CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Concrete Masonry Unit Proficiency Samples
Number 41 and Number 42

September 2016

CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

September 12, 2016

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

SUBJECT: Final Report for Concrete Masonry Units Proficiency Samples No. 41 and No. 42

Following is the report for the current pair of CCRL **Concrete Masonry Units** Proficiency Samples which were distributed in July 2016.

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 –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 41 & 42 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 41 & 42 the nominal dimensions for both length and height would be 8 inch.

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 2017.

Sincerely,

Robin K. Haupt

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

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. 41 and No. 42

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 2016. 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 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. 41 and No. 42

Final Report – September 12, 2016

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.41 Average	S.D.	C.V.	Sample No. 42 Average	S.D.	C.V.
Received Weight - Compression Units (lb)							
	242	9.8	0.08	0.86	11.2	0.14	1.27
	*235	9.8	0.07	0.70	11.2	0.11	0.97
* Labs Eliminated - 28, 1279, 1417, 2442, 3104, 3122, 3595							
Maximum Compressive Load (lbf)							
	243	53646	8953	16.7	46069	7117	15.4
	*239	53683	8643	16.1	46074	6528	14.2
* Labs Eliminated - 1033, 1189, 2398, 3595							
Net Area Compressive Strength (psi)							
	243	2773	497	17.9	2344	421	18.0
	*240	2773	480	17.3	2336	390	16.7
* Labs Eliminated - 210, 2155, 2935							
Received Weight - Absorption Units (lb)							
	244	9.8	0.08	0.77	11.2	0.11	1.02
	*239	9.8	0.07	0.74	11.2	0.10	0.92
* Labs Eliminated - 41, 1279, 1455, 2387, 3021							
Width (inch)							
	244	3.6	0.04	1.0	3.6	0.04	1.2
	*241	3.6	0.02	0.6	3.6	0.04	1.0
* Labs Eliminated - 1263, 1279, 1993							
Height (inch)							
	244	7.6	0.06	0.73	7.6	0.06	0.79
	*241	7.6	0.04	0.58	7.6	0.05	0.66
* Labs Eliminated - 1279, 1993, 2294							
Length (inch)							
	244	7.6	0.05	0.61	7.6	0.06	0.73
	*240	7.6	0.03	0.45	7.6	0.05	0.61
* Labs Eliminated - 103, 1993, 2294, 2341							

CCRL PROFICIENCY SAMPLE PROGRAM

Concrete Masonry Units Proficiency Samples No. 41 and No. 42

Final Report – September 12, 2016

SUMMARY OF RESULTS

Test (unit)	#Labs	Sample No.41 Average	S.D.	C.V.	Sample No. 42 Average	S.D.	C.V.
Minimum Face Shell Thickness (**inch**)							
	244	1.06	0.06	5.9	1.06	0.07	6.1
	*232	1.05	0.04	3.8	1.05	0.04	4.0
* Labs Eliminated - 103, 475, 1279, 1446, 1777, 1796, 2173, 2187, 2224, 2294, 3339, 3818							
Minimum Web Thickness (**inch**)							
	242	1.1	0.06	5.7	1.1	0.06	5.2
	*237	1.1	0.05	4.7	1.1	0.05	4.8
* Labs Eliminated - 103, 1200, 1279, 1649, 3811							
Web Height (**inch**)							
	239	7.3	1.29	17.62	7.3	1.30	17.66
	*223	7.6	0.05	0.67	7.6	0.06	0.72
* Labs Eliminated - 40, 41, 143, 1200, 1403, 1553, 1749, 1975, 1993, 2224, 2272, 2294, 2398, 3091, 3302, 4022							
Immersed Weight (**lb**)							
	244	5.3	0.14	2.6	6.6	0.16	2.5
	*234	5.3	0.06	1.2	6.6	0.08	1.2
* Labs Eliminated - 41, 42, 552, 840, 1455, 1790, 2079, 2224, 2420, 3252							
Saturated Weight (**lb**)							
	244	10.6	0.12	1.12	11.9	0.14	1.15
	*239	10.6	0.08	0.80	12.0	0.11	0.91
* Labs Eliminated - 41, 920, 1455, 2146, 3252							
Oven-Dry Weight (**lb**)							
	244	9.6	0.09	0.96	11.1	0.15	1.31
	*237	9.6	0.07	0.77	11.1	0.10	0.93
* Labs Eliminated - 41, 42, 1010, 1455, 1550, 2177, 2398							

CCRL PROFICIENCY SAMPLE PROGRAM

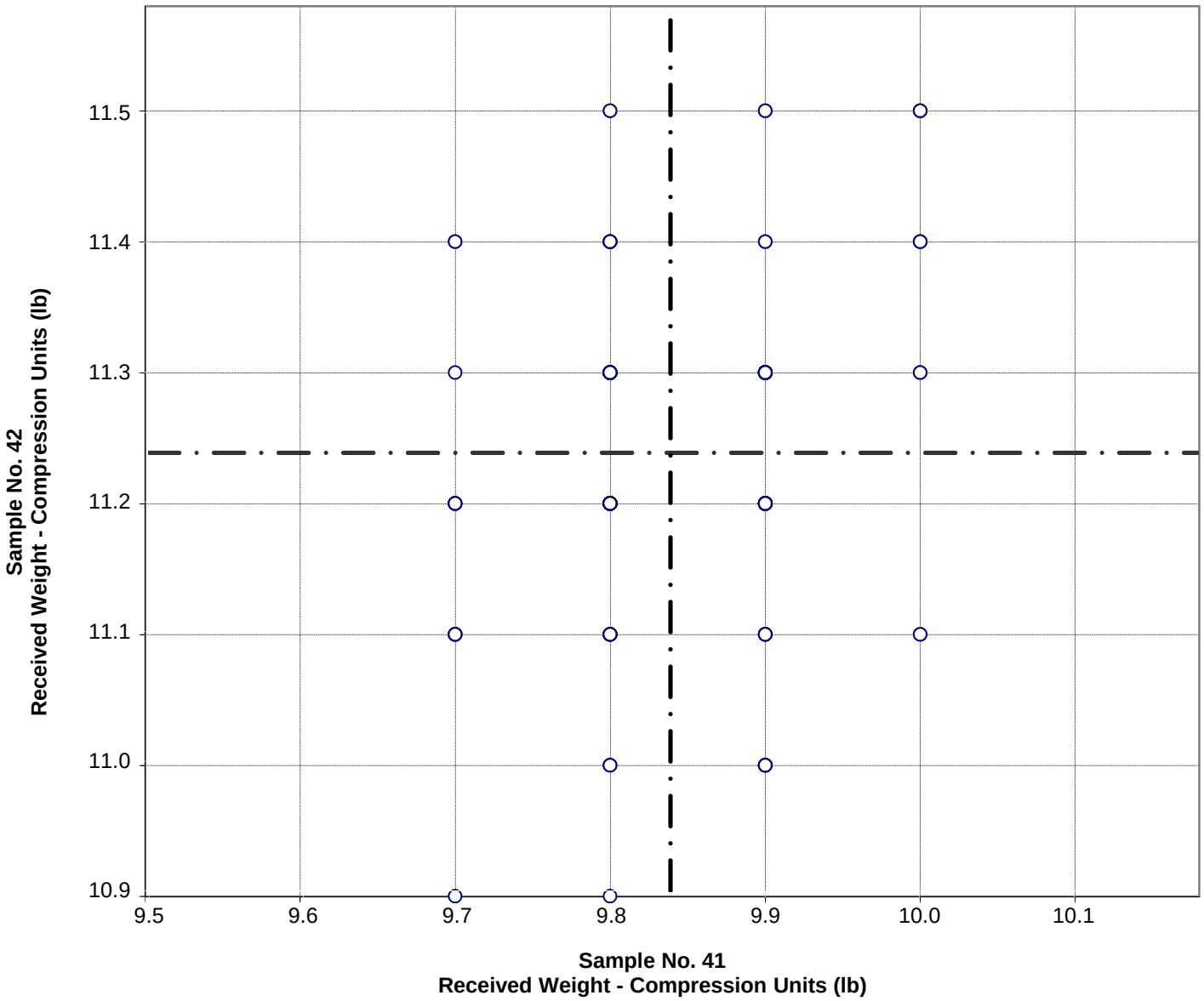
Concrete Masonry Units Proficiency Samples No. 41 and No. 42

Final Report – September 12, 2016

SUMMARY OF RESULTS

		Sample No.41			Sample No. 42		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Net Area (**sq in**)							
	244	19.4	1.51	7.8	19.7	1.50	7.6
	*228	19.2	0.33	1.7	19.5	0.26	1.3
* Labs Eliminated - 50, 788, 1140, 1455, 1522, 1906, 2079, 2155, 2187, 2224, 2240, 2291, 2294, 2398, 2420, 2935							
Absorption (**lb/ft³**)							
	243	11.8	0.96	8.1	10.3	1.24	12.1
	*231	11.7	0.69	5.9	10.2	0.65	6.3
* Labs Eliminated - 788, 1019, 1186, 1446, 1455, 1534, 1906, 2041, 2224, 2273, 2398, 2420							
Density (**lb/ft³**)							
	243	113.6	3.3	2.9	128.1	2.8	2.2
	*237	113.3	1.6	1.4	128.1	1.4	1.1
* Labs Eliminated - 41, 1265, 2173, 2224, 2420, 2442							
Net Volume (**ft³**)							
	241	0.0843	0.0055	6.5	0.0893	0.0500	56.0
	*234	0.0849	0.0018	2.1	0.0865	0.0013	1.5
* Labs Eliminated - 923, 1534, 2112, 2177, 2224, 2420, 2549							
Percent Solids (**percent**)							
	237	69.6	4.5	6.5	70.6	4.4	6.2
	*227	69.8	1.3	1.8	70.9	1.2	1.7
* Labs Eliminated - 28, 1455, 1534, 1993, 2187, 2240, 2294, 2420, 2472, 2549							
Normalized Web (**in²/ft²**)							
	228	29.1	11.2	38.4	29.1	11.2	38.4
No Labs Eliminated for This Test							
Equivalent Thickness (**inch**)							
	243	2.6	1.17	44.6	2.7	1.17	43.7
	*230	2.5	0.06	2.2	2.6	0.06	2.3
* Labs Eliminated - 40, 103, 906, 1068, 1200, 1440, 1522, 1539, 2173, 2240, 2294, 2422, 3252							

CCRL Proficiency Sample Program
Received Weight - Compression Units
CONCRETE MASONRY UNITS Samples No. 41 and No. 42



