

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 195 and Number 196

March 2015





March 20, 2015

To: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 195 and No. 196

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in January 2015. Portland Cement Samples No. 195 was an ASTM C150 meeting the specifications of Type I and. Portland Cement No. 196 was an ASTM C150 meeting the specifications of Type I and contained 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.

Carbon dioxide and limestone content – CCRL Sample 195 did not contain a limestone addition. Therefore for this sample, no test results, statistics, and laboratory ratings are available for these two tests.

Test Method C1038 – The test method now specifies a water-cement ration of 0.485 for non air-entraining cement. This is the first pair of CCRL samples to use this revised method. Some laboratories may have used the previous test revision to test this pair of samples. The standard deviation and coefficient of variation for this pair of samples were in line with past samples using the previous method. Therefore, if there was a mix of old and new test methods there was little or no effect on 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 June 2015.

Sincerely,

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

To: Participants in the CCRL Portland Cement Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor PSP

SUBJECT: Explanation of Final Report on Results of Tests for Portland Cement Proficiency Samples No. 195 and No. 196

This letter, and the material included with it, constitutes the final report, and summary of results for the current pair of Portland Cement Proficiency Samples, which were distributed in January 2015. This material includes a Table of Results for individual laboratory data, a statistical Summary of Results, and a set of general Scatter Diagrams. Your unique laboratory number is displayed at the top of the individual Table of Results.

An explanation of the program is contained in the paper: "Statistical Evaluation of Interlaboratory Cement Tests" by J. R. Crandall and R. L. Blaine [View Document](#), and "Statistical Aspects of the Cement Testing Program" by W.J. Youden [View Document](#), which can be found in Volume 59, Proceedings of the 62nd Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.

Each laboratory receives an individualized Table of Results. The Table of Results shows the, test title, and the reporting unit in the first two columns. After that it lists in order, the laboratory's results for the odd and even numbered samples, overall averages for the odd and even numbered samples, and the laboratory's ratings for the odd and even samples.

Laboratory ratings, shown in the Table of Results for the individual laboratory, were determined in the manner described by Crandall and Blaine using a rating scale of 1 to 5 instead of 0 to 4. The ratings have no valid standing beyond showing the difference between the individual laboratory result and the average for a particular test.

The following table details the relationship between the ratings and the averages.

Ratings	Range (Number of Standard Deviations)	Number (Per 100) of Laboratories achieving the rating ¹
5	Less than 1	69
4	1 to 1.5	18
3	1.5 to 2	9
2	2 to 2.5	3
1	Greater than 2.5	1

The sign of the rating merely shows whether the result reported was greater or less than the average obtained.

Participants subscribing to the primary chemical analysis portion of this report should note that the statistics were calculated using data obtained by wet methods, and rapid methods of chemical analysis. Participants in the secondary chemical analysis should note that laboratory ratings are assigned using primary chemical statistics.

Please note that individual laboratory ratings were not given for the flow of air content mortar (test no. 190) and compressive strength mortar (test no. 230). Air content flows in the range of 87.5 ± 7.5 are satisfactory, labs with flow values outside this range will be flagged as a "Labs Eliminated" or "Labs Off Diagram" on the scatter diagram. Averages, standard deviations, and a scatter diagram are provided for your information. This information may be a helpful indicator of a problem with flow table apparatus or

¹Youden, W.J., "Statistical Aspects of the Cement Testing Program", Volume 59, *Proceedings of the 62nd Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.*

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

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

Summary of Results

Usually, averages, standard deviations, and coefficients of variation are given with all results reported, and then with one or more outlying results omitted. Sometimes, two or more recalculations with laboratories omitted, have been done for the same test. In these cases, all of the laboratories omitted in previous recalculations are also omitted in subsequent ones. Results omitted are values that are more than three standard deviations from the mean of one or both samples. Often, elimination of these outlying results has little effect on the average, but may have a more pronounced effect on the standard deviation and coefficient of variation.

Scatter Diagrams

General scatter diagrams are supplied with this report. Crandall and Blaine describe the manner of preparing scatter diagrams, and their interpretation, in the paper published in the 1959 ASTM Proceedings. Each laboratory will receive a complete set of diagrams according to their subscription to the given program.

Using the results received from each laboratory, a scatter diagram is generated for each test method by plotting the value for the odd numbered samples on the X, or horizontal axis, against the value for the even numbered samples on the Y, or vertical axis. To find your point, just plot as you would when plotting any scatter diagram. Vertical and horizontal dashed lines, which divide the diagrams into four sections or quadrants, place the average values for the odd and even numbered samples, respectively. The first line of print under the diagram includes the test number, as given on the data sheet, the test title, and the number of data points on the diagrams. The number of plotted points may not agree with the total number of data pairs included in the analysis because a few points may be off the diagram, and some points may represent several data pairs, which are identical. Laboratories whose points are off the diagram will have a rating of ± 1 for that particular test. As described in Crandall and Blaine, a tight circular pattern of points around the intersection of the median lines is the ideal situation. Stretching out of the pattern into the first (upper right) and third (lower left) quadrants, suggests some kind of bias, or tendency for laboratories to get high or low results on both samples. Examination of the scatter diagrams indicates strong evidence of bias on many tests.

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Primary Chemical Results
 March 20, 2015

SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (percent)							
	228	20.88	1.45	6.93	19.79	1.77	8.97
	*218	20.80	0.20	0.97	19.66	0.24	1.21
* Labs Eliminated - 10, 50, 494, 1054, 1079, 1435, 2360, 3279, 3970, 3976							
Aluminum Oxide (percent)							
	223	5.04	0.15	2.9	5.07	0.17	3.4
	*219	5.05	0.11	2.2	5.07	0.13	2.6
* Labs Eliminated - 494, 1079, 3819, 3970							
Ferric Oxide (percent)							
	224	2.04	0.17	8.4	2.99	0.11	3.6
	*208	2.02	0.03	1.7	2.99	0.04	1.3
* Labs Eliminated - 51, 162, 221, 247, 494, 1054, 1079, 1251, 1435, 1594, 1644, 1940, 3279, 3661, 3695, 3970							
Calcium Oxide (percent)							
	226	63.80	2.99	4.69	64.14	2.39	3.73
	*218	64.00	0.35	0.54	64.31	0.36	0.56
* Labs Eliminated - 134, 494, 1435, 1594, 3279, 3970, 3976, 3990							
Magnesium Oxide (percent)							
	226	3.16	0.13	4.0	1.95	0.16	8.5
	*210	3.17	0.06	1.9	1.92	0.06	2.9
* Labs Eliminated - 8, 35, 221, 494, 694, 1025, 1054, 1676, 2363, 2463, 3279, 3663, 3819, 3970, 3976, 3990							
Sulfur Trioxide (percent)							
	230	2.54	0.12	4.7	3.09	0.15	4.8
	*217	2.53	0.06	2.5	3.09	0.07	2.4
* Labs Eliminated - 3, 8, 10, 50, 51, 134, 494, 1054, 1079, 2360, 2955, 3819, 3970							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Primary Chemical Results
 March 20, 2015

SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Loss on Ignition (percent)							
	233	1.45	0.14	9.7	1.60	0.14	8.9
	*213	1.44	0.09	6.2	1.58	0.07	4.6
* Labs Eliminated - 35, 41, 51, 60, 75, 92, 95, 116, 126, 142, 162, 181, 222, 407, 684, 2462, 3368, 3605, 3661, 3976							
Sodium Oxide (percent)							
	215	0.177	0.048	27	0.275	0.061	22
	*202	0.176	0.027	15	0.279	0.036	13
* Labs Eliminated - 8, 15, 407, 416, 1054, 1644, 1956, 2462, 2477, 3057, 3279, 3695, 3990							
Potassium Oxide (percent)							
	220	0.428	0.043	10.1	0.621	0.060	9.7
	*209	0.432	0.014	3.3	0.630	0.018	2.9
* Labs Eliminated - 8, 15, 1041, 1054, 1079, 1644, 2934, 3235, 3606, 3970, 3990							
Strontium Oxide (percent)							
	94	0.035	0.017	49	0.035	0.016	46
	*89	0.033	0.005	15	0.033	0.005	16
* Labs Eliminated - 4, 137, 494, 690, 3607							
Titanium Dioxide (percent)							
	174	0.30	0.020	6.7	0.32	0.020	6.5
	*168	0.30	0.009	3.0	0.32	0.010	3.2
* Labs Eliminated - 162, 494, 1079, 1466, 2484, 3970							
Phosphorus Pentoxide (percent)							
	171	0.084	0.018	21.0	0.083	0.016	19.5
	*162	0.083	0.007	7.9	0.082	0.007	8.7
* Labs Eliminated - 27, 56, 139, 494, 2462, 3235, 3279, 3368, 3695							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Primary Chemical Results
 March 20, 2015

SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Zinc Oxide (percent)							
	90	0.019	0.017	88.4	0.027	0.026	95.6
	*86	0.017	0.003	17.5	0.024	0.003	13.0
* Labs Eliminated - 219, 2363, 2463, 3607							
Manganic Oxide (percent)							
	143	0.090	0.014	15.8	0.037	0.012	32.2
	*128	0.091	0.004	4.1	0.036	0.004	11.3
* Labs Eliminated - 15, 178, 205, 354, 413, 494, 1054, 1435, 2363, 2466, 3057, 3238, 3607, 3707, 3970							
Chloride (percent)							
	118	0.025	0.011	44	0.018	0.010	55
	*115	0.024	0.009	38	0.017	0.006	38
* Labs Eliminated - 493, 692, 2463							
Insoluble Residue (percent)							
	214	0.33	0.48	146	0.24	0.22	89
	*200	0.28	0.08	28	0.21	0.09	41
* Labs Eliminated - 4, 50, 105, 222, 309, 697, 1053, 1644, 2308, 2462, 2466, 3235, 3415, 3819							
Free Lime (percent)							
	176	1.42	0.32	22	0.78	0.24	31
	*167	1.43	0.28	20	0.75	0.18	24
* Labs Eliminated - 60, 146, 162, 181, 246, 1644, 2466, 3238, 3970							
Carbon Dioxide (percent)							
	193	---	---	---	0.97	0.23	23.9
	*190	---	---	---	0.97	0.21	21.4
* Labs Eliminated - 15, 90, 3607							
Limestone Content (percent)							
	187	---	---	---	2.3	0.5	24.2
	*183	---	---	---	2.3	0.5	21.0
* Labs Eliminated - 6, 15, 90, 3607							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Primary Chemical Results
 March 20, 2015

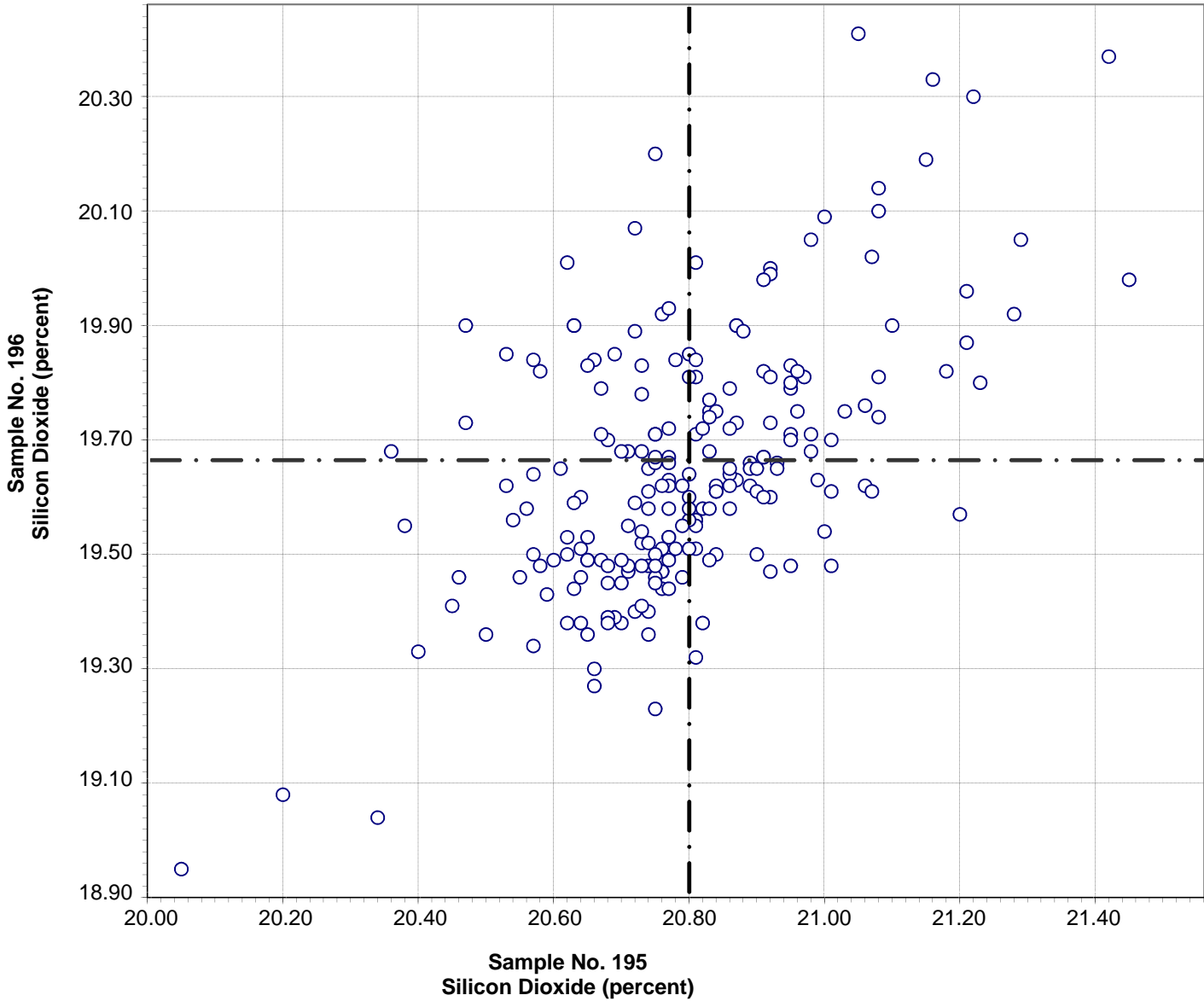
SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Chromium Oxide (percent)							
	85	0.014	0.007	47	0.016	0.007	41
	*74	0.013	0.003	20	0.015	0.002	16
* Labs Eliminated - 34, 66, 95, 116, 142, 157, 415, 450, 768, 1079, 3970							
Tricalcium Silicate (percent)							
	199	58.4	3.3	5.7	61.7	3.1	5.0
	*194	58.2	2.4	4.2	61.7	2.9	4.7
* Labs Eliminated - 10, 24, 38, 494, 3970							
Dicalcium Silicate (percent)							
	199	15.5	2.7	17	9.7	2.9	29
	*191	15.6	2.1	13	9.6	2.5	26
* Labs Eliminated - 10, 93, 494, 1054, 1466, 2477, 3279, 3970							
Tricalcium Aluminate (percent)							
	200	9.9	0.6	6.2	8.4	0.5	5.7
	*190	10.0	0.3	3.0	8.4	0.3	4.1
* Labs Eliminated - 116, 157, 494, 691, 1054, 1079, 2293, 2463, 3819, 3970							
Tetracalcium Aluminoferrite (percent)							
	200	6.3	0.9	13.9	9.1	0.7	7.2
	*188	6.1	0.1	2.1	9.1	0.2	1.7
* Labs Eliminated - 42, 64, 116, 157, 494, 691, 1054, 1079, 1466, 1644, 2293, 3970							

**CCRL Proficiency Sample Program
Silicon Dioxide
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 10 Silicon Dioxide 215 Points

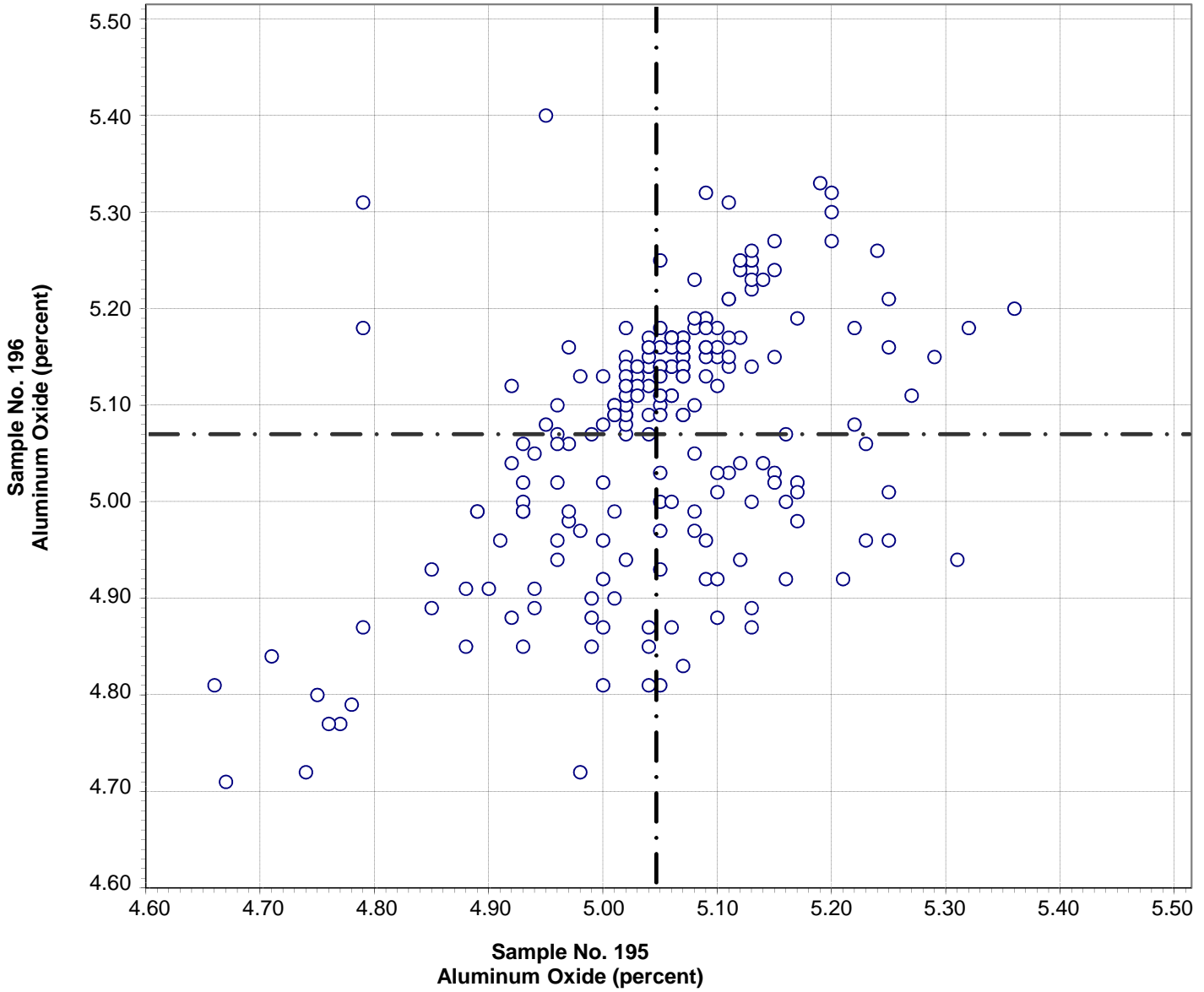
Sample No. 195 Ave 20.80 S.D. 0.20 C.V. 0.97

Sample No. 196 Ave 19.66 S.D. 0.24 C.V. 1.21

Labs Eliminated: 10, 50, 494, 1054, 1079, 1435, 2360, 3279, 3970, 3976

Labs off Diagram: 93, 152, 43

**CCRL Proficiency Sample Program
Aluminum Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



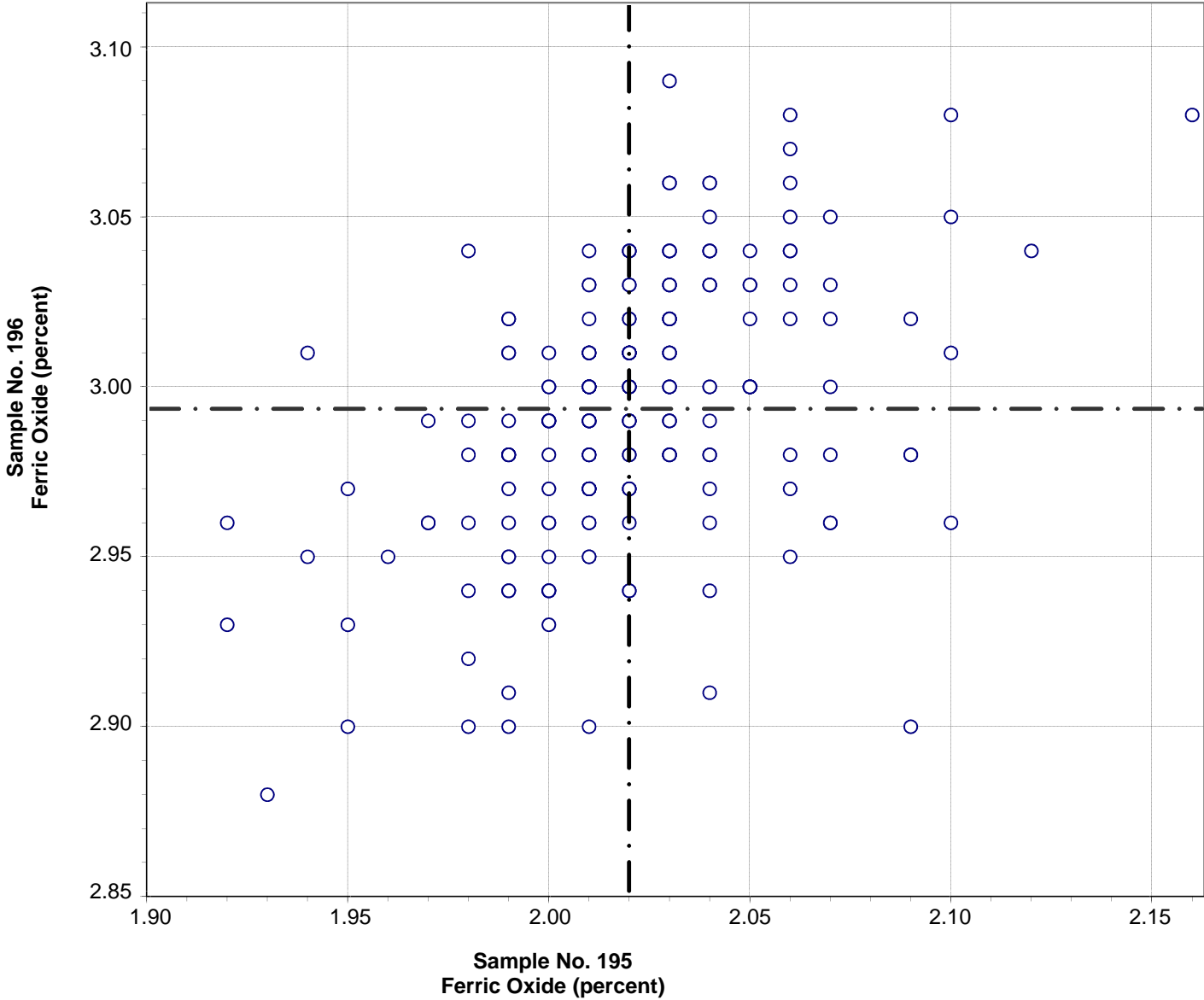
Test No. 21 Aluminum Oxide 219 Points

Sample No. 195 Ave 5.05 S.D. 0.11 C.V. 2.2

Sample No. 196 Ave 5.07 S.D. 0.13 C.V. 2.6

Labs Eliminated: 494, 1079, 3819, 3970

**CCRL Proficiency Sample Program
 Ferric Oxide
 PORTLAND CEMENT Samples No. 195 and No. 196**



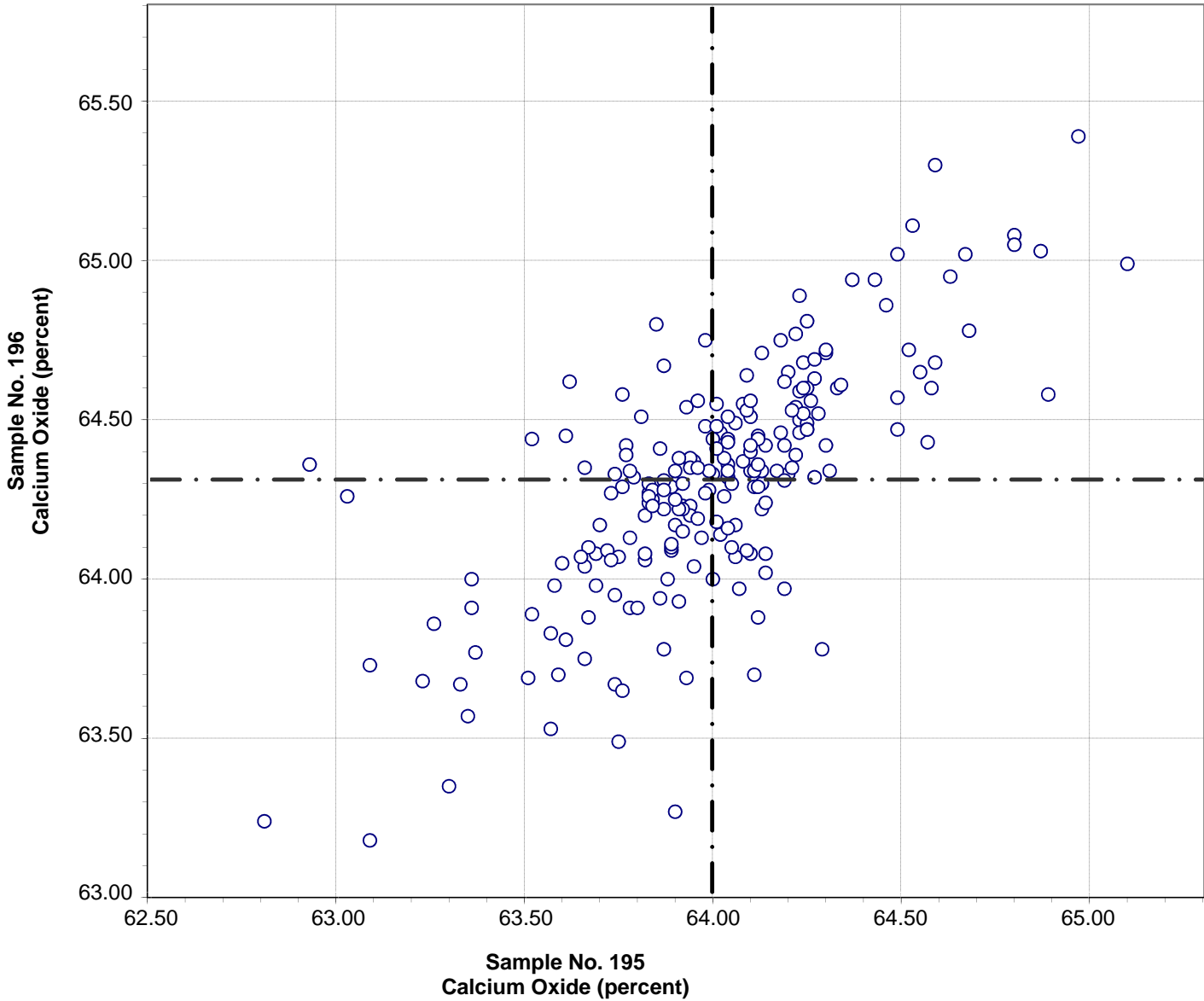
Test No. 30 Ferric Oxide 207 Points

Sample No. 195 Ave 2.02 S.D. 0.03 C.V. 1.7
 Sample No. 196 Ave 2.99 S.D. 0.04 C.V. 1.3

