CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Masonry Cement Proficiency Samples
Number 81 and Number 82

October 2018

CCRL
Cement and Concrete Reference Laboratory

www.ccrl.us

October 16, 2018

TO: Participants in the CCRL Masonry Cement Proficiency Sample Program

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

Enclosed is your copy of the final report on the test results for the pair of CCRL **Masonry Cement** Proficiency Samples which were distributed in August 2018. Masonry Cement Samples No. 81 and No. 82 were ASTM C91 Type M cements.

This report consists of a statistical Summary of Results, a set of general Scatter Diagrams, and associated detailed information. The Table of Results with test results and ratings for your laboratory can be downloaded at our website located at: http://www.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.

It is presently anticipated that the next Masonry Cement Proficiency Samples will be distributed in August 2019.

Sincerely,

Kent Niedzielski
Program Manager, Proficiency Samples
Cement and Concrete Reference Laboratory

To: Participants in the CCRL Masonry Cement Proficiency Sample Program

FROM: Kent Niedzielski, Program Manager, Proficiency Samples

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

This memo and the material included with it constitute the final report and summary of results for the current pair of Masonry Cement Proficiency Samples, which were distributed in August 2018. This material includes a Table of Results for individual laboratory data, a statistical Summary of Results, and a set of 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.

Laboratory Ratings

Each laboratory receives an individualized Laboratory Ratings. Each line of the ratings 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.

The ratings 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. Laboratory Ratings are calculated using the unrounded values for average and standard deviation.

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.

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

[1]Youden, W.J., "Statistical Aspects of the Cement Testing Program", *Proceedings of the American Society for testing and Materials Volume 59*, 1959.

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

The Summary of Results provide the statistical summary for each test. Each line lists the test, the number of participants represented, the averages, standard deviations and coefficients of variations. When necessary the data from the test is represented in two lines, one line with all results reported, and then a second line with outlying results omitted. Sometimes two or more recalculations are required to eliminate all outliers from the test. In these cases, all 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. Elimination of these outlying results may have 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.

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. 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

Masonry Cement Proficiency Samples No. 81 and No. 82
Final Report – October 16, 2018
SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No. 81 Average	S.D.	C.V.	Sample No. 82 Average	S.D.	C.V.
Normal Consistency - Water (**percent**)							
	69	26.8	0.79	3.0	28.2	0.77	2.7
	*66	26.7	0.33	1.2	28.1	0.36	1.3
* Labs Eliminated - 20, 96, 4351							
Gillmore Time of Set - Initial (**minute**)							
	69	249	26	10.6	148	26	17.8
	*68	250	23	9.3	146	18	12.4
* Labs Eliminated - 3185							
Gillmore Time of Set - Final (**minute**)							
	68	350	42	11.9	263	50	19.1
	*62	346	30	8.7	254	35	13.9
* Labs Eliminated - 54, 205, 246, 1936, 3185, 3368							
Autoclave Expansion (**percent**)							
	68	0.02	0.02	93.9	-0.02	0.03	-108.6
	*66	0.02	0.02	71.7	-0.02	0.02	-64.9
* Labs Eliminated - 143, 823							
Air Content (**percent**)							
	68	12.4	1.3	10.6	15.2	2.5	16.4
	*64	12.4	1.1	8.5	14.8	1.0	6.8
* Labs Eliminated - 52, 103, 698, 1715							
Air Content - Water (**percent**)							
	68	45.0	3.9	8.7	46.3	3.8	8.2
	*65	44.3	1.4	3.2	45.6	1.5	3.2
* Labs Eliminated - 103, 243, 1715							
Air Content - Flow (**percent**)							
	68	109	4.4	4.1	108	4.0	3.7
	*66	110	2.5	2.3	109	2.5	2.3
* Labs Eliminated - 103, 1715							

CCRL PROFICIENCY SAMPLE PROGRAM

Masonry Cement Proficiency Samples No. 81 and No. 82
Final Report – October 16, 2018
SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No. 81 Average	S.D.	C.V.	Sample No. 82 Average	S.D.	C.V.
Compressive Strength - 7 day (**psi**)							
	69	4412	478	10.8	3458	408	11.8
	*67	4462	383	8.6	3491	364	10.4
* Labs Eliminated - 9, 823							
Compressive Strength - 28 day (**psi**)							
	64	5422	552	10	4237	541	13
	*61	5468	475	9	4245	436	10
* Labs Eliminated - 9, 493, 823							
Fineness - 45µm Sieve Retained (**percent**)							
	69	3.03	0.61	20.2	1.58	0.43	27.5
	*63	3.08	0.42	13.6	1.51	0.27	18.1
* Labs Eliminated - 60, 157, 1466, 2938, 3368, 4351							
Density (**g/cm³**)							
	65	3.05	0.11	3.8	2.95	0.07	2.4
	*63	3.06	0.05	1.6	2.95	0.05	1.7
* Labs Eliminated - 181, 698							
Water Retention - Water (**percent**)							
	67	44.3	4.0	8.9	45.6	4.0	8.8
	*65	44.2	1.3	2.9	45.5	1.3	2.8
* Labs Eliminated - 142, 243							
Water Retention - Initial Flow (**percent**)							
	66	110	2.4	2.2	109	2.1	1.9
No Labs Eliminated for This Test							
Water Retention - Final Flow (**percent**)							
	66	79	9.1	11.5	90	5.3	5.8
	*65	80	7.7	9.7	90	5.3	5.9
* Labs Eliminated - 354							

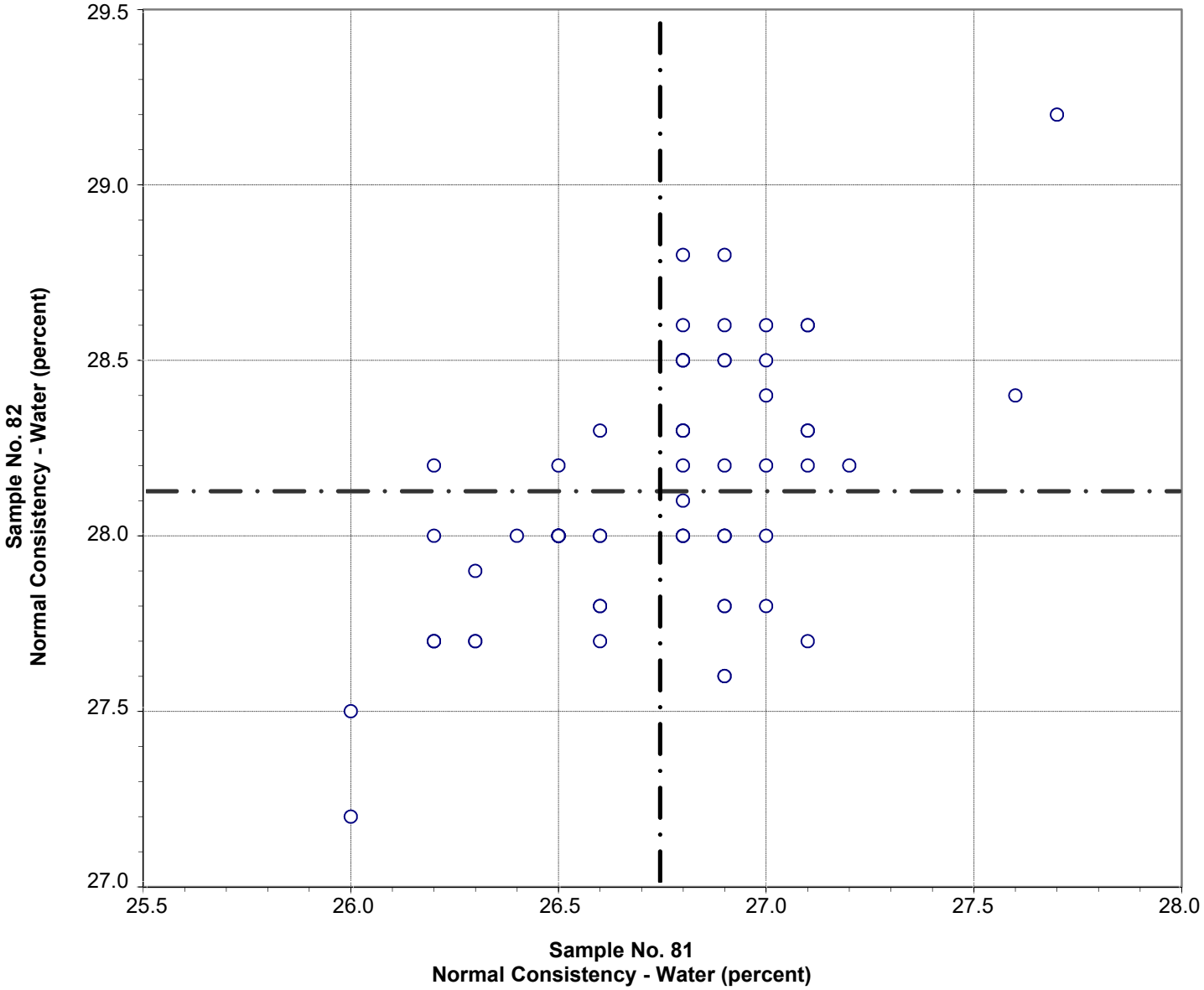
CCRL PROFICIENCY SAMPLE PROGRAM

Masonry Cement Proficiency Samples No. 81 and No. 82
Final Report – October 16, 2018
SUMMARY OF RESULTS