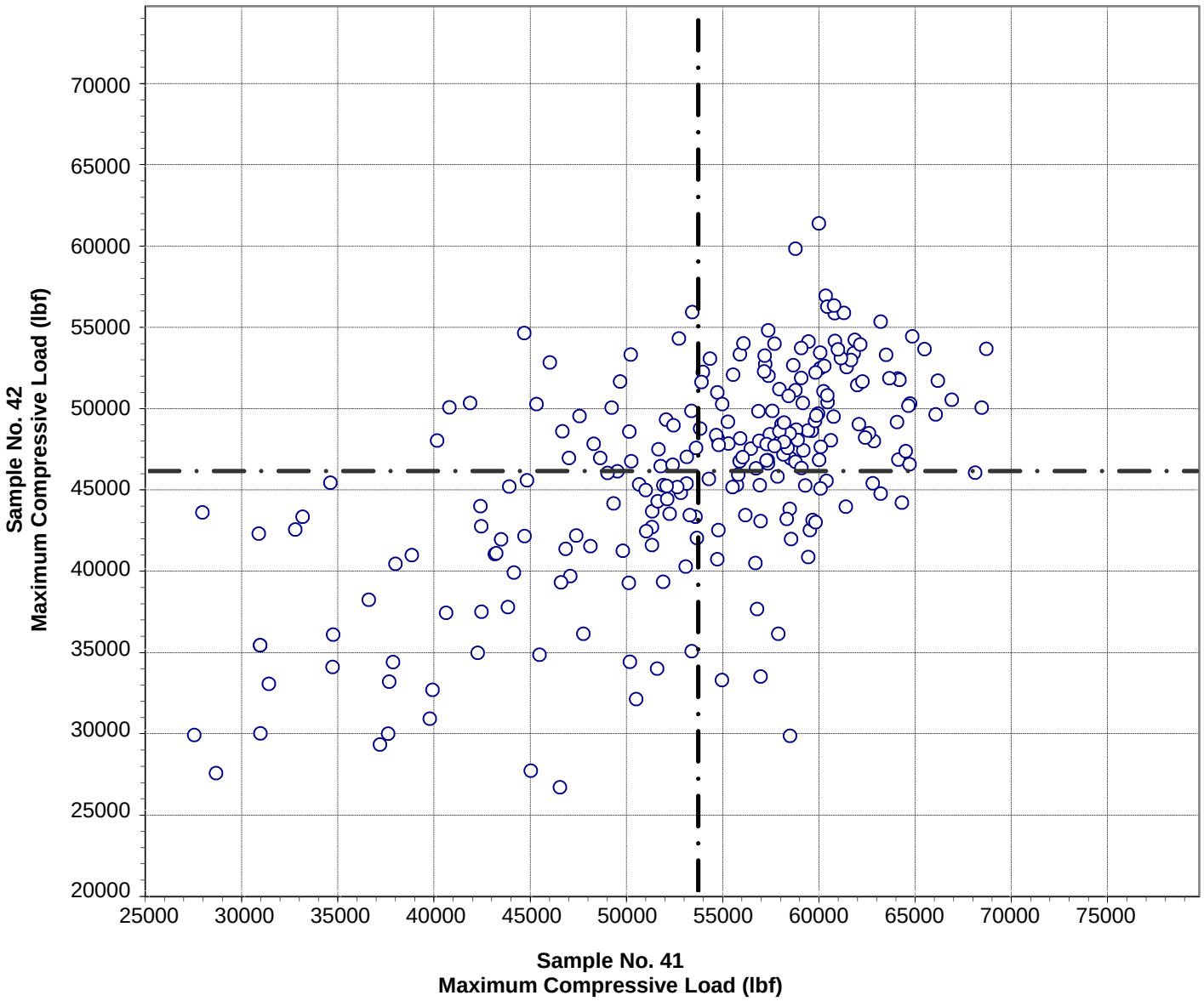
Test No. 500 Received Weight - Compression Units 233 Points

Sample No. 41 Ave 9.8 S.D. 0.07 C.V. 0.70
Sample No. 42 Ave 11.2 S.D. 0.11 C.V. 0.97

Labs Eliminated: 28, 1279, 1417, 2442, 3104, 3122, 3595

Labs off Diagram: 3021, 42

CCRL Proficiency Sample Program
Maximum Compressive Load
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

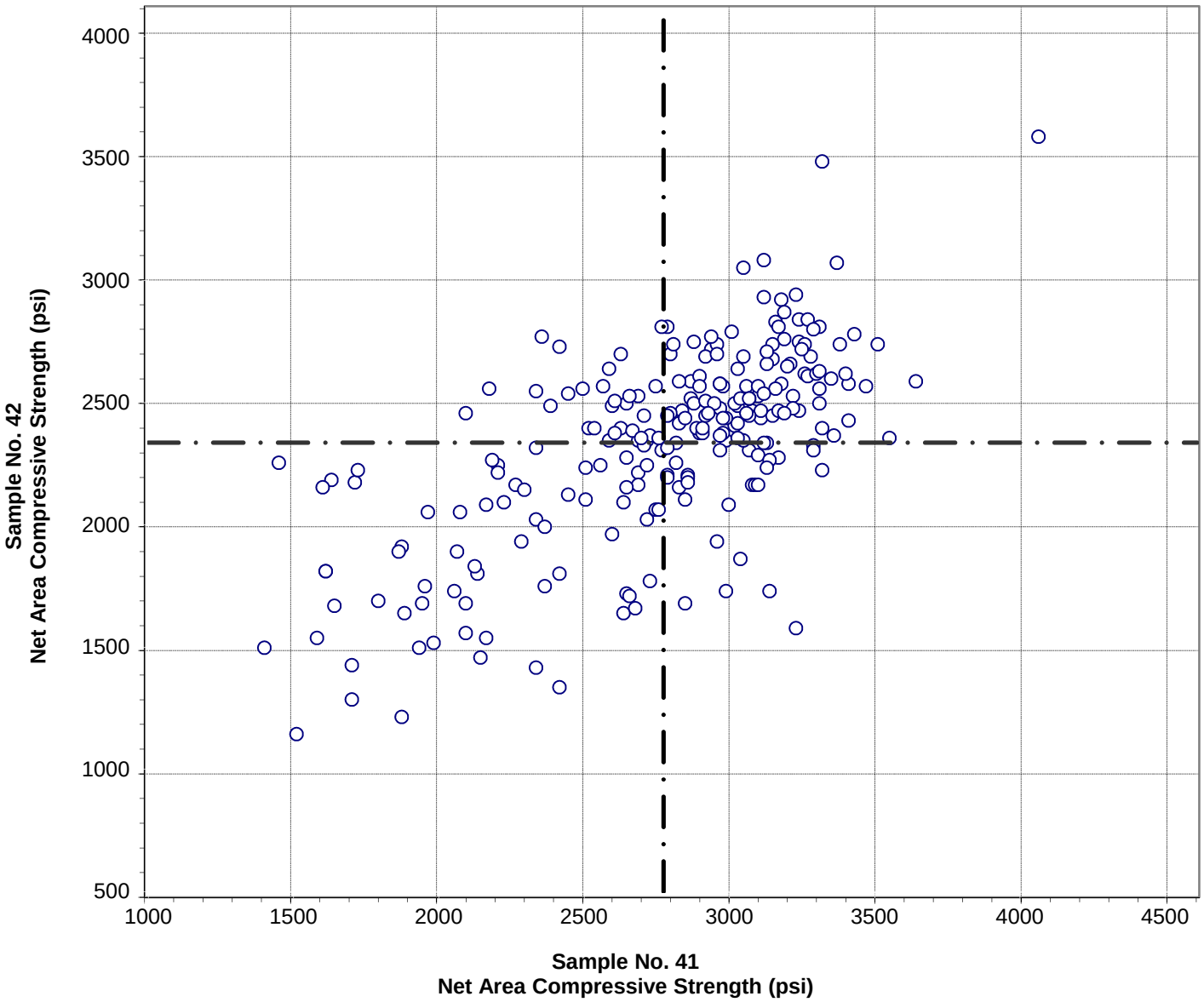


Test No. 550 Maximum Compressive Load 239 Points

Sample No. 41	Ave	53683	S.D.	8643	C.V. 16.1
Sample No. 42	Ave	46074	S.D.	6528	C.V. 14.2

Labs Eliminated: 1033, 1189, 2398, 3595

CCRL Proficiency Sample Program
Net Area Compressive Strength
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

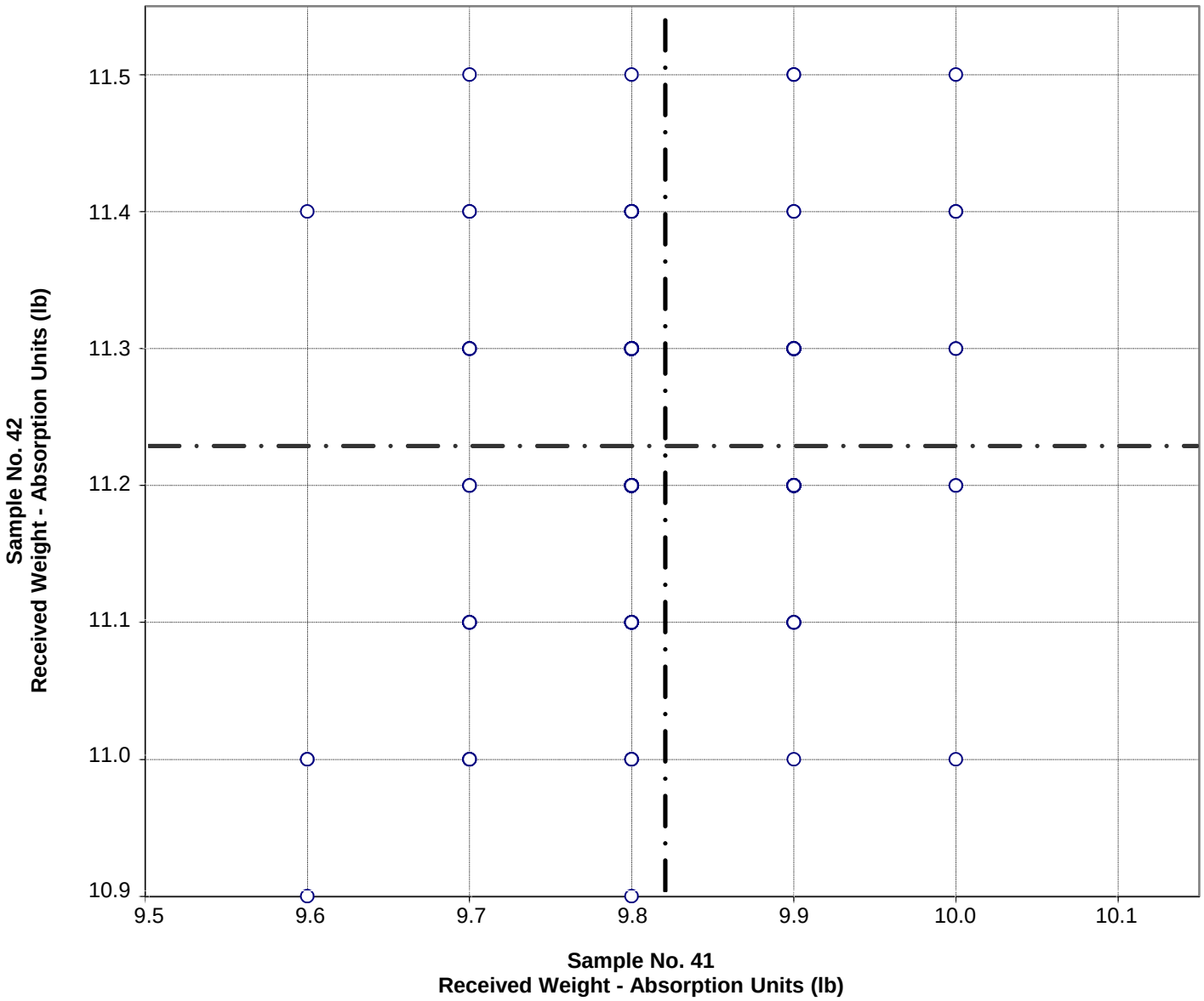


Test No. 560 Net Area Compressive Strength 240 Points

Sample No. 41	Ave	2773	S.D.	480	C.V. 17.3
Sample No. 42	Ave	2336	S.D.	390	C.V. 16.7

