

# **CEMENT AND CONCRETE REFERENCE LABORATORY**

## **PROFICIENCY SAMPLE PROGRAM**

### **Final Report**

### **Masonry Cement Proficiency Samples**

### **Number 77 and Number 78**

October 2016



**CCRL**  
Cement and Concrete  
Reference Laboratory

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

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

October 18, 2016

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

**SUBJECT: Final Report on Masonry Cement Proficiency Samples No. 77 and No. 78**

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 2016. Masonry Cement Samples No. 77 and No. 78 were ASTM C91 Type N 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 2017.

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. 77 and No. 78**

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 2016. 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 the types of error, systematic and random, contribute to ratings that are low. Systematic error, which is indicated by low

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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.

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. 77 and No. 78

Final Report – October 18, 2016

SUMMARY OF RESULTS

Sample No.77

Sample No. 78

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Normal Consistency - Water (percent)</b>							
	69	22.8	2.84	12.4	27.7	2.29	8.3
	*68	22.4	0.36	1.6	27.4	0.59	2.2
	* Labs Eliminated - 9						
<b>Gillmore Time of Set - Initial (minute)</b>							
	69	171	22	12.8	233	37	16.0
	No Labs Eliminated for This Test						
<b>Gillmore Time of Set - Final (minute)</b>							
	68	298	42	14.1	374	54	14.5
	No Labs Eliminated for This Test						
<b>Autoclave Expansion (percent)</b>							
	68	0.05	0.02	53.8	0.12	0.07	55.4
	*62	0.05	0.02	32.6	0.14	0.04	27.1
	* Labs Eliminated - 143, 157, 407, 493, 698, 2254						
<b>Air Content (percent)</b>							
	68	18.8	1.8	9.8	17.4	1.2	7.2
	*63	19.1	1.0	5.2	17.5	1.1	6.2
	* Labs Eliminated - 93, 142, 407, 474, 2116						
<b>Air Content - Water (percent)</b>							
	67	45.9	3.8	8.4	46.4	3.9	8.4
	*66	45.5	1.2	2.5	46.0	1.1	2.3
	* Labs Eliminated - 551						
<b>Air Content - Flow (percent)</b>							
	67	110	2.9	2.7	110	2.3	2.1
	No Labs Eliminated for This Test						

**CCRL PROFICIENCY SAMPLE PROGRAM**  
Masonry Cement Proficiency Samples No. 77 and No. 78

Final Report – October 18, 2016

SUMMARY OF RESULTS

Sample No.77

Sample No. 78

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Compressive Strength - 7 day (psi)</b>							
	70	1326	178	13.4	1443	256	17.7
	*69	1313	143	10.9	1433	243	17.0
* Labs Eliminated - 823							
<b>Compressive Strength - 28 day (psi)</b>							
	69	1724	391	23	2041	429	21
	*68	1684	205	12	2004	308	15
* Labs Eliminated - 823							
<b>Fineness - 45µm Sieve Retained (percent)</b>							
	69	11.88	2.68	22.6	3.44	2.52	73.3
	*59	12.39	0.93	7.5	3.05	0.35	11.4
* Labs Eliminated - 9, 93, 143, 176, 246, 255, 284, 551, 690, 2938							
<b>Density (g/cm<sup>3</sup>)</b>							
	66	2.91	0.10	3.5	2.92	0.10	3.3
	*63	2.92	0.04	1.3	2.91	0.05	1.6
* Labs Eliminated - 176, 354, 698							
<b>Water Retention - Water (percent)</b>							
	66	46.0	3.9	8.4	46.4	3.9	8.5
	*65	45.6	1.2	2.6	46.0	1.1	2.3
* Labs Eliminated - 551							
<b>Water Retention - Initial Flow (percent)</b>							
	67	110	2.7	2.5	110	2.4	2.2
No Labs Eliminated for This Test							
<b>Water Retention - Final Flow (percent)</b>							
	67	88	6.4	7.3	84	6.7	8.0
No Labs Eliminated for This Test							

**CCRL PROFICIENCY SAMPLE PROGRAM**  
Masonry Cement Proficiency Samples No. 77 and No. 78

Final Report – October 18, 2016

SUMMARY OF RESULTS

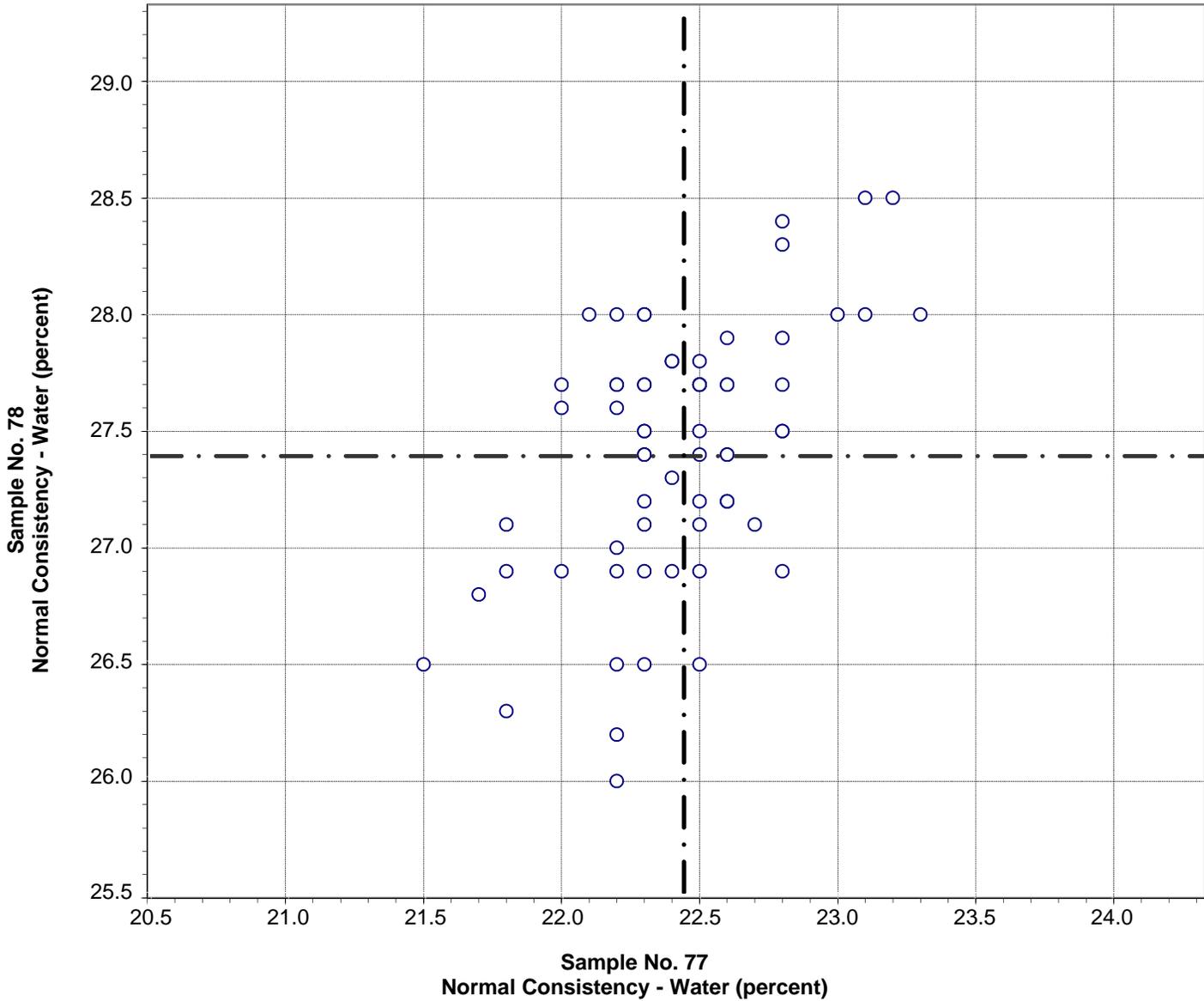
Sample No.77

Sample No. 78

Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
<b>Water Retention Value (percent)</b>	68	80	5.1	6.4	76	6.0	7.8

