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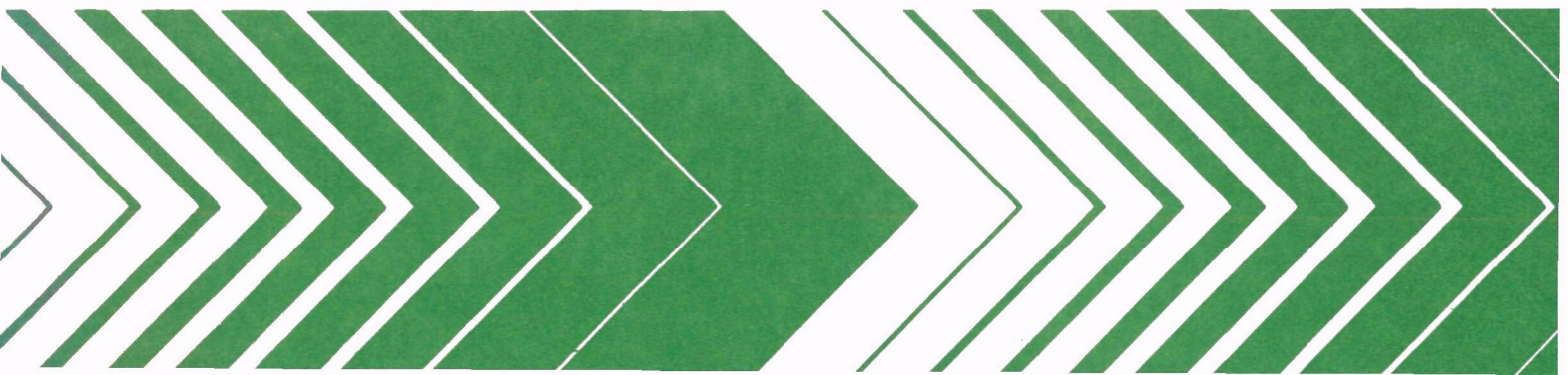

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A SUMMARY OF THE INTERLABORATORY SOURCE PERFORMANCE SURVEYS FOR EPA REFERENCE METHODS 5, 6, AND 7 - 1978

by

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FOREWORD

Measurement and monitoring research efforts are designed to anticipate potential environmental problems, to support regulatory actions by developing an in-depth understanding of the nature and processes that impact health and the ecology, to provide innovative means of monitoring compliance with regulations and to evaluate the effectiveness of health and environmental protection efforts through the monitoring of long-term trends. The Environmental Monitoring Systems Laboratory, Research Triangle Park, North Carolina, has responsibility for: assessment of environmental monitoring technology and systems; implementation of agency-wide quality assurance programs for air pollution measurement systems; and supplying technical support to other groups in the Agency including the Office of Air, Noise and Radiation, the Office of Toxic Substances and the Office of Enforcement.

The major concern of this study is to report the results of surveys in the national quality assurance program for stationary source tests. Surveys were designed to estimate the analytical and computational accuracy that can be expected with EPA Method 5 (dry gas meter only), Method 6 (sulfur dioxide) and Method 7 (nitrogen oxides). Statistical analysis was used to characterize the data.

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ABSTRACT

A national survey of methods in stationary source tests was conducted in 1978 by the Quality Assurance Division of the Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. In this program, quality assurance samples were sent to interested participants for the measurement of a gas volume (Method 5, dry gas meter only) or the analysis of liquid samples simulating collected sulfur dioxide and nitrogen oxides (Method 6 and 7, respectively). Each participant returned the analytical results to the Source Branch, Quality Assurance Division, for evaluation. An individual report was returned to each participant after processing.

This report summarizes the survey results for those three source test methods.

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ACKNOWLEDGMENTS

Our deep appreciation is extended to each of the survey participants. In addition, we also express thanks to Ms. Ellen Streib who analyzed the survey samples under our Acceptance Testing Program, and the programmers of the Data Management and Analysis Division for providing the data management systems necessary to store and summarize the survey data.

SECTION 1

INTRODUCTION

One of the responsibilities of the Environmental Protection Agency (EPA) is to provide adequate methodology as a means to monitor compliance with emission regulations. But to insure consistent results using EPA methodology, a good quality assurance program must be maintained.

The Source Branch (SB) of the Quality Assurance Division (QAD) of the Environmental Monitoring Systems Laboratory (EMSL), EPA provides a nationwide quality assurance program for air pollution measurement systems. As part of this overall program, the QAD began in 1977 to periodically provide reference samples for analysis by any contractor, industrial, or governmental laboratory that wished to participate in its program (1). This program had three main purposes:

- to verify that the analytical and computational parts of the specific reference methods were being properly used,
- to assist wherever possible to improve the quality of the measurement being made,
- to aid the participating laboratories in assessing their analytical performance relative to that of other laboratories conducting similar analyses.

These goals were realized by sending specific performance materials to interested laboratories for analysis.

In the two source test method surveys conducted in May and October of 1978, the technique of volume measurement by a dry gas meter was examined. This method is essential to the Method 5 source sampling train (2). Also examined were the analytical and computational parts of Method 6 for sulfur dioxide (SO_2) (3) and Method 7 for nitrogen oxides (NO_x) (4). This report describes the preparation and evaluation of these tests.

SECTION 2

SUMMARY

These quality assurance surveys were conducted in May and October of 1978 by the Quality Assurance Division of EPA's Environmental Monitoring Systems Laboratory. They included participants from industry, contracting firms, universities, foreign countries, and governmental agencies. Comparative data from past surveys (1977) are also contained in this report.

In examining the results of the Method 5 surveys, the investigators found that an average of 55% of the laboratories requesting samples actually returned data. The reported results from responding laboratories showed that 55% in survey 0578 (May 1978) came within 5% of the true value for the requested volume measurements, while in survey 1078 (October 1978) 70% were within 5%.

For Method 6, an average of 56% of those laboratories requesting samples returned data for both surveys. Of those laboratories returning data for survey 0578, 50% came within 1.28% of the true value in the analysis of all sample concentration levels, while in survey 1078, 50% were within 1.71%.

For Method 7, an average of 53% of those laboratories requesting samples returned data for both surveys. Fifty percent of the responding laboratories in survey 0578 came within 6.18 percent of the true value on all sample concentration levels while in survey 1078, 7.98 percent were able to do this. (Outliers, i.e., anomolous values, were removed from the above summary figures.)

Comparing the results of the two Method 6 surveys of 1978 with two source surveys conducted in 1977, the authors found that in 1977, 50% of the participants analyzing samples were 2.15 and 1.69% or less from the true value when the results of all sample concentration levels were combined, while in 1978

this same group showed results containing differences of 1.28 and 1.71%. Calculating a weighted value for all four surveys based on the number of samples taken in each survey gives a 50% value of 1.7%.

For the Method 7 study, in two surveys conducted in 1977, 50% of the participants came within 15.14 and 7.41% of the true value, respectively, while in the two surveys conducted in 1978, 50% came within 6.18 and 7.98%, respectively Except for the Method 7 result from the first survey (15.1%), the last three surveys gave a weighted value of 7.2% for 50% of the participants.

Whether these percent responses indicate a definite trend in the analytical abilities of users of these two source methods will be judged from future surveys.

SECTION 3

RECOMMENDATIONS

To create a sample repository, the Quality Assurance Division of the Environmental Monitoring Systems Laboratory intentionally produced an oversupply of samples for the surveys of EPA Methods 6 and 7 discussed in this report. These samples are available to any laboratory having a legitimate need for them, such as training new analysts and conducting periodic external quality control checks of the laboratory. Included with these practice samples is a statement of true concentration with no requirement for return of data to EPA. We recommend that all participants make use of this sample repository, as it may help laboratories to increase their overall analytical skills with these particular EPA reference methods.

SECTION 4

SURVEY DESIGN

The source sample surveys discussed in this report incorporate the experience gained from previous source surveys in such areas as survey procedures, prospective participants, categorization and preparation of survey materials, and data handling.

SURVEY PROCEDURES

All surveys began with a master list of prospective laboratories which had in the past participated or indicated a wish to take part in such a program.

Prospective participants were sent a description of the survey methods and instructions for participation. Through a response card, each laboratory indicated if it wished to participate. Response cards were returned to the appropriate EPA Regional Quality Control Coordinator (RQCC) who collected, logged, and forwarded them to the EPA contractor preparing the survey materials for QAD. Participating laboratories were assigned an identification number to facilitate storage of their data in the computer's data bank and to maintain the confidentiality of each participant's results. At a prearranged date, requested survey materials were shipped to the participants with the instructions for sample analysis, a blank data card to report the completed analysis values, and a mailing label for return of the data card to QAD. When the survey was completed, the participants received a computer data sheet containing the results of their performances. At the completion of all the studies, a summary of the total results will be published without reference to any specific laboratory.

PROSPECTIVE PARTICIPANTS

Using a previously compiled master list of laboratories from past surveys, invitations to participate in the upcoming source surveys 0578 (May) and 1078 (October) were sent to all volunteers who had previously participated in one or more of the source surveys. Other laboratories were added to the master list through their direct contact with the SB/QAD or the RQCC.

PREPARATION AND DISTRIBUTION OF SURVEY MATERIALS FOR METHODS 5, 6, AND 7

To provide a check on the calibration of the dry gas meter used in the Method 5 stack sampling train, a critical orifice device was developed to pass a certain volume of air through the dry gas meter when the measured vacuum on the orifice was at least 16 inches of mercury. This device allows an analyst to compare a volume measured at his location with one measured at an EPA location. Volumes measured at both locations are compared to the original calibration of the device, compensated for the effect of ambient temperature and pressure on the measurement at both locations. After initial calibration by an EPA contractor, it is recalibrated by an EPA laboratory which rejects any device whose volume measurement does not fall within ± 2% of the original calibration. This process of verification of the original calibration is known as Acceptance Testing.

Participants in the Method 5 survey were instructed to insert the critical orifice device in the probe connection of their gas sampling meter box, and, after a warmup period, to take three 15 min volume measurements. Using equation 5-1 of Method 5, they were told to calculate each of the three volumes in cubic meters and record them on the data card along with other pertinent information concerning sampling conditions. They were then to mail the device and data card back to EPA for comparison of volumes. Some meter boxes were equipped with diaphragm pumps that cannot pull 16 inches of mercury vacuum with these audit devices. Since a certain vacuum is necessary to produce critical flow, new devices were constructed with smaller orifice openings that allow the pumps to pull the required vacuum.

