CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Concrete Proficiency Samples
Number 185 and Number 186

December 2017

CCRL
Cement and Concrete Reference Laboratory

www.ccrl.us

December 19, 2017

TO: Participants in the CCRL Portland Cement Concrete Proficiency Sample Program

SUBJECT: Concrete Proficiency Samples No. 185 and No. 186

Enclosed is your copy of the final report on the test results for the CCRL Concrete Proficiency Samples which were distributed in October 2017.

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 viewed and printed at our website located at: http://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.

Results of survey – Laboratories responded to the following question, "Is the concrete mixer used to batch the concrete for these samples owned or rented?":

1090 responded – Owned by lab
305 responded - Rented

Additional samples of these two materials 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 Proficiency Samples will be distributed in April 2018.

Sincerely,

Robin K. Haupt

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

TO: Participants in the CCRL Concrete Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor, PSP

SUBJECT: Explanation of Final Report on Results of Tests on Portland Cement Concrete Proficiency Samples No. 185 and No. 186

This letter, and the material included with it, constitutes the final report and summary of results for the current pair of Concrete Proficiency Samples that were distributed in October 2017. This material includes a statistical Summary of Results, and a set of general Scatter Diagrams. If your laboratory was a participate in this program a Table of Laboratory Results (lab data and ratings) for your laboratory can be viewed and printed on the CCRL website.

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.

Table of Results

Each laboratory receives an individualized Table of Results that contains laboratory test results and ratings. Each line of the test information shows the test title and the reporting unit in the first two columns. After that it lists in order, the laboratory's test 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 temperature of concrete.

The ratings for each 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 indicates whether the result reported was greater or less than the average obtained.

[1]Youden, W.J., "Statistical Aspects of the Cement Testing Program",Volume 59, *Proceedings of the 62nd Annual Meeting of the Society, June 25, 1959, American Society for Testing and Materials.*

In cases where some laboratories' results are eliminated, averages, standard deviations, coefficients of variation, and the ratings of the remaining 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

The Summary of Results provides 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 invalid and 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. 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. 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 Proficiency Samples No. 185 and No. 186

Final Report – December 19, 2017

SUMMARY OF RESULTS

		Sample No.185			Sample No. 186		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content - Volumetric Method (**percent**)							
	1253	2.52	0.58	23	2.39	0.51	22
	*1226	2.48	0.49	20	2.35	0.44	19
Air Content - Pressure Method (**percent**)							
	1463	2.4	0.74	30	2.3	0.49	21
	*1410	2.4	0.44	18	2.2	0.37	16
Slump of Concrete (**inch**)							
	1469	3.54	1.18	33	3.83	1.15	30
	*1449	3.49	1.10	32	3.78	1.07	28
Unit Weight of Concrete (**lb/ft³**)							
	1468	155.5	2.4	1.5	155.7	2.4	1.5
	*1404	155.6	1.4	0.9	155.9	1.3	0.8
Density of Compressive Strength Specimen (**lb/ft³**)							
	1321	156	3.0	1.9	156	2.9	1.8
	*1264	156	1.5	1.0	157	1.4	0.9

Air Content - Volumetric Method (**percent**)

* Labs Eliminated - 3, 446, 923, 1179, 1200, 1549, 1615, 2053, 2143, 2477, 2501, 2678, 2708, 2935, 2987, 2991, 2999, 3542, 3604, 3633, 3766, 3805, 3842, 3860, 3875, 4172, 4205

Air Content - Pressure Method (**percent**)

* Labs Eliminated - 18, 446, 539, 923, 953, 1179, 1200, 1449, 1549, 1615, 1932, 1959, 2045, 2046, 2053, 2093, 2143, 2187, 2224, 2237, 2407, 2501, 2631, 2678, 2708, 2721, 2987, 2991, 3191, 3387, 3421, 3529, 3544, 3545, 3604, 3615, 3766, 3823, 3828, 3842, 3854, 3860, 3875, 3947, 4062, 4107, 4163, 4172, 4192, 4230, 4238, 4255, 4266

Slump of Concrete (**inch**)

* Labs Eliminated - 512, 546, 1191, 1294, 1446, 2206, 2221, 2372, 2400, 2407, 2966, 2991, 3472, 3544, 3545, 3548, 3842, 3867, 3961, 4199

Unit Weight of Concrete (**lb/ft³**)

* Labs Eliminated - 39, 273, 360, 446, 470, 490, 507, 756, 827, 898, 946, 1003, 1140, 1173, 1367, 1418, 1520, 1537, 1562, 1898, 2053, 2082, 2206, 2236, 2254, 2302, 2372, 2398, 2477, 2509, 2708, 2936, 2960, 3071, 3089, 3115, 3345, 3412, 3417, 3513, 3552, 3565, 3566, 3604, 3624, 3638, 3665, 3755, 3759, 3766, 3767, 3799, 3808, 3842, 3860, 3905, 3926, 4061, 4065, 4089, 4143, 4172, 4192, 4255

Density of Compressive Strength Specimen (**lb/ft³**)

* Labs Eliminated - 13, 95, 376, 446, 636, 756, 1003, 1026, 1028, 1179, 1359, 1372, 1457, 1540, 1898, 1987, 1995, 2082, 2093, 2206, 2273, 2336, 2341, 2372, 2398, 2438, 2471, 2509, 2549, 2708, 2721, 2933, 2936, 2954, 2974, 3046, 3071, 3115, 3412, 3417, 3502, 3536, 3552, 3565, 3759, 3766, 3832, 3842, 3860, 3880, 3951, 4061, 4089, 4140, 4143, 4205, 4264