No Labs Eliminated for This Test

**CCRL Proficiency Sample Program**  
**Normal Consistency - Water**  
**MASONRY CEMENT Samples No. 77 and No. 78**



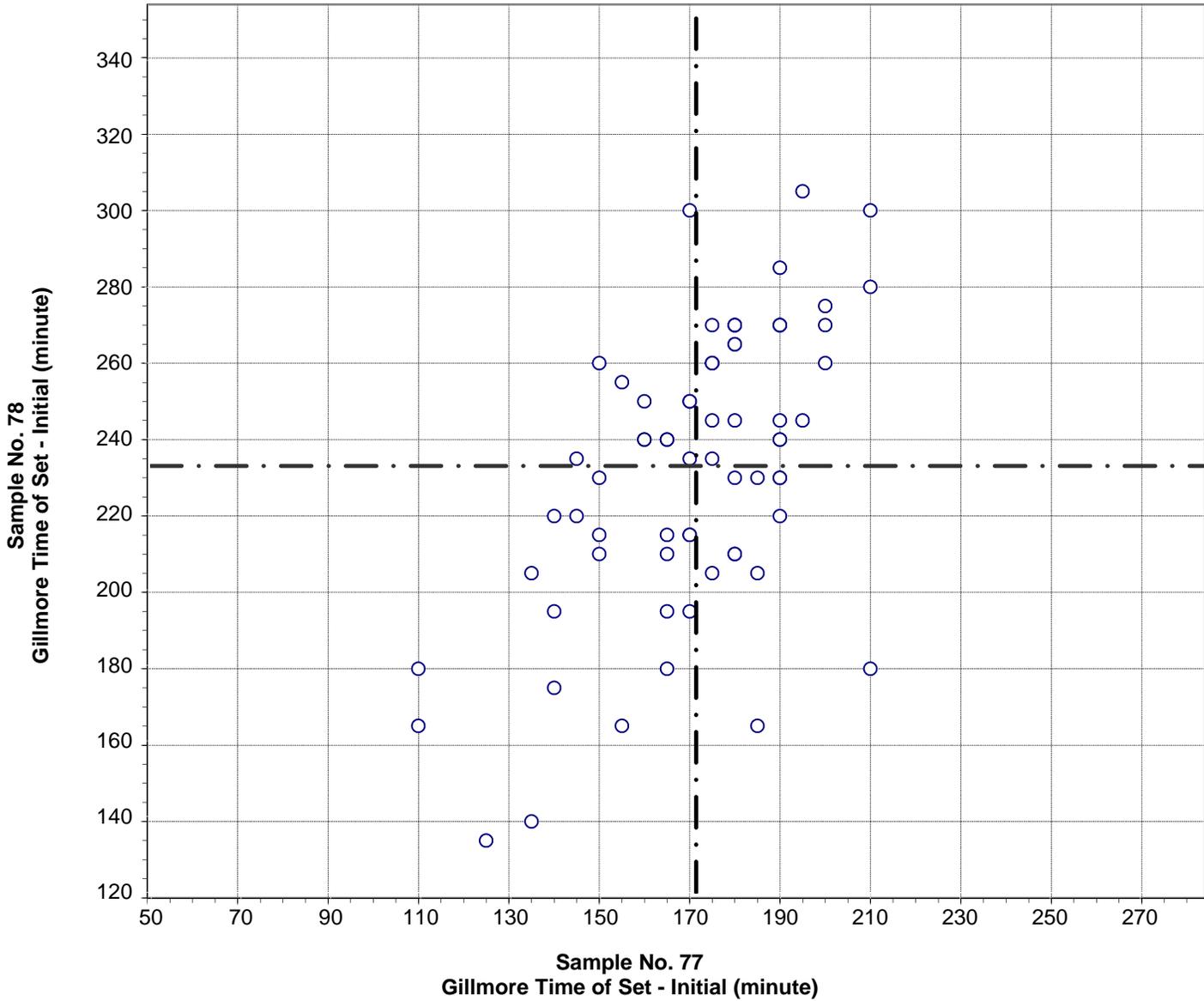
Test No. 110   Normal Consistency - Water   67 Points

Sample No. 77	Ave 22.4	S.D. 0.36	C.V. 1.6
Sample No. 78	Ave 27.4	S.D. 0.59	C.V. 2.2

Labs Eliminated: 9

Labs off Diagram: 142

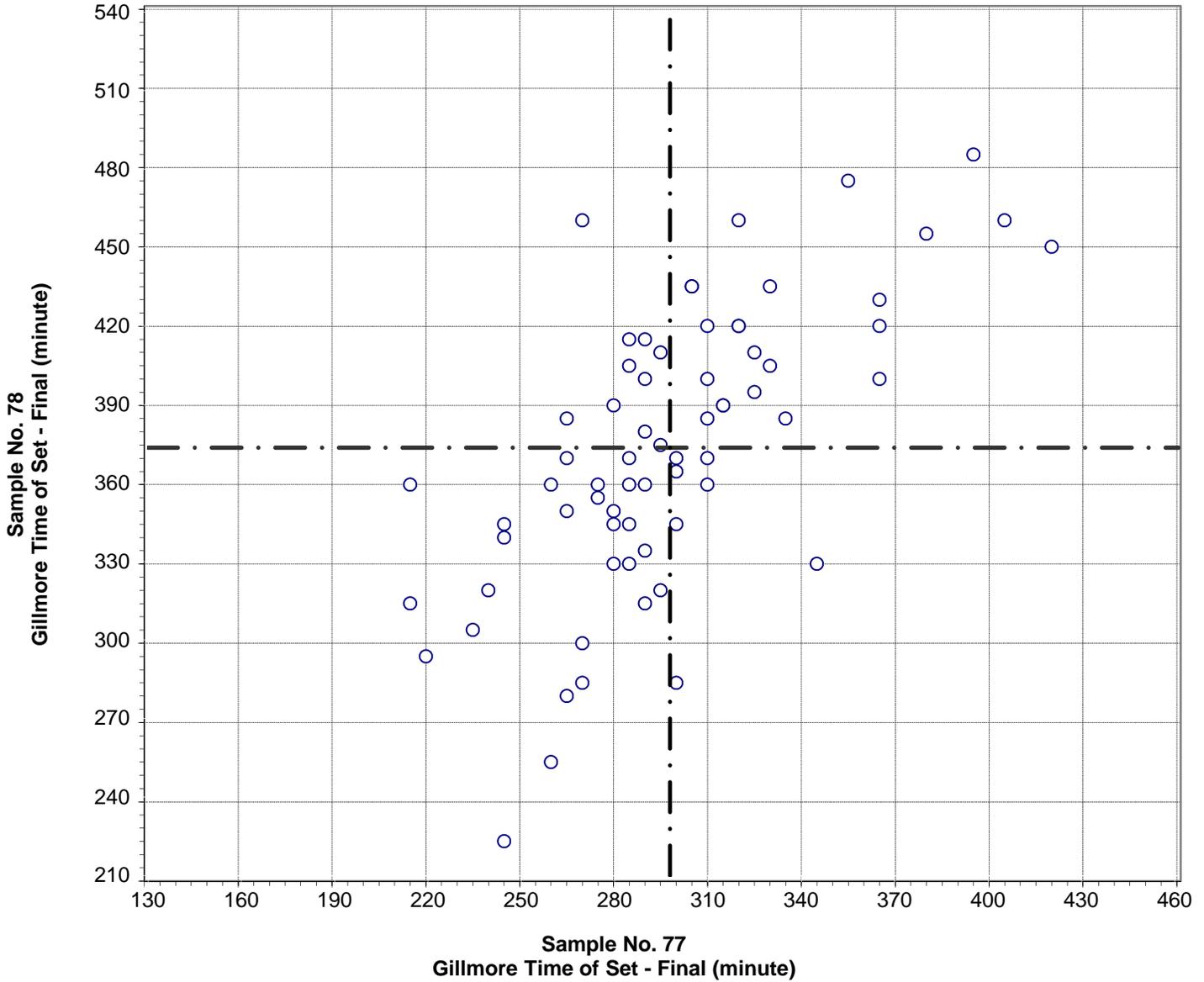
**CCRL Proficiency Sample Program**  
**Gillmore Time of Set - Initial**  
**MASONRY CEMENT Samples No. 77 and No. 78**



