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Final Report

Manual Testing and Continuous Emissions Monitoring Vertical Lime Kiln Baghouse Inlet and Outlet Chemical Lime Company Marble Falls, Texas

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FINAL REPORT

MANUAL TESTING AND CONTINUOUS EMISSIONS MONITORING VERTICAL LIME KILN BAGHOUSE INLET AND OUTLET

CHEMICAL LIME COMPANY
MARBLE FALLS, TEXAS

EPA Contract No. 68-D98-004
Work Assignment No. 3-03

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards (OAQPS) Emission Standards Division (ESD) is investigating the lime manufacturing industry to identify and quantify hazardous air pollutants (HAPs) emitted from lime kilns. ESD requested that EPA OAQPS Emissions, Monitoring and Analysis Division (EMAD) conduct the required testing. EMAD issued a work assignment to Pacific Environmental Services, Inc. (PES) to conduct a "screening" test to collect air emissions data as specified in the ESD test request. Initial planning, pre-test site survey, and preparation activities were conducted under EPA Contract No. 68-D7-0002, Work Assignment No. 0/005. Remaining preparation and field mobilization were conducted under EPA Contract No. 68-D7-0002, Work Assignment No. 1/007. The draft final report was completed under EPA Contract No. 68-D98-004, Work Assignment No. 2-04. Generation of the Final Report, incorporating EPA's comments on the Draft Final Report, was completed under EPA Contract No. 68-D98-004, Work Assignment No. 3-03.

The primary objective was to characterize the uncontrolled and controlled emissions of selected HAPs from a vertical kiln located at Chemical Lime Company's Marble Falls, Texas facility. The "screening" tests were conducted to quantify the air emissions of hydrogen chloride (HCl), total hydrocarbons (THC), and polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDDs/PCDFs). The basic test methods that were employed were US EPA Test Methods 1 (sample point location), 2 (effluent gas velocity), 3A (oxygen and carbon dioxide content), 4 (moisture content), 23 (PCDDs/PCDFs content) with proposed revisions, 25A (total hydrocarbon content), and Proposed Method 322 (HCl content). Testing at the facility was conducted on June 25, 1998. One 3-hour test, comprised of the sampling methods mentioned previously, was conducted at the baghouse inlet and baghouse outlet; inlet and outlet sampling were performed simultaneously. During testing, Research Triangle Institute (RTI), an ESD contractor, monitored and recorded process and emission control system operating parameters.

PES used three subcontractors for this effort: Air Pollution Characterization and Control Inc. (APCC), Paradigm Analytical Laboratories, Inc. (PAL), and Atlantic Technical Services, Inc. (ATS). APCC provided field testing support for measurement of oxygen (O_2), carbon dioxide (CO_2), total hydrocarbon (THC) and hydrogen chloride (HCl) concentrations using Continuous Emission Monitors (CEMs); PAL prepared the XAD®-2 sorbent resin traps and performed the analysis of the Method 23 sample fractions to determine catch weights of PCDD/PCDF congeners; and ATS provided support during preparation of the Quality Assurance Project Plan (QAPP), Site Specific Test Plan (SSTP), field testing and field data reduction, reduction of laboratory analytical data, and preparation of the Draft Final Report.

The PES test crew consisted of Michael D. Maret (who served as the Task Manager and Field Team Leader), Troy Abernathy, Gary Gay, Dennis D. Holzschuh, and Paul Siegel. APCC was represented by John Powell, Eric Dithrich, and Peter Day, and ATS was represented by Emil Stewart. Also present during the testing was Michael L. Toney, the EPA Work Assignment Manager, Joseph P. Wood, EPA, OAQPS, ESD, and Cybele M. Brockmann of RTI. Chemical Lime Company was represented by Rick L. Hohman, Plant Manager, and David R. Christiansen, Environmental, Health and Safety Manager.

Figure 1.1 presents the project organization and major lines of communication. Section 2.0 presents the results of the testing; Section 3.0 is reserved for a process description and operational data; Section 4.0 presents descriptions of the sampling locations; Section 5.0 presents descriptions of the sampling and analysis procedures; and Section 6.0 presents the Quality Assurance/Quality Control procedures that were employed during the testing program, and the results of calibrations and analytical QA data. Copies of all field data generated during the testing, the subcontracting laboratory analytical report, computer calculations and example calculations, calibration data and compressed gas certifications of analysis, reprints of the EPA Test Methods, and project participants are presented in the appendices to this document. Appendix F is reserved for process and operational data.

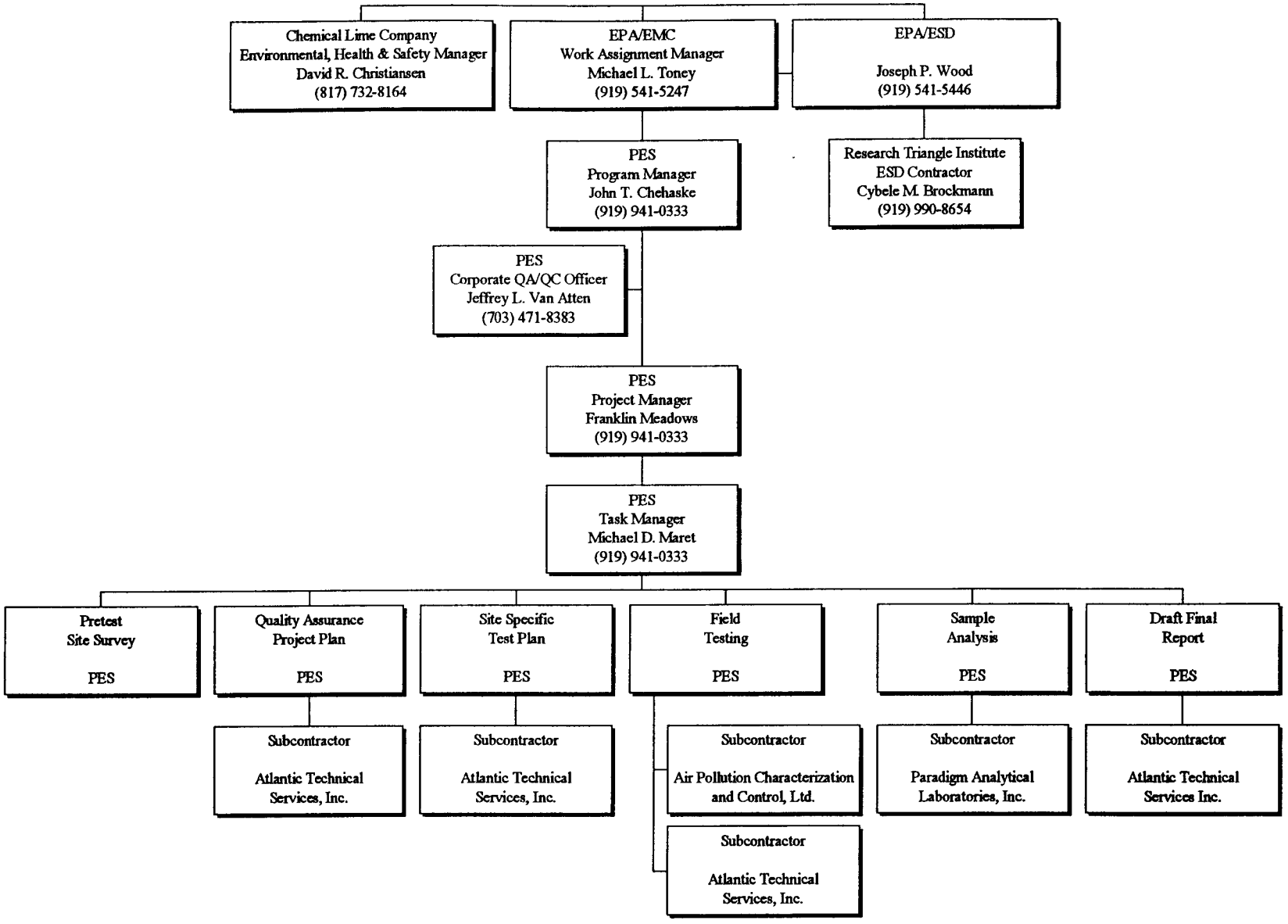


Figure 1.1 Project Organization - US EPA Texas Lime Kiln Screening, Chemical Lime Company - Marble Falls, Texas

2.0 SUMMARY OF RESULTS

This section summarizes the results of the testing that was conducted on the vertical kiln at Chemical Lime Company's facility at Marble Falls, Texas. Testing was conducted at the inlet to the baghouse and at the main stack. Table 2.1 presents the Emissions Test Log, which summarizes the sample run designators, test dates and times, target pollutants, and downtimes for port changes and other stoppages. Flue gas parameters, pollutant concentrations, and pollutant mass emission rates are summarized in Tables 2.2 through 2.5.

2.1 PCDDs/PCDFs MEASUREMENTS

Table 2.2 presents the Method 23 sampling parameters and parameters of the baghouse inlet and outlet airstreams. One Method 23 sampling run was performed at the baghouse inlet location, and one Method 23 sampling run was performed at the outlet location. Both runs were conducted simultaneously, and both sample runs were within the isokinetic sampling ratio criterion of 100 ± 10 percent(%); the isokinetic sampling ratio for the inlet run (M23-I-1) was 102.2% and the isokinetic sampling ratio for the outlet run (M23-O-1) was 101.6%. For purposes of the calculation of the volumetric flow rates, O_2 and CO_2 data were determined from the Method 3A CEM data, and moisture content was determined using the mass of condensate collected in the impinger trains during the runs.

From time to time during the Method 23 analyses, a peak elutes at the position expected for a particular congener, but the peak fails validation based on the theoretical split of chlorine isotopes. That is to say that the number of Cl^{35} isotopes and the number of Cl^{37} isotopes attached to the PCDDs/PCDFs congeners should agree with the Cl^{35}/Cl^{37} ratio found in nature. For each congener, this ratio must agree within fifteen percent. If the mass ratio of chlorine isotopes does not agree with the natural chlorine isotope ratio then the peak is flagged as an Estimated Maximum Possible Concentration, or "EMPC".

