NONMETHANE ORGANIC COMPOUNDS MONITORING ASSISTANCE FOR CERTAIN STATES IN EPA REGIONS III, IV, V, VI, AND VII PHASE II

Final Project Report

RADIAN CORPORATION

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1.0 SUMMARY

1.1 INTRODUCTION

An average of 62 ambient air samples were collected in stainless steel canisters at each of 22 sites between June and September, 1984. These samples were analyzed for nonmethane organic compounds by the Radian Corporation under EPA contract. Analysis was made with a cryogenic preconcentration, direct flame ionization detection (FID) method,* using one of four identical analytical systems operated simultaneously. Table 1-1 identifies the sampling sites, sampling dates, and the mean and maximum NMOC concentration for each site.

Section 2.0 presents the complete validated NMOC and sample data in tabular and graphical form. Information on invalidated data and missing samples are given at each site. Section 3.0 gives technical notes on the operation of the NMOC sampling and analysis equipment as well as specific equations for making daily calibration and analysis calculations.

Section 4.0 provides the details of the quality assurance/quality control data analysis and summarizes data quality. Topics covered in Section 4 include the quality of the instrument calibration and drift measurements, the NMOC completeness measurements, and NMOC precision and accuracy measures.

Section 5.0 presents the NMOC frequency analysis data graphically for all the sites combined and for each site separately. The NMOC data analysis includes investigating the nature of its potential autocorrelation.

Section 6.0 presents recommendations for additional study of the 1985 NMOC data. For future studies recommendations are also given for changes in the sampling equipment design, in the experimental design, and in the data analysis.

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*Method description available from the Measurement Standardization Branch, Quality Assurance Division, (MD-77), EPA, Research Triangle Park, NC 27711.

Table 1-1. Project Site Summary

Site Location	Site Code	First Possible Sampling Date	Final Possible Sampling Date	Total No. Possible Sampling Days	Total No. Duplicates	No. Valid Samples	Percent Complete	NMOC, ppmC Mean	NMOC, ppmC Max
Akron, Ohio	AKOH	6/27/84	9/28/84	68	3	68	96	0.79	2.95
Atlanta, Georgia	ATGA	7/11/84	9/28/84	58	3	55	90	0.79	4.27
Beaumont, Texas	BMTX	6/18/84	9/28/84	75	2	66	86	0.89	3.84
Birmingham, Alabama	BAL	7/11/84	9/28/84	58	1	56	95	0.99	2.91
Charlotte, North Carolina	CHNC	7/11/84	9/28/84	58	4	60	97	0.54	2.52
Chattanooga, Tennessee	CHTN	7/11/84	9/28/84	58	2	46	77	1.34	4.08
Cincinnati, Ohio	CNOH	6/27/84	9/28/84	68	1	65	94	0.93	3.93
Clute, Texas	CLTX	6/18/84	9/28/84	75	5	72	90	0.82	4.31
Dallas, Texas	DLTX	6/18/84	9/28/84	75	4	74	94	0.97	2.57
El Paso, Texas	ELTX	6/18/84	9/28/84	75	4	69	87	0.93	2.45
Fort Worth, Texas	FWTX	6/18/84	9/28/84	75	3	69	88	0.97	3.81
Indianapolis, Indiana	ININ	7/11/84	9/28/84	58	3	59	97	0.80	2.50
Kansas City, Missouri	KCMO	6/27/84	9/28/84	68	2	68	97	0.79	2.76
Memphis, Tennessee	MTN	7/11/84	9/28/84	58	1	52	88	1.43	4.75
Miami, Florida	MIFL	8/13/84	9/28/84	35	3	31	82	1.32	3.70
Philadelphia, Pennsylvania	PHPA	6/27/84	9/28/84	68	2	63	90	1.02	3.10
Richmond, Virginia	RVA	6/27/84	9/28/84	68	1	64	93	0.53	1.22
Texas City, Texas	TCTX	6/18/84	9/28/84	75	4	69	87	0.92	4.74
Washington, D.C.	WDC	6/27/84	9/28/84	68	3	63	89	0.81	2.93
West Orange, Texas	ORTX	6/18/84	9/28/84	75	3	71	91	0.69	3.35
West Palm Beach, Florida	WPFL	6/18/84	9/28/84	75	2	72	94	0.54	2.63
Wilkes-Barre/Scranton, PA	WBPA	6/27/84	9/28/84	68	2	63	90	0.45	0.96
	TOTAL:			1459	58	1375			
	OVERALL AVERAGE:					62.5	90.6	0.853	

1.2 DESCRIPTION OF OVERALL DATA QUALITY

1.2.1 Completeness

The completeness of sampling at the various sites ranged from 77% to 97%. Valid samples numbering 1,375 (including 58 duplicate samples) were analyzed, for an overall completeness of 90.6%. Completeness was defined as the number of valid samples divided by the total number of projected or planned samples at a given site. Table 1-1 itemizes the completeness data for each site, and for the overall project.

1.2.2 Calibration

Each analytical system was calibrated each day before samples were analyzed, using propane standards referenced to NBS propane SRM No. 1665b.

An instrument zero was determined with cleaned, dry air at the beginning of the day and at the end of the day. The zero drift, defined as the final zero reading minus the initial zero reading, ranged from -0.016 ppmC to +0.013 ppmC averaging -0.0002 ppmC. The operator's limit of estimation of ppmC for the instrument was about 0.001 ppmC.

A daily calibration check following completion of the day's sample analyses was used to monitor calibration drift during the day. Calibration drift was calculated as the daily calibration check minus the initial daily calibration value, and was calculated in terms of percent of the initial calibration reading. The percent drift of the calibration reading ranged from -10% to 14%, averaging about 1.5% of the initial calibration span.

1.2.3 Analytical Precision

Analytical precision was assessed from the differences obtained from 531 repeated analyses. For a given channel pair, several measures of precision are given in Table 1-2. The table also gives the pooled results for all 24 channel pairs.

Table 1-2. Measures of Precision for Channel Pairs

	Min.	Max.	Pooled Mean
Mean Difference, ppmC	-0.1904	0.2600	0.0398
% Mean Difference	-21.0	14.4	8.48[a]
Standard Deviation of Differences, ppmC	0.0000	0.2114	0.1605
% CV (% RSD)	0.00	22.2	16.5

[a]Pooled % mean difference of the absolute magnitude of % mean difference for each pair of channels.

The mean difference in the NMOC reading for repeated analyses for a given channel pair ranged from -0.1904 ppmC to +0.2600 ppmC, with a pooled average of 0.0398 ppmC. The % mean difference for a given channel pair ranged from -21.0% to 14.4%. The pooled average of the absolute magnitude of the mean difference equaled 8.48% of the pooled mean NMOC value. The standard deviations of the differences for the repeated analyses are given in ppmC for the channel pairs and an overall pooled standard deviation for all 24 pairs of channels. the percent coefficient of variation, % CV (or % RSD, the percent relative standard deviation) was taken to be the standard deviation of the differences (of repeated analyses) divided by mean NMOC measurement.

Thus the average difference expected for analytical error between two repeated analyses of the same sample for a given channel pair was about ±8.5% of the mean NMOC reading.

There appeared to be a significant difference between the NMOC value determined on the first analysis and the value determined on the second analysis, when the second analysis was done on a subsequent day. The differences reported in this section, DI, are the differences between the first analytical determination and a subsequent determination. When analyses were first done on a Radian channel, followed by an analysis on the EPA Quality Assurance Division channel (Channel E), or vice versa, the mean difference, DT, was consistently negative, indicating an increase in measured NMOC value for the second analysis. In separate repeated analyses, the mean difference (pooled) was equal to -0.1293 ppmC or -10.9%. Figure 1-1 shows a comparison of the Radian analysis of repeated samples versus the EPA QAD Channel E. An orthogonal linear regression of 120 samples resulted in a slope of 1.032 and an intercept of -0.1891.

Based on 330 repeated NMOC analyses for which the first analysis was done on a Radian channel and a subsequent analysis was done on EPA ESRL channel, designated as EPA GC channel, a positive difference resulted. On the average the Radian channel measured a higher NMOC value by +0.0374 ppmC, or about 4.1% of the overall mean NMOC reading. The mean difference, DT, was significantly different from zero at the 5% level of significance. The pooled % coefficient of variation equaled 18.5%. The positive mean difference might be attributed to the fact that heavier NMOC components did not completely elute from the regular GC column, whereas when the sample was analyzed by the cryogenic preconcentration direct FID method, the heavier components were measured.

Figure 1-2 shows an orthogonal linear regression of 336 repeated analysis on the EPA GC channel versus Radian channels. The slope was 1.081 and the intercept was 0.015.

1.2.4 Overall Precision

Overall precision, including analytical variability and any variability contributed by collection and storage of the air samples in the canisters, was assessed from analysis of 59 duplicate samples collected simultaneously in duplicate canisters. One of the 59 differences (absolute value) was substantially larger than the other 58 differences and was identified as an outlier. The results are shown in Table 1-3.

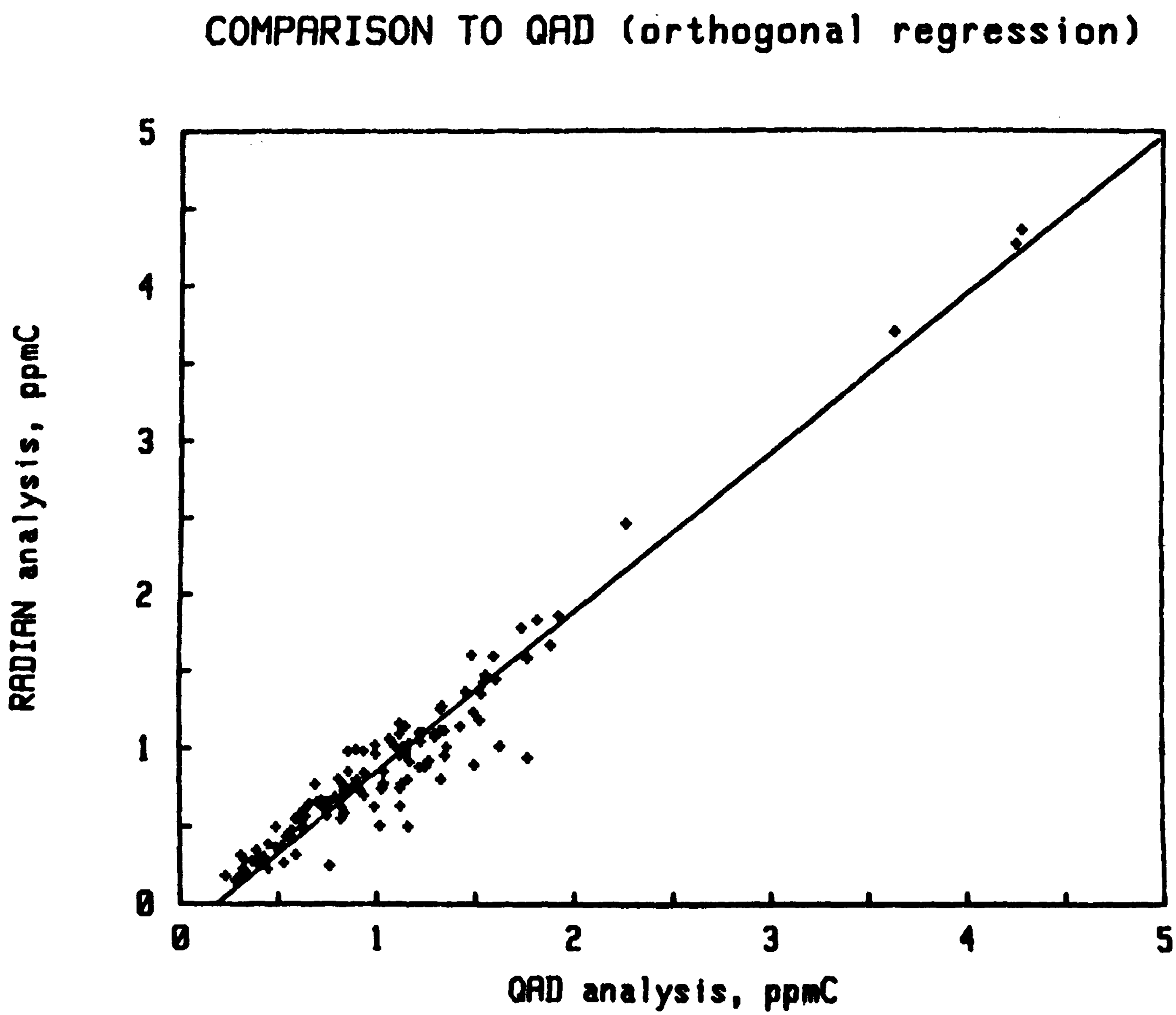
COMPARISON TO QAD (orthogonal regression)
RADIAN analysis, ppmC
QAD analysis, ppmC
0
1
2
3
4
5

Figure 1-1

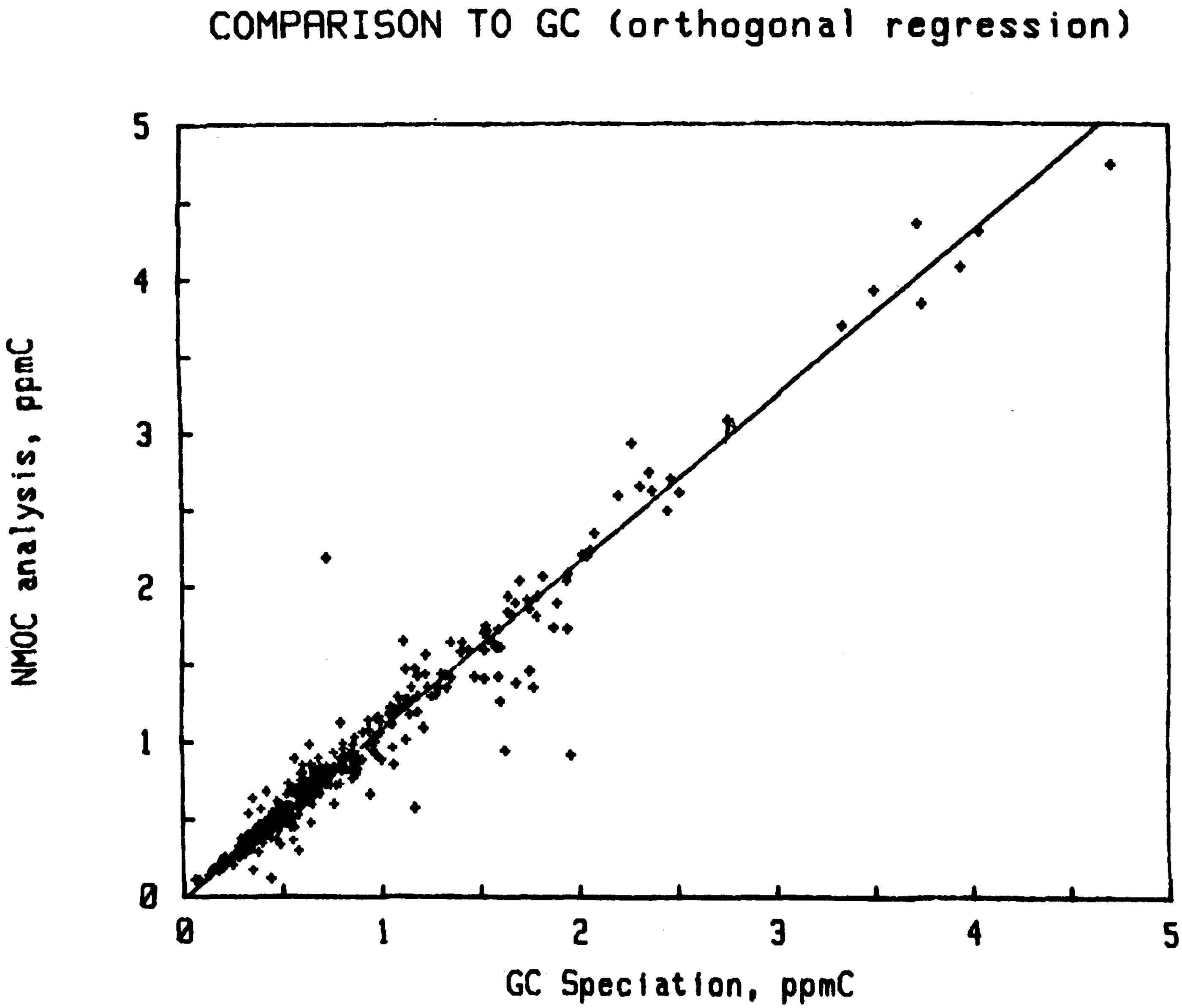
COMPARISON TO GC (orthogonal regression)
NMOC analysis, ppmC
GC Speciation, ppmC
0
1
2
3
4
5

Figure 1-2

Table 1-3. Precision for Duplicate Samples.

	All Duplicate Data	Excluding Outlier
N, Number of Duplicate Sample Pairs	59	58
Mean Difference, ppmC	-0.043	-0.028
Std. Deviation of Differences, ppmC	0.166	0.117
Overall Mean NMOC, ppmC	0.83576	0.8358
Percent Difference	-5.14%	-3.35%

No significant concentration dependence of the differences was apparent. These results were roughly one-half the overall analytical precision of 531 repeated analyses and indicate that the component of overall variability contributed by canisters was small relative to the variability of the repeated analyses between instruments and between laboratories.

1.2.5 Accuracy

Because the NMOC measurements encompass an unspecified mixture of various compounds, absolute accuracy was undefined. Some relative indicators of accurace are as follows:

Accuracy relative to propane standards was assessed with internal and external audits. Table 1-4 gives the slopes and intercepts when plotting measured ppmC for internal propane standards (in-house Radian QC standards) (y) as a function of calculated standards (x). The calculated in-house standard was computed from a propane standard referenced to NBS propane SRM No. 1665b fed through a flow meter and diluted with a measured amount of dried, cleaned air to the sample point. The 95% confidence intervals are given on the slope and intercept values. The combined data suggest that the slope was slightly greater than 1.0000, i.e., the 95% confidence intervals were 1.04446 and 1.01256 which indicates that there was a positive bias in the accuracy data. The 95% confidence intervals on the intercept values all spanned zero, except for Channel B.

Table 1-4. Accuracy Relative to Internal Standards.

Channel	N	Slope (95% Conf. Interval)	Intercept (95% Conf. Interval)	Correlation Coeff.	NMOC Mean	Mean Error	Error Std. Dev.	% Error[a]
A	21	1.02329 (±0.02474)	0.01461 (±0.02585)	0.9987	0.7629	0.0324	0.0413	4.2
B	21	1.01689 (±0.01540)	0.02045 (±0.01610)	0.9995	0.7629	0.0333	0.0265	3.5
C	15	1.02905 (±0.04208)	0.04442 (±0.07158)	0.9977	1.4313	0.0860	0.0724	5.1
D	16	1.02331 (±0.05264)	0.03655 (±0.08711)	0.9960	1.3813	0.0688	0.0892	6.5
E	9	1.02428 (±0.04173)	0.01491 (±0.06691)	0.9989	1.3533	0.0478	0.0497	3.7
Combined	82	1.02851 (±0.01595)	0.02070 (±0.02201)	0.9981	1.0706	0.0512	0.0607	5.7

[a] % Error = (Mean Error/NMOC Mean) x 100.

Table 1-4 gives further evidence that there was a positive bias in the in-house propane QC data. Column 7 shows mean error which was positive for all five channels (Radian Channels, A, B, C, and D and EPA Channel E) and for the combined channel results. The percent error for the combined results (all channels) was 5.7 which was less than for the precision of NMOC measurements of repeated analyses.

Table 1-5 gives the data from the accuracy estimates relative to external audits prepared by EPA Quality Assurance Division using samples referenced to NBS propane SRM No. 1665b. The average of the absolute magnitude of percent error was 5.8, which compared favorably with the Radian in-house QC samples. The reference NMOC measurement was analyzed on EPA/QAD Channel E.

Table 1-5. Accuracy Relative to External Propane Audit

RADID	Radian Channel	Propane Reference ppmC	Measured ppmC	Error ppmC	% Error
1722	A	0.91	0.91	0.00	0.00
1094	B	1.73	1.78	0.05	2.89
1722	B	0.91	0.93	0.02	2.20
1096	C	1.71	1.67	-0.04	-2.34
1722	C	0.91	1.01	0.10	10.99
1096	D	1.71	1.59	-0.12	-7.02
1722	D	0.91	1.05	0.14	15.38

NOTE: Average of the absolute magnitude % error = 5.83.

1.3 CONCLUSIONS

The following preliminary conclusions may be reached from this study:

- 1,375 NMOC measurements ranging from 0.06 ppmC to 4.75 ppmC, averaging 0.853 ppmC were taken at 22 sites.
- 90.6% overall completeness of sampling was achieved.
- NMOC measurements appeared to be approximately logarithmic normally distributed.
- NMOC measurements at Birmingham, Alabama; El Paso, Texas; Miami, Florida; Richmond, Virginia; and Wilkes-Barre, Pennsylvania appeared to be distributed differently than the NMOC data from the other 17 sites.
- An overall repeatability among 4 Radian channels and 2 EPA channels (one of which contained a gas chromatographic column) was 8.5%. The overall coefficient of variation for the same comparisons averaged 17%.
- The NMOC measurements from an instrument containing a gas chromatographic column averaged about 6.5% lower than measurements with cryogenic preconcentration and direct FID.
- NMOC measurements on 50 duplicate samples taken simultaneously differed from one another by about 3.5%, but the differences were not significantly different from zero at the 5% level of significance.
- Using a propane standard referenced to NBS propane SRM No. 1665b, a combined accuracy for internal and external audits averaged 5.8%.
- For analyses made on successive days from the same sample, the NMOC measurement appeared to increase by about 10.9%.
- NMOC measurements did not appear to be first order autocorrelated.

2.0 NMOC DATA SUMMARY

This section presents the NMOC Data Summaries. Table 2-1 presents various statistics by site. The table repeats some of the data of Table 1-1, and provides additional information. The first six columns of Table 2-1 are self explanatory. The "percent complete" column is the ratio of the number of valid samples divided by the total number of possible samples (= the number of duplicates plus the number of possible sampling days) multiplied by 100. The last 5 columns of the table present various statistics of the NMOC data in ppmC units for a particular site. The mean represents the arithmetic mean. The skewness indicates whether the distribution has a longer right-handed tail (skewness > 0.0) or left-handed tail (skewness < 0.0). SD is the standard deviation for the site data. "Max", "Min", and "Range" represent the maximum value, the minimum value, and the difference between them respectively. Table 2-2 summarizes the missing or invalid data results. Figures 2-1 through 2-22 plot the NMOC determinations by site.

Tables 2-3 through 2-24 summarize the NMOC data for the 22 sites. The data summarized in the tables include:

1. The site;
2. The calendar sample dates;
3. The Julian sample dates;
4. The weekday of the sample;
5. The Radian laboratory sample number;
6. The sample canister number;
7. The reported sample pressure;
8. The as-received sample pressure;
9. The Radian analysis date;
10. The Radian instrument (channel) code (A, B, C, D);
11. The EPA analysis date;
12. The Radian NMOC value, ppmC;
13. The EPA, Channel E NMOC value; and
14. The EPA, ESRL-GC NMOC value.

Table 2-1. NMOC Site Data Summary

Site Code	First Possible Sampling Date	Final Possible Sampling Date	Total No. Possible Sampling Days	Total No. Duplicates	No. Valid Samples	Percent Complete	NMOC, ppmC					
							Mean	Skewness	SD	Max	Min	Range
AKOH	6/27/84	9/28/84	68	3	68	96	0.79	2.254	0.56	2.95	0.23	2.72
ATGA	7/11/84	9/28/84	58	3	55	90	0.79	2.982	0.71	4.27	0.21	4.06
BAL	7/11/84	9/28/84	58	1	56	95	0.99	1.177	0.67	2.91	0.19	2.72
BMTX	6/18/84	9/28/84	75	2	66	86	0.89	1.968	0.67	3.84	0.11	3.73
CHNC	7/11/84	9/28/84	58	4	60	97	0.54	2.564	0.43	2.52	0.18	2.34
CHTN	7/11/84	9/28/84	58	2	46	77	1.34	2.015	0.70	4.08	0.52	3.56
CLTX	6/18/84	9/28/84	75	5	72	90	0.82	3.161	0.59	4.31	0.20	4.11
CNOH	6/27/84	9/28/84	68	1	65	94	0.93	2.481	0.70	3.93	0.12	3.81
DLTX	6/18/84	9/28/84	75	4	74	94	0.97	1.212	0.43	2.57	0.28	2.29
ELTX	6/18/84	9/28/84	75	4	69	87	0.93	0.983	0.45	2.45	0.28	2.17
FWTX	6/18/84	9/28/84	75	3	69	88	0.97	2.245	0.55	3.81	0.39	3.42
ININ	7/11/84	9/28/84	58	3	59	97	0.80	2.253	0.42	2.50	0.22	2.28
KCMO	6/27/84	9/28/84	68	2	68	97	0.79	2.104	0.53	2.76	0.29	2.47
MIFL	8/13/84	9/28/84	35	3	31	82	1.32	0.779	0.81	3.70	0.31	3.39
MTN	7/11/84	9/28/84	58	1	52	88	1.43	1.033	0.84	4.75	0.14	4.61
ORTX	6/18/84	9/28/84	75	3	71	91	0.69	2.764	0.46	3.35	0.13	3.22
PHPA	6/27/84	9/28/84	68	2	63	90	1.02	1.554	0.52	3.10	0.27	2.83
RVA	6/27/84	9/28/84	68	1	64	93	0.53	0.813	0.24	1.22	0.06	1.16
TCTX	6/18/84	9/28/84	75	4	69	87	0.92	3.078	0.78	4.74	0.14	4.60
WBPA	6/27/84	9/28/84	68	2	63	90	0.45	0.511	0.23	0.96	0.11	0.85
WDC	6/27/84	9/28/84	68	3	63	89	0.81	2.637	0.40	2.93	0.34	2.59
WPFL	6/18/84	9/28/84	75	2	72	94	0.54	3.392	0.34	2.63	0.17	2.46
TOTAL:			1459	58	1375							
OVERALL AVERAGE:					62.5	90.6	0.853					3.022

Table 2-2. Invalidated and Missing Samples.

1) Akron, Ohio -

Sample Date	Reason Missing
08/07/84	No sample received.
09/03/84	Holiday.

2) Altanta, Georgia -

Sample Date	Reason Missing
08/09/84	Zero sample pressure.
09/07/84	No sample received.
09/14/84	Invalidated (Low sample pressure).
09/17/84	Zero sample pressure.
09/18/84	Zero sample pressure.
09/20/84	No sample received.

3) Birmingham, Alabama -

Sample Date	Reason Missing
07/11/84	Zero sample pressure.
08/23/84	Zero sample pressure.
09/03/84	Holiday.

4) Beaumont, Texas -

Sample Date	Reason Missing
06/18/84	Zero sample pressure.
06/20/84	Zero sample pressure.
07/04/84	Zero sample pressure (Sampler problem).
07/05/84	No sample received.
07/06/84	No sample received.
07/10/84	No sample taken (Vandalism).
08/27/84	Zero sample pressure.
09/03/84	No sample taken (Power failure).
09/04/84	No sample received.
09/05/84	No sample received.

Table 2-2. Invalidated and Missing Samples. (cont.)

5) Charlotte, North Carolina -

Sample Date	Reason Missing
09/03/84	Holiday.
09/13/84	Invalidated (Low sample pressure).

6)Chattanooga, Tennessee -

Sample Date	Reason Missing
07/11/84	No sample taken (Late starting).
07/12/84	No sample taken (Late starting).
07/13/84	No sample taken (Late starting).
07/16/84	Zero sample pressure.
07/30/84	Zero sample pressure.
08/15/84	Invalidated (Suspect contamination).
08/27/84	No sample taken.
08/28/84	Zero sample pressure (Sampler problem).
08/29/84	Invalidated (Low sample pressure).
08/31/84	Zero sample pressure (Sampler problem).
09/03/84	Holiday.
09/04/84	No sample received.
09/27/84	No sample taken (Power failure).
09/28/84	Zero sample pressure.

7)Clute, Texas -

Sample Date	Reason Missing
06/18/84	Zero sample pressure.
06/26/84	Zero sample pressure.
07/05/84	No sample received.
07/06/84	No sample received.
07/09/84	No sample received.
08/24/84	Invalidated (Sampling problem).
09/05/84	Invalidated (Sampling problem).
09/06/84	Invalidated (Sampling problem).
09/24/84	Invalidated (Low sample pressure).

Table 2-2. Invalidated and Missing Samples. (cont.)

8) Cincinnati, Ohio -

Sample Date	Reason Missing
07/11/84	Zero sample pressure.
07/18/84	Zero sample pressure.
09/03/84	Holiday.
09/05/84	No sample taken.

9) Dallas, Texas -

Sample Date	Reason Missing
07/04/84	No sample collected.
07/06/84	No sample collected.
07/07/84	No sample received.
09/05/84	No sample received.
09/14/84	No sample received.
09/24/84	No sample received.

10) El Paso, Texas -

Sample Date	Reason Missing
06/28/84	No sample collected (Late start).
07/09/84	Zero sample pressure (Sampler problem).
07/16/84	Zero sample pressure.
07/27/84	Zero sample pressure.
07/31/84	Zero sample pressure.
08/03/84	Invalidated (Low sample pressure).
08/31/84	Zero sample pressure.
09/06/84	Invalidated (Low sample pressure).
09/14/84	No sample received.
09/18/84	No sample taken (Can failure).

11) Fort Worth, Texas -

Sample Date	Reason Missing
06/18/84	No sample taken (Late start).
06/19/84	No sample taken (Late start).
06/21/84	Zero sample pressure.
07/04/84	No sample received.
08/13/84	Zero sample pressure .
08/22/84	No sample taken (power failure).
08/23/84	No sample taken.
09/03/84	Holiday.
09/20/84	Zero sample pressure.

Table 2-2. Invalidated and Missing Samples. (cont.)

12) Indianapolis, Indiana -

Sample Date	Reason Missing
07/11/84	No sample taken (Late start).
08/14/84	Invalidated (Low sample pressure).

13) Kansas City, Missouri -

Sample Date	Reason Missing
07/04/84	No sample received.
09/03/84	Holiday.

14) Miami, Florida -

Sample Date	Reason Missing
08/13/84	Invalidated (Low sample pressure).
08/14/84	No sample received.
08/15/84	No sample received.
08/31/84	Low sample pressure (Can problem).
09/03/84	Holiday.
09/20/84	Zero sample pressure (Can problem).
09/27/84	No sample received.
09/28/84	No sample received.

15) Memphis, Tennessee -

Sample Date	Reason Missing
07/11/84	No sample received.
07/12/84	Zero sample pressure.
07/13/84	Zero sample pressure.
07/16/84	Zero sample pressure.
08/02/84	Zero sample pressure.
08/15/84	Invalidated (Suspect contamination).
08/17/84	Zero sample pressure.
09/03/84	Holiday.

Table 2-2. Invalidated and Missing Samples. (cont.)

16) West Orange, Texas -

Sample Date	Reason Missing
06/18/84	Zero sample pressure.
06/25/84	No sample received.
07/03/84	Zero sample pressure.
07/05/84	No sample received.
07/10/84	No sample received.
09/03/84	Zero sample pressure (Sampling problem).
09/04/84	No sample received.
09/12/84	Zero sample pressure.

17) Philadelphia, Pennsylvania -

Sample Date	Reason Missing
06/27/84	No sample taken (Late start).
07/04/84	No sample received.
08/23/84	Invalidated (Low sample pressure).
09/03/84	Holiday.
09/07/84	No sample taken (Can problem).
09/11/84	No sample taken (Sampler problem).
09/18/84	Zero sample pressure.

18) Richmond, Virginia -

Sample Date	Reason Missing
06/28/84	No sample taken (Late start).
07/11/84	Invalidated (Sampling error).
09/03/84	Holiday.
09/10/84	No sample taken (Can problem).
09/27/84	No sample received.

Table 2-2. Invalidated and Missing Samples. (cont.)

19) Texas City, Texas -

Sample Date	Reason Missing
06/18/84	Zero sample pressure.
06/19/84	Zero sample pressure.
07/05/84	No sample received.
07/06/84	Zero sample pressure (Sampler problem).
07/09/84	No sample received.
07/25/84	No sample received.
08/30/84	Invalidated (Sampler problem).
09/05/84	Invalidated (Low sample pressure).
09/06/84	Zero sample pressure.
09/12/84	Zero sample pressure (Sampling problem).
09/26/84	Zero sample pressure.

20) Wilkes-Barre, Pennsylvania -

Sample Date	Reason Missing
07/04/84	No sample received.
07/09/84	No sample received.
07/24/84	No sample received.
08/31/84	Invalidated (Can problem).
09/03/84	Holiday.
09/13/84	No sample taken (Can problem).
09/26/84	Invalidated (Low sample pressure).

21) Washington, D.C. -

Sample Date	Reason Missing
06/27/84	Zero sample pressure.
07/05/84	No sample received.
08/16/84	Invalidated (Low sample pressure).
08/17/84	Invalidated (Low sample pressure).
09/03/84	Holiday.
09/25/84	Zero sample pressure.
09/28/84	Zero sample pressure.

Table 2-2. Invalidated and Missing Samples. (cont.)

22) West Palm Beach, Florida -

Sample Date	Reason Missing
06/22/84	No sample received.
06/29/84	Zero sample pressure.
07/04/84	No sample received.
09/03/84	Holiday.
09/26/84	Zero sample pressure.

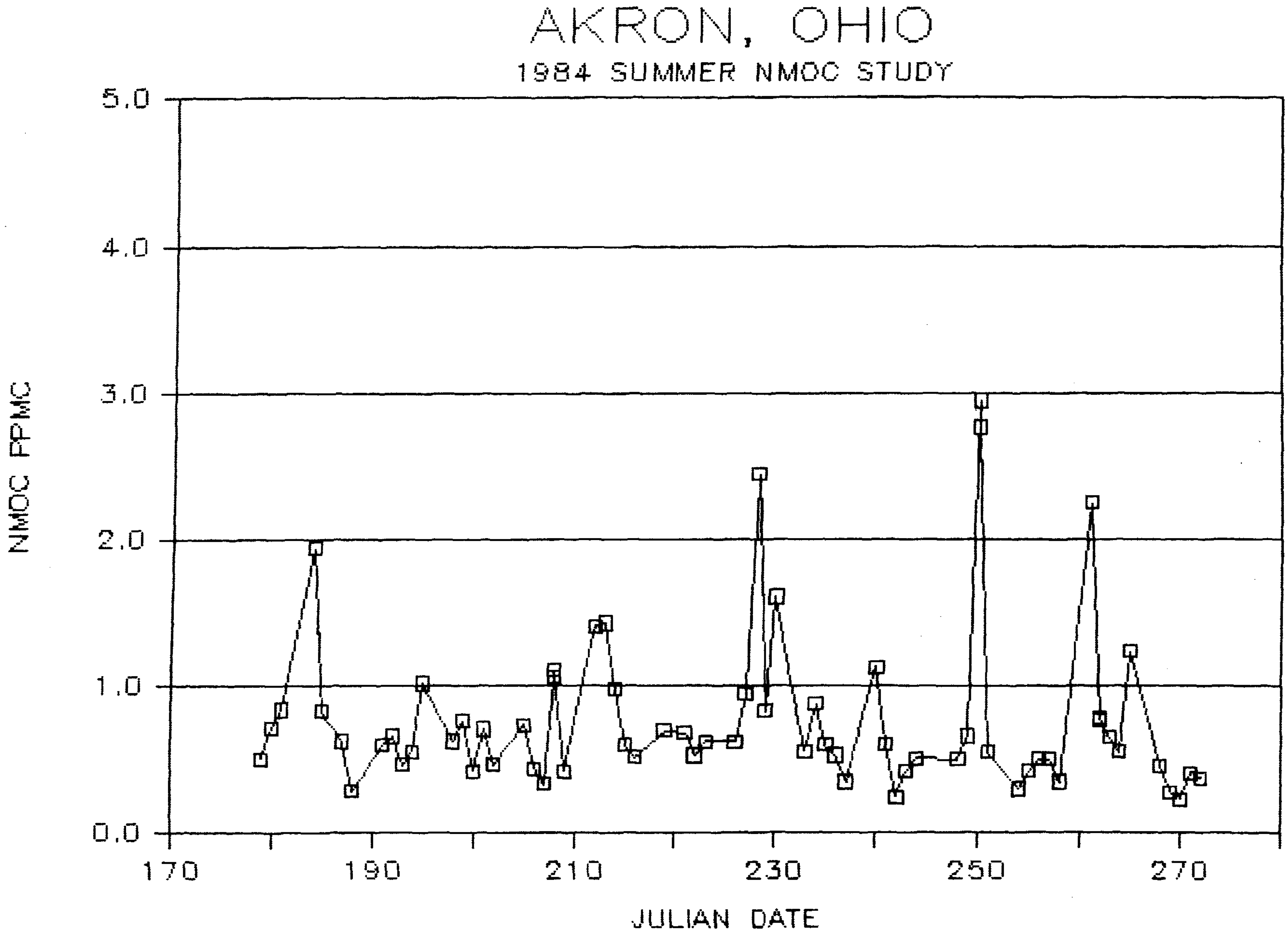

Figure 2-1. Plot of NMOC Data for Akron, Ohio.

Table 2-3. Data Listing for Akron, Ohio.

1984 SUMMER NMOC STUDY - AKRON, OHIO

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/27/84	179	WEDNESDAY	1074	72	18.0	18.0	07/02/84	B		0.51		
06/28/84	180	THURSDAY	1073	74	11.0	10.5	07/02/84	C	07/10/84	0.72		0.72
06/29/84	181	FRIDAY	1090	101	15.8	15.5	07/03/84	B		0.84		
07/02/84	184	MONDAY	1113	123	12.8	12.5	07/05/84	B	07/10/84	1.94		1.80
07/03/84	185	TUESDAY	1116	37	12.5	12.5	07/06/84	D	07/10/84	0.83		0.85
07/05/84	187	THURSDAY	1135	12	10.5	10.0	07/09/84	B	07/10/84	0.63	1.12	
07/06/84	188	FRIDAY	1153	19	14.8	14.5	07/10/84	D	07/13/84	0.29		0.38
07/09/84	191	MONDAY	1175	26	12.0	11.8	07/11/84	A		0.60		
07/10/84	192	TUESDAY	1184	60	13.0	13.5	07/12/84	A	07/13/84	0.66	0.76	
07/11/84	193	WEDNESDAY	1209	46	13.0	12.9	07/13/84	A	07/17/84	0.47		0.43
07/12/84	194	THURSDAY	1226	115	12.0	12.0	07/16/84	C		0.56		
07/13/84	195	FRIDAY	1246	173	14.5	14.5	07/17/84	C		1.02		
07/16/84	198	MONDAY	1261	139	12.5	12.0	07/18/84	B		0.63		
07/17/84	199	TUESDAY	1295	162	16.0	16.0	07/19/84	B		0.76		
07/18/84	200	WEDNESDAY	1324	18	15.5	15.0	07/21/84	C	07/24/84	0.43		0.38
07/19/84	201	THURSDAY	1337	100	16.0	16.5	07/23/84	C		0.71		
07/20/84	202	FRIDAY	1349	40	15.5	16.5	07/24/84	B		0.47		
07/23/84	205	MONDAY	1388	30	16.2	15.9	07/25/84	A		0.74		
07/24/84	206	TUESDAY	1402	50	15.5	15.0	07/26/84	A	07/27/84	0.44		0.40
07/25/84	207	WEDNESDAY	1425	170	16.5	17.2	07/27/84	B		0.34		
07/26/84	208	THURSDAY	1448	64	17.5	17.0	07/30/84	A		1.06		
07/26/84	208	THURSDAY	1447	102	17.5	16.9	07/30/84	C	07/31/84	1.11	1.35	
07/27/84	209	FRIDAY	1472	169	15.5	16.0	07/31/84	D		0.43		
07/30/84	212	MONDAY	1488	197	16.5	16.8	08/01/84	A		1.41		
07/31/84	213	TUESDAY	1513	98	16.0	16.1	08/02/84	C		1.43		
08/01/84	214	WEDNESDAY	1555	27	16.5	16.4	08/06/84	C		0.98		
08/02/84	215	THURSDAY	1563	77	16.0	16.0	08/06/84	A		0.60		
08/03/84	216	FRIDAY	1593	139	15.5	15.5	08/08/84	C	08/08/84	0.52		0.45
08/06/84	219	MONDAY	1618	97	16.0	15.8	08/08/84	A	08/09/84	0.70		0.59
08/08/84	221	WEDNESDAY	1652	106	16.0	16.0	08/13/84	C		0.68		
08/09/84	222	THURSDAY	1683	162	16.0	16.0	08/13/84	B		0.53		
08/10/84	223	FRIDAY	1697	78	15.5	14.9	08/15/84	A		0.62		
08/13/84	226	MONDAY	1723	65	16.0	15.0	08/15/84	D	08/20/84	0.62		0.47
08/14/84	227	TUESDAY	1749	70	15.5	15.5	08/16/84	D		0.94		
08/15/84	228	WEDNESDAY	1775	63	17.0	17.0	08/17/84	D		2.45		
08/16/84	229	THURSDAY	1793	189	16.0	16.2	08/20/84	D		0.83		
08/17/84	230	FRIDAY	1816	151	16.0	15.2	08/21/84	C		1.61		
08/20/84	233	MONDAY	1839	178	17.0	17.1	08/22/84	A		0.56		
08/21/84	234	TUESDAY	1863	198	16.5	17.5	08/24/84	D	08/24/84	0.88	1.25	
08/22/84	235	WEDNESDAY	1894	197	16.5	16.8	08/27/84	C		0.60		
08/23/84	236	THURSDAY	1918	15	16.0	16.0	08/28/84	B	08/29/84	0.53		0.49

Table 2-3. Data Listing for Akron, Ohio. (cont.)

1984 SUMMER NMOC STUDY - AKRON, OHIO

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/24/84	237	FRIDAY	1938	40	16.0	16.5	08/28/84	C		0.35		
08/27/84	240	MONDAY	1953	188	18.0	16.3	08/29/84	C		1.13		
08/28/84	241	TUESDAY	1986	82	16.0	16.0	08/30/84	A		0.61		
08/29/84	242	WEDNESDAY	2008	24	16.0	16.2	08/31/84	B		0.25		
08/30/84	243	THURSDAY	2014	138	16.0	16.1	09/04/84	B	09/05/84	0.42		0.42
08/31/84	244	FRIDAY	2035	157	0.0	16.5	09/05/84	B		0.51		
09/04/84	248	TUESDAY	2066	73	17.0	16.9	09/06/84	C		0.50		
09/05/84	249	WEDNESDAY	2096	94	16.5	16.5	09/07/84	D		0.66		
09/06/84	250	THURSDAY	2120	79	18.0	18.0	09/10/84	C		2.95		
09/06/84	250	THURSDAY	2119	9	18.0	19.5	09/10/84	C		2.77		
09/07/84	251	FRIDAY	2159	149	16.5	17.5	09/11/84	D	09/12/84	0.55		0.45
09/10/84	254	MONDAY	2178	97	17.0	17.6	09/12/84	D		0.30		
09/11/84	255	TUESDAY	2201	83	16.5	17.0	09/13/84	C		0.42		
09/12/84	256	WEDNESDAY	2226	28	16.0	17.0	09/14/84	A	09/15/84	0.50		0.52
09/13/84	257	THURSDAY	2230	65	16.5	17.0	09/17/84	C		0.50		
09/14/84	258	FRIDAY	2258	101	16.0	16.1	09/18/84	B		0.35		
09/17/84	261	MONDAY	2289	6	17.5	18.0	09/19/84	D		2.25		
09/18/84	262	TUESDAY	2299	149	16.5	17.0	09/20/84	C		0.79		
09/18/84	262	TUESDAY	2298	18	16.5	17.5	09/20/84	B	09/21/84	0.77		0.71
09/19/84	263	WEDNESDAY	2322	82	16.0	16.5	09/21/84	A		0.65		
09/20/84	264	THURSDAY	2348	26	16.5	16.6	09/24/84	B		0.55		
09/21/84	265	FRIDAY	2382	158	16.5	14.9	09/26/84	D		1.24		
09/24/84	268	MONDAY	2408	28	16.5	16.5	09/27/84	A		0.46		
09/25/84	269	TUESDAY	2429	101	14.5	14.5	09/28/84	A		0.28		
09/26/84	270	WEDNESDAY	2439	27	16.0	16.1	10/01/84	B	10/01/84	0.23	0.32	
09/27/84	271	THURSDAY	2467	139	17.0	17.0	10/01/84	C		0.41		
09/28/84	272	FRIDAY	2489	91	16.0	16.1	10/02/84	D	10/03/84	0.38		0.29

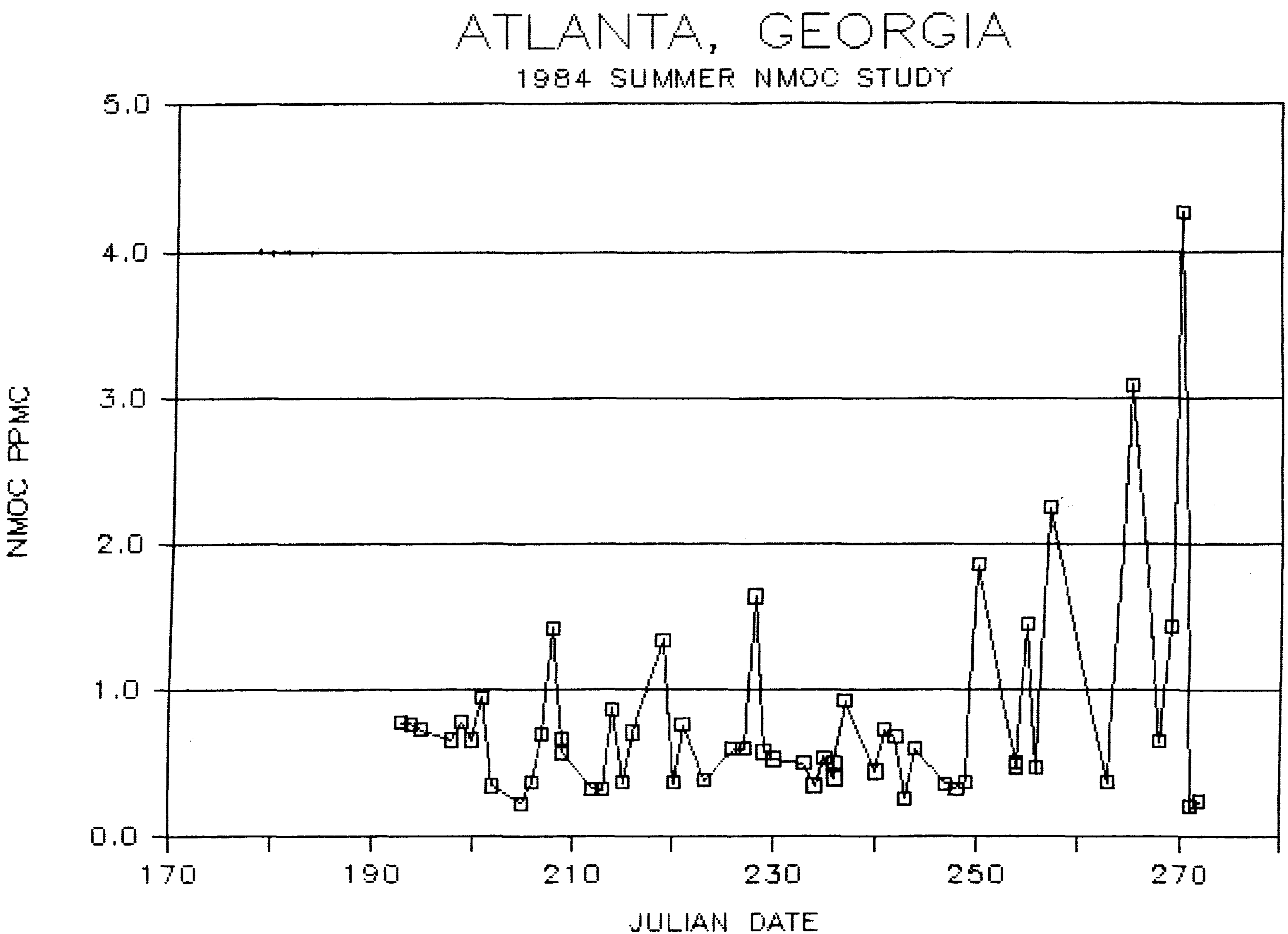

Figure 2-2. Plot of NMOC Data for Atlanta, Georgia.

Table 2-4. Data Listing for Atlanta, Georgia.

1984 SUMMER NMOC STUDY - ATLANTA, GEORIGA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
07/11/84	193	WEDNESDAY	1194	141	11.5	11.5	07/12/84	C		0.78		
07/12/84	194	THURSDAY	1213	113	12.0	12.0	07/13/84	D		0.77		
07/13/84	195	FRIDAY	1231	172	12.5	12.5	07/16/84	A	07/19/84	0.73		0.61
07/16/84	198	MONDAY	1256	10	12.0	12.0	07/17/84	B		0.66		
07/17/84	199	TUESDAY	1277	175	12.0	12.0	07/18/84	D		0.78		
07/18/84	200	WEDNESDAY	1310	195	11.5	12.0	07/20/84	A	07/24/84	0.66		0.69
07/19/84	201	THURSDAY	1357	31	13.0	12.8	07/24/84	D	07/25/84	0.95	1.12	
07/20/84	202	FRIDAY	1355	47	12.5	12.5	07/24/84	A		0.35		
07/23/84	205	MONDAY	1369	71	12.5	13.0	07/25/84	B		0.23		
07/24/84	206	TUESDAY	1395	70	12.0	12.5	07/26/84	B		0.37		
07/25/84	207	WEDNESDAY	1430	133	11.5	11.5	07/27/84	A		0.70		
07/26/84	208	THURSDAY	1473	158	13.0	12.9	08/01/84	A	08/03/84	1.42		1.48
07/27/84	209	FRIDAY	1455	32	14.0	13.5	07/31/84	C	08/01/84	0.66	0.70	
07/27/84	209	FRIDAY	1456	91	14.0	13.9	07/31/84	B		0.58		
07/30/84	212	MONDAY	1494	12	12.0	12.5	08/01/84	B	08/03/84	0.33		0.28
07/31/84	213	TUESDAY	1505	11	12.0	11.5	08/02/84	A		0.32		
08/01/84	214	WEDNESDAY	1544	60	11.5	11.5	08/06/84	C		0.87		
08/02/84	215	THURSDAY	1574	189	12.5	12.2	08/07/84	C		0.37		
08/03/84	216	FRIDAY	1586	50	12.5	12.9	08/07/84	D		0.71		
08/06/84	219	MONDAY	1613	170	12.5	13.5	08/08/84	C		1.34		
08/07/84	220	TUESDAY	1624	94	12.0	12.2	08/09/84	C	08/10/84	0.37		0.37
08/08/84	221	WEDNESDAY	1656	10	12.0	11.5	08/13/84	A	08/13/84	0.76	0.84	
08/10/84	223	FRIDAY	1699	9	12.5	12.5	08/15/84	A		0.39		
08/13/84	226	MONDAY	1757	33	12.5	12.0	08/17/84	C		0.60		
08/14/84	227	TUESDAY	1753	168	12.5	12.0	08/17/84	C	08/20/84	0.60		0.76
08/15/84	228	WEDNESDAY	1766	139	12.0	11.5	08/17/84	E	08/20/84	1.64		1.42
08/16/84	229	THURSDAY	1787	82	12.5	13.6	08/20/84	D		0.58		
08/17/84	230	FRIDAY	1818	35	12.5	12.2	08/21/84	D		0.53		
08/20/84	233	MONDAY	1834	32	12.5	12.1	08/22/84	B		0.50		
08/21/84	234	TUESDAY	1856	174	12.0	12.0	08/24/84	C	08/25/84	0.35		0.35
08/22/84	235	WEDNESDAY	1879	101	12.5	12.1	08/27/84	B	08/27/84	0.54		0.51
08/23/84	236	THURSDAY	1906	89	14.0	14.0	08/28/84	A		0.40		
08/23/84	236	THURSDAY	1905	21	14.0	13.8	08/28/84	C		0.51		
08/24/84	237	FRIDAY	1924	159	12.5	12.6	08/28/84	A		0.93		
08/27/84	240	MONDAY	1964	149	12.5	12.0	08/29/84	B		0.45		
08/28/84	241	TUESDAY	1978	141	12.0	12.5	08/30/84	C		0.73		
08/29/84	242	WEDNESDAY	2007	19	12.0	11.8	08/31/84	A		0.68		
08/30/84	243	THURSDAY	2024	185	13.0	12.5	09/04/84	D		0.26		
08/31/84	244	FRIDAY	2054	51	12.5	11.5	09/06/84	C	09/07/84	0.60		0.48
09/03/84	247	MONDAY	2078	45	12.5	12.4	09/06/84	D		0.36		
09/04/84	248	TUESDAY	2079	27	12.5	12.0	09/07/84	C		0.33		

Table 2-4. Data Listing for Atlanta, Georgia. (cont.)

1984 SUMMER NMOC STUDY - ATLANTA, GEORIGA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
09/05/84	249	WEDNESDAY	2102	144	12.5	13.1	09/07/84	B	09/10/84	0.38	0.52	
09/06/84	250	THURSDAY	2135	113	13.0	13.0	09/10/84	D		1.86		
09/10/84	254	MONDAY	2171	155	15.0	15.0	09/12/84	B		0.50		
09/10/84	254	MONDAY	2170	67	15.0	15.0	09/12/84	D		0.48		
09/11/84	255	TUESDAY	2196	43	12.5	13.0	09/13/84	D		1.45		
09/12/84	256	WEDNESDAY	2214	138	12.5	13.2	09/14/84	D		0.47		
09/13/84	257	THURSDAY	2243	186	13.0	12.9	09/18/84	B		2.25		
09/19/84	263	WEDNESDAY	2328	185	12.5	12.5	09/21/84	B		0.37		
09/21/84	265	FRIDAY	2363	56	13.5	11.5	09/25/84	A	09/26/84	3.09		2.77
09/24/84	268	MONDAY	2397	114	0.0	12.1	09/27/84	B		0.65		
09/25/84	269	TUESDAY	2421	111	12.5	12.5	09/28/84	A		1.44		
09/26/84	270	WEDNESDAY	2448	81	13.5	11.5	10/01/84	D	10/01/84	4.27	4.25	
09/27/84	271	THURSDAY	2468	9	13.5	13.4	10/01/84	C	10/02/84	0.21		0.25
09/28/84	272	FRIDAY	2500	95	13.0	10.5	10/03/84	C		0.24		

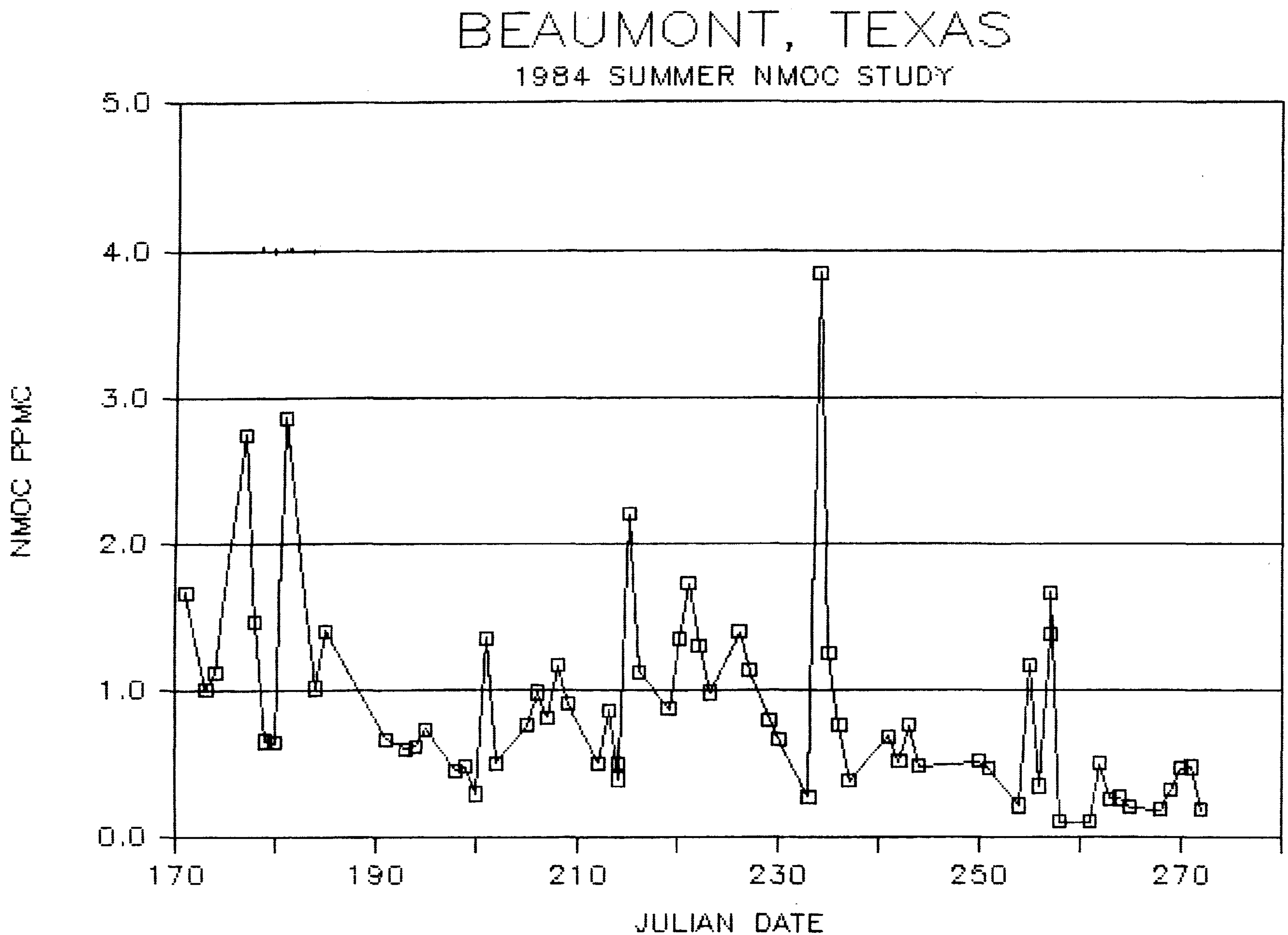

Figure 2-3. Plot of NMOC Data for Beaumont, Texas.

Table 2-5. Data Listing for Beaumont, Texas.

1984 SUMMER NMOC STUDY - BEAUMONT, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/19/84	171	TUESDAY	1011	8	17.5	17.0	06/22/84	D	06/25/84	1.67	1.89	
06/21/84	173	THURSDAY	1031	31	20.5	20.5	06/25/84	D	06/26/84	1.01	1.14	
06/22/84	174	FRIDAY	1046	40	16.5	16.5	06/27/84	C	06/28/84	1.12		0.80
06/25/84	177	MONDAY	1052	51	18.5	18.0	06/28/84	D	06/29/84	2.75		2.37
06/26/84	178	TUESDAY	1050	56	18.5	17.0	06/28/84	C	06/29/84	1.47		1.13
06/27/84	179	WEDNESDAY	1061	71	16.0	15.5	06/29/81	A	07/02/84	0.66	0.75	
06/28/84	180	THURSDAY	1076	88	19.0	18.5	07/02/84	B		0.65		
06/29/84	181	FRIDAY	1108	105	16.5	17.5	07/05/84	D		2.86		
07/02/84	184	MONDAY	1102	109	20.0	20.0	07/05/84	D		1.02		
07/03/84	185	TUESDAY	1121	139	17.5	17.2	07/06/84	C		1.41		
07/09/84	191	MONDAY	1191	48	19.0	18.5	07/12/84	B		0.67		
07/11/84	193	WEDNESDAY	1216	90	20.5	20.0	07/16/84	B	07/17/84	0.61		0.63
07/12/84	194	THURSDAY	1264	91	19.5	20.0	07/18/84	B	07/23/84	0.62		0.59
07/13/84	195	FRIDAY	1278	159	18.5	18.0	07/18/84	B		0.74		
07/16/84	198	MONDAY	1274	102	23.0	22.9	07/18/84	C	07/23/84	0.46		0.41
07/17/84	199	TUESDAY	1303	176	24.0	23.5	07/19/84	B		0.49		
07/18/84	200	WEDNESDAY	1327	19	19.0	22.5	07/21/84	D		0.30		
07/19/84	201	THURSDAY	1346	7	19.8	19.5	07/24/84	A		1.36		
07/20/84	202	FRIDAY	1358	60	21.0	16.7	07/24/84	D		0.51		
07/23/84	205	MONDAY	1413	168	23.0	22.0	07/26/84	B		0.76		
07/24/84	206	TUESDAY	1399	157	22.0	22.0	07/26/84	C		0.99		
07/25/84	207	WEDNESDAY	1444	187	24.0	23.5	07/30/84	B		0.82		
07/26/84	208	THURSDAY	1458	106	19.0	18.0	08/01/84	B	08/03/84	1.17		1.15
07/27/84	209	FRIDAY	1478	92	24.0	23.0	08/01/84	C		0.91		
07/30/81	212	MONDAY	1498	100	18.5	18.0	08/01/84	D		0.51		
07/31/84	213	TUESDAY	1531	76	18.5	18.2	08/06/84	D		0.87		
08/01/84	214	WEDNESDAY	1535	127	24.0	23.9	08/06/84	A		0.40		
08/01/84	214	WEDNESDAY	1534	109	24.5	24.8	08/06/84	C		0.51		
08/02/84	215	THURSDAY	1568	1	19.0	13.0	08/07/84	C		2.20		
08/03/84	216	FRIDAY	1616	110	17.0	17.0	08/08/84	B	08/09/84	1.13		1.00
08/06/84	219	MONDAY	1639	61	23.5	23.5	08/09/84	C		0.88		
08/07/84	220	TUESDAY	1638	62	25.0	24.1	08/09/84	D		1.35		
08/08/84	221	WEDNESDAY	1671	183	18.0	17.7	08/13/84	D	08/14/84	1.73		1.60
08/09/84	222	THURSDAY	1677	29	25.0	23.5	08/13/84	B		1.31		
08/10/84	223	FRIDAY	1717	14	0.0	16.5	08/15/84	B		0.99		
08/13/84	226	MONDAY	1710	42	0.0	17.8	08/15/84	D		1.40		
08/14/84	227	TUESDAY	1747	30	19.0	18.5	08/16/84	D		1.14		
08/16/84	229	THURSDAY	1783	129	29.0	17.0	08/20/84	D		0.80		
08/17/84	230	FRIDAY	1813	22	25.0	23.5	08/21/84	B		0.67		
08/20/84	233	MONDAY	1866	195	18.0	17.5	08/24/84	D		0.28		
08/21/84	234	TUESDAY	1872	180	18.5	18.5	08/24/84	B	08/25/84	3.84		3.75

Table 2-5. Data Listing for Beaumont, Texas. (cont.)

1984 SUMMER NMOC STUDY - BEAUMONT, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/22/84	235	WEDNESDAY	1882	66	17.5	17.0	08/27/84	A		1.26		
08/23/84	236	THURSDAY	1932	124	18.5	18.0	08/28/84	C		0.76		
08/24/84	237	FRIDAY	1934	189	24.0	23.9	08/29/84	D		0.39		
08/28/84	241	TUESDAY	2050	69	24.0	23.5	09/06/84	A	09/07/84	0.69		0.63
08/29/84	242	WEDNESDAY	2046	104	17.0	16.8	09/06/84	C		0.52		
08/30/84	243	THURSDAY	2058	93	25.5	24.4	09/06/84	C		0.76		
08/31/84	244	FRIDAY	2056	17	24.0	23.5	09/05/84	B		0.49		
09/06/84	250	THURSDAY	2115	143	18.5	18.0	09/10/84	A	09/11/84	0.52		0.47
09/07/84	251	FRIDAY	2157	195	17.5	17.5	09/11/84	D		0.47		
09/10/84	254	MONDAY	2218	123	23.0	23.5	09/14/84	A		0.22		
09/11/84	255	TUESDAY	2225	55	21.0	15.0	09/14/84	A		1.18		
09/12/84	256	WEDNESDAY	2275	93	18.0	17.0	09/19/84	A		0.35		
09/13/84	257	THURSDAY	2292	182	21.5	21.5	09/19/84	D		1.39		
09/13/84	257	THURSDAY	2291	173	21.5	18.0	09/19/84	C		1.67		
09/14/84	258	FRIDAY	2278	139	21.5	19.5	09/19/84	D	09/20/84	0.11		0.08
09/17/84	261	MONDAY	2294	9	20.0	19.0	09/19/84	B	09/20/84	0.11		0.06
09/18/84	262	TUESDAY	2341	147	20.5	20.9	09/21/84	C		0.50		
09/19/84	263	WEDNESDAY	2336	91	21.0	21.0	09/21/84	B		0.26		
09/20/84	264	THURSDAY	2370	21	20.0	17.6	09/26/84	C		0.27		
09/21/84	265	FRIDAY	2377	135	21.0	18.0	09/25/84	D		0.21		
09/24/84	268	MONDAY	2411	172	20.5	17.9	09/27/84	B		0.19		
09/25/84	269	TUESDAY	2449	182	21.0	18.0	10/01/84	C	10/01/84	0.32	0.31	
09/26/84	270	WEDNESDAY	2476	185	22.5	22.1	10/02/84	D		0.47		
09/27/84	271	THURSDAY	2471	8	21.0	20.5	10/02/84	A	10/03/84	0.48		0.43
09/28/84	272	FRIDAY	2485	174	21.0	19.6	10/02/84	D		0.19		

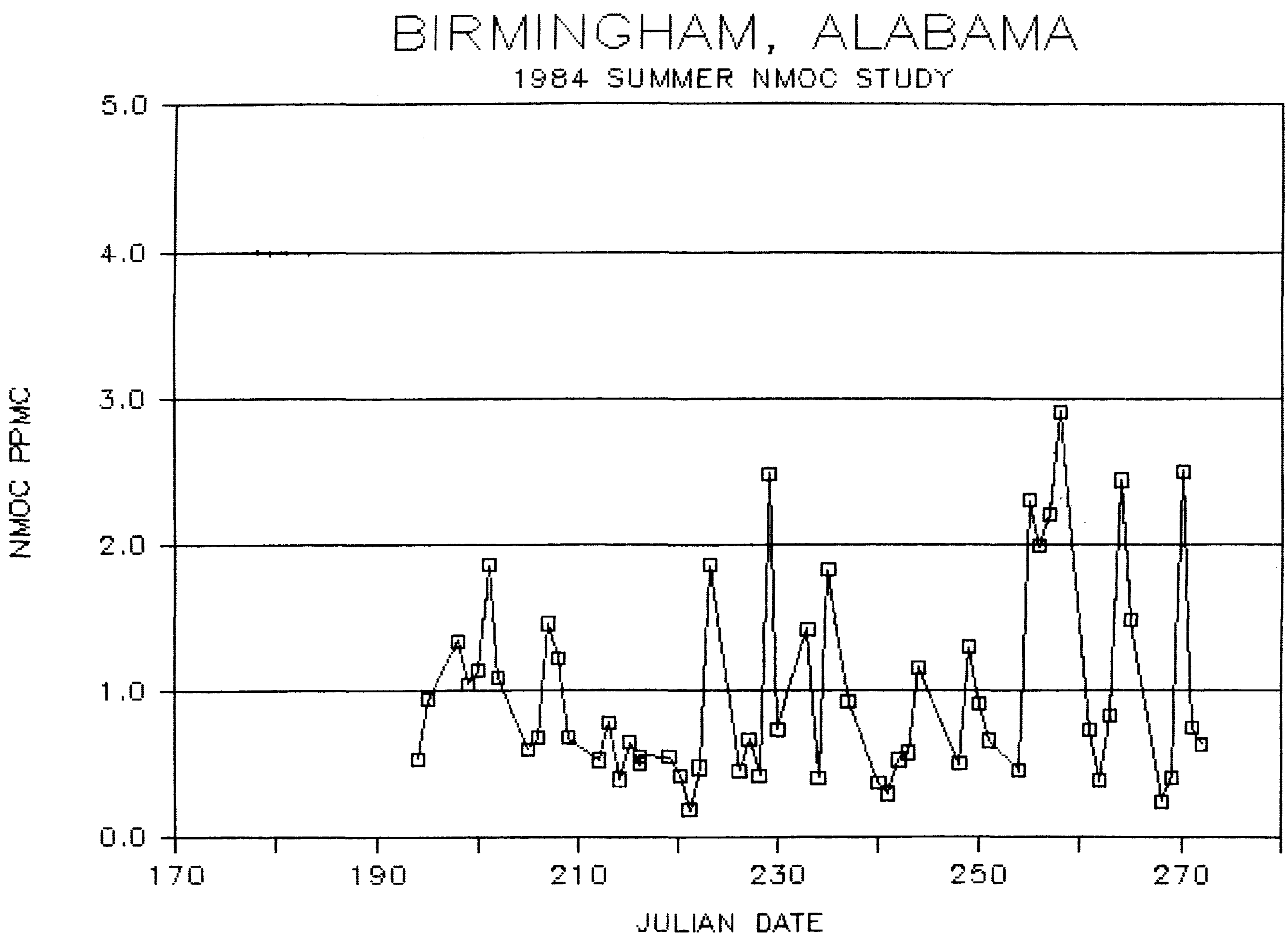

Figure 2-4. Plot of NMOC Data for Birmingham, Alabama.

Table 2-6. Data Listing for Birmingham, Alabama.

1984 SUMMER NMOC STUDY - BIRMINGHAM, ALABAMA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
07/12/84	194	THURSDAY	1212	82	18.0	18.5	07/13/84	A	07/17/84	0.54		0.52
07/13/84	195	FRIDAY	1249	151	11.9	12.0	07/17/84	A	07/19/84	0.94		1.63
07/16/84	198	MONDAY	1238	140	12.2	12.5	07/17/84	D		1.34		
07/17/84	199	TUESDAY	1280	120	12.1	12.5	07/18/84	A		1.05		
07/18/84	200	WEDNESDAY	1315	156	12.2	12.5	07/20/84	A	07/24/84	1.14		0.94
07/19/84	201	THURSDAY	1333	51	13.0	13.0	07/23/84	D		1.86		
07/20/84	202	FRIDAY	1362	89	13.0	13.0	07/24/84	B		1.09		
07/23/84	205	MONDAY	1379	131	13.2	13.0	07/25/84	D		0.61		
07/24/84	206	TUESDAY	1392	172	12.8	13.5	07/26/84	C		0.68		
07/25/84	207	WEDNESDAY	1418	152	12.7	13.0	07/27/84	B		1.46		
07/26/84	208	THURSDAY	1434	10	12.8	12.0	07/30/84	A	07/31/84	1.23	1.50	
07/27/84	209	FRIDAY	1453	132	11.9	12.0	07/31/84	B		0.68		
07/30/84	212	MONDAY	1493	137	13.0	13.1	08/01/84	D		0.53		
07/31/84	213	TUESDAY	1523	4	12.8	12.5	08/02/84	C	08/03/84	0.79		0.59
08/01/84	214	WEDNESDAY	1541	59	12.8	12.5	08/06/84	D		0.40		
08/02/84	215	THURSDAY	1572	99	13.1	12.5	08/07/84	D		0.65		
08/03/84	216	FRIDAY	1643	35	9.8	9.5	08/09/84	B		0.50		
08/03/84	216	FRIDAY	1642	188	9.8	9.5	08/09/84	B		0.56		
08/06/84	219	MONDAY	1610	82	12.8	13.0	08/08/84	C	08/09/84	0.55		0.53
08/07/84	220	TUESDAY	1628	184	8.2	9.0	08/09/84	A		0.43		
08/08/84	221	WEDNESDAY	1651	92	12.1	12.0	08/13/84	B		0.19		
08/09/84	222	THURSDAY	1680	12	12.9	11.5	08/13/84	A		0.48		
08/10/84	223	FRIDAY	1707	4	13.1	11.8	08/14/84	D		1.86		
08/13/84	226	MONDAY	1728	53	12.5	13.7	08/15/84	C		0.46		
08/14/84	227	TUESDAY	1750	144	12.5	12.9	08/16/84	A		0.67		
08/15/84	228	WEDNESDAY	1758	95	12.2	12.5	08/17/84	B		0.43		
08/16/84	229	THURSDAY	1801	123	13.0	13.1	08/20/84	D		2.49		
08/17/84	230	FRIDAY	1819	193	11.8	11.9	08/21/84	C	08/22/84	0.74		0.68
08/20/84	233	MONDAY	1831	92	12.2	13.0	08/22/84	C		1.42		
08/21/84	234	TUESDAY	1870	157	13.2	13.5	08/24/84	D	08/25/84	0.41		0.43
08/22/84	235	WEDNESDAY	1878	4	13.2	10.5	08/27/84	D	08/28/84	1.83	1.82	
08/24/84	237	FRIDAY	1939	127	11.5	11.5	08/28/84	D		0.93		
08/27/84	240	MONDAY	1951	18	11.8	11.7	08/29/84	D		0.38		
08/28/84	241	TUESDAY	1974	80	13.0	13.6	08/30/84	C		0.30		
08/29/84	242	WEDNESDAY	2011	25	12.3	12.5	08/31/84	A		0.53		
08/30/84	243	THURSDAY	2018	26	13.0	13.0	09/04/84	C		0.58		
08/31/84	244	FRIDAY	2039	20	11.6	11.5	09/06/84	D	09/06/84	1.16	1.12	
09/04/84	248	TUESDAY	2088	88	13.0	13.0	09/06/84	C		0.50		
09/05/84	249	WEDNESDAY	2104	84	15.2	13.5	09/07/84	C		1.30		
09/06/84	250	THURSDAY	2128	64	13.6	14.0	09/10/84	A	09/11/84	0.91		1.96
09/07/84	251	FRIDAY	2153	82	12.3	13.1	09/11/84	A		0.66		

Table 2-6. Data Listing for Birmingham, Alabama. (cont.)

1984 SUMMER NMOC STUDY - BIRMINGHAM, ALABAMA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
09/10/84	254	MONDAY	2172	130	12.8	13.0	09/12/84	A		0.46		
09/11/84	255	TUESDAY	2204	185	13.2	14.0	09/13/84	D		2.30		
09/12/84	256	WEDNESDAY	2216	175	12.7	13.5	09/14/84	B		1.99		
09/13/84	257	THURSDAY	2241	124	13.1	13.0	09/18/84	C	09/19/84	2.21		2.03
09/14/84	258	FRIDAY	2255	63	12.0	12.0	09/18/84	C		2.91		
09/17/84	261	MONDAY	2281	4	13.0	13.2	09/19/84	C	09/20/84	0.73		0.53
09/18/84	262	TUESDAY	2302	11	13.8	14.0	09/20/84	A		0.39		
09/19/84	263	WEDNESDAY	2321	152	13.5	13.3	09/21/84	B		0.83		
09/20/84	264	THURSDAY	2359	142	13.2	13.1	09/24/84	A		2.44		
09/21/84	265	FRIDAY	2372	23	12.8	13.5	09/25/84	C		1.48		
09/24/84	268	MONDAY	2405	126	13.7	13.0	09/26/84	B	09/27/84	0.25	0.76	
09/25/84	269	TUESDAY	2415	92	13.2	13.0	09/27/84	D		0.41		
09/26/84	270	WEDNESDAY	2435	93	12.4	12.0	09/28/84	A		2.50		
09/27/84	271	THURSDAY	2462	96	13.2	13.0	10/02/84	A	10/02/84	0.75	0.90	
09/28/84	272	FRIDAY	2491	51	12.1	12.0	10/02/84	B		0.64		

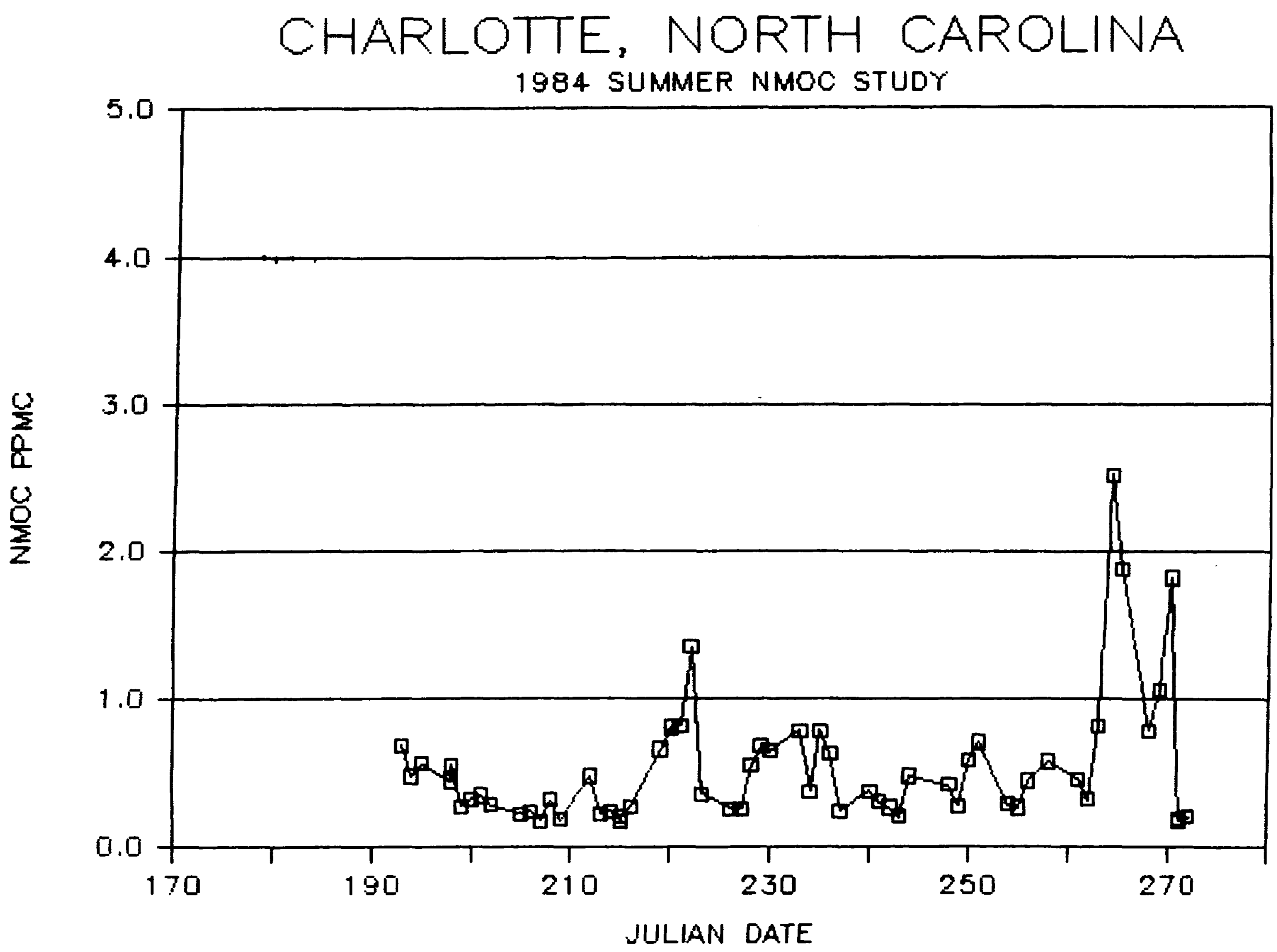

Figure 2-5. Plot of NMOC Data for Charlotte, North Carolina.

Table 2-7. Data Listing for Charlotte, North Carolina.

1984 SUMMER NMOC STUDY - CHARLOTTE, NORTH CAROLINA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
07/11/84	193	WEDNESDAY	1254	170	16.5	16.5	07/17/84	C	07/18/84	0.69	0.79	
07/12/84	194	THURSDAY	1255	169	16.5	16.5	07/17/84	A	07/19/84	0.48		0.51
07/13/84	195	FRIDAY	1253	157	17.5	17.5	07/17/84	D	07/18/84	0.57	0.75	
07/16/84	198	MONDAY	1251	184	19.0	19.0	07/17/84	D		0.45		
07/16/84	198	MONDAY	1252	188	19.0	19.5	07/17/84	C		0.56		
07/17/84	199	TUESDAY	1281	32	10.5	10.0	07/18/84	A		0.28		
07/18/84	200	WEDNESDAY	1298	192	17.0	17.0	07/19/84	A		0.33		
07/19/84	201	THURSDAY	1323	186	17.0	17.0	07/21/84	D	07/24/84	0.35		0.40
07/20/84	202	FRIDAY	1338	26	16.8	17.0	07/23/84	B		0.29		
07/23/84	205	MONDAY	1345	107	16.8	16.7	07/24/84	C		0.23		
07/24/84	206	TUESDAY	1384	43	16.5	16.5	07/25/84	C		0.25		
07/25/84	207	WEDNESDAY	1411	115	16.5	17.0	07/26/84	B	07/27/84	0.18		0.35
07/26/84	208	THURSDAY	1432	87	16.0	16.5	07/27/84	B		0.32		
07/27/84	209	FRIDAY	1442	105	16.5	16.5	07/30/84	C	08/03/84	0.19		0.18
07/30/84	212	MONDAY	1461	194	17.1	17.0	07/31/84	C		0.48		
07/31/84	213	TUESDAY	1495	21	16.5	16.5	08/01/84	D	08/03/84	0.23		0.22
08/01/84	214	WEDNESDAY	1521	43	15.9	16.0	08/02/84	A		0.25		
08/02/84	215	THURSDAY	1533	2	15.0	15.0	08/06/64	C		0.19		
08/02/84	215	THURSDAY	1532	156	15.0	14.8	08/06/84	A		0.21		
08/03/84	216	FRIDAY	1578	117	16.1	16.0	08/06/84	C		0.28		
08/06/84	219	MONDAY	1591	133	16.5	15.0	08/08/84	D	08/08/84	0.66		0.52
08/07/84	220	TUESDAY	1617	102	16.3	16.5	08/08/84	D	08/09/84	0.81		0.71
08/08/84	221	WEDNESDAY	1659	69	17.0	17.0	08/13/84	C	08/14/84	0.82		0.71
08/09/84	222	THURSDAY	1663	23	16.5	16.2	08/13/84	D	08/14/84	1.35		1.16
08/10/84	223	FRIDAY	1678	29	25.0	13.3	08/13/84	D	08/14/84	0.36		0.34
08/13/84	226	MONDAY	1721	127	16.5	16.4	08/15/84	C	08/20/84	0.26		0.28
08/14/84	227	TUESDAY	1715	136	16.5	17.0	08/15/84	C		0.26		
08/15/84	228	WEDNESDAY	1745	187	16.8	17.0	08/17/84	C		0.56		
08/16/84	229	THURSDAY	1765	165	15.5	15.0	08/17/84	A		0.68		
08/16/84	229	THURSDAY	1764	188	15.5	14.9	08/17/84	B		0.69		
08/17/84	230	FRIDAY	1803	113	16.7	16.5	08/20/84	A		0.65		
08/20/84	233	MONDAY	1847	151	17.5	15.3	08/22/84	A		0.79		
08/21/84	234	TUESDAY	1841	137	16.5	17.8	08/22/84	D	08/23/84	0.38		0.34
08/22/84	235	WEDNESDAY	1913	81	17.0	13.0	08/28/84	D		0.79		
08/23/84	236	THURSDAY	1886	20	16.2	15.5	08/27/84	D		0.64		
08/24/84	237	FRIDAY	1912	76	16.8	16.7	08/28/84	B		0.25		
08/27/84	240	MONDAY	1926	1	25.5	19.5	08/28/84	D		0.38		
08/28/84	241	TUESDAY	1961	112	16.5	16.5	08/29/84	A		0.31		
08/29/84	242	WEDNESDAY	1989	134	16.5	16.9	08/30/84	D		0.27		
08/30/84	243	THURSDAY	2012	77	16.5	16.1	08/31/84	C		0.21		
08/31/84	244	FRIDAY	2027	95	16.8	16.2	09/04/84	A	09/05/84	0.48		0.43

Table 2-7. Data Listing for Charlotte, North Carolina. (cont.)

1984 SUMMER NMOC STUDY - CHARLOTTE, NORTH CAROLINA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
09/04/84	248	TUESDAY	2073	163	16.0	15.9	09/06/84	D		0.42		
09/05/84	249	WEDNESDAY	2087	182	17.3	17.2	09/06/84	D	09/07/84	0.28	0.37	
09/06/84	250	THURSDAY	2106	105	17.2	17.0	09/10/84	D		0.59		
09/07/84	251	FRIDAY	2121	77	17.0	17.0	09/10/84	C		0.71		
09/10/84	254	MONDAY	2155	108	16.5	17.0	09/11/84	C	09/13/84	0.29	0.33	
09/11/84	255	TUESDAY	2193	32	16.8	17.0	09/13/84	B		0.27		
09/12/84	256	WEDNESDAY	2191	49	17.5	17.4	09/13/84	B		0.45		
09/14/84	258	FRIDAY	2240	114	16.9	16.5	09/18/84	D		0.58		
09/17/84	261	MONDAY	2264	163	17.5	18.0	09/18/84	D		0.46		
09/18/84	262	TUESDAY	2267	20	17.5	17.3	09/19/84	B		0.32		
09/19/84	263	WEDNESDAY	2301	80	17.3	18.0	09/20/84	D	09/21/84	0.82		0.82
09/20/84	264	THURSDAY	2319	95	17.2	17.0	09/21/84	B		2.52		
09/21/84	265	FRIDAY	2352	190	17.7	18.0	09/24/84	C		1.88		
09/24/84	268	MONDAY	2410	89	17.5	17.4	09/27/84	B	09/28/84	0.79		0.75
09/25/84	269	TUESDAY	2409	106	17.5	17.1	09/27/84	A	09/28/84	1.06		0.91
09/26/84	270	WEDNESDAY	2423	196	17.0	17.2	09/28/84	C	09/29/84	1.82		1.67
09/27/84	271	THURSDAY	2474	112	16.0	15.5	10/02/84	B	10/02/84	0.18	0.23	0.15
09/27/84	271	THURSDAY	2473	146	16.0	15.7	10/01/84	C		0.19		
09/28/84	272	FRIDAY	2472	32	17.5	17.3	10/02/84	C	10/03/84	0.21		0.21

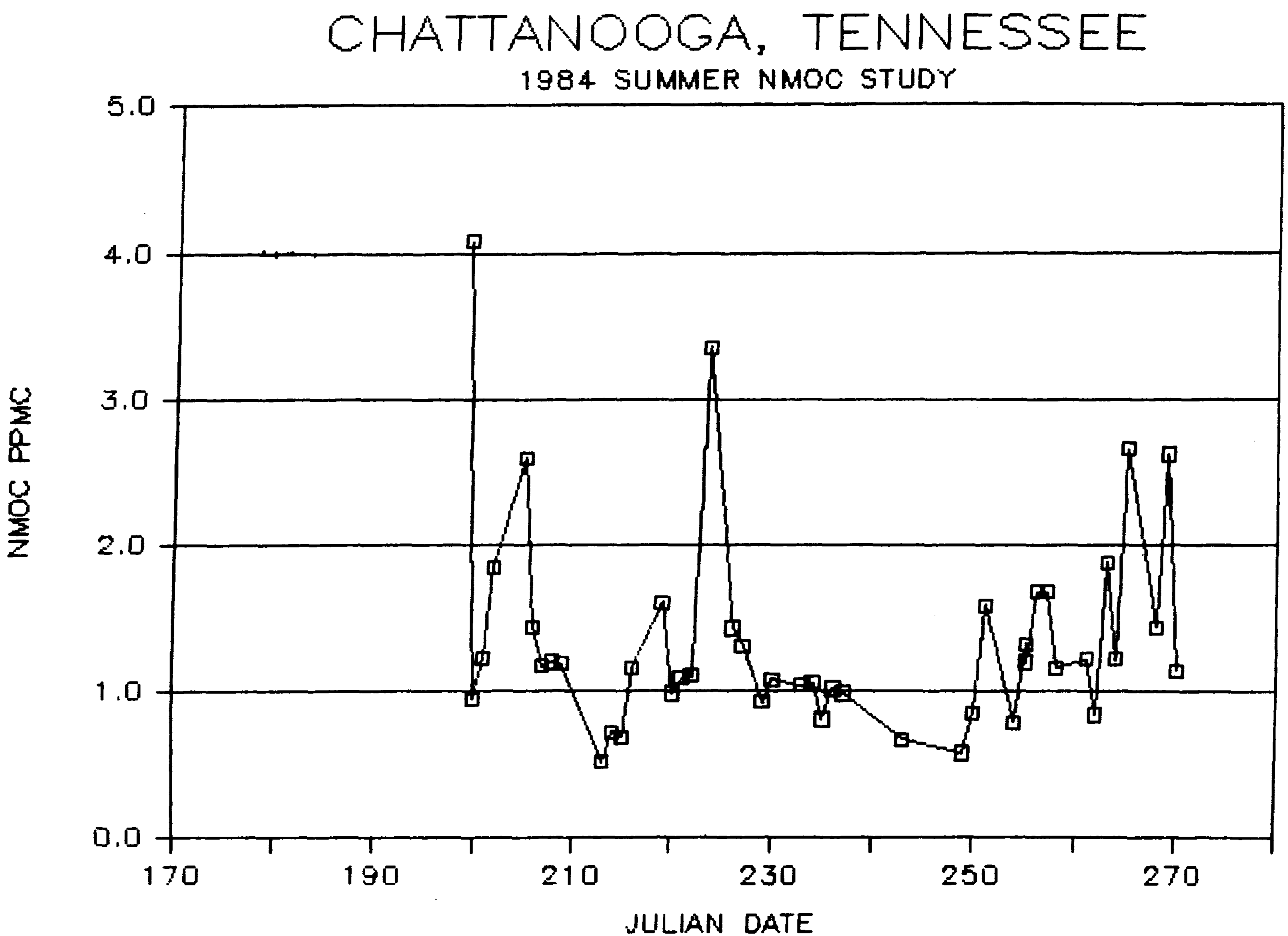

Figure 2-6. Plot of NMOC Data for Chattanooga, Tennessee.

Table 2-8. Data Listing for Chattanooga, Tennessee.

1984 SUMMER NMOC STUDY - CHATTANOOGA, TENNESSEE

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
07/17/84	199	TUESDAY	1371	44	25.2	14.5	07/25/84	A	07/27/84	4.08		3.94
07/18/84	200	WEDNESDAY	1368	33	22.3	15.5	07/25/84	D		0.95		
07/19/84	201	THURSDAY	1380	123	15.7	15.4	07/25/84	B	07/27/84	1.23		1.13
07/20/84	202	FRIDAY	1370	191	15.5	16.0	07/25/84	C		1.85		
07/23/84	205	MONDAY	1406	48	14.8	15.0	07/26/84	C	07/27/84	2.60		2.21
07/24/84	206	TUESDAY	1428	23	15.8	16.0	07/27/84	B	07/30/84	1.44	1.61	
07/25/84	207	WEDNESDAY	1436	184	15.0	14.5	07/30/84	D		1.17		
07/26/84	208	THURSDAY	1482	118	15.2	15.0	07/31/84	A		1.20		
07/27/84	209	FRIDAY	1490	108	16.0	15.6	08/01/84	D	08/03/84	1.19		1.19
07/31/84	213	TUESDAY	1537	147	16.0	15.6	08/06/84	D		0.52		
08/01/84	214	WEDNESDAY	1567	71	16.0	14.9	08/07/84	D		0.72		
08/02/84	215	THURSDAY	1587	104	14.0	14.0	08/08/84	B		0.69		
08/02/84	215	THURSDAY	1588	143	14.0	14.5	08/07/84	A		0.69		
08/03/84	216	FRIDAY	1608	155	15.0	15.0	08/08/84	D		1.16		
08/06/84	219	MONDAY	1666	68	14.0	14.0	08/13/84	B	08/13/84	1.60	1.49	
08/07/84	220	TUESDAY	1646	87	16.0	15.0	08/10/84	C	08/11/84	0.99		0.81
08/08/84	221	WEDNESDAY	1688	105	15.0	12.5	08/13/84	B		1.09		
08/09/84	222	THURSDAY	1691	90	15.0	14.0	08/14/84	A		1.11		
08/10/84	223	FRIDAY	1740	160	15.0	13.0	08/16/84	A		3.35		
08/13/84	226	MONDAY	1738	18	14.5	13.4	08/16/84	B		1.43		
08/14/84	227	TUESDAY	1778	128	16.0	14.9	08/20/84	C		1.31		
08/16/84	229	THURSDAY	1824	112	16.2	14.7	08/21/84	C		0.93		
08/17/84	230	FRIDAY	1835	150	16.5	16.0	08/22/84	D		1.08		
08/20/84	233	MONDAY	1853	158	15.5	15.0	08/24/84	D	08/24/84	1.04	1.23	
08/21/84	234	TUESDAY	1887	69	23.0	15.5	08/27/84	A	08/27/84	1.06	1.07	
08/22/84	235	WEDNESDAY	1907	14	15.0	14.6	08/28/84	A	08/29/84	0.81		0.73
08/23/84	236	THURSDAY	1937	30	14.5	14.1	08/28/84	A		1.02		
08/24/84	237	FRIDAY	1958	177	15.8	16.0	08/29/84	A	08/30/84	0.99	0.90	
08/30/84	243	THURSDAY	2042	48	14.0	13.5	09/06/84	C	09/06/84	0.67	0.72	
09/05/84	249	WEDNESDAY	2125	91	15.0	15.0	09/10/84	C		0.58		
09/06/84	250	THURSDAY	2150	177	15.5	16.5	09/11/84	D		0.85		
09/07/84	251	FRIDAY	2165	147	16.0	17.0	09/12/84	C		1.59		
09/10/84	254	MONDAY	2194	150	16.0	16.2	09/13/84	A		0.79		
09/11/84	255	TUESDAY	2211	34	15.5	16.1	09/14/84	C		1.33		
09/11/84	255	TUESDAY	2210	41	15.5	16.0	09/14/84	D		1.20		
09/12/84	256	WEDNESDAY	2263	92	15.5	15.2	09/18/84	B		1.68		
09/13/84	257	THURSDAY	2254	2	14.8	15.0	09/18/84	D		1.68		
09/14/84	258	FRIDAY	2283	45	16.0	16.0	09/19/84	C	09/20/84	1.16		0.99
09/17/84	261	MONDAY	2318	51	16.5	16.0	09/21/84	A		1.22		
09/18/84	262	TUESDAY	2335	153	16.0	16.5	09/21/84	A	09/24/84	0.84	0.94	
09/19/84	263	WEDNESDAY	2350	176	16.0	14.5	09/24/84	D		1.88		

Table 2-8. Data Listing for Chattanooga, Tennessee. (cont.)

