CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Pozzolan Proficiency Samples
Number 41 and Number 42

October 2007

CCRL CEMENT AND CONCRETE REFERENCE LABORATORY

October 12, 2007

TO: Participants in the CCRL Pozzolan Proficiency Sample Program

SUBJECT: Pozzolan Proficiency Samples No. 41 and No. 42

Following is the final report for the pair of CCRL **Pozzolan** Proficiency Samples which were distributed in July 2007. Both samples were a Class F fly ash.

This report consists of two parts and each part must be downloaded from our website located at: http://www.ccrl.us/. One part contains general information that consists of a statistical Summary of Results, a set of Scatter Diagrams, and other associated information. The second part is laboratory specific information that consists of the Table of Results containing test results and ratings for your laboratory.

Calcium Oxide - Depending on the method of analysis used by a laboratory , the values for CaO may contain BaO and SrO or may be CaO only. On future pozzolan samples we will ask labs to report test results for CaO only and CaO with BaO and SrO separately.

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 samples 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 Pozzolan Proficiency Samples will be distributed in July 2008.

Sincerely,

Robin K. Haupt

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

Attachment

To: Participants in the CCRL Pozzolan Proficiency Sample Program

FROM: Robin K. Haupt, Supervisor, PSP

SUBJECT: Explanation of Final Report on Results of Tests on Pozzolan Proficiency Samples No. 41 and No. 42

This memo and the material included with it constitute the final report and summary of results for the current pair of Pozzolan Proficiency Samples, which were distributed in July 2007. This material includes a Table of Results for individual laboratory data, a statistical Summary of Results, and a set of 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.

Table of Results - Laboratory Ratings

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.

The ratings for the individual laboratory were determined in the manner described by Crandall and Blaine using a rating scale 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.

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

In cases where some laboratories' results are eliminated, averages, standard deviations, coefficients of variation and the ratings of the 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, which 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 test results reported, and then with one or more outlying test results omitted. Sometimes, two or more recalculations with laboratories omitted, have been performed 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 participation in chemical and/or physical tests.

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 may indicate strong evidence of bias in many cases.

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficiency Samples No. 41 and No. 42
Final Report - Chemical Results
October 12, 2007

SUMMARY OF RESULTS

Test		#Labs	Sample No. 41 Average	S.D.	C.V.	Sample No. 42 Average	S.D.	C.V.
Moisture Content	prcnt	66	0.07	0.058	84.8	0.12	0.066	56.6
Moisture Content	prcnt *	61	0.06	0.032	57.3	0.10	0.041	39.9
Silicon Dioxide	prcnt	59	52.20	2.8	5.34	61.28	3.0	4.89
Silicon Dioxide	prcnt *	54	52.01	1.5	2.87	61.50	1.8	2.87
Al_2O_3 w/minor[1]	prcnt	24	19.31	2.2	11.3	17.50	3.0	17.2
Al_2O_3 w/minor[1]	prcnt *	23	19.72	0.89	4.52	18.05	1.42	7.89
[1](P_2O_3 & TiO_2 included)								
Al_2O_3 wo/minor[2]	prcnt	50	18.53	0.77	4.17	16.78	1.37	8.15
Al_2O_3 wo/minor[2]	prcnt *	47	18.54	0.64	3.45	16.80	0.91	5.42
[2](P_2O_3 & TiO_2 not included)								
Ferric Oxide	prcnt	57	8.82	1.6	18.6	5.07	1.8	35.0
Ferric Oxide	prcnt *	51	8.60	0.36	4.22	4.71	0.38	8.05
Calcium Oxide	prcnt	61	13.08	1.4	10.8	7.01	1.1	15.1
Calcium Oxide	prcnt *	55	13.14	0.50	3.84	6.89	0.36	5.24
Magnesium Oxide	prcnt	60	2.73	0.27	9.80	2.41	0.31	12.79
Magnesium Oxide	prcnt *	55	2.71	0.18	6.67	2.41	0.20	8.26

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

Moisture Content	19 207 29 284 2522
Silicon Dioxide	3 20 14 42 125
Al_2O_3 w/minor	2295
Al_2O_3 wo/minor	39 126 1038
Ferric Oxide	42 126 158 125 176 2295
Calcium Oxide	39 42 20 50 158 176
Magnesium Oxide	20 39 42 126 284

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficiency Samples No. 41 and No. 42
Final Report - Chemical Results
October 12, 2007

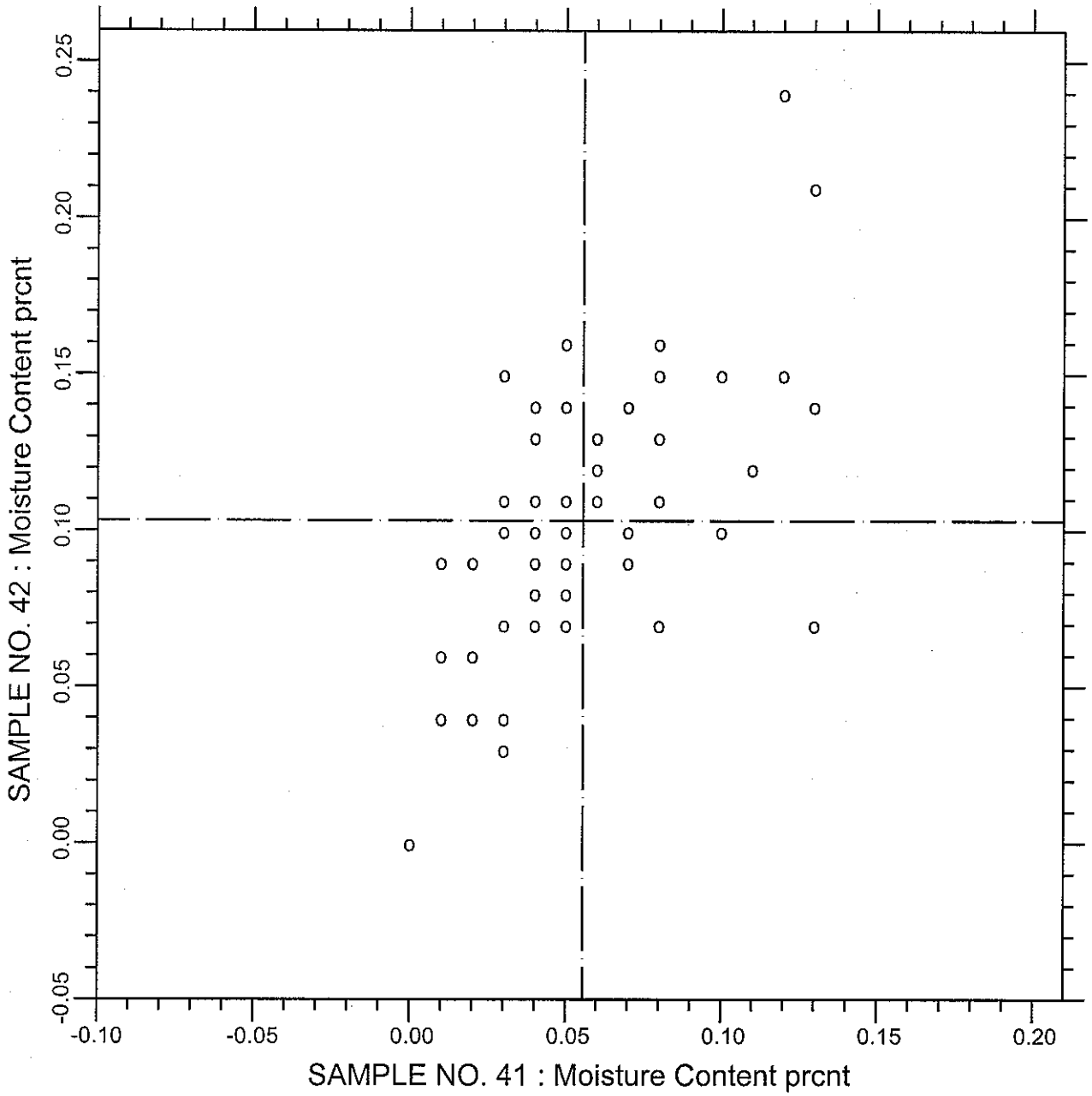
SUMMARY OF RESULTS

				Sample No. 41			Sample No. 42		
Test			#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Sulfur Trioxide	prcnt		66	0.66	0.19	29.0	0.60	0.15	25.4
Sulfur Trioxide	prcnt	*	62	0.65	0.124	19.0	0.60	0.097	16.2
Loss on Ignition	prcnt		72	0.15	0.30	196.3	0.42	0.22	52.7
Loss on Ignition	prcnt	*	67	0.11	0.069	65.6	0.40	0.093	23.2
Sodium Oxide	prcnt		54	0.49	0.16	32.9	2.61	0.70	26.7
Sodium Oxide	prcnt	*	50	0.51	0.13	26.0	2.76	0.38	13.8
Potassium Oxide	prcnt		56	1.16	0.12	9.98	1.54	0.17	10.96
Potassium Oxide	prcnt	*	50	1.17	0.051	4.36	1.56	0.085	5.47
Available Na_2O	prcnt		27	0.23	0.083	36.3	1.23	0.267	21.7
Available Na_2O	prcnt	*	26	0.22	0.046	21.3	1.21	0.253	20.9
Available K_2O	prcnt		27	0.38	0.13	34.4	0.58	0.18	30.5
Available Alkali	prcnt		28	0.50	0.15	29.0	1.71	0.51	29.9
Available Alkali	prcnt	*	27	0.49	0.13	26.2	1.63	0.30	18.3

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

Sulfur Trioxide	14 1379 205 1940
Loss on Ignition	20 1940 3 42 2295
Sodium Oxide	48 125 205 1479
Potassium Oxide	50 176 24 39 205 958
Available Sodium Oxide	23
Available Alkali	1251

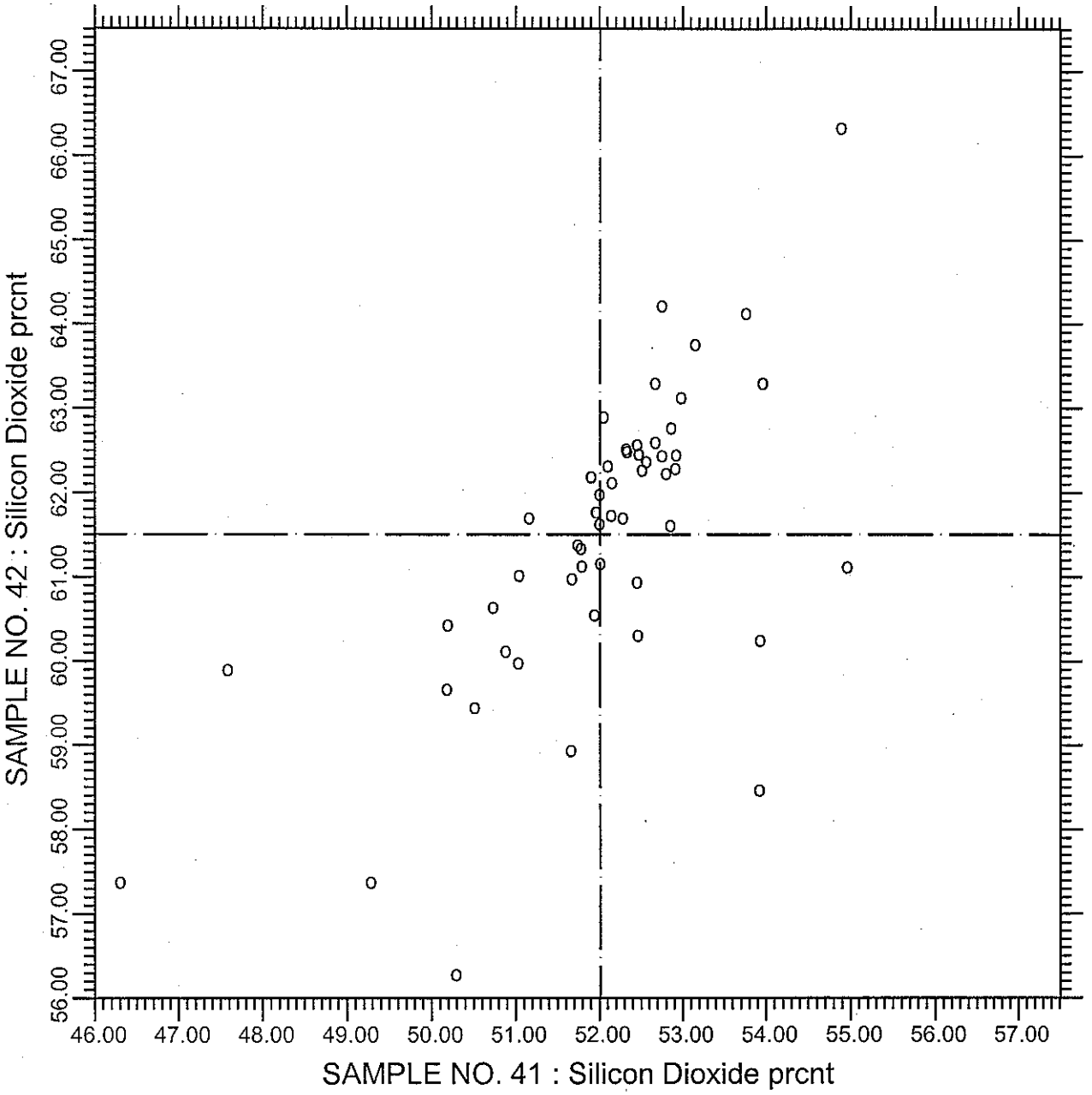
CCRL PROFICIENCY SAMPLE PROGRAM
Moisture Content
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.5 Moisture Content 61 POINTS