CCRL PROFICIENCY SAMPLE PROGRAM

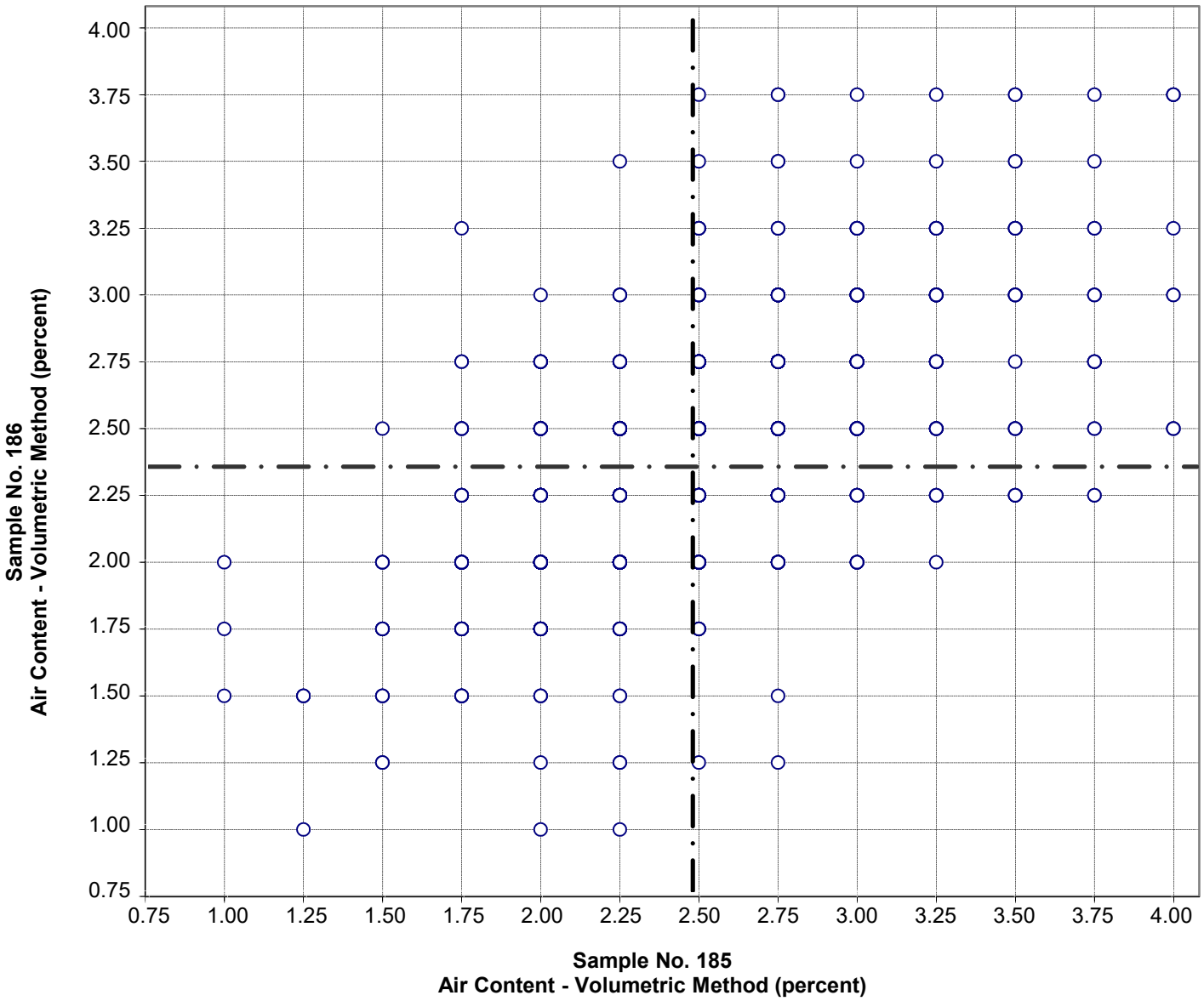
Concrete Proficiency Samples No. 185 and No. 186

Final Report – December 19, 2017

SUMMARY OF RESULTS

		Sample No.185			Sample No. 186		
Test (unit)	#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Compressive Strength 4 x 8 - 7 day (psi)							
	1191	5292	439	8.3	5114	405	7.9
	*1169	5317	359	6.7	5138	331	6.5
* Labs Eliminated - 41, 1179, 1191, 1446, 1536, 2273, 2372, 2407, 2509, 2708, 2966, 3004, 3184, 3412, 3552, 3674, 3766, 3867, 3875, 4147, 4196, 4199							
Compressive Strength 6 x 12 - 7 day (psi)							
	285	4844	366	7.6	4742	324	6.8
No Labs Eliminated for This Test							
Temperature of Concrete (°F)							
	1469	70	6	9.2	69	6	9.3
No Labs Eliminated for This Test							

CCRL Proficiency Sample Program
Air Content - Volumetric Method
CONCRETE Samples No. 185 and No. 186



