CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Portland Cement Proficiency Samples
Number 165 and Number 166

September 2007

CCRL CEMENT AND CONCRETE REFERENCE LABORATORY

CCRL
Cement and Concrete Reference Laboratory

www.ccrl.us

September 7, 2007

TO: Participants in the CCRL Portland Cement Proficiency Sample Program

SUBJECT: Final Report on Portland Cement Proficiency Samples No. 165 and No. 166

Following is the final report for the current pair of CCRL **Portland Cement** Proficiency Samples which were distributed in June 2007. Portland Cement Sample No 165 was an ASTM C150 Type I/II with limestone additions and No. 166 was an 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 calculation 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 2008.

Sincerely,

Robin K. Haupt

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

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. 165 and No. 166

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 2007. 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)

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[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.*

and compressive strength mortar (test no. 230). Air content flows in the range of 87.5 ± 7.5 are satisfactory, 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.

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. For this pair of samples, tricalcium silicate and dicalcium silicate results from laboratories not reporting CO_2 content were not included in calculation of statistics and were not assigned ratings.

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.

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.

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. 165 and No. 166
Final Report - Chemical Results
September 7, 2007

SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Silicon Dioxide	prcnt	240	20.58	0.38	1.82	19.05	0.37	1.95
Silicon Dioxide	prcnt	*224	20.63	0.22	1.05	19.04	0.25	1.31
Aluminum Oxide	prcnt	237	4.50	0.14	3.04	5.30	0.75	14.13
Aluminum Oxide	prcnt	*222	4.49	0.094	2.08	5.26	0.157	2.99
Ferric Oxide	prcnt	239	2.89	0.078	2.71	2.38	0.092	3.86
Ferric Oxide	prcnt	*225	2.90	0.049	1.70	2.38	0.049	2.06
Calcium Oxide	prcnt	238	62.63	0.67	1.07	63.44	0.77	1.21
Calcium Oxide	prcnt	*225	62.65	0.38	0.601	63.49	0.45	0.708
Magnesium Oxide	prcnt	239	2.59	0.14	5.30	2.09	0.12	5.94
Magnesium Oxide	prcnt	*222	2.59	0.082	3.17	2.08	0.067	3.22
Sulfur Trioxide	prcnt	243	3.23	0.12	3.81	3.67	0.17	4.68
Sulfur Trioxide	prcnt	*233	3.23	0.10	3.18	3.68	0.12	3.16
Loss on Ignition	prcnt	237	2.14	0.19	9.07	2.39	0.20	8.45
Loss on Ignition	prcnt	*230	2.14	0.11	5.27	2.40	0.13	5.39
Sodium Oxide	prcnt	227	0.159	0.035	22.3	0.156	0.036	23.2
Sodium Oxide	prcnt	*213	0.160	0.024	15.1	0.156	0.025	16.2

CONTINUED ON NEXT PAGE

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

Silicon Dioxide 20 51 69 696 768 2 26 50 93 126 132 201 207 504 2466 3235

Aluminum Oxide 26 69 768 1196 1251 30 43 47 143 305 494 504 696 1644 2466

Ferric Oxide 30 69 696 1524 1525 8 18 25 143 305 1523 1853 2039 2466

Calcium Oxide 2 3 43 168 2466 30 50 69 80 125 201 3233 3235

Magnesium Oxide 2 69 166 414 696 1251 2466 3127 1 8 26 504 667 1525 2483 2621 3233

Sulfur Trioxide 41 51 69 143 354 501 870 1940 2305 3009

Loss on Ignition 98 175 205 492 696 2621 3235

Sodium Oxide 168 698 1196 2464 2466 48 407 501 1799 1853 2621 3124 3233 3234

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 165 and No. 166
Final Report - Chemical Results
September 7, 2007

SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Potassium Oxide	prcnt	230	0.722	0.073	10.2	1.149	0.138	12.0
Potassium Oxide	prcnt	*212	0.726	0.020	2.75	1.175	0.035	2.98
Titanium Dioxide	prcnt	179	0.23	0.019	8.16	0.22	0.017	7.50
Titanium Dioxide	prcnt	*170	0.23	0.0085	3.69	0.22	0.0088	3.97
Phosphorus Pent	prcnt	169	0.140	0.028	20.0	0.140	0.026	18.2
Phosphorus Pent	prcnt	*158	0.139	0.0093	6.70	0.139	0.0084	6.09
Zinc Oxide	prcnt	78	0.018	0.035	188	0.018	0.041	227
Zinc Oxide	prcnt	* 76	0.014	0.0030	20.9	0.013	0.0036	27.1
Manganic Oxide	prcnt	130	0.196	0.046	23.6	0.056	0.020	35.5
Manganic Oxide	prcnt	*111	0.204	0.0066	3.24	0.055	0.0038	7.06
Chloride	prcnt	93	0.012	0.0112	90.3	0.010	0.0068	67.0
Chloride	prcnt	* 91	0.011	0.0051	45.7	0.009	0.0042	44.6
Insoluble Residue	prcnt	223	0.47	0.17	36.3	0.19	0.14	74.5
Insoluble Residue	prcnt	*207	0.45	0.099	22.0	0.17	0.083	49.2
Free Calcium Oxid	prcnt	189	0.78	0.20	25.6	0.97	0.26	26.4
Free Calcium Oxid	prcnt	*184	0.77	0.18	23.6	0.97	0.22	23.1

CONTINUED ON NEXT PAGE

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

Potassium Oxide 8 30 69 92 95 354 696 1196 73 75 975 1524 1853 2293 2466 3009 3233 3235

Titanium Dioxide 504 1251 47 125 175 492 696 2296 2466

Phosphorus Pentoxide 504 27 95 166 493 494 687 1196 1940 2293 2466

Zinc Oxide 30 95

Manganic Oxide 54 69 124 206 1196 1466 2466 309 696 1916 2412 2462 178 354 494 1940 2296 2484 3059

Chloride 2363 3057

Insoluble Residue 123 201 206 497 3127 3233 3235 15 121 203 289 407 1525 2296 3009 3249

Free Calcium Oxide 107 132 161 1054 1644

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 165 and No. 166
Final Report - Chemical Results
September 7, 2007

SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Carbon Dioxide	prcnt	181	1.42	0.41	29.2	1.72	0.44	25.4
Carbon Dioxide	prcnt	*167	1.47	0.25	17.3	1.78	0.26	14.8
Limestone	prcnt	177	4.0	1.05	26.4	4.0	0.84	21.2
Limestone	prcnt	*167	4.1	0.80	19.3	4.1	0.60	14.7
Chromium Oxide	prcnt	78	0.025	0.0071	28.1	0.011	0.0048	42.8
Chromium Oxide	prcnt	* 71	0.025	0.0072	28.5	0.011	0.0045	40.4
[1)]Tricalcium Silicate	prcnt	168	49.1	5.3	10.7	57.5	6.1	10.6
[(1)]Tricalcium Silicate	prcnt	*166	49.1	4.8	9.85	57.6	5.6	9.80
[(1)]Dicalcium Silicate	prcnt	165	22.0	4.5	20.6	11.3	5.2	45.7
[(1)]Dicalcium Silicate	prcnt	*162	22.1	3.9	17.7	11.1	4.6	41.3
Tricalc Aluminate	prcnt	207	7.0	0.40	5.72	9.8	1.10	11.26
Tricalc Aluminate	prcnt	*193	7.0	0.27	3.90	9.9	0.42	4.23
Tetracalc Alumino	prcnt	203	8.8	0.26	2.98	7.3	0.37	5.12
Tetracalc Alumino	prcnt	*187	8.8	0.14	1.60	7.2	0.15	2.08

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

Carbon Dioxide 96 167 611 690 1196 1483 2363 165 209 768 886 2462 3009 3059

Limestone 96 165 1196 1483 2363 2462 209 611 886 3009

Chromium Oxide 1466 69 2296

Tricalcium Silicate 30 2466

Dicalcium Silicate 30 50 2466

Tricalcium Aluminate 30 69 143 354 694 8 18 43 47 696 1525 1644 2466 3124

Tetracalcium Aluminoferrite 30 69 93 152 696 1525 2466 8 18 25 121 143 305 1523 1853 3124

NOTES:

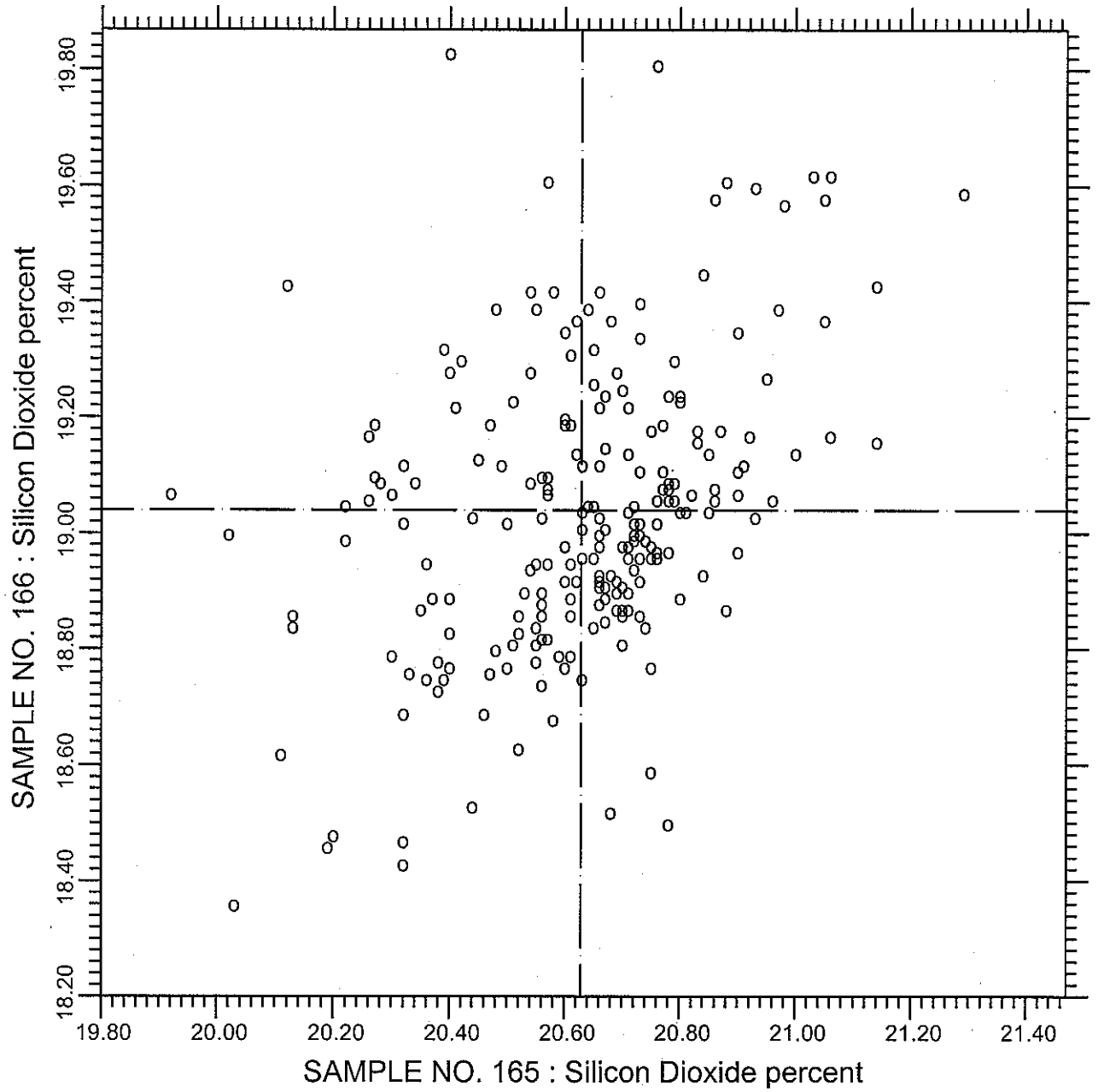
(1) Tricalcium silicate and Dicalcium silicate - ASTM C150 requires that cements containing limestone additions use CO_2 in the calculation of these two phases. Both Sample No. 165 and Sample No. 166 contain limestone additions, therefore test results of 40 laboratories not determining CO_2 were not used in calculating the statistics. See the following page for listing of excluded labs.

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

List of laboratories reporting test results for tricalcium silicate and dicalcium silicate but did not report values for CO_2.

8	870
40	918
45	996
47	1053
69	1523
80	1525
95	1853
106	1940
158	2116
161	2251
162	2435
181	2477
206	2483
219	2484
221	3057
252	3124
289	3126
407	3127
557	3235
696	
787	

CCRL PROFICIENCY SAMPLE PROGRAM
Silicon Dioxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



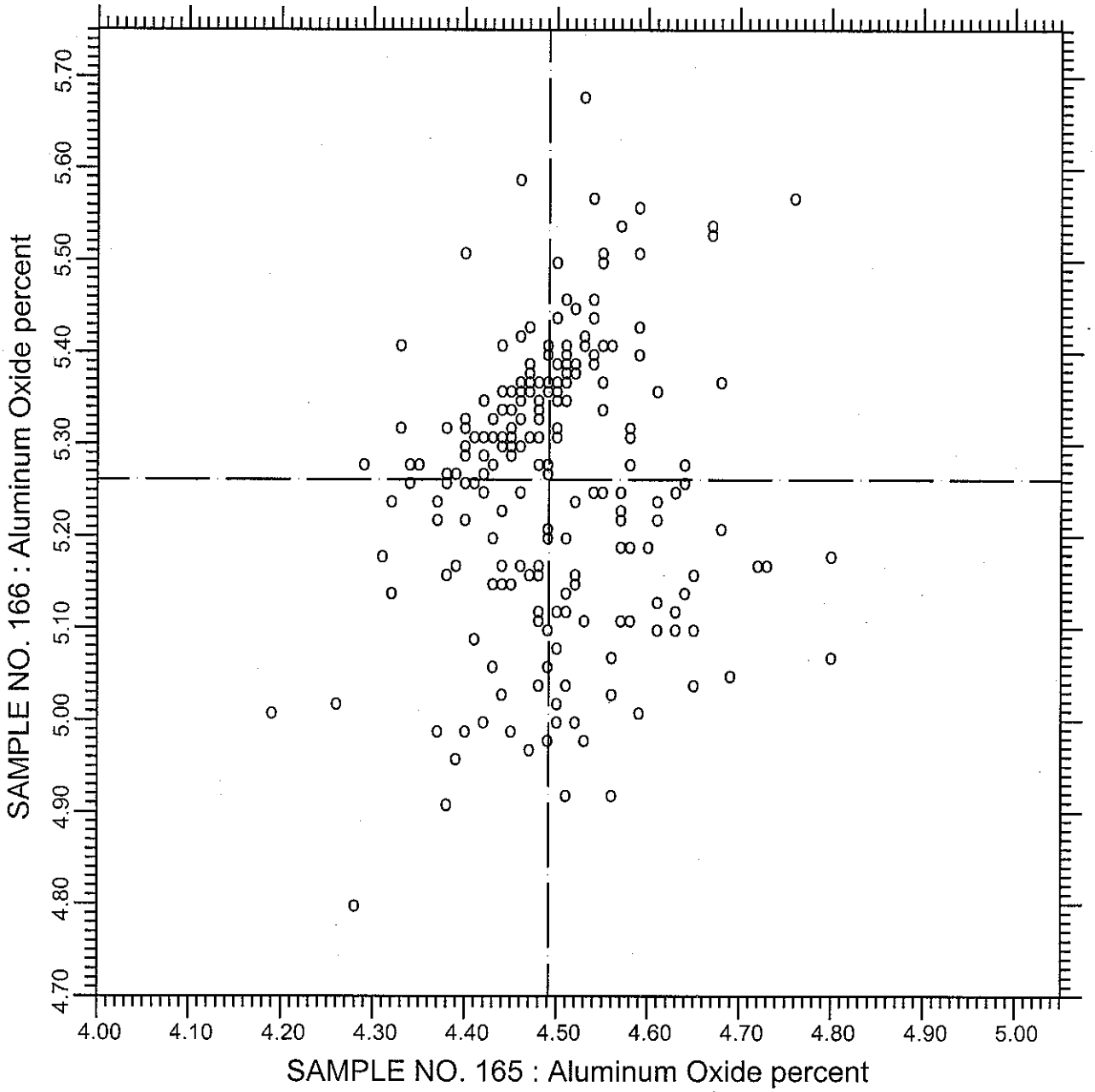
TEST NO.10 Silicon Dioxide 224 POINTS

SAMPLE NO. 165 AVE 20.629 S.D. 0.22 C.V. 1.05

SAMPLE NO. 166 AVE 19.040 S.D. 0.25 C.V. 1.31

LABS ELIMINATED 20 51 69 696 768 2 26 50 93 126 132 201 207 504 2466 3235

CCRL PROFICIENCY SAMPLE PROGRAM
Aluminum Oxide - wo/minor oxides
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.21 Aluminum Oxide 220 POINTS

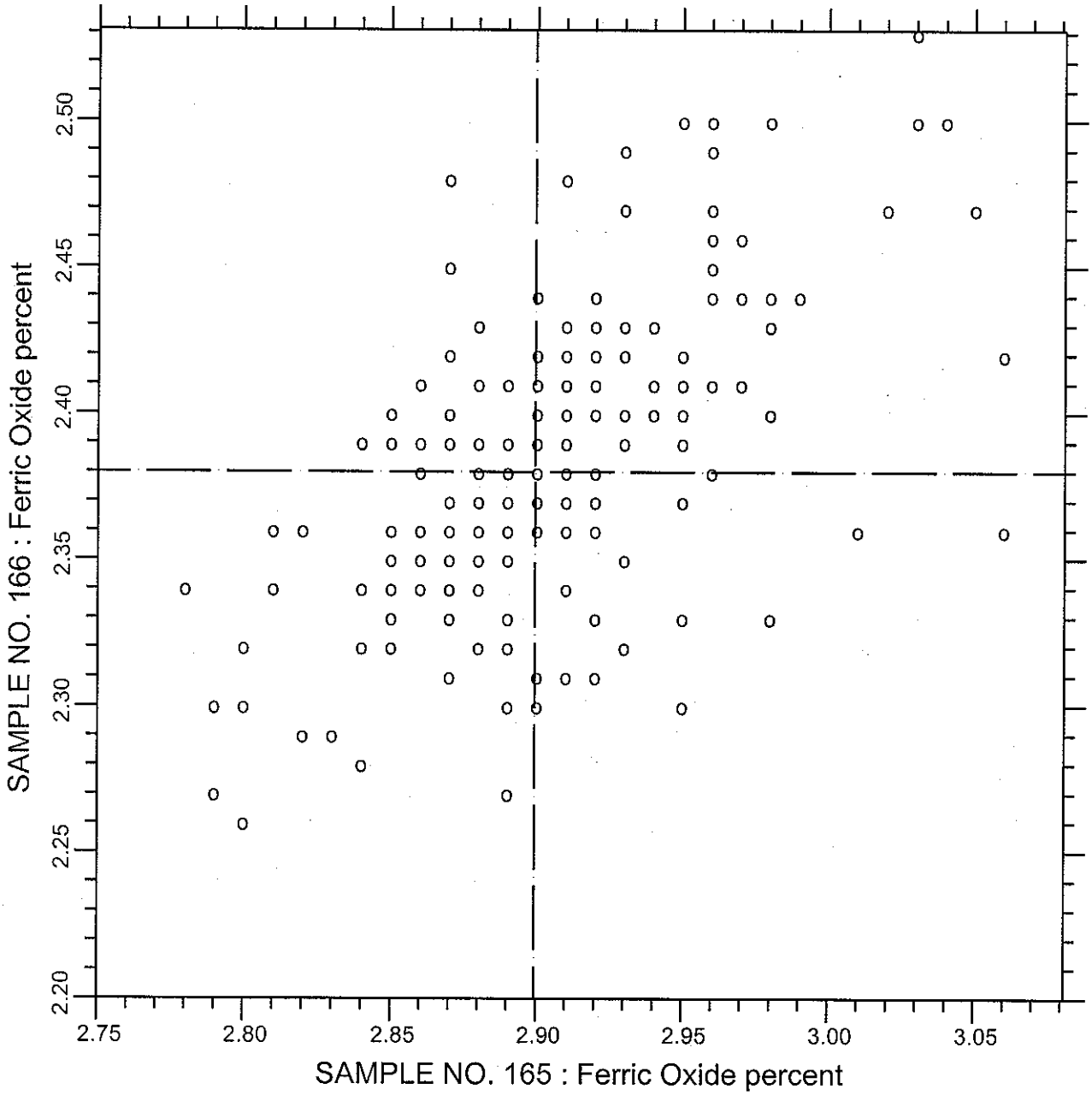
SAMPLE NO. 165 AVE 4.4917 S.D. 0.094 C.V. 2.08

SAMPLE NO. 166 AVE 5.2615 S.D. 0.157 C.V. 2.99

LABS ELIMINATED 26 69 768 1196 1251 30 43 47 143 305 494 504 696 1644 2466

LABS OFF DIAGRAM 8 125

CCRL PROFICIENCY SAMPLE PROGRAM
Ferric Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.30 Ferric Oxide 224 POINTS

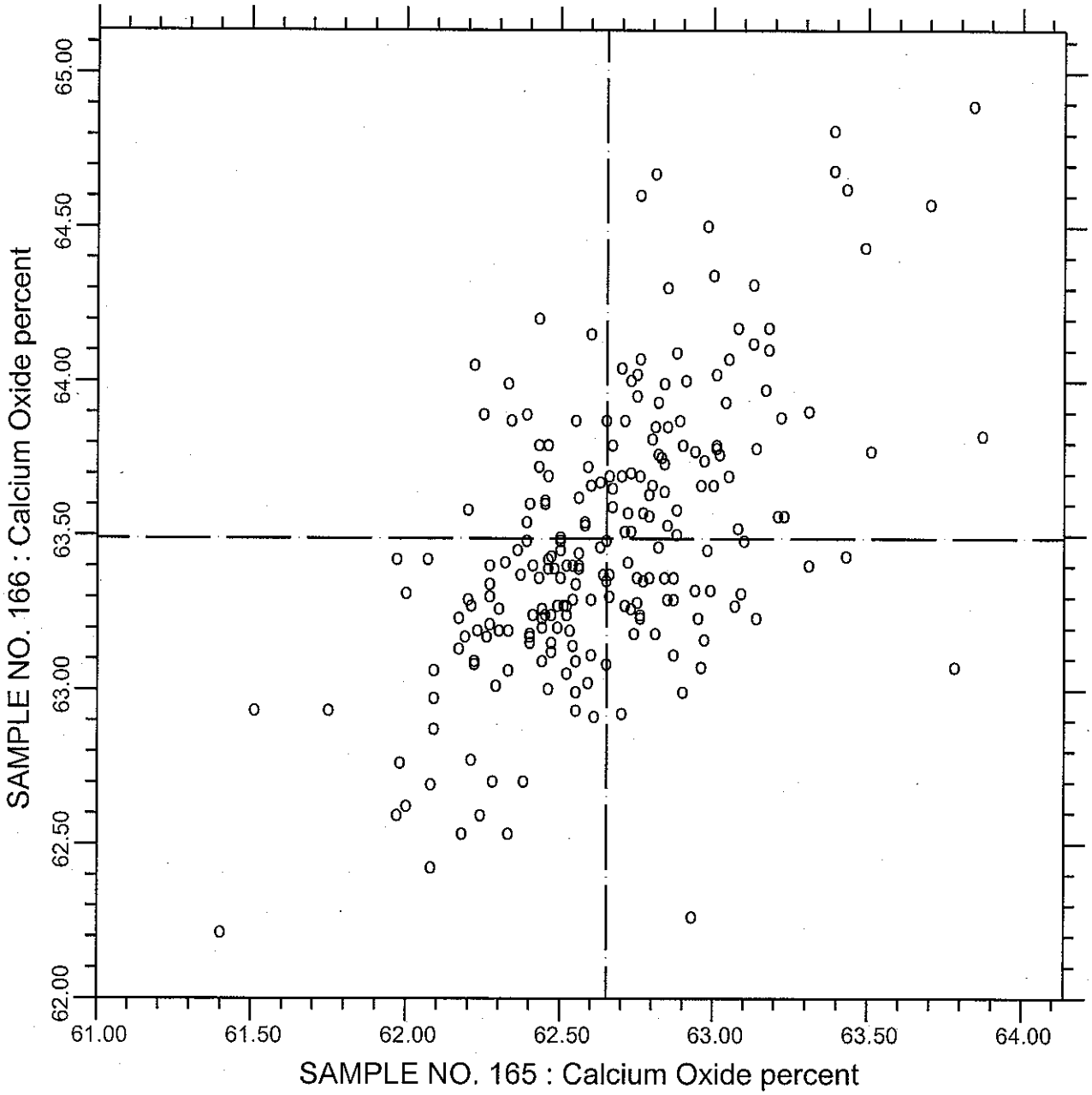
SAMPLE NO. 165 AVE 2.8994 S.D. 0.049 C.V. 1.70

SAMPLE NO. 166 AVE 2.3800 S.D. 0.049 C.V. 2.06

LABS ELIMINATED 30 69 696 1524 1525 8 18 25 143 305 1523 1853 2039 2466

LABS OFF DIAGRAM 121

CCRL PROFICIENCY SAMPLE PROGRAM
Calcium Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



