

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

**Final Report**  
**Masonry Cement Proficiency Samples**  
**Number 53 and Number 54**

December 2004

**CEMENT AND CONCRETE REFERENCE LABORATORY**

AT THE  
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY  
GAITHERSBURG, MARYLAND 20899  
(301) 975-6704

SPONSORED BY  
COMMITTEE C-1 ON CEMENT  
COMMITTEE C-9 ON CONCRETE AND  
CONCRETE AGGREGATES  
AMERICAN SOCIETY FOR TESTING AND MATERIALS

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December 20, 2004

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

**Subject: Final Report on Masonry Cement Proficiency Samples No. 53 and No. 54**

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 2004.

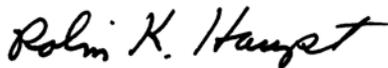
This report consists of a statistical Summary of Results, a set of general Scatter Diagrams, and associated detailed information. The Table of Results with test results and ratings for your laboratory can be downloaded at our website located at: <http://ccrl.us/psp/pspdata.htm>.

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 use.

**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 2005.

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. 53 and No. 54**

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 2004. 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. 53 and No. 54  
Final Report - December 20, 2004

SUMMARY OF RESULTS

Test		#Labs	Sample No. 53			Sample No. 54		
			Average	S.D.	C.V.	Average	S.D.	C.V.
N.C. Water	prcnt	66	28.0	0.72	2.59	25.4	0.89	3.52
N.C. Water	prcnt	* 65	27.9	0.59	2.11	25.3	0.38	1.50
Gillmore TS Initial	min	64	243	42.7	17.6	202	42.5	21.1
Gillmore TS Initial	min	* 62	241	42.7	17.7	197	34.0	17.2
Gillmore TS Final	min	64	373	56.3	15.1	340	55.9	16.5
Gillmore TS Final	min	* 63	374	56.3	15.0	337	51.4	15.3
Autoclave Expan	prcnt	61	0.03	0.023	87.8	0.03	0.026	83.6
Autoclave Expan	prcnt	* 60	0.02	0.014	56.8	0.03	0.013	47.3
Air Content	prcnt	65	18.9	1.4	7.48	16.2	1.1	7.00
AC Mix Water	prcnt	66	46.8	2.9	6.30	47.9	4.4	9.23
AC Mix Water	prcnt	* 62	46.2	1.23	2.65	46.9	0.91	1.94
AC Flow	prcnt	66	111	2.4	2.15	109	2.2	1.99
Comp Str 7 day	psi	64	1270	229.6	18.1	1146	167.6	14.6
Comp Str 28 day	psi	58	1504	253.3	16.8	1384	178.7	12.9

CONTINUED ON NEXT PAGE

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

N.C. Water	1200
Gillmore TS Intial	159 1466
Gillmore TS Final	162
Autoclave Expansion	1200
AC Mix Water	139 159 222 1379

CCRL PROFICIENCY SAMPLE PROGRAM  
Masonry Cement Proficiency Samples No. 53 and No. 54  
December 20, 2004  
Final Report

SUMMARY OF RESULTS

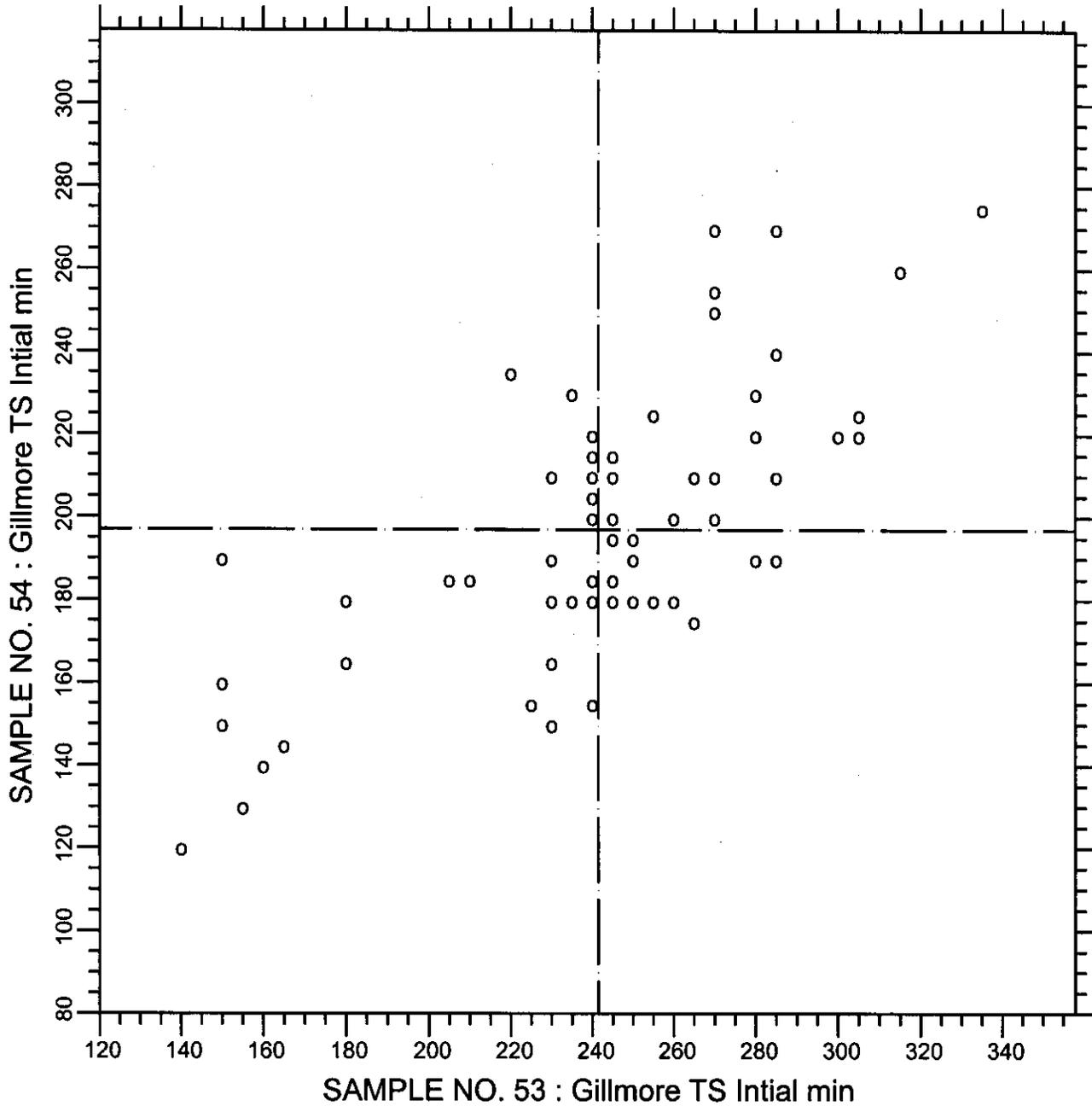
Test		#Labs	Sample No. 53			Sample No. 54		
			Average	S.D.	C.V.	Average	S.D.	C.V.
45µm Sieve	prcnt	65	1.76	1.9	105.9	5.96	1.1	18.4
45µm Sieve	prcnt	* 59	1.32	0.25	19.1	6.06	0.65	10.6
Density	g/cm <sup>3</sup>	48	2.88	0.12	4.36	2.91	0.12	4.28
Density	g/cm <sup>3</sup>	* 46	2.85	0.063	2.20	2.89	0.070	2.43
Water Sol Alkali	prcnt	2	0.31	0.000	0.00	0.18	0.014	7.86
<b>WATER RETENTION</b>								
WR Mix Water	prcnt	59	46.8	2.9	6.15	48.1	4.6	9.66
WR Mix Water	prcnt	* 56	46.3	1.3	2.79	47.0	1.0	2.21
WR Initial Flow	prcnt	60	111	2.1	1.92	109	2.3	2.10
WR Final Flow	prcnt	60	95	6.6	6.93	94	5.8	6.22
Water Retention	prcnt	61	86	5.6	6.49	86	5.0	5.83

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

45-micron Sieve	42 74 162 159 605 1200
Density	178 201
WR Mix Water	139 159 222



**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Gillmore Time of Set - Initial  
 MASONRY CEMENT SAMPLES NO. 53 & NO. 54