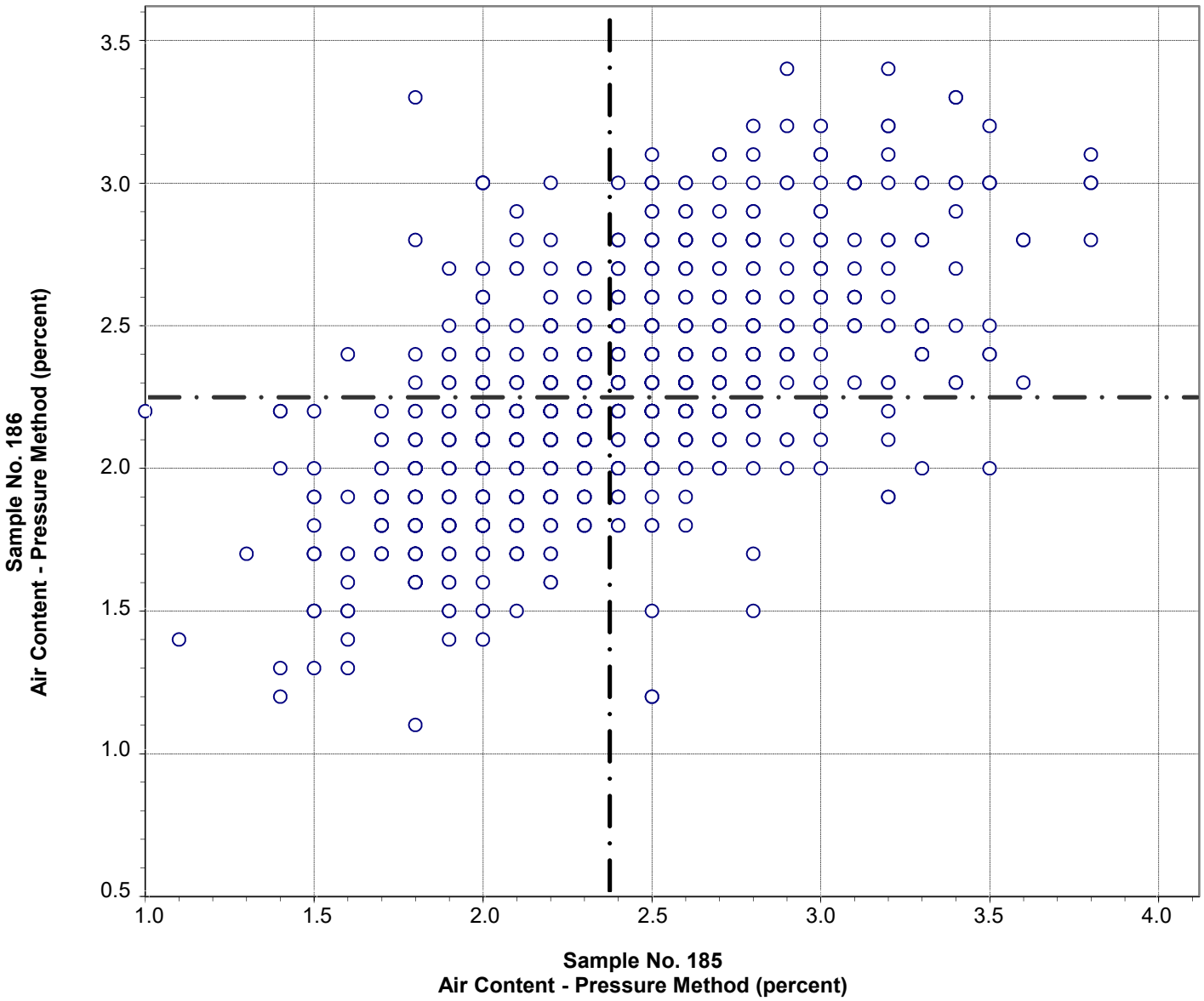
Test No. 1 Air Content - Volumetric Method 1223 Points

Sample No. 185 Ave 2.48 S.D. 0.49 C.V. 20
Sample No. 186 Ave 2.35 S.D. 0.44 C.V. 19

Labs Eliminated: 3, 446, 923, 1179, 1200, 1549, 1615, 2053, 2143, 2477, 2501, 2678, 2708, 2935, 2987, 2991, 2999, 3542, 3604, 3633, 3766, 3805, 3842, 3860, 3875, 4172, 4205

Labs off Diagram: 1449, 2093, 4230

CCRL Proficiency Sample Program
Air Content - Pressure Method
CONCRETE Samples No. 185 and No. 186

