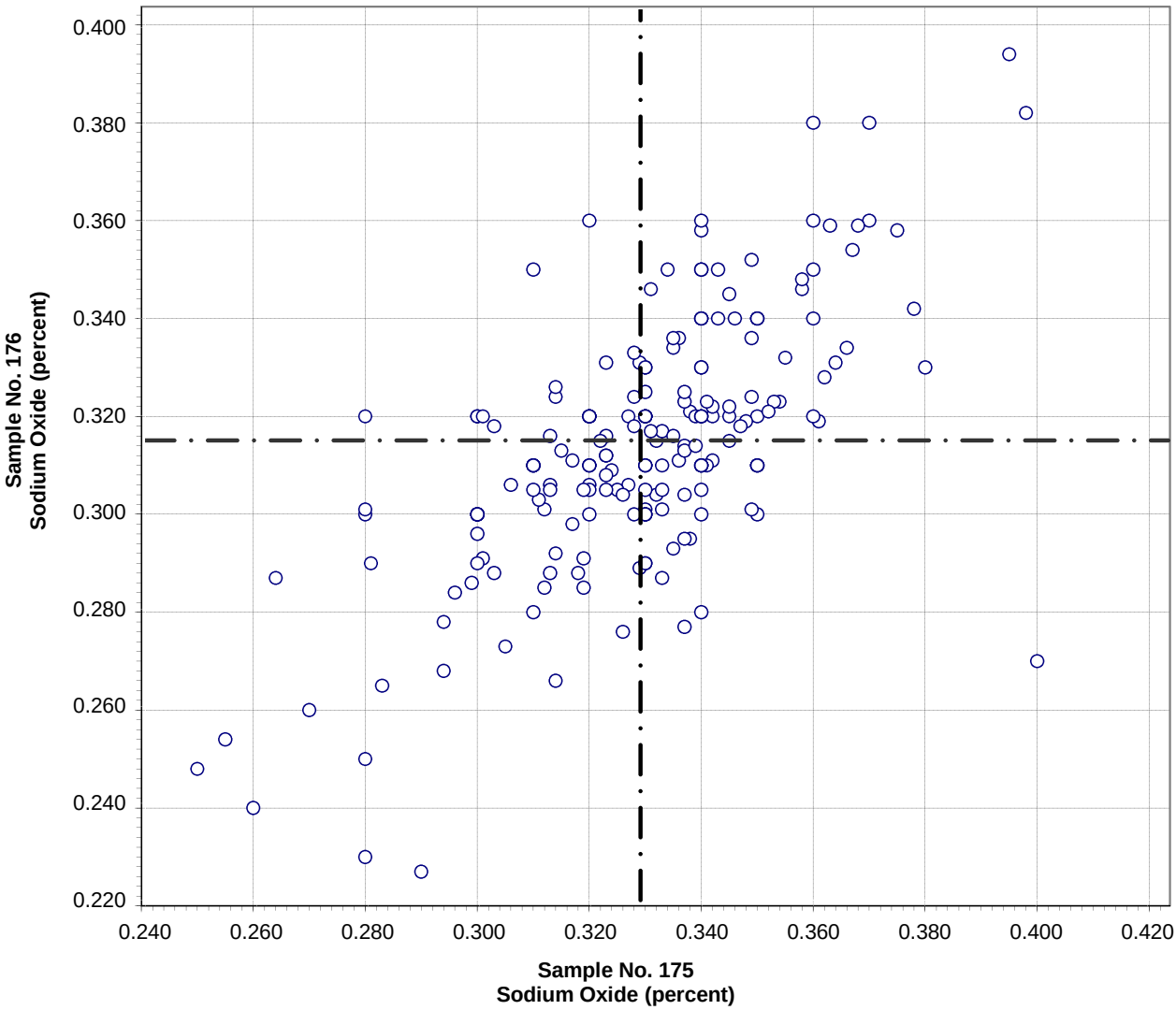
Test No. 70 Loss on Ignition 223 Points

Sample No. 175 Ave 5.80 S.D. 0.09 C.V. 1.5
Sample No. 176 Ave 1.70 S.D. 0.09 C.V. 5.4

Labs eliminated: 36, 53, 1644, 2763, 3415, 3422, 206, 684, 1940, 2435, 2437, 2464, 2466, 2621, 3127, 3457

Labs off Diagram: 416, 1715, 2463, 3059

CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 175 and No. 176



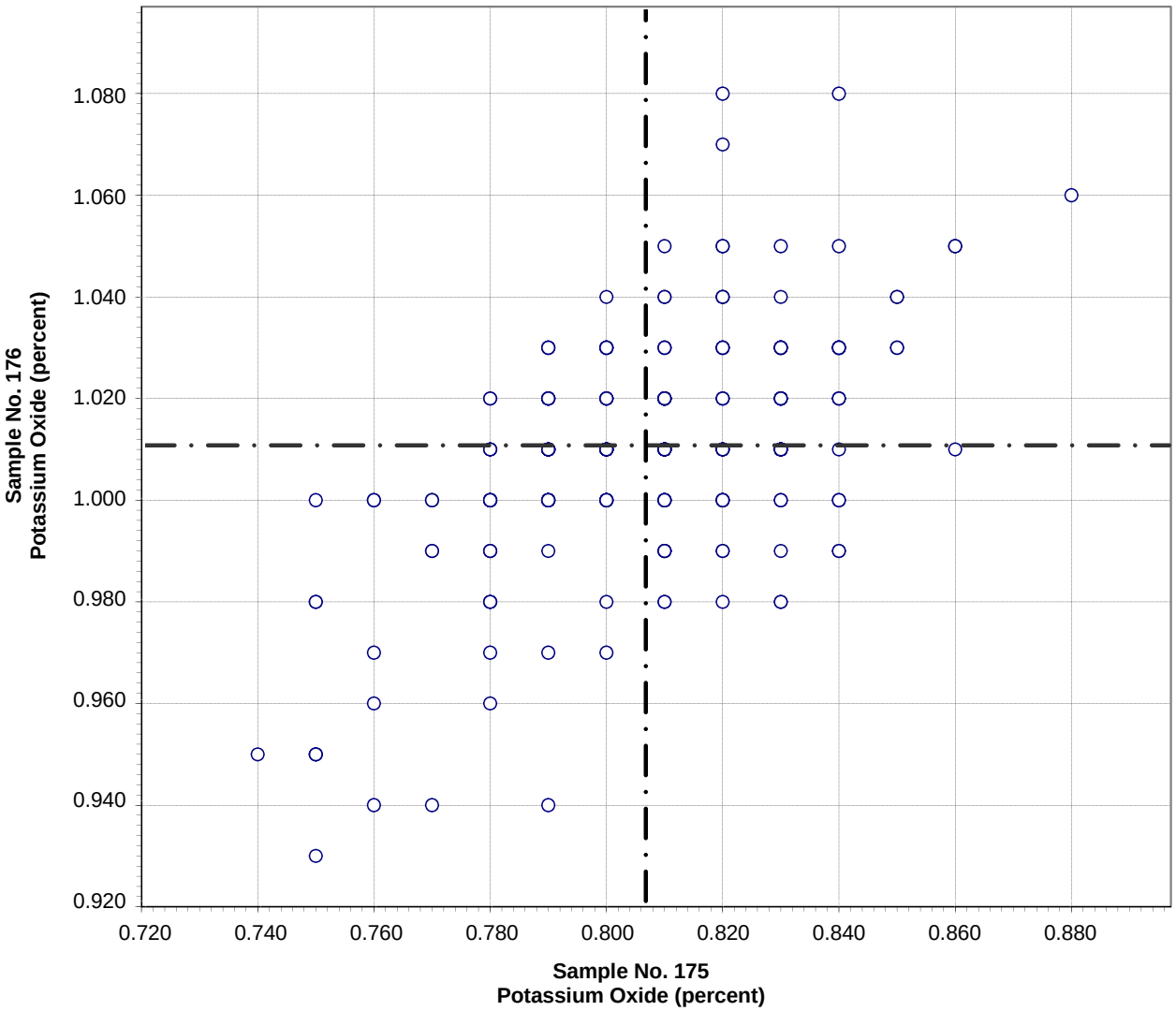
Test No. 90 Sodium Oxide 206 Points

Sample No. 175	Ave	0.329	S.D.	0.026	C.V.	7.9
Sample No. 176	Ave	0.315	S.D.	0.029	C.V.	9.1

Labs eliminated: 98, 110, 2463, 2464, 2466, 2621, 3057, 4, 53, 222, 494, 1251, 1799, 1956, 3422

Labs off Diagram: 137, 3279, 3428, 3454

CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 175 and No. 176



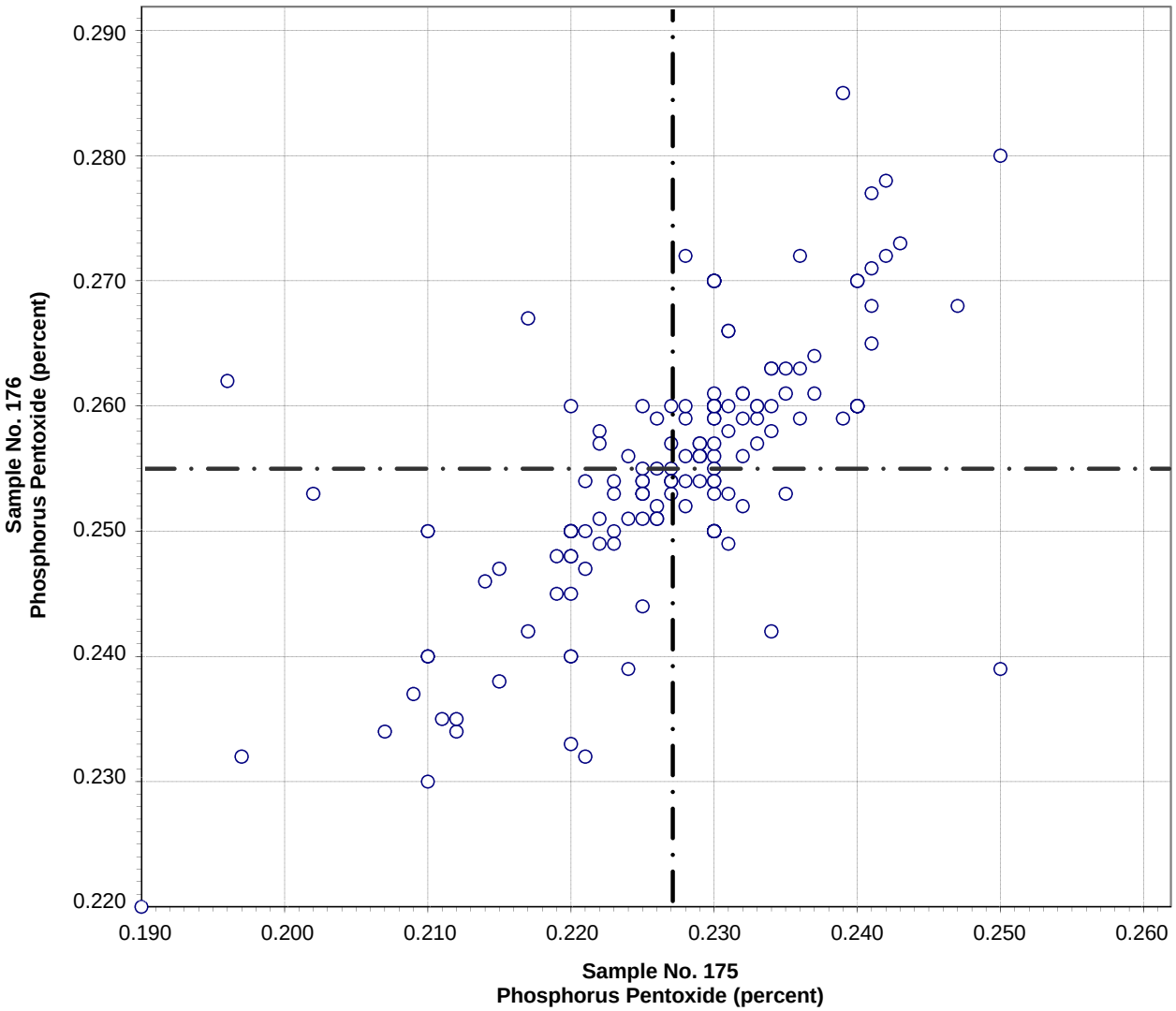
Test No. 100 Potassium Oxide 219 Points

Sample No. 175	Ave	0.807	S.D.	0.024	C.V.	3.0
Sample No. 176	Ave	1.011	S.D.	0.025	C.V.	2.4

Labs eliminated: 8, 36, 137, 692, 975, 2491, 3279, 3422, 3454

Labs off Diagram: 47, 2465

CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 175 and No. 176

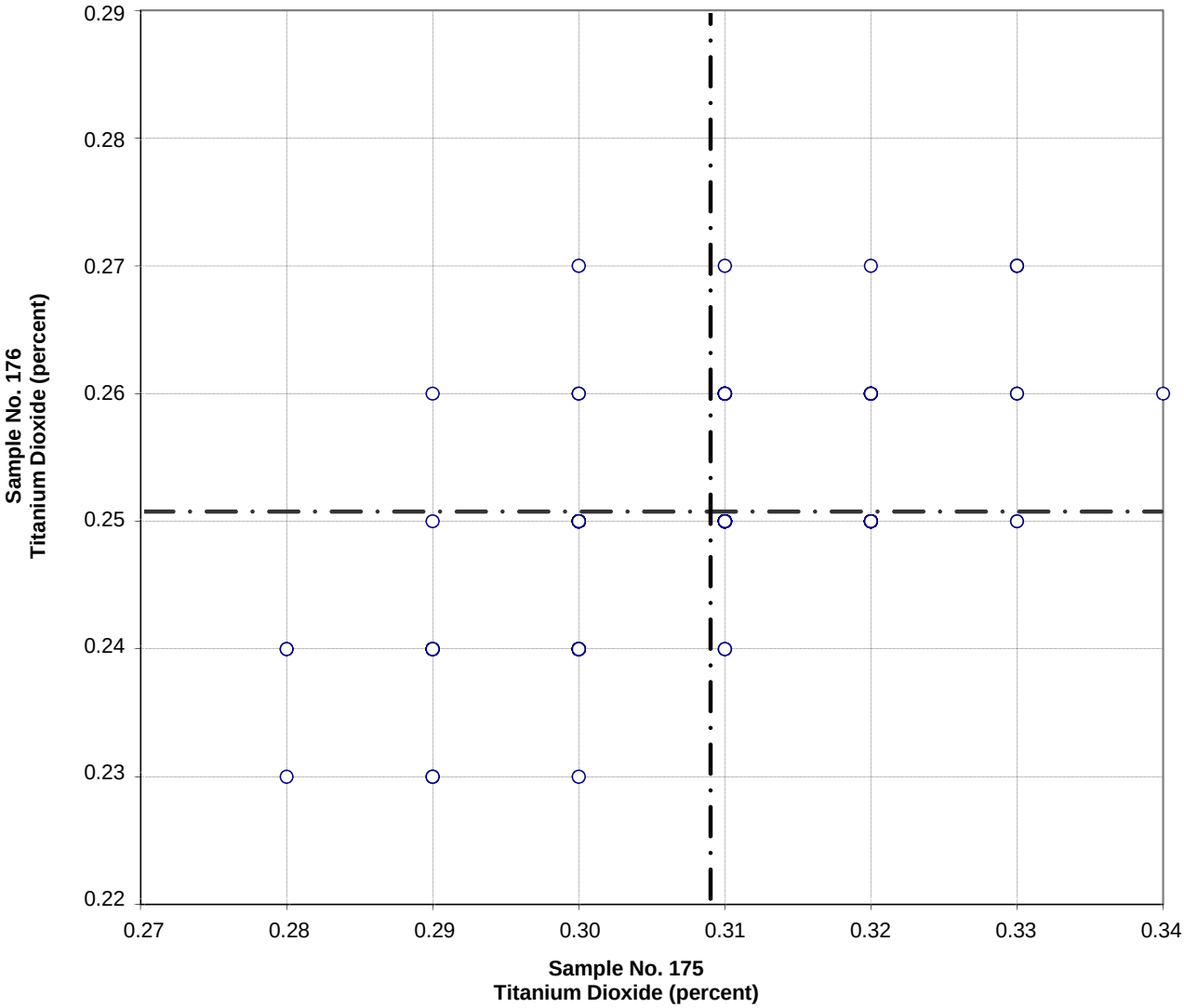


Test No. 102 Phosphorus Pentoxide 168 Points

Sample No. 175 Ave 0.227 S.D. 0.009 C.V. 4.2
Sample No. 176 Ave 0.255 S.D. 0.010 C.V. 3.9

Labs eliminated: 93, 98, 696, 2462, 2466, 9, 137, 139, 2363, 2465, 2476, 3279, 3368, 3428, 3454

CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 175 and No. 176

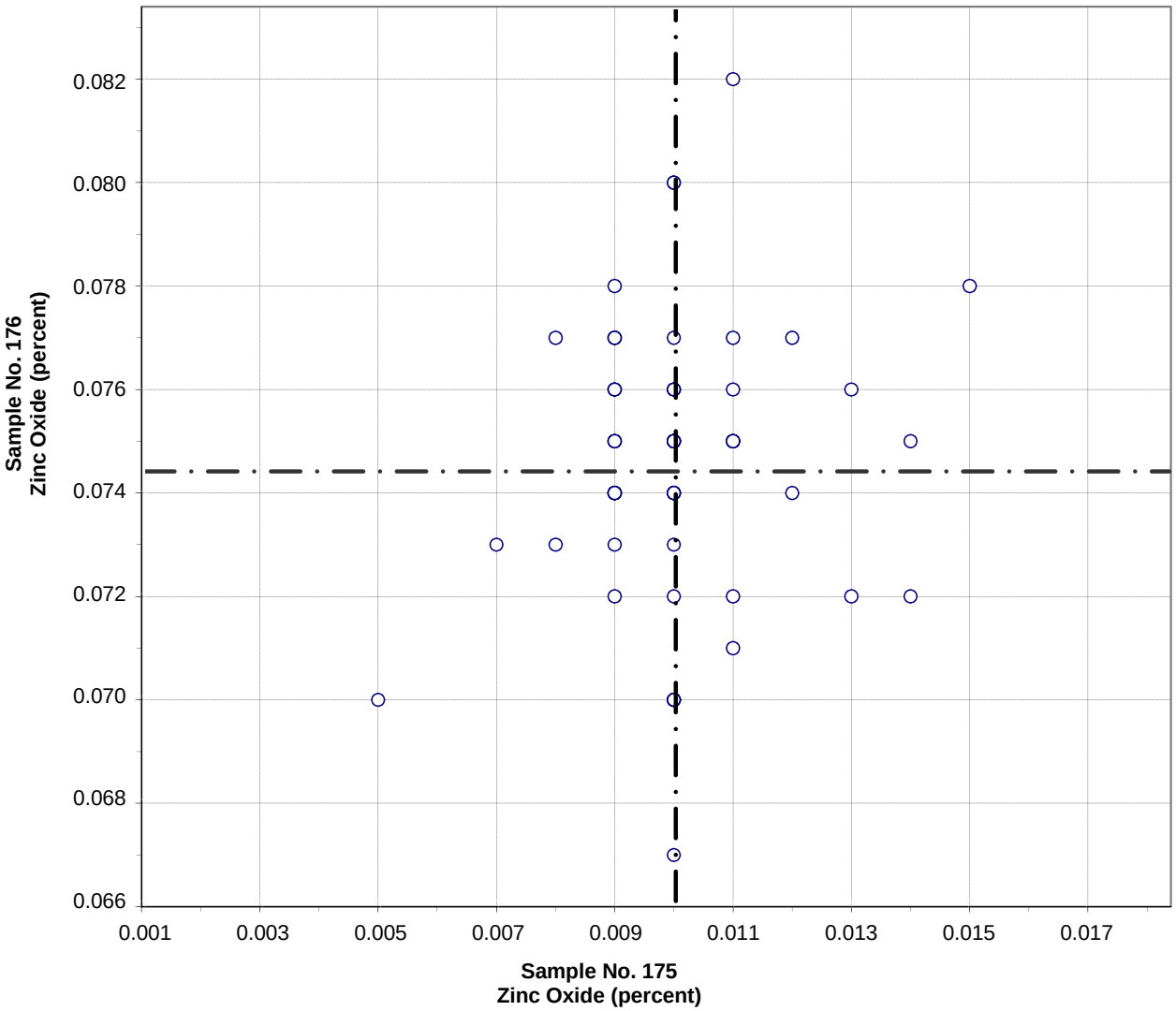


Test No. 103 Titanium Dioxide 166 Points

Sample No. 175 Ave 0.31 S.D. 0.010 C.V. 3.3
Sample No. 176 Ave 0.25 S.D. 0.007 C.V. 2.8

Labs eliminated: 48, 2296, 3422, 125, 247, 695, 975, 2305, 2363, 2462, 2483, 2621, 3279, 53, 75, 207, 3235, 3368, 3454

CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 175 and No. 176

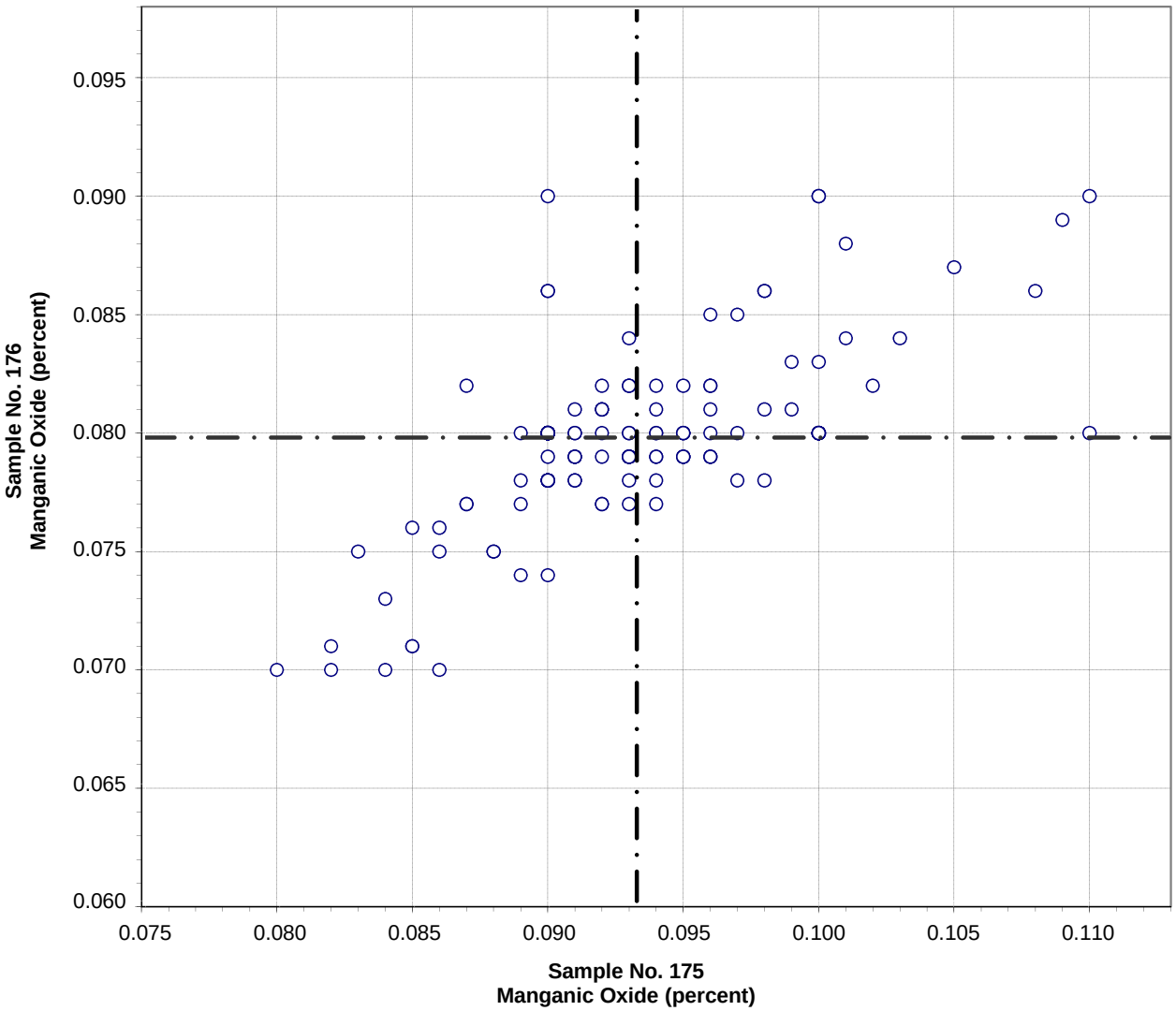


Test No. 99 Zinc Oxide 72 Points

Sample No. 175	Ave	0.010	S.D.	0.001	C.V.	14.7
Sample No. 176	Ave	0.074	S.D.	0.003	C.V.	3.6

Labs eliminated: 23, 619, 768, 206, 219, 501, 2476, 413, 2522, 3454

CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 175 and No. 176

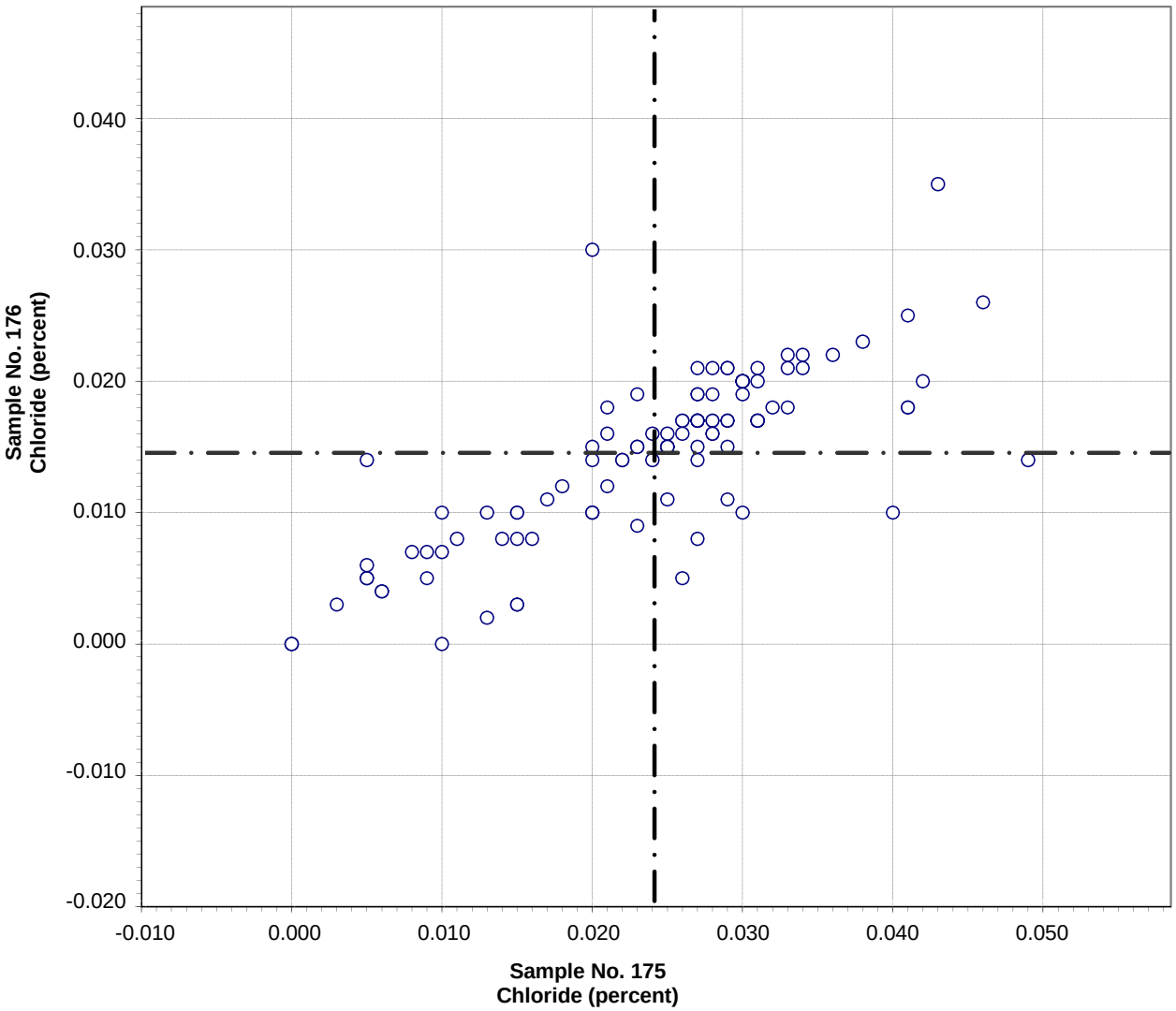


Test No. 101 Manganic Oxide 132 Points

Sample No. 175	Ave	0.093	S.D.	0.006	C.V.	5.9
Sample No. 176	Ave	0.080	S.D.	0.004	C.V.	4.8

Labs eliminated: 48, 413, 691, 2296, 3368, 408, 2462, 2463, 2476, 3454

CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 175 and No. 176

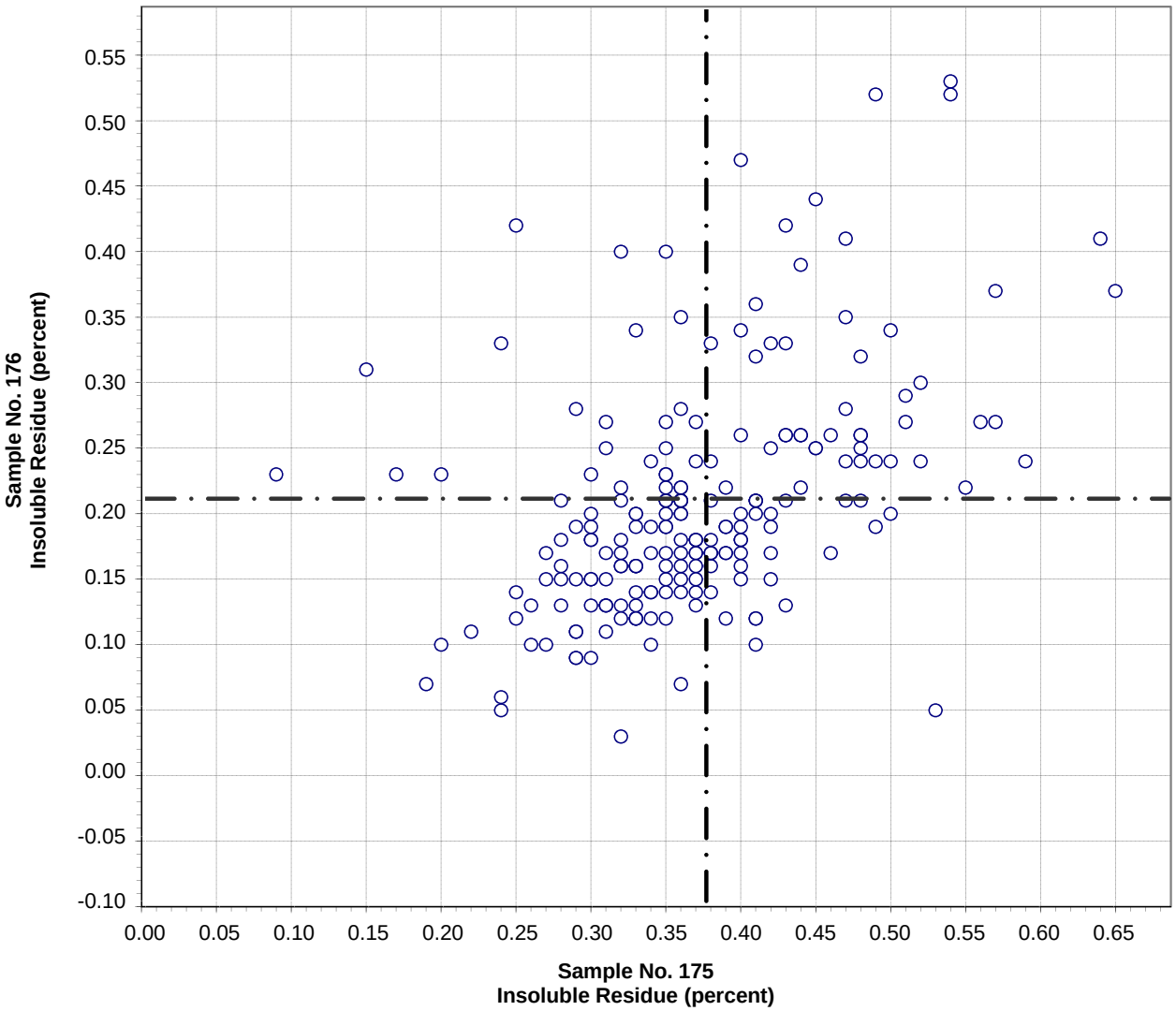


Test No. 104 Chloride 109 Points

Sample No. 175	Ave	0.024	S.D.	0.010	C.V.	41.7
Sample No. 176	Ave	0.014	S.D.	0.006	C.V.	44.3

Labs eliminated: 66, 354, 2484, 1466, 2491, 3454

CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 175 and No. 176



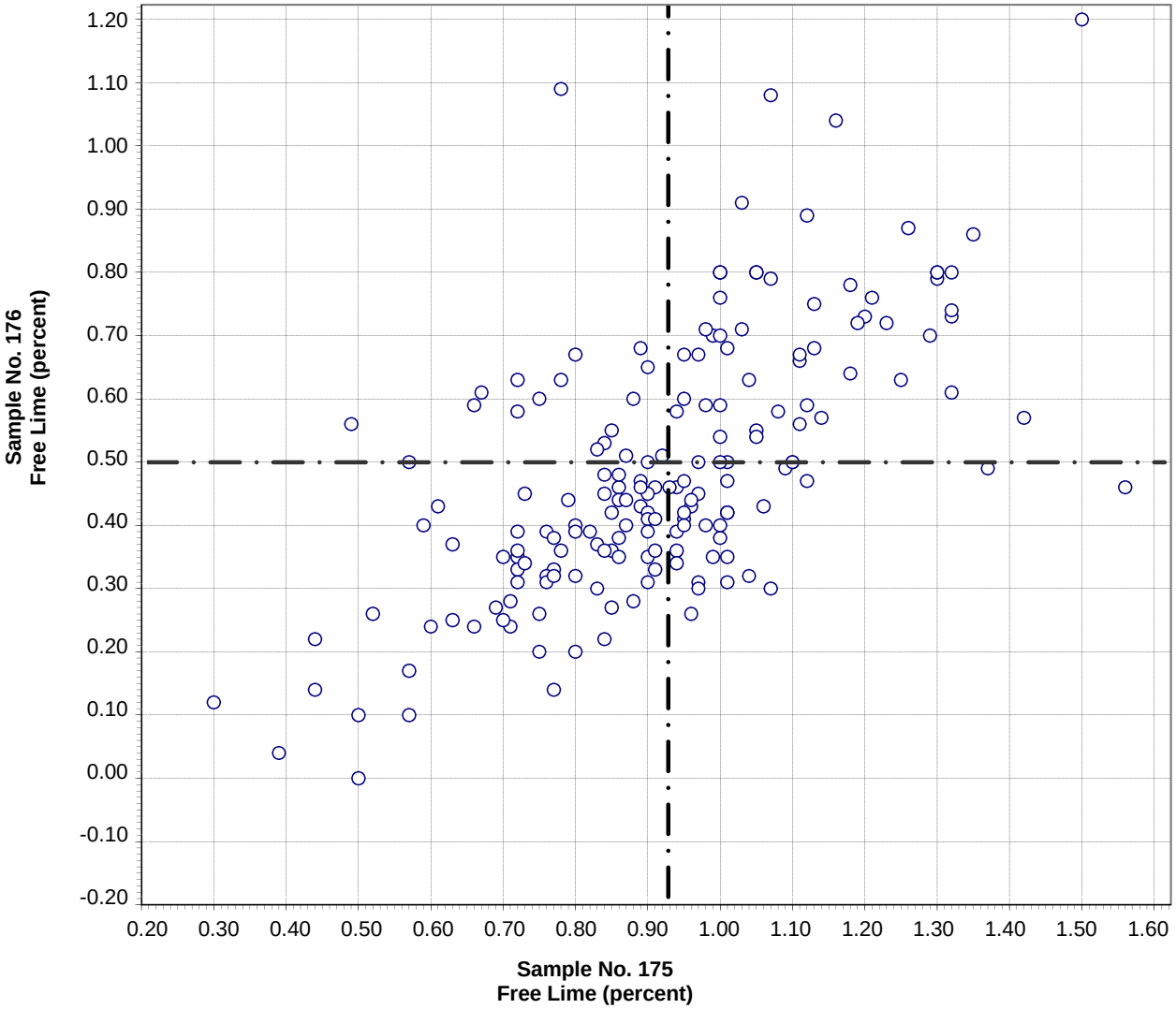
Test No. 80 Insoluble Residue 207 Points

Sample No. 175 Ave 0.38 S.D. 0.09 C.V. 25.1
Sample No. 176 Ave 0.21 S.D. 0.09 C.V. 43.1

Labs eliminated: 206, 1526, 2491, 99, 175, 458, 493, 1251, 1799, 3127, 3422, 3454

Labs off Diagram: 46, 246, 408

CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 175 and No. 176

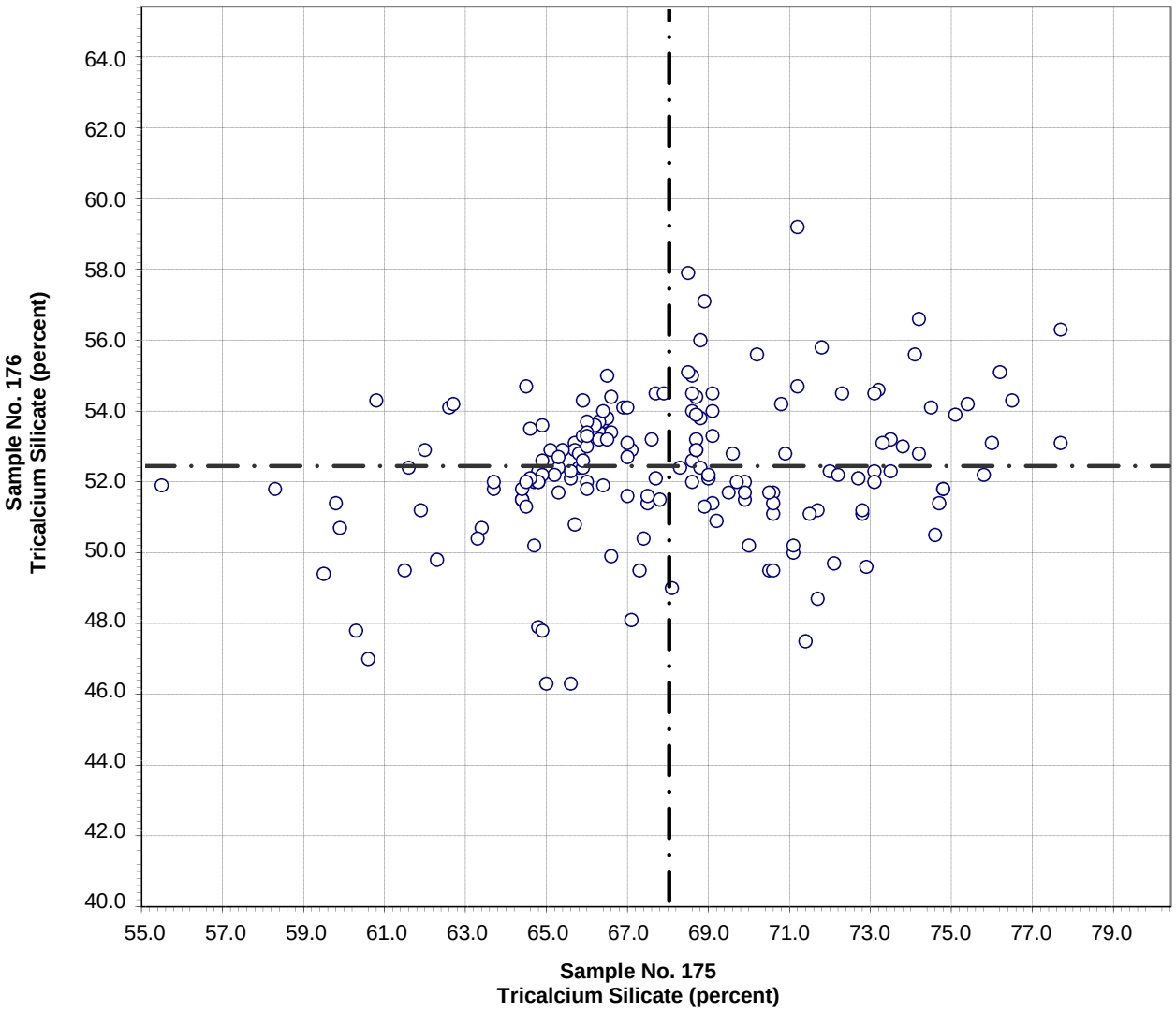


Test No. 41 Free Lime 180 Points

Sample No. 175	Ave	0.93	S.D.	0.23	C.V.	24.5
Sample No. 176	Ave	0.49	S.D.	0.21	C.V.	42.8

