

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

**Final Report**  
**Blended Cement Proficiency Samples**  
**Number 81 and Number 82**



**CCRL**  
Cement and Concrete  
Reference Laboratory

May 2018

[www.crl.us](http://www.crl.us)

---



**CCRL**  
Cement and Concrete  
Reference Laboratory

[www.ccrl.us](http://www.ccrl.us)

May 1, 2018

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

**SUBJECT: Final Report on Blended Cement Proficiency Samples No. 81 and No. 82**

Following is the final report for the current pair of CCRL **Blended Cement** Proficiency Samples which were distributed in February 2018. Both cements were an ASTM C595 Blended Hydraulic Cement. Sample No. 81 was a Type IS (30) and No. 82 was a Type IS (40).

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/>.

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 of CCRL EXTRA Samples.

It is presently anticipated that the next Blended Cement Proficiency Samples will be distributed in February 2018.

Sincerely,

Kent Niedzielski  
Program Manager  
Proficiency Sample Programs  
Cement and Concrete Reference Laboratory

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

**FROM: Kent Niedzielski, Program Manager, Proficiency Sample Programs**

**SUBJECT: Explanation of Final Report on Results of Tests for Blended Cement Proficiency Samples No. 81 and No. 82**

This letter, and the material included with it, constitutes the final report and summary of results for the current pair of Blended Cement Proficiency Samples, which were distributed in February 2017. 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.

---

<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.*

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 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**  
Blended Cement Proficiency Samples No. 81 and No. 82

Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	Sample No. 81				Sample No. 82		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Silicon Dioxide (percent)</b>							
	89	23.35	0.56	2.4	23.93	0.48	2.0
	*87	23.35	0.36	1.5	23.95	0.32	1.3
* Labs Eliminated - 413, 3910							
<b>Aluminum Oxide (percent)</b>							
	86	7.06	0.33	4.7	7.15	0.22	3.1
	*82	7.05	0.17	2.5	7.17	0.17	2.4
* Labs Eliminated - 125, 413, 3503, 3910							
<b>Ferric Oxide (percent)</b>							
	87	2.15	0.09	4.0	2.02	0.09	4.5
	*84	2.15	0.07	3.1	2.01	0.07	3.6
* Labs Eliminated - 2463, 3431, 3930							
<b>Calcium Oxide (percent)</b>							
	88	56.38	0.64	1.13	56.04	0.58	1.04
	*85	56.46	0.43	0.77	56.05	0.45	0.81
* Labs Eliminated - 413, 3297, 3910							
<b>Magnesium Oxide (percent)</b>							
	88	3.68	0.19	5.1	3.86	0.22	5.6
	*82	3.69	0.09	2.3	3.89	0.09	2.4
* Labs Eliminated - 246, 1715, 3255, 3910, 3930, 4310							
<b>Sulfur Trioxide - Corrected for S (percent)</b>							
	40	3.01	0.63	21	2.88	0.67	23
	*36	3.17	0.28	9	3.06	0.29	10
* Labs Eliminated - 19, 23, 25, 39							
<b>Sulfur Trioxide - Uncorrected for S (percent)</b>							
	81	3.45	0.25	7	3.37	0.26	8
	81	3.45	0.25	7	3.37	0.26	8
No Labs Eliminated for This Test							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
Blended Cement Proficiency Samples No. 81 and No. 82

Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	Sample No. 81				Sample No. 82		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Loss on Ignition - Corrected for S (percent)</b>							
	44	1.96	0.34	18	1.82	0.33	18
	*43	1.99	0.26	13	1.85	0.28	15
* Lab Eliminated - 975							
<b>Loss on Ignition - Uncorrected for S (percent)</b>							
	85	1.71	0.12	7.0	1.54	0.25	15.9
	*83	1.70	0.10	5.7	1.51	0.09	6.2
* Labs Eliminated - 2462, 2466							
<b>Sodium Oxide (percent)</b>							
	84	0.299	0.047	16	0.299	0.053	18
	*79	0.299	0.034	11	0.298	0.035	12
* Labs Eliminated - 246, 413, 2463, 3503, 3911							
<b>Potassium Oxide (percent)</b>							
	84	0.88	0.04	4.7	0.84	0.05	5.4
	*83	0.89	0.03	3.4	0.84	0.04	4.4
* Lab Eliminated - 24							
<b>Titanium Dioxide (percent)</b>							
	70	0.33	0.028	8.5	0.34	0.033	9.9
	*67	0.33	0.014	4.2	0.34	0.015	4.3
* Labs Eliminated - 246, 2463, 3503							
<b>Phosphorus Pentoxide (percent)</b>							
	72	0.202	0.092	45.6	0.193	0.090	46.6
	*69	0.192	0.021	10.8	0.182	0.018	10.0
* Labs Eliminated - 2463, 2466, 3911							
<b>Zinc Oxide (percent)</b>							
	40	0.050	0.008	16.2	0.045	0.009	18.8
	*35	0.051	0.002	4.3	0.045	0.002	4.9
* Labs Eliminated - 7, 413, 2463, 2477, 2491							

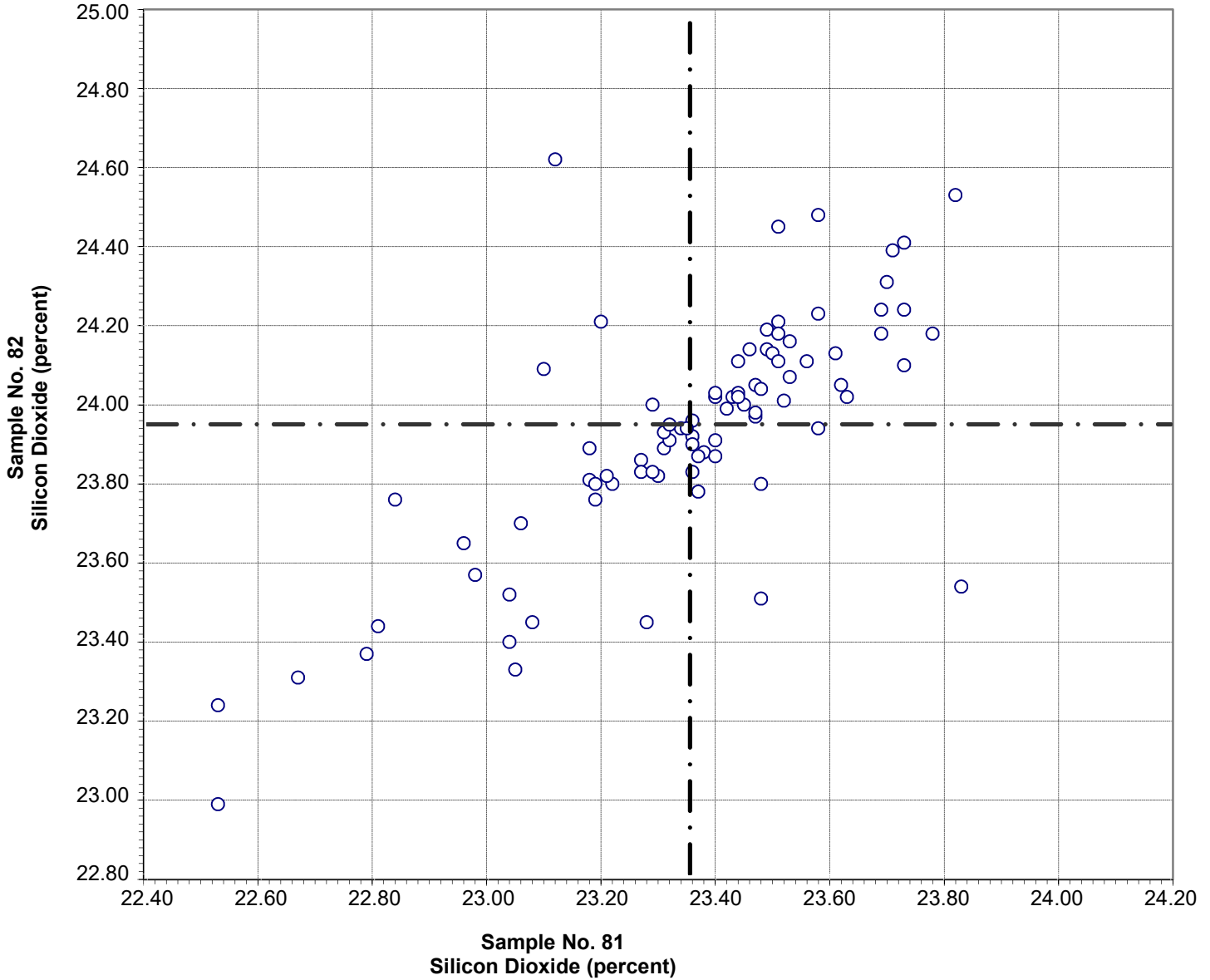
**CCRL PROFICIENCY SAMPLE PROGRAM**  
Blended Cement Proficiency Samples No. 81 and No. 82

Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	Sample No. 81				Sample No. 82		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Manganic Oxide (percent)</b>							
	55	0.155	0.011	6.9	0.160	0.013	8.0
	*50	0.155	0.007	4.2	0.160	0.007	4.5
	* Labs Eliminated - 101, 354, 413, 2491, 3503						
<b>Sulfide Sulfur (percent)</b>							
	30	0.290	0.257	89	0.313	0.258	83
	*25	0.224	0.070	31	0.239	0.079	33
	* Labs Eliminated - 25, 34, 39, 542, 2462						
<b>Chloride (percent)</b>							
	41	0.034	0.017	49	0.033	0.017	53
	*40	0.032	0.013	41	0.031	0.014	45
	* Lab Eliminated - 19						
<b>Insoluble Residue (percent)</b>							
	83	0.65	0.16	25	0.61	0.20	33
	*76	0.63	0.09	14	0.57	0.09	16
	* Labs Eliminated - 24, 36, 124, 246, 497, 695, 3249						
<b>Chromium Oxide (percent)</b>							
	37	0.010	0.006	62	0.008	0.007	79
	*34	0.008	0.002	24	0.008	0.002	26
	* Labs Eliminated - 148, 2477, 3911						

**CCRL Proficiency Sample Program  
Silicon Dioxide  
BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 10 Silicon Dioxide 85 Points

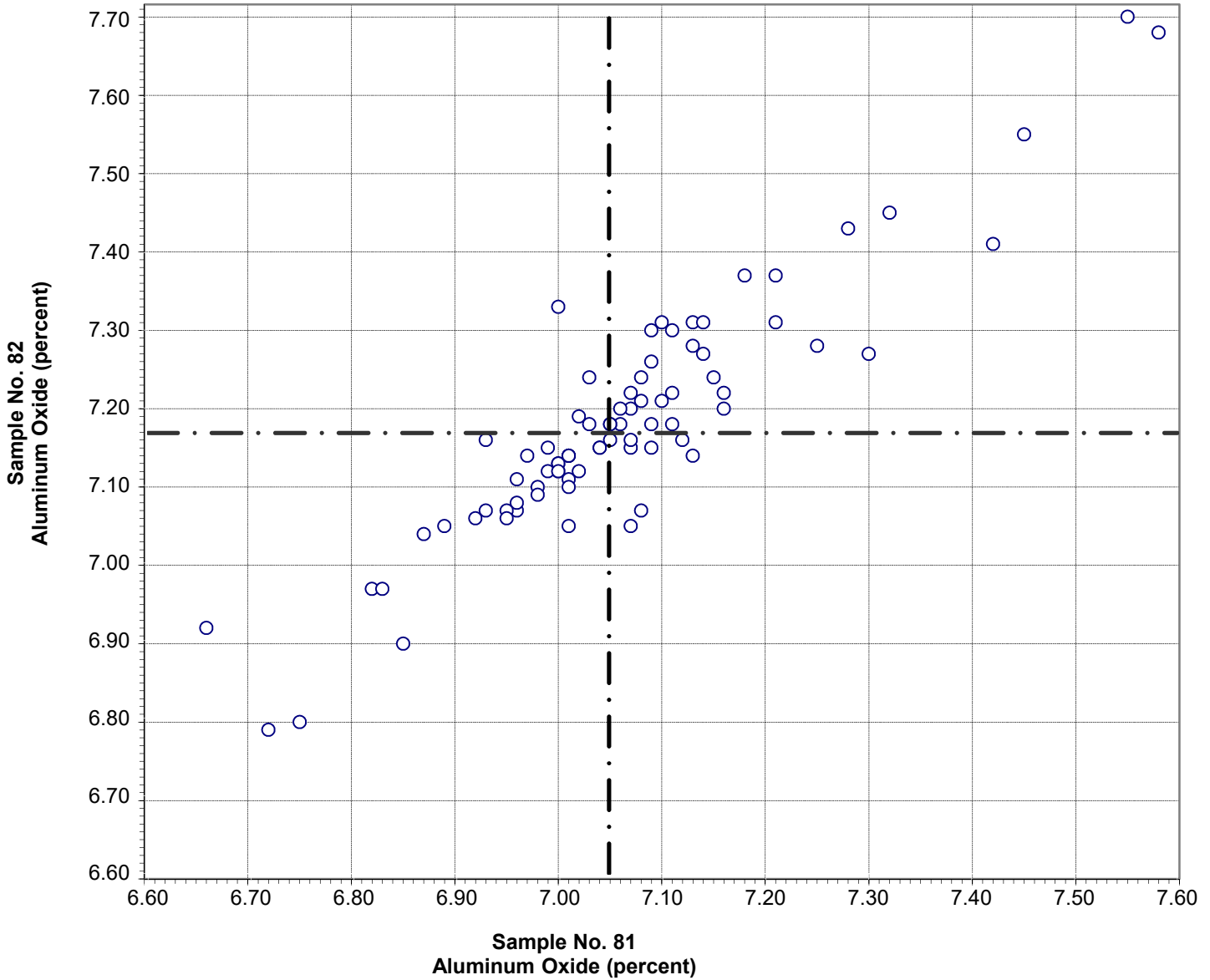
Sample No. 81	Ave 23.35	S.D. 0.36	C.V. 1.5
Sample No. 82	Ave 23.95	S.D. 0.32	C.V. 1.3

Labs Eliminated: 413, 3910

Labs off Diagram: 47, 125



**CCRL Proficiency Sample Program  
Aluminum Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**



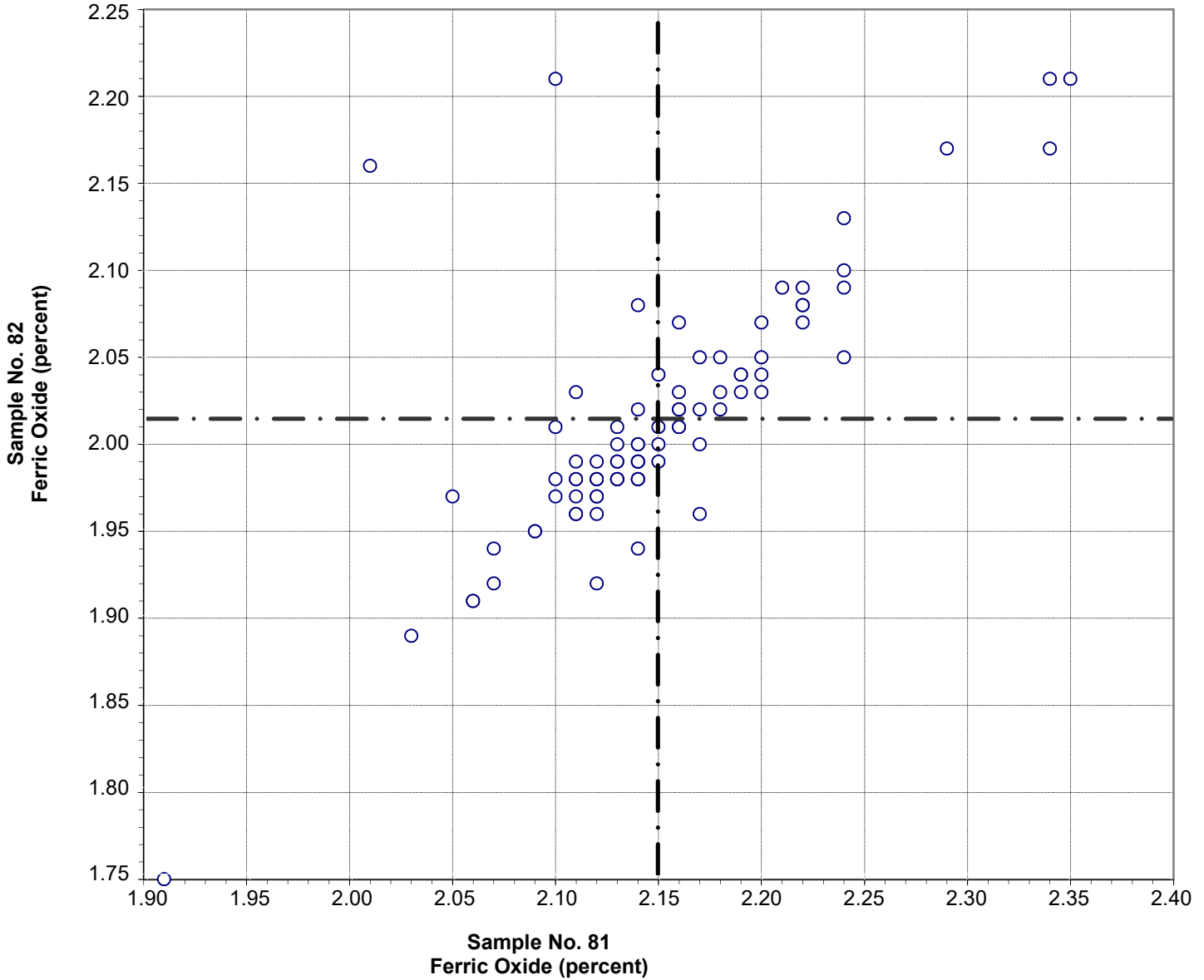
Test No. 21 Aluminum Oxide 80 Points

Sample No. 81	Ave 7.05	S.D. 0.17	C.V. 2.5
Sample No. 82	Ave 7.17	S.D. 0.17	C.V. 2.4

Labs Eliminated: 125, 413, 3503, 3910

Labs off Diagram: 284, 4310

**CCRL Proficiency Sample Program  
 Ferric Oxide  
 BLENDED CEMENT Samples No. 81 and No. 82**

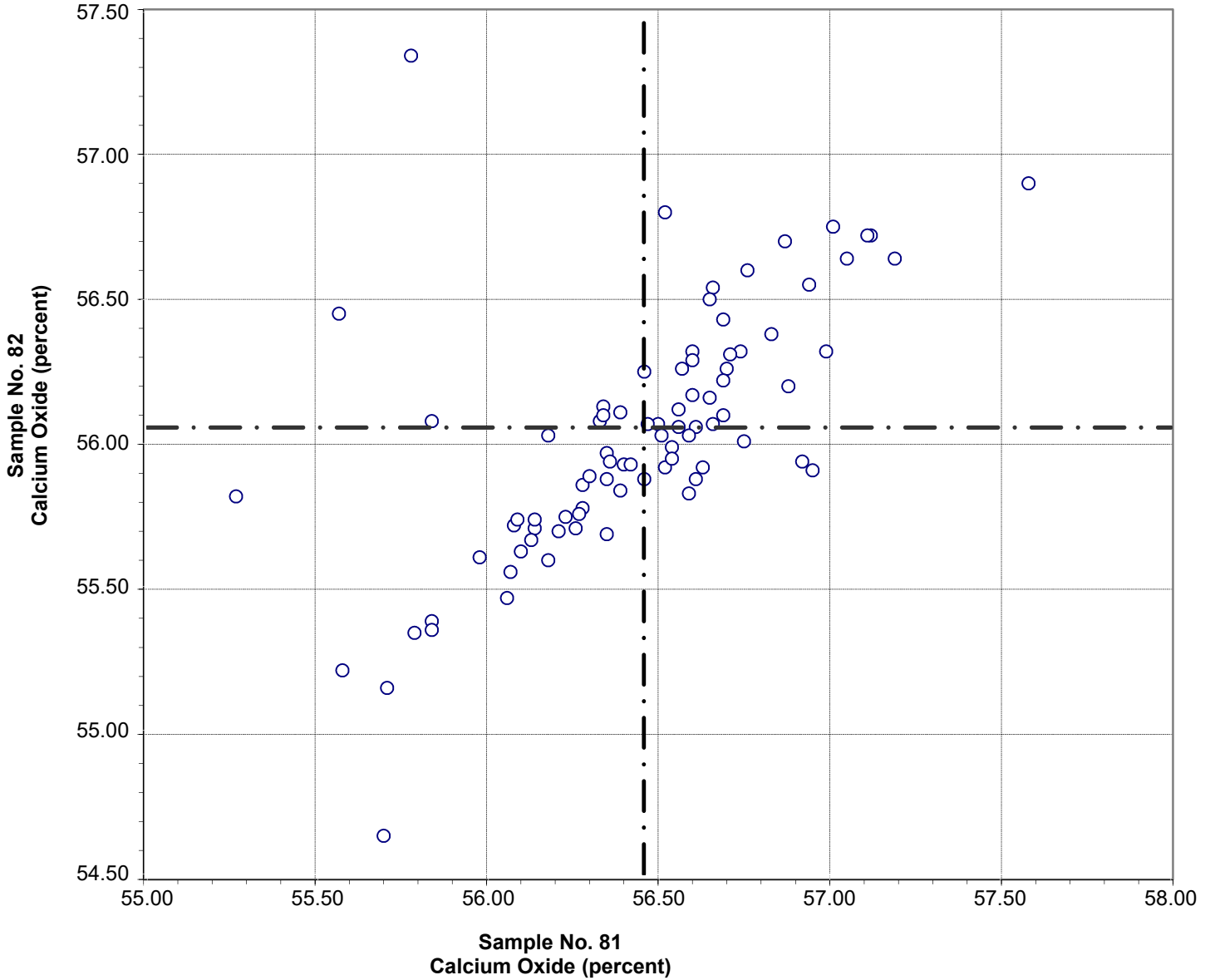


Test No. 30 Ferric Oxide 84 Points

Sample No. 81	Ave 2.15	S.D. 0.07	C.V. 3.1
Sample No. 82	Ave 2.01	S.D. 0.07	C.V. 3.6