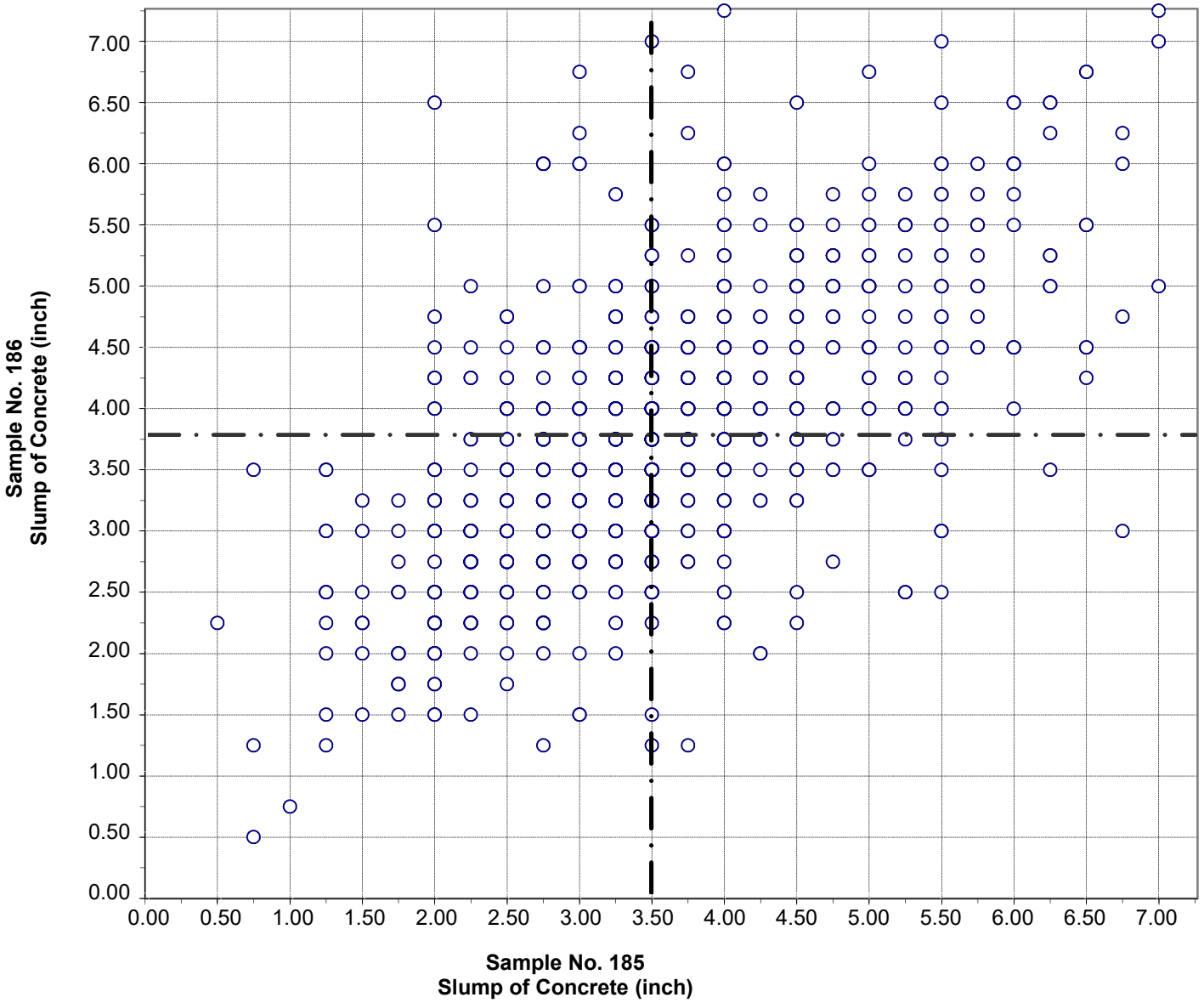


Test No. 6 Air Content - Pressure Method 1410 Points

Sample No. 185	Ave	2.4	S.D.	0.44	C.V. 18
Sample No. 186	Ave	2.2	S.D.	0.37	C.V. 16

Labs Eliminated: 18, 446, 539, 923, 953, 1179, 1200, 1449, 1549, 1615, 1932, 1959, 2045, 2046, 2053, 2093, 2143, 2187, 2224, 2237, 2407, 2501, 2631, 2678, 2708, 2721, 2987, 2991, 3191, 3387, 3421, 3529, 3544, 3545, 3604, 3615, 3766, 3823, 3828, 3842, 3854, 3860, 3875, 3947, 4062, 4107, 4163, 4172, 4192, 4230, 4238, 4255, 4266

CCRL Proficiency Sample Program
Slump of Concrete
CONCRETE Samples No. 185 and No. 186

