CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Concrete Masonry Units Proficiency Samples
Number 15 and Number 16

October 2003

CCRL CEMENT AND CONCRETE
REFERENCE LABORATORY

CEMENT AND CONCRETE REFERENCE LABORATORY

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

100 Bureau Dr., Stop 8618
Fax: 301-975-2243
e-mail: ccrl@nist.gov

October 17, 2003

TO: Participants in the CCRL Concrete Masonry Units Proficiency Sample Program

SUBJECT: Final Report for Concrete Masonry Units Proficiency Samples No. 15 and No. 16
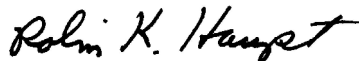
Enclosed is your copy of the final report, on the test results for the current pair of CCRL **Concrete Masonry Units** Proficiency Samples which were distributed in July 2003.

This report consists of Table of Results for individual laboratory data, a statistical Summary of Results, a set of general Scatter Diagrams, and associated detailed information.

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.

It is presently anticipated that the next Concrete Masonry Units Proficiency Samples will be distributed in July 2004.

Sincerely,

Robin K. Haupt
Supervisor, Proficiency Sample Programs
Cement and Concrete Reference Laboratory
Materials and Construction Research Division
Building and Fire Research Laboratory

Enclosure

To: Participants in the CCRL Concrete Masonry Units Proficiency Sample Program

From: Robin K. Haupt, Supervisor, PSP

Subject: Explanation of Final Report on Results of Tests on Concrete Masonry Units Proficiency Samples No. 15 and No. 16

This letter, and the material included with it, constitute the final report, and summary of results for the current pair of Concrete Masonry Units Proficiency Samples, which were distributed in July 2003. 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, and "Statistical Aspects of the Cement Testing Program" by W.J. Youden, 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.

Each laboratory receives an individualized Table of Results. The Table of Results shows the test number, test title and the reporting unit in the first three 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. (See reverse for an explanation of the scatter diagrams.)

Laboratory ratings, shown in the Table of Results 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.

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.

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

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 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 - General

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. Each laboratory will receive a complete set of diagrams according to their subscription to the given program.

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 indicates strong evidence of bias on many tests.

CCRL PROFICIENCY SAMPLE PROGRAM
Concrete Masonry Units Proficiency Samples No. 15 and No. 16
Final Report
October 17, 2003

SUMMARY OF RESULTS

			Sample No. 15			Sample No. 16		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
COMPRESSION UNITS								
Received Weight	lb	69	12.71	0.13	1.02	11.13	0.30	2.70
Received Weight	lb *	68	12.71	0.13	1.03	11.14	0.28	2.51
Max Comp Load	lbf	69	84330	18739.3	22.2	61617	15543.0	25.2
Max Comp Load	lbf *	66	87399	11919.4	13.6	63612	12182.7	19.2
Comp Strength	psi	69	4219	751.9	17.8	3222	663.4	20.6
Comp Strength	psi *	68	4258	685.5	16.1	3238	654.7	20.2
ABSORPTION UNITS								
Received Weight	lb	68	12.69	0.15	1.21	11.15	0.23	2.04
Width	inch	68	3.71	0.48	13.0	3.69	0.48	13.0
Width	inch *	67	3.65	0.0148	0.406	3.64	0.0092	0.255
Height	inch	68	7.55	0.48	6.39	7.60	0.49	6.45
Height	inch *	66	7.61	0.024	0.314	7.66	0.039	0.507
Length	inch	68	7.63	0.017	0.228	7.62	0.023	0.300
Length	inch *	65	7.63	0.014	0.187	7.62	0.016	0.213
Face Thickness	inch	68	1.07	0.058	5.40	1.05	0.051	4.83
Face Thickness	inch *	65	1.06	0.046	4.30	1.04	0.040	3.86

CONTINUED ON REVERSE SIDE

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

Received Weight (CU)	475
Max Compressive Load	270 825 926
Compressive Strength	825
Width	646
Height	646 1238
Length	39 646 951
Face Thickness	10 202 804

CCRL PROFICIENCY SAMPLE PROGRAM
Concrete Masonry Units Proficiency Samples No. 15 and No. 16
### Final Report
October 17, 2003

SUMMARY OF RESULTS

			Sample No. 15			Sample No. 16		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
ABSORPTION UNITS (continued)								
Web Thickness	inch	67	1.08	0.10	9.30	1.08	0.12	10.86
Web Thickness	inch *	66	1.08	0.066	6.19	1.06	0.061	5.74
Immersed Weight	lb	68	7.53	0.17	2.23	6.47	0.30	4.56
Immersed Weight	lb *	66	7.55	0.12	1.60	6.47	0.29	4.45
Saturated Weight	lb	68	13.12	0.15	1.16	11.80	0.20	1.66
Oven-Dry Weight	lb	68	12.43	0.14	1.17	10.93	0.28	2.58
Net Area	ft^3	68	20.75	2.8	13.6	19.74	2.9	14.5
Net Area	ft^3 *	65	20.28	0.28	1.40	19.26	0.65	3.39
Absorption	lb/ft^3	67	7.6	1.4	18.6	9.9	1.9	19.0
Absorption	lb/ft^3 *	61	7.9	0.38	4.77	10.2	1.19	11.59
Density	lb/ft^3	68	138.7	2.5	1.79	128.2	6.6	5.14
Density	lb/ft^3 *	67	138.9	1.8	1.26	128.4	6.5	5.07
Equivalent Thick	inch	68	2.68	0.46	17.1	2.54	0.44	17.4
Equivalent Thick	inch *	64	2.66	0.031	1.16	2.52	0.092	3.63

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

|	
Web Thickness	475
Immersed Weight	475 896
Net Area	148 646 896
Absorption	475 270 896 1279 1223 1577
Density	896
Equivalent Thickness	646 896 1279 1878

CCRL PROFICIENCY SAMPLE PROGRAM
Received Weight - Compression Units
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Received Weight (CU) lb

SAMPLE NO. 15 : Received Weight (CU) lb
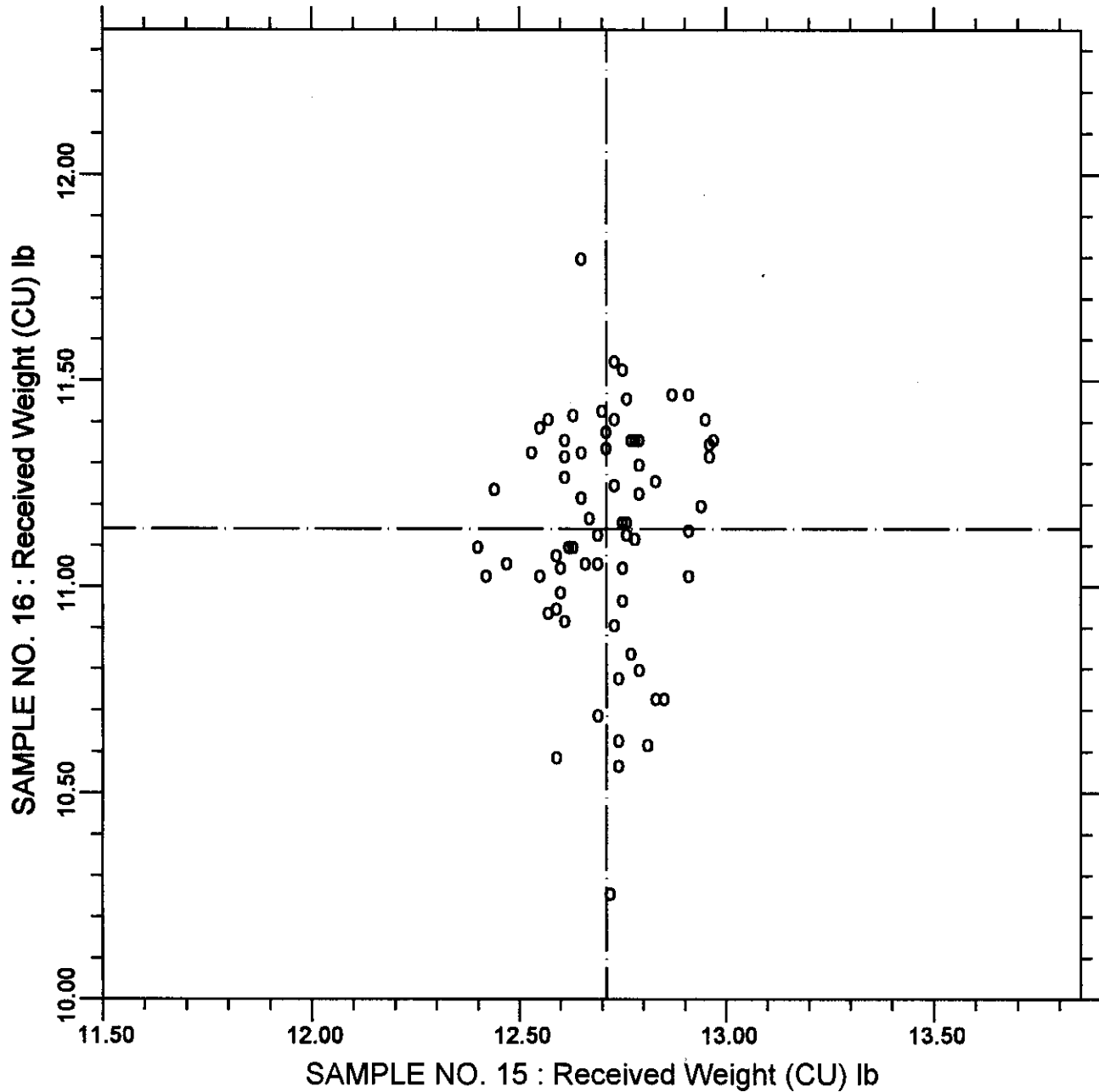
TEST NO.500   **Received Weight (CU)**   **68 POINTS**