Labs Eliminated: 2463, 3431, 3930

**CCRL Proficiency Sample Program  
Calcium Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**



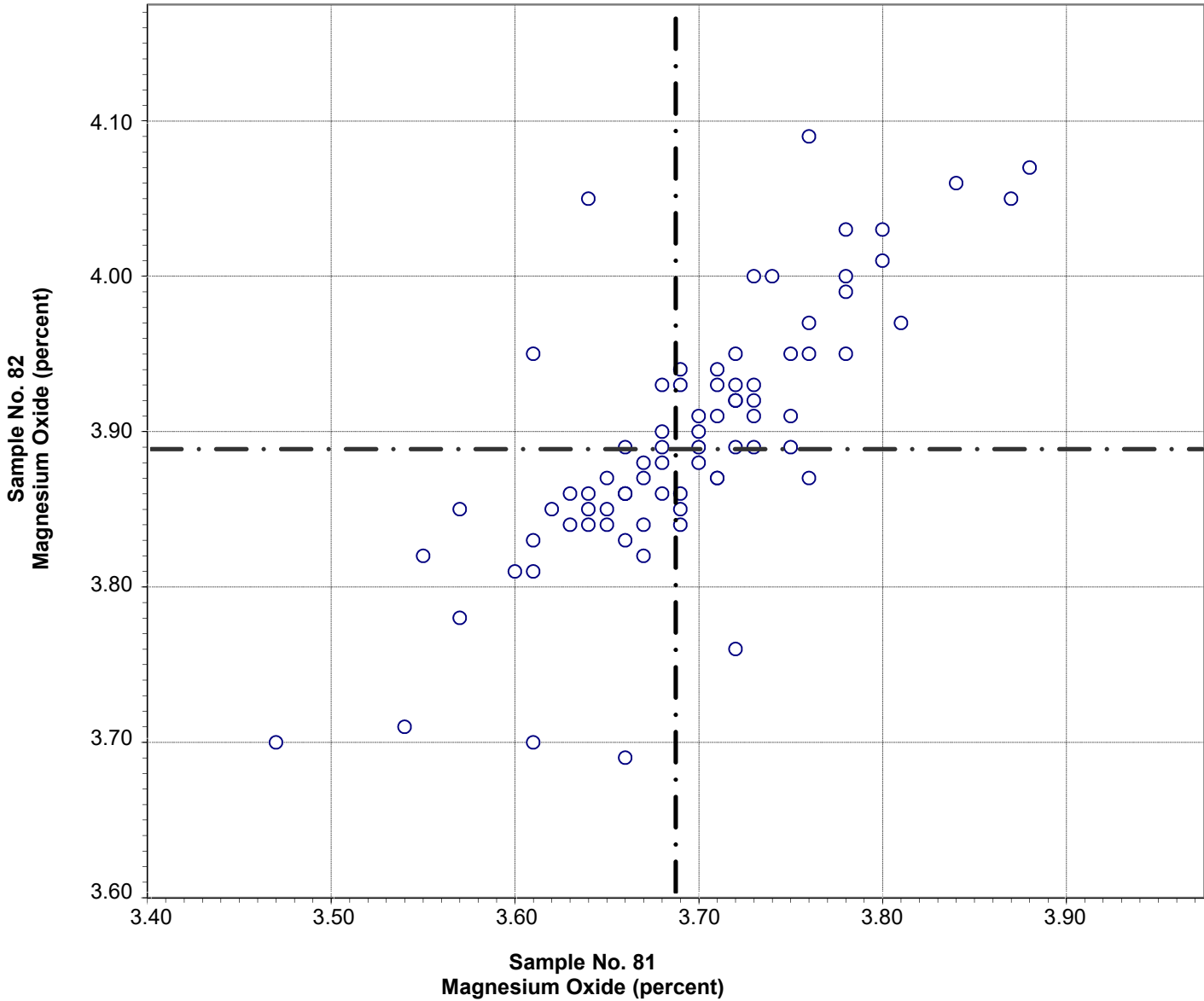
Test No. 40    Calcium Oxide    84 Points

Sample No. 81	Ave 56.46	S.D. 0.43	C.V. 0.77
Sample No. 82	Ave 56.05	S.D. 0.45	C.V. 0.81

Labs Eliminated: 413, 3297, 3910

Labs off Diagram: 3503

**CCRL Proficiency Sample Program  
Magnesium Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 50    Magnesium Oxide    79 Points

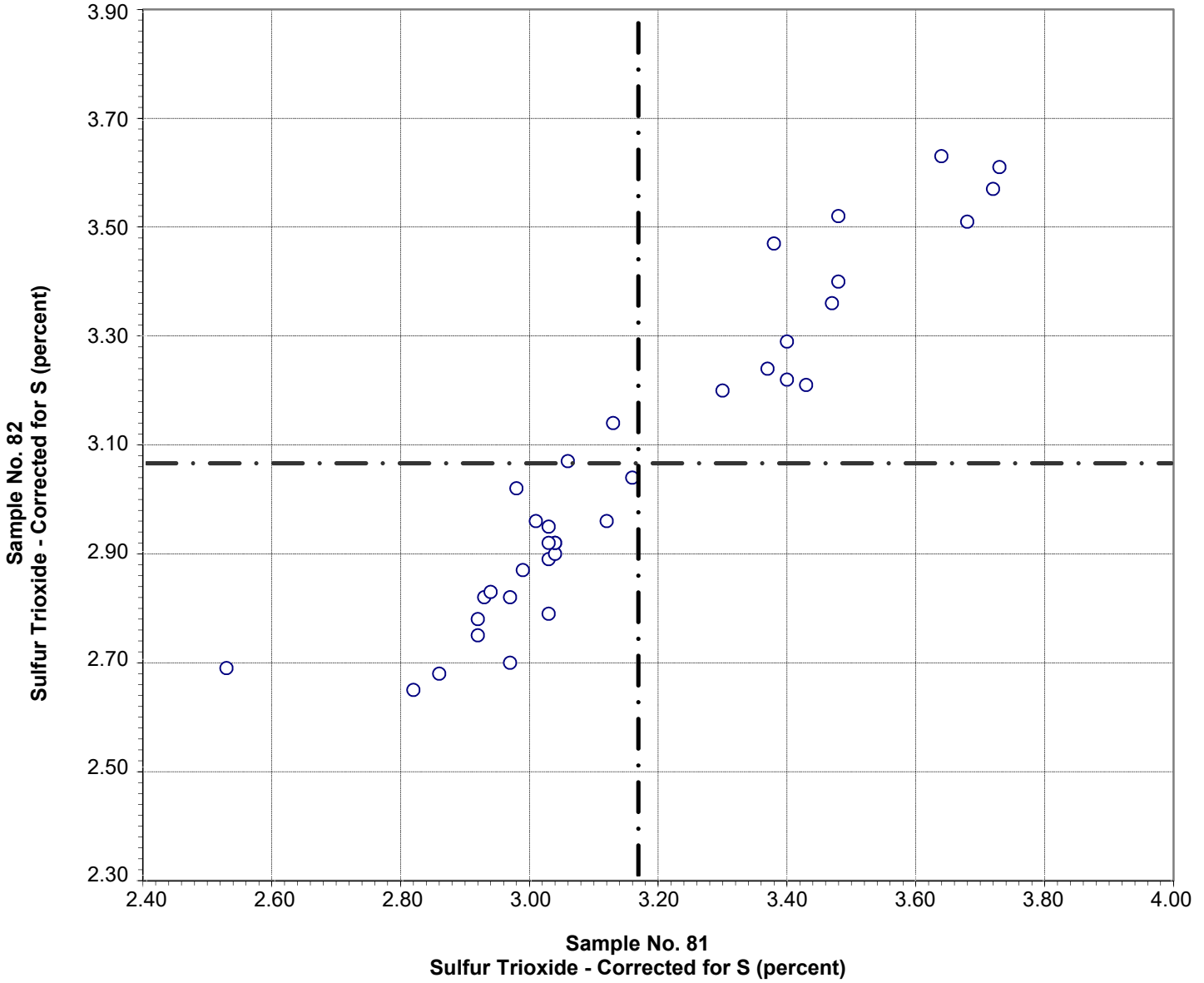
Sample No. 81    Ave 3.69    S.D. 0.09    C.V. 2.3

Sample No. 82    Ave 3.89    S.D. 0.09    C.V. 2.4

Labs Eliminated: 246, 1715, 3255, 3910, 3930, 4310

Labs off Diagram: 35, 440, 695

**CCRL Proficiency Sample Program  
Sulfur Trioxide - Corrected for S  
BLENDED CEMENT Samples No. 81 and No. 82**

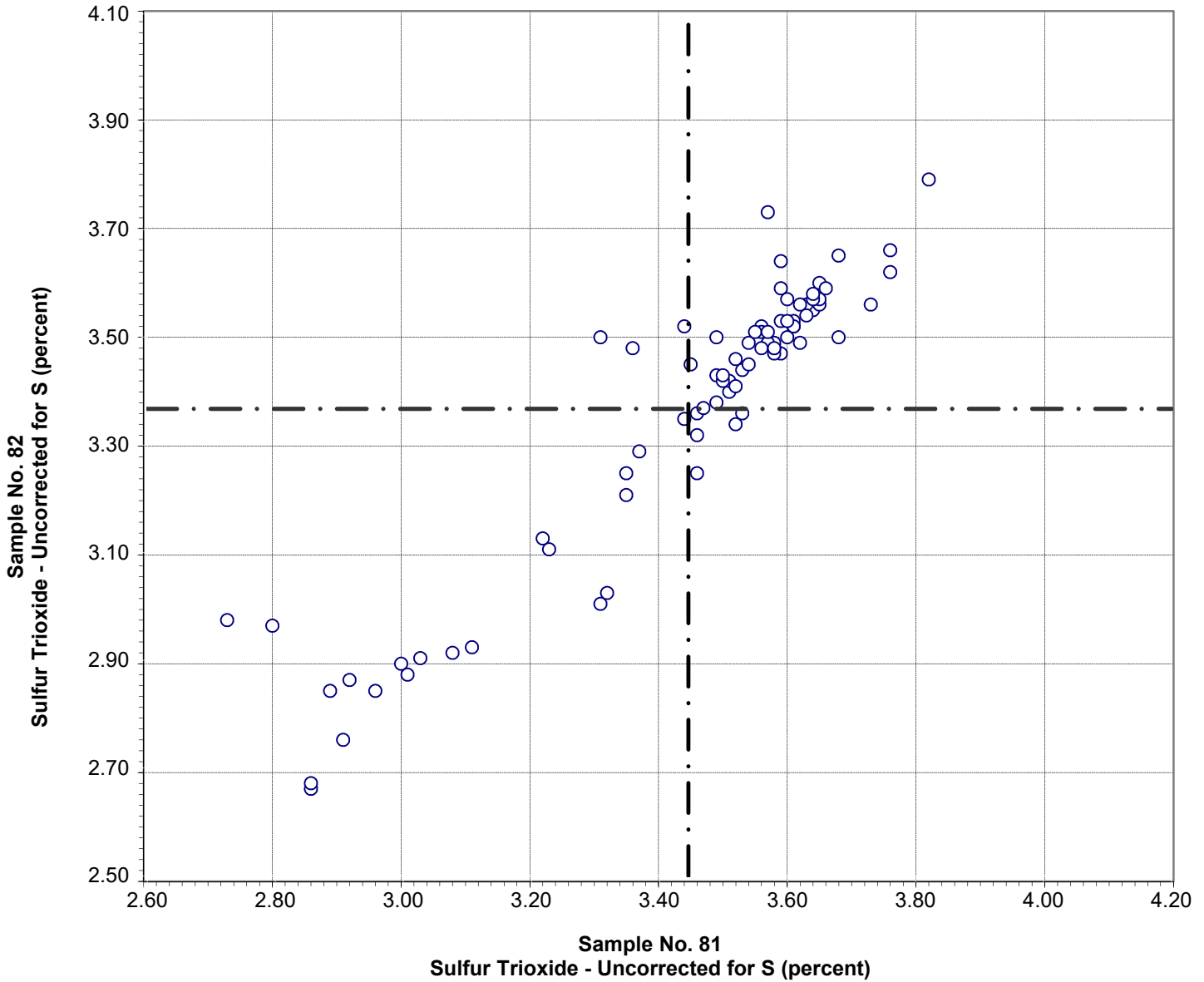


Test No. 61 Sulfur Trioxide - Corrected for S 36 Points

Sample No. 81	Ave 3.17	S.D. 0.28	C.V. 9
Sample No. 82	Ave 3.06	S.D. 0.29	C.V. 10

Labs Eliminated: 19, 23, 25, 39

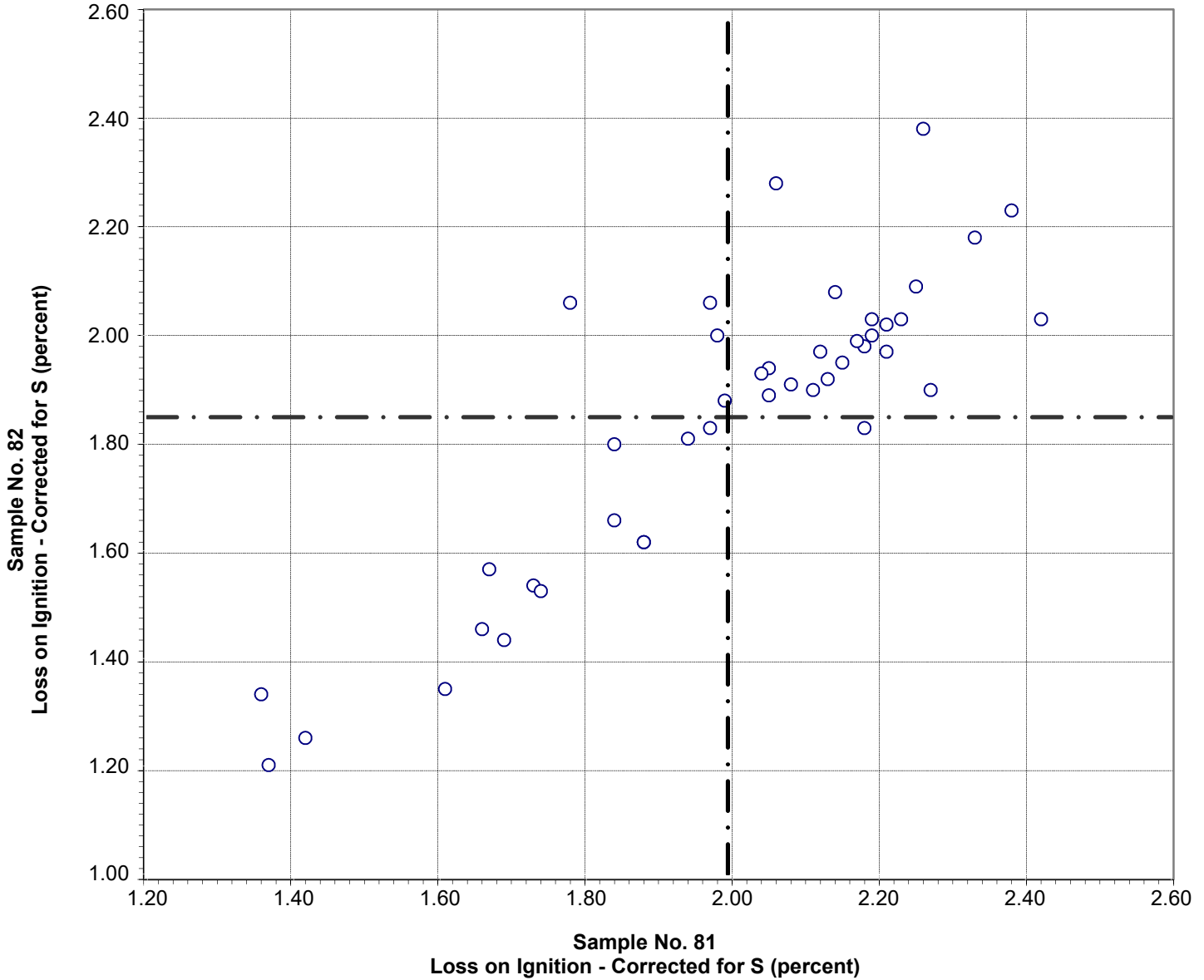
**CCRL Proficiency Sample Program  
Sulfur Trioxide - Uncorrected for S  
BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 62 Sulfur Trioxide - Uncorrected for S 81 Points

Sample No. 81	Ave 3.45	S.D. 0.25	C.V. 7
Sample No. 82	Ave 3.37	S.D. 0.26	C.V. 8

**CCRL Proficiency Sample Program  
Loss on Ignition - Corrected for S  
BLENDED CEMENT Samples No. 81 and No. 82**

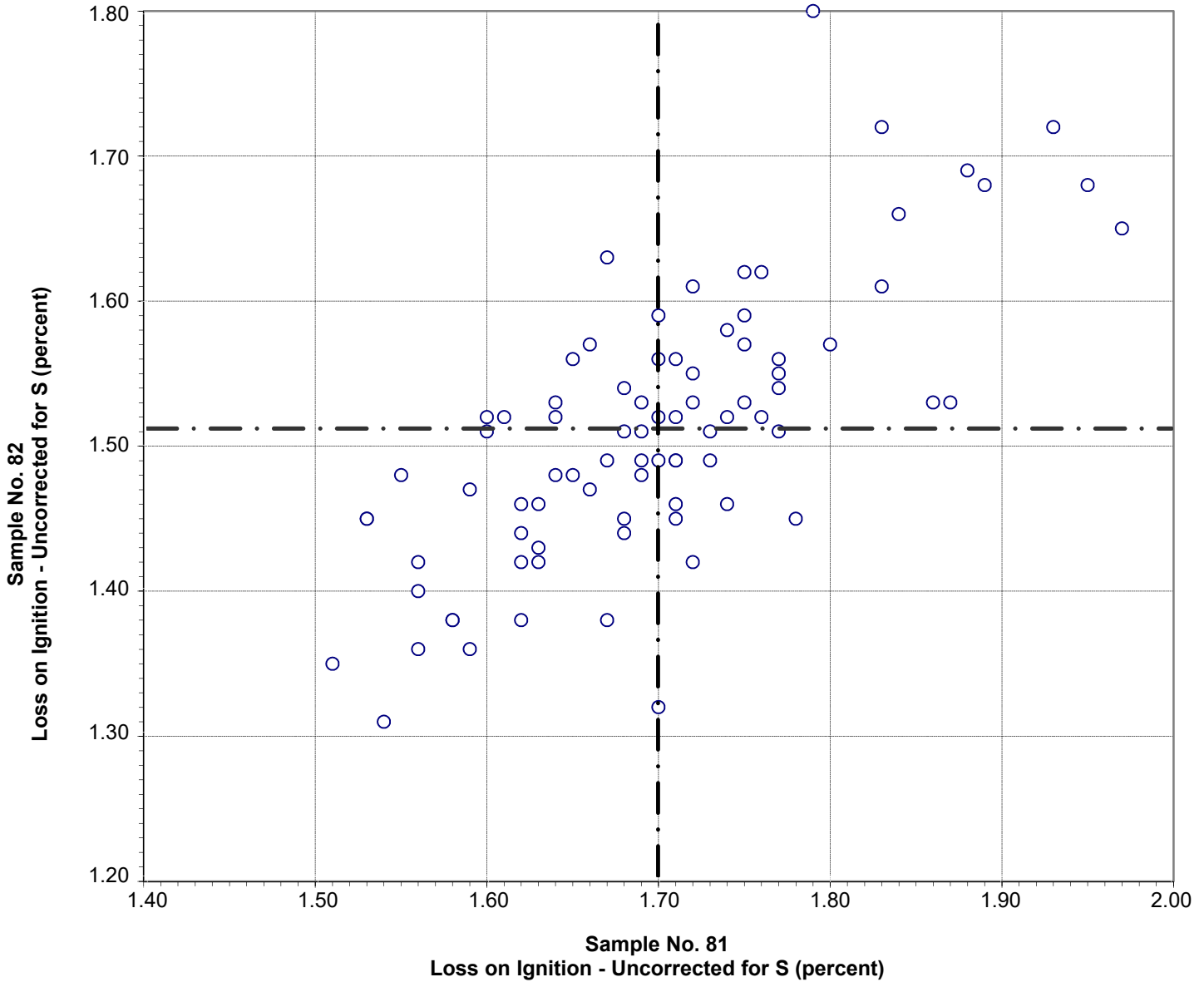


Test No. 71    Loss on Ignition - Corrected for S    43 Points

Sample No. 81	Ave 1.99	S.D. 0.26	C.V. 13
Sample No. 82	Ave 1.85	S.D. 0.28	C.V. 15

Labs Eliminated: 975

**CCRL Proficiency Sample Program  
Loss on Ignition - Uncorrected for S  
BLENDED CEMENT Samples No. 81 and No. 82**



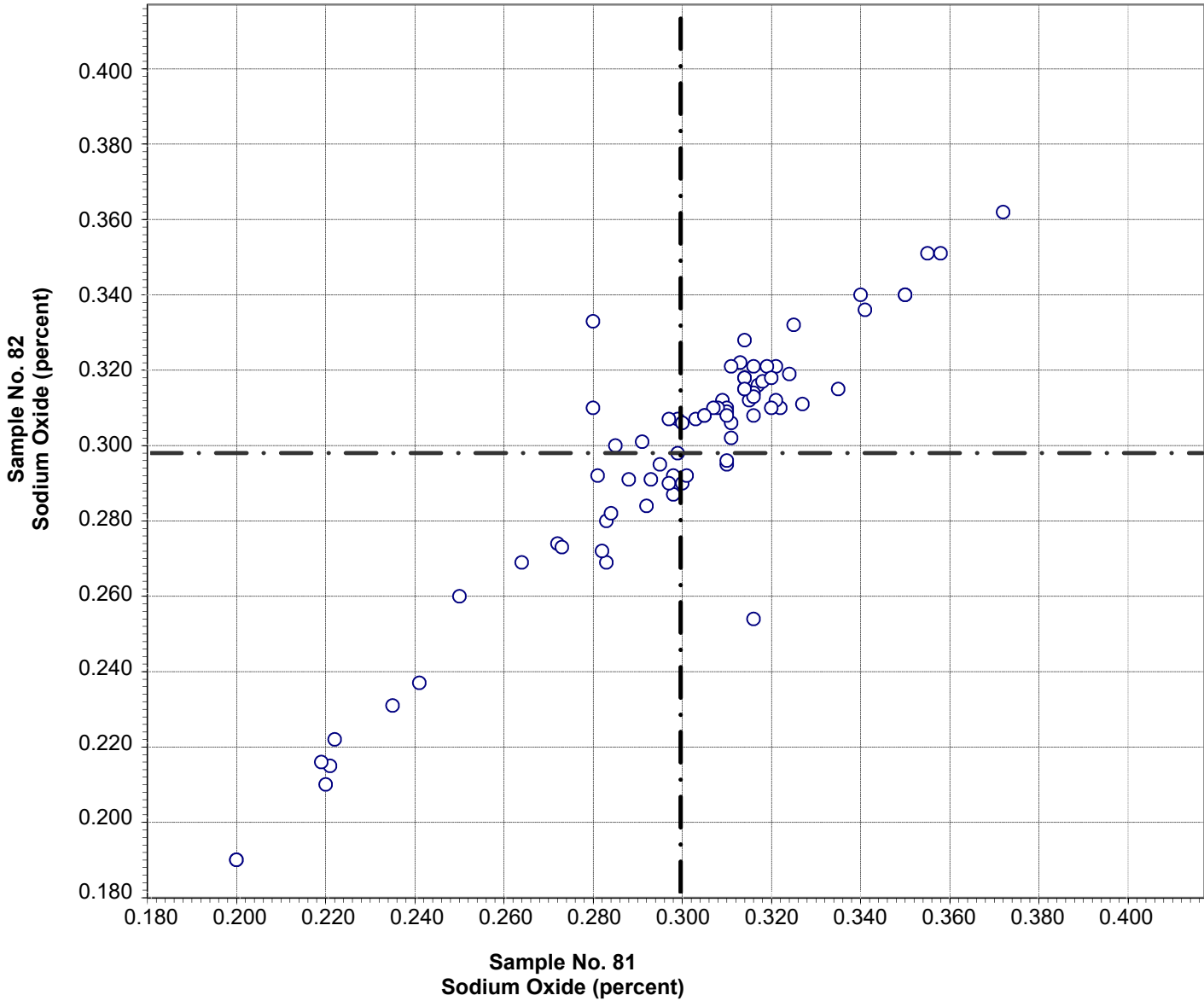
Test No. 72 Loss on Ignition - Uncorrected for S 83 Points

