

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Blended Cement Proficiency Samples
Number 73 and Number 74

May 2014





CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

May 5, 2014

To: Participants in the CCRL Blended Cement Proficiency Sample Program

SUBJECT: Final Report on Blended Cement Proficiency Samples No. 73 and No. 74

Following is the final report for the current pair of CCRL **Blended Cement** Proficiency Samples which were distributed in February 2014. Both cements were an ASTM C595 Blended Hydraulic Cement. Sample No 73 was a Type IP (25) and No. 74 was a Type IP (25).

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 2015.

Sincerely,

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

To: Participants in the CCRL Blended Cement Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor, PSP

SUBJECT: Explanation of Final Report on Results of Tests for Blended Cement Proficiency Samples No. 73 and No. 74

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 2014. 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.

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.*

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 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
Blended Cement Proficiency Samples No. 73 and No. 74

Final Report – Chemical Results
May 5, 2014

SUMMARY OF RESULTS

Sample No.73

Sample No. 74

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide (percent)							
	88	31.00	1.93	6.2	28.42	1.57	5.5
	*80	30.98	0.58	1.9	28.36	0.49	1.7
* Labs Eliminated - 38, 43, 51, 284, 413, 2466, 3431, 3695							
Aluminum Oxide (percent)							
	84	9.01	0.67	7.4	8.63	0.41	4.8
	*72	9.03	0.30	3.3	8.67	0.17	2.0
* Labs Eliminated - 40, 43, 52, 690, 1956, 3297, 3409, 3431, 3503, 3504, 3695, 3911							
Ferric Oxide (percent)							
	87	3.96	0.28	7.1	3.35	0.22	6.5
	*85	3.96	0.25	6.4	3.36	0.16	4.9
* Labs Eliminated - 51, 3695							
Calcium Oxide (percent)							
	85	48.03	1.12	2.33	50.67	1.44	2.85
	*82	47.94	0.99	2.07	50.71	0.87	1.71
* Labs Eliminated - 43, 440, 3911							
Magnesium Oxide (percent)							
	89	1.84	0.18	9.7	2.50	0.19	7.7
	*82	1.83	0.11	6.3	2.51	0.12	4.7
* Labs Eliminated - 40, 440, 698, 1956, 2251, 2466, 3503							
Sulfur Trioxide (percent)							
	92	3.02	0.18	6.0	3.07	0.21	6.8
	*84	3.01	0.12	4.0	3.08	0.10	3.3
* Labs Eliminated - 35, 40, 51, 126, 698, 2363, 2466, 3297							
Loss on Ignition (percent)							
	90	1.68	0.13	7.6	1.77	0.13	7.5
	*84	1.67	0.07	4.3	1.78	0.08	4.3
* Labs Eliminated - 43, 51, 54, 698, 1251, 2465							

CCRL PROFICIENCY SAMPLE PROGRAM
Blended Cement Proficiency Samples No. 73 and No. 74

Final Report – Chemical Results
May 5, 2014

SUMMARY OF RESULTS

Sample No.73

Sample No. 74

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Sodium Oxide (percent)							
	78	0.396	0.091	23	0.223	0.072	32
	*73	0.395	0.069	17	0.213	0.049	23
* Labs Eliminated - 1715, 2352, 2466, 2477, 3695							
Potassium Oxide (percent)							
	81	0.64	0.17	26.0	0.63	0.18	28.0
	*74	0.64	0.04	5.6	0.63	0.03	4.4
* Labs Eliminated - 50, 698, 1715, 2363, 2466, 3297, 3504							
Titanium Dioxide (percent)							
	67	0.56	0.047	8.4	0.51	0.041	8.1
	*66	0.56	0.031	5.5	0.51	0.026	5.1
* Labs Eliminated - 3409							
Phosphorus Pentoxide (percent)							
	69	0.209	0.023	11.2	0.127	0.021	16.3
	*64	0.211	0.013	6.4	0.124	0.010	7.6
* Labs Eliminated - 43, 1799, 2462, 2466, 3235							
Zinc Oxide (percent)							
	32	0.009	0.003	33.0	0.010	0.003	26.6
	*30	0.008	0.002	23.7	0.010	0.002	17.2
* Labs Eliminated - 413, 1657							
Manganic Oxide (percent)							
	55	0.053	0.015	27.3	0.067	0.013	19.8
	*50	0.053	0.005	10.2	0.068	0.006	8.4
* Labs Eliminated - 354, 413, 2466, 3409, 3504							
Chloride (percent)							
	30	0.009	0.011	123	0.007	0.006	91
	*27	0.007	0.005	79	0.005	0.004	67
* Labs Eliminated - 43, 497, 1657							

CCRL PROFICIENCY SAMPLE PROGRAM
Blended Cement Proficiency Samples No. 73 and No. 74

Final Report – Chemical Results
May 5, 2014

SUMMARY OF RESULTS

Sample No.73

Sample No. 74

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
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Insoluble Residue (percent)

78	20.75	4.11	20	13.32	2.50	19
*74	21.54	2.06	10	13.78	1.39	10

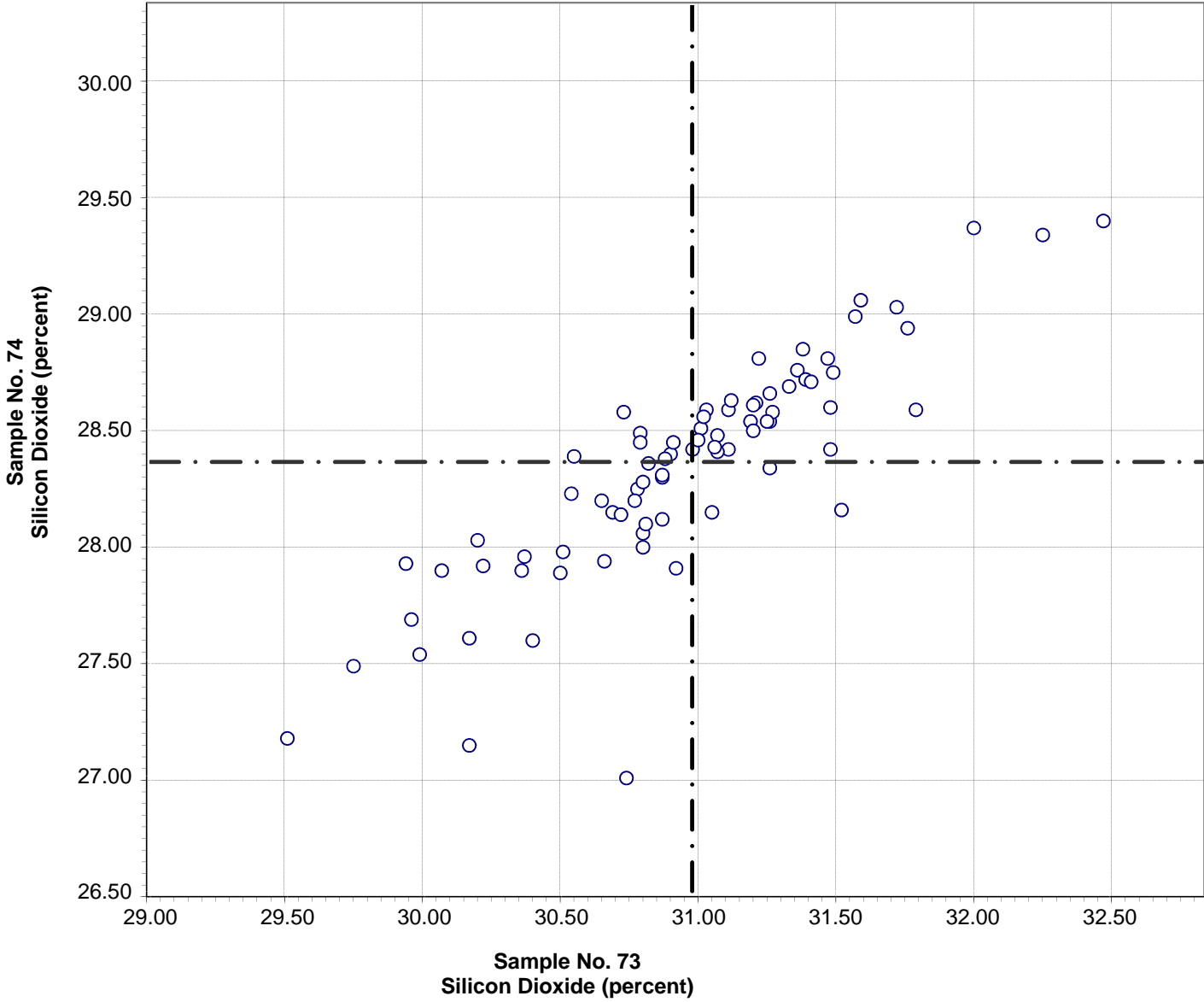
* Labs Eliminated - 51, 691, 698, 982

Chromium Oxide (percent)

30	0.014	0.005	34	0.015	0.005	30
*27	0.013	0.002	17	0.015	0.003	17

* Labs Eliminated - 43, 2462, 2477

**CCRL Proficiency Sample Program
Silicon Dioxide
BLENDED CEMENT Samples No. 73 and No. 74**



Test No. 10 Silicon Dioxide 79 Points

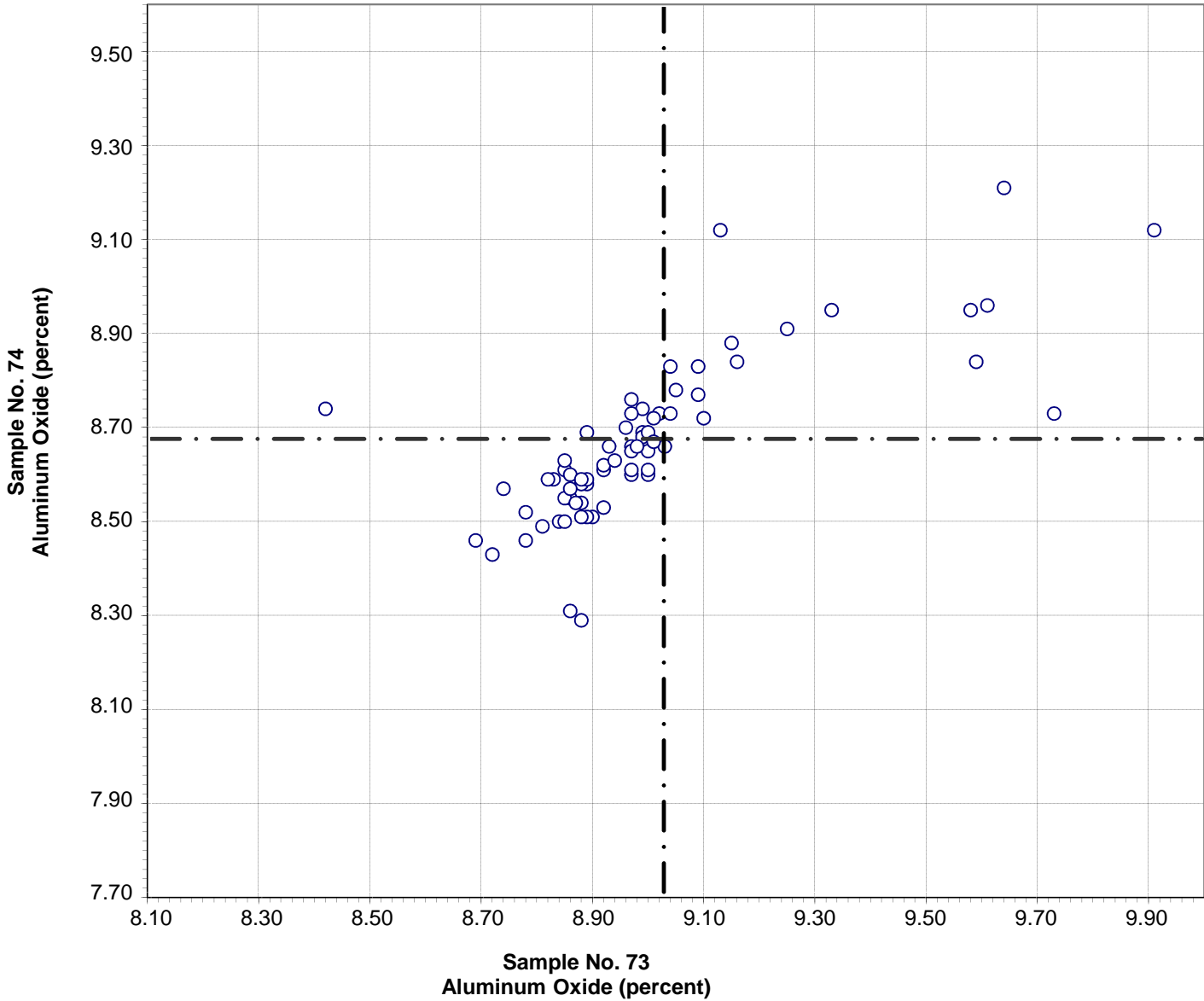
Sample No. 73 Ave 30.98 S.D. 0.58 C.V. 1.9

Sample No. 74 Ave 28.36 S.D. 0.49 C.V. 1.7

Labs Eliminated: 38, 43, 51, 284, 413, 2466, 3431, 3695

Labs off Diagram: 2464

**CCRL Proficiency Sample Program
Aluminum Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



Test No. 21 Aluminum Oxide 70 Points

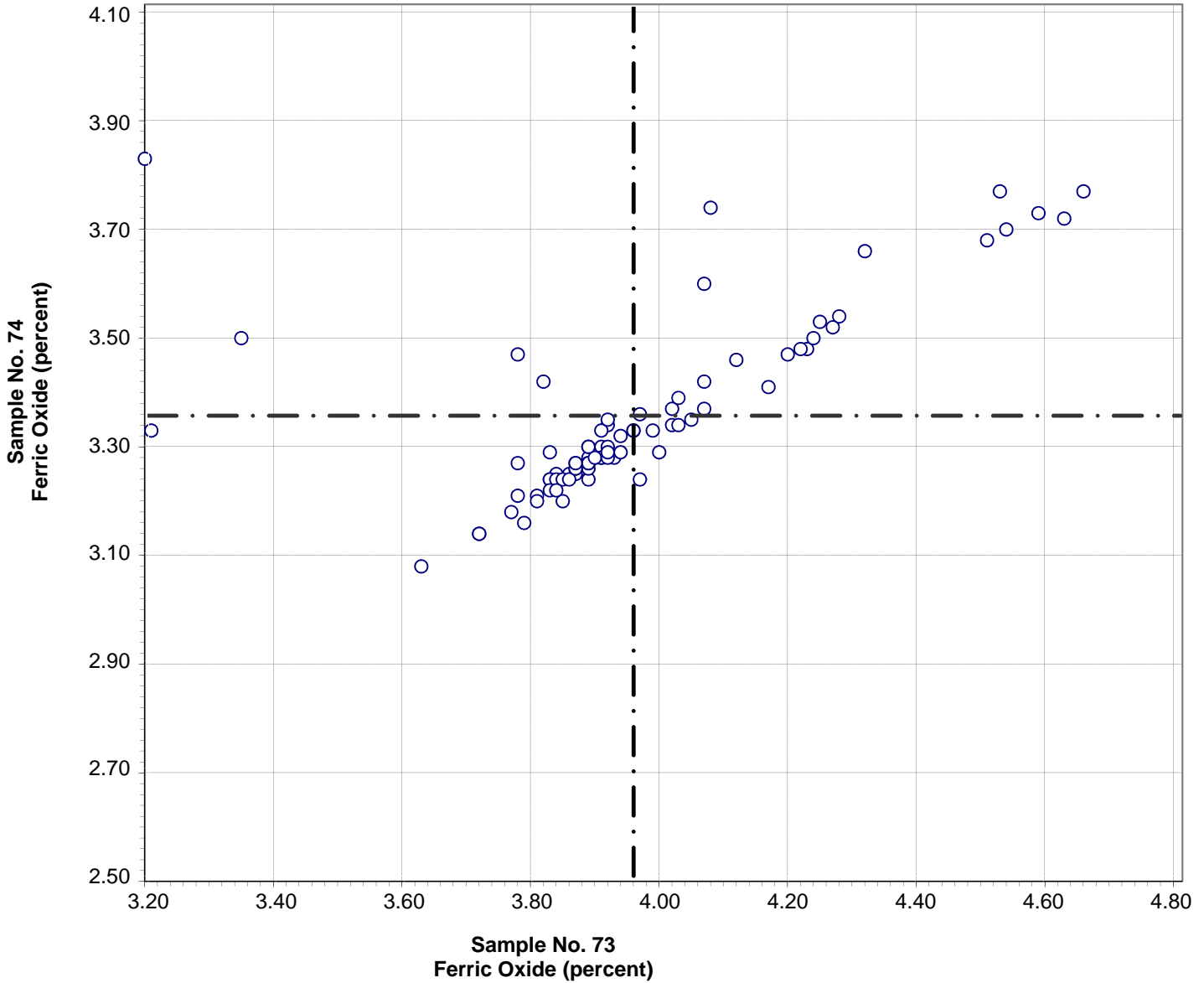
Sample No. 73 Ave 9.03 S.D. 0.30 C.V. 3.3

Sample No. 74 Ave 8.67 S.D. 0.17 C.V. 2.0

Labs Eliminated: 40, 43, 52, 690, 1956, 3297, 3409, 3431, 3503, 3504, 3695, 3911

Labs off Diagram: 38, 413

**CCRL Proficiency Sample Program
 Ferric Oxide
 BLENDED CEMENT Samples No. 73 and No. 74**

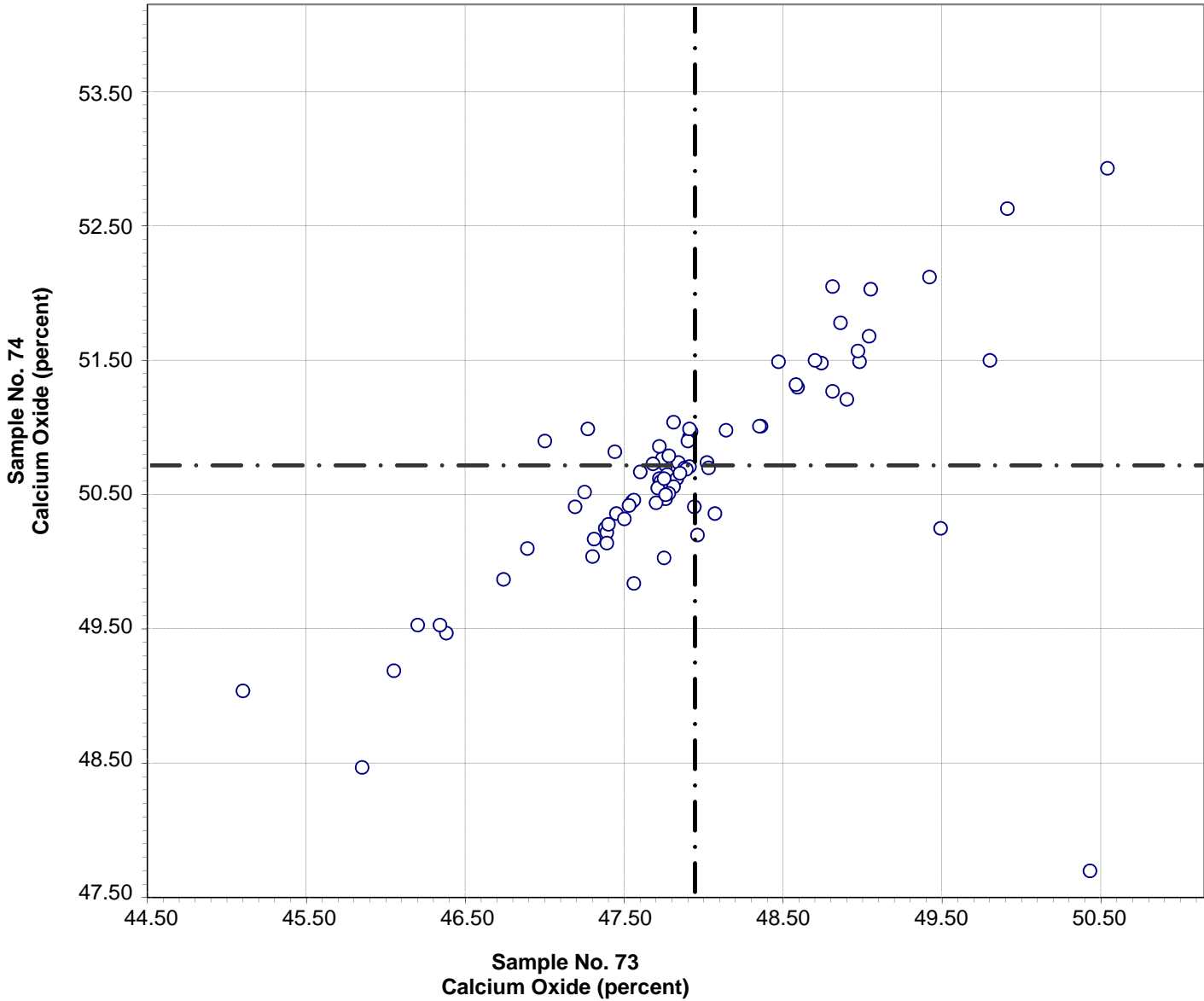


Test No. 30 Ferric Oxide 85 Points

Sample No. 73	Ave 3.96	S.D. 0.25	C.V. 6.4
Sample No. 74	Ave 3.36	S.D. 0.16	C.V. 4.9

