

**CEMENT AND CONCRETE REFERENCE LABORATORY**  
**PROFICIENCY SAMPLE PROGRAM**

**Final Report**  
**Concrete Proficiency Samples**  
**Number 155 and Number 156**

June 2010



June 25, 2010

**To: Participants in the CCRL Portland Cement Concrete Proficiency Sample Program**

**Subject: Concrete Proficiency Samples No. 155 and No. 156**

Enclosed is your copy of the final report on the test results for the CCRL Concrete Proficiency Samples which were distributed in April 2010.

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 downloaded 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.

**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 October 2010.

Sincerely,

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

Attachment

**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. 155 and No. 156**

This letter, and the material included with it, constitute the final report, and summary of results for the current pair of Concrete Proficiency Samples, which were distributed in April 2010. This material includes a statistical Summary of Results, and a set of general Scatter Diagrams. If your laboratory was a participant in this program a Table of Laboratory Results (lab data and ratings) for your laboratory data 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 62<sup>nd</sup> 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.

<b>Ratings</b>	<b>Range (Number of Standard Deviations)</b>	<b>Number (Per 100) of Laboratories achieving the rating <sup>1</sup></b>
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.

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<sup>1</sup>Youden, W.J., "Statistical Aspects of the Cement Testing Program", Volume 59, *Proceedings of the 62<sup>nd</sup> 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 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 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  $\pm 1$  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 Proficiency Samples No. 155 and No. 156  
Final Report - June 25, 2010

SUMMARY OF RESULTS

Test		#Labs	Sample No. 155			Sample No. 156		
			Average	S.D.	C.V.	Average	S.D.	C.V.
Air Cont, Volume	%	1053	1.65	0.45	27.3	1.57	0.46	29.2
Air Cont, Volume	%	*1028	1.63	0.37	22.7	1.54	0.36	23.1
Air Cont, Pressure	%	1233	1.6	0.4	23.9	1.5	0.4	27.6
Air Cont, Pressure	%	*1196	1.5	0.3	18.2	1.5	0.3	19.6
Slump	inches	1245	2.87	1.00	36.8	4.26	1.40	33.5
Slump	inches	*1233	2.83	0.98	34.6	4.24	1.41	33.3
Unit Weight	lbs/ft <sup>3</sup>	1243	150.6	2.8	1.9	150.5	2.8	1.9
Unit Weight	lbs/ft <sup>3</sup>	*1183	150.6	1.2	0.8	150.5	1.2	0.8
<b>Compressive Strength, 7 day, 6 x 12 inch specimens</b>								
Comp Strength	psi	584	4577	424	9.3	4277	410	9.6
Comp Strength	psi	* 575	4595	375	8.2	4295	355	8.3
<b>Compressive Strength, 7 day, 4 x 8 inch specimens</b>								
Comp Strength	psi	657	4961	437	8.8	4650	442	9.5
Comp Strength	psi	* 646	4986	389	7.8	4672	399	8.5
Temperature of Conc	°F	1244	76	7	8.7	75	7	8.8

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

Air Content - Volumetric 72 1158 1191 1200 1207 1307 1447 1585 1622 1663 1885 2053 2131 2208  
2346 2574 2989 3171 3397 3430 3444 3468 3474 3475 3514

Air Content - Pressure 72 849 981 1158 1191 1200 1207 1210 1307 1447 1570 1663 1772 1839 1885  
1995 2033 2053 2093 2219 2311 2346 2376 2574 2675 2812 3109 3171 3373 3391 3397 3417 3444  
3468 3474 3475 3514

