CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Concrete Masonry Unit Proficiency Samples
Number 45 and Number 46

September 2018

CCRL
Cement and Concrete Reference Laboratory

www.ccrl.us

September 21, 2018

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

SUBJECT: Final Report for Concrete Masonry Units Proficiency Samples No. 45 and No. 46

Following is the report for the current pair of CCRL **Concrete Masonry Units** Proficiency Samples which were distributed in July 2018. These specimens were 4x8x8" hollow concrete masonry units made to ASTM Specification C90.

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

Normalized Web Area – No ratings were reported for this test. Normalized web area is a physical requirement specified in Table 1 of ASTM Specification C90. The calculation for normalized web area is found in ASTM C140 Annex A.1.5.2. The normalized web area scatter diagram on the following pages shows a wide distribution of the reported test results. Some possible causes for this variation could be as follows:

- $A_{wt,}$ total web area – is the sum of the web areas. Since these specimens have two webs, the total web area would be the sum of the two web areas. For samples 45 & 46 the $A_{wt,}$ total web area is probably in the range of 15 to16 in.^{2}.
- L_n and H_n, nominal length and height – These are nominal dimensions, not actual measured dimensions. For samples 45 & 46 the nominal dimensions for both length and height would be 8 inch.
- These same variations were seen in last year's samples, samples 43 & 44.

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 concrete masonry units 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 Concrete Masonry Units Proficiency Samples will be distributed in July 2019.

Sincerely,

Kent Niedzielski
Program Manager
Proficiency Samples
Cement and Concrete Reference Laboratory

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

FROM: Kent Niedzielski, Program Manager, Proficiency Samples

SUBJECT: Explanation of Final Report on Results of Tests on Concrete Masonry Units Proficiency Samples No. 45 and No. 46

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 2018. 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 62nd 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. Please note that individual laboratory ratings were not given for some test results. These results were gathered for information at the request of consulting ASTM Committee member.

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.

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.

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

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

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

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 have 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 ±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. 45 and No. 46

Final Report – September 21, 2018

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No. 45 Average	S.D.	C.V.	Sample No. 46 Average	S.D.	C.V.
Received Weight - Compression Units (**lb**)							
	254	10.3	0.35	3.38	11.0	0.38	3.49
	*251	10.4	0.08	0.81	11.0	0.07	0.60
* Labs Eliminated - 40, 1828, 1978							
Maximum Compressive Load (**lbf**)							
	254	54579	7650	14.0	43798	5628	12.9
	*248	55089	6803	12.3	44156	5132	11.6
* Labs Eliminated - 454, 515, 1554, 1906, 2442, 3560							
Net Area Compressive Strength (**psi**)							
	254	2738	423	15.4	2222	339	15.3
	*243	2770	346	12.5	2242	270	12.1
* Labs Eliminated - 40, 202, 454, 515, 537, 1554, 1906, 2003, 2442, 3166, 3560							
Received Weight - Absorption Units (**lb**)							
	254	10.3	0.09	0.88	11.0	0.08	0.71
	*248	10.3	0.08	0.76	11.0	0.06	0.52
* Labs Eliminated - 103, 1120, 1318, 1550, 3166, 3811							
Width (**inch**)							
	254	3.6	0.04	1.1	3.6	0.04	1.0
No Labs Eliminated for This Test							
Height (**inch**)							
	254	7.7	0.05	0.61	7.7	0.05	0.64
	*250	7.7	0.04	0.56	7.7	0.05	0.59
* Labs Eliminated - 1509, 2387, 3560, 4257							
Length (**inch**)							
	254	7.6	0.03	0.40	7.6	0.03	0.33
No Labs Eliminated for This Test							

CCRL PROFICIENCY SAMPLE PROGRAM

Concrete Masonry Units Proficiency Samples No. 45 and No. 46

Final Report – September 21, 2018

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No. 45 Average	S.D.	C.V.	Sample No. 46 Average	S.D.	C.V.
Minimum Face Shell Thickness (**inch**)							
	254	1.08	0.05	5.1	1.08	0.05	5.0
	*246	1.07	0.04	3.5	1.07	0.04	3.5
* Labs Eliminated - 1189, 1440, 1446, 1704, 1991, 2128, 2132, 3166							
Minimum Web Thickness (**inch**)							
	251	1.06	0.07	6.2	1.06	0.06	5.4
	*247	1.05	0.06	5.5	1.06	0.05	4.9
* Labs Eliminated - 1509, 2272, 3302, 3811							
Web Height (**inch**)							
	250	7.5	0.98	13.08	7.5	0.98	13.08
	*240	7.6	0.06	0.79	7.6	0.06	0.81
* Labs Eliminated - 143, 210, 475, 1200, 1367, 1509, 1975, 3166, 3302, 4022							
Immersed Weight (**lb**)							
	254	5.7	0.08	1.5	6.4	0.08	1.3
	*249	5.7	0.07	1.2	6.4	0.06	0.9
* Labs Eliminated - 1186, 1435, 1822, 3166, 3252							
Saturated Weight (**lb**)							
	254	11.1	0.14	1.23	11.8	0.13	1.08
	*249	11.1	0.07	0.67	11.8	0.07	0.62
* Labs Eliminated - 9, 1318, 1375, 1509, 3252							
Oven-Dry Weight (**lb**)							
	254	10.1	0.12	1.17	10.8	0.11	1.06
	*251	10.1	0.08	0.81	10.8	0.06	0.60
* Labs Eliminated - 2935, 3252, 3811							
Net Area (**sq in**)							
	254	19.9	0.96	4.8	19.7	0.97	4.9
	*241	19.8	0.20	1.0	19.6	0.25	1.3
* Labs Eliminated - 9, 21, 537, 1474, 1577, 1670, 2003, 2187, 2221, 2420, 2438, 2518, 4198							

CCRL PROFICIENCY SAMPLE PROGRAM

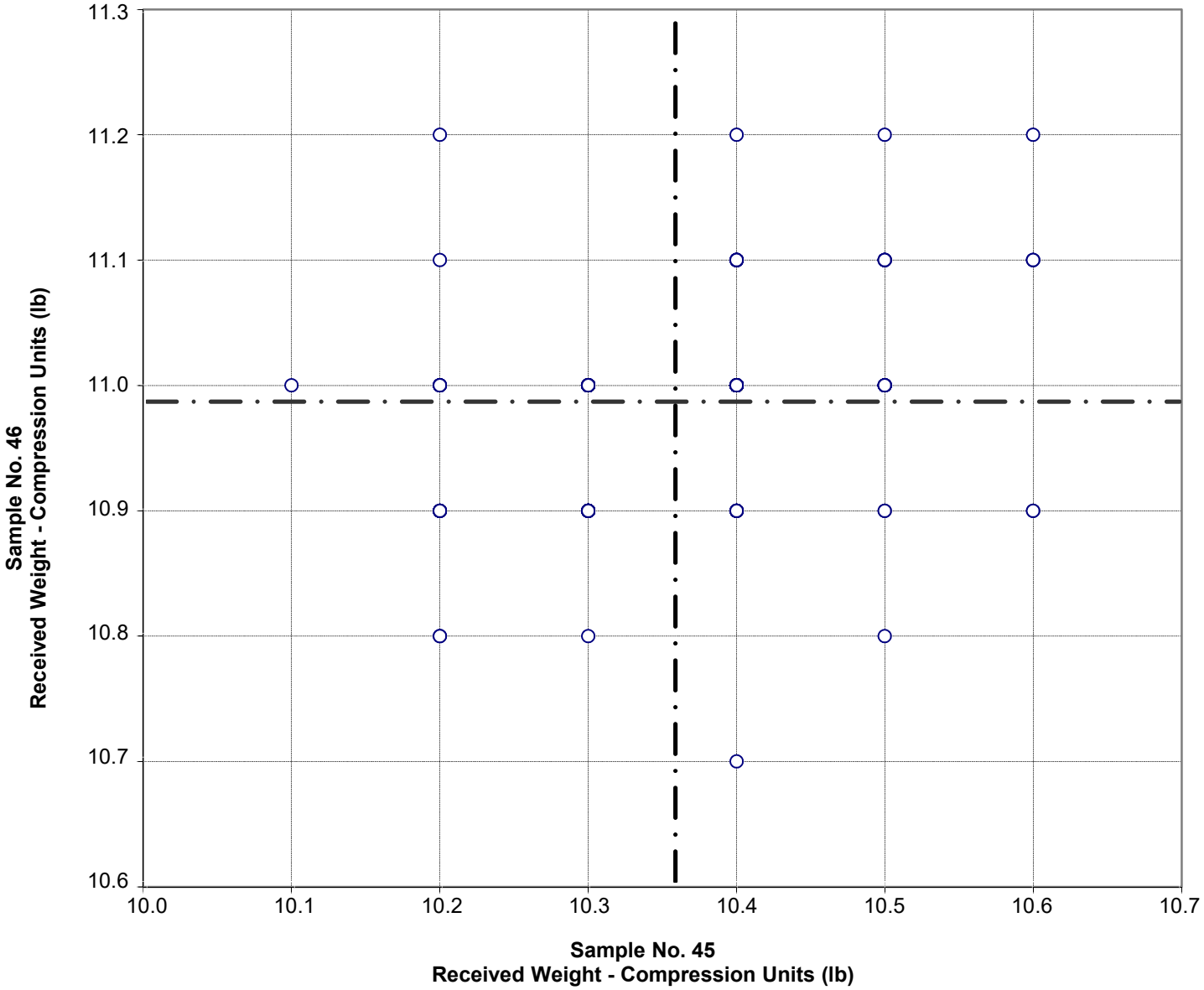
Concrete Masonry Units Proficiency Samples No. 45 and No. 46

Final Report – September 21, 2018

SUMMARY OF RESULTS

		Sample No. 45			Sample No. 46		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Absorption (**lb/ft³**)							
	254	12.3	0.75	6.1	11.4	0.95	8.3
	*249	12.3	0.64	5.2	11.5	0.65	5.7
* Labs Eliminated - 9, 210, 1441, 3252, 3402							
Density (**lb/ft³**)							
	254	114.3	1.6	1.4	124.8	1.7	1.4
	*249	114.3	1.3	1.2	124.7	1.4	1.2
* Labs Eliminated - 9, 1474, 1822, 3166, 3252							
Net Volume (**ft³**)							
	252	0.0877	0.0051	5.8	0.0864	0.0050	5.8
	*245	0.0880	0.0008	0.9	0.0868	0.0010	1.1
* Labs Eliminated - 9, 21, 103, 1474, 3166, 3219, 3252							
Percent Solids (**percent**)							
	248	71.4	4.2	5.8	70.6	4.0	5.7
	*241	71.8	1.1	1.5	71.0	1.2	1.7
* Labs Eliminated - 9, 565, 2128, 2132, 2214, 2438, 3560							
Normalized Web (**in²/ft³**)							
	240	30.4	9.7	32.0	30.4	9.6	31.7
No Labs Eliminated for This Test							
Equivalent Thickness (**inch**)							
	252	2.6	0.30	11.5	2.6	0.30	11.6
	*242	2.6	0.03	1.2	2.6	0.04	1.4
* Labs Eliminated - 9, 840, 1189, 1287, 1474, 2173, 2240, 2438, 3252, 4257							

CCRL Proficiency Sample Program
Received Weight - Compression Units
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

