CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 161 and Number 162

October 2006

CCRL CEMENT AND CONCRETE REFERENCE LABORATORY

CEMENT AND CONCRETE REFERENCE LABORATORY
AT THE
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SPONSORED BY
COMMITTEE C-1 ON CEMENT
COMMITTEE C-9 ON CONCRETE AND
CONCRETE AGGREGATES
AMERICAN SOCIETY FOR TESTING AND MATERIALS

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October 11, 2006

TO: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 161 and No. 162

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in June 2006. Portland Cement Sample No 161 was a ASTM C150 Type I and No. 162 was ASTM C150 Type I with limestone additions.

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 participating laboratories can be downloaded at our website located at: http://ccrl.us/. Some laboratory results were not included in the calclation of Tricalcium silicate and dicalcium silicate statistics. Additional information is provided in the following pages.

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 cements 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 Portland Cement Proficiency Samples will be distributed in January 2007.

Sincerely,

Robin K. Haupt

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

Attachment

TO: Participants in the CCRL Portland Cement Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor, PSP

SUBJECT: Explanation of Final Report on Results of Tests for Portland Cement Proficiency Samples No. 161 and No. 162

This letter, and the material included with it, constitute the final report, and summary of results for the current pair of Portland Cement Proficiency Samples, which were distributed in June 2006. 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.

Each laboratory receives an individualized Table of Results. The Table of Results 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.

Laboratory ratings, shown in the Table of Results 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.

Participants subscribing to the primary chemical analysis portion of this report should note that the statistics were calculated using data obtained by wet methods, and rapid methods of chemical analysis. Participants in the secondary chemical analysis should note that laboratory ratings are assigned using primary chemical statistics.
Please note that individual laboratory ratings were not given for the flow of air content mortar (test no. 190) and compressive strength mortar (test no. 230). Air content flows in the range of 87.5 ± 7.5 are satisfactory,

[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.*

labs with flow values outside this range will be flagged as a “Labs Eliminated” or “Labs Off Diagram” on the scatter diagram. Averages, standard deviations, and a scatter diagram are provided for your information. This information may be a helpful indicator of a problem with flow table apparatus or mortar mixing procedures. Flow values of 151 were assigned to laboratories reporting a mortar flow off the flow table top.

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 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

Usually, averages, standard deviations, and coefficients of variation are given with all results reported, and then with one or more outlying results omitted. Sometimes, two or more recalculations with laboratories omitted, have been done for the same 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.

Calculation of tricalcium silicate and dicalcium silicate -C150 requires the use of CO_2 content when calculating these two components for cements containing limestone additions. On Sample No. 162 and previous samples containing limestone additions it has been noticed that a significant number of laboratories reporting results for these two components did not report CO_2 content. For this pair of samples, tricalcium silcate and dicalcium silicate results from laboratories not reporting CO_2 content were not included in calculation of statistics and were not assigned ratings for Sample No. 162.

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. Each laboratory will receive a complete set of diagrams according to their subscription to the given program.

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. To find your point, just plot as you would when plotting any scatter diagram. 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.

Diagrams for CO_2 and Limestone - Sample No.161 did NOT contain limestone additions, therefore scatter diagrams for CO_2 and limestone content were not printed.

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
Portland Cement Proficiency Samples No. 161 and No. 162
Final Report - Chemical Results
October 11, 2006

SUMMARY OF RESULTS

			Sample No. 161			Sample No. 162		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide	prcnt	235	20.38	0.34	1.64	20.35	0.32	1.56
Silicon Dioxide	prcnt	*231	20.36	0.24	1.16	20.34	0.22	1.11
Aluminum Oxide	prcnt	233	5.17	0.16	3.20	4.76	0.14	3.01
Aluminum Oxide	prcnt	*216	5.18	0.092	1.78	4.75	0.087	1.83
Ferric Oxide	prcnt	236	3.66	0.089	2.43	3.52	0.087	2.48
Ferric Oxide	prcnt	*223	3.66	0.062	1.70	3.53	0.062	1.77
Calcium oxide	prcnt	233	63.90	0.44	0.695	61.92	0.55	0.889
Calcium Oxide	prcnt	*229	63.89	0.42	0.659	61.89	0.49	0.792
Magnesium Oxide	prcnt	234	1.16	0.099	8.54	3.53	0.152	4.29
Magnesium Oxide	prcnt	*219	1.17	0.056	4.80	3.55	0.101	2.85
Sulfur Trioxide	prcnt	236	2.74	0.12	4.23	3.00	0.14	4.75
Sulfur Trioxide	prcnt	*221	2.73	0.072	2.64	3.00	0.091	3.03
Loss on Ignition	prcnt	237	1.68	0.15	9.02	2.01	0.16	8.15
Loss on Ignition	prcnt	*222	1.67	0.089	5.30	2.00	0.100	4.98
Sodium Oxide	prcnt	219	0.103	0.062	60.6	0.139	0.080	57.8
Sodium Oxide	prcnt	*209	0.094	0.029	30.4	0.127	0.028	21.8

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

Silicon Dioxide	52 207 280 1190
Aluminum Oxide	3 8 29 207 768 2305 2483 2484 1 26 137 168 201 1025 1715 2466 3009
Ferric Oxide	3 6 207 280 305 167 201 492 1715 1956 2296 2484 2982
Calcium Oxide	3 107 207 3127
Magnesium Oxide	66 143 201 1799 2144 2296 2466 2484 8 177 207 1676 1715 3009 3125
Sulfur Trioxide	6 51 52 107 504 2305 137 413 491 1483 1799 2437 3009 3057 3133
Loss on Ignition	34 51 69 137 492 690 1466 156 159 181 244 696 932 1079 2295
Sodium Oxide	354 504 1799 9 56 280 557 1251 1379 3125

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 161 and No. 162
Final Report - Chemical Results
September 8, 2006

SUMMARY OF RESULTS

Test		#Labs	Sample No. 161 Average	S.D.	C.V.	Sample No. 162 Average	S.D.	C.V.
Potassium Oxide	prcnt	225	0.63	0.090	14.3	0.53	0.082	15.6
Potassium Oxide	prcnt	*205	0.63	0.017	2.65	0.53	0.018	3.36
Titanium Dioxide	prcnt	173	0.24	0.025	10.72	0.25	0.024	9.48
Titanium Dioxide	prcnt	*160	0.23	0.0083	3.53	0.25	0.0084	3.42
Phosphorus Pent	prcnt	160	0.237	0.044	18.4	0.066	0.018	28.1
Phosphorus Pent	prcnt	*150	0.237	0.0164	6.93	0.064	0.0093	14.51
Zinc Oxide	prcnt	73	0.016	0.025	159.3	0.053	0.025	46.2
Zinc Oxide	prcnt	* 67	0.011	0.0027	24.35	0.049	0.0039	8.08
Manganic Oxide	prcnt	124	0.193	0.028	14.4	0.188	0.095	50.3
Manganic Oxide	prcnt	*113	0.198	0.0054	2.74	0.184	0.0056	3.08
Chloride	prcnt	100	0.020	0.016	81.8	0.011	0.012	109.1
Chloride	prcnt	* 93	0.017	0.0078	45.6	0.009	0.0054	60.1
Insoluble Residue	prcnt	217	0.53	0.14	26.1	0.48	0.14	29.6
Insoluble Residue	prcnt	*208	0.52	0.108	21.0	0.47	0.098	20.9
Free Calcium Oxid	prcnt	186	1.41	0.35	25.0	0.56	0.25	45.6
Free Calcium Oxid	prcnt	*179	1.41	0.30	21.4	0.53	0.19	36.5

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

Potassium Oxide	17 18 36 95 156 169 177 207 698 1054 2477 8 25 176 206 501 883 2463 2483 3009
Titan Dioxide	207 284 492 504 48 130 161 175 1042 1190 2305 2412 2484
Phosph Pentoxide	176 504 687 1799 18 201 493 684 1466 1940
Zinc Oxide	22 284 54 95 2295 2434
Manganic Oxide	181 284 413 2434 2437 24 48 494 1251 2412 2462
Chloride	440 441 870 1799 246 284 2308
Insoluble Residue	23 280 64 694 696 1940 2435 2477 3057
Free Calcium Oxide	74 75 161 177 181 1676 2934

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 161 and No. 162
Final Report - Chemical Results
September 8, 2006

SUMMARY OF RESULTS

Test		#Labs	Sample No. 161 Average	S.D.	C.V.	Sample No. 162 Average	S.D.	C.V.
[1]Carbon Dioxide	prcnt	142	- - - -	- - - -	- - - -	1.29	0.16	12.7
[1]Limestone	prcnt	138	- - - -	- - - -	- - - -	3.1	0.4	13.5
Chromium Oxide	prcnt	69	0.018	0.0057	32.2	0.018	0.0050	27.8
Chromium Oxide	prcnt	* 66	0.018	0.0044	24.2	0.018	0.0040	21.9
Potential Phase Composition								
[2]Tricalcium Silicate	prcnt	140	56.8	3.0	5.38	47.0	3.8	8.10
[2]Tricalcium Silicate	prcnt	*139	56.9	2.8	4.94	47.0	3.7	7.84
[2]Dicalcium Silicate	prcnt	140	15.6	3.2	20.4	22.9	3.4	14.9
[2]Dicalcium Silicate	prcnt	*137	15.5	2.6	16.9	22.9	3.1	13.5
Tricalc Aluminate	prcnt	199	7.6	0.43	5.74	6.7	0.39	5.86
Tricalc Aluminate	prcnt	*187	7.5	0.28	3.78	6.6	0.27	4.02
Tetracalc Alumino	prcnt	192	11.2	1.1	10.3	10.8	1.2	10.8
Tetracalc Alumino	prcnt	*186	11.1	0.23	2.11	10.7	0.22	2.01

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

Carbon Dioxide	54 93 243 1042 1054 1079 1466
Limestone	54 93 243 1042 1254 1079 1466
Chromium Oxide	684 2412 3057
Tricalcium Silicate	2305
Dicalcium Silicate	167 2305 2492
Tricalcium Aluminate	8 29 209 491 1715 2305 2483 143 168 2466 2934 3009
Tetracalcium Aluminoferrite	209 219 305 491 1715 2522

NOTES:

(1) Carbon dioxide and Limestone - Sample No. 161 does not contain limestone additions, therefore no values are reported for these components for Sample No. 161.

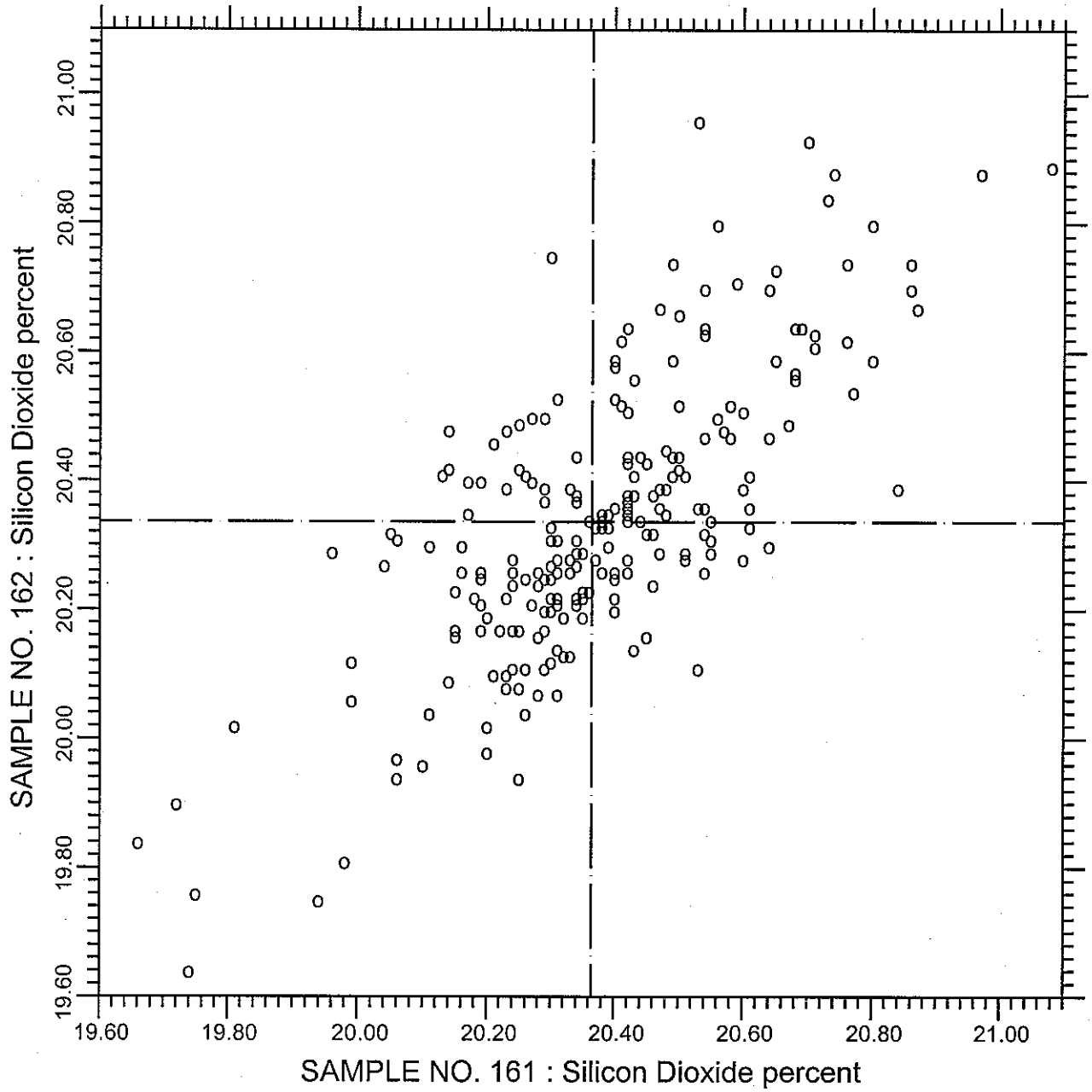
(2) Tricalcium silicate and Dicalcium silicate - ASTM C150 requires that cements containing limestone additions use CO_2 in the calculation of these two phases. Sample No. 162 contains limestone additions, therefore test results of 54 laboratories not determining CO_2 were not used in calculating the statistics. See following page for listing of labs not included.

Test Results Not Used in Calculating Statistics for Tricalcium Silicate and Dicalcium Silicate

List of laboratories reporting Portland No. 162 test results for tricalcium silicate and dicalcium silicate but did not report values for CO_2.

8	246
25	252
40	280
47	414
48	438
50	557
69	684
73	692
80	696
95	787
98	870
101	996
106	1053
129	1190
139	1799
158	1853
161	1940
162	2144
169	2435
177	2463
181	2483
197	2982
201	3057
206	3124
209	3126
219	3127
221	3133

CCRL PROFICIENCY SAMPLE PROGRAM
Silicon Dioxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.10 Silicon Dioxide 227 POINTS

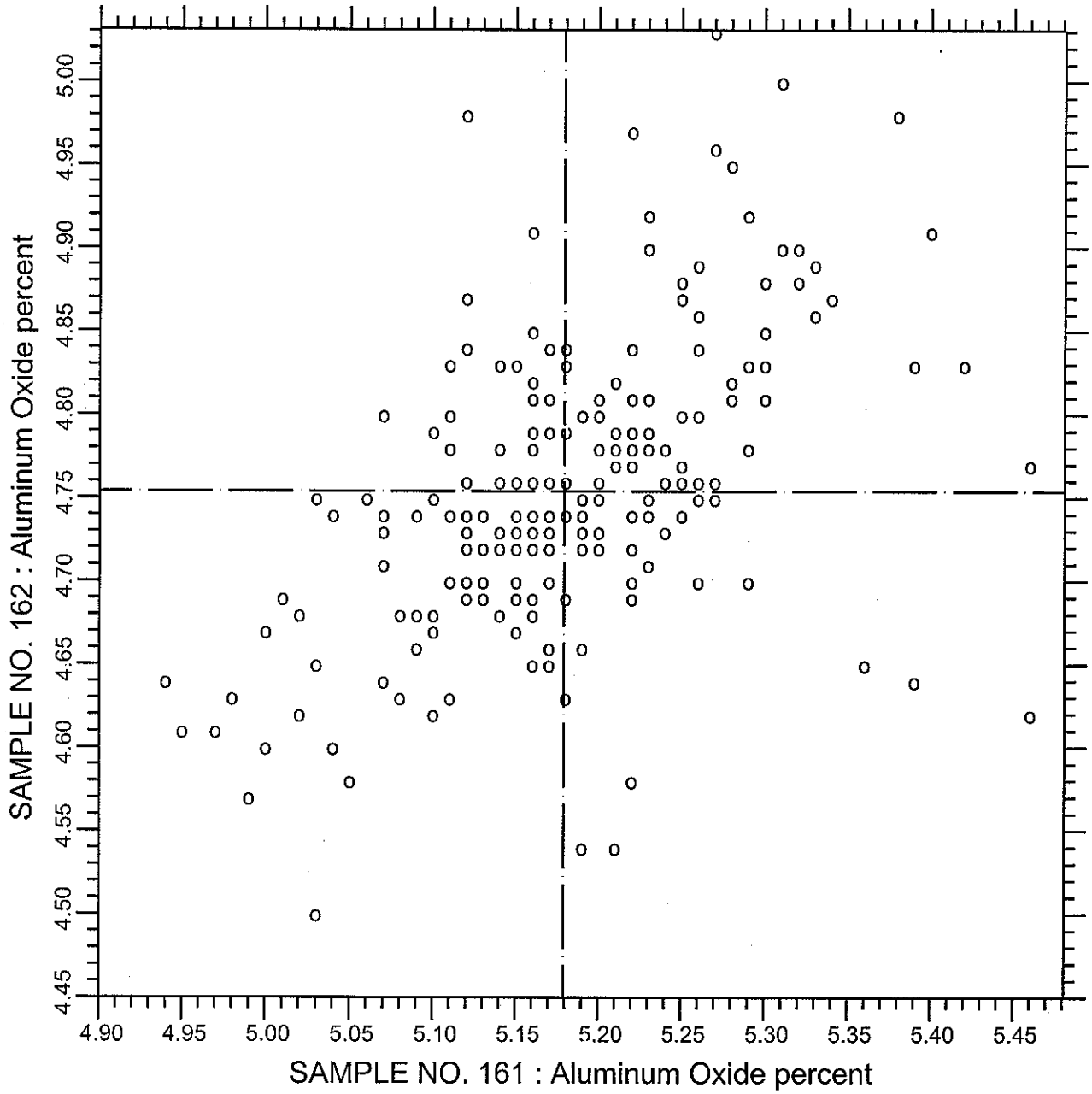
SAMPLE NO. 161 AVE 20.365 S.D. 0.24 C.V. 1.16

SAMPLE NO. 162 AVE 20.336 S.D. 0.22 C.V. 1.11

LABS ELIMINATED 52 207 280 1190

LABS OFF DIAGRAM 26 50 51 3009

CCRL PROFICIENCY SAMPLE PROGRAM
Aluminum Oxide - wo/minor oxides
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.21 Aluminum Oxide 215 POINTS

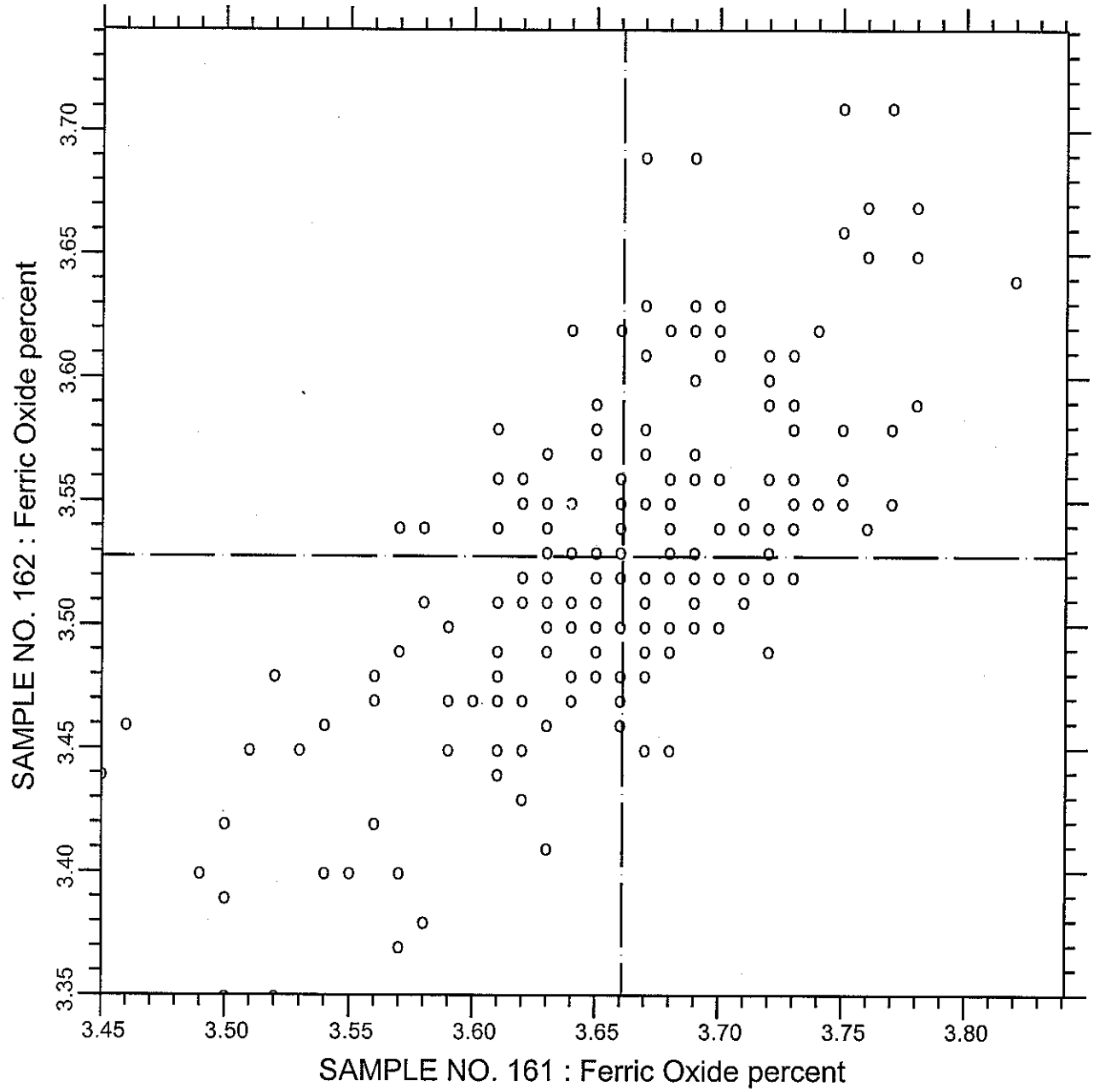
SAMPLE NO. 161 AVE 5.1791 S.D. 0.092 C.V. 1.78

SAMPLE NO. 162 AVE 4.7540 S.D. 0.087 C.V. 1.83

LABS ELIMINATED 3 8 29 207 768 2305 2483 2484 1 26 137 168 201 1025 1715 2466 3009

LABS OFF DIAGRAM 20

CCRL PROFICIENCY SAMPLE PROGRAM
Ferric Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