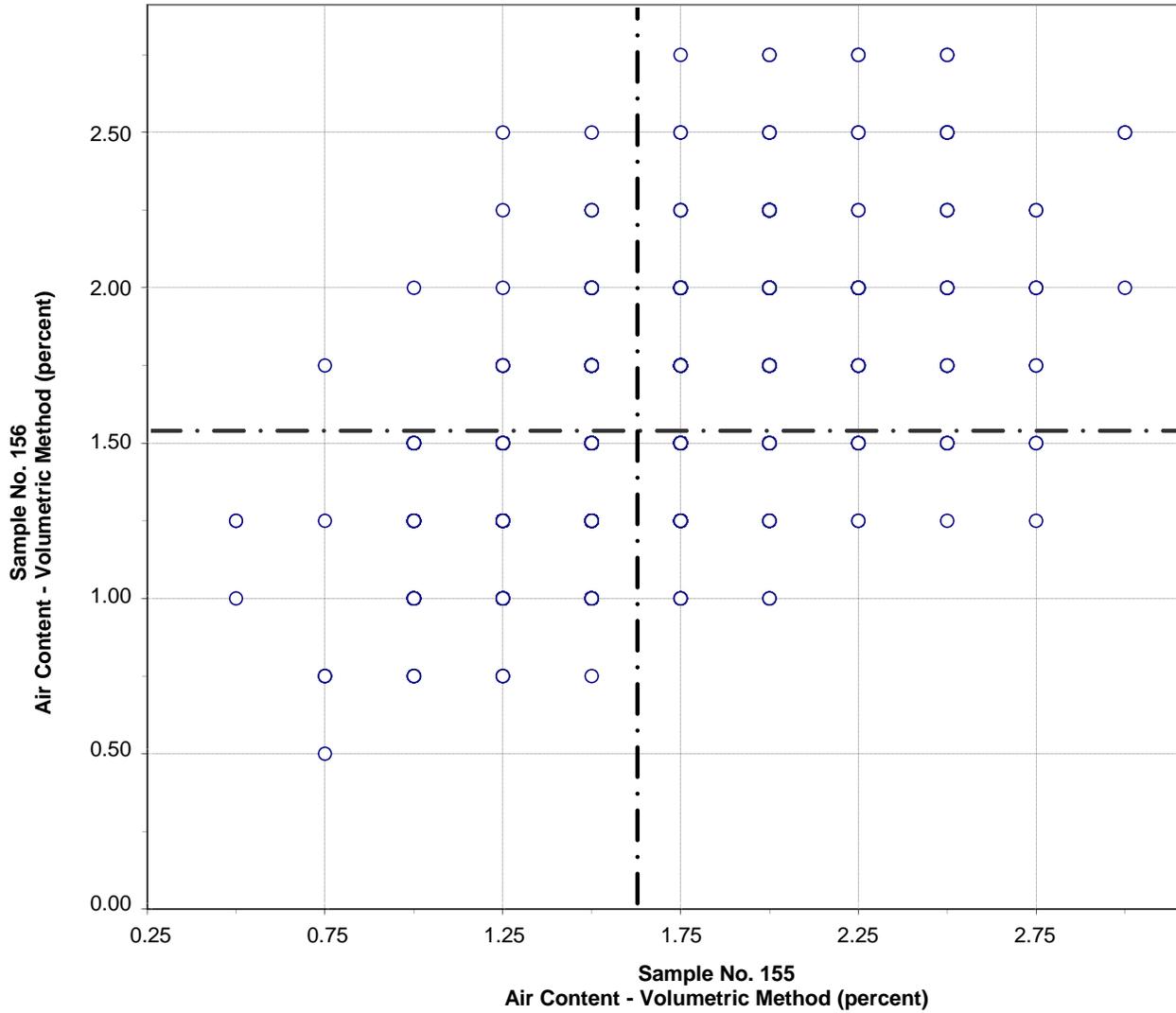
Slump of Concrete 640 801 906 1191 1226 1697 2093 2395 3091 3306 3403 3420

Unit Weight of Concrete 424 1103 1191 1226 1419 1536 1549 2041 2106 2302 2410 2923 2937 3028  
3171 3338 3370 3410 3474 788 849 897 1223 1313 1471 1516 1570 1573 1654 1697 1772 1839  
1932 2028 2031 2071 2108 2170 2187 2208 2214 2221 2325 2445 2475 2673 2812 3039 3040 3090  
3120 3151 3203 3295 3335 3452 3468 3479 3482 3548

Compressive Strength, 6 x 12 inch 15 640 1191 1549 1709 2030 2941 3206 3514

Compressive Strength, 4 x 8 inch 783 1103 1210 1721 1800 3091 3205 3303 3338 3417 3445