For all surveys of Methods 6 and 7, five different concentration levels of simulated source sulfur dioxide (SO_2) and nitrogen oxides (NO_x) samples were prepared. These solutions enabled the participants to analyze and calculate different concentration levels of SO_2 and NO_x, using Methods 6 and 7. The true values of these samples were based on theoretical concentrations calculated from gravimetric preparations and certain assumed volume measurements. After sample solutions were made, their concentrations were verified with the appropriate methods. This step was initially conducted by contractor personnel and then by EPA personnel, via Acceptance Testing.

Each sample solution, approximately 20 ml, was sealed in a 25 ml glass ampoule, and five different concentration levels were shipped to the participating laboratories. The ampoules containing NO_x samples were autoclaved to destroy bacteria that might possibly attack the solutions.

Instructions for the Method 6 samples prescribed that 5 ml of the test solution be diluted to 100 ml through the addition of 30 ml of 3% hydrogen peroxide (H_2O_2) and distilled water. An aliquot of this solution was then titrated with barium perchlorate ($Ba[ClO_4]_2$) in the presence of thorin indicator to a characteristic peach color endpoint. To complete Method 6 calculations, the participants assumed they had an original sample volume of 100-ml, and had sampled 21×10^{-3} DSCM (dry standard cubic meter) of stack gas.

The analysis of Method 7 samples involved dilution of a 5-ml aliquot of the original test sample with 25 ml of absorbing reagent, adjustment of the pH to approximately 9 to 12, and dilution to 50 ml with distilled water. After a digestion procedure, a colorimetric analysis followed. To complete Method 7 calculations, the participants assumed they had sampled 2000 ml of stack gas.

In each of our surveys, the samples were number coded. The key for the five concentration levels was based on the first digit of the sample number.

SECTION 5

STATISTICAL DATA HANDLING

Establishing performance criteria in order that participants could evaluate their reported data was a major concern of the survey program. The ideal approach would have been to develop statistics on a large number of analyses of the same sample made by laboratories across the nation at different times. Since this was not possible at the start of our survey program, we initially developed performance ranges. These performance ranges, based on the results of collaborative test studies, defined an acceptable variability around the known concentration of each sample. Construction of these ranges was based on the 1977 data summary of the Method 6 and 7 surveys (1).

This definition of performance ranges is arbitrary, however, because the ranges are not based on the same statistical population of volunteers as was used in the surveys.

The 1978 summary report also used information collected from the previous surveys of 1977. From the participants' reported data, a frequency distribution of percent difference was next devised showing how well all participants did in those surveys when their results were compared against the EPA true value for each concentration level. We chose to develop frequency distributions to aid the participant in his self-evaluation instead of the performance ranges we used initially. This method allowed comparisons and self-evaluations to be based on results taken from the same participants.

Although statistical comparisons are made between different surveys for the same pollutant, each laboratory participating in the surveys can use different analysts for each survey. Thus, any increase in overall survey accuracy could mean the analyst is becoming more familiar with the methods, or that better analysts are being used.

SECTION 6

DISCUSSION OF METHOD 5 RESULTS

The distribution of the types of laboratories responding to surveys 0578 and 1078 about Method 5 (dry gas meter only) is shown in Tables 1 and 2 below.

TABLE 1. METHOD 5 SURVEY 0578

	Laboratory Distribution						
	Contractor	Industrial	Foreign	Federal	State	Local	Total
Laboratories requesting samples	48	18	1	2	9	3	81
Laboratories returning data	25	6	1	1	8	2	43

The fact that a large percentage of participants request survey samples but do not analyze and return their data in this and the other source surveys is puzzling. Probable causes for not returning data are either conflicts with scheduled work or oversights -- failure to schedule the analysis of the QA samples during the alloted time period. These two reasons would not effect the overall statistics of the survey. However, if the sample results were not returned due to suspected inaccuracy of the data the survey statistics would be biased. In case analytical problems do arise, the survey participant may obtain a set of practice survey samples with their specific concentrations listed. These samples come from previous surveys, of which concentrations have been released to the public.

TABLE 2. METHOD 5 SURVEY 1078

	Laboratory Distribution						
	Contractor	Industrial	Foreign	Federal	State	Local	Total
Laboratories requesting samples	55	28	6	5	14	6	114
Laboratories returning data	30	14	4	2	11	4	65

Participants in this survey were instructed to take three 15 min volume measurements, calculate each volume at standard conditions in m^3 using equation 5-1 of Method 5, and report their results on the blank data card provided.

Since the compared results have been reported in percents, the participant can readily discover his standing in the overall group of participants. Percent difference has been calculated as follows:

$$PD = \frac{RV - TV}{TV} \times 100 \qquad (1)$$

where: PD = absolute percent difference
RV = reported value
TV = true value
100 = factor to change decimal to percent

Table 3 (below) describes the participants' degree of accuracy when their reported values were compared against the true value determined by EPA and contractor measurements.

TABLE 3. METHOD 5 - ABSOLUTE PERCENT DIFFERENCE

Survey	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
0578	14	21	31	43	52	64	71	79	84	89
1078	15	31	50	61	68	78	84	88	90	94

This table shows that in survey 0578, 52% of the participants were able to measure within 5% of the EPA value, while in survey 1078, 68% were able to do so.

A summary of all individual measurements received from survey 0578 for Method 5 is tabulated in Tables 4 and 5 (below). All outliers in this report were removed according to Chauvenet's Criterion (5). All outlier tests are used to remove suspected anomalous values from the various groups of survey data.

TABLE 4. METHOD 5 SURVEY 0578 - FREQUENCY DISTRIBUTION OF PERCENT DIFFERENCE

	10%	20%	30%	40%	50%	60%	70%	80%	90%
All data	-9.6	-7.9	-6.8	-5.2	-4.1	-3.5	-2.1	-0.1	1.0
Outliers removed	-9.2	-7.9	-6.3	-5.2	-4.1	-3.5	-2.3	-0.7	0.3

TABLE 5. METHOD 5 SURVEY 0578 - SUMMARY STATISTICS

	n	MIN (%)	MAX (%)	MEDIAN (%)	MEAN (%)	STD DEV (%)	SKEWNESS
All data	180	-18.3	86.3	-4.1	-3.1	±12.6	5.86
Outliers removed	172	-15.1	7.2	-4.1	-4.2	± 4.2	0.29

A summary of all individual measurements received from survey 1078 for Method 5 is tabulated in Tables 6 and 7 below.

TABLE 6. METHOD 5 SURVEY 1078 - FREQUENCY DISTRIBUTION OF PERCENT DIFFERENCE

	10%	20%	30%	40%	50%	60%	70%	80%	90%
All data	-9.0	-6.2	-5.2	-3.7	-3.0	-2.4	-1.7	-1.0	0.1
Outliers removed	-8.9	-6.2	-5.2	-3.7	-3.0	-2.4	-1.7	-1.0	0.0

TABLE 7. METHOD 5 SURVEY 1078 - SUMMARY STATISTICS

	n	MIN (%)	MAX (%)	MEDIAN (%)	MEAN (%)	STD DEV (%)	SKEWNESS
All data	255	-27.2	45.2	-3.0	-3.2	± 6.3	3.44
Outliers removed	249	-12.4	4.2	-3.0	-3.5	± 3.2	0.14

In Tables 4 and 5 for survey 0578, 70% of the reported data were found to lie in a range of -15.1 and -2.3% difference from the accepted EPA value. For survey 1078 the 70% range was -12.4 to -1.7%. In both cases when outliers were removed -- 8 for survey 0578 and 6 for survey 1078 -- no large effect was noted on this value. The overall means of both studies were within 0.7% when outliers were removed.

Since the skewness values were near zero and the median and mean values of each study were close to each other, both studies may be assumed to be normally distributed.

There was, however, a negative mean percent difference calculated for both studies (Tables 5 and 7). The weighted mean of both studies was -3.4% with outliers removed. When calibrated by an EPA laboratory, the orifices obtained an overall -0.5 ± 1.2% difference when compared to the original calibration. All percent difference values are based on the contractor's original calibration.

A negative bias can be caused by leakage in the wet test, dry test meter, or by infrequent calibration of both meters. There are several helpful publications on troubleshooting the dry test meter (6-8). During calibration of each device before each study, these devices must maintain ± 2% of the original contractor calibration value, or they are sent for cleaning and recalibration. This method follows EPA's Acceptance Testing Program, in which the EPA contractor's determinations are verified by an independent EPA laboratory. Although the volume determinations made with the meter boxes are expected to be within ± 2%, all participants' values have been calculated back to the original contractor calibration. Our laboratory plans to continue examining the results obtained from use of these critical orifices as calibration checks.

All results of these two Method 5 surveys are grouped according to the increasing concentration levels reported in Appendix A, so that individuals may note their exact placement in the survey results.

SECTION 7

DISCUSSION OF METHOD 6 RESULTS

The distribution of participants in the Method 6 surveys, 0578 and 1078, is shown in Tables 8 and 9 below.

TABLE 8. METHOD 6 SURVEY 0578

	Laboratory Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	72	19	2	4	15	8	0	120
Laboratories returning data	34	12	2	1	8	6	0	63

TABLE 9. METHOD 6 SURVEY 1078

	Laboratory Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	56	29	5	3	15	7	1	116
Laboratories returning data	26	20	2	1	14	5	1	69

Participants were instructed to use Method 6 for all analyses and report their results, based on equation 6-2 of Method 6 (mg SO_2/DSCM), on a blank data card.

Tables 10 and 11 are frequency distributions of the absolute percent differences between the participant's reported values and EPA values for each concentration level.

Table 10 reveals that 50% of the reported results for all sample concentration levels of Method 6 survey 0578 were less than or equal to an absolute percent difference of 1.28. The bottom line of this table compiles all the data regardless of concentration. Table 10 is also useful for self-evaluation. For instance if a participant reported a value for sample 4 that was more than 1.81% from the true value, he would see that results from 70% of the participants were closer to the true value than his. The Min and Max values listed in Tables 10 and 11 show the lowest and highest individual percent differences reported in the survey.