SAMPLE NO. 41 AVE 0.0556 S.D. 0.032 C.V. 57.3
SAMPLE NO. 42 AVE 0.1033 S.D. 0.041 C.V. 39.9
LABS ELIMINATED 19 207 29 284 2522

CCRL PROFICIENCY SAMPLE PROGRAM
Silicon Dioxide
POZZOLAN SAMPLES NO. 41 & NO. 42



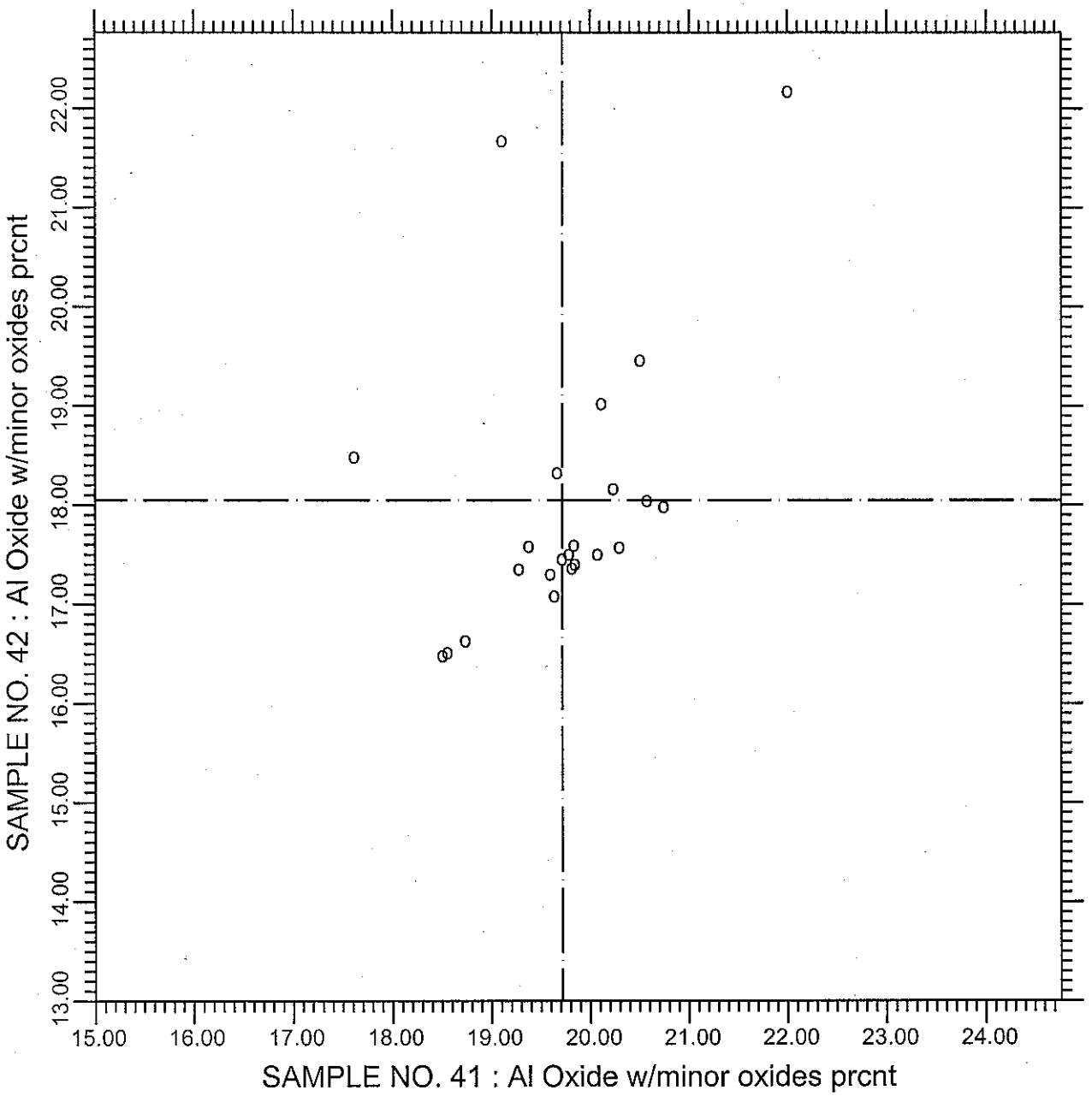
TEST NO.10 Silicon Dioxide 54 POINTS

SAMPLE NO. 41 AVE 52.01 S.D. 1.5 C.V. 2.87

SAMPLE NO. 42 AVE 61.50 S.D. 1.8 C.V. 2.87

LABS ELIMINATED 3 20 14 42 125

CCRL PROFICIENCY SAMPLE PROGRAM
Aluminum Oxide (minor oxides included)
POZZOLAN SAMPLES NO. 41 & NO. 42

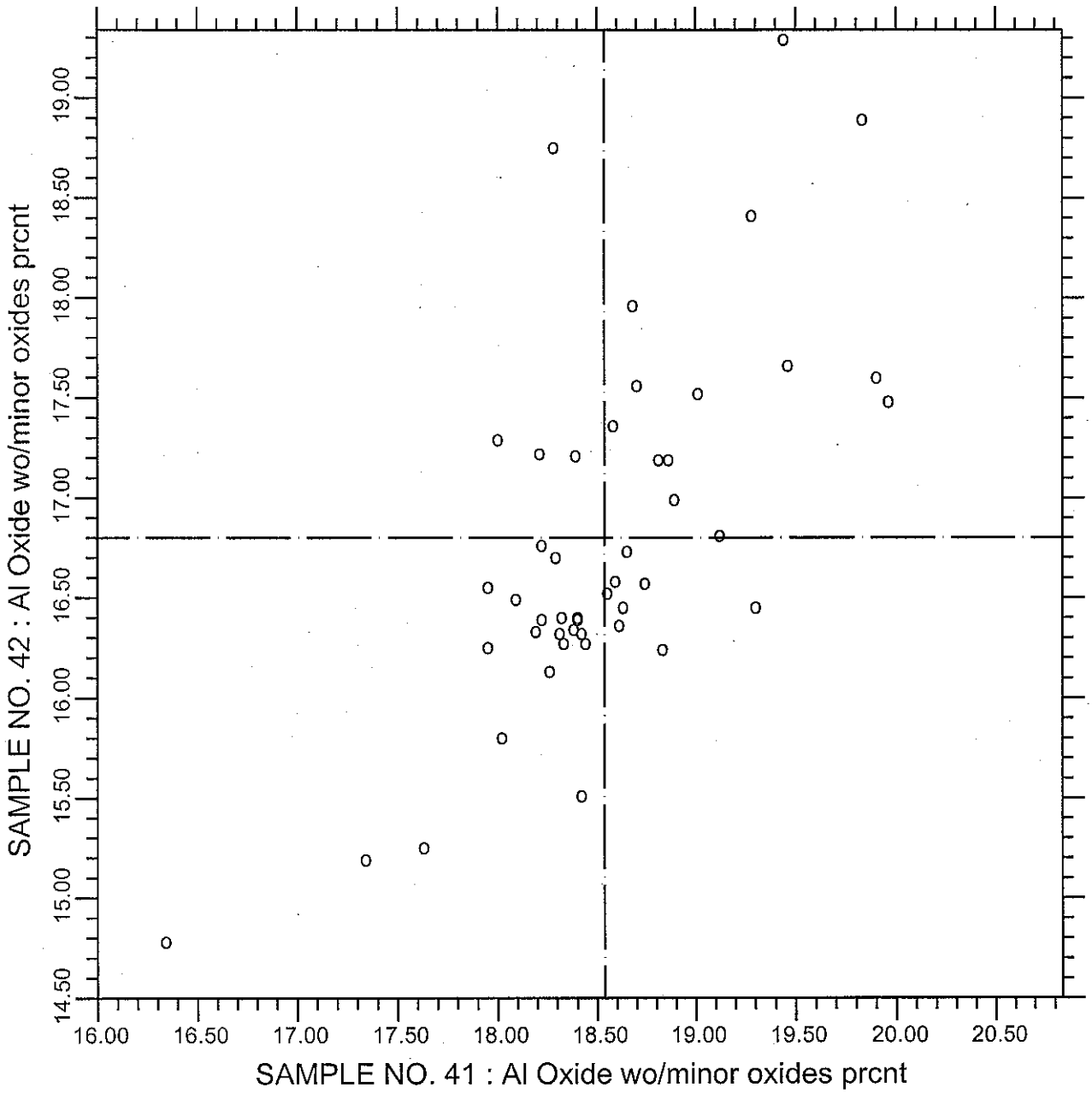


TEST NO.20 Al Oxide w/minor oxides 23 POINTS

SAMPLE NO. 41	AVE	19.72	S.D.	0.89	C.V.	4.52
SAMPLE NO. 42	AVE	18.05	S.D.	1.42	C.V.	7.89

LABS ELIMINATED 2295

CCRL PROFICIENCY SAMPLE PROGRAM
Aluminum Oxide (minor oxides excluded)
POZZOLAN SAMPLES NO. 41 & NO. 42



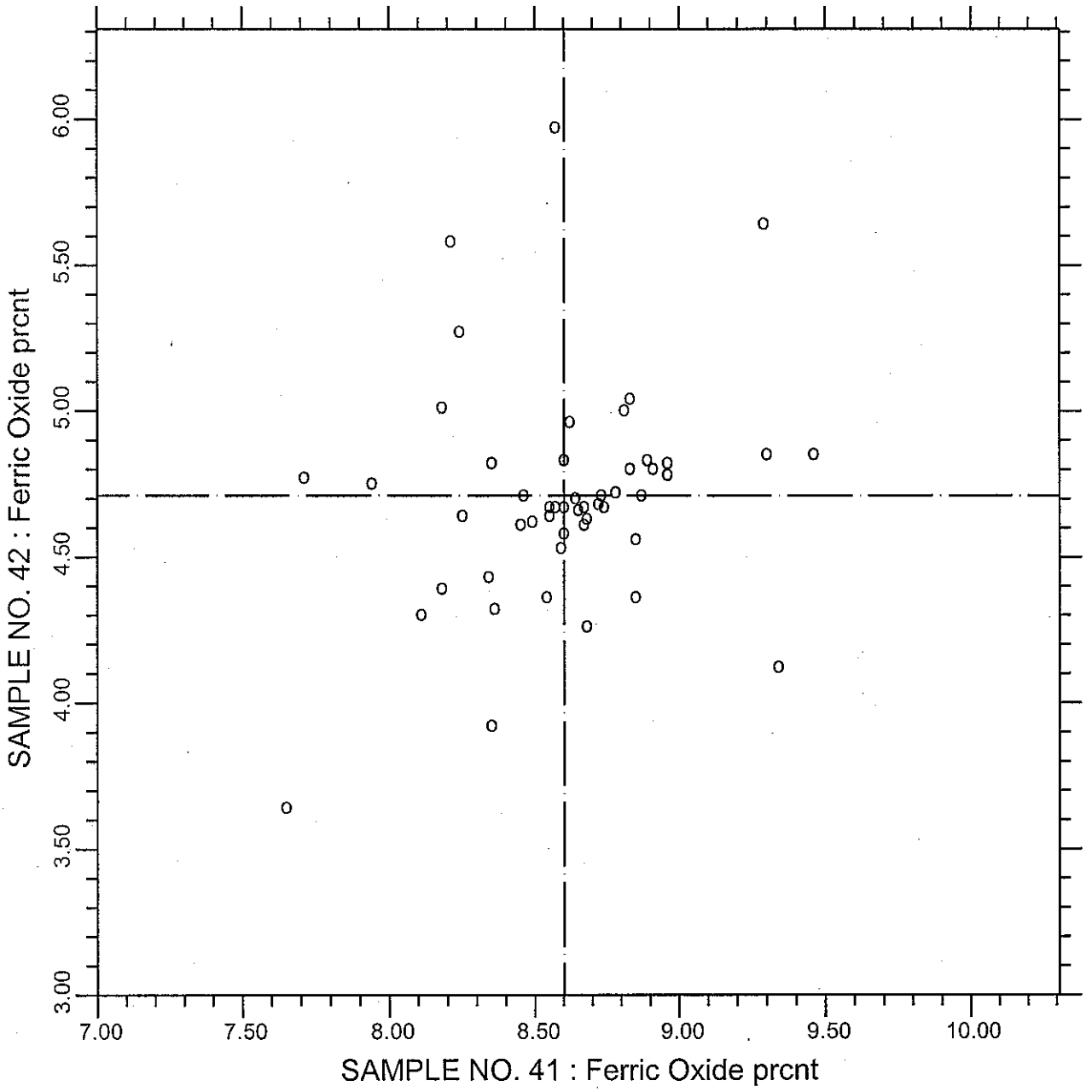
TEST NO.21 Al Oxide wo/minor oxides 47 POINTS

SAMPLE NO. 41 AVE 18.537 S.D. 0.64 C.V. 3.45

SAMPLE NO. 42 AVE 16.800 S.D. 0.91 C.V. 5.42

LABS ELIMINATED 39 126 1038

CCRL PROFICIENCY SAMPLE PROGRAM
Ferric Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42