**CCRL Proficiency Sample Program  
Air Content - Volumetric Method  
CONCRETE Samples No. 155 and No. 156**



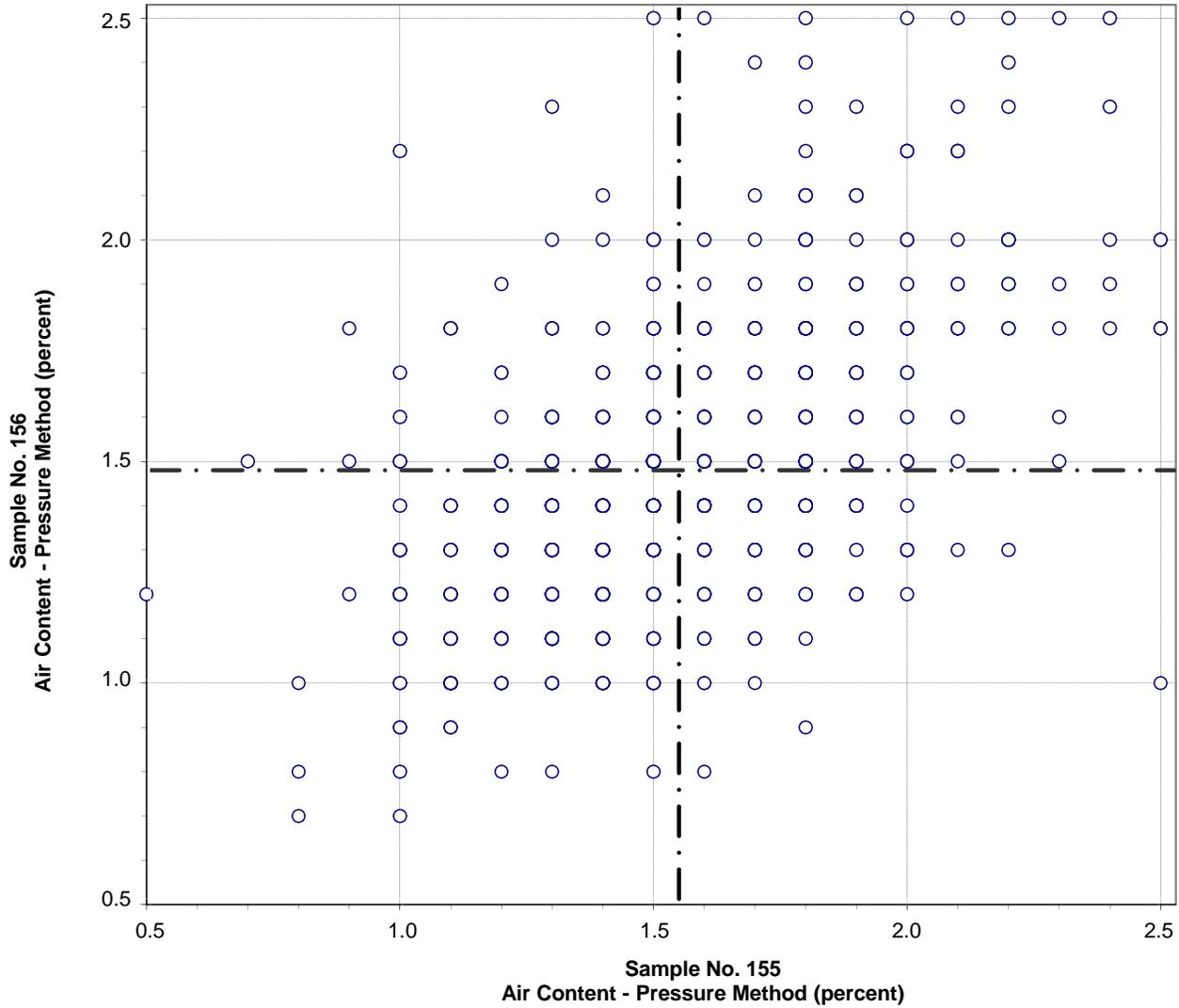
**Test No. 1      Air Content - Volumetric Method      1028 Points**

Sample No. 155    Ave 1.63    S.D. 0.37    C.V. 22.7

Sample No. 156    Ave 1.54    S.D. 0.36    C.V. 23.1

Labs eliminated: 72, 1158, 1191, 1200, 1207, 1307, 1447, 1585, 1622, 1663,  
1885, 2053, 2131, 2208, 2346, 2574, 2989, 3171, 3397, 3430, 3444, 3468, 3474,  
3475, 3514

