

CEMENT AND CONCRETE REFERENCE LABORATORY
PROFICIENCY SAMPLE PROGRAM

Final Report
Concrete Masonry Unit Proficiency Samples
Number 39 and Number 40

September 2015



CCRL
Cement and Concrete
Reference Laboratory

www.ccrl.us

September 25, 2015

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

SUBJECT: Final Report for Concrete Masonry Units Proficiency Samples No. 39 and No. 40

Following is the report for the current pair of CCRL **Concrete Masonry Units** Proficiency Samples which were distributed in July 2015.

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/>.

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 2016.

Sincerely,

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. 39 and No. 40

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 2015. 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

¹Youden, 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. 39 and No. 40

Final Report – September 25, 2015

SUMMARY OF RESULTS

Sample No.39

Sample No. 40

| Test (unit) | #Labs | Average | S.D. | C.V. | Average | S.D. | C.V. |
|---|-------|---------|-------|------|---------|------|------|
| Received Weight - Compression Units (lb) | | | | | | | |
| | 230 | 10.2 | 0.08 | 0.78 | 11.0 | 0.11 | 1.01 |
| | *228 | 10.2 | 0.07 | 0.69 | 11.0 | 0.08 | 0.71 |
| * Labs Eliminated - 1310, 3811 | | | | | | | |
| Maximum Compressive Load (lbf) | | | | | | | |
| | 231 | 65793 | 11499 | 17.5 | 47521 | 7988 | 16.8 |
| | *226 | 65922 | 10843 | 16.4 | 47545 | 7144 | 15.0 |
| * Labs Eliminated - 474, 1268, 2442, 2518, 2549 | | | | | | | |
| Net Area Compressive Strength (psi) | | | | | | | |
| | 231 | 3343 | 633 | 18.9 | 2428 | 446 | 18.4 |
| | *228 | 3349 | 622 | 18.6 | 2432 | 412 | 17.0 |
| * Labs Eliminated - 1268, 1446, 2549 | | | | | | | |
| Received Weight - Absorption Units (lb) | | | | | | | |
| | 232 | 10.2 | 0.09 | 0.88 | 11.0 | 0.07 | 0.65 |
| | *230 | 10.2 | 0.07 | 0.67 | 11.0 | 0.07 | 0.62 |
| * Labs Eliminated - 143, 1310 | | | | | | | |
| Width (inch) | | | | | | | |
| | 232 | 3.6 | 0.05 | 1.3 | 3.6 | 0.05 | 1.4 |
| | *231 | 3.6 | 0.05 | 1.3 | 3.6 | 0.05 | 1.4 |
| * Labs Eliminated - 3402 | | | | | | | |
| Height (inch) | | | | | | | |
| | 232 | 7.6 | 0.04 | 0.54 | 7.6 | 0.05 | 0.62 |
| | *229 | 7.6 | 0.02 | 0.27 | 7.6 | 0.02 | 0.32 |
| * Labs Eliminated - 1509, 1608, 3402 | | | | | | | |
| Length (inch) | | | | | | | |
| | 232 | 7.6 | 0.04 | 0.53 | 7.6 | 0.04 | 0.55 |
| | *230 | 7.6 | 0.02 | 0.24 | 7.6 | 0.02 | 0.29 |
| * Labs Eliminated - 1608, 3402 | | | | | | | |

CCRL PROFICIENCY SAMPLE PROGRAM
Concrete Masonry Units Proficiency Samples No. 39 and No. 40

Final Report – September 25, 2015

SUMMARY OF RESULTS

Sample No.39

Sample No. 40

| Test (unit) | #Labs | Average | S.D. | C.V. | Average | S.D. | C.V. |
|---|-------|---------|------|------|---------|------|------|
| Minimum Face Shell Thickness (inch) | | | | | | | |
| | 232 | 1.07 | 0.08 | 7.6 | 1.07 | 0.08 | 7.8 |
| | *218 | 1.05 | 0.05 | 4.3 | 1.05 | 0.05 | 4.3 |
| * Labs Eliminated - 903, 1442, 1446, 1554, 2132, 2187, 2250, 2311, 2438, 3402, 3560, 3595, 3680, 3904 | | | | | | | |
| Minimum Web Thickness (inch) | | | | | | | |
| | 231 | 1.06 | 0.11 | 10.1 | 1.07 | 0.11 | 10.0 |
| | *223 | 1.05 | 0.05 | 4.9 | 1.06 | 0.05 | 5.0 |
| * Labs Eliminated - 451, 1442, 1643, 1780, 2046, 2091, 2442, 3690 | | | | | | | |
| Immersed Weight (lb) | | | | | | | |
| | 232 | 5.5 | 0.19 | 3.4 | 6.5 | 0.18 | 2.7 |
| | *228 | 5.5 | 0.07 | 1.3 | 6.5 | 0.07 | 1.2 |
| * Labs Eliminated - 552, 1189, 1446, 2130 | | | | | | | |
| Saturated Weight (lb) | | | | | | | |
| | 231 | 10.9 | 0.07 | 0.62 | 11.8 | 0.11 | 0.92 |
| | *229 | 10.9 | 0.07 | 0.62 | 11.8 | 0.08 | 0.66 |
| * Labs Eliminated - 867, 3947 | | | | | | | |
| Oven-Dry Weight (lb) | | | | | | | |
| | 232 | 9.9 | 0.08 | 0.79 | 10.9 | 0.09 | 0.80 |
| | *227 | 9.9 | 0.07 | 0.71 | 10.9 | 0.07 | 0.67 |
| * Labs Eliminated - 1310, 1534, 1591, 2518, 2960 | | | | | | | |
| Net Area (sq in) | | | | | | | |
| | 232 | 19.7 | 1.73 | 8.8 | 19.6 | 1.75 | 8.9 |
| | *215 | 19.3 | 0.27 | 1.4 | 19.2 | 0.36 | 1.9 |
| * Labs Eliminated - 202, 552, 898, 1186, 1446, 1474, 1499, 1704, 2091, 2187, 2214, 2262, 2273, 2311, 2398, 2442, 2518 | | | | | | | |
| Absorption (lb/ft³) | | | | | | | |
| | 232 | 10.8 | 0.90 | 8.3 | 10.6 | 1.04 | 9.8 |
| | *228 | 10.8 | 0.79 | 7.3 | 10.5 | 0.94 | 8.9 |
| * Labs Eliminated - 1189, 2518, 2960, 3402 | | | | | | | |

CCRL PROFICIENCY SAMPLE PROGRAM
Concrete Masonry Units Proficiency Samples No. 39 and No. 40

Final Report – September 25, 2015

SUMMARY OF RESULTS

Sample No.39

Sample No. 40

| Test (unit) | #Labs | Average | S.D. | C.V. | Average | S.D. | C.V. |
|-------------|-------|---------|------|------|---------|------|------|
|-------------|-------|---------|------|------|---------|------|------|

Density (lb/ft³)

| | | | | | | |
|------|-------|-----|-----|-------|-----|-----|
| 232 | 116.9 | 4.5 | 3.8 | 128.2 | 5.0 | 3.9 |
| *220 | 116.8 | 1.3 | 1.1 | 128.2 | 1.6 | 1.3 |

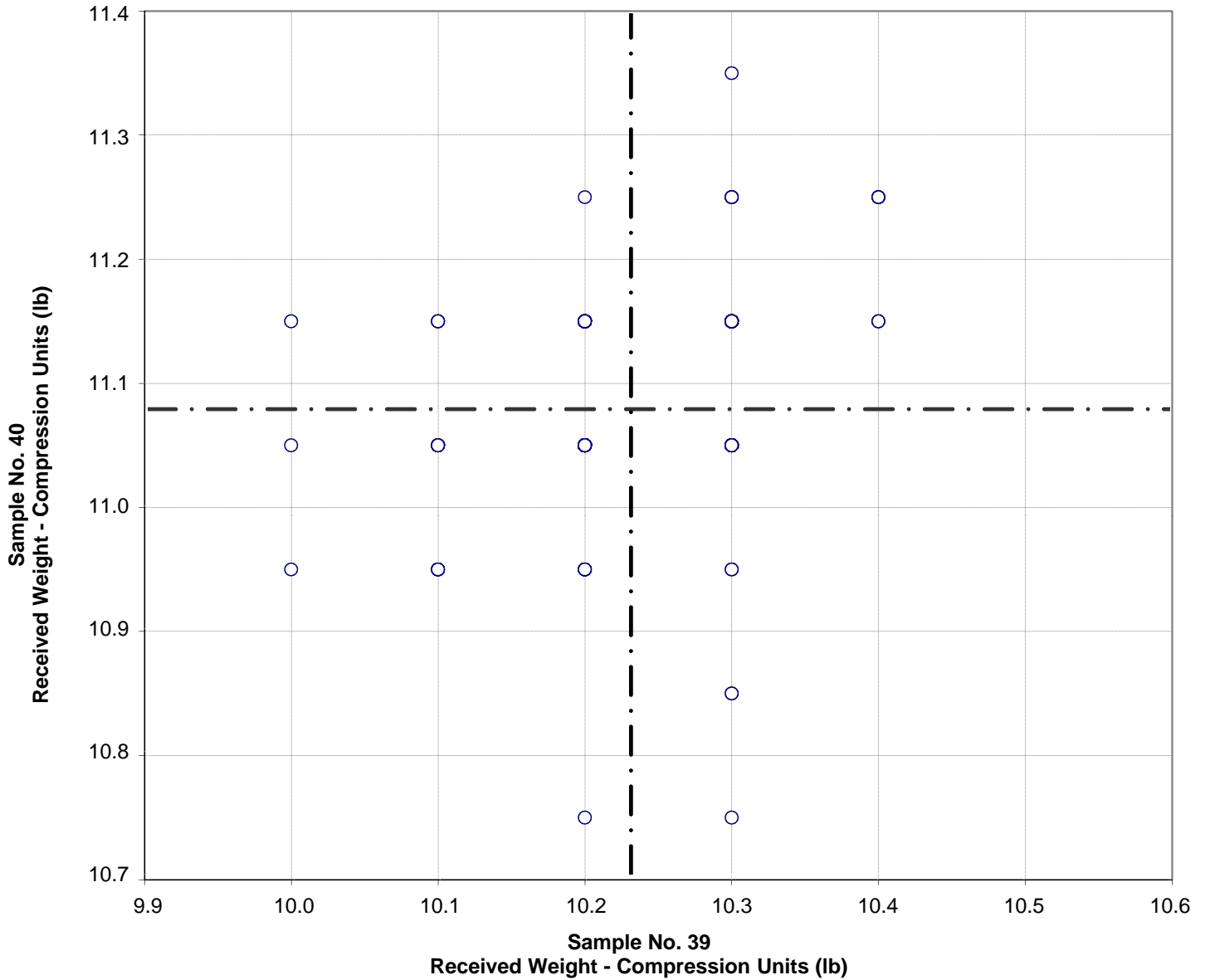
* Labs Eliminated - 454, 552, 1189, 1375, 1446, 1499, 2130, 2187, 2272, 2398, 2518, 3197