Labs Eliminated: 210, 2155, 2935

CCRL Proficiency Sample Program
Received Weight - Absorption Units
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

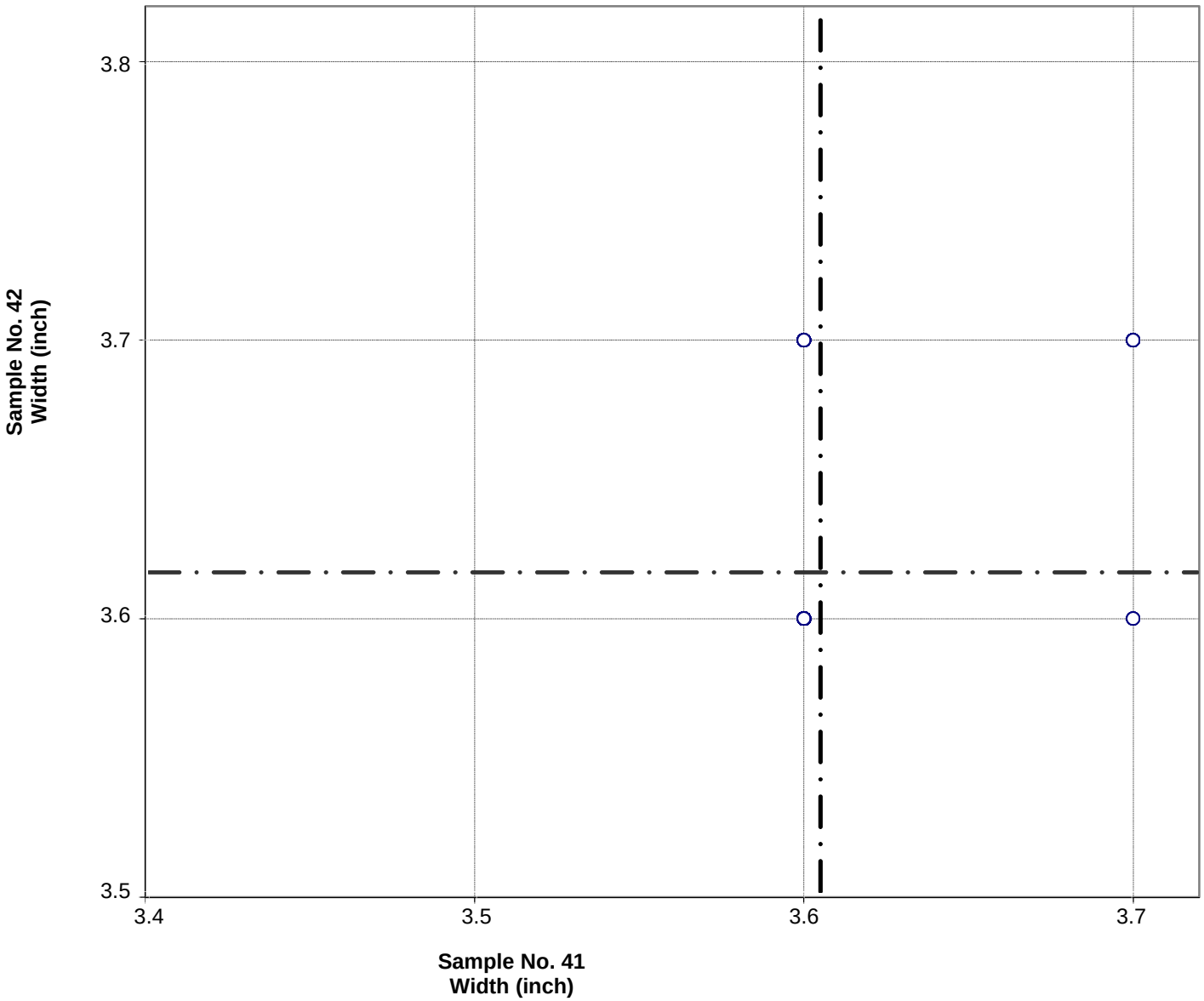


Test No. 600 Received Weight - Absorption Units 239 Points

Sample No. 41 Ave 9.8 S.D. 0.07 C.V. 0.74
Sample No. 42 Ave 11.2 S.D. 0.10 C.V. 0.92

Labs Eliminated: 41, 1279, 1455, 2387, 3021

CCRL Proficiency Sample Program
Width
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

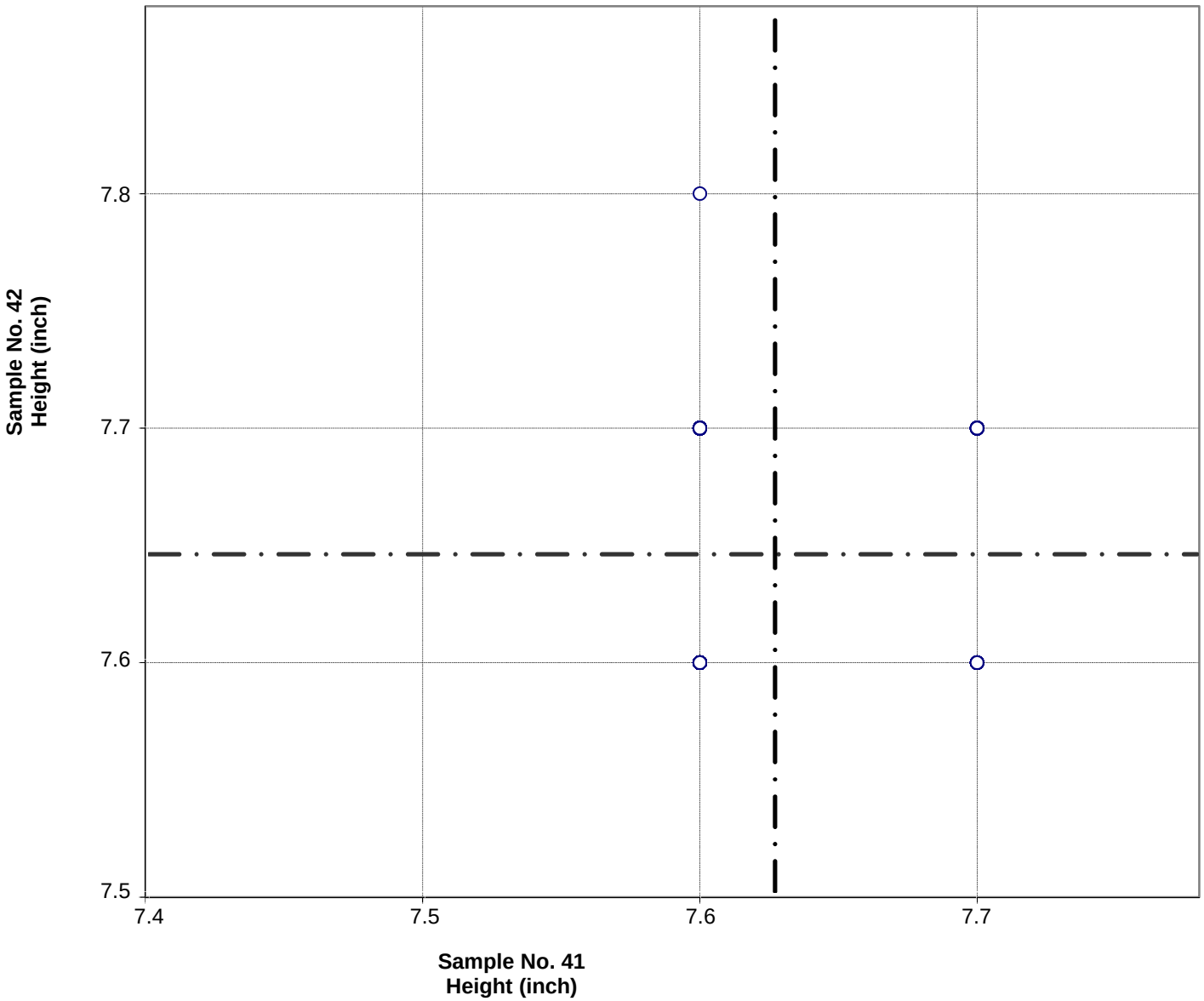


Test No. 510 Width 241 Points

Sample No. 41	Ave	3.6	S.D.	0.02	C.V. 0.6
Sample No. 42	Ave	3.6	S.D.	0.04	C.V. 1.0

Labs Eliminated: 1263, 1279, 1993

CCRL Proficiency Sample Program
Height
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

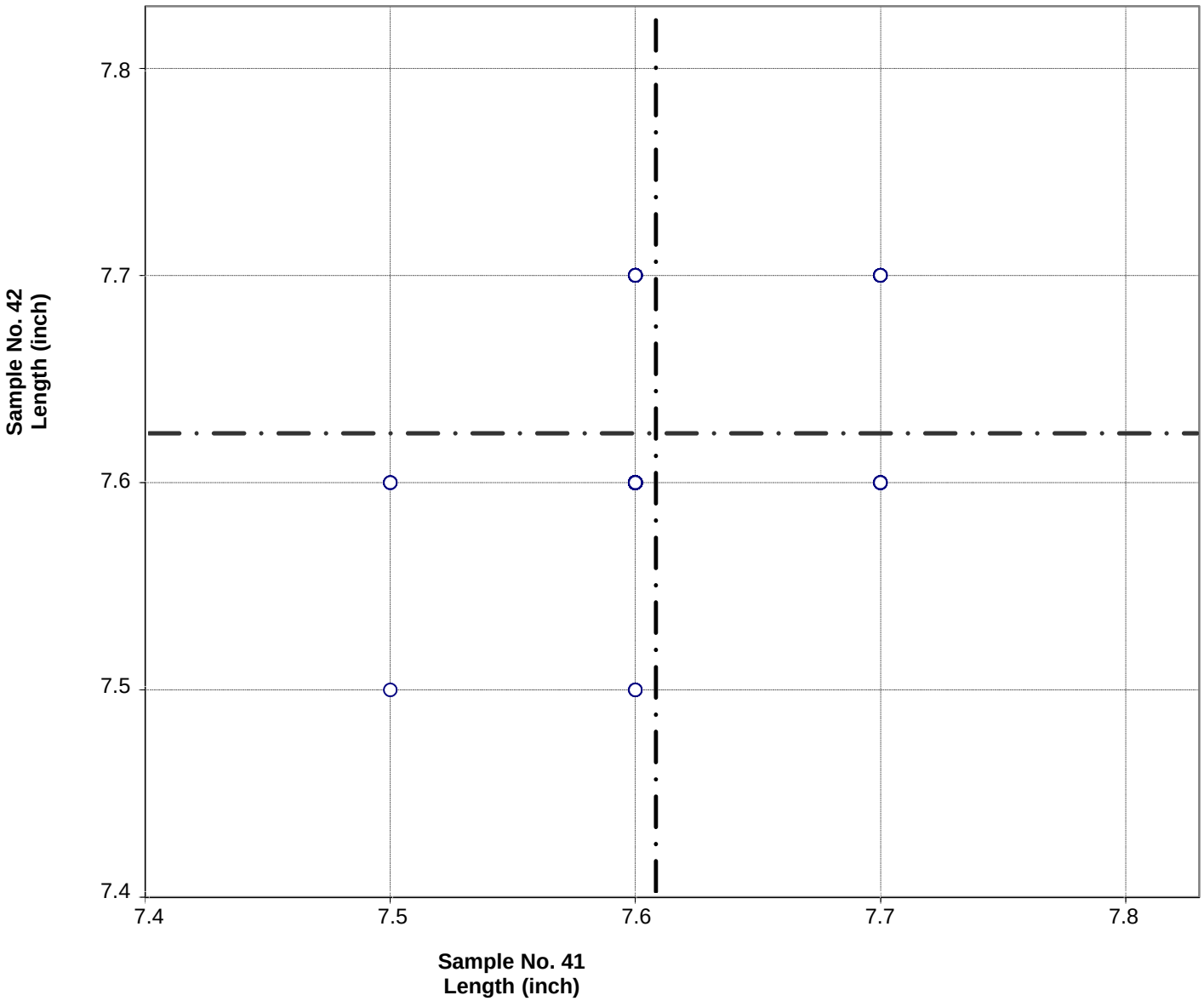


Test No. 520 Height 241 Points

Sample No. 41	Ave	7.6	S.D.	0.04	C.V. 0.58
Sample No. 42	Ave	7.6	S.D.	0.05	C.V. 0.66

