

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

**Final Report**  
**Masonry Cement Proficiency Samples**  
**Number 73 and Number 74**

October 2014



**CCRL**  
Cement and Concrete  
Reference Laboratory

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

October 7, 2014

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

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

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 July 2014. Masonry Cement Samples No. 73 and No. 74 were ASTM C91 Type S 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 2015.

Sincerely,

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

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

**FROM: Robin K. Haupt, Supervisor, PSP**

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

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 July 2014. 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 62<sup>nd</sup> 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.

<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.

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

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

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**

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 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. Elimination of these outlying results may 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  $\pm 1$  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**  
Masonry Cement Proficiency Samples No. 73 and No. 74

Final Report – October 7, 2014

SUMMARY OF RESULTS

Sample No.73

Sample No. 74

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Normal Consistency - Water (percent)</b>							
	67	25.8	1.29	5.0	24.5	0.79	3.2
	*65	26.0	0.43	1.6	24.6	0.37	1.5
* Labs Eliminated - 694, 3972							
<b>Gillmore Time of Set - Initial (minute)</b>							
	66	277	53	19.0	155	54	34.9
	*63	279	52	18.5	145	23	16.0
* Labs Eliminated - 151, 162, 883							
<b>Gillmore Time of Set - Final (minute)</b>							
	65	431	77	17.9	271	59	21.9
	*61	440	52	11.8	262	36	13.6
* Labs Eliminated - 151, 162, 883, 3972							
<b>Autoclave Expansion (percent)</b>							
	62	0.24	0.10	39.7	0.01	0.01	114.2
	*59	0.24	0.09	35.6	0.01	0.01	83.4
* Labs Eliminated - 169, 694, 1715							
<b>Air Content (percent)</b>							
	65	17.4	2.8	16.2	14.9	2.2	14.7
	*60	17.2	1.1	6.6	14.9	1.0	6.5
* Labs Eliminated - 52, 103, 354, 493, 3972							
<b>Air Content - Water (percent)</b>							
	63	44.7	4.7	10.4	46.0	5.0	10.9
	*58	43.5	1.0	2.2	44.8	1.1	2.4
* Labs Eliminated - 103, 142, 178, 493, 3970							
<b>Air Content - Flow (percent)</b>							
	63	111	2.6	2.4	109	2.9	2.6
No Labs Eliminated for This Test							

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

Final Report – October 7, 2014

SUMMARY OF RESULTS

Sample No.73

Sample No. 74

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Compressive Strength - 7 day (psi)</b>							
	67	2314	458	19.8	2728	378	13.9
	*66	2279	363	15.9	2701	306	11.3
* Labs Eliminated - 3972							
<b>Compressive Strength - 28 day (psi)</b>							
	68	2957	475	16	3345	391	12
No Labs Eliminated for This Test							
<b>Fineness - 45µm Sieve Retained (percent)</b>							
	66	3.42	0.73	21.4	3.08	0.84	27.2
	*62	3.44	0.47	13.7	3.08	0.44	14.3
* Labs Eliminated - 125, 148, 181, 3972							
<b>Density (g/cm<sup>3</sup>)</b>							
	62	2.97	0.09	3.0	2.94	0.09	3.1
	*59	2.97	0.04	1.2	2.95	0.03	1.1
* Labs Eliminated - 9, 246, 3972							
<b>Water Retention - Water (percent)</b>							
	62	44.0	3.0	6.8	45.3	3.1	6.8
	*59	43.6	1.2	2.7	44.8	1.1	2.5
* Labs Eliminated - 142, 690, 3970							
<b>Water Retention - Initial Flow (percent)</b>							
	62	111	2.4	2.2	110	2.8	2.6
No Labs Eliminated for This Test							
<b>Water Retention - Final Flow (percent)</b>							
	61	88	6.9	7.9	90	5.5	6.1
	*60	88	6.4	7.3	90	5.2	5.8
* Labs Eliminated - 690							

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

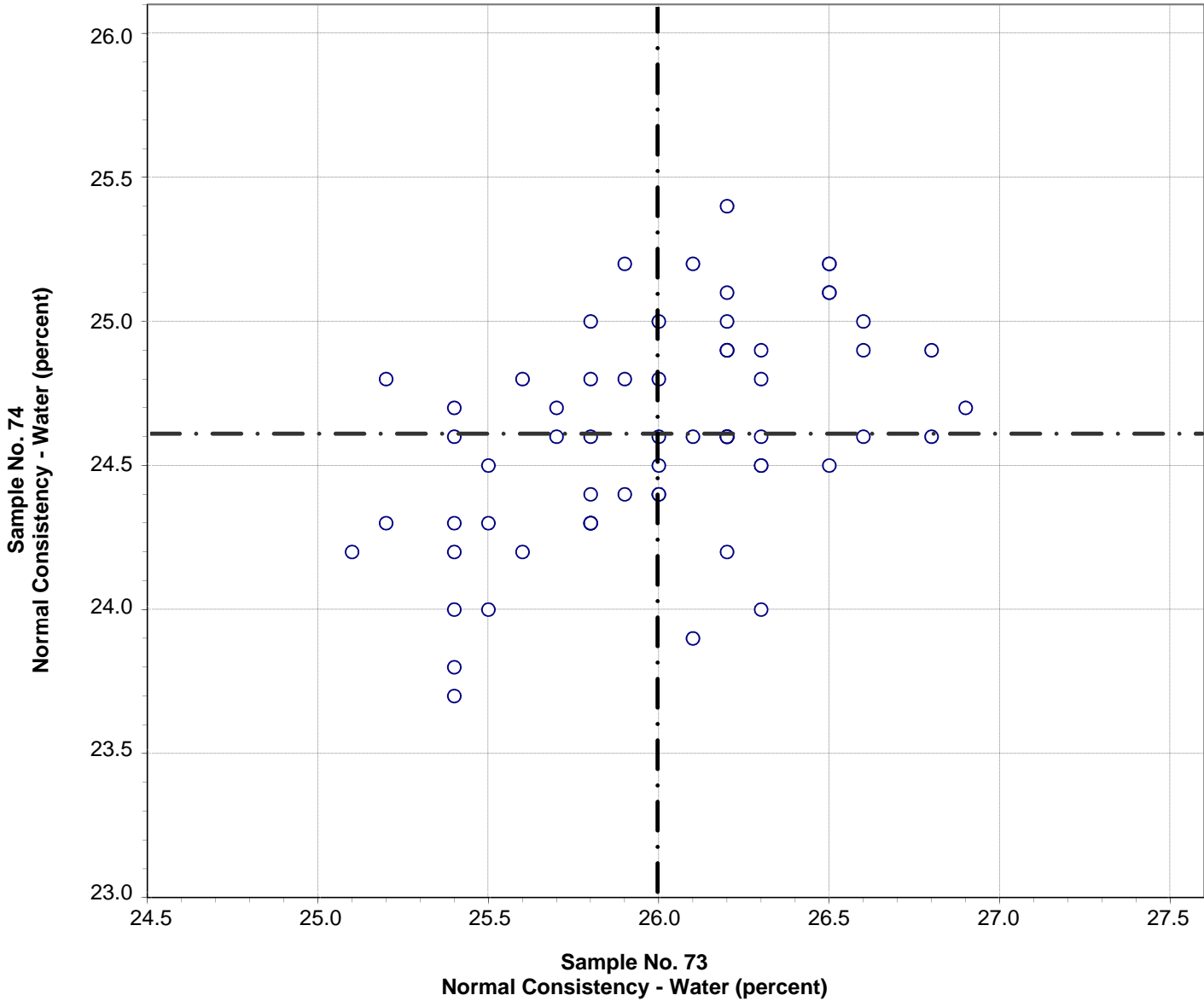
Final Report – October 7, 2014

SUMMARY OF RESULTS

Test (unit)	Sample No.73				Sample No. 74		
	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Water Retention Value (percent)</b>							
	61	79	5.8	7.3	82	4.8	5.9
	*57	79	4.2	5.4	82	4.0	4.9