To allow individuals to note their exact placement in the survey, all results are grouped in Appendix B according to increasing order of concentration levels reported.

Tables 12 and 13 list summary statistics on survey 0578 about Method 6, with and without outliers. Tables 14 and 15 list summary statistics for survey 1078 (Method 6) with and without outliers. Equations 3, 4, and 5 were used to calculate the statistics in these tables:

$$\% \text{ Coefficient of variation} = \frac{s}{\bar{X}} \times 100; \tag{2}$$

$$\text{Skewness} = \frac{\Sigma(X_i - \bar{X})^3}{n(s)^3}; \tag{3}$$

$$\text{Accuracy} = \frac{Mi - \delta}{\delta} \times 100 . \tag{4}$$

where:
- s = one standard deviation
- $\bar{X}$ = mean value
- X_i = individual value
- Mi = median value
- δ = true value
- n = number of values

TABLE 10. METHOD 6 SURVEY 0578 - FREQUENCY DISTRIBUTION OF ABSOLUTE PERCENT DIFFERENCE

	NO.	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN
Sample 3	63	0.01	0.22	0.41	0.67	0.99	1.28	1.65	2.30	3.45	4.11	96.9	3.82
Sample 4	63	0.03	0.20	0.44	0.61	0.83	1.08	1.47	1.81	3.75	4.50	96.9	3.79
Sample 5	63	0.09	0.17	0.34	0.60	0.73	1.09	1.45	1.85	2.73	5.20	96.9	3.69
Sample 7	63	0.03	0.15	0.24	0.49	0.79	1.00	1.27	1.77	2.58	4.54	96.9	3.57
Sample 9	63	0.05	0.37	0.79	1.21	1.68	1.94	2.99	4.35	6.03	13.5	96.9	6.47
All Samples	315	0.01	0.21	0.42	0.69	1.00	1.28	1.72	2.41	3.77	6.03	96.9	4.27

TABLE 11. METHODS 6 SURVEY 1078 - FREQUENCY DISTRIBUTION OF ABSOLUTE PERCENT DIFFERENCE

	NO.	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN
Sample 1	69	0.00	0.20	0.43	0.67	0.88	1.25	1.58	2.01	3.33	4.94	23.5	2.36
Sample 3	69	0.10	0.25	0.52	0.76	1.00	1.20	1.53	2.55	3.30	4.78	23.4	2.40
Sample 5	68	0.00	0.37	0.56	0.80	1.19	1.77	2.38	2.76	4.00	6.42	867.0	16.0
Sample 6	69	0.00	0.52	1.25	1.97	2.43	3.93	4.52	6.10	9.97	17.4	48.9	6.60
Sample 9	69	0.00	0.23	0.49	0.68	0.80	1.25	2.05	2.57	3.45	5.22	48.1	3.35
All Samples	344	0.00	0.30	0.58	0.86	1.19	1.71	2.39	3.11	4.47	7.12	867.0	6.12

TABLE 12. METHOD 6 SURVEY 0578 - SUMMARY STATISTICS

Parameter	Sample No. 3	4	5	7	9
Samples (n)	63	63	63	63	61
True value*	686.30	2478.50	1258.30	1906.00	190.70
Mean*	672.	2427.	1229.	1866.	194.
Median*	683.	2460.	1250.	1894.	192.
Std. dev.*	87.7	318.	160.	242.	11.9
% Coef. var.	13.1	13.1	13.0	13.0	6.1
Skewness	-6.43	-6.36	-6.48	-6.56	0.58
Accuracy	-0.50	-0.72	-0.67	-0.62	0.58

*All sample concentrations are in mg SO_2/DSCM.

TABLE 13. METHOD 6 SURVEY 0578 - SUMMARY STATISTICS (OUTLIERS REMOVED)

Parameter	Sample No. 3	4	5	7	9
Samples (n)	62	62	62	62	63
True value*	686.30	2478.50	1258.30	1906.00	190.70
Mean*	683.	2465.	1249.	1895.	193.
Median*	683.	2461.	1250.	1894.	192.
Std. dev.*	27.6	102.	49.0	71.4	29.9
% Coef. var.	4.04	4.15	3.93	3.77	15.5
Skewness	0.83	1.40	0.81	0.76	-3.04
Accuracy	-0.47	-0.69	-0.66	-0.62	0.58

*All sample concentrations are in mg SO_2/DSCM.

As previously stated, participants in survey 0578 and 1078 each received a set of five samples. These samples represented five different concentration levels of SO_2. The sample numbers were randomized from the numbers 0 through 9

TABLE 14. METHOD 6 SURVEY 1078 - SUMMARY STATISTICS

Parameter	Sample No. 1	3	5	6	9
Samples (n)	69	69	68	69	69
True value*	2555.00	1335.00	572.00	152.50	1754.00
Mean*	2551.	1332.	645.	158.	1737.
Median*	2550.	1329.	573.	156.	1751.
Std. dev.*	109.	57.1	603.	15.0	132.
% Coef. var.	4.28	4.28	93.5	9.45	7.59
Skewness	1.64	1.66	7.83	1.13	-3.23
Accuracy	-0.22	-0.47	0.10	2.30	-0.14

*All sample concentrations are in mg SO_2/DSCM.

TABLE 15. METHOD 6 SURVEY 1078 - SUMMARY STATISTICS (OUTLIERS REMOVED)

Parameter	Sample No. 1	3	5	6	9
Samples (n)	67	67	67	67	67
True value*	2555.00	1335.00	572.00	152.50	1754.00
Mean*	2547.	1331.	572.	158.	1743.
Median*	2550.	1329.	572.	156.	1752.
Std. dev.*	67.2	34.5	42.5	11.4	69.2
% Coef. var.	2.64	2.59	7.43	7.23	3.97
Skewness	-0.78	-0.13	-4.02	0.30	-1.21
Accuracy	-0.22	-0.47	0.00	2.30	-0.14

*All sample concentrations are in mg SO_2/DSCM.

From an examination of Tables 13 and 15, no bias is evident, as reflected by the low skewness value. Lack of bias is also suggested by the small difference between the mean and the true value and the low accuracy values. The low skewness value, and closeness of the median and true value also suggest a normally distributed sample population.

SECTION 8

DISCUSSION OF METHOD 7 RESULTS

Tables 16 and 17 (below) show the distribution of samples in surveys 0578 and 1078 for the NO_x method.

TABLE 16. METHOD 7 SURVEY 0578

	Laboratory Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	62	9	2	3	7	6	0	89
Laboratories returning data	29	7	2	1	3	4	0	46

TABLE 17. METHOD 7 SURVEY 1078

	Laboratory Distribution							
	Contractor	Industrial	Foreign	Federal	State	Local	University	Total
Laboratories requesting samples	49	23	5	4	11	7	0	99
Laboratories returning data	21	13	3	1	8	6	0	52

Participants were instructed to use Method 7 for the analysis and report their results based on equation 7-4 of the method as mg NO_x/DSCM. Under the section called Calculations in Method 7, the analyst was instructed to report the concentration of the NO_x samples as NO_2.

Tables 18 and 19 are frequency distributions of the absolute percent differences between the participant's reported values and the EPA values for each concentration level.

Table 18 reveals that 50% of the reported results in surveys 0578 and 1078 for all sample concentration levels of Method 7 were less than or equal to an absolute percent difference of 6.18 and 7.91, respectively. Like Method 6, Tables 18 and 19 can be used for self-evaluation. For example, if a participant reported a value for sample 8 (Table 18) that was more than 15.7% from the true value, he would see that results from 70% of the participants were closer to the true value than his.

To allow individuals to note their exact placement in the survey, all results are grouped in Appendix C according to increasing order of concentration levels reported.

Tables 20 and 21 list summary statistics for Method 7, survey 0578, with and without outliers.

Tables 22 and 23 present summary statistics for survey 1078, Method 7.

Examining Tables 21 and 23, no bias is evident, as reflected by a low skewness value and the closeness of the median and mean value.

TABLE 18. METHOD 7 SURVEY 0578 - FREQUENCY DISTRIBUTION OF ABSOLUTE PERCENT DIFFERENCE

	NO.	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN
Sample 1	46	0.27	0.35	1.89	3.03	4.08	5.46	6.13	9.14	18.7	45.7	142.	17.3
Sample 2	46	0.21	1.07	1.60	2.67	3.94	7.46	9.06	12.1	21.5	65.7	123.7	21.3
Sample 6	46	0.08	1.11	1.90	2.71	3.72	5.86	6.52	9.27	13.6	52.2	107.	17.3
Sample 8	46	0.05	0.40	2.31	3.06	5.51	7.48	10.6	15.7	21.3	49.6	101.	18.3
Sample 9	46	0.12	0.55	1.65	2.13	2.68	4.11	7.56	10.5	14.9	48.9	107.8	15.7
All Samples	230	0.05	1.07	1.89	2.73	4.08	6.18	8.29	11.8	21.3	64.3	142.	18.0

TABLE 19. METHODS 7 SURVEY 1078 - FREQUENCY DISTRIBUTION OF ABSOLUTE PERCENT DIFFERENCE

	NO.	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN
Sample 1	52	0.20	0.77	1.74	3.12	4.54	6.69	7.91	11.5	15.6	54.6	320.	22.6
Sample 2	52	0.56	1.78	3.74	4.79	6.08	7.82	9.23	13.3	17.6	47.3	131.	18.9
Sample 3	52	0.55	1.53	2.82	3.56	4.49	6.33	9.26	13.3	18.7	32.6	130.	15.9
Sample 5	52	0.24	0.87	2.60	3.90	5.93	7.95	11.4	14.6	18.8	26.5	260.	19.5
Sample 7	52	0.26	1.70	3.30	4.72	6.18	8.59	10.8	13.8	17.2	31.5	135.	19.0
All Samples	260	0.20	1.45	3.04	4.34	5.91	7.91	9.83	13.9	20.4	47.3	320.	19.2

TABLE 20. METHOD 7 SURVEY 0578 - SUMMARY STATISTICS

Parameter	Sample No. 1	2	6	8	9
Samples (n)	46	46	46	46	46
True value*	703.30	93.80	515.70	937.70	328.20
Mean*	729.	103.	524.	958.	341
Median*	701.	95.2	524	941.	334.
Std. dev.*	251.	36.7	171.	301.	101.
% Coef. var.	34.4	35.7	32.6	31.4	29.7
Skewness	1.61	1.68	0.90	0.89	1.48
Accuracy	-0.27	1.44	1.66	0.39	1.72

*All sample concentrations are in mg NO_x/DSCM.