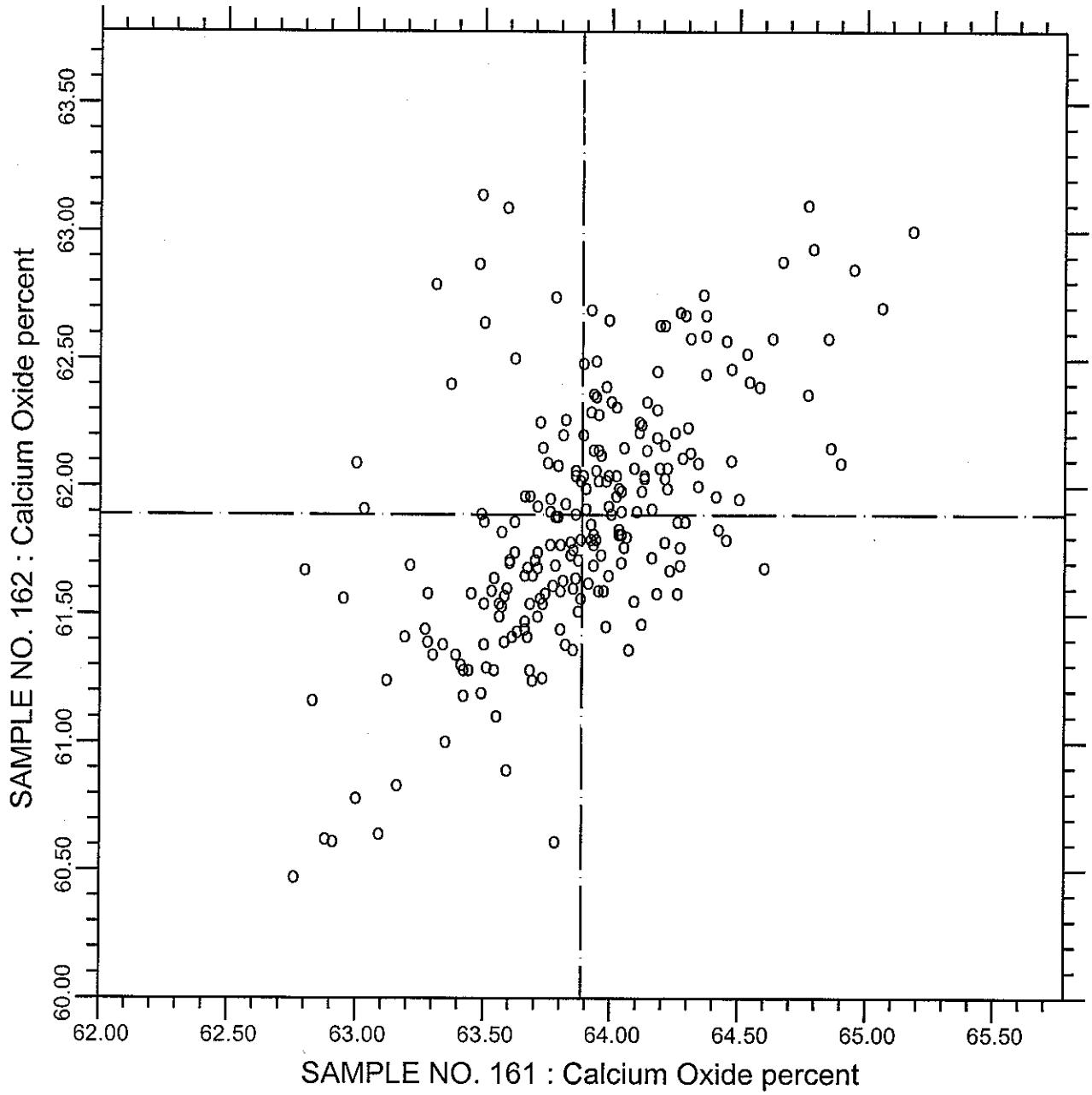
TEST NO.30 Ferric Oxide 223 POINTS

SAMPLE NO. 161 AVE 3.6610 S.D. 0.062 C.V. 1.70

SAMPLE NO. 162 AVE 3.5278 S.D. 0.062 C.V. 1.77

LABS ELIMINATED 3 6 207 280 305 167 201 492 1715 1956 2296 2484 2982

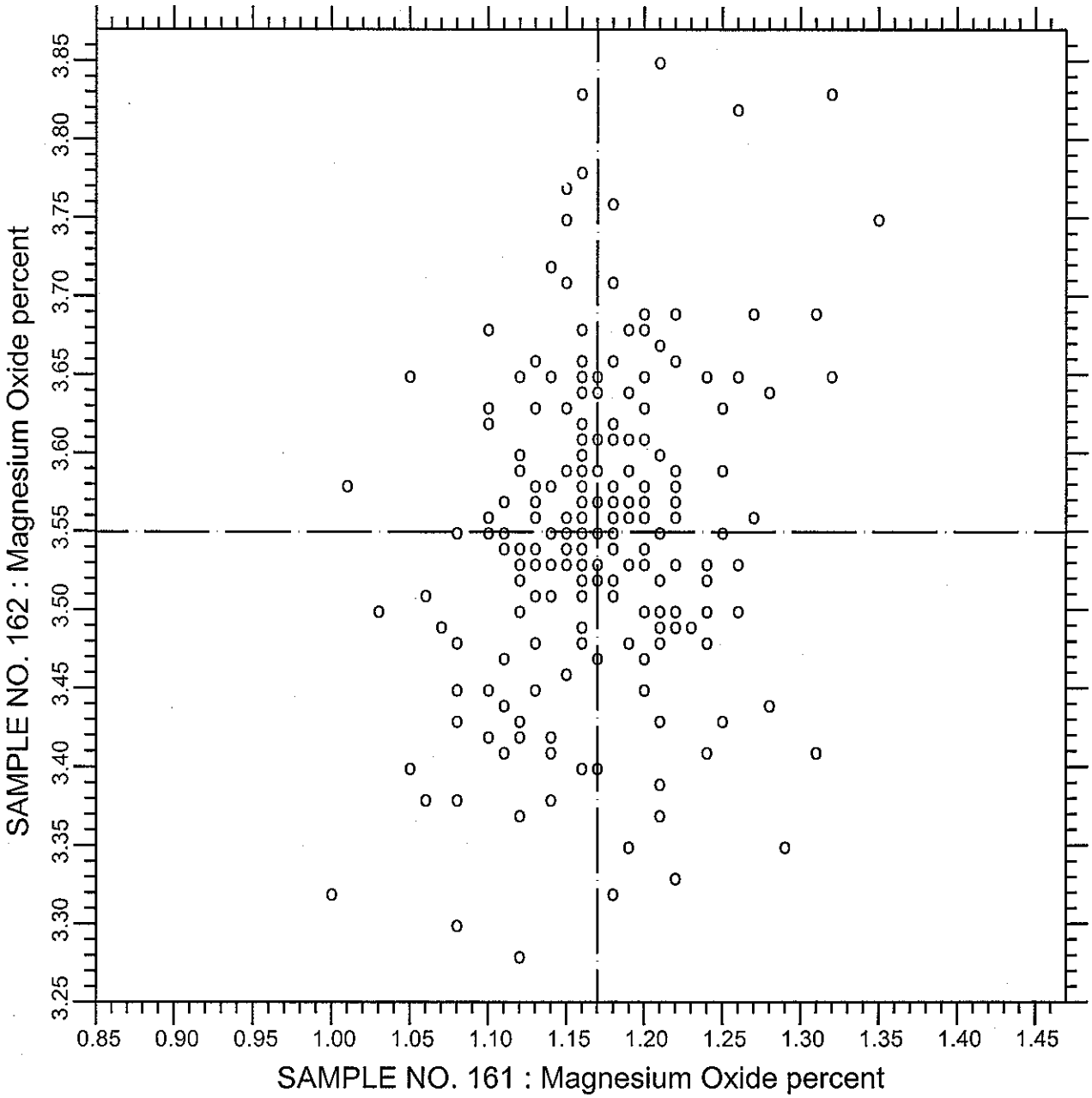
CCRL PROFICIENCY SAMPLE PROGRAM
Calcium Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.40 Calcium Oxide 229 POINTS

SAMPLE NO. 161 AVE 63.887 S.D. 0.42 C.V. 0.659
SAMPLE NO. 162 AVE 61.889 S.D. 0.49 C.V. 0.792
LABS ELIMINATED 3 107 207 3127

CCRL PROFICIENCY SAMPLE PROGRAM
Magnesium Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.50 Magnesium Oxide 218 POINTS

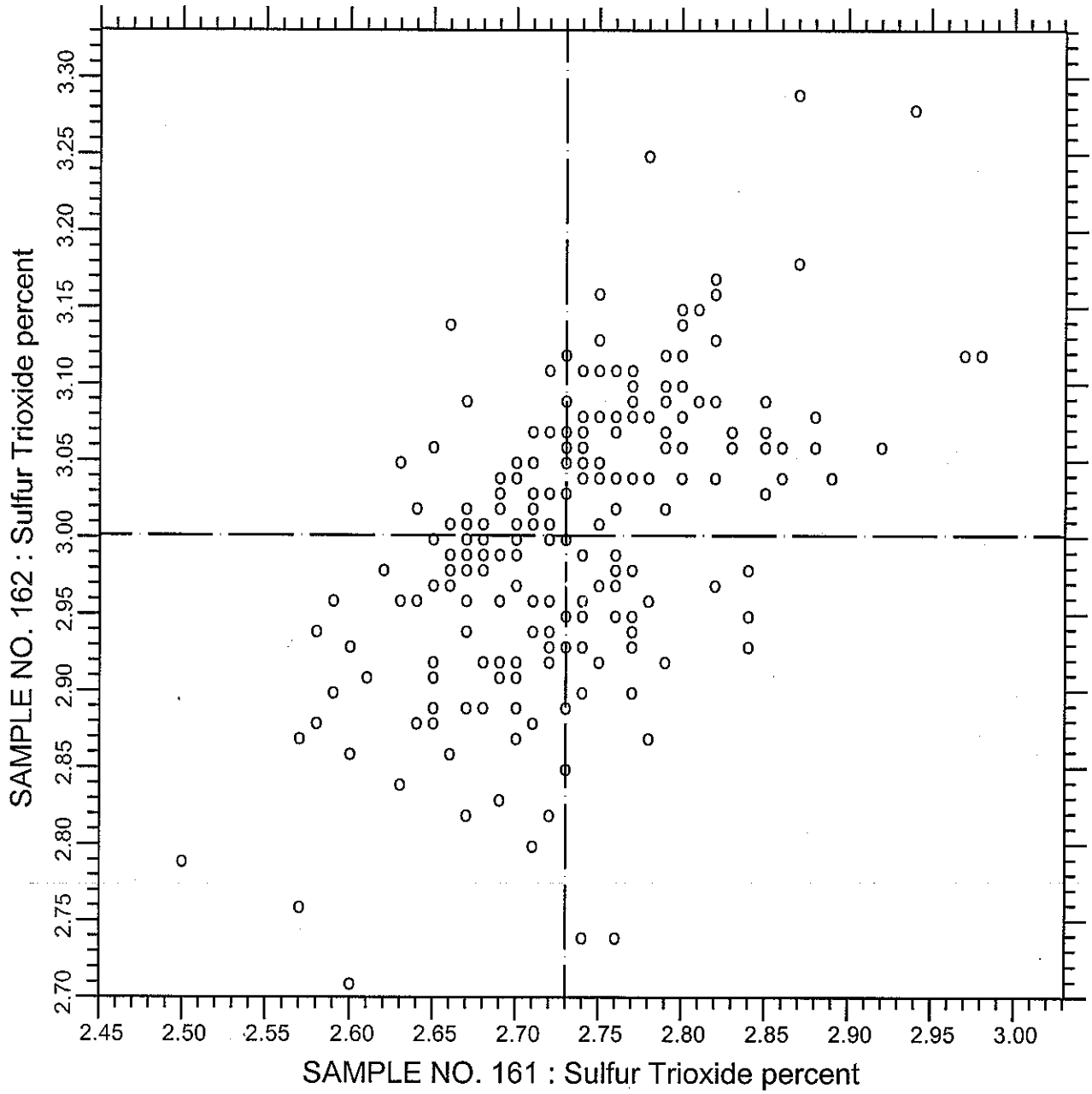
SAMPLE NO. 161 AVE 1.1701 S.D. 0.056 C.V. 4.80

SAMPLE NO. 162 AVE 3.5495 S.D. 0.101 C.V. 2.85

LABS ELIMINATED 66 143 201 1799 2144 2296 2466 2484 8 177 207 1676 1715 3009 3125

LABS OFF DIAGRAM 2982

CCRL PROFICIENCY SAMPLE PROGRAM
Sulfur Trioxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



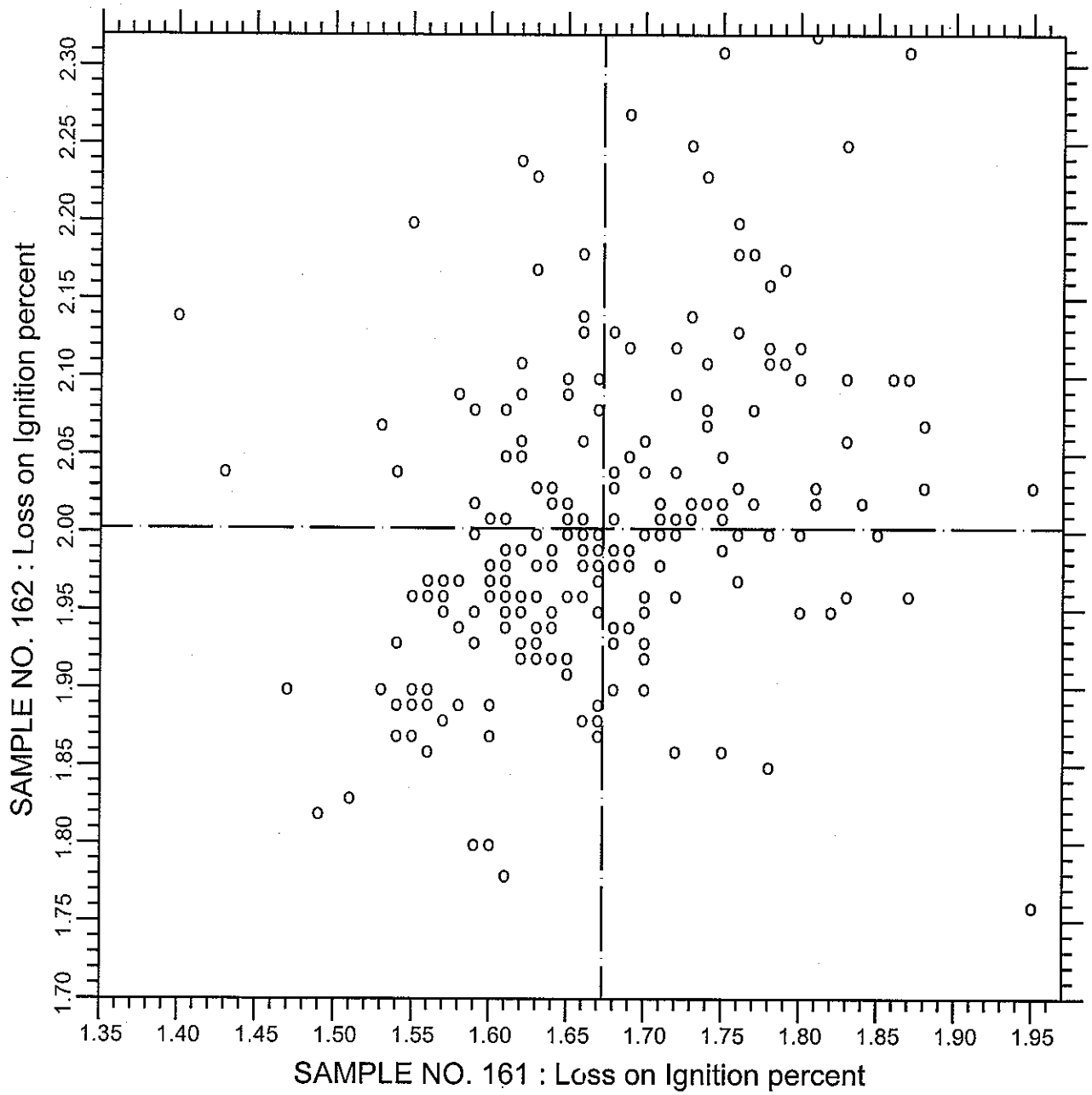
TEST NO.60 Sulfur Trioxide 221 POINTS

SAMPLE NO. 161 AVE 2.7302 S.D. 0.072 C.V. 2.64

SAMPLE NO. 162 AVE 3.0012 S.D. 0.091 C.V. 3.03

LABS ELIMINATED 6 51 52 107 504 2305 137 413 491 1483 1799 2437 3009 3057 3133

CCRL PROFICIENCY SAMPLE PROGRAM
Loss on Ignition
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.70 Loss on Ignition 221 POINTS

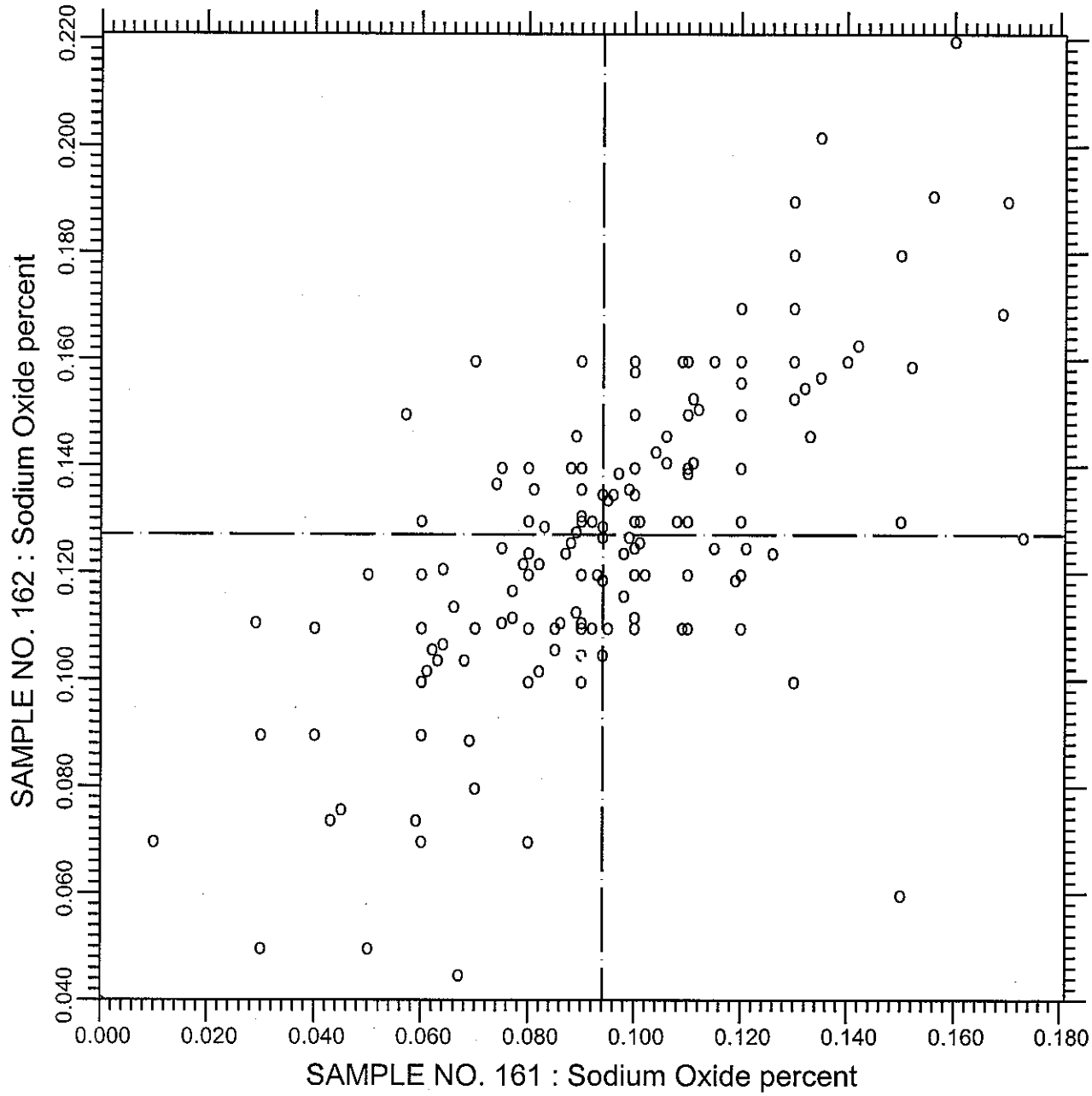
SAMPLE NO. 161 AVE 1.6732 S.D. 0.089 C.V. 5.30

SAMPLE NO. 162 AVE 2.0026 S.D. 0.100 C.V. 4.98

LABS ELIMINATED 34 51 69 137 492 690 1466 156 159 181 244 696 932 1079 2295

LABS OFF DIAGRAM 1594

CCRL PROFICIENCY SAMPLE PROGRAM
Sodium Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

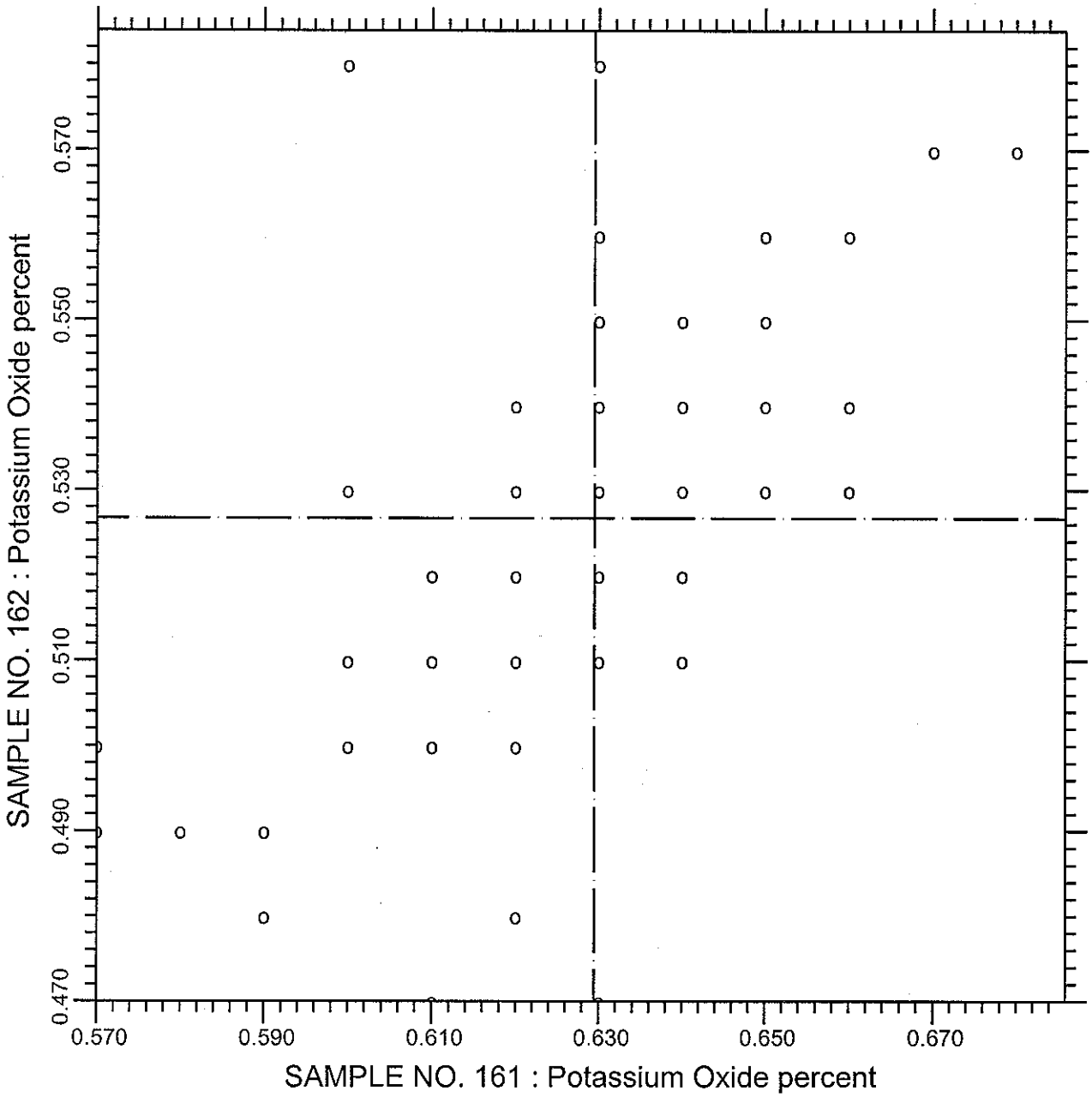


TEST NO.90 Sodium Oxide 209 POINTS

SAMPLE NO. 161	AVE	0.0941	S.D.	0.029	C.V.	30.4
SAMPLE NO. 162	AVE	0.1272	S.D.	0.028	C.V.	21.8

LABS ELIMINATED 354 504 1799 9 56 280 557 1251 1379 3125

CCRL PROFICIENCY SAMPLE PROGRAM
Potassium Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.100 Potassium Oxide 202 POINTS

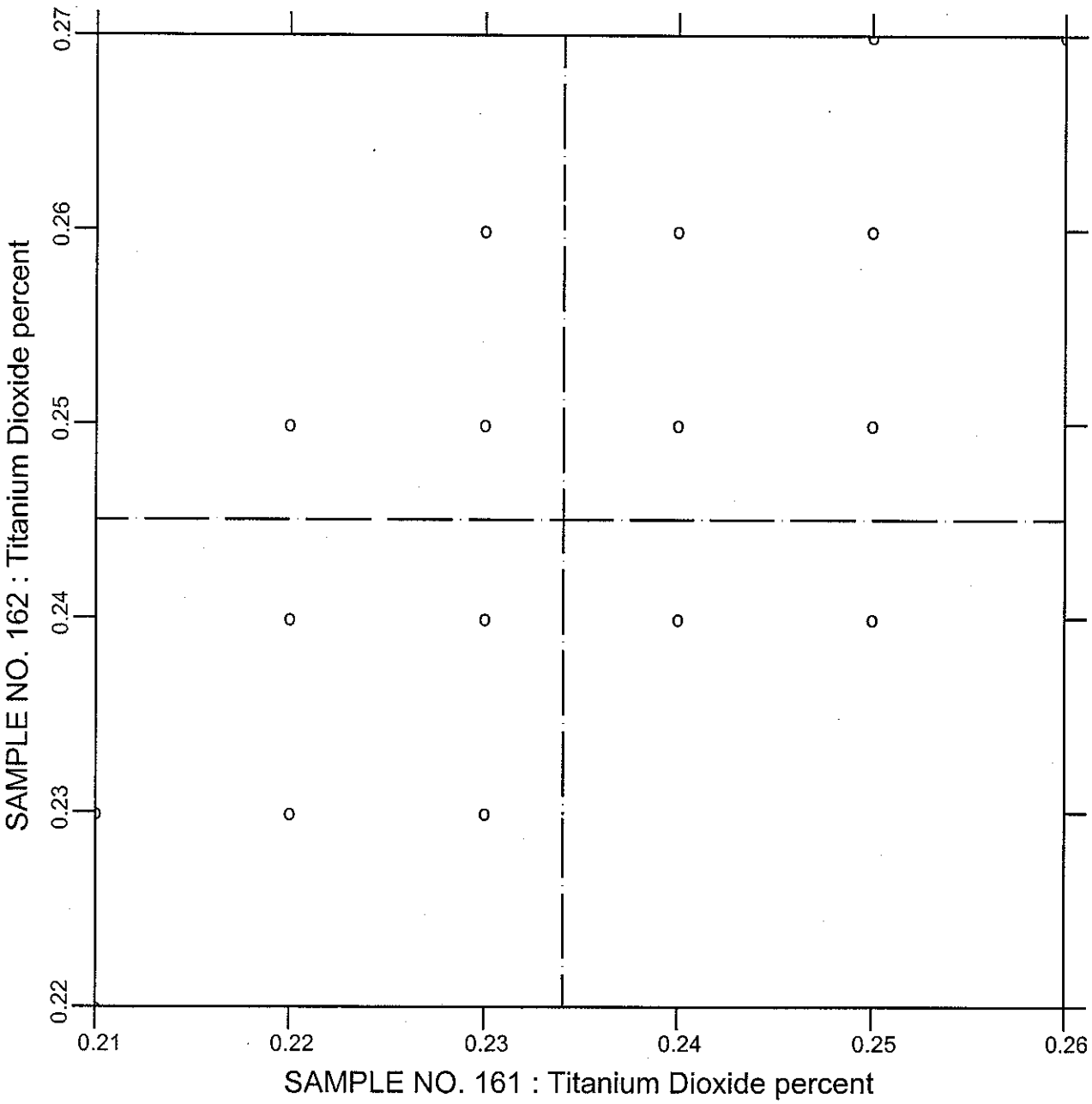
SAMPLE NO. 161 AVE 0.6295 S.D. 0.017 C.V. 2.65