Labs Eliminated: 51, 162, 221, 247, 494, 1054, 1079, 1251, 1435, 1594, 1644,
 1940, 3279, 3661, 3695, 3970

Labs off Diagram: 2464

**CCRL Proficiency Sample Program
Calcium Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



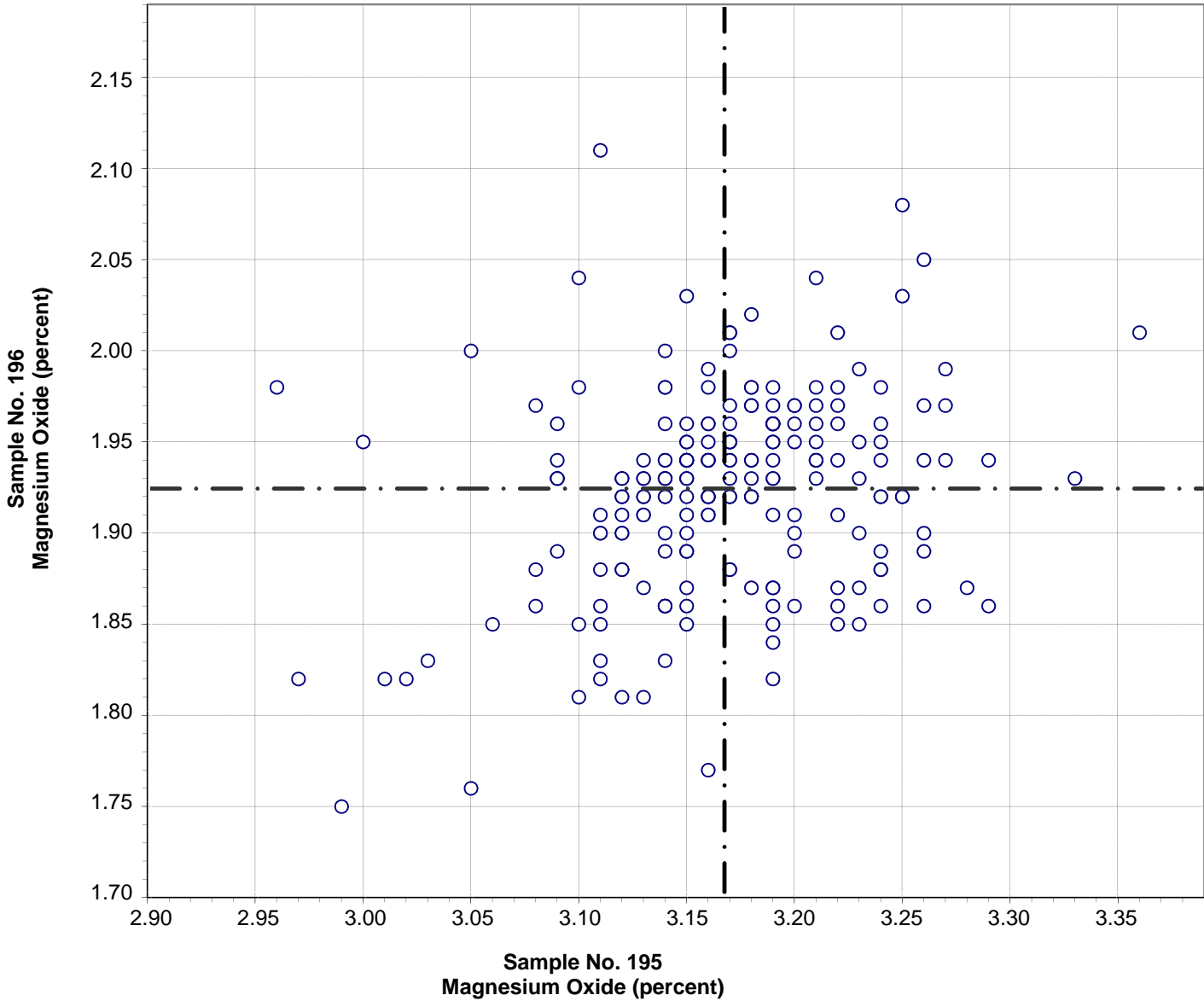
Test No. 40 Calcium Oxide 218 Points

Sample No. 195 Ave 64.00 S.D. 0.35 C.V. 0.54

Sample No. 196 Ave 64.31 S.D. 0.36 C.V. 0.56

Labs Eliminated: 134, 494, 1435, 1594, 3279, 3970, 3976, 3990

**CCRL Proficiency Sample Program
Magnesium Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



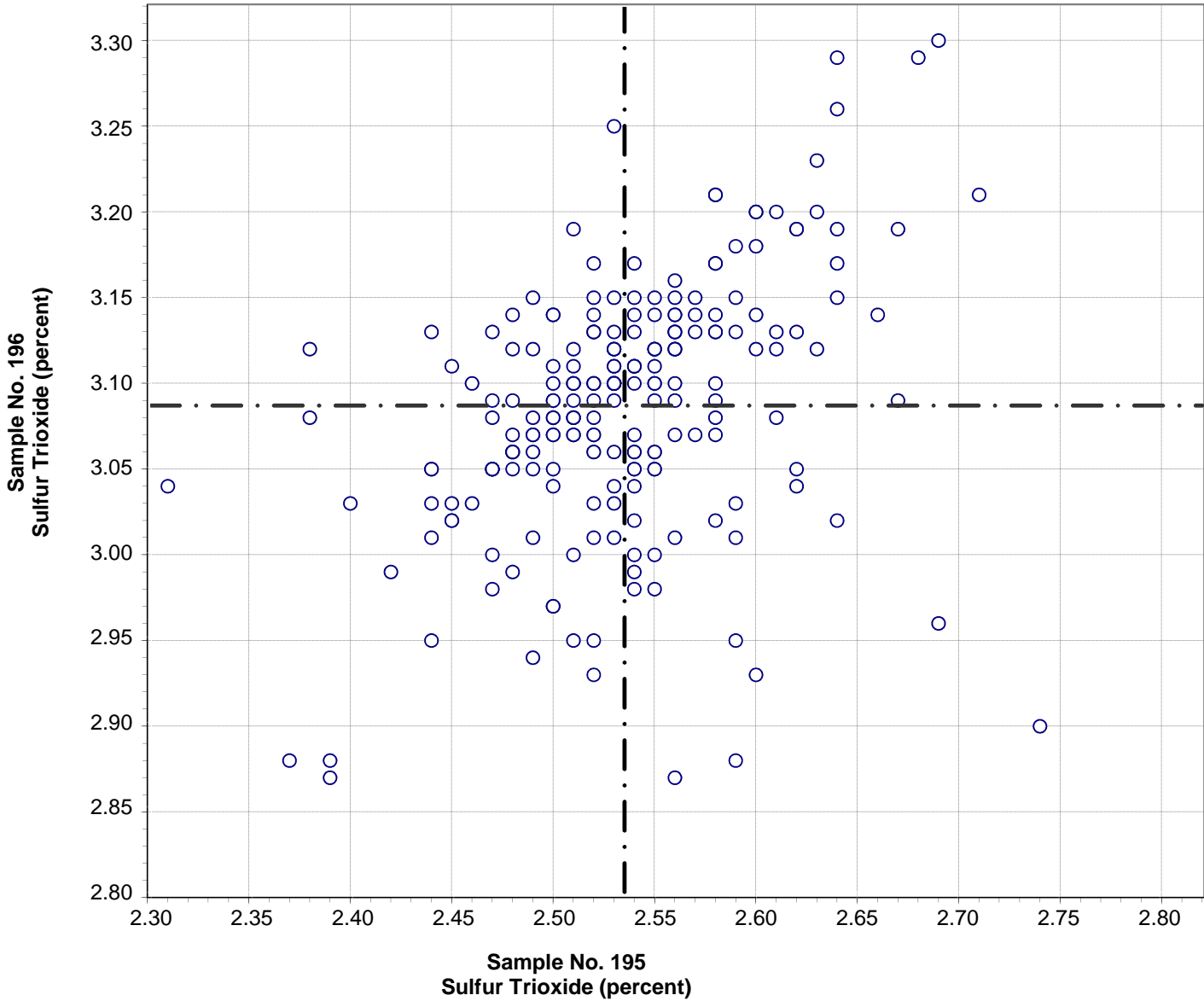
Test No. 50 Magnesium Oxide 210 Points

Sample No. 195 Ave 3.17 S.D. 0.06 C.V. 1.9

Sample No. 196 Ave 1.92 S.D. 0.06 C.V. 2.9

Labs Eliminated: 8, 35, 221, 494, 694, 1025, 1054, 1676, 2363, 2463, 3279, 3663, 3819, 3970, 3976, 3990

**CCRL Proficiency Sample Program
Sulfur Trioxide
PORTLAND CEMENT Samples No. 195 and No. 196**



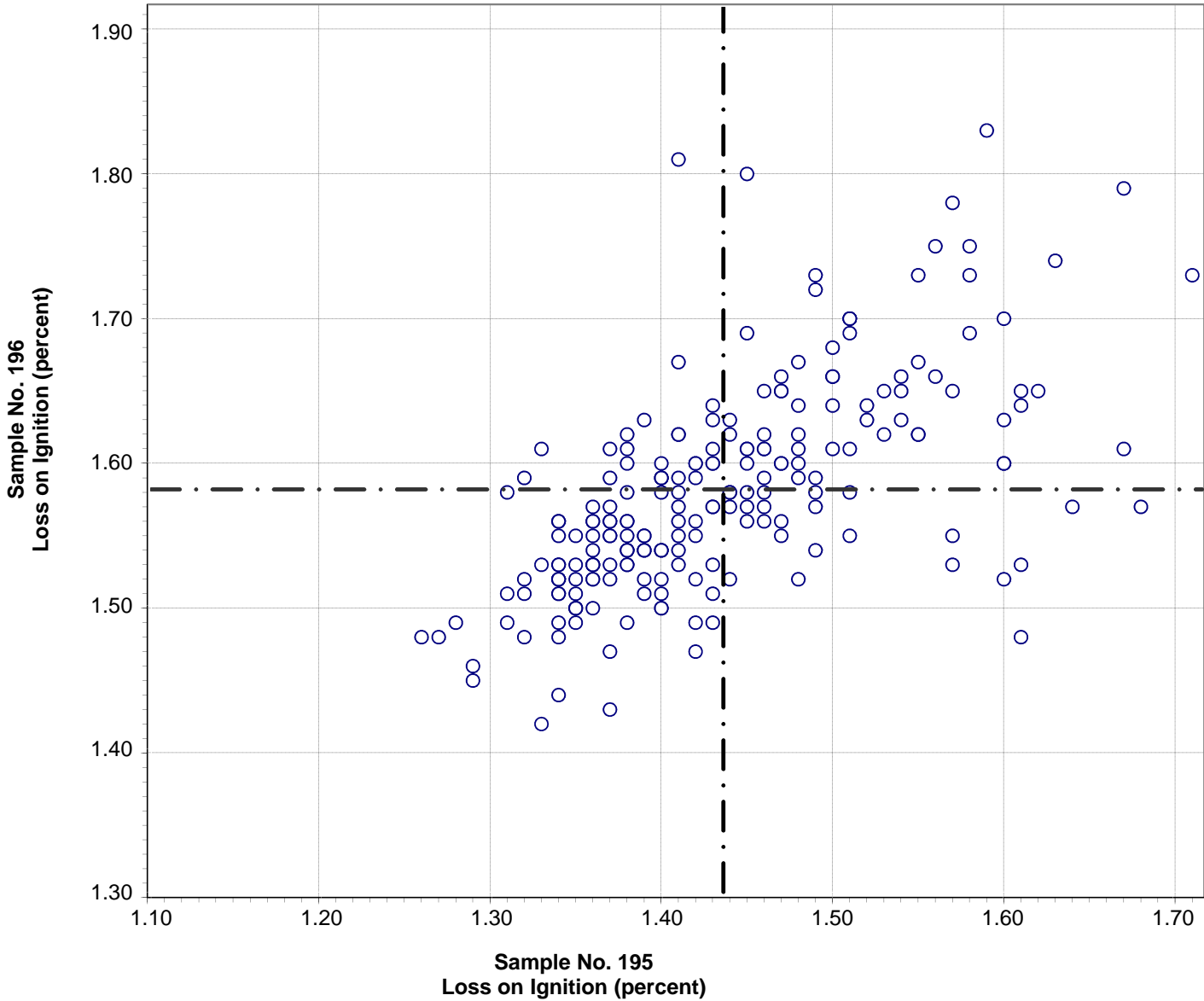
Test No. 60 Sulfur Trioxide 217 Points

Sample No. 195 Ave 2.53 S.D. 0.06 C.V. 2.5

Sample No. 196 Ave 3.09 S.D. 0.07 C.V. 2.4

Labs Eliminated: 3, 8, 10, 50, 51, 134, 494, 1054, 1079, 2360, 2955, 3819, 3970

**CCRL Proficiency Sample Program
Loss on Ignition
PORTLAND CEMENT Samples No. 195 and No. 196**



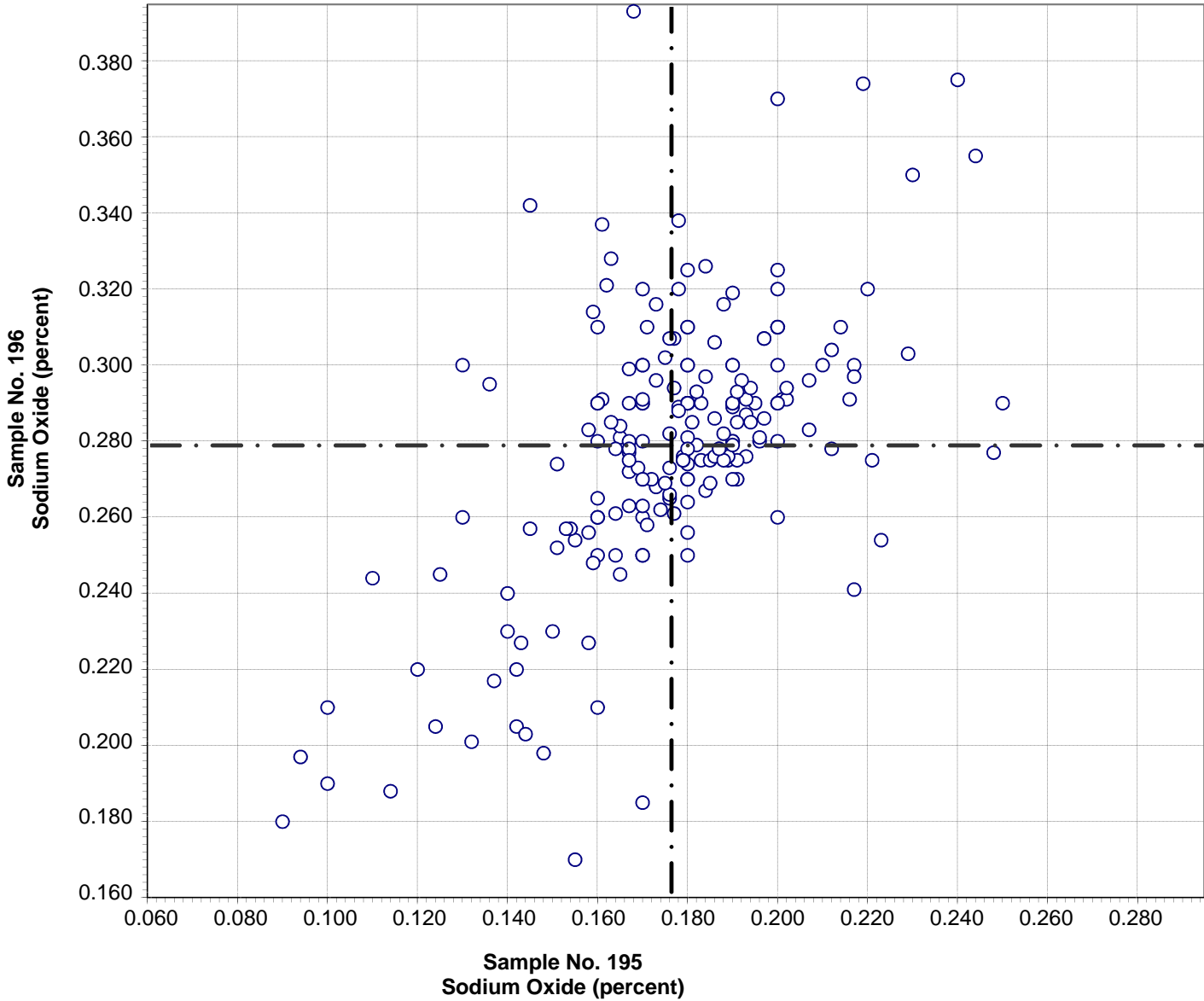
Test No. 70 Loss on Ignition 213 Points

Sample No. 195 Ave 1.44 S.D. 0.09 C.V. 6.2

Sample No. 196 Ave 1.58 S.D. 0.07 C.V. 4.6

Labs Eliminated: 35, 41, 51, 60, 75, 92, 95, 116, 126, 142, 162, 181, 222, 407, 684,
2462, 3368, 3605, 3661, 3976

**CCRL Proficiency Sample Program
Sodium Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



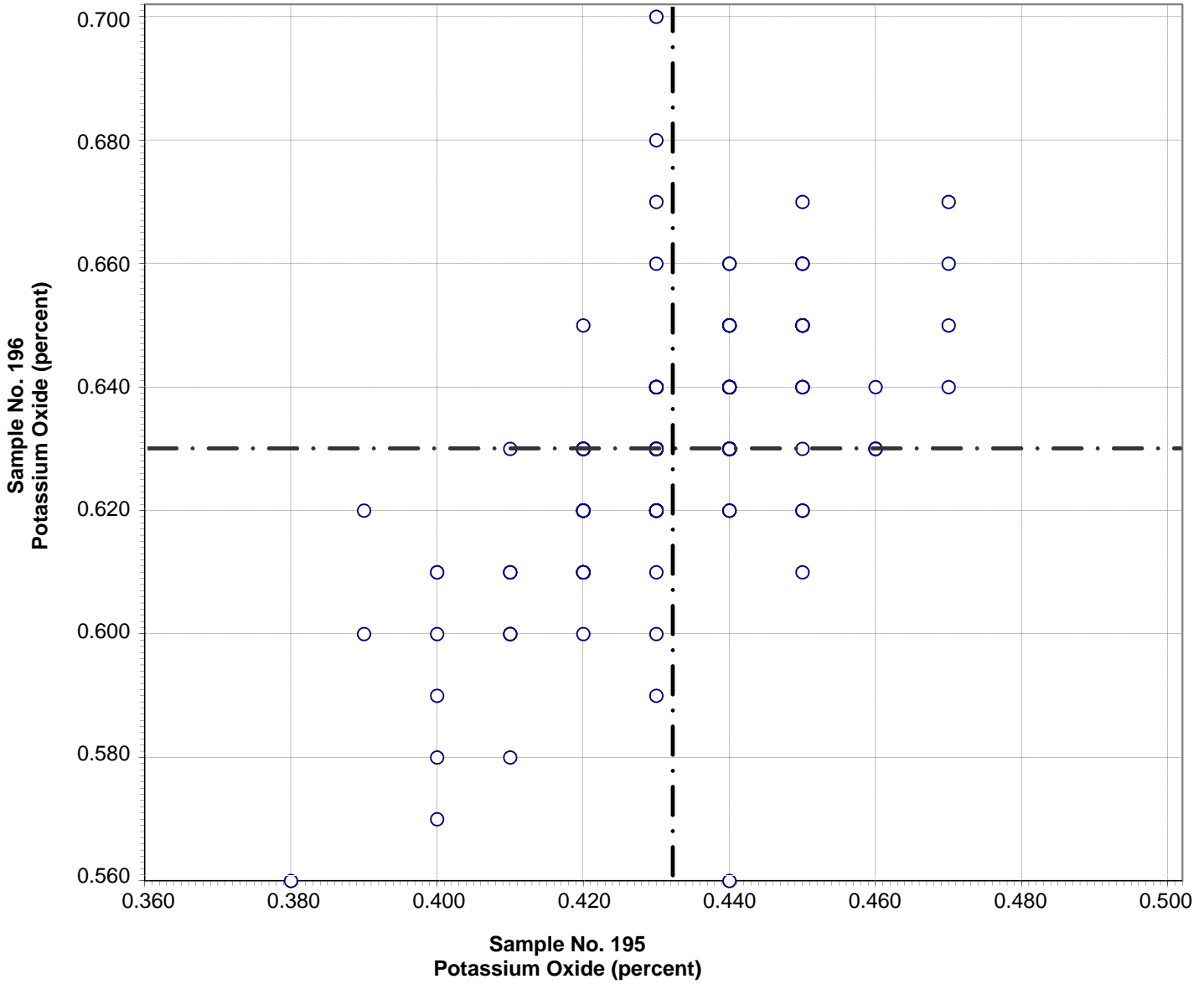
Test No. 90 Sodium Oxide 201 Points

Sample No. 195	Ave 0.176	S.D. 0.027	C.V. 15
Sample No. 196	Ave 0.279	S.D. 0.036	C.V. 13

Labs Eliminated: 8, 15, 407, 416, 1054, 1644, 1956, 2462, 2477, 3057, 3279, 3695, 3990

Labs off Diagram: 2463

**CCRL Proficiency Sample Program
Potassium Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**

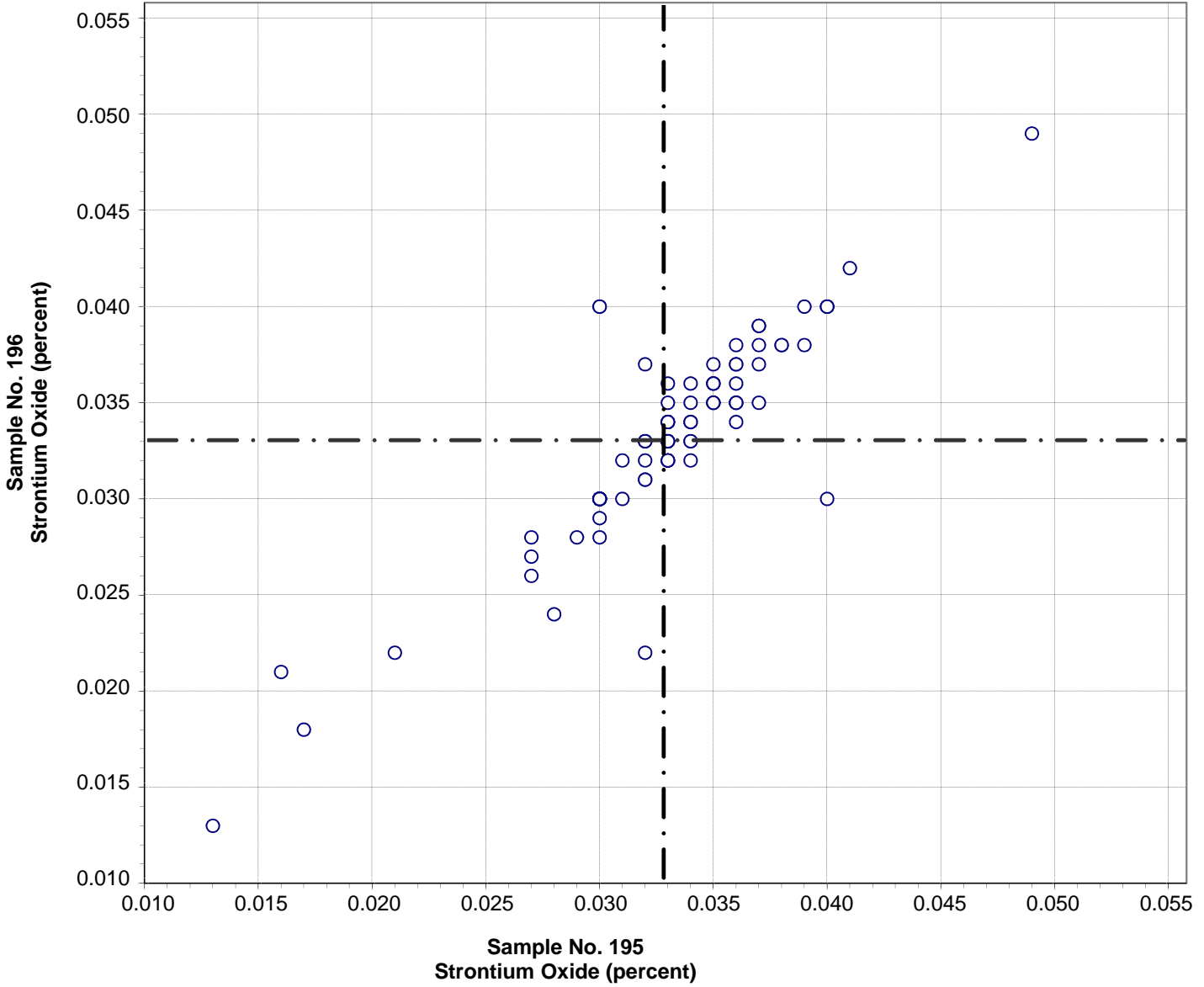


Test No. 100 Potassium Oxide 209 Points

Sample No. 195	Ave 0.432	S.D. 0.014	C.V. 3.3
Sample No. 196	Ave 0.630	S.D. 0.018	C.V. 2.9