TABLE 21. METHOD 7 SURVEY 0578 - SUMMARY STATISTICS (OUTLIERS REMOVED)

Parameter	Sample No. 1	2	6	8	9
Samples (n)	43	42	42	42	43
True value*	703.30	93.80	515.70	937.70	328.20
Mean*	674.5	93.0	498.3	916.	319.
Median*	697.	94.2	522.	940.	333.
Std. dev.*	140.	19.3	91.9	162.	56.9
% Coef. var.	20.7	20.8	18.5	17.7	17.9
Skewness	-2.14	0.29	-2.16	-1.28	-2.13
Accuracy	-0.85	0.37	1.12	0.20	1.49

*All sample concentrations are in mg NO_x/DSCM.

TABLE 22. METHOD 7 SURVEY 1078 - SUMMARY STATISTICS

Parameter	Sample No. 1	2	3	5	7
Samples (n)	52	52	52	52	52
True value*	246.50	730.60	880.30	123.20	457.70
Mean*	274.	776.	925.	137.	491.
Median*	257.	764.	910.	129.	481.
Std. dev.*	133.	251.	256.	52.8	161.
% Coef. var.	43.6	32.4	27.7	38.4	32.7
Skewness	3.55	0.98	1.82	3.88	1.76
Accuracy	4.14	4.61	3.33	4.30	5.17

*All sample concentrations are in mg NO_x/DSCM.

TABLE 23. METHOD 7 SURVEY 1078 - SUMMARY STATISTICS (OUTLIERS REMOVED)

Parameter	Sample No. 1	2	3	5	7
Samples (n)	51	50	50	51	49
True value*	246.50	730.60	880.30	123.20	457.70
Mean*	259.	740.	885.	131.	457.
Median*	256.	761.	908.	128.	479.
Std. dev.*	79.1	177.	161.	30.5	87.9
% Coef. var.	30.5	23.9	18.2	23.2	19.2
Skewness	0.34	-1.75	-1.29	1.26	-2.14
Accuracy	3.81	4.21	3.10	3.90	4.57

*All sample concentrations are in mg NO_x/DSCM.

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APPENDIX A
METHOD 5 DGM SUMMARY DATA

INTERLABORATORY STUDY 0578
Pollutant: DGM
Units: Percent Difference
(DATA IN ASCENDING ORDER)

-18.3	-9.5	-7.9	-6.3	-5.2	-4.1	-3.5	-2.1	-.7	1.6
-18.1	-9.2	-7.9	-6.3	-5.2	-4.1	-3.4	-2.1	-.7	1.7
-17.8	-9.2	-7.9	-6.2	-5.1	-4.1	-3.4	-1.9	-.6	1.8
-17.5	-9.2	-7.9	-6.1	-5.1	-4.0	-3.4	-1.7	-.6	1.9
-17.0	-9.2	-7.6	-6.1	-5.1	-3.9	-3.2	-1.5	-.6	2.8
-15.1	-9.1	-7.5	-6.0	-5.0	-3.9	-3.1	-1.5	-.6	2.9
-14.8	-9.1	-7.4	-5.7	-4.9	-3.8	-3.0	-1.4	-.5	2.9
-14.1	-9.0	-7.4	-5.6	-4.7	-3.7	-3.0	-1.4	-.5	3.0
-13.8	-9.0	-7.4	-5.6	-4.6	-3.7	-2.9	-1.3	-.3	4.2
-12.3	-8.8	-7.4	-5.6	-4.5	-3.7	-2.8	-1.2	-.3	5.7
-11.8	-8.8	-7.3	-5.5	-4.5	-3.6	-2.8	-1.1	-.2	6.0
-11.7	-8.7	-7.2	-5.4	-4.4	-3.6	-2.8	-1.0	-.1	6.0
-11.7	-8.6	-7.0	-5.4	-4.3	-3.6	-2.5	-1.0	-.1	6.2
-11.4	-8.6	-7.0	-5.2	-4.3	-3.6	-2.5	-.8	.1	6.5
-11.2	-8.4	-6.9	-5.2	-4.3	-3.6	-2.4	-.8	.3	7.2
-10.7	-8.1	-6.9	-5.2	-4.2	-3.6	-2.3	-.7	.3	83.2
-9.7	-7.9	-6.9	-5.2	-4.2	-3.5	-2.3	-.7	.4	83.6
-9.6	-7.9	-6.8	-5.2	-4.1	-3.5	-2.1	-.7	1.0	86.3

DATA SUMMARY

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
180	-18.3	-9.6	-7.9	-6.8	-5.2	-4.1	-3.5	-2.1	-.7	1.0	86.3	-3.1	12.3
SKEWNESS =	5.86	MEDIAN =		-4.1									

DATA SUMMARY (OUTLIERS REMOVED)

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
172	-15.1	-9.2	-7.9	-6.3	-5.2	-4.1	-3.5	-2.3	-.7	.3	7.2	-4.2	4.2
SKEWNESS =	.29	MEDIAN =		-4.1									

INTERLABORATORY STUDY 1078
Pollutant: DGM
Units: Percent Difference
(DATA IN ASCENDING ORDER)

-27.2	-8.4	-6.1	-5.0	-3.7	-2.9	-2.3	-1.6	-.8	.6
-27.0	-8.7	-6.0	-5.0	-3.6	-2.9	-2.3	-1.6	-.7	.6
-26.9	-7.7	-6.0	-5.0	-3.5	-2.9	-2.3	-1.5	-.7	.6
-12.4	-7.5	-5.9	-4.9	-3.5	-2.8	-2.2	-1.5	-.7	.6
-11.7	-7.4	-5.9	-4.8	-3.5	-2.8	-2.2	-1.5	-.7	1.1
-11.7	-7.4	-5.8	-4.8	-3.4	-2.8	-2.2	-1.4	-.7	1.3
-11.4	-7.2	-5.8	-4.7	-3.4	-2.8	-2.1	-1.4	-.7	1.7
-10.6	-7.2	-5.7	-4.6	-3.4	-2.7	-2.1	-1.4	-.7	1.8
-10.5	-7.2	-5.7	-4.5	-3.4	-2.7	-2.1	-1.3	-.6	1.8
-10.3	-7.2	-5.7	-4.5	-3.3	-2.7	-2.0	-1.3	-.6	2.5
-10.2	-7.1	-5.6	-4.5	-3.3	-2.7	-2.0	-1.3	-.6	2.5
-9.5	-6.9	-5.6	-4.3	-3.2	-2.7	-2.0	-1.2	-.5	2.6
-9.4	-6.8	-5.6	-4.2	-3.2	-2.7	-1.9	-1.1	-.4	3.6
-9.4	-6.7	-5.5	-4.2	-3.2	-2.6	-1.9	-1.1	-.4	3.6
-9.4	-6.7	-5.5	-4.2	-3.1	-2.6	-1.9	-1.1	-.4	3.6
-9.4	-6.6	-5.5	-4.1	-3.1	-2.6	-1.9	-1.1	-.3	3.6
-9.3	-6.6	-5.5	-4.1	-3.0	-2.5	-1.9	-1.1	-.2	3.8
-9.2	-6.5	-5.4	-4.1	-3.0	-2.5	-1.8	-1.1	-.2	4.2
-9.2	-6.5	-5.4	-4.0	-3.0	-2.5	-1.8	-1.1	.0	37.7
-9.2	-6.4	-5.4	-3.9	-3.0	-2.5	-1.8	-1.0	.1	41.0
-9.1	-6.3	-5.3	-3.8	-3.0	-2.5	-1.7	-1.0	.1	45.2
-9.1	-6.3	-5.2	-3.8	-3.0	-2.4	-1.7	-1.0	.1	
-9.0	-6.2	-5.2	-3.8	-3.0	-2.4	-1.7	-.9	.2	
-9.0	-6.2	-5.2	-3.7	-3.0	-2.4	-1.6	-.9	.2	
-9.0	-6.2	-5.2	-3.7	-3.0	-2.4	-1.6	-.8	.2	
-9.0	-6.2	-5.1	-3.7	-2.9	-2.3	-1.6	-.8	.2	

DATA SUMMARY

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
255	-27.2	-9.0	-6.2	-5.2	-3.7	-3.0	-2.4	-1.7	-1.0	.1	45.2	-3.2	6.3
SKEWNESS =	3.44	MEDIAN =		-3.0									

DATA SUMMARY (OUTLIERS REMOVED)

#SAMP	MIN	10%	20%	30%	40%	50%	60%	70%	80%	90%	MAX	MEAN	STDEV
249	-12.4	-8.9	-6.2	-5.2	-3.7	-3.0	-2.4	-1.7	-1.0	.0	4.2	-3.5	3.2
SKEWNESS =	.14	MEDIAN =		-3.0									

APPENDIX B
METHOD 6
SO_2 SUMMARY DATA

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3

N	63	RANGE	770.00	C.I.(UPPER)	693.97
TRUE-VALUE	686.30	VARIANCE	7696.96	C.I.(LOWER)	650.64
MEAN	672.31	STD. DEV.	87.73	SKEWNESS	-6.43
MEDIAN	682.90	COEF. VAR.	13.05	ACCURACY	-.50

DATA IN ASCENDING ORDER

21.20	667.00	679.60	685.50	695.10
573.60	668.10	681.10	686.40	696.00
645.20	672.00	681.20	686.70	696.50
657.40	672.40	681.40	686.90	700.30
657.40	674.90	682.10	688.80	700.50
658.10	675.00	682.90	689.10	701.60
659.00	676.00	683.30	689.20	702.10
660.40	676.20	683.90	689.40	707.30
660.80	676.20	684.00	690.90	711.50
661.00	678.00	684.30	692.60	789.40
662.60	679.00	684.70	692.90	791.20
664.40	679.30	684.80	693.10	
666.00	679.40	685.30	693.20	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3 **** WITH OUTLIERS REMOVED ****

