CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 181 and Number 182

September 2011

CCRL CEMENT AND CONCRETE REFERENCE LABORATORY

CCRL
Cement and Concrete Reference Laboratory

www.ccrl.us

September 9, 2011

TO: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 181 and No. 182

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in June 2011. Portland Cement Samples No. 181 was an ASTM C150 Type I with limestone addition. Portland Cement No. 182 was an ASTM C150 meeting the specifications of Type I and Type II with limestone addition and inorganic processing 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://ccrl.us/. Additional information is provided in the following pages.

Cement phase calculation test results of laboratories not submitting limestone addition results were not included in the statistical analysis.

The CCRL Proficiency Sample Programs are intended for internal use by the laboratory as a tool to identify potential problems in laboratory procedures or test equipment and to initiate remedial actions. These programs are designed to complement the CCRL Laboratory Inspection Program as part of a total quality system. Care should be taken when using this program for any other purpose.

Additional samples of these two cements and other CCRL samples are available for purchase. These samples may be useful for equipment verification, technician training, and research. Contact CCRL for availability and price.

It is presently anticipated that the next Portland Cement Proficiency Samples will be distributed in January 2012.

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. 181 and No. 182

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 June 2011. 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,

[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.*

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. 181 and No. 182

Final Report – Chemical Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
Silicon Dioxide (**percent**)							
	226	19.63	1.26	6.4	20.54	0.25	1.2
	*222	19.55	0.24	1.2	20.55	0.22	1.1
* Labs Eliminated - 2, 51, 53, 3422							
Aluminum Oxide (**percent**)							
	222	4.44	0.14	3.3	4.57	0.11	2.3
	*217	4.44	0.11	2.5	4.57	0.10	2.1
* Labs Eliminated - 206, 696, 3279, 3428, 3606							
Ferric Oxide (**percent**)							
	224	3.32	0.06	1.8	3.49	0.06	1.7
	*217	3.31	0.05	1.5	3.49	0.05	1.5
* Labs Eliminated - 2, 92, 289, 407, 687, 3422, 3661							
Calcium Oxide (**percent**)							
	222	63.35	1.94	3.06	64.07	0.51	0.80
	*210	63.44	0.46	0.72	64.07	0.36	0.56
* Labs Eliminated - 15, 50, 134, 206, 244, 497, 696, 1054, 2621, 3233, 3422, 3443							
Magnesium Oxide (**percent**)							
	222	3.00	0.14	4.7	0.76	0.29	38.9
	*207	3.01	0.08	2.7	0.71	0.07	9.4
* Labs Eliminated - 2, 52, 53, 169, 413, 696, 975, 1644, 2360, 2491, 3279, 3428, 3606, 3661, 3663							
Sulfur Trioxide (**percent**)							
	227	2.48	0.41	16.7	2.89	0.45	15.4
	*217	2.44	0.07	3.0	2.86	0.08	2.6
* Labs Eliminated - 2, 40, 51, 52, 53, 169, 694, 881, 3422, 3658							
Loss on Ignition (**percent**)							
	230	2.90	0.28	9.6	2.58	1.17	45.3
	*212	2.89	0.07	2.6	2.50	0.08	3.2
* Labs Eliminated - 2, 50, 52, 53, 74, 93, 132, 247, 416, 457, 493, 502, 1956, 2464, 2763, 3059, 3422, 3607							

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Chemical Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
Sodium Oxide (**percent**)							
	209	0.154	0.092	59	0.061	0.068	110
	*198	0.145	0.032	22	0.054	0.028	52
* Labs Eliminated - 110, 156, 222, 494, 779, 1956, 2463, 3233, 3235, 3428, 3606							
Potassium Oxide (**percent**)							
	215	0.537	0.052	9.6	0.739	0.088	11.9
	*198	0.545	0.015	2.8	0.756	0.021	2.8
* Labs Eliminated - 2, 36, 40, 110, 125, 137, 206, 975, 1079, 1956, 2412, 2484, 3057, 3233, 3606, 3607, 3661							
Titanium Dioxide (**percent**)							
	176	0.24	0.010	4.3	0.22	0.011	4.7
	*170	0.24	0.008	3.3	0.23	0.009	3.8
* Labs Eliminated - 156, 162, 206, 975, 3422, 3661							
Phosphorus Pentoxide (**percent**)							
	171	0.068	0.053	78.8	0.254	0.048	18.7
	*159	0.061	0.009	14.2	0.253	0.012	4.7
* Labs Eliminated - 2, 8, 53, 60, 139, 254, 1079, 2462, 2466, 2484, 3057, 3428							
Zinc Oxide (**percent**)							
	85	0.085	0.013	15.5	0.013	0.004	33.4
	*78	0.086	0.004	4.8	0.012	0.002	16.1
* Labs Eliminated - 7, 95, 134, 206, 932, 1079, 2463							
Chloride (**percent**)							
	108	0.014	0.008	55	0.007	0.008	115
	*102	0.013	0.005	39	0.005	0.003	63
* Labs Eliminated - 10, 134, 158, 206, 2491, 3422							
Insoluble Residue (**percent**)							
	212	0.51	0.12	24	0.22	0.13	61
	*202	0.50	0.09	18	0.20	0.08	42
* Labs Eliminated - 51, 74, 93, 206, 222, 695, 2360, 2491, 3235, 3422							

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Chemical Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
Free Lime (**percent**)							
	176	0.83	0.25	30	0.96	0.29	30
	*174	0.82	0.20	24	0.94	0.21	23
* Labs Eliminated - 3415, 3607							
Carbon Dioxide (**percent**)							
	183	1.88	0.31	16.7	1.48	0.28	19.1
	*172	1.90	0.21	11.0	1.50	0.18	11.7
* Labs Eliminated - 8, 52, 66, 132, 162, 222, 415, 886, 1251, 1483, 3605							
Limestone Content (**percent**)							
	34	4.5	0.6	14.2	3.9	0.5	12.1
	*33	4.6	0.5	10.9	3.9	0.5	12.3
* Labs Eliminated - 99							
Chromium Oxide (**percent**)							
	18	0.026	0.007	28	0.018	0.002	13
	*16	0.024	0.002	10	0.017	0.001	8
* Labs Eliminated - 407, 438							
Tricalcium Silicate (**percent**)							
	41	63.9	4.1	6.4	57.3	4.9	8.6
	*40	64.2	3.6	5.6	57.6	4.5	7.9
* Labs Eliminated - 53							
Dicalcium Silicate (**percent**)							
	41	6.8	3.4	50.6	13.8	4.4	32.0
	*39	6.3	2.4	38.8	13.3	3.8	28.7
* Labs Eliminated - 53, 696							
Tricalcium Aluminate (**percent**)							
	175	6.0	0.4	6.9	5.7	0.4	6.4
	*173	6.0	0.3	5.3	5.7	0.4	6.4
* Labs Eliminated - 605, 3606							

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Chemical Results
September 9, 2011

SUMMARY OF RESULTS

		Sample No.181			Sample No. 182		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Tetracalcium Aluminoferrite (**percent**)							
	41	10.0	0.3	3.0	10.4	0.3	2.8

No Labs Eliminated for This Test

NOTES:

(1) Cement Phase Calculations - ASTM C150 requires that cements containing limestone additions use CO_2 in the calculation of cement phases. Samples 181 and 182 contain limestone additions, therefore, test results of 23 laboratories not determining CO_2 were not used in calculating the statistics. See the following list of excluded labs.

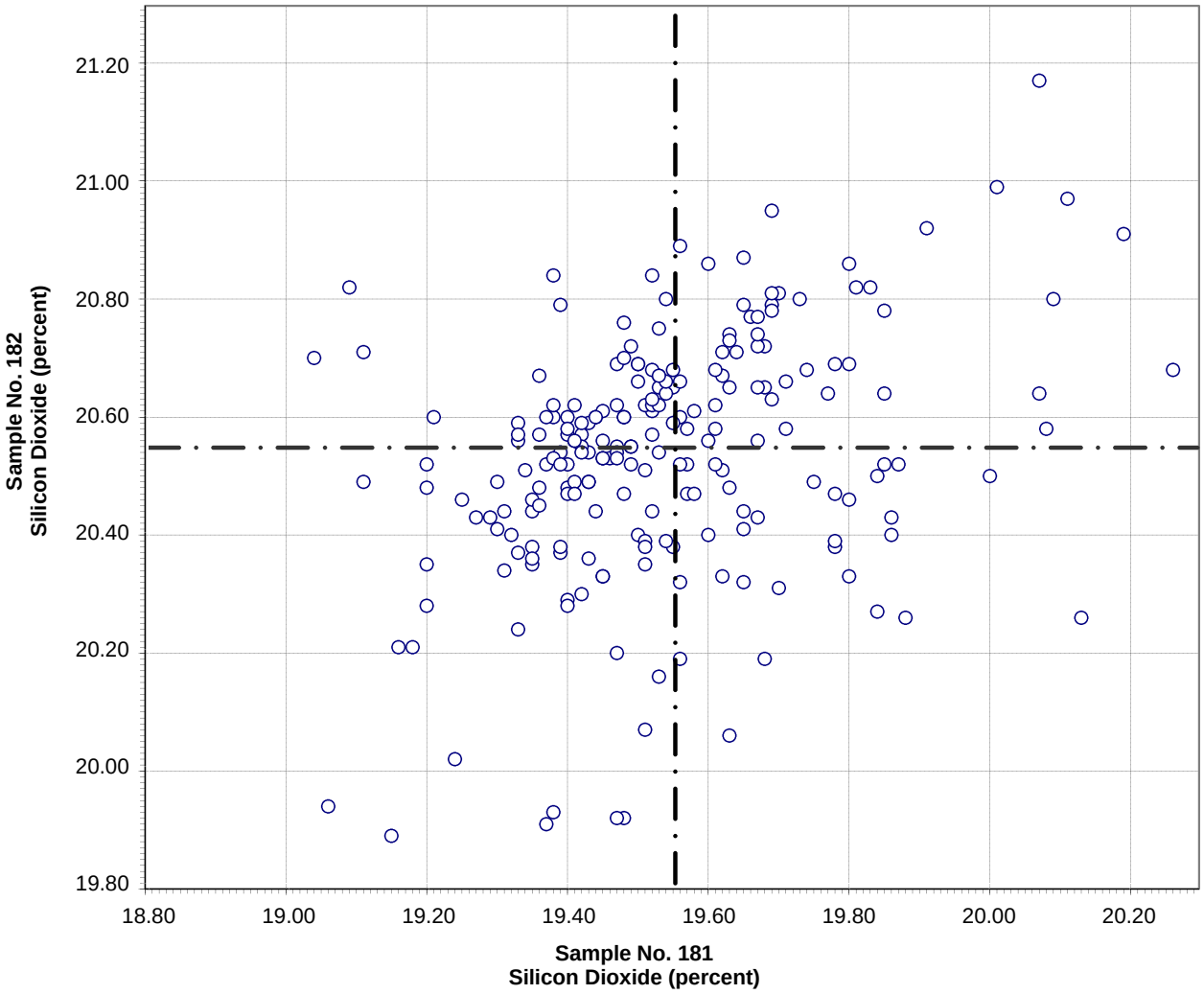
Test Results Not Used in Calculating Statistics for

Cement Phase Calculations

List of laboratories reporting test results for cement phase calculations silicate but did not report values for CO_2 .

2	557
3	687
7	696
43	1676
95	1799
98	2483
110	2484
181	2621
221	3249
254	3422
255	3428

CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 181 and No. 182



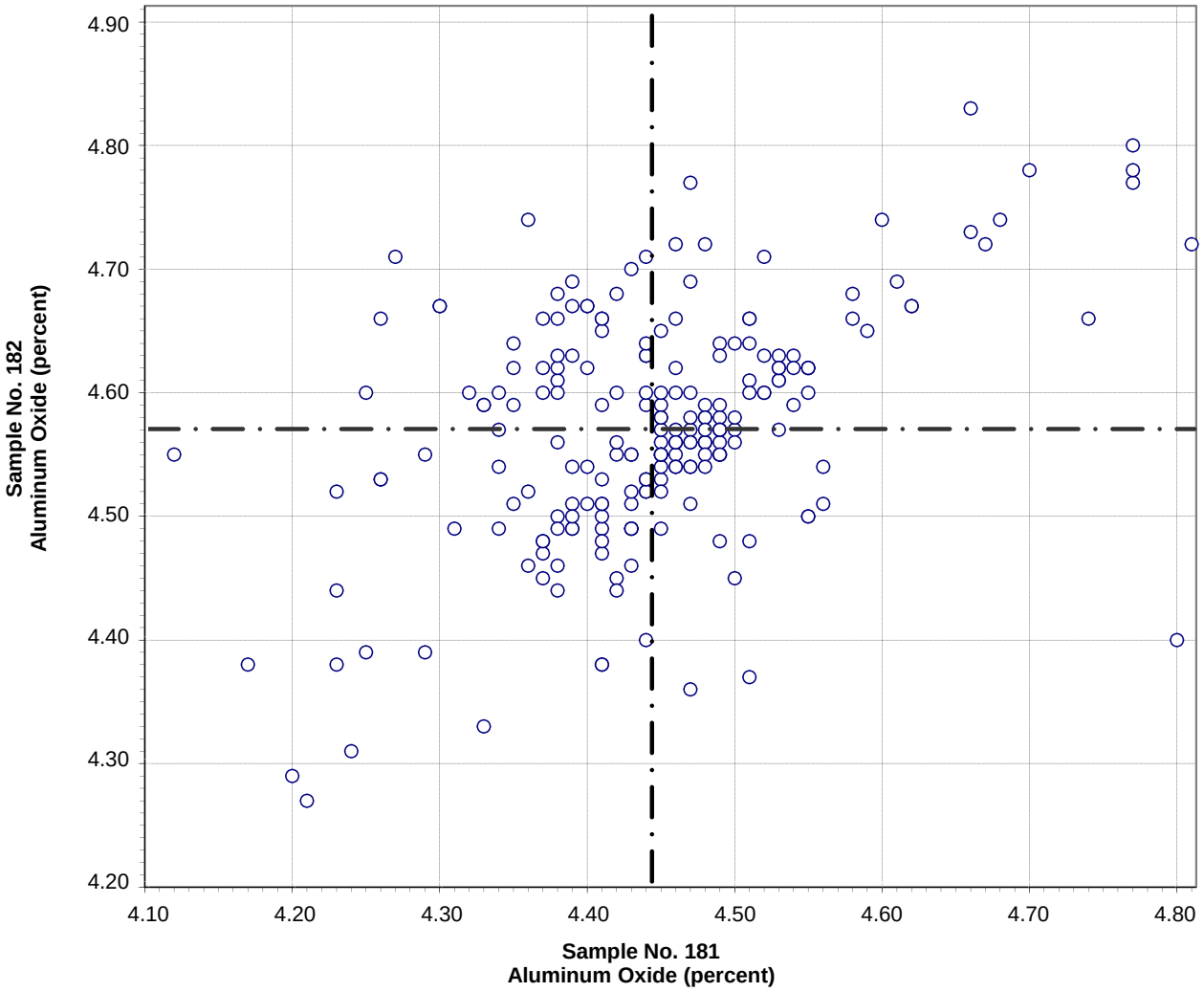
Test No. 10 Silicon Dioxide 218 Points

Sample No. 181	Ave	19.55	S.D.	0.24	C.V. 1.2
Sample No. 182	Ave	20.55	S.D.	0.22	C.V. 1.1

Labs Eliminated: 2, 51, 53, 3422

Labs off Diagram: 10, 93, 696, 3658

CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 181 and No. 182



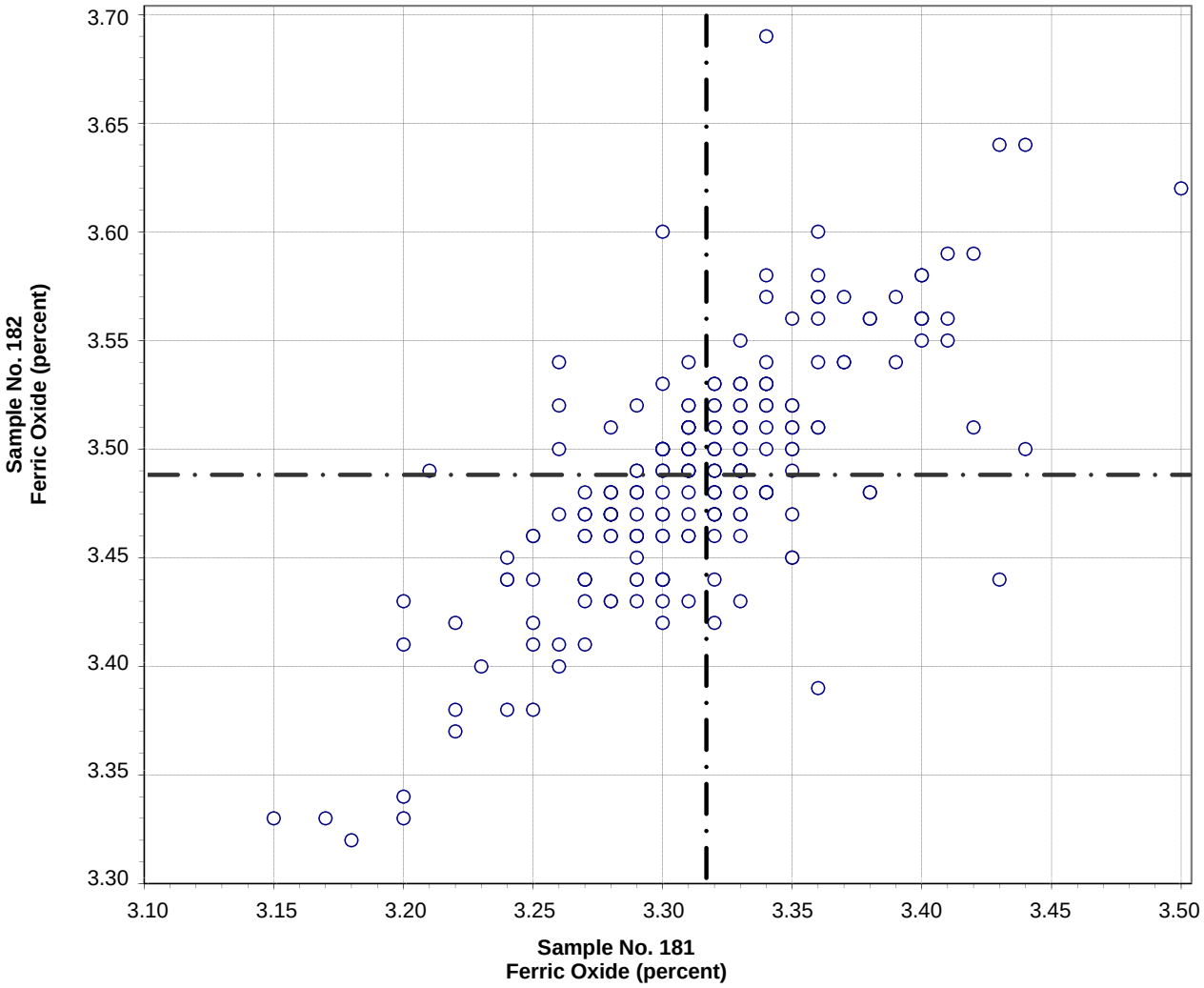
Test No. 21 Aluminum Oxide 215 Points

Sample No. 181 Ave 4.44 S.D. 0.11 C.V. 2.5
Sample No. 182 Ave 4.57 S.D. 0.10 C.V. 2.1

Labs Eliminated: 206, 696, 3279, 3428, 3606

Labs off Diagram: 38, 2437

CCRL Proficiency Sample Program
Ferric Oxide
PORTLAND CEMENT Samples No. 181 and No. 182

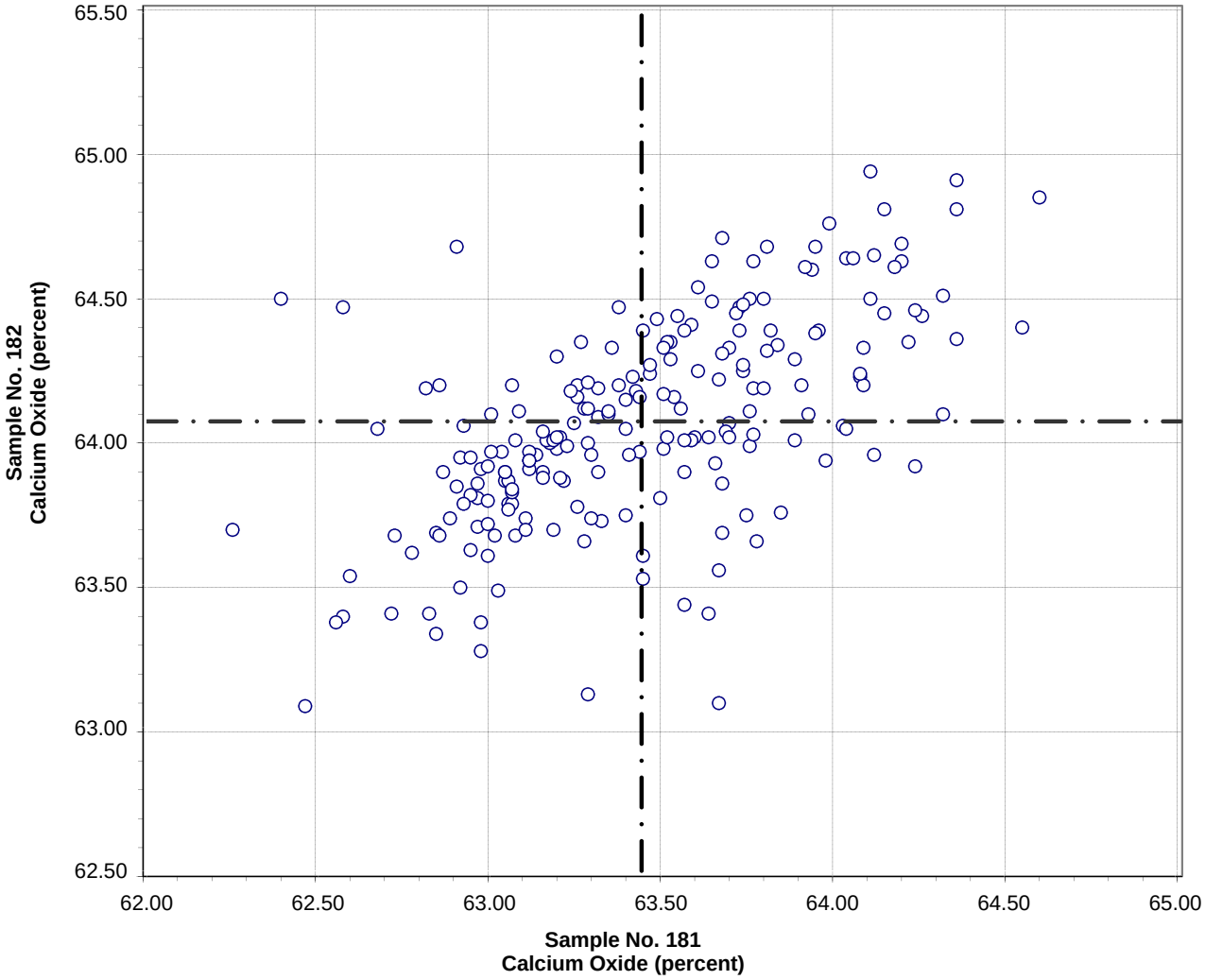


Test No. 30 Ferric Oxide 219 Points

Sample No. 181	Ave	3.32	S.D.	0.06	C.V.	1.8
Sample No. 182	Ave	3.49	S.D.	0.06	C.V.	1.7

Labs off Diagram: 2, 92, 407, 3422, 3661

CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 181 and No. 182

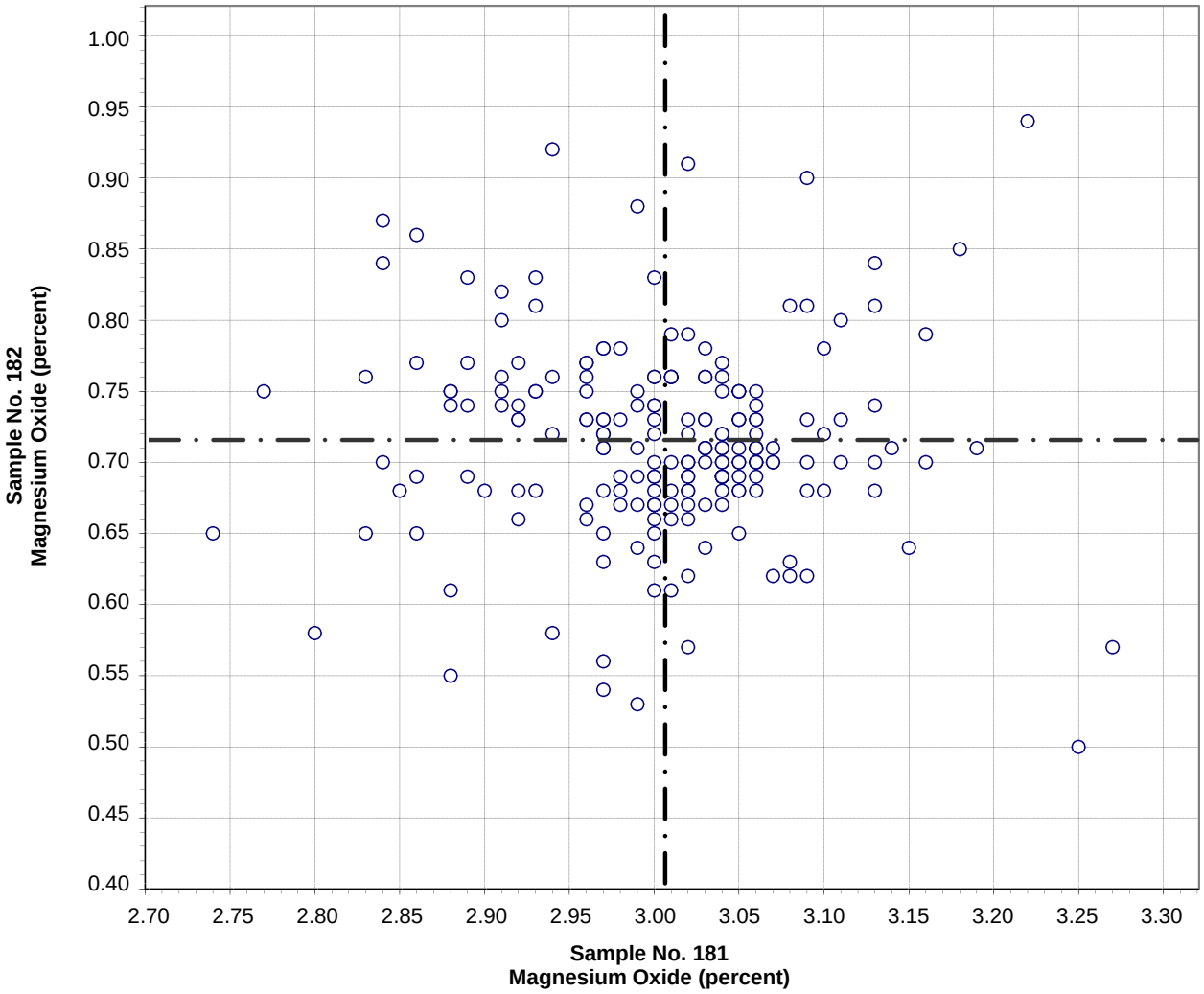


Test No. 40 Calcium Oxide 210 Points

Sample No. 181	Ave	63.44	S.D.	0.46	C.V. 0.72
Sample No. 182	Ave	64.07	S.D.	0.36	C.V. 0.56

