CEMENT AND CONCRETE REFERENCE LABORATORY

PROFICIENCY SAMPLE PROGRAM

Final Report
Pozzolan Proficiency Samples
Number 33 and Number 34

October 2003

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 24, 2003

TO: Participants in the CCRL Pozzolan Proficiency Sample Program

SUBJECT: Pozzolan Proficiency Samples No. 33 and No. 34

Enclosed is your copy of the final report on the test results for the CCRL **Pozzolan** Proficiency Samples which were distributed in August 2003.

This report consists of a Table of Results for individual laboratory data, a statistical Summary of Results, a set of general Scatter Diagrams and associated detailed information.

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 use.

It is presently anticipated that the next Pozzolan Proficiency Samples will be distributed in August 2004.

Sincerely,

Robin K. Haupt

Robin K. Haupt
Supervisor, Proficiency Sample Programs
Cement and Concrete Reference Laboratory
Materials and Construction Research Division
Building and Fire Research Laboratory

Enclosure

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. 33 and No. 34

This letter, 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 August 2003. 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, and "Statistical Aspects of the Cement Testing Program" by W.J. Youden, 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.

Laboratory Ratings

Each laboratory receives an individualized Laboratory Ratings. Each line of the ratings shows the test number, test title and the reporting unit in the first three 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.*

Continued on Reverse Side

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 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 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. 33 and No. 34
Final Report - Chemical Results
October 24, 2003

SUMMARY OF RESULTS

				Sample No. 33			Sample No. 34		
Test			#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Moisture Content	prcnt		58	0.17	0.39	231	0.18	0.39	215
Moisture Content	prcnt	*	55	0.11	0.072	65.6	0.12	0.075	62.0
Silicon Dioxide	prcnt		47	39.17	4.2	10.71	34.03	2.5	7.47
Silicon Dioxide	prcnt	*	44	40.12	1.1	2.65	34.61	1.1	3.15
Al_2O_3 w/minor[1]	prcnt		25	20.68	6.4	30.8	21.25	4.5	21.1
Al_2O_3 w/minor[1]	prcnt	*	22	20.06	1.1	5.38	21.79	1.4	6.23
[1] (P_2O_3 & TiO_2 included)									
Al_2O_3 wo/minor[2]	prcnt		37	18.08	4.8	26.5	18.82	3.4	18.0
Al_2O_3 wo/minor[2]	prcnt	*	35	17.93	1.0	5.67	19.09	1.0	5.44
[2] (P_2O_3 & TiO_2 not included)									
Ferric Oxide	prcnt		46	6.45	0.78	12.0	5.94	0.69	11.7
Ferric Oxide	prcnt	*	44	6.45	0.51	7.95	5.96	0.46	7.79
Calcium Oxide	prcnt		49	22.46	1.3	5.77	25.29	1.3	5.05

CONTINUED ON REVERSE SIDE

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

Moisture Content	25 29 176
Silicon Dioxide	3 41 2150
Al Oxide w/minor oxides	207 176 2150
Al Oxide wo/minor oxides	207 2150
Ferric Oxide	3 158

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficiency Samples No. 33 and No. 34
Final Report - Chemical Results
October 24, 2003

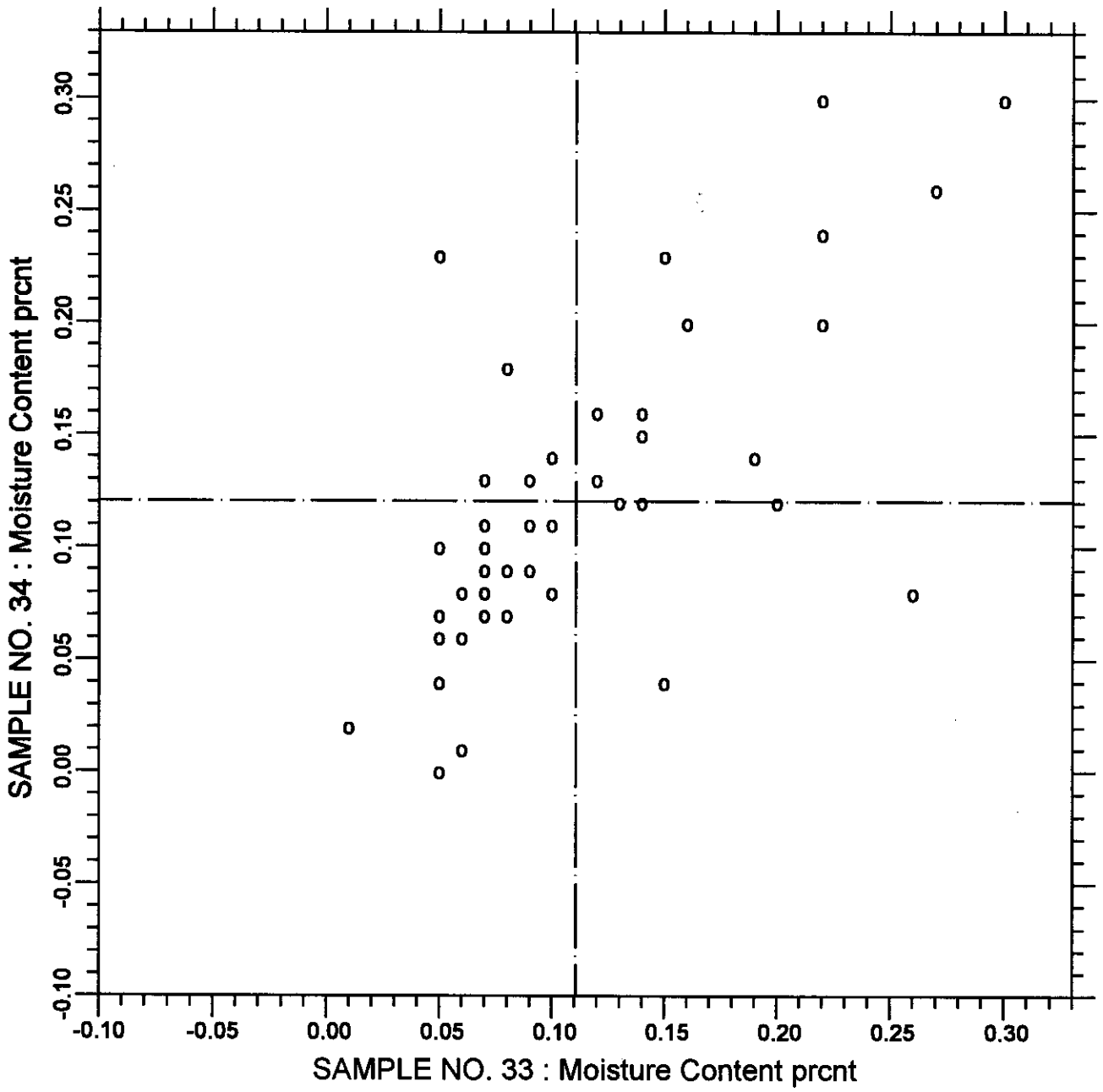
SUMMARY OF RESULTS

			Sample No. 33			Sample No. 34		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Magnesium Oxide	prcnt	48	4.73	0.74	15.7	5.73	0.88	15.4
Magnesium Oxide	prcnt	* 46	4.86	0.39	8.03	5.89	0.43	7.25
Sulfur Trioxide	prcnt	54	1.71	0.17	9.98	1.65	0.20	12.20
Sulfur Trioxide	prcnt	* 52	1.69	0.13	7.92	1.63	0.16	10.11
Loss on Ignition	prcnt	62	0.57	0.12	20.1	0.38	0.15	40.3
Loss on Ignition	prcnt	* 60	0.57	0.12	20.4	0.36	0.11	29.5
Sodium Oxide	prcnt	43	1.30	0.28	21.9	1.77	0.35	19.7
Potassium Oxide	prcnt	42	0.63	0.059	9.48	0.48	0.060	12.53
Potassium Oxide	prcnt	* 41	0.63	0.044	6.94	0.49	0.043	8.83
Available Na_2O	prcnt	21	1.02	0.47	46.3	1.34	0.51	37.8
Available Na_2O	prcnt	* 20	0.92	0.15	16.6	1.24	0.19	15.6
Available K_2O	prcnt	21	0.36	0.118	32.8	0.31	0.096	31.4
Available K_2O	prcnt	* 20	0.34	0.068	20.0	0.29	0.054	18.5
Available Alkali	prcnt	21	1.26	0.55	43.4	1.54	0.57	36.8
Available Alkali	prcnt	* 20	1.15	0.19	16.8	1.43	0.22	15.8

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

Magnesium Oxide	47 2116
Sulfur Trioxide	38 44
Loss on Ignition	29 205
Potassium Oxide	176
Available Sodium Oxide	15
Available Potassium Oxide	15
Available Alkali	15

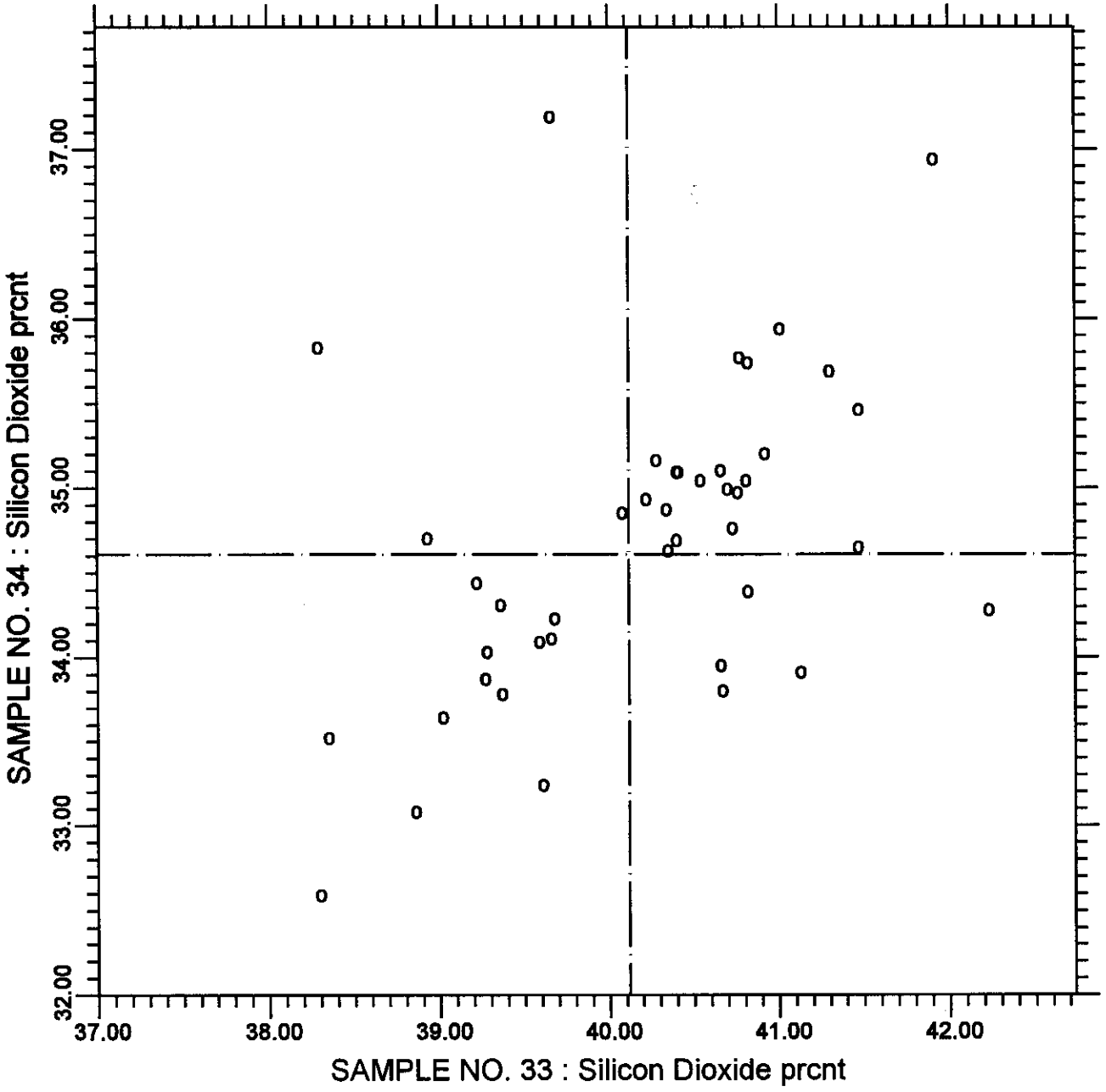
CCRL PROFICIENCY SAMPLE PROGRAM
Moisture Content
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.5 **Moisture Content** **54 POINTS**

SAMPLE NO. 33 AVE 0.1105 S.D. 0.072 C.V. 65.6
SAMPLE NO. 34 AVE 0.1204 S.D. 0.075 C.V. 62.0
LABS ELIMINATED 25 29 176
LABS OFF DIAGRAM 41

CCRL PROFICIENCY SAMPLE PROGRAM
Silicon Dioxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.10 **Silicon Dioxide** **43 POINTS**