SAMPLE NO. 15   AVE   12.711   S.D. 0.13   C.V. 1.03
SAMPLE NO. 16   AVE   11.141   S.D. 0.28   C.V. 2.51
LABS ELIMINATED 475

CCRL PROFICIENCY SAMPLE PROGRAM
Maximum Compressive Load
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16
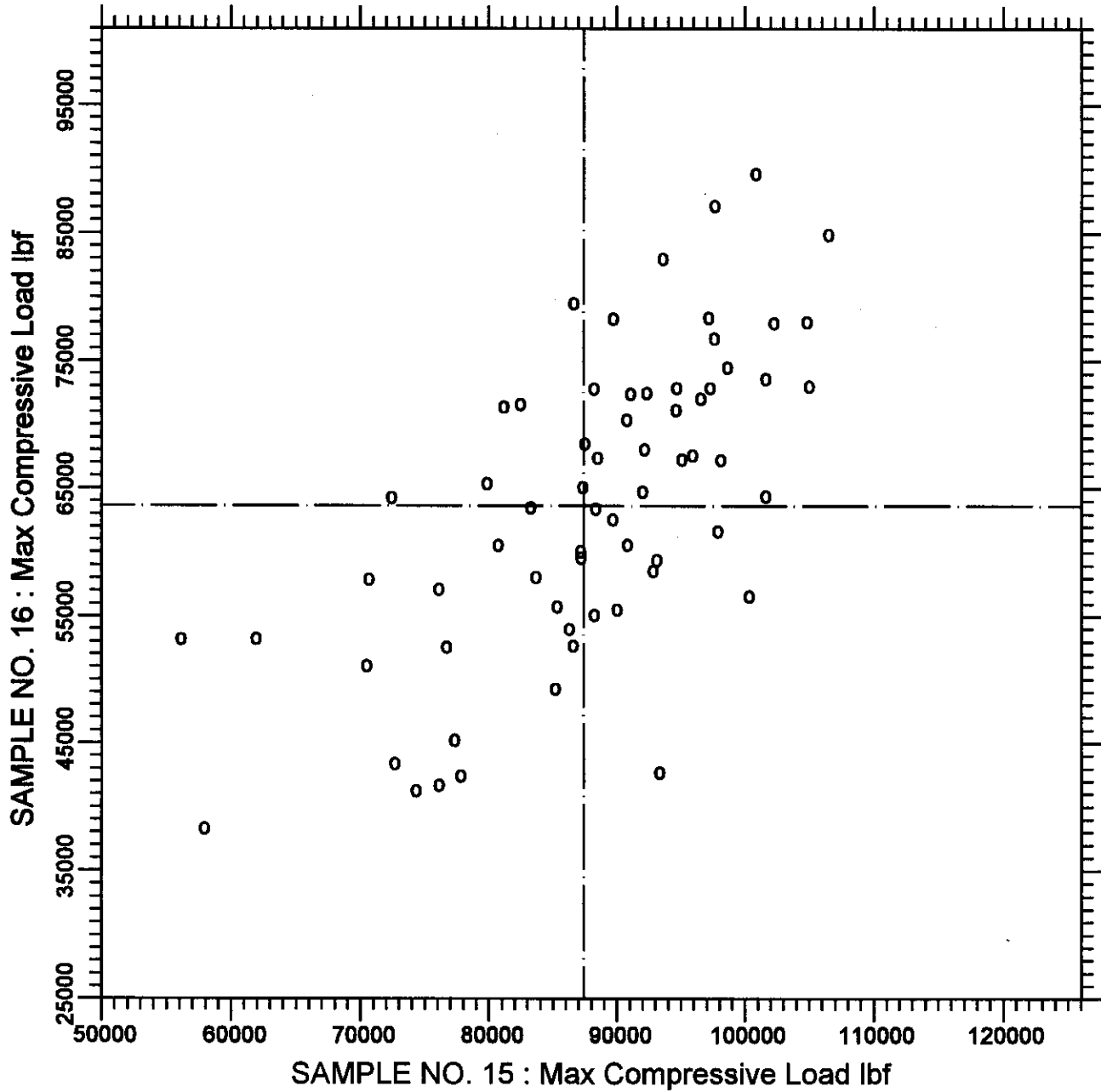
TEST NO.550   **Max Compressive Load**   **65 POINTS**

SAMPLE NO. 15   AVE   87398.9   S.D. 11919.4   C.V. 13.6
SAMPLE NO. 16   AVE   63611.7   S.D. 12182.7   C.V. 19.2
LABS ELIMINATED 270 825 926
LABS OFF DIAGRAM 1279

CCRL PROFICIENCY SAMPLE PROGRAM
Net Area Compressive Strength
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Compressive Strength psi

SAMPLE NO. 15 : Compressive Strength psi
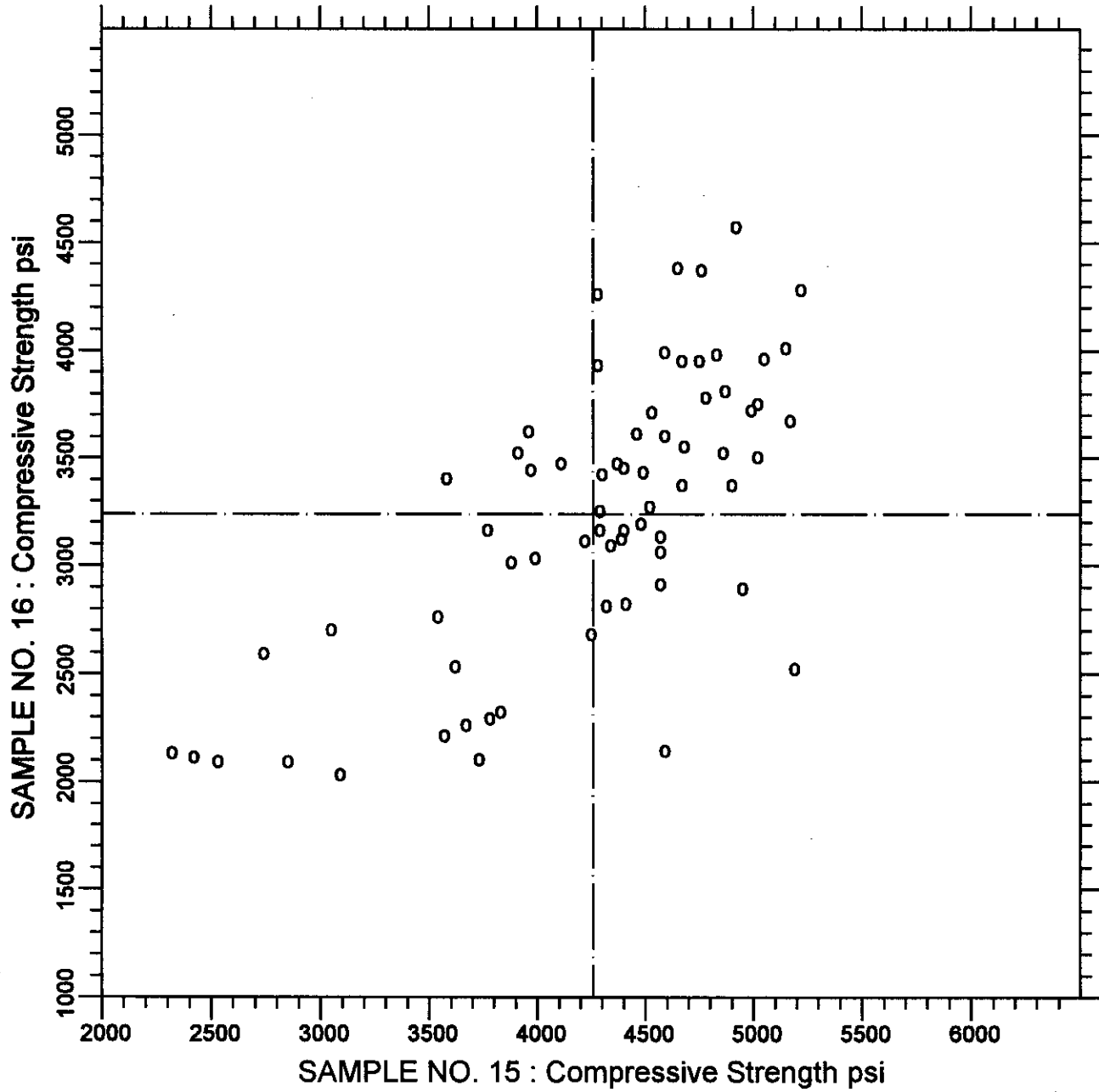
TEST NO.560   **Compressive Strength**   **68 POINTS**