Equivalent Thickness (inch)

| | | | | | | |
|------|-----|------|------|-----|------|------|
| 233 | 2.5 | 0.29 | 11.4 | 2.5 | 0.30 | 11.7 |
| *222 | 2.5 | 0.06 | 2.5 | 2.5 | 0.06 | 2.3 |

* Labs Eliminated - 1186, 1189, 1474, 1515, 1608, 1906, 2091, 2173, 2398, 2438, 3562

**CCRL Proficiency Sample Program
 Received Weight - Compression Units
 CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



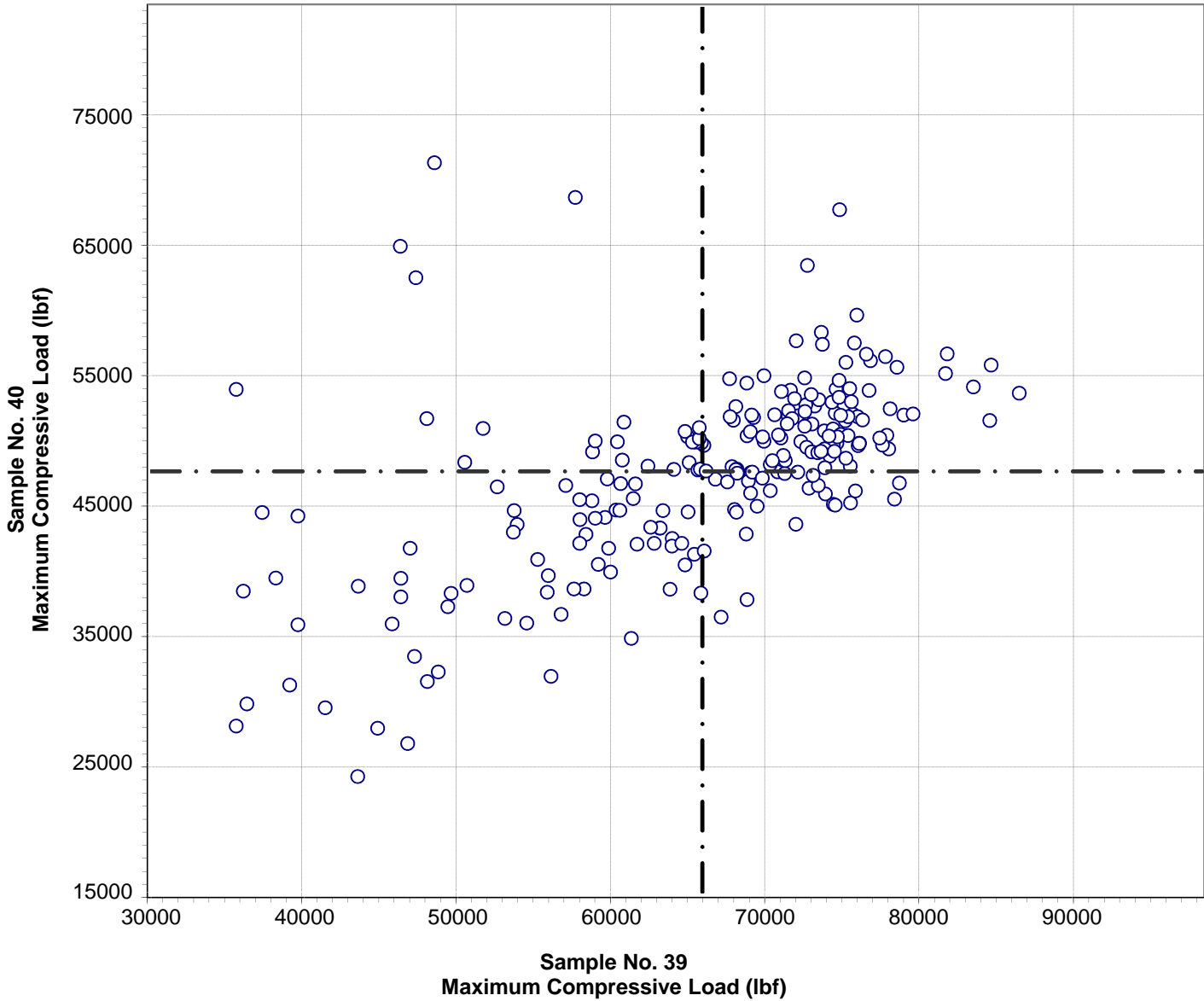
Test No. 500 Received Weight - Compression Units 228 Points

Sample No. 39 Ave 10.2 S.D. 0.07 C.V. 0.69

Sample No. 40 Ave 11.0 S.D. 0.08 C.V. 0.71

Labs Eliminated: 1310, 3811

**CCRL Proficiency Sample Program
Maximum Compressive Load
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**

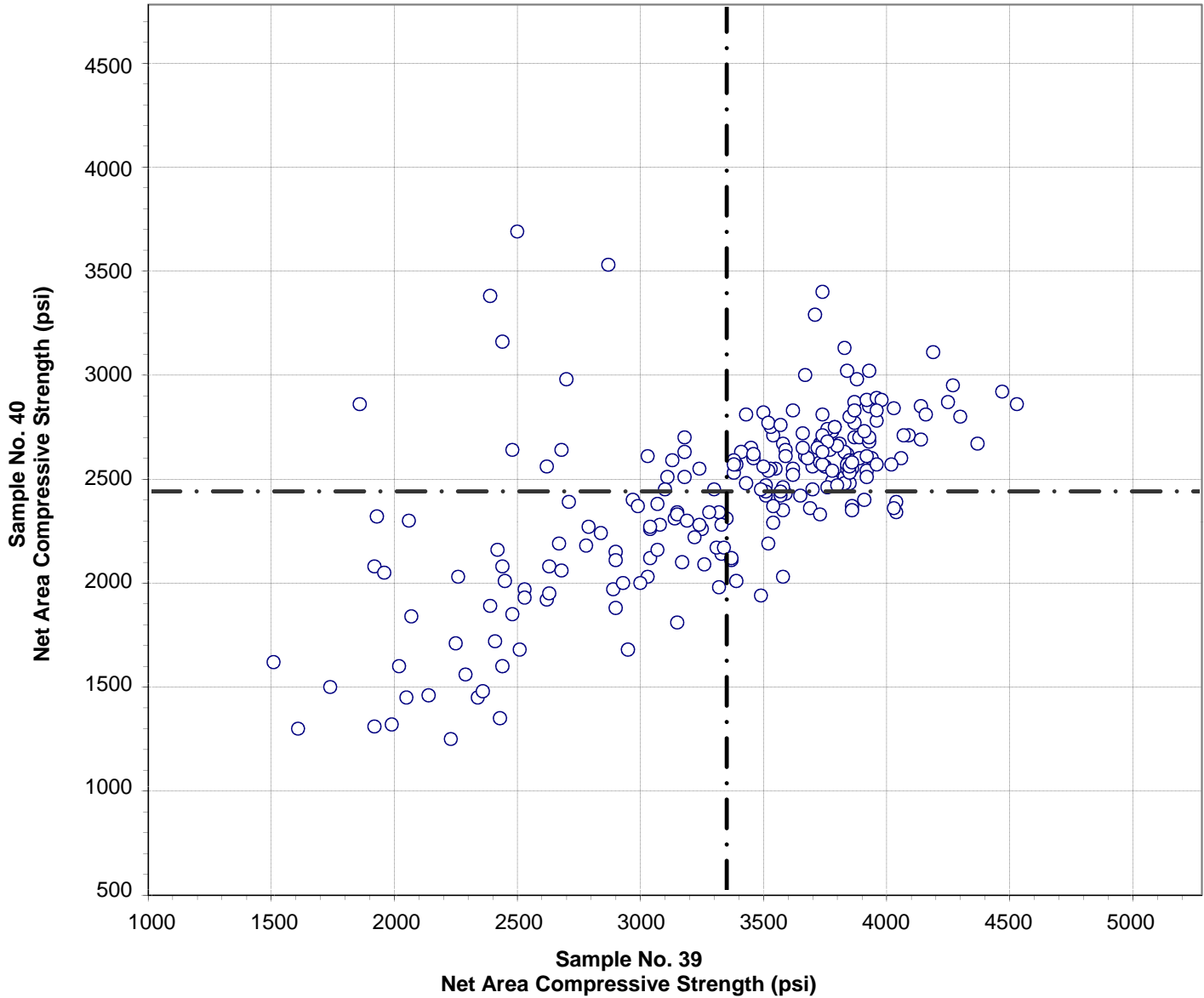


Test No. 550 Maximum Compressive Load 226 Points

| | | | |
|---------------|-----------|------------|-----------|
| Sample No. 39 | Ave 65922 | S.D. 10843 | C.V. 16.4 |
| Sample No. 40 | Ave 47545 | S.D. 7144 | C.V. 15.0 |