SAMPLE NO. 162 AVE 0.5267 S.D. 0.018 C.V. 3.36

LABS ELIMINATED 17 18 36 95 156 169 177 207 698 1054 2477 8 25 176 206 501 883 2463 2483 3009

LABS OFF DIAGRAM 414 504 1676

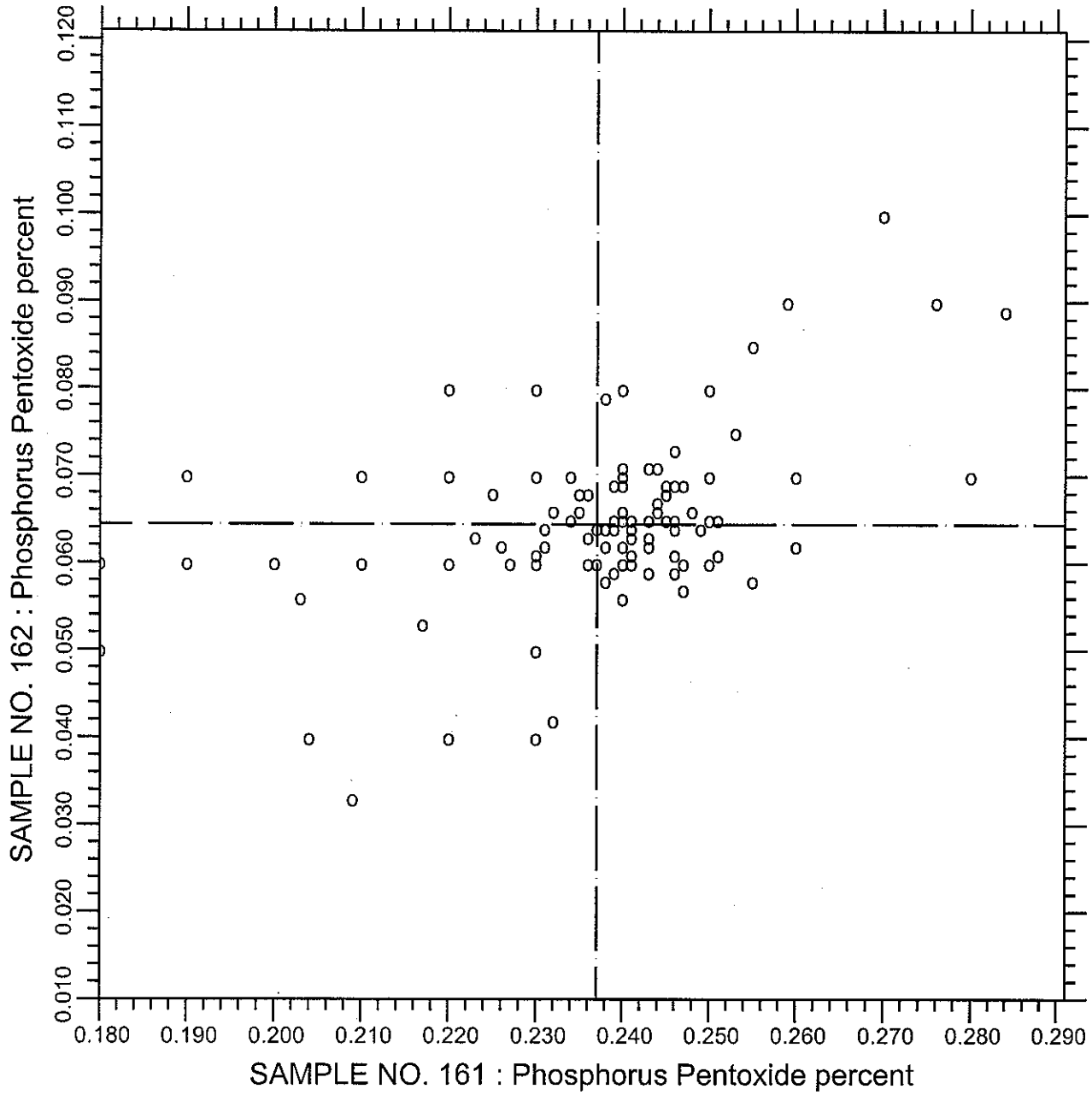
CCRL PROFICIENCY SAMPLE PROGRAM
Titanium Dioxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.103 Titanium Dioxide 160 POINTS

SAMPLE NO. 161 AVE 0.23406 S.D. 0.0083 C.V. 3.53
SAMPLE NO. 162 AVE 0.24506 S.D. 0.0084 C.V. 3.42
LABS ELIMINATED 207 284 492 504 48 130 161 175 1042 1190 2305 2412 2484

CCRL PROFICIENCY SAMPLE PROGRAM
Phosphorus Pentoxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.102 Phosphorus Pentoxide 149 POINTS

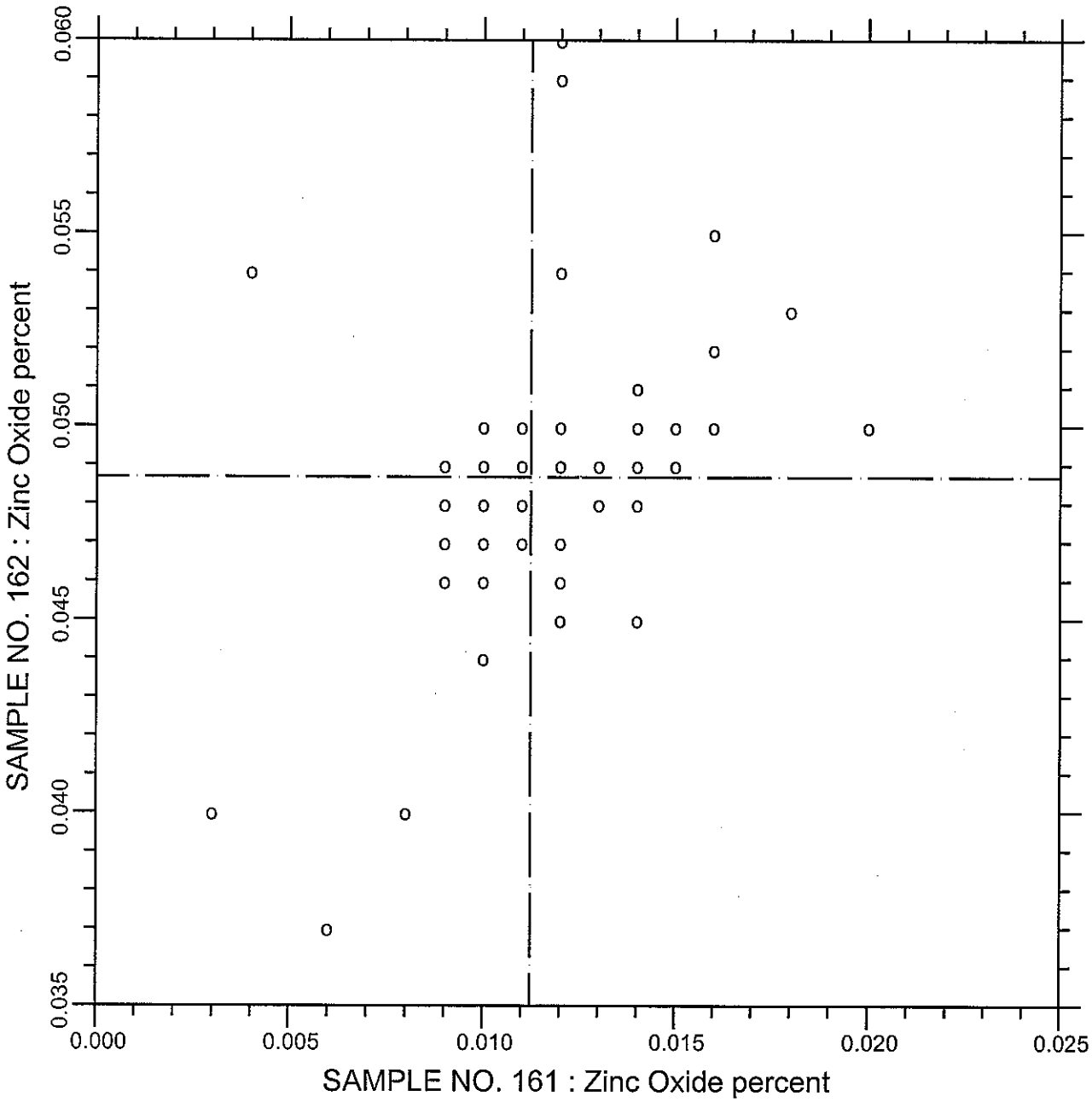
SAMPLE NO. 161 AVE 0.23705 S.D. 0.0164 C.V. 6.93

SAMPLE NO. 162 AVE 0.06441 S.D. 0.0093 C.V. 14.51

LABS ELIMINATED 176 504 687 1799 18 201 493 684 1466 1940

LABS OFF DIAGRAM 95

CCRL PROFICIENCY SAMPLE PROGRAM
Zinc Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



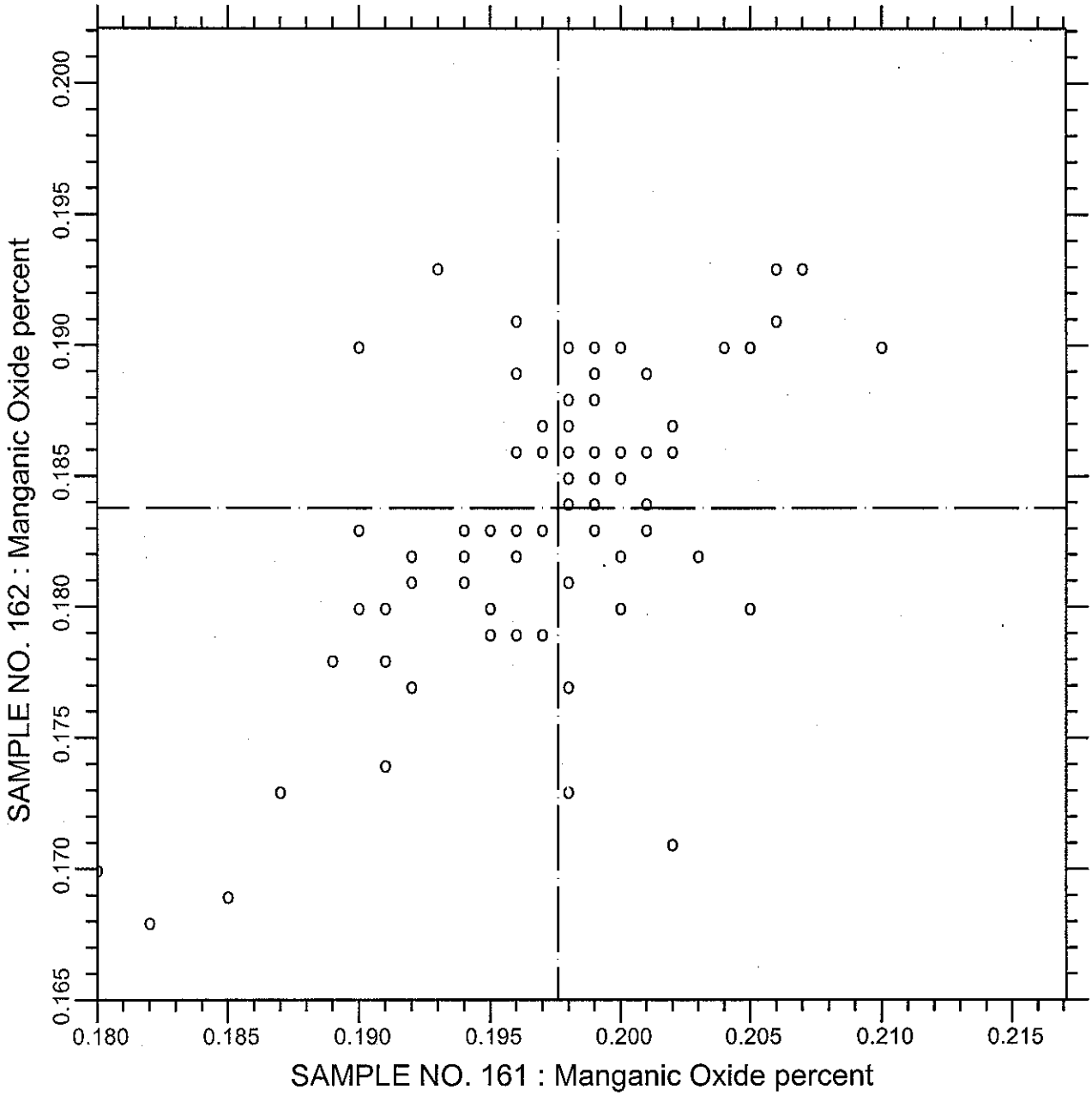
TEST NO.99 Zinc Oxide 66 POINTS

SAMPLE NO. 161	AVE	0.01124	S.D.	0.0027	C.V.	24.35
SAMPLE NO. 162	AVE	0.04869	S.D.	0.0039	C.V.	8.08

LABS ELIMINATED 22 284 54 95 2295 2434

LABS OFF DIAGRAM 881

CCRL PROFICIENCY SAMPLE PROGRAM
Manganic Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.101 Manganic Oxide 112 POINTS

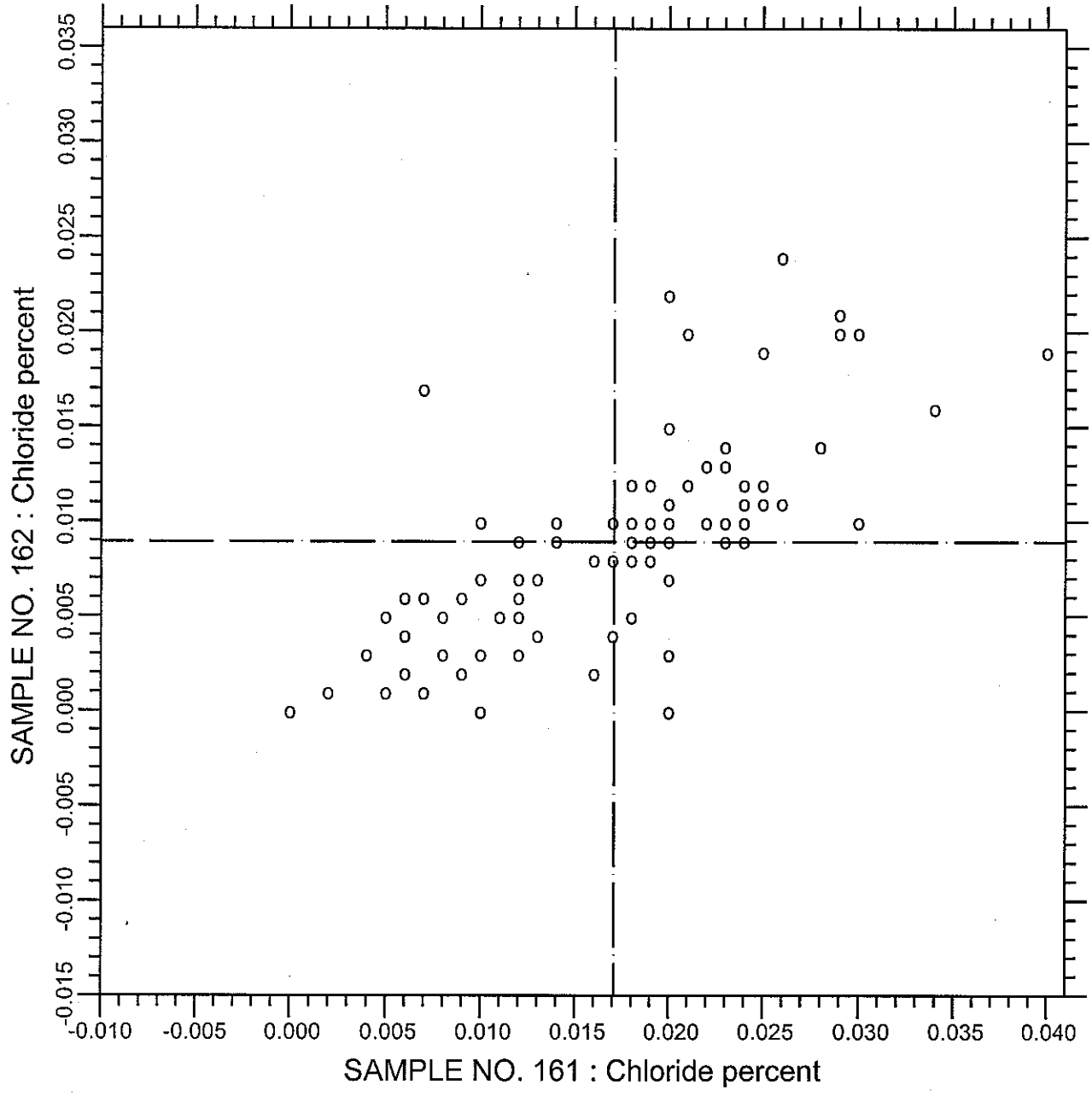
SAMPLE NO. 161 AVE 0.19760 S.D. 0.0054 C.V. 2.74

SAMPLE NO. 162 AVE 0.18378 S.D. 0.0056 C.V. 3.08

LABS ELIMINATED 181 284 413 2434 2437 24 48 494 1251 2412 2462

LABS OFF DIAGRAM 309

CCRL PROFICIENCY SAMPLE PROGRAM
Chloride
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



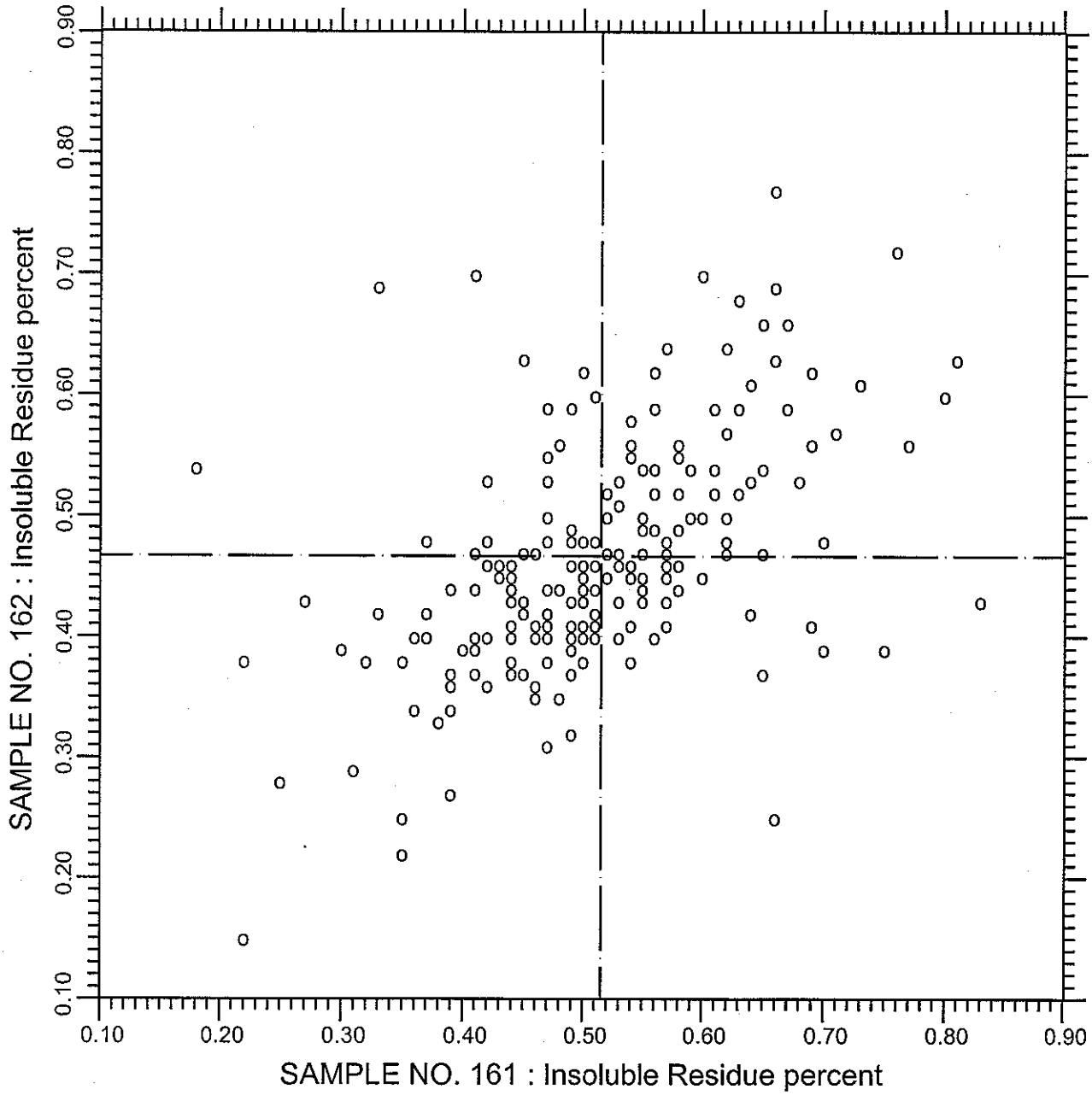
TEST NO.104 Chloride 93 POINTS

SAMPLE NO. 161 AVE 0.01709 S.D. 0.0078 C.V. 45.6

SAMPLE NO. 162 AVE 0.00892 S.D. 0.0054 C.V. 60.1

LABS ELIMINATED 440 441 870 1799 246 284 2308

CCRL PROFICIENCY SAMPLE PROGRAM
Insoluble Residue
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

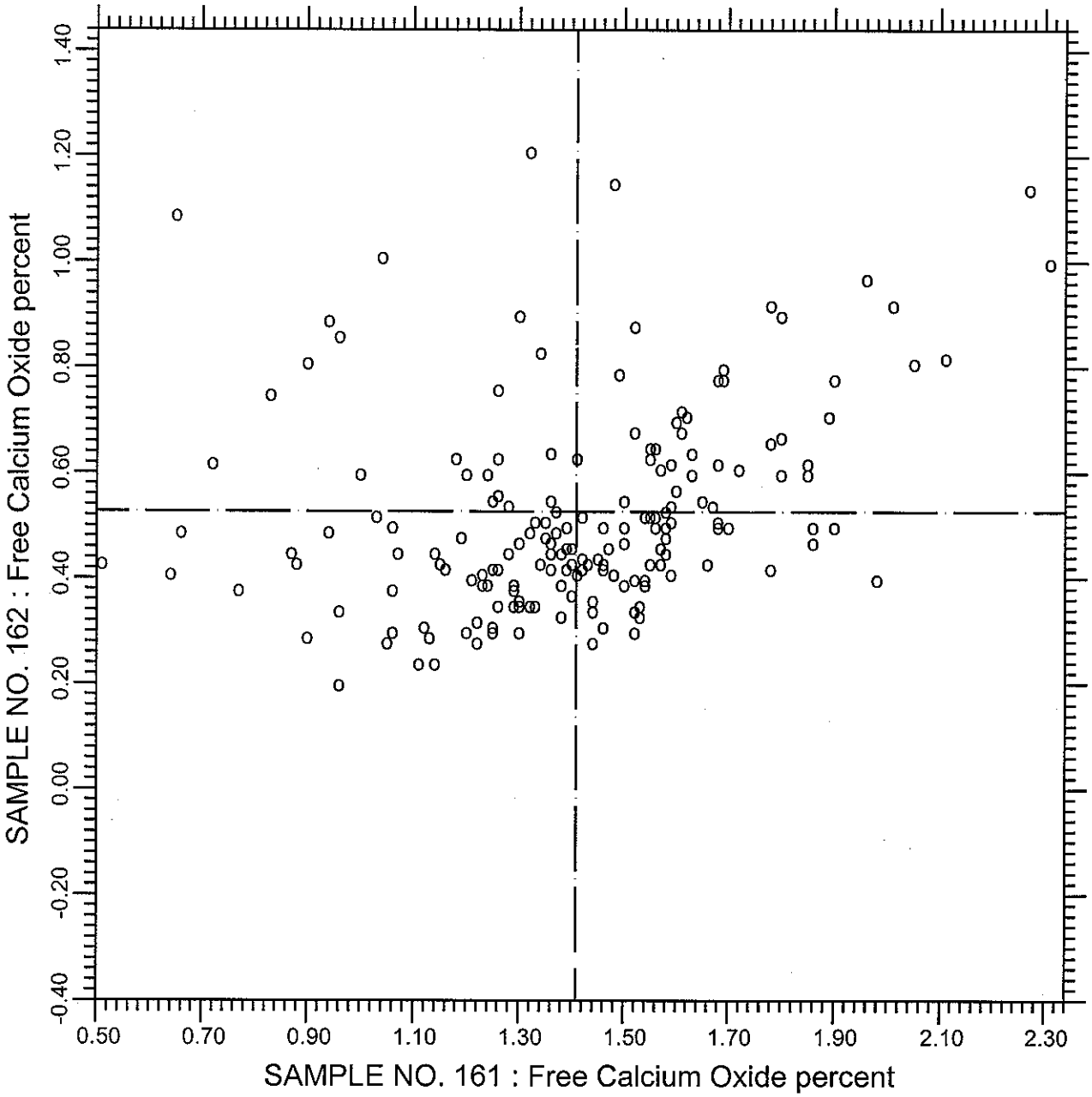


TEST NO.80 Insoluble Residue 208 POINTS

SAMPLE NO. 161	AVE	0.5153	S.D.	0.108	C.V.	21.0
SAMPLE NO. 162	AVE	0.4666	S.D.	0.098	C.V.	20.9

LABS ELIMINATED 23 280 64 694 696 1940 2435 2477 3057

CCRL PROFICIENCY SAMPLE PROGRAM
Free Calcium Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.41 Free Calcium Oxide 179 POINTS

SAMPLE NO. 161 AVE 1.409 S.D. 0.30 C.V. 21.4

SAMPLE NO. 162 AVE 0.527 S.D. 0.19 C.V. 36.5

LABS ELIMINATED 74 75 161 177 181 1676 2934

CCRL PROFICIENCY SAMPLE PROGRAM
Carbon Dioxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

No Diagram Printed for this Component

Sample No. 161 did not
Contain Limestone Additions.
Test Results Were Analyzed for
Sample No. 162 Only.