Test No. 130 Gillmore Time of Set - Initial 69 Points

Sample No. 77	Ave 171	S.D. 22	C.V. 12.8
Sample No. 78	Ave 233	S.D. 37	C.V. 16.0

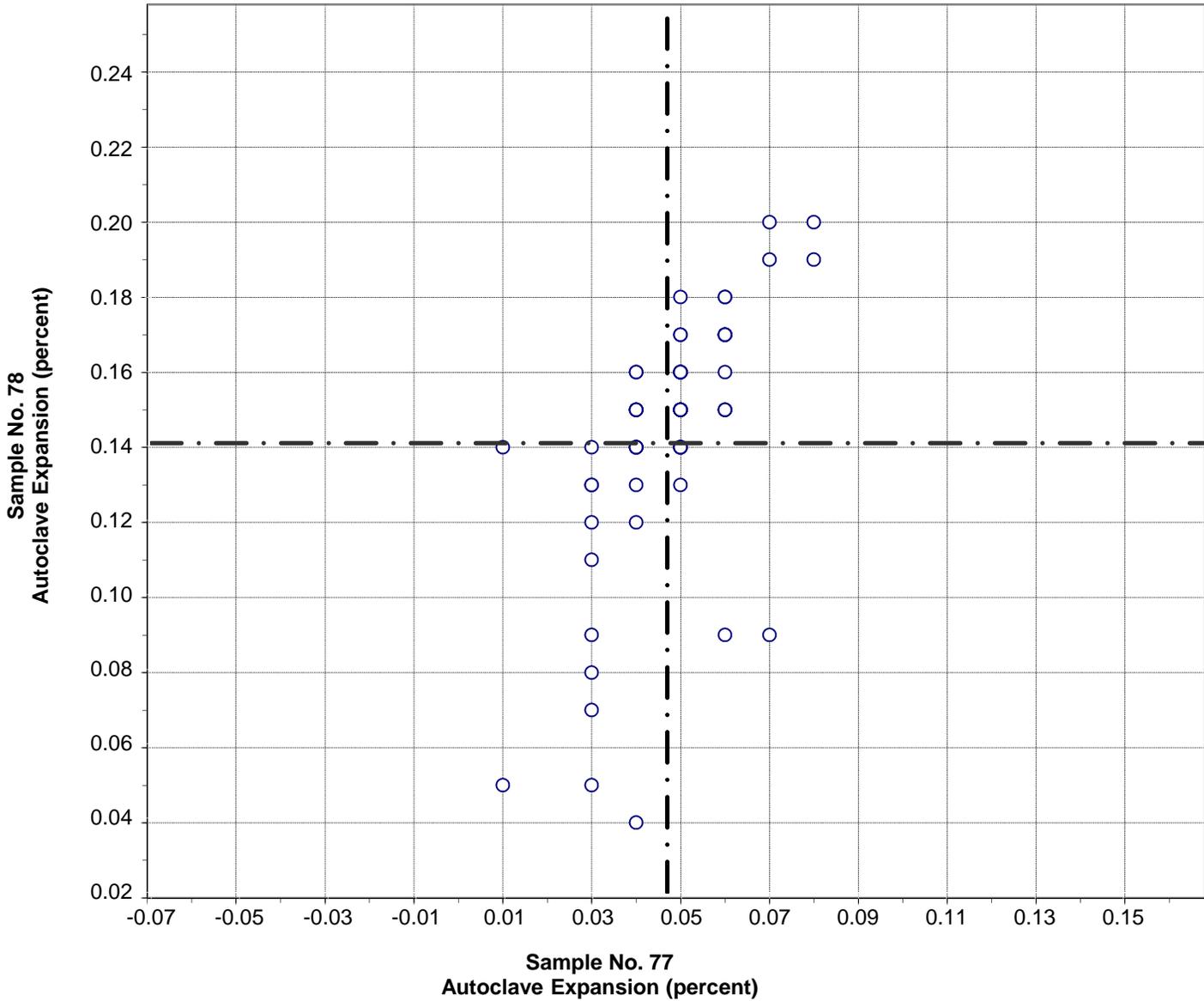
**CCRL Proficiency Sample Program  
Gillmore Time of Set - Final  
MASONRY CEMENT Samples No. 77 and No. 78**



Test No. 140 Gillmore Time of Set - Final 68 Points

Sample No. 77	Ave 298	S.D. 42	C.V. 14.1
Sample No. 78	Ave 374	S.D. 54	C.V. 14.5

**CCRL Proficiency Sample Program  
Autoclave Expansion  
MASONRY CEMENT Samples No. 77 and No. 78**



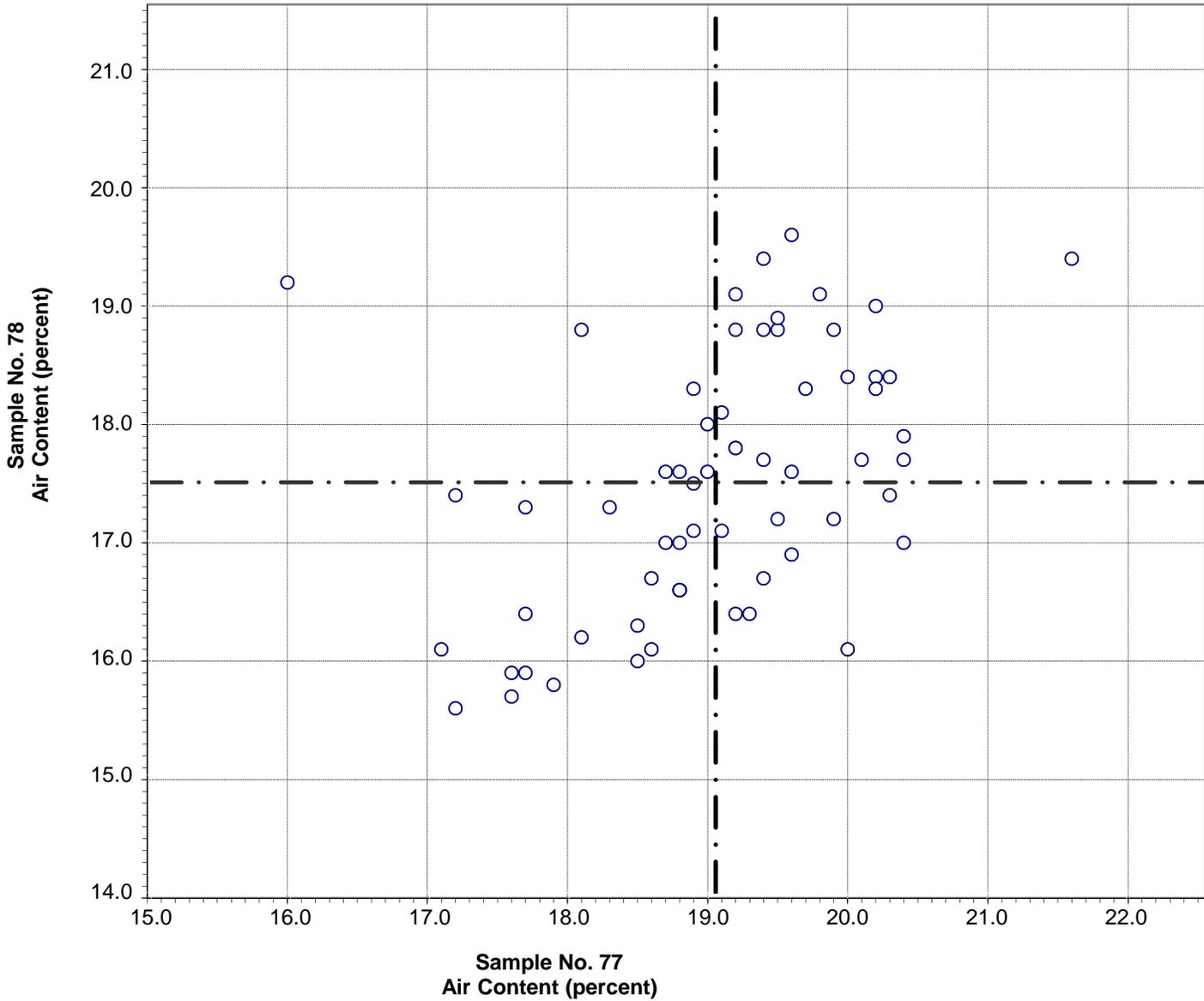
Test No. 160 Autoclave Expansion 61 Points

Sample No. 77	Ave 0.05	S.D. 0.02	C.V. 32.6
Sample No. 78	Ave 0.14	S.D. 0.04	C.V. 27.1