1984 SUMMER NMOC STUDY - CHATTANOOGA, TENNESSEE

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
09/20/84	264	THURSDAY	2367	59	14.7	14.5	09/25/84	B	09/26/84	1.22		1.10
09/21/84	265	FRIDAY	2393	7	16.2	16.0	09/26/84	C	09/27/84	2.66		2.32
09/24/84	268	MONDAY	2418	29	15.8	15.5	09/27/84	C	09/28/84	1.44		1.31
09/25/84	269	TUESDAY	2450	55	16.0	14.0	10/01/84	D	10/02/84	2.62		2.52
09/26/84	270	WEDNESDAY	2459	2	14.5	14.5	10/01/84	C	10/02/84	1.15		0.98

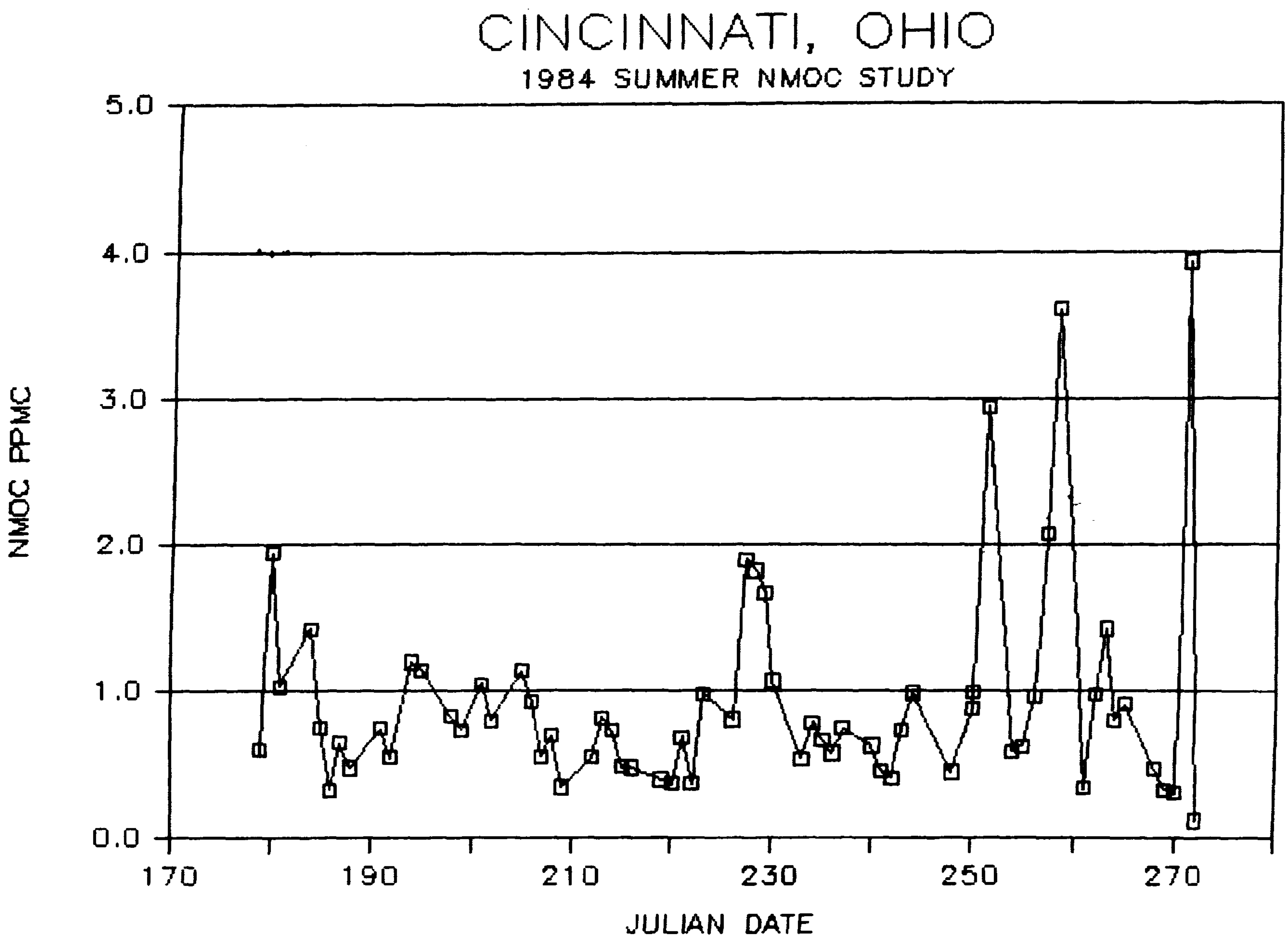

Figure 2-7. Plot of NMOC Data for Cincinnati, Ohio.

Table 2-9. Data Listing for Cincinnati, Ohio.

1984 SUMMER NMOC STUDY - CINCINNATI, OHIO

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC OAD	NMOC PPMC ESRL-GC
06/27/84	179	WEDNESDAY	1062	67	14.4	14.5	06/29/84	B		0.60		
06/28/84	180	THURSDAY	1078	70	14.9	15.0	07/02/84	C	07/10/84	1.94		1.65
06/29/84	181	FRIDAY	1084	103	14.3	14.0	07/03/84	B	07/10/84	1.03		0.87
07/02/84	184	MONDAY	1106	122	15.0	15.2	07/05/84	A	07/06/84	1.42	1.55	
07/03/84	185	TUESDAY	1128	138	14.5	14.8	07/06/84	D		0.75		
07/04/84	186	WEDNESDAY	1133	18	14.3	14.0	07/09/84	A	07/10/84	0.33		0.32
07/05/84	187	THURSDAY	1146	21	14.2	14.5	07/09/84	D		0.65		
07/06/84	188	FRIDAY	1154	27	14.3	14.5	07/10/84	A		0.48		
07/09/84	191	MONDAY	1161	58	15.1	15.5	07/11/84	C	07/16/84	0.75		0.64
07/10/84	192	TUESDAY	1179	56	14.5	13.5	07/12/84	B		0.55		
07/12/84	194	THURSDAY	1224	168	15.0	15.0	07/16/84	C		1.20		
07/13/84	195	FRIDAY	1247	20	14.0	14.5	07/17/84	A		1.15		
07/16/84	198	MONDAY	1260	167	15.0	15.0	07/18/84	A	07/23/84	0.83		0.66
07/17/84	199	TUESDAY	1287	24	14.0	14.0	07/19/84	E		0.74		
07/19/84	201	THURSDAY	1341	73	16.0	15.5	07/23/84	B		1.05		
07/20/84	202	FRIDAY	1353	3	14.0	14.5	07/24/84	A		0.80		
07/23/84	205	MONDAY	1383	59	15.0	15.2	07/25/84	B	07/26/84	1.14	1.43	
07/24/84	206	TUESDAY	1410	188	14.0	14.0	07/26/84	A	07/27/84	0.93		0.86
07/25/84	207	WEDNESDAY	1419	103	15.0	15.0	07/27/84	A		0.56		
07/26/84	208	THURSDAY	1449	126	16.0	14.9	07/30/84	D	07/31/84	0.70	0.94	
07/27/84	209	FRIDAY	1467	93	15.0	14.9	07/31/84	A		0.35		
07/30/84	212	MONDAY	1484	13	15.0	15.1	08/01/84	C	08/01/84	0.55	0.59	
07/31/84	213	THURSDAY	1520	78	14.0	20.0	08/02/84	B		0.82		
08/01/84	214	WEDNESDAY	1542	74	14.0	14.5	08/06/84	D		0.73		
08/02/84	215	THURSDAY	1573	152	16.0	15.5	08/07/84	C	08/08/84	0.49		0.44
08/03/84	216	FRIDAY	1598	125	14.0	15.0	08/07/84	A		0.48		
08/06/84	219	MONDAY	1607	196	15.0	15.0	08/08/84	C		0.40		
08/07/84	220	TUESDAY	1627	24	15.0	15.0	08/09/84	D		0.37		
08/08/84	221	WEDNESDAY	1650	22	15.0	15.0	08/10/84	C	08/13/84	0.69		0.65
08/09/84	222	THURSDAY	1684	145	14.0	14.0	08/13/84	A		0.37		
08/10/84	223	FRIDAY	1696	7	15.0	13.9	08/15/84	B		0.98		
08/13/84	226	MONDAY	1732	154	15.0	15.0	08/15/84	B		0.81		
08/14/84	227	TUESDAY	1773	135	14.0	14.5	08/20/84	A		1.90		
08/15/84	228	WEDNESDAY	1771	172	0.0	15.3	08/17/84	D		1.82		
08/16/84	229	THURSDAY	1785	182	15.0	15.8	08/20/84	D		1.67		
08/17/84	230	FRIDAY	1826	108	15.0	14.8	08/21/84	D	08/22/84	1.07		0.94
08/20/84	233	MONDAY	1838	68	15.0	14.5	08/22/84	A		0.54		
08/21/84	234	TUESDAY	1992	122	15.0	14.5	08/24/84	B		0.79		
08/22/84	235	WEDNESDAY	1890	57	15.0	14.5	08/27/84	B		0.67		
08/23/84	236	THURSDAY	1909	156	16.0	15.3	08/27/84	D		0.58		
08/24/84	237	FRIDAY	1929	102	15.0	14.9	08/28/84	C	08/28/84	0.75		0.59

Table 2-9. Data Listing for Cincinnati, Ohio. (cont.)

1984 SUMMER NMOC STUDY - CINCINNATI, OHIO

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC OAD	NMOC PPMC ESRL-GC
08/27/84	240	MONDAY	1962	71	15.0	15.0	08/29/84	D		0.63		
08/28/84	241	TUESDAY	1976	110	15.0	14.9	08/30/84	D	08/31/84	0.46		0.42
08/29/84	242	WEDNESDAY	2009	195	15.0	14.9	08/31/84	A		0.41		
08/30/84	243	THURSDAY	2032	98	15.0	14.9	09/04/84	B		0.74		
08/31/84	244	FRIDAY	2052	15	15.0	15.0	09/05/84	D		0.99		
09/04/84	248	TUESDAY	2095	54	15.0	14.5	09/07/84	C		0.45		
09/06/84	250	THURSDAY	2123	121	17.0	17.0	09/10/84	D		0.88		
09/06/84	250	THURSDAY	2124	71	17.0	15.5	09/10/84	D		1.00		
09/07/84	251	FRIDAY	2161	141	14.0	14.0	09/12/84	C	09/13/84	2.94		2.28
09/10/84	254	MONDAY	2174	129	22.0	23.1	09/12/84	C	09/13/84	0.59		0.59
09/11/84	255	TUESDAY	2205	26	14.0	13.5	09/13/84	C		0.62		
09/12/84	256	WEDNESDAY	2222	158	16.0	15.8	09/14/84	D		0.96		
09/13/84	257	THURSDAY	2236	75	17.0	16.7	09/17/84	D		2.07		
09/14/84	258	FRIDAY	2252	84	18.0	13.8	09/18/84	A		3.61		
09/17/84	261	MONDAY	2268	30	16.0	16.5	09/19/84	A	09/20/84	0.34		0.34
09/18/84	262	TUESDAY	2309	159	13.0	13.5	09/20/84	C		0.98		
09/19/84	263	WEDNESDAY	2317	42	14.0	14.2	09/21/84	C		1.43		
09/20/84	264	THURSDAY	2356	189	14.0	14.0	09/24/84	C	09/25/84	0.80	0.81	
09/21/84	265	FRIDAY	2366	76	13.0	14.0	09/25/84	B	09/26/84	0.91	1.17	
09/24/84	268	MONDAY	2404	169	15.0	15.1	09/26/84	D		0.47		
09/25/84	269	TUESDAY	2416	156	14.0	14.0	09/27/84	C		0.33		
09/26/84	270	WEDNESDAY	2451	107	15.0	15.0	10/01/84	C		0.31		
09/27/84	271	THURSDAY	2461	4	20.0	16.0	10/01/84	D	10/02/84	3.93		3.51
09/28/84	272	FRIDAY	2483	109	15.0	14.5	10/02/84	A		0.12		

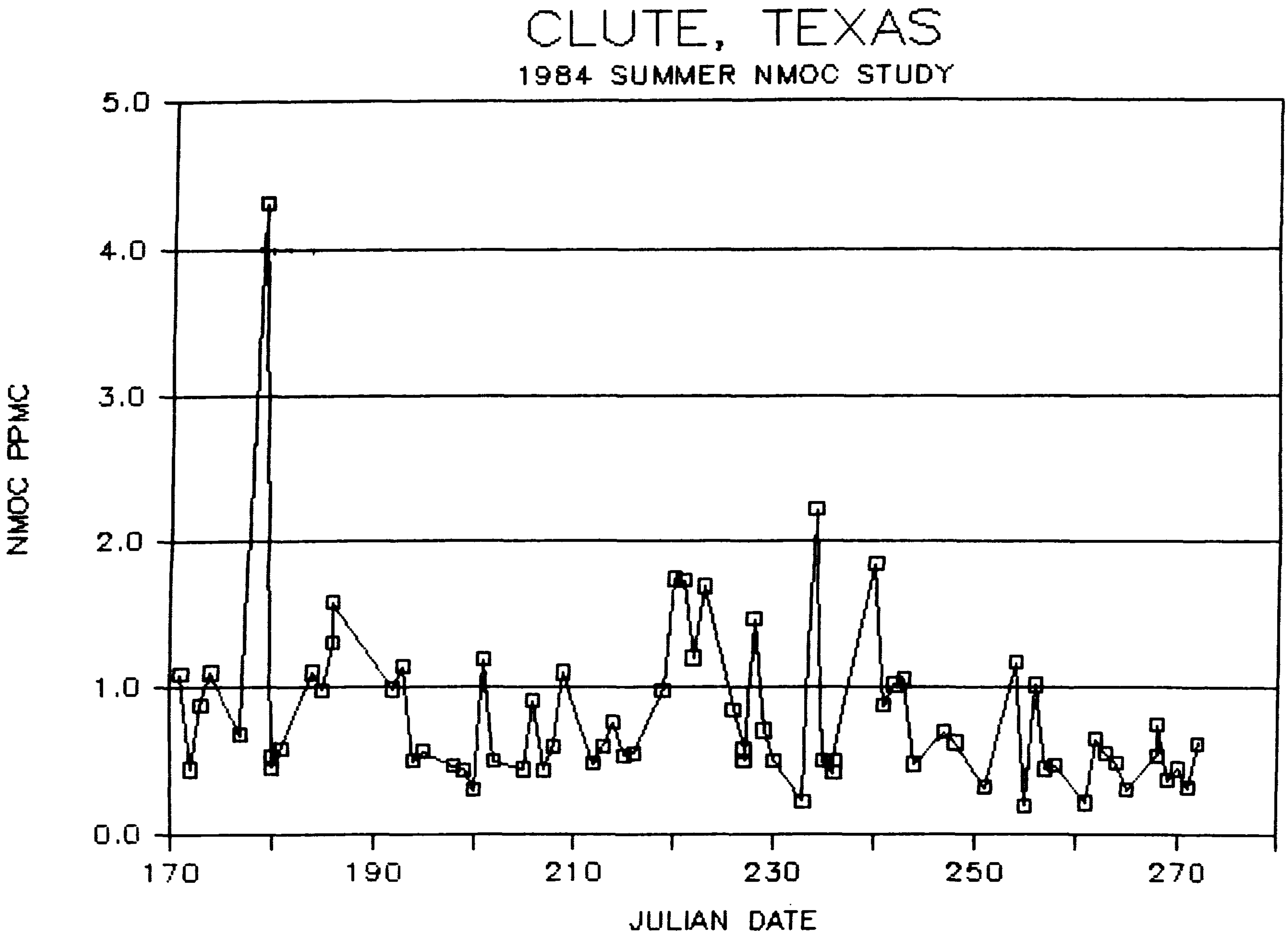

Figure 2-8. Plot of NMOC Data for Clute, Texas.

Table 2-10. Data Listing for Clute, Texas.

1984 SUMMER NMOC STUDY - CLUTE, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/19/84	171	TUESDAY	1006	19	17.5	18.0	06/21/84	D	06/22/84	1.09		1.22
06/20/84	172	WEDNESDAY	1009	24	17.5	18.5	06/21/84	B		0.45		
06/21/84	173	THURSDAY	1018	35	18.5	19.5	06/22/84	D	06/25/84	0.88		0.88
06/22/84	174	FRIDAY	1035	47	18.0	18.3	06/26/84	D		1.10		
06/25/84	177	MONDAY	1036	52	17.5	18.0	06/26/84	C		0.68		
06/27/84	179	WEDNESDAY	1053	84	17.9	17.5	06/28/84	A	06/29/84	4.31		4.03
06/28/84	180	THURSDAY	1069	99	17.1	17.5	06/29/84	D	07/10/84	0.53		0.45
06/28/84	180	THURSDAY	1068	96	17.1	17.3	06/29/84	B	07/10/84	0.46		0.45
06/29/84	181	FRIDAY	1071	107	15.8	17.3	07/02/84	D		0.59		
07/02/84	184	MONDAY	1087	127	20.0	20.0	07/03/84	D	07/05/84	1.10	1.24	
07/03/84	185	TUESDAY	1109	142	17.1	17.9	07/05/84	B		0.98		
07/04/84	186	WEDNESDAY	1131	17	5.1	8.0	07/06/84	C		1.30		
07/04/84	186	WEDNESDAY	1139	44	18.1	16.2	07/09/84	B		1.58		
07/10/84	192	TUESDAY	1168	41	17.0	17.5	07/11/84	A		0.99		
07/11/84	193	WEDNESDAY	1195	75	17.3	18.5	07/12/84	B	07/13/84	1.14	1.15	
07/12/84	194	THURSDAY	1203	101	18.0	18.9	07/13/84	A		0.50		
07/13/84	195	FRIDAY	1234	124	18.1	18.5	07/16/84	D	07/19/84	0.57		0.58
07/16/84	198	MONDAY	1258	105	23.0	24.0	07/17/84	D	07/19/84	0.47		0.49
07/17/84	199	TUESDAY	1271	116	16.8	17.0	07/18/84	C		0.44		
07/18/84	200	WEDNESDAY	1320	145	18.0	18.0	07/20/84	C		0.31		
07/19/84	201	THURSDAY	1331	34	19.0	19.5	07/23/84	A		1.19		
07/20/84	202	FRIDAY	1352	147	17.0	17.5	07/24/84	D		0.50		
07/23/84	205	MONDAY	1377	58	20.0	20.5	07/25/84	B	07/27/84	0.45		0.46
07/24/84	206	TUESDAY	1396	25	16.0	17.5	07/16/84	D		0.91		
07/25/84	207	WEDNESDAY	1414	139	17.0	19.0	07/27/84	C		0.44		
07/26/84	208	THURSDAY	1476	165	17.5	17.2	08/01/84	A		0.61		
07/27/84	209	FRIDAY	1481	174	16.4	16.5	08/01/84	C		1.10		
07/30/84	212	MONDAY	1518	145	20.5	21.0	08/02/84	A		0.49		
07/31/84	213	TUESDAY	1527	29	18.0	17.7	08/02/84	C		0.61		
08/01/84	214	WEDNESDAY	1547	14	18.0	17.9	08/06/84	C		0.76		
08/02/84	215	THURSDAY	1562	111	18.0	18.5	08/07/84	B	08/08/84	0.54		0.46
08/03/84	216	FRIDAY	1594	30	17.0	17.2	08/08/84	A		0.56		
08/06/84	219	MONDAY	1606	161	21.0	21.0	08/08/84	D		0.98		
08/07/84	220	TUESDAY	1636	193	17.5	17.5	08/09/84	A		1.74		
08/08/84	221	WEDNESDAY	1661	174	18.0	17.5	08/13/84	D	08/14/84	1.73		1.95
08/09/84	222	THURSDAY	1673	26	17.0	17.2	08/13/84	C		1.20		
08/10/84	223	FRIDAY	1702	21	17.0	17.9	08/15/84	C		1.69		
08/13/84	226	MONDAY	1727	153	19.0	19.0	08/15/84	D		0.85		
08/14/84	227	TUESDAY	1736	84	16.5	16.5	08/16/84	A		0.58		
08/14/84	227	TUESDAY	1735	164	16.5	17.0	08/16/84	C	08/20/84	0.51		0.51
08/15/84	228	WEDNESDAY	1763	124	18.0	18.6	08/17/84	C		1.47		

Table 2-10. Data Listing for Clute, Texas. (cont.)

1984 SUMMER NMOC STUDY - CLUTE, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/16/84	229	THURSDAY	1794	61	18.0	18.0	08/20/84	A		0.71		
08/17/84	230	FRIDAY	1812	83	18.0	18.0	08/21/84	C		0.51		
08/20/84	233	MONDAY	1842	19	18.0	17.9	08/22/84	A		0.23		
08/21/84	234	TUESDAY	1868	29	17.5	18.0	08/24/84	C		2.22		
08/22/84	235	WEDNESDAY	1889	100	18.0	18.2	08/27/84	A	08/27/84	0.50	1.16	
08/23/84	236	THURSDAY	1900	165	16.0	16.5	08/23/84	D		0.42		
08/23/84	236	THURSDAY	1901	172	16.0	16.5	08/27/84	B		0.51		
08/27/84	240	MONDAY	1965	115	18.0	18.0	08/29/84	A		1.84		
08/28/84	241	TUESDAY	1980	155	17.5	18.1	08/30/84	C		0.88		
08/29/84	242	WEDNESDAY	2002	150	18.0	18.1	08/31/84	C		1.02		
08/30/84	243	THURSDAY	2025	108	18.0	17.0	09/04/84	C		1.06		
08/31/84	244	FRIDAY	2038	136	18.0	18.0	09/06/84	B	09/07/84	0.48		0.47
09/03/84	247	MONDAY	2084	74	18.0	18.0	09/06/84	B		0.70		
09/04/84	248	TUESDAY	2069	75	17.0	17.2	09/06/84	D		0.63		
09/07/84	251	FRIDAY	2149	58	17.8	18.5	09/11/84	D	09/12/84	0.32		0.31
09/10/84	254	MONDAY	2180	189	18.0	18.0	09/13/84	C	09/14/84	1.17		1.05
09/11/84	255	TUESDAY	2187	77	18.0	18.0	09/13/84	D		0.20		
09/12/84	256	WEDNESDAY	2206	126	18.0	18.3	09/14/84	C		1.02	1.00	
09/13/84	257	THURSDAY	2233	17	18.0	18.0	09/17/84	B		0.45		
09/14/84	258	FRIDAY	2245	3	18.0	18.5	09/18/84	D		0.47		
09/17/84	261	MONDAY	2296	180	19.0	19.5	09/19/84	D		0.22		
09/18/84	262	TUESDAY	2312	44	17.0	19.1	09/20/84	B		0.65		
09/19/84	263	WEDNESDAY	2339	171	18.0	18.2	09/21/84	D		0.55		
09/20/84	264	THURSDAY	2346	110	18.0	18.6	09/24/84	B		0.49		
09/21/84	265	FRIDAY	2392	39	17.3	17.9	09/26/84	D	09/27/84	0.31	0.43	0.34
09/24/84	268	MONDAY	2395	157	18.0	18.5	09/26/84	C		0.54		
09/24/84	268	MONDAY	2394	62	18.0	16.5	09/26/84	B		0.75		
09/25/84	269	TUESDAY	2431	119	17.5	18.0	09/28/84	A		0.37		
09/26/84	270	WEDNESDAY	2445	74	18.0	18.4	10/01/84	A	10/02/84	0.45		0.54
09/27/84	271	THURSDAY	2463	164	19.0	19.5	10/01/84	D		0.32		
09/28/84	272	FRIDAY	2490	192	20.0	20.1	10/02/84	C		0.62		

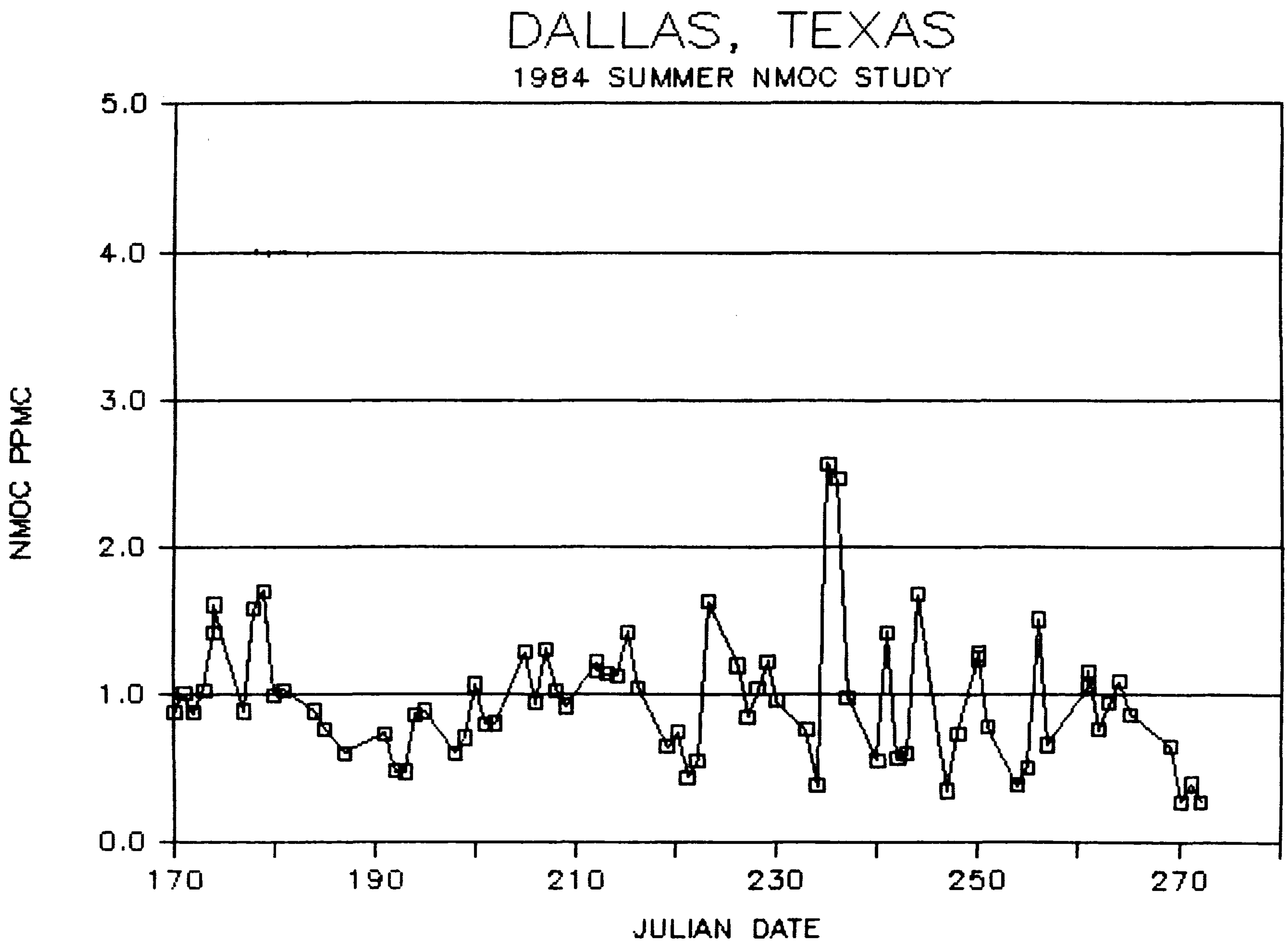

Figure 2-9. Plot of NMOC Data for Dallas, Texas.

Table 2-11. Data Listing for Dallas, Texas.

1984 SUMMER NMOC STUDY - DALLAS, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/18/84	170	MONDAY	1000	14	17.5	11.5	06/20/84	C	06/21/84	0.88		0.90
06/19/84	171	TUESDAY	1001	15	19.0	19.0	06/20/84	B	06/21/84	1.01	1.63	
06/20/84	172	WEDNESDAY	1007	26	19.0	18.5	06/21/84	B	06/22/84	0.88		1.00
06/21/84	173	THURSDAY	1017	33	17.5	17.0	06/22/84	C		1.03		
06/22/84	174	FRIDAY	1029	44	16.0	13.0	06/25/84	A	06/26/84	1.42		1.60
06/22/84	174	FRIDAY	1028	42	16.0	16.5	06/25/84	C	06/26/84	1.61		1.61
06/25/84	177	MONDAY	1033	53	16.0	16.0	06/26/84	A	06/27/84	0.89		0.56
06/26/84	178	TUESDAY	1044	61	18.0	18.0	06/27/84	D	06/28/84	1.58	1.77	
06/27/84	179	WEDNESDAY	1049	77	16.0	16.0	06/28/84	A	06/29/84	1.70		1.53
06/28/84	180	THURSDAY	1070	90	18.0	18.0	06/29/84	C	07/10/84	1.00		0.97
06/29/84	181	FRIDAY	1082	110	17.5	17.2	07/03/84	A		1.03		
07/02/84	184	MONDAY	1086	128	18.5	18.0	07/03/84	C		0.89		
07/03/84	185	TUESDAY	1110	143	18.0	17.5	07/05/84	C		0.77		
07/05/84	187	THURSDAY	1145	20	18.0	17.0	07/09/84	B		0.61		
07/09/84	191	MONDAY	1155	31	16.5	16.0	07/10/84	B	07/13/84	0.74		0.62
07/10/84	192	TUESDAY	1174	47	17.0	16.5	07/11/84	C	07/16/84	0.49		0.43
07/11/84	193	WEDNESDAY	1193	73	11.0	11.0	07/12/84	A		0.48		
07/12/84	194	THURSDAY	1201	96	17.5	17.5	07/13/84	C		0.87		
07/13/84	195	FRIDAY	1236	125	11.0	15.5	07/16/84	C		0.89		
07/16/84	198	MONDAY	1267	64	13.0	13.0	07/18/84	D	07/23/84	0.61		0.61
07/17/84	199	TUESDAY	1305	178	19.0	19.0	07/19/84	C		0.71		
07/18/84	200	WEDNESDAY	1325	171	11.5	10.5	07/21/84	C	07/23/84	1.07	1.30	
07/19/84	201	THURSDAY	1335	42	17.5	17.3	07/23/84	B	07/24/84	0.80	1.16	
07/20/84	202	FRIDAY	1365	141	12.5	12.0	07/24/84	B	07/27/84	0.81		0.75
07/23/84	205	MONDAY	1384	75	18.5	18.5	07/25/84	D		1.29		
07/24/84	206	TUESDAY	1401	109	12.0	12.2	07/16/84	D		0.94		
07/25/84	207	WEDNESDAY	1415	140	15.5	16.5	07/27/84	D		1.31		
07/26/84	208	THURSDAY	1441	114	17.5	17.0	07/30/84	D	08/03/84	1.03		0.97
07/27/84	209	FRIDAY	1465	150	18.0	17.2	08/01/84	B		0.92		
07/30/84	212	MONDAY	1499	19	13.0	16.0	08/01/84	C		1.22		
07/30/84	212	MONDAY	1500	186	18.6	16.0	08/01/84	D		1.16		
07/31/84	213	TUESDAY	1525	52	18.5	17.2	08/02/84	C		1.14		
08/01/84	214	WEDNESDAY	1545	67	19.0	18.5	08/06/84	D		1.13		
08/02/84	215	THURSDAY	1566	154	17.5	17.5	08/06/84	C	08/03/84	1.42		1.19
08/03/84	216	FRIDAY	1589	123	17.5	17.9	08/07/84	C		1.05		
08/06/84	219	MONDAY	1611	86	19.0	13.0	08/08/84	D		0.65		
08/07/84	220	TUESDAY	1625	142	19.0	19.0	08/09/84	D		0.75		
08/08/84	221	WEDNESDAY	1648	150	16.0	16.0	08/10/84	B		0.44		
08/09/84	222	THURSDAY	1687	173	17.5	17.1	08/13/84	C		0.56		
08/10/84	223	FRIDAY	1693	34	17.5	17.5	08/14/84	B		1.63		
08/13/84	226	MONDAY	1716	31	18.5	18.9	08/15/84	D		1.20		

Table 2-11. Data Listing for Dallas, Texas. (cont.)

1984 SUMMER NMOC STUDY - DALLAS, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/14/84	227	TUESDAY	1748	177	18.5	18.1	08/17/84	D	08/20/84	0.85		1.06
08/15/84	228	WEDNESDAY	1760	125	19.0	19.0	08/17/84	D		1.04		
08/16/84	229	THURSDAY	1804	120	17.5	17.1	08/20/84	C		1.23		
08/17/84	230	FRIDAY	1808	141	17.5	17.5	08/21/84	A		0.96		
08/20/84	233	MONDAY	1830	130	18.5	19.0	08/22/84	D		0.76		
08/21/84	234	TUESDAY	1852	169	19.5	19.0	08/24/84	C	08/25/84	0.39		0.37
08/22/84	235	WEDNESDAY	1876	78	19.5	15.9	08/27/84	A		2.57		
08/23/84	236	THURSDAY	1910	105	18.0	16.0	08/28/84	C		2.46		
08/24/84	237	FRIDAY	1936	77	17.5	17.1	08/29/84	C	08/30/84	0.98	0.94	0.93
08/27/84	240	MONDAY	1968	132	18.5	18.5	08/29/84	B		0.56		
08/28/84	241	TUESDAY	1987	86	20.0	16.6	08/30/84	D		1.42		
08/29/84	242	WEDNESDAY	2006	92	13.5	13.0	08/31/84	B	09/03/84	0.57		0.52
08/30/84	243	THURSDAY	2016	193	16.0	16.0	09/04/84	D		0.60		
08/31/84	244	FRIDAY	2036	174	17.5	17.5	09/05/84	D		1.68		
09/03/84	247	MONDAY	2085	156	18.0	17.5	09/06/84	A		0.35		
09/04/84	248	TUESDAY	2086	99	19.5	18.9	09/06/84	C		0.74		
09/06/84	250	THURSDAY	2117	6	16.5	15.5	09/10/84	D		1.28		
09/06/84	250	THURSDAY	2118	188	16.5	14.5	09/10/84	C		1.25		
09/07/84	251	FRIDAY	2152	152	18.5	18.0	09/11/84	C	09/12/84	0.78		0.68
09/10/84	254	MONDAY	2169	85	17.5	18.0	09/12/84	C		0.39		
09/11/84	255	TUESDAY	2203	104	15.5	16.0	09/13/84	C	09/14/84	0.51		0.46
09/12/84	256	WEDNESDAY	2229	56	19.0	17.2	09/14/84	C		1.51		
09/13/84	257	THURSDAY	2259	18	18.0	18.0	09/18/84	C		0.66		
09/17/84	261	MONDAY	2287	106	17.0	17.0	09/19/84	C		1.06		
09/17/84	261	MONDAY	2288	71	17.0	16.5	09/19/84	D		1.16		
09/18/84	262	TUESDAY	2311	164	15.0	14.9	09/20/84	B		0.76		
09/19/84	263	WEDNESDAY	2330	195	10.3	10.5	09/21/84	B	09/22/84	0.94		0.96
09/20/84	264	THURSDAY	2357	37	17.0	17.9	09/24/84	A		1.09		
09/21/84	265	FRIDAY	2385	49	17.5	16.5	09/25/84	A		0.87		
09/25/84	269	TUESDAY	2430	133	10.0	10.0	09/28/84	B		0.65		
09/26/84	270	WEDNESDAY	2457	14	15.5	15.5	10/01/84	C		0.28		
09/27/84	271	THURSDAY	2475	33	18.0	17.5	10/02/84	A		0.40		
09/28/84	272	FRIDAY	2498	24	19.0	15.5	10/03/84	D	10/03/84	0.28		0.26

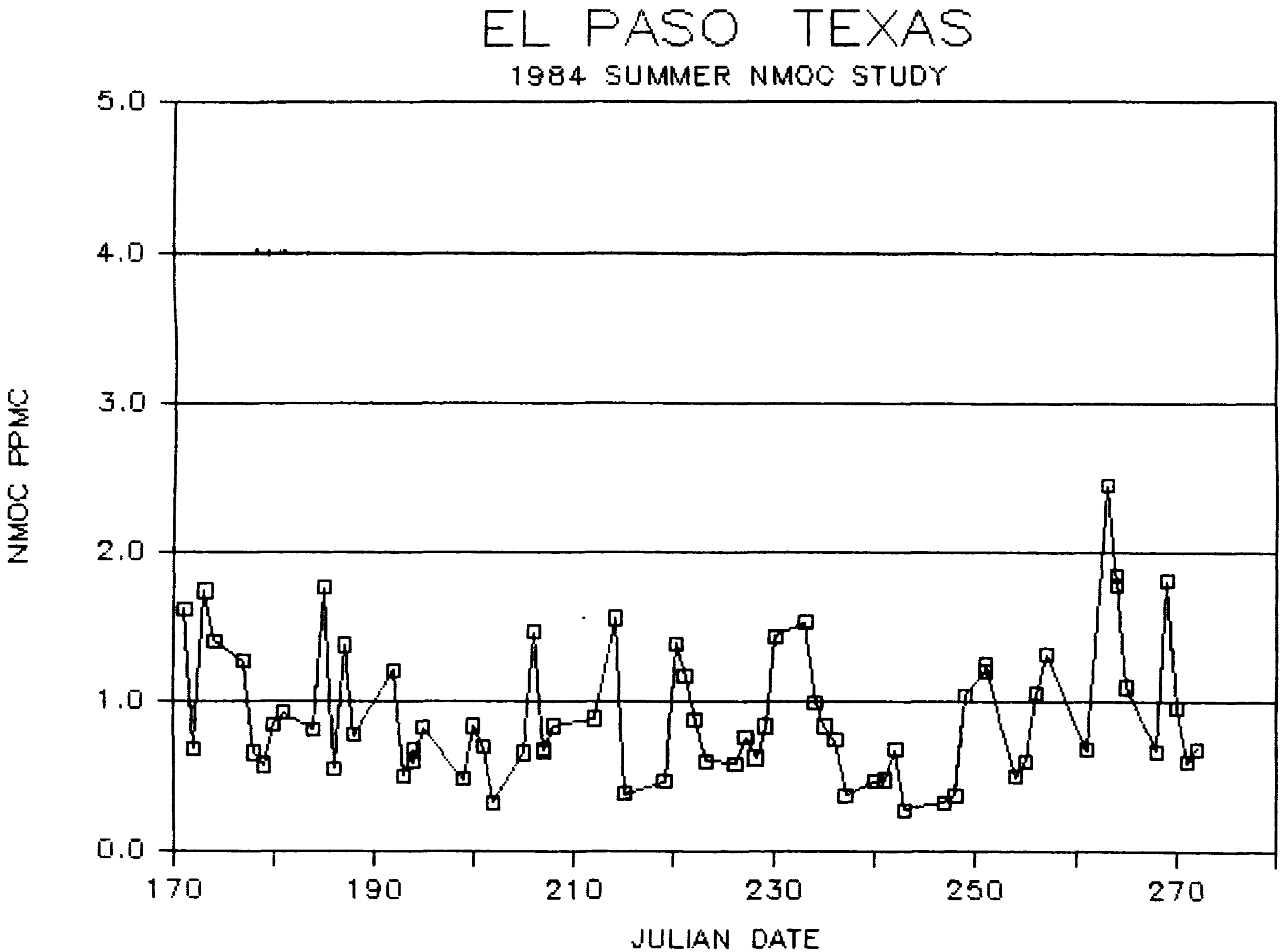

Figure 2-10. Plot of NMOC Data for El Paso, Texas.

Table 2-12. Data Listing for El Paso, Texas.

1984 SUMMER NMOC STUDY - EL PASO, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/19/84	171	TUESDAY	1002	10	21.5	18.0	06/21/84	C		1.62		
06/20/84	172	WEDNESDAY	1021	11	21.5	18.0	06/25/84	D	06/26/84	0.69		0.56
06/21/84	173	THURSDAY	1027	25	20.0	16.0	06/25/84	B	06/26/84	1.74		1.88
06/22/84	174	FRIDAY	1034	34	12.8	9.5	06/26/84	B	06/27/84	1.41		1.53
06/25/84	177	MONDAY	1051	46	13.0	9.8	06/28/84	D		1.27		
06/26/84	178	TUESDAY	1060	58	13.0	9.5	06/29/84	A		0.66		
06/27/84	179	WEDNESDAY	1065	12	12.0	9.5	06/29/84	D		0.58		
06/28/84	180	THURSDAY	1075	92	13.0	10.0	07/02/84	E	07/03/84	0.85	1.04	
06/29/84	181	FRIDAY	1092	83	21.5	18.0	07/03/84	A		0.93		
07/02/84	184	MONDAY	1104	113	13.0	9.0	07/05/84	A		0.82		
07/03/84	185	TUESDAY	1122	126	13.0	9.8	07/06/84	D		1.76		
07/04/84	186	WEDNESDAY	1137	146	13.0	9.5	07/09/84	A		0.56		
07/05/84	187	THURSDAY	1136	10	13.0	9.0	07/09/84	A		1.38		
07/06/84	188	FRIDAY	1156	4	13.0	10.0	07/10/84	B		0.78		
07/10/84	192	TUESDAY	1180	57	12.5	9.5	07/12/84	C	07/16/84	1.21		1.07
07/11/84	193	WEDNESDAY	1207	67	20.0	18.0	07/13/84	A		0.51		
07/12/84	194	THURSDAY	1223	17	13.0	13.0	07/16/84	B		0.68		
07/12/84	194	THURSDAY	1222	127	13.0	10.5	07/16/84	B		0.60		
07/13/84	195	FRIDAY	1250	83	13.0	10.5	07/17/84	A		0.83		
07/17/84	199	TUESDAY	1301	179	13.0	9.5	07/19/84	A		0.49		
07/18/84	200	WEDNESDAY	1322	190	13.0	10.5	07/21/84	C		0.84		
07/19/84	201	THURSDAY	1354	65	13.0	10.0	07/24/84	D		0.70		
07/20/84	202	FRIDAY	1361	99	12.0	9.5	07/24/84	B	07/27/84	0.33		0.32
07/23/84	205	MONDAY	1390	149	13.0	10.0	07/25/84	D		0.66		
07/24/84	206	TUESDAY	1408	128	13.0	10.0	07/26/84	C	07/27/84	1.47	1.56	
07/25/84	207	WEDNESDAY	1421	49	12.5	9.5	07/27/84	B		0.67		
07/25/84	207	WEDNESDAY	1422	97	13.5	10.3	07/27/84	B		0.68		
07/26/84	208	THURSDAY	1450	129	13.5	10.9	07/30/84	C	08/03/84	0.84		0.72
07/30/84	212	MONDAY	1491	51	13.0	10.2	08/01/84	B	08/03/84	0.89		0.85
08/01/84	214	WEDNESDAY	1538	112	13.0	10.0	08/06/84	B		1.56		
08/02/84	215	THURSDAY	1560	168	13.0	11.0	08/06/84	C		0.39		
08/06/84	219	MONDAY	1620	95	13.0	10.0	08/08/84	D		0.47		
08/07/84	220	TUESDAY	1641	126	13.0	11.0	08/09/84	C		1.39		
08/08/84	221	WEDNESDAY	1654	190	13.0	10.5	08/13/84	D		1.17		
08/09/84	222	THURSDAY	1685	51	13.0	10.0	08/14/84	D		0.88		
08/10/84	223	FRIDAY	1706	192	13.0	10.6	08/15/84	D		0.61		
08/13/84	226	MONDAY	1731	89	13.0	10.5	08/15/85	A	08/20/84	0.59		0.57
08/14/84	227	TUESDAY	1751	99	13.0	10.5	08/16/84	D		0.76		
08/15/84	228	WEDNESDAY	1770	149	13.0	11.0	08/17/84	C	08/20/84	0.63	0.99	
08/16/84	229	THURSDAY	1796	62	13.0	10.5	08/20/84	A		0.84		
08/17/84	230	FRIDAY	1821	3	13.0	11.1	08/21/84	C		1.44		

Table 2-12. Data Listing for El Paso, Texas. (cont.)

1984 SUMMER NMOC STUDY - EL PASO, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/20/84	233	MONDAY	1836	10	13.0	10.0	08/22/84	C		1.53		
08/21/84	234	TUESDAY	1859	183	13.0	10.5	08/24/84	D		1.00		
08/22/84	235	WEDNESDAY	1877	31	13.0	10.5	08/27/84	C	08/28/84	0.84		0.79
08/23/84	236	THURSDAY	1914	45	13.0	10.5	08/28/84	D		0.75		
08/24/84	237	FRIDAY	1941	161	13.0	10.5	08/28/84	A		0.38		
08/27/84	240	MONDAY	1955	125	13.0	10.8	08/29/84	D	08/30/84	0.47		0.54
08/28/84	241	TUESDAY	1979	190	13.0	11.0	08/30/84	A	08/31/84	0.48		0.45
08/29/84	242	WEDNESDAY	2004	32	13.0	10.7	08/31/84	D		0.68		
08/30/84	243	THURSDAY	2023	5	13.0	10.0	09/04/84	B		0.28		
09/03/84	247	MONDAY	2076	118	13.0	10.0	09/06/84	A		0.33		
09/04/84	248	TUESDAY	2077	165	14.0	11.0	09/06/84	D		0.38		
09/05/84	249	WEDNESDAY	2099	14	13.0	11.0	09/07/84	D		1.05		
09/07/84	251	FRIDAY	2146	106	14.0	12.0	09/11/84	C		1.21		
09/07/84	251	FRIDAY	2145	19	14.0	11.5	09/11/84	C		1.25		
09/10/84	254	MONDAY	2173	46	12.0	11.0	09/12/84	D	09/13/84	0.50	0.49	
09/11/84	255	TUESDAY	2189	57	12.0	10.8	09/13/84	B		0.61		
09/12/84	256	WEDNESDAY	2223	165	12.0	10.0	09/14/84	C		1.06		1.00
09/13/84	257	THURSDAY	2244	169	13.0	11.0	09/18/84	C		1.32		
09/17/84	261	MONDAY	2280	88	13.0	10.5	09/19/84	C		0.58		
09/19/84	263	WEDNESDAY	2332	54	13.0	11.5	09/21/84	C		2.45		
09/20/84	264	THURSDAY	2361	181	13.0	11.5	09/24/84	C	09/25/84	1.78	1.74	
09/20/84	264	THURSDAY	2360	43	13.0	11.2	09/24/84	B	09/25/84	1.84		1.65
09/21/84	265	FRIDAY	2373	120	13.0	10.5	09/25/84	C		1.10		
09/24/84	268	MONDAY	2390	65	12.0	10.9	09/26/84	C		0.67		
09/25/84	269	TUESDAY	2428	137	12.0	10.4	09/28/84	C	09/29/84	1.81		1.80
09/26/84	270	WEDNESDAY	2454	20	12.0	10.8	10/01/84	B		0.96		
09/27/84	271	THURSDAY	2460	18	11.0	9.0	10/01/84	C		0.60		
09/28/84	272	FRIDAY	2497	144	12.0	11.0	10/03/84	C		0.69		

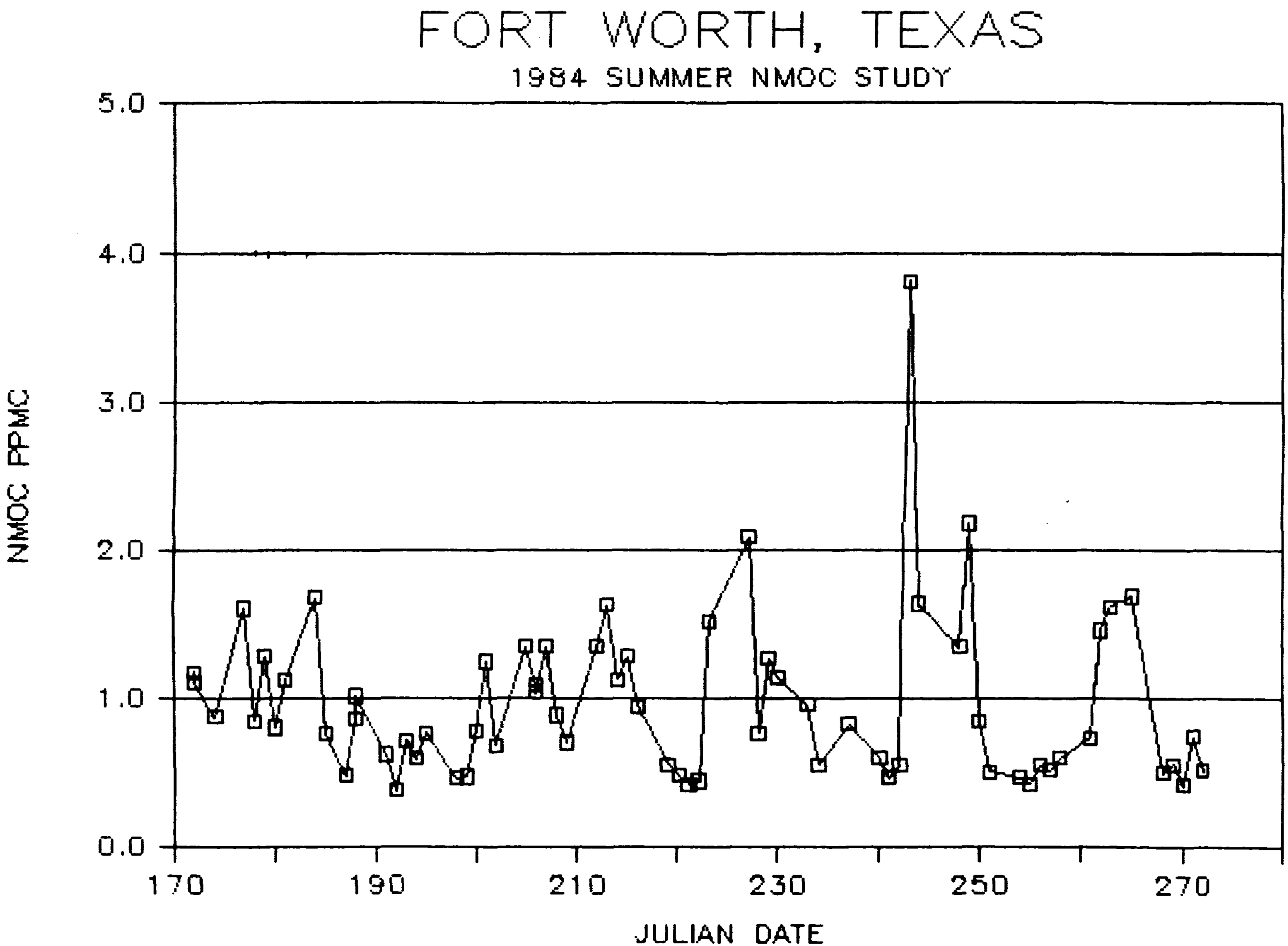

Figure 2-11. Plot of NMOC Data for Fort Worth, Texas.

Table 2-13. Data Listing for Fort Worth, Texas.

1984 SUMMER NMOC STUDY - FORT WORTH, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/20/84	172	WEDNESDAY	1023	3	18.0	17.7	06/25/84	A		1.18		
06/20/84	172	WEDNESDAY	1022	4	18.0	17.7	06/25/84	B		1.11		
06/22/84	174	FRIDAY	1040	43	16.0	15.5	06/26/84	A	06/27/84	0.88	1.22	
06/25/84	177	MONDAY	1039	45	16.0	16.0	06/26/84	D	06/27/84	1.61		1.59
06/26/84	178	TUESDAY	1042	55	20.0	19.5	06/27/84	C	07/28/84	0.85		0.60
06/27/84	179	WEDNESDAY	1047	62	17.0	17.5	06/28/84	B	06/29/84	1.29		1.19
06/28/84	180	THURSDAY	1063	78	15.0	15.5	06/29/84	C		0.81		
06/29/84	181	FRIDAY	1081	94	15.0	15.0	07/02/84	A	07/10/84	1.12		1.05
07/02/84	184	MONDAY	1089	125	15.0	15.5	07/03/84	C		1.68		
07/03/84	185	TUESDAY	1107	112	10.0	10.5	07/05/84	D		0.76		
07/05/84	187	THURSDAY	1127	2	17.0	16.5	07/06/84	D		0.49		
07/06/84	188	FRIDAY	1144	144	15.0	15.0	07/09/84	A		0.87		
07/06/84	188	FRIDAY	1143	145	15.0	15.0	07/09/84	C		1.02		
07/09/84	191	MONDAY	1152	52	15.0	15.0	07/10/84	C	07/11/84	0.63	0.82	
07/10/84	192	TUESDAY	1169	65	16.5	10.0	07/11/84	D		0.39		
07/11/84	193	WEDNESDAY	1197	111	15.0	15.5	07/12/84	B		0.72		
07/12/84	194	THURSDAY	1200	2	15.0	14.5	07/13/84	D	07/17/84	0.60		0.65
07/13/84	195	FRIDAY	1227	23	12.0	12.0	07/16/84	B		0.77		
07/16/84	198	MONDAY	1239	95	17.0	17.0	07/17/84	C	07/19/84	0.47		0.54
07/17/84	199	TUESDAY	1276	108	20.0	21.0	07/18/84	C		0.48		
07/18/84	200	WEDNESDAY	1294	92	16.0	17.0	07/19/84	A	07/23/84	0.79		0.74
07/19/84	201	THURSDAY	1314	135	15.0	15.5	07/20/84	B		1.25		
07/20/84	202	FRIDAY	1334	53	15.0	15.5	07/23/84	C	07/25/84	0.69		0.57
07/23/84	205	MONDAY	1376	55	17.0	15.5	07/25/84	A	07/27/84	1.35		1.24
07/24/84	206	TUESDAY	1404	63	17.0	16.0	07/26/84	C		1.09		
07/24/84	206	TUESDAY	1403	96	17.0	17.0	07/26/84	B		1.04		
07/25/84	207	WEDNESDAY	1423	95	13.0	13.0	07/27/84	A	07/30/84	1.35		1.78
07/26/84	208	THURSDAY	1437	166	16.0	15.5	07/30/84	C		0.89		
07/27/84	209	FRIDAY	1462	182	15.0	15.0	08/01/84	D		0.71		
07/30/84	212	MONDAY	1487	185	17.0	16.9	08/01/84	B		1.35		
07/31/84	213	TUESDAY	1526	9	17.0	16.1	08/02/84	D		1.63		
08/01/84	214	WEDNESDAY	1536	66	17.0	16.6	08/06/84	C		1.13		
08/02/84	215	THURSDAY	1565	161	16.0	16.0	08/06/84	D	08/03/84	1.29		1.09
08/03/84	216	FRIDAY	1582	58	15.0	16.0	08/07/84	B		0.95		
08/06/84	219	MONDAY	1614	181	16.0	15.5	08/08/84	B		0.56		
08/07/84	220	TUESDAY	1630	129	17.0	17.5	08/09/84	C	08/10/84	0.49		0.46
08/08/84	221	WEDNESDAY	1689	116	17.0	16.5	08/13/84	C		0.43		
08/09/84	222	THURSDAY	1676	195	15.0	15.5	08/13/84	D		0.45		
08/10/84	223	FRIDAY	1698	109	15.0	15.1	08/15/84	C		1.52		
08/14/84	227	TUESDAY	1739	77	17.0	17.5	08/16/84	B	08/20/84	2.09		1.96
08/15/84	228	WEDNESDAY	1761	142	16.5	16.9	08/17/84	C	08/20/84	0.77	1.04	

Table 2-13. Data Listing for Fort Worth, Texas. (cont.)

1984 SUMMER NMOC STUDY - FORT WORTH, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/16/84	229	THURSDAY	1802	25	16.0	16.1	08/20/84	C	08/21/84	1.27		1.13
08/17/84	230	FRIDAY	1817	64	15.0	15.8	08/21/84	D		1.15		
08/20/84	233	MONDAY	1854	167	15.0	15.5	08/24/84	C		0.96		
08/21/84	234	TUESDAY	1864	136	17.0	17.5	08/24/84	C		0.56		
08/24/84	237	FRIDAY	1944	58	15.0	15.5	08/29/84	B	08/30/84	0.83		0.79
08/27/84	240	MONDAY	1947	121	16.0	15.9	08/29/84	C		0.61		
08/28/84	241	TUESDAY	1988	6	16.0	16.7	08/30/84	C		0.47		
08/29/84	242	WEDNESDAY	1994	59	16.0	16.8	08/31/84	B		0.55		
08/30/84	243	THURSDAY	2015	55	18.0	14.9	09/04/84	A		3.81		
08/31/84	244	FRIDAY	2062	53	15.0	15.2	09/06/84	D	09/07/84	1.64		1.36
09/04/84	248	TUESDAY	2064	60	18.0	18.0	09/06/84	A	09/07/84	1.35		1.30
09/05/84	249	WEDNESDAY	2107	198	17.0	17.0	09/07/84	C		2.18		
09/06/84	250	THURSDAY	2133	66	16.0	16.0	09/10/84	B	09/11/84	0.85	0.86	
09/07/84	251	FRIDAY	2142	11	25.0	26.2	09/11/84	B		0.51		
09/10/84	254	MONDAY	2167	50	16.5	17.0	09/12/84	D		0.47		
09/11/84	255	TUESDAY	2195	95	17.0	17.8	09/13/84	A		0.43		
09/12/84	256	WEDNESDAY	2215	68	15.5	17.1	09/14/84	C		0.55		
09/13/84	257	THURSDAY	2266	196	15.5	16.0	09/18/84	D		0.52		
09/14/84	258	FRIDAY	2260	172	15.0	16.0	09/18/84	A		0.60		
09/17/84	261	MONDAY	2271	198	15.0	16.4	09/19/84	D		0.74		
09/18/84	262	TUESDAY	2314	8	17.0	17.5	09/20/84	B		1.46		
09/19/84	263	WEDNESDAY	2333	35	16.0	16.5	09/21/84	C	09/22/84	1.62		1.59
09/21/84	265	FRIDAY	2383	123	15.0	14.9	09/26/84	D		1.69		
09/24/84	268	MONDAY	2407	102	17.0	17.0	09/26/84	A	09/27/84	0.50	0.63	
09/25/84	269	TUESDAY	2422	90	17.0	16.5	09/28/84	B		0.56		
09/26/84	270	WEDNESDAY	2456	5	17.0	16.5	10/01/84	D		0.42		
09/27/84	271	THURSDAY	2484	85	16.0	15.5	10/02/84	C	10/03/84	0.75		0.72
09/28/84	272	FRIDAY	2486	190	16.0	16.1	10/02/84	D		0.52		

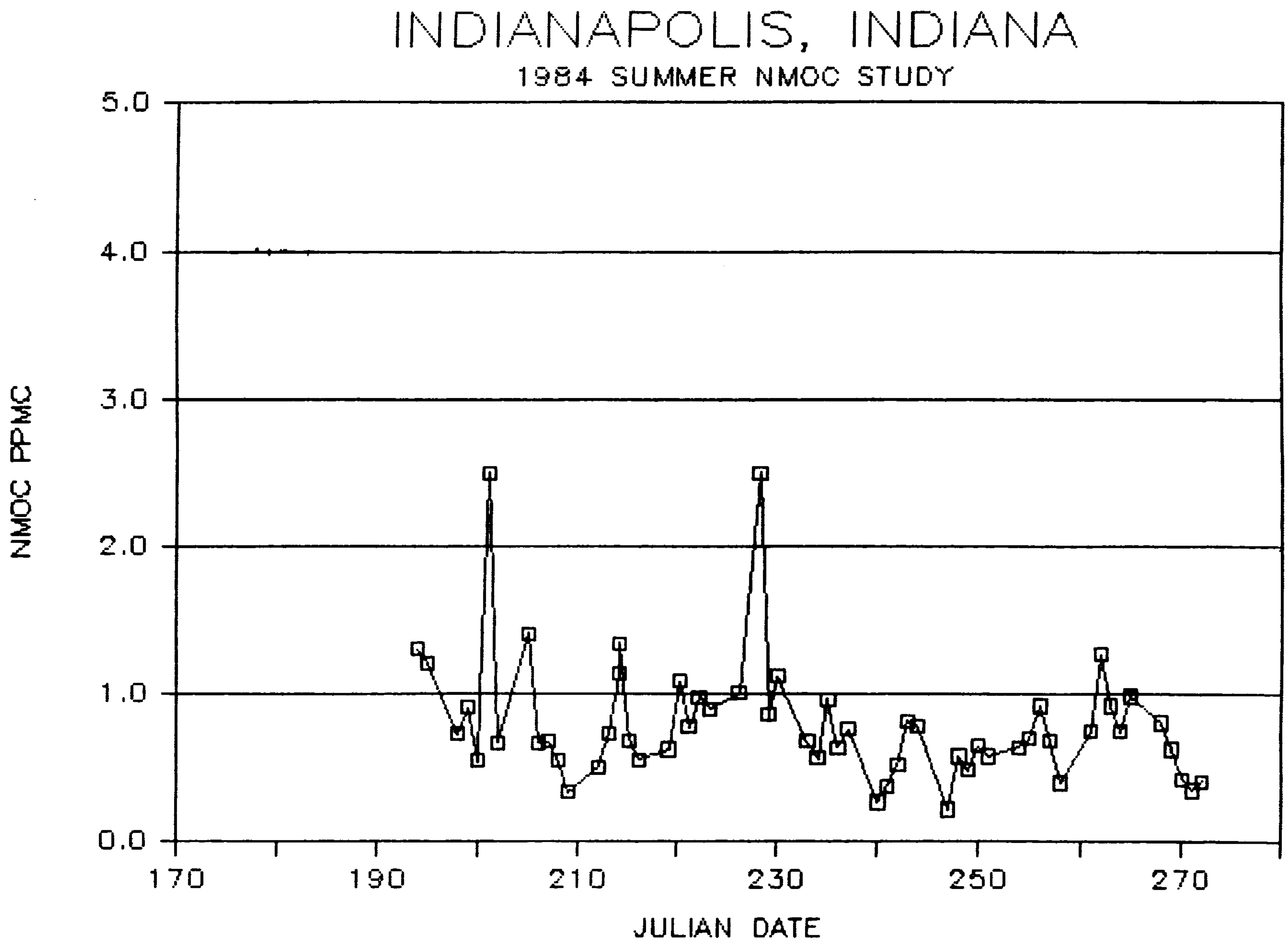

Figure 2-12. Plot of NMOC Data for Indianapolis, Indiana.

Table 2-14. Data Listing for Indianapolis, Indiana.

1984 SUMMER NMOC STUDY - INDIANAPOLIS, INDIANA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
07/12/84	194	THURSDAY	1218	50	13.0	13.0	07/16/84	A	07/19/84	1.30		1.28
07/13/84	195	FRIDAY	1245	85	13.0	13.0	07/17/84	A		1.21		
07/16/84	198	MONDAY	1266	160	12.5	12.2	07/18/84	A		0.73		
07/17/84	199	TUESDAY	1300	182	14.5	13.5	07/19/84	B		0.91		
07/18/84	200	WEDNESDAY	1309	122	14.0	14.0	07/20/84	C		0.55		
07/19/84	201	THURSDAY	1342	9	11.5	11.5	07/23/84	A	07/25/84	2.50		2.46
07/20/84	202	FRIDAY	1343	14	14.0	13.5	07/24/84	A	07/27/84	0.67		0.67
07/23/84	205	MONDAY	1387	79	15.0	15.0	07/25/84	D	07/27/84	1.41		1.36
07/24/84	206	TUESDAY	1394	74	13.5	13.5	07/26/84	A		0.67		
07/25/84	207	WEDNESDAY	1424	17	14.2	14.5	07/27/84	D	07/30/84	0.68		0.54
07/26/84	208	THURSDAY	1446	35	14.0	14.0	07/30/84	B		0.55		
07/27/84	209	FRIDAY	1454	151	14.5	13.9	07/31/84	A		0.34		
07/30/84	212	MONDAY	1492	20	16.5	16.8	08/01/84	A	08/03/84	0.51		0.55
07/31/84	213	TUESDAY	1504	180	14.0	13.5	08/02/84	B		0.74		
08/01/84	214	WEDNESDAY	1553	153	13.1	12.9	08/06/84	A		1.14		
08/01/84	214	WEDNESDAY	1554	131	13.1	12.5	08/06/84	C		1.34		
08/02/84	215	THURSDAY	1576	121	14.1	14.2	08/06/84	B		0.69		
08/03/84	216	FRIDAY	1590	124	14.1	13.5	08/07/84	B		0.56		
08/06/84	219	MONDAY	1602	79	13.5	13.2	08/08/84	A		0.63		
08/07/84	220	TUESDAY	1634	49	13.1	12.0	08/09/84	C	08/13/84	1.09	1.23	
08/08/84	221	WEDNESDAY	1649	175	14.0	14.8	08/10/84	A		0.78		
08/09/84	222	THURSDAY	1675	167	13.1	13.1	08/13/84	C	08/14/84	0.98	0.86	0.64
08/10/84	223	FRIDAY	1695	180	13.5	13.3	08/15/84	B		0.90		
08/13/84	226	MONDAY	1754	138	13.5	13.5	08/16/84	C	08/22/84	1.01	1.10	
08/15/84	228	WEDNESDAY	1772	191	11.0	11.0	08/20/84	B		2.50		
08/16/84	229	THURSDAY	1800	152	14.0	14.2	08/20/84	D		0.86		
08/17/84	230	FRIDAY	1807	181	13.5	13.5	08/21/84	B		1.12		
08/20/84	233	MONDAY	1833	94	14.0	13.5	08/22/84	C	08/23/84	0.68		0.42
08/21/84	234	TUESDAY	1860	96	13.5	13.5	08/24/84	D	08/27/84	0.57	0.64	0.49
08/22/84	235	WEDNESDAY	1892	90	10.0	9.5	08/27/84	D		0.97		
08/23/84	236	THURSDAY	1917	39	13.5	13.8	08/28/84	A		0.64		
08/24/84	237	FRIDAY	1942	99	14.0	13.8	08/28/84	B		0.76		
08/27/84	240	MONDAY	1960	147	24.0	23.3	08/29/84	C		0.27		
08/28/84	241	TUESDAY	1982	76	13.5	13.2	08/29/84	D		0.38		
08/29/84	242	WEDNESDAY	1995	106	14.3	14.0	08/31/84	A		0.52		
08/29/84	242	WEDNESDAY	1996	152	14.3	14.0	08/31/84	A		0.52		
08/30/84	243	THURSDAY	2063	183	14.0	13.2	09/06/84	C		0.82		
08/31/84	244	FRIDAY	2051	7	14.5	14.1	09/05/84	D	09/06/84	0.78		0.70
09/03/84	247	MONDAY	2060	89	13.5	13.5	09/05/84	A		0.22		
09/04/84	248	TUESDAY	2061	40	13.0	12.8	09/06/84	D	09/07/84	0.58		0.49

Table 2-14. Data Listing for Indianapolis, Indiana. (cont.)

1984 SUMMER NMOC STUDY - INDIANAPOLIS, INDIANA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
09/05/84	249	WEDNESDAY	2097	167	14.2	14.5	09/10/84	B	09/10/84	0.49	0.62	0.47
09/06/84	250	THURSDAY	2154	112	13.0	13.5	09/11/84	D	09/12/84	0.65	0.71	
09/07/84	251	FRIDAY	2160	184	13.5	13.5	09/12/84	D		0.58		
09/10/84	254	MONDAY	2166	110	11.5	11.0	09/12/84	A		0.64		
09/11/84	255	TUESDAY	2185	35	12.9	12.5	09/13/84	C		0.70		
09/12/84	256	WEDNESDAY	2212	29	13.0	13.0	09/14/84	A		0.92		
09/13/84	257	THURSDAY	2235	69	13.0	12.8	09/17/84	C		0.68		
09/14/84	258	FRIDAY	2250	40	13.5	13.1	09/18/84	B	09/19/84	0.40		0.41
09/17/84	261	MONDAY	2282	167	13.5	13.5	09/19/84	A		0.75		
09/18/84	262	TUESDAY	2327	15	14.0	13.0	09/21/84	A	09/22/84	1.27		1.14
09/19/84	263	WEDNESDAY	2325	112	15.5	15.1	09/21/84	D		0.92		
09/20/84	264	THURSDAY	2351	32	16.0	16.0	09/24/84	C		0.75		
09/21/84	265	FRIDAY	2380	46	14.0	13.8	09/26/84	D		0.99		
09/21/84	265	FRIDAY	2381	155	14.0	13.3	09/26/84	C		0.98		
09/24/84	268	MONDAY	2406	161	12.5	12.0	09/26/84	A		0.81		
09/25/84	269	TUESDAY	2424	63	13.0	12.1	09/24/84	D		0.63		
09/26/84	270	WEDNESDAY	2440	113	12.0	12.1	10/01/84	A	10/02/84	0.43		0.37
09/27/84	271	THURSDAY	2479	64	13.0	12.8	10/02/84	D		0.35		
09/28/84	272	FRIDAY	2493	15	13.0	12.5	10/02/84	A		0.41		

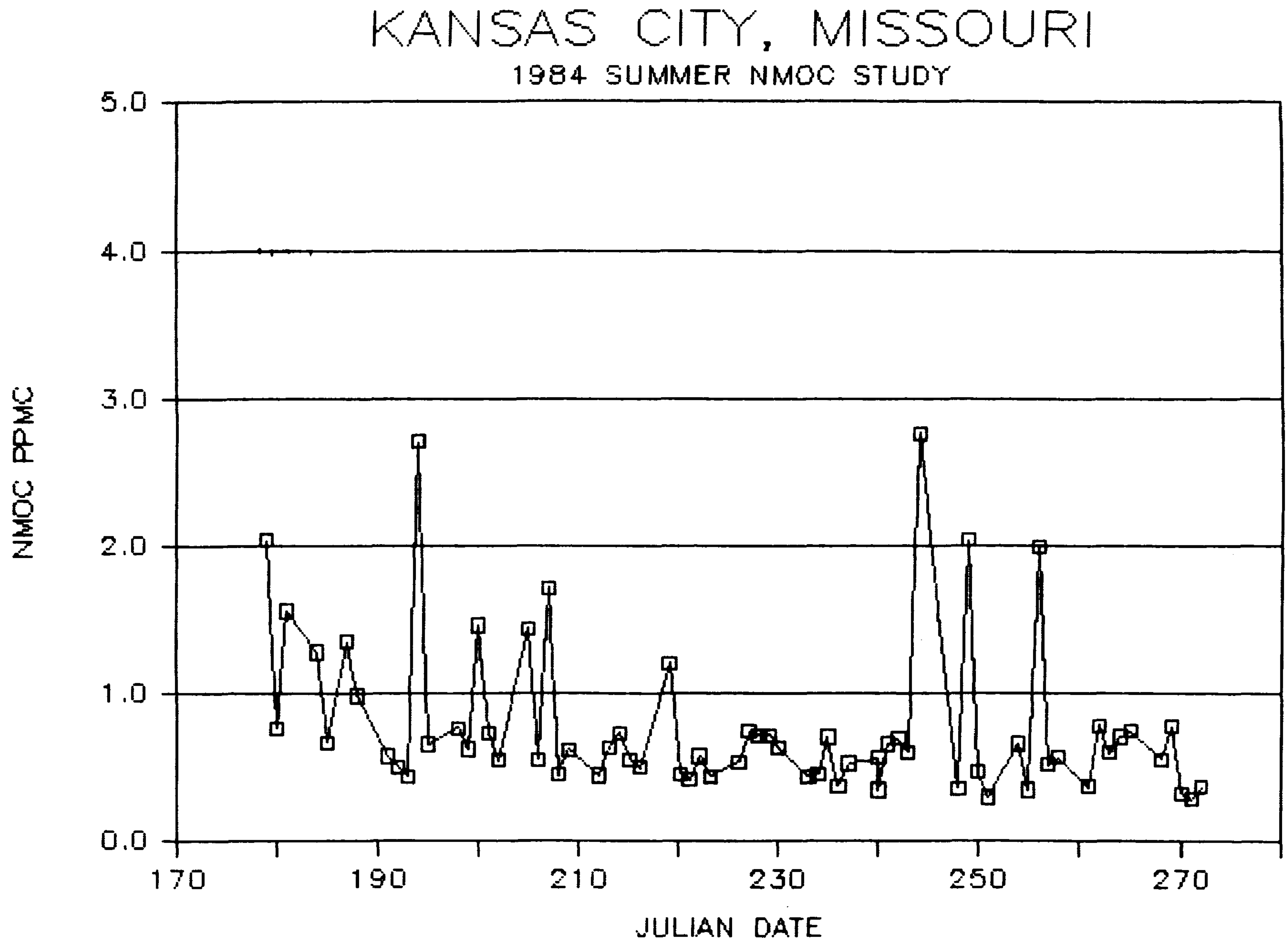

Figure 2-13. Plot of NMOC Data for Kansas City, Missouri.

Table 2-15. Data Listing for Kansas City, Missouri.

1984 SUMMER NMOC STUDY - KANSAS CITY, MISSOURI

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/27/84	179	WEDNESDAY	1172	117	12.5	11.0	07/11/84	A	07/16/84	2.04		1.71
06/28/84	180	THURSDAY	1165	117	10.5	12.5	07/11/84	B		0.77		
06/29/84	181	FRIDAY	1163	121	12.0	12.5	07/11/84	D	07/16/84	1.56		1.23
07/02/84	184	MONDAY	1185	76	13.5	14.0	07/12/84	A		1.28		
07/03/84	185	TUESDAY	1177	79	13.0	13.0	07/12/84	A		0.67		
07/05/84	187	THURSDAY	1189	131	12.0	12.5	07/12/84	C		1.35		
07/06/84	188	FRIDAY	1187	147	12.0	12.5	07/12/84	B		0.99		
07/09/84	191	MONDAY	1178	3	13.0	13.5	07/12/84	A	07/16/84	0.58		0.53
07/10/84	192	TUESDAY	1229	25	12.5	12.5	07/16/84	A		0.51		
07/11/84	193	WEDNESDAY	1230	38	12.5	12.5	07/16/84	A		0.44		
07/12/84	194	THURSDAY	1293	93	12.0	12.0	07/19/84	D	07/23/84	2.71		2.48
07/13/84	195	FRIDAY	1290	106	16.5	17.0	07/19/84	D		0.66		
07/16/84	198	MONDAY	1296	177	13.0	13.5	07/19/84	D		0.77		
07/17/84	199	TUESDAY	1292	126	12.5	13.0	07/19/84	C		0.63		
07/18/84	200	WEDNESDAY	1471	183	13.0	12.5	08/01/84	B	08/03/84	1.46		1.76
07/19/84	201	THURSDAY	1469	193	14.0	15.5	07/31/84	D		0.74		
07/20/84	202	FRIDAY	1457	15	12.5	12.5	07/31/84	D	08/01/84	0.55	0.82	
07/23/84	205	MONDAY	1479	45	13.5	13.8	08/01/84	A	08/03/84	1.44		1.23
07/24/84	206	TUESDAY	1468	61	14.0	14.5	07/31/84	B		0.56		
07/25/84	207	WEDNESDAY	1506	159	13.5	12.5	08/02/84	B	08/03/84	1.72		1.54
07/26/84	208	THURSDAY	1507	90	12.0	11.6	08/02/84	D		0.46		
07/27/84	209	FRIDAY	1514	136	12.5	13.0	08/02/84	B		0.62		
07/30/84	212	MONDAY	1511	69	14.0	14.1	08/02/84	C		0.45		
07/31/84	213	TUESDAY	1540	73	13.0	13.1	08/06/84	B		0.64		
08/01/84	214	WEDNESDAY	1551	89	12.8	12.9	08/06/84	D		0.74		
08/02/84	215	THURSDAY	1575	135	12.5	13.0	08/06/84	B		0.56		
08/03/84	216	FRIDAY	1599	81	13.0	13.0	08/07/84	B	08/08/84	0.50		0.43
08/06/84	219	MONDAY	1609	44	15.5	14.5	08/08/84	D		1.21		
08/07/84	220	TUESDAY	1633	72	13.0	13.0	08/09/84	B	08/10/84	0.46		0.44
08/08/84	221	WEDNESDAY	1657	108	12.5	12.0	08/13/84	A		0.42		
08/09/84	222	THURSDAY	1681	137	12.5	12.6	08/13/84	C		0.58		
08/10/84	223	FRIDAY	1694	93	12.5	12.5	08/15/84	A	08/15/84	0.44	0.54	
08/13/84	226	MONDAY	1714	159	13.5	14.2	08/15/84	C		0.54		
08/14/84	227	TUESDAY	1755	156	13.5	14.1	08/16/84	A		0.75		
08/15/84	228	WEDNESDAY	1777	107	13.0	13.1	08/20/84	D		0.72		
08/16/84	229	THURSDAY	1797	59	14.0	14.9	08/20/84	D	08/21/84	0.72		0.74
08/17/84	230	FRIDAY	1823	190	14.0	14.1	08/21/84	B		0.64		
08/17/84	230	FRIDAY	1822	106	14.0	14.8	08/21/84	C	08/22/84	0.64		0.60
08/20/84	233	MONDAY	1845	194	14.0	14.3	08/22/84	C	08/23/84	0.44	0.56	
08/21/84	234	TUESDAY	1857	173	13.5	13.5	08/24/84	B		0.46		
08/22/84	235	WEDNESDAY	1884	166	13.0	13.2	08/27/84	C		0.71		

Table 2-15. Data Listing for Kansas City, Missouri. (cont.)

1984 SUMMER NMOC STUDY - KANSAS CITY, MISSOURI

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/23/84	236	THURSDAY	1902	163	13.5	14.0	08/27/84	D	08/28/84	0.38		0.44
08/24/84	237	FRIDAY	1943	192	14.5	14.7	08/29/84	C		0.53		
08/27/84	240	MONDAY	1957	151	13.5	13.3	08/29/84	A		0.57		
08/27/84	240	MONDAY	1956	64	13.5	13.4	08/29/84	C		0.35		
08/28/84	241	TUESDAY	1984	22	13.5	14.0	08/30/84	B	08/31/84	0.66		0.58
08/29/84	242	WEDNESDAY	1993	120	13.0	13.2	08/31/84	A		0.70		
08/30/84	243	THURSDAY	2021	187	22.0	22.1	09/04/84	A	09/05/84	0.61	0.74	
08/31/84	244	FRIDAY	2053	49	11.5	11.0	09/05/84	C		2.76		
09/04/84	248	TUESDAY	2082	168	14.5	14.9	09/06/84	C		0.36		
09/05/84	249	WEDNESDAY	2109	4	17.0	16.5	09/10/84	C		2.04		
09/06/84	250	THURSDAY	2126	31	13.0	13.0	09/10/84	C	09/11/84	0.47		0.38
09/07/84	251	FRIDAY	2143	127	13.0	13.7	09/11/84	A		0.30		
09/10/84	254	MONDAY	2181	142	15.0	15.5	09/12/84	B	09/13/84	0.66		0.58
09/11/84	255	TUESDAY	2186	181	13.5	14.0	09/13/84	D		0.35		
09/12/84	256	WEDNESDAY	2208	131	16.0	15.9	09/14/84	D		1.99		
09/13/84	257	THURSDAY	2234	98	13.0	13.0	09/19/84	A		0.52		
09/14/84	258	FRIDAY	2261	156	13.5	13.9	09/18/84	A		0.57		
09/17/84	261	MONDAY	2285	33	13.5	13.5	09/19/84	A		0.37		
09/18/84	262	TUESDAY	2297	48	15.0	15.6	09/20/84	A	09/21/84	0.79		0.73
09/19/84	263	WEDNESDAY	2329	85	15.0	15.0	09/19/84	A		0.60		
09/20/84	264	THURSDAY	2343	174	12.5	13.5	09/24/84	C		0.71		
09/21/84	265	FRIDAY	2365	10	13.0	12.0	09/25/84	C		0.75		
09/24/84	268	MONDAY	2402	186	14.5	14.5	09/27/84	C		0.56		
09/25/84	269	TUESDAY	2425	1	17.0	10.6	09/28/84	C		0.78		
09/26/84	270	WEDNESDAY	2441	140	11.0	11.5	10/01/84	D		0.33		
09/27/84	271	THURSDAY	2494	167	16.0	16.1	10/02/84	D		0.29		
09/28/84	272	FRIDAY	2487	82	16.0	16.1	10/02/84	C	10/03/84	0.37		0.55

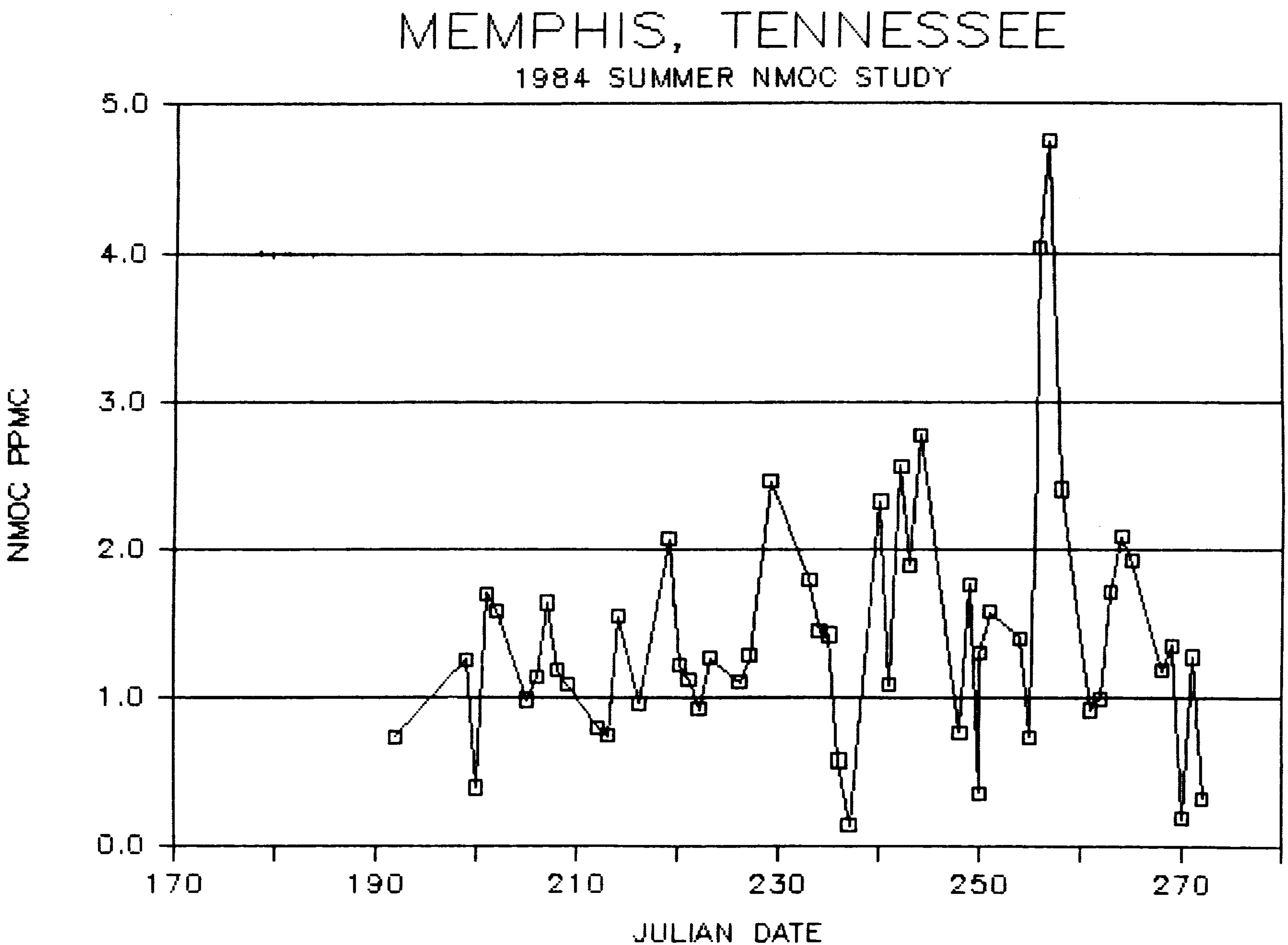

Figure 2-14. Plot of NMOC Data for Memphis, Tennessee.

Table 2-16. Data Listing for Memphis, Tennessee.

1984 SUMMER NMOC STUDY - MEMPHIS, TENNESSEE

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
07/10/84	192	TUESDAY	1210	128	0.0	11.0	07/13/84	C	07/16/84	0.74	1.03	
07/17/84	199	TUESDAY	1297	138	18.0	18.0	07/19/84	A		1.26		
07/18/84	200	WEDNESDAY	1317	166	18.0	17.5	07/20/84	D		0.40		
07/19/84	201	THURSDAY	1363	41	17.0	17.9	07/24/84	C		1.70		
07/20/84	202	FRIDAY	1351	112	16.0	16.7	07/24/84	C	07/27/84	1.59		1.53
07/23/84	205	MONDAY	1374	111	18.5	18.8	07/25/84	B		0.99		
07/24/84	206	TUESDAY	1393	124	19.5	20.5	07/26/84	D		1.14		
07/25/84	207	WEDNESDAY	1429	86	19.0	19.0	07/25/84	E	07/30/84	1.64		1.57
07/26/84	208	THURSDAY	1440	110	18.0	18.0	07/30/84	C		1.19		
07/27/84	209	FRIDAY	1475	54	16.5	17.0	07/31/84	D		1.09		
07/30/84	212	MONDAY	1489	122	18.0	18.5	08/01/84	A	08/03/84	0.80		0.60
07/31/84	213	TUESDAY	1510	195	19.8	19.9	08/02/84	A		0.75		
08/01/84	214	WEDNESDAY	1549	191	18.5	18.5	08/06/84	A		1.55		
08/03/84	216	FRIDAY	1600	113	21.0	21.5	08/07/84	C		0.97		
08/06/84	219	MONDAY	1603	38	19.5	18.5	08/08/84	D	08/09/84	2.07		1.83
08/07/84	220	TUESDAY	1629	85	18.5	16.0	08/09/84	D		1.22		
08/08/84	221	WEDNESDAY	1655	114	18.5	17.0	08/13/84	D		1.12		
08/09/84	222	THURSDAY	1674	185	24.5	23.4	08/13/84	D	08/14/84	0.93		0.76
08/10/84	223	FRIDAY	1704	171	15.5	16.1	08/15/84	D		1.27		
08/13/84	226	MONDAY	1724	27	15.5	17.5	08/15/84	E	08/16/84	1.11	1.33	
08/14/84	227	TUESDAY	1737	40	18.8	19.5	08/16/84	D		1.29		
08/16/84	229	THURSDAY	1791	133	25.5	25.5	08/16/84	B	08/21/84	2.46	2.27	
08/20/84	233	MONDAY	1832	175	24.5	24.9	08/22/84	B		1.80		
08/21/84	234	TUESDAY	1855	145	18.5	19.0	08/24/84	A		1.45		
08/22/84	235	WEDNESDAY	1875	154	18.5	19.1	08/27/84	A	08/28/84	1.43		1.33
08/23/84	236	THURSDAY	1908	65	18.9	18.0	08/27/84	C		0.58		
08/24/84	237	FRIDAY	1920	33	30.0	29.5	08/28/84	D		0.14		
08/27/84	240	MONDAY	1963	43	18.5	18.5	08/29/84	B		2.33		
08/28/84	241	TUESDAY	1999	135	19.0	19.0	08/31/84	A	09/04/84	1.09	1.12	
08/29/84	242	WEDNESDAY	2029	38	19.5	15.0	09/04/84	D		2.57		
08/30/84	243	THURSDAY	2022	116	20.5	20.0	09/04/84	A	09/05/84	1.90		1.90
08/31/84	244	FRIDAY	2047	57	17.5	17.7	09/05/84	C		2.78		
09/04/84	248	TUESDAY	2071	81	21.3	16.9	09/06/84	C	09/07/84	0.77	0.69	
09/05/84	249	WEDNESDAY	2105	90	20.0	18.5	09/10/84	C		1.77		
09/06/84	250	THURSDAY	2132	134	20.5	20.0	09/10/84	A		0.36		
09/06/84	250	THURSDAY	2131	18	20.5	20.5	09/10/84	B		1.30		
09/07/84	251	FRIDAY	2144	132	18.5	19.0	09/11/84	D	09/12/84	1.58		1.41
09/10/84	254	MONDAY	2176	109	18.0	18.6	09/12/84	C		1.41		
09/11/84	255	TUESDAY	2200	178	18.5	19.5	09/13/84	C		0.74		0.70
09/12/84	256	WEDNESDAY	2220	23	19.0	19.5	09/14/84	A		4.03		
09/13/84	257	THURSDAY	2239	136	18.5	18.5	09/17/84	B		4.75		

Table 2-16. Data Listing for Memphis, Tennessee. (cont.)

1984 SUMMER NMOC STUDY - MEMPHIS, TENNESSEE

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
09/14/84	258	FRIDAY	2249	105	18.0	15.5	09/18/84	C		2.41		
09/17/84	261	MONDAY	2270	90	19.0	18.8	09/19/84	C		0.92		
09/18/84	262	TUESDAY	2303	24	19.0	19.5	09/20/84	D		1.00		
09/19/84	263	WEDNESDAY	2326	108	20.0	18.5	09/21/84	C		1.71		
09/20/84	264	THURSDAY	2355	129	20.5	19.0	09/24/84	D		2.09		
09/21/84	265	FRIDAY	2364	187	18.5	18.0	09/25/84	A	09/26/84	1.92		1.75
09/24/84	268	MONDAY	2434	103	17.5	17.6	09/28/84	D	09/29/84	1.19		1.05
09/25/84	269	TUESDAY	2433	124	18.0	18.3	09/28/84	C		1.36		
09/26/84	270	WEDNESDAY	2455	45	20.0	20.1	10/01/84	A		0.19		
09/27/84	271	THURSDAY	2504	188	25.0	18.0	10/05/84	C		1.28		
09/28/84	272	FRIDAY	2482	6	13.9	12.5	10/02/84	A		0.33		

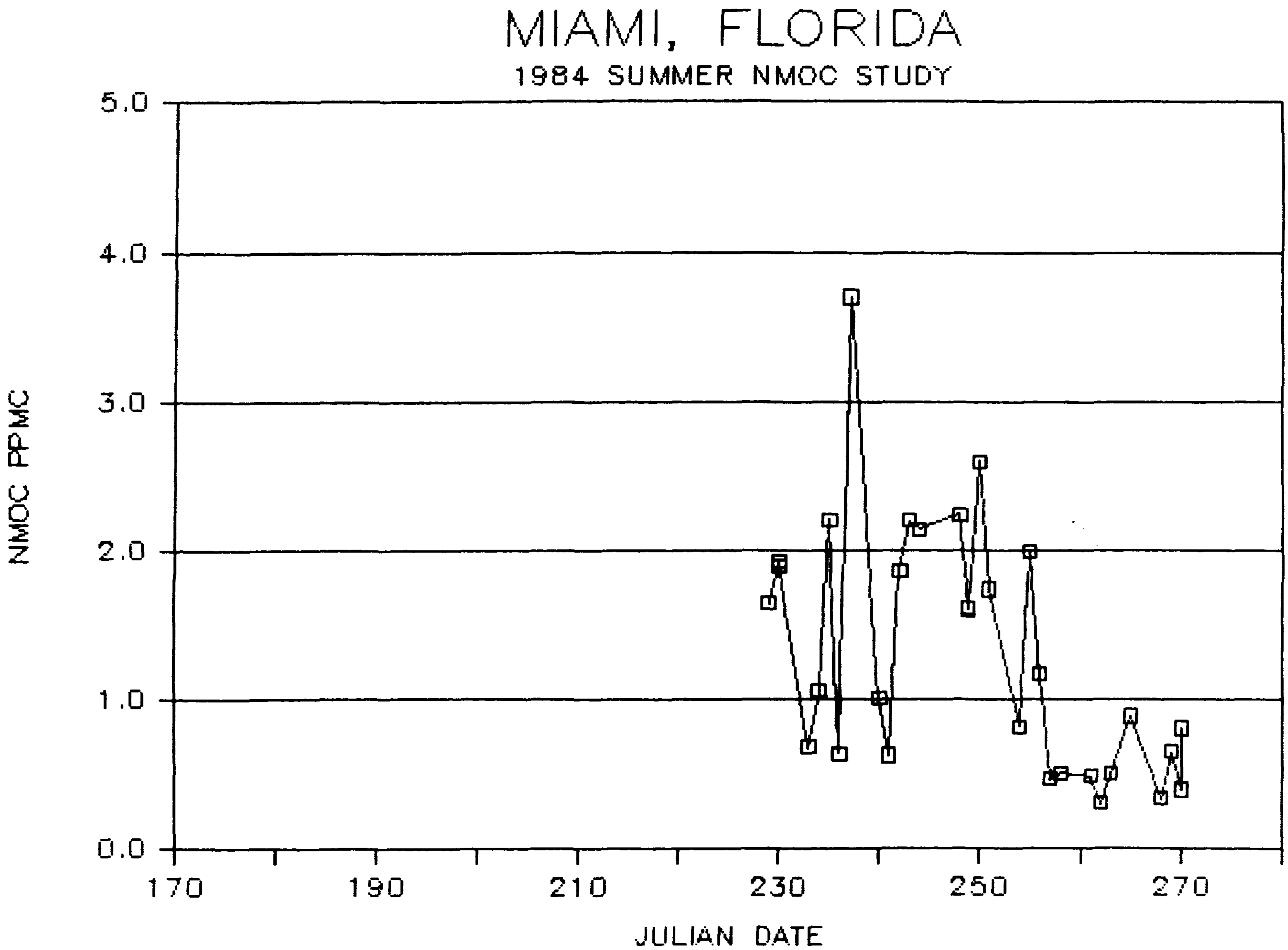

Figure 2-15. Plot of NMOC Data for Miami, Florida.

Table 2-17. Data Listing for Miami, Florida.