Sample No. 81	Ave 1.70	S.D. 0.10	C.V. 5.7
Sample No. 82	Ave 1.51	S.D. 0.09	C.V. 6.2

Labs Eliminated: 2462, 2466



**CCRL Proficiency Sample Program  
Sodium Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**

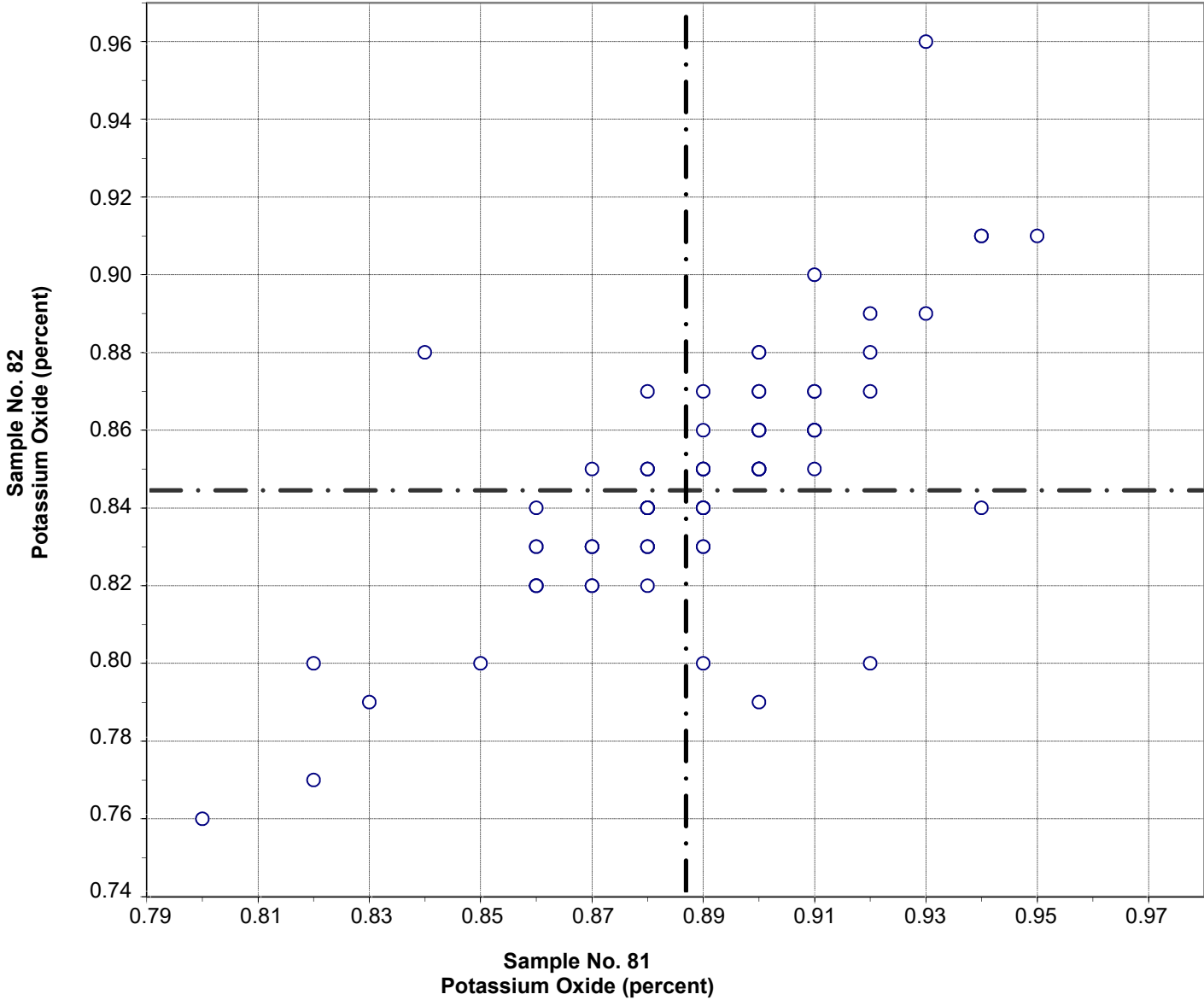


Test No. 90 Sodium Oxide 79 Points

Sample No. 81	Ave 0.299	S.D. 0.034	C.V. 11
Sample No. 82	Ave 0.298	S.D. 0.035	C.V. 12

Labs Eliminated: 246, 413, 2463, 3503, 3911

**CCRL Proficiency Sample Program  
Potassium Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**



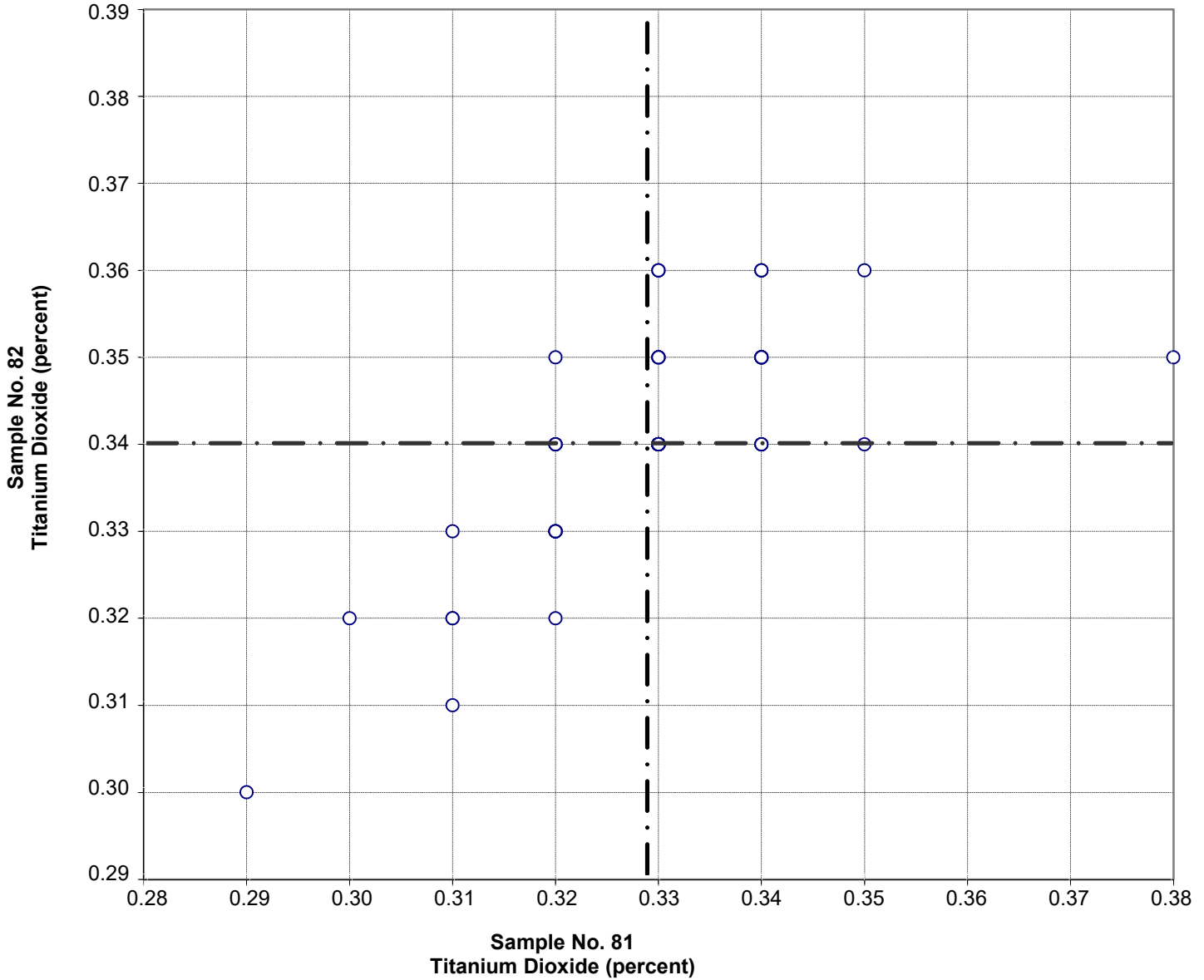
Test No. 100 Potassium Oxide 81 Points

Sample No. 81	Ave 0.89	S.D. 0.03	C.V. 3.4
Sample No. 82	Ave 0.84	S.D. 0.04	C.V. 4.4

Labs Eliminated: 24

Labs off Diagram: 148, 3409

**CCRL Proficiency Sample Program  
Titanium Dioxide  
BLENDED CEMENT Samples No. 81 and No. 82**



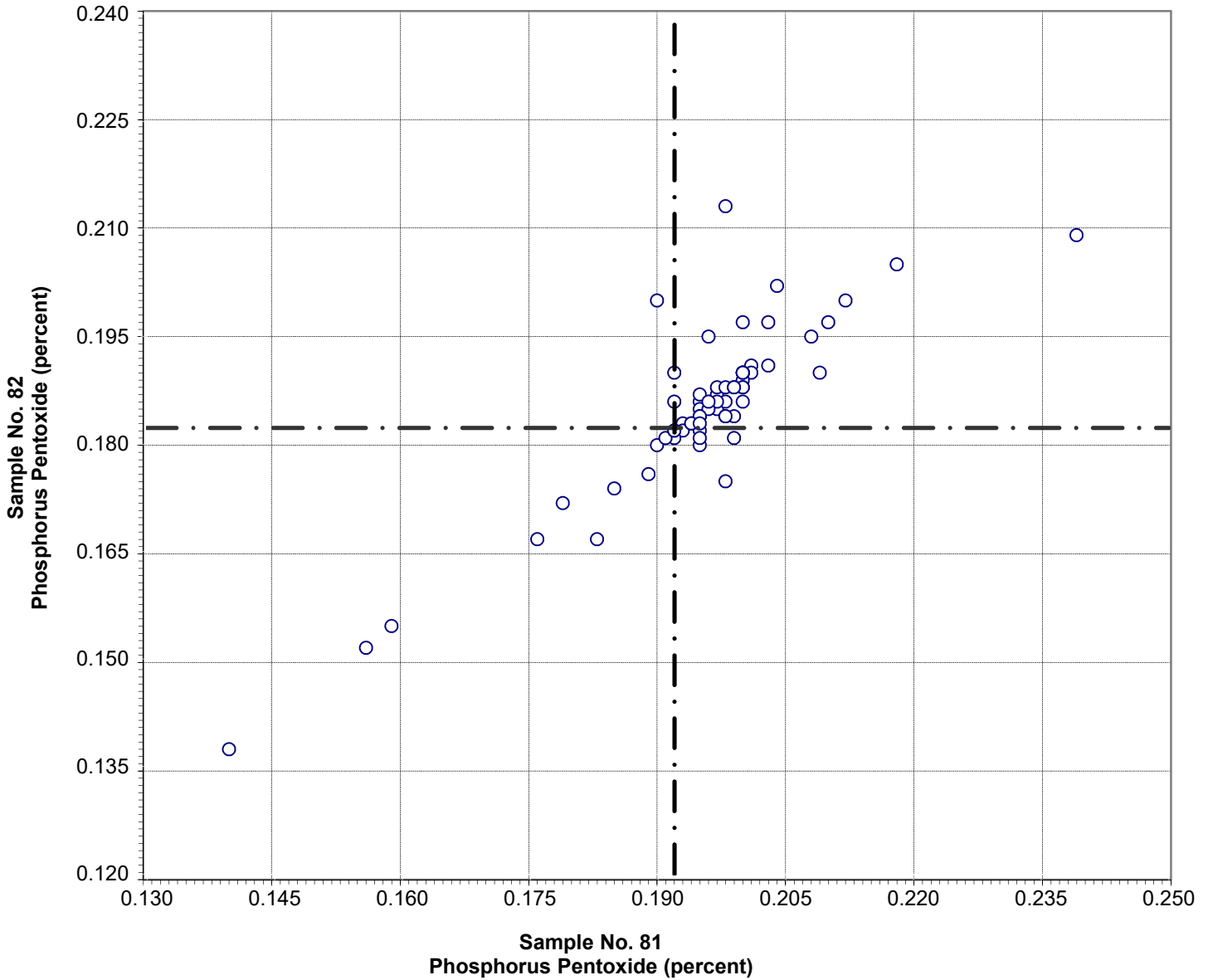
Test No. 103    Titanium Dioxide    66 Points

Sample No. 81	Ave 0.33	S.D. 0.014	C.V. 4.2
Sample No. 82	Ave 0.34	S.D. 0.015	C.V. 4.3

Labs Eliminated: 246, 2463, 3503

Labs off Diagram: 47

**CCRL Proficiency Sample Program  
Phosphorus Pentoxide  
BLENDED CEMENT Samples No. 81 and No. 82**



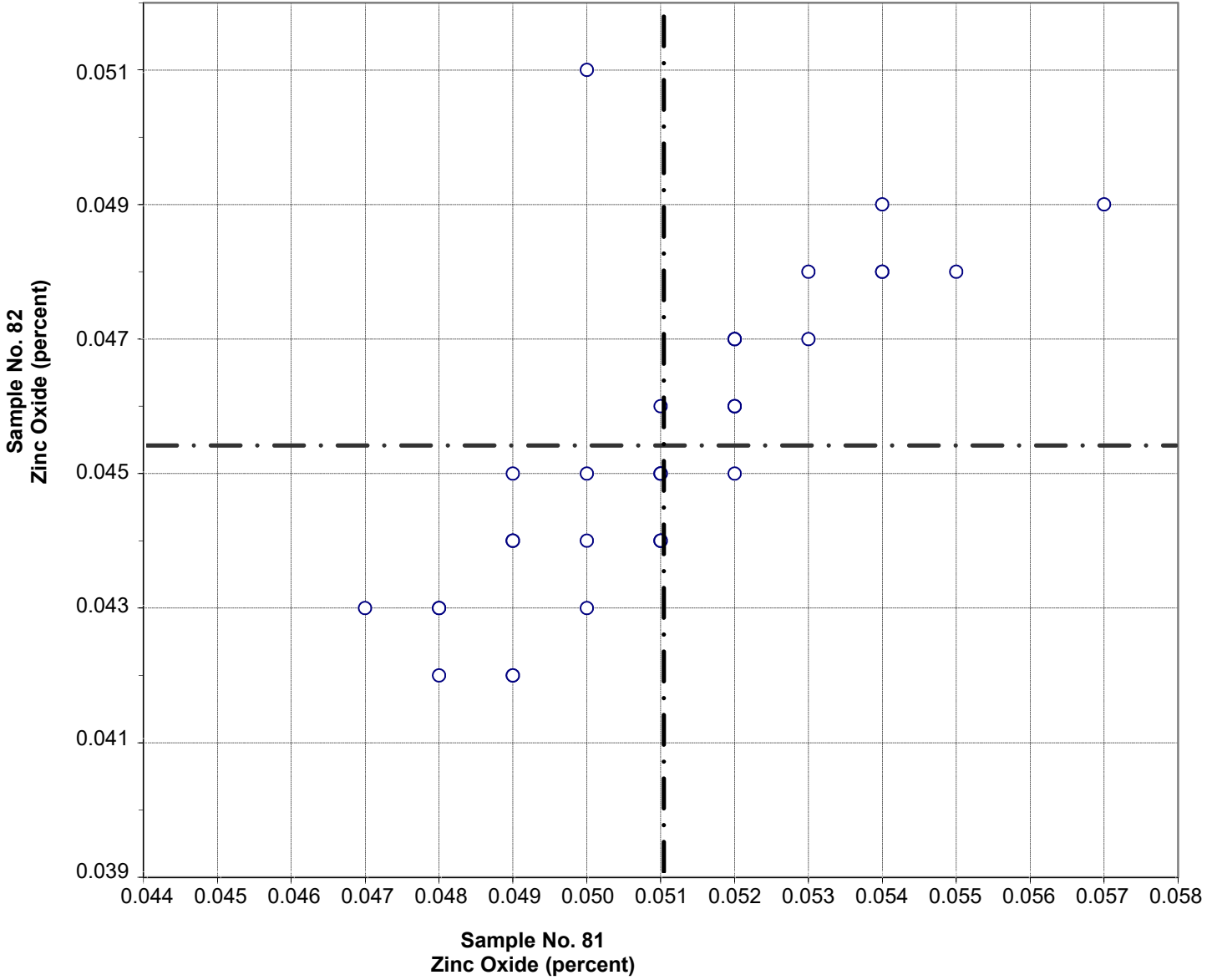
Test No. 102    Phosphorus Pentoxide    66 Points

Sample No. 81	Ave 0.192	S.D. 0.021	C.V. 10.8
Sample No. 82	Ave 0.182	S.D. 0.018	C.V. 10.0

Labs Eliminated: 2463, 2466, 3911

Labs off Diagram: 47, 2491, 3930

**CCRL Proficiency Sample Program  
Zinc Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**

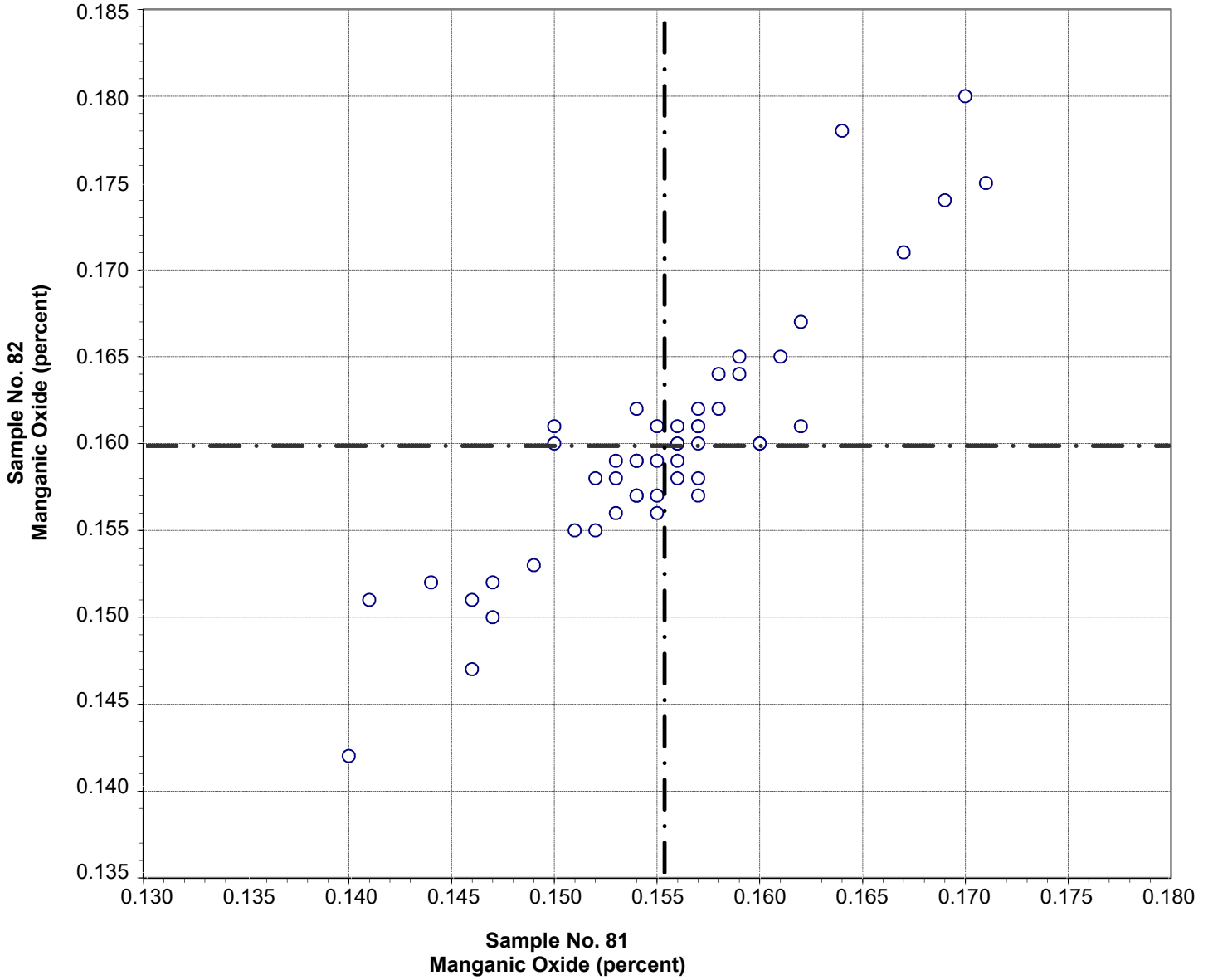


Test No. 99    Zinc Oxide    35 Points

Sample No. 81	Ave 0.051	S.D. 0.002	C.V. 4.3
Sample No. 82	Ave 0.045	S.D. 0.002	C.V. 4.9

