

**CEMENT AND CONCRETE REFERENCE LABORATORY**  
**PROFICIENCY SAMPLE PROGRAM**

**Final Report**  
**Portland Cement Proficiency Samples**  
**Number 197 and Number 198**

August 2015



August 31, 2015

**To: Participants in the CCRL Portland Cement Proficiency Sample Program**

**SUBJECT: Final Report on Portland Cement Proficiency Samples No. 197 and No. 198**

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in July 2015. Portland Cement Samples No. 197 was an ASTM C150 meeting the specifications of Type I and Type II and contained limestone addition. Portland Cement No. 198 was an ASTM C150 meeting the specifications of Type I and Type II 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.

**False Set Test (ASTM C451):** The final report results (average 45%) show that Portland Cement Sample 197 had false setting tendency. ASTM C451 states that a Remix Penetration can be determined at the option of the operator. We only request Percent Final Penetration test results for CCRL samples and not the Remix Penetration. Laboratory ratings were not assigned for False Set results on Sample 197.

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 2016.

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. 197 and No. 198**

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 July 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 62<sup>nd</sup> 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.

<b>Ratings</b>	<b>Range (Number of Standard Deviations)</b>	<b>Number (Per 100) of Laboratories achieving the rating <sup>1</sup></b>
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  $87.5 \pm 7.5$  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

---

<sup>1</sup>Youden, W.J., "Statistical Aspects of the Cement Testing Program", Volume 59, *Proceedings of the 62<sup>nd</sup> 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  $\pm 1$  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. 197 and No. 198

Final Report – Primary Chemical Results  
 August 31, 2015

SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Silicon Dioxide (percent)</b>							
	218	19.27	0.29	1.51	20.06	0.27	1.32
	*205	19.23	0.19	0.99	20.05	0.17	0.84
* Labs Eliminated - 8, 24, 43, 50, 93, 206, 975, 1644, 2305, 2462, 3059, 4040, 4042							
<b>Aluminum Oxide (percent)</b>							
	217	4.81	0.15	3.1	4.82	0.13	2.7
	*210	4.82	0.13	2.6	4.83	0.10	2.2
* Labs Eliminated - 26, 42, 219, 611, 819, 2463, 3948							
<b>Ferric Oxide (percent)</b>							
	217	3.44	0.09	2.5	3.93	0.09	2.2
	*207	3.44	0.05	1.6	3.94	0.06	1.5
* Labs Eliminated - 8, 24, 34, 42, 50, 206, 440, 2955, 3752, 3819							
<b>Calcium Oxide (percent)</b>							
	217	64.39	0.46	0.71	63.88	0.46	0.72
	*214	64.38	0.42	0.65	63.87	0.42	0.66
* Labs Eliminated - 975, 3368, 3819							
<b>Magnesium Oxide (percent)</b>							
	217	1.47	0.10	6.7	1.16	0.09	8.0
	*203	1.47	0.06	3.8	1.15	0.05	4.5
* Labs Eliminated - 1, 8, 24, 64, 95, 176, 181, 206, 883, 1644, 1956, 2463, 2491, 3279							
<b>Sulfur Trioxide (percent)</b>							
	221	2.95	0.11	3.6	3.00	0.09	3.1
	*212	2.95	0.07	2.3	3.00	0.07	2.3
* Labs Eliminated - 24, 35, 50, 116, 690, 2360, 2477, 3819, 4042							
<b>Loss on Ignition (percent)</b>							
	225	2.32	0.15	6.7	2.31	0.13	5.7
	*210	2.30	0.10	4.2	2.29	0.08	3.6
* Labs Eliminated - 34, 47, 116, 137, 146, 181, 203, 221, 493, 691, 736, 2253, 2522, 3235, 4042							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

Final Report – Primary Chemical Results  
 August 31, 2015

SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Sodium Oxide (percent)</b>							
	207	0.176	0.051	29	0.078	0.080	102
	*195	0.172	0.028	17	0.066	0.026	40
* Labs Eliminated - 23, 24, 50, 56, 975, 1956, 2305, 2462, 2484, 2490, 3368, 4042							
<b>Potassium Oxide (percent)</b>							
	213	0.527	0.037	7.0	0.452	0.047	10.4
	*202	0.531	0.015	2.9	0.457	0.013	2.8
* Labs Eliminated - 8, 24, 46, 255, 450, 975, 1644, 2462, 3059, 3235, 3605							
<b>Strontium Oxide (percent)</b>							
	91	0.082	0.021	26	0.054	0.019	34
	*81	0.084	0.006	7	0.054	0.004	8
* Labs Eliminated - 3, 4, 7, 24, 137, 407, 1657, 1956, 2296, 3607							
<b>Titanium Dioxide (percent)</b>							
	174	0.27	0.014	5.2	0.32	0.023	7.2
	*164	0.27	0.008	3.0	0.32	0.010	3.2
* Labs Eliminated - 24, 137, 181, 246, 457, 494, 1956, 2484, 3607, 4042							
<b>Phosphorus Pentoxide (percent)</b>							
	165	0.221	0.024	11.0	0.113	0.020	17.7
	*146	0.221	0.009	3.9	0.112	0.006	5.2
* Labs Eliminated - 10, 24, 27, 56, 134, 139, 407, 413, 494, 692, 1956, 2412, 2462, 2463, 2466, 3235, 3606, 3607, 3807							
<b>Zinc Oxide (percent)</b>							
	91	0.103	0.025	24.4	0.085	0.022	25.8
	*84	0.109	0.008	7.3	0.090	0.007	8.0
* Labs Eliminated - 7, 95, 2296, 2463, 2484, 3607, 4051							
<b>Manganic Oxide (percent)</b>							
	138	0.090	0.009	9.6	0.074	0.010	13.1
	*127	0.089	0.004	4.2	0.073	0.004	5.6

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

Final Report – Primary Chemical Results  
 August 31, 2015

SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
-------------	-------	---------	------	------	---------	------	------

\* Labs Eliminated - 18, 24, 151, 205, 354, 413, 457, 768, 2466, 3279, 3297

**Chloride (percent)**

118	0.016	0.020	124	0.007	0.009	133
*112	0.013	0.005	41	0.005	0.003	62

\* Labs Eliminated - 101, 206, 493, 692, 1942, 3368

**Insoluble Residue (percent)**

205	0.25	0.11	44	0.22	0.11	48
*197	0.24	0.09	37	0.21	0.09	42

\* Labs Eliminated - 50, 497, 691, 2466, 2955, 2982, 3415, 4040

**Free Lime (percent)**

170	1.31	0.28	21	0.70	0.23	33
*160	1.31	0.24	18	0.68	0.17	25

\* Labs Eliminated - 56, 124, 126, 175, 181, 690, 691, 3297, 3415, 4051

**Carbon Dioxide (percent)**

184	1.30	0.30	23.4	1.52	0.27	18.0
*161	1.32	0.18	13.3	1.55	0.12	7.6

\* Labs Eliminated - 15, 24, 34, 50, 54, 66, 146, 203, 221, 254, 255, 440, 692, 886, 1251, 1644, 2363, 2466, 3233, 3415, 3658, 3752, 4040

**Limestone Content (percent)**

183	3.2	0.8	23.8	3.5	0.7	18.4
*171	3.3	0.5	16.8	3.6	0.4	10.2

\* Labs Eliminated - 15, 24, 66, 254, 692, 886, 1644, 2363, 3233, 3415, 3658, 4040

**Chromium Oxide (percent)**

87	0.021	0.007	33	0.010	0.005	48
*81	0.021	0.004	21	0.010	0.004	38

\* Labs Eliminated - 66, 151, 157, 247, 684, 2296

**Tricalcium Silicate (percent)**

192	65.2	4.0	6.2	53.8	4.9	9.1
-----	------	-----	-----	------	-----	-----

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

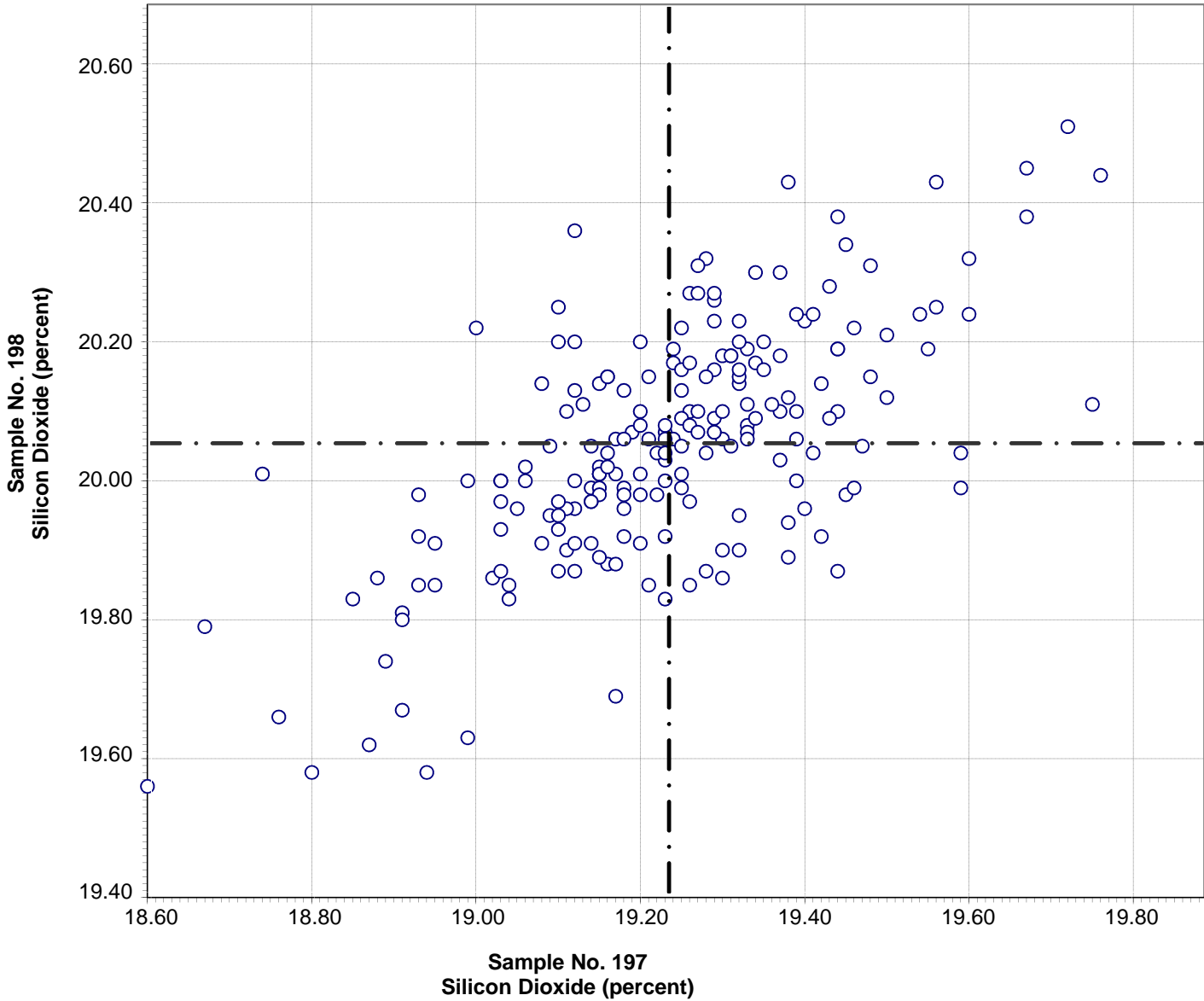
Final Report – Primary Chemical Results  
 August 31, 2015

SUMMARY OF RESULTS

Test (unit)	Sample No.197				Sample No. 198		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
	*188	65.2	3.4	5.2	53.7	4.4	8.1
	* Labs Eliminated - 8, 24, 50, 691						
<b>Dicalcium Silicate (percent)</b>							
	192	6.0	3.4	56.7	16.9	3.8	22.7
	*184	6.0	2.6	44.3	16.9	3.5	20.5
	* Labs Eliminated - 24, 50, 56, 124, 157, 159, 691, 1644						
<b>Tricalcium Aluminate (percent)</b>							
	192	6.9	0.5	7.9	6.1	0.4	6.7
	*188	6.9	0.4	5.5	6.1	0.3	5.5
	* Labs Eliminated - 7, 24, 42, 691						
<b>Tetracalcium Aluminoferrite (percent)</b>							
	192	10.4	0.3	2.8	11.9	0.4	3.6
	*184	10.4	0.2	2.0	12.0	0.2	1.9
	* Labs Eliminated - 7, 8, 24, 34, 50, 440, 2484, 2490						



**CCRL Proficiency Sample Program  
Silicon Dioxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

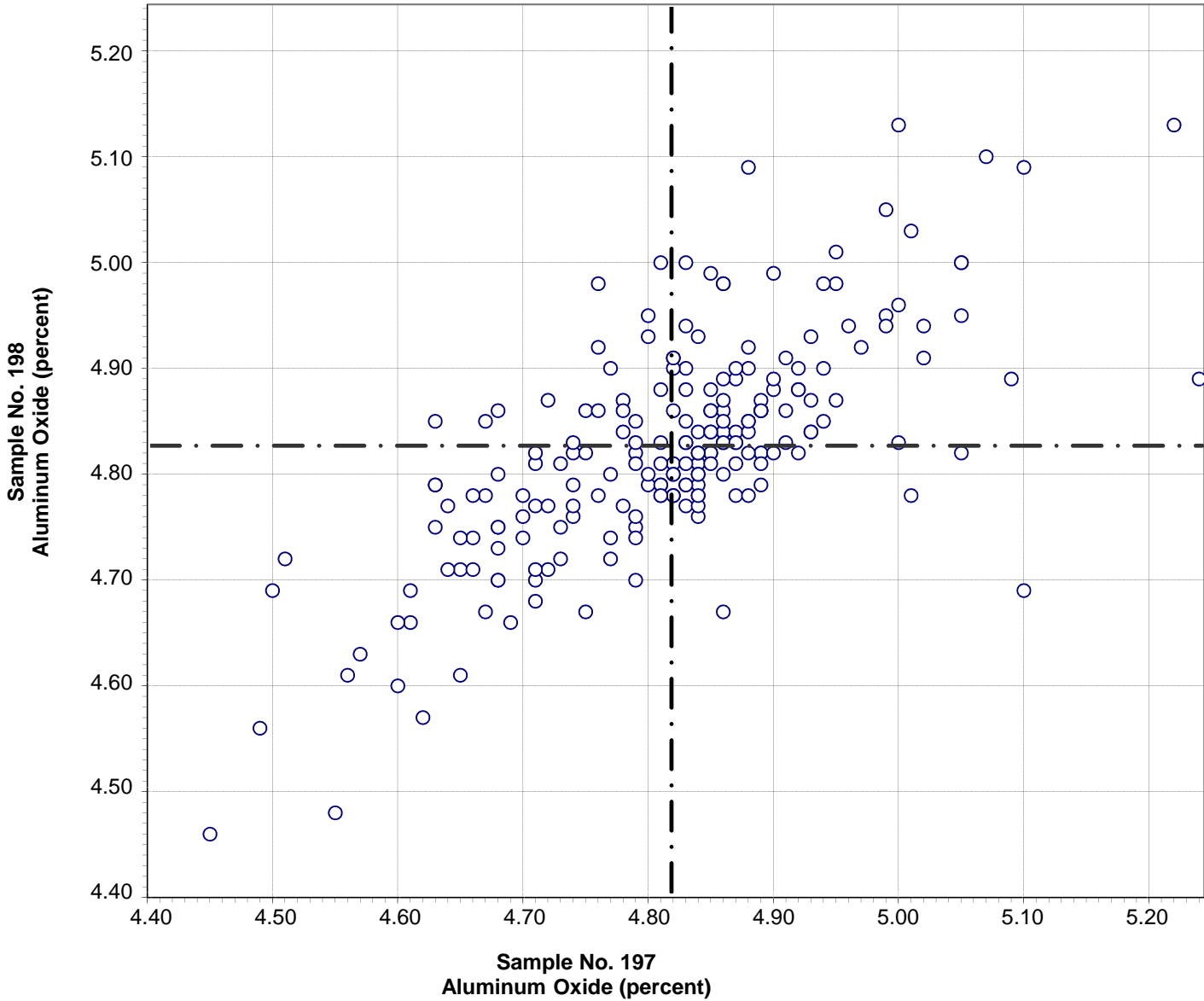


**Test No. 10   Silicon Dioxide   205 Points**

Sample No. 197	Ave 19.23	S.D. 0.19	C.V. 0.99
Sample No. 198	Ave 20.05	S.D. 0.17	C.V. 0.84

Labs Eliminated: 8, 24, 43, 50, 93, 206, 975, 1644, 2305, 2462, 3059, 4040, 4042

**CCRL Proficiency Sample Program  
Aluminum Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

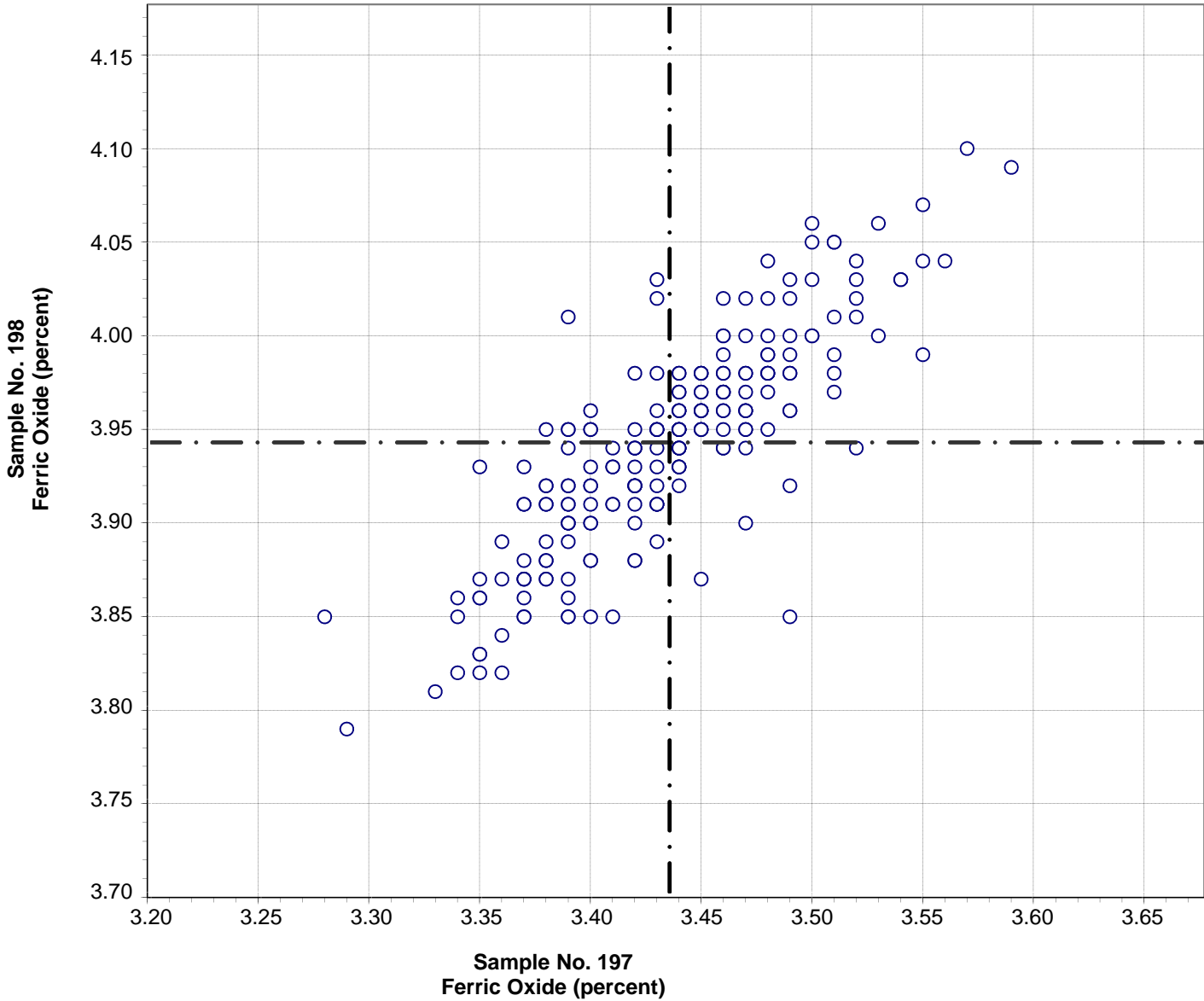


Test No. 21    Aluminum Oxide    210 Points

Sample No. 197	Ave 4.82	S.D. 0.13	C.V. 2.6
Sample No. 198	Ave 4.83	S.D. 0.10	C.V. 2.2

Labs Eliminated: 26, 42, 219, 611, 819, 2463, 3948

**CCRL Proficiency Sample Program  
Ferric Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

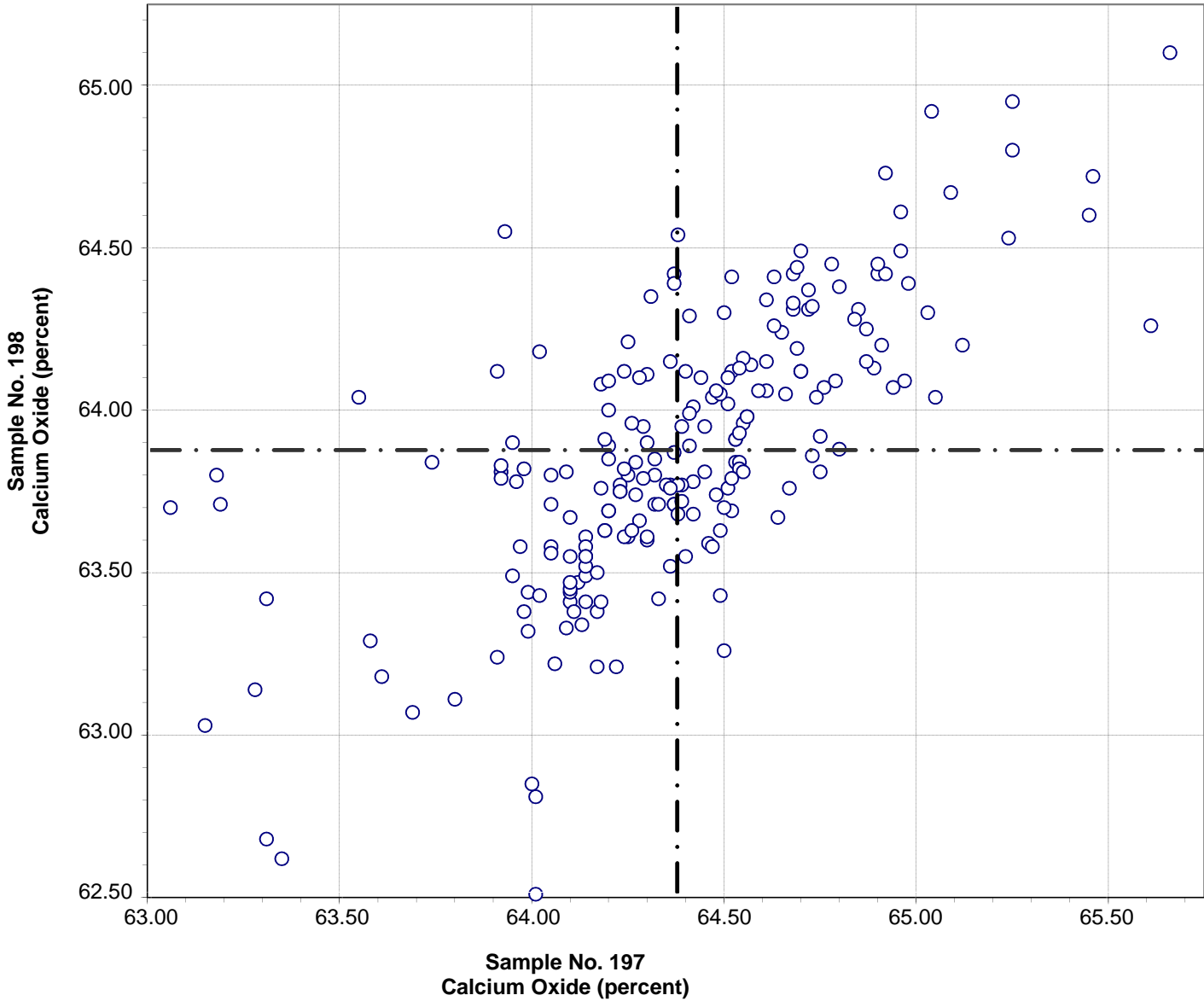


Test No. 30 Ferric Oxide 207 Points

Sample No. 197	Ave 3.44	S.D. 0.05	C.V. 1.6
Sample No. 198	Ave 3.94	S.D. 0.06	C.V. 1.5

Labs Eliminated: 8, 24, 34, 42, 50, 206, 440, 2955, 3752, 3819

**CCRL Proficiency Sample Program  
Calcium Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

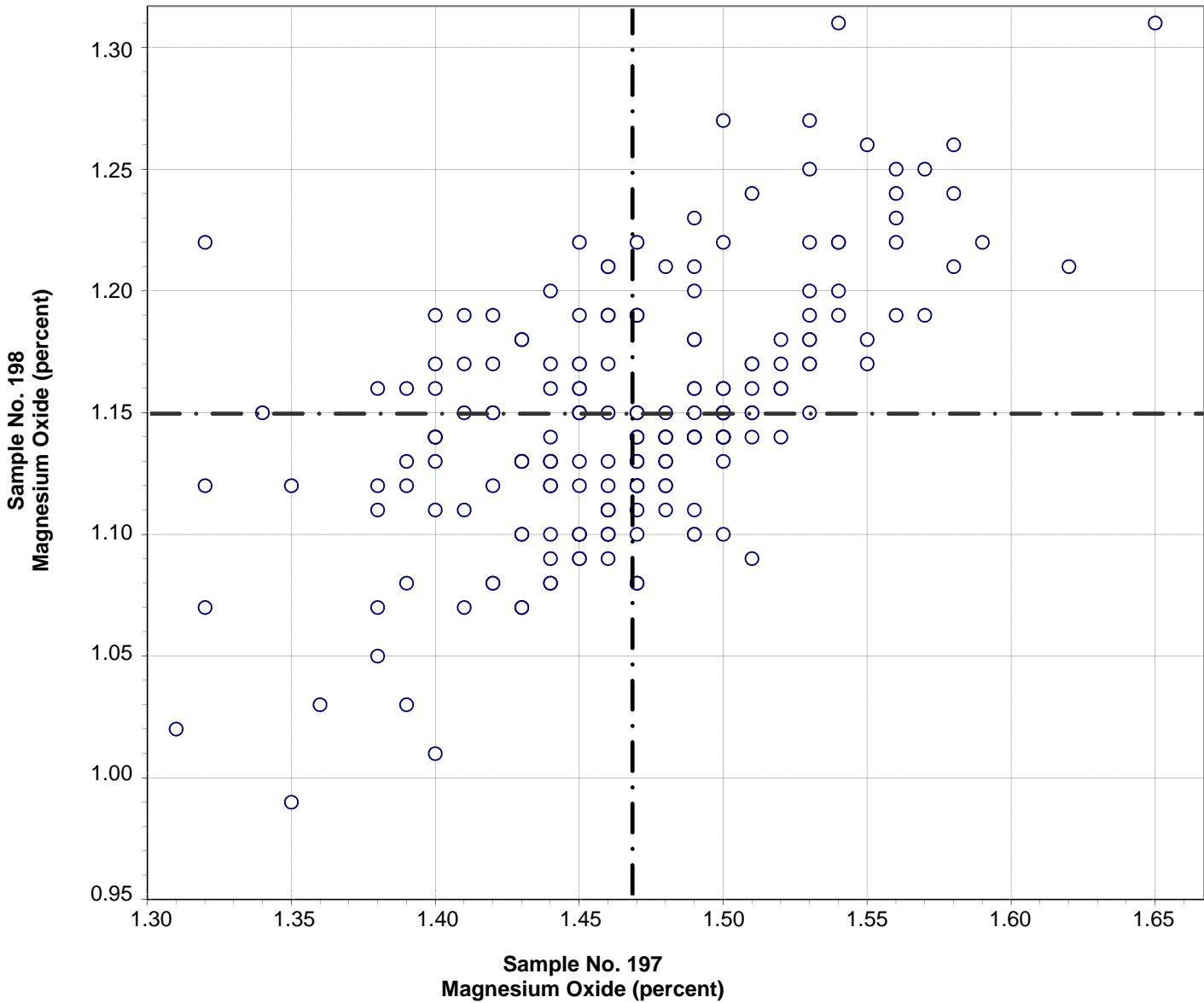


Test No. 40    Calcium Oxide    214 Points

Sample No. 197	Ave 64.38	S.D. 0.42	C.V. 0.65
Sample No. 198	Ave 63.87	S.D. 0.42	C.V. 0.66