TEST NO. 97	Carbon Dioxide	142 labs

Sample No. 162	AVE 1.29	S.D. 0.32	C.V. 12.7

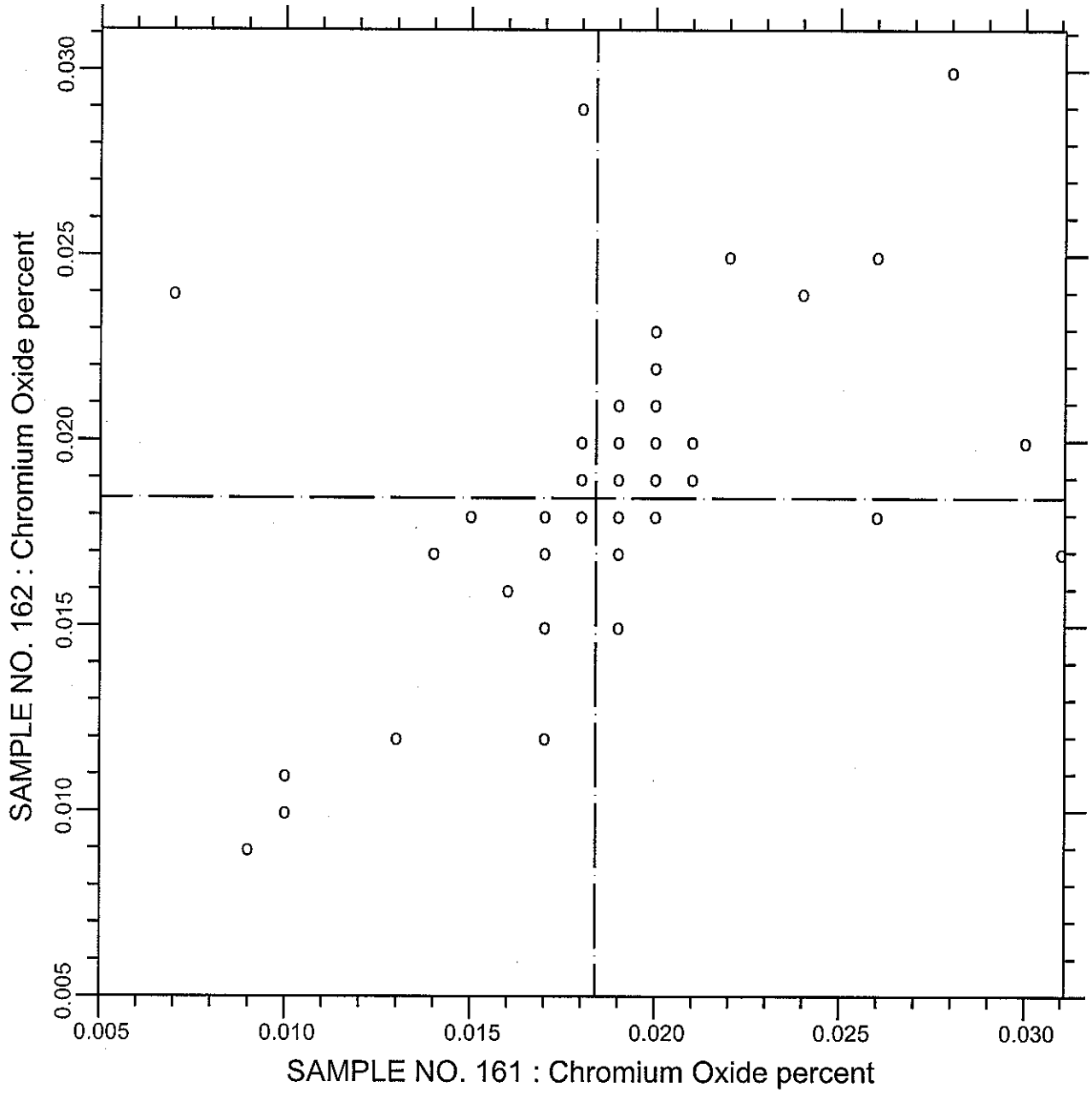
CCRL PROFICIENCY SAMPLE PROGRAM
Limestone Content
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

No Diagram Printed for this Component

Sample No. 161 did not
Contain Limestone Additions.
Test Results Were Analyzed for
Sample No. 162 Only.

TEST NO. 98	Limestone Content			138 labs
Sample No. 162	AVE 3.1	S.D. 0.4	C.V. 13.5	

CCRL PROFICIENCY SAMPLE PROGRAM
Chromium Oxide
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

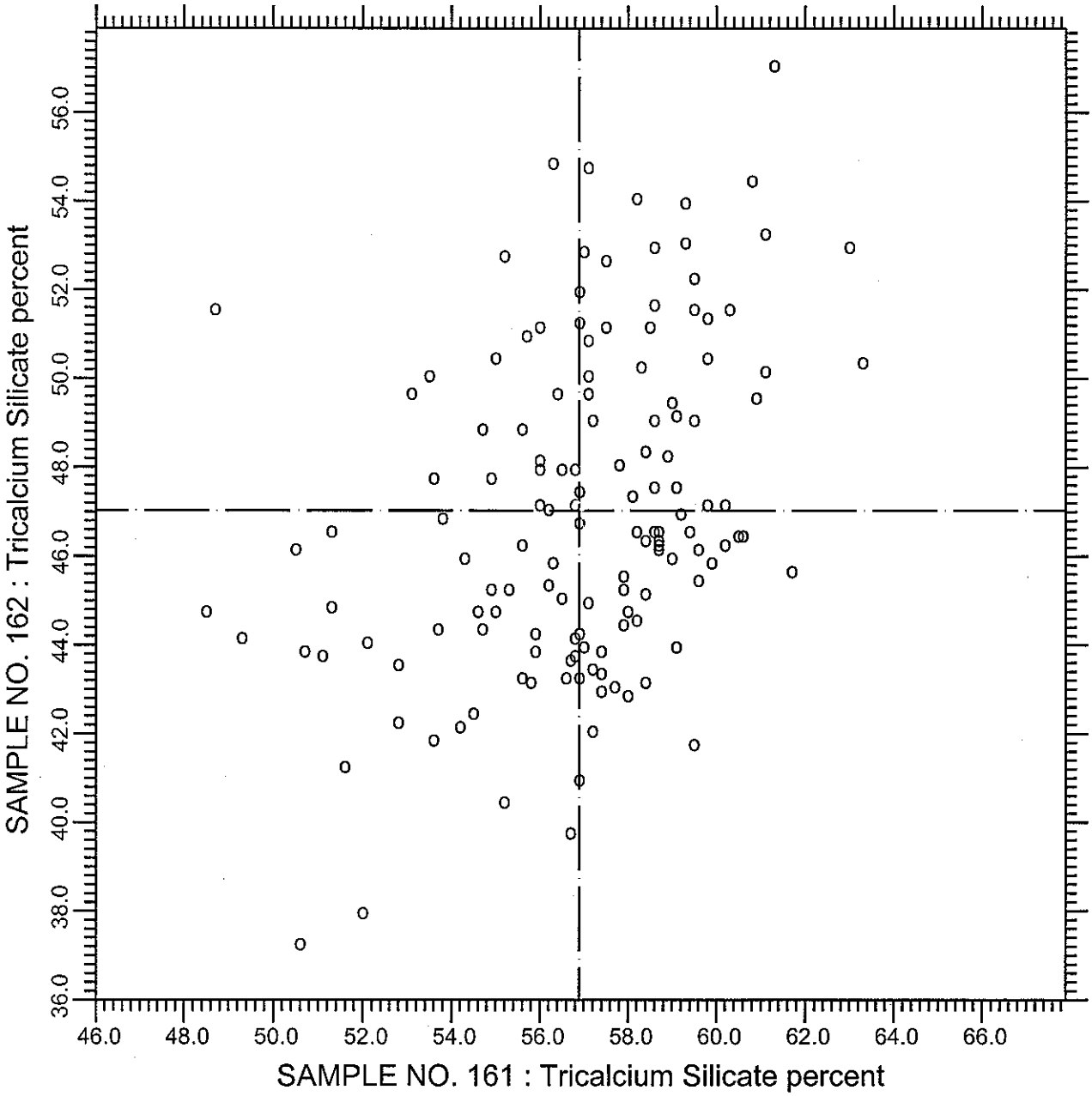


TEST NO.105 Chromium Oxide 66 POINTS

SAMPLE NO. 161	AVE	0.01839	S.D.	0.0044	C.V.	24.2
SAMPLE NO. 162	AVE	0.01845	S.D.	0.0040	C.V.	21.9

LABS ELIMINATED 684 2412 3057

CCRL PROFICIENCY SAMPLE PROGRAM
Tricalcium Silicate
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

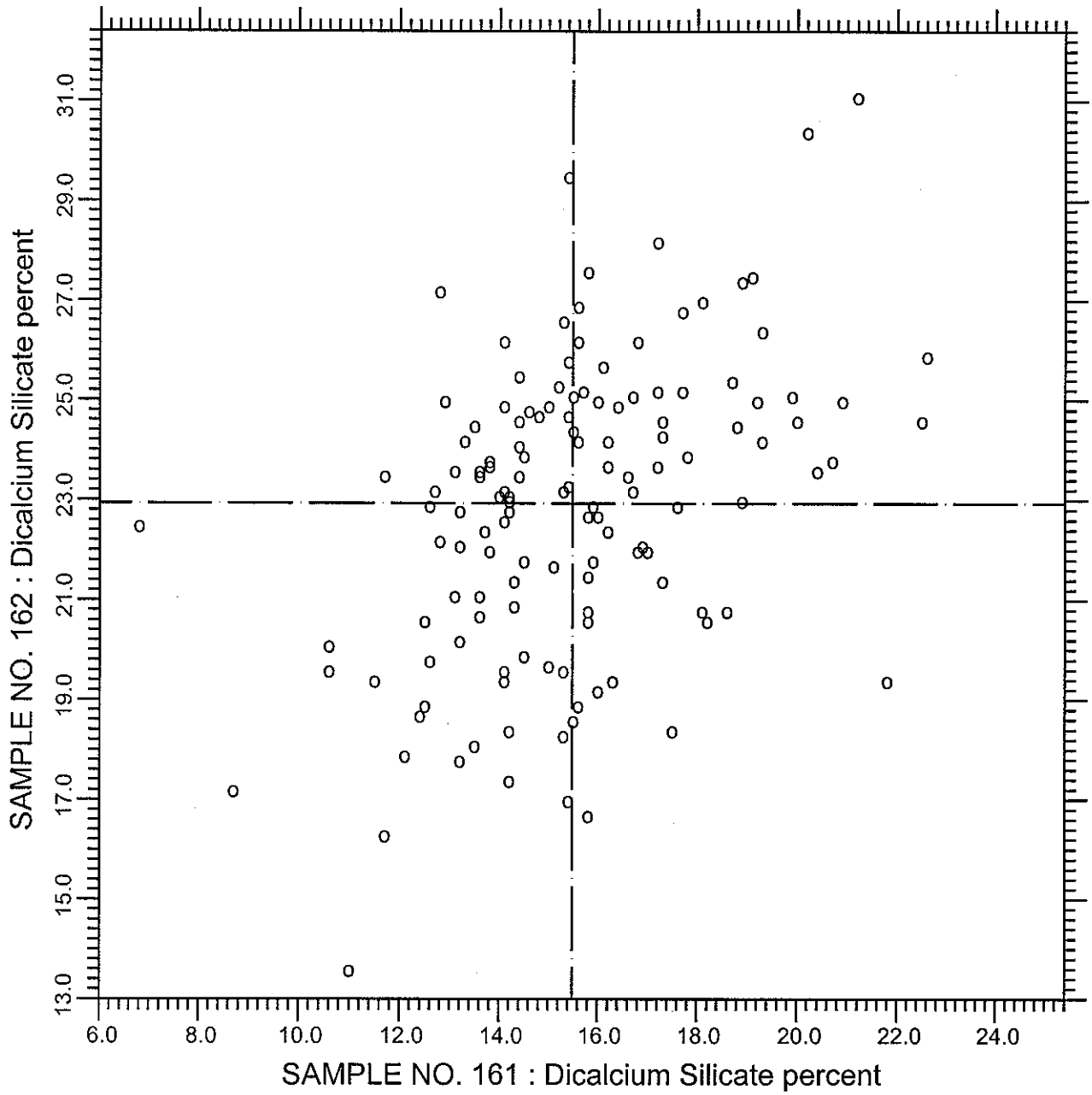


TEST NO.106 Tricalcium Silicate 139 POINTS

SAMPLE NO. 161	AVE	56.89	S.D.	2.8	C.V.	4.94
SAMPLE NO. 162	AVE	47.03	S.D.	3.7	C.V.	7.84

LABS ELIMINATED 2305

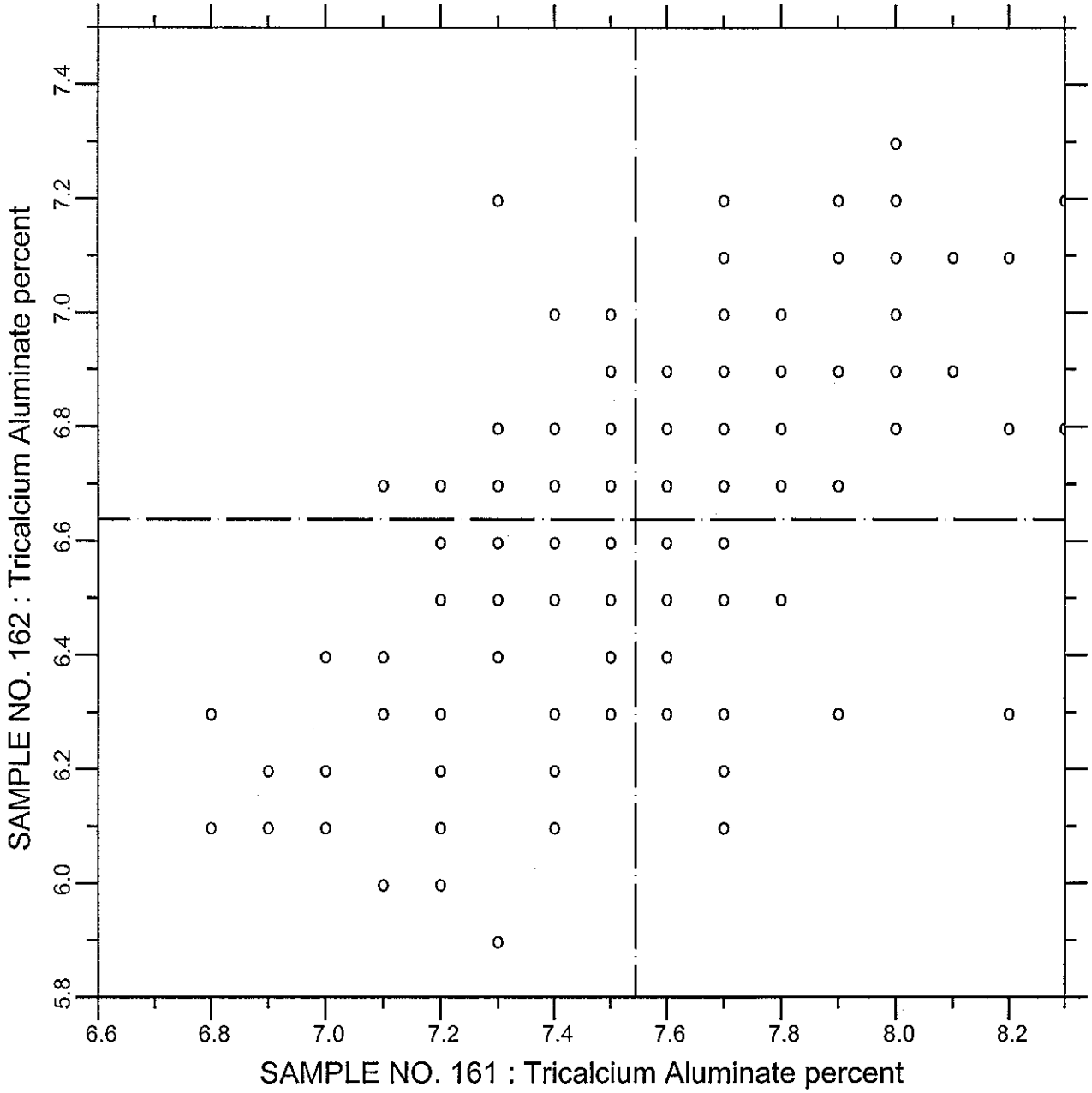
CCRL PROFICIENCY SAMPLE PROGRAM
Dicalcium Silicate
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.107 Dicalcium Silicate 136 POINTS

SAMPLE NO. 161 AVE 15.49 S.D. 2.6 C.V. 16.9
SAMPLE NO. 162 AVE 22.93 S.D. 3.1 C.V. 13.5
LABS ELIMINATED 167 2305 2492
LABS OFF DIAGRAM 244

CCRL PROFICIENCY SAMPLE PROGRAM
Tricalcium Aluminate
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



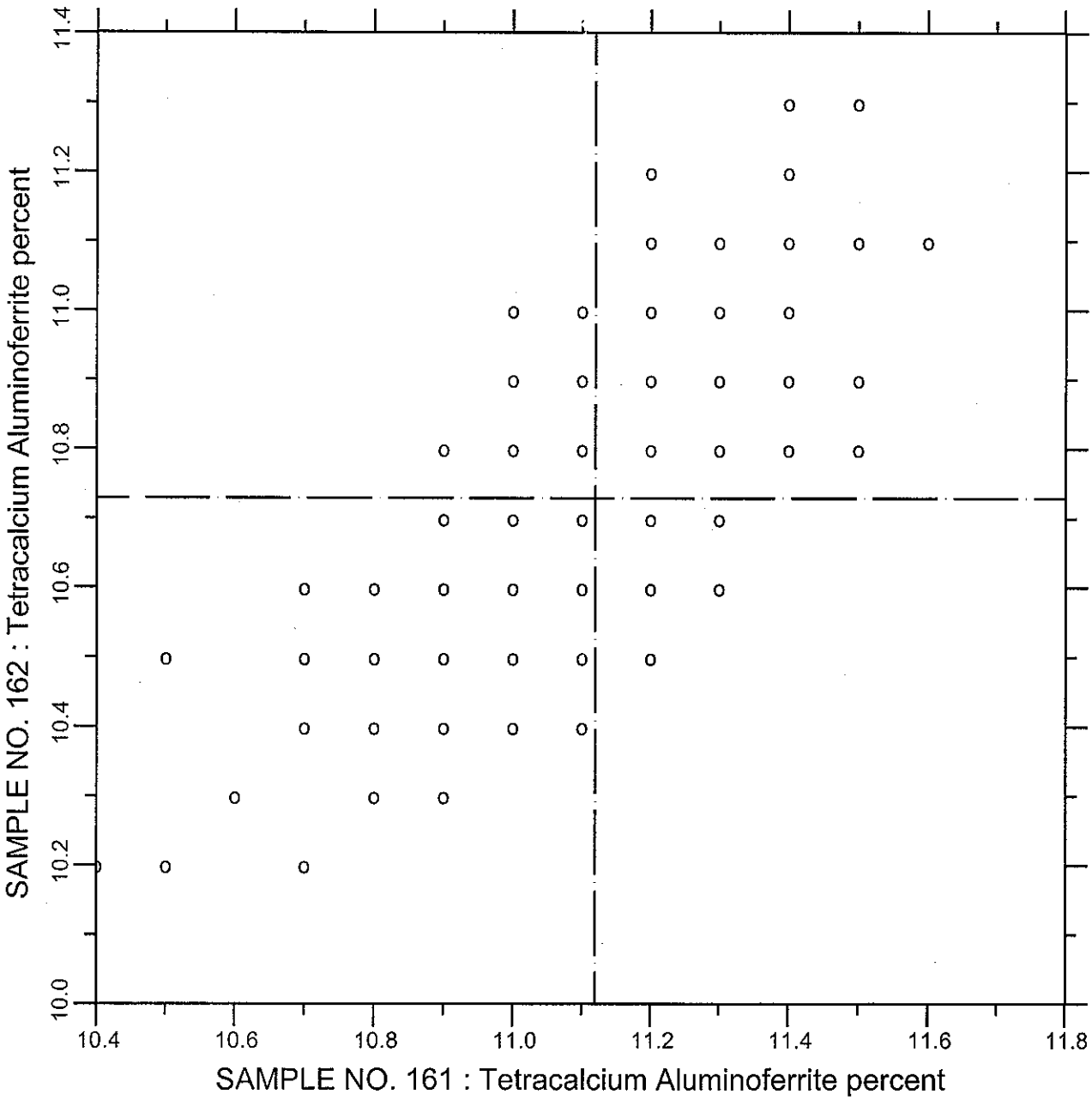
TEST NO.108 Tricalcium Aluminate 187 POINTS

SAMPLE NO. 161 AVE 7.544 S.D. 0.28 C.V. 3.78

SAMPLE NO. 162 AVE 6.637 S.D. 0.27 C.V. 4.02

LABS ELIMINATED 8 29 209 491 1715 2305 2483 143 168 2466 2934 3009

CCRL PROFICIENCY SAMPLE PROGRAM
Tetracalcium Aluminoferrite
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.109 Tetracalcium Aluminoferrite 182 POINTS

SAMPLE NO. 161 AVE 11.119 S.D. 0.23 C.V. 2.11

SAMPLE NO. 162 AVE 10.729 S.D. 0.22 C.V. 2.01

LABS ELIMINATED 209 219 305 491 1715 2522

LABS OFF DIAGRAM 167 280 1956 2982

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 161 and No. 162
Final Report - Physical Results
October 11, 2006

SUMMARY OF RESULTS

Test		#Labs	Sample No. 161 Average	S.D.	C.V.	Sample No. 162 Average	S.D.	C.V.
N.C. Water	prcnt	248	25.6	2.2	8.70	25.1	2.2	8.58
N.C. Water	prcnt	* 239	25.5	0.45	1.77	25.1	0.38	1.50
Vicat TS Initial	min	241	121	18.2	15.0	138	21.4	15.4
Vicat TS Initial	min	* 237	121	13.8	11.4	139	16.3	11.7
Vicat TS Final	min	234	228	40.0	17.6	251	40.9	16.3
Vicat TS Final	min	* 231	229	32.9	14.4	253	32.9	13.0
Gillmore TS Final	min	170	161	24.6	15.3	178	27.3	15.3
Gillmore TS Final	min	* 167	160	22.6	14.1	178	25.4	14.3
Gillmore TS Initial	min	170	264	38.8	14.7	286	38.6	13.5
Gillmore TS Initial	min	* 168	262	34.9	13.3	284	36.2	12.8
False Set	prcnt	203	83	9.4	11.2	78	9.9	12.7
False Set	prcnt	* 201	84	6.8	8.14	78	8.3	10.54
Autoclave Expan	prcnt	227	-0.013	0.045	-339.19	0.021	0.034	163.28
Autoclave Expan	prcnt	* 213	-0.015	0.024	-157.93	0.021	0.018	84.02

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

Normal Consistency, Water	33 43 25 52 74 168 440 2144 2477
Vicat TS Initial	15 33 360 2462
Vicat TS Final	14 15 33
Gillmore TS Initial	14 1079 2484
Gillmore TS Final	14 2484
False Set	15 43
Autoclave Expansion	60 252 502 691 1853 93 146 222 458 1054 1379 2466 2477 2482

CCRL PROFICIENCY SAMPLE PROGRAM

Portland Cement Proficiency Samples No. 161 and No. 162

Final Report - Physical Results

October 11, 2006

SUMMARY OF RESULTS

			Sample No. 161			Sample No. 162		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content	prcnt	225	8.3	1.1	13.1	9.5	1.2	12.9
Air Content	prcnt	* 219	8.4	0.96	11.5	9.5	1.10	11.5
AC Mix Water	prcnt	219	68.2	5.3	7.74	67.4	5.7	8.42
AC Mix Water	prcnt	* 210	68.6	2.2	3.23	67.9	2.2	3.27
AC Flow	prcnt	224	87	3.8	4.36	89	4.0	4.52
AC Flow	prcnt	* 220	87	3.4	3.97	89	3.2	3.59
Comp Str, 3 day	psi	250	3658	284.5	7.78	3540	241.9	6.83
Comp Str, 3 day	psi	* 246	3653	215.7	5.90	3554	215.3	6.06
Comp Str, 7 day	psi	250	4697	342.0	7.28	4402	297.9	6.77
Comp Str, 7 day	psi	* 246	4692	284.8	6.07	4417	261.6	5.92
Comp Str, 28 day	psi	221	6161	414.4	6.73	5768	400.4	6.94
Comp Str, 28 day	psi	* 218	6186	352.5	5.70	5787	363.0	6.27
Comp Str, Flow	prcnt	226	120	10.1	8.41	121	9.8	8.08
Comp Str, Flow	prcnt	* 222	120	9.1	7.55	122	8.7	7.18

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

Air Content	35 44 1079 1819 2435 2491
Air Content, Mix Water	95 691 1936 2351 35 51 1956 2484 2491
Air Content, Flow	932 2484 440 1251
Comp Strength, 3 day	9 33 440 1819
Comp Strength, 7 day	9 33 360 1819
Comp Strength, 14 day	9 33 823
Comp Strength, Flow	94 161 2305 3133

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 161 and No. 162
Final Report - Physical Results
October 11, 2006