Labs Eliminated: 7, 413, 2463, 2477, 2491

**CCRL Proficiency Sample Program  
Manganic Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**

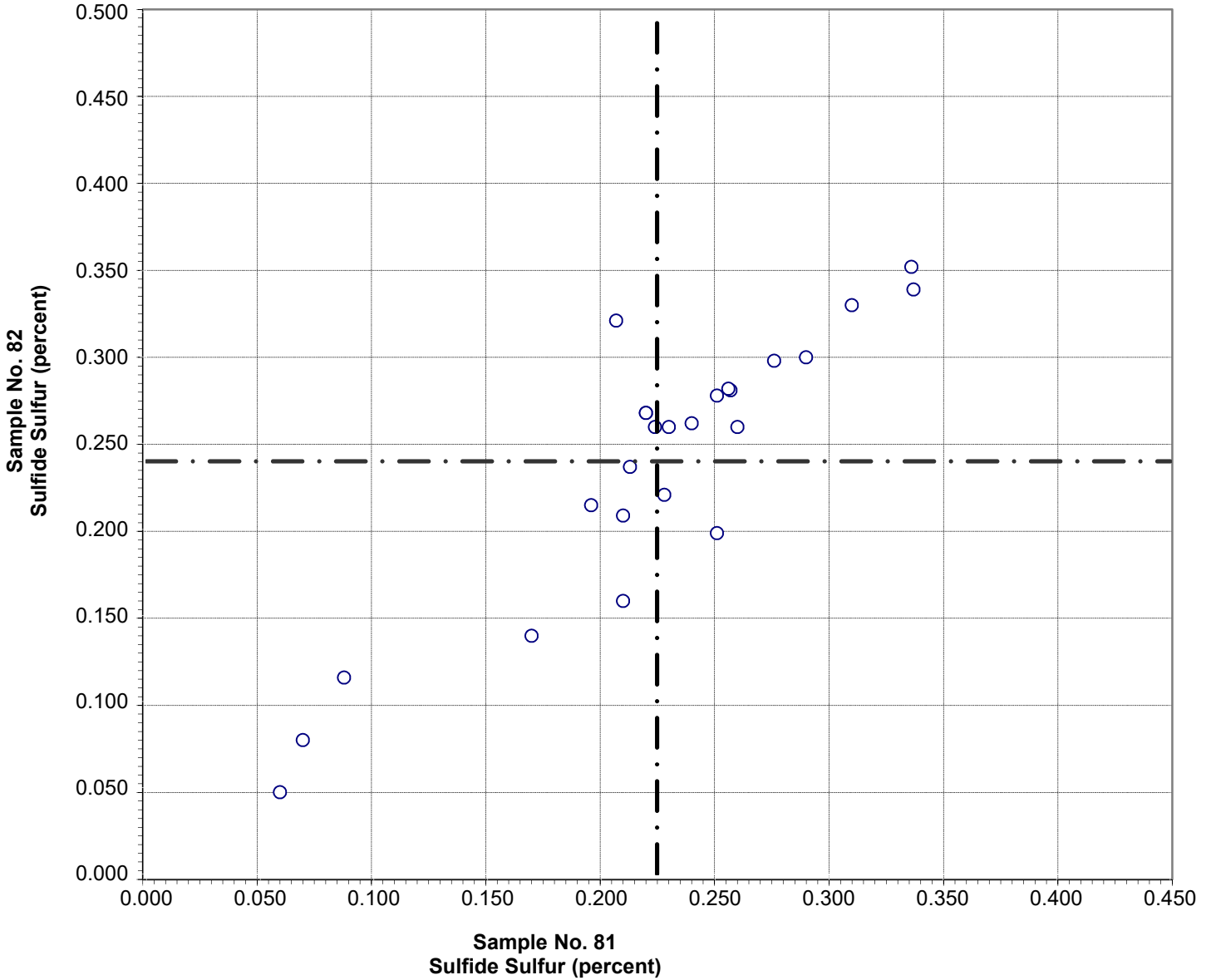


Test No. 101 Manganic Oxide 50 Points

Sample No. 81	Ave 0.155	S.D. 0.007	C.V. 4.2
Sample No. 82	Ave 0.160	S.D. 0.007	C.V. 4.5

Labs Eliminated: 101, 354, 413, 2491, 3503

**CCRL Proficiency Sample Program  
Sulfide Sulfur  
BLENDED CEMENT Samples No. 81 and No. 82**

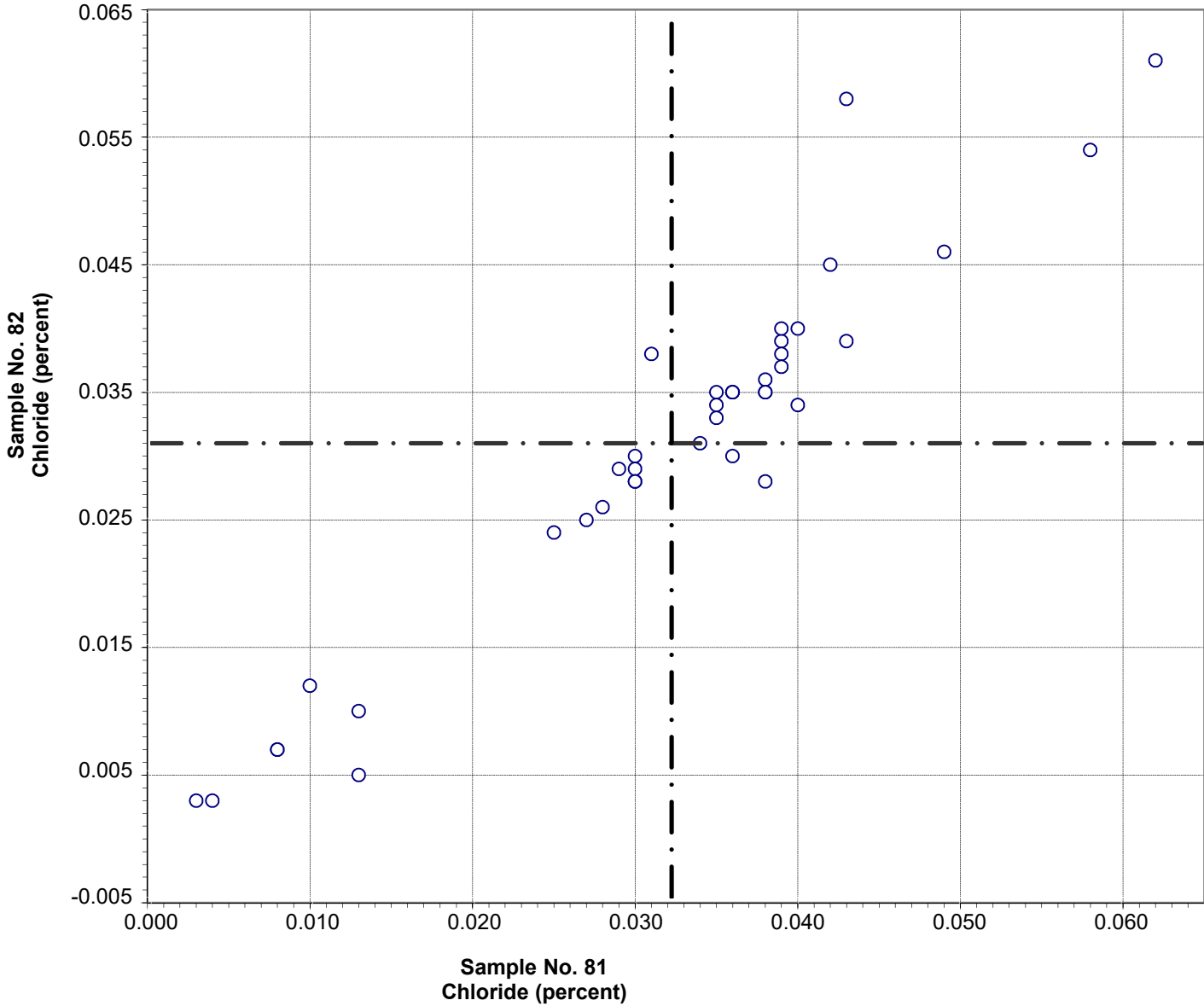


Test No. 65 Sulfide Sulfur 25 Points

Sample No. 81	Ave 0.224	S.D. 0.070	C.V. 31
Sample No. 82	Ave 0.239	S.D. 0.079	C.V. 33

Labs Eliminated: 25, 34, 39, 542, 2462

**CCRL Proficiency Sample Program  
Chloride  
BLENDED CEMENT Samples No. 81 and No. 82**



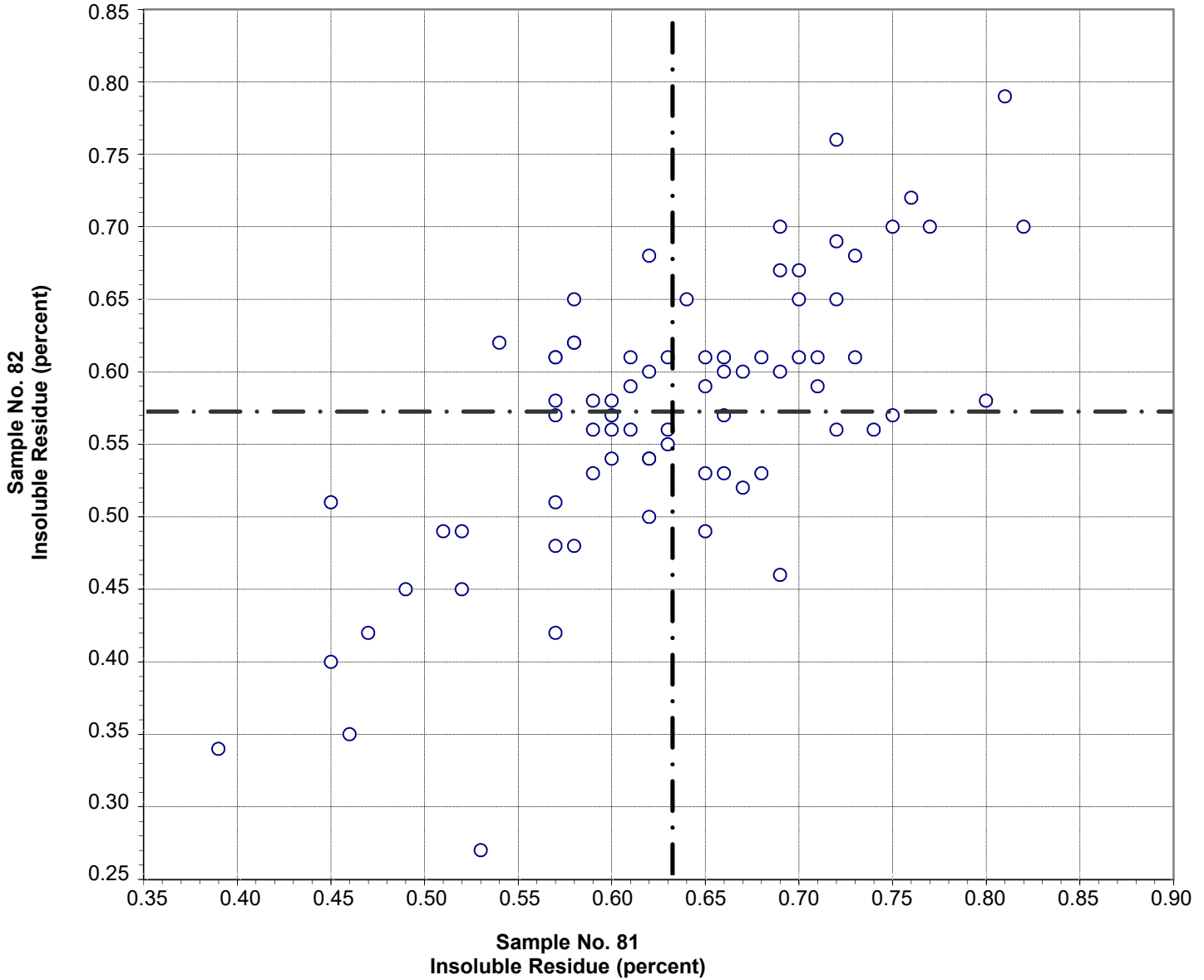
Test No. 104 Chloride 40 Points

Sample No. 81	Ave 0.032	S.D. 0.013	C.V. 41
Sample No. 82	Ave 0.031	S.D. 0.014	C.V. 45

Labs Eliminated: 19



**CCRL Proficiency Sample Program  
Insoluble Residue  
BLENDED CEMENT Samples No. 81 and No. 82**

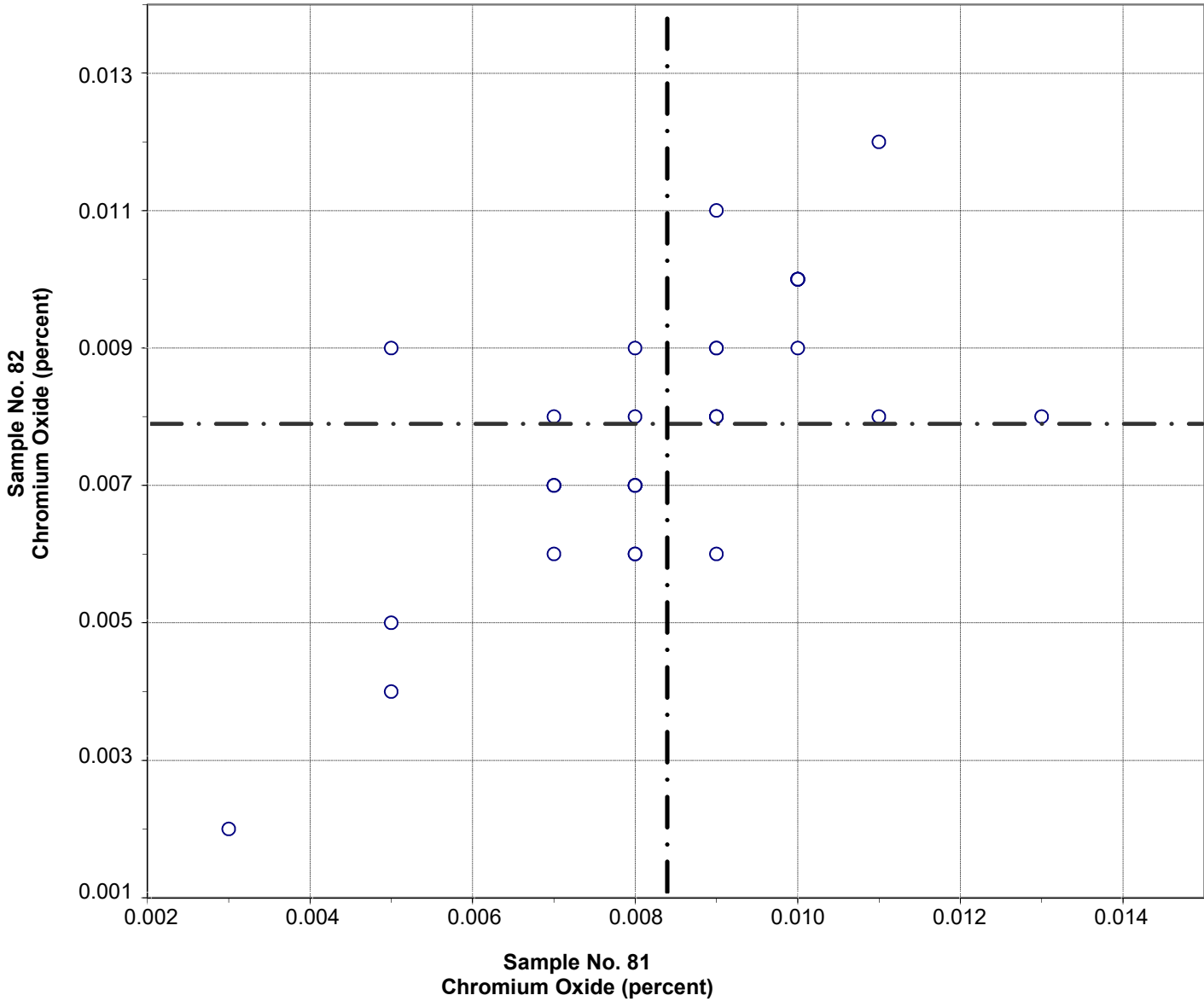


Test No. 80 Insoluble Residue 76 Points

Sample No. 81	Ave 0.63	S.D. 0.09	C.V. 14
Sample No. 82	Ave 0.57	S.D. 0.09	C.V. 16

Labs Eliminated: 24, 36, 124, 246, 497, 695, 3249

**CCRL Proficiency Sample Program  
Chromium Oxide  
BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 105 Chromium Oxide 34 Points

Sample No. 81	Ave 0.008	S.D. 0.002	C.V. 24
Sample No. 82	Ave 0.008	S.D. 0.002	C.V. 26

Labs Eliminated: 148, 2477, 3911

**CCRL PROFICIENCY SAMPLE PROGRAM**  
Blended Cement Proficiency Samples No. 81 and No. 82

Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	Sample No. 81				Sample No. 82		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Normal Consistency - % Water (percent)</b>							
	100	27.0	2.7	10.1	26.8	2.7	10.1
	*99	27.3	0.4	1.5	27.0	0.4	1.6
	* Lab Eliminated - 2490						
<b>Vicat Time of Set - Initial (min)</b>							
	99	119	13	11.3	129	15	11.9
	*96	118	11	9.5	128	14	10.8
	* Labs Eliminated - 2462, 2477, 4098						
<b>Vicat Time of Set - Final (min)</b>							
	94	241	35	15	245	37	15
	*92	239	32	14	243	34	14
	* Labs Eliminated - 10, 34						
<b>Autoclave Expansion (percent)</b>							
	92	0.04	0.03	68	0.01	0.02	207
	*89	0.04	0.02	50	0.01	0.02	146
	* Labs Eliminated - 441, 2466, 3431						
<b>Air Content % (percent)</b>							
	86	8.8	1.2	13	8.0	1.3	16
	No Labs Eliminated for This Test						
<b>Air Content - % Water (percent)</b>							
	84	68.1	4.9	7.3	68.5	5.0	7.3
	*83	68.6	2.4	3.5	69.0	2.6	3.7
	* Lab Eliminated - 4098						
<b>Air Content - Flow (percent)</b>							
	84	87	3.1	3.5	86	3.3	3.9
	84	87	3.1	3.5	86	3.3	3.9
	No Labs Eliminated for This Test						

**CCRL PROFICIENCY SAMPLE PROGRAM**  
Blended Cement Proficiency Samples No. 81 and No. 82

Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	Sample No. 81				Sample No. 82		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Specific Gravity (g/cm<sup>3</sup>)</b>							
	85	3.03	0.08	2.6	3.04	0.13	4.2
	*78	3.04	0.02	0.8	3.03	0.03	0.8
	* Labs Eliminated - 9, 25, 44, 101, 413, 474, 2466						
<b>Compressive Strength - 3 day (psi)</b>							
	99	3757	335	8.9	3647	300	8.2
	*97	3787	262	6.9	3673	236	6.4
	* Labs Eliminated - 33, 51						
<b>Compressive Strength - 7 day (psi)</b>							
	99	5164	399	7.7	5093	428	8.4
	*98	5186	335	6.5	5120	332	6.5
	* Lab Eliminated - 33						
<b>Compressive Strength - 28 day (psi)</b>							
	94	6768	565	8.3	6830	576	8.4
	*93	6802	461	6.8	6870	429	6.3
	* Lab Eliminated - 33						
<b>Compressive Strength - % Water (percent)</b>							
	96	47.4	6.4	13.6	47.5	6.5	13.6
	*93	48.1	1.1	2.2	48.3	1.0	2.2
	* Labs Eliminated - 35, 694, 2490						
<b>Compressive Strength - Flow (percent)</b>							
	96	109	5.0	4.5	109	4.9	4.5
	*92	110	2.8	2.5	110	2.6	2.4
	* Labs Eliminated - 3, 22, 35, 38						
<b>Fineness - Air Permeability (m<sup>2</sup>/kg)</b>							
	94	476	32	6.8	464	30	6.5
	*92	479	28	5.8	467	25	5.5
	* Labs Eliminated - 25, 2464						

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Blended Cement Proficiency Samples No. 81 and No. 82

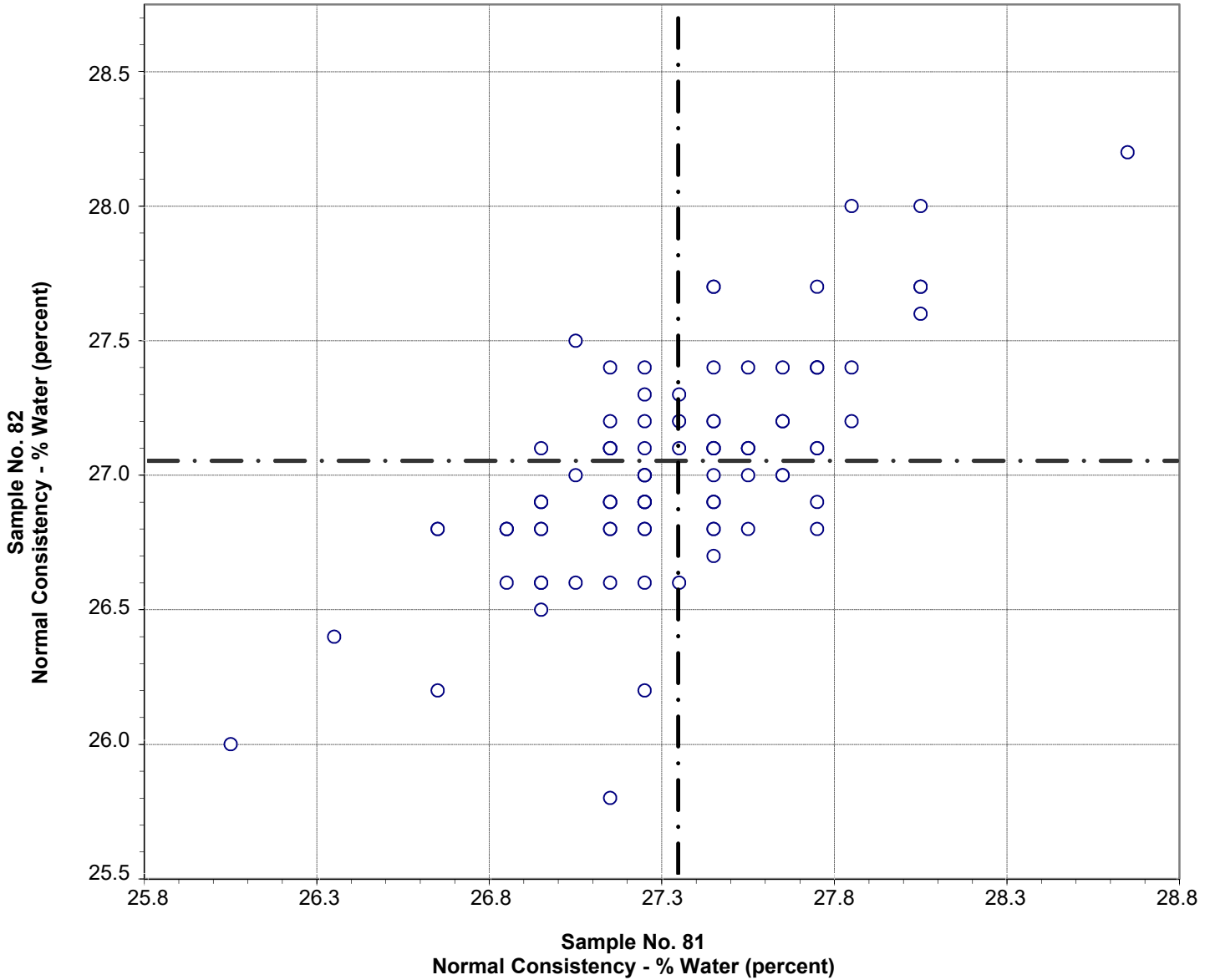
Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No. 81			Sample No. 82		
		Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Fineness - 45µm % Passing (percent)</b>							
	98	96.66	7.80	8.07	96.11	7.59	7.89
	*95	97.47	0.41	0.42	96.92	0.47	0.48