Labs Eliminated: 975, 3368, 3819

**CCRL Proficiency Sample Program  
Magnesium Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

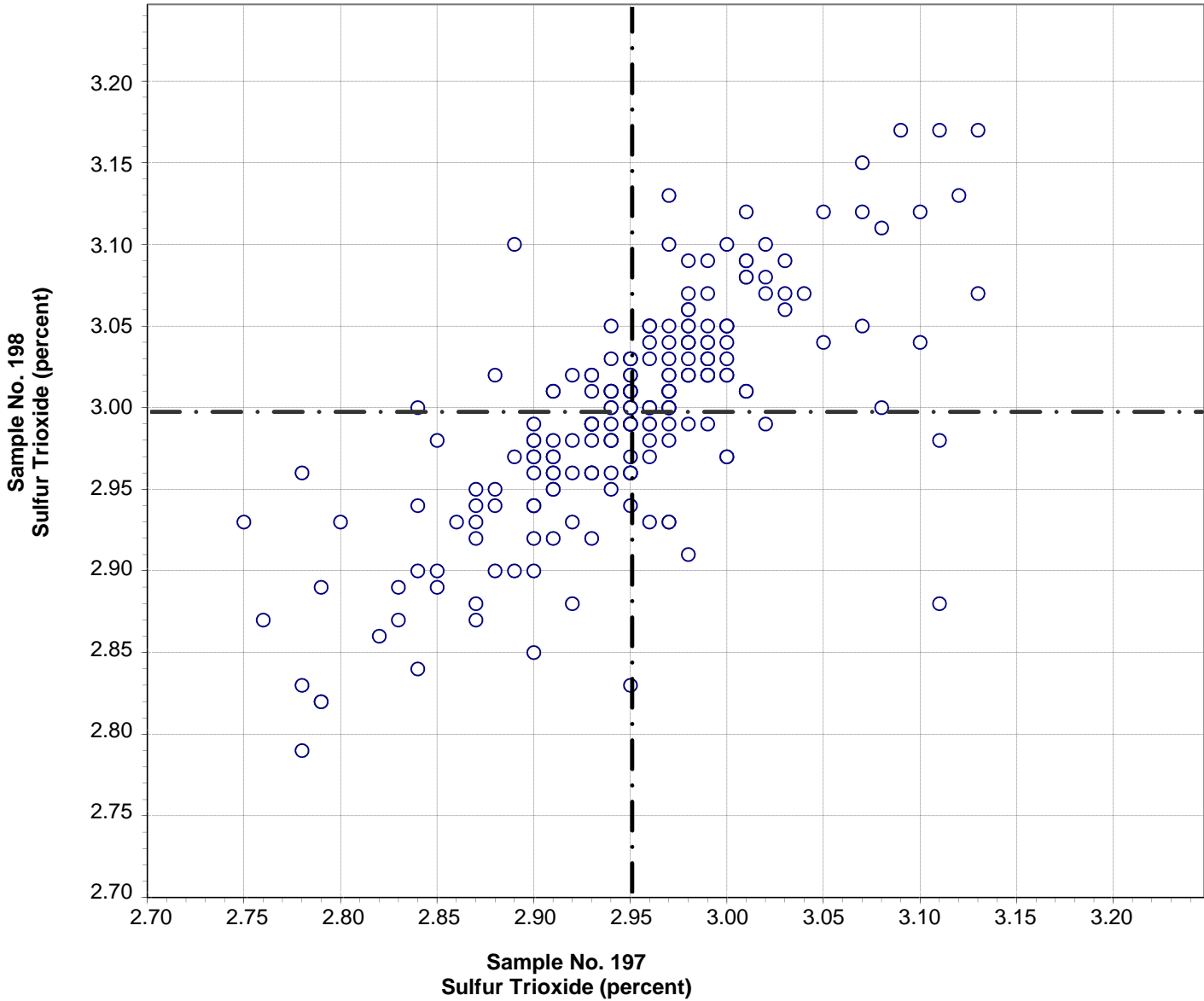


Test No. 50    Magnesium Oxide    203 Points

Sample No. 197	Ave 1.47	S.D. 0.06	C.V. 3.8
Sample No. 198	Ave 1.15	S.D. 0.05	C.V. 4.5

Labs Eliminated: 1, 8, 24, 64, 95, 176, 181, 206, 883, 1644, 1956, 2463, 2491, 3279

**CCRL Proficiency Sample Program  
Sulfur Trioxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

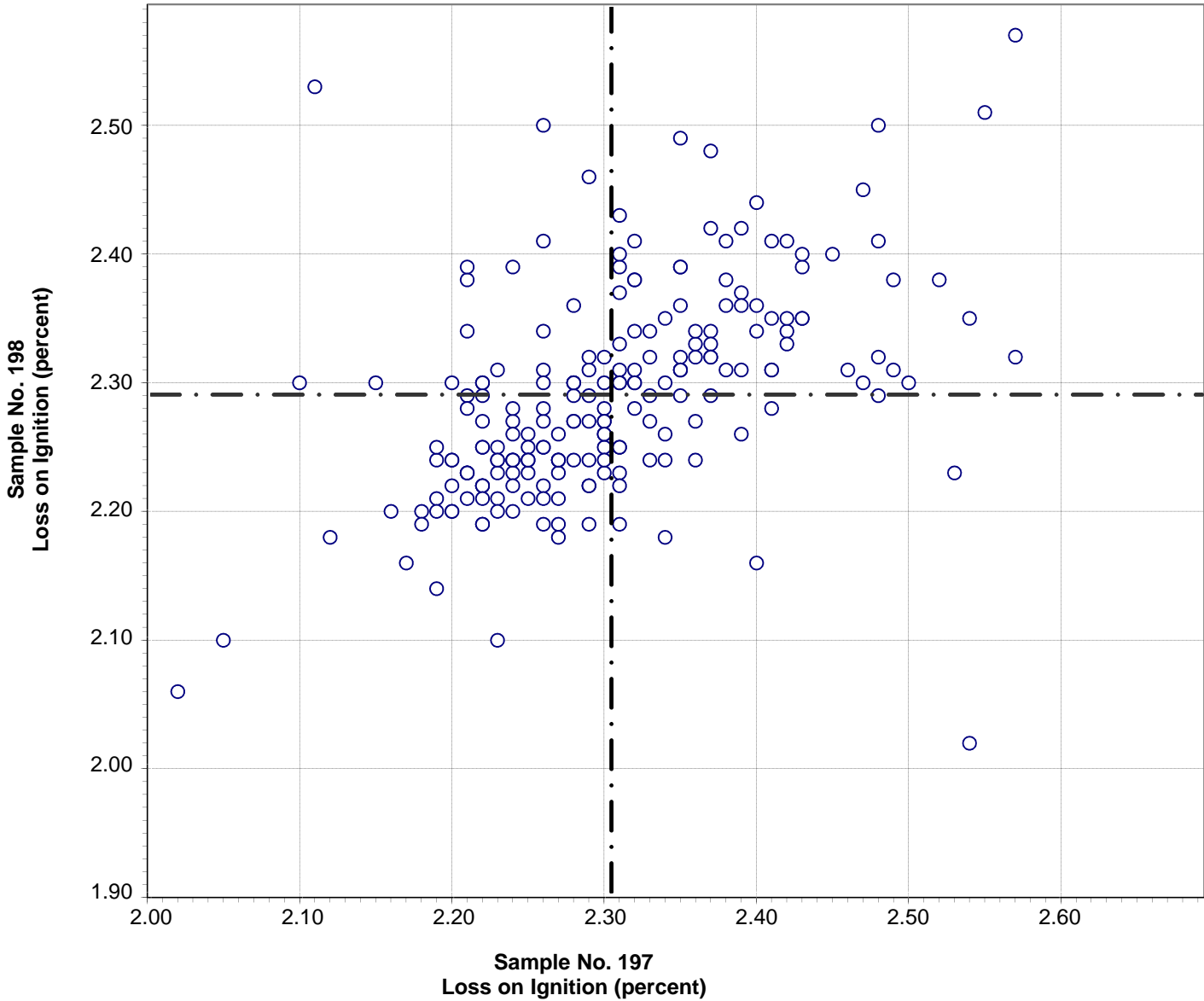


Test No. 60 Sulfur Trioxide 212 Points

Sample No. 197	Ave 2.95	S.D. 0.07	C.V. 2.3
Sample No. 198	Ave 3.00	S.D. 0.07	C.V. 2.3

Labs Eliminated: 24, 35, 50, 116, 690, 2360, 2477, 3819, 4042

**CCRL Proficiency Sample Program  
Loss on Ignition  
PORTLAND CEMENT Samples No. 197 and No. 198**



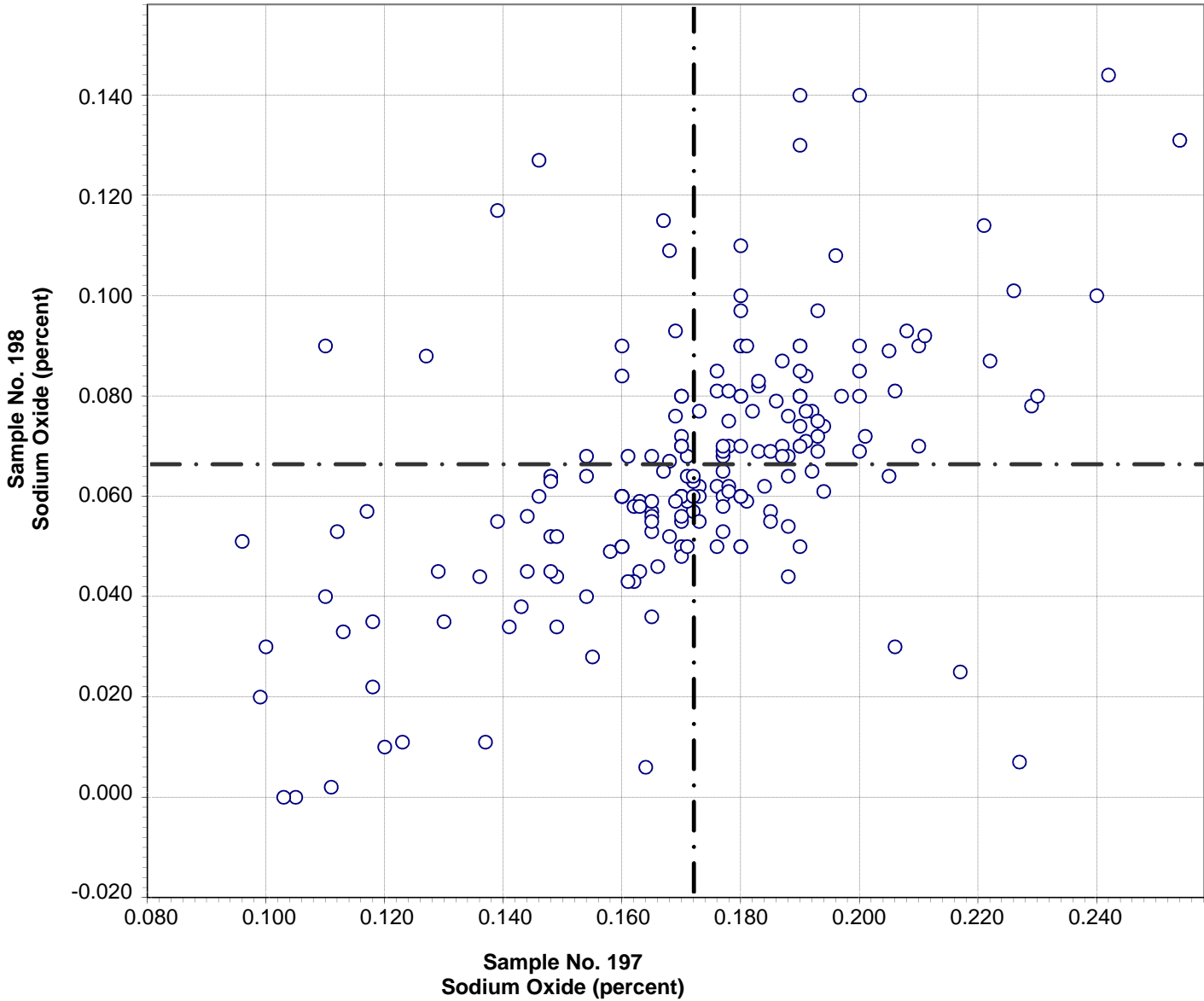
**Test No. 70 Loss on Ignition 209 Points**

Sample No. 197	Ave 2.30	S.D. 0.10	C.V. 4.2
Sample No. 198	Ave 2.29	S.D. 0.08	C.V. 3.6

Labs Eliminated: 34, 47, 116, 137, 146, 181, 203, 221, 493, 691, 736, 2253, 2522, 3235, 4042

Labs off Diagram: 497

**CCRL Proficiency Sample Program  
Sodium Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**



Test No. 90 Sodium Oxide 193 Points

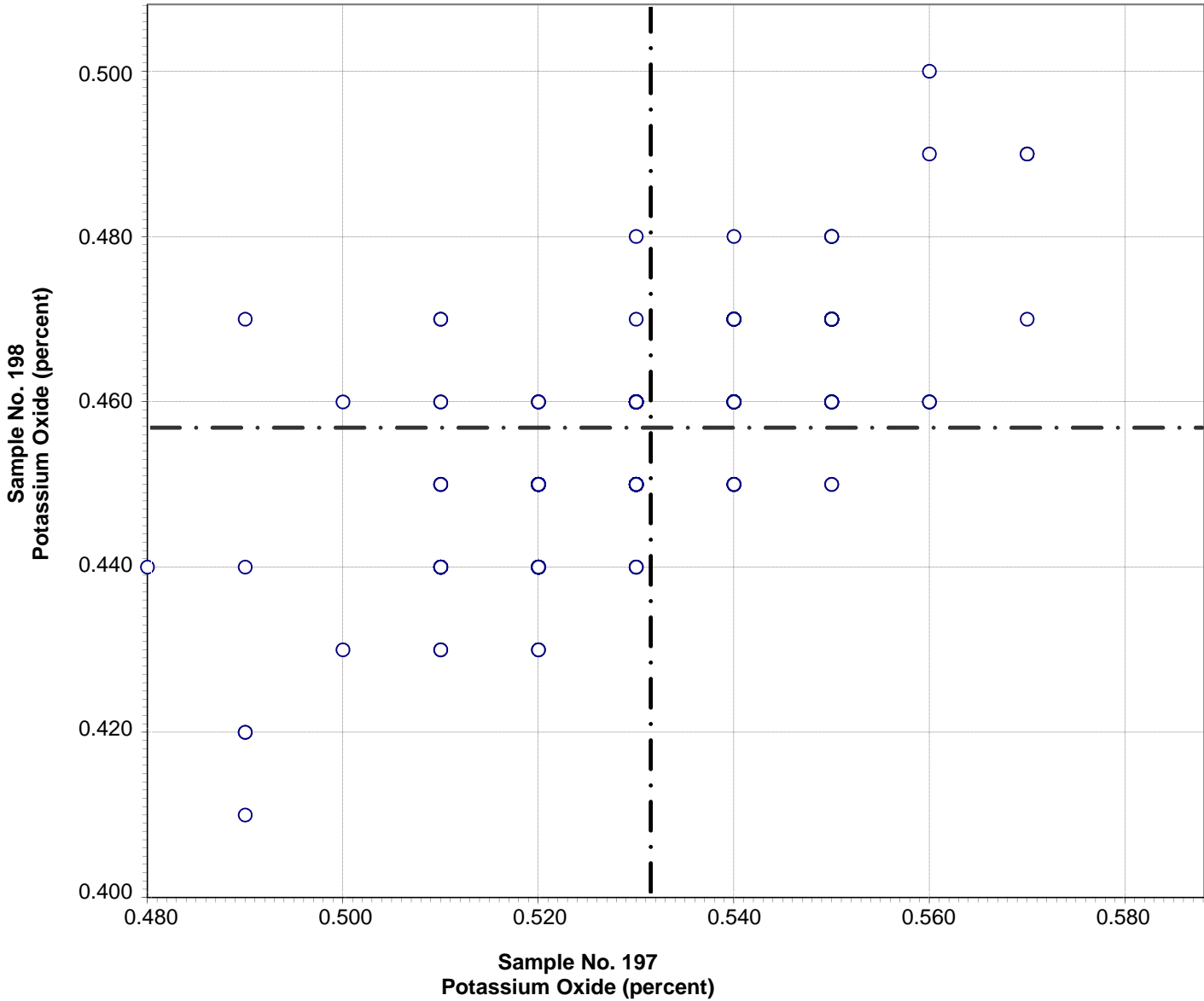
Sample No. 197	Ave 0.172	S.D. 0.028	C.V. 17
Sample No. 198	Ave 0.066	S.D. 0.026	C.V. 40

Labs Eliminated: 23, 24, 50, 56, 975, 1956, 2305, 2462, 2484, 2490, 3368, 4042

Labs off Diagram: 284, 3238



**CCRL Proficiency Sample Program  
Potassium Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

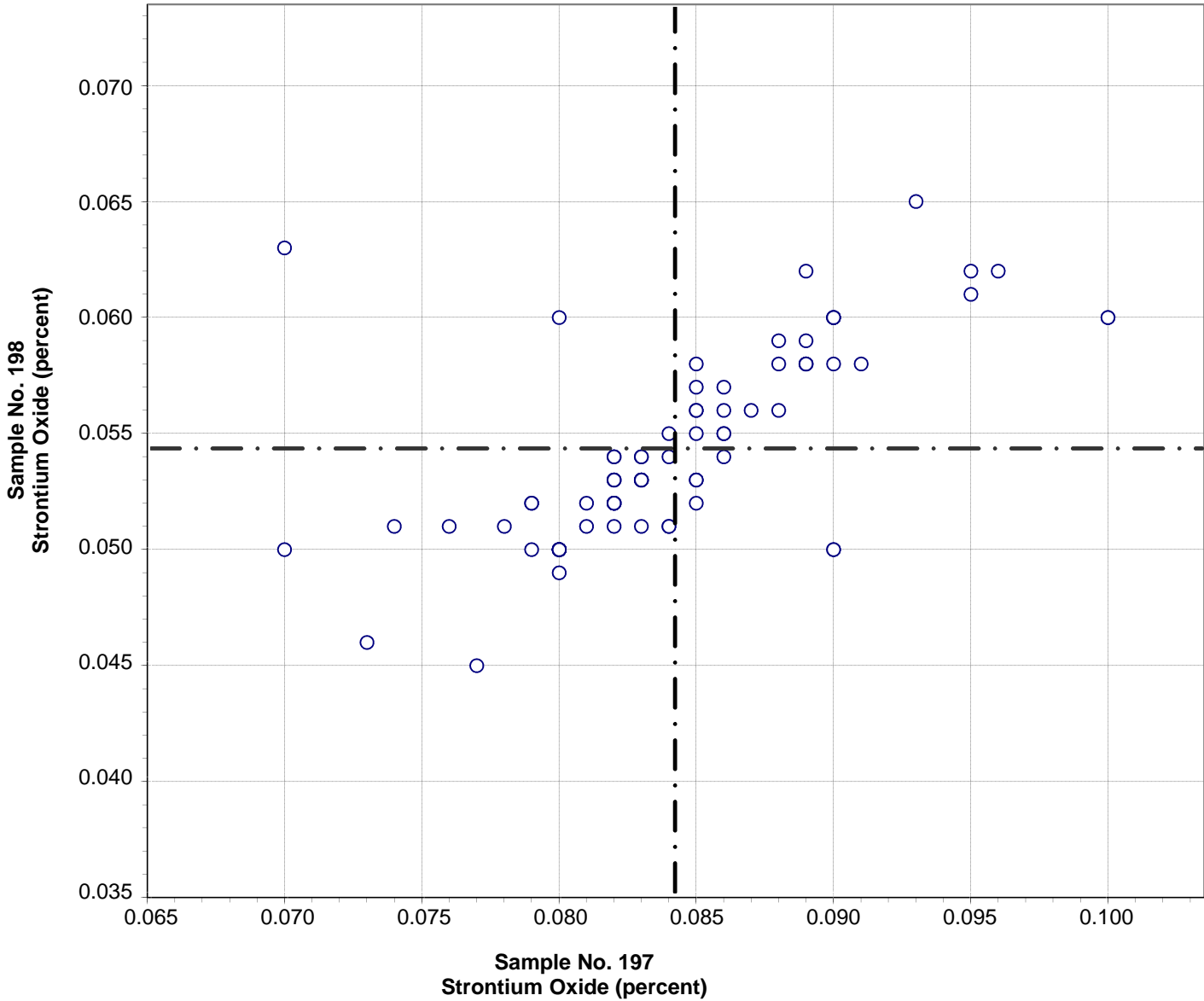


Test No. 100 Potassium Oxide 202 Points

Sample No. 197	Ave 0.531	S.D. 0.015	C.V. 2.9
Sample No. 198	Ave 0.457	S.D. 0.013	C.V. 2.8

Labs Eliminated: 8, 24, 46, 255, 450, 975, 1644, 2462, 3059, 3235, 3605

**CCRL Proficiency Sample Program  
Strontium Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

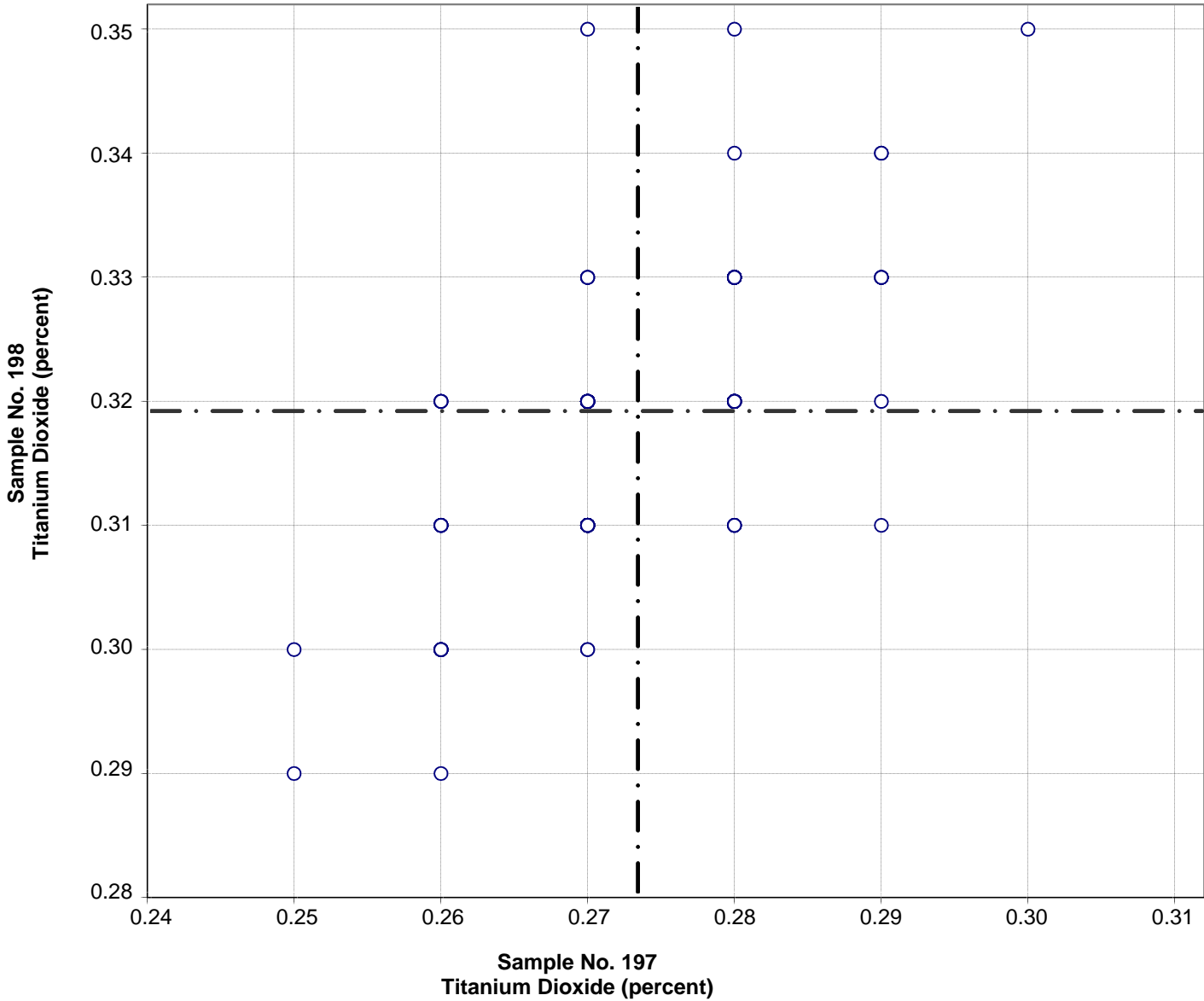


Test No. 92 Strontium Oxide 81 Points

Sample No. 197	Ave 0.084	S.D. 0.006	C.V. 7
Sample No. 198	Ave 0.054	S.D. 0.004	C.V. 8