1984 SUMMER NMOC STUDY - MIAMI, FLORIDA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/16/84	229	THURSDAY	1782	37	25.0	25.0	08/20/84	C	08/21/84	1.65		1.12
08/17/84	230	FRIDAY	1809	5	16.0	16.5	08/21/84	B	08/22/84	1.90		1.69
08/17/84	230	FRIDAY	1810	6	16.0	16.1	08/21/84	A		1.93		
08/20/84	233	MONDAY	1846	87	16.0	17.0	08/22/84	D	08/23/84	0.68		0.54
08/21/84	234	TUESDAY	1862	28	24.0	24.0	08/24/84	D		1.06		
08/22/84	235	WEDNESDAY	1885	109	16.5	16.7	08/27/84	B		2.21		
08/23/84	236	THURSDAY	1898	34	24.5	24.5	08/28/84	D	08/29/84	0.64		0.64
08/24/84	237	FRIDAY	1927	143	17.0	17.8	08/28/84	C	08/29/84	3.70	3.64	3.35
08/27/84	240	MONDAY	1969	184	16.0	16.7	08/29/84	C	08/30/84	1.01	1.36	
08/28/84	241	TUESDAY	1985	3	16.5	17.2	08/30/84	B	08/31/84	0.63	0.73	0.61
08/29/84	242	WEDNESDAY	2033	175	17.0	17.1	09/04/84	A	09/05/84	1.86	1.93	1.76
08/30/84	243	THURSDAY	2019	126	18.0	17.0	09/04/84	C		2.20		
08/31/84	244	FRIDAY	2040	145	17.0	18.0	09/05/84	A		2.14		
09/04/84	248	TUESDAY	2070	154	16.0	16.0	09/06/84	B	09/07/84	2.24		2.07
09/05/84	249	WEDNESDAY	2093	52	18.0	18.5	09/10/84	D		1.62		
09/05/84	249	WEDNESDAY	2094	176	18.0	16.0	09/10/84	D		1.61		
09/06/84	250	THURSDAY	2122	192	18.5	19.0	09/10/84	D		2.60		
09/07/84	251	FRIDAY	2147	42	24.0	22.0	09/11/84	D		1.74		
09/10/84	254	MONDAY	2175	25	23.0	23.9	09/12/84	D	09/13/84	0.82		0.88
09/11/84	255	TUESDAY	2190	10	16.0	16.2	09/13/84	A		1.99		
09/12/84	256	WEDNESDAY	2213	103	22.5	23.5	09/14/84	B		1.17		
09/13/84	257	THURSDAY	2262	78	18.0	18.5	09/18/84	D		0.47		
09/14/84	258	FRIDAY	2257	111	15.5	16.0	09/18/84	A		0.51		
09/17/84	261	MONDAY	2290	122	24.0	22.5	09/19/84	C		0.49		
09/18/84	262	TUESDAY	2305	64	23.5	24.0	09/20/84	C		0.31		
09/19/84	263	WEDNESDAY	2323	128	17.0	17.2	09/21/84	C	09/22/84	0.50		0.49
09/21/84	265	FRIDAY	2386	104	16.0	16.0	09/25/84	B		0.89		
09/24/84	268	MONDAY	2413	136	17.0	17.9	09/26/84	C		0.34		
09/25/84	269	TUESDAY	2398	163	17.5	18.0	09/26/84	A	09/27/84	0.65	0.66	
09/26/84	270	WEDNESDAY	2438	118	18.5	21.5	09/28/84	B		0.40		
09/26/84	270	WEDNESDAY	2437	121	18.5	18.4	10/01/84	A		0.81		

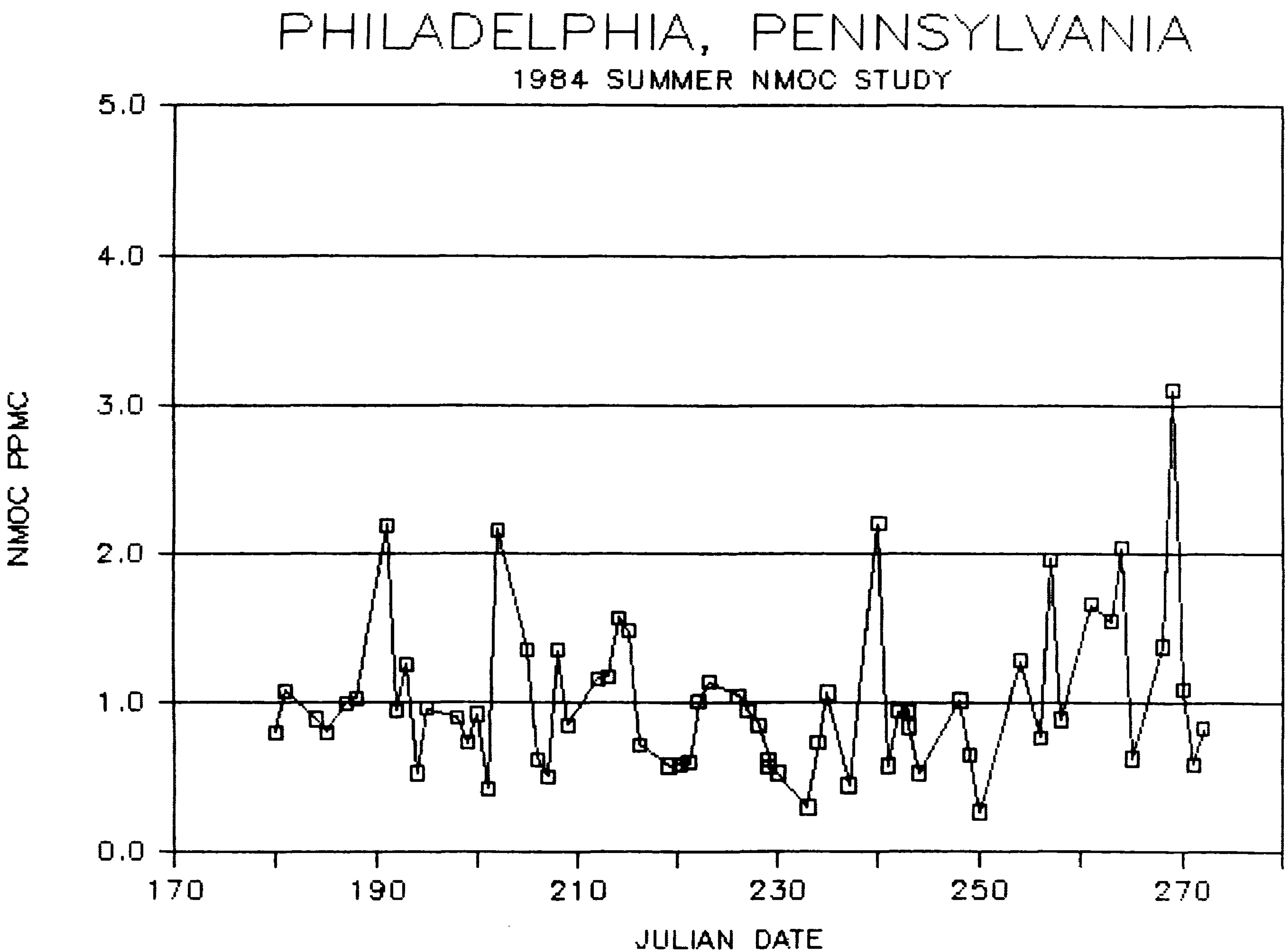

Figure 2-16. Plot of NMOC Data for Philadelphia, Pennsylvania.

Table 2-18. Data Listing for Philadelphia, Pennsylvania.

1984 SUMMER NMOC STUDY - PHILADELPHIA, PENNSYLVANIA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/28/94	180	THURSDAY	1091	95	16.0	16.5	07/03/84	B	07/10/84	0.80		0.85
06/29/84	181	FRIDAY	1112	97	12.0	12.5	07/05/84	C		1.08		
07/02/84	184	MONDAY	1124	102	17.8	18.5	07/06/84	D	07/09/84	0.89	1.50	
07/03/84	185	TUESDAY	1138	119	16.0	16.8	07/09/84	A	07/10/84	0.80	1.33	
07/05/84	187	THURSDAY	1158	149	16.4	16.5	07/10/84	A		1.00		
07/06/84	188	FRIDAY	1164	33	15.0	15.0	07/11/84	B		1.03		
07/09/84	191	MONDAY	1192	133	17.8	18.0	07/12/84	D	07/16/84	2.19		0.73
07/10/84	192	TUESDAY	1208	35	16.0	16.5	07/13/84	D	07/16/84	0.95	1.35	
07/11/84	193	WEDNESDAY	1225	49	16.0	16.5	07/16/84	D	07/19/84	1.26		1.61
07/12/84	194	THURSDAY	1240	88	16.0	16.7	07/17/84	B		0.53		
07/13/84	195	FRIDAY	1265	54	15.5	16.0	07/18/84	B		0.96		
07/16/84	198	MONDAY	1302	130	17.0	17.5	07/19/84	C		0.90		
07/17/84	199	TUESDAY	1321	98	16.0	16.5	07/21/84	D	07/24/84	0.73		0.79
07/18/84	200	WEDNESDAY	1340	185	16.3	16.2	07/23/84	A	077/24/84	0.92	1.27	
07/19/84	201	THURSDAY	1356	80	17.0	18.0	07/24/84	A		0.43		
07/20/84	202	FRIDAY	1375	27	14.9	15.5	07/25/84	B		2.16		
07/23/84	205	MONDAY	1409	2	17.0	17.6	07/26/84	D	07/27/84	1.36	1.46	
07/24/84	206	TUESDAY	1417	68	16.0	15.0	07/27/84	B		0.62		
07/25/84	207	WEDNESDAY	1433	94	16.8	17.9	07/27/84	A		0.51		
07/26/84	208	THURSDAY	1451	175	16.7	17.2	07/30/84	D	07/31/84	1.35	1.54	
07/27/84	209	FRIDAY	1459	24	16.0	15.8	08/01/84	A		0.85		
07/30/84	212	MONDAY	1508	192	17.6	18.2	08/02/84	A		1.16		
07/31/84	213	TUESDAY	1539	3	16.5	17.0	08/06/84	D		1.18		
08/01/84	214	WEDNESDAY	1579	47	15.5	16.0	08/06/84	D		1.57		
08/02/84	215	THURSDAY	1592	119	15.8	16.0	08/08/84	D		1.48		
08/03/84	216	FRIDAY	1621	115	15.0	15.5	08/08/84	C	08/09/84	0.72		0.77
08/06/84	219	MONDAY	1622	25	16.0	18.0	08/09/84	A		0.58		
08/07/84	220	TUESDAY	1664	169	20.0	20.8	08/13/84	D	08/14/84	0.59		0.53
08/08/84	221	WEDNESDAY	1665	32	20.0	20.0	08/13/84	A		0.60		
08/09/84	222	THURSDAY	1669	158	17.0	17.0	08/13/84	A		1.01		
08/10/84	223	FRIDAY	1719	13	15.0	15.0	08/16/84	C		1.14		
08/13/84	226	MONDAY	1752	67	17.2	17.8	08/17/84	D		1.05		
08/14/84	227	TUESDAY	1768	121	16.5	17.2	08/17/84	A		0.94		
08/15/84	228	WEDNESDAY	1790	119	16.5	16.8	08/20/84	B	08/21/84	0.85		0.64
08/16/84	229	THURSDAY	1799	170	15.8	16.1	08/20/84	B		0.62		
08/16/84	229	THURSDAY	1798	184	15.8	16.1	08/20/84	C		0.57		
08/17/84	230	FRIDAY	1849	38	15.0	14.8	08/22/84	B		0.53		
08/20/84	233	MONDAY	1871	118	16.2	17.0	08/24/84	A	08/25/84	0.30		0.58
08/21/84	234	TUESDAY	1880	98	17.0	17.2	08/27/84	C		0.74		
08/22/84	235	WEDNESDAY	1931	74	16.0	17.0	08/28/84	D		1.07		
08/24/84	237	FRIDAY	1954	9	15.6	15.9	08/29/84	D		0.45		

Table 2-18. Data Listing for Philadelphia, Pennsylvania. (cont.)

1984 SUMMER NMOC STUDY - PHILADELPHIA, PENNSYLVANIA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/27/84	240	MONDAY	1983	62	16.8	17.6	08/30/84	C	08/31/84	2.20		2.05
08/28/84	241	TUESDAY	2010	142	17.0	17.8	08/31/84	B		0.58		
08/29/84	242	WEDNESDAY	2028	83	16.3	16.5	09/04/84	C		0.94		
08/30/84	243	THURSDAY	2044	137	15.8	16.0	09/05/84	A		0.95		
08/30/84	243	THURSDAY	2043	87	15.8	16.0	09/05/84	B		0.84		
08/31/84	244	FRIDAY	2080	60	15.0	14.0	09/07/84	D		0.53		
09/04/84	248	TUESDAY	2098	63	17.5	17.5	09/07/84	C		1.02		
09/05/84	249	WEDNESDAY	2116	44	16.3	17.0	09/10/84	D	09/11/84	0.65		0.65
09/06/84	250	THURSDAY	2162	171	16.5	17.8	09/11/84	B		0.27		
09/10/84	254	MONDAY	2192	120	17.0	18.5	09/13/84	C		1.29		
09/12/84	256	WEDNESDAY	2231	157	13.5	14.1	09/17/84	D		0.77		
09/13/84	257	THURSDAY	2273	73	16.5	17.2	09/19/84	C		1.96		
09/14/84	258	FRIDAY	2272	154	15.0	15.5	09/19/84	B	09/20/84	0.89		0.81
09/17/84	261	MONDAY	2304	86	18.0	13.5	09/20/84	C		1.66		
09/19/84	263	WEDNESDAY	2358	132	16.9	17.5	09/24/84	E		1.55		
09/20/84	264	THURSDAY	2368	13	16.8	17.0	09/25/84	D	09/26/84	2.04		1.95
09/21/84	265	FRIDAY	2399	68	15.0	16.0	09/26/84	B		0.63		
09/24/84	268	MONDAY	2419	131	17.8	17.0	09/28/84	A		1.38		
09/25/84	269	TUESDAY	2444	84	16.8	16.6	10/01/84	B		3.10		
09/26/84	270	WEDNESDAY	2469	98	16.0	16.5	10/02/84	B		1.09		
09/27/84	271	THURSDAY	2496	154	16.8	17.0	10/02/84	B	10/03/84	0.59		0.50
09/28/84	272	FRIDAY	2502	61	15.5	16.5	10/03/84	C		0.83		

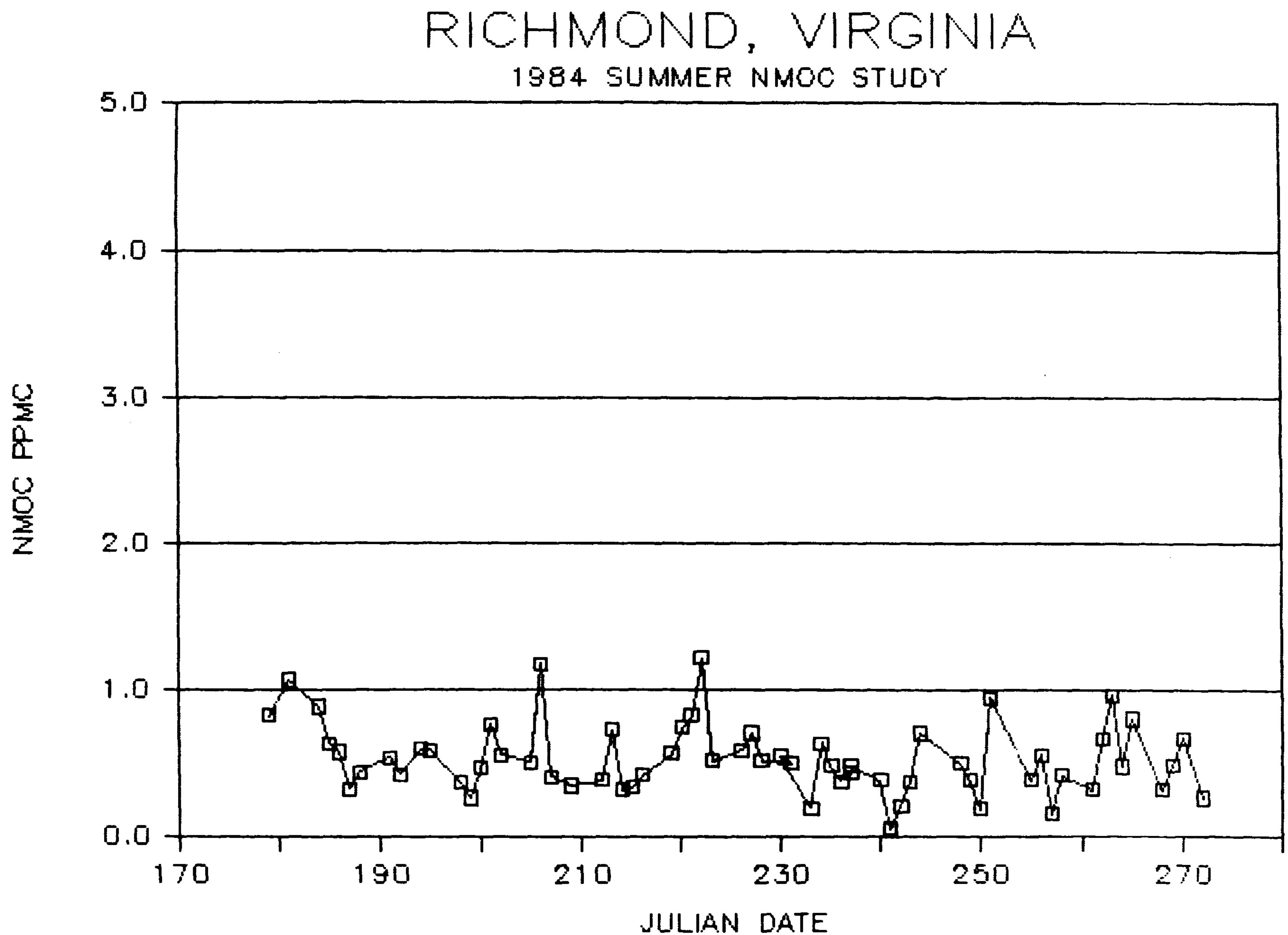

Figure 2-17. Plot of NMOC Data for Richmond, Virginia.

Table 2-19. Data Listing for Richmond, Virginia.

1984 SUMMER NMOC STUDY - RICHMOND, VIRGINIA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/27/84	179	WEDNESDAY	1056	86	13.5	13.5	06/29/84	D	07/02/84	0.83		0.69
06/29/84	181	FRIDAY	1083	85	22.5	22.3	07/03/84	A		1.07		
07/02/84	184	MONDAY	1093	98	22.0	22.0	07/03/84	D		0.89		
07/03/84	185	TUESDAY	1099	114	14.5	15.0	07/05/84	A	07/10/84	0.64		0.58
07/04/84	186	WEDNESDAY	1120	150	21.5	22.0	07/06/84	B		0.58		
07/05/84	187	THURSDAY	1115	24	14.0	14.0	07/06/84	A		0.33		
07/06/84	188	FRIDAY	1140	134	14.5	14.5	07/09/84	B	07/10/84	0.44		0.44
07/09/84	191	MONDAY	1147	22	22.0	22.8	07/10/84	D		0.54		
07/10/84	192	TUESDAY	1162	51	14.5	15.0	07/11/84	B		0.43		
07/12/84	194	THURSDAY	1206	63	21.5	21.0	07/13/84	B	07/17/84	0.60		0.54
07/13/84	195	FRIDAY	1219	62	14.0	14.5	07/16/84	B	07/17/84	0.59	0.84	
07/16/84	198	MONDAY	1248	165	14.0	14.0	07/17/84	B	07/19/84	0.37		0.47
07/17/84	199	TUESDAY	1262	114	14.5	15.0	07/18/84	B	07/19/84	0.27	0.53	
07/18/84	200	WEDNESDAY	1288	198	22.5	23.0	07/19/84	D		0.47		
07/19/84	201	THURSDAY	1313	163	14.0	14.0	07/20/84	D	07/23/84	0.77	1.13	
07/20/84	202	FRIDAY	1330	137	14.0	15.0	07/23/84	B		0.56		
07/23/84	205	MONDAY	1350	11	13.8	14.0	07/24/84	C		0.51		
07/24/84	206	TUESDAY	1385	1	17.0	15.0	07/25/84	A	07/26/84	1.18	1.53	
07/25/84	207	WEDNESDAY	1400	46	22.5	23.5	07/26/84	B	07/27/84	0.41		0.36
07/27/84	209	FRIDAY	1435	120	13.8	13.5	07/30/84	B		0.35		
07/30/84	212	MONDAY	1470	178	22.5	22.0	08/01/84	D		0.39		
07/31/84	213	TUESDAY	1501	34	22.5	22.8	08/01/84	C		0.73		
08/01/84	214	WEDNESDAY	1516	157	16.0	16.1	08/02/84	D		0.32		
08/01/84	214	WEDNESDAY	1515	96	16.0	16.1	08/02/84	D		0.32		
08/02/84	215	THURSDAY	1556	65	14.0	14.5	08/06/84	C		0.34		
08/03/84	216	FRIDAY	1561	80	13.8	15.0	08/06/84	D	08/03/84	0.42		0.37
08/06/84	219	MONDAY	1583	48	21.8	22.5	08/07/84	A		0.57		
08/07/84	220	TUESDAY	1612	63	22.0	20.5	08/08/84	C		0.75		
08/08/84	221	WEDNESDAY	1632	151	22.5	22.0	08/09/84	D		0.83		
08/09/84	222	THURSDAY	1653	15	14.2	15.0	08/10/84	D	08/11/84	1.22		1.05
08/10/84	223	FRIDAY	1682	96	14.2	15.0	08/13/84	D		0.52		
08/13/84	226	MONDAY	1700	186	21.5	22.0	08/15/84	B	08/16/84	0.59		0.52
08/14/84	227	TUESDAY	1730	2	15.0	15.1	08/16/84	D		0.71		
08/15/84	228	WEDNESDAY	1743	47	16.5	16.1	08/16/84	B		0.52		
08/16/84	231	THURSDAY	1767	46	13.5	14.0	08/17/84	A		0.50		
08/17/84	230	FRIDAY	1805	132	14.0	14.0	08/20/84	B		0.55		
08/20/84	233	MONDAY	1820	24	14.0	14.0	08/21/84	A	08/22/84	0.20		0.18
08/21/84	234	TUESDAY	1840	162	24.5	24.5	08/22/84	C	08/23/84	0.64		0.35
08/22/84	235	WEDNESDAY	1858	114	16.0	16.5	08/24/84	A	08/25/84	0.49		0.49
08/23/84	236	THURSDAY	1893	153	13.5	14.0	08/27/84	D	08/28/84	0.38		0.40
08/24/84	237	FRIDAY	1897	139	15.0	15.1	08/28/84	C		0.44		

Table 2-19. Data Listing for Richmond, Virginia. (cont.)

1984 SUMMER NMOC STUDY - RICHMOND, VIRGINIA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/24/84	237	FRIDAY	1896	176	15.0	14.8	08/27/84	B	08/28/84	0.49		0.41
08/27/84	240	MONDAY	1923	171	14.5	15.1	08/28/84	B	08/29/84	0.39		0.35
08/28/84	241	TUESDAY	1967	144	25.4	27.0	08/29/84	D		0.06		
08/29/84	242	WEDNESDAY	1975	113	15.5	15.9	08/30/84	D		0.21		
08/30/84	243	THURSDAY	1997	130	13.5	14.8	08/31/84	B		0.38		
08/31/84	244	FRIDAY	2020	85	13.5	13.5	09/04/84	D		0.71		
09/04/84	248	TUESDAY	2089	78	14.5	14.2	09/06/84	D		0.50		
09/05/84	249	WEDNESDAY	2065	172	14.5	15.0	09/06/84	B		0.39		
09/06/84	250	THURSDAY	2101	186	13.5	14.2	09/07/84	A		0.19		
09/07/84	251	FRIDAY	2112	159	14.5	15.5	09/10/84	D	09/11/84	0.95		0.81
09/11/84	255	TUESDAY	2177	59	14.5	15.6	09/12/84	C	09/13/84	0.39		0.40
09/12/84	256	WEDNESDAY	2197	70	15.0	16.0	09/13/84	D		0.56		
09/13/84	257	THURSDAY	2209	87	14.5	14.5	09/14/84	C		0.16		
09/14/84	258	FRIDAY	2242	161	13.5	13.6	09/18/84	A		0.42		
09/17/84	261	MONDAY	2265	14	14.5	14.0	09/18/84	C		0.32		
09/18/84	262	TUESDAY	2274	107	14.5	14.9	09/19/84	D		0.67		
09/19/84	263	WEDNESDAY	2300	146	14.5	15.1	09/20/84	B		0.97		
09/20/84	264	THURSDAY	2324	192	16.0	16.9	09/21/84	D	09/22/84	0.48		0.44
09/21/84	265	FRIDAY	2347	150	14.0	14.0	09/24/84	A		0.81		
09/24/84	268	MONDAY	2371	138	14.0	14.5	09/25/84	D	09/26/84	0.32	0.59	
09/25/84	269	TUESDAY	2403	25	14.2	14.5	09/27/84	D		0.49		
09/26/84	270	WEDNESDAY	2427	180	21.2	21.1	09/28/84	D		0.67		
09/28/84	272	FRIDAY	2478	94	14.3	14.3	10/02/84	C		0.27		

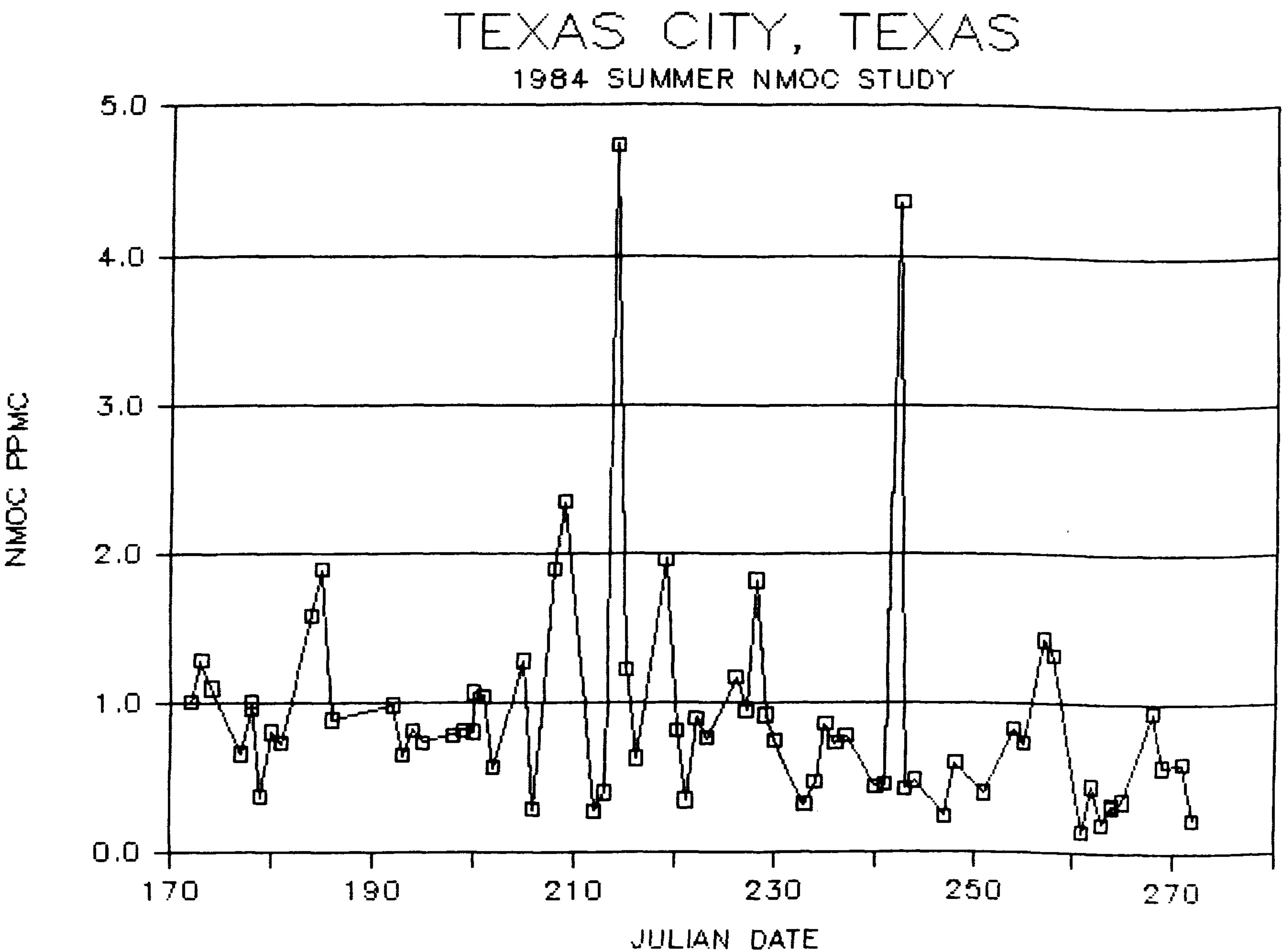

Figure 2-18. Plot of NMOC Data for Texas City, Texas.

Figure 4-14 (cont.)

THE FOLLOWING RESULTS ARE FOR:
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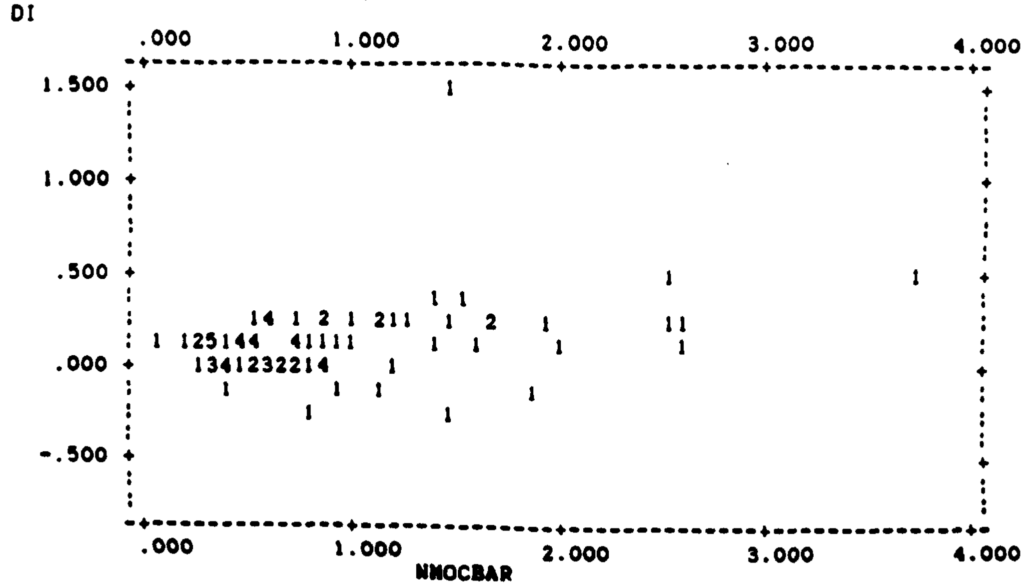
BETA = 6.00



THE FOLLOWING RESULTS ARE FOR:
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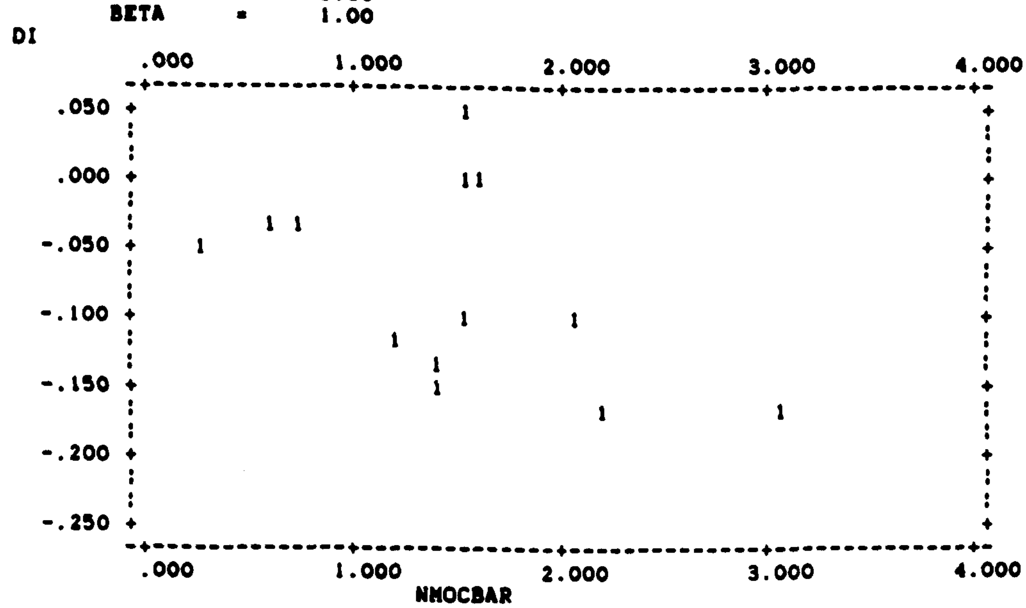
BETA = 1.00



THE FOLLOWING RESULTS ARE FOR:
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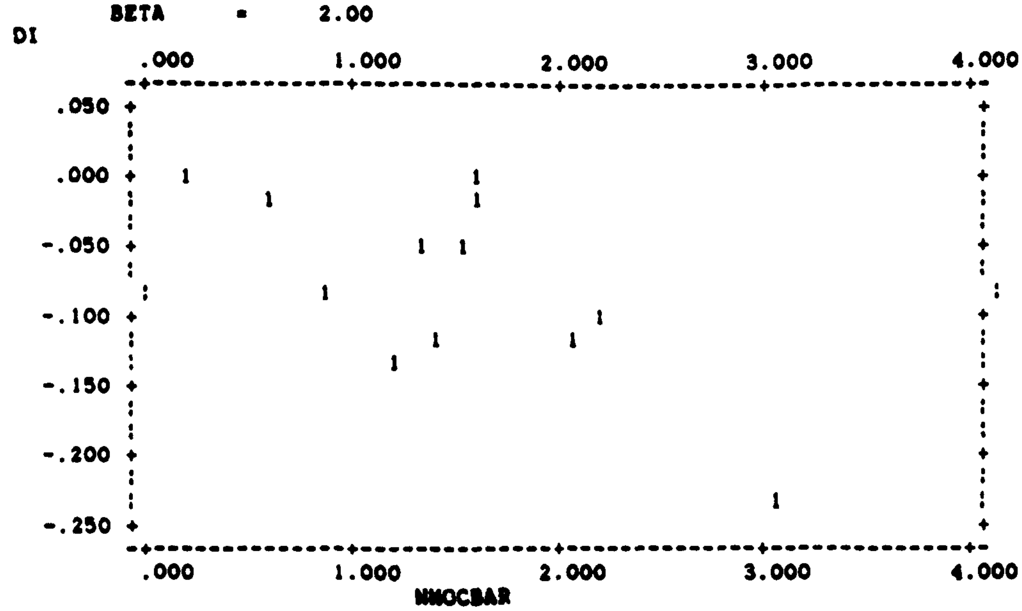
BETA = 2.00



NMOCBAR

THE FOLLOWING RESULTS ARE FOR:
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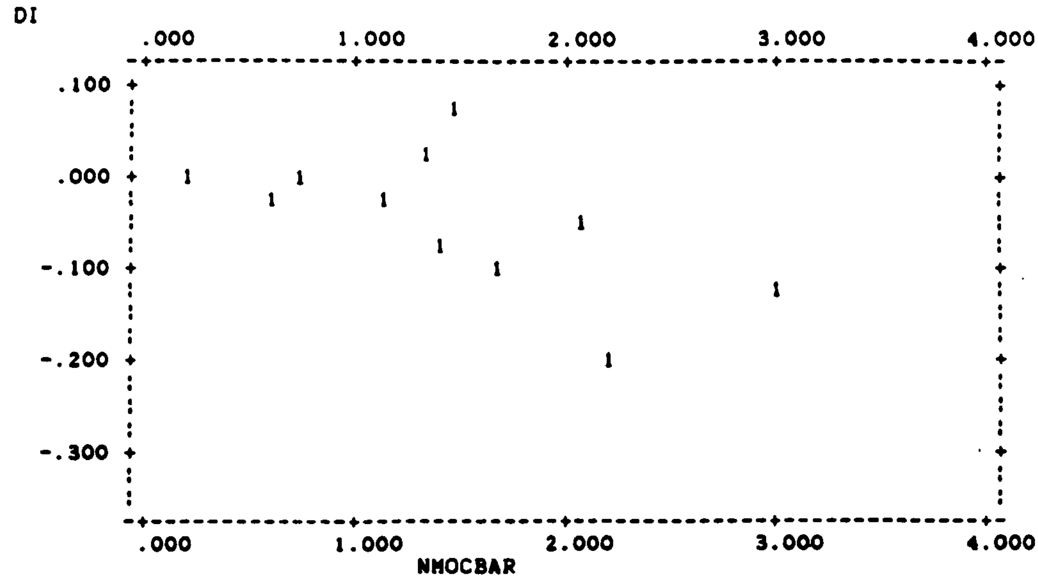
BETA = 3.00



THE FOLLOWING RESULTS ARE FOR:
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BETA = 4.00

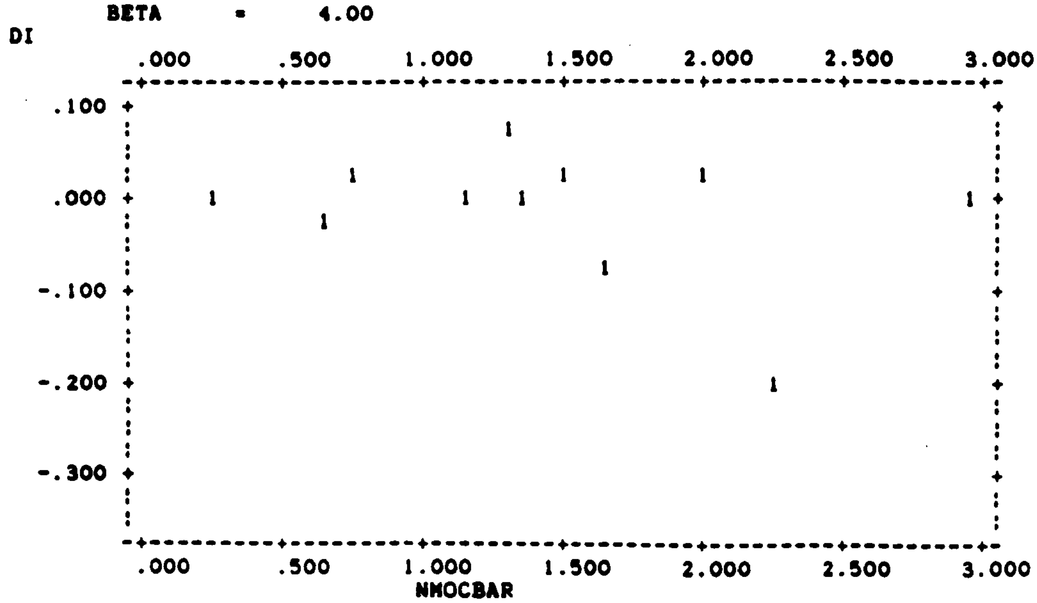


Table 2-20. Data Listing for Texas City, Texas.

1984 SUMMER NMOC STUDY - TEXAS CITY, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/20/84	172	WEDNESDAY	1008	27	0.0	16.5	06/21/84	A	06/22/84	1.01		1.13
06/21/84	173	THURSDAY	1019	36	17.5	18.0	06/22/84	B	06/25/84	1.29		1.26
06/22/84	174	FRIDAY	1024	48	16.0	16.5	06/25/84	C	06/26/84	1.10	1.22	
06/25/84	177	MONDAY	1038	60	17.8	18.0	06/26/84	B	06/27/84	0.66		0.58
06/26/84	178	TUESDAY	1054	66	18.0	18.0	06/28/84	C	06/26/84	0.96	1.00	
06/26/84	178	TUESDAY	1055	73	18.0	18.0	06/28/84	C		1.01		
06/27/84	179	WEDNESDAY	1048	75	16.0	16.0	06/28/84	D	06/29/84	0.37	0.49	
06/28/84	180	THURSDAY	1064	93	15.8	16.0	06/29/84	C		0.81		
06/29/84	181	FRIDAY	1072	106	15.0	15.5	07/02/84	C	07/03/84	0.73	0.84	
07/02/84	184	MONDAY	1088	124	17.8	18.0	07/03/84	A	07/05/84	1.59	1.60	
07/03/84	185	TUESDAY	1111	141	16.8	17.0	07/05/84	A		1.89		
07/04/84	186	WEDNESDAY	1130	7	10.1	11.0	07/06/84	C	07/10/84	0.89		0.79
07/10/84	192	TUESDAY	1176	34	17.5	18.0	07/11/84	B	07/12/84	0.99	1.15	
07/11/84	193	WEDNESDAY	1196	78	21.9	22.0	07/12/84	D		0.65		
07/12/84	194	THURSDAY	1202	70	18.0	18.0	07/13/84	C		0.82		
07/13/84	195	FRIDAY	1235	94	17.0	17.0	07/16/84	D	07/19/84	0.74		0.71
07/16/84	198	MONDAY	1257	110	19.0	20.0	07/17/84	B	07/19/84	0.79		0.87
07/17/84	199	TUESDAY	1272	118	16.8	17.0	07/18/84	D		0.82		
07/18/82	200	WEDNESDAY	1312	12	25.0	25.0	07/20/84	C		0.81		
07/18/84	200	WEDNESDAY	1311	52	25.0	24.0	07/20/84	B		1.07		
07/19/84	201	THURSDAY	1332	4	17.8	17.5	07/23/84	C		1.05		
07/20/84	202	FRIDAY	1344	56	17.0	17.5	07/24/84	B	07/27/84	0.57		1.17
07/23/84	205	MONDAY	1378	144	17.5	18.0	07/25/84	A		1.28		
07/24/84	206	TUESDAY	1397	127	17.0	18.0	07/26/84	C		0.29		
07/26/84	208	THURSDAY	1474	160	25.0	25.0	07/31/84	C		1.90		
07/27/84	209	FRIDAY	1483	198	16.0	16.0	08/01/84	C	08/03/84	2.35		2.09
07/30/84	212	MONDAY	1517	162	17.5	17.2	08/02/84	D		0.28		
07/31/84	213	TUESDAY	1528	171	17.0	17.5	08/02/84	C		0.40		
08/01/84	214	WEDNESDAY	1548	56	19.0	11.7	08/06/84	B	08/03/84	4.74		4.70
08/02/84	215	THURSDAY	1558	177	18.0	18.2	08/06/84	A		1.23		
08/03/84	216	FRIDAY	1595	59	17.0	16.5	08/08/84	A		0.63		
08/06/84	219	MONDAY	1604	187	17.5	17.8	08/08/84	B		1.96		
08/07/84	220	TUESDAY	1635	54	17.0	17.5	08/09/84	A	08/10/84	0.82		0.76
08/08/84	221	WEDNESDAY	1660	178	18.0	17.5	08/13/84	B		0.35		
08/09/84	222	THURSDAY	1672	179	18.0	18.0	08/13/84	D		0.90		
08/10/84	223	FRIDAY	1703	8	17.0	16.5	08/15/84	D		0.76		
08/13/84	226	MONDAY	1726	74	17.0	17.5	08/15/84	A		1.17		
08/14/84	227	TUESDAY	1744	161	17.0	17.6	08/17/84	D		0.95		
08/15/84	228	WEDNESDAY	1762	143	17.5	18.1	08/17/84	D		1.82		
08/16/84	229	THURSDAY	1795	110	18.0	18.7	08/20/84	C	08/21/84	0.92		0.97
08/17/84	230	FRIDAY	1811	50	16.0	16.9	08/21/84	D		0.75		

Table 2-20. Data Listing for Texas City, Texas. (cont.)

1984 SUMMER NMOC STUDY - TEXAS CITY, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/20/84	233	MONDAY	1843	85	17.5	16.5	08/22/84	C	08/23/84	0.32		0.32
08/21/84	234	TUESDAY	1867	26	17.5	17.5	08/24/84	C		0.47		
08/22/84	235	WEDNESDAY	1888	7	18.0	17.5	08/27/84	B		0.86		
08/23/84	236	THURSDAY	1895	63	18.0	18.2	08/27/84	A		0.73		
08/24/84	237	FRIDAY	1930	13	16.0	16.2	08/28/84	D	08/29/84	0.78		0.74
08/27/84	240	MONDAY	1966	61	18.0	18.0	08/29/84	B		0.44		
08/28/84	241	TUESDAY	1981	119	17.0	18.1	08/30/84	D	08/31/84	0.46		0.41
08/29/84	242	WEDNESDAY	2005	56	20.0	17.8	08/31/84	A	09/03/84	4.36	4.28	3.72
08/30/84	243	THURSDAY	2026	123	18.0	18.0	09/04/84	B		0.43		
08/31/84	244	FRIDAY	2037	21	16.0	16.4	09/05/84	C		0.48		
09/03/84	247	MONDAY	2083	161	17.5	17.5	09/06/84	B		0.25		
09/04/84	248	TUESDAY	2075	96	18.0	17.9	09/06/84	D		0.60		
09/04/84	248	TUESDAY	2074	65	18.0	17.9	09/06/84	C		0.60		
09/07/84	251	FRIDAY	2148	102	16.0	17.5	09/11/84	C		0.40		
09/10/84	254	MONDAY	2179	125	17.5	18.5	09/12/84	A		0.83		
09/11/84	255	TUESDAY	2188	119	17.0	18.0	09/13/84	C	09/14/84	0.73		0.72
09/13/84	257	THURSDAY	2232	21	18.0	18.5	09/17/84	A		1.43		
09/14/84	258	FRIDAY	2248	22	16.0	16.5	09/18/84	D		1.32		
09/17/84	261	MONDAY	2295	27	19.0	18.9	09/19/84	D		0.14		
09/18/84	262	TUESDAY	2313	66	17.0	17.9	09/20/84	A		0.45		
09/19/84	263	WEDNESDAY	2338	31	17.0	18.0	09/21/84	B		0.20		
09/20/84	264	THURSDAY	2354	77	19.0	19.5	09/24/84	D		0.32		
09/20/84	264	THURSDAY	2353	130	19.0	20.0	09/24/84	D	09/25/84	0.31		0.33
09/21/84	265	FRIDAY	2391	141	15.5	16.0	09/26/84	D		0.35		
09/24/84	268	MONDAY	2389	148	18.0	18.9	09/26/84	D		0.94		
09/25/84	269	TUESDAY	2432	17	17.0	17.5	09/28/84	B	09/29/84	0.58		0.54
09/27/84	271	THURSDAY	2458	79	18.0	17.0	10/01/84	D		0.60		
09/28/84	272	FRIDAY	2488	143	16.0	15.5	10/02/84	B		0.23		

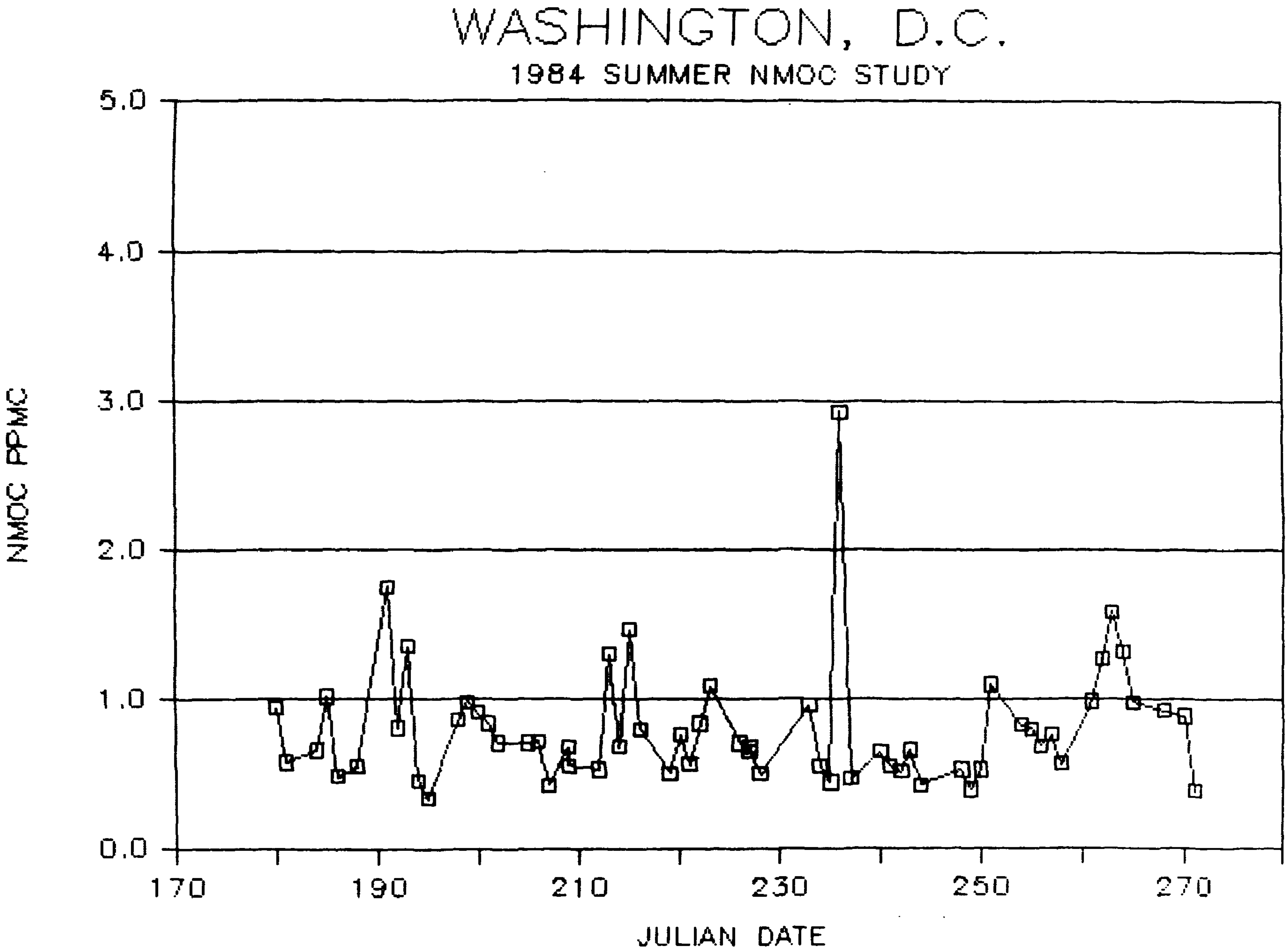


Figure 2-19. Plot of NMOC Data for Washington, D.C.

Table 2-21. Data Listing for Washington, D.C.

1984 SUMMER NMOC STUDY - WASHINGTON, D.C.

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/28/84	180	THURSDAY	1119	87	16.0	16.2	07/06/84	C	07/09/84	0.94	1.77	
06/29/84	181	FRIDAY	1118	100	16.0	17.0	07/06/84	B	07/10/84	0.58		0.54
07/02/84	184	MONDAY	1114	118	16.0	16.0	07/06/84	A		0.66		
07/03/84	185	TUESDAY	1141	136	15.0	15.5	07/09/84	C		1.02		
07/04/84	186	WEDNESDAY	1151	13	17.5	18.0	07/10/84	C	07/13/84	0.49		0.42
07/06/84	188	FRIDAY	1182	55	17.0	17.0	07/12/84	B		0.55		
07/06/84	188	FRIDAY	1183	53	17.0	17.5	07/12/84	C		0.56		
07/09/84	191	MONDAY	1186	1	18.5	13.0	07/12/84	D	07/16/84	1.75		1.54
07/10/84	192	TUESDAY	1221	8	16.0	16.5	07/16/84	D		0.81		
07/11/84	193	WEDNESDAY	1220	81	15.0	16.0	07/16/84	A	07/19/84	1.35		1.34
07/12/84	194	THURSDAY	1243	86	16.5	17.0	07/17/84	D		0.46		
07/13/84	195	FRIDAY	1270	142	17.0	17.5	07/18/84	D		0.34		
07/16/84	198	MONDAY	1291	174	16.0	16.0	07/19/84	C		0.86		
07/17/84	199	TUESDAY	1316	154	16.0	16.5	07/20/84	D	07/24/84	0.98		0.86
07/18/84	200	WEDNESDAY	1339	153	0.0	16.0	07/23/84	D		0.91		
07/19/84	201	THURSDAY	1364	36	19.0	16.8	07/24/84	D		0.84		
07/20/84	202	FRIDAY	1386	119	17.0	18.0	07/25/84	C		0.71		
07/23/84	205	MONDAY	1405	121	16.0	16.9	07/26/84	D		0.71		
07/24/84	206	TUESDAY	1416	57	16.0	17.0	07/27/84	A		0.72		
07/25/84	207	WEDNESDAY	1445	82	16.0	16.5	07/30/84	A		0.43		
07/27/84	209	FRIDAY	1464	101	20.0	20.5	08/01/84	B	08/03/84	0.68		0.56
07/27/84	209	FRIDAY	1496	164	17.0	17.8	08/01/84	C		0.56		
07/30/84	212	MONDAY	1512	179	16.0	16.6	08/02/84	C		0.53		
07/31/84	213	TUESDAY	1559	176	12.0	12.1	08/06/84	B		1.30		
08/01/84	214	WEDNESDAY	1571	107	18.0	18.8	08/07/84	D		0.68		
08/02/84	215	THURSDAY	1597	36	18.0	10.0	08/07/84	D		1.47		
08/03/84	216	FRIDAY	1605	141	18.0	18.5	08/08/84	C	08/09/84	0.80		0.69
08/06/84	219	MONDAY	1623	57	17.0	17.0	08/09/84	B	08/13/84	0.51	1.02	
08/07/84	220	TUESDAY	1662	88	16.0	16.0	08/13/84	A		0.76		
08/08/84	221	WEDNESDAY	1690	91	16.0	16.1	08/13/84	C		0.57		
08/09/84	222	THURSDAY	1708	101	17.3	17.2	08/14/84	B	08/15/84	0.84		0.76
08/10/84	223	FRIDAY	1712	11	17.0	17.0	08/15/84	B	08/16/84	1.09	1.30	
08/13/84	226	MONDAY	1756	43	15.8	15.6	08/17/84	C	08/20/84	0.71		0.67
08/14/84	227	TUESDAY	1780	73	16.0	16.0	08/20/84	C		0.68		
08/14/84	227	TUESDAY	1781	76	16.0	16.0	08/20/84	D		0.65		
08/15/84	228	WEDNESDAY	1786	196	16.2	16.5	08/20/84	B		0.50		
08/20/84	233	MONDAY	1899	44	17.2	15.2	08/20/84	C		0.96		
08/21/84	234	TUESDAY	1916	88	16.5	17.0	08/28/84	C		0.55		
08/22/84	235	WEDNESDAY	1911	91	16.3	17.0	08/28/84	D		0.45		
08/23/84	236	THURSDAY	1921	52	20.0	12.5	08/28/84	C		2.93		
08/24/84	237	FRIDAY	1922	11	18.0	18.7	08/28/84	A		0.47		

Table 2-21. Data Listing for Washington, D.C. (cont.)

1984 SUMMER NMOC STUDY - WASHINGTON, D.C.

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/27/84	240	MONDAY	1990	70	17.0	17.1	08/30/84	C	08/31/84	0.65		0.62
08/28/84	241	TUESDAY	2003	46	16.2	17.0	08/31/84	B	09/04/84	0.56	0.60	
08/29/84	242	WEDNESDAY	2030	196	15.9	16.4	09/04/84	B		0.52		
08/30/84	243	THURSDAY	2059	103	17.4	15.0	09/05/84	A		0.66		
08/31/84	244	FRIDAY	2090	162	17.0	17.5	09/06/84	A		0.43		
09/04/84	248	TUESDAY	2100	114	17.1	17.5	09/07/84	D	09/10/84	0.53		0.58
09/05/84	249	WEDNESDAY	2136	39	16.3	17.0	09/10/84	C		0.40		
09/06/84	250	THURSDAY	2163	100	17.8	18.5	09/12/84	D		0.53		
09/07/84	251	FRIDAY	2182	61	17.9	19.0	09/12/84	B		1.10		
09/10/84	254	MONDAY	2198	140	17.0	17.5	09/13/84	C		0.83		
09/11/84	255	TUESDAY	2217	190	16.5	17.9	09/14/84	D		0.80	0.90	
09/12/84	256	WEDNESDAY	2238	62	16.3	15.5	09/17/84	A		0.69		
09/13/84	257	THURSDAY	2253	137	18.0	19.1	09/18/84	A		0.76		
09/14/84	258	FRIDAY	2284	96	17.3	17.5	09/19/84	B	09/20/84	0.57		0.52
09/17/84	261	MONDAY	2306	188	19.7	18.5	09/20/84	D		0.99		
09/18/84	262	TUESDAY	2334	94	17.0	18.0	09/21/84	A	09/24/84	1.27	1.34	
09/19/84	263	WEDNESDAY	2345	199	16.9	17.9	09/24/84	A	09/25/84	1.59		1.45
09/20/84	264	THURSDAY	2379	100	17.8	18.1	09/26/84	C		1.33		
09/21/84	265	FRIDAY	2396	57	17.5	17.2	09/26/84	D		0.98		
09/24/84	268	MONDAY	2420	116	18.1	18.0	09/28/84	B		0.93		
09/26/84	270	WEDNESDAY	2464	78	16.7	16.5	10/01/84	D	10/02/84	0.89		0.87
09/27/84	271	THURSDAY	2481	88	18.4	19.5	10/02/84	B		0.39		

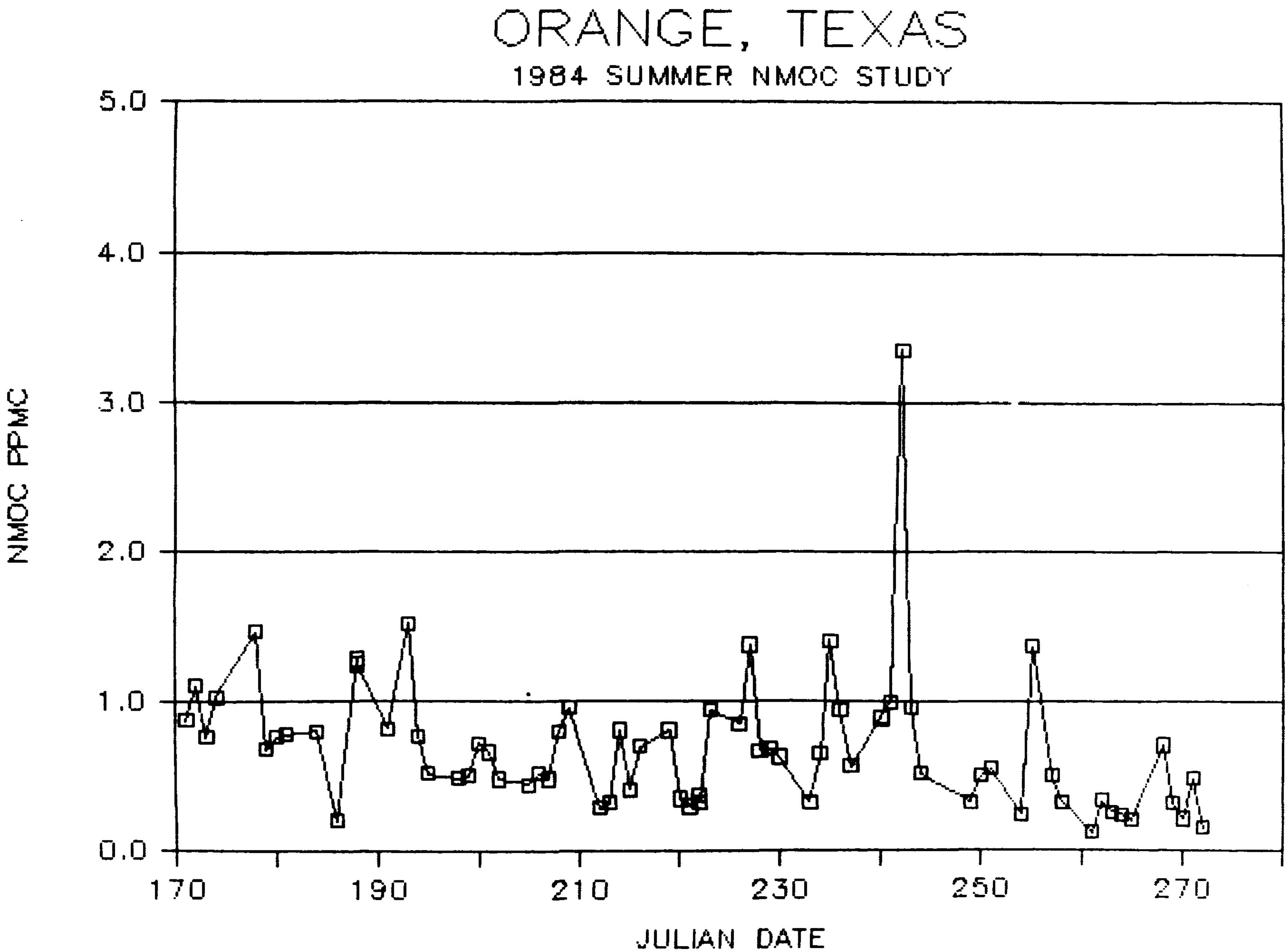


Figure 2-20. Plot of NMOC Data for West Orange, Texas.

Table 2-22. Data Listing for West Orange, Texas.

1984 SUMMER NMOC STUDY - ORANGE, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/19/84	171	TUESDAY	1012	17	25.5	23.5	06/25/84	C	06/26/84	0.88		0.85
06/20/84	172	WEDNESDAY	1032	22	13.0	11.5	06/25/84	C	06/26/84	1.11		1.06
06/21/84	173	THURSDAY	1030	32	19.0	17.0	06/25/84	A	06/26/84	0.76		0.85
06/22/84	174	FRIDAY	1045	41	19.0	17.5	06/27/84	D	06/28/84	1.03	1.17	
06/26/84	178	TUESDAY	1059	65	21.5	19.5	06/29/84	C	06/29/84	1.47		1.18
06/27/84	179	WEDNESDAY	1066	81	19.0	17.0	06/29/84	E	07/02/84	0.68	0.82	
06/28/84	180	THURSDAY	1077	89	19.0	17.3	07/02/84	D		0.76		
06/29/84	181	FRIDAY	1097	104	20.0	18.0	07/05/84	C		0.78		
07/02/84	184	MONDAY	1125	130	19.5	17.5	07/06/84	A		0.80		
07/04/84	186	WEDNESDAY	1157	29	19.0	17.3	07/10/84	D	06/11/84	0.21	0.33	
07/06/84	188	FRIDAY	1171	32	18.8	16.5	07/11/84	A		1.28		
07/06/84	188	FRIDAY	1170	42	18.8	16.5	07/11/84	C	07/12/84	1.25	1.33	
07/09/84	191	MONDAY	1190	45	30.0	28.5	07/12/84	A	07/16/84	0.82		0.70
07/11/84	193	WEDNESDAY	1215	68	16.0	13.0	07/16/84	A		1.52		
07/12/84	194	THURSDAY	1263	69	22.0	19.0	07/18/84	A	07/19/84	0.77	0.90	
07/13/84	195	FRIDAY	1279	164	16.0	13.0	07/18/84	D		0.52		
07/16/84	198	MONDAY	1275	87	20.0	17.5	07/18/84	C		0.49		
07/17/84	199	TUESDAY	1304	132	19.0	16.5	07/19/84	D		0.50		
07/18/84	200	WEDNESDAY	1326	29	19.0	16.5	07/21/84	D		0.72		
07/19/84	201	THURSDAY	1347	76	19.0	17.0	07/24/84	C	07/25/84	0.66	0.74	
07/20/84	202	FRIDAY	1359	67	17.0	14.7	07/24/84	C	07/27/84	0.48		0.54
07/23/84	205	MONDAY	1412	77	20.0	18.0	07/26/84	A		0.44		
07/24/84	206	TUESDAY	1398	88	26.0	24.5	07/26/84	A		0.52		
07/25/84	207	WEDNESDAY	1443	83	19.5	17.0	07/30/84	D		0.48		
07/26/84	208	THURSDAY	1460	173	19.5	17.2	07/31/84	B	08/03/84	0.80		0.66
07/27/84	209	FRIDAY	1466	167	19.5	17.0	08/01/81	D		0.96		
07/30/84	212	MONDAY	1497	163	20.0	18.0	08/01/84	A	08/03/84	0.29		0.28
07/31/84	213	TUESDAY	1552	31	26.0	23.7	08/06/84	B		0.32		
08/01/84	214	WEDNESDAY	1550	7	19.5	16.5	08/06/84	D		0.81		
08/02/84	215	THURSDAY	1569	144	19.0	17.0	08/07/84	D		0.41		
08/03/84	216	FRIDAY	1615	83	26.0	24.3	08/08/84	A		0.70		
08/06/84	219	MONDAY	1640	118	26.5	24.5	08/09/84	C	08/10/84	0.81		0.71
08/07/84	220	TUESDAY	1637	182	19.4	17.1	08/09/84	D		0.35		
08/08/84	221	WEDNESDAY	1670	98	19.5	17.0	08/13/84	C	08/14/84	0.30	0.42	0.29
08/09/84	222	THURSDAY	1667	157	18.0	15.7	08/13/84	C		0.38		
08/09/84	222	THURSDAY	1668	19	18.0	15.3	08/13/84	D		0.33		
08/10/84	223	FRIDAY	1718	147	0.0	17.1	08/16/84	C		0.94		
08/13/84	226	MONDAY	1711	197	20.0	18.1	08/15/84	C		0.85		
08/14/84	227	TUESDAY	1746	81	26.0	23.1	08/16/84	E		1.38		
08/15/84	228	WEDNESDAY	1774	102	16.0	14.8	08/17/84	C	08/20/84	0.67		0.67
08/16/84	229	THURSDAY	1784	115	29.0	29.5	08/20/84	A		0.68		

Table 2-22. Data Listing for West Orange, Texas. (cont.)

1984 SUMMER NMOC STUDY - ORANGE, TEXAS

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/17/84	230	FRIDAY	1814	140	20.0	17.5	08/21/84	A		0.63		
08/20/84	233	MONDAY	1865	116	21.8	19.5	08/24/84	C		0.33		
08/21/84	234	TUESDAY	1873	21	19.5	17.0	08/24/84	A		0.65		
08/22/84	235	WEDNESDAY	1883	51	18.5	16.6	08/27/84	B		1.41		
08/23/84	236	THURSDAY	1933	164	19.8	17.4	08/29/84	D		0.94		
08/24/84	237	FRIDAY	1935	107	20.0	17.8	08/29/84	C	08/30/84	0.57	0.61	0.39
08/27/84	240	MONDAY	1971	181	19.0	17.1	08/29/84	C		0.89		
08/27/84	240	MONDAY	1972	140	19.0	17.0	08/30/84	D		0.90		
08/28/84	241	TUESDAY	2049	68	19.8	17.5	09/06/84	D		1.00		
08/29/84	242	WEDNESDAY	2045	131	20.5	12.0	09/05/84	D		3.35		
08/30/84	243	THURSDAY	2057	169	13.0	11.1	09/06/84	A	09/07/84	0.96		1.06
08/31/84	244	FRIDAY	2055	23	17.0	18.0	09/05/84	B		0.52		
09/05/84	249	WEDNESDAY	2130	30	21.0	20.0	09/10/84	C		0.33		
09/06/84	250	THURSDAY	2114	107	18.0	18.0	09/10/84	B		0.50		
09/07/84	251	FRIDAY	2158	80	16.0	16.5	09/11/84	C	09/12/84	0.55		0.51
09/10/84	254	MONDAY	2219	89	20.0	20.5	09/14/84	B		0.25		
09/11/84	255	TUESDAY	2224	187	19.5	20.0	09/14/84	B		1.37		
09/13/84	257	THURSDAY	2277	81	19.0	15.9	09/19/84	C		0.50		
09/14/84	258	FRIDAY	2279	1133	17.5	15.5	09/19/84	D	09/20/84	0.33		0.30
09/17/84	261	MONDAY	2293	19	18.0	16.5	09/19/84	C		0.13		
09/18/84	262	TUESDAY	2340	67	17.5	18.1	09/21/84	D	09/22/84	0.34		0.49
09/19/84	263	WEDNESDAY	2337	61	17.0	17.5	09/21/84	A		0.26		
09/20/84	264	THURSDAY	2369	69	17.0	15.0	09/25/84	A		0.25		
09/21/84	265	FRIDAY	2378	178	17.5	15.5	09/25/84	C		0.21		
09/24/84	268	MONDAY	2412	105	16.5	12.9	09/27/84	A	09/28/84	0.71		0.67
09/25/84	269	TUESDAY	2442	40	23.5	20.5	10/01/84	D		0.33		
09/25/84	269	TUESDAY	2243	19	23.5	10.0	10/01/84	C		0.32		
09/26/84	270	WEDNESDAY	2477	128	17.0	16.8	10/02/84	D		0.22		
09/27/84	271	THURSDAY	2470	134	16.0	15.5	10/02/84	B		0.49		
09/28/84	272	FRIDAY	2480	153	16.0	14.5	10/02/84	B		0.16		

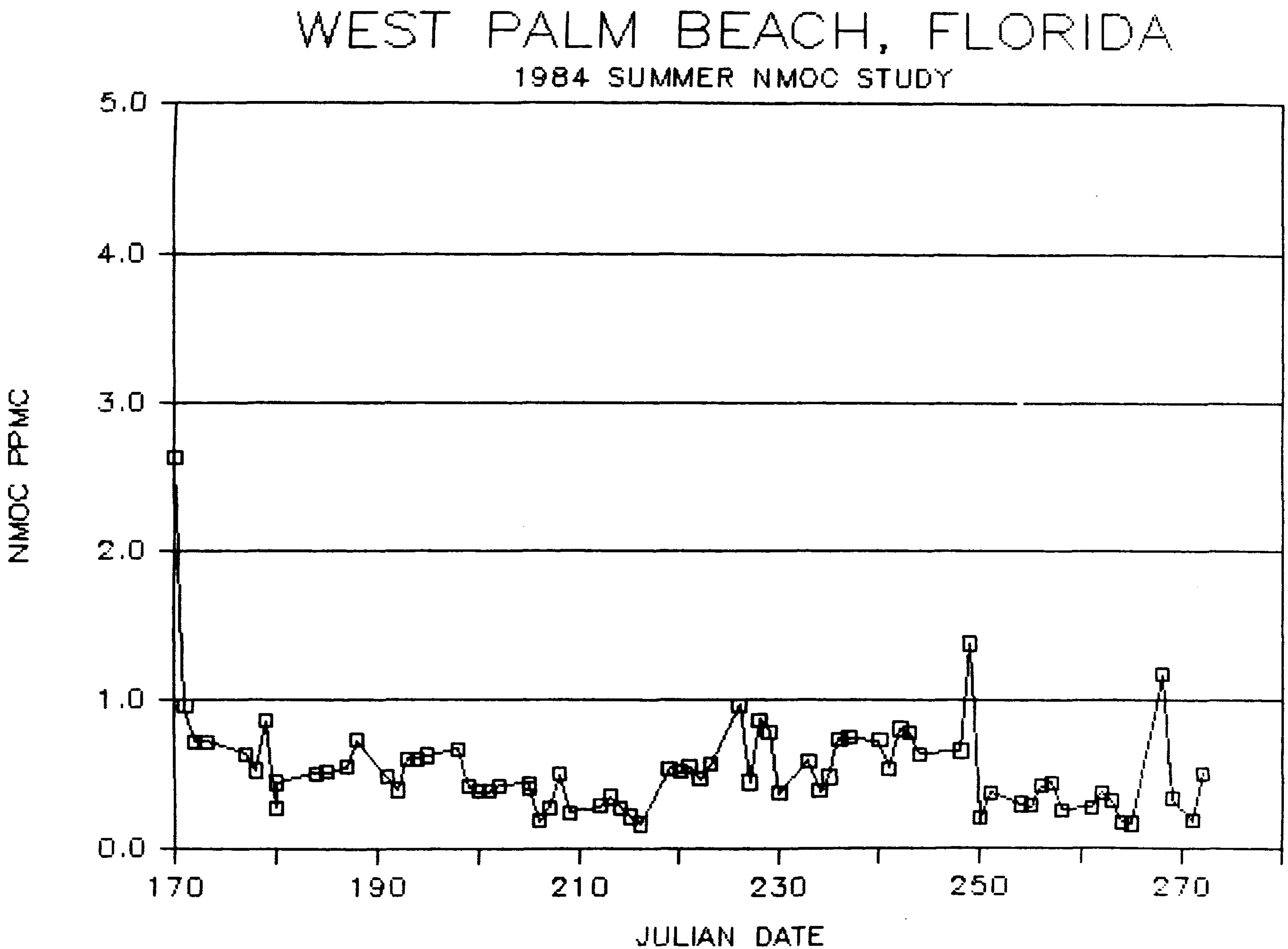


Figure 2-21. Plot of NMOC Data for West Palm Beach, Florida.

Table 2-23. Data Listing for West Palm Beach, Florida.

1984 SUMMER NMOC STUDY - WEST PALM BEACH, FLORIDA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/18/84	170	MONDAY	1016	1	19.5	11.5	06/25/84	D	06/26/84	2.63		2.38
06/19/84	171	TUESDAY	1015	2	16.0	15.5	06/22/84	A	06/25/84	0.96	1.15	
06/20/84	172	WEDNESDAY	1010	23	15.8	16.0	06/22/84	C	06/25/84	0.72		0.69
06/21/84	173	THURSDAY	1037	30	14.5	14.5	06/26/84	A	06/27/84	0.72		0.59
06/25/84	177	MONDAY	1058	38	15.0	15.0	06/29/84	D		0.64		
06/26/84	178	TUESDAY	1057	49	15.0	15.0	06/29/84	B		0.53		
06/27/84	179	WEDNESDAY	1067	54	15.2	15.0	06/29/84	A		0.86		
06/28/84	180	THURSDAY	1080	69	15.0	15.0	07/02/84	A	07/10/84	0.28		0.31
06/28/84	180	THURSDAY	1079	68	15.0	15.0	07/02/84	A	07/10/84	0.45		0.37
07/02/84	184	MONDAY	1105	82	16.0	16.0	07/05/84	B		0.51		
07/03/84	185	TUESDAY	1129	108	15.5	15.8	07/06/84	C		0.52		
07/05/84	187	THURSDAY	1132	135	15.7	15.5	07/09/84	B		0.55		
07/06/84	188	FRIDAY	1148	15	14.5	14.5	07/10/84	A		0.73		
07/09/84	191	MONDAY	1166	14	16.4	16.8	07/11/84	B		0.49		
07/10/84	192	TUESDAY	1188	43	15.3	15.5	07/12/84	C	07/16/84	0.40		0.32
07/11/84	193	WEDNESDAY	1211	77	16.2	16.5	07/13/84	B		0.61		
07/12/84	194	THURSDAY	1233	107	15.8	15.5	07/16/84	A	07/17/84	0.61	0.63	
07/13/84	195	FRIDAY	1241	72	14.9	15.0	07/17/84	B		0.63		
07/16/84	198	MONDAY	1268	158	16.2	16.0	07/18/84	C		0.67		
07/17/84	199	TUESDAY	1289	103	15.6	15.5	07/19/84	A		0.42		
07/18/84	200	WEDNESDAY	1308	136	15.5	16.0	07/20/84	D		0.39		
07/19/84	201	THURSDAY	1336	13	15.0	15.0	07/23/84	D		0.39		
07/20/84	202	FRIDAY	1360	189	14.9	15.0	07/24/84	B	07/27/84	0.43		0.48
07/23/84	205	MONDAY	1372	113	16.2	16.5	07/25/84	C	07/27/84	0.44		0.39
07/23/84	205	MONDAY	1373	78	16.2	16.5	07/25/84	A		0.41		
07/24/84	206	TUESDAY	1407	81	15.9	16.2	07/26/84	D		0.19		
07/25/84	207	WEDNESDAY	1420	125	15.2	15.5	07/27/84	A		0.28		
07/26/84	208	THURSDAY	1438	85	16.0	16.0	07/30/84	A		0.50		
07/27/84	209	FRIDAY	1463	130	15.0	15.3	07/31/84	A		0.25		
07/30/84	212	MONDAY	1485	190	17.0	16.9	08/01/84	B		0.29		
07/31/84	213	TUESDAY	1524	26	14.0	15.8	08/02/84	D		0.35		
08/01/84	214	WEDNESDAY	1543	33	15.4	15.5	08/06/84	C		0.28		
08/02/84	215	THURSDAY	1564	172	15.6	16.0	08/07/84	C	08/08/84	0.22		0.21
08/03/84	216	FRIDAY	1596	46	15.1	15.2	08/08/84	B		0.17		
08/06/84	219	MONDAY	1619	103	16.9	17.0	08/08/84	C	08/09/84	0.54		0.33
08/07/84	220	TUESDAY	1631	194	16.0	16.5	08/09/84	B		0.52		
08/08/84	221	WEDNESDAY	1647	165	16.0	16.8	08/10/84	D		0.55		
08/09/84	222	THURSDAY	1679	198	15.9	16.1	08/13/84	D		0.47		
08/10/84	223	FRIDAY	1705	52	15.0	15.0	08/15/84	A	08/16/84	0.57		0.52
08/13/84	226	MONDAY	1720	66	16.0	16.5	08/15/84	A		0.97		
08/14/84	227	TUESDAY	1742	80	15.9	15.9	08/16/84	C	08/20/84	0.45		0.56

Table 2-23. Data Listing for West Palm Beach, Florida. (cont.)

1984 SUMMER NMOC STUDY - WEST PALM BEACH, FLORIDA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/15/84	228	WEDNESDAY	1779	176	16.5	13.0	08/20/84	A		0.87		
08/16/84	229	THURSDAY	1792	97	15.8	15.8	08/20/84	C		0.79		
08/17/84	230	FRIDAY	1825	79	15.0	15.1	08/21/84	D		0.37		
08/20/84	233	MONDAY	1850	17	17.0	15.5	08/22/84	B		0.59		
08/21/84	234	TUESDAY	1861	134	15.8	13.0	08/24/84	D		0.39		
08/22/84	235	WEDNESDAY	1891	8	16.0	15.2	08/27/84	C	08/28/84	0.48	0.57	0.64
08/23/84	236	THURSDAY	1904	179	15.6	16.0	08/27/84	C	08/28/84	0.74	0.91	
08/24/84	237	FRIDAY	1925	125	15.0	15.2	08/28/84	B		0.75		
08/27/84	240	MONDAY	1950	182	15.9	16.9	08/29/84	C		0.73		
08/28/84	241	TUESDAY	1977	79	15.7	16.5	08/30/84	D		0.54		
08/29/84	242	WEDNESDAY	2000	178	16.0	16.3	08/31/84	D	09/03/84	0.81		0.80
08/30/84	243	THURSDAY	2017	10	21.0	20.6	09/04/84	B		0.78		
08/31/84	244	FRIDAY	2041	29	16.0	15.5	09/05/84	C		0.64		
09/04/84	248	TUESDAY	2081	180	16.7	16.5	09/07/84	A		0.66		
09/05/84	249	WEDNESDAY	2108	153	16.2	16.5	09/10/84	A	09/11/84	1.38		1.69
09/06/84	250	THURSDAY	2111	164	15.8	16.5	09/10/84	D		0.21		
09/07/84	251	FRIDAY	2156	13	15.3	15.9	09/11/84	A		0.38		
09/10/84	254	MONDAY	2183	128	15.9	16.0	09/12/84	B		0.30		
09/11/84	255	TUESDAY	2199	135	15.9	16.5	09/13/84	D	09/14/84	0.29		0.30
09/12/84	256	WEDNESDAY	2221	116	15.9	16.4	09/14/84	C		0.42		
09/13/84	257	THURSDAY	2246	74	15.8	16.0	09/18/84	C		0.44		
09/14/84	258	FRIDAY	2247	53	16.0	16.1	09/18/84	B		0.26		
09/17/84	261	MONDAY	2286	179	16.9	16.5	09/19/84	C		0.28		
09/18/84	262	TUESDAY	2308	79	15.9	15.5	09/20/84	D		0.38		
09/19/84	263	WEDNESDAY	2331	109	16.1	16.0	09/21/84	B		0.32		
09/20/84	264	THURSDAY	2344	125	15.5	16.0	09/24/84	D		0.18		
09/21/84	265	FRIDAY	2375	34	16.0	16.0	09/25/84	B	09/26/84	0.17		0.18
09/24/84	268	MONDAY	2388	75	17.5	15.9	09/26/84	C	09/27/84	1.17		1.06
09/25/84	269	TUESDAY	2417	162	15.9	15.5	09/27/84	D		0.34		
09/27/84	271	THURSDAY	2466	11	15.0	15.0	10/01/84	D	10/02/84	0.19	0.31	
09/28/84	272	FRIDAY	2495	147	15.9	15.5	10/02/84	A		0.51		

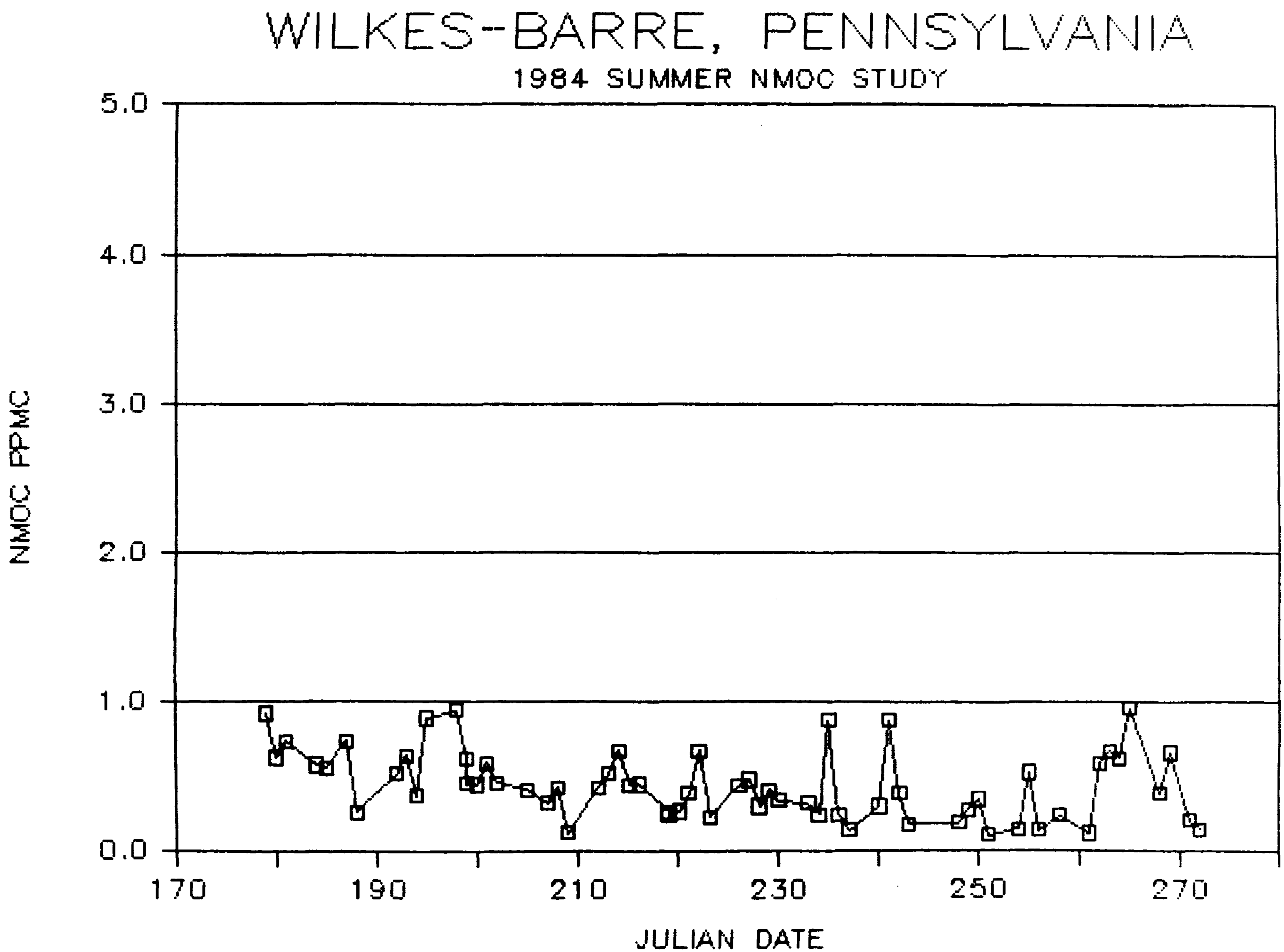


Figure 2-22. Plot of NMOC Data for Wilkes-Barre/Scranton, Pennsylvania.

Table 2-24. Data Listing for Wilkes-Barre/Scranton, Pennsylvania.

1984 SUMMER NMOC STUDY - WILKES-BARRE, PENNSYLVANIA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
06/27/84	179	WEDNESDAY	1100	116	16.5	16.5	07/05/84	B	07/10/84	0.92		0.84
06/28/84	180	THURSDAY	1101	115	15.0	15.5	07/05/84	C		0.63		
06/29/84	181	FRIDAY	1098	64	16.0	16.0	07/05/84	D	07/06/84	0.74	1.12	
07/02/84	184	MONDAY	1103	120	15.0	15.0	07/05/84	A	07/10/84	0.58		0.52
07/03/84	185	TUESDAY	1134	132	15.5	16.0	07/09/84	D		0.56		
07/05/84	187	THURSDAY	1149	148	11.0	10.5	07/10/84	C		0.74		
07/06/84	188	FRIDAY	1167	11	16.5	14.5	07/11/84	D	07/16/84	0.26		0.21
07/10/84	192	TUESDAY	1181	30	24.0	24.8	07/12/84	D		0.52		
07/11/84	193	WEDNESDAY	1217	99	24.0	24.0	07/16/84	A		0.64		
07/12/84	194	THURSDAY	1228	59	11.5	11.0	07/16/84	B		0.37		
07/13/84	195	FRIDAY	1244	129	17.0	17.5	07/17/84	C	07/19/84	0.89		0.68
07/16/84	198	MONDAY	1269	181	17.0	17.9	07/18/84	C		0.94		
07/17/84	199	TUESDAY	1286	187	17.0	17.5	07/19/84	C		0.62		
07/17/84	199	TUESDAY	1285	180	17.0	17.4	07/19/84	B	07/23/84	0.46		0.47
07/18/84	200	WEDNESDAY	1319	196	16.0	16.5	07/20/84	C		0.45		
07/19/84	201	THURSDAY	1329	22	16.0	16.2	07/23/84	A		0.59		
07/20/84	202	FRIDAY	1348	117	16.5	16.7	07/24/84	D		0.46		
07/23/84	205	MONDAY	1382	66	0.0	24.0	07/25/84	C		0.41		
07/25/84	207	WEDNESDAY	1431	38	24.0	23.5	07/25/84	A		0.32		
07/26/84	208	THURSDAY	1439	8	24.0	24.0	07/30/84	B	08/03/84	0.43		0.42
07/27/84	209	FRIDAY	1480	142	15.5	15.5	07/31/84	C		0.13		
07/30/84	212	MONDAY	1486	116	23.5	24.2	08/01/84	A		0.43		
07/31/84	213	TUESDAY	1509	138	16.0	16.0	08/02/84	B		0.52		
08/01/84	214	WEDNESDAY	1546	18	16.0	16.0	08/06/84	D		0.67		
08/02/84	215	THURSDAY	1577	40	17.0	17.0	08/07/84	A		0.44		
08/03/84	216	FRIDAY	1585	149	16.0	15.5	08/08/84	C	08/08/84	0.45		0.41
08/06/84	219	MONDAY	1645	120	22.0	22.0	08/09/84	A		0.26		
08/06/84	219	MONDAY	1644	64	22.0	21.5	08/09/84	A	08/10/84	0.24		0.20
08/07/84	220	TUESDAY	1626	140	16.0	15.5	08/09/84	B		0.27		
08/08/84	221	WEDNESDAY	1658	130	16.0	15.5	08/13/84	C		0.39		
08/09/84	222	THURSDAY	1686	100	18.0	16.7	08/14/84	C	08/15/84	0.67		0.69
08/10/84	223	FRIDAY	1692	122	16.0	14.0	08/14/84	C	08/15/84	0.23	0.45	
08/13/84	226	MONDAY	1713	163	15.5	16.0	08/15/84	A		0.44		
08/14/84	227	TUESDAY	1741	60	23.0	23.0	08/16/84	C		0.48		
08/15/84	228	WEDNESDAY	1769	71	16.0	16.0	08/17/84	B		0.30		
08/16/84	229	THURSDAY	1788	104	24.5	24.5	08/20/84	A	08/21/84	0.41		0.33
08/17/84	230	FRIDAY	1815	155	23.5	24.0	08/21/84	A		0.34		
08/20/84	233	MONDAY	1844	126	16.0	15.2	08/22/84	D		0.32		
08/21/84	234	TUESDAY	1869	185	24.5	25.0	08/24/84	C		0.25		
08/22/84	235	WEDNESDAY	1881	54	24.0	21.8	08/27/84	D	08/28/84	0.88		0.88
08/23/84	236	THURSDAY	1903	186	17.0	17.1	08/27/84	A	08/28/84	0.25	0.41	

Table 2-24. Data Listing for Wilkes-Barre/Scranton, Pennsylvania. (cont.)

1984 SUMMER NMOC STUDY - WILKES-BARRE, PENNSYLVANIA

DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
08/24/84	237	FRIDAY	1928	27	16.0	16.1	08/28/84	B		0.14		
08/27/84	240	MONDAY	1948	67	16.0	16.4	08/29/84	D		0.30		
08/28/84	241	TUESDAY	1973	97	16.5	17.0	08/30/84	C	08/31/84	0.88		0.80
08/29/84	242	WEDNESDAY	1998	37	24.0	24.0	08/31/84	E		0.39		
08/30/84	243	THURSDAY	2013	35	24.5	24.7	09/04/84	A		0.18		
09/04/84	248	TUESDAY	2072	122	23.0	22.9	09/06/84	C	09/07/84	0.19		0.16
09/05/84	249	WEDNESDAY	2103	101	16.0	16.5	09/07/84	D		0.28		
09/06/84	250	THURSDAY	2127	179	19.0	19.0	09/10/84	B	09/11/84	0.35	0.39	
09/07/84	251	FRIDAY	2151	15	16.5	17.1	09/11/84	B		0.11		
09/10/84	254	MONDAY	2168	76	17.0	17.5	09/12/84	C	09/13/84	0.15	0.28	
09/11/84	255	TUESDAY	2202	37	24.0	24.0	09/13/84	D		0.53		
09/12/84	256	WEDNESDAY	2227	133	16.0	17.0	09/14/84	B		0.14		0.13
09/14/84	258	FRIDAY	2256	162	16.5	16.9	09/18/84	B		0.24		
09/17/84	261	MONDAY	2269	60	25.0	25.0	09/19/84	B	09/20/84	0.12		0.44
09/18/84	262	TUESDAY	2307	134	17.0	17.3	09/20/84	A		0.59		
09/19/84	263	WEDNESDAY	2316	143	16.0	16.4	09/21/84	D		0.67		
09/20/84	264	THURSDAY	2384	70	23.0	23.6	09/26/84	D		0.62		
09/21/84	265	FRIDAY	2374	97	16.0	16.0	09/25/84	D		0.96		
09/24/84	268	MONDAY	2400	87	16.0	16.8	09/27/84	A	09/27/84	0.39	0.45	
09/25/84	269	TUESDAY	2426	22	16.0	16.4	09/28/84	D	09/29/84	0.66		0.94
09/27/84	271	THURSDAY	2465	44	17.0	17.5	10/01/84	C		0.21		
09/28/84	272	FRIDAY	2492	41	24.0	23.8	10/02/84	C		0.15		

3.0 ANALYTICAL TECHNICAL NOTES

3.1 INSTRUCTIONS FOR OPERATION OF NMOC SAMPLERS

3.1.1 Installation

1. Locate the sampler in a convenient place close to the sample inlet point. The location should be in an air conditioned (70-85° F) area with suitable space and electrical power.

2. Make sure that the electrical solenoid valve is installed on the pump outlet. The valve should have a tee fitting on top, one leg of which is plugged.

3. Verify that the inlet to the pump has a flow-control needle/filter assembly mounted on it. The needle assembly should be marked with an "S".

4. Connect a 1/8-inch stainless steel inlet line from the top on the needle/filter assembly to the inlet manifold. This should be the same manifold used for the NO_x monitor. If there is no inlet manifold, install a suitable inlet line of 1/8-inch stainless steel to the sampling point. If possible, avoid using any plastic parts, such as plastic line or fittings in the sample inlet. The sample inlet should be kept as short as possible and installed so that it will not collect water. If it is necessary to use a long sample inlet line (over 10-12 feet from the pump to the manifold or sample point), a small vacuum pump should be connected to the pump end of the inlet line to keep the inlet purged during sampling. The local agency will be asked to supply such a pump and any other incidental items needed to connect the sampler to the sample inlet point.

5. Connect the pump and the solenoid valve to the timer, and connect the timer to an electrical power outlet. Set the timer to the correct local time by turning the large dial in a clockwise direction.

6. Verify that the pump is operational by turning the timer switch ON and OFF. NOTE: The solenoid valve is a special latching valve with a time-delay power circuit. It may not operate properly if the timer switch is turned ON and OFF too fast. The switch must be left in the ON or OFF position at least 20 seconds before it is switched to the other position to operate the valve properly.

7. Disconnect the sample inlet from the top of the filter assembly and connect the rotameter to the filter assembly, holding or mounting the rotameter in a vertical position. Start the pump and record the flowmeter reading. Remove the "S" needle assembly, install the "D" needle assembly, and record the flowmeter reading. Turn the timer switch OFF. After 20 seconds, unplug the solenoid valve, then turn the timer switch ON and verify that the valve is closed and that there is no flow. Turn the timer switch OFF and reconnect the solenoid valve. Disconnect the rotameter, reinstall the "S" needle assemb'y, and reconnect the sample inlet to the filter assembly.

8. Operator familiarization:
    1. Demonstrate installation of canister(s).
    2. Delay in turning solenoid valve on and off.
    3. Measuring flow with rotameter.
    4. Change needle assemblies.
    5. Change filter element.
    6. Correct tightening of Swagelock® fittings.
    7. Set timer and ON/OFF dogs.
    8. Fill out sample form.
    9. Go through sampling procedure.
    10. Go through troubleshooting instructions.
    11. Know whom to call if problems are encountered.

3.1.2 <u>Operation - Presampling</u>

1. Set the timer to the correct day and time, or to verify that the timer is correctly set. Verify that the ON/OFF dogs are correctly installed on the timer disk.

2. With no canisters connected to the sampling system, turn the timer switch to the OFF position.

3. Disconnect the sample inlet from the top of the needle/filter assembly mounted on the pump inlet. Connect the rotameter to the top of the needle/filter assembly. Hold or mount the rotameter vertically.

4. If the timer switch has been OFF less than 20 seconds, wait until the switch has been OFF at least 20 seconds. Then turn the timer switch ON. The pump should run and the valve should open. Verify that the rotameter reading is approximately the same (+/- 15%) as the reading obtained during installation. If the rotameter reading is not correct, see the troubleshooting instructions.

5. Allow the pump to run for at least 20 seconds, then turn the timer switch OFF.

6. Connect a cleaned, evacuated canister to the sampling system. NOTE: If duplicate samples are to be collected, remove the plug from the second leg of the tee and connect a second canister to the sampling system. Remove the needle assembly marked with an "S" (do not remove the filter assembly), and install the needle assembly marked with a "D" in its place. Replace the plug and the "S" needle assembly to return to collection of single samples.

7. Open the valve (wide open) on the canister (or on one of the canisters if two are connected) and verify that no flow is registered on the rotameter with the pump off. If any flow is detected by the rotameter, immediately close the canister valve and see the troubleshooting instructions.

8. If no flow is detected, disconnect the rotameter and reconnect the sample inlet to the filter assembly. If two canisters are connected, open the valve on the second canister.

9. Reverify that the canister valve(s) is(are) open and the timer is properly set for sampling from 6 to 9 AM the next weekday.

3.1.3 Operation - Post Sampling

1. Close the canister valve(s) firmly. Disconnect the canister(s) from the sampling system.

2. Connect the pressure gauge to the canister and open the canister valve. Record the canister pressure. Close the canister valve and remove the pressure gauge. Do the same if there is a second canister. If the pressure reading is not at least 11 psi, see the troubleshooting instructions.

3. Fill in the required information on the sample form(s).

4. Verify that the timer still shows the correct time setting. If not, note that fact on the sample form along with any information pertaining to the possible cause. Reset the timer to the correct time.

5. Verify that the canister valves are closed firmly, but do not overtighten them. Put the protective cap(s) on the valve(s) and prepare the canister(s) for shipment to RTP.

3.1.4 Troubleshooting Instructions

The following checks and test should be carried out in the order given unless there is reason to alter the order.

Rotameter flow too low	1. Make sure pump is running.
	2. Valve may not be open. Turn timer switch OFF, wait 20 seconds, then turn the switch ON.
	3. Disconnect the solenoid valve from pump. If flow is then correct, solenoid valve may be defective. Consult RTP.
	4. Needle may be clogged. Replace needle assembly (not filter) with spare "S" needle assembly. If flow is correct, return defective needle to RTP for replacement.
Rotameter flow too high	1. Check for leaks.
	2. Try spare needle assembly. If flow is correct, return defective needle assembly to RTP for replacement.
Flow is detected with canister valve open and pump off	1. Solenoid valve not closed. Turn off canister valve. Turn timer switch ON, wait 20 seconds, then turn timer switch OFF. Open canister valve and check again. If flow is still detected, call for assistance.

Canister pressure over 15 psi after sampling	1. Check flow rate. 2. Check for leaks; tighten all fittings. 3. Check timer for correct positions of ON/OFF dogs. 4. Canister may have leaked or may not have been evacuated. Note on sample form and collect the next scheduled sample. If the next sample also has excessive pressure, call for assistance.

3.2 ANALYTICAL

3.2.1 Instrumentation

Two gas chromatographs were used by Radian in this study. Each was a dual-channel Hewlett-Packard 5880 using flame ionization detection (FID). NMOC instrument Channels A and B were on a single unit, and Channels C and D were on the other 5880 unit. These chromatographs were modified similarly to the prototype unit (NMOC instrument E), which is described in the attached Appendix. Instrument E (also called Channel E in subsequent sections of this report) was used as a quality assurance check during this program. Also a glass-capillary gas chromatographic instrument (called Channel GC) was used as the gas speciation method shown in the quality assurance data.