Labs Eliminated: 51, 3695

**CCRL Proficiency Sample Program
Calcium Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



Test No. 40 Calcium Oxide 81 Points

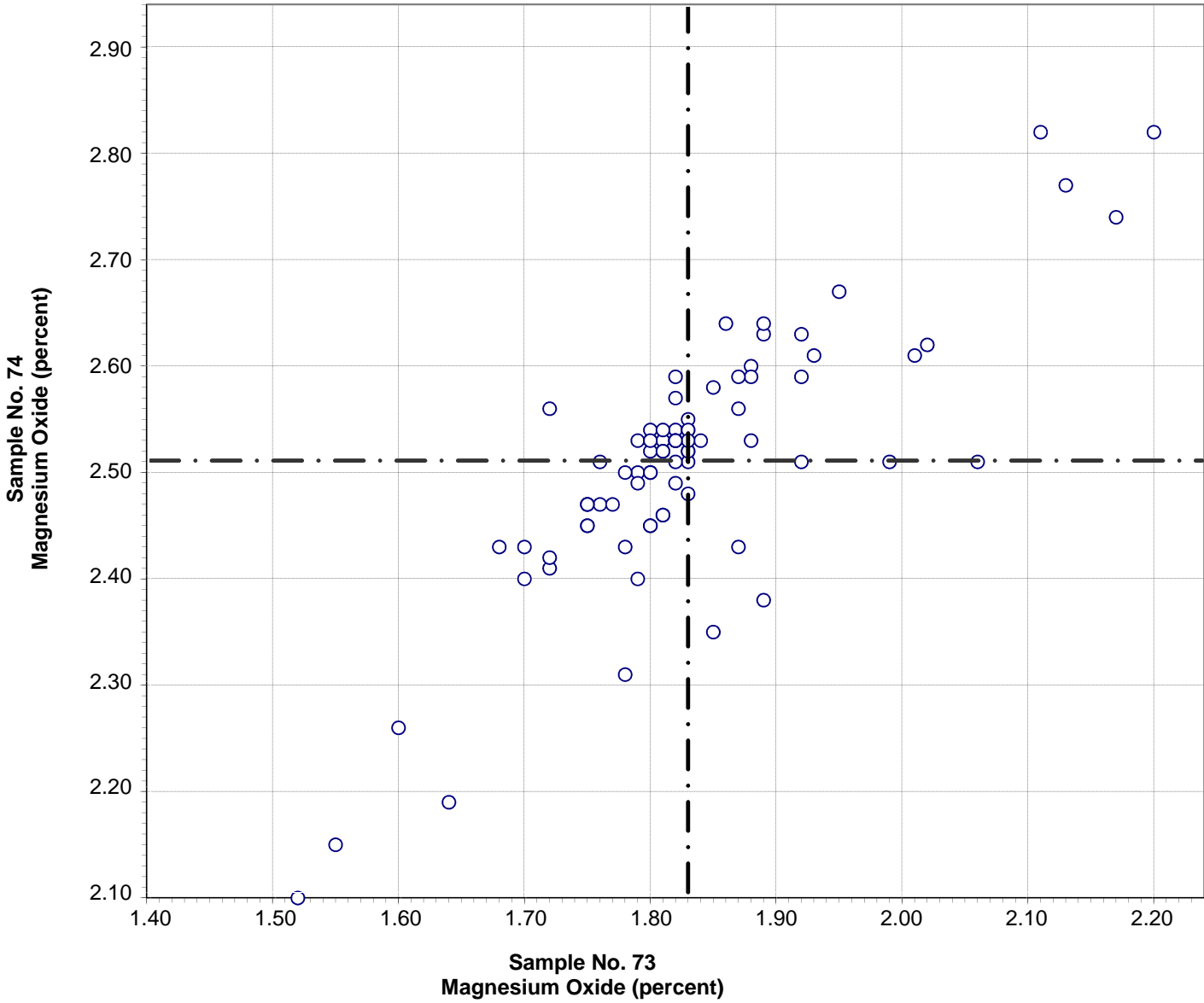
Sample No. 73 Ave 47.94 S.D. 0.99 C.V. 2.07