		Sample No. 81			Sample No. 82		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Water Retention Value (**percent**)							
	67	71	7.8	10.9	83	4.5	5.5
	*66	72	6.5	9.0	83	4.6	5.5

* Labs Eliminated - 354

CCRL Proficiency Sample Program
Normal Consistency - Water
MASONRY CEMENT Samples No. 81 and No. 82

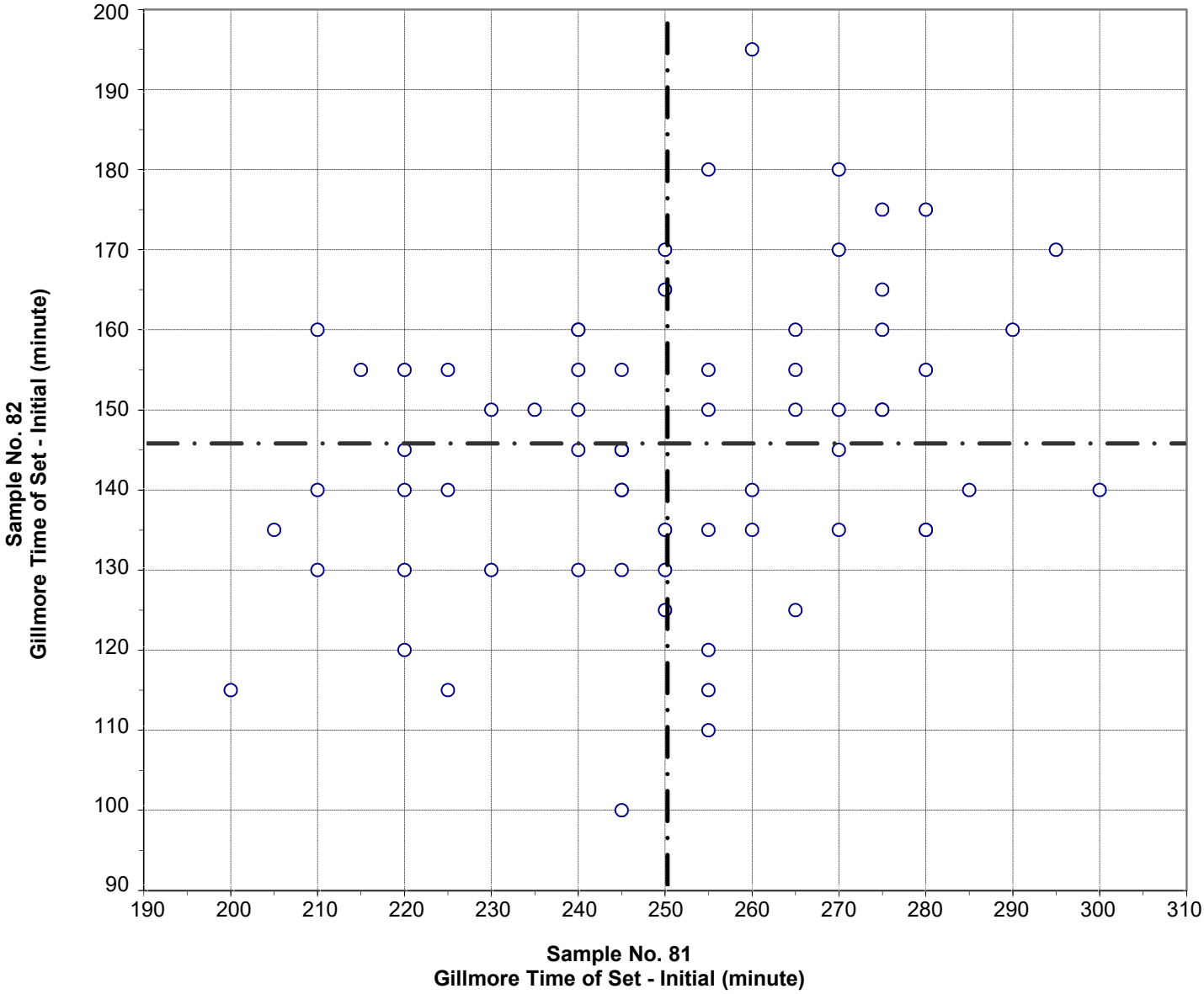


Test No. 110 Normal Consistency - Water 66 Points

Sample No. 81	Ave	26.7	S.D.	0.33	C.V. 1.2
Sample No. 82	Ave	28.1	S.D.	0.36	C.V. 1.3

Labs Eliminated: 20, 96, 4351

CCRL Proficiency Sample Program
Gillmore Time of Set - Initial
MASONRY CEMENT Samples No. 81 and No. 82

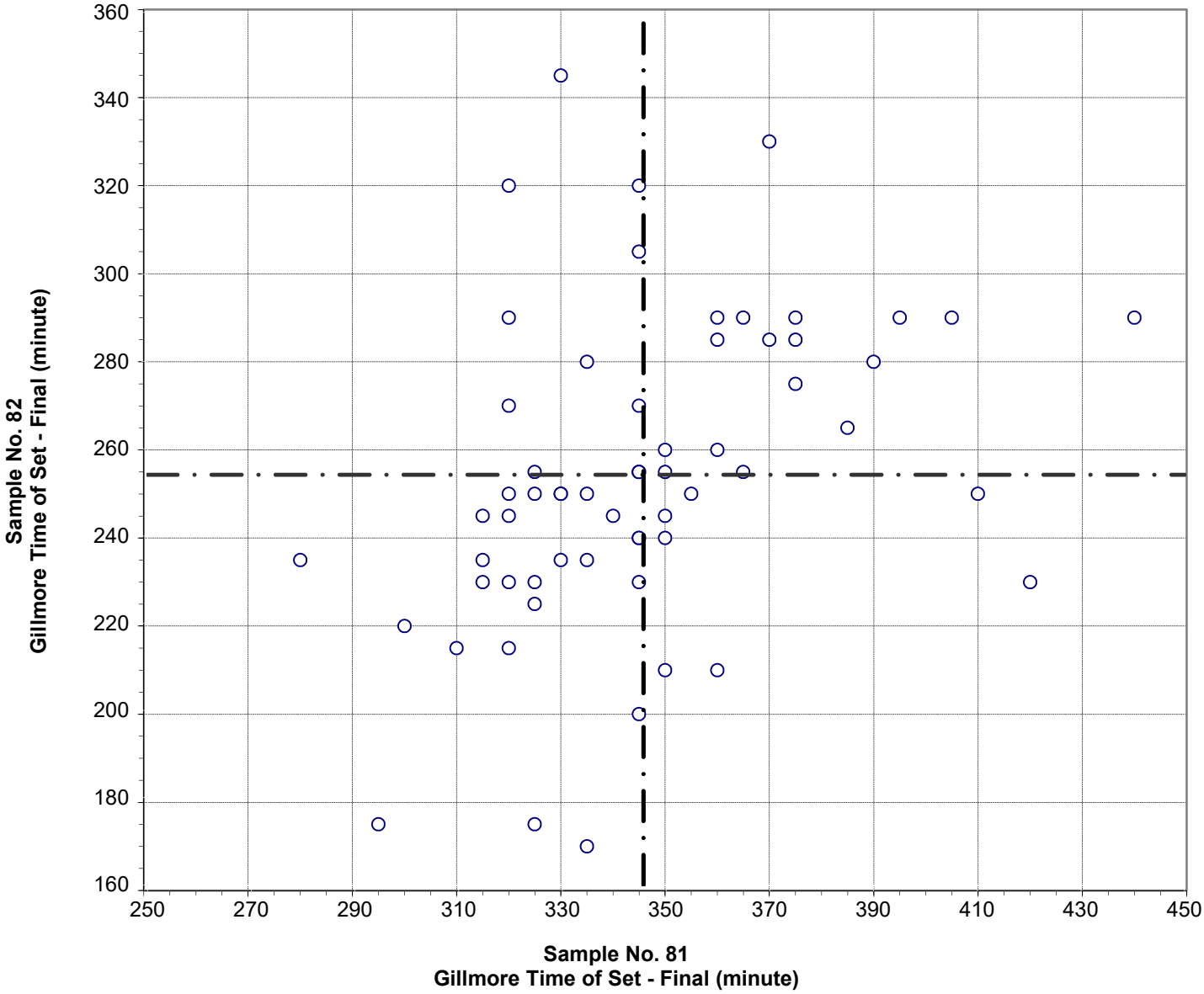


Test No. 130 Gillmore Time of Set - Initial 68 Points

Sample No. 81	Ave	250	S.D.	23	C.V. 9.3
Sample No. 82	Ave	146	S.D.	18	C.V. 12.4

Labs Eliminated: 3185

CCRL Proficiency Sample Program
Gillmore Time of Set - Final
MASONRY CEMENT Samples No. 81 and No. 82

