

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

**Final Report**  
**Masonry Cement Proficiency Samples**  
**Number 57 and Number 58**

January 2007

# CEMENT AND CONCRETE REFERENCE LABORATORY

AT THE  
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY  
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COMMITTEE C-1 ON CEMENT  
COMMITTEE C-9 ON CONCRETE AND  
CONCRETE AGGREGATES  
AMERICAN SOCIETY FOR TESTING AND MATERIALS

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January 9, 2007

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

**SUBJECT: Final Report on Masonry Cement Proficiency Samples No. 57 and No. 58**

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 2006. Masonry Cement Samples No 57 and No. 58 were ASTM C91 Type N cements.

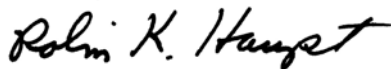
This report consists of a statistical Summary of Results, a set of general Scatter Diagrams, and associated detailed information. The Table of Results with test results and ratings for your laboratory can be downloaded at our website located at: <http://www.ccrl.us/>.

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 2007.

Sincerely,



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

Enclosure

**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. 57 and No. 58**

This letter, 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 2006. 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.

### **Laboratory Ratings**

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 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.

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

Note: The sign of the rating shows whether the result reported was greater or less than the average obtained.

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<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 and initial water retention flow. Mortar flows in the range of  $110 \pm 5$  are satisfactory, labs with flow values outside this range will be flagged as a “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.

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, that 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.

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 may indicate strong evidence of bias in many cases.

CCRL PROFICIENCY SAMPLE PROGRAM  
Masonry Cement Proficiency Samples No. 57 and No. 58  
Final Report - January 9, 2007

SUMMARY OF RESULTS

Test		#Labs	Sample No. 57			Sample No. 58		
			Average	S.D.	C.V.	Average	S.D.	C.V.
N.C. Water	prcnt	71	27.0	0.57	2.10	31.0	0.86	2.79
N.C. Water	prcnt	* 70	27.0	0.55	2.05	31.0	0.79	2.54
Gillmore TS Initial	min	66	139	30.1	21.6	261	36.0	13.8
Gillmore TS Final	min	66	256	44.9	17.6	379	39.5	10.4
Gillmore TS Final	min	* 65	256	45.2	17.66	377	36.0	9.55
Autoclave Expan	prcnt	67	0.003	0.027	911	0.017	0.028	168
Autoclave Expan	prcnt	* 62	0.006	0.011	183.2	0.021	0.014	67.3
Air Content	prcnt	69	11.7	1.7	14.5	17.2	2.2	12.6
Air Content	prcnt	* 62	11.4	0.90	7.90	17.0	1.01	5.95
AC Mix Water	prcnt	68	52.3	4.9	9.42	50.6	4.8	9.60
AC Mix Water	prcnt	* 63	51.0	1.4	2.68	49.3	1.3	2.72
AC Flow	prcnt	68	108	2.4	2.25	111	4.2	3.83
AC Flow	prcnt	* 67	108	2.4	2.20	111	2.4	2.14
Comp Str 7 day	psi	70	1696	163.7	9.65	2670	409.7	15.34
Comp Str 28 day	psi	63	2226	250.6	11.2	3130	414.9	13.2
Comp Str 28day	psi	* 61	2257	185.2	8.20	3168	362.3	11.43

CONTINUED ON NEXT PAGE

\* ELIMINATED LABS: Data over three S.D. from the mean

N.C. Water	289
Gillmore TS Final	98
Autoclave Expansion	309 687 176 694 1466
Air Content	64 157 159 52 158 354 694
AC Mix Water	159 354 407 413 694
AC Flow	918
Comp Strength 28 day	158 1196

CCRL PROFICIENCY SAMPLE PROGRAM  
Masonry Cement Proficiency Samples No. 57 and No. 58  
Final Report - January 9, 2007

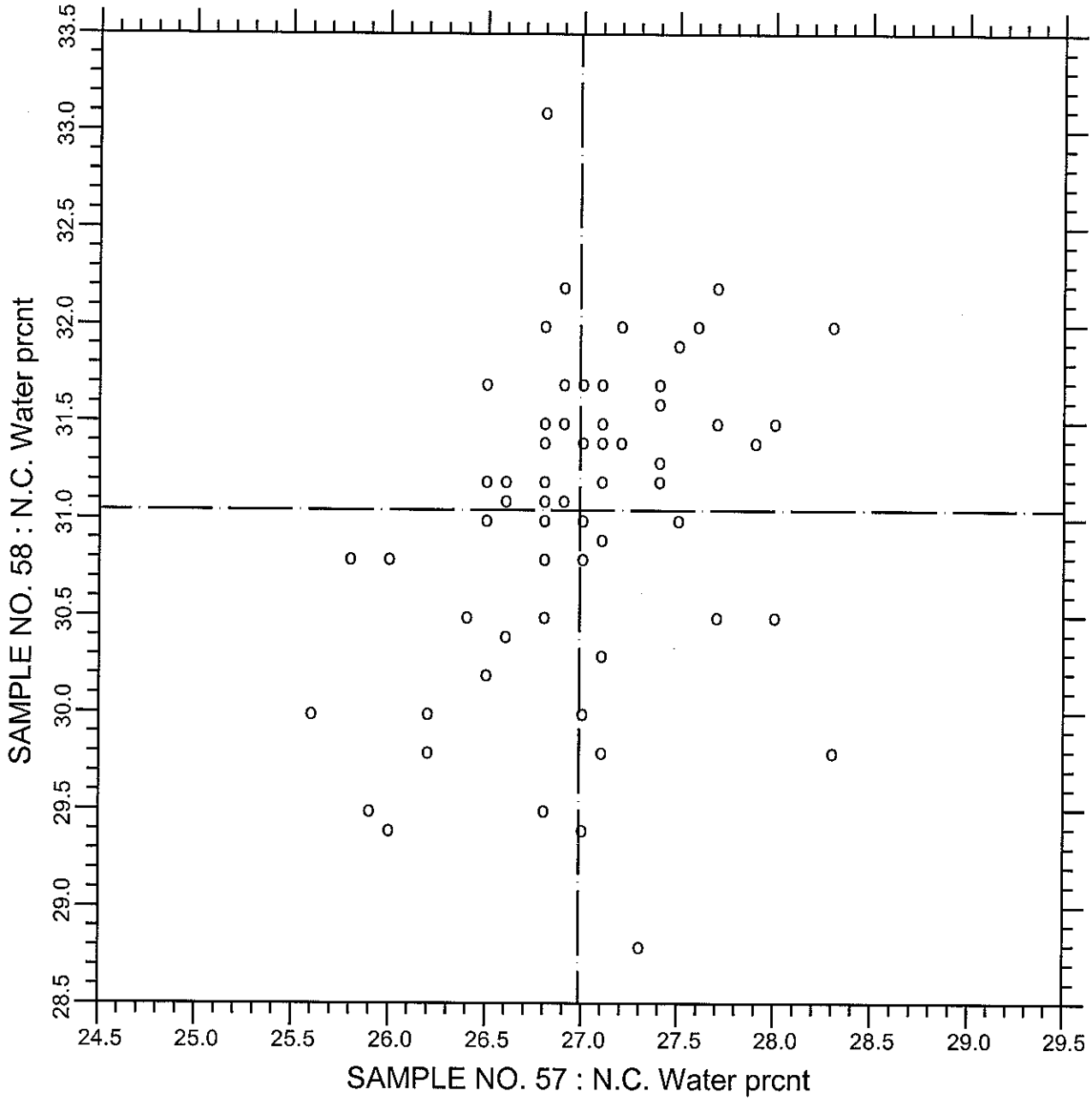
SUMMARY OF RESULTS

Test	#Labs	Sample No. 57			Sample No. 58		
		Average	S.D.	C.V.	Average	S.D.	C.V.
45µm Sieve	prcnt 70	1.61	0.45	28.1	0.45	0.32	69.8
45µm Sieve	prcnt * 65	1.61	0.31	19.4	0.39	0.16	40.6
Density	g/cm <sup>3</sup> 58	2.89	0.090	3.10	3.00	0.081	2.70
Density	g/cm <sup>3</sup> * 55	2.87	0.045	1.57	2.99	0.039	1.32
<b>WATER RETENTION</b>							
WR Mix Water	prcnt 62	51.4	1.9	3.68	49.6	2.1	4.26
WR Mix Water	prcnt * 61	51.3	1.3	2.62	49.4	1.3	2.69
WR Initial Flow	prcnt 62	109	3.6	3.31	111	5.6	5.06
WR Initial Flow	prcnt * 61	109	2.4	2.22	111	2.0	1.80
WR Final Flow	prcnt 62	94	5.9	6.27	93	7.0	7.47
WR Final Flow	prcnt * 60	94	5.2	5.54	94	6.0	6.42
Water Retention	prcnt 62	86	4.7	5.44	82	12.3	14.94
Water Retention	prcnt * 60	86	4.3	5.03	84	5.7	6.81