Labs Eliminated: 15, 50, 134, 206, 244, 497, 696, 1054, 2621, 3233, 3422, 3443

CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 181 and No. 182

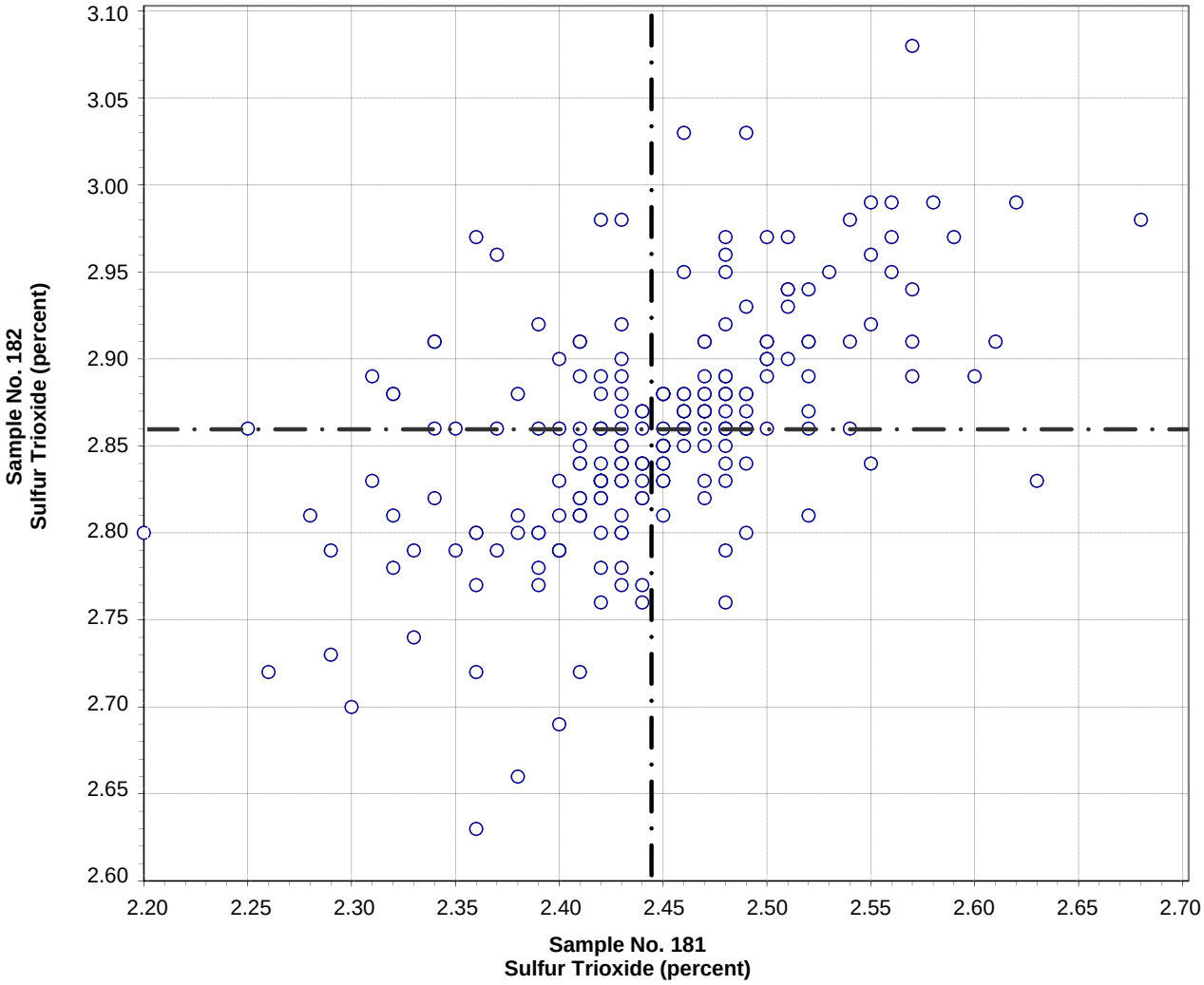


Test No. 50 Magnesium Oxide 207 Points

Sample No. 181 Ave 3.01 S.D. 0.08 C.V. 2.7
Sample No. 182 Ave 0.71 S.D. 0.07 C.V. 9.4

Labs Eliminated: 2, 52, 53, 169, 413, 696, 975, 1644, 2360, 2491, 3279, 3428, 3606, 3661, 3663

CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 181 and No. 182



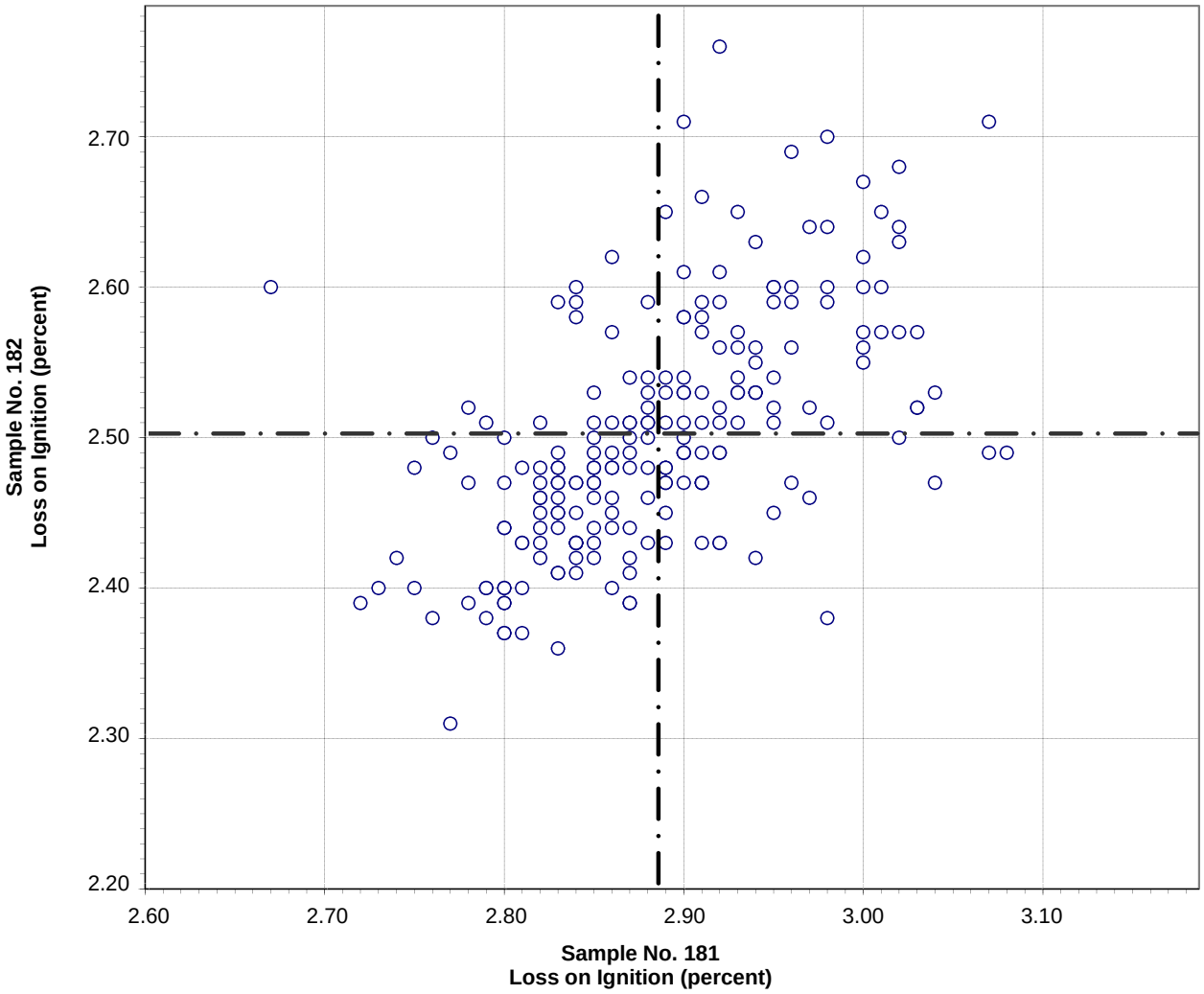
Test No. 60 Sulfur Trioxide 214 Points

Sample No. 181	Ave	2.44	S.D.	0.07	C.V. 3.0
Sample No. 182	Ave	2.86	S.D.	0.08	C.V. 2.6

Labs Eliminated: 2, 40, 51, 52, 53, 169, 694, 881, 3422, 3658

Labs off Diagram: 206, 886, 3057

CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 181 and No. 182

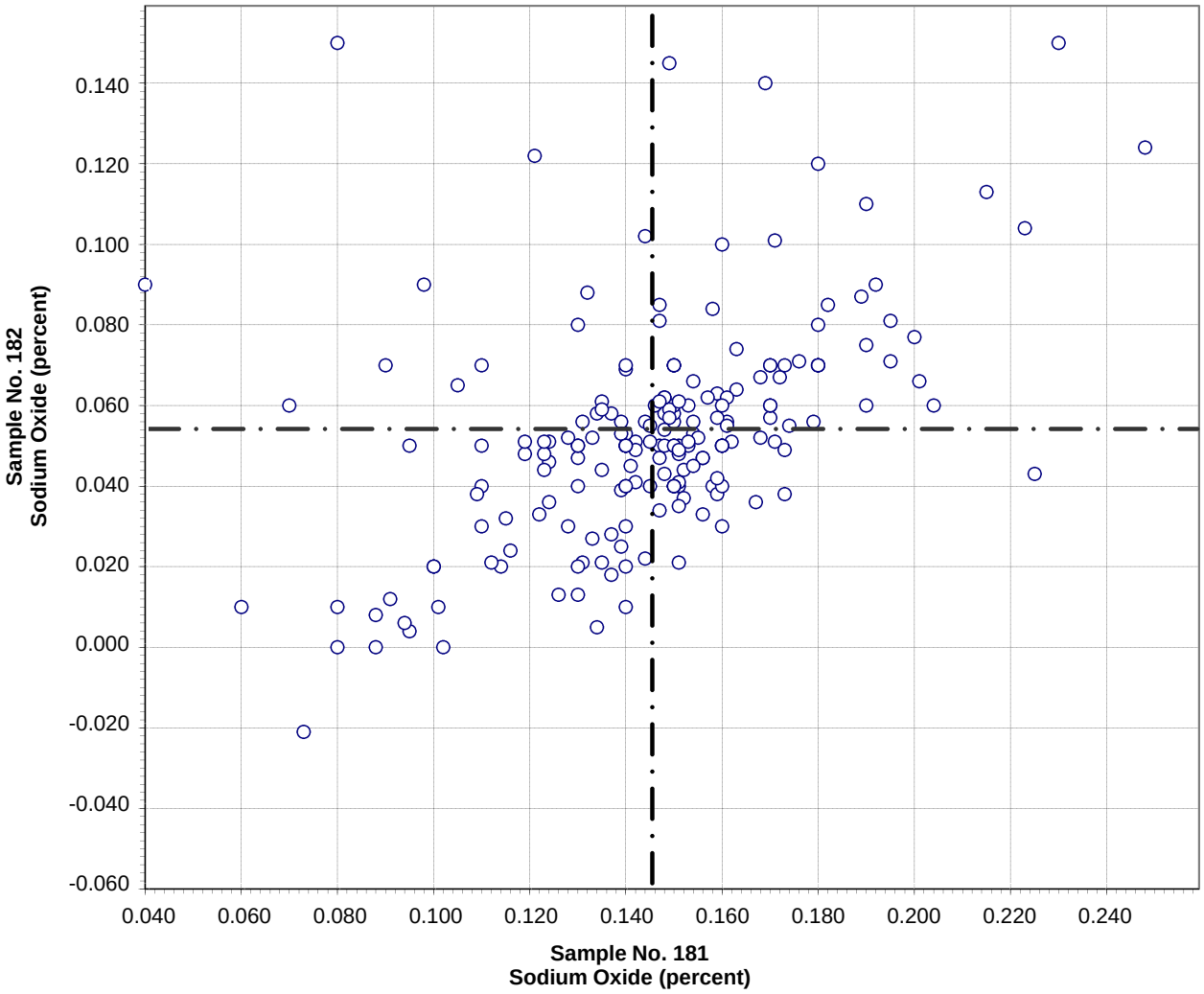


Test No. 70 Loss on Ignition 212 Points

Sample No. 181 Ave 2.89 S.D. 0.07 C.V. 2.6
Sample No. 182 Ave 2.50 S.D. 0.08 C.V. 3.2

Labs Eliminated: 2, 50, 52, 53, 74, 93, 132, 247, 416, 457, 493, 502, 1956, 2464, 2763, 3059, 3422, 3607

CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 181 and No. 182



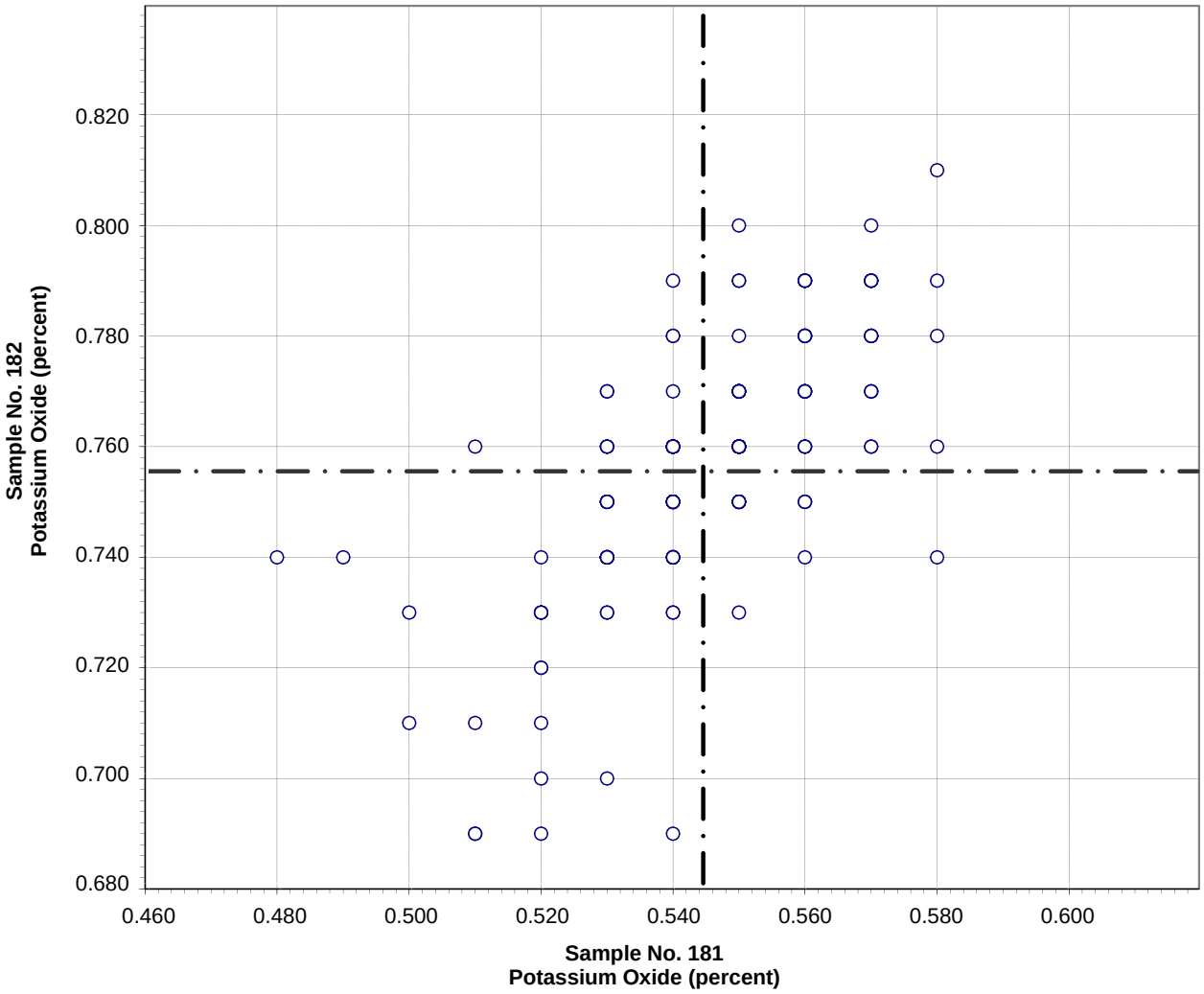
Test No. 90 Sodium Oxide 196 Points

Sample No. 181 Ave 0.145 S.D. 0.032 C.V. 22
Sample No. 182 Ave 0.054 S.D. 0.028 C.V. 52

Labs Eliminated: 110, 156, 222, 494, 779, 1956, 2463, 3233, 3235, 3428, 3606

Labs off Diagram: 2484, 3605

CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 181 and No. 182



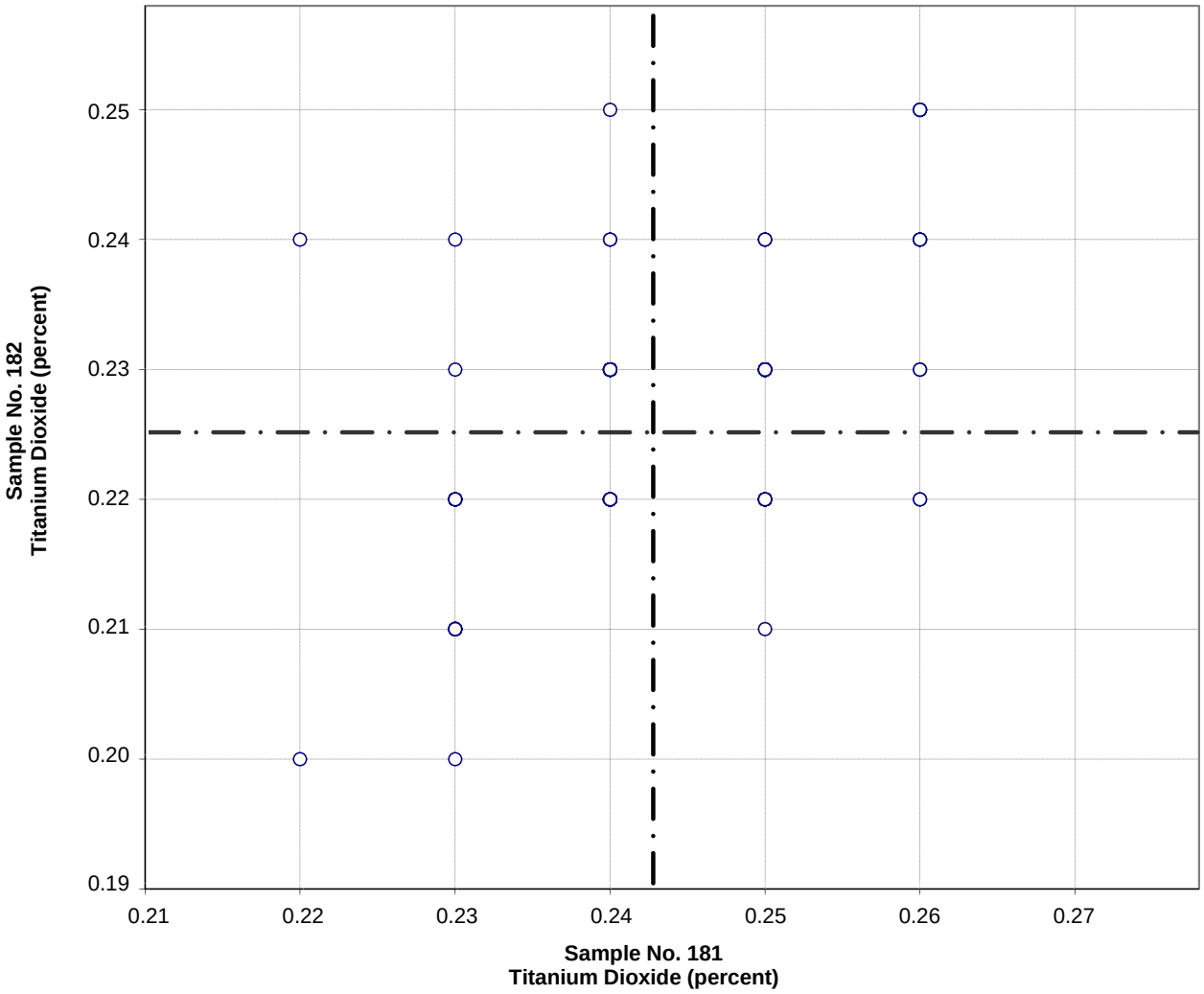
Test No. 100 Potassium Oxide 200 Points

Sample No. 181 Ave 0.544 S.D. 0.017 C.V. 3.1
Sample No. 182 Ave 0.755 S.D. 0.023 C.V. 3.0

Labs Eliminated: 2, 36, 110, 125, 137, 206, 1079, 1956, 2412, 3233, 3606, 3607, 3661

Labs off Diagram: 40, 975

CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 181 and No. 182

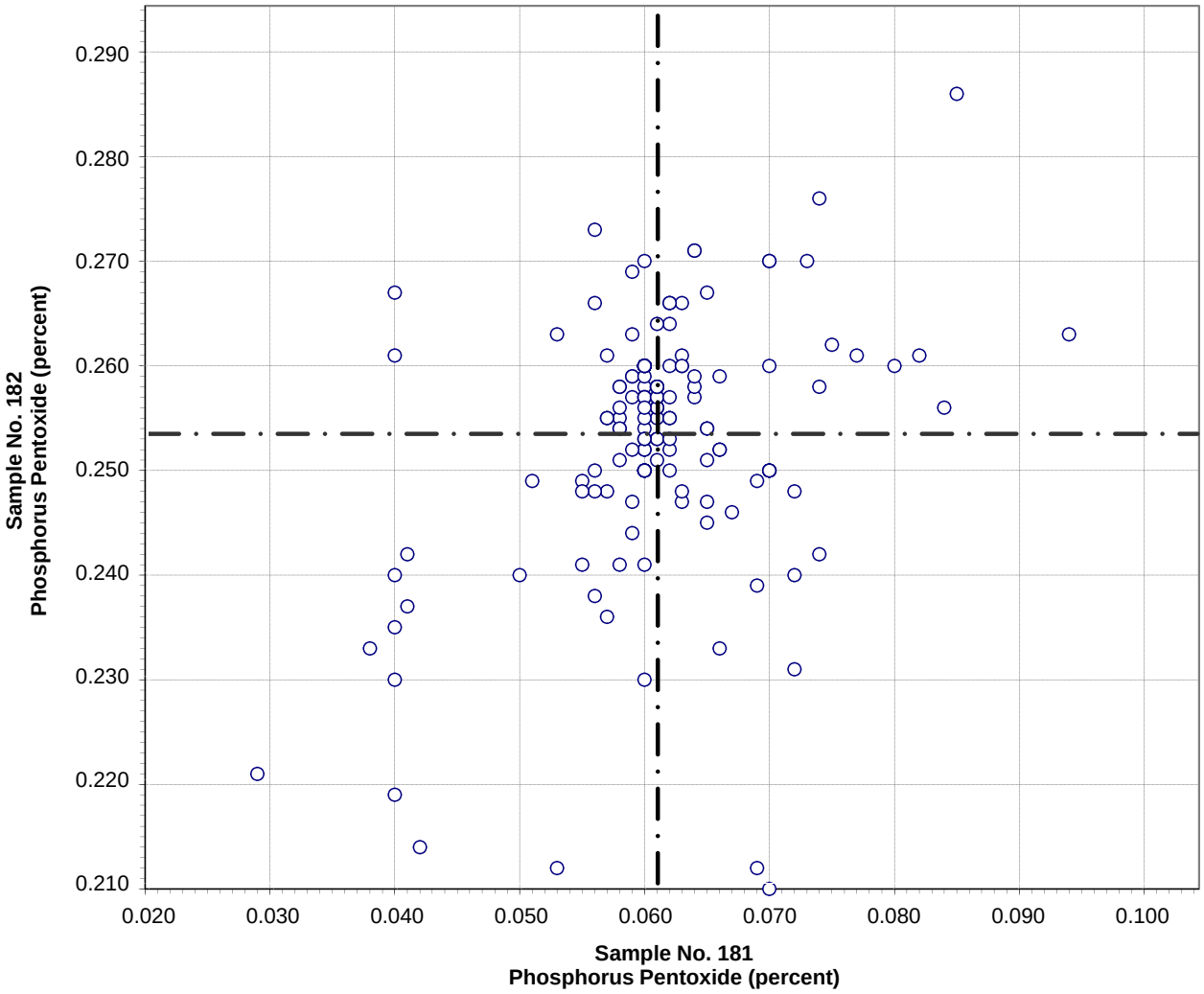


Test No. 103 Titanium Dioxide 170 Points

Sample No. 181	Ave	0.24	S.D.	0.008	C.V.	3.3
Sample No. 182	Ave	0.23	S.D.	0.009	C.V.	3.8

Labs Eliminated: 156, 162, 206, 975, 3422, 3661

CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 181 and No. 182

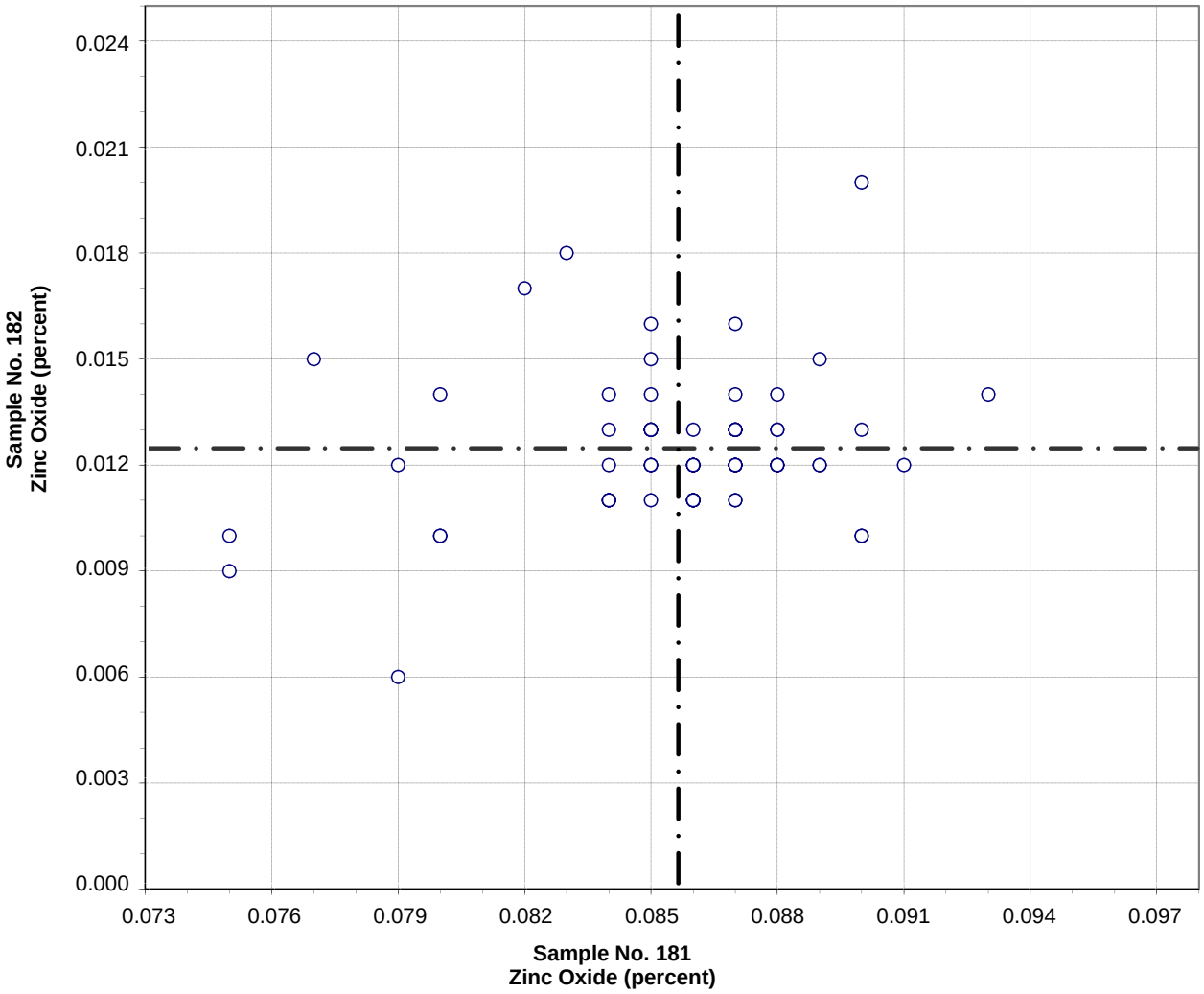


Test No. 102 Phosphorus Pentoxide 159 Points

Sample No. 181	Ave	0.061	S.D.	0.009	C.V. 14.2
Sample No. 182	Ave	0.253	S.D.	0.012	C.V. 4.7