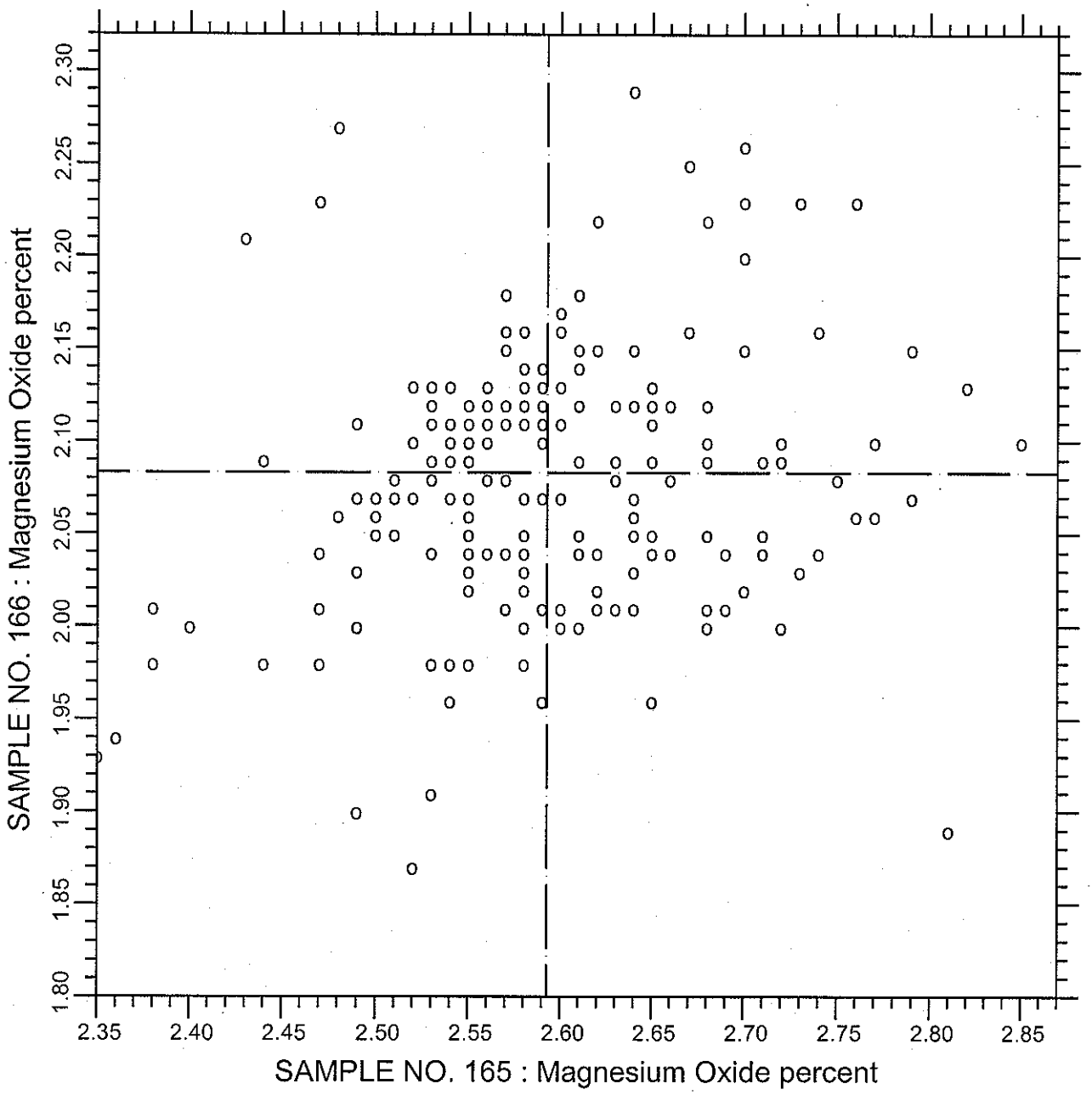
TEST NO.40 Calcium Oxide 225 POINTS

SAMPLE NO. 165 AVE 62.652 S.D. 0.38 C.V. 0.601

SAMPLE NO. 166 AVE 63.491 S.D. 0.45 C.V. 0.708

LABS ELIMINATED 2 3 43 168 2466 30 50 69 80 125 201 3233 3235

CCRL PROFICIENCY SAMPLE PROGRAM
Magnesium Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



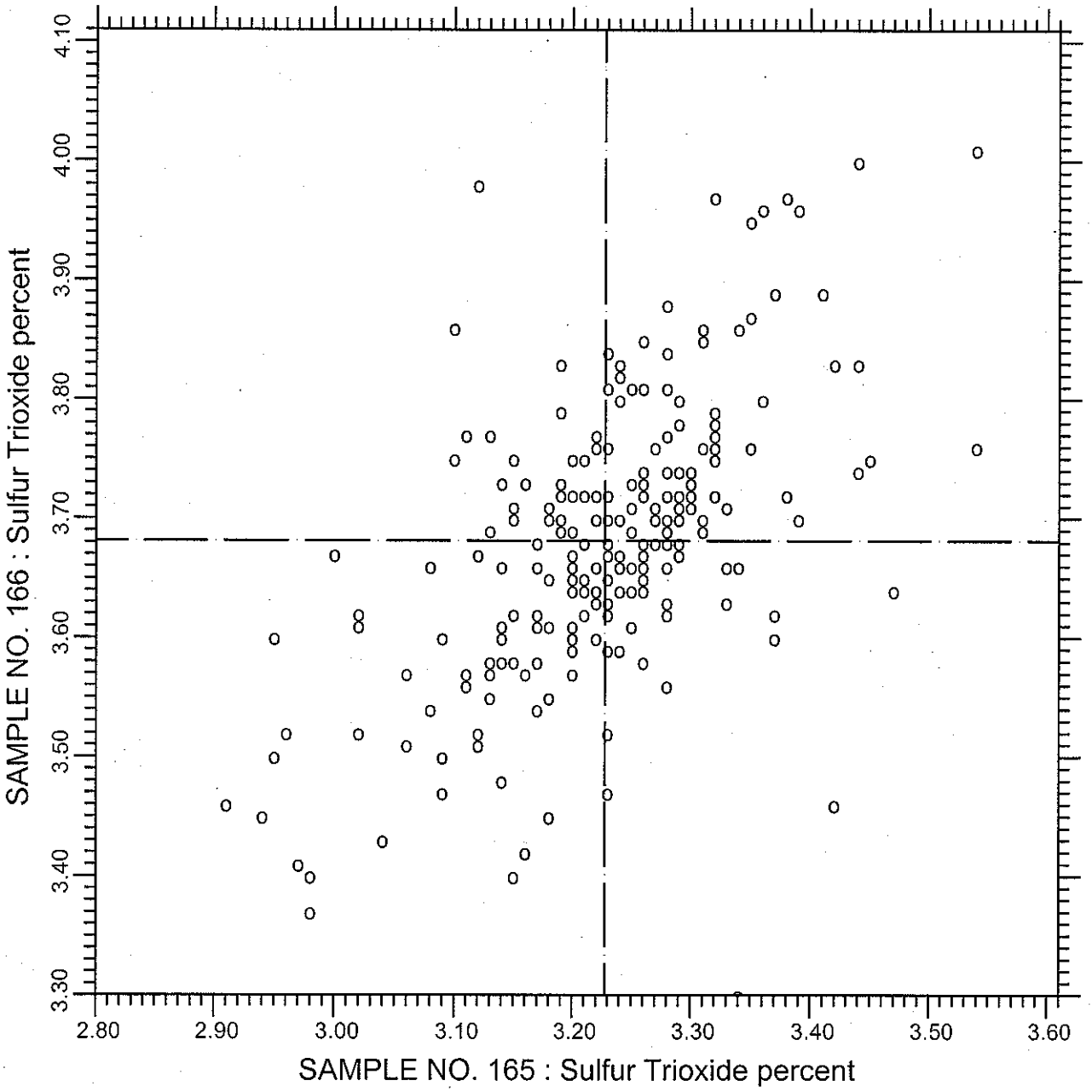
TEST NO.50 Magnesium Oxide 222 POINTS

SAMPLE NO. 165 AVE 2.5928 S.D. 0.082 C.V. 3.17

SAMPLE NO. 166 AVE 2.0832 S.D. 0.067 C.V. 3.22

LABS ELIMINATED 2 69 166 414 696 1251 2466 3127 1 8 26 504 667 1525 2483 2621 3233

CCRL PROFICIENCY SAMPLE PROGRAM
Sulfur Trioxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



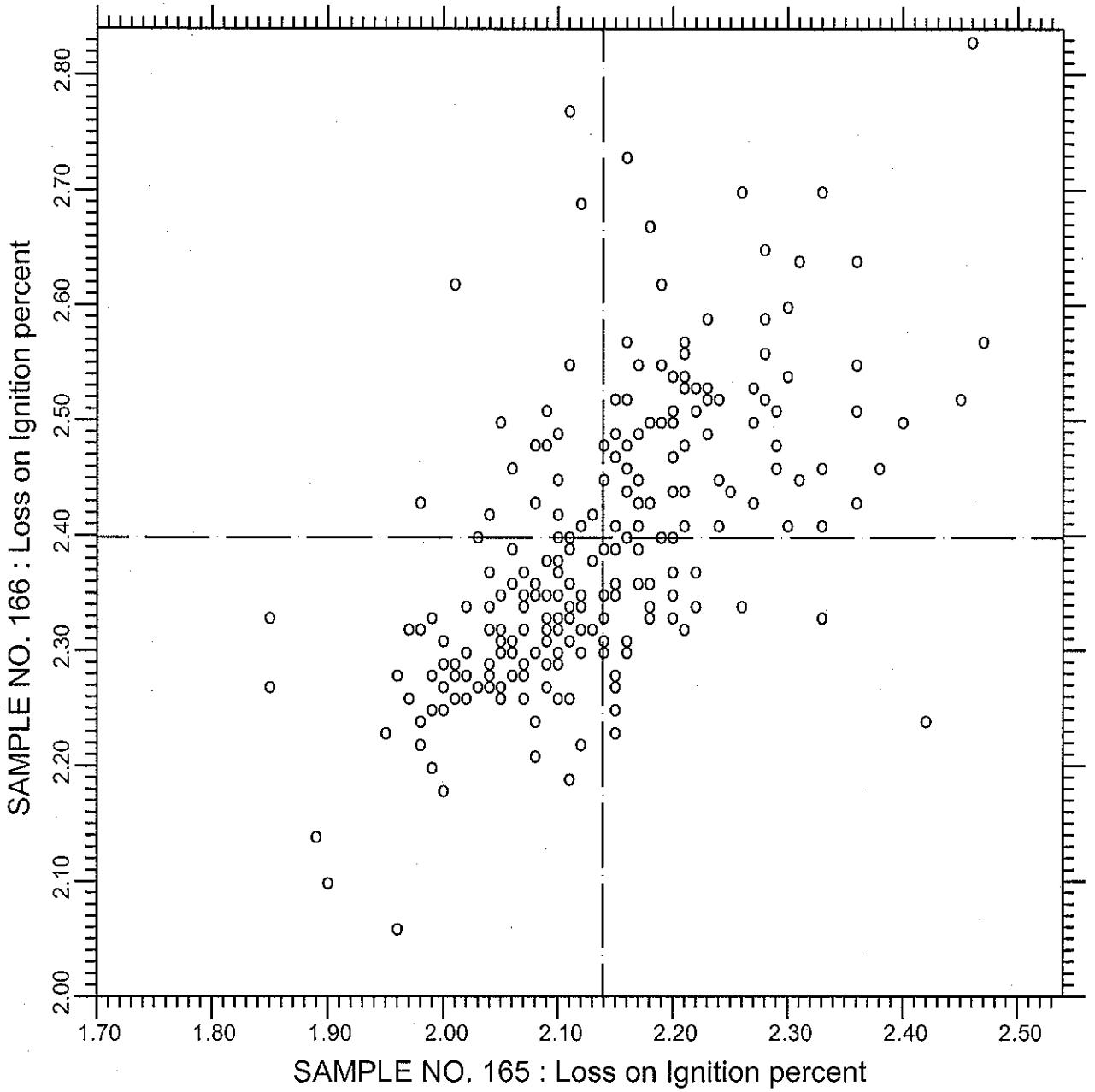
TEST NO.60 Sulfur Trioxide 233 POINTS

SAMPLE NO. 165 AVE 3.2277 S.D. 0.10 C.V. 3.18

SAMPLE NO. 166 AVE 3.6812 S.D. 0.12 C.V. 3.16

LABS ELIMINATED 41 51 69 143 354 501 870 1940 2305 3009

CCRL PROFICIENCY SAMPLE PROGRAM
Loss on Ignition
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.70 Loss on Ignition 228 POINTS

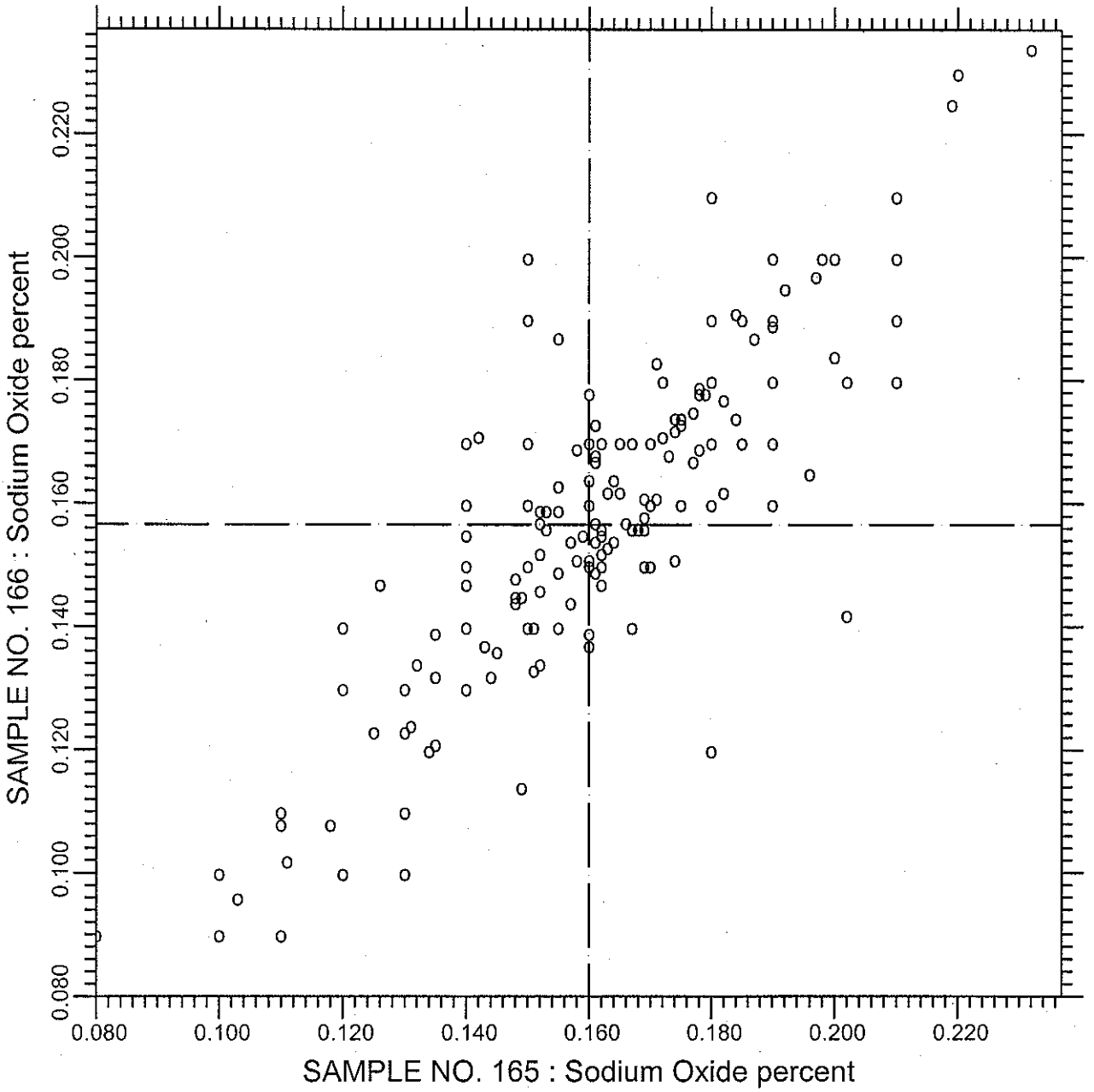
SAMPLE NO. 165 AVE 2.1393 S.D. 0.11 C.V. 5.27

SAMPLE NO. 166 AVE 2.3980 S.D. 0.13 C.V. 5.39

LABS ELIMINATED 98 175 205 492 696 2621 3235

LABS OFF DIAGRAM 289 502

CCRL PROFICIENCY SAMPLE PROGRAM
Sodium Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



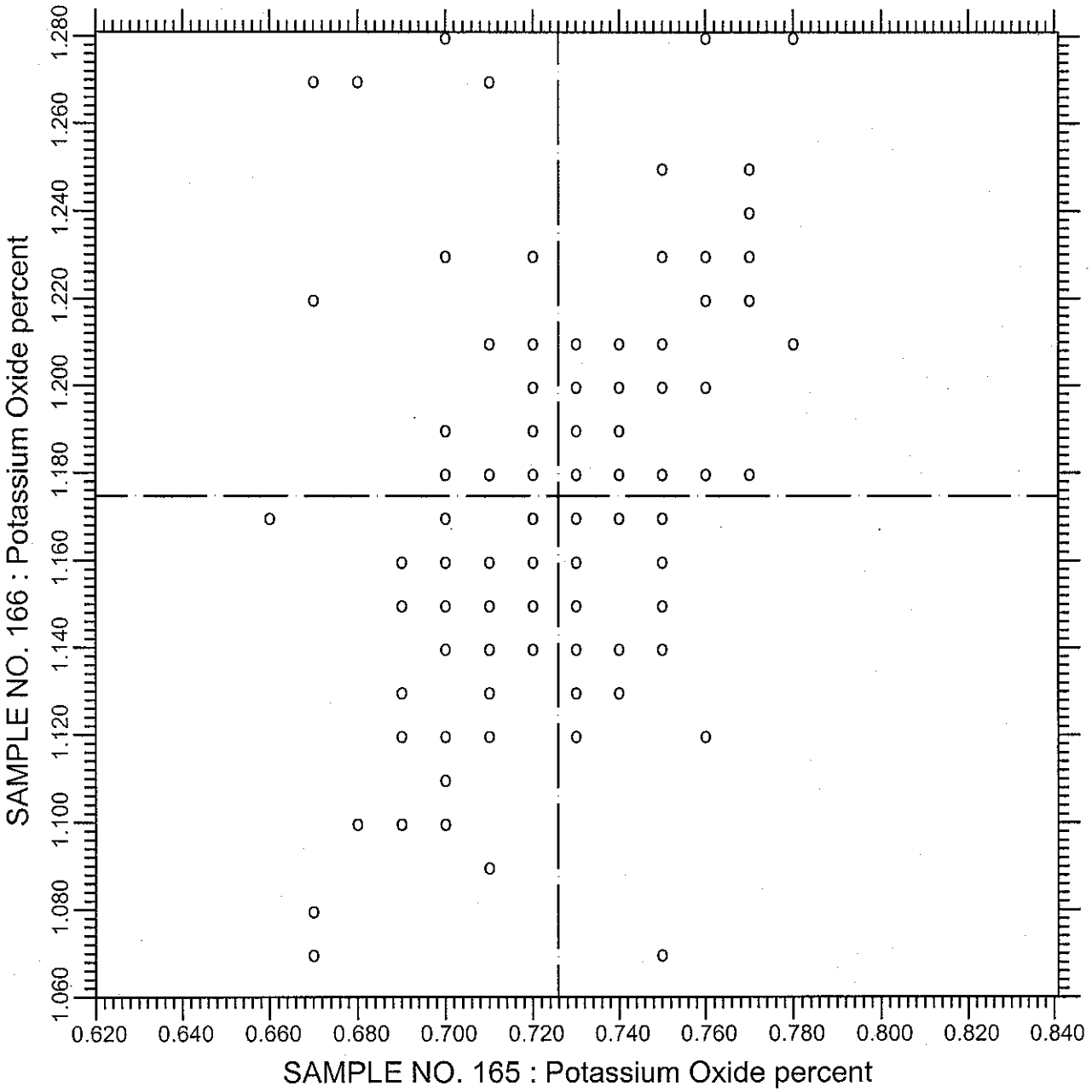
TEST NO.90 Sodium Oxide 213 POINTS

SAMPLE NO. 165 AVE 0.1600 S.D. 0.024 C.V. 15.1

SAMPLE NO. 166 AVE 0.1565 S.D. 0.025 C.V. 16.2

LABS ELIMINATED 168 698 1196 2464 2466 48 407 501 1799 1853 2621 3124 3233 3234

CCRL PROFICIENCY SAMPLE PROGRAM
Potassium Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.100 Potassium Oxide 211 POINTS

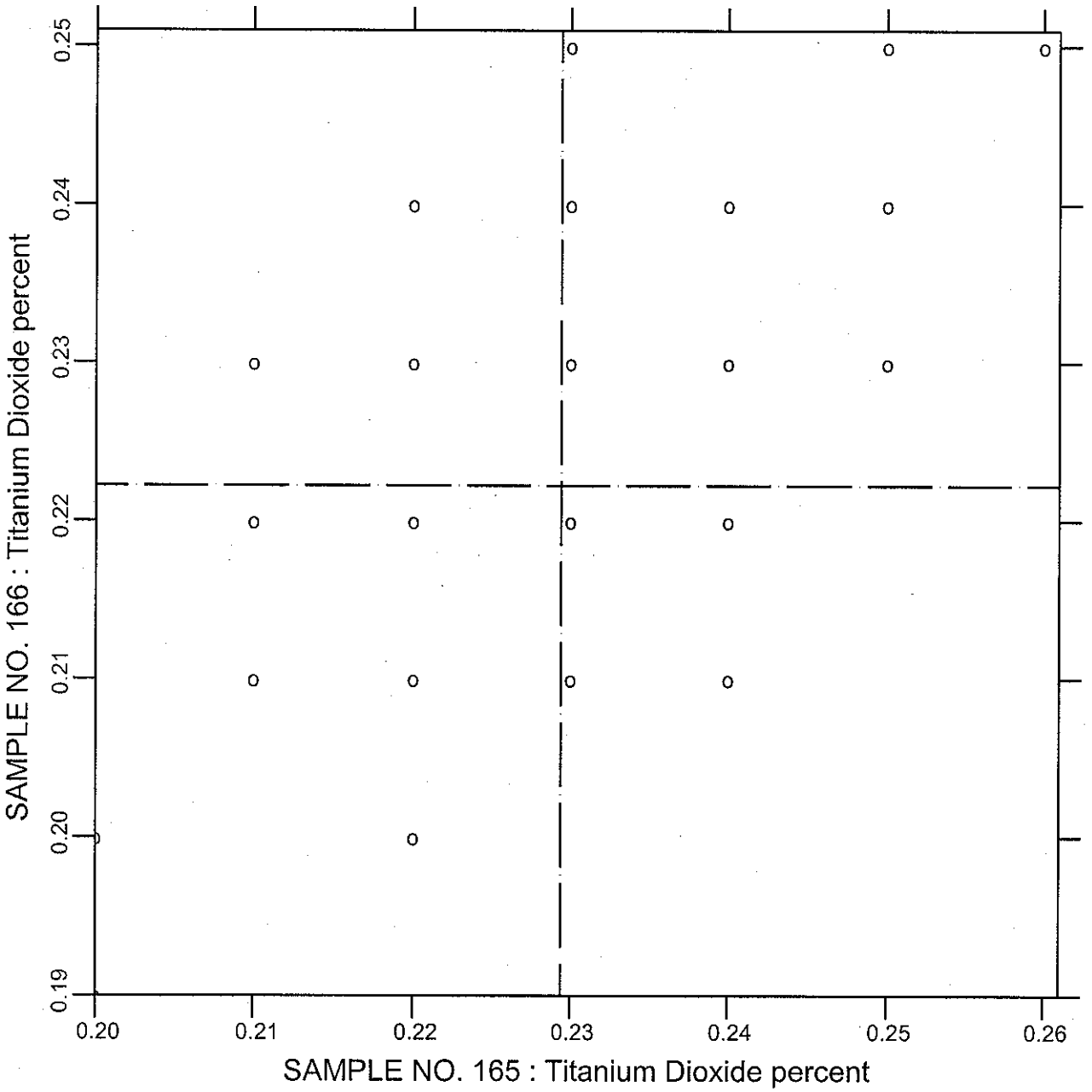
SAMPLE NO. 165 AVE 0.7258 S.D. 0.020 C.V. 2.75

SAMPLE NO. 166 AVE 1.1747 S.D. 0.035 C.V. 2.98

LABS ELIMINATED 8 30 69 92 95 354 696 1196 73 75 975 1524 1853 2293 2466 3009 3233 3235

LABS OFF DIAGRAM 270

CCRL PROFICIENCY SAMPLE PROGRAM
Titanium Dioxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

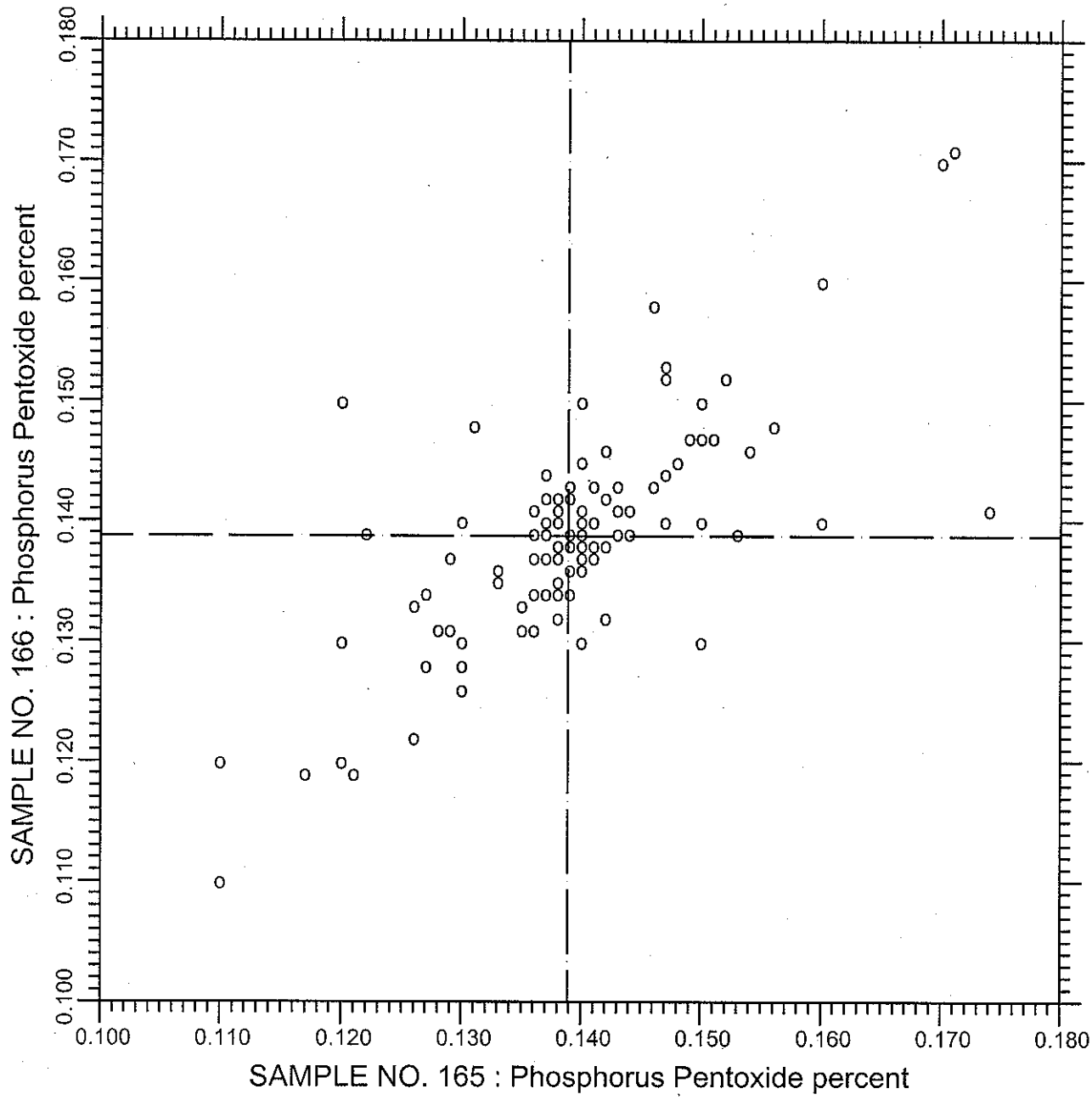


TEST NO.103 Titanium Dioxide 170 POINTS

SAMPLE NO. 165	AVE	0.22941	S.D.	0.0085	C.V. 3.69
SAMPLE NO. 166	AVE	0.22224	S.D.	0.0088	C.V. 3.97

LABS ELIMINATED 504 1251 47 125 175 492 696 2296 2466

CCRL PROFICIENCY SAMPLE PROGRAM
Phosphorus Pentoxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