3.2.2 Hewlett-Packard 5880 Gas Chromatograph Operation

3.2.2.1 Sample Trap -

30 cm of 1/8-inch OD stainless steel packed with 60/80 mesh glass beads

3.2.2.2 Support Gas -

Gas	Composition	Instrument Pressure	Flow Rate
Carrier Gas	Helium	30 psig	31* sccm
FID Air	Purified Air	30 psig	385 sccm
FID Fuel	Hydrogen	32 psig	30 sccm

*Controller set point 30.0 ccm

3.2.2.3 Operating Temperatures -

FID	250°C
Oven	Programmed up to 90°C
Aux. Area	90°C

Oven Program -

Initial Value	30°C
Initial Time	0.20 min.
Rate	30°C/min.
Final Value	90°C
Final Time	4.00 min.

3.2.2.4 Integration Parameters -

Signal Attenuation	2^4
Peak Area Threshold	1
Min. Peak Width	0.04

Integrator Analysis Program -

Program Line	Activity	Comments
20	VALVE 5 OFF	
25	LIST VALVE 5	
30	OVEN TEMP INITIAL VALUE 30	
35	OVEN TEMP OFF	
40	WAIT 2	
60	START	
70	OVEN TEMP 90	
80	VALVE 5 ON	

Integrator Run Table -

Minutes	Activity	Comments
0.01	INTG OFF	
0.01	VALVE 5 ON	
0.01	PAGE	
0.02	LIST ATTN 2	
0.04	OVEN TEMP ON	
0.20	VALVE 2 ON	Beeper signal to remove cryogen
0.21	VALVE 2 OFF	and close oven door
0.22	INTG ON	
0.23	SET BL	Set integration baseline point
0.23	LIST INTG	
1.87	SET BL	
1.88	INTG OFF	
1.89	LIST INTG	
1.90	CHART SPEED 1.5	
3.50	STOP	

3.2.3 NMOC Analytical Technique

The modified HP5880, dual-FID chromatographs were operated in a manner very similar to the method described in Section 7.3 of the document attached as Appendix A. Further description is given to help explain the analytical apparatus and procedure.

The 6-port valve shown in Figure 1 of Appendix A was installed in the auxiliary heated zone of the HP5880 and was pneumatically actuated using the chromatographic valve control signals to apply either compressed air or vacuum to the valve. The sample trap itself was located inside the chromatograph's column oven. A length of one-sixteenth-inch OD tubing was trimmed to a length which prevented pressure and flow surges from extinguishing the FID flame. This length has to be determined experimentally and is expected to differ between chromatographs. This length of tubing effectively substitutes for the restriction caused by a chromatographic column.

During sample trapping, a rotameter was used to assure excess sample gas flow (instead of the bubbles shown in the Figure). A flow control valve was used, instead of the canister shutoff valve, to maintain a slight excess of sample gas flow during trapping.

A pressure change of 80 mm in a 1.7 liter vacuum reservoir was used to gauge the volume of sample gas cryogenically trapped. After trapping was complete, the HP5880 program shown in Section 3.2.2 was initiated. When the program produced an audible beep, the cryogen was removed from the trap and the oven door closed. The chromatographic program then took control of raising the oven temperature to release the trapped sample to the FID, as well as setting up the integration parameters.

3.3 CALCULATIONS

3.3.1 Daily Calibration

3.3.1.1 Zero Response = Peak area response. Average of two analyses of Clean Air from Clean Air System

3.3.1.2 Blank (ppmC) = Zero response peak area x calibration factor

3.3.1.3 Calibration Factor -

$$\text{Factor} = \frac{\text{Concentration (ppmV) of Propane Standard} \times 3\ \text{ppmC/ppmV}}{(\text{Propane Response} - \text{Zero Response})}$$

3.3.2 NMOC Sample Concentrations

$$\text{NMOC (ppmC)} = \left(\begin{array}{c}\text{Sample Response}\\ \text{Peak Area}\end{array}\right) \times \text{Calibration Factor}$$

4.0 QUALITY ASSURANCE/QUALITY CONTROL DATA ANALYSIS

4.1 INTRODUCTION

The quality assurance and quality control (QA/QC) procedures were given in the Quality Assurance Project Plan. The proposed outline of the NMOC data analysis and the QA/QC data analysis are given in Appendix B. Several features of the data analysis not originally proposed are included below, along with essentially the analysis outlined in Appendix B. Section 4.2 focuses on QA/QC data and its interpretation. Calibration and drift data are given in Section 4.2.1.

Section 4.2.3 presents the data on repeated analyses on the same sample, and the analysis and some possible interpretations of the results. Two types of repeated analyses are described in Sections 4.2.3.1 and 4.2.3.2. The first type of repeated analyses were done on the samples drawn from the 22 sample sites, while the other type of repeated analyses were done on local ambient samples.

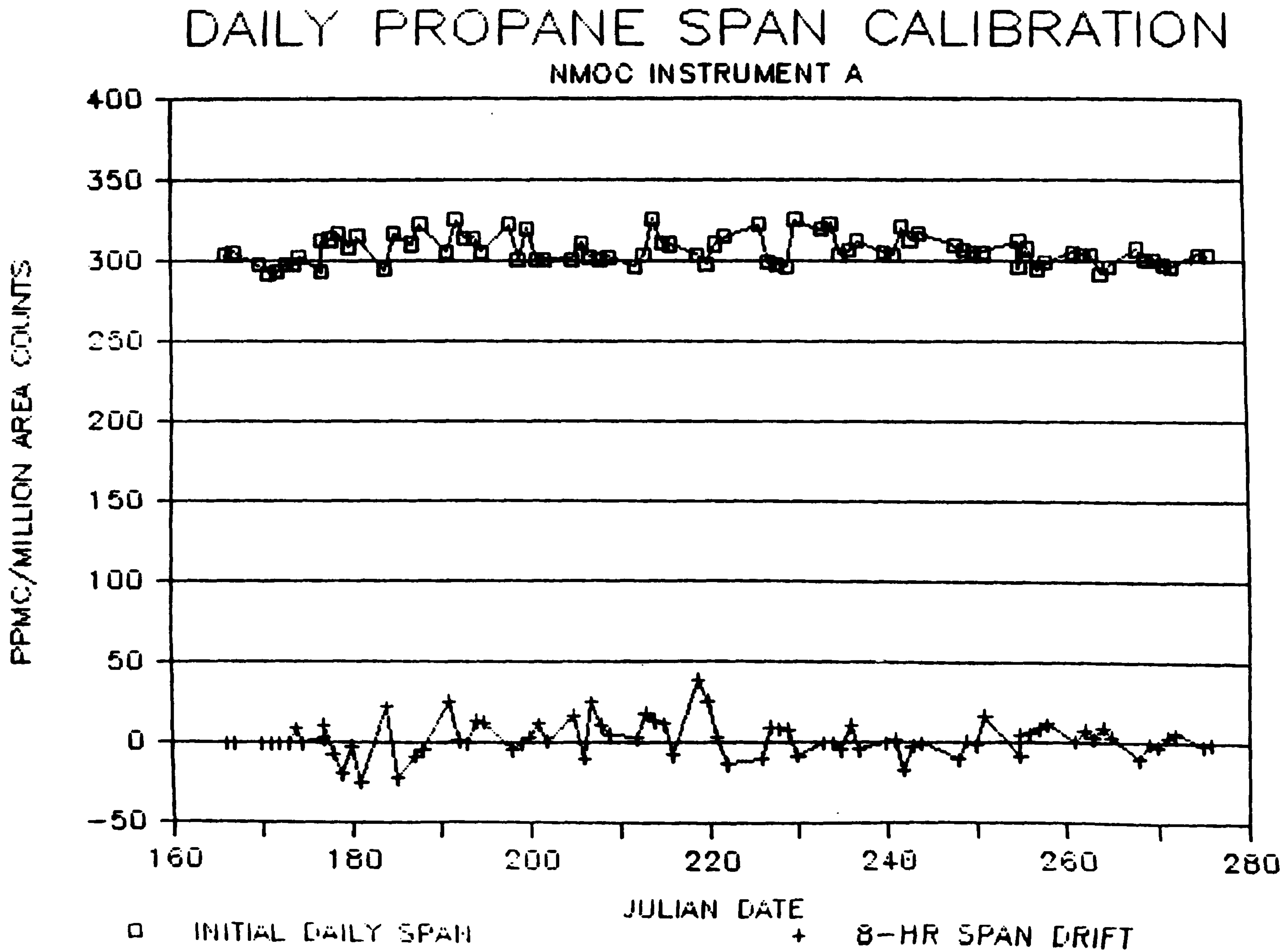
Section 4.2.4 presents the results and analyses for the duplicate samples taken at the 22 designated test sites. Section 4.2.5 presents the data and analyses for Radian In-House QC samples and other types of QC samples.

4.2 QA/QC DATA

4.2.1 Calibration and Drift

Calibration and drift data for the Radian Channels A, B, C, and D, are given in Table 4-1 through 4-4. These data are also plotted in Figures 4-1 through 4-8, and relate the daily zero and span determinations to the 1984 Julian Date on which the determination was made. Table 4-1 lists five

Figure 4-1



DAILY PROPANE SPAN CALIBRATION
NMOC INSTRUMENT A
PPMC/MILLION AREA COUNTS
400
350
300
250
200
150
100
50
0
-50
160
180
200
220
240
260
280
JULIAN DATE
INITIAL DAILY SPAN
8-HR SPAN DRIFT

Table 4-1. Calibration and Drift Data for Radian Channel A.

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
CASE 1	0.003	0.001	299.000	9.000	3.010
CASE 2	0.007	-0.002	294.000	3.000	1.020
CASE 3	0.007	-0.001	314.000	-6.000	-1.911
CASE 4	0.008	-0.006	317.000	-19.000	-5.994
CASE 5	0.008	0.001	309.000	-2.000	-0.647
CASE 6	0.005	0.002	316.000	-24.000	-7.595
CASE 7	0.005	0.	295.000	22.000	7.458
CASE 8	0.005	0.001	317.000	-22.000	-6.940
CASE 9	0.004	-0.001	311.000	-8.000	-2.572
CASE 10	0.005	0.	323.000	-4.000	-1.238
CASE 11	0.006	-0.003	306.000	26.000	8.497
CASE 12	0.003	0.001	326.000	2.000	0.613
CASE 13	0.005	0.	315.000	14.000	4.444
CASE 14	0.002	0.001	306.000	13.000	4.248
CASE 15	0.003	0.001	323.000	-4.000	-1.238
CASE 16	0.004	0.	321.000	4.000	1.246
CASE 17	0.004	-0.002	302.000	12.000	3.974
CASE 18	0.005	0.	302.000	1.000	0.331
CASE 19	0.004	-0.002	302.000	17.000	5.629
CASE 20	0.003	0.001	312.000	-9.000	-2.885
CASE 21	0.005	-0.005	303.000	25.000	8.251
CASE 22	0.004	-0.001	301.000	11.000	3.654
CASE 23	0.003	-0.001	303.000	5.000	1.650
CASE 24	0.002	0.001	297.000	3.000	1.010
CASE 25	0.004	-0.001	305.000	19.000	6.230
CASE 26	0.002	0.	327.000	14.000	4.281
CASE 27	0.004	0.	312.000	12.000	3.846
CASE 28	0.003	0.003	311.000	-7.000	-2.251
CASE 29	0.019	-0.016	305.000	39.000	12.787
CASE 30	0.005	0.	299.000	26.000	8.696
CASE 31	0.003	0.002	311.000	4.000	1.286
CASE 32	0.005	-0.002	316.000	-13.000	-4.114
CASE 33	0.004	-0.002	323.000	-9.000	-2.786
CASE 34	0.001	0.002	300.000	10.000	3.333
CASE 35	0.004	-0.002	299.000	9.000	3.010
CASE 36	0.005	0.	297.000	8.000	2.694
CASE 37	0.005	-0.003	326.000	-8.000	-2.454
CASE 38	0.002	0.002	305.000	-4.000	-1.311
CASE 39	0.003	-0.001	307.000	11.000	3.583
CASE 40	0.003	-0.001	313.000	-4.000	-1.278
CASE 41	0.002	0.001	305.000	2.000	0.656
CASE 42	0.001	0.	322.000	-17.000	-5.280
CASE 43	0.002	-0.001	314.000	-2.000	-0.637
CASE 44	0.002	-0.001	310.000	-10.000	-3.226
CASE 45	0.003	-0.002	307.000	1.000	0.326
CASE 46	0.003	-0.001	306.000	-1.000	-0.327
CASE 47	0.004	-0.002	306.000	17.000	5.556
CASE 48	0.003	-0.001	313.000	-8.000	-2.556
CASE 49	0.003	-0.001	297.000	5.000	1.684
CASE 50	0.004	0.002	308.000	6.000	1.948
CASE 51	0.002	0.001	295.000	9.000	3.051
CASE 52	0.001	0.002	300.000	12.000	4.000
CASE 53	0.002	0.001	306.000	1.000	0.327
CASE 54	0.002	0.001	305.000	8.000	2.623
CASE 55	0.002	0.	304.000	3.000	0.987
CASE 56	0.002	-0.001	293.000	10.000	3.413
CASE 57	0.001	0.001	297.000	4.000	1.347
CASE 58	0.001	0.006	308.000	-10.000	-3.247
CASE 59	0.002	0.	302.000	-2.000	-0.662
CASE 60	0.002	0.001	298.000	4.000	1.342
CASE 61	0.002	-0.001	297.000	6.000	2.020
CASE 62	0.002	-0.001	305.000	-1.000	-0.328
CASE 63	0.003	0.	313.000	11.000	3.514

Figure 4-2

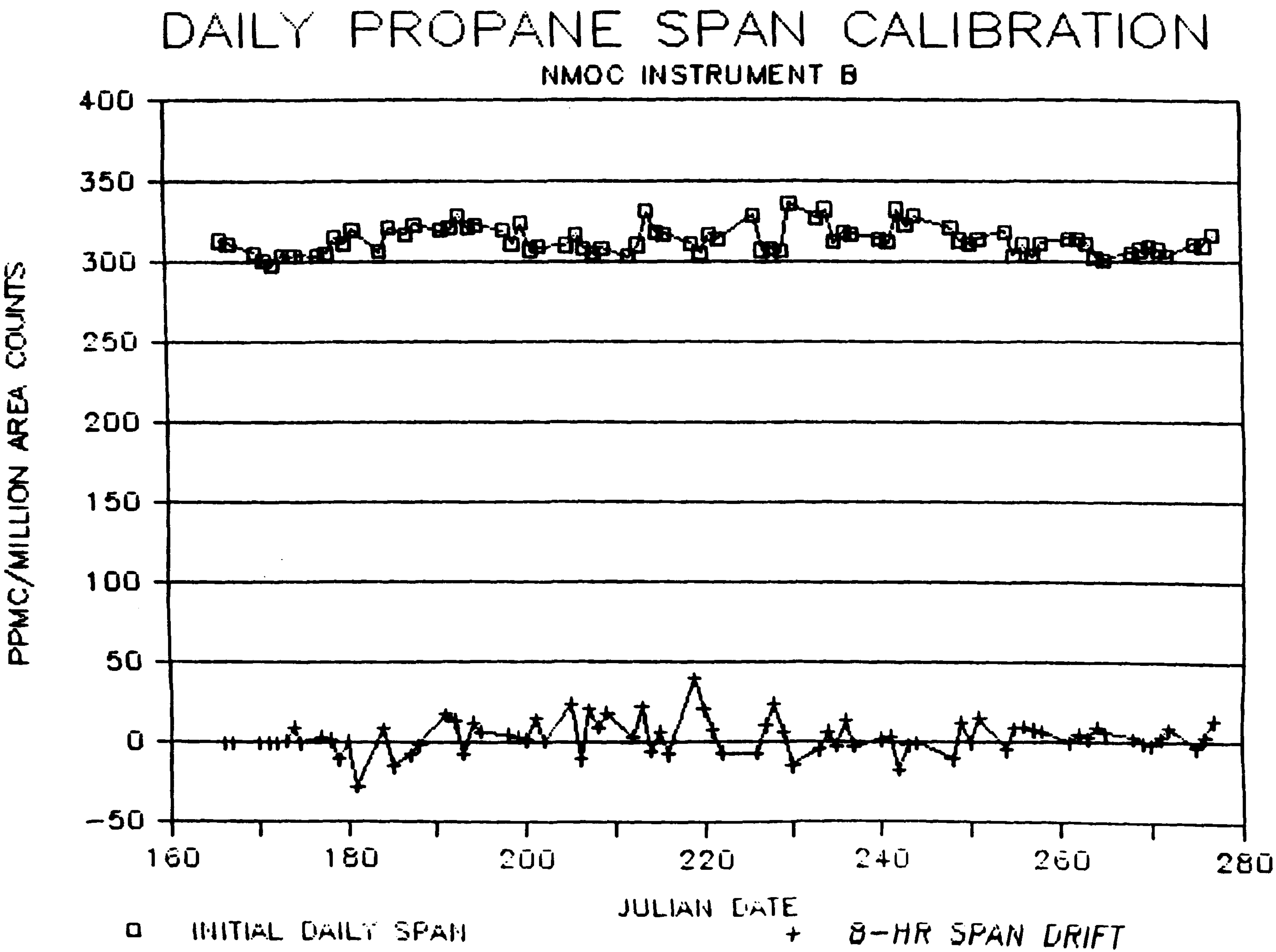

DAILY PROPANE SPAN CALIBRATION
NMOC INSTRUMENT B
PPMC/MILLION AREA COUNTS
400
350
300
250
200
150
100
50
0
-50
160
180
200
220
240
260
280
JULIAN DATE
INITIAL DAILY SPAN
8-HR SPAN DRIFT

Table 4-2. Calibration and Drift Data for Radian Channel B.

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
CASE 1	0.010	-0.006	305.000	1.000	0.328
CASE 2	0.015	-0.006	304.000	10.000	3.289
CASE 3	0.020	-0.012	304.000	4.000	1.316
CASE 4	0.010	-0.005	306.000	2.000	0.654
CASE 5	0.013	-0.007	316.000	-10.000	-3.165
CASE 6	0.003	0.005	312.000	1.000	0.321
CASE 7	0.009	0.004	321.000	-27.000	-8.411
CASE 8	0.009	0.005	307.000	9.000	2.932
CASE 9	0.011	-0.005	322.000	-14.000	-4.348
CASE 10	0.006	0.004	318.000	-7.000	-2.201
CASE 11	0.007	0.002	324.000	-1.000	-0.309
CASE 12	0.006	-0.001	320.000	18.000	5.625
CASE 13	0.009	0.	322.000	14.000	4.348
CASE 14	0.006	-0.002	330.000	-6.000	-1.818
CASE 15	0.006	0.001	322.000	13.000	4.037
CASE 16	0.005	-0.002	324.000	7.000	2.160
CASE 17	0.006	0.002	320.000	5.000	1.562
CASE 18	0.006	-0.004	312.000	4.000	1.282
CASE 19	0.007	-0.004	325.000	2.000	0.615
CASE 20	0.004	-0.003	308.000	15.000	4.870
CASE 21	0.003	0.001	310.000	1.000	0.323
CASE 22	0.003	-0.002	311.000	24.000	7.717
CASE 23	0.003	0.	318.000	-10.000	-3.145
CASE 24	0.003	-0.003	309.000	21.000	6.796
CASE 25	0.003	0.001	306.000	10.000	3.268
CASE 26	0.003	-0.001	309.000	19.000	6.149
CASE 27	0.	0.002	304.000	4.000	1.316
CASE 28	0.004	-0.003	311.000	22.000	7.074
CASE 29	0.001	0.001	332.000	-5.000	-1.506
CASE 30	0.004	0.	319.000	7.000	2.194
CASE 31	0.003	0.001	318.000	-7.000	-2.201
CASE 32	0.004	0.001	312.000	40.000	12.821
CASE 33	0.003	0.001	306.000	21.000	6.863
CASE 34	0.003	0.002	318.000	8.000	2.516
CASE 35	0.006	-0.003	315.000	-6.000	-1.905
CASE 36	0.001	0.001	330.000	-6.000	-1.818
CASE 37	0.001	0.	308.000	11.000	3.571
CASE 38	0.002	-0.001	309.000	24.000	7.767
CASE 39	0.004	-0.002	307.000	7.000	2.280
CASE 40	0.002	-0.001	337.000	-14.000	-4.154
CASE 41	0.001	0.	328.000	-4.000	-1.220
CASE 42	0.001	0.001	333.000	7.000	2.102
CASE 43	0.002	0.	313.000	-2.000	-0.639
CASE 44	0.001	0.001	319.000	14.000	4.389
CASE 45	0.002	0.	318.000	-2.000	-0.629
CASE 46	0.001	0.001	315.000	2.000	0.635
CASE 47	0.002	-0.001	313.000	4.000	1.278
CASE 48	0.001	0.	333.000	-17.000	-5.105
CASE 49	0.001	0.	323.000	-1.000	-0.310
CASE 50	0.002	-0.001	322.000	-10.000	-3.106
CASE 51	0.002	-0.001	314.000	13.000	4.140
CASE 52	0.002	0.	315.000	16.000	5.079
CASE 53	0.002	-0.001	319.000	-4.000	-1.254
CASE 54	0.002	-0.001	305.000	9.000	2.951
CASE 55	0.002	0.	311.000	10.000	3.215
CASE 56	0.003	0.	304.000	8.000	2.632
CASE 57	0.001	0.001	312.000	7.000	2.244
CASE 58	0.001	0.	315.000	5.000	1.587
CASE 59	0.001	0.	312.000	3.000	0.962
CASE 60	0.002	-0.001	303.000	10.000	3.300
CASE 61	0.001	0.	302.000	6.000	1.987
CASE 62	0.001	0.	306.000	3.000	0.980
CASE 63	0.002	-0.001	310.000	-1.000	-0.323
CASE 64	0.002	-0.001	308.000	3.000	0.974
CASE 65	0.001	0.	304.000	9.000	2.961
CASE 66	0.001	0.	312.000	-3.000	-0.962
CASE 67	0.001	0.	311.000	3.000	0.965
CASE 68	0.002	0.	317.000	14.000	4.416

Figure 4-3

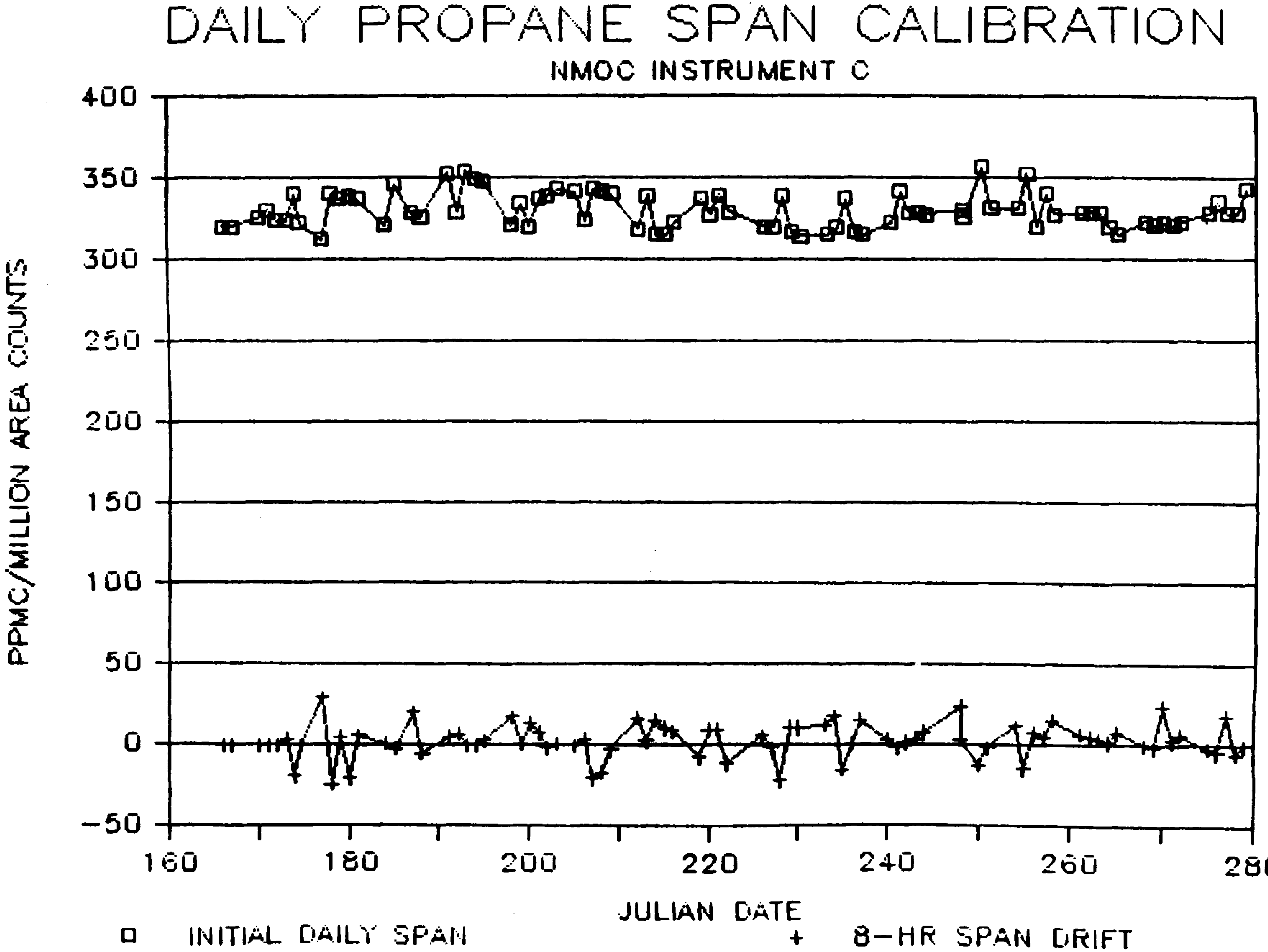
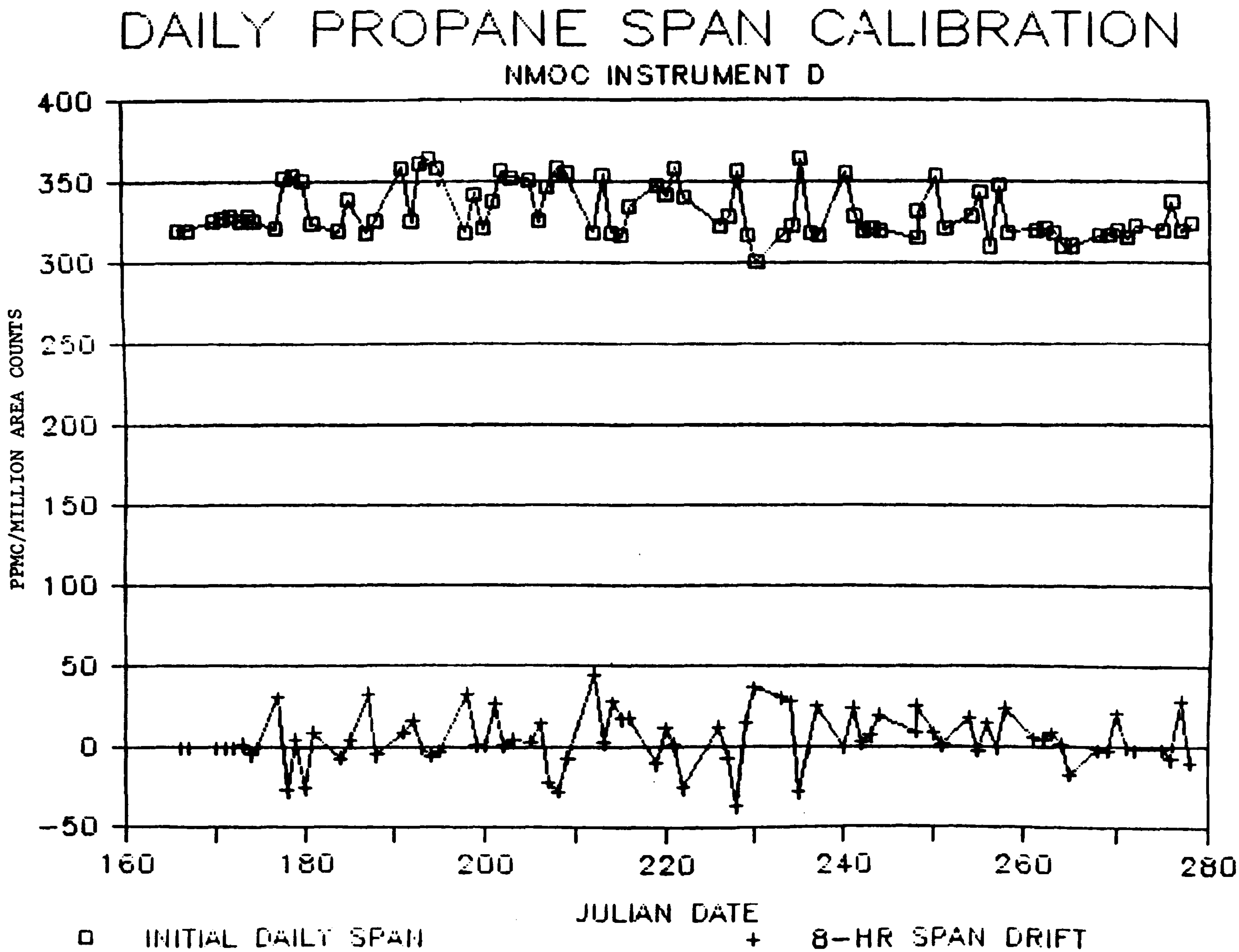

DAILY PROPANE SPAN CALIBRATION
NMOC INSTRUMENT C
PPMC/MILLION AREA COUNTS
400
350
300
250
200
150
100
50
0
-50
160
180
200
220
240
260
280
JULIAN DATE
INITIAL DAILY SPAN
+ 8-HR SPAN DRIFT

Table 4-3. Calibration and Drift Data for Radian Channel C.

	ZERO1	ZDFT	SPAN1	CALCFT	PCDFT
CASE 1	0.001	0.	325.000	4.000	1.231
CASE 2	0.002	0.	341.000	-19.000	-5.572
CASE 3	0.001	0.003	313.000	30.000	9.585
CASE 4	0.001	0.	341.000	-24.000	-7.038
CASE 5	0.001	0.003	338.000	5.000	1.479
CASE 6	0.002	0.	340.000	-20.000	-5.882
CASE 7	0.002	0.	338.000	6.000	1.775
CASE 8	0.002	-0.001	322.000	1.000	0.311
CASE 9	0.003	0.	347.000	-2.000	-0.576
CASE 10	0.002	0.	329.000	21.000	6.383
CASE 11	0.001	0.	326.000	-5.000	-1.534
CASE 12	0.001	0.004	353.000	5.000	1.416
CASE 13	0.	0.	330.000	7.000	2.121
CASE 14	0.001	0.001	349.000	3.000	0.860
CASE 15	0.002	-0.001	322.000	18.000	5.590
CASE 16	0.	0.001	335.000	1.000	0.299
CASE 17	0.	0.	321.000	14.000	4.361
CASE 18	0.001	0.	338.000	8.000	2.367
CASE 19	0.	0.	339.000	-1.000	-0.295
CASE 20	0.001	0.	344.000	1.000	0.291
CASE 21	0.	0.001	325.000	4.000	1.231
CASE 22	0.	0.001	344.000	-20.000	-5.814
CASE 23	0.001	0.	343.000	-17.000	-4.956
CASE 24	0.002	-0.001	341.000	-3.000	-0.880
CASE 25	0.	0.001	319.000	17.000	5.329
CASE 26	0.	0.	340.000	3.000	0.882
CASE 27	0.	0.	316.000	16.000	5.063
CASE 28	0.	0.	316.000	11.000	3.481
CASE 29	0.	0.	323.000	9.000	2.786
CASE 30	0.001	0.	338.000	-7.000	-2.071
CASE 31	0.	0.	328.000	10.000	3.049
CASE 32	0.001	-0.001	340.000	10.000	2.941
CASE 33	0.	0.	330.000	-11.000	-3.333
CASE 34	0.	0.	321.000	6.000	1.869
CASE 35	0.	0.	321.000	-1.000	-0.312
CASE 36	0.	0.	339.000	-22.000	-6.490
CASE 37	0.	0.001	317.000	11.000	3.470
CASE 38	0.	0.	315.000	11.000	3.492
CASE 39	0.	0.	316.000	13.000	4.114
CASE 40	0.	0.	320.000	18.000	5.625
CASE 41	0.	0.	338.000	-15.000	-4.438
CASE 42	0.	0.	317.000	1.000	0.315
CASE 43	0.	0.	316.000	16.000	5.063
CASE 44	0.	0.	323.000	4.000	1.238
CASE 45	0.	0.	342.000	-1.000	-0.292
CASE 46	0.	0.	330.000	2.000	0.606
CASE 47	0.	0.	329.000	4.000	1.216
CASE 48	0.	0.	328.000	8.000	2.439
CASE 49	0.002	-0.002	331.000	24.000	7.251
CASE 50	0.	0.	327.000	4.000	1.223
CASE 51	0.	0.	357.000	-12.000	-3.361
CASE 52	0.	0.	332.000	-1.000	-0.301
CASE 53	0.	0.	332.000	12.000	3.614
CASE 54	0.	0.	353.000	-14.000	-3.966
CASE 55	0.	0.	321.000	8.000	2.492
CASE 56	0.	0.	341.000	5.000	1.466
CASE 57	0.	0.	328.000	16.000	4.878
CASE 58	0.	0.	329.000	7.000	2.128
CASE 59	0.002	-0.002	330.000	5.000	1.515
CASE 60	0.	0.	329.000	4.000	1.216
CASE 61	0.	0.002	320.000	2.000	0.625
CASE 62	0.	0.	316.000	8.000	2.532
CASE 63	0.001	0.	322.000	-1.000	-0.311
CASE 64	0.001	0.	323.000	24.000	7.430
CASE 65	0.001	0.	322.000	3.000	0.932
CASE 66	0.	0.	324.000	7.000	2.160
CASE 67	0.002	-0.001	329.000	-2.000	-0.608
CASE 68	0.	0.001	336.000	-4.000	-1.190
CASE 69	0.003	-0.003	329.000	19.000	5.775
CASE 70	0.	0.003	329.000	-5.000	-1.520

Figure 4-4



DAILY PROPANE SPAN CALIBRATION
NMOC INSTRUMENT D
PPMC/MILLION AREA COUNTS
400
350
300
250
200
150
100
50
0
-50
160
180
200
220
240
260
280
JULIAN DATE
INITIAL DAILT SPAN
8-HR SPAN DRIFT

Table 4-4. Calibration and Drift Data for Radian Channel D.

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
CASE 1	0.003	0.	327.000	2.000	0.612
CASE 2	0.001	0.002	329.000	-4.000	-1.216
CASE 3	0.008	0.	322.000	31.000	9.627
CASE 4	0.007	-0.002	353.000	-26.000	-7.365
CASE 5	0.004	-0.001	354.000	5.000	1.412
CASE 6	0.006	-0.001	351.000	-25.000	-7.123
CASE 7	0.007	-0.002	325.000	10.000	3.077
CASE 8	0.004	-0.001	320.000	-6.000	-1.875
CASE 9	0.005	0.	339.000	5.000	1.475
CASE 10	0.004	0.	319.000	33.000	10.345
CASE 11	0.004	-0.001	326.000	-4.000	-1.227
CASE 12	0.004	0.001	359.000	10.000	2.786
CASE 13	0.002	0.002	326.000	17.000	5.215
CASE 14	0.002	0.001	364.000	-5.000	-1.374
CASE 15	0.002	0.	359.000	-2.000	-0.557
CASE 16	0.004	-0.001	319.000	33.000	10.345
CASE 17	0.003	-0.001	343.000	2.000	0.583
CASE 18	0.001	-0.001	322.000	1.000	0.311
CASE 19	0.001	0.	338.000	27.000	7.988
CASE 20	0.001	0.	357.000	2.000	0.560
CASE 21	0.001	0.001	353.000	5.000	1.416
CASE 22	0.002	-0.001	352.000	4.000	1.136
CASE 23	0.001	0.001	326.000	15.000	4.601
CASE 24	0.001	0.001	347.000	-21.000	-6.052
CASE 25	0.001	0.	358.000	-27.000	-7.542
CASE 26	0.002	-0.002	356.000	-6.000	-1.685
CASE 27	0.001	0.001	319.000	45.000	14.107
CASE 28	0.001	0.	355.000	3.000	0.845
CASE 29	0.001	0.013	319.000	28.000	8.777
CASE 30	0.001	0.	317.000	18.000	5.678
CASE 31	0.001	0.	335.000	19.000	5.672
CASE 32	0.001	0.	349.000	-10.000	-2.865
CASE 33	0.001	0.	342.000	12.000	3.509
CASE 34	0.003	-0.002	359.000	2.000	0.557
CASE 35	0.001	0.	341.000	-25.000	-7.331
CASE 36	0.001	0.	324.000	13.000	4.012
CASE 37	0.001	-0.001	330.000	-6.000	-1.818
CASE 38	0.001	0.001	357.000	-36.000	-10.084
CASE 39	0.001	-0.001	318.000	16.000	5.031
CASE 40	0.	0.	301.000	37.000	12.292
CASE 41	0.001	-0.001	318.000	31.000	9.748
CASE 42	0.001	0.	323.000	28.000	8.669
CASE 43	0.	0.	364.000	-28.000	-7.692
CASE 44	0.001	0.002	318.000	25.000	7.862
CASE 45	0.001	0.001	329.000	24.000	7.295
CASE 46	0.001	0.	320.000	3.000	0.937
CASE 47	0.001	-0.001	322.000	8.000	2.484
CASE 48	0.001	0.001	321.000	20.000	6.231
CASE 49	0.001	0.	316.000	10.000	3.165
CASE 50	0.001	0.001	332.000	26.000	7.831
CASE 51	0.001	-0.001	354.000	9.000	2.542
CASE 52	0.001	0.001	322.000	2.000	0.621
CASE 53	0.	0.002	330.000	19.000	5.758
CASE 54	0.001	0.	344.000	-2.000	-0.581
CASE 55	0.001	0.	311.000	15.000	4.823
CASE 56	0.001	-0.001	319.000	24.000	7.524
CASE 57	0.	0.001	321.000	6.000	1.869
CASE 58	0.002	0.001	322.000	5.000	1.553
CASE 59	0.	0.002	319.000	9.000	2.821
CASE 60	0.001	0.	311.000	2.000	0.643
CASE 61	0.001	0.	311.000	-17.000	-5.466
CASE 62	0.001	0.	317.000	-1.000	-0.315
CASE 63	0.001	0.001	318.000	-2.000	-0.629
CASE 64	0.002	0.001	321.000	21.000	6.542
CASE 65	0.001	0.	323.000	-1.000	-0.310
CASE 66	0.001	0.001	321.000	-1.000	-0.312
CASE 67	0.002	0.	338.000	-7.000	-2.071
CASE 68	0.001	0.001	320.000	29.000	9.063
CASE 69	0.001	0.	325.000	-9.000	-2.769

Figure 4-5

DAILY ZERO CALIBRATION

NMOC INSTRUMENT A

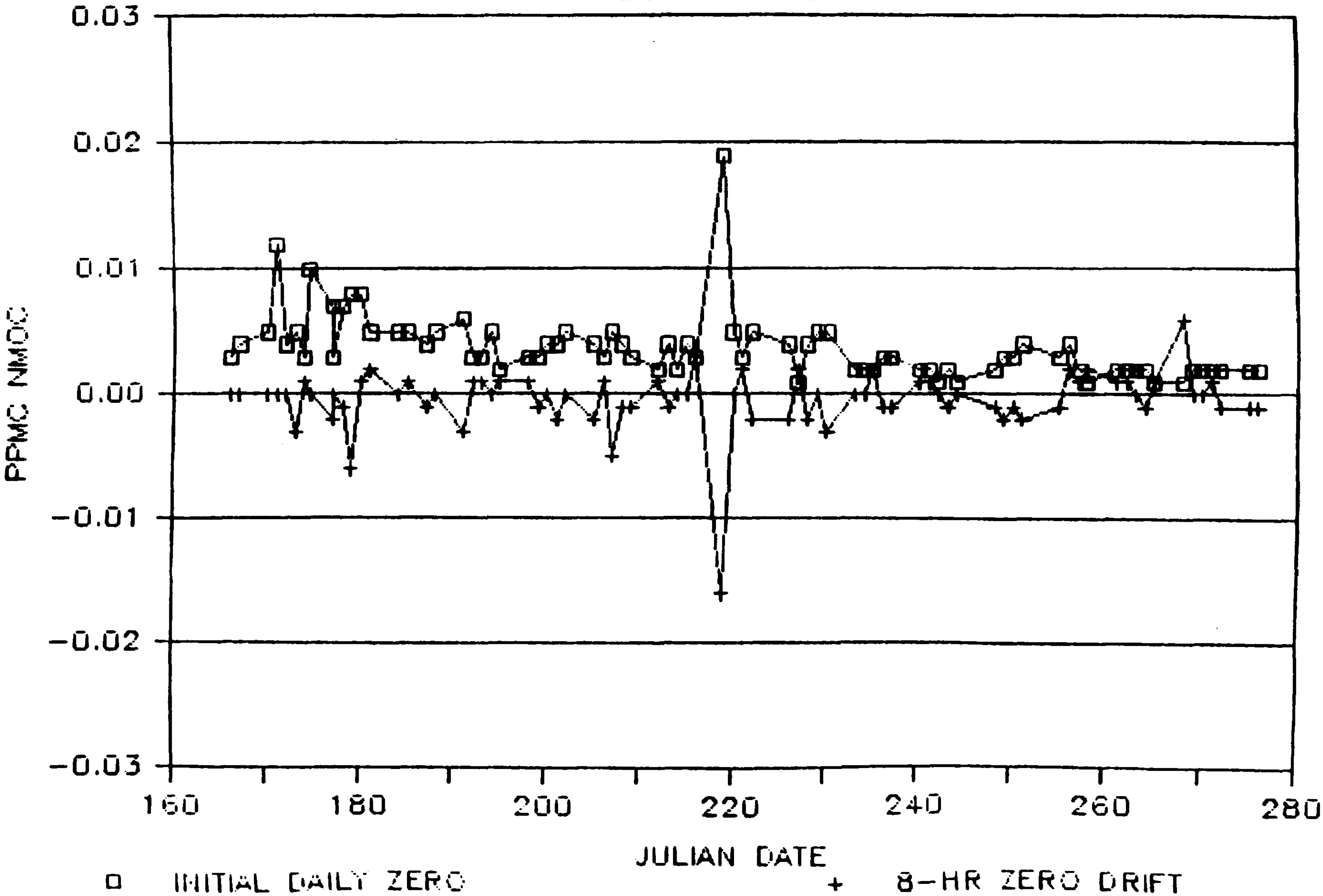


Figure 4-6

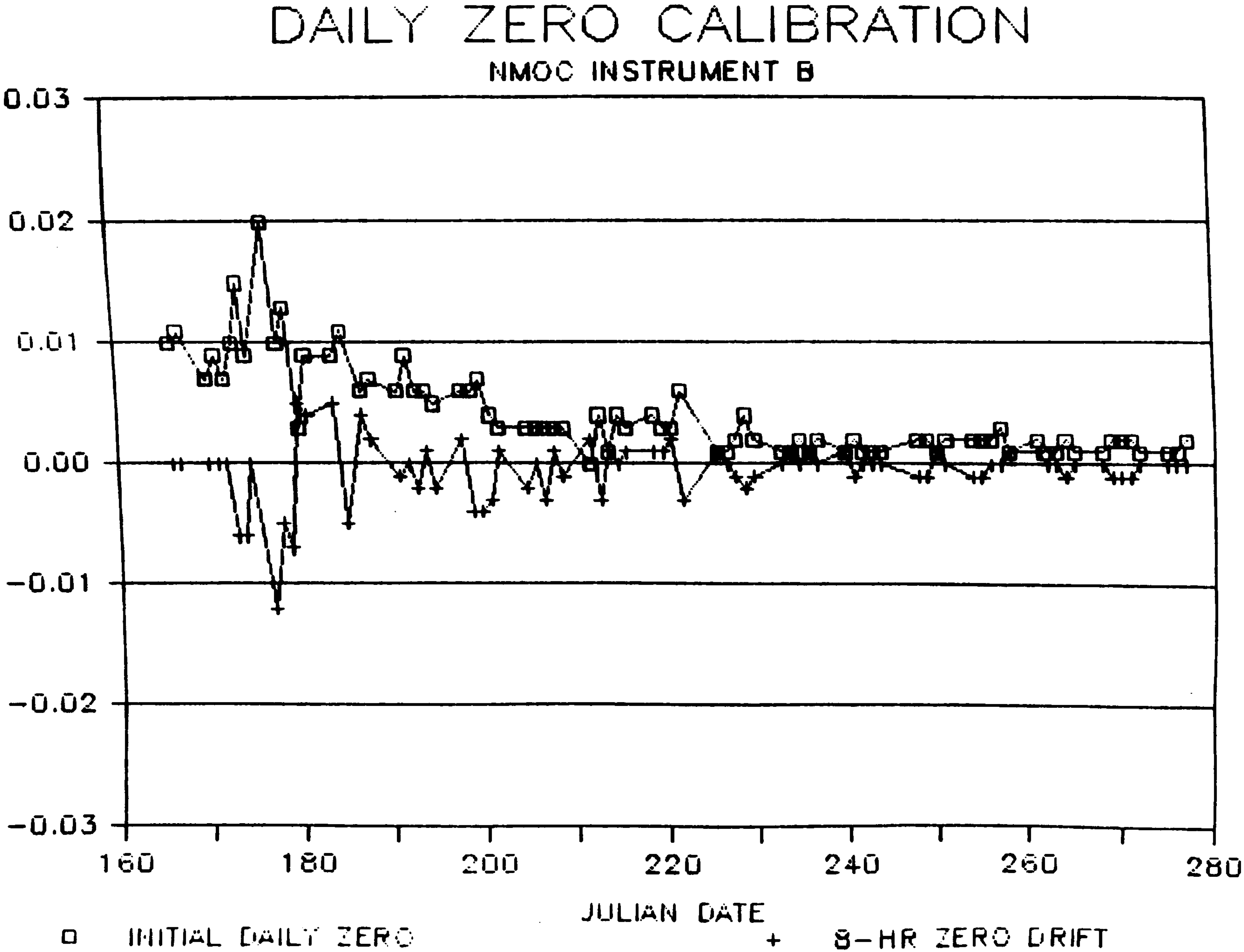
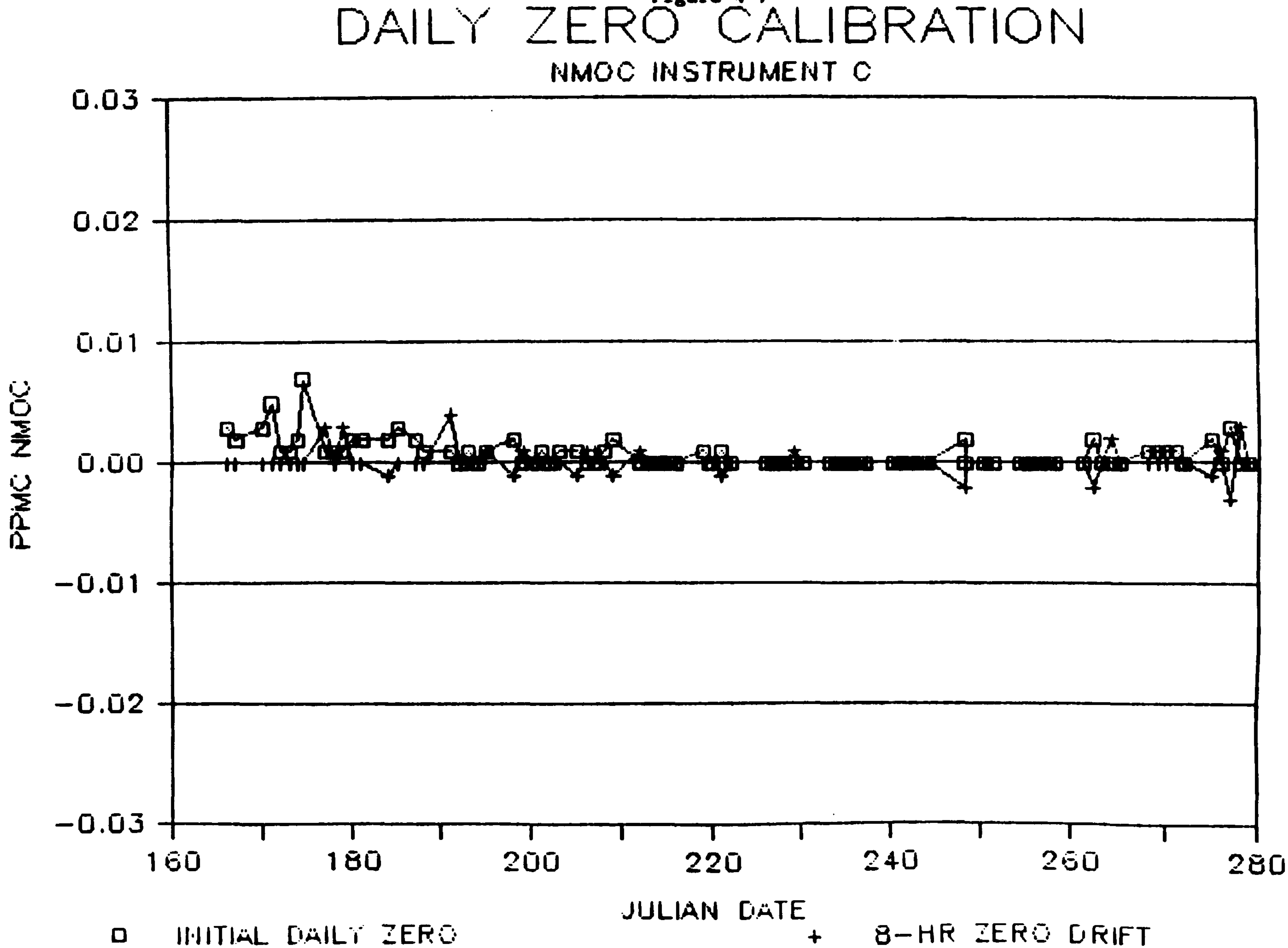
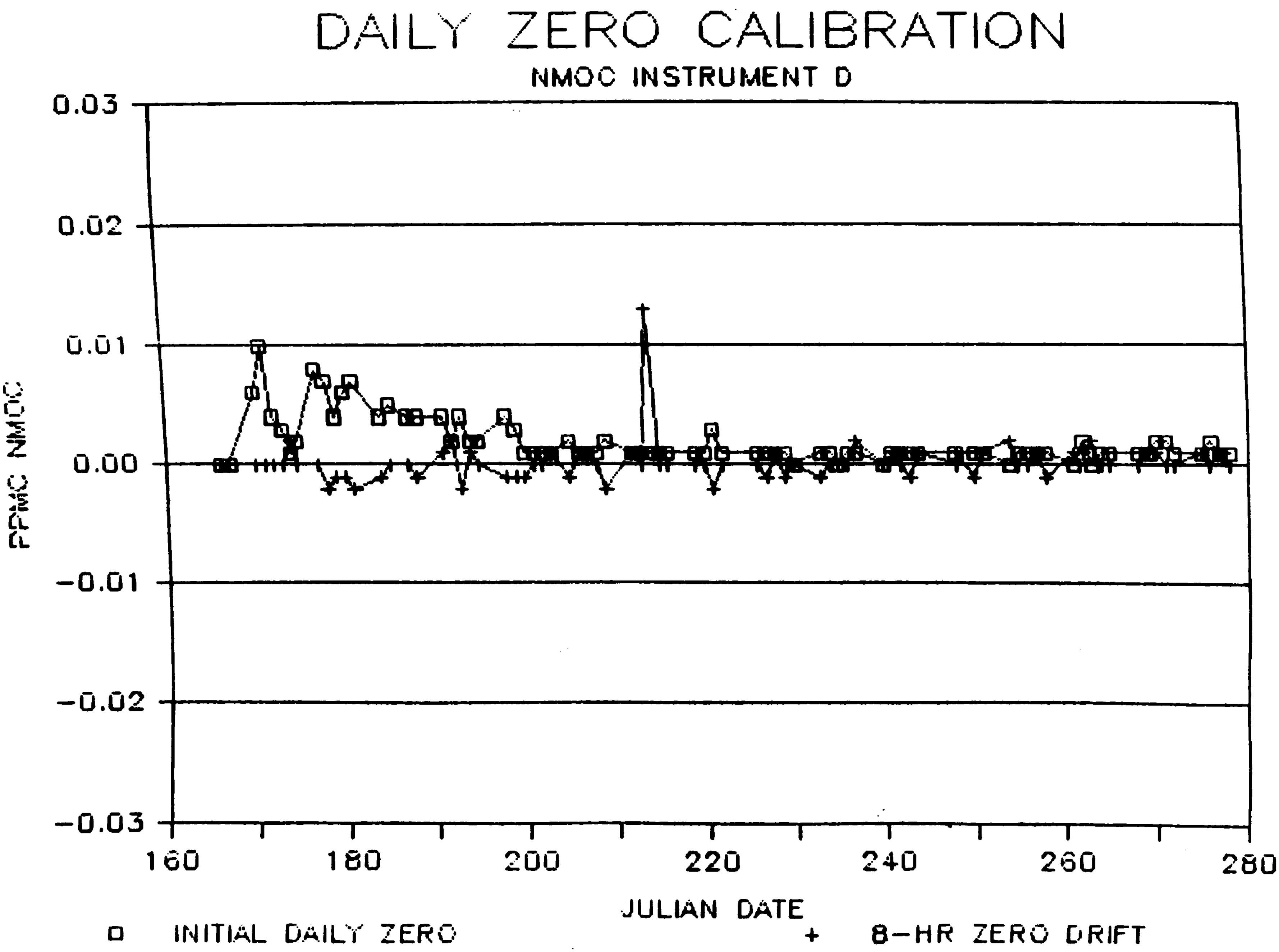

DAILY ZERO CALIBRATION
NMOC INSTRUMENT B
PPMC NMOC
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
160
180
200
220
240
260
280
JULIAN DATE
□ INITIAL DAILY ZERO
+ 8-HR ZERO DRIFT

Figure 4-7



DAILY ZERO CALIBRATION
NMOC INSTRUMENT C
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
PPMC NMOC
160
180
200
220
240
260
280
JULIAN DATE
□ INITIAL DAILY ZERO
+ 8−HR ZERO DRIFT

Figure 4-8


DAILY ZERO CALIBRATION
NMOC INSTRUMENT D
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
PPMC NMOC
160
180
200
220
240
260
280
JULIAN DATE
INITIAL DAILY ZERO
+ 8-HR ZERO DRIFT

variables ZERO1, ZDFT, SPAN1, CALDFT, and PCDFT. ZERO1, in ppmC, was the initial instrument "zero," determined from cleaned, dry air at the beginning of the day. ZDFT was the zero drift for the day. At the end of the day a second "zero" determination (ZERO2) was made and ZDFT was calculated from ZERO2 minus ZERO1.

SPAN1 is reported in Tables 4-1 through 4-4 in units of ppmC per area count and was done at the beginning of the day. It was the initial instrument span determination. A second span determination, SPAN2 was made at the close of the day. The calibration drift, CALDFT, was calculated equal to SPAN2 minus SPAN1. Variable PCDFT is the percent CALDFT was of the initial span, or:

$$PCDFT = (CALDFT/SPAN1) \times 100. \tag{4-1}$$

Gases used for the span determinations used propane standards referenced to NBS propane, SRM No. 1665b. Statistics for all four Radian instrument channels combined are given in Table 4-5. The zero drift ranged from -0.016 ppmC to 0.013 ppmC averaging -0.00016 which was about 6.5% of the mean zero reading.

The percent drift of the calibration reading ranged from -10% to +14%, averaging about 1.5% of the initial calibration span. For the Radian Channels A, B, C, and D, average percent calibration drifts were 1.2%, 1.5%, 1.1% and 2.1%, respectively as shown in Tables 4-6, 4-7, 4-8, and 4-9 respectively. The statistical test of hypothesis for equal population means at the 0.05 level of significance (giving a 95% probability that the assertion is correct) indicates that the mean percent calibration drifts were essentially equal for all Radian channels.

Additional character of the calibration and drift data can be seen in Figures 4-9 and 4-10 which show a stem and leaf plot of variables CALDFT and ZDFT respectively. The numbers on the left of the diagram are the stems and represent equal incremental distances from the smallest value, given at the top of the plot to the largest value at the bottom of the plot (given as a maximum figure in Table 4-5). The leaves are the numbers on the right of the diagram and the length of each leaf is proportional to the number of data points falling into each stem interval. The letters "M"

TABLE 4-5. Statistics for Calibration and Drift for All Radian Channels.

TOTAL OBSERVATIONS: 270

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
N OF CASES	270	270	270	270	270
MINIMUM	0.	-0.01600	293.00000	-36.00000	-10.08403
MAXIMUM	0.02000	0.01300	364.00000	45.00000	14.10658
RANGE	0.02000	0.02900	71.00000	81.00000	24.19062
MEAN	0.00246	-0.00016	321.61111	4.50370	1.46974
VARIANCE	0.00001	0.00000	234.74411	172.35500	16.52047
STANDARD DEV	0.00280	0.00219	15.32136	13.12840	4.06454
STD. ERROR	0.00017	0.00013	0.93243	0.79897	0.24736
SKEWNESS	2.73246	-1.39021	0.64171	-0.03179	0.09102
KURTOSIS	11.10380	17.35084	0.00037	0.56515	0.48760

TABLE 4-6. Statistics for Calibration and Drift of Radian Channel A.

TOTAL OBSERVATIONS: 63

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
N OF CASES	63	63	63	63	63
MINIMUM	0.00100	-0.01600	293.00000	-24.00000	-7.59494
MAXIMUM	0.01900	0.00600	327.00000	39.00000	12.78689
RANGE	0.01800	0.02200	34.00000	63.00000	20.38182
MEAN	0.00370	-0.00046	307.63492	3.55556	1.20791
VARIANCE	0.00001	0.00001	76.78392	143.08961	15.06184
STANDARD DEV	0.00256	0.00270	8.76264	11.96201	3.88096
STD. ERROR	0.00032	0.00034	1.10399	1.50707	0.48895
SKEWNESS	3.54339	-3.00599	0.47247	0.17860	0.23378
KURTOSIS	18.34753	16.14156	-0.55452	0.45991	0.46404

TABLE 4-7. Statistics for Calibration and Drift for Radian Channel B.

TOTAL OBSERVATIONS: 68

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
N OF CASES	68	68	68	68	68
MINIMUM	0.	-0.01200	302.00000	-27.00000	-8.41121
MAXIMUM	0.02000	0.00500	337.00000	40.00000	12.82051
RANGE	0.02000	0.01700	35.00000	67.00000	21.23173
MEAN	0.00393	-0.00063	314.82353	4.60294	1.50388
VARIANCE	0.00001	0.00001	70.83406	120.89969	12.14230
STANDARD DEV	0.00375	0.00271	8.41630	10.99544	3.48458
STD. ERROR	0.00045	0.00033	1.02063	1.33339	0.42257
SKEWNESS	1.99246	-1.24521	0.62921	0.13026	0.18693
KURTOSIS	4.51519	3.78811	-0.26579	1.07134	1.07389

TABLE 4-8. Statistics for Calibration and Drift for Radian Channel C.

TOTAL OBSERVATIONS: 70

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
N OF CASES	70	70	70	70	70
MINIMUM	0.	-0.00300	313.00000	-24.00000	-7.03812
MAXIMUM	0.00300	0.00400	357.00000	30.00000	9.58466
RANGE	0.00300	0.00700	44.00000	54.00000	16.62279
MEAN	0.00059	0.00014	330.37143	3.41429	1.09681
VARIANCE	0.00000	0.00000	108.38178	129.55052	11.86151
STANDARD DEV	0.00084	0.00104	10.41066	11.38203	3.44405
STD. ERROR	0.00010	0.00012	1.24431	1.36041	0.41164
SKEWNESS	1.19233	1.03727	0.43018	-0.38565	-0.29032
KURTOSIS	0.30980	4.36667	-0.53375	0.15612	0.13963

TABLE 4-9. Statistics for Calibration and Drift for Radian Channel D.

TOTAL OBSERVATIONS: 69

	ZERO1	ZDFT	SPAN1	CALDFT	PCDFT
N OF CASES	69	69	69	69	69
MINIMUM	0.	-0.00200	301.00000	-36.00000	-10.08403
MAXIMUM	0.00800	0.01300	364.00000	45.00000	14.10658
RANGE	0.00800	0.01500	63.00000	81.00000	24.19062
MEAN	0.00180	0.00026	332.17391	6.37681	2.05349
VARIANCE	0.00000	0.00000	259.58696	295.15004	27.06687
STANDARD DEV	0.00170	0.00184	16.11170	17.17993	5.20258
STD. ERROR	0.00020	0.00022	1.93962	2.06822	0.62632
SKEWNESS	1.94010	4.78339	0.52123	-0.20955	-0.06096
KURTOSIS	3.35464	31.21183	-1.01342	-0.18583	-0.27960

Figure 4-9. Frequency Diagram of Calibration Drift Data.

```
    STEM AND LEAF PLOT OF VARIABLE:    CALDFT

SMALLEST VALUE AT TOP OF PLOT IS:   -36.00000

          -3   6
          -2   87765544
     ***OUTSIDE VALUES***
          -2   22100
          -1   9977775
          -1   444321000000
          -0   9998887777766666665555
          -0 H 4444444443322222222221111111111111
           0 M 111111111112222222222222333333333333444444444444444
           0   555555555555666666777777778888888889999999999
           1 H 0000000000011111112222233333444444
           1   555666667777888899999
           2   0111122444444
           2   556667889
           3   01133
     ***OUTSIDE VALUES***
           3   79
           4   05
```

Figure 4-10. Frequency Diagram of Drift Data

```
        STEM AND LEAF PLOT OF VARIABLE:     ZDFT

SMALLEST VALUE AT TOP OF PLOT IS:  -.1600000E-01

           -16   0
           -12   0
            -7   0
            -6   000
            -5   000
        ***OUTSIDE VALUES***
            -4   00
            -3   0000000
            -2   000000000000000000
            -1 H 0000000000000000000000000000000000000000000000
            -0
             0 M 00000000000000000000000000000000000000000000000000000000000*
             1 H 00000000000000000000000000000000000000000000000000
             2   0000000000000000
             3   0000
             4   000
        ***OUTSIDE VALUES***
             5   00
             6   0
            13   0
```

and "H" in the space between the steams and leaves denote the locations of the median, and hinges respectively. The median divides the data sorted by size into two halves, and the hinges divide the upper and lower halves into halves again. The "H-spread" is the difference between the values of the two hinges. The "inner fences" are defined as follows:

$$\text{lower fence} = \text{lower hinge} - (1.5 \times \text{H-spread}), \qquad (4\text{-}2)$$

$$\text{upper fence} = \text{upper hinge} + (1.5 \times \text{H-spread}). \qquad (4\text{-}3)$$

Any values outside the inner fences are printed on separate lines and separated from the inner values by a line of text, "***OUTSIDE VALUES***."

Additional insight into how the daily initial zero calibrations and drifts changed during the course of the project can be seen especially in Figures 4-6, 4-7, 4-8, and 4-9. The plotted data indicate a rather large scatter (up to ± 0.010 ppmC) for the first 30 days or so of the project, after which time the scatter decreases to a considerably lower value. This may indicate that there was an initial period of time to learn how to operate the instrument and to obtain consistent and precise results. The first 20 days for Channel B, for example, taking absolute magnitudes, average ZDFT = 0.00375 (standard deviation = 0.0028), while the last 20 days average 0.00035 (standard deviation = 0.0005). No such trend is as readily apparent in the daily propane span calibration graphs, Figures 4-1, 4-2, 4-3, or 4-4.

4.2.2 <u>Preliminary Multiple Analyses</u>

Before NMOC data were obtained from the 22 designated sample sites ambient samples were obtained on each of four days in four canisters and analyzed for NMOC on four Radian channels. The purposes of the runs were to verify that the sampling and analysis equipment was working properly and to investigate possible differences among the Radian instrument channels. Four sets of samples were taken on June 14, 15, 18, and 19, 1984 and are identified as DAY 1.000, 2.000, 3.000, and 4.000 respectively in Table 4-10. Four canisters were used to obtain samples and are labeled CAN 1.000, 2.000, 3.000, and 4.000. Channels 1.000 through 4.000 in the table

TABLE 4-10. Preliminary Multiple Analyses of Ambient Samples.

	DAY	CAN	CHANNEL	NMOC
CASE 1	1.000	1.000	1.000	0.213
CASE 2	1.000	1.000	2.000	0.221
CASE 3	1.000	1.000	3.000	0.167
CASE 4	1.000	1.000	4.000	0.202
CASE 5	1.000	2.000	1.000	0.198
CASE 6	1.000	2.000	2.000	0.204
CASE 7	1.000	2.000	3.000	0.161
CASE 8	1.000	2.000	4.000	0.171
CASE 9	1.000	3.000	1.000	0.216
CASE 10	1.000	3.000	2.000	0.206
CASE 11	1.000	3.000	3.000	0.182
CASE 12	1.000	3.000	4.000	0.209
CASE 13	1.000	4.000	1.000	0.189
CASE 14	1.000	4.000	2.000	0.181
CASE 15	1.000	4.000	3.000	0.168
CASE 16	1.000	4.000	4.000	0.173
CASE 17	2.000	1.000	1.000	0.326
CASE 18	2.000	1.000	2.000	0.247
CASE 19	2.000	1.000	3.000	0.274
CASE 20	2.000	1.000	4.000	0.275
CASE 21	2.000	2.000	1.000	0.312
CASE 22	2.000	2.000	2.000	0.353
CASE 23	2.000	2.000	3.000	0.358
CASE 24	2.000	2.000	4.000	0.305
CASE 25	2.000	3.000	1.000	0.315
CASE 26	2.000	3.000	2.000	0.260
CASE 27	2.000	3.000	3.000	0.262
CASE 28	2.000	3.000	4.000	0.254
CASE 29	2.000	4.000	1.000	0.274
CASE 30	2.000	4.000	2.000	0.250
CASE 31	2.000	4.000	3.000	0.257
CASE 32	2.000	4.000	4.000	0.252
CASE 33	3.000	1.000	1.000	.
CASE 34	3.000	1.000	2.000	.
CASE 35	3.000	1.000	3.000	0.212
CASE 36	3.000	1.000	4.000	0.212
CASE 37	3.000	2.000	1.000	.
CASE 38	3.000	2.000	2.000	.
CASE 39	3.000	2.000	3.000	0.209
CASE 40	3.000	2.000	4.000	0.262
CASE 41	3.000	3.000	1.000	0.252
CASE 42	3.000	3.000	2.000	0.185
CASE 43	3.000	3.000	3.000	0.142
CASE 44	3.000	3.000	4.000	0.170
CASE 45	3.000	4.000	1.000	0.221
CASE 46	3.000	4.000	2.000	0.173
CASE 47	3.000	4.000	3.000	0.155
CASE 48	3.000	4.000	4.000	0.160
CASE 49	4.000	1.000	1.000	1.207
CASE 50	4.000	1.000	2.000	1.249
CASE 51	4.000	1.000	3.000	1.116
CASE 52	4.000	1.000	4.000	1.121
CASE 53	4.000	2.000	1.000	1.127
CASE 54	4.000	2.000	2.000	1.242
CASE 55	4.000	2.000	3.000	1.085
CASE 56	4.000	2.000	4.000	1.072
CASE 57	4.000	3.000	1.000	0.838
CASE 58	4.000	3.000	2.000	0.851
CASE 59	4.000	3.000	3.000	0.764
CASE 60	4.000	3.000	4.000	0.761
CASE 61	4.000	4.000	1.000	0.867
CASE 62	4.000	4.000	2.000	0.834
CASE 63	4.000	4.000	3.000	0.770
CASE 64	4.000	4.000	4.000	0.722

Table 4-11. Statistics for Preliminary Ambient Samples.

THE FOLLOWING RESULTS ARE FOR:
DAY = 1.00
CAN = 1.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.1670
MAXIMUM	0.2210
MEAN	0.2007
VARIANCE	0.0006
STANDARD DEV	0.0238
STD. ERROR	0.0119

THE FOLLOWING RESULTS ARE FOR:
DAY = 1.00
CAN = 2.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.1610
MAXIMUM	0.2040
MEAN	0.1835
VARIANCE	0.0004
STANDARD DEV	0.0208
STD. ERROR	0.0104

THE FOLLOWING RESULTS ARE FOR:
DAY = 1.00
CAN = 3.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.1820
MAXIMUM	0.2160
MEAN	0.2032
VARIANCE	0.0002
STANDARD DEV	0.0148
STD. ERROR	0.0074

THE FOLLOWING RESULTS ARE FOR:
DAY = 1.00
CAN = 4.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.1680
MAXIMUM	0.1890
MEAN	0.1778
VARIANCE	0.0001
STANDARD DEV	0.0092
STD. ERROR	0.0046

(Cont.)

Table 4-11. (cont.)

THE FOLLOWING RESULTS ARE FOR:
DAY = 2.00
CAN = 1.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.2470
MAXIMUM	0.3260
MEAN	0.2805
VARIANCE	0.0011
STANDARD DEV	0.0330
STD. ERROR	0.0165

THE FOLLOWING RESULTS ARE FOR:
DAY = 2.00
CAN = 2.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.3050
MAXIMUM	0.3580
MEAN	0.3320
VARIANCE	0.0007
STANDARD DEV	0.0274
STD. ERROR	0.0137

THE FOLLOWING RESULTS ARE FOR:
DAY = 2.00
CAN = 3.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.2540
MAXIMUM	0.3150
MEAN	0.2727
VARIANCE	0.0008
STANDARD DEV	0.0284
STD. ERROR	0.0142

THE FOLLOWING RESULTS ARE FOR:
DAY = 2.00
CAN = 4.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.2500
MAXIMUM	0.2740
MEAN	0.2583
VARIANCE	0.0001
STANDARD DEV	0.0109
STD. ERROR	0.0055

(Cont.)

Table 4-11. (cont.)

```
THE FOLLOWING RESULTS ARE FOR:
                  DAY      =      3.00
                  CAN      =      2.00

TOTAL OBSERVATIONS:     4

                          NMOC

  N OF CASES                       2
  MINIMUM                     0.2090
  MAXIMUM                     0.2620
  MEAN                        0.2355
  VARIANCE                    0.0014
  STANDARD DEV                0.0375
  STD. ERROR                  0.0265


THE FOLLOWING RESULTS ARE FOR:
                  DAY      =      3.00
                  CAN      =      3.00

TOTAL OBSERVATIONS:     4

                          NMOC

  N OF CASES                       4
  MINIMUM                     0.1420
  MAXIMUM                     0.2520
  MEAN                        0.1872
  VARIANCE                    0.0022
  STANDARD DEV                0.0467
  STD. ERROR                  0.0234


THE FOLLOWING RESULTS ARE FOR:
                  DAY      =      3.00
                  CAN      =      4.00

TOTAL OBSERVATIONS:     4

                          NMOC

  N OF CASES                       4
  MINIMUM                     0.1550
  MAXIMUM                     0.2210
  MEAN                        0.1772
  VARIANCE                    0.0009
  STANDARD DEV                0.0301
  STD. ERROR                  0.0151


THE FOLLOWING RESULTS ARE FOR:
                  DAY      =      4.00
                  CAN      =      1.00

TOTAL OBSERVATIONS:     4

                          NMOC

  N OF CASES                       4
  MINIMUM                     1.1160
  MAXIMUM                     1.2490
  MEAN                        1.1733
  VARIANCE                    0.0043
  STANDARD DEV                0.0655
  STD. ERROR                  0.0328
```

(Cont.)

Table 4-11. (cont.)

THE FOLLOWING RESULTS ARE FOR:
DAY = 4.00
CAN = 2.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	1.0720
MAXIMUM	1.2420
MEAN	1.1315
VARIANCE	0.0060
STANDARD DEV	0.0773
STD. ERROR	0.0387

THE FOLLOWING RESULTS ARE FOR:
DAY = 4.00
CAN = 3.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.7610
MAXIMUM	0.8510
MEAN	0.8035
VARIANCE	0.0023
STANDARD DEV	0.0477
STD. ERROR	0.0238

THE FOLLOWING RESULTS ARE FOR:
DAY = 4.00
CAN = 4.00

TOTAL OBSERVATIONS: 4

	NMOC
N OF CASES	4
MINIMUM	0.7220
MAXIMUM	0.8670
MEAN	0.7982
VARIANCE	0.0042
STANDARD DEV	0.0649
STD. ERROR	0.0324

Table 4-12. Analysis of Variance for Preliminary Ambient Data.

MODEL: NMOC = μ + DAY + CAN + CHANNEL + ERROR

OBSERVATION 33 HAS BEEN DELETED DUE TO MISSING DATA.

OBSERVATION 34 HAS BEEN DELETED DUE TO MISSING DATA.

OBSERVATION 37 HAS BEEN DELETED DUE TO MISSING DATA.

OBSERVATION 38 HAS BEEN DELETED DUE TO MISSING DATA.

NUMBER OF CASES PROCESSED: 60

DEPENDENT VARIABLE MEAN: 0.427

MULTIPLE CORRELATION: .975

SQUARED MULTIPLE CORRELATION: .951

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
DAY	6.506	3	2.169	304.504	.000
CAN	0.210	3	0.070	9.819	.000
CHANNEL	0.039	3	0.013	1.826	.154
ERROR	0.356	50	0.007		

****

are Radian instrument Channels A, B, C, and D, respectively. Table 4-11 shows statistics for NMOC values of the DAY-CAN combinations given in Table 4-10. The first set of statistics are for DAY=1.00 and CAN=1.00 and shows a maximum NMOC value of 0.221 ppmC and a minimum of 0.167 with a mean of 0.2007 ppmC. The other statistics given in Table 4-11 for DAY=1.00, CAN=1.00, are the variance, the standard deviation, and the standard error. The table summarizes similar statistics for the several DAY-CAN combinations. The number of cases cited refer to the number of analyses done on Radian Channels.

Table 4-12 shows the analysis of variance (ANOVA) to assess the potential of the variables DAY, CAN, and CHANNEL to have significant effects in characterizing the NMOC variance. Observations 33, 34, 37, and 38 were deleted because of missing data. The program used to calculate the ANOVA was able to handle the calculations for the unbalanced design and the results are shown in Table 4-12. The analysis of variance indicated that the collection day (variable DAY), and the canister (CAN) to be highly significant ("P" in the ANOVA table <0.01), but that the variable CHANNEL was not signficant at the 0.05 level ("P" in the ANOVA table >0.05). The preliminary analysis of the four ambient samples indicated that the NMOC values did not differ significantly among the Radian channels.

These results can be misleading, however, because pairs of canisters were sampled consecutively on each of the four days. If sampling is introduced as a factor, then CANS no longer is a factor, but Sampling Procedure does become significant. Because these were preliminary tests designed primarily to check out the instrumentation operability, little weight was given these preliminary results. Tests on duplicate samples (see Section 4.2.4 below) shows that the "CAN" effect is not a significant factor.

4.2.3 Repeated Analyses

Several ambient samples were analyzed more than once, either by the same channel, or by a different channel. The purposes of repeating the analyses were to obtain the overall precision of the determination for a particular channel, and also to obtain the between-channel variability. It was also possible to determine if there were significant differences between the various channels.

The samples from the 22 designated sites were all sent to the Radian Research Triangle Park Laboratory where they were first analyzed. Two types of repeated analyses were done. The first type involved reanalysis of a sample from one of the designated 22 sites. Repeated analyzes of these samples were done either by one of the Radian Channels, A, B, C, or D, and/or by one or both of the EPA Channels, E or GC. The selection of these samples for the repeated analyes was done on a random basis as described in the Quality Assurance Project Plan, and the selection of the channel(s) for the repeated analyses was also done by random selection.

For the second type of repeated analysis ambient samples were collected locally in the Raleigh-Durham-Chapel Hill-Research Triangle Park area by the Quality Assurance Division (QAD) of the U.S. EPA's Environmental Monitoring System Laboratory at Research Triangle Park. These samples were first analyzed by EPA's Channel E (QAD Instrument) followed by reanalyses on the four Radian Channels. This series of repeated analyses are considered separately below in Section 4.2.3.2 Local Ambient Samples.

4.2.3.1 All Sites Table 4-13 presents the data for the repeated analyses from all sampling sites including the local ambient samples discussed above. Cases 485 through 531 summarize the results of the repeated analyses from the local ambient samples. All the rest of the cases given in Table 4-13 are results from the 22 designated sites. As seen from Table 4-13, the Radian identification number, the mean NMOC value (in ppmC), the difference between the NMOC values for analyses, and the channels of the first and subsequent analysis. Negative values of DI indicate that the initial analysis had a lower value than the subsequent analysis. Mean NMOC values for the repeated analyses (NMOCBAR) are given to explore if the NMOC level had any effect on the results.

Table 4-14 and Figure 4-11 give additional statistics and information on the character of the repeated analysis data. A striking statistic given in Table 4-14 is the kurtosis of the difference data, DI, which equals 11.03264. This may indicate an unusually sharp peak in the frequency distribution data, or the presence of outliers among the DI data. Examination of Tables 4-13 and 4-14 indicate that the maximum DI value of 1.46 (Case 356) and the minimum DI value of -1.05 (Case 77 of Table 4-13) are

Table 4-13. Mean NMOC Value and Differences of Repeated Analyses.

RADID Radian Sample Identification Number
ALPHA Channel for the First Analysis
BETA Channel for a Subsequent Analysis
NMOCBAR Mean NMOC for Repeated Analyses (=(NMOC1+NMOC2)/2)
DI Difference of Repeated Analyses (=NMOC1-NMOC2)

CHANNEL IDENTIFICATION:

1.000	Radian Channel A	4.000	Radian Channel D
2.000	Radian Channel B	5.000	EPA OAD Channel
3.000	Radian Channel C	6.000	EPA ESRL Channel

	RADID	ALPHA	BETA	NMOCBAR	DI
CASE 1	1175.000	1.000	1.000	0.580	0.040
CASE 2	2172.000	1.000	1.000	0.475	-0.030
CASE 3	1082.000	1.000	1.000	1.000	0.060
CASE 4	2307.000	1.000	1.000	0.585	0.010
CASE 5	1684.000	1.000	2.000	0.400	-0.060
CASE 6	1665.000	1.000	2.000	0.605	-0.010
CASE 7	1158.000	1.000	4.000	0.945	0.110
CASE 8	1184.000	1.000	5.000	0.710	-0.100
CASE 9	1656.000	1.000	5.000	0.800	-0.080
CASE 10	1434.000	1.000	5.000	1.365	-0.270
CASE 11	2462.000	1.000	5.000	0.825	-0.150
CASE 12	1061.000	1.000	5.000	0.705	-0.090
CASE 13	1877.000	1.000	5.000	1.065	-0.010
CASE 14	1958.000	1.000	5.000	0.945	0.090
CASE 15	2335.000	1.000	5.000	0.890	-0.100
CASE 16	1889.000	1.000	5.000	0.830	-0.660
CASE 17	1106.000	1.000	5.000	1.485	-0.130
CASE 18	1040.000	1.000	5.000	1.050	-0.340
CASE 19	2407.000	1.000	5.000	0.565	-0.130
CASE 20	1694.000	1.000	5.000	0.490	-0.100
CASE 21	2021.000	1.000	5.000	0.675	-0.130
CASE 22	2033.000	1.000	5.000	1.895	-0.070
CASE 23	2398.000	1.000	5.000	0.655	-0.010
CASE 24	1999.000	1.000	5.000	1.105	-0.030
CASE 25	1263.000	1.000	5.000	0.835	-0.130
CASE 26	1138.000	1.000	5.000	1.065	-0.530
CASE 27	1340.000	1.000	5.000	1.095	-0.350
CASE 28	1385.000	1.000	5.000	1.355	-0.350
CASE 29	1088.000	1.000	5.000	1.595	-0.010
CASE 30	2005.000	1.000	5.000	4.320	0.080
CASE 31	1903.000	1.000	5.000	0.330	-0.160
CASE 32	2400.000	1.000	5.000	0.420	-0.060
CASE 33	2334.000	1.000	5.000	1.305	-0.070
CASE 34	1015.000	1.000	5.000	1.055	-0.190
CASE 35	1233.000	1.000	5.000	0.620	-0.020
CASE 36	1209.000	1.000	6.000	0.450	0.040
CASE 37	1402.000	1.000	6.000	0.420	0.040
CASE 38	1618.000	1.000	6.000	0.645	0.110
CASE 39	2226.000	1.000	6.000	0.510	-0.020
CASE 40	1231.000	1.000	6.000	0.670	0.120
CASE 41	1310.000	1.000	6.000	0.675	-0.030
CASE 42	1473.000	1.000	6.000	1.450	-0.060
CASE 43	2363.000	1.000	6.000	2.930	0.320
CASE 44	1212.000	1.000	6.000	0.530	0.020
CASE 45	1249.000	1.000	6.000	1.285	-0.690
CASE 46	1315.000	1.000	6.000	1.040	0.200
CASE 47	2128.000	1.000	6.000	1.435	-1.050
CASE 48	2050.000	1.000	6.000	0.660	0.060
CASE 49	2115.000	1.000	6.000	0.495	0.050
CASE 50	2471.000	1.000	6.000	0.455	0.050
CASE 51	1255.000	1.000	6.000	0.495	-0.030
CASE 52	2027.000	1.000	6.000	0.455	0.050
CASE 53	2409.000	1.000	6.000	0.985	0.150
CASE 54	1371.000	1.000	6.000	4.010	0.140
CASE 55	1907.000	1.000	6.000	0.770	0.080
CASE 56	1053.000	1.000	6.000	4.170	0.280
CASE 57	2445.000	1.000	6.000	0.495	-0.090
CASE 58	1133.000	1.000	6.000	0.325	0.010
CASE 59	1260.000	1.000	6.000	0.745	0.170
CASE 60	1410.000	1.000	6.000	0.895	0.070
CASE 61	2268.000	1.000	6.000	0.340	0.
CASE 62	1029.000	1.000	6.000	1.510	-0.180
CASE 63	1033.000	1.000	6.000	0.725	0.330

Table 4-13 (cont.)

CASE 64	1049.000	1.000	6.000	1.615	0.170
CASE 65	1731.000	1.000	6.000	0.580	0.020
CASE 66	1979.000	1.000	6.000	0.465	0.030
CASE 67	1081.000	1.000	6.000	1.085	0.070
CASE 68	1294.000	1.000	6.000	0.765	0.050
CASE 69	1376.000	1.000	6.000	1.295	0.110
CASE 70	1423.000	1.000	6.000	1.565	-0.430
CASE 71	2064.000	1.000	6.000	1.325	0.050
CASE 72	1218.000	1.000	6.000	1.290	0.020
CASE 73	1342.000	1.000	6.000	2.480	0.040
CASE 74	1343.000	1.000	6.000	0.670	0.
CASE 75	1492.000	1.000	6.000	0.530	-0.040
CASE 76	2327.000	1.000	6.000	1.205	0.130
CASE 77	2440.000	1.000	6.000	0.400	0.060
CASE 78	1172.000	1.000	6.000	1.875	0.330
CASE 79	1178.000	1.000	6.000	0.555	0.050
CASE 80	1479.000	1.000	6.000	1.335	0.210
CASE 81	2297.000	1.000	6.000	0.760	0.060
CASE 82	2033.000	1.000	6.000	1.810	0.100
CASE 83	1489.000	1.000	6.000	0.700	0.200
CASE 84	1875.000	1.000	6.000	1.380	0.100
CASE 85	2022.000	1.000	6.000	1.900	0.
CASE 86	2364.000	1.000	6.000	1.835	0.170
CASE 87	1030.000	1.000	6.000	0.805	-0.090
CASE 88	1190.000	1.000	6.000	0.760	0.120
CASE 89	1497.000	1.000	6.000	0.285	0.010
CASE 90	2057.000	1.000	6.000	1.010	-0.100
CASE 91	2412.000	1.000	6.000	0.690	0.040
CASE 92	1871.000	1.000	6.000	0.440	-0.280
CASE 93	1099.000	1.000	6.000	0.610	0.060
CASE 94	1820.000	1.000	6.000	0.190	0.020
CASE 95	1858.000	1.000	6.000	0.490	0.
CASE 96	1008.000	1.000	6.000	1.070	-0.120
CASE 97	1635.000	1.000	6.000	0.790	0.060
CASE 98	2005.000	1.000	6.000	4.040	0.640
CASE 99	1103.000	1.000	6.000	0.550	0.060
CASE 100	1644.000	1.000	6.000	0.220	0.040
CASE 101	1788.000	1.000	6.000	0.370	0.080
CASE 102	1220.000	1.000	6.000	1.345	0.010
CASE 103	2345.000	1.000	6.000	1.520	0.140
CASE 104	1037.000	1.000	6.000	0.655	0.130
CASE 105	1080.000	1.000	6.000	0.295	-0.030
CASE 106	1079.000	1.000	6.000	0.410	0.080
CASE 107	1705.000	1.000	6.000	0.545	0.050
CASE 108	2108.000	1.000	6.000	1.535	-0.310
CASE 109	2469.000	2.000	1.000	1.100	-0.020
CASE 110	1344.000	2.000	1.000	0.620	-0.100
CASE 111	1559.000	2.000	1.000	1.275	0.050
CASE 112	1494.000	2.000	2.000	0.330	0.
CASE 113	1651.000	2.000	2.000	0.235	-0.090
CASE 114	1084.000	2.000	2.000	1.055	-0.050
CASE 115	1113.000	2.000	3.000	1.810	0.260
CASE 116	1135.000	2.000	5.000	0.875	-0.490
CASE 117	2439.000	2.000	5.000	0.275	-0.090
CASE 118	2102.000	2.000	5.000	0.450	-0.140
CASE 119	2405.000	2.000	5.000	0.505	-0.510
CASE 120	2474.000	2.000	5.000	0.205	-0.050
CASE 121	1428.000	2.000	5.000	1.525	-0.170
CASE 122	1666.000	2.000	5.000	1.545	0.110
CASE 123	1195.000	2.000	5.000	1.145	-0.010
CASE 124	1383.000	2.000	5.000	1.285	-0.290
CASE 125	2366.000	2.000	5.000	1.040	-0.260
CASE 126	1001.000	2.000	5.000	1.320	-0.620
CASE 127	1335.000	2.000	5.000	0.980	-0.360
CASE 128	1075.000	2.000	5.000	0.945	-0.190
CASE 129	2133.000	2.000	5.000	0.855	-0.010
CASE 130	2097.000	2.000	5.000	0.555	-0.130
CASE 131	1985.000	2.000	5.000	0.680	-0.100
CASE 132	1724.000	2.000	5.000	1.220	-0.220
CASE 133	1791.000	2.000	5.000	2.365	0.190
CASE 134	1066.000	2.000	5.000	0.750	-0.140
CASE 135	1219.000	2.000	5.000	0.715	-0.250
CASE 136	1262.000	2.000	5.000	0.400	-0.260
CASE 137	1176.000	2.000	5.000	1.070	-0.160
CASE 138	2127.000	2.000	5.000	0.370	-0.040

CASE 139	1623.000	2.000	5.000	0.765	-0.510
CASE 140	1712.000	2.000	5.000	1.195	-0.210
CASE 141	2003.000	2.000	5.000	0.580	-0.040
CASE 142	1113.000	2.000	6.000	1.870	0.140
CASE 143	1918.000	2.000	6.000	0.510	0.040
CASE 144	2014.000	2.000	6.000	0.420	0.
CASE 145	2298.000	2.000	6.000	0.740	0.060
CASE 146	1494.000	2.000	6.000	0.305	0.050
CASE 147	1766.000	2.000	6.000	1.530	0.220
CASE 148	1879.000	2.000	6.000	0.525	0.030
CASE 149	1216.000	2.000	6.000	0.620	-0.020
CASE 150	1264.000	2.000	6.000	0.605	0.030
CASE 151	1458.000	2.000	6.000	1.160	0.020
CASE 152	1616.000	2.000	6.000	1.065	0.130
CASE 153	1872.000	2.000	6.000	3.795	0.090
CASE 154	2294.000	2.000	6.000	0.085	0.050
CASE 155	1411.000	2.000	6.000	0.265	-0.170
CASE 156	2410.000	2.000	6.000	0.770	0.040
CASE 157	2474.000	2.000	6.000	0.165	0.030
CASE 158	1380.000	2.000	6.000	1.180	0.100
CASE 159	2367.000	2.000	6.000	1.160	0.120
CASE 160	1068.000	2.000	6.000	0.455	0.010
CASE 161	1377.000	2.000	6.000	0.455	-0.010
CASE 162	1562.000	2.000	6.000	0.500	0.080
CASE 163	2038.000	2.000	6.000	0.475	0.010
CASE 164	1084.000	2.000	6.000	0.950	0.160
CASE 165	1007.000	2.000	6.000	0.940	-0.120
CASE 166	1155.000	2.000	6.000	0.680	0.120
CASE 167	1365.000	2.000	6.000	0.780	0.060
CASE 168	2006.000	2.000	6.000	0.545	0.050
CASE 169	2330.000	2.000	6.000	0.950	-0.020
CASE 170	1027.000	2.000	6.000	1.810	-0.140
CASE 171	1034.000	2.000	6.000	1.470	-0.120
CASE 172	1361.000	2.000	6.000	0.325	0.010
CASE 173	1491.000	2.000	6.000	0.870	0.040
CASE 174	2360.000	2.000	6.000	1.745	0.190
CASE 175	1047.000	2.000	6.000	1.240	0.100
CASE 176	1739.000	2.000	6.000	2.025	0.130
CASE 177	1944.000	2.000	6.000	0.810	0.040
CASE 178	2097.000	2.000	6.000	0.480	0.020
CASE 179	2250.000	2.000	6.000	0.405	-0.010
CASE 180	1471.000	2.000	6.000	1.610	-0.300
CASE 181	1506.000	2.000	6.000	1.630	0.180
CASE 182	1599.000	2.000	6.000	0.465	0.070
CASE 183	1633.000	2.000	6.000	0.450	0.020
CASE 184	1984.000	2.000	6.000	0.620	0.080
CASE 185	2181.000	2.000	6.000	0.620	0.080
CASE 186	1809.000	2.000	6.000	1.795	0.210
CASE 187	1985.000	2.000	6.000	0.620	0.020
CASE 188	2070.000	2.000	6.000	2.155	0.170
CASE 189	1429.000	2.000	6.000	1.605	0.070
CASE 190	1460.000	2.000	6.000	0.730	0.140
CASE 191	1091.000	2.000	6.000	0.825	-0.050
CASE 192	1790.000	2.000	6.000	0.745	0.210
CASE 193	2272.000	2.000	6.000	0.850	0.080
CASE 194	2496.000	2.000	6.000	0.545	0.090
CASE 195	1140.000	2.000	6.000	0.440	0.
CASE 196	1206.000	2.000	6.000	0.570	0.060
CASE 197	1248.000	2.000	6.000	0.420	-0.100
CASE 198	1400.000	2.000	6.000	0.385	0.050
CASE 199	1700.000	2.000	6.000	0.555	0.070
CASE 200	1896.000	2.000	6.000	0.450	0.080
CASE 201	1923.000	2.000	6.000	0.370	0.040
CASE 202	1019.000	2.000	6.000	1.275	0.030
CASE 203	1038.000	2.000	6.000	0.620	0.080
CASE 204	1257.000	2.000	6.000	0.830	-0.060
CASE 205	1344.000	2.000	6.000	0.870	-0.600
CASE 206	1548.000	2.000	6.000	4.720	0.040
CASE 207	2432.000	2.000	6.000	0.560	0.040
CASE 208	1100.000	2.000	6.000	0.880	0.080
CASE 209	1285.000	2.000	6.000	0.465	-0.010
CASE 210	1439.000	2.000	6.000	0.425	0.010

Table 4-13 (cont.)

CASE 211	2227.000	2.000	6.000	0.135	0.010
CASE 212	2269.000	2.000	6.000	0.280	-0.320
CASE 213	1118.000	2.000	6.000	0.560	0.040
CASE 214	1464.000	2.000	6.000	0.620	0.120
CASE 215	1708.000	2.000	6.000	0.800	0.080
CASE 216	2284.000	2.000	6.000	0.545	0.050
CASE 217	1360.000	2.000	6.000	0.455	-0.050
CASE 218	2375.000	2.000	6.000	0.175	-0.010
CASE 219	1202.000	3.000	1.000	0.795	0.050
CASE 220	1792.000	3.000	1.000	0.820	-0.060
CASE 221	1236.000	3.000	3.000	0.855	0.070
CASE 222	1490.000	3.000	4.000	1.325	0.270
CASE 223	1812.000	3.000	4.000	0.525	-0.030
CASE 224	1718.000	3.000	4.000	0.815	0.250
CASE 225	2273.000	3.000	4.000	1.870	0.180
CASE 226	1973.000	3.000	4.000	0.855	0.050
CASE 227	1447.000	3.000	5.000	1.230	-0.240
CASE 228	1455.000	3.000	5.000	0.680	-0.040
CASE 229	2449.000	3.000	5.000	0.315	0.010
CASE 230	1254.000	3.000	5.000	0.740	-0.100
CASE 231	2155.000	3.000	5.000	0.310	-0.040
CASE 232	2042.000	3.000	5.000	0.695	-0.050
CASE 233	2206.000	3.000	5.000	1.010	0.020
CASE 234	1484.000	3.000	5.000	0.570	-0.040
CASE 235	2356.000	3.000	5.000	0.805	-0.010
CASE 236	1325.000	3.000	5.000	1.185	-0.230
CASE 237	1936.000	3.000	5.000	0.960	0.040
CASE 238	1408.000	3.000	5.000	1.515	-0.090
CASE 239	1770.000	3.000	5.000	0.810	-0.360
CASE 240	2361.000	3.000	5.000	1.760	0.040
CASE 241	1152.000	3.000	5.000	0.725	-0.190
CASE 242	1761.000	3.000	5.000	0.905	-0.270
CASE 243	1634.000	3.000	5.000	1.160	-0.140
CASE 244	1675.000	3.000	5.000	0.920	0.120
CASE 245	1754.000	3.000	5.000	1.055	-0.090
CASE 246	1845.000	3.000	5.000	0.500	-0.120
CASE 247	1927.000	3.000	5.000	3.670	0.060
CASE 248	1969.000	3.000	5.000	1.185	-0.350
CASE 249	1210.000	3.000	5.000	0.885	-0.290
CASE 250	2071.000	3.000	5.000	0.730	0.080
CASE 251	1170.000	3.000	5.000	1.290	-0.080
CASE 252	1347.000	3.000	5.000	0.700	-0.080
CASE 253	1670.000	3.000	5.000	0.360	-0.120
CASE 254	1935.000	3.000	5.000	0.590	-0.040
CASE 255	1024.000	3.000	5.000	1.160	-0.120
CASE 256	1054.000	3.000	5.000	0.980	-0.040
CASE 257	1072.000	3.000	5.000	0.785	-0.110
CASE 258	1692.000	3.000	5.000	0.340	-0.220
CASE 259	2168.000	3.000	5.000	0.215	-0.130
CASE 260	1119.000	3.000	5.000	1.355	-0.830
CASE 261	1891.000	3.000	5.000	0.525	-0.090
CASE 262	1904.000	3.000	5.000	0.825	-0.170
CASE 263	1073.000	3.000	6.000	0.720	0.
CASE 264	1324.000	3.000	6.000	0.405	0.050
CASE 265	1593.000	3.000	6.000	0.485	0.070
CASE 266	1624.000	3.000	6.000	0.370	0.
CASE 267	1753.000	3.000	6.000	0.680	-0.160
CASE 268	1856.000	3.000	6.000	0.350	0.
CASE 269	2054.000	3.000	6.000	0.540	0.120
CASE 270	2468.000	3.000	6.000	0.230	-0.040
CASE 271	1523.000	3.000	6.000	0.690	0.200
CASE 272	1610.000	3.000	6.000	0.540	0.020
CASE 273	1819.000	3.000	6.000	0.710	0.060
CASE 274	2241.000	3.000	6.000	2.120	0.180
CASE 275	2281.000	3.000	6.000	0.630	0.200
CASE 276	1046.000	3.000	6.000	0.960	0.320
CASE 277	1050.000	3.000	6.000	1.300	0.340
CASE 278	1274.000	3.000	6.000	0.435	0.050
CASE 279	1442.000	3.000	6.000	0.185	0.010
CASE 280	1659.000	3.000	6.000	0.765	0.110
CASE 281	1721.000	3.000	6.000	0.270	-0.020
CASE 282	2423.000	3.000	6.000	1.745	0.150
CASE 283	2472.000	3.000	6.000	0.210	0.
CASE 284	1406.000	3.000	6.000	2.405	0.390

Table 4-13 (cont.)