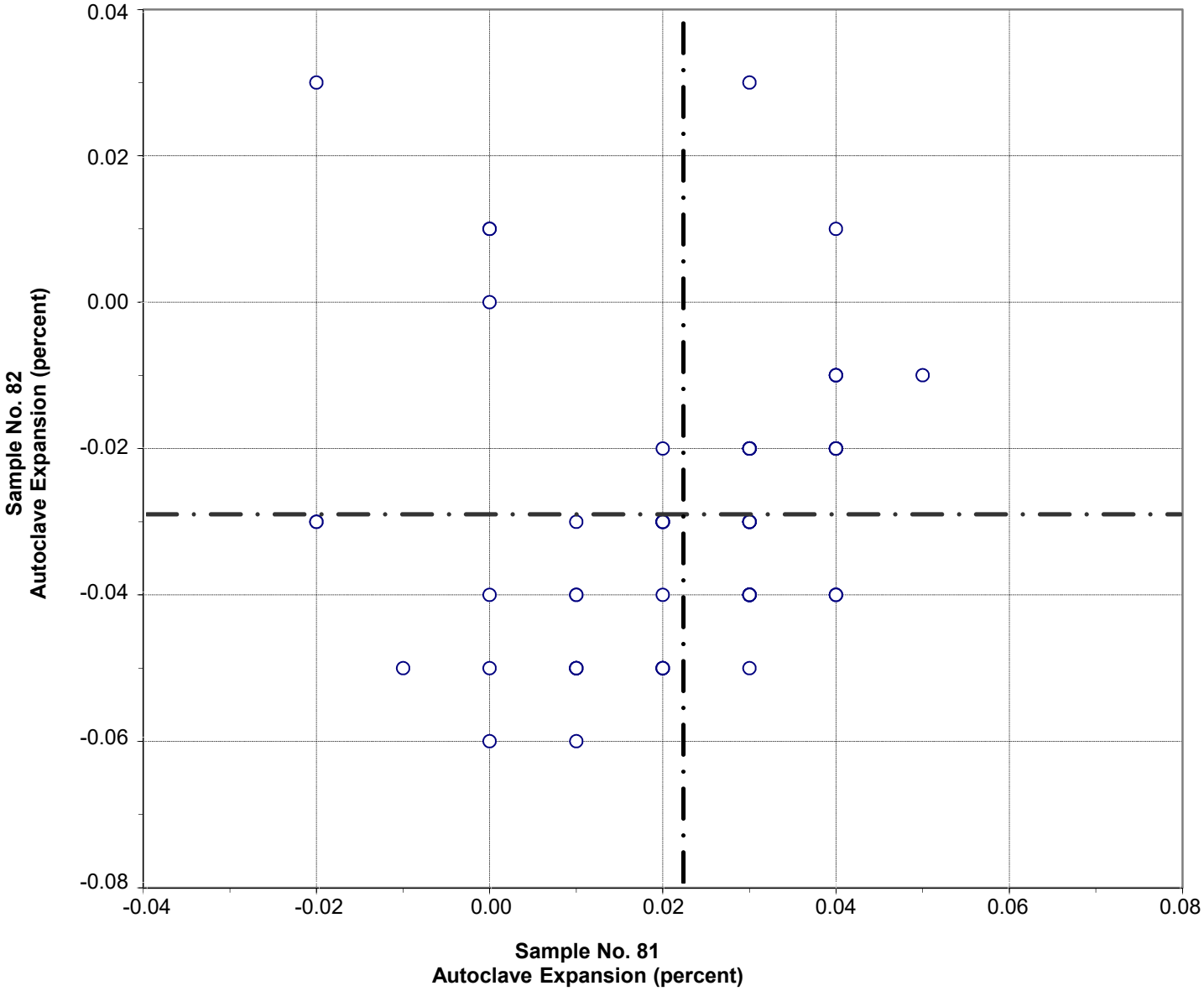


Test No. 140 Gillmore Time of Set - Final 62 Points

Sample No. 81	Ave	346	S.D.	30	C.V. 8.7
Sample No. 82	Ave	254	S.D.	35	C.V. 13.9

Labs Eliminated: 54, 205, 246, 1936, 3185, 3368

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

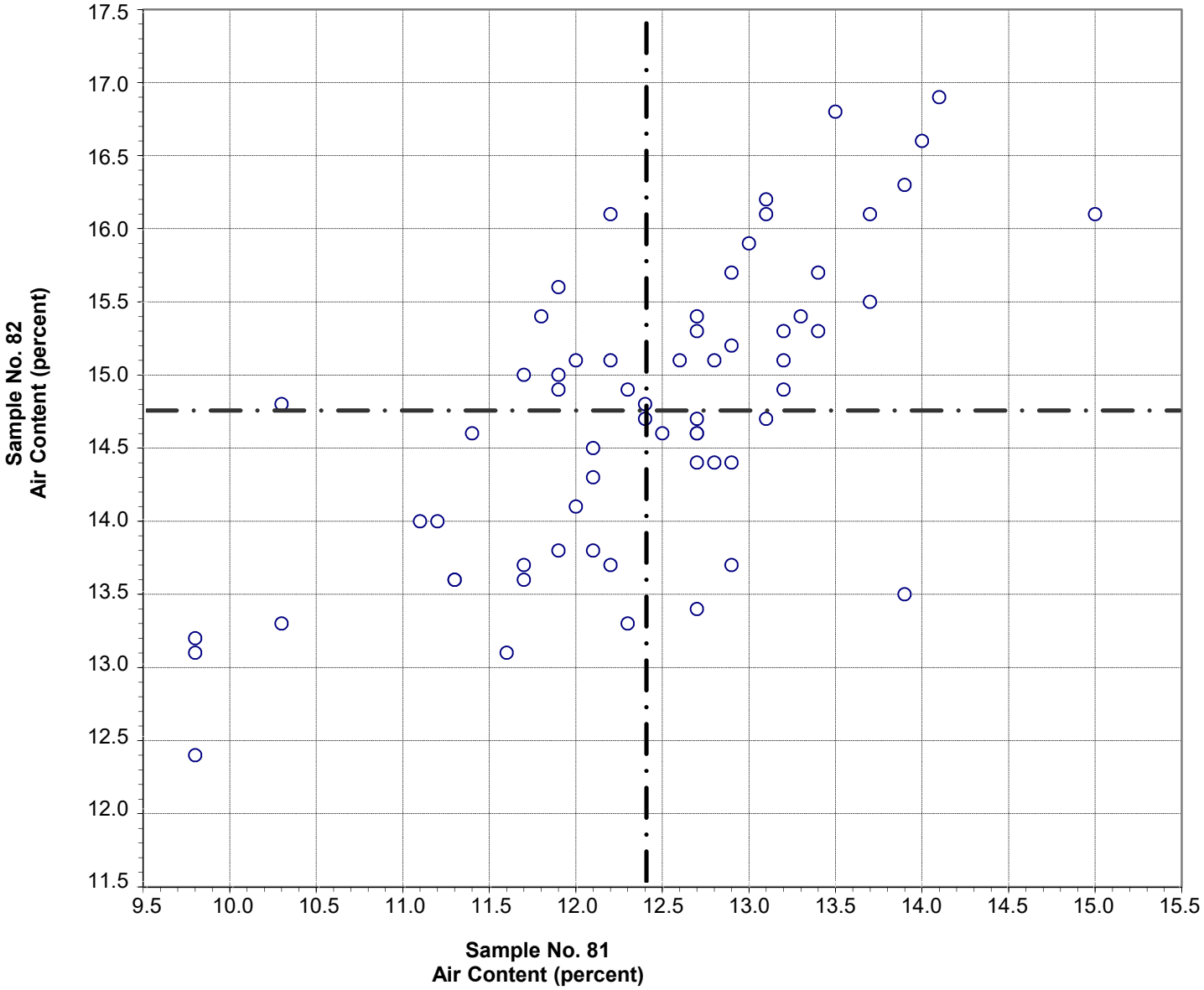


Test No. 160 Autoclave Expansion 66 Points

Sample No. 81	Ave 0.02	S.D. 0.02	C.V. 71.7
Sample No. 82	Ave -0.02	S.D. 0.02	C.V. -64.9