Labs Eliminated: 3, 4, 7, 24, 137, 407, 1657, 1956, 2296, 3607

**CCRL Proficiency Sample Program  
Titanium Dioxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

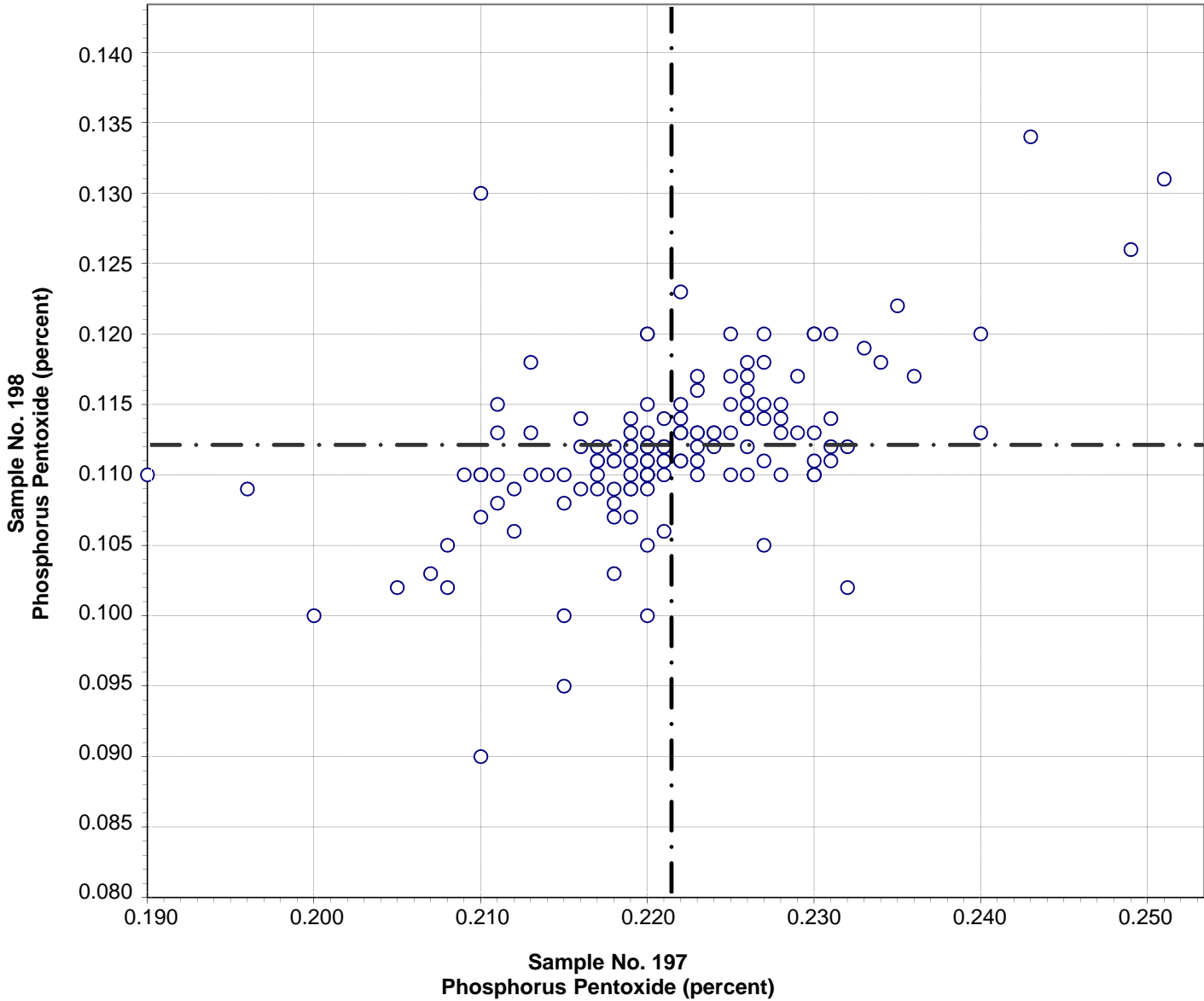


Test No. 103 Titanium Dioxide 164 Points

Sample No. 197	Ave 0.27	S.D. 0.008	C.V. 3.0
Sample No. 198	Ave 0.32	S.D. 0.010	C.V. 3.2

Labs Eliminated: 24, 137, 181, 246, 457, 494, 1956, 2484, 3607, 4042

**CCRL Proficiency Sample Program  
Phosphorus Pentoxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

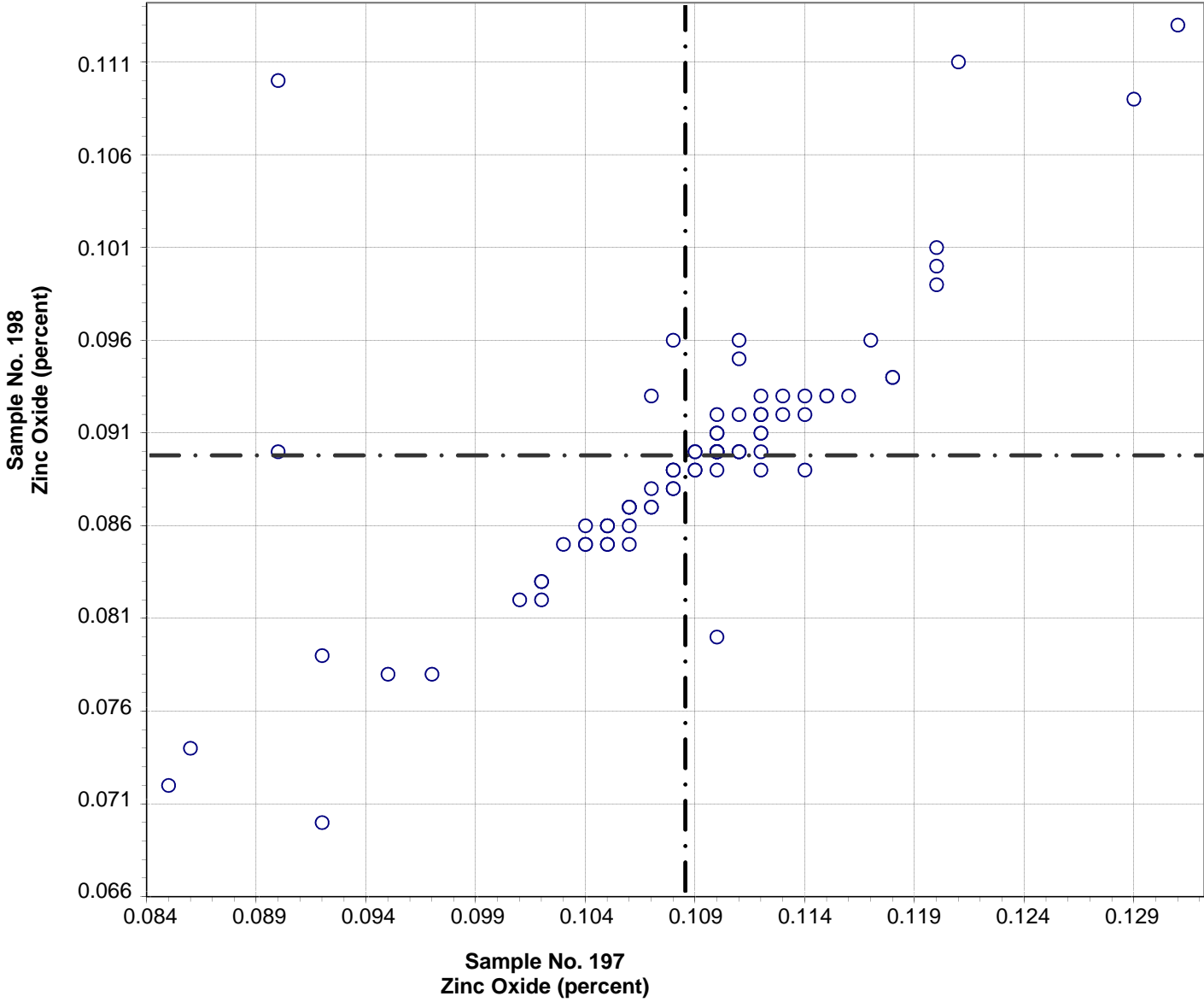


Test No. 102 Phosphorus Pentoxide 146 Points

Sample No. 197	Ave 0.221	S.D. 0.009	C.V. 3.9
Sample No. 198	Ave 0.112	S.D. 0.006	C.V. 5.2

Labs Eliminated: 10, 24, 27, 56, 134, 139, 407, 413, 494, 692, 1956, 2412, 2462, 2463, 2466, 3235, 3606, 3607, 3807

**CCRL Proficiency Sample Program  
Zinc Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

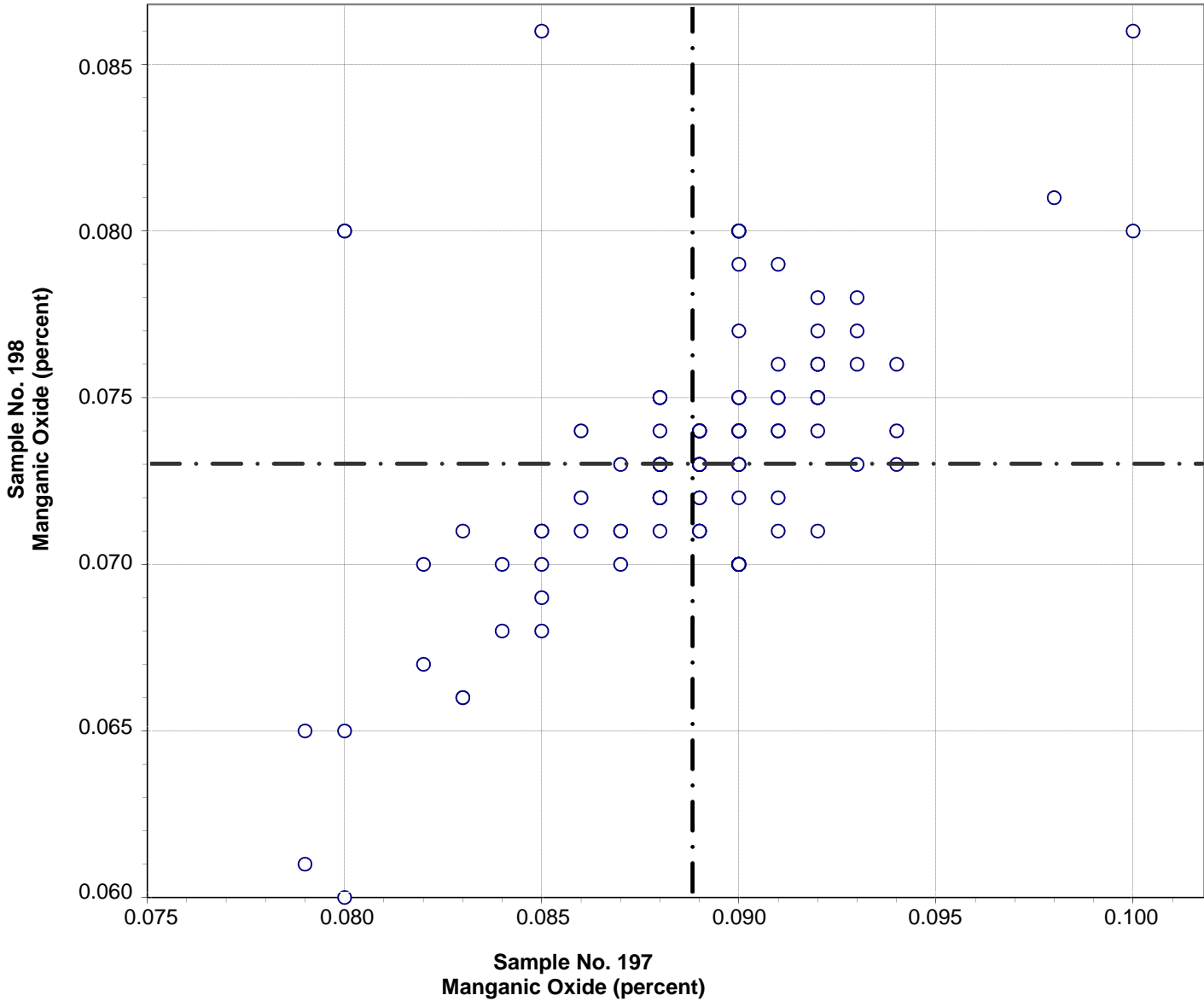


Test No. 99 Zinc Oxide 84 Points

Sample No. 197	Ave 0.109	S.D. 0.008	C.V. 7.3
Sample No. 198	Ave 0.090	S.D. 0.007	C.V. 8.0

Labs Eliminated: 7, 95, 2296, 2463, 2484, 3607, 4051

**CCRL Proficiency Sample Program  
Manganic Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**



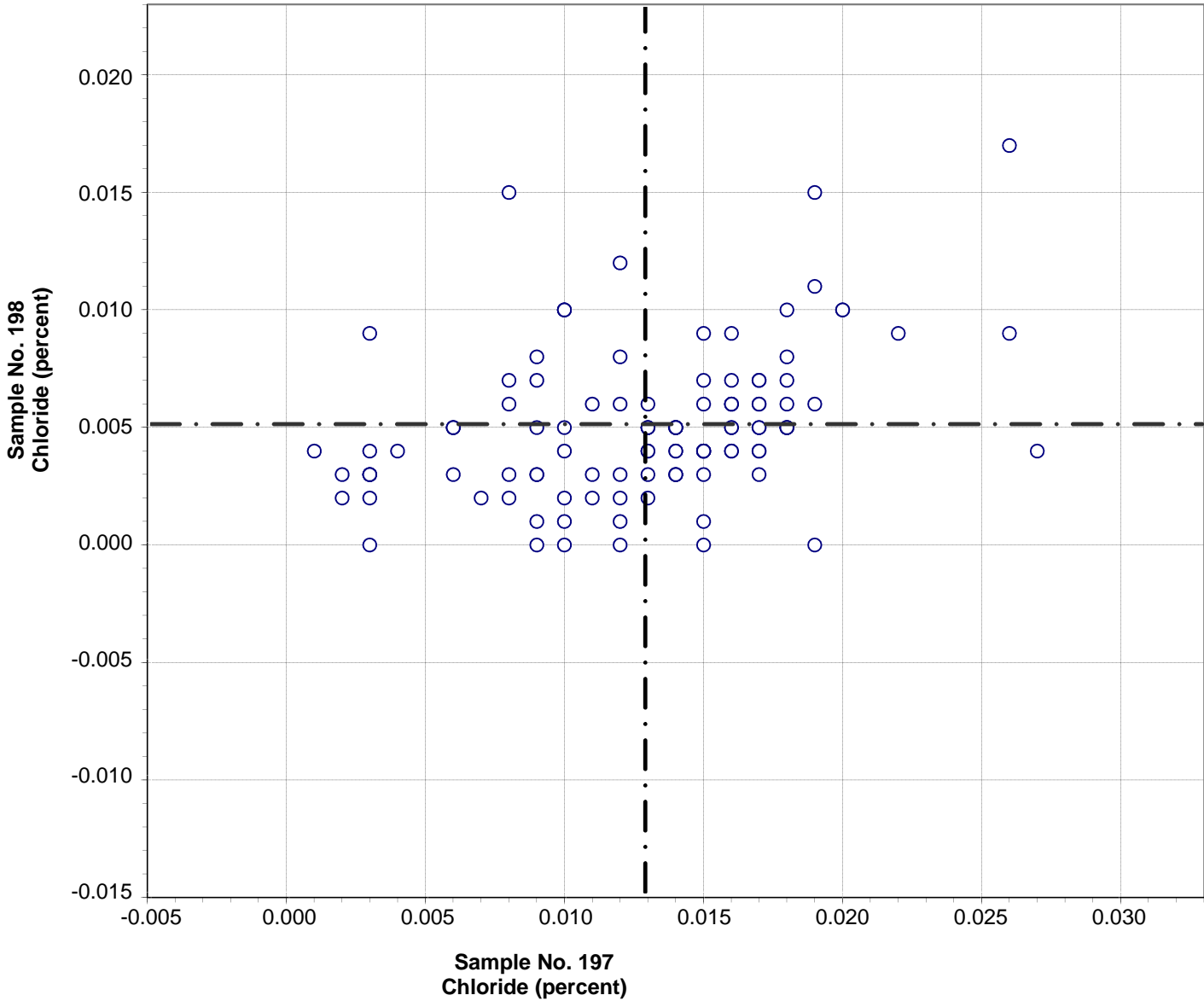
Test No. 101 Manganic Oxide 126 Points

Sample No. 197	Ave 0.089	S.D. 0.004	C.V. 4.2
Sample No. 198	Ave 0.073	S.D. 0.004	C.V. 5.6

Labs Eliminated: 18, 24, 151, 205, 354, 413, 457, 768, 2466, 3279, 3297

Labs off Diagram: 27

**CCRL Proficiency Sample Program  
Chloride  
PORTLAND CEMENT Samples No. 197 and No. 198**

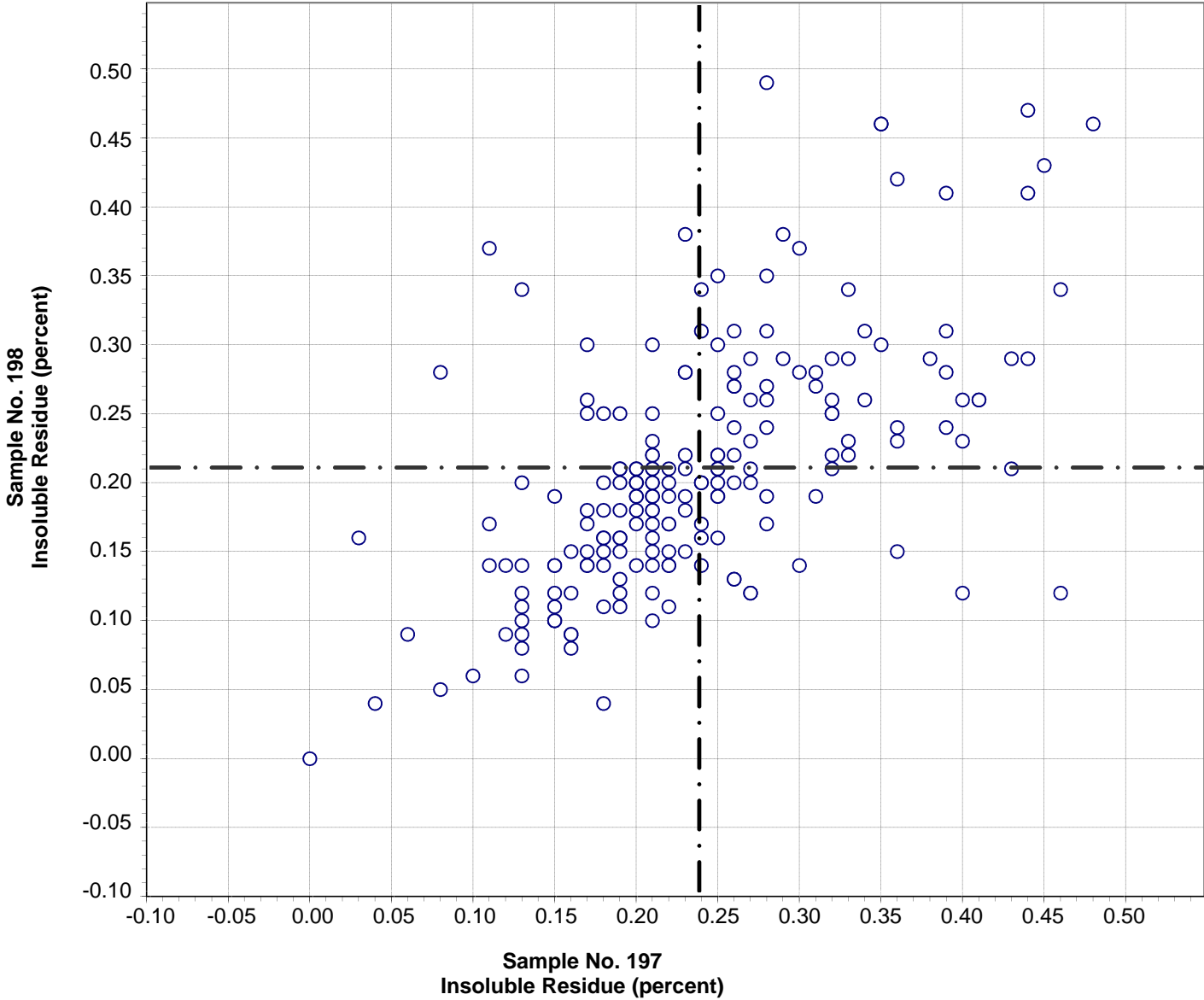


Test No. 104 Chloride 112 Points

Sample No. 197	Ave 0.013	S.D. 0.005	C.V. 41
Sample No. 198	Ave 0.005	S.D. 0.003	C.V. 62

Labs Eliminated: 101, 206, 493, 692, 1942, 3368

**CCRL Proficiency Sample Program  
Insoluble Residue  
PORTLAND CEMENT Samples No. 197 and No. 198**



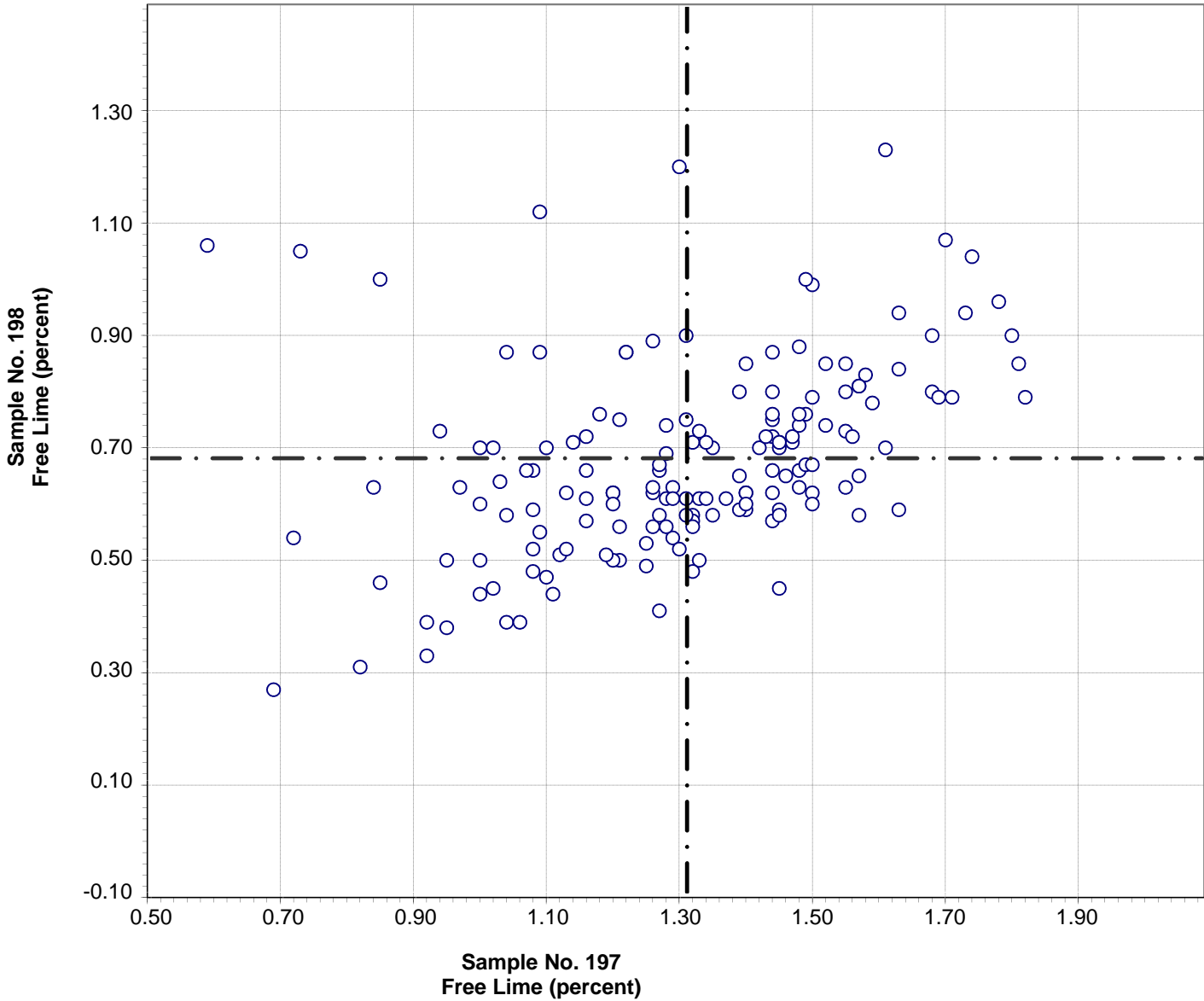
Test No. 80 Insoluble Residue 197 Points

Sample No. 197	Ave 0.24	S.D. 0.09	C.V. 37
Sample No. 198	Ave 0.21	S.D. 0.09	C.V. 42