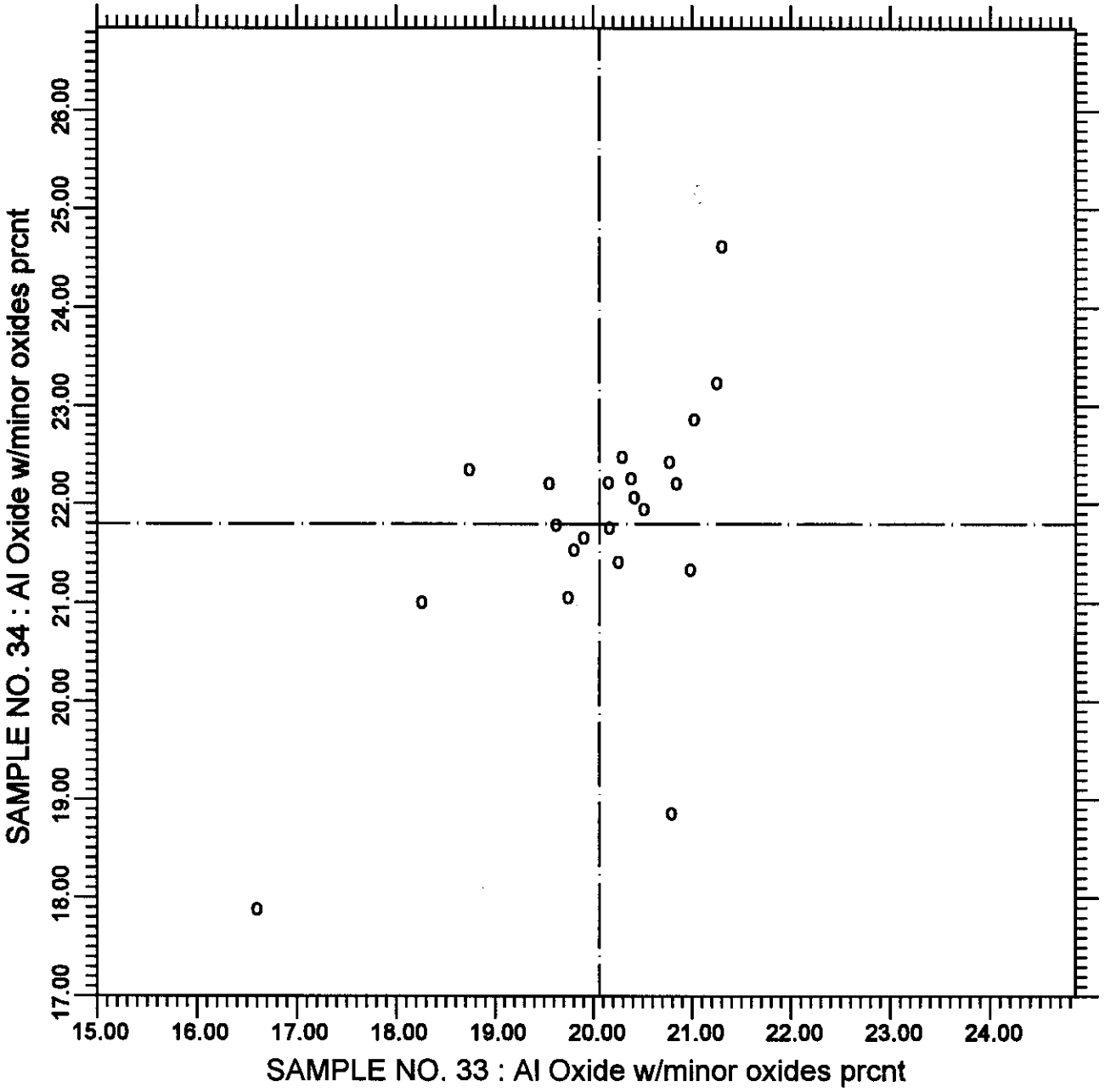
SAMPLE NO. 33 AVE 40.12 S.D. 1.1 C.V. 2.65

SAMPLE NO. 34 AVE 34.61 S.D. 1.1 C.V. 3.15

LABS ELIMINATED 3 41 2150

LABS OFF DIAGRAM 44

CCRL PROFICIENCY SAMPLE PROGRAM
Aluminum Oxide (minor oxides included)
POZZOLAN SAMPLES NO. 33 & NO. 34



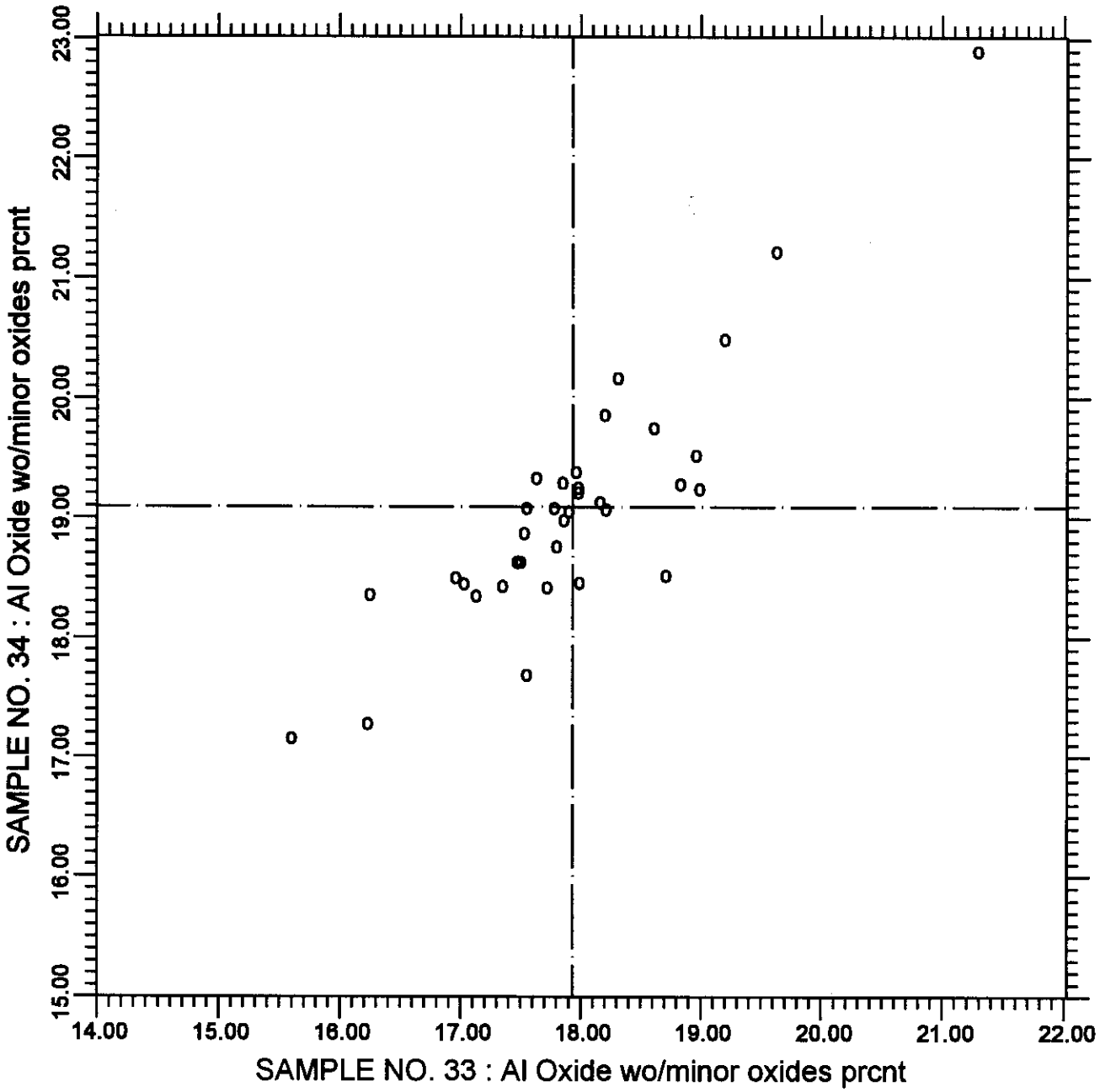
TEST NO.20 **Al Oxide w/minor oxides** **22 POINTS**

SAMPLE NO. 33 AVE 20.06 S.D. 1.1 C.V. 5.38

SAMPLE NO. 34 AVE 21.79 S.D. 1.4 C.V. 6.23

LABS ELIMINATED 207 176 2150

CCRL PROFICIENCY SAMPLE PROGRAM
Aluminum Oxide (minor oxides excluded)
POZZOLAN SAMPLES NO. 33 & NO. 34



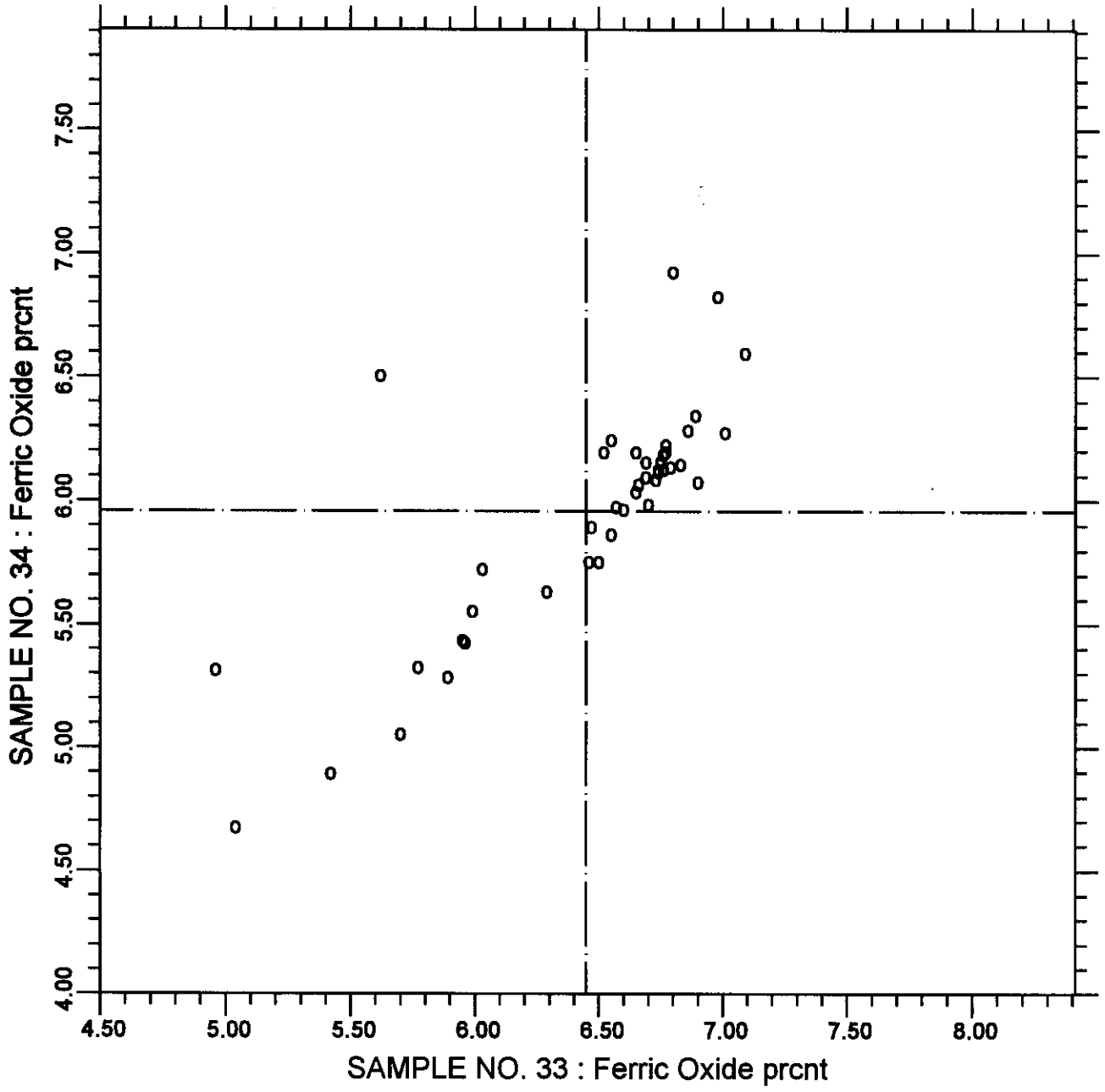
TEST NO.21 **Al Oxide wo/minor oxides** **35 POINTS**