\* Labs Eliminated - 143, 152, 225, 690

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



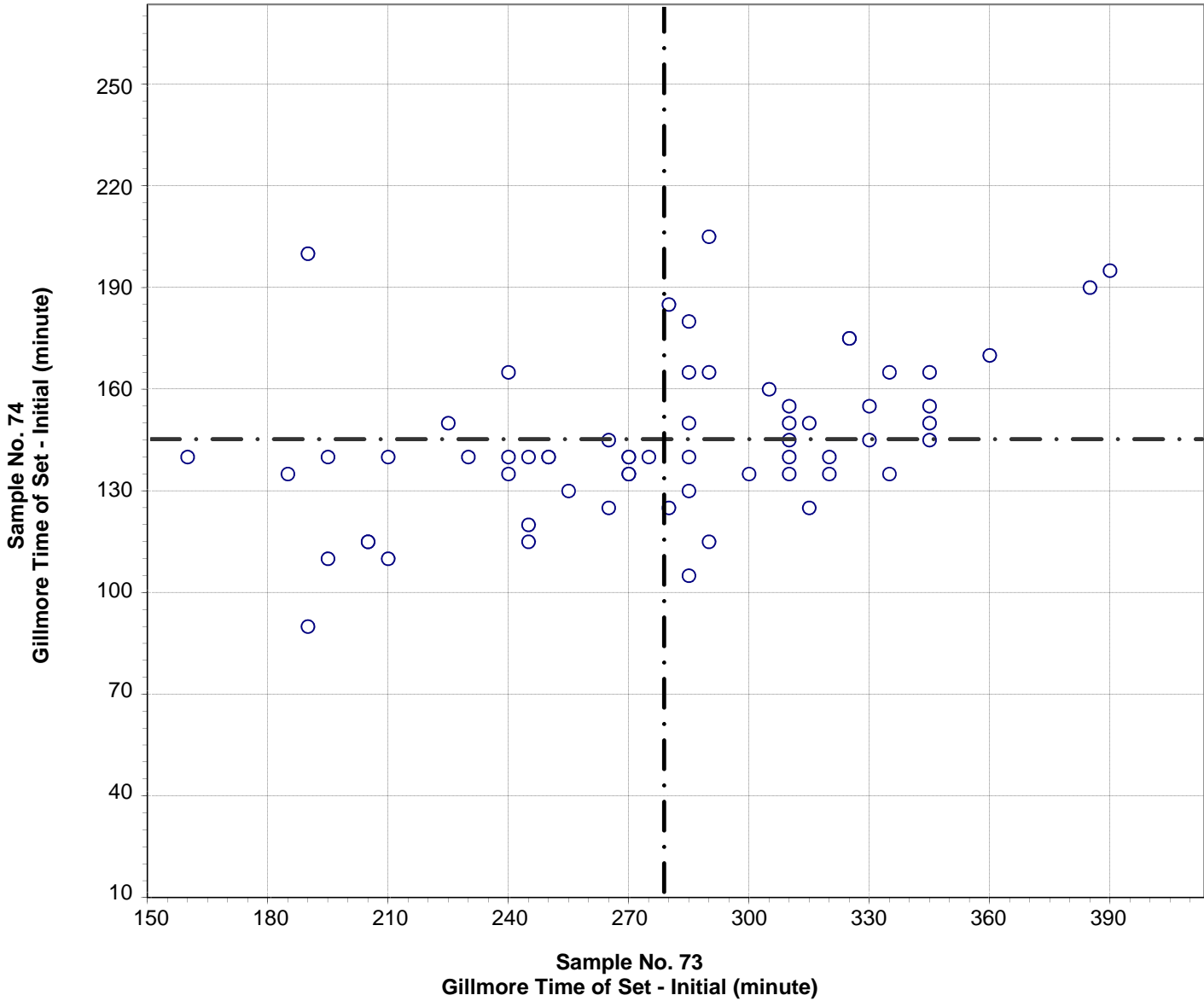
**Test No. 110 Normal Consistency - Water 65 Points**

Sample No. 73	Ave 26.0	S.D. 0.43	C.V. 1.6
Sample No. 74	Ave 24.6	S.D. 0.37	C.V. 1.5

Labs Eliminated: 694, 3972



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



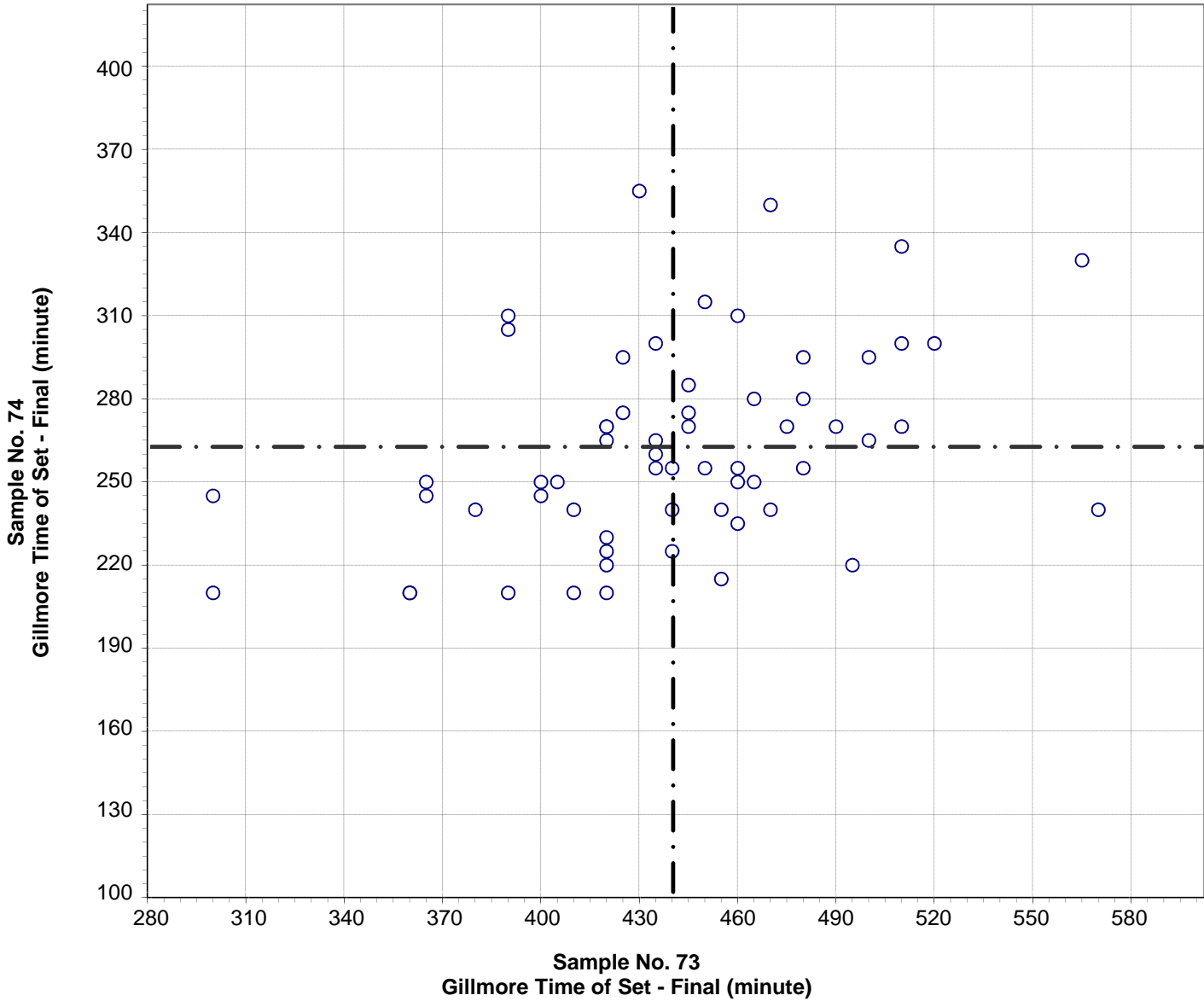
Test No. 130 Gillmore Time of Set - Initial 63 Points