Labs Eliminated: 143, 157, 407, 493, 698, 2254

Labs off Diagram: 162

**CCRL Proficiency Sample Program  
Air Content  
MASONRY CEMENT Samples No. 77 and No. 78**

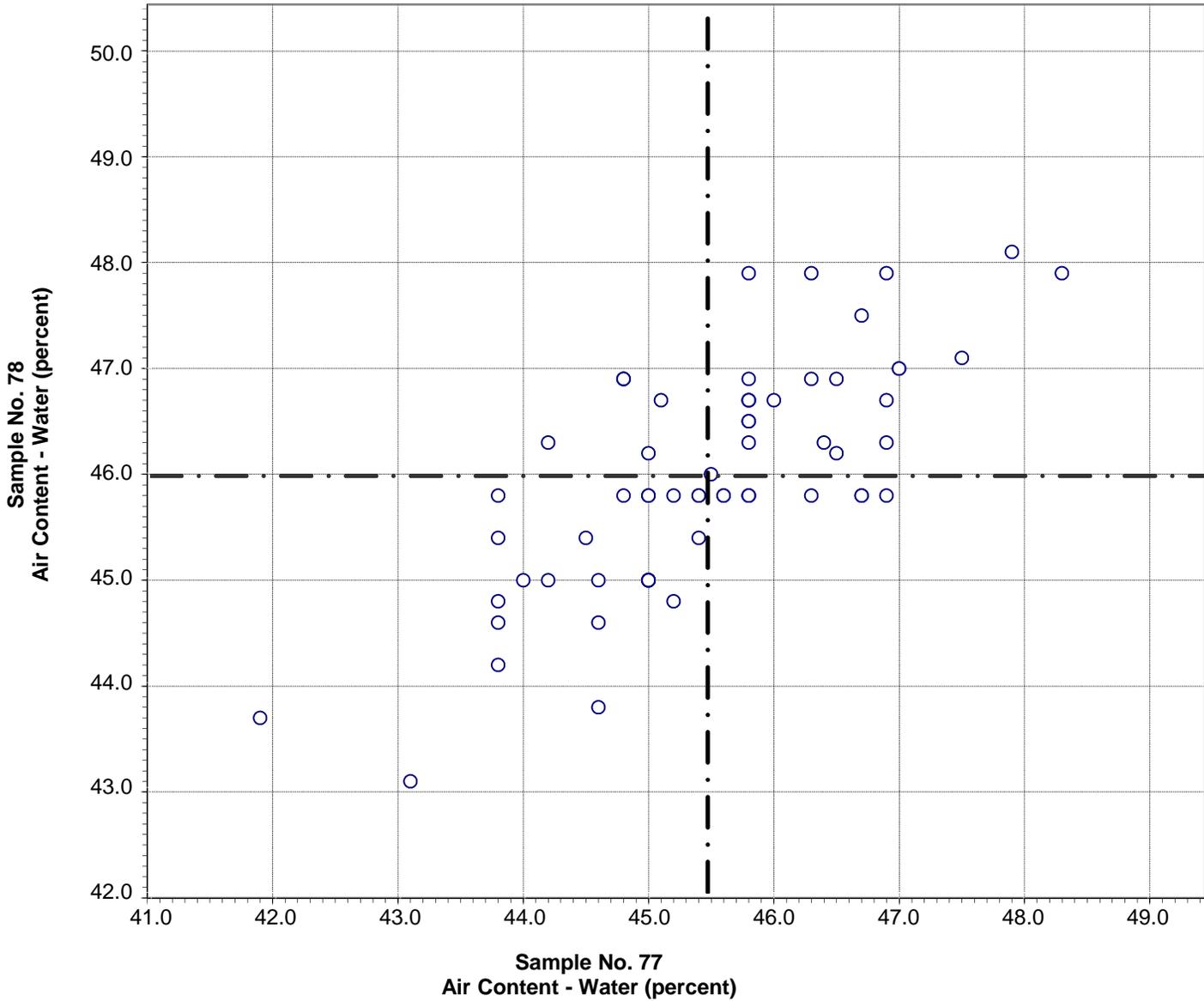


Test No. 170 Air Content 63 Points

Sample No. 77	Ave 19.1	S.D. 1.0	C.V. 5.2
Sample No. 78	Ave 17.5	S.D. 1.1	C.V. 6.2

Labs Eliminated: 93, 142, 407, 474, 2116

**CCRL Proficiency Sample Program**  
**Air Content - Water**  
**MASONRY CEMENT Samples No. 77 and No. 78**

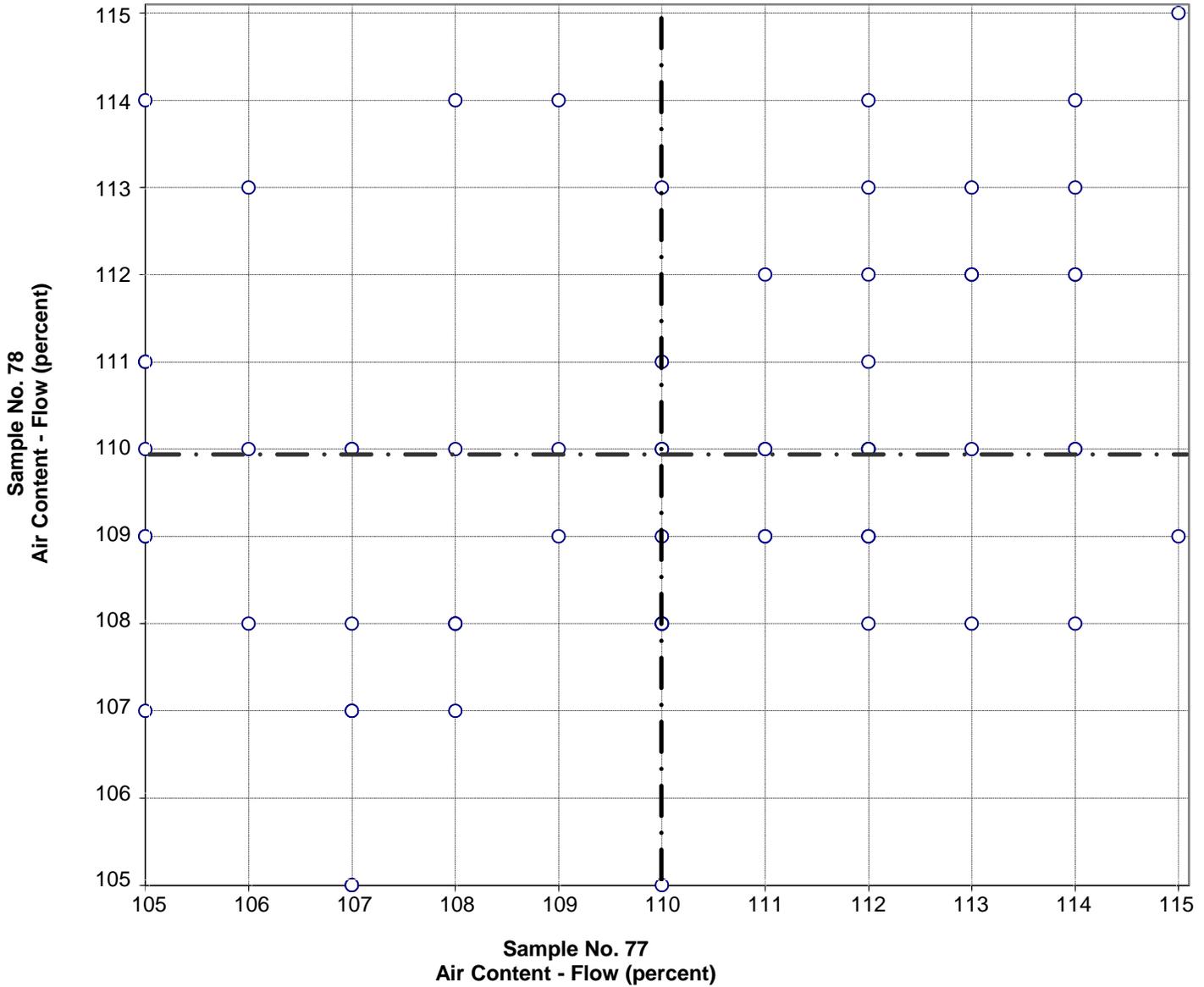


Test No. 180   Air Content - Water   66 Points

Sample No. 77	Ave 45.5	S.D. 1.2	C.V. 2.5
Sample No. 78	Ave 46.0	S.D. 1.1	C.V. 2.3