\* ELIMINATED LABS: Data over three S.D. from the mean

45µm Sieve	413 493 1196 56 2116
Density	157 176 201
WR Mix Water	694
WR Initial Flow	98
WR Final Flow	98 1196
Water Retention	176 1196

CCRL PROFICIENCY SAMPLE PROGRAM  
 Normal Consistency - Water  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.110

N.C. Water

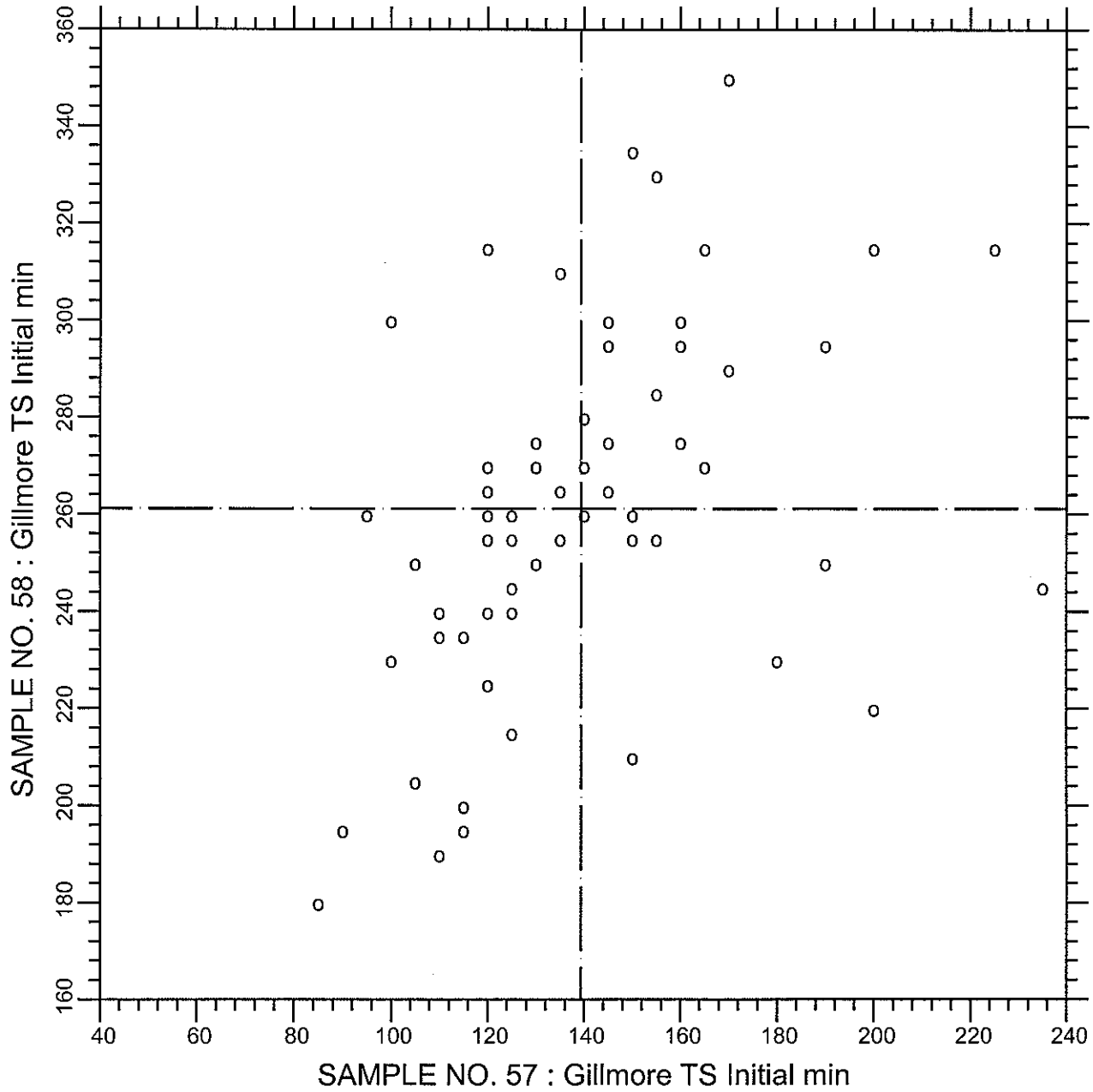
70 POINTS

SAMPLE NO. 57 AVE 26.986 S.D. 0.55 C.V. 2.05

SAMPLE NO. 58 AVE 31.044 S.D. 0.79 C.V. 2.54

LABS ELIMINATED 289

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Gillmore Time of Set - Initial**  
**MASONRY CEMENT SAMPLES NO. 57 & NO. 58**



TEST NO.130

Gillmore TS Initial

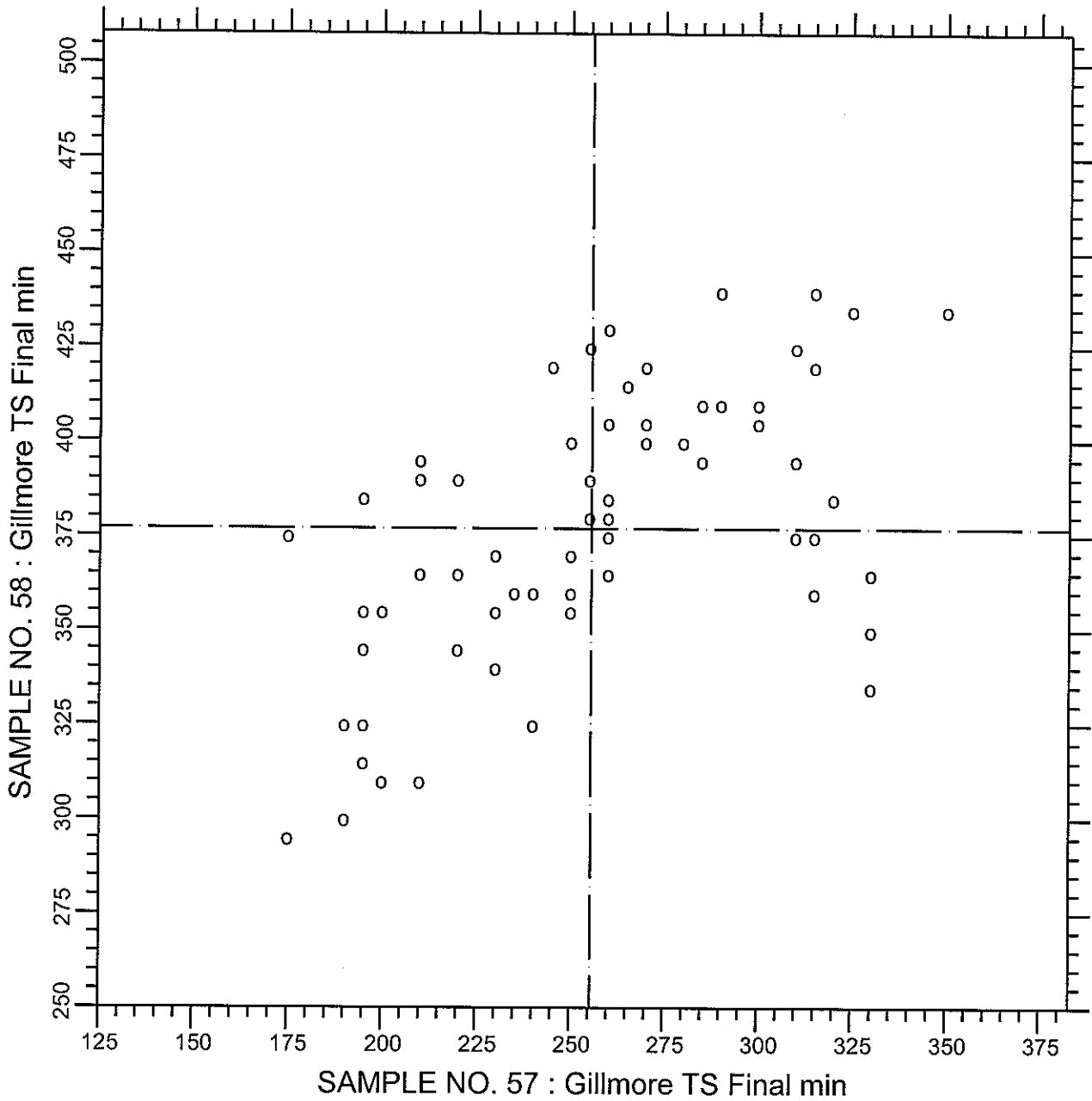
66 POINTS

SAMPLE NO. 57    AVE 139.4    S.D. 30.1    C.V. 21.6

SAMPLE NO. 58    AVE 261.1    S.D. 36.0    C.V. 13.8



**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Gillmore Time of Set - Final  
**MASONRY CEMENT SAMPLES NO. 57 & NO. 58**