SAMPLE NO. 15   AVE   4257.5   S.D. 685.5   C.V. 16.1
SAMPLE NO. 16   AVE   3238.4   S.D. 654.7   C.V. 20.2
LABS ELIMINATED 825

CCRL PROFICIENCY SAMPLE PROGRAM
Received Weight - Absorption Units
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Received Weight (AU) lb

SAMPLE NO. 15 : Received Weight (AU) lb
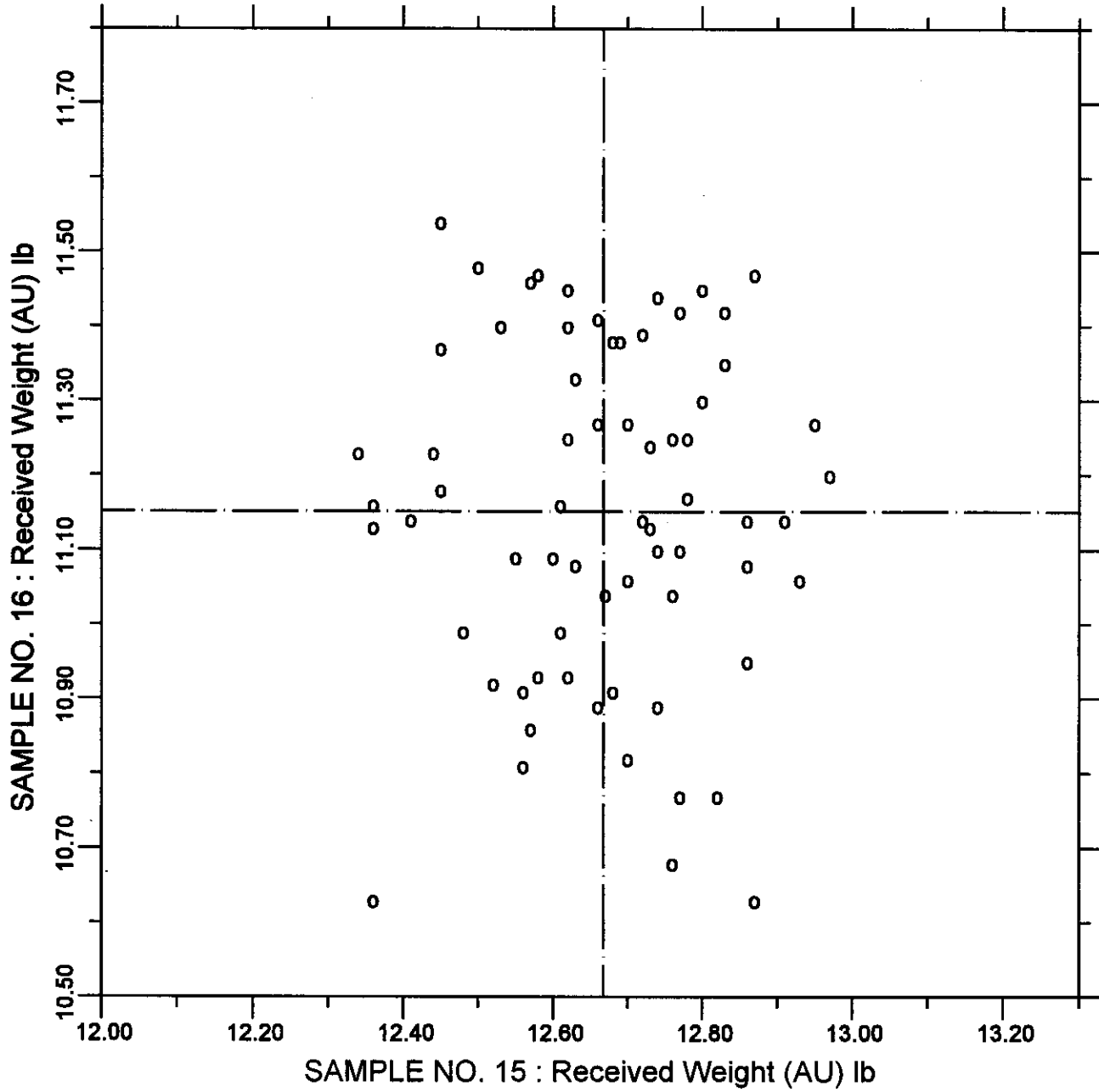
TEST NO.600   Received Weight (AU)   68 POINTS

SAMPLE NO. 15   AVE 12.668   S.D. 0.15   C.V. 1.21
SAMPLE NO. 16   AVE 11.151   S.D. 0.23   C.V. 2.04

CCRL PROFICIENCY SAMPLE PROGRAM
Width
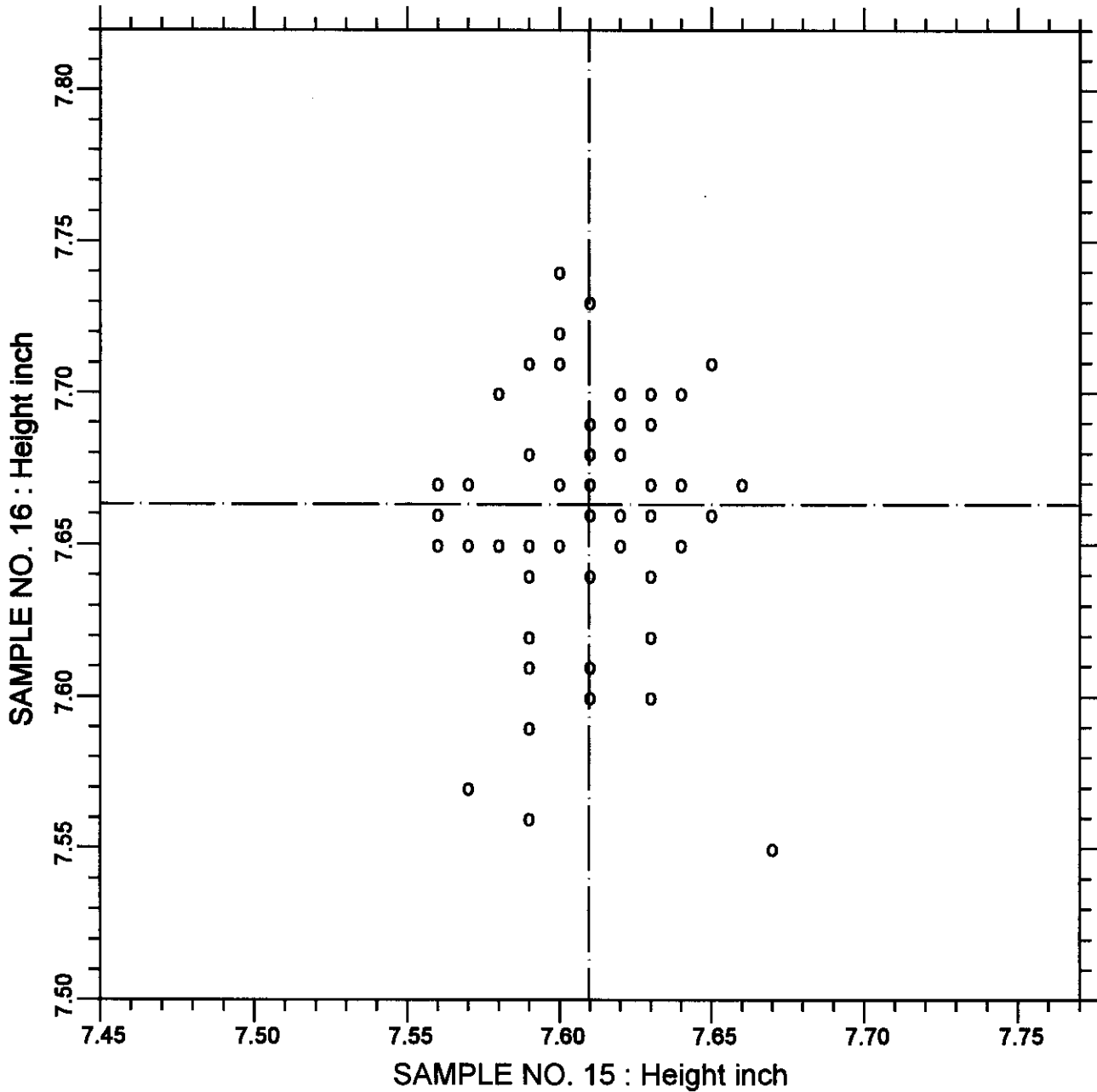## CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16
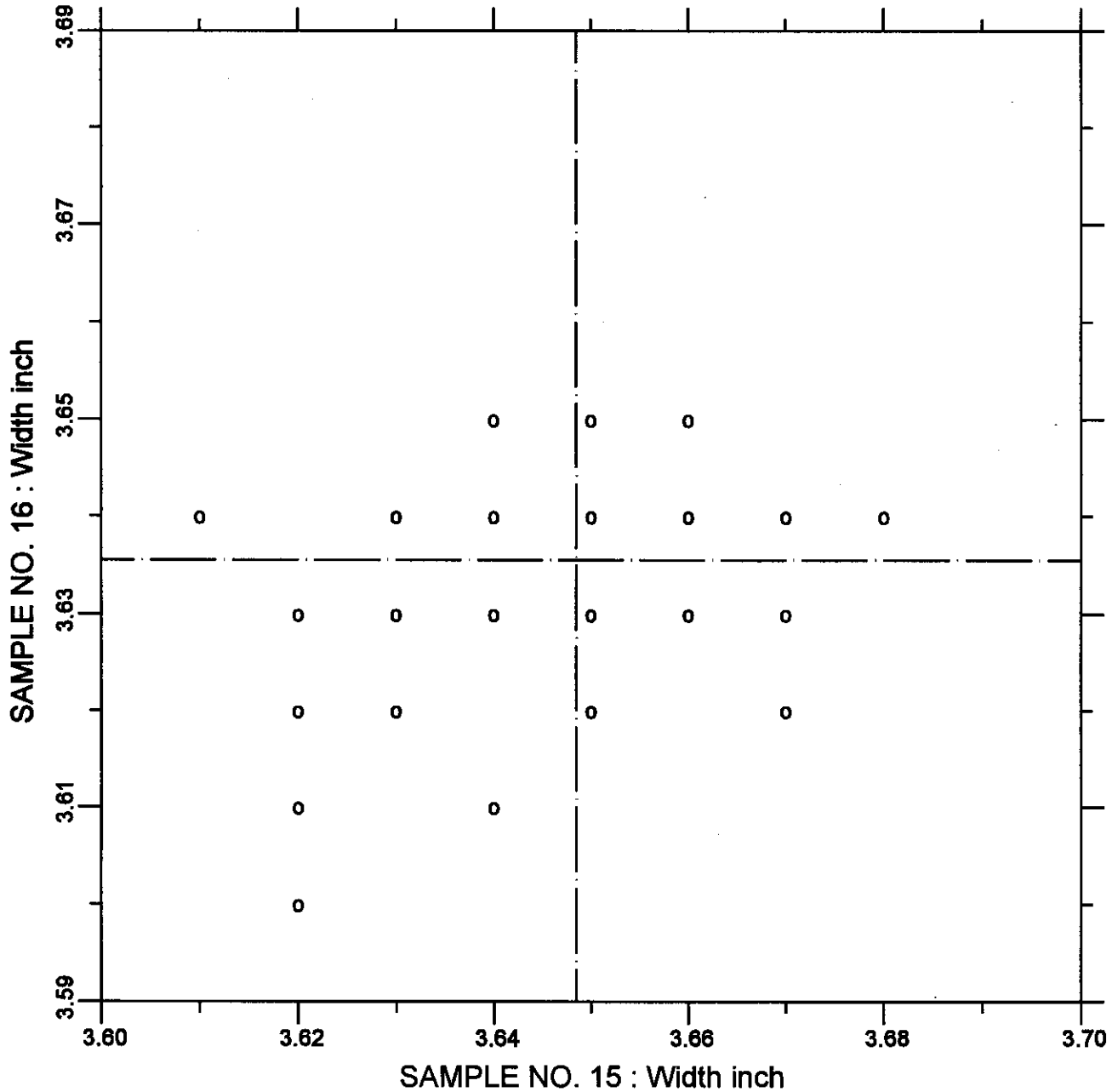
TEST NO.510   **Width**   **67 POINTS**