Labs Eliminated: 8, 15, 1041, 1054, 1079, 1644, 2934, 3235, 3606, 3970, 3990

**CCRL Proficiency Sample Program
Strontium Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**

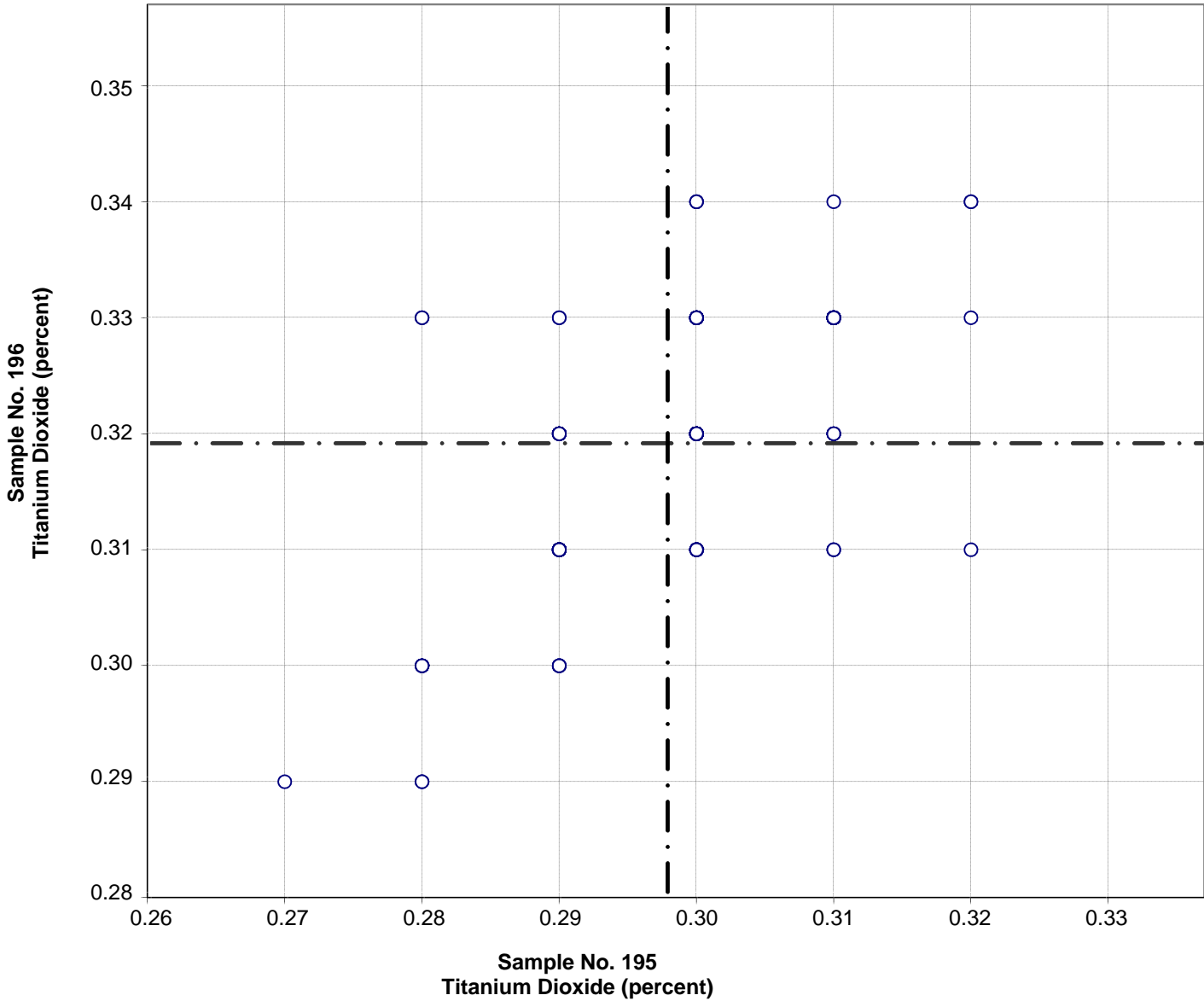


Test No. 92 Strontium Oxide 89 Points

Sample No. 195	Ave 0.033	S.D. 0.005	C.V. 15
Sample No. 196	Ave 0.033	S.D. 0.005	C.V. 16

Labs Eliminated: 4, 137, 494, 690, 3607

**CCRL Proficiency Sample Program
Titanium Dioxide
PORTLAND CEMENT Samples No. 195 and No. 196**



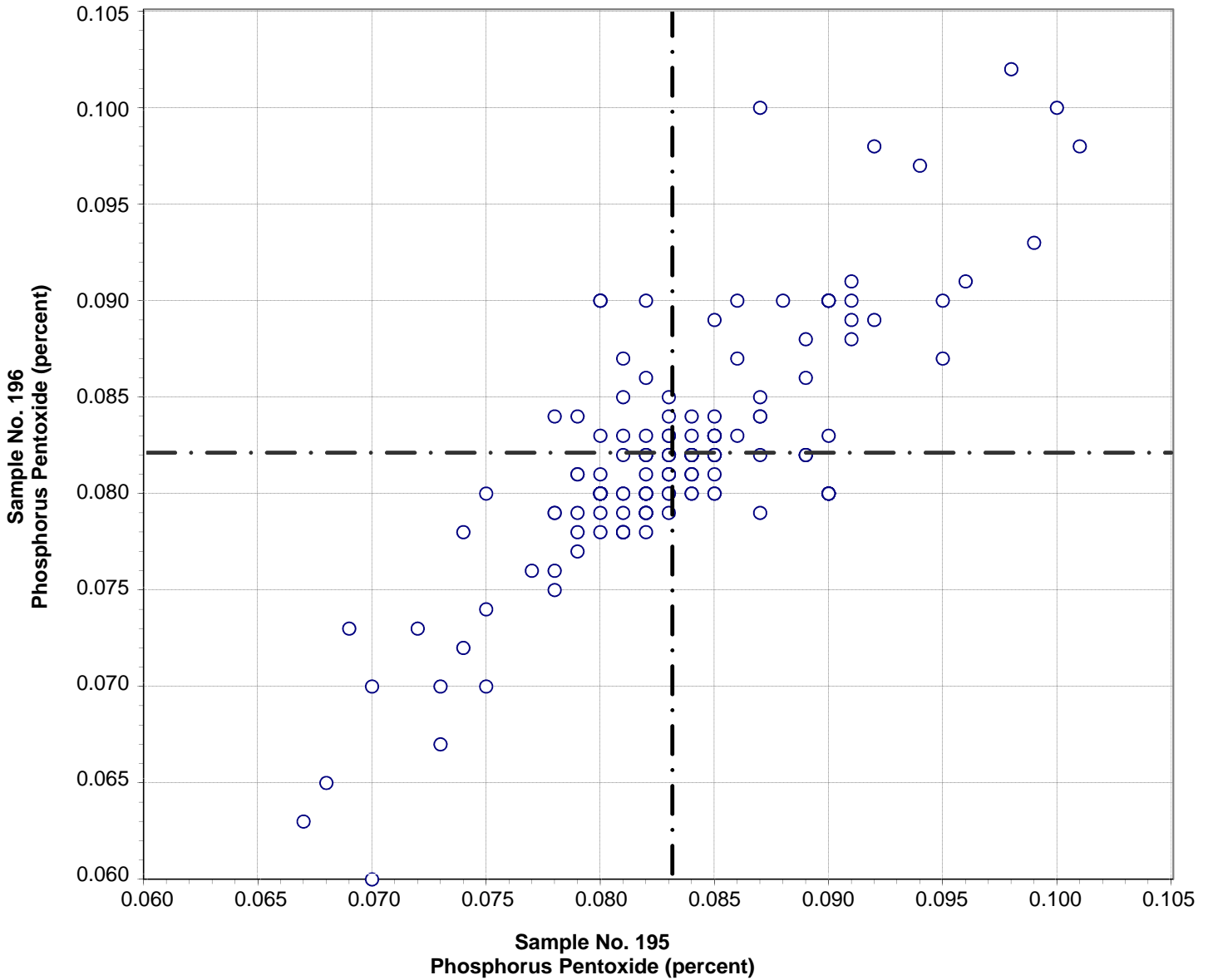
Test No. 103 Titanium Dioxide 168 Points

Sample No. 195 Ave 0.30 S.D. 0.009 C.V. 3.0

Sample No. 196 Ave 0.32 S.D. 0.010 C.V. 3.2

Labs Eliminated: 162, 494, 1079, 1466, 2484, 3970

**CCRL Proficiency Sample Program
Phosphorus Pentoxide
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 102 Phosphorus Pentoxide 158 Points

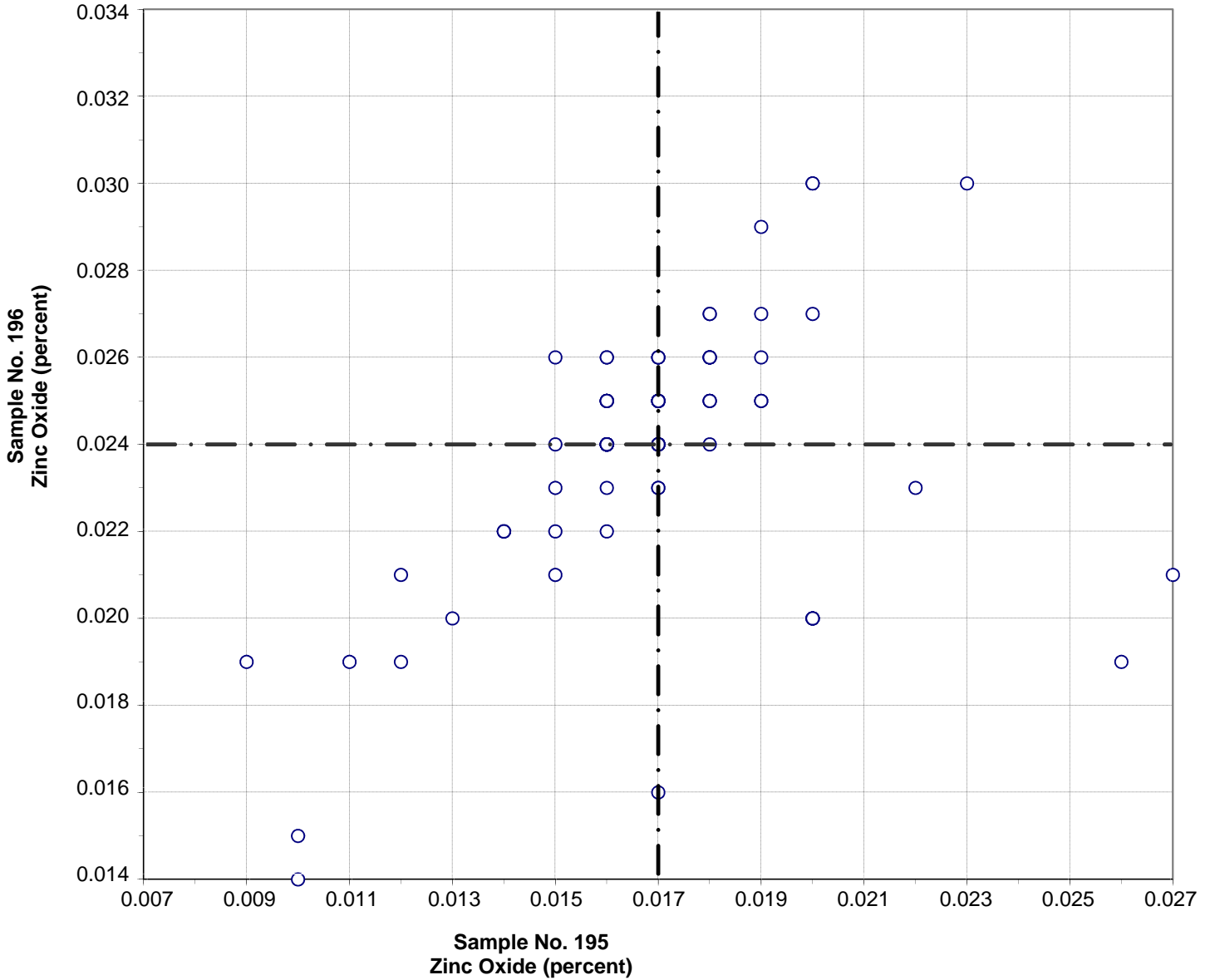
Sample No. 195 Ave 0.083 S.D. 0.007 C.V. 7.9

Sample No. 196 Ave 0.082 S.D. 0.007 C.V. 8.7

Labs Eliminated: 27, 56, 139, 494, 2462, 3235, 3279, 3368, 3695

Labs off Diagram: 416, 2412, 8, 3807

**CCRL Proficiency Sample Program
Zinc Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



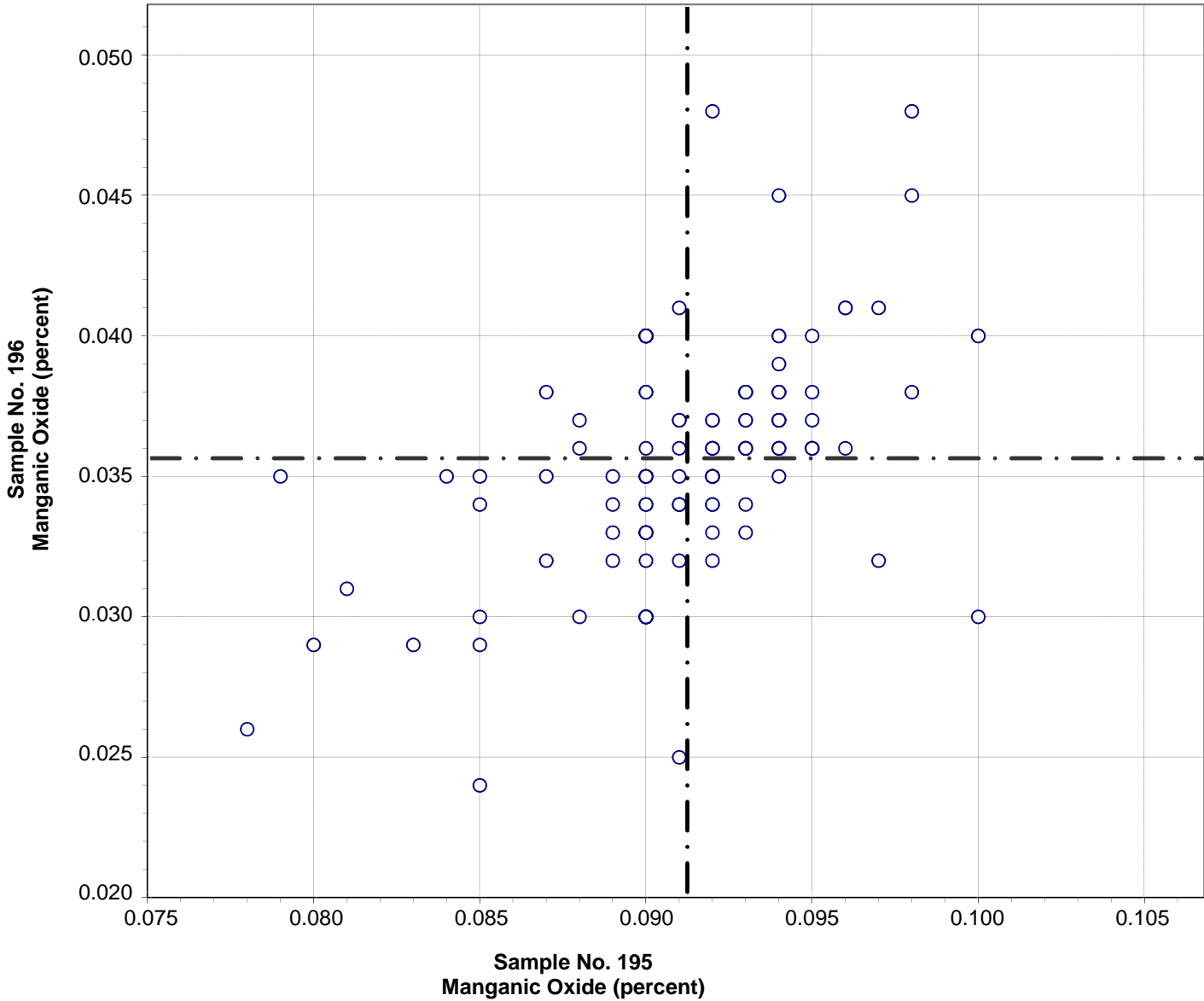
Test No. 99 Zinc Oxide 85 Points

Sample No. 195	Ave 0.017	S.D. 0.003	C.V. 17.5
Sample No. 196	Ave 0.024	S.D. 0.003	C.V. 13.0

Labs Eliminated: 219, 2363, 2463, 3607

Labs off Diagram: 36

**CCRL Proficiency Sample Program
Manganic Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



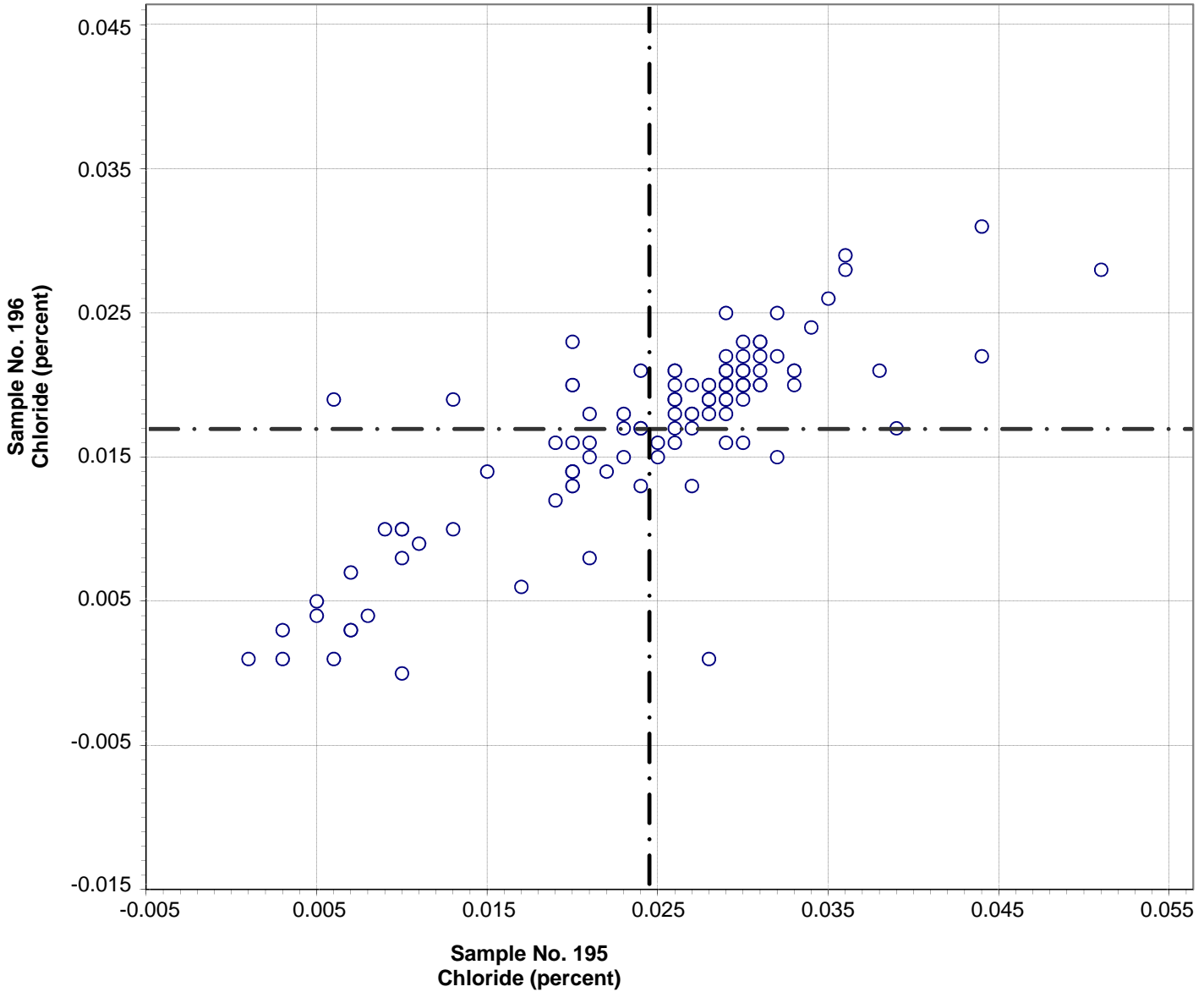
Test No. 101 Manganic Oxide 128 Points

Sample No. 195 Ave 0.091 S.D. 0.004 C.V. 4.1

Sample No. 196 Ave 0.036 S.D. 0.004 C.V. 11.3

Labs Eliminated: 15, 178, 205, 354, 413, 494, 1054, 1435, 2363, 2466, 3057, 3238, 3607, 3707, 3970

**CCRL Proficiency Sample Program
Chloride
PORTLAND CEMENT Samples No. 195 and No. 196**

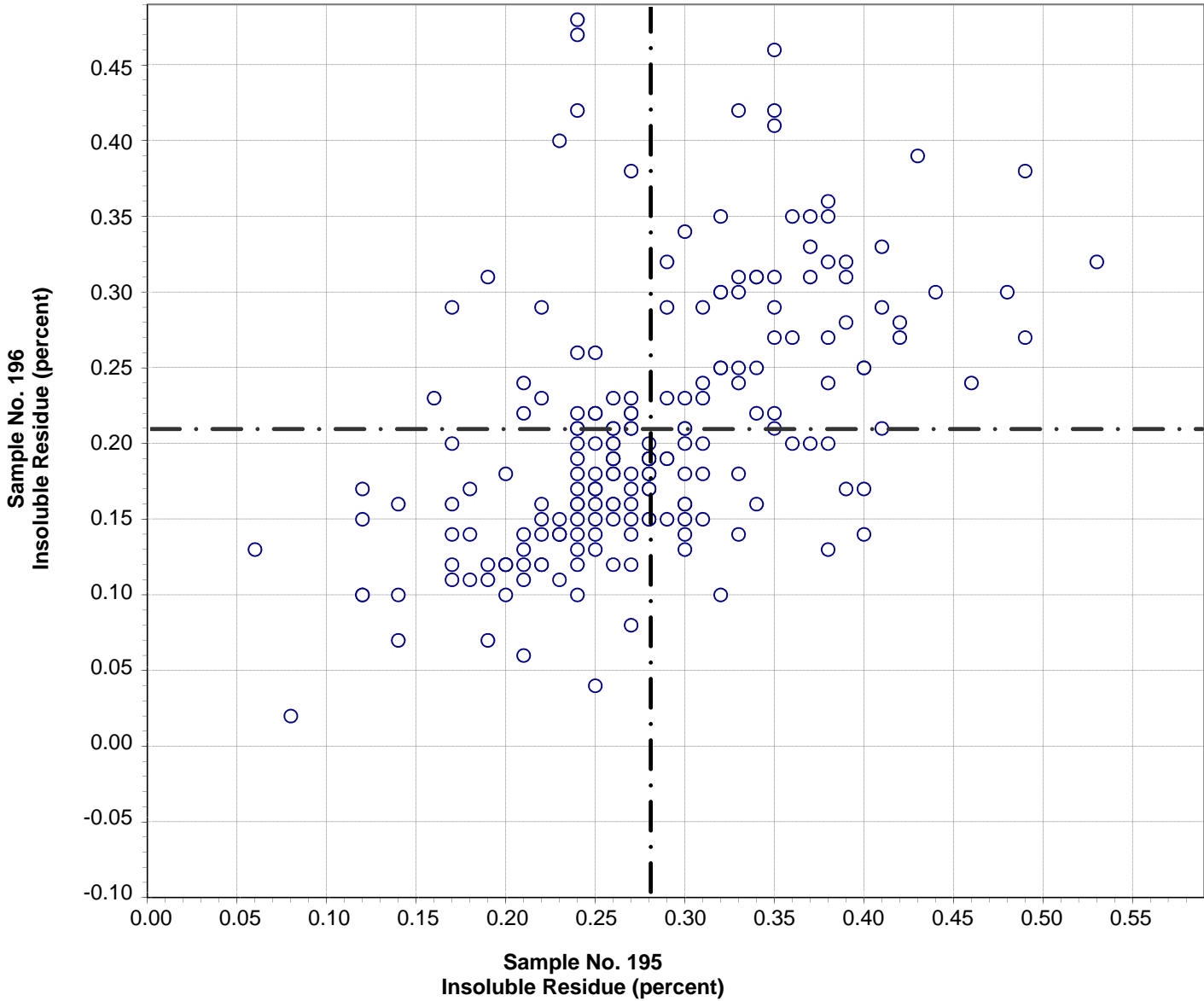


Test No. 104 Chloride 115 Points

Sample No. 195	Ave 0.024	S.D. 0.009	C.V. 38
Sample No. 196	Ave 0.017	S.D. 0.006	C.V. 38

Labs Eliminated: 493, 692, 2463

**CCRL Proficiency Sample Program
Insoluble Residue
PORTLAND CEMENT Samples No. 195 and No. 196**



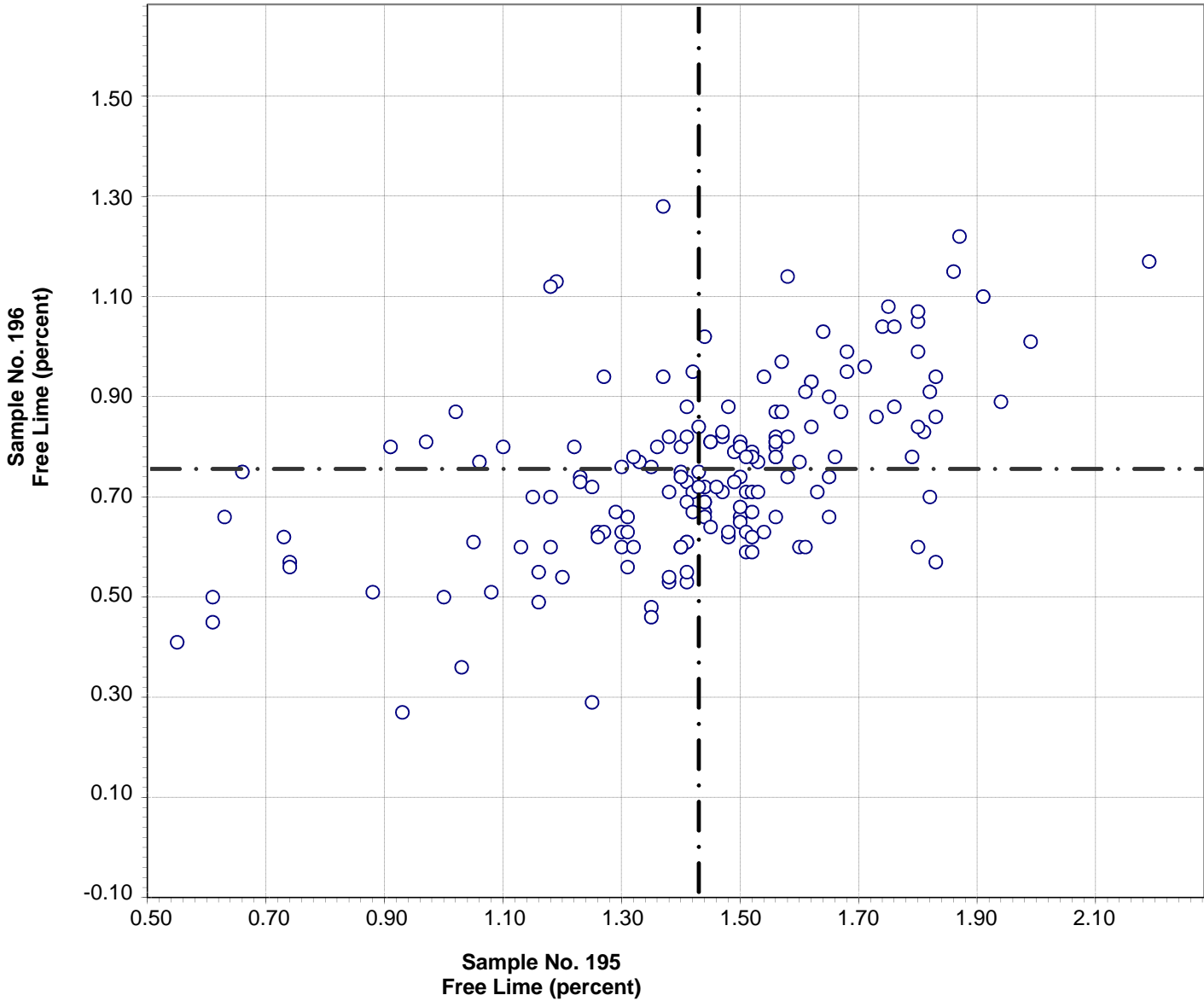
Test No. 80 Insoluble Residue 200 Points

Sample No. 195 Ave 0.28 S.D. 0.08 C.V. 28

Sample No. 196 Ave 0.21 S.D. 0.09 C.V. 41

Labs Eliminated: 4, 50, 105, 222, 309, 697, 1053, 1644, 2308, 2462, 2466, 3235, 3415, 3819

**CCRL Proficiency Sample Program
Free Lime
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 41 Free Lime 167 Points

Sample No. 195	Ave 1.43	S.D. 0.28	C.V. 20
Sample No. 196	Ave 0.75	S.D. 0.18	C.V. 24

Labs Eliminated: 60, 146, 162, 181, 246, 1644, 2466, 3238, 3970

**CCRL Proficiency Sample Program
Carbon Dioxide
PORTLAND CEMENT Samples No. 195 & No. 196**

No Diagram Printed for this Component

Sample No. 195 did not
Contain Limestone Additions.
Test Results Were Analyzed for
Sample No. 196 Only.