TEST NO.140

Gillmore TS Final

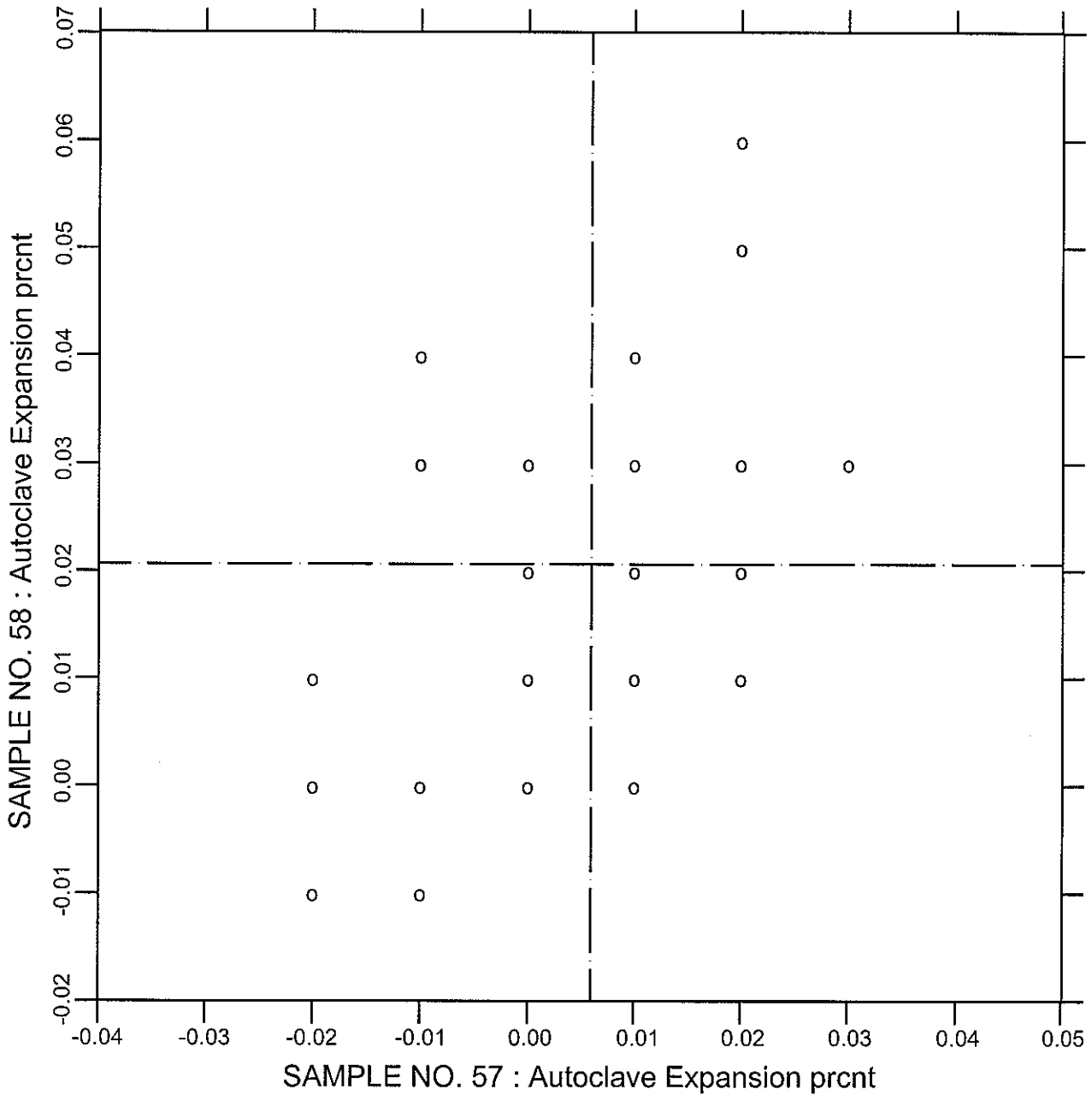
65 POINTS

SAMPLE NO. 57 AVE 255.6 S.D. 45.2 C.V. 17.66

SAMPLE NO. 58 AVE 376.9 S.D. 36.0 C.V. 9.55

LABS ELIMINATED 98

CCRL PROFICIENCY SAMPLE PROGRAM  
 Autoclave Expansion  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



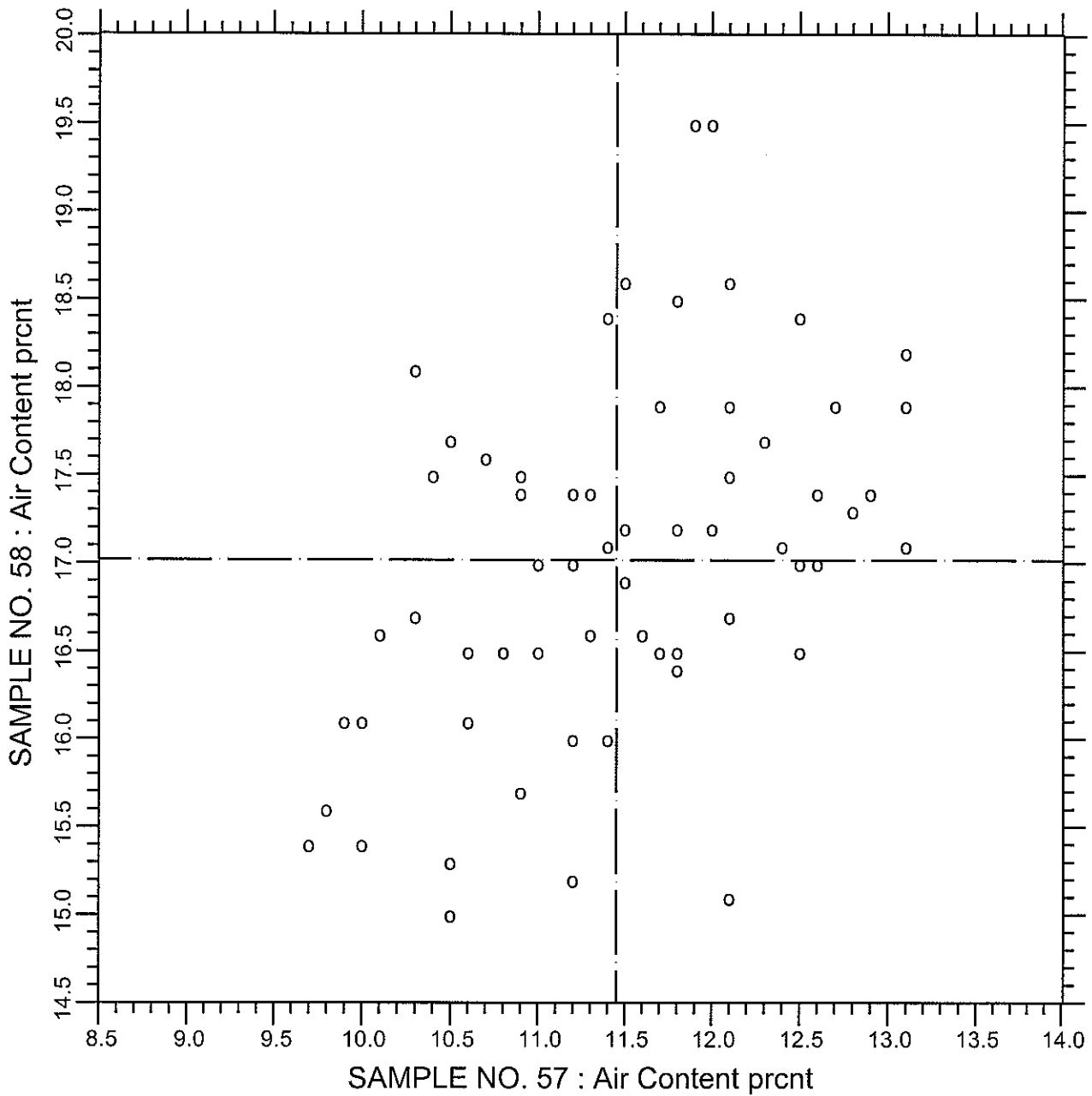
TEST NO.160                      Autoclave Expansion                      62 POINTS