Sample No. 74 Ave 50.71 S.D. 0.87 C.V. 1.71

Labs Eliminated: 43, 440, 3911

Labs off Diagram: 3695

**CCRL Proficiency Sample Program
Magnesium Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



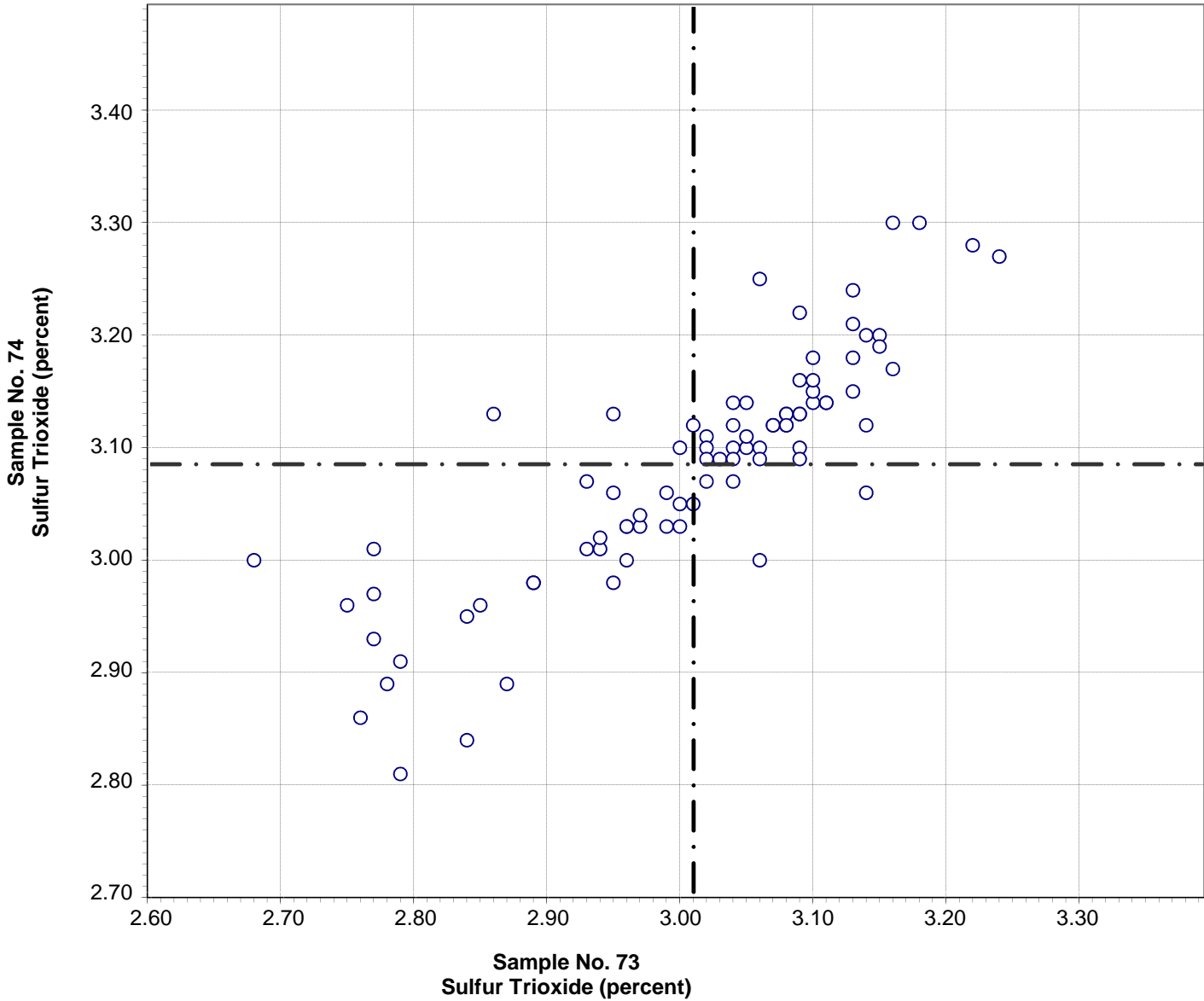
Test No. 50 Magnesium Oxide 82 Points

Sample No. 73 Ave 1.83 S.D. 0.11 C.V. 6.3

Sample No. 74 Ave 2.51 S.D. 0.12 C.V. 4.7

Labs Eliminated: 40, 440, 698, 1956, 2251, 2466, 3503

**CCRL Proficiency Sample Program
Sulfur Trioxide
BLENDED CEMENT Samples No. 73 and No. 74**



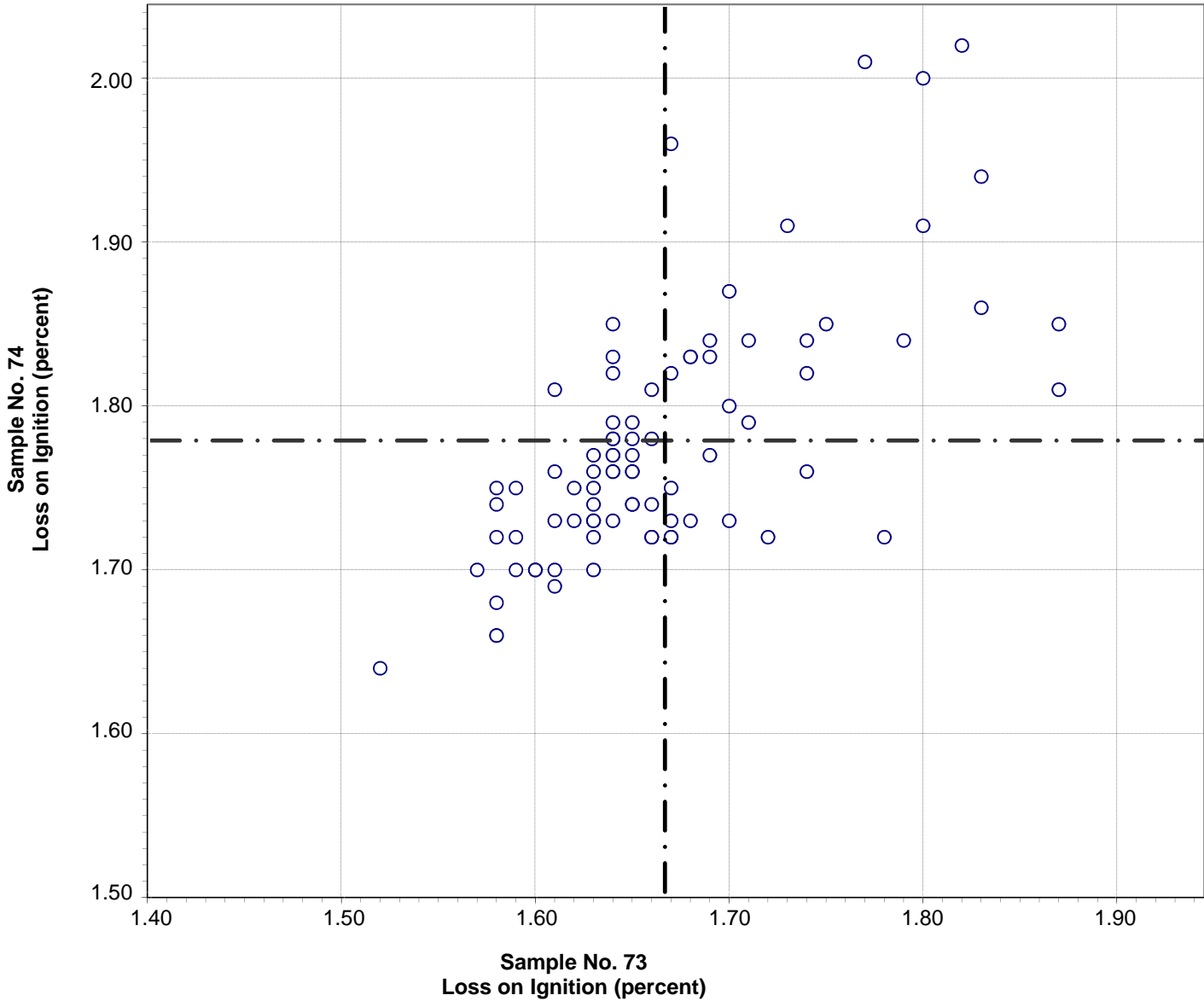
Test No. 60 Sulfur Trioxide 84 Points

Sample No. 73 Ave 3.01 S.D. 0.12 C.V. 4.0

Sample No. 74 Ave 3.08 S.D. 0.10 C.V. 3.3

Labs Eliminated: 35, 40, 51, 126, 698, 2363, 2466, 3297

**CCRL Proficiency Sample Program
Loss on Ignition
BLENDED CEMENT Samples No. 73 and No. 74**



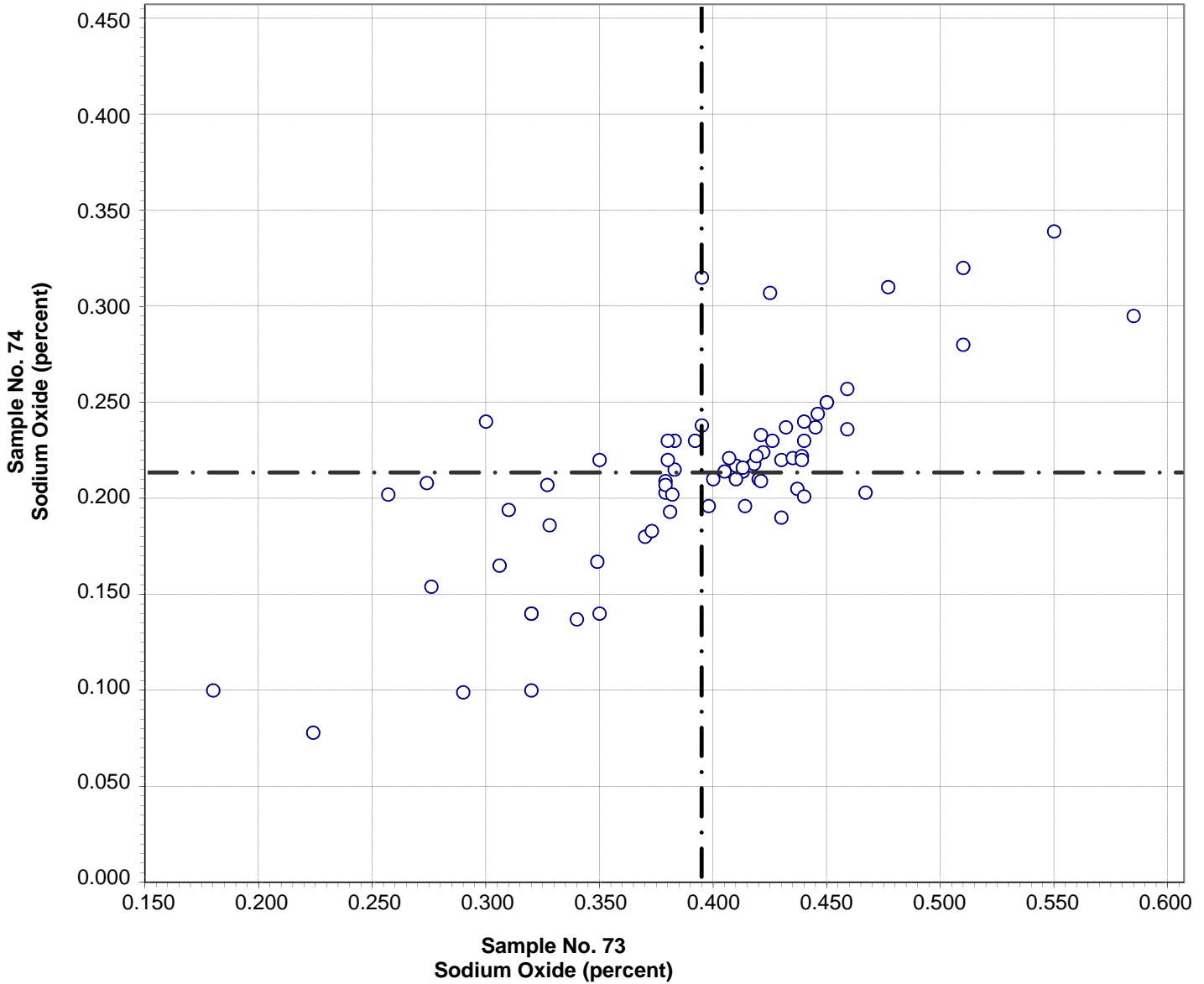
Test No. 70 Loss on Ignition 84 Points

Sample No. 73 Ave 1.67 S.D. 0.07 C.V. 4.3

Sample No. 74 Ave 1.78 S.D. 0.08 C.V. 4.3

Labs Eliminated: 43, 51, 54, 698, 1251, 2465

**CCRL Proficiency Sample Program
Sodium Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



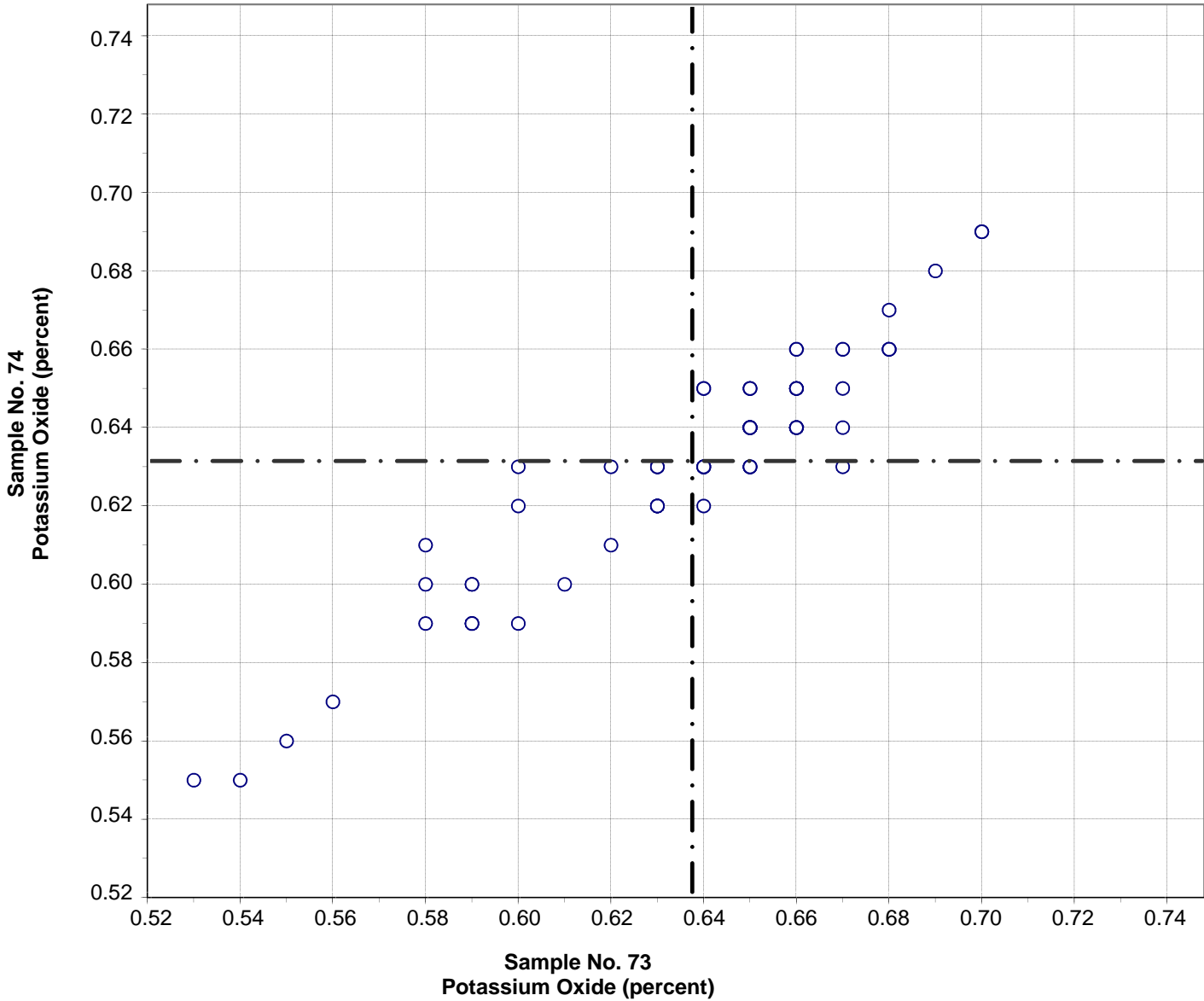
Test No. 90 Sodium Oxide 73 Points

Sample No. 73 Ave 0.395 S.D. 0.069 C.V. 17

Sample No. 74 Ave 0.213 S.D. 0.049 C.V. 23

Labs Eliminated: 1715, 2352, 2466, 2477, 3695

**CCRL Proficiency Sample Program
Potassium Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



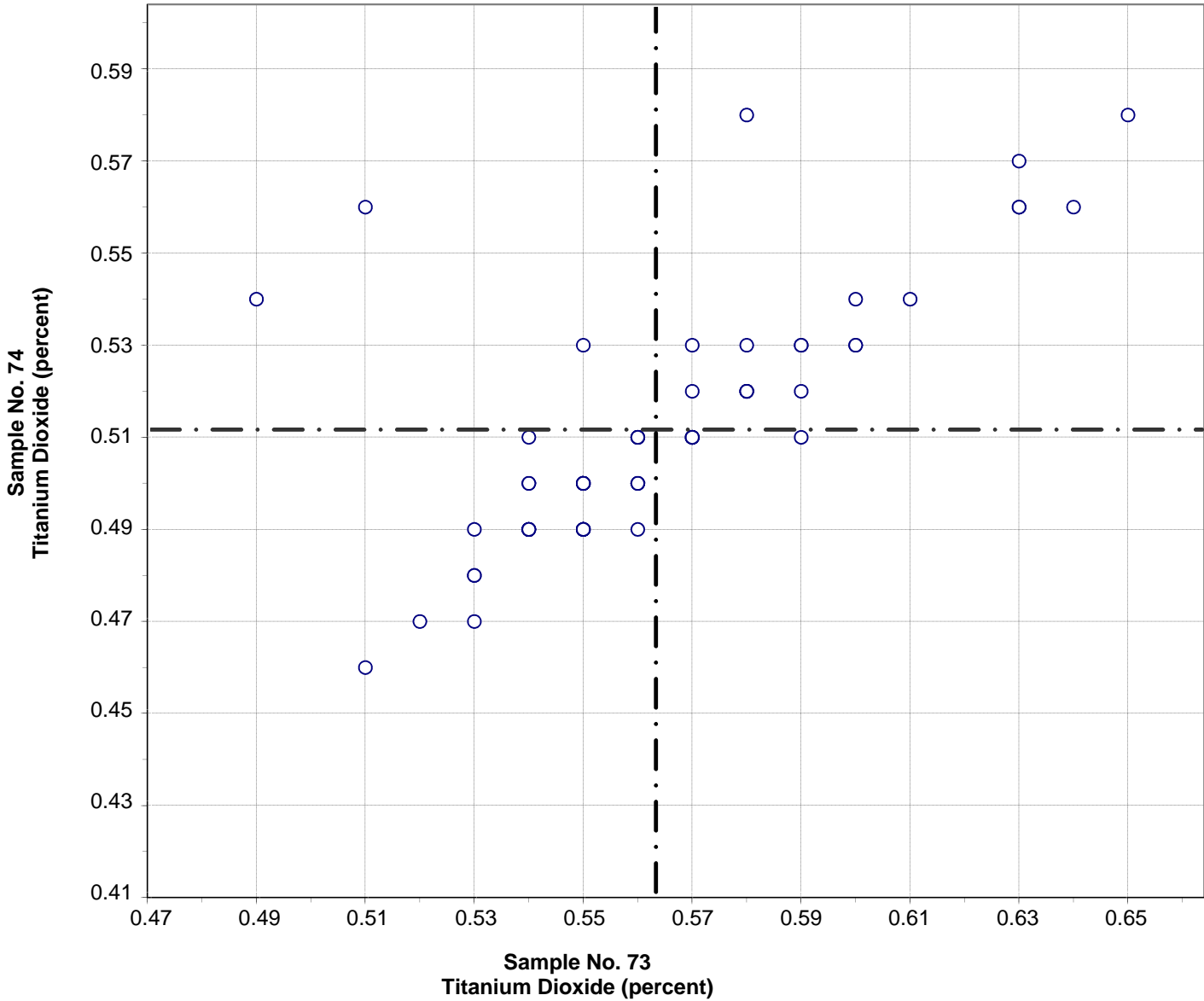
Test No. 100 Potassium Oxide 74 Points

Sample No. 73 Ave 0.64 S.D. 0.04 C.V. 5.6

Sample No. 74 Ave 0.63 S.D. 0.03 C.V. 4.4

Labs Eliminated: 50, 698, 1715, 2363, 2466, 3297, 3504

**CCRL Proficiency Sample Program
Titanium Dioxide
BLENDED CEMENT Samples No. 73 and No. 74**



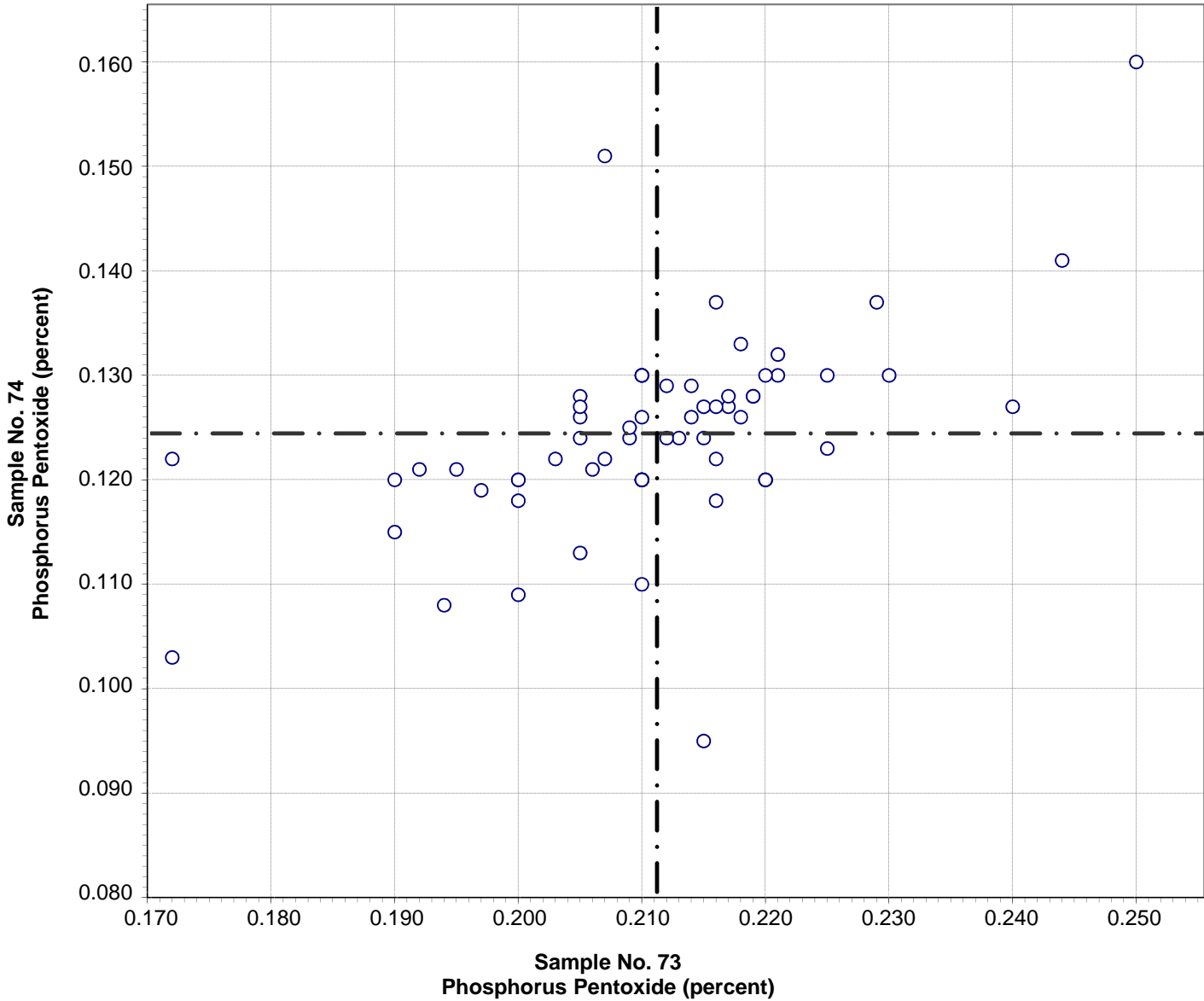
Test No. 103 Titanium Dioxide 66 Points

Sample No. 73 Ave 0.56 S.D. 0.031 C.V. 5.5

Sample No. 74 Ave 0.51 S.D. 0.026 C.V. 5.1

Labs Eliminated: 3409

**CCRL Proficiency Sample Program
Phosphorus Pentoxide
BLENDED CEMENT Samples No. 73 and No. 74**



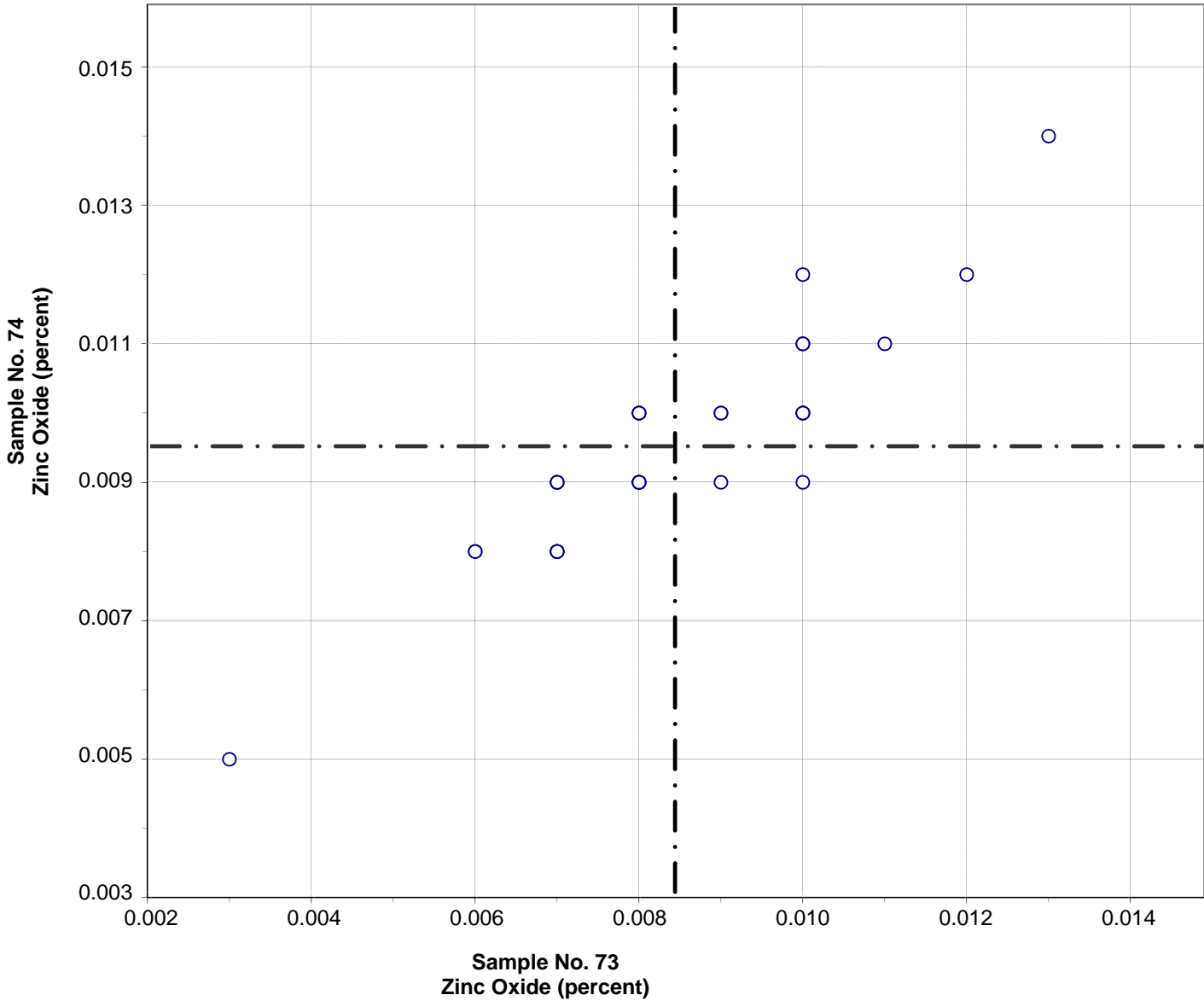
Test No. 102 Phosphorus Pentoxide 64 Points