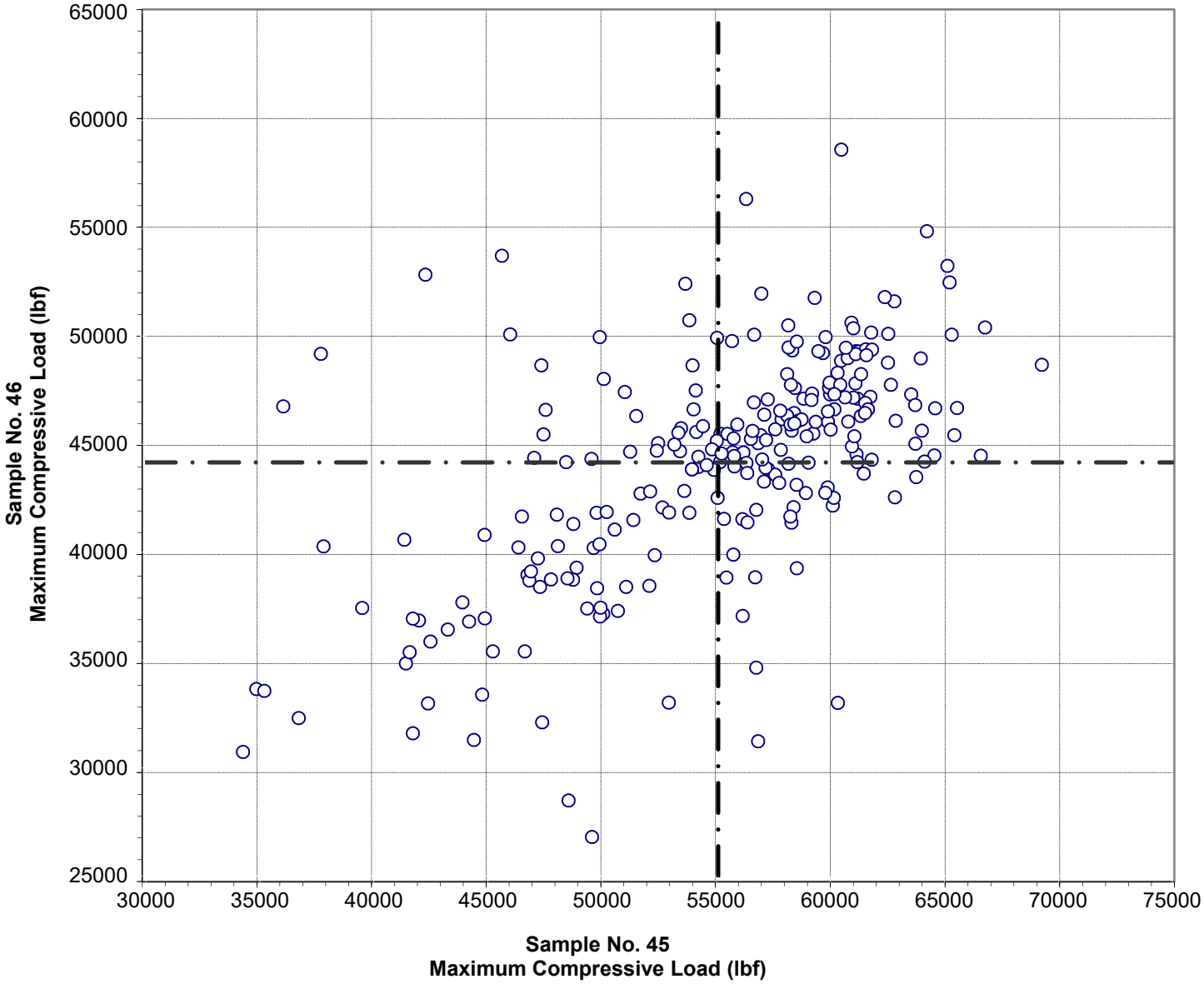


Test No. 500 Received Weight - Compression Units 251 Points

Sample No. 45	Ave	10.4	S.D.	0.08	C.V.	0.81
Sample No. 46	Ave	11.0	S.D.	0.07	C.V.	0.60

Labs Eliminated: 40, 1828, 1978

CCRL Proficiency Sample Program
Maximum Compressive Load
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

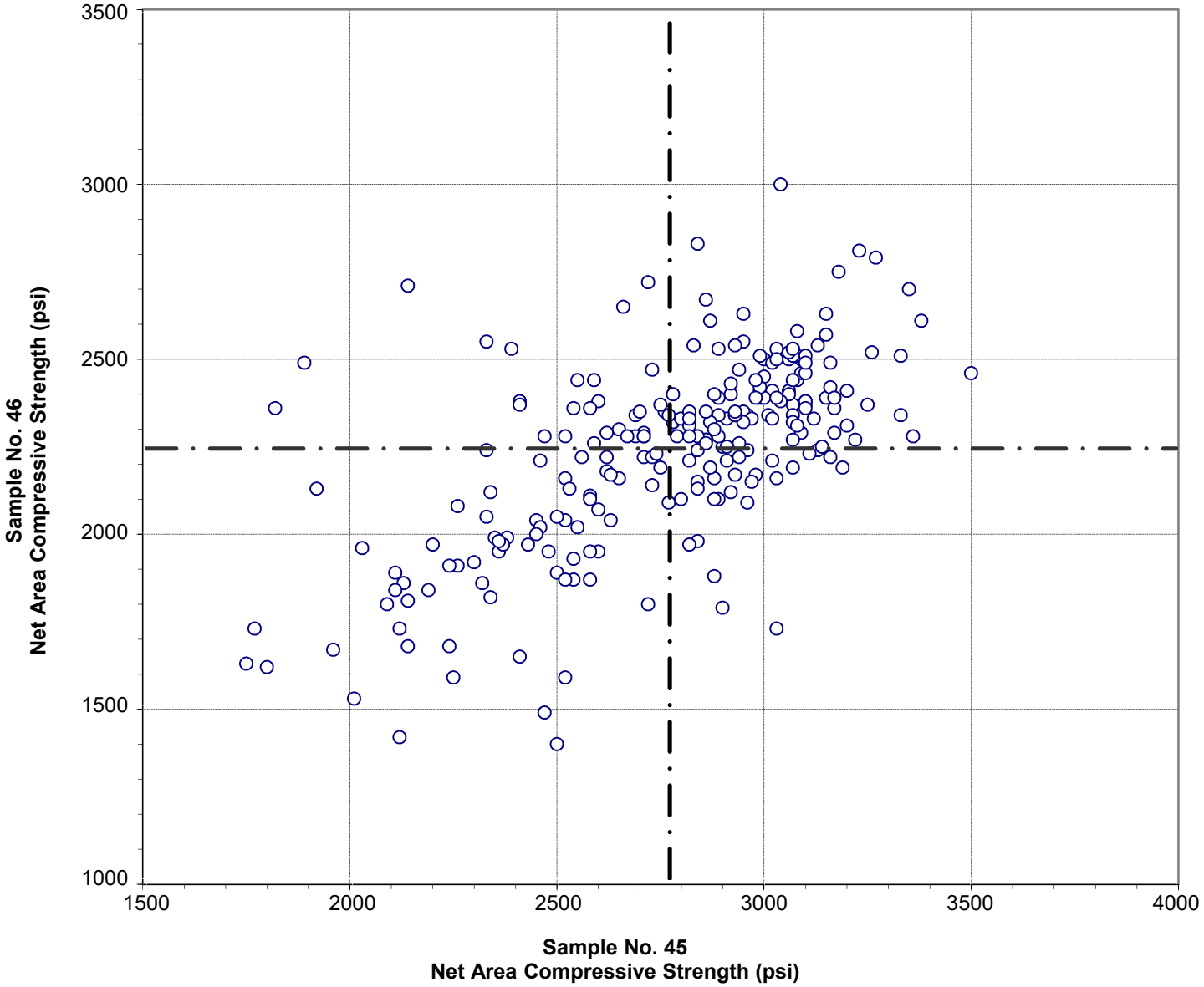


Test No. 550 Maximum Compressive Load 248 Points

Sample No. 45	Ave	55089	S.D.	6803	C.V. 12.3
Sample No. 46	Ave	44156	S.D.	5132	C.V. 11.6

Labs Eliminated: 454, 515, 1554, 1906, 2442, 3560

CCRL Proficiency Sample Program
Net Area Compressive Strength
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

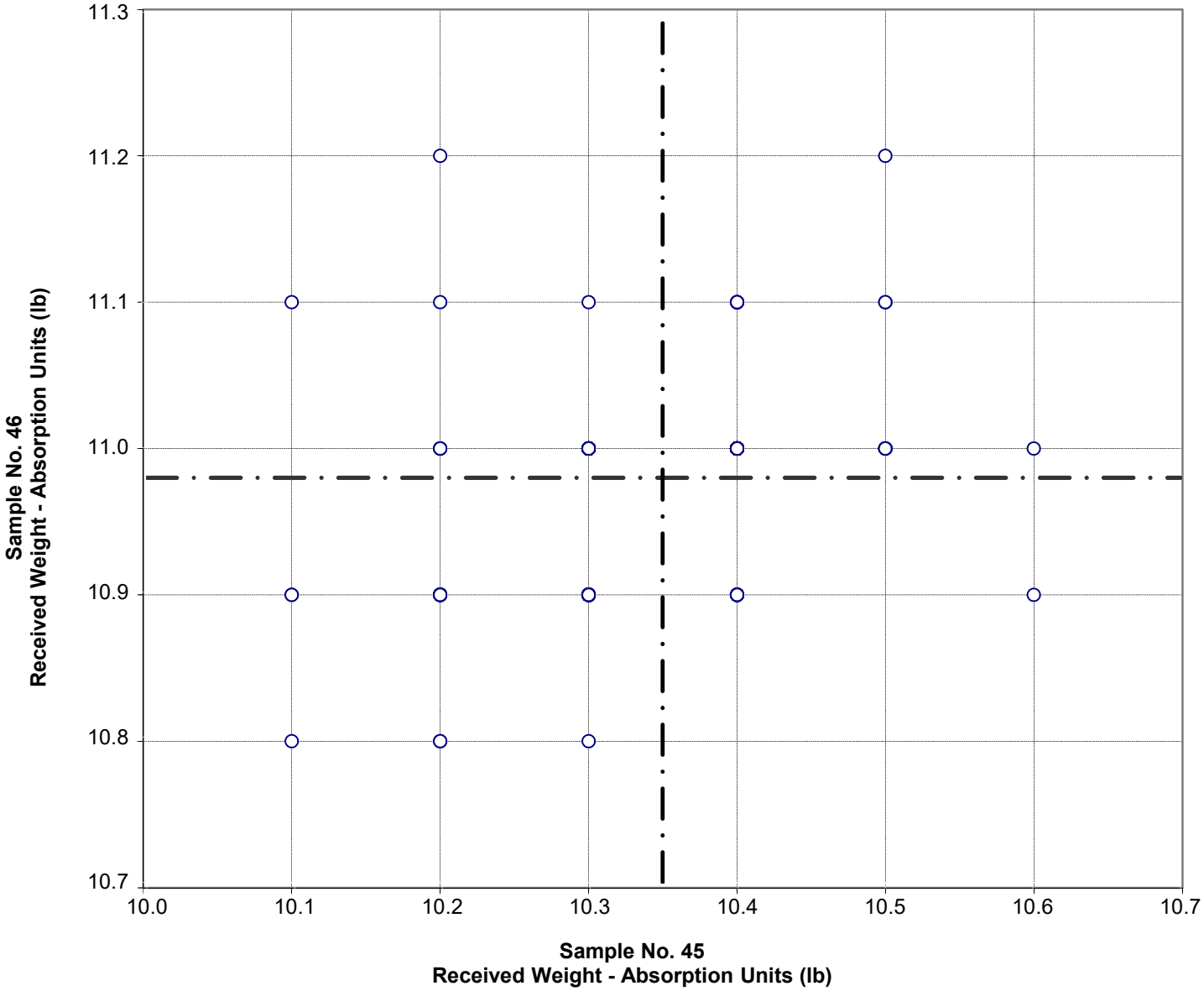


Test No. 560 Net Area Compressive Strength 243 Points

Sample No. 45	Ave	2770	S.D.	346	C.V. 12.5
Sample No. 46	Ave	2242	S.D.	270	C.V. 12.1