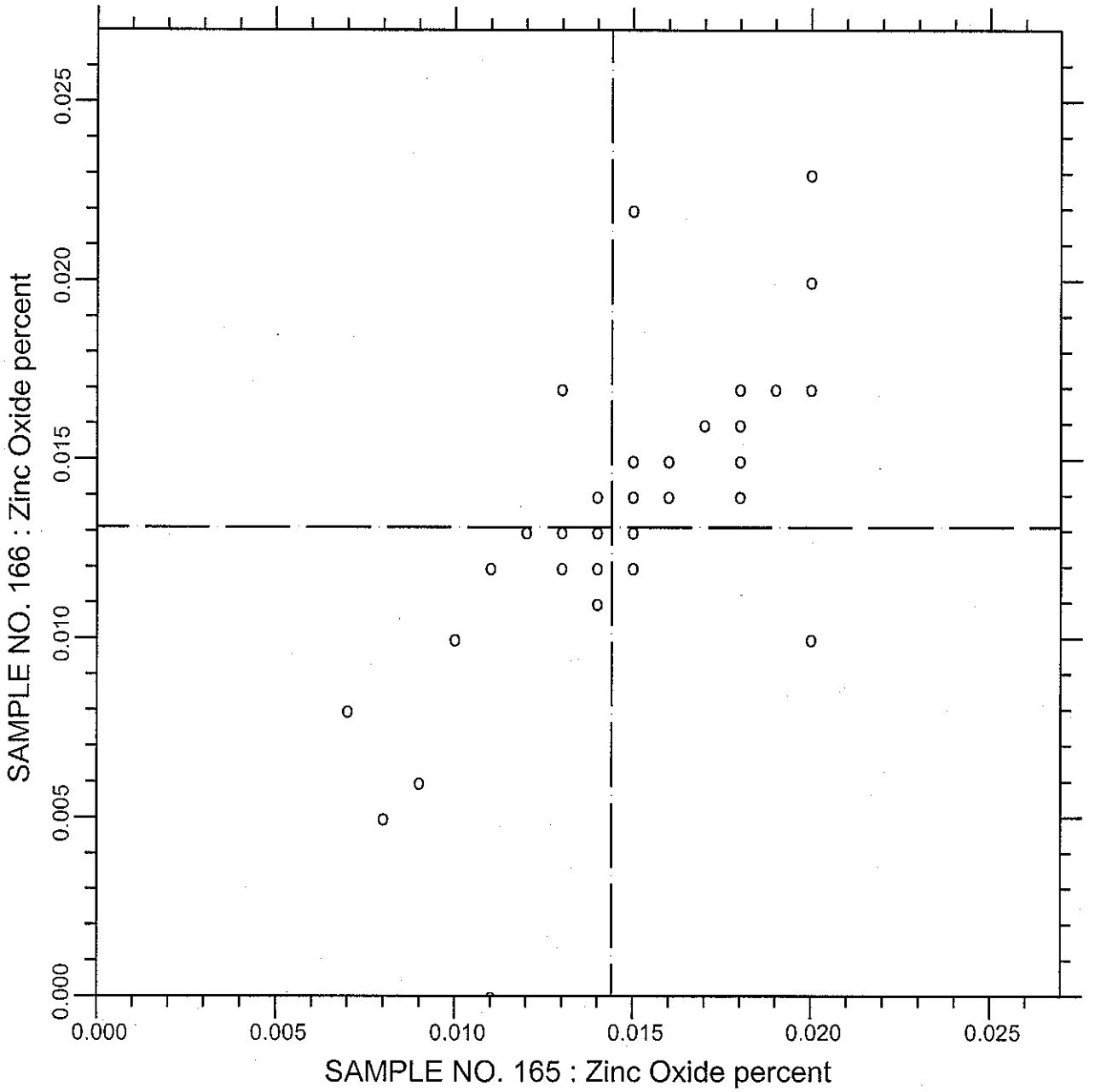
TEST NO.102 Phosphorus Pentoxide 158 POINTS

SAMPLE NO. 165 AVE 0.13890 S.D. 0.0093 C.V. 6.70

SAMPLE NO. 166 AVE 0.13873 S.D. 0.0084 C.V. 6.09

LABS ELIMINATED 504 27 95 166 493 494 687 1196 1940 2293 2466

CCRL PROFICIENCY SAMPLE PROGRAM
Zinc Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.99 Zinc Oxide 76 POINTS

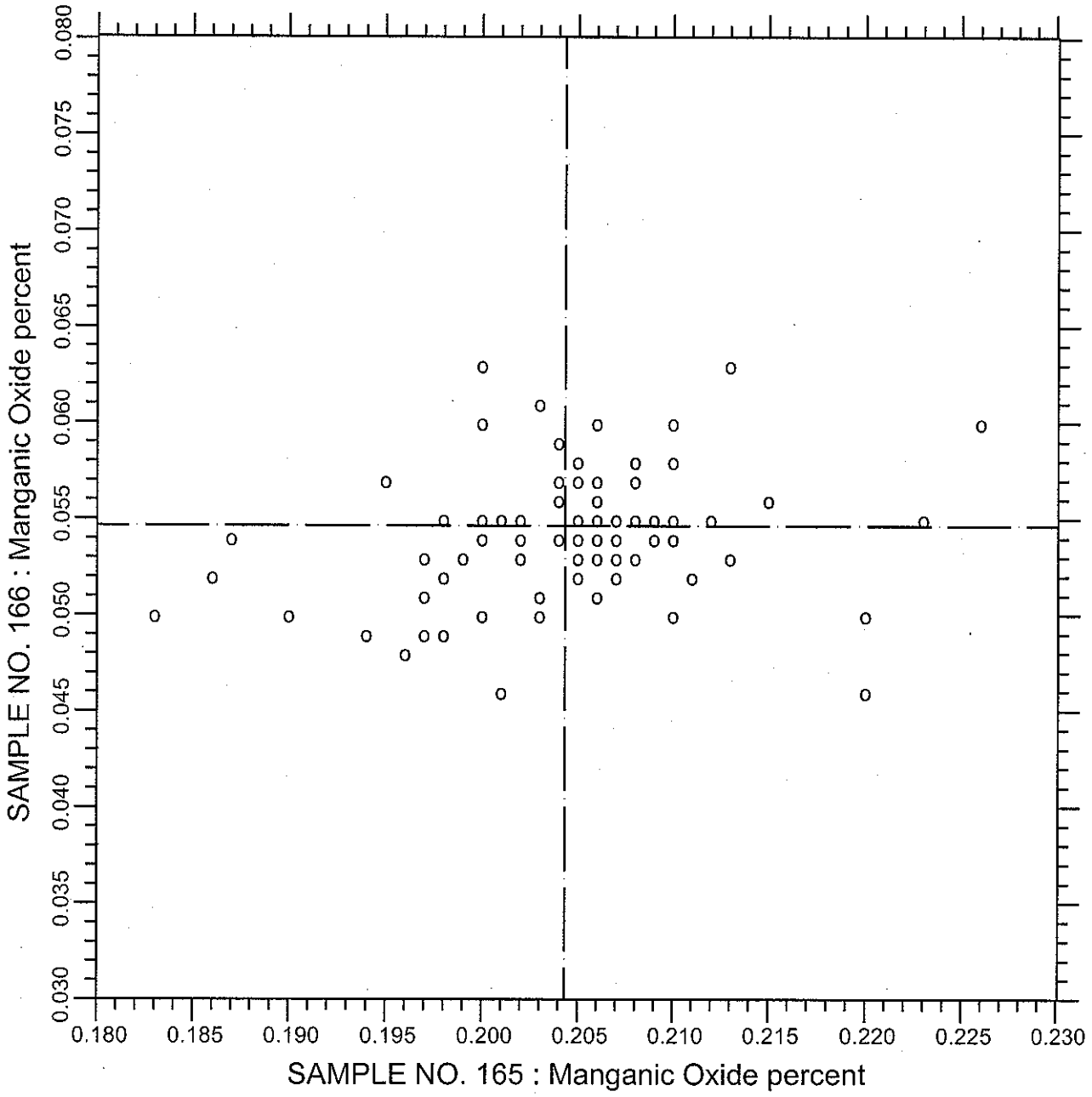
SAMPLE NO. 165	AVE	0.01441	S.D.	0.0030	C.V.	20.9
SAMPLE NO. 166	AVE	0.01310	S.D.	0.0036	C.V.	27.1

LABS ELIMINATED 30 95

CCRL PROFICIENCY SAMPLE PROGRAM

Manganic Oxide

PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



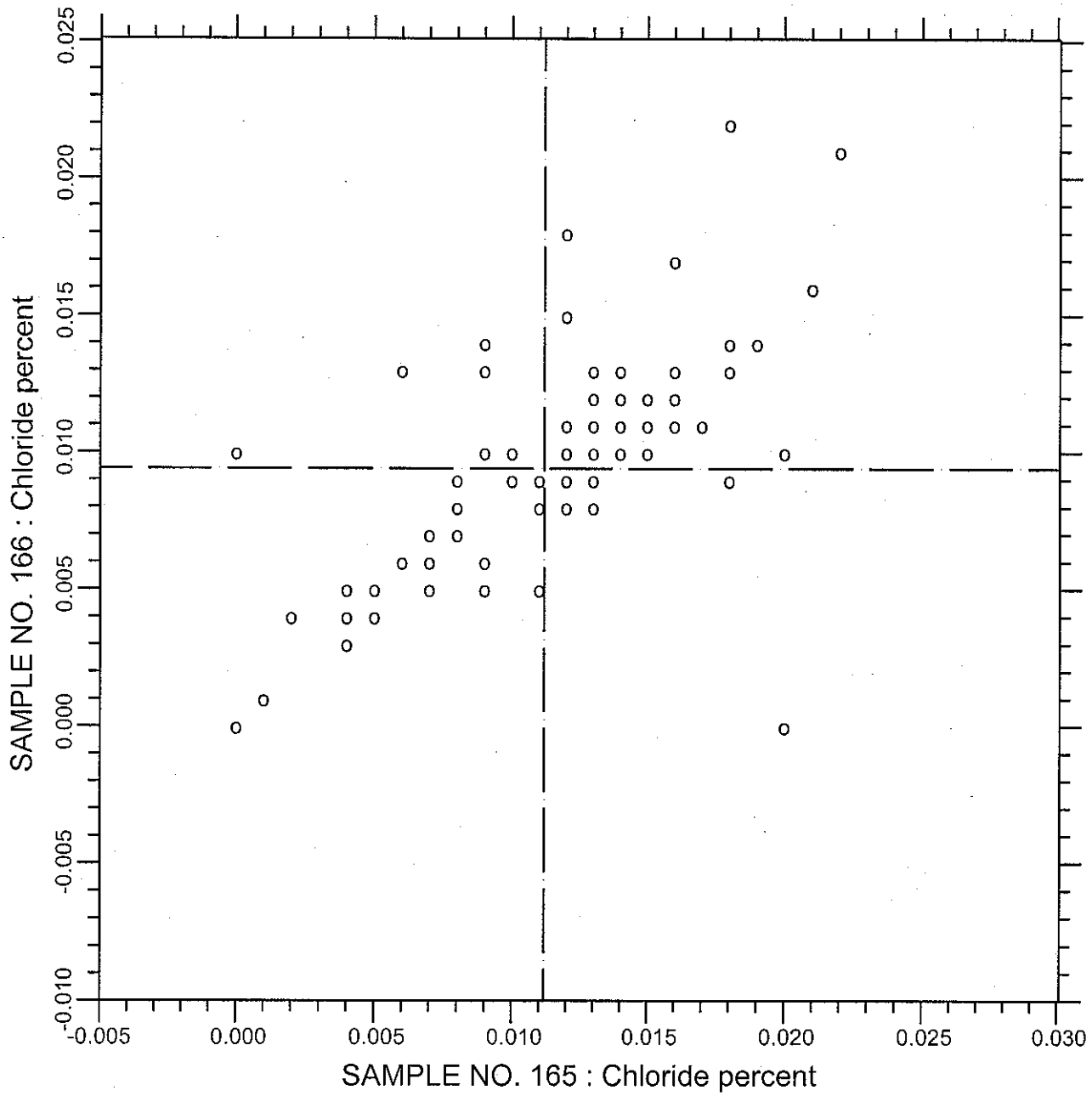
TEST NO.101 Manganic Oxide 111 POINTS

SAMPLE NO. 165 AVE 0.20434 S.D. 0.0066 C.V. 3.24

SAMPLE NO. 166 AVE 0.05465 S.D. 0.0038 C.V. 7.06

LABS ELIMINATED 54 69 124 206 1196 1466 2466 309 696 1916 2412 2462 178 354 494 1940 2296 2484 3059

CCRL PROFICIENCY SAMPLE PROGRAM
Chloride
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

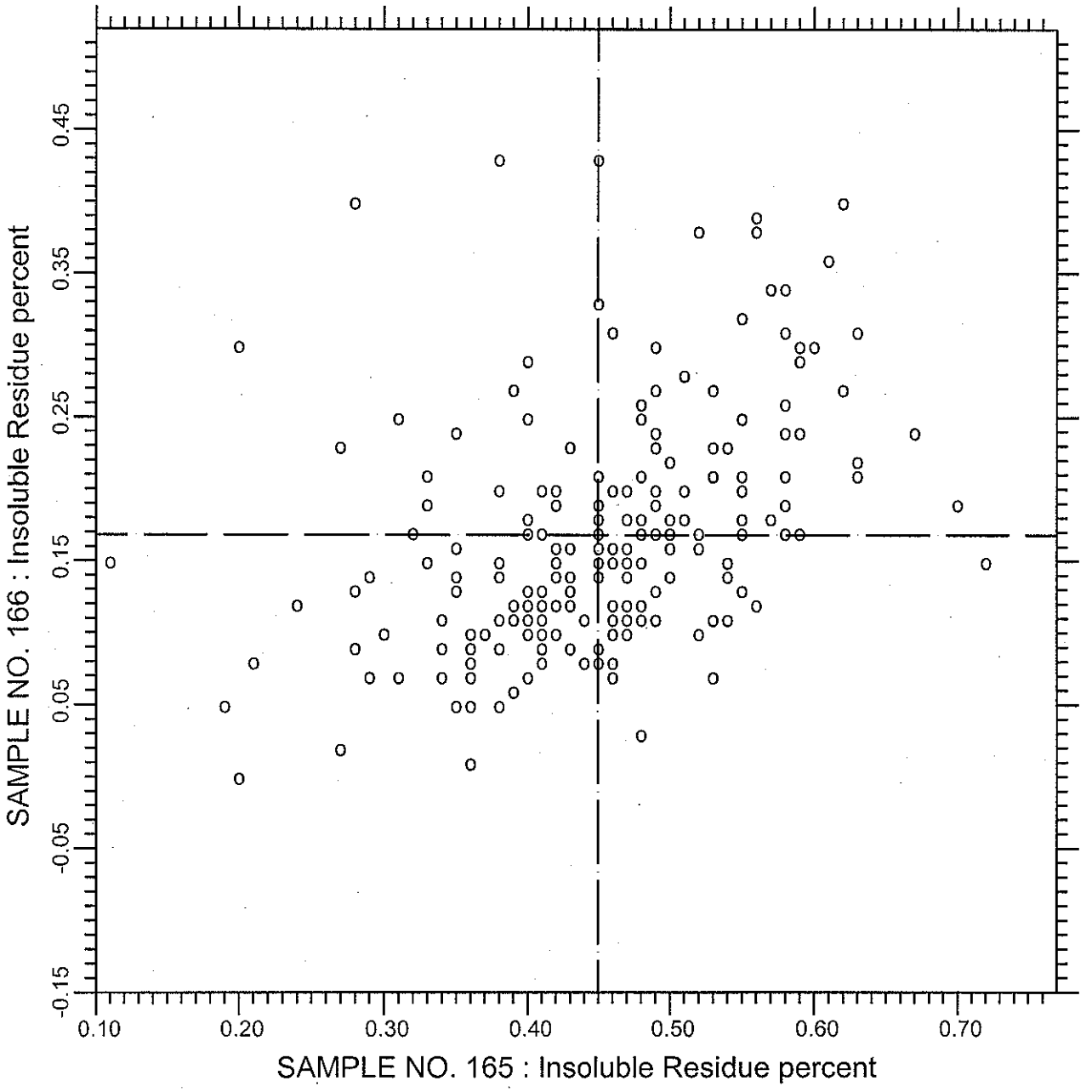


TEST NO.104 Chloride 91 POINTS

SAMPLE NO. 165	AVE	0.01119	S.D.	0.0051	C.V. 45.7
SAMPLE NO. 166	AVE	0.00941	S.D.	0.0042	C.V. 44.6

LABS ELIMINATED 2363 3057

CCRL PROFICIENCY SAMPLE PROGRAM
Insoluble Residue
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.80 Insoluble Residue 206 POINTS

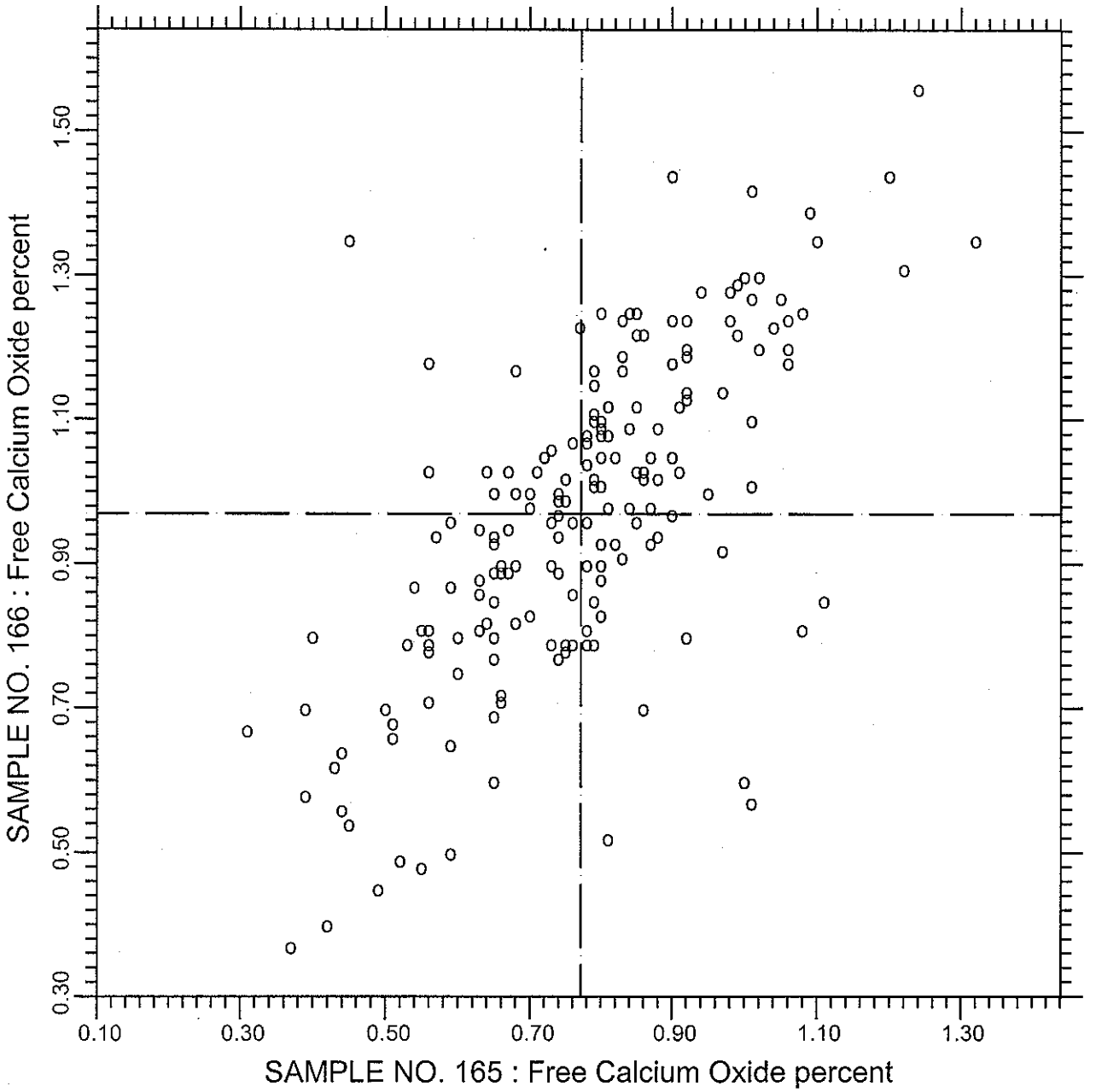
SAMPLE NO. 165 AVE 0.4498 S.D. 0.099 C.V. 22.0

SAMPLE NO. 166 AVE 0.1680 S.D. 0.083 C.V. 49.2

LABS ELIMINATED 123 201 206 497 3127 3233 3235 15 121 203 289 407 1525 2296 3009 3249

LABS OFF DIAGRAM 54

CCRL PROFICIENCY SAMPLE PROGRAM
Free Calcium Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

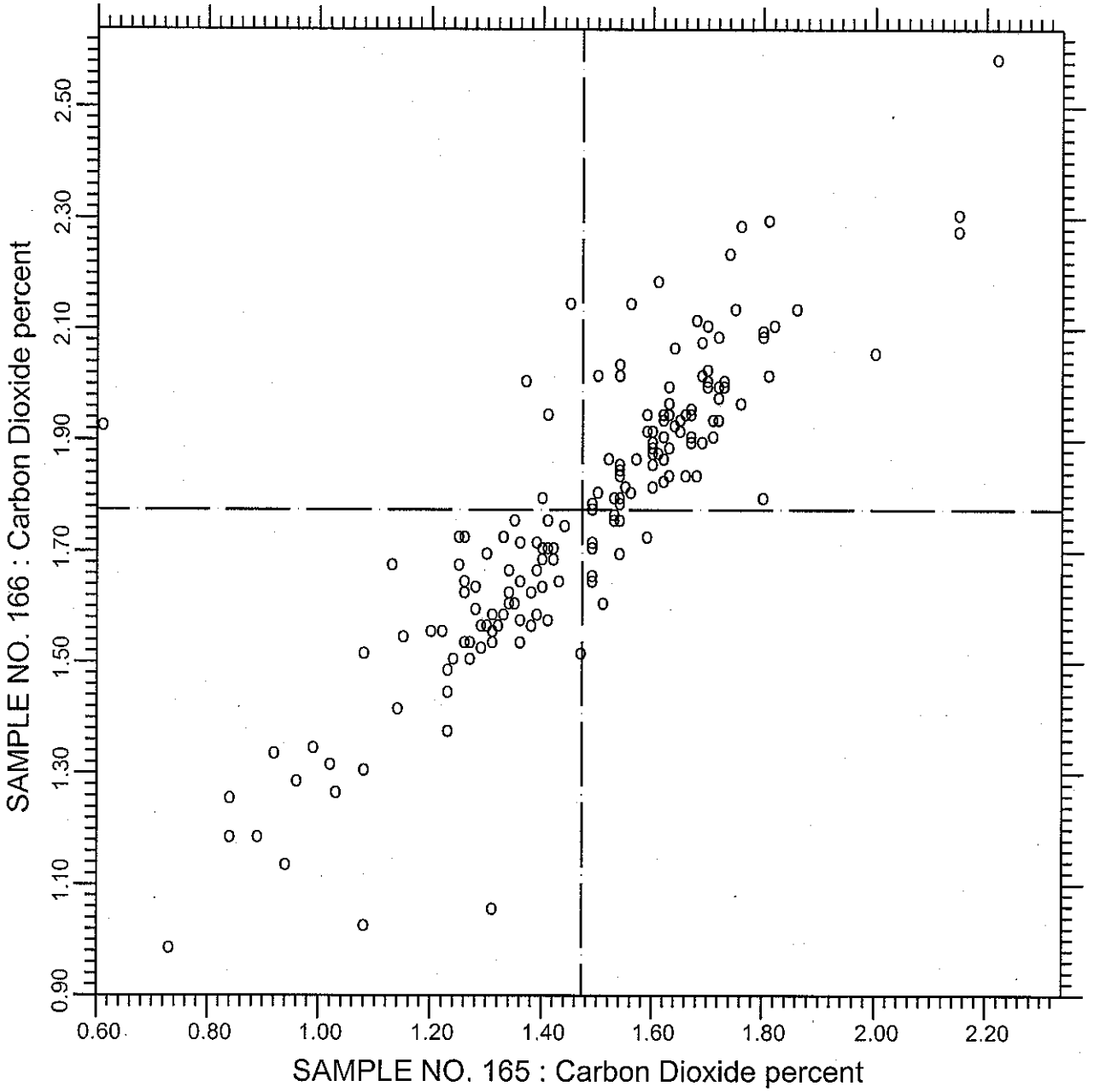


TEST NO.41 Free Calcium Oxide 184 POINTS

SAMPLE NO. 165	AVE	0.772	S.D.	0.18	C.V. 23.6
SAMPLE NO. 166	AVE	0.970	S.D.	0.22	C.V. 23.1

LABS ELIMINATED 107 132 161 1054 1644

CCRL PROFICIENCY SAMPLE PROGRAM
Carbon Dioxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