Labs Eliminated: 50, 497, 691, 2466, 2955, 2982, 3415, 4040



**CCRL Proficiency Sample Program  
Free Lime  
PORTLAND CEMENT Samples No. 197 and No. 198**

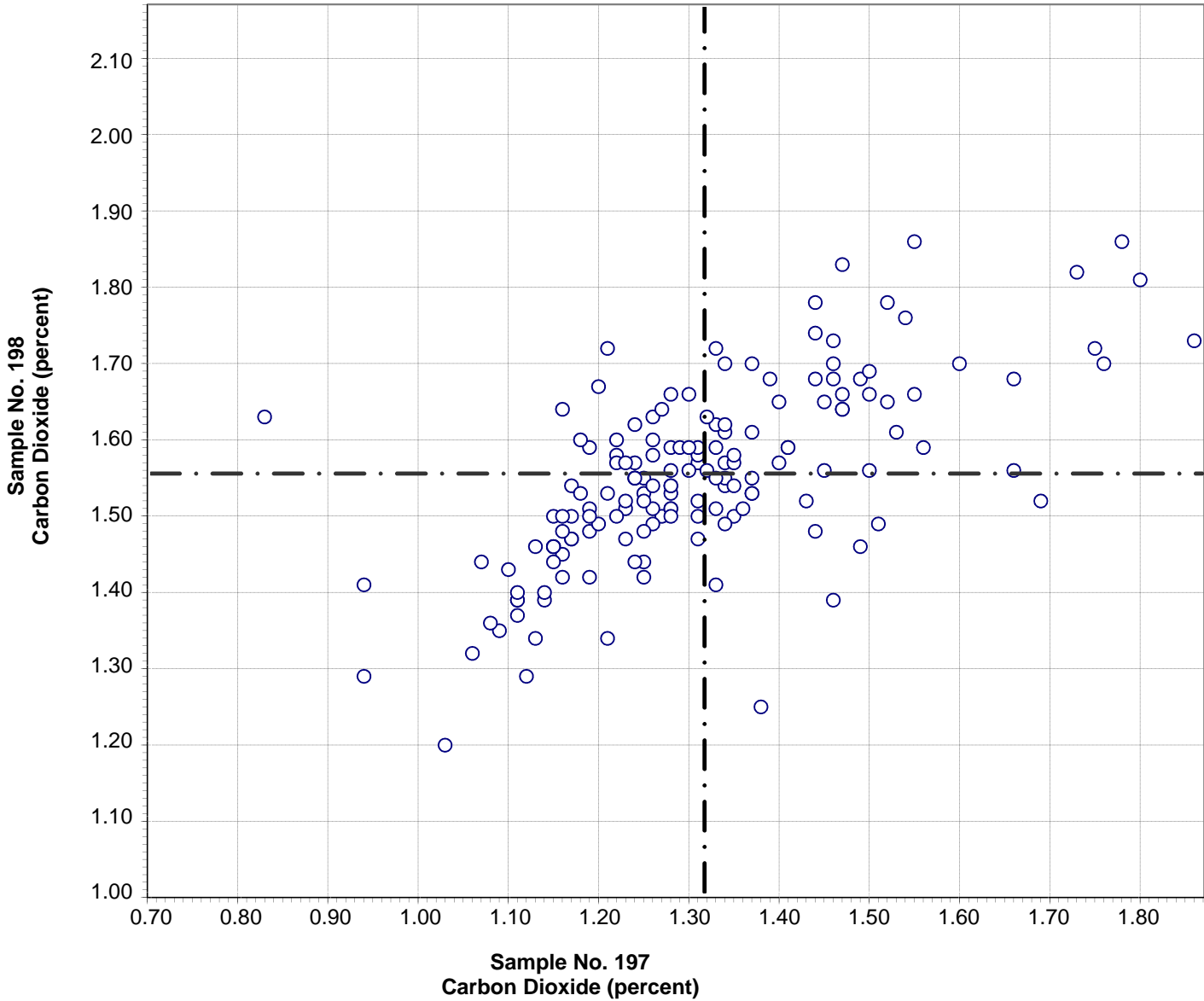


Test No. 41 Free Lime 160 Points

Sample No. 197	Ave 1.31	S.D. 0.24	C.V. 18
Sample No. 198	Ave 0.68	S.D. 0.17	C.V. 25

Labs Eliminated: 56, 124, 126, 175, 181, 690, 691, 3297, 3415, 4051

**CCRL Proficiency Sample Program  
Carbon Dioxide  
PORTLAND CEMENT Samples No. 197 and No. 198**



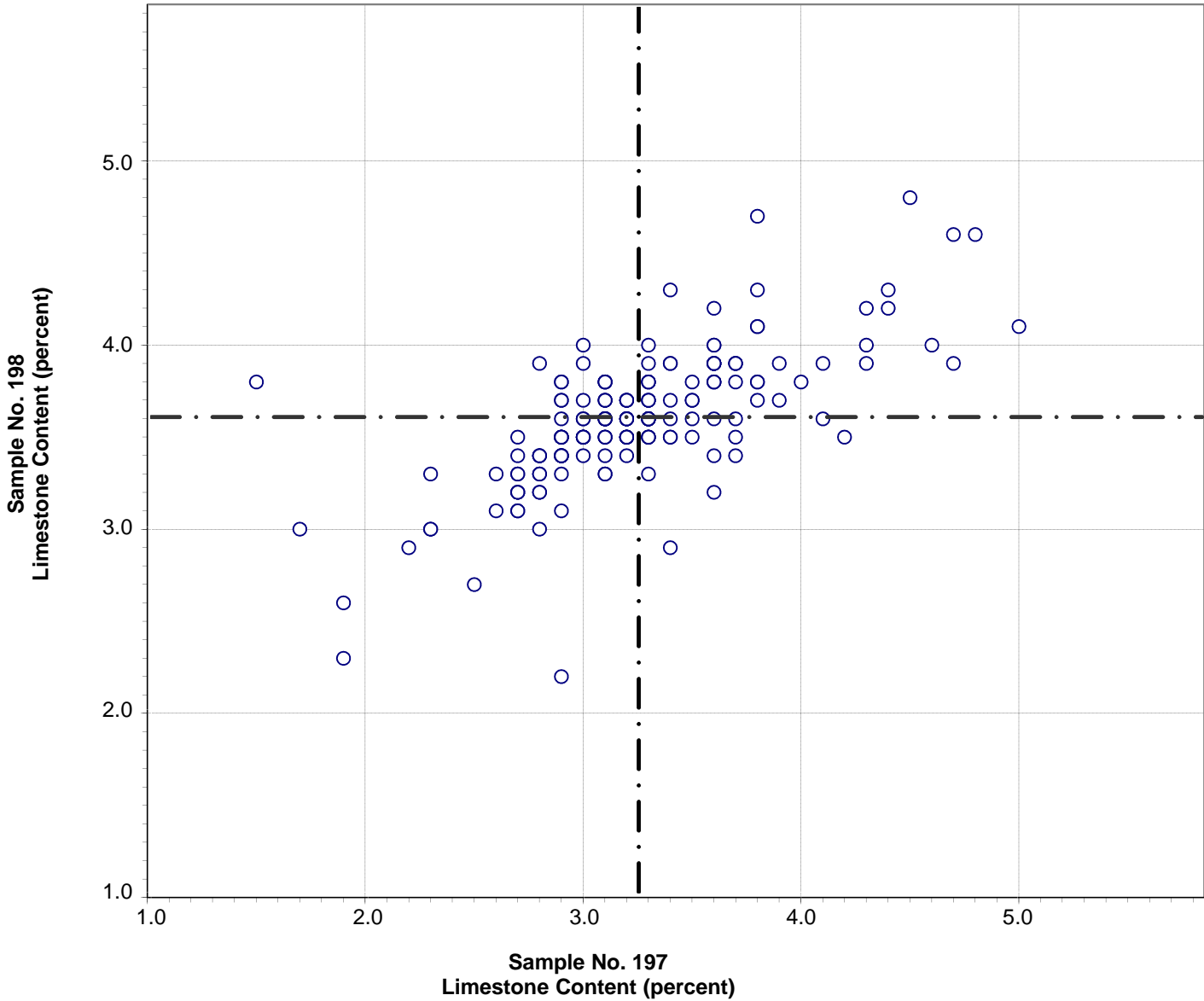
Test No. 97 Carbon Dioxide 160 Points

Sample No. 197	Ave 1.32	S.D. 0.18	C.V. 13.3
Sample No. 198	Ave 1.55	S.D. 0.12	C.V. 7.6

Labs Eliminated: 15, 24, 34, 50, 54, 66, 146, 203, 221, 254, 255, 440, 692, 886, 1251, 1644, 2363, 2466, 3233, 3415, 3658, 3752, 4040

Labs off Diagram: 3368

**CCRL Proficiency Sample Program  
Limestone Content  
PORTLAND CEMENT Samples No. 197 and No. 198**

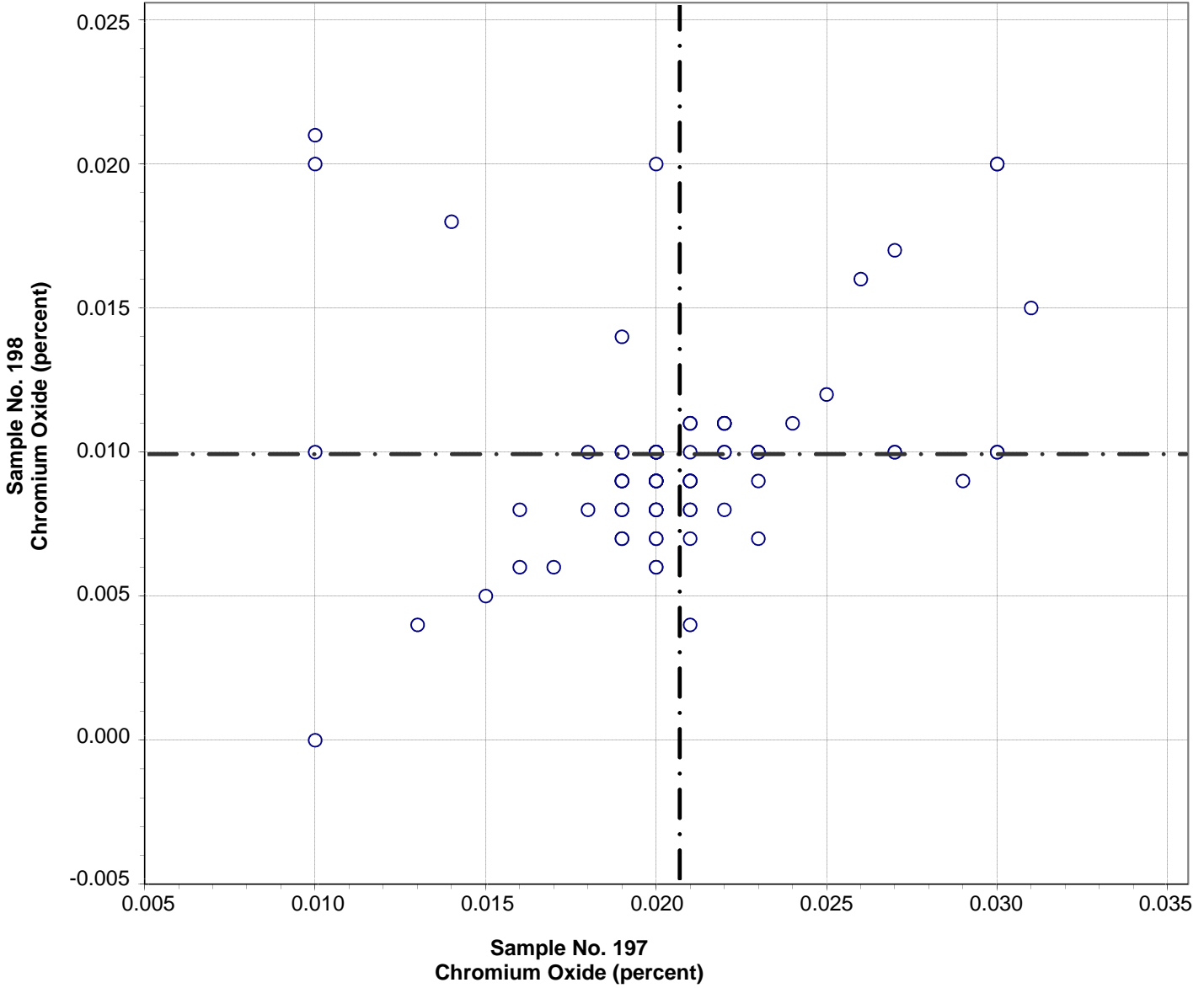


Test No. 98 Limestone Content 171 Points

Sample No. 197	Ave 3.3	S.D. 0.5	C.V. 16.8
Sample No. 198	Ave 3.6	S.D. 0.4	C.V. 10.2

Labs Eliminated: 15, 24, 66, 254, 692, 886, 1644, 2363, 3233, 3415, 3658, 4040

**CCRL Proficiency Sample Program  
Chromium Oxide  
PORTLAND CEMENT Samples No. 197 and No. 198**

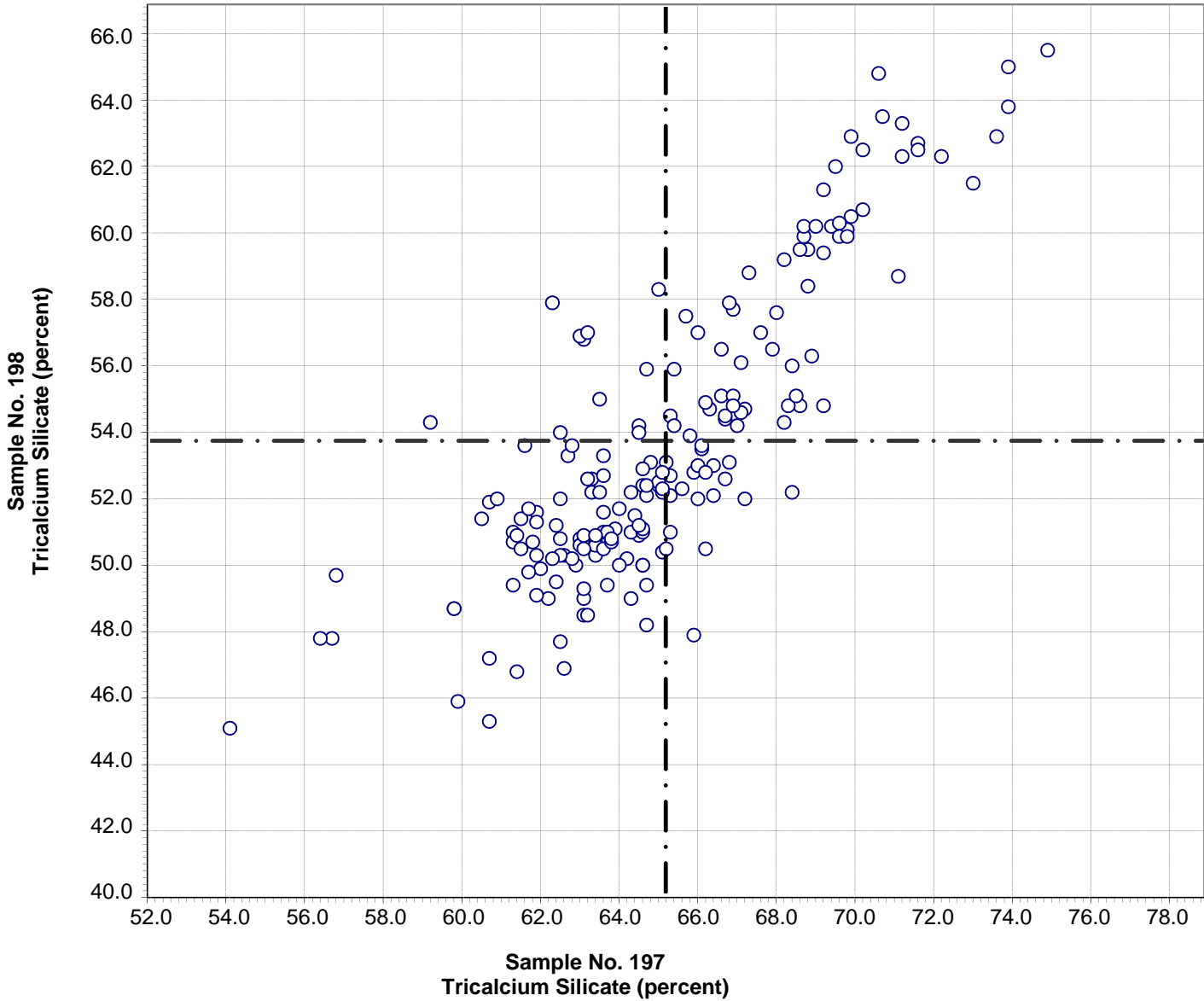


Test No. 105 Chromium Oxide 81 Points

Sample No. 197	Ave 0.021	S.D. 0.004	C.V. 21
Sample No. 198	Ave 0.010	S.D. 0.004	C.V. 38

Labs Eliminated: 66, 151, 157, 247, 684, 2296

**CCRL Proficiency Sample Program  
Tricalcium Silicate  
PORTLAND CEMENT Samples No. 197 and No. 198**

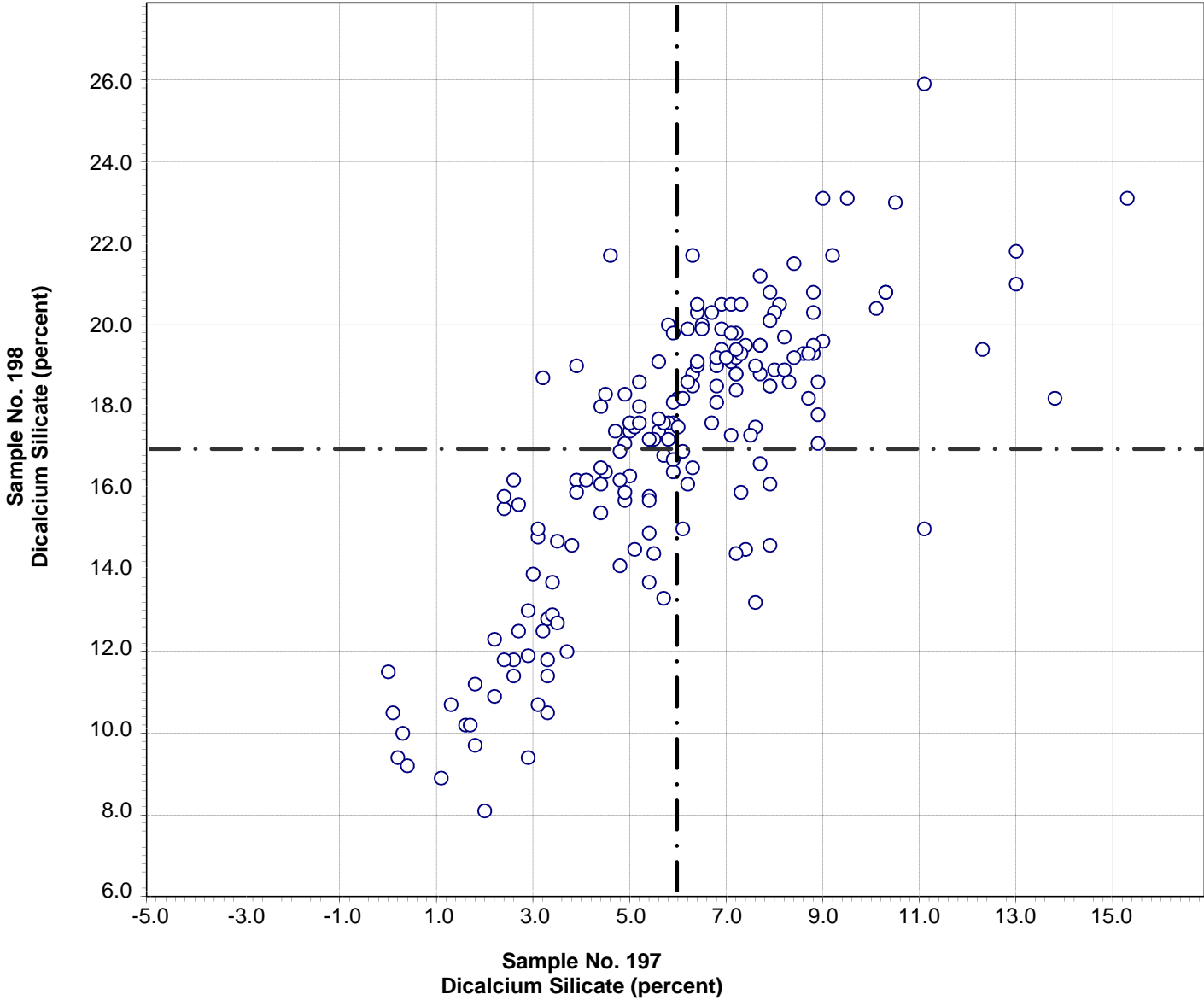


Test No. 106    Tricalcium Silicate    188 Points

Sample No. 197	Ave 65.2	S.D. 3.4	C.V. 5.2
Sample No. 198	Ave 53.7	S.D. 4.4	C.V. 8.1

Labs Eliminated: 8, 24, 50, 691

**CCRL Proficiency Sample Program  
Dicalcium Silicate  
PORTLAND CEMENT Samples No. 197 and No. 198**



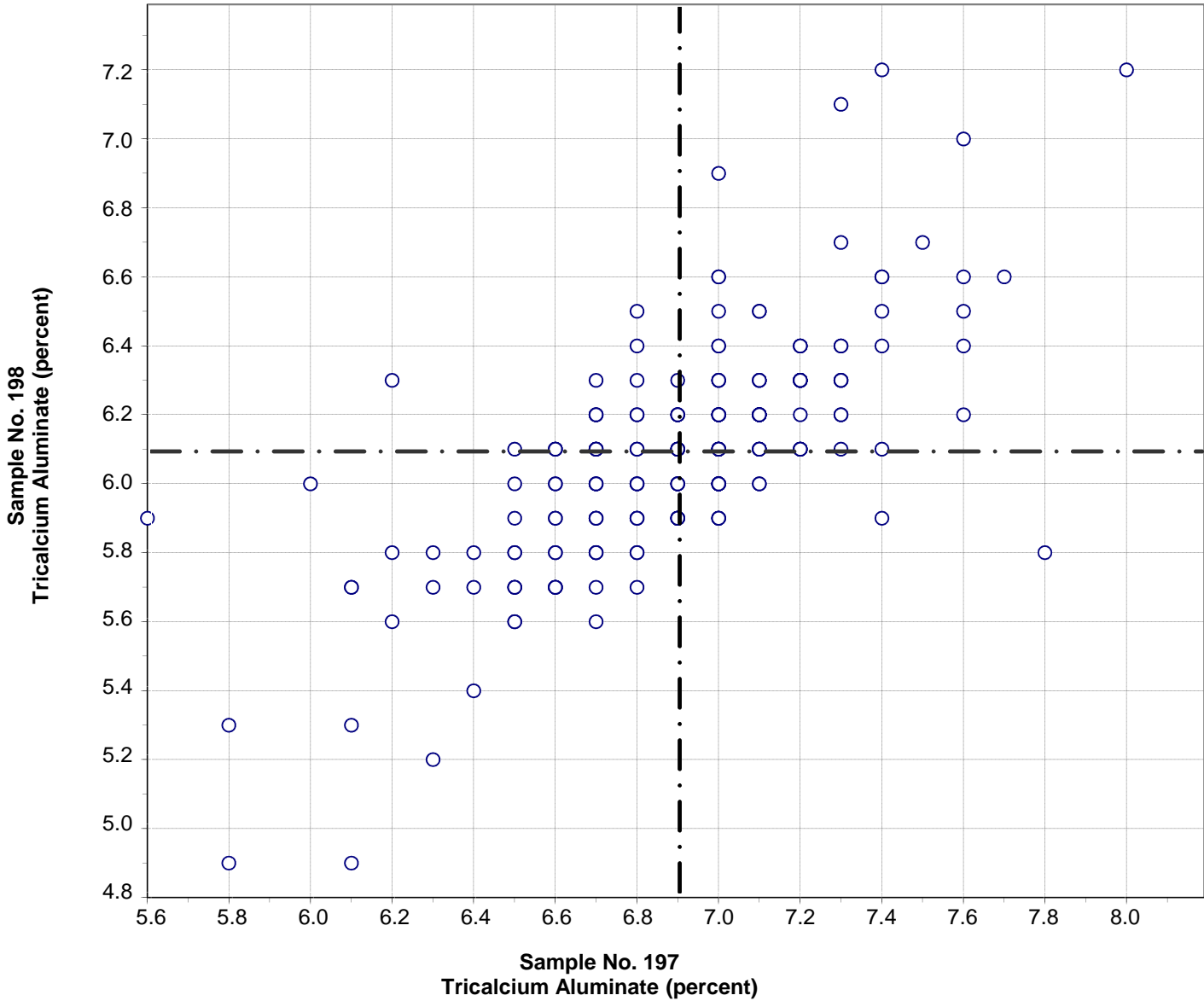
Test No. 107    Dicalcium Silicate    183 Points

Sample No. 197    Ave 6.0    S.D. 2.6    C.V. 44.3  
 Sample No. 198    Ave 16.9    S.D. 3.5    C.V. 20.5

Labs Eliminated: 24, 50, 56, 124, 157, 159, 691, 1644

Labs off Diagram: 8

**CCRL Proficiency Sample Program  
Tricalcium Aluminate  
PORTLAND CEMENT Samples No. 197 and No. 198**



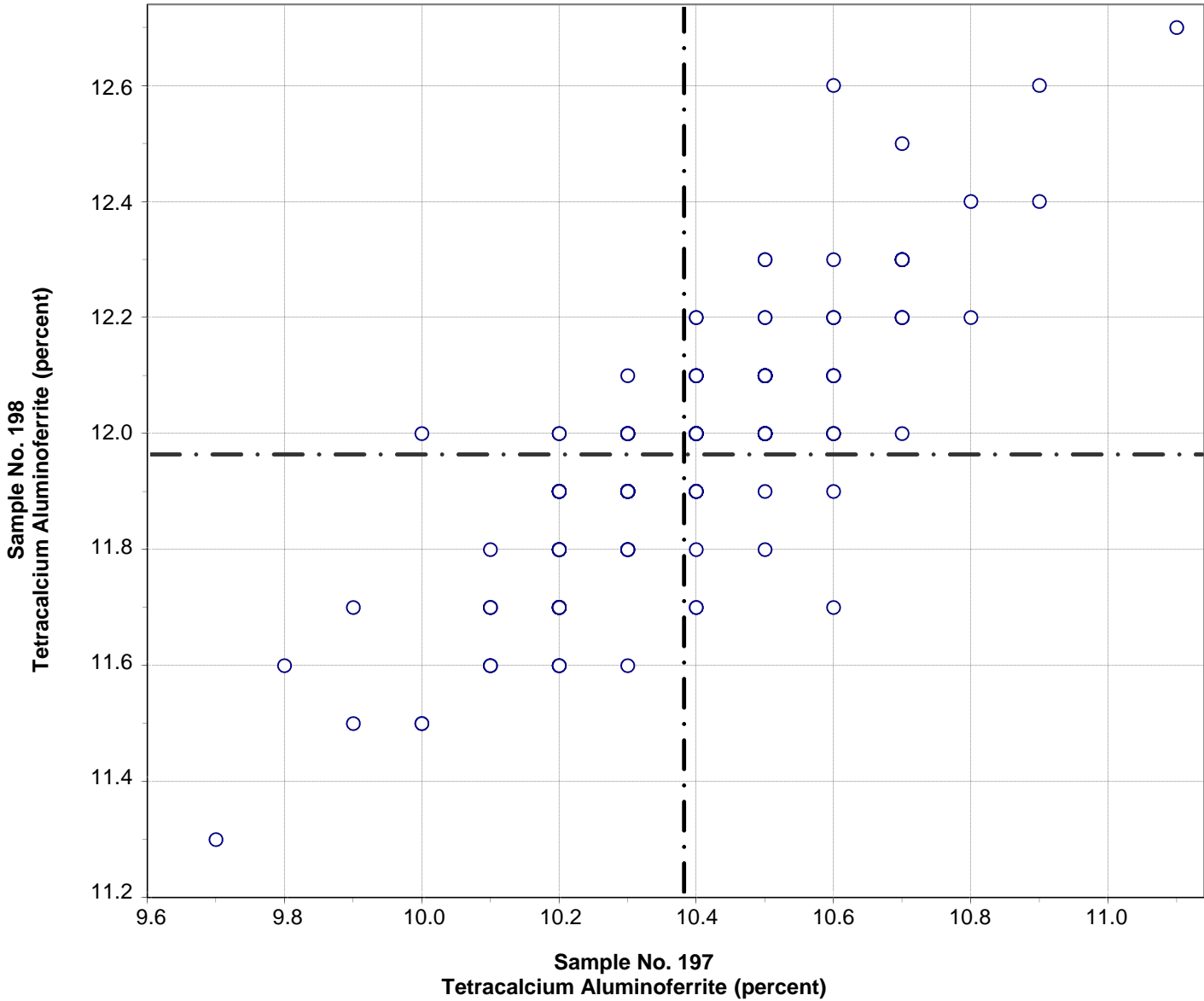
Test No. 108 Tricalcium Aluminate 187 Points