**CCRL Proficiency Sample Program  
Air Content - Pressure Method  
CONCRETE Samples No. 155 and No. 156**



**Test No. 6      Air Content - Pressure Method      1192 Points**

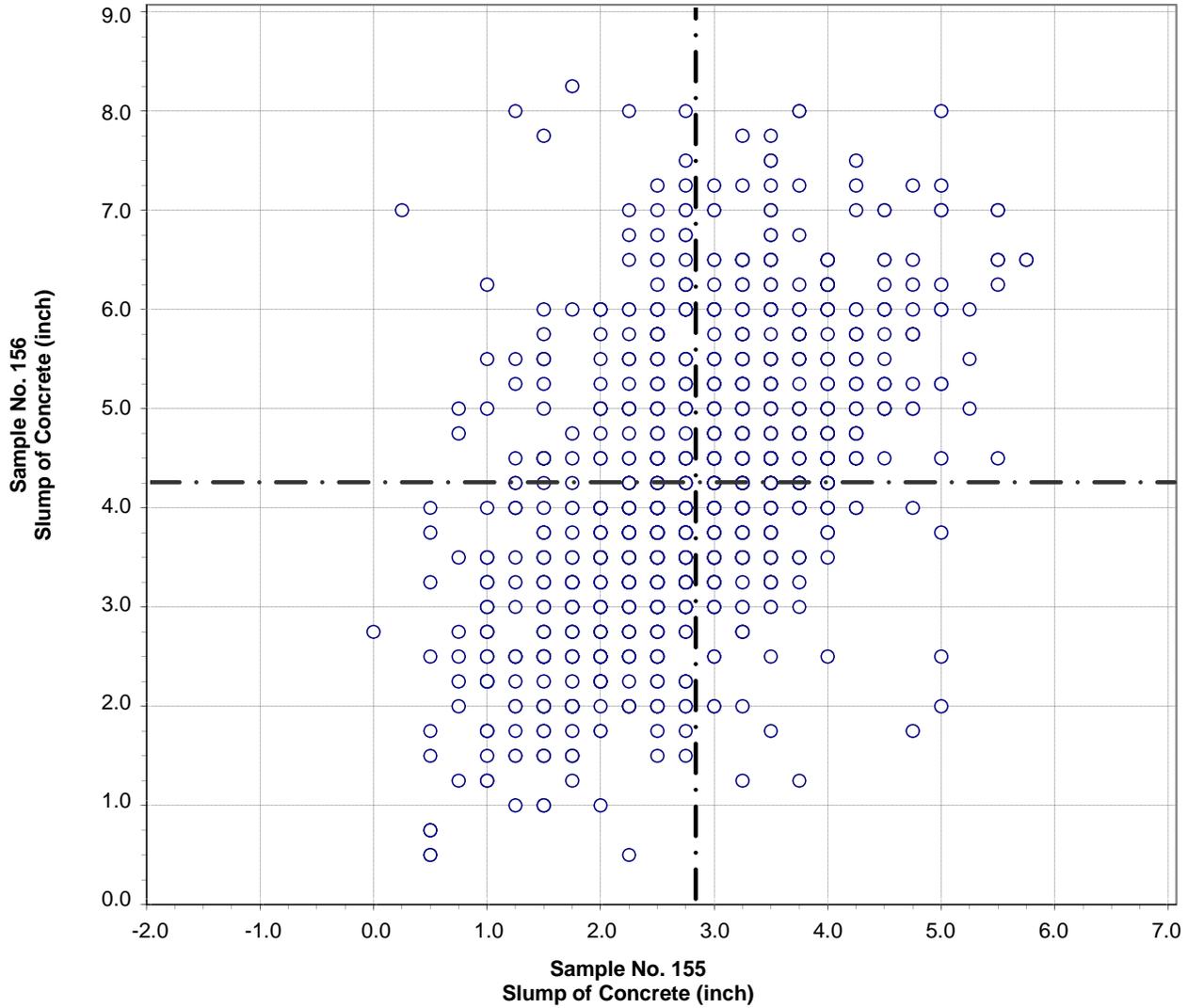
Sample No. 155    Ave 1.5    S.D. 0.3    C.V. 18.2

Sample No. 156    Ave 1.5    S.D. 0.3    C.V. 19.6

Labs eliminated: 72, 849, 981, 1158, 1191, 1200, 1207, 1210, 1307, 1447, 1570, 1663, 1772, 1839, 1885, 1995, 2033, 2053, 2093, 2219, 2311, 2346, 2376, 2574, 2675, 2812, 3109, 3171, 3373, 3391, 3397, 3417, 3444, 3468, 3474, 3475, 3514