SAMPLE NO. 33 AVE 17.93 S.D. 1.0 C.V. 5.67

SAMPLE NO. 34 AVE 19.09 S.D. 1.0 C.V. 5.44

LABS ELIMINATED 207 2150

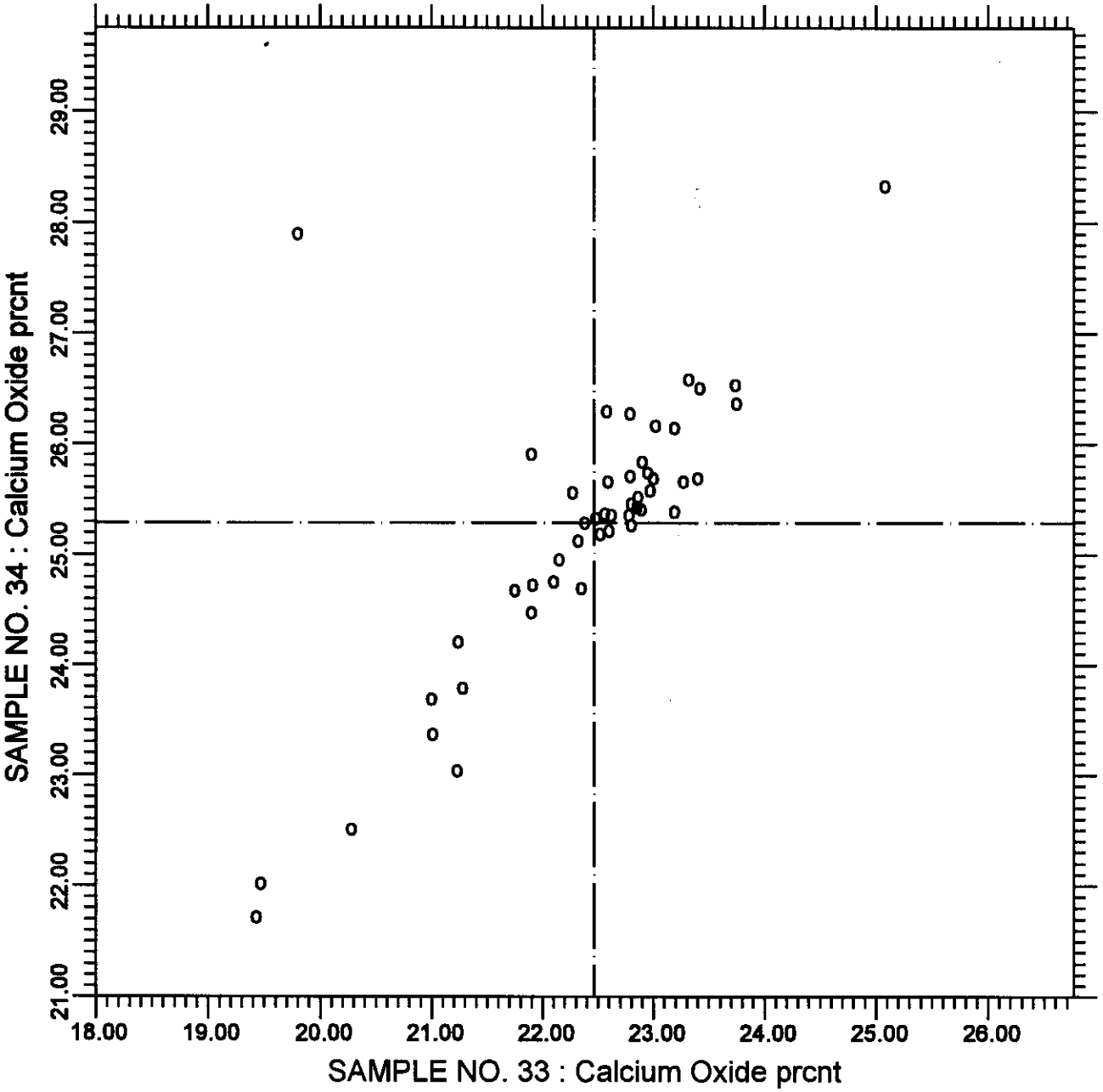
CCRL PROFICIENCY SAMPLE PROGRAM
Ferric Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.30 **Ferric Oxide** **44 POINTS**

SAMPLE NO. 33 AVE 6.449 S.D. 0.51 C.V. 7.95
SAMPLE NO. 34 AVE 5.958 S.D. 0.46 C.V. 7.79
LABS ELIMINATED 3 158

CCRL PROFICIENCY SAMPLE PROGRAM
Calcium Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34

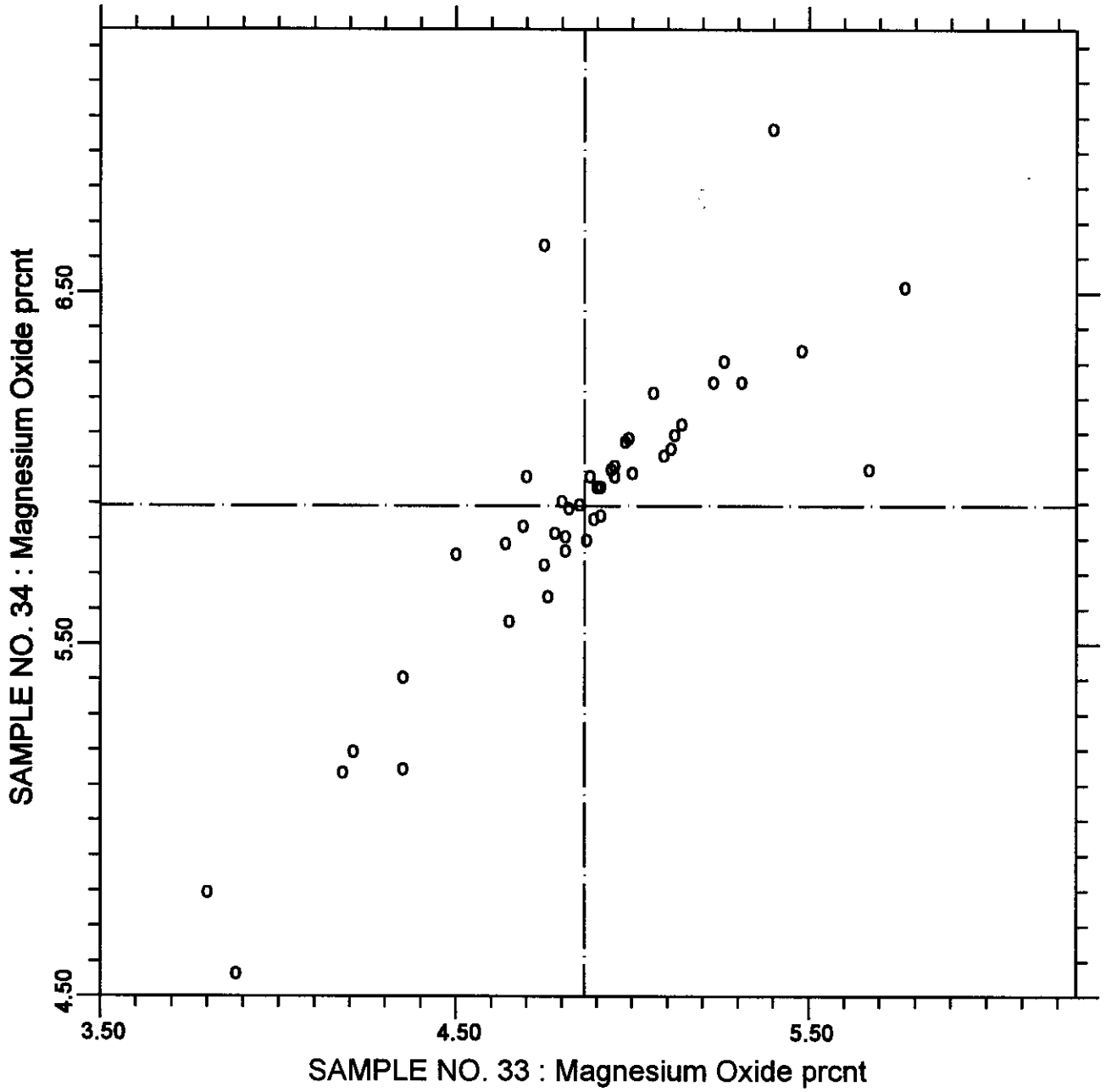


TEST NO.40 **Calcium Oxide** **48 POINTS**

SAMPLE NO. 33	AVE	22.46	S.D.	1.3	C.V.	5.77
SAMPLE NO. 34	AVE	25.29	S.D.	1.3	C.V.	5.05

LABS OFF DIAGRAM 176

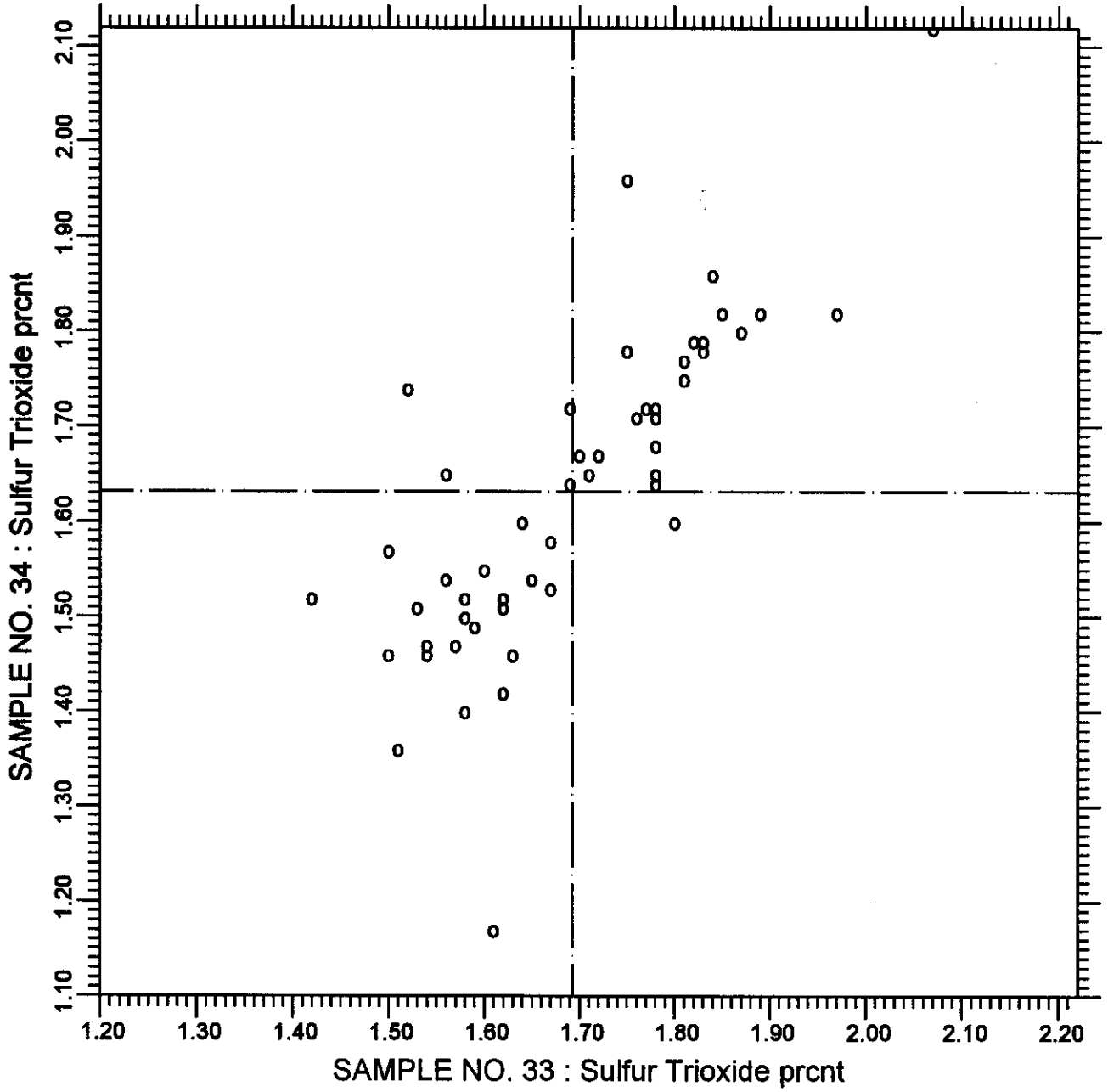
CCRL PROFICIENCY SAMPLE PROGRAM
Magnesium Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.50 **Magnesium Oxide** **46 POINTS**

SAMPLE NO. 33 AVE 4.865 S.D. 0.39 C.V. 8.03
SAMPLE NO. 34 AVE 5.893 S.D. 0.43 C.V. 7.25
LABS ELIMINATED 47 2116

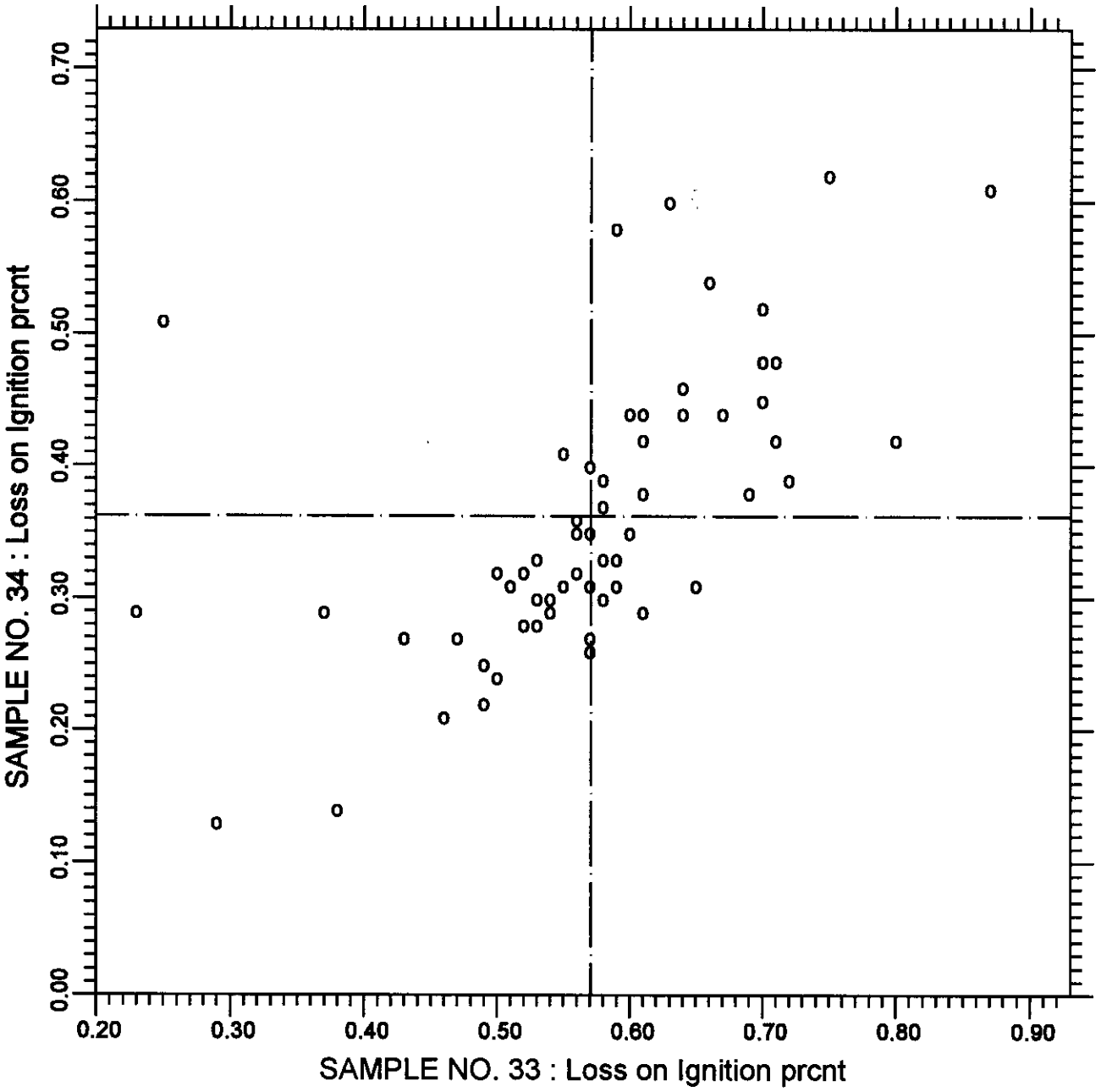
CCRL PROFICIENCY SAMPLE PROGRAM
Sulfur Trioxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.60 **Sulfur Trioxide** **52 POINTS**