Sample No. 73 Ave 279 S.D. 52 C.V. 18.5

Sample No. 74 Ave 145 S.D. 23 C.V. 16.0

Labs Eliminated: 151, 162, 883

**CCRL Proficiency Sample Program  
Gillmore Time of Set - Final  
MASONRY CEMENT Samples No. 73 and No. 74**



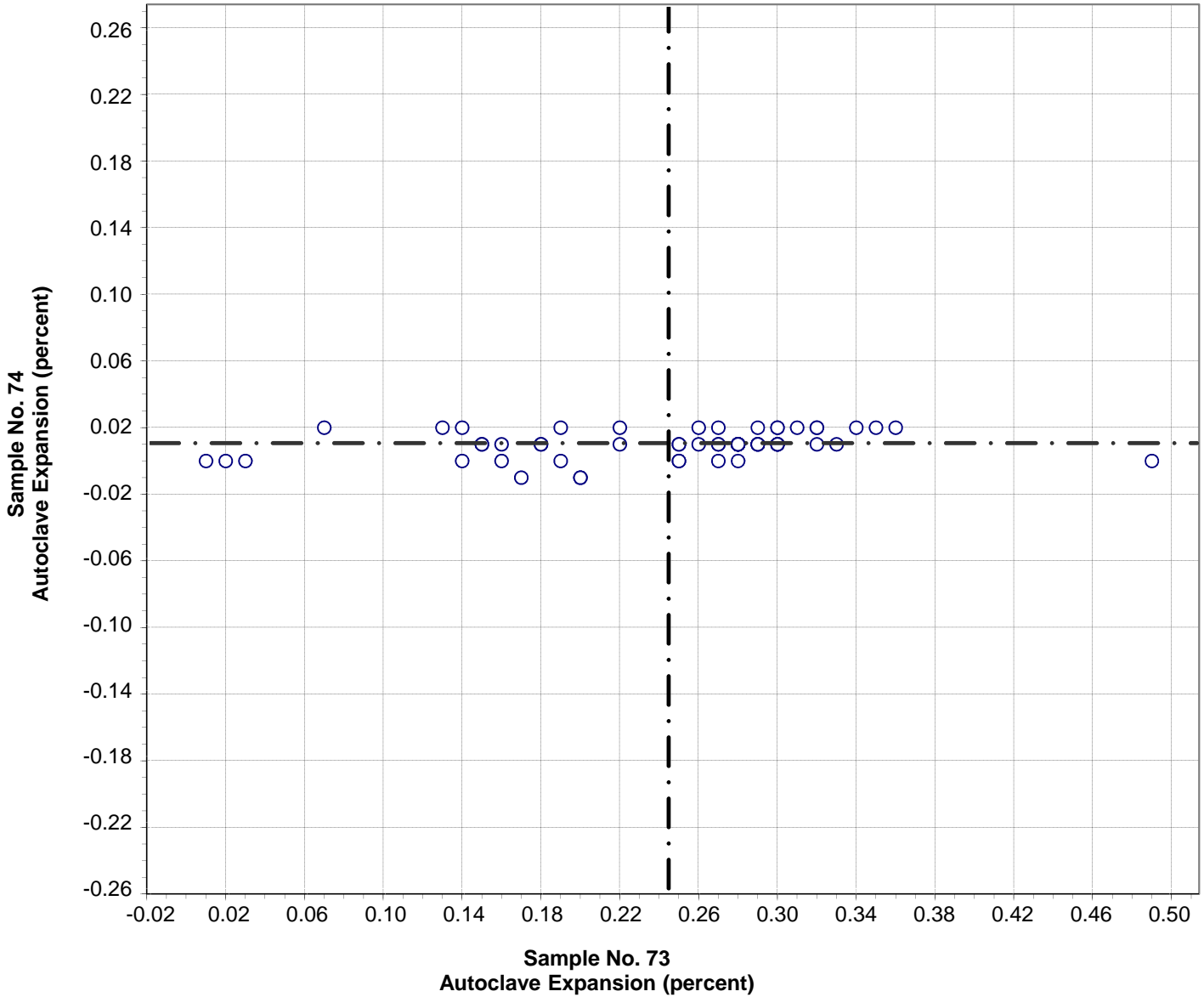
Test No. 140 Gillmore Time of Set - Final 61 Points

Sample No. 73 Ave 440 S.D. 52 C.V. 11.8

Sample No. 74 Ave 262 S.D. 36 C.V. 13.6

Labs Eliminated: 151, 162, 883, 3972

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



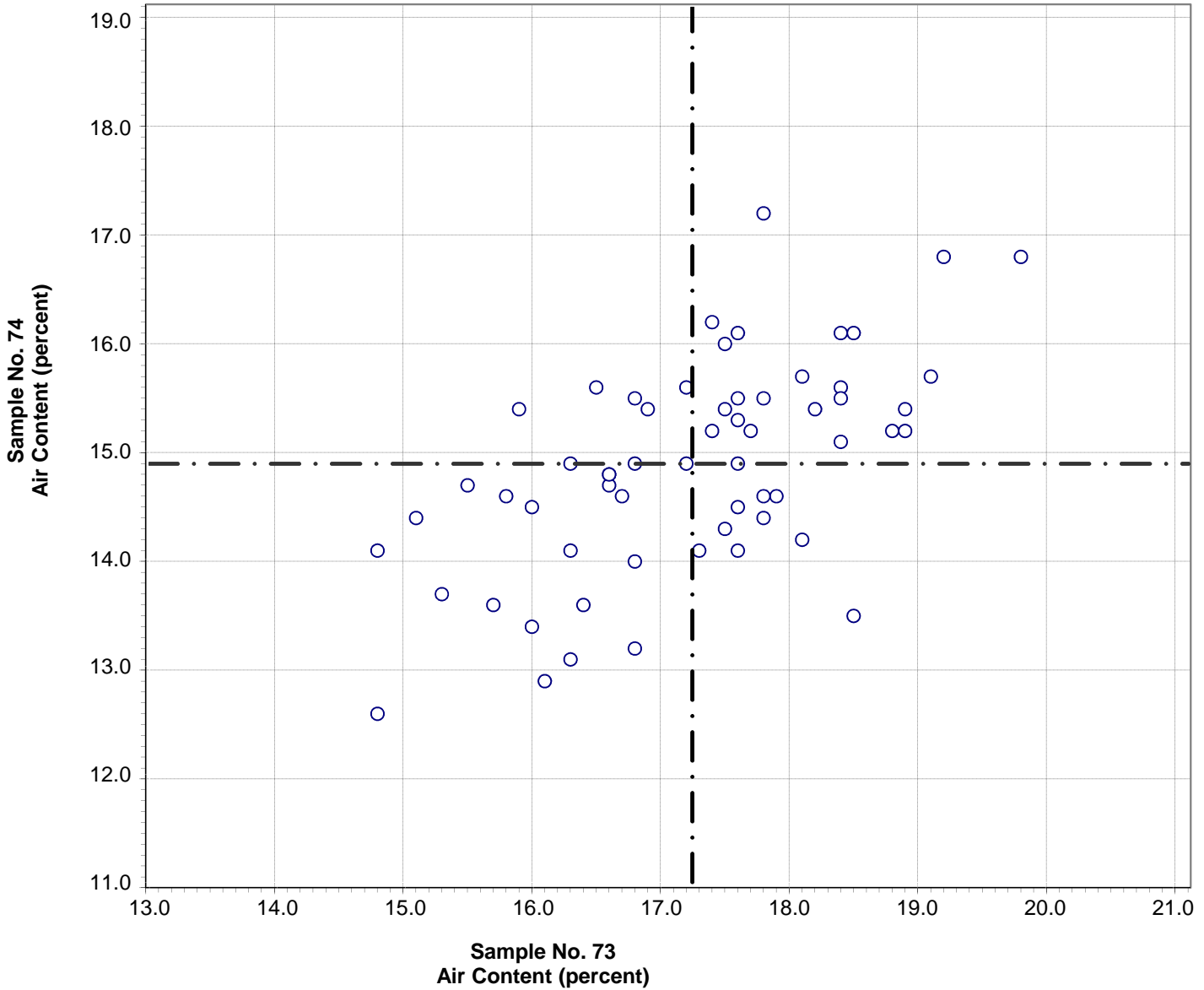
Test No. 160 Autoclave Expansion 59 Points