SAMPLE NO. 57    AVE 0.0060    S.D. 0.011    C.V. 183.2

SAMPLE NO. 58    AVE 0.0206    S.D. 0.014    C.V. 67.3

LABS ELIMINATED 309 687 176 694 1466

CCRL PROFICIENCY SAMPLE PROGRAM  
Air Content  
MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.170

Air Content

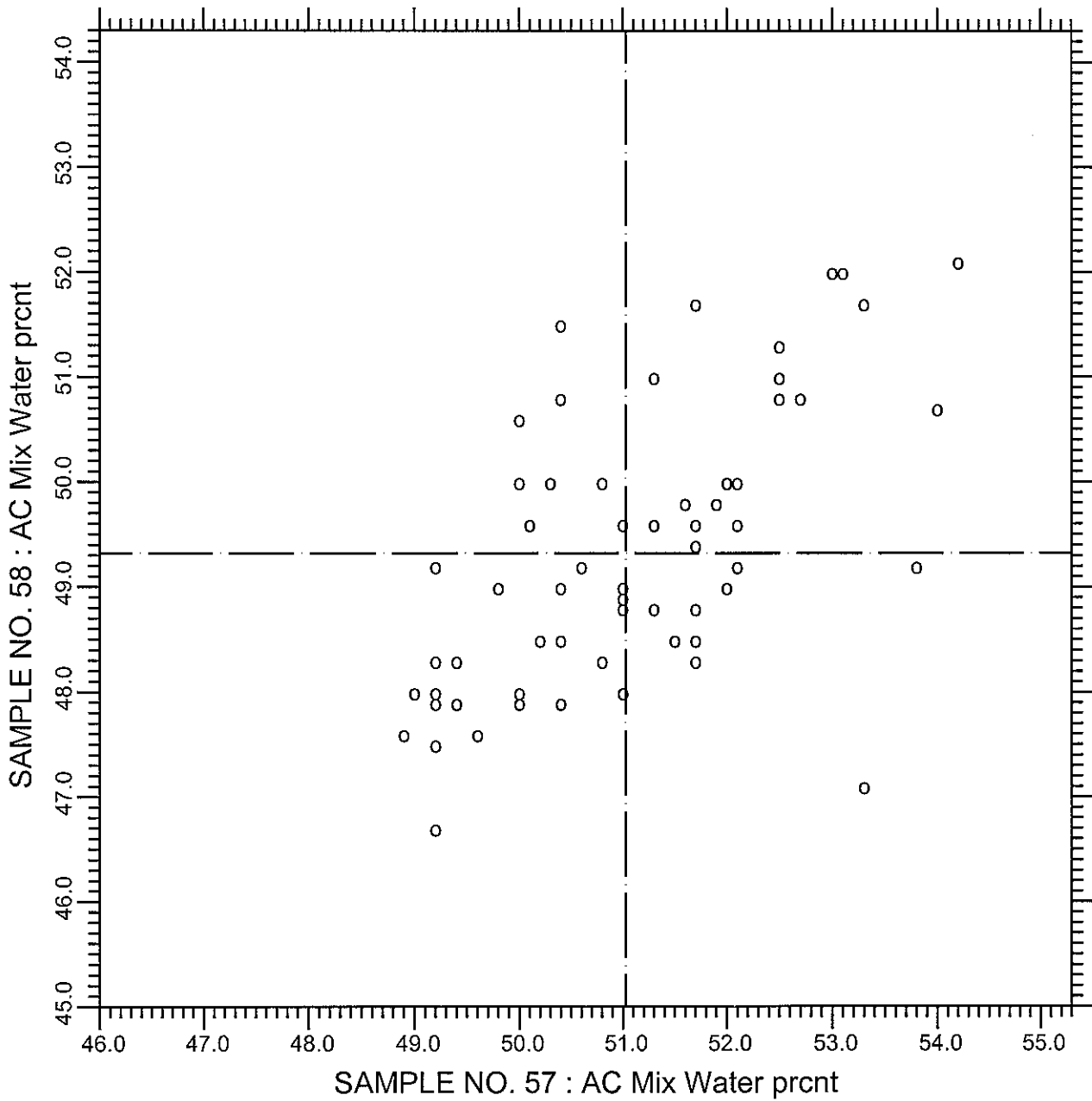
62 POINTS

SAMPLE NO. 57 AVE 11.45 S.D. 0.90 C.V. 7.90

SAMPLE NO. 58 AVE 17.02 S.D. 1.01 C.V. 5.95

LABS ELIMINATED 64 157 159 52 158 354 694

CCRL PROFICIENCY SAMPLE PROGRAM  
Air Content - Water  
MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.180

AC Mix Water

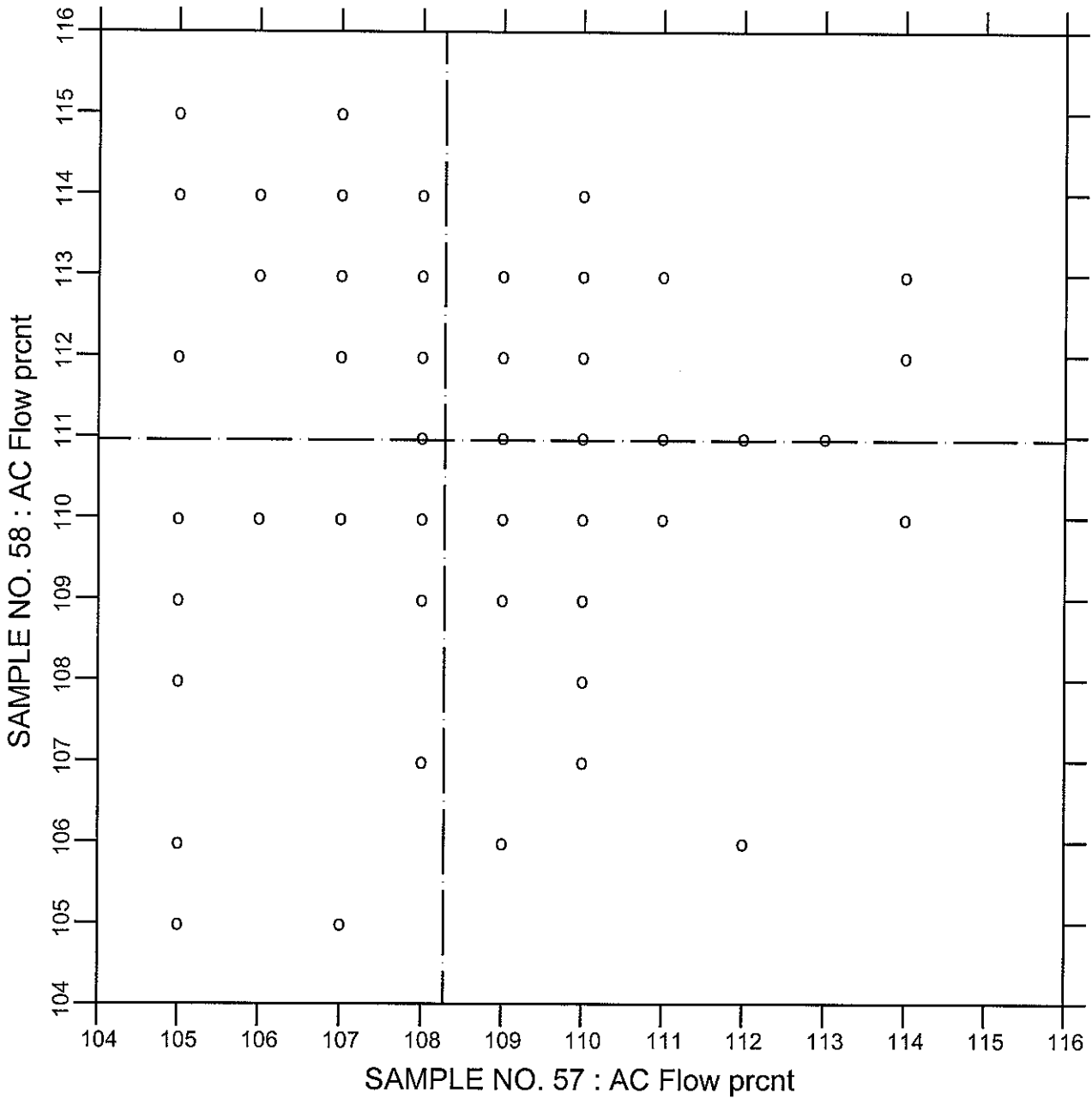
63 POINTS

SAMPLE NO. 57 AVE 51.03 S.D. 1.4 C.V. 2.68

SAMPLE NO. 58 AVE 49.32 S.D. 1.3 C.V. 2.72

LABS ELIMINATED 159 354 407 413 694

CCRL PROFICIENCY SAMPLE PROGRAM  
Air Content - Flow  
MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.190