N	62	RANGE	217.60	C.I.(UPPER)	689.68
TRUE-VALUE	686.30	VARIANCE	761.19	C.I.(LOWER)	675.94
MEAN	682.81	STD. DEV.	27.59	SKEWNESS	.83
MEDIAN	683.10	COEF. VAR.	4.04	ACCURACY	-.47

DATA IN ASCENDING ORDER

573.60	668.10	681.10	686.40	696.00
645.20	672.00	681.20	686.70	696.50
657.40	672.40	681.40	686.90	700.30
657.40	674.90	682.10	688.80	700.50
658.10	675.00	682.90	689.10	701.60
659.00	676.00	683.30	689.20	702.10
660.40	676.20	683.90	689.40	707.30
660.80	676.20	684.00	690.90	711.50
661.00	678.00	684.30	692.60	789.40
662.60	679.00	684.70	692.90	791.20
664.40	679.30	684.80	693.10	
666.00	679.40	685.30	693.20	
667.00	679.60	685.50	695.10	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 4

N	63	RANGE	2866.80	C.I.(UPPER)	2505.52
TRUE-VALUE	2478.50	VARIANCE	100799.29	C.I.(LOWE R)	2348.72
MEAN	2427.12	STD. DEV.	317.49	SKEWNESS	-6.36
MEDIAN	2460.70	COEF. VAR.	13.08	ACCURACY	-.72

DATA IN ASCENDING ORDER

76.90	2433.70	2452.60	2467.20	2489.50
2085.20	2434.40	2453.00	2467.60	2499.00
2344.30	2437.00	2455.00	2468.00	2501.40
2355.60	2437.00	2458.40	2470.00	2509.10
2367.00	2437.20	2460.30	2473.90	2509.20
2374.00	2439.00	2460.70	2477.00	2561.60
2374.20	2439.70	2462.00	2477.00	2569.70
2379.70	2442.10	2462.50	2479.30	2580.30
2380.00	2442.40	2463.10	2479.60	2605.40
2385.50	2445.00	2463.30	2483.40	2803.80
2421.30	2451.00	2463.80	2485.00	2943.70
2430.00	2451.80	2464.00	2487.30	
2431.60	2452.00	2465.60	2488.70	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 4 **** WITH OUTLIERS REMOVED ****

N	62	RANGE	858.50	C.I.(UPPER)	2490.46
TRUE-VALUE	2478.50	VARIANCE	10441.51	C.I.(LOWE R)	2439.59
MEAN	2465.03	STD. DEV.	102.18	SKEWNESS	1.40
MEDIAN	2461.35	COEF. VAR.	4.15	ACCURACY	-.69

DATA IN ASCENDING ORDER

2085.20	2434.40	2453.00	2467.60	2499.00
2344.30	2437.00	2455.00	2468.00	2501.40
2355.60	2437.00	2458.40	2470.00	2509.10
2367.00	2437.20	2460.30	2473.90	2509.20
2374.00	2439.00	2460.70	2477.00	2561.60
2374.20	2439.70	2462.00	2477.00	2569.70
2379.70	2442.10	2462.50	2479.30	2580.30
2380.00	2442.40	2463.10	2479.60	2605.40
2385.50	2445.00	2463.30	2483.40	2803.80
2421.30	2451.00	2463.80	2485.00	2943.70
2430.00	2451.80	2464.00	2487.30	
2431.60	2452.00	2465.60	2488.70	
2433.70	2452.60	2467.20	2489.50	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5

N	63	RANGE	1417.40	C.I.(UPPER)	1268.94
TRUE-VALUE	1258.30	VARIANCE	25591.84	C.I.(LOWER)	1189.94
MEAN	1229.44	STD. DEV.	159.97	SKEWNESS	-6.48
MEDIAN	1249.90	COEF. VAR.	13.01	ACCURACY	-.67

DATA IN ASCENDING ORDER

39.00	1227.70	1244.60	1256.00	1266.00
1053.80	1230.30	1245.30	1256.20	1267.00
1170.00	1230.50	1245.70	1256.80	1267.50
1190.10	1235.00	1247.80	1256.90	1268.30
1191.20	1235.40	1249.50	1257.20	1268.80
1192.90	1235.70	1249.90	1259.40	1273.70
1202.90	1239.40	1250.10	1259.80	1278.60
1216.40	1240.00	1250.50	1261.60	1280.00
1218.70	1240.00	1250.70	1262.10	1318.50
1220.00	1240.80	1254.00	1262.80	1421.40
1224.00	1243.60	1254.00	1263.40	1456.40
1225.20	1244.00	1255.00	1263.40	
1225.50	1244.00	1255.60	1264.10	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5 **** WITH OUTLIERS REMOVED ****

N	62	RANGE	402.60	C.I.(UPPER)	1260.85
TRUE-VALUE	1258.30	VARIANCE	2404.77	C.I.(LOWER)	1236.43
MEAN	1248.64	STD. DEV.	49.04	SKEWNESS	.81
MEDIAN	1250.00	COEF. VAR.	3.93	ACCURACY	-.66

DATA IN ASCENDING ORDER

1053.80	1230.30	1245.30	1256.20	1267.00
1170.00	1230.50	1245.70	1256.80	1267.50
1190.10	1235.00	1247.80	1256.90	1268.30
1191.20	1235.40	1249.50	1257.20	1268.80
1192.90	1235.70	1249.90	1259.40	1273.70
1202.90	1239.40	1250.10	1259.80	1278.60
1216.40	1240.00	1250.50	1261.60	1280.00
1218.70	1240.00	1250.70	1262.10	1318.50
1220.00	1240.80	1254.00	1262.80	1421.40
1224.00	1243.60	1254.00	1263.40	1456.40
1225.20	1244.00	1255.00	1263.40	
1225.50	1244.00	1255.60	1264.10	
1227.70	1244.60	1256.00	1266.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7

N	63	RANGE	2137.40	C.I.(UPPER)	1925.70
TRUE-VALUE	1906.00	VARIANCE	58547.23	C.I.(LOWE R)	1806.20
MEAN	1865.95	STD. DEV.	241.97	SKEWNESS	-6.56
MEDIAN	1894.10	COEF. VAR.	12.97	ACCURACY	-.62

DATA IN ASCENDING ORDER

58.60	1871.70	1888.00	1902.00	1921.00
1612.40	1876.10	1890.00	1902.50	1923.00
1787.80	1879.70	1890.90	1904.10	1923.30
1792.00	1879.90	1892.30	1906.50	1936.40
1799.40	1881.40	1892.80	1907.00	1936.60
1820.40	1881.80	1894.10	1907.40	1939.80
1827.10	1882.10	1894.30	1908.30	1942.20
1840.00	1884.30	1895.00	1908.80	1955.20
1851.60	1884.50	1896.60	1908.80	1992.60
1852.80	1884.60	1898.30	1909.80	2143.00
1860.00	1885.10	1899.50	1910.00	2196.00
1868.50	1887.00	1900.70	1914.40	
1870.90	1887.30	1901.50	1915.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7 **** WITH OUTLIERS REMOVED ****

N	62	RANGE	583.60	C.I.(UPPER)	1912.86
TRUE-VALUE	1906.00	VARIANCE	5094.03	C.I.(LOWE R)	1877.33
MEAN	1895.10	STD. DEV.	71.37	SKEWNESS	.76
MEDIAN	1894.20	COEF. VAR.	3.77	ACCURACY	-.62

DATA IN ASCENDING ORDER

1612.40	1876.10	1890.00	1902.50	1923.00
1787.80	1879.70	1890.90	1904.10	1923.30
1792.00	1879.90	1892.30	1906.50	1936.40
1799.40	1881.40	1892.80	1907.00	1936.60
1820.40	1881.80	1894.10	1907.40	1939.80
1827.10	1882.10	1894.30	1908.30	1942.20
1840.00	1884.30	1895.00	1908.80	1955.20
1851.60	1884.50	1896.60	1908.80	1992.60
1852.80	1884.60	1898.30	1909.80	2143.00
1860.00	1885.10	1899.50	1910.00	2196.00
1868.50	1887.00	1900.70	1914.40	
1870.90	1887.30	1901.50	1915.00	
1871.70	1888.00	1902.00	1921.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9 **** WITH OUTLIERS REMOVED ****

N	61	RANGE	65.80	C.I.(UPPER)	196.71
TRUE-VALUE	190.70	VARIANCE	141.13	C.I.(LOWE R)	190.75
MEAN	193.73	STD. DEV.	11.88	SKEWNESS	.58
MEDIAN	191.80	COEF. VAR.	6.13	ACCURACY	.58

DATA IN ASCENDING ORDER

160.70	187.30	190.10	194.00	203.40
165.00	188.00	190.40	194.30	208.60
179.20	188.30	190.60	194.50	211.00
179.20	188.40	191.30	195.30	212.30
182.40	188.40	191.80	196.00	213.50
184.60	188.40	192.00	196.80	219.60
184.90	188.80	192.20	197.60	221.20
185.00	189.00	192.30	197.60	226.00
185.90	189.30	192.40	197.90	226.50
187.00	189.90	193.30	199.90	
187.00	189.90	193.40	200.10	
187.10	190.00	193.50	201.30	
187.10	190.00	193.90	202.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9

N	63	RANGE	295.80	C.I.(UPPER)	199.83
TRUE-VALUE	190.70	VARIANCE	892.24	C.I.(LOWE R)	185.08
MEAN	192.46	STD. DEV.	29.87	SKEWNESS	-3.04
MEDIAN	191.80	COEF. VAR.	15.52	ACCURACY	.58

DATA IN ASCENDING ORDER

5.80	187.10	190.00	193.90	202.00
160.70	187.30	190.10	194.00	203.40
165.00	188.00	190.40	194.30	208.60
179.20	188.30	190.60	194.50	211.00
179.20	188.40	191.30	195.30	212.30
182.40	188.40	191.80	196.00	213.50
184.60	188.40	192.00	196.80	219.60
184.90	188.80	192.20	197.60	221.20
185.00	189.00	192.30	197.60	226.00
185.90	189.30	192.40	197.90	226.50
187.00	189.90	193.30	199.90	301.60
187.00	189.90	193.40	200.10	
187.10	190.00	193.50	201.30	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1

N	69	RANGE	984.30	C.I.(UPPER)	2576.24
TRUE-VALUE	2555.00	VARIANCE	11890.82	C.I.(LOWER)	2524.78
MEAN	2550.51	STD. DEV.	109.05	SKEWNESS	1.64
MEDIAN	2549.50	COEF. VAR.	4.28	ACCURACY	-.22