Labs Eliminated: 1279, 1993, 2294

CCRL Proficiency Sample Program
Length
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

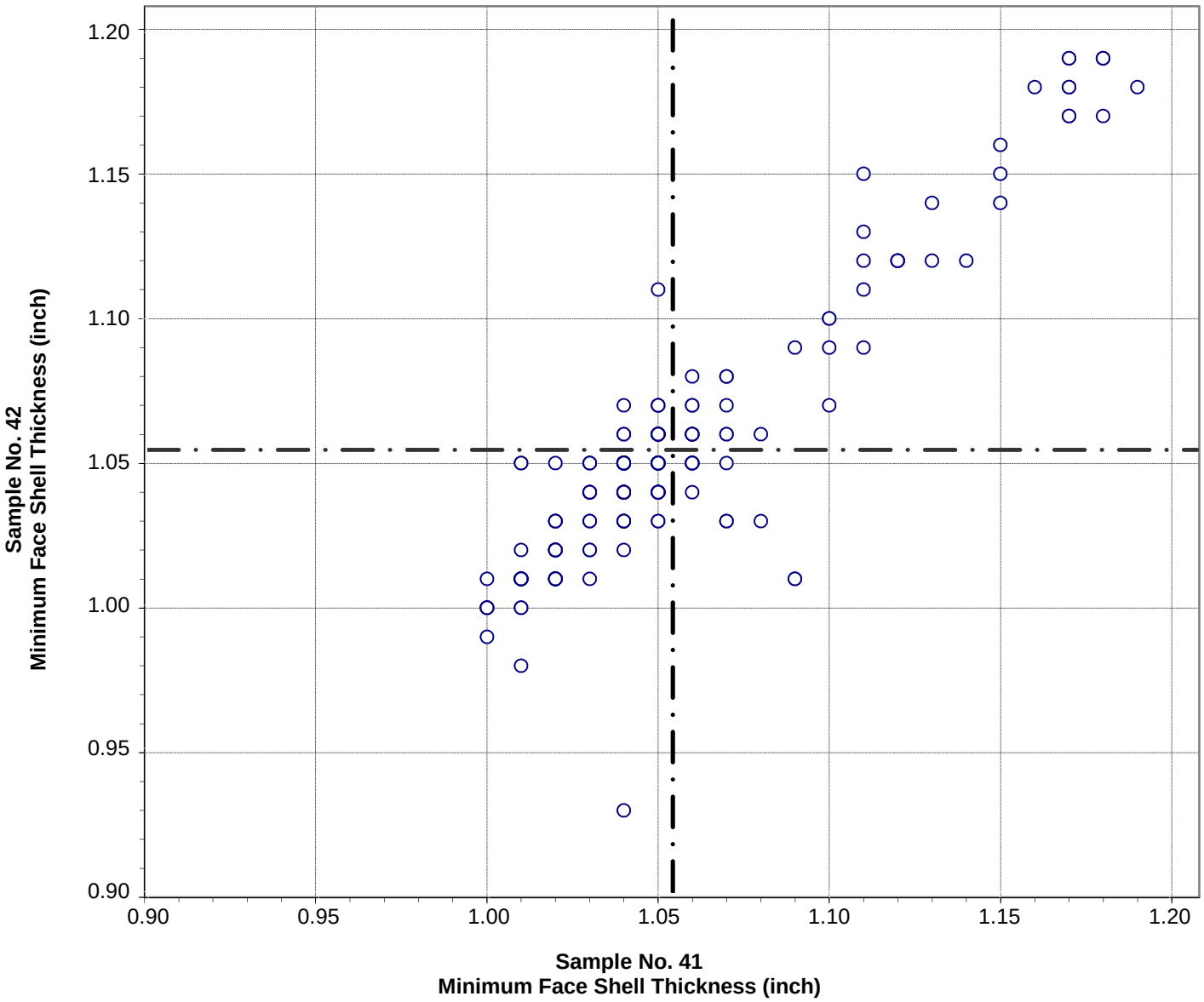


Test No. 530 Length 240 Points

Sample No. 41	Ave	7.6	S.D.	0.03	C.V. 0.45
Sample No. 42	Ave	7.6	S.D.	0.05	C.V. 0.61

Labs Eliminated: 103, 1993, 2294, 2341

CCRL Proficiency Sample Program
Minimum Face Shell Thickness
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

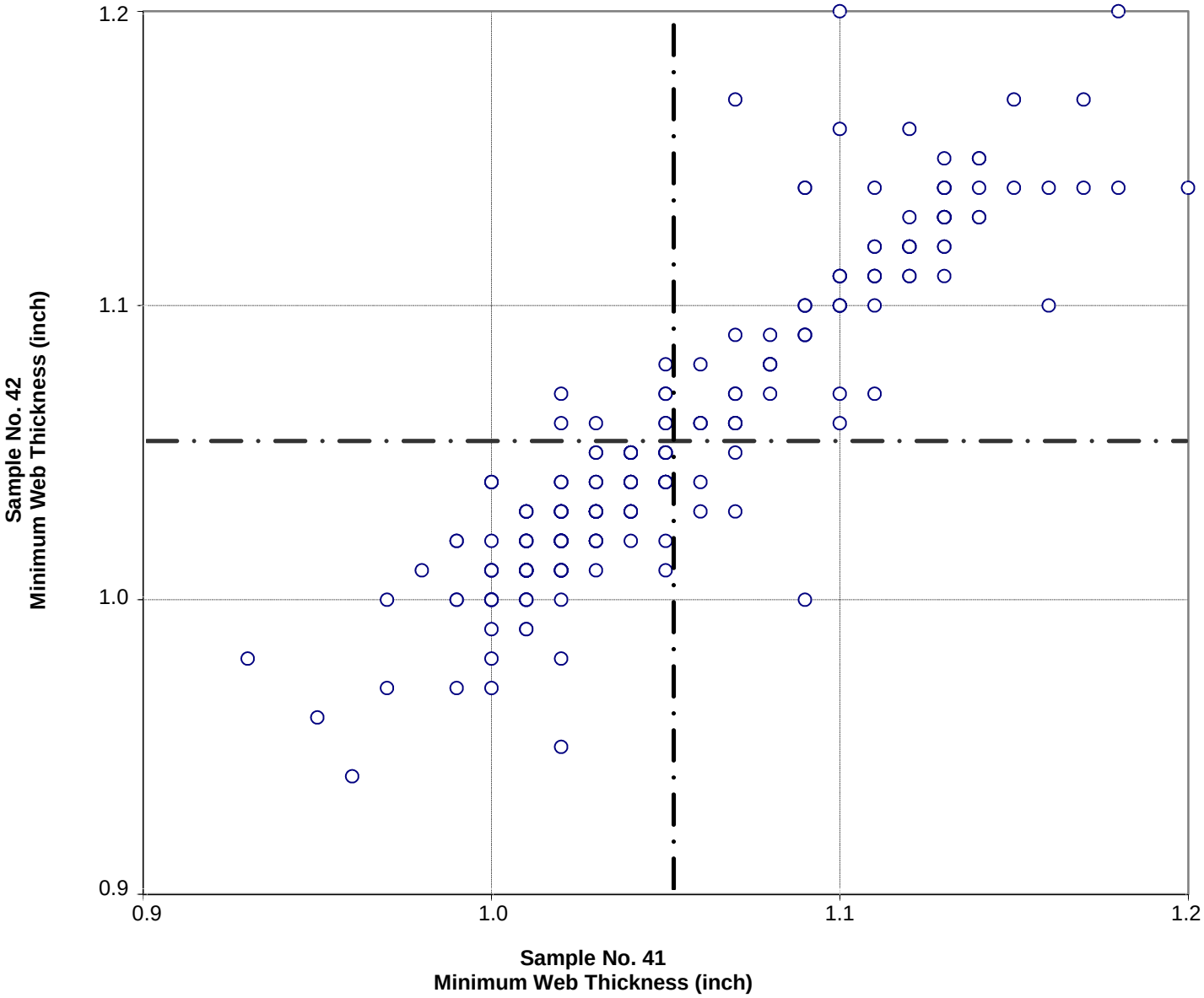


Test No. 532 Minimum Face Shell Thickness 232 Points

Sample No. 41	Ave	1.05	S.D.	0.04	C.V.	3.8
Sample No. 42	Ave	1.05	S.D.	0.04	C.V.	4.0

Labs Eliminated: 103, 475, 1279, 1446, 1777, 1796, 2173, 2187, 2224, 2294, 3339, 3818

CCRL Proficiency Sample Program
Minimum Web Thickness
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