TEST NO.130

Gillmore TS Initial

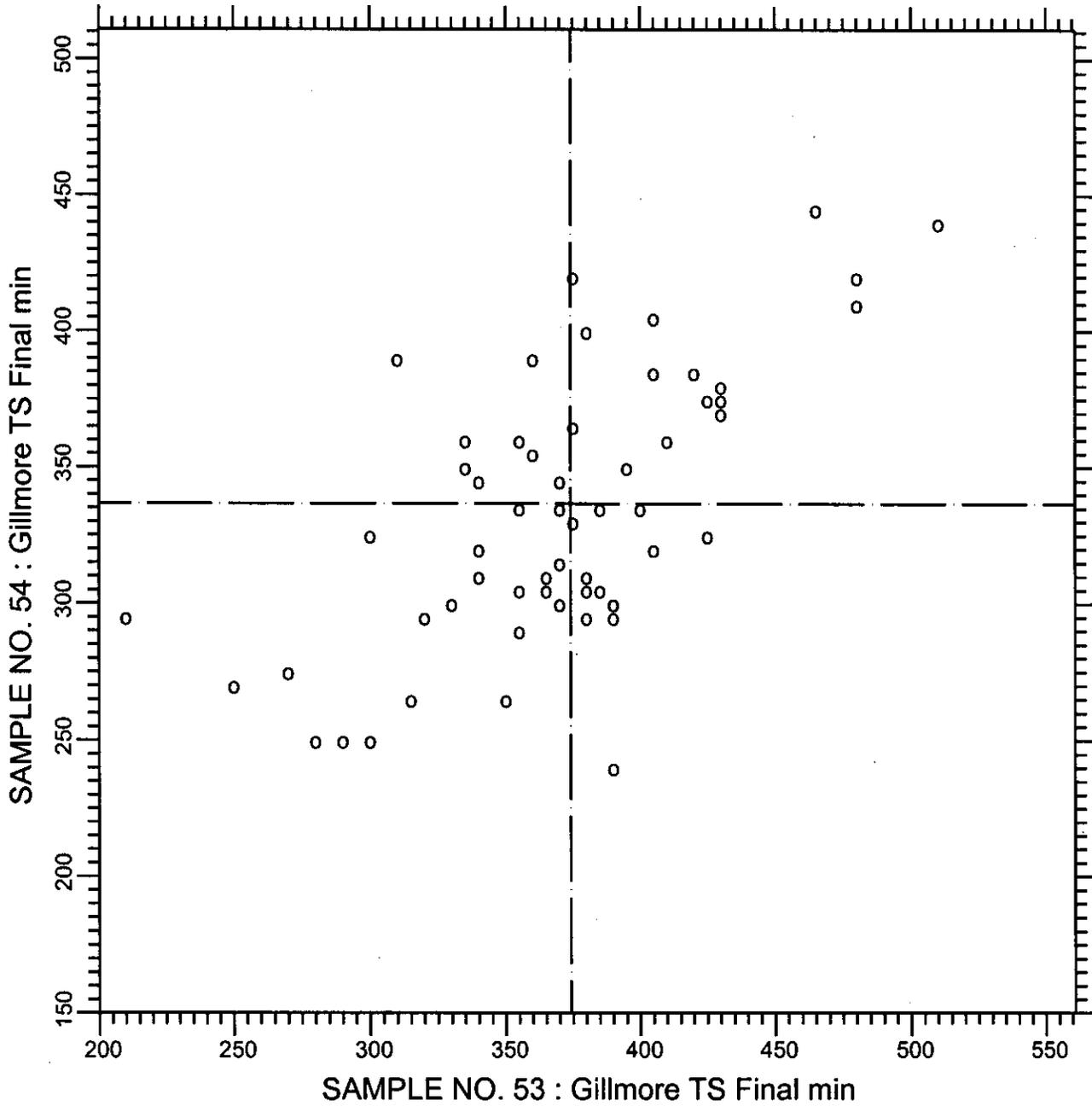
62 POINTS

SAMPLE NO. 53    AVE 241.4    S.D. 42.7    C.V. 17.7

SAMPLE NO. 54    AVE 197.0    S.D. 34.0    C.V. 17.2

LABS ELIMINATED 159 1466

**CCRL PROFICIENCY SAMPLE PROGRAM**  
 Gillmore Time of Set - Final  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.140

Gillmore TS Final

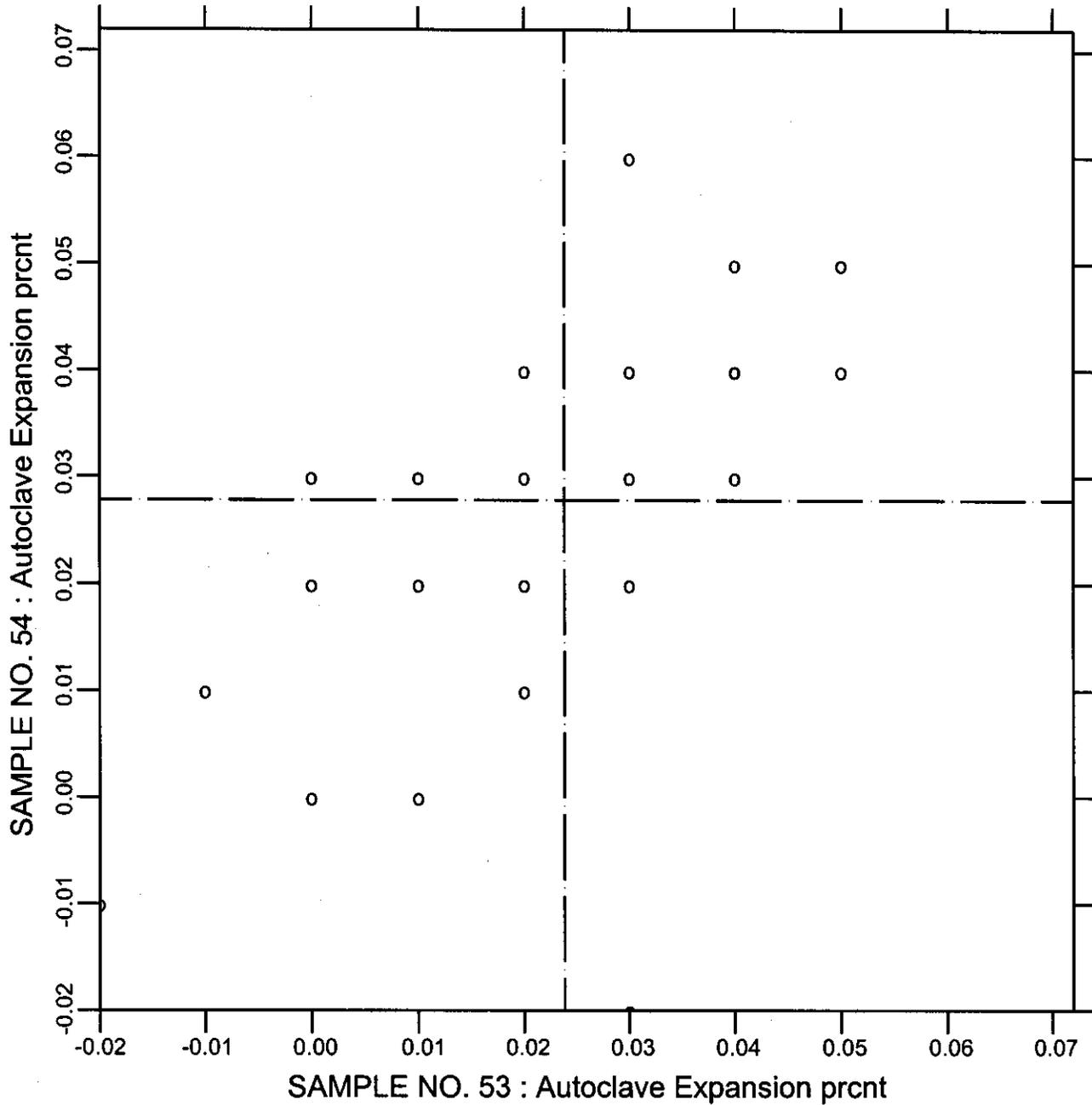
63 POINTS

SAMPLE NO. 53 AVE 374.2 S.D. 56.3 C.V. 15.0

SAMPLE NO. 54 AVE 336.7 S.D. 51.4 C.V. 15.3

LABS ELIMINATED 162

CCRL PROFICIENCY SAMPLE PROGRAM  
Autoclave Expansion  
MASONRY CEMENT SAMPLES NO. 53 & NO. 54