SAMPLE NO. 33 AVE 1.693 S.D. 0.13 C.V. 7.92
SAMPLE NO. 34 AVE 1.631 S.D. 0.16 C.V. 10.11
LABS ELIMINATED 38 44

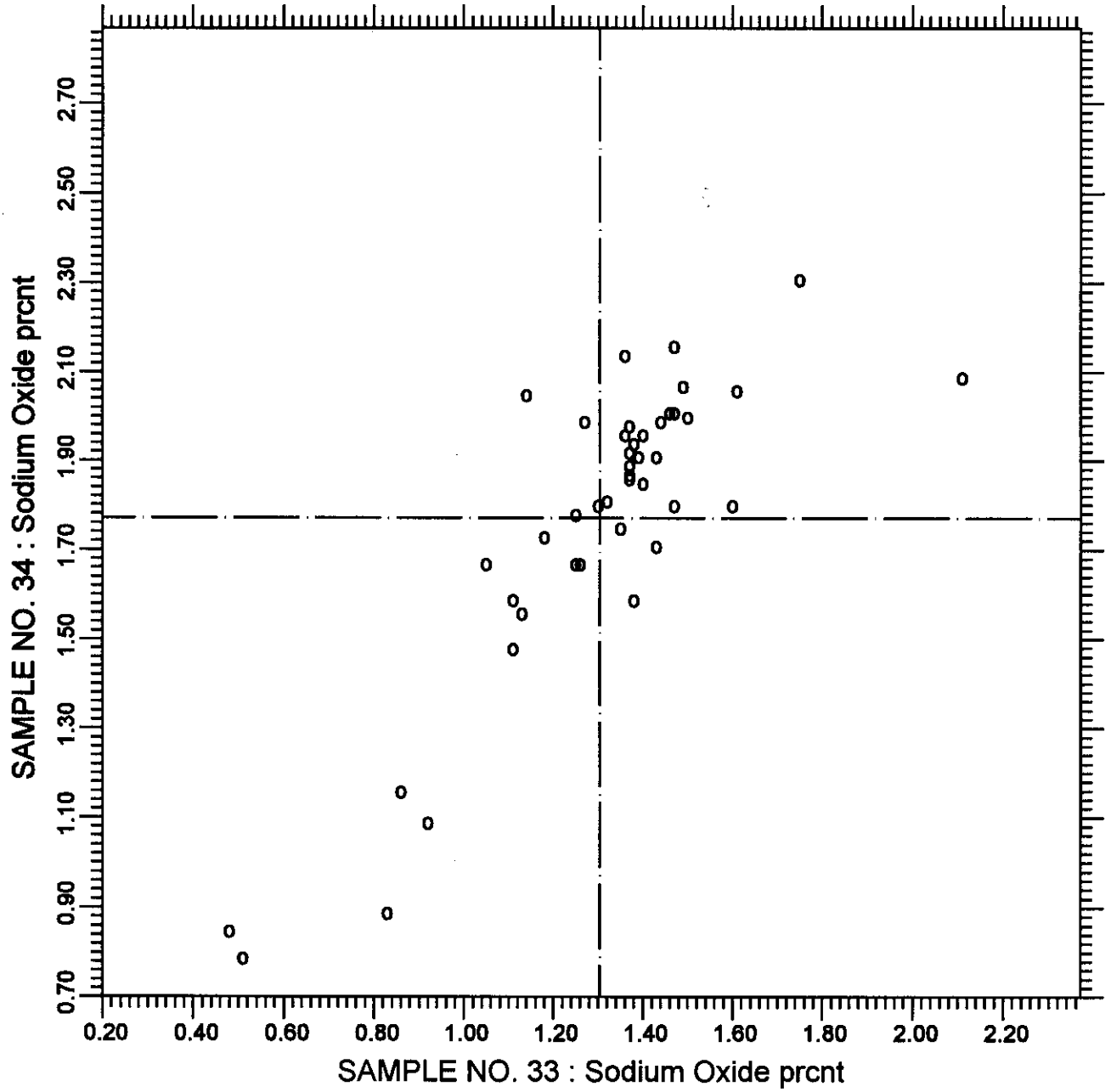
CCRL PROFICIENCY SAMPLE PROGRAM
Loss on Ignition
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.70 **Loss on Ignition** **60 POINTS**

SAMPLE NO. 33 AVE 0.571 S.D. 0.12 C.V. 20.4
SAMPLE NO. 34 AVE 0.362 S.D. 0.11 C.V. 29.5
LABS ELIMINATED 29 205

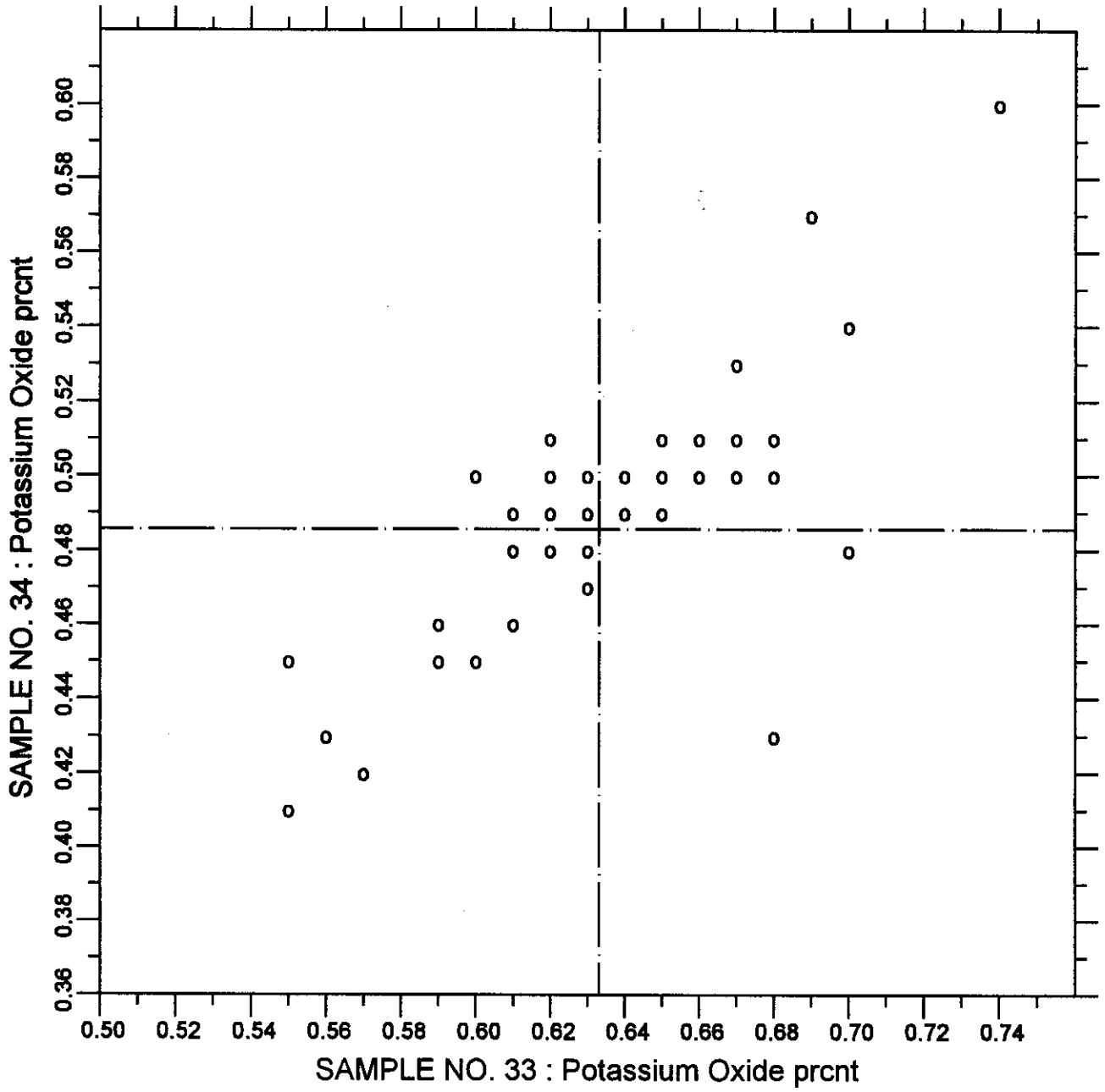
CCRL PROFICIENCY SAMPLE PROGRAM
Sodium Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.90 **Sodium Oxide** **43 POINTS**

SAMPLE NO. 33	AVE	1.304	S.D.	0.28	C.V.	21.9
SAMPLE NO. 34	AVE	1.770	S.D.	0.35	C.V.	19.7

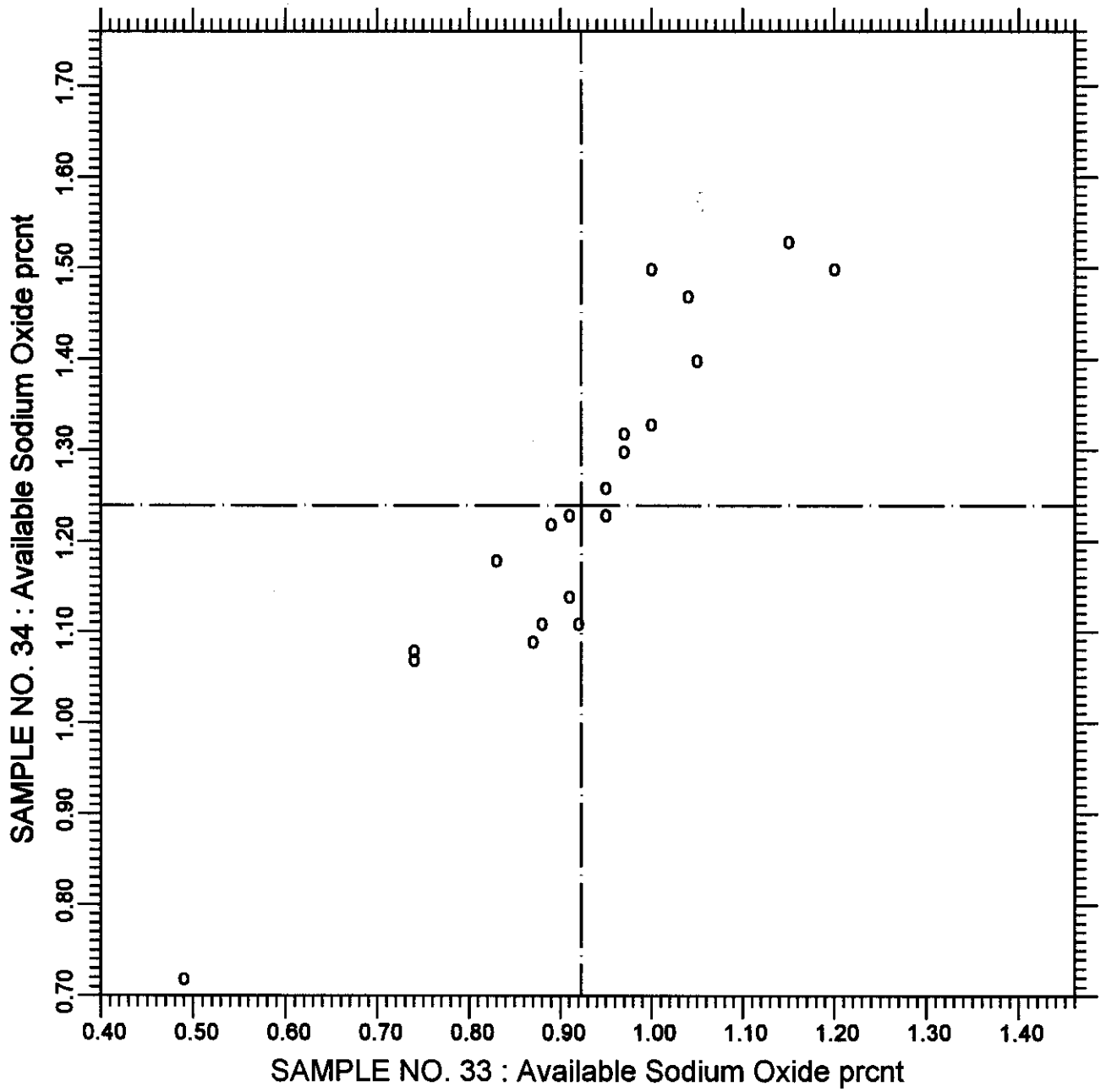
CCRL PROFICIENCY SAMPLE PROGRAM
Potassium Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.100 **Potassium Oxide** **40 POINTS**