Labs Eliminated: 40, 202, 454, 515, 537, 1554, 1906, 2003, 2442, 3166, 3560

CCRL Proficiency Sample Program
Received Weight - Absorption Units
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

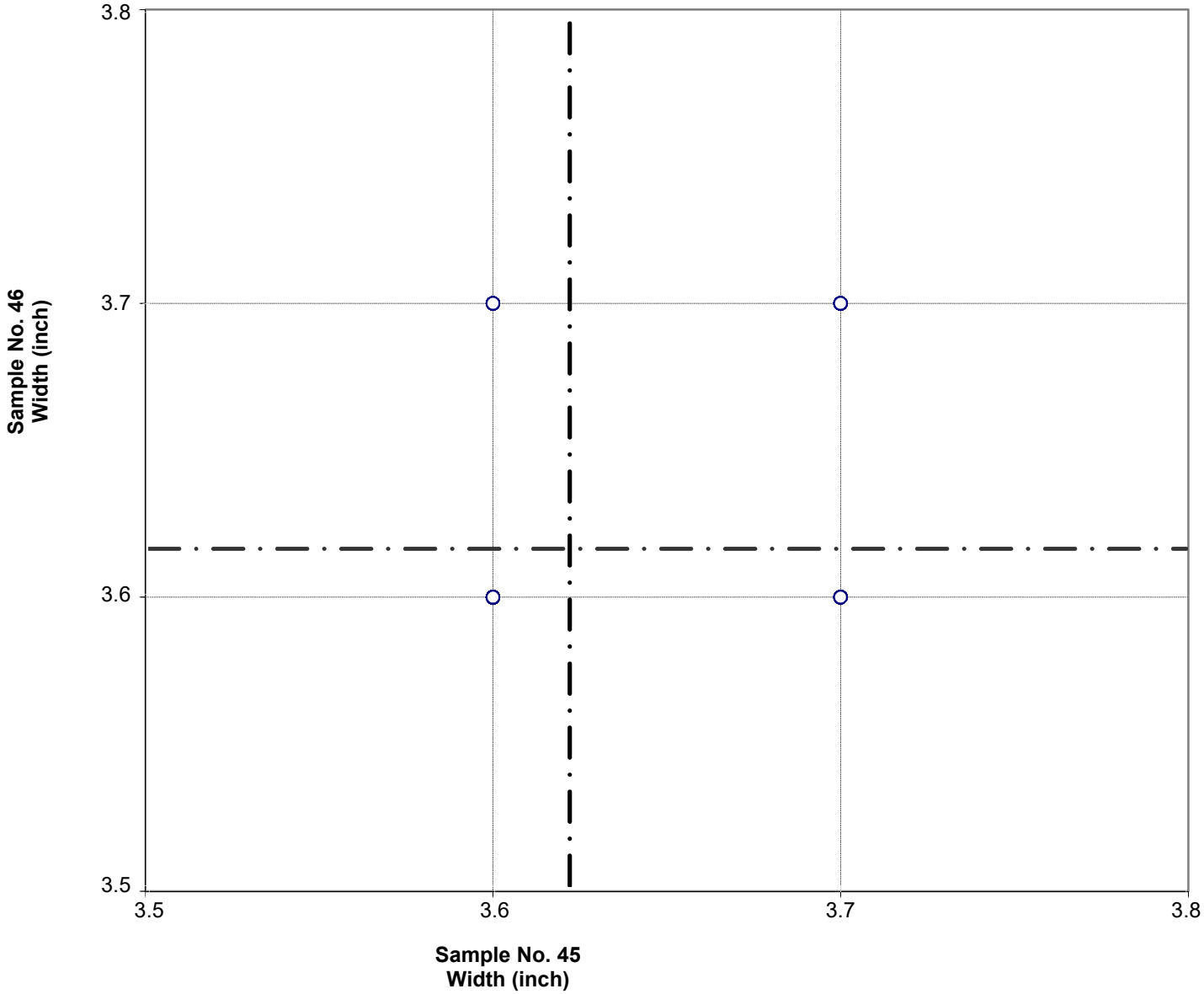


Test No. 600 Received Weight - Absorption Units 248 Points

Sample No. 45	Ave	10.3	S.D.	0.08	C.V.	0.76
Sample No. 46	Ave	11.0	S.D.	0.06	C.V.	0.52

Labs Eliminated: 103, 1120, 1318, 1550, 3166, 3811

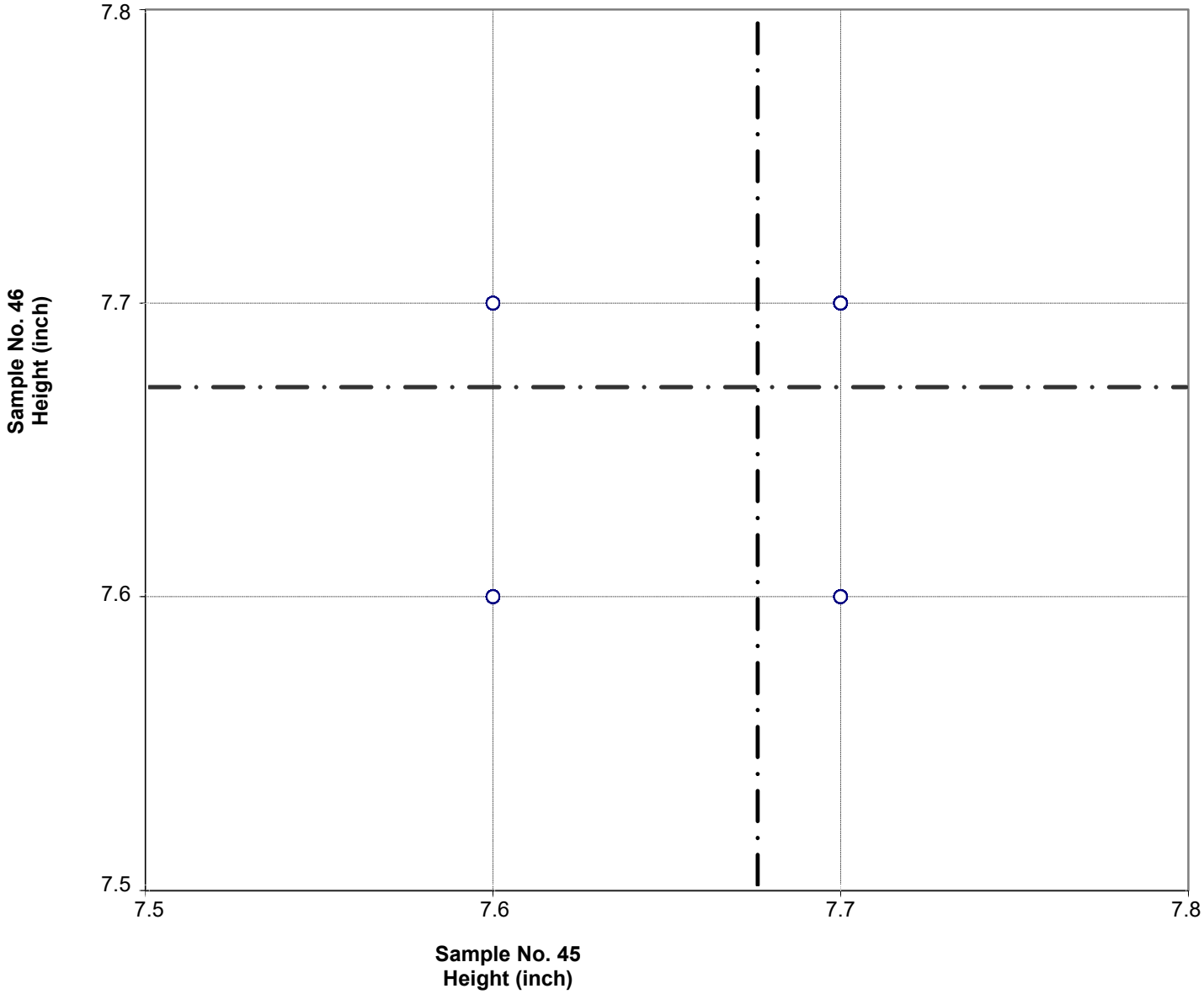
CCRL Proficiency Sample Program
Width
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



Test No. 510 Width 254 Points

Sample No. 45	Ave	3.6	S.D.	0.04	C.V.	1.1
Sample No. 46	Ave	3.6	S.D.	0.04	C.V.	1.0

CCRL Proficiency Sample Program
Height
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