SAMPLE NO. 15   AVE 3.6485   S.D. 0.0148   C.V. 0.406
SAMPLE NO. 16   AVE 3.6355   S.D. 0.0092   C.V. 0.255
LABS ELIMINATED 646

CCRL PROFICIENCY SAMPLE PROGRAM
Height
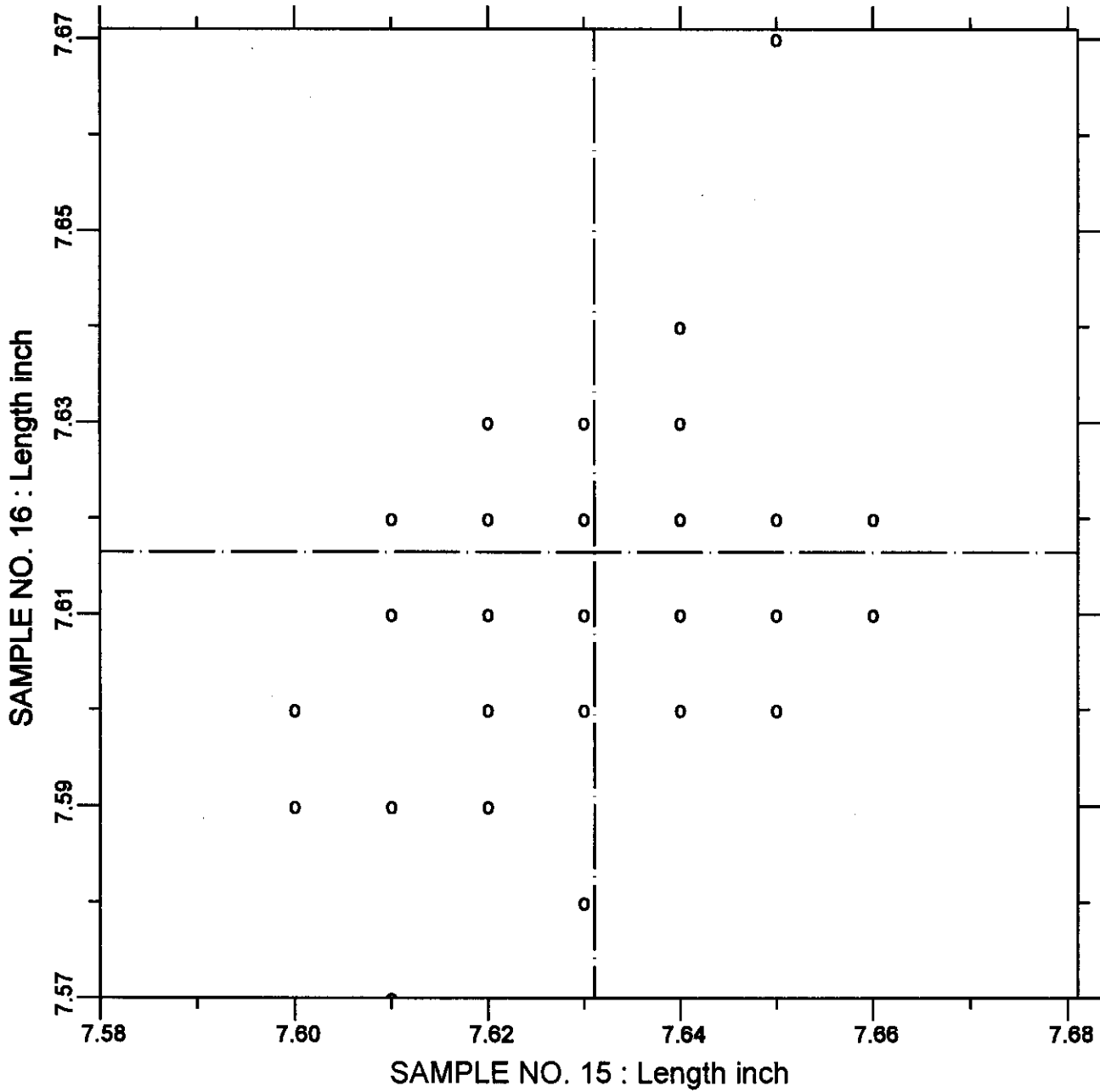## CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

TEST NO.520   **Height**   **66 POINTS**

SAMPLE NO. 15   AVE   7.6097   S.D.   0.024   C.V.   0.314
SAMPLE NO. 16   AVE   7.6632   S.D.   0.039   C.V.   0.507
LABS ELIMINATED   646 1238