Test No. 97	Carbon Dioxide	190 labs
Sample No. 196	AVE 0.97 S.D. 0.21 C.V. 21.4	
Labs Eliminated:	15, 90, 3607	

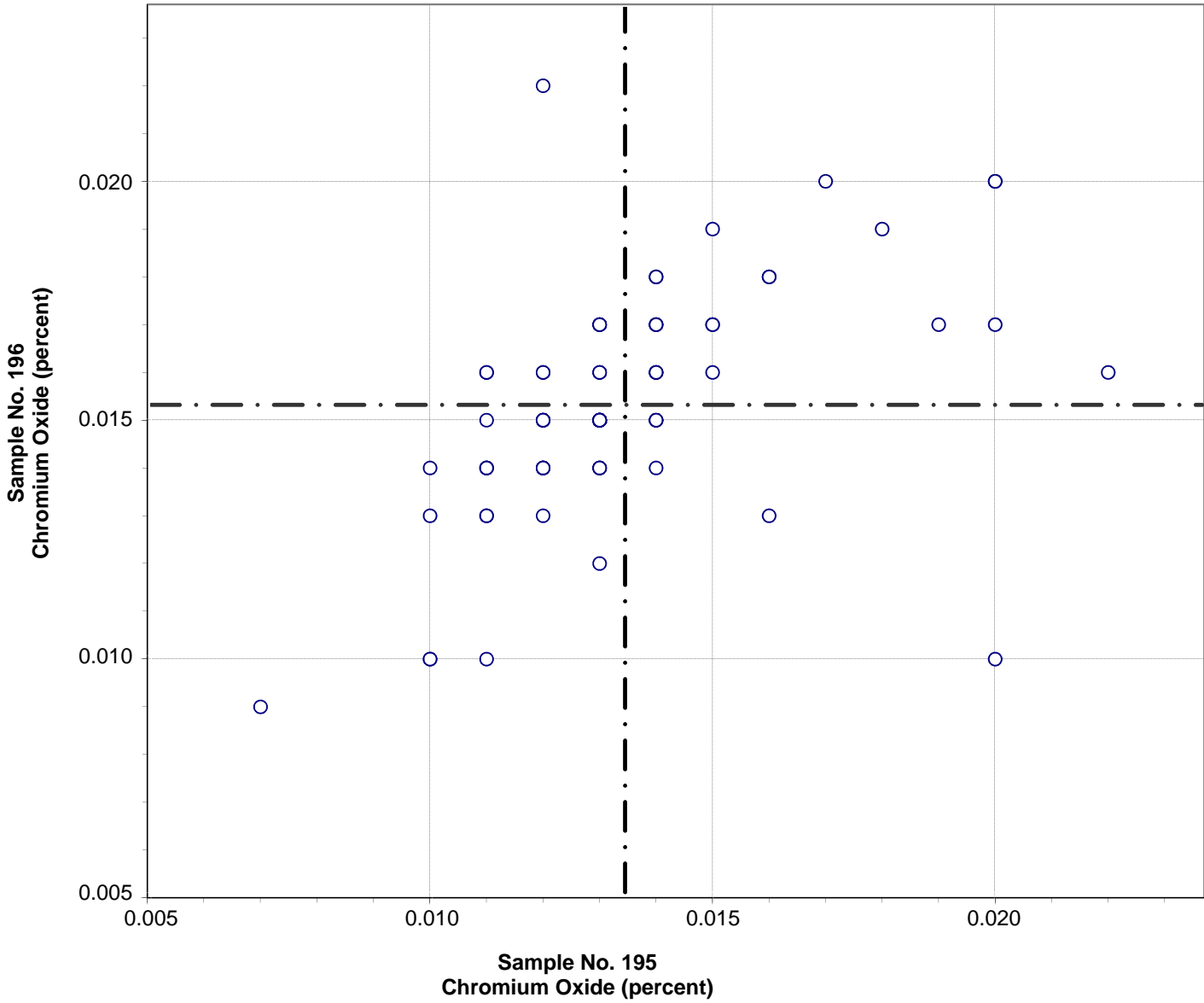
**CCRL Proficiency Sample Program
Limestone Content
PORTLAND CEMENT Samples No. 195 & No. 196**

No Diagram Printed for this Component

Sample No. 195 did not
Contain Limestone Additions.
Test Results Were Analyzed for
Sample No. 196 Only.

Test No. 98	Limestone Content	183 labs
Sample No. 196	AVE 2.3 S.D. 0.5 C.V. 21.0	
Labs Eliminated:	6, 15, 90, 3607	

**CCRL Proficiency Sample Program
Chromium Oxide
PORTLAND CEMENT Samples No. 195 and No. 196**



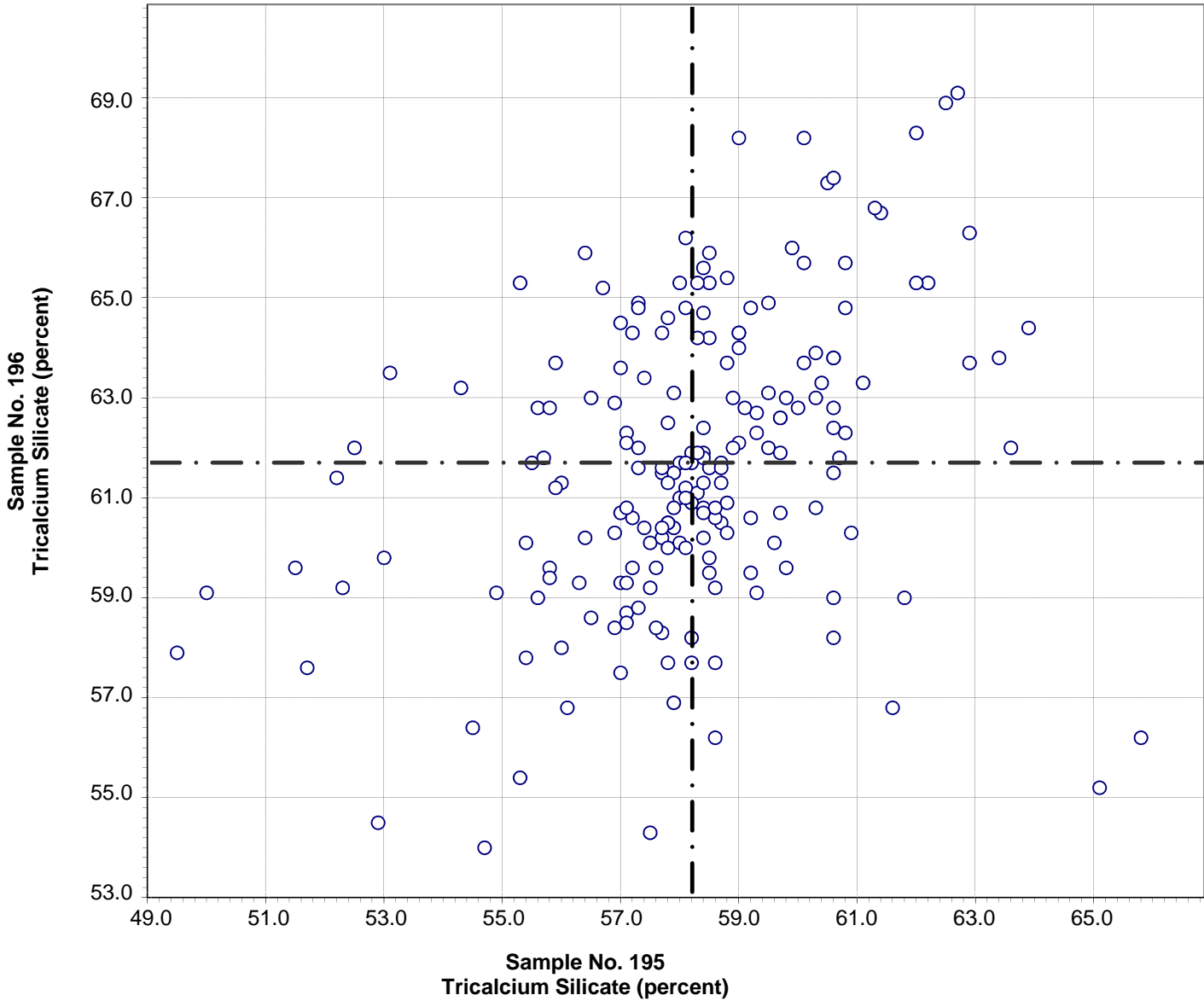
Test No. 105 Chromium Oxide 74 Points

Sample No. 195 Ave 0.013 S.D. 0.003 C.V. 20

Sample No. 196 Ave 0.015 S.D. 0.002 C.V. 16

Labs Eliminated: 34, 66, 95, 116, 142, 157, 415, 450, 768, 1079, 3970

**CCRL Proficiency Sample Program
Tricalcium Silicate
PORTLAND CEMENT Samples No. 195 and No. 196**



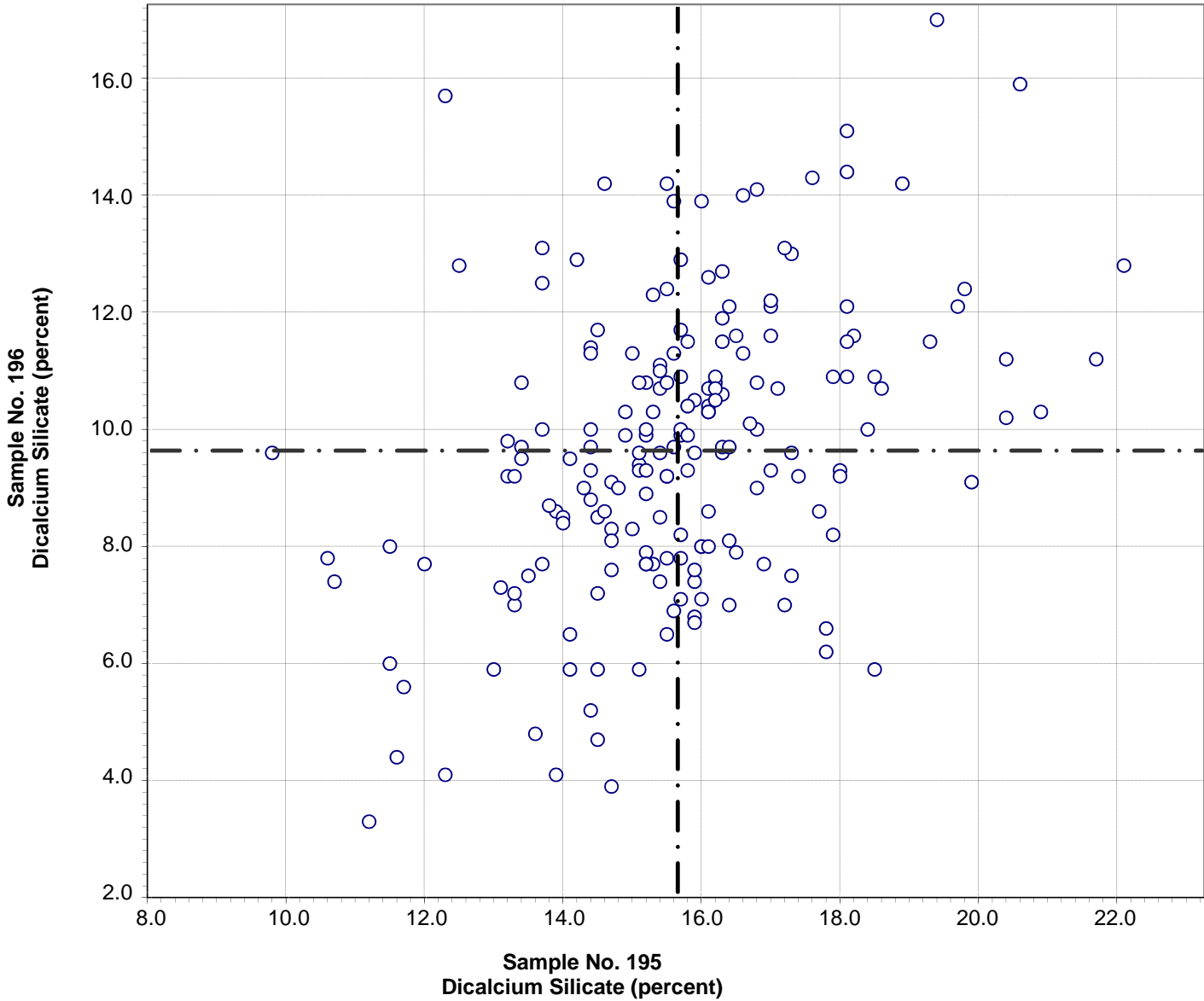
Test No. 106 Tricalcium Silicate 194 Points

Sample No. 195 Ave 58.2 S.D. 2.4 C.V. 4.2

Sample No. 196 Ave 61.7 S.D. 2.9 C.V. 4.7

Labs Eliminated: 10, 24, 38, 494, 3970

**CCRL Proficiency Sample Program
Dicalcium Silicate
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 107 Dicalcium Silicate 190 Points

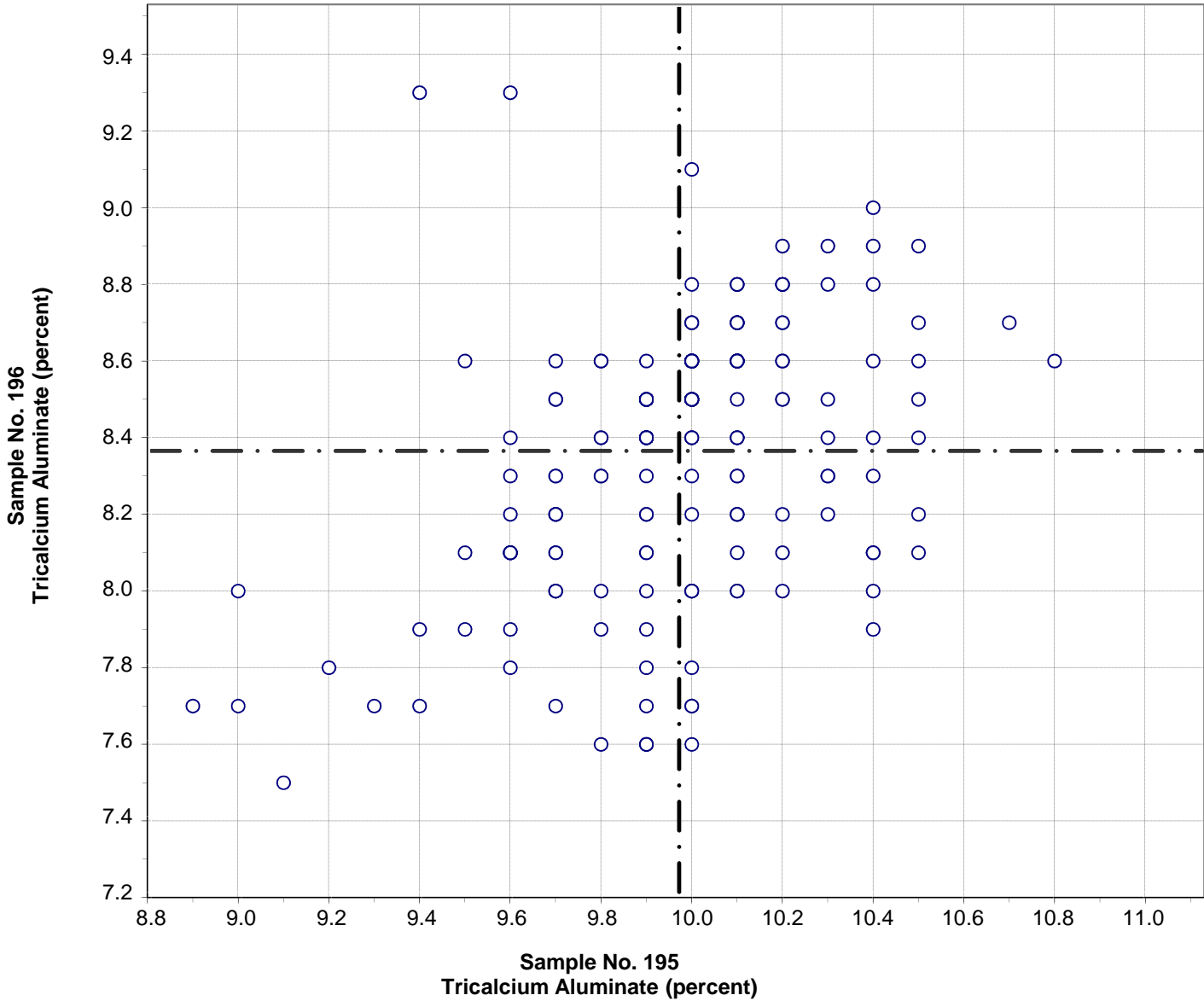
Sample No. 195 Ave 15.6 S.D. 2.1 C.V. 13

Sample No. 196 Ave 9.6 S.D. 2.5 C.V. 26

Labs Eliminated: 10, 93, 494, 1054, 1466, 2477, 3279, 3970

Labs off Diagram: 24

**CCRL Proficiency Sample Program
Tricalcium Aluminate
PORTLAND CEMENT Samples No. 195 and No. 196**



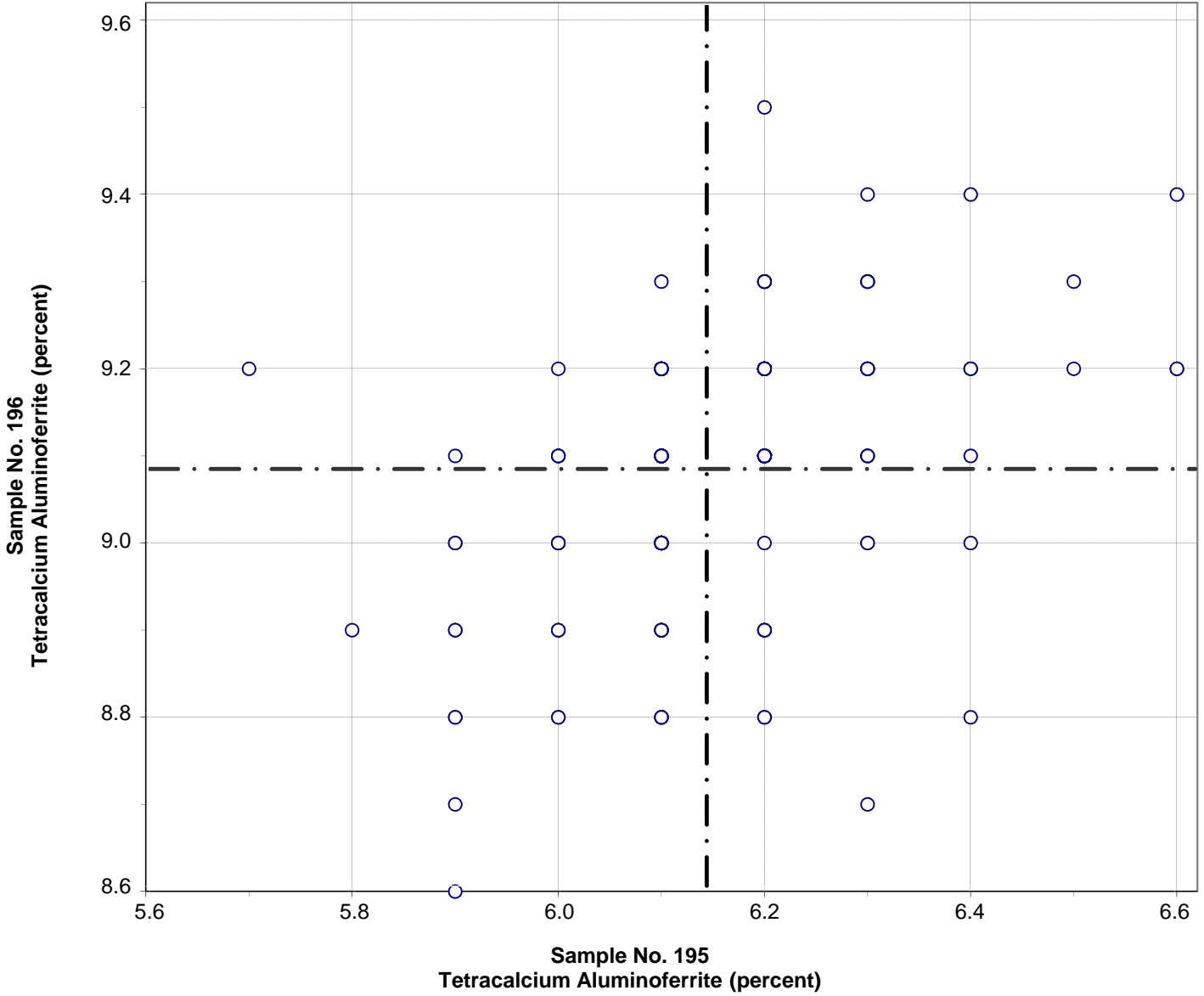
Test No. 108 Tricalcium Aluminate 190 Points

Sample No. 195 Ave 10.0 S.D. 0.3 C.V. 3.0

Sample No. 196 Ave 8.4 S.D. 0.3 C.V. 4.1

Labs Eliminated: 116, 157, 494, 691, 1054, 1079, 2293, 2463, 3819, 3970

**CCRL Proficiency Sample Program
Tetracalcium Aluminoferrite
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 109 Tetracalcium Aluminoferrite 187 Points

Sample No. 195 Ave 6.1 S.D. 0.1 C.V. 2.1

Sample No. 196 Ave 9.1 S.D. 0.2 C.V. 1.7

Labs Eliminated: 42, 64, 116, 157, 494, 691, 1054, 1079, 1466, 1644, 2293, 3970

Labs off Diagram: 221

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Physical Results
March 20, 2015

SUMMARY OF RESULTS

Sample No.195

Sample No. 196

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

246	26.6	1.95	7.30	24.7	1.73	7.00
*234	26.6	0.67	2.50	24.7	0.46	1.90

* Labs Eliminated - 8, 38, 41, 49, 565, 1644, 2293, 2466, 2477, 2483, 3966, 3976

Vicat Time of Set - Initial (minutes)

242	118	16	14	147	16	11
*236	116	12	11	147	14	10

* Labs Eliminated - 38, 40, 49, 103, 691, 3976

Vicat Time of Set - Final (minutes)

232	219	31	14	237	30	13
*227	217	28	13	236	28	12

* Labs Eliminated - 40, 49, 50, 565, 3976

Gillmore Time of Set - Initial (minutes)

144	155	23	15	177	26	15
*143	155	22	14	176	25	14

* Labs Eliminated - 309

Gillmore Time of Set - Final (minutes)

144	255	37	14	269	40	15
*141	253	33	13	266	35	13

* Labs Eliminated - 26, 99, 309

False Set - Paste Method (percent)

191	76	19.7	26.0	72	13.6	18.8
*176	80	11.1	13.8	73	11.9	16.3

* Labs Eliminated - 40, 51, 94, 96, 101, 143, 284, 354, 360, 493, 698, 1054, 1435, 3658, 3662

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Physical Results
 March 20, 2015

SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Autoclave Expansion (percent)							
	221	0.17	0.088	52	0.00	0.046	25236
	*203	0.18	0.068	38	-0.01	0.015	711
* Labs Eliminated - 36, 38, 40, 139, 146, 157, 222, 491, 494, 1025, 1053, 1715, 1956, 2293, 2491, 2763, 3368, 3695							
Air Content % (percent)							
	227	8.6	1.4	16	7.5	1.5	20
	*223	8.6	1.1	13	7.4	1.2	16
* Labs Eliminated - 360, 1041, 2296, 3976							
Air Content - % Water (percent)							
	222	69.2	10.9	15.8	68.9	10.9	15.8
	*211	70.9	2.2	3.2	70.6	2.1	3.0
* Labs Eliminated - 60, 66, 95, 124, 180, 309, 474, 1041, 3279, 3662, 3948							
Air Content - Flow (percent)							
	224	85	3.5	4.1	85	3.4	4.0
	*222	85	3.3	3.9	85	3.2	3.8
* Labs Eliminated - 54, 3605							
Compressive Strength - 3 day (psi)							
	251	3626	296	8.2	4394	300	6.8
	*243	3636	228	6.3	4409	258	5.8
* Labs Eliminated - 38, 103, 565, 823, 1644, 2293, 3973, 3976							
Compressive Strength - 7 day (psi)							
	249	4702	352	7.5	5099	321	6.3
	*245	4721	280	5.9	5109	290	5.7
* Labs Eliminated - 38, 49, 565, 823							