Labs Eliminated: 2, 8, 53, 60, 139, 254, 1079, 2462, 2466, 2484, 3057, 3428

CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 181 and No. 182



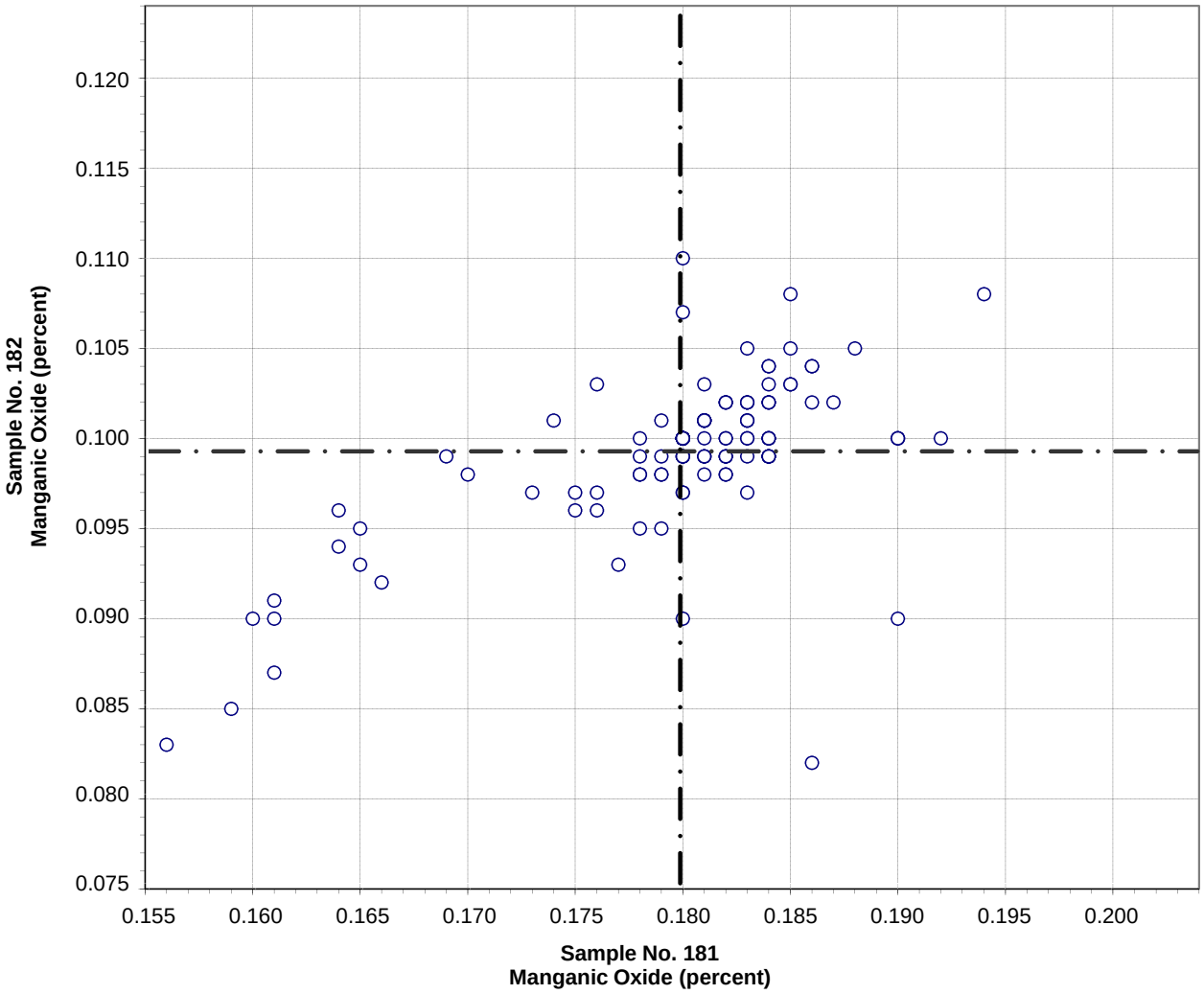
Test No. 99 Zinc Oxide 76 Points

Sample No. 181 Ave 0.086 S.D. 0.004 C.V. 4.8
Sample No. 182 Ave 0.012 S.D. 0.002 C.V. 16.1

Labs Eliminated: 7, 95, 134, 206, 932, 1079, 2463

Labs off Diagram: 2522, 3605

CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 181 and No. 182

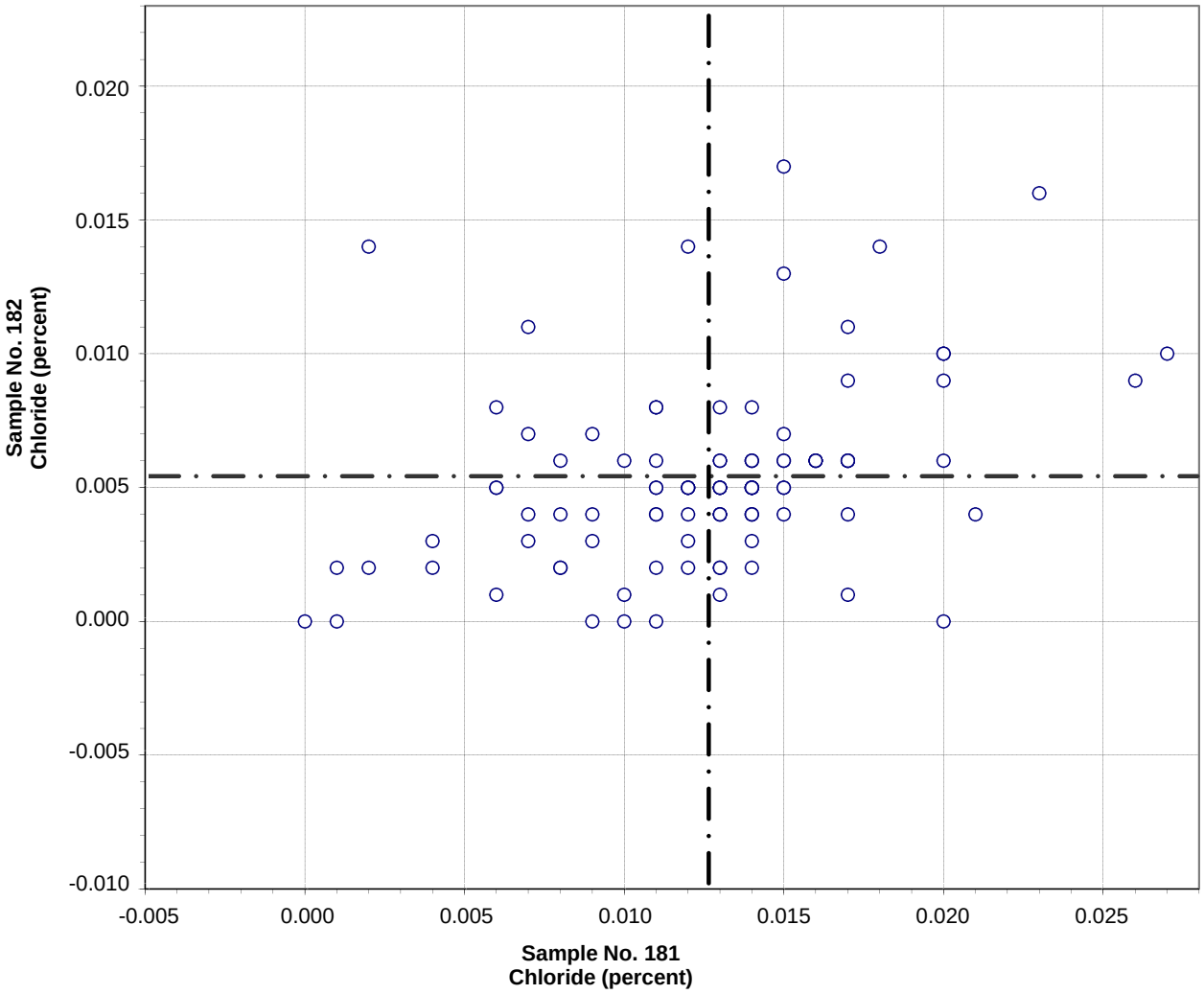


Test No. 101 Manganic Oxide 123 Points

Sample No. 181	Ave	0.180	S.D.	0.007	C.V. 3.8
Sample No. 182	Ave	0.099	S.D.	0.004	C.V. 4.5

Labs Eliminated: 2, 10, 162, 205, 413, 441, 457, 501, 1079, 2412, 2462

CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 181 and No. 182

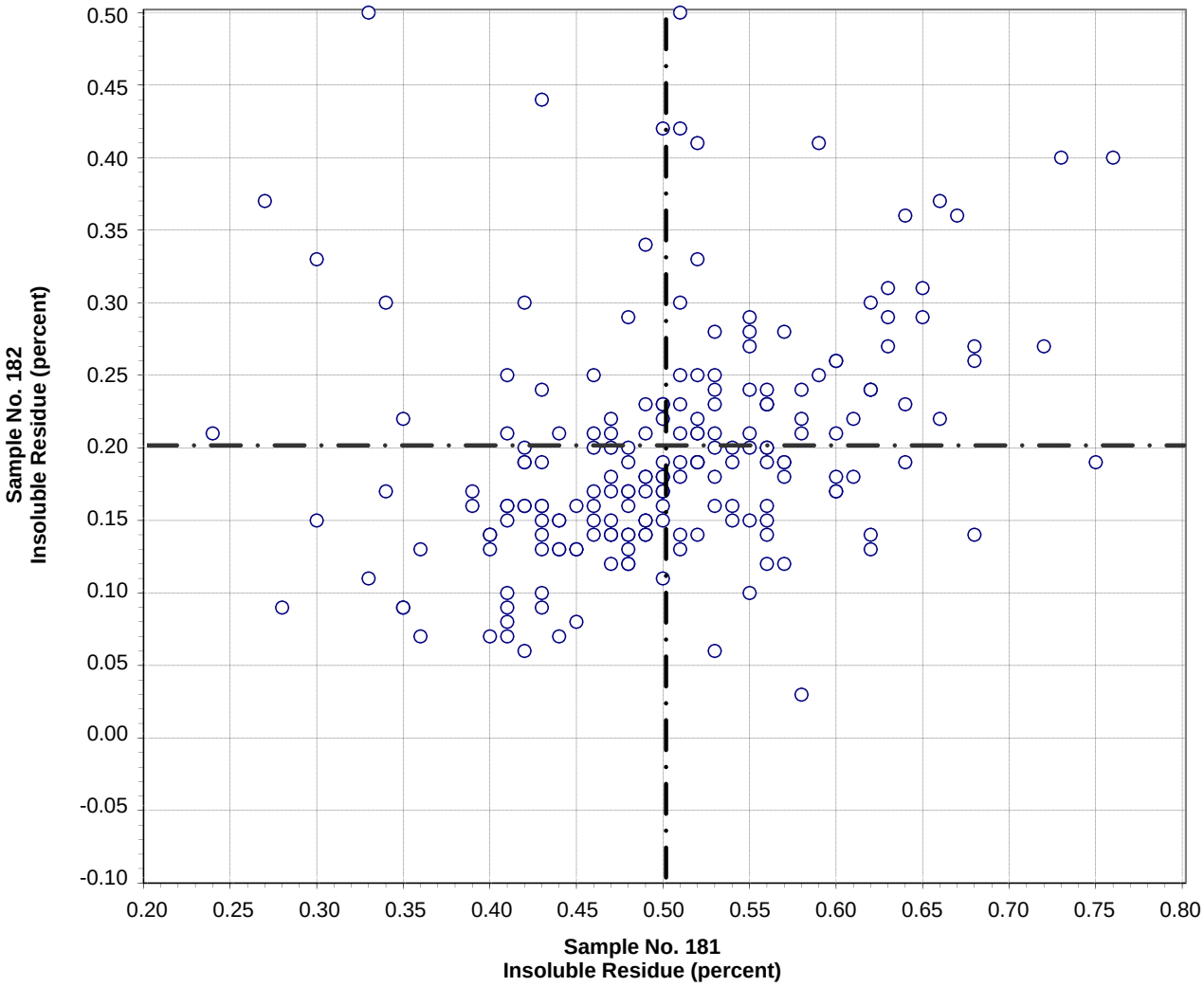


Test No. 104 Chloride 102 Points

Sample No. 181	Ave	0.013	S.D.	0.005	C.V. 39
Sample No. 182	Ave	0.005	S.D.	0.003	C.V. 63

Labs Eliminated: 10, 134, 158, 206, 2491, 3422

CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 181 and No. 182



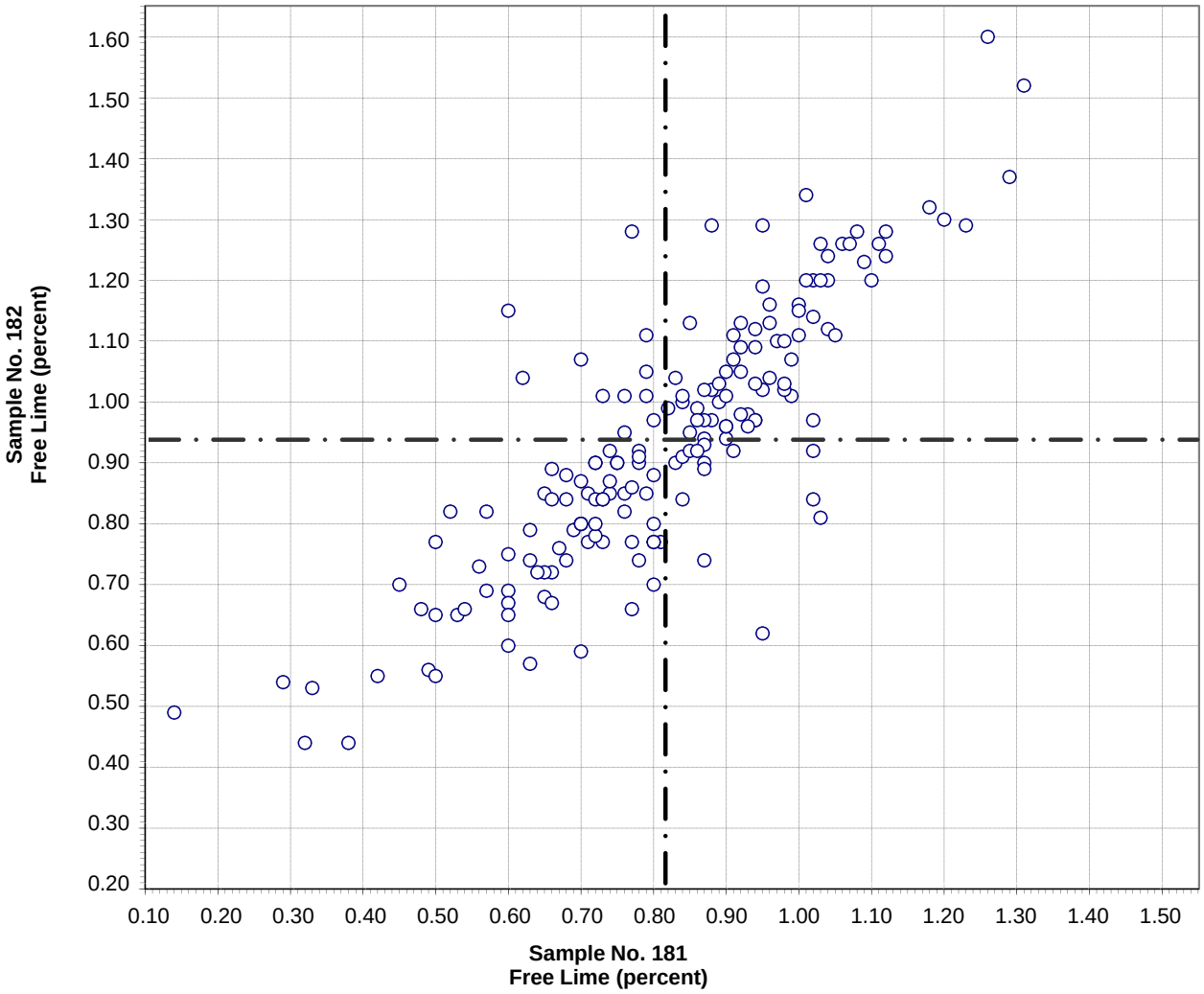
Test No. 80 Insoluble Residue 200 Points

Sample No. 181	Ave	0.50	S.D.	0.09	C.V. 18
Sample No. 182	Ave	0.20	S.D.	0.08	C.V. 42

Labs Eliminated: 51, 74, 93, 206, 222, 695, 2360, 2491, 3235, 3422

Labs off Diagram: 691, 2412

CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 181 and No. 182

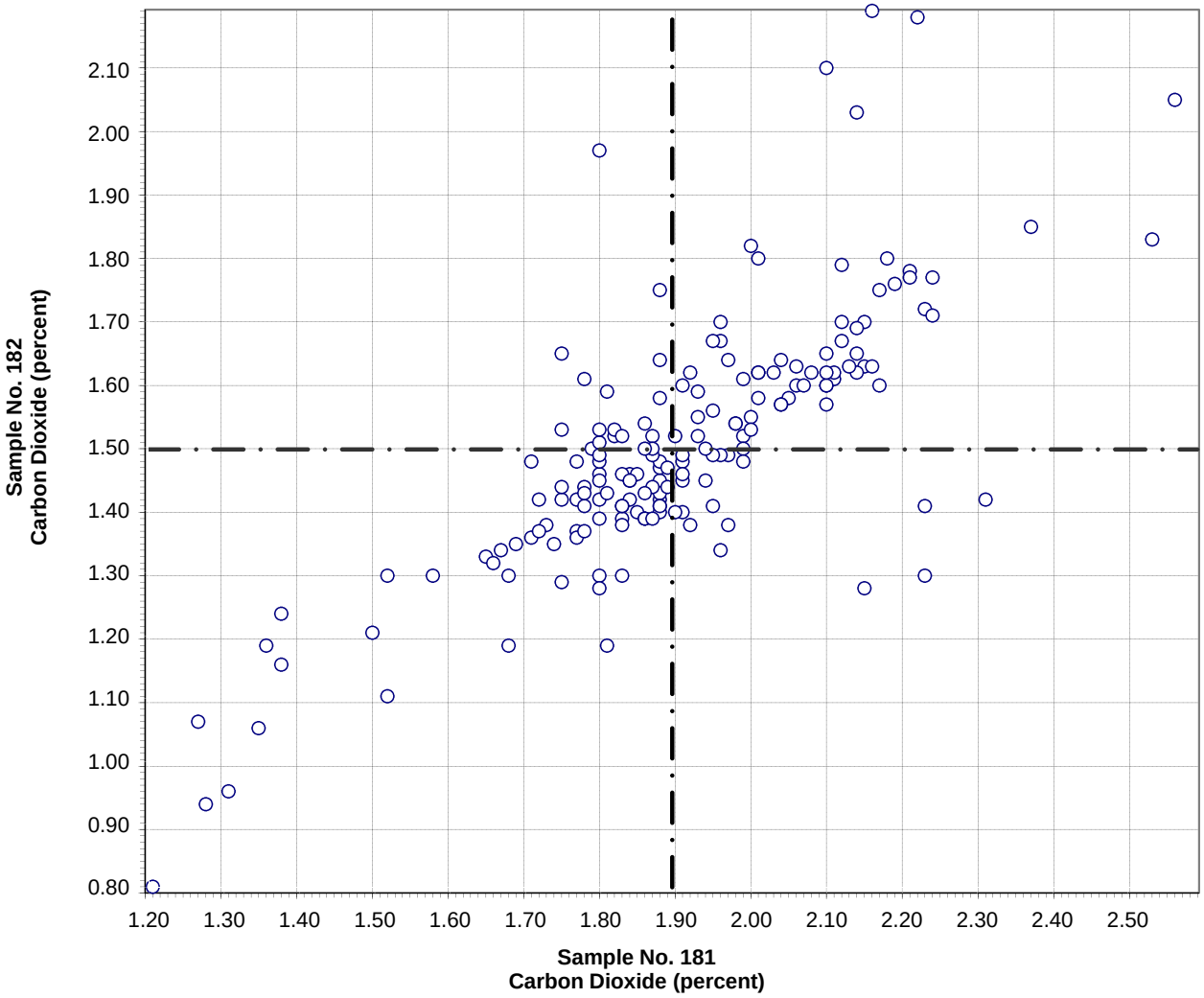


Test No. 41 Free Lime 174 Points

Sample No. 181	Ave	0.82	S.D.	0.20	C.V. 24
Sample No. 182	Ave	0.94	S.D.	0.21	C.V. 23

Labs Eliminated: 3415, 3607

CCRL Proficiency Sample Program
Carbon Dioxide
PORTLAND CEMENT Samples No. 181 and No. 182



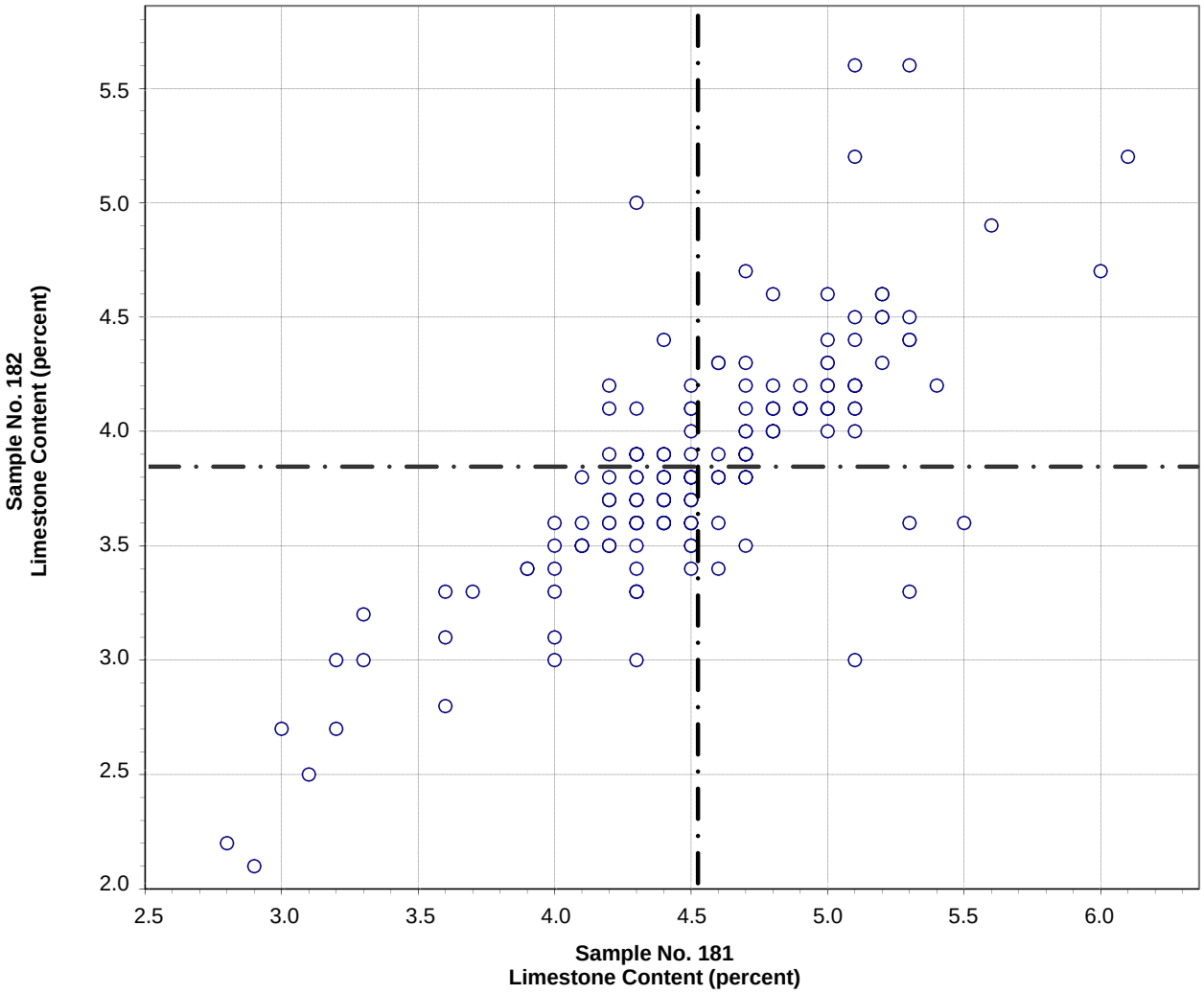
Test No. 97 Carbon Dioxide 176 Points

Sample No. 181	Ave	1.89	S.D.	0.23	C.V. 12
Sample No. 182	Ave	1.50	S.D.	0.21	C.V. 14

Labs Eliminated: 162, 222, 415, 886, 1251, 1483

Labs off Diagram: 66, 3605

CCRL Proficiency Sample Program
Limestone Content
PORTLAND CEMENT Samples No. 181 and No. 182