In-stack concentrations and associated mass emission rates of the PCDDs/PCDFs congeners are presented in Table 2.3 for the inlet and outlet sampling runs. The values presented as "Total PCDDs" are the sum of the "12346789 OCDD" polychlorinated dibenzo-p-dioxin and all of the dioxins labeled "Total"; "Total PCDFs" values are the sum of the "12346789 OCDF" polychlorinated dibenzofuran and all of the furans labeled "Total". "Total PCDDs + Total PCDFs" values are the sum of the "Total PCDDs" and "Total PCDFs" values. Values that have been qualified as being EMPC have been included in the sums. Concentrations and emission rates based on or including EMPC values are denoted by braces ({ }).

TABLE 2.1

EMISSIONS TEST LOG
CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

Run No.	Date	Pollutant	Run Time	Downtime, Minutes [a]
Vertical Kiln Baghouse Inlet				
M23-I-1	06/25/98	PCDDs/PCDFs	1520-1857	37
M3A-I-1	06/25/98	CO_2 / O_2	1543-1826	87
M25A-I-1	06/25/98	THC	1543-1826	87
M322-I-1	06/25/98	HCl	1543-1826	87
Vertical Kiln Baghouse Stack				
M23-O-1	06/25/98	PCDDs/PCDFs	1518-1855	37
M3A-O-1	06/25/98	CO_2 / O_2	1519-1850	116
M25A-O-1	06/25/98	THC	1519-1850	116
M322-O-1	06/25/98	HCl	1519-1850	116

[a] The CEMs sample acquisition system operated on a time-shared basis, switching between the baghouse inlet and stack locations. This applies to Methods 3A, 25A, and 322.

Table 2.4 presents two PCDDs/PCDFs concentration-based measurements for both the inlet and the outlet sampling locations. In the second and third columns of the table, the in-stack concentrations of the 2378-PCDDs/PCDFs congeners as well as the homologues (i.e., PCDDs and PCDFs groups that have the same degree of chlorination) are presented adjusted to 7% O_2. The fourth and fifth columns of the table present the 2378 tetra-chloro dibenzo-dioxin (TCDD) toxic equivalent values for those congeners chlorinated at the 2, 3, 7, and 8 positions. These columns represent the in-stack concentrations of the 2378 congeners after being adjusted for toxicity relative to 2378-TCDDs. PCDDs/PCDFs congeners that are not chlorinated at the 2, 3, 7, and 8 positions have a relative toxicity of zero and therefore the total homologues (e.g., Total TCDD) are not presented in the Toxic Equivalency columns.

2.2 CEM MEASUREMENTS

Measurements were conducted at the baghouse inlet and the outlet to determine the concentrations of O_2, CO_2, THC, and HCl. These measurements were conducted using CEMs. The CEMs were housed in a trailer supplied by APCC. Table 2.5 presents the average THC and HCl concentrations and mass emission rates.

O_2 and CO_2 concentrations have been corrected for observed calibration and bias errors using Equation 6C-1, as required in Method 3A, and HCl concentrations have been corrected using Equation 1 in Proposed Method 322. THC concentrations are presented uncorrected, as required in Method 25A; the uncorrected O_2, CO_2, and HCl concentrations are given in Appendix A.3. Refer to Appendix D for example equations.

The CEMs collected data from the inlet and the outlet locations on a time-sharing basis. The system was switched from inlet to outlet and back again every twenty-four minutes. The first five minutes of data from each 24-minute period were excluded from the calculation of average responses to allow for the time necessary to purge the CEMs system of the stack gases from the previous sampling location and for the responses to stabilize.

TABLE 2.2

PCDDs/PCDFs SAMPLING AND EXHAUST GAS PARAMETERS
VERTICAL KILN BAGHOUSE INLET AND STACK
CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

Run No.	M23-I-1	M23-O-1
Date	06/25/98	06/25/98
Time	1520-1857	1518-1855
Total Sampling Time, minutes	180	180
Average Sampling Rate, dscfm [a]	0.710	0.740
Sample Volume:		
dscf [b]	127.849	133.265
dscm [c]	3.620	3.774
Average Exhaust Gas Temperature, °F	254	231
O_2 Concentration, % by Volume	9.8	13.6
CO_2 Concentration, % by Volume	24.6	15.7
Moisture, % by Volume	10.0	9.9
Exhaust Gas Volumetric Flow Rate:		
acfm [d]	50,900	52,400
dscfm [a]	33,300	35,400
dscmm [e]	943	1,000
Isokinetic Sampling Ratio, %	102.2	101.6

[a] Dry standard cubic feet per minute at 68° F (20° C) and 1 atm.
[b] Dry standard cubic feet at 68° F (20° C) and 1 atm.
[c] Dry standard cubic meters at 68° F (20° C) and 1 atm.
[d] Actual cubic feet per minute at exhaust gas conditions.
[e] Dry standard cubic meters per minute at 68° F (20° C) and 1 atm.

TABLE 2.3

PCDDs/PCDFs CONCENTRATIONS AND EMISSION RATES VERTICAL KILN BAGHOUSE INLET AND STACK CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

CONGENER	CONCENTRATION [a] (ng/dscm, as measured)		EMISSION RATE [b] (µg/hr)	
	M23-I-1	M23-O-1	M23-I-1	M23-O-1
DIOXINS:				
2378 TCDD	{0.00472}	0.00318	{0.267}	0.192
Total TCDD	0.375	0.292	21.2	17.6
12378 PeCDD	{0.00594}	0.00238	{0.336}	0.144
Total PeCDD	0.152	0.0700	8.62	4.21
123478 HxCDD	{0.00348}	0.000795	{0.197}	0.0479
123678 HxCDD	{0.00576}	0.00132	{0.326}	0.0798
123789 HxCDD	0.00696	0.00106	0.394	0.0638
Total HxCDD	0.145	0.0307	8.23	1.85
1234678 HpCDD	0.0141	0.00185	0.795	0.112
Total HpCDD	0.0266	0.00344	1.51	0.207
12346789 OCDD	0.0156	0.00636	0.881	0.383
Total PCDDs	**0.715**	**0.403**	**40.4**	**24.2**
FURANS:				
2378 TCDF	0.0520	0.0424	2.94	2.55
Total TCDF	2.85	2.42	161	146
12378 PeCDF	0.0356	0.0231	2.01	1.39
23478 PeCDF	0.0436	0.0228	2.47	1.37
Total PeCDF	0.749	0.421	42.4	25.4
123478 HxCDF	0.0446	0.0125	2.52	0.750
123678 HxCDF	0.0169	0.00450	0.956	0.271
234678 HxCDF	0.0126	0.00291	0.714	0.176
123789 HxCDF	0.00351	0.00106	0.198	0.064
Total HxCDF	0.157	0.0440	8.87	2.65
1234678 HpCDF	0.0189	0.00450	1.07	0.271
1234789 HpCDF	{0.00199}	0.000530	{0.113}	0.0319
Total HpCDF	0.0238	0.00609	1.34	0.367
12346789 OCDF	{0.00267}	0.00265	{0.151}	0.160
Total PCDFs	**{3.78}**	**2.89**	**{214}**	**174**
Total PCDDs + PCDFs	**{4.50}**	**3.29**	**{254}**	**198**

[a] Nanograms per dry standard cubic meter at 20°C and 1 atm.

[b] Micrograms per hour.

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

TABLE 2.4

PCDDs/PCDFs CONCENTRATIONS AND 2378-TCDD TOXIC EQUIVALENT CONCENTRATIONS ADJUSTED TO 7 PERCENT OXYGEN VERTICAL KILN BAGHOUSE INLET AND STACK CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

CONGENER	CONCENTRATION [a] (ng/dscm, adjusted to 7 percent O_2)		2378-TCDD [b] Toxicity Equivalency Factor	2378 TOXIC EQUIVALENCIES (ng/dscm, adjusted to 7 percent O_2)	
	M23-I-1	M23-O-1		M23-I-1	M23-O-1
DIOXINS:					
2378 TCDD	{0.00591}	0.00605	1.000	{0.00591}	0.00605
Total TCDD	0.469	0.556			
12378 PeCDD	{0.00744}	0.00454	0.500	{0.00372}	0.00227
Total PeCDD	0.191	0.133			
123478 HxCDD	{0.00436}	0.00151	0.100	{0.000436}	0.000151
123678 HxCDD	{0.00722}	0.00252	0.100	{0.000722}	0.000252
123789 HxCDD	0.00872	0.00202	0.100	0.000872	0.000202
Total HxCDD	0.182	0.0585			
1234678 HpCDD	0.0176	0.00353	0.010	0.000176	0.0000353
Total HpCDD	0.0333	0.00656			
12346789 OCDD	0.0195	0.0121	0.001	0.0000195	0.0000121
Total PCDDs	**0.895**	**0.766**	**Total PCDDs TEQ**	**{0.0119}**	**0.00898**
FURANS:					
2378 TCDF	0.0652	0.0807	0.100	0.00652	0.00807
Total TCDF	3.57	4.60			
12378 PeCDF	0.0446	0.0439	0.050	0.00223	0.00219
23478 PeCDF	0.0547	0.0434	0.500	0.0273	0.0217
Total PeCDF	0.938	0.802			
123478 HxCDF	0.0558	0.0237	0.100	0.00558	0.00237
123678 HxCDF	0.0212	0.00858	0.100	0.00212	0.000858
234678 HxCDF	0.0158	0.00555	0.100	0.00158	0.000555
123789 HxCDF	0.00439	0.00202	0.100	0.000439	0.000202
Total HxCDF	0.196	0.0838			
1234678 HpCDF	0.0237	0.00858	0.010	0.000237	0.0000858
1234789 HpCDF	{0.00250}	0.00101	0.010	{0.0000250}	0.0000101
Total HpCDF	0.0297	0.0116			
12346789 OCDF	{0.00335}	0.00505	0.001	{0.00000335}	0.00000505
Total PCDFs	**{4.74}**	**5.50**	**Total PCDFs TEQ**	**{0.0461}**	**0.0361**
Total PCDDs + PCDFs	**{5.63}**	**6.27**	**Total TEQ**	**{0.0579}**	**0.0450**

[a] Nanograms per dry standard cubic meter at 20°C and 1 atm and corrected to 7 percent oxygen.