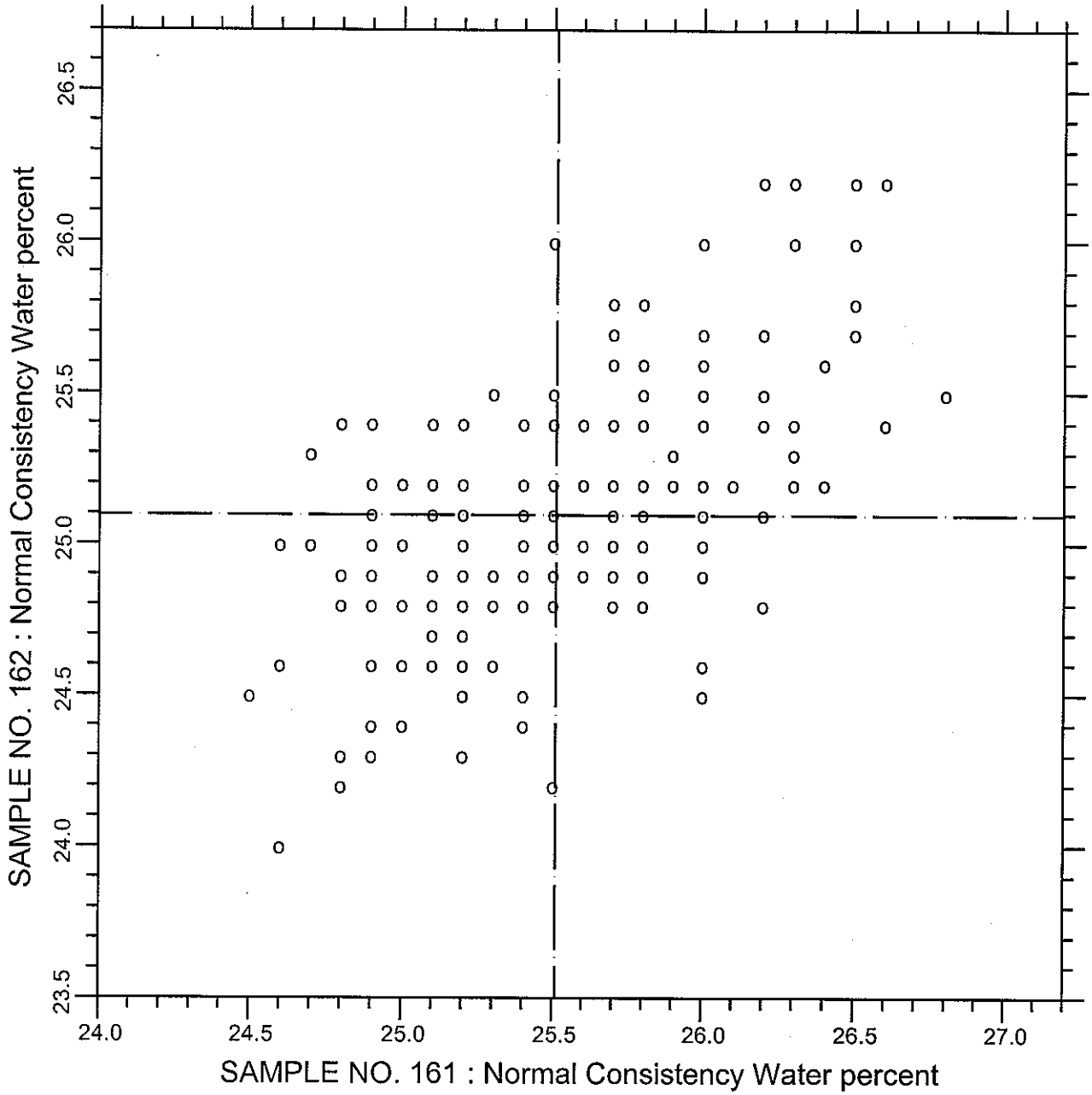
SUMMARY OF RESULTS

Test		#Labs	Sample No. 161 Average	S.D.	C.V.	Sample No. 162 Average	S.D.	C.V.
Fineness, AP	cm^2/g	249	3691	115.8	3.14	3744	140.8	3.76
Fineness, AP	cm^2/g	* 243	3686	91.9	2.49	3740	95.4	2.55
Fineness, WT	cm^2/g	14	1962	79.1	4.03	2018	82.1	4.07
45µm Sieve	prcnt	230	93.34	1.10	1.177	96.37	0.71	0.740
45µm Sieve	prcnt	* 225	93.37	0.92	0.986	96.40	0.63	0.658
C1038 Expansion								
Mortar Expansion	prcnt	139	0.005	0.0094	174	0.006	0.0062	110
Mortar Expansion	prcnt	* 128	0.005	0.0034	69.9	0.005	0.0036	76.1
Mortar Water	prcnt	136	237	13.2	5.56	237	13.2	5.59
Mortar Water	prcnt	* 133	237	5.6	2.38	236	5.8	2.44
Mortar Flow	prcnt	135	111	4.8	4.28	111	5.0	4.54
Mortar Flow	prcnt	* 128	111	2.6	2.35	110	2.7	2.47

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

Fineness, Air Permeability	7 15 28 33 51 691
Fineness, 45µm sieve	125 431 458 493 2468
C1038 Expansion	
Mortar Bar Expansion	36 96 139 159 207 1054 54 92 375 438 1190
Mortar Water	207 493 932
Mortar Flow	440 883 1936 416 2351 3125 3126

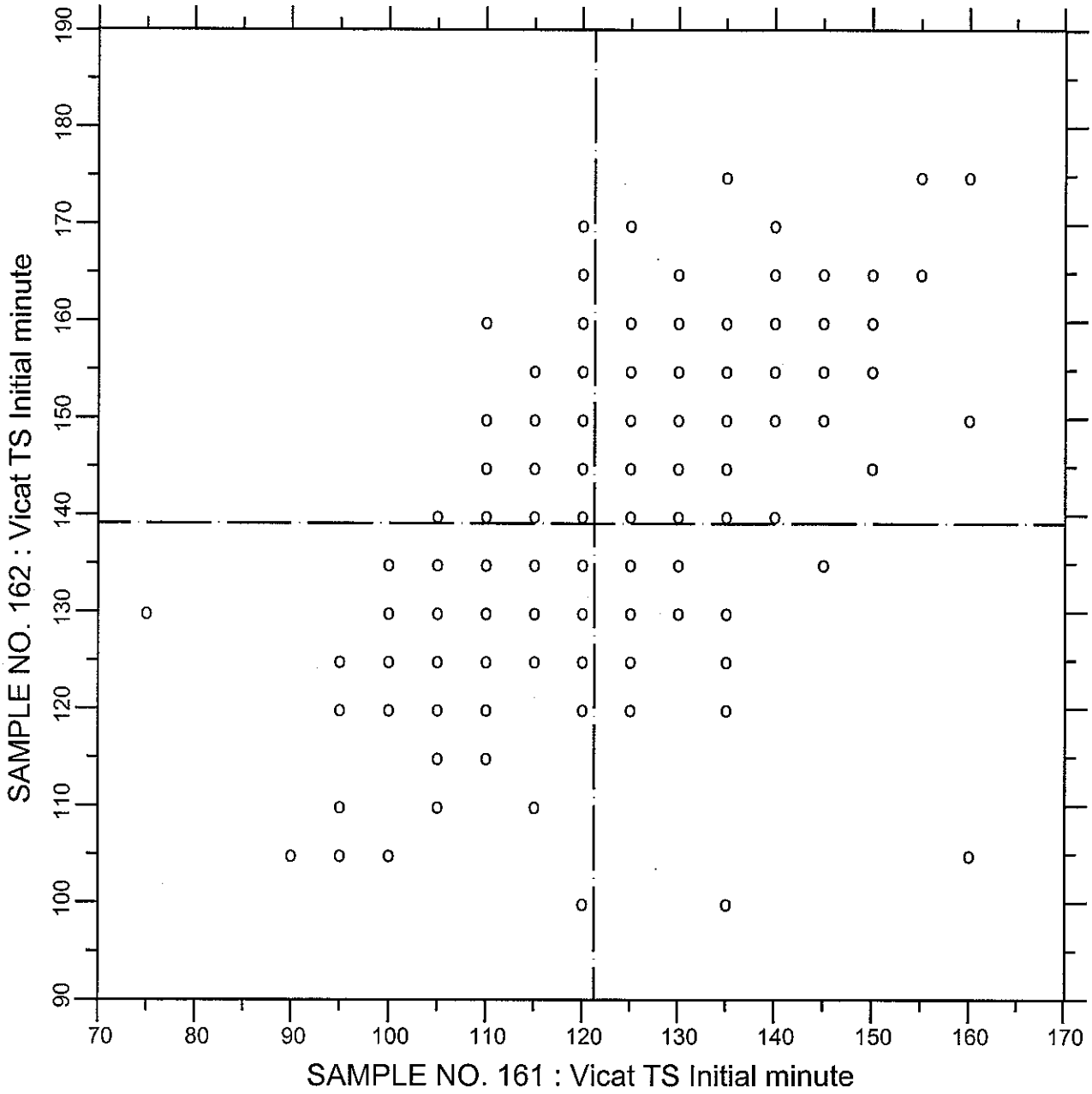
CCRL PROFICIENCY SAMPLE PROGRAM
Normal Consistency - % Water
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.110 Normal Consistency Water 239 POINTS

SAMPLE NO. 161 AVE 25.510 S.D. 0.45 C.V. 1.77
SAMPLE NO. 162 AVE 25.095 S.D. 0.38 C.V. 1.50
LABS ELIMINATED 33 43 25 52 74 168 440 2144 2477

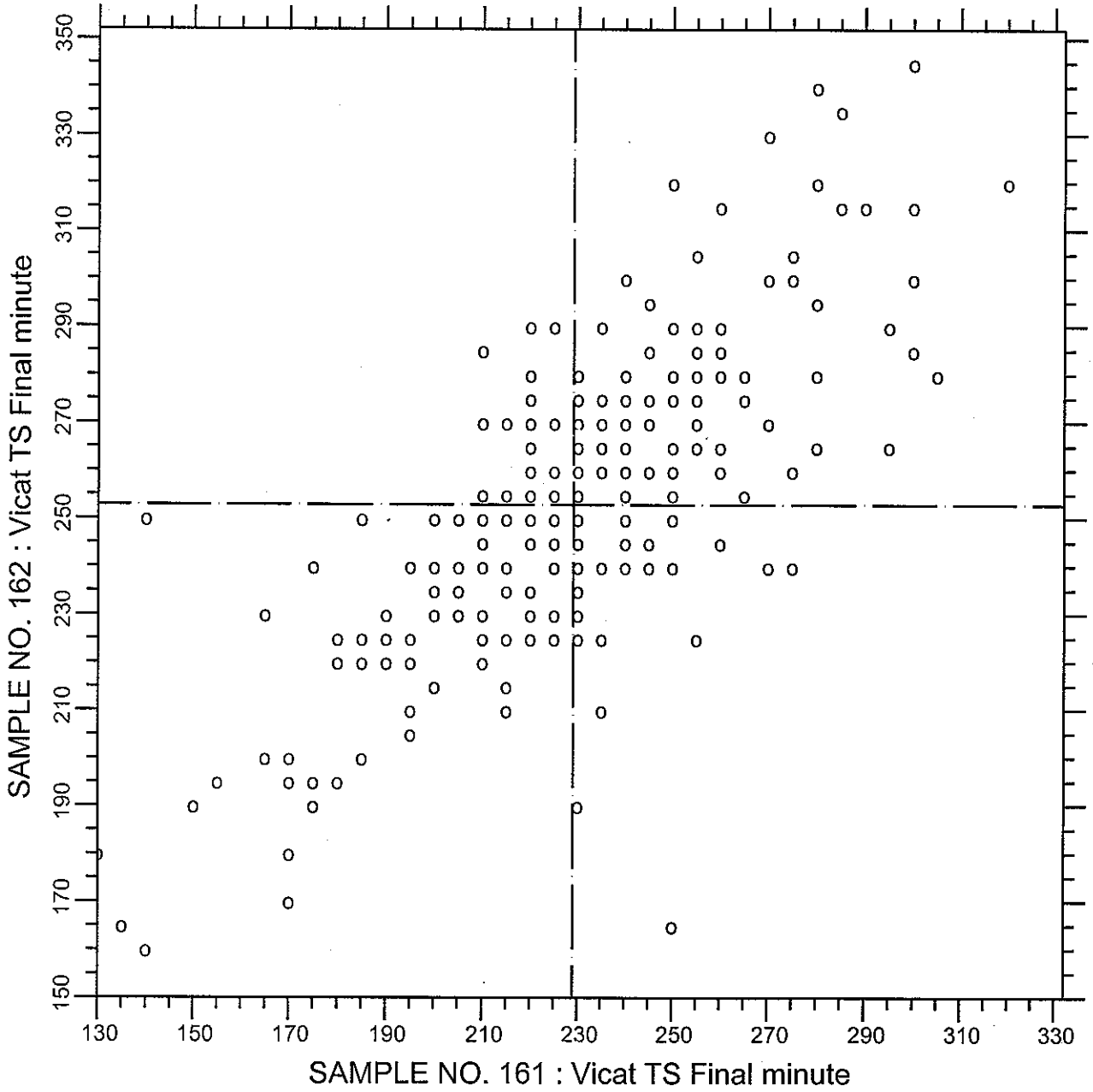
CCRL PROFICIENCY SAMPLE PROGRAM
Vicat Time of Set - Initial
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.120 Vicat TS Initial 233 POINTS

SAMPLE NO. 161 AVE 121.26 S.D. 13.8 C.V. 11.4
SAMPLE NO. 162 AVE 139.11 S.D. 16.3 C.V. 11.7
LABS ELIMINATED 15 33 360 2462
LABS OFF DIAGRAM 265 375 458 1956

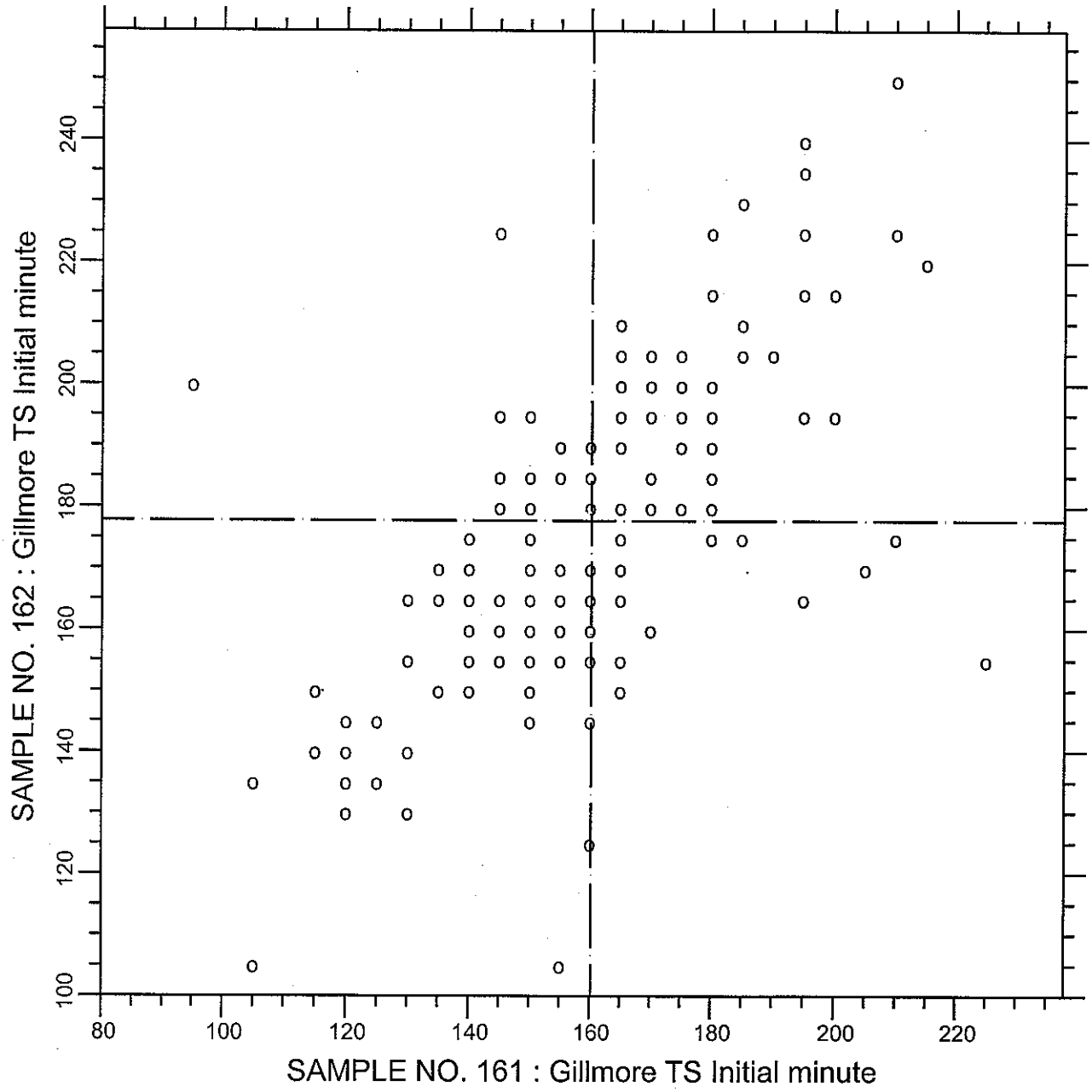
CCRL PROFICIENCY SAMPLE PROGRAM
Vicat Time of Set - Final
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.121 Vicat TS Final 229 POINTS

SAMPLE NO. 161 AVE 229.1 S.D. 32.9 C.V. 14.4
SAMPLE NO. 162 AVE 252.8 S.D. 32.9 C.V. 13.0
LABS ELIMINATED 14 15 33
LABS OFF DIAGRAM 416 1956

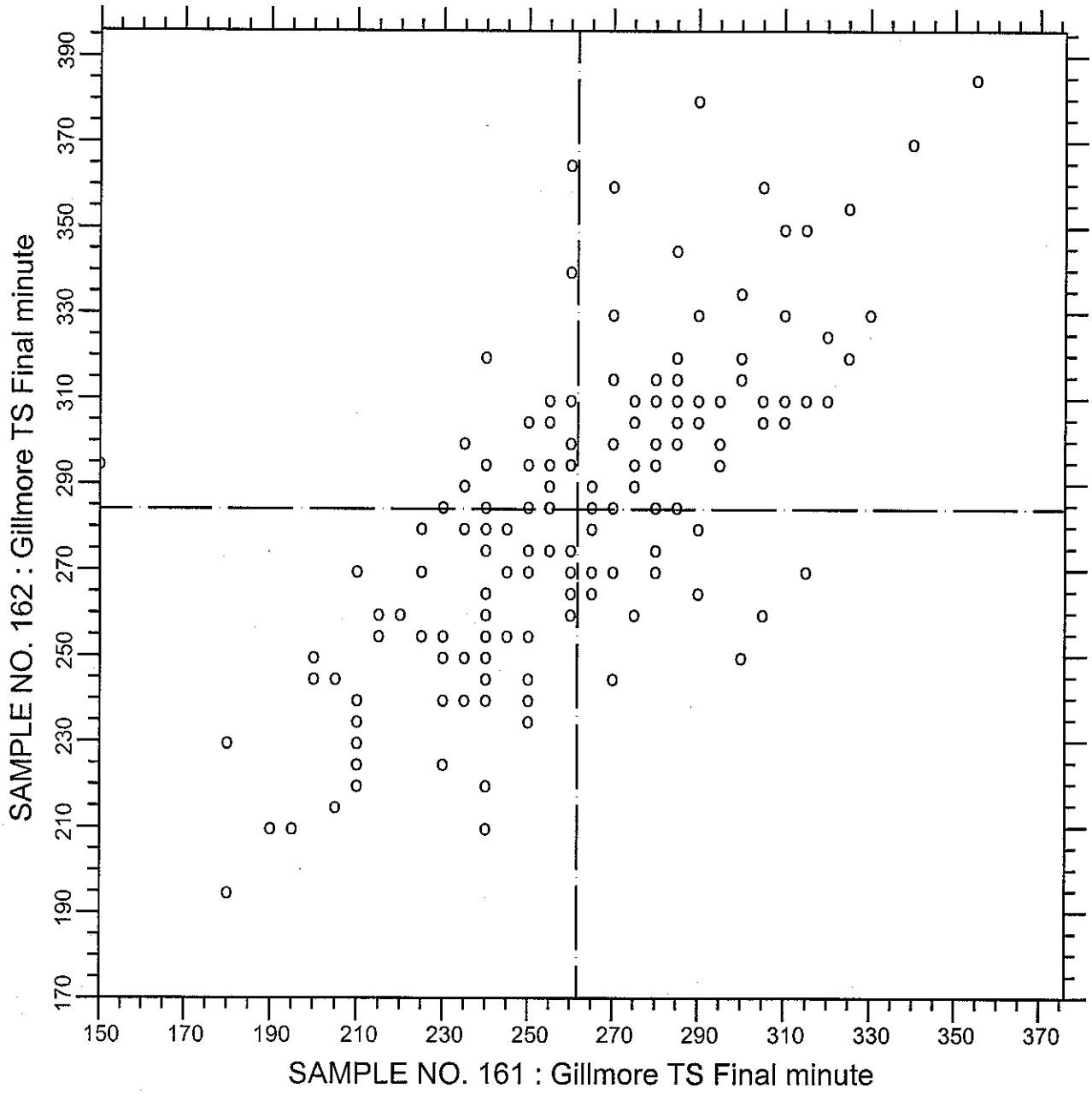
CCRL PROFICIENCY SAMPLE PROGRAM
Gillmore Time of Set - Initial
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.130 Gillmore TS Initial 166 POINTS

SAMPLE NO. 161 AVE 160.2 S.D. 22.6 C.V. 14.1
SAMPLE NO. 162 AVE 177.8 S.D. 25.4 C.V. 14.3
LABS ELIMINATED 14 1079 2484
LABS OFF DIAGRAM 181

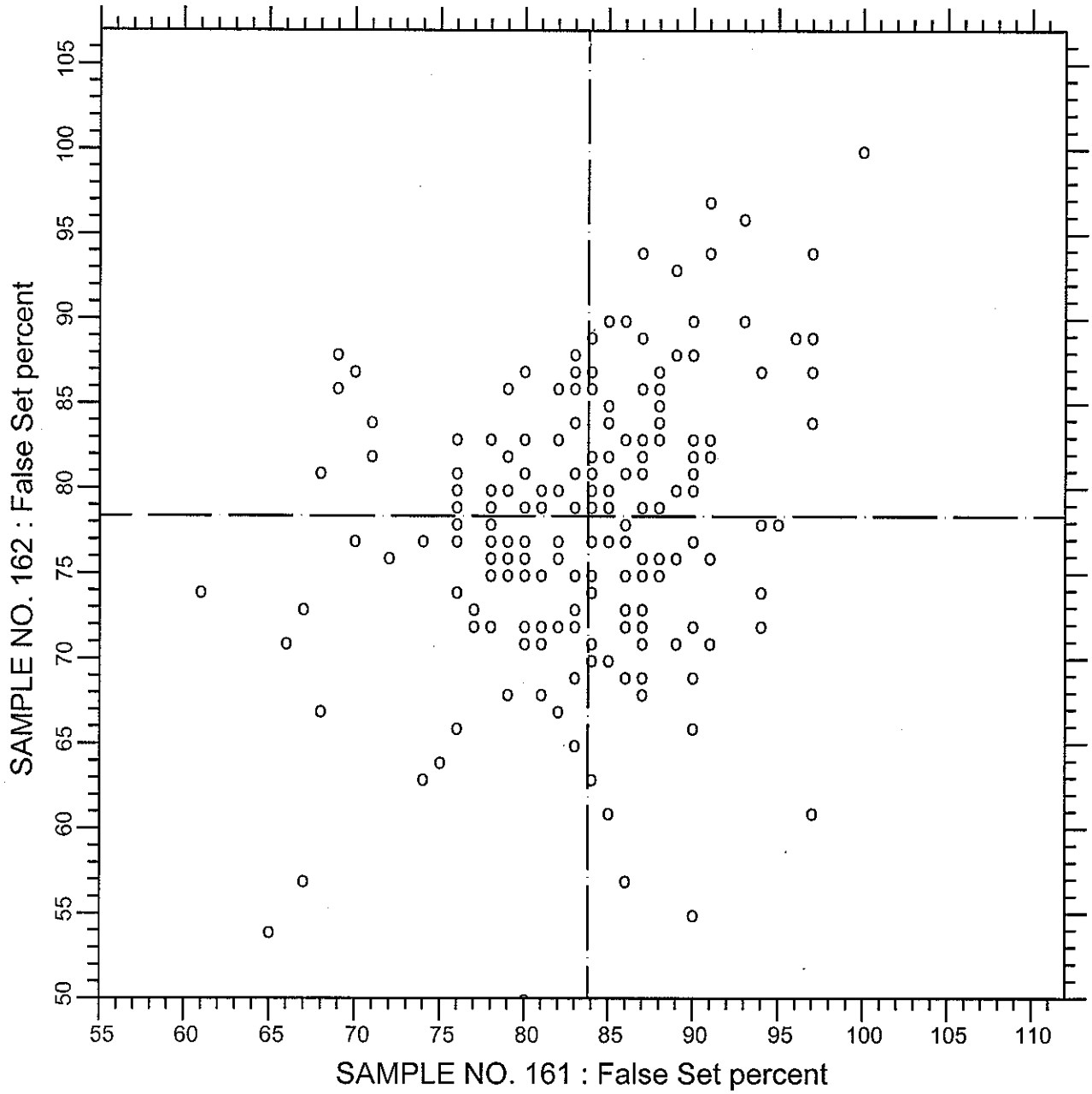
CCRL PROFICIENCY SAMPLE PROGRAM
Gillmore Time of Set - Final
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.140 Gillmore TS Final 167 POINTS

SAMPLE NO. 161 AVE 261.6 S.D. 34.9 C.V. 13.3
SAMPLE NO. 162 AVE 284.2 S.D. 36.2 C.V. 12.8
LABS ELIMINATED 14 2484
LABS OFF DIAGRAM 252

CCRL PROFICIENCY SAMPLE PROGRAM
False Set - Paste Method
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