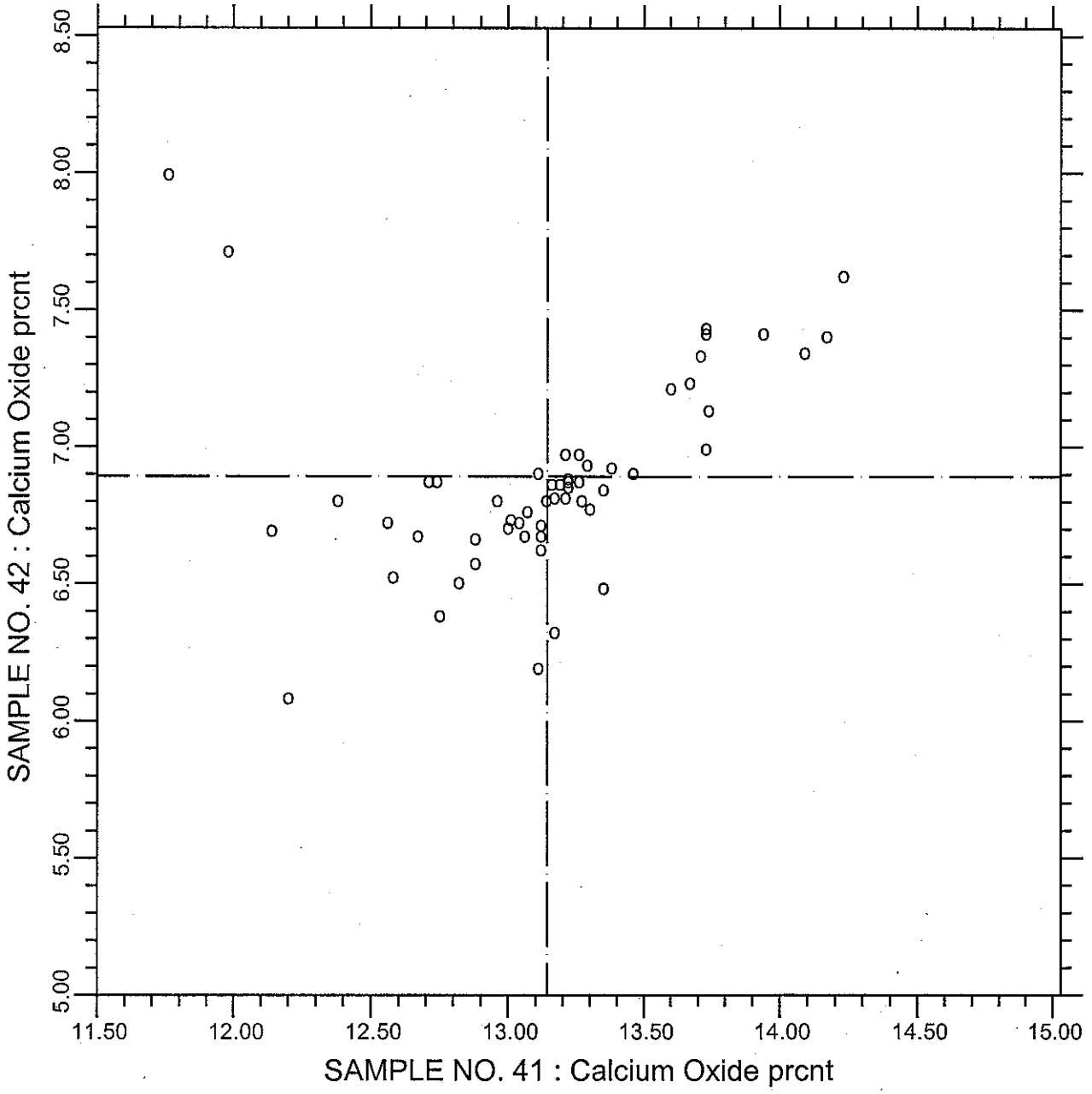
TEST NO.30 Ferric Oxide 51 POINTS

SAMPLE NO. 41 AVE 8.601 S.D. 0.36 C.V. 4.22

SAMPLE NO. 42 AVE 4.711 S.D. 0.38 C.V. 8.05

LABS ELIMINATED 42 126 158 125 176 2295

CCRL PROFICIENCY SAMPLE PROGRAM
Calcium Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42



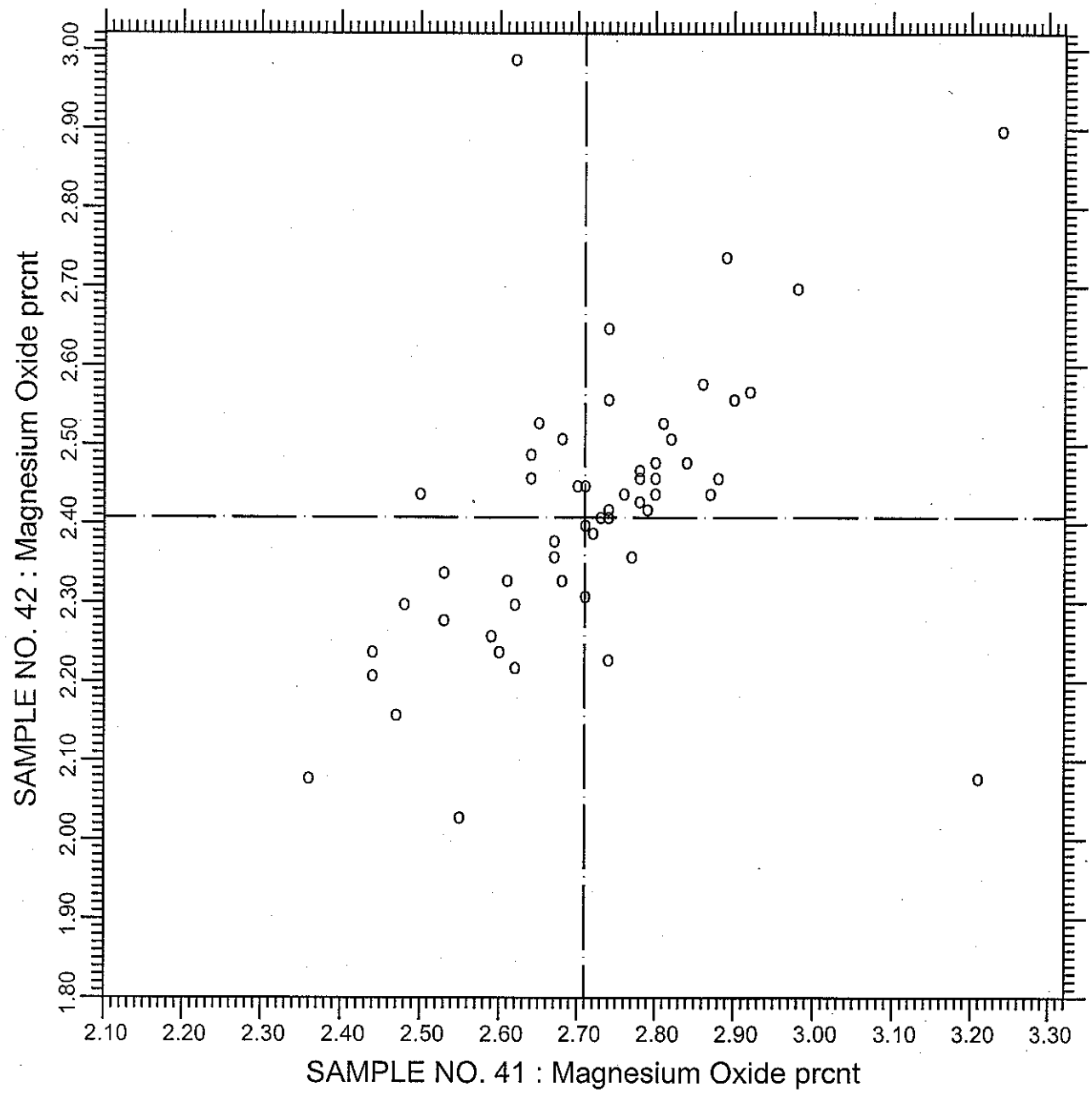
TEST NO.40 Calcium Oxide 55 POINTS

SAMPLE NO. 41 AVE 13.144 S.D. 0.50 C.V. 3.84

SAMPLE NO. 42 AVE 6.892 S.D. 0.36 C.V. 5.24

LABS ELIMINATED 39 42 20 50 158 176

CCRL PROFICIENCY SAMPLE PROGRAM
Magnesium Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.50 Magnesium Oxide 54 POINTS

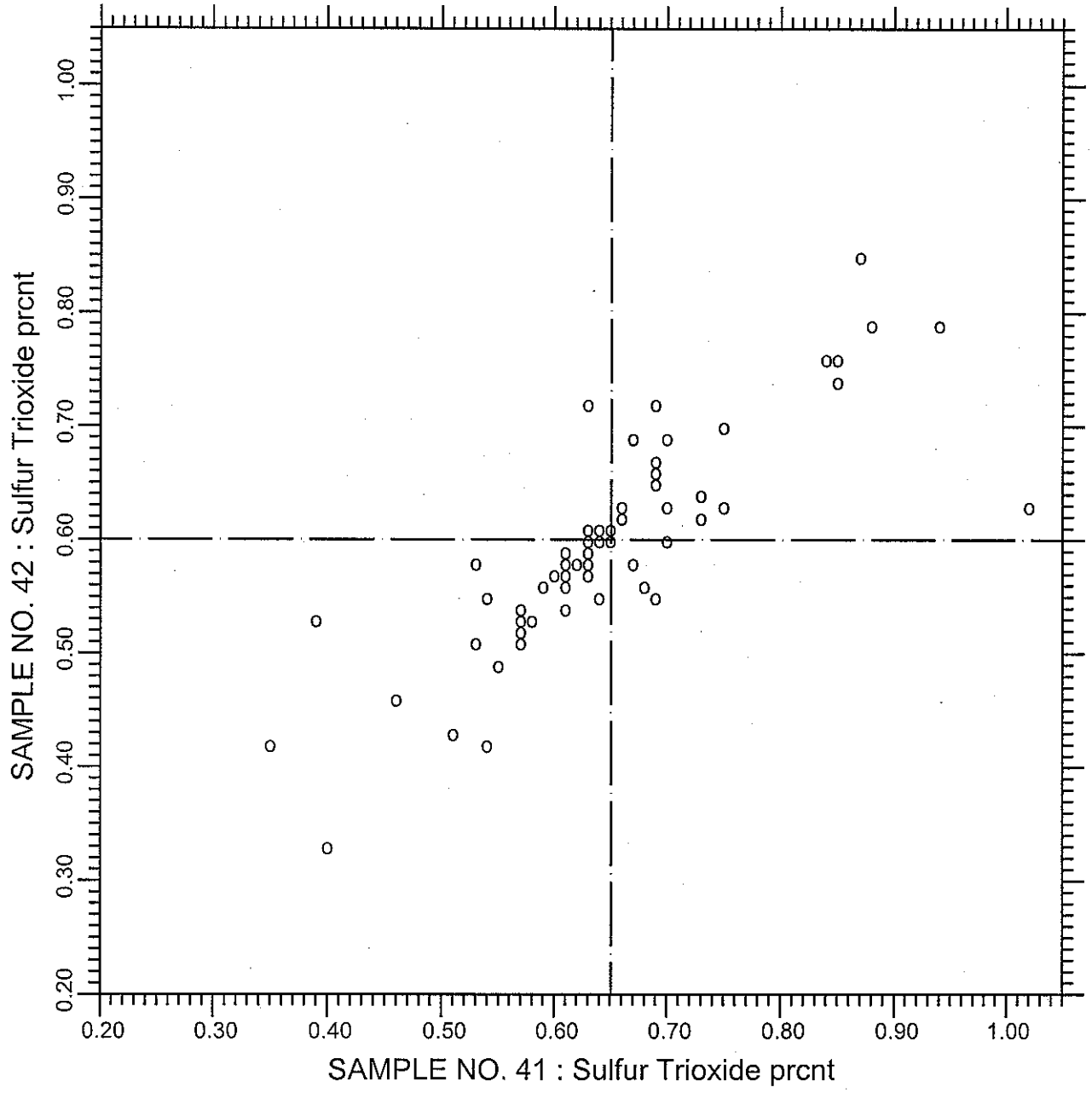
SAMPLE NO. 41 AVE 2.710 S.D. 0.18 C.V. 6.67