Sample No. 73 Ave 0.24 S.D. 0.09 C.V. 35.6

Sample No. 74 Ave 0.01 S.D. 0.01 C.V. 83.4

Labs Eliminated: 169, 694, 1715

**CCRL Proficiency Sample Program  
Air Content  
MASONRY CEMENT Samples No. 73 and No. 74**

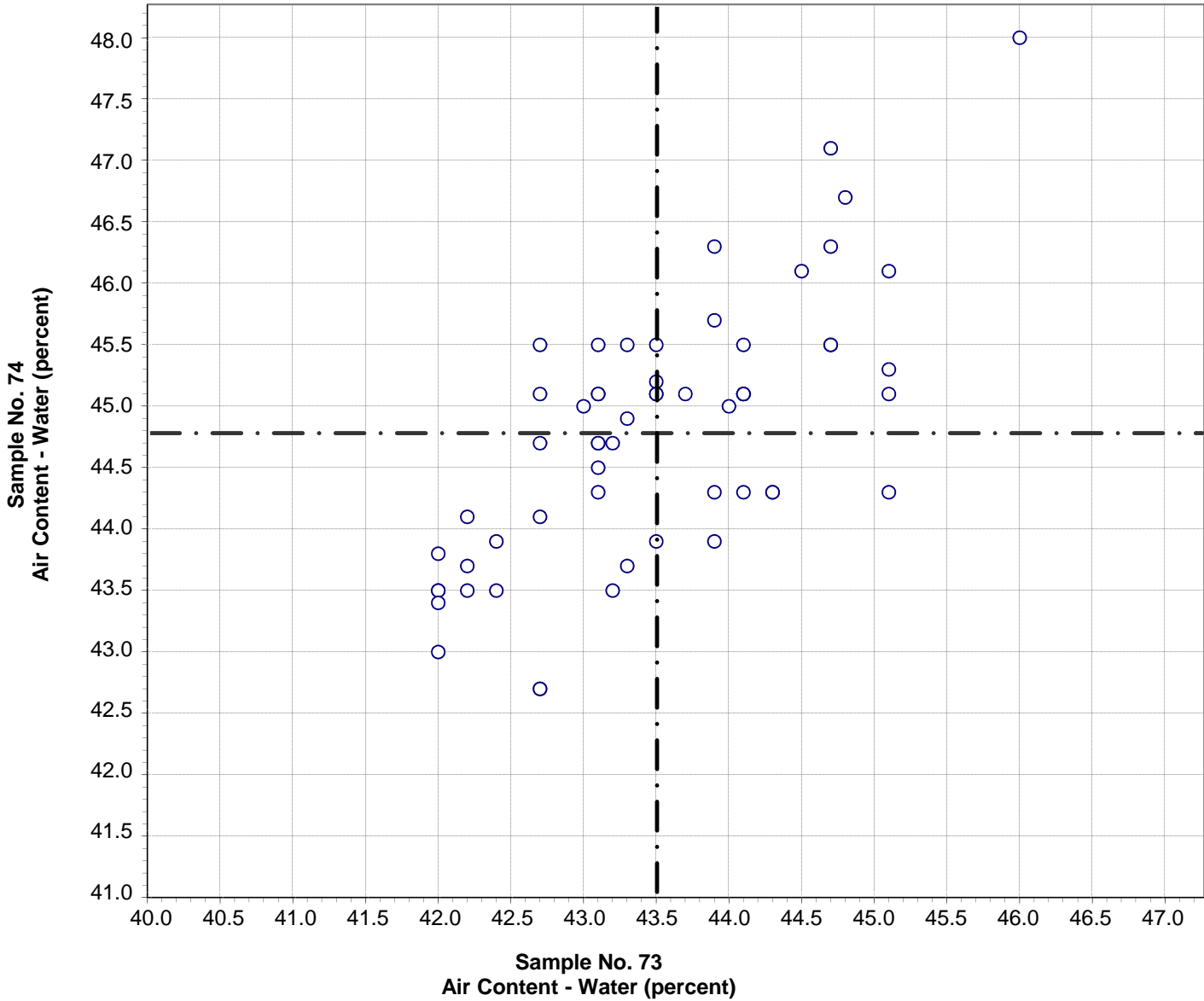


Test No. 170 Air Content 60 Points

Sample No. 73	Ave 17.2	S.D. 1.1	C.V. 6.6
Sample No. 74	Ave 14.9	S.D. 1.0	C.V. 6.5

Labs Eliminated: 52, 103, 354, 493, 3972

**CCRL Proficiency Sample Program  
Air Content - Water  
MASONRY CEMENT Samples No. 73 and No. 74**



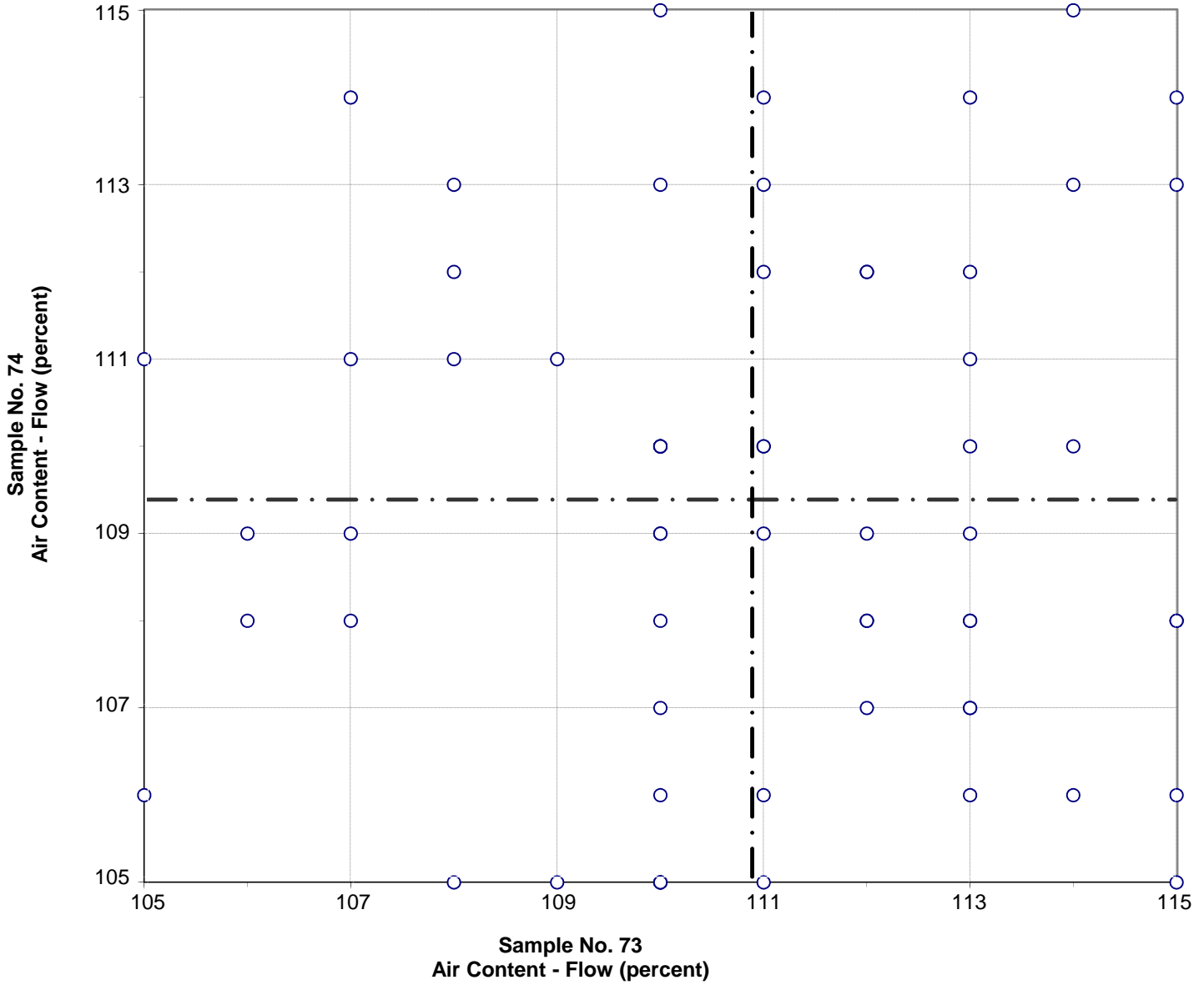
Test No. 180   Air Content - Water   58 Points