[b] North Atlantic Treaty Organization, Committee on the Challenges of Modern Society. Pilot study on Information Exchange on Dioxins and Related Compounds: International Toxicity Equivalency Factor (I-TEF) Methods of Risk Assessment for Complex Mixtures of Dioxins and Related Compounds. Report No. 176, August 1988.

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

TABLE 2.5

HCL AND THC CONCENTRATIONS AND EMISSION RATES
VERTICAL KILN BAGHOUSE INLET AND STACK
CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

Run No.	M322-I-1	M322-O-1
Date	06/25/98	06/25/98
Sampling Location	Inlet	Stack
Total Sampling Time, minutes	76	95
O_2 Concentration, % by Volume	9.8	13.6
Moisture, % by Volume	10.0	9.9
Volumetric Flow Rate, dscfm [a]	33,300	35,400
HCl:		
Formula Weight, lb/lb-mole	36.47	36.47
Concentration, ppmvw [b]	22.7	15.8
Concentration, ppmvd [c]	25.2	17.5
Concentration, ppmvd @ 7%O_2 [d]	31.6	33.4
Emission Rate, lb/hr [e]	4.77	3.53
THC (as propane):		
Formula Weight, lb/lb-mole	44.11	44.11
Concentration, ppmvw [b]	17.8	10.2
Concentration, ppmvd [c]	19.8	11.3
Concentration, ppmvd @ 7%O_2 [d]	24.8	21.6
Emission Rate, lb/hr [e]	4.52	2.76

[a] Dry standard cubic feet per minute at 68° F (20° C) and 1 atm.
[b] Parts per million by volume wet basis.
[c] Parts per million by volume dry basis.
[d] Parts per million by volume dry basis corrected to 7% oxygen.
[e] Pounds per hour.

3.0 PROCESS DESCRIPTION

The process description is considered confidential business information (CBI) and is not discussed in this report. During the testing, however, an ESD contractor, Research Triangle Institute, monitored and recorded process operational data which will be supplied to EPA EMC under a separate EPA contract.

4.0 SAMPLING LOCATIONS

As stated previously, source sampling was conducted to determine uncontrolled and controlled emissions of HCl, PCDDs/PCDFs, and THC from the vertical kiln located at Chemical Lime Company's Marble Falls, Texas facility. Testing was conducted at the inlet of the baghouse and at two locations on the baghouse outlet. Figure 4.1 presents a simplified process flow schematic depicting the sampling locations. Descriptions of the sampling locations are presented in the following text; additional figures showing details of the sampling locations are also presented.

4.1 VERTICAL KILN BAGHOUSE INLET SAMPLING LOCATION

The baghouse inlet was a 47.5-inch inside diameter (ID) round duct which leads from the kiln to baghouse. Due to geometric constraints, only one portion of the duct was accessible for isokinetic sampling. The location used was previously occupied by an auxiliary air preheater which was retired from service prior to the testing program. The air preheater interface was a 14-inch square duct which was joined to the baghouse inlet duct. A square plate with a 3-inch sample port was fabricated and attached to the preheater duct; it was through this port that the PCDDs/PCDFs sampling was conducted. Two additional ports were installed on the baghouse inlet duct approximately fifteen inches downstream of the PCDDs/PCDFs sampling port, and it was through these ports that CEM samples were extracted.

A schematic diagram of the inlet sampling location is presented in Figure 4.2. The nearest upstream disturbance was a bend 1080 inches (22.7 equivalent duct diameters) from the sample port. The nearest downstream disturbance was an elbow 128 inches (2.7 equivalent duct diameters) downstream of the sample port. Method 1 specifies a 12 point sample matrix for this test location. Due to space constraints at the sampling location, only one traverse axis was available for isokinetic sampling. Therefore, with approval of the WAM, PES conducted isokinetic testing for PCDDs/PCDFs using one sample port and a six point traverse on a single traverse line. Figure 4.2 also shows the sample points within the duct that were used for isokinetic testing.

A check for the presence of non-parallel or cyclonic flow, as outlined in Section 2.4 of EPA Method 1, was performed prior to testing. The results of the cyclonic flow test indicated an average yaw angle (α), of 6.8°. Since the average yaw angle was less than 20°, which is the maximum allowed by Method 1, the location was considered suitable for isokinetic sampling and required no adjustment to the alignment of the nozzle direction.

4.2 VERTICAL KILN BAGHOUSE OUTLET SAMPLING LOCATIONS

Sampling at the vertical kiln outlet was conducted at two locations. Isokinetic sampling was conducted using existing sample ports located close to the stack exhaust. In order to decrease the amount of heated sample line required for the CEMs testing, additional sample ports were installed approximately 34 feet upstream of the PCDDs/PCDFs sampling ports.

4.2.1 PCDDS/PCDFS Sampling Location

The baghouse stack at the top of the kiln is a 47.84-inch average ID round stack (47.1875 inches on the A axis and 48.5 inches on the B axis) which exhausts emissions to the atmosphere. An induced draft fan located at ground level pulls kiln exhaust gases through the baghouse; the gases are transported through approximately 200 feet of ductwork prior to release. A sampling platform located at the top of the kiln provided access to the sample ports. A schematic diagram of the sample ports and sample point locations is presented in Figure 4.3. The nearest downstream disturbance was the opening to the atmosphere which was 209 inches (4.4 equivalent duct diameters) from the sample ports. The nearest upstream disturbance was a 45° bend located 128 inches (2.7 equivalent duct diameters) upstream of the sample ports. PES conducted isokinetic testing for PCDDs/PCDFs using a 24 point traverse matrix consisting of 12 traverse points on each of two perpendicular traverse lines.

A check for the presence of non-parallel or cyclonic flow, as outlined in Section 2.4 of EPA Method 1, was performed prior to testing. The results of the cyclonic flow test indicated an average yaw angle (α), of 7.3°. Since the average yaw angle was less than 20°, which is the maximum allowed by Method 1, the location was considered suitable for isokinetic sampling and required no adjustment to the alignment of the nozzle direction.

4.2.2 CEM Sampling Location

The CEM sampling location was located approximately 34 feet upstream of the outlet isokinetic sampling ports. Two ports were installed at this location to facilitate the extraction of samples for analysis of O_2, CO_2, THC, and HCl using CEMs. The nearest disturbances were bends in the duct, located approximately 8 feet downstream and 25 feet upstream from the location of the ports.