Labs Eliminated: 143, 823

CCRL Proficiency Sample Program
Air Content
MASONRY CEMENT Samples No. 81 and No. 82

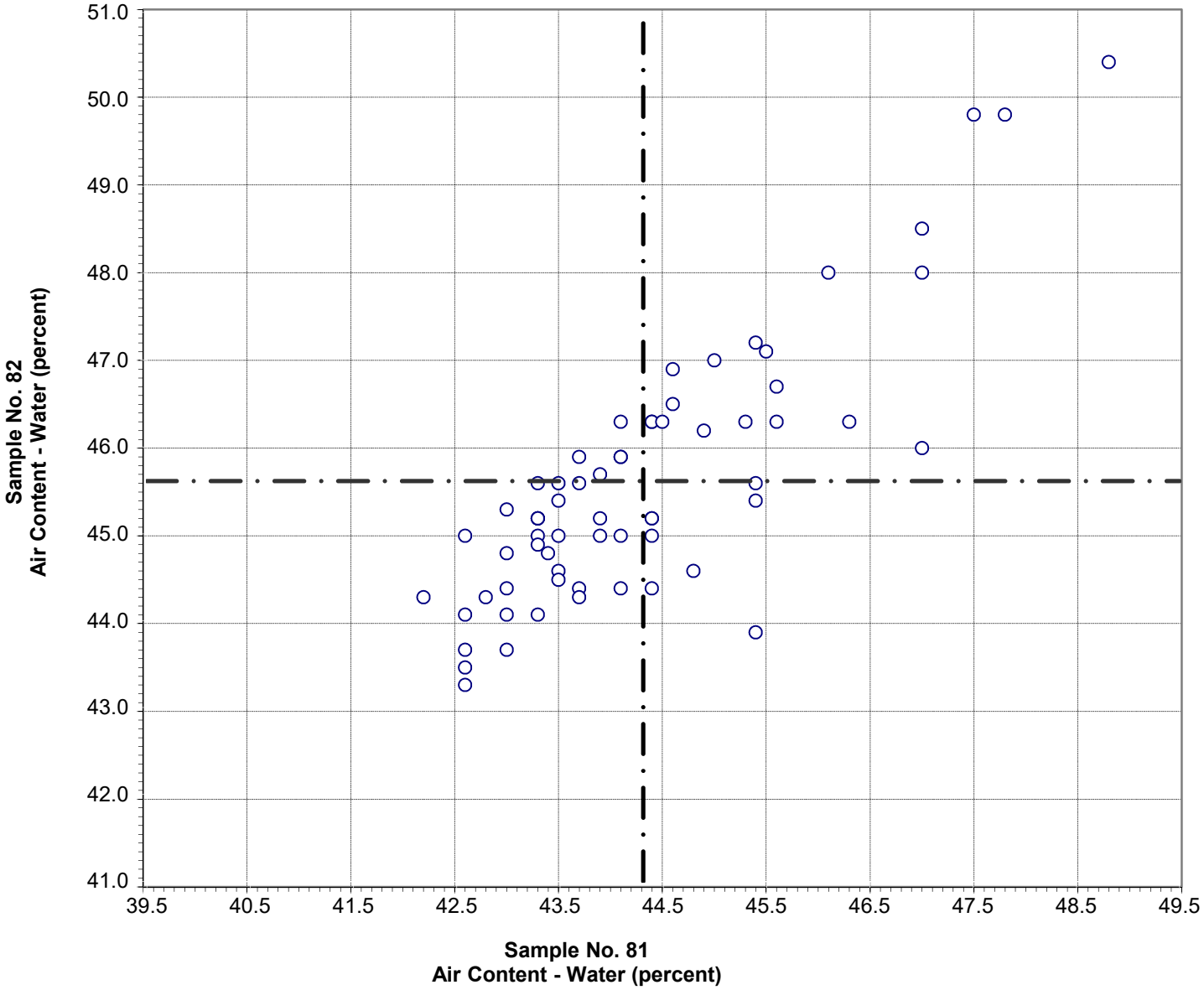


Test No. 170 Air Content 64 Points

Sample No. 81	Ave	12.4	S.D.	1.1	C.V. 8.5
Sample No. 82	Ave	14.8	S.D.	1.0	C.V. 6.8

Labs Eliminated: 52, 103, 698, 1715

CCRL Proficiency Sample Program
Air Content - Water
MASONRY CEMENT Samples No. 81 and No. 82

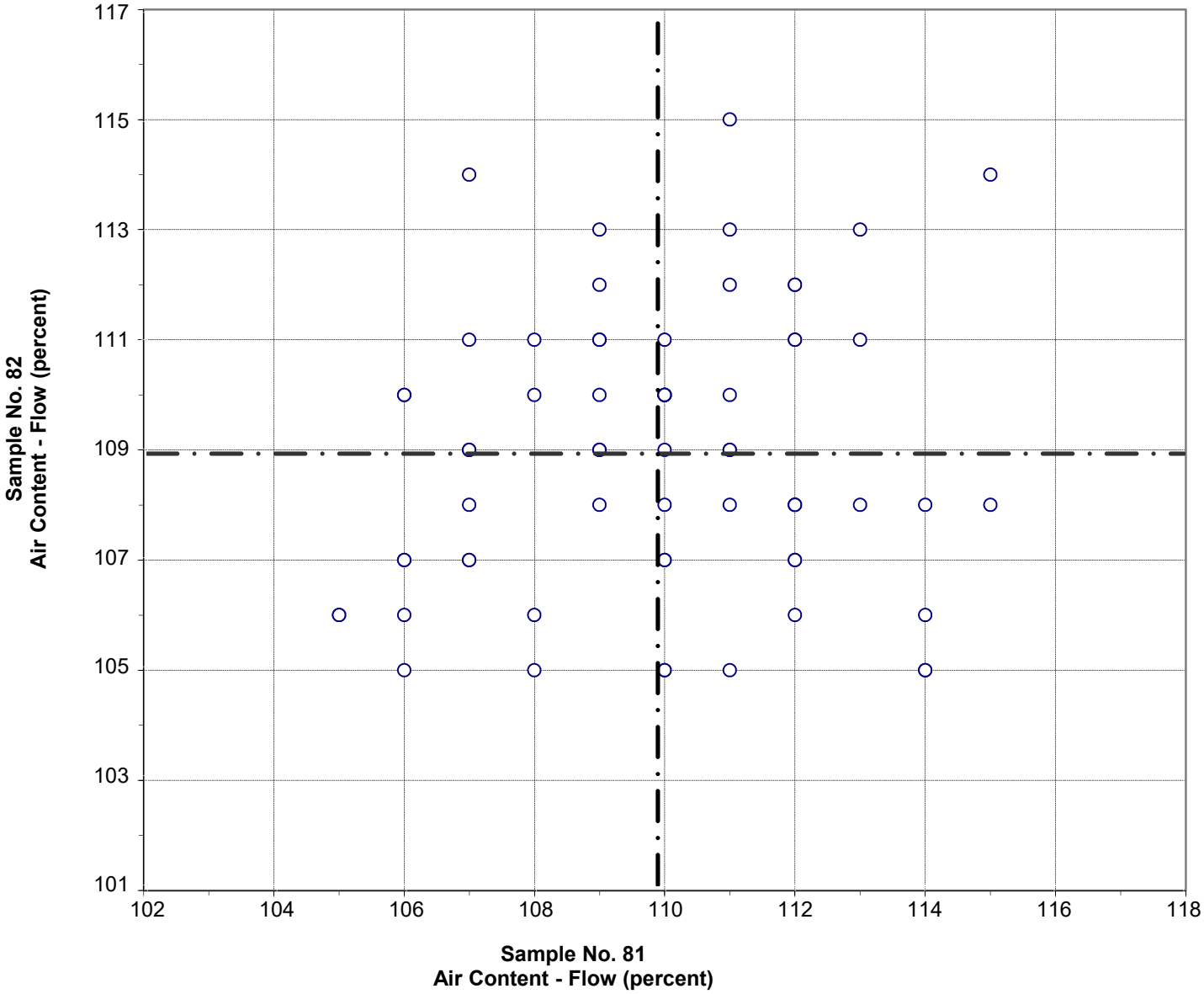


Test No. 180 Air Content - Water 65 Points

Sample No. 81	Ave	44.3	S.D.	1.4	C.V. 3.2
Sample No. 82	Ave	45.6	S.D.	1.5	C.V. 3.2