Labs eliminated: 3297, 3454

CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 175 and No. 176

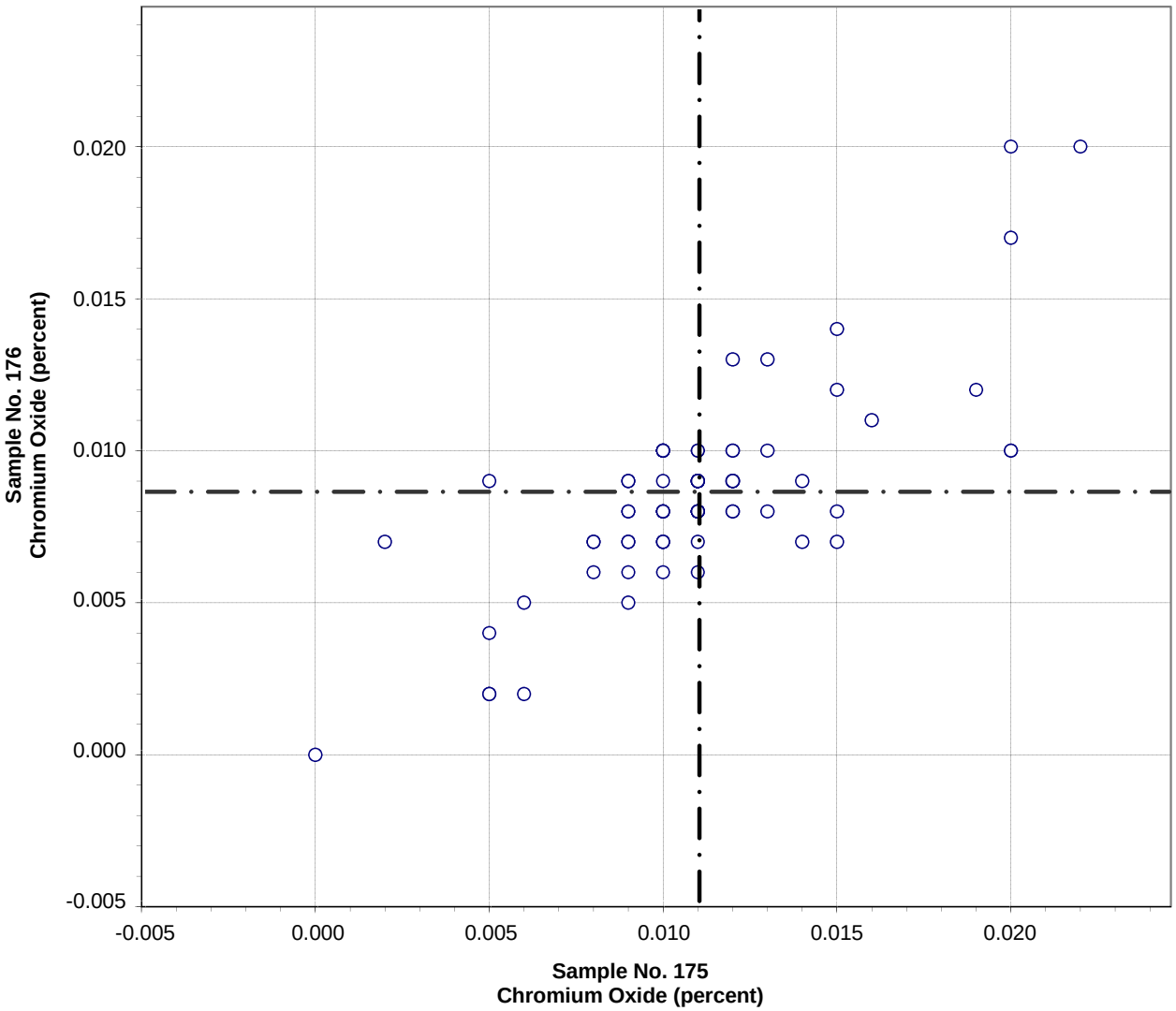


Test No. 106 Tricalcium Silicate 176 Points

Sample No. 175	Ave	68.0	S.D.	4.0	C.V. 5.9
Sample No. 176	Ave	52.4	S.D.	2.0	C.V. 3.8

Labs eliminated: 50, 491, 779, 1715, 1799, 2254, 2296, 2463, 2491, 2621, 8, 24, 48, 246, 416, 1483, 3454

CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 175 and No. 176

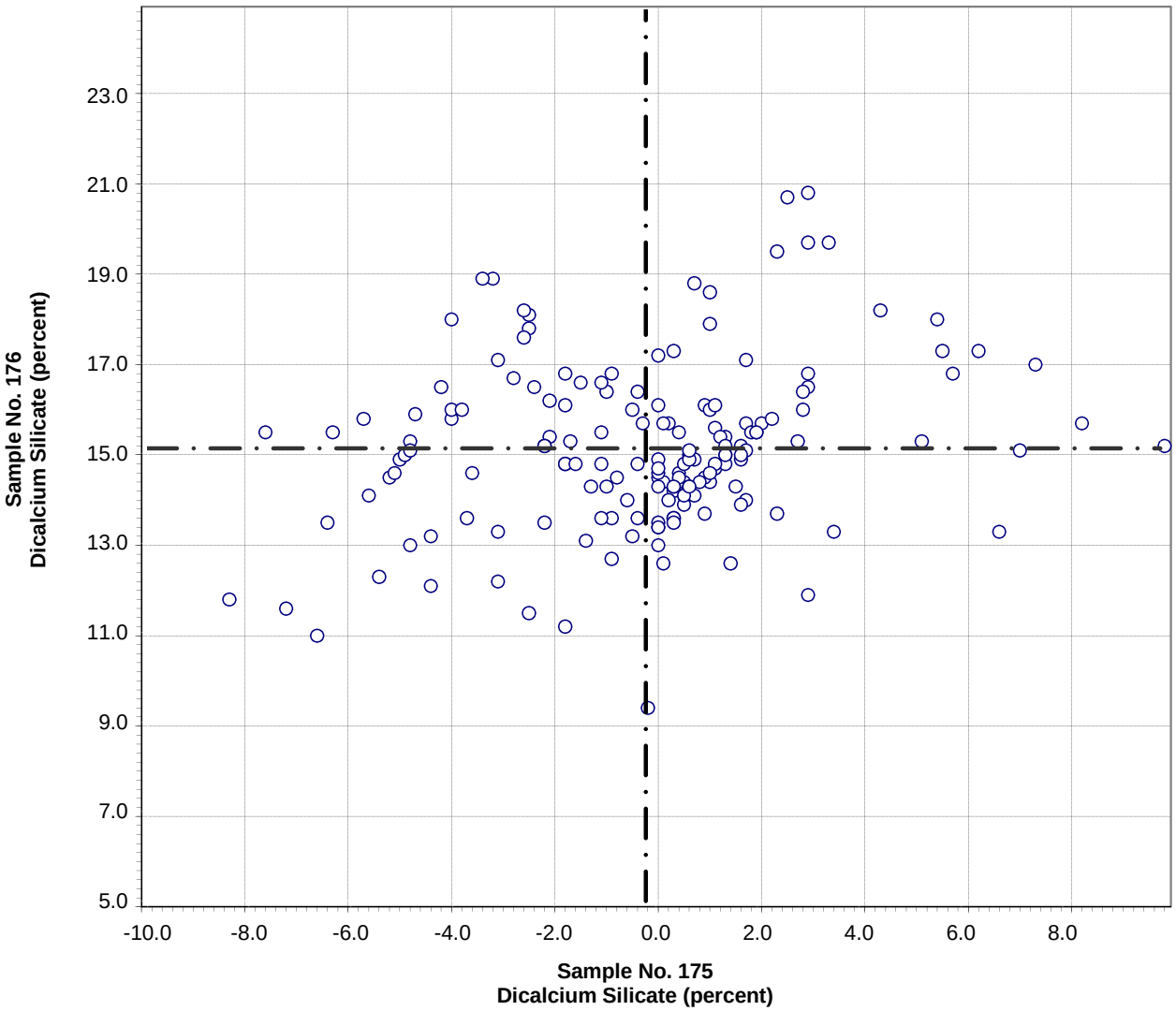


Test No. 105 Chromium Oxide 79 Points

Sample No. 175	Ave	0.011	S.D.	0.004	C.V.	34.2
Sample No. 176	Ave	0.009	S.D.	0.003	C.V.	36.5

Labs eliminated: 10, 48, 98

CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 175 and No. 176



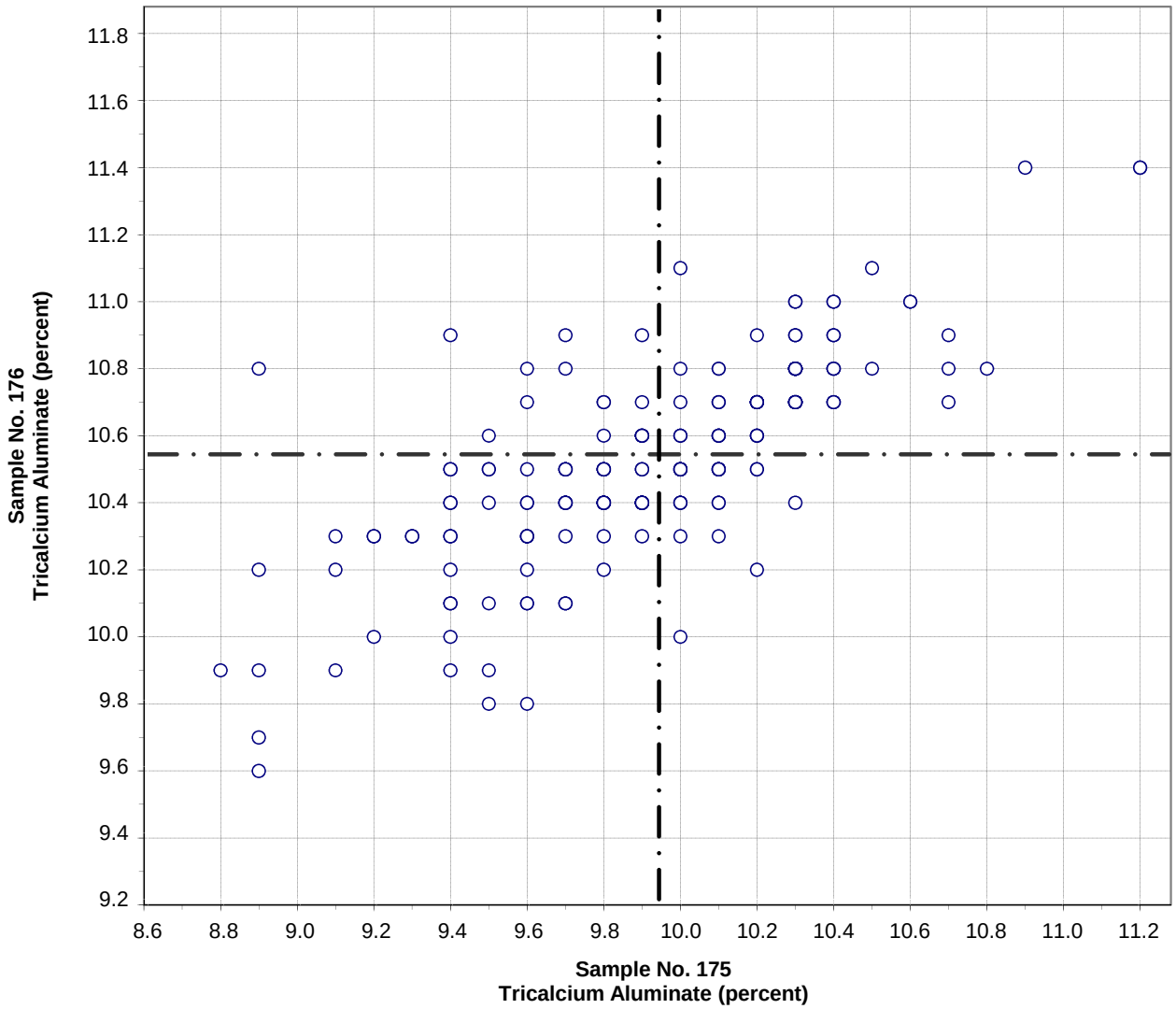
Test No. 107 Dicalcium Silicate 168 Points

Sample No. 175 Ave -0.2 S.D. 3.1 C.V. -1604.3
Sample No. 176 Ave 15.1 S.D. 1.9 C.V. 12.3

Labs eliminated: 50, 491, 779, 1715, 1799, 2254, 2296, 2463, 2491, 2621, 24, 48, 93, 246, 1483, 3454

Labs off Diagram: 151

CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 175 and No. 176



Test No. 108 Tricalcium Aluminate 189 Points

Sample No. 175 Ave 9.9 S.D. 0.4 C.V. 4.4
Sample No. 176 Ave 10.5 S.D. 0.3 C.V. 2.9

Labs eliminated: 151, 48, 125, 206, 416, 457, 975, 2464

Labs off Diagram: 687

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 175 and No. 176
Final Report - Physical Results
March 26, 2010

SUMMARY OF RESULTS

			Sample No. 175			Sample No. 176		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
N.C. Water	%	254	24.9	0.7	2.7	30.0	0.8	2.8
N.C. Water	%	* 242	24.8	0.4	1.5	30.0	0.5	1.7
Vicat TS Initial	min	247	126	17	13.7	123	17	13.9
Vicat TS Initial	min	* 241	124	15	12.0	122	16	13.0
Vicat TS Final	min	238	232	33	14.3	240	34	14.1
Vicat TS Final	min	* 235	232	30	12.9	239	33	13.6
Gillmore TS Initial	min	157	156	27	17.1	163	32	19.5
Gillmore TS Initial	min	* 153	158	24	15.0	164	27	16.5
Gillmore TS Final	min	157	263	41	15.5	275	43	15.6
Gillmore TS Final	min	* 152	261	35	13.2	273	36	13.2
False Set	%	191	53	13.5	25.7	64	13.1	20.5
Autoclave Expan	%	230	0.11	0.08	73.1	0.03	0.04	116
Autoclave Expan	%	* 220	0.11	0.04	38.9	0.04	0.02	57.3

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* ELIMINATED LABS: Data over three S.D. from the mean

Normal Consistency 39 413 932 1466 2476 10 123 551 2363 2483 3413 3422

Vicat TS Initial 3 130 1483 1526 2476 2982

Vicat TS Final 3 441 2982

Gillmore TS Initial 103 180 415 2476

Gillmore TS Final 38 46 75 167 180

Autoclave Expansion 134 982 5 90 93 196 1251 2251 2462 3413

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 175 and No. 176
Final Report - Physical Results
March 26, 2010

SUMMARY OF RESULTS

			Sample No. 175			Sample No. 176		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content	%	229	15.1	7.8	51.4	9.0	2.0	22.0
Air Content	%	* 224	14.6	1.2	8.5	8.9	1.2	13.2
AC Mix Water	%	224	61.3	5.6	9.2	69.6	5.7	8.2
AC Mix Water	%	* 220	61.9	3.0	4.9	70.2	2.6	3.7
AC Flow	%	224	89	3.4	3.9	87	3.5	4.0
AC Flow	%	* 223	89	3.4	3.8	87	3.5	4.0
Comp Str, 1 day	psi	254	1940	202	10.4	3415	316	9.2
Comp Str, 1 day	psi	* 250	1935	169	8.7	3420	286	8.3
Comp Str, 3 day	psi	259	3438	258	7.5	4529	366	819
Comp Str, 3 day	psi	* 255	3438	234	6.8	4536	324	7.1
Comp Str, 7 day	psi	255	4028	290	7.2	5157	406	7.9
Comp Str, 7 day	psi	* 251	4024	262	6.5	5165	360	7.0
Comp Str, Flow	%	233	122	10.5	8.6	89	12.6	14.1
Comp Str, Flow	%	* 229	123	8.7	7.1	90	12.0	13.4

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* ELIMINATED LABS: Data over three S.D. from the mean

Air Content 196 23 2435 2476 2522

Air Content - % Water 203 343 1190 2476

Air Content - Flow 2363

Comp Strength - 1 day 103 196 2476 3255

Comp Strength - 3 day 43 103 2476 3422

Comp Strength - 7 day 37 2296 2476 3422

Comp Strength Flow 129 162 2477 3511

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 175 and No. 176
Final Report - Physical Results
March 26, 2010

SUMMARY OF RESULTS

Test		#Labs	Sample No. 175 Average	S.D.	C.V.	Sample No. 176 Average	S.D.	C.V.
FINENESS								
Air Permeability	cm^2/g	248	4626	326	7.0	4649	340	7.3
Air Permeability	cm^2/g	* 230	4650	139	3.0	4669	140	3.0
Wagner Turbidim	cm^2/g	11	2559	857	33.5	2702	719	26.6
45µm Sieve	%	241	95.24	1.22	1.3	98.34	0.91	0.9
45µm Sieve	%	* 229	95.22	0.92	1.0	98.50	0.43	0.4
C1038 MORTAR BAR EXPANSION								
Mortar Expansion	%	148	0.007	0.034	512	0.006	0.027	432
Mortar Expansion	%	* 136	0.006	0.003	57.3	0.006	0.003	57.6
Mortar Water	mL	144	233	12.3	5.3	257	12.4	4.8
Mortar Water	mL	* 140	233	6.2	2.7	257	9.6	3.7
Mortar Flow	%	141	110	3.2	2.9	109	5.8	5.3
Mortar Flow	%	* 137	110	2.6	2.4	109	2.8	2.5

* ELIMINATED LABS: Data over three S.D. from the mean

FINENESS

Air Permeability 18 343 14 36 116 265 450 565 768 1435 1594 2293 8 19 103 1715 2251 2296

45µm Sieve 2 42 49 169 493 502 958 1942 2476 2477 2491 3368

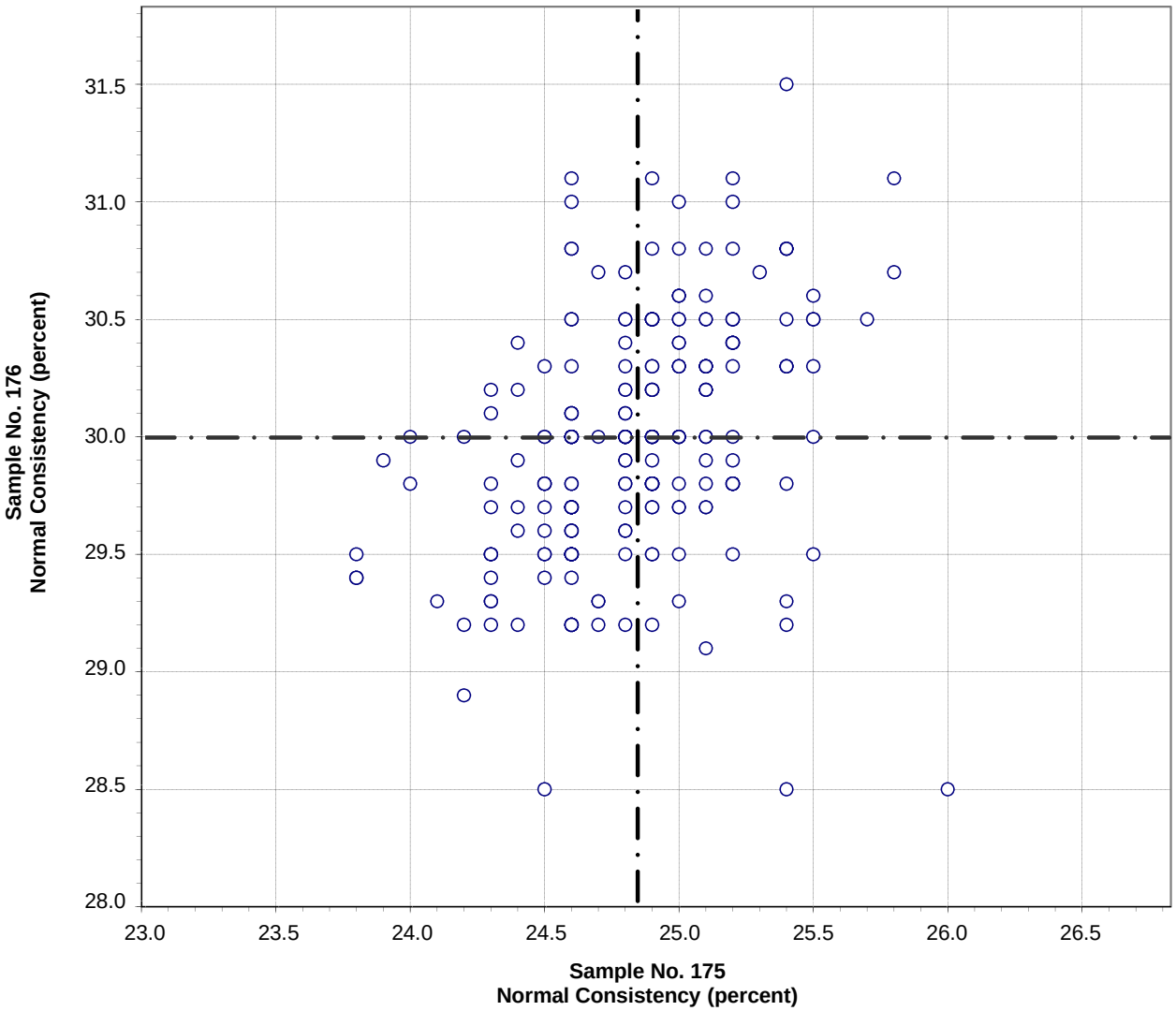
C1038 MORTAR BAR EXPANSION

Mortar Bar Expansion 8 134 125 146 958 2296 2466 20 34 84 975 3057

Mortar - Water 408 611 691 2476

Mortar - Flow 46 106 134 167

CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 175 and No. 176

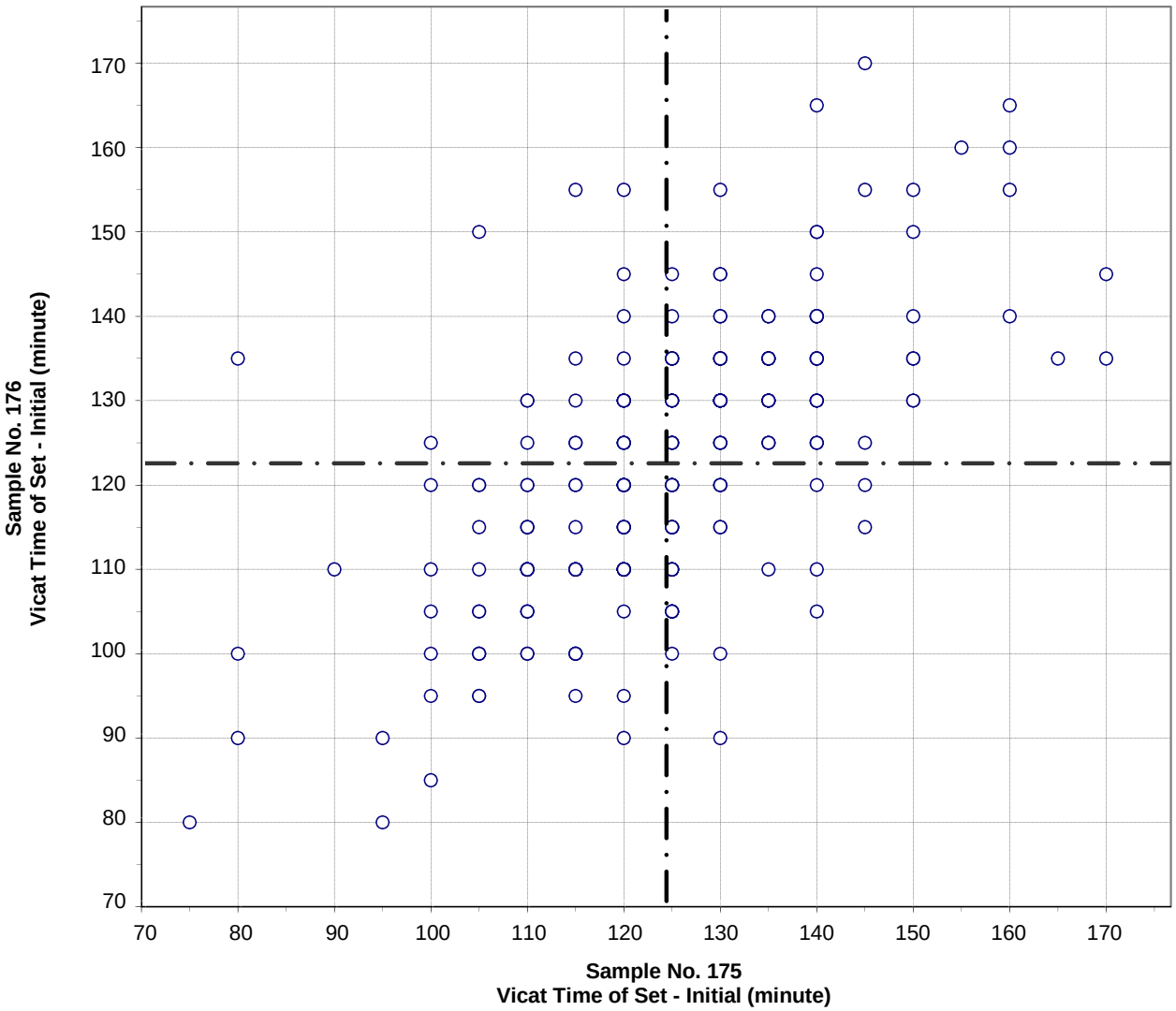


Test No. 110 Normal Consistency - % Water 242 Points

Sample No. 175	Ave	24.8	S.D.	0.4	C.V.	1.5
Sample No. 176	Ave	30.0	S.D.	0.5	C.V.	1.7