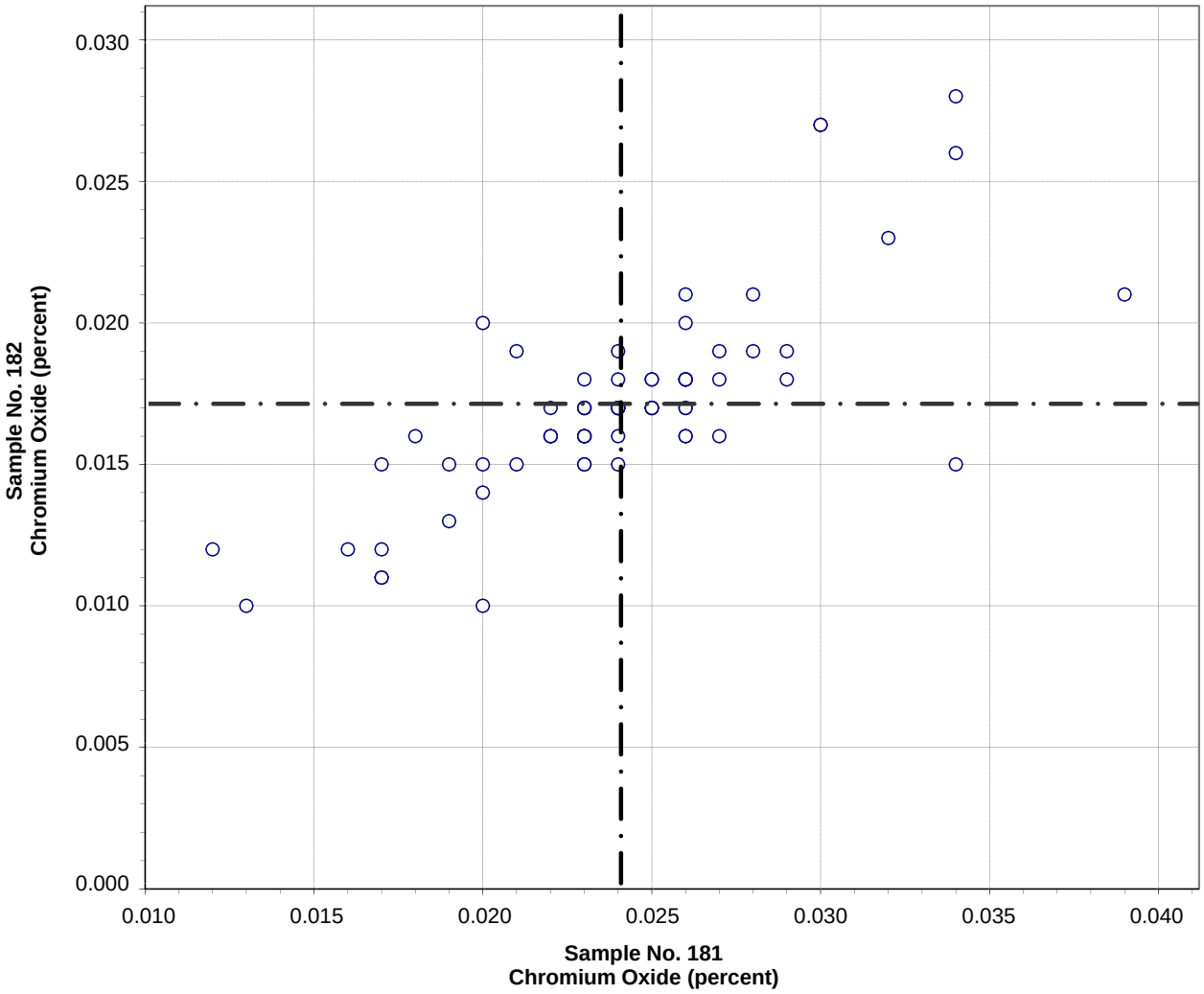


Test No. 98 Limestone Content 174 Points

Sample No. 181	Ave	4.5	S.D.	0.5	C.V. 12
Sample No. 182	Ave	3.8	S.D.	0.5	C.V. 13

Labs Eliminated: 66, 99, 162, 222, 415, 886, 1251, 1483

CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 181 and No. 182

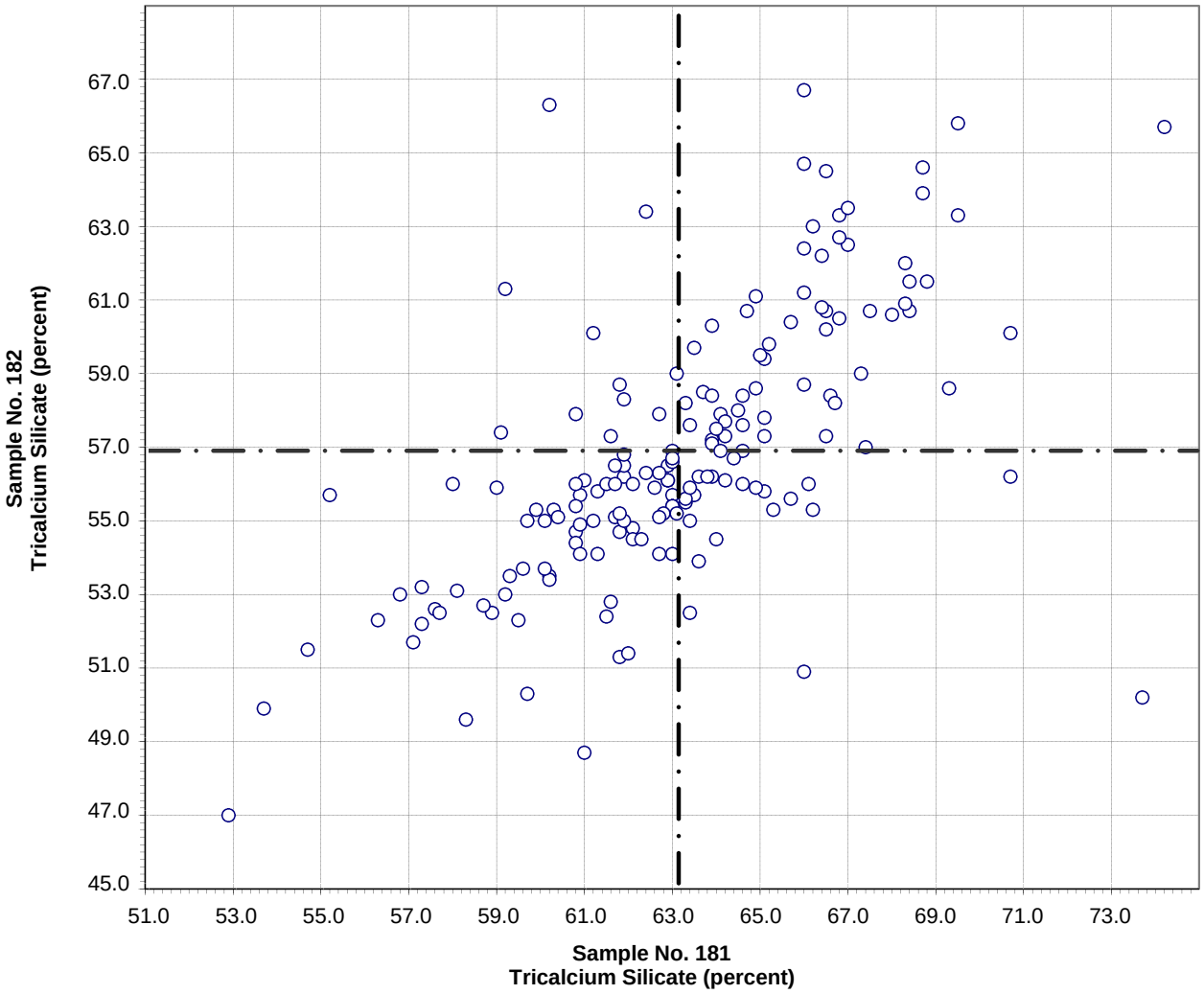


Test No. 105 Chromium Oxide 75 Points

Sample No. 181	Ave	0.024	S.D.	0.005	C.V. 19
Sample No. 182	Ave	0.017	S.D.	0.003	C.V. 20

Labs Eliminated: 24, 36, 40, 95, 438, 1079, 3661

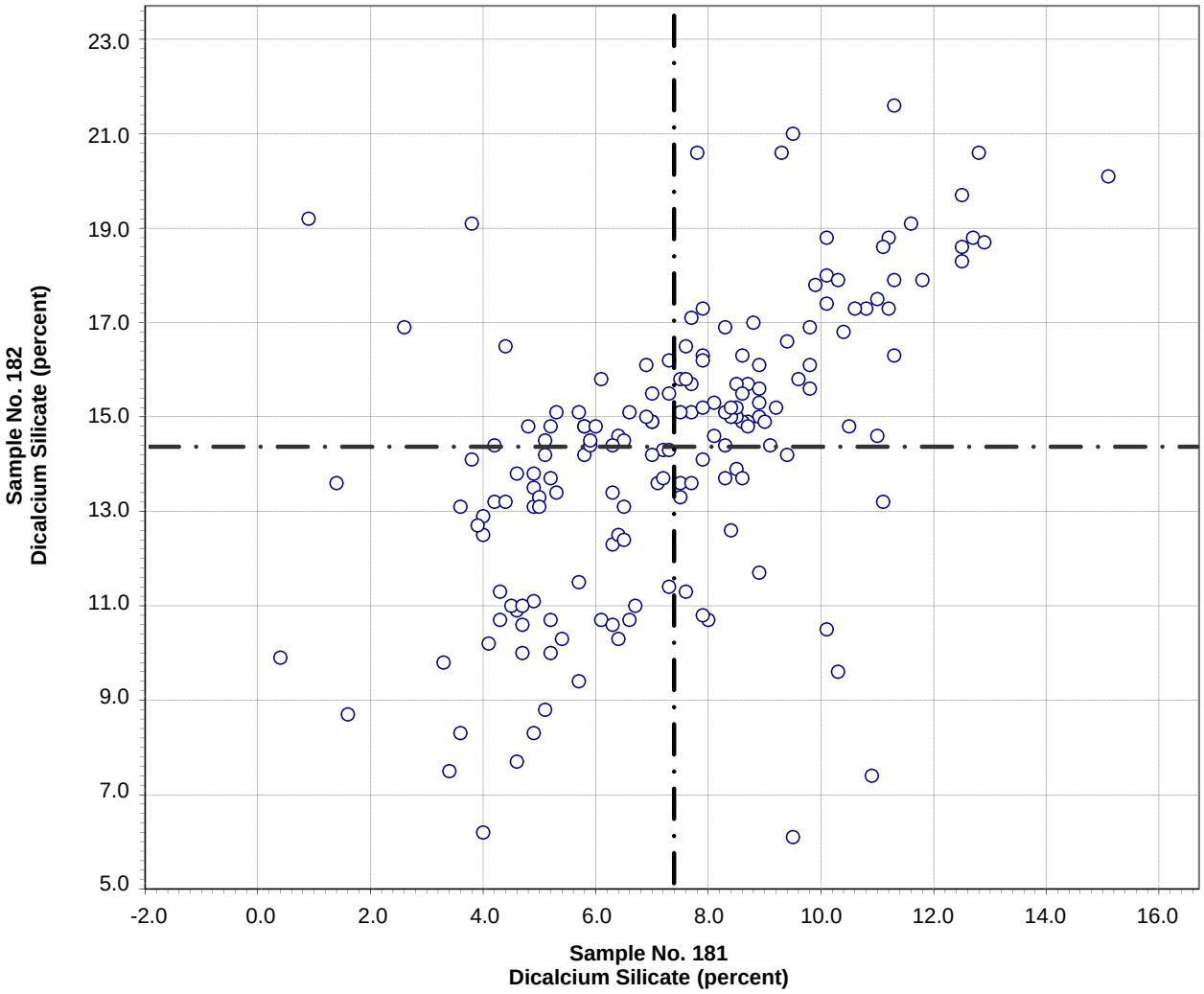
CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 106 Tricalcium Silicate 172 Points

Sample No. 181	Ave	63.1	S.D.	3.6	C.V.	5.7
Sample No. 182	Ave	56.9	S.D.	3.8	C.V.	6.8

CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 181 and No. 182

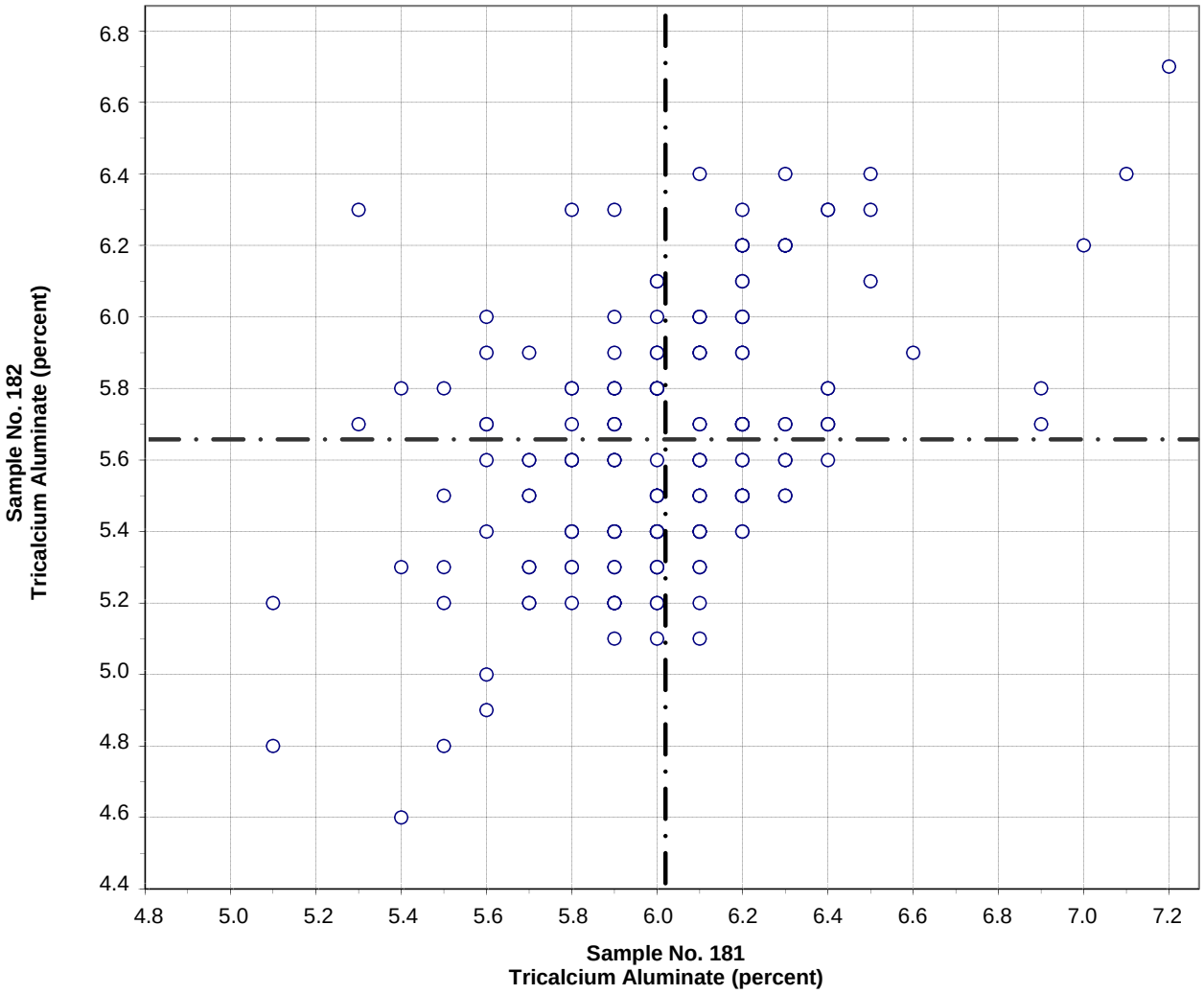


Test No. 107 Dicalcium Silicate 171 Points

Sample No. 181 Ave 7.4 S.D. 2.6 C.V. 35
Sample No. 182 Ave 14.3 S.D. 3.0 C.V. 21

Labs Eliminated: 53, 504, 2462

CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 181 and No. 182

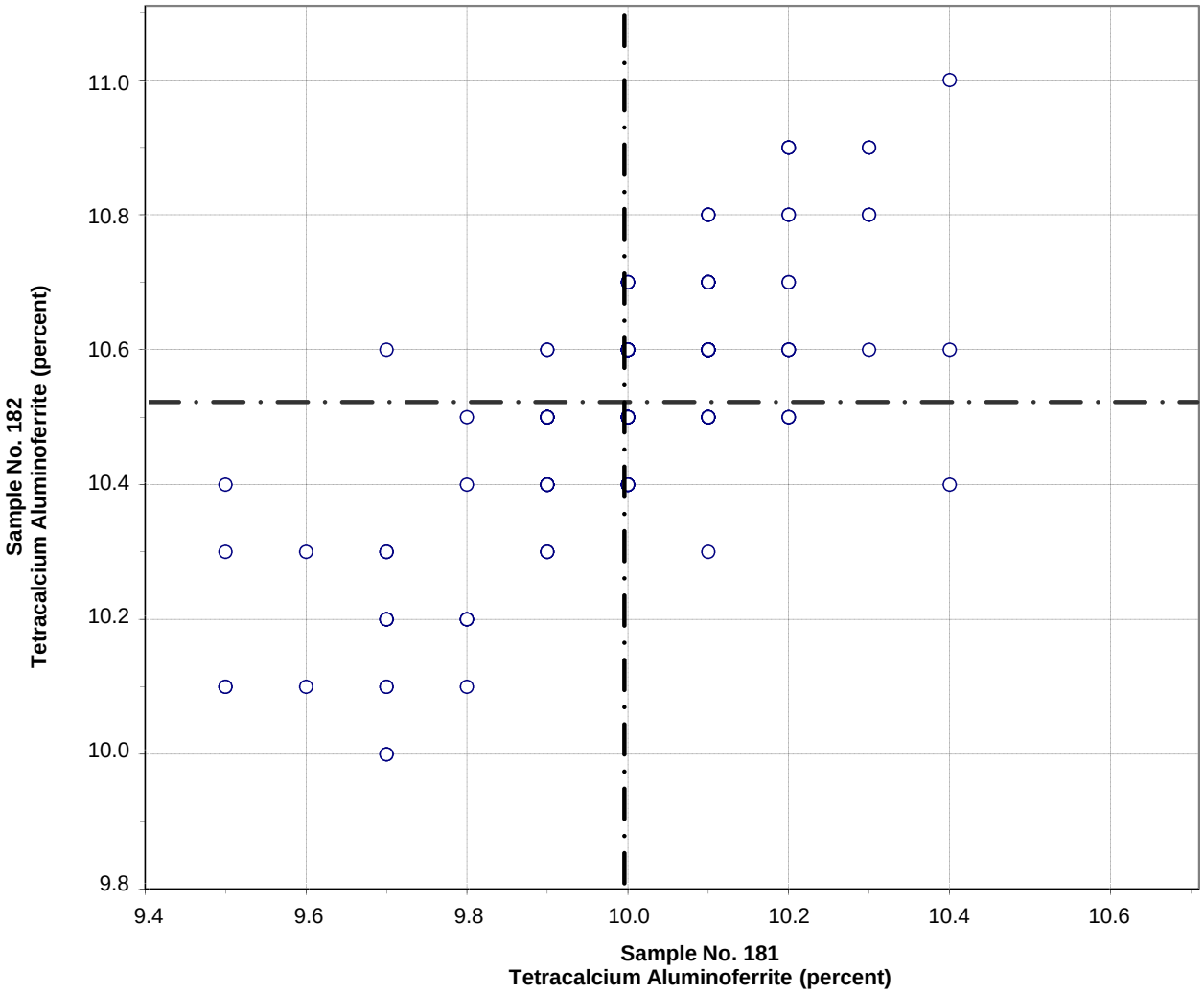


Test No. 108 Tricalcium Aluminate 173 Points

Sample No. 181	Ave	6.0	S.D.	0.3	C.V. 5.3
Sample No. 182	Ave	5.7	S.D.	0.4	C.V. 6.4

Labs Eliminated: 605, 3606

CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 109 Tetracalcium Aluminoferrite 167 Points

Sample No. 181 Ave 10.0 S.D. 0.2 C.V. 1.7
Sample No. 182 Ave 10.5 S.D. 0.2 C.V. 1.7

Labs Eliminated: 92, 206, 289, 407, 494, 3235, 3661

CCRL PROFICIENCY SAMPLE PROGRAM

Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Physical Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
Normal Consistency - % Water (**percent**)							
	242	25.0	13.23	53.0	26.6	13.63	51.3
	*233	23.7	0.44	1.9	25.3	0.42	1.7
* Labs Eliminated - 134, 221, 255, 515, 2116, 2292, 2938, 3057, 3658							
Vicat Time of Set - Initial (**minutes**)							
	239	143	14	10	131	16	12
	*234	142	13	9	130	12	9
* Labs Eliminated - 47, 116, 416, 565, 690							
Vicat Time of Set - Final (**minutes**)							
	229	248	31	13	237	29	12
	*226	248	28	11	236	28	12
* Labs Eliminated - 2, 43, 47							
Gillmore Time of Set - Initial (**minutes**)							
	144	176	23	13	169	24	14
	*143	176	22	12	169	24	14
* Labs Eliminated - 3605							
Gillmore Time of Set - Final (**minutes**)							
	144	277	35	13	269	37	14
No Labs Eliminated for This Test							
False Set - Paste Method (**percent**)							
	190	70	10.0	14	81	7.0	8.6
	*189	70	10.0	14	81	6.6	8.2
* Labs Eliminated - 25							
Autoclave Expansion (**percent**)							
	223	0.01	0.020	165	-0.01	0.067	-340
	*205	0.01	0.013	98	-0.02	0.019	73
* Labs Eliminated - 35, 47, 49, 86, 116, 152, 221, 222, 252, 413, 687, 690, 1054, 1523, 1644, 1940, 2466, 3059							

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Physical Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
Air Content % (percent)							
	216	9.8	1.4	14	8.8	1.3	15
	*212	9.8	1.2	12	8.8	1.2	14
* Labs Eliminated - 687, 736, 2192, 3059							
Air Content - % Water (percent)							
	213	75.6	37.4	49.4	76.0	37.7	49.6
	*195	68.0	2.5	3.7	68.2	2.6	3.8
* Labs Eliminated - 80, 165, 203, 221, 252, 407, 494, 692, 736, 958, 982, 1054, 2192, 2293, 2522, 3059, 3144, 3663							
Air Content - Flow (percent)							
	212	87	4.1	4.7	88	4.3	4.9
	*208	87	3.7	4.2	88	3.6	4.2
* Labs Eliminated - 95, 360, 494, 3663							
Compressive Strength - 3 day (psi)							
	248	3628	296	8.2	3799	362	9.5
	*242	3643	246	6.8	3827	267	7.0
* Labs Eliminated - 2, 14, 360, 1019, 1435, 3662							
Compressive Strength - 7 day (psi)							
	248	4452	402	9.0	4685	434	9.3
	*241	4455	294	6.6	4708	301	6.4
* Labs Eliminated - 2, 26, 49, 360, 1019, 3422, 3662							
Compressive Strengh - Flow (percent)							
	229	119	11	8.9	119	12	9.7
	*227	120	10	8.2	120	11	8.9
* Labs Eliminated - 2, 51							
Fineness - Air Permeability (m^2/kg)							
	240	384	14	3.8	370	13	3.4
	*223	384	8	2.0	369	8	2.1
* Labs Eliminated - 17, 46, 51, 70, 207, 551, 565, 684, 687, 698, 958, 1483, 2251, 2360, 3135, 3605, 3661							

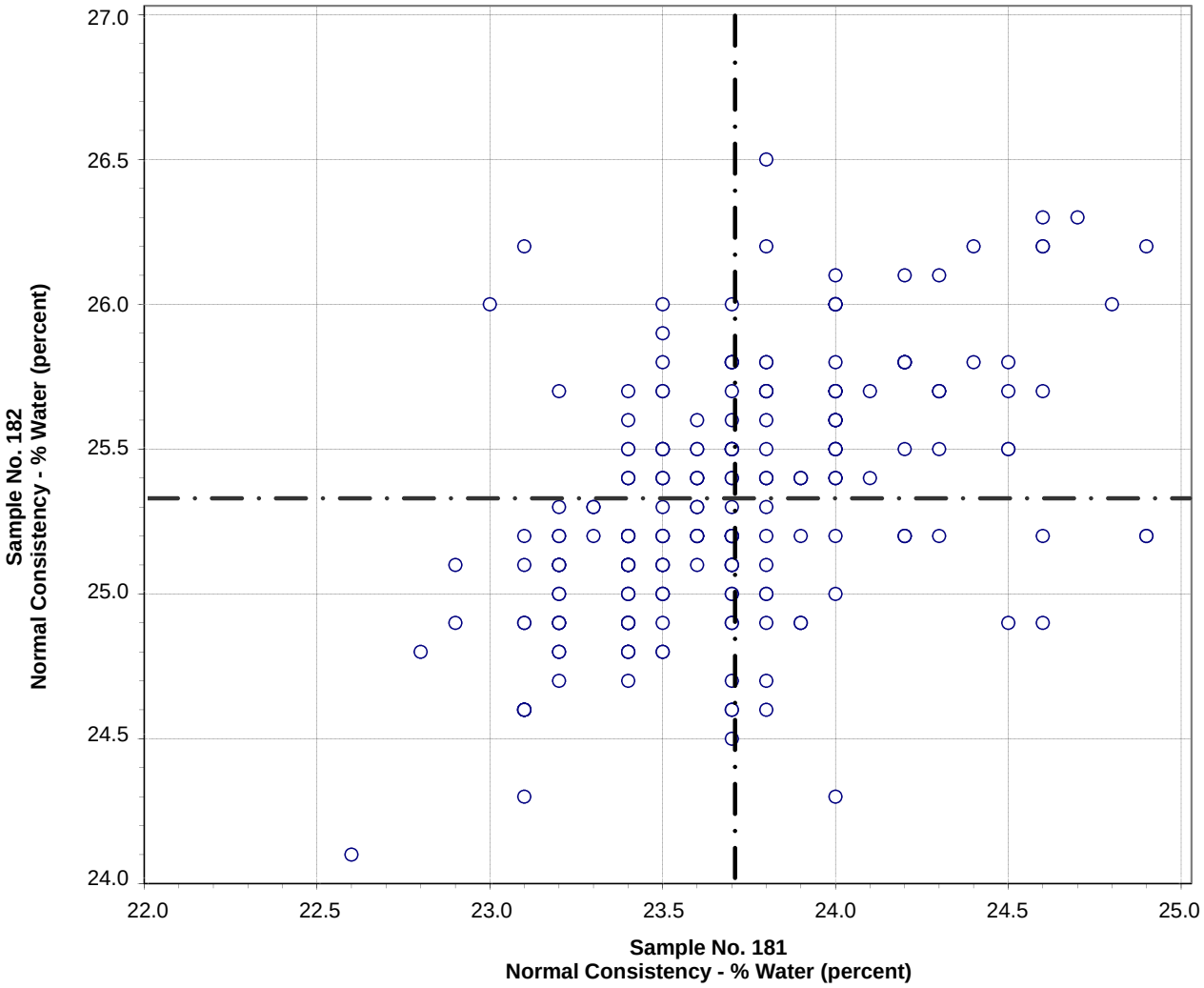
CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Physical Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
Fineness - Wagner Turbidimeter (**cm²/g**)							
	6	196	15	7.6	199	14	7.0
No Labs Eliminated for This Test							
Fineness - 45µm Sieve (**percent**)							
	225	92.23	1.24	1.3	96.47	0.75	0.8
	*220	92.28	1.04	1.1	96.52	0.53	0.6
* Labs Eliminated - 47, 95, 116, 206, 565							
C1038 Mortar Bar Expansion (**percent**)							
	149	0.006	0.009	150.0	0.004	0.012	314.0
	*140	0.005	0.004	70.0	0.002	0.004	148.0
* Labs Eliminated - 8, 34, 40, 66, 80, 101, 2466, 3607, 3658							
C1038 Mortar - Water (**ml**)							
	149	238	22	9.3	238	22	9.3
	*146	236	7	2.8	236	7	2.9
* Labs Eliminated - 51, 611, 2462							
C1038 Mortar - Flow (**percent**)							
	148	110	5	4.7	110	5	4.2
	*141	110	3	2.7	110	3	2.7
* Labs Eliminated - 46, 177, 360, 694, 1251, 2462, 3662							

CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 181 and No. 182



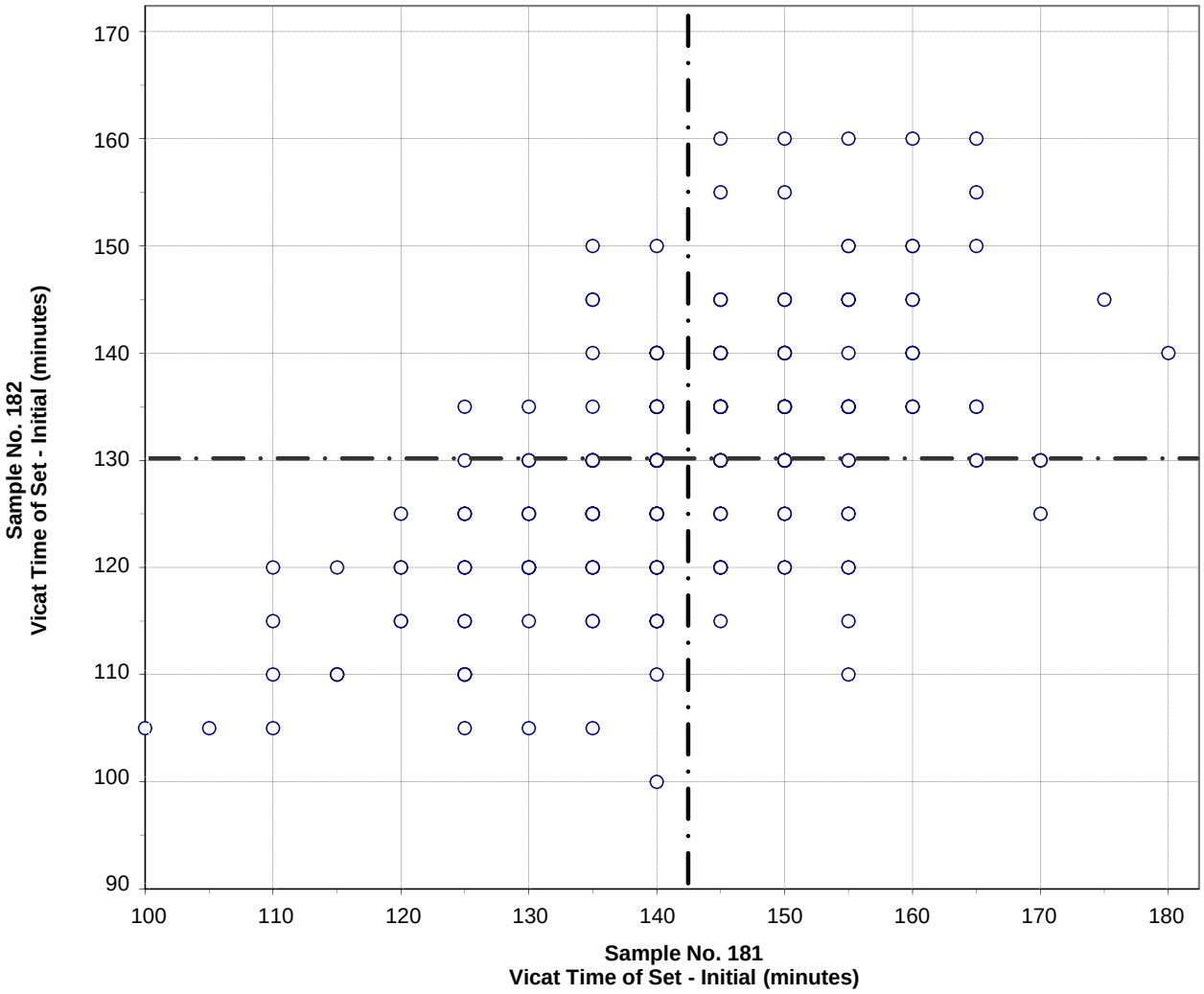
Test No. 110 Normal Consistency - % Water 231 Points

Sample No. 181 Ave 23.7 S.D. 0.44 C.V. 1.9
Sample No. 182 Ave 25.3 S.D. 0.42 C.V. 1.7

Labs Eliminated: 134, 221, 255, 515, 2116, 2292, 2938, 3057, 3658

Labs off Diagram: 565, 1483

CCRL Proficiency Sample Program
Vicat Time of Set - Initial
PORTLAND CEMENT Samples No. 181 and No. 182



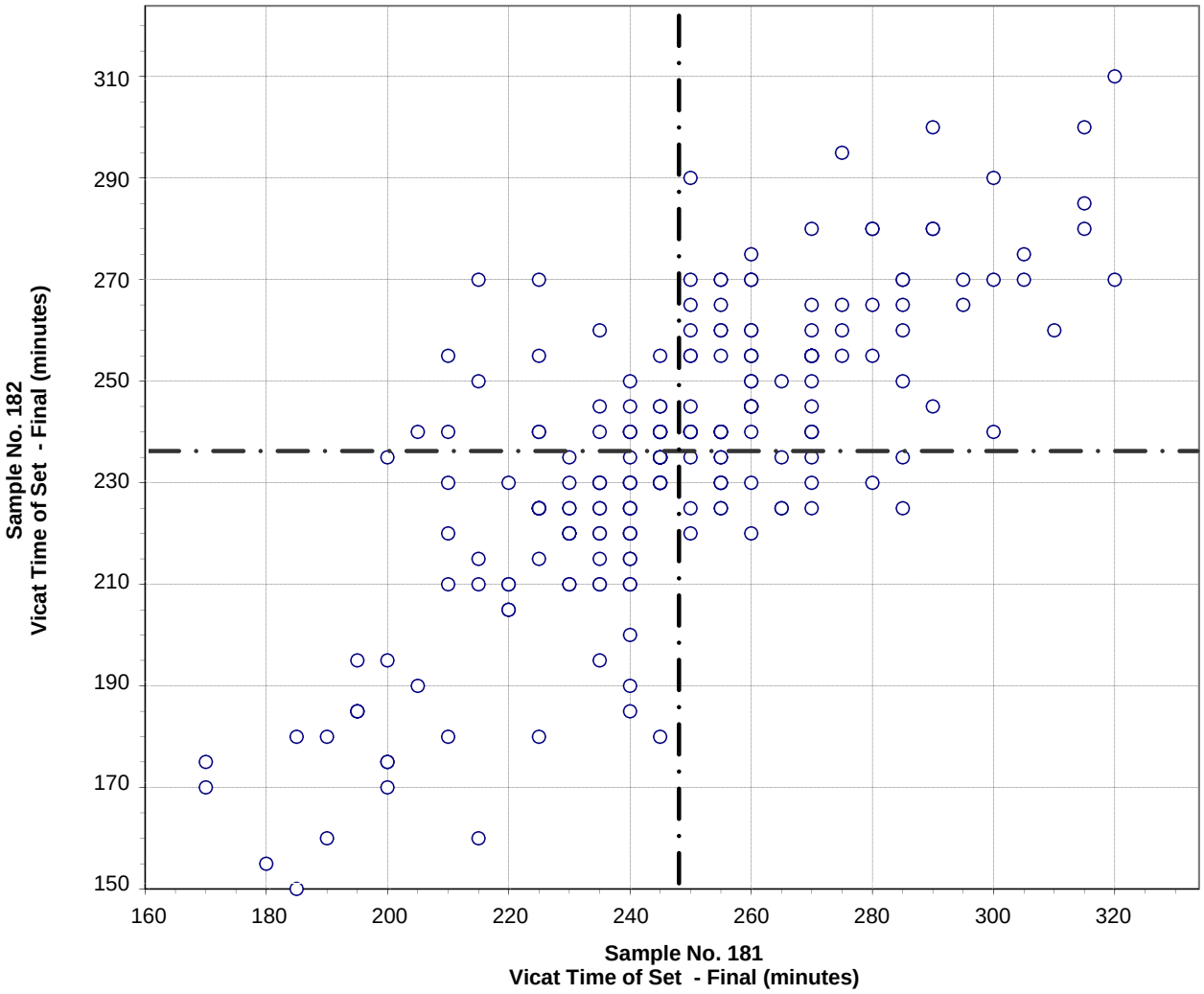
Test No. 120 Vicat Time of Set - Initial 233 Points

Sample No. 181 Ave 142 S.D. 13 C.V. 9
Sample No. 182 Ave 130 S.D. 12 C.V. 9

Labs Eliminated: 47, 116, 416, 565, 690

Labs off Diagram: 162

CCRL Proficiency Sample Program
Vicat Time of Set - Final
PORTLAND CEMENT Samples No. 181 and No. 182



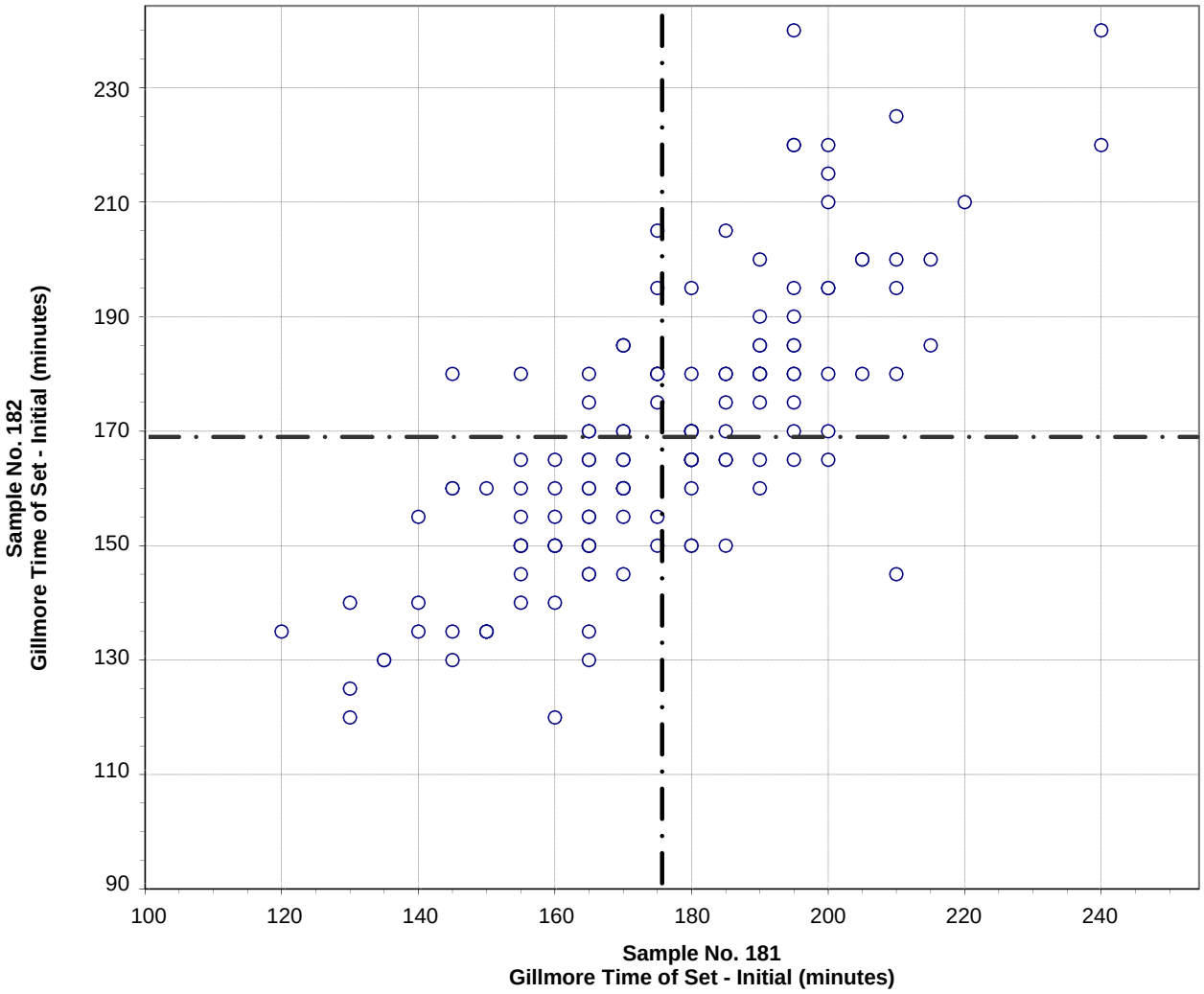
Test No. 121 Vicat Time of Set - Final 225 Points

Sample No. 181	Ave 248	S.D. 28	C.V. 11
Sample No. 182	Ave 236	S.D. 28	C.V. 12

Labs Eliminated: 2, 43, 47

Labs off Diagram: 134

CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 181 and No. 182

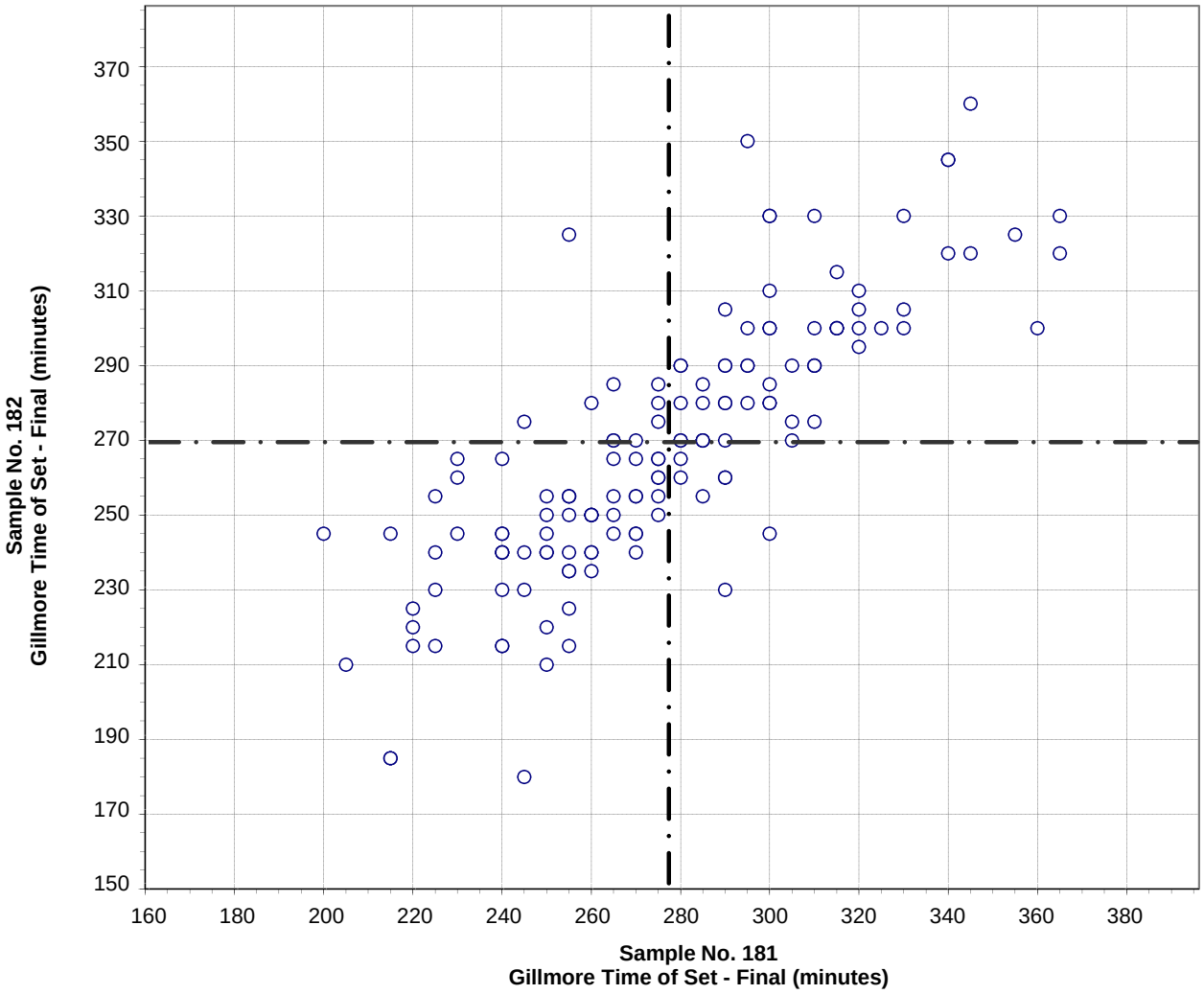


Test No. 130 Gillmore Time of Set - Initial 143 Points

Sample No. 181 Ave 176 S.D. 22 C.V. 12
Sample No. 182 Ave 169 S.D. 24 C.V. 14

Labs Eliminated: 3605

CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 181 and No. 182

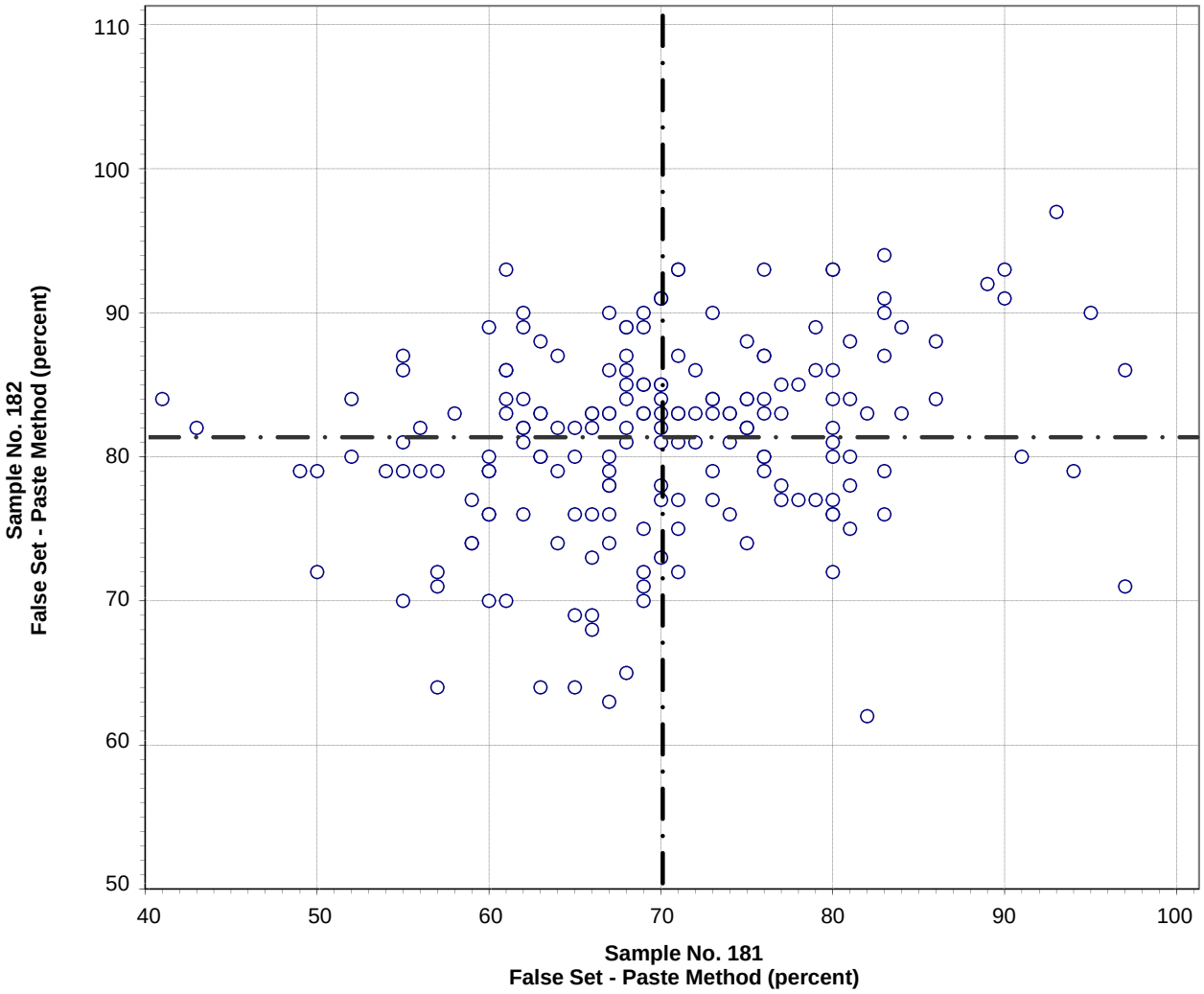


Test No. 140 Gillmore Time of Set - Final 143 Points

Sample No. 181	Ave 277	S.D. 35	C.V. 13
Sample No. 182	Ave 269	S.D. 37	C.V. 14

Labs off Diagram: 90

CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 181 and No. 182

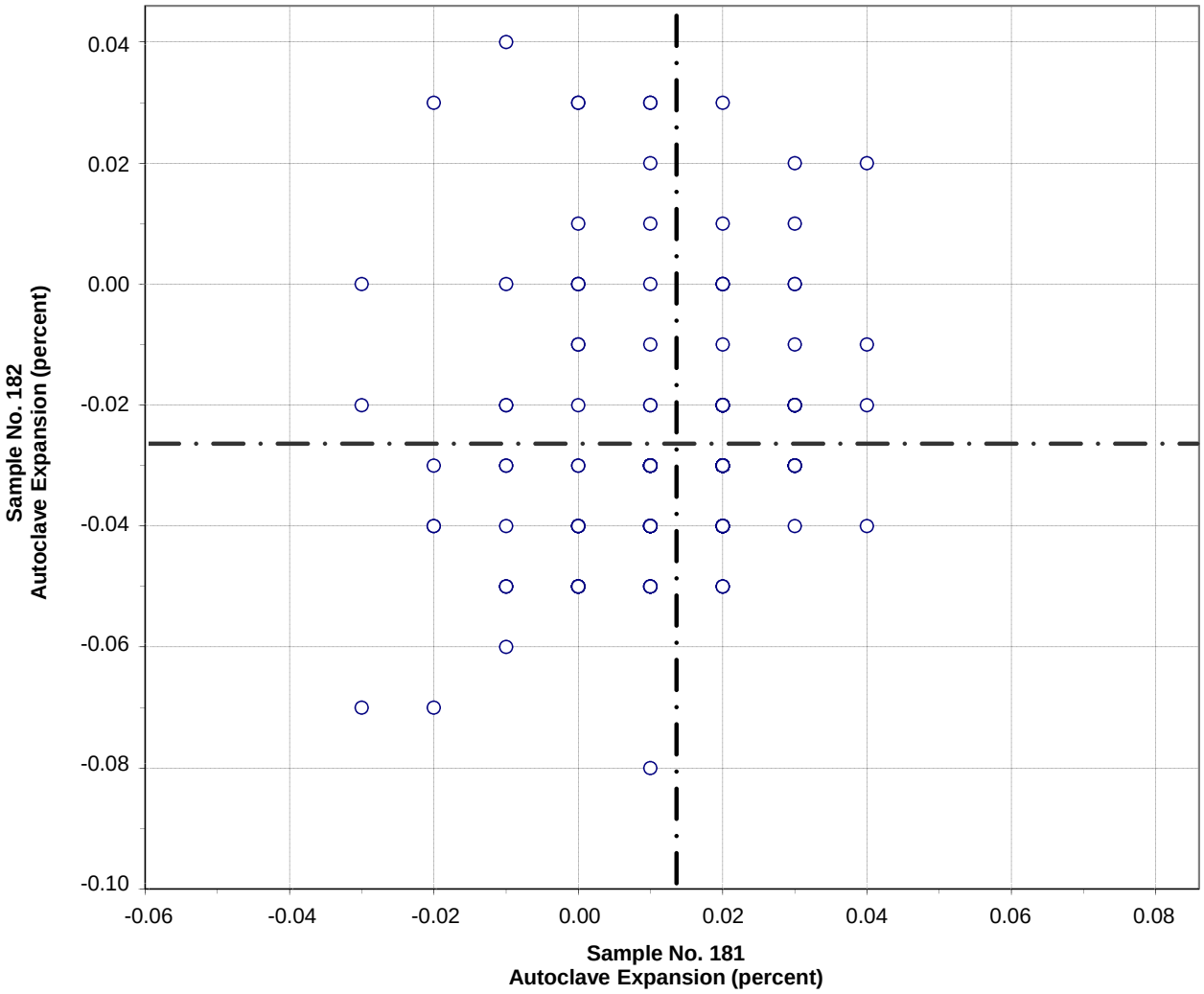


Test No. 150 False Set - Paste Method 189 Points

Sample No. 181 Ave 70 S.D. 10.0 C.V. 14
Sample No. 182 Ave 81 S.D. 6.6 C.V. 8.2

Labs Eliminated: 25

CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 181 and No. 182

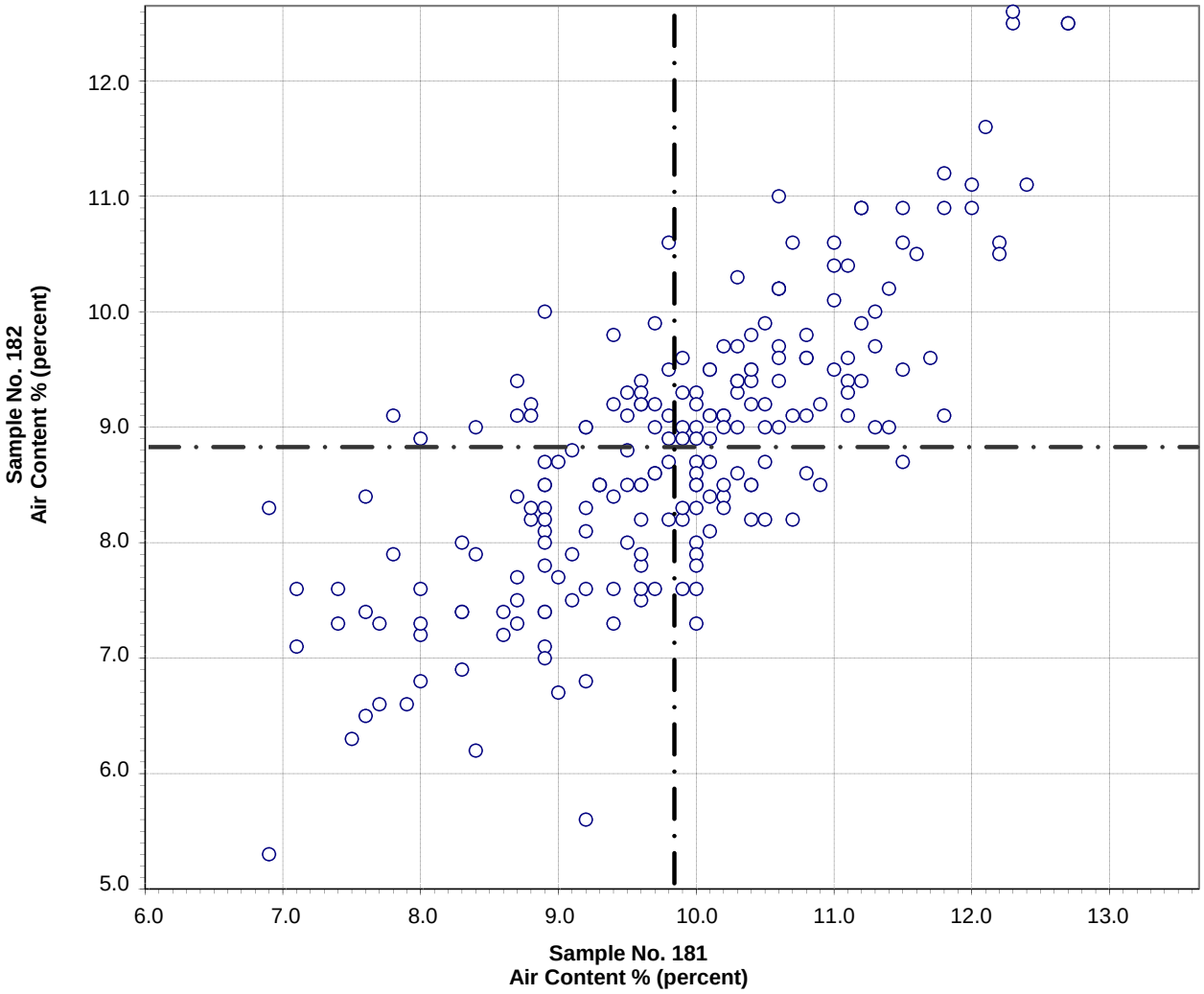


Test No. 160 Autoclave Expansion 205 Points

Sample No. 181 Ave 0.01 S.D. 0.013 C.V. 98
Sample No. 182 Ave -0.02 S.D. 0.019 C.V. 73