Sample No. 73   Ave 43.5   S.D. 1.0   C.V. 2.2

Sample No. 74   Ave 44.8   S.D. 1.1   C.V. 2.4

Labs Eliminated: 103, 142, 178, 493, 3970

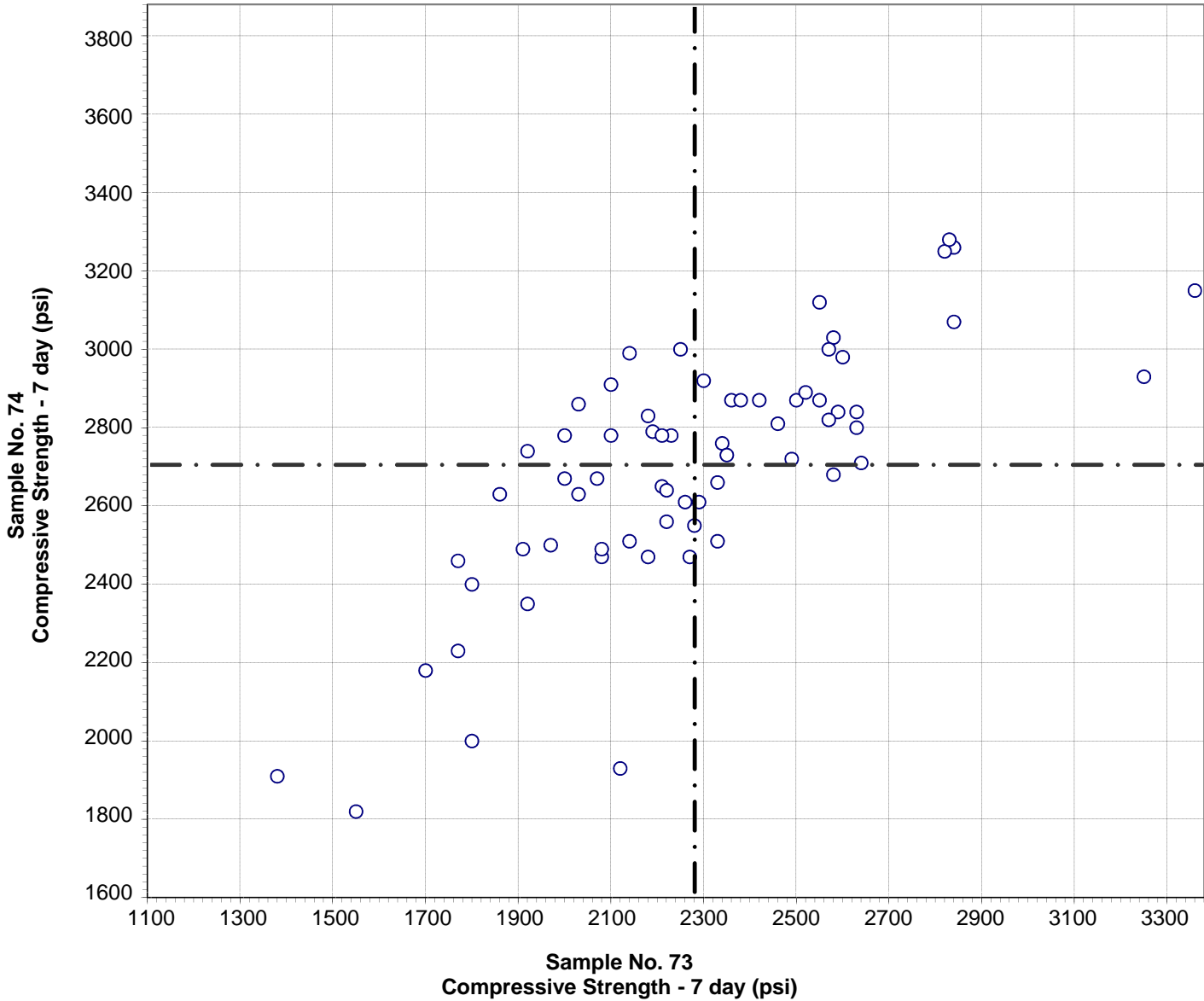
**CCRL Proficiency Sample Program**  
**Air Content - Flow**  
**MASONRY CEMENT Samples No. 73 and No. 74**



Test No. 190 Air Content - Flow 63 Points

Sample No. 73	Ave 111	S.D. 2.6	C.V. 2.4
Sample No. 74	Ave 109	S.D. 2.9	C.V. 2.6

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



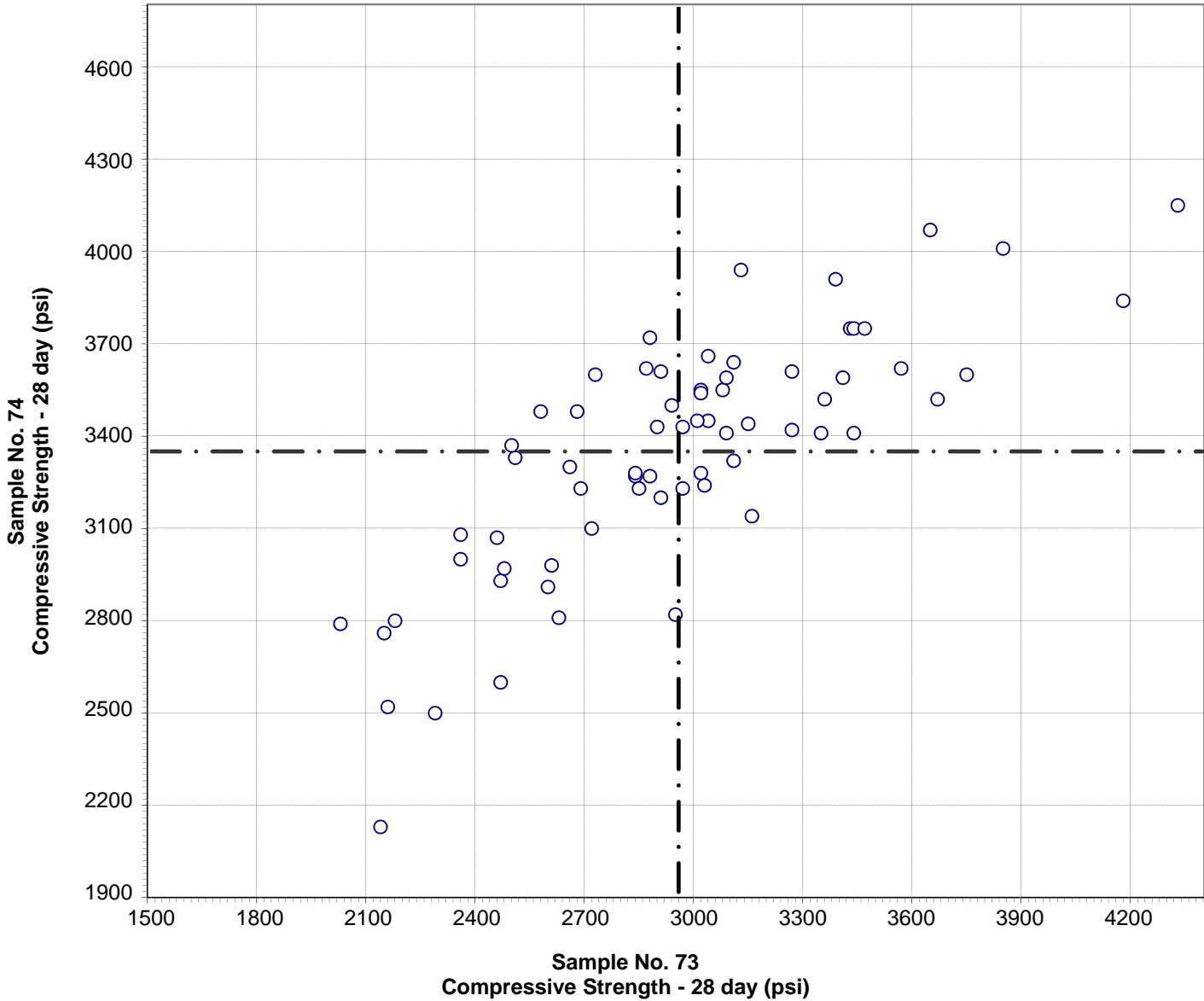
**Test No. 210 Compressive Strength - 7 day 66 Points**