CCRL PROFICIENCY SAMPLE PROGRAM
Length
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16
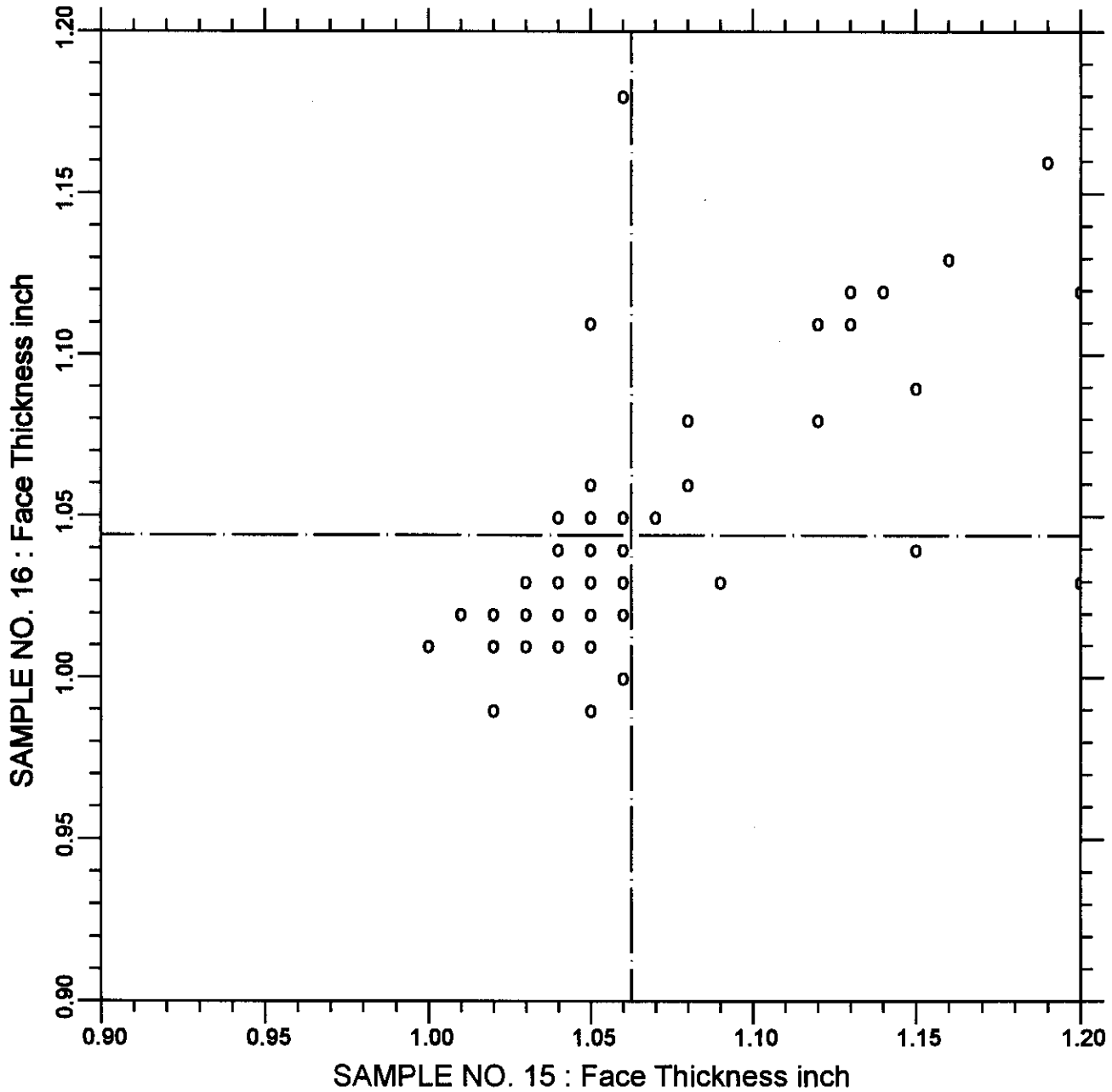

TEST NO.530   **Length**   **65 POINTS**

SAMPLE NO. 15   AVE   7.6311   S.D. 0.014   C.V. 0.187
SAMPLE NO. 16   AVE   7.6165   S.D. 0.016   C.V. 0.213
LABS ELIMINATED 39 646 951

CCRL PROFICIENCY SAMPLE PROGRAM
Minimum Face Shell Thickness
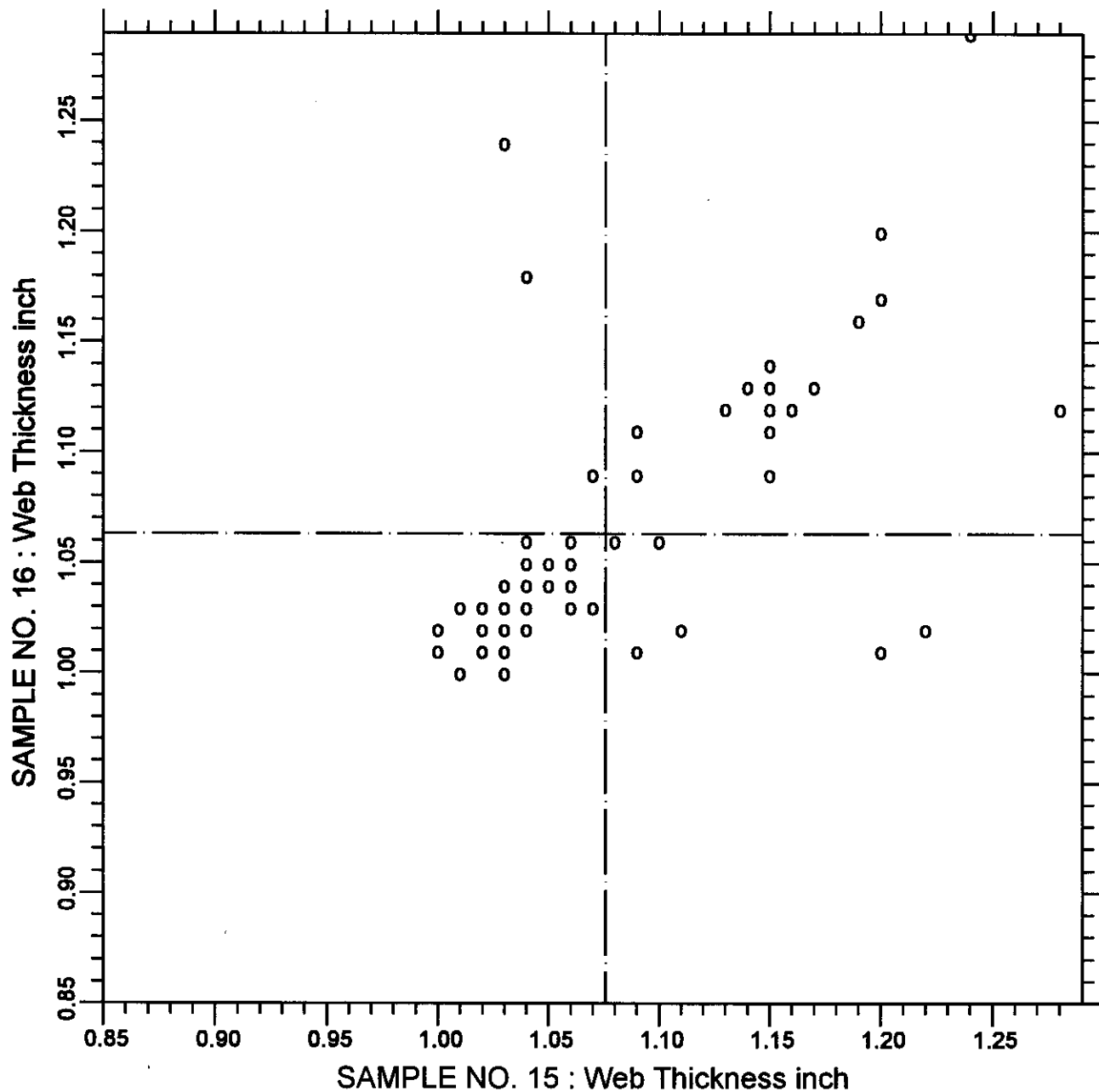## CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Face Thickness inch (y-axis)

SAMPLE NO. 15 : Face Thickness inch (x-axis)

TEST NO.532   **Face Thickness**   **65 POINTS**

SAMPLE NO. 15   AVE   1.0626   S.D.   0.046   C.V.   4.30
SAMPLE NO. 16   AVE   1.0442   S.D.   0.040   C.V.   3.86
LABS ELIMINATED   10 202 804

CCRL PROFICIENCY SAMPLE PROGRAM
Minimum Web Thickness
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Web Thickness inch (y-axis)

SAMPLE NO. 15 : Web Thickness inch (x-axis)

TEST NO.533   **Web Thickness**   **66 POINTS**
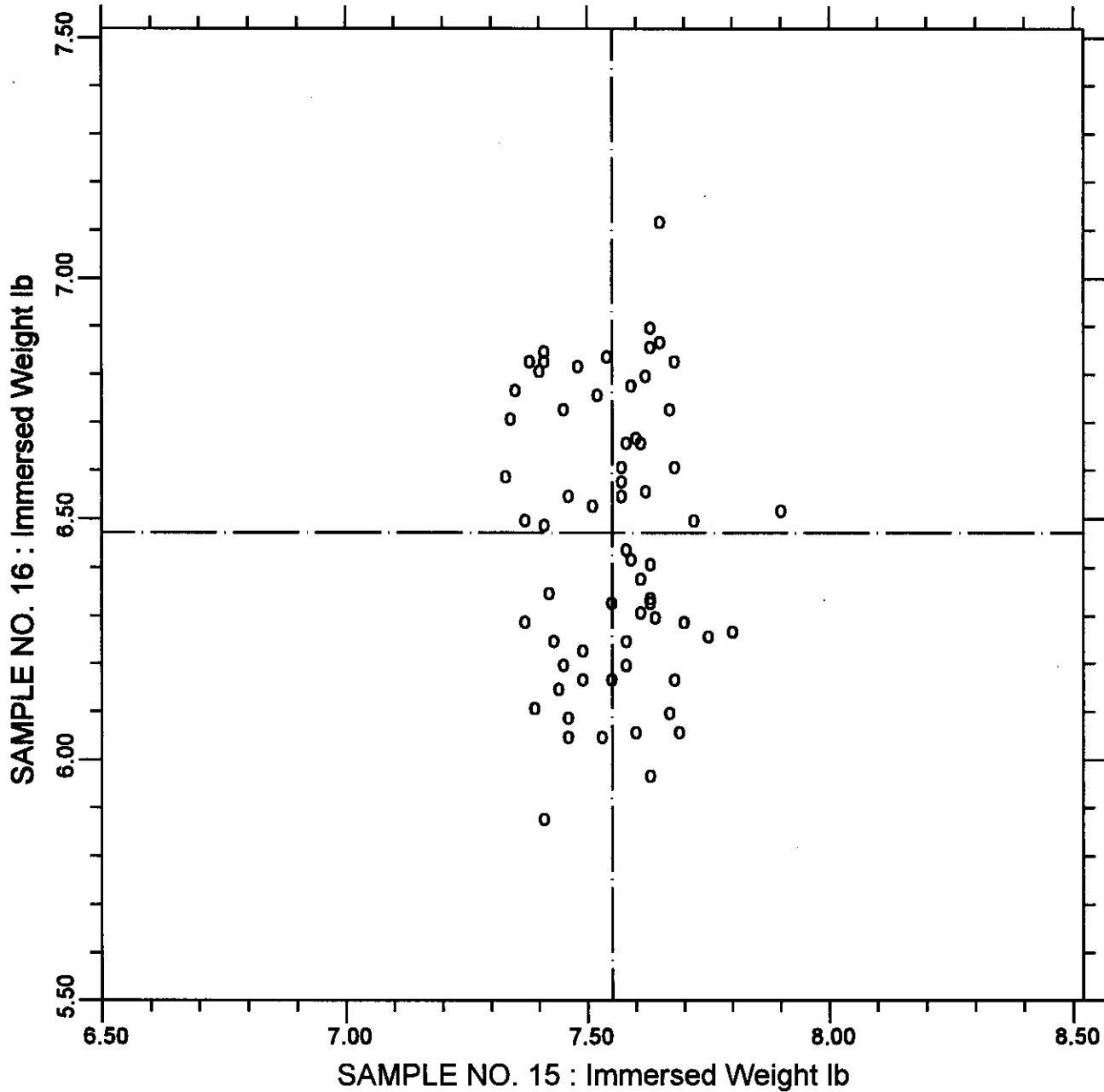
SAMPLE NO. 15   AVE   1.0758   S.D. 0.066   C.V. 6.19
SAMPLE NO. 16   AVE   1.0630   S.D. 0.061   C.V. 5.74
LABS ELIMINATED 475