SAMPLE NO. 42 AVE 2.408 S.D. 0.20 C.V. 8.26

LABS ELIMINATED 20 39 42 126 284

LABS OFF DIAGRAM 205

CCRL PROFICIENCY SAMPLE PROGRAM
Sulfur Trioxide
POZZOLAN SAMPLES NO. 41 & NO. 42



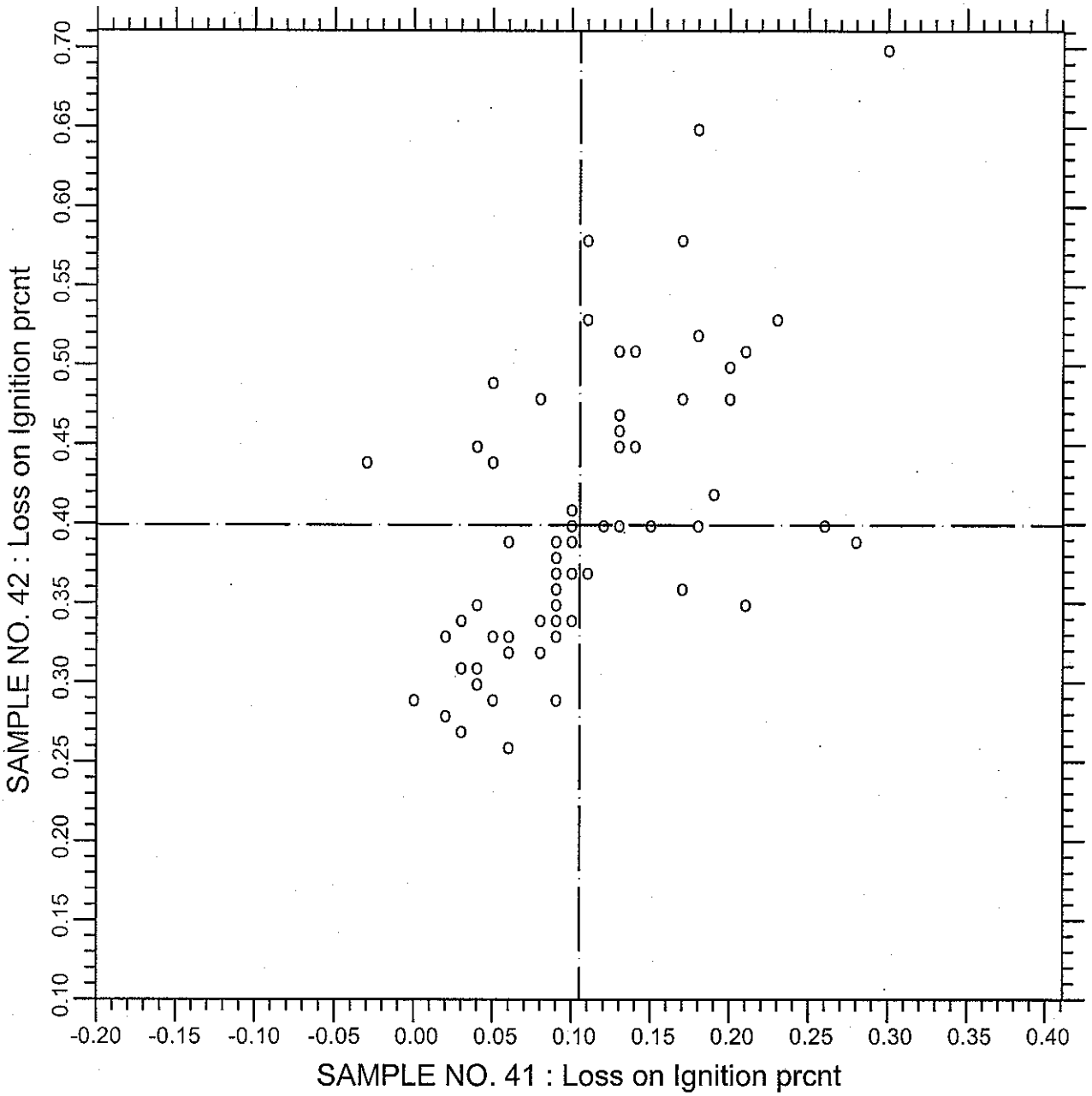
TEST NO.60 Sulfur Trioxide 62 POINTS

SAMPLE NO. 41 AVE 0.651 S.D. 0.124 C.V. 19.0

SAMPLE NO. 42 AVE 0.600 S.D. 0.097 C.V. 16.2

LABS ELIMINATED 14 1379 205 1940

CCRL PROFICIENCY SAMPLE PROGRAM
Loss on Ignition
POZZOLAN SAMPLES NO. 41 & NO. 42



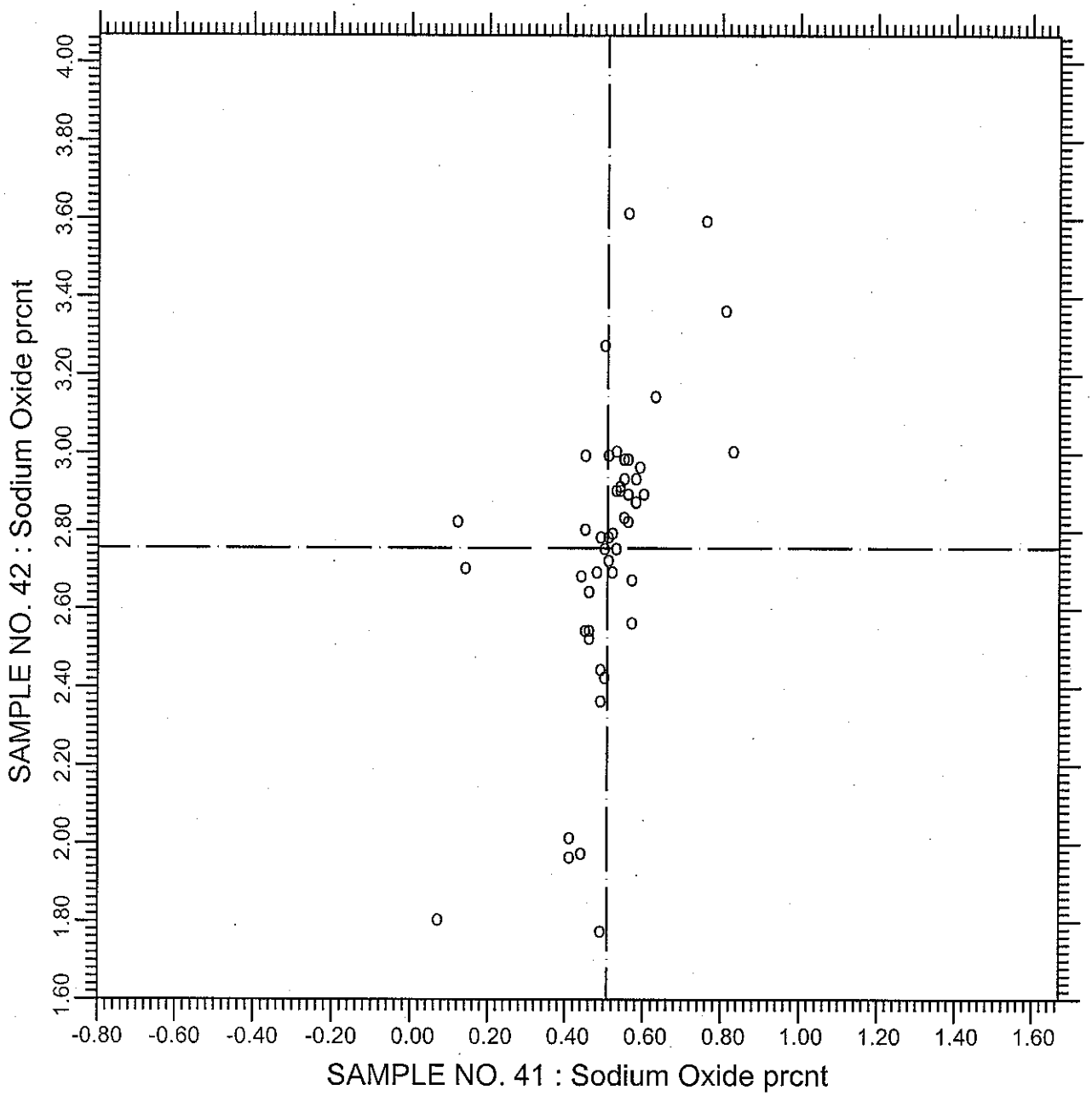
TEST NO.70 Loss on Ignition 67 POINTS

SAMPLE NO. 41 AVE 0.1051 S.D. 0.069 C.V. 65.6

SAMPLE NO. 42 AVE 0.3994 S.D. 0.093 C.V. 23.2

LABS ELIMINATED 20 1940 3 42 2295

CCRL PROFICIENCY SAMPLE PROGRAM
Sodium Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42



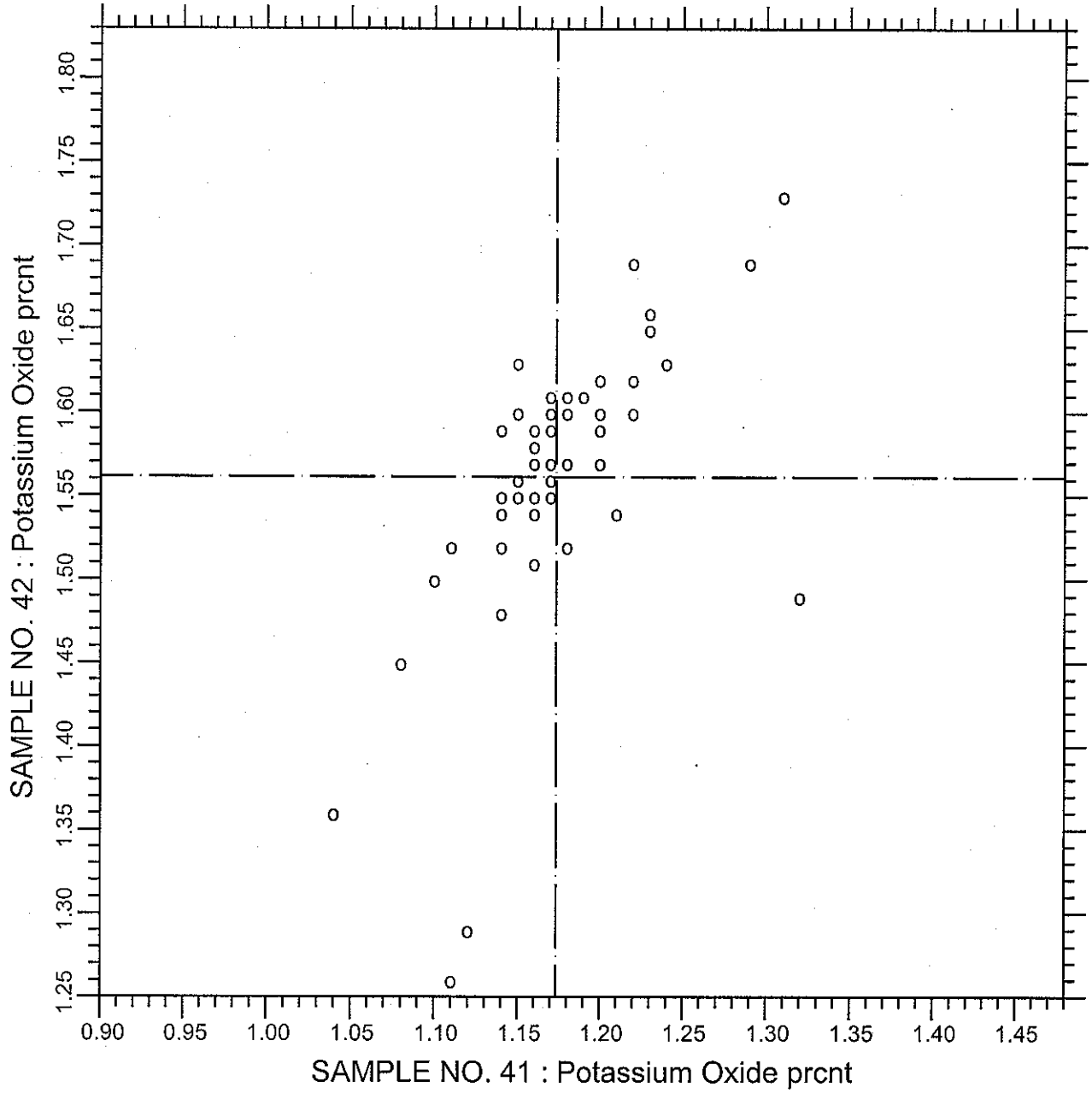
TEST NO.90 Sodium Oxide 50 POINTS

SAMPLE NO. 41 AVE 0.508 S.D. 0.13 C.V. 26.0

SAMPLE NO. 42 AVE 2.757 S.D. 0.38 C.V. 13.8

LABS ELIMINATED 48 125 205 1479

CCRL PROFICIENCY SAMPLE PROGRAM
Potassium Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42



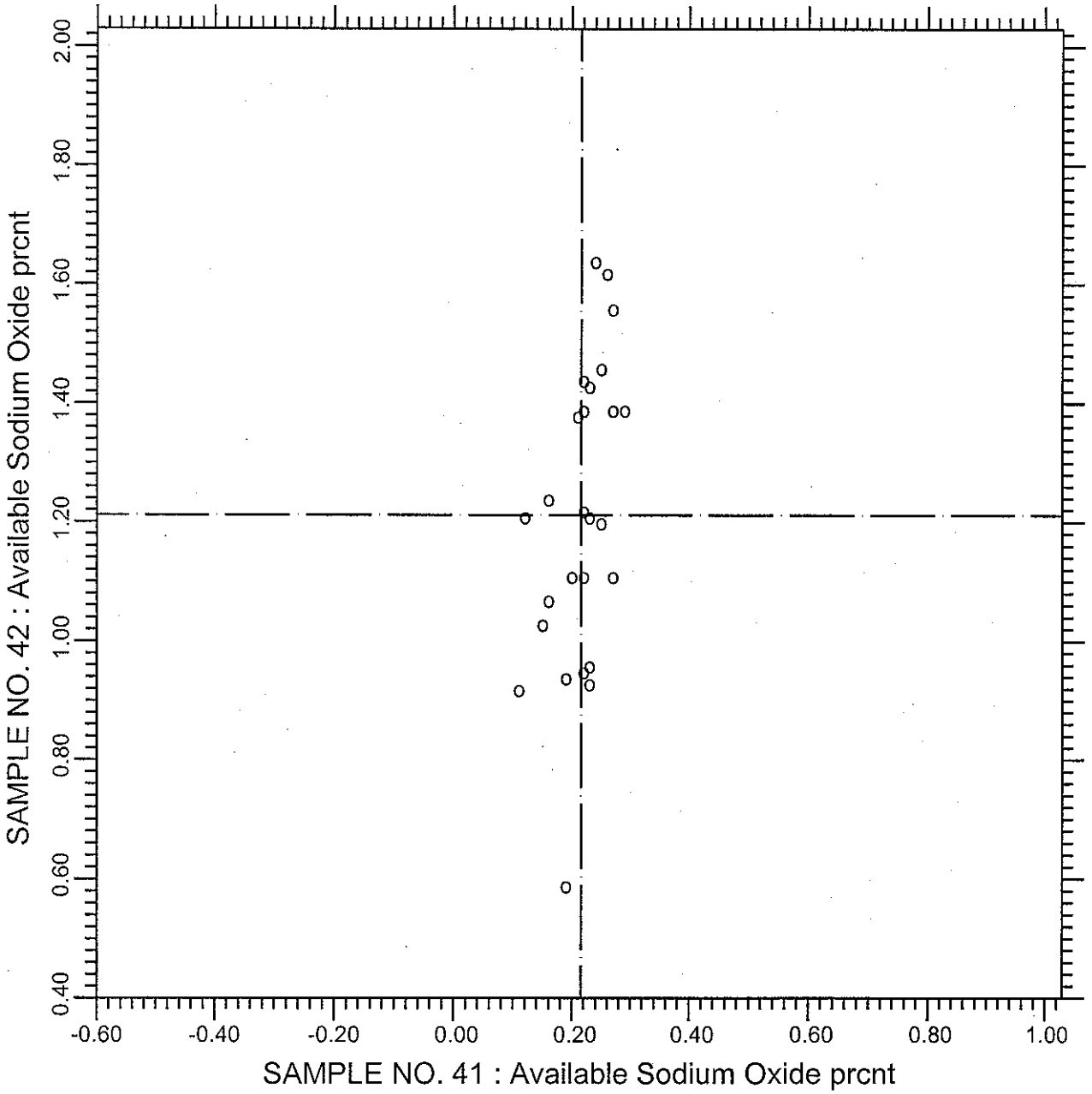
TEST NO.100 Potassium Oxide 50 POINTS

SAMPLE NO. 41 AVE 1.1736 S.D. 0.051 C.V. 4.36

SAMPLE NO. 42 AVE 1.5614 S.D. 0.085 C.V. 5.47

LABS ELIMINATED 50 176 24 39 205 958

CCRL PROFICIENCY SAMPLE PROGRAM
Available Sodium Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42