\* Labs Eliminated - 246, 497, 4098

**CCRL Proficiency Sample Program  
Normal Consistency - % Water  
BLENDED CEMENT Samples No. 81 and No. 82**



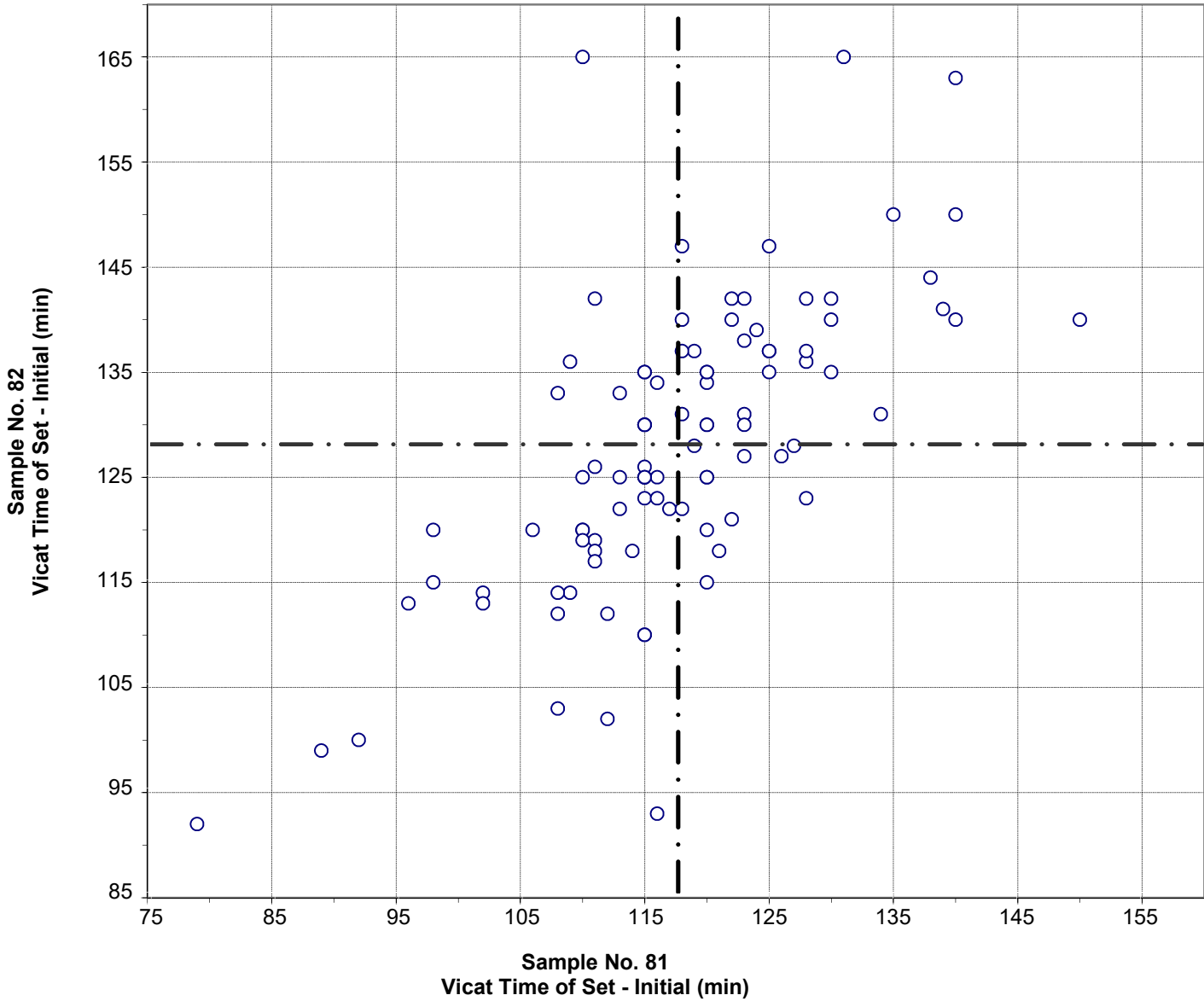
**Test No. 110 Normal Consistency - % Water 98 Points**

Sample No. 81	Ave 27.3	S.D. 0.4	C.V. 1.5
Sample No. 82	Ave 27.0	S.D. 0.4	C.V. 1.6

Labs Eliminated: 2490

Labs off Diagram: 2477

**CCRL Proficiency Sample Program**  
**Vicat Time of Set - Initial**  
**BLENDED CEMENT Samples No. 81 and No. 82**

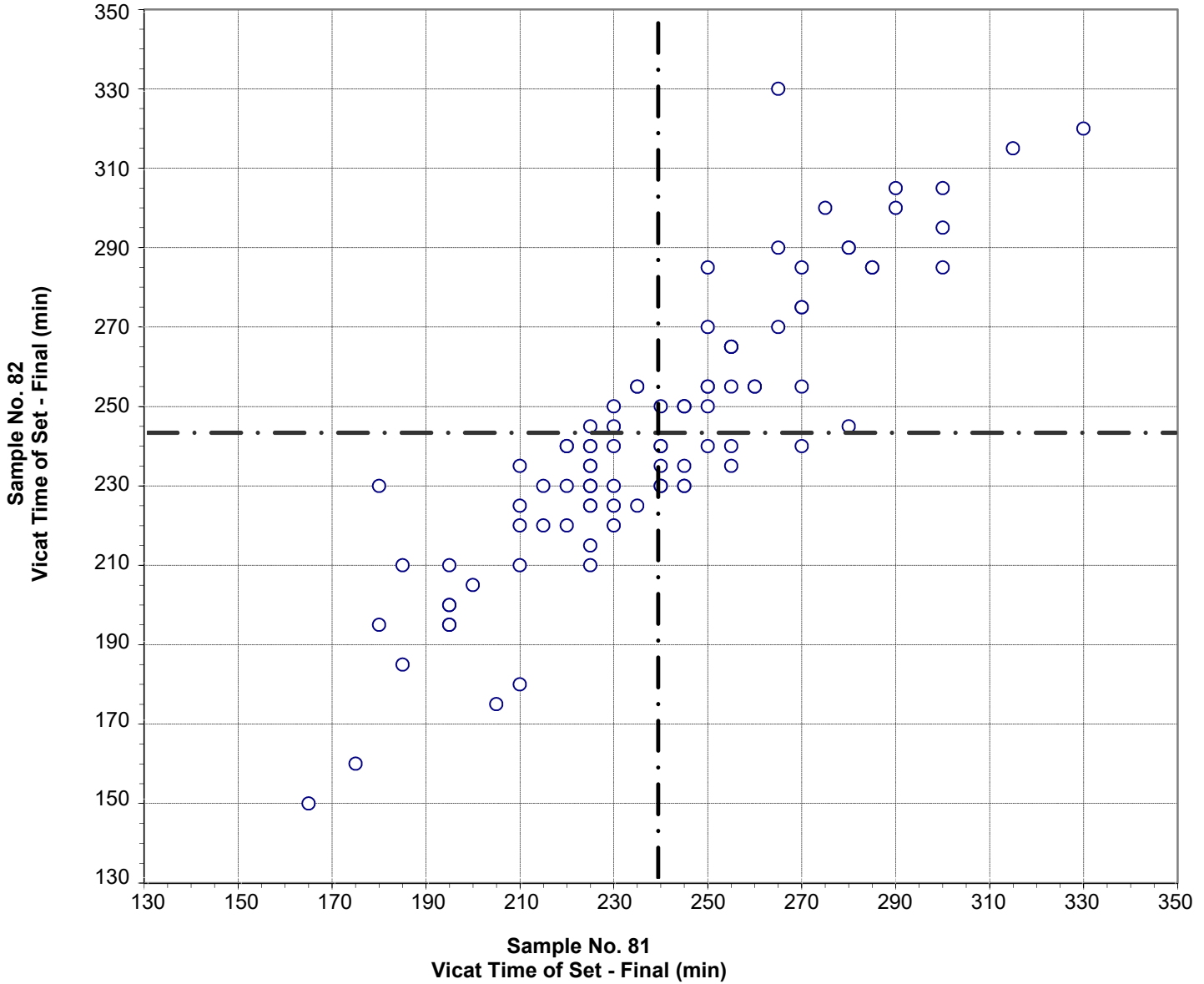


Test No. 120 Vicat Time of Set - Initial 96 Points

Sample No. 81	Ave 118	S.D. 11	C.V. 9.5
Sample No. 82	Ave 128	S.D. 14	C.V. 10.8

Labs Eliminated: 2462, 2477, 4098

**CCRL Proficiency Sample Program  
 Vicat Time of Set - Final  
 BLENDED CEMENT Samples No. 81 and No. 82**



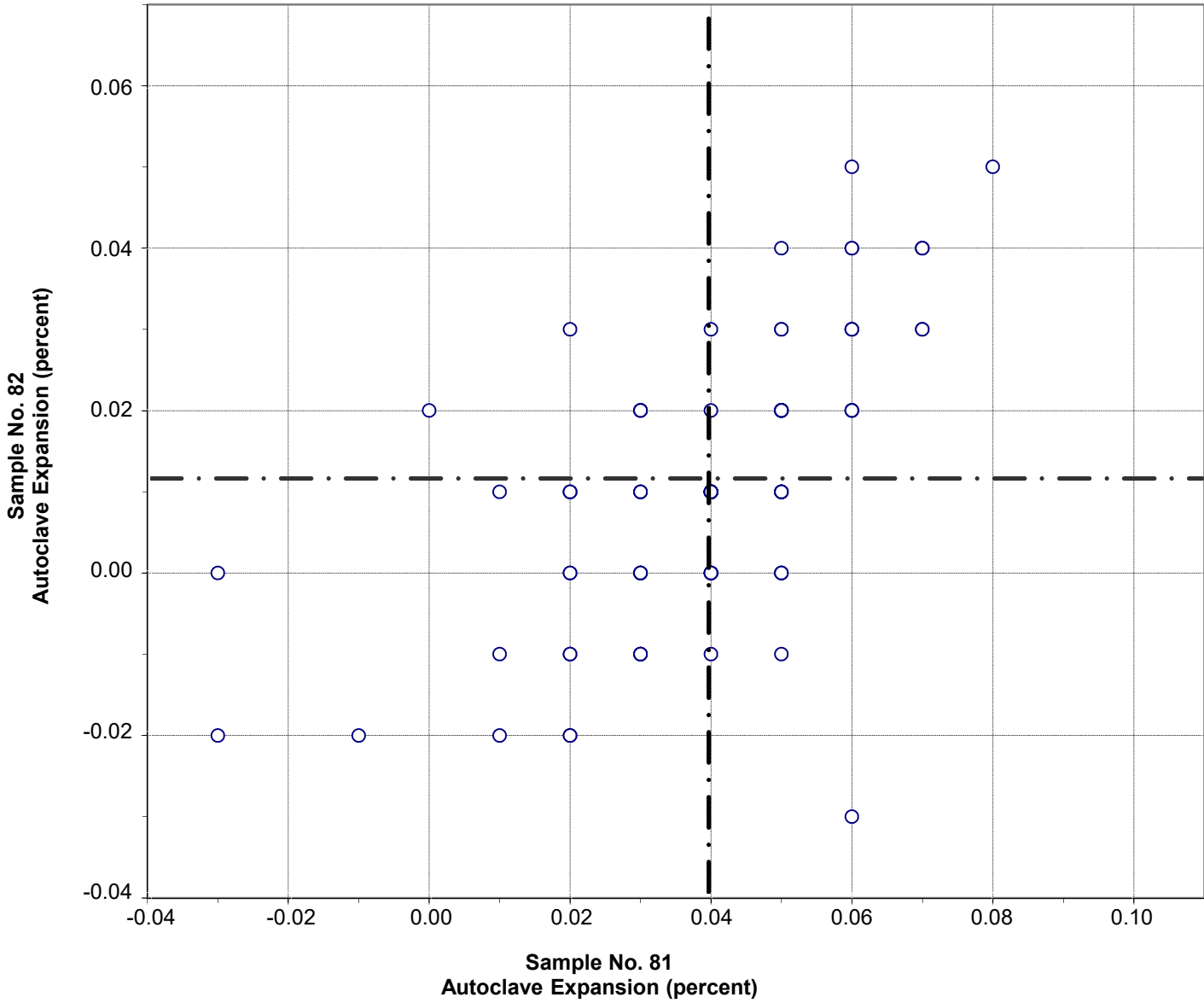
Test No. 121 Vicat Time of Set - Final 92 Points

Sample No. 81	Ave 239	S.D. 32	C.V. 14
Sample No. 82	Ave 243	S.D. 34	C.V. 14

Labs Eliminated: 10, 34



**CCRL Proficiency Sample Program  
Autoclave Expansion  
BLENDED CEMENT Samples No. 81 and No. 82**

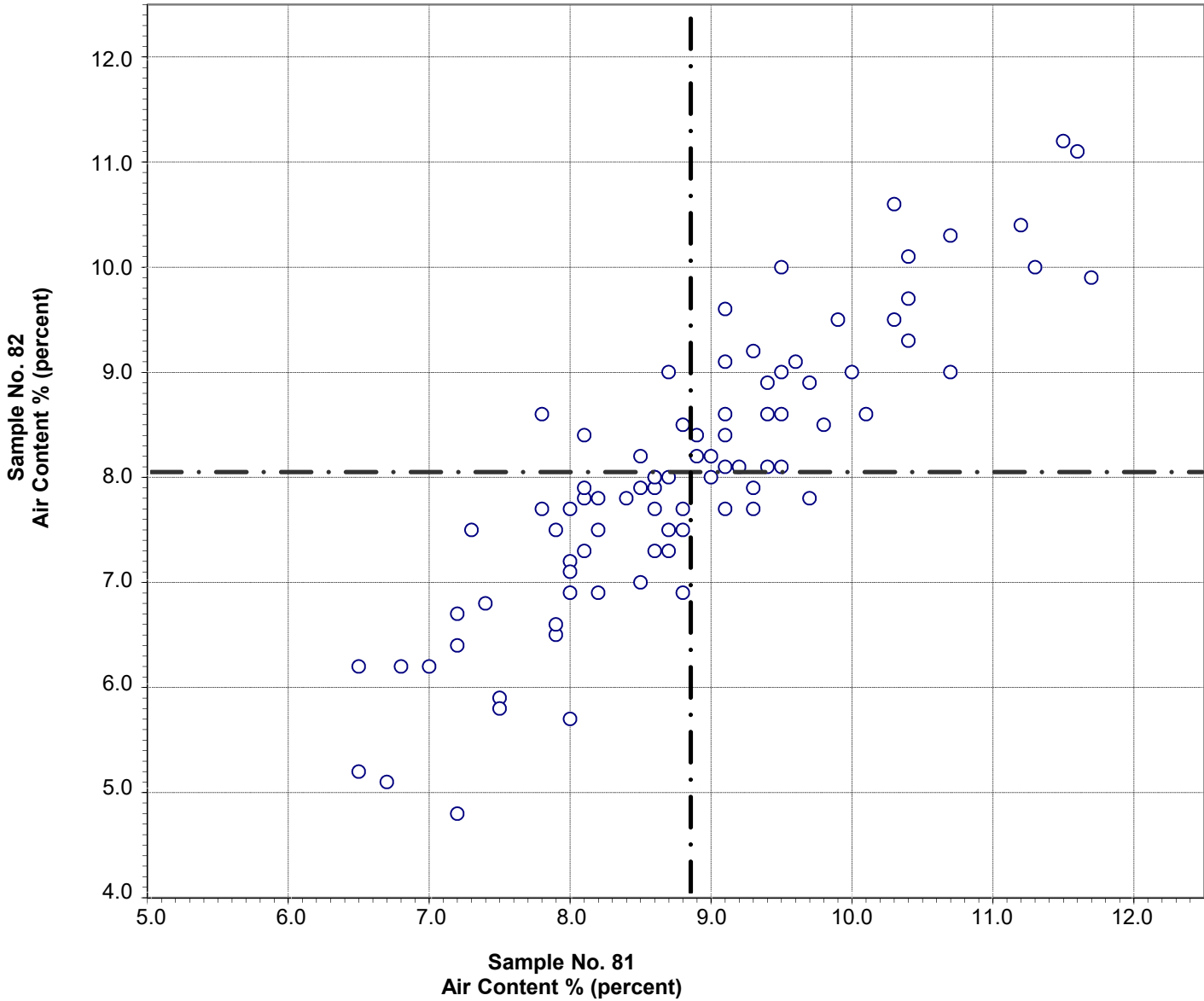


Test No. 160 Autoclave Expansion 89 Points

Sample No. 81	Ave 0.04	S.D. 0.02	C.V. 50
Sample No. 82	Ave 0.01	S.D. 0.02	C.V. 146

Labs Eliminated: 441, 2466, 3431

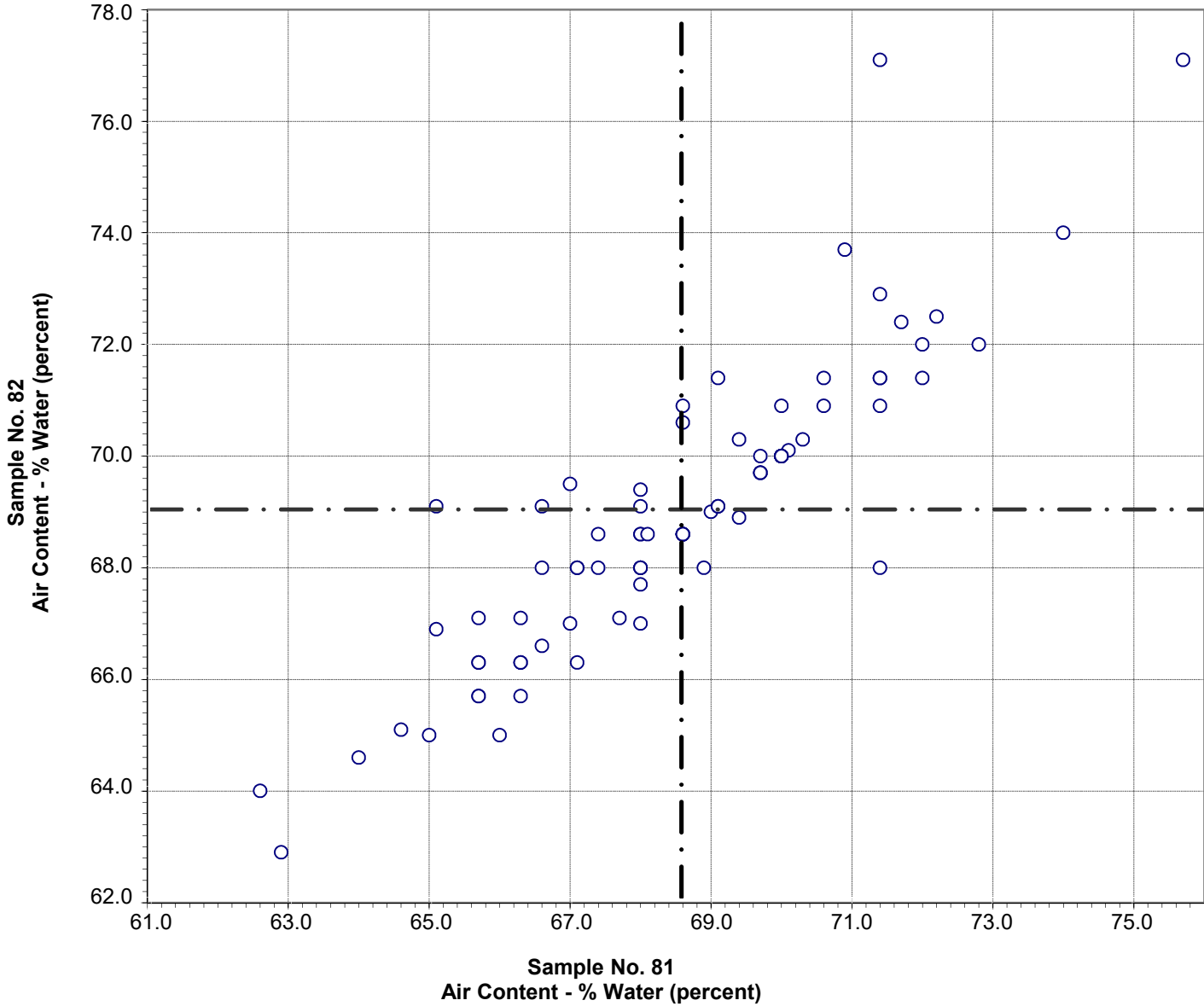
**CCRL Proficiency Sample Program**  
**Air Content %**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 170 Air Content % 86 Points