CCRL PROFICIENCY SAMPLE PROGRAM
Immersed Weight
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

TEST NO.610   Immersed Weight   66 POINTS
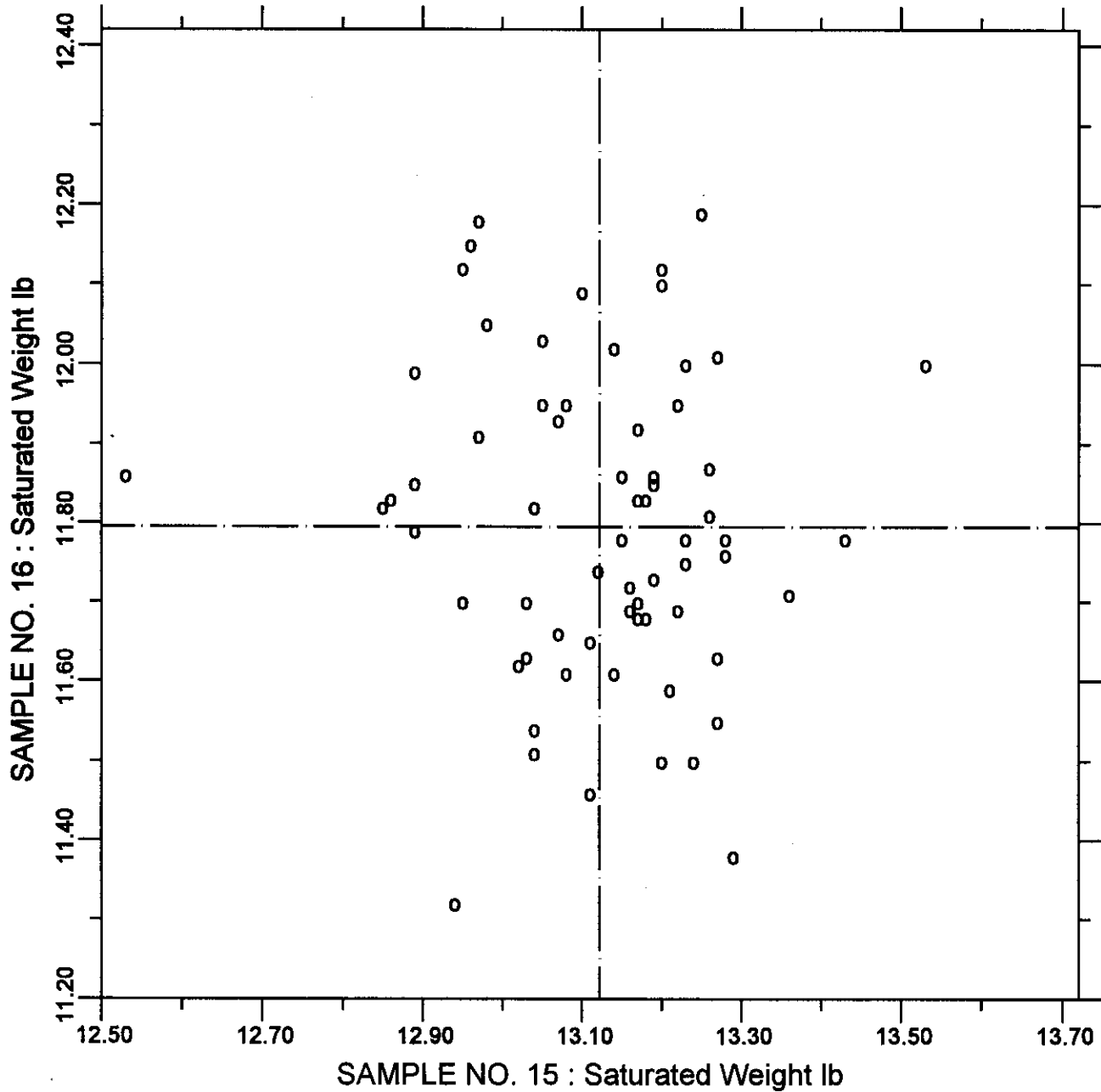
SAMPLE NO. 15   AVE   7.551   S.D. 0.12   C.V. 1.60
SAMPLE NO. 16   AVE   6.472   S.D. 0.29   C.V. 4.45
LABS ELIMINATED 475 896

CCRL PROFICIENCY SAMPLE PROGRAM
Saturated Weight
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16
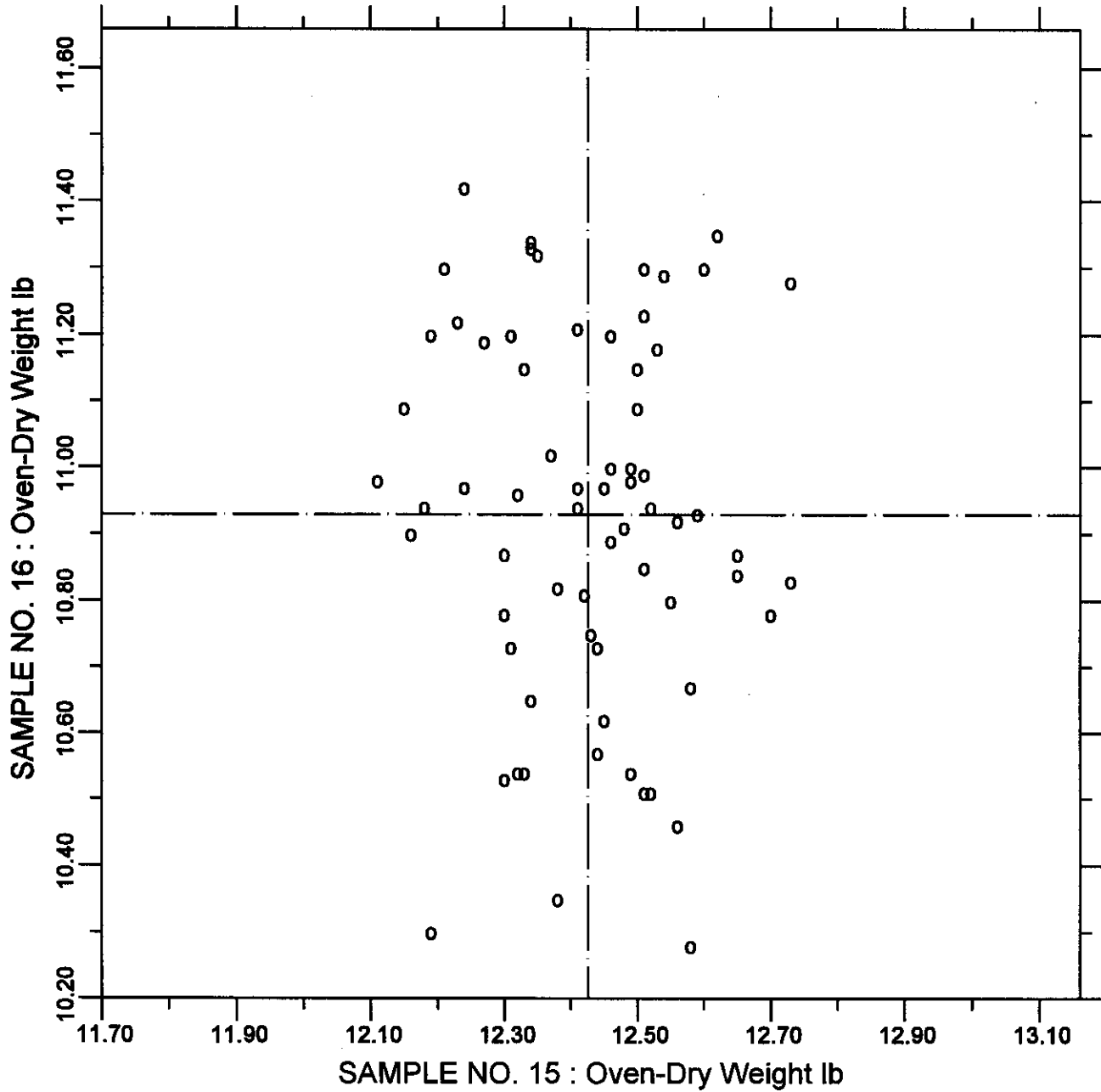