Labs eliminated: 39, 413, 932, 1466, 2476, 10, 123, 551, 2363, 2483, 3413, 3422

CCRL Proficiency Sample Program
Vicat Time of Set - Initial
PORTLAND CEMENT Samples No. 175 and No. 176

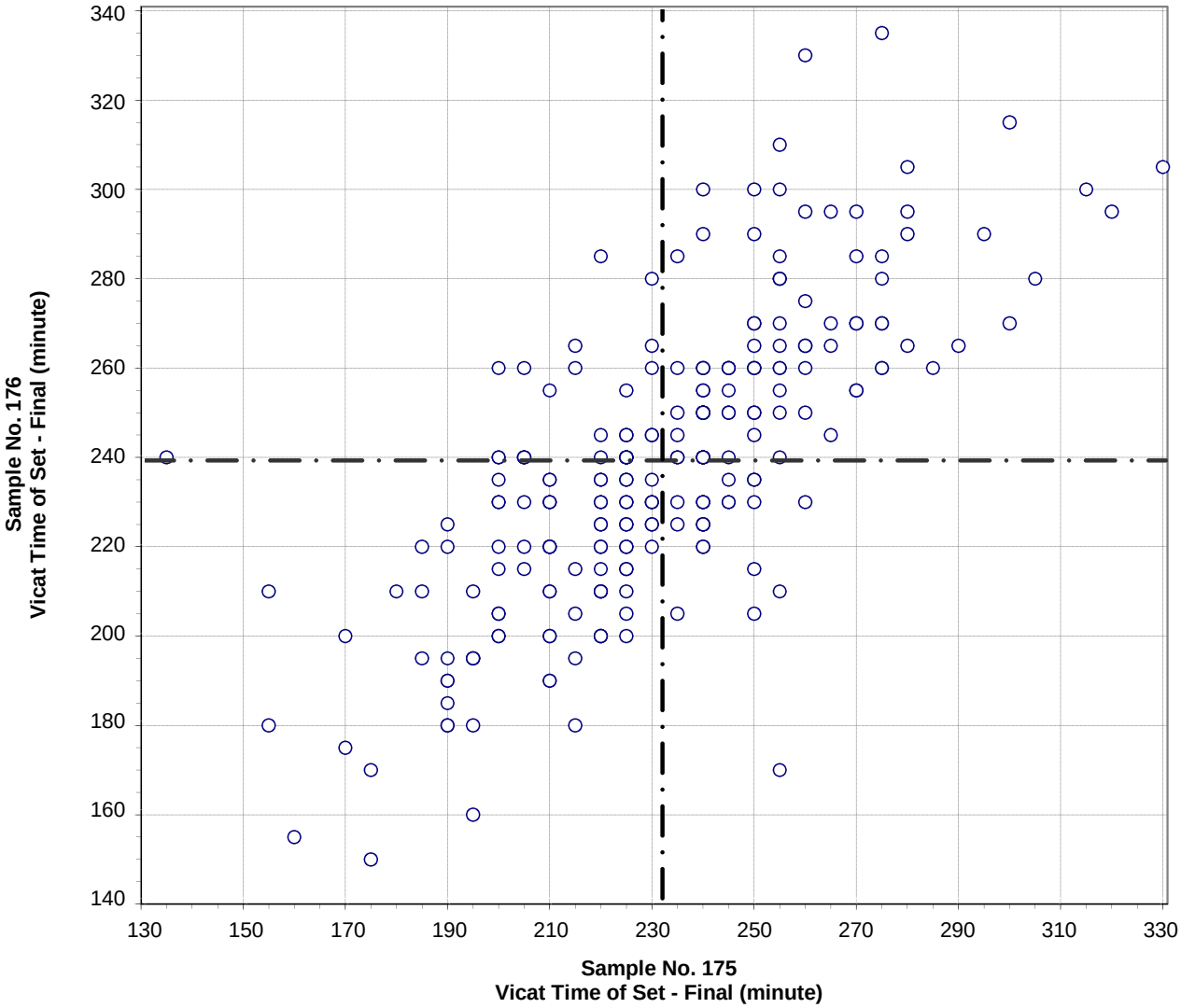


Test No. 120 Vicat Time of Set - Initial 241 Points

Sample No. 175	Ave	124	S.D.	14.9	C.V. 12.0
Sample No. 176	Ave	122	S.D.	15.9	C.V. 13.0

Labs eliminated: 3, 130, 1483, 1526, 2476, 2982

CCRL Proficiency Sample Program
Vicat Time of Set - Final
PORTLAND CEMENT Samples No. 175 and No. 176

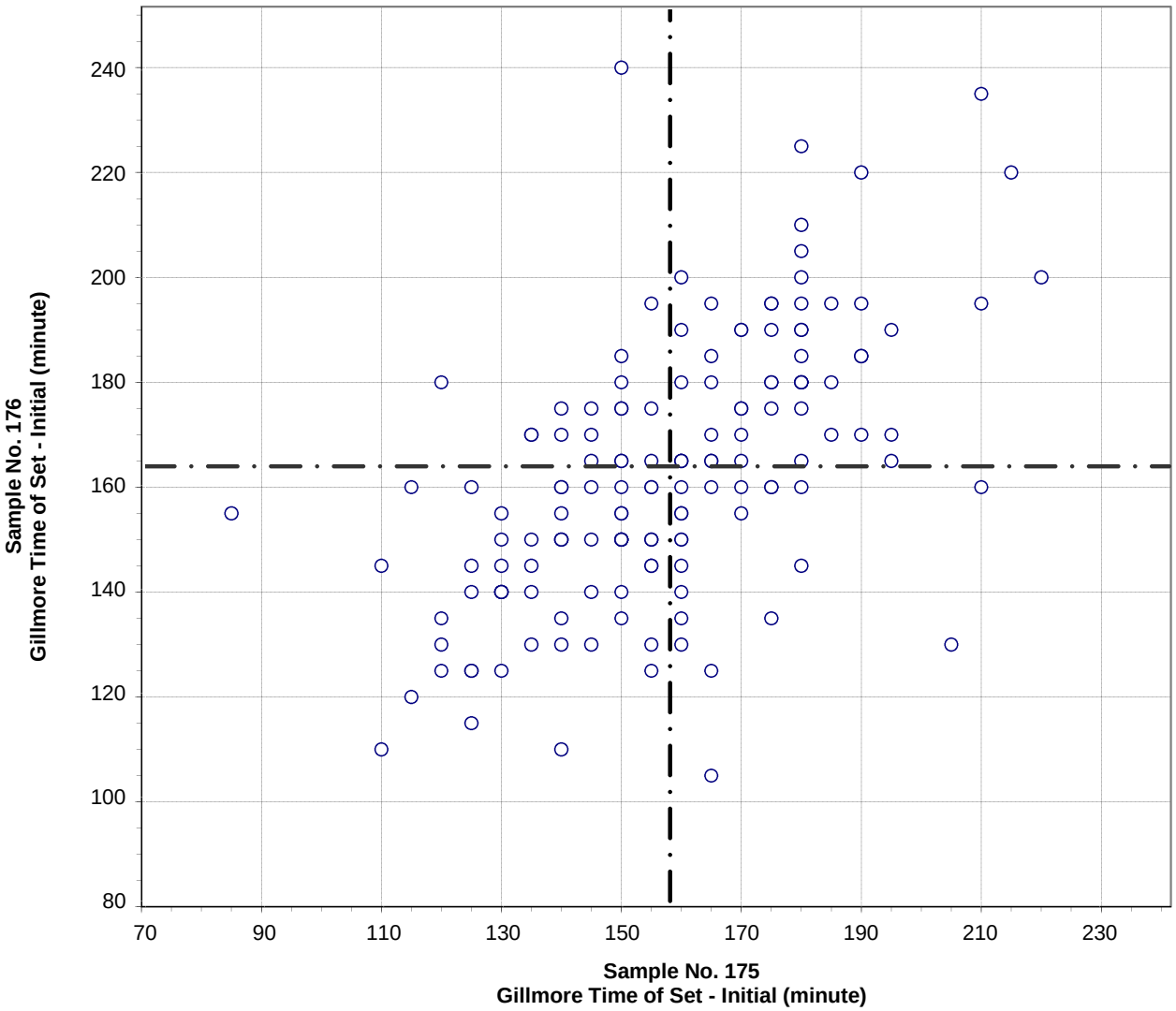


Test No. 121 Vicat Time of Set - Final 235 Points

Sample No. 175	Ave	232	S.D.	30	C.V.	12.9
Sample No. 176	Ave	239	S.D.	33	C.V.	13.6

Labs eliminated: 3, 441, 2982

CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 175 and No. 176



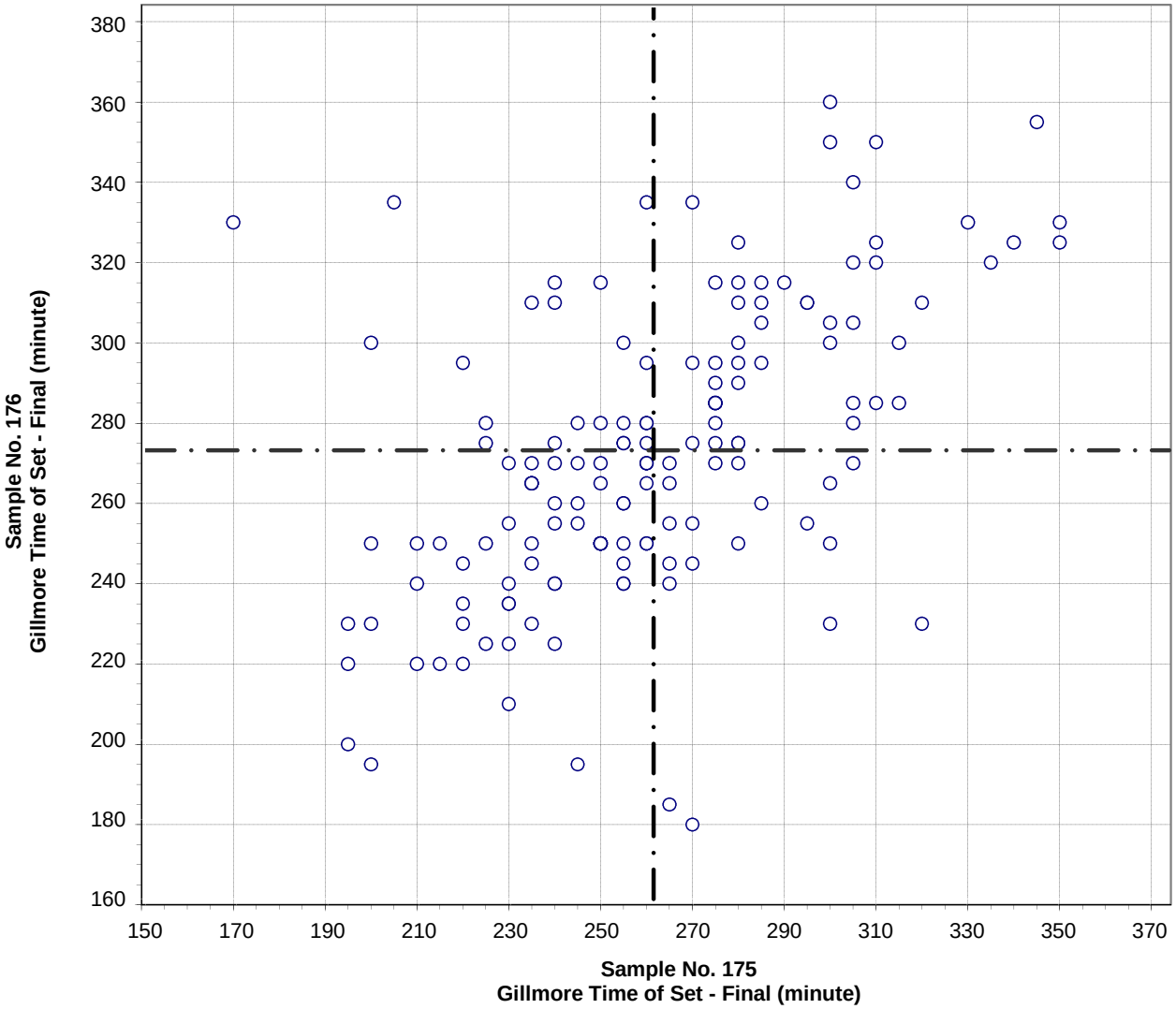
Test No. 130 Gillmore Time of Set - Initial 151 Points

Sample No. 175	Ave	158	S.D.	24	C.V.	15.0
Sample No. 176	Ave	164	S.D.	27	C.V.	16.5

Labs eliminated: 103, 180, 415, 2476

Labs off Diagram: 167, 2305

CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 175 and No. 176

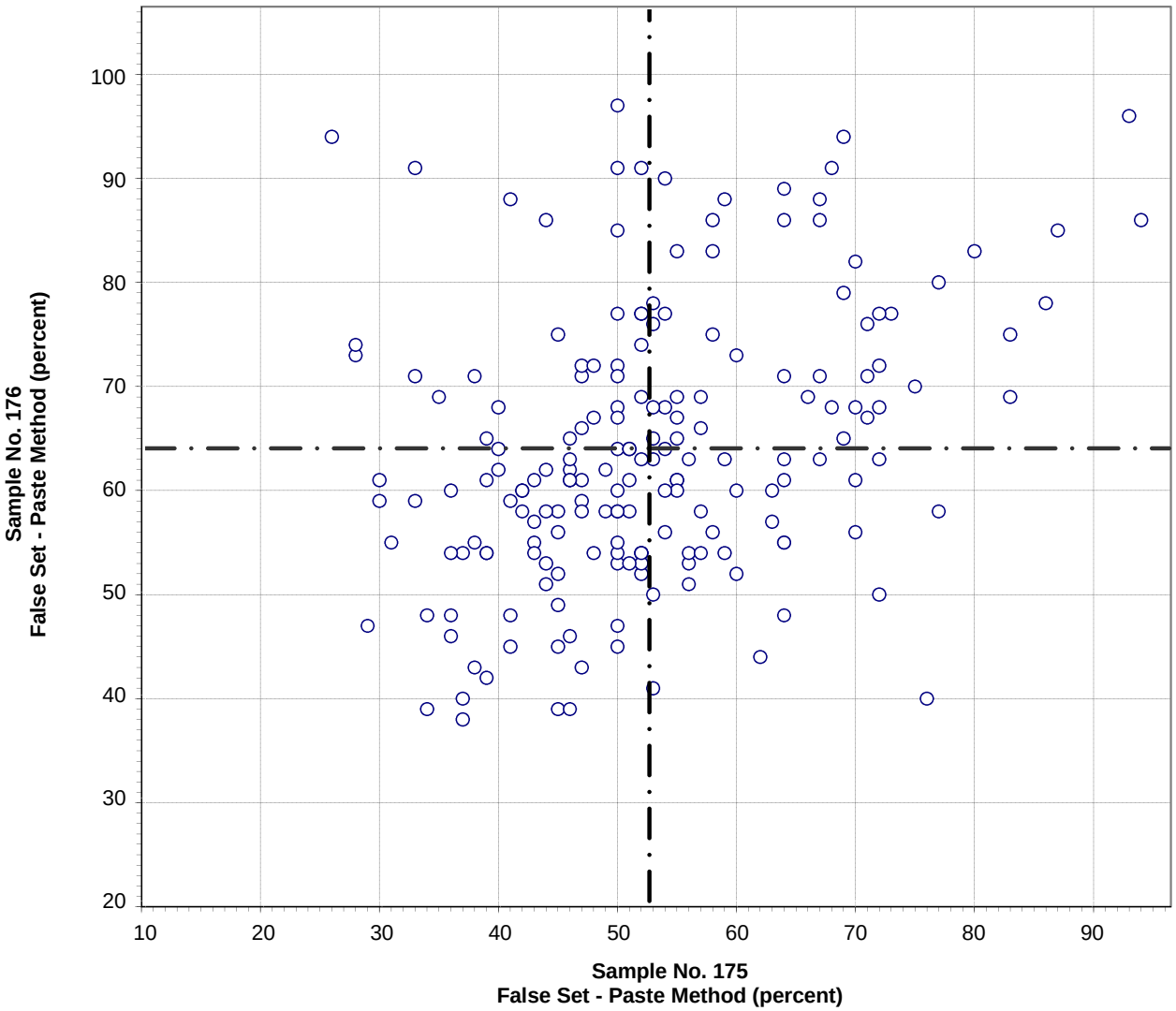


Test No. 140 Gillmore Time of Set - Final 152 Points

Sample No. 175	Ave	261	S.D.	35	C.V.	13.3
Sample No. 176	Ave	273	S.D.	36	C.V.	13.2

Labs eliminated: 38, 46, 75, 167, 180

CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 175 and No. 176

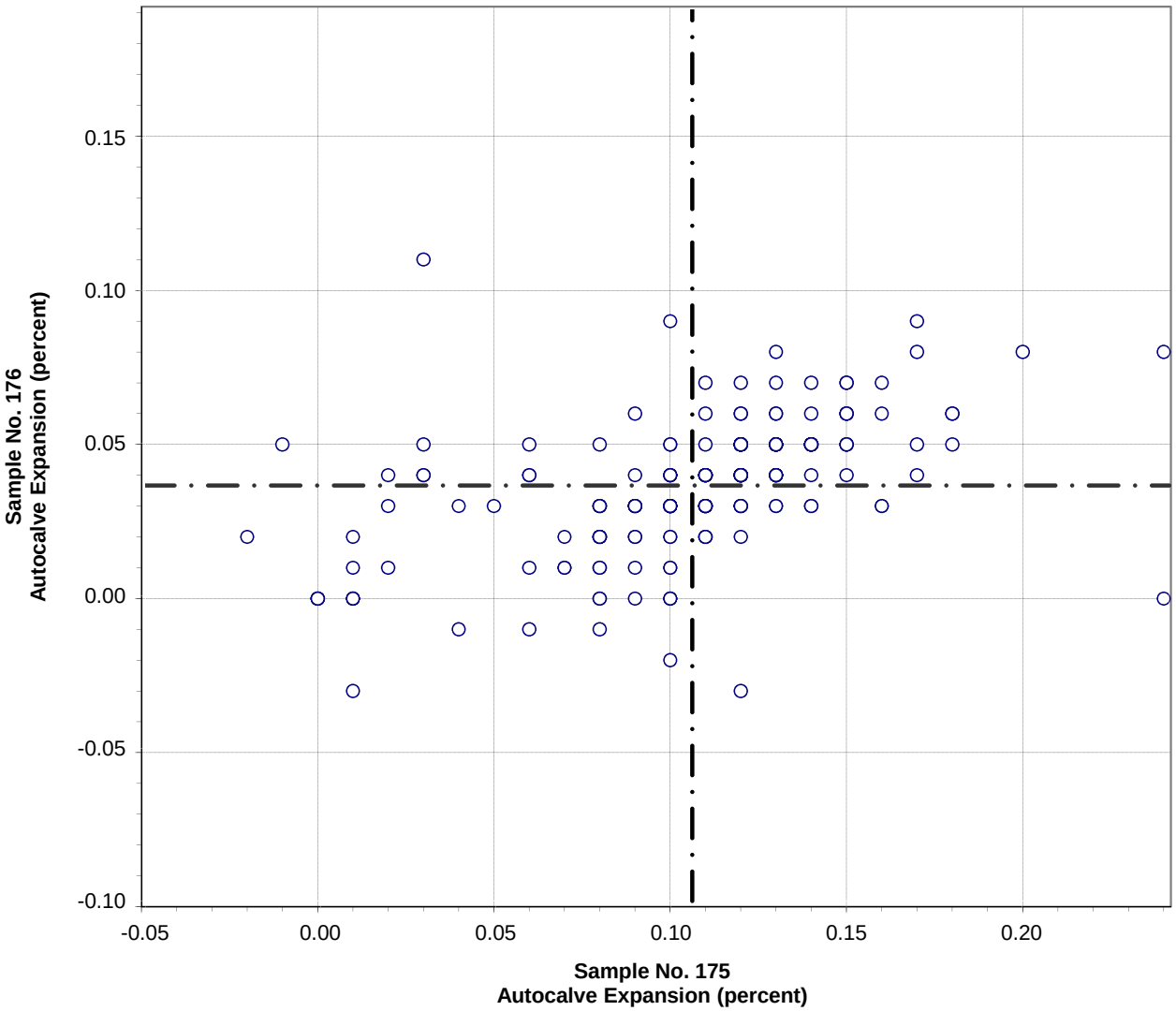


Test No. 150 False Set - Paste Method 190 Points

Sample No. 175	Ave	53	S.D.	13.5	C.V. 25.7
Sample No. 176	Ave	64	S.D.	13.1	C.V. 20.5