Labs Eliminated: 474, 1268, 2442, 2518, 2549

**CCRL Proficiency Sample Program
Net Area Compressive Strength
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



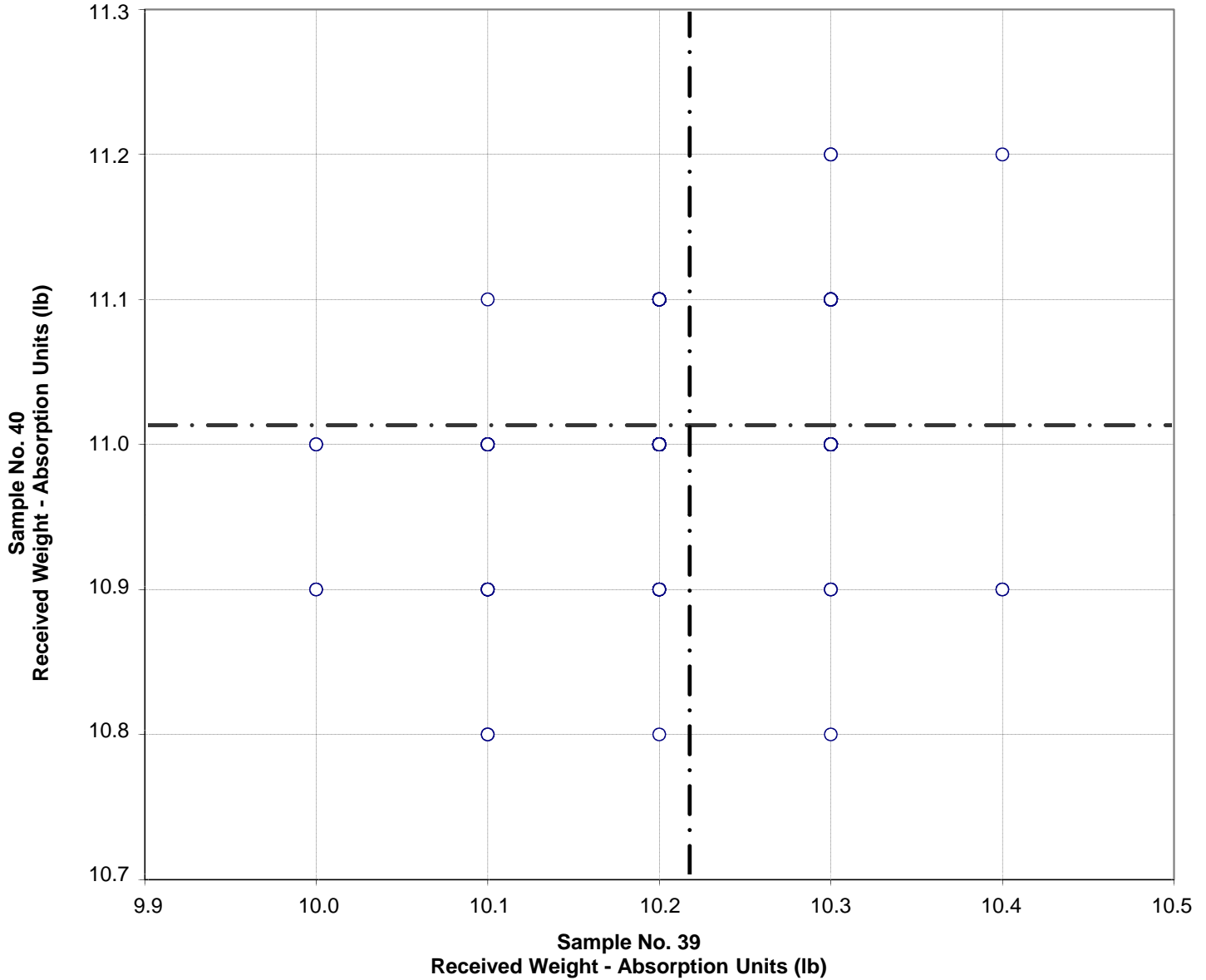
Test No. 560 Net Area Compressive Strength 228 Points

Sample No. 39 Ave 3349 S.D. 622 C.V. 18.6

Sample No. 40 Ave 2432 S.D. 412 C.V. 17.0

Labs Eliminated: 1268, 1446, 2549

**CCRL Proficiency Sample Program
 Received Weight - Absorption Units
 CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



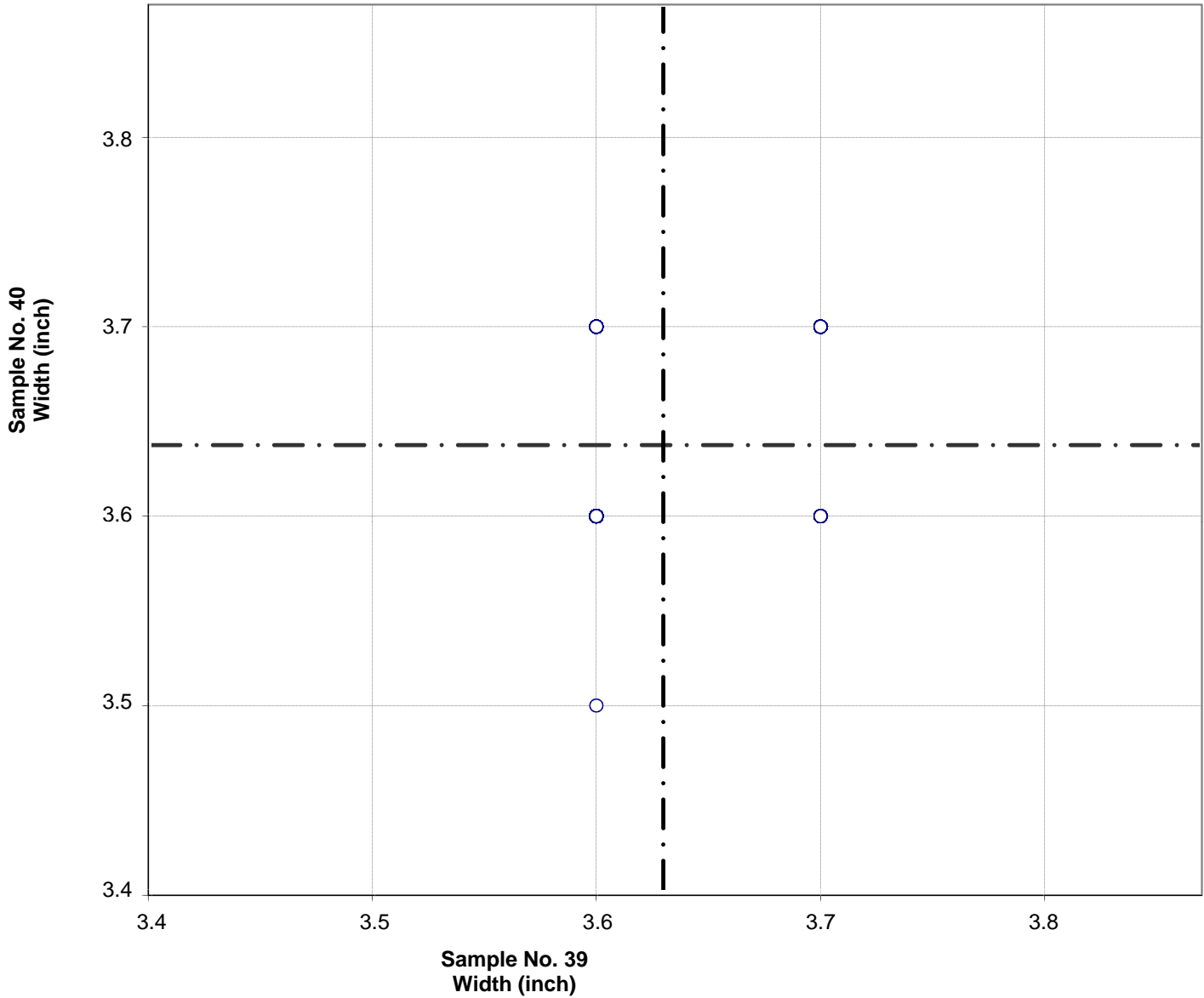
Test No. 600 Received Weight - Absorption Units 230 Points

Sample No. 39 Ave 10.2 S.D. 0.07 C.V. 0.67

Sample No. 40 Ave 11.0 S.D. 0.07 C.V. 0.62

Labs Eliminated: 143, 1310

CCRL Proficiency Sample Program
Width
CONCRETE MASONRY UNITS Samples No. 39 and No. 40