TEST NO.620   **Saturated Weight**   **68 POINTS**

SAMPLE NO. 15   AVE   13.122   S.D. 0.15   C.V. 1.16
SAMPLE NO. 16   AVE   11.795   S.D. 0.20   C.V. 1.66

CCRL PROFICIENCY SAMPLE PROGRAM
Oven-Dry Weight
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16
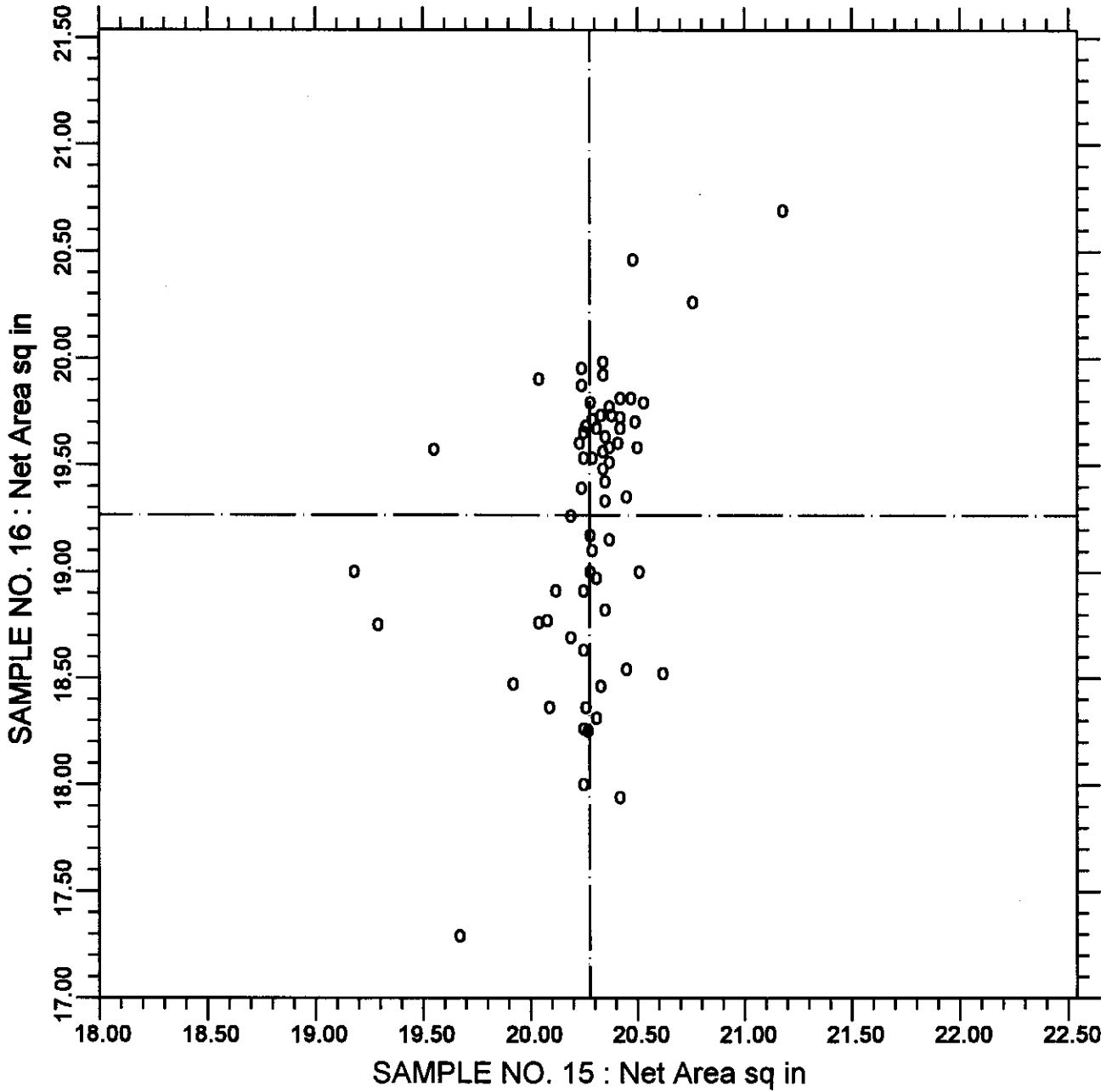

TEST NO.630   **Oven-Dry Weight**   **68 POINTS**

SAMPLE NO. 15   AVE   12.426   S.D. 0.14   C.V. 1.17
SAMPLE NO. 16   AVE   10.929   S.D. 0.28   C.V. 2.58

CCRL PROFICIENCY SAMPLE PROGRAM
Net Area
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Net Area sq in

SAMPLE NO. 15 : Net Area sq in

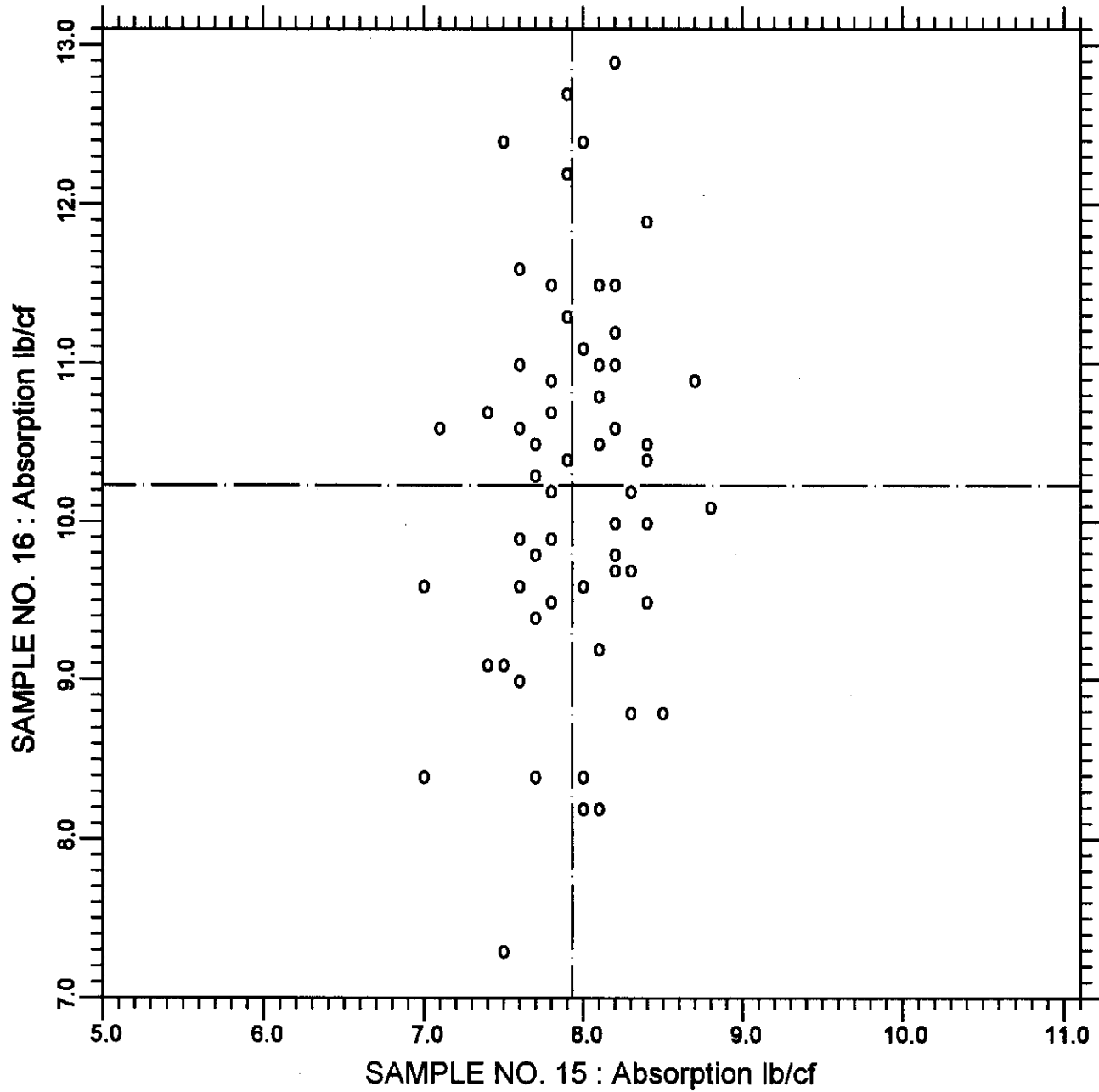**TEST NO.635**   **Net Area**   **65 POINTS**