TEST NO.160

Autoclave Expansion

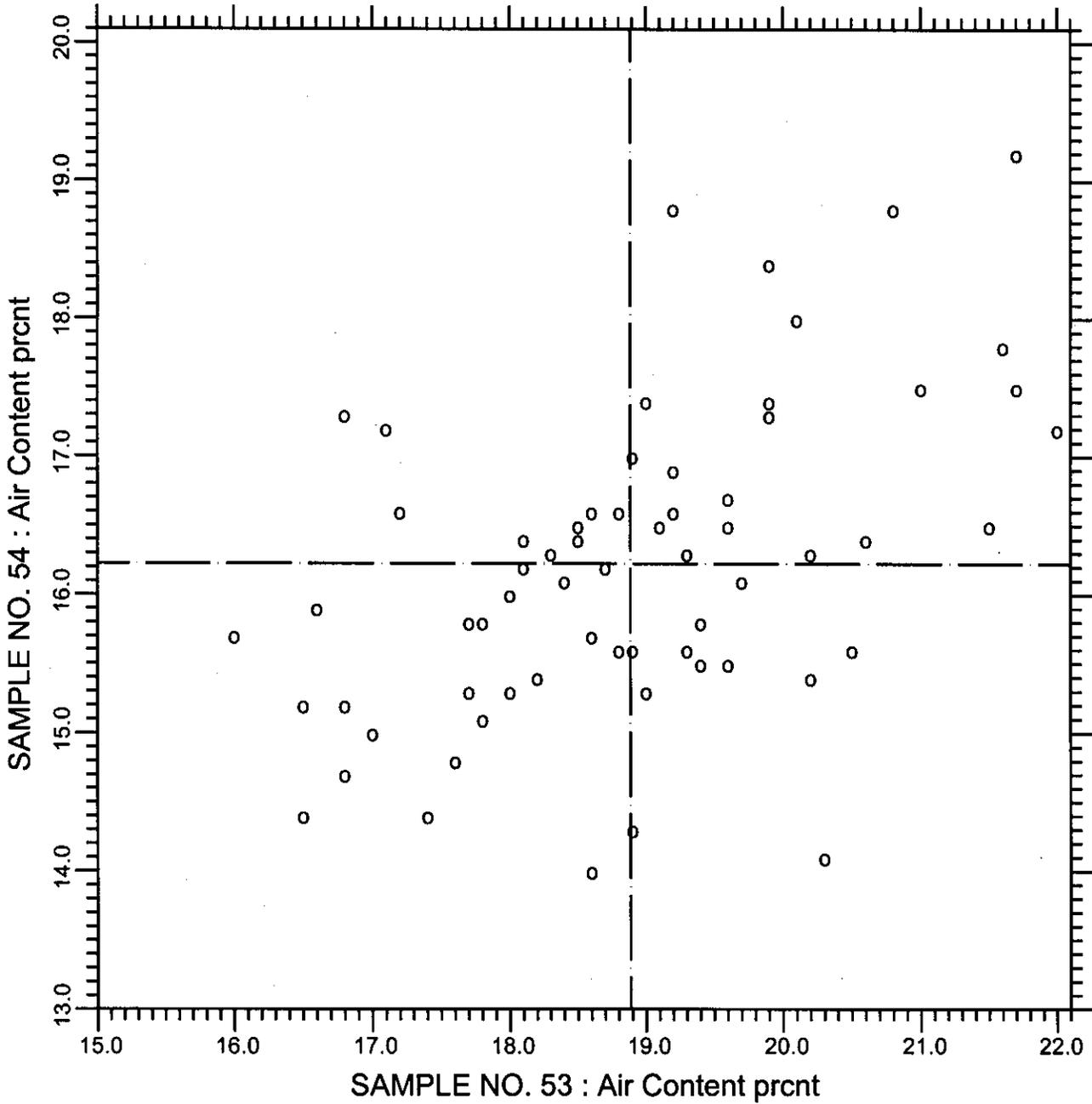
60 POINTS

SAMPLE NO. 53 AVE 0.0238 S.D. 0.014 C.V. 56.8

SAMPLE NO. 54 AVE 0.0278 S.D. 0.013 C.V. 47.3

LABS ELIMINATED 1200

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Air Content**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



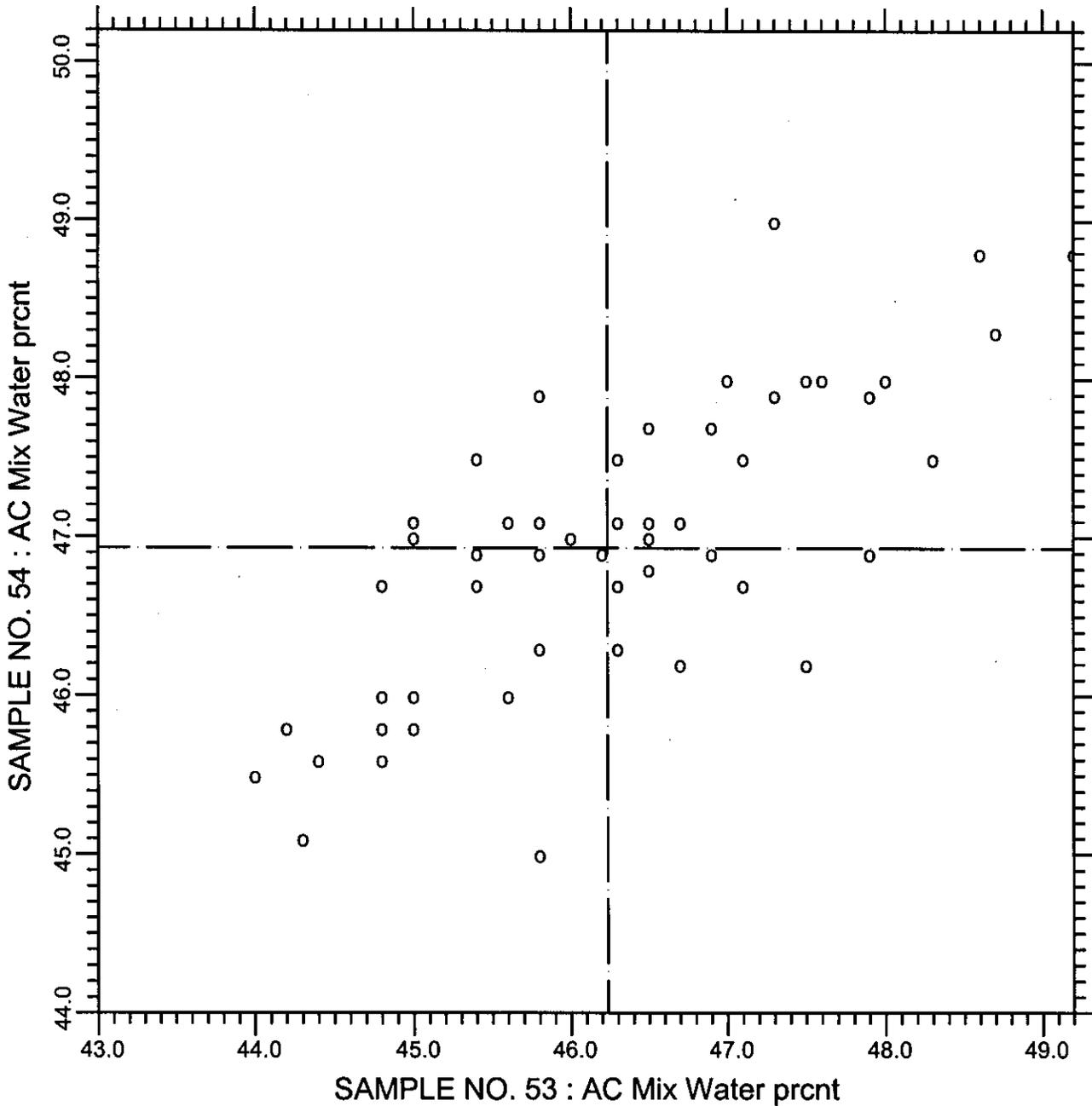
TEST NO.170

Air Content

65 POINTS

SAMPLE NO. 53	AVE	18.89	S.D.	1.4	C.V.	7.48
SAMPLE NO. 54	AVE	16.22	S.D.	1.1	C.V.	7.00

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Air Content - Water**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.180