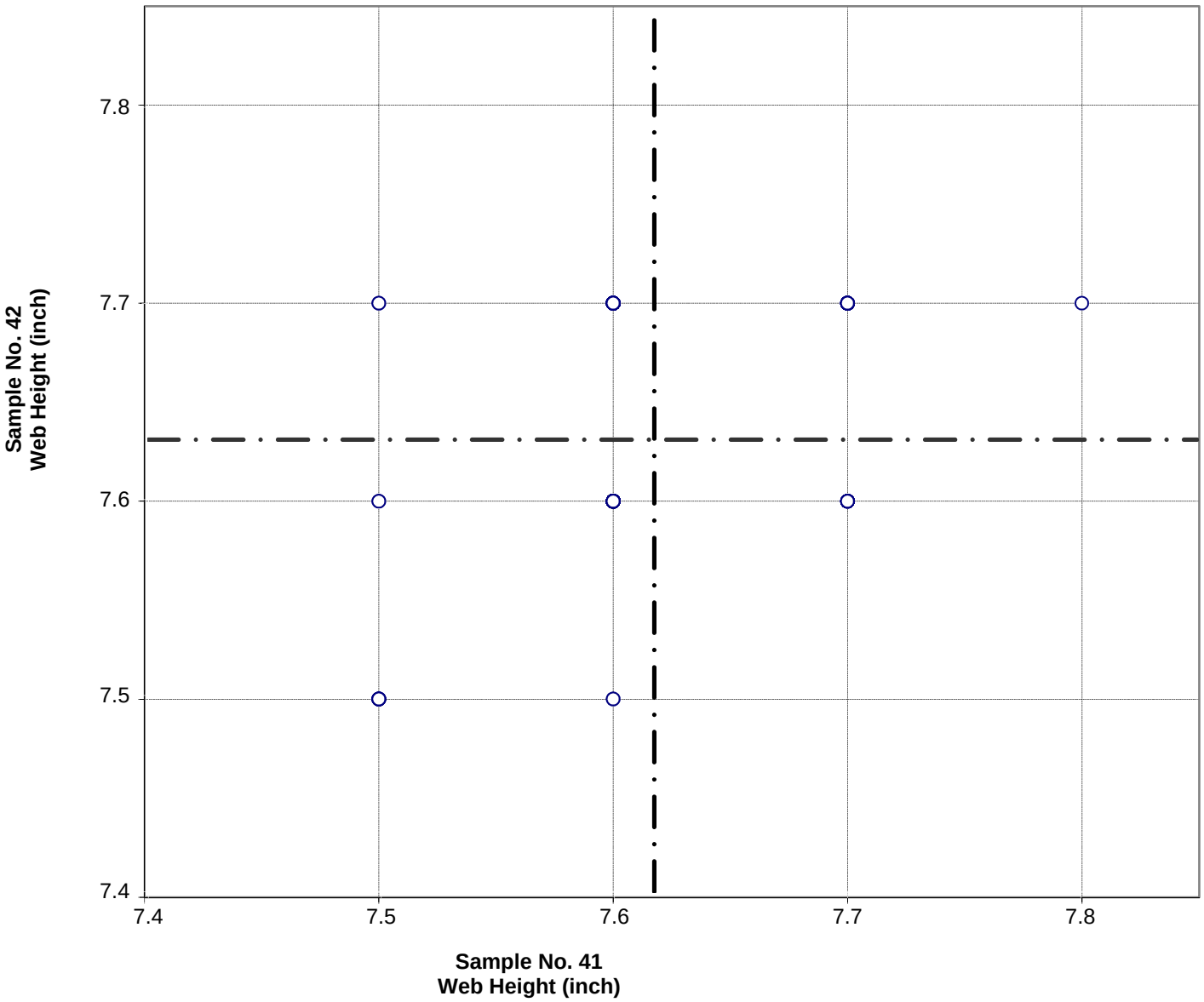


Test No. 533 Minimum Web Thickness 237 Points

Sample No. 41	Ave	1.1	S.D.	0.05	C.V. 4.7
Sample No. 42	Ave	1.1	S.D.	0.05	C.V. 4.8

Labs Eliminated: 103, 1200, 1279, 1649, 3811

CCRL Proficiency Sample Program
Web Height
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

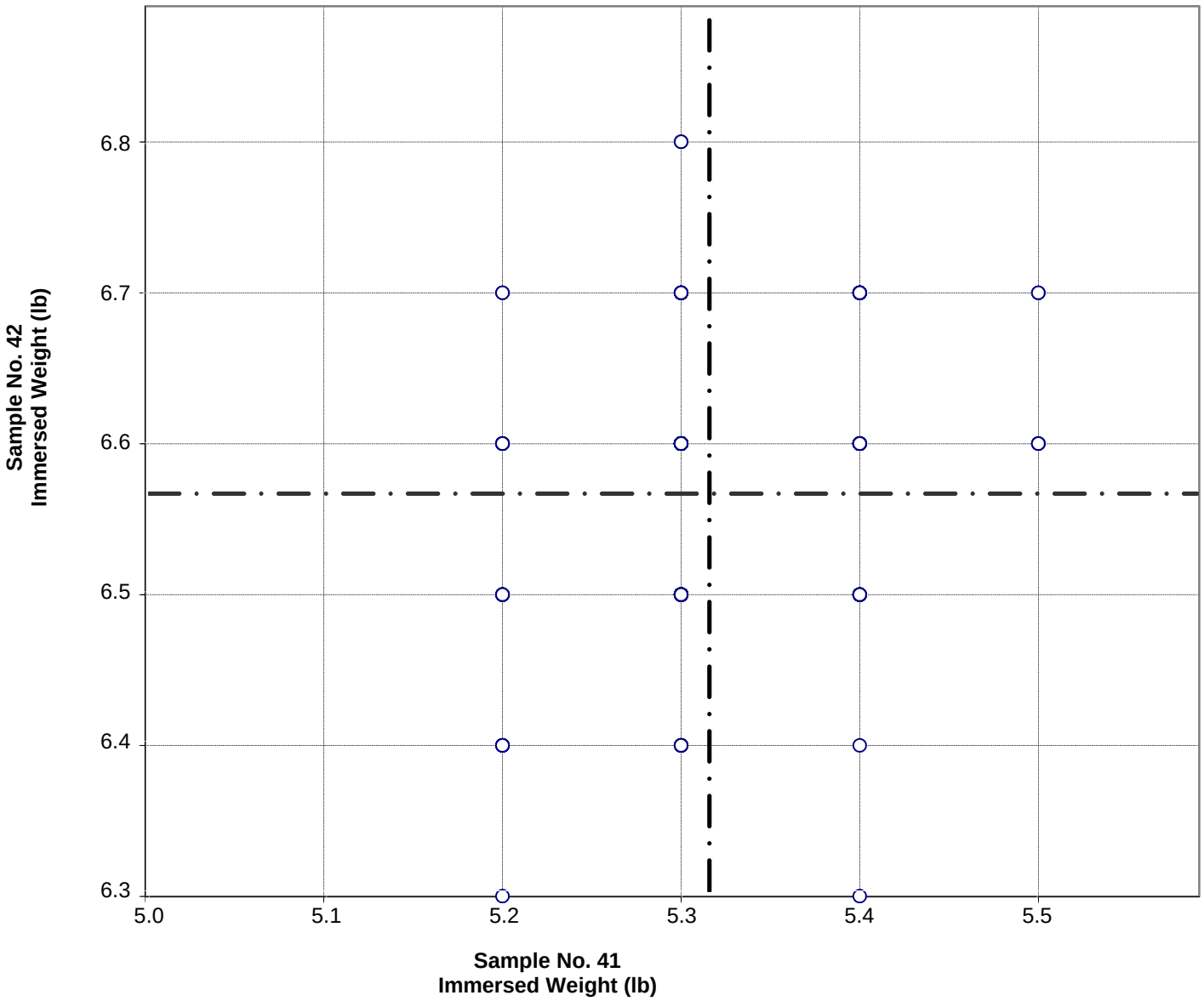


Test No. 534 Web Height 223 Points

Sample No. 41	Ave	7.6	S.D.	0.05	C.V. 0.67
Sample No. 42	Ave	7.6	S.D.	0.06	C.V. 0.72

Labs Eliminated: 40, 41, 143, 1200, 1403, 1553, 1749, 1975, 1993, 2224, 2272, 2294, 2398, 3091, 3302, 4022

CCRL Proficiency Sample Program
Immersed Weight
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

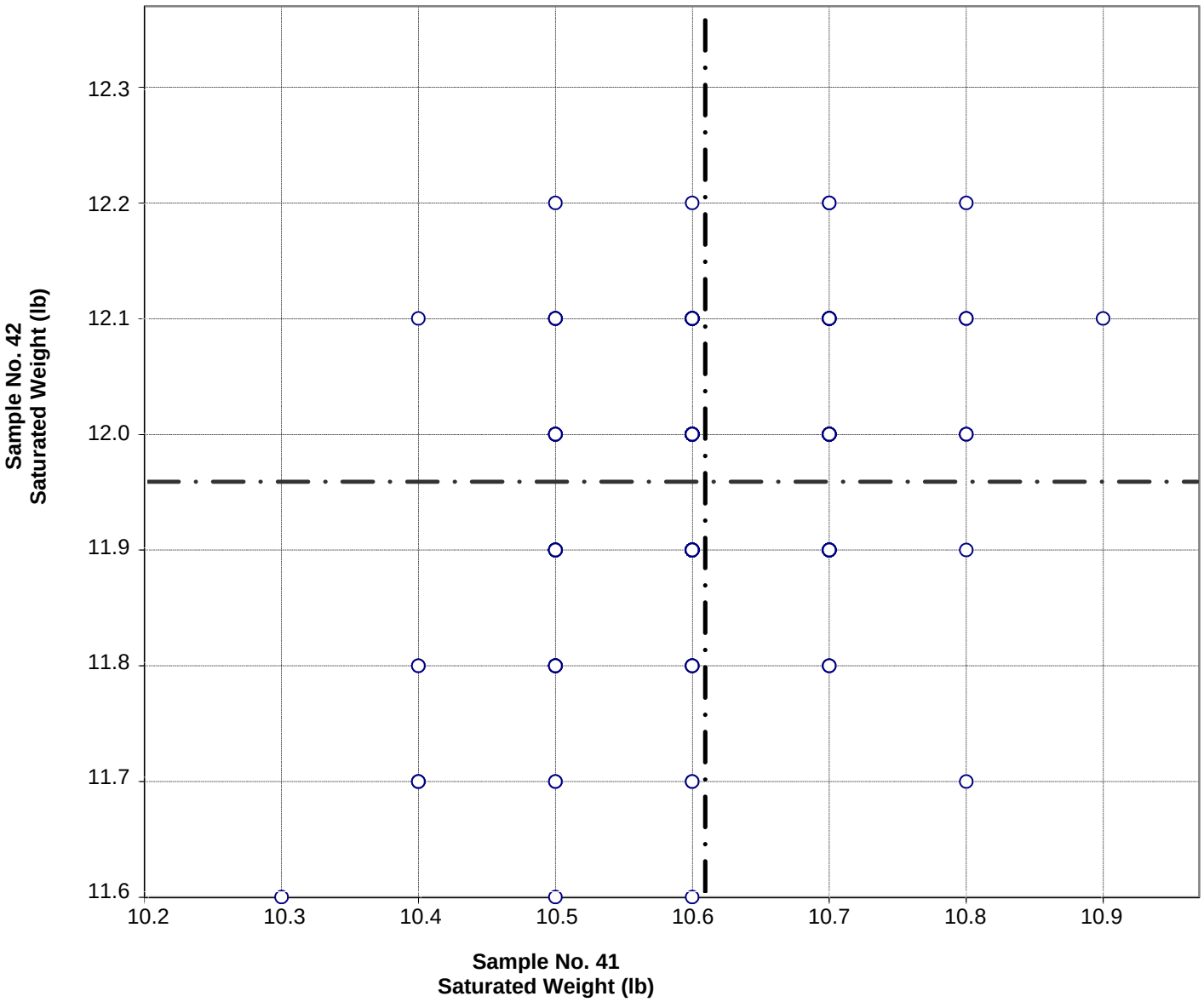


Test No. 610 Immersed Weight 234 Points

Sample No. 41	Ave	5.3	S.D.	0.06	C.V. 1.2
Sample No. 42	Ave	6.6	S.D.	0.08	C.V. 1.2

Labs Eliminated: 41, 42, 552, 840, 1455, 1790, 2079, 2224, 2420, 3252

CCRL Proficiency Sample Program
Saturated Weight
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