Labs Eliminated: 35, 47, 49, 86, 116, 152, 221, 222, 252, 413, 687, 690, 1054, 1523, 1644, 1940, 2466, 3059

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 181 and No. 182

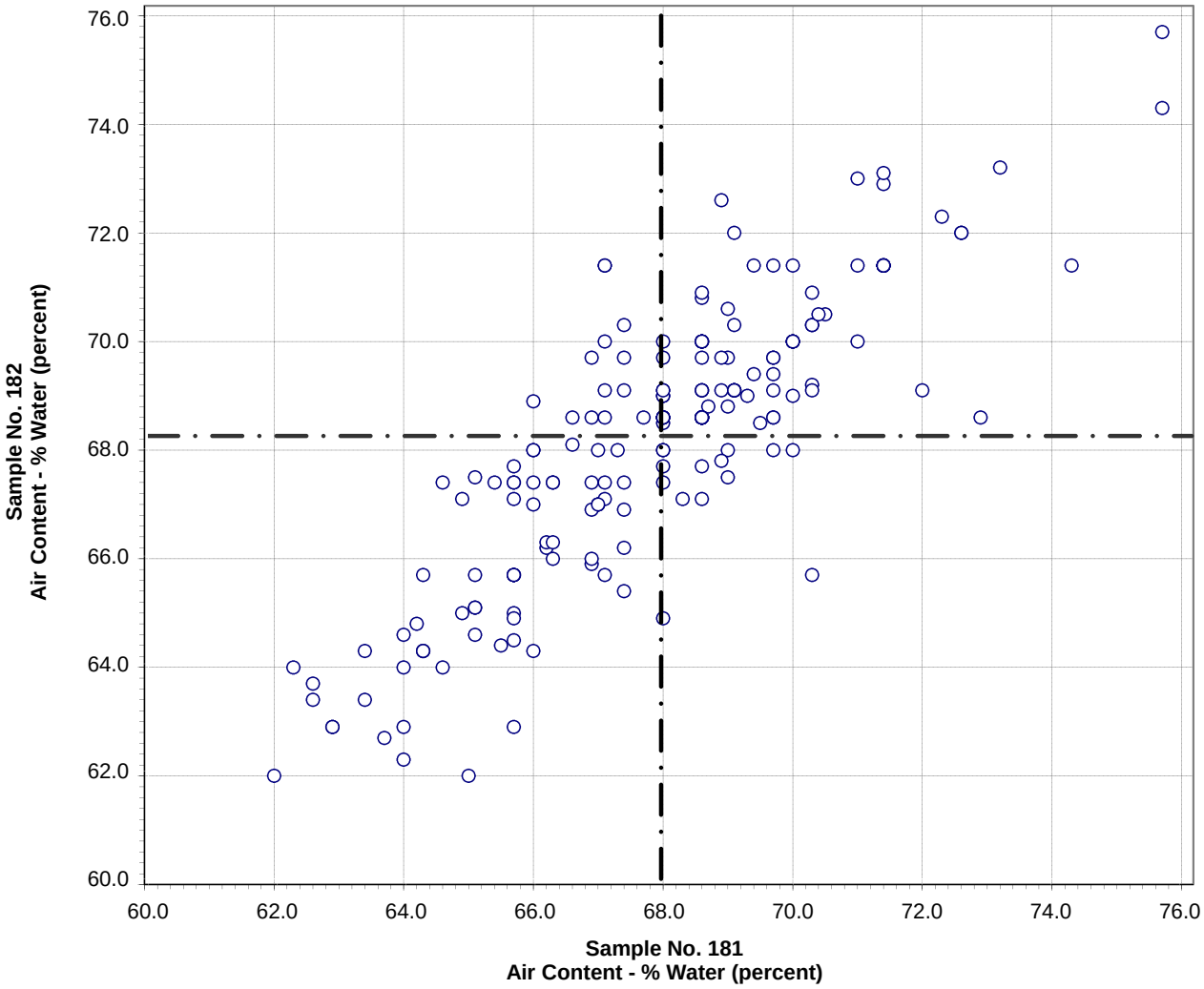


Test No. 170 Air Content % 212 Points

Sample No. 181	Ave	9.8	S.D.	1.2	C.V. 12
Sample No. 182	Ave	8.8	S.D.	1.2	C.V. 14

Labs Eliminated: 687, 736, 2192, 3059

CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 181 and No. 182



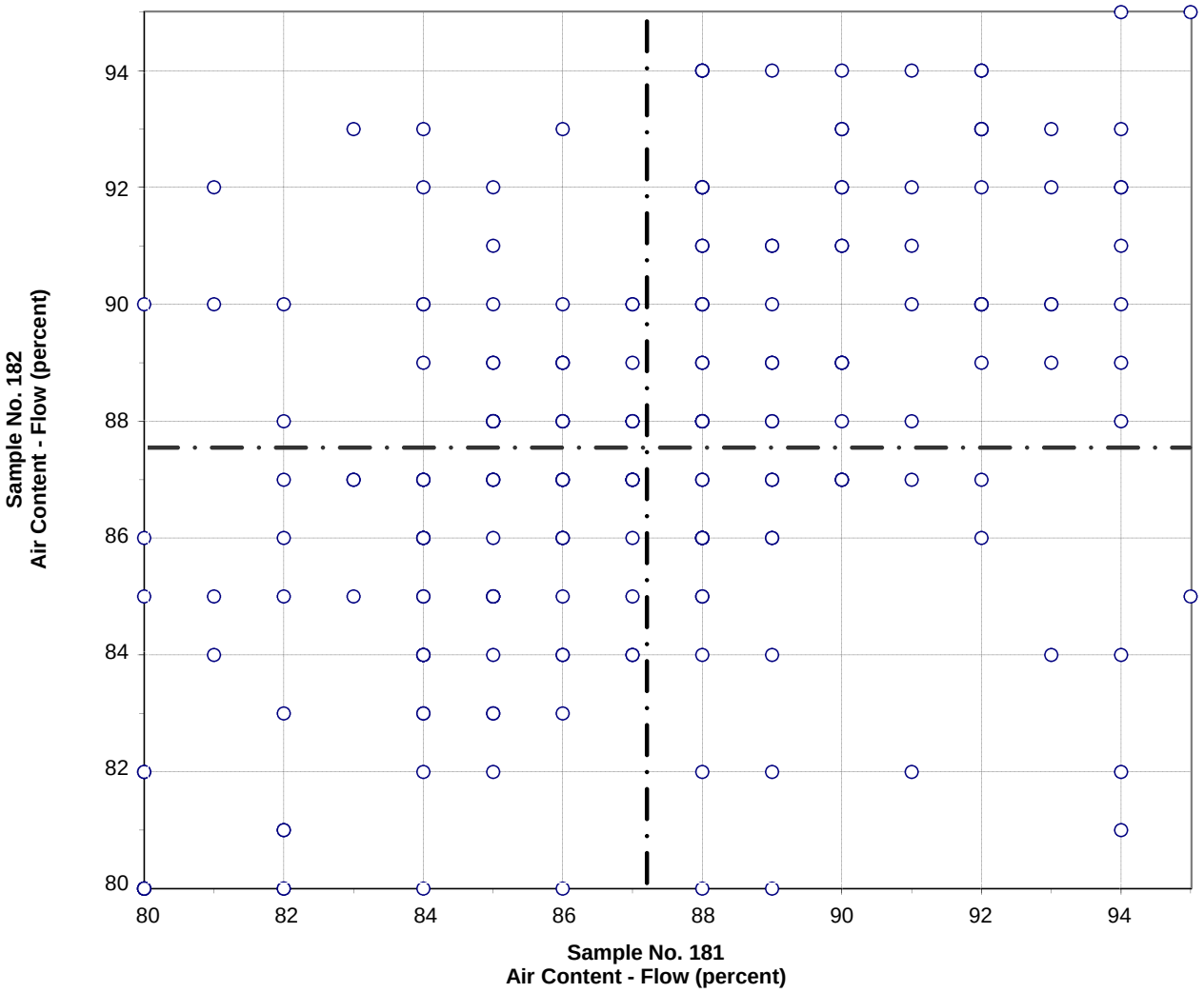
Test No. 180 Air Content - % Water 194 Points

Sample No. 181 Ave 68.0 S.D. 2.5 C.V. 3.7
Sample No. 182 Ave 68.2 S.D. 2.6 C.V. 3.8

Labs Eliminated: 80, 165, 203, 221, 252, 407, 494, 692, 736, 958, 982, 1054, 2192, 2293, 2522, 3059, 3144, 3663

Labs off Diagram: 180

CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 181 and No. 182

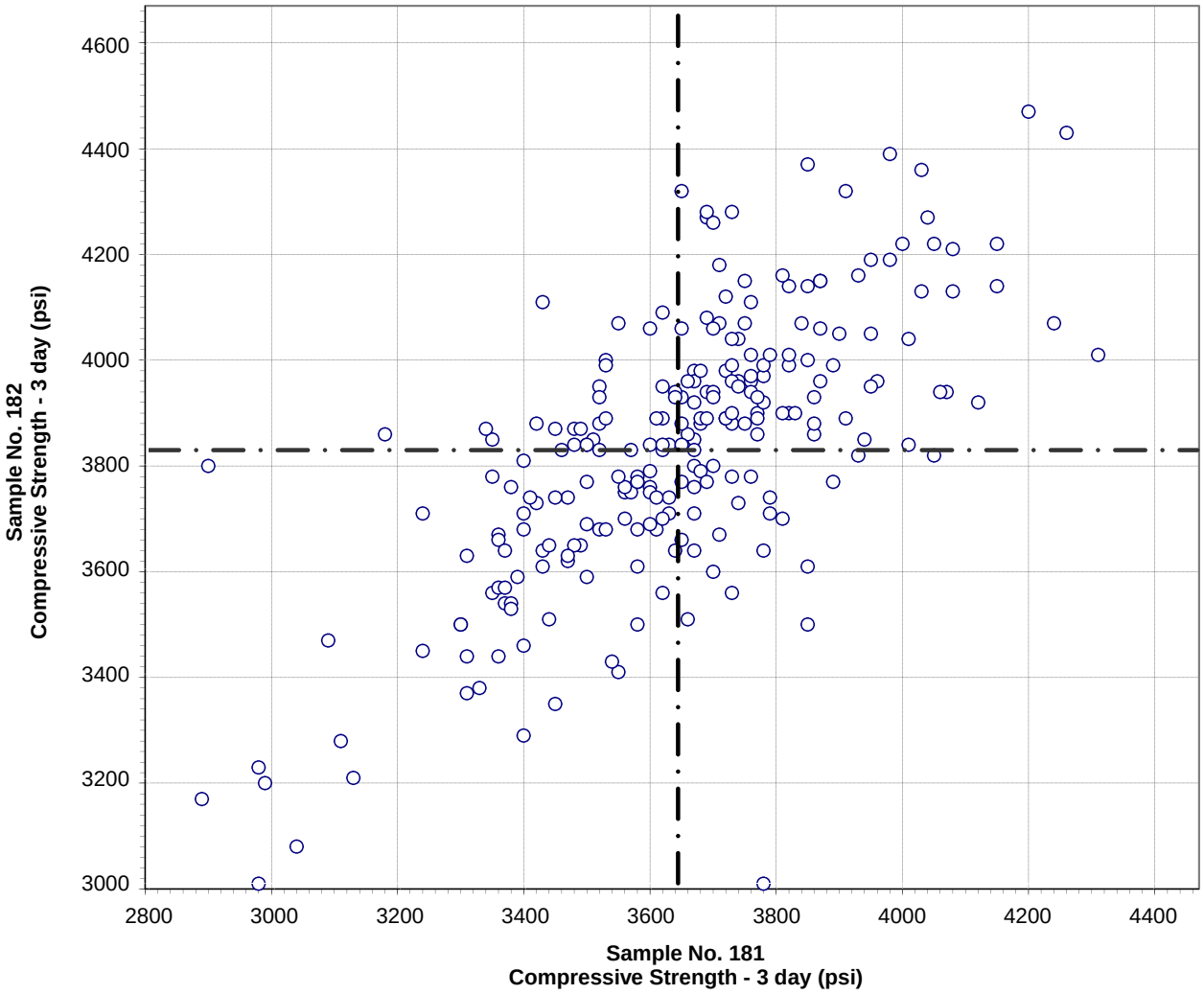


Test No. 190 Air Content - Flow 208 Points

Sample No. 181	Ave 87	S.D. 3.7	C.V. 4.2
Sample No. 182	Ave 88	S.D. 3.6	C.V. 4.2

Labs Eliminated: 95, 360, 494, 3663

CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 181 and No. 182



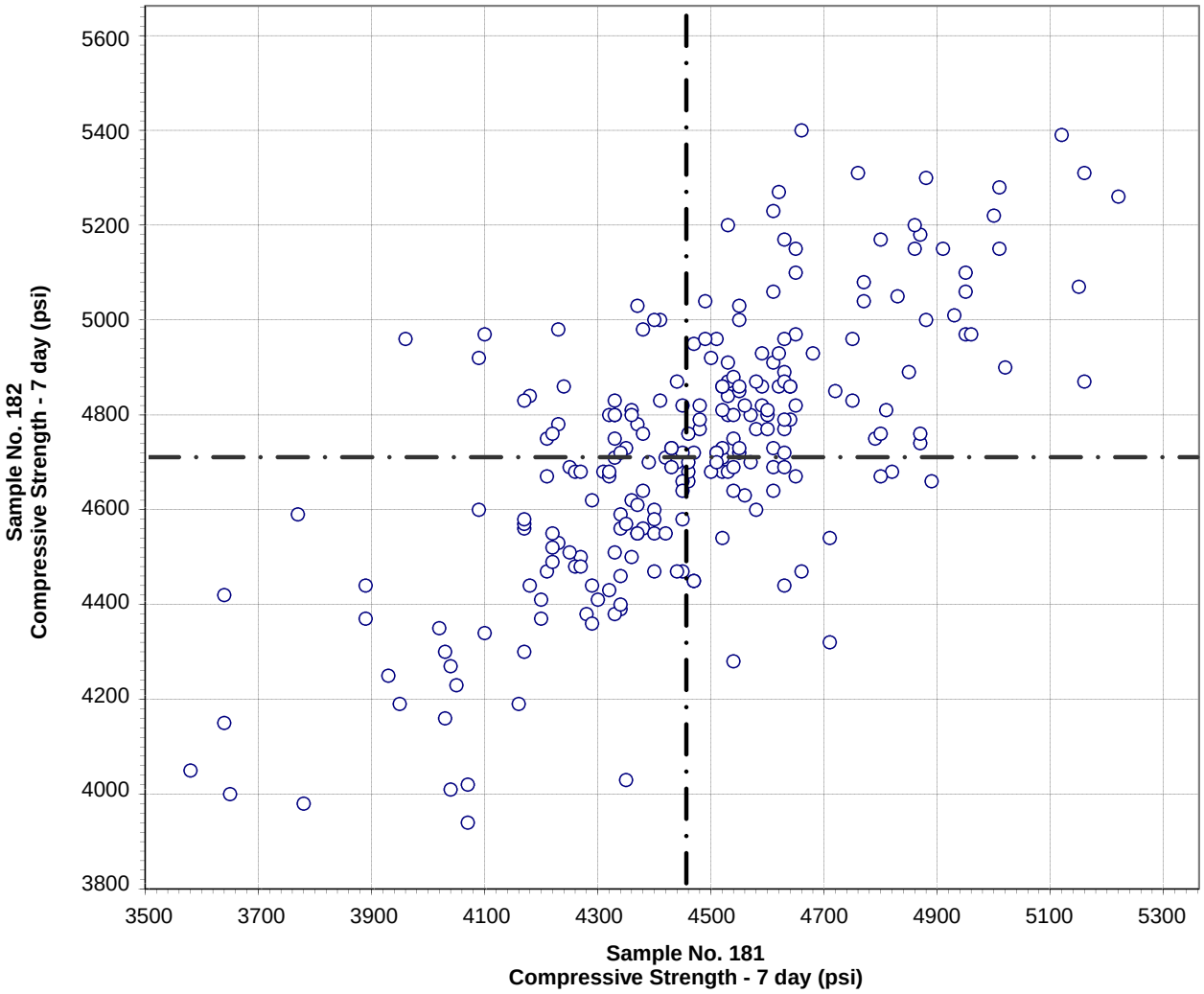
Test No. 200 Compressive Strength - 3 day 240 Points

Sample No. 181	Ave	3643	S.D.	246	C.V. 6.8
Sample No. 182	Ave	3827	S.D.	267	C.V. 7.0

Labs Eliminated: 2, 14, 360, 1019, 1435, 3662

Labs off Diagram: 49, 450

CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 181 and No. 182



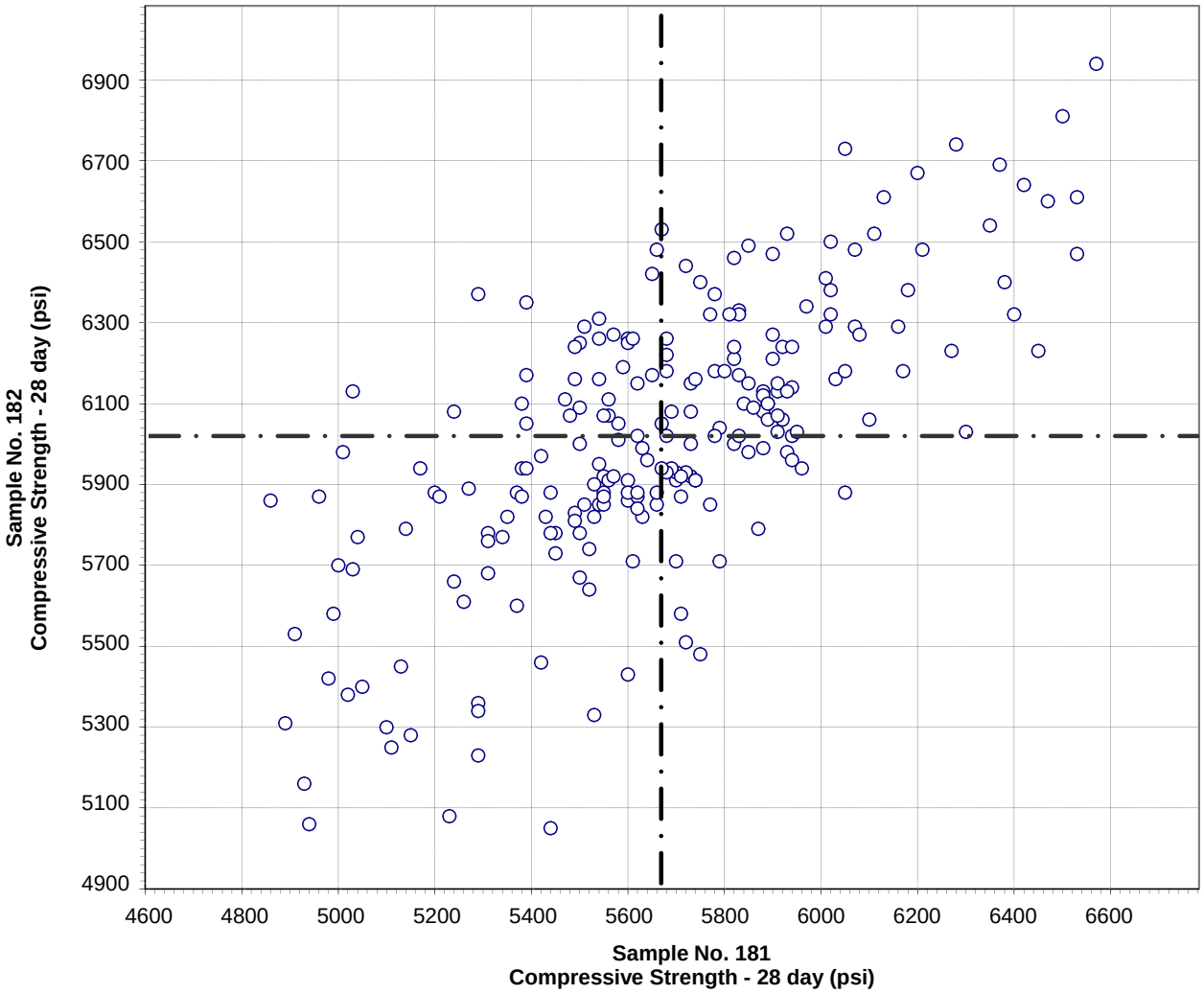
Test No. 210 Compressive Strength - 7 day 237 Points

Sample No. 181	Ave	4455	S.D.	294	C.V. 6.6
Sample No. 182	Ave	4708	S.D.	301	C.V. 6.4

Labs Eliminated: 2, 26, 49, 360, 1019, 3422, 3662

Labs off Diagram: 14, 45, 52, 450

CCRL Proficiency Sample Program
Compressive Strength - 28 day
PORTLAND CEMENT Samples No. 181 and No. 182

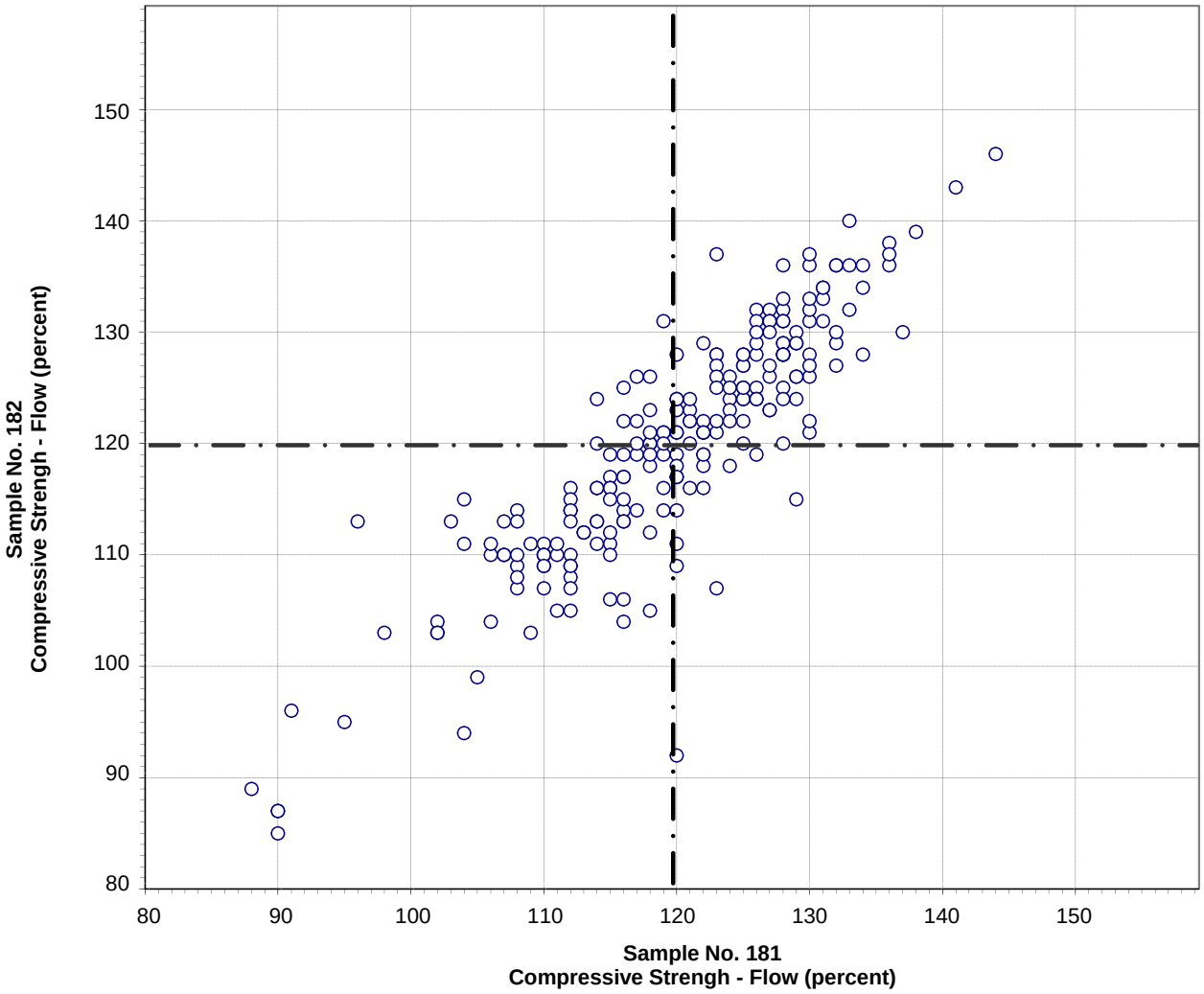


Test No. 211 Compressive Strength - 28 day 222 Points

Sample No. 181 Ave 5666 S.D. 350 C.V. 6.2
Sample No. 182 Ave 6016 S.D. 339 C.V. 5.6

Labs Eliminated: 2, 23, 26, 360, 450, 691, 1019, 1523, 1726, 2360, 3422

CCRL Proficiency Sample Program
Compressive Strengh - Flow
PORTLAND CEMENT Samples No. 181 and No. 182