AC Mix Water

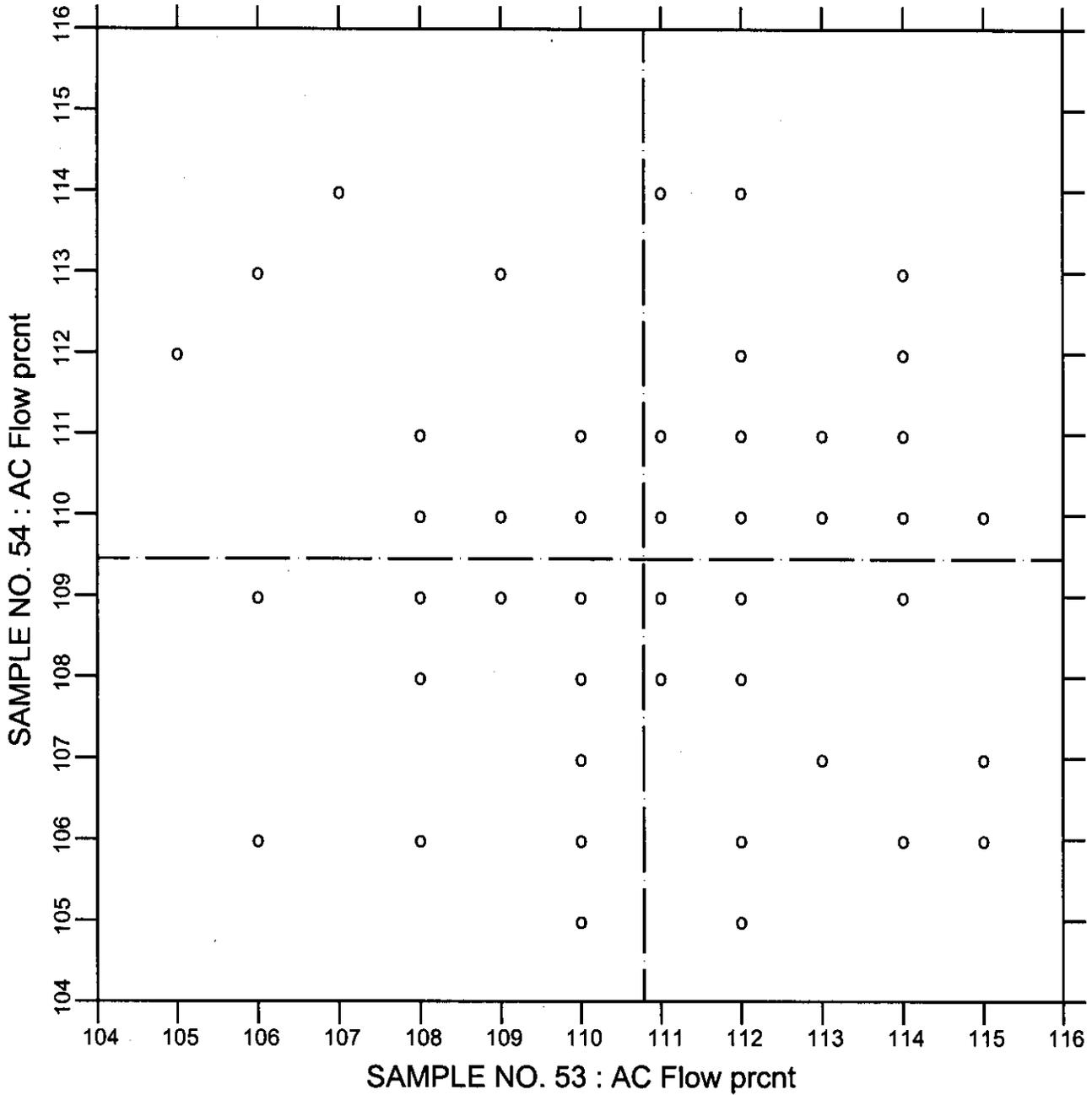
62 POINTS

SAMPLE NO. 53    AVE 46.24    S.D. 1.23    C.V. 2.65

SAMPLE NO. 54    AVE 46.93    S.D. 0.91    C.V. 1.94

LABS ELIMINATED 139 159 222 1379

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Air Content - Flow**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