Sample No. 73 Ave 0.211 S.D. 0.013 C.V. 6.4

Sample No. 74 Ave 0.124 S.D. 0.010 C.V. 7.6

Labs Eliminated: 43, 1799, 2462, 2466, 3235

**CCRL Proficiency Sample Program
Zinc Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



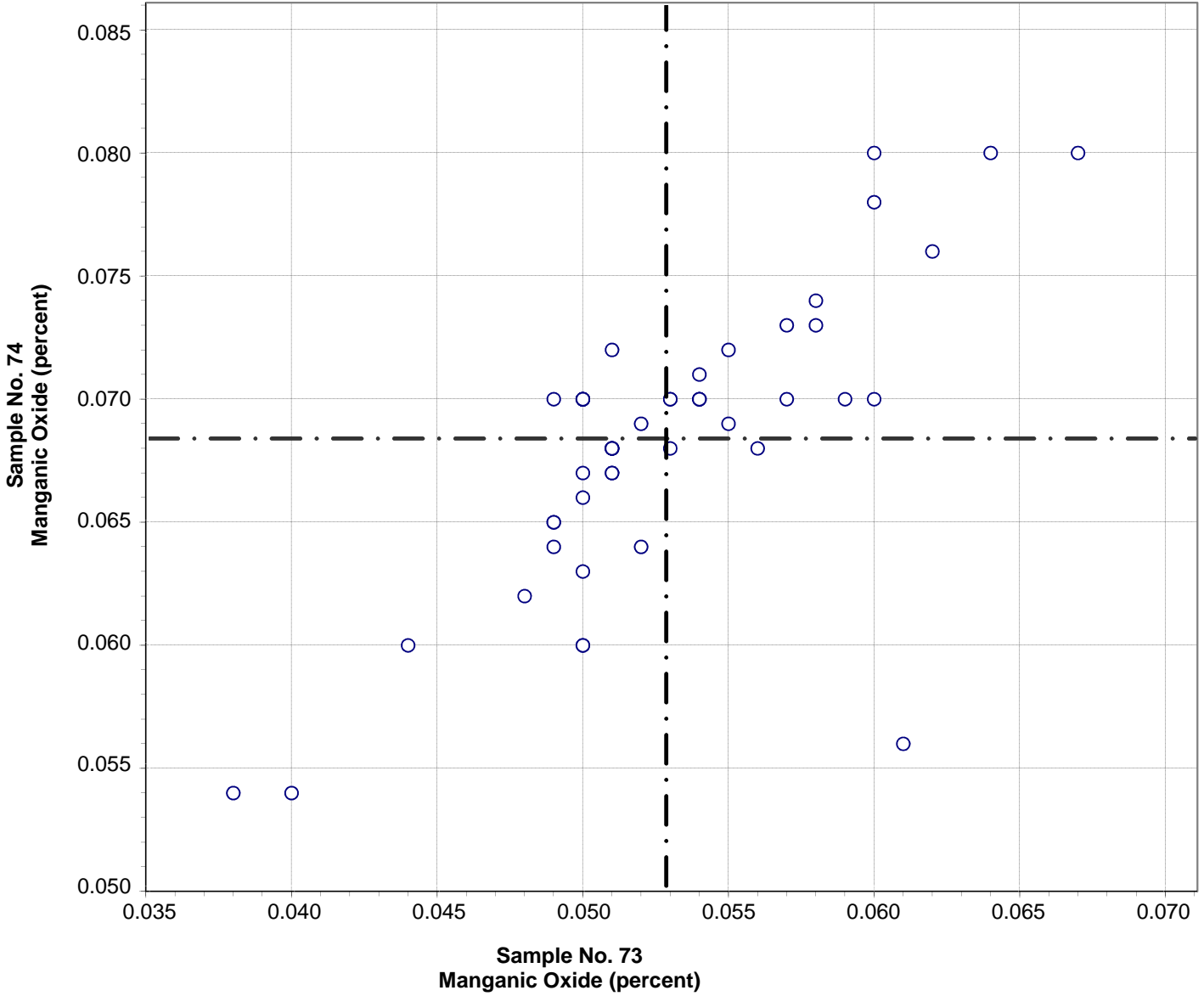
Test No. 99 Zinc Oxide 30 Points

Sample No. 73 Ave 0.008 S.D. 0.002 C.V. 23.7

Sample No. 74 Ave 0.010 S.D. 0.002 C.V. 17.2

Labs Eliminated: 413, 1657

**CCRL Proficiency Sample Program
Manganic Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



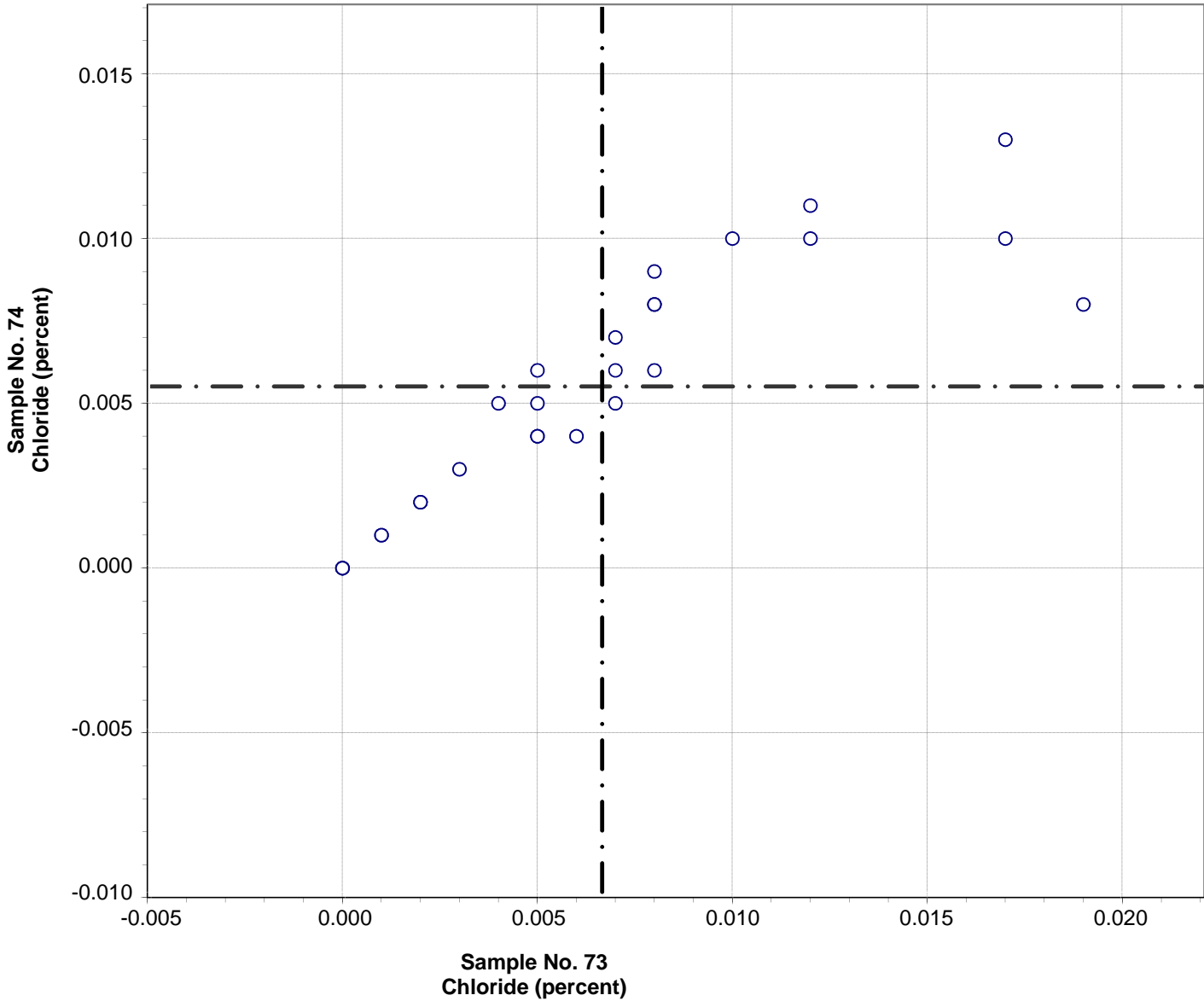
Test No. 101 Manganic Oxide 50 Points

Sample No. 73 Ave 0.053 S.D. 0.005 C.V. 10.2

Sample No. 74 Ave 0.068 S.D. 0.006 C.V. 8.4

Labs Eliminated: 354, 413, 2466, 3409, 3504

**CCRL Proficiency Sample Program
Chloride
BLENDED CEMENT Samples No. 73 and No. 74**



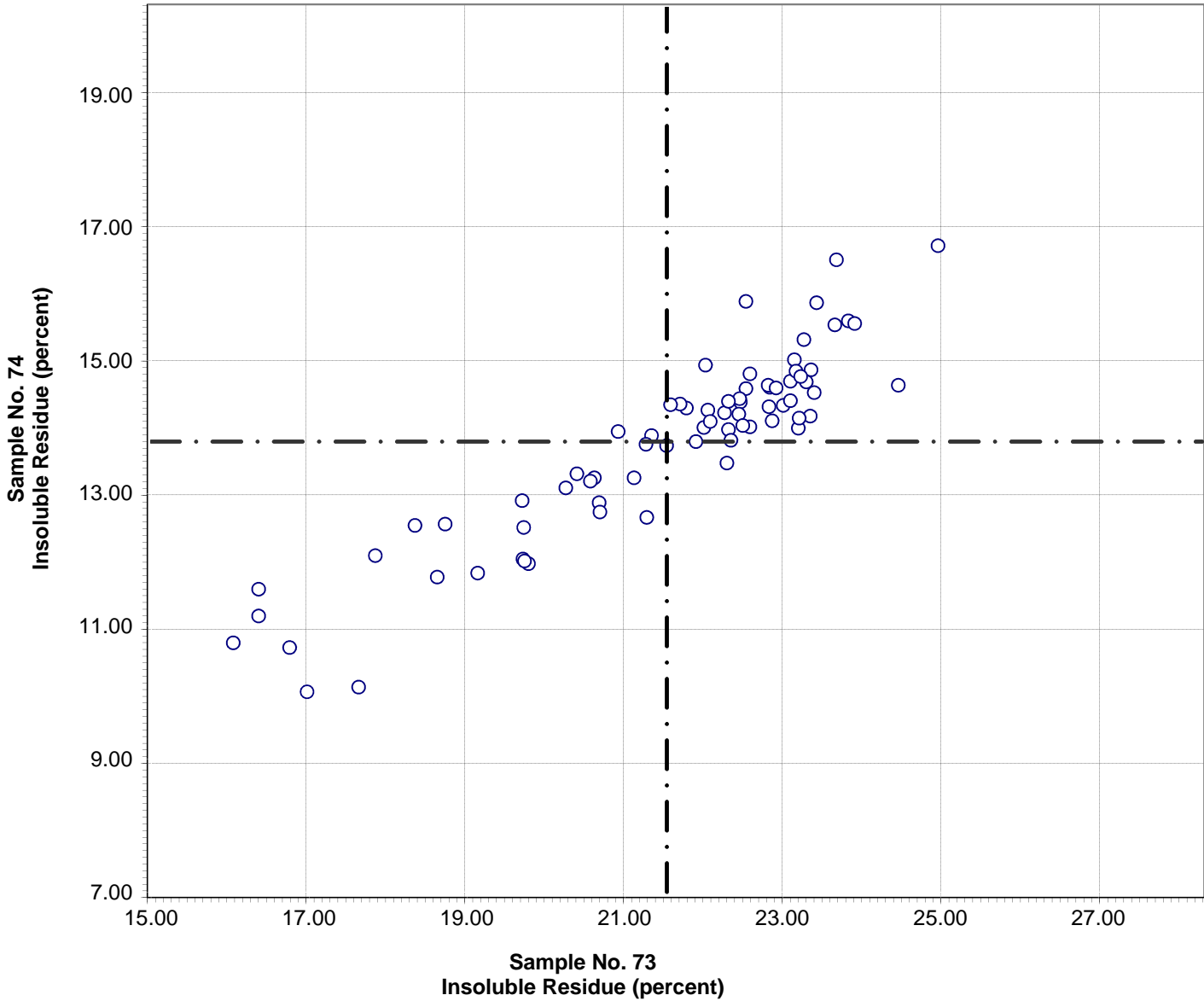
Test No. 104 Chloride 27 Points

Sample No. 73 Ave 0.007 S.D. 0.005 C.V. 79

Sample No. 74 Ave 0.005 S.D. 0.004 C.V. 67

Labs Eliminated: 43, 497, 1657

**CCRL Proficiency Sample Program
Insoluble Residue
BLENDED CEMENT Samples No. 73 and No. 74**



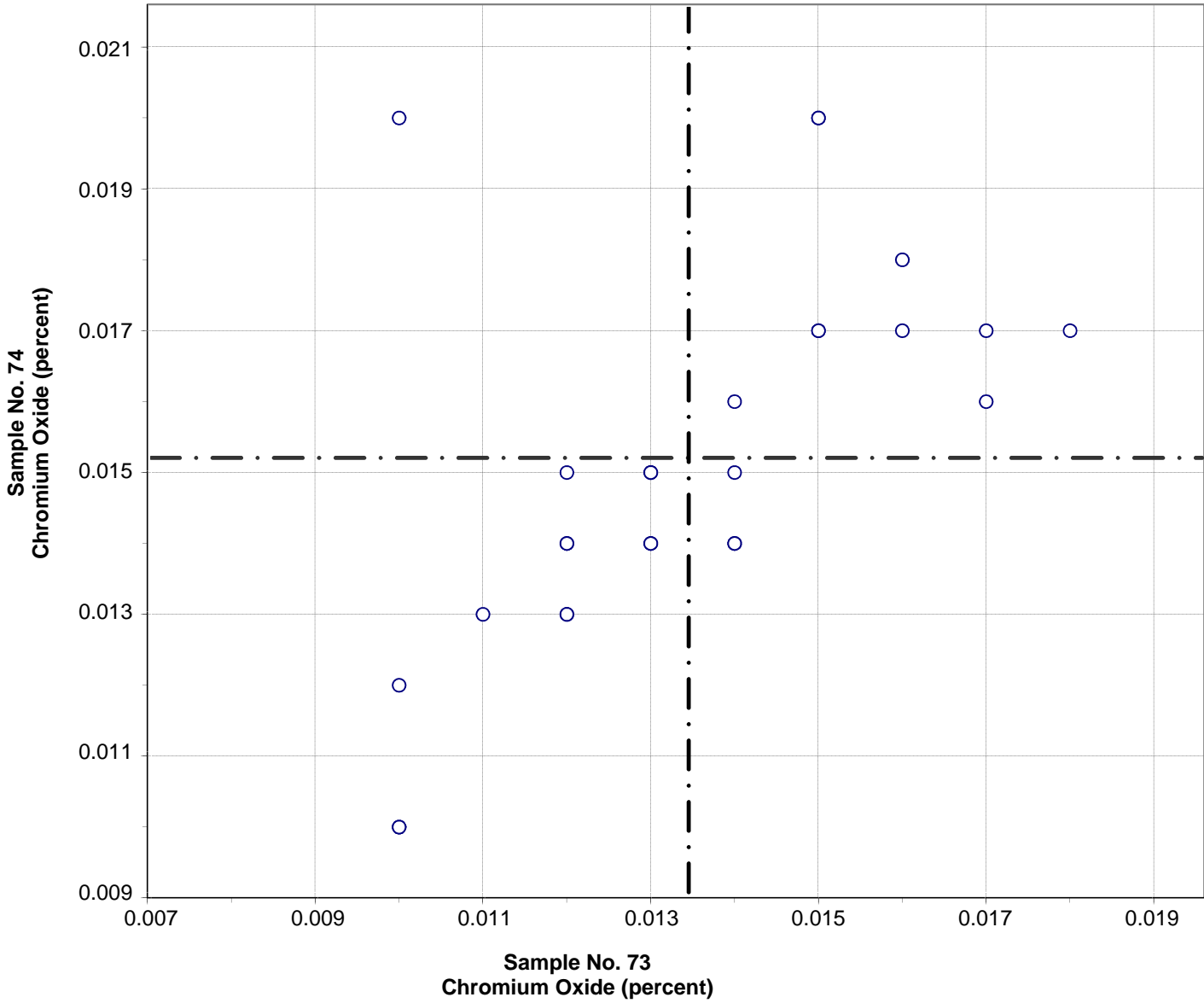
Test No. 80 Insoluble Residue 74 Points

Sample No. 73 Ave 21.54 S.D. 2.06 C.V. 10

Sample No. 74 Ave 13.78 S.D. 1.39 C.V. 10

Labs Eliminated: 51, 691, 698, 982

**CCRL Proficiency Sample Program
Chromium Oxide
BLENDED CEMENT Samples No. 73 and No. 74**



Test No. 105 Chromium Oxide 27 Points

Sample No. 73 Ave 0.013 S.D. 0.002 C.V. 17

Sample No. 74 Ave 0.015 S.D. 0.003 C.V. 17

Labs Eliminated: 43, 2462, 2477

CCRL PROFICIENCY SAMPLE PROGRAM
Blended Cement Proficiency Samples No. 73 and No. 74

Final Report – Physical Results
May 5, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.73				Sample No. 74		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Normal Consistency - % Water (percent)							
	94	28.5	1.4	5.0	25.5	1.1	4.1
	*91	28.6	1.2	4.2	25.5	0.8	3.1
	* Labs Eliminated - 2465, 3504, 3695						
Vicat Time of Set - Initial (min)							
	92	175	33	18.8	96	29	30.5
	*86	178	30	17.1	90	15	17.0
	* Labs Eliminated - 19, 38, 1455, 1956, 2352, 2462						
Vicat Time of Set - Final (min)							
	88	280	46	17	196	39	20
	*84	283	39	14	193	34	18
	* Labs Eliminated - 34, 38, 1455, 2462						
Autoclave Expansion (percent)							
	85	-0.07	0.05	85	-0.02	0.04	135
	*78	-0.07	0.04	50	-0.04	0.03	75
	* Labs Eliminated - 24, 38, 1251, 1715, 2462, 3059, 3695						
Air Content % (percent)							
	75	4.6	1.6	34	5.9	1.5	25
	*74	4.5	1.5	32	5.9	1.4	24
	* Labs Eliminated - 354						
Air Content - % Water (percent)							
	74	69.1	8.4	12.2	67.0	8.2	12.2
	*71	70.1	2.6	3.7	67.9	2.5	3.7
	* Labs Eliminated - 51, 105, 2490						
Air Content - Flow (percent)							
	77	88	4.8	5.5	90	4.7	5.3
	*75	88	3.7	4.2	89	3.0	3.4
	* Labs Eliminated - 3503, 3504						

CCRL PROFICIENCY SAMPLE PROGRAM
Blended Cement Proficiency Samples No. 73 and No. 74

Final Report – Physical Results
May 5, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.73				Sample No. 74		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Specific Gravity							
	77	2.86	0.09	3.0	2.93	0.09	3.1
	*70	2.86	0.03	1.2	2.94	0.04	1.3
	* Labs Eliminated - 25, 40, 51, 169, 440, 497, 691						
Compressive Strength - 3 day (psi)							
	96	3127	314	10.0	3493	349	10.0
	*94	3123	303	9.7	3490	284	8.1
	* Labs Eliminated - 38, 51						
Compressive Strength - 7 day (psi)							
	97	3979	361	9.1	4226	345	8.2
	*95	3965	346	8.7	4203	307	7.3
	* Labs Eliminated - 38, 3503						
Compressive Strength - 28 day (psi)							
	88	5605	498	8.9	5989	551	9.2
	*87	5580	441	7.9	5954	445	7.5
	* Labs Eliminated - 38						
Compressive Strength - % Water (percent)							
	89	49.0	4.8	9.8	46.5	5.2	11.2
	*84	49.0	1.2	2.4	46.7	1.4	3.0
	* Labs Eliminated - 28, 38, 101, 105, 3912						
Compressive Strength - Flow (percent)							
	90	109	5.6	5.2	111	5.5	5.0
	*82	109	3.0	2.7	111	2.8	2.5
	* Labs Eliminated - 22, 24, 34, 38, 40, 691, 958, 3910						
Fineness - Air Permeability (cm²/g)							
	93	4904	605	12.3	5037	587	11.7
	*92	4944	473	9.6	5077	445	8.8
	* Labs Eliminated - 50						

CCRL PROFICIENCY SAMPLE PROGRAM
 Blended Cement Proficiency Samples No. 73 and No. 74

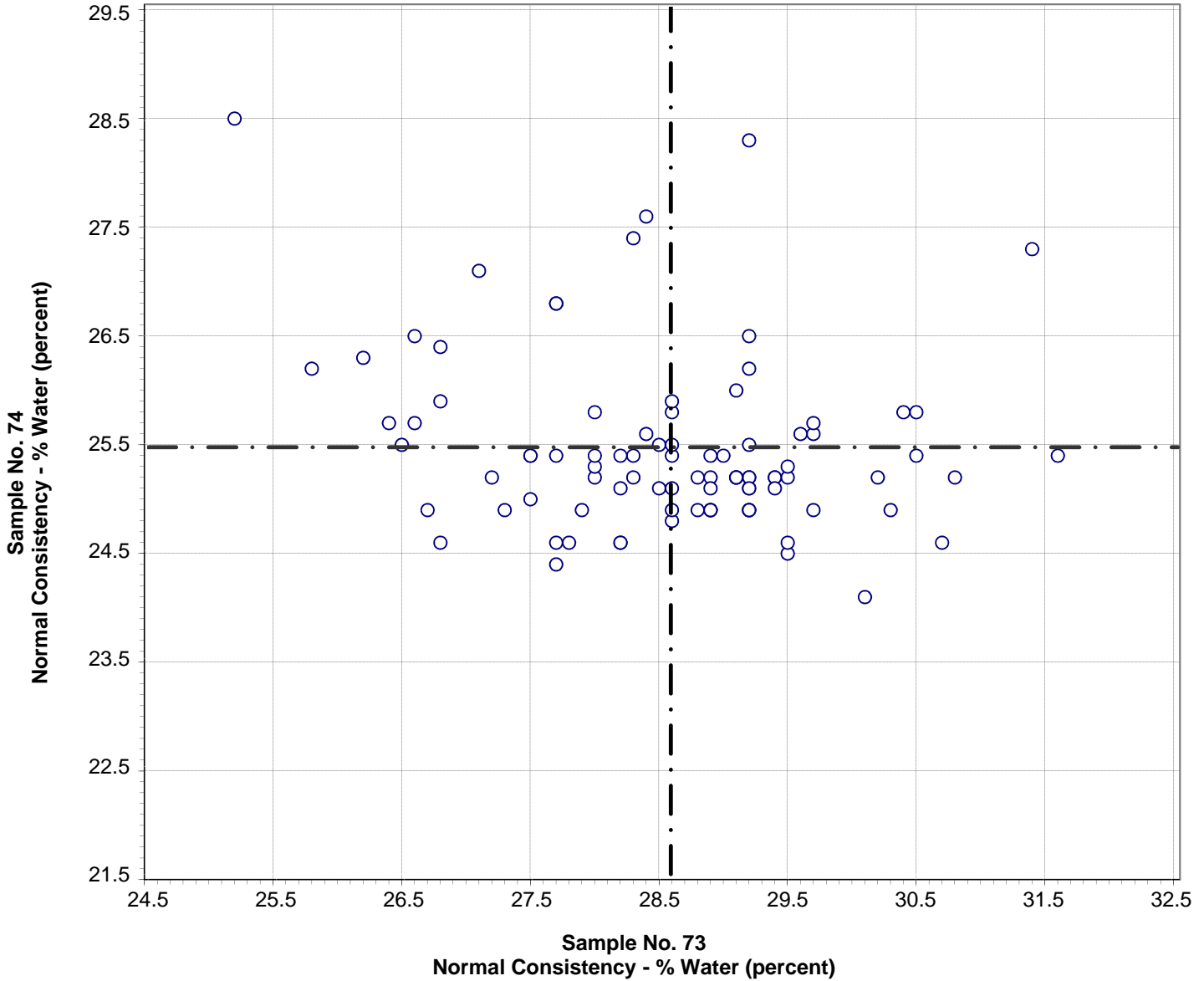
Final Report – Physical Results
 May 5, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.73				Sample No. 74		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Fineness - 45µm % Passing (percent)							
	93	97.24	0.48	0.50	97.26	0.61	0.62
	*88	97.30	0.38	0.39	97.37	0.33	0.34