CASE 285	1646.000	3.000	6.000	0.900	0.180
CASE 286	2283.000	3.000	6.000	1.075	0.170
CASE 287	2393.000	3.000	6.000	2.490	0.340
CASE 288	2418.000	3.000	6.000	1.375	0.130
CASE 289	2459.000	3.000	6.000	1.065	0.170
CASE 290	1735.000	3.000	6.000	0.510	0.
CASE 291	2180.000	3.000	6.000	1.110	0.120
CASE 292	1078.000	3.000	6.000	1.795	0.290
CASE 293	1161.000	3.000	6.000	0.695	0.110
CASE 294	1573.000	3.000	6.000	0.465	0.050
CASE 295	1650.000	3.000	6.000	0.670	0.040
CASE 296	1929.000	3.000	6.000	0.670	0.160
CASE 297	2161.000	3.000	6.000	2.610	0.660
CASE 298	2174.000	3.000	6.000	0.590	0.
CASE 299	1000.000	3.000	6.000	0.890	-0.020
CASE 300	1028.000	3.000	6.000	1.610	0.
CASE 301	1070.000	3.000	6.000	0.985	0.030
CASE 302	1174.000	3.000	6.000	0.460	0.060
CASE 303	1566.000	3.000	6.000	1.305	0.230
CASE 304	1852.000	3.000	6.000	0.380	0.020
CASE 305	1936.000	3.000	6.000	0.955	0.050
CASE 306	2152.000	3.000	6.000	0.730	0.100
CASE 307	2203.000	3.000	6.000	0.485	0.050
CASE 308	1180.000	3.000	6.000	1.140	0.140
CASE 309	1450.000	3.000	6.000	0.780	0.120
CASE 310	1877.000	3.000	6.000	0.815	0.050
CASE 311	2223.000	3.000	6.000	1.030	0.060
CASE 312	2428.000	3.000	6.000	1.805	0.010
CASE 313	1042.000	3.000	6.000	0.725	0.250
CASE 314	1239.000	3.000	6.000	0.505	-0.070
CASE 315	1334.000	3.000	6.000	0.630	0.120
CASE 316	1630.000	3.000	6.000	0.475	0.030
CASE 317	1802.000	3.000	6.000	1.200	0.140
CASE 318	2333.000	3.000	6.000	1.605	0.030
CASE 319	2484.000	3.000	6.000	0.735	0.030
CASE 320	1675.000	3.000	6.000	0.810	0.340
CASE 321	1833.000	3.000	6.000	0.550	0.260
CASE 322	1822.000	3.000	6.000	0.620	0.040
CASE 323	2126.000	3.000	6.000	0.425	0.090
CASE 324	2487.000	3.000	6.000	0.460	-0.180
CASE 325	1782.000	3.000	6.000	1.385	0.530
CASE 326	1927.000	3.000	6.000	3.525	0.350
CASE 327	2323.000	3.000	6.000	0.495	0.010
CASE 328	1351.000	3.000	6.000	1.560	0.060
CASE 329	2200.000	3.000	6.000	0.720	0.040
CASE 330	1012.000	3.000	6.000	0.865	0.030
CASE 331	1032.000	3.000	6.000	1.085	0.050
CASE 332	1059.000	3.000	6.000	1.325	0.290
CASE 333	1359.000	3.000	6.000	0.510	-0.060
CASE 334	1640.000	3.000	6.000	0.760	0.100
CASE 335	1670.000	3.000	6.000	0.295	0.010
CASE 336	1774.000	3.000	6.000	0.670	0.
CASE 337	1935.000	3.000	6.000	0.480	0.180
CASE 338	2158.000	3.000	6.000	0.530	0.040
CASE 339	1621.000	3.000	6.000	0.745	-0.050
CASE 340	1983.000	3.000	6.000	2.125	0.150
CASE 341	1840.000	3.000	6.000	0.495	0.290
CASE 342	2177.000	3.000	6.000	0.395	-0.010
CASE 343	1130.000	3.000	6.000	0.840	0.100
CASE 344	1483.000	3.000	6.000	2.220	0.260
CASE 345	1795.000	3.000	6.000	0.945	-0.050
CASE 346	1843.000	3.000	6.000	0.320	0.
CASE 347	2188.000	3.000	6.000	0.725	0.010
CASE 348	1244.000	3.000	6.000	0.785	0.210
CASE 349	1585.000	3.000	6.000	0.430	0.040
CASE 350	1686.000	3.000	6.000	0.680	-0.020
CASE 351	1973.000	3.000	6.000	0.840	0.080
CASE 352	2072.000	3.000	6.000	0.175	0.030
CASE 353	1151.000	3.000	6.000	0.455	0.070

CASE 354	1605.000	3.000	6.000	0.745	0.110
CASE 355	1756.000	3.000	6.000	0.690	0.040
CASE 356	1990.000	3.000	6.000	0.635	0.030
CASE 357	1010.000	3.000	6.000	0.705	0.030
CASE 358	1188.000	3.000	6.000	0.360	0.080
CASE 359	1372.000	3.000	6.000	0.415	0.050
CASE 360	1564.000	3.000	6.000	0.215	0.010
CASE 361	1619.000	3.000	6.000	0.435	0.210
CASE 362	1742.000	3.000	6.000	0.505	-0.110
CASE 363	1891.000	3.000	6.000	0.560	-0.160
CASE 364	2388.000	3.000	6.000	1.115	0.110
CASE 365	1797.000	4.000	2.000	0.765	-0.090
CASE 366	1169.000	4.000	3.000	0.395	-0.010
CASE 367	1777.000	4.000	3.000	0.705	0.030
CASE 368	2147.000	4.000	3.000	1.810	-0.140
CASE 369	2170.000	4.000	4.000	0.490	-0.020
CASE 370	2325.000	4.000	4.000	0.930	-0.020
CASE 371	1863.000	4.000	5.000	1.065	-0.370
CASE 372	1357.000	4.000	5.000	1.035	-0.170
CASE 373	2448.000	4.000	5.000	4.260	0.020
CASE 374	1878.000	4.000	5.000	1.825	0.010
CASE 375	2039.000	4.000	5.000	1.140	0.040
CASE 376	1011.000	4.000	5.000	1.780	-0.220
CASE 377	1031.000	4.000	5.000	1.075	-0.130
CASE 378	1253.000	4.000	5.000	0.660	-0.180
CASE 379	2087.000	4.000	5.000	0.325	-0.090
CASE 380	1853.000	4.000	5.000	1.135	-0.190
CASE 381	1087.000	4.000	5.000	1.170	-0.140
CASE 382	2392.000	4.000	5.000	0.370	-0.120
CASE 383	1449.000	4.000	5.000	0.820	-0.240
CASE 384	1044.000	4.000	5.000	1.675	-0.190
CASE 385	2173.000	4.000	5.000	0.495	0.010
CASE 386	1860.000	4.000	5.000	0.605	-0.070
CASE 387	2154.000	4.000	5.000	0.680	-0.060
CASE 388	1457.000	4.000	5.000	0.685	-0.270
CASE 389	1045.000	4.000	5.000	1.100	-0.140
CASE 390	1157.000	4.000	5.000	0.270	-0.120
CASE 391	1124.000	4.000	5.000	1.195	-0.610
CASE 392	1208.000	4.000	5.000	1.150	-0.400
CASE 393	1409.000	4.000	5.000	1.410	-0.100
CASE 394	1451.000	4.000	5.000	1.445	-0.190
CASE 395	1313.000	4.000	5.000	0.950	-0.360
CASE 396	2371.000	4.000	5.000	0.455	-0.270
CASE 397	1048.000	4.000	5.000	0.430	-0.120
CASE 398	1098.000	4.000	5.000	0.930	-0.380
CASE 399	2217.000	4.000	5.000	0.850	-0.100
CASE 400	2466.000	4.000	5.000	0.250	-0.120
CASE 401	1116.000	4.000	6.000	0.840	-0.020
CASE 402	1153.000	4.000	6.000	0.335	-0.090
CASE 403	1723.000	4.000	6.000	0.545	0.150
CASE 404	2159.000	4.000	6.000	0.500	0.100
CASE 405	2489.000	4.000	6.000	0.335	0.090
CASE 406	1870.000	4.000	6.000	0.420	-0.020
CASE 407	1052.000	4.000	6.000	2.560	0.380
CASE 408	1671.000	4.000	6.000	1.665	0.130
CASE 409	2278.000	4.000	6.000	0.095	0.030
CASE 410	1323.000	4.000	6.000	0.375	-0.050
CASE 411	1495.000	4.000	6.000	0.225	0.010
CASE 412	1591.000	4.000	6.000	0.590	0.140
CASE 413	1617.000	4.000	6.000	0.760	0.100
CASE 414	1663.000	4.000	6.000	1.255	0.190
CASE 415	1678.000	4.000	6.000	0.350	0.020
CASE 416	1841.000	4.000	6.000	0.360	0.040
CASE 417	2301.000	4.000	6.000	0.820	0.
CASE 418	1490.000	4.000	6.000	1.190	0.
CASE 419	2450.000	4.000	6.000	2.570	0.100
CASE 420	1006.000	4.000	6.000	1.155	-0.130
CASE 421	1018.000	4.000	6.000	0.880	0.
CASE 422	1069.000	4.000	6.000	0.490	0.080
CASE 423	1234.000	4.000	6.000	0.575	-0.010
CASE 424	1258.000	4.000	6.000	0.480	-0.020
CASE 425	1661.000	4.000	6.000	1.840	-0.220

Table 4-13 (cont.)

CASE 426	2149.000	4.000	6.000	0.315	0.010
CASE 427	2392.000	4.000	6.000	0.325	-0.030
CASE 428	1826.000	4.000	6.000	1.005	0.130
CASE 429	1976.000	4.000	6.000	0.440	0.040
CASE 430	2461.000	4.000	6.000	3.720	0.420
CASE 431	1267.000	4.000	6.000	0.610	0.
CASE 432	1441.000	4.000	6.000	1.000	0.060
CASE 433	1748.000	4.000	6.000	0.955	-0.210
CASE 434	2498.000	4.000	6.000	0.270	0.020
CASE 435	1021.000	4.000	6.000	0.625	0.130
CASE 436	1955.000	4.000	6.000	0.505	-0.070
CASE 437	1039.000	4.000	6.000	1.600	0.020
CASE 438	1200.000	4.000	6.000	0.625	-0.050
CASE 439	1565.000	4.000	6.000	1.190	0.200
CASE 440	2062.000	4.000	6.000	1.500	0.280
CASE 441	1387.000	4.000	6.000	1.385	0.050
CASE 442	1424.000	4.000	6.000	0.610	0.140
CASE 443	1860.000	4.000	6.000	0.530	0.080
CASE 444	2051.000	4.000	6.000	0.740	0.080
CASE 445	2061.000	4.000	6.000	0.535	0.090
CASE 446	1163.000	4.000	6.000	1.395	0.330
CASE 447	1293.000	4.000	6.000	2.595	0.230
CASE 448	1797.000	4.000	6.000	0.730	-0.020
CASE 449	1902.000	4.000	6.000	0.410	-0.060
CASE 450	1846.000	4.000	6.000	0.610	0.140
CASE 451	1898.000	4.000	6.000	0.640	0.
CASE 452	2175.000	4.000	6.000	0.850	-0.060
CASE 453	1603.000	4.000	6.000	1.950	0.240
CASE 454	1674.000	4.000	6.000	0.845	0.170
CASE 455	2144.000	4.000	6.000	1.495	0.170
CASE 456	2434.000	4.000	6.000	1.120	0.140
CASE 457	2279.000	4.000	6.000	0.315	0.030
CASE 458	2340.000	4.000	6.000	0.415	-0.150
CASE 459	1192.000	4.000	6.000	1.460	1.460
CASE 460	1225.000	4.000	6.000	1.435	-0.350
CASE 461	1321.000	4.000	6.000	0.760	-0.060
CASE 462	1664.000	4.000	6.000	0.560	0.060
CASE 463	2116.000	4.000	6.000	0.650	0.
CASE 464	2368.000	4.000	6.000	1.995	0.090
CASE 465	1056.000	4.000	6.000	0.760	0.140
CASE 466	1561.000	4.000	6.000	0.395	0.050
CASE 467	1653.000	4.000	6.000	1.135	0.170
CASE 468	1893.000	4.000	6.000	0.390	-0.020
CASE 469	2112.000	4.000	6.000	0.880	0.140
CASE 470	2324.000	4.000	6.000	0.460	0.040
CASE 471	1235.000	4.000	6.000	0.725	0.030
CASE 472	1930.000	4.000	6.000	0.760	0.040
CASE 473	1981.000	4.000	6.000	0.435	0.050
CASE 474	2353.000	4.000	6.000	0.320	-0.020
CASE 475	1167.000	4.000	6.000	0.235	0.050
CASE 476	1881.000	4.000	6.000	0.880	0.
CASE 477	2426.000	4.000	6.000	0.800	-0.280
CASE 478	1186.000	4.000	6.000	1.645	0.210
CASE 479	1316.000	4.000	6.000	0.920	0.120
CASE 480	2100.000	4.000	6.000	0.555	-0.050
CASE 481	2464.000	4.000	6.000	0.880	0.020
CASE 482	1016.000	4.000	6.000	2.505	0.250
CASE 483	2000.000	4.000	6.000	0.805	0.010
CASE 484	2199.000	4.000	6.000	0.295	-0.010
CASE 485	1041.000	5.000	1.000	1.610	0.
CASE 486	1095.000	5.000	1.000	0.760	-0.040
CASE 487	1160.000	5.000	1.000	2.220	-0.180
CASE 488	1282.000	5.000	1.000	1.405	-0.150
CASE 489	1502.000	5.000	1.000	1.410	-0.140
CASE 490	1529.000	5.000	1.000	1.535	-0.110
CASE 491	1581.000	5.000	1.000	1.525	-0.010
CASE 492	1733.000	5.000	1.000	1.560	0.040
CASE 493	1851.000	5.000	1.000	0.245	-0.050
CASE 494	1946.000	5.000	1.000	1.190	-0.120
CASE 495	2034.000	5.000	1.000	0.630	-0.040

Table 4-13 (cont.)

CASE 496	2387.000	5.000	1.000	2.065	-0.110
CASE 497	2499.000	5.000	1.000	3.050	-0.180
CASE 498	1041.000	5.000	2.000	1.620	-0.020
CASE 499	1095.000	5.000	2.000	0.785	-0.090
CASE 500	1160.000	5.000	2.000	2.180	-0.100
CASE 501	1282.000	5.000	2.000	1.360	-0.060
CASE 502	1502.000	5.000	2.000	1.400	-0.120
CASE 503	1581.000	5.000	2.000	1.550	-0.060
CASE 504	1733.000	5.000	2.000	1.580	0.
CASE 505	1851.000	5.000	2.000	0.220	0.
CASE 506	1946.000	5.000	2.000	1.200	-0.140
CASE 507	2034.000	5.000	2.000	0.620	-0.020
CASE 508	2387.000	5.000	2.000	2.075	-0.130
CASE 509	2499.000	5.000	2.000	3.080	-0.240
CASE 510	1041.000	5.000	3.000	1.660	-0.100
CASE 511	1095.000	5.000	3.000	0.750	-0.020
CASE 512	1160.000	5.000	3.000	2.230	-0.200
CASE 513	1282.000	5.000	3.000	1.325	0.010
CASE 514	1502.000	5.000	3.000	1.385	-0.090
CASE 515	1581.000	5.000	3.000	1.490	0.060
CASE 516	1851.000	5.000	3.000	0.220	0.
CASE 517	1946.000	5.000	3.000	1.150	-0.040
CASE 518	2034.000	5.000	3.000	0.630	-0.040
CASE 519	2387.000	5.000	3.000	2.040	-0.060
CASE 520	2499.000	5.000	3.000	3.030	-0.140
CASE 521	1041.000	5.000	4.000	1.655	-0.090
CASE 522	1095.000	5.000	4.000	0.735	0.010
CASE 523	1160.000	5.000	4.000	2.240	-0.220
CASE 524	1282.000	5.000	4.000	1.300	0.060
CASE 525	1502.000	5.000	4.000	1.340	0.
CASE 526	1581.000	5.000	4.000	1.510	0.020
CASE 527	1851.000	5.000	4.000	0.225	-0.010
CASE 528	1946.000	5.000	4.000	1.140	-0.020
CASE 529	2034.000	5.000	4.000	0.625	-0.030
CASE 530	2387.000	5.000	4.000	2.000	0.020
CASE 531	2499.000	5.000	4.000	2.970	-0.020

Table 4-14. Statistics for Repeated Analyses, Mean NMOC, and NMOC Differences.

TOTAL OBSERVATIONS: 531

	NMOCBAR	DI
N OF CASES	531	531
MINIMUM	0.08500	-1.05000
MAXIMUM	4.72000	1.46000
RANGE	4.63500	2.51000
MEAN	0.97391	-0.00194
VARIANCE	0.48021	0.03377
STANDARD DEV	0.69297	0.18376
STD. ERROR	0.03007	0.00797
SKEWNESS	2.13691	0.06887
KURTOSIS	6.29178	11.03264

Figure 4-11. Frequency Diagram of Repeated Difference Data.

```
STEM AND LEAF PLOT OF VARIABLE:       DI

SMALLEST VALUE AT TOP OF PLOT IS:  -1.050000

           -10   5
            -8   3
            -6   96210
            -5   311
            -4   930
            -3   8766655554
       ***OUTSIDE VALUES***
            -3   2
            -3   10
            -2   9988
            -2   777766
            -2   5444
            -2   322222
            -2   110
            -1   99999988888
            -1   77776666
            -1   5554444444444
            -1   333333333222222222222
            -1   1111000000000000
            -0 H 999999999999998888
            -0   77777666666666666
            -0   555555555554444444444444
            -0   33333333222222222222222222222
            -0   11111111111111111
             0 M 000000000000000000000000000011111111111111111111111
             0   22222222222222222233333333333333333
             0   4444444444444444444444444444555555555555555555555555555
             0   666666666666666666677777777
             0 H 8888888888888888889999999
             1   000000000011111111
             1   2222222222233333333
             1   4444444444445555
             1   66777777777
             1   88888999
             2   00000111111
             2   233
             2   4555
             2   6667
             2   88999
             3
             3   22
       ***OUTSIDE VALUES***
             3   333444589
             4   2
             5   3
             6   46
            14   6
```

likely to be outliers. Recalculating the statistics for NMOCBAR and DI, deleting Cases 77 and 356 from the data set results in the numbers given in Table 4-15. The kurtosis number for DI in Table 4-15 is 3.608, a more reasonable number. The standard deviation of the differences moves from 0.18376 for all the data points to 0.16664, considering two outliers in the original set. This would give a percent coefficient of variation (%CV) of 18.9% for the mean NMOC measurement for repeated analyses for the entire data set and a percent coefficient of variation of 17.1% for the mean NMOC measurement considering the maximum and minimum differences of the original data set to be outliers. Because the presence of only 2 potential outliers (out of 531) changes the %CV about 1.8% and the kurtosis from 11.0 to 3.6, it could be argued that the two data points should be removed from the data set. In the analysis that follows, however, Cases 77 and 356 of the original data set were retained.

Precision of the repeated analyses may be characterized by either the standard deviations of the differences, or the coefficient of variation percentage. These numbers would be: (1) standard deviation = $\pm$ 0.184 ppmC, or (2) % coefficient of variation = 18.9%.

An additional measure of precision may be calculated from the average of the absolute magnitudes of the differences. Table 4-16 gives the statistics for that calculation, showing an overall percent difference of [(0.11896)/(0.97391)] x 100 which equals 12.2%.

Table 4-13 and Figure 4-11 also indicate that the frequency distribution of the repeated difference data is approximately symmetrical about the mean, median, and mode. Note also that the mean difference, $\overline{DI}$ = -0.00194, is essentially zero.

Table 4-17 gives the statistics for the repeated analyses tabulated by the channels pairs on which the repeated analyses were done. For example the first data set shows results for ALPHA = 1.00 and BETA = 1.00, which indicate that for 4 cases both the first analysis and the second analysis was done on Channel A. The second data set indicates that the results are for ALPHA = 1.00 and BETA = 2.00, indicating that the first analysis was on Radian Channel A and the second analysis was on Channel B.

Table 4-15. Statistics for Repeated Analyses.
Two Possible Outliers Removed.

TOTAL OBSERVATIONS: 529

	NMOCBAR	DI
N OF CASES	529	529
MINIMUM	0.08500	-0.83000
MAXIMUM	4.72000	0.66000
RANGE	4.63500	1.49000
MEAN	0.97212	-0.00272
VARIANCE	0.48117	0.02777
STANDARD DEV	0.69367	0.16664
STD. ERROR	0.03016	0.00725
SKEWNESS	2.14510	-0.70164
KURTOSIS	6.31095	3.60832

Table 4-16. Statistics for Repeated Analyses with the Absolute Magnitude of NMOC Differences.

TOTAL OBSERVATIONS: 531

	NMOCBAR	DI
N OF CASES	531	531
MINIMUM	0.08500	0.
MAXIMUM	4.72000	1.46000
RANGE	4.63500	1.46000
MEAN	0.97391	0.11896
VARIANCE	0.48021	0.01959
STANDARD DEV	0.69297	0.13998
STD. ERROR	0.03007	0.00607
SKEWNESS	2.13691	3.56047
KURTOSIS	6.29178	21.69396

Table 4-17. Statistics for Repeated Analyses, Tabulated by Instrument Channel Pairs.

NMOCBAR	Mean of two Analyses on the Same Sample.
DI	Difference between Repeated Anayses, (NMOC1-NMOC2).
ALPHA	Channel of the First Analysis.
BETA	Channel of the Second Analysis.

CHANNEL IDENTIFICATION

1.000	Radian Channel A	4.000	Radian Channel D
2.000	Radian Channel B	5.000	EPA QAD Channel
3.000	Radian Channel C	6.000	EPA ESRL Channel

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 1.00

TOTAL OBSERVATIONS: 4

	NMOCBAR	DI
N OF CASES	4	4
MINIMUM	0.47500	-0.03000
MAXIMUM	1.00000	0.06000
MEAN	0.66000	0.02000
VARIANCE	0.05395	0.00153
STANDARD DEV	0.23227	0.03916
STD. ERROR	0.11614	0.01958

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 2.00

TOTAL OBSERVATIONS: 2

	NMOCBAR	DI
N OF CASES	2	2
MINIMUM	0.40000	-0.06000
MAXIMUM	0.60500	-0.01000
MEAN	0.50250	-0.03500
VARIANCE	0.02101	0.00125
STANDARD DEV	0.14496	0.03536
STD. ERROR	0.10250	0.02500

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 4.00

TOTAL OBSERVATIONS: 1

	NMOCBAR	DI
N OF CASES	1	1
MINIMUM	0.94500	0.11000
MAXIMUM	0.94500	0.11000
MEAN	0.94500	0.11000
VARIANCE	0.	0.
STANDARD DEV	0.	0.
STD. ERROR	0.	0.

Table 4-17 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 5.00

TOTAL OBSERVATIONS: 28

	NMOCBAR	DI
N OF CASES	28	28
MINIMUM	0.33000	-0.66000
MAXIMUM	4.32000	0.09000
MEAN	1.07321	-0.14643
VARIANCE	0.53947	0.02872
STANDARD DEV	0.73448	0.16947
STD. ERROR	0.13880	0.03203

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 6.00

TOTAL OBSERVATIONS: 73

	NMOCBAR	DI
N OF CASES	73	73
MINIMUM	0.19000	-1.05000
MAXIMUM	4.17000	0.64000
MEAN	1.03582	0.03082
VARIANCE	0.69262	0.04467
STANDARD DEV	0.83224	0.21136
STD. ERROR	0.09741	0.02474

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 1.00

TOTAL OBSERVATIONS: 3

	NMOCBAR	DI
N OF CASES	3	3
MINIMUM	0.62000	-0.10000
MAXIMUM	1.27500	0.05000
MEAN	0.99833	-0.02333
VARIANCE	0.11501	0.00563
STANDARD DEV	0.33913	0.07506
STD. ERROR	0.19580	0.04333

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 2.00

TOTAL OBSERVATIONS: 3

	NMOCBAR	DI
N OF CASES	3	3
MINIMUM	0.23500	-0.09000
MAXIMUM	1.05500	0.
MEAN	0.54000	-0.04667
VARIANCE	0.20118	0.00203
STANDARD DEV	0.44853	0.04509
STD. ERROR	0.25896	0.02603

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 3.00

TOTAL OBSERVATIONS: 1

	NMOCBAR	DI
N OF CASES	1	1
MINIMUM	1.81000	0.26000
MAXIMUM	1.81000	0.26000
MEAN	1.81000	0.26000
VARIANCE	0.	0.
STANDARD DEV	0.	0.
STD. ERROR	0.	0.

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 5.00

TOTAL OBSERVATIONS: 26

	NMOCBAR	DI
N OF CASES	26	26
MINIMUM	0.20500	-0.62000
MAXIMUM	2.36500	0.19000
MEAN	0.90827	-0.19038
VARIANCE	0.22770	0.03700
STANDARD DEV	0.47718	0.19236
STD. ERROR	0.09358	0.03773

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 6.00

TOTAL OBSERVATIONS: 77

	NMOCBAR	DI
N OF CASES	77	77
MINIMUM	0.08500	-0.60000
MAXIMUM	4.72000	0.22000
MEAN	0.87468	0.03039
VARIANCE	0.54024	0.01449
STANDARD DEV	0.73501	0.12036
STD. ERROR	0.08376	0.01372

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 1.00

TOTAL OBSERVATIONS: 2

	NMOCBAR	DI
N OF CASES	2	2
MINIMUM	0.79500	-0.06000
MAXIMUM	0.82000	0.05000
MEAN	0.80750	-0.00500
VARIANCE	0.00031	0.00605
STANDARD DEV	0.01768	0.07778
STD. ERROR	0.01250	0.05500

Table 4-17 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 3.00

TOTAL OBSERVATIONS: 1

	NMOCBAR	DI
N OF CASES	1	1
MINIMUM	0.85500	0.07000
MAXIMUM	0.85500	0.07000
MEAN	0.85500	0.07000
VARIANCE	0.	0.
STANDARD DEV	0.	0.
STD. ERROR	0.	0.

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 4.00

TOTAL OBSERVATIONS: 5

	NMOCBAR	DI
N OF CASES	5	5
MINIMUM	0.52500	-0.03000
MAXIMUM	1.87000	0.27000
MEAN	1.07800	0.14400
VARIANCE	0.27824	0.01688
STANDARD DEV	0.52749	0.12992
STD. ERROR	0.23590	0.05810

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 5.00

TOTAL OBSERVATIONS: 36

	NMOCBAR	DI
N OF CASES	36	36
MINIMUM	0.21500	-0.83000
MAXIMUM	3.67000	0.12000
MEAN	0.92903	-0.11972
VARIANCE	0.34556	0.02810
STANDARD DEV	0.58785	0.16763
STD. ERROR	0.09797	0.02794

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 6.00

TOTAL OBSERVATIONS: 102

	NMOCBAR	DI
N OF CASES	102	102
MINIMUM	0.17500	-0.18000
MAXIMUM	3.52500	0.66000
MEAN	0.85917	0.09402
VARIANCE	0.34438	0.01805
STANDARD DEV	0.58684	0.13434
STD. ERROR	0.05811	0.01330

Table 4-17. (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 2.00

TOTAL OBSERVATIONS: 1

	NMOCBAR	DI
N OF CASES	1	1
MINIMUM	0.76500	-0.09000
MAXIMUM	0.76500	-0.09000
MEAN	0.76500	-0.09000
VARIANCE	0.	0.
STANDARD DEV	0.	0.
STD. ERROR	0.	0.

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 3.00

TOTAL OBSERVATIONS: 3

	NMOCBAR	DI
N OF CASES	3	3
MINIMUM	0.39500	-0.14000
MAXIMUM	1.81000	0.03000
MEAN	0.97000	-0.04000
VARIANCE	0.55322	0.00790
STANDARD DEV	0.74379	0.08888
STD. ERROR	0.42943	0.05132

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 4.00

TOTAL OBSERVATIONS: 2

	NMOCBAR	DI
N OF CASES	2	2
MINIMUM	0.49000	-0.02000
MAXIMUM	0.93000	-0.02000
MEAN	0.71000	-0.02000
VARIANCE	0.09680	0.00000
STANDARD DEV	0.31113	0.00000
STD. ERROR	0.22000	0.00000

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 5.00

TOTAL OBSERVATIONS: 30

	NMOCBAR	DI
N OF CASES	30	30
MINIMUM	0.25000	-0.61000
MAXIMUM	4.26000	0.04000
MEAN	1.04117	-0.17567
VARIANCE	0.55849	0.02038
STANDARD DEV	0.74732	0.14277
STD. ERROR	0.13644	0.02607

Table 4-17 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 6.00

TOTAL OBSERVATIONS: 84

	NMOCBAR	DI
N OF CASES	84	84
MINIMUM	0.09500	-0.35000
MAXIMUM	3.72000	1.46000
MEAN	0.90125	0.06774
VARIANCE	0.42506	0.03986
STANDARD DEV	0.65196	0.19966
STD. ERROR	0.07114	0.02178

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 1.00

TOTAL OBSERVATIONS: 13

	NMOCBAR	DI
N OF CASES	13	13
MINIMUM	0.24500	-0.18000
MAXIMUM	3.05000	0.04000
MEAN	1.47731	-0.08385
VARIANCE	0.52031	0.00513
STANDARD DEV	0.72133	0.07159
STD. ERROR	0.20006	0.01986

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 2.00

TOTAL OBSERVATIONS: 12

	NMOCBAR	DI
N OF CASES	12	12
MINIMUM	0.22000	-0.24000
MAXIMUM	3.08000	0.
MEAN	1.47250	-0.08167
VARIANCE	0.57703	0.00496
STANDARD DEV	0.75962	0.07043
STD. ERROR	0.21928	0.02033

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 3.00

TOTAL OBSERVATIONS: 11

	NMOCBAR	DI
N OF CASES	11	11
MINIMUM	0.22000	-0.20000
MAXIMUM	3.03000	0.06000
MEAN	1.44636	-0.05636
VARIANCE	0.62836	0.00537
STANDARD DEV	0.79269	0.07325
STD. ERROR	0.23901	0.02209

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 4.00

TOTAL OBSERVATIONS: 11

	NMOCBAR	DI
N OF CASES	11	11
MINIMUM	0.22500	-0.22000
MAXIMUM	2.97000	0.06000
MEAN	1.43091	-0.02545
VARIANCE	0.61018	0.00557
STANDARD DEV	0.78114	0.07461
STD. ERROR	0.23552	0.02250

Table 4-18 summarizes certain statistics of Table 4-17 for the repeated analyses and adds values for percent difference (%DIFF) and a percent coefficient of variation (%CV). Percent difference is defined as

$$\%DIFF = (\text{MEAN DI}/\text{MEAN NMOCBAR}) \times 100 \qquad (4\text{-}4)$$

and

$$\%CV = ((\text{STANDARD DEV OF DI})/(\text{MEAN NMOCBAR})) \times 100 \qquad (4\text{-}5)$$

Pooled statistics below the solid line are the weighted means of the columns, and are estimates of the properly weighted averages for the data set. For example:

$$\text{Pooled NMOCBAR} = \frac{N_1\ \text{NMOCBAR}_1 + N_2\ \text{NMOCBAR}_2 + \ldots + N_n\ \text{NMOCBAR}_n}{N_1 + N_2 + \ldots + N_n} \qquad (4\text{-}6)$$

$$\text{Pooled N} = \sum_{i=1}^{n} N_i = 531 \qquad (4\text{-}7)$$

$$\text{Pooled \% DIFF} = \sum_{i=1}^{n} N_i\ (\ \%\text{DIFF}_i\ ))/(\sum_{i=1}^{n} N_i) \qquad (4\text{-}8)$$

$$\text{Pooled SD}_{DI} = \left(\frac{v_1\ s_1^2 + v_2\ s_2^2 + \ldots + v_n\ s_n^2}{v_1 + v_2 + \ldots + v_n}\right)^{1/2} \qquad (4\text{-}9)$$

$$\text{Pooled \%CV} = (\text{pooled SD}_{DI}/\text{pooled NMOCBAR}) \times 100. \qquad (4\text{-}10)$$

The numbers in Table 4-18 are statistics for the within-instrument pairs. The standard deviation squared is the an estimate of the variance for the within-instrument variability or error for a given instrument pair. Within-instrument pair standard deviations range from 0.00% to 21.2% when expressed in terms of a % coefficient of variation for a given pair. A pooled average error (or within-pair variability) is calculated to be 16.7%

Table 4-18. Summary Statistics for Repeated Analyses. Precision Estimates

Channel		N	NMOCBAR	$\overline{DI}$	Percent Difference[a]	SD_{DI}	v[b]	Percent CV[c]
A	A	4	0.6600	0.0200	3.03	0.03916	3	5.93
A	B	2	0.5025	-0.0350	-6.97	0.03536	1	7.04
A	D	1	0.9450	0.110C	11.6	-	-	-
A	E	28	1.0732	-0.1464	-13.6	0.16947	27	15.8
A	GC	73	1.0358	0.0308	2.79	0.21136	72	20.4
B	A	3	0.9983	-0.0233	-2.33	0.07506	2	7.52
B	B	3	0.5400	-0.0467	-8.65	0.04509	2	8.35
B	C	1	1.8100	0.2600	14.4	-	-	-
B	E	26	0.9083	-0.1904	-21.0	0.19236	25	21.2
B	GC	77	0.8747	0.0304	3.48	0.12036	76	13.8
C	A	2	0.8075	-0.005	-0.62	0.07778	1	9.62
C	C	1	0.8550	0.0700	8.19	-	-	-
C	D	5	1.0780	0.1440	13.4	0.12992	4	12.1
C	E	36	0.9290	-0.1197	12.9	0.16763	35	18.0
C	GC	102	0.8592	0.0940	10.9	0.13434	101	15.6
D	B	1	0.7650	-0.090	11.8	-	-	-
D	C	3	0.9700	-0.0400	-4.12	0.08888	2	9.16
D	D	2	0.7100	-0.0200	-2.18	0.00000	1	0.00
D	E	30	1.0412	-0.1757	-16.9	0.14277	29	13.7
D	GC	84	0.9013	0.0677	7.51	0.19966	83	22.2
E	A	13	1.4773	-0.0839	-5.68	0.07159	12	4.85
E	B	12	1.4725	-0.0817	-5.55	0.07043	11	4.78
E	C	11	1.4464	-0.0564	-3.90	0.07325	10	5.06
E	D	11	1.4309	-0.0255	-1.78	0.07461	10	5.21
Pooled		531	0.9739	-0.00196	8.48[d]	0.1605	507	16.7

[a]Percent difference = (mean DI, $\overline{DI}$/mean NMOCBAR) x 100.

[b]v = N-1, degrees of freedom for the standard deviation of DI, SD_{DI}.

[c]Percent CV = (standard deviation of DI/mean NMOCBAR) x 100.

[d]Pooled mean difference of the absolute magnitude of percent difference for each pair of channels.

coefficient of variation. This is a measure of precision. A previous measure of precision was calculated as 18.9% CV from the data of Table 4-14. The latter figure is an overall precision which includes the between-instrument pairs variability (=18.9% CV) and the within-instrument pairs (error for a given pair) variability (=16.7% CV).

Table 4-18 also gives statistics for average percent difference of the NMOC values determined from a pair of instruments. Percent differences of NMOC determinations for a given pair of instruments range from -21.0% to +14.4%. A weighted average of the absolute magnitude of the difference is 8.48%. It can be stated that the average percent difference of the NMOC measurements for a pair of instruments tested in this study was about 8.5%. As noted above, the average percent difference of the NMOC measurements including the between-pairs variability was about 12%.

Table 4-19 again summarizes statistics from Table 4-17 for repeated analyses for pairs of channels, adding 95% confidence intervals for each data set and the t statistics necessary to test the hypothesis that the population mean of each set of differences is zero. The second through the sixth columns and the eighth and ninth columns of channel pairs 1 through 24 in Table 4-19 were taken directly from Table 4-17. Column 10 is the t statistic testing the null hypothesis that the population mean difference for a particular data set (channel pair involved in repeated analysis) equals zero. Student's t statistic for the appropriate degrees of freedom for a level of significance equal to 0.05 is given in column 11. If t is greater than $t_{1-\alpha/2,\nu}$, then the null hypothesis is rejected. Note that the null hypothesis is rejected for channel pairs No. 4, 9, 10, 14, 15, 19, 20, 21, 22 and 23 in the first group of data. Note also that in every case, except for Channel Pair 24, involving EPA Channel E, the null hypothesis is rejected, i.e., there is a mean difference significantly different from zero. In the case of pairs of channels involving EPA GC channel the null hypotheses are rejected, except for Channel Pair No. 5. For all the channel pairs involving two Radian Channels, the null hypothesis was accepted, i.e., there was no significant difference between the mean channel differences and zero. It is also to be noted that for the channel pairs involving Radian channels, significantly fewer repeated

Table 4-19. Statistics for Repeated Analyses. Confidence Intervals for Pairs and Groups of Channels

Channel Pair	Channel Alpha	Channel Beta	NMOCBAR	Mean DI	N	v	SD	SEE	t	$t_{1-\alpha/2,v}$	Ho: μ=0.0	95 percent C.I. Lower	95 percent C.I. Upper
1	A	A	0.6600	0.020	4	3	0.0392	0.0196	1.021	3.182	Accept	-0.0424	0.0824
2	A	B	0.5025	-0.035	2	1	0.0354	0.0250	-1.400	12.71	Accept	-0.353	0.283
3	A	D	0.9450	0.110	1	0	-	-	-	-	-	-	-
4	A	E	1.0732	-0.1464	28	27	0.1695	0.0320	-4.575	2.048	Reject	-0.212	-0.081
5	A	GC	1.C358	0.0308	73	72	0.2114	0.0247	1.246	1.992	Accept	-0.018	0.080
6	B	A	0.9983	-0.0233	3	2	0.0751	0.0433	-0.538	4.303	Accept	-0.210	0.163
7	B	B	0.5400	-0.0467	3	2	0.0451	0.0260	-1.793	4.303	Accept	-0.159	0.065
8	B	C	1.8100	0.260	1	0	-	-	-	-	-	-	-
9	B	E	0.9083	-0.1904	26	25	0.1924	0.0377	-5.046	2.060	Reject	-0.268	-0.113
10	B	GC	0.8747	0.0304	77	76	0.1204	0.0137	2.215	1.991	Reject	0.003	0.058
11	C	A	0.8075	-0.0050	2	1	0.0778	0.0550	-0.091	12.71	Accept	-0.704	0.694
12	C	C	0.8550	0.0700	1	0	-	-	-	-	-	-	-
13	C	D	1.0780	0.1440	5	4	0.1299	0.0581	2.478	2.776	Accept	-0.017	0.305
14	C	E	0.9290	-0.1197	36	35	0.1676	0.0279	-4.284	2.032	Reject	-0.176	-0.063
15	C	GC	0.8592	0.0940	102	101	0.1343	0.0133	7.609	1.983	Reject	0.068	0.120
16	D	B	0.765	-0.090	1	0	-	-	-	-	-	-	-
17	D	C	0.9700	-0.0400	3	2	0.0889	0.0513	-0.779	4.303	Accept	-0.261	0.181
18	D	D	0.7100	-0.0200	2	1	0.0000	0.0000	-	12.71	-	0.020	0.020
19	D	E	1.0412	-0.1757	30	29	0.1428	0.0261	-6.738	2.045	Reject	-0.229	-0.1223
20	D	GC	0.9013	0.0677	84	83	0.1997	0.0218	3.110	1.989	Reject	0.024	0.111
21	E	A	1.4773	-0.0839	13	12	0.07159	0.0199	-4.222	2.179	Reject	-0.127	-0.041
22	E	B	1.4725	-0.0817	12	11	0.0704	0.0203	-4.017	2.201	Reject	-0.127	-0.037
23	E	C	1.4464	-0.0564	11	10	0.0733	0.0221	-2.551	2.228	Reject	-0.106	-0.007
24	E	D	1.4309	-0.0255	11	10	0.0746	0.0225	-1.131	2.228	Accept	-0.076	0.0247

(continued)

Table 4-19. Continued

Channel Pair	Channel Alpha	Channel Beta	NMOCBAR	Mean DI	N	v	SD	SEE	t	$t_{1-\alpha/2,v}$	Ho: μ=0.0	95 percent C.I. Lower	95 percent C.I. Upper
25	A,B,C,E	A	1.2025	-0.0496	22	18	0.0681	0.0145	-3.421	2.101	Rejectt	-0.0800	-0.0191
26	A,B,D,E	B	1.1700	-0.0711	17	14	0.0654	0.0159	-4.472	2.145	Reject	-0.1052	-0.0370
27	B,D,E	C	1.3443	-0.0529	14	12	0.0761	0.0203	-2.606	2.179	Reject	-0.0971	-0.0087
28	C,D,E	D	1.2528	0.0223	18	15	0.0906	0.0214	1.042	2.131	Accept	-0.0233	0.0679
29	A,B,C,D	E	0.9862	-0.1552	120	116	0.1680	0.0153	-10.14	1.982	Reject	-0.1855	-0.1249
-	A,B,C,D	GC	0.9116	0.0591	336	332	0.1687	0.0092	6.42	1.964	Reject	0.0410	0.0772
30	A	A,B,D,E,GC	1.021	-0.0160	108	107	0.2086	0.0200	-0.80	1.983	Accept	-0.0557	0.0237
31	B	A,B,C,E,GC	0.8853	-0.0233	110	109	0.1679	0.0160	-1.46	1.983	Accept	-0.0550	0.0084
32	C	A,C,D,E,GC	0.8832	0.0415	146	145	0.1693	0.0140	2.964	1.978	Reject	0.0138	0.0692
33	D	B,C,D,E,GC	0.9336	0.0014	120	119	0.2099	0.0192	0.073	1.982	Accept	-0.0367	0.0395
34	E	A,B,C,D	1.4580	-0.0632	47	46	0.0739	0.0108	-5.85	2.013	Reject	-0.0849	-0.0415

Alpha — Channel for first analysis.

Beta — Channel for subsequent analysis.

NMOCBAR — Mean NMOC for repeated analysis = (NMOC1 + NMOC2)/2.

DI — Difference of repeated analyses = NMOC1 - NMOC2.

$\overline{DI}$ — Mean difference of several repeated analyses.

N — Number of repeated analyses.

SD — Standard deviation of NMOC differences.

SEE — Standard error of estimate = $SD/\sqrt{N}$

$t_{1-\alpha/2,v}$ — Student's t statistic (2-tailed) for level of significance α (= 0.05 in this comparison), and degrees of freedom v (= N-1).

t — The t statistic = $\overline{DI}/(SD/\sqrt{N})$ testing the hypothesis (Ho: μ_{DI} = 0.0). If t > $t_{1-\alpha/2,v}$, then reject the hypothesis that the mean difference is zero.

C.I. — Confidence interval.

Channels A,B,C,D — Radian channels.

Channel E — EPA QAD channel.

Channel GC — EPA ESRL channel.

analyses were accomplished. This reduces the robustness of the comparisons involving the Radian channels. In any similar future study it is recommended that the number of repeats for any channel pair be more nearly balanced than was accomplished in the present study. The Quality Assurance Project Plan for the present study called for the repeated analyses to be selected on a random basis, which resulted in the unbalanced design.

These results are presented in an equivalent way in the last two columns in Table 4-19, in which the 95% confidence intervals for the mean differences are tabulated. Note that for those cases in which the null hypothesis is accepted, the upper and lower limits on the 95% confidence interval span zero. On the other hand, where the null hypothesis is rejected, the upper and lower limits on the confidence interval do not span zero.

Channel "pairs" 25 through 29 combine all the pairs for which a second analysis was done on a particular channel. Likewise channel "pairs" 30 through 34 combine all the pairs for which the first analysis was done on a particular channel. For example for channel "Pair" No. 25, all the data were pooled for those pairs in which the second analysis was done on Channel A. Conversely, all those cases in which the first analysis was done on Channel A were pooled and are presented as Channel "Pair" No. 30. Similar statistics as described above are presented which compares the mean differences with zero for all the groups of data in which one of the channels was the channel of the first analysis. For only two channel pairs (No. 32 and No. 34) did the data justify the conclusion that the mean difference was significantly different from zero.

Figures 4-12 and 4-13 display these relationships graphically, and in addition show how one channel compares (approximately) to another. It is reasonably clear in Figure 4-12 that Channel A, B, and C produce differences with other channels that are quite similar and that Channels E and GC are quite different from each other and from Channels A, B, and C in the mean differences produced with other channels. Channel E results are significantly less than those of the other channels, while Channel GC is greater than A, B, C, or E.

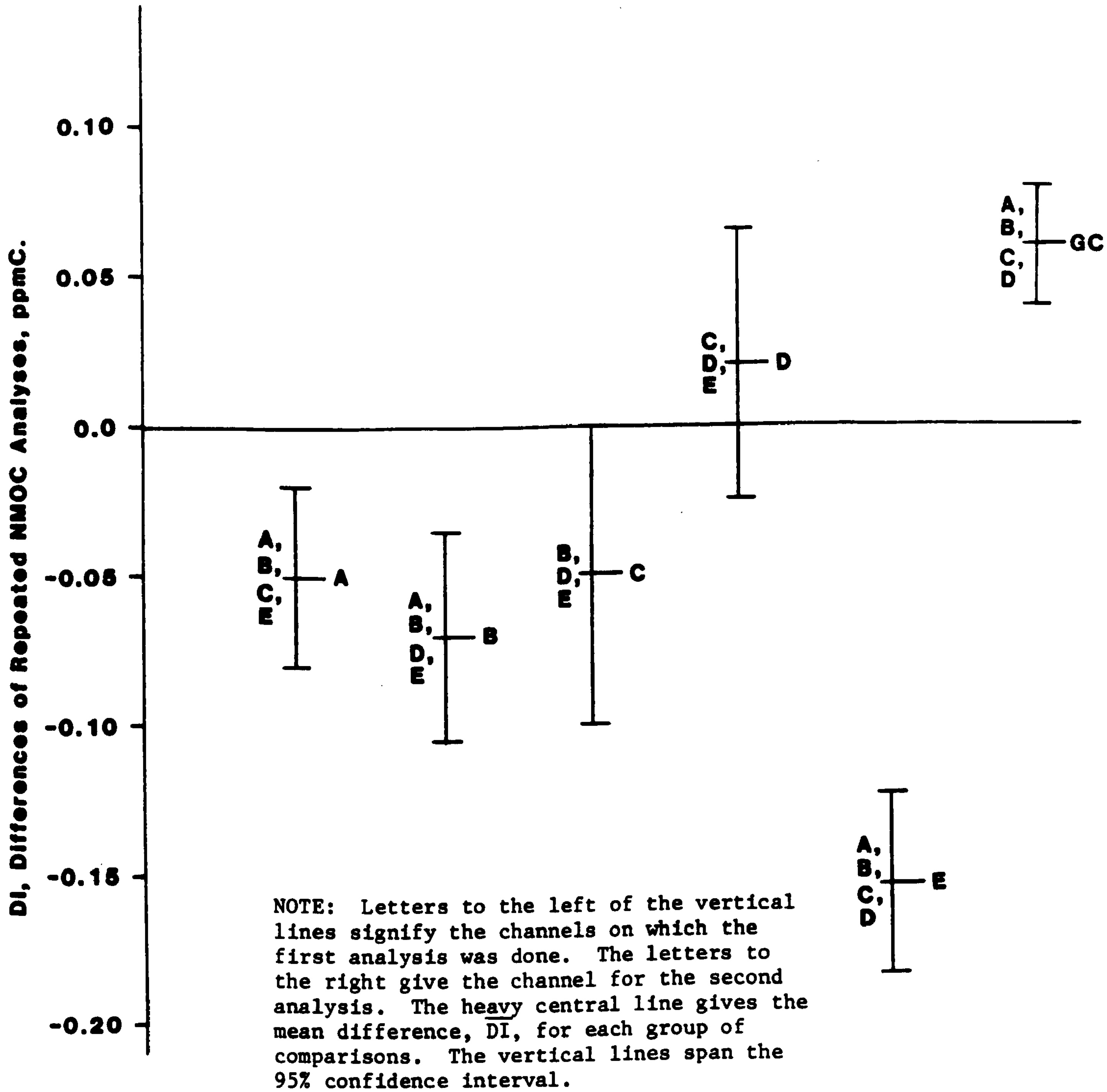
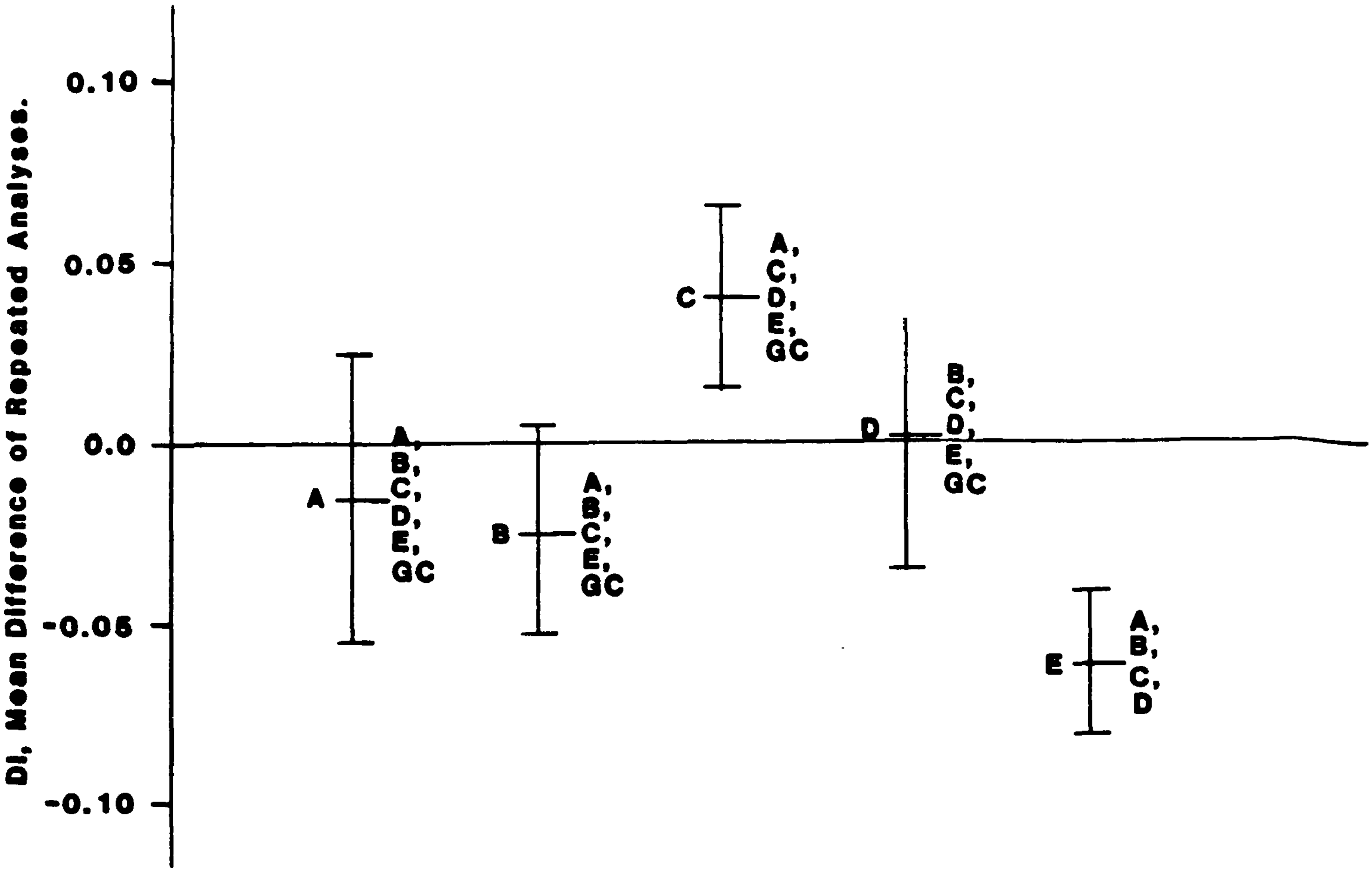


Figure 4-12. Comparisons of Repeated Analyses, Grouped by the Channel of the Second Analysis.



NOTE: Letters to the left of the vertical lines signify the Channels on which the first analysis was made. The letters to the right give the channel for subsequent analyses. The heavy central line on each vertical line gives the mean difference $\overline{DI}$ for each group of comparisons. The vertical lines span the 95% confidence interval.

Figure 4-13. Comparisons of Repeated Analyses Grouped by the Channel of the First Analysis.

Channel D, on the other hand seems to bridge the difference between Channel C (and A and B) and Channel GC. At the 5 percent level of significance, however there is a significant difference in the mean between the results from Channel C and Channel D.

Figures 4-13 shows similar, but not identical comparisons. The results for Channel E are again less than the other Radian Channels A, B, C, or D. Channels A, B, and D are indistinguishable. Testing the hypothesis that the mean of Channel C equals the mean of Channel D leads to the conclusion that they are equal, even though the mean of Channel C is tested in Table 4-19 to be different from zero, while the mean of Channel D is tested equal to zero.

All the tests involving the repeated analyses (Figures 4-12, Figure 4-13, and Table 4-19) are approximate because none of the comparisons is perfectly balanced. In Figure 4-12 comparing the results for Channel A and Channel B (see also Channel Pairs 25 and 26 in Table 4-19) shows that in the first case, first analyses were on Channels A, B, C, and E, while for Channel B (Channel "Pair" 26 in Table 4-19), the first analyses were on Channels A, B, D, and E. The differences between the comparisons, however, are small and should have negligible effect on the results.

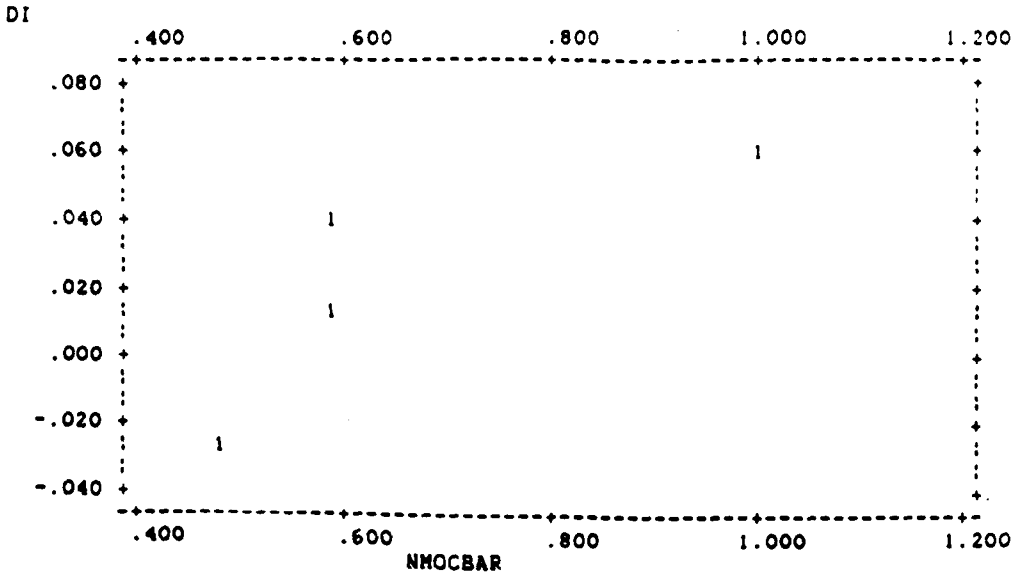
For the cases in which the first analysis was on a Radian channel, there appears to be little difference between the means of the differences of the repeated analyses, and the means of the differences are not siginificantly different from zero with the exception of Channel C. Comparing the differences among the channels when the second analysis was done on a Radian channel indicates there to be a negligible differences between the channels except for Channel D. These results indicate that the comparisons were not sensitive to differences because the number of comparisons were not sufficient balanced, i.e., the same number of comparisons with each channel pair.

The repeated analyses showed Channels E and Channel GC to be significantly different from the Radian Channels.

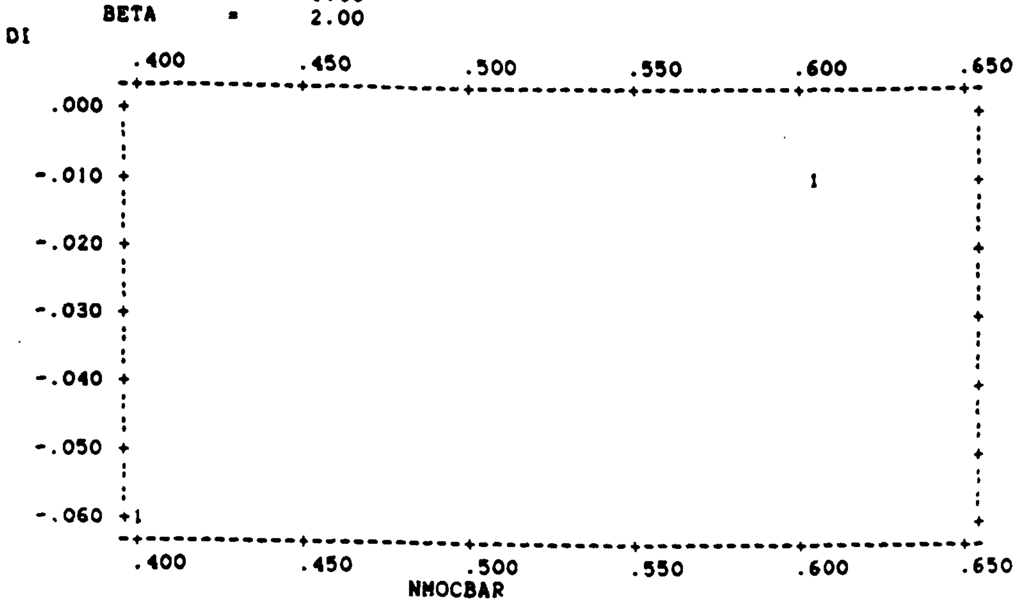
Figure 4-14 and Table 4-20 test relationship between the mean NMOC for repeated analyses and the differences for a given channel pair. Figure 4-14 plots DI on the ordinate and NMOCBAR on the abscissa for each channel

Figure 4-14. Differences of Repeated Analyses as a Function of Mean NMOC.

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 1.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 2.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 5.00

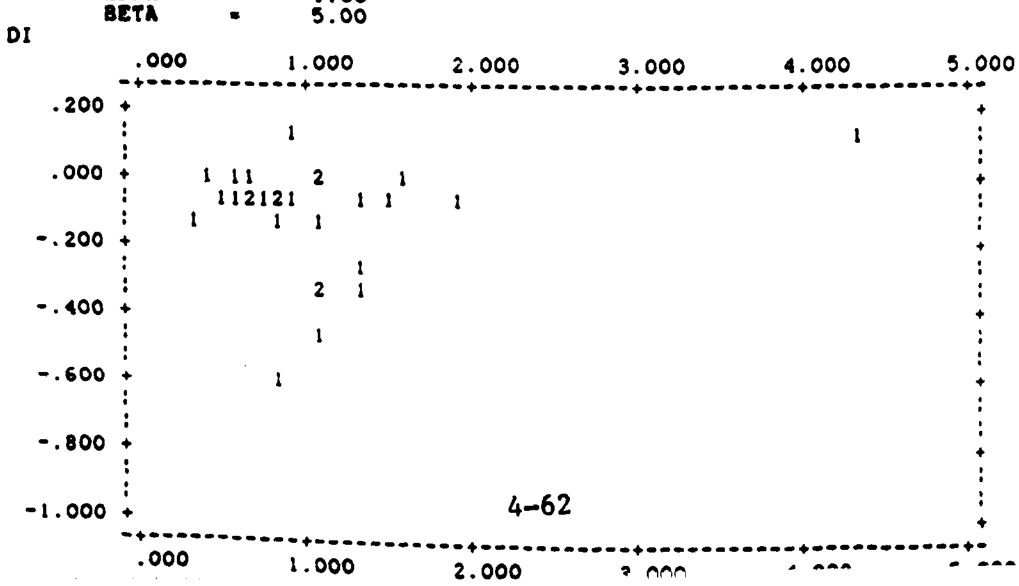
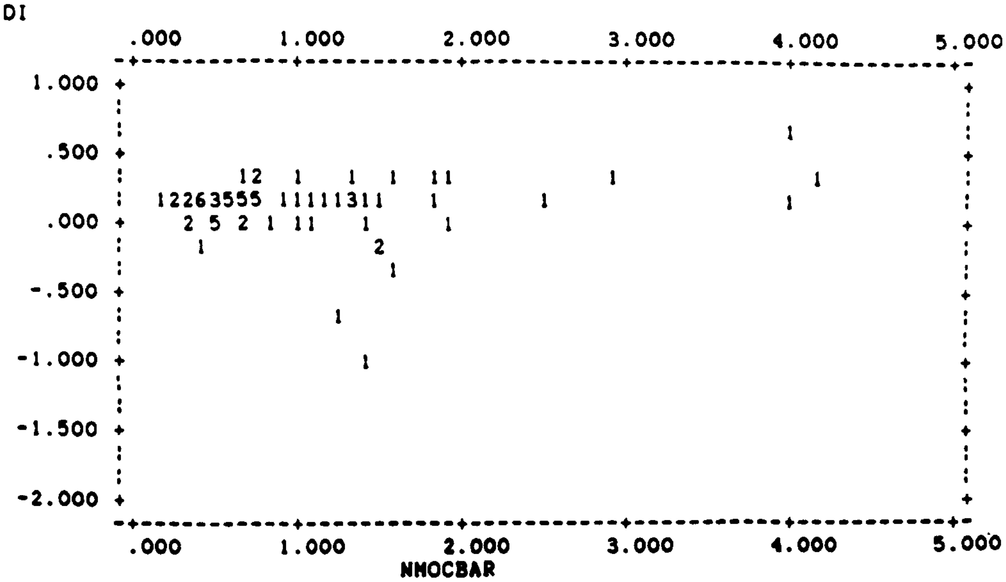
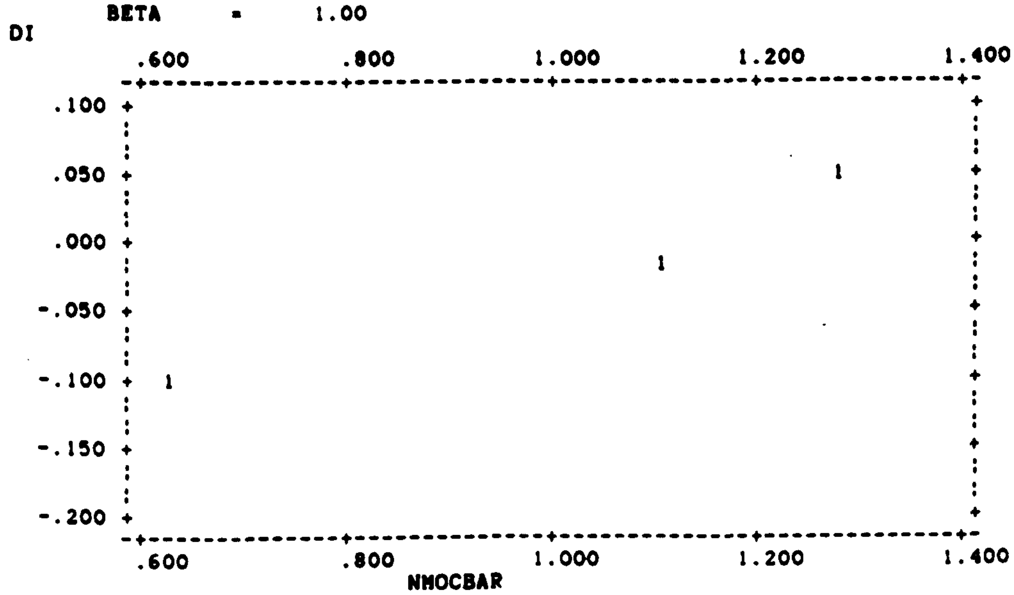


Figure 4-14 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 1.00
BETA = 6.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 1.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 2.00

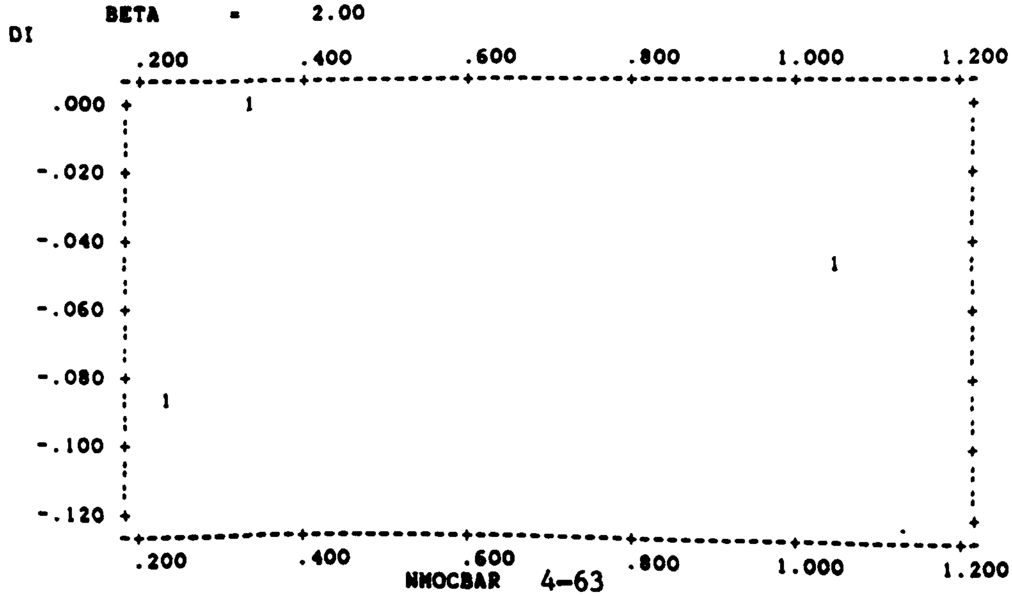
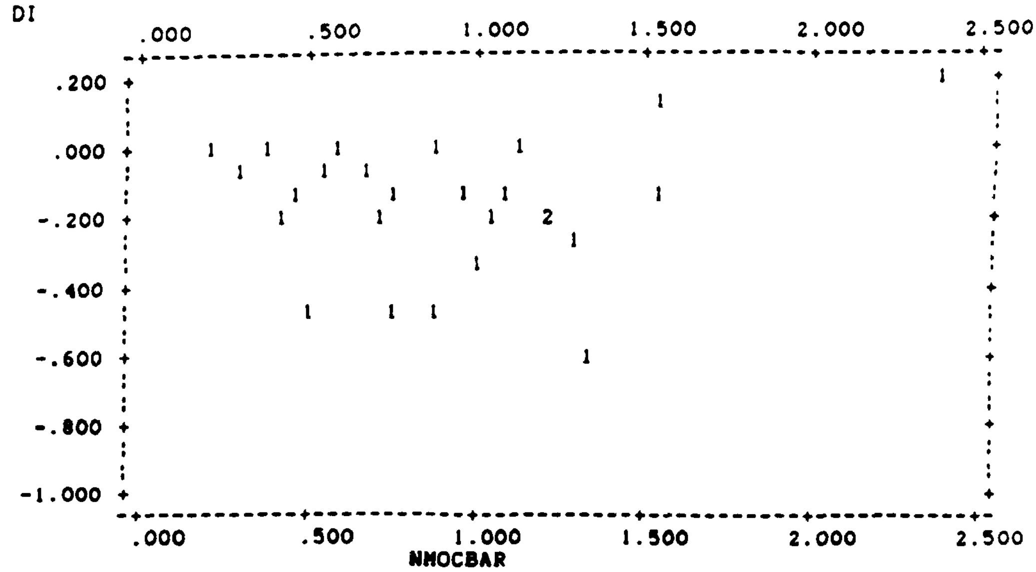
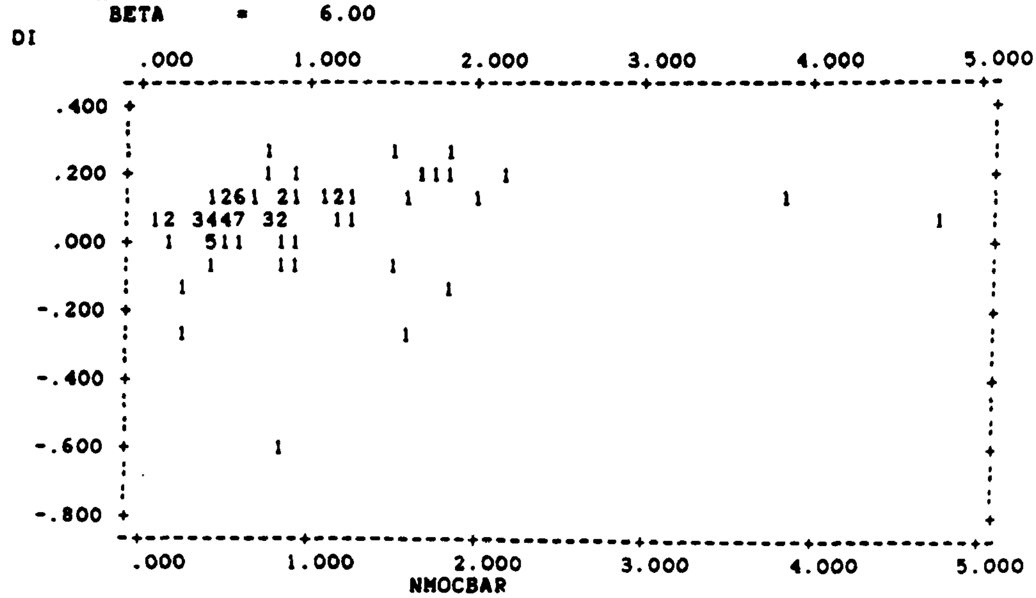


Figure 4-14 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 5.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 6.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 1.00

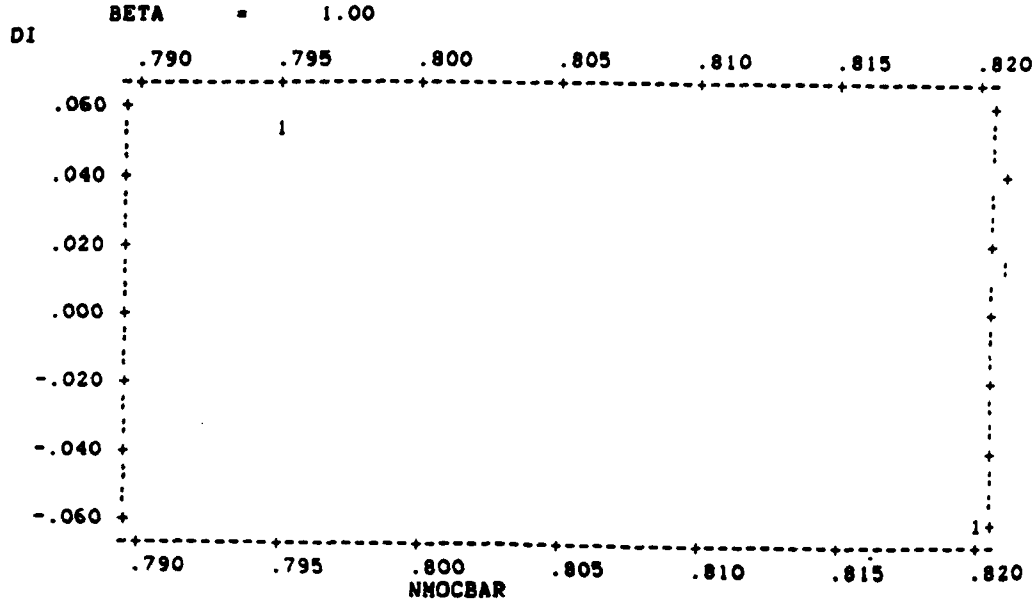
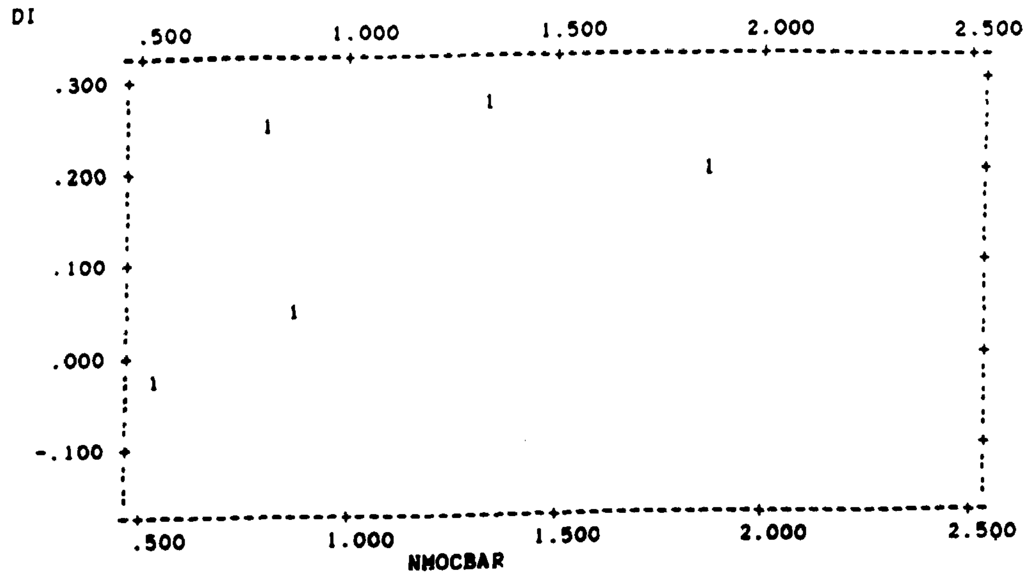
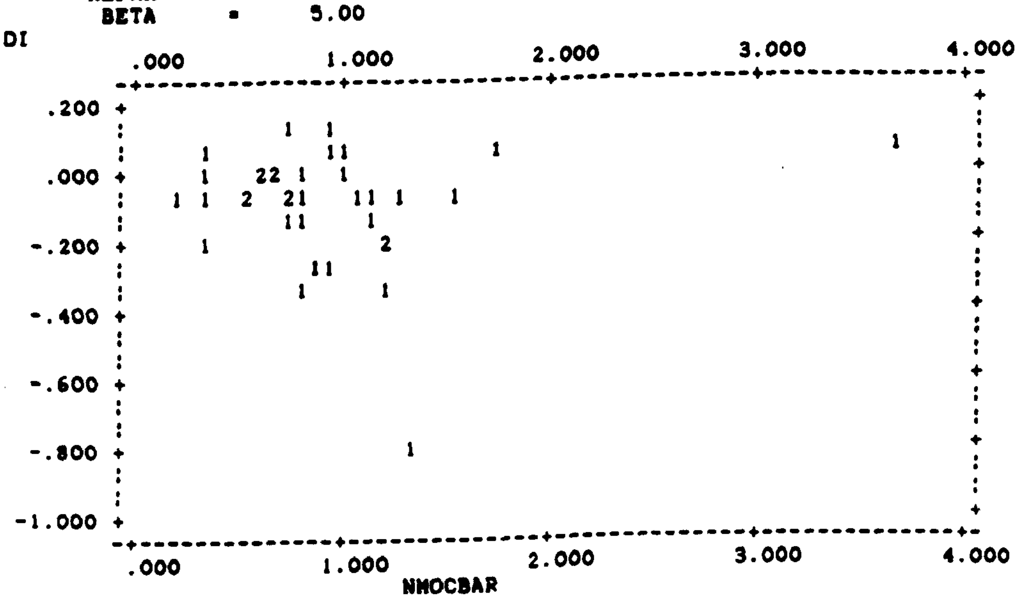


Figure 4-14 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 4.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 5.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 6.00

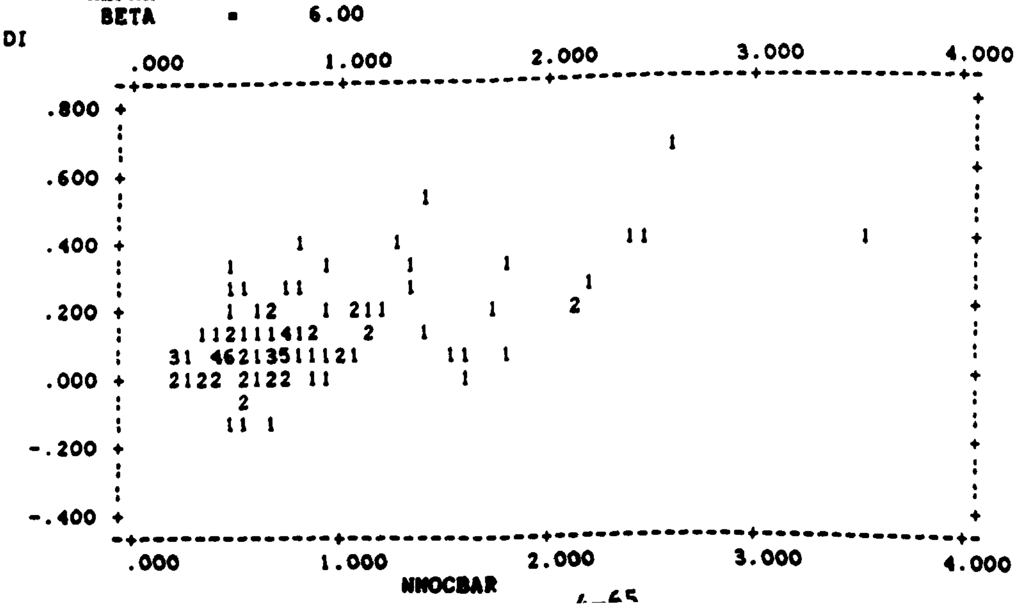
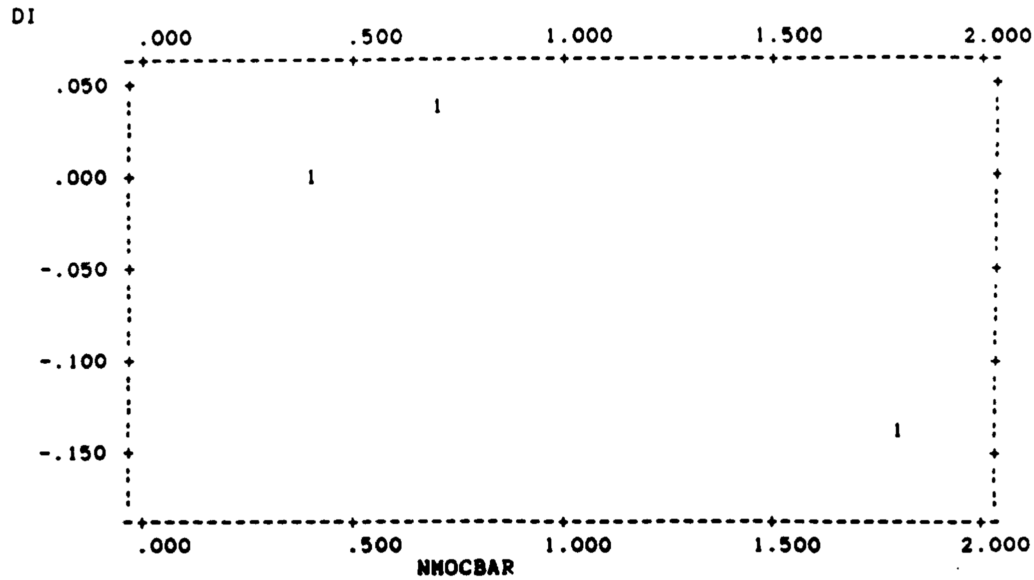
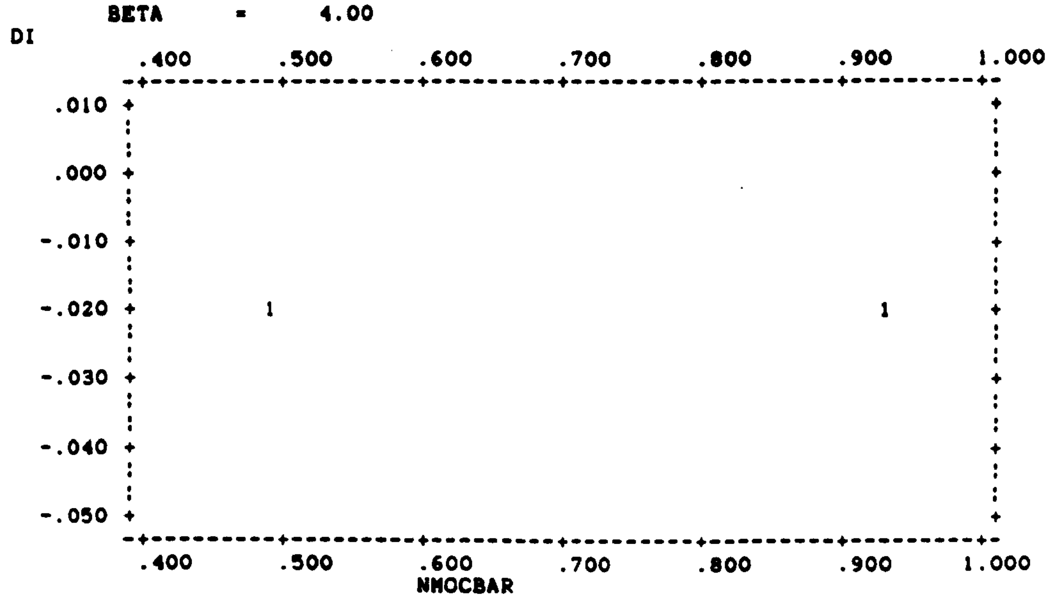


Figure 4-14 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 3.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 4.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 5.00

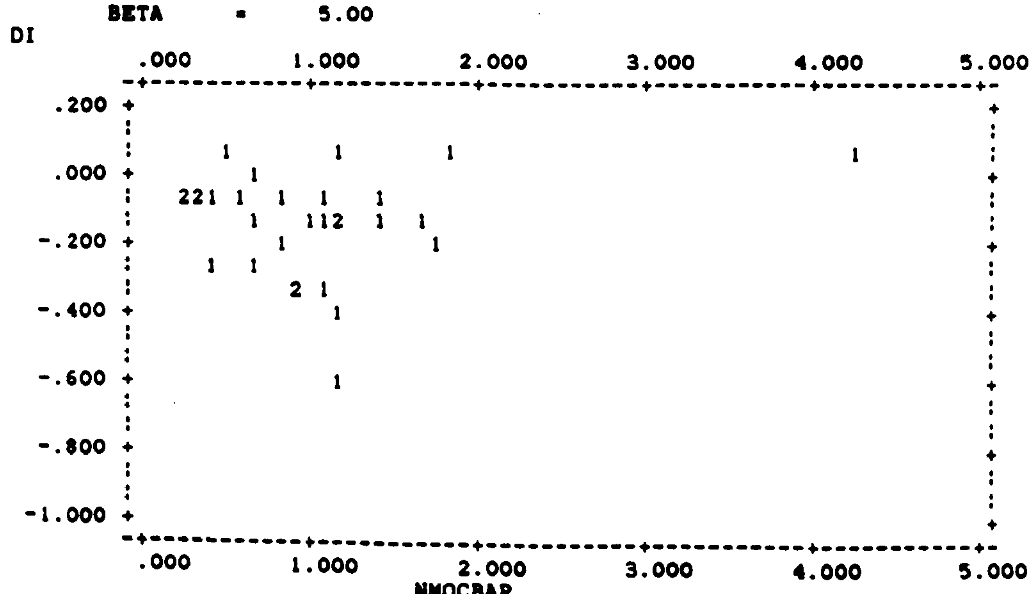
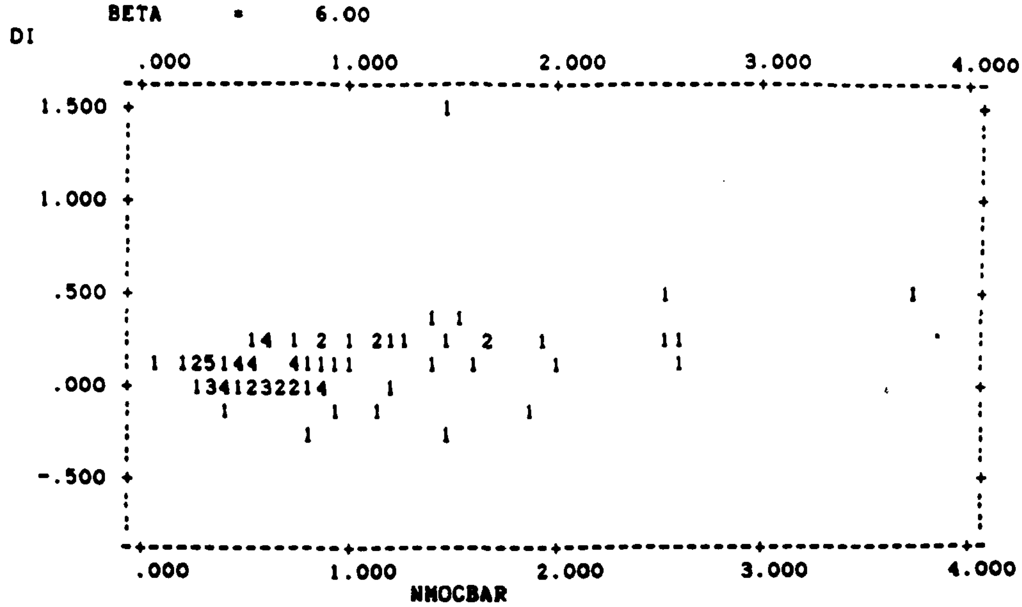
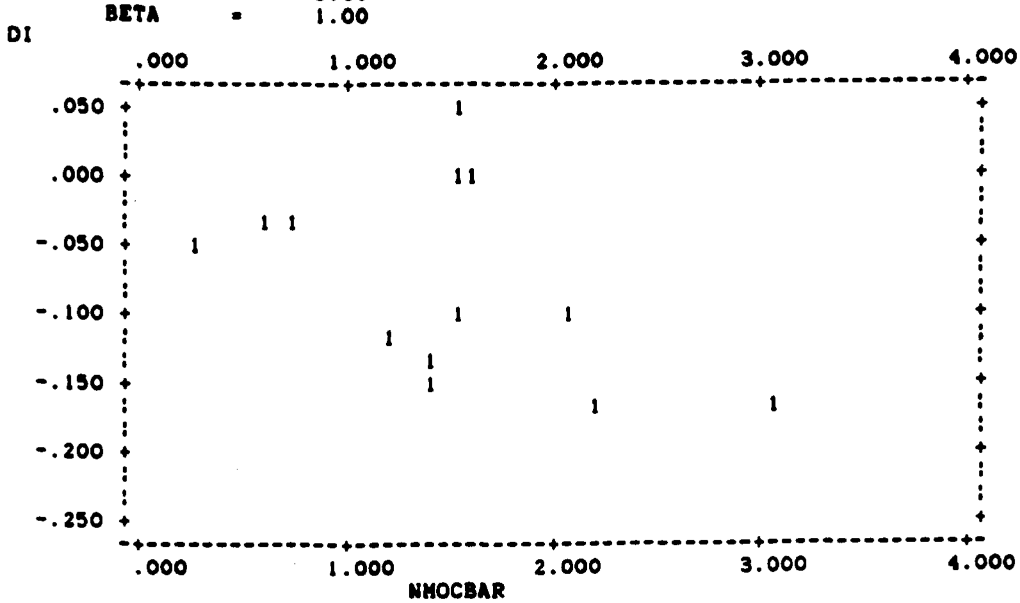


Figure 4-14 (cont.)

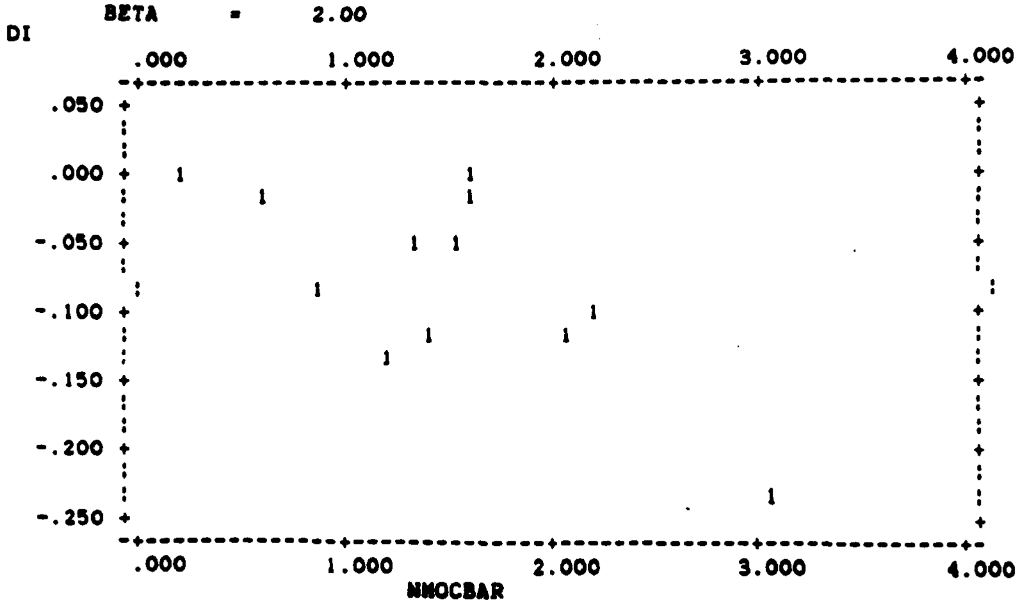
THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 6.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 1.00

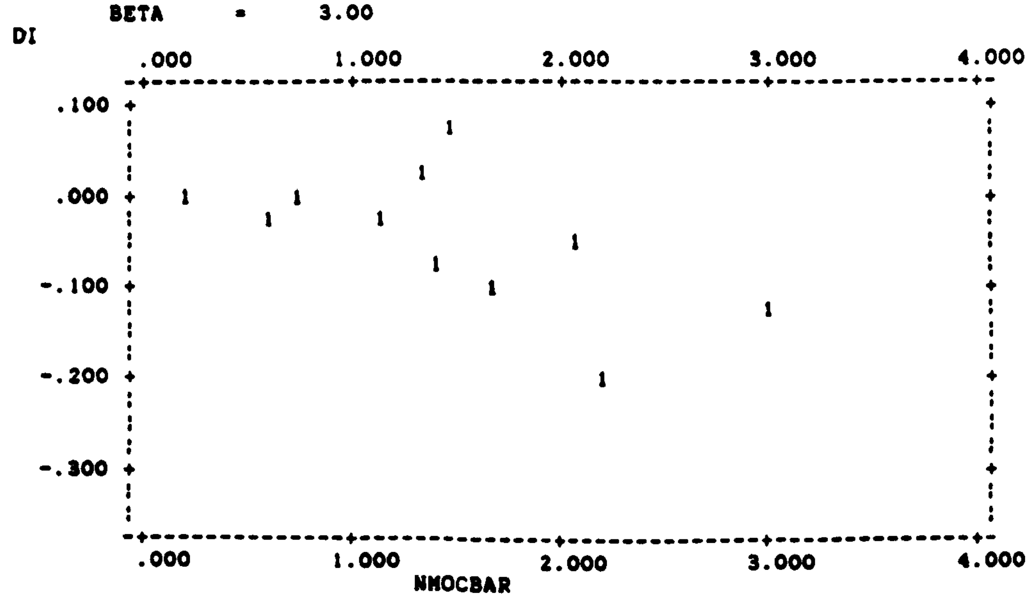


THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 2.00



NMOCBAR

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 3.00



THE FOLLOWING RESULTS ARE FOR:
ALPHA = 5.00
BETA = 4.00

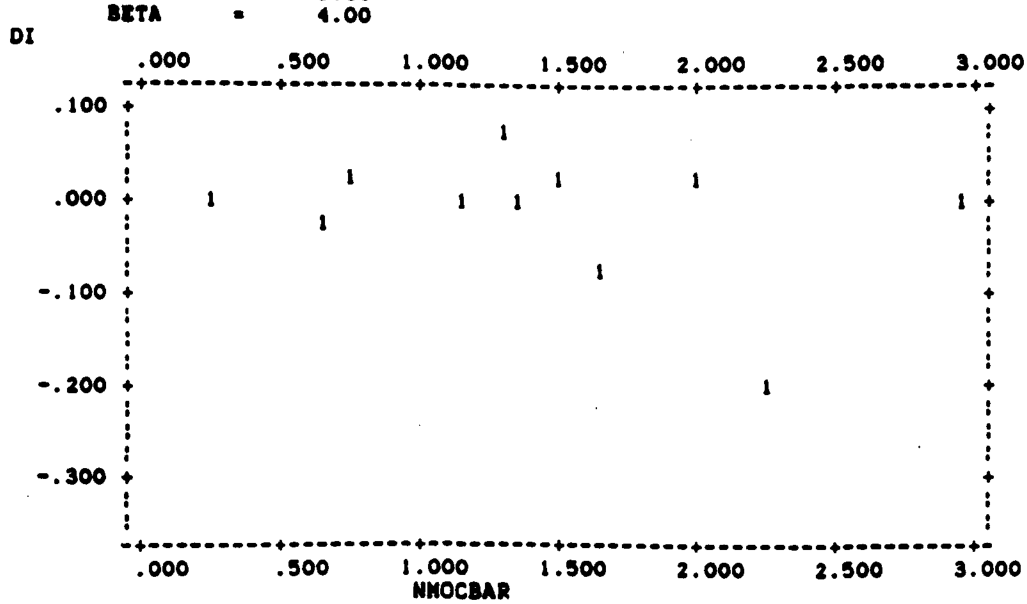


Table 4-20. Differences of Repeated Analyses as a Function of Mean NMOC.

MODEL: DI = A + B*NMOCBAR.

THE FOLLOWING RESULTS ARE FOR:

ALPHA = 1.00

BETA = 1.00

NUMBER OF CASES PROCESSED: 4

DEPENDENT VARIABLE MEAN: -0.02000

MULTIPLE CORRELATION: .806

SQUARED MULTIPLE CORRELATION: .650

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 4, AND DF= 2: .475

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.06571	0.04865	0.	.	-1.43	.288
NMOCBAR	0.13593	0.07052	0.80628	1.00000	1.93	.194

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN SQUARE	F-RATIO	P
REGRESSION	0.00299	1	0.00299	3.716	.194
RESIDUAL	0.00161	2	0.00080		

****

THE FOLLOWING RESULTS ARE FOR:

ALPHA = 1.00

BETA = 2.00

NUMBER OF CASES PROCESSED: 2

DEPENDENT VARIABLE MEAN: -0.03500

MULTIPLE CORRELATION: 1.000

SQUARED MULTIPLE CORRELATION: 1.000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.15756	2.00000	0.		-.08	1.000
NMOCBAR	0.24790	0.02101	1.00000	1.00000	11.61	1.000

****

Table 4-20 (cont.)