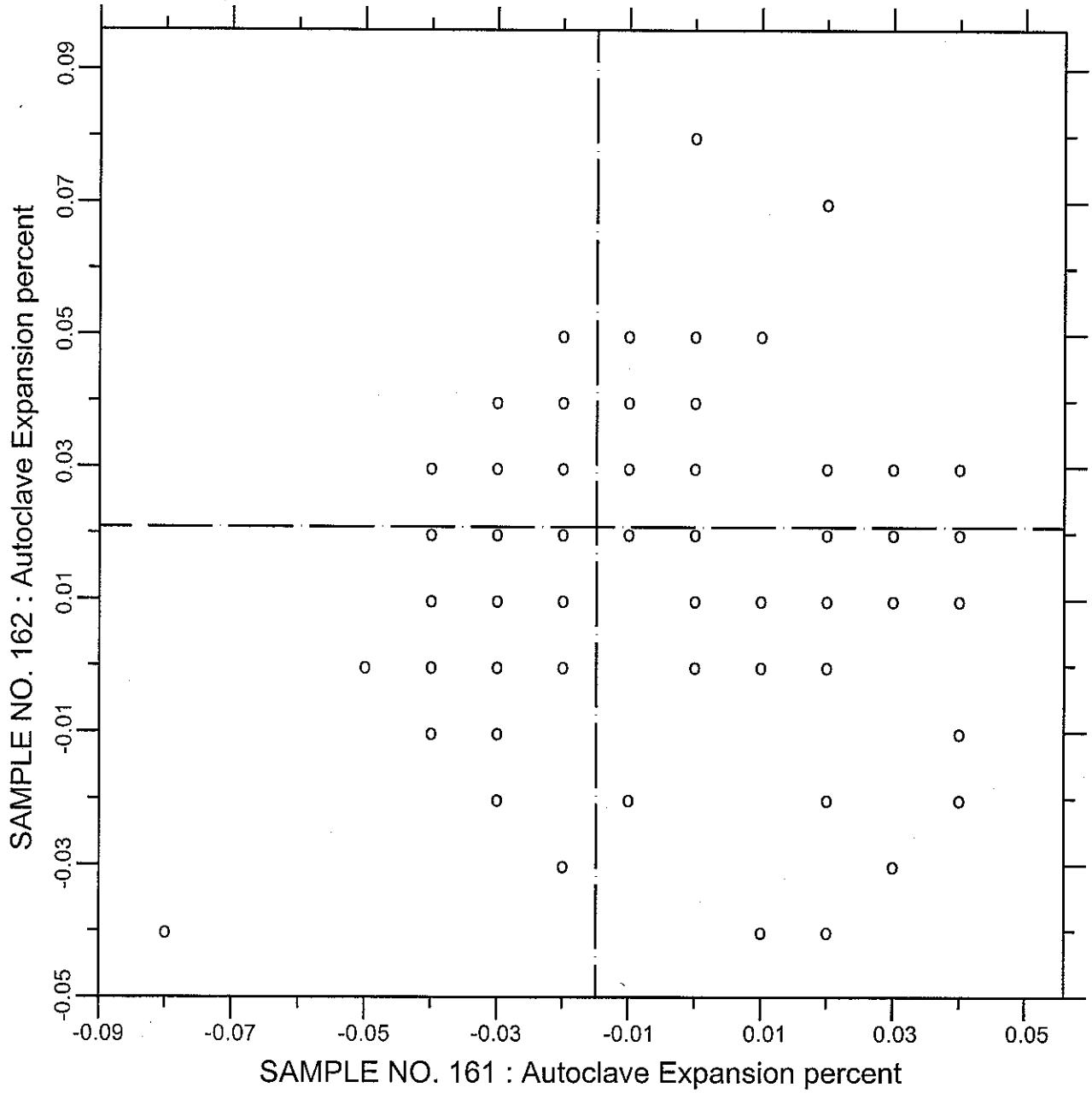


TEST NO.150 False Set 201 POINTS

SAMPLE NO. 161	AVE	83.80	S.D.	6.8	C.V.	8.14
SAMPLE NO. 162	AVE	78.38	S.D.	8.3	C.V.	10.54

LABS ELIMINATED 15 43

CCRL PROFICIENCY SAMPLE PROGRAM
Autoclave Expansion
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.160 Autoclave Expansion 209 POINTS

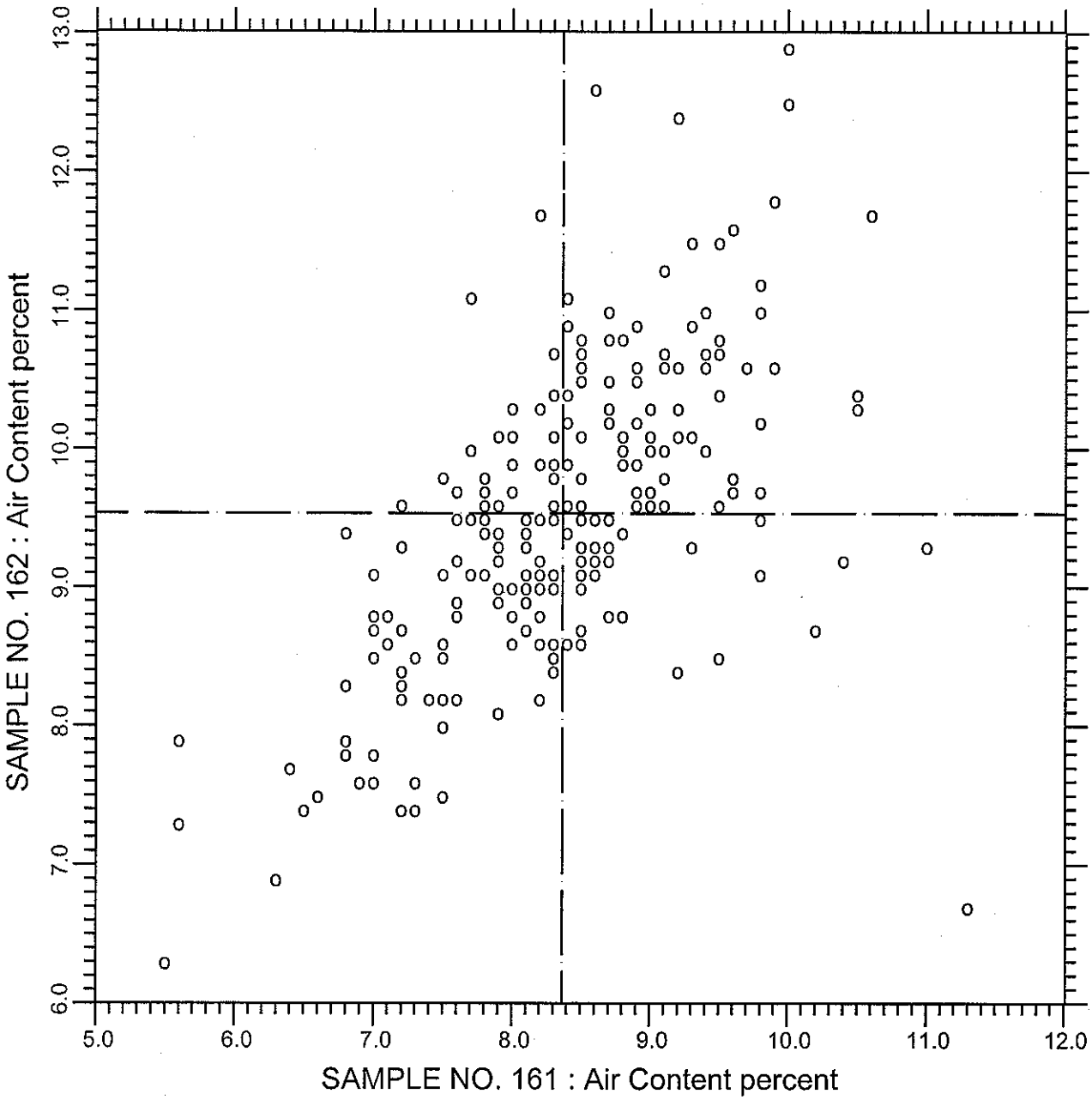
SAMPLE NO. 161 AVE -0.0149 S.D. 0.024 C.V. -157.933

SAMPLE NO. 162 AVE 0.0209 S.D. 0.018 C.V. 84.025

LABS ELIMINATED 60 252 502 691 1853 93 146 222 458 1054 1379 2466 2477 2482

LABS OFF DIAGRAM 10 162 205 1466

CCRL PROFICIENCY SAMPLE PROGRAM
Air Content
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

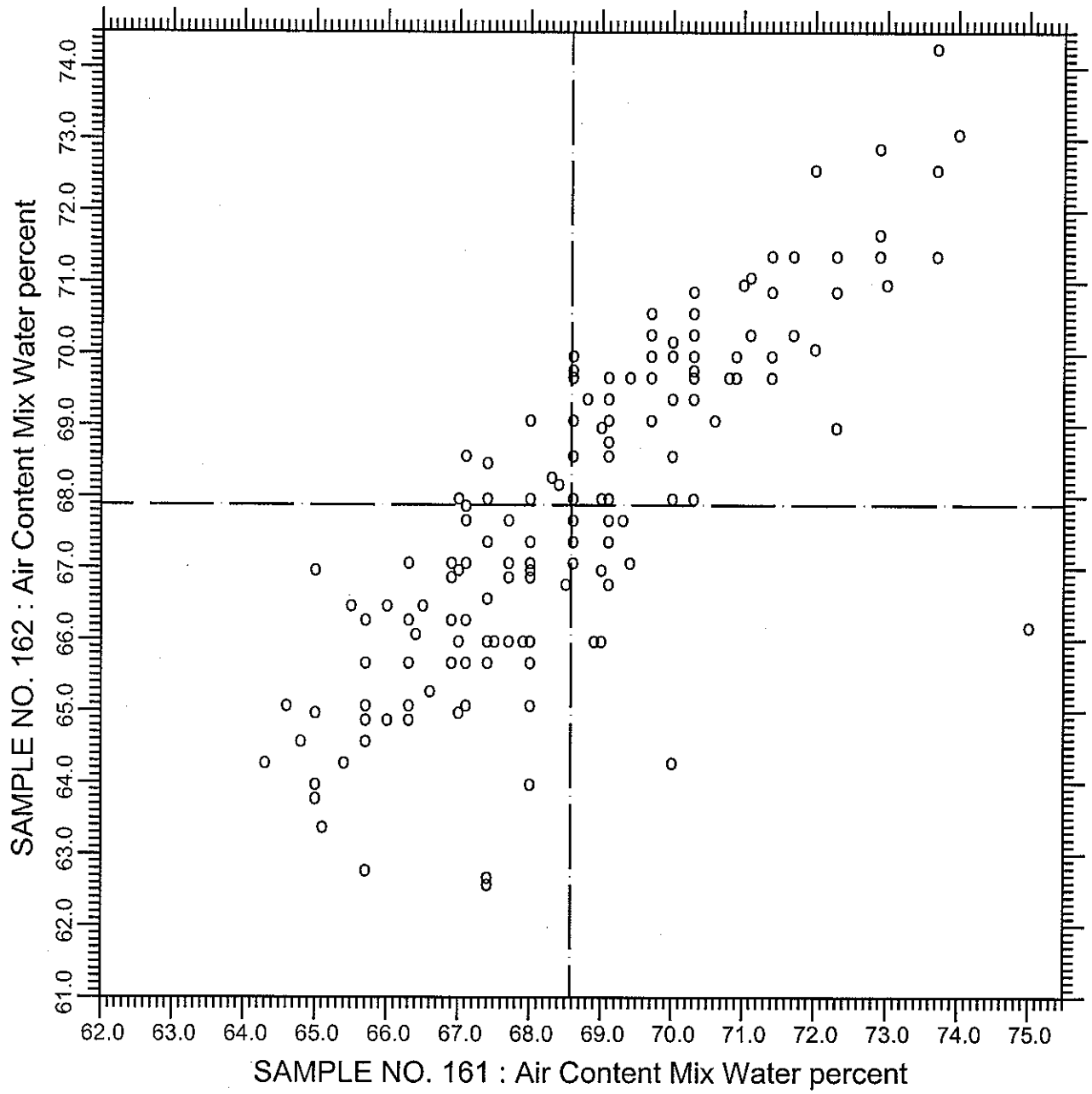


TEST NO.170 Air Content 219 POINTS

SAMPLE NO. 161	AVE	8.368	S.D.	0.96	C.V. 11.5
SAMPLE NO. 162	AVE	9.533	S.D.	1.10	C.V. 11.5

LABS ELIMINATED 35 44 1079 1819 2435 2491

CCRL PROFICIENCY SAMPLE PROGRAM
Air Content - % Water
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.180 Air Content Mix Water 207 POINTS

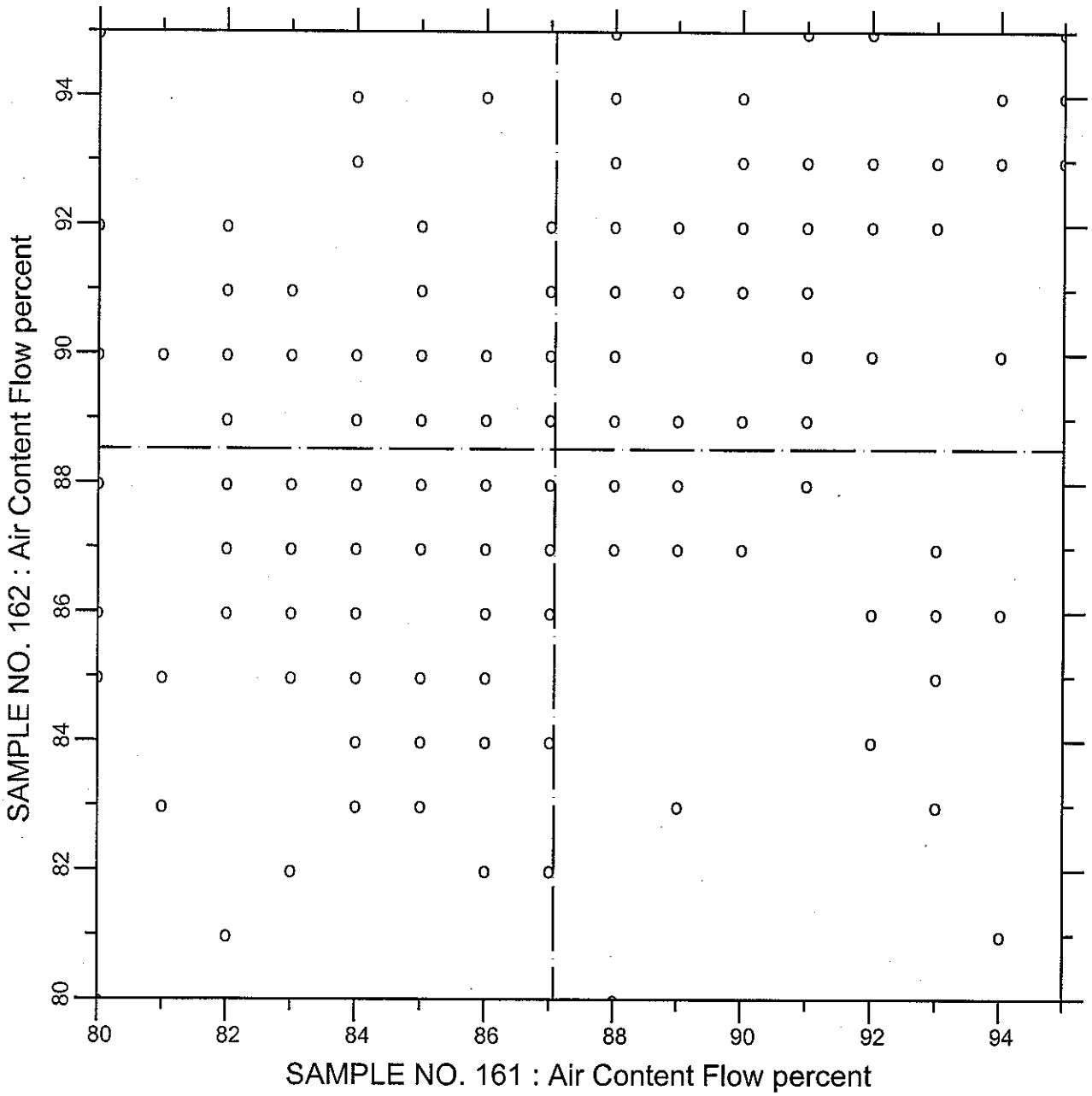
SAMPLE NO. 161 AVE 68.58 S.D. 2.2 C.V. 3.23

SAMPLE NO. 162 AVE 67.88 S.D. 2.2 C.V. 3.27

LABS ELIMINATED 95 691 1936 2351 35 51 1956 2484 2491

LABS OFF DIAGRAM 1079 2305 2468

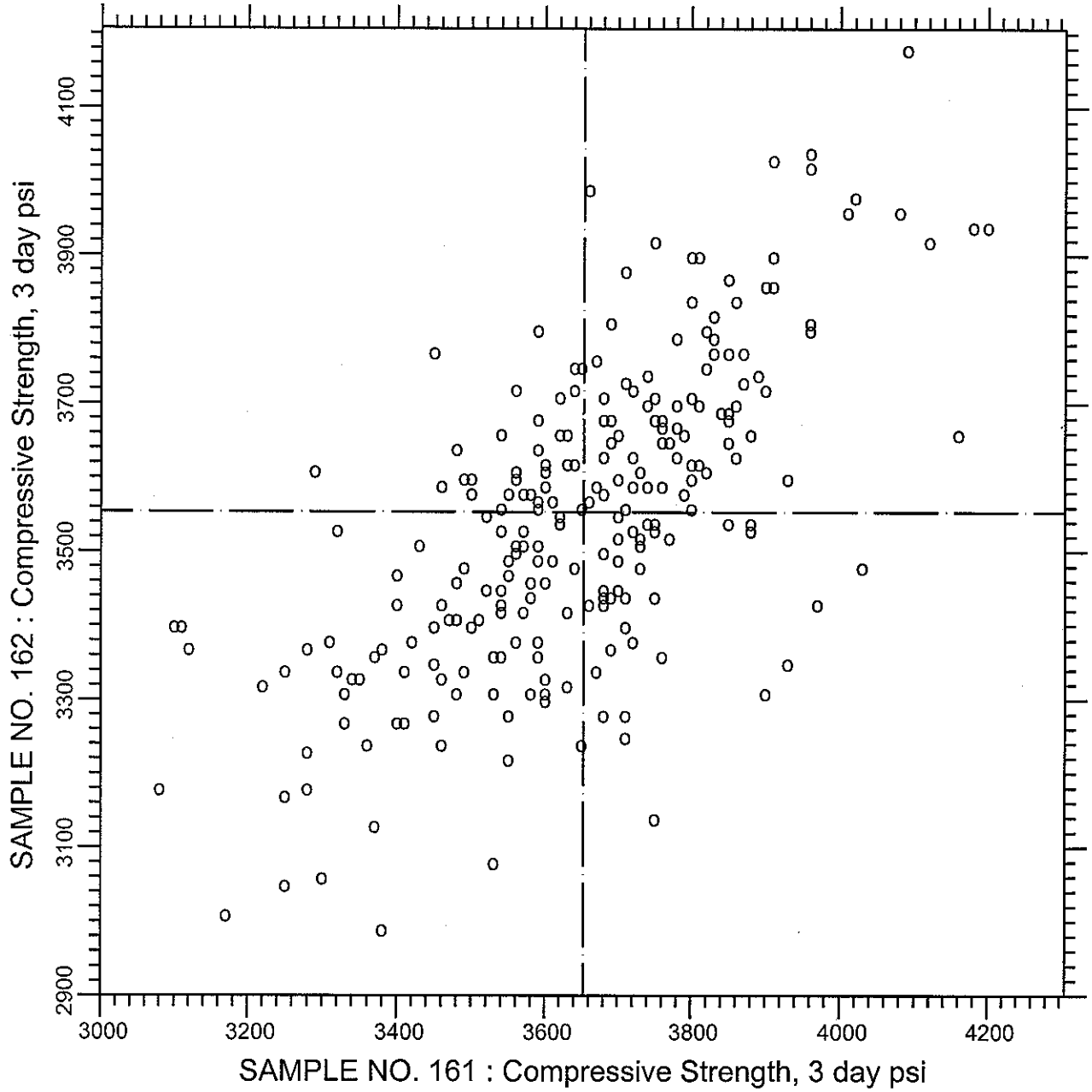
CCRL PROFICIENCY SAMPLE PROGRAM
Air Content - Flow
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.190 Air Content Flow 220 POINTS

SAMPLE NO. 161 AVE 87.08 S.D. 3.4 C.V. 3.97
SAMPLE NO. 162 AVE 88.53 S.D. 3.2 C.V. 3.59
LABS ELIMINATED 932 2484 440 1251

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - 3 day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.200 Compressive Strength, 3 day 243 POINTS

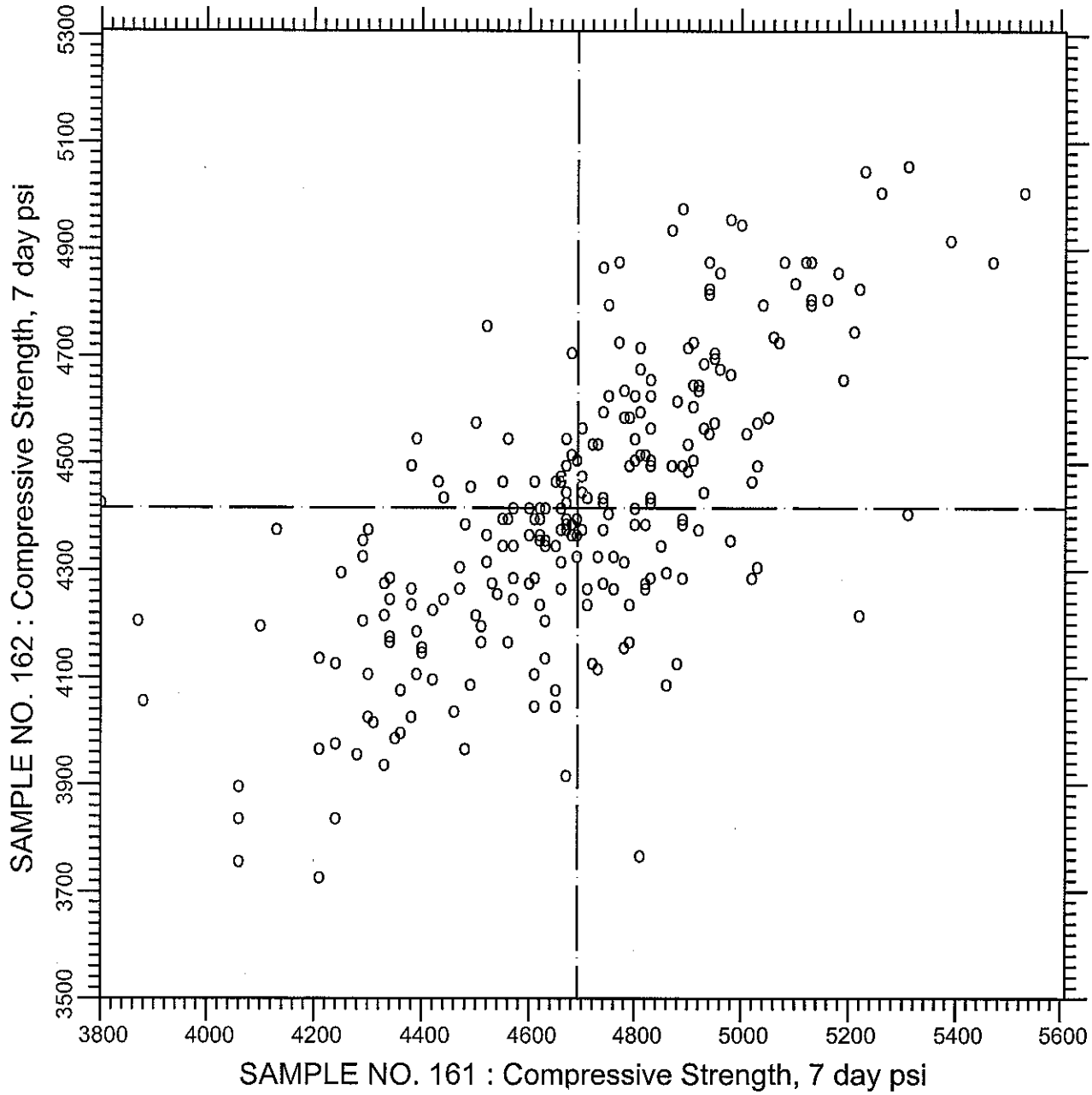
SAMPLE NO. 161 AVE 3653.0 S.D. 215.7 C.V. 5.90

SAMPLE NO. 162 AVE 3553.6 S.D. 215.3 C.V. 6.06

LABS ELIMINATED 9 33 440 1819

LABS OFF DIAGRAM 41 175 2522

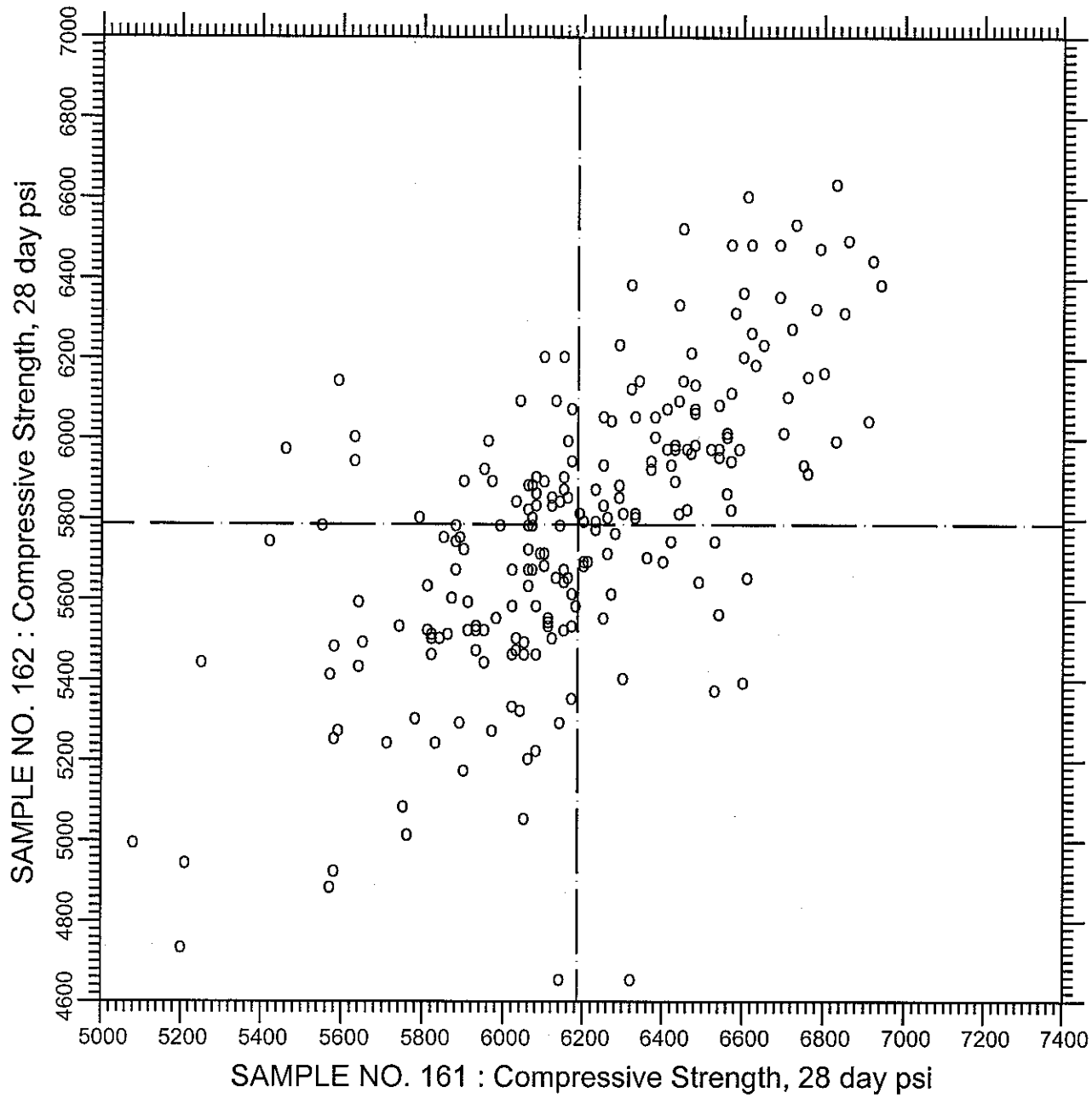
CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - 7 day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.210 Compressive Strength, 7 day 246 POINTS