Labs off Diagram: 3464

CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 175 and No. 176

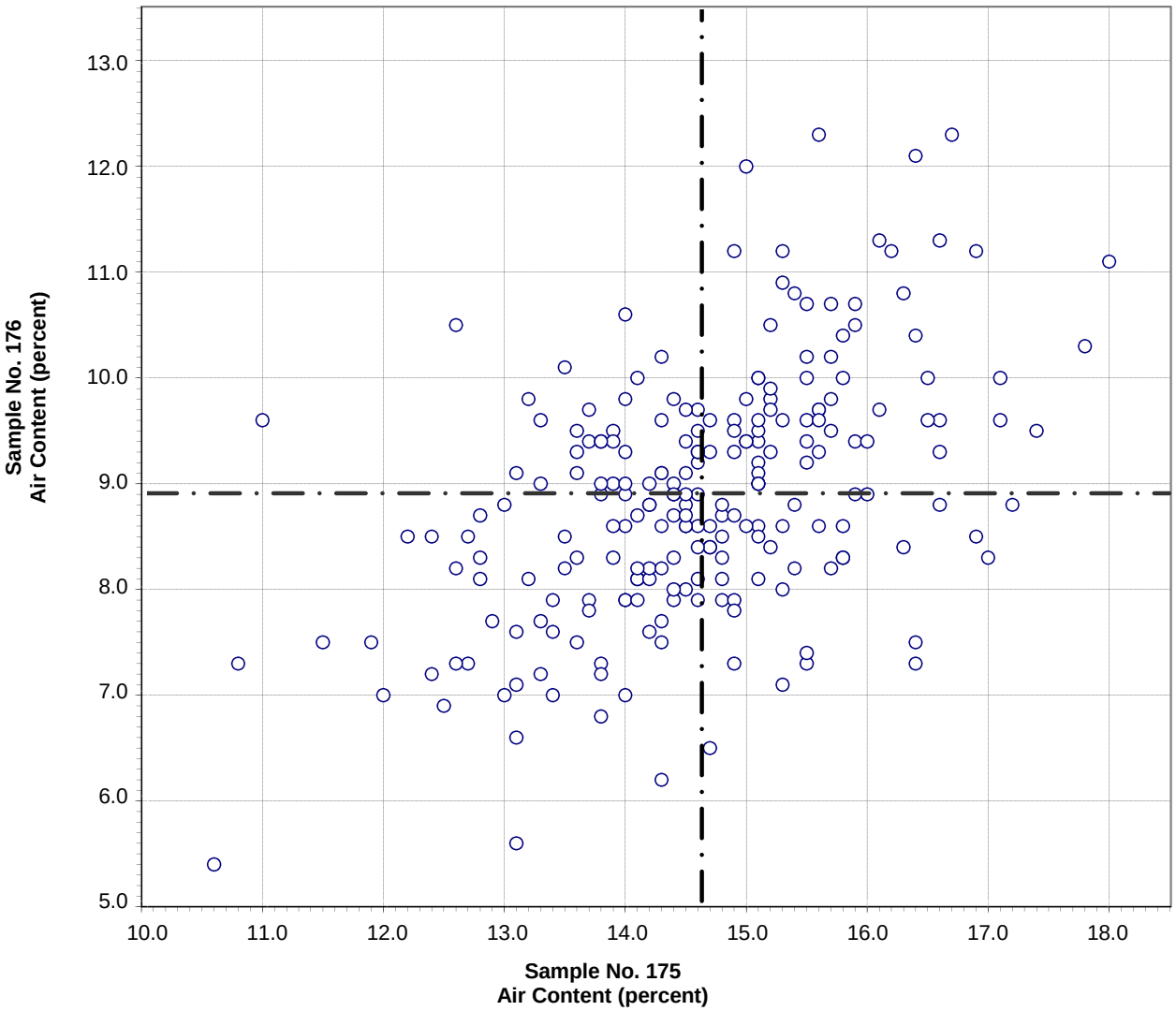


Test No. 160 Autoclave Expansion 220 Points

Sample No. 175	Ave	0.11	S.D.	0.04	C.V.	38.9
Sample No. 176	Ave	0.04	S.D.	0.02	C.V.	57.3

Labs eliminated: 134, 982, 5, 90, 93, 196, 1251, 2251, 2462, 3413

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 175 and No. 176

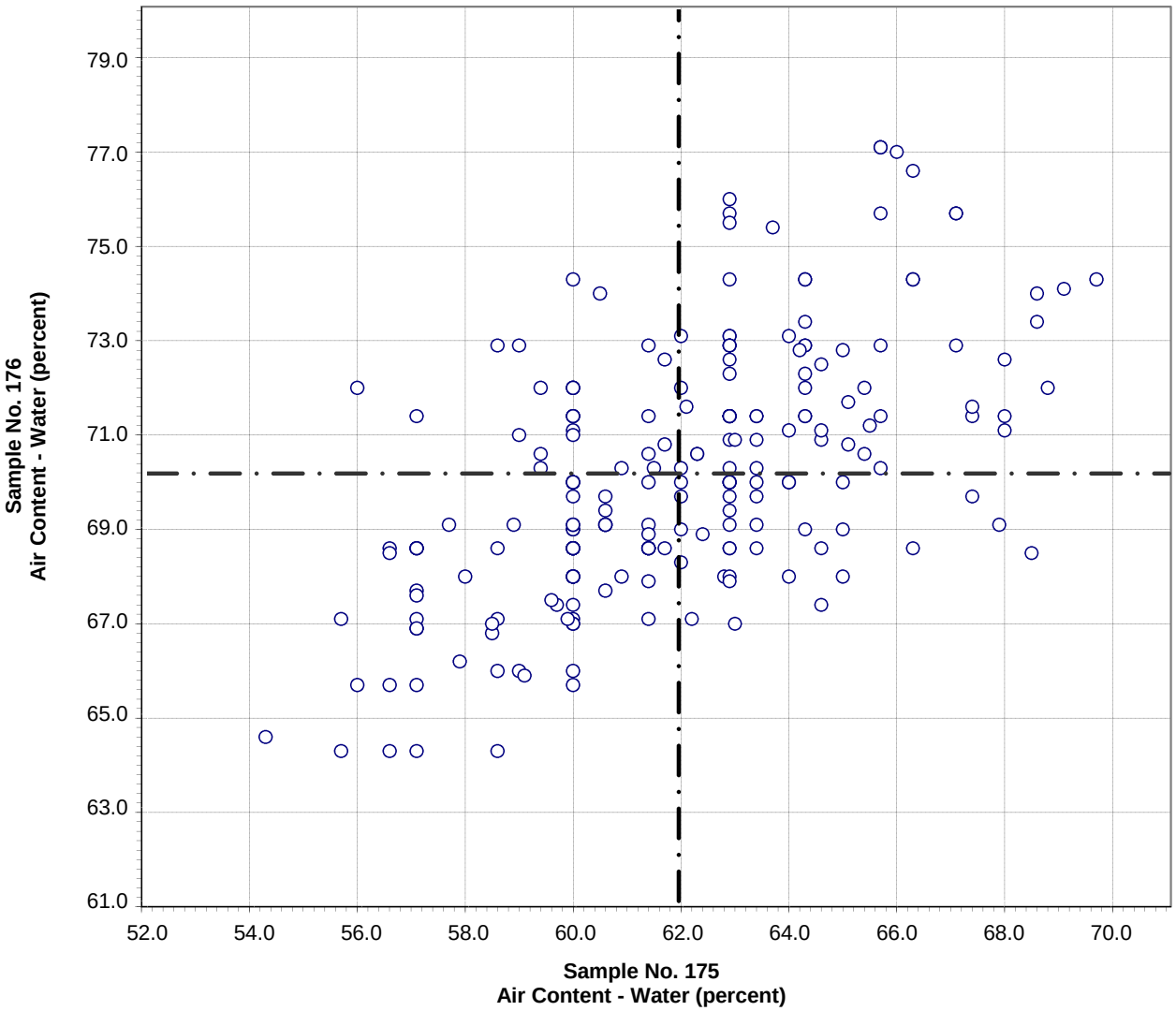


Test No. 170 Air Content % 224 Points

Sample No. 175 Ave 14.6 S.D. 1.2 C.V. 8.5
Sample No. 176 Ave 8.9 S.D. 1.2 C.V. 13.1

Labs eliminated: 196, 23, 2435, 2476, 2522

CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 175 and No. 176

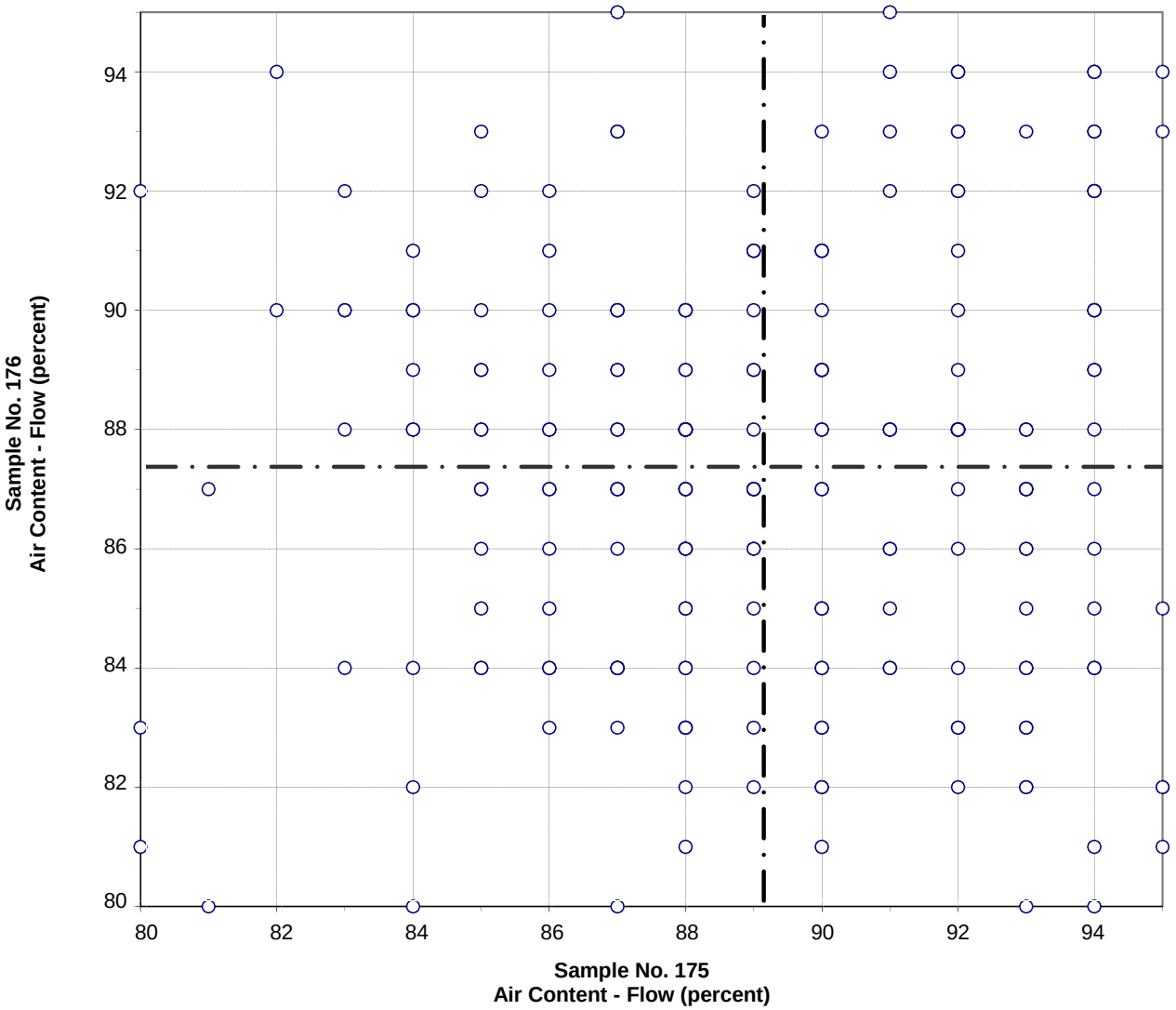


Test No. 180 Air Content - % Water 220 Points

Sample No. 175	Ave	61.9	S.D.	3.0	C.V. 4.9
Sample No. 176	Ave	70.2	S.D.	2.6	C.V. 3.7

Labs eliminated: 203, 343, 1190, 2476

CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 175 and No. 176

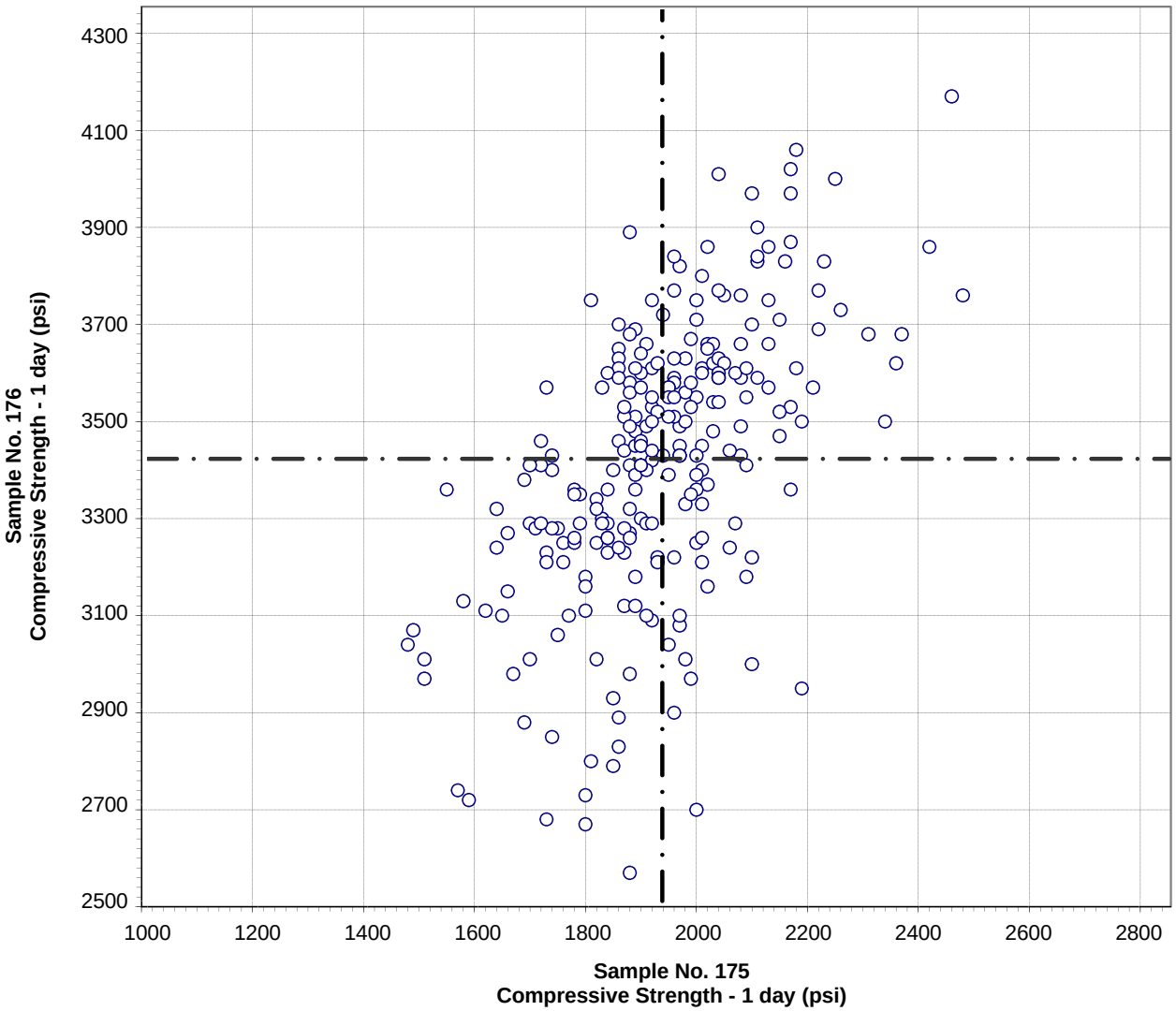


Test No. 190 Air Content - Flow 223 Points

Sample No. 175	Ave	89	S.D.	3.4	C.V. 3.8
Sample No. 176	Ave	87	S.D.	3.5	C.V. 4.0

Labs eliminated: 2363

CCRL Proficiency Sample Program
Compressive Strength - 1 day
PORTLAND CEMENT Samples No. 175 and No. 176

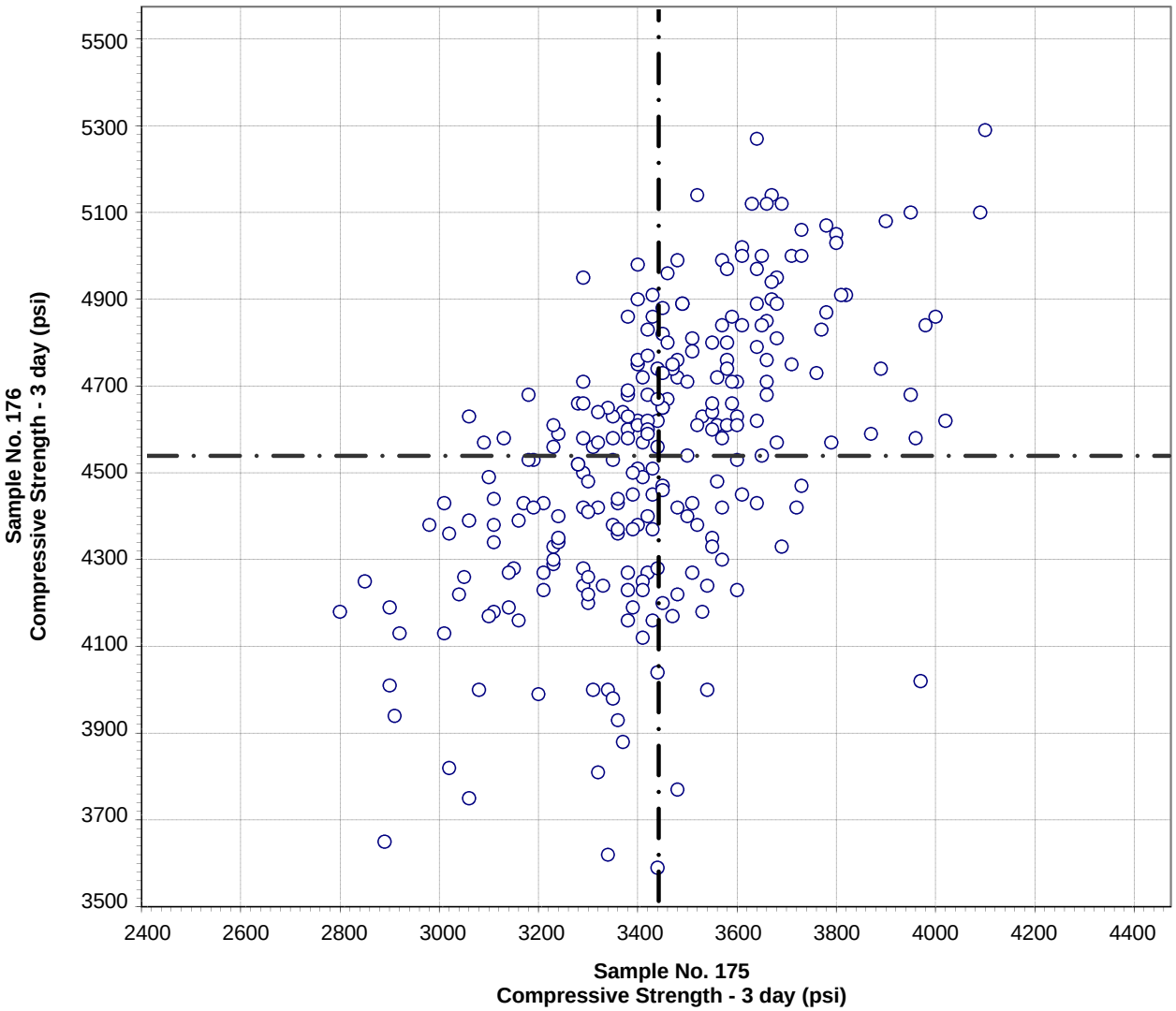


Test No. 199 Compressive Strength - 1 day 250 Points

Sample No. 175	Ave	1935	S.D.	169	C.V.	8.7
Sample No. 176	Ave	3420	S.D.	286	C.V.	8.3