Sample No. 81	Ave 8.8	S.D. 1.2	C.V. 13
Sample No. 82	Ave 8.0	S.D. 1.3	C.V. 16

**CCRL Proficiency Sample Program**  
**Air Content - % Water**  
**BLENDED CEMENT Samples No. 81 and No. 82**

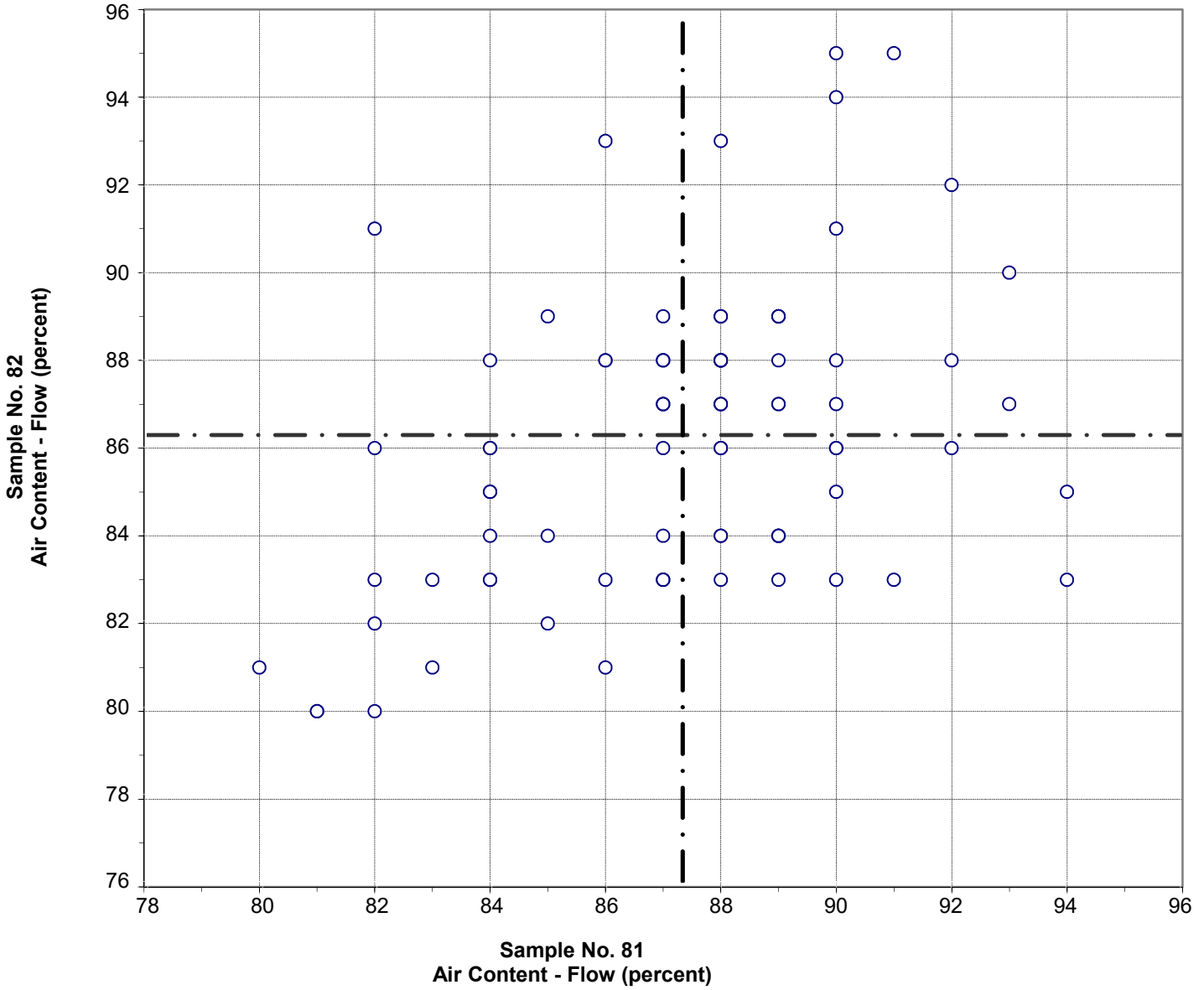


Test No. 180    Air Content - % Water    83 Points

Sample No. 81	Ave 68.6	S.D. 2.4	C.V. 3.5
Sample No. 82	Ave 69.0	S.D. 2.6	C.V. 3.7

Labs Eliminated: 4098

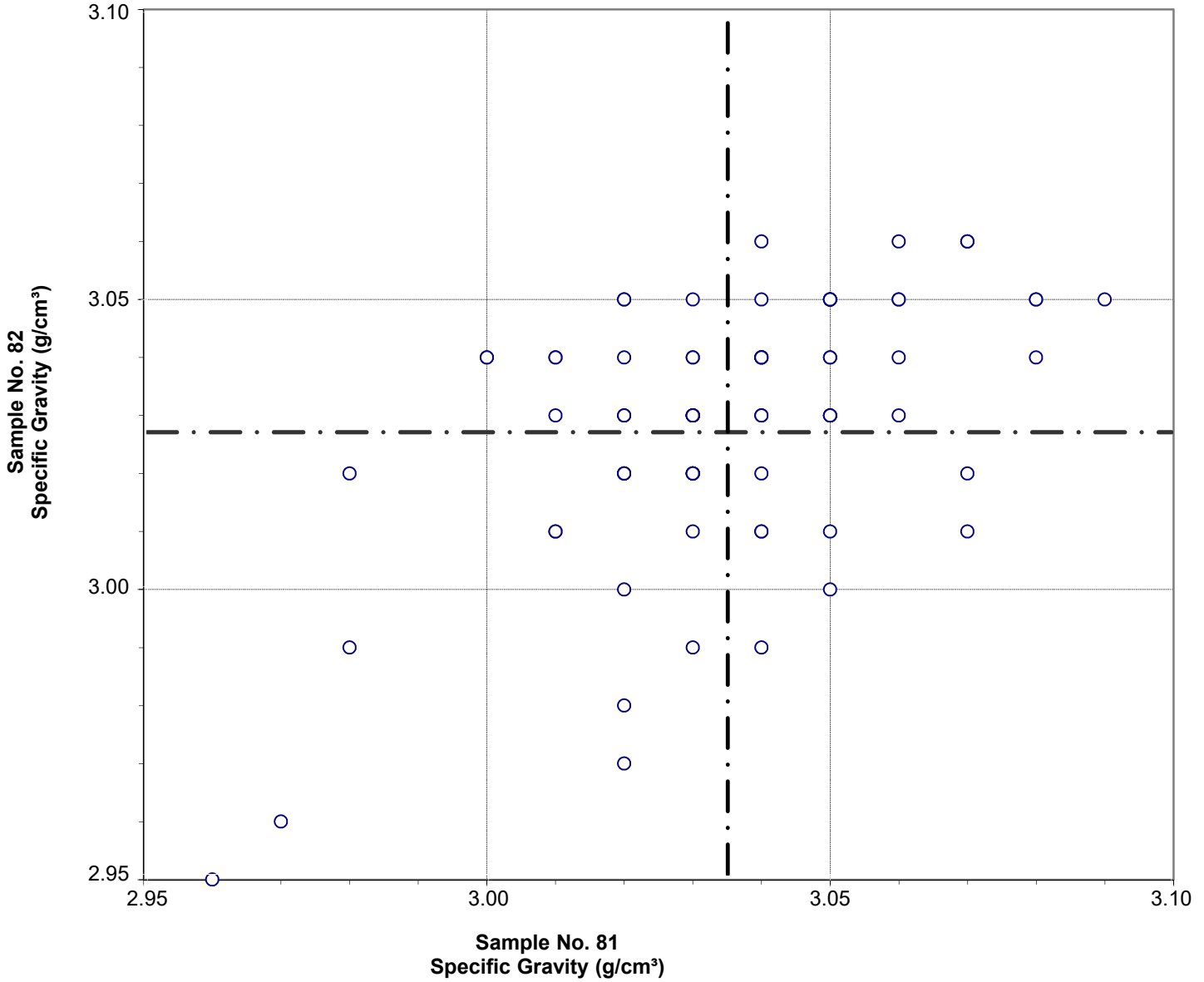
**CCRL Proficiency Sample Program**  
**Air Content - Flow**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 190 Air Content - Flow 84 Points

Sample No. 81	Ave 87	S.D. 3.1	C.V. 3.5
Sample No. 82	Ave 86	S.D. 3.3	C.V. 3.9

**CCRL Proficiency Sample Program  
Specific Gravity  
BLENDED CEMENT Samples No. 81 and No. 82**



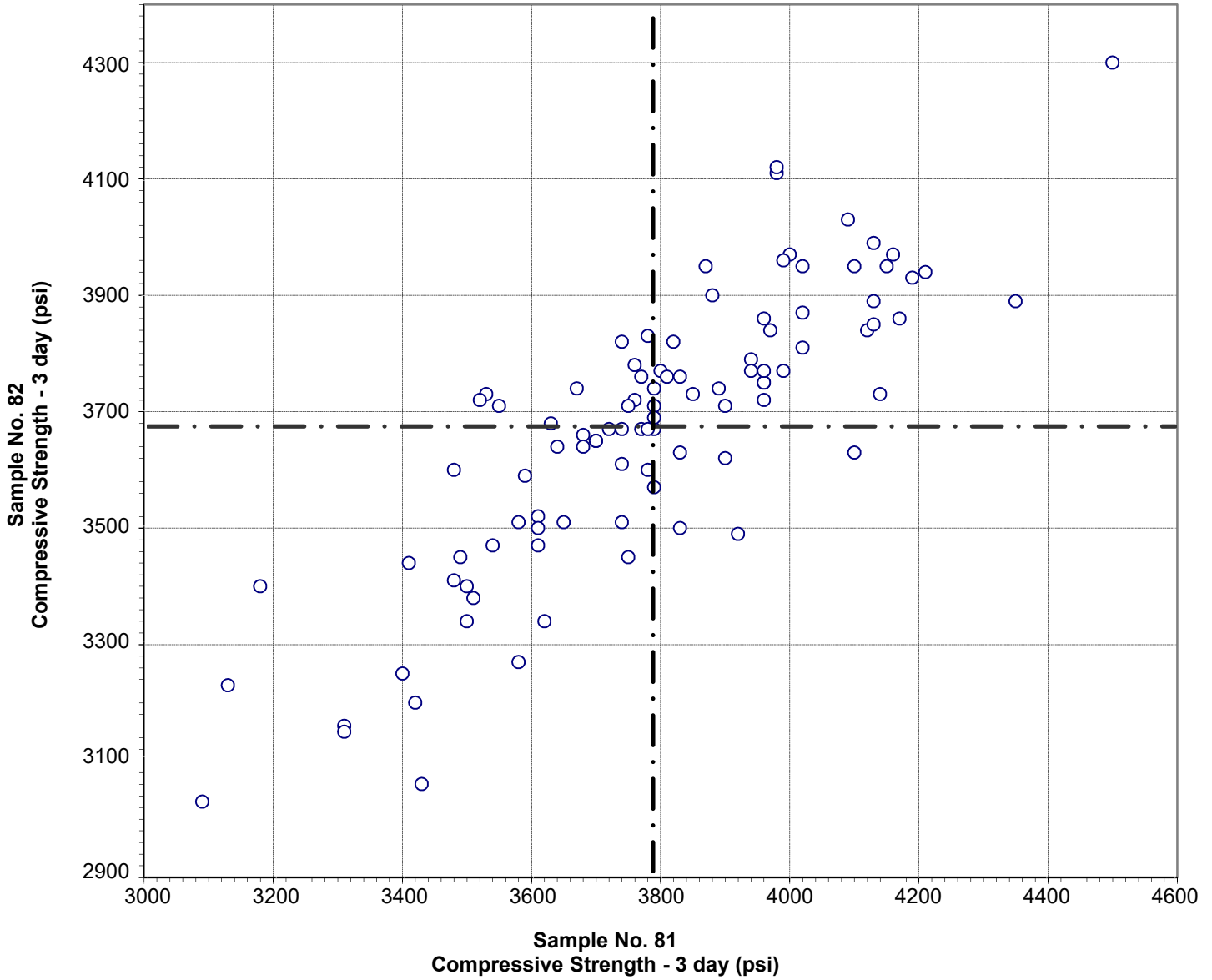
Test No. 310    Specific Gravity    77 Points

Sample No. 81	Ave 3.04	S.D. 0.02	C.V. 0.8
Sample No. 82	Ave 3.03	S.D. 0.03	C.V. 0.8

Labs Eliminated: 9, 25, 44, 101, 413, 474, 2466

Labs off Diagram: 500

**CCRL Proficiency Sample Program  
Compressive Strength - 3 day  
BLENDED CEMENT Samples No. 81 and No. 82**

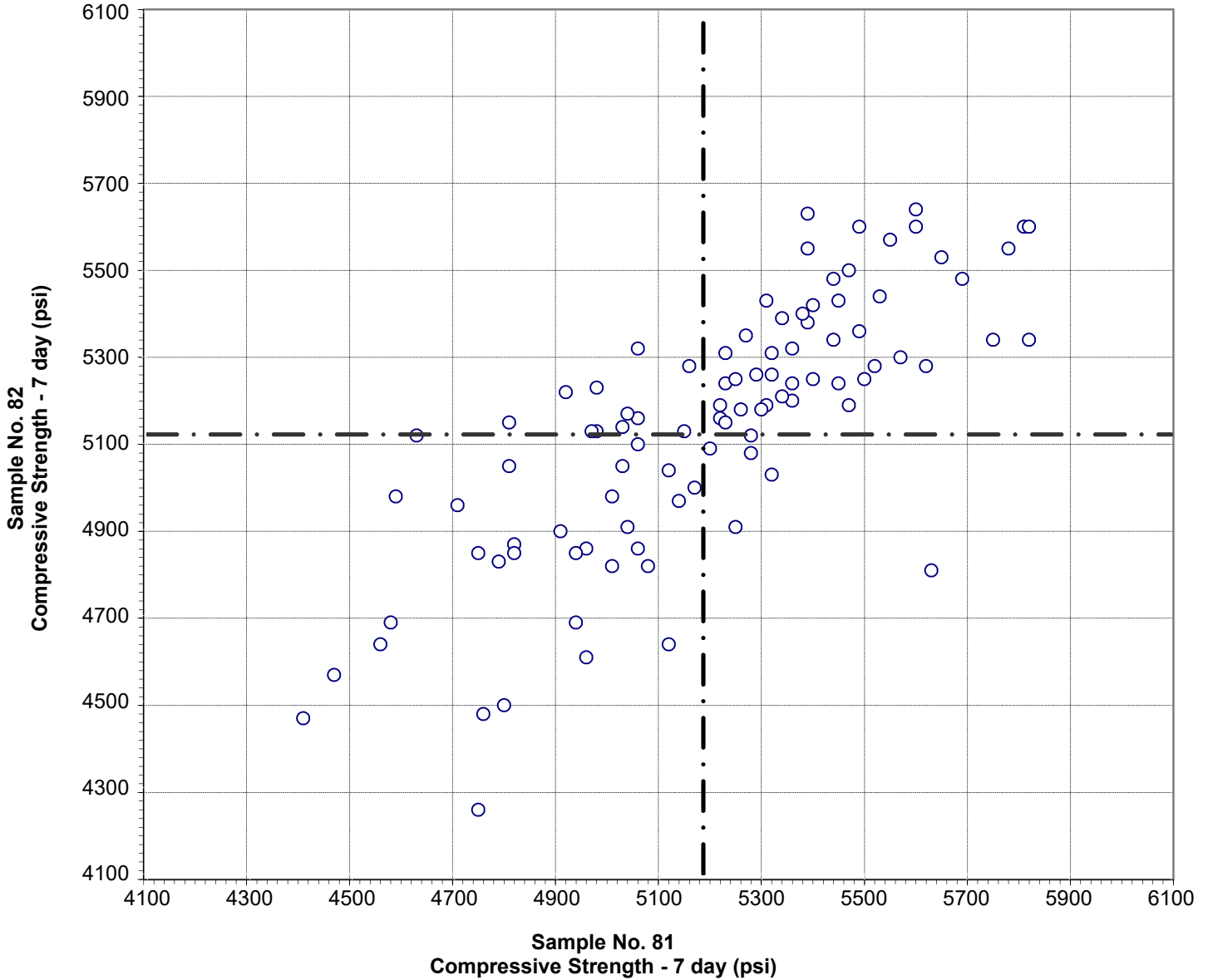


**Test No. 200 Compressive Strength - 3 day 97 Points**

Sample No. 81	Ave 3787	S.D. 262	C.V. 6.9
Sample No. 82	Ave 3673	S.D. 236	C.V. 6.4

Labs Eliminated: 33, 51

**CCRL Proficiency Sample Program  
Compressive Strength - 7 day  
BLENDED CEMENT Samples No. 81 and No. 82**



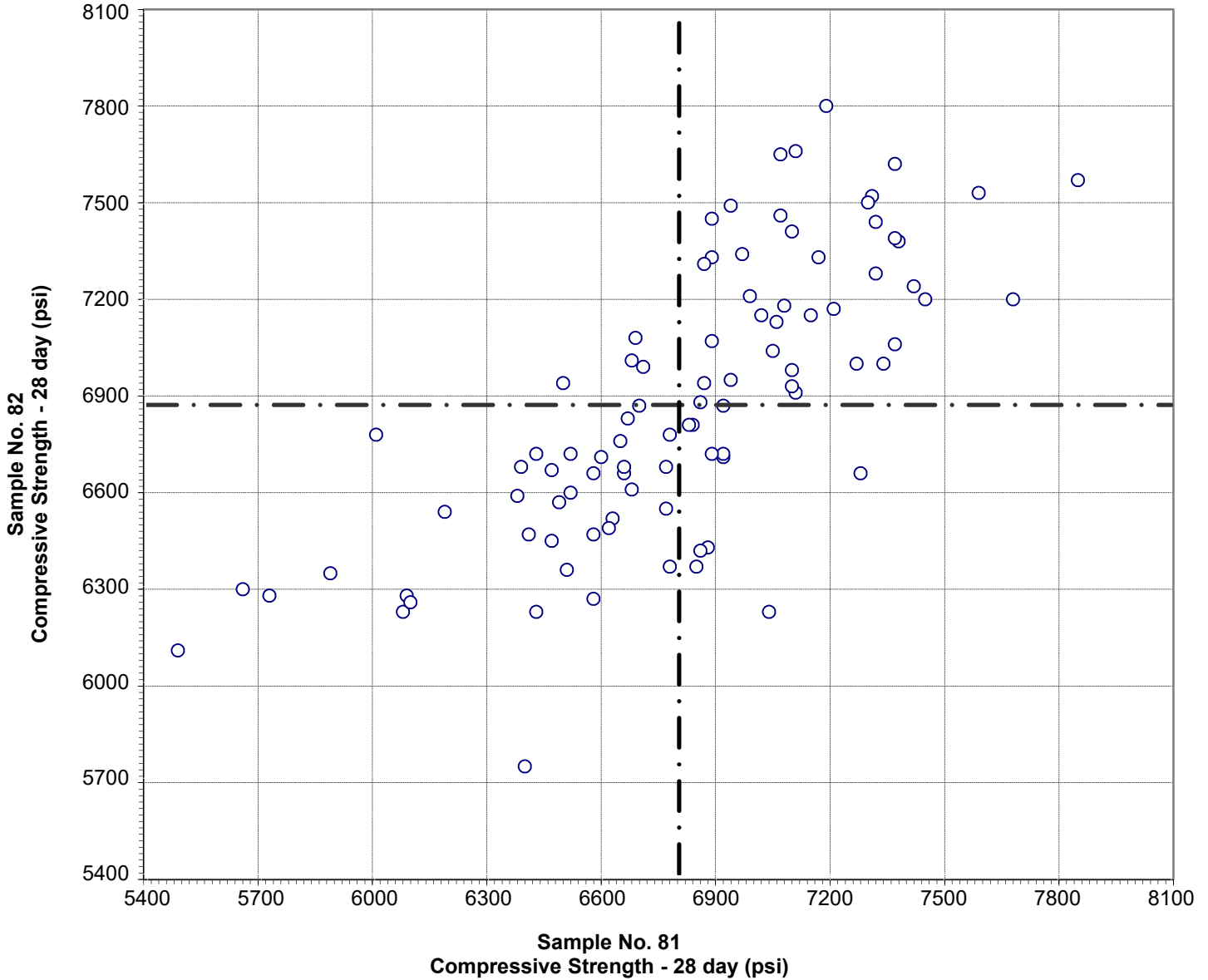
**Test No. 210 Compressive Strength - 7 day 96 Points**

Sample No. 81	Ave 5186	S.D. 335	C.V. 6.5
Sample No. 82	Ave 5120	S.D. 332	C.V. 6.5

Labs Eliminated: 33

Labs off Diagram: 34, 39

**CCRL Proficiency Sample Program  
Compressive Strength - 28 day  
BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 211    Compressive Strength - 28 day    92 Points

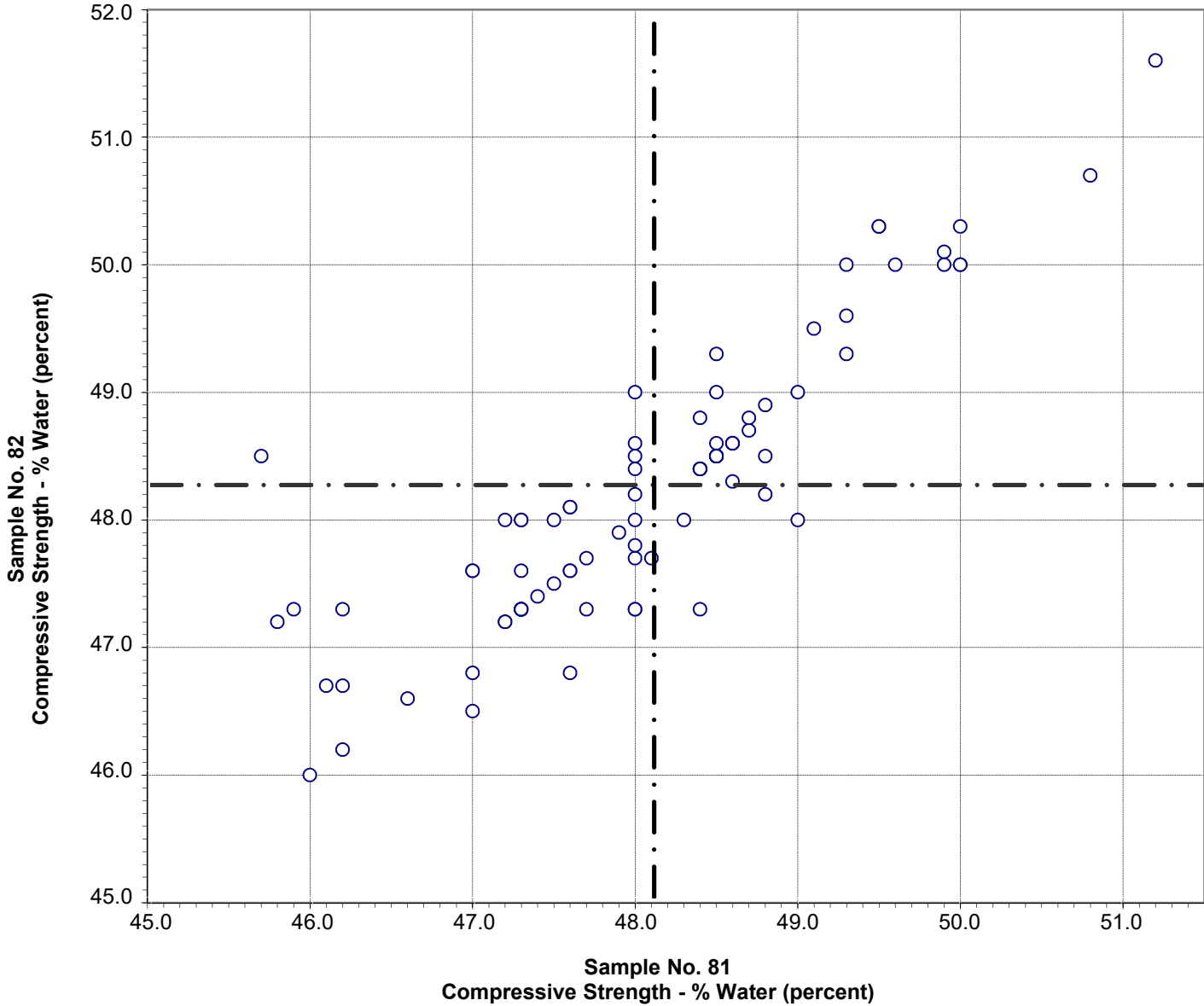
Sample No. 81	Ave 6802	S.D. 461	C.V. 6.8
Sample No. 82	Ave 6870	S.D. 429	C.V. 6.3