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Physical Results
 March 20, 2015

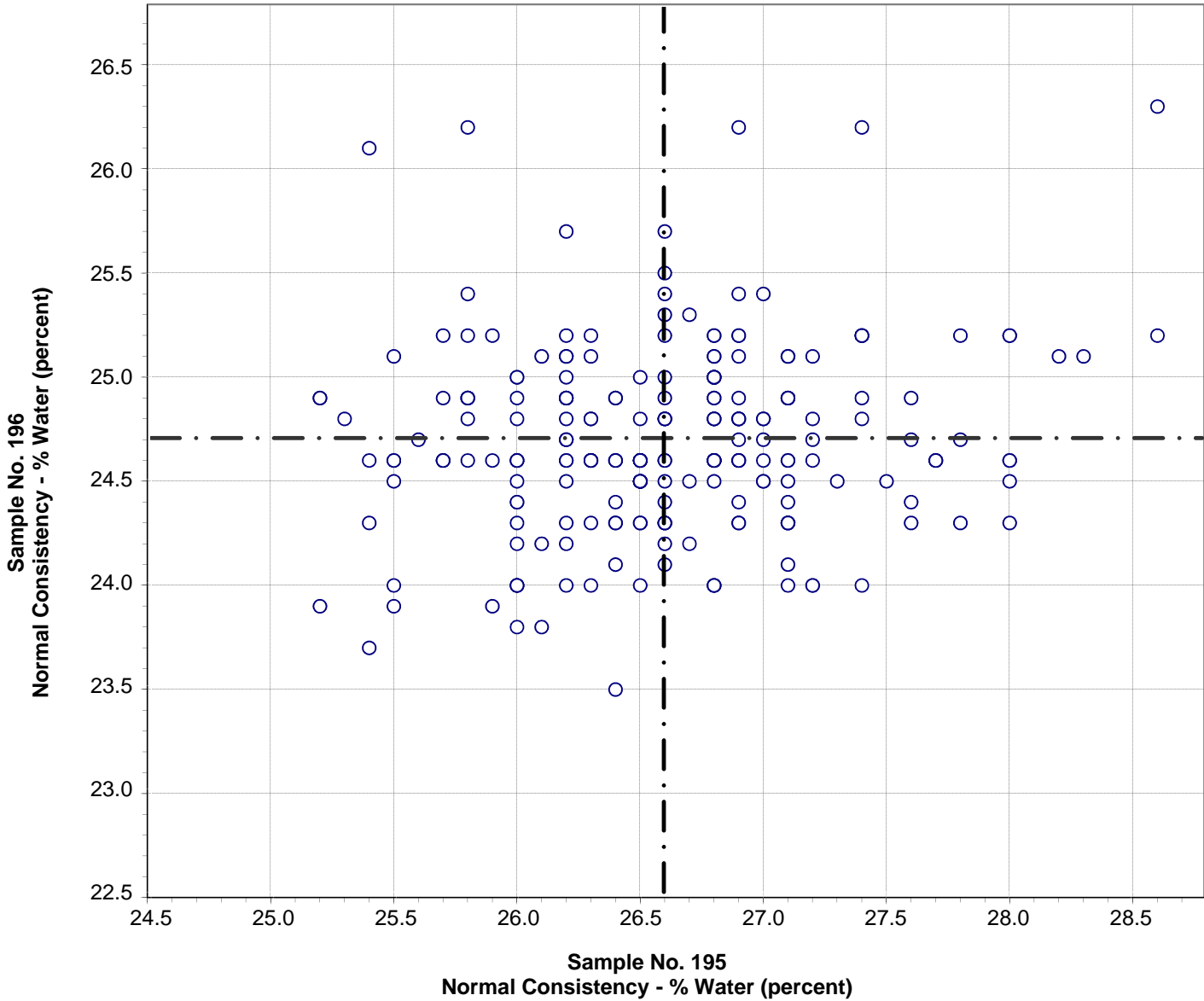
SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Compressive Strength - 28 day (psi)							
	223	5985	473	7.9	5954	399	6.7
	*220	6015	394	6.6	5972	371	6.2
* Labs Eliminated - 38, 565, 823							
Compressive Strength - Flow (percent)							
	217	102	9	8.8	107	9	8.7
	*214	102	9	8.4	107	9	8.2
* Labs Eliminated - 407, 840, 1466							
Fineness - Air Permeability (m²/kg)							
	241	426	18	4.3	417	20	4.9
	*232	426	12	2.8	417	12	3.0
* Labs Eliminated - 15, 51, 78, 99, 116, 137, 143, 360, 3850							
Fineness - Wagner Turbidimeter (m²/kg)							
	3	283	122	43.3	280	126	45.0
No Labs Eliminated for This Test							
Fineness - 45µm Sieve (percent)							
	225	93.75	1.12	1.19	93.87	1.24	1.32
	*214	93.78	0.84	0.89	93.90	0.84	0.90
* Labs Eliminated - 3, 26, 50, 95, 99, 205, 360, 502, 690, 2484, 3752							
C1038 Mortar Bar Expansion (percent)							
	157	0.007	0.022	306	0.005	0.011	210
	*147	0.008	0.004	53	0.005	0.003	64
* Labs Eliminated - 26, 36, 49, 101, 151, 491, 494, 667, 2483, 3607							

**CCRL Proficiency Sample Program
Normal Consistency - % Water
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 110 Normal Consistency - % Water 233 Points

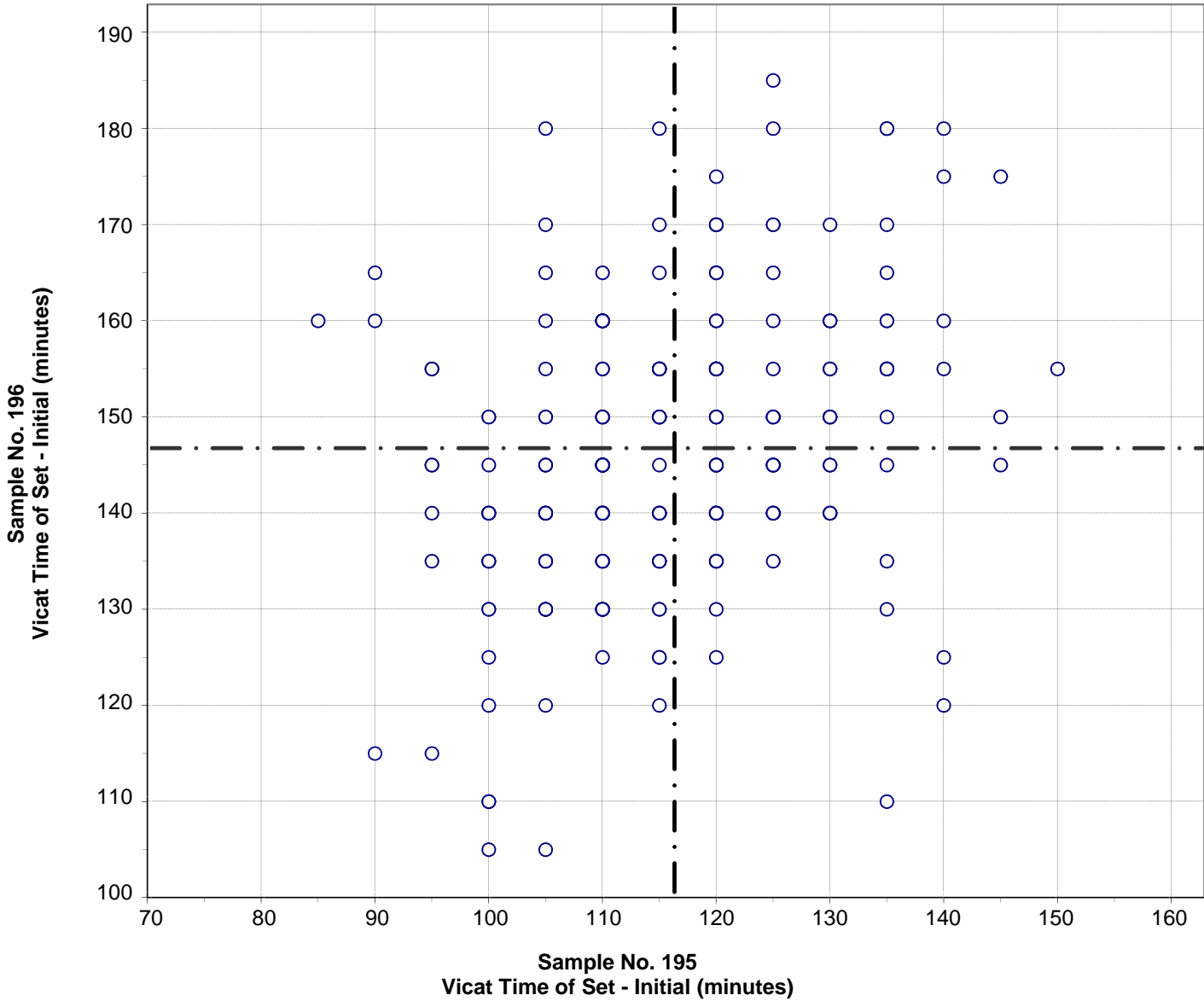
Sample No. 195 Ave 26.6 S.D. 0.67 C.V. 2.50

Sample No. 196 Ave 24.7 S.D. 0.46 C.V. 1.90

Labs Eliminated: 8, 38, 41, 49, 565, 1644, 2293, 2466, 2477, 2483, 3966, 3976

Labs off Diagram: 3237

CCRL Proficiency Sample Program
Vicat Time of Set - Initial
PORTLAND CEMENT Samples No. 195 and No. 196



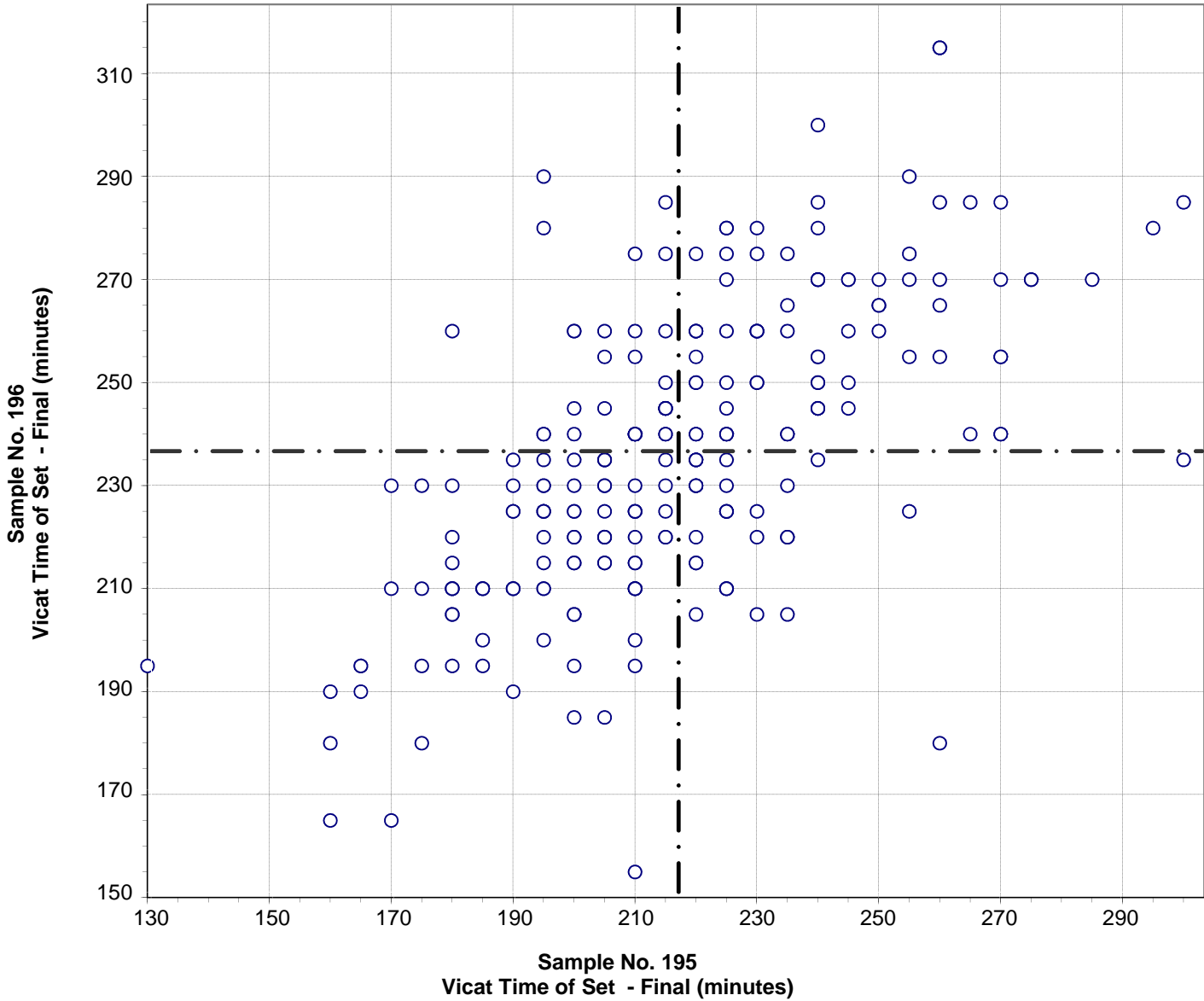
Test No. 120 Vicat Time of Set - Initial 235 Points

Sample No. 195 Ave 116 S.D. 12 C.V. 11
 Sample No. 196 Ave 147 S.D. 14 C.V. 10

Labs Eliminated: 38, 40, 49, 103, 691, 3976

Labs off Diagram: 3279

**CCRL Proficiency Sample Program
 Vicat Time of Set - Final
 PORTLAND CEMENT Samples No. 195 and No. 196**

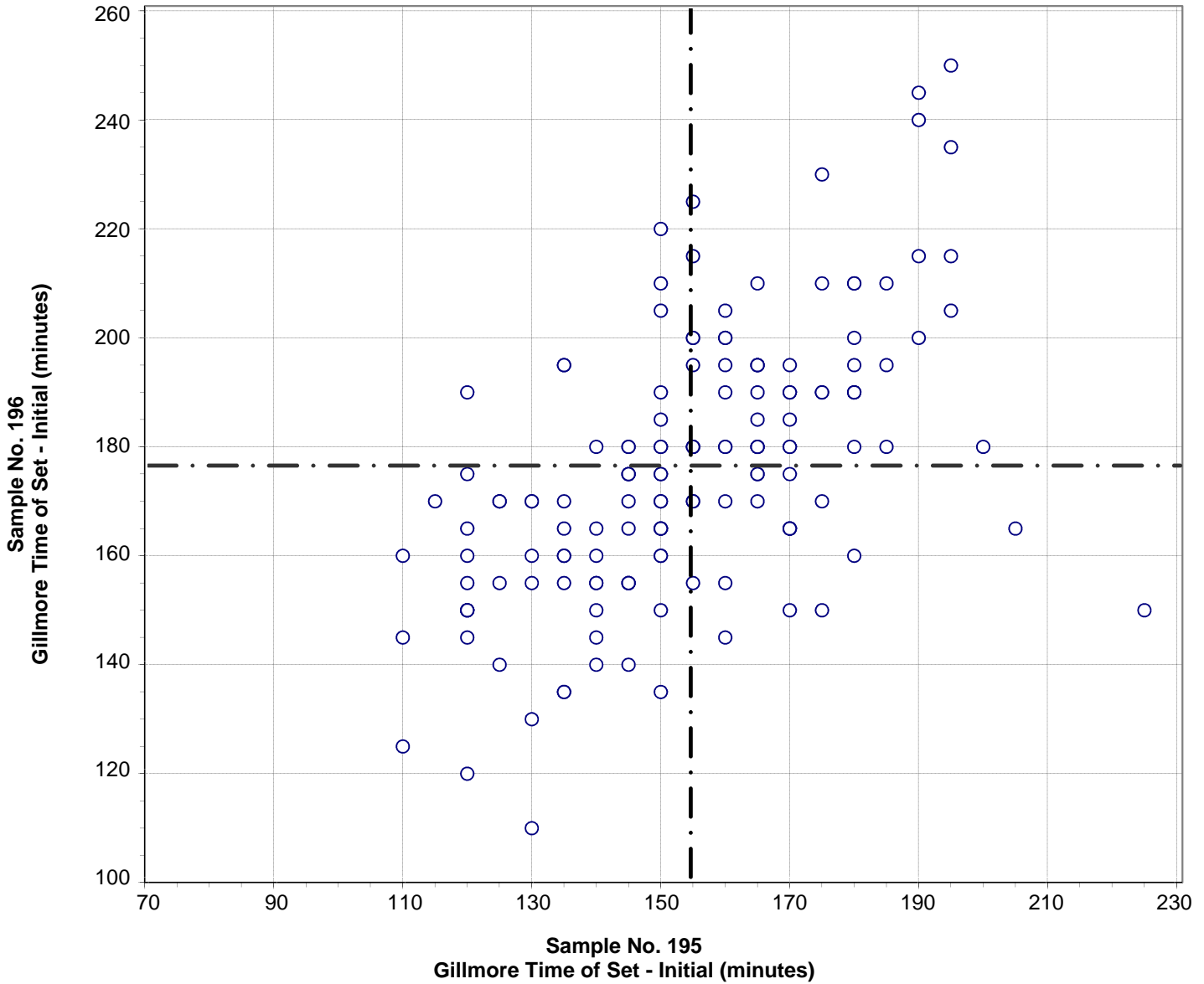


Test No. 121 Vicat Time of Set - Final 227 Points

Sample No. 195	Ave 217	S.D. 28	C.V. 13
Sample No. 196	Ave 236	S.D. 28	C.V. 12

Labs Eliminated: 40, 49, 50, 565, 3976

**CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
PORTLAND CEMENT Samples No. 195 and No. 196**

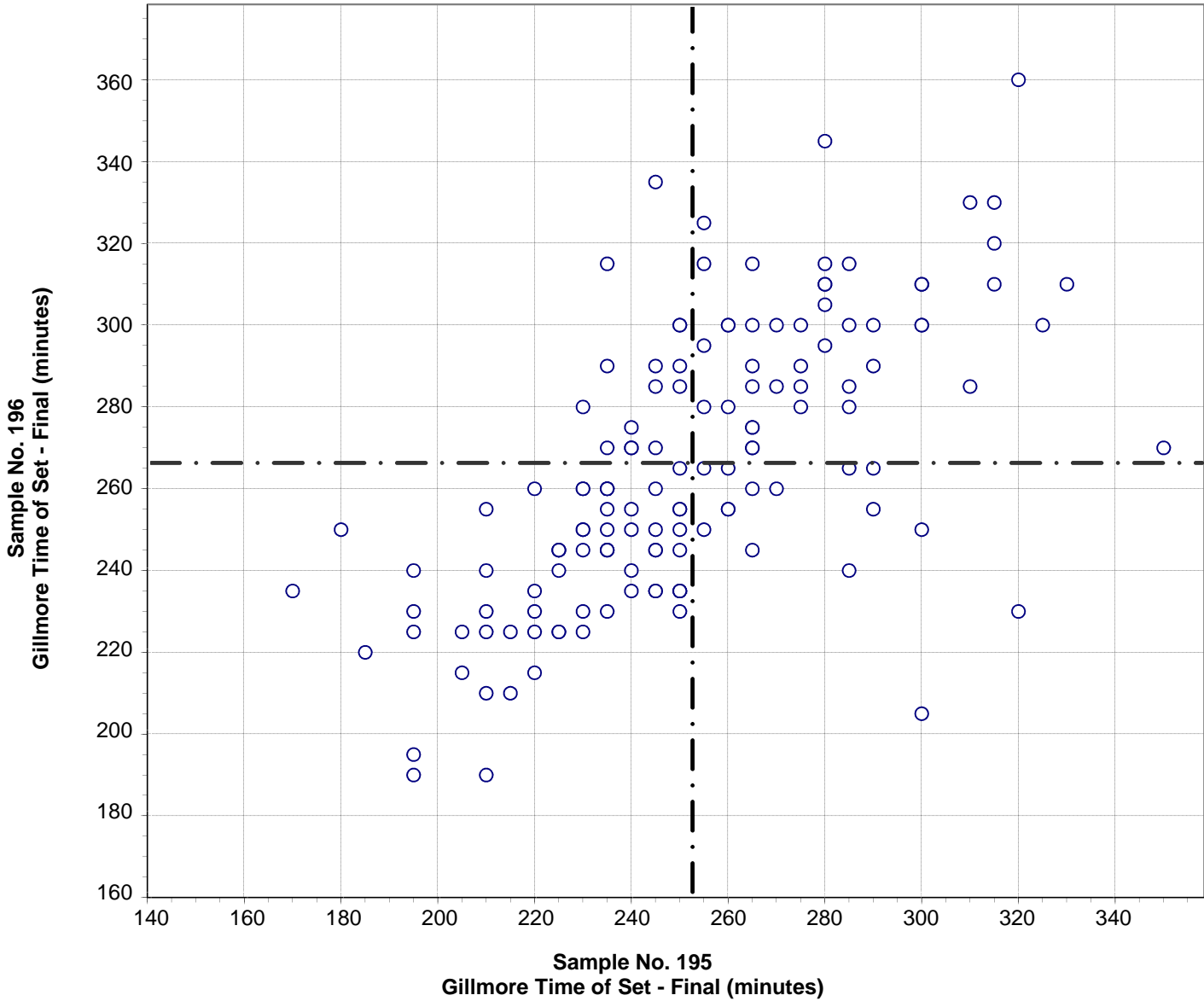


Test No. 130 Gillmore Time of Set - Initial 143 Points

Sample No. 195	Ave 155	S.D. 22	C.V. 14
Sample No. 196	Ave 176	S.D. 25	C.V. 14

Labs Eliminated: 309

**CCRL Proficiency Sample Program
Gillmore Time of Set - Final
PORTLAND CEMENT Samples No. 195 and No. 196**



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

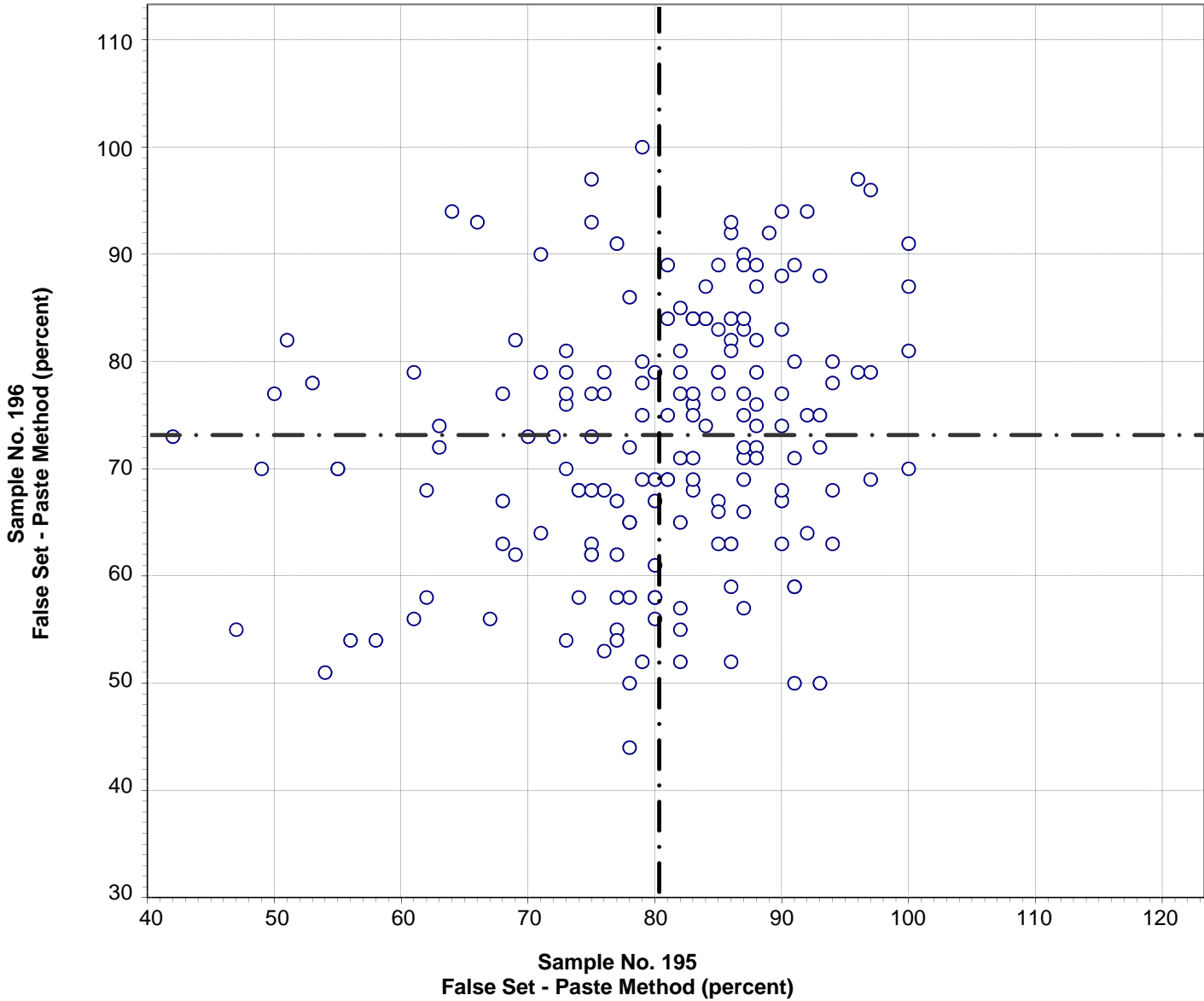
Sample No. 195 Ave 253 S.D. 33 C.V. 13

Sample No. 196 Ave 266 S.D. 35 C.V. 13

Labs Eliminated: 26, 99, 309

Labs off Diagram: 54

**CCRL Proficiency Sample Program
False Set - Paste Method
PORTLAND CEMENT Samples No. 195 and No. 196**



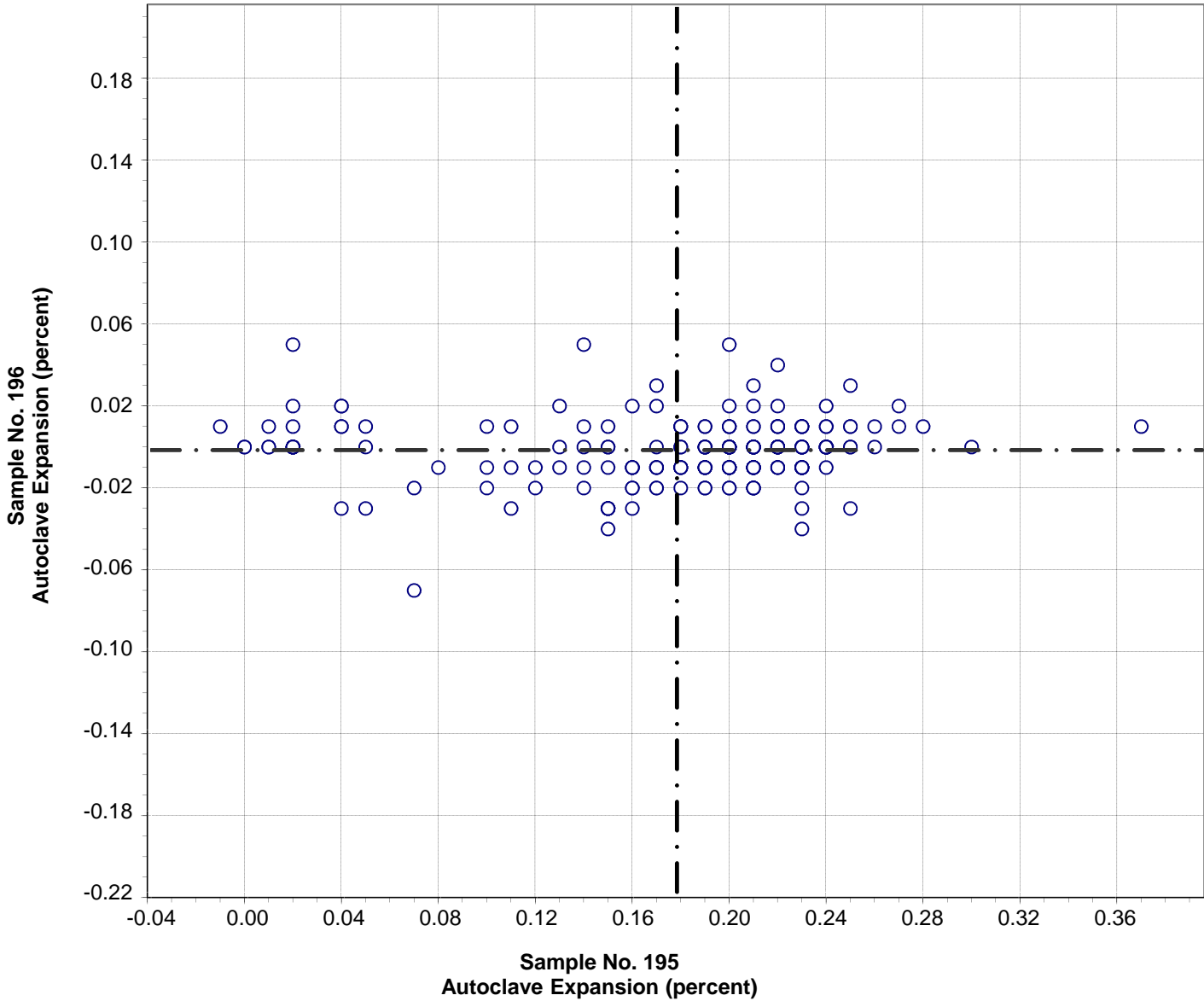
Test No. 150 False Set - Paste Method 176 Points