Labs Eliminated: 551

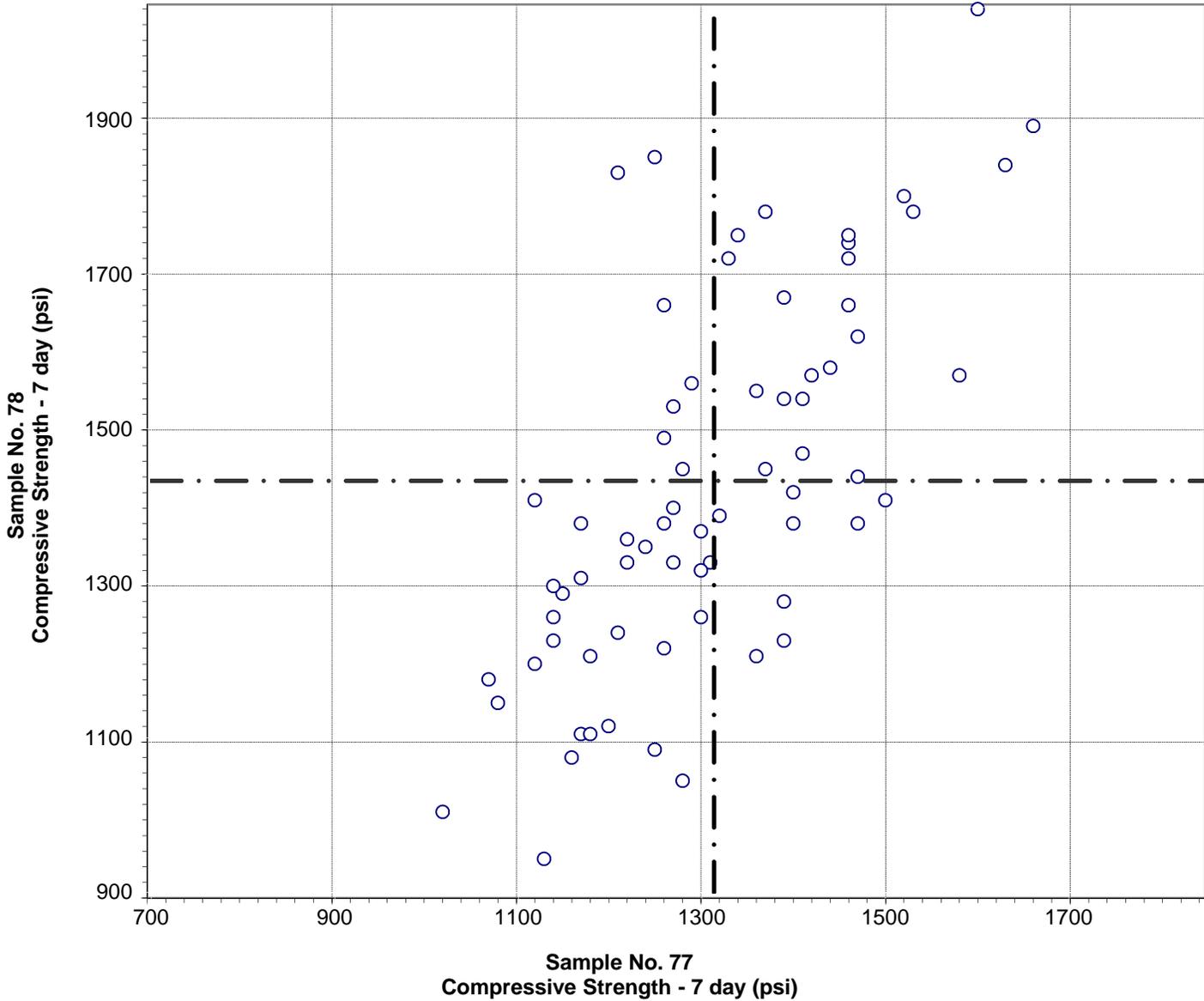
**CCRL Proficiency Sample Program**  
**Air Content - Flow**  
**MASONRY CEMENT Samples No. 77 and No. 78**



Test No. 190 Air Content - Flow 67 Points

Sample No. 77	Ave 110	S.D. 2.9	C.V. 2.7
Sample No. 78	Ave 110	S.D. 2.3	C.V. 2.1

**CCRL Proficiency Sample Program  
Compressive Strength - 7 day  
MASONRY CEMENT Samples No. 77 and No. 78**

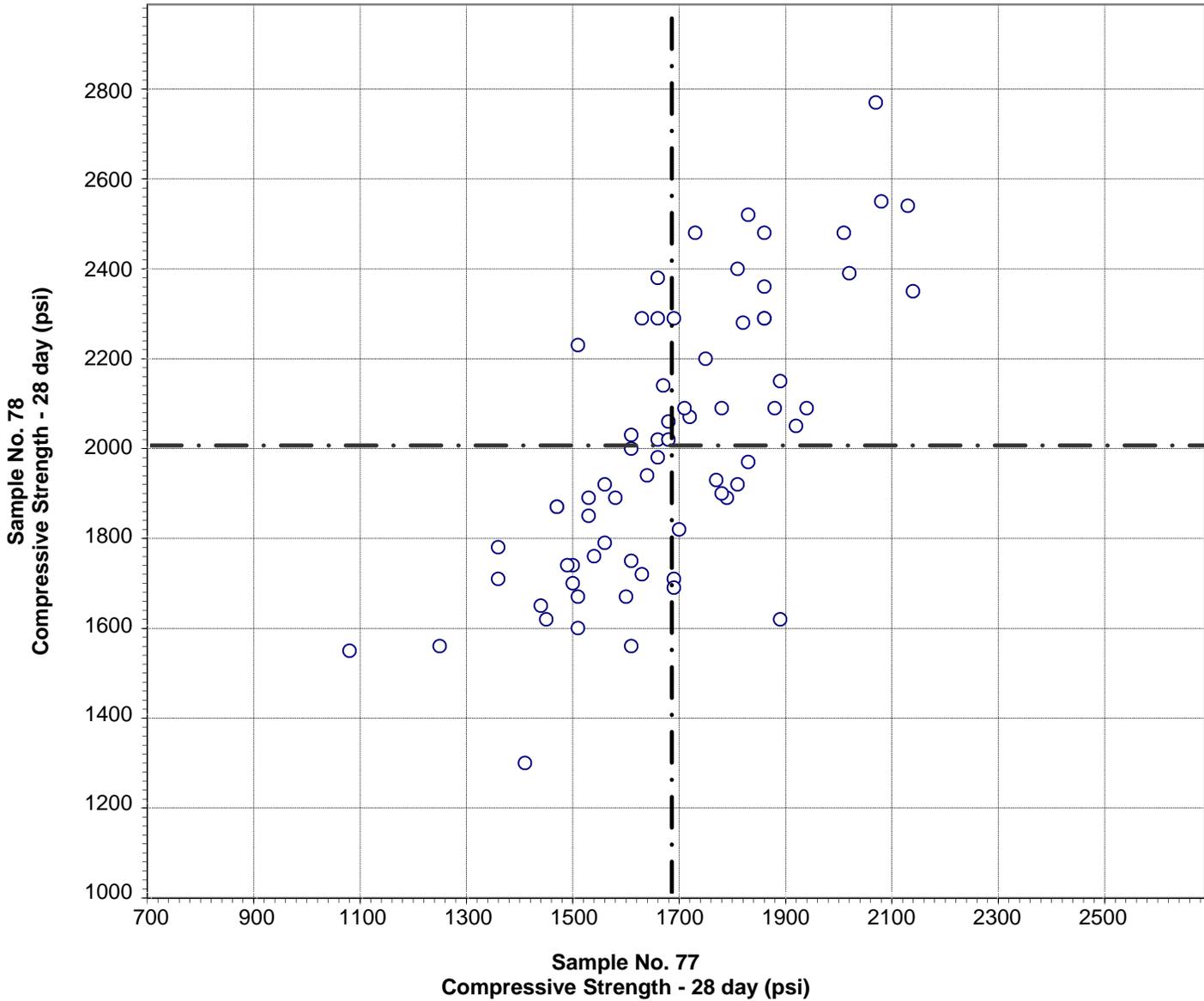


**Test No. 210 Compressive Strength - 7 day 69 Points**

Sample No. 77	Ave 1313	S.D. 143	C.V. 10.9
Sample No. 78	Ave 1433	S.D. 243	C.V. 17.0