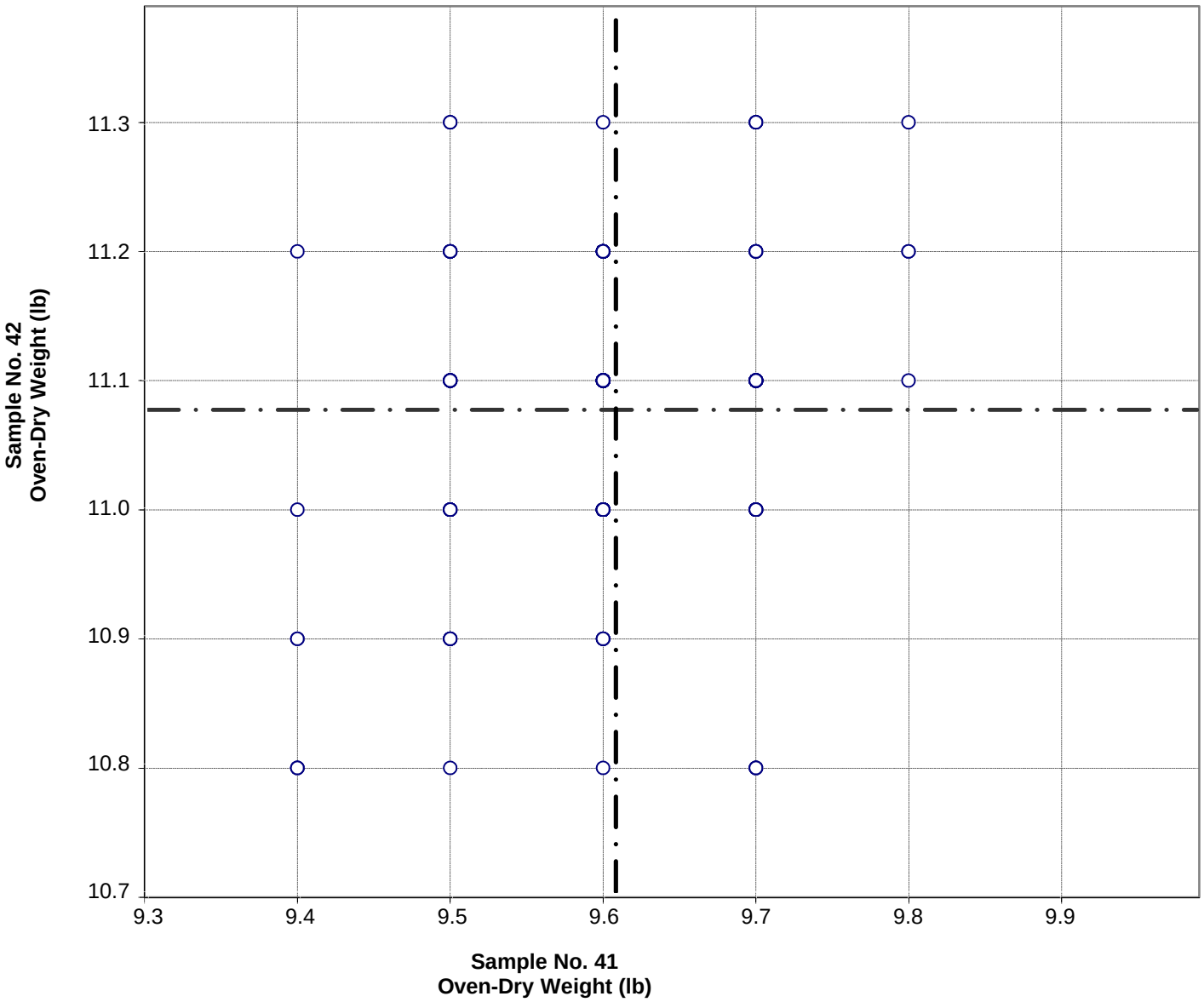


Test No. 620 Saturated Weight 239 Points

Sample No. 41	Ave	10.6	S.D.	0.08	C.V.	0.80
Sample No. 42	Ave	12.0	S.D.	0.11	C.V.	0.91

Labs Eliminated: 41, 920, 1455, 2146, 3252

CCRL Proficiency Sample Program
Oven-Dry Weight
CONCRETE MASONRY UNITS Samples No. 41 and No. 42



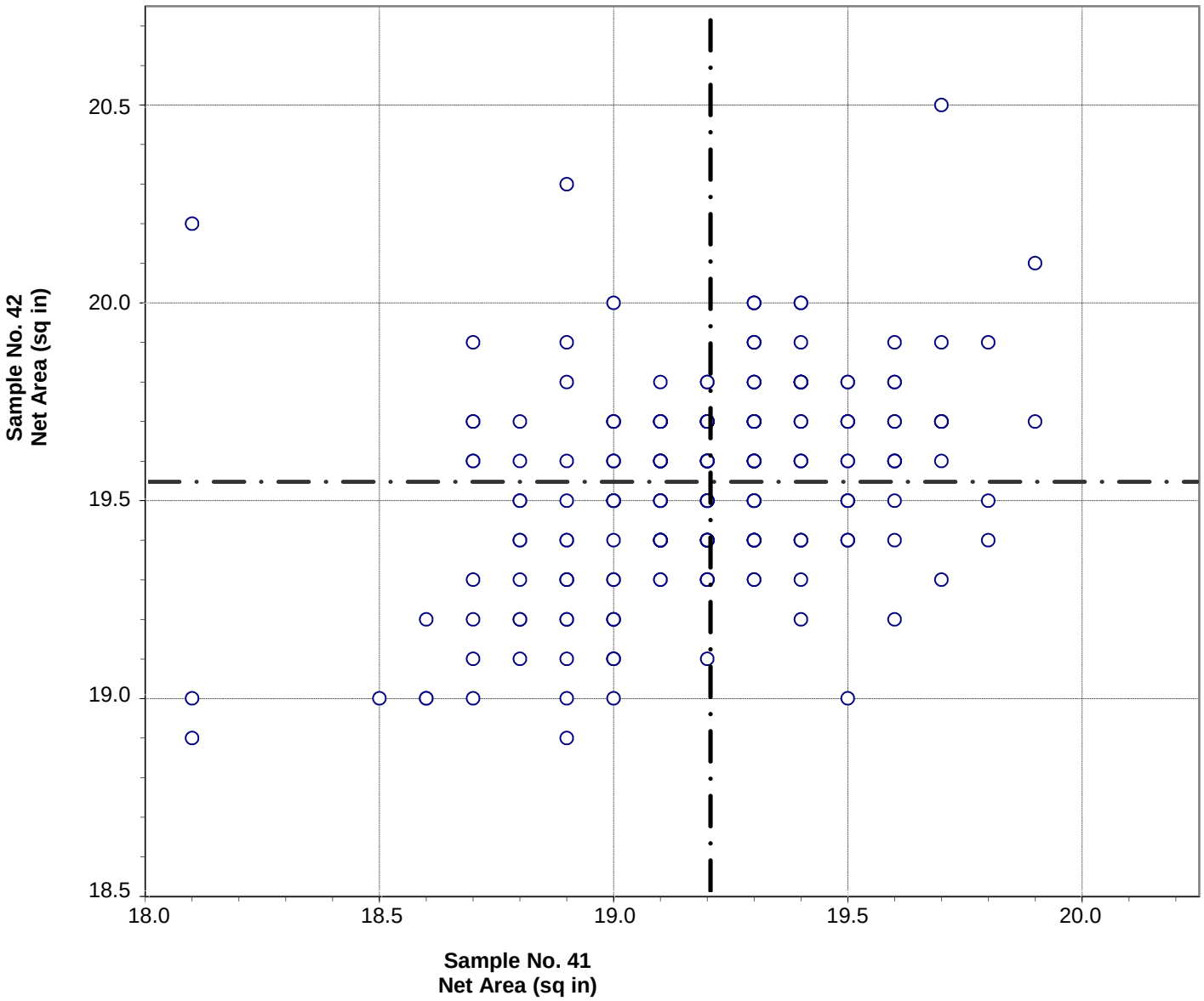
Test No. 630 Oven-Dry Weight 236 Points

Sample No. 41 Ave 9.6 S.D. 0.07 C.V. 0.77
Sample No. 42 Ave 11.1 S.D. 0.10 C.V. 0.93

Labs Eliminated: 41, 42, 1010, 1455, 1550, 2177, 2398

Labs off Diagram: 2387

CCRL Proficiency Sample Program
Net Area
CONCRETE MASONRY UNITS Samples No. 41 and No. 42



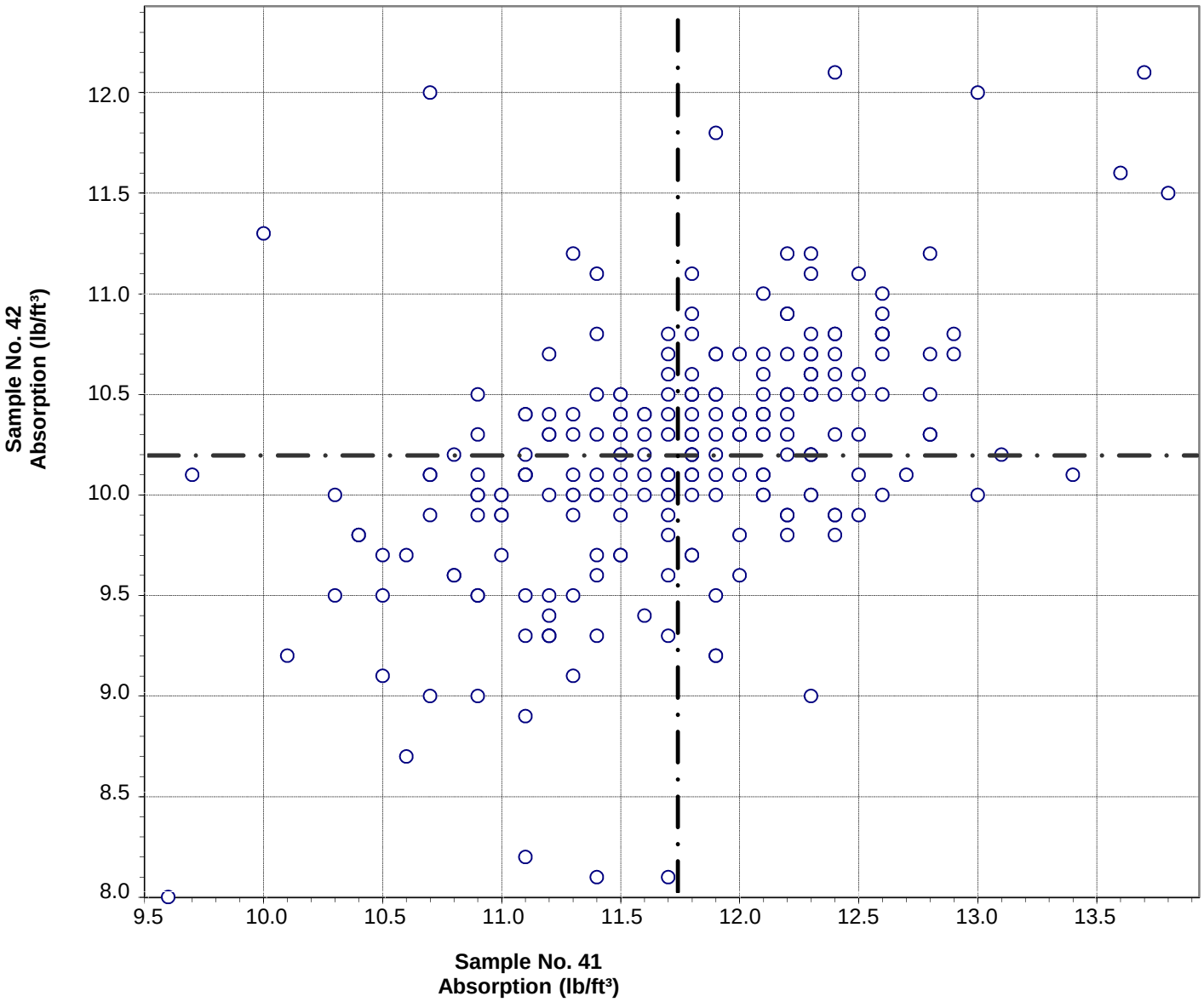
Test No. 635 Net Area 225 Points

Sample No. 41	Ave	19.2	S.D.	0.33	C.V. 1.7
Sample No. 42	Ave	19.5	S.D.	0.26	C.V. 1.3