Sample No. 195 Ave 80 S.D. 11.1 C.V. 13.8

Sample No. 196 Ave 73 S.D. 11.9 C.V. 16.3

Labs Eliminated: 40, 51, 94, 96, 101, 143, 284, 354, 360, 493, 698, 1054, 1435, 3658, 3662

**CCRL Proficiency Sample Program
Autoclave Expansion
PORTLAND CEMENT Samples No. 195 and No. 196**

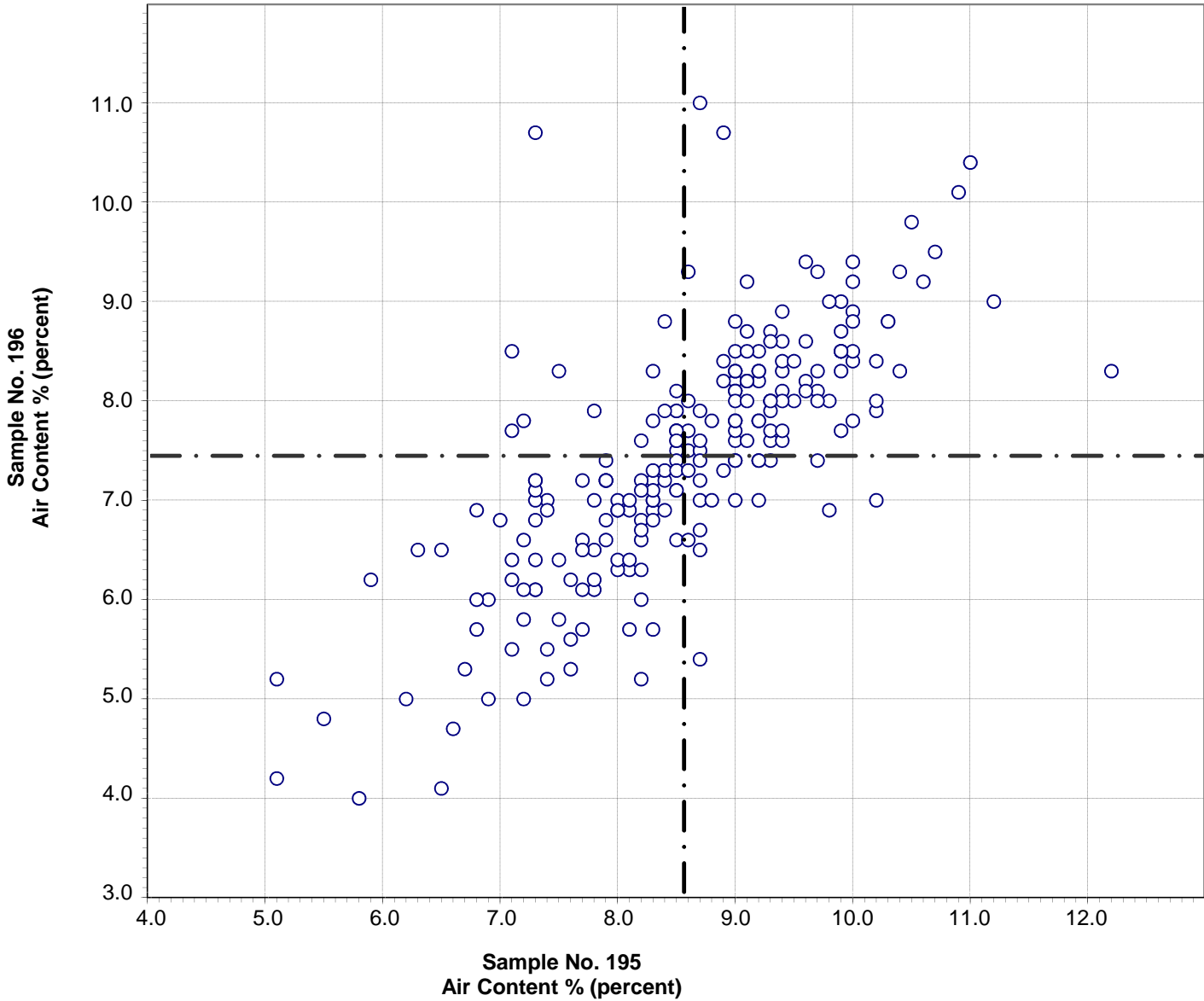


Test No. 160 Autoclave Expansion 203 Points

Sample No. 195	Ave 0.18	S.D. 0.068	C.V. 38
Sample No. 196	Ave -0.01	S.D. 0.015	C.V. 711

Labs Eliminated: 36, 38, 40, 139, 146, 157, 222, 491, 494, 1025, 1053, 1715, 1956, 2293, 2491, 2763, 3368, 3695

CCRL Proficiency Sample Program
Air Content %
PORTLAND CEMENT Samples No. 195 and No. 196



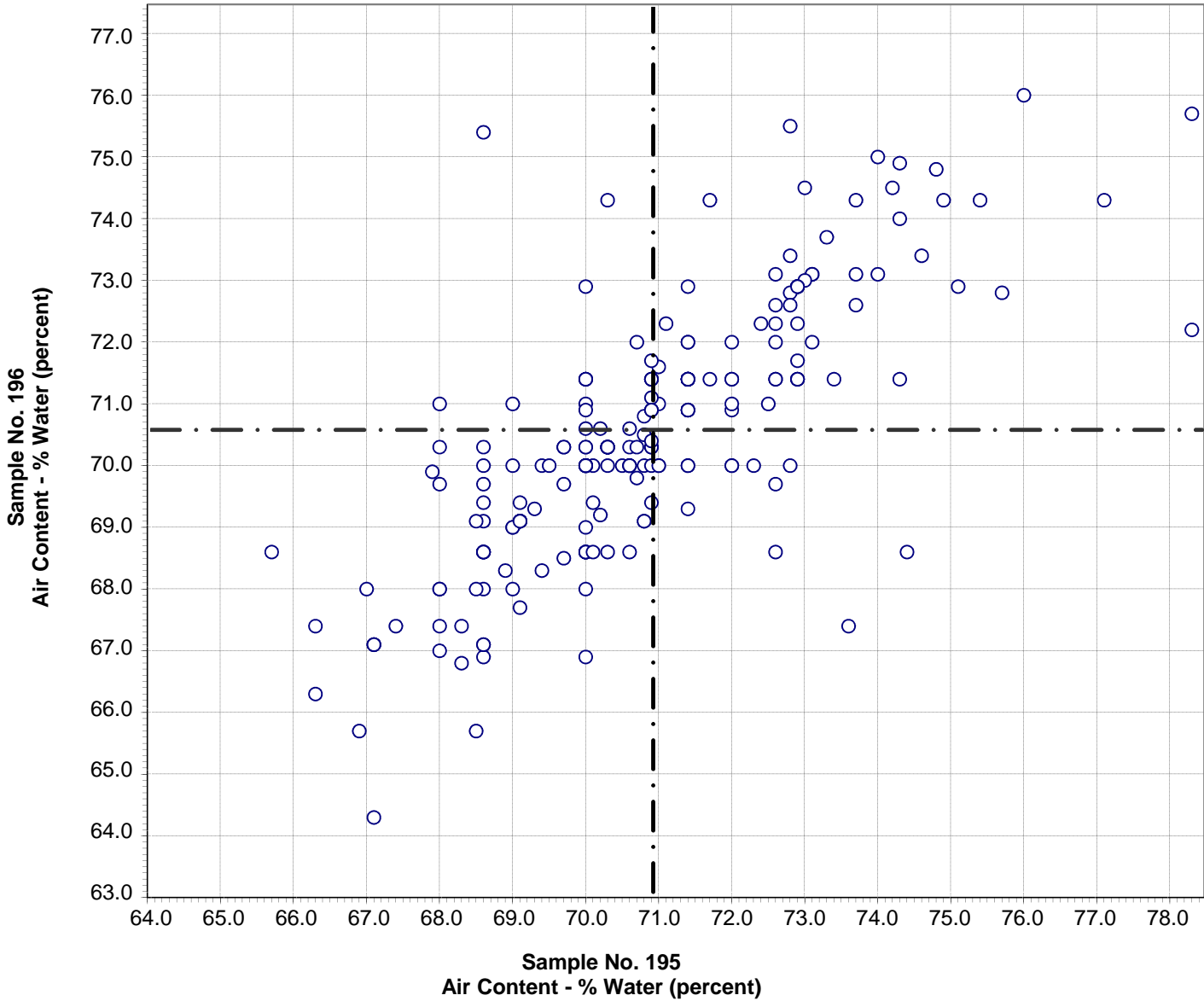
Test No. 170 Air Content % 223 Points

Sample No. 195 Ave 8.6 S.D. 1.1 C.V. 13

Sample No. 196 Ave 7.4 S.D. 1.2 C.V. 16

Labs Eliminated: 360, 1041, 2296, 3976

CCRL Proficiency Sample Program
Air Content - % Water
PORTLAND CEMENT Samples No. 195 and No. 196



Test No. 180 Air Content - % Water 209 Points

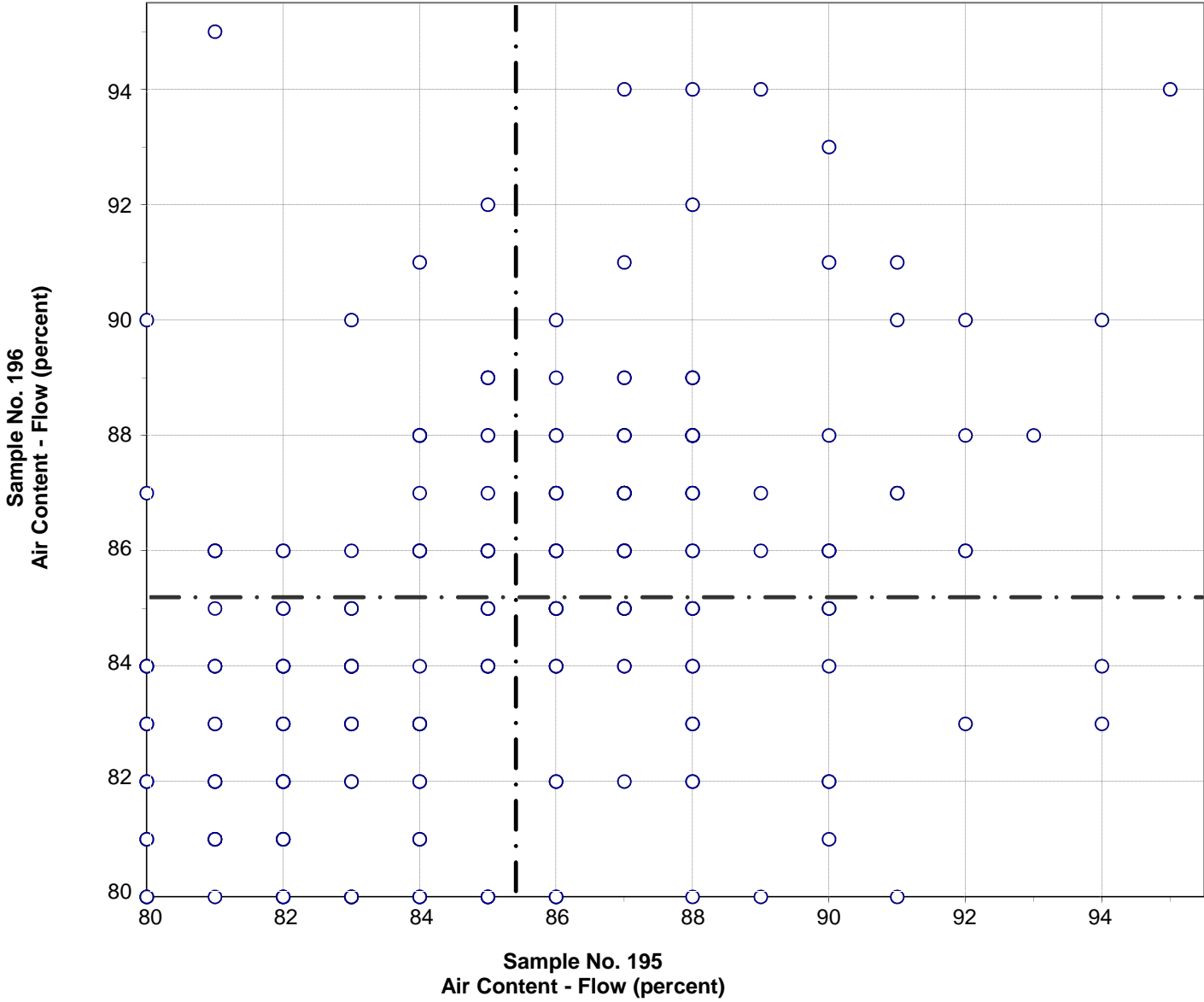
Sample No. 195 Ave 70.9 S.D. 2.2 C.V. 3.2

Sample No. 196 Ave 70.6 S.D. 2.1 C.V. 3.0

Labs Eliminated: 60, 66, 95, 124, 180, 309, 474, 1041, 3279, 3662, 3948

Labs off Diagram: 1676, 2465

CCRL Proficiency Sample Program
Air Content - Flow
PORTLAND CEMENT Samples No. 195 and No. 196

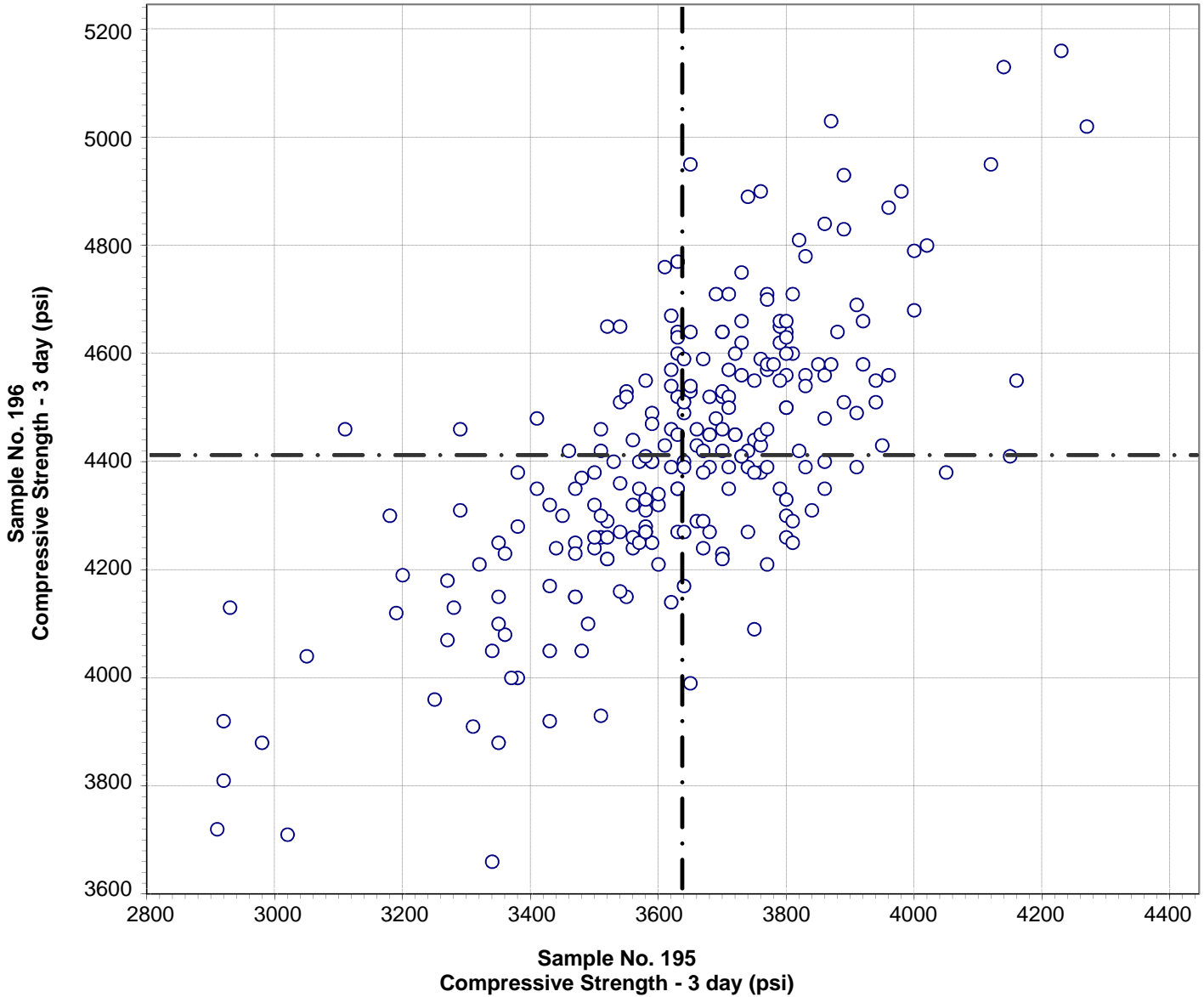


Test No. 190 Air Content - Flow 222 Points

Sample No. 195 Ave 85 S.D. 3.3 C.V. 3.9
 Sample No. 196 Ave 85 S.D. 3.2 C.V. 3.8

Labs Eliminated: 54, 3605

**CCRL Proficiency Sample Program
Compressive Strength - 3 day
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 200 Compressive Strength - 3 day 241 Points

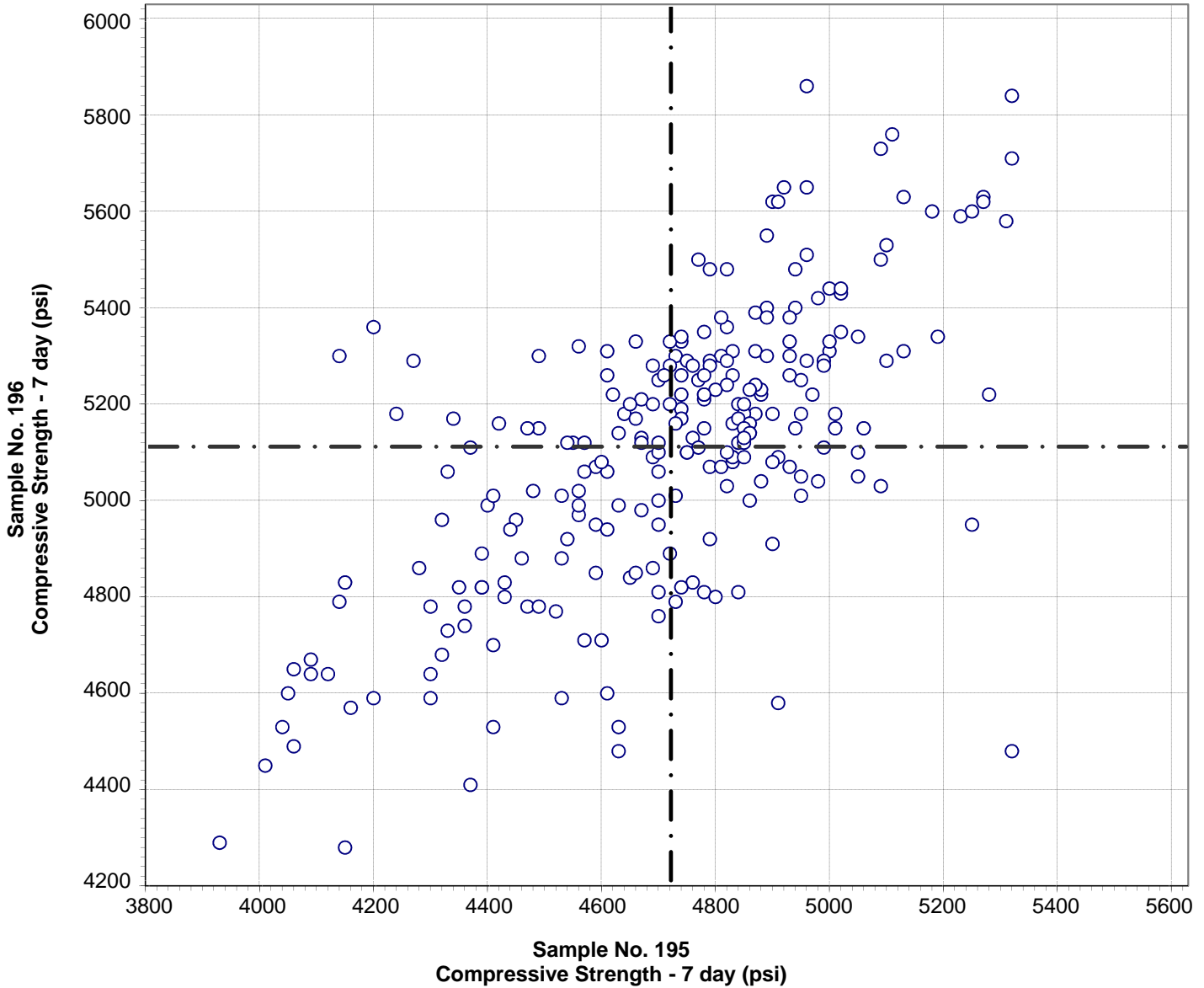
Sample No. 195 Ave 3636 S.D. 228 C.V. 6.3

Sample No. 196 Ave 4409 S.D. 258 C.V. 5.8

Labs Eliminated: 38, 103, 565, 823, 1644, 2293, 3973, 3976

Labs off Diagram: 143, 2080

**CCRL Proficiency Sample Program
Compressive Strength - 7 day
PORTLAND CEMENT Samples No. 195 and No. 196**

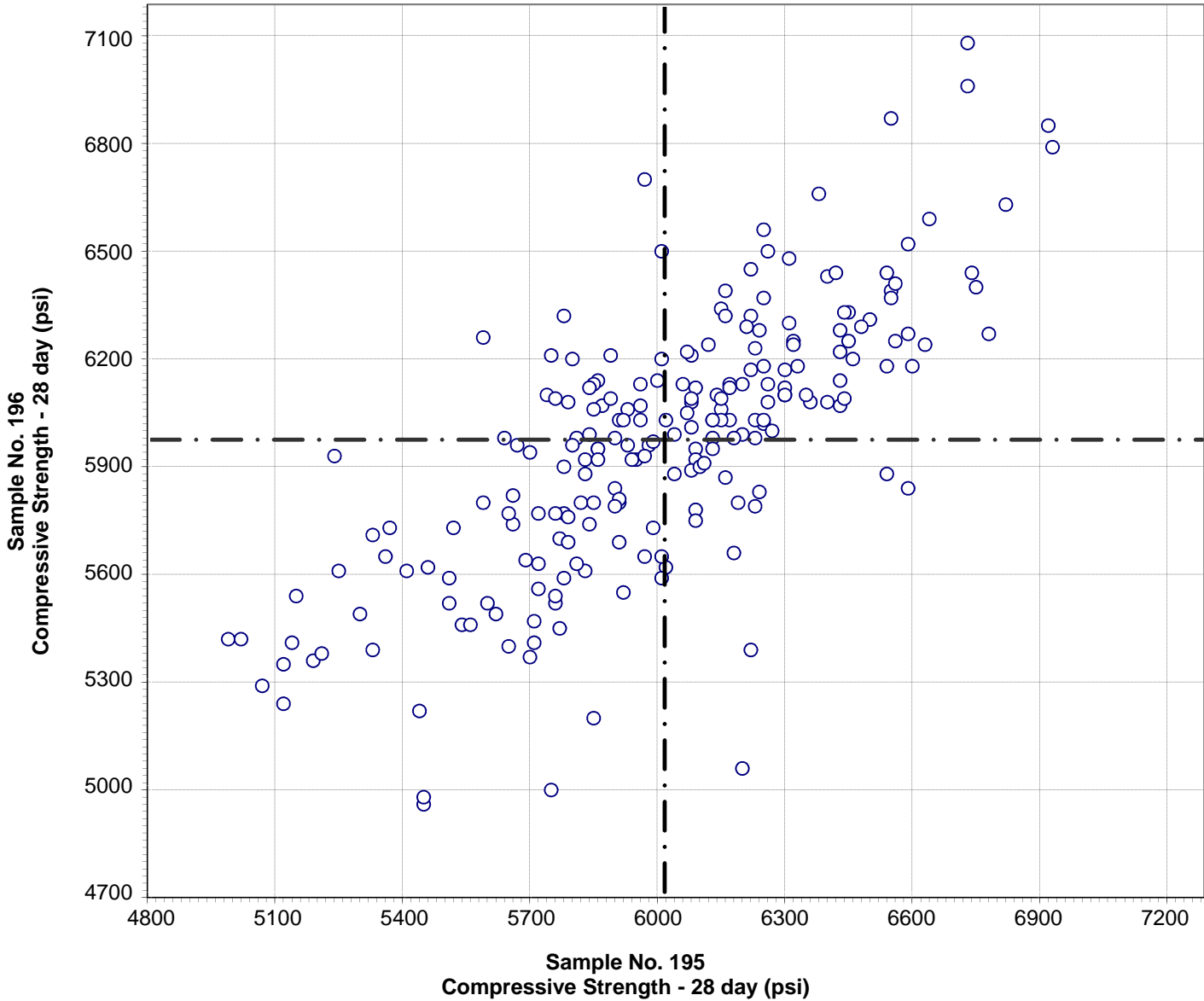


Test No. 210 Compressive Strength - 7 day 245 Points

Sample No. 195	Ave 4721	S.D. 280	C.V. 5.9
Sample No. 196	Ave 5109	S.D. 290	C.V. 5.7