Labs off Diagram: 1318, 2170, 2941, 3090

**CCRL Proficiency Sample Program  
Slump of Concrete  
CONCRETE Samples No. 155 and No. 156**

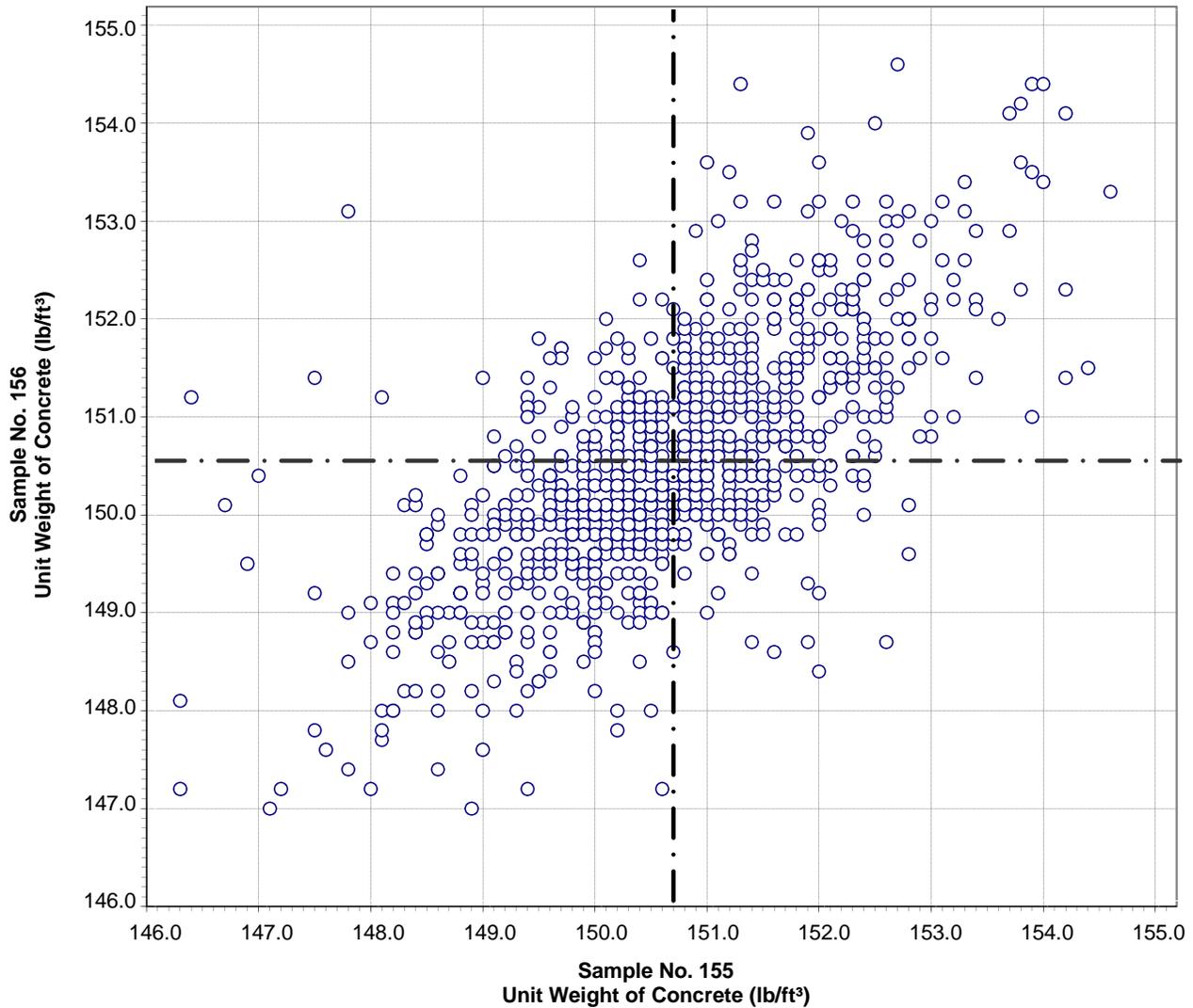


**Test No. 2      Slump of Concrete      1233 Points**

Sample No. 155	Ave 2.83	S.D. 0.98	C.V. 34.6
Sample No. 156	Ave 4.24	S.D. 1.41	C.V. 33.3

Labs eliminated: 640, 801, 906, 1191, 1226, 1697, 2093, 2395, 3091, 3306, 3403, 3420