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 5.00

NUMBER OF CASES PROCESSED: 26

DEPENDENT VARIABLE MEAN: -0.19078

MULTIPLE CORRELATION: .179

SQUARED MULTIPLE CORRELATION: .032

ADJUSTED R^2 = 1 - (1-R^2)*(N-1)/DF, WHERE N= 26, AND DF= 24: .000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.25601	0.08271	0.		-3.10	.005
NMOCRAP	0.07225	0.08095	0.17922	1.00000	.89	.381

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.02971	1	0.02971	.796	.381
RESIDUAL	0.89538	24	0.03731		

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 2.00
BETA = 6.00

NUMBER OF CASES PROCESSED: 77

DEPENDENT VARIABLE MEAN: 0.03039

MULTIPLE CORRELATION: .164

SQUARED MULTIPLE CORRELATION: .027

ADJUSTED R^2 = 1 - (1-R^2)*(N-1)/DF, WHERE N= 77, AND DF= 75: .014

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.00685	0.02125	0.		.32	.748
NMOCRAP	0.02691	0.01865	0.16434	1.00000	1.44	.153

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.02973	1	0.02973	2.082	.153
RESIDUAL	1.07116	75	0.01428		

****

Table 4-20 (cont.)

```
THE FOLLOWING RESULTS ARE FOR:
            ALPHA     =     [illegible]
            BETA      =     1.00

NUMBER OF CASES PROCESSED:      [illegible]

DEPENDENT VARIABLE MEAN:     -0.02333

MULTIPLE CORRELATION:   .975

SQUARED MULTIPLE CORRELATION:   .951

                2            2
ADJUSTED R = 1-(1-R )*(N-1)/DF, WHERE N=   3, AND DF=   1:   .901
```

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.23876	0.05097	0.		-4.68	.134
NMOCRAR	0.21578	0.04920	0.97498	1.00000	4.39	.14[illegible]

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.01071	1	0.01071	19.238	.143
RESIDUAL	0.00056	1	0.00056		

****

```
THE FOLLOWING RESULTS ARE FOR:
            ALPHA     =     2.00
            BETA      =     2.00

NUMBER OF CASES PROCESSED:      3

DEPENDENT VARIABLE MEAN:     -0.04667

MULTIPLE CORRELATION:   .042

SQUARED MULTIPLE CORRELATION:   .002

                2            2
ADJUSTED R = 1-(1-R )*(N-1)/DF, WHERE N=   3, AND DF=   1:   .000
```

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.04895	0.06554	0.		-.75	.592
NMOCRAR	0.00423	0.10045	0.04203	1.00000	.04	.973

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.00001	1	0.00001	.002	.973
RESIDUAL	0.00406	1	0.00406		

Table 4-20 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = [illegible]
BETA = 5.00

NUMBER OF CASES PROCESSED: 36

DEPENDENT VARIABLE MEAN: -0.11972

MULTIPLE CORRELATION: .021

SQUARED MULTIPLE CORRELATION: .000

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 36, AND DF= 34: .000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.12540	0.05754	0.		-2.34	.025
NMOCBAR	0.00611	0.04889	0.02142	1.00000	.12	.901

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.00045	1	0.00045	.016	.901
RESIDUAL	0.98305	34	0.02891		

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 6.00

NUMBER OF CASES PROCESSED: 102

DEPENDENT VARIABLE MEAN: 0.09402

MULTIPLE CORRELATION: .592

SQUARED MULTIPLE CORRELATION: .350

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 102, AND DF= 100: .344

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.02238	0.01917	0.		-1.17	.246
NMOCBAR	0.13548	0.01845	0.59182	1.00000	7.34	.000

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.63845	1	0.63845	53.905	.000
RESIDUAL	1.18440	100	0.01184		

****

Table 4-20 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 1.00

NUMBER OF CASES PROCESSED:

DEPENDENT VARIABLE MEAN: -0.00500

MULTIPLE CORRELATION: 1.000

SQUARED MULTIPLE CORRELATION: 1.000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	3.54800	2.00000	0.		1.77	1.000
NMOCBAR	-4.40000	0.00031	-1.00000	1.00000	-14080.00	1.000

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 3.00
BETA = 4.00

NUMBER OF CASES PROCESSED: 5

DEPENDENT VARIABLE MEAN: 0.14400

MULTIPLE CORRELATION: .543

SQUARED MULTIPLE CORRELATION: .295

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 5, AND DF= 3: .060

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.00026	0.14048	0.		.00	.999
NMOCBAR	0.17382	0.11978	0.54331	1.00000	1.12	.344

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.01993	1	0.01993	1.256	.344
RESIDUAL	0.04755	3	0.01586		

Table 4-20 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 5.00

NUMBER OF CASES PROCESSED: 30

DEPENDENT VARIABLE MEAN: -0.17563

MULTIPLE CORRELATION: .132

SQUARED MULTIPLE CORRELATION: .017

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 30, AND DF= 28: .000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEFF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.20195	0.04561	0.		-4.43	.000
NMOCHAR	0.02524	0.03579	0.13212	1.00000	.71	.486

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN SQUARE	F-RATIO	P
REGRESSION	0.01032	1	0.01032	.497	.486
RESIDUAL	0.58082	28	0.02074		

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 6.00

NUMBER OF CASES PROCESSED: 84

DEPENDENT VARIABLE MEAN: 0.06774

MULTIPLE CORRELATION: .378

SQUARED MULTIPLE CORRELATION: .143

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 84, AND DF= 82: .132

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEFF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.07651	0.07476	0.		1.05	.297
NMOCHAR	0.11567	0.03131	0.37769	1.00000	3.69	.000

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.47199	1	0.47199	13.644	.000
RESIDUAL	2.83668	82	0.03459		

****

Table 4-20 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 3.00

NUMBER OF CASES PROCESSED: 3

DEPENDENT VARIABLE MEAN: -0.04000

MULTIPLE CORRELATION: .906

SQUARED MULTIPLE CORRELATION: .821

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 3, AND DF= 1: .642

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.06500	0.05787	0.		1.12	.463
NMOCHAR	-0.10827	0.05056	-0.90607	1.00000	-2.14	.278

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.01297	1	0.01297	4.586	.278
RESIDUAL	0.00283	1	0.00283		

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 4.00
BETA = 4.00

NUMBER OF CASES PROCESSED: 2

DEPENDENT VARIABLE MEAN: -0.02000

MULTIPLE CORRELATION: 1.000

SQUARED MULTIPLE CORRELATION: 1.000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.02000	2.00000	0.		-.01	1.000
NMOCHAR	0.00000	0.09680	1.00000	1.00000	.00	1.000

****

Table 4-20 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 6.00
BETA = 3.00

NUMBER OF CASES PROCESSED: 11

DEPENDENT VARIABLE MEAN:

MULTIPLE CORRELATION:

SQUARED MULTIPLE CORRELATION:

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 11, AND DF= 9: .340

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.02883	0.03874	0.	.	.74	.476
NMOCBAR	-0.05889	0.02374	-0.63732	1.00000	-2.48	.035

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.02179	1	0.02179	6.156	.035
RESIDUAL	0.03186	9	0.00354		

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 6.00
BETA = 4.00

NUMBER OF CASES PROCESSED: 11

DEPENDENT VARIABLE MEAN: -0.02545

MULTIPLE CORRELATION: .324

SQUARED MULTIPLE CORRELATION: .105

ADJUSTED R^2 = 1-(1-R^2)*(N-1)/DF, WHERE N= 11, AND DF= 9: .005

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.01881	0.04859	0.	.	.39	.706
NMOCBAR	-0.03093	0.03012	-0.32384	1.00000	-1.03	.331

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.00584	1	0.00584	1.054	.331
RESIDUAL	0.04983	9	0.00554		

****

Table 4-20 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ALPHA = [illegible]
BETA = 1.00

NUMBER OF CASES PROCESSED: 13

DEPENDENT VARIABLE MEAN: -0.09385

MULTIPLE CORRELATION: .494

SQUARED MULTIPLE CORRELATION: .244

ADJUSTED R = 1-(1-R)*(N-1)/DF, WHERE N= 13, AND DF= 11: .175

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.01145	0.04246	0.		.27	.792
NMOCHAR	-0.04901	0.02602	-0.49376	1.00000	-1.88	.086

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.01500	1	0.01500	3.546	.086
RESIDUAL	0.04651	11	0.00423		

****

THE FOLLOWING RESULTS ARE FOR:
ALPHA = 6.00
BETA = 2.00

NUMBER OF CASES PROCESSED: [illegible]

DEPENDENT VARIABLE MEAN: -0.08167

MULTIPLE CORRELATION: .697

SQUARED MULTIPLE CORRELATION: .485

ADJUSTED R = 1-(1-R)*(N-1)/DF, WHERE N= 12, AND DF= 10: .434

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.01744	0.02455	0.		.79	.705
NMOCRAF	-0.06459	0.02104	-0.69658	1.00000	-3.07	.012

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.02648	1	0.02648	9.426	.012
RESIDUAL	0.02809	10	0.00281		

****

Table 4-21. Summary Statistics for Linear Regression, DI Versus NMOCBAR

Case	Alpha	Beta	Multiple Correlation	ANOVA F-Ratio	N	a	b
1	1.00	1.00	0.806	3.716	4	-0.0697	0.1359
2	1.00	2.00	1.000	-	2	-0.1576	0.2439
3	1.00	5.00	0.188	0.951	28	0.0274	0.7481
4	1.00	6.00	0.233	4.09	73	-0.0306	0.0593
5	2.00	1.00	0.975	19.238	3	-0.2388	0.2158
6	2.00	2.00	0.042	0.002	3	-0.0490	0.0042
7	2.00	5.00	0.179	0.796	26	-0.2560	0.0723
8	2.00	6.00	0.164	2.082	77	0.0069	0.0269
9	3.00	1.00	1.000	-	2	3.5480	4.4400
10	3.00	4.00	0.543	1.256	5	-0.0003	0.1338
11	3.00	5.00	0.021	0.016	36	-0.1254	0.0061
12	3.00	6.00	0.592	53.905	102	-0.0224	0.1355
13	4.00	3.00	0.906	4.586	3	0.0650	-0.1083
14	4.00	4.00	1.000	-	2	-0.0200	0.0000
15	4.00	5.00	0.132	0.497	30	0.01032	0.5808
16	4.00	6.00	0.378	13.644	84	-0.0365	0.1157
17	6.00	1.00	0.494	3.546	13	-0.01145	-0.0490
18	6.00	2.00	0.697	9.426	12	0.0134	-0.0646
19	6.00	3.00	0.637	6.156	11	0.0288	-0.0589
20	6.00	4.00	0.324	1.054	11	0.0188	-0.0309

Alpha/Beta	Channel
1.00	Radian A
2.00	Radian B
3.00	Radian C
4.00	Radian D
5.00	EPA QAD E
6.00	EPA ESRL GC

Model: DI = a + b* (NMOCBAR)

pair. ALPHA = 1.00 and BETA = 1.00 signifies that the first analysis was done on Channel A and the second analysis on Channel A. The data in Table 4-20 give the results of a linear regression between DI and NMOCBAR. Table 4-21 summarizes the data of Table 4-20 for the linear regression. Table 4-21, in addition to specifying the channels of the repeated analyses give the correlation coefficient R and the F-Ratio in the analysis of variance for the regression. N is the number of data points for each case. The last two columns in the table, a and b are the intercept and slope respectively in the linear model tested:

$$DI = a + b * NMOCBAR.$$

Discounting those cases having numbers of data points less than four, the multiple correlation coefficient (R) ranges from 0.021 to 0.806 with five cases out of 14 having $R > 0.500$. Note that the first 16 cases had a positive slope (with the exception of Cases 9 and 13) and the last 4 had a negative slope. While this analysis shows only a weak relationship between DI and NMOCBAR, the results suggest that the potential relationship should be investigated further. The analysis which follows in Section 4.2.3.2 suggests that there may be a relationship between the difference of repeated analyses which is something other than random.

If Table 4-18 is reexamined for the data in which both analyses were performed on the same channel, the following summary may be seen:

Table 4-22. Repeated Analyses on the Same Channel

ALPHA	BETA	N	NMOCBAR	$\overline{DI}$	%DIFF	SD	%CV
A	A	4	0.6600	0.020	3.03	0.0392	5.94
B	B	3	0.5400	-0.0467	-8.65	0.0451	8.35
C	C	1	0.8500	0.0700	8.24	-	-
D	D	2	0.7100	-0.0200	-2.82	0.000	0.00
Pooled		10	0.6530	-0.0030	5.20[a]	0.0380	5.81

[a]Weighted absolute magnitude.

Table 4-23. Repeated Analysis Precision Radian vs. EPA GC Channels.

CHANNEL								
ALPHA	BETA	N	Mean NMOCBAR	$\overline{DI}$	% Diff.	SD_{DI}	ν	% CV
A	GC	73	1.0358	0.0308	2.97	0.21136	72	20.4
B	GC	77	0.8747	0.0304	3.48	0.12036	76	13.8
C	GC	102	0.8592	0.0940	10.9	0.13434	101	15.6
D	GC	84	0.9013	0.0677	7.51	0.19966	83	22.2
		336	0.9116	0.0591	6.49	0.1687	332	18.5

Test the hypothesis: $Ho{:}\mu_{DI} = 0.0$

$$t = \frac{0.0591}{0.1687/\sqrt{332}} = 6.383 \quad \text{with 332 degrees of freedom}$$

$$t_{332,0.975} = 1.970$$

$\therefore$ reject Ho . The difference is significantly different from zero.

The statistics calculated in Table 4-22 were calculated in the same way as corresponding values in Table 4-18. The results suggest there was less variability in repeated analyses when both repeated analyses were done on the same instrument than when they were done on different instruments. The pooled "within-instrument" % difference calculated in Table 4-22 was 5.20, compared to 8.49 for the "between-instrument" % difference calculated in Table 4-18. The pooled % coefficient of variation in Table 4-22 was 5.81, compared to 16.7% calculated in Table 4-18. Although the number of comparisons was small in this study (N = 10), the results suggest that the mean differences of repeated analyses is significantly less when both analyses were done on the same channel than when they were done on different channels. This postulate should be further investigated in any future study.

Table 4-23 collects the repeated analysis data involving the four Radian channels and the EPA Channel GC. The table shows that in each channel pair, the mean value of the measured NMOC difference, DI is positive, averaging 5.9%. The test of hypothesis tests whether the pooled differences between the channel pairs is zero. The test indicates that the difference is significantly greater than zero. This result was not unexpected because the EPA GC channel replaced the cryogenic trap with a capillary gas chromatographic column. Molecules with a large molecular weight were not expected to be able to pass completely through the GC column, but would be trapped in the cryogenic trap and give the latter (measured on the Radian Channels) a higher NMOC measurement.

4.2.3.2 Local Ambient Samples--Four local ambient samples were collected by the U.S. EPA Quality Assurance Division and analyzed first on Channel E, then the analysis was repeated on each Radian channel. The results of these analyses are listed in Table 4-13, Cases 485 through 531. Table 4-19 also lists statistics resulting from the samples as channel pairs No. 21 through 24 (and No. 34).

Table 4-24. Analysis of Variance of Repeated Analyses of Local Ambient Samples.

MODEL: DI = CONSTANT + BETA

NUMBER OF CASES PROCESSED: 47

DEPENDENT VARIABLE MEAN: -0.06319

MULTIPLE CORRELATION: .321

SQUARED MULTIPLE CORRELATION: .103

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
BETA	0.02582	3	0.00861	1.642	.194
ERROR	0.22540	43	0.00524		

****

Table 4-24 gives an analysis of variance for the repeated analyses of local ambient samples, testing the model to see if BETA (the channel of the second analysis) is a factor. The fact that the F-Ratio is 1.642 and that P = 0.194 (i.e. 0.05) indicate that BETA is not a factor, at the 5 percent level of significance. It may be concluded that there was no apparent difference among the Radian channels performing the second analysis.

Table 4-25 presents the results of the repeated analyses for the channel pairs involving EPA QAD Channel E and the Radian Channels A, B, C, and D from still another perspective. The first row in Table 4-25 summarizes statistics when the first analysis was done on Channel A and the second analysis was done on Channel E. The second row shows the statistics for the case in which the first analysis was done on Channel E and the second analysis was done on Channel A. Pairs of rows which complete the table follow the same pattern for Radian Channels B, C, and D and EPA Channel E. The third column in the table gives the mean NMOC value determined from two repeated analyses. It is to be noted that in every case for the local ambient samples (first analysis on Channel E), the NMOCBAR values are from 38 to 62 percent higher than for the cases in which the samples were analyzed first on the Radian channels. The fact that the NMOCBAR values for the local ambient samples were higher than the NMOCBAR values when Channel E was the channel of the second analysis may be important in helping to explain why the variances of the differences in the comparisons made below are not equal.

The fourth column in the table gives the mean difference, DT, defined as the NMOC value from the first analysis (NMOC1) minus the NMOC value from the second repeated analysis (NMOC2). The striking result displayed in column 4 is that the mean differences are all negative. If one instrument were recording consistently higher values than the other, the mean difference DT would be positive in one case and negative in the next case. The results reported in Table 4-25 for DT suggest that the NMOC value from the second analysis was always greater than the NMOC value from the first analysis. To explain such an occurrence, it may be postulated that at the higher pressure (before the first analysis) sufficient NMOC adsorbed on the tank to reduce the NMOC concentration for the first analysis, regardless of the channel on which the first analysis occurred. Then on the second (and possibly subsequent analyses) analysis, NMOC desorbed from the tank walls to increase the concentration of the second analysis.

Column 5 gives the number of cases for a given pair of repeated analyses. Columns 6, 7, and 8 tabulate the standard deviation, the F statistic and Fisher's F for a 5 percent level of significance and the appropriate degrees of freedom. The F statistic may be used to test the Null Hypothesis that the population variances are equal, i.e., Ho: σ_{A-E}^2 = σ_{E-A}^2, for the pairs of analyses on Channels A-E and E-A, respectively. Column 9 notes that the data indicate that the variances of the differences when the analysis is performed on the Radian channels first are not equal to the variances of the differences when the analysis is done first on the EPA QAD Channel E. A possible explanation of this kind of phenomenon might be that both DI and the standard deviation, SD, are functions of NMOCBAR such that as NMOCBAR decreases, SD increases. As pointed out above the mean values of NMOCBAR for the local ambient samples was from 38 to 62 percent higher than for the cases in which Channel E was the channel of the second analysis. This phenonenon might be investigated in future studies.

The final three columns in Table 4-25 are used to test the hypotheses that the mean differences are equal for the A-E channel pair compared to the E-A, and so on for B-E/E-B, C-E/E-C, and D-E/E-D. The table indicates the result that, except for the first case (A-E/E-A) it cannot be concluded that the mean differences are equal. This may suggest that the NMOC differences for repeated analyses are a function of NMOC level. The analyses done earlier in this section on a linear relationship between, DI, and NMOCBAR, showed only a weak functionality, but the comparisons made here are strongly suggestive of at least a linear relationship. Future studies should investigate this potential phenonenon further.

4.2.4 Duplicate Samples

Duplicate samples were taken at various sites on a random schedule that was given in the Test Plan for the project. Table 4-26 summarizes data for the duplicate samples. It gives information on the site, the sample date and the Radian NMOC value, along with NMOC determinations from Channel E and the ESRL-GC determination. Table 4-27 gives the difference, DI, between the analysis of the first duplicate and the second duplicate.

Table 4-25. Repeated Analyses, Effect of Channel of First Analysis

First Analysis	Second Analysis	NMOCBAR	$\overline{DI}$	N	Standard Deviation	F Statistic	Fisher's $F_{0.975,\nu_1,\nu_2}$	Ho: $\sigma_1^2 = \sigma_2^2$	t Statistic	Students $t_{0.975,\nu}$	Ho $\mu_{\overline{DI}_1} = \mu_{\overline{DI}_2}$
A	E	1.0732	-0.1464	28	0.1695	5.604	2.97	Reject	-1.658	2.020	Accept
E	A	1.4773	-0.0839	13	0.0716						
B	E	0.9083	-0.1904	26	0.1924	7.469	3.16	Reject	-2.536	2.029	Reject
E	B	1.4725	-0.0817	12	0.0704						
C	E	0.9290	-0.1197	36	0.1676	5.228	3.28	Reject	-1 777	2.019	Reject
E	C	1.4464	-0.0564	11	0.0733						
D	E	1.0412	-0.1757	30	0.1428	3.664	3.32	Reject	-4.365	2.027	Reject
E	D	1.4309	-0.0254	11	0.0746						
	Pooled:	1.1190	-0.1293								

% Difference = (-0.1293/1.1190) x 100 = 10.9%

Table 4-26 (cont.)

1984 SUMMER NMOC STUDY

SAMPLING SITE CODE	DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
CHNC	07/16/84	198	MONDAY	1251	184	19.0	19.0	07/17/84	D		0.45		
CHNC	07/16/84	198	MONDAY	1252	188	19.0	19.5	07/17/84	C		0.56		
CHNC	08/02/84	215	THURSDAY	1533	2	15.0	15.0	08/06/84	C		0.18		
CHNC	08/02/84	215	THURSDAY	1532	156	15.0	14.8	08/06/84	A		0.21		
CHNC	08/16/84	229	THURSDAY	1765	165	15.5	15.0	08/17/84	A		0.68		
CHNC	08/16/84	229	THURSDAY	1764	188	15.5	14.9	08/17/84	D		0.69		
CHNC	09/27/84	271	THURSDAY	2474	112	16.0	15.5	10/02/84	B	10/02/84	0.18	0.23	0.15
CHNC	09/27/84	271	THURSDAY	2473	146	16.0	15.7	10/01/84	C		0.19		
CHTN	08/02/84	215	THURSDAY	1587	104	14.0	14.0	08/08/84	B		0.69		
CHTN	08/02/84	215	THURSDAY	1588	143	14.0	14.5	08/07/84	A		0.69		
CHTN	09/11/84	255	TUESDAY	2211	34	15.5	16.1	09/14/84	C		1.33		
CHTN	09/11/84	255	TUESDAY	2210	41	15.5	16.0	09/14/84	D		1.20		
CLTX	06/28/84	180	THURSDAY	1069	99	17.1	17.5	06/29/84	D	07/10/84	0.53		0.45
CLTX	06/28/84	180	THURSDAY	1068	96	17.1	17.3	06/29/84	B	07/10/84	0.46		0.45
CLTX	07/04/84	186	WEDNESDAY	1131	17	5.1	8.0	07/06/84	C		1.30		
CLTX	07/04/84	186	WEDNESDAY	1139	44	18.1	16.2	07/09/84	E		1.58		
CLTX	08/14/84	227	TUESDAY	1736	84	16.5	16.5	08/16/84	A		0.58		
CLTX	08/14/84	227	TUESDAY	1735	164	16.5	17.0	08/16/84	C	08/20/84	0.51		0.51
CLTX	08/23/84	236	THURSDAY	1900	165	16.0	16.5	08/23/84	D		0.42		
CLTX	08/23/84	236	THURSDAY	1901	172	16.0	16.5	08/27/84	B		0.51		
CLTX	09/24/84	268	MONDAY	2395	157	18.0	18.5	09/26/84	C		0.54		
CLTX	09/24/84	268	MONDAY	2394	62	18.0	16.5	09/26/84	B		0.75		

(continued)

Table 4-26. Duplicate Samples Summary.

1984 SUMMER NMOC STUDY

SAMPLING SITE CODE	DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
AKOH	07/26/84	208	THURSDAY	1448	64	17.5	17.0	07/30/84	A		1.06		
AKOH	07/26/84	208	THURSDAY	1447	102	17.5	16.9	07/30/84	C	07/31/84	1.11	1.35	
AKOH	09/06/84	250	THURSDAY	2120	79	18.0	18.0	09/10/84	C		2.95		
AKOH	09/06/84	250	THURSDAY	2119	9	18.0	19.5	09/10/84	C		2.77		
AKOH	09/18/84	262	TUESDAY	2299	149	16.5	17.0	09/20/84	C		0.79		
AKOH	09/18/84	262	TUESDAY	2298	18	16.5	17.5	09/20/84	E	09/21/84	0.77		0.71
ATGA	07/27/84	209	FRIDAY	1455	32	14.0	13.5	07/31/84	C	08/01/84	0.66	0.70	
ATGA	07/27/84	209	FRIDAY	1456	91	14.0	13.9	07/31/84	B		0.58		
ATGA	08/23/84	236	THURSDAY	1906	89	14.0	14.0	08/28/84	A		0.40		
ATGA	08/23/84	236	THURSDAY	1905	21	14.0	13.8	08/28/84	C		0.51		
ATGA	09/10/84	254	MONDAY	2171	155	15.0	15.0	09/12/84	B		0.50		
ATGA	09/10/84	254	MONDAY	2170	67	15.0	15.0	09/12/84	D		0.48		
BRL	08/03/84	216	FRIDAY	1643	35	9.8	9.5	08/09/84	B		0.50		
BRL	08/03/84	216	FRIDAY	1642	188	9.8	9.5	08/09/84	E		0.56		
BNTX	08/01/84	214	WEDNESDAY	1535	127	24.0	23.9	08/06/84	A		0.40		
BNTX	08/01/84	214	WEDNESDAY	1534	109	24.5	24.8	08/06/84	C		0.51		
BNTX	09/13/84	257	THURSDAY	2292	182	21.5	21.5	09/19/84	D		1.39		
BNTX	09/13/84	257	THURSDAY	2291	173	21.5	18.0	09/19/84	C		1.67		

(continued)

Table 4-26 (cont.)

1984 SUMMER NMOC STUDY

SAMPLING SITE CODE	DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
ININ	08/01/84	214	WEDNESDAY	1553	153	13.1	12.9	08/06/84	A		1.14		
ININ	08/01/84	214	WEDNESDAY	1554	131	13.1	12.5	08/06/84	C		1.34		
ININ	08/29/84	242	WEDNESDAY	1995	106	14.3	14.0	08/31/84	A		0.52		
ININ	08/29/84	242	WEDNESDAY	1996	152	14.3	14.0	08/31/84	A		0.52		
ININ	09/21/84	265	FRIDAY	2380	46	14.0	13.8	09/26/84	D		0.99		
ININ	09/21/84	265	FRIDAY	2381	155	14.0	13.3	09/26/84	C		0.98		
KCMO	08/17/84	230	FRIDAY	1823	190	14.0	14.1	08/21/84	B		0.64		
KCMO	08/17/84	230	FRIDAY	1822	106	14.0	14.8	08/21/84	C	08/22/84	0.64		0.60
KCMO	08/27/84	240	MONDAY	1957	151	13.5	13.3	08/29/84	A		0.57		
KCMO	08/27/84	240	MONDAY	1956	64	13.5	13.4	08/29/84	C		0.35		
MIFL	08/17/84	230	FRIDAY	1809	5	16.0	16.5	08/21/84	B	08/22/84	1.90		1.69
MIFL	08/17/84	230	FRIDAY	1810	6	16.0	16.1	08/21/84	A		1.93		
MIFL	09/05/84	249	WEDNESDAY	2093	52	18.0	18.5	09/10/84	D		1.62		
MIFL	09/05/84	249	WEDNESDAY	2094	176	18.0	16.0	09/10/84	D		1.61		
MIFL	09/26/84	270	WEDNESDAY	2438	118	18.5	21.5	09/28/84	B		0.40		
MIFL	09/26/84	270	WEDNESDAY	2437	121	18.5	18.4	10/01/84	A		0.81		
MTN	09/06/84	250	THURSDAY	2132	134	20.5	20.0	09/10/84	A		0.36		
MTN	09/06/84	250	THURSDAY	2131	18	20.5	20.5	09/10/84	B		1.30		

(continued)

Table 4-26 (cont.)

1984 SUMMER NMOC STUDY

SAMPLING SITE CODE	DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
CNOH	09/06/84	250	THURSDAY	2123	121	17.0	17.0	09/10/84	D		0.88		
CNOH	09/06/84	250	THURSDAY	2124	71	17.0	15.5	09/10/84	D		1.00		
DLTX	06/22/84	174	FRIDAY	1029	44	16.0	13.0	06/25/84	A	06/26/84	1.42		1.60
DLTX	06/22/84	174	FRIDAY	1028	42	16.0	16.5	06/25/84	C	06/26/84	1.61		1.61
DLTX	07/30/84	212	MONDAY	1499	19	13.0	16.0	08/01/84	C		1.22		
DLTX	07/30/84	212	MONDAY	1500	186	18.6	16.0	08/01/84	D		1.16		
DLTX	09/06/84	250	THURSDAY	2117	6	16.5	15.5	09/10/84	D		1.28		
DLTX	09/06/84	250	THURSDAY	2118	188	16.5	14.5	09/10/84	C		1.25		
DLTX	09/17/84	261	MONDAY	2287	106	17.0	17.0	09/19/84	C		1.06		
DLTX	09/17/84	261	MONDAY	2288	71	17.0	16.5	09/19/84	D		1.16		
ELTX	07/12/84	194	THURSDAY	1223	17	13.0	13.0	07/16/84	B		0.68		
ELTX	07/12/84	194	THURSDAY	1222	127	13.0	10.5	07/16/84	B		0.60		
ELTX	07/25/84	207	WEDNESDAY	1421	49	12.5	9.5	07/27/84	B		0.67		
ELTX	07/25/84	207	WEDNESDAY	1422	97	13.5	10.3	07/27/84	B		0.68		
ELTX	09/07/84	251	FRIDAY	2146	106	14.0	12.0	09/11/84	C		1.21		
ELTX	09/07/84	251	FRIDAY	2145	19	14.0	11.5	09/11/84	C		1.25		
ELTX	09/20/84	264	THURSDAY	2361	181	13.0	11.5	09/24/84	C	09/25/84	1.78	1.74	
ELTX	09/20/84	264	THURSDAY	2360	43	13.0	11.2	09/24/84	B	09/25/84	1.84		1.65
FWTX	06/20/84	172	WEDNESDAY	1023	3	18.0	17.7	06/25/84	A		1.18		
FWTX	06/20/84	172	WEDNESDAY	1022	4	18.0	17.7	06/25/84	B		1.11		
FWTX	07/06/84	188	FRIDAY	1144	144	15.0	15.0	07/09/84	A		0.87		
FWTX	07/06/84	188	FRIDAY	1143	145	15.0	15.0	07/09/84	C		1.02		
FWTX	07/24/84	206	TUESDAY	1404	63	17.0	16.0	07/26/84	C		1.09		
FWTX	07/24/84	206	TUESDAY	1403	96	17.0	17.0	07/26/84	B		1.04		

(continued)

Table 4-26 (cont.)

1984 SUMMER NMOC STUDY

SAMPLING SITE CODE	DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
WBPA	07/17/84	199	TUESDAY	1286	187	17.0	17.5	07/19/84	C		0.62		
WBPA	07/17/84	199	TUESDAY	1285	180	17.0	17.4	07/19/84	B	07/23/84	0.46		0.47
WBPA	08/06/84	219	MONDAY	1645	120	22.0	22.0	08/09/84	A		0.26		
WBPA	08/06/84	219	MONDAY	1644	64	22.0	21.5	08/09/84	A	08/10/84	0.24		0.20
WDC	07/06/84	188	FRIDAY	1182	55	17.0	17.0	07/12/84	B		0.55		
WDC	07/06/84	188	FRIDAY	1183	53	17.0	17.5	07/12/84	C		0.56		
WDC	07/27/84	209	FRIDAY	1464	101	20.0	20.5	08/01/84	B	08/03/84	0.68		0.56
WDC	07/27/84	209	FRIDAY	1496	164	17.0	17.8	08/01/84	C		0.56		
WDC	08/14/84	227	TUESDAY	1780	73	16.0	16.0	08/20/84	C		0.68		
WDC	08/14/84	227	TUESDAY	1781	76	16.0	16.0	08/20/84	D		0.65		
WPFL	06/28/84	180	THURSDAY	1080	69	15.0	15.0	07/02/84	A	07/10/84	0.28		0.31
WPFL	06/28/84	180	THURSDAY	1079	68	15.0	15.0	07/02/84	A	07/10/84	0.45		0.37
WPFL	07/23/84	205	MONDAY	1372	113	16.2	16.5	07/25/84	C	07/27/84	0.44		0.39
WPFL	07/23/84	205	MONDAY	1373	78	16.2	16.5	07/25/84	A		0.41		

Table 4-26 (cont.)

1984 SUMMER NMOC STUDY

SAMPLING SITE CODE	DATE SAMPLED	JULIAN DATE SAMPLED	SAMPLED WEEKDAY	RADIAN LAB ID	CAN NO. SAMPLED	(PSIG) PRESSURE SAMPLED	(PSIG) PRESSURE RECEIVED	RADIAN ANALYSIS DATE	RADIAN NMOC INST	EPA ANALYSIS DATE	RADIAN PPMC NMOC	NMOC PPMC QAD	NMOC PPMC ESRL-GC
ORTX	07/06/84	188	FRIDAY	1171	32	18.8	16.5	07/11/84	A		1.28		
ORTX	07/06/84	188	FRIDAY	1170	42	18.8	16.5	07/11/84	C	07/12/84	1.25	1.33	
ORTX	08/09/84	222	THURSDAY	1667	157	18.0	15.7	08/13/84	C		0.38		
ORTX	08/09/84	222	THURSDAY	1668	19	18.0	15.3	08/13/84	D		0.33		
ORTX	08/27/84	240	MONDAY	1971	181	19.0	17.1	08/29/84	C		0.89		
ORTX	08/27/84	240	MONDAY	1972	140	19.0	17.0	08/30/84	D		0.90		
PHPA	08/16/84	229	THURSDAY	1799	170	15.8	16.1	08/20/84	B		0.62		
PHPA	08/16/84	229	THURSDAY	1798	184	15.8	16.1	08/20/84	C		0.57		
PHPA	08/30/84	243	THURSDAY	2044	137	15.8	16.0	09/05/84	A		0.95		
PHPA	08/30/84	243	THURSDAY	2043	87	15.8	16.0	09/05/84	B		0.84		
RVA	08/01/84	214	WEDNESDAY	1516	157	16.0	16.1	08/02/84	D		0.32		
RVA	08/01/84	214	WEDNESDAY	1515	96	16.0	16.1	08/02/84	D		0.32		
RVA	08/24/84	237	FRIDAY	1897	139	15.0	15.1	08/28/84	C		0.44		
RVA	08/24/84	237	FRIDAY	1896	176	15.0	14.8	08/27/84	B	08/28/84	0.49		0.41
TCTX	06/26/84	178	TUESDAY	1054	66	18.0	18.0	06/28/84	C	06/26/84	0.96	1.00	
TCTX	06/26/84	178	TUESDAY	1055	73	18.0	18.0	06/28/84	C		1.01		
TCTX	07/18/82	200	WEDNESDAY	1312	12	25.0	25.0	07/20/84	C		0.81		
TCTX	07/18/84	200	WEDNESDAY	1311	52	25.0	24.0	07/20/84	B		1.07		
TCTX	09/04/84	248	TUESDAY	2075	96	18.0	17.9	09/06/84	D		0.60		
TCTX	09/04/84	248	TUESDAY	2074	65	18.0	17.9	09/06/84	C		0.60		
TCTX	09/20/84	264	THURSDAY	2354	77	19.0	19.5	09/24/84	D		0.32		
TCTX	09/20/84	264	THURSDAY	2353	130	19.0	20.0	09/24/84	D	09/25/84	0.31		0.33

(continued)

No attempt was made to differentiate between or to determine any effect of the channel on the result. Table 4-27 gives the result in terms of the site code name, e.g. for Case 1, the site is AKOH (Akron, Ohio) and DI = -0.050 is the difference between the analysis of the first duplicate, 1.06, and the analysis of the second duplicate, 1.11. The duplicate samples were taken simultaneously in parallel in two stainless steel evacuated cylinders through a teed sample line.

The upper set of statistics in Table 4-28 is for DI for duplicate samples from all the sites (total observations 59). The skewness and kurtosis statistics given in Table 4-28 are the third and fourth moments, respectively about the sample mean and may be used to compare the frequency-size data with the normal distribution. Examination of the data in Tables 4-26 and 4-27 indicates that Case 41 for Memphis, Tennessee (MTN) is an outlier. This case is discussed in more detail below. The lower set of statistics in Table 4-28 reanalyzes the duplicate sample differences, eliminating the outlier from the set of duplicate samples. Note that the range, the skewness, and the kurtosis all are substantially reduced when the one outlier is removed and the mean is significantly increased.

Figures 4-15 and 4-16 represent distribution diagrams for the composite duplicate sample differences, not including Case 41 of Table 4-27. Figure 4-15 shows DI (duplicate sample NMOC difference values) ranging from -0.41 and 0.22. The symbol "^" on the abscissa shows the approximate location of the mean of all the duplicate sample differences, while the left and right parentheses show the approximate location of one standard deviation (plus and minus) from the mean. All the values given in Figures 4-15 and 4-16 may be confirmed by comparing with the statistics given in Table 4-28 (minimum = -0.410, maximum = 0.220, mean = -0.0277, standard deviation = 0.1174). Figure 4-15 is a histogram of the DI data for the duplicate samples, and Figure 4-16 is a stem and leaf plot of variable DI. Both are frequency diagrams and display the frequency distribution of DI first with the magnitude DI on a horizontal scale and secondly in Figure 4-16 the magnitude of DI is on a vertical scale. The hinges (H) shown in

Table 4-27. Differences of Duplicate NMOC Analyses.

		SYTE$	SITE	DI
CASE	1	AKOH	1.000	-0.050
CASE	2	AKOH	1.000	0.180
CASE	3	AKOH	1.000	0.020
CASE	4	ATGA	2.000	0.080
CASE	5	ATGA	2.000	-0.110
CASE	6	ATGA	2.000	0.020
CASE	7	BAL	3.000	-0.060
CASE	8	BMTX	4.000	-0.110
CASE	9	BMTX	4.000	-0.280
CASE	10	CHNC	5.000	-0.110
CASE	11	CHNC	5.000	-0.030
CASE	12	CHNC	5.000	-0.010
CASE	13	CHNC	5.000	-0.010
CASE	14	CHTN	6.000	0.
CASE	15	CHTN	6.000	0.130
CASE	16	CLTX	7.000	0.070
CASE	17	CLTX	7.000	-0.280
CASE	18	CLTX	7.000	0.070
CASE	19	CLTX	7.000	-0.090
CASE	20	CLTX	7.000	-0.210
CASE	21	CNOH	8.000	-0.120
CASE	22	DLTX	9.000	-0.190
CASE	23	DLTX	9.000	0.060
CASE	24	DLTX	9.000	0.030
CASE	25	DLTX	9.000	-0.100
CASE	26	ELTX	10.000	0.080
CASE	27	ELTX	10.000	-0.010
CASE	28	ELTX	10.000	-0.040
CASE	29	ELTX	10.000	-0.060
CASE	30	FWTX	11.000	0.070
CASE	31	FWTX	11.000	-0.150
CASE	32	FWTX	11.000	0.050
CASE	33	ININ	12.000	-0.200
CASE	34	ININ	12.000	0.
CASE	35	ININ	12.000	0.010
CASE	36	KCMO	13.000	0.
CASE	37	KCMO	13.000	0.220
CASE	38	MIFL	14.000	-0.030
CASE	39	MIFL	14.000	0.010
CASE	40	MIFL	14.000	-0.410
CASE	41	MTN	15.000	-0.940
CASE	42	ORTX	16.000	0.030
CASE	43	ORTX	16.000	0.050
CASE	44	ORTX	16.000	-0.010
CASE	45	PHPA	17.000	0.050
CASE	46	PHPA	17.000	0.110
CASE	47	RVA	18.000	0.
CASE	48	RVA	18.000	-0.050
CASE	49	TCTX	19.000	-0.050
CASE	50	TCTX	19.000	-0.260
CASE	51	TCTX	19.000	0.
CASE	52	TCTX	19.000	0.010
CASE	53	WBPA	20.000	0.160
CASE	54	WBPA	20.000	0.020
CASE	55	WDC	21.000	-0.010
CASE	56	WDC	21.000	0.012
CASE	57	WDC	21.000	0.030
CASE	58	WPFL	22.000	-0.170
CASE	59	WPFL	22.000	0.030

Figure 4-15. Duplicate Sample Differences Histogram

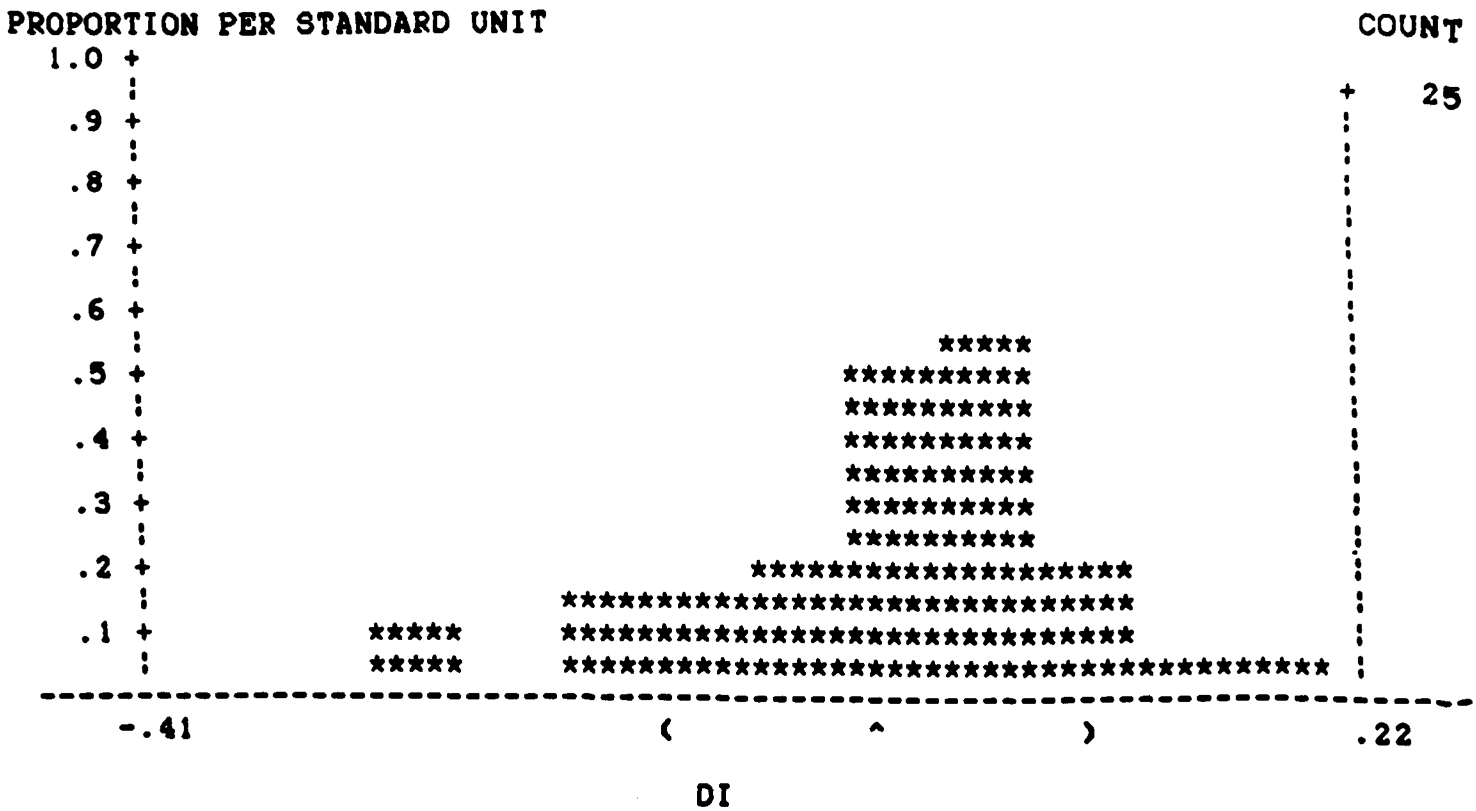


Table 4-28. Duplicate Sample Differences.

TOTAL OBSERVATIONS: 59

	DI
N OF CASES	59
MINIMUM	-0.94000
MAXIMUM	0.22000
RANGE	1.16000
MEAN	-0.04319
VARIANCE	0.02766
STANDARD DEV	0.16631
STD. ERROR	0.02165
SKEWNESS	-2.88146
KURTOSIS	12.76553

OUTLIER FROM MTN HAS BEEN REMOVED FROM THE FOLLOWING DATA.

TOTAL OBSERVATIONS: 58

	DI
N OF CASES	58
MINIMUM	-0.41000
MAXIMUM	0.22000
RANGE	0.63000
MEAN	-0.02772
VARIANCE	0.01379
STANDARD DEV	0.11744
STD. ERROR	0.01542
SKEWNESS	-0.84871
KURTOSIS	1.18219

Figure 4-16 between the stems and the leaves split the upper half and the lower half of the frequency data into halves again. The "H-spread" is the difference between the values of the two hinges. The "inner fences" are defined as follows:

lower fence = lower hinge - (1.5 x Hspread)

upper fence = upper hinge + (1.5 x Hspread)

Any NMOC difference values outside the inner fences are printed on separate lines and separated from the other lines by a line of text "***OUTSIDE VALUES***."

Table 4-29 presents the duplicate difference statistics by sites. These data are summarized in a more compact tabular form in Table 4-30. The first six columns summarize selected statistics of Table 4-29. The last 5 columns are ranked by mean difference, DI. The penultimate column shows the t statistic for the designated site which may be used to test the hypothesis that $\mu_{DI} = 0.0$. The last column is Student's t statistic which gives t_c, the critical t at the 5% significance level and appropriate degrees of freedom. If t is greater than t_c, then accept the hypothesis that the mean difference between duplicate samples is not equal to zero. Table 4-30 also indicates that the difference datum for Memphis, Tennesseess (MTN) is apparently an outlier. This may be clearly seen also by examination of Figure 4-17, which plots DI for all the sites in this study. The fact that only one duplicate was measured for MTN (Site No. 15) requires that a qualitative test be used to declare it to be an outlier. The footnote in Table 4-30 indicates that there was an unusual circumstance in the duplicate measurement for MTN in the cause of the analysis which justified the declaration of the point to be an outlier.

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[a] Tukey, J. W. Exploratory Data Analysis, Addison-Wesley, Reading, Mass. (1977).

Figure 4-16. Stem and Leaf Plot of Duplicate Differences.

```
        STEM AND LEAF PLOT OF VARIABLE:       DI

SMALLEST VALUE AT TOP OF PLOT IS:  -.4100000

              -4    1
              -2    88
        ***OUTSIDE VALUES***
              -2    6
              -2    10
              -1    975
              -1    21110
              -0 H  966555
              -0    43311111
               0 H  0000011112223333
               0    555677788
               1    13
               1    68
        ***OUTSIDE VALUES***
               2    2
```

Table 4-29 (cont.)

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = DLTX

TOTAL OBSERVATIONS: 4

	DI
N OF CASES	4
MINIMUM	-0.190
MAXIMUM	0.060
MEAN	-0.050
VARIANCE	0.014
STANDARD DEV	0.116
STD. ERROR	0.058

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = ELTX

TOTAL OBSERVATIONS: 4

	DI
N OF CASES	4
MINIMUM	-0.060
MAXIMUM	0.080
MEAN	-0.007
VARIANCE	0.004
STANDARD DEV	0.062
STD. ERROR	0.031

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = FWTX

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.150
MAXIMUM	0.070
MEAN	-0.010
VARIANCE	0.015
STANDARD DEV	0.122
STD. ERROR	0.070

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = ININ

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.200
MAXIMUM	0.010
MEAN	-0.063
VARIANCE	0.014
STANDARD DEV	0.118
STD. ERROR	0.068

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = FCMO

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	0.
MAXIMUM	0.220
MEAN	0.110
VARIANCE	0.024
STANDARD DEV	0.156
STD. ERROR	0.110

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = MIFL

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.410
MAXIMUM	0.010
MEAN	-0.143
VARIANCE	0.054
STANDARD DEV	0.232
STD. ERROR	0.134

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = MTN

TOTAL OBSERVATIONS: 1

	DI
N OF CASES	1
MINIMUM	-0.940
MAXIMUM	-0.940
MEAN	-0.940
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = ORTX

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.010
MAXIMUM	0.050
MEAN	0.023
VARIANCE	0.001
STANDARD DEV	0.031
STD. ERROR	0.018

(continued)

Table 4-29. Analysis of Duplicate Sample Difference by Site.

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = AKOH

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.050
MAXIMUM	0.180
MEAN	0.050
VARIANCE	0.014
STANDARD DEV	0.118
STD. ERROR	0.068

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = ATGA

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.110
MAXIMUM	0.080
MEAN	-0.003
VARIANCE	0.009
STANDARD DEV	0.097
STD. ERROR	0.056

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = BAL

TOTAL OBSERVATIONS: 1

	DI
N OF CASES	1
MINIMUM	-0.060
MAXIMUM	-0.060
MEAN	-0.060
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = BMTX

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	-0.280
MAXIMUM	-0.110
MEAN	-0.195
VARIANCE	0.014
STANDARD DEV	0.120
STD. ERROR	0.085

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = CHNC

TOTAL OBSERVATIONS: 4

	DI
N OF CASES	4
MINIMUM	-0.110
MAXIMUM	-0.010
MEAN	-0.040
VARIANCE	0.002
STANDARD DEV	0.048
STD. ERROR	0.024

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = CHTN

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	0.
MAXIMUM	0.130
MEAN	0.065
VARIANCE	0.008
STANDARD DEV	0.092
STD. ERROR	0.065

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = CLTX

TOTAL OBSERVATIONS: 5

	DI
N OF CASES	5
MINIMUM	-0.280
MAXIMUM	0.070
MEAN	-0.088
VARIANCE	0.025
STANDARD DEV	0.159
STD. ERROR	0.071

THE FOLLOWING RESULTS ARE FOR:
SYTE$ = CNOH

TOTAL OBSERVATIONS: 1

	DI
N OF CASES	1
MINIMUM	-0.120
MAXIMUM	-0.120
MEAN	-0.120
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

(continued)

Table 4-30. Duplicate Sample Statistics

Duplicate Sample Statistics						Ranked by DI, $\overline{DI}$				
Site No.	Site Code	$\overline{DI}$	Std. Dev.	n	Std. Error	Site Code	$\overline{DI}$	Std. Error	t	t_c
1	AKOH	0.050	0.118	3	0.068	KCMO	0.110	0.110	1.618	12.706
2	ATGA	-0.003	0.097	3	0.056	WBPA	0.090	0.070	1.286	12.706
3	BAL	-0.060	0.000	1	0.000	PHPA	0.080	0.030	2.667	12.706
4	BMTX	-0.195	0.120	2	0.085	CHTN	0.065	0.065	1.000	12.706
5	CHNC	-0.040	0.048	4	0.024	AKOH	0.050	0.068	0.735	4.303
6	CHTN	0.065	0.092	2	0.065	ORTX	0.023	0.018	1.278	4.303
7	CLTX	-0.088	0.159	5	0.071	WDC	0.011	0.012	0.916	4.303
8	CNOH	-0.120	0.000	1	0.000	ATGA	-0.003	0.056	-0.054	4.303
9	DLTX	-0.050	0.116	4	0.058	ELTX	-0.007	0.062	-0.113	3.182
10	ELTX	-0.007	0.062	4	0.031	FWTX	-0.010	0.070	-0.143	4.303
11	FWTX	-0.010	0.122	3	0.070	RVA	-0.025	0.025	-1.000	12.706
12	ININ	-0.063	0.118	3	0.068	CHNC	-0.040	0.024	-1.667	3.182
13	KCMO	0.110	0.156	2	0.110	DLTX	-0.050	0.058	-0.862	3.182
14	MIFL	-0.143	0.232	3	0.134	BAL	-0.060	0.000	-	-
15	MTN	-0.940[a]	0.000	1	0.000	ININ	-0.063	0.068	-0.926	4.303
16	ORTX	0.023	0.031	3	0.018	WPFL	-0.070	0.100	-0.700	12.706
17	PHPA	0.080	0.042	2	0.030	TCTX	-0.075	0.063	-1.190	3.182
18	RVA	-0.025	0.035	2	0.025	CLTX	-0.088	0.071	1.239	2.776
19	TCTX	-0.075	0.126	4	0.063	CNOH	-0.120	0.000	-	-
20	WBPA	0.090	0.099	2	0.070	MIFL	-0.143	0.134	-1.067	4.303
21	WDC	0.011	0.020	3	0.012	BMTX	-0.195	0.120	1.625	12.706
22	WPFL	-0.070	0.141	2	0.100	MTN	-0.940[a]	0.000	-	-

[a] This sample is apparently an outlier. Examination of the laboratory notebooks showed the following for Radian Sample ID No. 2131 and No. 2132, the two ID numbers for the duplicate samples from Memphis, Tennessee.

Analysis No.	Sample No. 2131		Sample No. 2132		
	Area Count	ppmC	Area Count	ppmC	
1	4336.10	1.38	1078.76	0.34	
2	3825.67	1.22	~~[illegible]~~	~~[illegible]~~	(Deleted as "inconsistent")
3		Average = 1.30	1169.04	0.37	
				Average = 0.36	

DI = 0.36 - 1.30 = -0.940

This datum was discarded as an outlier.

Table 4-29 (cont.)

THE FOLLOWING RESULTS ARE FOR:
SYTE# = PHPA

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	0.050
MAXIMUM	0.110
MEAN	0.080
VARIANCE	0.002
STANDARD DEV	0.042
STD. ERROR	0.030

THE FOLLOWING RESULTS ARE FOR:
SYTE# = RVA

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	-0.050
MAXIMUM	0.
MEAN	-0.025
VARIANCE	0.001
STANDARD DEV	0.035
STD. ERROR	0.025

THE FOLLOWING RESULTS ARE FOR:
SYTE# = TCTX

TOTAL OBSERVATIONS: 4

	DI
N OF CASES	4
MINIMUM	-0.260
MAXIMUM	0.010
MEAN	-0.075
VARIANCE	0.016
STANDARD DEV	0.126
STD. ERROR	0.063

THE FOLLOWING RESULTS ARE FOR:
SYTE# = WEFA

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	0.020
MAXIMUM	0.160
MEAN	0.090
VARIANCE	0.010
STANDARD DEV	0.099
STD. ERROR	0.070

THE FOLLOWING RESULTS ARE FOR:
SYTE# = WDC

TOTAL OBSERVATIONS: 3

	DI
N OF CASES	3
MINIMUM	-0.010
MAXIMUM	0.030
MEAN	0.011
VARIANCE	0.000
STANDARD DEV	0.020
STD. ERROR	0.012

THE FOLLOWING RESULTS ARE FOR:
SYTE# = WPFL

TOTAL OBSERVATIONS: 2

	DI
N OF CASES	2
MINIMUM	-0.170
MAXIMUM	0.030
MEAN	-0.070
VARIANCE	0.020
STANDARD DEV	0.141
STD. ERROR	0.100

Table 4-30 indicates that none of the sites had a mean duplicate sample difference significantly different from zero. (Note that BAL and MTN could not be tested, having only one measurement each.) This assertion is supported by the analysis of variance calculations summarized in Tables 4-31 and 4-32. Table 4-31 includes all the duplicate sample difference data including the MTN datum discussed above as an outlier. The analysis of variance data in Table 4-32 indicates that SITE is an important factor in describing the mean duplicate sample difference DT. The P statistic is the probablity that the variable SITE is not a factor. That probability is zero (to 3 decimal points) and therefore SITE must be considered a factor. Because the datum for MTN is so far removed from the remaining data it is not surprising that SITE is a factor.

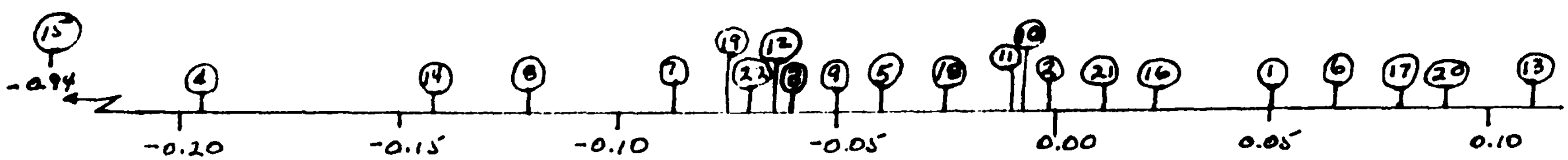
If the datum for Memphis, Tennessee is removed and an analysis of variance (ANOVA) performed again, the results are shown in Table 4-32. For this ANOVA the probability that SITE is not a factor is 0.442, which is significantly high to lead to the conclusion that SITE is not a factor in analyzing the duplicate sample data.

In summary the analysis of the duplicate sample data indicates that there is no significant difference between the duplicate samples among any of the sites tested. Table 1-3 indicated the precision of duplicate analyses to be -3.4%, but this cannot be said to be different from zero.

4.2.5 QC Samples

4.2.5.1 Radian In-House QC Samples--Various statistics are given in Table 4-33 for the in-house QC samples. A Radian QC coordinator prepared the samples by diluting dry propane samples with cleaned, dry air with calibrated, proportional flow controllers according to the schedule shown in the QA Project Plan and in the table. The dry propane was prepared and certified by the EPA's EMSL-RTP facility. The error term reported in Table 4-33 is the difference between the measured ppmC value and the calculated ppmC value. The Radian QC sample was inserted among the daily samples (see QA Project Plan). The analyst did not know the composition of the QC sample at the time of analysis.

Figure 4-17. $\overline{DI}$, Mean Difference in NMOC for Duplicate Sample Analyses.



NOTE: Site numbers are circled at $\overline{DI}$ for site.

Table 4-32

Comparison of Duplicate Sample Differences.

NUMBER OF CASES PROCESSED: 58 (Datum for Memphis, Tenn. Deleted as an Outlier.)

DEPENDENT VARIABLE MEAN: -0.028

MULTIPLE CORRELATION: .600

SQUARED MULTIPLE CORRELATION: .361

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
SITE	0.283	20	0.014	1.043	442
ERROR	0.503	37	0.014		

****

MODEL: $\overline{DI} = \mu + (SITE) + ERROR$

Table 4-31

Comparison of Duplicate Sample Differences.

MODEL: $\overline{DI} = \mu + (SITE) + (ERROR)$

NUMBER OF CASES PROCESSED: 59

DEPENDENT VARIABLE MEAN: -0.043

MULTIPLE CORRELATION: .829

SQUARED MULTIPLE CORRELATION: .687

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
SITE	1.102	21	0.052	3.861	.000
ERROR	0.503	37	0.014		

****

Table 4-33 (cont.)

IN HOUSE QC SAMPLES - NMOC INSTRUMENT B

QC SAMPLE PREP. DAT	JULIAN DATE	WEEKDAY	ANALYSIS DATE	RADIAN ID #	NMOC INST	CALC PPMC	MEAS PPMC	ERROR PPMC	QC SAMPLE DESCRIPTION
07/12/84	194	THURSDAY	07/12/84	1199	B	0.22	0.25	0.03	DRY DILUTED PROPANE STD.
07/17/84	199	TUESDAY	07/17/84	1259	B	0.85	0.87	0.02	DRY DILUTED PROPANE STD.
07/19/84	201	THURSDAY	07/19/84	1283	B	0.44	0.47	0.03	DRY DILUTED PROPANE STD.
07/20/84	202	FRIDAY	07/20/84	1284	B	0.17	0.18	0.01	DRY DILUTED PROPANE STD.
07/23/84	205	MONDAY	07/23/84	1306	B	0.00	0.01	0.01	DRY DILUTED PROPANE STD.
07/23/84	205	MONDAY	07/23/84	1307	B	1.32	1.37	0.05	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/26/84	1366	B	0.10	0.11	0.01	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/25/84	1367	B	1.52	1.59	0.07	DRY DILUTED PROPANE STD.
07/31/84	213	TUESDAY	07/31/84	1452	B	2.18	2.18	.00	DRY DILUTED PROPANE STD.
08/02/84	215	THURSDAY	08/02/84	1503	B	0.71	0.77	0.06	DRY DILUTED PROPANE STD.
08/03/84	216	FRIDAY	08/03/84	1530	B	0.04	0.05	0.01	DRY DILUTED PROPANE STD.
08/07/84	220	TUESDAY	08/07/84	1580	B	1.06	1.08	0.02	DRY DILUTED PROPANE STD.
08/09/84	222	THURSDAY	08/09/84	1601	B	0.17	0.19	0.02	DRY DILUTED PROPANE STD.
08/15/84	228	WEDNESDAY	08/15/84	1709	B	0.82	0.87	0.05	DRY DILUTED PROPANE STD.
08/21/84	234	TUESDAY	08/21/84	1806	B	0.20	0.21	0.01	DRY DILUTED PROPANE STD.
08/23/84	236	THURSDAY	08/23/84	1828	B	0.69	0.72	0.03	DRY DILUTED PROPANE STD.
08/24/84	237	FRIDAY	08/24/84	1829	B	1.31	1.41	0.10	DRY DILUTED PROPANE STD.
08/31/84	244	FRIDAY	08/31/84	1991	B	0.06	0.07	0.01	DRY DILUTED PROPANE STD.
09/13/84	257	THURSDAY	09/13/84	2184	B	0.82	0.89	0.07	DRY DILUTED PROPANE STD.
09/24/84	268	MONDAY	09/24/84	2342	B	2.74	2.8	0.06	DRY DILUTED PROPANE STD.
10/01/84	275	MONDAY	10/01/84	2446	B	0.60	0.63	0.03	DRY DILUTED PROPANE STD.
					NUMBER =	21	21	21	
					MEAN =	0.762	0.796	0.033	
					Sd =	0.731	0.744	0.027	

(continued)

Table 4-33. In-House QC Samples.

IN HOUSE QC SAMPLES - NMOC INSTRUMENT A

QC SAMPLE PREP. DAT	JULIAN DATE	WEEKDAY	ANALYSIS DATE	RADIAN ID #	NMOC INST	CALC PPMC	MEAS PPMC	ERROR PPMC	QC SAMPLE DESCRIPTION
07/12/84	194	THURSDAY	07/12/84	1199	A	0.22	0.24	0.02	DRY DILUTED PROPANE STD.
07/17/84	199	TUESDAY	07/17/84	1259	A	0.05	0.06	0.01	DRY DILUTED PROPANE STD.
07/19/84	201	THURSDAY	07/19/84	1283	A	0.44	0.40	0.04	DRY DILUTED PROPANE STD.
07/20/84	202	FRIDAY	07/20/84	1284	A	0.17	0.18	0.01	DRY DILUTED PROPANE STD.
07/23/84	205	MONDAY	07/23/84	1306	A	0.00	0.02	0.02	DRY DILUTED PROPANE STD.
07/23/84	205	MONDAY	07/23/84	1307	A	1.32	1.34	0.02	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/26/84	1366	A	0.10	0.11	0.01	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/25/84	1367	A	1.52	1.53	0.01	DRY DILUTED PROPANE STD.
07/31/84	213	TUESDAY	07/31/84	1452	A	2.18	2.15	-0.03	DRY DILUTED PROPANE STD.
08/02/84	215	THURSDAY	08/02/84	1503	A	0.71	0.78	0.07	DRY DILUTED PROPANE STD.
08/03/84	216	FRIDAY	08/03/84	1530	A	0.04	0.04	.00	DRY DILUTED PROPANE STD.
08/07/84	220	TUESDAY	08/07/84	1580	A	1.06	1.05	-0.01	DRY DILUTED PROPANE STD.
08/09/84	222	THURSDAY	08/09/84	1601	A	0.17	0.21	0.04	DRY DILUTED PROPANE STD.
08/15/84	228	WEDNESDAY	08/15/84	1709	A	0.02	0.06	0.04	DRY DILUTED PROPANE STD.
08/21/84	234	TUESDAY	08/21/84	1806	A	0.20	0.22	0.02	DRY DILUTED PROPANE STD.
08/23/84	236	THURSDAY	08/23/84	1828	A	0.69	0.73	0.04	DRY DILUTED PROPANE STD.
08/24/84	237	FRIDAY	08/24/84	1829	A	1.31	1.42	0.11	DRY DILUTED PROPANE STD.
08/31/84	244	FRIDAY	08/31/84	1991	A	0.06	0.07	0.01	DRY DILUTED PROPANE STD.
09/13/84	257	THURSDAY	09/13/84	2184	A	0.82	0.87	0.05	DRY DILUTED PROPANE STD.
09/24/84	268	MONDAY	09/24/84	2342	A	2.74	2.9	0.16	DRY DILUTED PROPANE STD.
10/01/84	275	MONDAY	10/01/84	2446	A	0.60	0.64	0.04	DRY DILUTED PROPANE STD.
					NUMBER =	21	21	21	
					MEAN =	0.762	0.795	0.032	
					Sd =	0.731	0.749	0.041	

(continued)

Table 4-33 (cont.)

IN HOUSE QC SAMPLES - NMOC INSTRUMENT D

QC SAMPLE PREP. DAT	JULIAN DATE	WEEKDAY	ANALYSIS DATE	RADIAN ID #	NMOC INST	CALC PPMC	MEAS PPMC	ERROR PPMC	QC SAMPLE DESCRIPTION
07/10/84	192	TUESDAY	07/10/84	1159	D	0.63	0.67	0.04	DRY DILUTED PROPANE STD.
07/13/84	195	FRIDAY	07/13/84	1214	D	0.87	0.95	0.08	DRY DILUTED PROPANE STD.
07/16/84	198	MONDAY	07/16/84	1237	D	0.28	0.27	-0.01	DRY DILUTED PROPANE STD.
07/24/84	206	TUESDAY	07/24/84	1328	D	1.95	1.79	-0.16	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/25/84	1367	D	1.52	1.63	0.11	DRY DILUTED PROPANE STD.
07/27/84	209	FRIDAY	07/27/84	1391	D	1.22	1.44	0.22	DRY DILUTED PROPANE STD.
08/06/84	219	MONDAY	08/06/84	1557	D	2.53	2.7	0.17	DRY DILUTED PROPANE STD.
08/28/84	241	TUESDAY	08/28/84	1919	D	1.76	1.79	0.03	DRY DILUTED PROPANE STD.
08/30/84	243	THURSDAY	08/30/84	1945	D	0.50	0.54	0.04	DRY DILUTED PROPANE STD.
09/06/84	250	THURSDAY	09/06/84	2091	D	3.09	3.19	0.10	DRY DILUTED PROPANE STD.
09/07/84	251	FRIDAY	09/07/84	2092	D	0.94	1	0.06	DRY DILUTED PROPANE STD.
09/10/84	254	MONDAY	09/10/84	2110	D	3.26	3.36	0.10	DRY DILUTED PROPANE STD.
09/11/84	255	TUESDAY	09/11/84	2139	D	1.49	1.68	0.19	DRY DILUTED PROPANE STD.
09/21/84	265	FRIDAY	09/21/84	2315	D	0.21	0.21	.00	DRY DILUTED PROPANE STD.
09/27/84	271	THURSDAY	09/27/84	2414	D	1.25	1.34	0.09	DRY DILUTED PROPANE STD.
10/01/84	275	MONDAY	10/01/84	2446	D	0.60	0.64	0.04	DRY DILUTED PROPANE STD.
					NUMBER =	16	16	16	
					MEAN =	1.380	1.450	0.069	
					Sd =	0.942	0.968	0.089	

(continued)

Table 4-33 (cont.)

IN HOUSE QC SAMPLES - NMOC INSTRUMENT C

QC SAMPLE PREP. DAT	JULIAN DATE	WEEKDAY	ANALYSIS DATE	RADIAN ID #	NMOC INST	CALC PPMC	MEAS PPMC	ERROR PPMC	QC SAMPLE DESCRIPTION
07/13/84	195	FRIDAY	07/13/84	1214	C	0.87	0.94	0.07	DRY DILUTED PROPANE STD.
07/16/84	198	MONDAY	07/16/84	1237	C	0.28	0.28	.00	DRY DILUTED PROPANE STD.
07/24/84	206	TUESDAY	07/24/84	1328	C	1.95	1.91	-0.04	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/25/84	1367	C	1.52	1.63	0.11	DRY DILUTED PROPANE STD.
07/27/84	209	FRIDAY	07/27/84	1391	C	1.22	1.39	0.17	DRY DILUTED PROPANE STD.
08/06/84	219	MONDAY	08/06/84	1557	C	2.53	2.7	0.17	DRY DILUTED PROPANE STD.
08/28/84	241	TUESDAY	08/28/84	1919	C	1.76	1.91	0.15	DRY DILUTED PROPANE STD.
08/30/84	243	THURSDAY	08/30/84	1945	C	0.50	0.54	0.04	DRY DILUTED PROPANE STD.
09/06/84	250	THURSDAY	09/06/84	2091	C	3.09	3.24	0.15	DRY DILUTED PROPANE STD.
09/07/84	251	FRIDAY	09/07/84	2092	C	0.94	1.01	0.07	DRY DILUTED PROPANE STD.
09/10/84	254	MONDAY	09/10/84	2110	C	3.26	3.31	0.05	DRY DILUTED PROPANE STD.
09/11/84	255	TUESDAY	09/11/84	2139	C	1.49	1.7	0.21	DRY DILUTED PROPANE STD.
09/21/84	265	FRIDAY	09/21/84	2315	C	0.21	0.22	0.01	DRY DILUTED PROPANE STD.
09/27/84	271	THURSDAY	09/27/84	2414	C	1.25	1.34	0.09	DRY DILUTED PROPANE STD.
10/01/84	275	MONDAY	10/01/84	2446	C	0.60	0.64	0.04	DRY DILUTED PROPANE STD.
					NUMBER =	15	15	15	
					MEAN =	1.431	1.517	0.087	
					Sd =	0.952	0.982	0.072	

(continued)

Note that only 5 of 82 cases were negative. This suggests that there is a positive bias between the measured and calculated concentrations. As will be shown below at the 5% level of significance, the mean differences for each channel are greater than zero. A positive bias in the results shown here might be a result of all or some of the following:

(a) Not measuring and subtracting an analytical blank reading,

(b) Not measuring and correcting for a can "blank,"

(c) Calibration drift in flowmeters used to mix the QA samples, and

(d) Having a bias in the standard mixture used to make the QA samples.

It is felt that the first two factors cause the primary differences seen in the in-house QC data.

Tables 4-34 and 4-35 include selected in-house QC sample data sorted first by channel and then by Radian ID number. The variable CHANL in Tables 4-34 and 4-35 identifies Radian Channels A, B, C, and D, and EPA Channel E, while the Radian Sample Identification Numbers (RADID) are also identified in the tables by the variable ID (see especially Table 4-35, sorted by ID Number). Table 4-36 gives selected statistics on the in-house sample statistics. Note that the skewness is less than 1.000 and suggests a nearly symetrical distribution.

Figure 4-18 and 4-19 show a histogram and a stem and leaf plot of the in-house QC sample difference data, both of which suggest a near-normal distribution of the sample differences.

Table 4-37 shows statistics for the in-house sample differences, by channel. Channels 1 through 5 correspond to Channels A through E. In Table 4-38 the data of Table 4-37 are summarized along with several t statistics. In Table 4-38 DI is the mean difference, SD is the standard deviation, SEE is the standard error, N the number of samples, and t the statistic (= $DI/(SD/\sqrt{N})$). The statistic t is used to test the hypothesis that the channel mean = 0. The final column in Table 4-38 is Student's t statistic at the appropriate degrees of freedom and the 5 percent level of significance. In every case the t statistic (penultimate column) is greater than the t in the final column, therefore one must reject the hypothesis that the channel mean difference is zero. The lower part of

Table 4-33 (cont.)

IN HOUSE QC SAMPLES - NMOC INSTRUMENT E

QC SAMPLE PREP. DAT	JULIAN DATE	WEEKDAY	ANALYSIS DATE	RADIAN ID #	NMOC INST	CALC PPMC	MEAS PPMC	ERROR PPMC	QC SAMPLE DESCRIPTION
07/10/84	192	TUESDAY	07/11/84	1159	E	0.63	0.68	0.05	DRY DILUTED PROPANE STD.
07/17/84	199	TUESDAY	07/18/84	1259	E	0.85	0.89	0.04	DRY DILUTED PROPANE STD.
07/24/84	206	TUESDAY	07/25/84	1328	E	1.95	1.95	.00	DRY DILUTED PROPANE STD.
07/25/84	207	WEDNESDAY	07/25/84	1367	E	1.52	1.52	0.00	DRY DILUTED PROPANE STD.
07/31/84	213	TUESDAY	08/01/84	1452	E	2.18	2.34	0.16	DRY DILUTED PROPANE STD.
08/15/84	228	WEDNESDAY	08/16/84	1709	E	0.82	0.86	0.04	DRY DILUTED PROPANE STD.
08/21/84	234	TUESDAY	08/22/84	1806	E	0.20	0.21	0.01	DRY DILUTED PROPANE STD.
09/06/84	250	THURSDAY	09/07/84	2091	E	3.09	3.17	0.08	DRY DILUTED PROPANE STD.
09/07/84	251	FRIDAY	09/10/84	2092	E	0.94	0.99	0.05	DRY DILUTED PROPANE STD.
					NUMBER =	9	9	9	
					MEAN =	1.353	1.401	0.048	
					Sd =	0.911	0.934	0.050	

Table 4-34 (cont.)

		RADID	CHANNEL#	DELTA	ID	CHANL
CASE	42	2446.000	B	0.030	21.000	2.00
CASE	43	1214.000	C	0.070	22.000	3.00
CASE	44	1237.000	C	0.	23.000	3.00
CASE	45	1328.000	C	-0.040	24.000	3.00
CASE	46	1367.000	C	0.110	8.000	3.00
CASE	47	1391.000	C	0.170	25.000	3.00
CASE	48	1557.000	C	0.170	26.000	3.00
CASE	49	1919.000	C	0.150	27.000	3.00
CASE	50	1945.000	C	0.040	28.000	3.00
CASE	51	2091.000	C	0.150	29.000	3.00
CASE	52	2092.000	C	0.070	30.000	3.00
CASE	53	2110.000	C	0.050	31.000	3.00
CASE	54	2139.000	C	0.210	32.000	3.00
CASE	55	2315.000	C	0.010	33.000	3.00
CASE	56	2414.000	C	0.090	34.000	3.00
CASE	57	2446.000	C	0.040	21.000	3.00
CASE	58	1159.000	D	0.040	35.000	4.00
CASE	59	1214.000	D	0.080	22.000	4.00
CASE	60	1237.000	D	-0.010	23.000	4.00
CASE	61	1328.000	D	-0.160	24.000	4.00
CASE	62	1367.000	D	0.110	8.000	4.00
CASE	63	1391.000	D	0.220	25.000	4.000
CASE	64	1557.000	D	0.170	26.000	4.000
CASE	65	1919.000	D	0.030	27.000	4.000
CASE	66	1945.000	D	0.040	28.000	4.000
CASE	67	2091.000	D	0.100	29.000	4.000
CASE	68	2092.000	D	0.060	30.000	4.000
CASE	69	2110.000	D	0.100	31.000	4.000
CASE	70	2139.000	D	0.190	32.000	4.000
CASE	71	2315.000	D	0.	33.000	4.000
CASE	72	2414.000	D	0.090	34.000	4.000
CASE	73	2446.000	D	0.040	21.000	4.000
CASE	74	1159.000	E	0.050	35.000	5.000
CASE	75	1259.000	E	0.040	2.000	5.000
CASE	76	1328.000	E	0.	24.000	5.000
CASE	77	1367.000	E	0.	8.000	5.000
CASE	78	1452.000	E	0.160	9.000	5.000
CASE	79	1709.000	E	0.040	14.000	5.000
CASE	80	1806.000	E	0.010	15.000	5.000
CASE	81	2091.000	E	0.080	29.000	5.000
CASE	82	2092.000	E	0.050	30.000	5.000

82 CASES AND 5 VARIABLES PROCESSED.

Table 4-34. In-House QC Sample Differences, Sorted by Channel.

		RADID	CHANNEL$	DELTA	ID	CHANL
CASE	1	1199.000	A	0.020	1.000	1.000
CASE	2	1259.000	A	0.010	2.000	1.000
CASE	3	1283.000	A	0.040	3.000	1.000
CASE	4	1284.000	A	0.010	4.000	1.000
CASE	5	1306.000	A	0.020	5.000	1.000
CASE	6	1307.000	A	0.020	6.000	1.000
CASE	7	1366.000	A	0.010	7.000	1.000
CASE	8	1367.000	A	0.010	8.000	1.000
CASE	9	1452.000	A	-0.030	9.000	1.000
CASE	10	1503.000	A	0.070	10.000	1.000
CASE	11	1530.000	A	0.	11.000	1.000
CASE	12	1580.000	A	-0.010	12.000	1.000
CASE	13	1601.000	A	0.040	13.000	1.000
CASE	14	1709.000	A	0.040	14.000	1.000
CASE	15	1806.000	A	0.020	15.000	1.000
CASE	16	1828.000	A	0.040	16.000	1.000
CASE	17	1829.000	A	0.110	17.000	1.000
CASE	18	1991.000	A	0.010	18.000	1.000
CASE	19	2184.000	A	0.050	19.000	1.000
CASE	20	2342.000	A	0.160	20.000	1.000
CASE	21	2446.000	A	0.040	21.000	1.000
CASE	22	1199.000	B	0.030	1.000	2.000
CASE	23	1259.000	B	0.020	2.000	2.000
CASE	24	1283.000	B	0.030	3.000	2.000
CASE	25	1284.000	B	0.010	4.000	2.000
CASE	26	1306.000	B	0.010	5.000	2.000
CASE	27	1307.000	B	0.050	6.000	2.000
CASE	28	1366.000	B	0.010	7.000	2.000
CASE	29	1367.000	B	0.070	8.000	2.000
CASE	30	1452.000	B	0.	9.000	2.000
CASE	31	1503.000	B	0.060	10.000	2.000
CASE	32	1530.000	B	0.010	11.000	2.000
CASE	33	1580.000	B	0.020	12.000	2.000
CASE	34	1601.000	B	0.020	13.000	2.000
CASE	35	1709.000	B	0.050	14.000	2.000
CASE	36	1806.000	B	0.010	15.000	2.000
CASE	37	1828.000	B	0.030	16.000	2.000
CASE	38	1829.000	B	0.100	17.000	2.000
CASE	39	1991.000	B	0.010	18.000	2.000
CASE	40	2184.000	B	0.070	19.000	2.000
CASE	41	2342.000	B	0.060	20.000	2.000

(continued)

Table 4-35 (cont.)

	RADID	CHANNEL#	DELTA	ID	CHANL
CASE 42	1991.000	A	0.010	18.000	1.000
CASE 43	1991.000	B	0.010	18.000	2.000
CASE 44	2184.000	A	0.050	19.000	1.000
CASE 45	2184.000	B	0.070	19.000	2.000
CASE 46	2342.000	A	0.160	20.000	1.000
CASE 47	2342.000	B	0.060	20.000	2.000
CASE 48	2446.000	A	0.040	21.000	1.000
CASE 49	2446.000	B	0.030	21.000	2.000
CASE 50	2446.000	C	0.040	21.000	3.000
CASE 51	2446.000	D	0.040	21.000	4.000
CASE 52	1214.000	C	0.070	22.000	3.000
CASE 53	1214.000	D	0.080	22.000	4.000
CASE 54	1237.000	C	0.	23.000	3.000
CASE 55	1237.000	D	-0.010	23.000	4.000
CASE 56	1328.000	C	-0.040	24.000	3.000
CASE 57	1328.000	D	-0.160	24.000	4.000
CASE 58	1328.000	E	0.	24.000	5.000
CASE 59	1391.000	C	0.170	25.000	3.000
CASE 60	1391.000	D	0.220	25.000	4.000
CASE 61	1557.000	C	0.170	26.000	3.000
CASE 62	1557.000	D	0.170	26.000	4.000
CASE 63	1919.000	C	0.150	27.000	3.000
CASE 64	1919.000	D	0.030	27.000	4.000
CASE 65	1945.000	C	0.040	28.000	3.000
CASE 66	1945.000	D	0.040	28.000	4.000
CASE 67	2091.000	C	0.150	29.000	3.000
CASE 68	2091.000	D	0.100	29.000	4.000
CASE 69	2091.000	E	0.080	29.000	5.000
CASE 70	2092.000	C	0.070	30.000	3.000
CASE 71	2092.000	D	0.060	30.000	4.000
CASE 72	2092.000	E	0.050	30.000	5.000
CASE 73	2110.000	C	0.050	31.000	3.000
CASE 74	2110.000	D	0.100	31.000	4.000
CASE 75	2139.000	C	0.210	32.000	3.000
CASE 76	2139.000	D	0.190	32.000	4.000
CASE 77	2315.000	C	0.010	33.000	3.000
CASE 78	2315.000	D	0.	33.000	4.000
CASE 79	2414.000	C	0.090	34.000	3.000
CASE 80	2414.000	D	0.090	34.000	4.000
CASE 81	1159.000	D	0.040	35.000	4.000
CASE 82	1159.000	E	0.050	35.000	5.000

82 CASES AND 5 VARIABLES PROCESSED.

Table 4-35. In-House QC Sample Differences, Sorted by Radian ID.

	RADID	CHANNEL$	DELTA	ID	CHANL
CASE 1	1199.000	A	0.020	1.000	1.000
CASE 2	1199.000	B	0.030	1.000	2.000
CASE 3	1259.000	A	0.010	2.000	1.000
CASE 4	1259.000	B	0.020	2.000	2.000
CASE 5	1259.000	E	0.040	2.000	5.000
CASE 6	1283.000	A	0.040	3.000	1.000
CASE 7	1283.000	B	0.030	3.000	2.000
CASE 8	1284.000	A	0.010	4.000	1.000
CASE 9	1284.000	B	0.010	4.000	2.000
CASE 10	1306.000	A	0.020	5.000	1.000
CASE 11	1306.000	B	0.010	5.000	2.000
CASE 12	1307.000	A	0.020	6.000	1.000
CASE 13	1307.000	B	0.050	6.000	2.000
CASE 14	1366.000	A	0.010	7.000	1.000
CASE 15	1366.000	B	0.010	7.000	2.000
CASE 16	1367.000	A	0.010	8.000	1.000
CASE 17	1367.000	B	0.070	8.000	2.000
CASE 18	1367.000	C	0.110	8.000	3.000
CASE 19	1367.000	D	0.110	8.000	4.000
CASE 20	1367.000	E	0.	8.000	5.000
CASE 21	1452.000	A	-0.030	9.000	1.000
CASE 22	1452.000	B	0.	9.000	2.000
CASE 23	1452.000	E	0.160	9.000	5.000
CASE 24	1503.000	A	0.070	10.000	1.000
CASE 25	1503.000	B	0.060	10.000	2.000
CASE 26	1530.000	A	0.	11.000	1.000
CASE 27	1530.000	B	0.010	11.000	2.000
CASE 28	1580.000	A	-0.010	12.000	1.000
CASE 29	1580.000	B	0.020	12.000	2.000
CASE 30	1601.000	A	0.040	13.000	1.000
CASE 31	1601.000	B	0.020	13.000	2.000
CASE 32	1709.000	A	0.040	14.000	1.000
CASE 33	1709.000	B	0.050	14.000	2.000
CASE 34	1709.000	E	0.040	14.000	5.000
CASE 35	1806.000	A	0.020	15.000	1.000
CASE 36	1806.000	B	0.010	15.000	2.000
CASE 37	1806.000	E	0.010	15.000	5.000
CASE 38	1828.000	A	0.040	16.000	1.000
CASE 39	1828.000	B	0.030	16.000	2.000
CASE 40	1829.000	A	0.110	17.000	1.000
CASE 41	1829.000	B	0.100	17.000	2.000

(continued)

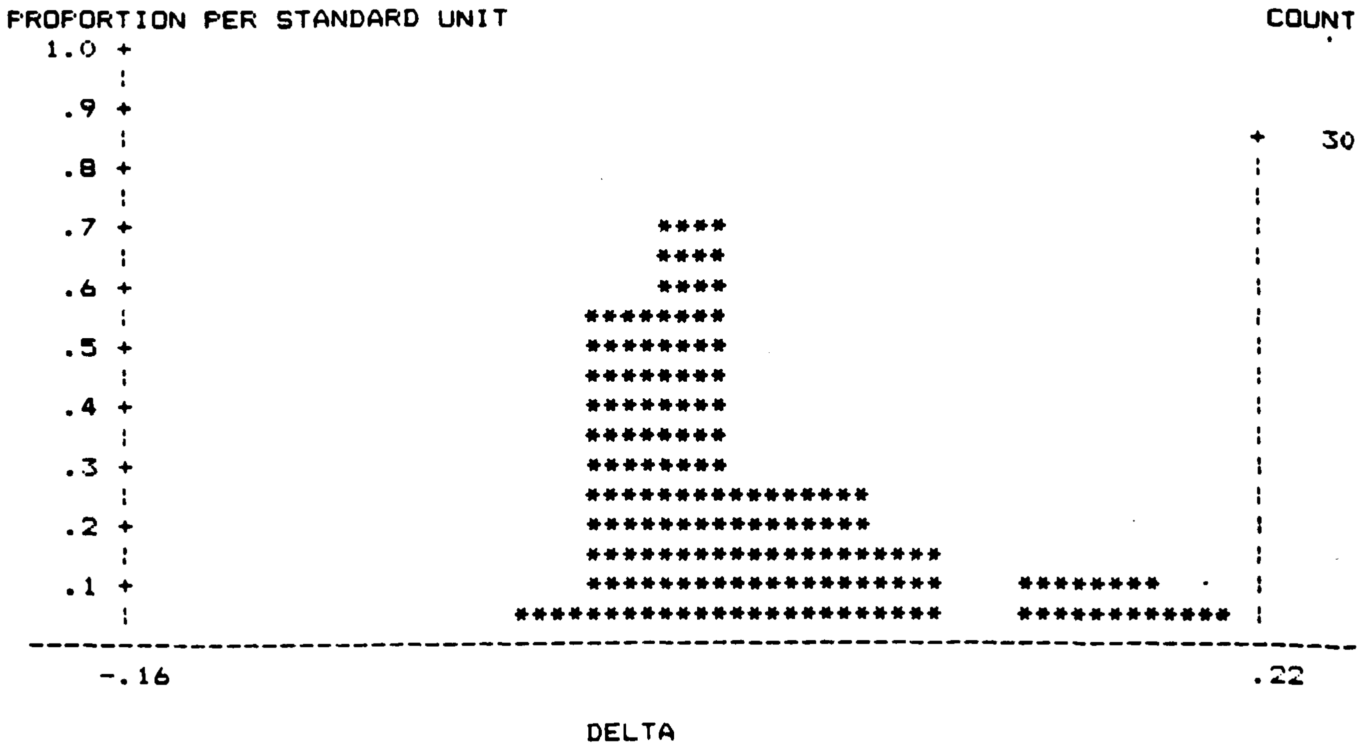


Figure 4-18. In-House QC Sample Differences, Histogram.

Table 4-36

In-House QC Sample Differences.

TOTAL OBSERVATIONS: 82

	DELTA
N OF CASES	82
MINIMUM	-0.16000
MAXIMUM	0.22000
RANGE	0.38000
MEAN	0.05122
VARIANCE	0.00368
STANDARD DEV	0.06066
STD. ERROR	0.00670
SKEWNESS	0.50075
KURTOSIS	1.76487

Table 4-37. In-House QC Sample Differences, by Channel.

THE FOLLOWING RESULTS ARE FOR:
CHANL = 1.00

TOTAL OBSERVATIONS: 21

DELTA

N OF CASES	21
MINIMUM	-0.030
MAXIMUM	0.160
MEAN	0.032
VARIANCE	0.002
STANDARD DEV	0.041
STD. ERROR	0.009

THE FOLLOWING RESULTS ARE FOR:
CHANL = 2.00

TOTAL OBSERVATIONS: 21

DELTA

N OF CASES	21
MINIMUM	0.
MAXIMUM	0.100
MEAN	0.033
VARIANCE	0.001
STANDARD DEV	0.027
STD. ERROR	0.006

THE FOLLOWING RESULTS ARE FOR:
CHANL = 3.00

TOTAL OBSERVATIONS: 15

DELTA

N OF CASES	15
MINIMUM	-0.040
MAXIMUM	0.210
MEAN	0.086
VARIANCE	0.005
STANDARD DEV	0.072
STD. ERROR	0.019

THE FOLLOWING RESULTS ARE FOR:
CHANL = 4.00

TOTAL OBSERVATIONS: 16

DELTA

N OF CASES	16
MINIMUM	-0.160
MAXIMUM	0.220
MEAN	0.069
VARIANCE	0.008
STANDARD DEV	0.089
STD. ERROR	0.022

THE FOLLOWING RESULTS ARE FOR:
CHANL = 5.00

TOTAL OBSERVATIONS: 9

DELTA

N OF CASES	9
MINIMUM	0.
MAXIMUM	0.160
MEAN	0.048
VARIANCE	0.002
STANDARD DEV	0.050
STD. ERROR	0.017

```
        STEM AND LEAF PLOT OF VARIABLE:    DELTA


SMALLEST VALUE AT TOP OF PLOT IS:   -.1600000

          -1    6
        ***OUTSIDE VALUES***
          -0    4
          -0    3
          -0    11
           0 H  0000001111111111111
           0    222222233333
           0 M  44444444444555555
           0 H  66677777
           0    8899
           1    000111
           1
           1    55
           1    66
        ***OUTSIDE VALUES***
           1    7779
           2    12
```

Figure 4-19. In-House QC Sample Differences, Stem and Leaf Plot.

Table 4-38 tests the hypothesis that the means of Channel 1 (= Channel A) and Channel 3 (= Channel C) are equal. The t statistic for this test is

$$t = \frac{(\bar{X}_1 - \bar{X}_3)}{\sqrt{\frac{(N_1 - 1)\, S_1^2 + (N_2 - 1)\, S_2^2}{N_1 + N_2 - 2}} \; \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$$

with $N_1 + N_2 - 2$ degrees of freedom. The table shows that t = 1.201, whereas the Student's t statistic is $\pm$ 2.042. Therefore it may be concluded that there is no significant difference in these tests between the four Radian channels and the EPA Channel E, and that there is a positive bias in the results. In addition, as noted above, all channels tested significantly greater than zero.

In doing the two-way analysis of variance for the in-house QC sample difference data, it was discovered that the memory size of the computer being used (an IBM PC computer with 256K memory), was insufficient to analyze all the data in one pass. It was therefore decided to break the data into 2 data sets with several overlapping ID numbers in the two sets. For Table 4-39 the ID numbers are for ID numbers 1 through 20. For Table 4-40 the ID numbers range from 16 through 35. The purpose of the analysis given in Tables 4-39 and 4-40 is to do an analysis of variance (ANOVA) to determine whether the channel or the sample ID is a factor in determining the difference DELTA. The model is

$$\text{DELTA} = \mu + \text{ID} + \text{CHANL} + \text{ERROR}$$

As noted in the tables, neither ID nor CHANL is a factor at the 5% level of significance (i.e., $P > 0.05$) for the data of Table 4-39, whereas ID is a strong factor in determining the variance of DELTA in Table 4-40.

Table 4-41 lists statistics for in-house QC sample differences by ID Number. These data are used to investigate why the ID number is a significant factor in the ANOVA given in Table 4-38. The results of the analysis are given in Table 4-42.

Table 4-38. Tests of Hypotheses In-House QC Sample Differences, by Channel.

CHANNEL	$\overline{DI}$	SD	SEE	N	t	$t_{\nu,0.975}$
1 = A	0.032	0.041	0.0089	21	3.596	2.086
2 = B	0.033	0.027	0.0059	21	5.593	2.086
3 = C	0.086	0.072	0.0186	15	4.624	2.145
4 = D	0.069	0.089	0.0223	16	3.094	2.131
5 = E	0.048	0.050	0.0167	9	2.874	2.306

Compare Channel 3 with Channel 1 (largest with smallest)

$t = 1.201$ with 34 degrees of freedom.

$t_{34,0.975} = 2.042$ There is no significant difference.

Conclusions

- There were no significant differences between in-house QC samples for Channels A, B, C, D, and E.
- There was a significant difference from zero, or bias in the data. The mean bias for all channels is +0.051 ppmc (Table 4-42).
- All channels significantly greater than zero.

Table 4-40

In-House QC Sample Differences.
ID 16 through 35.

NUMBER OF CASES PROCESSED: 45

DEPENDENT VARIABLE MEAN: 0.068

MULTIPLE CORRELATION: .933

SQUARED MULTIPLE CORRELATION: .870

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ID	0.186	19	0.010	7.107	.000
CHANL	0.003	4	0.001	.596	.670
ERROR	0.029	21	0.001		

****

Table 4-39

In-House QC Sample Differences.

ID = 1 through 20

NUMBER OF CASES PROCESSED: 47

DEPENDENT VARIABLE MEAN: 0.038

MULTIPLE CORRELATION: .797

SQUARED MULTIPLE CORRELATION: .636

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ID	0.037	19	0.002	1.585	.146
CHANL	0.011	4	0.003	2.335	.086
ERROR	0.028	23	0.001		

****

Table 4-41 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ID = 5.00

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.01000
MAXIMUM	0.02000
MEAN	0.01500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 6.00

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.02000
MAXIMUM	0.05000
MEAN	0.03500
VARIANCE	0.00045
STANDARD DEV	0.02121
STD. ERROR	0.01500

THE FOLLOWING RESULTS ARE FOR:
ID = 7.00

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.01000
MAXIMUM	0.01000
MEAN	0.01000
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
ID = 8.00

TOTAL OBSERVATIONS: 5

DELTA

N OF CASES	5
MINIMUM	0.
MAXIMUM	0.11000
MEAN	0.06000
VARIANCE	0.00280
STANDARD DEV	0.05292
STD. ERROR	0.02366

THE FOLLOWING RESULTS ARE FOR:
ID = 9.00

TOTAL OBSERVATIONS: 3

DELTA

N OF CASES	3
MINIMUM	-0.03000
MAXIMUM	0.16000
MEAN	0.04333
VARIANCE	0.01043
STANDARD DEV	0.10214
STD. ERROR	0.05897

THE FOLLOWING RESULTS ARE FOR:
ID = 10.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.06000
MAXIMUM	0.07000
MEAN	0.06500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 11.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.
MAXIMUM	0.01000
MEAN	0.00500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 12.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	-0.01000
MAXIMUM	0.02000
MEAN	0.00500
VARIANCE	0.00045
STANDARD DEV	0.02121
STD. ERROR	0.01500

Table 4-41. In-House QC Sample Differences, by ID Number.