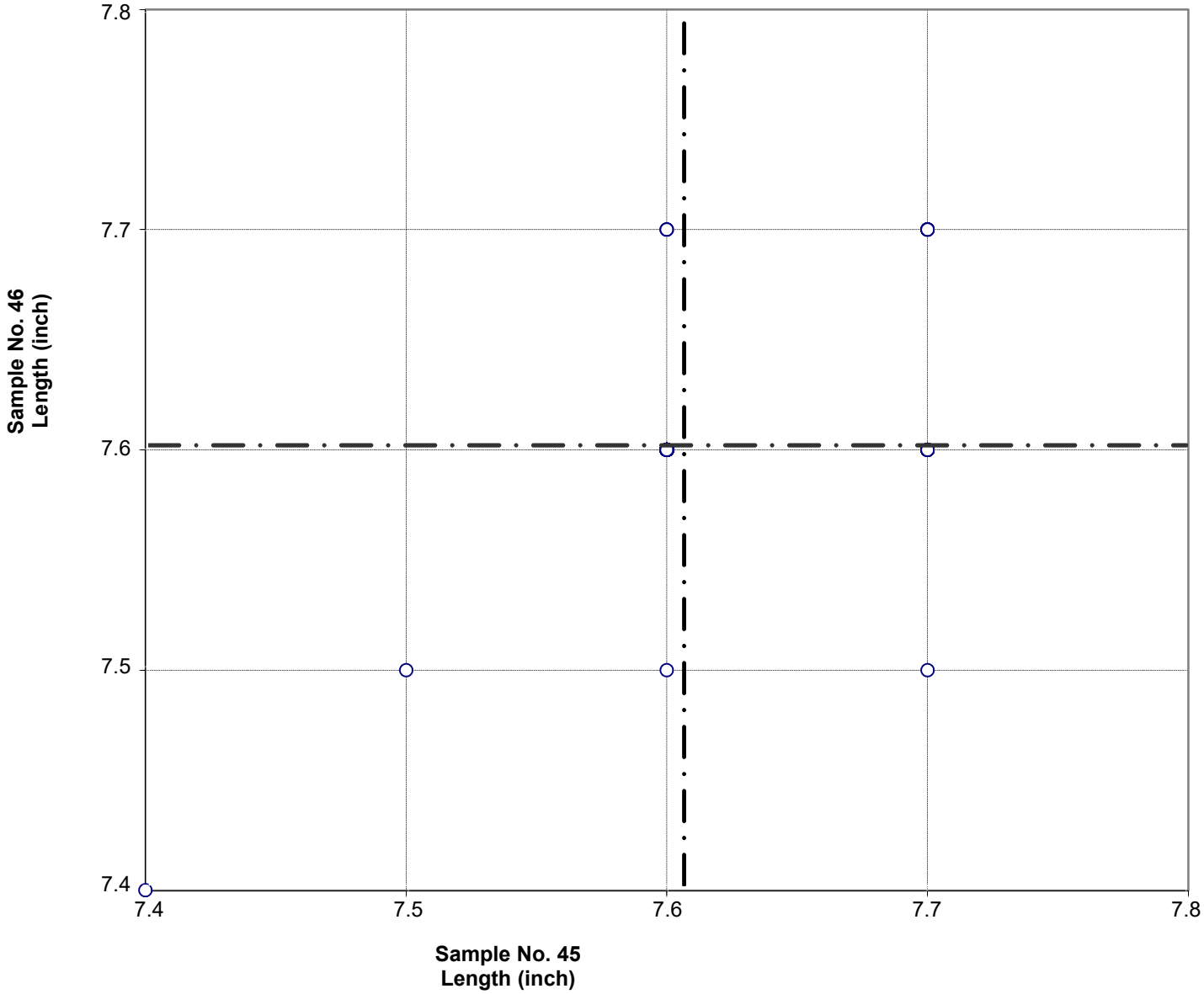


Test No. 520 Height 250 Points

Sample No. 45	Ave	7.7	S.D.	0.04	C.V. 0.56
Sample No. 46	Ave	7.7	S.D.	0.05	C.V. 0.59

Labs Eliminated: 1509, 2387, 3560, 4257

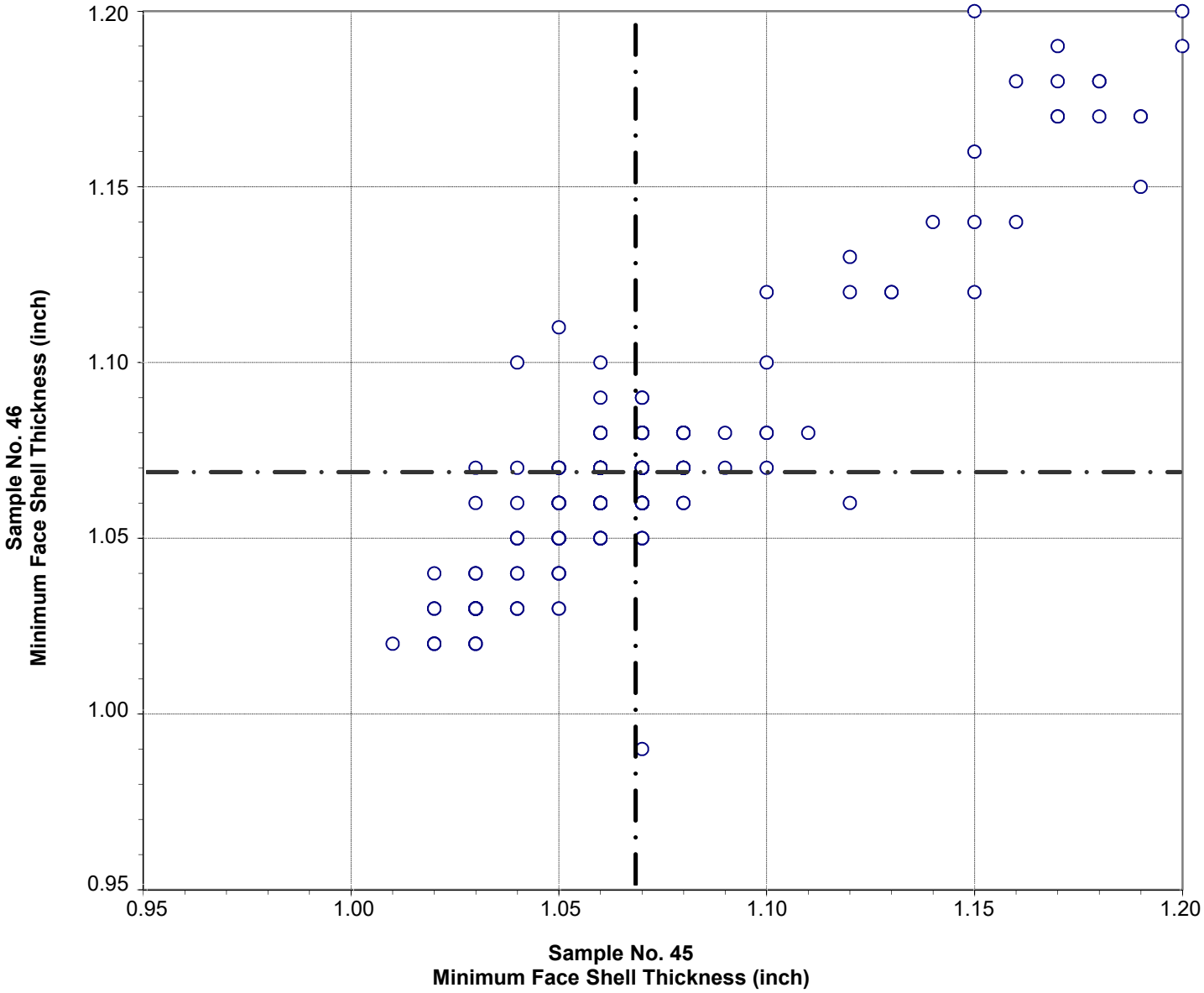
CCRL Proficiency Sample Program
Length
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



Test No. 530 Length 254 Points

Sample No. 45	Ave	7.6	S.D.	0.03	C.V.	0.40
Sample No. 46	Ave	7.6	S.D.	0.03	C.V.	0.33

CCRL Proficiency Sample Program
Minimum Face Shell Thickness
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



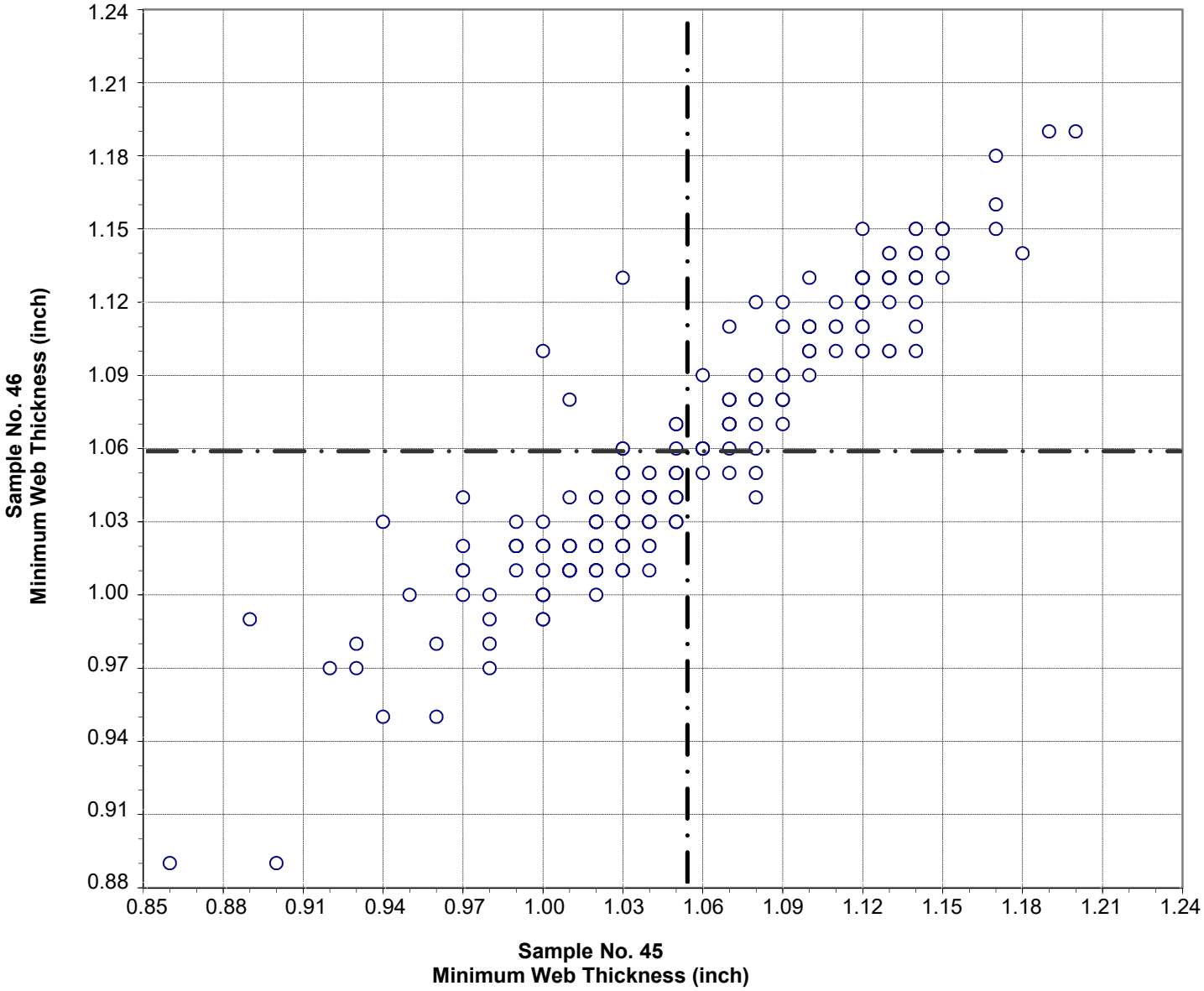
Test No. 532 Minimum Face Shell Thickness 244 Points

Sample No. 45	Ave	1.07	S.D.	0.04	C.V. 3.5
Sample No. 46	Ave	1.07	S.D.	0.04	C.V. 3.5

Labs Eliminated: 1189, 1440, 1446, 1704, 1991, 2128, 2132, 3166

Labs off Diagram: 1509, 2438

CCRL Proficiency Sample Program
Minimum Web Thickness
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