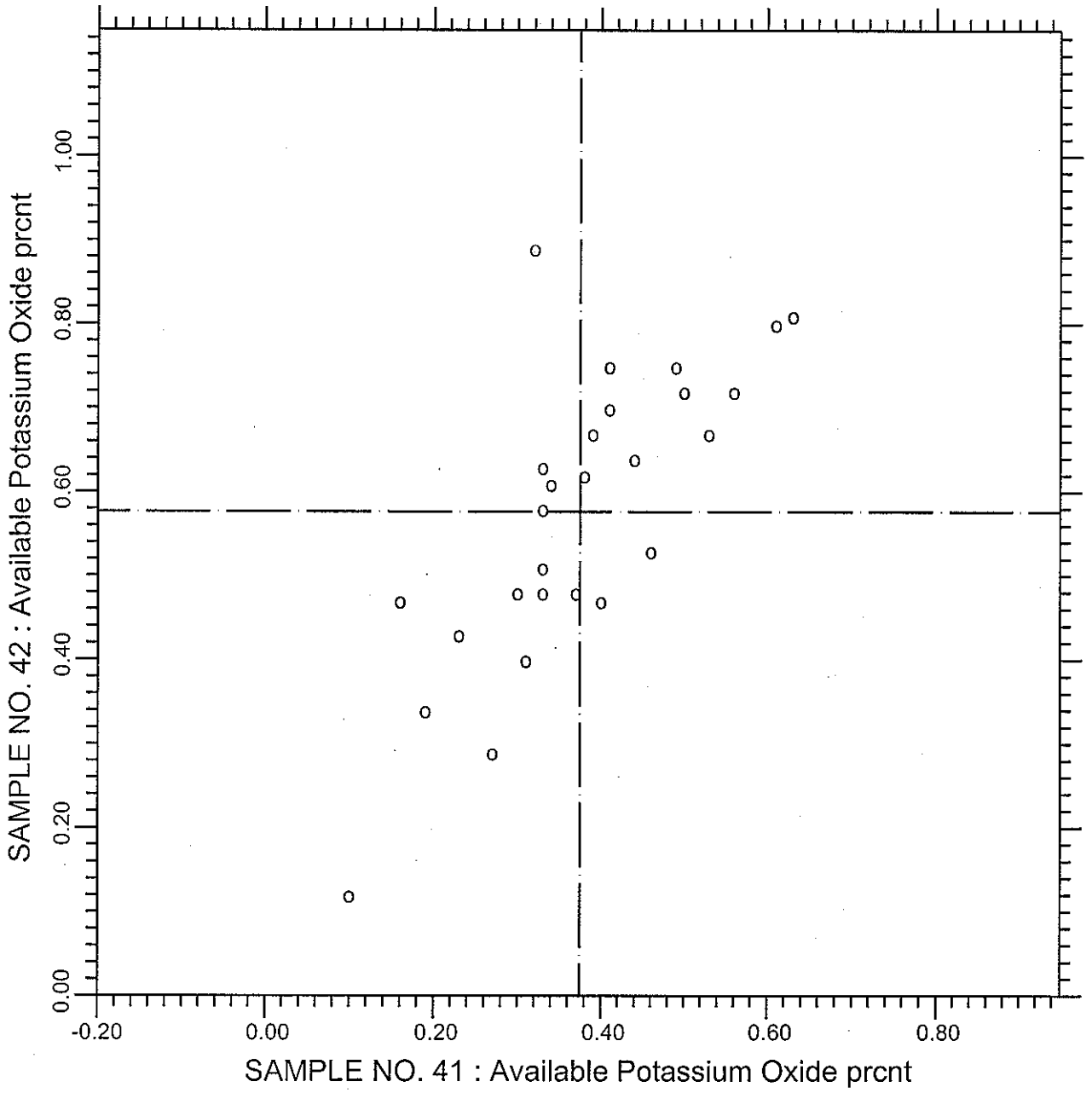


TEST NO.91 Available Sodium Oxide 26 POINTS

SAMPLE NO. 41	AVE	0.2158	S.D.	0.046	C.V.	21.3
SAMPLE NO. 42	AVE	1.2115	S.D.	0.253	C.V.	20.9

LABS ELIMINATED 23

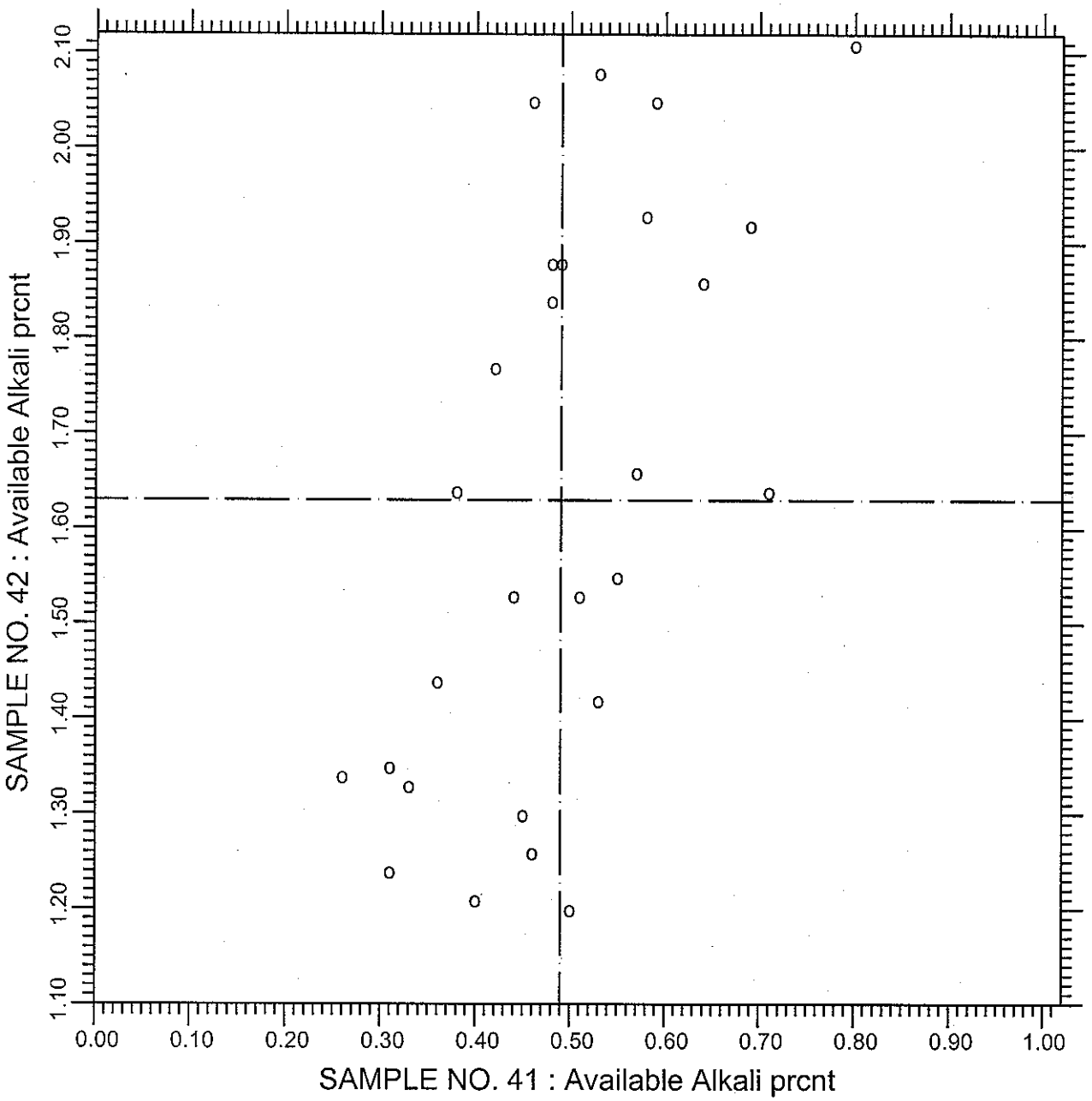
CCRL PROFICIENCY SAMPLE PROGRAM
Available Potassium Oxide
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.93 Available Potassium Oxide 27 POINTS

SAMPLE NO. 41	AVE	0.375	S.D.	0.13	C.V.	34.4
SAMPLE NO. 42	AVE	0.576	S.D.	0.18	C.V.	30.5

CCRL PROFICIENCY SAMPLE PROGRAM
Available Alkali
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.95 Available Alkali 27 POINTS

SAMPLE NO. 41 AVE 0.490 S.D. 0.13 C.V. 26.2
SAMPLE NO. 42 AVE 1.630 S.D. 0.30 C.V. 18.3
LABS ELIMINATED 1251

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficency Sample No. 41 and No. 42
Final Report - Physical Results
October 12, 2007