AC Flow

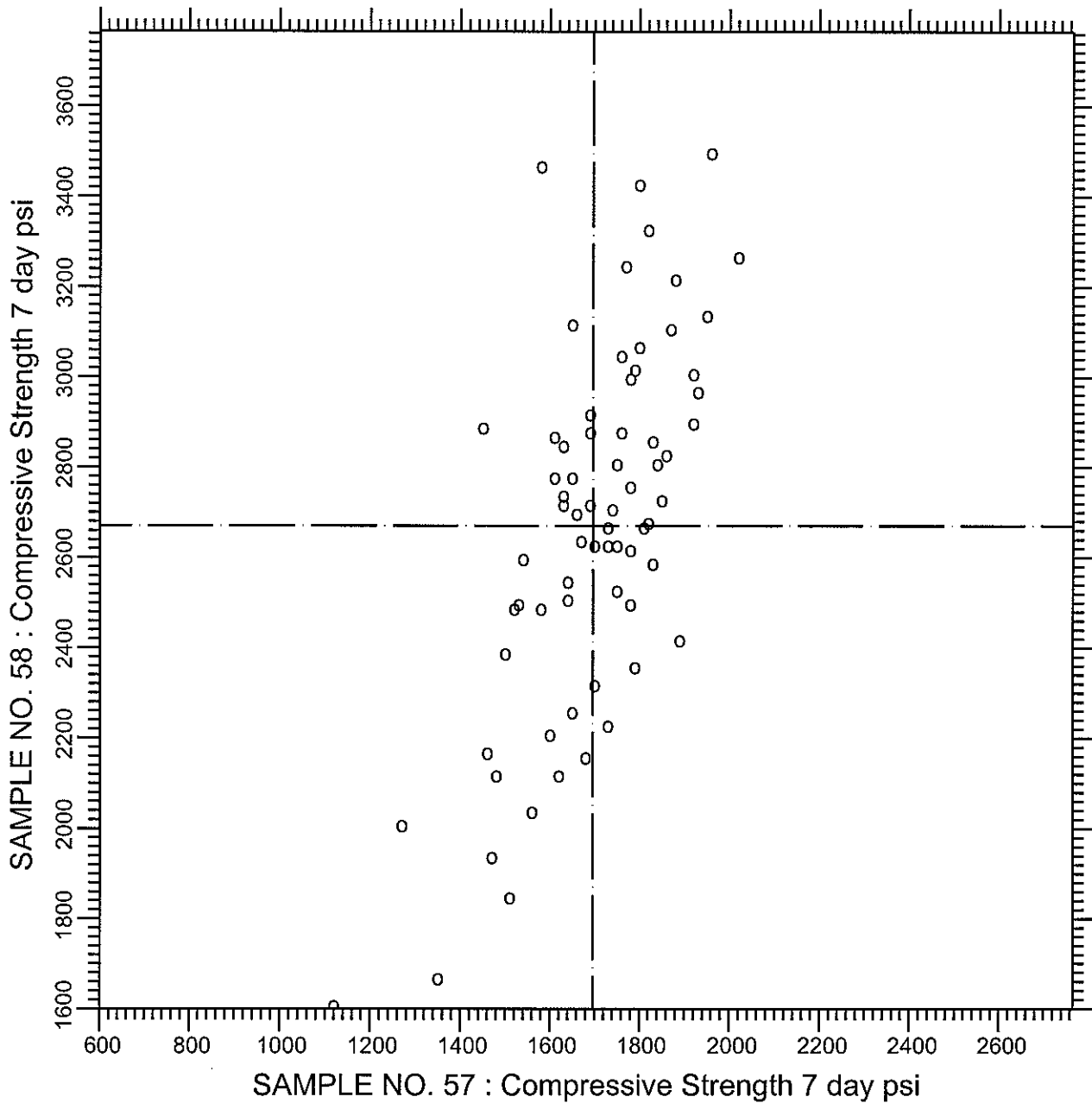
67 POINTS

SAMPLE NO. 57 AVE 108.28 S.D. 2.4 C.V. 2.20

SAMPLE NO. 58 AVE 110.96 S.D. 2.4 C.V. 2.14

LABS ELIMINATED 918

CCRL PROFICIENCY SAMPLE PROGRAM  
Compressive Strength - 7 day  
MASONRY CEMENT SAMPLES NO. 57 & NO. 58

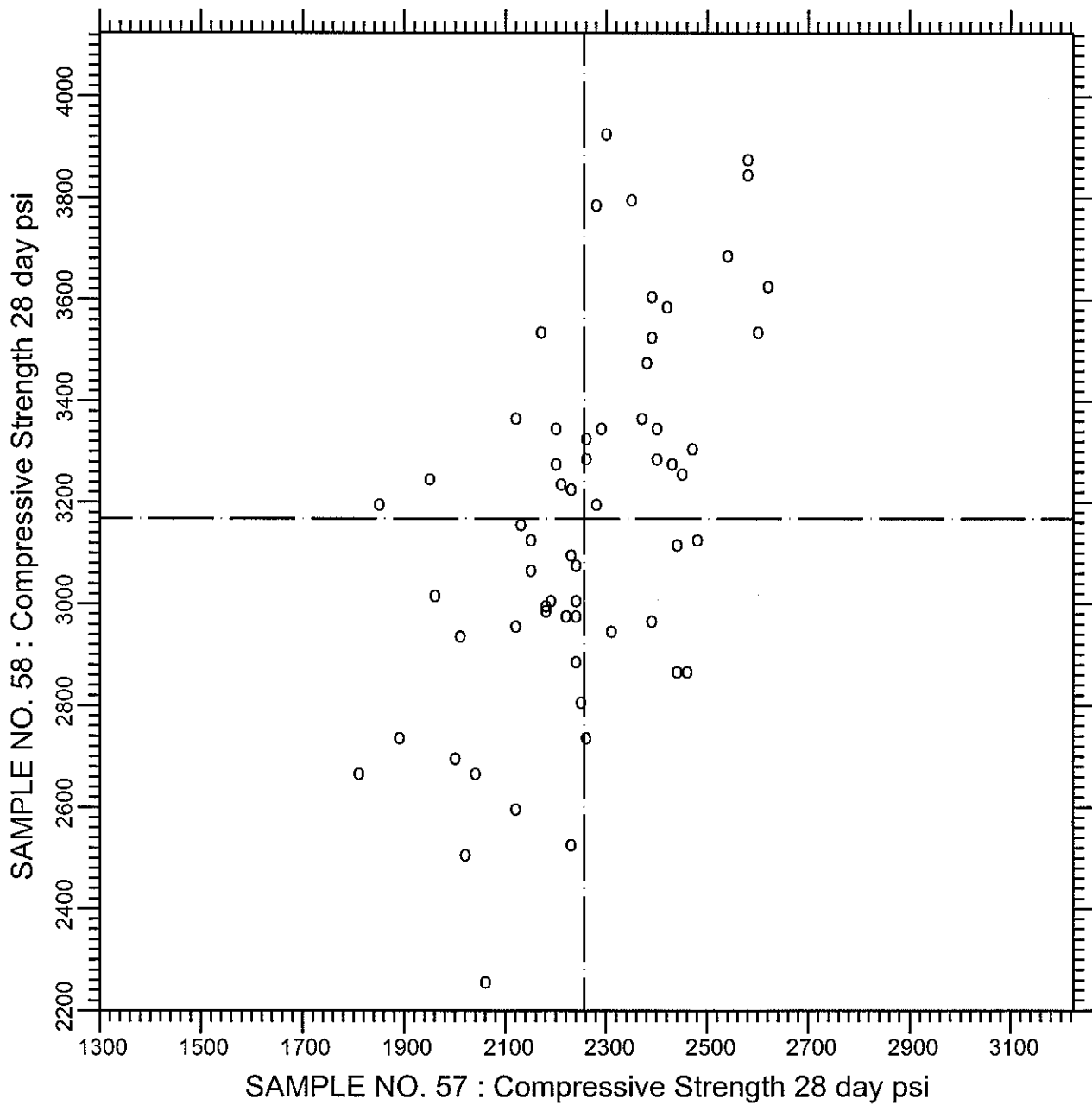


TEST NO.210      Compressive Strength 7 day      70 POINTS

SAMPLE NO. 57    AVE 1696.1    S.D. 163.7    C.V. 9.65

SAMPLE NO. 58    AVE 2670.1    S.D. 409.7    C.V. 15.34

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Compressive Strength - 28 day  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