Labs Eliminated: 103, 243, 1715

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

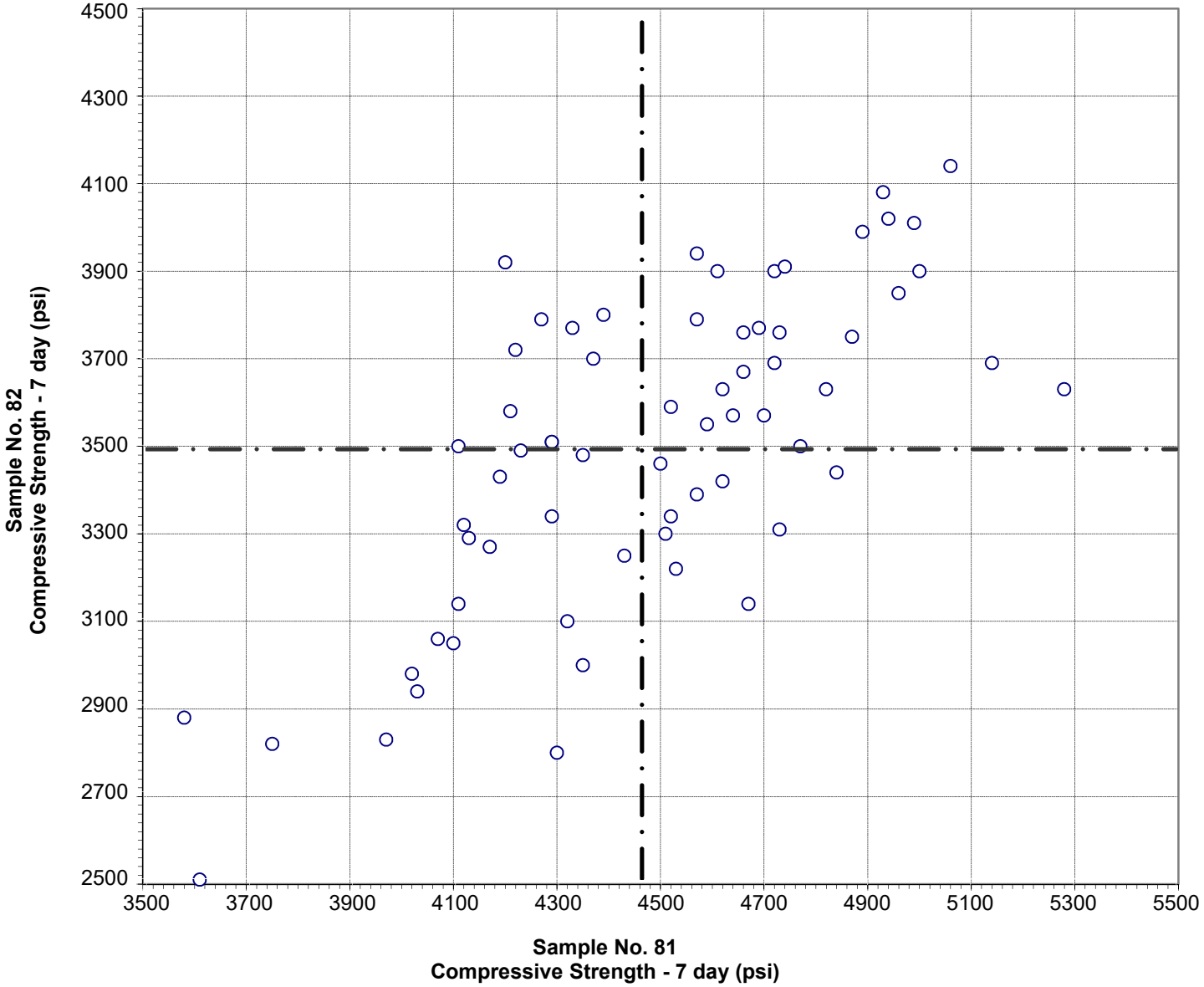


Test No. 190 Air Content - Flow 66 Points

Sample No. 81	Ave	110	S.D.	2.5	C.V. 2.3
Sample No. 82	Ave	109	S.D.	2.5	C.V. 2.3

Labs Eliminated: 103, 1715

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



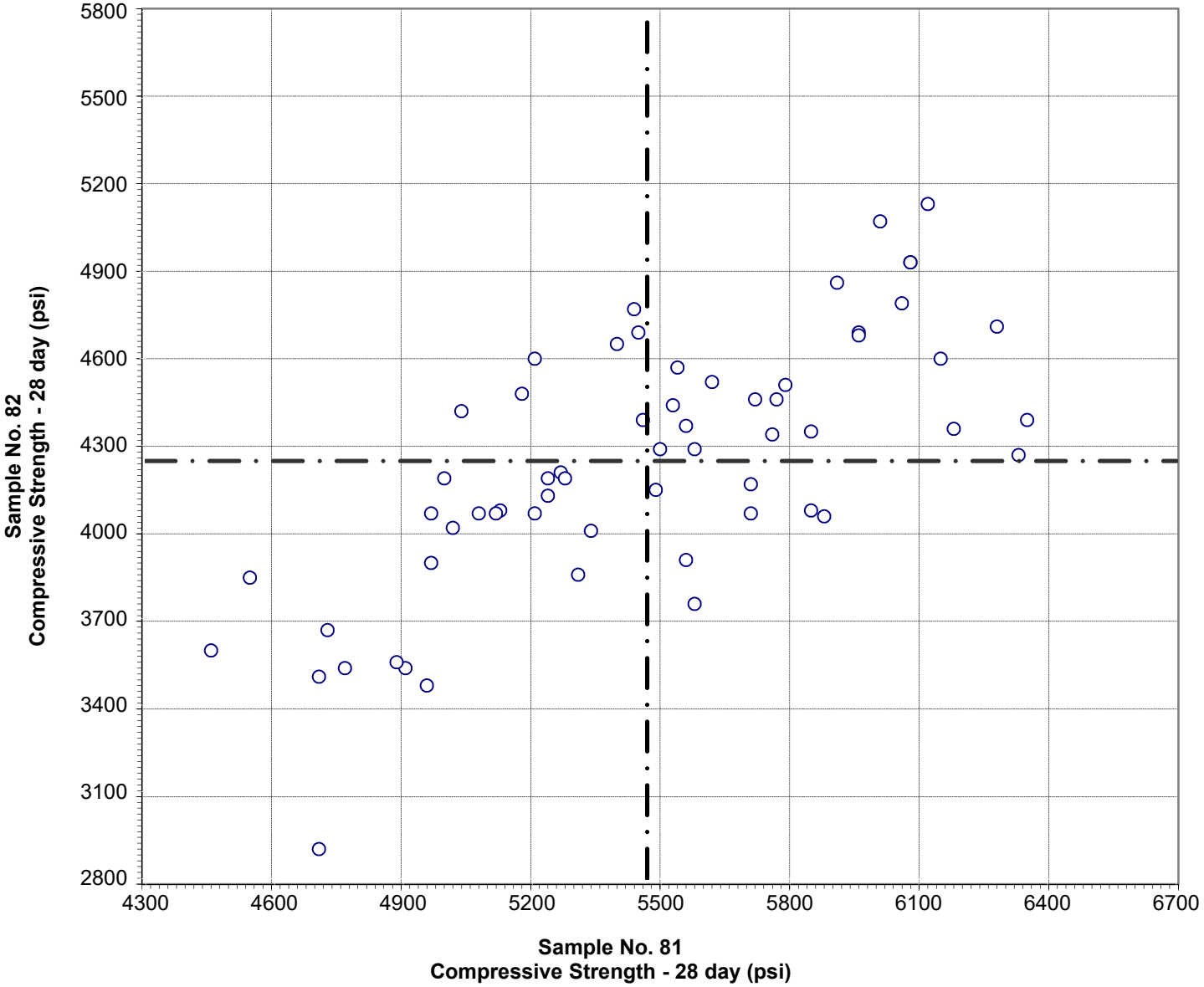
Test No. 210 Compressive Strength - 7 day 66 Points