SAMPLE NO. 15   AVE 20.278   S.D. 0.28   C.V. 1.40
SAMPLE NO. 16   AVE 19.265   S.D. 0.65   C.V. 3.39
LABS ELIMINATED 148 646 896

CCRL PROFICIENCY SAMPLE PROGRAM
Absorption
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16
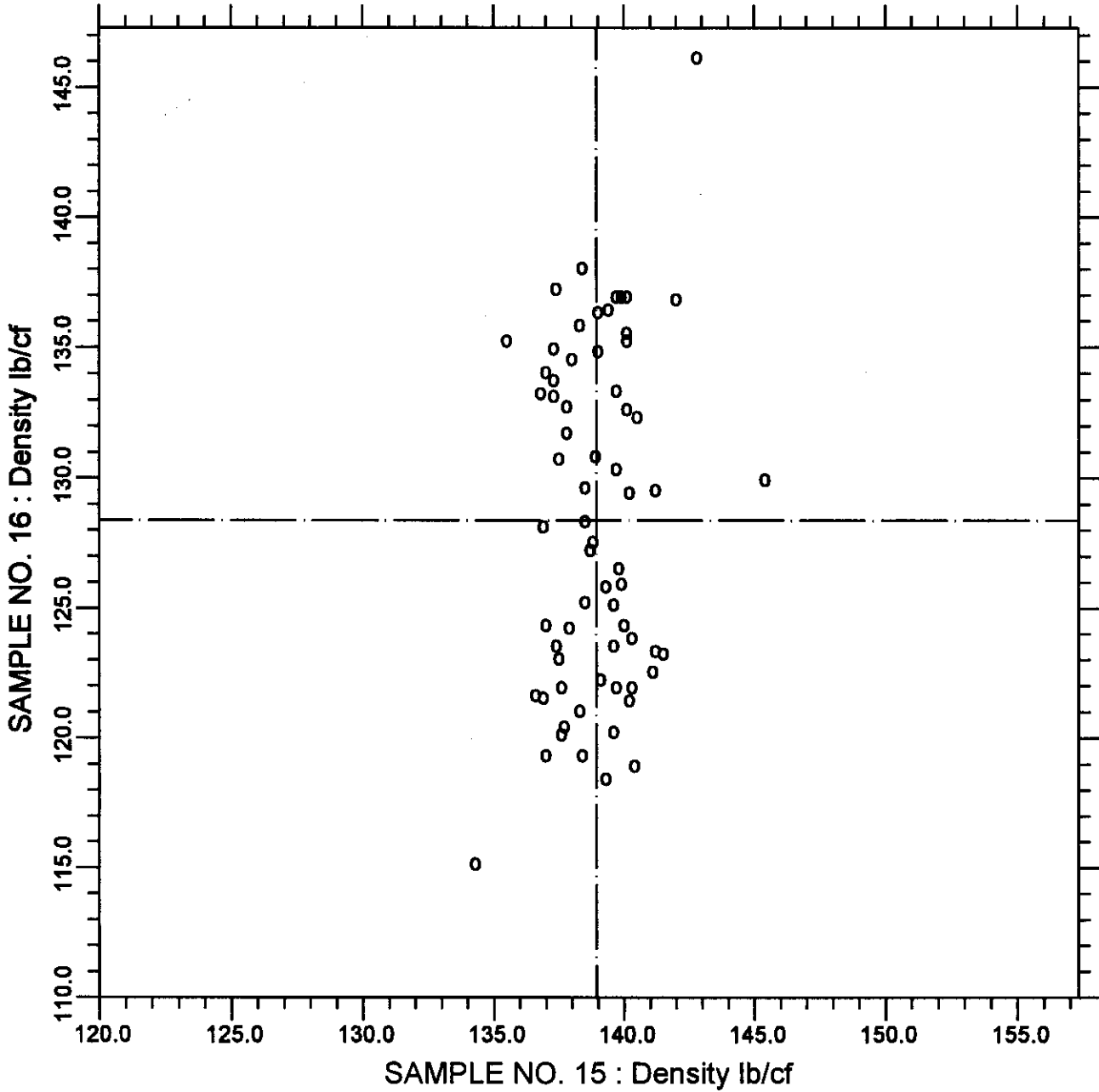

TEST NO.640　　　　**Absorption**　　　　**61 POINTS**

SAMPLE NO. 15　　AVE　7.930　S.D.　0.38　C.V.　4.77
SAMPLE NO. 16　　AVE　10.230　S.D.　1.19　C.V.　11.59
LABS ELIMINATED　475 270 896 1279 1223 1577

CCRL PROFICIENCY SAMPLE PROGRAM
Density
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Density lb/cf

SAMPLE NO. 15 : Density lb/cf

TEST NO.650   **Density**   **67 POINTS**
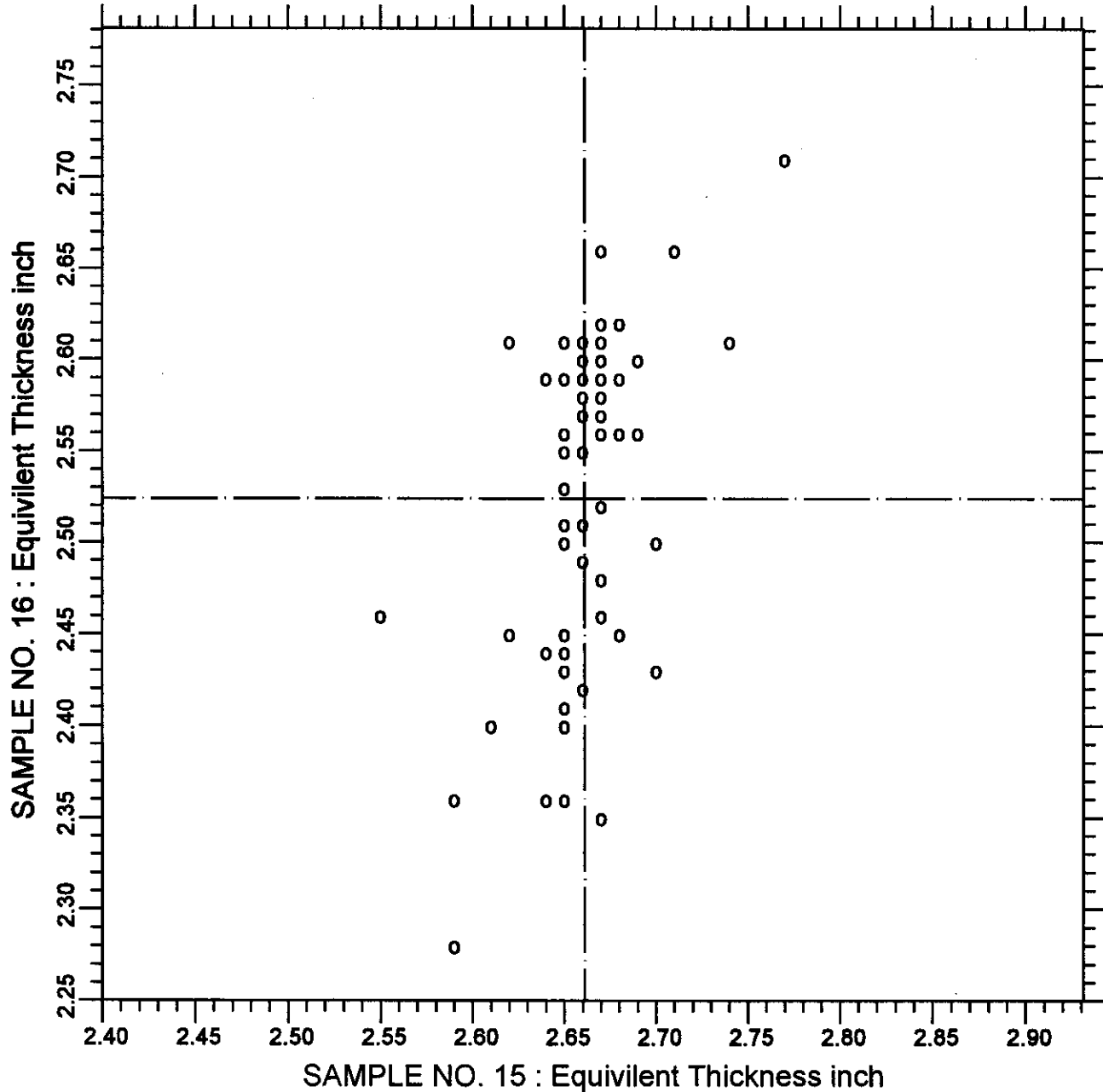
SAMPLE NO. 15   AVE 138.94   S.D. 1.8   C.V. 1.26
SAMPLE NO. 16   AVE 128.38   S.D. 6.5   C.V. 5.07
LABS ELIMINATED 896

CCRL PROFICIENCY SAMPLE PROGRAM
Equivalent Thickness
CONCRETE MASONRY UNITS SAMPLE NOS. 15 & 16

SAMPLE NO. 16 : Equivilent Thickness inch

SAMPLE NO. 15 : Equivilent Thickness inch

TEST NO.660   Equivilent Thickness   64 POINTS

SAMPLE NO. 15   AVE 2.6611   S.D. 0.031   C.V. 1.16
SAMPLE NO. 16   AVE 2.5241   S.D. 0.092   C.V. 3.63
LABS ELIMINATED 646 896 1279 1878