SAMPLE NO. 33 AVE 0.6332 S.D. 0.044 C.V. 6.94
SAMPLE NO. 34 AVE 0.4856 S.D. 0.043 C.V. 8.83
LABS ELIMINATED 176
LABS OFF DIAGRAM 44

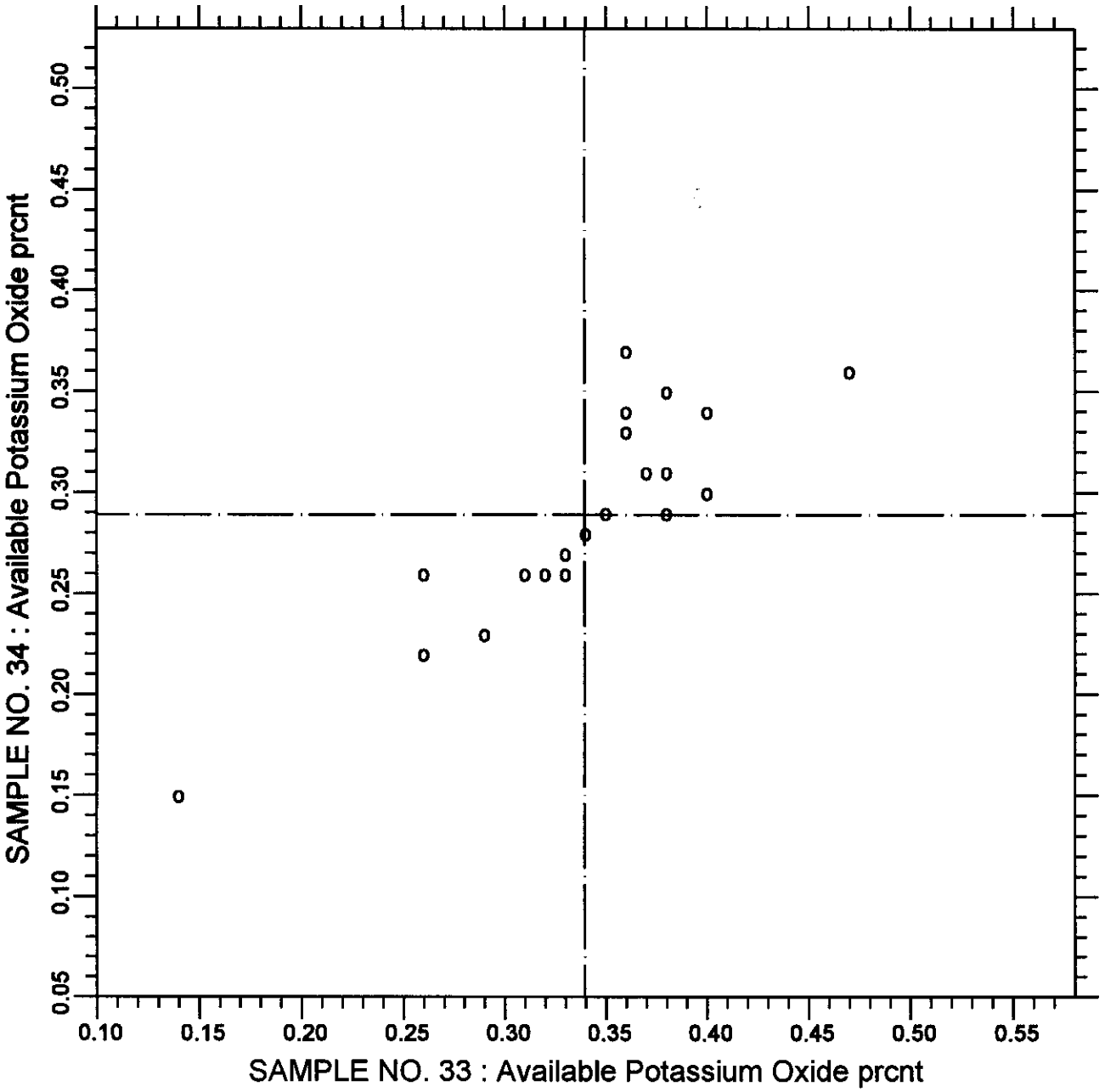
CCRL PROFICIENCY SAMPLE PROGRAM
Available Sodium Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.91 **Available Sodium Oxide** **20 POINTS**

SAMPLE NO. 33 AVE 0.923 S.D. 0.15 C.V. 16.6
SAMPLE NO. 34 AVE 1.240 S.D. 0.19 C.V. 15.6
LABS ELIMINATED 15

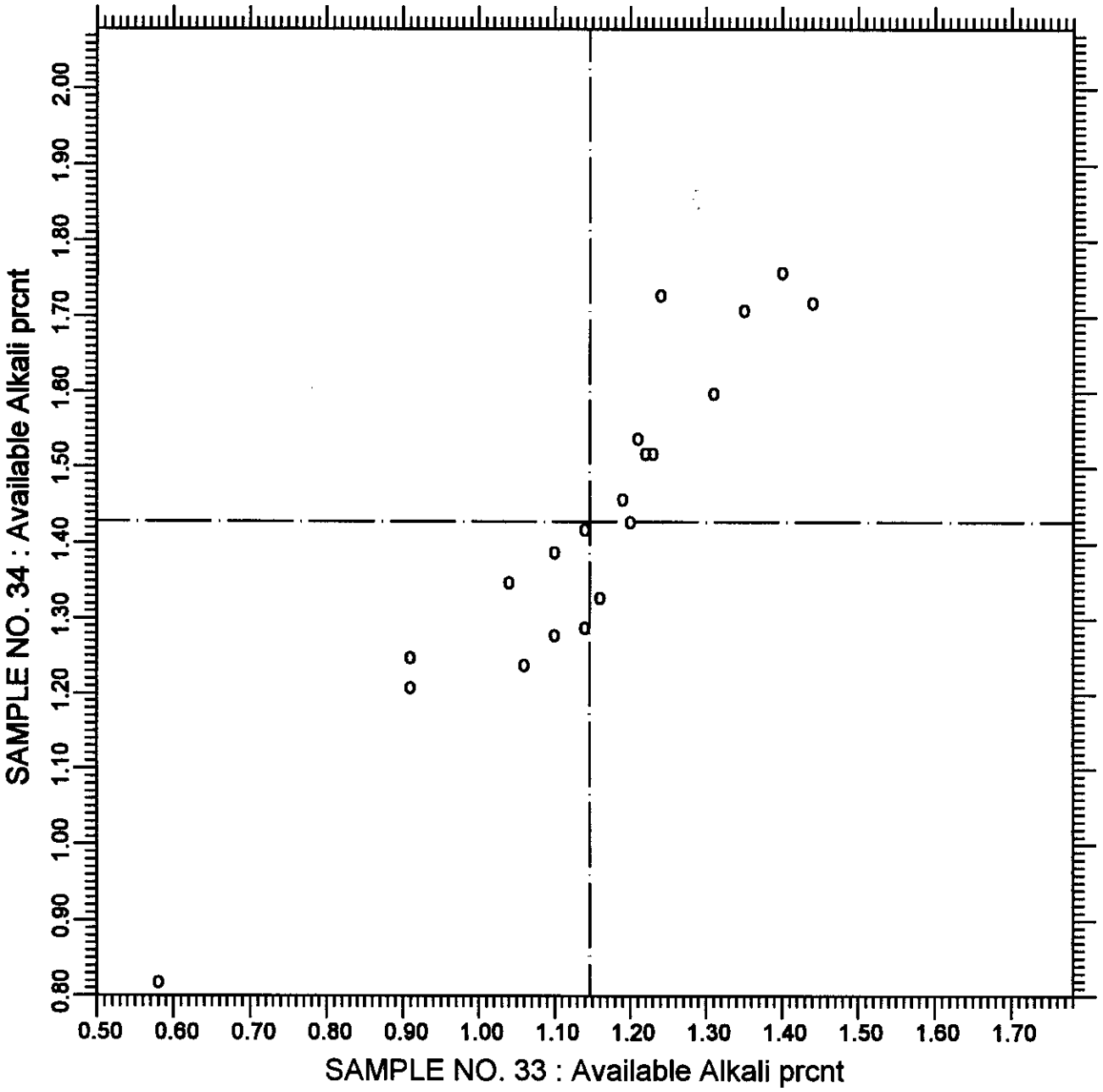
CCRL PROFICIENCY SAMPLE PROGRAM
Available Potassium Oxide
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.93 Available Potassium Oxide 20 POINTS

SAMPLE NO. 33 AVE 0.340 S.D. 0.068 C.V. 20.0
SAMPLE NO. 34 AVE 0.289 S.D. 0.054 C.V. 18.5
LABS ELIMINATED 15

CCRL PROFICIENCY SAMPLE PROGRAM
Available Alkali
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.95 **Available Alkali** **20 POINTS**

SAMPLE NO. 33 AVE 1.146 S.D. 0.19 C.V. 16.8
SAMPLE NO. 34 AVE 1.428 S.D. 0.22 C.V. 15.8
LABS ELIMINATED 15

CCRL PROFICIENCY SAMPLE PROGRAM
Pozzolan Proficency Sample No. 33 and No. 34
Final Report - Physical Results
October 24, 2003