Sample No. 197	Ave 6.9	S.D. 0.4	C.V. 5.5
Sample No. 198	Ave 6.1	S.D. 0.3	C.V. 5.5

Labs Eliminated: 7, 24, 42, 691

Labs off Diagram: 3279

**CCRL Proficiency Sample Program  
Tetracalcium Aluminoferrite  
PORTLAND CEMENT Samples No. 197 and No. 198**



Test No. 109    Tetracalcium Aluminoferrite    183 Points

Sample No. 197	Ave 10.4	S.D. 0.2	C.V. 2.0
Sample No. 198	Ave 12.0	S.D. 0.2	C.V. 1.9

Labs Eliminated: 7, 8, 24, 34, 50, 440, 2484, 2490

Labs off Diagram: 2955



**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

Final Report – Physical Results  
 August 31, 2015

SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Normal Consistency - % Water (percent)</b>							
	241	24.6	0.82	3.30	26.0	1.06	4.10
	*234	24.5	0.67	2.70	25.9	0.75	2.90
* Labs Eliminated - 14, 24, 49, 1644, 2683, 3819, 4040							
<b>Vicat Time of Set - Initial (minutes)</b>							
	237	121	16	13	135	19	14
	*233	120	15	13	135	16	12
* Labs Eliminated - 24, 252, 416, 4040							
<b>Vicat Time of Set - Final (minutes)</b>							
	228	225	36	16	243	34	14
	*224	225	32	14	242	31	13
* Labs Eliminated - 246, 252, 1644, 4040							
<b>Gillmore Time of Set - Initial (minutes)</b>							
	142	160	21	13	174	24	14
	*139	160	20	12	175	23	13
* Labs Eliminated - 96, 413, 2296							
<b>Gillmore Time of Set - Final (minutes)</b>							
	142	258	37	14	276	38	14
	*141	257	35	14	275	38	14
* Labs Eliminated - 246							
<b>False Set - Paste Method (percent)</b>							
	182	45	21.9	49.2	61	17.0	27.9
	*177	45	21.7	47.9	62	14.8	23.7
* Labs Eliminated - 132, 203, 246, 1053, 3658							
<b>Autoclave Expansion (percent)</b>							
	222	-0.03	0.046	-193	-0.04	0.043	-134
	*210	-0.02	0.021	83	-0.04	0.024	75
* Labs Eliminated - 24, 93, 309, 360, 504, 515, 1054, 1251, 3003, 3236, 3607, 3658							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

Final Report – Physical Results  
 August 31, 2015

SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Air Content % (percent)</b>							
	224	8.7	1.3	15	8.0	1.4	17
	*222	8.8	1.2	14	8.0	1.3	16
* Labs Eliminated - 50, 3850							
<b>Air Content - % Water (percent)</b>							
	219	68.0	9.2	13.5	68.8	10.2	14.9
	*207	69.3	2.4	3.5	70.4	2.4	3.5
* Labs Eliminated - 26, 60, 84, 180, 360, 698, 1644, 2466, 2763, 3233, 3279, 3662							
<b>Air Content - Flow (percent)</b>							
	223	88	4.7	5.3	86	4.2	4.9
	*220	88	3.7	4.3	85	3.2	3.8
* Labs Eliminated - 48, 1019, 3607							
<b>Compressive Strength - 3 day (psi)</b>							
	246	4201	323	7.7	3772	281	7.4
	*240	4218	278	6.6	3779	244	6.5
* Labs Eliminated - 4, 43, 49, 175, 565, 2683							
<b>Compressive Strength - 7 day (psi)</b>							
	246	5116	403	7.9	4814	353	7.3
	*240	5152	327	6.3	4840	307	6.3
* Labs Eliminated - 41, 43, 46, 2683, 3003, 3788							
<b>Compressive Strength - 28 day (psi)</b>							
	229	6206	435	7.0	6320	442	7.0
	*224	6218	385	6.2	6323	388	6.1
* Labs Eliminated - 15, 43, 49, 413, 2254							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

Final Report – Physical Results  
 August 31, 2015

SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
-------------	-------	---------	------	------	---------	------	------

**Compressive Strength - Flow (percent)**

223	111	9	8.2	106	10	9.3
*221	112	9	7.7	107	9	8.2

\* Labs Eliminated - 26, 565

**Fineness - Air Permeability (m<sup>2</sup>/kg)**

238	443	20	4.5	403	17	4.3
*221	443	11	2.4	402	10	2.5

\* Labs Eliminated - 24, 26, 40, 46, 78, 99, 116, 180, 360, 431, 491, 1435, 3235, 3279, 3607, 3850, 4050

**Fineness - Wagner Turbidimeter (m<sup>2</sup>/kg)**

2	204	6	3.1	205	13	6.2
---	-----	---	-----	-----	----	-----

No Labs Eliminated for This Test

**Fineness - 45µm Sieve (percent)**

225	93.00	2.39	2.58	94.16	1.54	1.64
*209	93.20	0.77	0.83	94.26	0.70	0.74

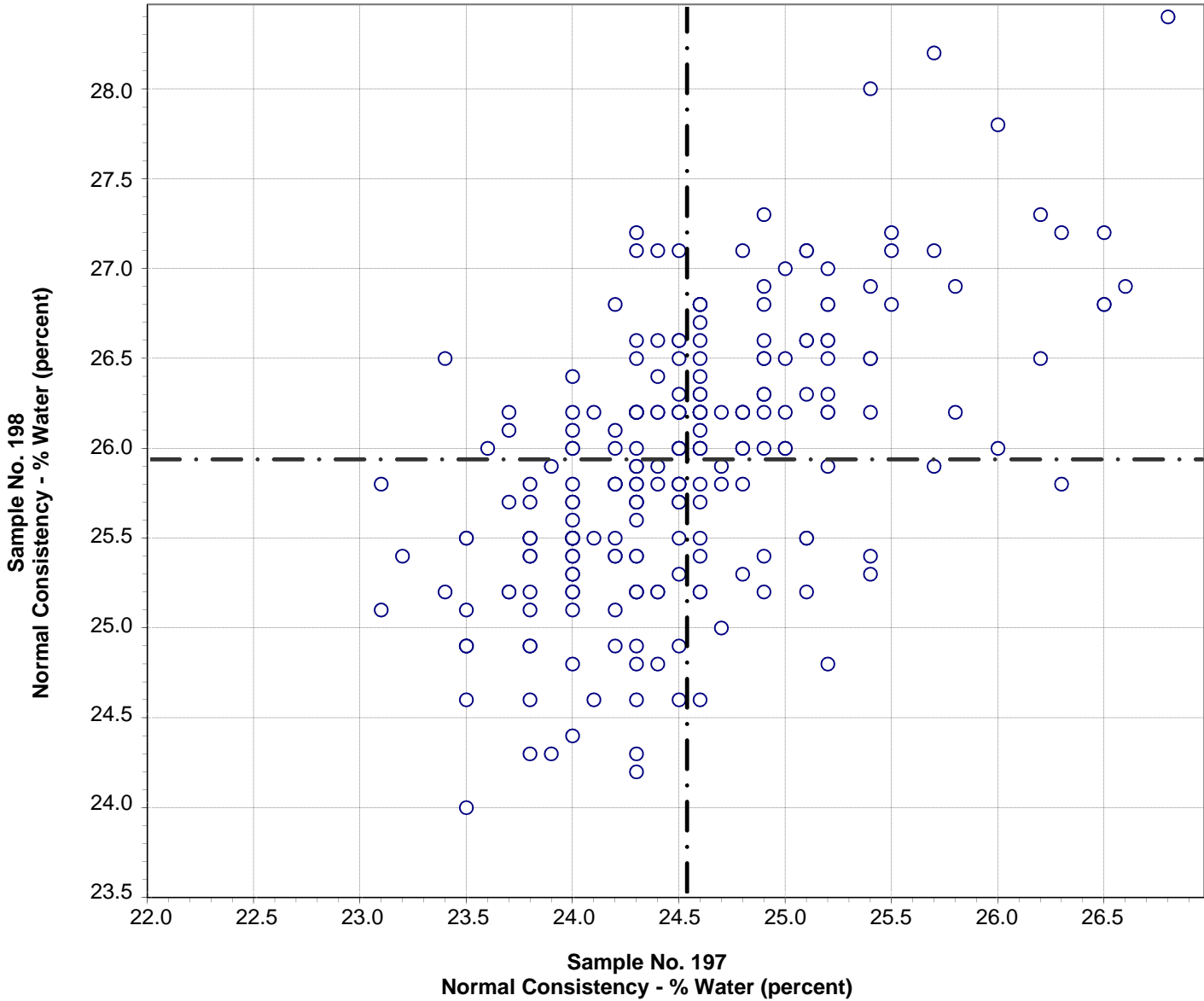
\* Labs Eliminated - 19, 26, 49, 95, 116, 137, 360, 407, 501, 515, 736, 1603, 2468, 2484, 3752, 4051

**C1038 Mortar Bar Expansion (percent)**

158	0.004	0.009	253	0.002	0.007	406
*147	0.003	0.003	108	0.002	0.004	152

\* Labs Eliminated - 51, 74, 116, 146, 221, 491, 565, 611, 1466, 1916, 2466

**CCRL Proficiency Sample Program  
Normal Consistency - % Water  
PORTLAND CEMENT Samples No. 197 and No. 198**

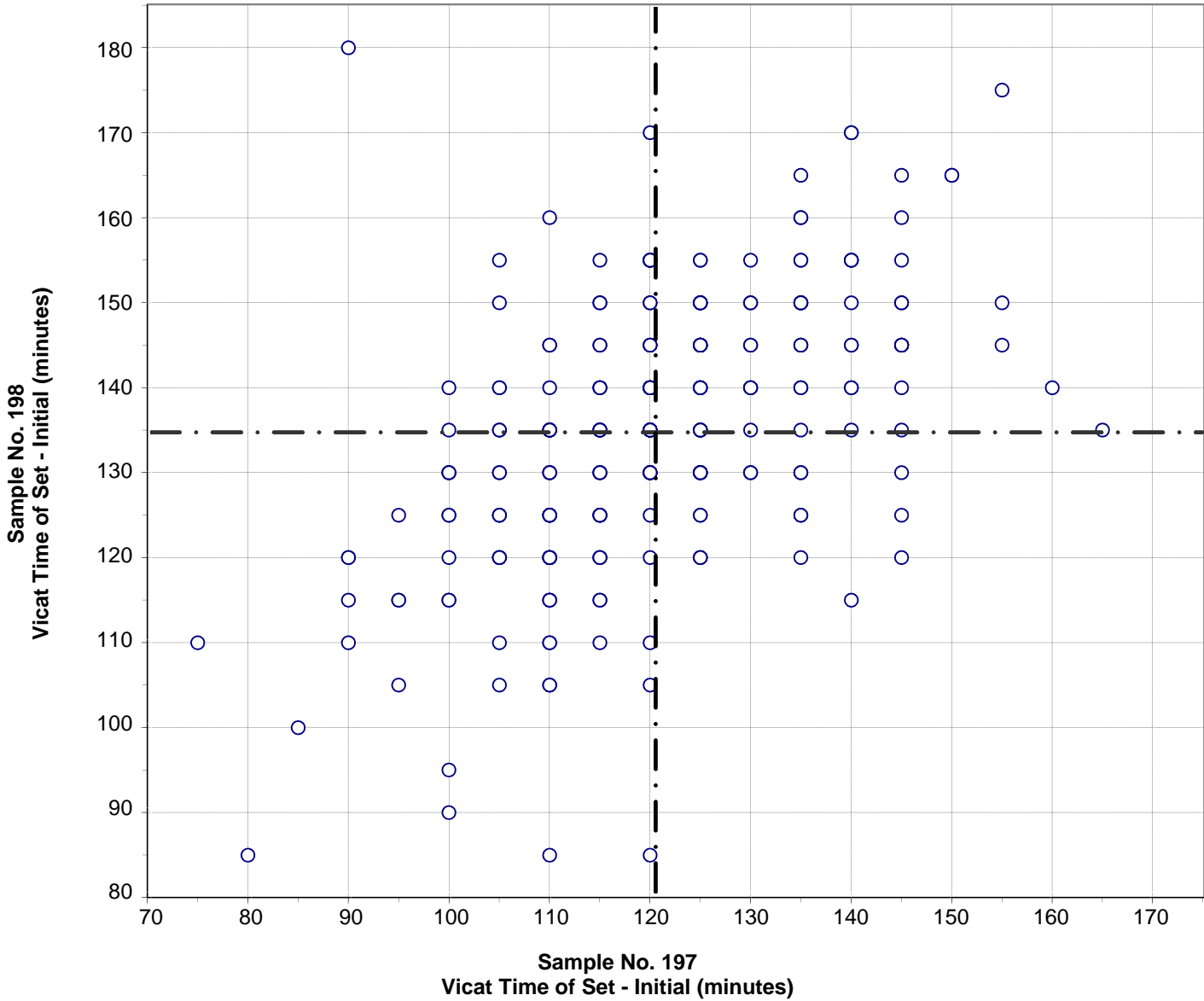


Test No. 110 Normal Consistency - % Water 234 Points

Sample No. 197	Ave 24.5	S.D. 0.67	C.V. 2.70
Sample No. 198	Ave 25.9	S.D. 0.75	C.V. 2.90

Labs Eliminated: 14, 24, 49, 1644, 2683, 3819, 4040

**CCRL Proficiency Sample Program**  
**Vicat Time of Set - Initial**  
**PORTLAND CEMENT Samples No. 197 and No. 198**

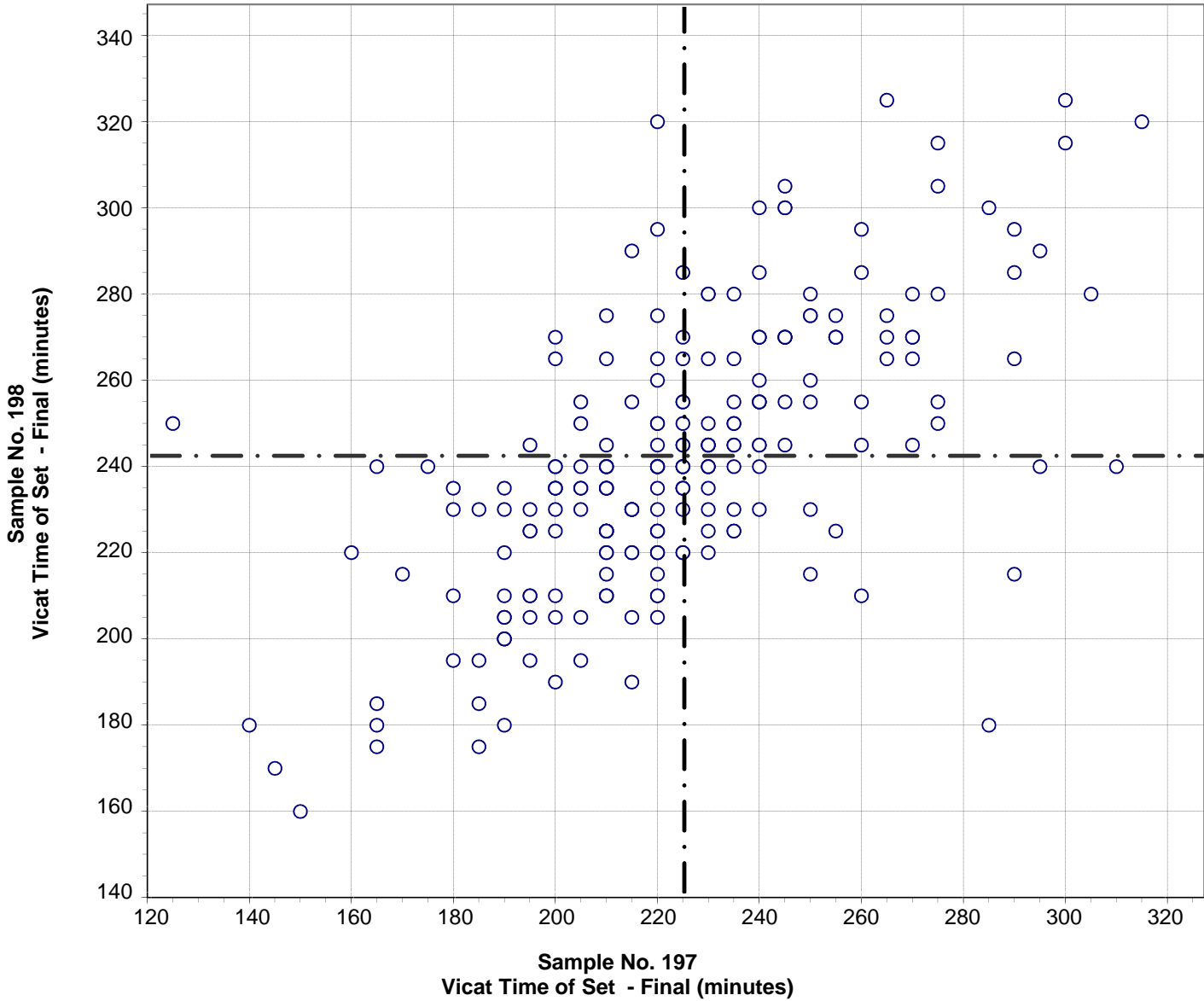


Test No. 120 Vicat Time of Set - Initial 233 Points

Sample No. 197	Ave 120	S.D. 15	C.V. 13
Sample No. 198	Ave 135	S.D. 16	C.V. 12

Labs Eliminated: 24, 252, 416, 4040

**CCRL Proficiency Sample Program**  
**Vicat Time of Set - Final**  
**PORTLAND CEMENT Samples No. 197 and No. 198**



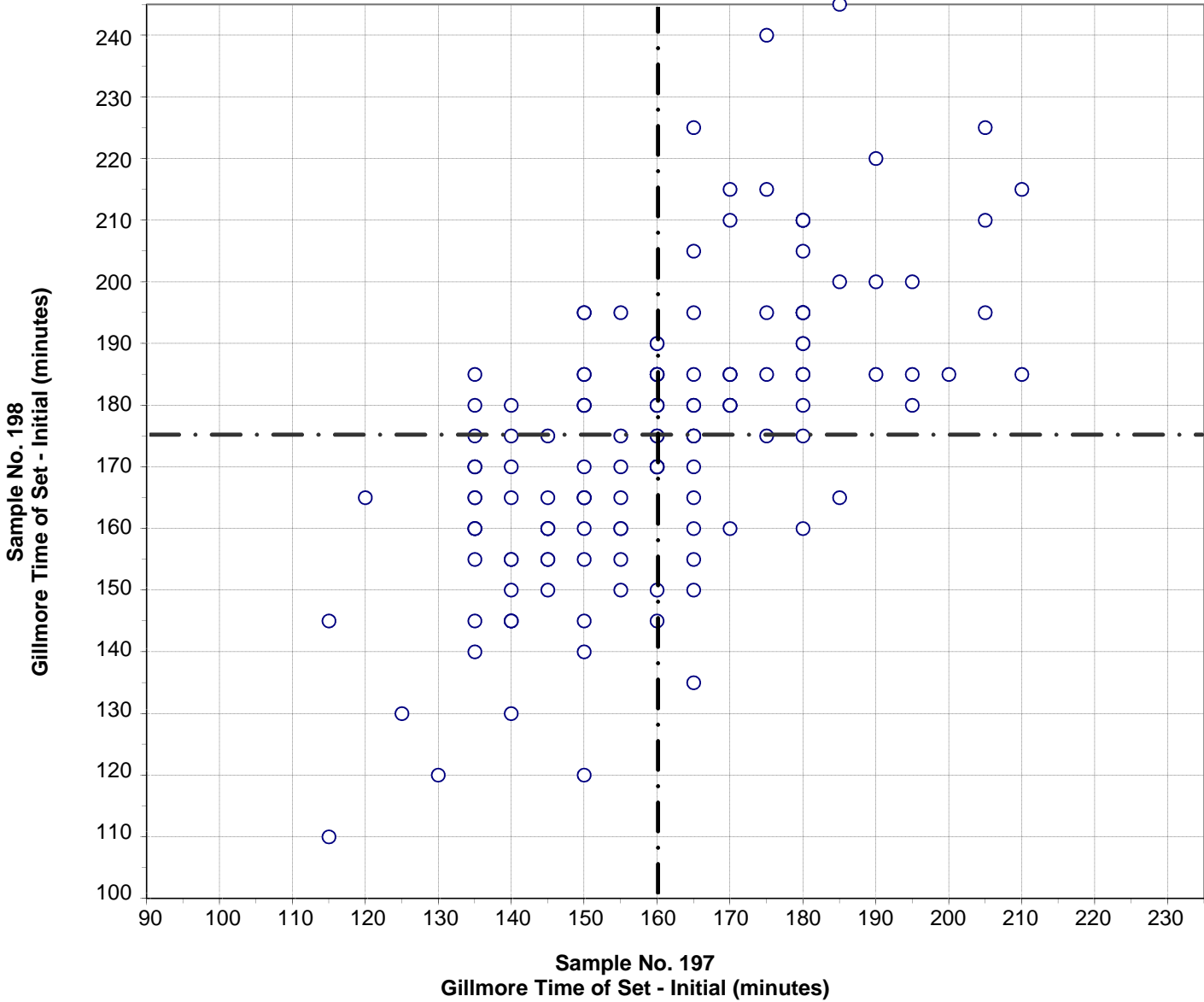
Test No. 121 Vicat Time of Set - Final 223 Points

Sample No. 197	Ave 225	S.D. 32	C.V. 14
Sample No. 198	Ave 242	S.D. 31	C.V. 13

Labs Eliminated: 246, 252, 1644, 4040

Labs off Diagram: 1956

**CCRL Proficiency Sample Program  
Gillmore Time of Set - Initial  
PORTLAND CEMENT Samples No. 197 and No. 198**

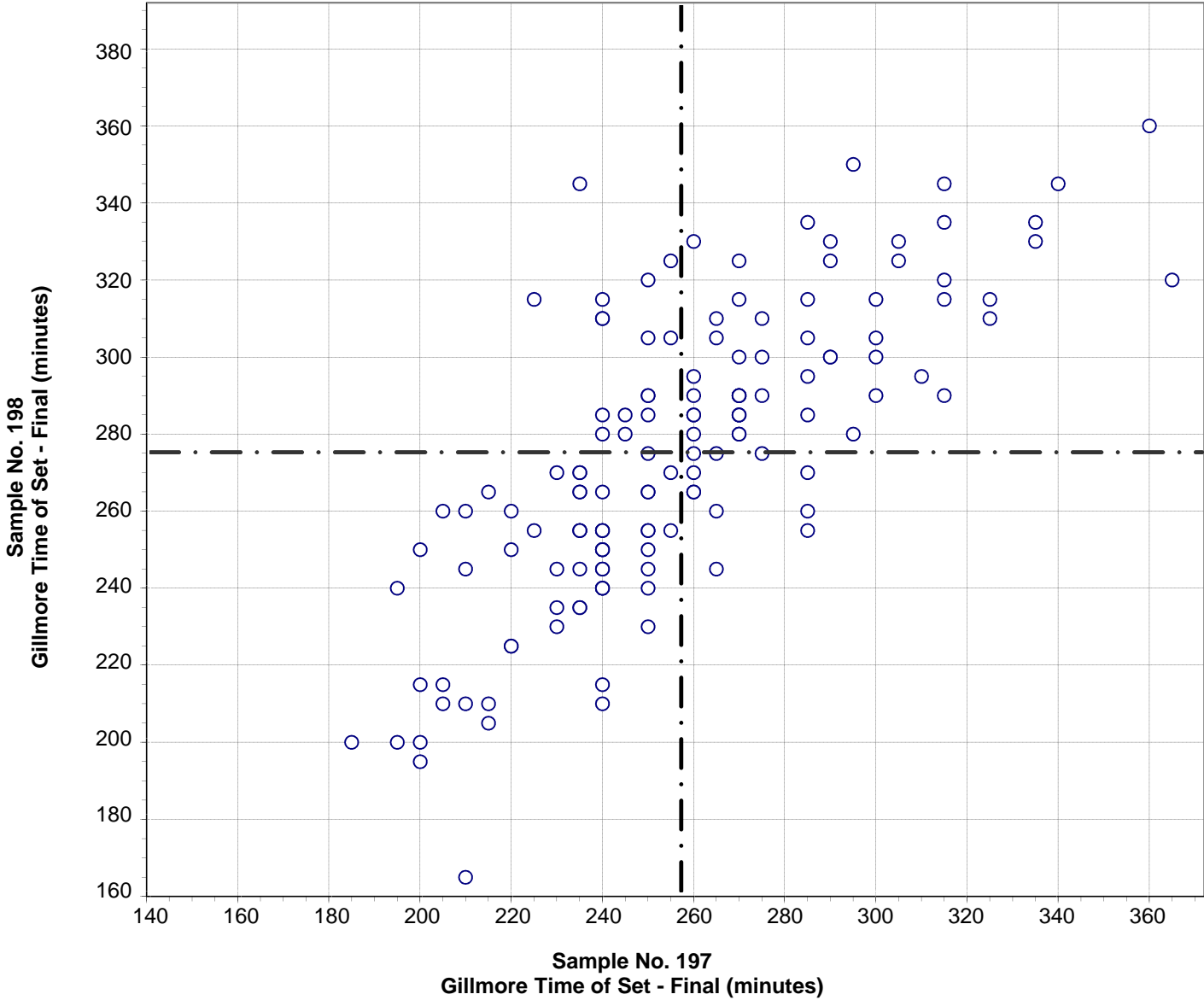


**Test No. 130 Gillmore Time of Set - Initial 139 Points**

Sample No. 197	Ave 160	S.D. 20	C.V. 12
Sample No. 198	Ave 175	S.D. 23	C.V. 13

Labs Eliminated: 96, 413, 2296

**CCRL Proficiency Sample Program  
Gillmore Time of Set - Final  
PORTLAND CEMENT Samples No. 197 and No. 198**



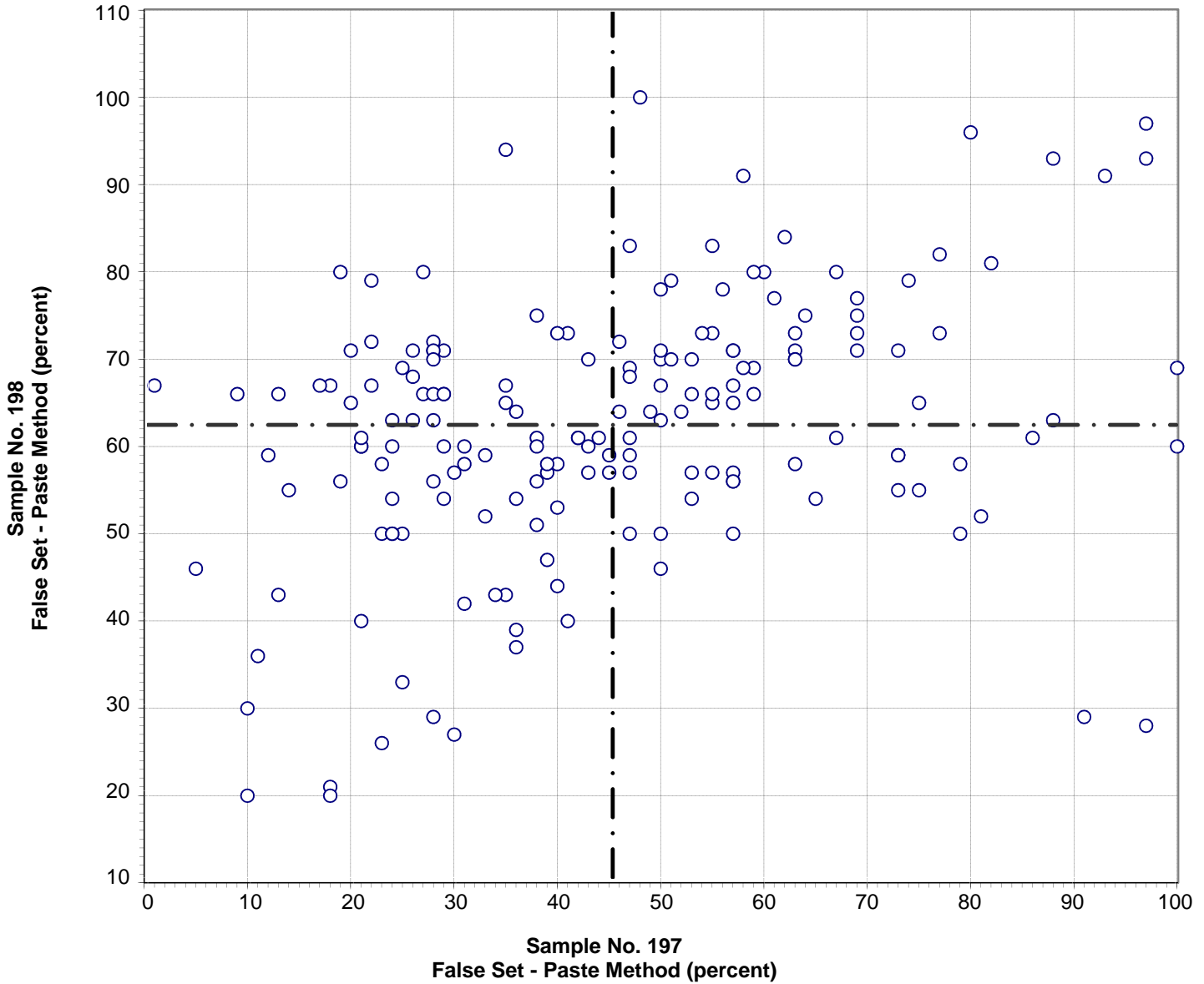
Test No. 140 Gillmore Time of Set - Final 141 Points