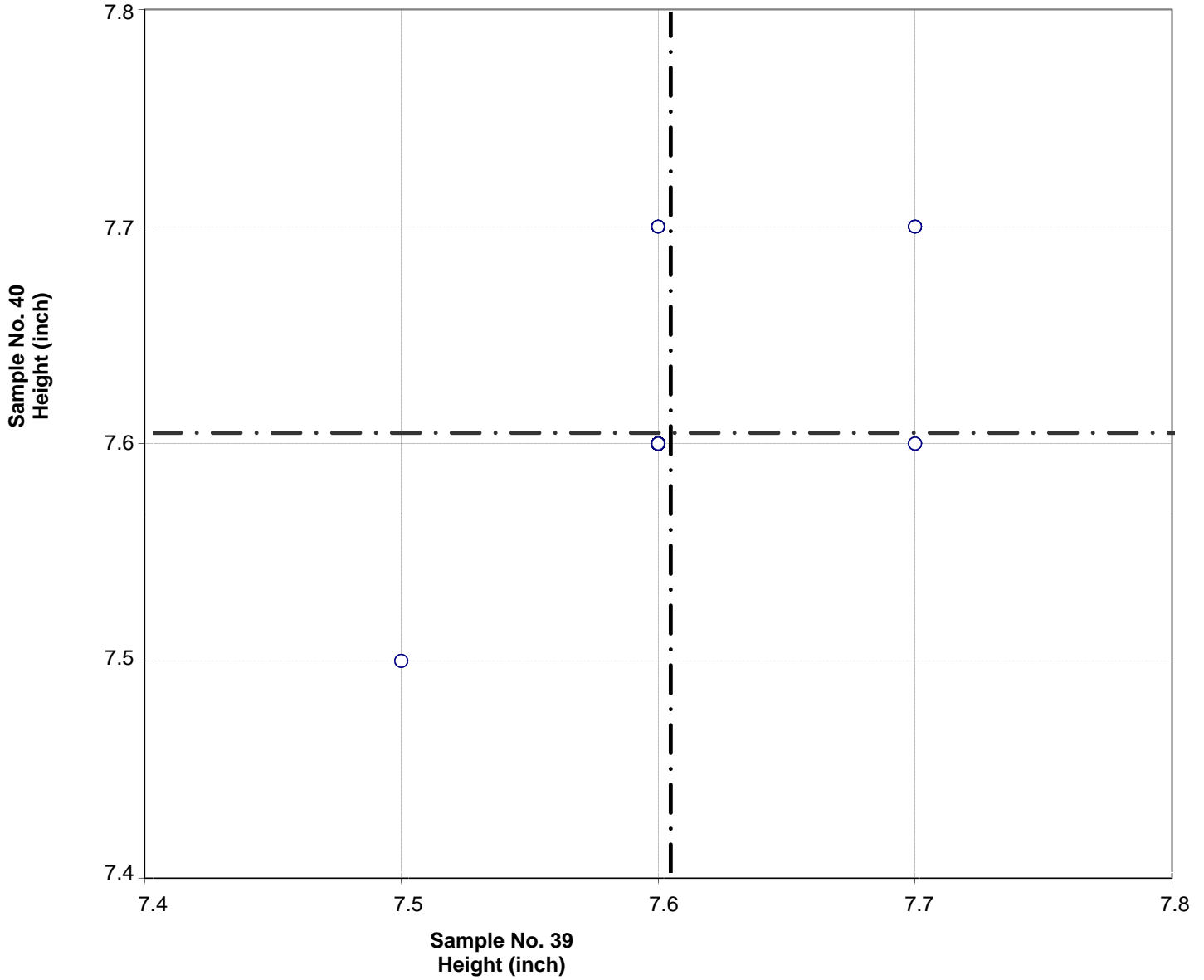


Test No. 510 Width 231 Points

| | | | |
|---------------|---------|-----------|----------|
| Sample No. 39 | Ave 3.6 | S.D. 0.05 | C.V. 1.3 |
| Sample No. 40 | Ave 3.6 | S.D. 0.05 | C.V. 1.4 |

Labs Eliminated: 3402

CCRL Proficiency Sample Program
Height
CONCRETE MASONRY UNITS Samples No. 39 and No. 40



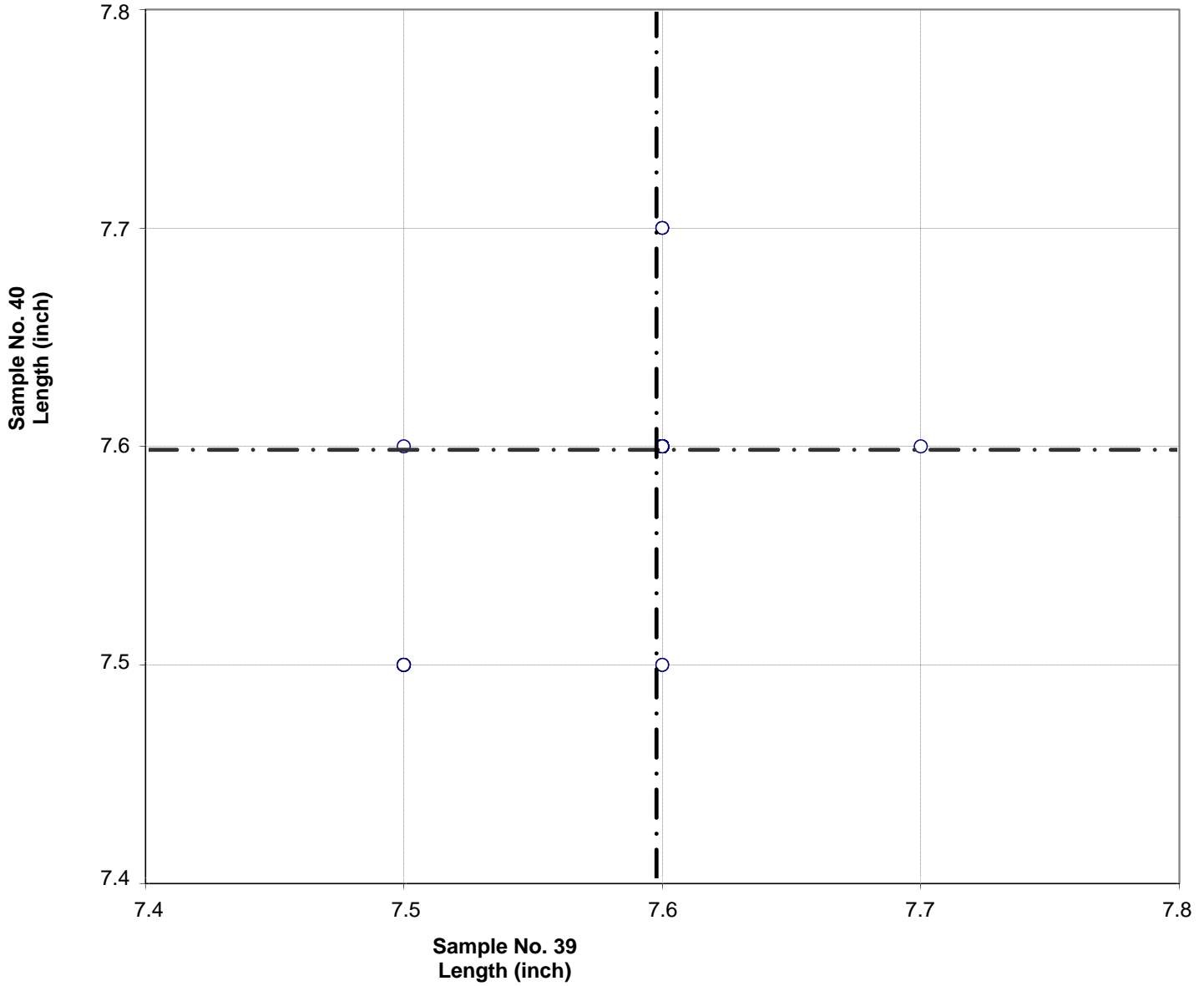
Test No. 520 Height 229 Points

Sample No. 39 Ave 7.6 S.D. 0.02 C.V. 0.27

Sample No. 40 Ave 7.6 S.D. 0.02 C.V. 0.32

Labs Eliminated: 1509, 1608, 3402

CCRL Proficiency Sample Program
Length
CONCRETE MASONRY UNITS Samples No. 39 and No. 40