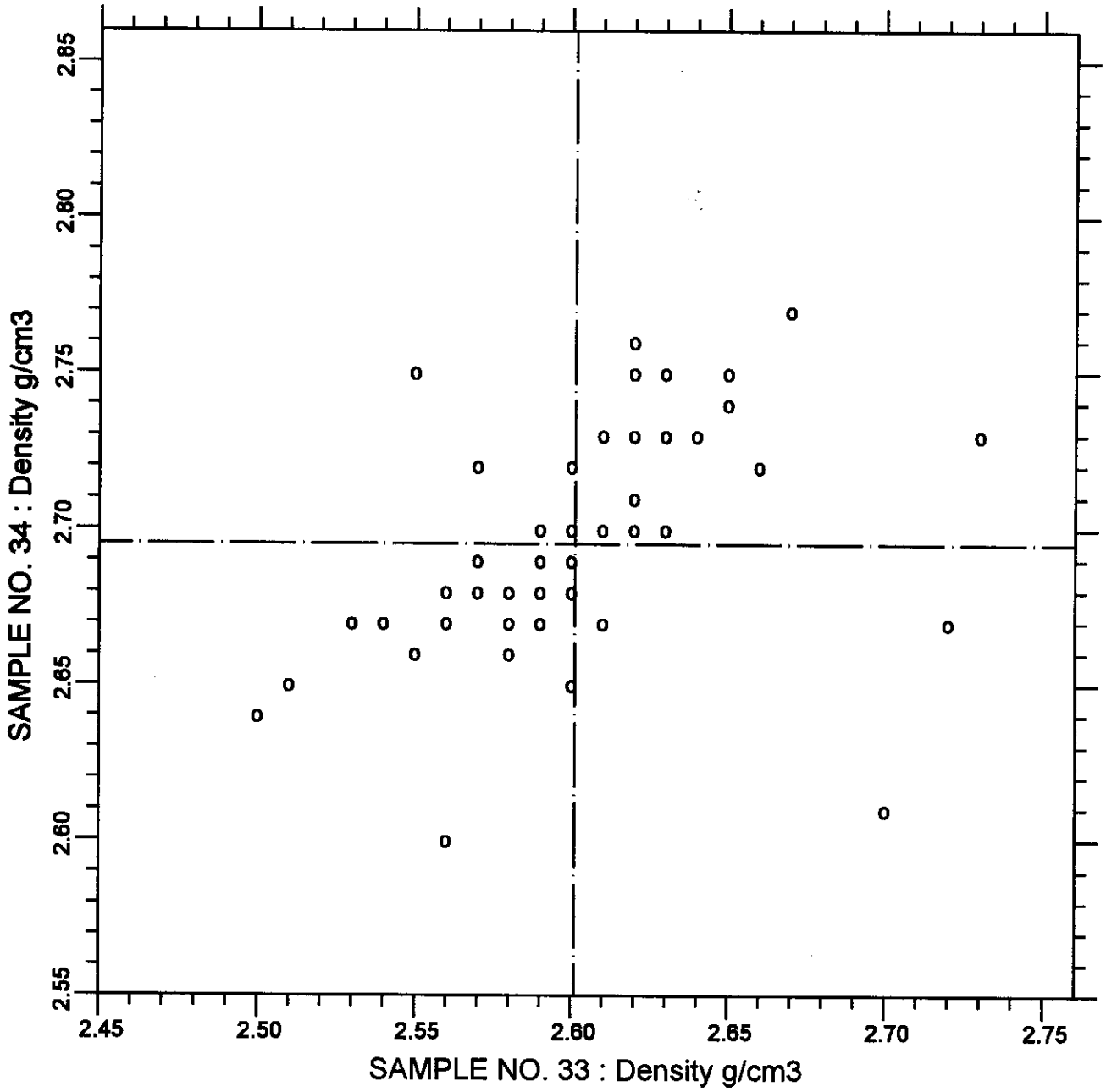
SUMMARY OF RESULTS

			Sample No. 33			Sample No. 34		
Test		#Labs	Average	S.D.	C.V.	Average	S.D.	C.V.
Density	g/cm^3	57	2.59	0.058	2.22	2.69	0.046	1.71
Density	g/cm^3 *	53	2.60	0.044	1.71	2.70	0.035	1.31
45µm Sieve	prcnt	63	15.52	2.4	15.7	13.38	2.0	15.3
45µm Sieve	prcnt *	62	15.77	1.4	9.20	13.59	1.2	8.50
Dry Shrink	prcnt	12	0.008	0.044	592	0.099	0.283	285
Dry Shrink	prcnt *	11	0.011	0.045	411	0.020	0.066	336
Autoclave Expan	prcnt	47	0.12	0.040	33.1	0.13	0.040	30.9
N.C. Water	prcnt	47	24.6	1.01	4.12	24.2	0.92	3.82
N.C. Water	prcnt *	46	24.4	0.33	1.35	24.1	0.32	1.35
Air Entrainment	prcnt	9	0.047	0.054	115	0.050	0.056	112
STRENGTH ACTIVITY INDEX (SAI) WITH PORTLAND CEMENT								
SAI 7 day	prcnt	51	93	4.6	4.92	95	5.0	5.34
SAI 28 day	prcnt	44	102	6.2	6.10	104	5.6	5.32
SAI Water	prcnt	49	96	1.8	1.94	95	1.9	2.04
EFFECTIVENESS OF MINERAL ADMIXTURES IN CONTROLLING ALKALI-SILICA REACTIONS (ASR)								
Reduction Expan	prcnt	6	28	11.2	40.8	20	7.8	39.2

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

Density	12 22 58 1882
45µm Sieve	158
Drying Shrinkage	205
N.C. Water	1773

CCRL PROFICIENCY SAMPLE PROGRAM
Density
POZZOLAN SAMPLES NO. 33 & NO. 34



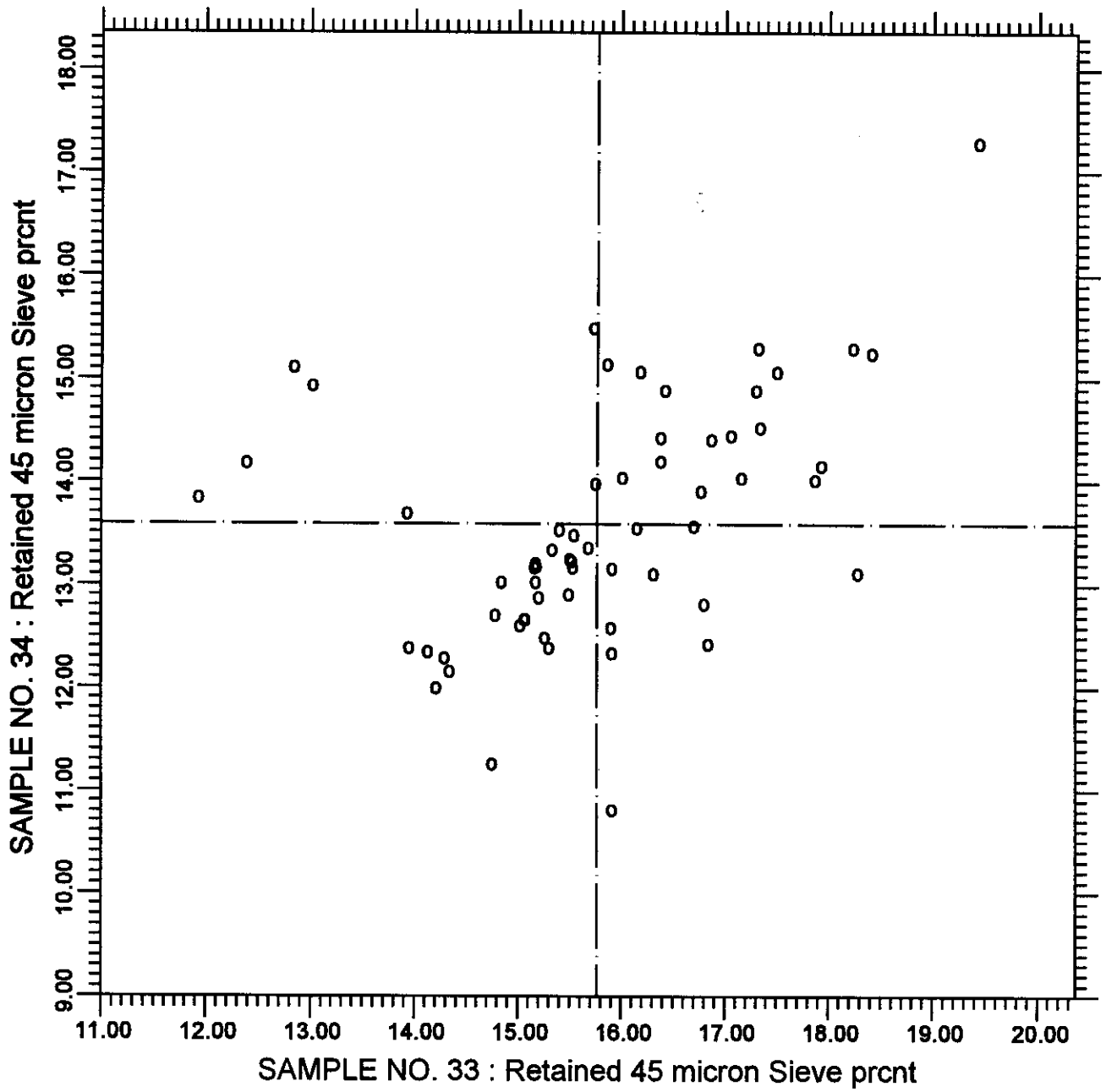
TEST NO.310 **Density** **53 POINTS**

SAMPLE NO. 33 AVE 2.6011 S.D. 0.044 C.V. 1.71

SAMPLE NO. 34 AVE 2.6953 S.D. 0.035 C.V. 1.31

LABS ELIMINATED 12 22 58 1882

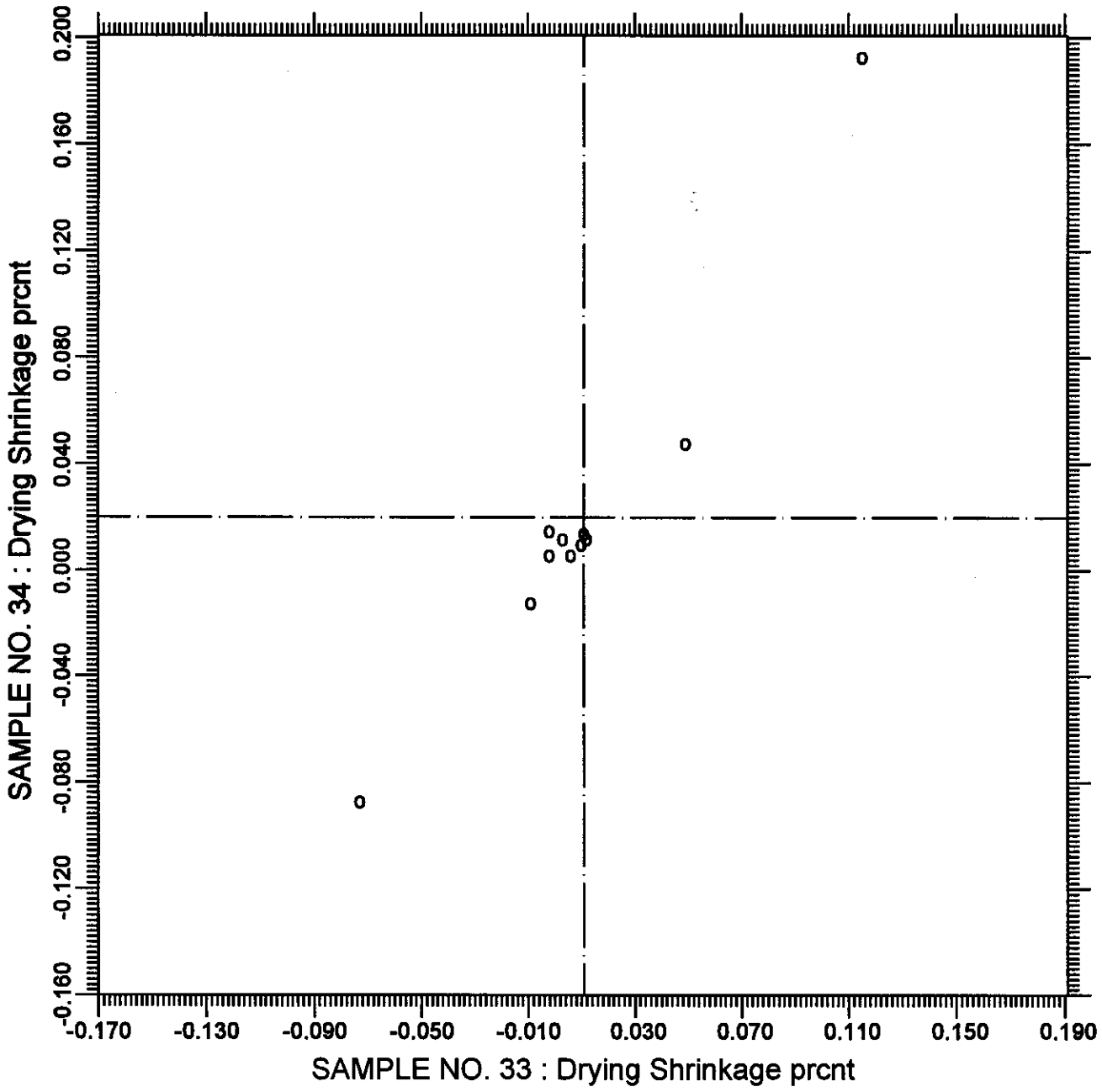
CCRL PROFICIENCY SAMPLE PROGRAM
Fineness - 45 micron Sieve Retained
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.281 **Retained 45 micron Sieve** **62 POINTS**

SAMPLE NO. 33 AVE 15.77 S.D. 1.4 C.V. 9.20
SAMPLE NO. 34 AVE 13.59 S.D. 1.2 C.V. 8.50
LABS ELIMINATED 158

CCRL PROFICIENCY SAMPLE PROGRAM
Drying Shrinkage
POZZOLAN SAMPLES NO. 33 & NO. 34