Sample No. 73 Ave 2279 S.D. 363 C.V. 15.9

Sample No. 74 Ave 2701 S.D. 306 C.V. 11.3

Labs Eliminated: 3972

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

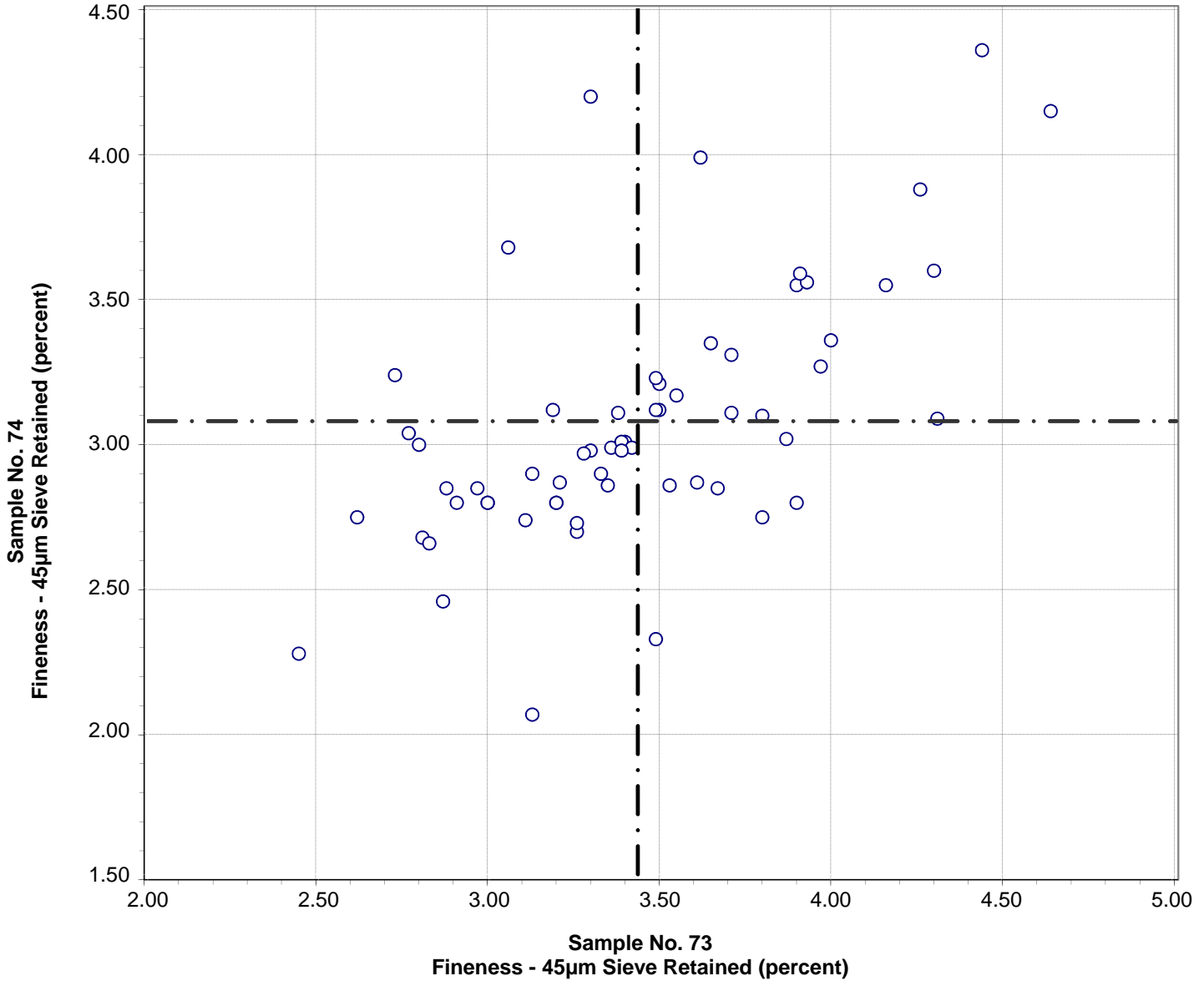


Test No. 211    Compressive Strength - 28 day    68 Points

Sample No. 73	Ave 2957	S.D. 475	C.V. 16
Sample No. 74	Ave 3345	S.D. 391	C.V. 12



**CCRL Proficiency Sample Program  
Fineness - 45µm Sieve Retained  
MASONRY CEMENT Samples No. 73 and No. 74**



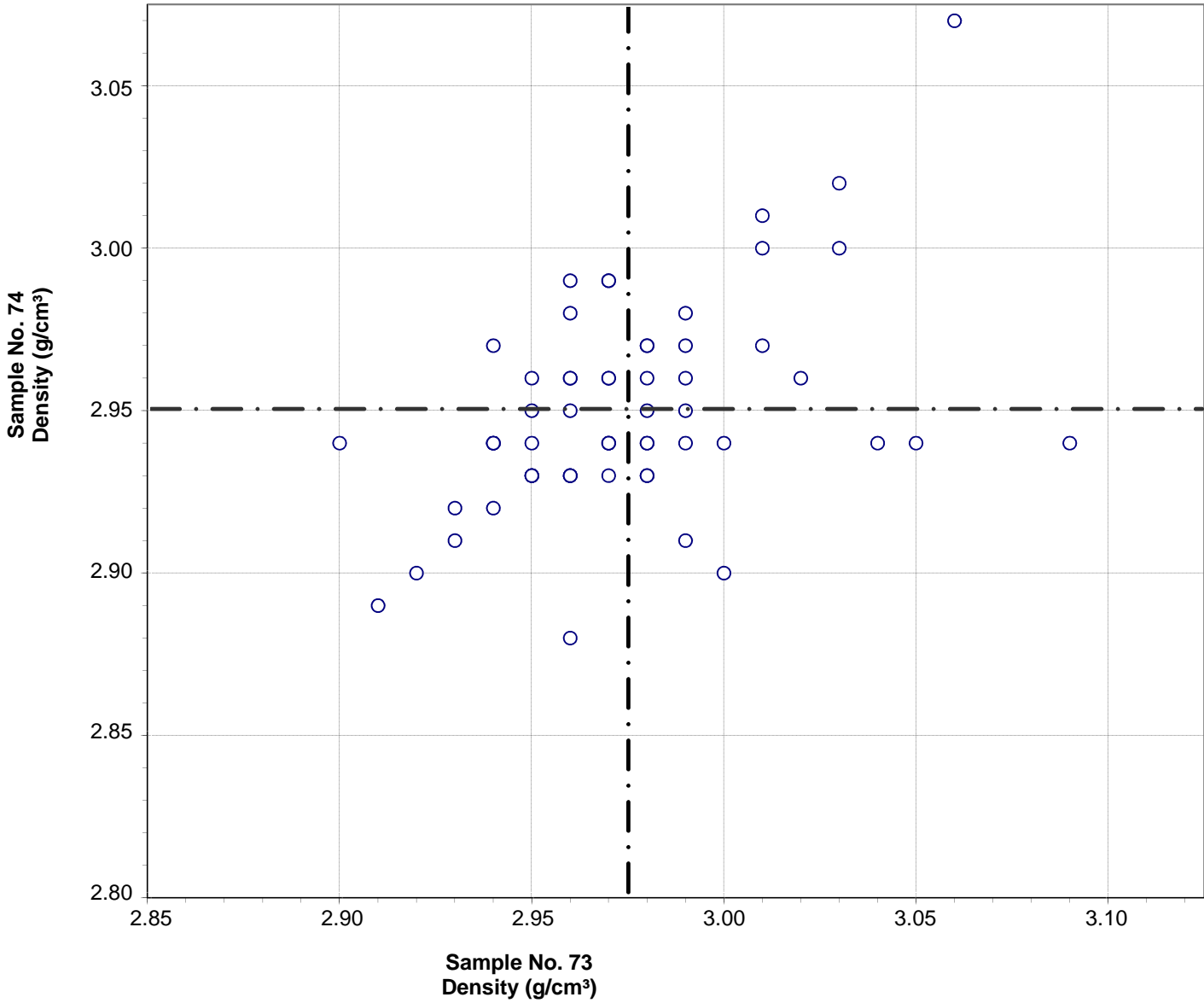
Test No. 281    Fineness - 45µm Sieve Retained    62 Points