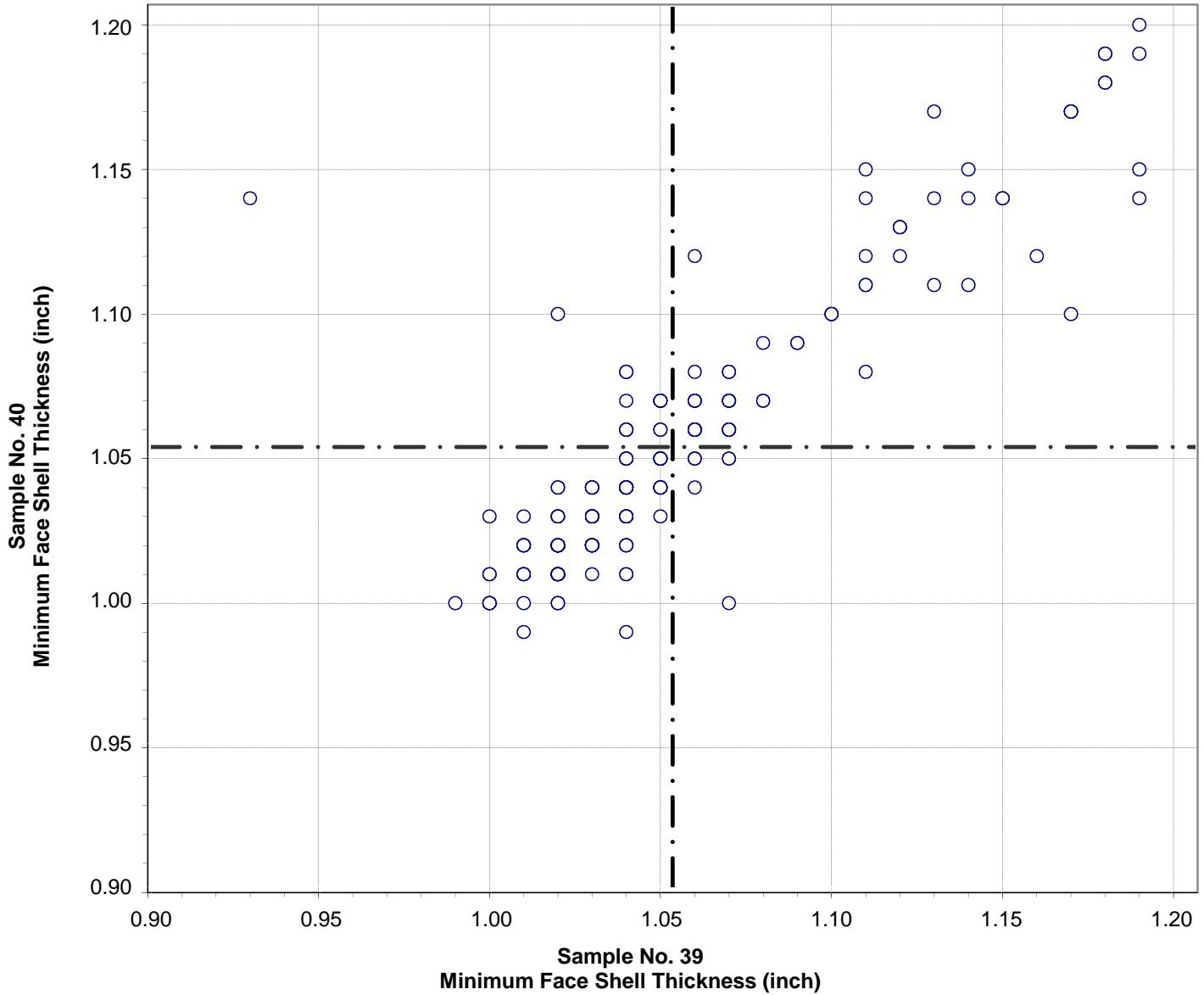


Test No. 530 Length 230 Points

| | | | |
|---------------|---------|-----------|-----------|
| Sample No. 39 | Ave 7.6 | S.D. 0.02 | C.V. 0.24 |
| Sample No. 40 | Ave 7.6 | S.D. 0.02 | C.V. 0.29 |

Labs Eliminated: 1608, 3402

**CCRL Proficiency Sample Program
Minimum Face Shell Thickness
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



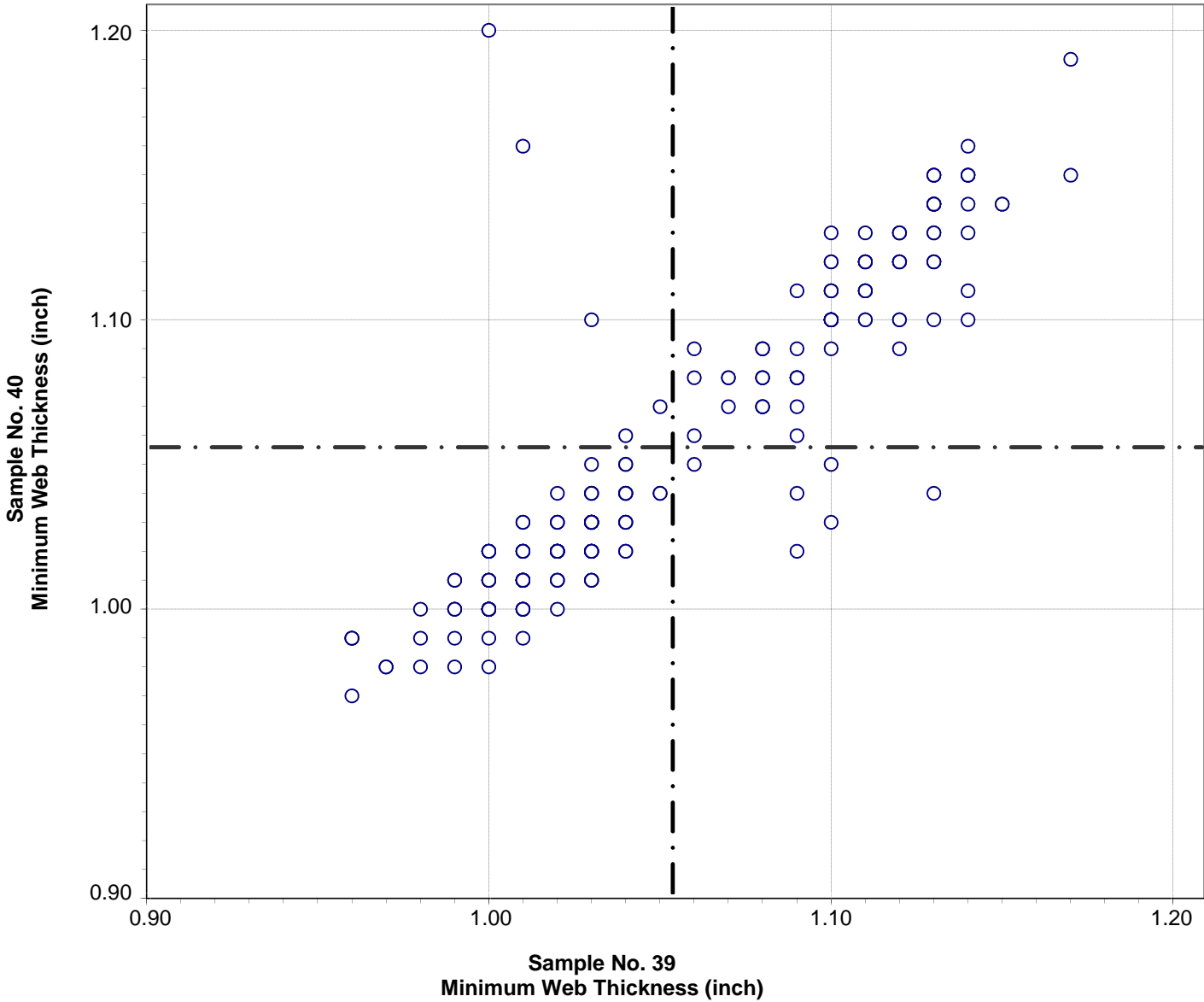
Test No. 532 Minimum Face Shell Thickness 218 Points

Sample No. 39 Ave 1.05 S.D. 0.05 C.V. 4.3

Sample No. 40 Ave 1.05 S.D. 0.05 C.V. 4.3

Labs Eliminated: 903, 1442, 1446, 1554, 2132, 2187, 2250, 2311, 2438, 3402,
3560, 3595, 3680, 3904