* Labs Eliminated - 23, 44, 47, 158, 413

**CCRL Proficiency Sample Program
Normal Consistency - % Water
BLENDED CEMENT Samples No. 73 and No. 74**

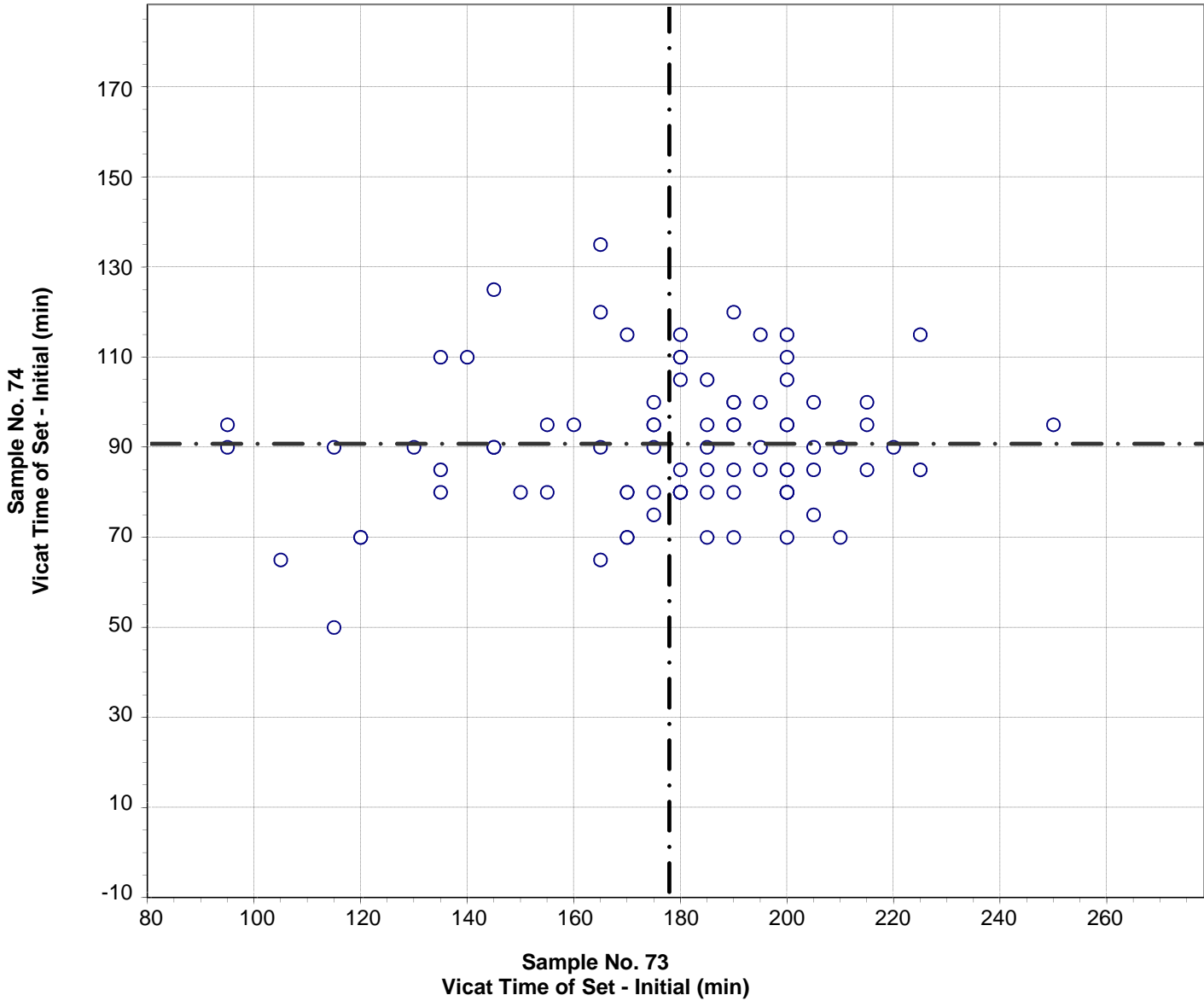


Test No. 110 Normal Consistency - % Water 91 Points

Sample No. 73	Ave 28.6	S.D. 1.2	C.V. 4.2
Sample No. 74	Ave 25.5	S.D. 0.8	C.V. 3.1

Labs Eliminated: 2465, 3504, 3695

**CCRL Proficiency Sample Program
 Vicat Time of Set - Initial
 BLENDED CEMENT Samples No. 73 and No. 74**



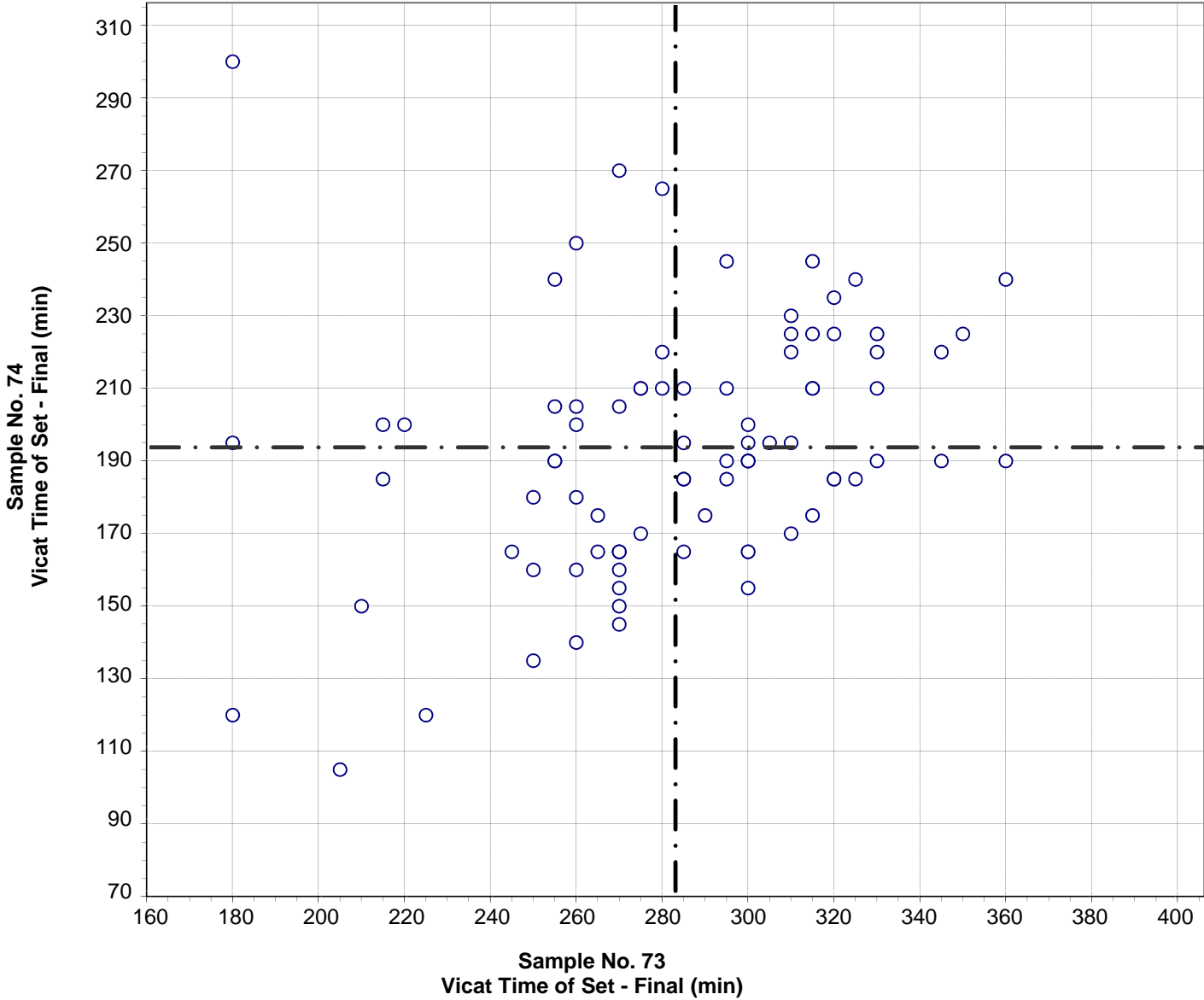
Test No. 120 Vicat Time of Set - Initial 86 Points

Sample No. 73 Ave 178 S.D. 30 C.V. 17.1

Sample No. 74 Ave 90 S.D. 15 C.V. 17.0

Labs Eliminated: 19, 38, 1455, 1956, 2352, 2462

CCRL Proficiency Sample Program
Vicat Time of Set - Final
BLENDED CEMENT Samples No. 73 and No. 74

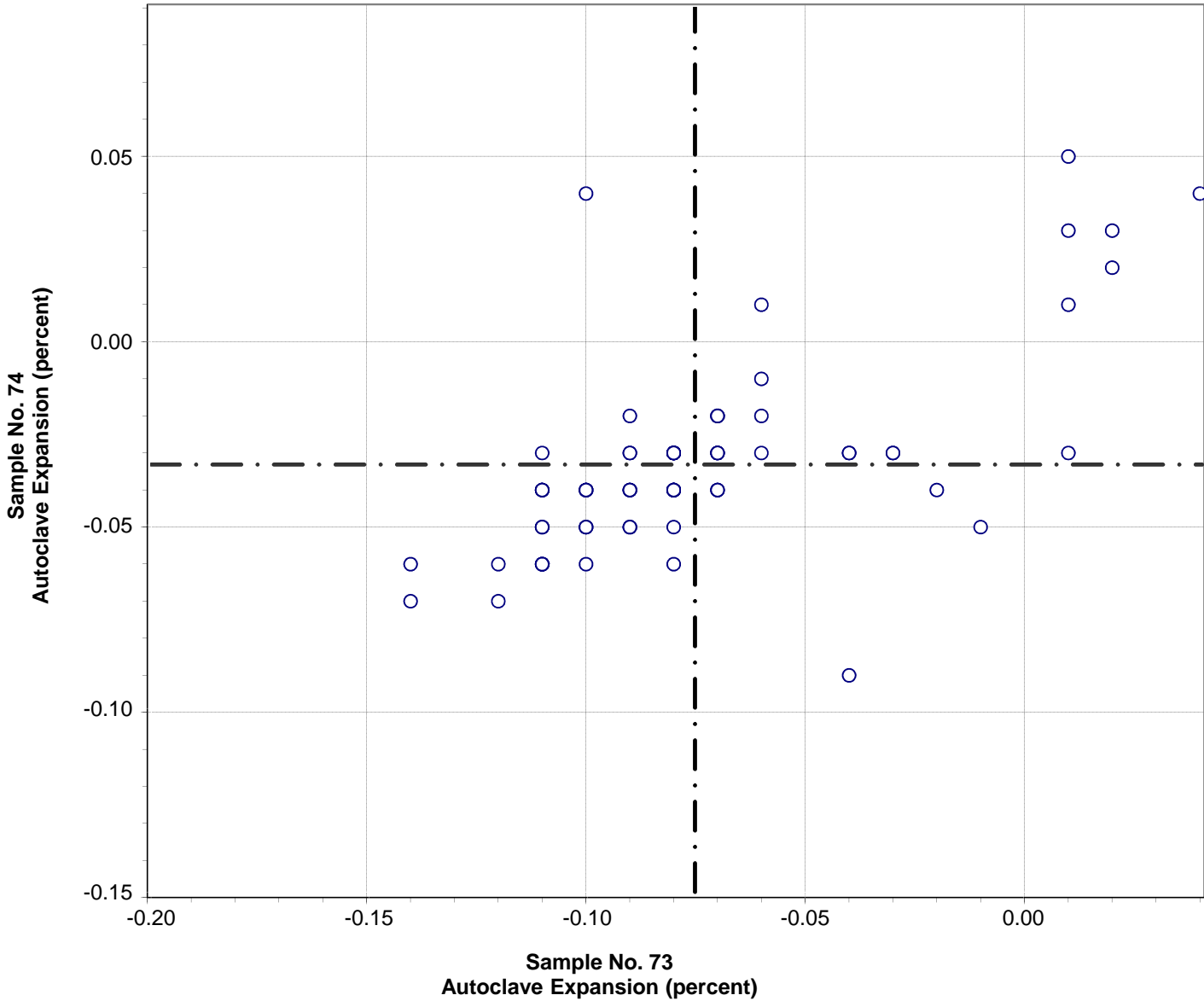


Test No. 121 Vicat Time of Set - Final 84 Points

Sample No. 73 Ave 283 S.D. 39 C.V. 14
 Sample No. 74 Ave 193 S.D. 34 C.V. 18

Labs Eliminated: 34, 38, 1455, 2462

**CCRL Proficiency Sample Program
Autoclave Expansion
BLENDED CEMENT Samples No. 73 and No. 74**



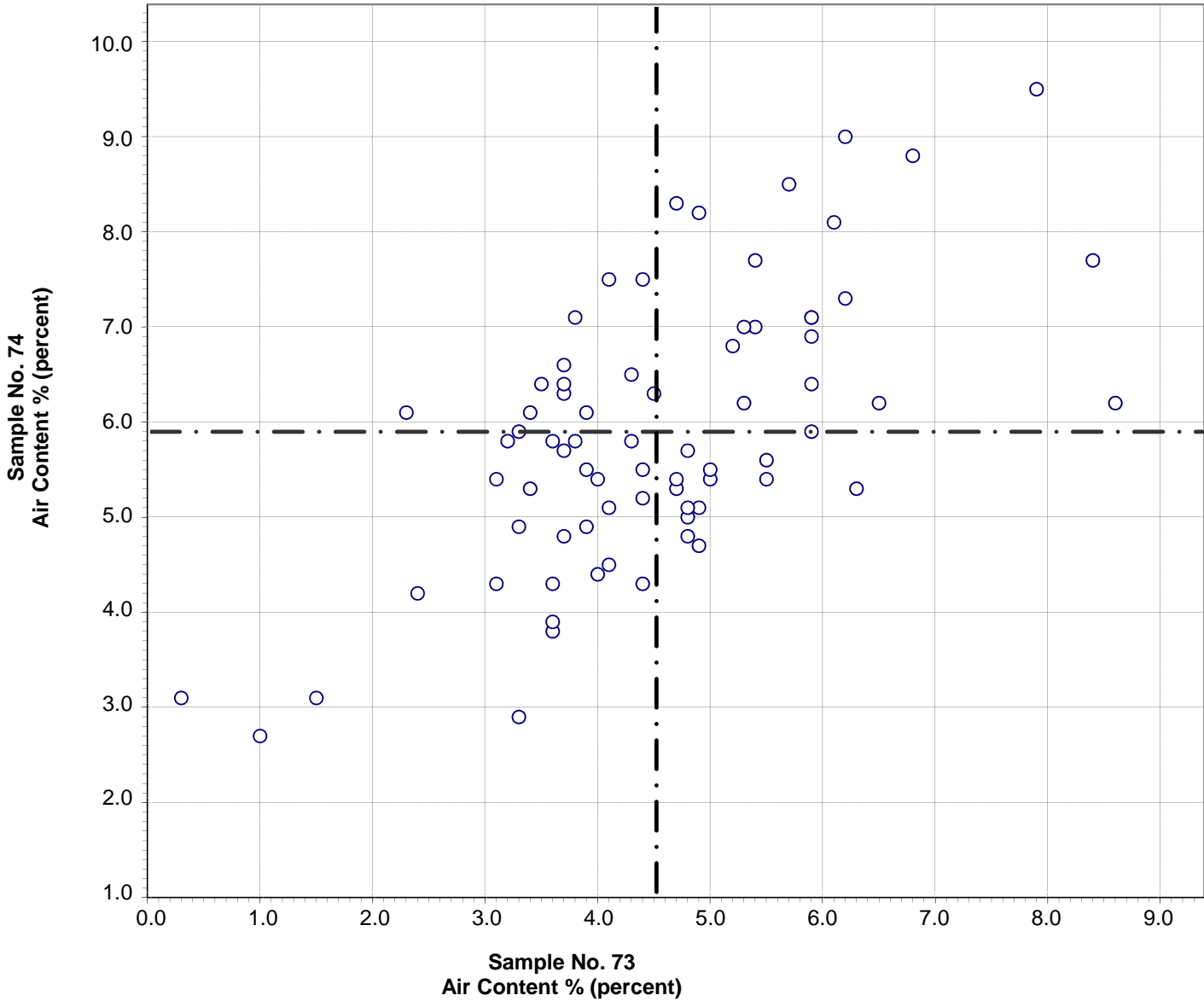
Test No. 160 Autoclave Expansion 78 Points

Sample No. 73 Ave -0.07 S.D. 0.04 C.V. 50

Sample No. 74 Ave -0.04 S.D. 0.03 C.V. 75

Labs Eliminated: 24, 38, 1251, 1715, 2462, 3059, 3695

CCRL Proficiency Sample Program
Air Content %
BLENDED CEMENT Samples No. 73 and No. 74

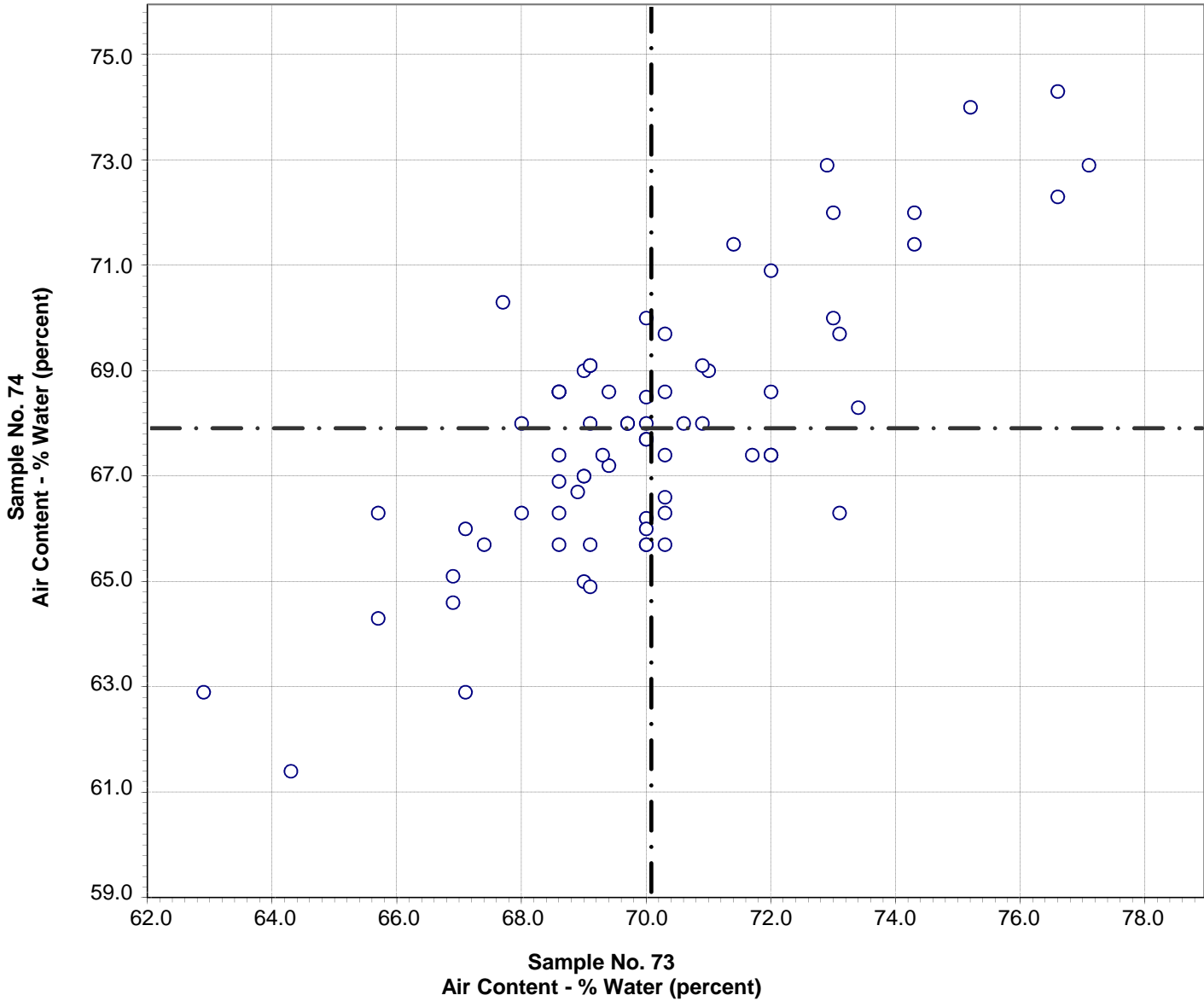


Test No. 170 Air Content % 74 Points

Sample No. 73	Ave 4.5	S.D. 1.5	C.V. 32
Sample No. 74	Ave 5.9	S.D. 1.4	C.V. 24

Labs Eliminated: 354

CCRL Proficiency Sample Program
Air Content - % Water
BLENDED CEMENT Samples No. 73 and No. 74