Sample No. 73    Ave 3.44    S.D. 0.47    C.V. 13.7

Sample No. 74    Ave 3.08    S.D. 0.44    C.V. 14.3

Labs Eliminated: 125, 148, 181, 3972

**CCRL Proficiency Sample Program**  
**Density**  
**MASONRY CEMENT Samples No. 73 and No. 74**

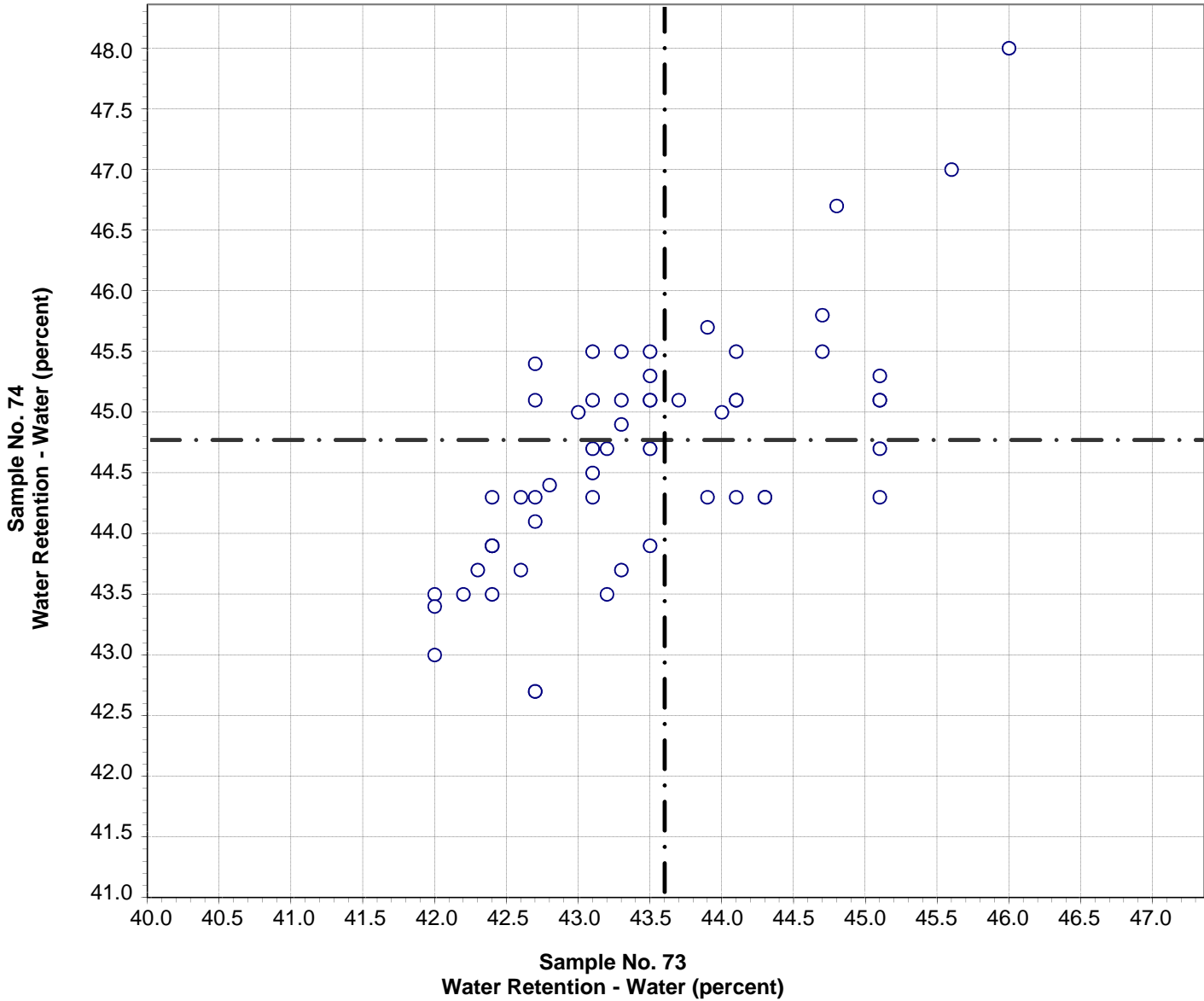


Test No. 310 Density 59 Points

Sample No. 73	Ave 2.97	S.D. 0.04	C.V. 1.2
Sample No. 74	Ave 2.95	S.D. 0.03	C.V. 1.1

Labs Eliminated: 9, 246, 3972

**CCRL Proficiency Sample Program  
Water Retention - Water  
MASONRY CEMENT Samples No. 73 and No. 74**



Test No. 330 Water Retention - Water 57 Points

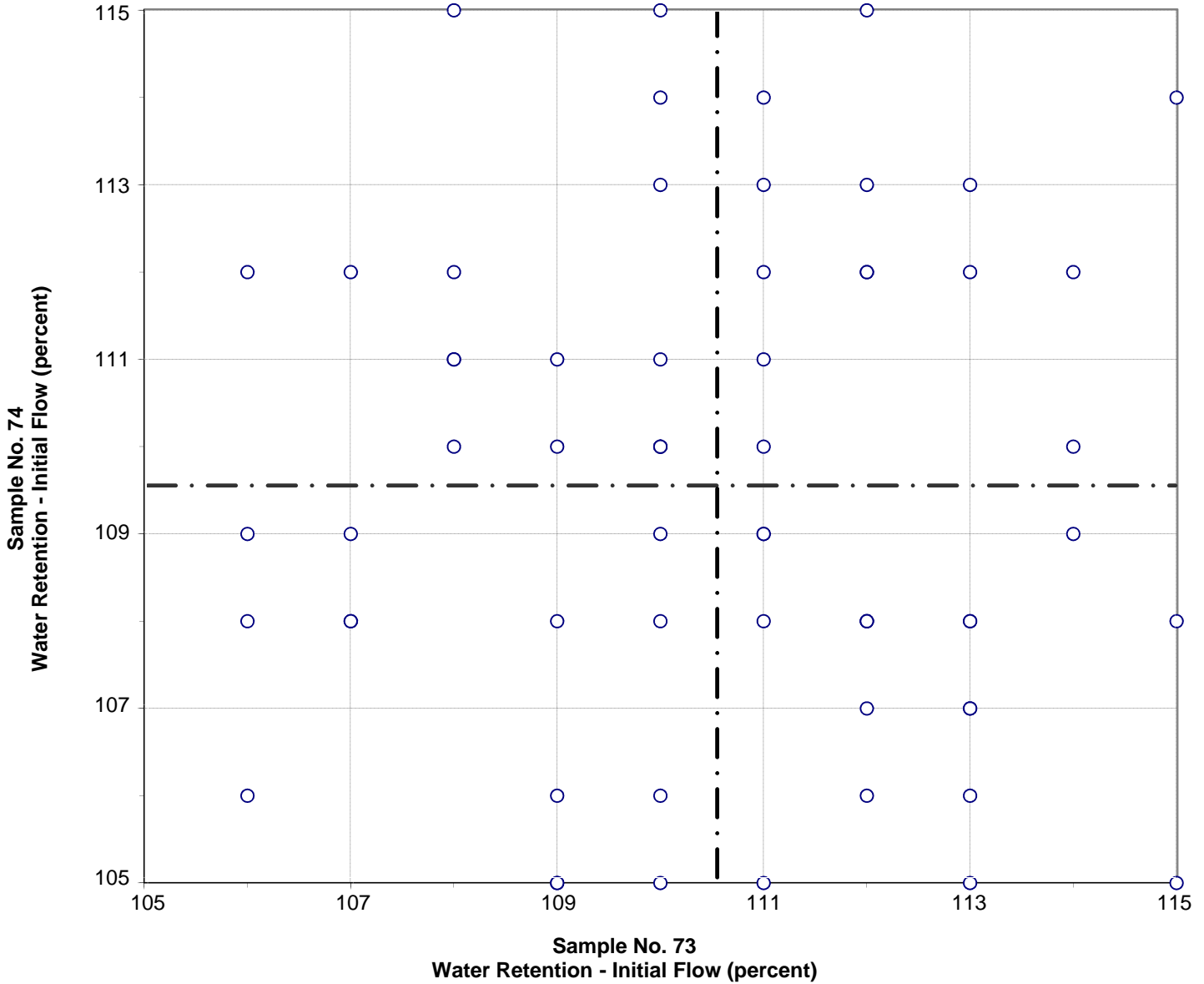
Sample No. 73 Ave 43.6 S.D. 1.2 C.V. 2.7