**CCRL Proficiency Sample Program
Minimum Web Thickness
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**

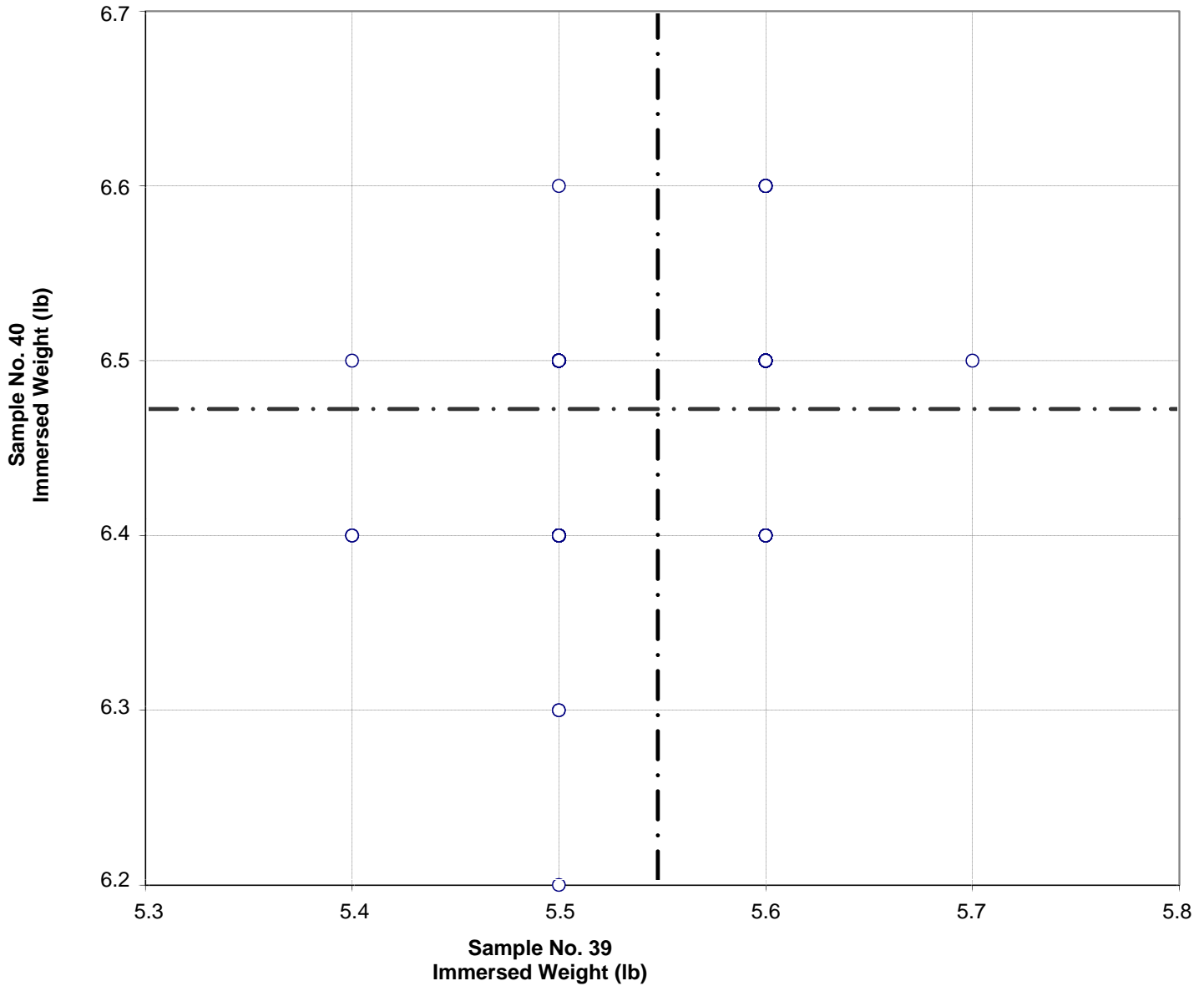


Test No. 533 Minimum Web Thickness 223 Points

| | | | |
|---------------|----------|-----------|----------|
| Sample No. 39 | Ave 1.05 | S.D. 0.05 | C.V. 4.9 |
| Sample No. 40 | Ave 1.06 | S.D. 0.05 | C.V. 5.0 |

Labs Eliminated: 451, 1442, 1643, 1780, 2046, 2091, 2442, 3690

**CCRL Proficiency Sample Program
Immersed Weight
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



Test No. 610 Immersed Weight 223 Points

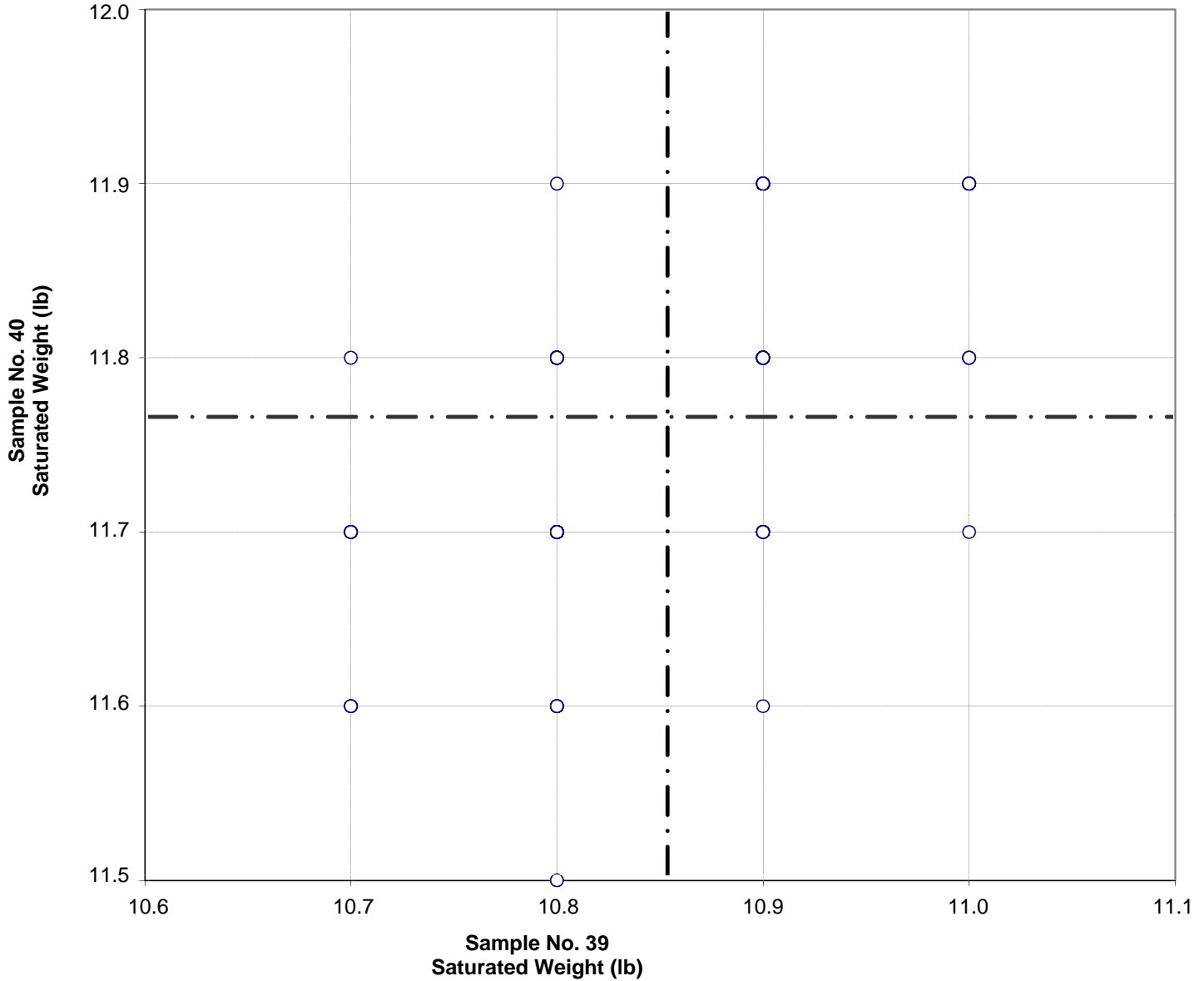
Sample No. 39 Ave 5.5 S.D. 0.07 C.V. 1.3

Sample No. 40 Ave 6.5 S.D. 0.07 C.V. 1.2

Labs Eliminated: 552, 1189, 1446, 2130

Labs off Diagram: 1375, 1499, 2272, 2398, 2518

**CCRL Proficiency Sample Program
Saturated Weight
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



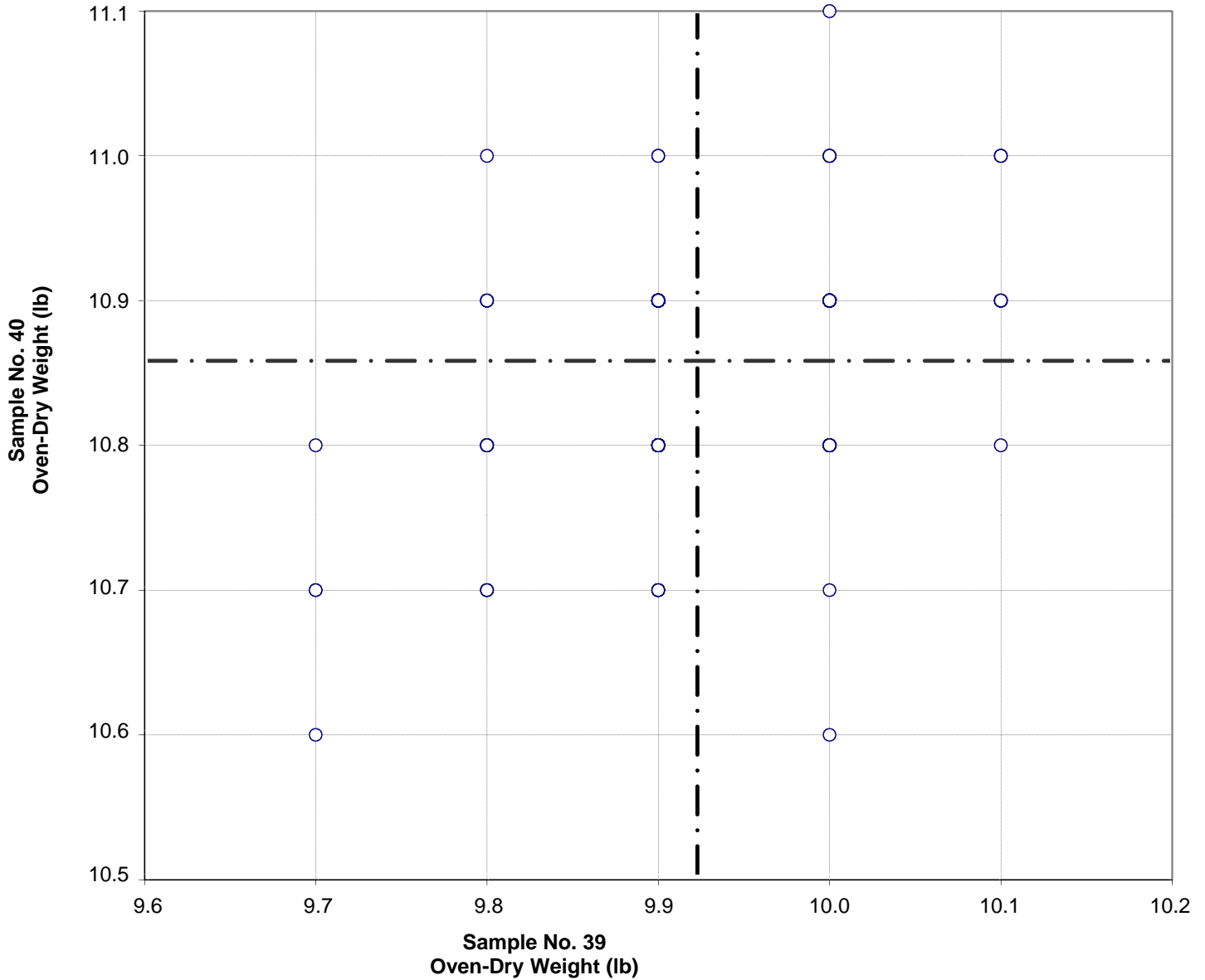
Test No. 620 Saturated Weight 229 Points