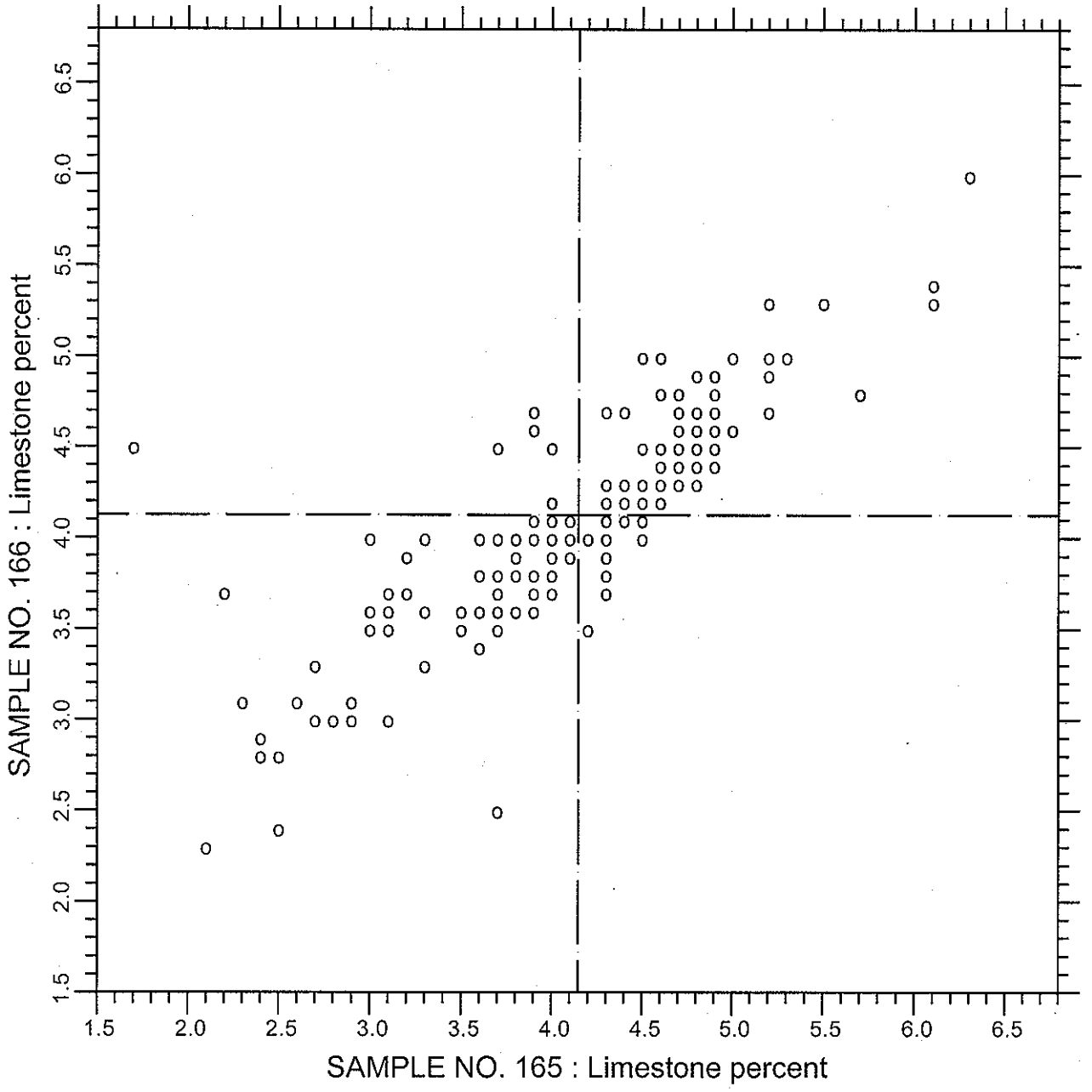
TEST NO.97 Carbon Dioxide 167 POINTS

SAMPLE NO. 165 AVE 1.473 S.D. 0.25 C.V. 17.3

SAMPLE NO. 166 AVE 1.775 S.D. 0.26 C.V. 14.8

LABS ELIMINATED 96 167 611 690 1196 1483 2363 165 209 768 886 2462 3009 3059

CCRL PROFICIENCY SAMPLE PROGRAM
Limestone Content
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

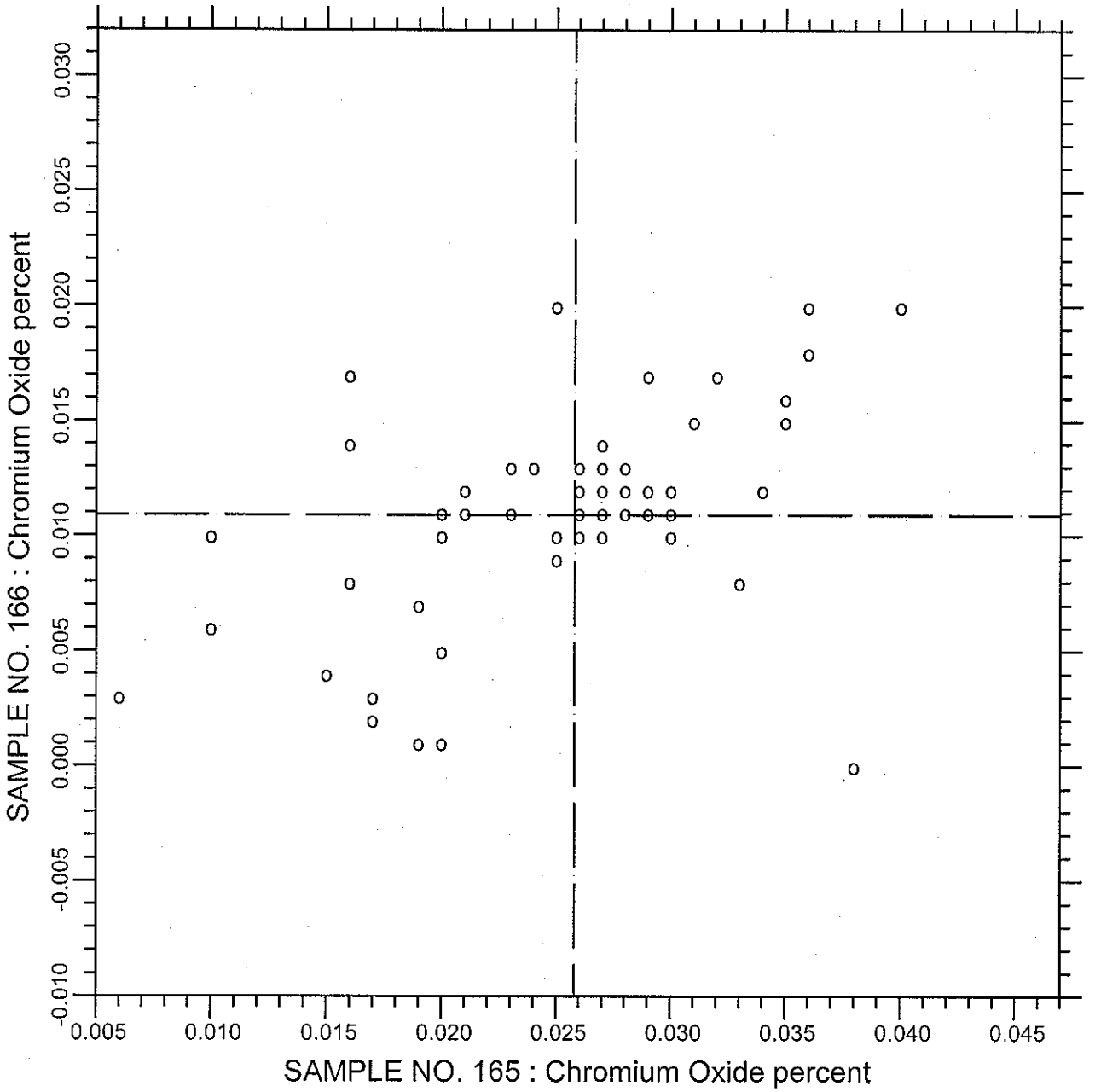


TEST NO.98 Limestone 167 POINTS

SAMPLE NO. 165	AVE	4.148	S.D.	0.80	C.V. 19.3
SAMPLE NO. 166	AVE	4.125	S.D.	0.60	C.V. 14.7

LABS ELIMINATED 96 165 1196 1483 2363 2462 209 611 886 3009

CCRL PROFICIENCY SAMPLE PROGRAM
Chromium Oxide
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

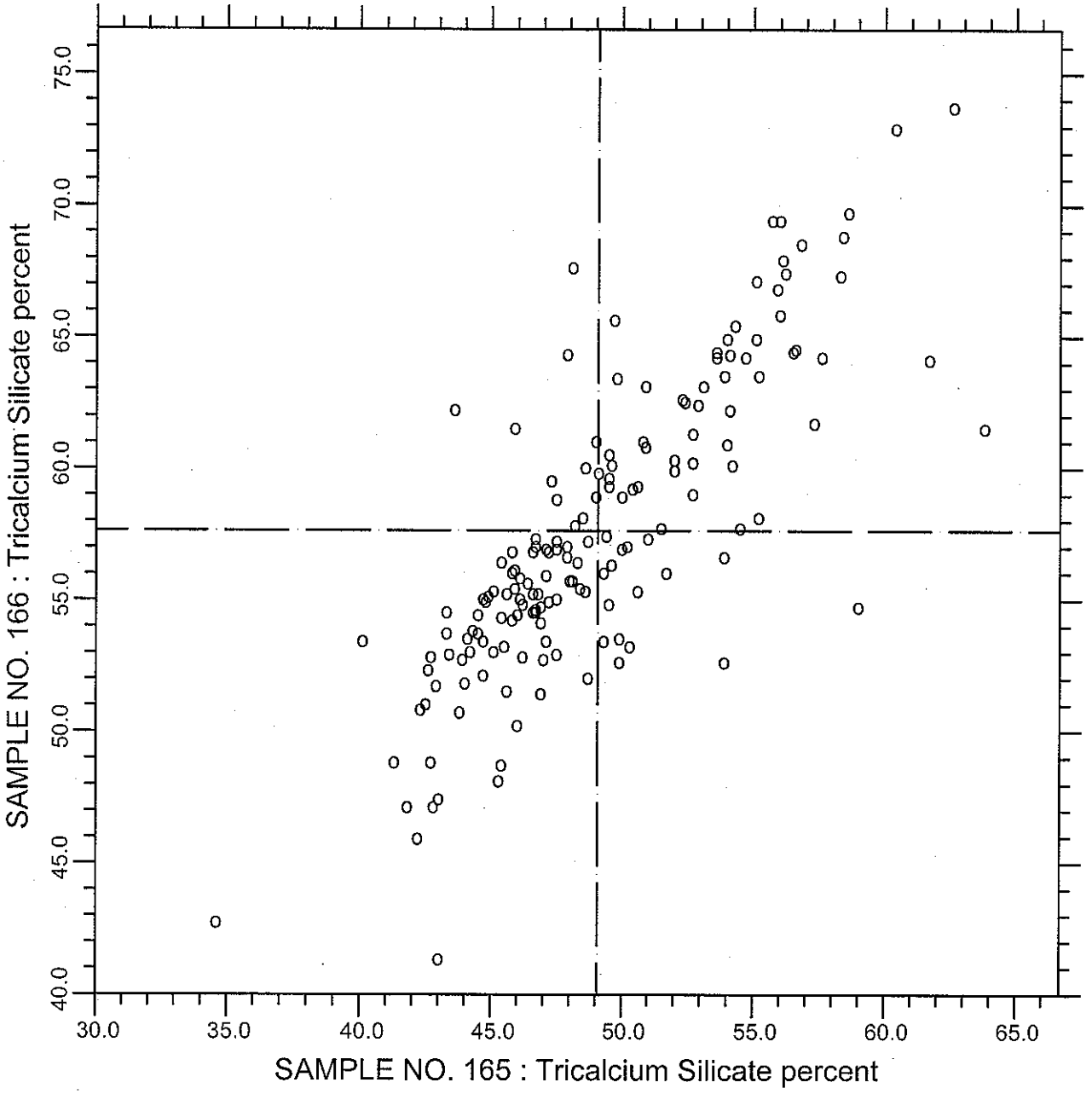


TEST NO.105 Chromium Oxide 75 POINTS

SAMPLE NO. 165	AVE	0.02581	S.D.	0.0063	C.V.	24.4
SAMPLE NO. 166	AVE	0.01089	S.D.	0.0040	C.V.	37.0

LABS ELIMINATED 1466 69 2296

CCRL PROFICIENCY SAMPLE PROGRAM
Tricalcium Silicate
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

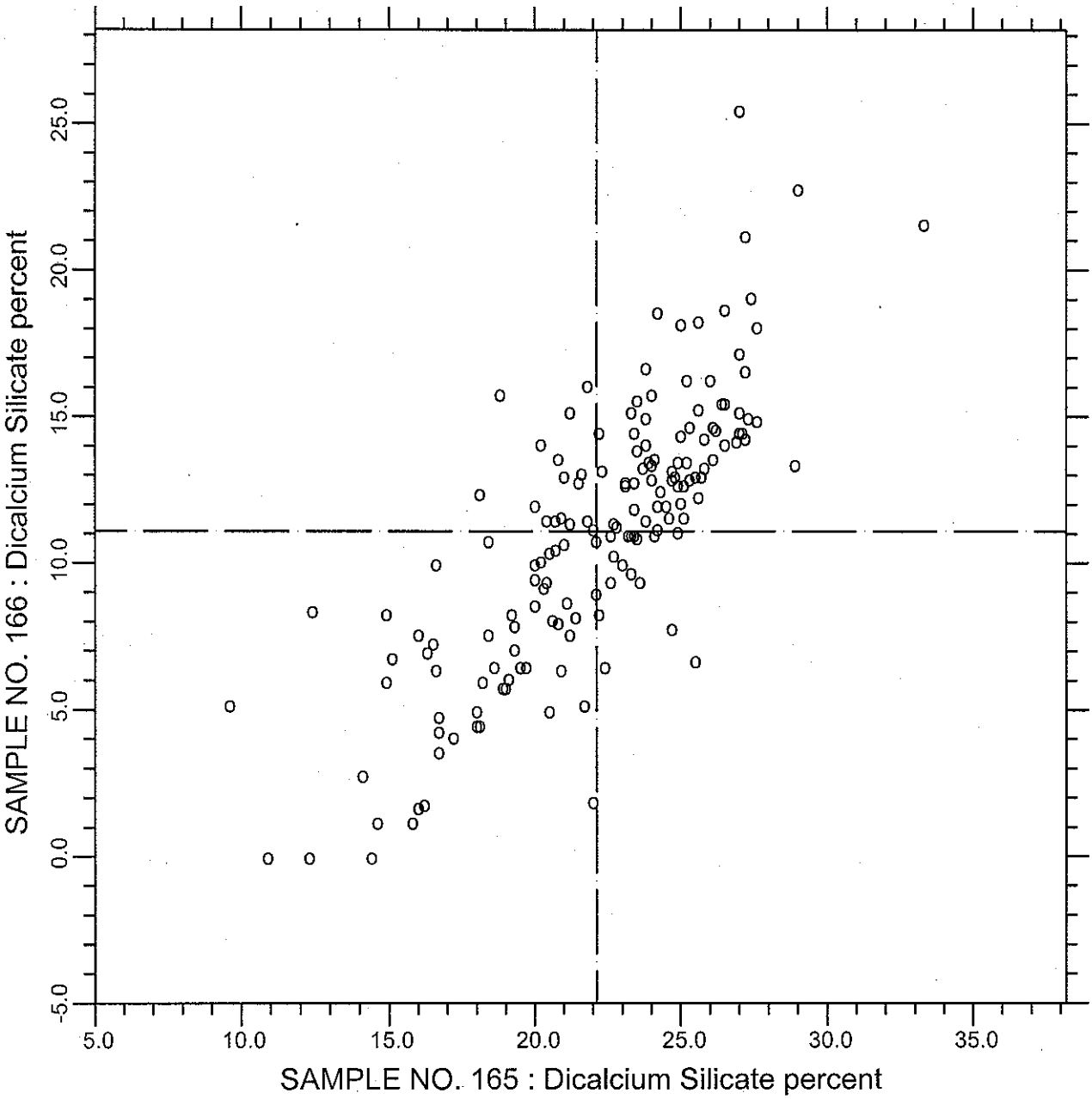


TEST NO.106 Tricalcium Silicate 166 POINTS

SAMPLE NO. 165	AVE	49.08	S.D.	4.8	C.V. 9.85
SAMPLE NO. 166	AVE	57.64	S.D.	5.6	C.V. 9.80

LABS ELIMINATED 30 2466

CCRL PROFICIENCY SAMPLE PROGRAM
Dicalcium Silicate
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

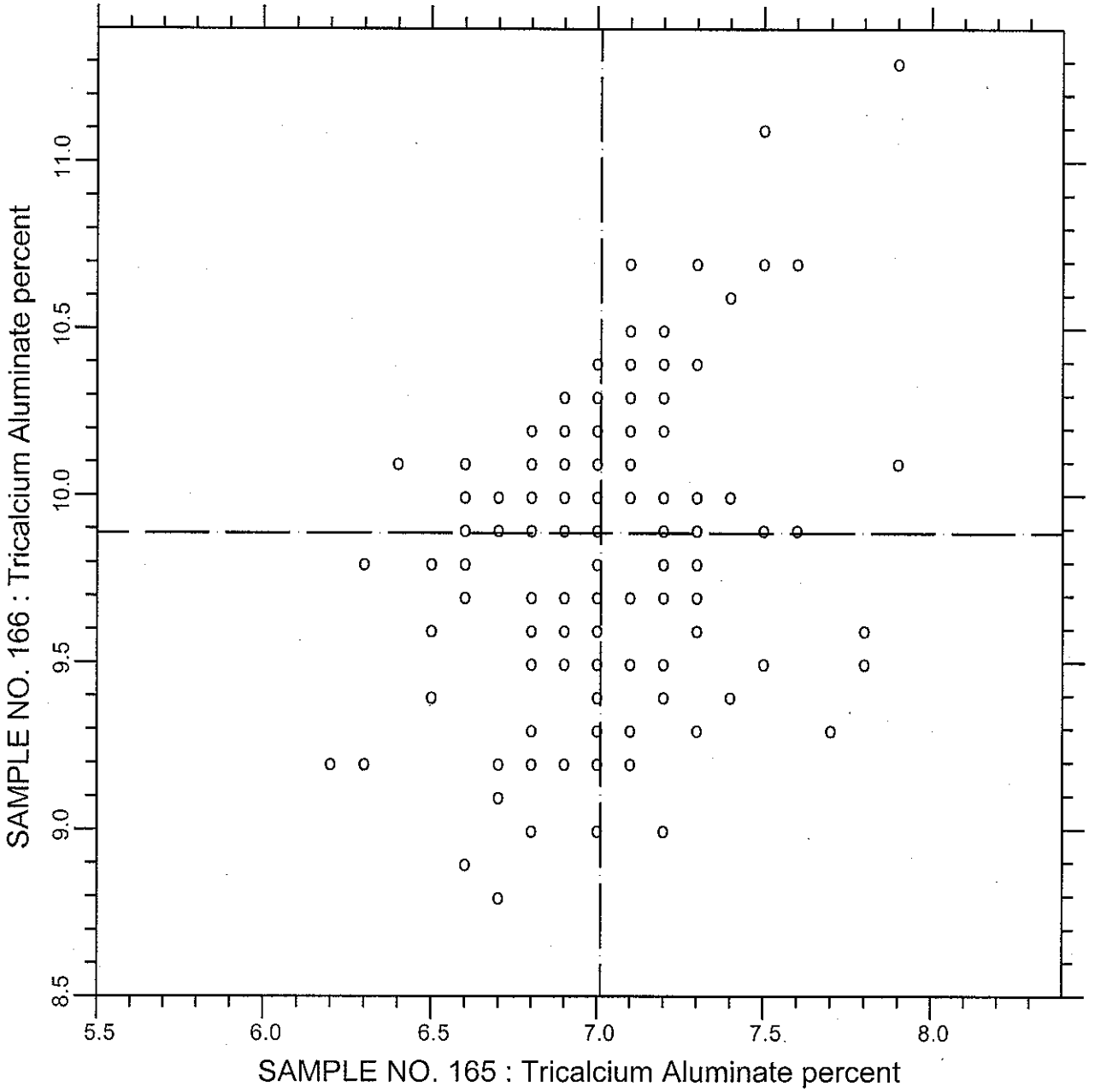


TEST NO.107 Dicalcium Silicate 162 POINTS

SAMPLE NO. 165	AVE	22.12	S.D.	3.9	C.V. 17.7
SAMPLE NO. 166	AVE	11.09	S.D.	4.6	C.V. 41.3

LABS ELIMINATED 30 50 2466

CCRL PROFICIENCY SAMPLE PROGRAM
Tricalcium Aluminate
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.108 Tricalcium Aluminate 192 POINTS

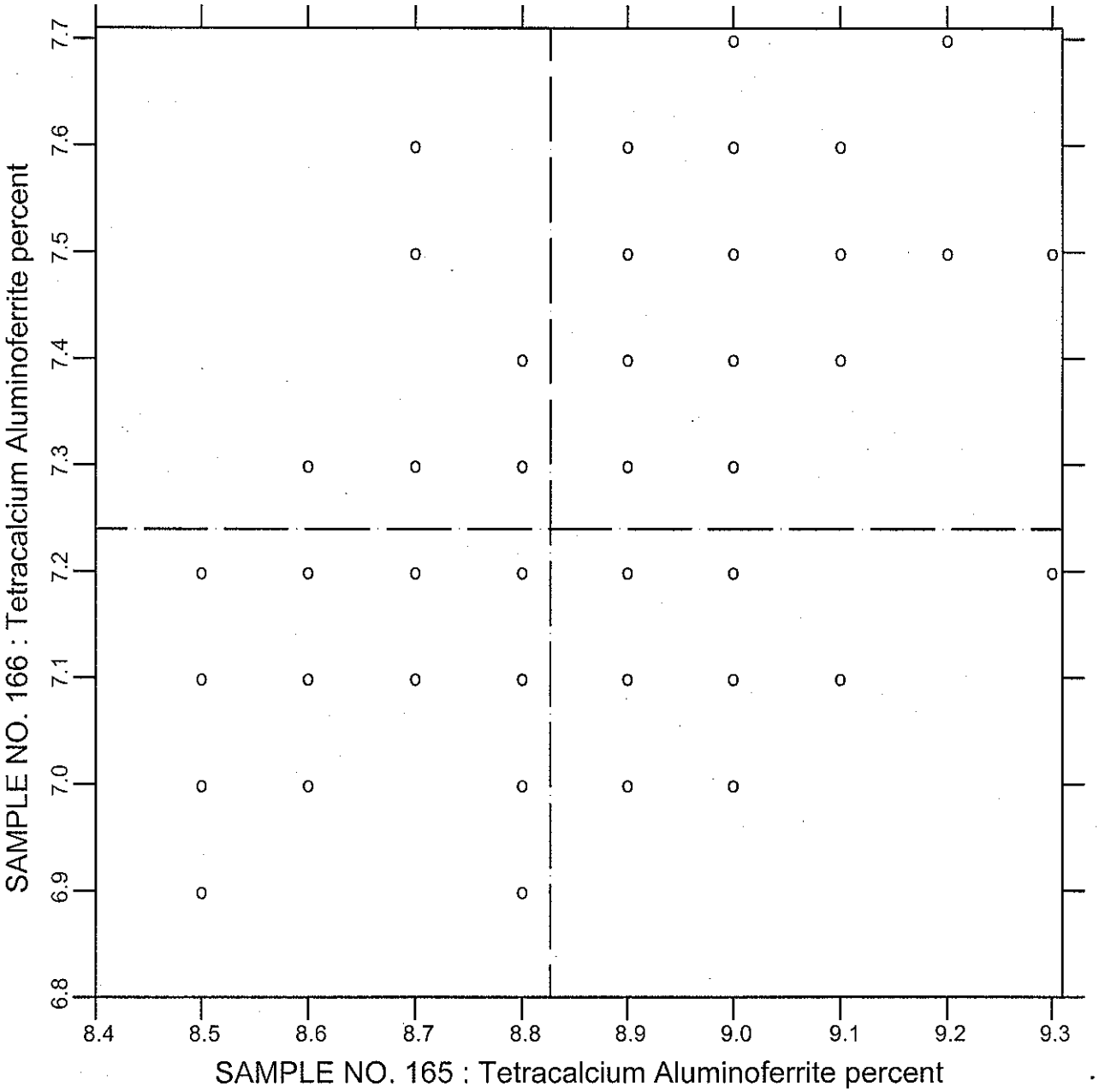
SAMPLE NO. 165 AVE 7.011 S.D. 0.27 C.V. 3.90

SAMPLE NO. 166 AVE 9.888 S.D. 0.42 C.V. 4.23

LABS ELIMINATED 30 69 143 354 694 8 18 43 47 696 1525 1644 2466 3124

LABS OFF DIAGRAM 125

CCRL PROFICIENCY SAMPLE PROGRAM
Tetracalcium Aluminoferrite
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.109 Tetracalcium Aluminoferrite 187 POINTS

SAMPLE NO. 165 AVE 8.827 S.D. 0.14 C.V. 1.60

SAMPLE NO. 166 AVE 7.240 S.D. 0.15 C.V. 2.08

LABS ELIMINATED 30 69 93 152 696 1525 2466 8 18 25 121 143 305 1523 1853 3124

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 165 and No. 166
Final Report - Physical Results
September 7, 2007

SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
N.C. Water	prcnt	261	24.7	0.48	1.96	26.9	0.56	2.08
N.C. Water	prcnt	* 254	24.7	0.41	1.65	26.9	0.49	1.82
Vicat TS Initial	min	254	123	14.1	11.4	118	14.9	12.6
Vicat TS Initial	min	* 249	123	12.9	10.5	118	12.7	10.8
Vicat TS Final	min	245	231	34.7	15.0	223	32.7	14.7
Vicat TS Final	min	* 242	232	32.3	13.9	223	32.6	14.6
Gillmore TS Initial	min	174	162	26.0	16.0	158	30.4	19.3
Gillmore TS Initial	min	* 167	161	22.7	14.1	156	23.9	15.3
Gillmore TS Final	min	173	264	37.3	14.1	256	40.8	15.9
Gillmore TS Final	min	* 171	263	35.7	13.6	255	36.1	14.2
False Set	prcnt	209	69	11.6	16.8	71	12.8	17.9
False Set	prcnt	* 205	70	9.8	14.0	72	10.4	14.4
Autoclave Expan	prcnt	243	0.03	0.020	71.6	0.03	0.023	89.9
Autoclave Expan	prcnt	* 229	0.03	0.013	48.6	0.02	0.013	53.7

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

N.C. Water	10 34 129 768 996 1657 3144
Vicat TS Initial	126 493 696 2462 3234
Vicat TS Final	3 2477 3234
Gillmore TS Initial	126 176 8 23 130 605 2412
Gillmore TS Final	3 126
False Set	34 42 84 143
Autoclave Expansion	107 137 407 1054 2412 11 90 123 252 414 1940 2296 2466 2481

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 165 and No. 166
Final Report - Physical Results
September 7, 2007

SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Air Content	prcnt	234	9.2	1.3	14.7	10.5	1.2	11.6
Air Content	prcnt	* 230	9.2	1.2	13.2	10.5	1.2	11.3
AC, Mix Water	prcnt	228	67.0	4.7	7.00	67.0	4.7	7.00
AC, Mix Water	prcnt	* 219	67.4	2.3	3.39	67	2.5	3.68
AC, Flow	prcnt	229	88	5.0	5.69	90	5.0	5.58
AC, Flow	prcnt	* 221	88	3.5	3.98	89	3.4	3.83
Comp Str, 3 day	psi	265	3563	250.4	7.03	4252	301.0	7.08
Comp Str, 3 day	psi	* 260	3557	222.1	6.24	4252	279.4	6.57
Comp Str, 7 day	psi	267	4431	304.2	6.87	4947	326.2	6.60
Comp Str, 7 day	psi	* 262	4427	272.8	6.16	4955	289.3	5.84
Comp Str, 28 day	psi	238	5802	389.7	6.72	5807	462.8	7.97
Comp Str, 28 day	psi	* 233	5796	360.1	6.21	5825	382.8	6.57
Comp Str, Flow	prcnt	224	120	10.8	9.00	116	10.2	8.78
Comp Str, Flow	prcnt	* 216	122	8.5	7.02	117	7.9	6.74