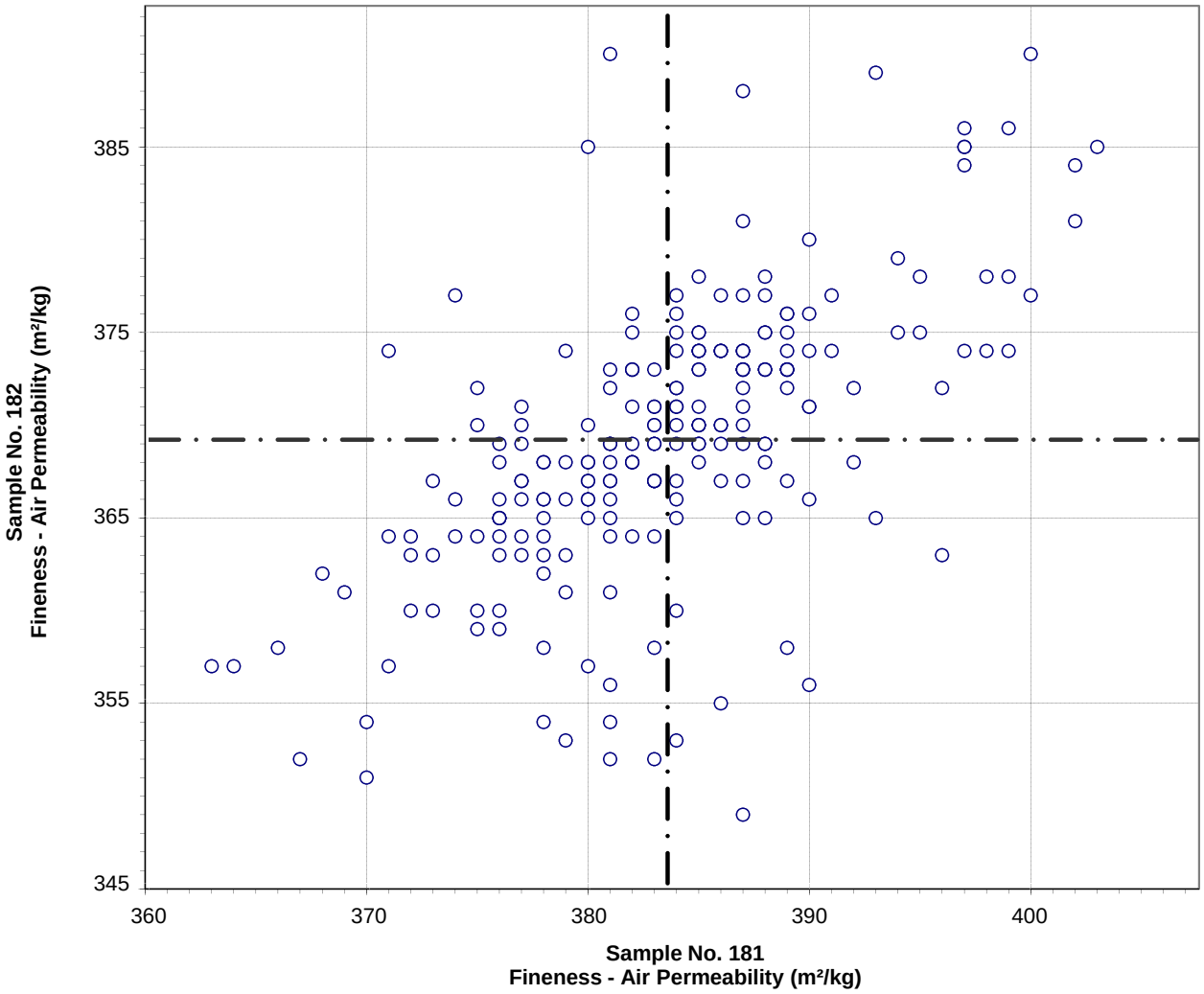


Test No. 230 Compressive Strengh - Flow 227 Points

Sample No. 181 Ave 120 S.D. 10 C.V. 8.2
Sample No. 182 Ave 120 S.D. 11 C.V. 8.9

Labs Eliminated: 2, 51

CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 181 and No. 182



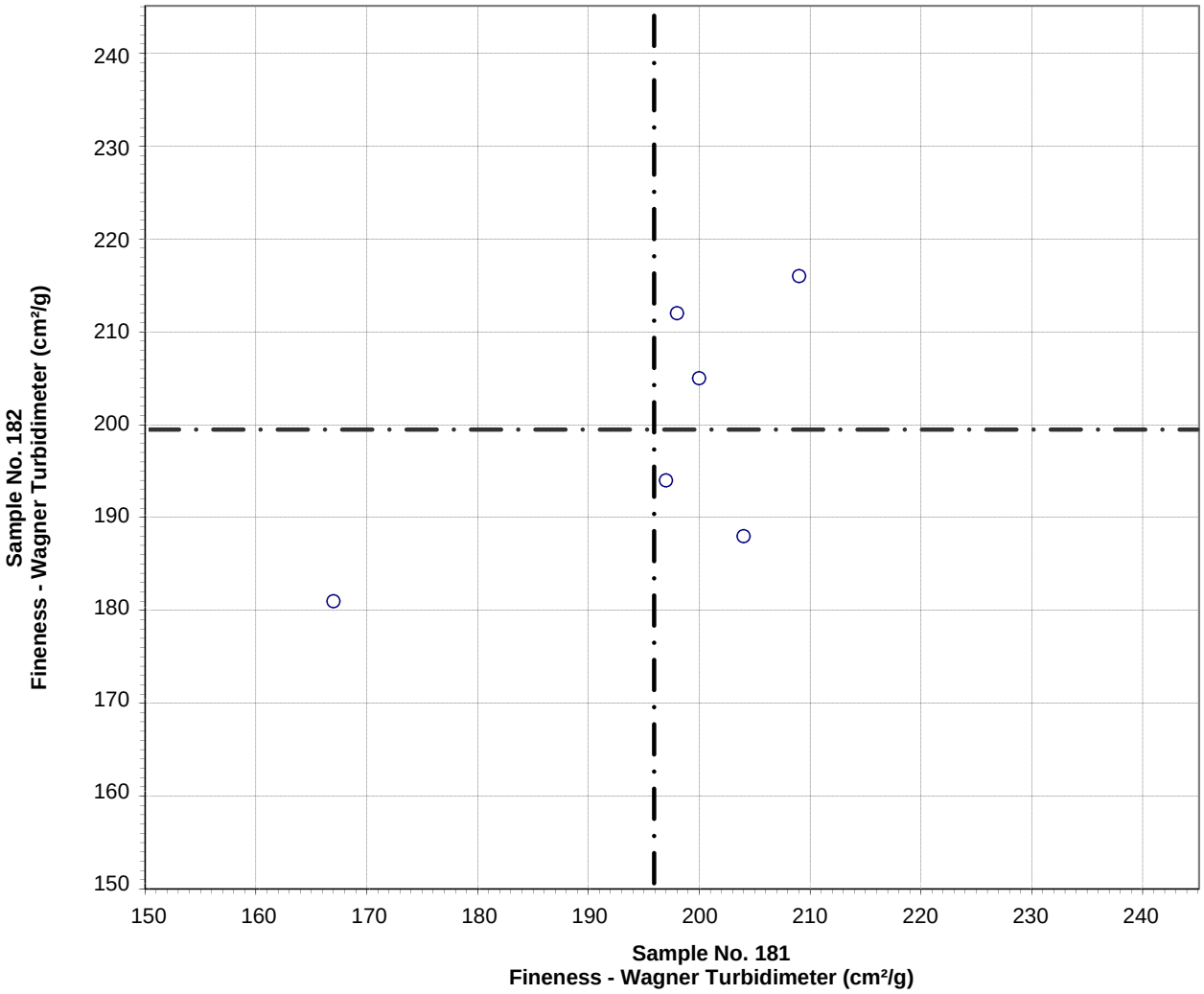
Test No. 270 Fineness - Air Permeability 221 Points

Sample No. 181 Ave 384 S.D. 8 C.V. 2.0
Sample No. 182 Ave 369 S.D. 8 C.V. 2.1

Labs Eliminated: 17, 46, 51, 70, 207, 551, 565, 684, 687, 698, 958, 1483, 2251, 2360, 3135, 3605, 3661

Labs off Diagram: 1435, 1956

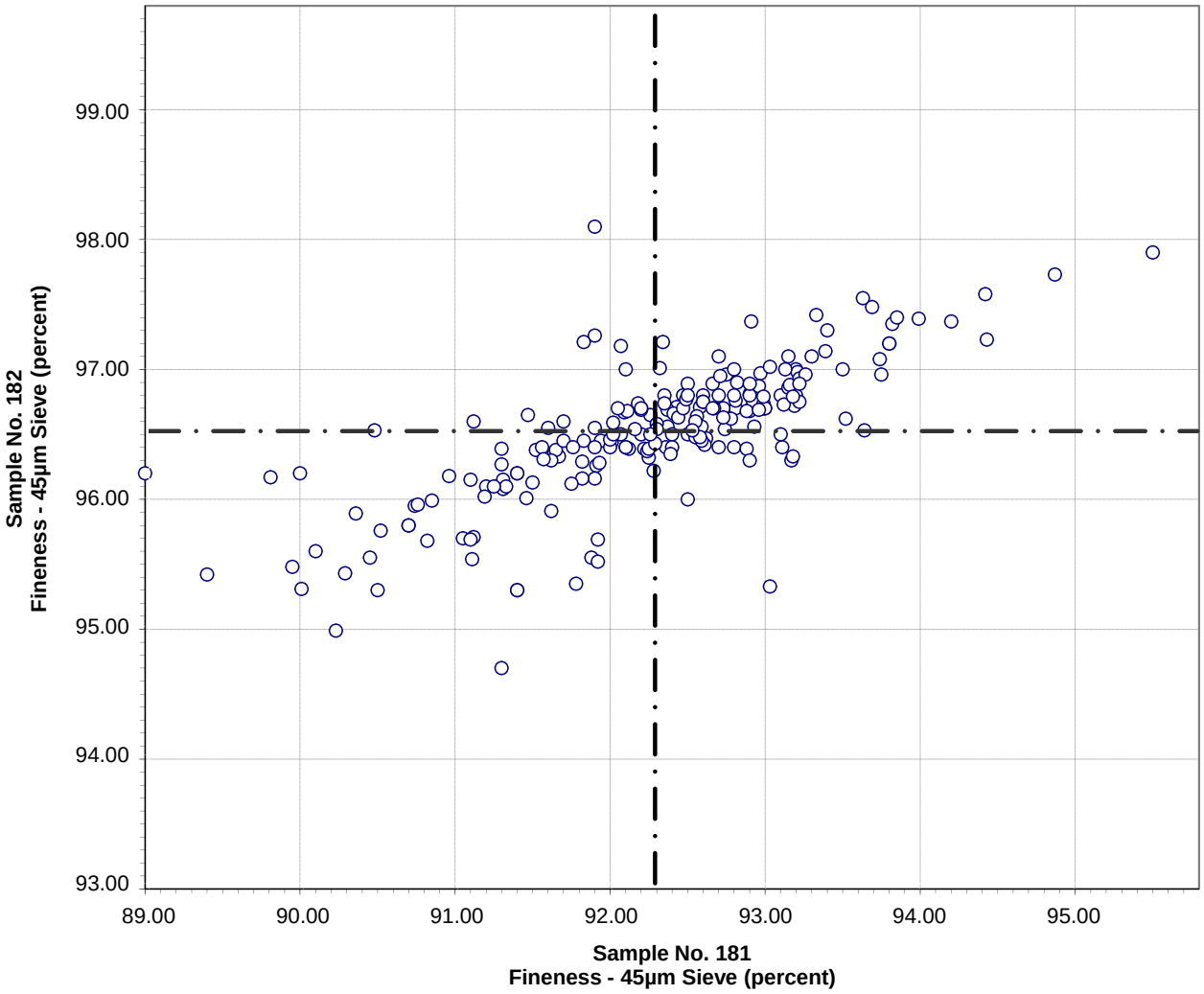
CCRL Proficiency Sample Program
Fineness - Wagner Turbidimeter
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 280 Fineness - Wagner Turbidimeter 6 Points

Sample No. 181	Ave 196	S.D. 15	C.V. 7.6	
Sample No. 182	Ave 199	S.D. 14	C.V. 7.0	

CCRL Proficiency Sample Program
Fineness - 45µm Sieve
PORTLAND CEMENT Samples No. 181 and No. 182



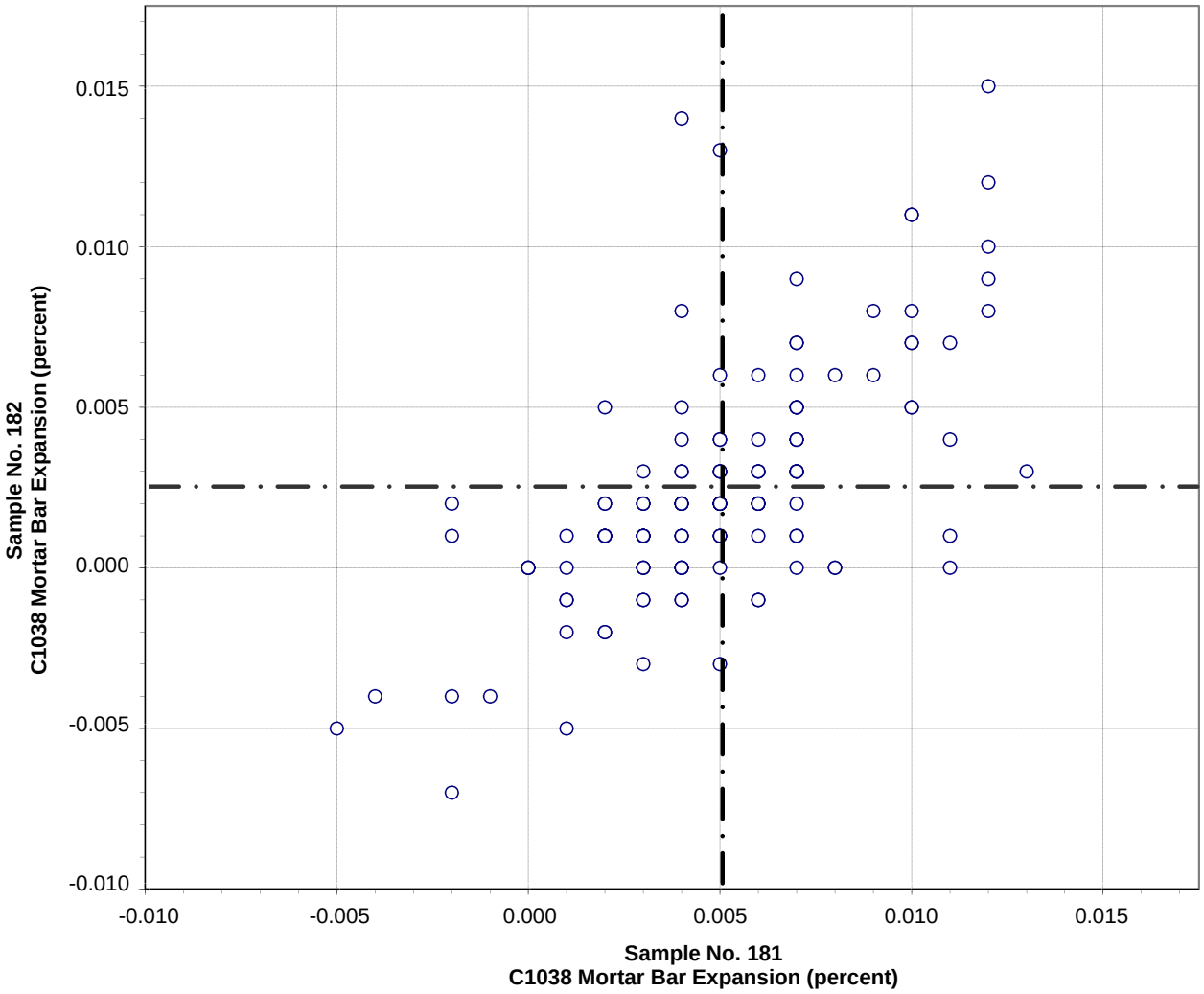
Test No. 281 Fineness - 45µm Sieve 218 Points

Sample No. 181	Ave	92.28	S.D.	1.04	C.V. 1.1
Sample No. 182	Ave	96.52	S.D.	0.53	C.V. 0.6

Labs Eliminated: 47, 95, 116, 206, 565

Labs off Diagram: 46, 1819

CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 181 and No. 182



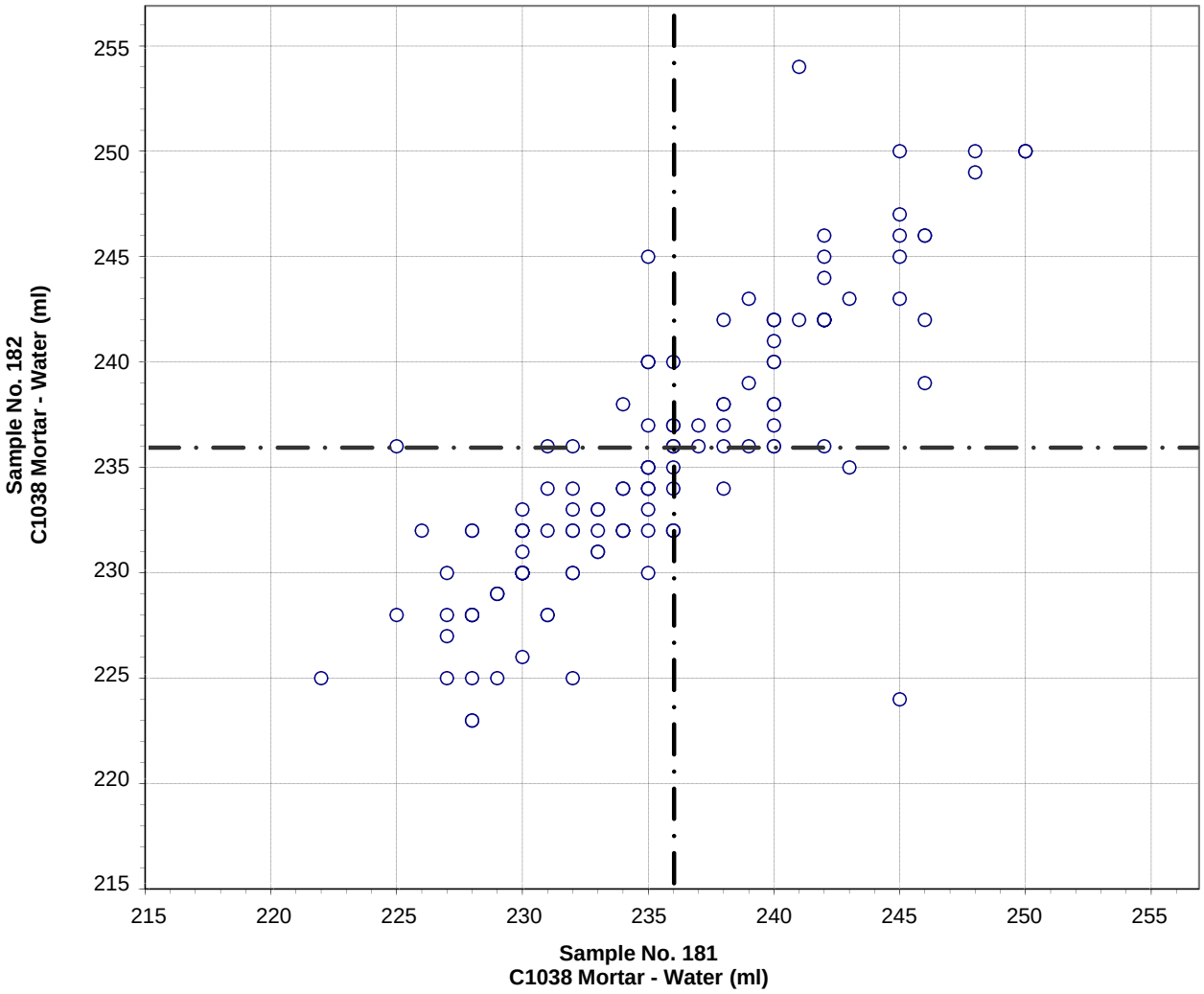
Test No. 400 C1038 Mortar Bar Expansion 139 Points

Sample No. 181	Ave	0.005	S.D.	0.004	C.V. 70.0
Sample No. 182	Ave	0.002	S.D.	0.004	C.V. 148.0

Labs Eliminated: 8, 34, 40, 66, 80, 101, 2466, 3607, 3658

Labs off Diagram: 18

CCRL Proficiency Sample Program
C1038 Mortar - Water
PORTLAND CEMENT Samples No. 181 and No. 182



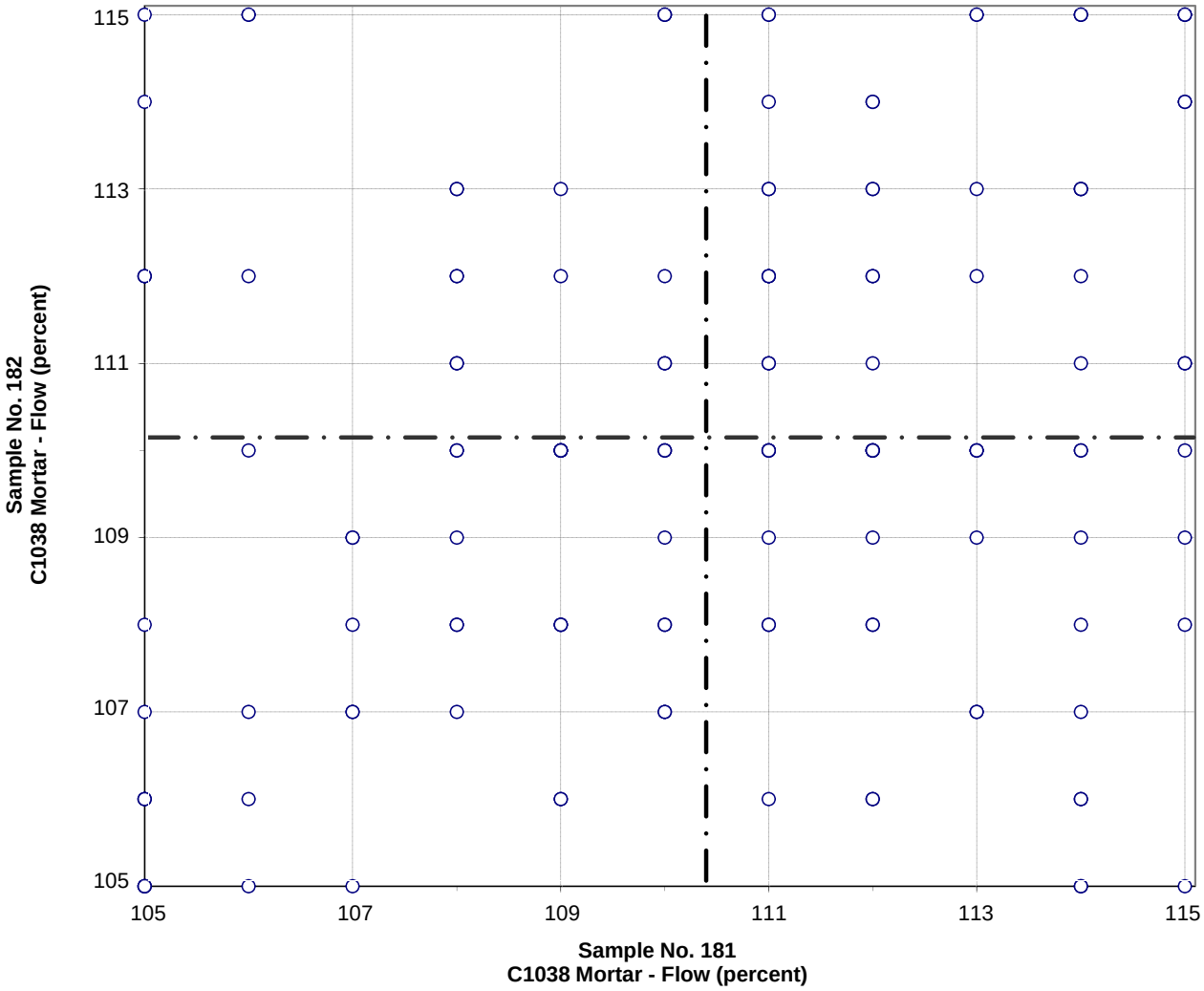
Test No. 401 C1038 Mortar - Water 144 Points

Sample No. 181 Ave 236 S.D. 7 C.V. 2.8
Sample No. 182 Ave 236 S.D. 7 C.V. 2.9

Labs Eliminated: 51, 611, 2462

Labs off Diagram: 84, 768

CCRL Proficiency Sample Program
C1038 Mortar - Flow
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 402 C1038 Mortar - Flow 141 Points

Sample No. 181	Ave 110	S.D. 3	C.V. 2.7	
Sample No. 182	Ave 110	S.D. 3	C.V. 2.7	

Labs Eliminated: 46, 177, 360, 694, 1251, 2462, 3662

CCRL PROFICIENCY SAMPLE PROGRAM

Portland Cement Proficiency Samples No. 181 and No. 182

Final Report – Heat of Hydration Results
September 9, 2011

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.181 Average	S.D.	C.V.	Sample No. 182 Average	S.D.	C.V.
C1702 Heat of Hydration - 3 day (**J/g**)							
	4	275	48	17.3	270	53	19.7
No Labs Eliminated for This Test							
C186 Heat of Solution - Dry (**cal/g**)							
	24	596.0	12.6	2.1	584.0	13.8	2.4
	*22	596.0	7.8	1.3	585.0	6.8	1.2
* Labs Eliminated - 2490, 3057							
C186 Heat of Solution - 7 day (**cal/g**)							
	24	519.6	10.3	2.0	507.3	8.3	1.6
	*23	520.4	9.9	1.9	508.5	6.1	1.2
* Labs Eliminated - 3057							
C186 Heat of Solution 28 day (**cal/g**)							
	17	511.6	7.5	1.5	499.8	8.4	1.7
No Labs Eliminated for This Test							
C186 Heat of Hydration - 7 day (**cal/g**)							
	25	76.1	9.4	12.4	77.1	8.2	10.7
	*23	76.5	7.4	9.7	76.6	3.1	4.1
* Labs Eliminated - 2490, 3057							
C1702 Heat of Hydration - 7 day (**J/g**)							
	4	330	65	19.8	330	73	22.1
No Labs Eliminated for This Test							
C186 Heat of Hydration - 28 day (**cal/g**)							
	19	83.7	10.6	12.7	83.6	7.4	8.8
	*18	85.8	5.9	6.8	84.9	4.9	5.8
* Labs Eliminated - 3057							
C1702 Heat of Hydration - 3 day (**J/g**)							
	4	275	48	17.3	270	53	19.7
No Labs Eliminated for This Test							