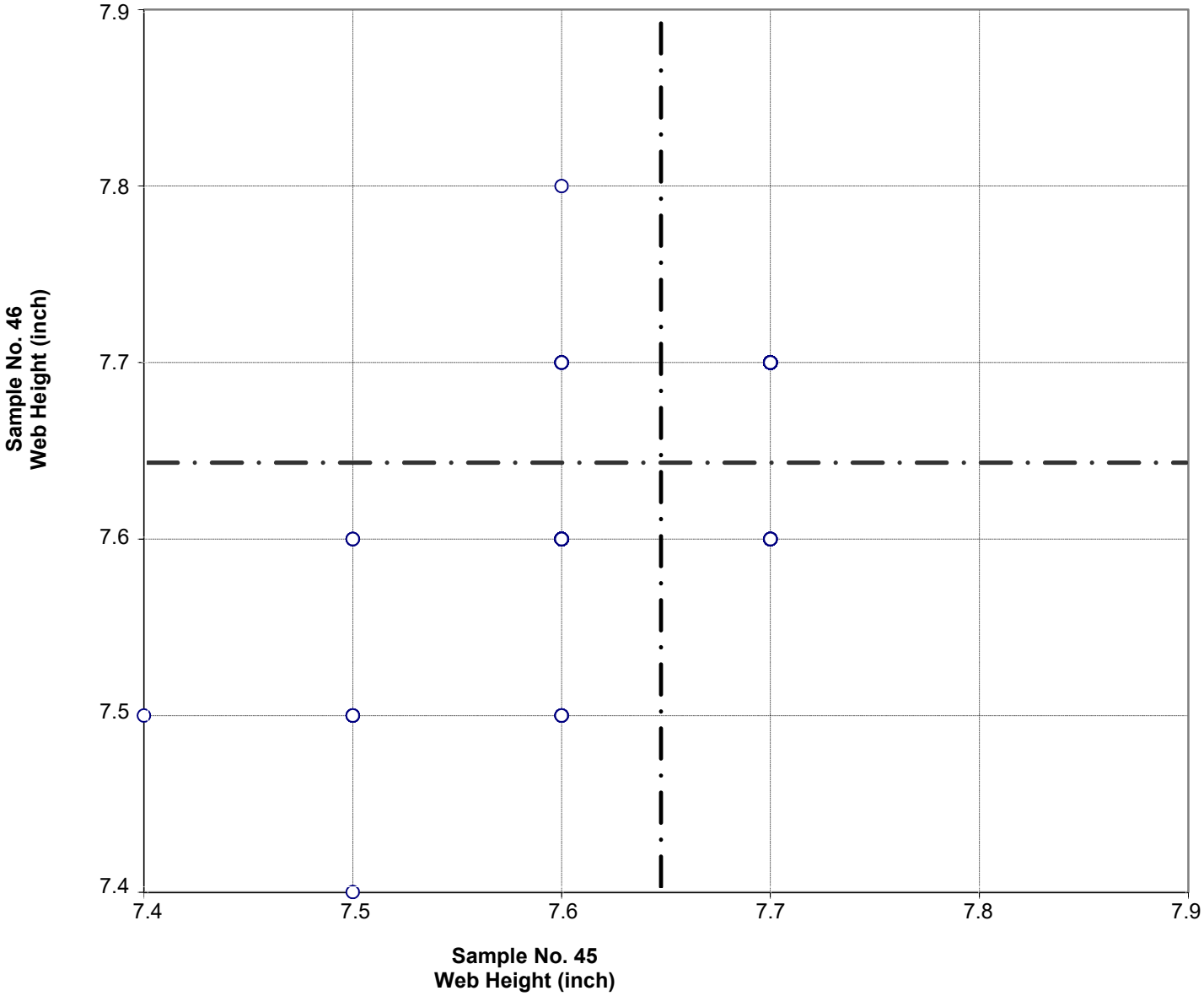


Test No. 533 Minimum Web Thickness 247 Points

Sample No. 45	Ave	1.05	S.D.	0.06	C.V.	5.5
Sample No. 46	Ave	1.06	S.D.	0.05	C.V.	4.9

Labs Eliminated: 1509, 2272, 3302, 3811

CCRL Proficiency Sample Program
Web Height
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

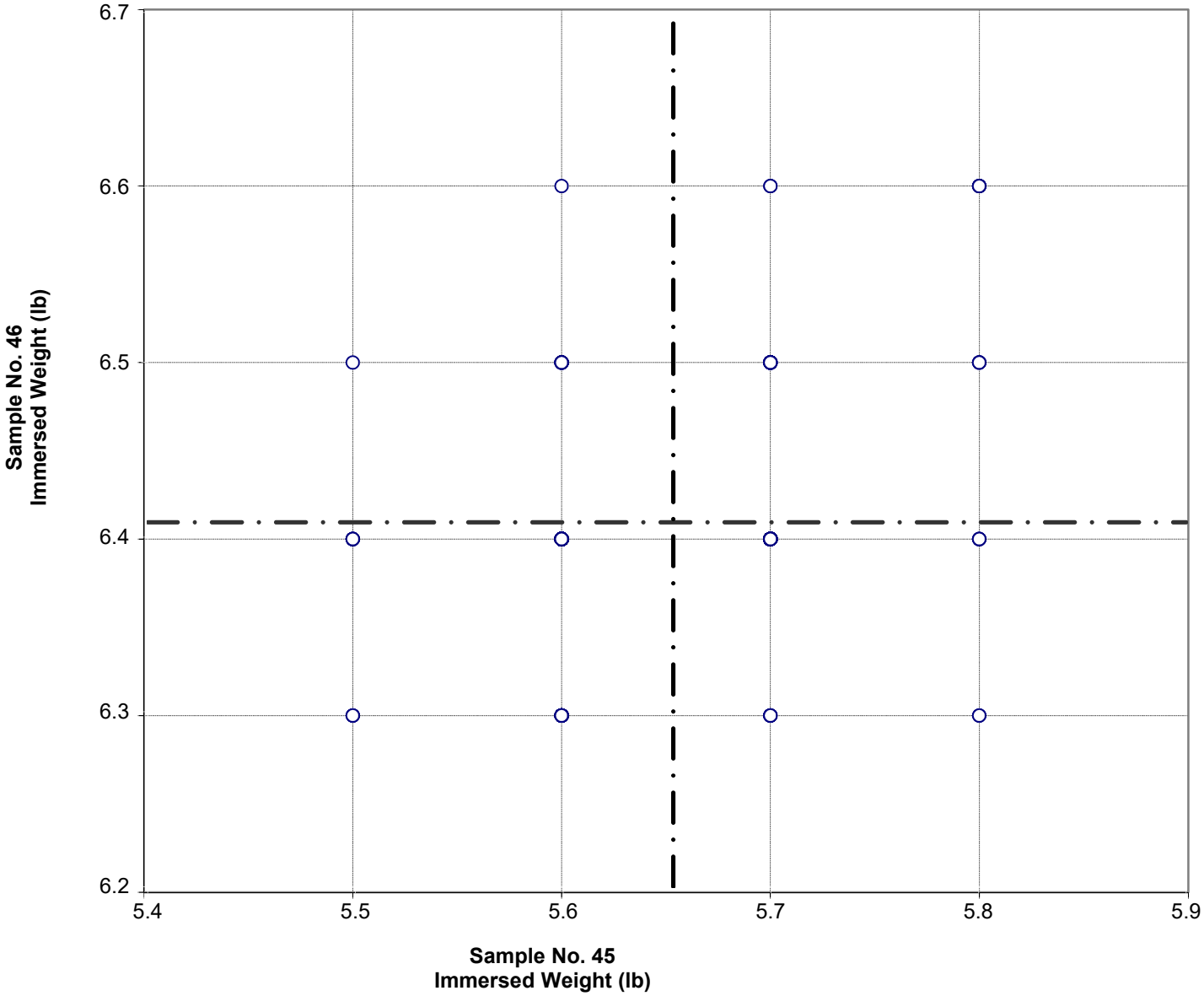


Test No. 534 Web Height 240 Points

Sample No. 45	Ave	7.6	S.D.	0.06	C.V. 0.79
Sample No. 46	Ave	7.6	S.D.	0.06	C.V. 0.81

Labs Eliminated: 143, 210, 475, 1200, 1367, 1509, 1975, 3166, 3302, 4022

CCRL Proficiency Sample Program
Immersed Weight
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

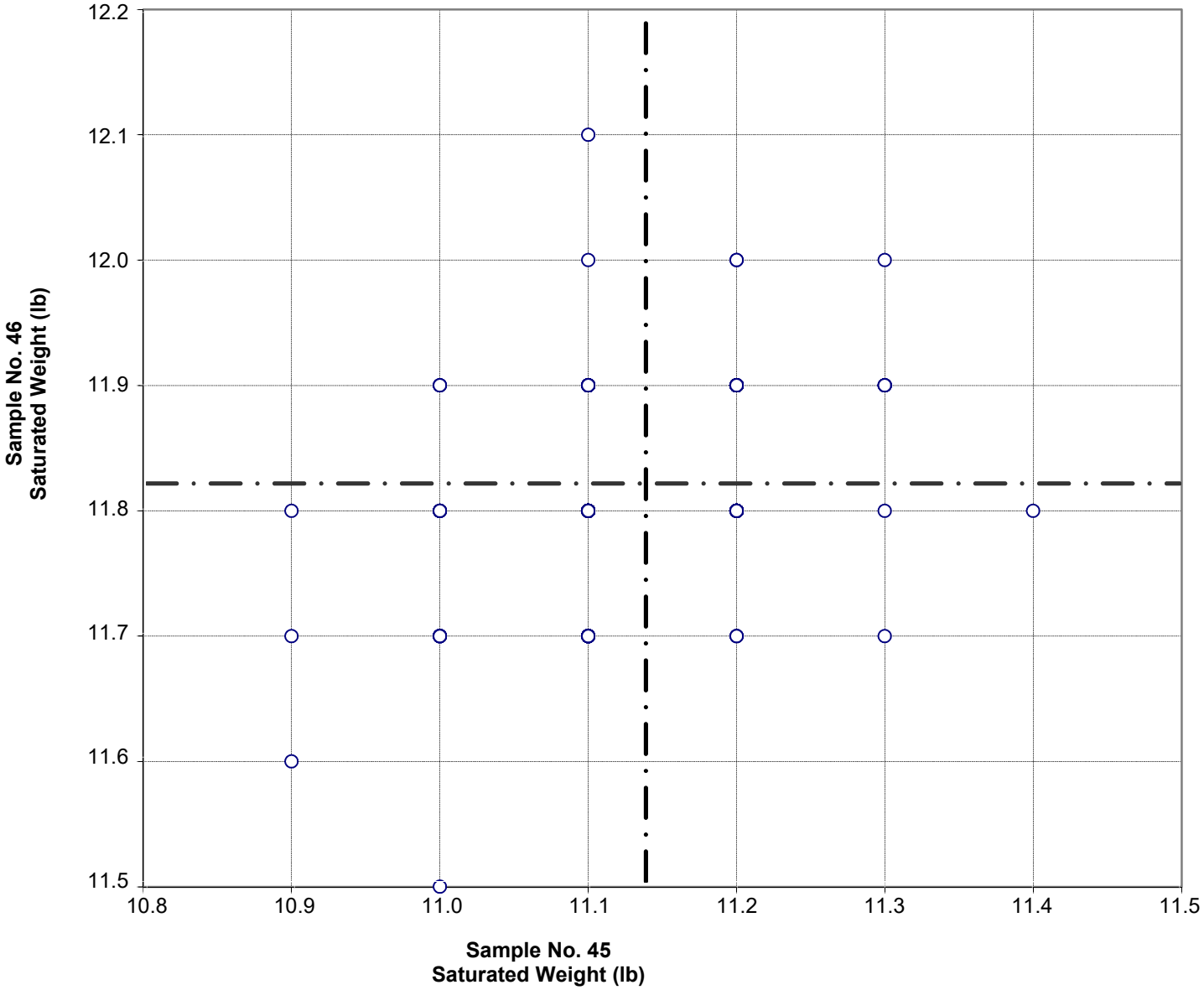


Test No. 610 Immersed Weight 249 Points

Sample No. 45	Ave	5.7	S.D.	0.07	C.V. 1.2
Sample No. 46	Ave	6.4	S.D.	0.06	C.V. 0.9