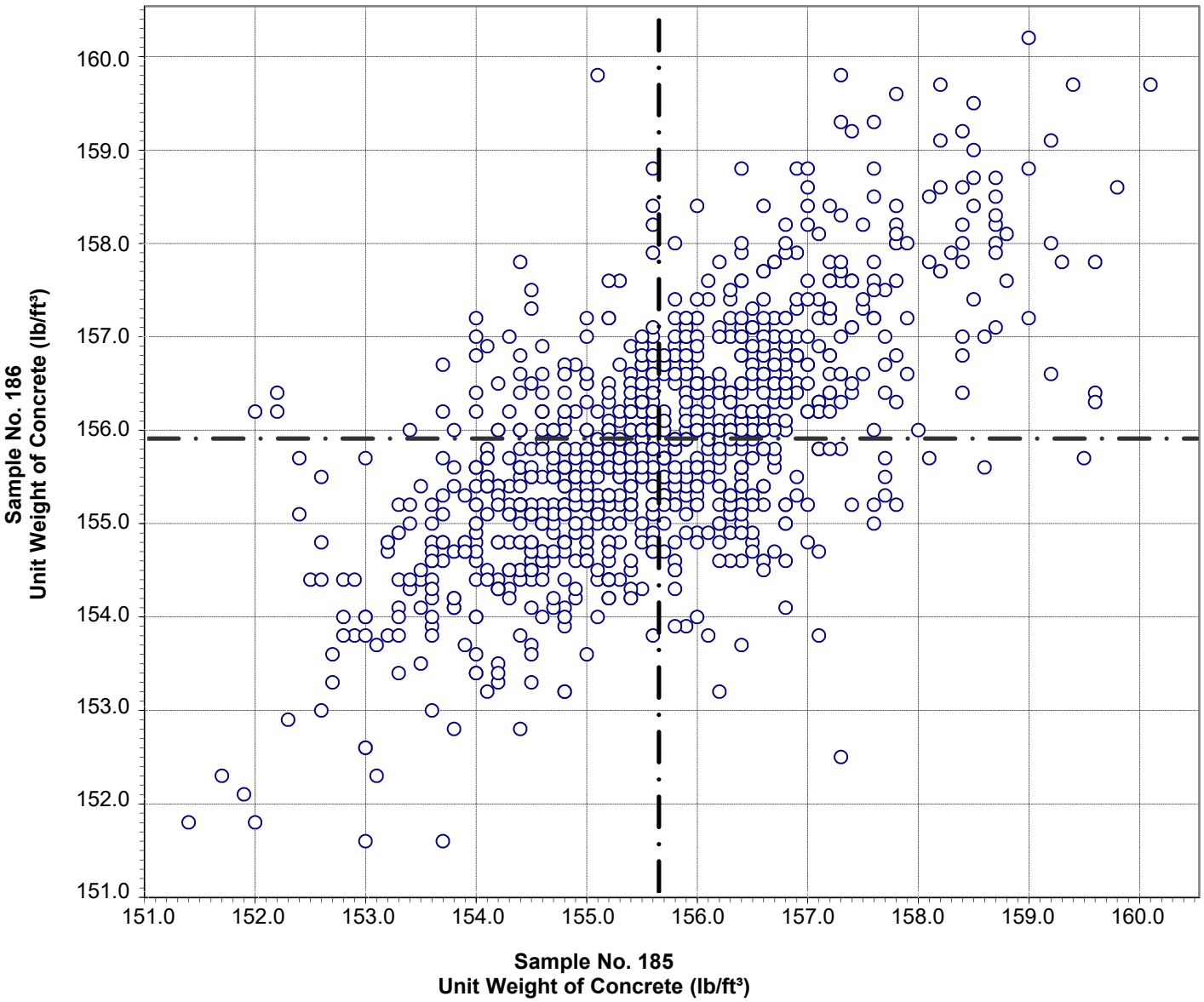


Test No. 2 Slump of Concrete 1449 Points

Sample No. 185	Ave	3.49	S.D.	1.10	C.V. 32
Sample No. 186	Ave	3.78	S.D.	1.07	C.V. 28

Labs Eliminated: 512, 546, 1191, 1294, 1446, 2206, 2221, 2372, 2400, 2407, 2966, 2991, 3472, 3544, 3545, 3548, 3842, 3867, 3961, 4199

CCRL Proficiency Sample Program
Unit Weight of Concrete
CONCRETE Samples No. 185 and No. 186