Labs Eliminated: 823

**CCRL Proficiency Sample Program  
Compressive Strength - 28 day  
MASONRY CEMENT Samples No. 77 and No. 78**

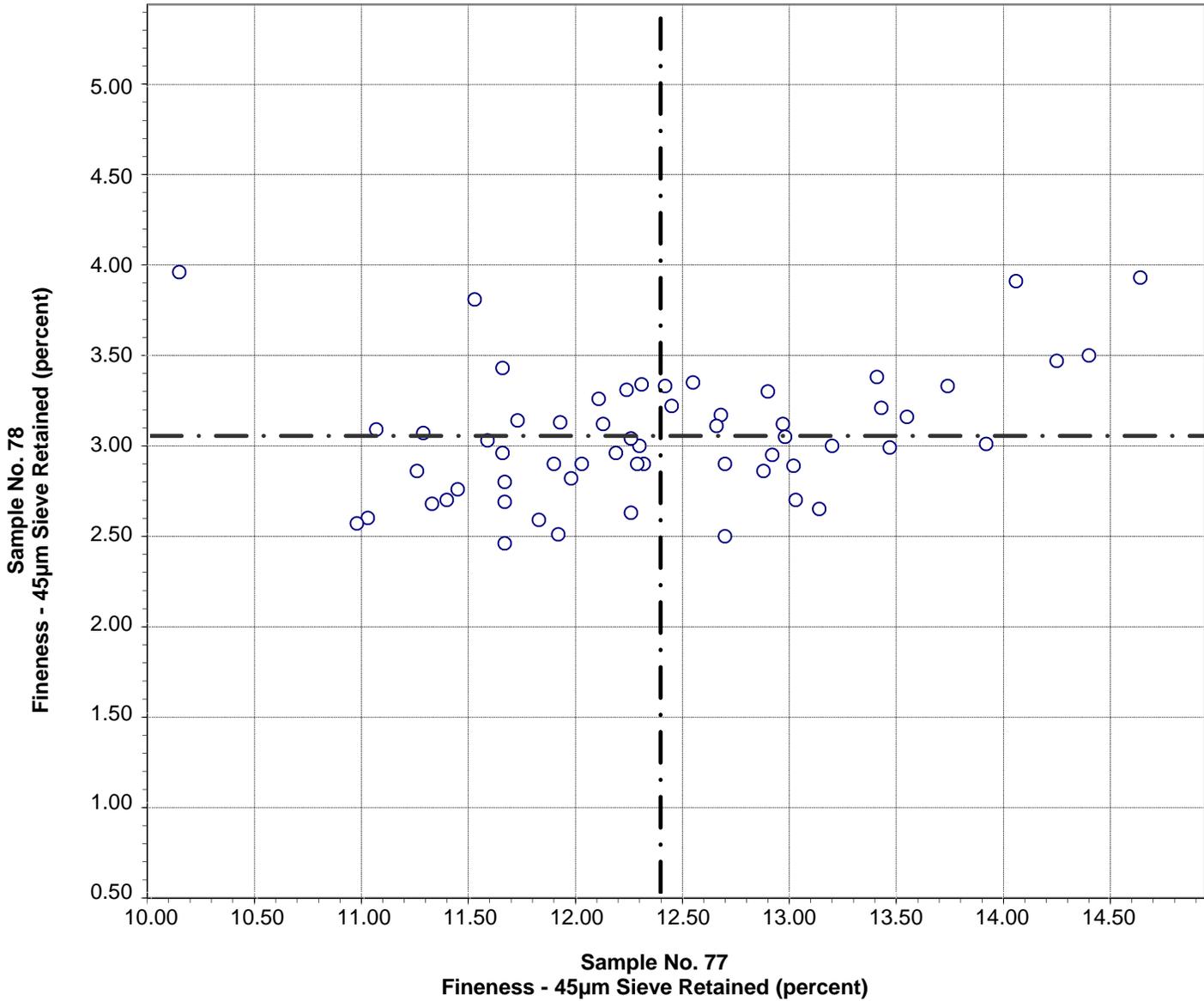


Test No. 211    Compressive Strength - 28 day    68 Points

Sample No. 77	Ave 1684	S.D. 205	C.V. 12
Sample No. 78	Ave 2004	S.D. 308	C.V. 15

Labs Eliminated: 823

**CCRL Proficiency Sample Program  
Fineness - 45µm Sieve Retained  
MASONRY CEMENT Samples No. 77 and No. 78**



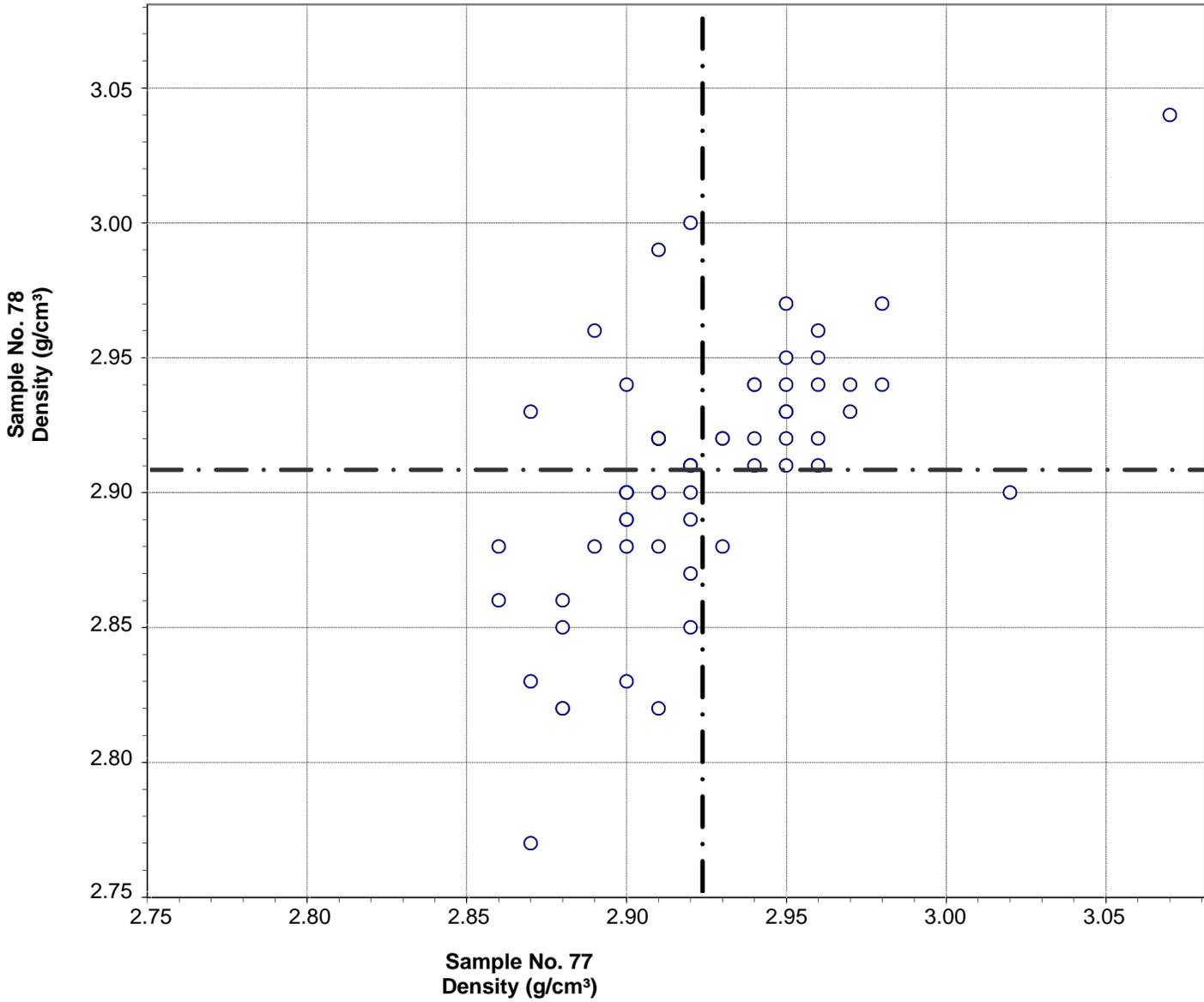
Test No. 281    Fineness - 45µm Sieve Retained    59 Points