DATA IN ASCENDING ORDER

2170.70	2512.50	2539.70	2565.00	2595.00
2289.70	2514.30	2542.80	2565.90	2605.80
2385.10	2514.70	2543.00	2568.40	2628.00
2426.90	2515.20	2544.20	2569.70	2630.00
2428.70	2518.00	2547.80	2571.40	2630.20
2440.40	2519.00	2548.50	2572.10	2633.00
2452.80	2522.90	2549.50	2573.40	2640.20
2455.90	2525.00	2550.00	2574.60	2645.00
2486.10	2527.50	2552.40	2575.00	2654.00
2489.00	2528.50	2554.90	2577.50	2654.60
2503.70	2532.20	2555.80	2577.70	2684.40
2503.70	2533.00	2559.40	2583.00	2687.80
2505.20	2533.60	2559.80	2587.00	3155.00
2509.00	2537.00	2560.70	2592.60	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	398.10	C.I.(UPPER)	2563.25
TRUE-VALUE	2555.00	VARIANCE	4517.52	C.I.(LOWER)	2531.06
MEAN	2547.15	STD. DEV.	67.21	SKEWNESS	-.78
MEDIAN	2549.50	COEF. VAR.	2.64	ACCURACY	-.22

DATA IN ASCENDING ORDER

2289.70	2514.30	2542.80	2565.90	2605.80
2385.10	2514.70	2543.00	2568.40	2628.00
2426.90	2515.20	2544.20	2569.70	2630.00
2428.70	2518.00	2547.80	2571.40	2630.20
2440.40	2519.00	2548.50	2572.10	2633.00
2452.80	2522.90	2549.50	2573.40	2640.20
2455.90	2525.00	2550.00	2574.60	2645.00
2486.10	2527.50	2552.40	2575.00	2654.00
2489.00	2528.50	2554.90	2577.50	2654.60
2503.70	2532.20	2555.80	2577.70	2684.40
2503.70	2533.00	2559.40	2583.00	2687.80
2505.20	2533.60	2559.80	2587.00	
2509.00	2537.00	2560.70	2592.60	
2512.50	2539.70	2565.00	2595.00	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3

N	69	RANGE	523.70	C.I.(UPPER)	1345.67
TRUE-VALUE	1335.00	VARIANCE	3255.68	C.I.(LOWER)	1318.75
MEAN	1332.21	STD. DEV.	57.06	SKEWNESS	1.66
MEDIAN	1328.70	COEF. VAR.	4.28	ACCURACY	-.47

DATA IN ASCENDING ORDER

1123.10	1314.00	1323.20	1338.40	1357.00
1216.30	1314.60	1323.40	1340.00	1360.80
1264.50	1315.00	1324.20	1340.20	1362.00
1270.90	1316.00	1324.80	1340.60	1369.10
1272.40	1316.90	1325.40	1342.00	1372.50
1275.30	1317.40	1326.00	1342.20	1376.00
1277.40	1319.00	1328.70	1342.20	1379.00
1288.80	1319.00	1331.20	1342.80	1381.00
1294.20	1319.40	1333.60	1344.00	1389.40
1295.20	1319.90	1336.70	1346.00	1398.80
1297.90	1320.70	1336.70	1346.60	1400.90
1300.00	1321.20	1337.70	1348.30	1430.00
1310.50	1321.60	1338.00	1350.90	1646.80
1311.00	1322.80	1338.30	1352.00	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	213.70	C.I.(UPPER)	1338.89
TRUE-VALUE	1335.00	VARIANCE	1189.77	C.I.(LOWER)	1322.37
MEAN	1330.63	STD. DEV.	34.49	SKEWNESS	-.13
MEDIAN	1328.70	COEF. VAR.	2.59	ACCURACY	-.47

DATA IN ASCENDING ORDER

1216.30	1314.60	1323.40	1340.00	1360.80
1264.50	1315.00	1324.20	1340.20	1362.00
1270.90	1316.00	1324.80	1340.60	1369.10
1272.40	1316.90	1325.40	1342.00	1372.50
1275.30	1317.40	1326.00	1342.20	1376.00
1277.40	1319.00	1328.70	1342.20	1379.00
1288.80	1319.00	1331.20	1342.80	1381.00
1294.20	1319.40	1333.60	1344.00	1389.40
1295.20	1319.90	1336.70	1346.00	1398.80
1297.90	1320.70	1336.70	1346.60	1400.90
1300.00	1321.20	1337.70	1348.30	1430.00
1310.50	1321.60	1338.00	1350.90	
1311.00	1322.80	1338.30	1352.00	
1314.00	1323.20	1338.40	1357.00	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5

N	68	RANGE	5244.10	C.I.(UPPER)	787.94
TRUE-VALUE	572.00	VARIANCE	363461.84	C.I.(LOWER)	501.35
MEAN	644.64	STD. DEV.	602.88	SKEWNESS	7.83
MEDIAN	572.55	COEF. VAR.	93.52	ACCURACY	.10

DATA IN ASCENDING ORDER

286.90	561.90	569.40	576.60	591.80
529.20	562.00	569.70	577.00	592.00
537.60	562.10	570.30	577.70	596.00
547.00	565.00	570.40	577.90	598.00
549.10	565.00	570.50	579.60	599.30
549.10	565.20	572.00	580.30	601.10
552.00	566.20	573.10	583.40	608.70
553.10	566.60	574.10	584.10	611.00
556.70	566.90	574.90	584.80	611.50
556.70	568.00	575.10	586.00	639.80
557.20	568.00	575.20	586.00	698.50
558.40	568.30	576.00	586.00	5531.00
560.00	569.00	576.20	587.80	
560.50	569.00	576.30	589.80	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	411.60	C.I.(UPPER)	581.88
TRUE-VALUE	572.00	VARIANCE	1804.16	C.I.(LOWER)	561.54
MEAN	571.71	STD. DEV.	42.48	SKEWNESS	-4.02
MEDIAN	572.00	COEF. VAR.	7.43	ACCURACY	.00

DATA IN ASCENDING ORDER

286.90	561.90	569.40	576.60	591.80
529.20	562.00	569.70	577.00	592.00
537.60	562.10	570.30	577.70	596.00
547.00	565.00	570.40	577.90	598.00
549.10	565.00	570.50	579.60	599.30
549.10	565.20	572.00	580.30	601.10
552.00	566.20	573.10	583.40	608.70
553.10	566.60	574.10	584.10	611.00
556.70	566.90	574.90	584.80	611.50
556.70	568.00	575.10	586.00	639.80
557.20	568.00	575.20	586.00	698.50
558.40	568.30	576.00	586.00	
560.00	569.00	576.20	587.80	
560.50	569.00	576.30	589.80	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6

N	69	RANGE	112.20	C.I.(UPPER)	161.83
TRUE-VALUE	152.50	VARIANCE	223.96	C.I.(LOWER)	154.76
MEAN	158.29	STD. DEV.	14.97	SKEWNESS	1.13
MEDIAN	156.00	COEF. VAR.	9.45	ACCURACY	2.30

DATA IN ASCENDING ORDER

114.80	151.30	154.50	158.50	164.80
120.00	151.70	154.90	159.00	167.70
136.00	152.50	155.30	159.10	167.80
142.60	152.50	155.60	159.20	173.70
143.20	153.00	156.00	159.30	175.60
144.90	153.00	156.00	159.50	176.40
145.60	153.00	156.00	160.00	178.10
147.10	153.90	156.00	160.40	179.00
147.60	153.90	156.20	160.80	181.00
148.70	154.00	156.90	161.40	183.00
149.50	154.10	157.00	163.00	183.00
149.50	154.10	157.10	163.00	189.70
149.50	154.40	158.50	163.90	227.00
150.40	154.40	158.50	164.70	

INTER-LABORATORY STUDY 1078

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	69.70	C.I.(UPPER)	160.65
TRUE-VALUE	152.50	VARIANCE	130.42	C.I.(LOWER)	155.18
MEAN	157.92	STD. DEV.	11.42	SKEWNESS	.30
MEDIAN	156.00	COEF. VAR.	7.23	ACCURACY	2.30

DATA IN ASCENDING ORDER

120.00	151.70	154.90	159.00	167.70
136.00	152.50	155.30	159.10	167.80
142.60	152.50	155.60	159.20	173.70
143.20	153.00	156.00	159.30	175.60
144.90	153.00	156.00	159.50	176.40
145.60	153.00	156.00	160.00	178.10
147.10	153.90	156.00	160.40	179.00
147.60	153.90	156.20	160.80	181.00
148.70	154.00	156.90	161.40	183.00
149.50	154.10	157.00	163.00	183.00
149.50	154.10	157.10	163.00	189.70
149.50	154.40	158.50	163.90	
150.40	154.40	158.50	164.70	
151.30	154.50	158.50	164.80	

INTER-LABORATORY STUDY 1C78

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9

N	69	RANGE	1251.40	C.I.(UPPER)	1768.56
TRUE-VALUE	1754.00	VARIANCE	17395.91	C.I.(LOWE R)	1706.32
MEAN	1737.44	STD. DEV.	131.89	SKEWNESS	-3.23
MEDIAN	1751.50	COEF. VAR.	7.59	ACCURACY	-.14

DATA IN ASCENDING ORDER

910.00	1709.50	1741.40	1762.60	1790.00
1447.70	1717.00	1743.00	1763.10	1790.00
1515.50	1717.60	1745.90	1763.40	1795.00
1599.90	1718.30	1748.60	1763.50	1796.00
1632.00	1726.00	1749.90	1764.20	1798.00
1667.40	1728.00	1751.00	1765.00	1808.50
1677.70	1731.60	1751.50	1766.00	1814.60
1680.90	1732.00	1754.00	1767.10	1816.00
1699.80	1733.80	1754.90	1767.90	1817.70
1700.60	1734.30	1756.50	1767.90	1840.30
1701.40	1736.00	1758.00	1768.00	1845.50
1707.60	1737.30	1758.00	1768.00	1975.00
1708.10	1740.80	1759.00	1770.50	2161.40
1709.00	1740.80	1761.90	1784.00	