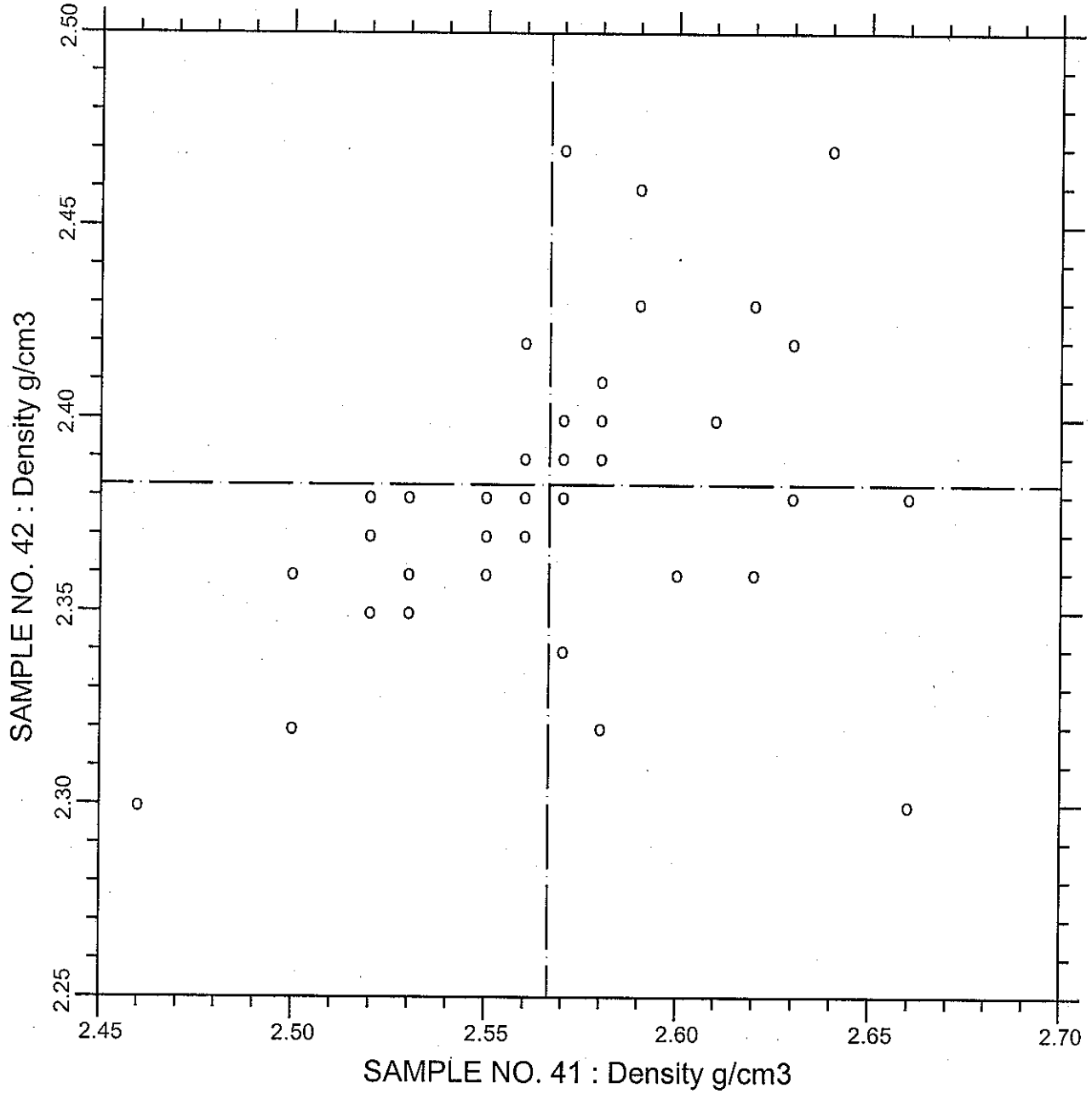
SUMMARY OF RESULTS

			Sample No. 41			Sample No. 42		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Density	g/cm3	66	2.58	0.069	2.67	2	0.130	5.37
Density	g/cm3	* 59	2.57	0.037	1.44	2.38	0.033	1.38
45µm Sieve	prcnt	77	20.64	2.6	12.5	19.66	3.1	15.9
45µm Sieve	prcnt	* 71	20.54	1.8	8.53	19.80	2.0	9.89
Drying Shrinkage	prcnt	19	-0.006	0.035	-580.84	-0.004	0.045	-1009.96
Drying Shrinkage	prcnt	* 18	-0.011	0.027	-238.17	-0.012	0.028	-229.53
Autoclave Expan	prcnt	57	0.04	0.022	49.3	0.11	0.062	55.5
Autoclave Expan	prcnt	* 55	0.05	0.018	39.4	0.11	0.034	32.0
N.C. Water	prcnt	61	24.5	1.00	4.10	24.8	0.99	4.01
N.C. Water	prcnt	* 58	24.3	0.48	1.96	24.7	0.50	2.01
Air Entrainment	prcnt	9	0.057	0.12	202	0.066	0.13	197
STRENGTH ACTIVITY INDES (SAI) WITH PORTLAND CEMENT								
SAI 7 day	prcnt	68	88	11.7	13.4	88	10.6	12.2
SAI 7 day	prcnt	* 66	88	5.2	5.87	88	6.1	6.92
SAI 28 day	prcnt	62	96	6.7	7.00	97	6.9	7.11
SAI 28 day	prcnt	* 60	95	5.2	5.49	96	5.9	6.14
SAI Water	prcnt	63	93	2.3	2.45	93	2.0	2.14
SAI Water	prcnt	* 61	93	1.7	1.85	93	1.6	1.68
EFFECTIVENESS OF MINERAL ADMIXTURES IN CONTROLLING ALKALI-SILICA REACTIONS (ASR)								
Reduction Expan	prcnt	8	66	3.6	5.53	63	7.7	12.24

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

Density	2295 2621 47 840 125 126 3059
45µm Sieve	265 1323 22 22 58 3135
Drying Shrinkage	3059
Autoclave Expansion	2938 3207
N.C. Water	19 480 1038
SAI 7 day	284 3059
SAI 28 day	284 1435
SAI Water Requirement	1379 1435

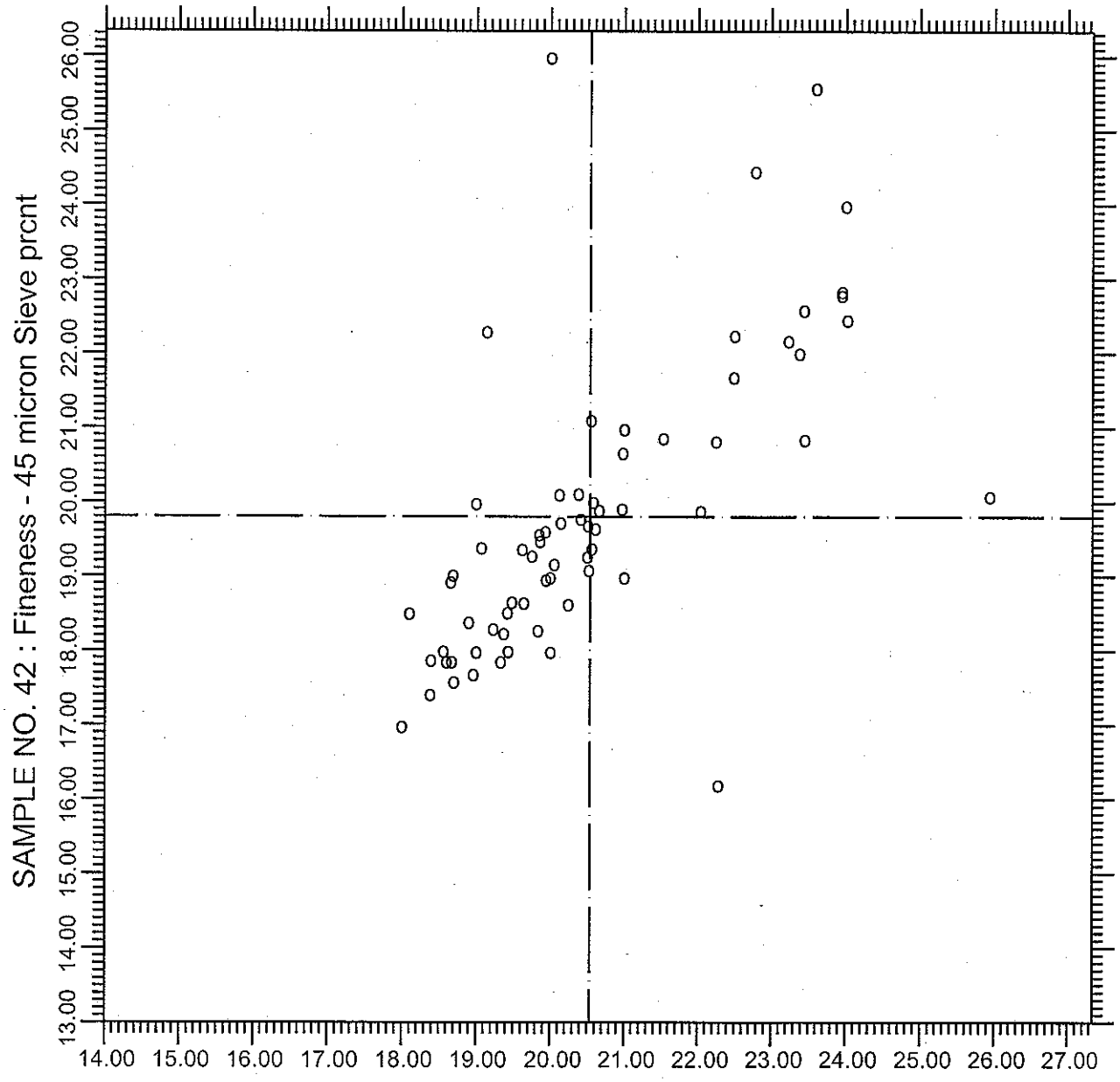
CCRL PROFICIENCY SAMPLE PROGRAM
Density
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.310 Density 59 POINTS

SAMPLE NO. 41 AVE 2.5664 S.D. 0.037 C.V. 1.44
SAMPLE NO. 42 AVE 2.3829 S.D. 0.033 C.V. 1.38
LABS ELIMINATED 2295 2621 47 840 125 126 3059

CCRL PROFICIENCY SAMPLE PROGRAM
Fineness - 45 micron Sieve Retained
POZZOLAN SAMPLES NO. 41 & NO. 42



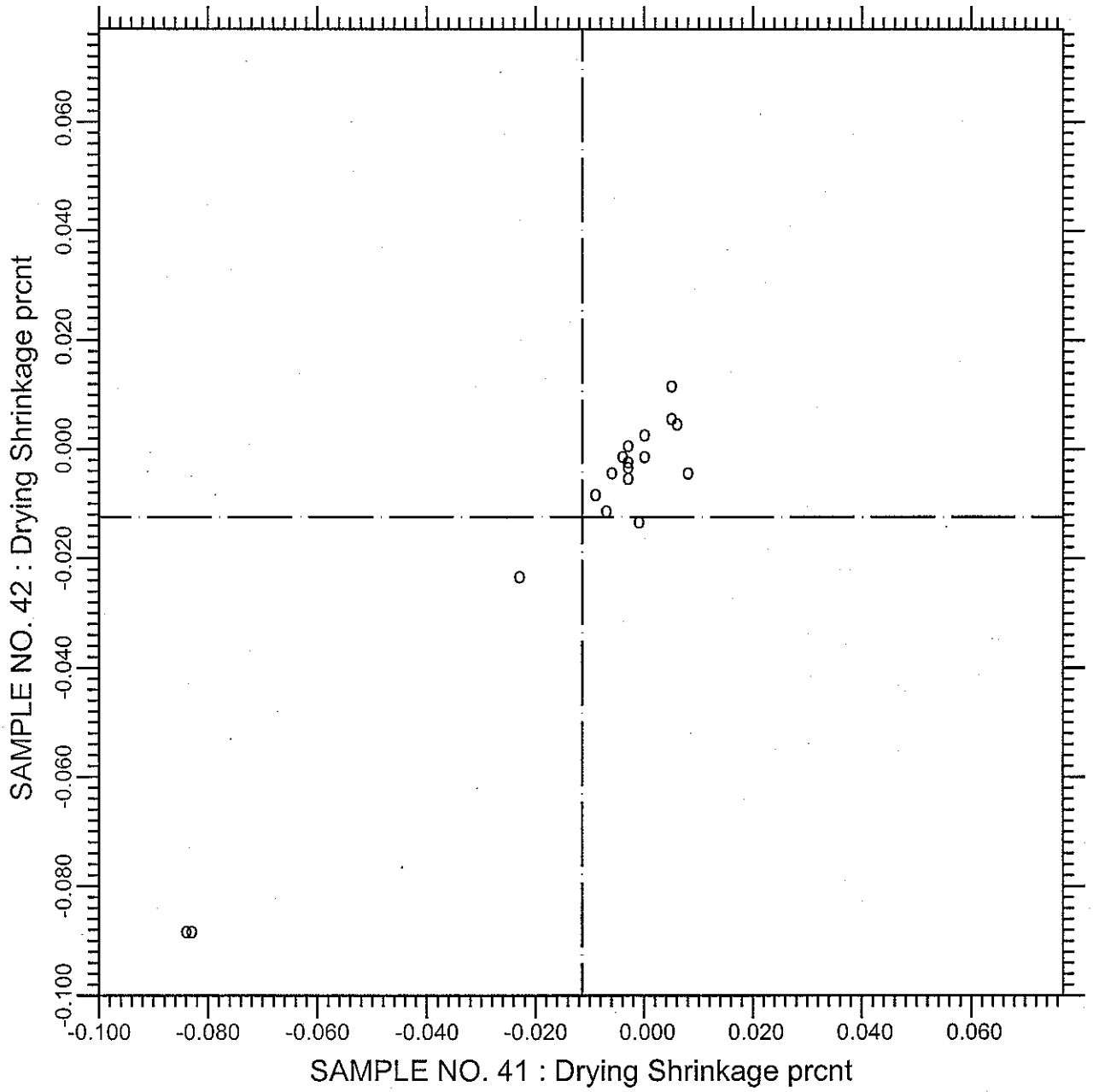
TEST NO.281 Fineness - 45 micron Sieve 71 POINTS

SAMPLE NO. 41 AVE 20.54 S.D. 1.8 C.V. 8.53

SAMPLE NO. 42 AVE 19.80 S.D. 2.0 C.V. 9.89

LABS ELIMINATED 265 1323 22 22 58 3135

CCRL PROFICIENCY SAMPLE PROGRAM
Drying Shrinkage
POZZOLAN SAMPLES NO. 41 & NO. 42



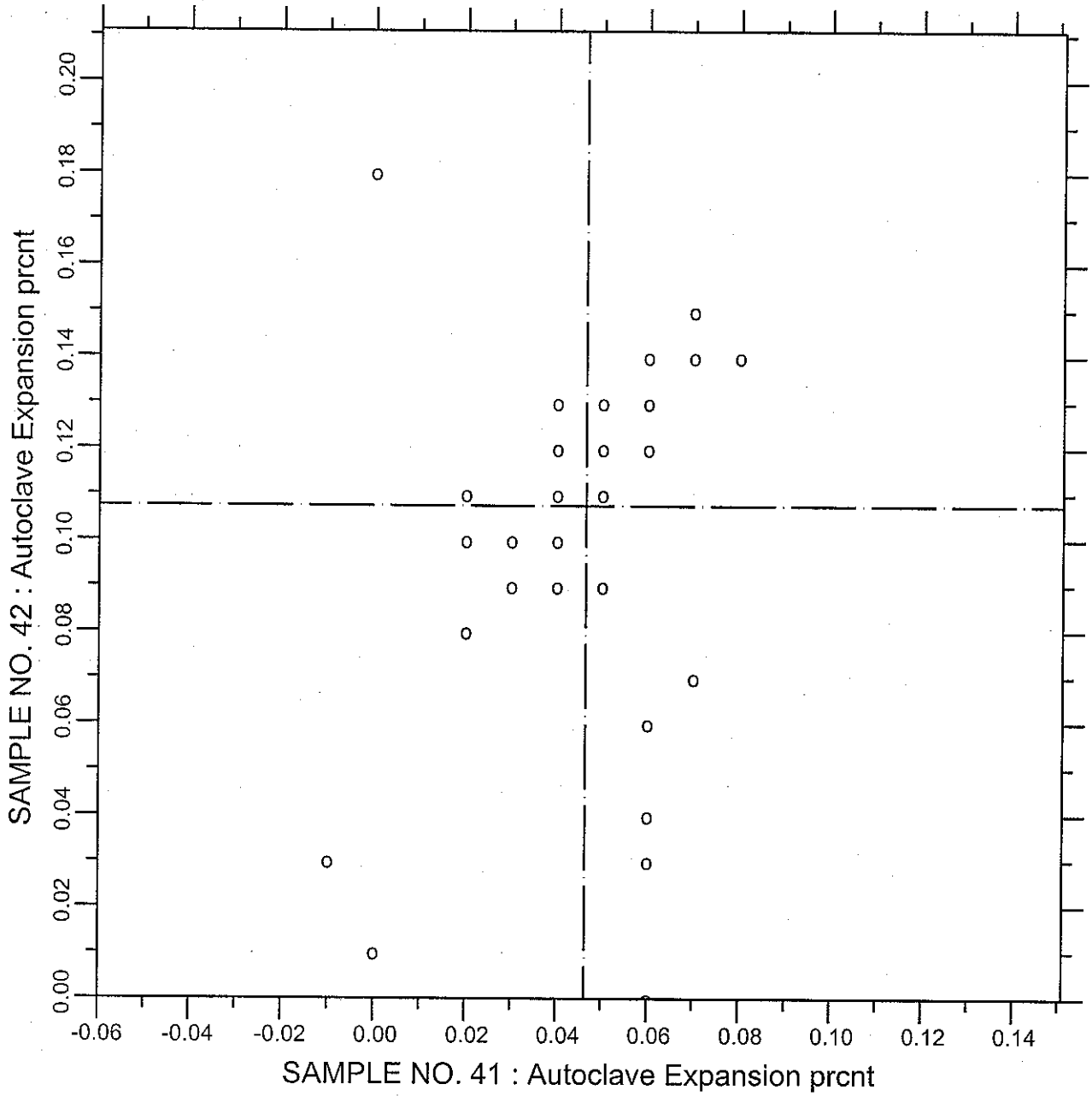
TEST NO.340 Drying Shrinkage 18 POINTS

SAMPLE NO. 41 AVE -0.0114 S.D. 0.027 C.V. -238.173

SAMPLE NO. 42 AVE -0.0124 S.D. 0.028 C.V. -229.533

LABS ELIMINATED 3059

CCRL PROFICIENCY SAMPLE PROGRAM
Autoclave Expansion
POZZOLAN SAMPLES NO. 41 & NO. 42