Labs eliminated: 103, 196, 2476, 3255

CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 175 and No. 176



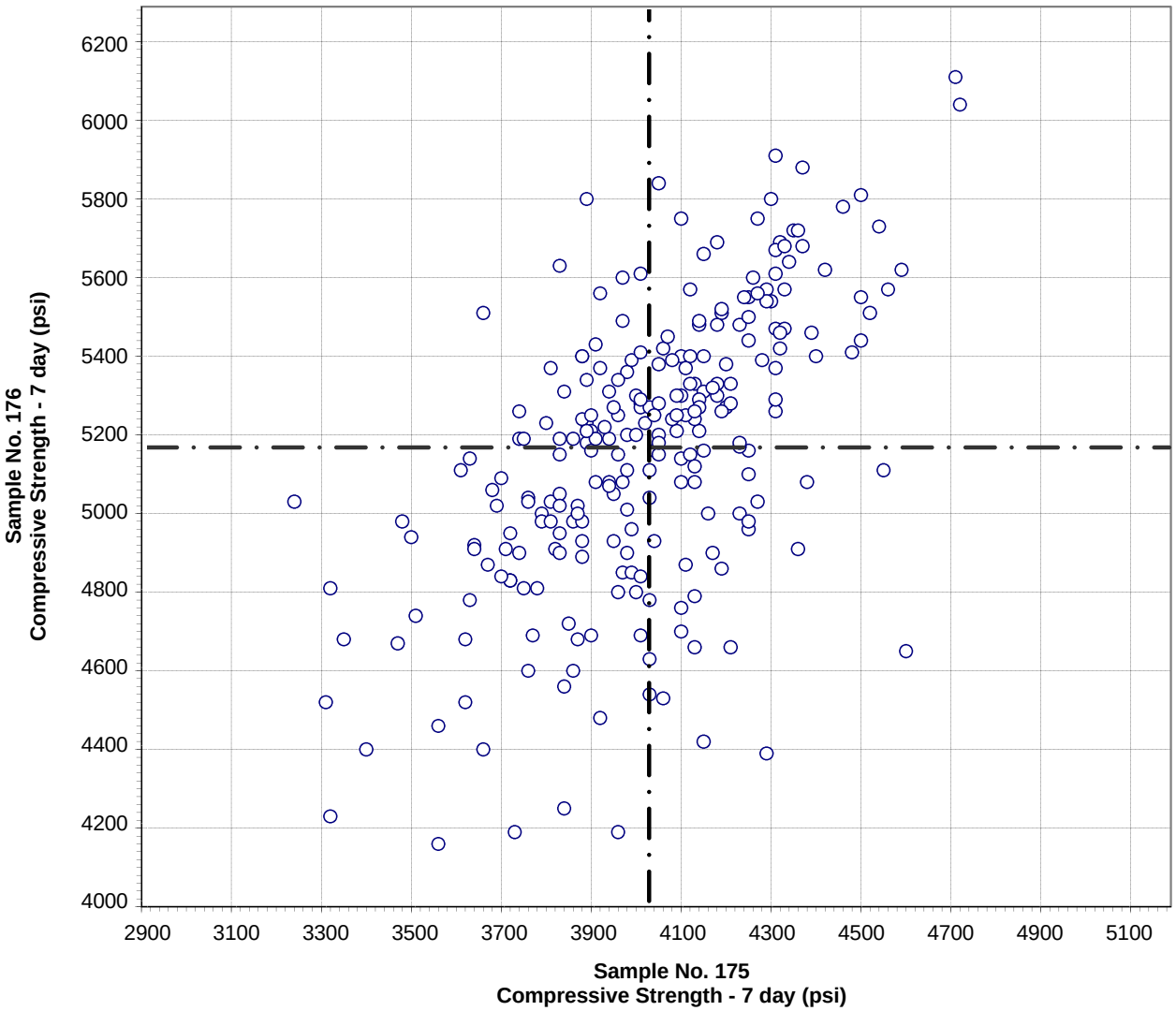
Test No. 200 Compressive Strength - 3 day 254 Points

Sample No. 175	Ave	3438	S.D.	234	C.V. 6.8
Sample No. 176	Ave	4536	S.D.	324	C.V. 7.1

Labs eliminated: 43, 103, 2476, 3422

Labs off Diagram: 2296

CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 175 and No. 176

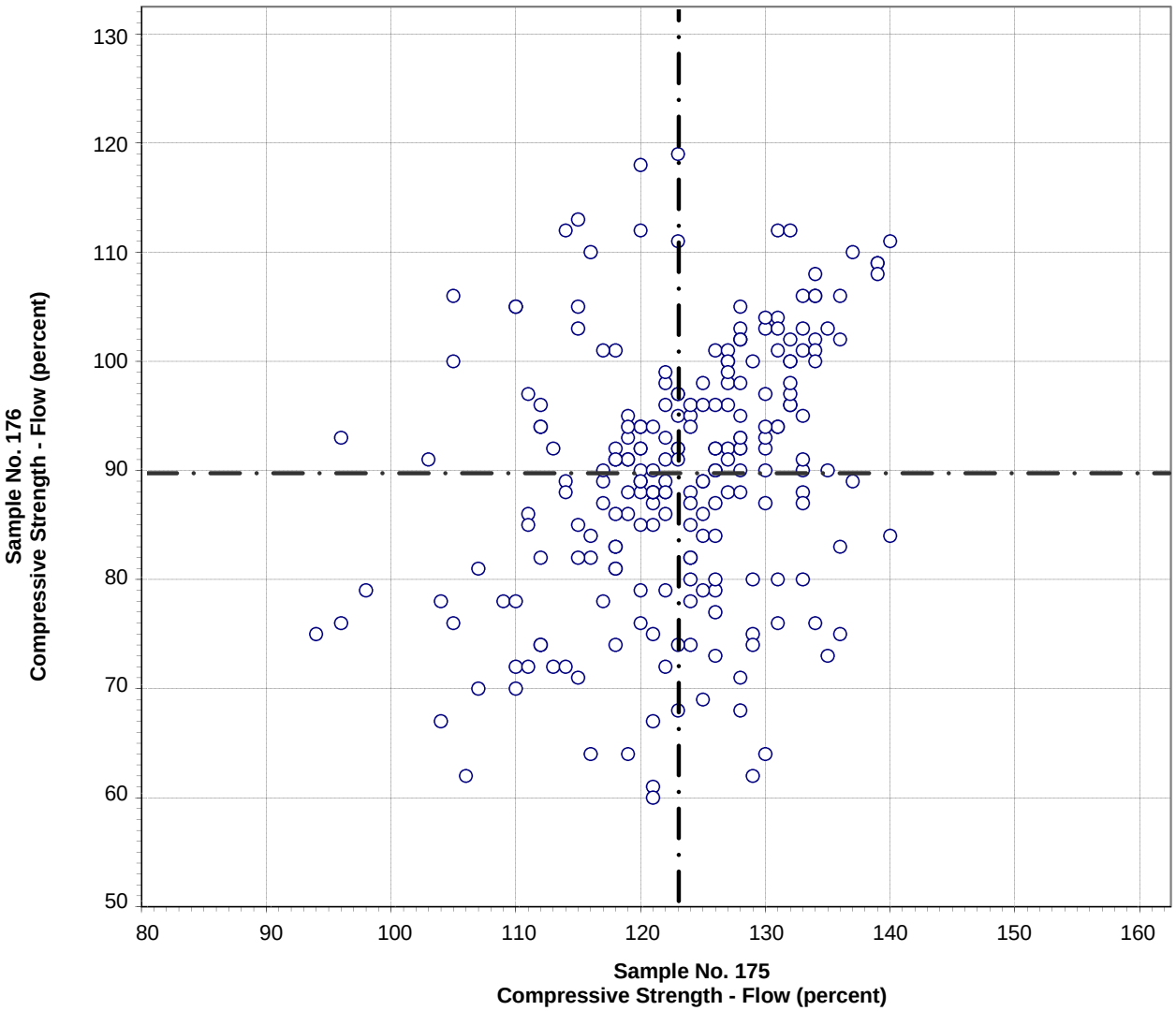


Test No. 210 Compressive Strength - 7 day 251 Points

Sample No. 175	Ave	4024	S.D.	262	C.V.	6.5
Sample No. 176	Ave	5165	S.D.	360	C.V.	7.0

Labs eliminated: 37, 2296, 2476, 3422

CCRL Proficiency Sample Program
Compressive Strength - Flow
PORTLAND CEMENT Samples No. 175 and No. 176

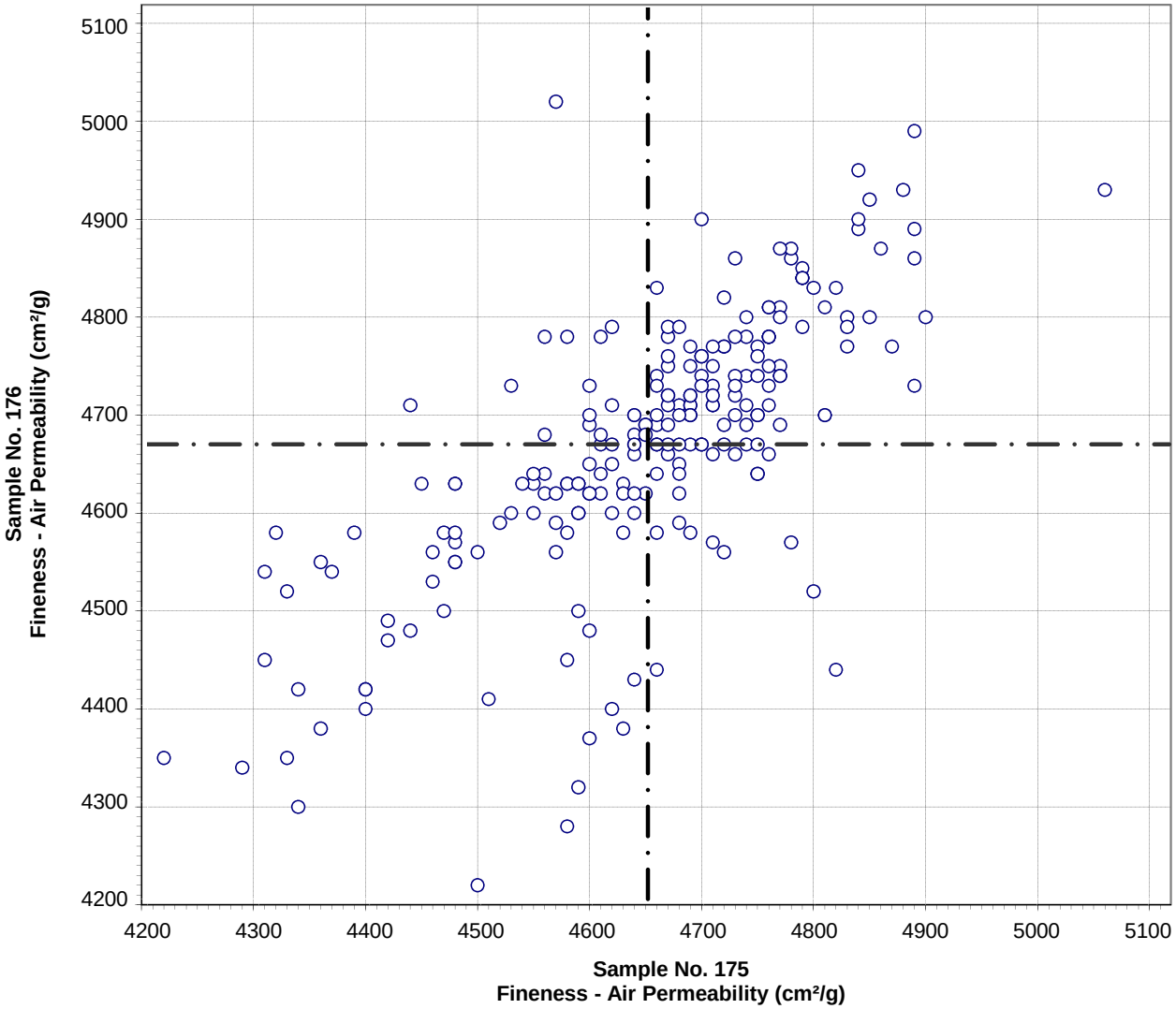


Test No. 230 Compressive Strength - Flow 229 Points

Sample No. 175 Ave 123 S.D. 9 C.V. 7.1
Sample No. 176 Ave 90 S.D. 12 C.V. 13.4

Labs eliminated: 129, 162, 2477, 3511

CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 175 and No. 176



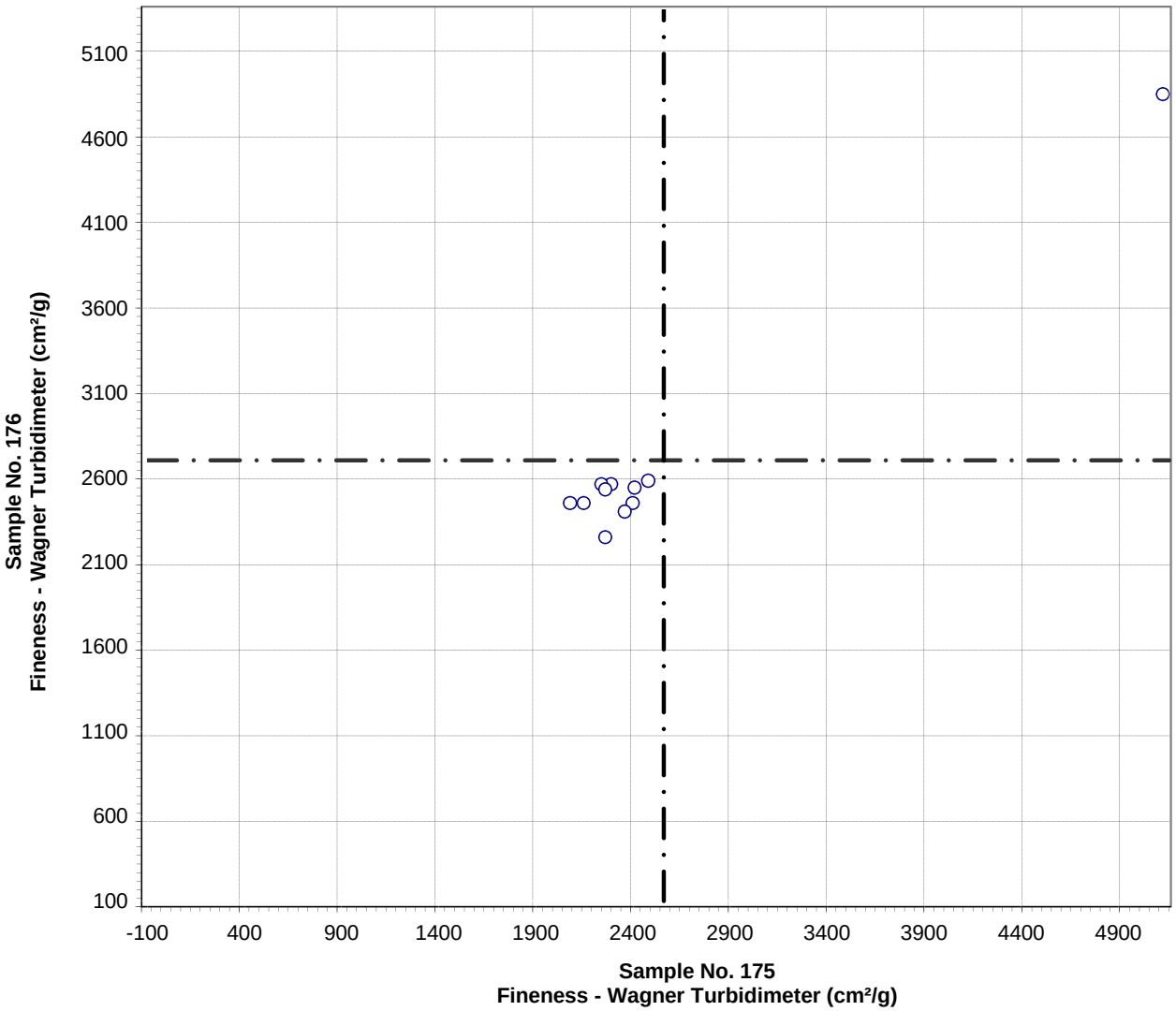
Test No. 270 Fineness - Air Permeability 228 Points

Sample No. 175 Ave 4650 S.D. 139 C.V. 3.0
Sample No. 176 Ave 4669 S.D. 140 C.V. 3.0

Labs eliminated: 18, 343, 14, 36, 116, 265, 450, 565, 768, 1435, 1594, 2293, 8, 19, 103, 1715, 2251, 2296

Labs off Diagram: 52, 169

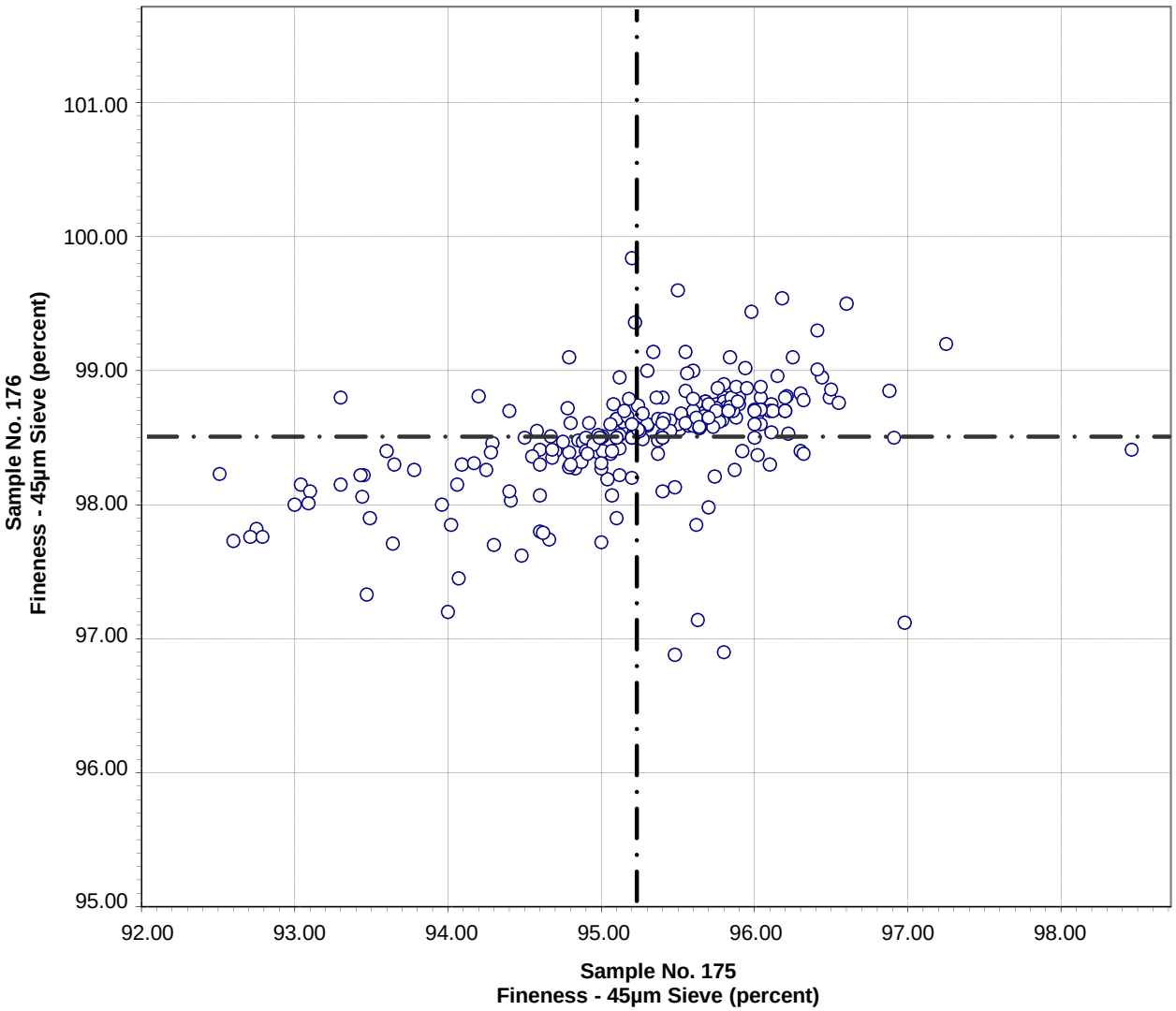
CCRL Proficiency Sample Program
Fineness - Wagner Turbidimeter
PORTLAND CEMENT Samples No. 175 and No. 176



Test No. 280 Fineness - Wagner Turbidimeter 11 Points

Sample No. 175	Ave	2559	S.D.	857	C.V.	33.5
Sample No. 176	Ave	2702	S.D.	719	C.V.	26.6

CCRL Proficiency Sample Program
Fineness - 45-micron Sieve
PORTLAND CEMENT Samples No. 175 and No. 176