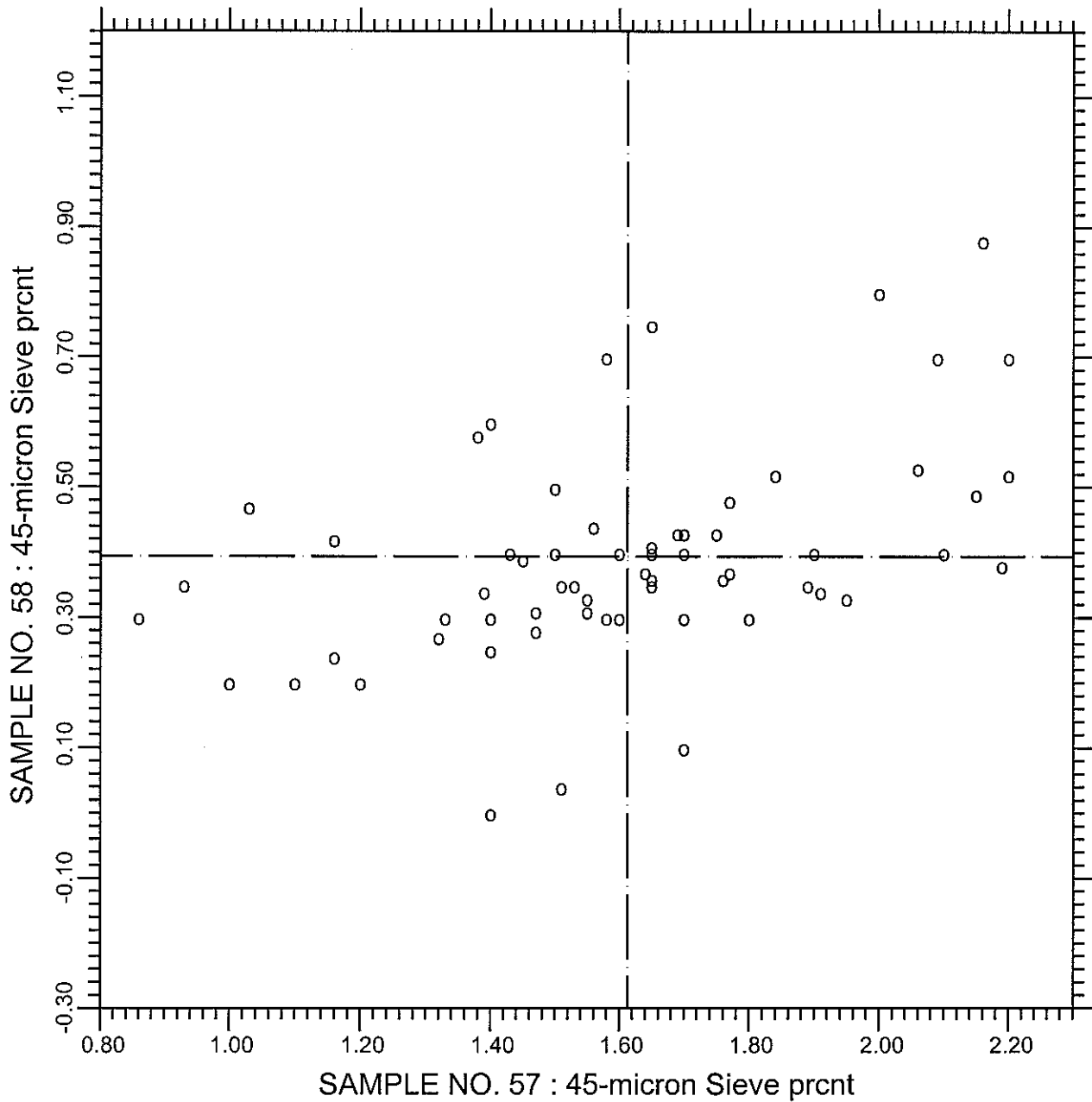
TEST NO.211    Compressive Strength 28 day    61 POINTS

SAMPLE NO. 57    AVE 2256.6    S.D. 185.2    C.V. 8.20

SAMPLE NO. 58    AVE 3168.4    S.D. 362.3    C.V. 11.43

LABS ELIMINATED 158 1196

CCRL PROFICIENCY SAMPLE PROGRAM  
 Fineness - 45 micron Sieve Retained  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.281

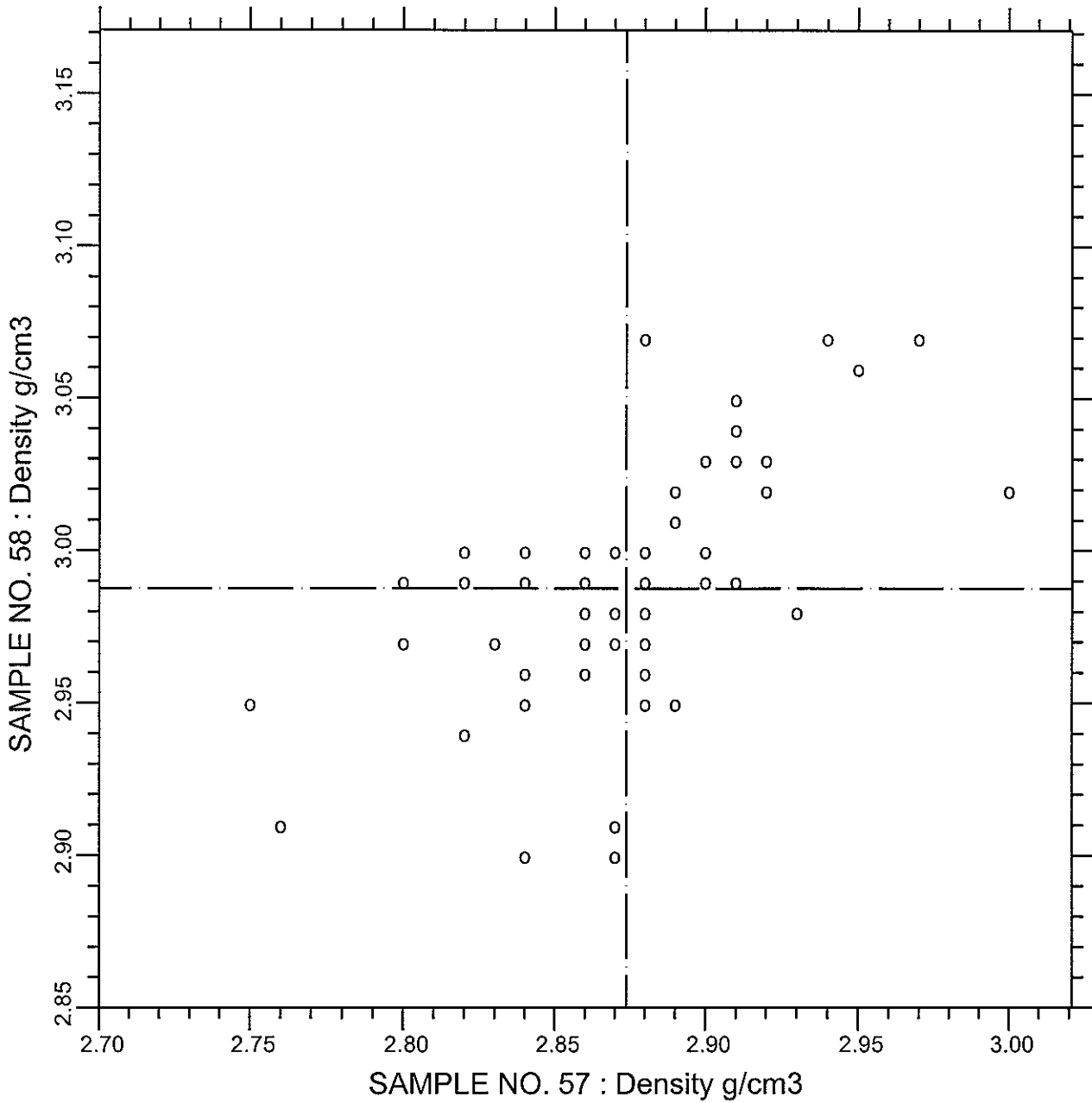
45-micron Sieve

65 POINTS

SAMPLE NO. 57	AVE	1.613	S.D.	0.31	C.V.	19.4
SAMPLE NO. 58	AVE	0.394	S.D.	0.16	C.V.	40.6
LABS ELIMINATED 413 493 1196 56 2116						



CCRL PROFICIENCY SAMPLE PROGRAM  
Density  
MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.310