Sample No. 77    Ave 12.39    S.D. 0.93    C.V. 7.5

Sample No. 78    Ave 3.05    S.D. 0.35    C.V. 11.4

Labs Eliminated: 9, 93, 143, 176, 246, 255, 284, 551, 690, 2938

**CCRL Proficiency Sample Program**  
**Density**  
**MASONRY CEMENT Samples No. 77 and No. 78**

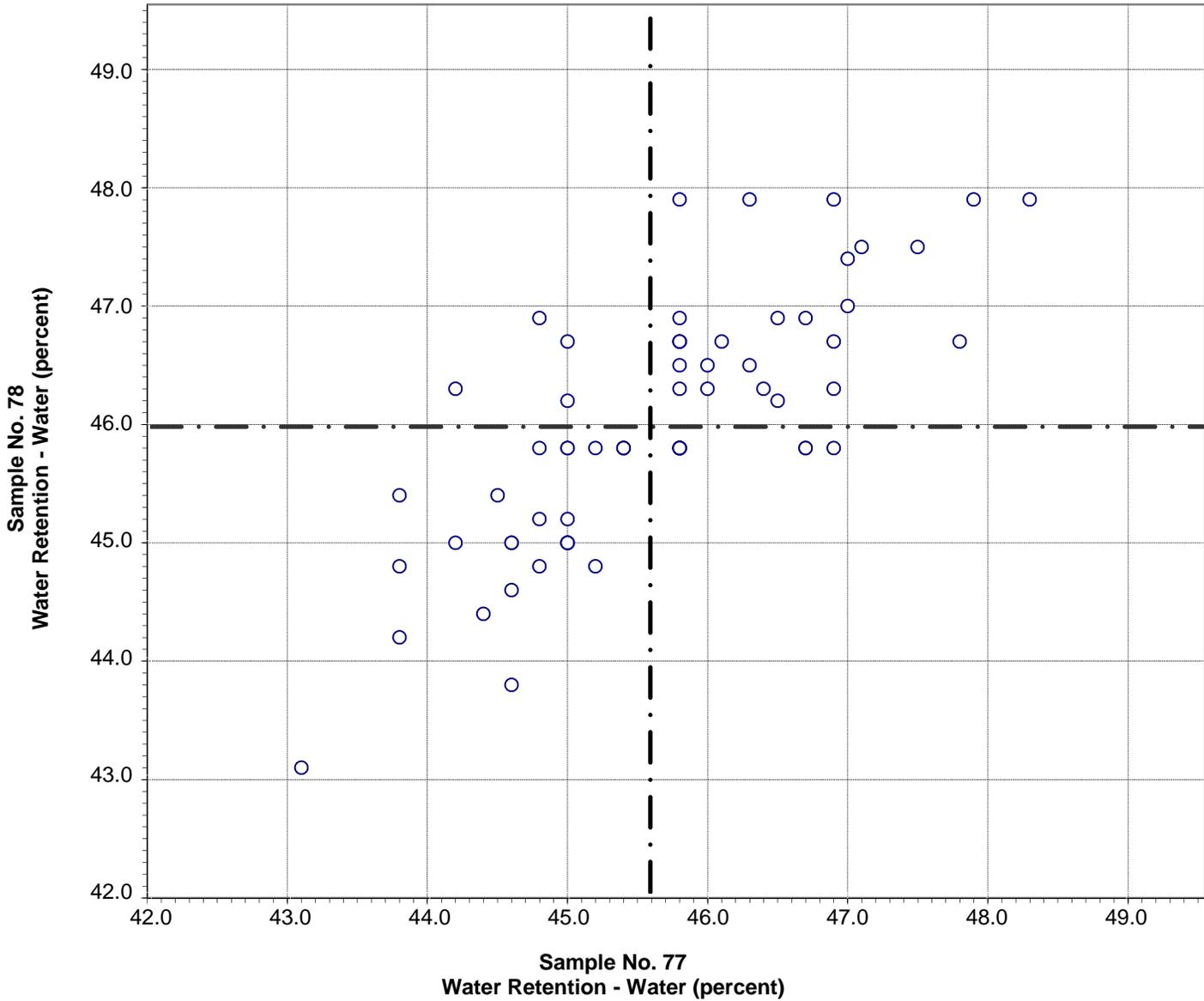


Test No. 310 Density 63 Points

Sample No. 77	Ave 2.92	S.D. 0.04	C.V. 1.3
Sample No. 78	Ave 2.91	S.D. 0.05	C.V. 1.6

Labs Eliminated: 176, 354, 698

**CCRL Proficiency Sample Program**  
**Water Retention - Water**  
**MASONRY CEMENT Samples No. 77 and No. 78**



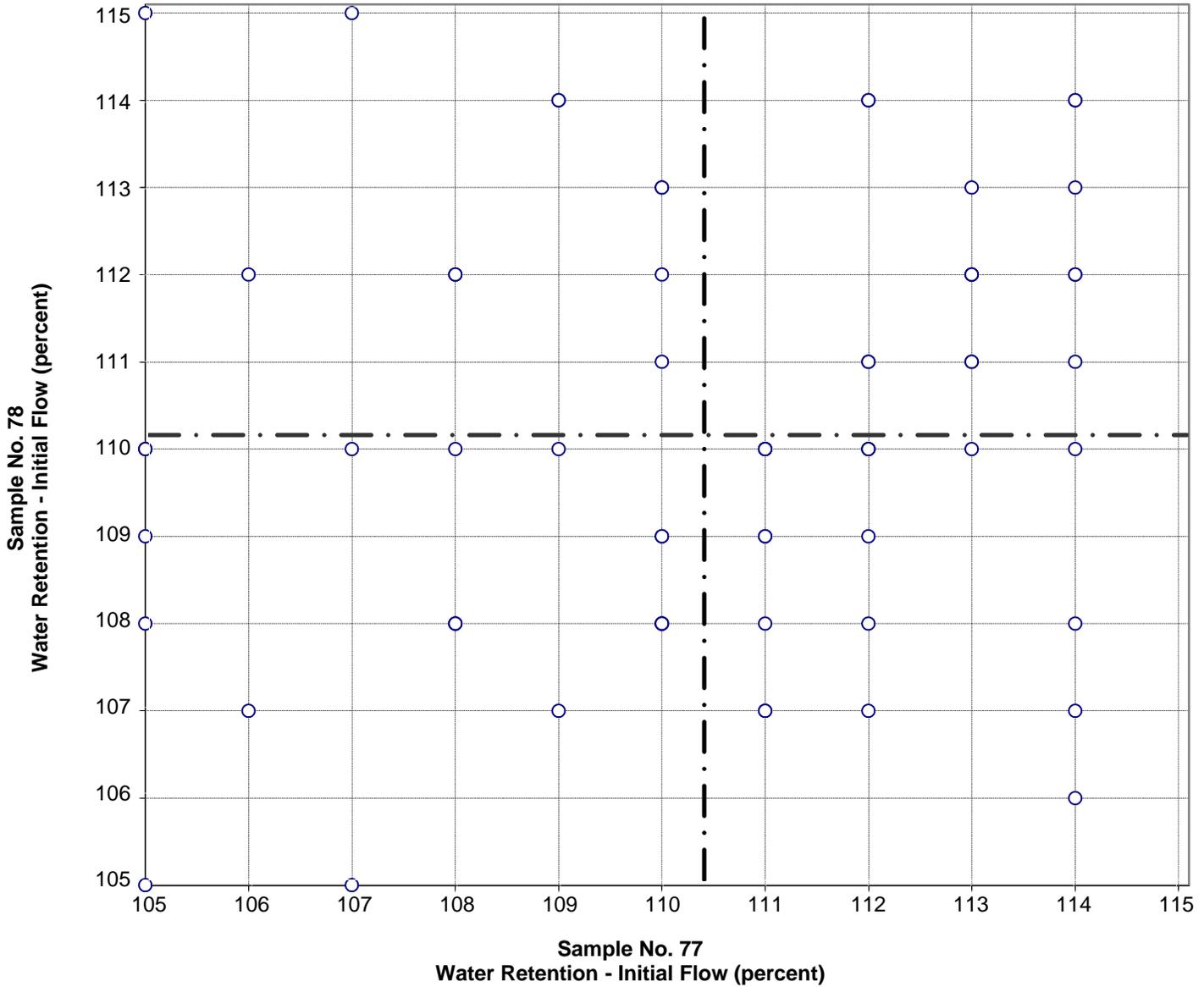
Test No. 330 Water Retention - Water 64 Points

Sample No. 77	Ave 45.6	S.D. 1.2	C.V. 2.6
Sample No. 78	Ave 46.0	S.D. 1.1	C.V. 2.3