Labs Eliminated: 1186, 1435, 1822, 3166, 3252

CCRL Proficiency Sample Program
Saturated Weight
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

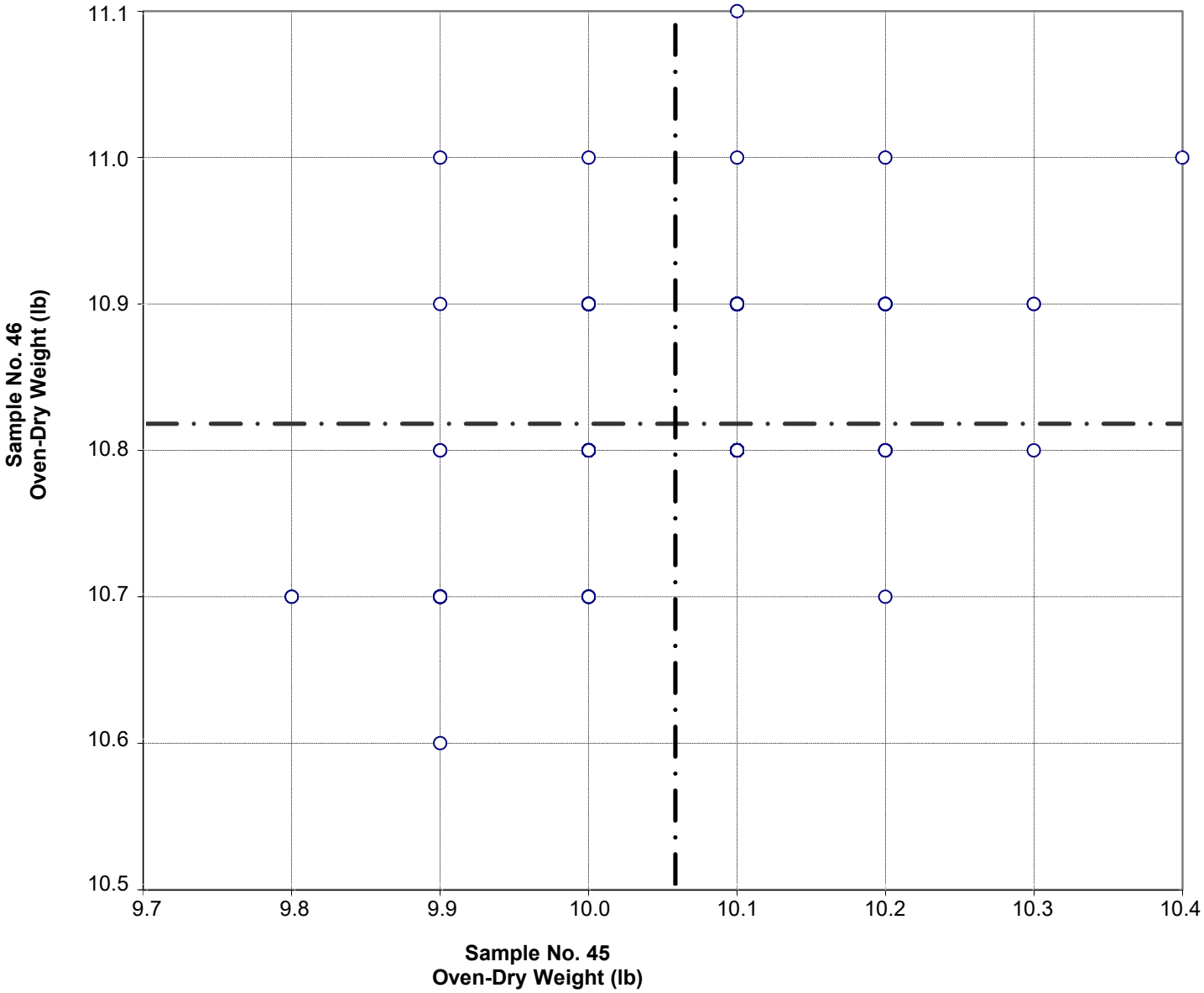


Test No. 620 Saturated Weight 249 Points

Sample No. 45	Ave	11.1	S.D.	0.07	C.V.	0.67
Sample No. 46	Ave	11.8	S.D.	0.07	C.V.	0.62

Labs Eliminated: 9, 1318, 1375, 1509, 3252

CCRL Proficiency Sample Program
Oven-Dry Weight
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

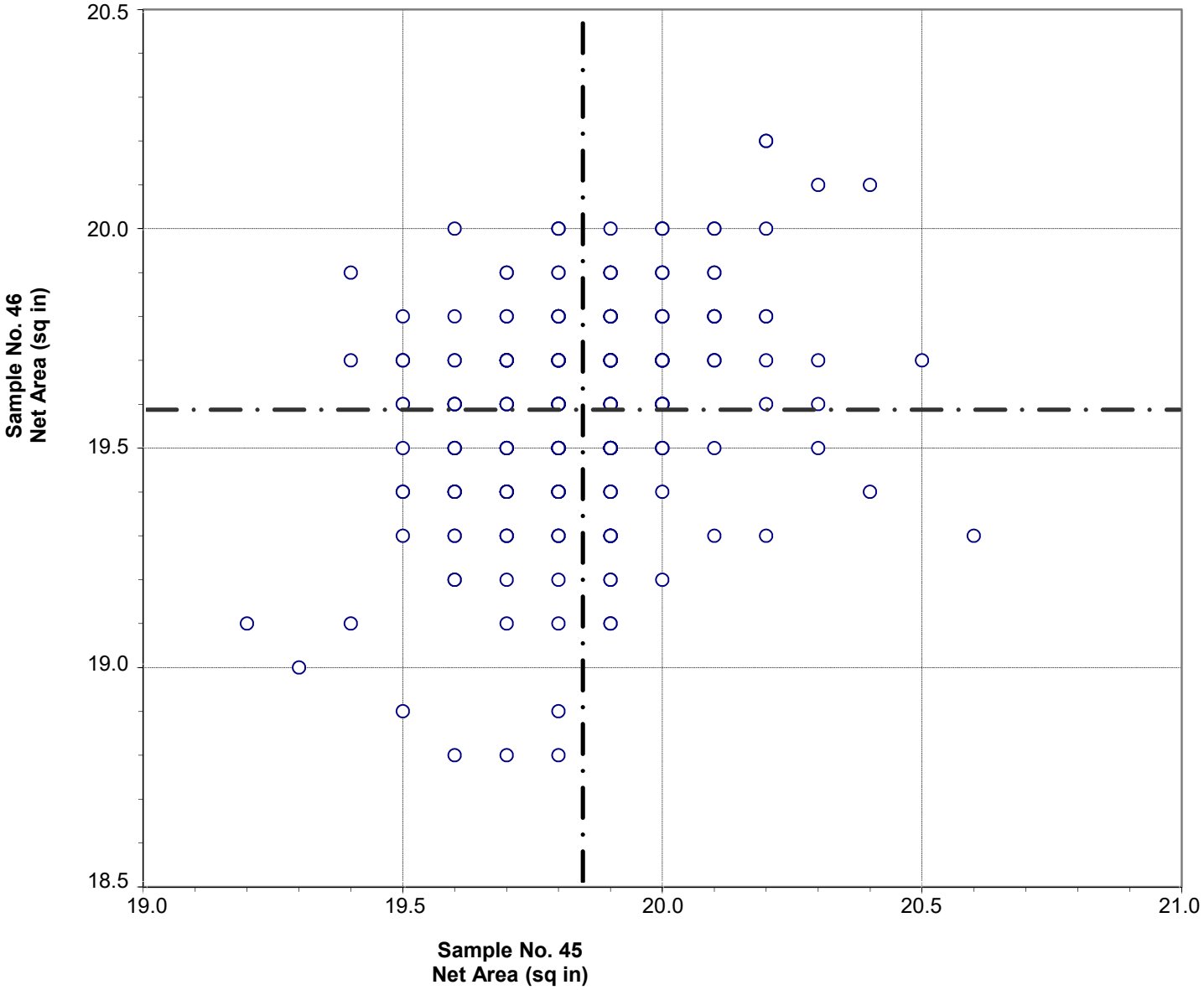


Test No. 630 Oven-Dry Weight 251 Points

Sample No. 45	Ave	10.1	S.D.	0.08	C.V. 0.81
Sample No. 46	Ave	10.8	S.D.	0.06	C.V. 0.60

Labs Eliminated: 2935, 3252, 3811

CCRL Proficiency Sample Program
Net Area
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

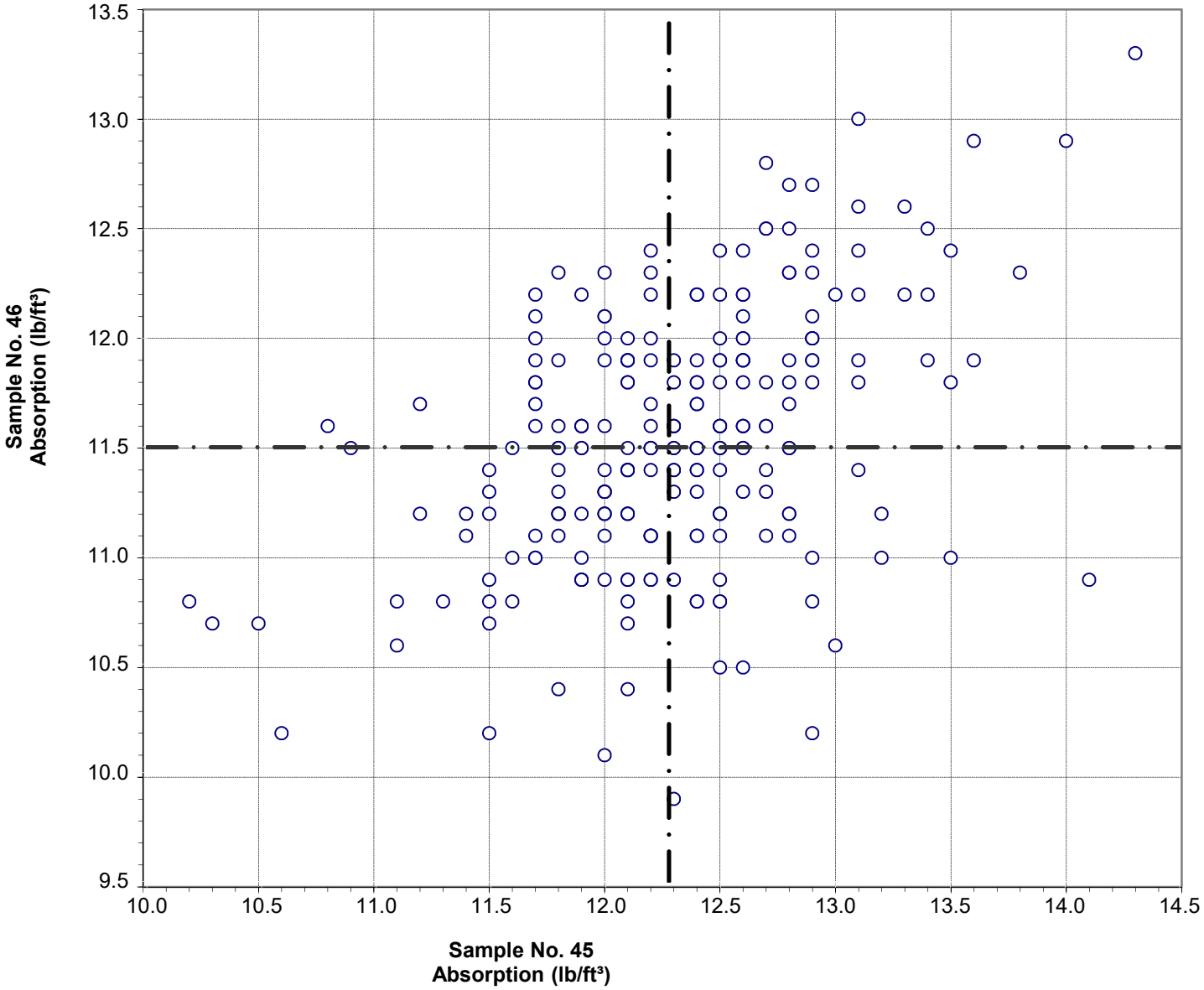


Test No. 635 Net Area 241 Points

Sample No. 45	Ave	19.8	S.D.	0.20	C.V.	1.0
Sample No. 46	Ave	19.6	S.D.	0.25	C.V.	1.3