CCRL PROFICIENCY SAMPLE PROGRAM

Portland Cement Proficiency Samples No. 181 and No. 182

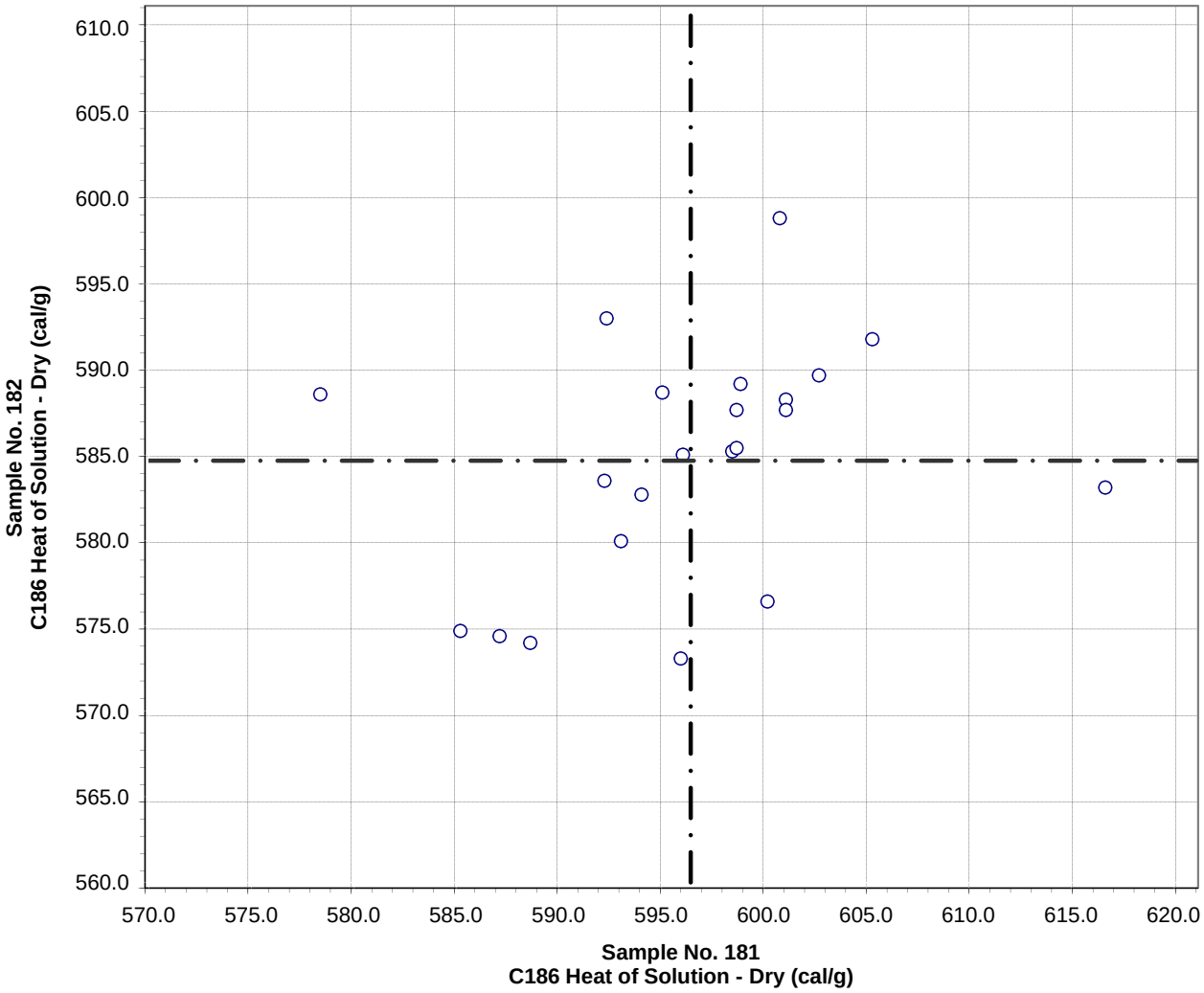
Final Report – Heat of Hydration Results
September 9, 2011

SUMMARY OF RESULTS

		Sample No.181			Sample No. 182		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C1702 Heat of Hydration - 7 day (**J/g**)							
	4	330	65	19.8	330	73	22.1

No Labs Eliminated for This Test

CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 181 and No. 182

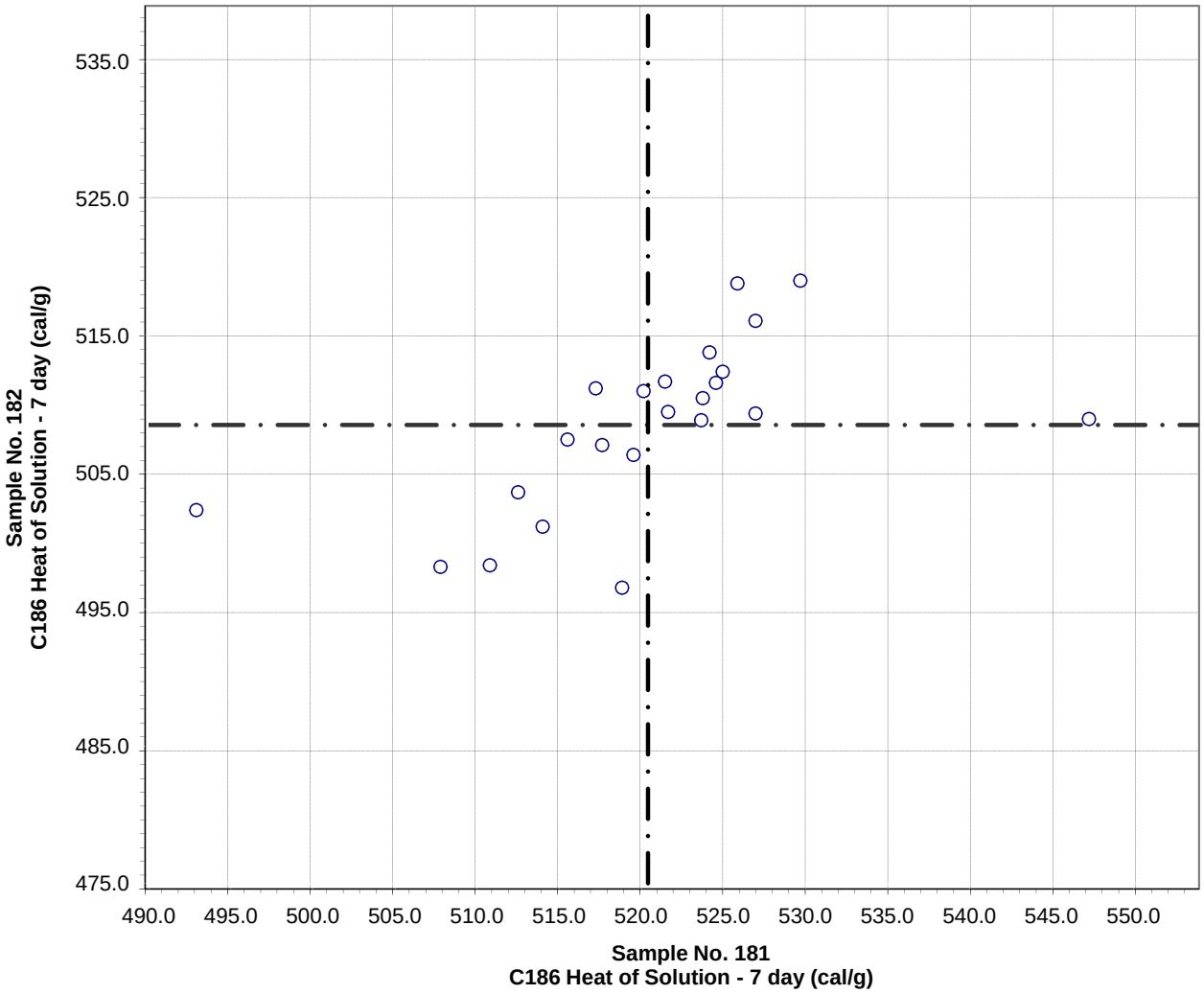


Test No. 291 C186 Heat of Solution - Dry 22 Points

Sample No. 181	Ave	596.0	S.D.	7.8	C.V. 1.3
Sample No. 182	Ave	585.0	S.D.	6.8	C.V. 1.2

Labs Eliminated: 2490, 3057

CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 181 and No. 182

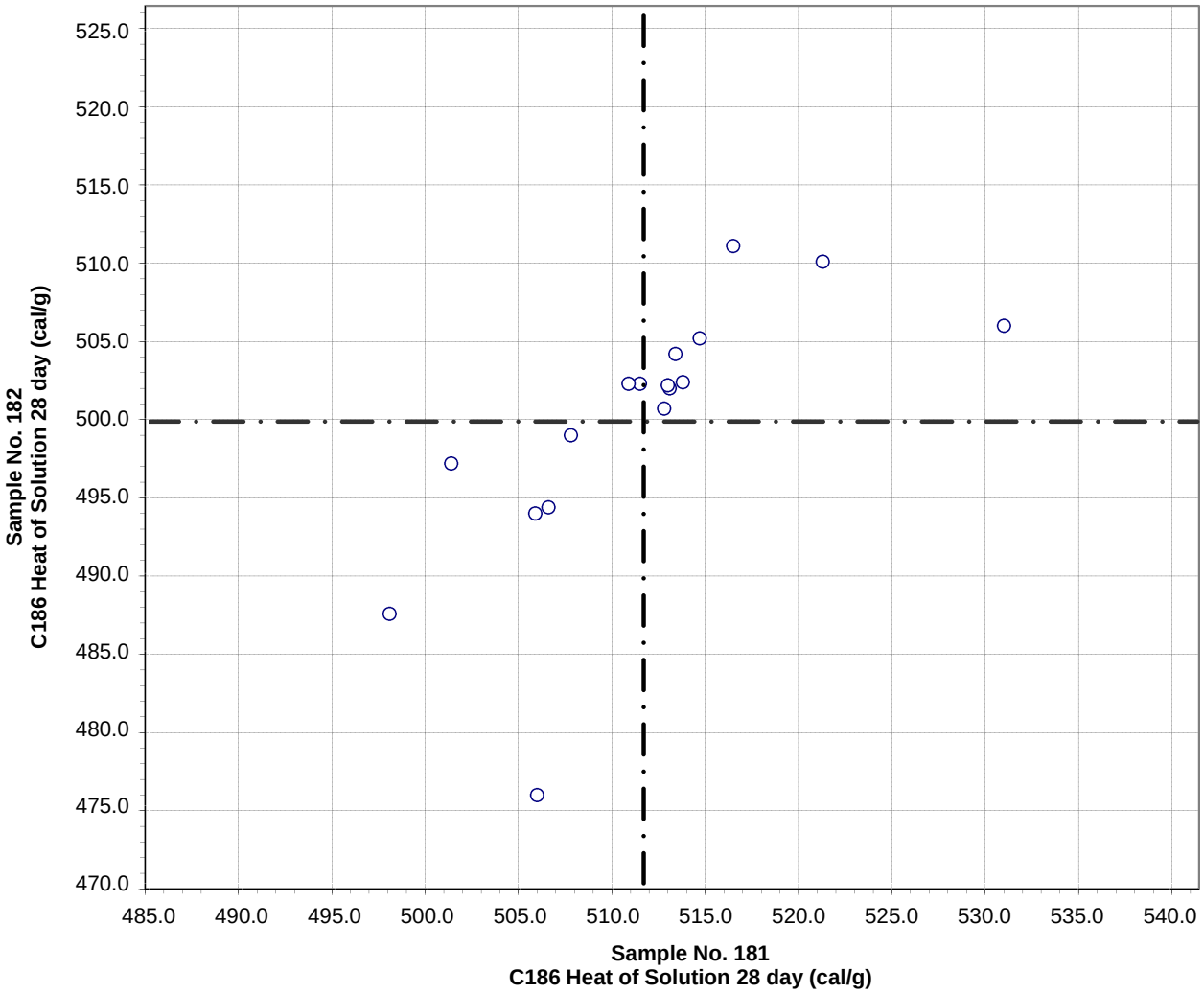


Test No. 292 C186 Heat of Solution - 7 day 23 Points

Sample No. 181 Ave 520.4 S.D. 9.9 C.V. 1.9
Sample No. 182 Ave 508.5 S.D. 6.1 C.V. 1.2

Labs Eliminated: 3057

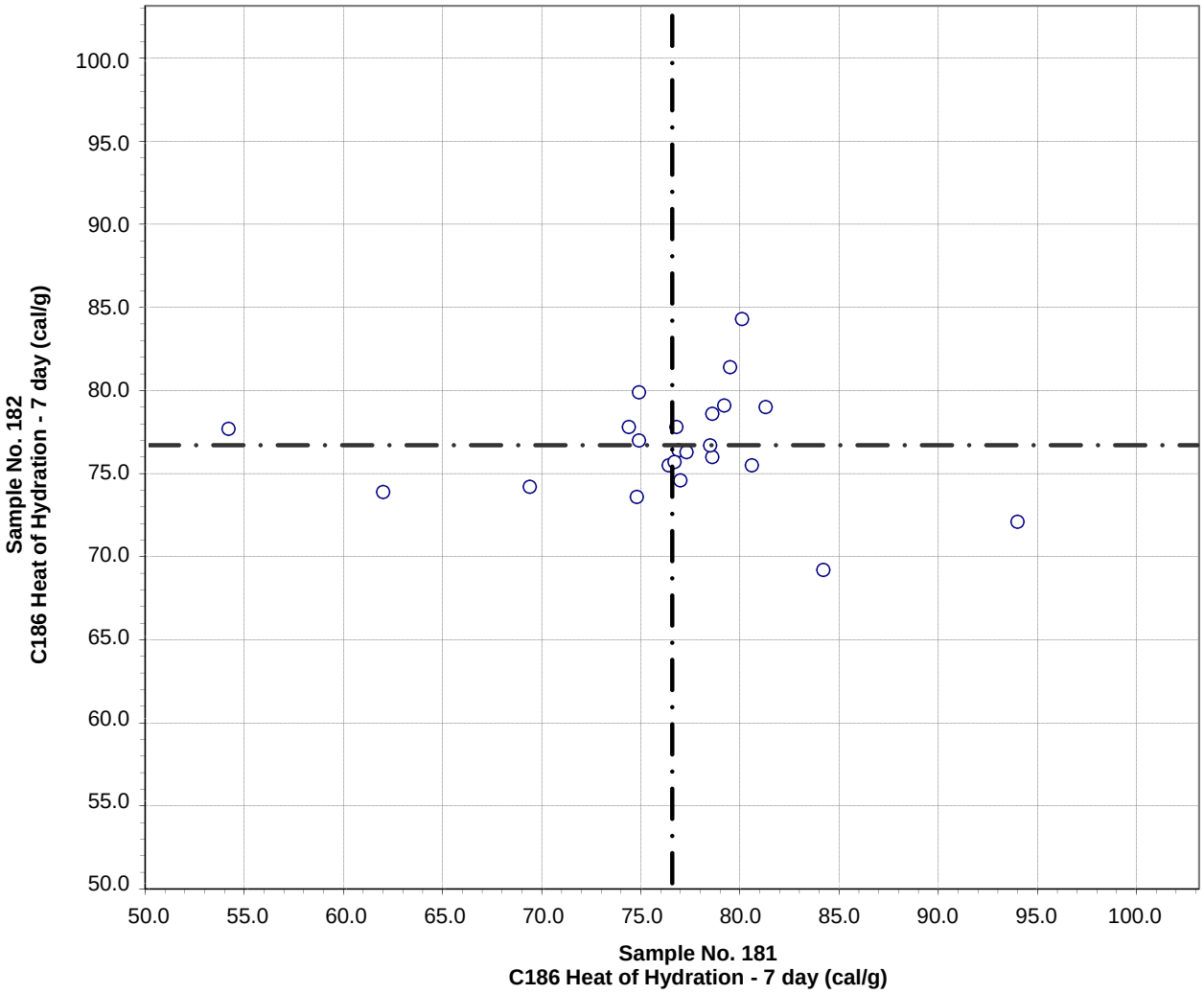
CCRL Proficiency Sample Program
C186 Heat of Solution 28 day
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 301 C186 Heat of Solution 28 day 17 Points

Sample No. 181	Ave	511.6	S.D.	7.5	C.V.	1.5
Sample No. 182	Ave	499.8	S.D.	8.4	C.V.	1.7

CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 181 and No. 182

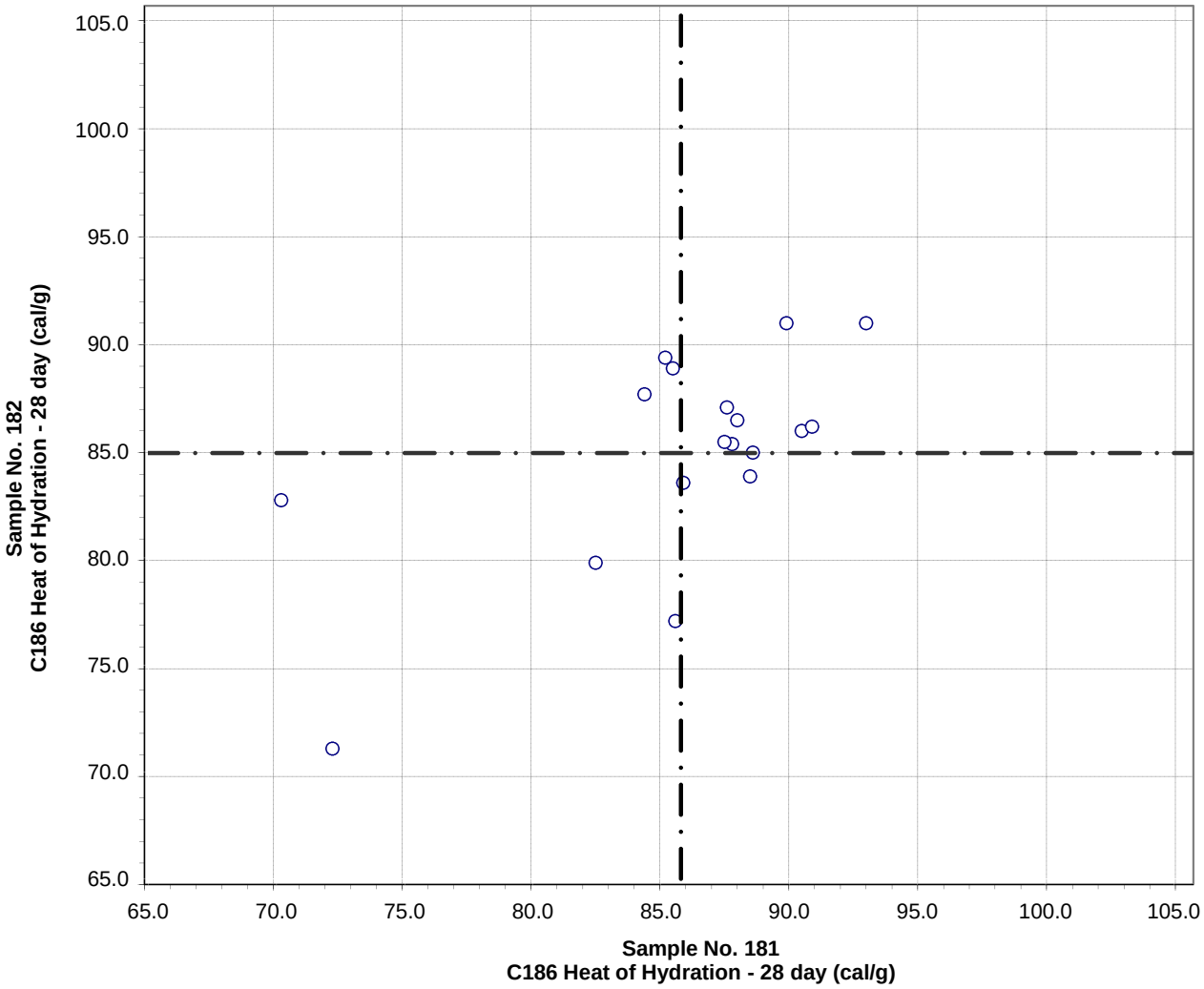


Test No. 290 C186 Heat of Hydration - 7 day 23 Points

Sample No. 181	Ave	76.5	S.D.	7.4	C.V. 9.7
Sample No. 182	Ave	76.6	S.D.	3.1	C.V. 4.1

Labs Eliminated: 2490, 3057

CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 181 and No. 182

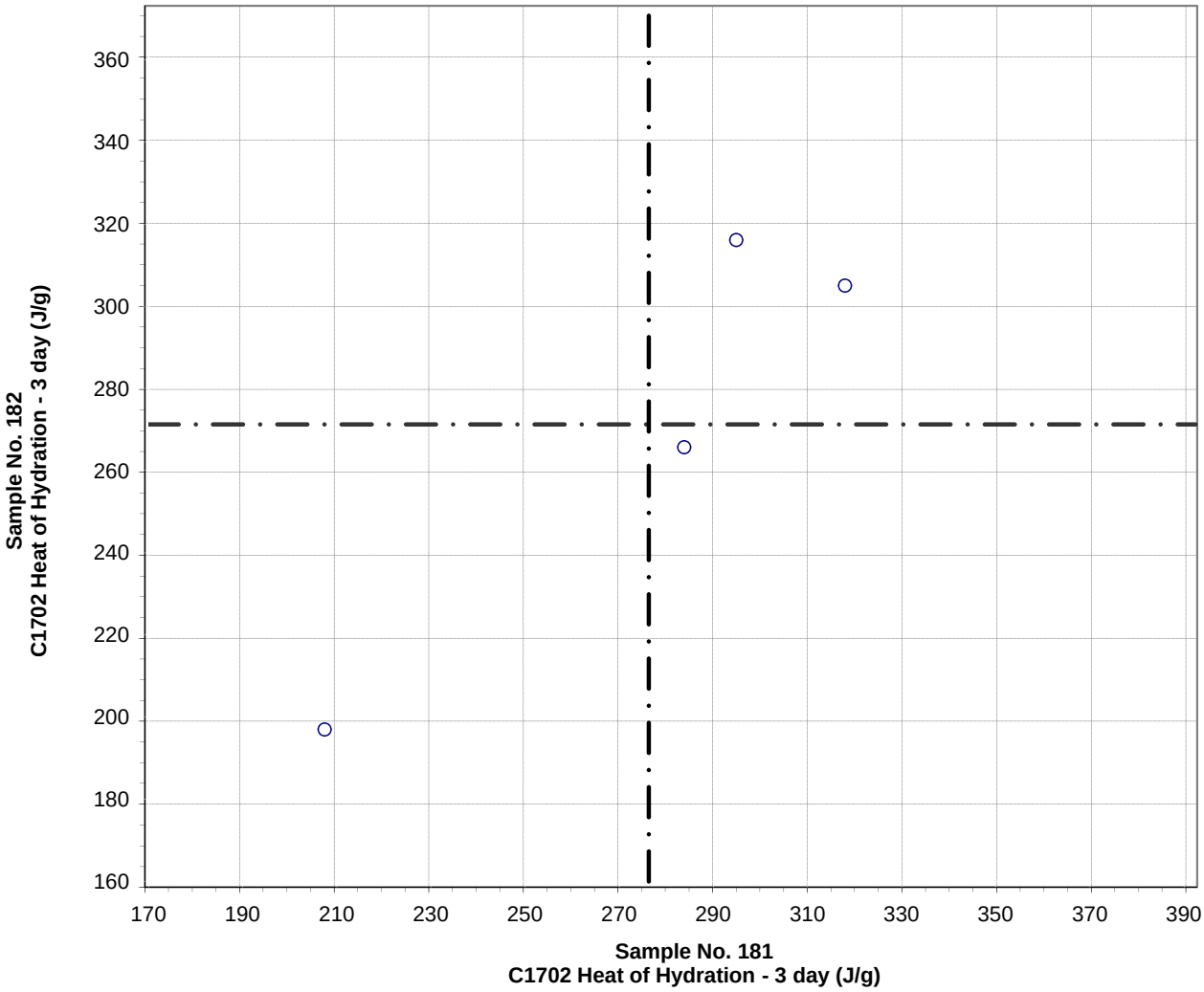


Test No. 300 C186 Heat of Hydration - 28 day 18 Points

Sample No. 181	Ave	85.8	S.D.	5.9	C.V.	6.8
Sample No. 182	Ave	84.9	S.D.	4.9	C.V.	5.8

Labs Eliminated: 3057

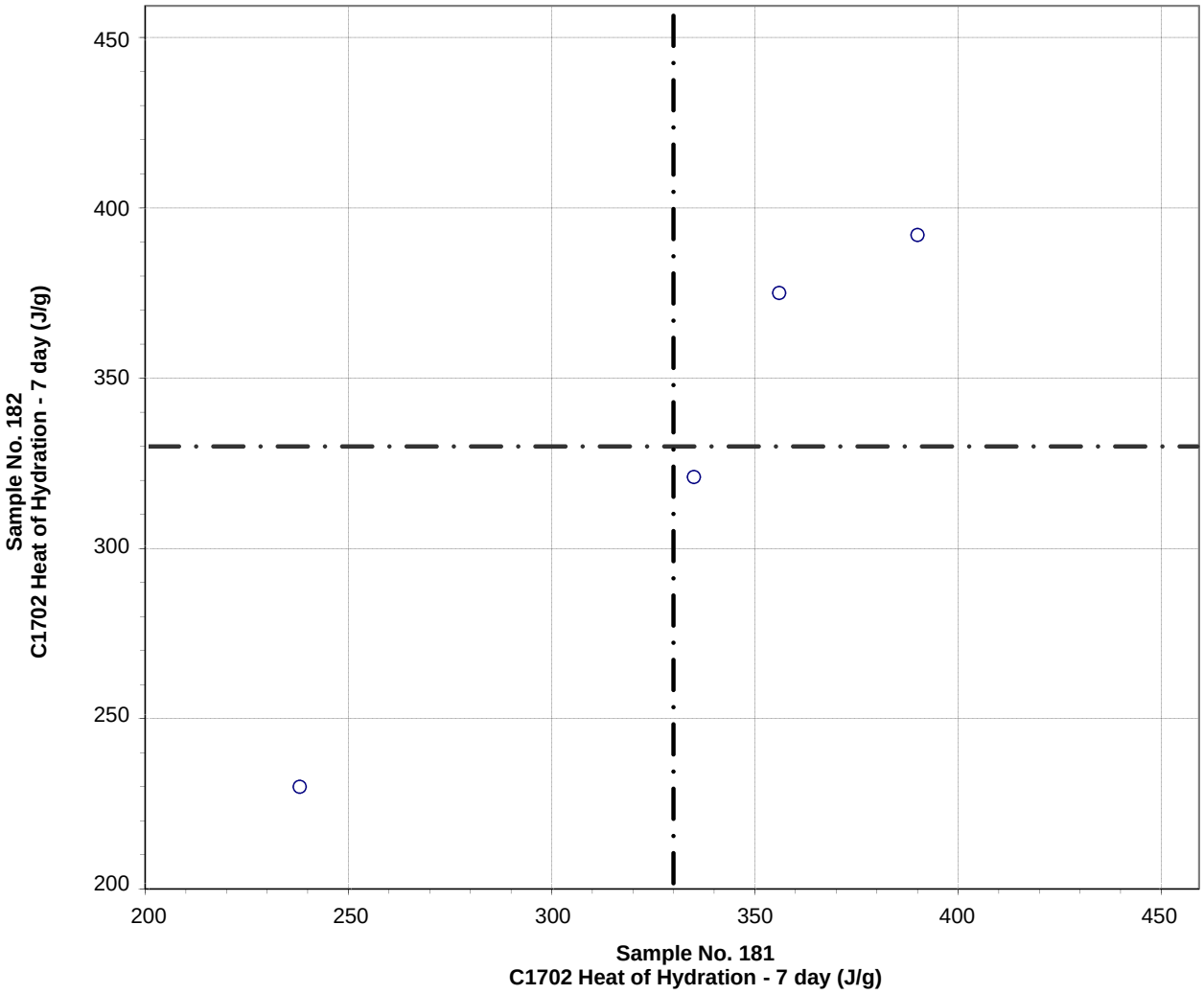
CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 500 C1702 Heat of Hydration - 3 day 4 Points

Sample No. 181	Ave	275	S.D.	48	C.V.	17.3
Sample No. 182	Ave	270	S.D.	53	C.V.	19.7

CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 181 and No. 182



Test No. 510 C1702 Heat of Hydration - 7 day 4 Points

Sample No. 181	Ave	330	S.D.	65	C.V.	19.8
Sample No. 182	Ave	330	S.D.	73	C.V.	22.1