Labs Eliminated: 33

Labs off Diagram: 9



**CCRL Proficiency Sample Program  
Compressive Strength - % Water  
BLENDED CEMENT Samples No. 81 and No. 82**

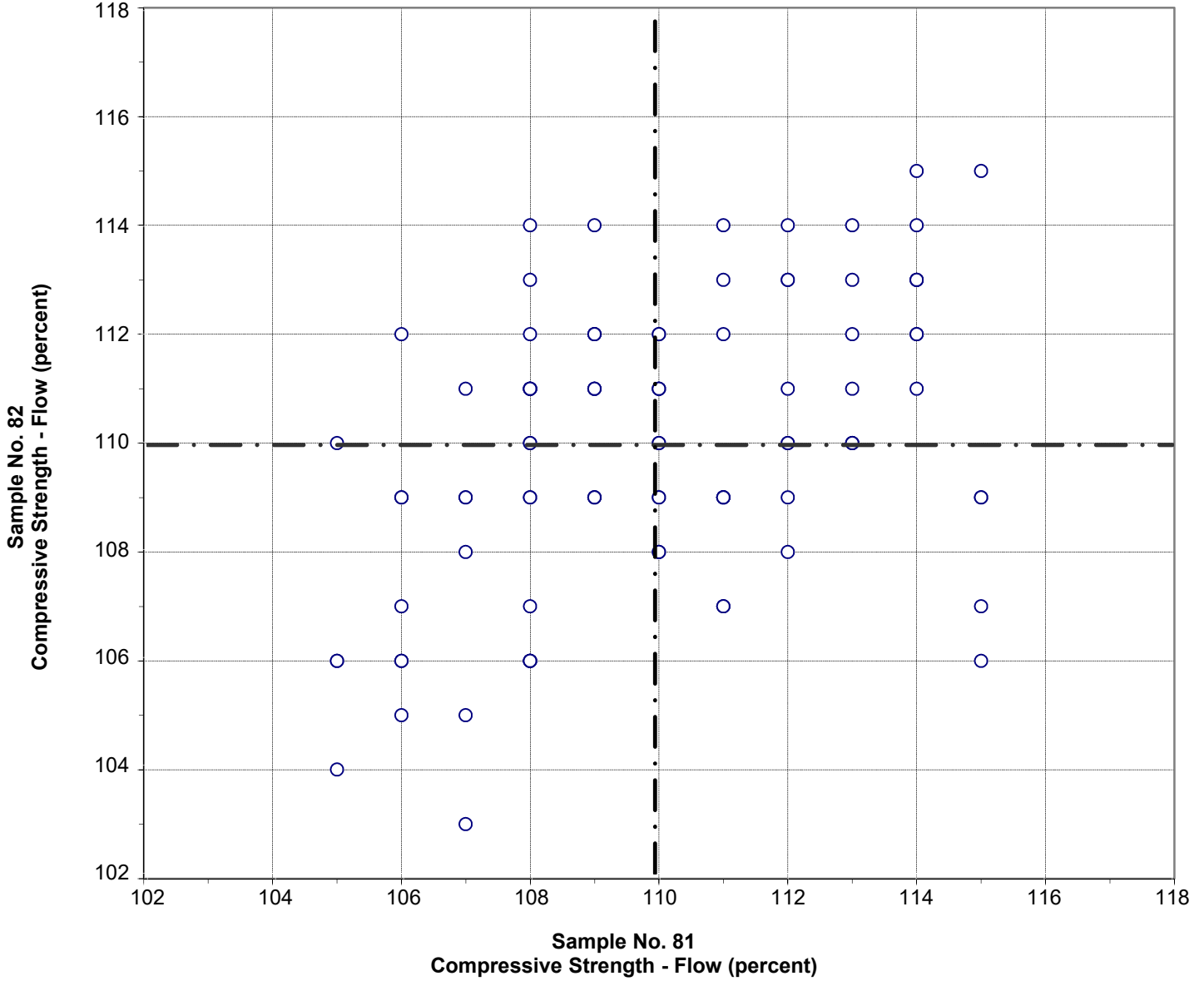


Test No. 220    Compressive Strength - % Water    93 Points

Sample No. 81	Ave 48.1	S.D. 1.1	C.V. 2.2
Sample No. 82	Ave 48.3	S.D. 1.0	C.V. 2.2

Labs Eliminated: 35, 694, 2490

**CCRL Proficiency Sample Program  
Compressive Strength - Flow  
BLENDED CEMENT Samples No. 81 and No. 82**

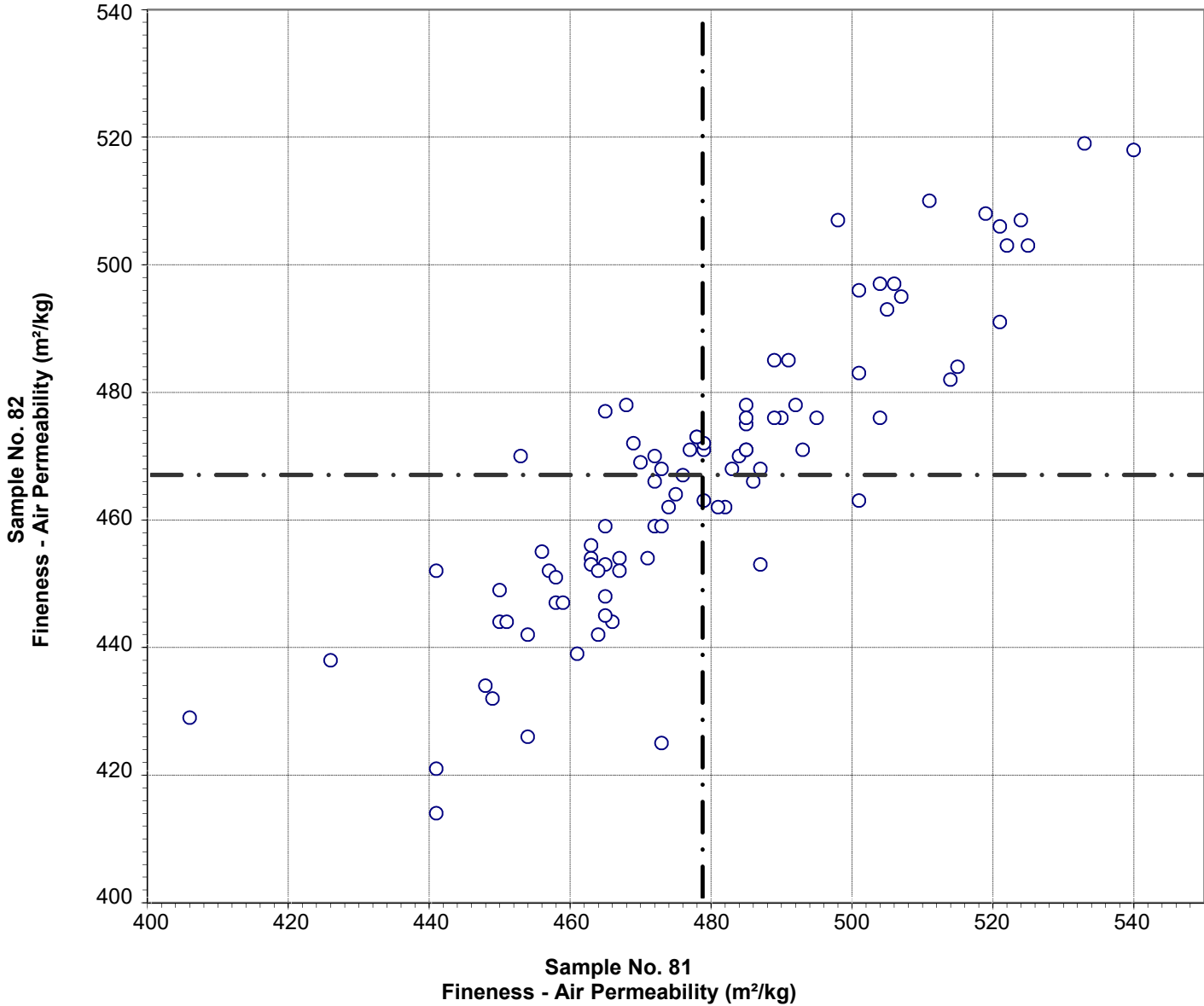


**Test No. 230 Compressive Strength - Flow 92 Points**

Sample No. 81	Ave 110	S.D. 2.8	C.V. 2.5
Sample No. 82	Ave 110	S.D. 2.6	C.V. 2.4

Labs Eliminated: 3, 22, 35, 38

**CCRL Proficiency Sample Program  
Fineness - Air Permeability  
BLENDED CEMENT Samples No. 81 and No. 82**



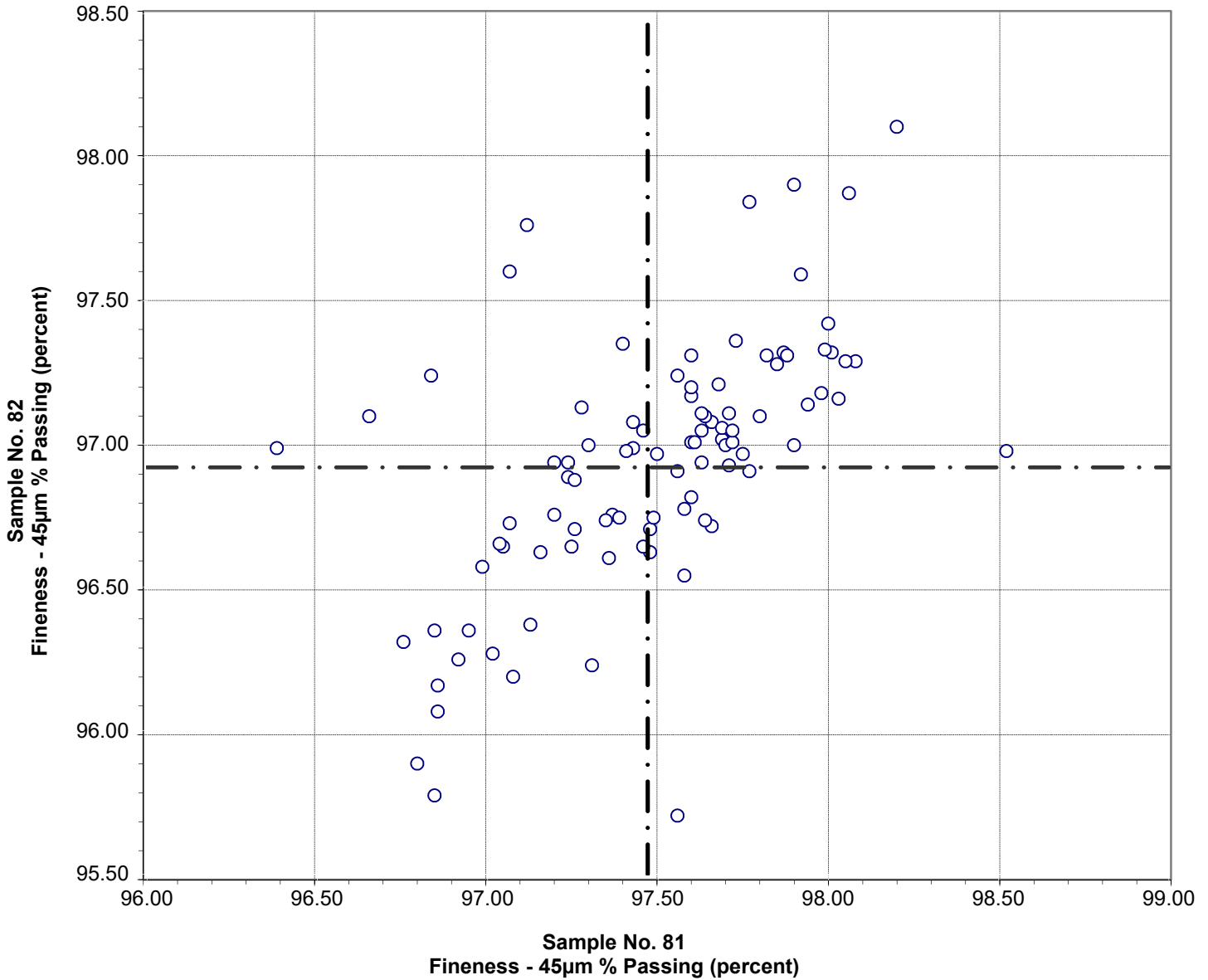
Test No. 270    Fineness - Air Permeability    90 Points

Sample No. 81	Ave 479	S.D. 28	C.V. 5.8
Sample No. 82	Ave 467	S.D. 25	C.V. 5.5

Labs Eliminated: 25, 2464

Labs off Diagram: 9, 17

**CCRL Proficiency Sample Program**  
**Fineness - 45 $\mu$ m % Passing**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 281    Fineness - 45 $\mu$ m % Passing    94 Points

Sample No. 81	Ave 97.47	S.D. 0.41	C.V. 0.42
Sample No. 82	Ave 96.92	S.D. 0.47	C.V. 0.48

Labs Eliminated: 246, 497, 4098

Labs off Diagram: 22

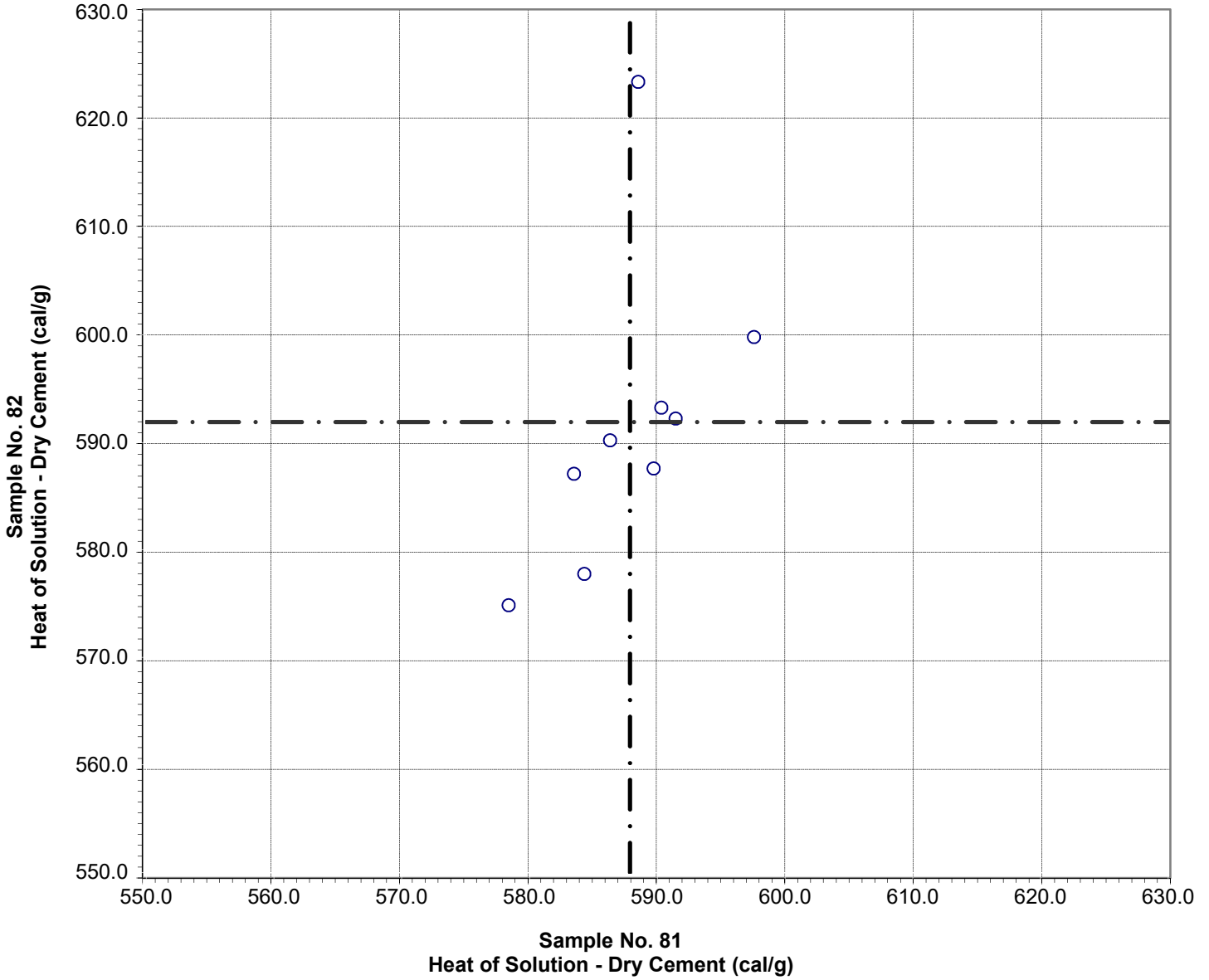
**CCRL PROFICIENCY SAMPLE PROGRAM**  
Blended Cement Proficiency Samples No. 81 and No. 82

Final Report – May 1, 2018

SUMMARY OF RESULTS

Test (unit)	Sample No. 81				Sample No. 82		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Heat of Solution - Dry Cement (cal/g)</b>							
	9	587.9	5.5	0.9	591.9	14.0	2.4
	9	587.9	5.5	0.9	591.9	14.0	2.4
No Labs Eliminated for This Test							
<b>Heat of Solution - 7 day (cal/g)</b>							
	8	511.6	5.2	1.0	510.0	5.2	1.0
	8	511.6	5.2	1.0	510.0	5.2	1.0
No Labs Eliminated for This Test							
<b>Heat of Solution - 28 day (cal/g)</b>							
	7	503.1	6.1	1.21	508.5	17.9	3.53
	7	503.1	6.1	1.21	508.5	17.9	3.53
No Labs Eliminated for This Test							
<b>Heat of Hydration - 7 day (cal/g)</b>							
	8	77.3	6.1	7.9	78.1	4.8	6.2
	8	77.3	6.1	7.9	78.1	4.8	6.2
No Labs Eliminated for This Test							
<b>Heat of Hydration - 28 day (cal/g)</b>							
	7	86.6	4.4	5.1	87.6	8.1	9.2
	7	86.6	4.4	5.1	87.6	8.1	9.2
No Labs Eliminated for This Test							
<b>C1702 Heat of Hydration - 3 day (J/g)</b>							
	7	297	10	3.2	301	36	12.0
	7	297	10	3.2	301	36	12.0
No Labs Eliminated for This Test							
<b>C1702 Heat of Hydration - 7 day (J/g)</b>							
	7	349	23	6.7	355	13	3.6
	7	349	23	6.7	355	13	3.6
No Labs Eliminated for This Test							

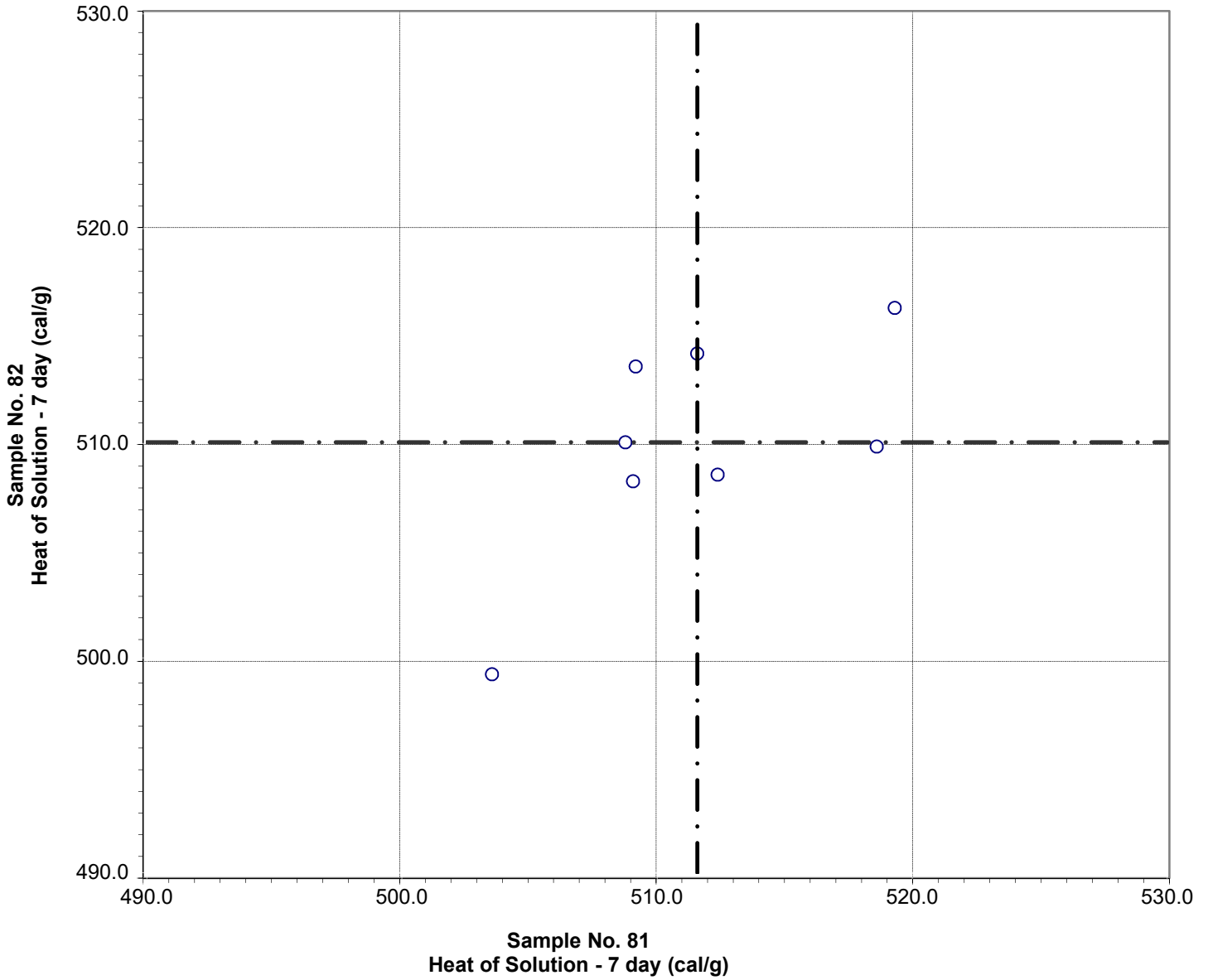
**CCRL Proficiency Sample Program**  
**Heat of Solution - Dry Cement**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 291 Heat of Solution - Dry Cement 9 Points