Sample No. 197	Ave 257	S.D. 35	C.V. 14
Sample No. 198	Ave 275	S.D. 38	C.V. 14

Labs Eliminated: 246



**CCRL Proficiency Sample Program  
False Set - Paste Method  
PORTLAND CEMENT Samples No. 197 and No. 198**

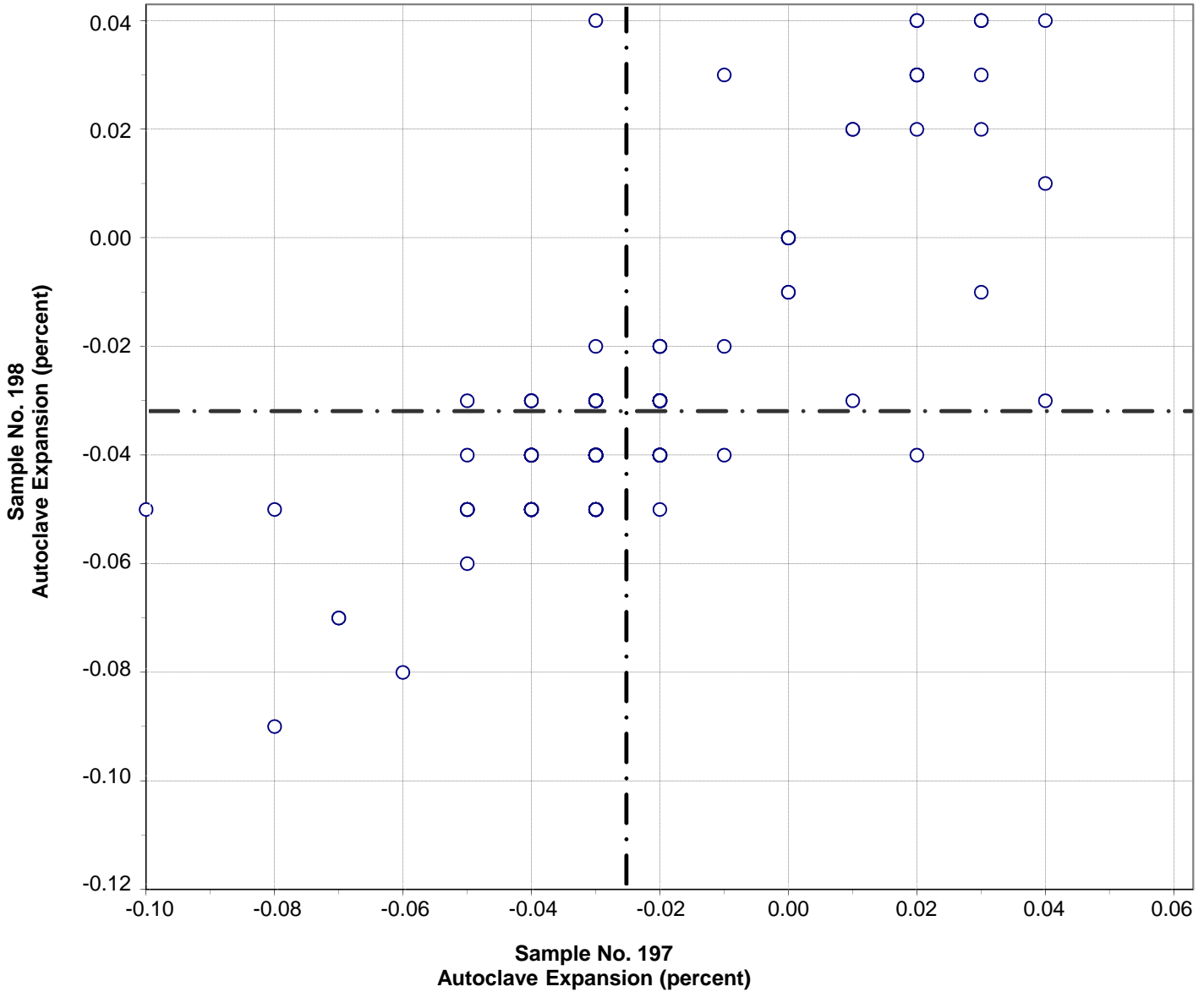


**Test No. 150 False Set - Paste Method 177 Points**

Sample No. 197	Ave 45	S.D. 21.7	C.V. 47.9
Sample No. 198	Ave 62	S.D. 14.8	C.V. 23.7

Labs Eliminated: 132, 203, 246, 1053, 3658

**CCRL Proficiency Sample Program  
Autoclave Expansion  
PORTLAND CEMENT Samples No. 197 and No. 198**



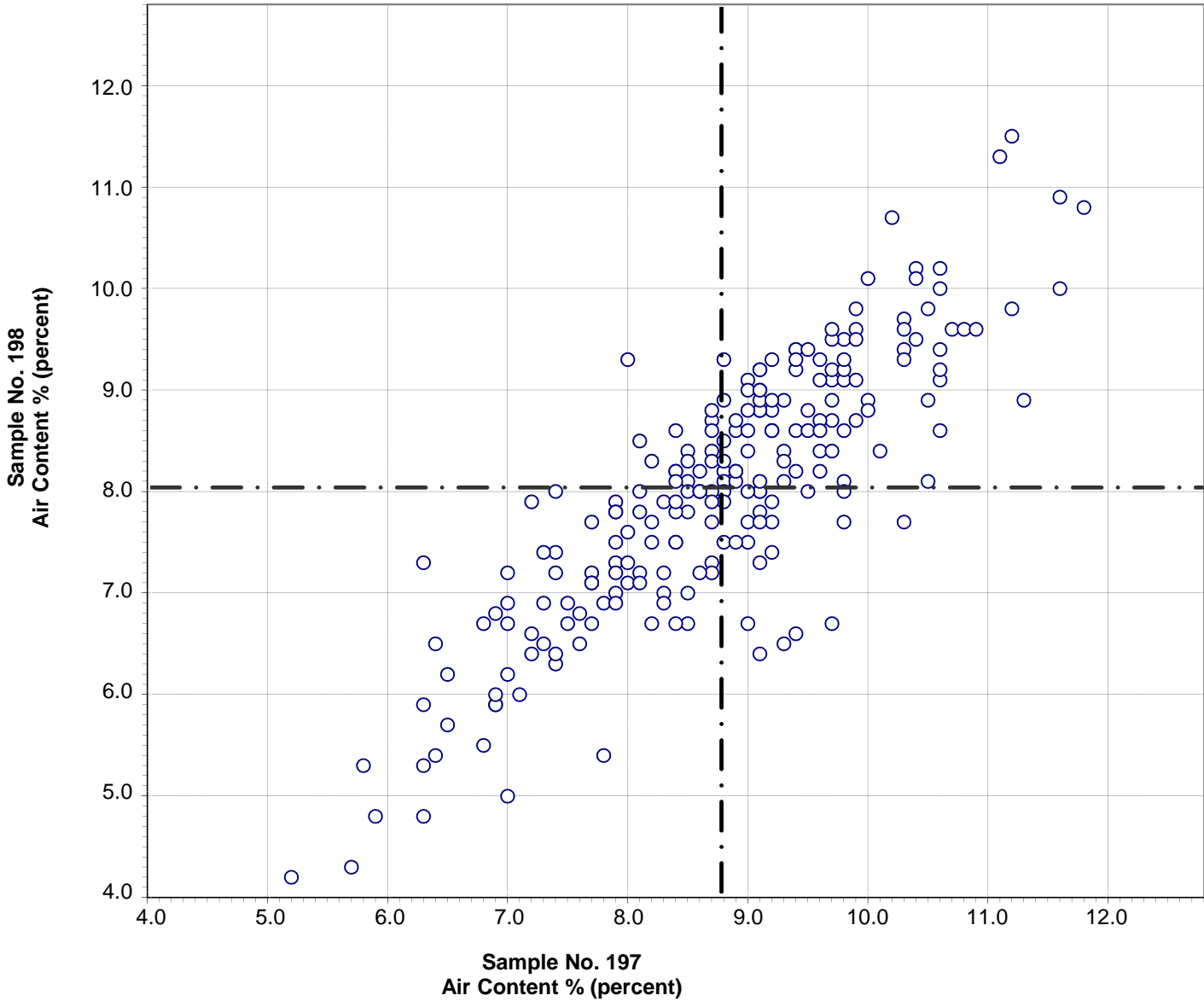
Test No. 160 Autoclave Expansion 208 Points

Sample No. 197	Ave -0.02	S.D. 0.021	C.V. 83
Sample No. 198	Ave -0.04	S.D. 0.024	C.V. 75

Labs Eliminated: 24, 93, 309, 360, 504, 515, 1054, 1251, 3003, 3236, 3607, 3658

Labs off Diagram: 246, 491

**CCRL Proficiency Sample Program**  
**Air Content %**  
**PORTLAND CEMENT Samples No. 197 and No. 198**

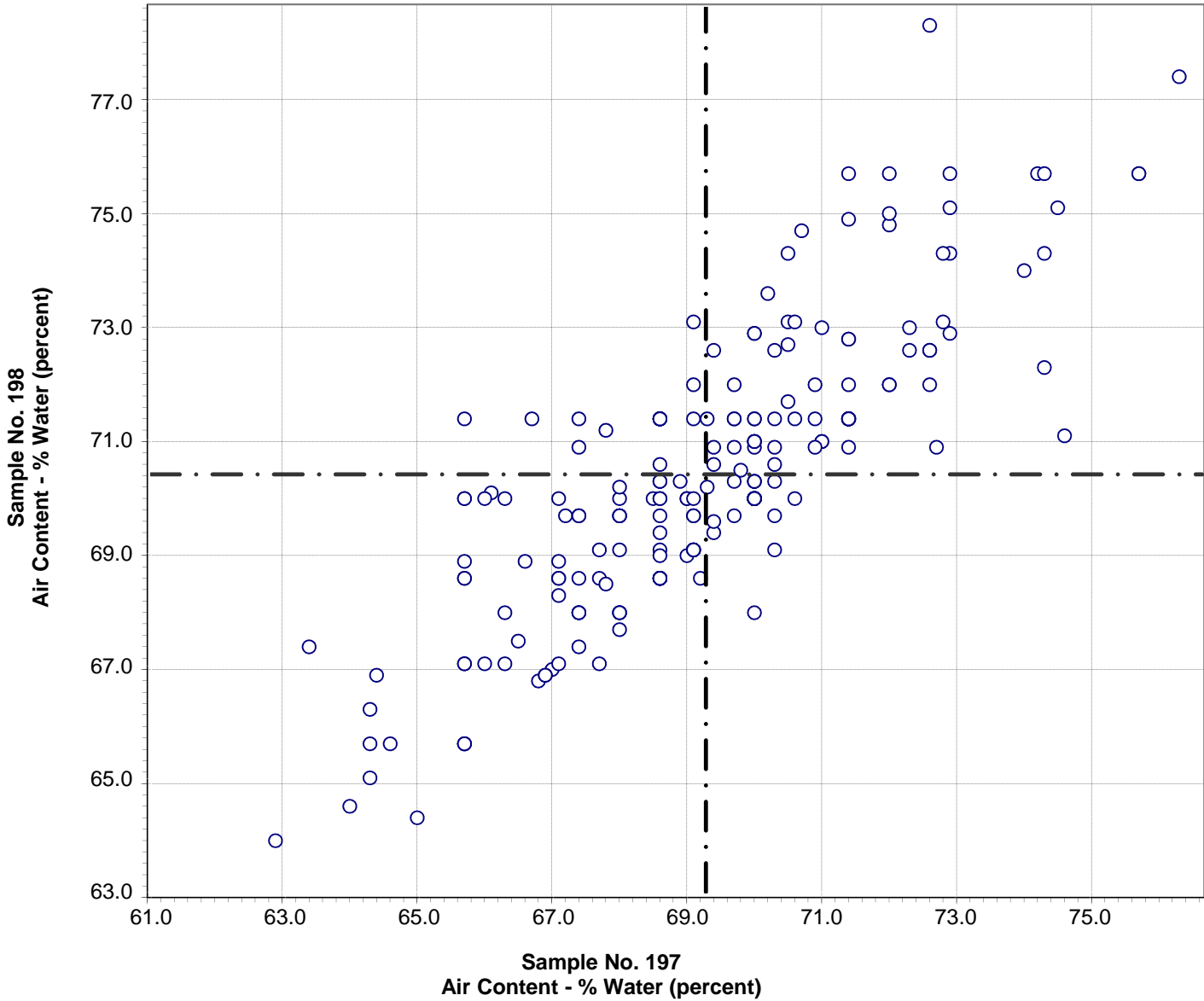


Test No. 170    Air Content %    222 Points

Sample No. 197	Ave 8.8	S.D. 1.2	C.V. 14
Sample No. 198	Ave 8.0	S.D. 1.3	C.V. 16

Labs Eliminated: 50, 3850

**CCRL Proficiency Sample Program**  
**Air Content - % Water**  
**PORTLAND CEMENT Samples No. 197 and No. 198**

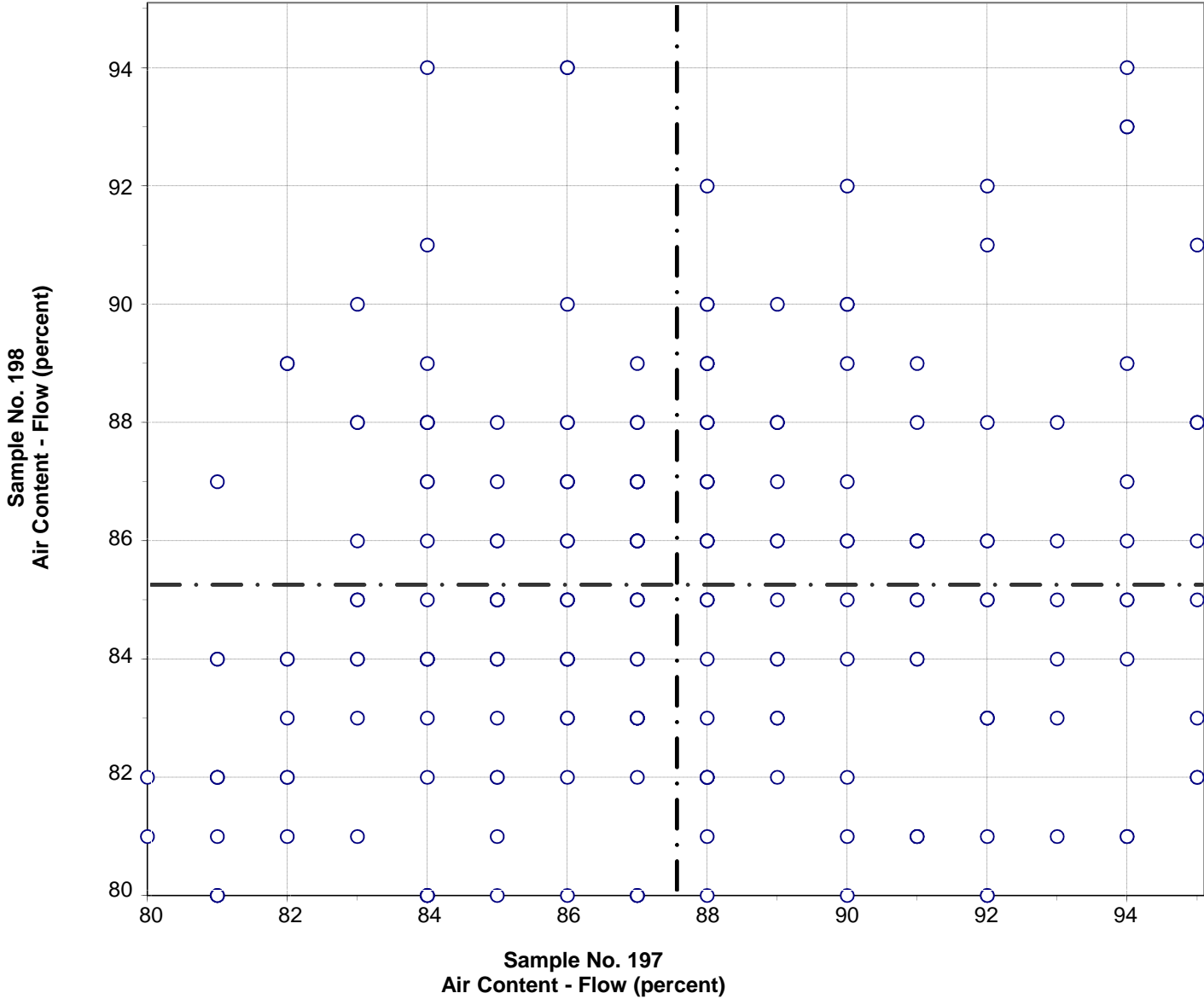


Test No. 180 Air Content - % Water 207 Points

Sample No. 197	Ave 69.3	S.D. 2.4	C.V. 3.5
Sample No. 198	Ave 70.4	S.D. 2.4	C.V. 3.5

Labs Eliminated: 26, 60, 84, 180, 360, 698, 1644, 2466, 2763, 3233, 3279, 3662

**CCRL Proficiency Sample Program**  
**Air Content - Flow**  
**PORTLAND CEMENT Samples No. 197 and No. 198**

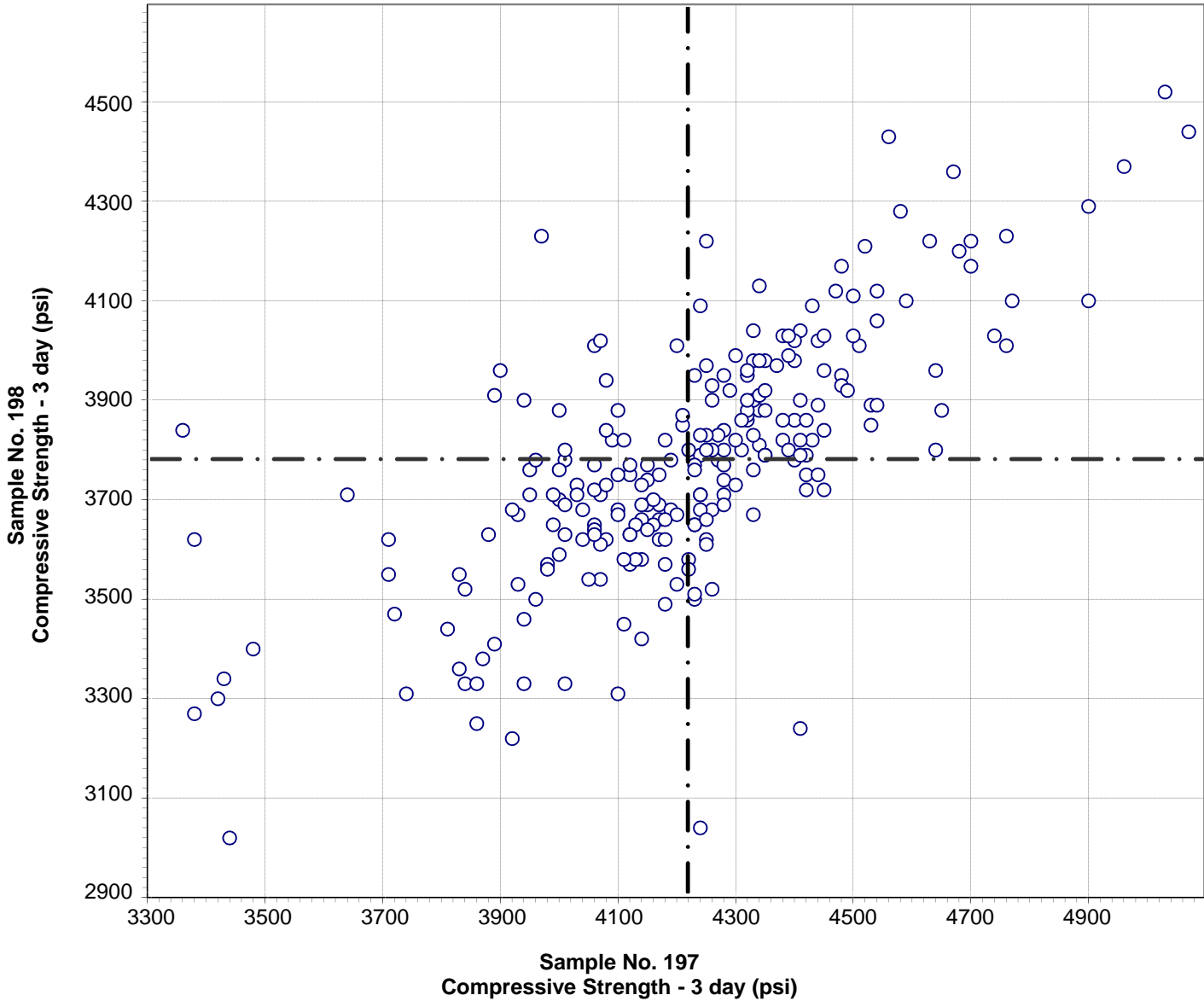


Test No. 190    Air Content - Flow    220 Points

Sample No. 197	Ave 88	S.D. 3.7	C.V. 4.3
Sample No. 198	Ave 85	S.D. 3.2	C.V. 3.8

Labs Eliminated: 48, 1019, 3607

**CCRL Proficiency Sample Program  
Compressive Strength - 3 day  
PORTLAND CEMENT Samples No. 197 and No. 198**

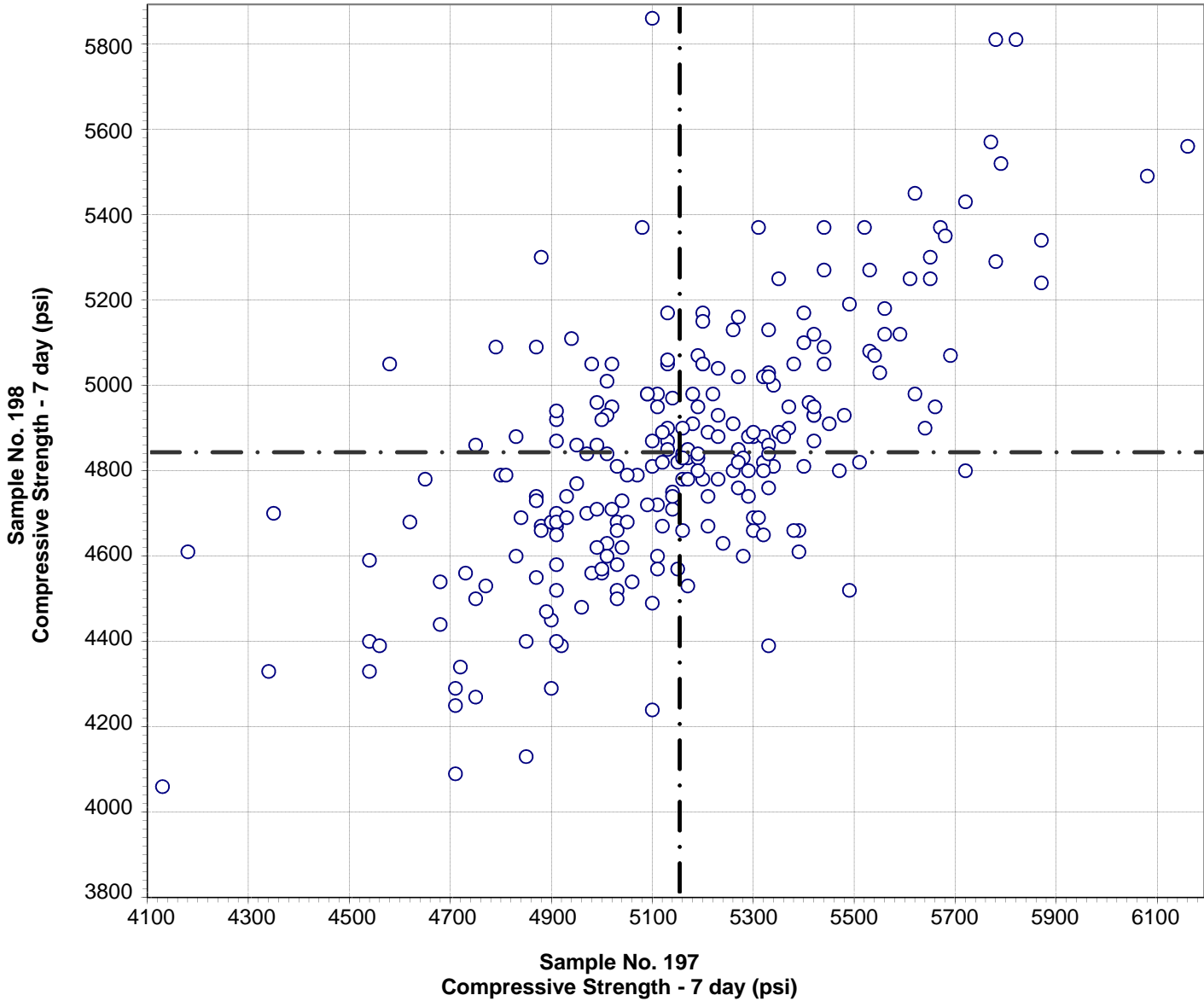


Test No. 200    Compressive Strength - 3 day    240 Points

Sample No. 197	Ave 4218	S.D. 278	C.V. 6.6
Sample No. 198	Ave 3779	S.D. 244	C.V. 6.5