Labs Eliminated: 38, 49, 565, 823

**CCRL Proficiency Sample Program
Compressive Strength - 28 day
PORTLAND CEMENT Samples No. 195 and No. 196**



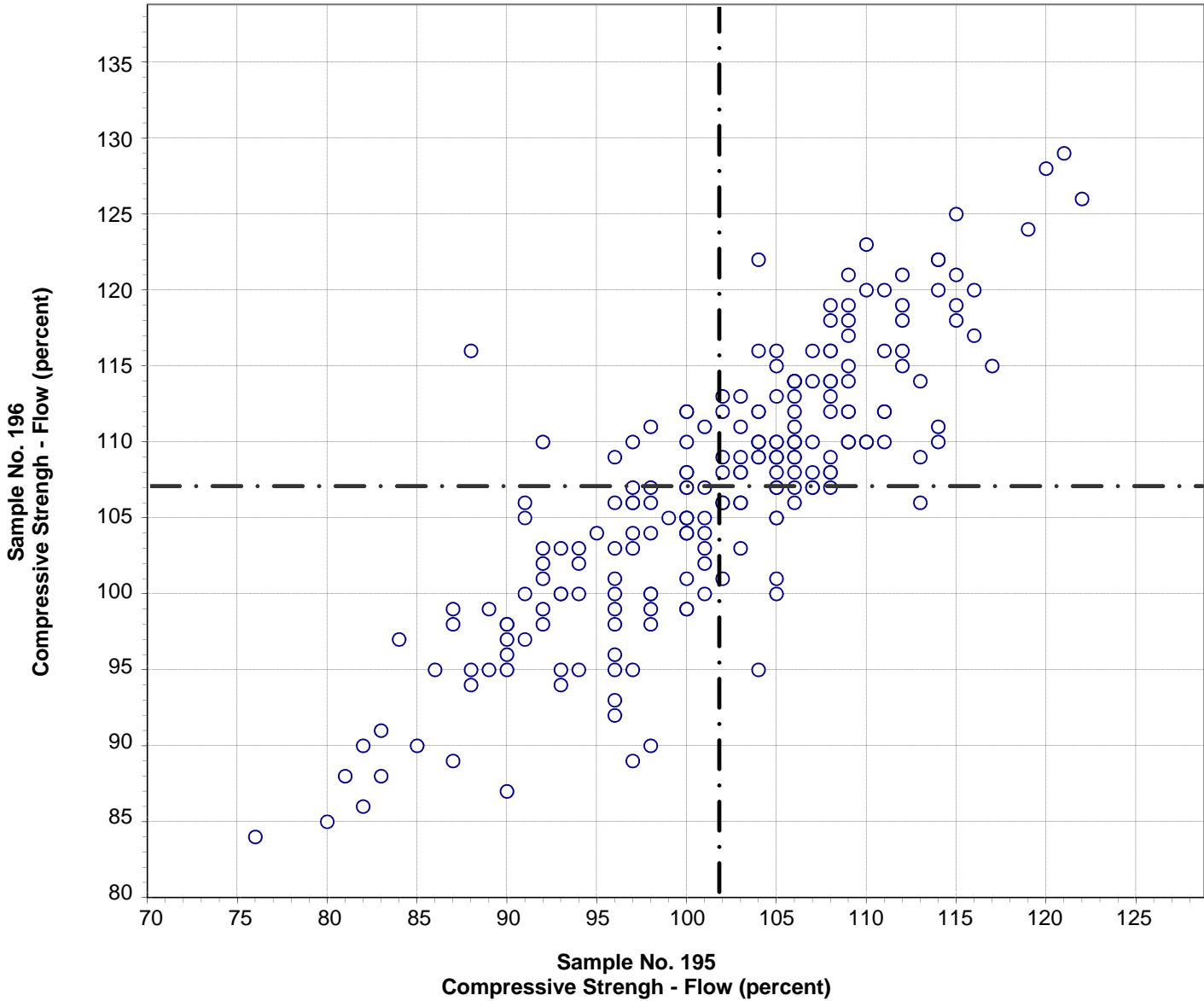
Test No. 211 Compressive Strength - 28 day 219 Points

Sample No. 195	Ave 6015	S.D. 394	C.V. 6.6
Sample No. 196	Ave 5972	S.D. 371	C.V. 6.2

Labs Eliminated: 38, 565, 823

Labs off Diagram: 49

**CCRL Proficiency Sample Program
Compressive Strength - Flow
PORTLAND CEMENT Samples No. 195 and No. 196**

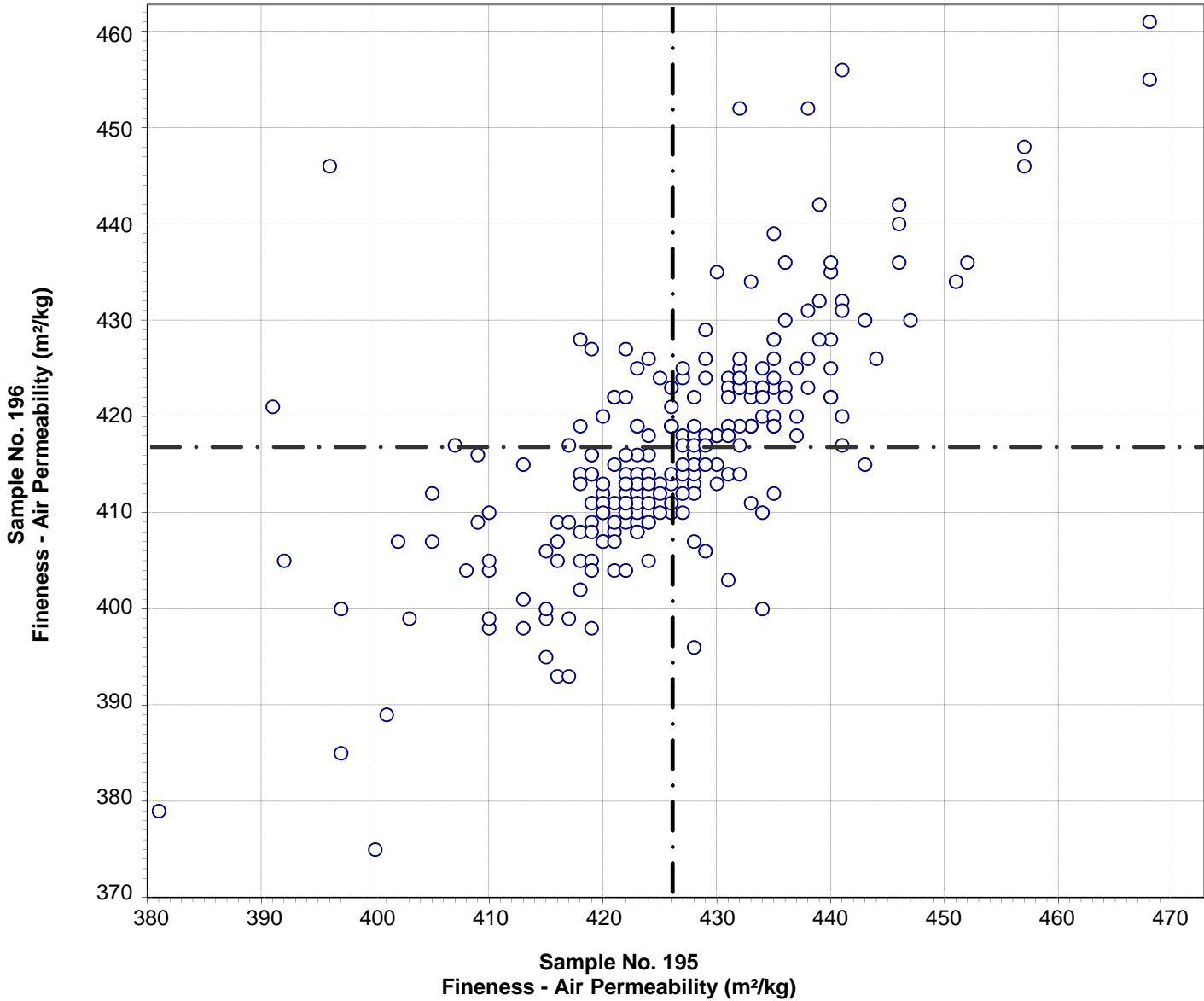


Test No. 230 Compressive Strength - Flow 214 Points

Sample No. 195 Ave 102 S.D. 9 C.V. 8.4
 Sample No. 196 Ave 107 S.D. 9 C.V. 8.2

Labs Eliminated: 407, 840, 1466

**CCRL Proficiency Sample Program
Fineness - Air Permeability
PORTLAND CEMENT Samples No. 195 and No. 196**



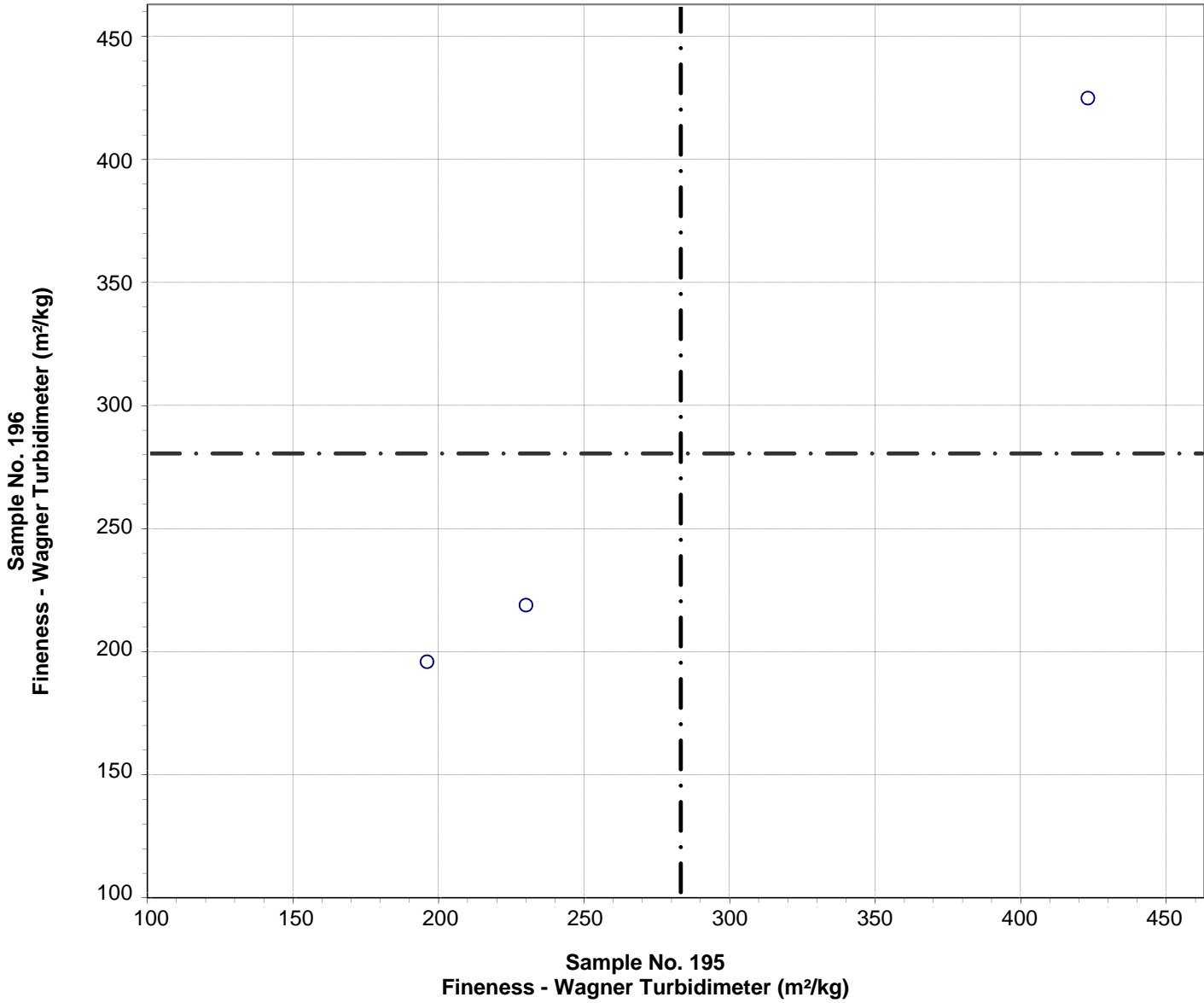
Test No. 270 Fineness - Air Permeability 232 Points

Sample No. 195 Ave 426 S.D. 12 C.V. 2.8

Sample No. 196 Ave 417 S.D. 12 C.V. 3.0

Labs Eliminated: 15, 51, 78, 99, 116, 137, 143, 360, 3850

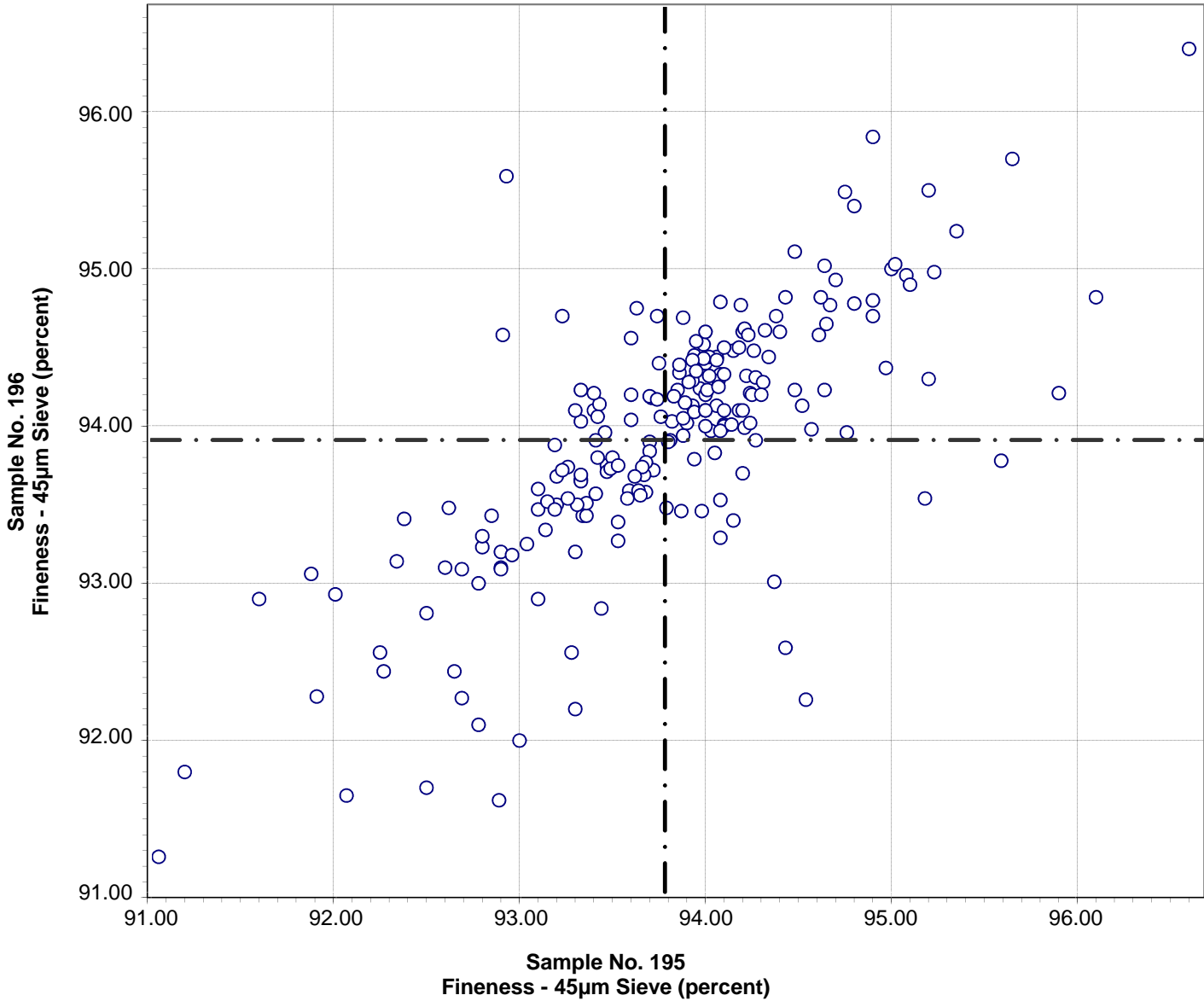
**CCRL Proficiency Sample Program
Fineness - Wagner Turbidimeter
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 280 Fineness - Wagner Turbidimeter 3 Points

Sample No. 195	Ave 283	S.D. 122	C.V. 43.3
Sample No. 196	Ave 280	S.D. 126	C.V. 45.0

**CCRL Proficiency Sample Program
Fineness - 45 μ m Sieve
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 281 Fineness - 45 μ m Sieve 212 Points

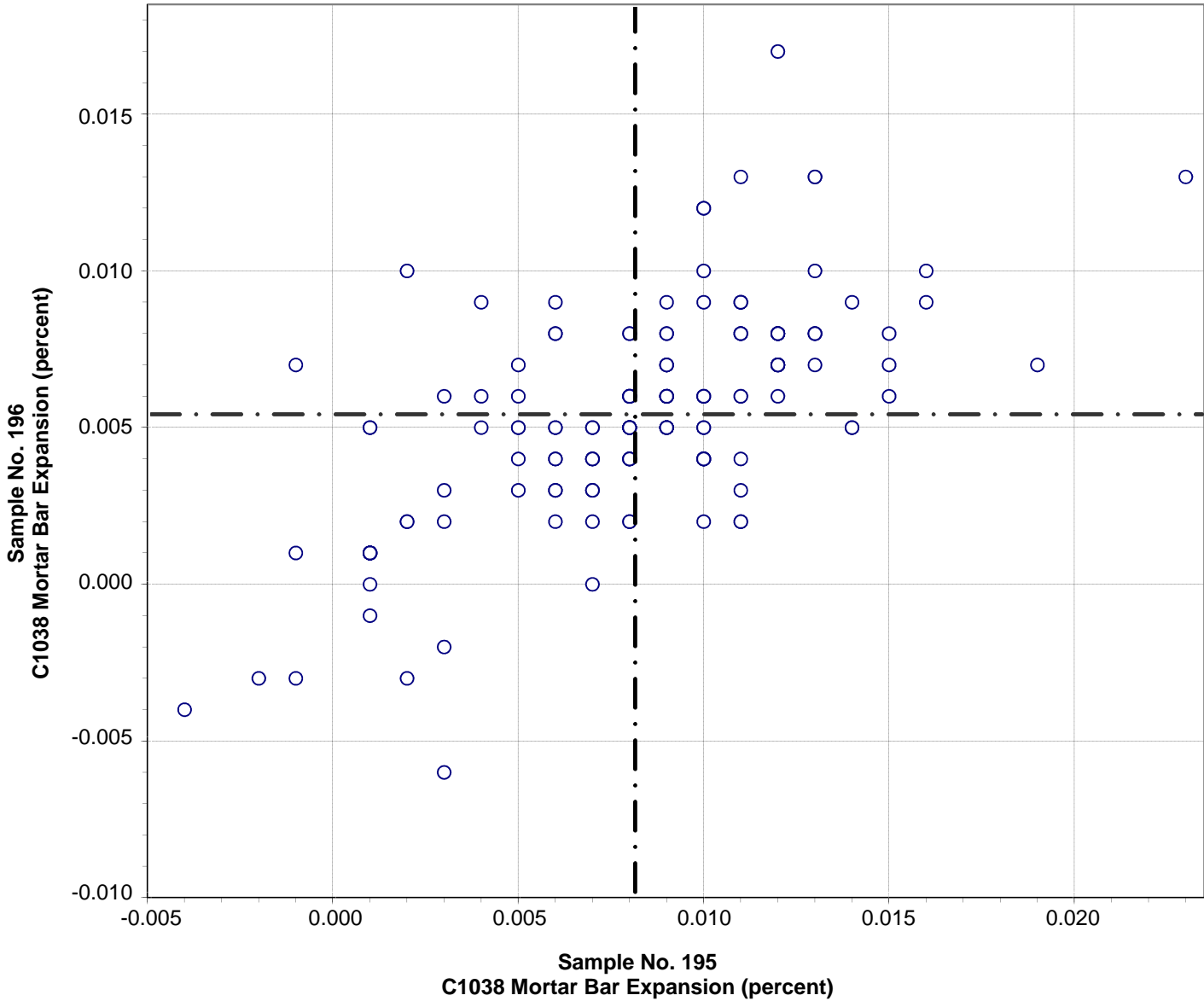
Sample No. 195 Ave 93.78 S.D. 0.84 C.V. 0.89

Sample No. 196 Ave 93.90 S.D. 0.84 C.V. 0.90

Labs Eliminated: 3, 26, 50, 95, 99, 205, 360, 502, 690, 2484, 3752

Labs off Diagram: 515, 3144

**CCRL Proficiency Sample Program
C1038 Mortar Bar Expansion
PORTLAND CEMENT Samples No. 195 and No. 196**



Test No. 400 C1038 Mortar Bar Expansion 147 Points

Sample No. 195	Ave 0.008	S.D. 0.004	C.V. 53
Sample No. 196	Ave 0.005	S.D. 0.003	C.V. 64

Labs Eliminated: 26, 36, 49, 101, 151, 491, 494, 667, 2483, 3607

CCRL PROFICIENCY SAMPLE PROGRAM
 Portland Cement Proficiency Samples No. 195 and No. 196

Final Report – Heat of Hydration Results
 March 20, 2015

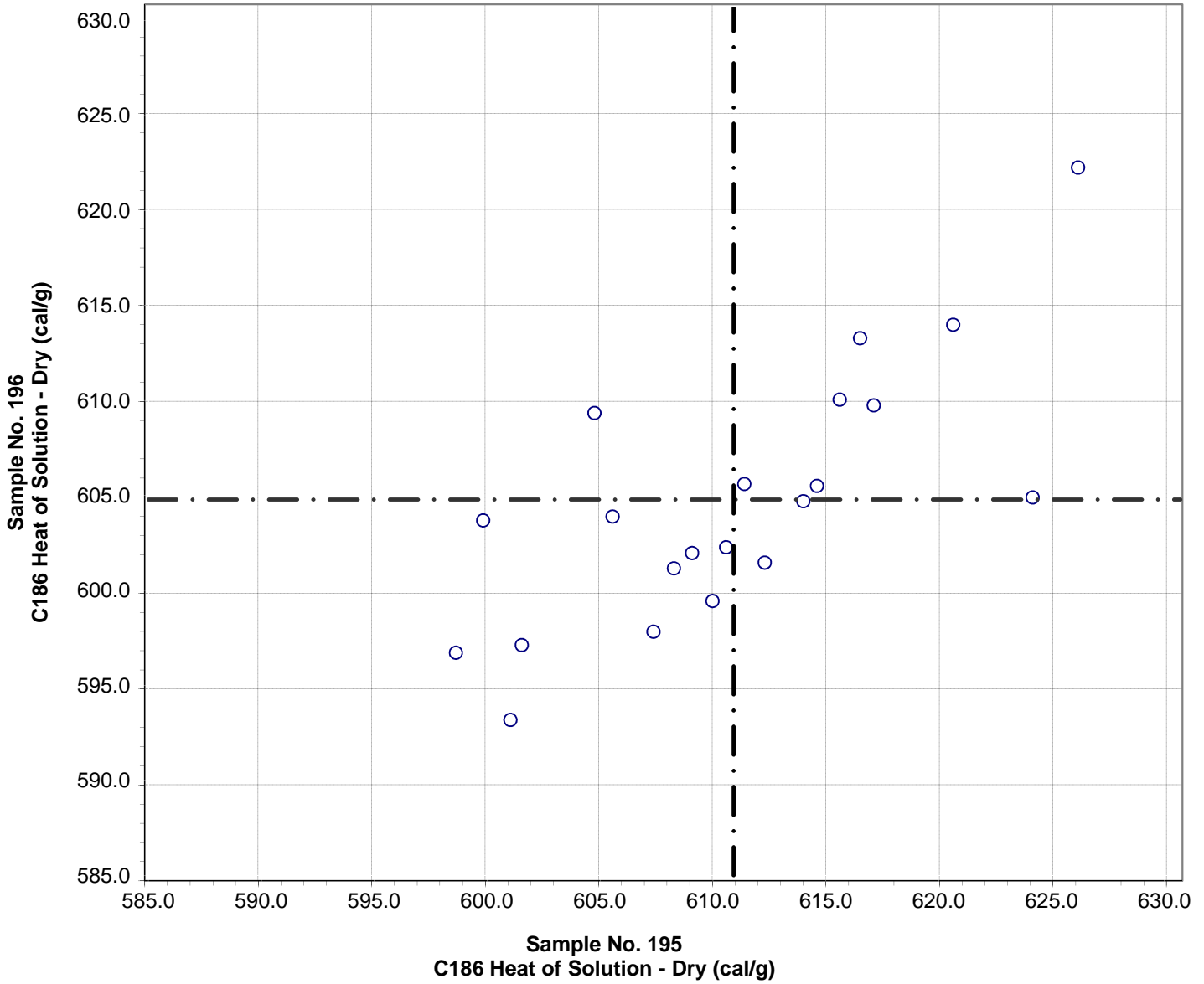
SUMMARY OF RESULTS

Sample No.195

Sample No. 196

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
C186 Heat of Solution - Dry (cal/g)							
	24	603.0	28.6	4.7	584.0	74.3	12.7
	*21	611.0	7.6	1.2	605.0	6.7	1.1
* Labs Eliminated - 176, 491, 2293							
C186 Heat of Solution - 7 day (cal/g)							
	23	521.0	28.2	5.4	516.7	23.0	4.4
	*22	526.5	11.2	2.1	520.8	11.5	2.2
* Labs Eliminated - 491							
C186 Heat of Solution 28 day (cal/g)							
	17	513.5	15.4	3.0	513.0	10.7	2.1
	*15	518.4	7.2	1.4	515.7	6.3	1.2
* Labs Eliminated - 110, 2293							
C186 Heat of Hydration - 7 day (cal/g)							
	27	82.1	7.7	9.4	83.4	9.6	11.5
	*24	83.9	4.7	5.6	81.2	4.9	6.1
* Labs Eliminated - 1644, 2293, 3057							
C186 Heat of Hydration - 28 day (cal/g)							
	20	95.0	8.0	8.4	92.0	5.4	5.9
	*18	93.9	4.7	5.0	91.0	3.5	3.9
* Labs Eliminated - 110, 1799							
C1702 Heat of Hydration - 3 day (J/g)							
	6	320	12	3.8	325	18	5.6
No Labs Eliminated for This Test							
C1702 Heat of Hydration - 7 day (J/g)							
	6	378	19	5.0	364	23	6.2
No Labs Eliminated for This Test							