Labs Eliminated: 50, 788, 1140, 1455, 1522, 1906, 2079, 2155, 2187, 2224, 2240, 2291, 2294, 2398, 2420, 2935

Labs off Diagram: 2506, 1982, 2214

CCRL Proficiency Sample Program
Absorption
CONCRETE MASONRY UNITS Samples No. 41 and No. 42



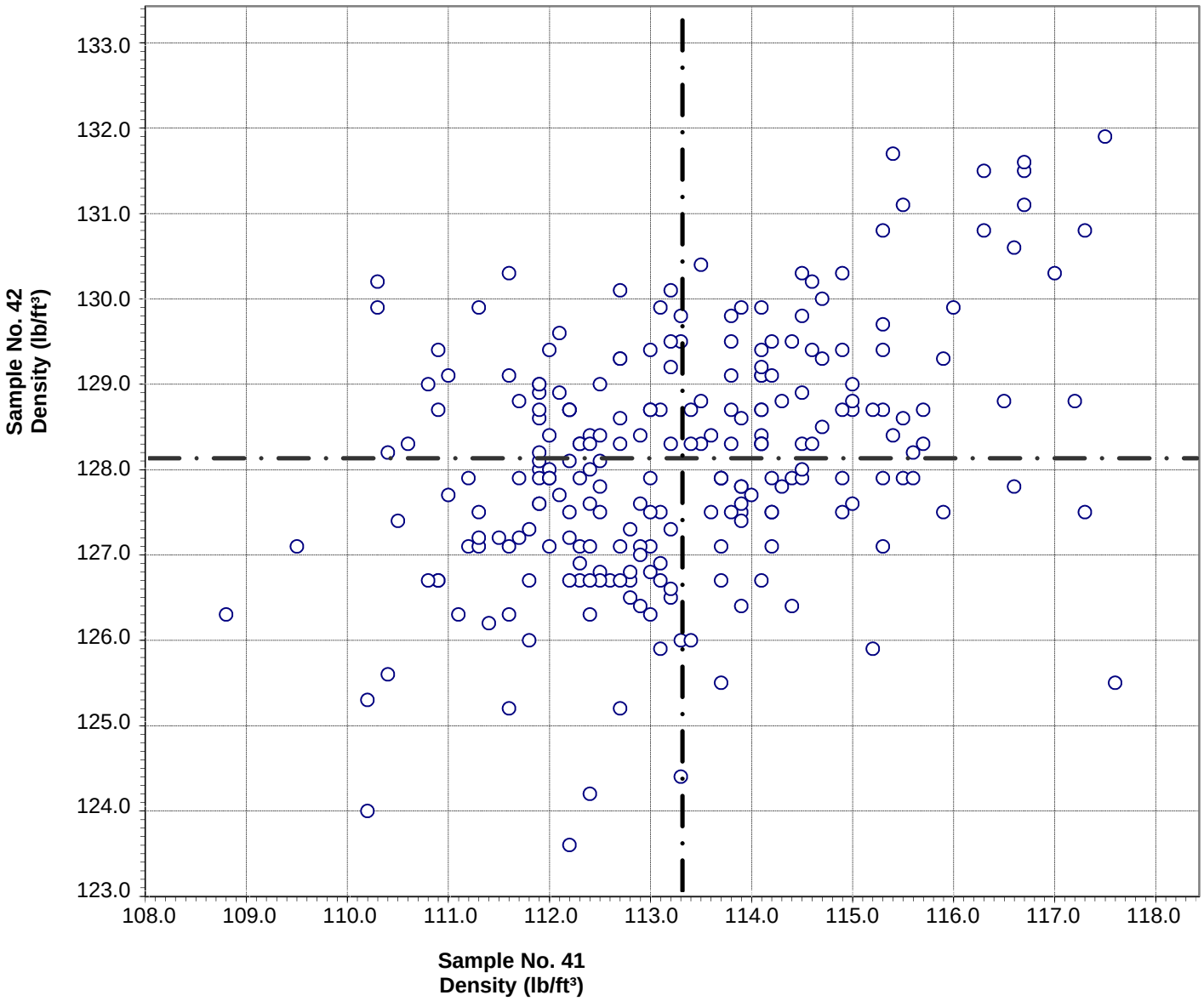
Test No. 640 Absorption 230 Points

Sample No. 41	Ave	11.7	S.D.	0.69	C.V. 5.9
Sample No. 42	Ave	10.2	S.D.	0.65	C.V. 6.3

Labs Eliminated: 788, 1019, 1186, 1446, 1455, 1534, 1906, 2041, 2224, 2273, 2398, 2420

Labs off Diagram: 1207

CCRL Proficiency Sample Program
Density
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

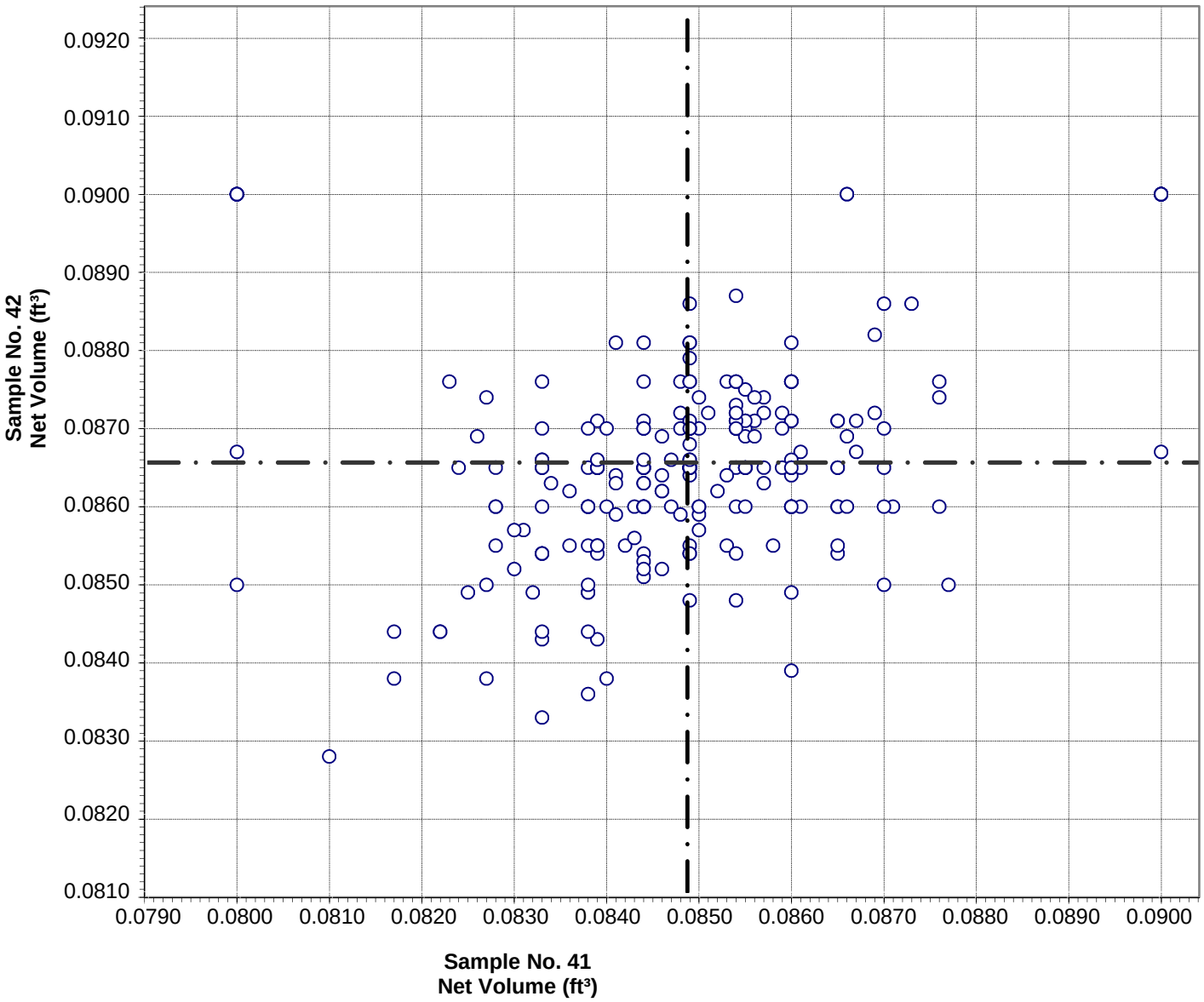


Test No. 650 Density 237 Points

Sample No. 41	Ave	113.3	S.D.	1.6	C.V. 1.4
Sample No. 42	Ave	128.1	S.D.	1.4	C.V. 1.1

Labs Eliminated: 41, 1265, 2173, 2224, 2420, 2442

CCRL Proficiency Sample Program
Net Volume
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