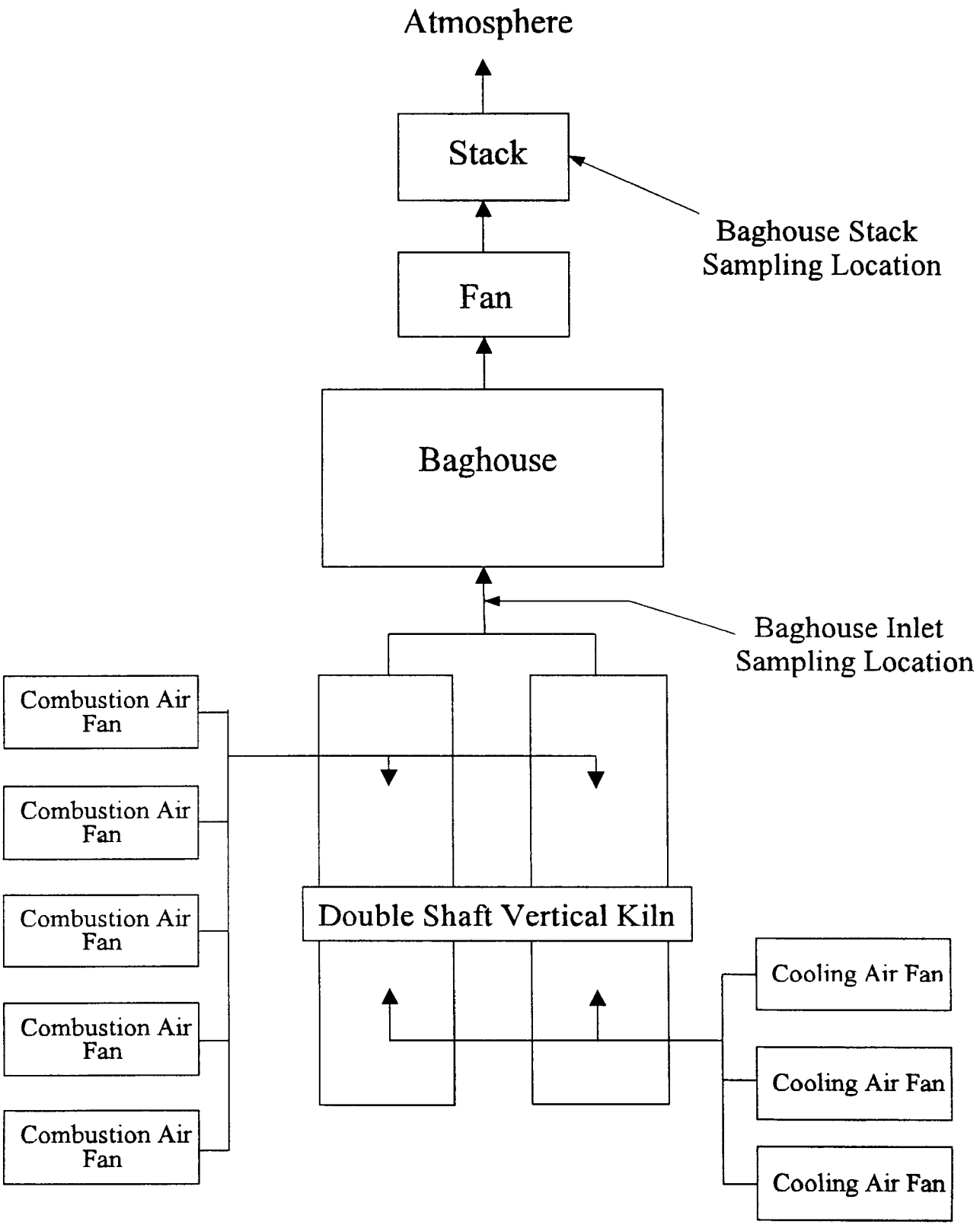
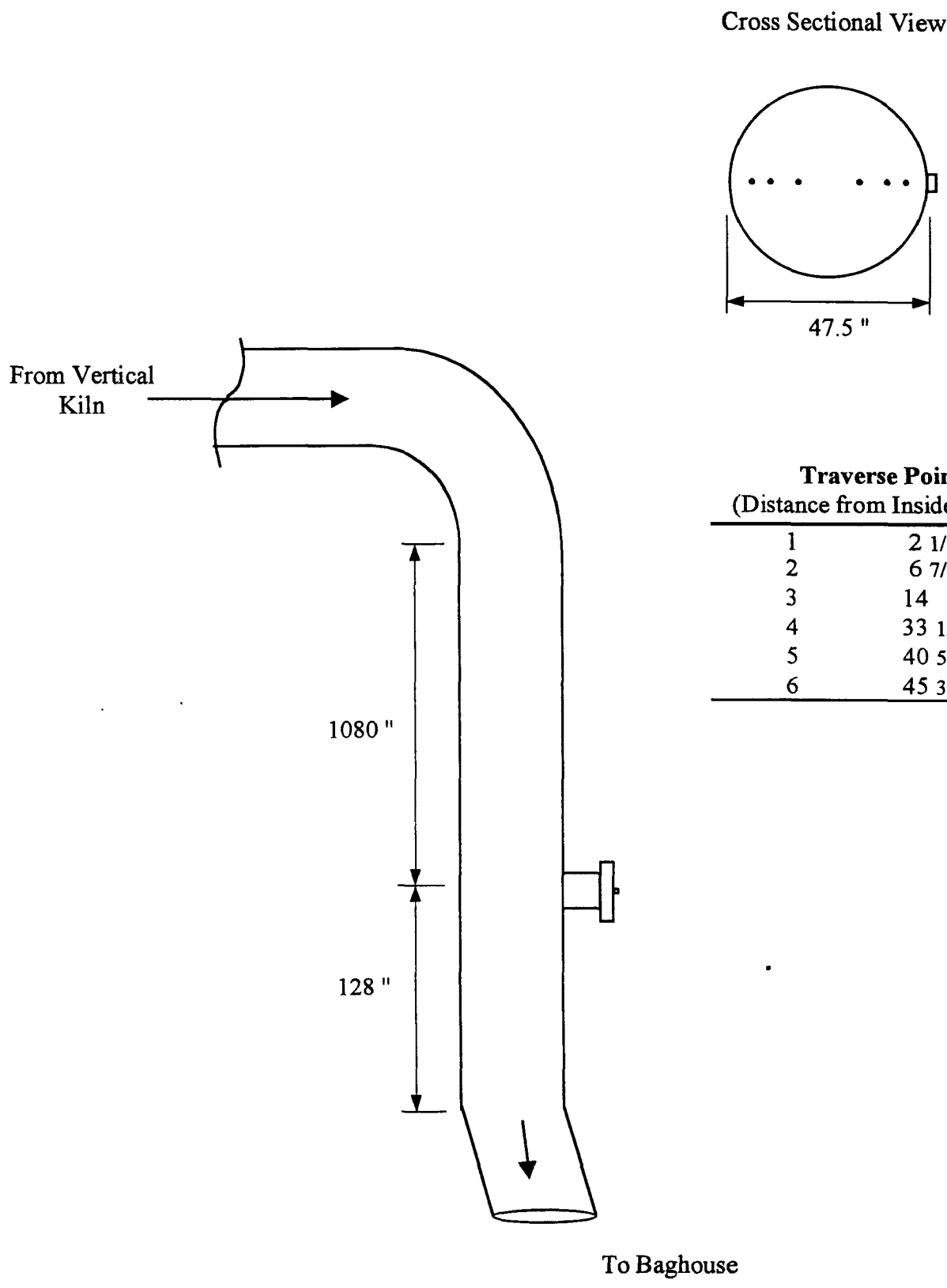


Figure 4.1 Vertical Kiln Process Exhaust Gas Schematic, Chemical Lime Company - Marble Falls, Texas

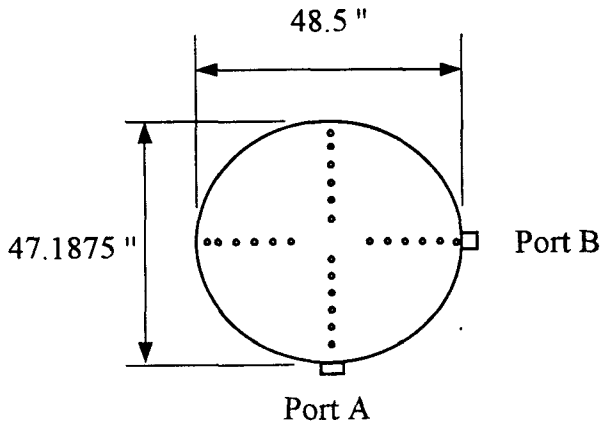


Traverse Points
(Distance from Inside Wall, in.)

1	2 1/8
2	6 7/8
3	14
4	33 1/2
5	40 5/8
6	45 3/8

Figure 4.2 Vertical Kiln Baghouse Inlet Sample Port and Sample Point Locations, Chemical Lime Company - Marble Falls, Texas

Cross Sectional View



Traverse Points
(Distance from Inside Wall, in.)

	PORT A	PORT B
1	1	1
2	3 1/8	3 1/4
3	5 5/8	5 3/4
4	8 3/8	8 5/8
5	11 3/4	12 1/8
6	16 3/4	17 1/4
7	30 3/8	31 1/4
8	35 3/8	36 3/8
9	38 7/8	39 7/8
10	41 5/8	42 3/4
11	44	45 1/4
12	46 1/4	47 1/2

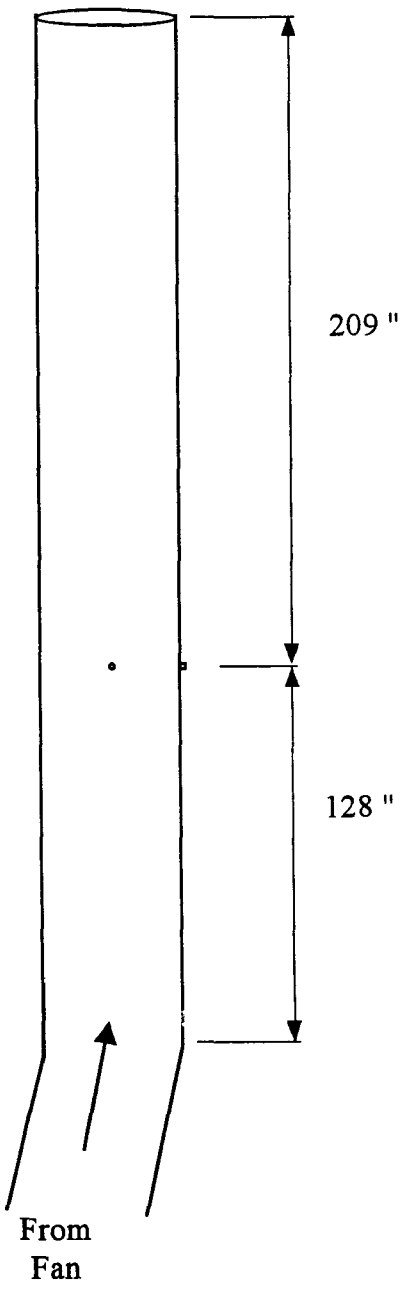


Figure 4.3 Vertical Kiln Baghouse Outlet Sample Ports and Sample Point Locations for Isokinetic Testing, Chemical Lime Company - Marble Falls, Texas

5.0 SAMPLING AND ANALYSIS PROCEDURES

Source sampling was performed at the baghouse inlet and baghouse stack to determine the concentrations and mass emission rates of PCDDs/PCDFs, THC, and HCl. One test run was performed at each location, with each run having a net sampling time of three hours. The sampling and analytical methods that were used are summarized in Table 5.1. In Table 5.2, the parameters measured, the sampling method, the number of tests performed, and the duration of each test are summarized. Brief descriptions of the sampling and analysis procedures used are presented below. Copies of all the methods that were used are presented in Appendix G.

5.1 LOCATION OF MEASUREMENT SITES AND SAMPLE/VELOCITY TRAVERSE POINTS

EPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to establish velocity and sample traverse point locations. The process ductwork and the locations of measurement sites and traverse points, are discussed in Section 4.0 of this document.

5.2 DETERMINATION OF EXHAUST GAS VOLUMETRIC FLOW RATE

EPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used in conjunction with EPA Method 23 to determine exhaust gas velocity. A Type S Pitot tube, constructed according to Method 2 criteria and having an assigned coefficient of 0.84, was connected to an inclined-vertical manometer. The pitot tube was inserted into the duct and the velocity pressure (Δp) was recorded at each traverse point. The effluent gas temperature was also recorded at each traverse point using a Type K thermocouple. The average exhaust gas velocity was calculated from the average square roots of the velocity pressure, average exhaust gas temperature, exhaust gas molecular weight, and absolute stack pressure. The volumetric flow rate is the product of velocity and the stack cross-sectional area of the duct at the sampling location.

5.3 DETERMINATION OF EXHAUST GAS MOISTURE CONTENT

EPA Method 4, "Determination of Moisture Content in Stack Gases," was used to determine the exhaust gas moisture content. EPA Method 4 was performed in conjunction with each EPA Method 23 test run. Integrated, multi-point, isokinetic sampling was performed. Condensed moisture was determined by recording pre-test and post-test weights of the impingers, XAD® sorbent module, and silica gel.