SAMPLE NO. 161 AVE 4692.2 S.D. 284.8 C.V. 6.07
SAMPLE NO. 162 AVE 4416.7 S.D. 261.6 C.V. 5.92
LABS ELIMINATED 9 33 360 1819

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - 28 day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



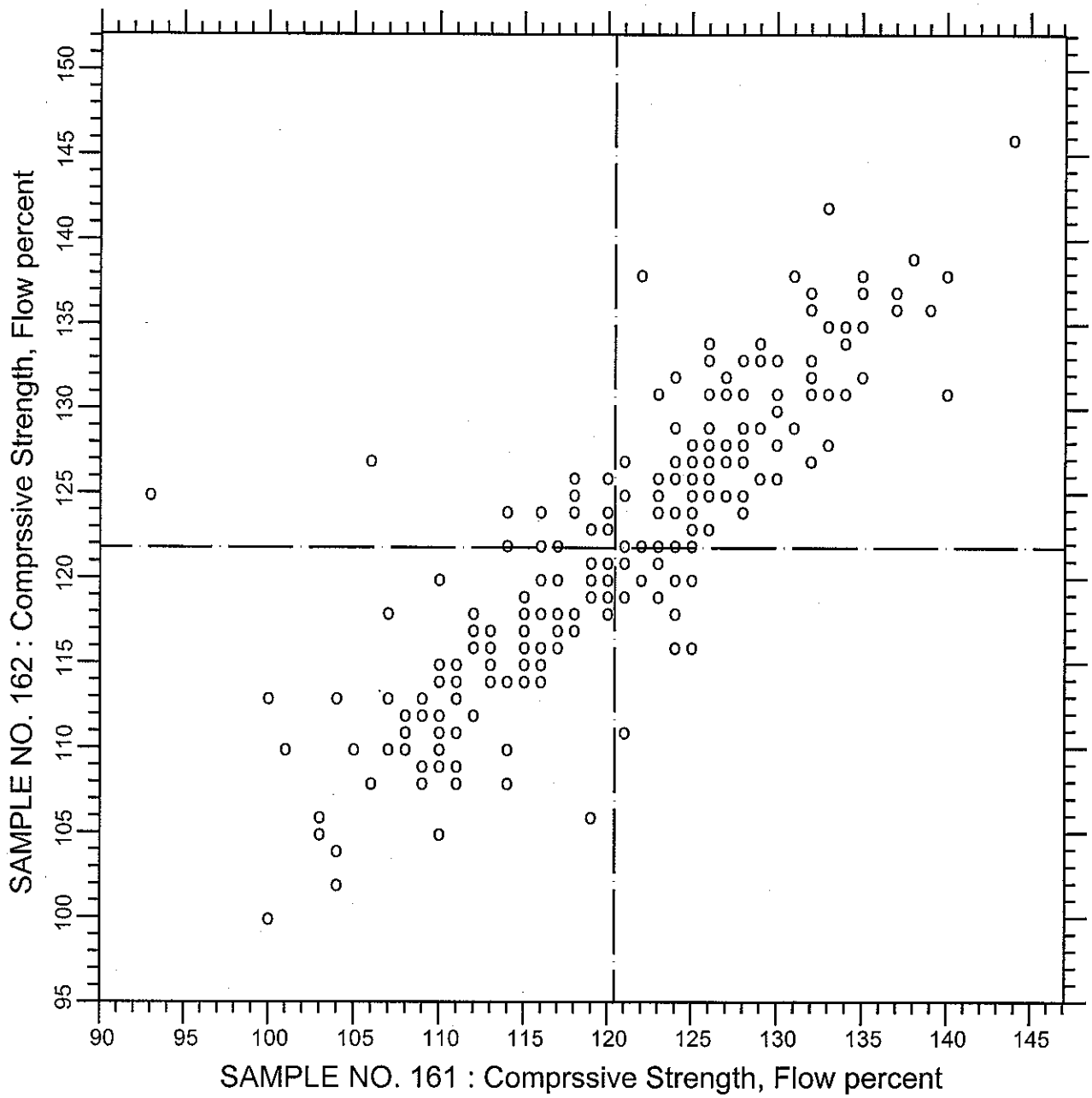
TEST NO.211 Compressive Strength, 28 day 218 POINTS

SAMPLE NO. 161 AVE 6185.9 S.D. 352.5 C.V. 5.70

SAMPLE NO. 162 AVE 5787.2 S.D. 363.0 C.V. 6.27

LABS ELIMINATED 9 33 823

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - Flow
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



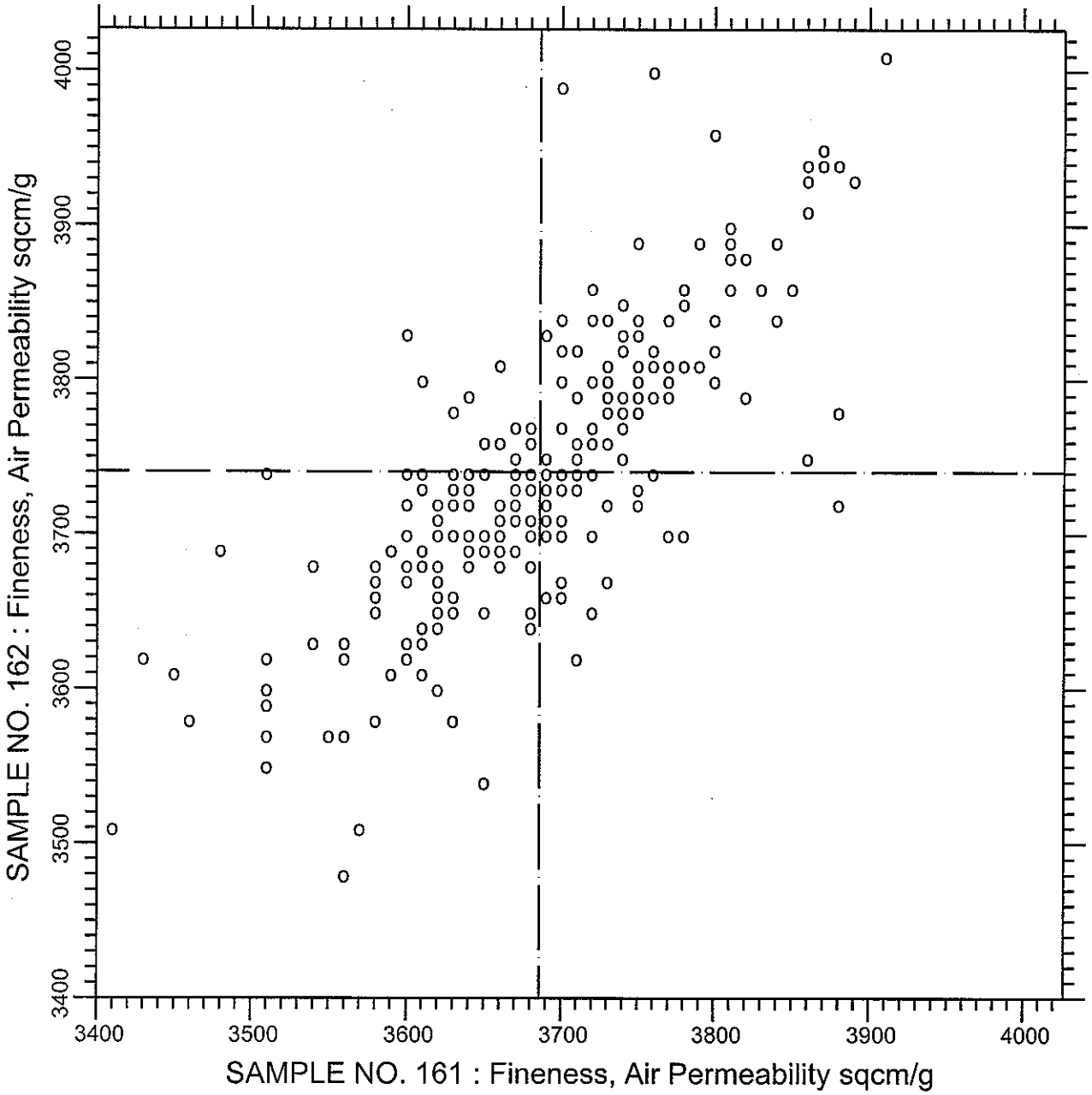
TEST NO.230 Comprssive Strength, Flow 222 POINTS

SAMPLE NO. 161 AVE 120.43 S.D. 9.1 C.V. 7.55

SAMPLE NO. 162 AVE 121.78 S.D. 8.7 C.V. 7.18

LABS ELIMINATED 94 161 2305 3133

CCRL PROFICIENCY SAMPLE PROGRAM
Fineness - Air Permeability
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.270 Fineness, Air Permeability 241 POINTS

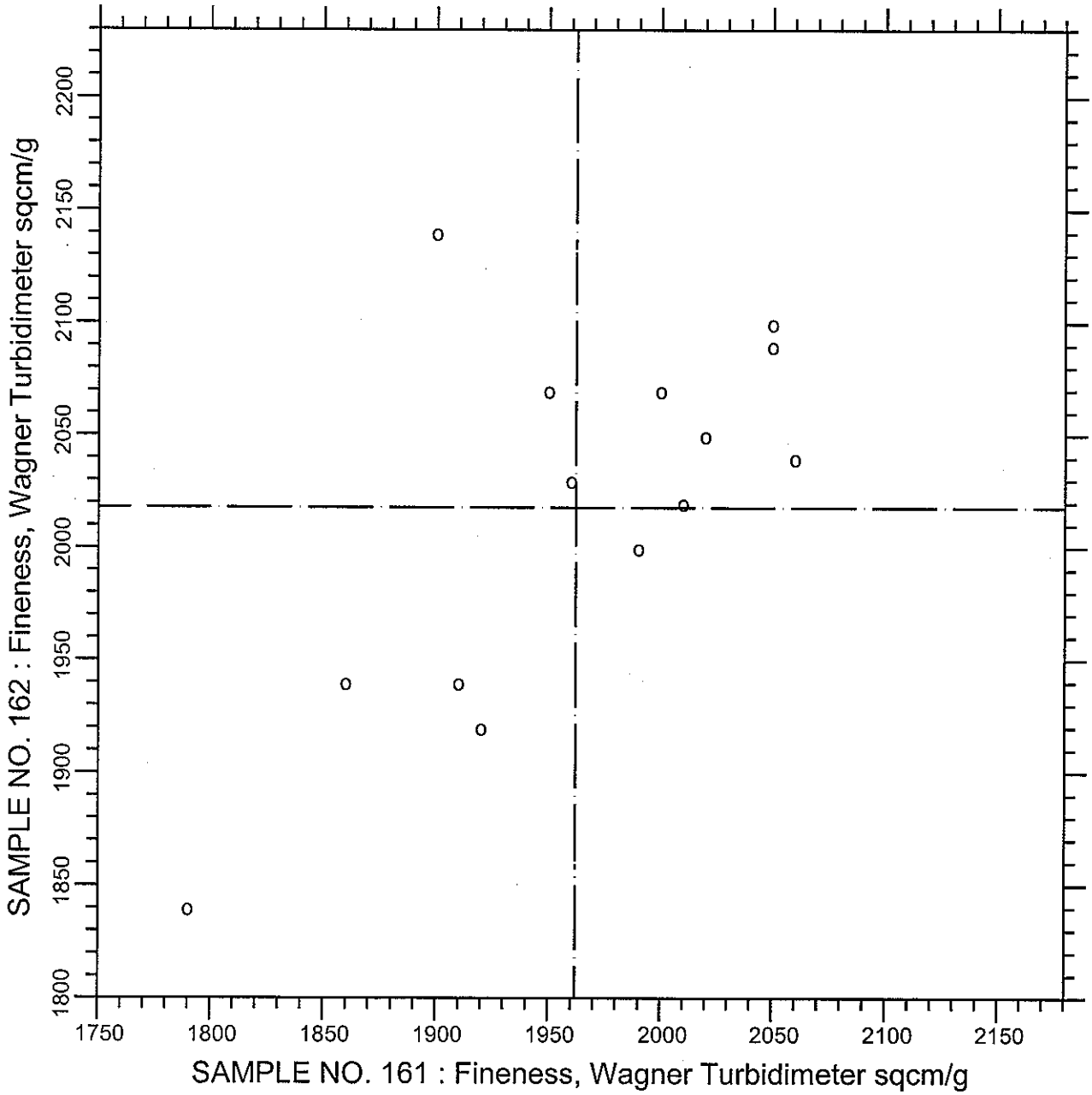
SAMPLE NO. 161 AVE 3686.1 S.D. 91.9 C.V. 2.49

SAMPLE NO. 162 AVE 3740.5 S.D. 95.4 C.V. 2.55

LABS ELIMINATED 7 15 28 33 51 691

LABS OFF DIAGRAM 2477 2938

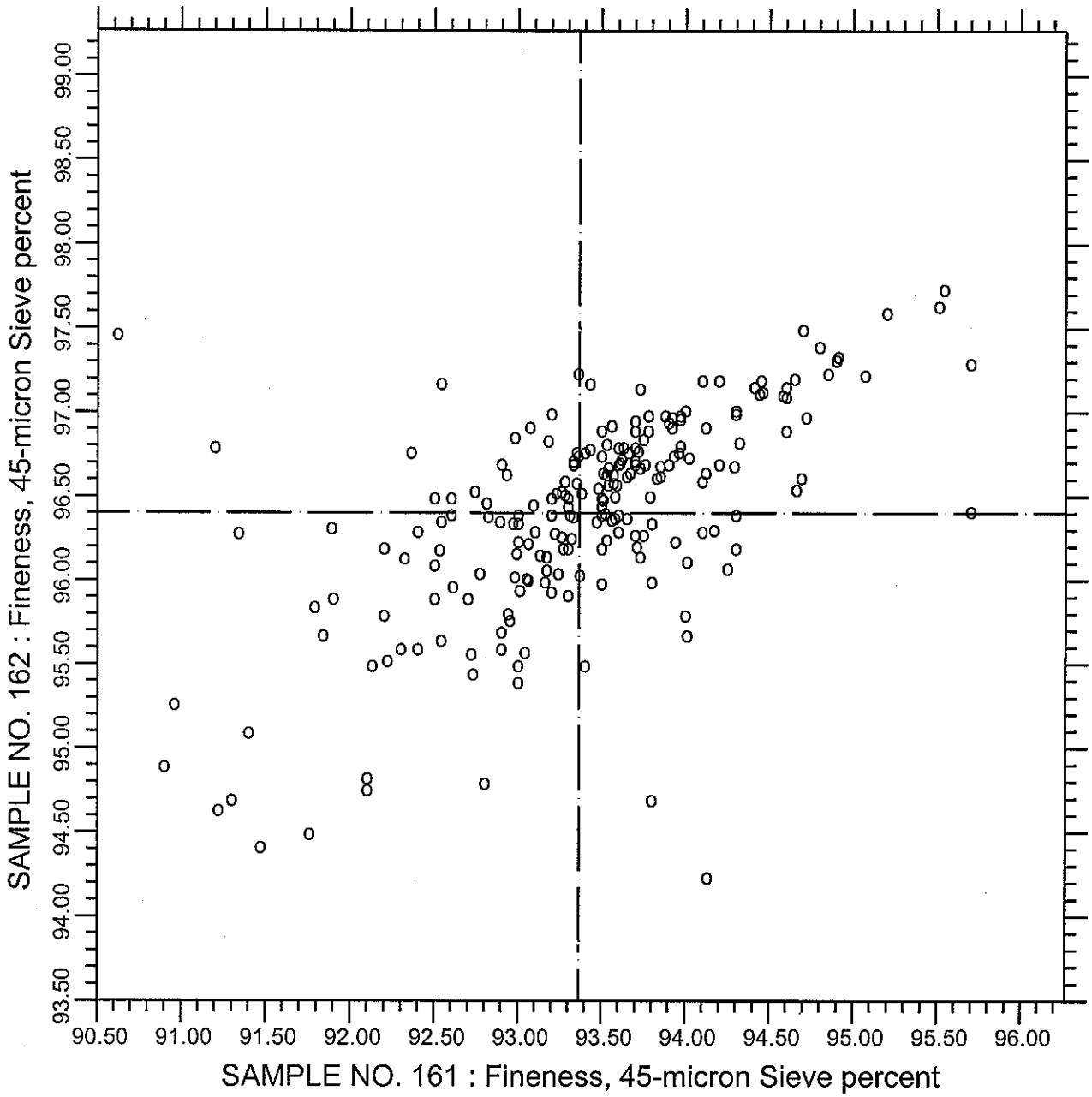
CCRL PROFICIENCY SAMPLE PROGRAM
Fineness - Wagner Turbidimeter
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.280 Fineness, Wagner Turbidimeter 14 POINTS

SAMPLE NO. 161	AVE	1962.1	S.D.	79.1	C.V.	4.03
SAMPLE NO. 162	AVE	2017.8	S.D.	82.1	C.V.	4.07

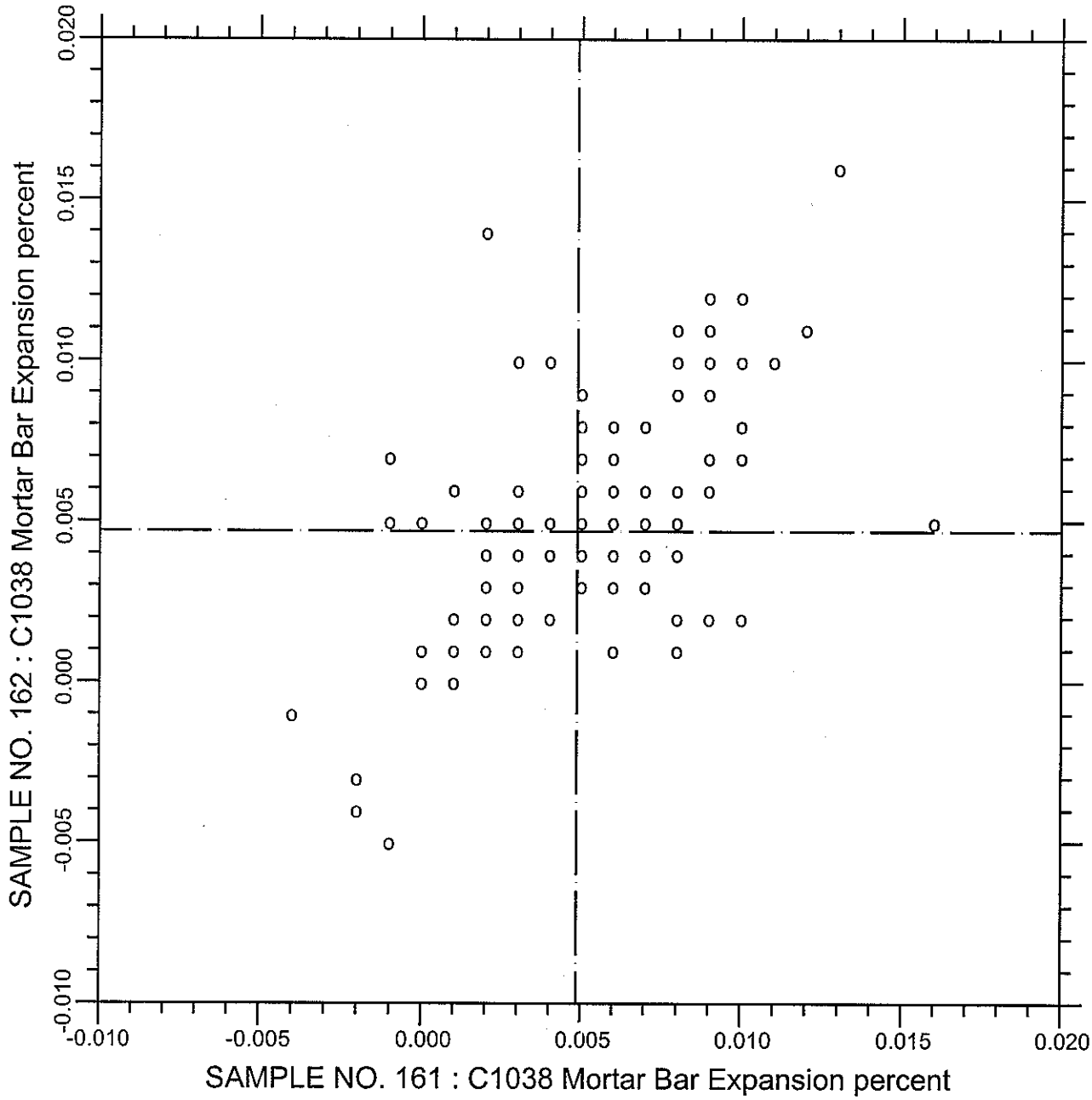
CCRL PROFICIENCY SAMPLE PROGRAM
45-micron Sieve - % Passing
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.281 Fineness, 45-micron Sieve 222 POINTS

SAMPLE NO. 161 AVE 93.367 S.D. 0.92 C.V. 0.986
SAMPLE NO. 162 AVE 96.402 S.D. 0.63 C.V. 0.658
LABS ELIMINATED 125 431 458 493 2468
LABS OFF DIAGRAM 40 441 1657

CCRL PROFICIENCY SAMPLE PROGRAM
C1038 Mortar Bar Expansion
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



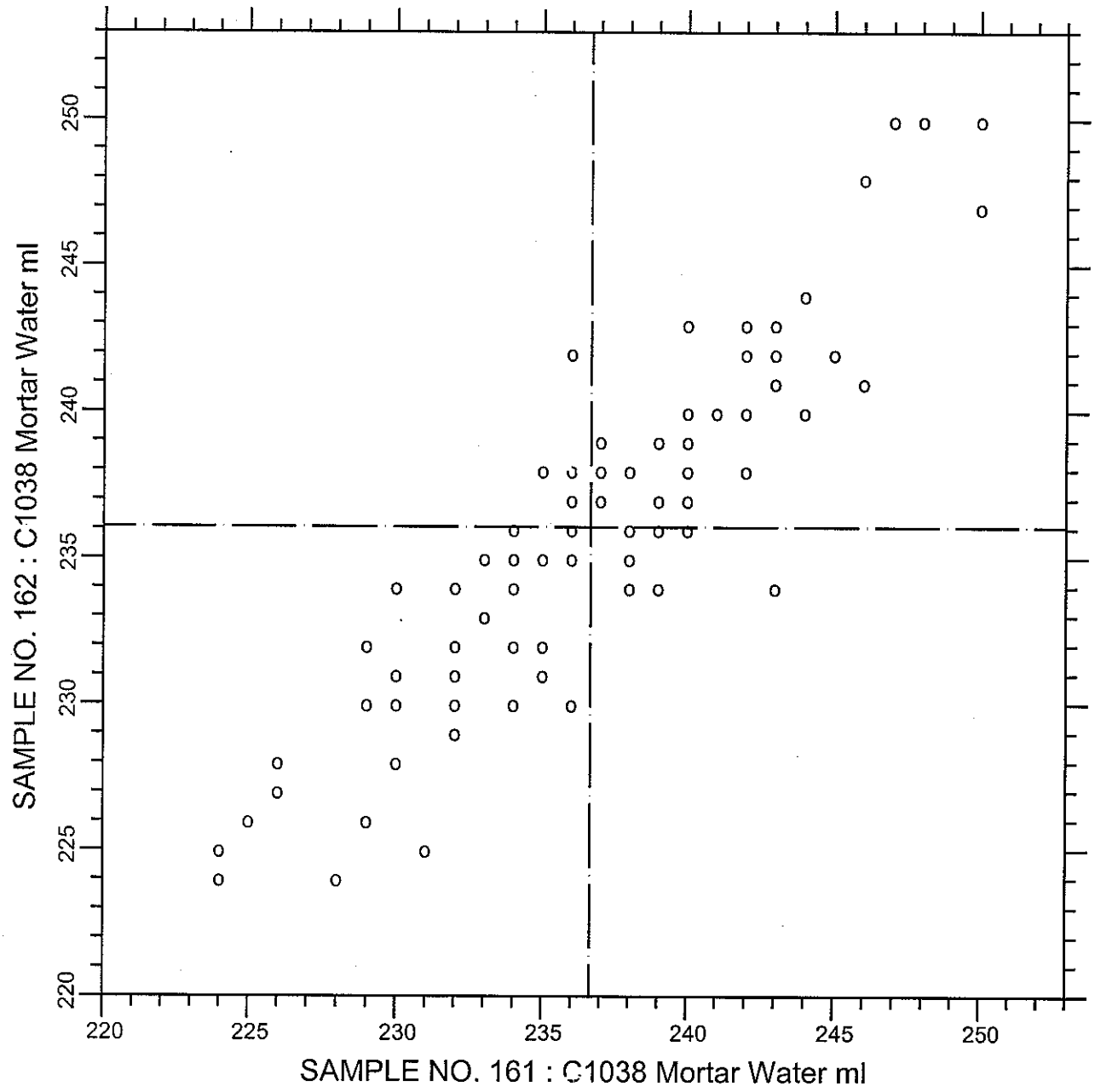
TEST NO.400 C1038 Mortar Bar Expansion 128 POINTS