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

Air Content	1483 1644 2477 3233
Air Content Mix Water	32 551 768 1379 51 159 360 1956 2477
Air Content Flow	18 154 779 1054 1379 2363 2464 2477
Comp Strength, 3 day	10 103 157 457 3235
Comp Strength, 7 day	12 157 457 2330 3235
Comp Strength, 28 day	157 457 491 3059 3235
Comp Strength, Flow	360 1483 2330 2464 3144 3059 3185 3232

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 165 and No. 166
Final Report - Physical Results
September 7, 2007

SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Fineness AP	cm^2/g	260	3807	173.7	4.56	4069	170.7	4.19
Fineness AP	cm^2/g	* 249	3803	102.6	2.70	4061	112.5	2.77
Fineness WT	cm^2/g	15	2027	85.1	4.20	2086	90.4	4.33
45µm Sieve	prcnt	243	95.42	0.90	0.942	94.36	1.08	1.145
45µm Sieve	prcnt	* 238	95.45	0.79	0.825	94.43	0.89	0.942
C1038 Mortar Bar Expansion								
Mortar Expansion	prcnt	146	0.006	0.0094	146	0.008	0.0118	142
Mortar Expansion	prcnt	* 139	0.005	0.0043	82.0	0.008	0.0043	55.6
Mortar Water	mL	139	234	23.4	10.0	236	24.9	10.6
Mortar Water	mL	* 132	235	5.3	2.24	238	4.9	2.07
Mortar Flow	prcnt	134	111	3.1	2.77	109	2.6	2.35
Mortar Flow	prcnt	* 133	111	2.8	2.57	109	2.6	2.35

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

Fineness, Air Permeability 47 49 51 1799 3185 252 492 611 1940 2463 3234

Fineness, 45µm Sieve 94 125 413 502 2484

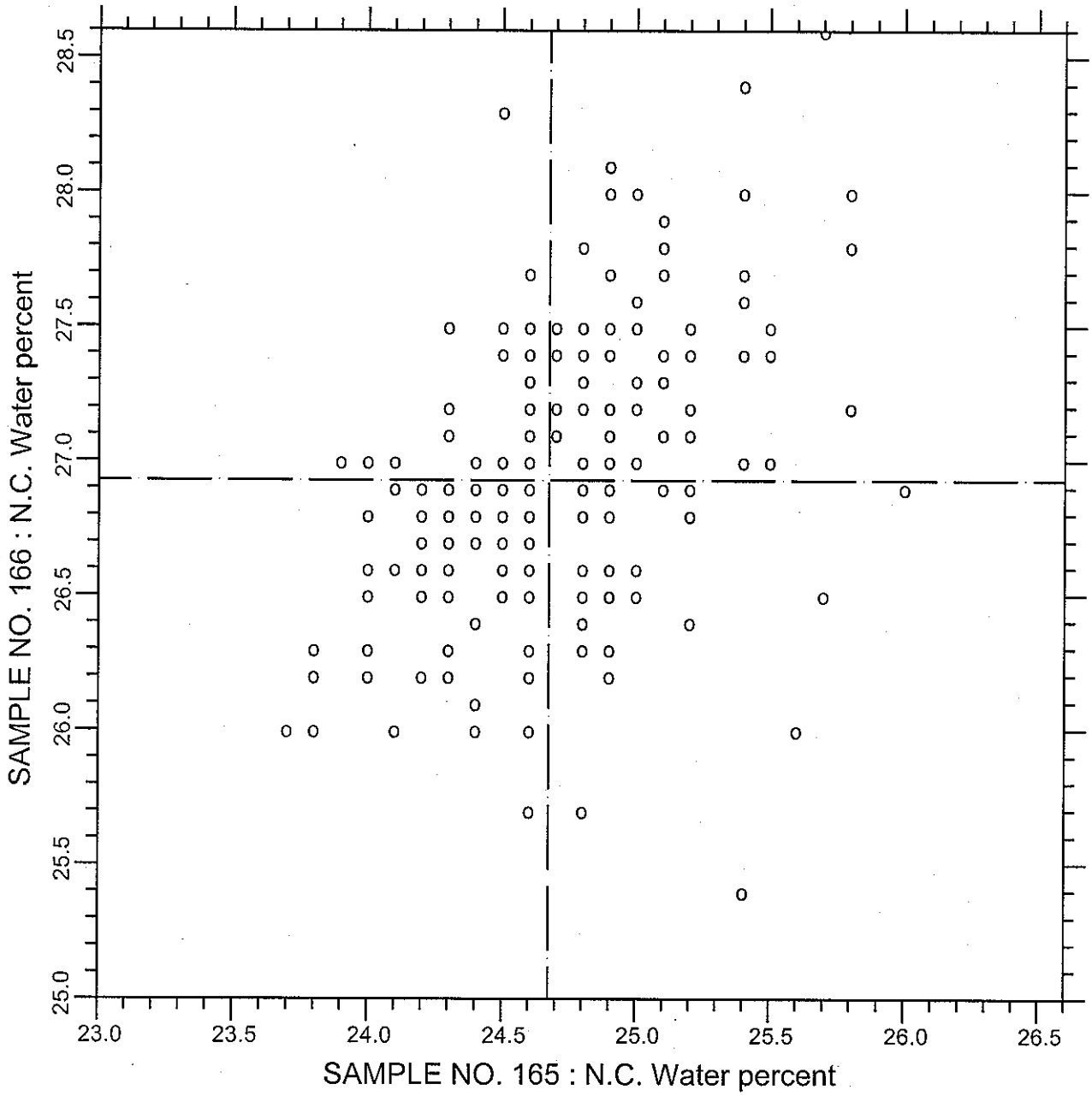
C1038 Mortar Bar Expansion

Mortar Bar Expansion 54 121 413 154 500 687 1190

Mortar Water 207 551 1054 1190 932 3232 3235

Mortar Flow 416

CCRL PROFICIENCY SAMPLE PROGRAM
Normal Consistency - % Water
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.110 N.C. Water 254 POINTS

SAMPLE NO. 165 AVE 24.675 S.D. 0.41 C.V. 1.65

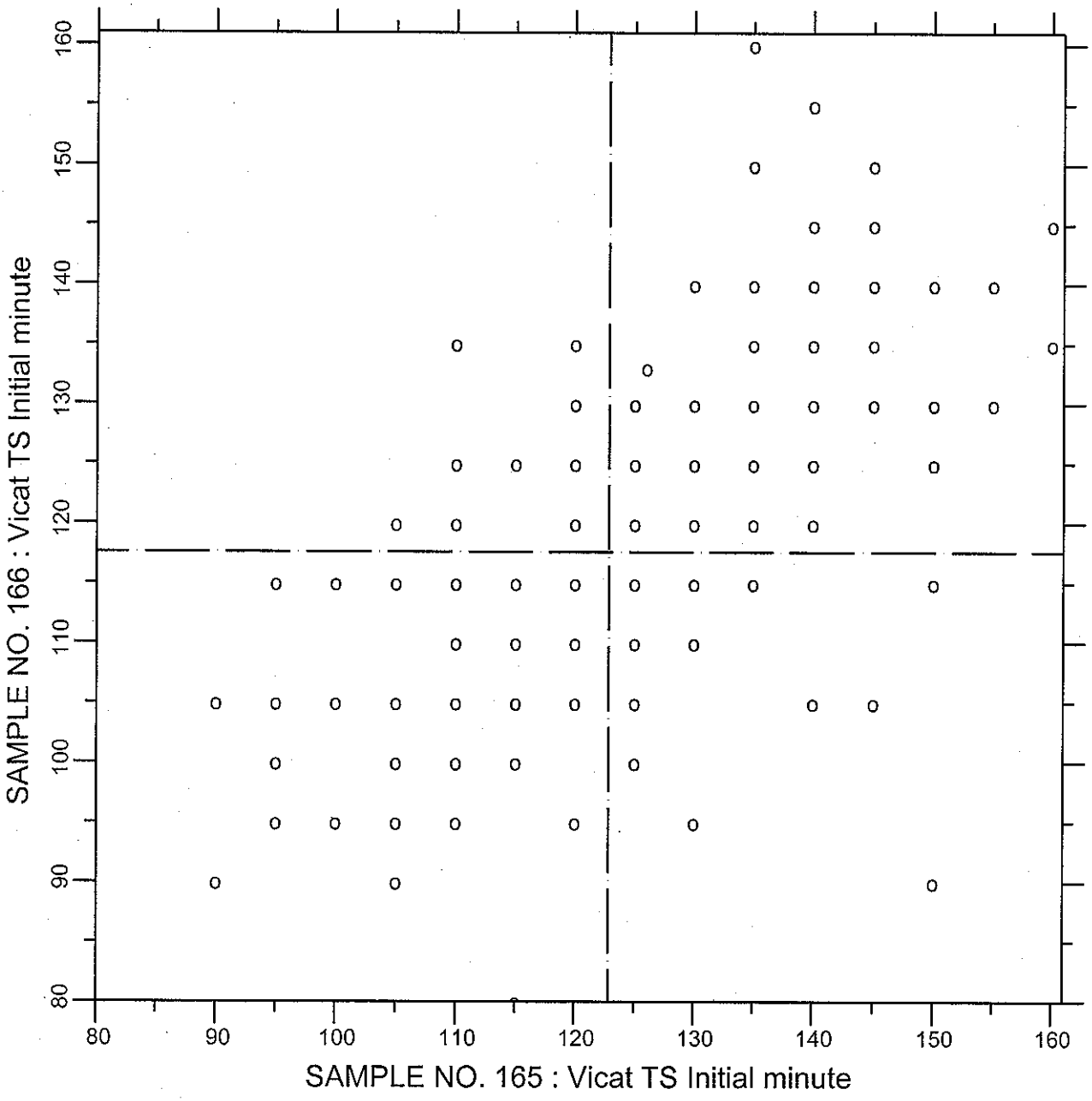
SAMPLE NO. 166 AVE 26.928 S.D. 0.49 C.V. 1.82

LABS ELIMINATED 10 34 129 768 996 1657 3144

CCRL PROFICIENCY SAMPLE PROGRAM

Vicat Time of Set - Initial

PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

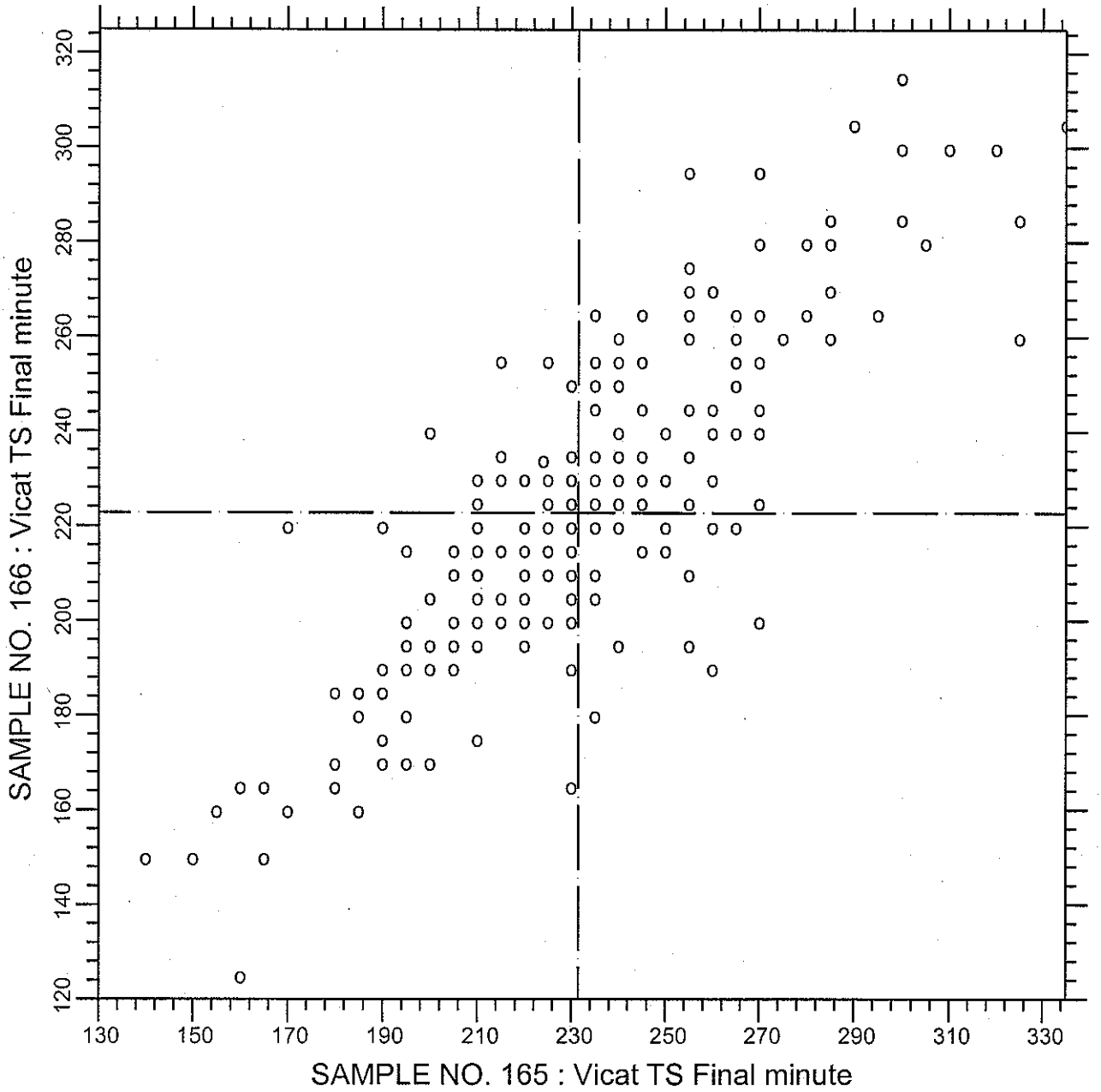


TEST NO.120 Vicat TS Initial 249 POINTS

SAMPLE NO. 165	AVE	122.86	S.D.	12.9	C.V. 10.5
SAMPLE NO. 166	AVE	117.58	S.D.	12.7	C.V. 10.8

LABS ELIMINATED 126 493 696 2462 3234

CCRL PROFICIENCY SAMPLE PROGRAM
Vicat Time of Set - Final
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.121 Vicat TS Final 242 POINTS

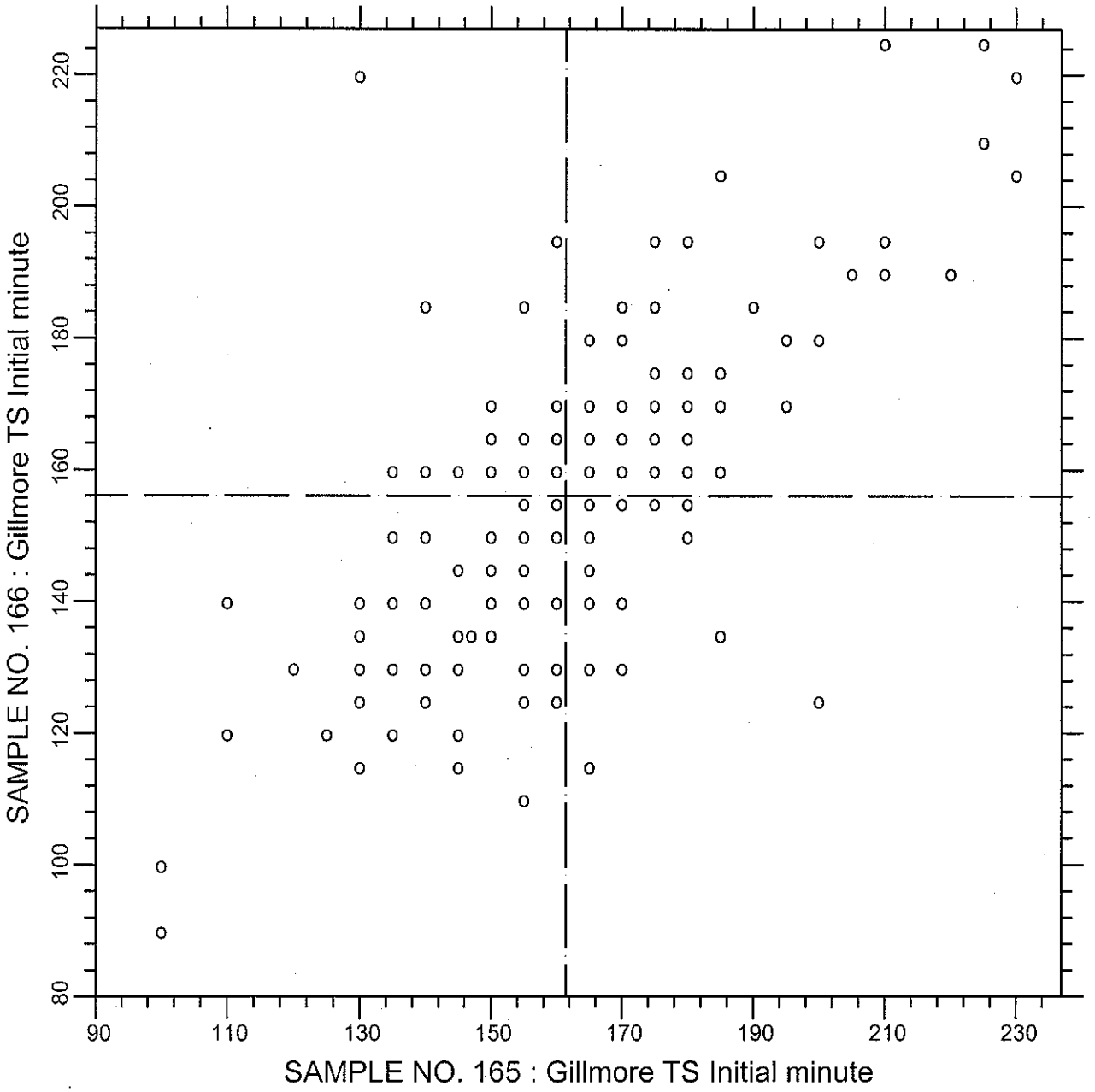
SAMPLE NO. 165	AVE	231.5	S.D.	32.3	C.V.	13.9
SAMPLE NO. 166	AVE	222.7	S.D.	32.6	C.V.	14.6

LABS ELIMINATED 3 2477 3234

CCRL PROFICIENCY SAMPLE PROGRAM

Gillmore Time of Set - Initial

PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

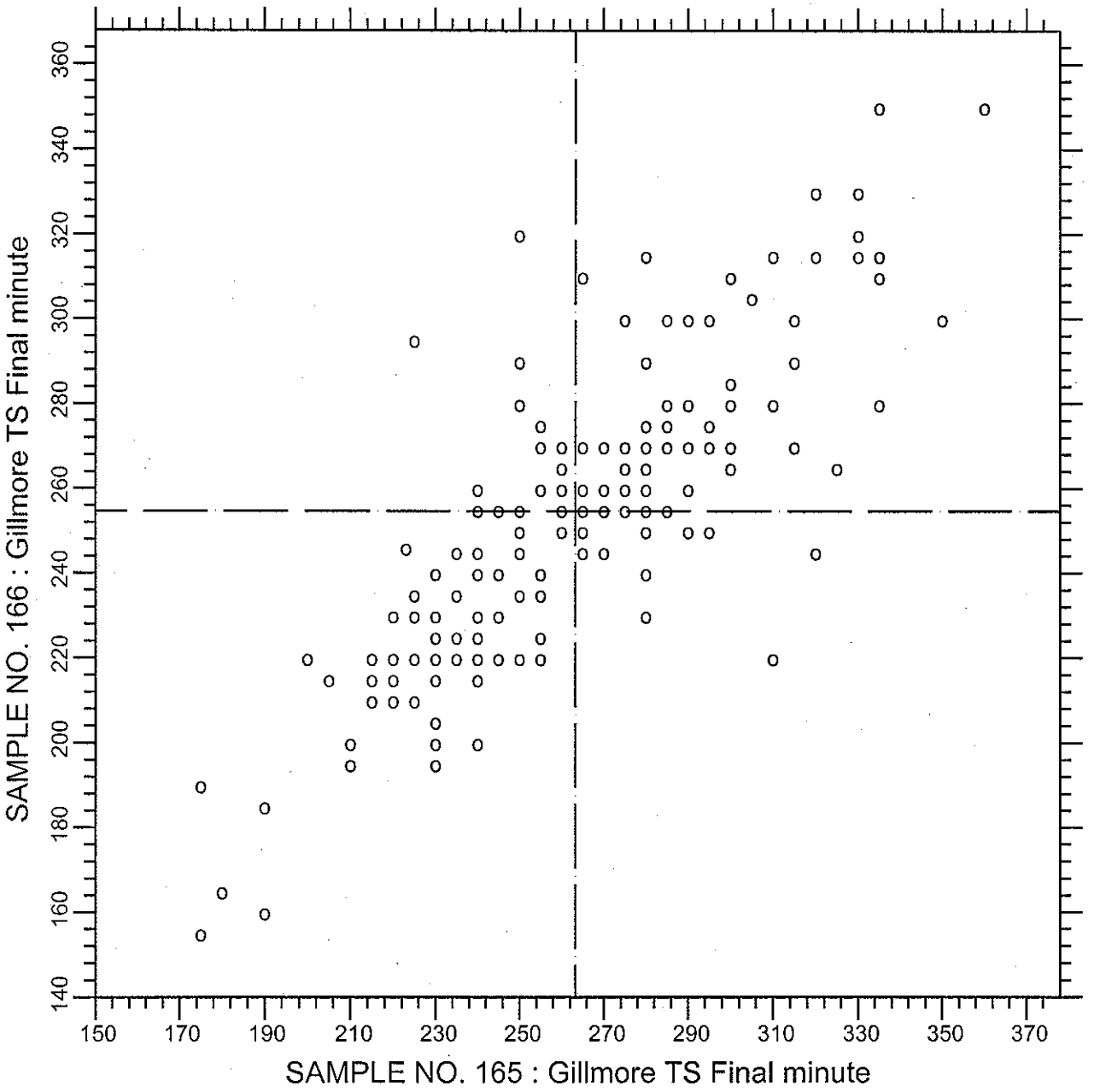


TEST NO.130 Gillmore TS Initial 167 POINTS

SAMPLE NO. 165	AVE	161.4	S.D.	22.7	C.V. 14.1
SAMPLE NO. 166	AVE	156.0	S.D.	23.9	C.V. 15.3

LABS ELIMINATED 126 176 8 23 130 605 2412

CCRL PROFICIENCY SAMPLE PROGRAM
Gillmore Time of Set - Final
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

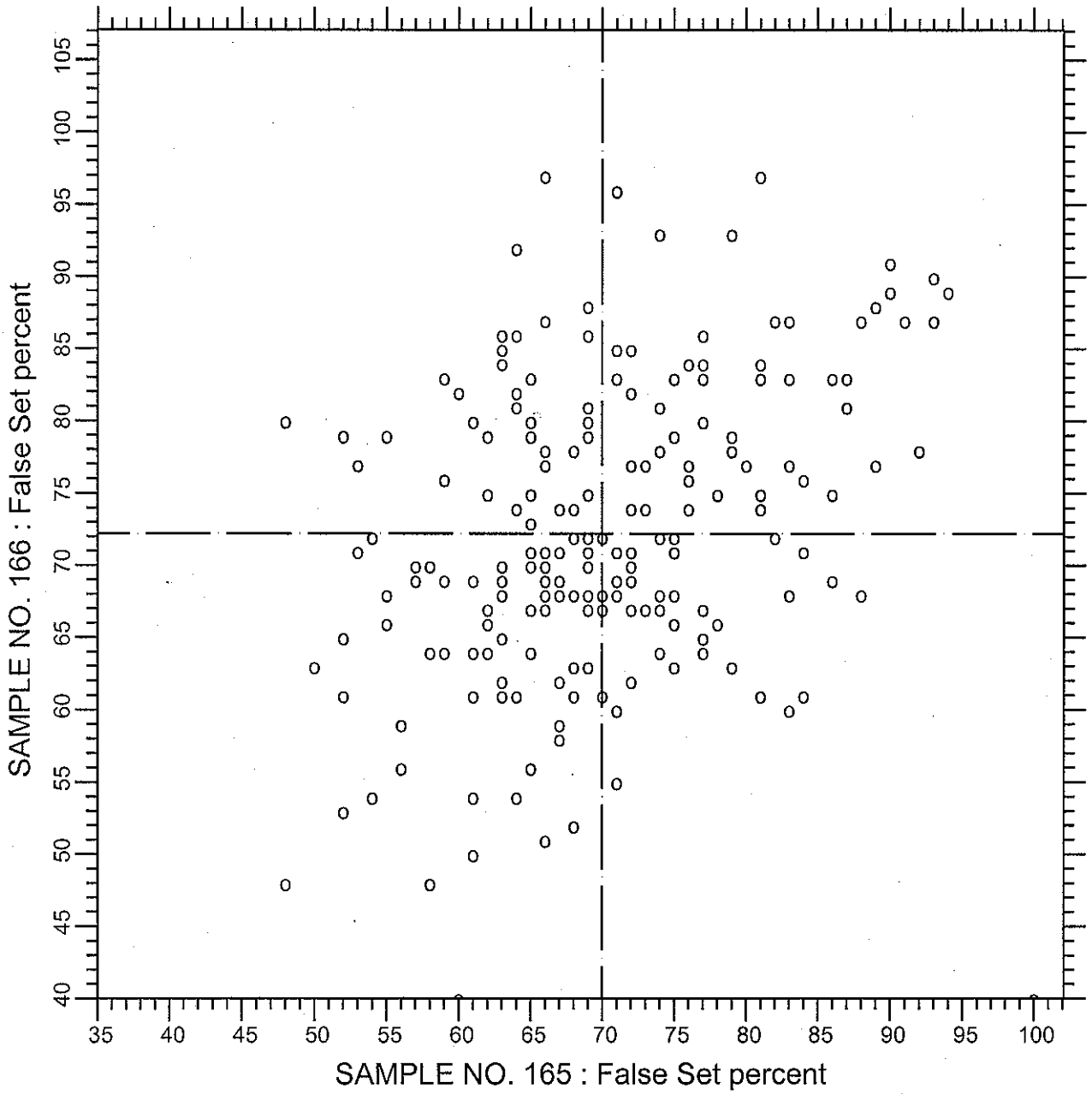


TEST NO.140 Gillmore TS Final 170 POINTS

SAMPLE NO. 165	AVE	263.3	S.D.	35.7	C.V.	13.6
SAMPLE NO. 166	AVE	254.7	S.D.	36.1	C.V.	14.2

LABS ELIMINATED 3 126

CCRL PROFICIENCY SAMPLE PROGRAM
False Set - Paste Method
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