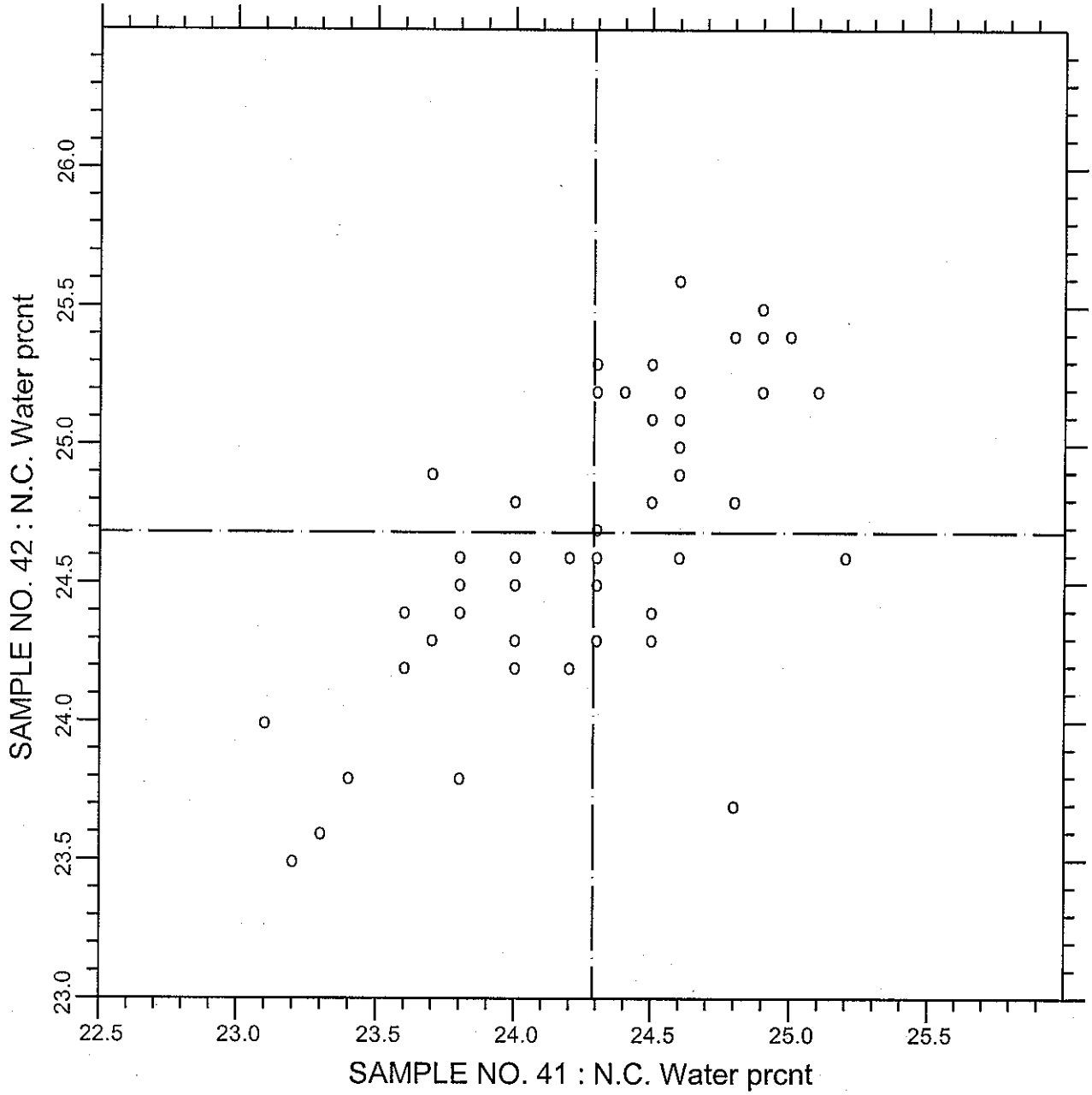
TEST NO.160 Autoclave Expansion 55 POINTS

SAMPLE NO. 41 AVE 0.0464 S.D. 0.018 C.V. 39.4

SAMPLE NO. 42 AVE 0.1074 S.D. 0.034 C.V. 32.0

LABS ELIMINATED 2938 3207

CCRL PROFICIENCY SAMPLE PROGRAM
Normal Consistency Water
POZZOLAN SAMPLES NO. 41 & NO. 42