Labs Eliminated: 9, 21, 537, 1474, 1577, 1670, 2003, 2187, 2221, 2420, 2438, 2518, 4198

CCRL Proficiency Sample Program
Absorption
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



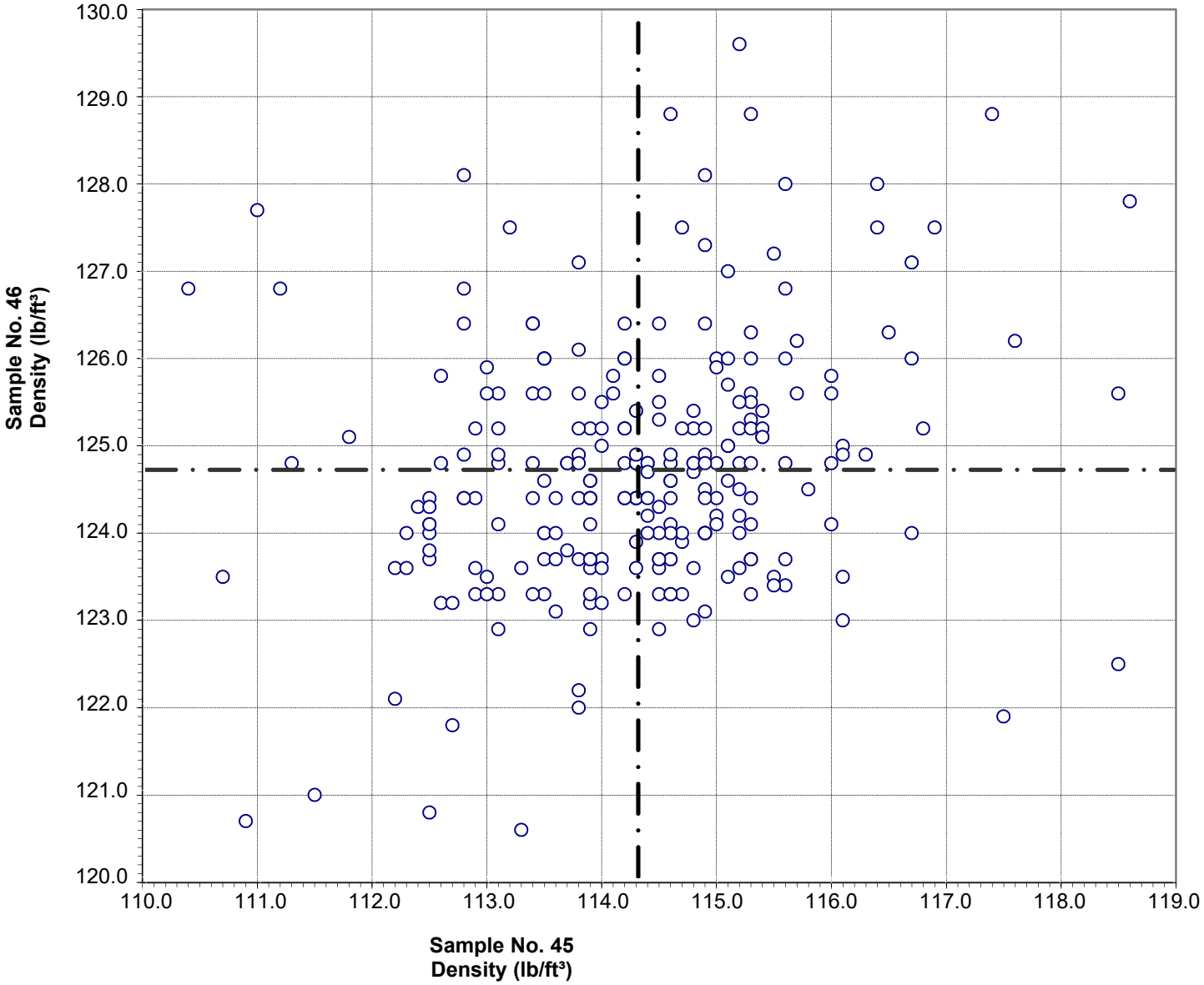
Test No. 640 Absorption 244 Points

Sample No. 45 Ave 12.3 S.D. 0.64 C.V. 5.2
Sample No. 46 Ave 11.5 S.D. 0.65 C.V. 5.7

Labs Eliminated: 9, 210, 1441, 3252, 3402

Labs off Diagram: 51, 1097, 1552, 1749, 2387

CCRL Proficiency Sample Program
Density
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



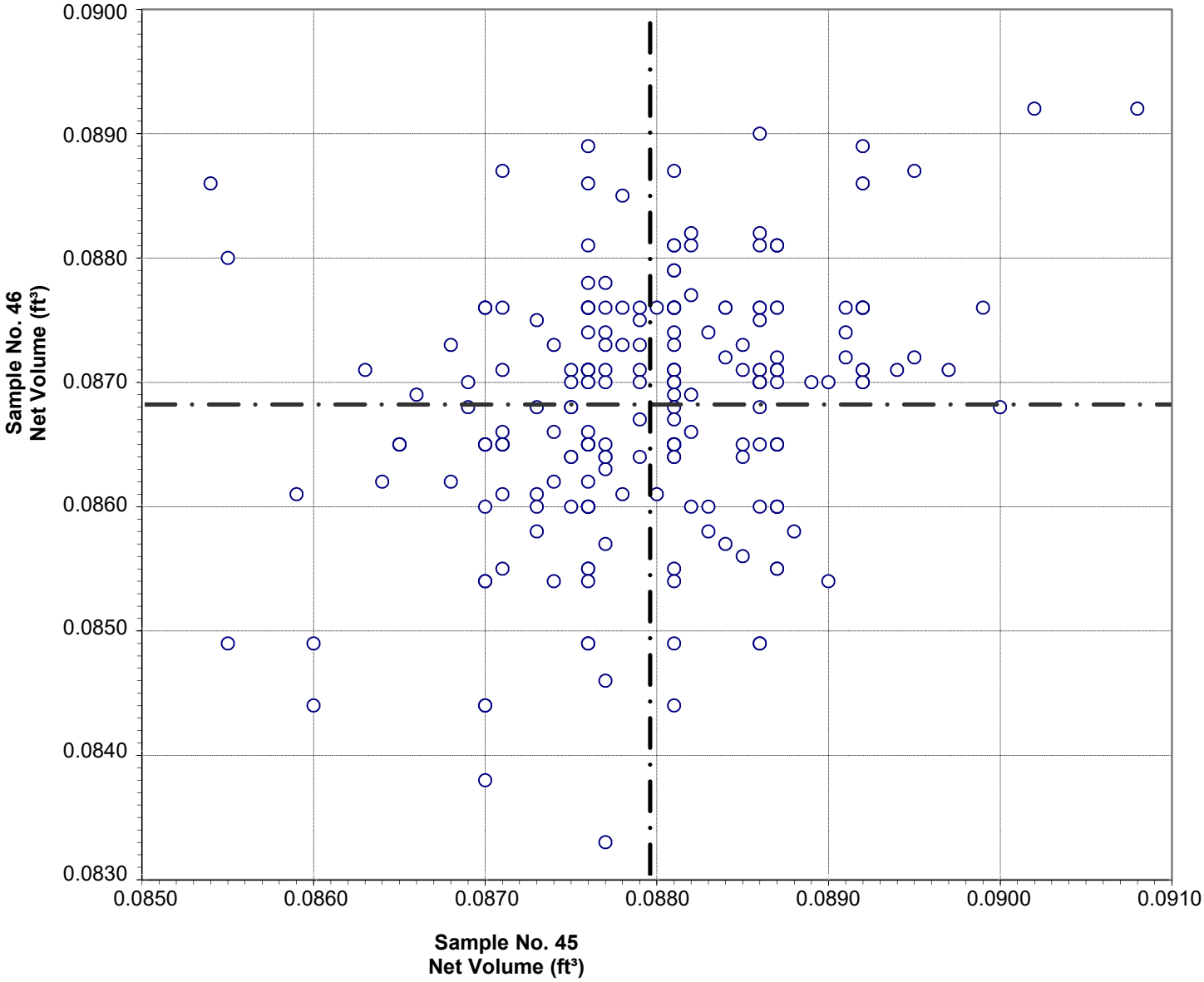
Test No. 650 Density 248 Points

Sample No. 45	Ave	114.3	S.D.	1.3	C.V.	1.2
Sample No. 46	Ave	124.7	S.D.	1.4	C.V.	1.2

Labs Eliminated: 9, 1474, 1822, 3166, 3252

Labs off Diagram: 1435

CCRL Proficiency Sample Program
Net Volume
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