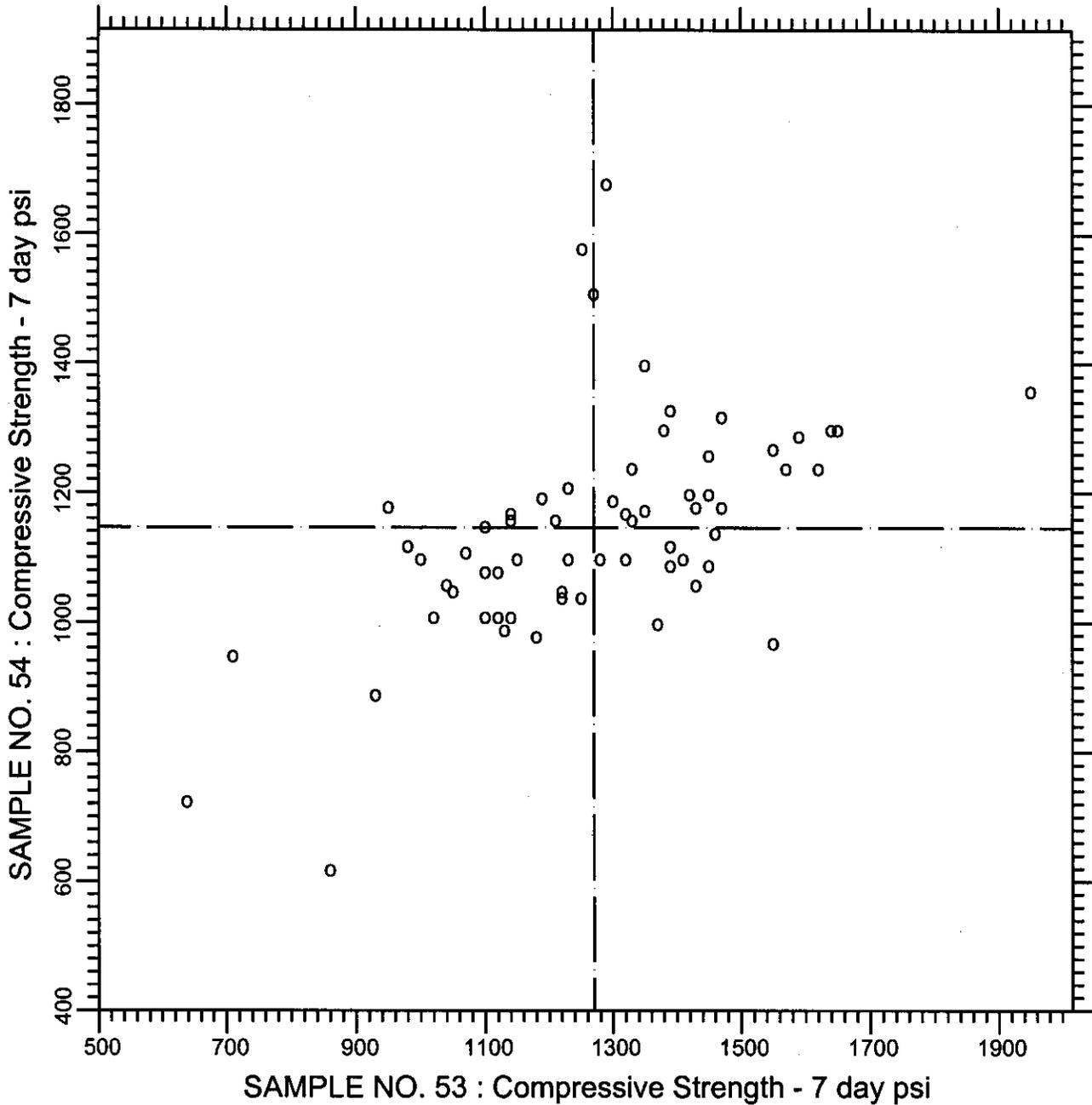
TEST NO.190

AC Flow

66 POINTS

SAMPLE NO. 53	AVE	110.79	S.D.	2.4	C.V.	2.15
SAMPLE NO. 54	AVE	109.45	S.D.	2.2	C.V.	1.99

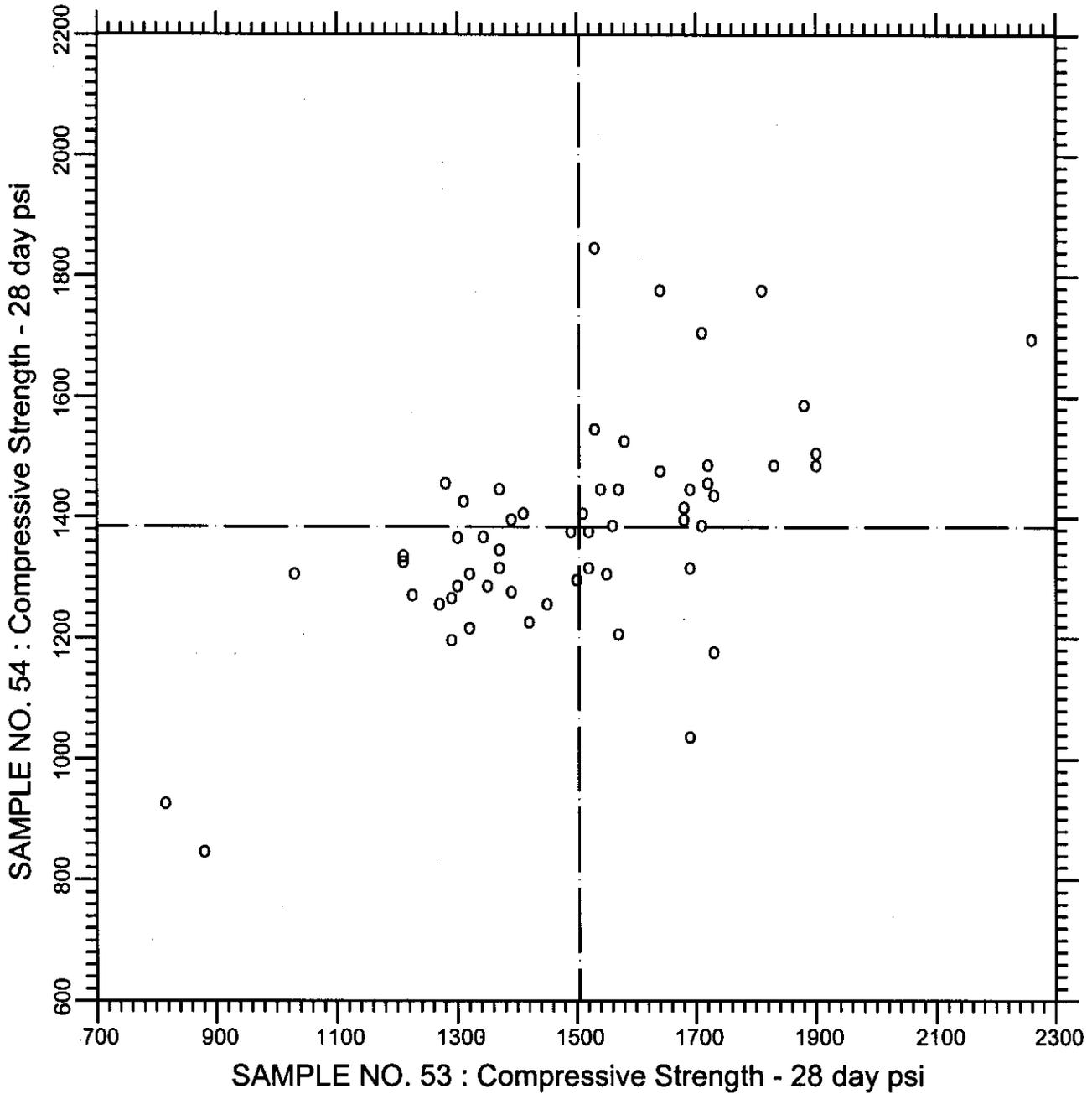
**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Compressive Strength - 7 day**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



**TEST NO.210      Compressive Strength - 7 day      64 POINTS**

SAMPLE NO. 53	AVE	1270.3	S.D.	229.6	C.V.	18.1
SAMPLE NO. 54	AVE	1146.2	S.D.	167.6	C.V.	14.6

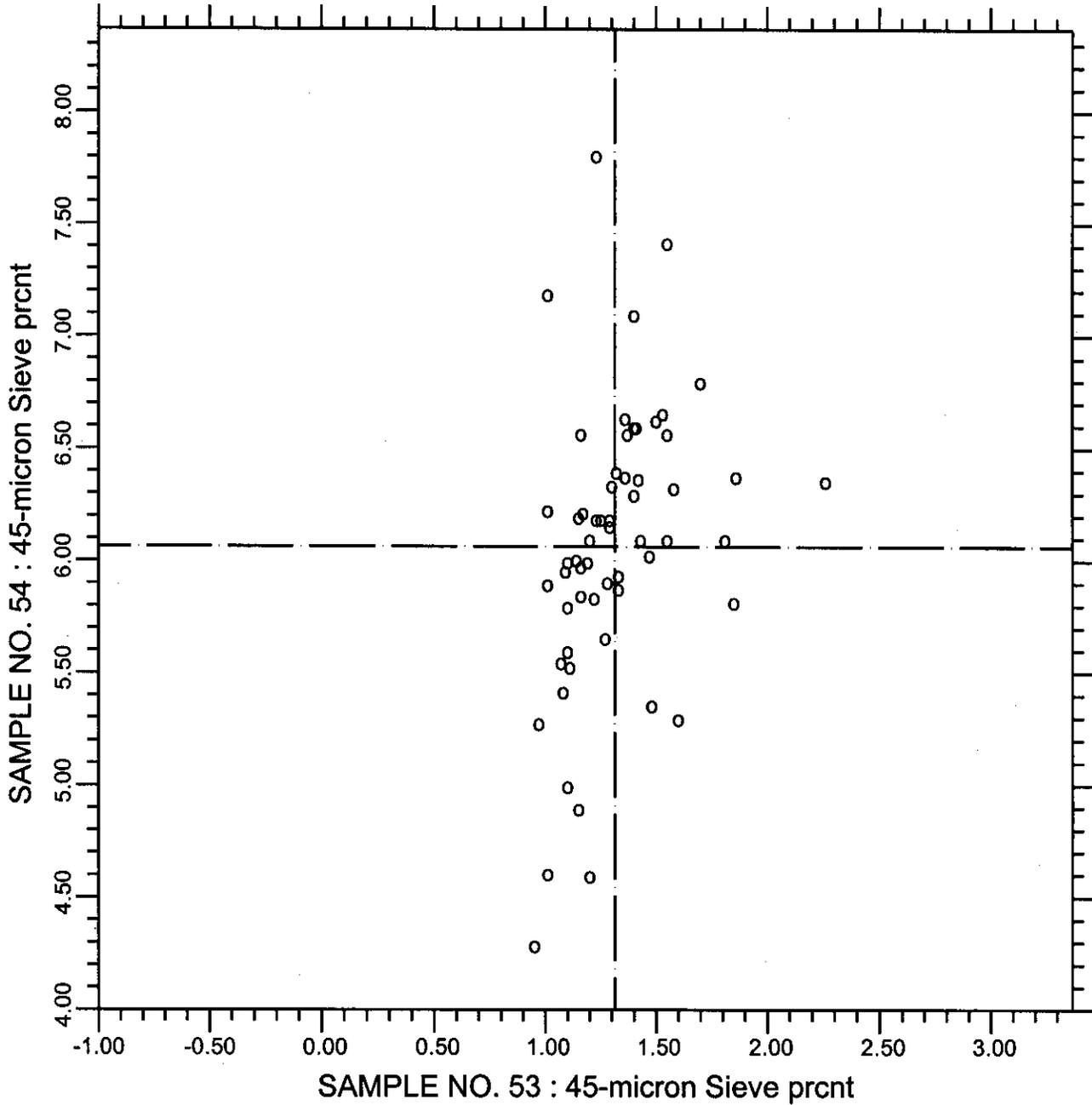
**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Compressive Strength - 28 day**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



**TEST NO.211    Compressive Strength - 28 day    58 POINTS**

SAMPLE NO. 53	AVE	1503.8	S.D.	253.3	C.V.	16.8
SAMPLE NO. 54	AVE	1384.4	S.D.	178.7	C.V.	12.9

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Fineness - 45 micron Sieve Retained**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.281