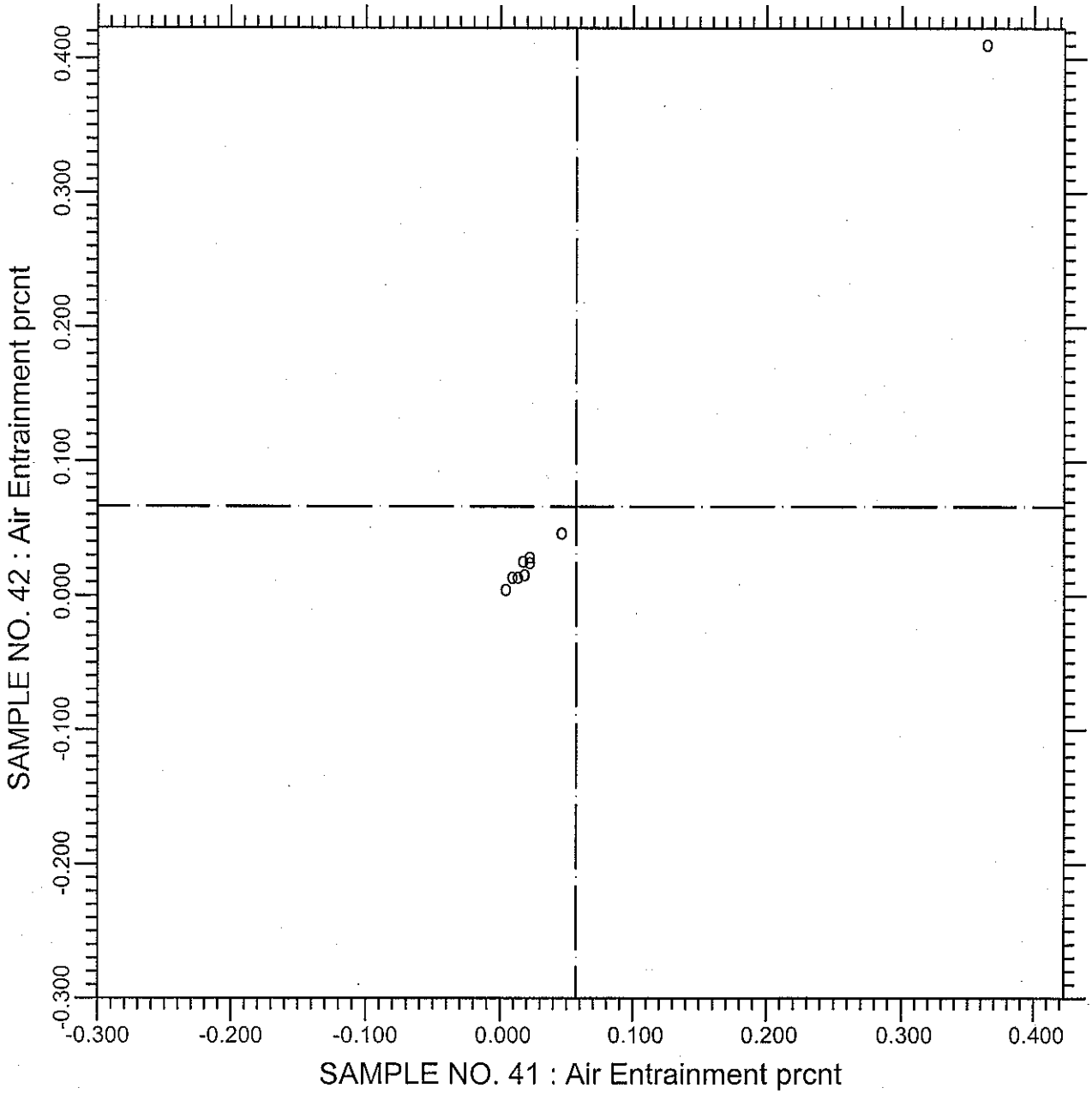
TEST NO.110 N.C. Water 58 POINTS

SAMPLE NO. 41 AVE 24.290 S.D. 0.48 C.V. 1.96

SAMPLE NO. 42 AVE 24.683 S.D. 0.50 C.V. 2.01

LABS ELIMINATED 19 480 1038

CCRL PROFICIENCY SAMPLE PROGRAM
Air Entrainment
POZZOLAN SAMPLES NO. 41 & NO. 42



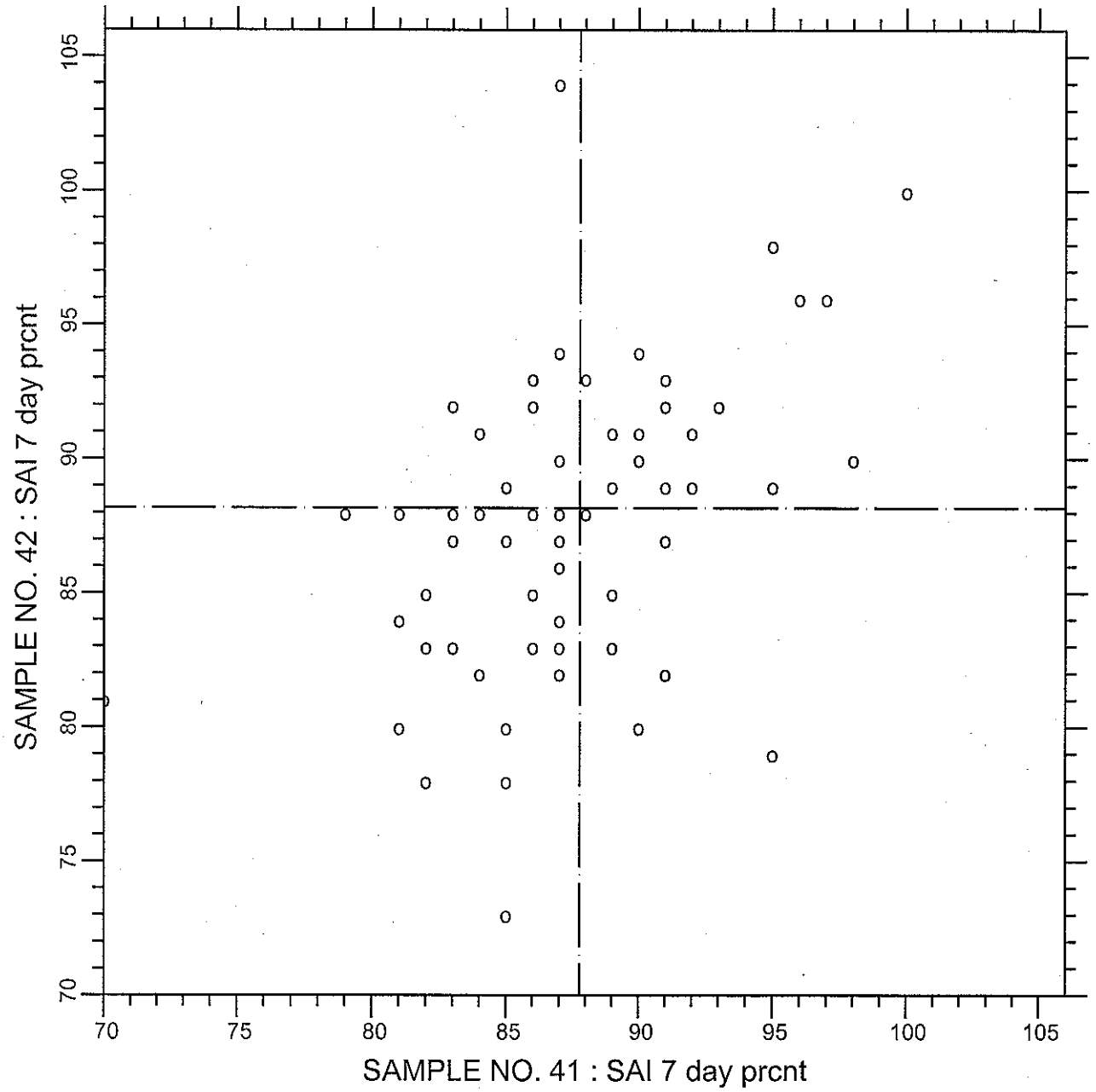
TEST NO.350 Air Entrainment 9 POINTS

SAMPLE NO. 41	AVE	0.057	S.D.	0.12	C.V.	202
SAMPLE NO. 42	AVE	0.066	S.D.	0.13	C.V.	197

CCRL PROFICIENCY SAMPLE PROGRAM

Strength Activity Index - 7 day

POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.359 SAI 7 day 65 POINTS

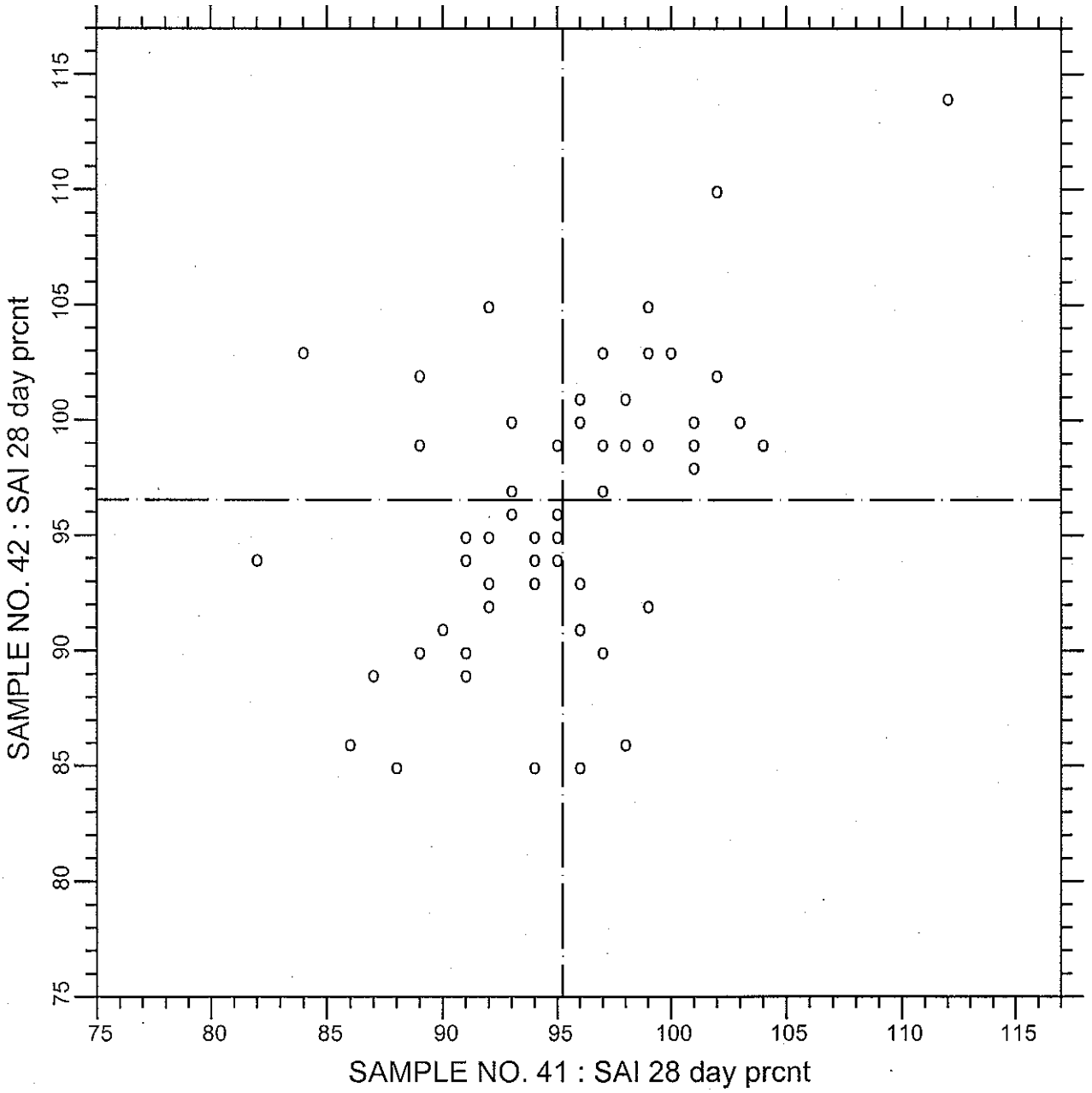
SAMPLE NO. 41 AVE 87.79 S.D. 5.2 C.V. 5.87

SAMPLE NO. 42 AVE 88.18 S.D. 6.1 C.V. 6.92

LABS ELIMINATED 284 3059

LABS OFF DIAGRAM 1435

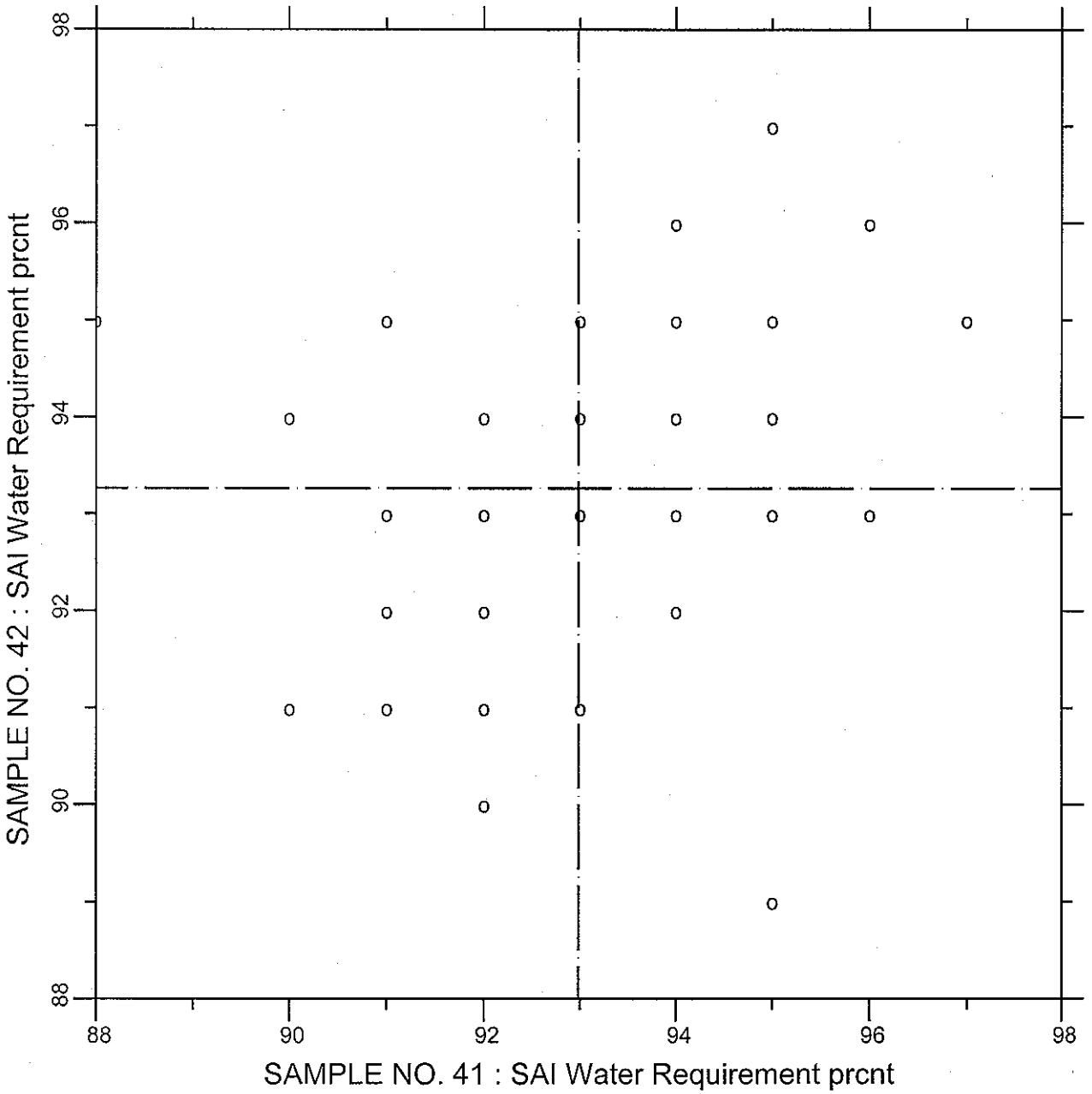
CCRL PROFICIENCY SAMPLE PROGRAM
Strength Activity Index - 28 day
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.360 SAI 28 day 60 POINTS

SAMPLE NO. 41 AVE 95.23 S.D. 5.2 C.V. 5.49
SAMPLE NO. 42 AVE 96.53 S.D. 5.9 C.V. 6.14
LABS ELIMINATED 284 1435

CCRL PROFICIENCY SAMPLE PROGRAM
SAI Water Requirement
POZZOLAN SAMPLES NO. 41 & NO. 42

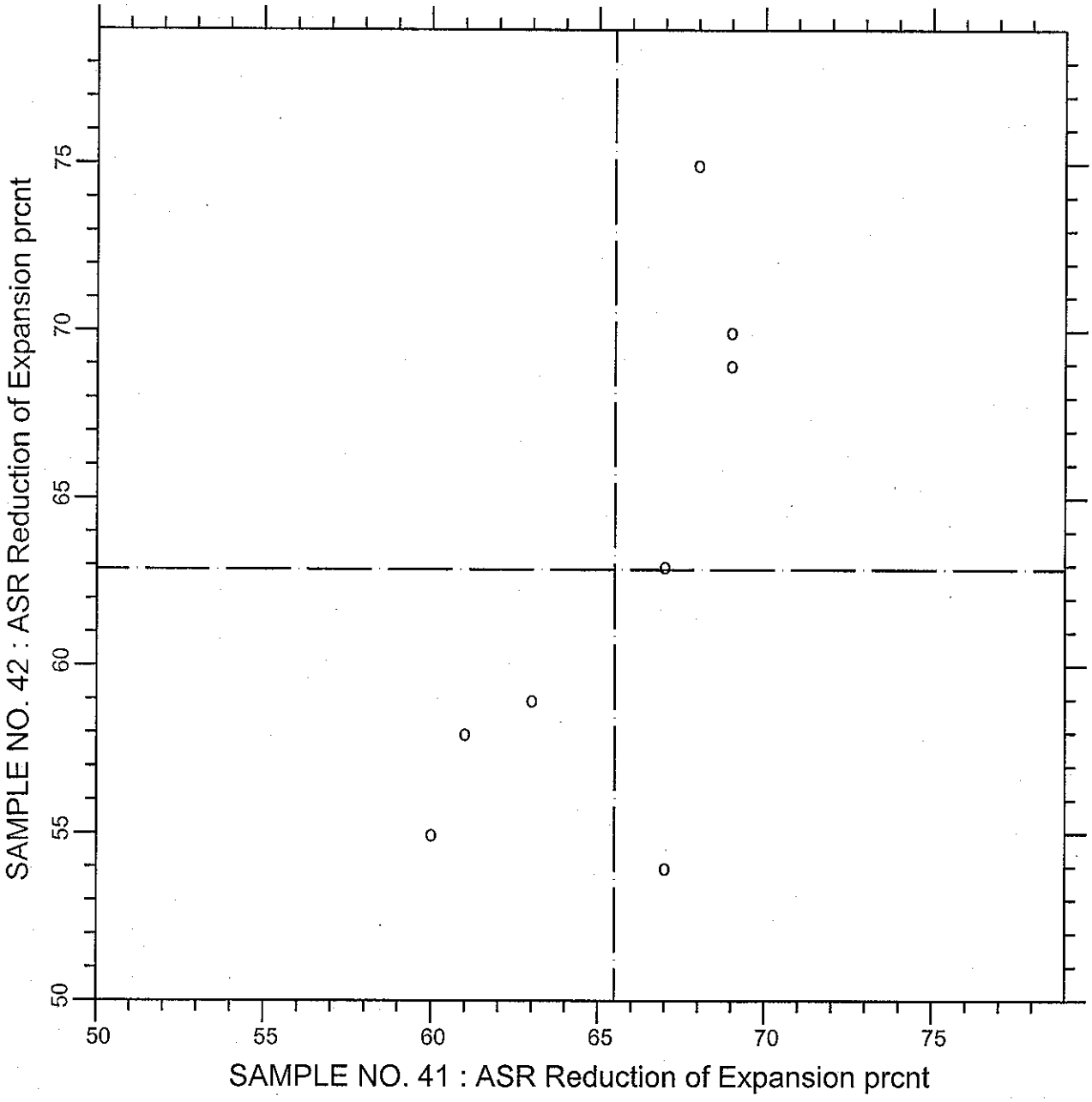


TEST NO.370 SAI Water Requirement 61 POINTS

SAMPLE NO. 41	AVE	92.98	S.D.	1.7	C.V. 1.85
SAMPLE NO. 42	AVE	93.26	S.D.	1.6	C.V. 1.68

LABS ELIMINATED 1379 1435

CCRL PROFICIENCY SAMPLE PROGRAM
Alkali-Silica Reaction - Reduction of Expansion
POZZOLAN SAMPLES NO. 41 & NO. 42



TEST NO.390 ASR Reduction of Expansion 8 POINTS

SAMPLE NO. 41	AVE	65.5	S.D.	3.6	C.V.	5.53
SAMPLE NO. 42	AVE	62.9	S.D.	7.7	C.V.	12.24