Sample No. 74 Ave 44.8 S.D. 1.1 C.V. 2.5

Labs Eliminated: 142, 690, 3970

Labs off Diagram: 103, 3352

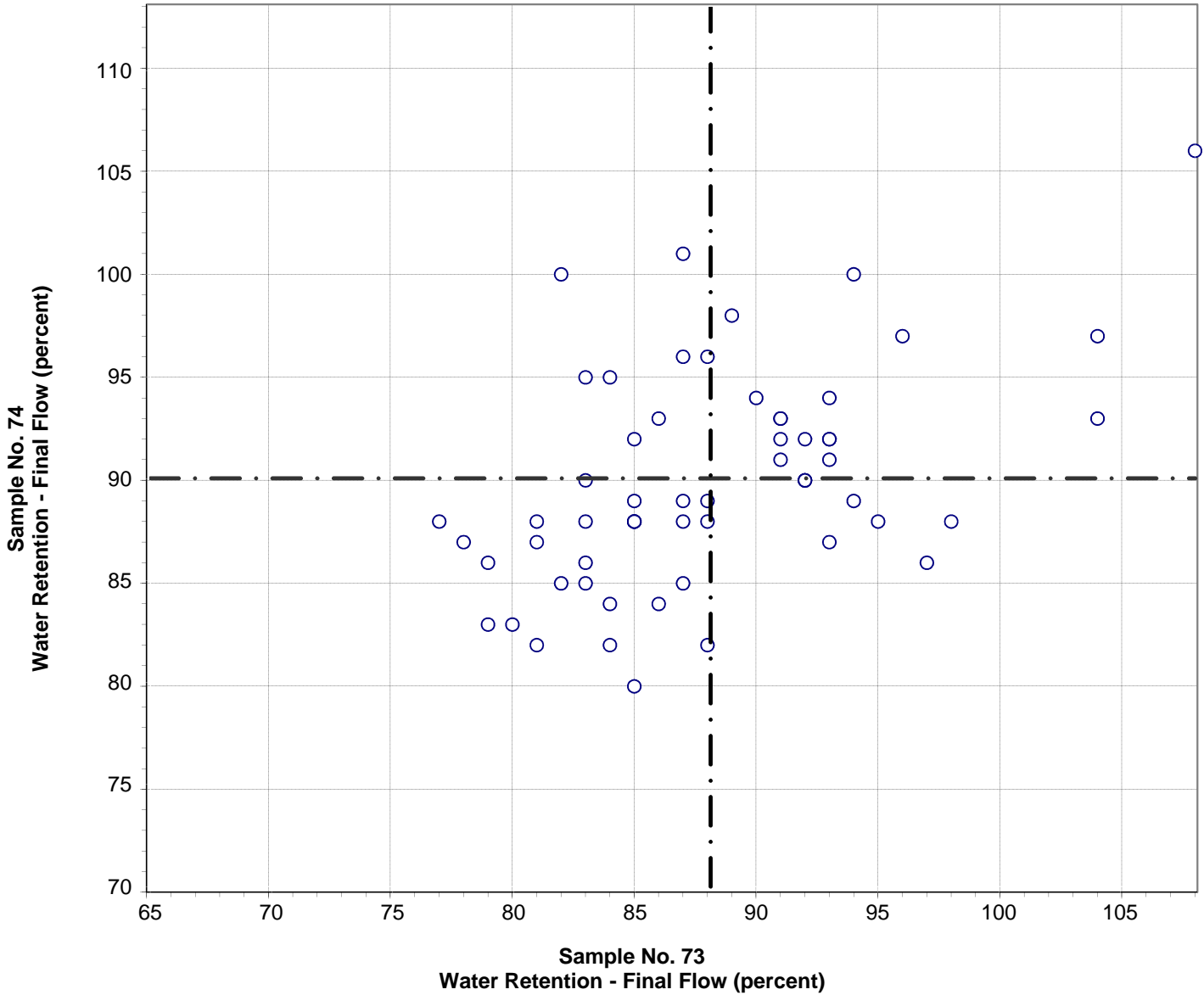
**CCRL Proficiency Sample Program  
Water Retention - Initial Flow  
MASONRY CEMENT Samples No. 73 and No. 74**



Test No. 331 Water Retention - Initial Flow 62 Points

Sample No. 73	Ave 111	S.D. 2.4	C.V. 2.2
Sample No. 74	Ave 110	S.D. 2.8	C.V. 2.6

**CCRL Proficiency Sample Program  
Water Retention - Final Flow  
MASONRY CEMENT Samples No. 73 and No. 74**



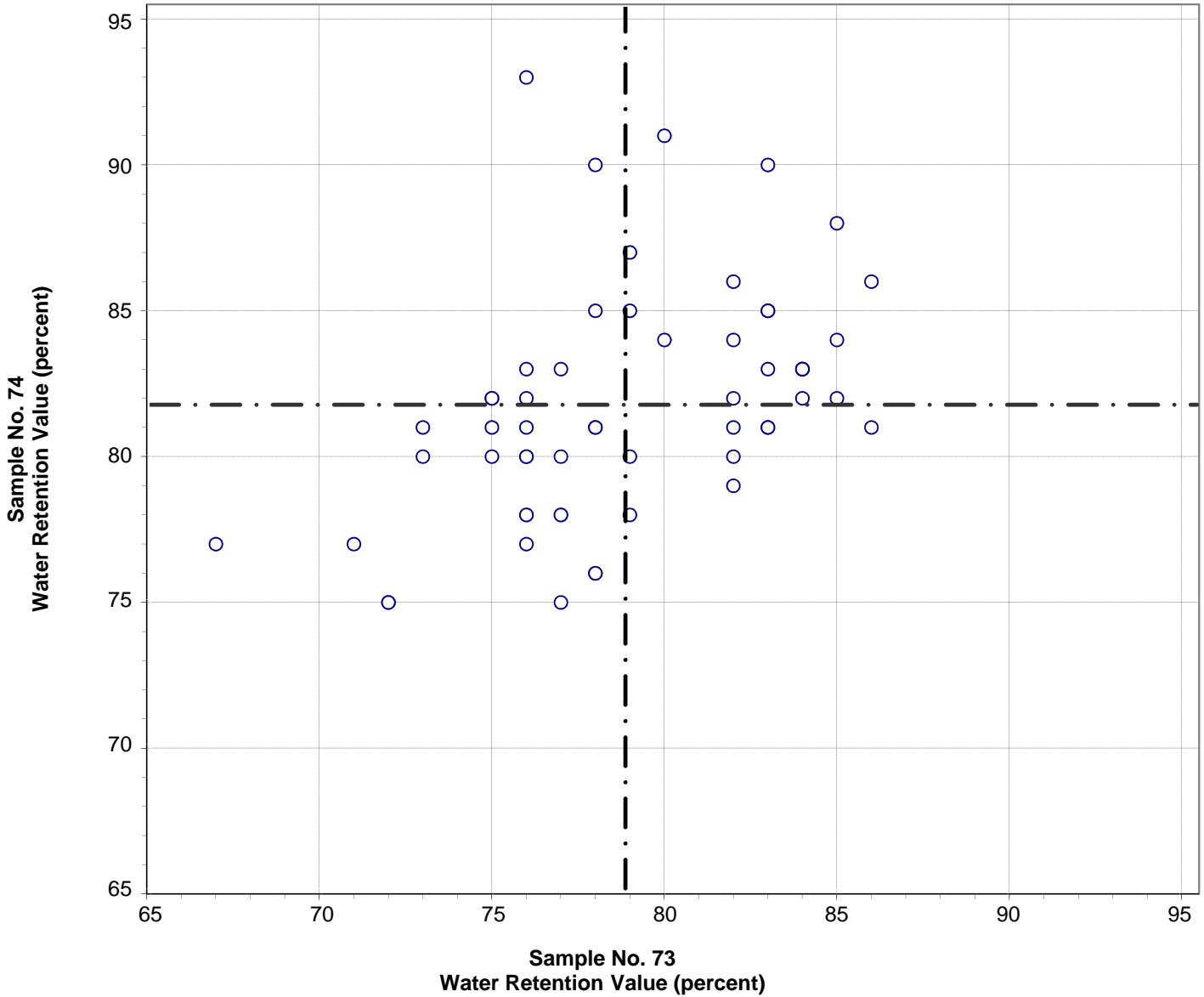
**Test No. 332    Water Retention - Final Flow    60 Points**

Sample No. 73    Ave 88    S.D. 6.4    C.V. 7.3

Sample No. 74    Ave 90    S.D. 5.2    C.V. 5.8

Labs Eliminated: 690

**CCRL Proficiency Sample Program  
Water Retention Value  
MASONRY CEMENT Samples No. 73 and No. 74**



**Test No. 333 Water Retention Value 57 Points**

Sample No. 73 Ave 79 S.D. 4.2 C.V. 5.4

Sample No. 74 Ave 82 S.D. 4.0 C.V. 4.9

Labs Eliminated: 143, 152, 225, 690