Density

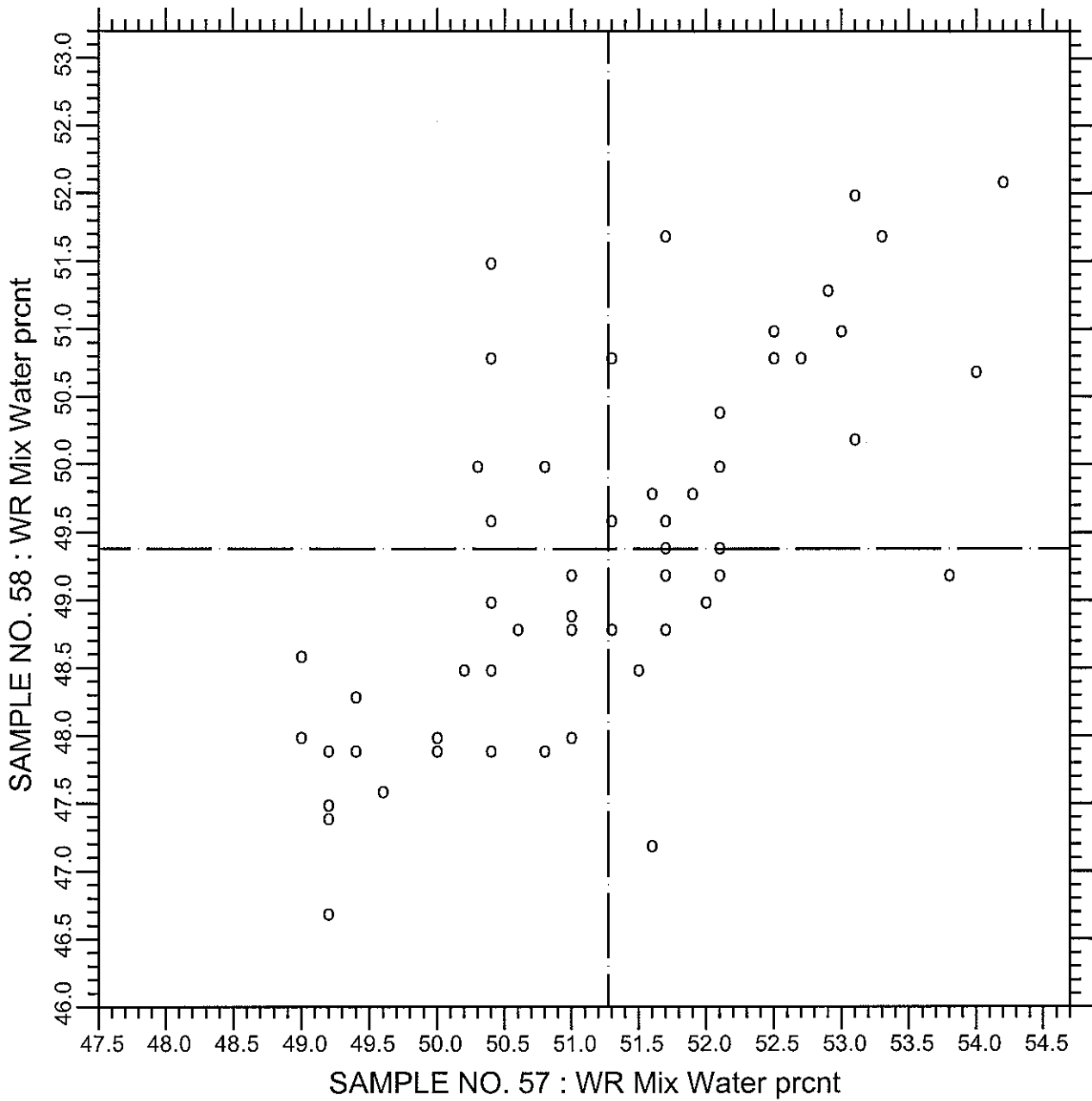
55 POINTS

SAMPLE NO. 57 AVE 2.8738 S.D. 0.045 C.V. 1.57

SAMPLE NO. 58 AVE 2.9876 S.D. 0.039 C.V. 1.32

LABS ELIMINATED 157 176 201

CCRL PROFICIENCY SAMPLE PROGRAM  
 Water Retention - Water  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.330

WR Mix Water

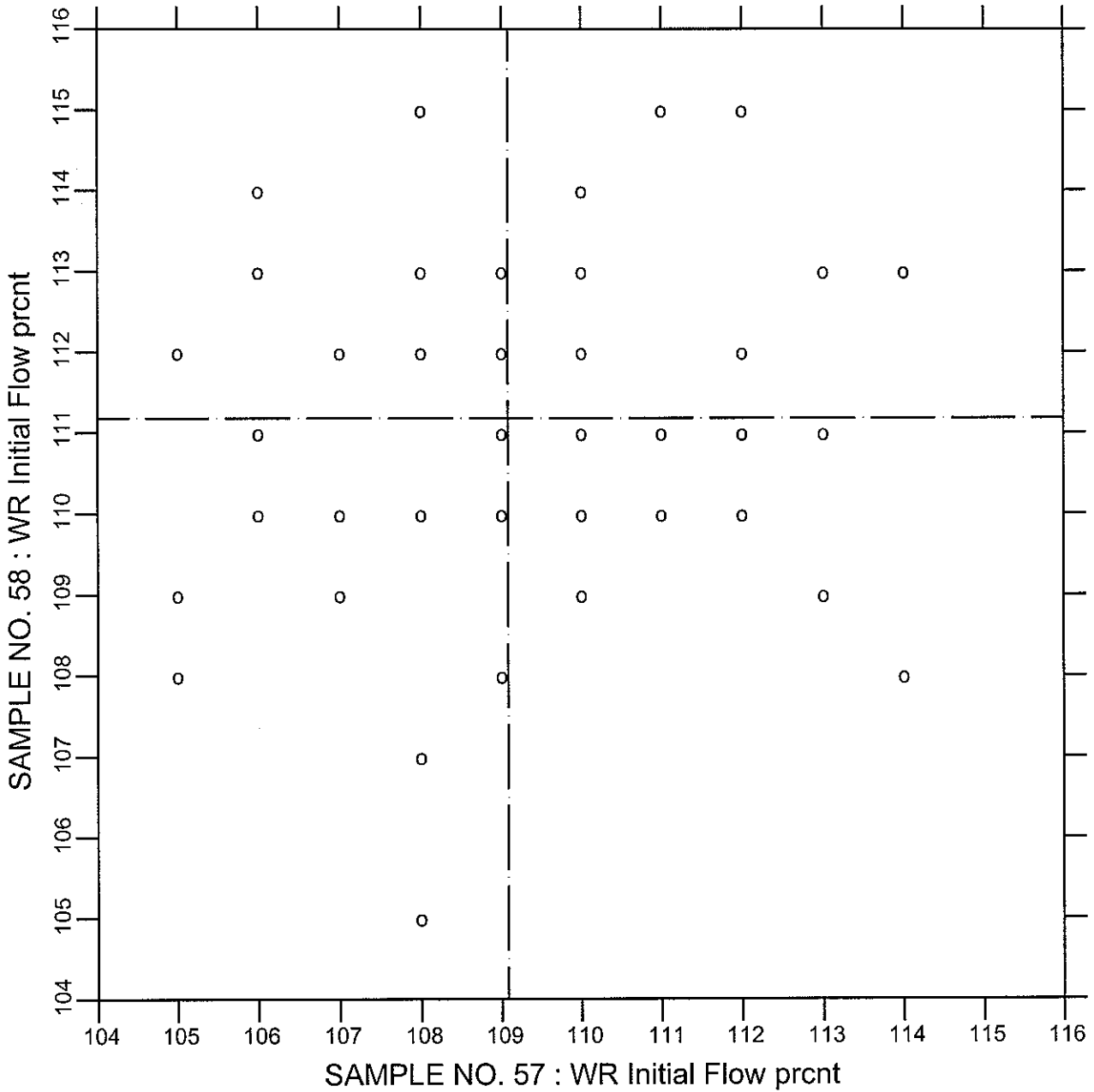
61 POINTS

SAMPLE NO. 57 AVE 51.27 S.D. 1.3 C.V. 2.62

SAMPLE NO. 58 AVE 49.38 S.D. 1.3 C.V. 2.69

LABS ELIMINATED 694

CCRL PROFICIENCY SAMPLE PROGRAM  
 Water Retention - Initial Flow  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.331