INTER-LABORATORY STUDY 1C78

POLLUTANT - SO2 UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9 **** WITH OUTLIERS REMOVED ****

N	67	RANGE	527.30	C.I.(UPPER)	1760.03
TRUE-VALUE	1754.00	VARIANCE	4789.27	C.I.(LOWE R)	1726.89
MEAN	1743.46	STD. DEV.	69.20	SKEWNESS	-1.21
MEDIAN	1751.50	COEF. VAR.	3.97	ACCURACY	-.14

DATA IN ASCENDING ORDER

1447.70	1717.00	1743.00	1763.10	1790.00
1515.50	1717.60	1745.90	1763.40	1795.00
1599.90	1718.30	1748.60	1763.50	1796.00
1632.00	1726.00	1749.90	1764.20	1798.00
1667.40	1728.00	1751.00	1765.00	1808.50
1677.70	1731.60	1751.50	1766.00	1814.60
1680.90	1732.00	1754.00	1767.10	1816.00
1699.80	1733.80	1754.90	1767.90	1817.70
1700.60	1734.30	1756.50	1767.90	1840.30
1701.40	1736.00	1758.00	1768.00	1845.50
1707.60	1737.30	1758.00	1768.00	1975.00
1708.10	1740.80	1759.00	1770.50	
1709.00	1740.80	1761.90	1784.00	
1709.50	1741.40	1762.60	1790.00	

APPENDIX C
METHOD 7
NO_X SUMMARY DATA

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1

N	46	RANGE	1577.10	C.I.(UPPER)	801.31
TRUE-VALUE	703.30	VARIANCE	62760.93	C.I.(LOWER)	656.52
MEAN	728.91	STD. DEV.	250.52	SKEWNESS	1.61
MEDIAN	701.40	COEF. VAR.	34.37	ACCURACY	-.27

DATA IN ASCENDING ORDER

123.30	660.80	693.00	732.00	855.30
239.40	668.30	697.30	733.50	865.50
381.90	669.80	701.40	740.00	878.00
533.00	675.00	701.40	741.70	1406.90
565.00	675.60	708.50	741.80	1418.80
590.60	677.50	712.10	746.00	1700.40
639.00	678.60	713.80	746.40	
640.00	682.00	716.00	764.40	
645.00	686.30	718.20	769.00	
655.00	690.00	718.80	833.70	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1 **** WITH OUTLIERS REMOVED ****

N	43	RANGE	754.70	C.I.(UPPER)	716.21
TRUE-VALUE	703.30	VARIANCE	19466.06	C.I.(LOWER)	632.81
MEAN	674.51	STD. DEV.	139.52	SKEWNESS	-2.14
MEDIAN	697.30	COEF. VAR.	20.68	ACCURACY	-.85

DATA IN ASCENDING ORDER

123.30	655.00	686.30	716.00	746.40
239.40	660.80	690.00	718.20	764.40
381.90	668.30	693.00	718.80	769.00
533.00	669.80	697.30	732.00	833.70
565.00	675.00	701.40	733.50	855.30
590.60	675.60	701.40	740.00	865.50
639.00	677.50	708.50	741.70	878.00
640.00	678.60	712.10	741.80	
645.00	682.00	713.80	746.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2

N	46	RANGE	177.00	C.I.(UPPER)	113.29
TRUE-VALUE	93.80	VARIANCE	1343.66	C.I.(LOWER)	92.10
MEAN	102.70	STD. DEV.	36.66	SKEWNESS	1.68
MEDIAN	95.15	COEF. VAR.	35.69	ACCURACY	1.44

DATA IN ASCENDING ORDER

32.20	88.00	93.60	99.50	115.50
45.50	88.50	94.70	100.00	168.00
71.40	91.00	95.10	100.80	195.30
72.90	91.00	95.20	102.00	204.00
73.60	91.30	95.30	102.00	207.80
80.00	92.00	95.30	102.80	209.20
82.50	92.30	95.60	104.80	
85.10	92.80	96.80	105.00	
85.30	92.80	97.50	110.50	
86.00	93.10	97.50	113.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2 **** WITH OUTLIERS REMOVED ****

N	42	RANGE	135.80	C.I.(UPPER)	98.89
TRUE-VALUE	93.80	VARIANCE	373.73	C.I.(LOWER)	87.20
MEAN	93.04	STD. DEV.	19.33	SKEWNESS	.29
MEDIAN	94.15	COEF. VAR.	20.78	ACCURACY	.37

DATA IN ASCENDING ORDER

32.20	86.00	92.80	96.80	104.80
45.50	88.00	93.10	97.50	105.00
71.40	88.50	93.60	97.50	110.50
72.90	91.00	94.70	99.50	113.00
73.60	91.00	95.10	100.00	115.50
80.00	91.30	95.20	100.80	168.00
82.50	92.00	95.30	102.00	
85.10	92.30	95.30	102.00	
85.30	92.80	95.60	102.80	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6

N	46	RANGE	971.90	C.I.(UPPER)	573.10
TRUE-VALUE	515.70	VARIANCE	29195.07	C.I.(LOWER)	474.35
MEAN	523.73	STD. DEV.	170.87	SKEWNESS	.90
MEDIAN	524.25	COEF. VAR.	32.63	ACCURACY	1.66

DATA IN ASCENDING ORDER

93.60	496.50	520.00	541.40	576.00
184.10	499.00	520.00	541.80	585.80
246.70	499.00	523.00	545.90	589.50
256.00	501.30	525.50	548.00	959.00
262.40	505.20	529.00	548.60	1045.50
429.60	507.20	529.00	555.00	1065.50
479.00	508.30	529.70	558.00	
480.00	508.80	534.00	563.50	
482.10	510.00	535.00	564.00	
484.10	515.30	537.20	573.30	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 6 **** WITH OUTLIERS REMOVED ****

N	42	RANGE	405.40	C.I.(UPPER)	526.08
TRUE-VALUE	515.70	VARIANCE	8447.47	C.I.(LOWER)	470.48
MEAN	498.28	STD. DEV.	91.91	SKEWNESS	-2.16
MEDIAN	521.50	COEF. VAR.	18.45	ACCURACY	1.12

DATA IN ASCENDING ORDER

184.10	496.50	515.30	535.00	563.50
246.70	499.00	520.00	537.20	564.00
256.00	499.00	520.00	541.40	573.30
262.40	501.30	523.00	541.80	576.00
429.60	505.20	525.50	545.90	585.80
479.00	507.20	529.00	548.00	589.50
480.00	508.30	529.00	548.60	
482.10	508.80	529.70	555.00	
484.10	510.00	534.00	558.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8

N	46	RANGE	1726.50	C.I.(UPPER)	1045.47
TRUE-VALUE	937.70	VARIANCE	90641.87	C.I.(LOWE R)	871.46
MEAN	958.46	STD. DEV.	301.07	SKEWNESS	.89
MEDIAN	941.40	COEF. VAR.	31.41	ACCURACY	.39

DATA IN ASCENDING ORDER

156.20	862.40	927.80	983.00	1137.60
340.60	866.20	938.20	989.40	1184.80
472.80	872.00	941.00	1000.00	1218.20
674.00	875.00	941.80	1002.50	1717.40
715.00	890.00	942.00	1007.80	1879.30
763.70	909.00	946.00	1037.00	1882.70
765.00	915.00	955.50	1039.50	
790.60	915.70	963.30	1040.00	
812.00	916.00	967.00	1048.40	
861.20	925.60	968.00	1133.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 8 **** WITH OUTLIERS REMOVED ****

N	42	RANGE	877.60	C.I.(UPPER)	964.64
TRUE-VALUE	937.70	VARIANCE	26336.99	C.I.(LOWE R)	866.48
MEAN	915.56	STD. DEV.	162.29	SKEWNESS	-1.28
MEDIAN	939.60	COEF. VAR.	17.73	ACCURACY	.20

DATA IN ASCENDING ORDER

340.60	862.40	925.60	967.00	1040.00
472.80	866.20	927.80	968.00	1048.40
674.00	872.00	938.20	983.00	1133.00
715.00	875.00	941.00	989.40	1137.60
763.70	890.00	941.80	1000.00	1184.80
765.00	909.00	942.00	1002.50	1218.20
790.60	915.00	946.00	1007.80	
812.00	915.70	955.50	1037.00	
861.20	916.00	963.30	1039.50	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9

N	46	RANGE	564.50	C.I.(UPPER)	369.92
TRUE-VALUE	328.20	VARIANCE	10228.06	C.I.(LOWER)	311.47
MEAN	340.70	STD. DEV.	101.13	SKEWNESS	1.48
MEDIAN	333.85	COEF. VAR.	29.68	ACCURACY	1.72

DATA IN ASCENDING ORDER

115.10	320.00	330.00	340.50	377.00
138.30	321.00	333.10	341.70	389.30
167.60	322.00	333.60	343.00	392.00
246.50	322.50	334.10	347.50	646.20
275.60	323.10	335.20	351.00	649.10
280.90	325.10	336.00	353.00	679.60
285.60	325.50	337.00	353.10	
294.00	326.40	337.10	362.10	
303.00	327.00	337.60	362.60	
319.90	328.60	340.00	363.00	

INTER-LABORATORY STUDY 0578

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 9 **** WITH OUTLIERS REMOVED ****

N	43	RANGE	276.90	C.I.(UPPER)	335.54
TRUE-VALUE	328.20	VARIANCE	3234.58	C.I.(LOWER)	301.54
MEAN	318.54	STD. DEV.	56.87	SKEWNESS	-2.13
MEDIAN	333.10	COEF. VAR.	17.85	ACCURACY	1.49

DATA IN ASCENDING ORDER

115.10	319.90	327.00	337.10	353.10
138.30	320.00	328.60	337.60	362.10
167.60	321.00	330.00	340.00	362.60
246.50	322.00	333.10	340.50	363.00
275.60	322.50	333.60	341.70	377.00
280.90	323.10	334.10	343.00	389.30
285.60	325.10	335.20	347.50	392.00
294.00	325.50	336.00	351.00	
303.00	326.40	337.00	353.00	

INTER-LABORATORY STUDY 1C78

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1

N	52	RANGE	1020.90	C.I.(UPPER)	310.21
TRUE-VALUE	246.50	VARIANCE	17719.72	C.I.(LOWER)	237.85
MEAN	274.03	STD. DEV.	133.12	SKEWNESS	3.55
MEDIAN	256.70	COEF. VAR.	48.58	ACCURACY	4.14