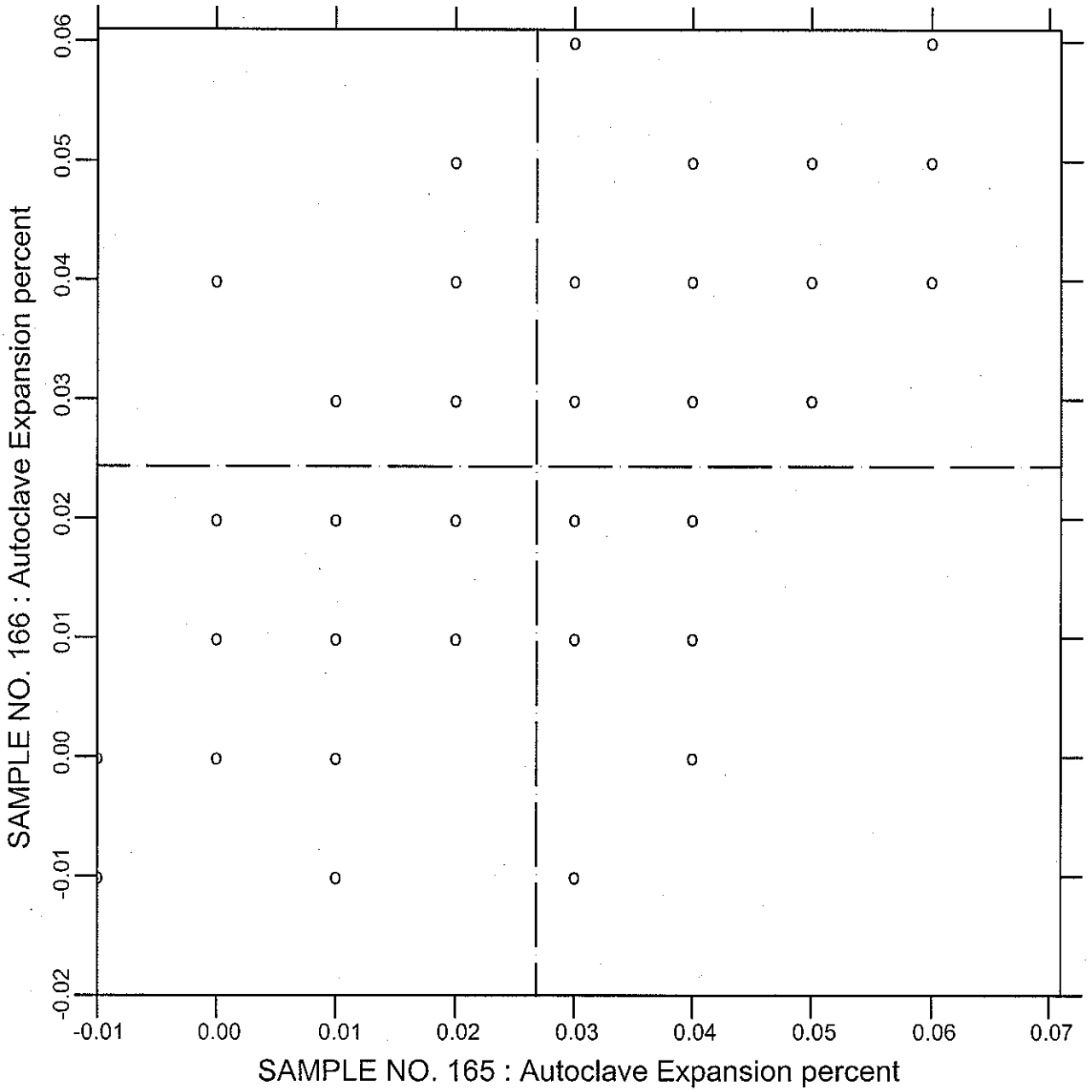


TEST NO.150 False Set 205 POINTS

SAMPLE NO. 165	AVE	69.99	S.D.	9.8	C.V. 14.0
SAMPLE NO. 166	AVE	72.22	S.D.	10.4	C.V. 14.4

LABS ELIMINATED 34 42 84 143

CCRL PROFICIENCY SAMPLE PROGRAM
Autoclave Expansion
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



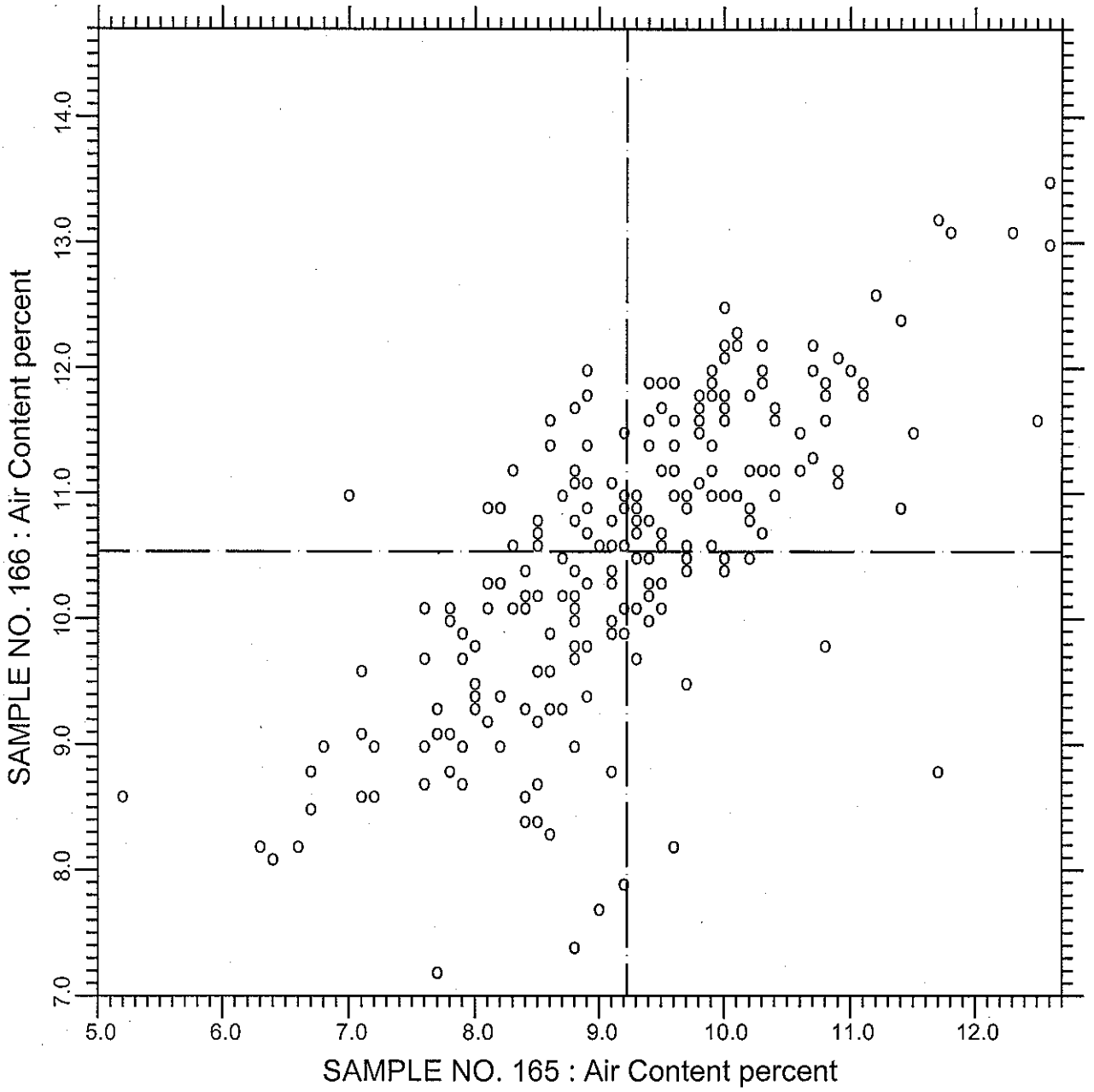
TEST NO.160 Autoclave Expansion 229 POINTS

SAMPLE NO. 165 AVE 0.02681 S.D. 0.013 C.V. 48.6

SAMPLE NO. 166 AVE 0.02437 S.D. 0.013 C.V. 53.7

LABS ELIMINATED 107 137 407 1054 2412 11 90 123 252 414 1940 2296 2466 2481

CCRL PROFICIENCY SAMPLE PROGRAM
Air Content
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.170 Air Content 229 POINTS

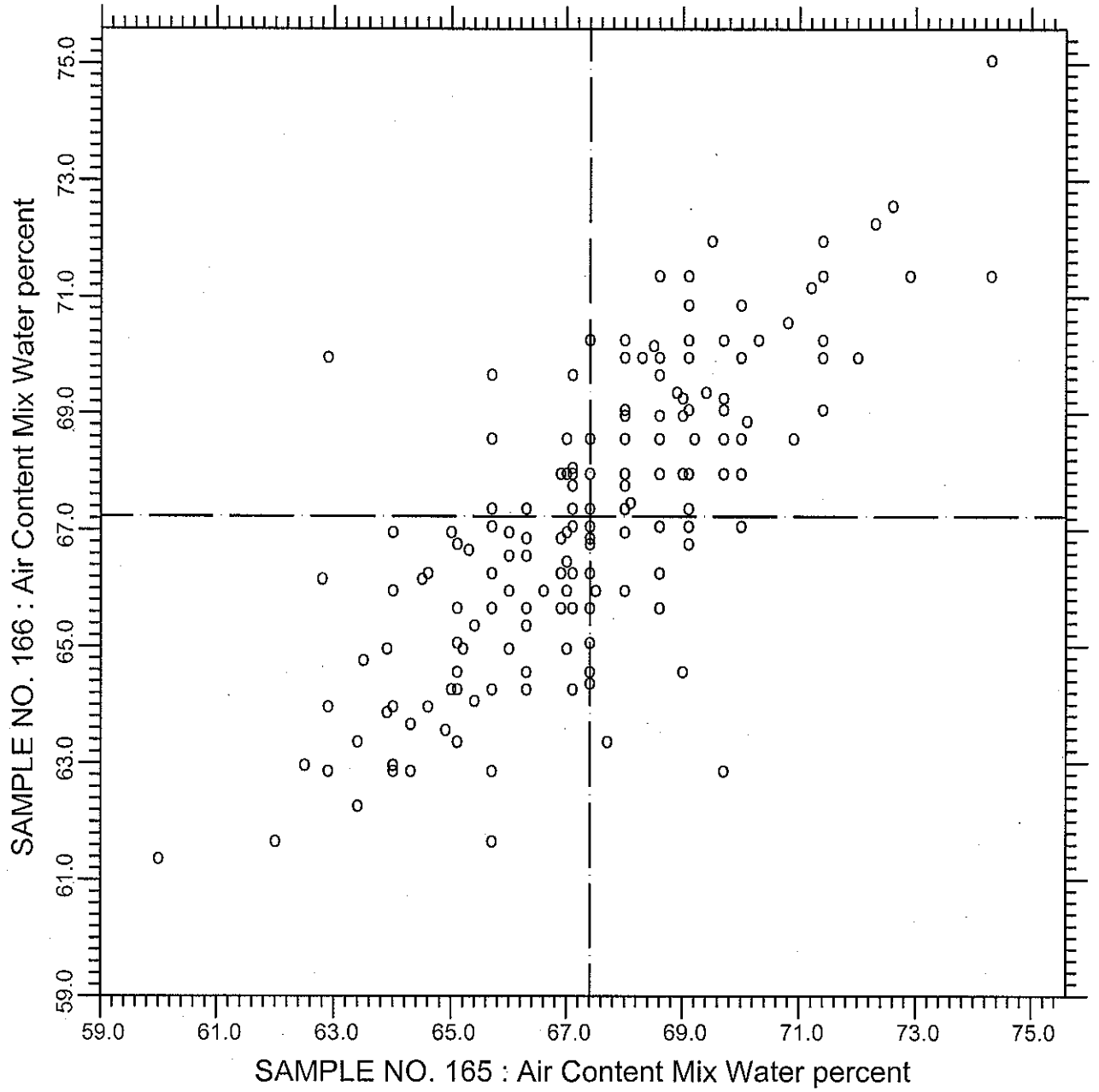
SAMPLE NO. 165 AVE 9.223 S.D. 1.2 C.V. 13.2

SAMPLE NO. 166 AVE 10.536 S.D. 1.2 C.V. 11.3

LABS ELIMINATED 1483 1644 2477 3233

LABS OFF DIAGRAM 159

CCRL PROFICIENCY SAMPLE PROGRAM
Air Content - % Water
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



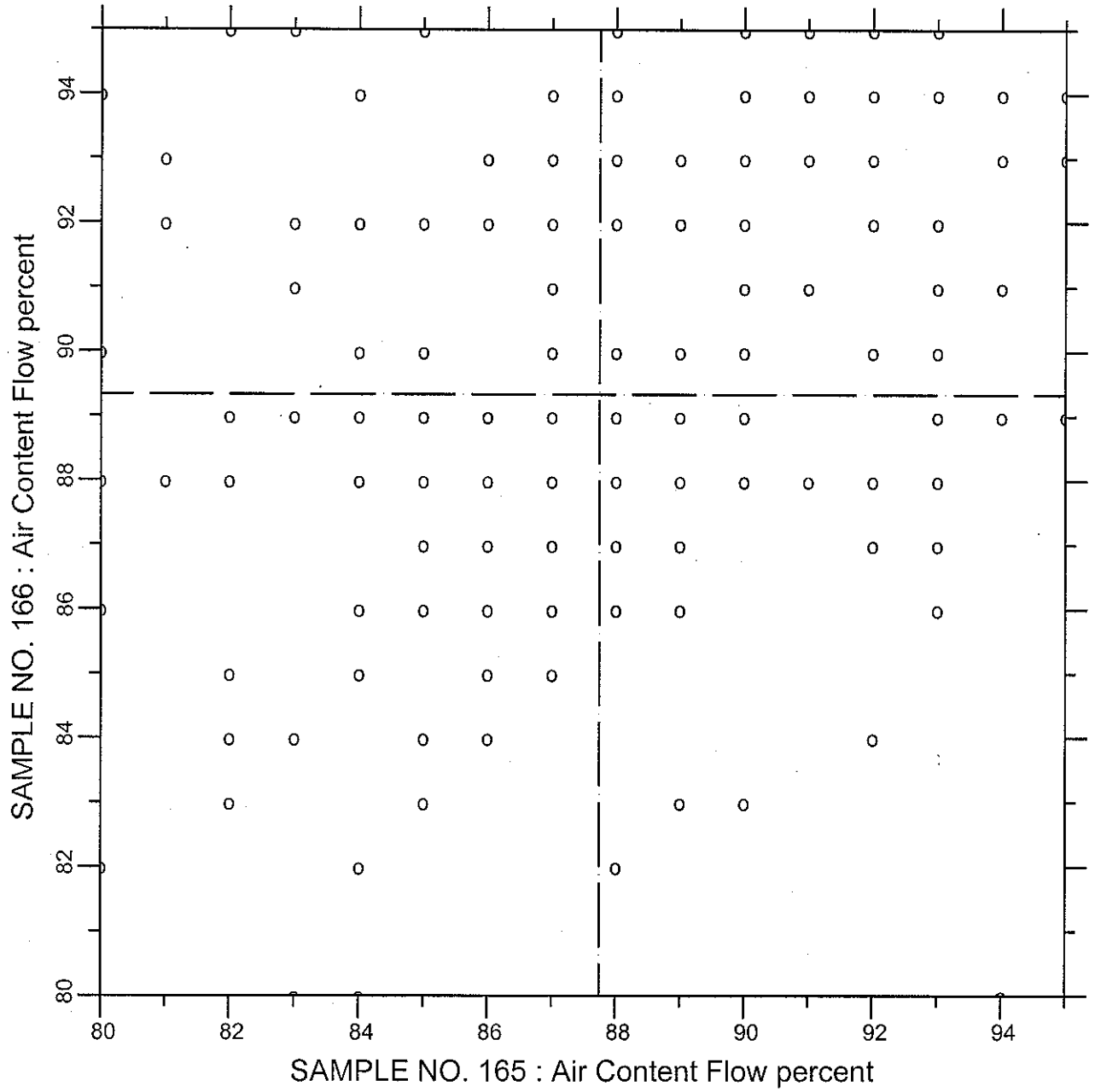
TEST NO.180 Air Content Mix Water 219 POINTS

SAMPLE NO. 165 AVE 67.41 S.D. 2.3 C.V. 3.39

SAMPLE NO. 166 AVE 67.23 S.D. 2.5 C.V. 3.68

LABS ELIMINATED 32 551 768 1379 51 159 360 1956 2477

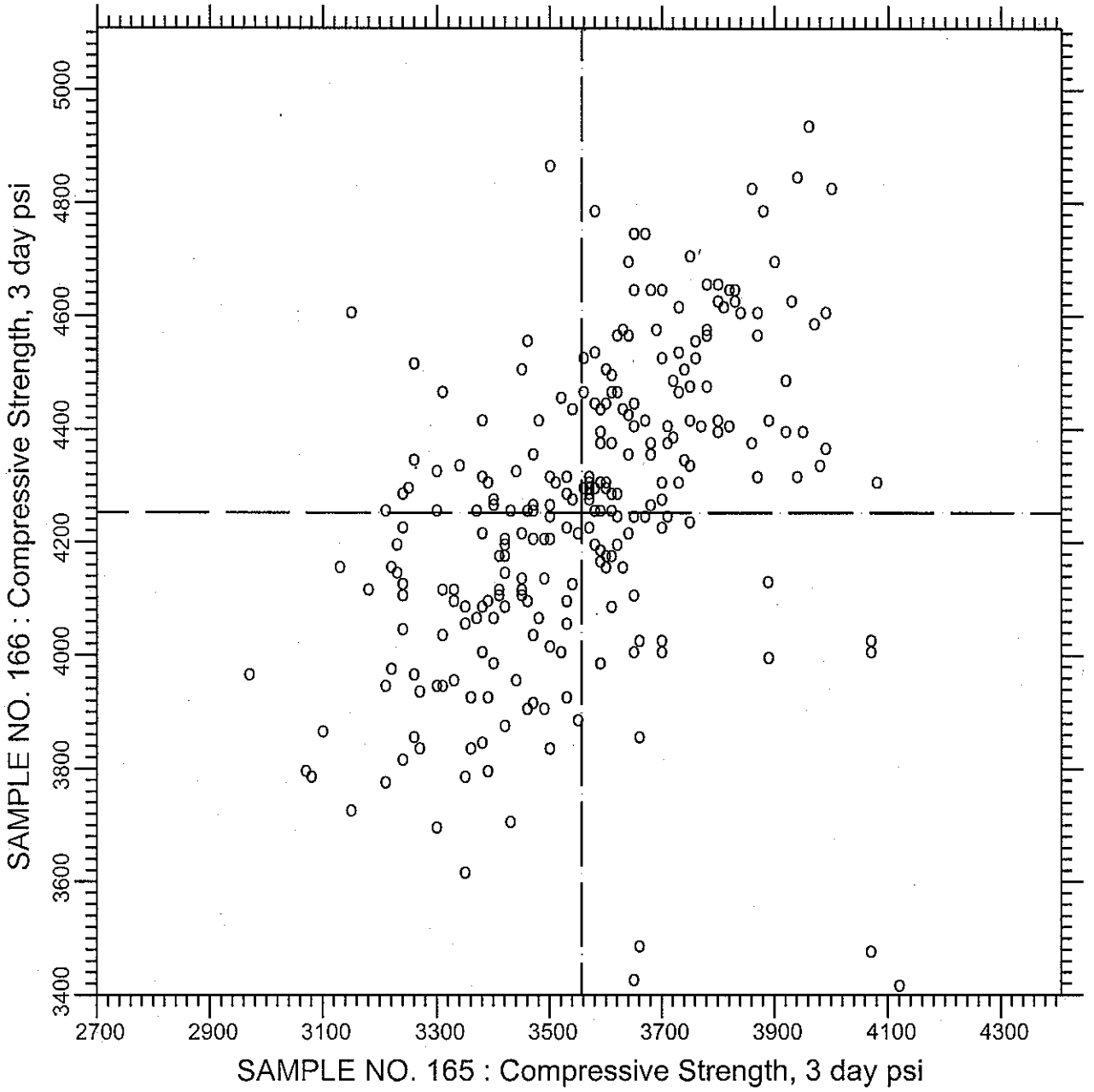
CCRL PROFICIENCY SAMPLE PROGRAM
Air Content - Flow
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.190 Air Content Flow 221 POINTS

SAMPLE NO. 165 AVE 87.75 S.D. 3.5 C.V. 3.98
SAMPLE NO. 166 AVE 89.33 S.D. 3.4 C.V. 3.83
LABS ELIMINATED 18 154 779 1054 1379 2363 2464 2477

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - 3 day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.200 Compressive Strength, 3 day 258 POINTS

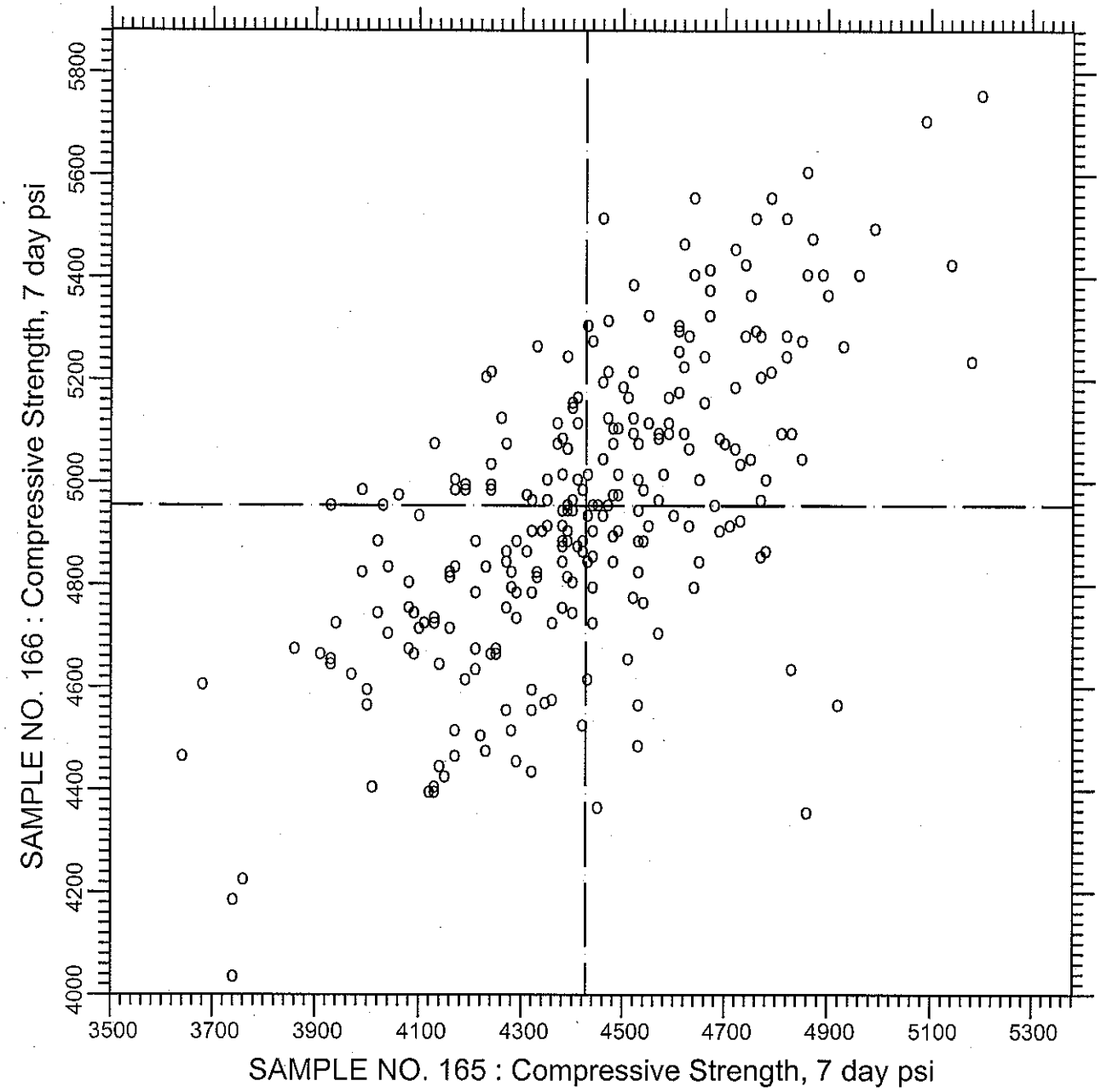
SAMPLE NO. 165 AVE 3557.0 S.D. 222.1 C.V. 6.24

SAMPLE NO. 166 AVE 4252.4 S.D. 279.4 C.V. 6.57

LABS ELIMINATED 10 103 157 457 3235

LABS OFF DIAGRAM 12 2330

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - 7 day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