**CCRL Proficiency Sample Program  
Unit Weight of Concrete  
CONCRETE Samples No. 155 and No. 156**



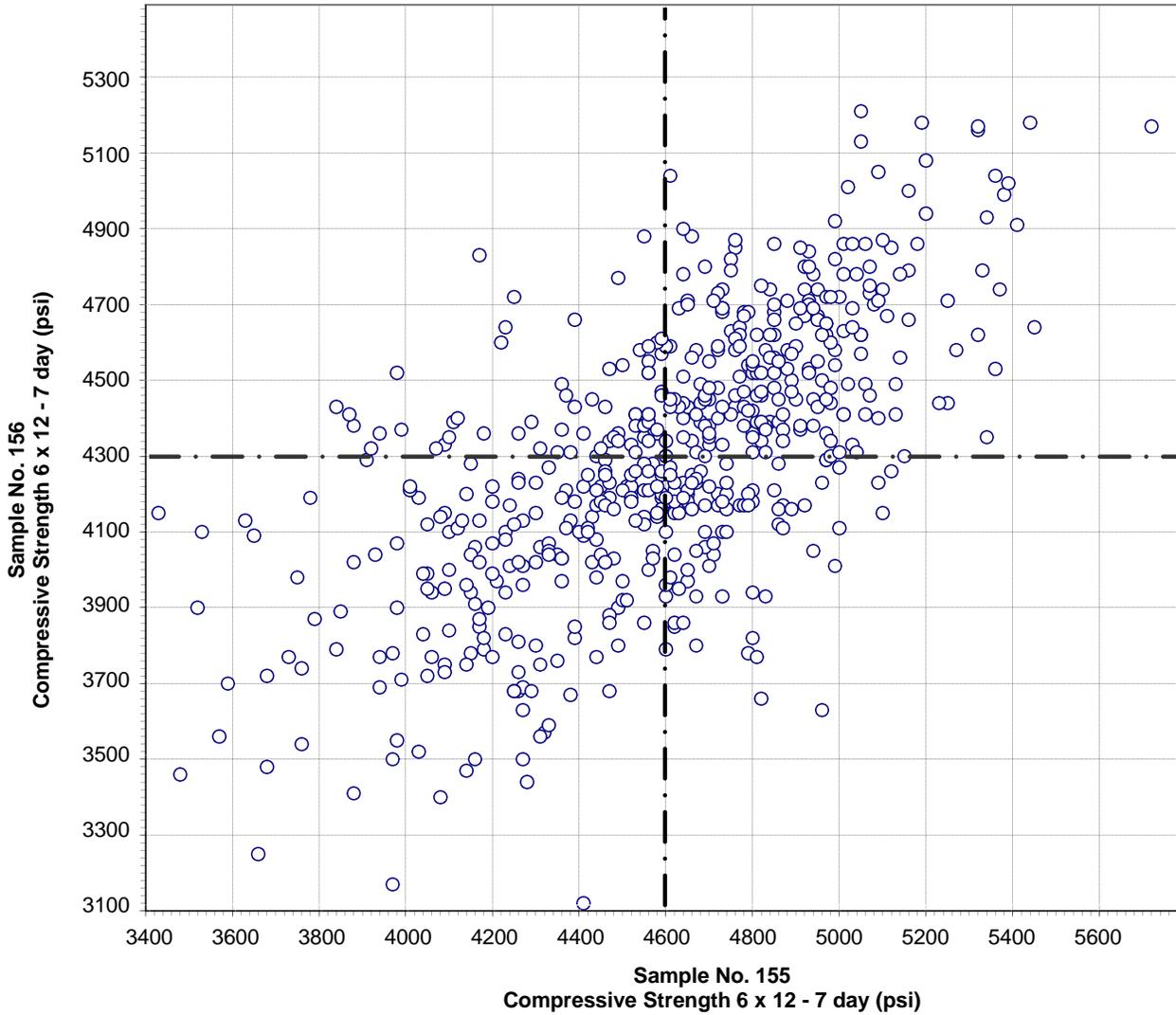
**Test No. 3      Unit Weight of Concrete      1183 Points**

Sample No. 155    Ave 150.6    S.D. 1.2    C.V. 0.8

Sample No. 156    Ave 150.5    S.D. 1.2    C.V. 0.8

Labs eliminated: See SUMMARY OF RESULTS page for list of labs.