Sample No. 81	Ave 4462	S.D. 383	C.V. 8.6
Sample No. 82	Ave 3491	S.D. 364	C.V. 10.4

Labs Eliminated: 9, 823

Labs off Diagram: 75

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

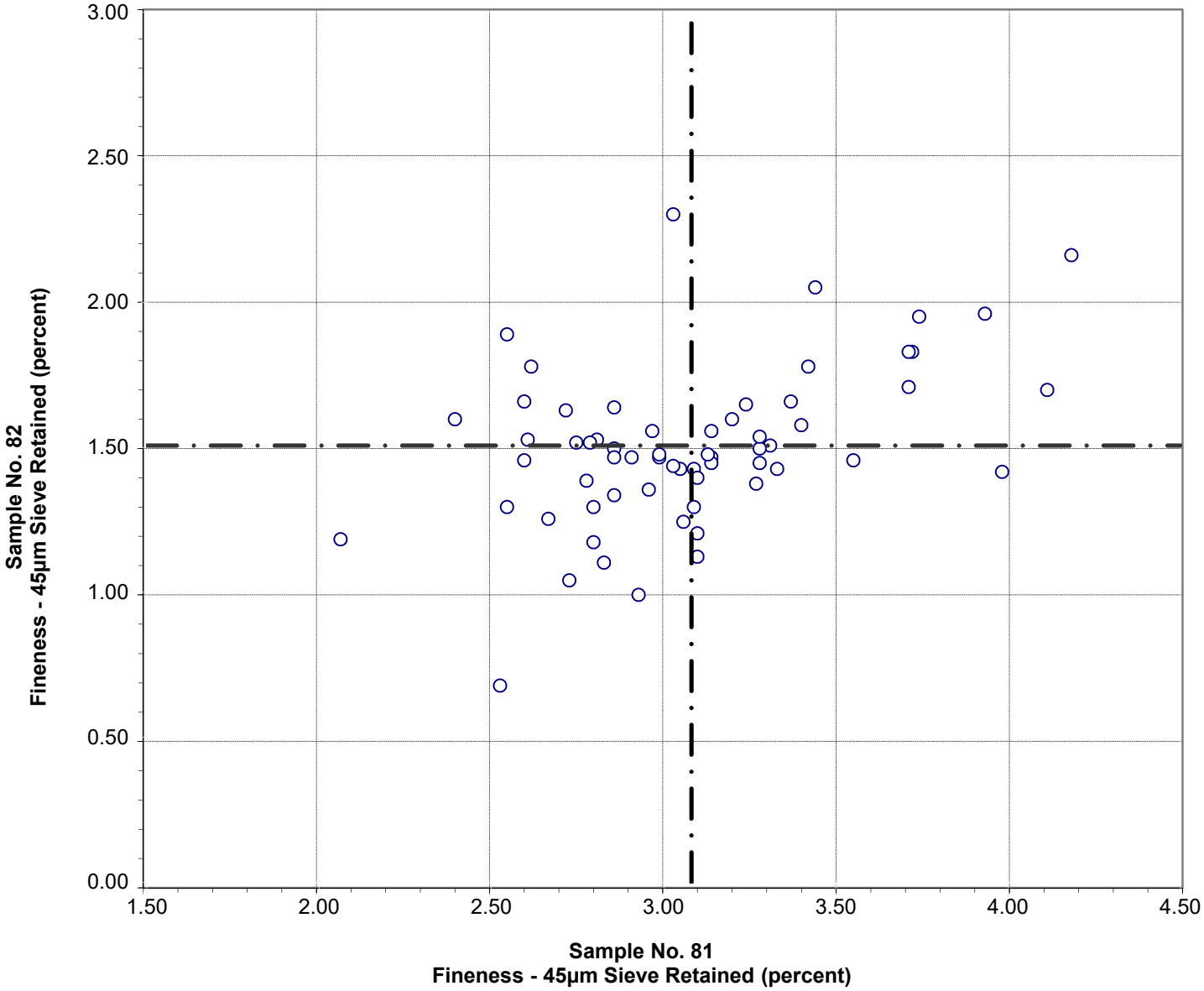


Test No. 211 Compressive Strength - 28 day 61 Points

Sample No. 81	Ave	5468	S.D.	475	C.V. 9
Sample No. 82	Ave	4245	S.D.	436	C.V. 10

Labs Eliminated: 9, 493, 823

CCRL Proficiency Sample Program
Fineness - 45µm Sieve Retained
MASONRY CEMENT Samples No. 81 and No. 82

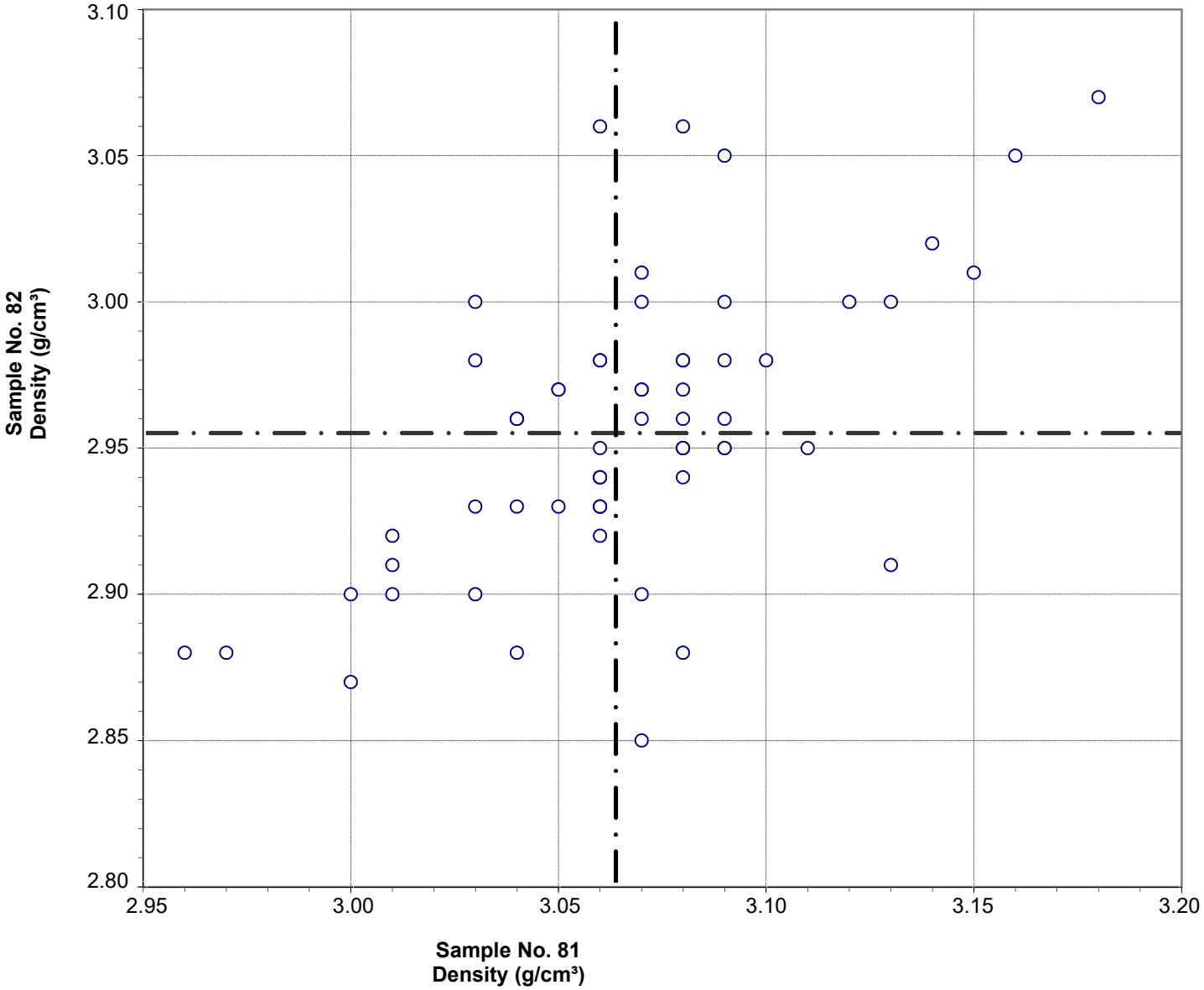


Test No. 281 Fineness - 45µm Sieve Retained 63 Points

Sample No. 81	Ave	3.08	S.D.	0.42	C.V. 13.6
Sample No. 82	Ave	1.51	S.D.	0.27	C.V. 18.1