THE FOLLOWING RESULTS ARE FOR:
ID = 1.00

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.02000
MAXIMUM	0.03000
MEAN	0.02500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 2.00

TOTAL OBSERVATIONS: 3

	DELTA
N OF CASES	3
MINIMUM	0.01000
MAXIMUM	0.04000
MEAN	0.02333
VARIANCE	0.00023
STANDARD DEV	0.01528
STD. ERROR	0.00882

THE FOLLOWING RESULTS ARE FOR:
ID = 3.00

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.03000
MAXIMUM	0.04000
MEAN	0.03500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 4.00

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.01000
MAXIMUM	0.01000
MEAN	0.01000
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

Table 4-41 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ID = 21.0

TOTAL OBSERVATIONS: 4

	DELTA
N OF CASES	4
MINIMUM	0.03000
MAXIMUM	0.04000
MEAN	0.03750
VARIANCE	0.00002
STANDARD DEV	0.00500
STD. ERROR	0.00250

THE FOLLOWING RESULTS ARE FOR:
ID = 22.0

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.07000
MAXIMUM	0.08000
MEAN	0.07500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 23.0

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	-0.01000
MAXIMUM	0.
MEAN	-0.00500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 24.0

TOTAL OBSERVATIONS: 3

	DELTA
N OF CASES	3
MINIMUM	-0.16000
MAXIMUM	0.
MEAN	-0.06667
VARIANCE	0.00693
STANDARD DEV	0.08327
STD. ERROR	0.04807

THE FOLLOWING RESULTS ARE FOR:
ID = 25.0

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.17000
MAXIMUM	0.22000
MEAN	0.19500
VARIANCE	0.00125
STANDARD DEV	0.03536
STD. ERROR	0.02500

THE FOLLOWING RESULTS ARE FOR:
ID = 26.0

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.17000
MAXIMUM	0.17000
MEAN	0.17000
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
ID = 27.0

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.03000
MAXIMUM	0.15000
MEAN	0.09000
VARIANCE	0.00720
STANDARD DEV	0.08485
STD. ERROR	0.06000

THE FOLLOWING RESULTS ARE FOR:
ID = 28.0

TOTAL OBSERVATIONS: 2

	DELTA
N OF CASES	2
MINIMUM	0.04000
MAXIMUM	0.04000
MEAN	0.04000
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
ID = 13.0

TOTAL OBSERVATIONS: 2

DELTA	
N OF CASES	2
MINIMUM	0.02000
MAXIMUM	0.04000
MEAN	0.03000
VARIANCE	0.00020
STANDARD DEV	0.01414
STD. ERROR	0.01000

THE FOLLOWING RESULTS ARE FOR:
ID = 14.0

TOTAL OBSERVATIONS: 3

DELTA	
N OF CASES	3
MINIMUM	0.04000
MAXIMUM	0.05000
MEAN	0.04333
VARIANCE	0.00003
STANDARD DEV	0.00577
STD. ERROR	0.00333

THE FOLLOWING RESULTS ARE FOR:
ID = 15.0

TOTAL OBSERVATIONS: 3

DELTA	
N OF CASES	3
MINIMUM	0.01000
MAXIMUM	0.02000
MEAN	0.01333
VARIANCE	0.00003
STANDARD DEV	0.00577
STD. ERROR	0.00333

THE FOLLOWING RESULTS ARE FOR:
ID = 16.0

TOTAL OBSERVATIONS: 2

DELTA	
N OF CASES	2
MINIMUM	0.03000
MAXIMUM	0.04000
MEAN	0.03500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID 17.0

TOTAL OBSERVATIONS: 2

DELTA	
N OF CASES	2
MINIMUM	0.10000
MAXIMUM	0.11000
MEAN	0.10500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 18.0

TOTAL OBSERVATIONS: 2

DELTA	
N OF CASES	2
MINIMUM	0.01000
MAXIMUM	0.01000
MEAN	0.01000
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
ID = 19.0

TOTAL OBSERVATIONS: 2

DELTA	
N OF CASES	2
MINIMUM	0.05000
MAXIMUM	0.07000
MEAN	0.06000
VARIANCE	0.00020
STANDARD DEV	0.01414
STD. ERROR	0.01000

THE FOLLOWING RESULTS ARE FOR:
ID = 20.0

TOTAL OBSERVATIONS: 2

DELTA	
N OF CASES	2
MINIMUM	0.06000
MAXIMUM	0.16000
MEAN	0.11000
VARIANCE	0.00500
STANDARD DEV	0.07071
STD. ERROR	0.05000

Table 4-42. In-House QC Sample Differences, Ranked by Mean Difference of ID Number

Rank	ID	$\overline{DELTA}$	N	Std. Dev.	Radian ID
1	32	0.200	2	0.0141	2139
2	25	0.195	2	0.0354	1391
3	26	0.170	2	0.0000	1557
4	29	0.110	3	0.0361	2091
5	20	0.110	2	0.0071	2342
6	17	0.105	2	0.0071	1829
7	27	0.090	2	0.0899	1919
8	34	0.090	2	0.000	2414
9	31	0.095	2	0.0354	2110
10	22	0.075	2	0.0071	1214
11	10	0.065	2	0.0071	1503
12	19	0.060	2	0.0141	2184
13	30	0.060	3	0.0100	2092
14	8	0.060	5	0.0529	1367
15	35	0.045	2	0.007	1159
16	9	0.043	3	0.1021[a]	1452
17	14	0.043	3	0.0057	1709
18	28	0.040	2	0.0000	1945
19	21	0.038	4	0.0050	2446
20	3	0.035	2	0.0071	1283
21	6	0.035	2	0.0212	2446
22	16	0.035	2	0.0071	1828
23	13	0.030	2	0.0141	1601
24	1	0.025	2	0.0071	1199
25	2	0.023	3	0.0153	1259
26	5	0.015	2	0.0071	1306
27	15	0.013	3	0.0058	1806
28	7	0.010	2	0.0000	1366
29	4	0.010	2	0.0071	1284
30	18	0.010	2	0.0000	1991
31	11	0.005	2	0.0071	1530
32	33	0.005	2	0.0071	2315
33	12	0.005	2	0.0212	1580
34	23	-0.005	2	0.0071	2414
35	24	-0.067	2	0.0833	1159

[a]This standard deviation seems to be an outlier.

Table 4-42 ranks the ID numbers by the size of the difference (DELTA). Note that ID numbers 20, 29, 26, 25, and 32 are the largest of all the ID means, and ID number 24 is the smallest. These means are among the ID numbers in the ANOVA done in Table 4-41 and explain why the ID factor is highly significant in the analyses. The conclusions that may be drawn from the comparisons made in Table 4-42 are the following:

- The ID number with mean DELTA between 0.005 and 0.110 are indistinguishable from each other and from zero.
- ID numbers 25, 26 and 32 are significantly greater than ID number 20 or 29 (means = 0.110).
- ID numbers 23 and 24 are significantly less than ID number 29 (mean = 0.110).

Although the analysis done here on the in-house QC sample differences show that the channel is not a factor in explaining the in-house QC difference, it does indicate that the sample itself is a factor. Moreover in the data presented here, only the samples in the second set of samples analyzed show a significant relationship to DELTA. What the information may reveal is that the in-house QC samples in the second batch were not as carefully prepared as in the first batch, resulting in some "outliers." Insofar as the NMOC technique itself is concerned, it may be that one should plot the propane in-house sample difference DELTA in a quality control chart and whenever the reading goes outside the 2σ limits of the QC plot, then the cause of that kind of phenomenon should be sought, and the appropriate corrective action taken.

Table 1-4 summarizes the In-House QC Standards data in terms of an accuracy measurement. It shows the % error measurement ranging from +3.5% to 6.5% for the four Radian channels and the EPA Channel E. The average for all channels was +5.7%.

4.2.5.2 <u>Other QC Samples</u>—Three QC samples prepared by the U.S. EPA Quality Assurance Divison (QAD) were analyzed on the EPA Channel E (at QAD) and several Radian channels. The samples were either pure dry propane or propane blended with purified dried air. Table 1-5 summarizes the results of the analyses on these samples. The samples were analyzed first on EPA

Table 4-41 (cont.)

THE FOLLOWING RESULTS ARE FOR:
ID = 29.0

TOTAL OBSERVATIONS: 3

DELTA

N OF CASES	3
MINIMUM	0.08000
MAXIMUM	0.15000
MEAN	0.11000
VARIANCE	0.00130
STANDARD DEV	0.03606
STD. ERROR	0.02082

THE FOLLOWING RESULTS ARE FOR:
ID = 30.0

TOTAL OBSERVATIONS: 3

DELTA

N OF CASES	3
MINIMUM	0.05000
MAXIMUM	0.07000
MEAN	0.06000
VARIANCE	0.00010
STANDARD DEV	0.01000
STD. ERROR	0.00577

THE FOLLOWING RESULTS ARE FOR:
ID = 31.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.05000
MAXIMUM	0.10000
MEAN	0.07500
VARIANCE	0.00125
STANDARD DEV	0.03536
STD. ERROR	0.02500

THE FOLLOWING RESULTS ARE FOR:
ID = 32.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.19000
MAXIMUM	0.21000
MEAN	0.20000
VARIANCE	0.00020
STANDARD DEV	0.01414
STD. ERROR	0.01000

THE FOLLOWING RESULTS ARE FOR:
ID = 33.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.
MAXIMUM	0.01000
MEAN	0.00500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

THE FOLLOWING RESULTS ARE FOR:
ID = 34.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.09000
MAXIMUM	0.09000
MEAN	0.09000
VARIANCE	0.
STANDARD DEV	0.
STD. ERROR	0.

THE FOLLOWING RESULTS ARE FOR:
ID = 35.0

TOTAL OBSERVATIONS: 2

DELTA

N OF CASES	2
MINIMUM	0.04000
MAXIMUM	0.05000
MEAN	0.04500
VARIANCE	0.00005
STANDARD DEV	0.00707
STD. ERROR	0.00500

Channel E, followed by one or more analyses on Radian channels as indicated. Table 1-5 does not imply the order in which analyses were done and that information is not available in the Table. Error is defined as the NMOC value for the first NMOC analysis minus the NMOC value for the subsequent analysis. The first analysis was always done on EPA Channel E.

The overall absolute value of the error ranged from zero to 15.38%, averaging about 5.8%. This is an accuracy measure for the measurement of propane. Since the NMOC measurements made at the sites were of unknown composition, no absolute measure of accuracy was possible.

5.0 NMOC DATA ANALYSIS

The NMOC data for 22 sites are found in Tables 2-3 to 2-24. The tables include the following information:

1. The sample site identification;
2. The sample dates;
3. The Julian date;
4. The week-day of the sample date;
5. Radian laboratory identification number;
6. The sample canister number;
7. The pressure at the completion of sampling;
8. The date the sample was analyzed;
9. The Radian instrument on which the analysis took place;
10. The NMOC value determined by Radian, ppmC;
11. The NMOC value determined by EPA, Channel E, ppmC; and
12. The NMOC value determined by EPA, ESRL by GC, ppmC.

The discussion that follows will first examine statistics for all 22 NMOC sites, and then the discussion will focus on the several sites individually.

Figure 5-1 gives a stem and leaf plot of the NMOC data. The plot is a graph of the frequency of occurrence (horizontal scale) versus size (vertical scale), and is made according to Tukey[a]. The overall shape of the NMOC distribution suggests that the data approximately fit a logarithmic normal distribution. The stems for this plot are equally spaced and are numbered from zero to 47 in the left hand column of the plot. For Figure 5-1 there are 60 stems. The leaves are plotted on the right hand side of the diagram and represent the frequency of occurrence for a particular stem. The median M and the hinges H are plotted in the vertical area between the stems and the leaves. The median splits the ordered data in

---

[a]Tukey, J. W., Exploratory Data Analysis, Addison-Wesley, Reading, Mass. (1977).

Figure 5-1. Complete NMOC Data.

```
        STEM AND LEAF PLOT OF VARIABLE:        F

    SMALLEST VALUE AT TOP OF PLOT IS:    .6000000E-01

              0    6
              1    11122334444
              1    556677888889999999999
              2    0001111111111222223333333444
              2    5555555555566666667777777778888888888888899999999
              3    00000000011111122222222222222222333333333333333444444444
              3    555555555555555556666777777777777788888888888889999999999999999999
              4    00000000000011111111122222222222333333333333333444444444444444
              4 H  5555555555555555666666666666677777777777777777777888888888888888888999999999999999
              5    000000000000000000000111111111111111111111222222222222222223333333333333344444
              5    55555555555555556666666666666666666666667777777777778888888888888888899999999999
              6    000000000000000001111111111111222222222223333333333333334444444444444
              6 M  5555555555555555666666666666666666667777777777777777788888888888888888899999999999
              7    00000001111111111111112222222222333333333333444444444444444444
              7    5555555555555556666666666666666777777777777888888888899999999999
              8    00000000000111111111111112222222222333333333333444444444
              8    55555555566667777778888888888899999999999999
              9    00001111112222222333333344444444444
              9    5555556666666666666677778888888899999999999
             10 H  000000111111122222222233333444
             10    555555666666667777788999999999
             11    000000111112222333444444444
             11    5556666667777777788889999
             12    0000011112222233334
             12    55556667777788888999999
             13    000001112233444
             13    5555555556667888899
             14    01111112222223333344444
             14    556667777788
             15    1223
             15    556678889999
             16    0111122233444
             16    5677788899
             17    001233444
             17    5678
             18    01222344
             18    56666
          ***OUTSIDE VALUES***
             18    889
             19    0000234466999
             20    4447799
             21    4689
             22    000112455
             23    035
             24    1455669
             25    000277
             26    00236
             27    15678
             28    6
             29    1345
             30    9
             31    0
             33    55
             36    1
             37    0
             38    14
             39    3
             40    38
             42    7
             43    16
             47    45
```

Table 5-1. Statistics for Complete NMOC Data.

TOTAL OBSERVATIONS: 1375

	NMOC
N OF CASES	1375
MINIMUM	0.06000
MAXIMUM	4.75000
RANGE	4.69000
MEAN	0.85284
VARIANCE	0.36734
STANDARD DEV	0.60608
STD. ERROR	0.01634
SKEWNESS	2.35013
KURTOSIS	8.13863

For Stem and Leaf Plot

$4.690 \div 60 = 0.07817$ NMOC/Stem

Mean $= 0.06 + x(0.07817) = 0.85284$ ppmC

$x = 10.1$ stems

Median = 13 stems, from initial value of 0.060

Median = $0.06 + 13(0.07817) = 1.076$ ppmC

Mode $= 0.06 + 9(0.07817) = 0.7635$ ppmC

For a logarithmic normal distribution

mean $>$ median $>$ mode.

For NMOC data (Figure 5-1)

median $>$ mean $>$ mode

half and the hinges divide each half once more in equal quarters. The "H-spread" is the difference between the values of the two hinges. The "inner fences" are defined as follows:

lower fence = lower hinge - (1.5*Hspread)

upper fence = upper hinge + (1.5*Hspread)

Any values outside the inner fences are printed on separate lines and separated from the inner values by a line of text: ***OUTSIDE VALUES***.

In order to put the stem and leaf plot into additional perspective, refer to Table 5-1 which gives the minimum and maximum and mean values for the NMOC data. Table 5-1 also shows approximate calculations for the stem and leaf plot and estimates numerical values for the mean, the median, and the mode. The table also shows that the NMOC data does not fit the general requirements of a logarithmic normal distribution because the NMOC estimated median is apparently greater than the NMOC mean. The logarithmic normal distribution requires that the mean is greater than the median. Nevertheless the expectation is that the data fit a logarithmic normal distribution better than most other mathematically defined distributions.

Figure 5-2 gives a stem and leaf plot of the NMOC Data Analyzed by the EPA Channel E, and Table 5-2 gives the statistics corresponding to those data. The skewness is not as pronounced with the Channel E results as with the Radian results in Figure 5-1, but only 120 cases are involved in the construction of Figure 5-2. Figure 5-3 and Table 5-3 present the data analyzed by EPA Channel GC and both the frequency distribution (Figure 5-3) and the statistics (Table 5-3) appear to be similar to the results from all the Radian measurements (Figure 5-1 and Table 5-1).

Figure 5-4 and Table 5-4 present the data of the standard deviations of pairs of NMOC measurements made by Radian. Each of the Radian NMOC measurements resulted from an average of two readings. The standard deviations of each of 1372 pairs of readings on each sample are summarized in Figure 5-4 and Table 5-4, and show a distribution highly skewed with a very high peak. The asterisks at the right-hand edges of stems 0 through 4 indicate that the actual peak is higher than shown. The mean standard deviation from Table 5-4 is 0.05425 ppmC, which is about 6.4% of the mean NMOC reading of 0.85284 (given in Table 5-1). This is an indication of the within-instrument precision.

Figure 5-2. NMOC Data Analyzed by EPA Channel E.

```
        STEM AND LEAF PLOT OF VARIABLE:   CHANLE

SMALLEST VALUE AT TOP OF PLOT IS:    .2300000

                2   38
                3   1123379
                4   1235599
                5   2346799
                6 H 01233469
                7   01234455669
                8   122244466
                9 M 000014449
               10   0023447
               11   022222345556677
               12   2233457
               13 H 003334556
               14   369
               15   003456
               16   013
               17   477
               18   29
               19   3
        ***OUTSIDE VALUES***
               22   7
               36   4
               42   58
```

Table 5-2. NMOC Data Analyzed by EPA Channel E.

	CHANLE
N OF CASES	120
MINIMUM	0.23000
MAXIMUM	4.28000
RANGE	4.05000
MEAN	1.06383
VARIANCE	0.40721
STANDARD DEV	0.63813
STD. ERROR	0.05825
SKEWNESS	2.63603
KURTOSIS	10.47658

Figure 5-3. NMOC Data Analyzed by EPA GC.

```
STEM AND LEAF PLOT OF VARIABLE:      GC

SMALLEST VALUE AT TOP OF PLOT IS:   .6000000E-01

        0    68
        1    356888
        2    011125688899
        3    00112222333444455556777777888 99
        4 H  000011111222223333334444444555556666777777889999999
        5    011112222222233334444444444556666778888888899999
        6 M  0001112233444444555667777788899999
        7    00011111122222333444556666679999
        8    000111245555566777888
        9    013444677789
       10 H  0005555666679
       11    02333345678999
       12    233468
       13    013466
       14    1258
       15    33344799
       16    0011355799
       17    15668
       18    0038
       19    05566
 ***OUTSIDE VALUES***
       20    3579
       22    18
       23    278
       24    68
       25    2
       27    7
       33    5
       35    1
       37    25
       39    4
       40    3
       47    0
```

Table 5-3. NMOC Data Analyzed by EPA Channel GC.

	GC
N OF CASES	336
MINIMUM	0.06000
MAXIMUM	4.70000
RANGE	4.64000
MEAN	0.88205
VARIANCE	0.45508
STANDARD DEV	0.67460
STD. ERROR	0.03680
SKEWNESS	2.32995
KURTOSIS	7.18846

Figure 5-4. Stem and Leaf Plot of the Standard Deviation of Radian NMOC Measurements.

STEM AND LEAF PLOT OF VARIABLE: SDNM

SMALLEST VALUE AT TOP OF PLOT IS: .0000000

3 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

Table 5-4. Standard Deviations of Radian NMOC Analyses.

	SDNM
N OF CASES	1372
MINIMUM	0.
MAXIMUM	0.66000
RANGE	0.66000
MEAN	0.03995
VARIANCE	0.00294
STANDARD DEV	0.05425
STD. ERROR	0.00146
SKEWNESS	4.07394
KURTOSIS	27.24995

Data from four sites (Dallas, Texas; Clute, Texas; Philadelphia, Pennsylvania; and Akron, Ohio) were tested for first-order autocorrelation. In order to test the data, one may plot NMOC on a given day (Y) versus the NMOC value from the previous day (X). These plots are shown in Figures 5-5 through 5-8. Tables 5-5 through 5-8 are linear regressions of Y vs. X for the four sites. Slopes of the lines are the first-order autocorrelation coefficients and are given below:

Site	First-Order Autocorrelation Coefficient
Dallas	0.221
Clute	0.008
Philadelphia	0.114
Akron	0.103

The coefficients given above indicate that the data are not significantly autocorrelated. Autocorrelation coefficients range from -1.000 to 1.000 and the closer they are to the terminal values, the more strongly are they autocorrelated.

Figures 5-9 through 5-30 show histograms of the size distributions of the NMOC data for each site. The figures also contain statistics for the data from each site. The means for the individual sites ranged from 0.532 ppmC for Richmond, Virginia to 1.432 ppmC for Memphis, Tennessee. The overall mean for the complete data set was 0.853 ppmC. The shapes of the distribution diagrams were similar (skewness about 2., kurtosis greater than 3.) with notable exceptions at Birmingham, El Paso, Miami, Richmond, and Wilkes-Barre.

Table 5-9 tests the minimum and maximum data points from each site as outliers. In no case were the minimum points considered to be outliers by the Grubbs test used in Table 5-9. All of the maximum values tested for each site were declared outliers at the 1% level of significance by the Grubbs and Beck test used (see Table 5-9 for the reference), except those in Birmingham, Miami, Richmond and Wilkes-Barre. The conclusions to be reached in these tests is that the Grubbs test assumes a random error from a normally distributed sample population and probably should not be used with the NMOC data. The NMOC data gathered in the study are not random

Figure 5-5

Time Series Analysis Plot, First-Order Autoregression.

Dallas, Texas Data.

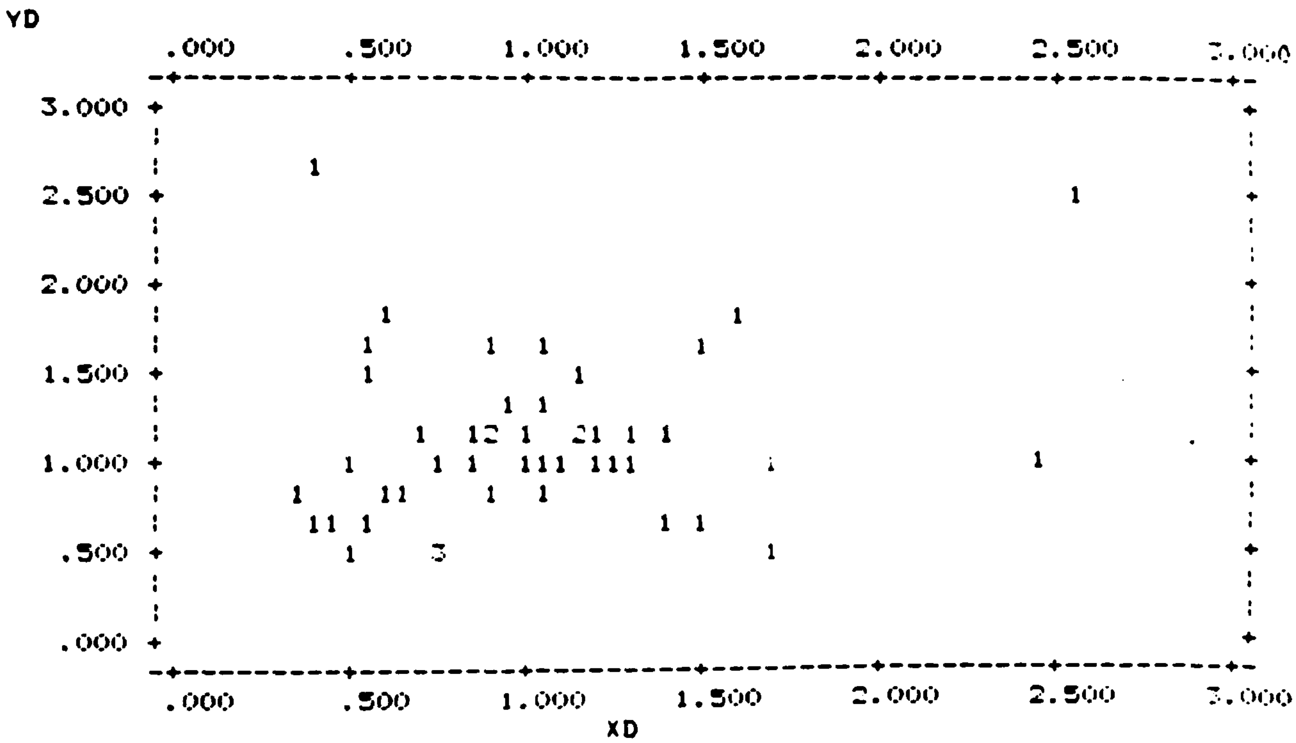


Table 5-5

First-Order Autoregression for Dallas, Texas Data.

NUMBER OF CASES PROCESSED: 48

DEPENDENT VARIABLE MEAN: 1.036

MULTIPLE CORRELATION: .224

SQUARED MULTIPLE CORRELATION: .050

ADJUSTED $R^2 = 1-(1-R^2)*(N-1)/DF$, WHERE N= 48, AND DF= 46: .029

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.811	0.159	0.	.	5.09	.000
XD	0.221	0.142	0.224	1.00000	1.56	.127

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.519	1	0.519	2.422	.127
RESIDUAL	9.857	46	0.214		

****

Figure 5-6

Time Series Analysis Plot, First-Order Autoregression.

Clute, Texas Data.

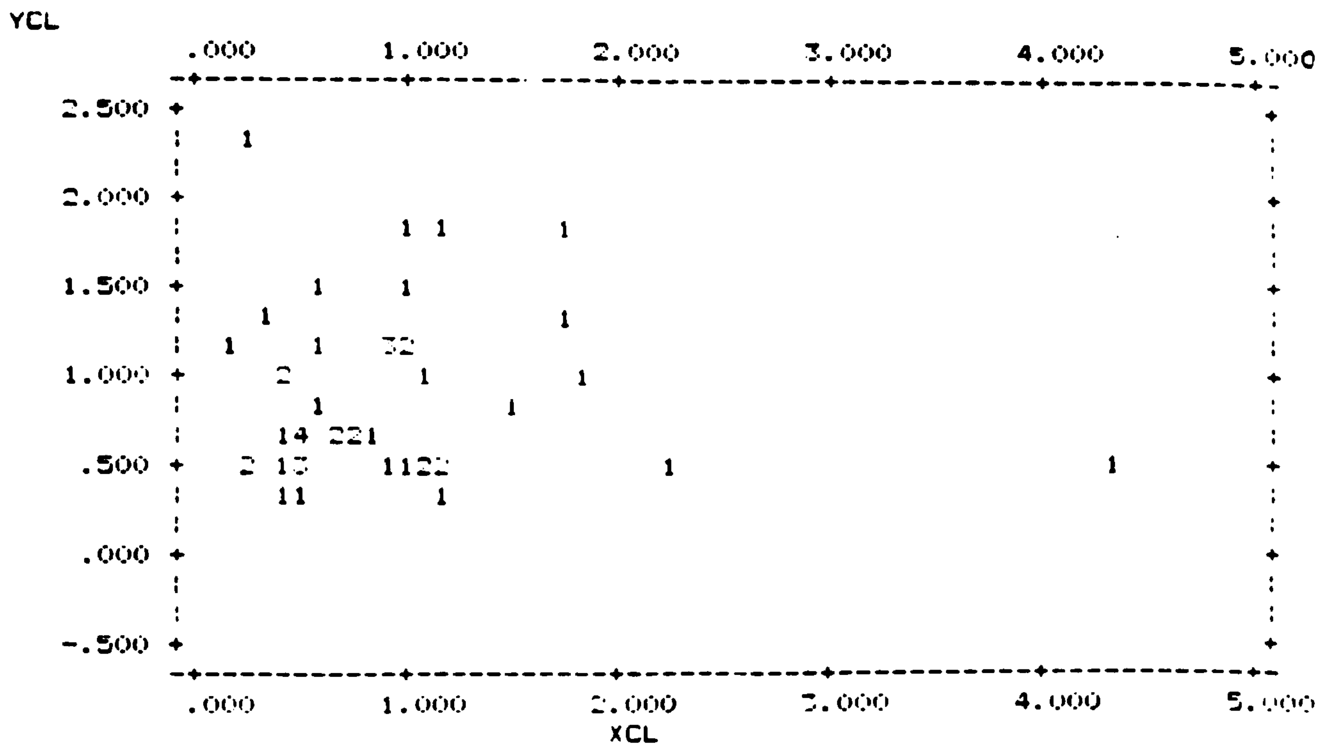


Table 5-6

First-Order Autoregression for Clute, Texas Data.

NUMBER OF CASES PROCESSED: 48

DEPENDENT VARIABLE MEAN: 0.798

MULTIPLE CORRELATION: .012

SQUARED MULTIPLE CORRELATION: .000

ADJUSTED $R^2 = 1-(1-R^2)*(N-1)/DF$, WHERE N= 48, AND DF= 46: .000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.791	0.108	0.	.	7.30	.000
XCL	0.008	0.098	0.012	1.00000	.08	.937

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.001	1	0.001	.006	.937
RESIDUAL	9.352	46	0.203		

****

Figure 5-7

Time Series Analysis Plot, First-Order Autoregression.

Philadelphia, Pennsylvania Data.

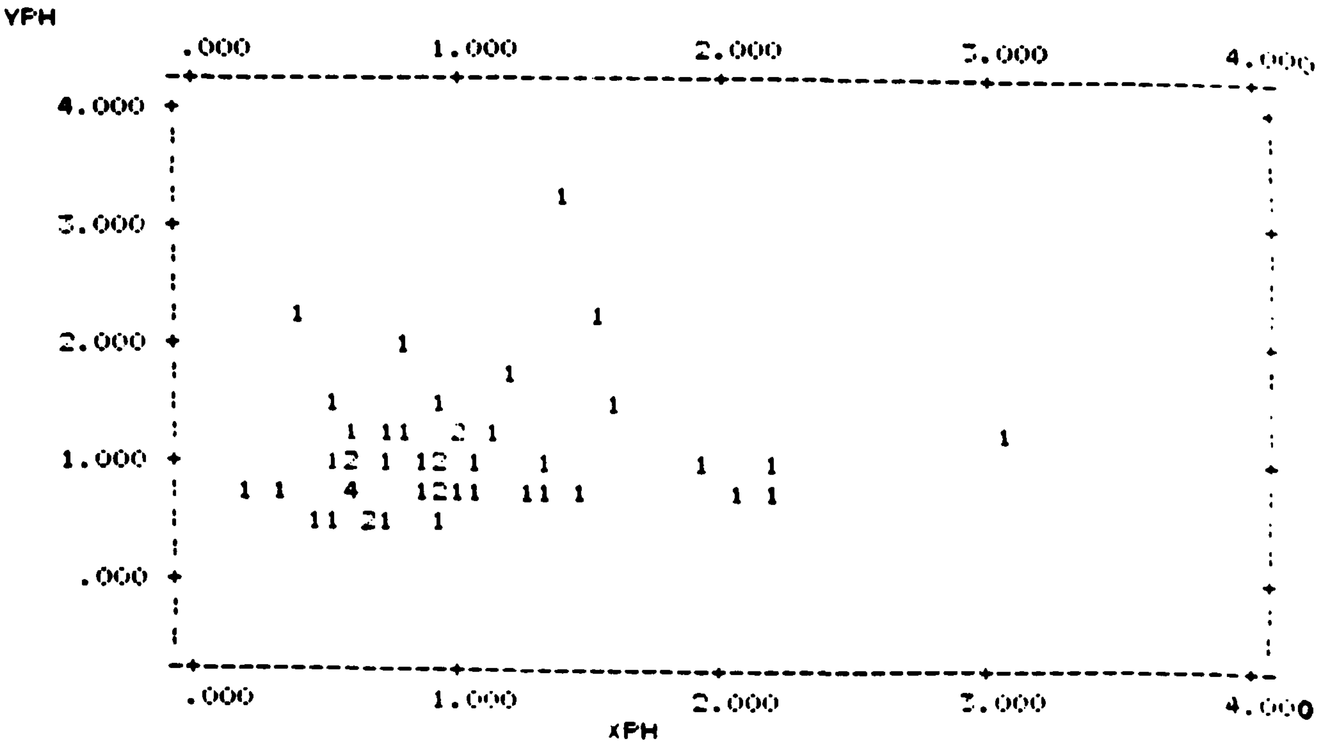


Table 5-7

First-Order Autoregression for Philadelphia.

NUMBER OF CASES PROCESSED: 48

DEPENDENT VARIABLE MEAN: 0.923

MULTIPLE CORRELATION: .152

SQUARED MULTIPLE CORRELATION: .023

ADJUSTED R^2 = $1-(1-R^2)*(N-1)/DF$, WHERE N= 48, AND DF= 46: .002

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.777	0.160	0.	.	4.86	.000
XPH	0.144	0.139	0.152	1.00000	1.04	.304

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.308	1	0.308	1.081	.304
RESIDUAL	13.115	46	0.285		

****

Figure 5-8

Time Series Analysis Plot, First-Order Autoregression.

Akron, Ohio Data.

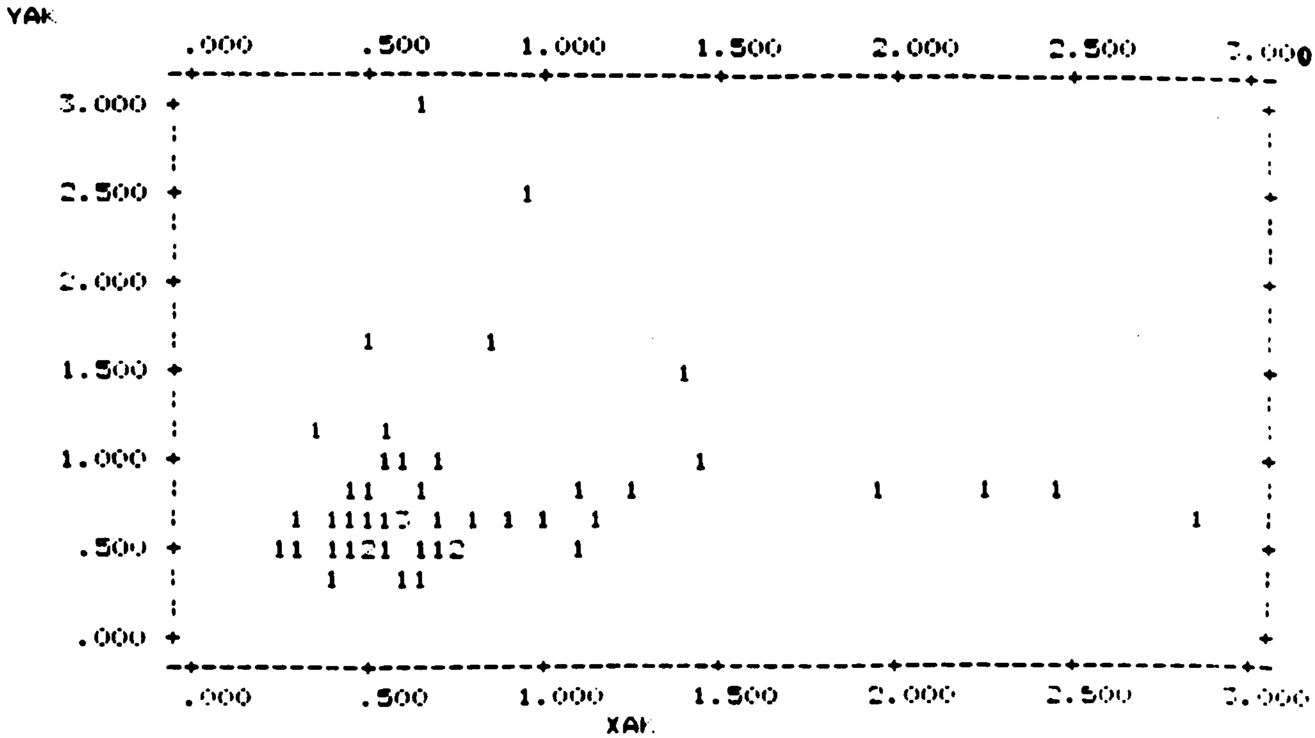


Table 5-8

First-Order Autoregression for Akron, Ohio Data.

NUMBER OF CASES PROCESSED: 48

DEPENDENT VARIABLE MEAN: 0.749

MULTIPLE CORRELATION: .114

SQUARED MULTIPLE CORRELATION: .013

ADJUSTED $R^2 = 1-(1-R^2)*(N-1)/DF$, WHERE N= 48, AND DF= 46: .000

VARIABLE	COEFFICIENT	STD. ERROR	STD. COEF.	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.665	0.130	0.		5.12	.000
XA1	0.103	0.132	0.114	1.00000	.78	.442

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.153	1	0.153	.602	.442
RESIDUAL	11.668	46	0.254		

****

Figure 5-9

```
          Akron Ohio NMOC Data.

PROPORTION PER STANDARD UNIT                                                  COUNT
 1.0 +
     :
  .9 -    ****                                                              -   20
     :    ****                                                              :
  .8 +    ********                                                          :
     :    ********                                                          :
  .7 +    ********                                                          :
     :    ********                                                          :
  .6 +    ********                                                          :
     :    ********                                                          :
  .5 +    ********                                                          :
     :************                                                          :
  .4 +************                                                          :
     :************                                                          :
  .3 +************                                                          :
     :****************                                                      :
  .2 +********************                                                  :
     :********************                                                  :
  .1 +********************                                                  :
     :********************    ****                                   ****   :
------------------------------------------------------------------------------
    .23                       )                                         2.95

                                 NMOC
```

Akron Ohio NMOC Data.

TOTAL OBSERVATIONS: 68

	NMOC
N OF CASES	68
MINIMUM	0.230
MAXIMUM	2.950
RANGE	2.720
MEAN	0.786
VARIANCE	0.318
STANDARD DEV	0.564
STD. ERROR	0.068
SKEWNESS	2.254
KURTOSIS	4.956

Figure 5-10

Atlanta, Georgia NMOC Data.

```
PROPORTION PER STANDARD UNIT                                                          COUNT
  1.0 +
      ! ******                                                                       +    30
   .9 + ******                                                                       :
      ! ******                                                                       :
   .8 + ******                                                                       :
      ! ******                                                                       :
   .7 + ******                                                                       :
      ! ******                                                                       :
   .6 + ******                                                                       :
      ! ******                                                                       :
   .5 + ************                                                                 :
      ! ************                                                                 :
   .4 + ************                                                                 :
      ! ************                                                                 :
   .3 + ************                                                                 :
      ! ************                                                                 :
   .2 + ************                                                                 :
      ! ************                                                                 :
   .1 + ************                                                                 :
      ! ************************                                                     :
---------------------------------------------------------------------------------------------
      .21        ^          )                                                      4.27

                                          NMOC
```

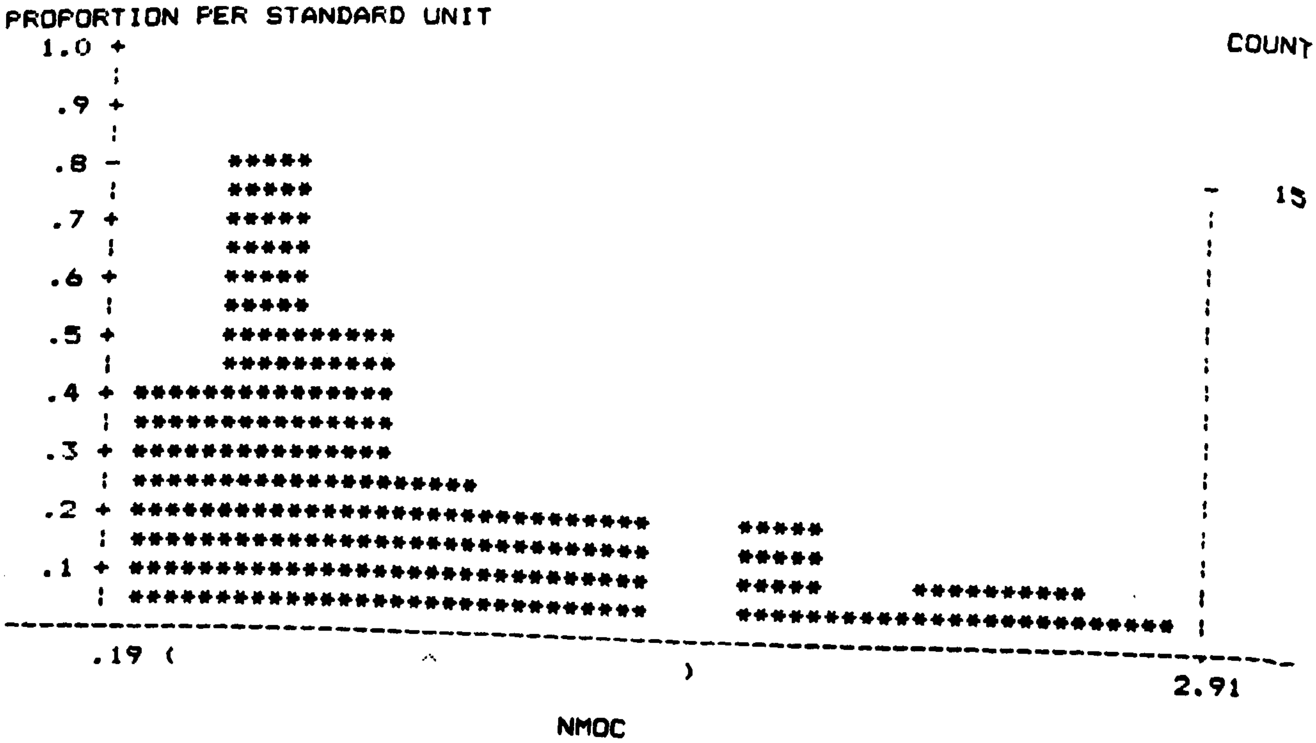
Atlanta Georgia NMOC Data.

TOTAL OBSERVATIONS: 55

	NMOC
N OF CASES	55
MINIMUM	0.210
MAXIMUM	4.270
RANGE	4.060
MEAN	0.788
VARIANCE	0.512
STANDARD DEV	0.715
STD. ERROR	0.096
SKEWNESS	2.982
KURTOSIS	10.175

Figure 5-11

Birmingham, Alabama NMOC Data.



Birmingham Alabama NMOC Data.

TOTAL OBSERVATIONS: 56

	NMOC
N OF CASES	56
MINIMUM	0.190
MAXIMUM	2.910
RANGE	2.720
MEAN	0.992
VARIANCE	0.460
STANDARD DEV	0.678
STD. ERROR	0.091
SKEWNESS	1.177
KURTOSIS	0.369

Figure 5-12

Beaumont, Texas NMOC Data.

```
PROPORTION PER STANDARD UNIT                                                       COUNT
 1.0 +
     |                                                                           +    30
  .9 +                                                                           |
     |                                                                           |
  .8 +                                                                           |
     |                                                                           |
  .7 +                                                                           |
     |                                                                           |
  .6 +      *****                                                                |
     |      *****                                                                |
  .5 +      *****                                                                |
     | **********                                                                |
  .4 + ***************                                                           |
     | ***************                                                           |
  .3 + ***************                                                           |
     | ********************                                                      |
  .2 + ********************                                                      |
     | *************************                                                 |
  .1 + *************************                                                 |
     | ******************************          *****                             |
-------------------------------------------------------------------------------------
    .11(             ^          )                                             3.84

                                        NMOC
```

Beaumont Texas NMOC Data.

TOTAL OBSERVATIONS: 66

	NMOC
N OF CASES	66
MINIMUM	0.110
MAXIMUM	3.840
RANGE	3.730
MEAN	0.891
VARIANCE	0.462
STANDARD DEV	0.680
STD. ERROR	0.084
SKEWNESS	1.968
KURTOSIS	5.063

Figure 5-13

Charlotte, North Carolina NMOC Data.

```
PROPORTION PER STANDARD UNIT                                                   COUNT
 1.0 +
     :
  .9 -  ******                                                               -    30
     :  ******                                                               :
  .8 +  ******                                                               :
     :  ******                                                               :
  .7 +  ******                                                               :
     :  ******                                                               :
  .6 +  ******                                                               :
     :  ******                                                               :
  .5 +  ******                                                               :
     :  ******                                                               :
  .4 +  ************                                                         :
     :  ******************                                                   :
  .3 +  ******************                                                   :
     :  ******************                                                   :
  .2 +  ******************                                                   :
     :  ******************                                                   :
  .1 +  ******************                                                   :
     :  ******************                        ******                     :
-----------------------------------------------------------------------------------
    .18         ^          )                                             2.52

                                 NMOC
```

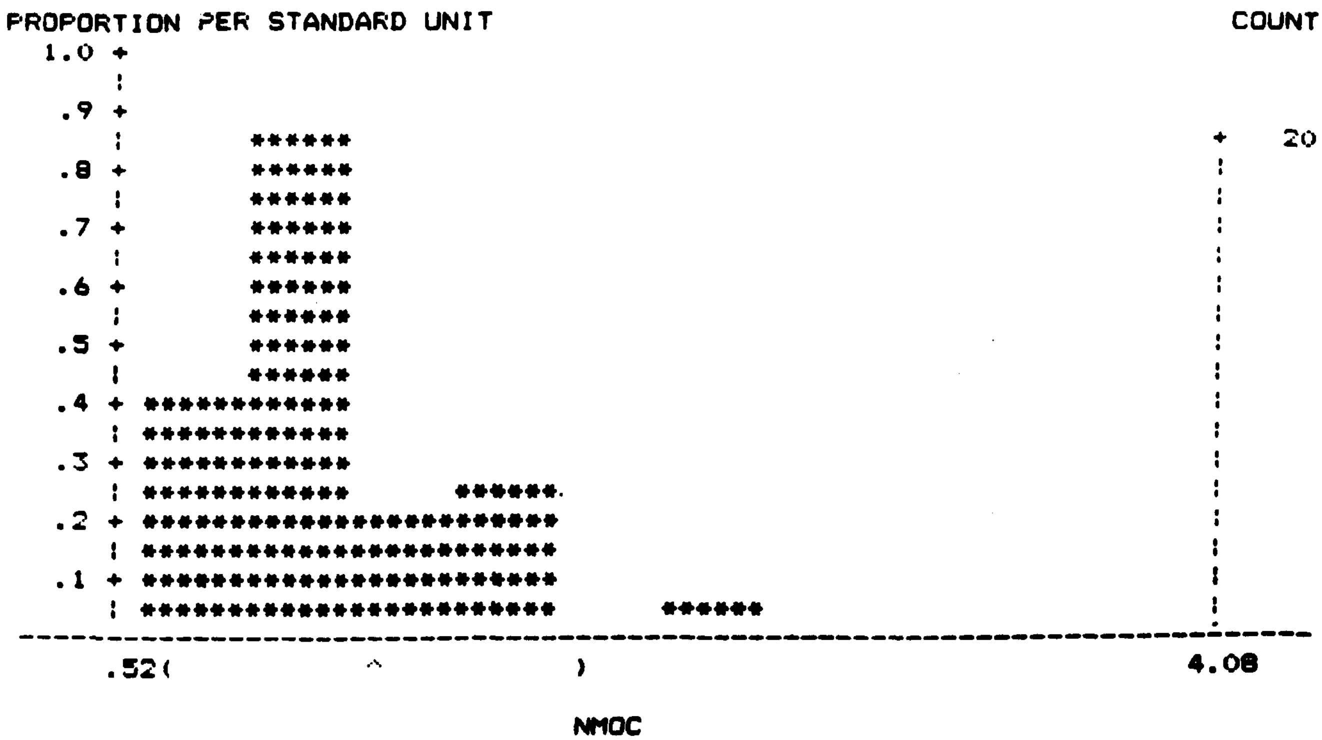
Charlotte North Carolina NMOC Data.

TOTAL OBSERVATIONS: 60

	NMOC
N OF CASES	60
MINIMUM	0.180
MAXIMUM	2.520
RANGE	2.340
MEAN	0.537
VARIANCE	0.190
STANDARD DEV	0.436
STD. ERROR	0.056
SKEWNESS	2.564
KURTOSIS	7.542

Figure 5-14

Chattanooga, Tennessee NMOC Data.



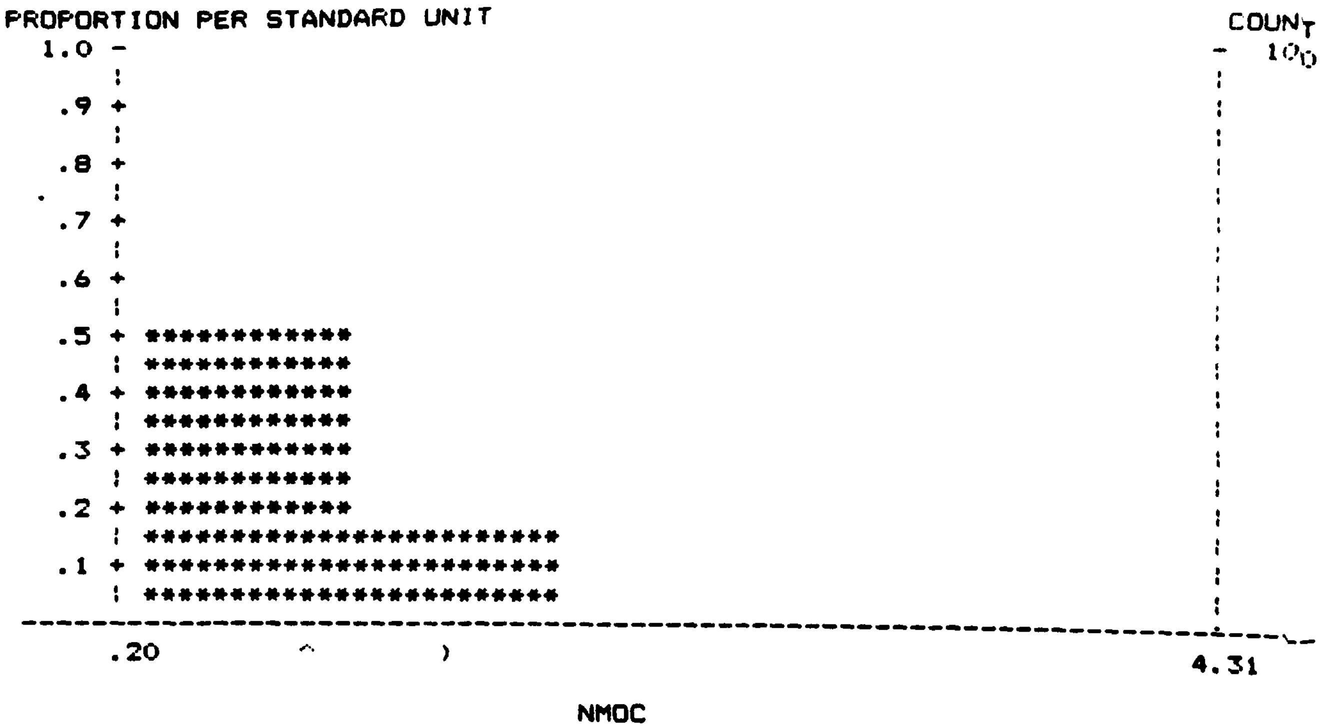
Chattanooga Tennessee NMOC Data.

TOTAL OBSERVATIONS: 46

	NMOC
N OF CASES	46
MINIMUM	0.520
MAXIMUM	4.080
RANGE	3.560
MEAN	1.345
VARIANCE	0.505
STANDARD DEV	0.710
STD. ERROR	0.105
SKEWNESS	2.015
KURTOSIS	4.349

Figure 5-15

Clute, Texas NMOC Data.



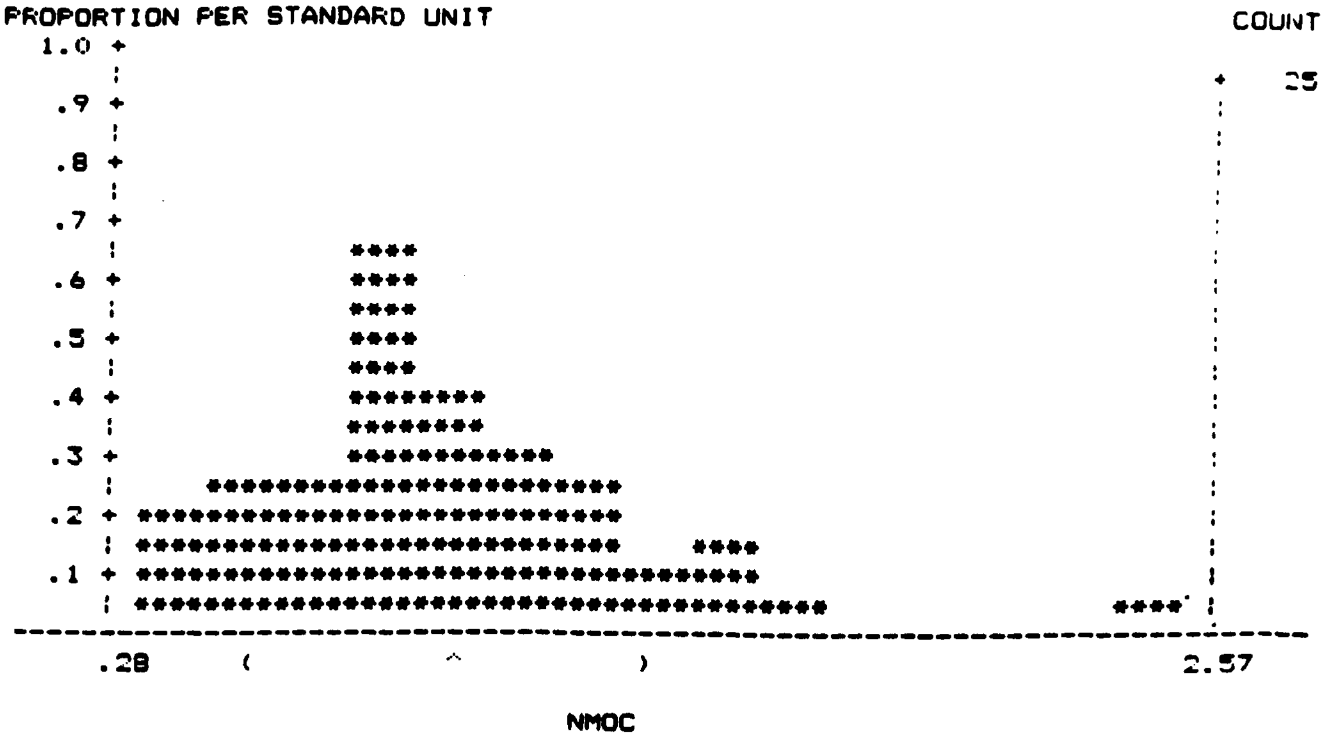
Clute Texas NMOC Data.

TOTAL OBSERVATIONS: 72

	NMOC
N OF CASES	72
MINIMUM	0.200
MAXIMUM	4.310
RANGE	4.110
MEAN	0.819
VARIANCE	0.356
STANDARD DEV	0.597
STD. ERROR	0.070
SKEWNESS	3.161
KURTOSIS	14.658

Figure 5-16

Dallas, Texas NMOC Data.

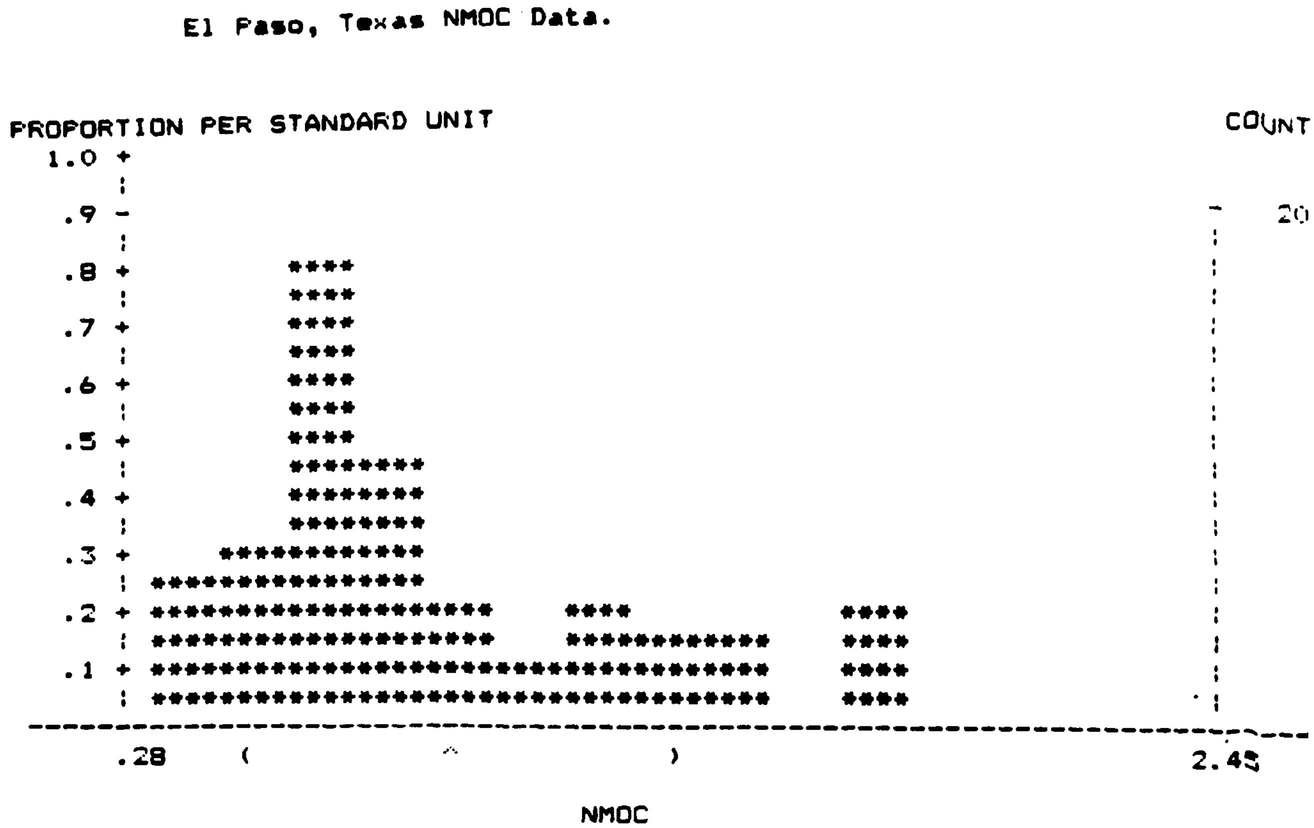


Dallas Texas NMOC Data.

TOTAL OBSERVATIONS: 74

	NMOC
N OF CASES	74
MINIMUM	0.280
MAXIMUM	2.570
RANGE	2.290
MEAN	0.968
VARIANCE	0.188
STANDARD DEV	0.433
STD. ERROR	0.050
SKEWNESS	1.212
KURTOSIS	2.595

Figure 5-17



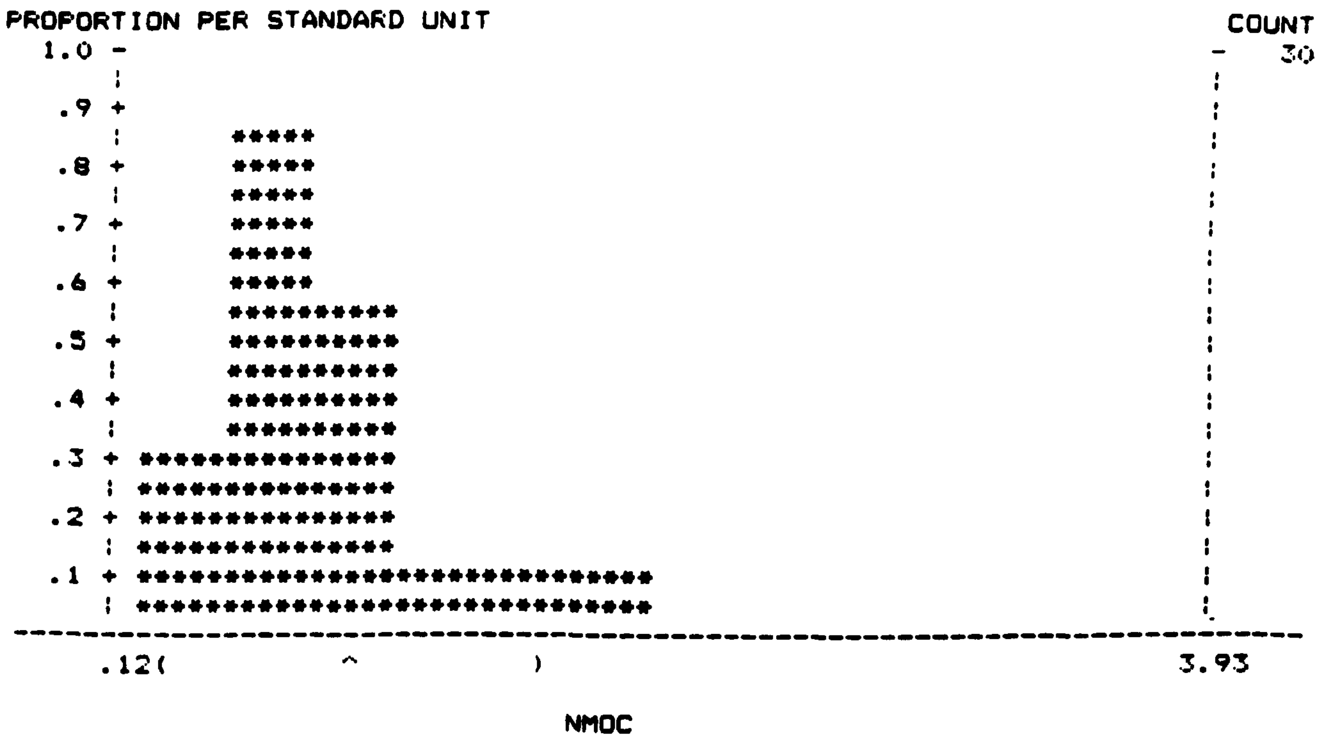
El Paso Texas NMOC Data.

TOTAL OBSERVATIONS: 69

	NMOC
N OF CASES	69
MINIMUM	0.280
MAXIMUM	2.450
RANGE	2.170
MEAN	0.926
VARIANCE	0.206
STANDARD DEV	0.454
STD. ERROR	0.055
SKEWNESS	0.983
KURTOSIS	0.552

Figure 5-18

Cincinnati, Ohio NMOC Data.



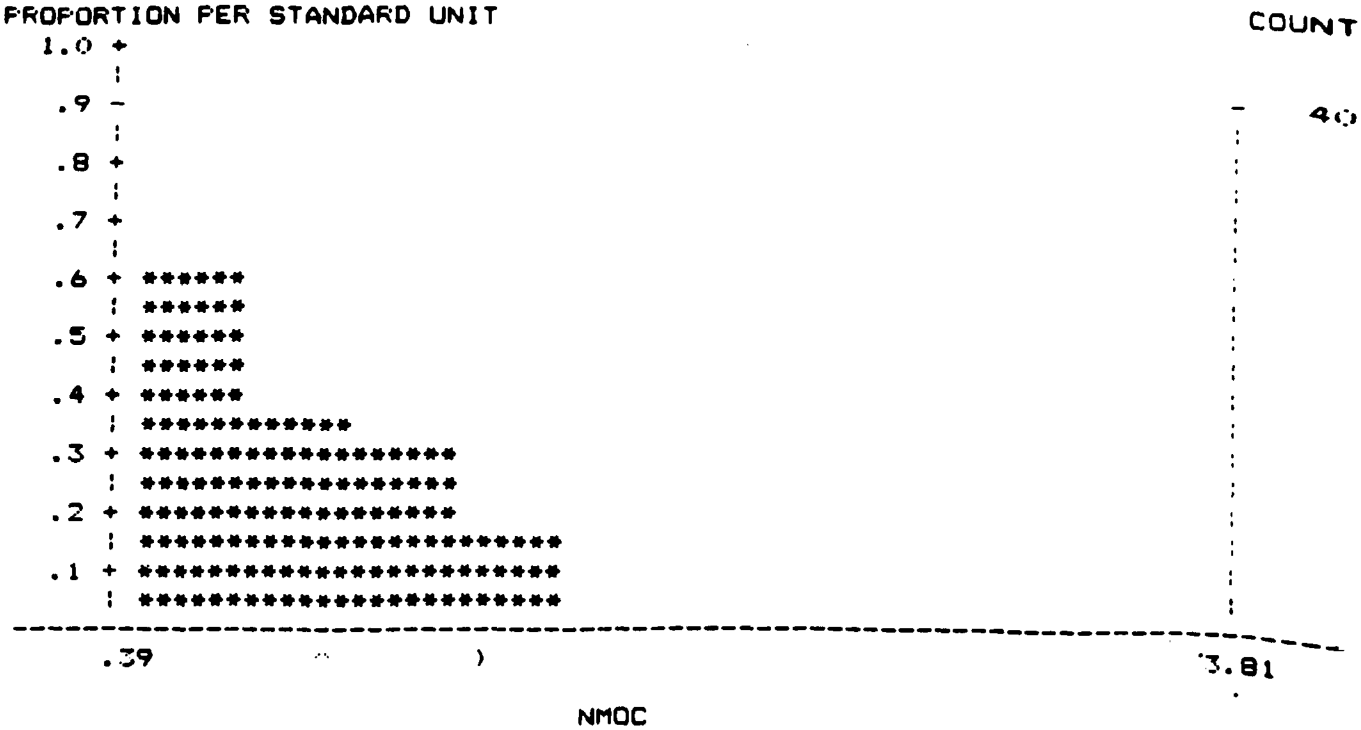
Cincinnati Ohio NMOC Data.

TOTAL OBSERVATIONS: 65

	NMOC
N OF CASES	65
MINIMUM	0.120
MAXIMUM	3.930
RANGE	3.810
MEAN	0.929
VARIANCE	0.501
STANDARD DEV	0.708
STD. ERROR	0.088
SKEWNESS	2.481
KURTOSIS	6.821

Figure 5-19

Fort Worth, Texas NMOC Data.



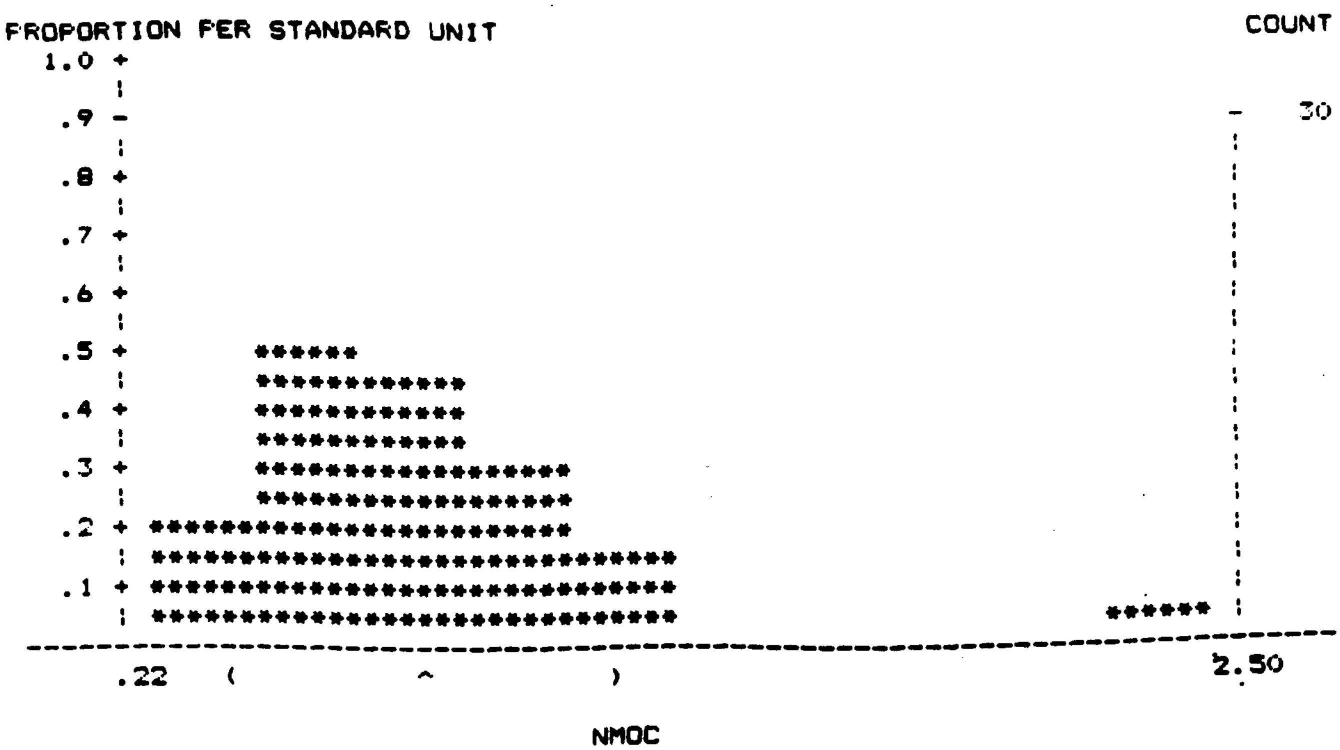
Ft. Worth Texas NMOC Data.

TOTAL OBSERVATIONS: 69

	NMOC
N OF CASES	69
MINIMUM	0.390
MAXIMUM	3.810
RANGE	3.420
MEAN	0.973
VARIANCE	0.307
STANDARD DEV	0.554
STD. ERROR	0.067
SKEWNESS	2.245
KURTOSIS	8.248

Figure 5-20

Indianapolis, Indiana NMOC Data.



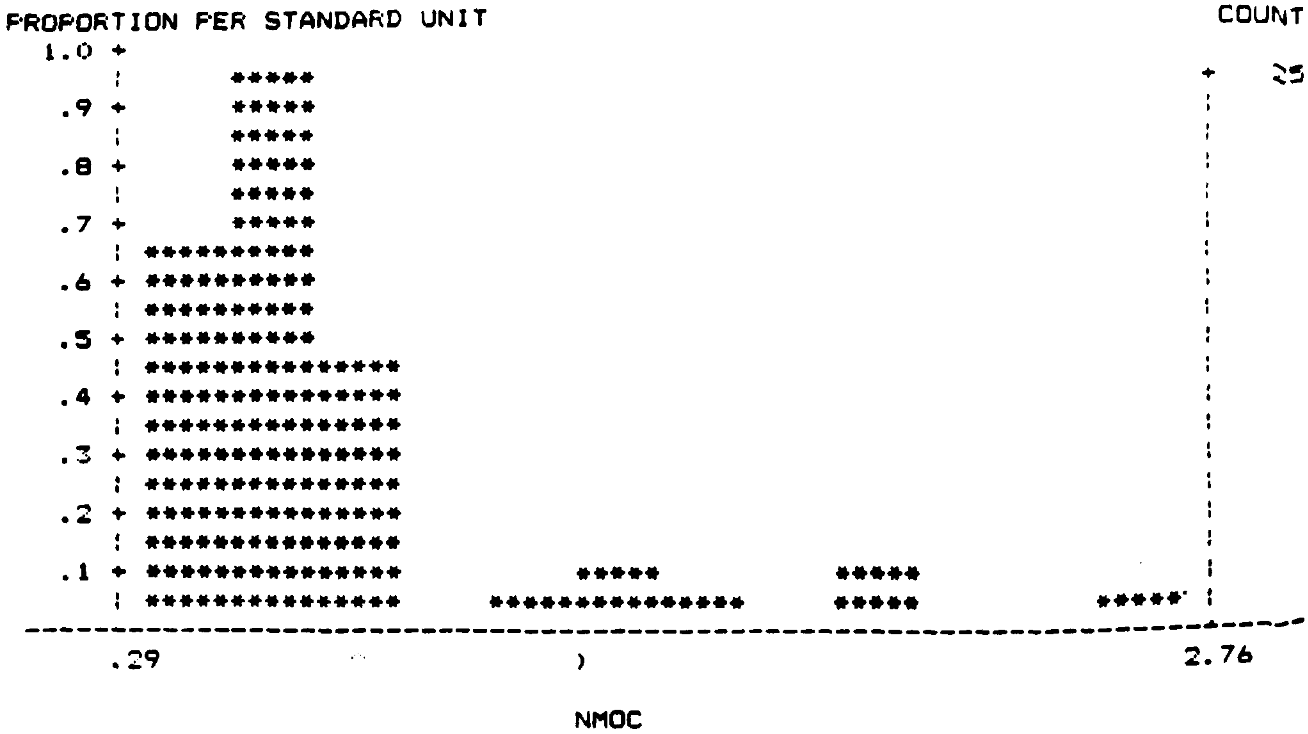
Indianapolis Indiana NMOC Data.

TOTAL OBSERVATIONS: 59

	NMOC
N OF CASES	59
MINIMUM	0.220
MAXIMUM	2.500
RANGE	2.280
MEAN	0.804
VARIANCE	0.176
STANDARD DEV	0.419
STD. ERROR	0.055
SKEWNESS	2.253
KURTOSIS	6.887

Figure 5-21

Kansas City, Missouri NMOC Data.

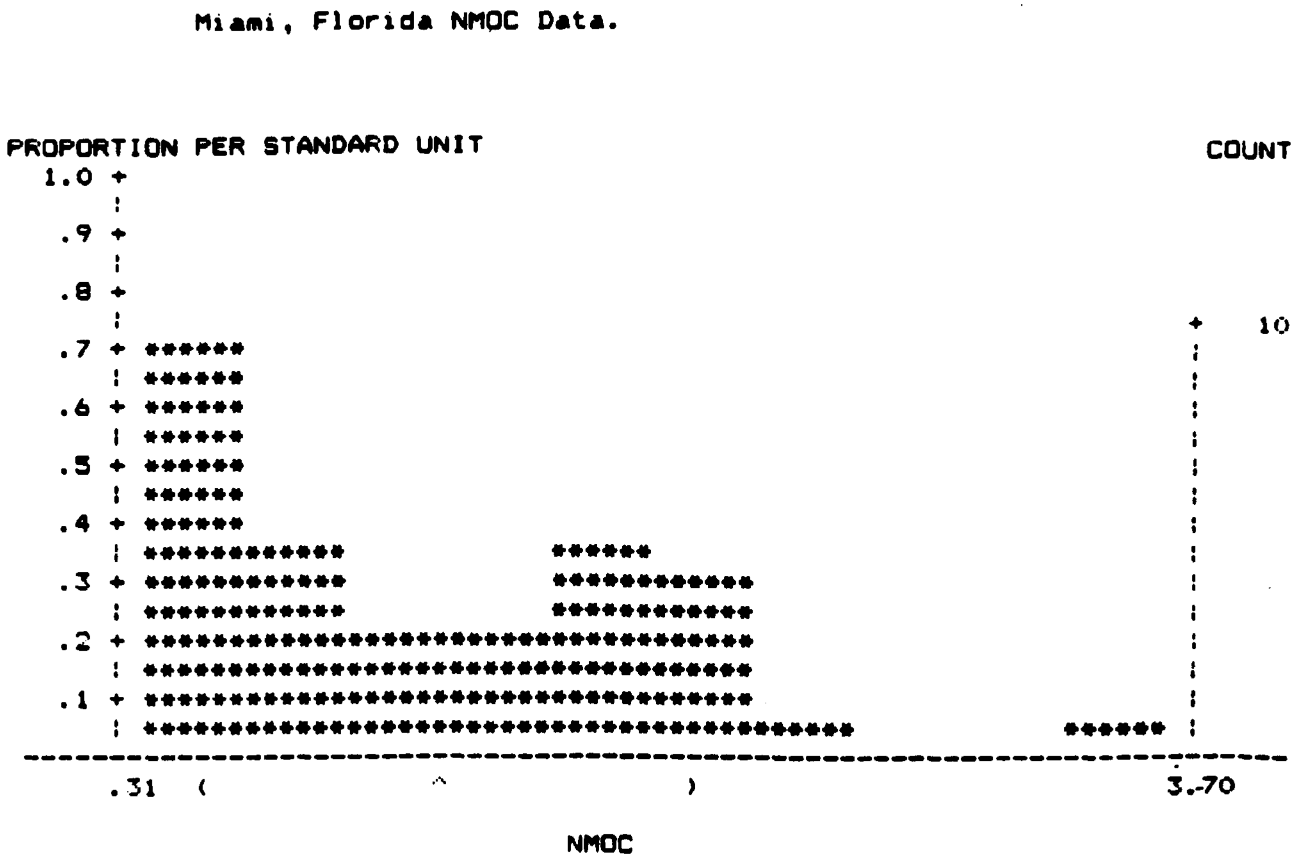


Kansas City Missouri NMOC Data.

TOTAL OBSERVATIONS: 68

	NMOC
N OF CASES	68
MINIMUM	0.290
MAXIMUM	2.760
RANGE	2.470
MEAN	0.787
VARIANCE	0.286
STANDARD DEV	0.534
STD. ERROR	0.065
SKEWNESS	2.104
KURTOSIS	4.073

Figure 5-22

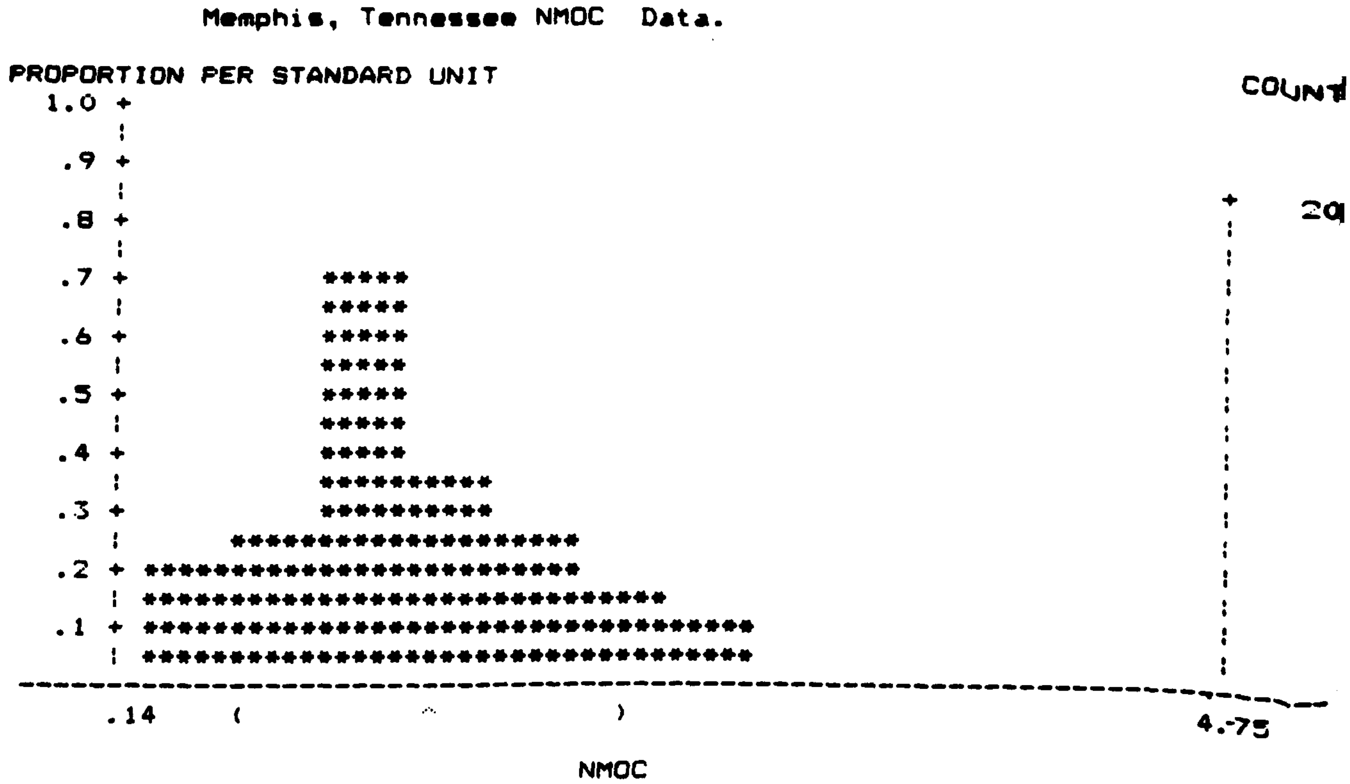


Miami, Florida NMOC Data.

TOTAL OBSERVATIONS: 31

	NMOC
N OF CASES	31
MINIMUM	0.310
MAXIMUM	3.700
RANGE	3.390
MEAN	1.315
VARIANCE	0.685
STANDARD DEV	0.827
STD. ERROR	0.149
SKEWNESS	0.779
KURTOSIS	0.200

Figure 5-23



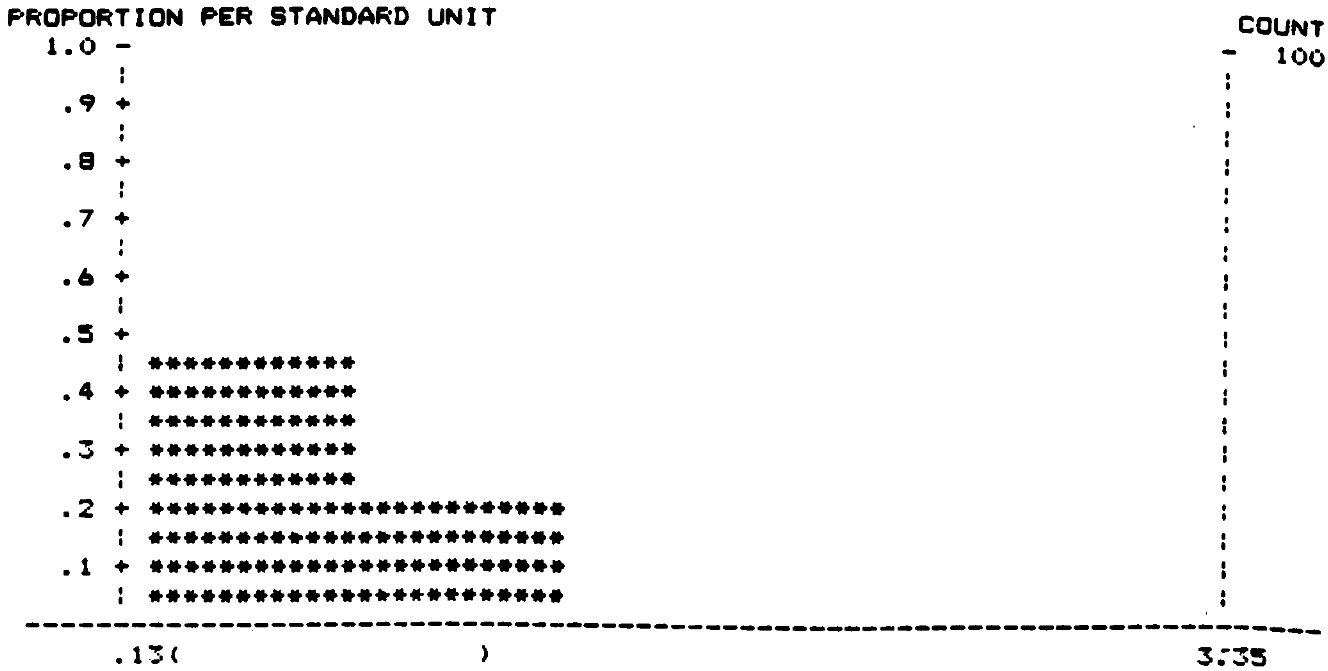
Memphis Tennessee NMOC Data.

TOTAL OBSERVATIONS: 52

	NMOC
N OF CASES	52
MINIMUM	0.140
MAXIMUM	4.750
RANGE	4.610
MEAN	1.432
VARIANCE	0.726
STANDARD DEV	0.852
STD. ERROR	0.118
SKEWNESS	1.633
KURTOSIS	4.049

Figure 5-24

Orange, Texas NMOC Data.



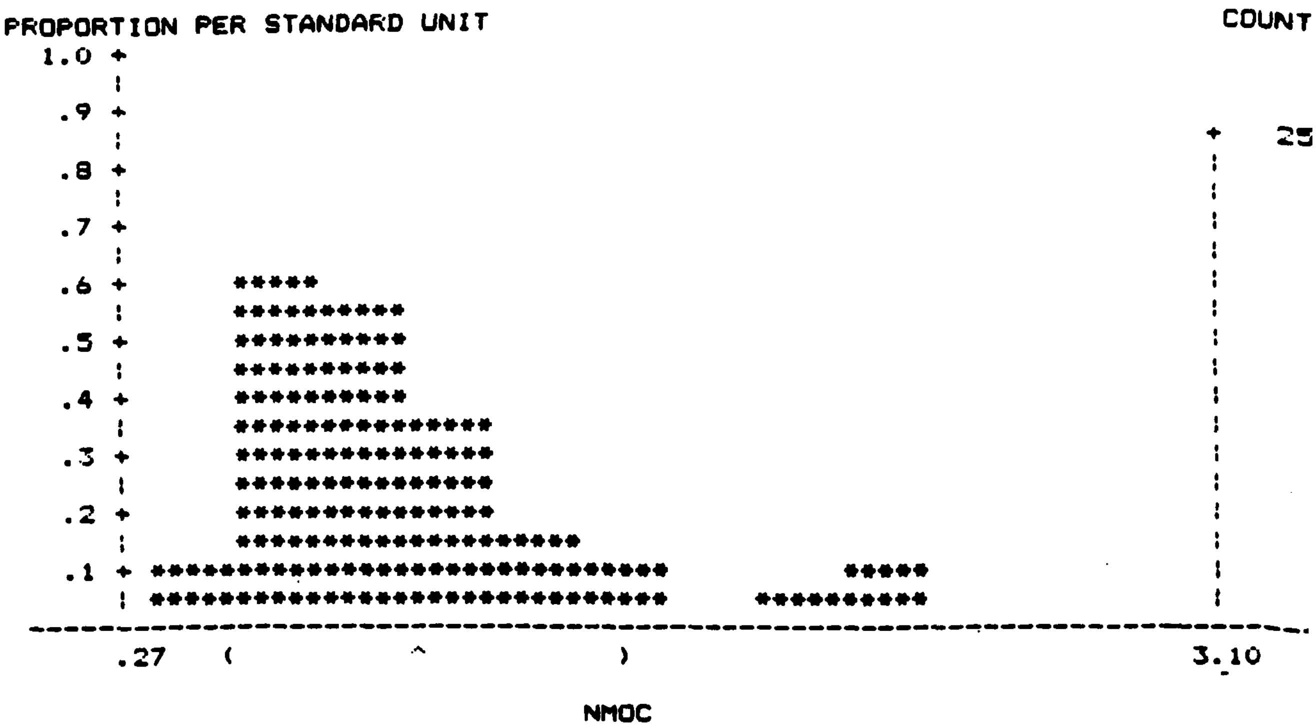
Orange Texas NMOC Data.

TOTAL OBSERVATIONS: 71

	NMOC
N OF CASES	71
MINIMUM	0.130
MAXIMUM	3.350
RANGE	3.220
MEAN	0.695
VARIANCE	0.219
STANDARD DEV	0.468
STD. ERROR	0.056
SKEWNESS	2.764
KURTOSIS	12.736

Figure 5-25

Philadelphia, Pennsylvania NMOC Data.



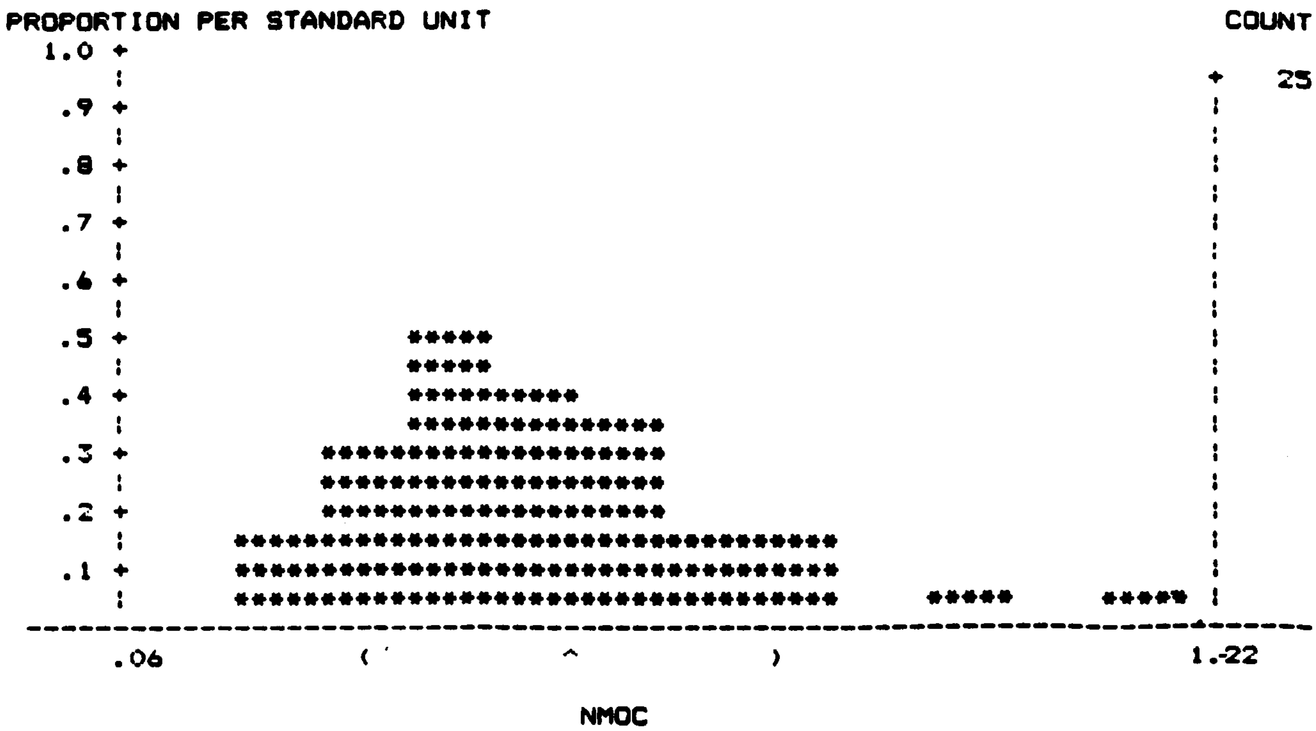
Philadelphia Pennsylvania NMOC Data.

TOTAL OBSERVATIONS: 63

	NMOC
N OF CASES	63
MINIMUM	0.270
MAXIMUM	3.100
RANGE	2.830
MEAN	1.020
VARIANCE	0.277
STANDARD DEV	0.526
STD. ERROR	0.066
SKEWNESS	1.554
KURTOSIS	2.968

Figure 5-26

Richmond, Virginia NMOC Data.



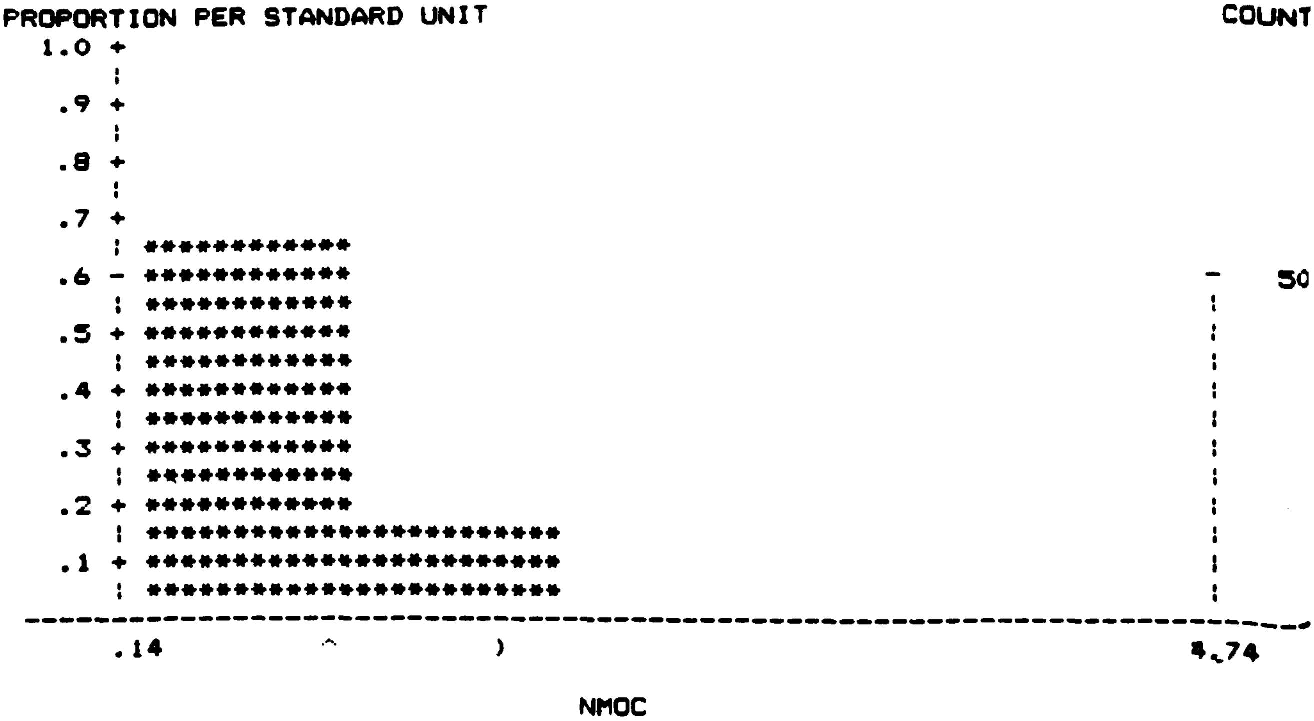
Richmond Virginia NMOC Data.

TOTAL OBSERVATIONS: 64

	NMOC
N OF CASES	64
MINIMUM	0.060
MAXIMUM	1.220
RANGE	1.160
MEAN	0.532
VARIANCE	0.057
STANDARD DEV	0.238
STD. ERROR	0.030
SKEWNESS	0.815
KURTOSIS	0.663

Figure 5-27

Texas City, Texas NMOC Data.



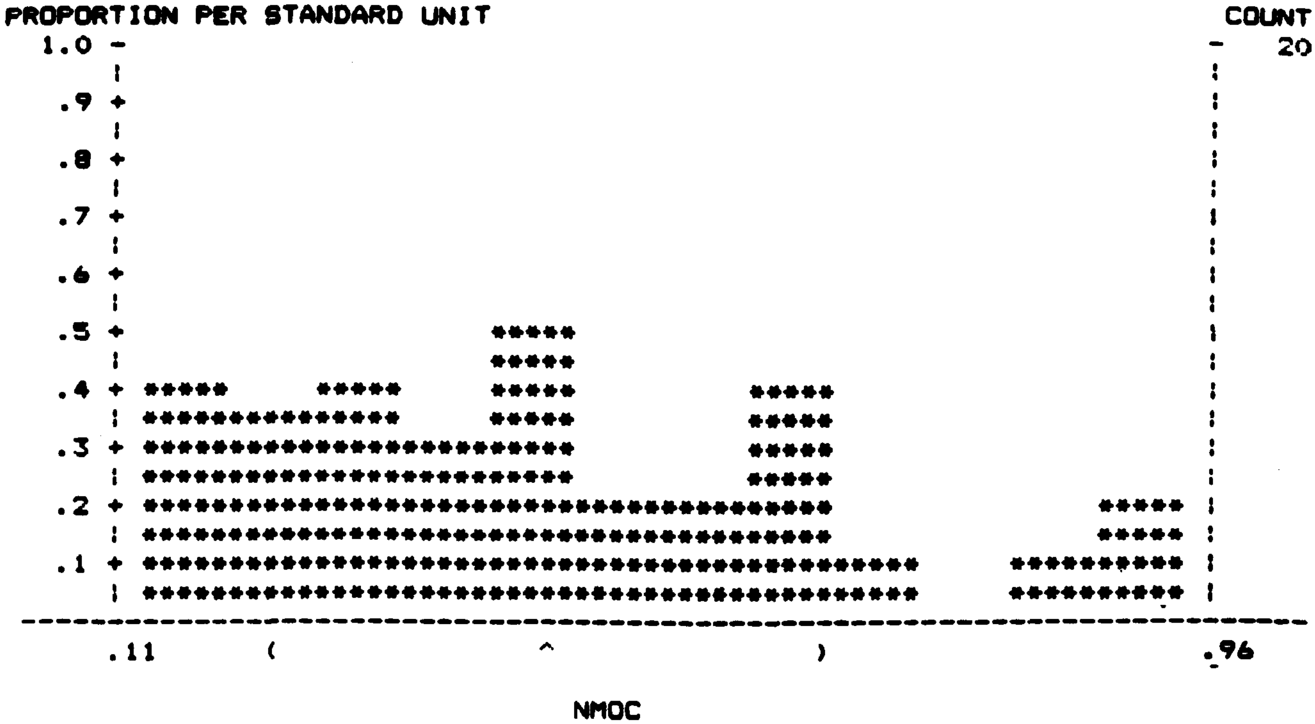
Texas City Texas NMOC Data.

TOTAL OBSERVATIONS: 69

	NMOC
N OF CASES	69
MINIMUM	0.140
MAXIMUM	4.740
RANGE	4.600
MEAN	0.924
VARIANCE	0.610
STANDARD DEV	0.781
STD. ERROR	0.094
SKEWNESS	3.078
KURTOSIS	11.540

Figure 5-28

Wilkes-Barre, Pennsylvania NMOC Data.