TABLE 5.1

SUMMARY OF SAMPLING AND ANALYSIS METHODS, CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

Sampling Method	Parameter or Target	Measurement Principle
EPA Method 1	Traverse Point Locations	Linear Measurement
EPA Method 2	Velocity and Flow Rate	Differential Pressure, Thermocouple
EPA Method 3A	CO_2 and O_2 Content	Micro-Fuel Cell, FINOR
EPA Method 4	Moisture Content	Gravimetric
EPA Method 23 (Proposed Revisions)	PCDDs/PCDFs	Gas Chromatography / Mass Spectrometry (GC/MS)
EPA Method 25A	THC	Flame Ionization Detector
EPA Proposed Method 322	HCl	Gas Filter Correlation / Infrared (GFC/IR)

TABLE 5.2

SUMMARY OF SAMPLING LOCATIONS, TEST PARAMETERS, SAMPLING METHODS, AND NUMBER AND DURATION OF TESTS, CHEMICAL LIME COMPANY - MARBLE FALLS, TEXAS

Sampling Location	Test Parameter	Sampling Methods	Number of Tests	Duration, (minutes)
Baghouse Inlet	Exhaust Gas Flow Rate	EPA Method 2	1	180
	CO_2 & O_2 Content	EPA Method 3A	1	76
	Moisture Content	EPA Method 4	1	180
	PCDDs/PCDFs	EPA Method 23 (Proposed Revisions)	1	180
	THC	EPA Method 25A	1	76
	HCl	EPA Proposed Method 322	1	76
Baghouse Stack	Exhaust Gas Flow Rate	EPA Method 2	1	180
	CO_2 & O_2 Content	EPA Method 3A	1	95
	Moisture Content	EPA Method 4	1	180
	PCDDs/PCDFs	EPA Method 23 (Proposed Revisions)	1	180
	THC	EPA Method 25A	1	95
	HCl	EPA Proposed Method 322	1	95

5.4 DETERMINATION OF PCDDs/PCDFs

EPA Method 23, "Determination of Polychlorinated Dibenzo-P-Dioxins and Polychlorinated Dibenzofurans from Stationary Sources," was used to collect dioxins and furans at each location. In addition, the proposed rules amending Method 23 as published in the Federal Register, Volume 60, No. 104, May 31, 1995 were employed. These proposed rules correct existing errors in the method, eliminate the methylene chloride rinse, and clarify the quality assurance requirements of the method. A multi-point integrated sample was extracted isokinetically from the six (at the baghouse inlet) or 24 (at the baghouse stack) traverse points shown in Section 4.0. At each traverse point, sampling was performed for 15 (at the baghouse inlet, with each point traversed twice), or 7.5 (at the baghouse stack) minutes for a total run time of 180 minutes per test. The EPA Method 23 samples were extracted through a glass nozzle, a heated glass-lined probe, a precleaned and heated glass fiber filter, a water-cooled condenser coil, and a sorbent trap containing approximately 40 g of XAD®-2 sorbent resin. The EPA Method 23 sampling train is shown in Figure 5.1.

The samples were extracted and analyzed according to EPA Method 23 and the above mentioned proposed rules amendment. The sample components (filter, XAD®, and rinses) were Soxhlet extracted and combined. The sample was then split with half being archived and the other half analyzed. For the inlet sample analysis, an additional separate "loose" particulate fraction was also Soxhlet extracted and analyzed; results of the two inlet analyses were added to get a single inlet catch weight. Refer to Appendix B for a tabulation of the inlet sample catches. Analysis was performed on a high resolution Gas Chromatograph with a high resolution Mass Spectrometer (GC/MS) detector.

5.5 DETERMINATION OF HYDROGEN CHLORIDE

EPA Proposed Method 322, "Measurement of Hydrogen Chloride Emissions from Portland Cement Kilns by GFC/IR," was used to monitor HCl emissions at each location. Stack gas samples were extracted from each duct or stack and transported through a heated sample probe, sample conditioning system, heated sample line, and a heated sample pump into the analyzer containing the gas filter correlation infrared spectrometer (GFC/IR). Sampling components were maintained at a minimum temperature of 375 °F. A heated three-way valve was attached to the probe assembly to allow for sampling of stack gas or for the introduction of HCl calibration standards.

HCl in the sample cell attenuates an infrared light source. The intensity of the attenuated beam is measured by a detector positioned at the end of the cell. The amount of HCl in the sample gas stream is related to the amount of light attenuated. A schematic of this system is presented in Figure 5.2.