Sample No. 39 Ave 10.9 S.D. 0.07 C.V. 0.62

Sample No. 40 Ave 11.8 S.D. 0.08 C.V. 0.66

Labs Eliminated: 867, 3947

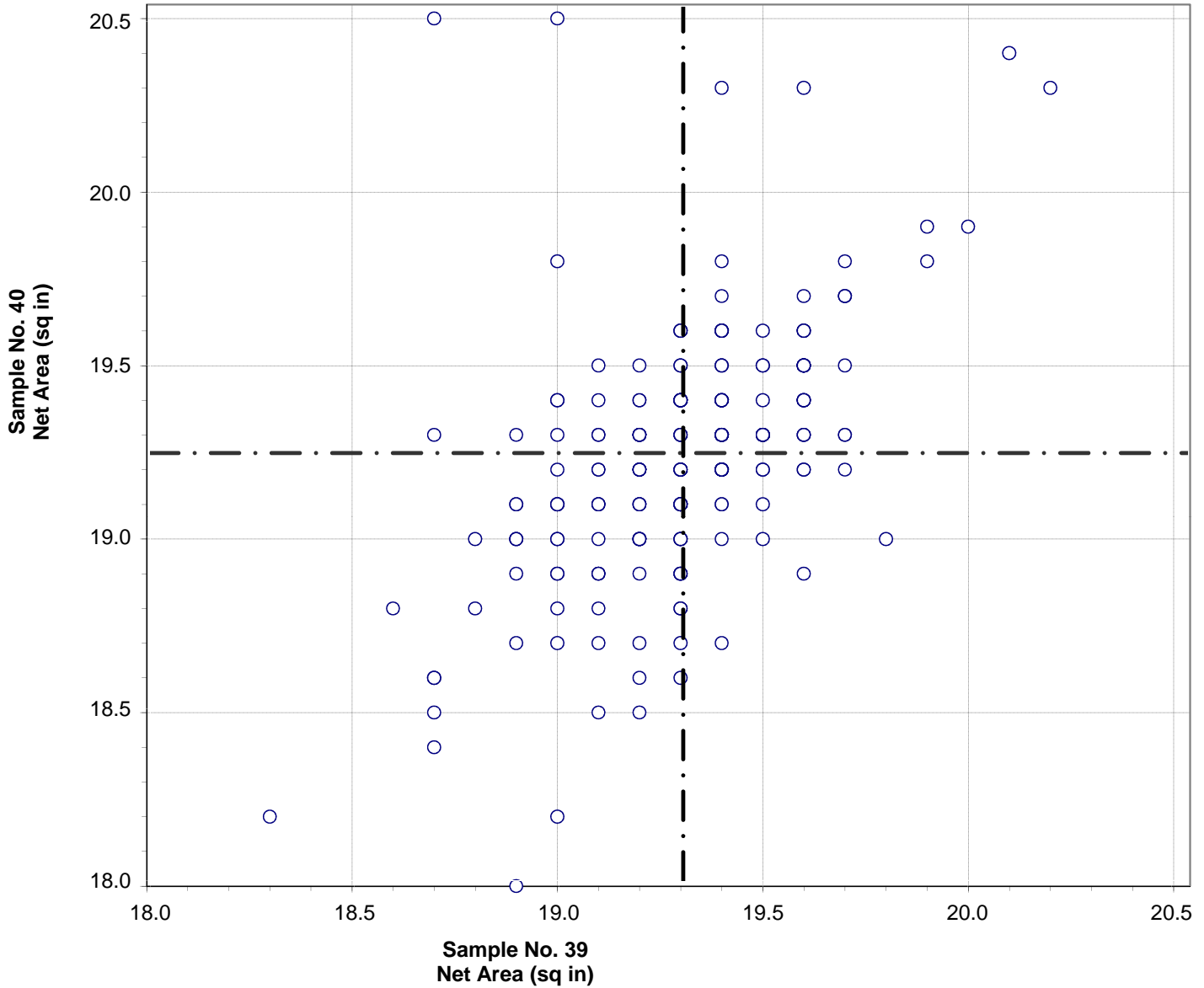
**CCRL Proficiency Sample Program
Oven-Dry Weight
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



Test No. 630 Oven-Dry Weight 227 Points

Sample No. 39 Ave 9.9 S.D. 0.07 C.V. 0.71
 Sample No. 40 Ave 10.9 S.D. 0.07 C.V. 0.67
 Labs Eliminated: 1310, 1534, 1591, 2518, 2960

CCRL Proficiency Sample Program
Net Area
CONCRETE MASONRY UNITS Samples No. 39 and No. 40



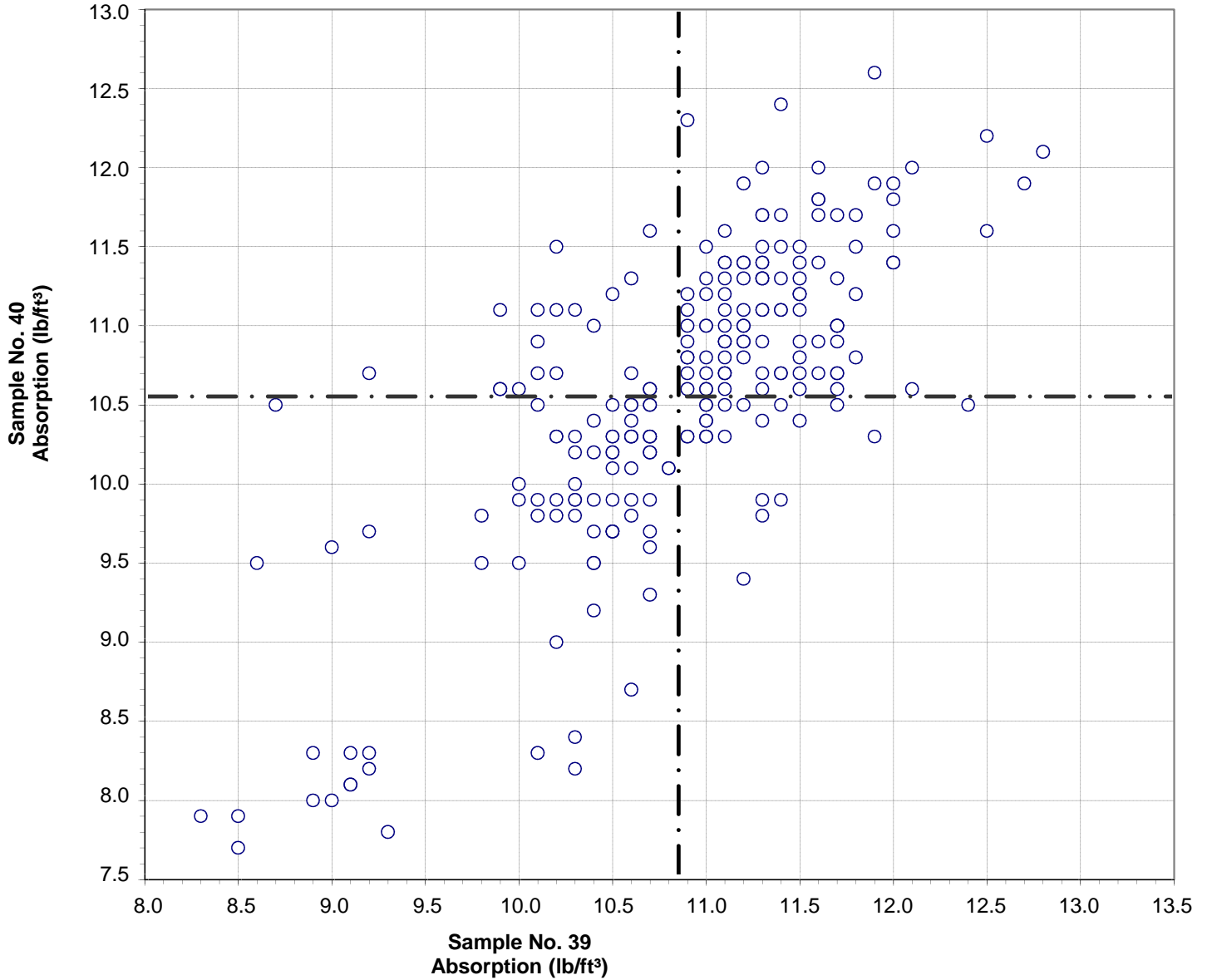
Test No. 635 Net Area 215 Points

Sample No. 39 Ave 19.3 S.D. 0.27 C.V. 1.4

Sample No. 40 Ave 19.2 S.D. 0.36 C.V. 1.9

Labs Eliminated: 202, 552, 898, 1186, 1446, 1474, 1499, 1704, 2091, 2187, 2214,
 2262, 2273, 2311, 2398, 2442, 2518