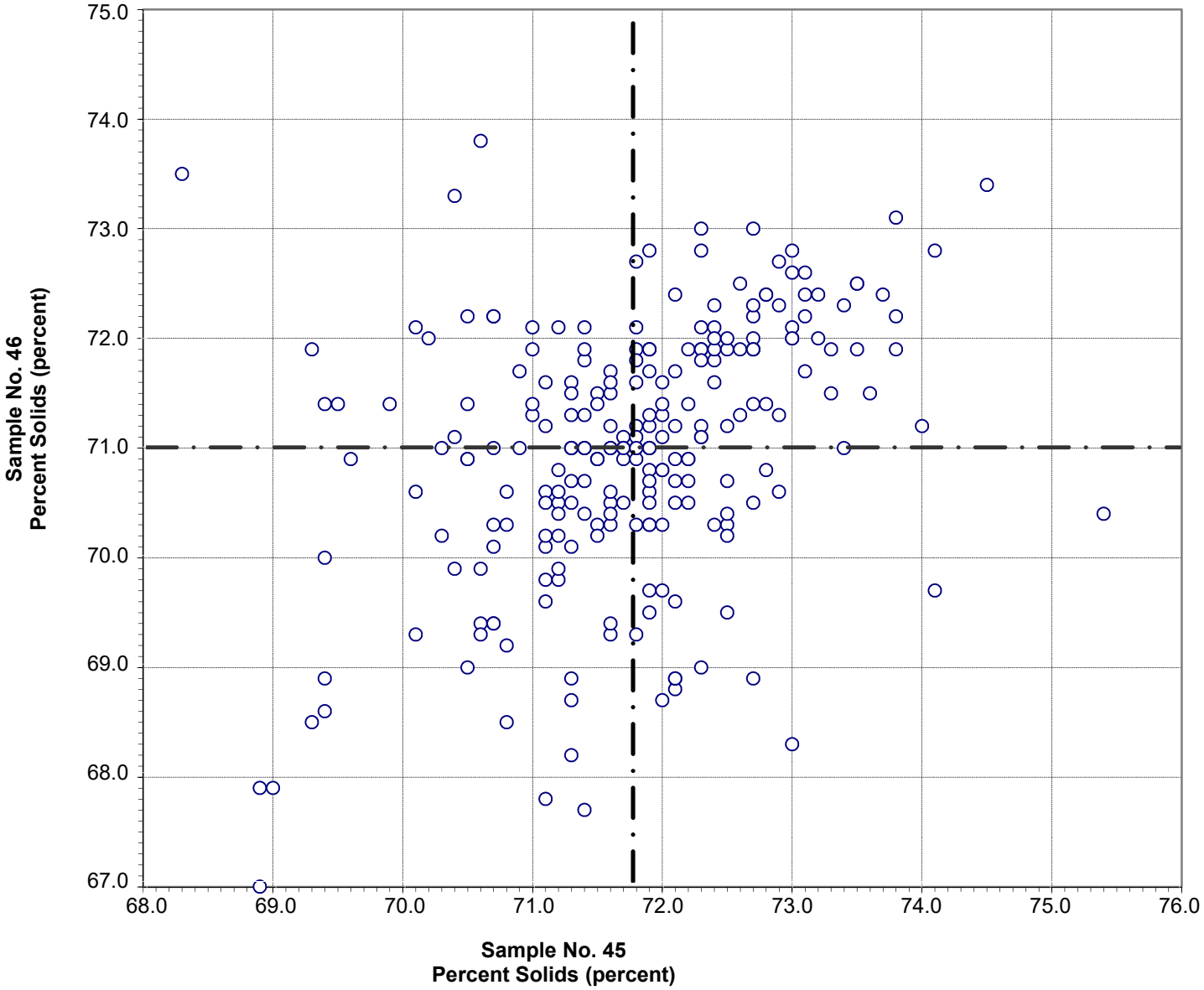


Test No. 652 Net Volume 245 Points

Sample No. 45	Ave	0.0880	S.D.	0.0008	C.V.	0.9
Sample No. 46	Ave	0.0868	S.D.	0.0010	C.V.	1.1

Labs Eliminated: 9, 21, 103, 1474, 3166, 3219, 3252

CCRL Proficiency Sample Program
Percent Solids
CONCRETE MASONRY UNITS Samples No. 45 and No. 46

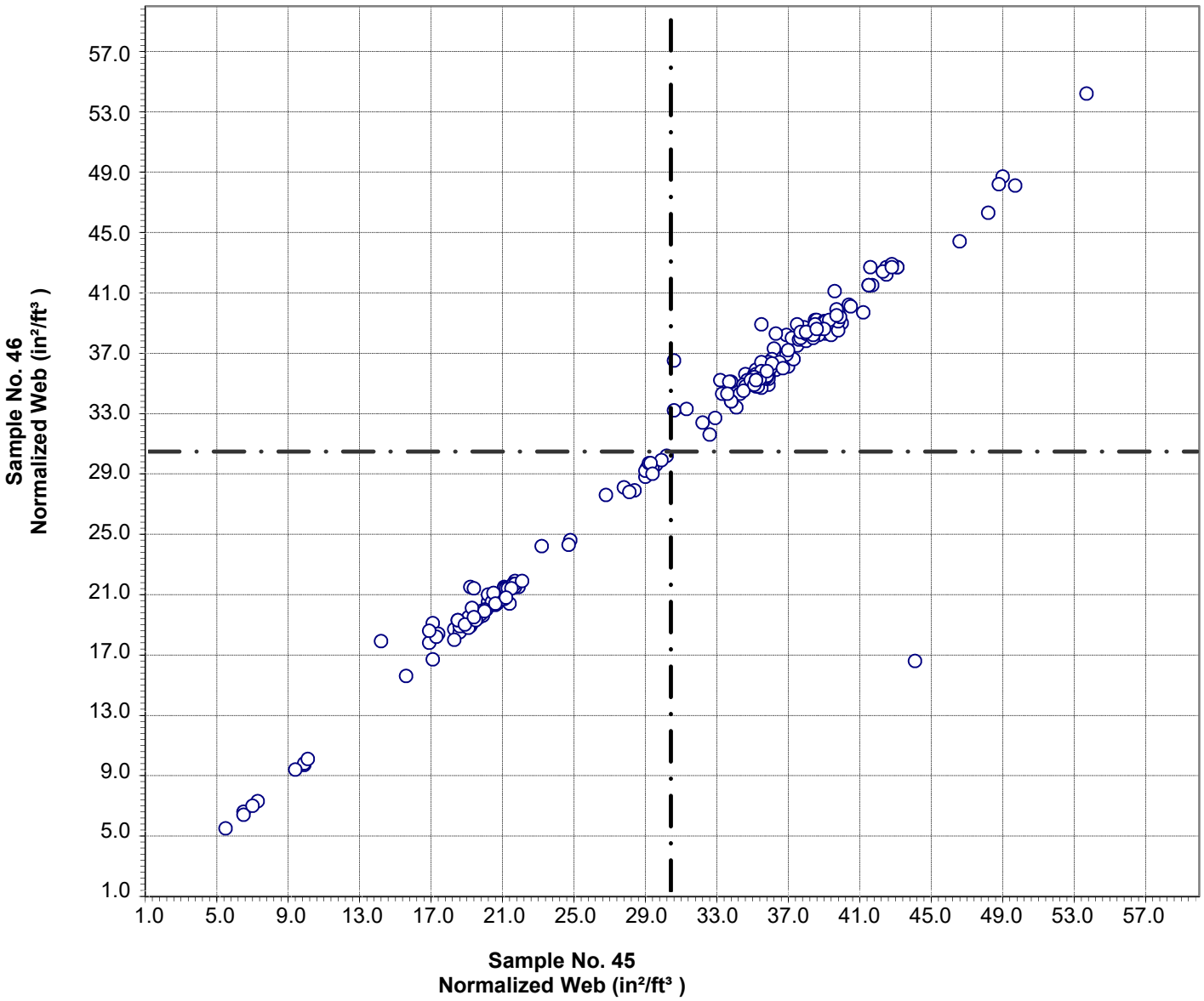


Test No. 654 Percent Solids 241 Points

Sample No. 45	Ave	71.8	S.D.	1.1	C.V. 1.5
Sample No. 46	Ave	71.0	S.D.	1.2	C.V. 1.7

Labs Eliminated: 9, 565, 2128, 2132, 2214, 2438, 3560

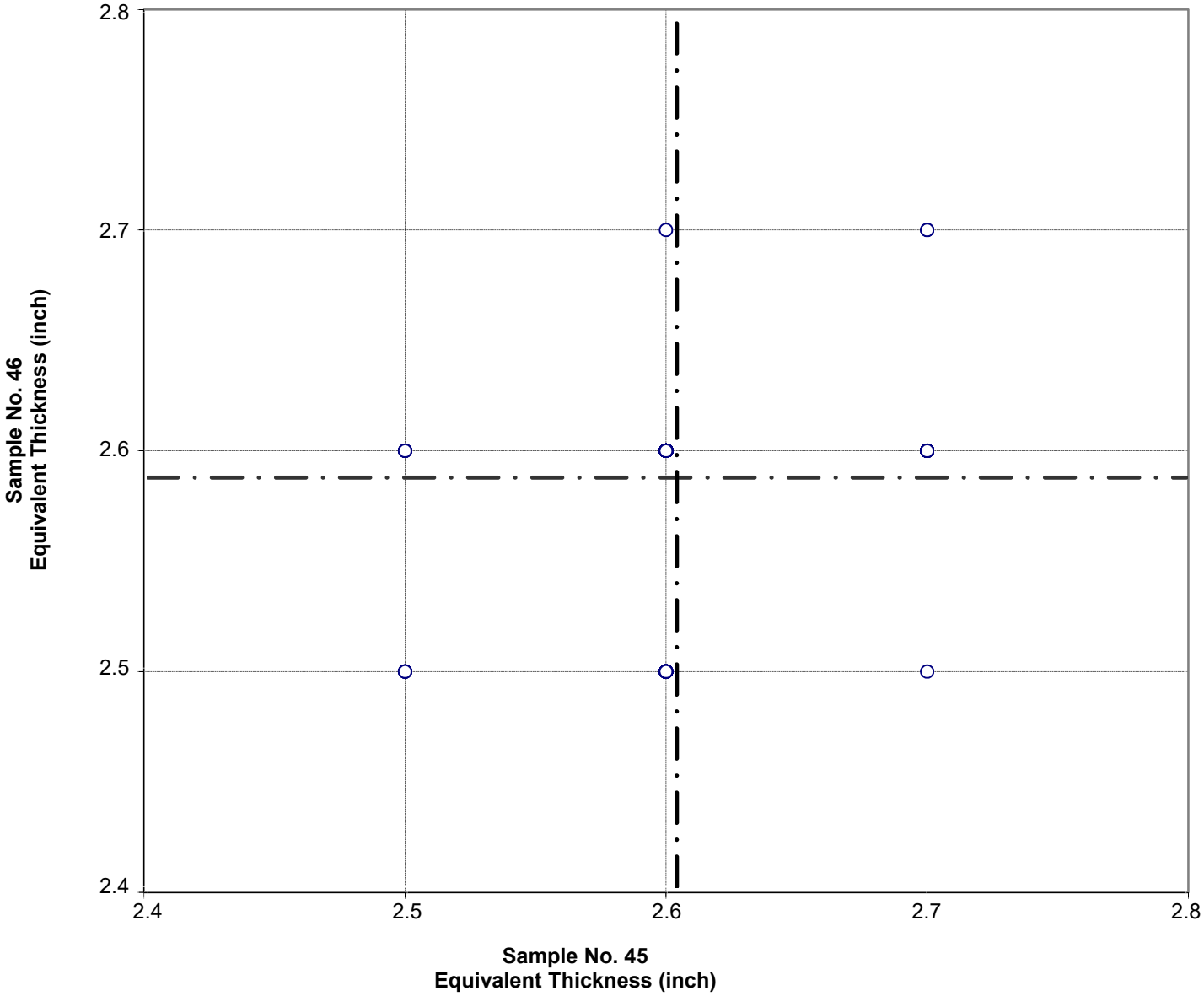
CCRL Proficiency Sample Program
Normalized Web
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



Test No. 656 Normalized Web 240 Points

Sample No. 45	Ave	30.4	S.D.	9.7	C.V.	32.0
Sample No. 46	Ave	30.4	S.D.	9.6	C.V.	31.7

CCRL Proficiency Sample Program
Equivalent Thickness
CONCRETE MASONRY UNITS Samples No. 45 and No. 46



Test No. 660 Equivalent Thickness 242 Points

Sample No. 45	Ave	2.6	S.D.	0.03	C.V. 1.2
Sample No. 46	Ave	2.6	S.D.	0.04	C.V. 1.4

Labs Eliminated: 9, 840, 1189, 1287, 1474, 2173, 2240, 2438, 3252, 4257