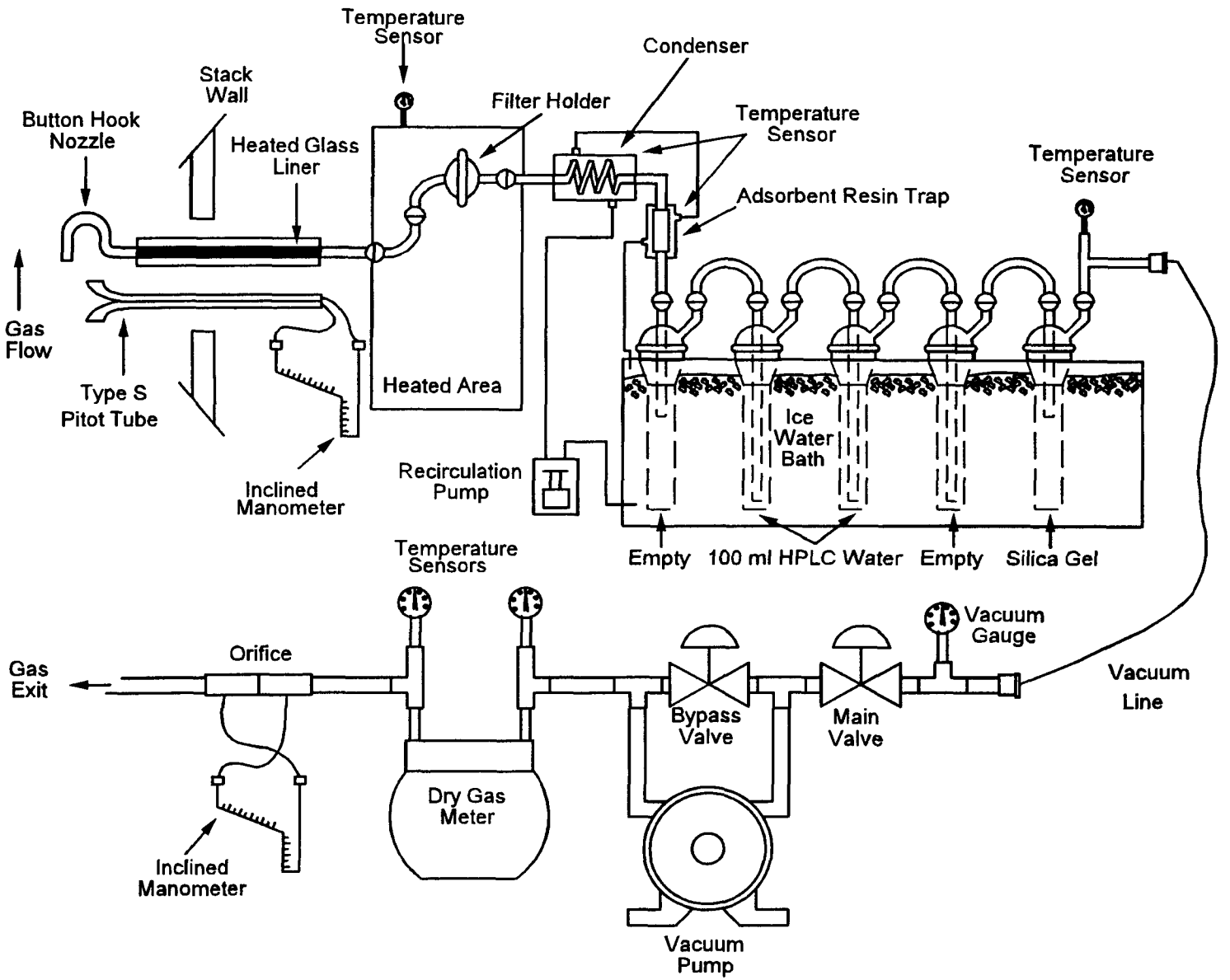


Figure 5.1 Sampling Train Schematic for EPA Method 23

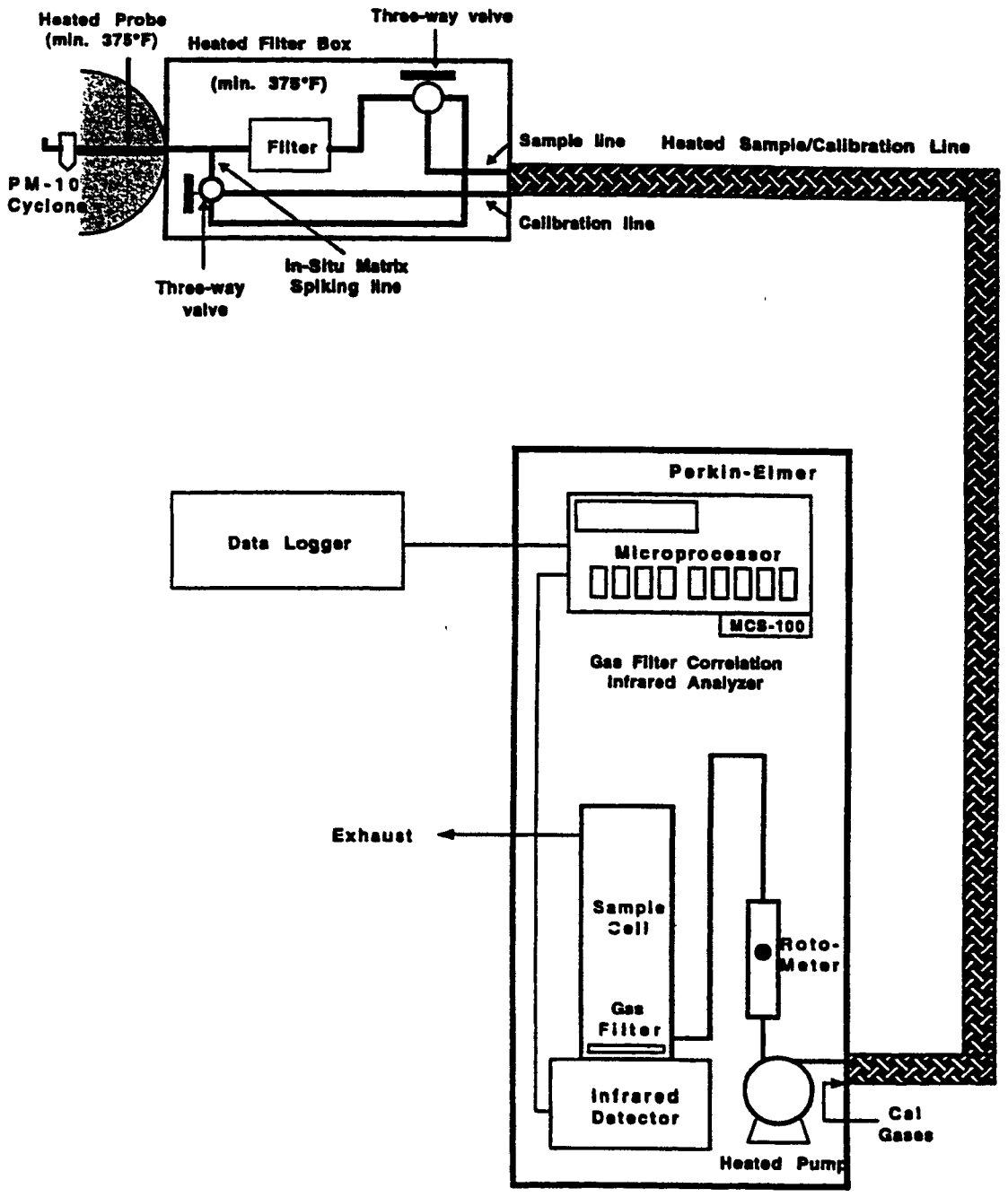


Figure 5.2 Sampling Train Schematic for Proposed EPA Method 322

5.6 DETERMINATION OF CARBON DIOXIDE, OXYGEN, AND TOTAL HYDROCARBONS

Continuous emission monitoring (CEM) was performed at the baghouse inlet and stack. All CEM data was recorded using a Tracor/Westronics 3000 automatic digital data logger. The CEMs were housed in the APCC Environmental Monitoring Laboratory positioned at the base of the stack. Stack gas was drawn from the stack through a heated Teflon® sample line which is maintained at a temperature of approximately 375°F. A portion of the extracted sample was conditioned to remove moisture and directed to the O_2 and CO_2 analyzers to determine diluent concentrations on a dry basis. The remaining portion of the stack gas sample was directed to the THC analyzer. Figure 5.3 shows a schematic of the sampling system.

5.6.1 Carbon Dioxide and Oxygen

EPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources," was used to determine the O_2 and CO_2 concentrations at the inlet and outlet test locations.

A Westinghouse/Maihak FINOR CO_2 analyzer was used to monitor CO_2 concentrations. The measurement principle for CO_2 is IR absorption. Radiation absorbed by CO_2 in the sample cell produces a capacitance change in the detector which is proportional to the CO_2 concentration.

A Teledyne Analytical Instruments Model 326 O_2 analyzer was utilized to measure the percentage concentration of O_2 in the gas stream. The analyzer utilizes a unique micro-fuel cell to measure the concentration of O_2. The output signal is linear over the specified ranges of analysis.

5.6.2 Total Hydrocarbons

EPA Method 25A, "Determination of Total Gaseous Organic Concentration using a Flame Ionization Analyzer," was used to determine the THC concentrations at both test locations. A VIG Industries THC analyzer (or equivalent), which utilizes a flame ionization detector (FID) to measure THC, was calibrated with propane. Approximately 5.0 liters per minute (lpm) of sample gas is drawn from the source through a heated Teflon® sample line. The sample gas is drawn through a heated filter and valves by a heated pump. The sample gas is introduced into the FID chamber and THCs in the sample are ionized by a hydrogen flame. The flame is positioned between two charged plates, and the associated electric field induces the migration of the ions towards the charged plates. The ion migration results in the generation of a current, which is directly proportional to the amount of THCs present in the sample.

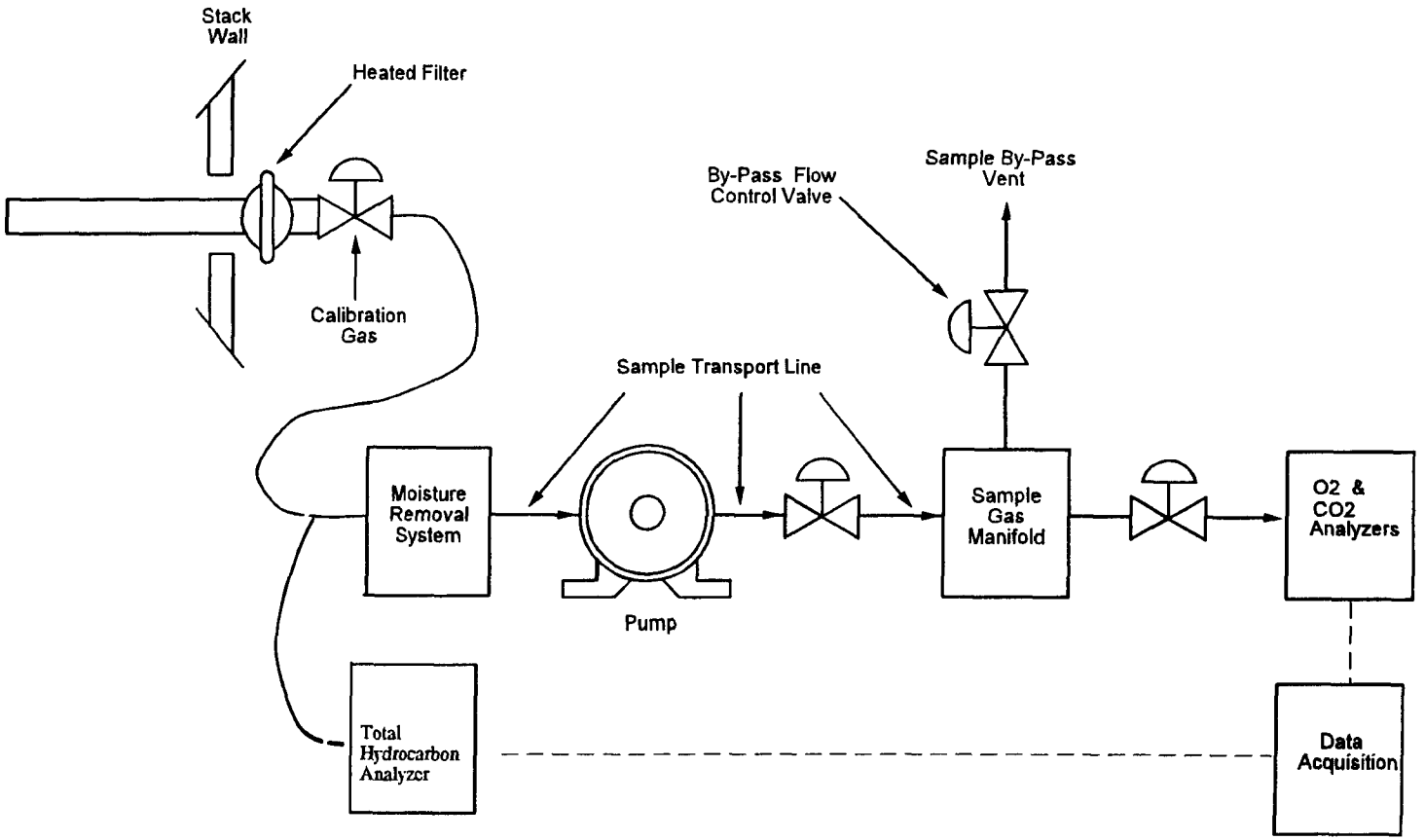


Figure 5.3 Sampling Train Schematic for EPA Methods 3A and 25A

5.7 CEMs DATA ACQUISITION AND HANDLING

Analyzer responses were recorded by a Tracor/Westronics 3000 digital data logger which recorded the O_2, CO_2, HCl and THC concentrations using its integral color printer. Trends were monitored using the strip chart mode with averages printed digitally at 19 minute intervals and at the conclusion of the test period. Analyzer responses were recorded by the data logger at 5 second intervals.

6.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES AND RESULTS

For any environmental measurement, a degree of uncertainty exists in the data generated due to the inherent limitations of the measurement system employed. The goals of a QA/QC program are to ensure, to the highest degree possible, the accuracy of the data collected. This section summarizes the QA/QC procedures that were employed by PES in the performance of this test program. The procedures contained in the reference test methods and in the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods," EPA/600/R-94/038c, served as the basis for performance for all testing and related work activities in this project.

6.1 CALIBRATION AND PREPARATION OF APPARATUS

The preparation and calibration of source sampling equipment is essential in maintaining data quality. Brief descriptions of the calibration procedures used by PES are presented below. The results of equipment and sensor calibrations may be found in Appendix E. Detailed procedures as presented in the EPA test methods are presented in Appendix G.

6.1.1 Barometers

PES used aneroid barometers which were calibrated against a barometric pressure value reported by a nearby National Weather Service station.

6.1.2 Temperature Sensors

Bimetallic dial thermometers and Type K thermocouples were calibrated using the procedure described in Calibration Procedure 2e of EPA/600/R-94/038c. Each temperature sensor was calibrated over the expected range of use against an ASTM 3C or 3F thermometer. Table 6.1 summarizes the type of calibrations performed, the acceptable levels of variance, and the results. Digital thermocouple displays were calibrated using a thermocouple simulator having a range of 0-2400°F.