Labs Eliminated: 551

Labs off Diagram: 2116

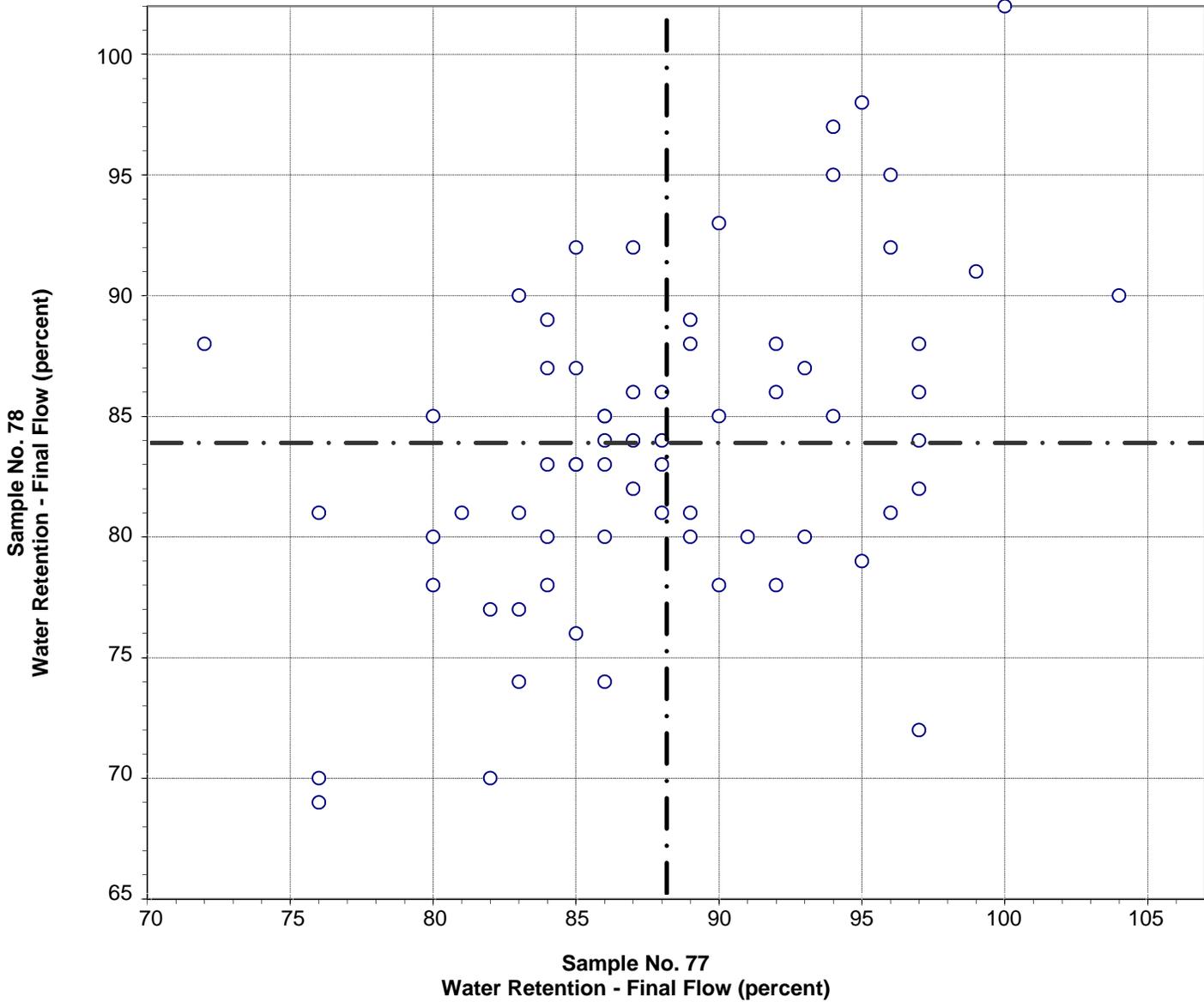
**CCRL Proficiency Sample Program  
Water Retention - Initial Flow  
MASONRY CEMENT Samples No. 77 and No. 78**



Test No. 331 Water Retention - Initial Flow 67 Points

Sample No. 77	Ave 110	S.D. 2.7	C.V. 2.5
Sample No. 78	Ave 110	S.D. 2.4	C.V. 2.2

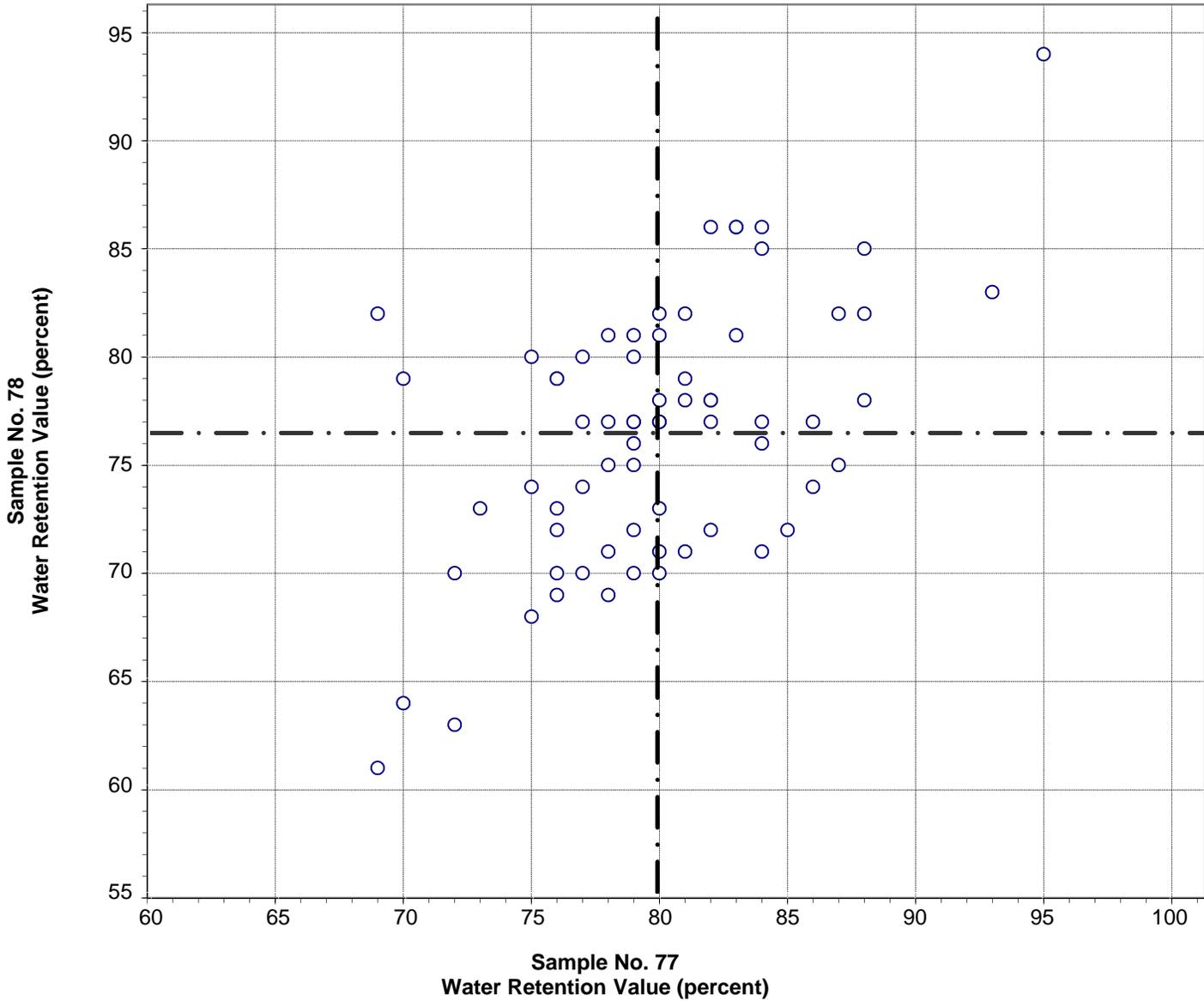
**CCRL Proficiency Sample Program  
Water Retention - Final Flow  
MASONRY CEMENT Samples No. 77 and No. 78**



Test No. 332    Water Retention - Final Flow    67 Points

Sample No. 77	Ave 88	S.D. 6.4	C.V. 7.3
Sample No. 78	Ave 84	S.D. 6.7	C.V. 8.0

**CCRL Proficiency Sample Program  
Water Retention Value  
MASONRY CEMENT Samples No. 77 and No. 78**



**Test No. 333 Water Retention Value 68 Points**

Sample No. 77	Ave 80	S.D. 5.1	C.V. 6.4
Sample No. 78	Ave 76	S.D. 6.0	C.V. 7.8