DATA IN ASCENDING ORDER

14.60	243.70	254.00	265.00	296.70
28.80	244.60	254.60	265.80	313.20
88.30	245.00	255.40	266.00	316.30
210.00	245.90	255.90	269.10	317.80
225.00	247.00	257.50	270.00	381.00
233.00	248.00	257.70	274.30	439.00
233.10	250.00	258.00	274.80	577.50
233.80	250.20	261.60	276.50	1035.50
238.80	250.80	263.00	280.00	
239.00	252.70	264.00	280.00	
243.60	253.50	264.90	285.00	

INTER-LABORATORY STUDY 1C78

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 1 **** WITH OUTLIERS REMOVED ****

N	51	RANGE	562.90	C.I.(UPPER)	280.80
TRUE-VALUE	246.50	VARIANCE	6249.96	C.I.(LOWER)	237.40
MEAN	259.10	STD. DEV.	79.06	SKEWNESS	.34
MEDIAN	255.90	COEF. VAR.	30.51	ACCURACY	3.81

DATA IN ASCENDING ORDER

14.60	243.70	254.00	265.00	296.70
28.80	244.60	254.60	265.80	313.20
88.30	245.00	255.40	266.00	316.30
210.00	245.90	255.90	269.10	317.80
225.00	247.00	257.50	270.00	381.00
233.00	248.00	257.70	274.30	439.00
233.10	250.00	258.00	274.80	577.50
233.80	250.20	261.60	276.50	
238.80	250.80	263.00	280.00	
239.00	252.70	264.00	280.00	
243.60	253.50	264.90	285.00	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2

N	52	RANGE	1581.60	C.I.(UPPER)	843.73
TRUE-VALUE	730.60	VARIANCE	62999.04	C.I.(LOWER)	707.29
MEAN	775.51	STD. DEV.	251.00	SKEWNESS	.98
MEDIAN	764.30	COEF. VAR.	32.37	ACCURACY	4.61

DATA IN ASCENDING ORDER

107.00	694.00	757.90	793.80	859.40
124.60	701.50	758.00	797.00	878.00
268.70	712.00	759.70	798.00	920.20
546.60	712.50	763.00	798.20	933.70
625.00	717.60	765.60	802.70	1075.80
664.00	720.60	768.00	822.30	1118.30
673.50	723.20	770.60	827.90	1662.50
676.70	726.50	775.00	828.00	1688.60
680.00	741.20	780.00	831.80	
684.90	751.70	783.60	856.60	
693.00	757.40	792.10	858.00	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 2 **** WITH OUTLIERS REMOVED ****

N	50	RANGE	1011.30	C.I.(UPPER)	788.45
TRUE-VALUE	730.60	VARIANCE	31177.00	C.I.(LOWER)	690.57
MEAN	739.51	STD. DEV.	176.57	SKEWNESS	-1.75
MEDIAN	761.35	COEF. VAR.	23.88	ACCURACY	4.21

DATA IN ASCENDING ORDER

107.00	694.00	757.90	793.80	859.40
124.60	701.50	758.00	797.00	878.00
268.70	712.00	759.70	798.00	920.20
546.60	712.50	763.00	798.20	933.70
625.00	717.60	765.60	802.70	1075.80
664.00	720.80	768.00	822.30	1118.30
673.50	723.20	770.60	827.90	
676.70	726.50	775.00	828.00	
680.00	741.20	780.00	831.80	
684.90	751.70	783.60	856.60	
693.00	757.40	792.10	858.00	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3

N	52	RANGE	1728.30	C.I.(UPPER)	994.41
TRUE-VALUE	880.30	VARIANCE	55544.85	C.I.(LOWER)	855.23
MEAN	924.82	STD. DEV.	256.02	SKEWNESS	1.82
MEDIAN	909.60	COEF. VAR.	27.68	ACCURACY	3.33

DATA IN ASCENDING ORDER

298.00	835.50	898.20	920.50	1045.00
370.40	836.30	900.90	932.30	1060.10
593.50	849.00	906.10	936.00	1060.80
687.00	855.50	909.00	950.00	1089.30
718.70	858.00	910.20	953.80	1202.80
755.00	863.90	911.00	960.60	1246.00
773.00	867.50	911.70	981.10	1805.00
795.00	869.60	912.70	990.00	2026.30
798.80	872.80	918.00	997.00	
803.00	875.50	918.50	1000.00	
833.00	893.80	919.80	1015.20	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 3 **** WITH OUTLIERS REMOVED ****

N	50	RANGE	948.00	C.I.(UPPER)	929.92
TRUE-VALUE	880.30	VARIANCE	26046.47	C.I.(LOWER)	840.45
MEAN	885.19	STD. DEV.	161.39	SKEWNESS	-1.29
MEDIAN	907.55	COEF. VAR.	18.23	ACCURACY	3.10

DATA IN ASCENDING ORDER

298.00	835.50	898.20	920.50	1045.00
370.40	836.30	900.90	932.30	1060.10
593.50	849.00	906.10	936.00	1060.80
687.00	855.50	909.00	950.00	1089.30
718.70	858.00	910.20	953.80	1202.80
755.00	863.90	911.00	960.60	1246.00
773.00	867.50	911.70	981.10	
795.00	869.60	912.70	990.00	
798.80	872.80	918.00	997.00	
803.00	875.50	918.50	1000.00	
833.00	893.80	919.80	1015.20	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5

N	52	RANGE	413.30	C.I.(UPPER)	151.77
TRUE-VALUE	123.20	VARIANCE	2787.77	C.I.(LOWER)	123.07
MEAN	137.42	STD. DEV.	52.80	SKEWNESS	3.88
MEDIAN	128.50	COEF. VAR.	38.42	ACCURACY	4.30

DATA IN ASCENDING ORDER

30.50	119.50	127.00	133.00	151.00
90.50	121.90	127.50	135.00	153.50
95.60	122.00	128.00	136.00	155.30
105.60	122.50	128.00	138.00	156.00
108.00	123.50	129.00	140.90	165.00
109.20	123.80	130.00	141.30	219.50
111.20	123.90	130.00	141.40	262.50
111.50	124.90	130.50	144.10	443.80
113.90	125.00	130.80	145.00	
115.10	125.50	132.00	145.50	
117.30	126.40	132.70	146.30	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 5 **** WITH OUTLIERS REMOVED ****

N	51	RANGE	232.00	C.I.(UPPER)	139.78
TRUE-VALUE	123.20	VARIANCE	929.36	C.I.(LOWER)	123.05
MEAN	131.41	STD. DEV.	30.49	SKEWNESS	1.26
MEDIAN	128.00	COEF. VAR.	23.20	ACCURACY	3.90

DATA IN ASCENDING ORDER

30.50	119.50	127.00	133.00	151.00
90.50	121.90	127.50	135.00	153.50
95.60	122.00	128.00	136.00	155.30
105.60	122.50	128.00	138.00	156.00
108.00	123.50	129.00	140.90	165.00
109.20	123.80	130.00	141.30	219.50
111.20	123.90	130.00	141.40	262.50
111.50	124.90	130.50	144.10	
113.90	125.00	130.80	145.00	
115.10	125.50	132.00	145.50	
117.30	126.40	132.70	146.30	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7

N	52	RANGE	952.40	C.I.(UPPER)	534.20
TRUE-VALUE	457.70	VARIANCE	25784.07	C.I.(LOWER)	446.91
MEAN	490.56	STD. DEV.	160.57	SKEWNESS	1.76
MEDIAN	481.35	COEF. VAR.	32.73	ACCURACY	5.17

DATA IN ASCENDING ORDER

125.10	445.00	474.00	497.00	523.90
139.90	448.00	475.40	499.20	530.10
305.50	455.90	478.60	500.00	537.00
313.40	456.50	479.30	502.70	552.80
337.50	459.20	483.40	503.00	598.70
379.20	463.40	484.00	507.10	976.40
394.40	465.50	486.00	513.00	1046.90
400.00	466.80	486.00	515.00	1077.50
420.50	468.50	490.30	517.30	
421.50	472.80	492.60	521.20	
430.00	473.00	496.80	522.10	

INTER-LABORATORY STUDY 1078

POLLUTANT - NOX UNITS - MILLIGRAMS PER DRY STD CUBIC METER

SAMPLE NUMBER - 7 **** WITH OUTLIERS REMOVED ****

N	49	RANGE	473.60	C.I.(UPPER)	481.92
TRUE-VALUE	457.70	VARIANCE	7724.08	C.I.(LOWER)	432.70
MEAN	457.31	STD. DEV.	87.89	SKEWNESS	-2.14
MEDIAN	478.60	COEF. VAR.	19.22	ACCURACY	4.57

DATA IN ASCENDING ORDER

125.10	430.00	472.80	490.30	515.00
139.90	445.00	473.00	492.60	517.30
305.50	448.00	474.00	496.80	521.20
313.40	455.90	475.40	497.00	522.10
337.50	456.50	478.60	499.20	523.90
379.20	459.20	479.30	500.00	530.10
394.40	463.40	483.40	502.70	537.00
400.00	465.50	484.00	503.00	552.80
420.50	466.80	486.00	507.10	598.70
421.50	468.50	486.00	513.00	

TECHNICAL REPORT DATA

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15 SUPPLEMENTARY NOTES

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16 ABSTRACT

A national survey of methods in stationary source tests was conducted in 1978 by the Quality Assurance Division of the Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. In this program, quality assurance samples were sent to interested participants for the measurement of a gas volume (Method 5, dry gas meter only) or the analysis of liquid samples simulating collected sulfur dioxide and nitrogen oxides (Method 6 and 7, respectively). Each participant returned the analytical results to the Source Branch, Quality Assurance Division, for evaluation. An individual report was returned to each participant after processing.

This report summarizes the survey results for those three source test methods.

17 KEY WORDS AND DOCUMENT ANALYSIS

a DESCRIPTORS	b IDENTIFIERS/OPEN ENDED TERMS	c COSATI Field/Group
Performance survey Reference methods	EPA Source Method 5 EPA Source Method 6 EPA Source Method 7 Sulfur dioxide Nitrogen dioxide	43F 68A

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