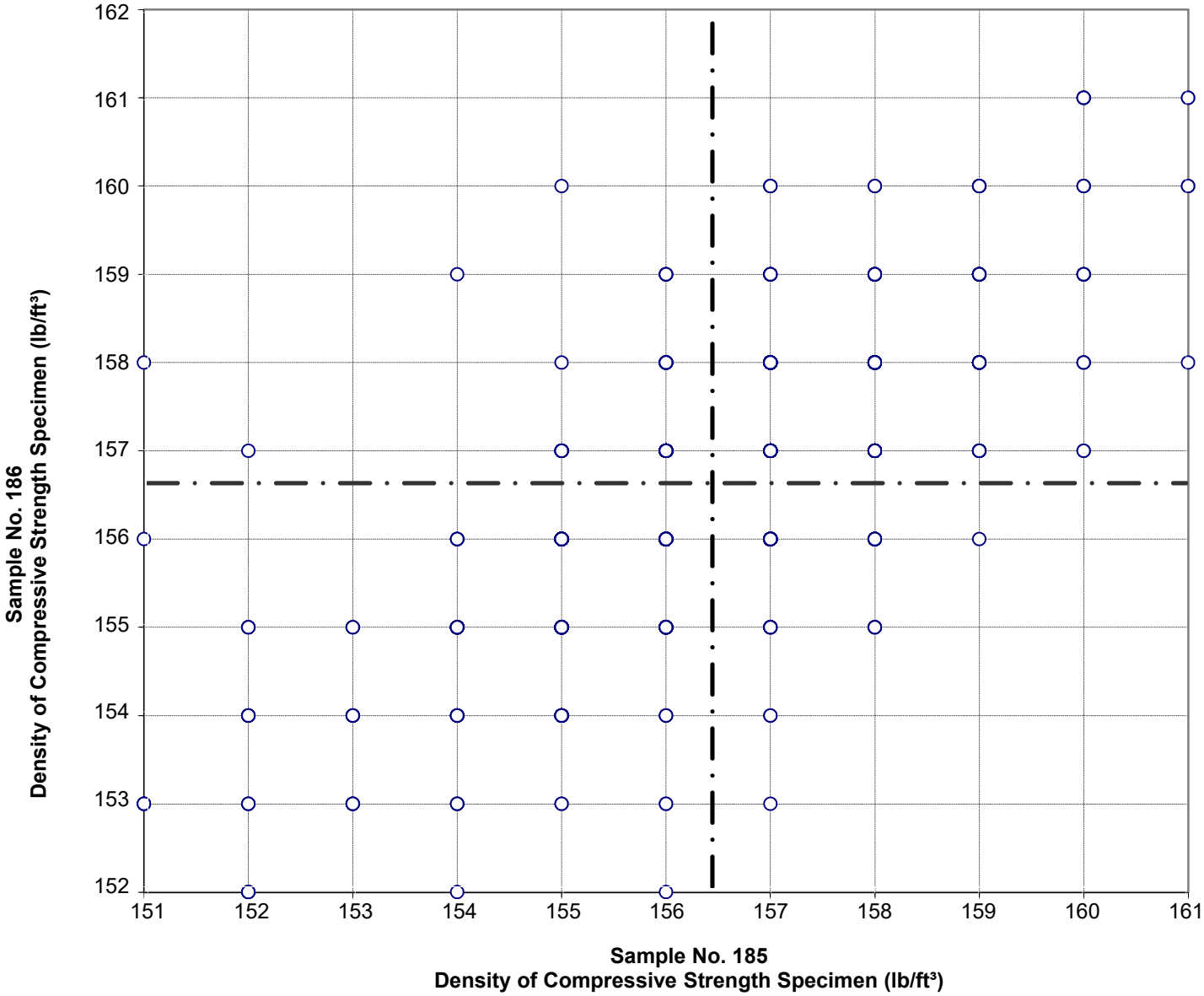


Test No. 3 Unit Weight of Concrete 1404 Points

Sample No. 185	Ave	155.6	S.D.	1.4	C.V.	0.9
Sample No. 186	Ave	155.9	S.D.	1.3	C.V.	0.8

Labs Eliminated: 39, 273, 360, 446, 470, 490, 507, 756, 827, 898, 946, 1003, 1140, 1173, 1367, 1418, 1520, 1537, 1562, 1898, 2053, 2082, 2206, 2236, 2254, 2302, 2372, 2398, 2477, 2509, 2708, 2936, 2960, 3071, 3089, 3115, 3345, 3412, 3417, 3513, 3552, 3565, 3566, 3604, 3624, 3638, 3665, 3755, 3759, 3766, 3767, 3799, 3808, 3842, 3860, 3905, 3926, 4061, 4065, 4089, 4143, 4172, 4192, 4255

CCRL Proficiency Sample Program
Density of Compressive Strength Specimen
CONCRETE Samples No. 185 and No. 186