**CCRL Proficiency Sample Program  
Compressive Strength 6 X 12 - 7 day  
CONCRETE Samples No. 155 and No. 156**



**Test No. 6      Compressive Strength 6 X 12 - 7 day      574 Points**

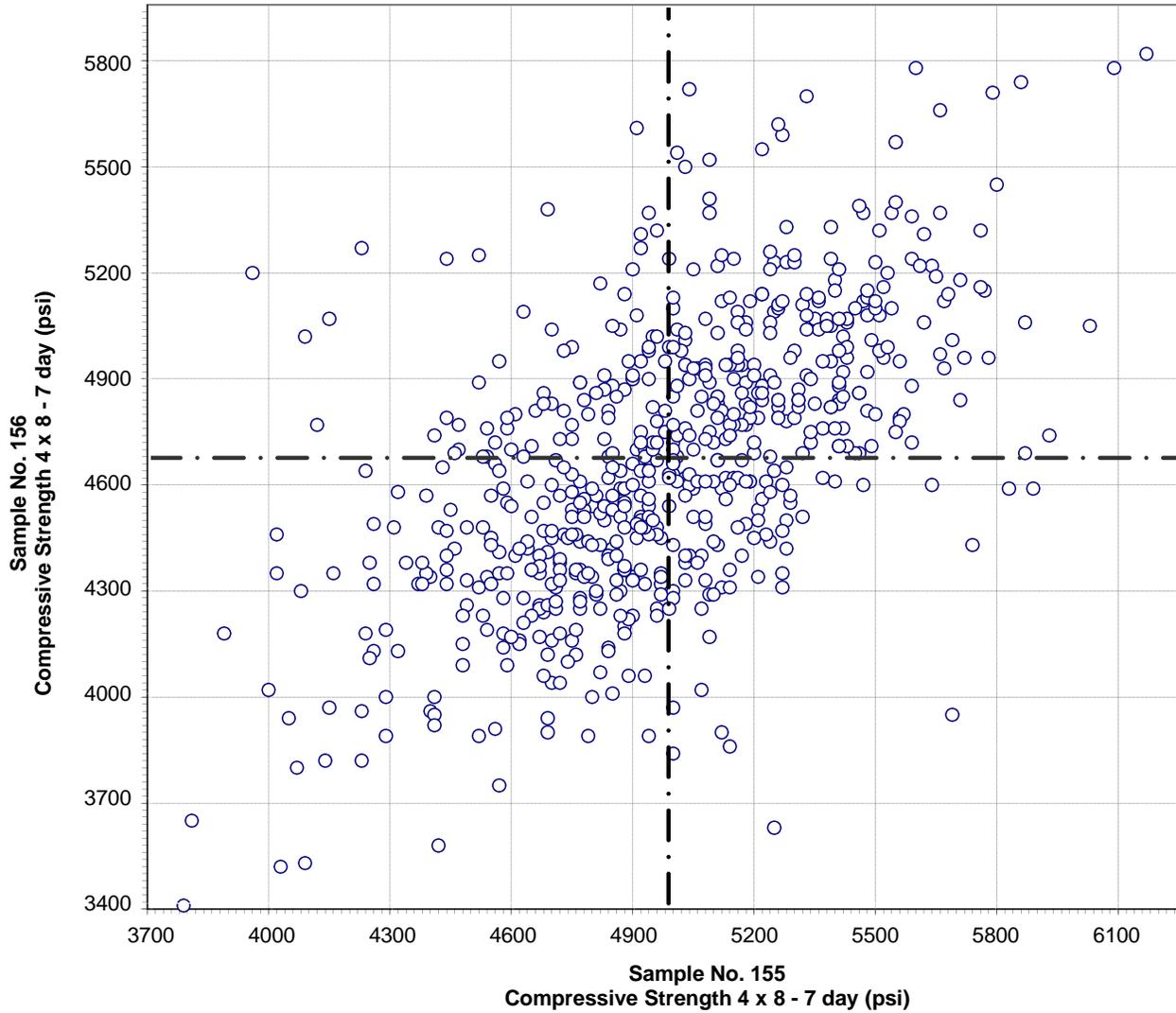
Sample No. 155    Ave 4595    S.D. 375    C.V. 8.2