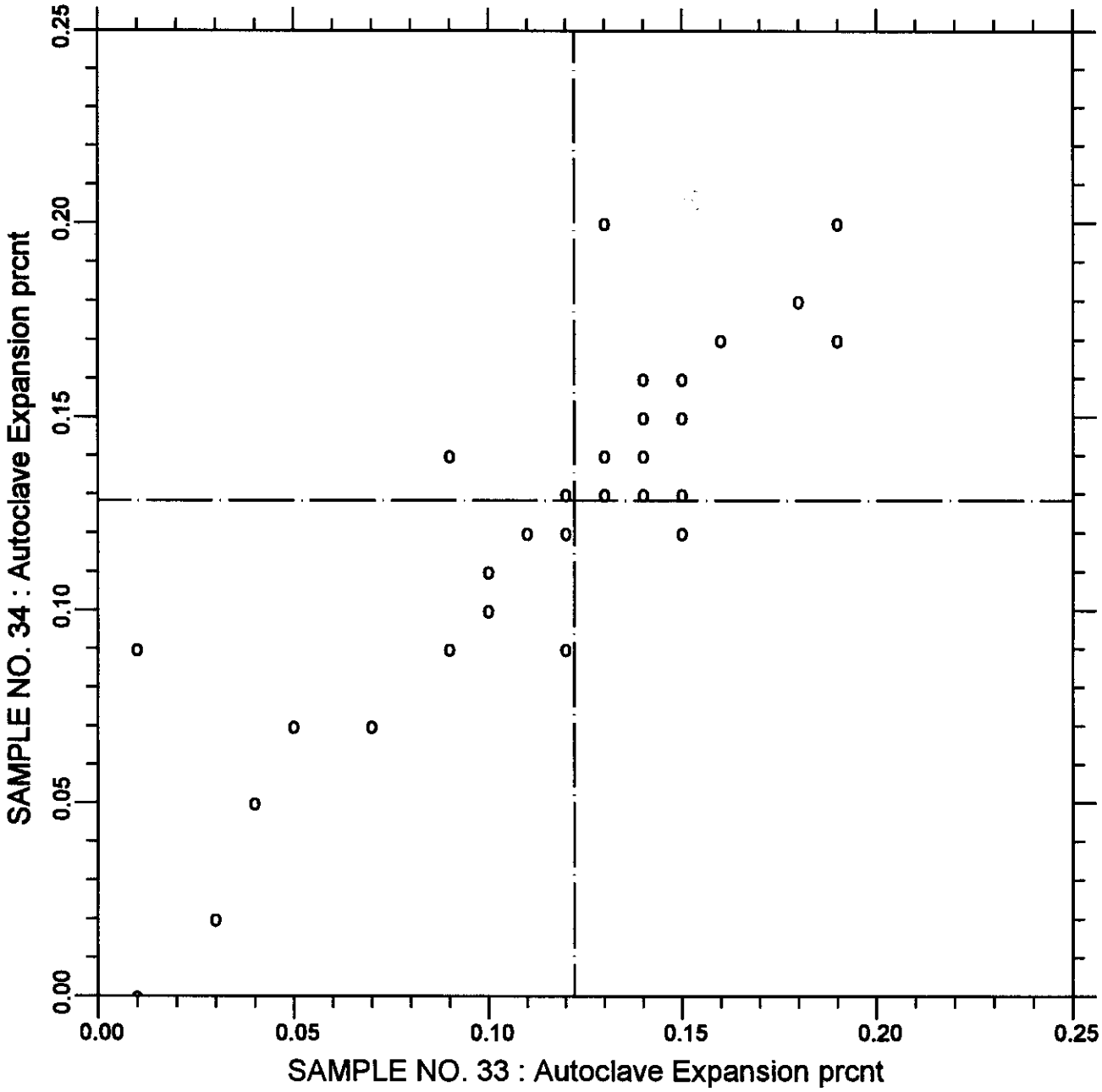


TEST NO.340 **Drying Shrinkage** **11 POINTS**

SAMPLE NO. 33	AVE	0.011	S.D.	0.045	C.V.	411
SAMPLE NO. 34	AVE	0.020	S.D.	0.066	C.V.	336

LABS ELIMINATED 205

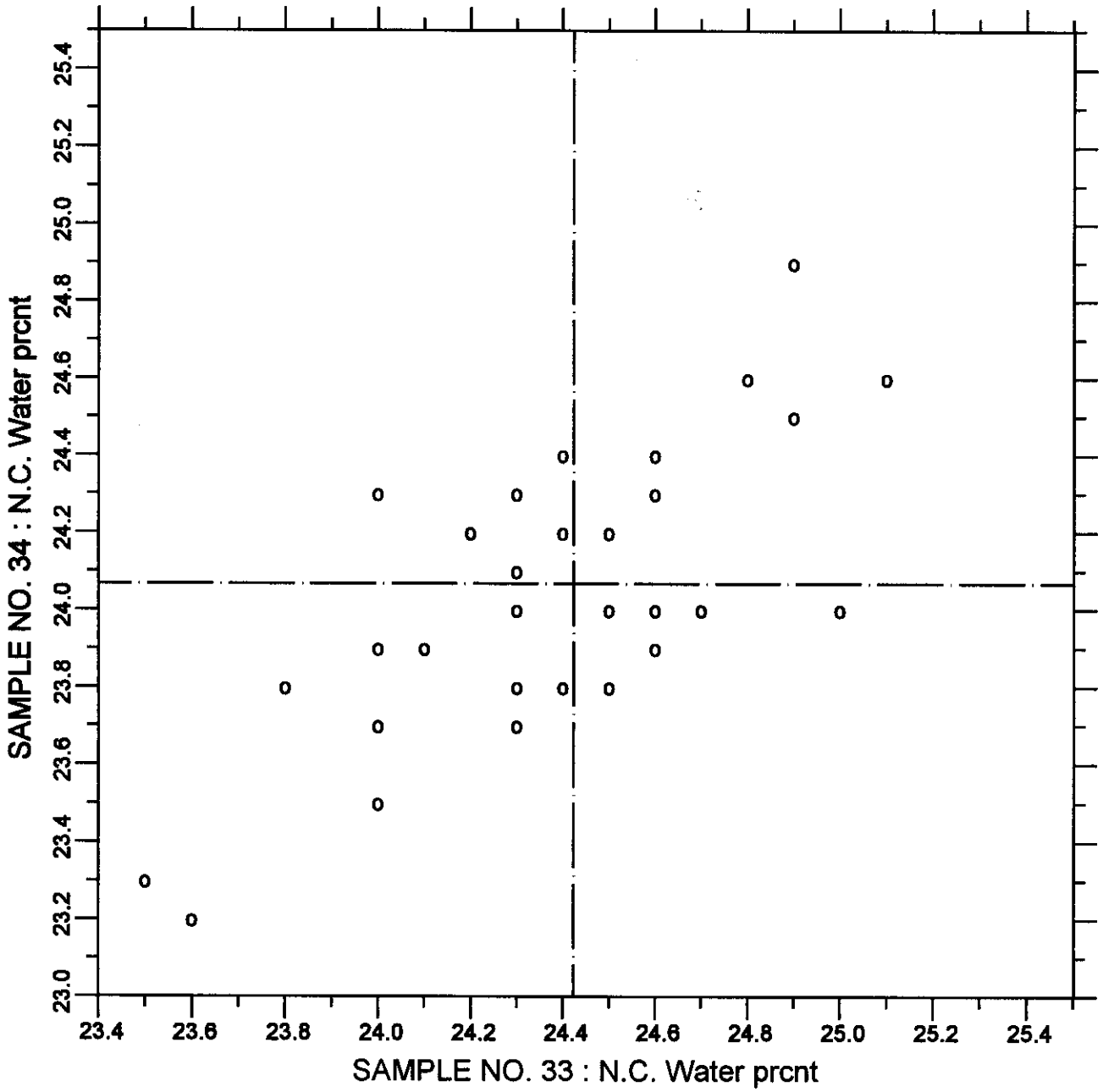
CCRL PROFICIENCY SAMPLE PROGRAM
Autoclave Expansion
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.160 **Autoclave Expansion** **47 POINTS**

SAMPLE NO. 33	AVE	0.1221	S.D.	0.040	C.V.	33.1
SAMPLE NO. 34	AVE	0.1283	S.D.	0.040	C.V.	30.9

CCRL PROFICIENCY SAMPLE PROGRAM
Normal Consistency Water
POZZOLAN SAMPLES NO. 33 & NO. 34



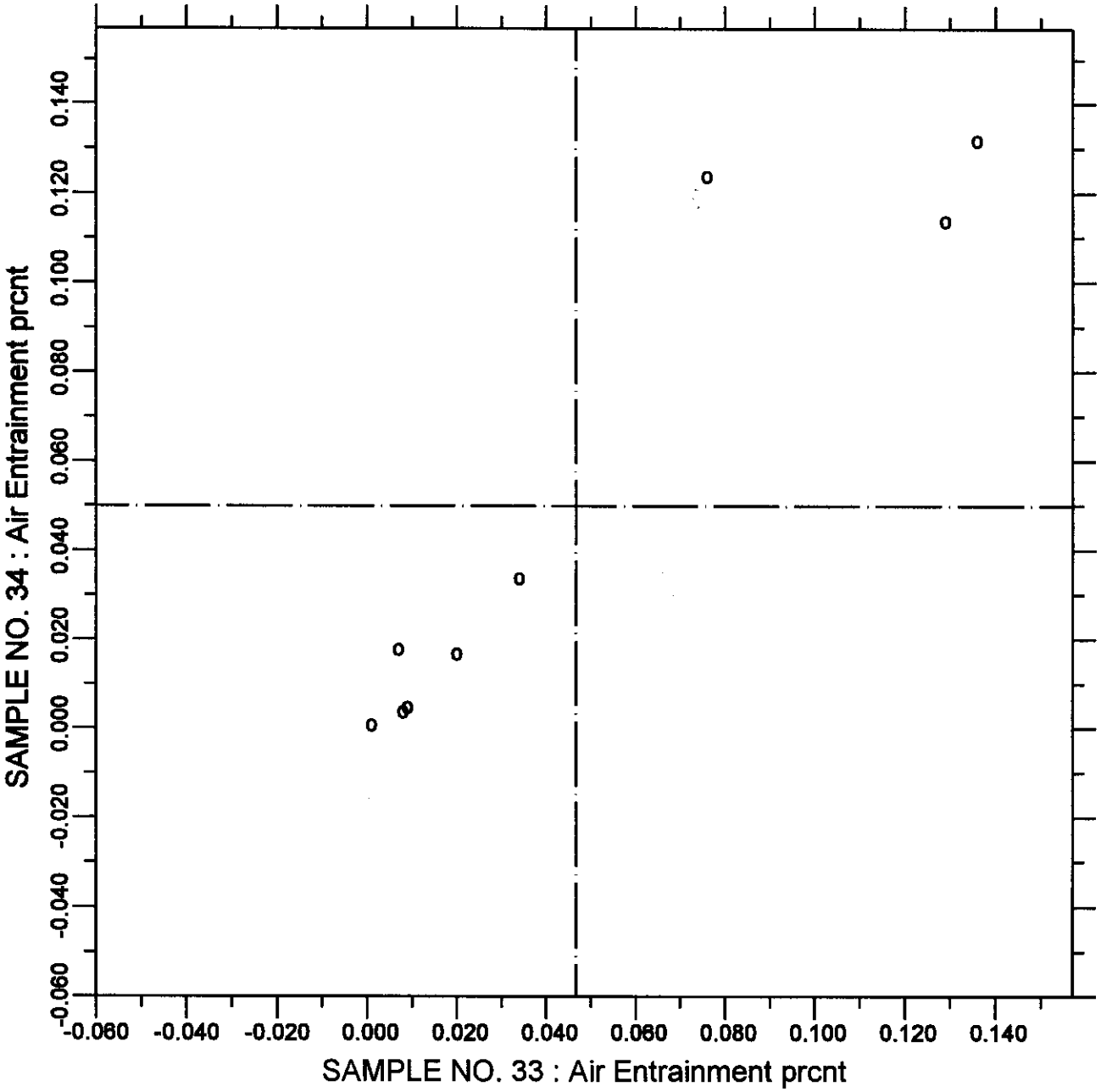
TEST NO.110 **N.C. Water** **46 POINTS**

SAMPLE NO. 33 AVE 24.424 S.D. 0.33 C.V. 1.35

SAMPLE NO. 34 AVE 24.067 S.D. 0.32 C.V. 1.35

LABS ELIMINATED 1773

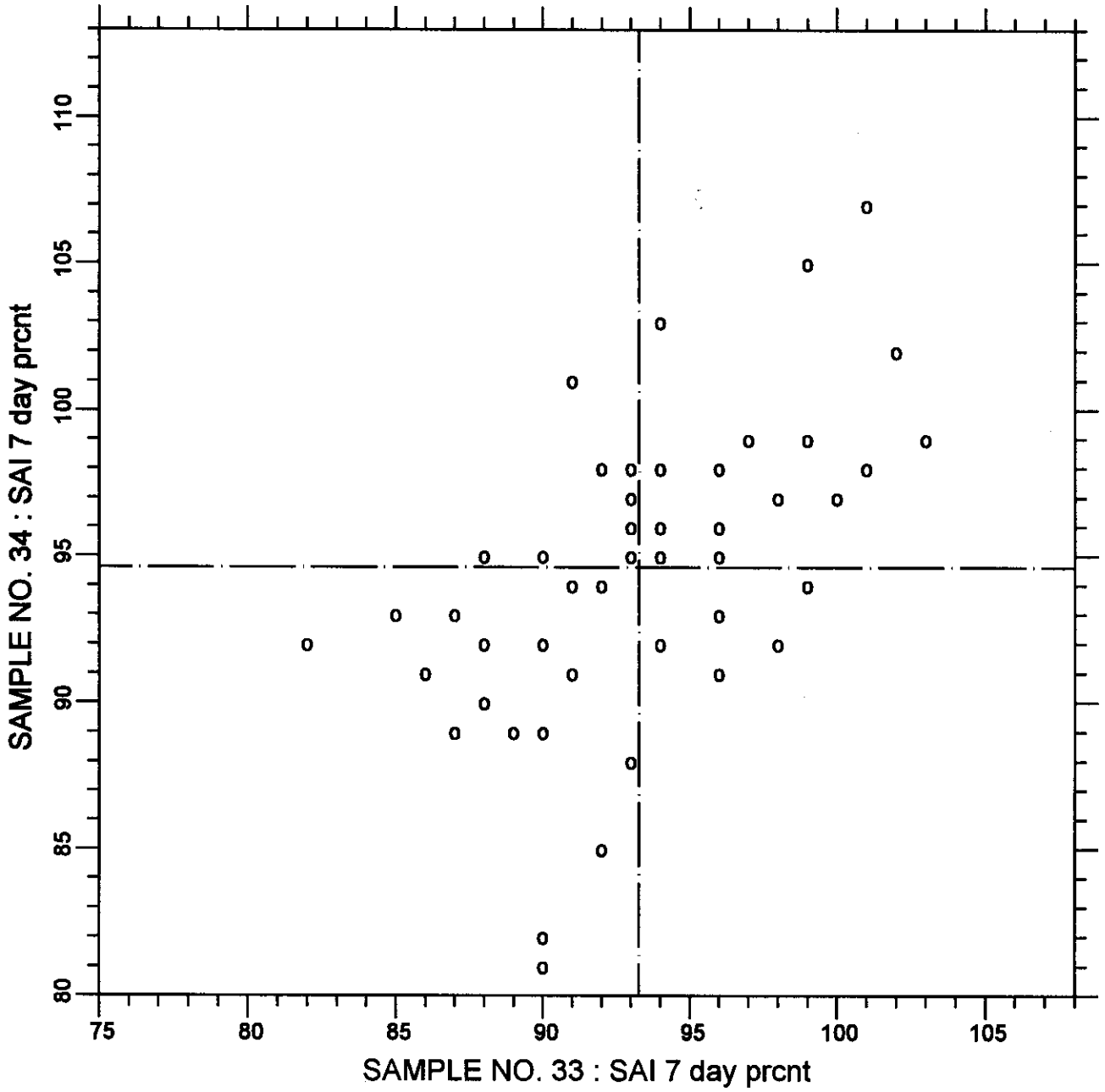
CCRL PROFICIENCY SAMPLE PROGRAM
Air Entrainment
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.350 **Air Entrainment** **9 POINTS**