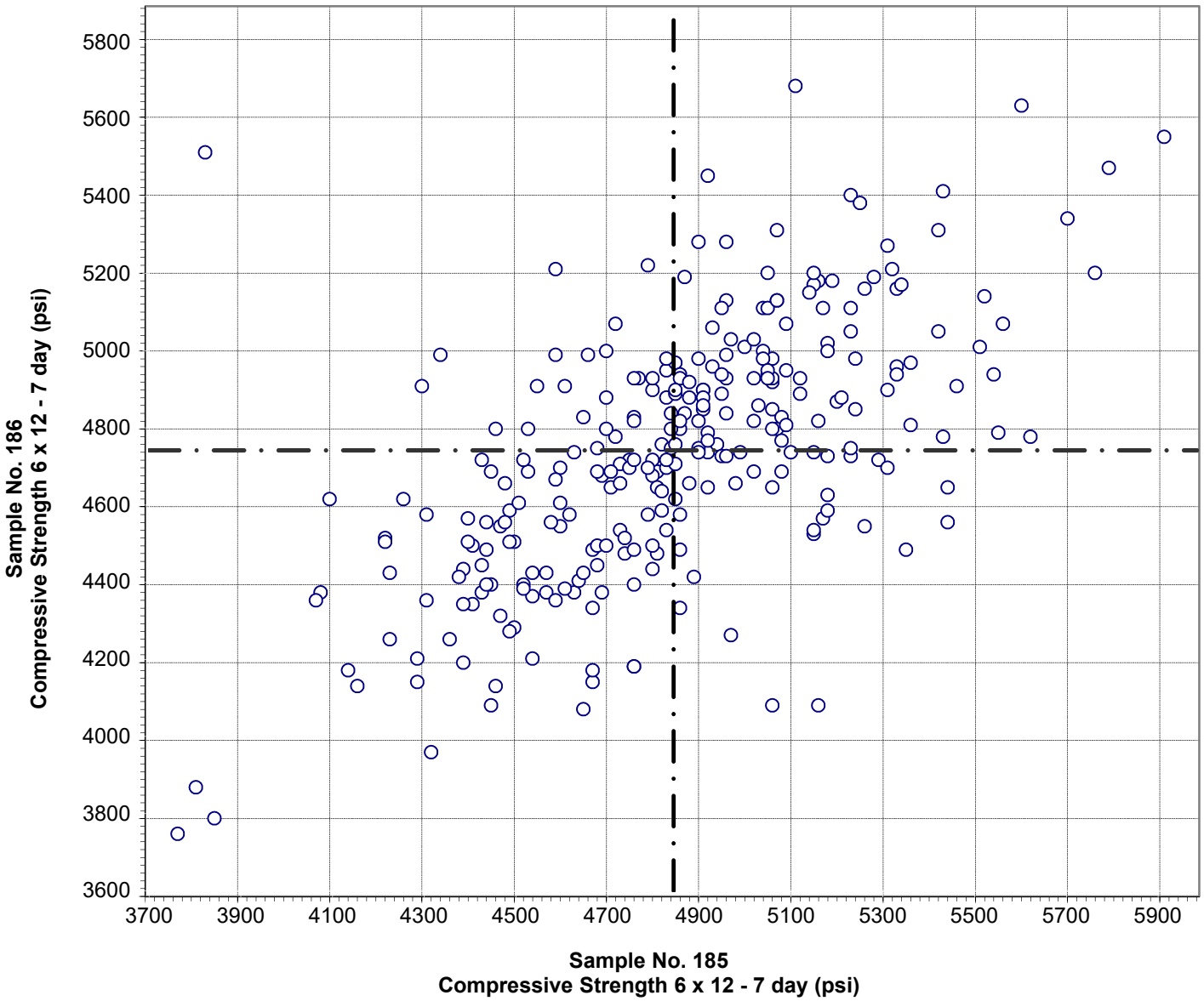


Test No. 7 Density of Compressive Strength Specimen 1264 Points

Sample No. 185	Ave	156	S.D.	1.5	C.V.	1.0
Sample No. 186	Ave	157	S.D.	1.4	C.V.	0.9

Labs Eliminated: 13, 95, 376, 446, 636, 756, 1003, 1026, 1028, 1179, 1359, 1372, 1457, 1540, 1898, 1987, 1995, 2082, 2093, 2206, 2273, 2336, 2341, 2372, 2398, 2438, 2471, 2509, 2549, 2708, 2721, 2933, 2936, 2954, 2974, 3046, 3071, 3115, 3412, 3417, 3502, 3536, 3552, 3565, 3759, 3766, 3832, 3842, 3860, 3880, 3951, 4061, 4089, 4140, 4143, 4205, 4264

CCRL Proficiency Sample Program
Compressive Strength 6 x 12 - 7 day
CONCRETE Samples No. 185 and No. 186

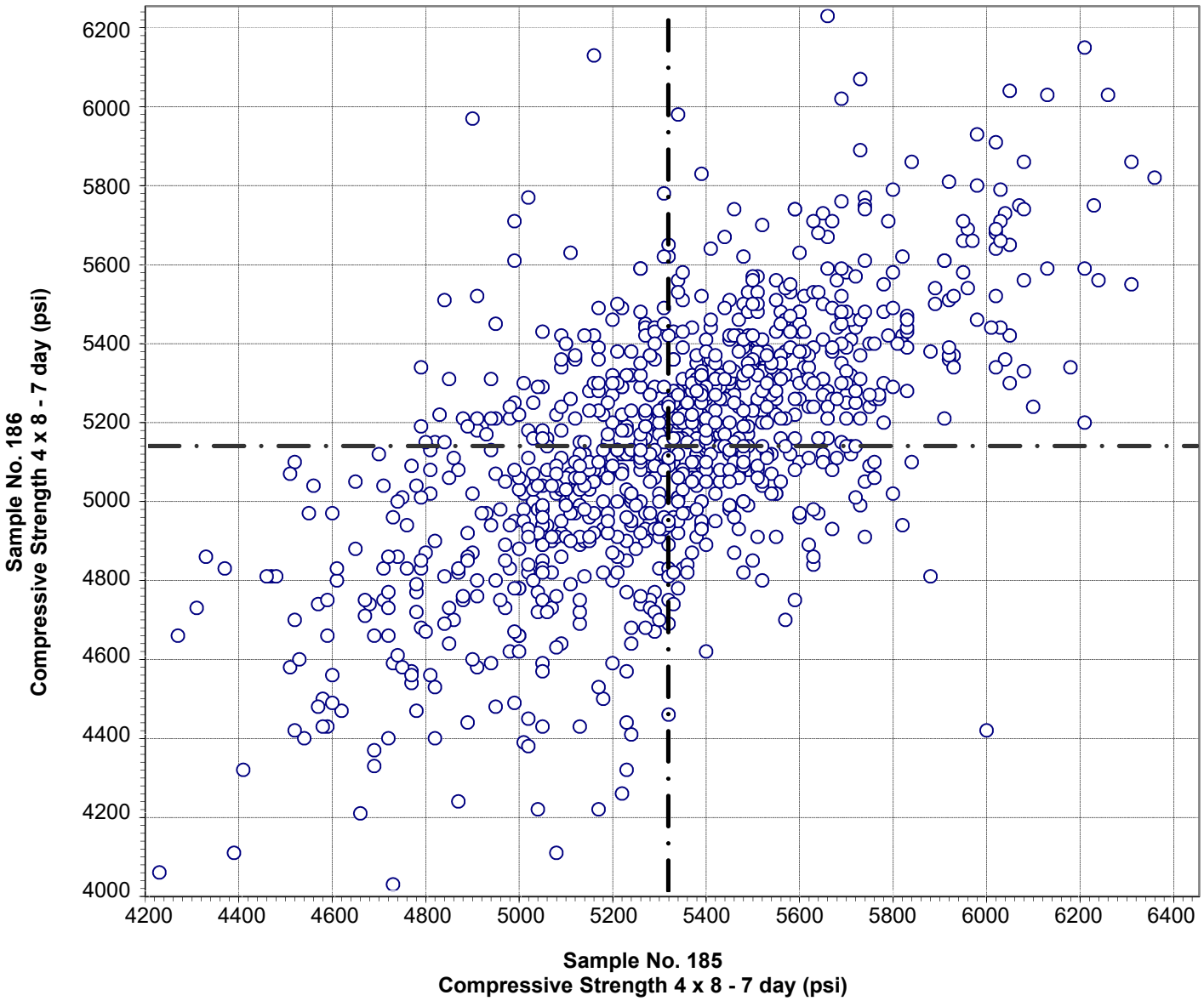


Test No. 4 Compressive Strength 6 x 12 - 7 day 284 Points

Sample No. 185	Ave 4844	S.D. 366	C.V. 7.6
Sample No. 186	Ave 4742	S.D. 324	C.V. 6.8