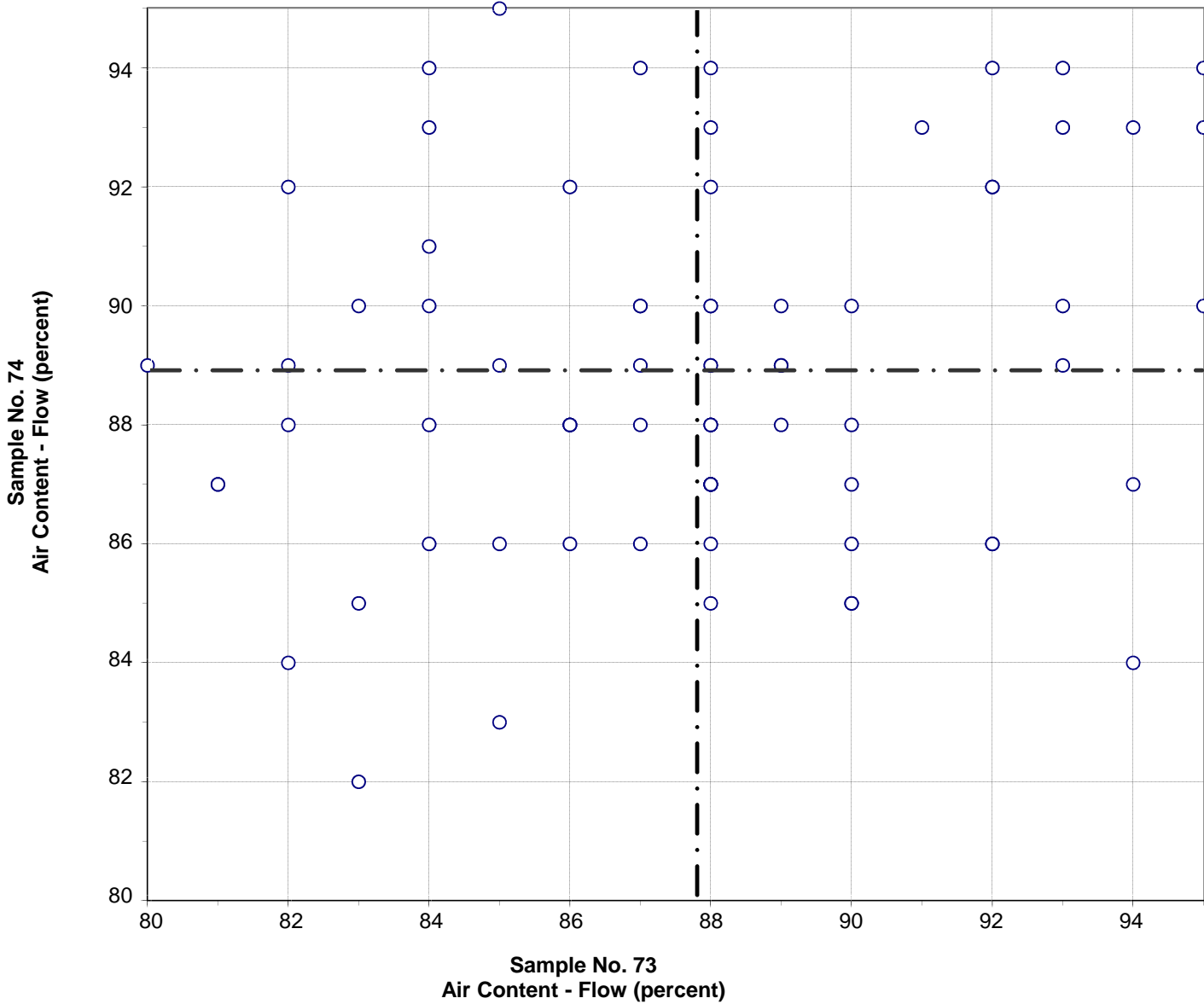
Test No. 180 Air Content - % Water 71 Points

Sample No. 73 Ave 70.1 S.D. 2.6 C.V. 3.7

Sample No. 74 Ave 67.9 S.D. 2.5 C.V. 3.7

Labs Eliminated: 51, 105, 2490

**CCRL Proficiency Sample Program
Air Content - Flow
BLENDED CEMENT Samples No. 73 and No. 74**



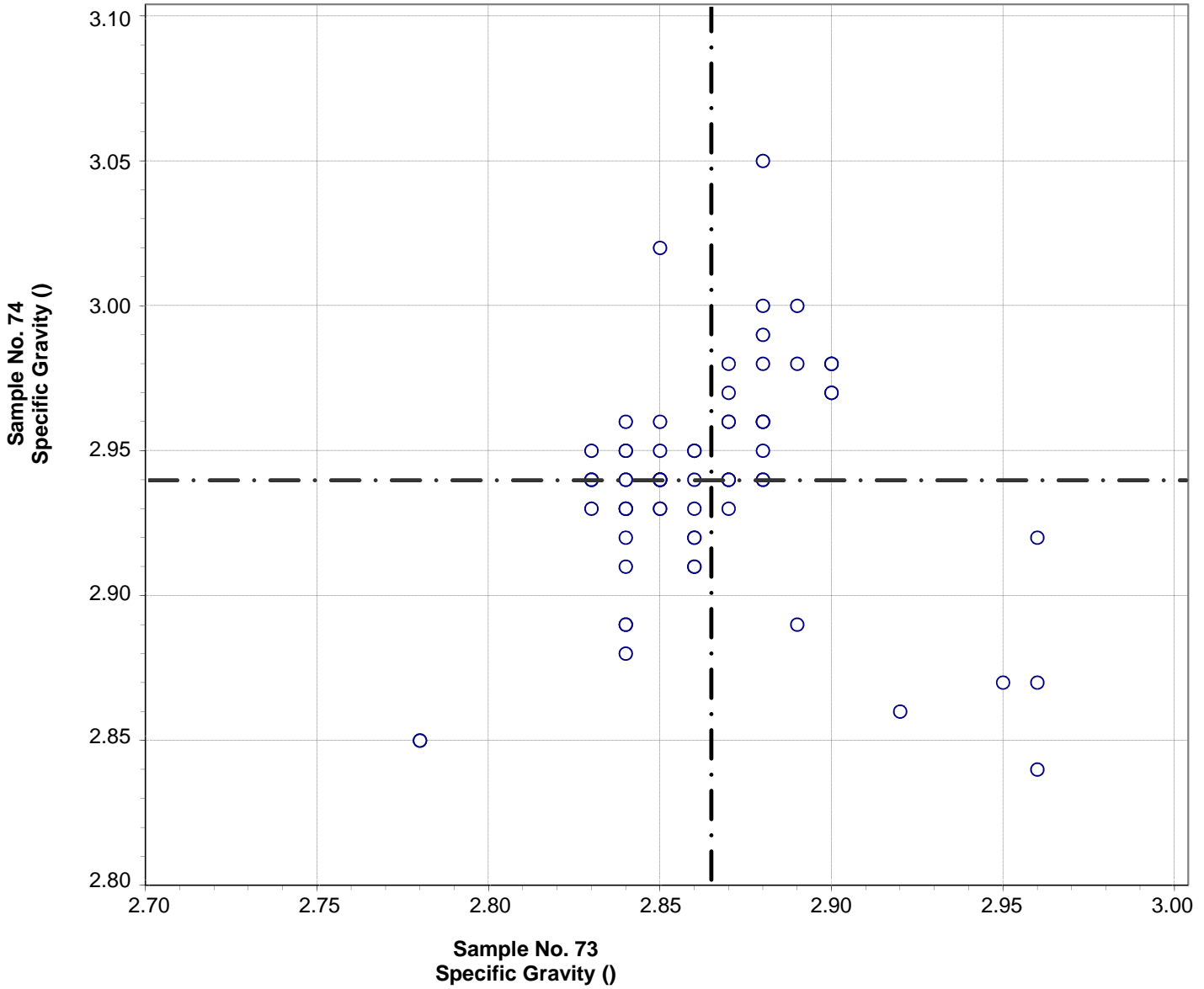
Test No. 190 Air Content - Flow 75 Points

Sample No. 73 Ave 88 S.D. 3.7 C.V. 4.2

Sample No. 74 Ave 89 S.D. 3.0 C.V. 3.4

Labs Eliminated: 3503, 3504

**CCRL Proficiency Sample Program
Specific Gravity
BLENDED CEMENT Samples No. 73 and No. 74**



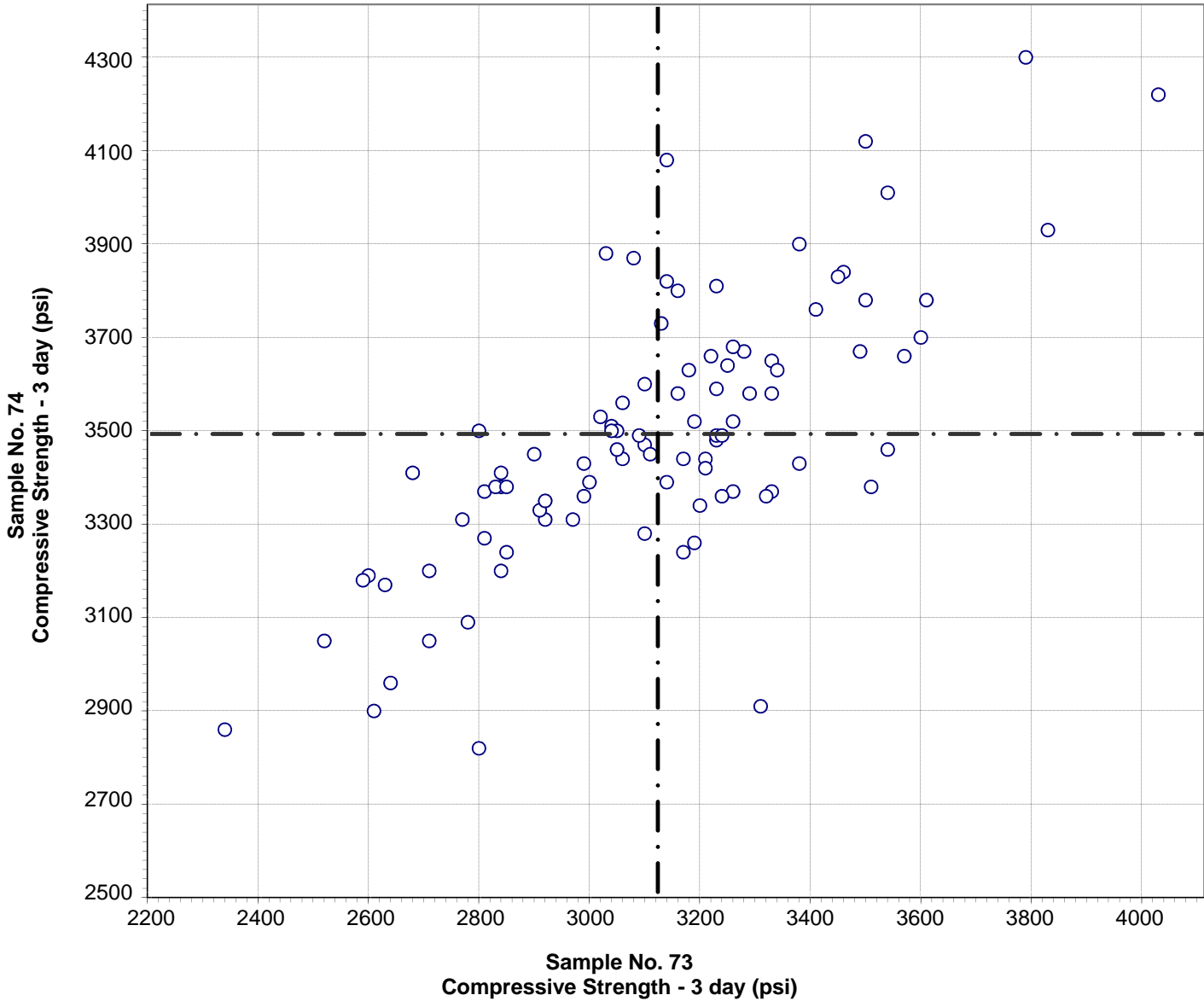
Test No. 310 Specific Gravity 70 Points

Sample No. 73 Ave 2.86 S.D. 0.03 C.V. 1.2

Sample No. 74 Ave 2.94 S.D. 0.04 C.V. 1.3

Labs Eliminated: 25, 40, 51, 169, 440, 497, 691

**CCRL Proficiency Sample Program
Compressive Strength - 3 day
BLENDED CEMENT Samples No. 73 and No. 74**



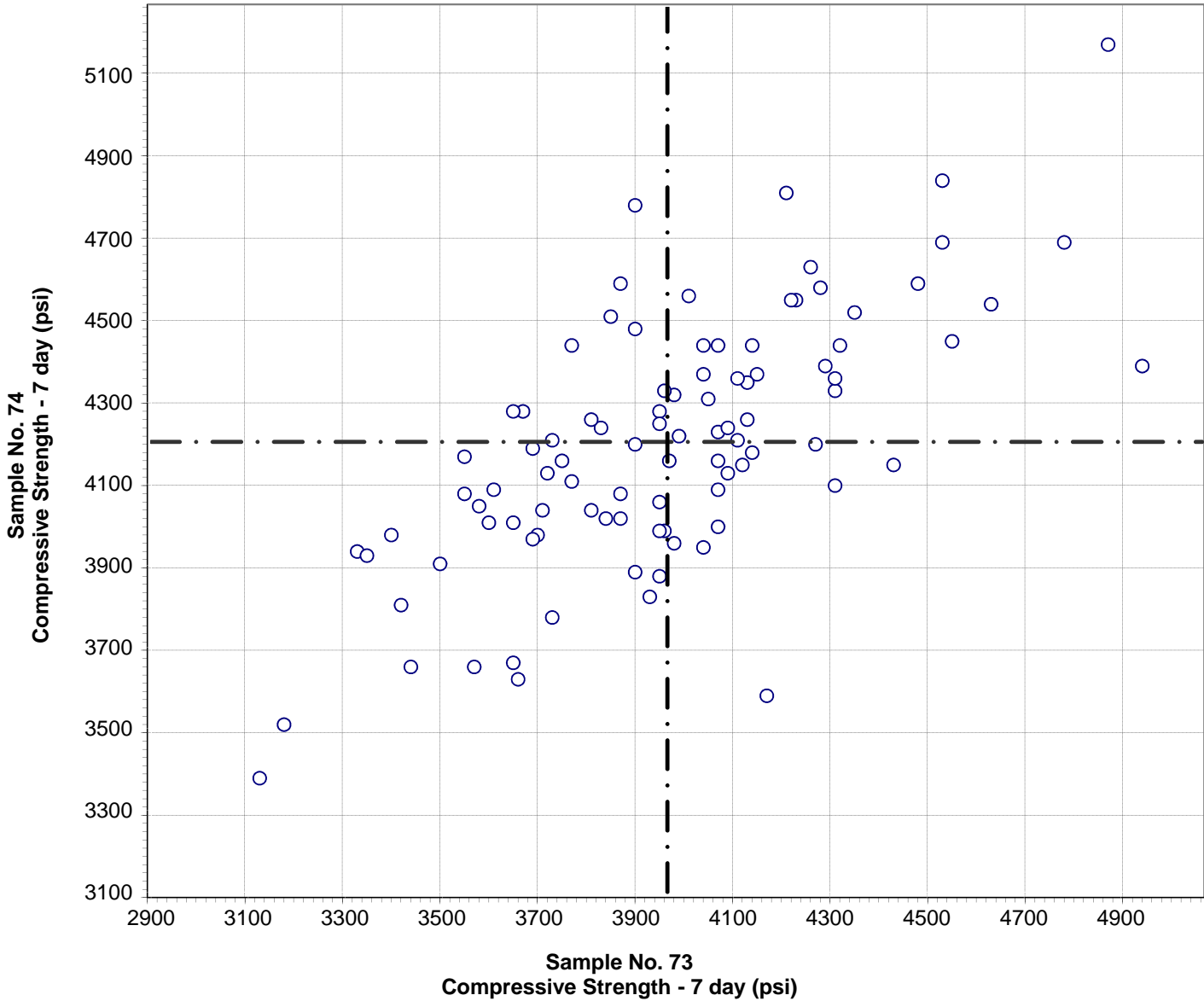
Test No. 200 Compressive Strength - 3 day 94 Points

Sample No. 73 Ave 3123 S.D. 303 C.V. 9.7

Sample No. 74 Ave 3490 S.D. 284 C.V. 8.1

Labs Eliminated: 38, 51

**CCRL Proficiency Sample Program
Compressive Strength - 7 day
BLENDED CEMENT Samples No. 73 and No. 74**

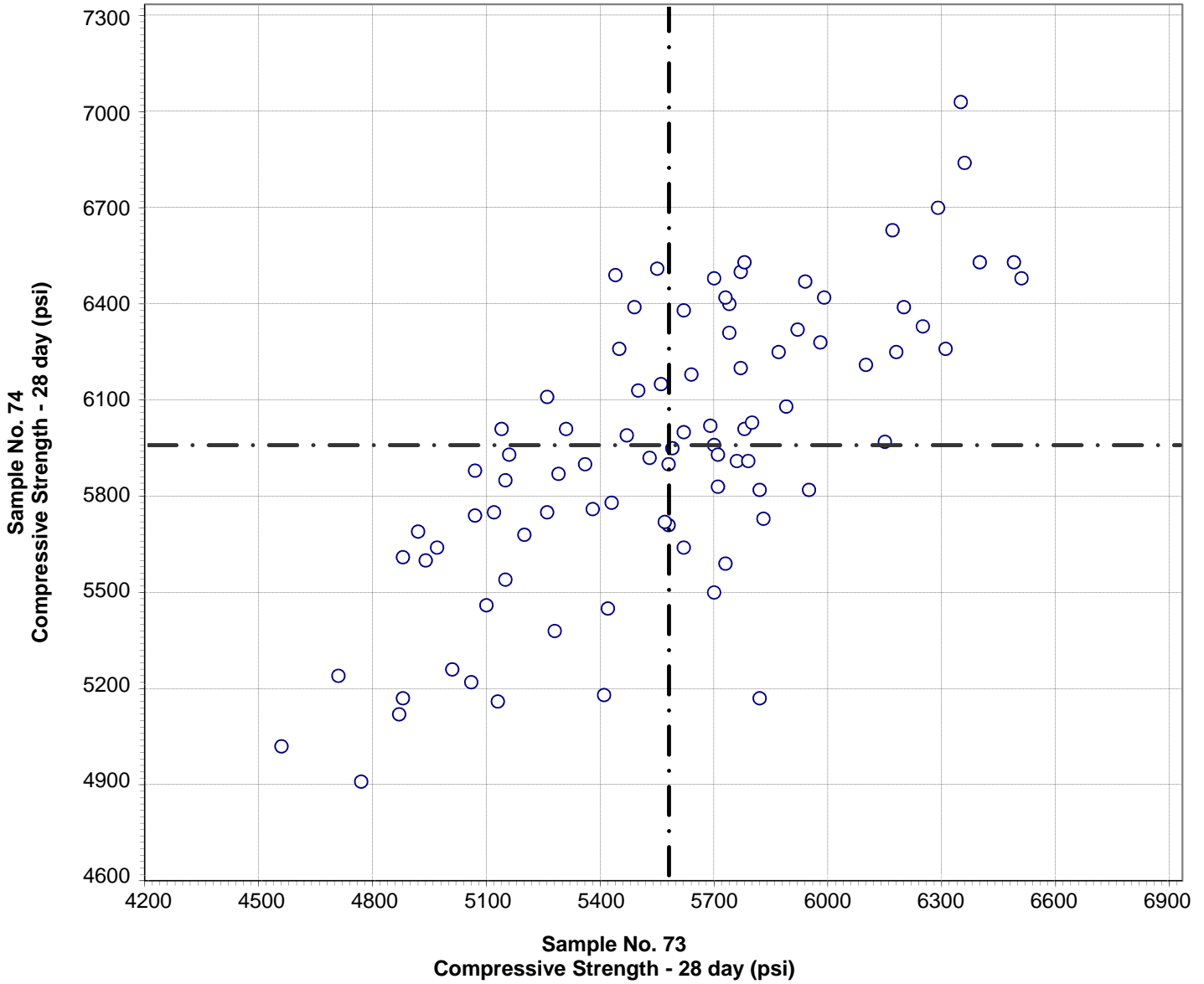


Test No. 210 Compressive Strength - 7 day 95 Points

Sample No. 73	Ave 3965	S.D. 346	C.V. 8.7
Sample No. 74	Ave 4203	S.D. 307	C.V. 7.3