6.1.3 Pitot Tubes

PES used Type S pitot tubes constructed according to EPA Method 2 specifications. Each pitot tube was inspected for conformance to the geometric specifications by the application of Calibration Procedure 2 of EPA/600/R-94/038c. Pitot tubes that meet these

TABLE 6.1

SUMMARY OF TEMPERATURE SENSOR CALIBRATION DATA

Temp. Sensor I.D.	Usage	Temperature, °R		Temperature Difference	Tolerances
		Reference	Sensor		
T5A	Stack Gas	532	532	0.0%	<±1.5%
		504	504	0.0%	<±1.5%
		664	664	0.0%	<±1.5%
		860	860	0.0%	<±1.5%
T6F	Stack Gas	534	534	0.0%	<±1.5%
		494	493	-0.20%	<±1.5%
		632	632	0.0%	<±1.5%
		809	810	0.12%	<±1.5%
MB-10	Meter Box Inlet	493	494	0.20%	<±1.5%
		536	536	0.0%	<±1.5%
		666	665	-0.15%	<±1.5%
	Outlet	492	494	0.40%	<±1.5%
		536	537	0.19%	<±1.5%
		666	665	-0.15%	<±1.5%
RMB-15	Meter Box Inlet	493	495	0.40%	<±1.5%
		534	534	0.0%	<±1.5%
		668	670	0.30%	<±1.5%
	Outlet	493	493	0.00%	<±1.5%
		534	535	0.19%	<±1.5%
		668	668	0.00%	<±1.5%

requirements are assigned a pitot coefficient, C_p, of 0.84. The dimensional criteria and results for each pitot tube used are presented in Table 6.2.

6.1.4 Differential Pressure Gauges

PES used Dwyer inclined/vertical manometers to measure differential pressures. The differential pressure measurements included velocity pressure, static pressure, and meter orifice pressure. Manometers were selected with sufficient sensitivity to accurately measure pressures over the entire range of expected values. Manometers are primary standards and require no calibration.

6.1.5 EPA Method 23 Dry Gas Meters and Orifices

The EPA Method 23 dry gas meters and orifices were calibrated in accordance with Sections 5.3.1 and 5.3.2 of EPA Method 5. This procedure involves direct comparison of the metered volume passed through the dry gas meter to a reference dry test meter. The reference dry test meter is calibrated annually using a wet test meter. Before its initial use in the field and annually thereafter, the metering system is calibrated over the entire range of operation as specified in EPA Method 5. Acceptable tolerances for the individual dry gas meter correction factor (γ) and orifice calibration factor ($\Delta H_@$) during initial or annual calibrations are ± 0.02 and ± 0.20 from the average, respectively. After field use, a calibration check of the metering system was performed at a single intermediate setting based on the previous field test. The post-test calibration check of the dry gas meter correction factor must agree within 5% of the correction factor generated during the initial or annual calibration. The results for the gas meters and orifices used in this test program are summarized in Table 6.3.

6.2 REAGENTS AND GLASSWARE PREPARATION

Sample reagents consisted of pesticide (or better) grade acetone and toluene for glassware preparation and sample recoveries, and pesticide (or better) grade hexane for glassware preparation. Sample filters and the XAD®-2 sorbent resin traps were prepared by PAL according to the procedures outlined in Method 23. Water used in the impinger trains was HPLC-grade reagent water.

After preparation of the XAD®-2 sorbent resin traps by PAL, each trap was spiked with a mixture of PCDDs/PCDFs surrogates, and capped with glass balls and sockets until used in the field.

Prior to the field testing portion of the program, all sampling train components and sample recovery apparatus were prepared according to the following procedure.

1. Wash in hot soapy water (Alconox®).
2. Rinse three times with tap water.
3. Rinse three times with distilled/deionized water.

TABLE 6.2

SUMMARY OF PITOT TUBE DIMENSIONAL DATA

Measurement	Criteria	Results	
		Pitot Tube Identification	
		5H	6A
α_1	<10°	0.7	1
α_2	<10°	1.6	0.2
β_1	<5°	4	0.2
β_2	<5°	3.3	0.8
Υ	-	0.6	2.2
θ	-	0.4	1.1
A	-	0.956	1.006
z	≤ 0.125"	0.010	0.039
w	≤ 0.0313"	0.0067	0.019
D_t	0.1875" ≤ D_t ≤ 0.375"	0.375	0.375
$(A/2)/D_t$	1.05 ≤ $(A/2)/D_t$ ≤ 1.50	1.27	1.34
	Acceptable	Yes	Yes
	Assigned Coefficient	0.84	0.84

TABLE 6.3

SUMMARY OF DRY GAS METER AND ORIFICE CALIBRATION DATA

Meter No.	Dry Gas Meter Correction Factor, γ				Orifice Coefficient, $\Delta H_@$		
	Pre-test	Post-test	% Diff.	EPA Criteria	Average	Range	EPA Criteria
MB-10	1.021	1.020	-0.2	± 5%	1.92	1.73 - 2.44	1.72 - 2.12
RMB-15	1.000	0.995	-0.5	± 5%	1.90	1.86 - 1.92	1.70 - 2.10

4. Rinse with pesticide-grade acetone.
5. Rinse with pesticide-grade-toluene.
6. Rinse with pesticide-grade hexane.
7. Allow to air dry.
8. Cap all openings with hexane-rinsed aluminum foil.

6.3 ON-SITE SAMPLING

The on-site QA/QC activities included:

6.3.1 Measurement Sites

Prior to sampling, the stack and inlet duct were checked dimensionally to determine measurement site locations, location of velocity and sample test ports, inside stack/duct dimensions, and sample traverse point locations. Inside stack/duct dimensions were checked through both traverse axes to confirm uniformity of the stack/duct inside diameter. The baghouse outlet stack was found to be out-of-round; therefore, two sets of sample traverse points were calculated. The inside stack/duct dimensions, wall thickness, and sample port depths were measured to the nearest 1/16 inch.

6.3.2 Velocity Measurements

All velocity measurement apparatus were assembled, leveled, zeroed, and leak-checked prior to use and at the end of each determination. The static pressure was determined at a single point near the center of the stack or duct cross-section.

6.3.3 Moisture

The Method 23 trains were used to determine stack gas moisture. During sampling, the exit gas of the last impinger was maintained below 68°F to ensure adequate condensation of the exhaust gas water vapor. The total moisture was determined on-site gravimetrically using an electronic platform balance with 0.1 gram sensitivity. The amount of moisture collected by the XAD® trap was also measured.

6.3.4 EPA Method 23

The field sampling QA/QC for EPA Method 23 began in the sample recovery area. The sample trains were set up and leak-checked to verify sample train integrity before transport to the sampling sites. At the sampling sites, the sample trains were leak checked a second time. Leaks found in excess of 0.02 cubic feet per minute (cfm) were corrected prior to beginning the test runs. Leak checks were also conducted before and after any sample train component changes, between sample ports, and upon completion of the test runs. Sampling was conducted within the isokinetic sampling criteria of 100 ± 10%. Table 6.4 summarizes the EPA Method 23 field sampling QA/QC measurements and EPA's acceptability criteria.

In addition to the inlet and outlet samples, one field blank sample was collected. A Method 23 sampling train was assembled and transported to the outlet sampling location, and leak-checked twice. The sample train was then recovered using the same procedures employed during the recovery of the sample trains used during actual sample runs. The collected fractions were transferred to labeled, pre-cleaned sample bottles, transported to the subcontract laboratory, and analyzed in the same manner as the collected samples.

PES also collected samples of the reagents that were used during the program as blanks. Samples were collected of the acetone and toluene; an unused filter and XAD®-2 sorbent module were also collected. These reagent blank samples were transported to the subcontract laboratory and analyzed for PCDDs/PCDFs using the same procedures as during the analysis of the collected samples.

6.3.5 Continuous Emission Monitors

CEMs were used to quantify the in-stack concentrations of O_2, CO_2, THC, and HCl using EPA Methods 3A, 25A and Proposed Method 322, respectively. QA/QC checks performed included direct calibrations, bias checks, and drift checks; matrix spikes were also performed on the Method 322 HCl CEMs sampling system. Table 6.5 summarizes the compressed gas standards that were used during the test program.

6.3.5.1 EPA Method 3A

Prior to the start of each day of testing, the O_2 and CO_2 analyzers were calibrated with a zero gas standard and two upscale standards corresponding to approximately 55 and 85% of the instrument measurement ranges. The calibration error of the analyzers on direct calibration was less than or equal to 2% of span. The sampling line bias was then checked with the zero gas and one upscale gas for each analyzer. The sampling line bias was less than or equal to 5% of the response of the analyzer to the calibration standard when injected directly into the analyzer. At the conclusion of the sampling run, the sampling system was again checked by introducing the zero and upscale standard into the system at the probe end. The sampling system drift was less than 3% of the instrument span for both the zero and upscale calibration gases. The true concentration of the gases measured was then calculated from the average instrument response and the results of the calibration responses using Equation 6C-1 as found in Method 6C, which is the procedure specified in Method 3A. The gases used for calibrations were certified by the manufacturer, and prepared according to the procedures in "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (September 1993)." Results of the above mentioned QC checks are tabulated in Appendix E.

6.3.5.2 EPA Method 25A

Prior to the start of each day of testing, the THC sampling system was calibrated with a zero gas standard and three upscale propane standards corresponding to approximately 25, 50, and 85% of the instrument measurement range. The calibration errors of the THC system

TABLE 6.4

SUMMARY OF EPA METHOD 23 FIELD SAMPLING QA/QC DATA

Run No.	M23-I-1	M23-O-1
Site	Vertical Kiln Baghouse Inlet	Vertical Kiln Baghouse Stack
Date	06/25/98	06/25/98
Pre-Test Leak Rate, acfm	0.001 @ 15" Hg	0.004 @ 15" Hg
Post-Test Leak Rate, acfm	0.001 @ 15" Hg	0.004 @ 10" Hg
EPA Criteria, acfm	0.02	0.02
Percent Isokinetic	102.2	101.6
EPA Criteria	90-110%	90-110%

TABLE 6.5

SUMMARY OF CALIBRATION GAS CYLINDERS

Cylinder Number	Contents	Expiration Date
CC88470	46.0 ppm HCl in nitrogen	Certified on 6/12/98
1836637Y	303.0 ppm HCl in nitrogen	Certified on 6/12/98
AAL-13302	30.0 ppm C_3H_8 in air	5/01/01
SG9128557BAL	58.3 ppm C_3H_8 in air	9/27/99
SG9128479BAL	92.4 ppm C_3H_8 in air	2/18/01
CC84329	11.03 % CO_2 in $N_2/O_2/CO_2$	3/02/01
CC84329	11.04 % O_2 in $N_2/O_2/CO_2$	3/02/01
CC86922	19.01 % CO_2 in $N_2/O_2/CO_2$	3/02/01
CC86922	19.17 % O_2 in $N_2/O_2/CO_2$	3/02/01

were less than 5% of the instrument operating range. At the conclusion of the sampling run, the sampling system was again checked by introducing the zero and one upscale standard into the system at the probe. The sampling system drift was less than 3% of the instrument span for both the zero and upscale calibration gases. The THC results are reported as the average of the instrument responses over the period of the sampling run. The gases used for calibration were certified by the manufacturer, and prepared according to the procedures in "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (September 1993)." Results of the above mentioned QC checks are tabulated in Appendix E.