SAMPLE NO. 161 AVE 0.00487 S.D. 0.0034 C.V. 69.9

SAMPLE NO. 162 AVE 0.00470 S.D. 0.0036 C.V. 76.1

LABS ELIMINATED 36 96 139 159 207 1054 54 92 375 438 1190

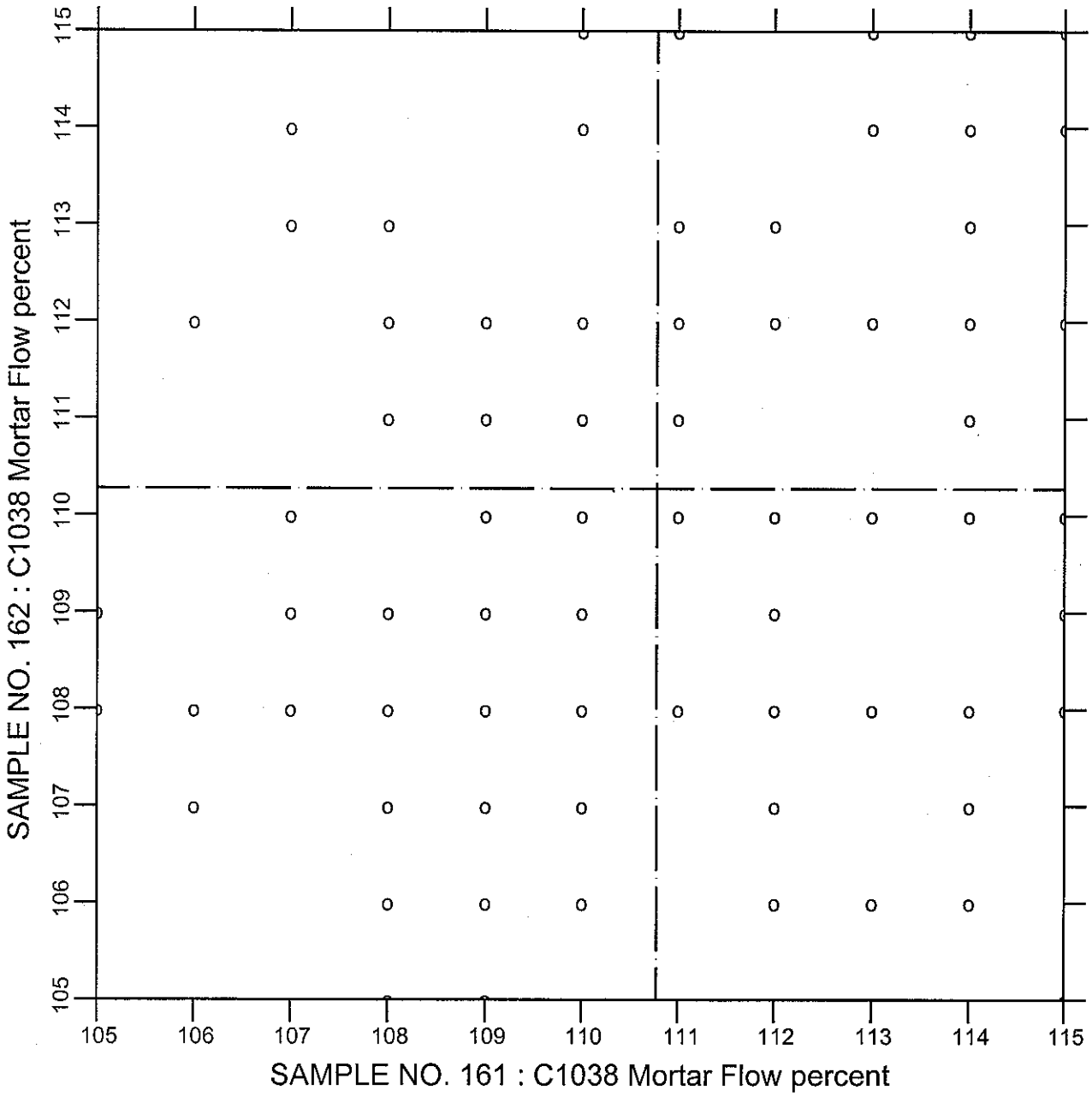
CCRL PROFICIENCY SAMPLE PROGRAM
C1038 Mortar - Water
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.410 C1038 Mortar Water 133 POINTS

SAMPLE NO. 161 AVE 236.67 S.D. 5.6 C.V. 2.38
SAMPLE NO. 162 AVE 236.07 S.D. 5.8 C.V. 2.44
LABS ELIMINATED 207 493 932

CCRL PROFICIENCY SAMPLE PROGRAM
C1038 Mortar - Flow
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.402 C1038 Mortar Flow 128 POINTS

SAMPLE NO. 161 AVE 110.78 S.D. 2.6 C.V. 2.35
SAMPLE NO. 162 AVE 110.27 S.D. 2.7 C.V. 2.47
LABS ELIMINATED 440 883 1936 416 2351 3125 3126

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 161 and No. 162
Final Report - Heat of Hydration Results
October 11, 2006

SUMMARY OF RESULTS

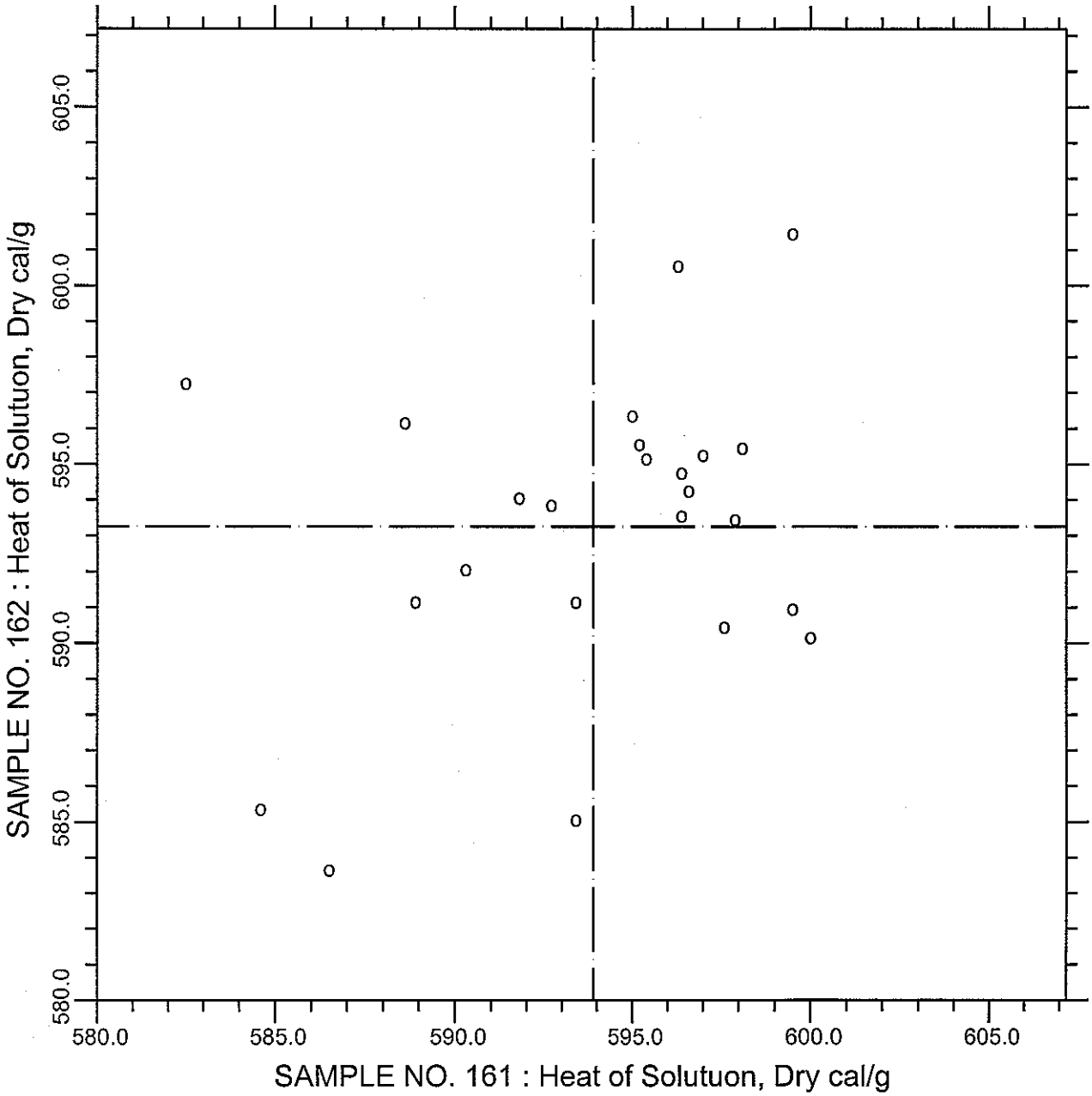
			Sample No. 161			Sample No. 162		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Heat Solution, Dry	cal/g	26	593.5	5.3	0.890	592.6	9.6	1.628
Heat Solution, Dry	cal/g *	24	593.9	4.8	0.809	593.3	4.3	0.730
Heat Sol, 7 day	cal/g	26	514.8	7.4	1.43	512.9	8.5	1.66
Heat Sol, 7 day	cal/g *	25	515.6	6.6	1.27	514.0	6.7	1.30
Heat Sol, 28 day	cal/g	20	504.0	5.0	1.000	504.9	5.0	1.000
Heat Hyd, 7 day	cal/g	27	79.0	5.9	7.50	79.8	6.6	8.32
Heat Hyd, 28 day	cal/g	21	91.2	6.0	6.53	90.6	4.2	4.64

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

Heat of Solution, Dry 139 2435

Heat of Solution, 7 day 2435

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Solution - Dry Cement
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

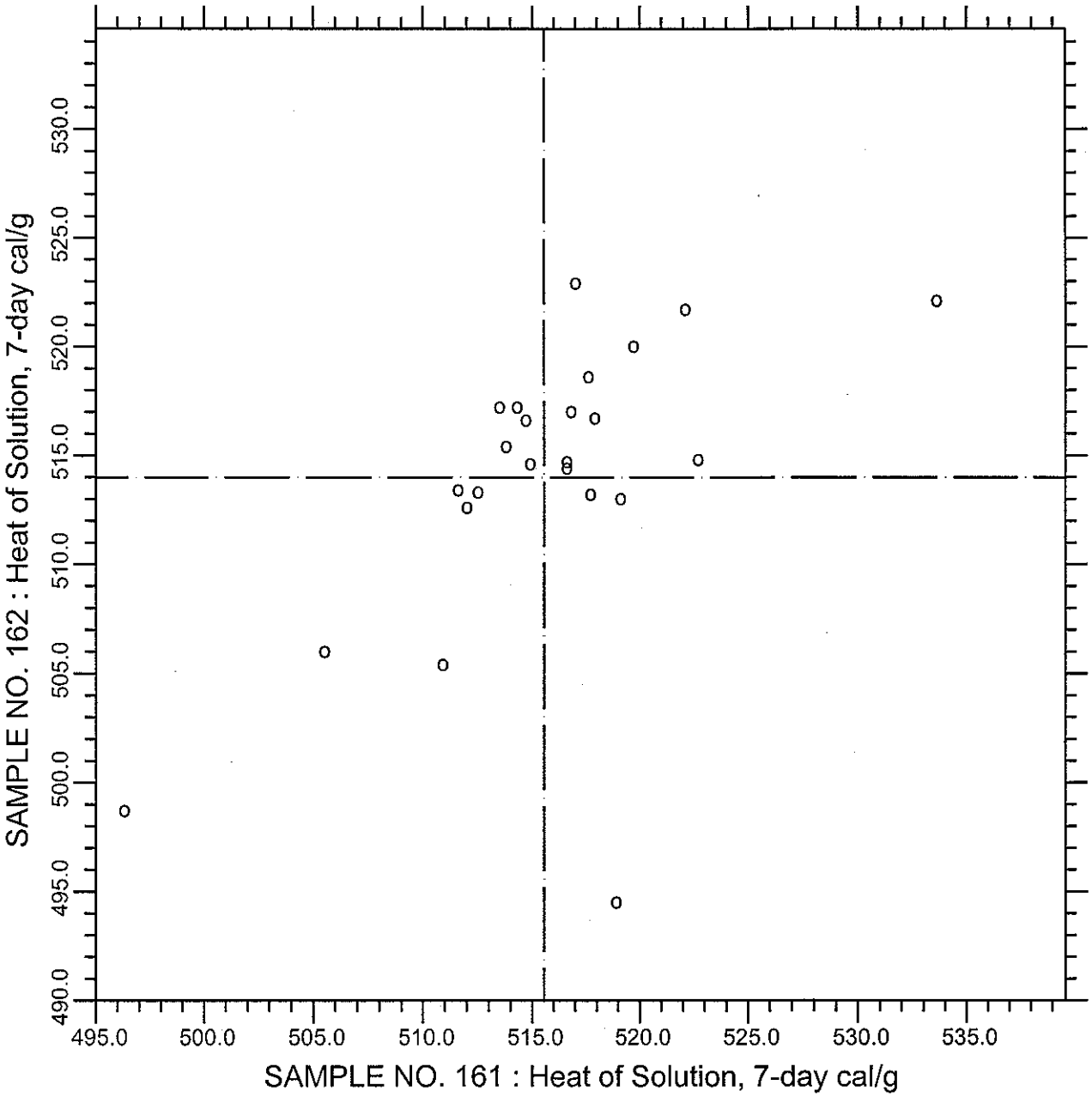


TEST NO.291 Heat of Solutuon, Dry 24 POINTS

SAMPLE NO. 161	AVE	593.90	S.D. 4.8	C.V. 0.809
SAMPLE NO. 162	AVE	593.26	S.D. 4.3	C.V. 0.730

LABS ELIMINATED 139 2435

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Solution - 7-day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162

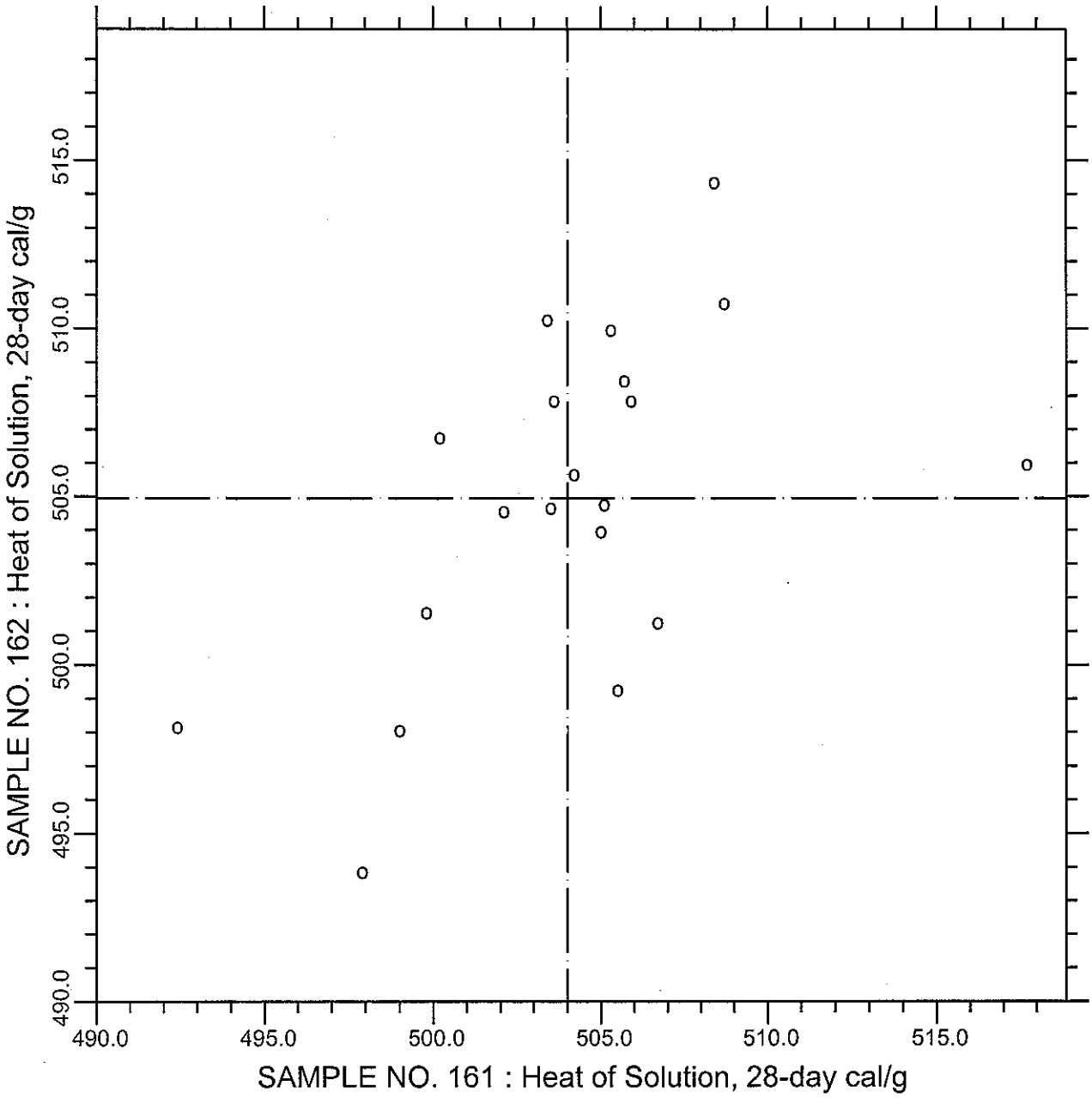


TEST NO.292 Heat of Solution, 7-day 25 POINTS

SAMPLE NO. 161	AVE	515.6	S.D.	6.6	C.V. 1.27
SAMPLE NO. 162	AVE	514.0	S.D.	6.7	C.V. 1.30

LABS ELIMINATED 2435

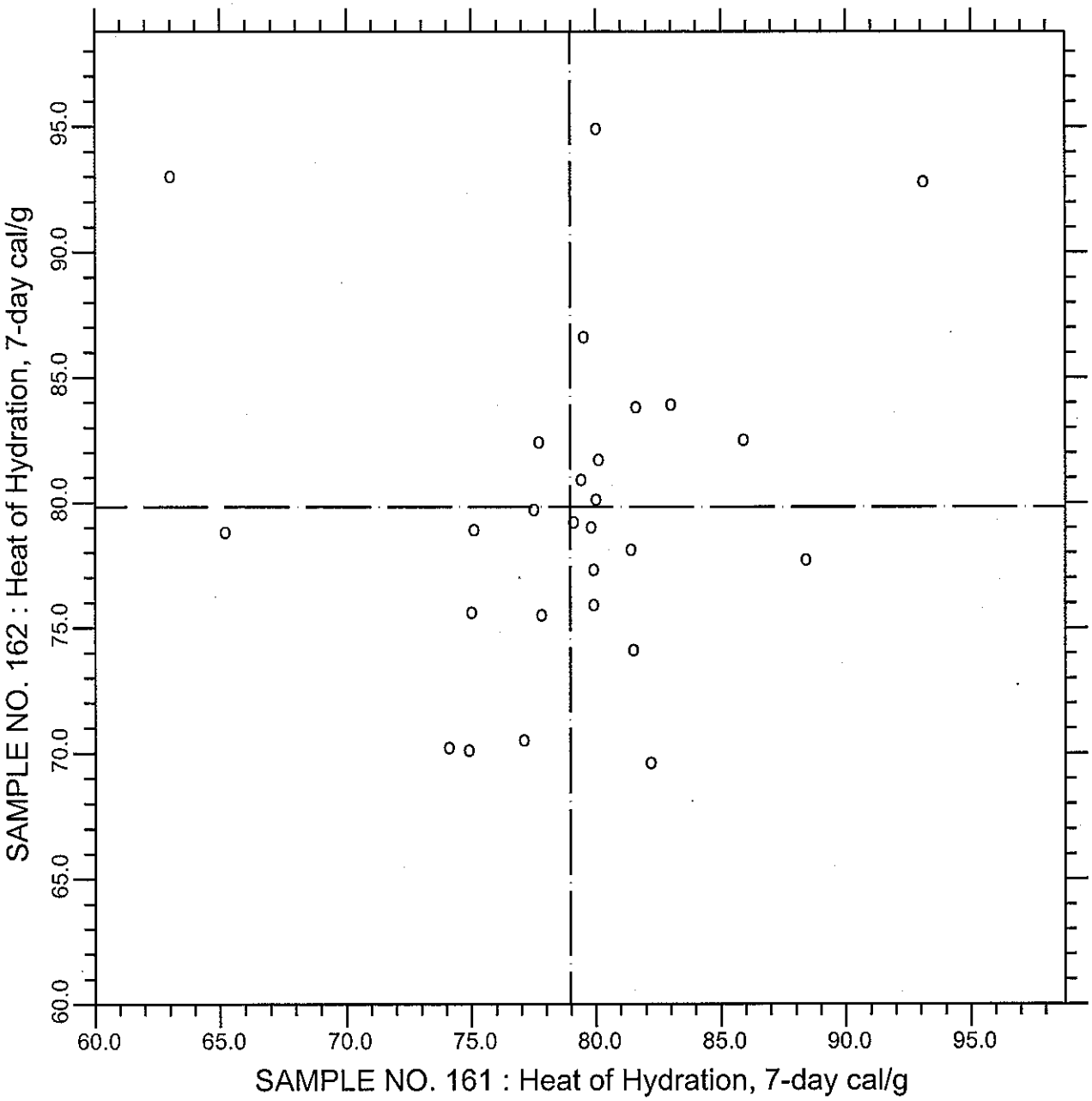
CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Solution - 28-day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.301 Heat of Solution, 28-day 20 POINTS

SAMPLE NO. 161	AVE	504.0	S.D.	5.0	C.V.	1.000
SAMPLE NO. 162	AVE	504.9	S.D.	5.0	C.V.	1.000

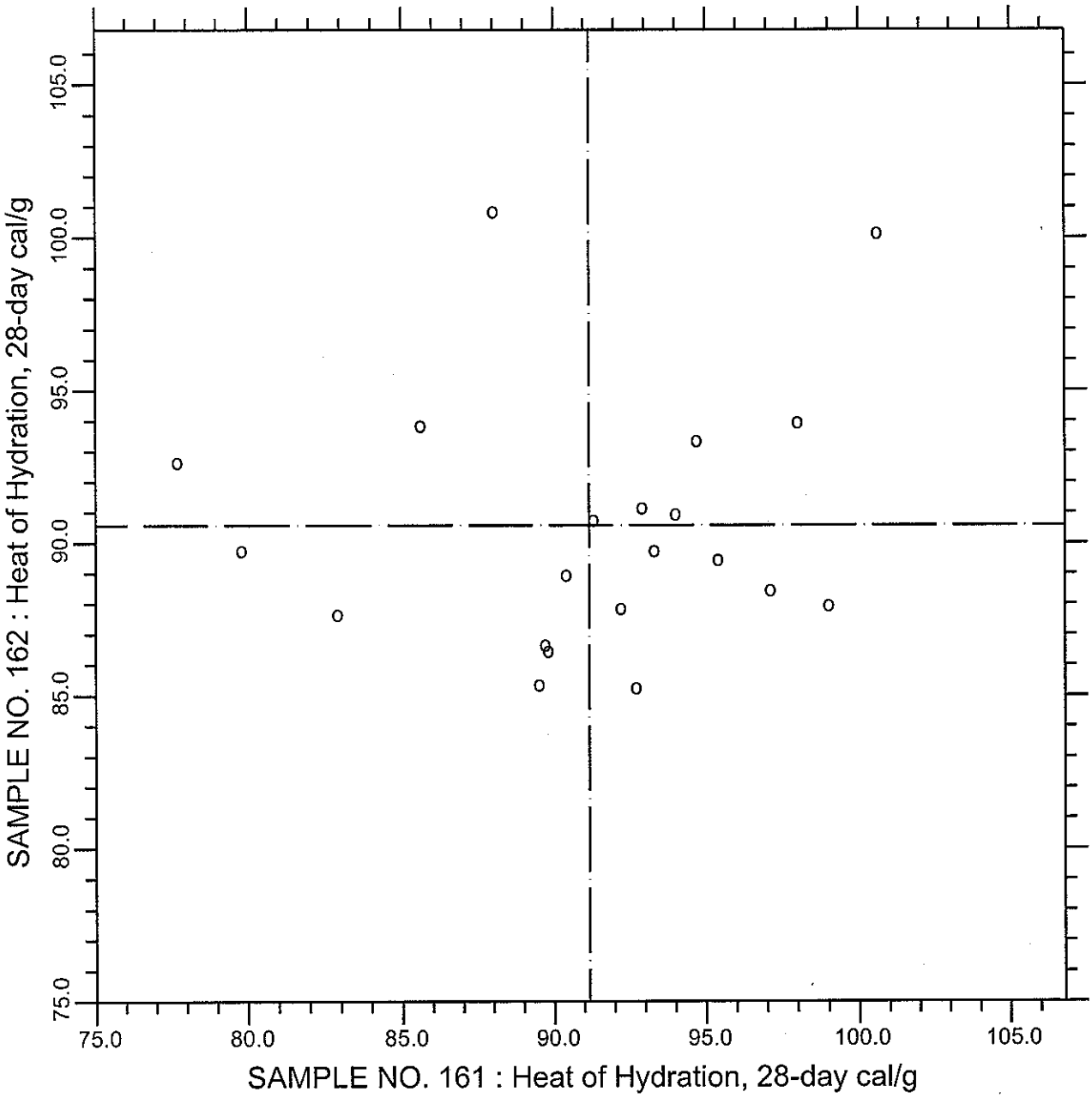
CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Hydration - 7-day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.290 Heat of Hydration, 7-day 27 POINTS

SAMPLE NO. 161	AVE	79.0	S.D.	5.9	C.V.	7.50
SAMPLE NO. 162	AVE	79.8	S.D.	6.6	C.V.	8.32

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Hydration - 28-day
PORTLAND CEMENT SAMPLES NO. 161 & NO. 162



TEST NO.300 Heat of Hydration, 28-day 21 POINTS

SAMPLE NO. 161	AVE	91.17	S.D.	6.0	C.V.	6.53
SAMPLE NO. 162	AVE	90.58	S.D.	4.2	C.V.	4.64