Labs Eliminated: 38, 3503

**CCRL Proficiency Sample Program
Compressive Strength - 28 day
BLENDED CEMENT Samples No. 73 and No. 74**

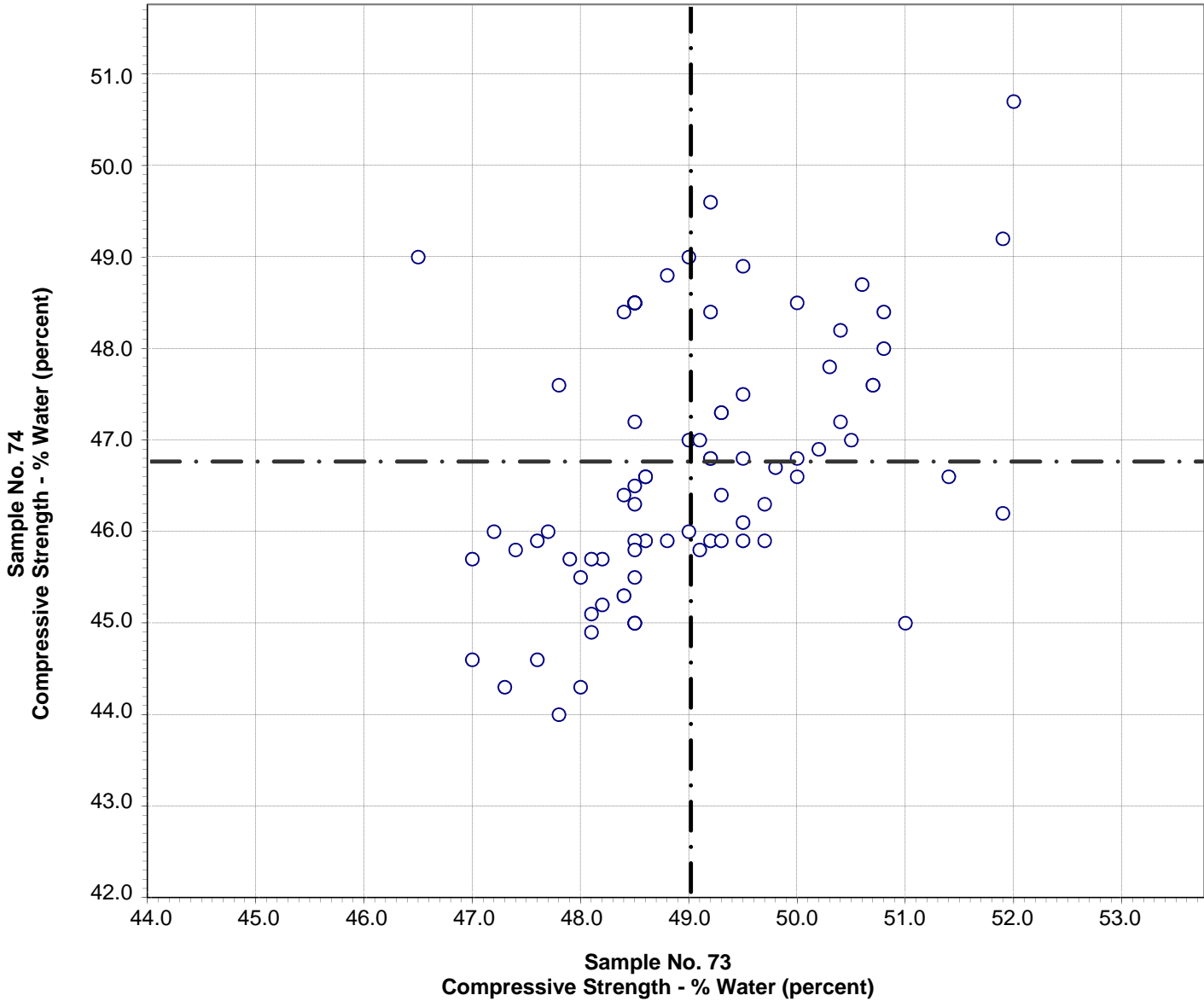


Test No. 211 Compressive Strength - 28 day 87 Points

Sample No. 73	Ave 5580	S.D. 441	C.V. 7.9
Sample No. 74	Ave 5954	S.D. 445	C.V. 7.5

Labs Eliminated: 38

**CCRL Proficiency Sample Program
Compressive Strength - % Water
BLENDED CEMENT Samples No. 73 and No. 74**



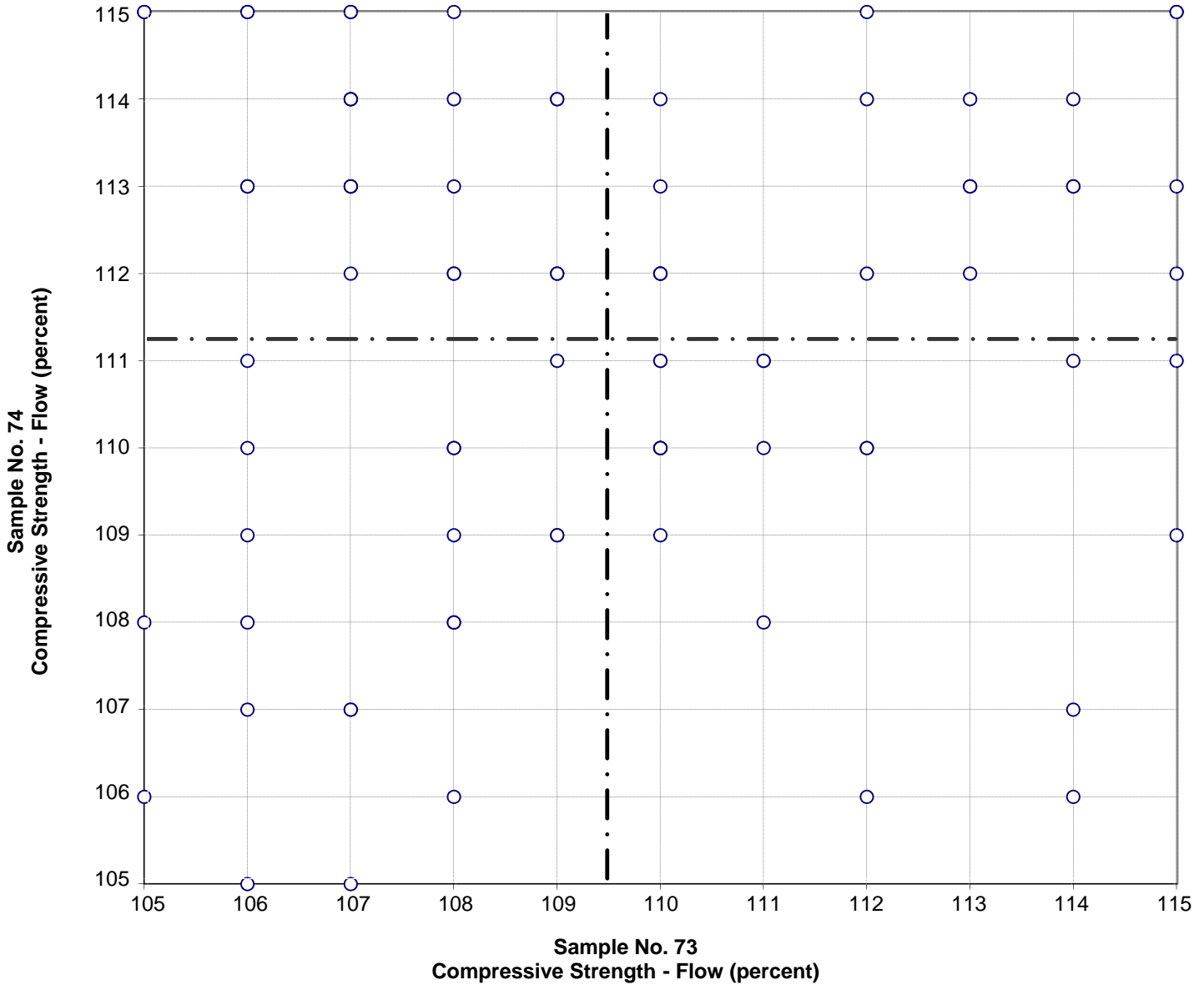
Test No. 220 Compressive Strength - % Water 84 Points

Sample No. 73 Ave 49.0 S.D. 1.2 C.V. 2.4

Sample No. 74 Ave 46.7 S.D. 1.4 C.V. 3.0

Labs Eliminated: 28, 38, 101, 105, 3912

**CCRL Proficiency Sample Program
Compressive Strength - Flow
BLENDED CEMENT Samples No. 73 and No. 74**

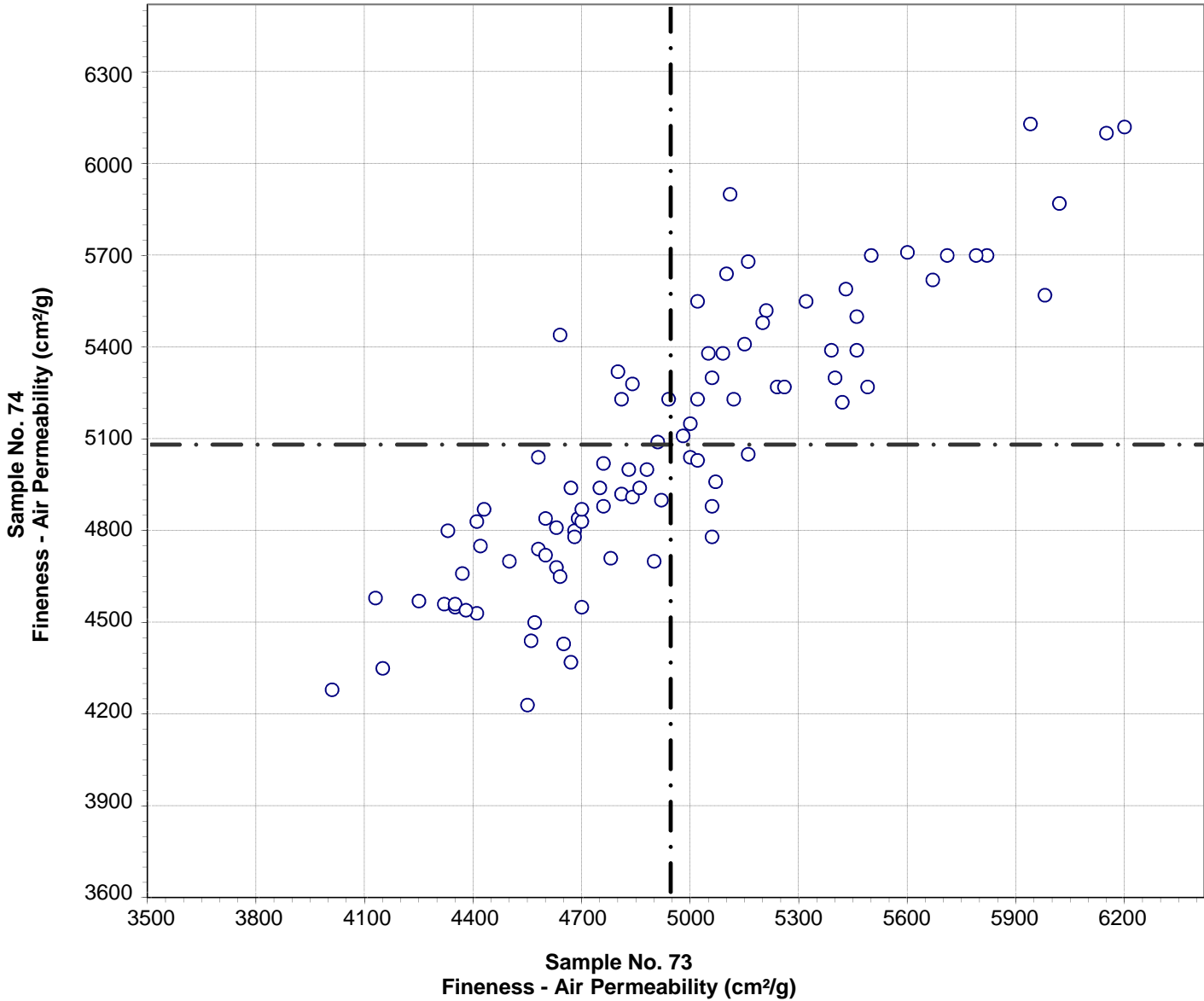


Test No. 230 Compressive Strength - Flow 82 Points

Sample No. 73 Ave 109 S.D. 3.0 C.V. 2.7
 Sample No. 74 Ave 111 S.D. 2.8 C.V. 2.5

Labs Eliminated: 22, 24, 34, 38, 40, 691, 958, 3910

**CCRL Proficiency Sample Program
Fineness - Air Permeability
BLENDED CEMENT Samples No. 73 and No. 74**

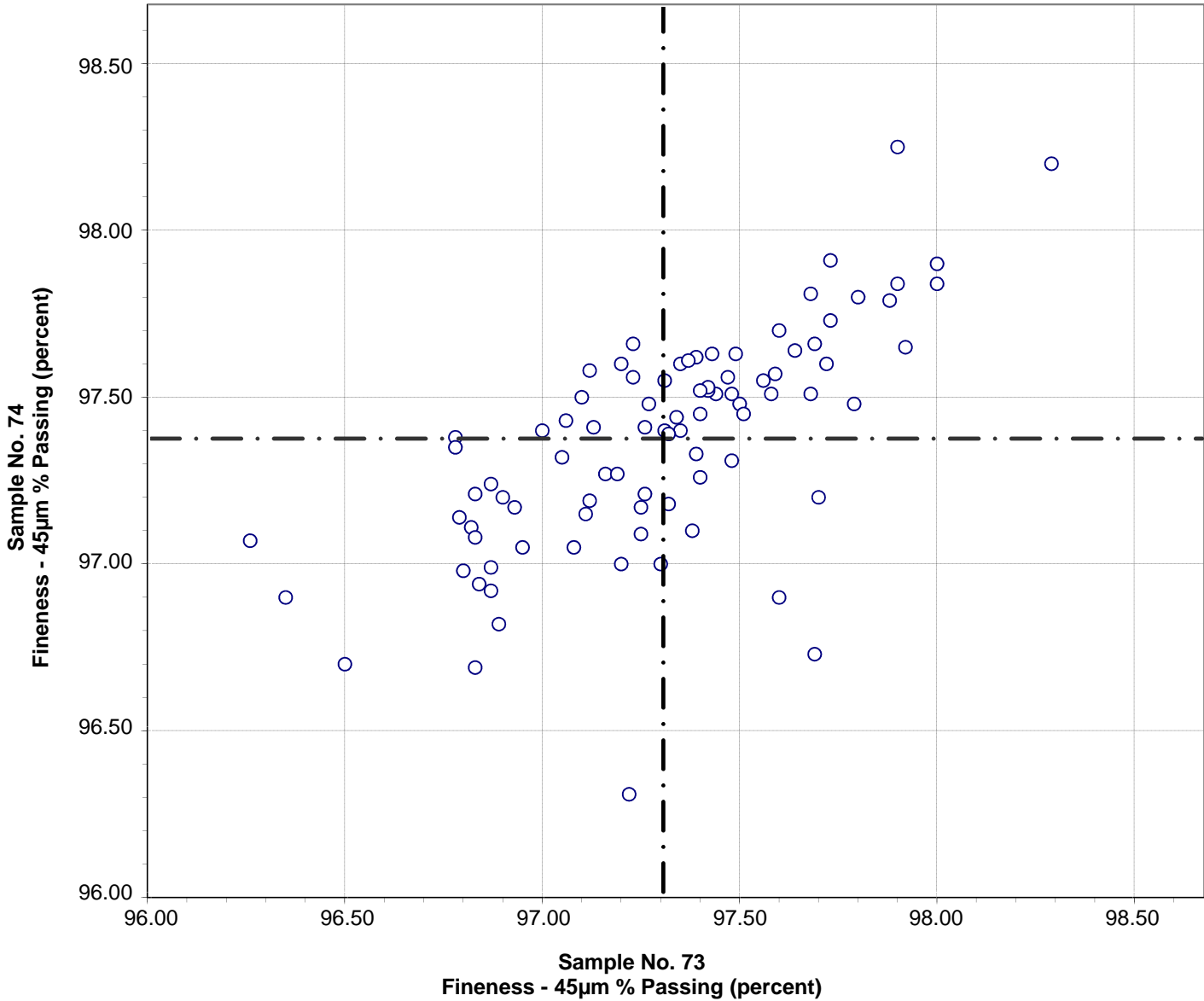


Test No. 270 Fineness - Air Permeability 92 Points

Sample No. 73	Ave 4944	S.D. 473	C.V. 9.6
Sample No. 74	Ave 5077	S.D. 445	C.V. 8.8