Labs Eliminated: 60, 157, 1466, 2938, 3368, 4351

CCRL Proficiency Sample Program
Density
MASONRY CEMENT Samples No. 81 and No. 82



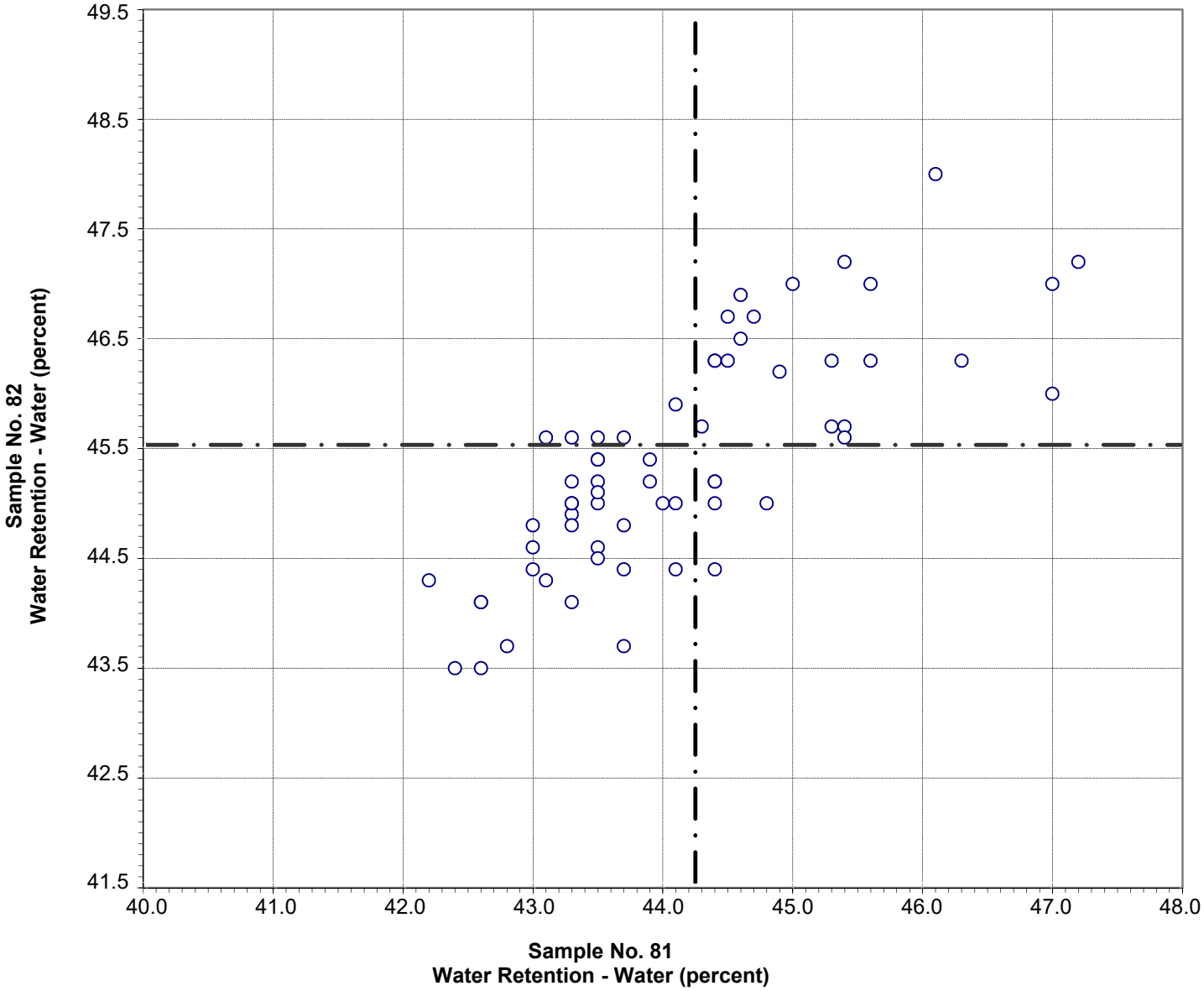
Test No. 310 Density 62 Points

Sample No. 81	Ave	3.06	S.D.	0.05	C.V. 1.6
Sample No. 82	Ave	2.95	S.D.	0.05	C.V. 1.7

Labs Eliminated: 181, 698

Labs off Diagram: 354

CCRL Proficiency Sample Program
Water Retention - Water
MASONRY CEMENT Samples No. 81 and No. 82



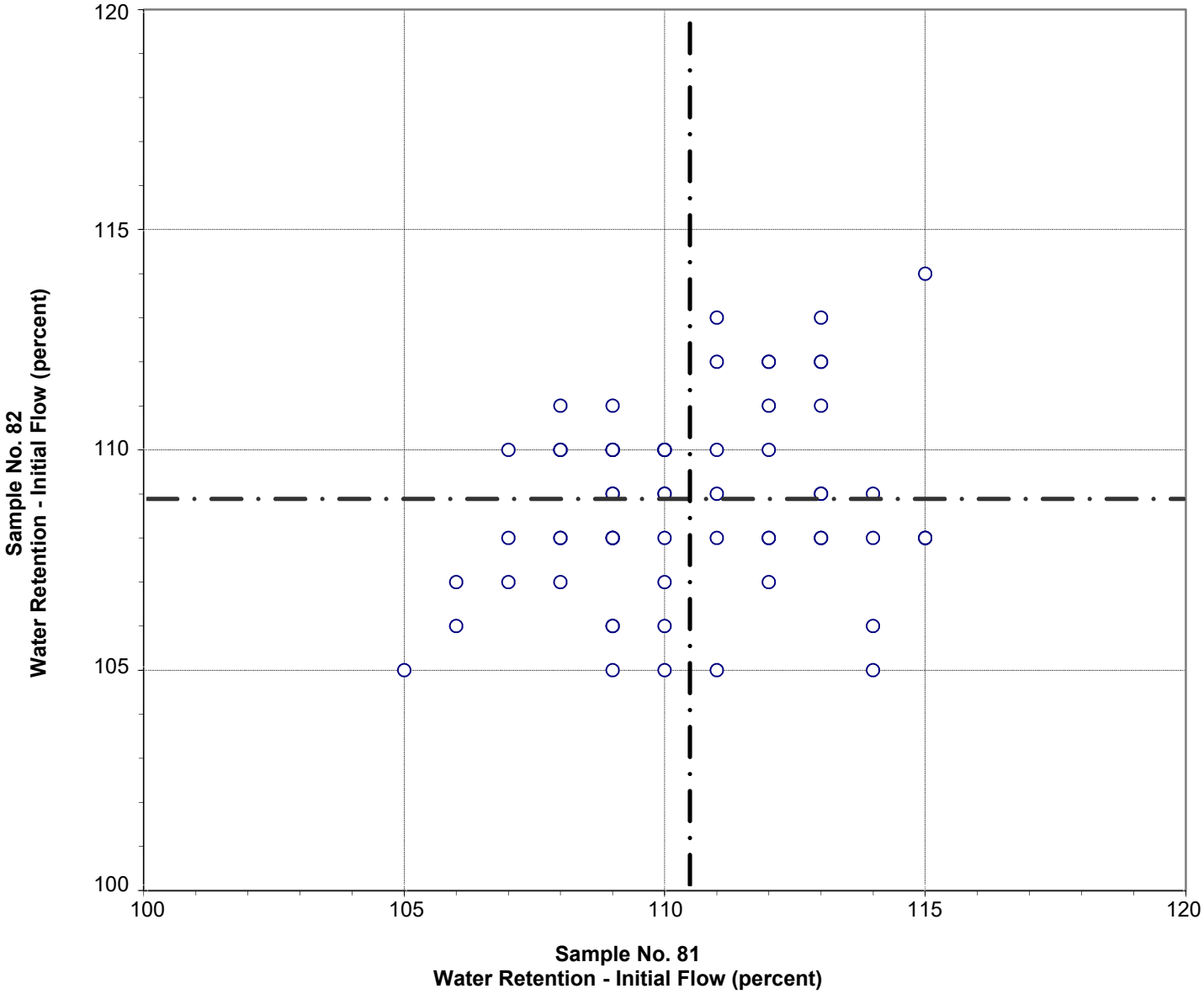
Test No. 330 Water Retention - Water 63 Points

Sample No. 81	Ave	44.2	S.D.	1.3	C.V. 2.9
Sample No. 82	Ave	45.5	S.D.	1.3	C.V. 2.8