Sample No. 81	Ave 587.9	S.D. 5.5	C.V. 0.9
Sample No. 82	Ave 591.9	S.D. 14.0	C.V. 2.4

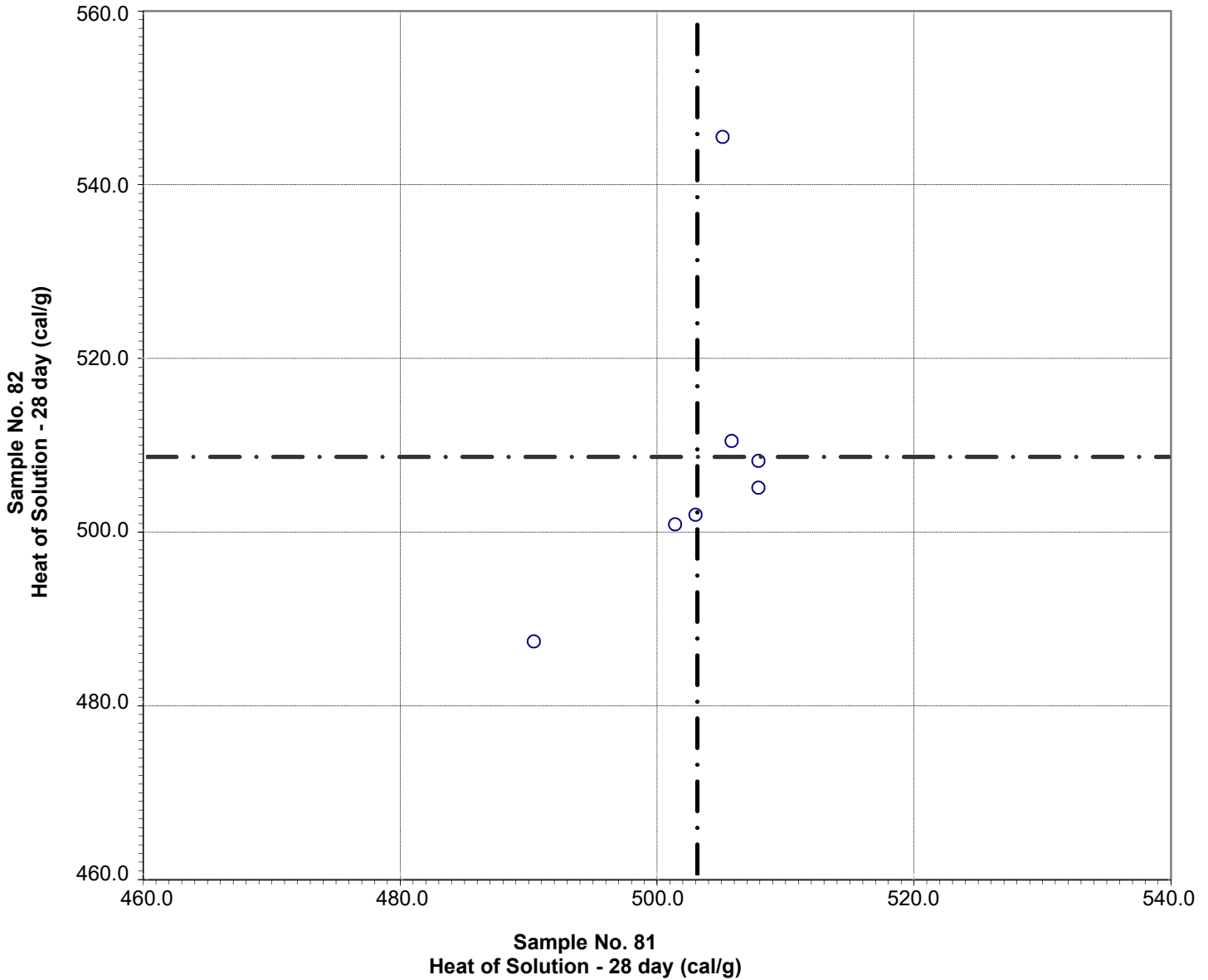
**CCRL Proficiency Sample Program**  
**Heat of Solution - 7 day**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 292 Heat of Solution - 7 day 8 Points

Sample No. 81	Ave 511.6	S.D. 5.2	C.V. 1.0
Sample No. 82	Ave 510.0	S.D. 5.2	C.V. 1.0

**CCRL Proficiency Sample Program**  
**Heat of Solution - 28 day**  
**BLENDED CEMENT Samples No. 81 and No. 82**

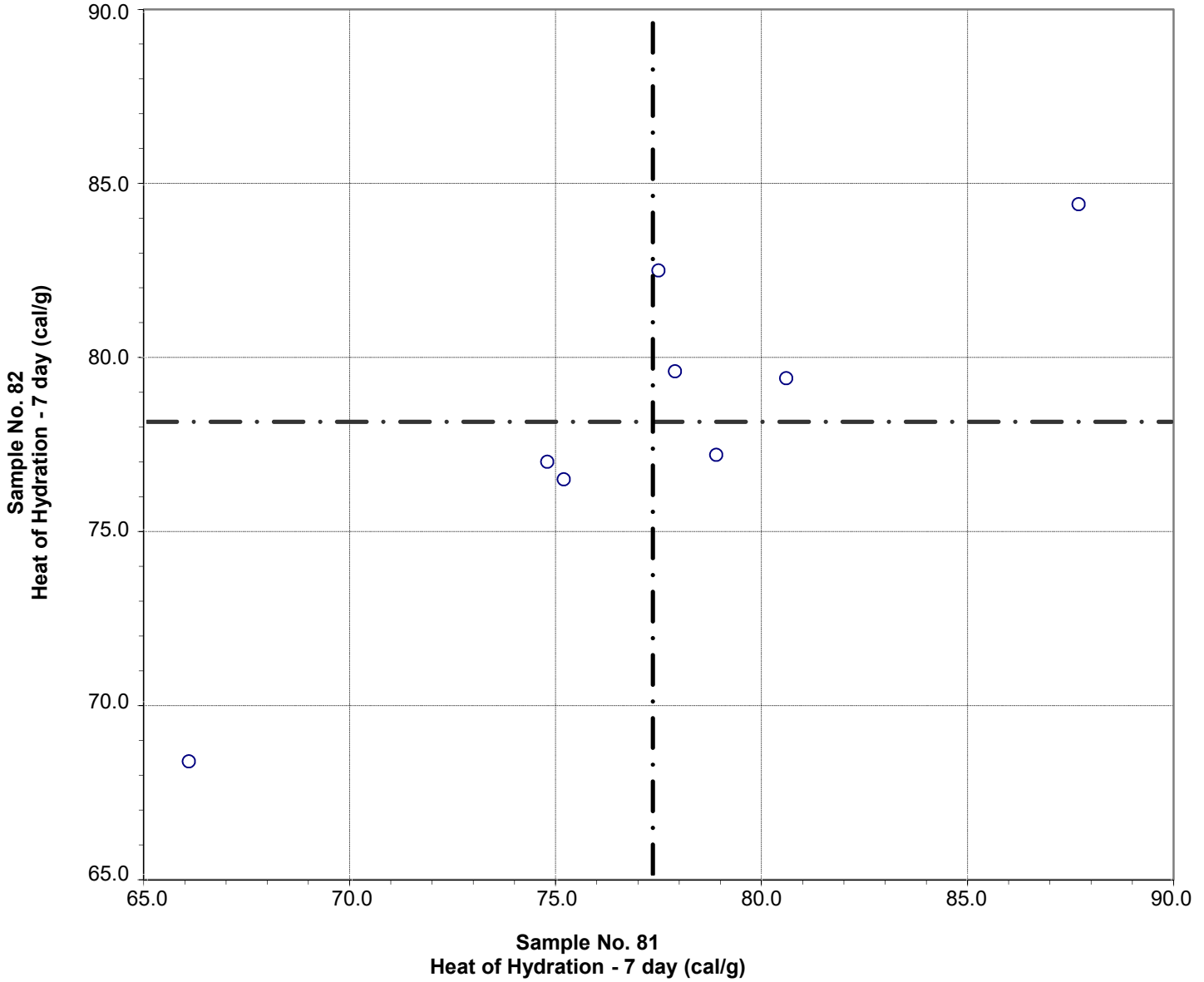


Test No. 301 Heat of Solution - 28 day 7 Points

Sample No. 81	Ave 503.1	S.D. 6.1	C.V. 1.21
Sample No. 82	Ave 508.5	S.D. 17.9	C.V. 3.53



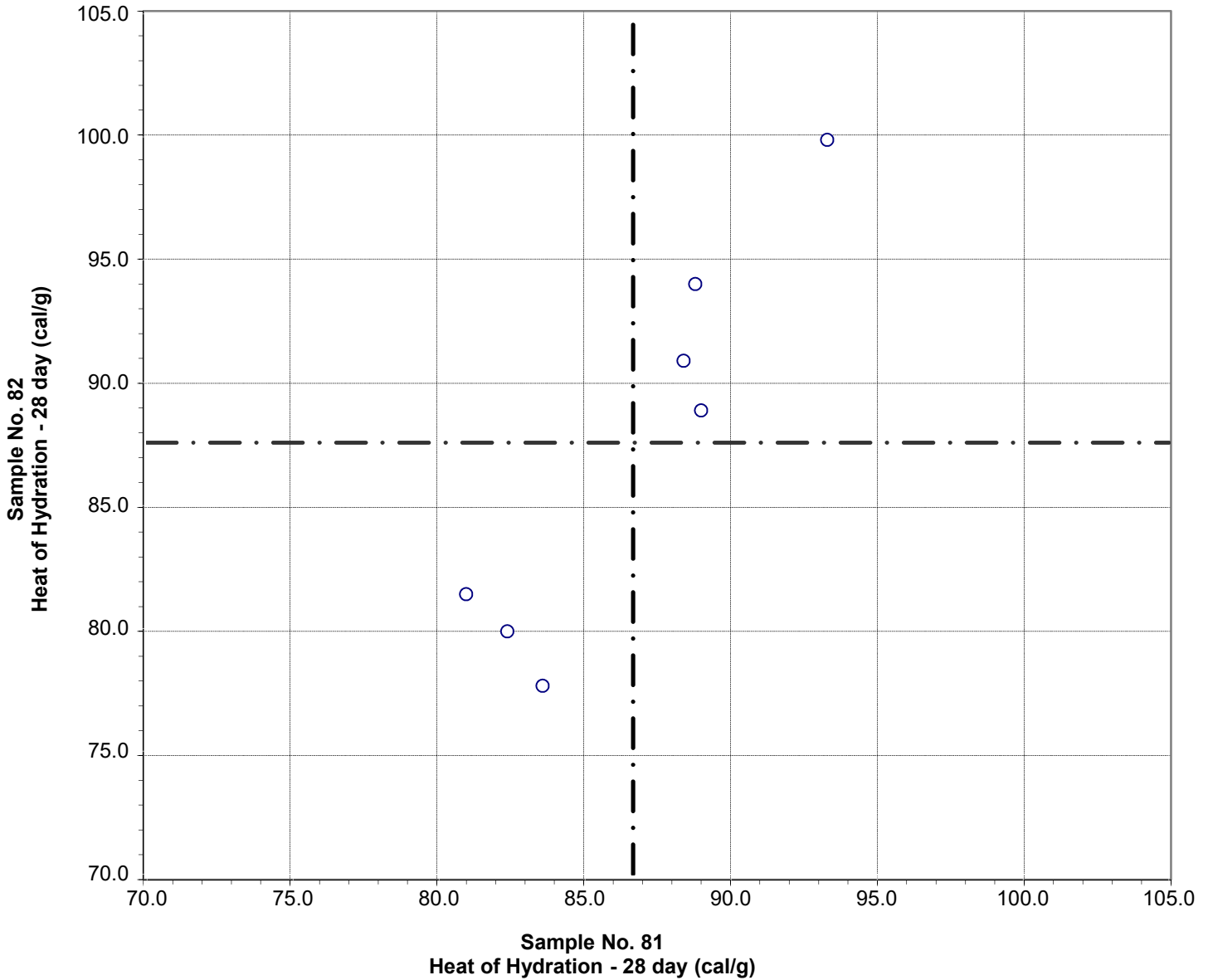
**CCRL Proficiency Sample Program**  
**Heat of Hydration - 7 day**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 290 Heat of Hydration - 7 day 8 Points

Sample No. 81	Ave 77.3	S.D. 6.1	C.V. 7.9
Sample No. 82	Ave 78.1	S.D. 4.8	C.V. 6.2

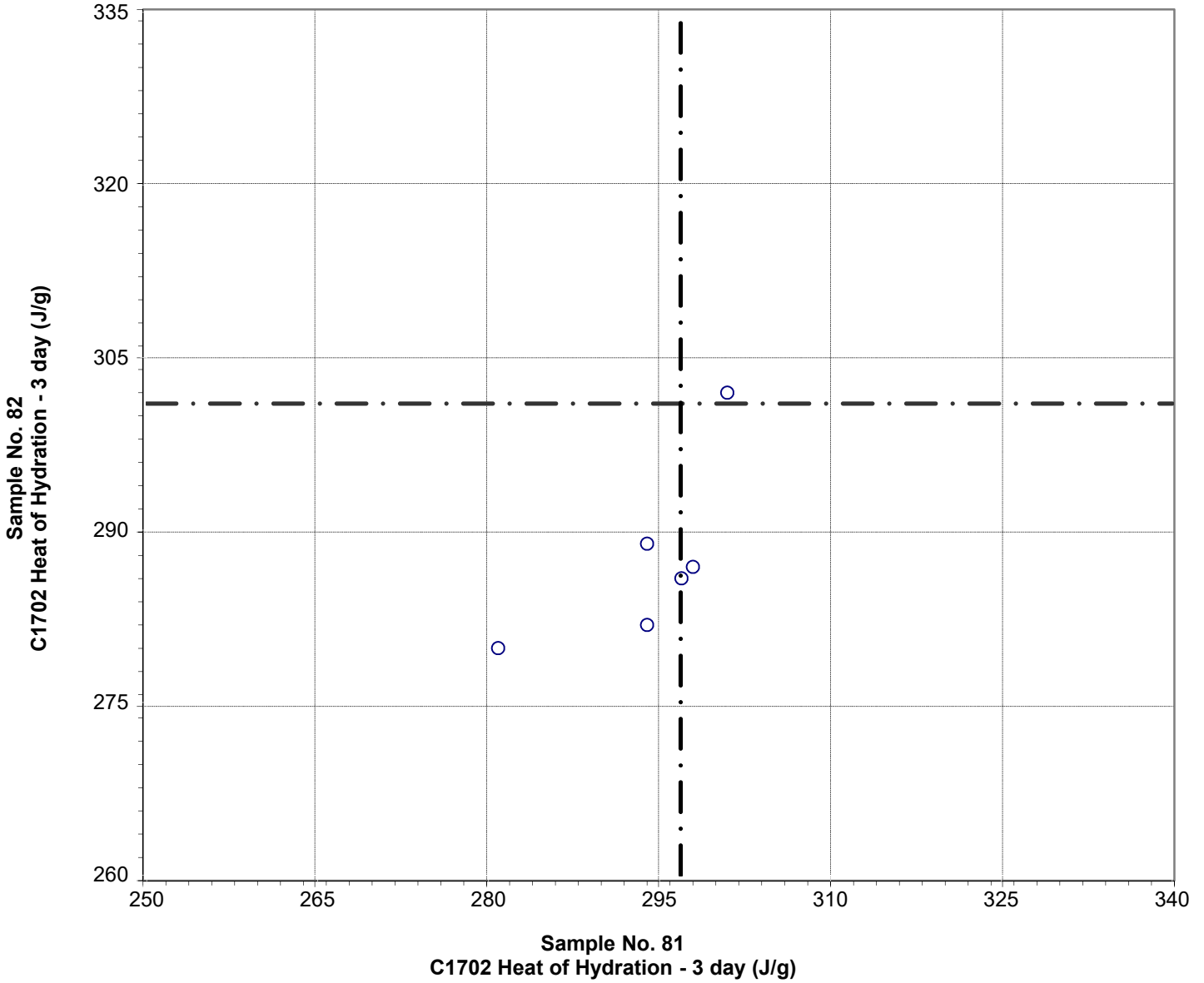
**CCRL Proficiency Sample Program**  
**Heat of Hydration - 28 day**  
**BLENDED CEMENT Samples No. 81 and No. 82**



Test No. 300 Heat of Hydration - 28 day 7 Points

Sample No. 81	Ave 86.6	S.D. 4.4	C.V. 5.1
Sample No. 82	Ave 87.6	S.D. 8.1	C.V. 9.2

**CCRL Proficiency Sample Program  
C1702 Heat of Hydration - 3 day  
BLENDED CEMENT Samples No. 81 and No. 82**

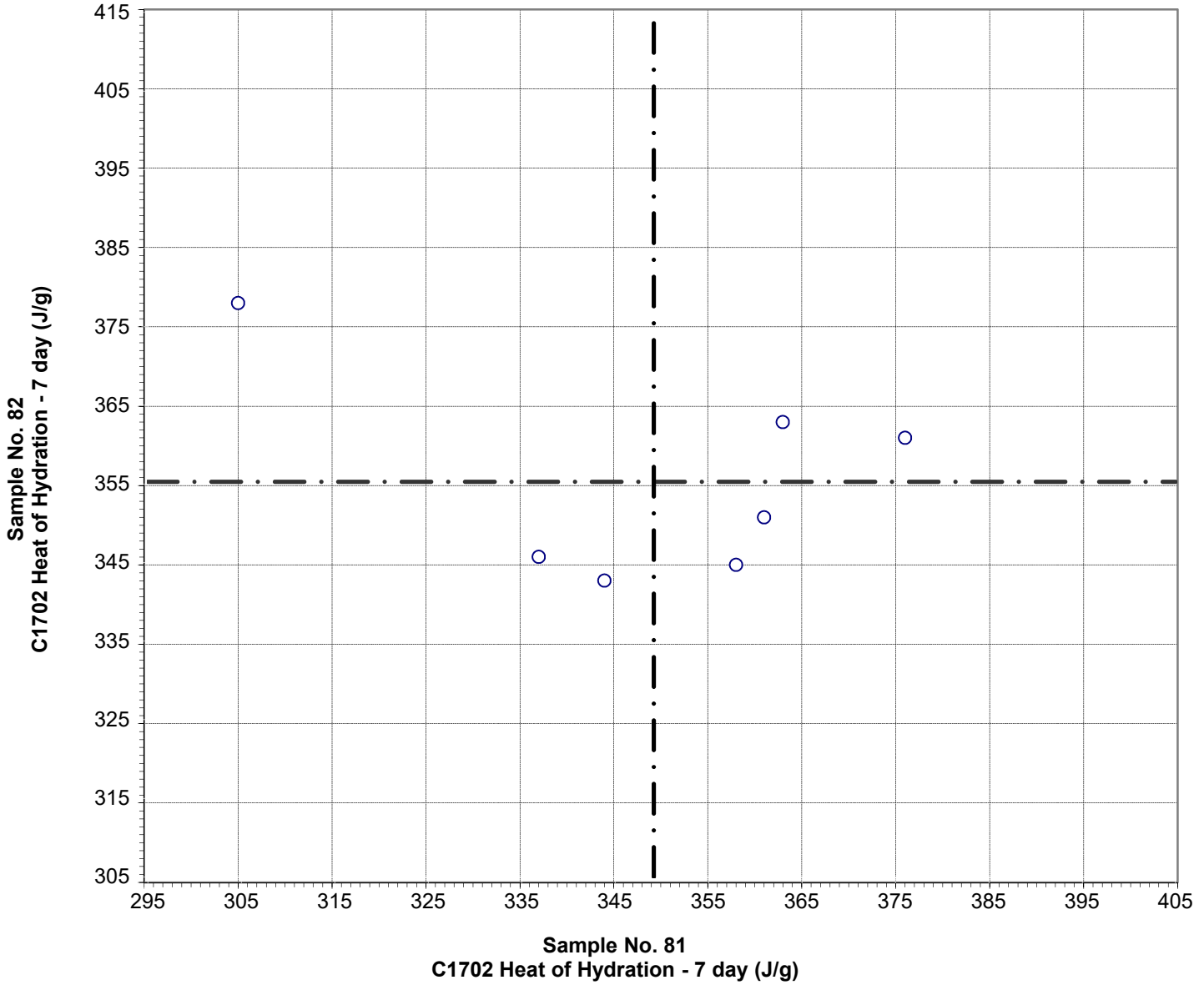


Test No. 500 C1702 Heat of Hydration - 3 day 6 Points

Sample No. 81	Ave 297	S.D. 10	C.V. 3.2
Sample No. 82	Ave 301	S.D. 36	C.V. 12.0

Labs off Diagram: 126

**CCRL Proficiency Sample Program**  
**C1702 Heat of Hydration - 7 day**  
**BLENDED CEMENT Samples No. 81 and No. 82**



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

Sample No. 81	Ave 349	S.D. 23	C.V. 6.7
Sample No. 82	Ave 355	S.D. 13	C.V. 3.6