**CCRL Proficiency Sample Program
C186 Heat of Solution - Dry
PORTLAND CEMENT Samples No. 195 and No. 196**



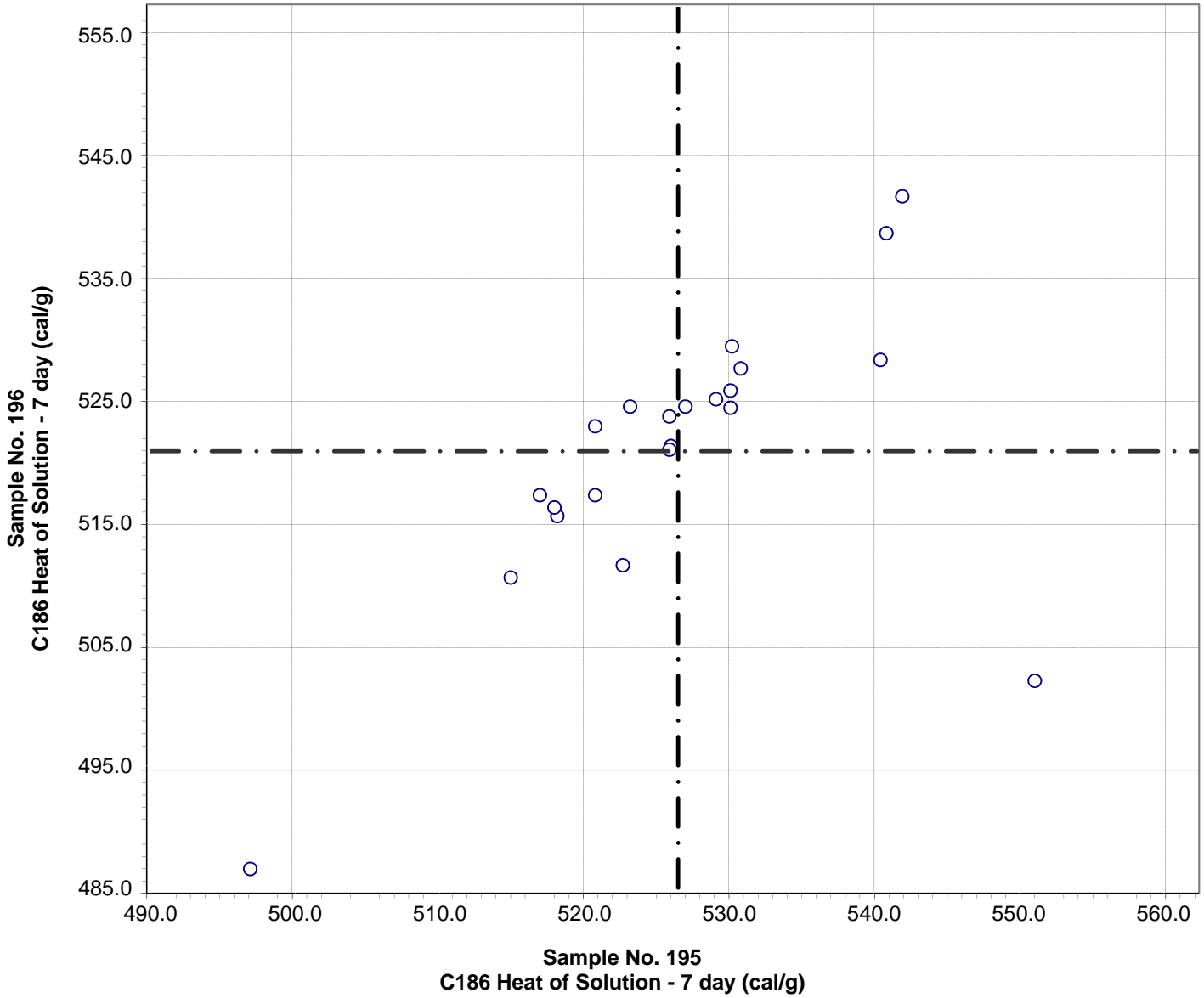
Test No. 291 C186 Heat of Solution - Dry 21 Points

Sample No. 195 Ave 611.0 S.D. 7.6 C.V. 1.2

Sample No. 196 Ave 605.0 S.D. 6.7 C.V. 1.1

Labs Eliminated: 176, 491, 2293

**CCRL Proficiency Sample Program
C186 Heat of Solution - 7 day
PORTLAND CEMENT Samples No. 195 and No. 196**

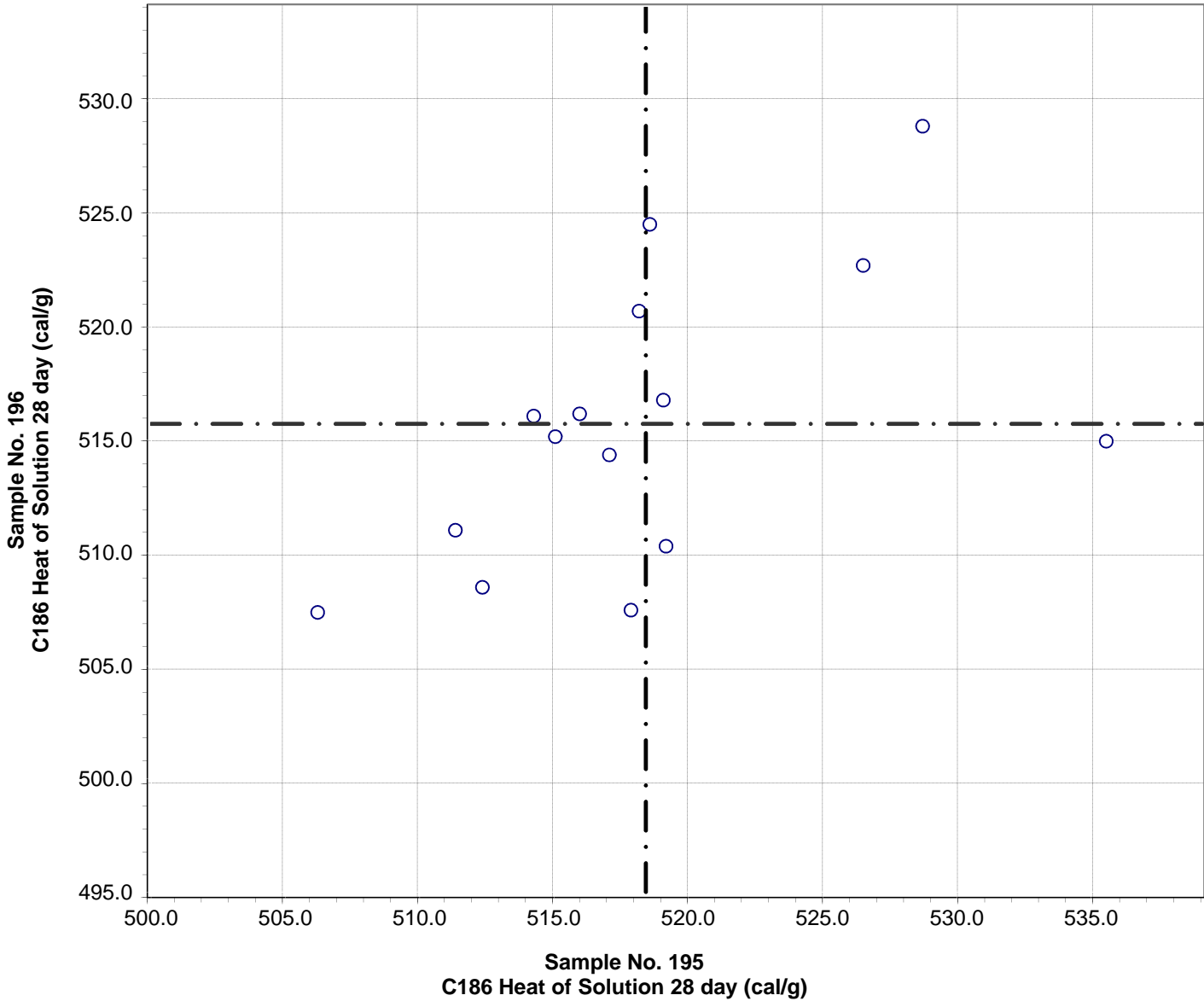


Test No. 292 C186 Heat of Solution - 7 day 22 Points

Sample No. 195	Ave 526.5	S.D. 11.2	C.V. 2.1
Sample No. 196	Ave 520.8	S.D. 11.5	C.V. 2.2

Labs Eliminated: 491

**CCRL Proficiency Sample Program
C186 Heat of Solution 28 day
PORTLAND CEMENT Samples No. 195 and No. 196**

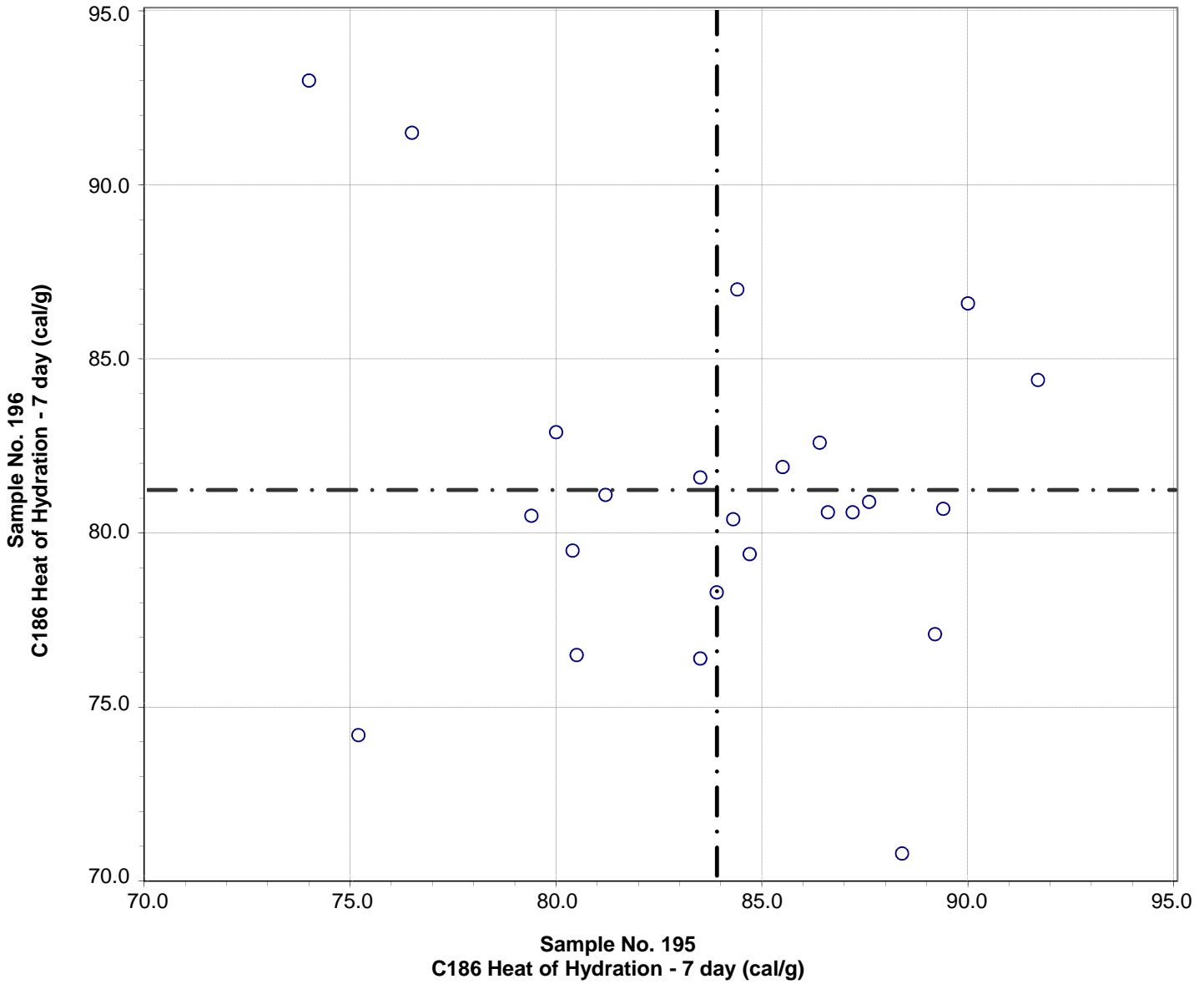


Test No. 301 C186 Heat of Solution 28 day 15 Points

Sample No. 195	Ave 518.4	S.D. 7.2	C.V. 1.4
Sample No. 196	Ave 515.7	S.D. 6.3	C.V. 1.2

Labs Eliminated: 110, 2293

CCRL Proficiency Sample Program
C186 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 195 and No. 196



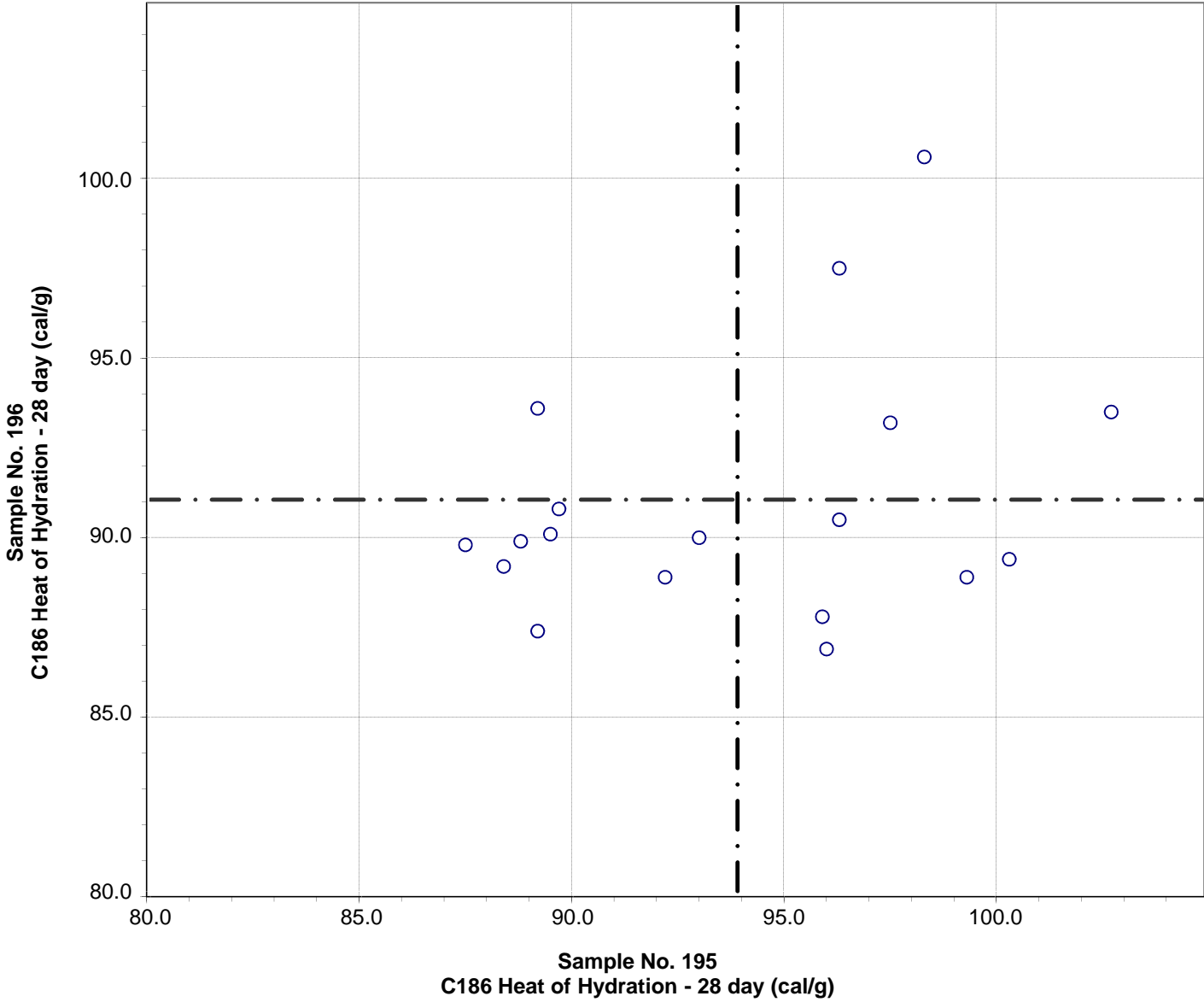
Test No. 290 C186 Heat of Hydration - 7 day 24 Points

Sample No. 195 Ave 83.9 S.D. 4.7 C.V. 5.6

Sample No. 196 Ave 81.2 S.D. 4.9 C.V. 6.1

Labs Eliminated: 1644, 2293, 3057

**CCRL Proficiency Sample Program
C186 Heat of Hydration - 28 day
PORTLAND CEMENT Samples No. 195 and No. 196**



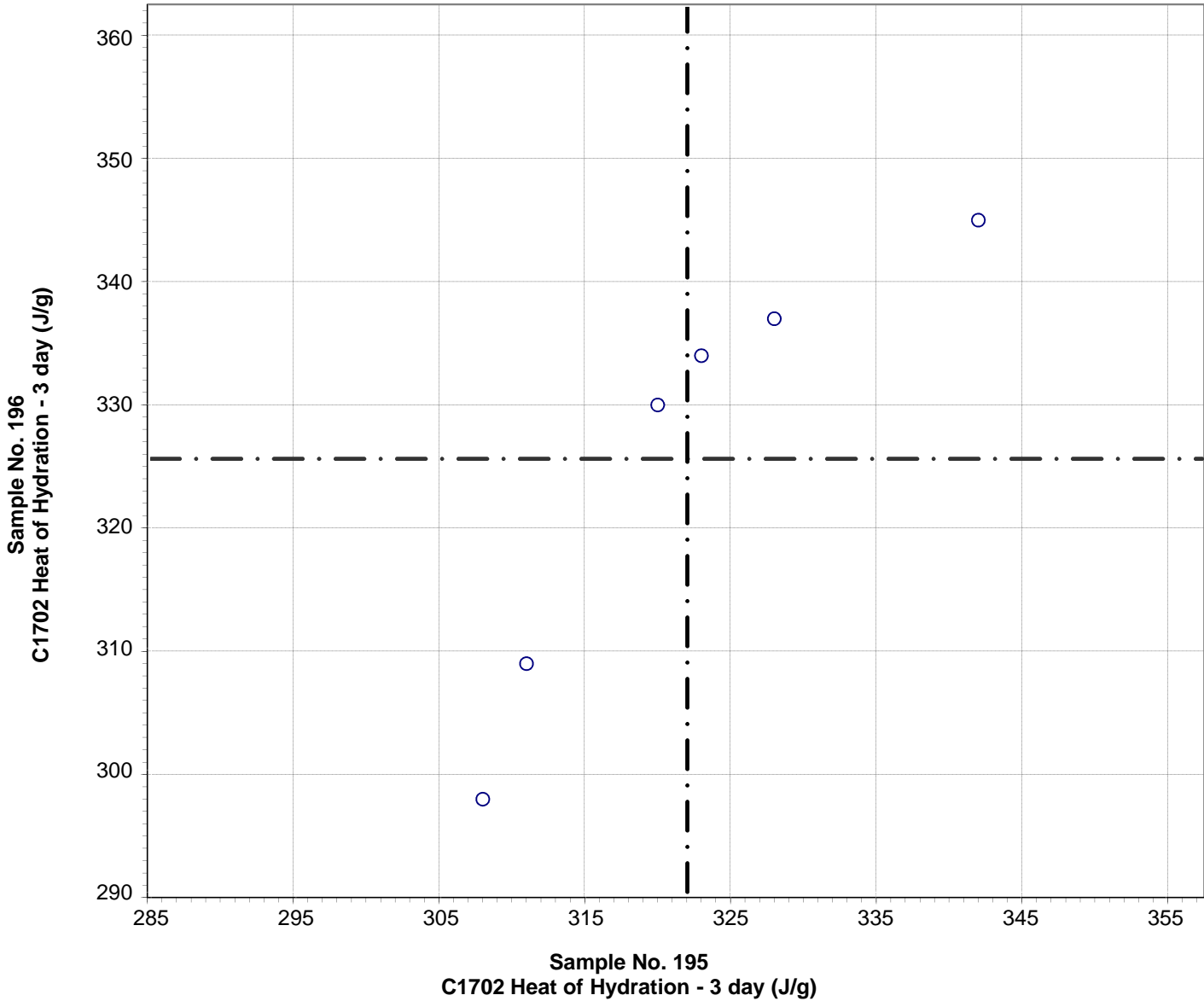
Test No. 300 C186 Heat of Hydration - 28 day 18 Points

Sample No. 195 Ave 93.9 S.D. 4.7 C.V. 5.0

Sample No. 196 Ave 91.0 S.D. 3.5 C.V. 3.9

Labs Eliminated: 110, 1799

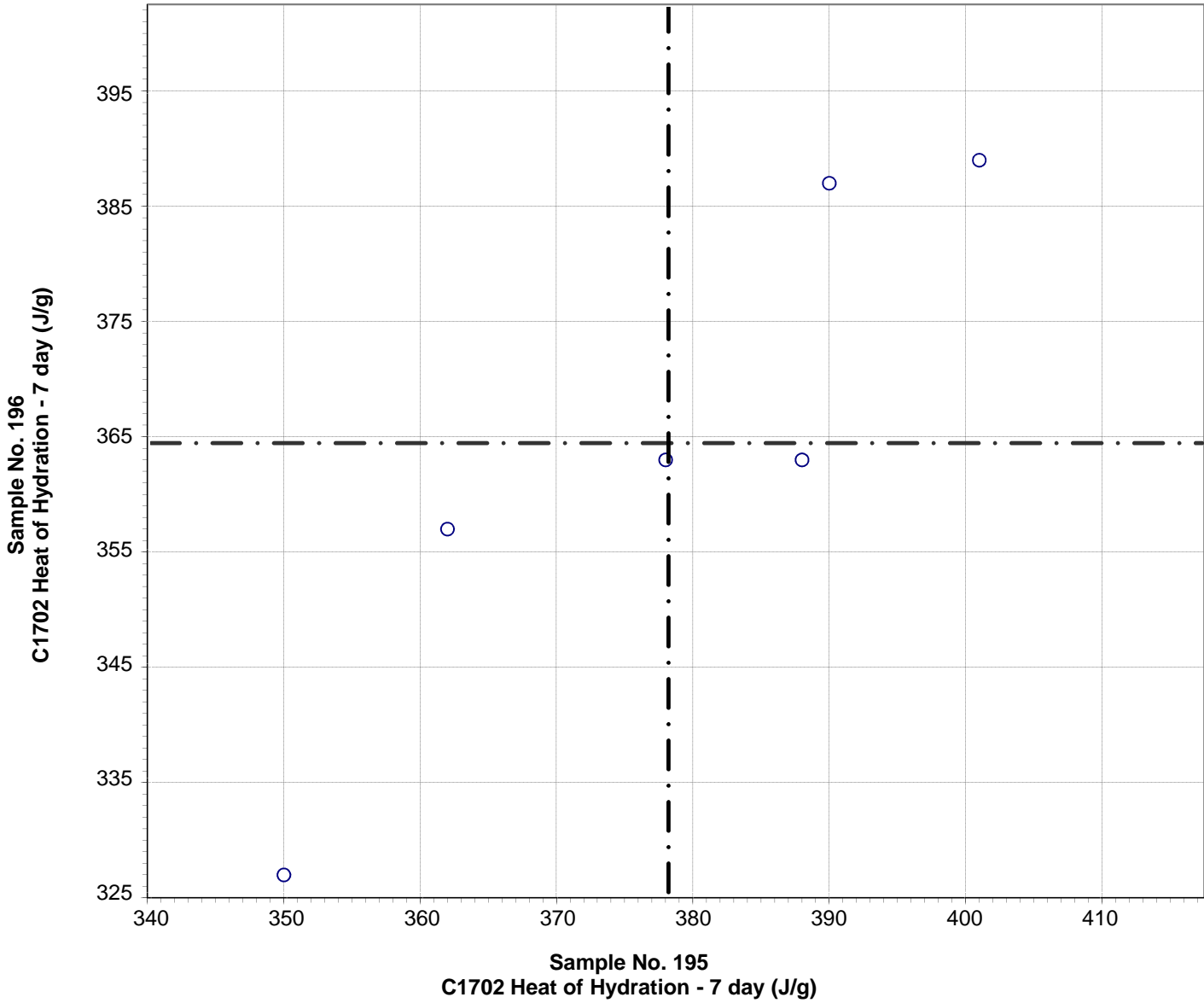
CCRL Proficiency Sample Program
C1702 Heat of Hydration - 3 day
PORTLAND CEMENT Samples No. 195 and No. 196



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

Sample No. 195	Ave 320	S.D. 12	C.V. 3.8
Sample No. 196	Ave 325	S.D. 18	C.V. 5.6

**CCRL Proficiency Sample Program
C1702 Heat of Hydration - 7 day
PORTLAND CEMENT Samples No. 195 and No. 196**



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

Sample No. 195	Ave 378	S.D. 19	C.V. 5.0
Sample No. 196	Ave 364	S.D. 23	C.V. 6.2