45-micron Sieve

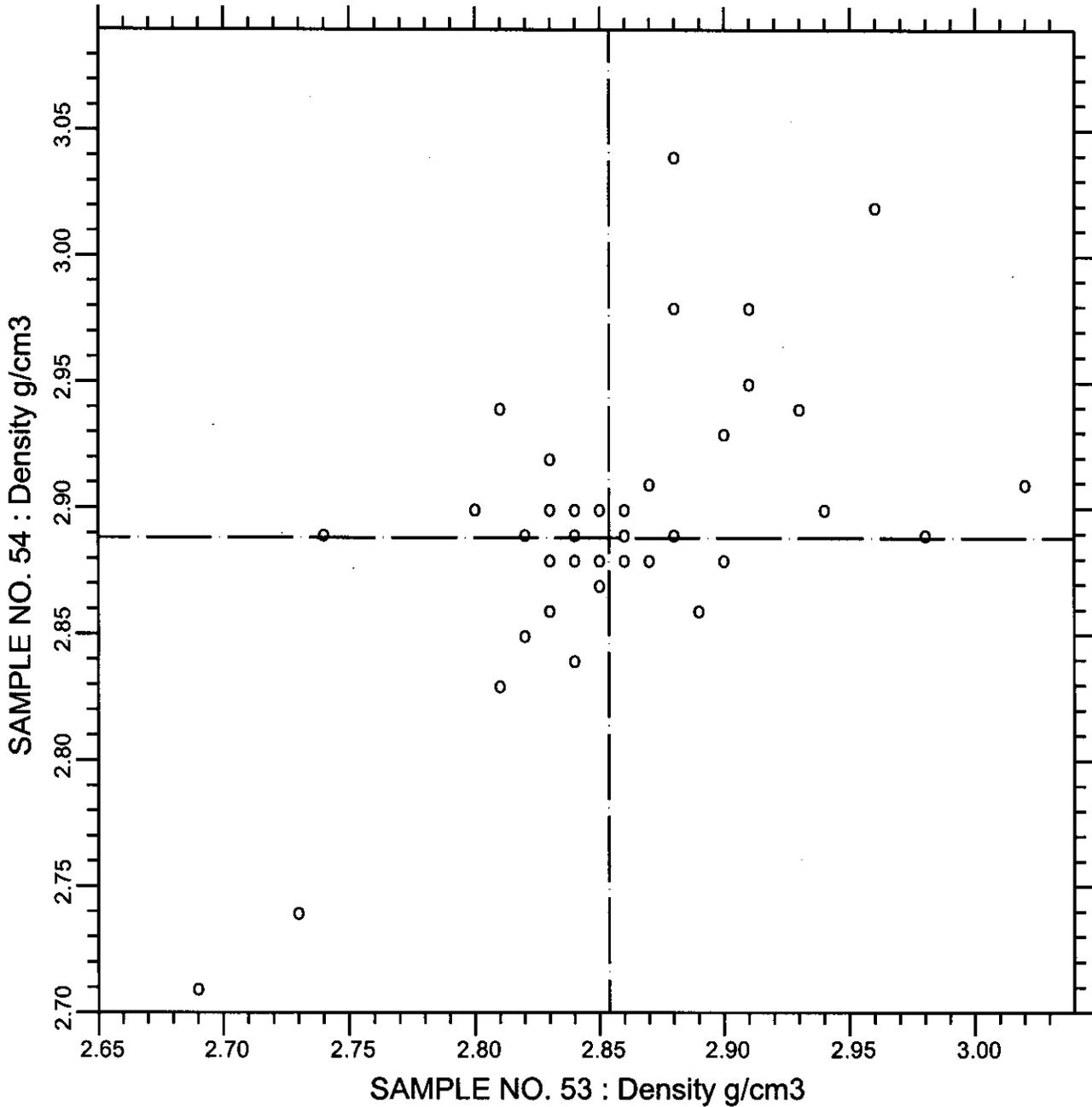
59 POINTS

SAMPLE NO. 53    AVE 1.315    S.D. 0.25    C.V. 19.1

SAMPLE NO. 54    AVE 6.065    S.D. 0.65    C.V. 10.6

LABS ELIMINATED 42 74 162 159 605 1200

CCRL PROFICIENCY SAMPLE PROGRAM  
Density  
MASONRY CEMENT SAMPLES NO. 53 & NO. 54



TEST NO.310

Density

45 POINTS

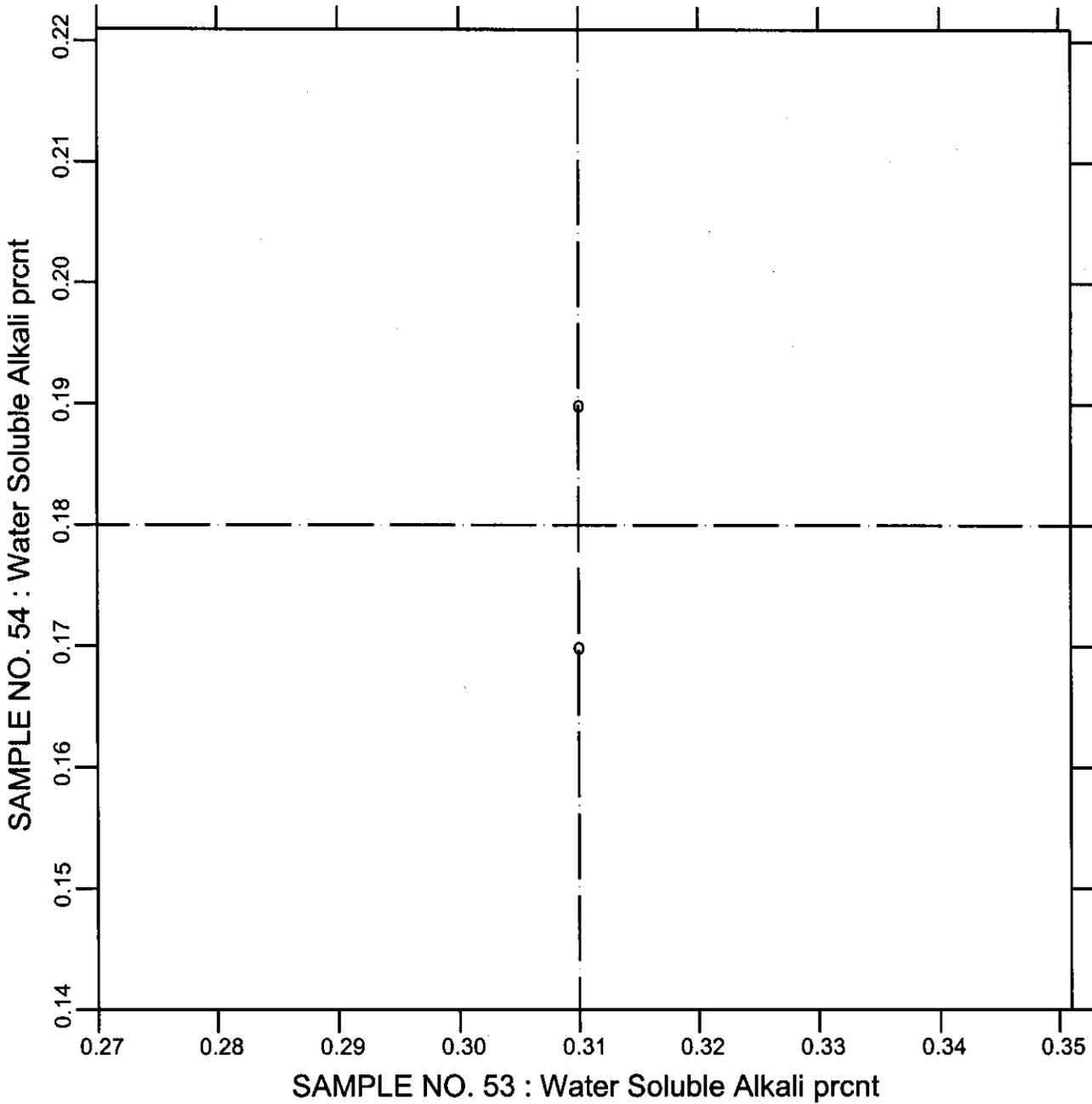
SAMPLE NO. 53 AVE 2.8539 S.D. 0.063 C.V. 2.20

SAMPLE NO. 54 AVE 2.8883 S.D. 0.070 C.V. 2.43

LABS ELIMINATED 178 201

LABS OFF DIAGRAM 98

CCRL PROFICIENCY SAMPLE PROGRAM  
 Water Soluble Alkali  
 MASONRY CEMENT SAMPLES NO. 53 & NO. 54