Sample No. 156    Ave 4295    S.D. 355    C.V. 8.3

Labs eliminated: 15, 640, 1191, 1549, 1709, 2030, 2941, 3206, 3514

Labs off Diagram: 2511

**CCRL Proficiency Sample Program  
Compressive Strength 4 x 8 - 7 day  
CONCRETE Samples No. 155 and No. 156**



**Test No. 4      Compressive Strength 4 x 8 - 7 day      644 Points**

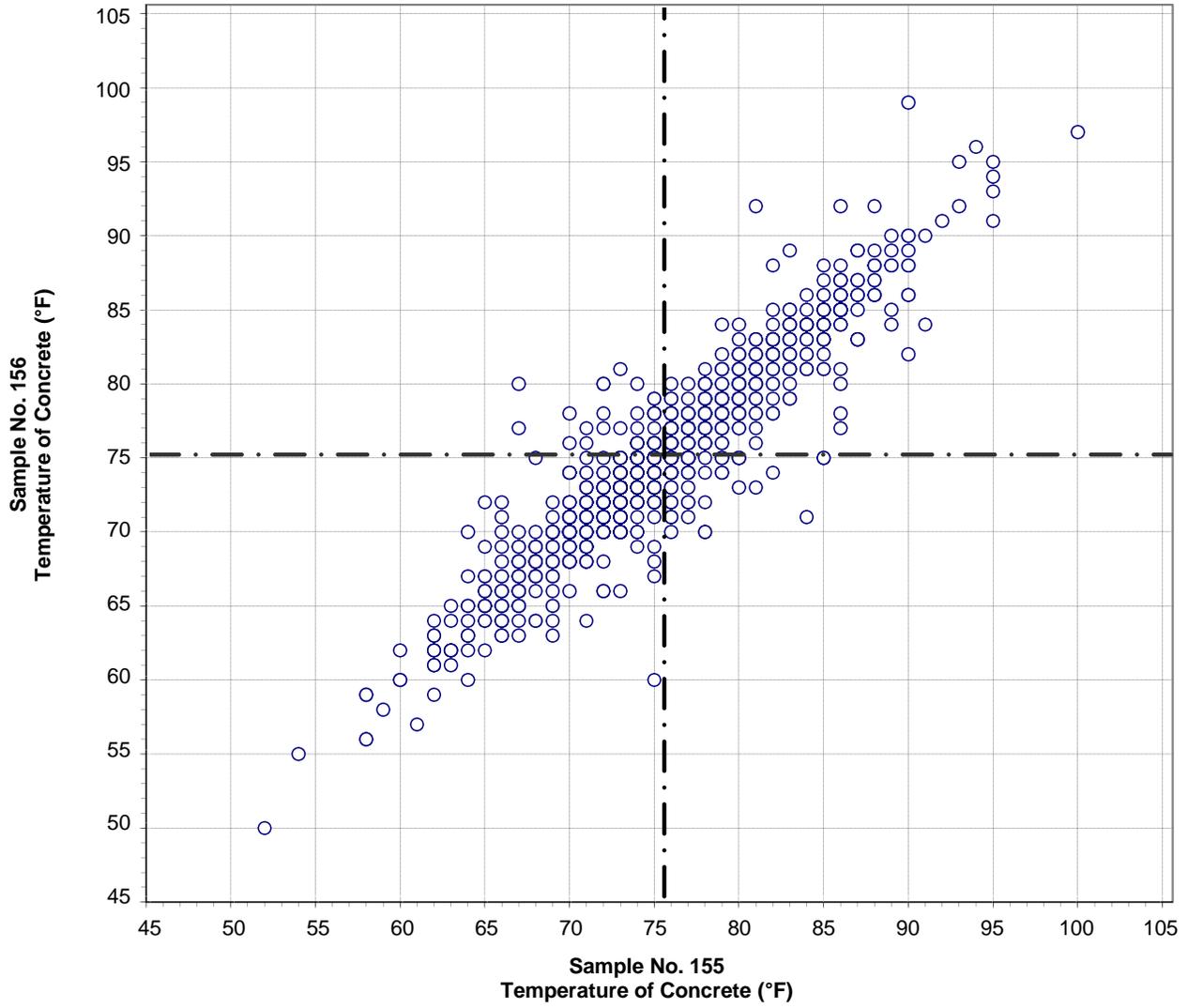
Sample No. 155    Ave 4986    S.D. 389    C.V. 7.8

Sample No. 156    Ave 4672    S.D. 399    C.V. 8.5

Labs eliminated: 783, 1103, 1210, 1721, 1800, 3091, 3205, 3303, 3338, 3417, 3445

Labs off Diagram: 38, 1003

CCRL Proficiency Sample Program  
Temperature of Concrete  
CONCRETE Samples No. 155 and No. 156



Test No. 5      Temperature of Concrete      1242 Points

Sample No. 155    Ave 76    S.D. 7    C.V. 8.7  
Sample No. 156    Ave 75    S.D. 7    C.V. 8.8

Labs off Diagram: 2498, 3410