CCRL Proficiency Sample Program
Absorption
CONCRETE MASONRY UNITS Samples No. 39 and No. 40



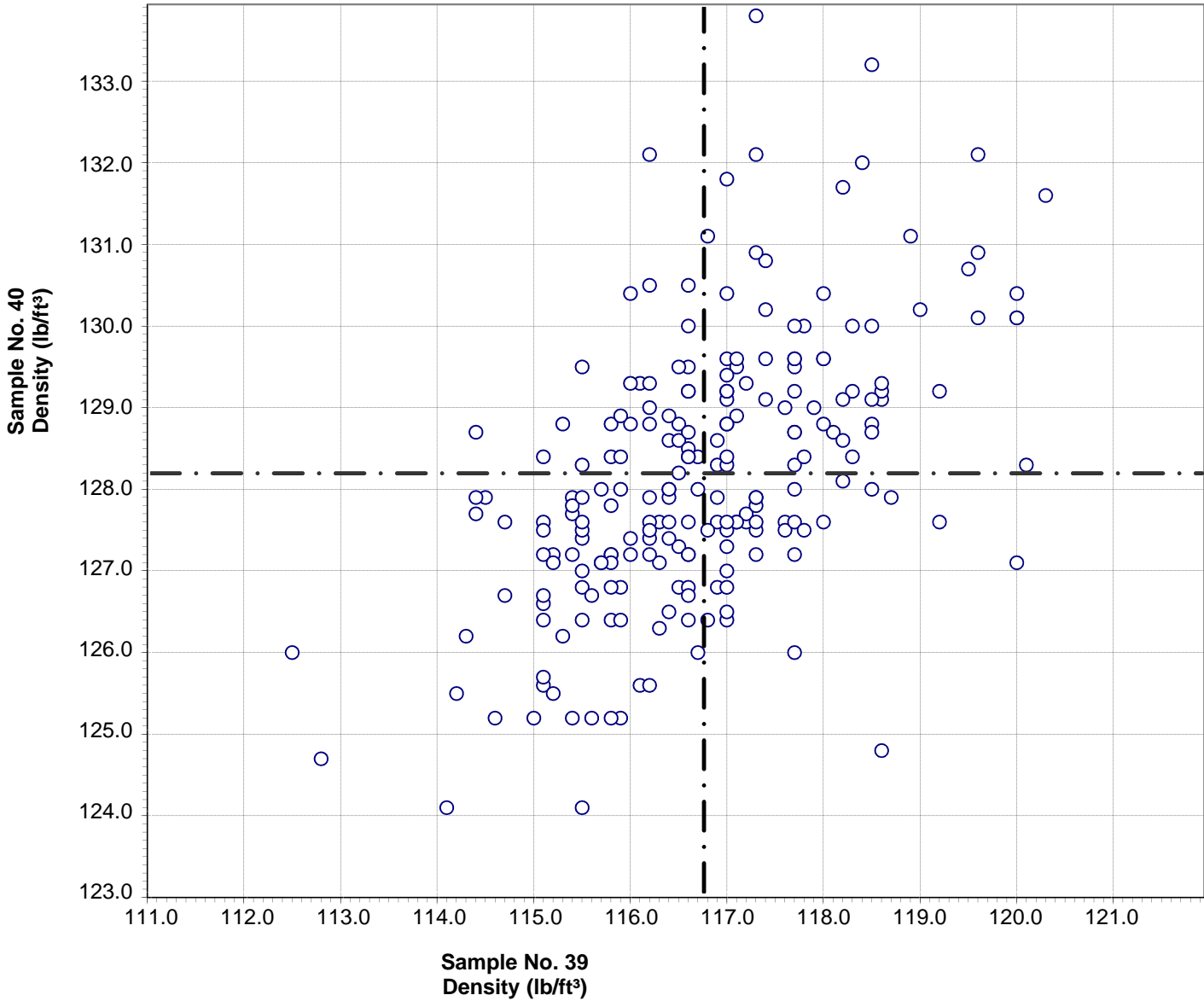
Test No. 640 Absorption 228 Points

Sample No. 39 Ave 10.8 S.D. 0.79 C.V. 7.3

Sample No. 40 Ave 10.5 S.D. 0.94 C.V. 8.9

Labs Eliminated: 1189, 2518, 2960, 3402

CCRL Proficiency Sample Program
Density
CONCRETE MASONRY UNITS Samples No. 39 and No. 40

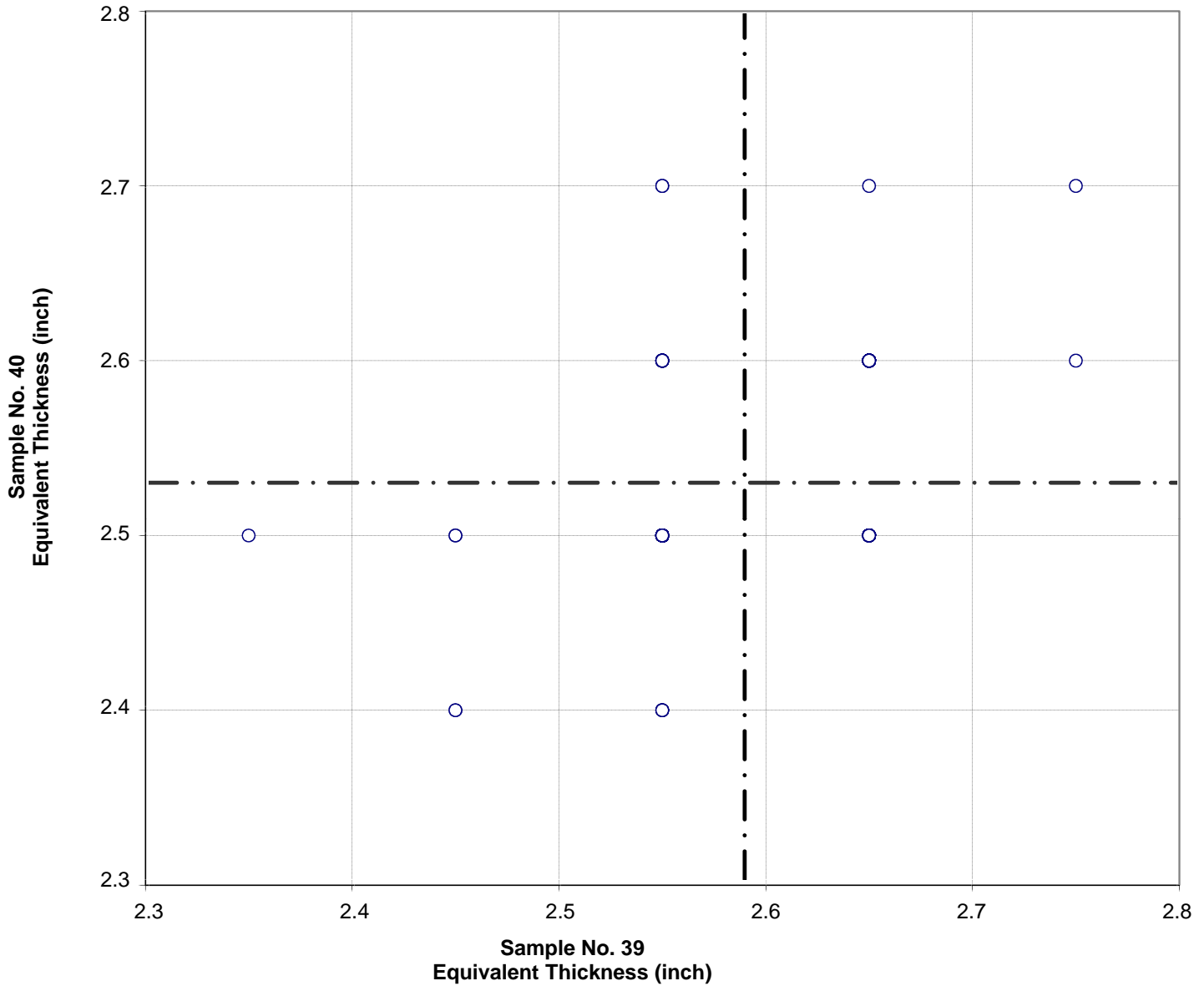


Test No. 650 Density 220 Points

| | | | |
|---------------|-----------|----------|----------|
| Sample No. 39 | Ave 116.8 | S.D. 1.3 | C.V. 1.1 |
| Sample No. 40 | Ave 128.2 | S.D. 1.6 | C.V. 1.3 |

Labs Eliminated: 454, 552, 1189, 1375, 1446, 1499, 2130, 2187, 2272, 2398, 2518, 3197

**CCRL Proficiency Sample Program
Equivalent Thickness
CONCRETE MASONRY UNITS Samples No. 39 and No. 40**



Test No. 660 Equivalent Thickness 219 Points

Sample No. 39 Ave 2.5 S.D. 0.06 C.V. 2.5

Sample No. 40 Ave 2.5 S.D. 0.06 C.V. 2.3

Labs Eliminated: 1186, 1189, 1474, 1515, 1608, 1906, 2091, 2173, 2398, 2438, 3562

Labs off Diagram: 1499, 2130, 2187