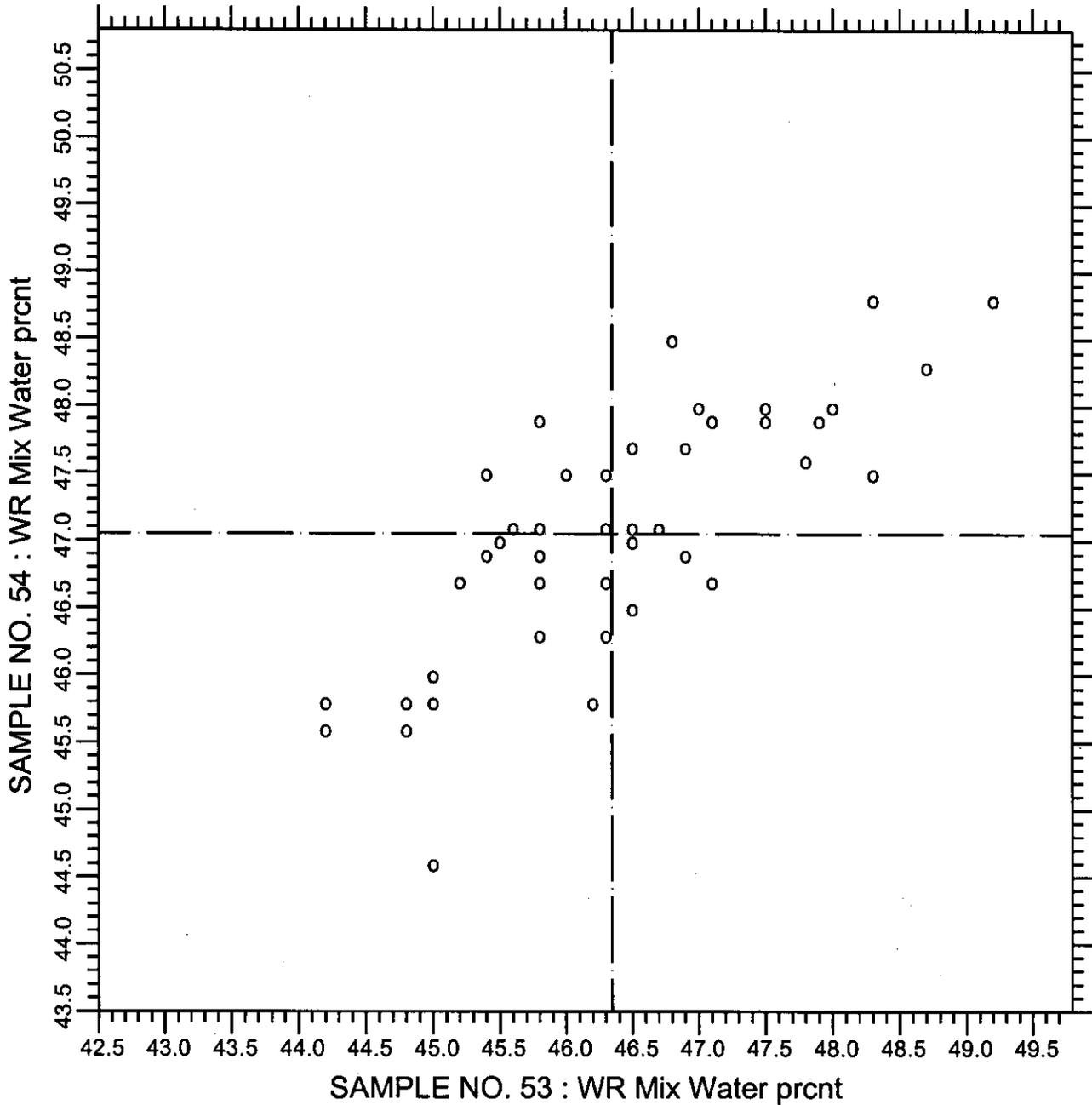
TEST NO.320

Water Soluble Alkali

2 POINTS

SAMPLE NO. 53	AVE	0.310000	S.D.	0.000000	C.V.	0.000001
SAMPLE NO. 54	AVE	0.180000	S.D.	0.014142	C.V.	7.856742

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Water Retention - Water**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.330

WR Mix Water

55 POINTS

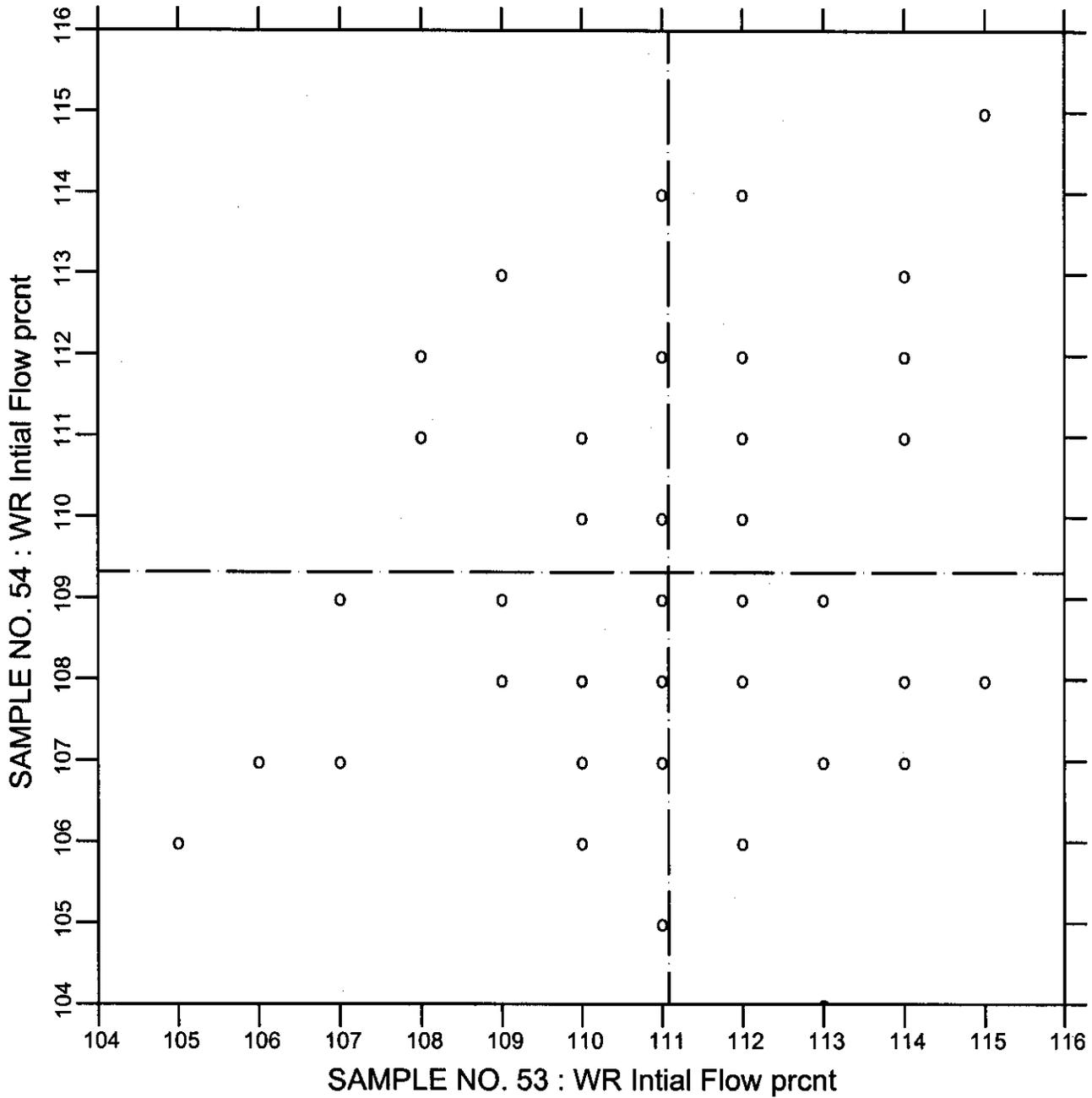
SAMPLE NO. 53 AVE 46.34 S.D. 1.3 C.V. 2.79

SAMPLE NO. 54 AVE 47.05 S.D. 1.0 C.V. 2.21

LABS ELIMINATED 139 159 222

LABS OFF DIAGRAM 1379

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Water Retention - Initial Flow**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.331