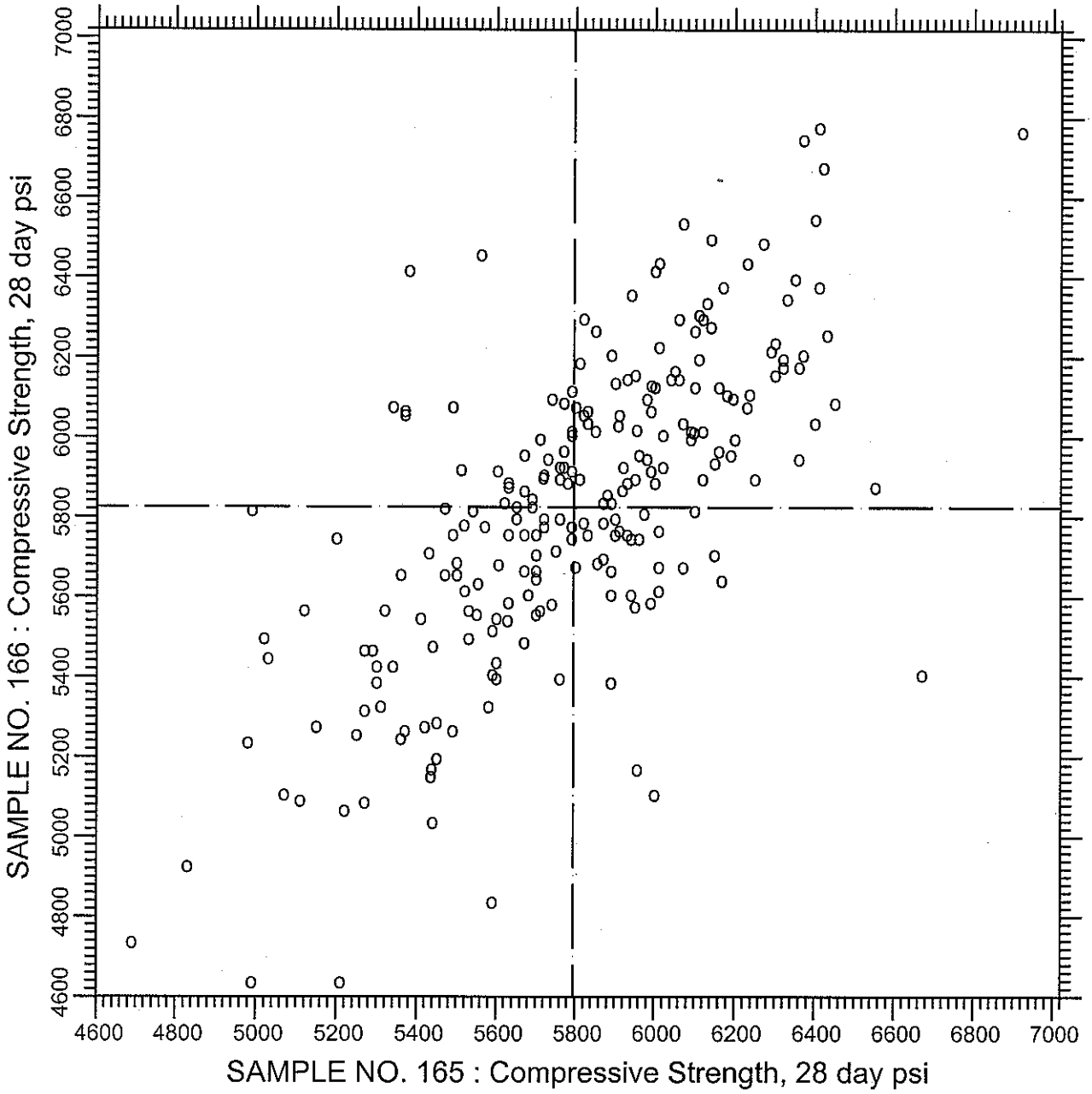


TEST NO.210 Compressive Strength, 7 day 262 POINTS

SAMPLE NO. 165	AVE	4426.8	S.D.	272.8	C.V.	6.16
SAMPLE NO. 166	AVE	4955.1	S.D.	289.3	C.V.	5.84

LABS ELIMINATED 12 157 457 2330 3235

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - 28 day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



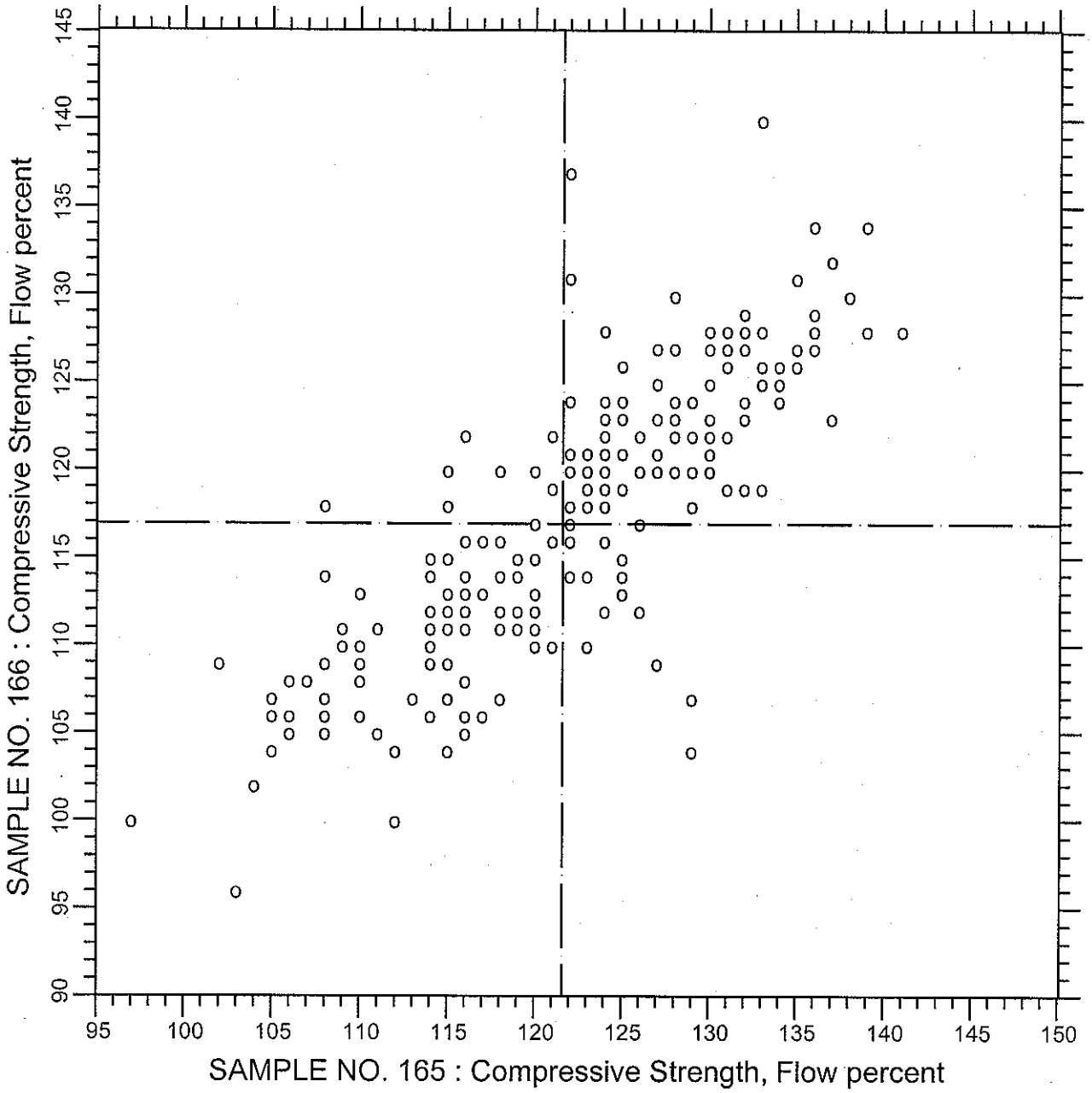
TEST NO.211 Compressive Strength, 28 day 233 POINTS

SAMPLE NO. 165 AVE 5795.5 S.D. 360.1 C.V. 6.21

SAMPLE NO. 166 AVE 5825.4 S.D. 382.8 C.V. 6.57

LABS ELIMINATED 157 457 491 3059 3235

CCRL PROFICIENCY SAMPLE PROGRAM
Compressive Strength - Flow
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

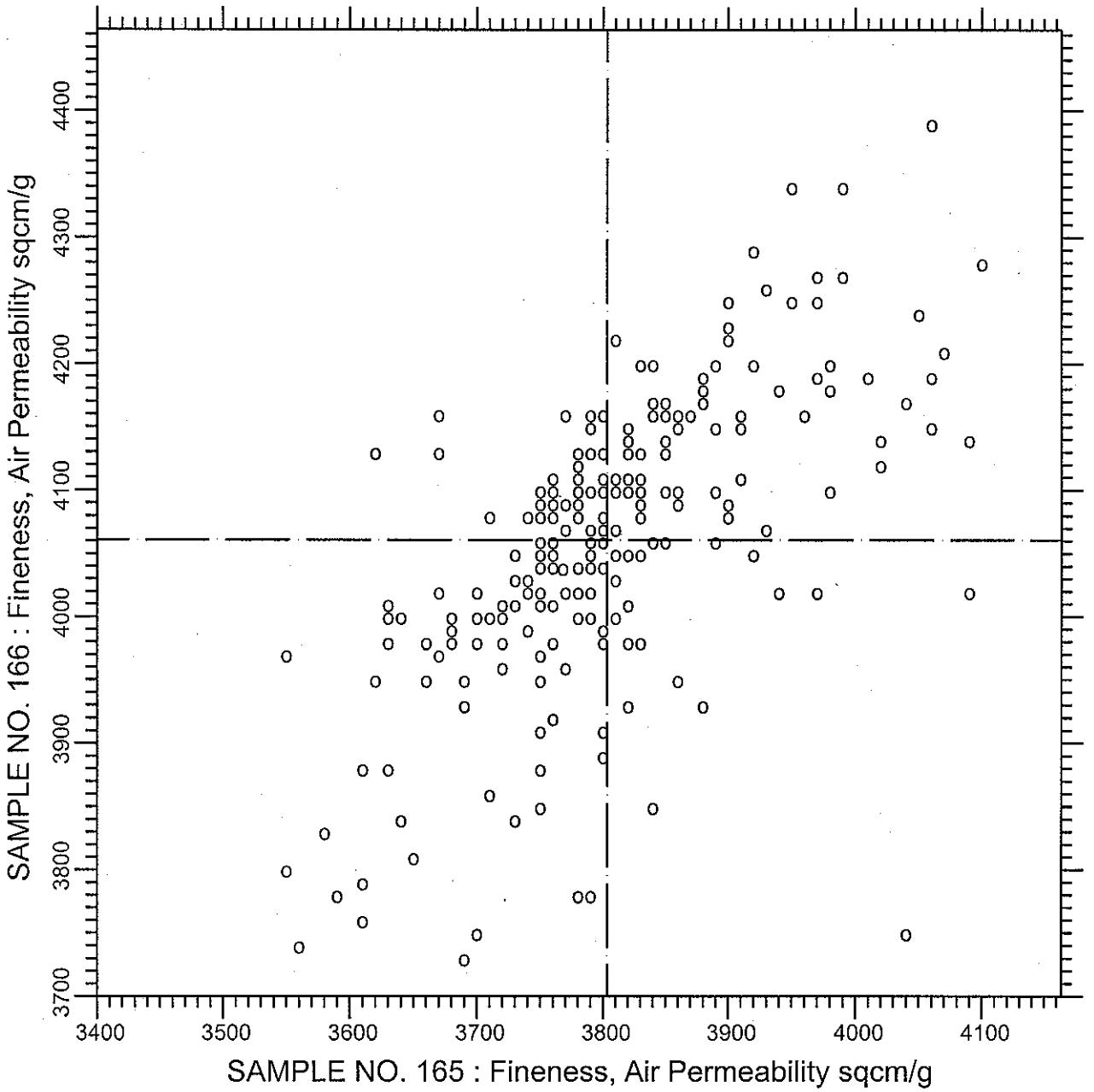


TEST NO.230 Compressive Strength, Flow 216 POINTS

SAMPLE NO. 165	AVE	121.61	S.D.	8.5	C.V. 7.02
SAMPLE NO. 166	AVE	116.93	S.D.	7.9	C.V. 6.74

LABS ELIMINATED 360 1483 2330 2464 3144 3059 3185 3232

CCRL PROFICIENCY SAMPLE PROGRAM
Fineness - Air Permeability
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



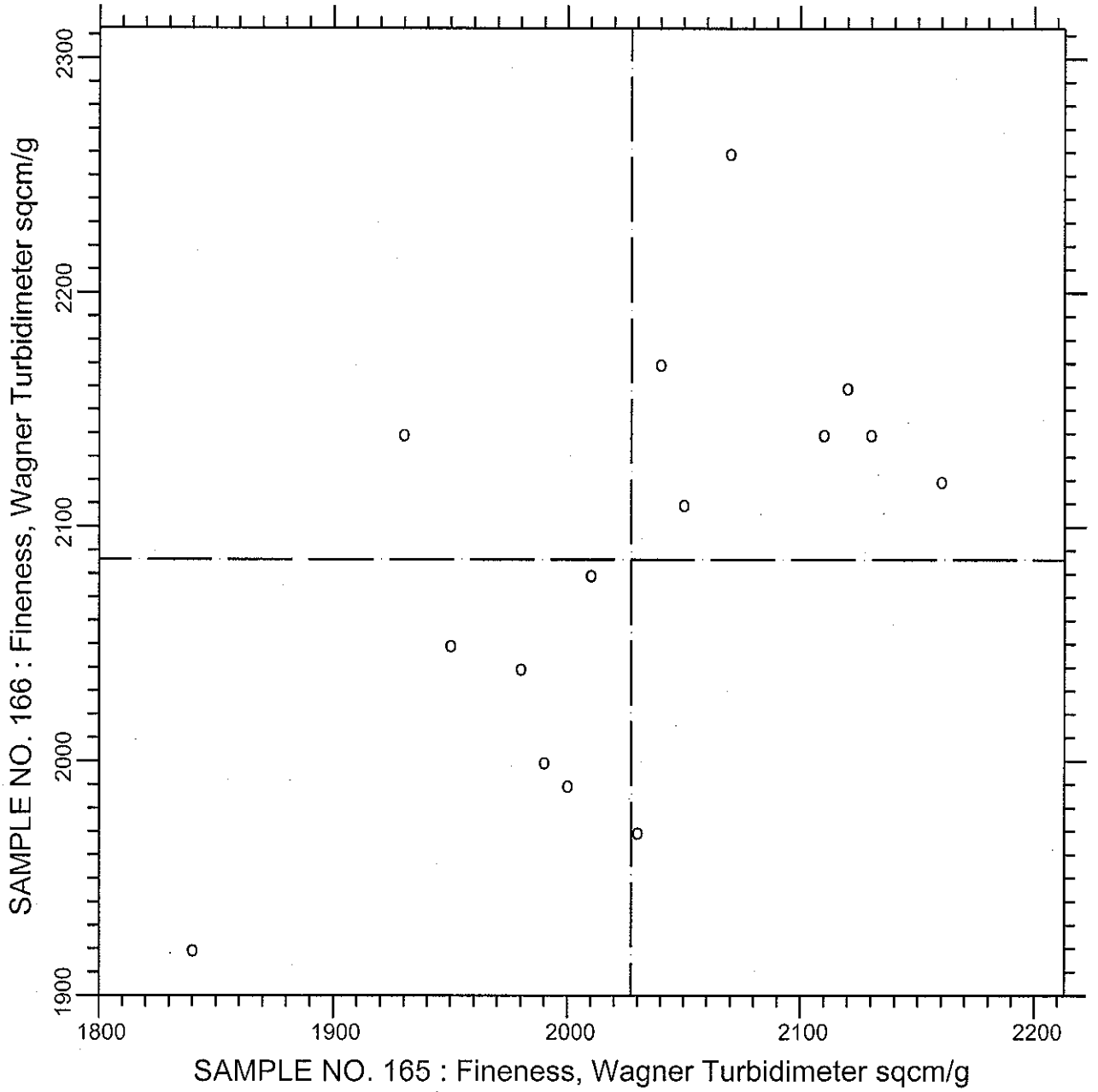
TEST NO.270 Fineness, Air Permeability 249 POINTS

SAMPLE NO. 165 AVE 3803.4 S.D. 102.6 C.V. 2.70

SAMPLE NO. 166 AVE 4060.8 S.D. 112.5 C.V. 2.77

LABS ELIMINATED 47 49 51 1799 3185 252 492 611 1940 2463 3234

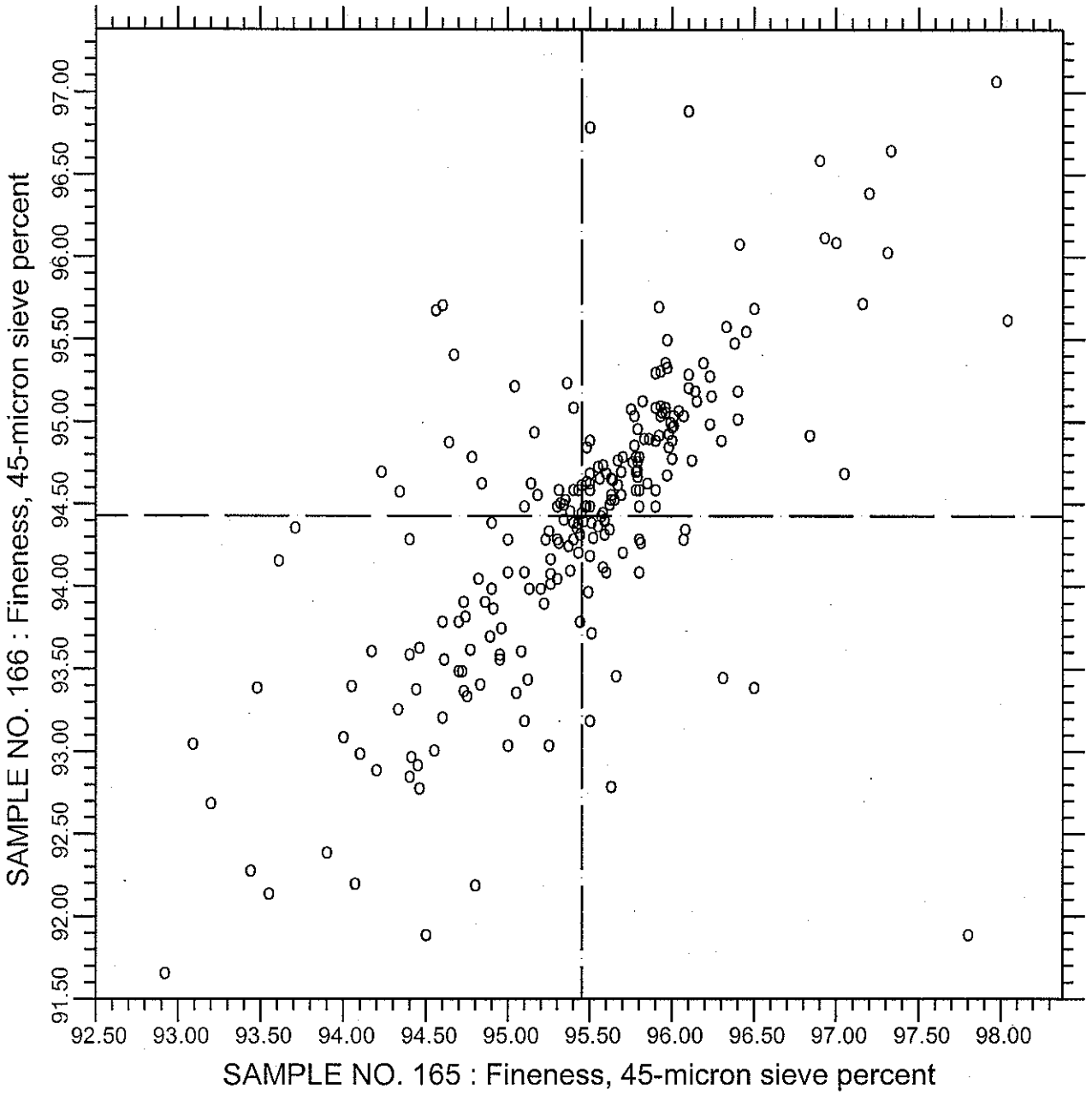
CCRL PROFICIENCY SAMPLE PROGRAM
Fineness - Wagner Turbidimeter
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.280 Fineness, Wagner Turbidimeter 15 POINTS

SAMPLE NO. 165	AVE	2027.3	S.D.	85.1	C.V.	4.20
SAMPLE NO. 166	AVE	2086.0	S.D.	90.4	C.V.	4.33

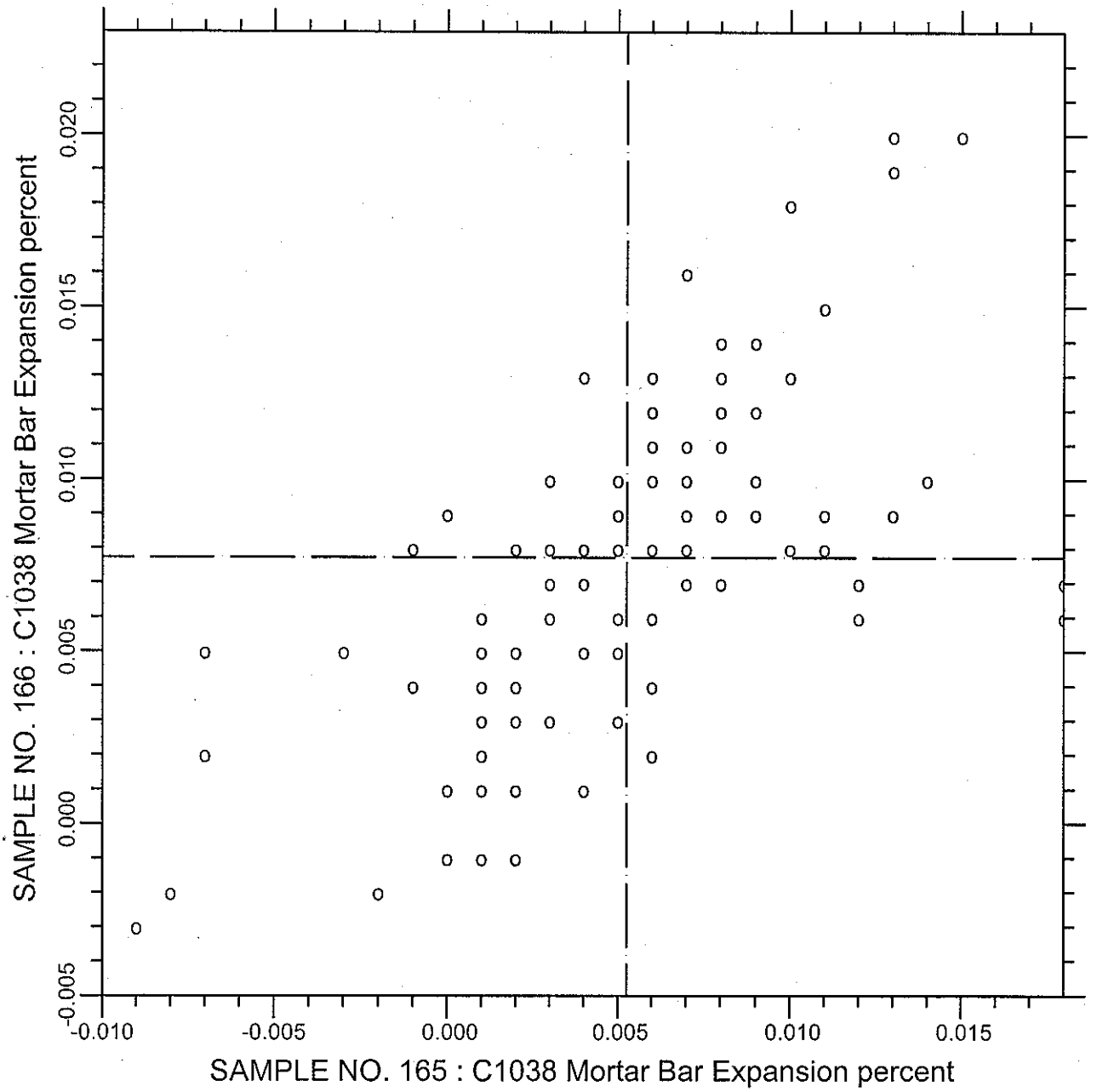
CCRL PROFICIENCY SAMPLE PROGRAM
45-micron Sieve - % Passing
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.281 Fineness, 45-micron sieve 238 POINTS

SAMPLE NO. 165	AVE 95.450	S.D. 0.79	C.V. 0.825	
SAMPLE NO. 166	AVE 94.428	S.D. 0.89	C.V. 0.942	
LABS ELIMINATED	94 125 413 502 2484			

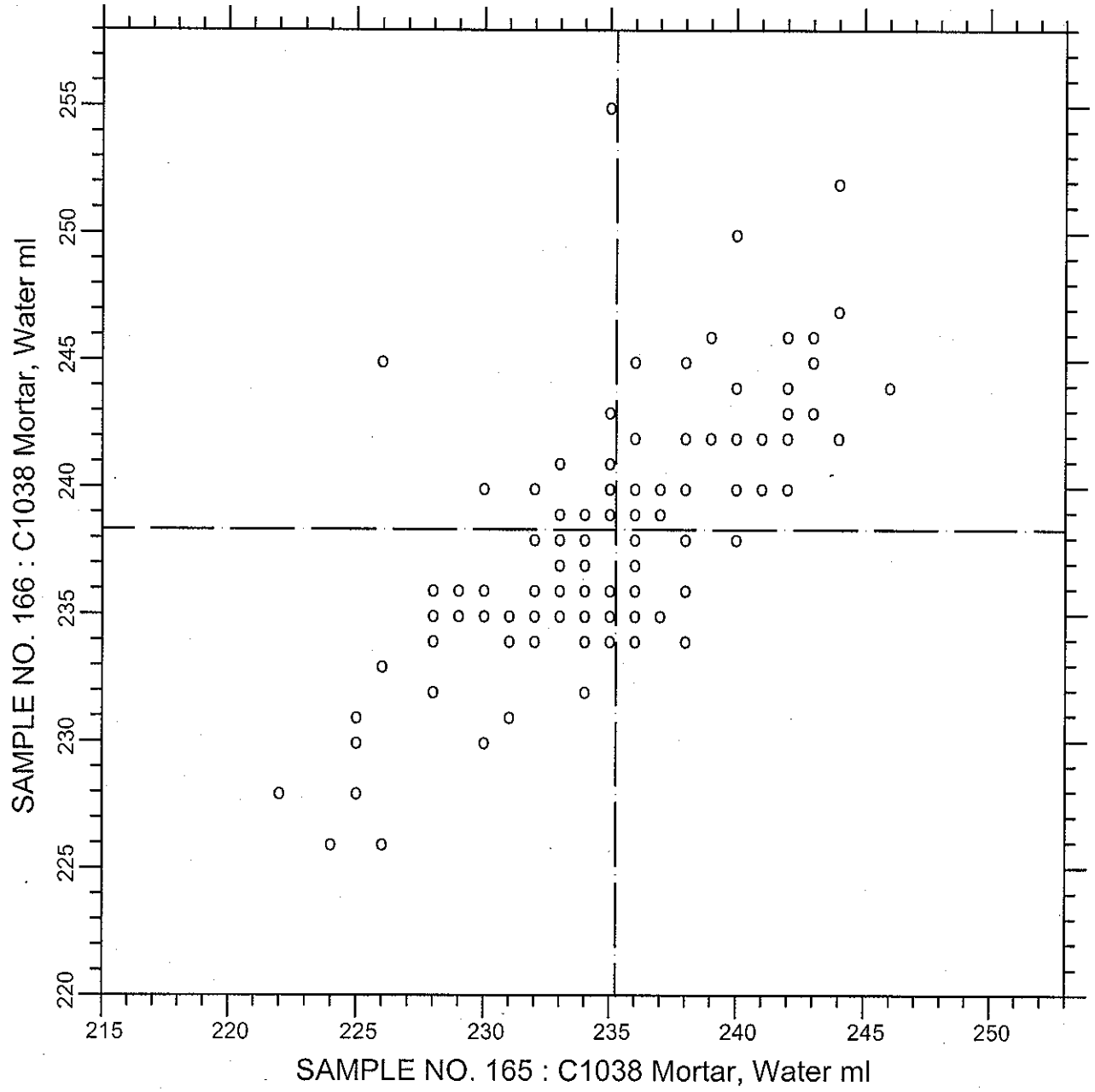
CCRL PROFICIENCY SAMPLE PROGRAM
C1038 Mortar Bar Expansion
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.400 C1038 Mortar Bar Expansion 139 POINTS