Labs Eliminated: 4, 43, 49, 175, 565, 2683

**CCRL Proficiency Sample Program  
Compressive Strength - 7 day  
PORTLAND CEMENT Samples No. 197 and No. 198**



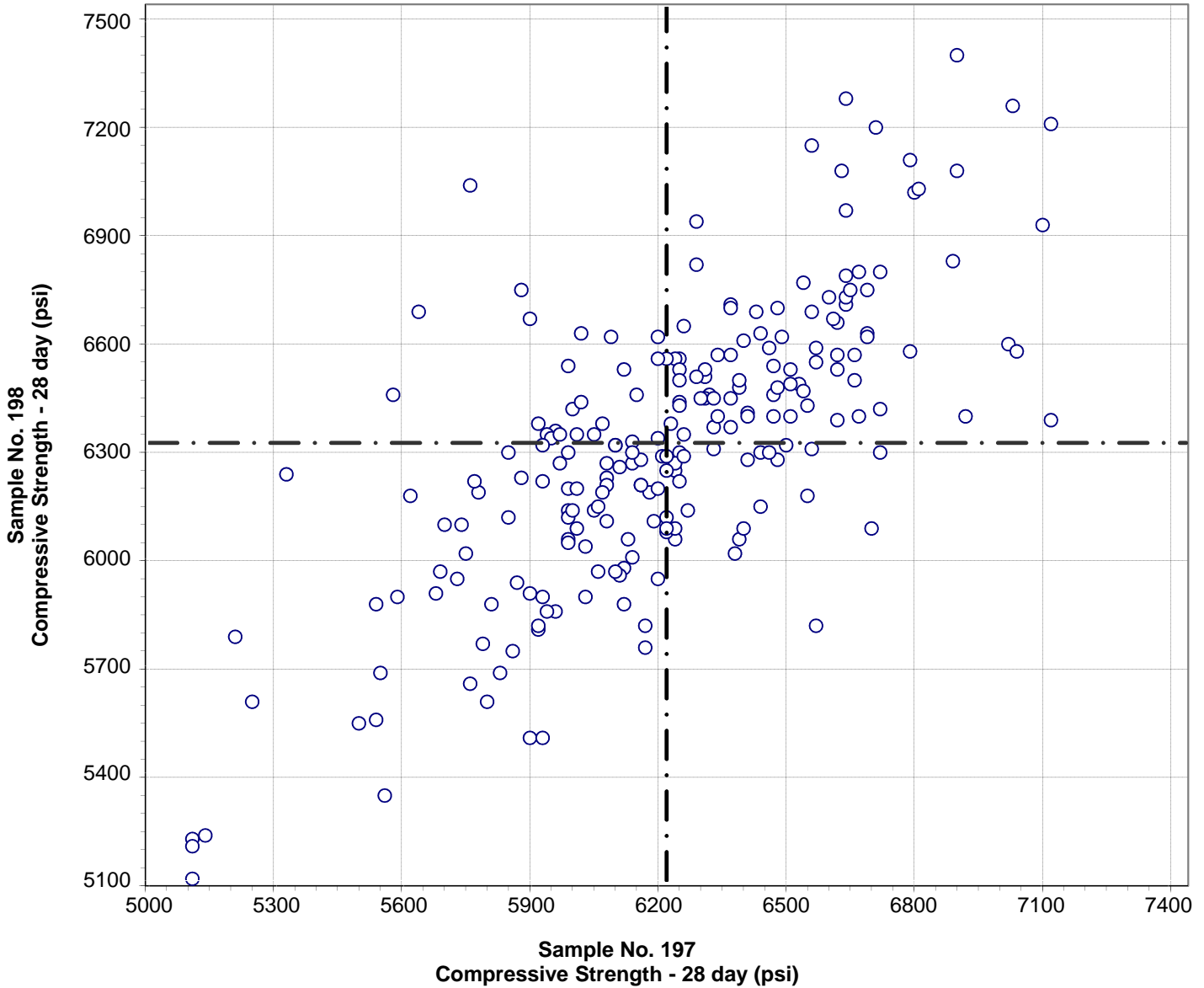
Test No. 210    Compressive Strength - 7 day    238 Points

Sample No. 197	Ave 5152	S.D. 327	C.V. 6.3
Sample No. 198	Ave 4840	S.D. 307	C.V. 6.3

Labs Eliminated: 41, 43, 46, 2683, 3003, 3788

Labs off Diagram: 38, 51

**CCRL Proficiency Sample Program  
Compressive Strength - 28 day  
PORTLAND CEMENT Samples No. 197 and No. 198**



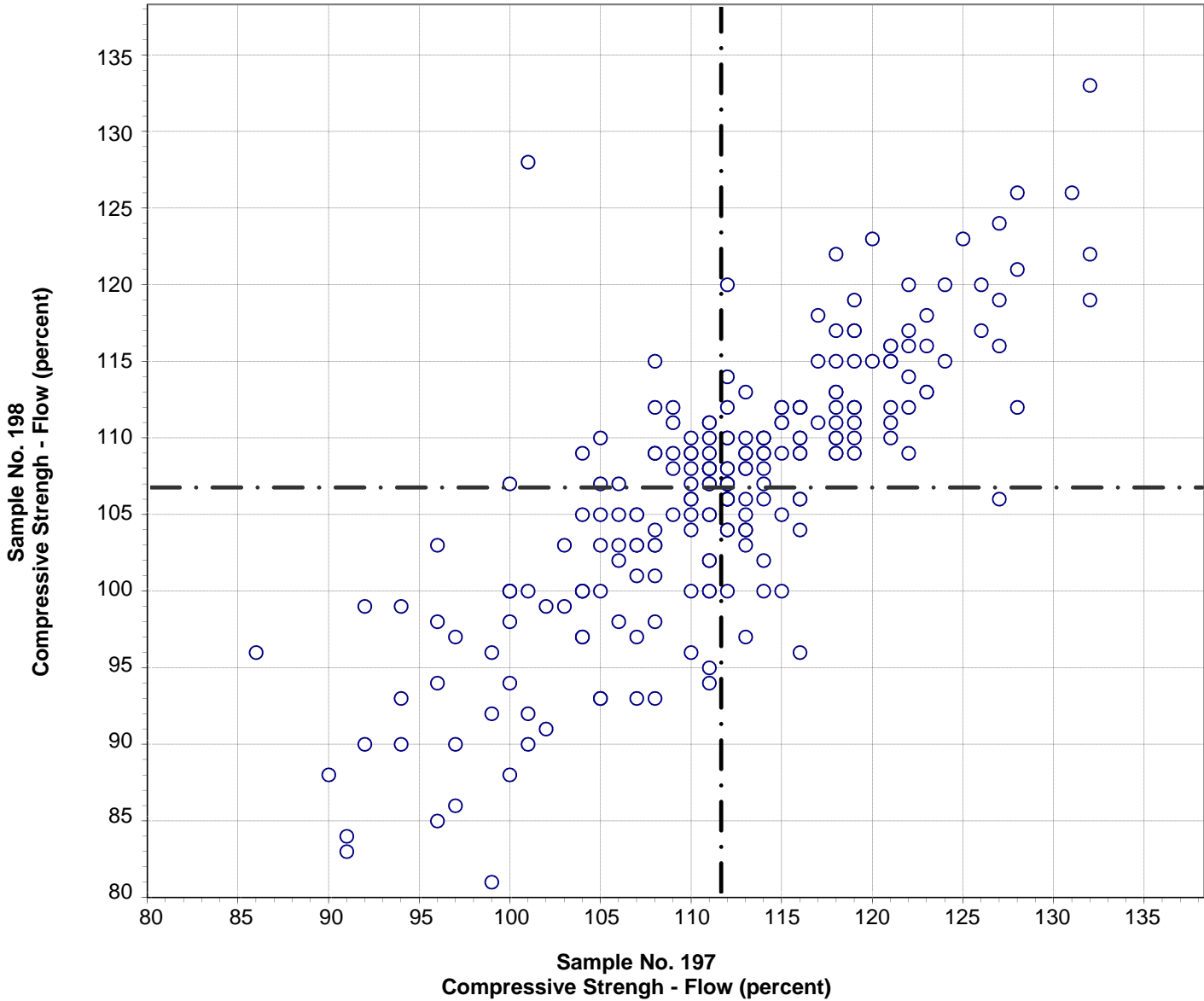
Test No. 211    Compressive Strength - 28 day    224 Points

Sample No. 197	Ave 6218	S.D. 385	C.V. 6.2
Sample No. 198	Ave 6323	S.D. 388	C.V. 6.1

Labs Eliminated: 15, 43, 49, 413, 2254



**CCRL Proficiency Sample Program  
Compressive Strength - Flow  
PORTLAND CEMENT Samples No. 197 and No. 198**

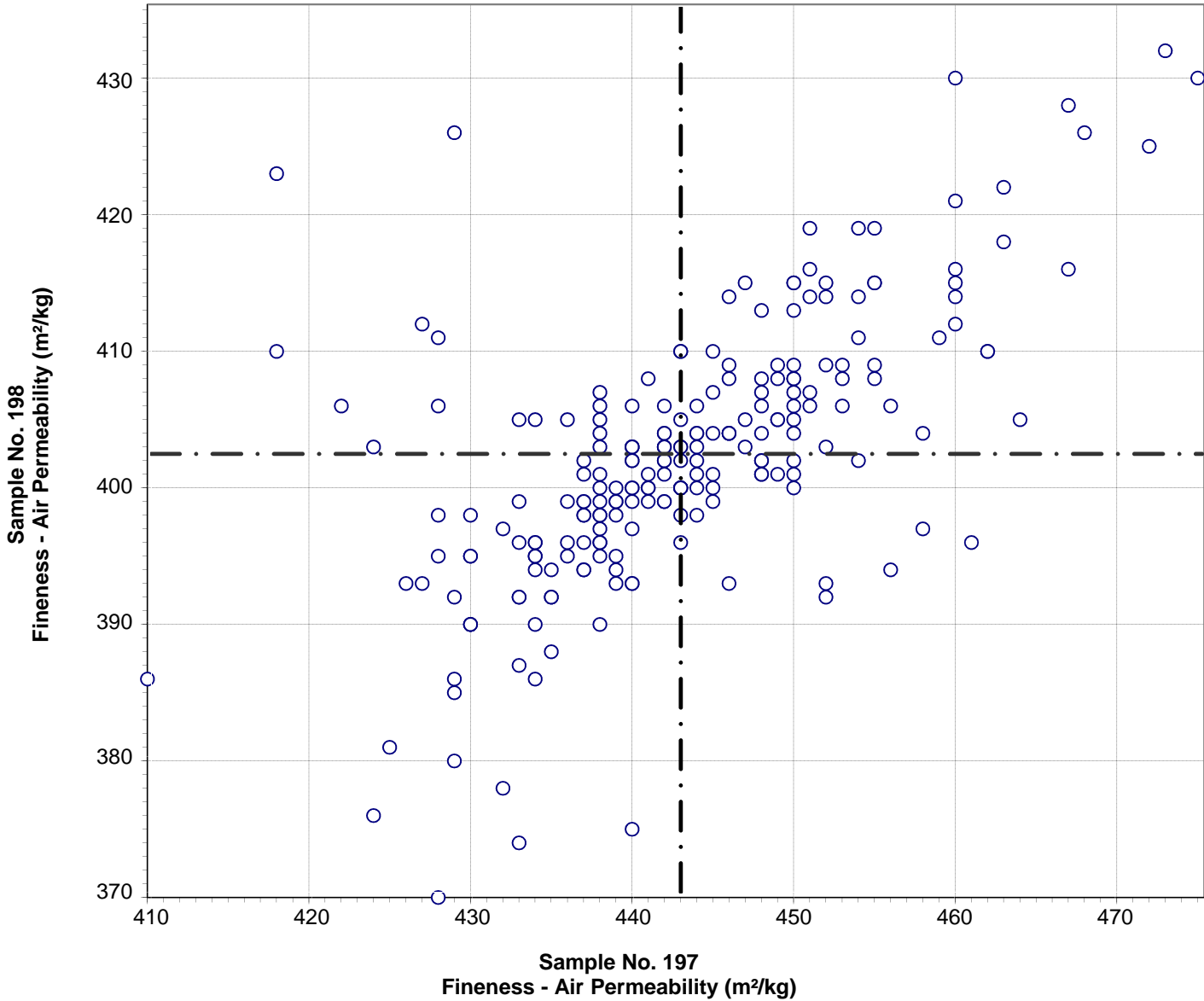


**Test No. 230    Compressive Strength - Flow    221 Points**

Sample No. 197	Ave 112	S.D. 9	C.V. 7.7
Sample No. 198	Ave 107	S.D. 9	C.V. 8.2

Labs Eliminated: 26, 565

**CCRL Proficiency Sample Program  
Fineness - Air Permeability  
PORTLAND CEMENT Samples No. 197 and No. 198**



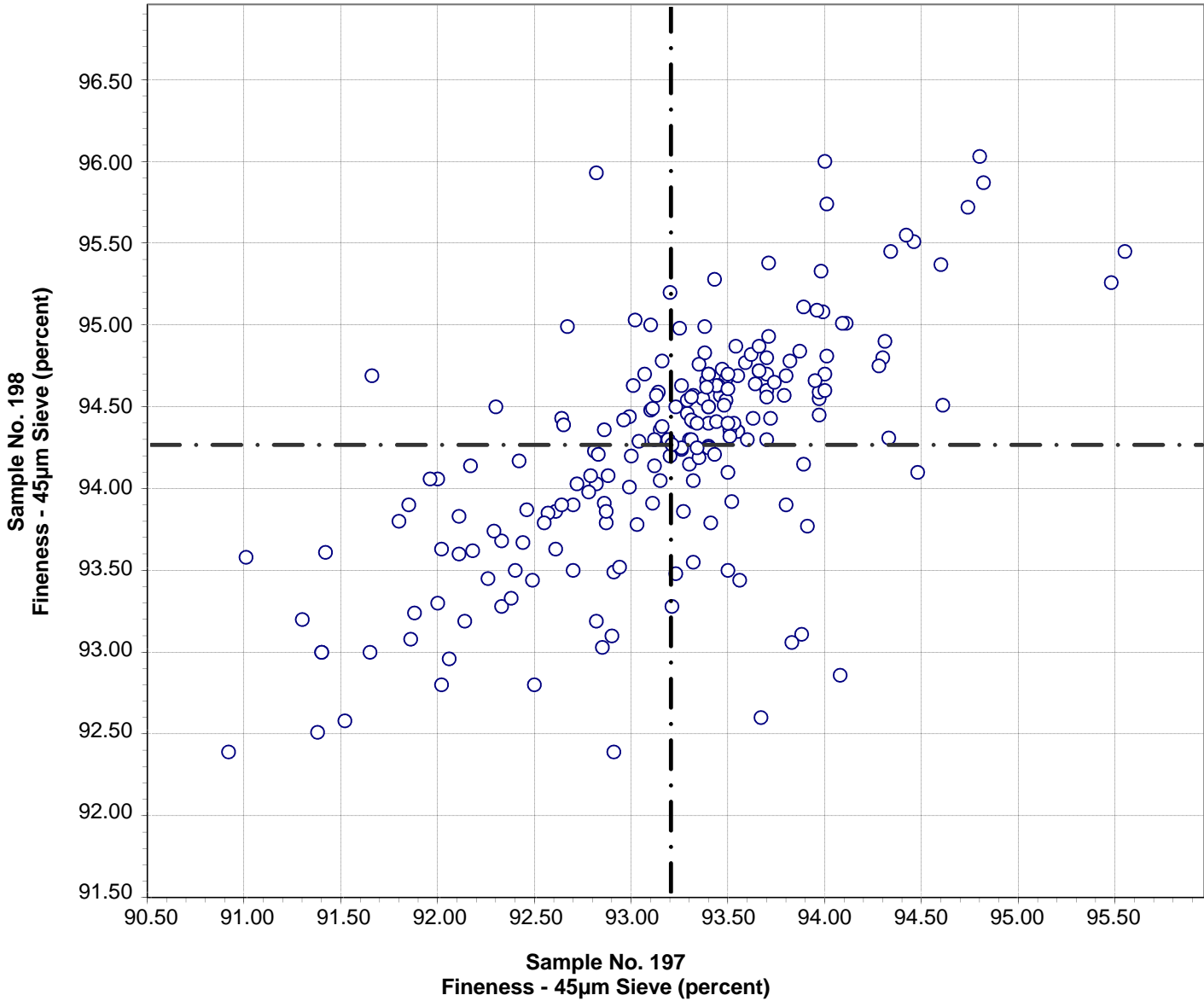
Test No. 270    Fineness - Air Permeability    220 Points

Sample No. 197	Ave 443	S.D. 11	C.V. 2.4
Sample No. 198	Ave 402	S.D. 10	C.V. 2.5

Labs Eliminated: 24, 26, 40, 46, 78, 99, 116, 180, 360, 431, 491, 1435, 3235, 3279, 3607, 3850, 4050

Labs off Diagram: 54

**CCRL Proficiency Sample Program  
Fineness - 45µm Sieve  
PORTLAND CEMENT Samples No. 197 and No. 198**

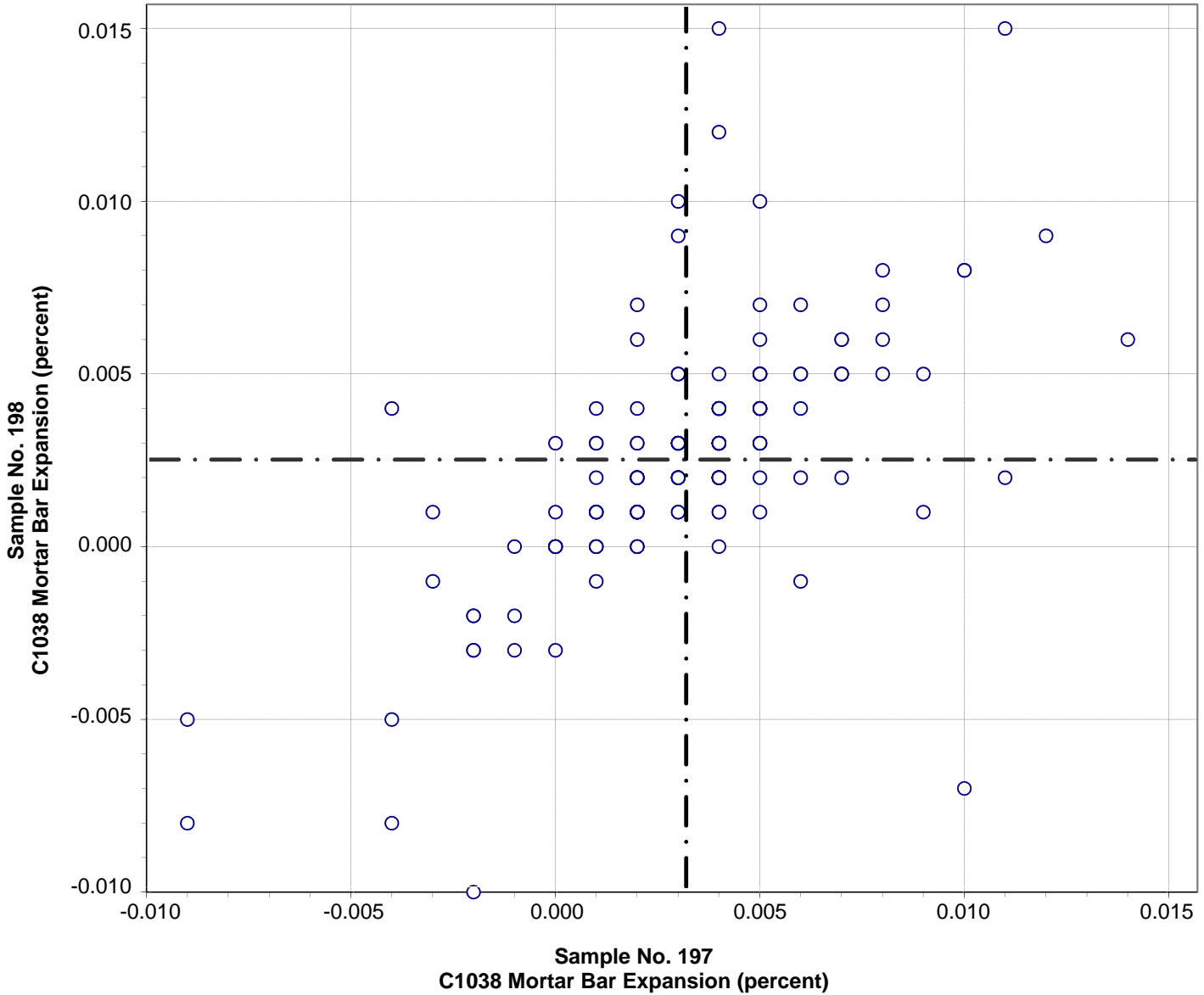


**Test No. 281    Fineness - 45µm Sieve    209 Points**

Sample No. 197	Ave 93.20	S.D. 0.77	C.V. 0.83
Sample No. 198	Ave 94.26	S.D. 0.70	C.V. 0.74

Labs Eliminated: 19, 26, 49, 95, 116, 137, 360, 407, 501, 515, 736, 1603, 2468, 2484, 3752, 4051

**CCRL Proficiency Sample Program  
C1038 Mortar Bar Expansion  
PORTLAND CEMENT Samples No. 197 and No. 198**



Test No. 400 C1038 Mortar Bar Expansion 146 Points

Sample No. 197	Ave 0.003	S.D. 0.003	C.V. 108
Sample No. 198	Ave 0.002	S.D. 0.004	C.V. 152

Labs Eliminated: 51, 74, 116, 146, 221, 491, 565, 611, 1466, 1916, 2466

Labs off Diagram: 142

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Portland Cement Proficiency Samples No. 197 and No. 198

Final Report – Heat of Hydration Results  
 August 31, 2015

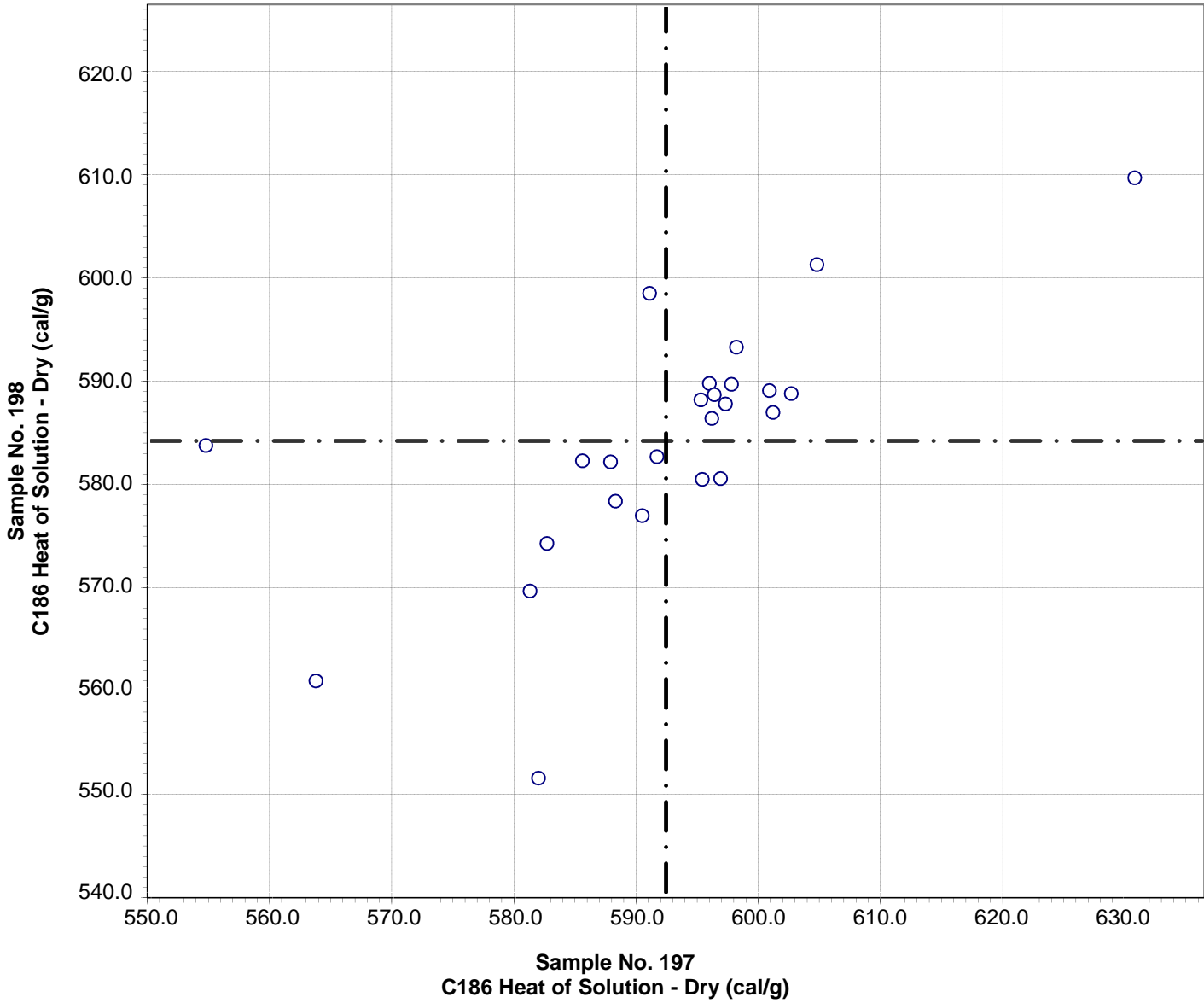
SUMMARY OF RESULTS

Sample No.197

Sample No. 198

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>C186 Heat of Solution - Dry (cal/g)</b>							
	25	592.0	14.0	2.4	584.0	12.0	2.0
No Labs Eliminated for This Test							
<b>C186 Heat of Solution - 7 day (cal/g)</b>							
	25	511.6	12.8	2.5	507.0	10.5	2.1
No Labs Eliminated for This Test							
<b>C186 Heat of Solution 28 day (cal/g)</b>							
	18	503.0	6.7	1.3	498.4	6.7	1.3
	*16	505.1	2.5	0.5	500.0	5.1	1.0
* Labs Eliminated - 143, 1435							
<b>C186 Heat of Hydration - 7 day (cal/g)</b>							
	28	81.0	13.8	17.0	77.2	9.6	12.4
	*27	82.8	10.4	12.6	77.3	9.7	12.6
* Labs Eliminated - 1916							
<b>C186 Heat of Hydration - 28 day (cal/g)</b>							
	21	88.2	11.0	12.5	85.4	9.5	11.1
	*19	90.9	5.2	5.7	87.2	5.6	6.4
* Labs Eliminated - 126, 1916							
<b>C1702 Heat of Hydration - 3 day (J/g)</b>							
	8	260	78	30.4	240	76	31.8
No Labs Eliminated for This Test							
<b>C1702 Heat of Hydration - 7 day (J/g)</b>							
	7	324	55	16.9	303	49	16.0
No Labs Eliminated for This Test							