Labs Eliminated: 50

**CCRL Proficiency Sample Program
Fineness - 45 μ m % Passing
BLENDED CEMENT Samples No. 73 and No. 74**



Test No. 281 Fineness - 45 μ m % Passing 88 Points

Sample No. 73 Ave 97.30 S.D. 0.38 C.V. 0.39

Sample No. 74 Ave 97.37 S.D. 0.33 C.V. 0.34

Labs Eliminated: 23, 44, 47, 158, 413

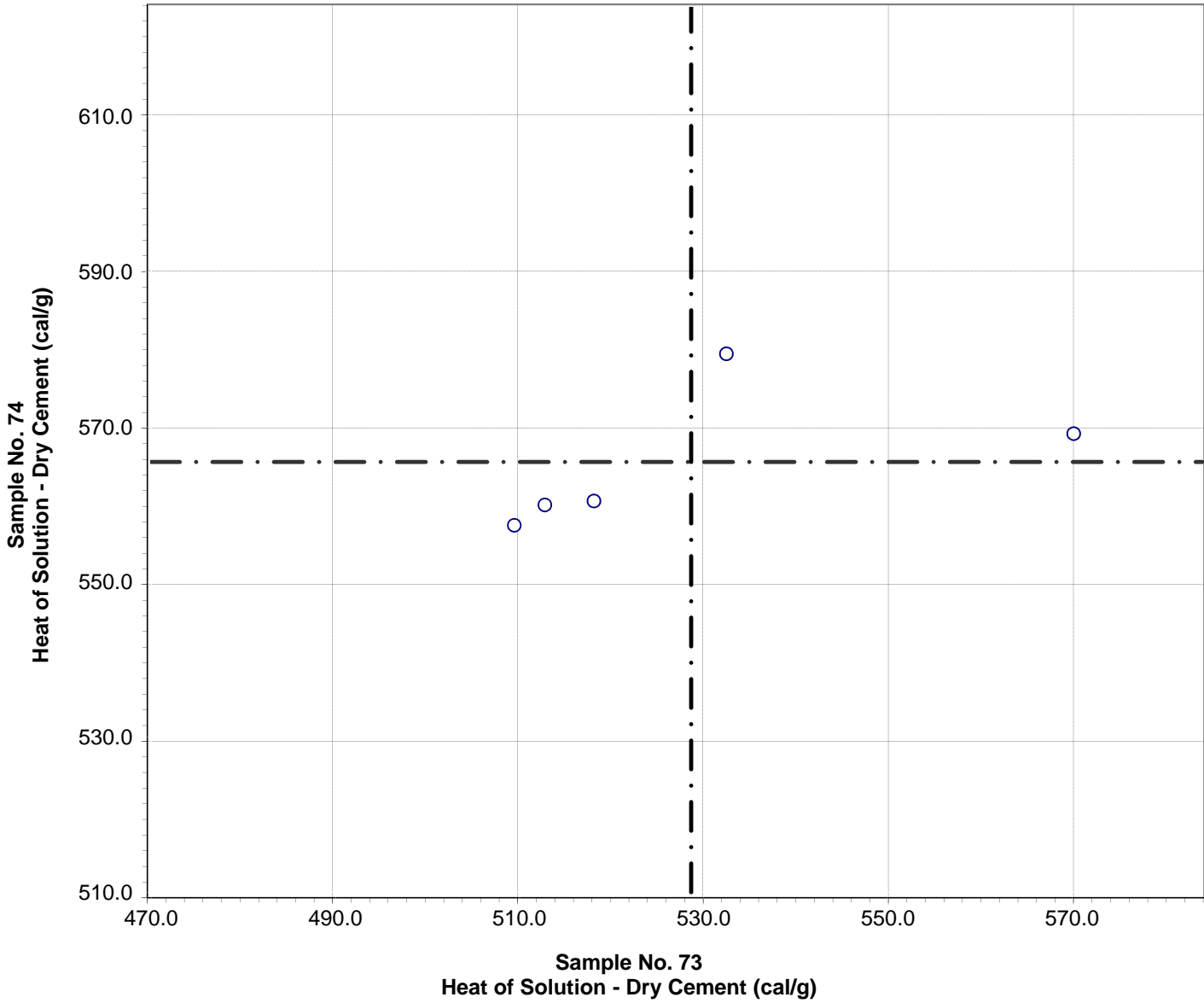
CCRL PROFICIENCY SAMPLE PROGRAM
Blended Cement Proficiency Samples No. 73 and No. 74

Final Report – Heat of Hydration Results
May 5, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.73				Sample No. 74		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Heat of Solution - Dry Cement (cal/g)							
	5	528.6	24.7	4.7	565.5	9.0	1.6
	No Labs Eliminated for This Test						
Heat of Solution - 7 day (cal/g)							
	5	462.4	23.1	5.0	487.0	13.5	2.8
	No Labs Eliminated for This Test						
Heat of Solution - 28 day (cal/g)							
	4	443.4	6.9	1.5	476.5	5.6	1.2
	No Labs Eliminated for This Test						
Heat of Hydration - 7 day (cal/g)							
	6	68.2	5.3	7.8	83.4	15.0	18.0
	No Labs Eliminated for This Test						
Heat of Hydration - 28 day (cal/g)							
	4	80.0	7.0	8.8	90.3	5.8	6.4
	No Labs Eliminated for This Test						

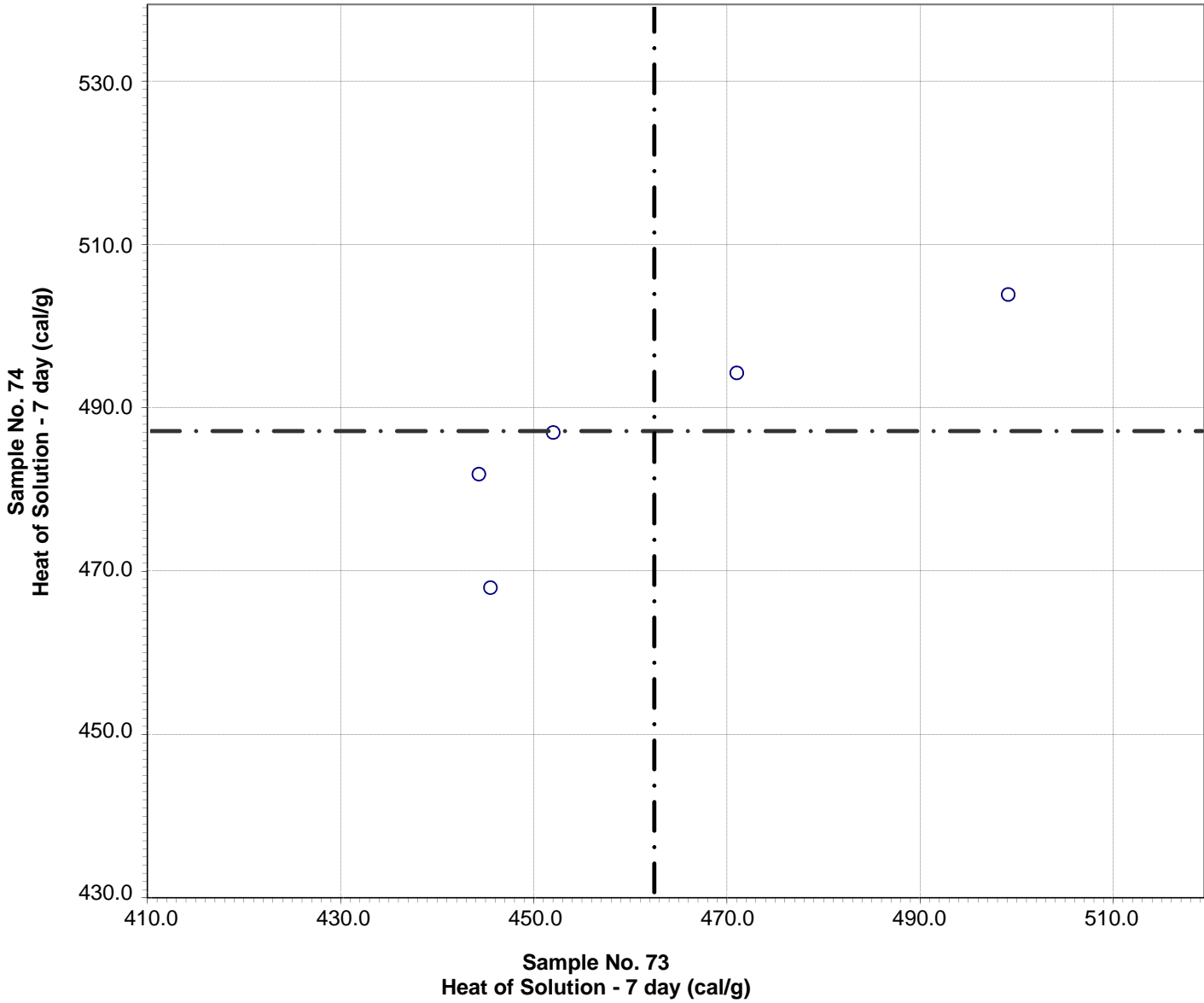
CCRL Proficiency Sample Program
Heat of Solution - Dry Cement
BLENDED CEMENT Samples No. 73 and No. 74



Test No. 291 Heat of Solution - Dry Cement 5 Points

Sample No. 73	Ave 528.6	S.D. 24.7	C.V. 4.7
Sample No. 74	Ave 565.5	S.D. 9.0	C.V. 1.6

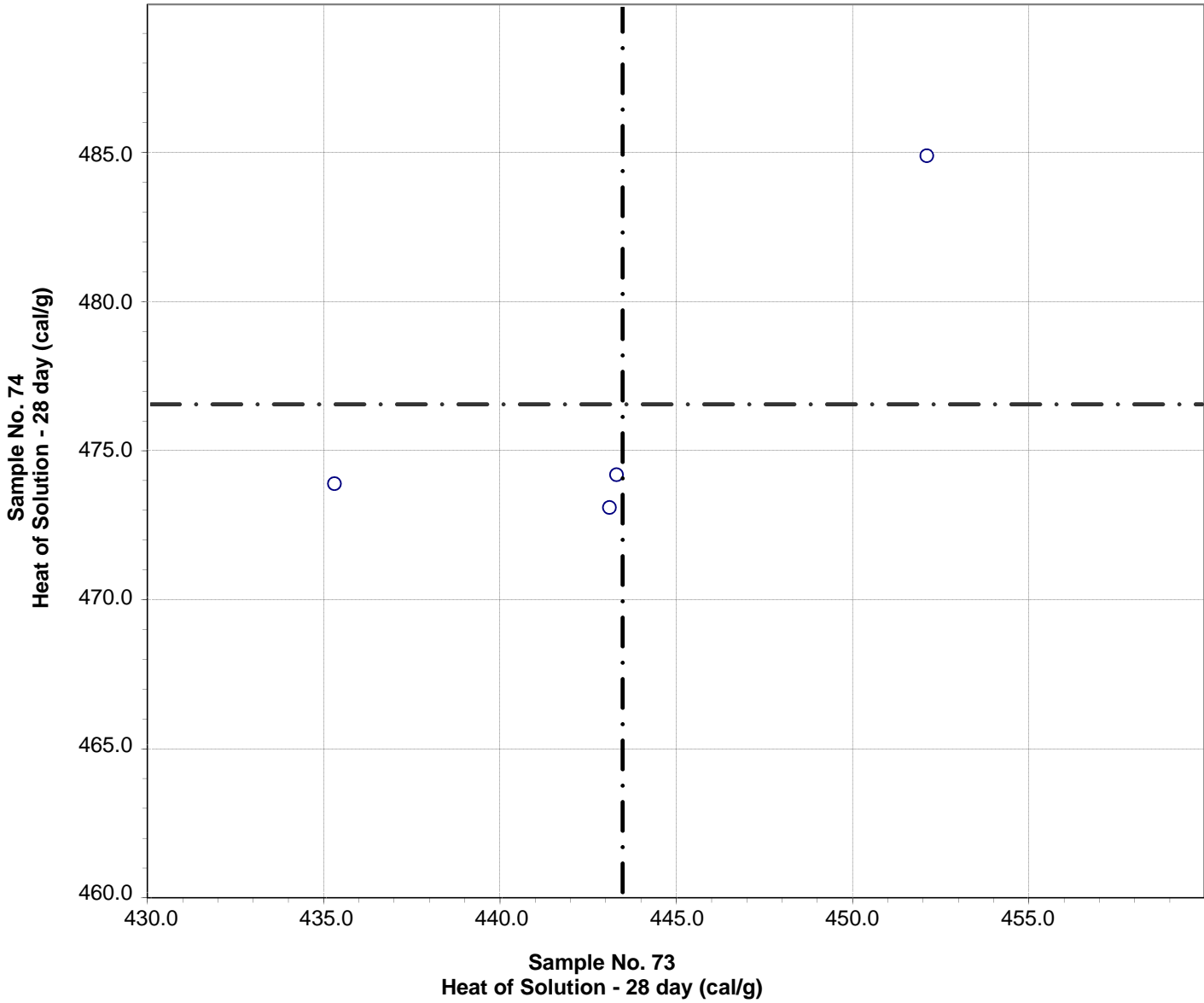
CCRL Proficiency Sample Program
Heat of Solution - 7 day
BLENDED CEMENT Samples No. 73 and No. 74



Test No. 292 Heat of Solution - 7 day 5 Points

Sample No. 73	Ave 462.4	S.D. 23.1	C.V. 5.0
Sample No. 74	Ave 487.0	S.D. 13.5	C.V. 2.8

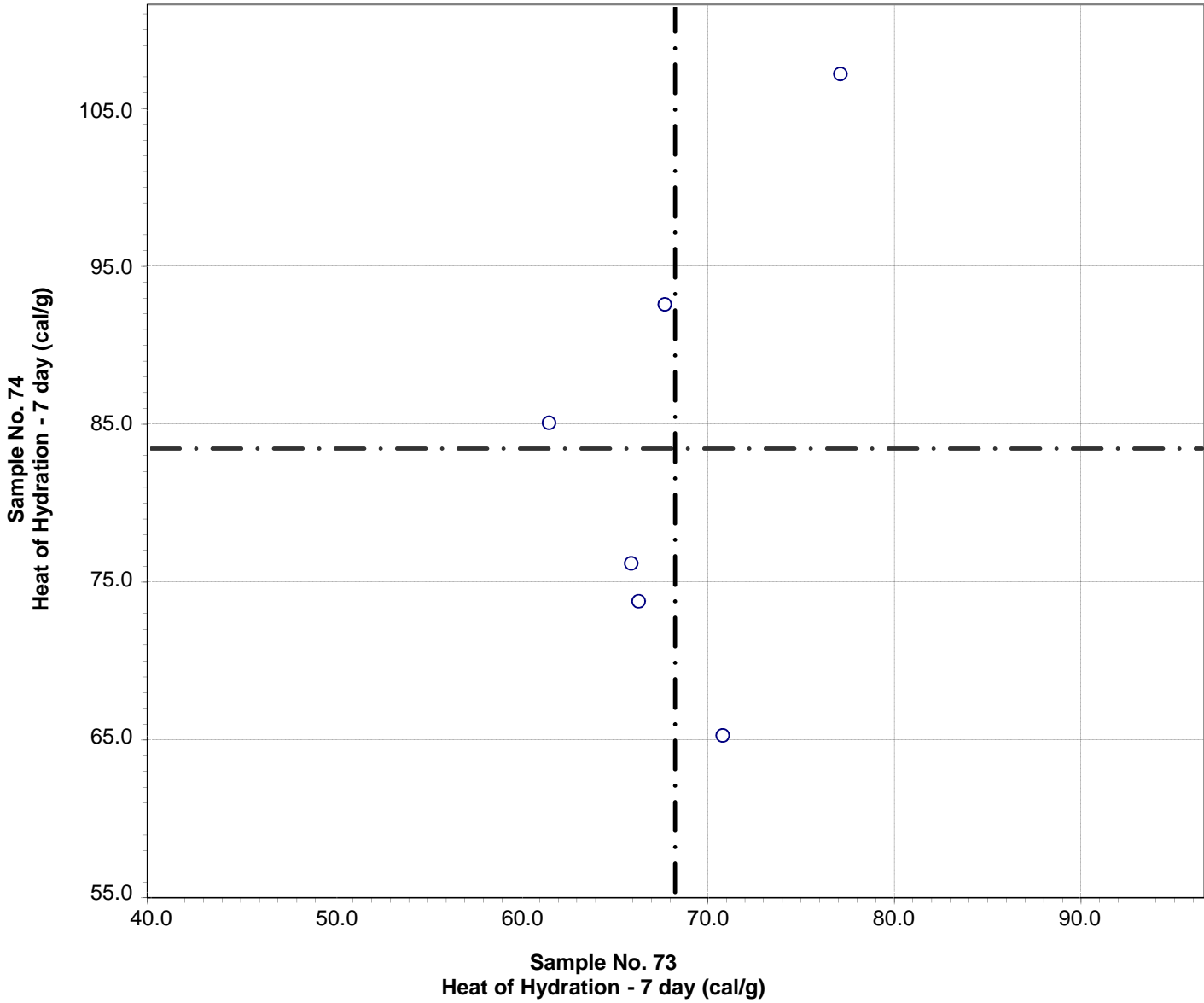
CCRL Proficiency Sample Program
Heat of Solution - 28 day
BLENDED CEMENT Samples No. 73 and No. 74



Test No. 301 Heat of Solution - 28 day 4 Points

Sample No. 73	Ave 443.4	S.D. 6.9	C.V. 1.5
Sample No. 74	Ave 476.5	S.D. 5.6	C.V. 1.2

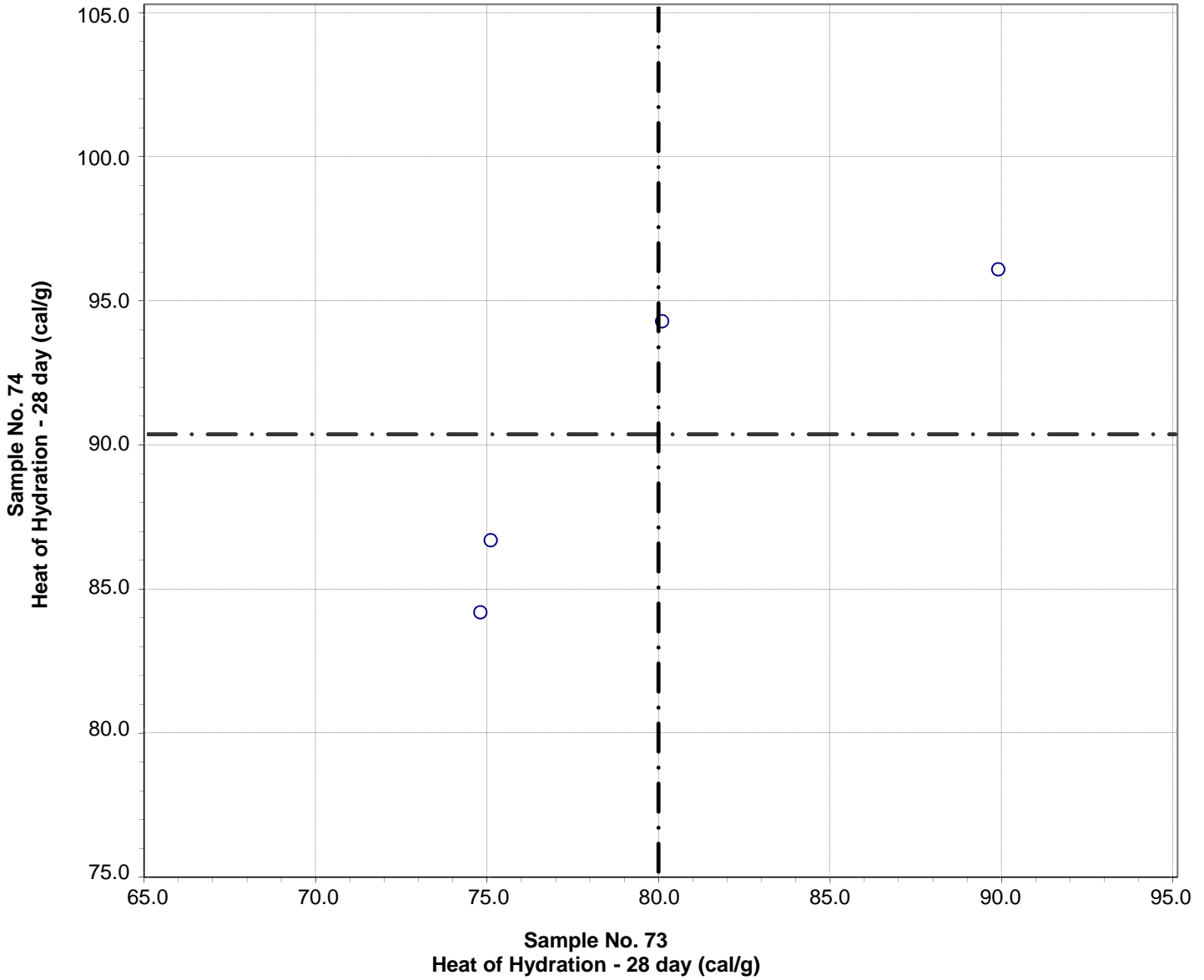
CCRL Proficiency Sample Program
Heat of Hydration - 7 day
BLENDED CEMENT Samples No. 73 and No. 74



Test No. 290 Heat of Hydration - 7 day 6 Points

Sample No. 73	Ave 68.2	S.D. 5.3	C.V. 7.8
Sample No. 74	Ave 83.4	S.D. 15.0	C.V. 18.0

CCRL Proficiency Sample Program
Heat of Hydration - 28 day
BLENDED CEMENT Samples No. 73 and No. 74



Test No. 300 Heat of Hydration - 28 day 4 Points

Sample No. 73	Ave 80.0	S.D. 7.0	C.V. 8.8
Sample No. 74	Ave 90.3	S.D. 5.8	C.V. 6.4