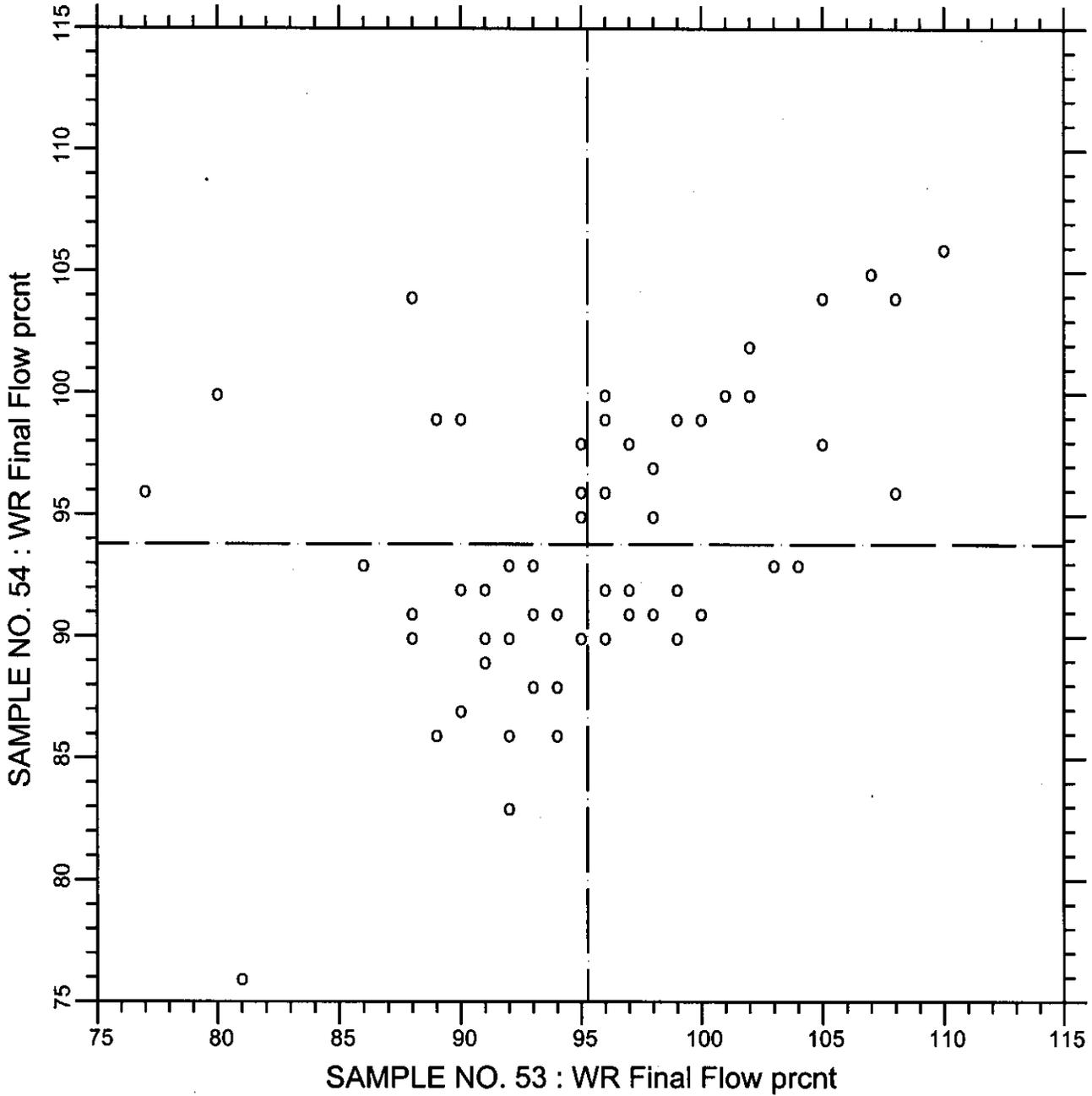
WR Intial Flow

60 POINTS

SAMPLE NO. 53    AVE 111.08    S.D. 2.1    C.V. 1.92

SAMPLE NO. 54    AVE 109.32    S.D. 2.3    C.V. 2.10

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Water Retention - Final Flow**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.332

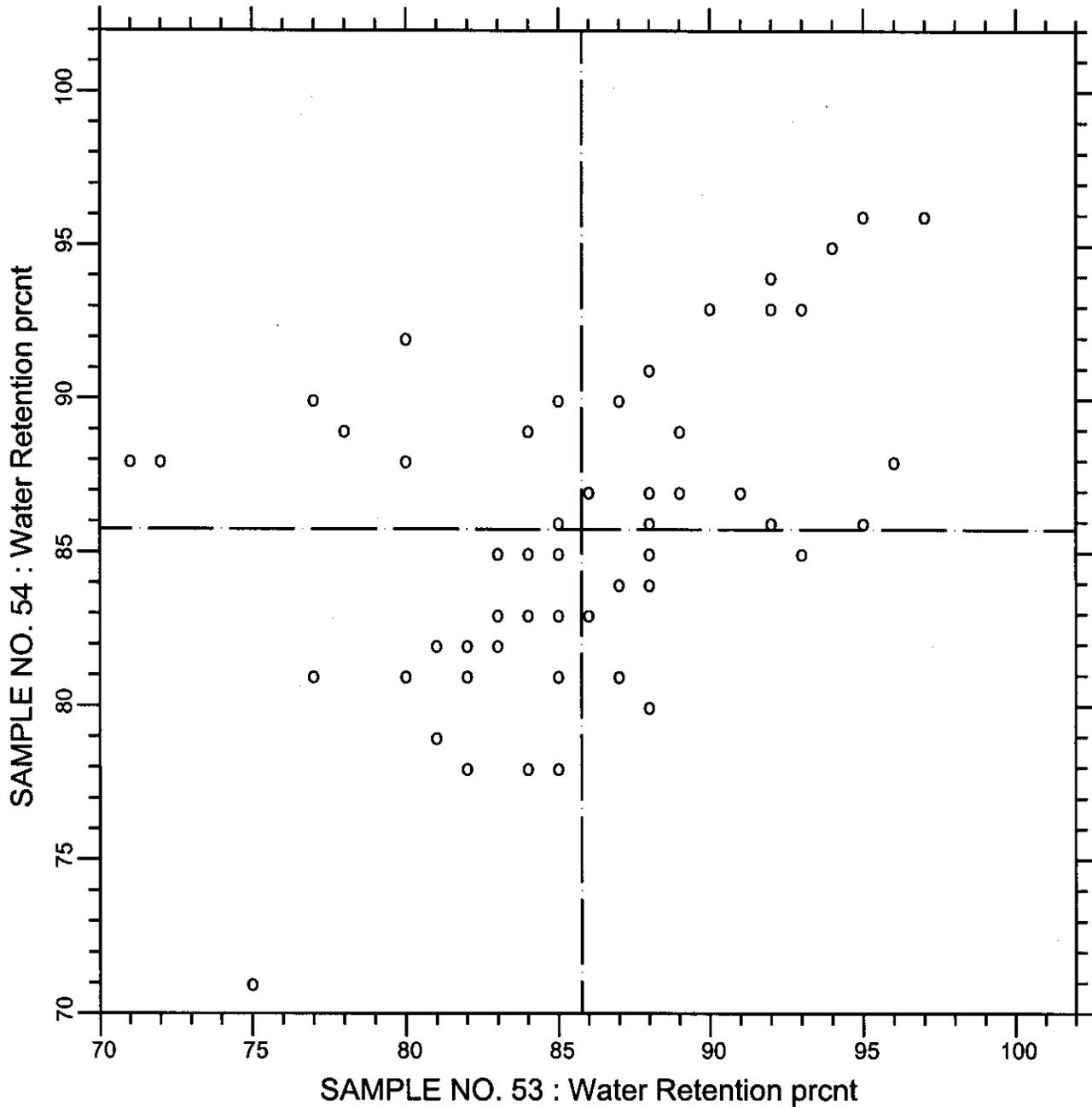
WR Final Flow

60 POINTS

SAMPLE NO. 53    AVE 95.27    S.D. 6.6    C.V. 6.93

SAMPLE NO. 54    AVE 93.80    S.D. 5.8    C.V. 6.22

**CCRL PROFICIENCY SAMPLE PROGRAM**  
**Water Retention Value**  
**MASONRY CEMENT SAMPLES NO. 53 & NO. 54**



TEST NO.333

Water Retention

61 POINTS

SAMPLE NO. 53    AVE 85.77    S.D. 5.6    C.V. 6.49

SAMPLE NO. 54    AVE 85.75    S.D. 5.0    C.V. 5.83