SAMPLE NO. 165 AVE 0.00526 S.D. 0.0043 C.V. 82.0
SAMPLE NO. 166 AVE 0.00773 S.D. 0.0043 C.V. 55.6
LABS ELIMINATED 54 121 413 154 500 687 1190

CCRL PROFICIENCY SAMPLE PROGRAM
C1038 Mortar - Water
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



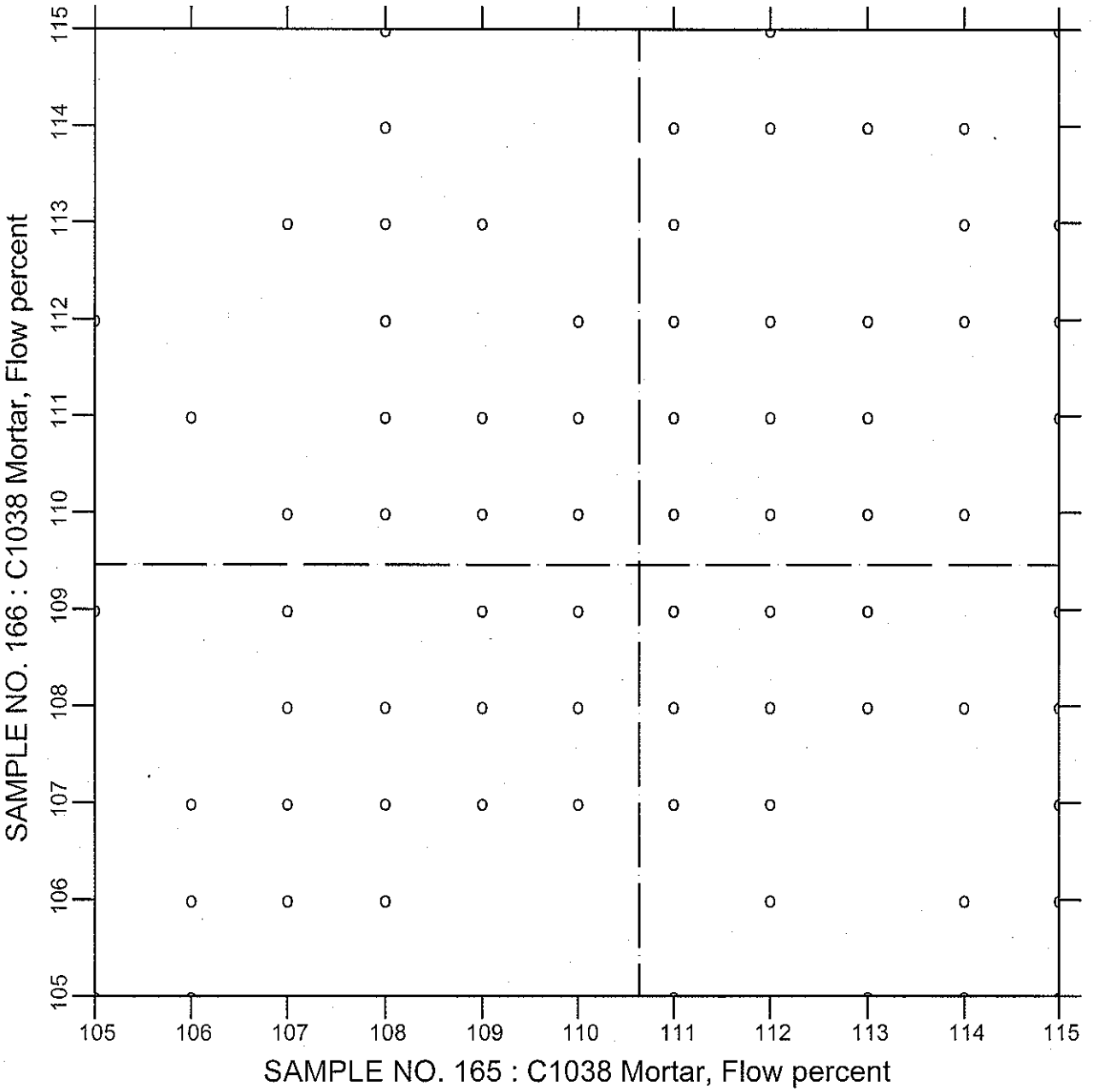
TEST NO.401 C1038 Mortar, Water 132 POINTS

SAMPLE NO. 165 AVE 235.26 S.D. 5.3 C.V. 2.24

SAMPLE NO. 166 AVE 238.32 S.D. 4.9 C.V. 2.07

LABS ELIMINATED 207 551 1054 1190 932 3232 3235

CCRL PROFICIENCY SAMPLE PROGRAM
C1038 Mortar - Flow
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.402 C1038 Mortar, Flow 133 POINTS

SAMPLE NO. 165 AVE 110.64 S.D. 2.8 C.V. 2.57

SAMPLE NO. 166 AVE 109.46 S.D. 2.6 C.V. 2.35

LABS ELIMINATED 416

CCRL PROFICIENCY SAMPLE PROGRAM
Portland Cement Proficiency Samples No. 165 and No. 166
Final Report - Heat of Hydration Results
September 7, 2007

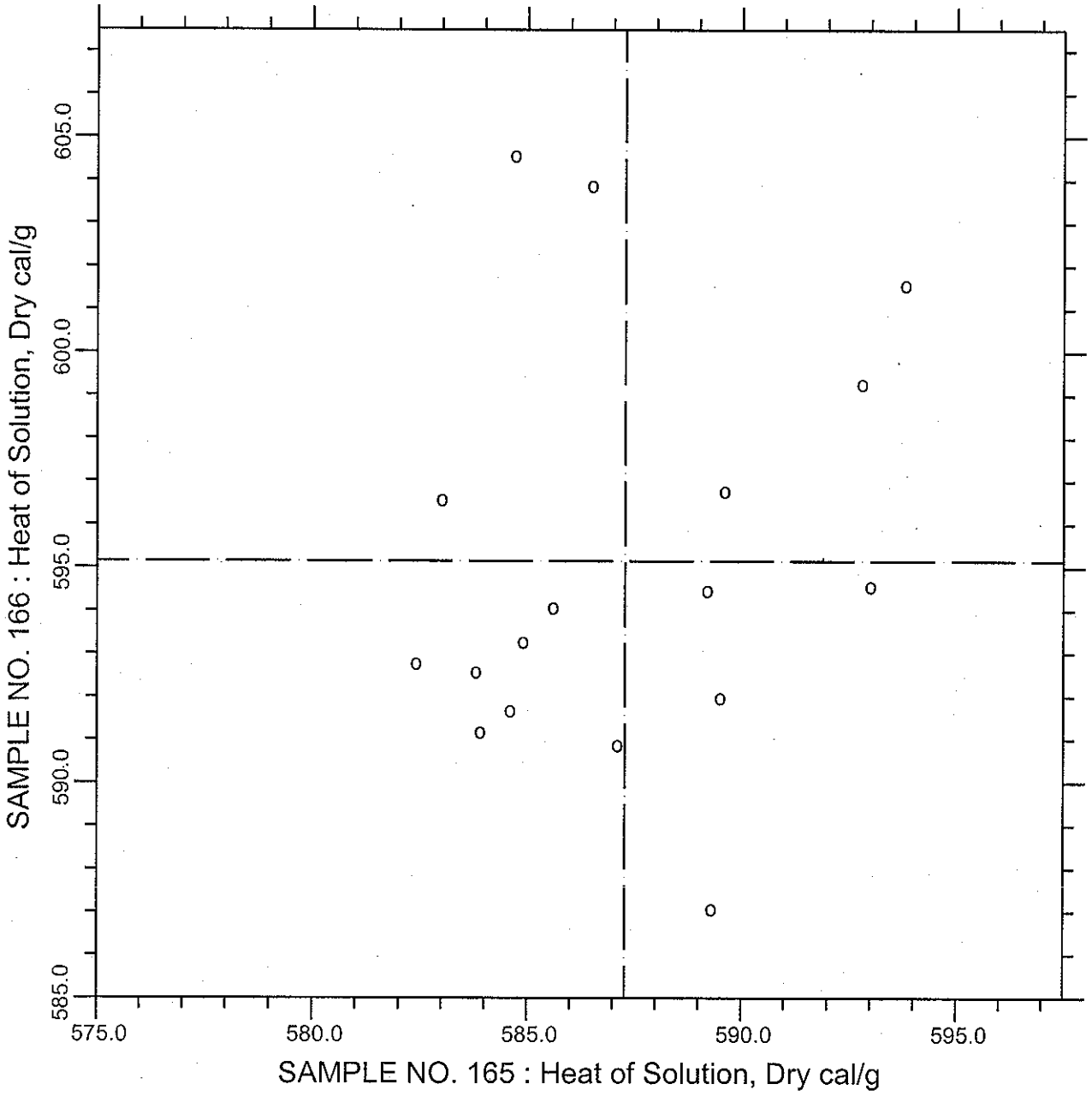
SUMMARY OF RESULTS

			Sample No. 165			Sample No. 166		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Heat Solution, Dry	cal/g	19	587.0	10.9	1.86	589.5	26.6	4.50
Heat Solution, Dry	cal/g	* 17	587.3	3.6	0.620	595.2	4.8	0.805
Heat Solution, 7 day	cal/g	19	511.4	9.8	1.92	507.4	23.6	4.65
Heat Solution, 7 day	cal/g	* 17	511.6	4.2	0.816	512.0	7.0	1.375
Heat Sol, 28 day	cal/g	14	503.1	10.0	1.99	497.2	26.4	5.30
Heat Sol, 28 day	cal/g	* 13	504.9	7.8	1.54	504.1	5.3	1.06
Heat Hyd, 7 day	cal/g	22	76.1	4.1	5.36	82.3	4.8	5.90
Heat Hyd, 7 day	cal/g	* 21	76.3	4.0	5.30	83.0	3.7	4.41
Heat Hyd, 28 day	cal/g	15	83.5	4.0	4.81	90.1	6.1	6.73

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

Heat of Solution, Dry	975 1644
Heat of Solution, 7 day	975 1644
Heat of Solution, 28 day	1644
Heat of Hydration, 7 day	1644

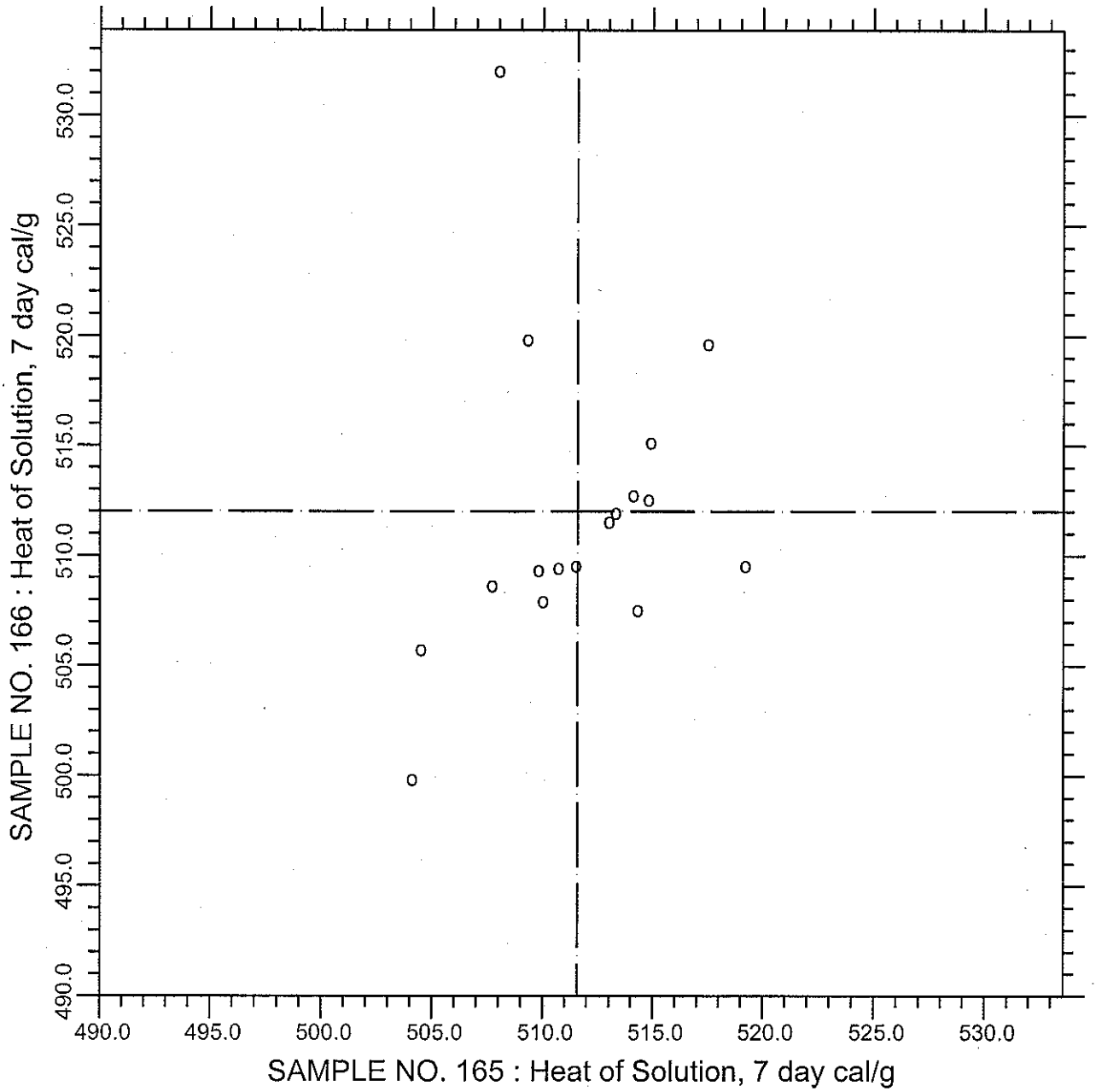
CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Solution - Dry Cement
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.291 Heat of Solution, Dry 17 POINTS

SAMPLE NO. 165 AVE 587.28 S.D. 3.6 C.V. 0.620
SAMPLE NO. 166 AVE 595.15 S.D. 4.8 C.V. 0.805
LABS ELIMINATED 975 1644

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Solution - 7-day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

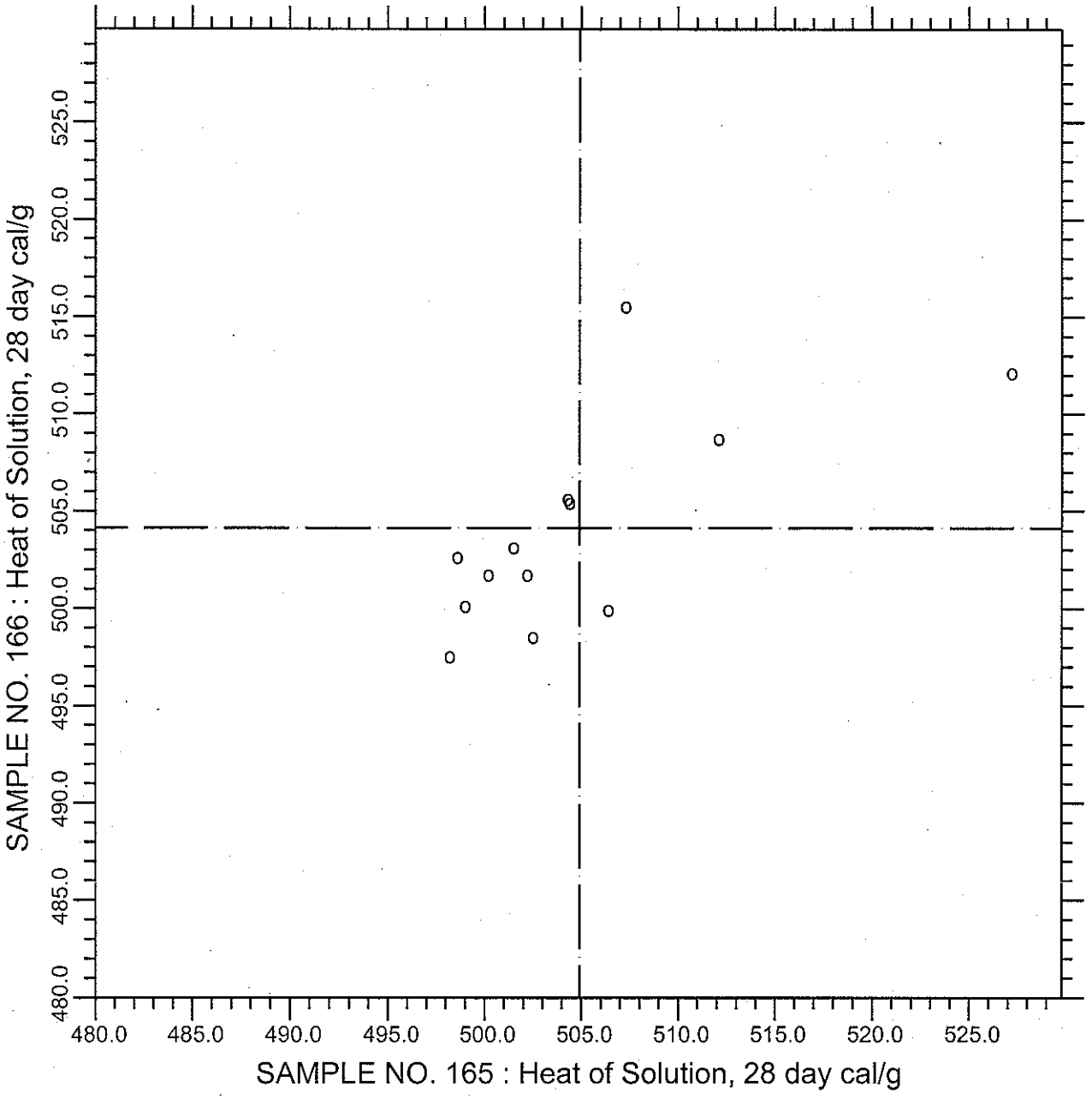


TEST NO.292 Heat of Solution, 7 day 17 POINTS

SAMPLE NO. 165	AVE	511.6	S.D.	4.2	C.V. 0.816
SAMPLE NO. 166	AVE	512.0	S.D.	7.0	C.V. 1.375

LABS ELIMINATED 975 1644

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Solution - 28-day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

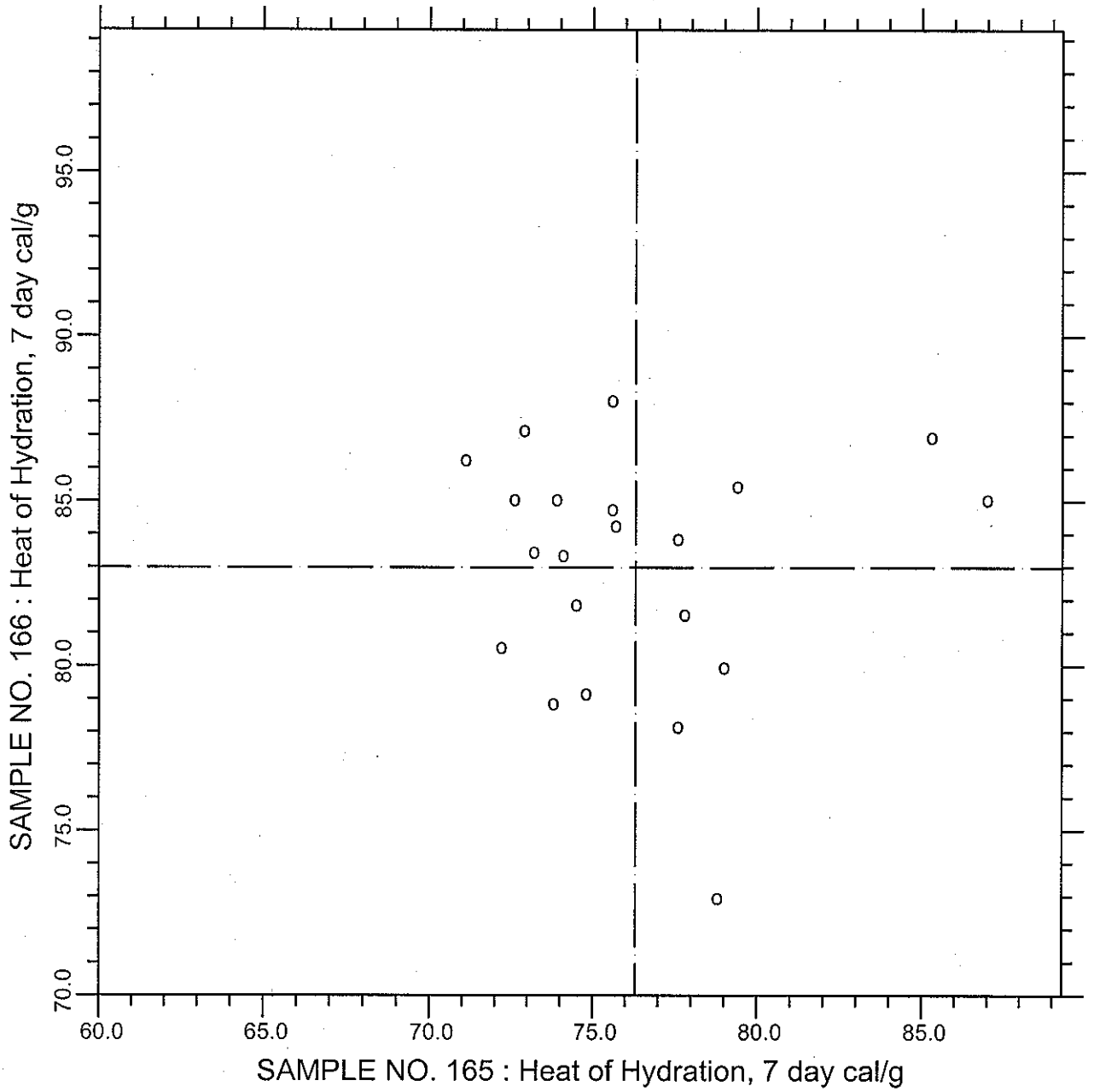


TEST NO.301 Heat of Solution, 28 day 13 POINTS

SAMPLE NO. 165	AVE	504.9	S.D.	7.8	C.V. 1.54
SAMPLE NO. 166	AVE	504.1	S.D.	5.3	C.V. 1.06

LABS ELIMINATED 1644

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Hydration - 7-day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166

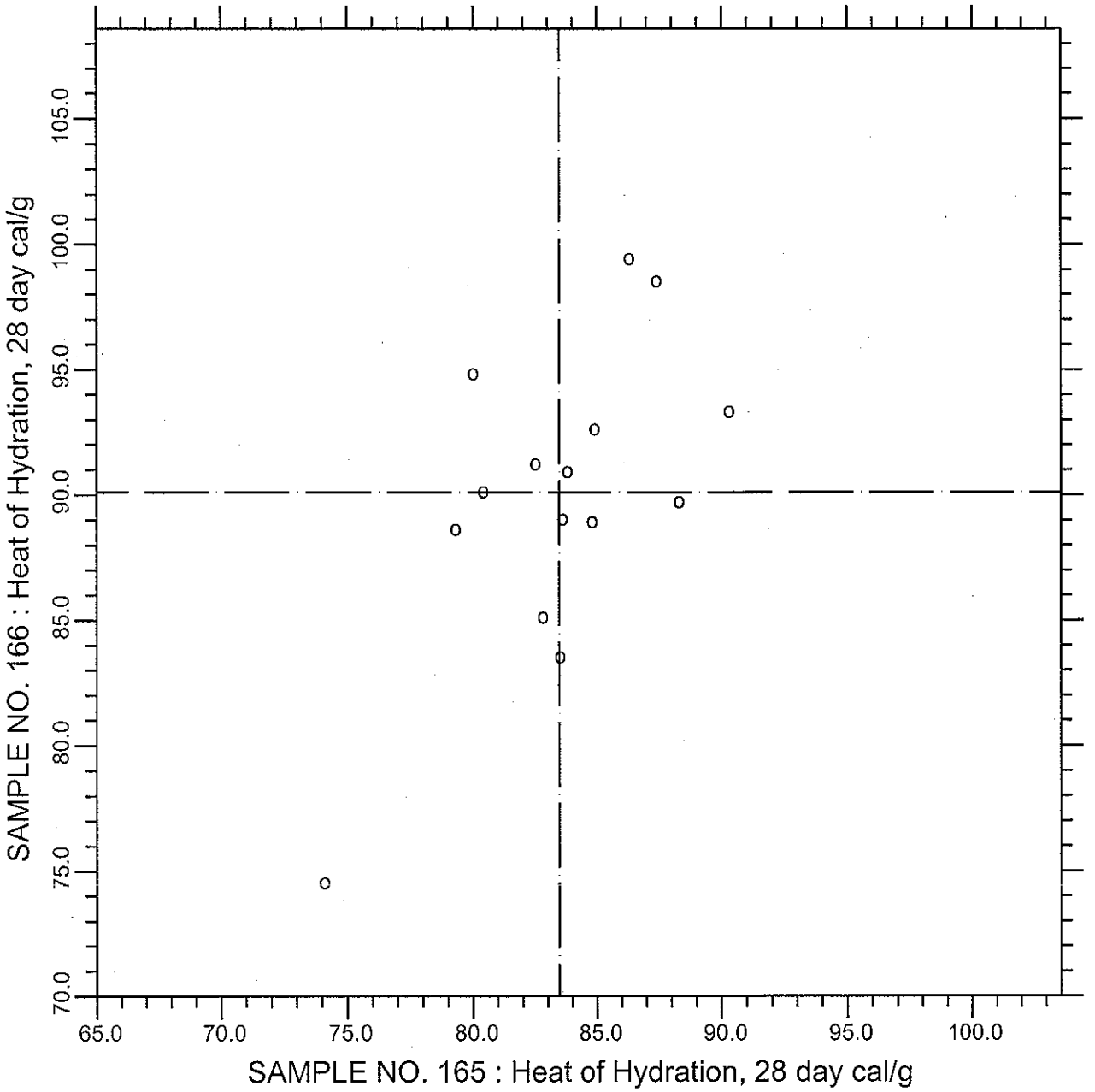


TEST NO.290 Heat of Hydration, 7 day 21 POINTS

SAMPLE NO. 165	AVE	76.31	S.D.	4.0	C.V.	5.30
SAMPLE NO. 166	AVE	82.98	S.D.	3.7	C.V.	4.41

LABS ELIMINATED 1644

CCRL PROFICIENCY SAMPLE PROGRAM
Heat of Hydration - 28-day
PORTLAND CEMENT SAMPLES NO. 165 & NO. 166



TEST NO.300 Heat of Hydration, 28 day 15 POINTS

SAMPLE NO. 165	AVE	83.5	S.D.	4.0	C.V.	4.81
SAMPLE NO. 166	AVE	90.1	S.D.	6.1	C.V.	6.73