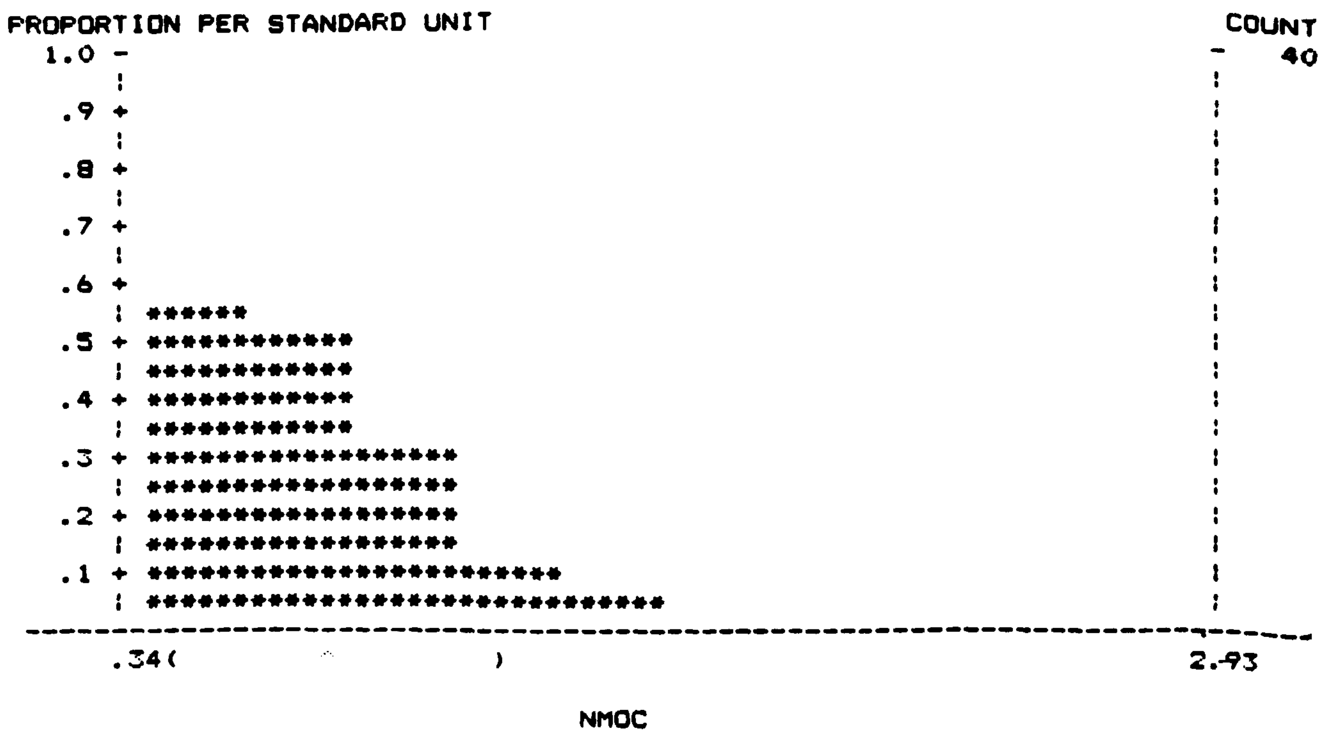
Wilkes-Barre Pennsylvania NMOC Data.

TOTAL OBSERVATIONS: 63

	NMOC
N OF CASES	63
MINIMUM	0.110
MAXIMUM	0.960
RANGE	0.850
MEAN	0.447
VARIANCE	0.052
STANDARD DEV	0.228
STD. ERROR	0.029
SKEWNESS	0.541
KURTOSIS	-0.497

Figure 5-29

Washington, District of Columbia NMOC Data.



Washington DC NMOC Data.

TOTAL OBSERVATIONS: 63

	NMOC
N OF CASES	63
MINIMUM	0.340
MAXIMUM	2.930
RANGE	2.590
MEAN	0.806
VARIANCE	0.167
STANDARD DEV	0.408
STD. ERROR	0.051
SKEWNESS	2.637
KURTOSIS	10.157

Figure 5-30

West Palm Beach, Florida NMOC Data.

```
PROPORTION PER STANDARD UNIT                                          COUNT
 1.0 +
     !                                                              +  100
  .9 +                                                              !
     !                                                              !
  .8 +                                                              !
     !                                                              !
  .7 +                                                              !
     !                                                              !
  .6 +                                                              !
     !                                                              !
  .5 + ************                                                 !
     ! ************                                                 !
  .4 + ************                                                 !
     ! ************                                                 !
  .3 + ************                                                 !
     ! ************                                                 !
  .2 + ************                                                 !
     ! ************                                                 !
  .1 + ***********************                                      !
     ! ***********************                                      !
-----------------------------------------------------------------------------
      .17        ^       )                                          2.63

                                   NMOC
```

West Palm Beach Florida NMOC Data.

TOTAL OBSERVATIONS: 72

	NMOC
N OF CASES	72
MINIMUM	0.170
MAXIMUM	2.630
RANGE	2.460
MEAN	0.541
VARIANCE	0.118
STANDARD DEV	0.344
STD. ERROR	0.041
SKEWNESS	3.392
KURTOSIS	17.344

Table 5-9

Tests of the Maximum (X_n) and Minimum (X) NMOC Values as Outliers

Site Code	n	T_n	T_n^1	T_c	$P(T_n=0)$	$P(T_n^1=0)$
AKOH	68	3.837	-0.986	3.071	<0.01	>0.05
ATGA	55	4.870	-0.808	2.992	<0.01	>0.05
BAL	56	2.829	-1.829	3.000	>0.05	>0.05
BMTX	66	4.278	-1.149	3.061	<0.01	>0.05
CHNC	60	4.548	-0.819	3.025	<0.01	>0.05
CHTN	46	3.852	-1.162	2.923	<0.01	>0.05
CLTX	72	5.847	-1.037	3.092	<0.01	>0.05
ELTX	69	3.357	-1.423	3.076	<0.01	>0.05
CNOH	65	4.239	-1.143	3.055	<0.01	>0.05
FWTX	69	5.121	-1.052	3.076	<0.01	>0.05
ININ	59	4.048	-1.394	3.019	<0.01	>0.05
MIFL	31	2.884	-1.215	2.759	>0.05	>0.05
MTN	52	3.894	-1.516	2.971	<0.01	>0.05
ORTX	71	5.673	-1.207	3.087	<0.01	>0.05
PHPA	63	3.954	-1.426	3.044	<0.01	>0.05
RVA	64	2.891	-1.983	3.049	>0.05	>0.05
TCTX	69	4.886	-1.004	3.076	<0.01	>0.05
WBPA	63	2.250	-1.478	3.044	>0.05	>0.05
WDC	63	5.206	-1.142	3.044	<0.01	>0.05
WPFL	72	6.073	-1.078	3.092	<0.01	>0.05
DLTX	74	3.700	-1.589	3.102	<0.01	>0.05
KCMO	68	3.695	-0.931	3.017	<0.01	>0.05

$X_1 < X_2 < X_3 \ldots . < X_{n-1} < X_n$ = Sorted NMOC values.

$T_n = (X_n - \bar{X})\ s$

$T_n^1 = (X_1 - \bar{X})\ s$

T_c = Critical Statistics, Grubbs, F.E., and G. Beck, ''Extension of Sample Sizes and Percentage Points for Significance Tests of Outlying Observations,'' Technometrics, Vol. 14, No. 4, Nov. 1972, pp. 847-854.

If $T_n > T_c$, X_n is an outlier at the five percent level of significance, i.e., $P(T_n = 0) < 0.05$.

data, in the sense that an assignable cause could probably be found for each large value of NMOC measured. Further as discussed above, the NMOC data appear to approximate a logarithmic normal distribution from which large values would be expected, hence the right-handed "tail" in the lognormal distribution (large positive skewness). This is further supported by the fact that the same sites for which the maximum value was not found to be an outlier by the Grubbs and Beck test were those whose skewness factors were less than 1.0. The conclusion may be reached that the Grubbs and Beck test for outliers should not be applied to the NMOC data set. Further the assertion may be made that none of the present NMOC data points should be declared to be outliers.

The Grubbs and Beck test could be run on the logarithmic of the NMOC values instead of the NMOC values themselves. Unless there is a specific reason, e.g., known or suspected malfunction of the equipment, to suspect the maximum or the minimum datum as an outlier, the datum should be retained as a legitimate part of the data set.

6.0 RECOMMENDATIONS

Based on the experiences and results of the 1984 NMOC study, certain recommendations redound. The general categories into which these recommendations fall are equipment design and recommendations, sample stability determinations, repeated analyses considerations, NMOC speciation study, and additional treatment of the 1984 NMOC data. These categories are discussed briefly below.

6.1 EQUIPMENT DESIGN AND RECOMMENDATIONS

The scheduling, shipping, analytical requirements, and sample can preparation requirements dictate that a minimum of 10 cans per site be available prior to, and during, the period of the study. Fewer than 10 cans per site will probably cause additional cost in personnel overtime charges in order to keep the project on schedule or to perform all the tasks required.

Two key equipment design changes are recommended. First, weld the sample tube into the sample can, rather than press fit the tube. An additional sleeve could be welded around the tube itself and bonded to the can, better to ensure a leak-free joint and to provide additional structural strength to this connection. The second design change in the equipment is to provide a sleeve which is permanently fixed to the sample shipment container lid, similar to a round biscuit cutter that fits down over the sample line and valve on the top of the sample can. A foam and/or rubber gasket should be attached to the sleeve to provide a tight, cushioned seal between the sleeve and the can firmly holding the can in one place during shipment.

Additionally, it is recommended that the 6-port sample injection valves for the gas chromatograph be replaced with similar valves of higher temperature rating. This is recommended to allow the valve to be maintained at a temperature above the boiling point of water (100°C).

6.2 SAMPLE STABILITY

Prior to beginning a future NMOC study at various sites, a study of sample stability should be conducted. The purposes of this series of tests are two-fold: 1) to determine any potential difference in the NMOC value that results from waiting several time intervals between the initial sampling day and the day on which the analysis is done, and 2) to see if there is a detectable difference in NMOC when the time interval for the second and third analysis is different. A suggested experimental design is presented in Table 6-1. Twelve simultaneous ambient air samples are to be taken at a sample location suspected of having a NMOC concentration >1.0 ppmC. Table 6-1 shows the days on which can pressure readings are noted and NMOC analyses are performed. It is recommended that the barometric pressure and temperature be recorded on each day of the sampling and analysis program, and that all the analyses be done on the same channel, preferably by the same operator.

6.3 REPEATED ANALYSES

The 1984 NMOC study showed that the second NMOC analysis performed on a sample produced a larger measured NMOC reading than the first NMOC analysis. It is proposed that in future studies each sample is analyzed three times, on three channels -- either two Radian channels and one EPA channel (to get interlaboratory variance) or on three Radian channels. It is further proposed that the experimental design assure a balance of readings for each channel pair, e.g., A-A, A-B, A-C, A-D, B-A, B-B, B-C, B-D, C-A, C-B, etc., for however many channel pairs are involved in the study. The experimental design should also balance the number of determinations that are the first, second, and third analyses out of the sample can. These data from all the sample sites may be combined with the sample stability data described above to help reach possible conclusions from the study.

Care should be taken to record the date, the time of day, the relative humidity, the temperature, the barometric and gauge pressure at the sampling site, and the same information at the point of each analysis from the sample can.

Table 6-1. NMOC Sampling and Analysis Stability Study

Sample Day	Simultaneous Sample Cannisters											
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
1 M	P[a]	P	P,A[b]	P,A	P	P	P	P	P	P	P	P
2 T					P,A	P,A						
3 W			P,A	P,A			P,A	P,A				
4 T									P,A	P,A		
5 F			P,A	P,A	P,A	P,A					P,A	P,A
6 S												
7 S												
8 M					P,A,	P,A						
9 T												
10 W												
11 T							P,A,	P,A				
12 F												
13 S												
14 S												
15 M											P,A	P,A
16 T												
17 W									P,A,	P,A,		
18 T												
19 F							P,A	P,A				
20 S												
21 S												
22 M												
23 T												
24 W												
25 T												
26 F												
27 S												
28 S												
29 M												
30 T	P,A	P,A	P	P	P	P	P	P	P,A	P,A	P,A	P,A

[a]The symbol P indicates the day a barometric and sample-can gauge pressure reading is determined.

[b]The symbol A indicates the day an analysis is done. Pressure is recorded before the analysis is done.

Each NMOC determination in the 1984 study was the average of two consecutive analyses. Only the mean of the two analyses was recorded. It is recommended to tabulate both the first and second analysis for each NMOC determination, so that a more definitive analysis of the effect of can pressure on the measured NMOC reading may be assessed. It is suggested that the NMOC determinations in future data bases be recorded to three "significant" figures past the decimal point, and that the standard deviations be recorded to three "significant" figures. For reporting purposes, the final NMOC values will be recorded to two figures past the decimal point.

6.4 NMOC SPECIATION BY GC/MS

Identification of compounds that make up the NMOC readings is of interest in several ways. There may be some effort to identify a source of a component in an NMOC sample, or the presence of certain compounds may affect such things as modeling NMOC composition at various locations in a specific region. In particular identification, the aldehyde and ketone composition of NMOC samples may be of interest. The presence of certain components in NMOC may have an effect not only on smog or haze potential, but also on the expected character (mean, standard deviation, skewness, kurtosis, and frequency distribution of measured NMOC concentrations) of the NMOC readings at a specific location.

Ten sites have been selected for speciation analyses by GC/MS. These sites are listed below and cover a wide range of mean NMOC value, standard deviation, skewness, and kurtosis in the 1984 NMOC study.

Table 6-2. Proposed Sites for Speciation by GC/MS

Birmingham, Alabama	Philadelphia, Pennsylvania
Charlotte, North Carolina	Richmond, Virginia
El Paso, Texas	Texas City, Texas
Miami, Florida	Wilkes-Barre, Pennsylvania
Memphis, Tennessee	Washington, District of Columbia

It is proposed that on the same day in the first week of July, August, and September 1985 duplicate samples are taken at the 10 sites listed in Table 6-2. One of the duplicates is analyzed on the GC/MS using a capillary column coated with a polar material, and the other duplicate sample from each of the 10 sites is analyzed on the GC/MS using a nonpolar coating on a capillary column. Speciation and quantitation of major components will be done. Following the GC/MS analysis, NMOC determinations from the duplicate sample cans are made by the standard procedure on at least two additional Radian channels.

These data will be compiled along with meteorological data of temperature, humidity, barometric pressure, and average wind speed and direction at the time of sampling.

6.5 ADDITIONAL 1984 NMOC DATA ANALYSIS

Additional analysis of the 1984 NMOC data should be made with the speciation data. The results should be examined as a function of NMOC concentration. For Wilkes-Barre, Pennsylvania, all the NMOC measurements were found to be less than 1.0 ppmC. Several sites had NMOC measurements between 1.0 ppmC and 2.0 ppmC, and some sites had readings even higher. It would be instructive to see if the measured NMOC level relates to the composition of the organic components. Moreover, is there any similarity in composition of all the readings over 3.0 ppmC, or over 2.0 ppmC, or less than 1 ppmC?

Geographical location should be examined relative to the NMOC speciation. Does the composition of NMOC, perhaps at several NMOC levels at West Palm Beach, Florida relate to the NMOC composition at Miami, Florida? Is the composition of the NMOC in the concentration range <1.0 ppmC independent of geographical location?

Additional analysis of the 1984 NMOC speciation data is needed in order to get a better understanding of NMOC phenomena. Predictive models to build atmospheric behavior of NMOC materials in the atmosphere depend on the chemical and physical nature of the NMOC itself. The 1984 NMOC speciation data should be analyzed as quickly as possible to allow a better understanding of the phenomena involved, and to permit the design of more fruitful and efficient studies in the future in order to understand NMOC behavior.

Additional data analysis of the 1984 NMOC data is possible and may be fruitful. To investigate further the effect of a second analysis on the measured NMOC data, it would be possible to return to the original laboratory notebooks and data sheets and to record both NMOC determinations from which each of the reported NMOC values were determined. Moreover, on those analyses which were repeated, several were repeated for a third time. It would be instructive to identify the channels and the order of the analysis to see if the third analysis had resulted in a signficantly different measured NMOC value than the second or first analysis. Additional information on the effect of repeated analyses in other pairs of channels, e.g., B-C, C-B; A-D, D-A; A-C, C-A; etc. can be gleaned from the data base to supplement the analyses already done with the combinations reported above in the section on repeated analyses, Section 4.2.3.2.

Recommendations for further analysis of the 1984 NMOC data are based on perceived utility of the data or potential for significantly increasing understanding of the NMOC phenomenon in a cost effective way. The highest priority for further analysis of the 1984 NMOC data should be placed on the speciation results. Whatever information can be gleaned from the 1984 study would be helpful in planning and conducting the 1985 or future NMOC studies. The speciation information would also aid in understanding the NMOC phenomenon.

Retrieving additional information on repeated analyses from the 1984 data should be the second priority item. Additional information gained would not only assist in planning future studies, but would serve as a better basis for making judgments on the precision and validity of the current NMOC method.

Studying 1984 meteorological data relative to the 1984 NMOC data would further aid in understanding the NMOC phenomenon.

There is some preliminary evidence that may indicate that NMOC peaks occur very close together (i.e., near the same date) between sample locations. Table 6-3 shows apparent peaks in the NMOC data near Julian dates 228 and 251. The data strongly suggest that peak NMOC

Table 6-3. Peak NMOC Values

Julian[a] Date	Site	NMOC ppmC	Julian Date	Site	NMOC ppmC
228	AKOH	2.45	250	AKOH	2.95
228	ATGA	1.64	250	ATGA	1.86
234	BMTX	3.84	255	BMTX	1.18
229	BAL	2.49	255	BAL	2.30
222	CHNC	1.35	264	CHNC	2.52
223	CHTN	3.35	254	CHTN	1.59
227	CNOH	1.90	251	CNOH	2.94
228	CLTX	1.47	254	CLTX	1.17
223	DLTX	1.63	250	DLTX	1.28
230	ELTX	1.44	251	ELTX	1.25
227	FWTX	2.09	249	FWTX	2.18
228	ININ	2.50	250	ININ	N.A.P.
228	KCMO	N.A.P.[b]	249	KCMO	2.04
229	MTN	2.46	244	KCMO	2.76
230	MIFL	1.93	256	MTN	4.03
230	PHPA	N.A.P.	257	MTN	4.75
230	RVA	N.A.P.	250	MIFL	2.60
228	TCTX	1.82	250	PHPA	N.A.P.
228	WDC	N.A.P.	251	RVA	0.95
227	ORTX	1.38	242	TCTX	4.36
226	WPFL	0.97	251	WDC	1.10
228	WBPA	N.A.P.	242	ORTX	3.35
			249	WPFL	1.30
			250	WBPA	N.A.P.

[a]Julian date 230 = 8/17/84
250 = 9/06/84

[b]N.A.P. - no apparent peak ±5 days.

values occur at several geographical locations on the same day, which is probably related to temperature and wind conditions (and possibly barometric pressure) at the site. A more detailed study of this possible phenomenon as a function of meteorological conditions warrants further study. This recommendation is placed on a third priority level because of the necessity to collect meteorological information (not currently available in the 1984 NMOC data base).

APPENDIX A

EPA Document

"Determination of Atmospheric Nonmethane Organic Compounds (NMOC) by Cryogenic Preconcentration and Direct Flame Ionization Detection"

DETERMINATION OF ATMOSPHERIC NONMETHANE ORGANIC COMPOUNDS (NMOC) BY CRYOGENIC PRECONCENTRATION AND DIRECT FLAME IONIZATION DETECTION

December 1983

QUALITY ASSURANCE DIVISION

ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

DETERMINATION OF ATMOSPHERIC NONMETHANE ORGANIC COMPOUNDS (NMOC) BY CRYOGENIC PRECONCENTRATION AND DIRECT FLAME IONIZATION DETECTION

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DECEMBER 1983

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INTRODUCTION

A variety of photochemical dispersion models have been developed to describe the quantitative relationships between ambient concentrations of precursor organic compounds and subsequent downwind concentrations of ozone.[1] An important application of such models is to determine the degree of control of such organic compounds that is necessary in a particular area to achieve compliance with applicable ambient air quality standards for ozone.[1,2] For this purpose, the models require input of data on ambient concentrations of nonmethane organic compounds (NMOC).

The more elaborate theoretical models generally require detailed organic species data.[2] Such species data must be obtained by analysis of air samples with a sophisticated, multicomponent gas chromatographic (GC) analysis system.[2,3] Simpler empirical models such as the Empirical Kinetic Modeling Approach (EKMA)[1] require only total NMOC concentration data, specifically the average total NMOC concentrations from 6 a.m. to 9 a.m. daily.[2]

For many EKMA applications, NMOC measurements are required at urban, center-city-type sites.[2] The moderately high NMOC concentrations typically found at such urban sites may be adequately measured by commercially available continuous (or semicontinuous) NMOC analyzers.[2,4] However, if transport of precursors into an area is to be considered, then NMOC measurements upwind of the area are necessary.[1] Upwind NMOC concentrations are likely to be very low (less than a few tenths of 1 ppm) and therefore may not be accurately measured by conventional NMOC analyzers.[2,4] NMOC GC species measurements can be used by summing the various components to obtain a total NMOC concentration.[2] But for EKMA, the species data are not needed, and the cost and complexity of species analysis is very high.

The method described herein can be used to obtain the requisite upwind, as well as the urban, NMOC measurements.[5,6] This method is a compromise between the continuous and GC methods mentioned above. It combines the cryogenic concentration technique used in the GC method for high sensitivity with the simple flame ionization detector (FID) for total NMOC measurements without the complex GC columns necessary for species separation. And because of the use of helium carrier gas, the FID has less response variation to various organic compounds than a conventional NMOC analyzer with air carrier or direct sample injection into the FID.

This method can be used either for direct, in situ ambient measurements or for analysis of integrated samples contained in metal canisters. Making direct measurements at the monitoring site avoids the potential sample loss or contamination problems possible with the use of canisters. However, the analyst must be present during the 6 to 9 a.m. period, and repeated measurements (approximately six per hour) must be taken to obtain the 6 to 9 a.m. average NMOC concentration. A separate analytical system and analyst (or a conventional NMOC analyzer) is needed for each monitoring site. (Further development of the method may allow for automatic operation for on-line semi-continuous analysis in the future.)

The use of sample canisters allows the collection of integrated air samples over the 6 to 9 a.m. period by automated samplers at unattended monitoring sites. One analytical system can then analyze the samples from several monitoring sites. Degradation or contamination of the air from several monitoring sites. Degradation or contamination of the air samples by the canister may be a potential problem, but tests indicate that the use of properly cleaned stainless steel canisters, as described in the procedure, is viable and adds relatively little additional variability to the method.[7]

One possible compromise for regional monitoring is to locate the analytical system at the upwind site for direct measurements of the low upwind NMOC concentrations, while integrated canister samples are collected at the urban monitoring sites. Direct measurements may then be carried out during the 6 to 9 a.m. period, after which the canister samples from the urban sites may be brought to the upwind site for subsequent analysis. The higher concentrations at the urban sites will minimize the effect of losses or contamination of the canister samples, while the low, upwind concentrations are measured directly. All measurements can be made with a single analytical system. The canister samples should be analyzed the same day they are collected, although there is some evidence that the sample may be stable for several days in the stainless steel canisters when stored at room temperature.

DETERMINATION OF ATMOSPHERIC NONMETHANE ORGANIC COMPOUNDS (NMOC) BY CRYOGENIC PRECONCENTRATION AND DIRECT FLAME IONIZATION DETECTION

1. APPLICABILITY

This method is applicable to measurement of concentrations of total gaseous nonmethane organic compounds (NMOC) in the atmosphere, for use with atmospheric photochemical models such as EKMA.[1] Measurements may be obtained either in situ, or by subsequent analysis of integrated air samples collected over a fixed time period such as the 3-hour (6 to 9 a.m.) measurements specified for EKMA. Collection of integrated samples also allows for remote analysis of samples from multiple sites. The high sensitivity and low detection limit of the method makes it suitable for upwind measurements, while the wide dynamic range allows analysis of urban air samples as well.

2. PRINCIPLE

An air sample is taken either directly from the ambient air at the monitoring site, where the analytical system is located, or from a sample canister filled previously at a remote site. A fixed-volume portion of the sample is drawn at a low flow rate through a glass beaded trap cooled to approximately -186° C. This temperature is such that all organic compounds in the sample other than methane are collect (either via condensation or adsorption) in the trap, while methane, nitrogen, oxygen, etc., pass through. The system is dynamically calibrated so that the volume of sample passing through the trap does not have to be quantitatively measured, but must be precisely repeatable between the calibration and analytical phases.

After the fixed volume air sample has been drawn through the trap, the helium carrier gas is diverted to pass through the trap in a direction opposite to that of the sample flow and into a flame ionization detector (FID). When the residual air and methane has been cleared from the trap and the FID baseline becomes steady, the cryogen is removed and the temperature of the trap is raised to approximately 90° C. The organic compounds collected in the trap revolatilize and are carried into the FID, resulting in a response peak or peaks from the FID. The area of the peak or peaks is integrated, and the integrated value is translated to concentration units via a previously obtained calibration curve relating integrated areas with known concentrations of propane.

The cryogenic trap simultaneously concentrates the nonmethane organic compounds while separating and removing the methane from air samples. Thus the technique is direct reading for NMOC and, because of the concentration step, is more sensitive than conventional NMOC analyzers. Also, operation of the FID detector with a helium carrier results in less response variation to different organic compounds than is observed with conventional NMOC analyzers having air carriers or direct air injection. Quantitative trapping has been shown for most compounds tested.[5,7]

3. PRECISION AND ACCURACY

The overall precision estimate for the method, including the effect of collecting and storing the ambient samples in stainless steel canisters, was found to be 4.5%.[7]

Because of the number and variety of organic compounds included in the NMOC measurement, determination of absolute accuracy is not practical. Based on comparison with manual GC speciation analysis--a technique regarded as the best available for measurement of atmospheric organic compounds--the proportional bias was determined to be +5.7%, with a negligible fixed bias.[7] Although the 5.7% bias was statistically significant, no correction factor is proposed for the method because this bias is modest and the speciation techique is not an absolute standard.

Experimental tests indicate some degree of FID baseline shift from water vapor in ambient samples, which could result in positive bias, variability, or both. These problems can be adequately minimized by careful selection of the integration termination points and appropriate baseline corrections, as described in Section 7.3.

4. APPARATUS

The following components and materials are required or recommended. Sources for the more specialized components are given in the Appendix. An overall schematic diagram of the analytical system is shown in Figure 1, and a suggested system for collecting ambient samples in canisters is shown in Figure 2. The cryogenic trap is specified in figure 3, and a canister cleaning system is shown in Figure 4.

4.1 Direct Sampling

4.1.1 Sample manifold or sample inlet line, to bring air sample into the analytical system.

4.1.2 Vacuum pump or blower to draw air sample through sample manifold or inlet line with a low residence time.

4.2 Sample Collection in Pressurized Canisters

4.2.1 Sample canisters. Stainless steel pressure vessels of 4 to 6-L volume having electropolished interior and integral, leak-free shut-off valves (see Appendix). Each canister should have a unique identification number.

4.2.2 Sample pump. Stainless steel, Metal Bellows (model MB-151 or equivalent) capable of 2 atmospheres (200 kPa, 30 psig) minimum output pressure. Pump must be clean and uncontaminated by oil or organic compounds.

4.2.3 Auxiliary pump. Inexpensive vacuum pump to draw air sample through inlet line to sample pump with a low residence time.

4.2.4 Pressure gauge. 0-200 kPa (0-30 psig).

4.2.5 Shut-off valve.

4.2.6 Stainless steel orifice or short capillary. Capable of maintaining a substantially constant flow over the sampling period (see Section 6.2).

4.2.7 Needle valve. Fine metering valve to adjust flow rate of sample from canister during analysis.

4.3 <u>Sample Canister Cleaning</u>

4.3.1 Vacuum pump. Capable of evacuating the sample canisters to an absolute pressure of >5 mm Hg.

4.3.2 Vacuum manifold. A metal manifold with connections for several canisters to be simultaneously cleaned.

4.3.3 Shut off valve. A low leakage vacuum valve placed in-line between the vacuum pump and the vacuum manifold.

4.3.4 Vacuum gauge. Capable of measuring the vacuum in the vacuum manifold to an absolute pressure of 1 mm Hg.

4.3.5 Cryogenic trap. U-shaped open tubular trap cooled with liquid nitrogen or argon, to prevent contamination from back diffusion of oil from the vacuum pump.

4.3.6 Pressure gauge. 0-50 psig (0-345 kPa), to monitor canister pressure.

4.3.7 Flow Control valve, to regulate flow of zero air into canisters.

4.4 Analytical System

4.4.1 FID detector system, including flow controls for the FID fuel and air, temperature control for the FID block, and signal conditioning electronics.

4.4.2 Chart recorder, compatible with the FID output signal, to record

4.4.3 Integrator, electronic, compatible with the FID output signal and capable of integrating the area of one or more peaks and calculating corrections for baseline drift.

NOTE: Items 4.4.1, 4.4.2 and 4.4.3 are conveniently provided by a late-model laboratory chromatograph such as the Hewlett Packard model 5840A or similar. See also sections 6.3.8 and 6.3.11. The chromatograph may also provide other convenient features such as an oven for warming the trap and valve, and automatic control of the valve and integrator (see below).

4.4.4 Six-port chromatographic valve. Seiscor model VIII (pneumatic), valco 9110 (manual), or equivalent.

4.4.5 Trap. Fabricated from a 30-cm length of 0.3175 cm (1/8 inch) o.d., 0.21 cm i.d. chromatographic grade stainless steel tubing to the dimensions shown in Figure 3. A 10 to 15-cm section in the center of the trap is packed with 60/80 mesh glass beads, held in place with dimethyldichlorosilane-treated glass wool at both ends.

4.4.6 Cylinder pressure regulators. Standard, two-stage cylinder pressure regulator, with pressure gauges, for helium, air and hydrogen cylinders.

4.4.7 Low pressure regulators. Single stage, with pressure gauge, to maintain constant helium carrier gas and hydrogen flow rates.

4.4.8 Needle valve. Fine metering valve to adjust sample flow rate through trap.

4.4.9 Cryogenic Dewar, to hold liquid cryogen; sized to contain submerged portion of trap.

4.4.10 Absolute pressure gauge. 0-200 torr, Wallace-Tiernan model 61D-ID-0200, or equivalent.

4.4.11 Vaccum reservoir. Vacuum tank of about 2-L capacity.

4.4.12 Gas purifiers. Gas scrubbers containing Drierite or silica gel and 5A molecular sieve to remove moisture and organic impurities in the helium carrier gas, air, and hydrogen.

4.4.13 Shut-off valves (2). Leak free.

4.4.14 Vacuum pump. Capable of evacuating the vacuum reservoir to an appropriate vacuum that allows the desired sample volume to be drawn through the trap.

4.4.15 Trap heating system. Chromatograph oven, hot water, or other means to heat trap to 70 - 90° C.

4.5 Other Materials

4.5.1 Various connecting tubing and plumbing fittings. All such items in contact with the sample, analyte, or support gases prior to analysis should be stainless steel or other inert metal. Do not use a plastic or Teflon tubing or fittings.

4.5.2 Various mechanical mounting fixtures as necessary.

5. SUPPLIES

5.1 Helium. Cylinder of high purity grade helium.

5.2 Combustion air. Cylinder of zero-grade air containing less than 0.5 ppm hydrocarbons, or equivalent air source.

5.3 Hydrogen. Cylinder of ultra high purity grade hydrogen, or equivalent source.

5.4 Propane calibration standard. Cylinder containing 1 to 100 ppm propane in air. Cylinder assay should be traceable to a National Bureau of Standards (NBS) propane in air Standard Reference Material (SRM) or a commercially available Certified Reference Material (CRM).

5.5 Zero air, containing less than 0.01 ppm C hydrocarbons, zero air may be obtained from a cylinder of zero-grade compressed air scrubbed with Drierite or silica gel and 5A molecular sieve or activated charcoal, or by catalytic cleanup of ambient air. All zero air should be passed through a cryogenic cold trap for final clean up.

5.6 Cryogen. Liquid argon or liquid oxgen. (Observe appropriate safety precautions with liquid oxgen).

6. SYSTEM DESCRIPTION

6.1 Direct Sampling

Allow the cryogenic trapping system to draw the air sample directly from a pump-ventilated distribution manifold or sample line. The connecting line should be kept as short as possible to minimize its dead volume. If this technique is used, multiple analysis will have to be taken over the sampling period to establish hourly or 3-hour averages. Direct sampling avoids potential sample degradation or contamination from sample collection containers.

6.2 Sample Collection in Pressurized Canisters

Collection of ambient air samples in pressurized canisters provides a number of advantages, including (1) integration of ambient samples over a time period, e.g., 1 or 3 hours; (2) remote sampling and central analysis; (3) storage and shipping of samples; (4) unattended sample collection; (5) analysis of samples from multiple sites with one analytical system; and (6) collection of replicate samples for statistical analysis. However, great care must be exercised in selecting, cleaning, and handling the sample canisters and sampling apparatus to avoid losses or contamination of the samples.

Figure 2 shows a schematic diagram of a recommended sample collection system. The small auxiliary pump purges the inlet manifold or lines with a flow of several liters/minute to minimize the sample residence time. The larger Metal Bellows pump (MB-151) takes a small portion of this sample to fill and pressurize the sample canisters. Both pumps should be shock-mounted to minimize vibration.

A critical orifice connected to the inlet of the Metal Bellows pump is used to maintain a substantially constant flow into the canisters and must be selected to provide the desired flow rate. This flow rate is chosen so that the canisters are pressurized to at least 1 atmosphere above ambient pressure (2 atmospheres absolute pressure) over the desired sample period. The flow rate can be calculated by

$$F = \frac{P\ V\ N}{T \times 60} \qquad (1)$$

where

F = Flow rate, cm^3/min

P = Final canister pressure, atmospheres absolute

V = Volume of the canister, cm^3

N = Number of canisters connected together for simultaneous sample collection

T = Sample period, hours.

For example, if two 4-L canisters are to be filled to 2 atmospheres absolute pressure (15 psig) in 3 hours,

$$F = \frac{2 \times 4000 \times 2}{3 \times 60} = 89 \text{ cm}^3/\text{min}.$$

The canisters are originally evacuated, and once they are filled to above atmospheric pressure (about half the sample period), then pressure can be monitored with the pressure gauge. The connecting lines between the sample pump and the canisters should be as short as possible to minimize their volume. Be sure the flow rate into the canister remains relatively constant over the entire sampling period (some drop in the flow rate may occur near the end of the sample period as the canister pressure approaches 2 atmospheres pressure).

Replicate samples provide useful quality control information. They can also decrease the possibility of lost samples due to leakage or contamination in either of the canisters. If replicates are needed, two canisters should be filled simultaneously.

Prior to field use, each sampling system should be tested for pump contamination (see Section 7.2), leaks, and proper flow rate. The plumbing on the outlet side of the Metal Bellows pump can be checked for leaks by shutting off the canister valves, pressurizing the system, and checking fittings, etc., with a nonhydrocarbon-based leak detector fluid. The MB-151 pump should also be leak checked by plugging its outlet and ensuring that there is no flow into its inlet side. The canisters must be cleaned and checked for contamination before use (see Section 7.1).

During analysis, a pressurized canister is connected to the six-port valve via a needle valve (V4) and vent as shown in Figure 1. The needle valve reduces the canister pressure and adjusts the canister flow rate to a value slightly higher than the trap flow rate set by valve V3. The excess flow exhausts through the vent, which assures that the sample air flowing through the trap is at atmospheric pressure. The vent is connected to a flow indicator or is submerged in water so that the escaping bubbles provide a visual indication of vent flow and assist in adjusting valve V4.

6.3 <u>Analytical System</u>

6.3.1 Sample volume metering system. The vacuum reservoir and pressure gauge (see Figure 1) are used to meter precisely repeatable volumes of sample air through the cryogenic trap. With valve V2 closed and valve V1 open, the reservoir is first evacuated with the vacuum pump. Then V1 is closed and V2 is opened to allow a fixed volume of sample air to be drawn through the cryogenic trap and into the evacuated reservoir. The volume of air sampled is determined by the pressure rise in the evacuated reservoir, measured by the pressure gauge. This volume can be calculated by

$$V_s = \frac{\Delta P \; V_r}{P_s} \qquad (2)$$

where

V_s = Volume of air sampled, standard cm^3

ΔP = Pressure difference measured by gauge, torr

V_r = Volume of vacuum reservoir

P_s = Standard pressure (760 torr).

For example, with a vacuum reservoir of 1700 cm^3 and a pressure change of 180 torr (20 to 200), the volume sampled would be 403 $cm.^3$ The actual reservoir volume is noncritical, since it will be constant throughout calibration and sample analysis, but changing the volume of the sample (ΔP or V_r) will change the sensitivity of the method. Sample volumes of 200 cm^3 to 500 cm^3 appear to be appropriate for typical ambient NMOC concentrations. If the response peak obtained for a 500 cm^3 sample turns out to be outside the calibration range or off scale, a second analysis of a 250 cm^3 sample can be carried out.

6.3.2 Trap. The trap should be carefully constructed from a single piece of tubing in the shape shown in Figure 3. The central portion of the trap (10 to 15 centimeters) is packed with 60/80 mesh glass beads with glass wool filling the remainder to retain the beads. The trap must fit conveniently into the Dewar flask (Section 4.4.7), and the arms must be of an appropriate length to allow the beaded portion of the trap to be submerged below the level of liquid cryogen in the Dewar. The trap should connect directly to the six-port valve, if possible, to minimize line length between the trap and the FID. It must be mounted to allow the Dewar to be conveniently slipped on and off the trap and also to facillitate heating of the trap (see 6.3.4).

6.3.3 Liquid cryogen. Either liquid oxygen (bp -183.0° C) or liquid argon (bp -185.7° C) may be used for the cryogen; experiments have shown no difference in trapping efficiency between the two cryogenic liquids.[5] However, appropriate safety precautions must be taken if liquid oxygen is used. Liquid nitrogen (bp -195° C) should not be used as it causes condensation of oxygen and methane in the trap. It may be possible to use liquid nitrogen in an automated system if an automatic temperature controller is used to obtain an operational temperature in the range of 180-185° C. The level of the cryogenic liquid should be maintained constant with respect to the trap and should completely cover the beaded portion of the trap.

6.3.4 Heat source. To facilitate integration of the NMOC response peak, a hot bath or other heating source is used to heat the trap and volatilize the concentrated NMOC such that the FID produces one (or only a few) sharp and easily integrated peaks. The trap should be heated to a temperature in the range of 75° C to 90° C. A simple heating source for the trap is a beaker or Dewar filled with water maintained at 75° to 90° C. Other types of heat sources include a temperature-programmed chromatograph oven, electrical heating of the trap itself, or any type heater that brings the temperature of the trap up to 75° - 90° C in .7-.9 minutes.

6.3.5 Carrier gas. Helium is used to purge residual air and methane from the trap at the conclusion of the sampling phase and to carry the revolatilized NMOC from the trap into the FID. A single-stage auxiliary regulator between the cylinder and the analyzer may not be necessary but is recommended to regulate helium pressure better than the two-stage cylinder regulator. When an auxiliary regulator is used, the secondary stage of the two-stage regulator must be set at a pressure higher than the pressure setting of the single-stage regulator.

6.3.6 Construction. The 6 port valve and as much of the interconnecting tubing as practical should be located inside an oven or otherwise heated to 40 - 90° C to minimize wall losses or adsorption/

desorption in the connecting lines. All lines should be kept as short as possible.

All tubing used for the system should be chromatographic grade stainless steel connected with stainless steel fittings. Pneumatic damping may be needed between the 6 port valve and the FID to dampen the effect of valve actuations, which may otherwise cause upsets in the FID signal or extinguish the flame. A stainless steel capillary may be used for damping, but its length should be as short as possible to prevent broadening of the peak.

After assembly, the system should be pressurized to about 80 psig (550 kPa) and checked for leaks. During this procedure, disconnect the absolute pressure gauge and cap the line to prevent damage to the gauge. If the system is leak free, depressurize the system and reconnect the gauge.

6.3.7 FID Detector. The NMOC Analyzer should be set up to accommodate helium carrier gas so that the entire sample is directed to the FID. The FID burner air, hydrogen, and carrier flow rates should be set to obtain an adequate FID response while maintaining as stable a flame as possible throughout all phases of the analytical cycle. The flow rates that were used for the Hewlett Packard model 5840A in the comparison study[7] were as follows: hydrogen, 80 cm^3/min; carrier (He), 30 cm^3/min; burner air, 400 cm^3/min.

6.3.8 Linearity. Response has been shown to be liner over a wide range (0-10,000 ppb C).[5,7]

6.3.9 Range. Some FID detector systems such as laboratory chromatographs may have autoranging. Others, provide a front panel "range" (attenuator) control and internal full-scale output voltage selectors. An appropriate combination should be chosen so that an adequate output level for accurate integration is obtained down to the detection limit, yet the electrometer or integrator must not be driven into saturation at the upper end of the calibration. Saturation of the electrometer may be indicated by flattening of the calibration curve at high concentrations. Additional adjustment of range and sensitivity can be provided by adjusting the sample volume used, as discussed in Section 6.3.1.

6.3.10 Integrator. The integrator must be electrically compatible with the output signal of the FID detector so that sufficient resolution is available at low concentrations without overranging on high concentrations. If both an integrator and a separate chart recorder are used, care must be exercised to be sure they don't interfere with each other electrically. Range selector controls on both the integrator and the FID analyzer may not provide accurate range ratios, so individual calibration curves should be prepared for each range to be used.

The integrator should be capable of marking the beginning and end of peaks, constructing the appropriate baseline between the start and end of the integration period, and calculating the peak area accordingly (see fig. 5). This is necessary because the H_2O in the sample, which is also concentrated in the trap, will cause a slight positive baseline shift. This shift continues much longer than the organic peaks. If this shift is not taken into account by the integrator, it can cause a substantial positive bias in the area as well as increased measurement variability.

7. PROCEDURE

7.1 Recommended Procedure for Canister Cleaning

7.1.1 Leak-test all canisters by pressurization to 40 psig (275 kPa) with zero air and immersion in water.

7.1.2 Connect canisters to the vacuum manifold as shown in Figure 4.

7.1.3 Open the canister shut-off valves and evacuate the canisters to 5.0 mm Hg or less, using a cryogenically-cooled trap in the vacuum line to eliminate back-diffusion of hydrocarbons and oil from the vacuum pump.

7.1.4 Close valve V5 and shut-off valve V7. Open valve V6 to pressurize the canisters with zero air to about 40 psig (300 kPa). If a zero gas generation system is used the rate of flow may need to be controlled.

7.1.5 Close valve V6 and allow the canisters to vent down to atmospheric pressure through the vent valve V8.

7.1.6 Close valve V8, open valve V5 and evacuate the canisters to <5.0 mm Hg. Open valve V7 only after the manifold pressure is below ambient pressure to monitor the vacuum.

7.1.7 Evacuate the canisters for 10 to 15 minutes. Then close valves V5 and V7.

7.1.8 Repeat steps 7.1.3 to 7.1.6 two additional times.

7.1.9 Fill the canisters with zero air and analyze the contents as a blank check of the canisters and the cleanup system and procedures. This step should be performed on 100% of the canisters until the cleanup system and procedures are proven reliable. The check can then be reduced to a lower percentage unless problems arise. Any canister that does not test clean (compared to direct analysis of zero air) after repeated cleaning should not be used.

7.1.10 Re-evacuate the canister after the analysis and leave evacuated until used.

7.1.11 Attach a paper tag to each canister for field notes.

The canister is now ready for collection of an air sample.

7.2 Procedure for Collection of Samples in Canisters

7.2.1 Clean and test the canisters according to the procedure in Section 7.1.

7.2.2 Assemble a sample collection system such as the one shown in Figure 2.

7.2.3 Check the pump for contamination by filling two evacuated, cleaned canisters with zero air through the sampling system and analyzing them.

7.2.4 Turn on pumps and allow them to warm up for 15 minutes. The orifice should be pre-checked on each sampling system to make sure the sample flow remains relatively constant up to about 15 psig (2 atmospheres absolute pressure). After warming up, loosely attach the fittings to the canisters to purge the lines for at least 1 minute. Leave the canister valves and the gauge shut-off valve closed.

7.2.5 Without turning off the pumps, tighten the fittings, then open the canister shut-off valves.

7.2.6 The canisters will fill slowly over the selected period at the predetermined flow rate. At the end of the sample period, measure the canister pressure with the pressure gauge to ensure that the canisters have been pressurized to about 2 atmospheres (15 psig).

7.2.7 Close canister valves and disconnect the canisters from the pump setup. Then turn off the pumps.

7.2.8 The identification tags on the sample canisters should be filled out as necessary. Bring the canisters to the analytical system for analysis.

7.2.9 Complete records of the sampling should be entered in a laboratory notebook. The sampling operator should be alerted to take note of any activities or special conditions in the area (rain, smoke, etc.) that may affect the sample contents.

7.3 Analysis Procedure

7.3.1 Assemble the analysis system as shown in Figure 1 and as discussed in Section 6. Allow the FID detector to warm up and stabilize for several hours before analysis.

7.3.2 Check and adjust the helium carrier pressure to provide the correct carrier flow rate for the system. Also check FID hydrogen and burner air flow rates.

7.3.3 Close valve V2 and open valve V1 to evacuate the vacuum reservoir.

7.3.4 With the trap at room temperature, place the six-port valve in the inject position.

7.3.5 Open valve V2 and adjust valve V3 for a sample flow of 50 to 100 cm^3/min.

7.3.6 Connect a sample canister or direct sample inlet to the six-port valve as shown in Figure 1. For a canister, open the canister valve and adjust valve V4 to obtain a slight vent flow as indicated by the flow indicator or by constant bubbles. (CAUTION: Do not allow water to be drawn into the six-port valve.) Then close valve V2.

7.3.7 Open valve V1 (if not already open) to evacuate the vacuum reservoir. With the six-port valve in the inject position and valve V1 open, open valve V2 for a few minutes to flush and condition the inlet lines. Then close valve V2.

7.3.8 Submerge the trap in the cryogen and allow a few minutes for the trap to cool completely (indicated when the cryogen stops boiling). Check and maintain the initial cryogen level to the same level used during calibration.

7.3.9 With the six-port valve still in the inject position, close valve V1 and open valve V2.

7.3.10 Observe the increasing pressure on the pressure gauge; when it reaches an arbitrary point such as 20 mm Hg, quickly switch the six-port valve to the sample position. (Alternatively, valve V2 can be closed momentarily to allow more time while the six-port valve is switched.)

7.3.11 Observe the increasing pressure on the pressure gauge; when it reaches a second arbitrary point, such as 200 mm Hg, close valve V2. Then switch the valve to the inject position, keeping the cryogenic bath on the trap. Also close valve V4 to conserve the remaining sample in the canister.

7.3.12 Start the chart recorder, and wait until the FID response baseline has stabilized (about 40 to 60 seconds). Do not wait longer than 2 minutes.

7.3.13 Start the integrator. Remove the liquid cryogenic bath from the trap and smoothly but not too quickly replace it with a Dewar of hot water (approximately 90° C) or an alternate heating system. Use the same level of hot water or a consistent heating procedure for both calibration and sample analyses. Heating the trap too quickly may cause an initial negative-going response which could hamper accurate integration. Some initial experimentation may be necessary to determine the optional heating procedure for each system, but once established, the procedure should be consistent for each analysis.

7.3.14 Continue the integration only long enough to include all the organic compound peaks and establish the end FID baseline, as shown in Figure 5. The end baseline may be shifted somewhat higher than the initial baseline due to moisture in the sample. Construct an operational baseline from the initial baseline at the beginning of the first peak to the end baseline as shown in Figure 5, and correct the peak area reading according to this operational baseline. Electronic integrators either do this automatically or they should be programmed to do this correction.

7.3.15 Use the calibration curve (section 8.3) to convert the peak area reading into concentration units (ppmC). Note that the NMOC peak shape may not be precisely reproducible due to variations in heating the trap, but the total NMOC peak area should be reproducible.

7.3.16 Duplicate Analysis. Analyze each canister sample at least two times and report the average NMOC concentration. Problems occasionally occur during an analysis that will cause improper results to occur. If the first 2 analyses do not agree closely, additional analyses should be made to identify inaccurate measurements and produce a more accurate average.

8. CALIBRATION

8.1 Calibration Frequency

Initially, a complete dynamic calibration of five or more points should be carried out on each range to define the calibration curve. Subsequently, the calibration should be verified with two- or three-point calibration checks (including zero) each time the analytical system is used to analyze samples.

8.2 Calibration Standards

Propane calibration standards may be obtained directly from low concentration cylinder standards or by dilution of high concentration cylinder standards with zero air. Dilution flow rates must be measured accurately, and the combined gas stream must be mixed thoroughly. Calibration standards must be sampled directly from a vented manifold or tee. Remember that a propane concentration in ppmC is three times the volumetric concentration in ppm.

8.3 Calibration Procedure

8.3.1 Select one or more combinations of FID attenuator setting, output voltage setting, integrator resolution (if applicable), and sample volume to provide the desired range or ranges (e.g., 0-1.0 ppm C or 0-5.0 ppm C). Each such range should be calibrated individually and have a separate calibration curve.

8.3.2 Analyze each calibration standard three times according to the procedure in Section 7.3. Be sure that flow rates, initial cryogen liquid level in the dewar, timing, heating and other variables are the same as will be used during analysis of ambient samples.

8.3.3 Average the three analyses for each concentration standard and plot the calibration curve(s) as integrated peak area reading versus concentration in ppm C. The relative standard deviation for the three analyses should be less than 3 percent. Linearity should be expected; points that appear to deviate abnormally should be repeated. If nonlinearity is observed, an effort should be made to identify and correct the problem. If the problem cannot be corrected, additional points in the non-linear region may be needed to adequately define the calibration curve.

9. METHOD MODIFICATIONS

9.1 Sample Metering System

Although the vacuum reservoir and absolute pressure gauge technique for metering the sample volume during analysis is efficient and convenient, other techniques should work also. For example, a constant sample flow could be established with a vacuum pump and a critical orifice, with the six-port valve being switched to the sample position for a measured time period. Or a gas volume meter such as a wet test meter could be used to measure the total volume of sample air drawn through the trap. However, these alternate techniques have not been tested or evaluated.

9.2 <u>TOC Analyzer</u>

FID detector systems other than the Hewlett Packard Model 5840A may also be adaptable to the method. The specific flow rates and necessary modifications for the helium carrier for any alternate FID instrument would have to be worked out by the user.

9.3 <u>Range</u>

It may be possible to increase the sensitivity of the method by increasing the sample volume. However, limitations are likely to arise, such as plugging of the trap by ice; hence any attempts to increase the sensitivity should be tested carefully.

9.4 <u>Alternate Carrier Gas</u>

It may be possible to substitute nitrogen for the helium carrier, but no tests using a nitrogen carrier have been carried out.

9.5 <u>Trap Heating</u>

Alternative techniques may be used for heating the trap during analysis For example, with a suitable temperature control, the trap could be heated electrically by passing electrical current directly through the trap tubing, using its internal resistance to heat it, or by using a trap wrapped around an electrical heater.

10. REFERENCES

1. Uses, Limitations and Technical Basis of Procedures for Quantifying Relationships Between Photochemical Oxidants and Precursors. EPA-450/2-77-021a, U.S. Environmental Protection Agency, Research Triangle Park, NC, November 1977.

2. Guidance for Collection of Ambient Non-Methane Organic Compound (NMOC) Data for Use in 1982 Ozone SIP Development, and Network Design and Siting Criteria for the NMOC and NO_x Monitors. EPA-450/4-80-011, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, June 1980.

3. Guidance for the Collection and Use of Ambient Hydrocarbon Species Data in Development of Ozone Control Strategies. EPA-450/4-80-008, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, April 1980.

4. Sexton, F.W., F.F. McElroy, R.A. Michie, Jr., and V.L. Thompson. A Comparative Evaluation of Seven Automatic Ambient Non-Methane Organic Compound Analyzers. EPA-600/S4-82-046, Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, NC, August 1982.

5. Jayanty, R.K.M., A. Blackard, F.F. McElroy, and W.A. McClenny. Laboratory Evaluation of Nonmethane Organic Carbon Determination in Ambient Air by Cryogenic Preconcentration and Flame Ionization Detection. EPA-600/54-82-019, July 1982.

6. Collection and Analysis of Non-Methane Hydrocarbon Transport Data from Upwind Ozone Monitoring Sites for Louisville, Kentucky and Nashville, Tennessee. EPA-904/9-80-055, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, January 1981.

7. McElroy, F.F., V.L. Thompson, D. Holland, W.A. Lonneman, R.L. Seila. Cryogenic Preconcentration-Direct FID Method for Measurement of Ambient NMOC: Refinement and Comparison with GC Speciation. In press, October 1983.

APPENDIX

MATERIAL	MODEL/DIMENSIONS	SUPPLIER
1. Sample Canister	4-6 Liter	Demaray Scientific Instruments, Ltd. N. 1218C Grand Ave. Pullman, WA 99163 (509) 332-3684
2. Absolute Pressure Gauge	Model 61D-ID-0200 (0-200 mm Hg), 2½ in. Face	Wallace & Tiernan Div. of Pennwalt Corp. 25 Main Street Belleville, NJ 07109
3. Six-Port Valve	Seiscor Model V111	Seismograph Service Corp. Seiscor Division P.O. Box 1590 Tulsa, OK 74102
	Valco 9110	Alltech Associates 606A Union Street Kenneth Square, PA 19348
4. Gas Purifiers	Cat #8125	Alltech Associates
5. Chromatographic Grade Stainless Steel Tubing	Cat #30101 (1/8 in. x 0.085 in.)	Alltech Associates
6. Integrating Chart Recorder	Linear Model 252A	Cole-Parmer 7425 North Oak Avenue Chicago, IL 60648
8. FID TOC Analyzer	Beckman Model 400	Beckman Instruments, Inc. Process Instruments Div. 2500 Harbor Boulevard Fullerton, CA 92634
	HP Model 8440/8840	Hewlett Packard Corp. Avondale, PA
9. Metal Bellows Pump	Model MB-151	Metal Bellows Corp. 1075 Providence Highway Sharon, MA 02067
10. Vacuum Gauge	0-10^{-3} mm Hg	Consolidated Vacuum Corp.
11. Cryogenic Dewar	10-196-10B (30 cm x 26 cm)	Fisher Scientific Co.

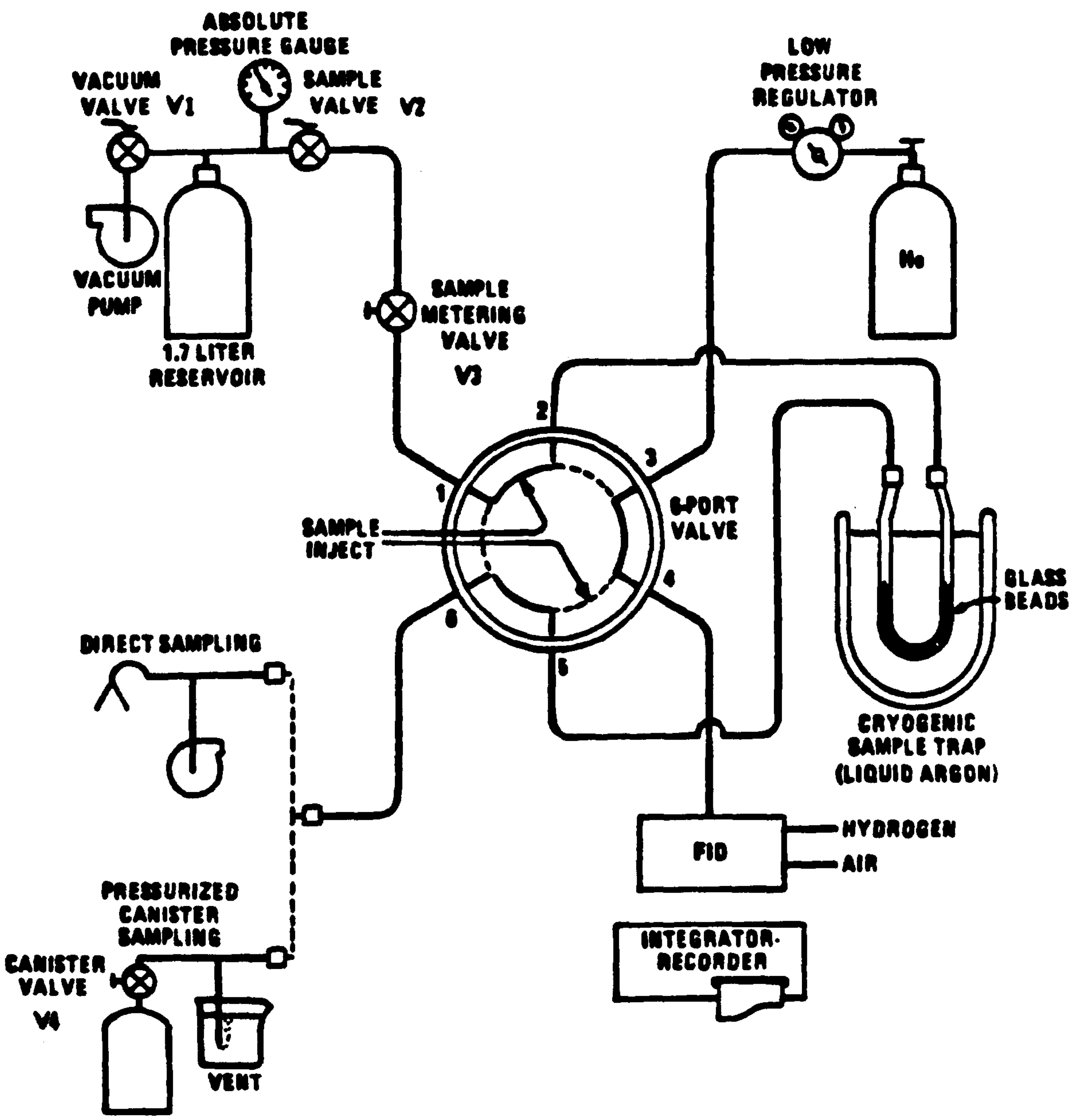

Figure 1. Schematic of analysis system showing two sampling modes.

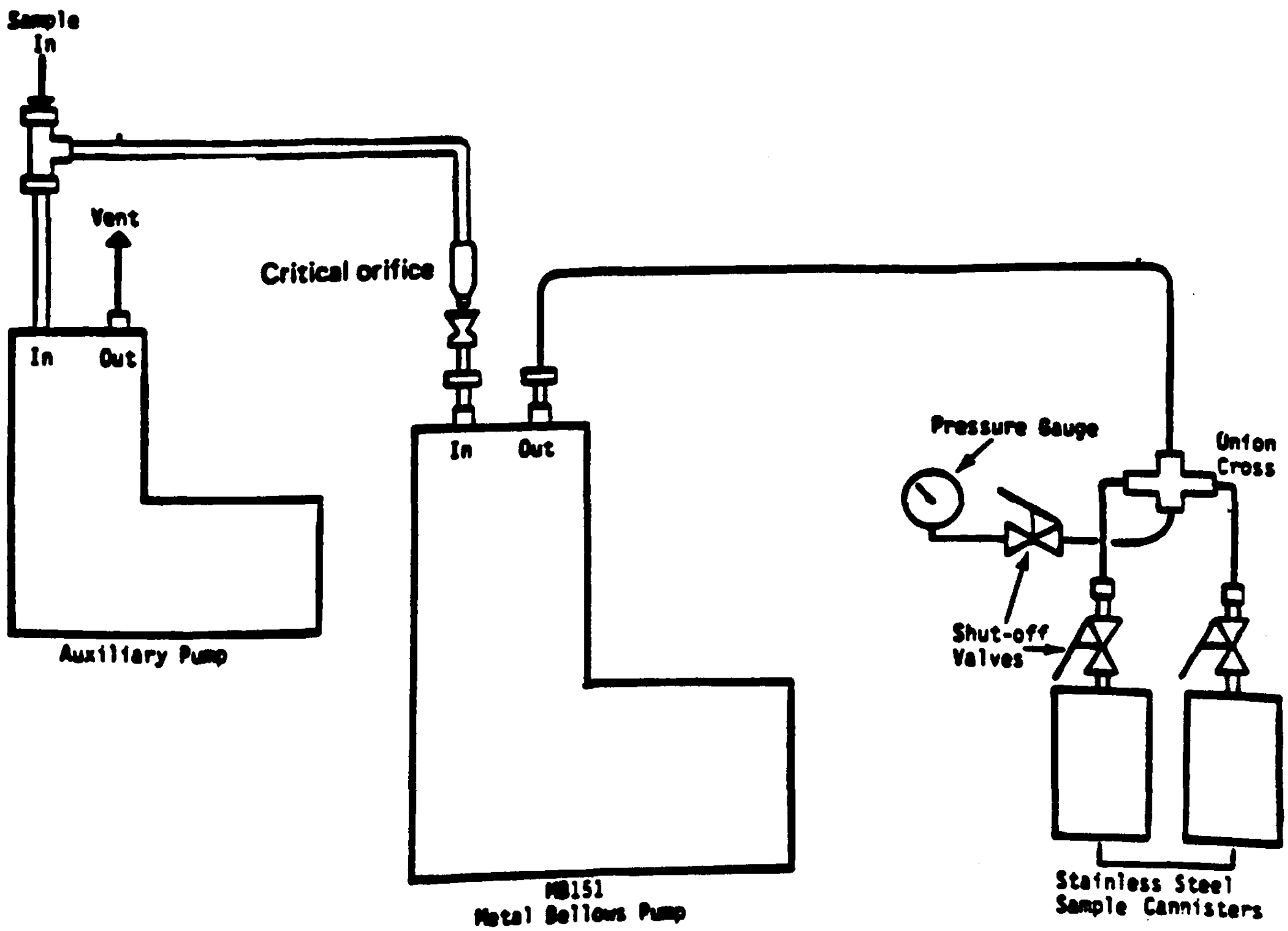

Figure 2. Sample system for collection of integrated field samples.

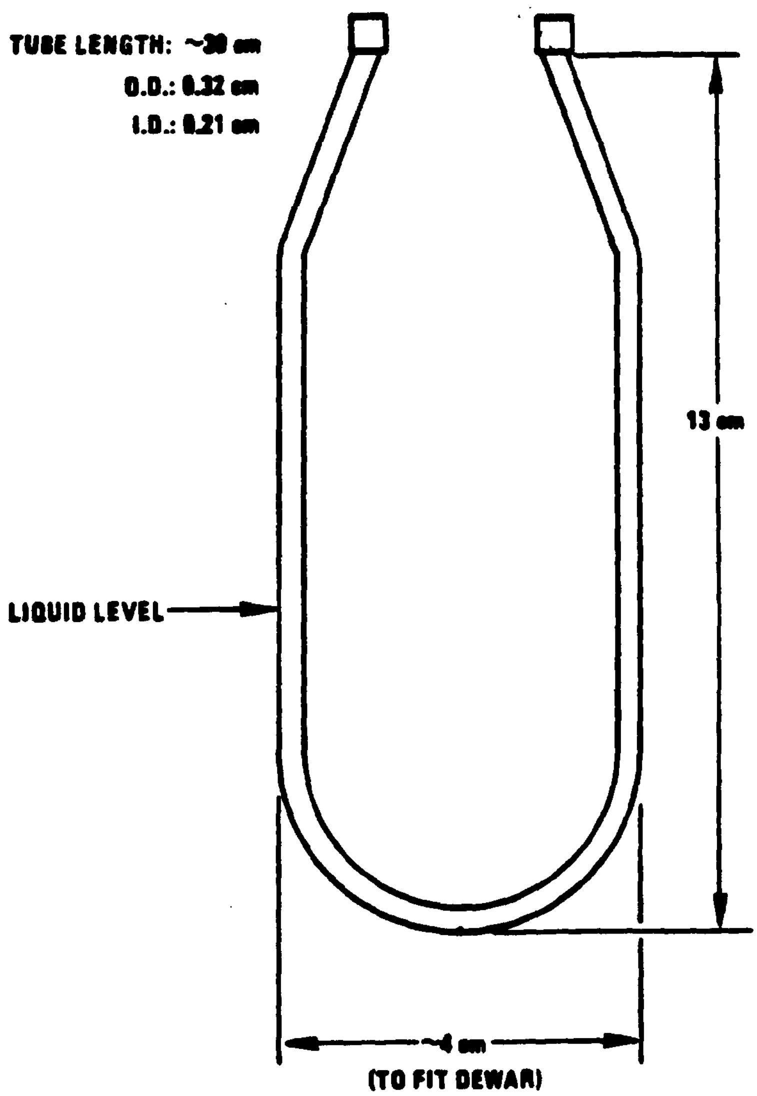

Figure 3. Cryogenic sample trap dimensions.

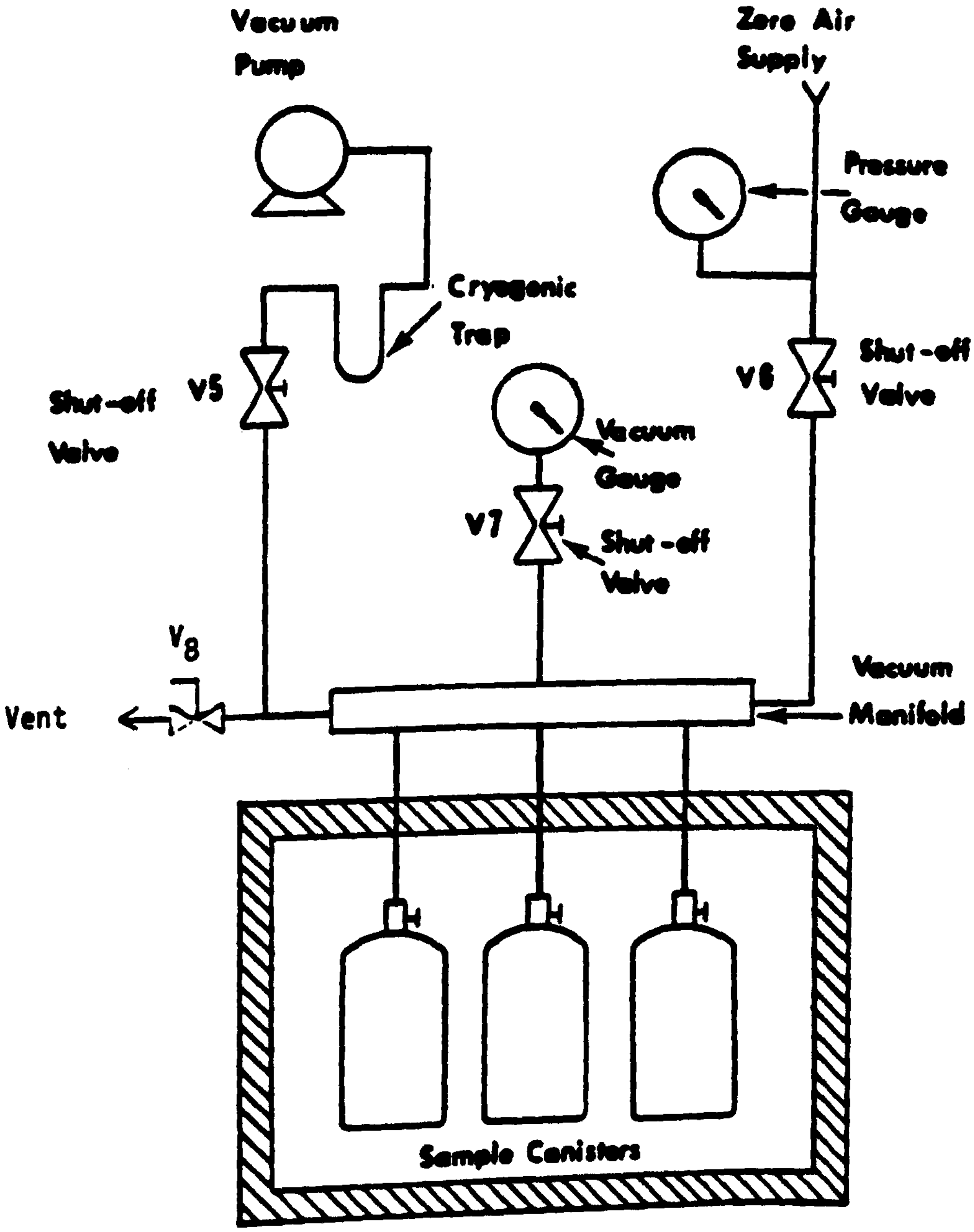

Figure 4. Canister cleaning system.

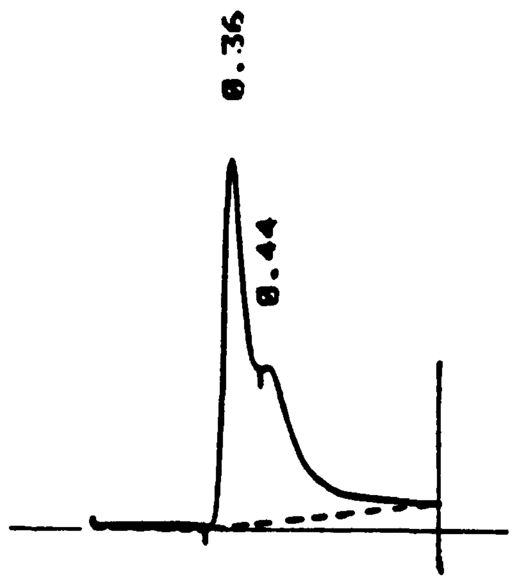

Figure 5. Construction of operational baseline and corresponding correction of peak area.

APPENDIX B

OUTLINE OF NMOC DATA ANALYSIS

OUTLINE OF NMOC DATA ANALYSIS

1. NMOC DATA

A. A final list of sites needs to be tabulated, including location.

B. For each site, the following will be listed to get some measure of completeness: number of total samples, number of valid samples, and percent complete. It is assumed that once a site began on the analysis plan that the site was committed to five samples per week whether or not there was a holiday. Further, each site was scheduled for duplicate samples. These will be included in the talley of total samples.

Definitions:

Total Samples -- Number of samples a site was scheduled to take, including holidays and duplicate samples.

Valid Samples -- The number of samples which resulted in an analyzable sample.

Invalid Sample -- (Total Samples) - (Valid Samples). Invalid sample includes no samples, or ones for which sample was taken but lost.

% Valid Sample -- A completeness parameter =

$$\frac{\text{(No. Valid Samples)}}{\text{Total Samples}} \times 100.$$

For all the sites (throughout the country), an overall completeness will be calculated from a ratio of overall valid samples to the total number of samples.

C. For each site and for the entire 22 sites, the following statistics will be recorded.

Mean -- An arithmetic mean of all the readings of the valid samples, including any zeros among the valid samples.

$$\bar{X} = \sum_{i=1}^{n} X_i/n$$

Median -- The value of the valid NMOC readings such that one-half of the values are larger than the median, and one-half are below it. For an even number of readings, the median will be assumed to be the arithmetic mean of the two middle data points, after the NMOC values are sorted according to size.

Standard Deviation -- The square root of the estimate of the variance of the values.

$$s_x^2 = \sum_{i=1}^{n} [(X_i - \bar{X})^2/(n-1)]$$

$$s_x = \sqrt{\frac{\sum_{i=1}^{n} X_i^2 - (\sum_{i=1}^{n} X_i)^2/n}{(n-1)}}$$

High -- The largest value of NMOC for a given data set.

Low -- The smallest value of the valid NMOC readings for a given data set.

Range -- The range will be calculated as [(high)-(low)].

D. Testing for outliers. Rank the valid values of NMOC such that $X_1 \leq X_2 \leq X_3 \ . \ . \ . \leq X_{n-2} \leq X_{n-1} \leq X_n$. Thus, X is the smallest value and X_n is the largest value. The number of valid data points is n. Calculate the following statistic

$$T_n = (X_n - \bar{X})/s,$$

where:

$\bar{X}$ = the sample mean, and

s = the sample standard deviation.

Compare the value of the T_n with the critical value given in Table 1 at the upper 5 percent significance level. If T_n is greater than the tabulated value, then T_n is an outlier at the 0.05 significance level.

Similarly, test X as an outlier with the following statistic:

$$T_1 = (\bar{X} - X_1)/s.$$

Continue testing X_{n-1}, X_{n-2}, . . ., and X_2, X_3 . . . until an outlier is not found.

E. For two sets of data for which the percent completeness is high, run either: (1) an autoregression program such as the Box-Jenkins USID program (Box, George E. P., and Gwilym M Jenkins, "Time Series Analysis Forecasting and Control," Holden-Day, San Francisco (1976); Program 1, p. 496; or (2) construct plot as indicated below:

For the chronological (not ranked by size) NMOC data, plot

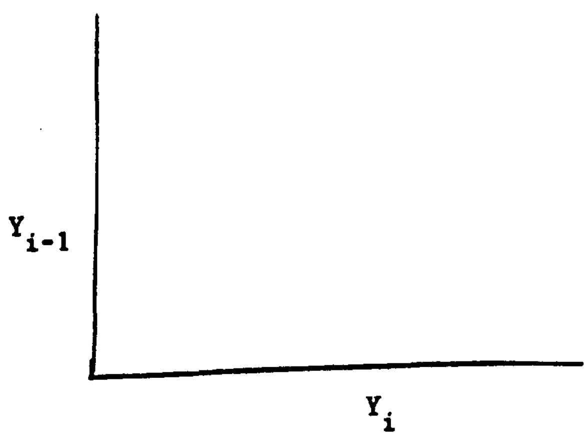

Table 1. GRUBBS[a] CRITERIA FOR OUTLIERS

Number of observations n	Upper 1% significance level	Upper 2.5% significance level	Upper 5% significance level
3	1.155	1.155	1.153
4	1.492	1.481	1.463
5	1.749	1.715	1.672
6	1.944	1.887	1.822
7	2.097	2.020	1.938
8	2.221	2.126	2.032
9	2.323	2.215	2.110
10	2.410	2.290	2.176
11	2.485	2.355	2.234
12	2.550	2.412	2.285
13	2.607	2.462	2.331
14	2.659	2.507	2.371
15	2.705	2.549	2.409
16	2.747	2.585	2.443
17	2.785	2.620	2.475
18	2.821	2.651	2.504
19	2.854	2.681	2.532
20	2.884	2.709	2.557
21	2.912	2.733	2.580
22	2.939	2.758	2.603
23	2.963	2.781	2.624
24	2.987	2.802	2.644
25	3.009	2.822	2.663
26	3.029	2.841	2.681
27	3.049	2.859	2.698
28	3.068	2.876	2.714
29	3.085	2.893	2.730
30	3.103	2.908	2.745
31	3.119	2.924	2.759
32	3.135	2.938	2.773
33	3.150	2.952	2.786
34	3.164	2.965	2.799
35	3.178	2.979	2.811

(continued)

Table 1. Continued

Number of observations n	Upper 1% significance level	Upper 2.5% significance level	Upper 5% significance level
36	3.191	2.991	2.823
37	3.204	3.003	2.835
38	3.216	3.014	2.846
39	3.228	3.025	2.857
40	3.240	3.036	2.866
41	3.251	3.046	2.877
42	3.261	3.057	2.887
43	3.271	3.067	2.896
44	3.282	3.075	2.905
45	3.292	3.085	2.914
46	3.302	3.094	2.923
47	3.310	3.103	2.931
48	3.319	3.111	2.940
49	3.329	3.120	2.948
50	3.336	3.128	2.956
51	3.345	3.136	2.964
52	3.353	3.143	2.971
53	3.361	3.151	2.978
54	3.368	3.158	2.986
55	3.376	3.166	2.992
56	3.383	3.172	3.000
57	3.391	3.180	3.006
58	3.397	3.186	3.013
59	3.405	3.193	3.019
60	3.411	3.199	3.025
61	3.418	3.205	3.032
62	3.424	3.212	3.037
63	3.430	3.218	3.044
64	3.437	3.224	3.049
65	3.442	3.230	3.055
66	3.449	3.235	3.061
67	3.454	3.241	3.066
68	3.460	3.246	3.071
69	3.466	3.252	3.076
70	3.471	3.257	3.082

(continued)

Table 1. Concluded

Number of observations n	Upper 1% significance level	Upper 2.5% significance level	Upper 5% significance level
71	3.476	3.262	3.087
72	3.482	3.267	3.092
73	3.487	3.272	3.098
74	3.492	3.278	3.102
75	3.496	3.282	3.107
76	3.502	3.287	3.111
77	3.507	3.291	3.117
78	3.511	3.297	3.121
79	3.516	3.301	3.125
80	3.521	3.305	3.130
81	3.525	3.309	3.134
82	3.529	3.315	3.139
83	3.534	3.319	3.143
84	3.539	3.323	3.147
85	3.543	3.327	3.151
86	3.547	3.331	3.155
87	3.551	3.335	3.160
88	3.555	3.339	3.163
89	3.559	3.343	3.167
90	3.563	3.347	3.171
91	3.567	3.350	3.174
92	3.570	3.355	3.179
93	3.575	3.358	3.182
94	3.579	3.362	3.186
95	3.582	3.365	3.189
96	3.586	3.369	3.193
97	3.589	3.372	3.196
98	3.593	3.377	3.201
99	3.597	3.380	3.204
100	3.600	3.383	3.207
200	3.570	3.369	3.193
500	3.553	3.359	3.184

[a]Grubbs, F. E. and G. Beck, Extension of Sample Sizes and Percentage Points for Significance Tests of Outlying Observations, Technometrics, Vol. 14, No. 4, November 1972, pp. 847-854.

Data Point	NMOC Reading Y_i	Y_{i-1}
First Week		
#1	Tuesday	Monday
#2	Wednesday	Tuesday
#3	Thursday	Wednesday
#4	Friday	Thursday
Second Week		
#5	Tuesday	Monday
#6	Wednesday	Tuesday
#7	Thursday	Wednesday
#8	Friday	Thursday
Etc.		

Now fit a linear regression line, using $X_i \equiv Y_i$, and $Y_i' \equiv Y_{i-1}$ for $Y_i' = a + bX_i$. Coefficient b is the first order autocorrelation coefficient. If $b \geq 0.5$, the data may be first-order autocorrelated, which may have important consequences drawing any statistical conclusions, e.g., tests of hypotheses or setting confidence intervals.

2. DUPLICATE SAMPLES

A. Tabulate completeness data as follows:

Site	No. valid	No. invalid	Total	% valid (complete)
#1	X	X	X	X
#2	X	X	X	X
⋮	⋮	⋮	⋮	⋮
#22	X	X	X	X
Overall	X	X	X	X

As indicated above, "Total Samples" includes all samples for which the site was scheduled in the original test plan to obtain duplicate samples.

B. NMOC data. For NMOC data, tabulate the following:

Site	Duplicate No.	Y_1	Y_2	$\bar{Y}$	S_Y	% RSD	d
#1	1						
	2						
	3						
	⋮						
	n_{1j}						
							$\bar{d}_1$, S_{d1}
#2	1						
	2						
	3						
	⋮						
	n_{2j}						
							$\bar{d}_2$, S_{d2}

where:

$(Y_1)_{ij}$ = NMOC reading of Duplicate Sample No. 1 (the sample with the lowest Radian ID number), or the mean of the readings if a duplicate had repeated analyses at site i for sample number j;

$(Y_2)_{ij}$ = NMOC reading of Duplicate Sample No. 2, or the mean of the readings if a duplicate had repeated analyses at site i for sample number j;

$\bar{Y}$ = $(Y_1 + Y_2)/2$, or $(2Y_1 + Y_2)/3$ if Y_1 was a mean of two repeated analyses, or in general

$$\bar{Y} = \sum_{i=1}^{n} Y_i/n;$$

S_Y = the standard deviation of the duplicate samples = $[(Y_1 - Y_2)/\sqrt{2}]$;

% RSD = the relative standard deviation = $(S_Y/\bar{Y}) \times 100$;

$d_{ij} = (Y_1)_{ij} - (Y_2)_{ij}$;

$\bar{d}_1 = \sum_{j=1}^{n_i} (d_{ij}/n_i)$ where subscript i refers to the site

number and j refers to the duplicate number at a given site;

n_{ij} = the total number of duplicate samples, j, taken at site i;

$$S_{di} = \sqrt{\sum_{j=1}^{n_i} (d_{ij} - \bar{d}_i)^2/(n_i - 1)};$$

$$\bar{\bar{d}} = \sum_{i=1}^{22} (\bar{d}_i/(22)),$$ assuming 22 sites with valid duplicate; and

$$S_{\bar{d}} = \sqrt{\sum_{i=1}^{22} (n_i - 1) \cdot S_{di}^2/(\sum_{i=1}^{22} (n_{ij} - 1)}$$

C. Test d_i for outliers according to Grubbs, as indicated above. Identify those outliers but do not remove them from the calculated means and standard deviations.

D. Test the hypotheses that:

H_o: $\mu_{di} = 0.0$ as follows:

Calculate test statistic, $t_i = \dfrac{\bar{d}_i - 0}{S_{\bar{d}_i}}$

If $t_i < t_{n_{i-1}, \alpha/2}$ or $t_i > t_{n_{i-1}, 1-\alpha/2}$, then H_o is rejected, i.e., d_i is significantly different from zero at the α level of significance. Choose $\alpha = 0.05$ (or 0.01) and $t_{n_{i-1}, 1-\alpha/2}$ from Table 2 for a 97.5 percent (or 99.5) probability, where f is the degrees of freedom and equal to n_{i-1}. Note that $t_{1-p} = -t_p$.

3. REPEATED ANALYSES

A. Several cases will be tabulated. Case I will include all the analyses for which the first analysis was done on Channel #1, a Radian channel on Instrument #1.

Table 2. FRACTILES OF THE t DISTRIBUTION
($t_{1-p} = -t_p$)

	p	
	Probability in percent	
f	97.5	99.5
1	12.71	63.66
2	4.303	9.925
3	3.182	5.841
4	2.776	4.604
5	2.571	4.032
6	2.447	3.707
7	2.365	3.499
8	2.306	3.355
9	2.262	3.250
10	2.228	3.169
11	2.201	3.106
12	2.179	3.055
13	2.160	3.012
14	2.145	2.977
15	2.131	2.947
16	2.120	2.921
17	2.110	2.898
18	2.101	2.878
19	2.093	2.861
20	2.086	2.845
21	2.080	2.831
22	2.074	2.819
23	2.069	2.807
24	2.064	2.797
25	2.060	2.787
26	2.056	2.779
27	2.052	2.771
28	2.048	2.763
29	2.045	2.756
30	2.042	2.750
40	2.021	2.704
50	2.009	2.678
60	2.000	2.660
80	1.990	2.639
100	1.984	2.626
200	1.972	2.601
500	1.965	2.586
∞	1.960	2.576

Case I. First analysis on C_1,

Second analysis	d_{ijk}	n_{ij}	$\bar{d}_{ij}$	s_{ij}
C_1	#1			
	#2			
	⋮			
	n_{11}			
C_2	#1			
	#2			
	⋮			
	n_{12}			
C_3	#1			
	#2			
	⋮			
	n_{13}			
C_6	#1			
	#2			
	⋮			
	n_{16}			

where:

C_1 = Radian Channel No. 1, Instrument #1;

C_2 = Radian Channel No. 2, Instrument #1;

C_3 = Radian Channel No. 3, Instrument #2;

C_4 = Radian Channel No. 4, Instrument #2;

C_5 = EPA Channel, Vince Thompson Laboratory; and

C_6 = EPA Channel, William Lonneman Laboratory.

Case II. First analysis on C_2. Similar table as Case I.

Case VI. First analysis on C_6. Similar table as Case I.

$d_{ijk} = (Y_1 - Y_2)_{ijk}$.

Y_1 = the first of a repeated analysis.

Y_2 = the second of a repeated analysis.

i = the channel on which the first analysis was done.

j = the channel on which the second (or third, or higher) analysis was done.

$k = 1, 2, \ldots, n_{ij}$, the number of repeated analyses for which channel i was the first analysis and channel j was the second analysis.

$\bar{d}_{ij}$ = the mean of the differences for case ij.

s_{ij} = the standard deviation of the differences for case ij.

B. A one-way analysis of variance will be run for each case, using the following model:

$$Y_{ijk} = \mu + T_{ij} + \varepsilon_{ijk}$$

where:

$Y_{ijk} = d_{ijk} = Y_{ij1} - Y_{ij2}$;

Y_{ij1} = the first NMOC analysis for case i, in which j was a second analysis;

Y_{ij2} = the second NMOC analysis for case j, in which i was the first analysis;

k = the number of the repeated analysis for Channel i and Channel j;

T_{ij} = the channel effect (j) for case i; and

ε_{ijk} = the error for a given case and analysis.

For each case, the error mean square from the ANOVA will be used to calculate a precision for the repeated analysis using Channel i as the base channel.

C. For the cases for which the treatments (channels for the second repeated analyses) are significant at the 0.05 or 0.01 percent level, the following comparisons will be made, using the Duncan Multiple Range Test.

1. For each treatment, calculate $\bar{d}_i$.
2. Average the k means in order from low to high.
3. Enter ANOVA table and take error mean square with its degrees of freedom.

4. Obtain the standard error of the mean for each treatment.

$$S_{\bar{d}_{ij}} = \sqrt{\frac{\text{Error mean square}}{\text{No. of observations in } \bar{d}_{ij} \ (= n_{ij})}}$$

5. Enter Duncan's table (see below) of significant ranges at the α level desired, using n_2 = degrees of freedom for the error mean square and p = 2, 3, . . . k, and list these k-1 ranges (if there are six channels, k = 6).

6. Multiply these ranges by $S_{\bar{d}}$ to form a group of k-1 least significant ranges.

7. Test the observed ranges between means, beginning with the largest versus the smallest, which is compared with the least significant range for p = k; then test the largest versus the second smallest with the least significant range for p k-1; etc. Continue this for the second largest versus smallest, etc. until all k(k-1)/2 possible pairs have been tested. The sole exception to the rule above is that no difference between two means can be declared significant if two means concerned are both contained in a subset with a nonsignificant range.

A numerical example will be given once the first set of cases is calculated. Significant Studentized Ranges for a 5-percent Level New Multiple Range Test is shown in Table 3.

4. FOR THE RADIAN QA SAMPLES, THE FOLLOWING COMPARISONS WILL BE MADE

A. Tabulate the data as follows:

QA sample no.	QA concentration C_{ij}	Analysis Y_{ij}	Difference d_{ij}
Channel No. 1			
1	C_{11}	Y_{11}	d_{11}
2	C_{12}	Y_{12}	d_{12}
3	C_{13}	Y_{13}	d_{13}
⋮	⋮	⋮	⋮
n_1	C_{1n_1}	Y_{1n_1}	d_{1n_1}
			$\bar{d}_1$, S_{d_1}

Table 3. SIGNIFICANT STUDENTIZED RANGES FOR A 5-PERCENT LEVEL NEW[a] MULTIPLE RANGE TEST

n/p	2	3	4	5	6	7	8	9	10	12	14	16	18	20	50	100
1	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
2	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09	6.09
3	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
4	3.93	4.01	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02
5	3.64	3.74	3.79	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
6	3.46	3.58	3.64	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68
7	3.35	3.47	3.54	3.58	3.60	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61
8	3.26	3.39	3.47	3.52	3.55	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56
9	3.20	3.34	3.41	3.47	3.50	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.52
10	3.15	3.30	3.37	3.43	3.46	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.48	3.48	3.48
11	3.11	3.27	3.35	3.39	3.43	3.44	3.45	3.46	3.46	3.46	3.46	3.46	3.47	3.48	3.48	3.48
12	3.08	3.23	3.33	3.36	3.40	3.42	3.44	3.44	3.46	3.46	3.46	3.46	3.47	3.48	3.48	3.48
13	3.06	3.21	3.30	3.35	3.38	3.41	3.42	3.44	3.45	3.45	3.46	3.46	3.47	3.47	3.47	3.47
14	3.03	3.18	3.27	3.33	3.37	3.39	3.41	3.42	3.44	3.45	3.46	3.46	3.47	3.47	3.47	3.47
15	3.01	3.16	3.25	3.31	3.36	3.38	3.40	3.42	3.43	3.44	3.45	3.46	3.47	3.47	3.47	3.47
16	3.00	3.15	3.23	3.30	3.34	3.37	3.39	3.41	3.43	3.44	3.45	3.46	3.47	3.47	3.47	3.47
17	2.98	3.13	3.22	3.28	3.33	3.36	3.38	3.40	3.42	3.44	3.45	3.46	3.47	3.47	3.47	3.47
18	2.97	3.12	3.21	3.27	3.32	3.35	3.37	3.39	3.41	3.43	3.45	3.46	3.47	3.47	3.47	3.47
19	2.96	3.11	3.19	3.26	3.31	3.35	3.37	3.39	3.41	3.43	3.44	3.46	3.47	3.47	3.47	3.47
20	2.95	3.10	3.18	3.25	3.30	3.34	3.36	3.38	3.40	3.43	3.44	3.46	3.46	3.47	3.47	3.47
22	2.93	3.08	3.17	3.24	3.29	3.32	3.35	3.37	3.39	3.42	3.44	3.45	3.46	3.47	3.47	3.47
24	2.92	3.07	3.15	3.22	3.28	3.31	3.34	3.37	3.38	3.41	3.44	3.45	3.46	3.47	3.47	3.47
26	2.91	3.06	3.14	3.21	3.27	3.30	3.34	3.36	3.38	3.41	3.43	3.45	3.46	3.47	3.47	3.47
28	2.90	3.04	3.13	3.20	3.26	3.30	3.33	3.35	3.37	3.40	3.43	3.45	3.46	3.47	3.47	3.47
30	2.89	3.04	3.12	3.20	3.25	3.29	3.32	3.35	3.37	3.40	3.42	3.44	3.46	3.47	3.47	3.47
40	2.86	3.01	3.10	3.17	3.22	3.27	3.30	3.33	3.35	3.39	3.42	3.44	3.46	3.47	3.47	3.47
60	2.83	2.98	3.08	3.14	3.20	3.24	3.28	3.31	3.33	3.37	3.40	3.43	3.45	3.47	3.48	3.48
100	2.80	2.95	3.05	3.12	3.18	3.22	3.26	3.29	3.32	3.36	3.40	3.42	3.45	3.47	3.53	3.53
∞	2.77	2.92	3.02	3.09	3.15	3.19	3.23	3.26	3.29	3.34	3.38	3.41	3.44	3.47	3.61	3.67

From Duncan, D. B., "Multiple Range and Multiple F Tests," *Biometrics*, 11. 1956.

[a]Using special protection levels based on degrees of freedom.

QA sample no.	QA concentration C_{ij}	Analysis Y_{ij}	Difference d_{ij}
Channel No. 2			
1	C_{21}	Y_{21}	d_{21}
2	C_{22}	Y_{22}	d_{22}
3	C_{23}	Y_{23}	d_{23}
⋮	⋮	⋮	⋮
n_1	C_{2n_1}	Y_{2n_1}	d_{2n_2}
			$\bar{d}_2$, S_{d_2}
Channel No. 3			
1	C_{31}	Y_{31}	d_{31}
2	C_{32}	Y_{32}	d_{32}
3	C_{33}	Y_{33}	d_{33}
⋮	⋮	⋮	⋮
n_1	C_{3n_3}	Y_{3n_3}	d_{3n_3}
			$\bar{d}_3$, S_{d_3}
Channel No. 4			
1	C_{41}	Y_{41}	d_{41}
2	C_{42}	Y_{42}	d_{42}
3	C_{43}	Y_{43}	d_{43}
⋮	⋮	⋮	⋮
n_1	C_{4n_4}	Y_{4n_4}	d_{4n_4}
			$\bar{d}4$, S_{d_4}

where:

c_{ij} = the composition of the QA sample, calculated by the QA coordinator;

Y_{ij} = the analysis of the QA sample on Channel i for QA sample j;

$d_{ij} = Y_{ij} - C_{ij}$;

$\bar{d}_i$ = the mean d_{ij} for Channel i = $\sum_{i=1}^{n_i} (d_{ij}/n_i)$; and

S_{d_i} = the standard deviation of the difference for Channel i

$$= \sqrt{\sum_{j=1}^{n_i} \left(\frac{(d_{ij} - \bar{d}_i)^2}{(n_i - 1)} \right)}$$

B. Do a one-way analysis of variance with channels as treatments

$$X_{ij} = \mu + T_i + \varepsilon_{ij}$$

where:

$X_{ij} = d_{ij}$;

T_i = Channels 1, 2, 3, and 4;

$i = 1, \ldots, 4$; and

$j = 1, 2, \ldots, n_i$.

C. Make the comparisons of the means $\bar{d}_i$ using the Duncan Multiple Range Test described in 3C above, if T_i is significant.

5. FOR AMBIENT QA SAMPLES, DATA WILL BE TABULATED AS FOLLOWS

A.

Ambient sample no.	NMOC Analysis Channel No. 1	2	3	4	5	Ambient sample means
1	X_{11}	X_{21}	X_{31}	X_{41}	X_{51}	$\bar{A}_1$
2	X_{12}	X_{22}	X_{32}	X_{42}	X_{52}	$\bar{A}_2$
3	X_{13}	X_{23}	X_{33}	X_{43}	X_{53}	$\bar{A}_3$
4	X_{14}	X_{24}	X_{34}	X_{44}	X_{54}	$\bar{A}_4$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
n	X_{1n}	X_{2n}	X_{3n}	X_{4n}	X_{5n}	$\bar{A}_n$
Mean	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$	$\bar{A}$

B. Do a two-way analysis of variances with A_i as the ambient sample effect, and B_j as the channel effect

$$X_{ij} = \mu + A_i + B_j + \varepsilon_{ij}$$

C. Compare channel means $\bar{X}_i$ according to the Duncan (Duncan, D. B., "Multiple Range and Multiple F Test," Biometrics, No. 11 (1956)) Multiple Range Test given in 3C above, if channel effect is significant.

6. CALIBRATION DATA

A. Calibration data will be tabulated as follows:

Let X = concentration calculated from the generator,

Y_i = area counts from calibration sample,

Y_j = area counts from blank run,

$\Delta Y = Y_i - Y_j$,

$X/\Delta Y$ = calibration factor, and

$d = (X/\Delta Y)$ a.m. reading $- (X/\Delta Y)$ p.m. reading

CALIBRATION DATA

	$X/\Delta Y$ a.m. reading	$X/\Delta Y$ p.m. reading	d	$d/(X/\Delta Y) \cdot 100$ percent of a.m. reading
Channel #1:				
		$\bar{d}_1$, S_{d1}		
Channel #2:				
		$\bar{d}_2$, S_{d2}		
Channel #3:				
		$\bar{d}_3$, S_{d3}		

	$X/\Delta Y$ a.m. reading	$X/\Delta Y$ p.m. reading	d	$d/(X/\Delta Y) \cdot 100$ percent of a.m. reading
Channel #4:				
		$\overline{\bar{d}_4, S_{d4}}$		

B. Test the hypotheses that Ho: $\mu_{di} = 0.0$.

1. Calculate the statistics

$$t_i = \frac{\bar{d}_i - 0.0}{S_{di}}$$

2. Determine critical values at the 5 percent level.

   $t_{n_i-1,\ 1-\alpha/2}$ and $t_{n_i-1,\ \alpha/2}$ with n_i-1 degrees of freedom
   See Table in Section 2C.

3. If $t_{n_i-1,\ \alpha/2} < t_i < t_{n_i-1,\ 1-\alpha/2}$, then accept Ho, i.e., there is no significant difference between the mean differences $\bar{d}_i$ and zero.