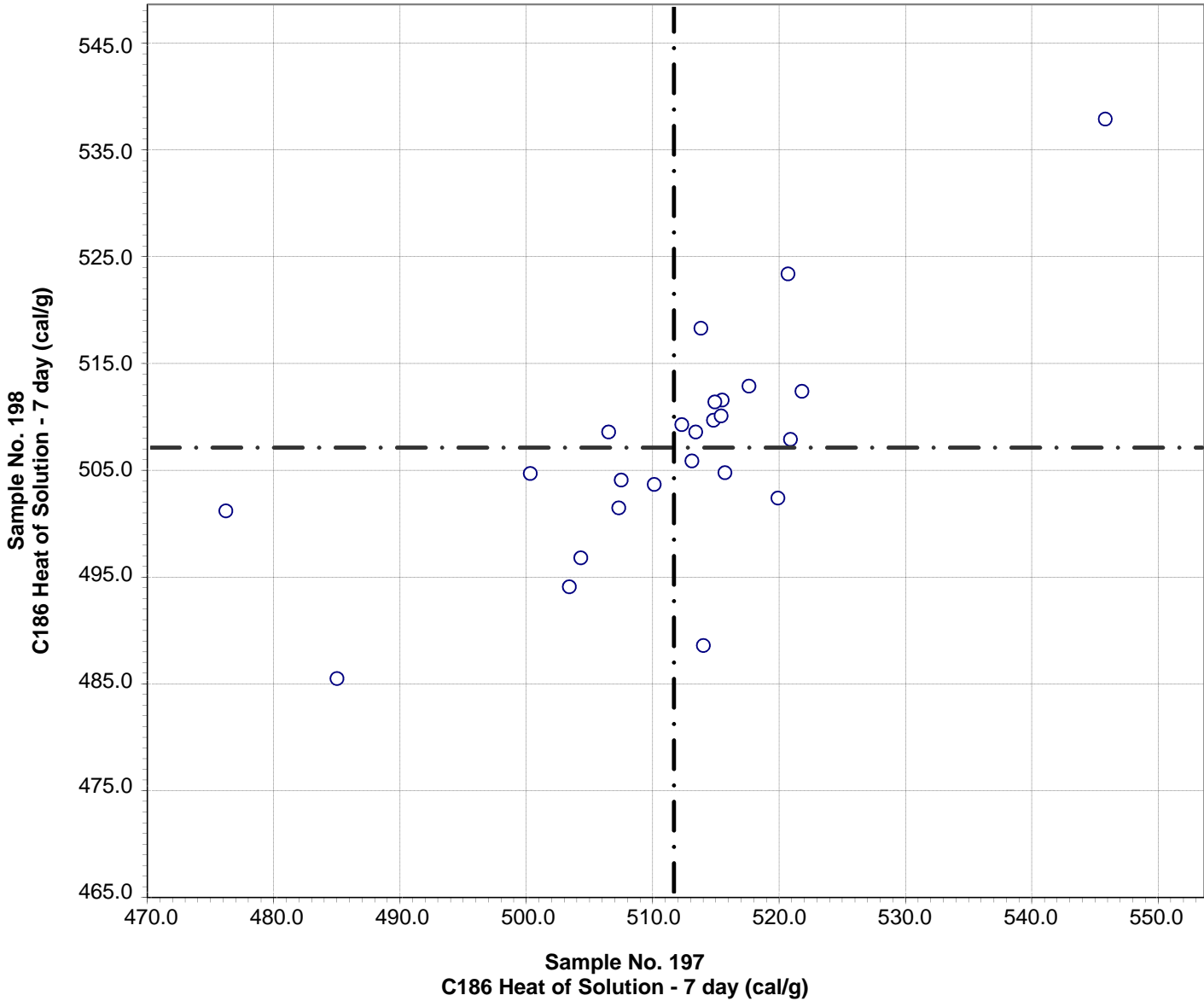
**CCRL Proficiency Sample Program  
C186 Heat of Solution - Dry  
PORTLAND CEMENT Samples No. 197 and No. 198**



Test No. 291 C186 Heat of Solution - Dry 25 Points

Sample No. 197	Ave 592.0	S.D. 14.0	C.V. 2.4
Sample No. 198	Ave 584.0	S.D. 12.0	C.V. 2.0

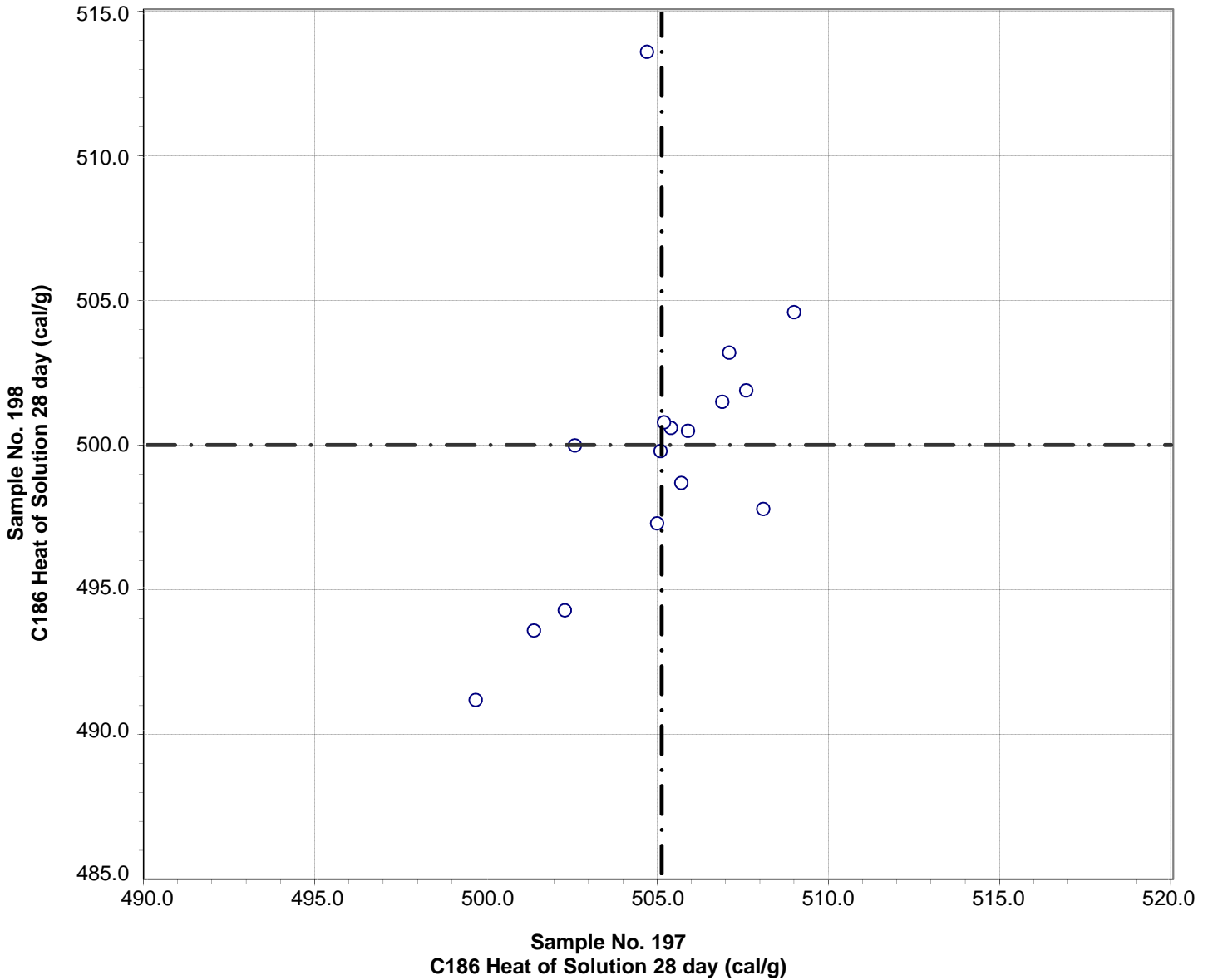
**CCRL Proficiency Sample Program  
C186 Heat of Solution - 7 day  
PORTLAND CEMENT Samples No. 197 and No. 198**



Test No. 292 C186 Heat of Solution - 7 day 25 Points

Sample No. 197	Ave 511.6	S.D. 12.8	C.V. 2.5
Sample No. 198	Ave 507.0	S.D. 10.5	C.V. 2.1

**CCRL Proficiency Sample Program  
C186 Heat of Solution 28 day  
PORTLAND CEMENT Samples No. 197 and No. 198**



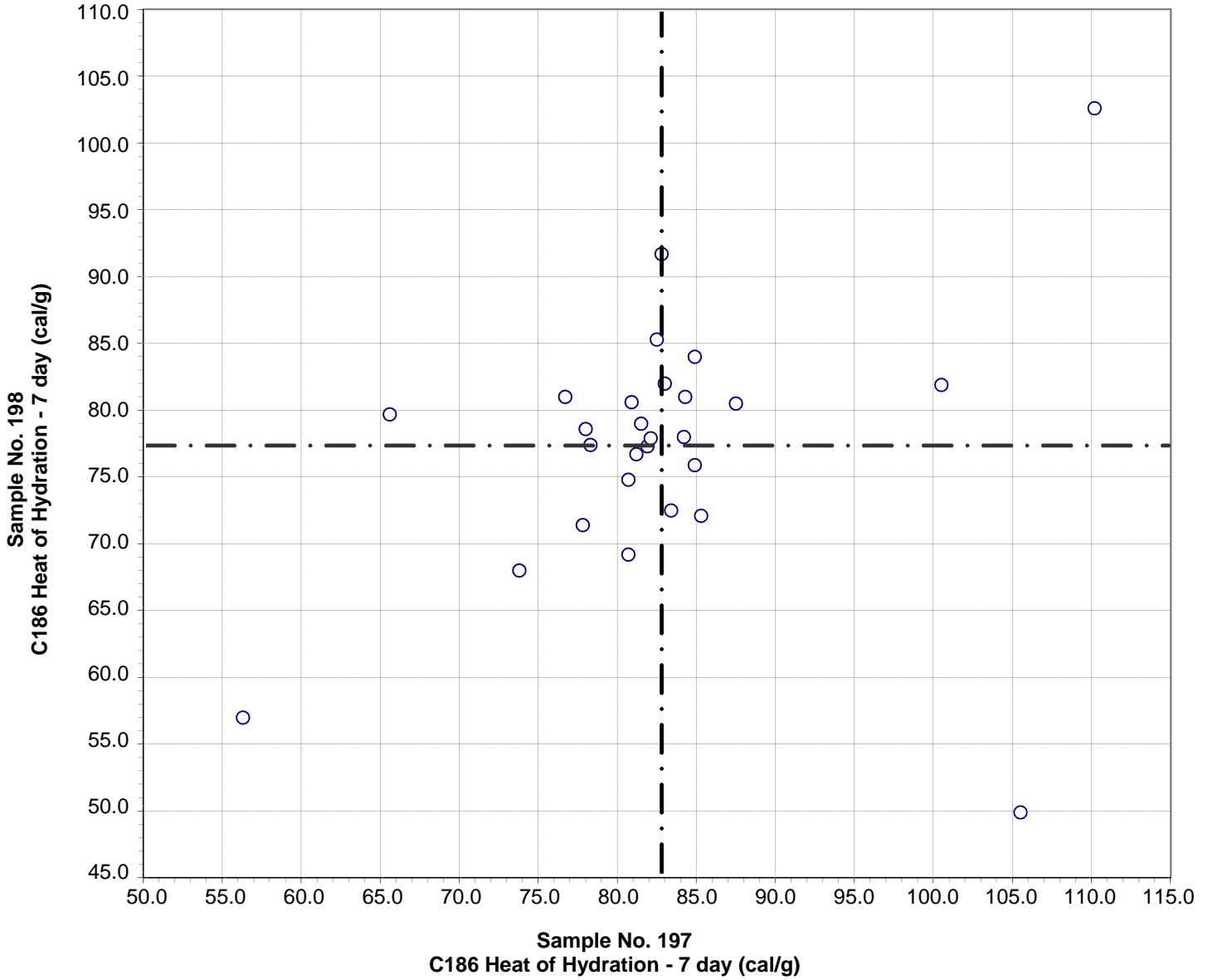
Test No. 301 C186 Heat of Solution 28 day 16 Points

Sample No. 197	Ave 505.1	S.D. 2.5	C.V. 0.5
Sample No. 198	Ave 500.0	S.D. 5.1	C.V. 1.0

Labs Eliminated: 143, 1435



**CCRL Proficiency Sample Program  
C186 Heat of Hydration - 7 day  
PORTLAND CEMENT Samples No. 197 and No. 198**

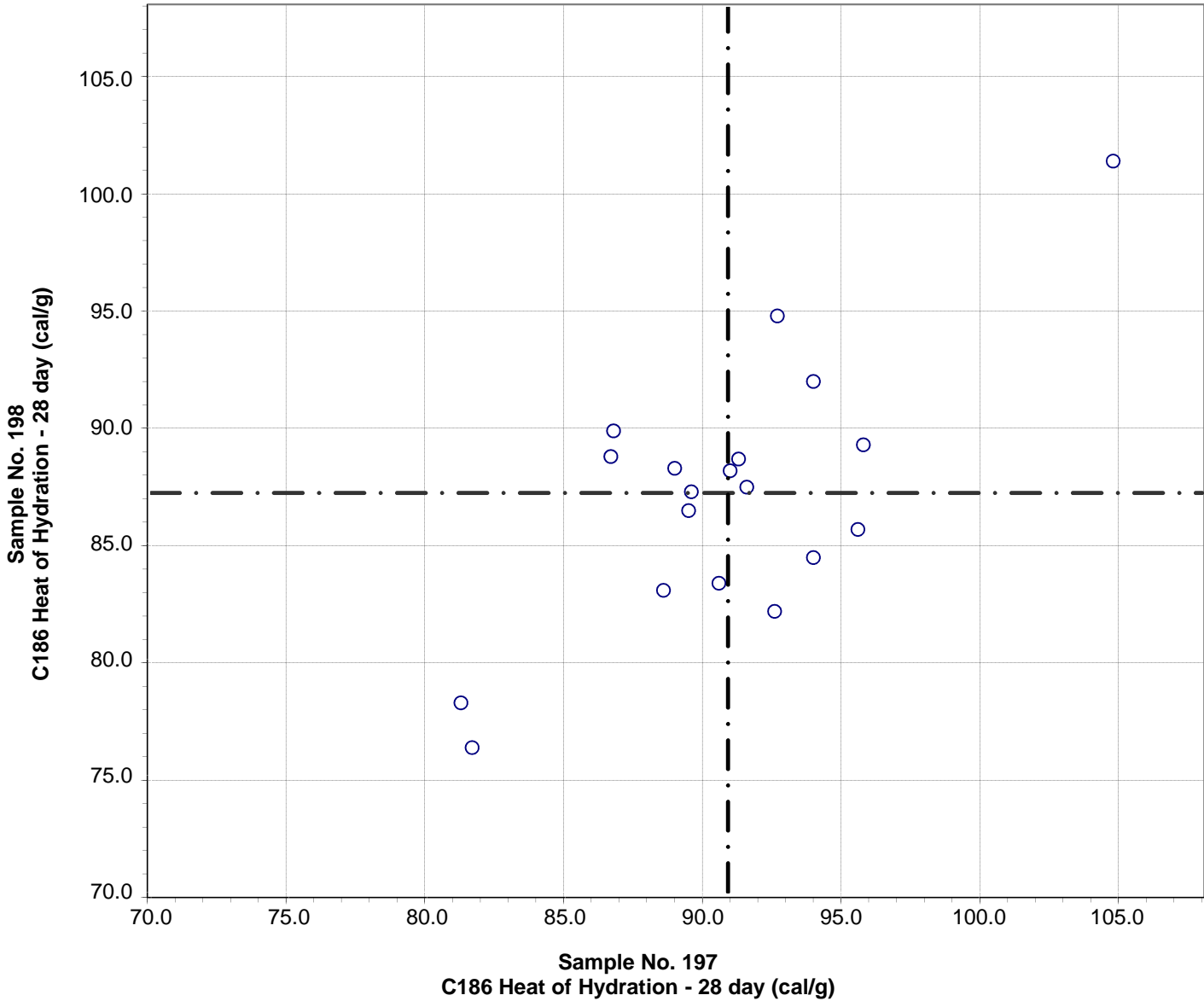


Test No. 290 C186 Heat of Hydration - 7 day 27 Points

Sample No. 197	Ave 82.8	S.D. 10.4	C.V. 12.6
Sample No. 198	Ave 77.3	S.D. 9.7	C.V. 12.6

Labs Eliminated: 1916

**CCRL Proficiency Sample Program  
C186 Heat of Hydration - 28 day  
PORTLAND CEMENT Samples No. 197 and No. 198**

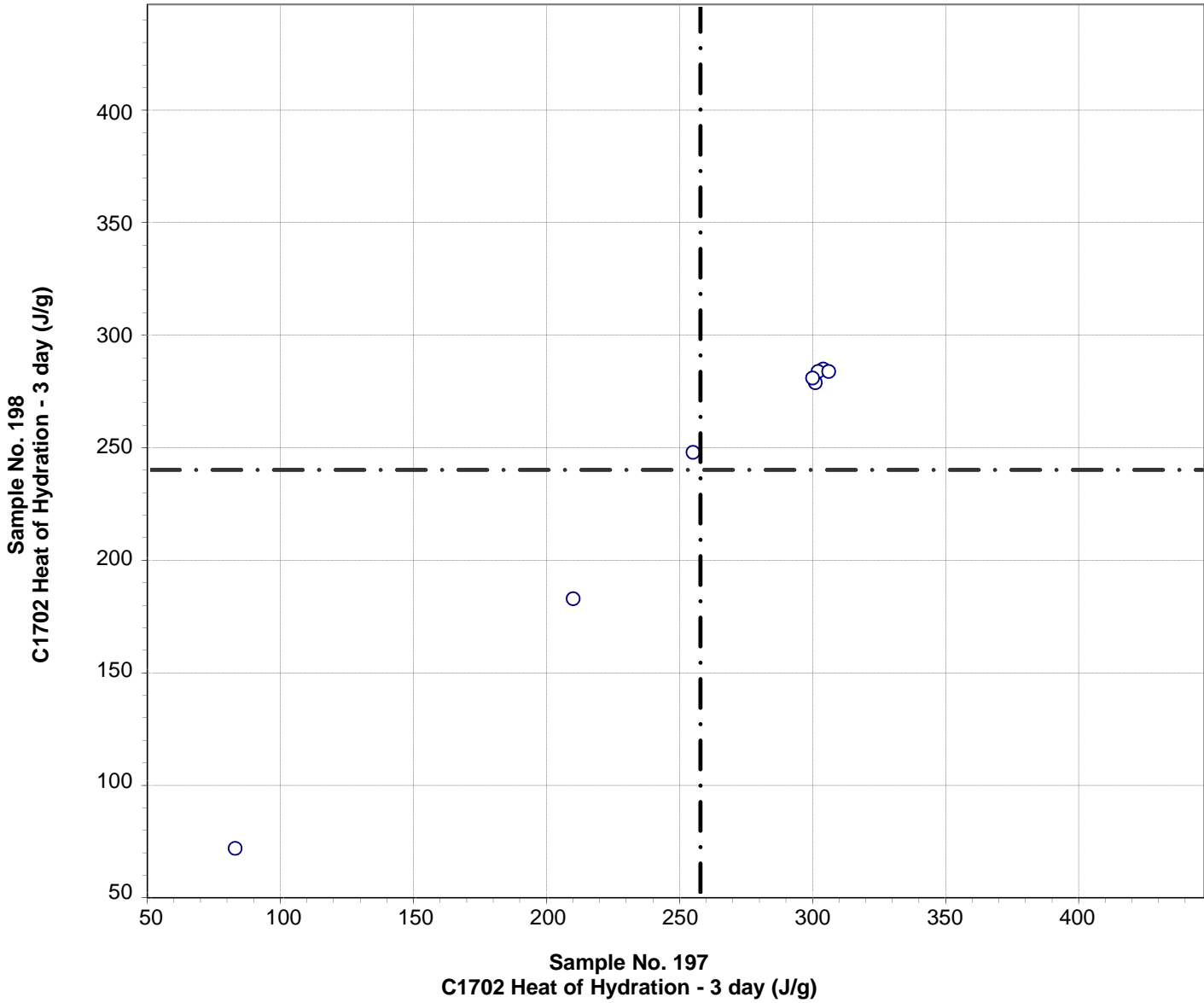


Test No. 300 C186 Heat of Hydration - 28 day 19 Points

Sample No. 197	Ave 90.9	S.D. 5.2	C.V. 5.7
Sample No. 198	Ave 87.2	S.D. 5.6	C.V. 6.4

Labs Eliminated: 126, 1916

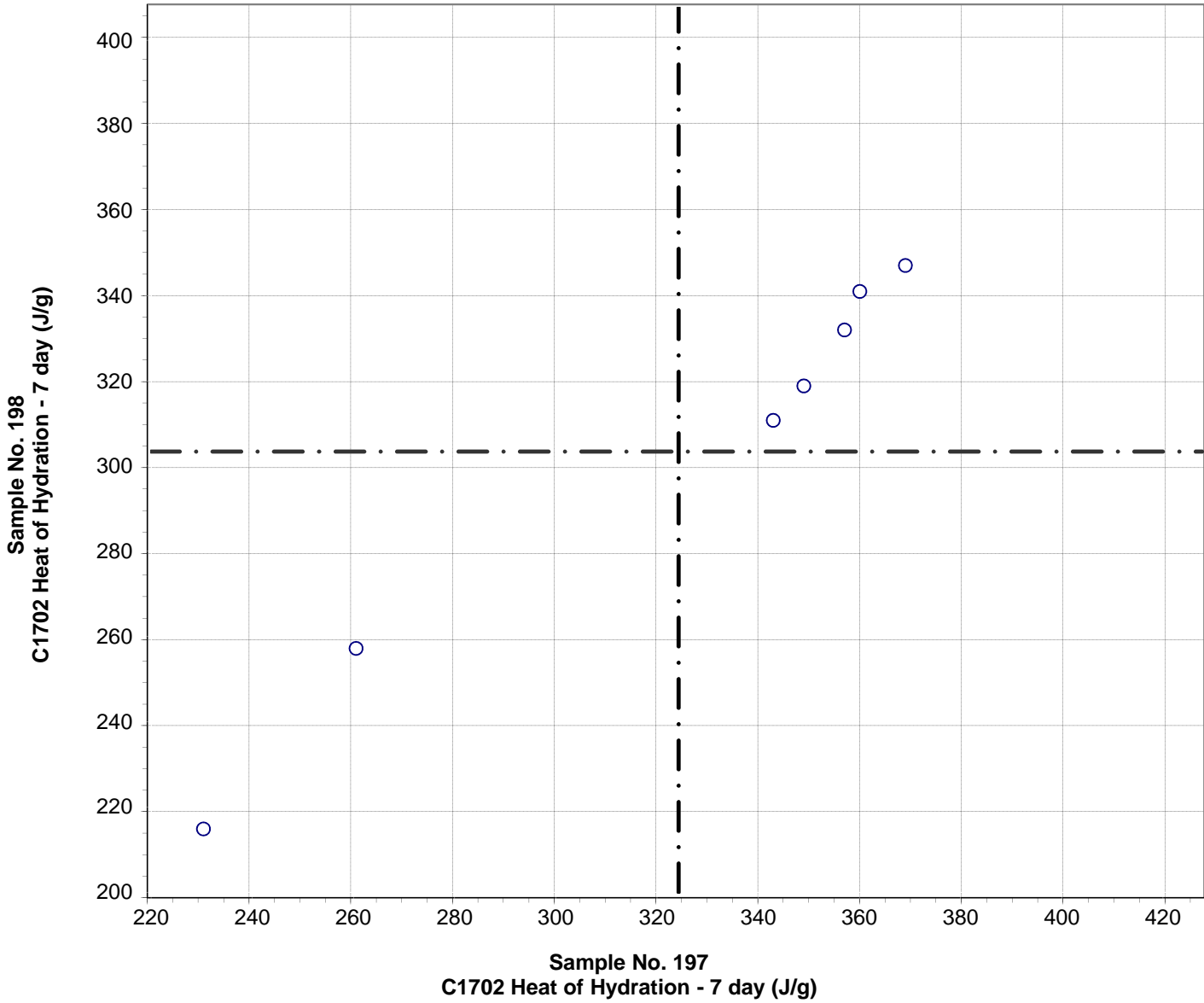
**CCRL Proficiency Sample Program  
C1702 Heat of Hydration - 3 day  
PORTLAND CEMENT Samples No. 197 and No. 198**



Test No. 500 C1702 Heat of Hydration - 3 day 8 Points

Sample No. 197	Ave 260	S.D. 78	C.V. 30.4
Sample No. 198	Ave 240	S.D. 76	C.V. 31.8

**CCRL Proficiency Sample Program  
C1702 Heat of Hydration - 7 day  
PORTLAND CEMENT Samples No. 197 and No. 198**



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

Sample No. 197	Ave 324	S.D. 55	C.V. 16.9
Sample No. 198	Ave 303	S.D. 49	C.V. 16.0