Labs off Diagram: 1186

CCRL Proficiency Sample Program
Compressive Strength 4 x 8 - 7 day
CONCRETE Samples No. 185 and No. 186



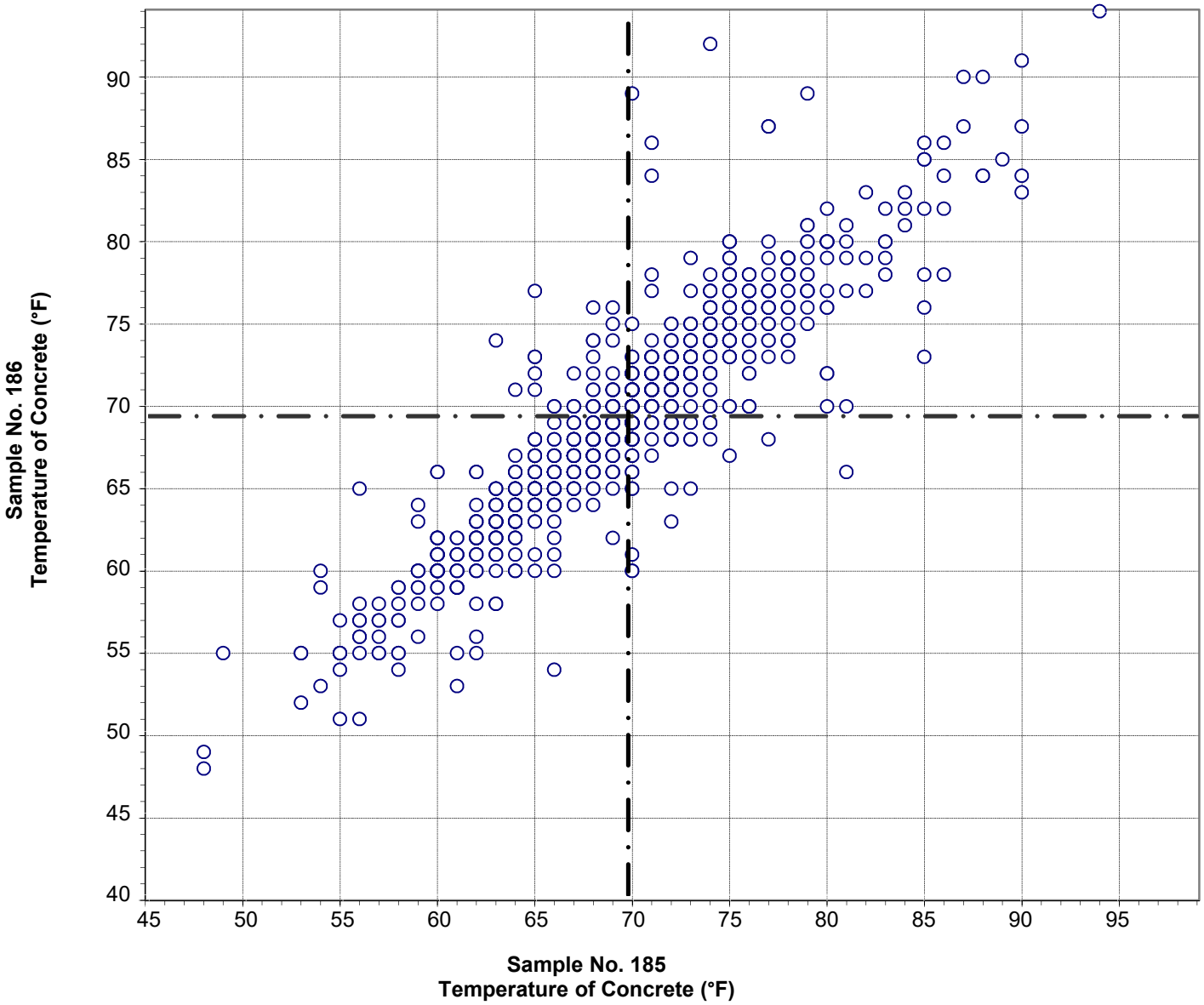
Test No. 4 Compressive Strength 4 x 8 - 7 day 1161 Points

Sample No. 185	Ave 5317	S.D. 359	C.V. 6.7
Sample No. 186	Ave 5138	S.D. 331	C.V. 6.5

Labs Eliminated: 41, 1179, 1191, 1446, 1536, 2273, 2372, 2407, 2509, 2708, 2966, 3004, 3184, 3412, 3552, 3674, 3766, 3867, 3875, 4147, 4196, 4199

Labs off Diagram: 72, 1003, 1898, 2600, 2936, 2965, 3417, 3781

CCRL Proficiency Sample Program
Temperature of Concrete
CONCRETE Samples No. 185 and No. 186



Test No. 5 Temperature of Concrete 1466 Points

Sample No. 185	Ave 70	S.D. 6	C.V. 9.2
Sample No. 186	Ave 69	S.D. 6	C.V. 9.3

Labs off Diagram: 3145, 3479, 3823