SAMPLE NO. 33	AVE	0.047	S.D.	0.054	C.V.	115
SAMPLE NO. 34	AVE	0.050	S.D.	0.056	C.V.	112

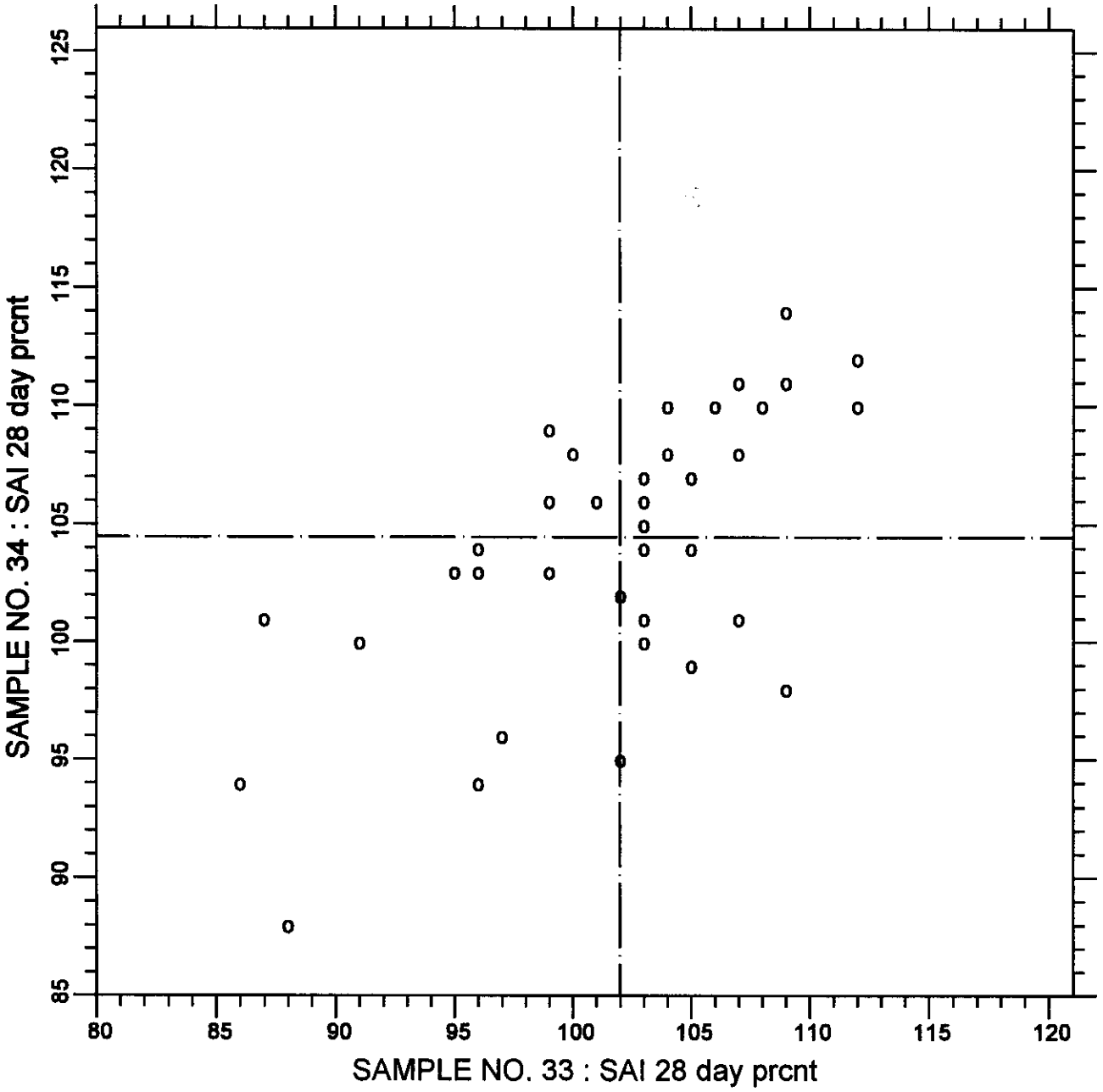
CCRL PROFICIENCY SAMPLE PROGRAM
Strength Activity Index - 7 day
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.359 **SAI 7 day** **51 POINTS**

SAMPLE NO. 33	AVE	93.27	S.D.	4.6	C.V.	4.92
SAMPLE NO. 34	AVE	94.61	S.D.	5.0	C.V.	5.34

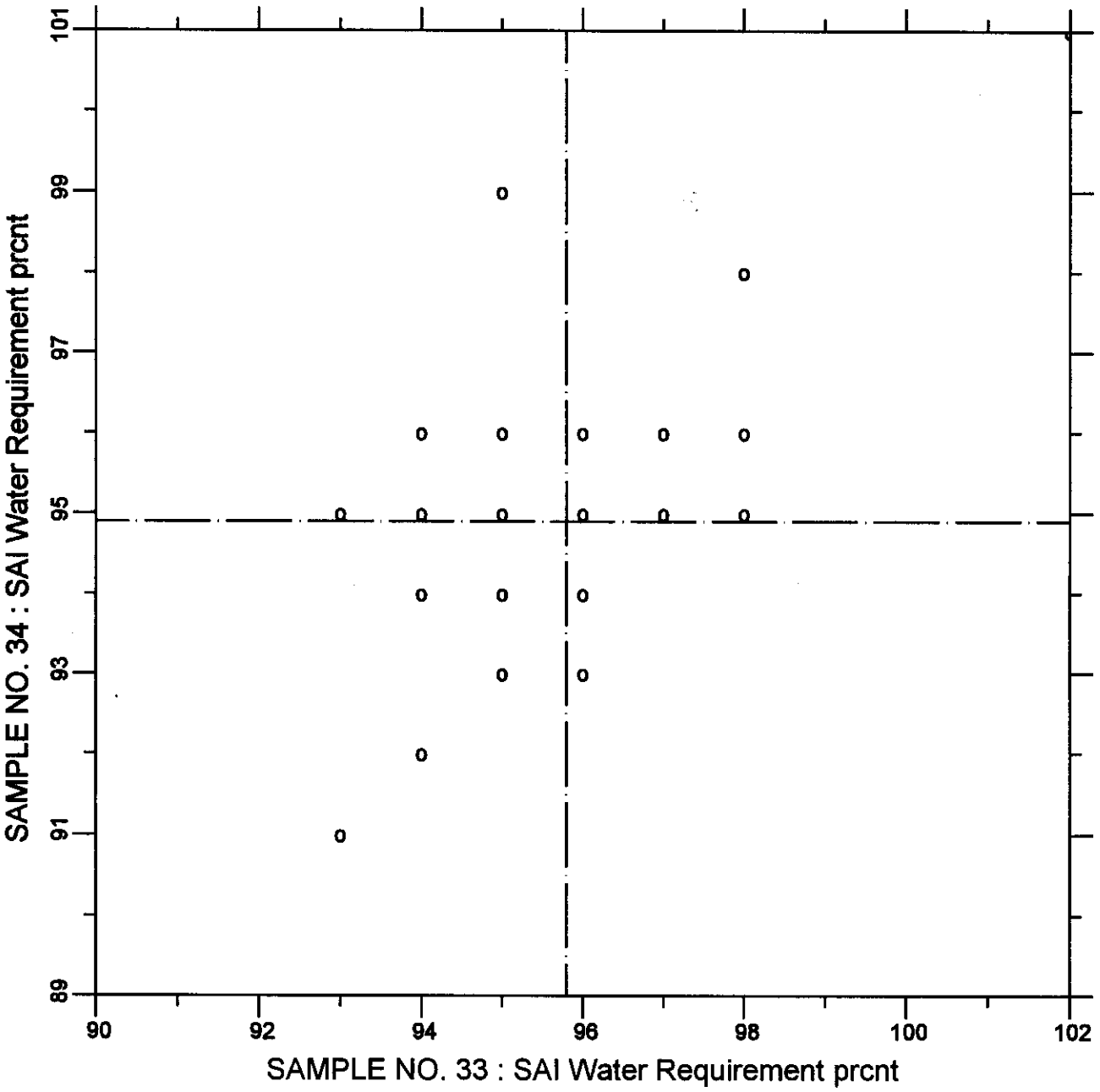
CCRL PROFICIENCY SAMPLE PROGRAM
Strength Activity Index - 28 day
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.360 **SAI 28 day** **44 POINTS**

SAMPLE NO. 33	AVE	101.98	S.D.	6.2	C.V. 6.10
SAMPLE NO. 34	AVE	104.48	S.D.	5.6	C.V. 5.32

CCRL PROFICIENCY SAMPLE PROGRAM
SAI Water Requirement
POZZOLAN SAMPLES NO. 33 & NO. 34

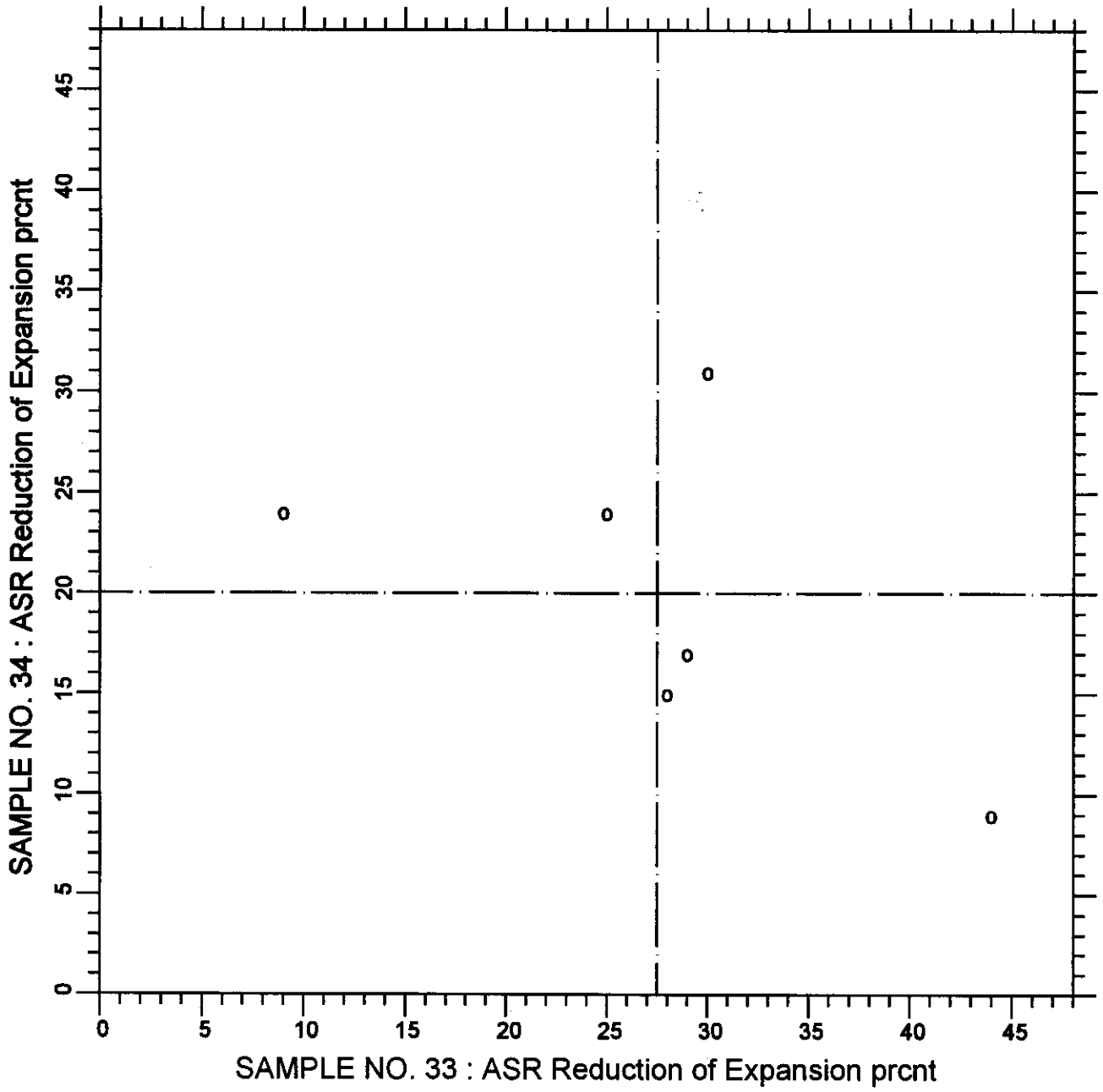


TEST NO.370 **SAI Water Requirement** **48 POINTS**

SAMPLE NO. 33	AVE	95.80	S.D.	1.8	C.V.	1.94
SAMPLE NO. 34	AVE	94.90	S.D.	1.9	C.V.	2.04

LABS OFF DIAGRAM 207

CCRL PROFICIENCY SAMPLE PROGRAM
Alkali-Silica Reaction - Reduction of Expansion
POZZOLAN SAMPLES NO. 33 & NO. 34



TEST NO.390 ASR Reduction of Expansion 6 POINTS

SAMPLE NO. 33	AVE	27.5	S.D.	11.2	C.V. 40.8
SAMPLE NO. 34	AVE	20.0	S.D.	7.8	C.V. 39.2