WR Initial Flow

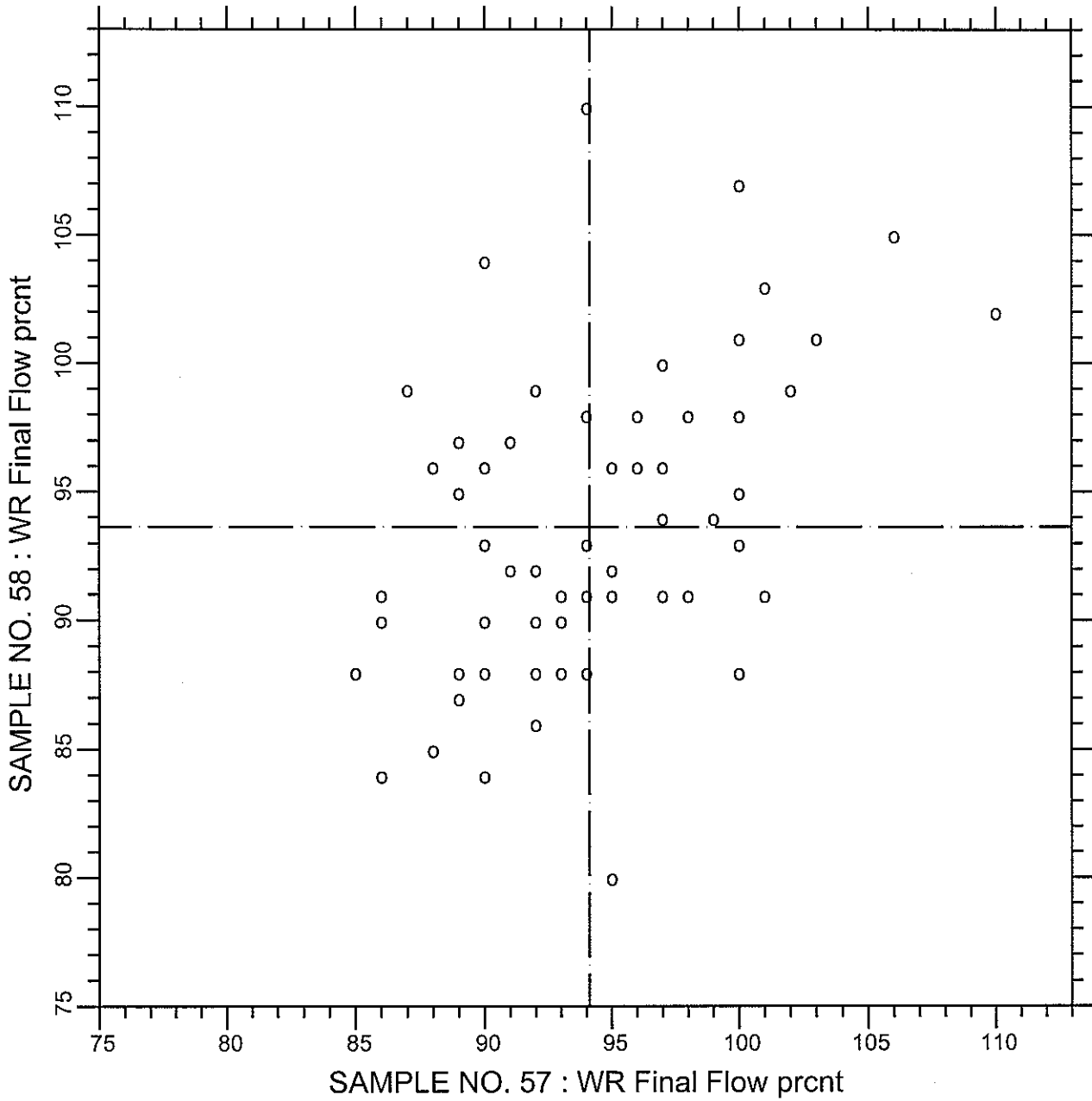
61 POINTS

SAMPLE NO. 57 AVE 109.08 S.D. 2.4 C.V. 2.22

SAMPLE NO. 58 AVE 111.18 S.D. 2.0 C.V. 1.80

LABS ELIMINATED 98

CCRL PROFICIENCY SAMPLE PROGRAM  
 Water Retention - Final Flow  
 MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.332

WR Final Flow

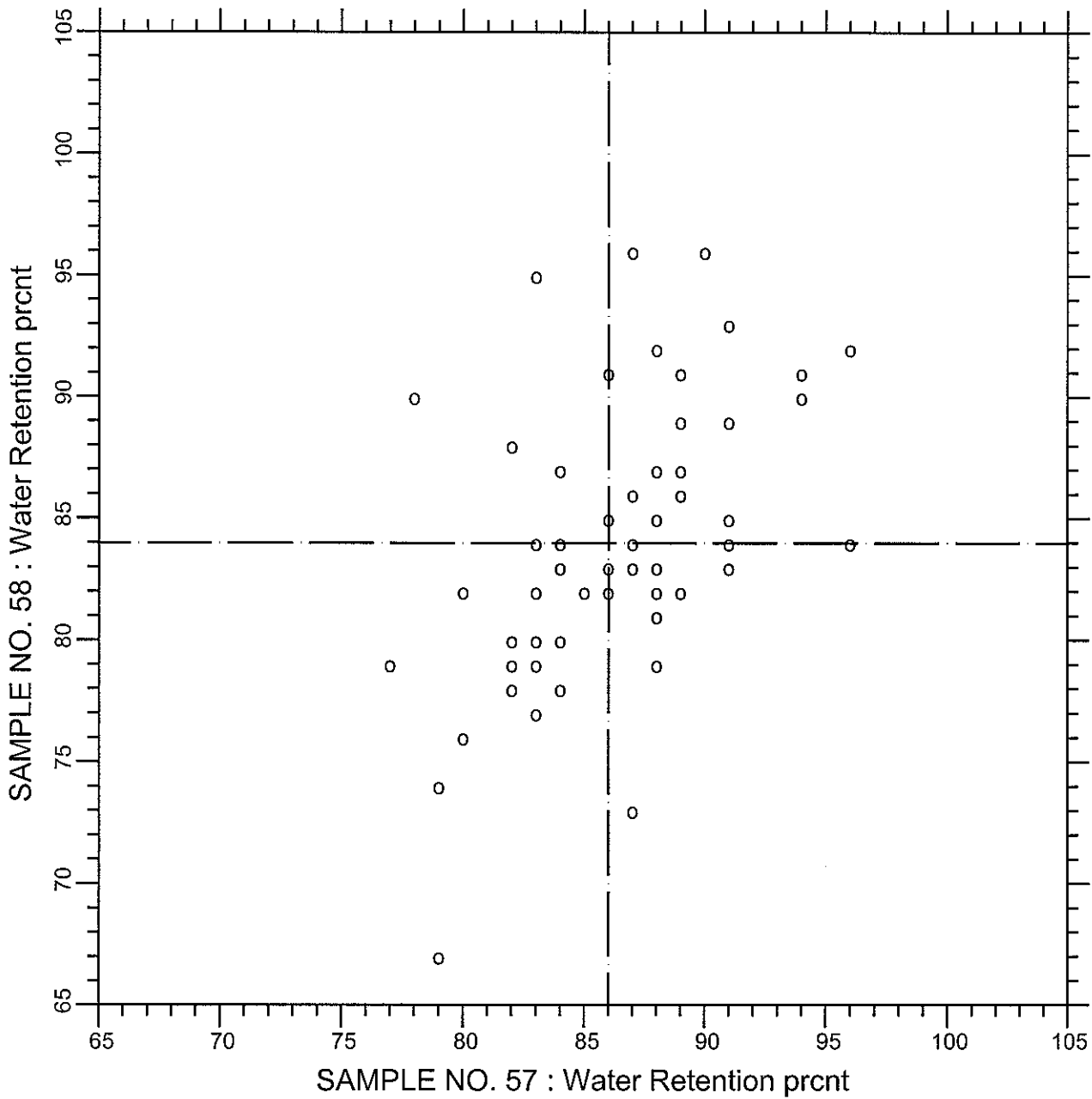
60 POINTS

SAMPLE NO. 57 AVE 94.12 S.D. 5.2 C.V. 5.54

SAMPLE NO. 58 AVE 93.63 S.D. 6.0 C.V. 6.42

LABS ELIMINATED 98 1196

CCRL PROFICIENCY SAMPLE PROGRAM  
Water Retention Value  
MASONRY CEMENT SAMPLES NO. 57 & NO. 58



TEST NO.333

Water Retention

60 POINTS

SAMPLE NO. 57 AVE 86.02 S.D. 4.3 C.V. 5.03

SAMPLE NO. 58 AVE 83.98 S.D. 5.7 C.V. 6.81

LABS ELIMINATED 176 1196