Labs Eliminated: 142, 243

Labs off Diagram: 20, 157

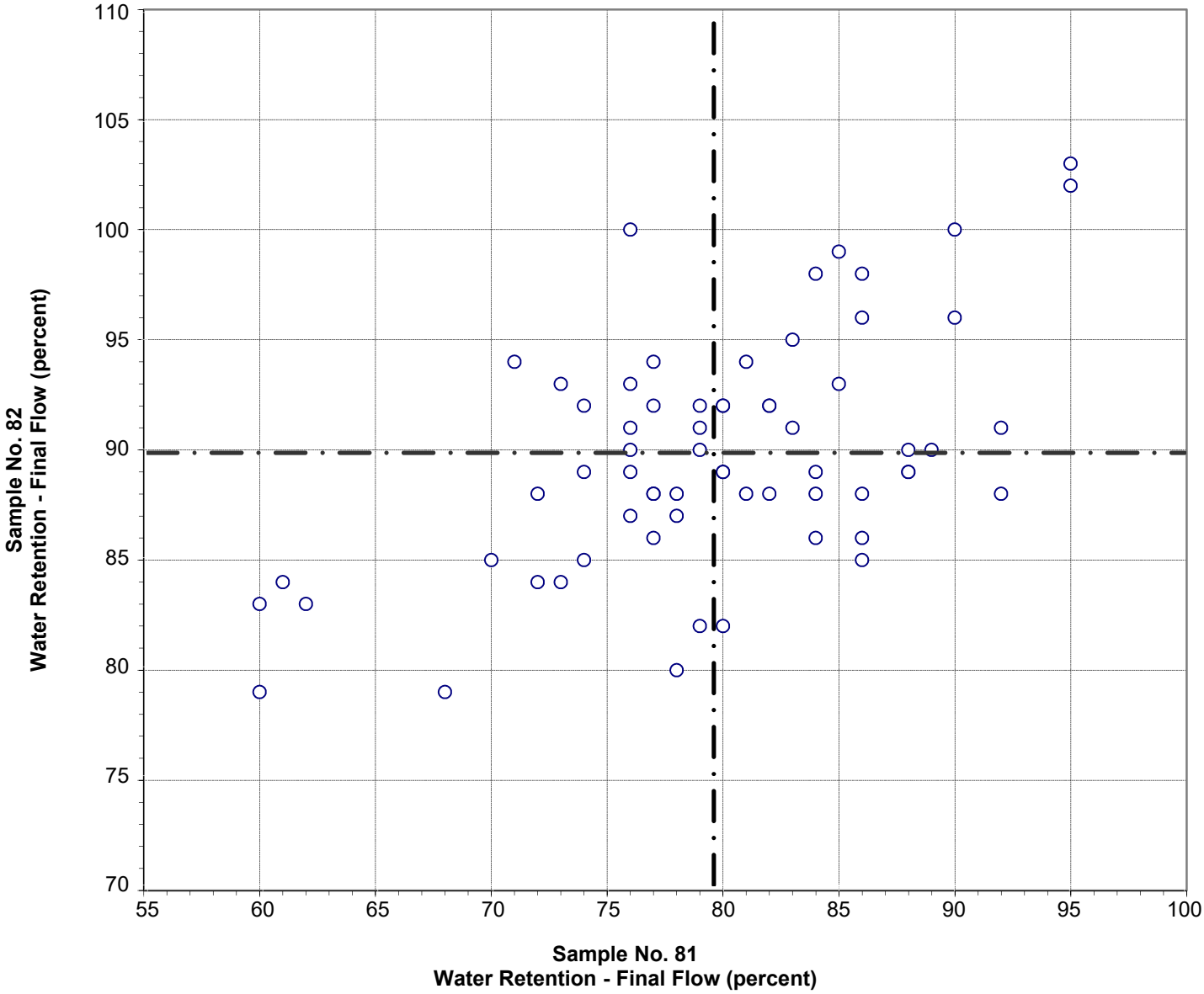
CCRL Proficiency Sample Program
Water Retention - Initial Flow
MASONRY CEMENT Samples No. 81 and No. 82



Test No. 331 Water Retention - Initial Flow 66 Points

Sample No. 81	Ave	110	S.D.	2.4	C.V.	2.2
Sample No. 82	Ave	109	S.D.	2.1	C.V.	1.9

CCRL Proficiency Sample Program
Water Retention - Final Flow
MASONRY CEMENT Samples No. 81 and No. 82

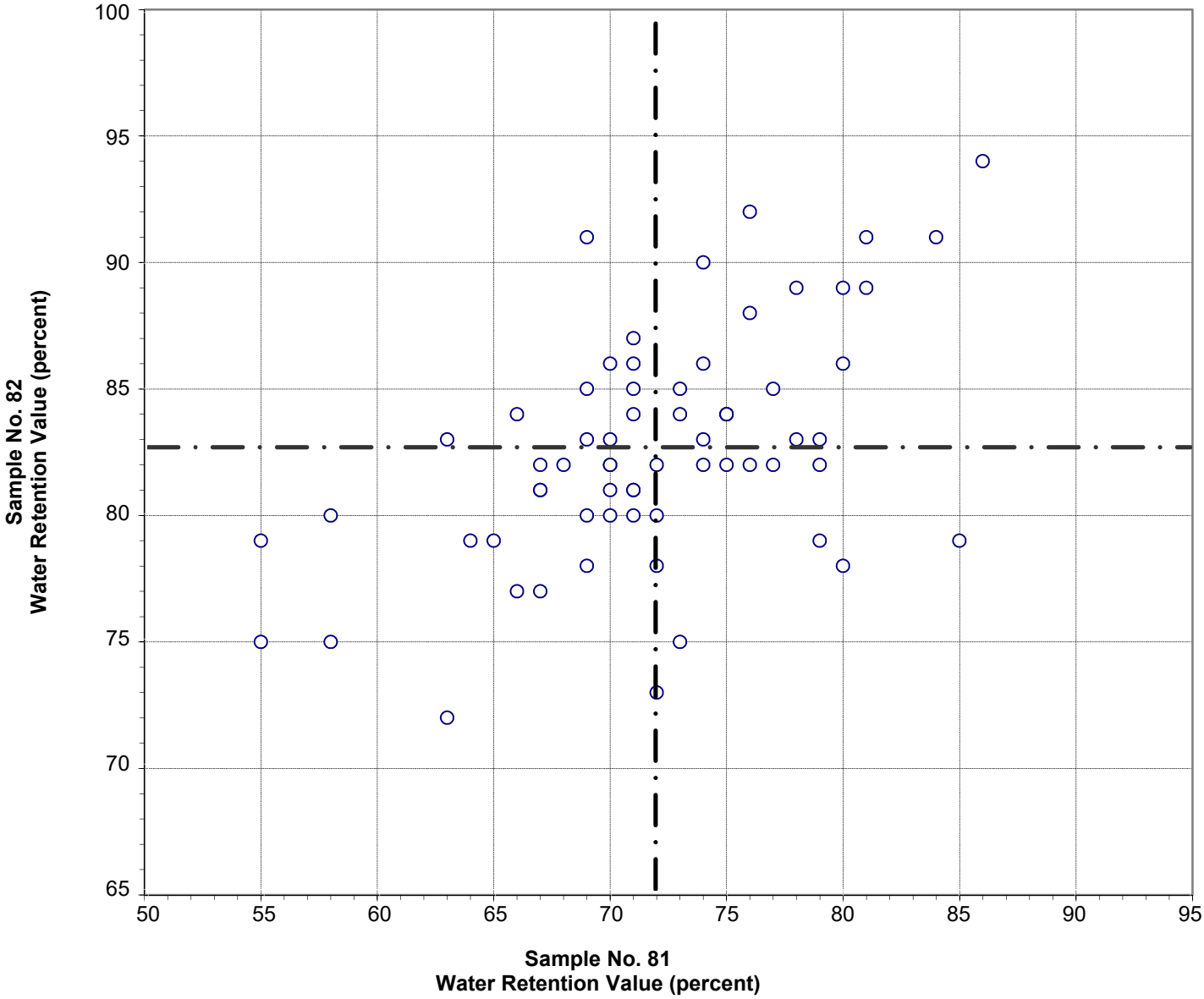


Test No. 332 Water Retention - Final Flow 65 Points

Sample No. 81	Ave	80	S.D.	7.7	C.V. 9.7
Sample No. 82	Ave	90	S.D.	5.3	C.V. 5.9

Labs Eliminated: 354

CCRL Proficiency Sample Program
Water Retention Value
MASONRY CEMENT Samples No. 81 and No. 82



Test No. 333 Water Retention Value 66 Points

Sample No. 81	Ave	72	S.D.	6.5	C.V. 9.0
Sample No. 82	Ave	83	S.D.	4.6	C.V. 5.5

Labs Eliminated: 354