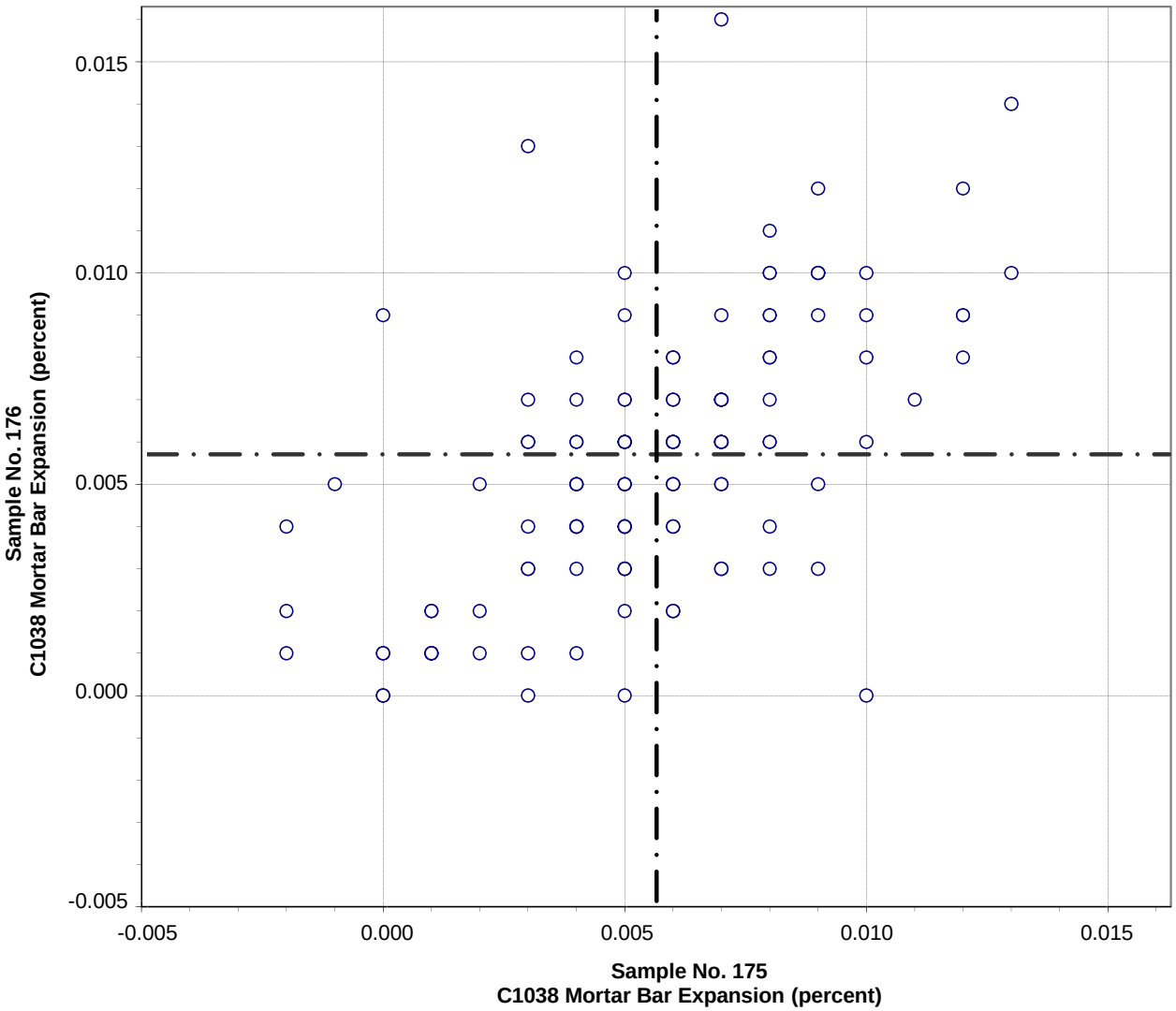
Test No. 281 Fineness - 45-micron Sieve 228 Points

Sample No. 175	Ave	95.22	S.D.	0.92	C.V.	1.0
Sample No. 176	Ave	98.50	S.D.	0.43	C.V.	0.4

Labs eliminated: 2, 42, 49, 169, 493, 502, 958, 1942, 2476, 2477, 2491, 3368

Labs off Diagram: 23

CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 175 and No. 176



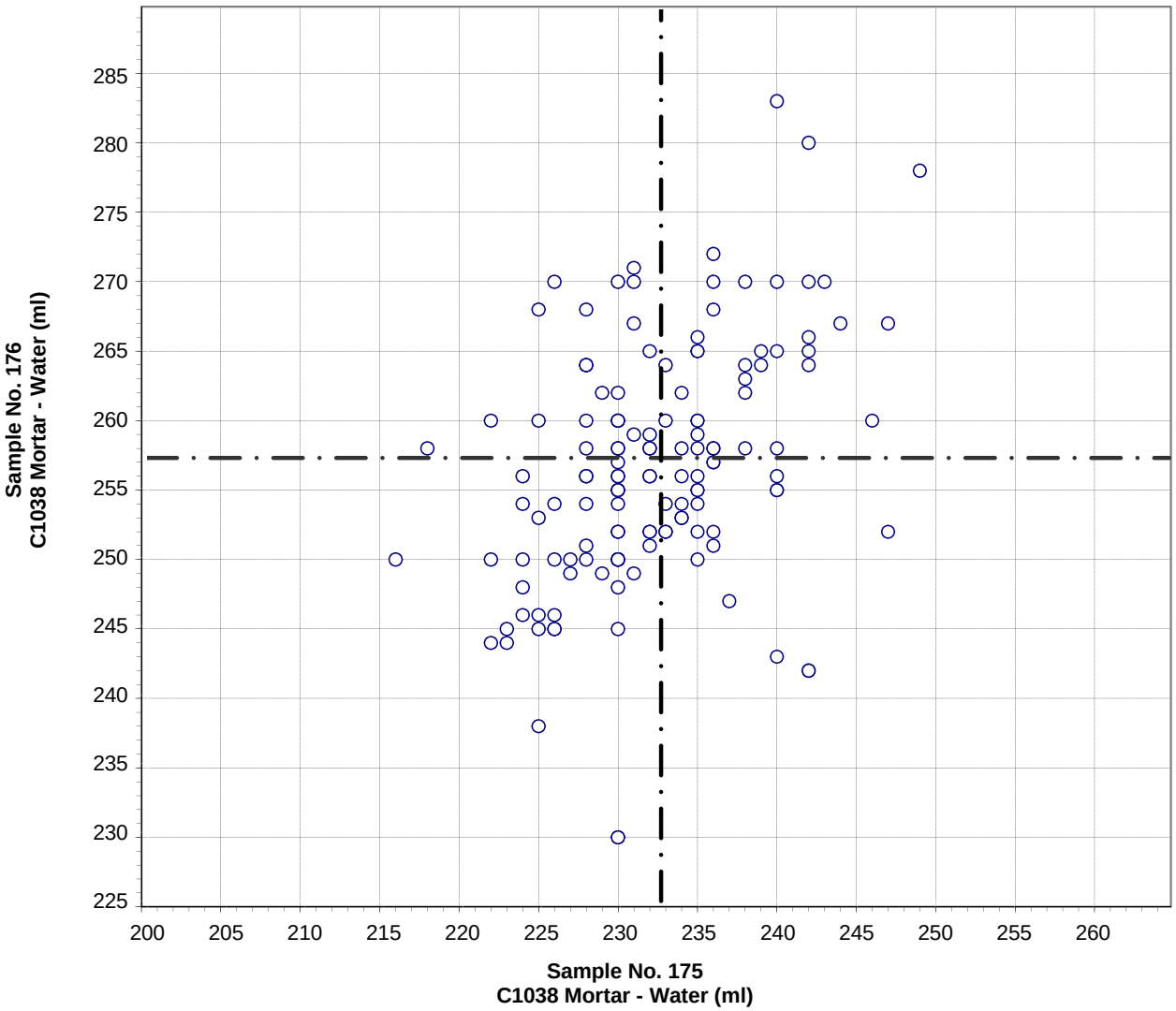
Test No. 400 C1038 Mortar Bar Expansion 134 Points

Sample No. 175	Ave	0.006	S.D.	0.003	C.V.	57.3
Sample No. 176	Ave	0.006	S.D.	0.003	C.V.	57.6

Labs eliminated: 8, 134, 125, 146, 958, 2296, 2466, 20, 34, 84, 975, 3057

Labs off Diagram: 40, 823

CCRL Proficiency Sample Program
C1038 Mortar - Water
PORTLAND CEMENT Samples No. 175 and No. 176



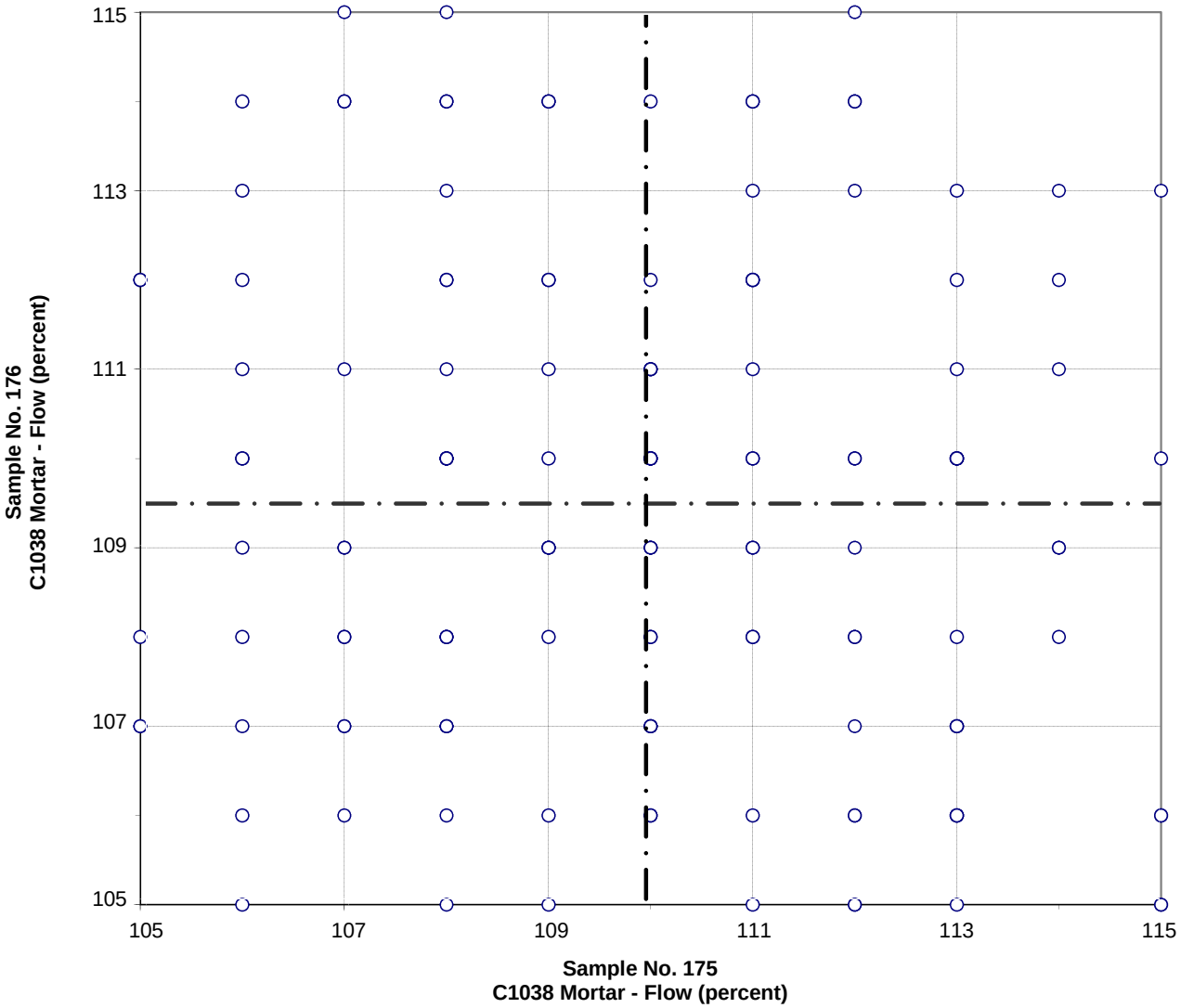
Test No. 401 C1038 Mortar - Water 138 Points

Sample No. 175 Ave 233 S.D. 6 C.V. 2.7
Sample No. 176 Ave 257 S.D. 10 C.V. 3.7

Labs eliminated: 408, 611, 691, 2476

Labs off Diagram: 1435, 2296

CCRL Proficiency Sample Program
C1038 Mortar - Flow
PORTLAND CEMENT Samples No. 175 and No. 176



Test No. 402 C1038 Mortar - Flow 137 Points

Sample No. 175	Ave 110	S.D. 3	C.V. 2.4
Sample No. 176	Ave 109	S.D. 3	C.V. 2.5

Labs eliminated: 46, 106, 134, 167

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 175 and No. 176
Final Report - Heat of Hydration Results
March 26, 2010
SUMMARY OF RESULTS

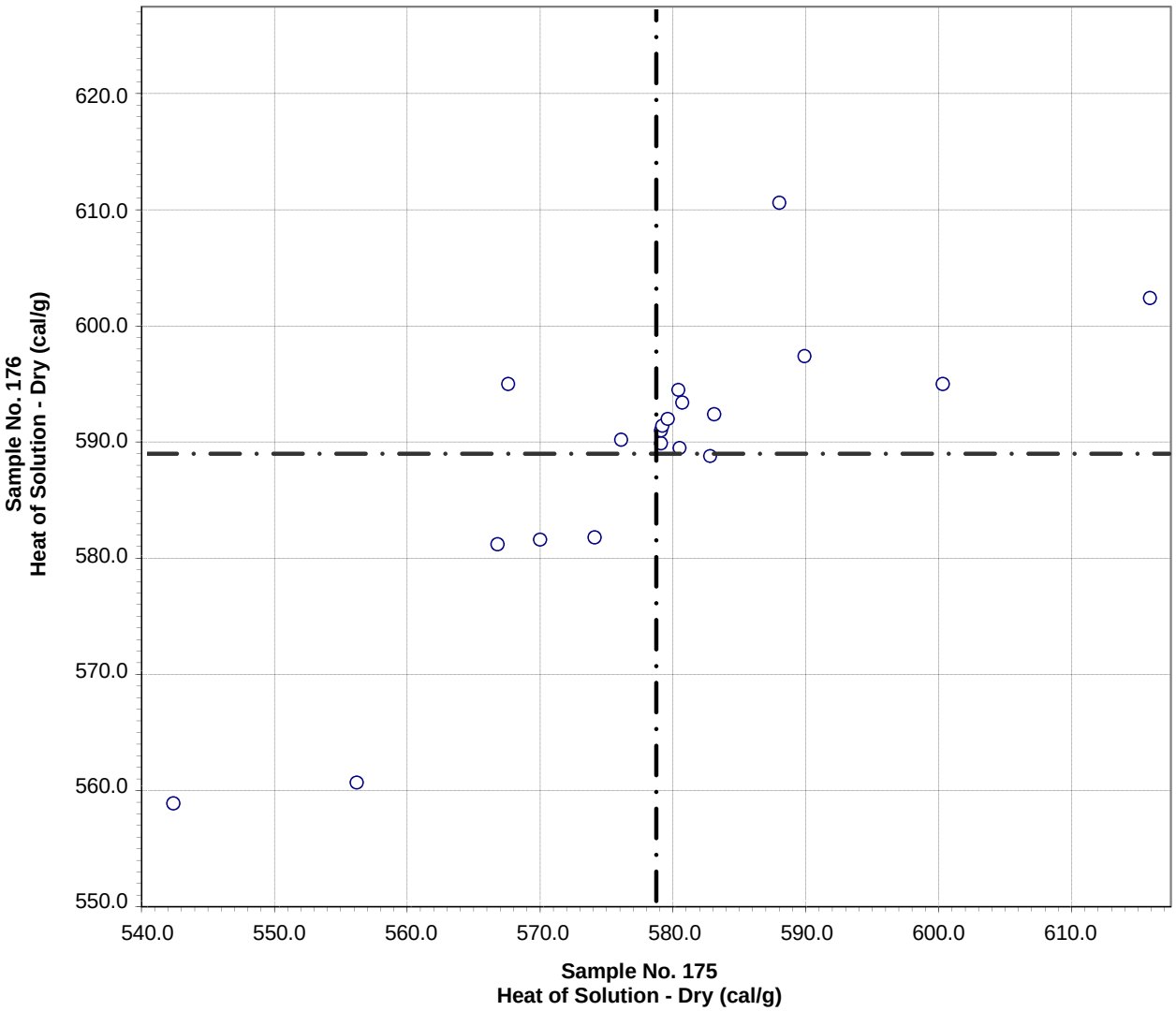
Test		#Labs	Sample No. 175 Average	S.D.	C.V.	Sample No. 176 Average	S.D.	C.V.
C186 HEAT OF HYDRATION								
Heat Solution, Dry	cal/g	21	581.9	21.1	3.6	589.8	12.4	2.1
Heat Solution, Dry	cal/g	*20	578.6	15.0	2.6	588.9	12.0	2.0
Heat Sol, 7 day	cal/g	21	493.6	20.0	4.0	499.9	10.9	2.2
Heat Sol, 7 day	cal/g	*20	496.7	14.8	3.0	499.4	10.9	2.2
Heat Sol, 28 day	cal/g	15	490.0	9.7	2.0	493.6	7.8	1.6
Heat Hyd, 7 day	cal/g	23	84.6	19.2	22.7	89.3	9.2	10.2
Heat Hyd, 7 day	cal/g	*22	80.8	5.4	6.7	87.8	5.6	6.4
Heat Hyd, 28 day	cal/g	20	87.5	5.1	5.8	94.2	6.0	6.3
Heat Hyd, 28 day	cal/g	*19	88.4	3.3	3.8	94.8	5.4	5.7
C1702 HEAT OF HYDRATION USING ISOTHERMAL CONDUCTION CALORIMETRY								
Heat Hyd, 3 day	J/g	7	268	99	36.9	326	121	37.2
Heat Hyd, 7 day	J/g	7	318	119	37.3	363	138	38.0

* ELIMINATED LABS: Data over three S.D. from the mean

C186 HEAT OF HYDRATION

Heat of Solution, Dry	491
Heat of Solution, 7 day	3057
Heat of Hydration, 7 day	491
Heat of Hydration, 28 day	2360

CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 175 and No. 176

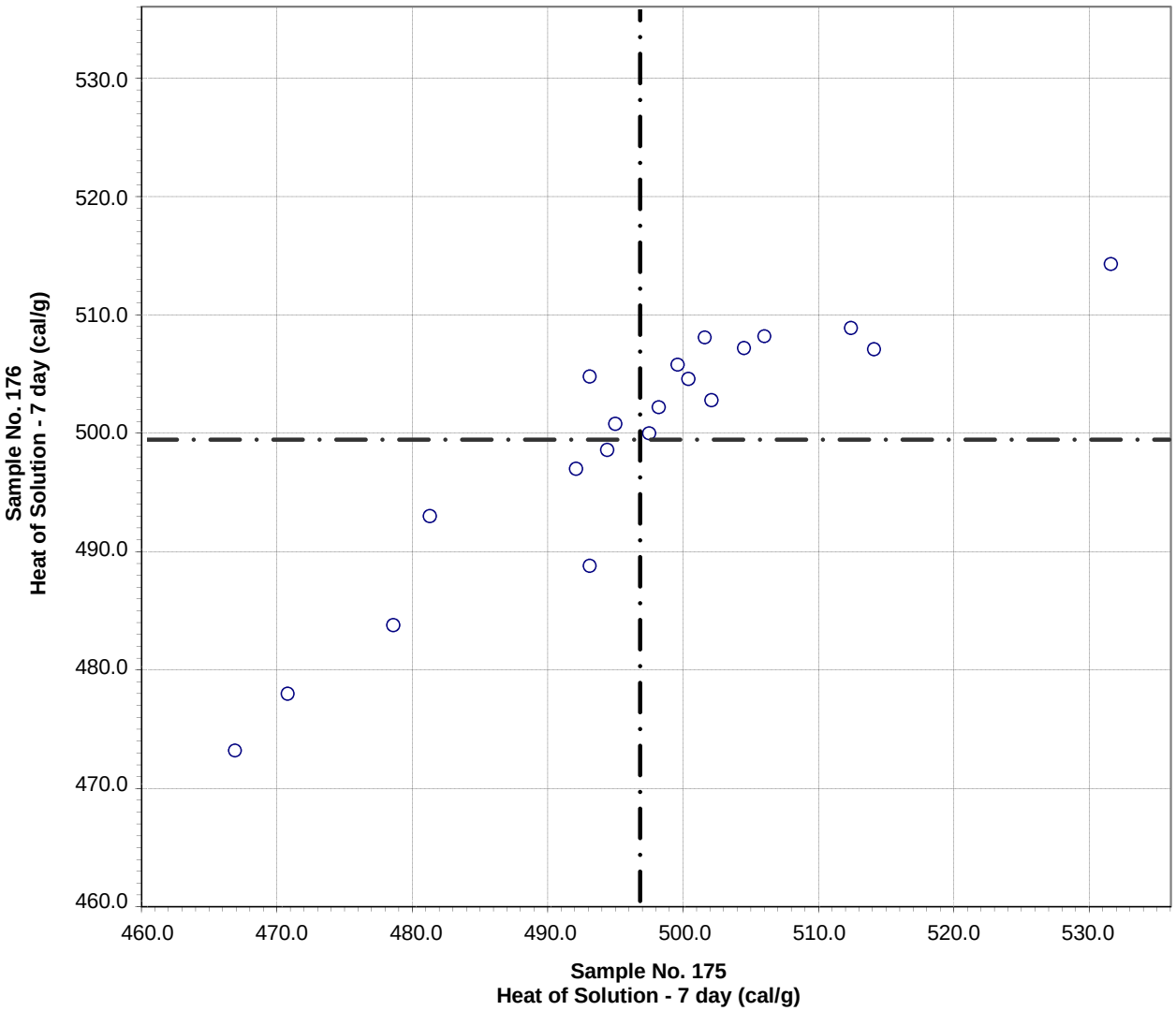


Test No. 291 C186 Heat of Solution - Dry 20 Points

Sample No. 175	Ave	578.6	S.D.	15.0	C.V.	2.6
Sample No. 176	Ave	588.9	S.D.	12.0	C.V.	2.0