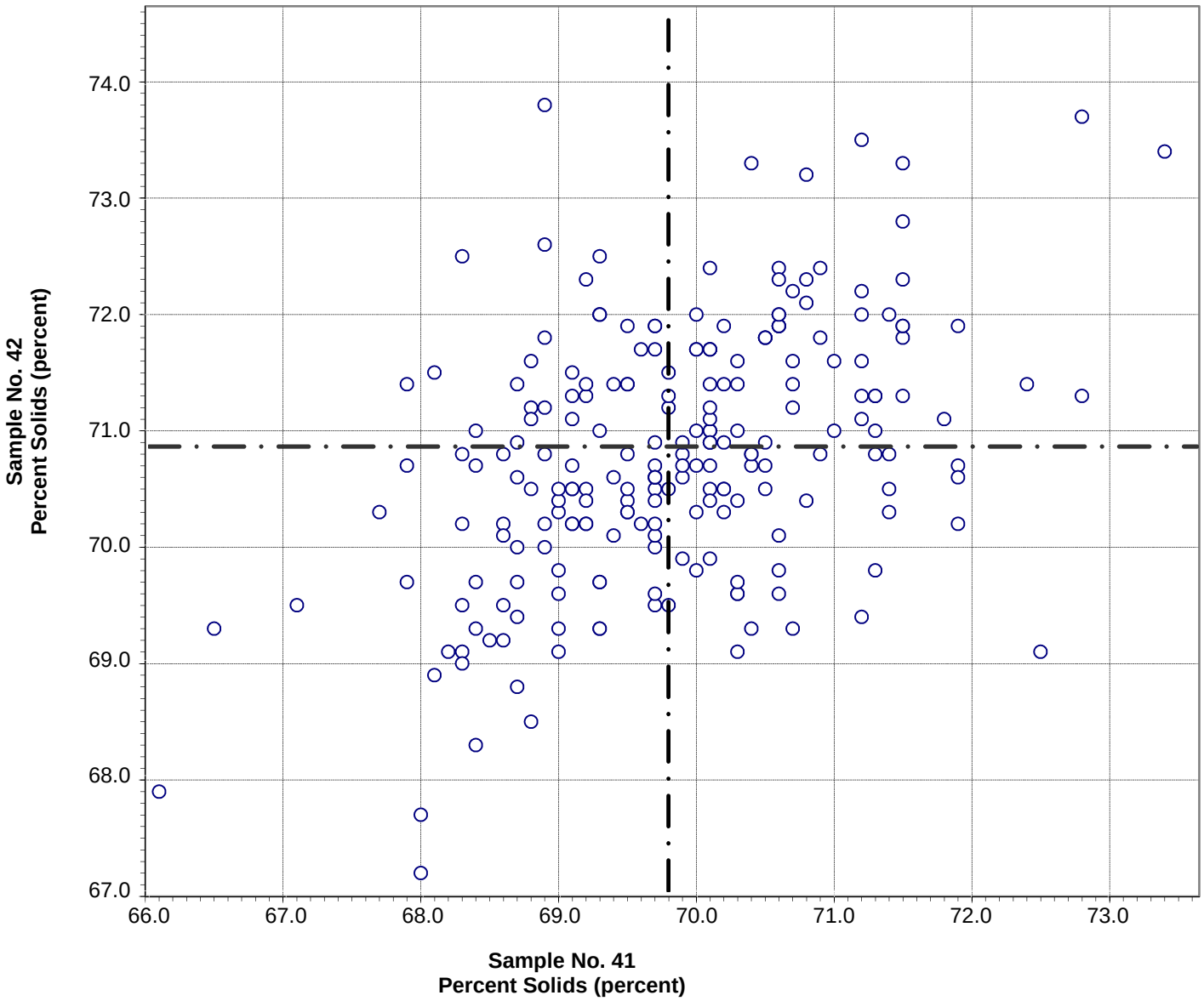


Test No. 652 Net Volume 234 Points

Sample No. 41	Ave	0.0849	S.D.	0.0018	C.V.	2.1
Sample No. 42	Ave	0.0865	S.D.	0.0013	C.V.	1.5

Labs Eliminated: 923, 1534, 2112, 2177, 2224, 2420, 2549

CCRL Proficiency Sample Program
Percent Solids
CONCRETE MASONRY UNITS Samples No. 41 and No. 42



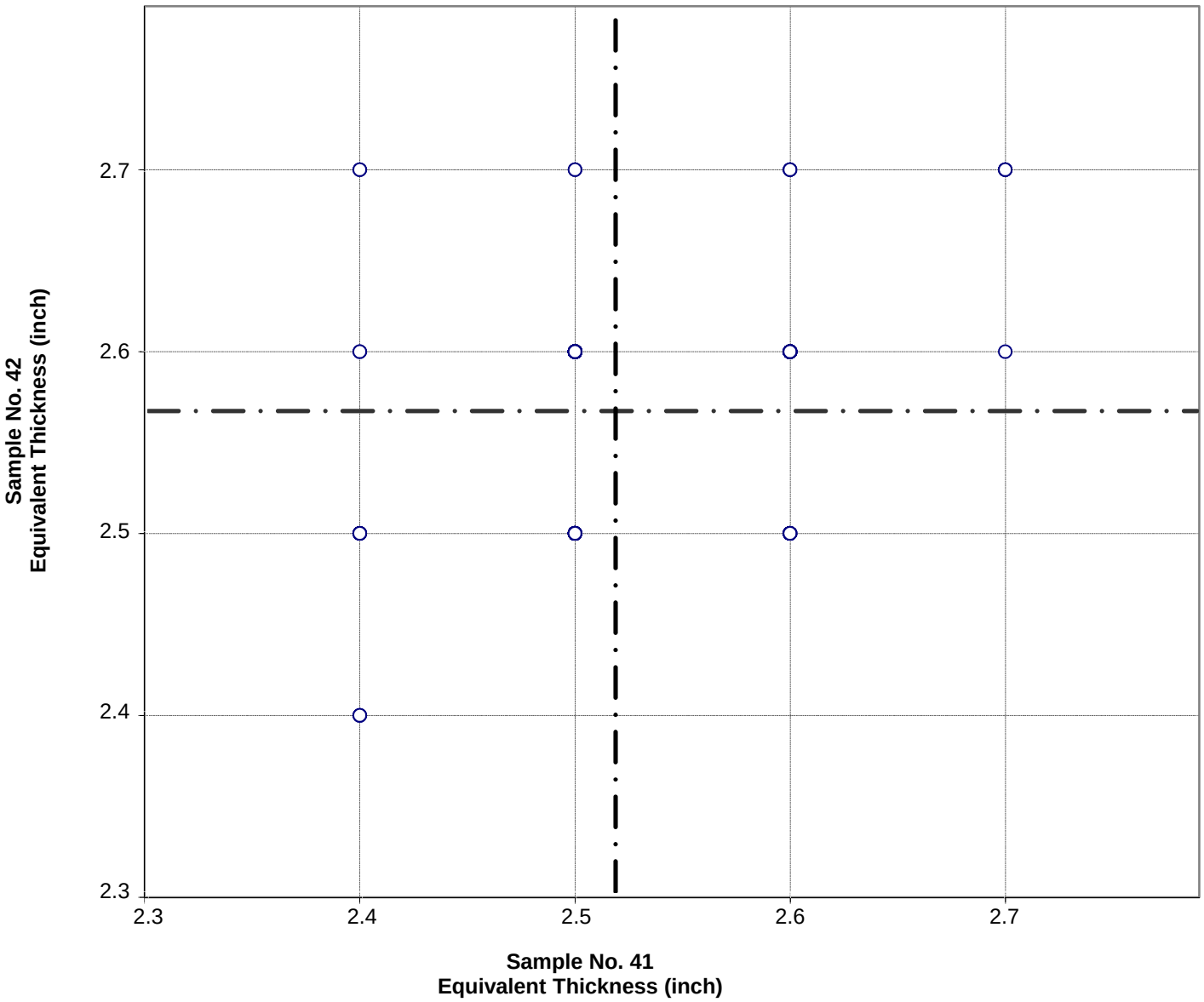
Test No. 654 Percent Solids 221 Points

Sample No. 41	Ave	69.8	S.D.	1.3	C.V. 1.8
Sample No. 42	Ave	70.9	S.D.	1.2	C.V. 1.7

Labs Eliminated: 28, 1455, 1534, 1993, 2187, 2240, 2294, 2420, 2472, 2549

Labs off Diagram: 2442, 1268, 2683, 1515, 2214, 990

CCRL Proficiency Sample Program
Equivalent Thickness
CONCRETE MASONRY UNITS Samples No. 41 and No. 42

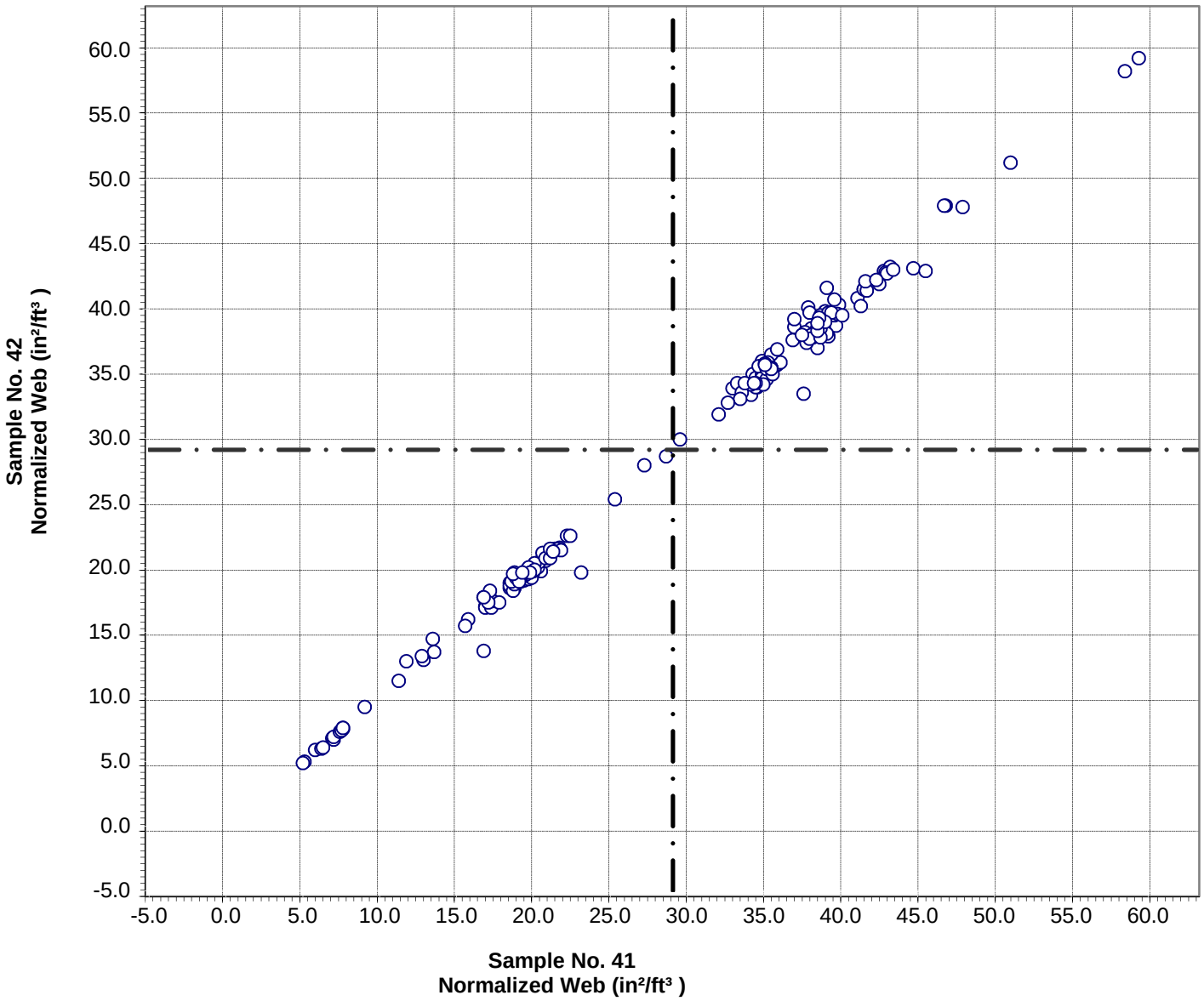


Test No. 660 Equivalent Thickness 230 Points

Sample No. 41	Ave	2.5	S.D.	0.06	C.V. 2.2
Sample No. 42	Ave	2.6	S.D.	0.06	C.V. 2.3

Labs Eliminated: 40, 103, 906, 1068, 1200, 1440, 1522, 1539, 2173, 2240, 2294, 2422, 3252

CCRL Proficiency Sample Program
Normalized Web
CONCRETE MASONRY UNITS Samples No. 41 and No. 42



Test No. 656 Normalized Web 228 Points

Sample No. 41	Ave	29.1	S.D.	11.2	C.V. 38.4
Sample No. 42	Ave	29.1	S.D.	11.2	C.V. 38.4