Labs eliminated: 491

CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 175 and No. 176

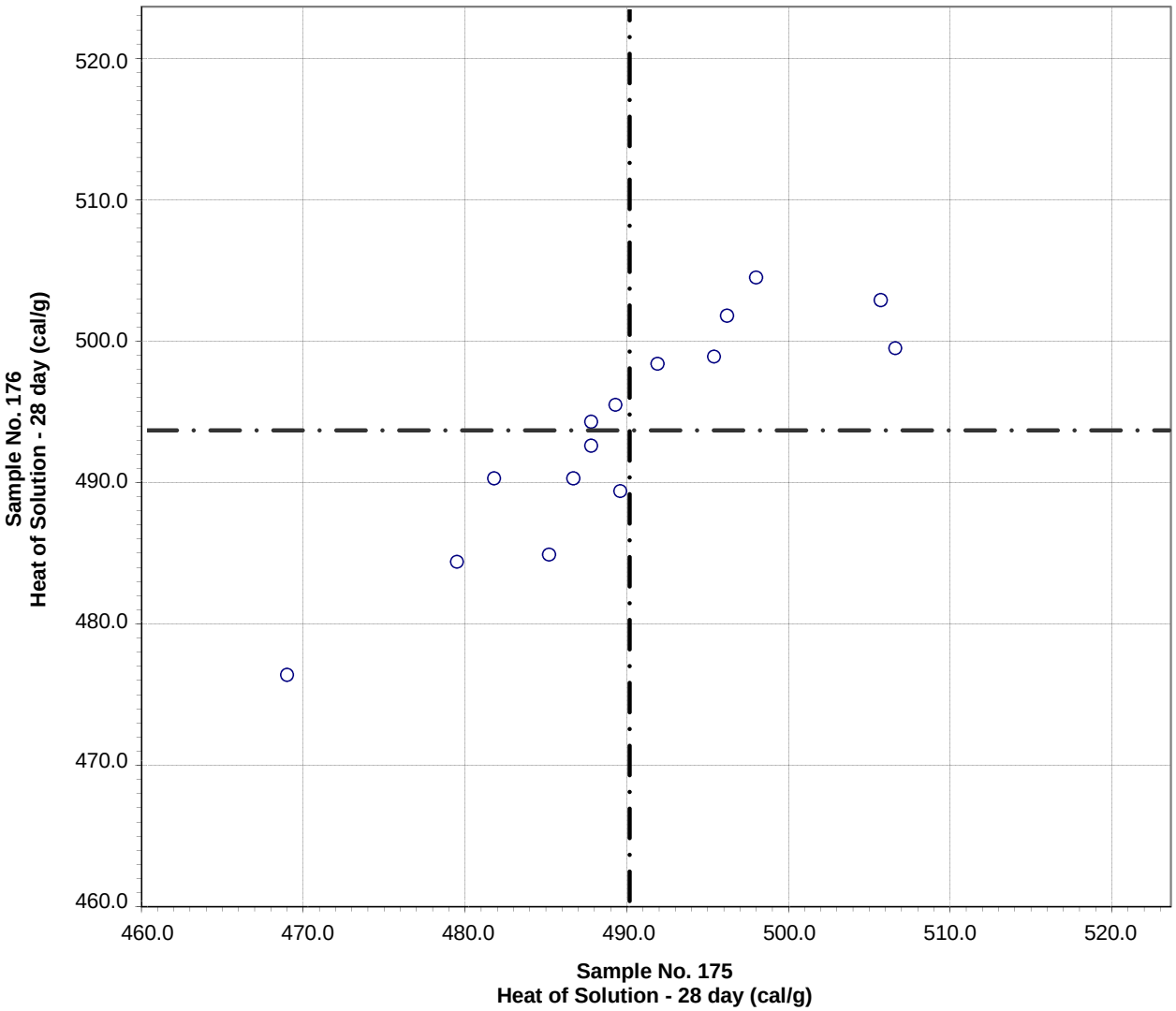


Test No. 292 C186 Heat of Solution - 7 day 20 Points

Sample No. 175	Ave	496.7	S.D.	14.8	C.V.	3.0
Sample No. 176	Ave	499.4	S.D.	10.9	C.V.	2.2

Labs eliminated: 3057

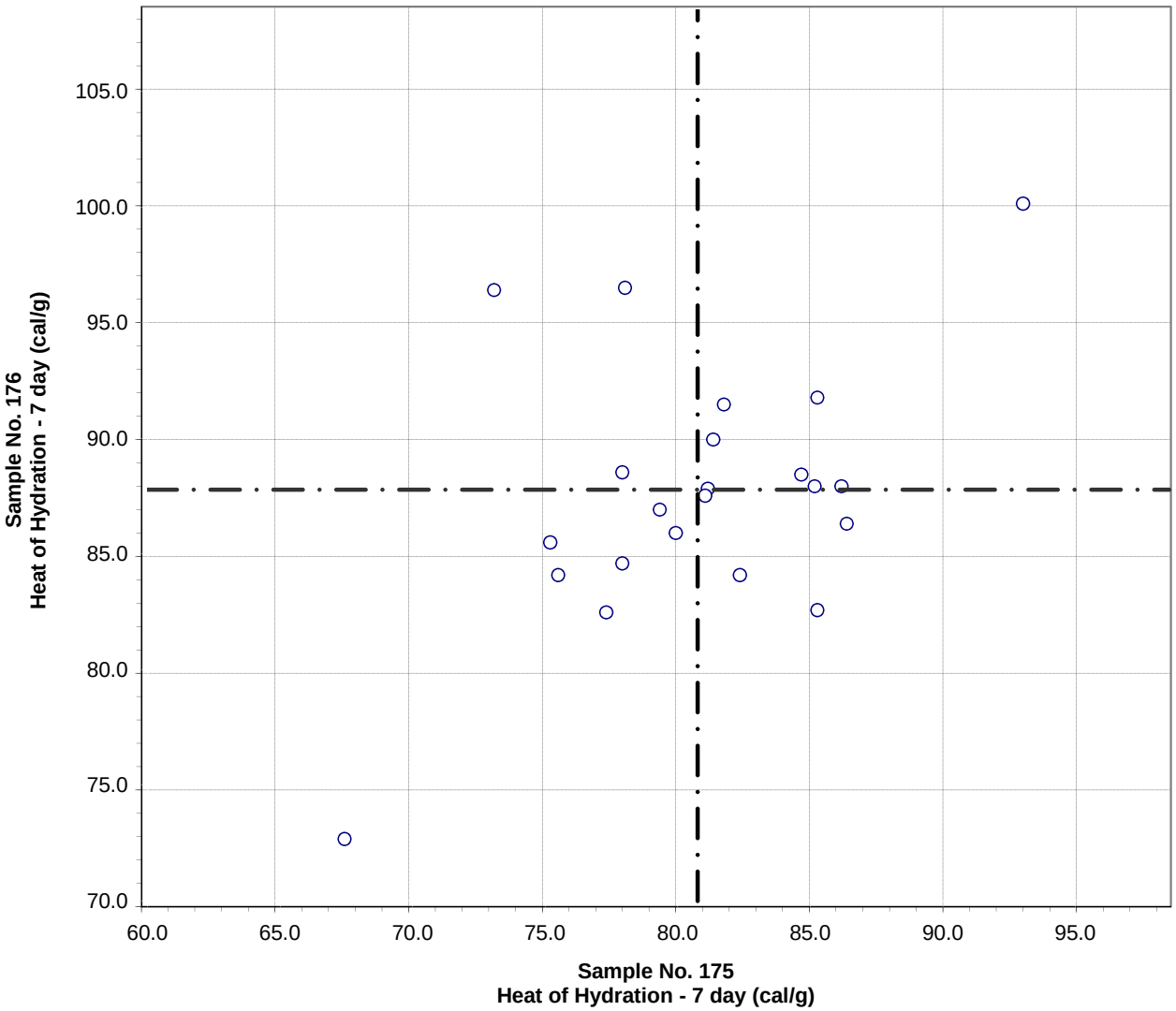
CCRL Proficiency Sample Program
C186 Heat of Solution - 28 day
PORTLAND CEMENT Samples No. 175 and No. 176



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

Sample No. 175	Ave	490.0	S.D.	9.7	C.V.	2.0
Sample No. 176	Ave	493.6	S.D.	7.8	C.V.	1.6

CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 175 and No. 176

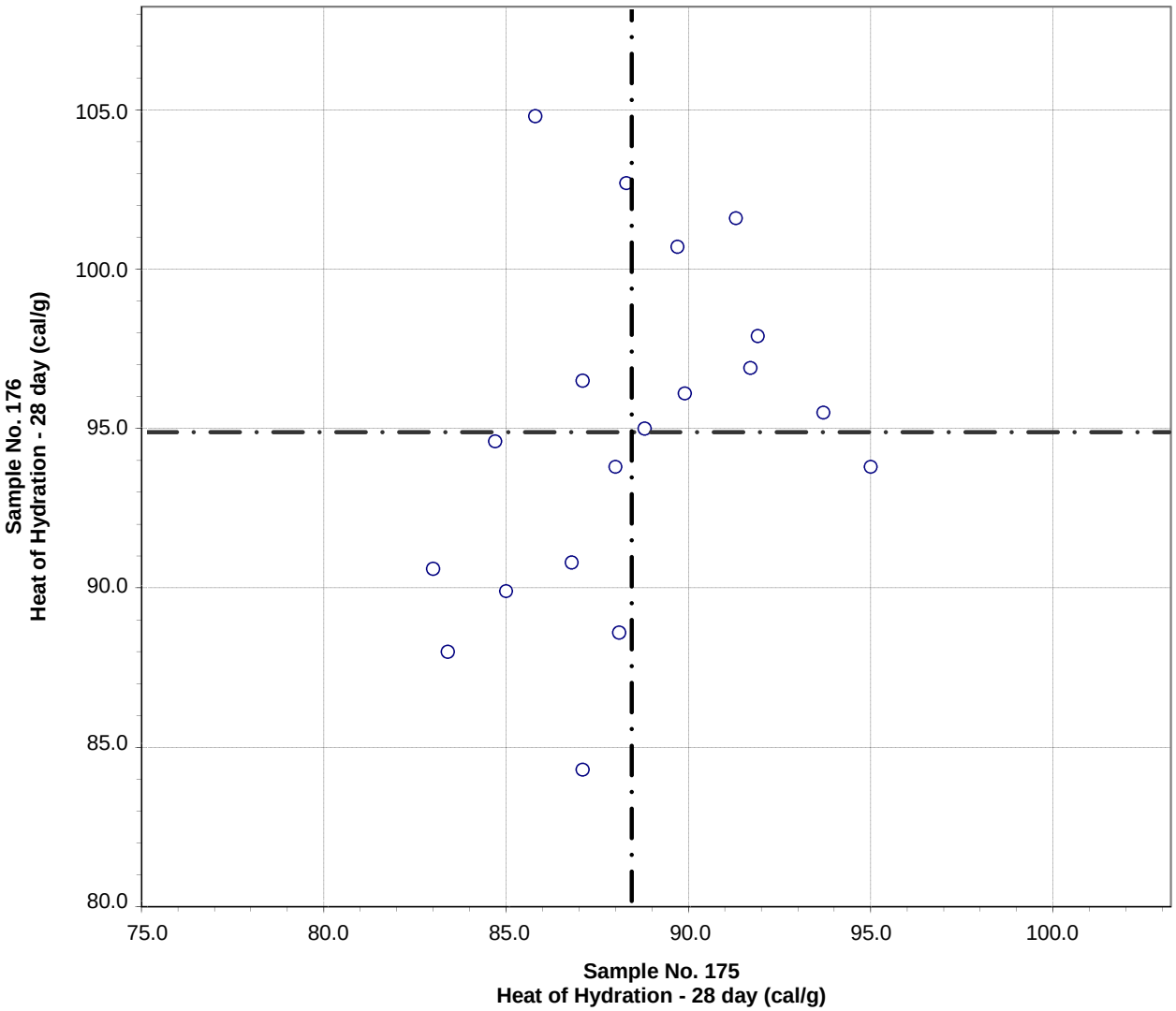


Test No. 290 C186 Heat of Hydration - 7 day 22 Points

Sample No. 175	Ave	80.8	S.D.	5.4	C.V.	6.7
Sample No. 176	Ave	87.8	S.D.	5.6	C.V.	6.4

Labs eliminated: 491

CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 175 and No. 176

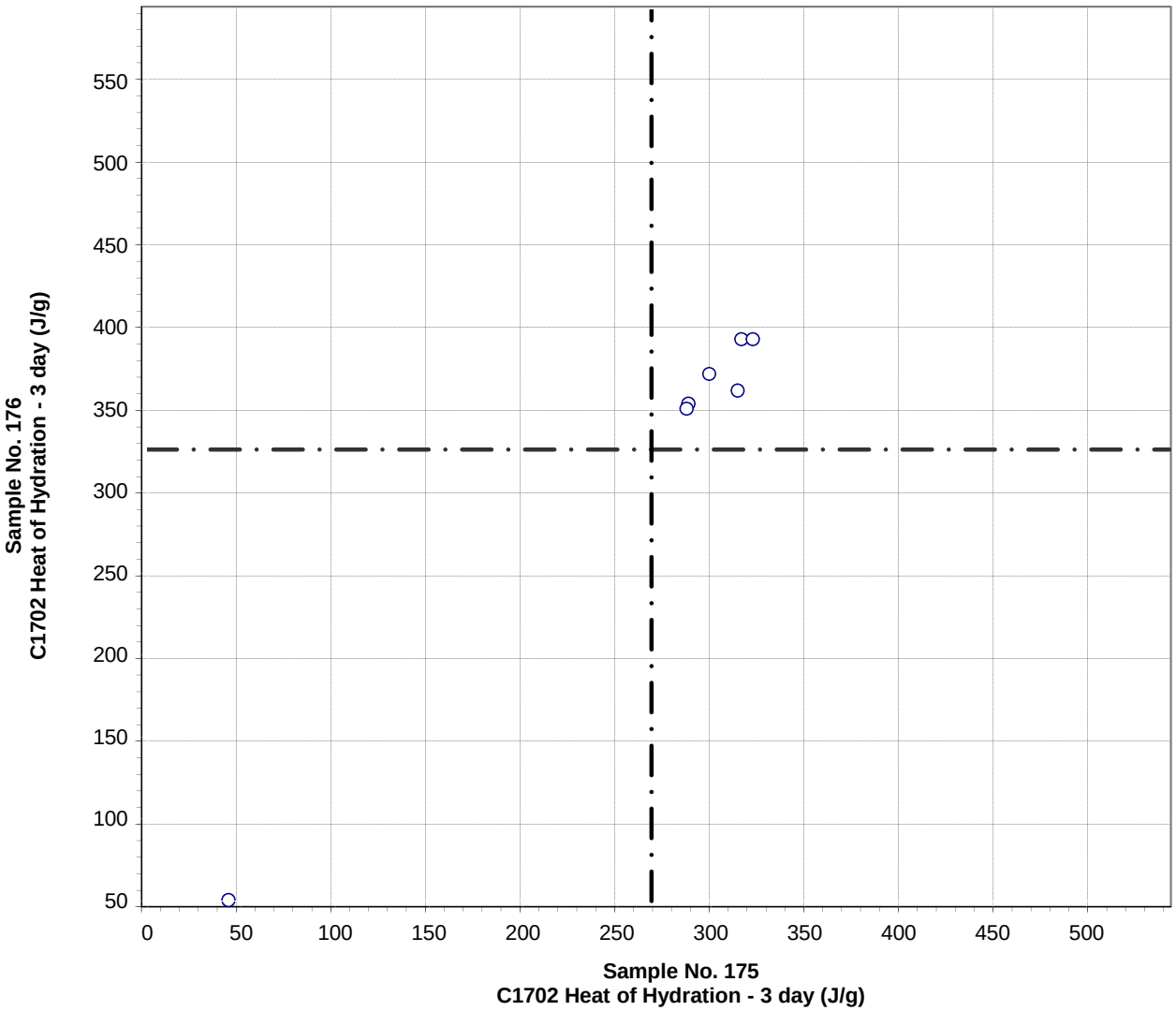


Test No. 300 C186 Heat of Hydration - 28 day 19 Points

Sample No. 175	Ave	88.4	S.D.	3.3	C.V.	3.8
Sample No. 176	Ave	94.8	S.D.	5.4	C.V.	5.7

Labs eliminated: 2360

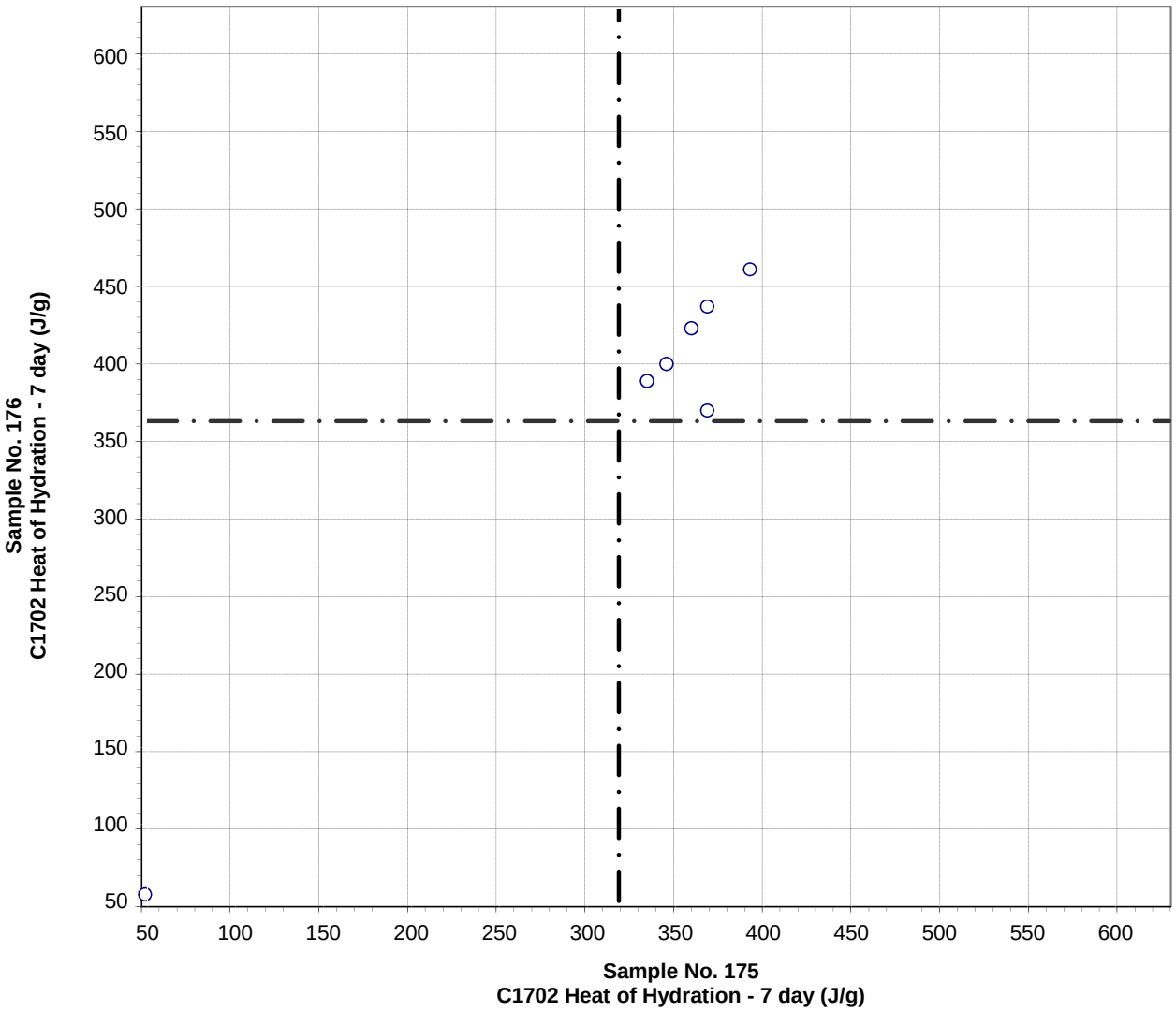
CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 175 and No. 176



Test No. 500 C1702 Heat of Hydration - 3 day 7 Points

Sample No. 175	Ave	268	S.D.	99	C.V.	36.9
Sample No. 176	Ave	326	S.D.	121	C.V.	37.2

CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 175 and No. 176



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

Sample No. 175	Ave	318	S.D.	119	C.V.	37.3
Sample No. 176	Ave	363	S.D.	138	C.V.	38.0