6.3.5.3 Proposed Method 322

Prior to the start of each day of testing, the HCl analyzer was calibrated with a zero gas standard and two upscale standards corresponding to approximately 25 and 85% of the instrument measurement ranges. The calibration error of the analyzers on direct calibration was less than or equal to 5% of span or 1 ppm, whichever was greater. The sampling line bias was then checked with the zero gas and one upscale gas. The sampling line bias was less than or equal to 7.5% (or 1.5 ppm, whichever was greater) of the response of the analyzer to the calibration standard when injected directly into the analyzer. Results of the above mentioned QC checks are tabulated in Appendix E.

Following the direct calibration and bias checks, a matrix spike for HCl was conducted so that the integrity of the sampling and analysis system for HCl could be ascertained. The flue gas was sampled to determine the baseline concentration of the HCl, and after the baseline concentration was established, a known quantity of HCl was injected into the sampling system. The analyzer response must report the concentration of the HCl in the effluent stream plus the contribution of the HCl from the matrix spike injection. The allowable tolerance for the matrix spike is ± 30% from the predicted value. During the matrix spike procedures conducted on the sampling system at Chemical Lime Company, the matrix spikes were within the ± 30% tolerance. The results of the matrix spikes are presented in Table 6.6 and Appendix E.

TABLE 6.6

SUMMARY OF METHOD 322 HCl IN-SITU SPIKING DATA

Test Location	HCl Spike Recovery Efficiencies, %			
	Pre-test	Post-test	Average	EPA Criteria
Inlet	109	122	116	70-130
Stack	106	106	106	70-130

6.4 LABORATORY ANALYTICAL QA/QC PROCEDURES

6.4.1 Analysis of Blank Samples

The Method 23 blank samples were analyzed following the procedures of EPA Method 23. Field blanks (FB), reagent blanks (RB), and laboratory blanks were used to evaluate the effectiveness of the sample train clean-up procedures and to check for contamination of the reagent materials. In addition, the subcontract laboratory conducted the Laboratory Method Blank (LMB) to evaluate the presence of contamination of the samples during analysis. The results of these blank analyses and the actual run sample catches are presented in Table 6.7.

6.4.2 Standards Recovery Efficiencies

Prior to shipment of the XAD®-2 sorbent modules by PAL, each module was spiked with a mixture of surrogate (sampling) standards. The modules were then sent to Marble Falls, Texas, via Federal Express for use in the sampling program. Upon analysis, the recoveries of the surrogate standards provide a measure of the capture and holding efficiency of the XAD®-2 sorbent traps for the sampled PCDDs/PCDFs. A low recovery efficiency may indicate the loss of PCDDs/PCDFs congeners from the XAD®-2 sorbent module after its recovery from the sampling train. A special "cleanup" standard was added to the separate particulate sample fraction of the inlet Method 23 sample train sample (recovered separately due to the excessively large amount of the particulate). The recovery efficiency of these standards are presented in lieu of the non-existent surrogate standard recoveries. Table 6.8 presents the results of the surrogate and "cleanup" standards recoveries.

Four of the five M23-I-1 sampling standards were below 70%; the laboratory case narrative states "No simple explanation can be offered for this observation." The sampling standards are an indication of the efficiency of the sample recovery effort. When the sampling standards are less than 100%, the sample catches may be under-reported. Since the samples in question are from the inlet location, the removal efficiency of the baghouse would be biased high. The inlet concentration may be biassed low by 25 to 67%; note that Method 23 accepts a low bias of 30%.

Upon receipt of the XAD®-2 sorbent modules by the laboratory after sampling, the XAD®-2 sorbent resin modules are spiked with a mixture of internal (extraction) standards. The purpose of these standards is to evaluate the efficiency of the extraction of the PCDDs/PCDFs congeners from the sample fractions. The results of these recoveries are presented in Table 6.8.

TABLE 6.7

SUMMARY OF EPA METHOD 23 BLANKS AND SAMPLE CATCHES

	Catch, ng Per Sample				
	PAL LMB	M23-RB-1	M23-FB-1	M23-I-1 + FH [a]	M23-O-1
PAL Lab Report Page Numbers in Appendix B	003 / 025	003 / 112	003 / 093	0 / 043 / 129	068
Analyte					
2378-TCDD	{0.00094}	0.0011	{0.00095}	{0.0171}	0.0124
12378-PeCDD	{0.00052}	(0.0004)	(0.0003)	{0.0215}	0.0087
123478-HxCDD	(0.0007)	(0.0006)	(0.0005)	{0.0126}	0.0027
123678-HxCDD	(0.0006)	{0.00096}	{0.00092}	{0.0209}	0.0049
123789-HxCDD	(0.0006)	0.0014	{0.00088}	0.0252	0.0043
1234678-HpCDD	0.0032	0.0031	0.0045	0.0509	0.0073
OCDD	0.0093	0.0096	0.0162	0.0564	0.0243
2378-TCDF [b]	{0.00104}	(0.0006)	0.0030	0.1884	0.160
12378-PeCDF	(0.0004)	(0.0004)	(0.0005)	0.1288	0.0874
23478-PeCDF	(0.0004)	(0.0004)	(0.0004)	0.158	0.0864
123478-HxCDF	{0.00112}	0.0008	0.0014	0.1613	0.0474
123678-HxCDF	0.0006	(0.0003)	{0.00044}	0.0612	0.0171
234678-HxCDF	(0.0003)	(0.0003)	(0.0002)	0.0457	0.0114
123789-HxCDF	(0.0004)	(0.0004)	(0.0003)	0.0127	0.0037
1234678-HpCDF	0.0027	0.0030	0.0071	0.0684	0.0170
1234789-HpCDF	(0.0007)	(0.0006)	(0.0008)	{0.00722}	0.0016
OCDF	0.0021	0.0028	0.0059	{0.00968}	0.0103
Total TCDDs	{0.0009}	0.0011	0.0016	1.3562	1.102
Total PeCDDs	{0.0004}	(0.0004)	0.0016	0.5514	0.264
Total HxCDDs	{0.0016}	0.0024	0.0040	0.5264	0.116
Total HpCDDs	0.0032	0.0032	0.0080	0.0964	0.0132
Total TCDFs	0.0012	(0.0006)	0.0108	10.3236	9.12
Total PeCDFs	(0.0004)	(0.0004)	{0.0016}	2.7118	1.59
Total HxCDFs	0.0004	0.0008	0.0024	0.5676	0.166
Total HpCDFs	0.0028	0.0032	0.0072	0.0860	0.0228
Total PCDD/Fs [c]	**0.019**	**0.023**	**0.058**	**16.3**	**12.4**

[a] Result obtained by summing the two inlet sample fractions analyzed.
[b] Result obtained from the DB-225 analysis.
[c] Total PCDD/Fs represent the sum of all polychlorinated dibenzo-p-dioxins & dibenzofurans.
( ) Denotes a non-detect value using the detection limit.
{} Denotes an EMPC value.

TABLE 6.8

SUMMARY OF EPA METHOD 23 STANDARDS RECOVERY EFFICIENCIES

	Percent Recovery						QC Limits
	PAL LMB	M23-I-1	M23-I-1 FH	M23-O-1	M23-FB-1	M23-RB-1	
FULL SCREEN ANALYSIS							
PAL Lab Report Page Number	026	044	130	069	094	113	
Internal (Extraction) Standards							
2378-TCDD	94.6	94.8	74.4	97.4	87.4	86.4	40-130%
12378-PeCDD	101.9	108.8	83.9	113.1	100.9	94.1	40-130%
123678-HxCDD	96.3	88.6	76.8	93.8	94.6	87.4	40-130%
1234678-HpCDD	91.8	93.7	78.3	102.1	95.6	92.3	40-130%
OCDD	86.2	84.0	66.5	92.4	87.1	83.6	40-130%
2378-TCDF	91.4	95.4	69.2	98.6	88.2	87.7	40-130%
12378-PeCDF	88.1	95.9	63.3	101.2	87.1	81.5	25-130%
123678-HxCDF	100.8	80.6	61.2	94.2	94.8	91.8	25-130%
1234678-HpCDF	74.5	78.8	53.5	82.9	75.2	73.7	25-130%
Surrogate (Sampling) Standards							
2378-TCDD	104.4	**69.2**	100.2 [a]	95.3	94.4	96.4	70-130%
23478-PeCDF	109.4	**61.0**	107.0 [a]	98.5	97.8	98.2	70-130%
123478-HxCDD	103.0	75.3	110.7 [a]	109.6	90.2	110.1	70-130%
123478-HxCDF	95.8	**56.2**	103.7 [a]	96.3	79.6	88.2	70-130%
1234789-HpCDF	97.7	**33.2**	109.1 [a]	92.0	77.8	81.6	70-130%

[a] The "Surrogate" recoveries presented for Sample "M23-I-1 FH" are actually recoveries for the "cleanup" standards which were added to the separate particulate phase of the inlet sample only.

APPENDIX A

RAW FIELD DATA

Appendix A.1

Raw Field Data

Vertical Kiln Baghouse Inlet

PES

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant: Chemical Lime Co. Marble Falls

Date: 6-23-98

Sampling Location: Kiln Baghouse Inlet

Inside of Far Wall to Outside of Nipple: 58 1/4

Inside of Near Wall to Outside of Nipple (Nipple Length): 10 3/4

Stack I.D.: 47.5

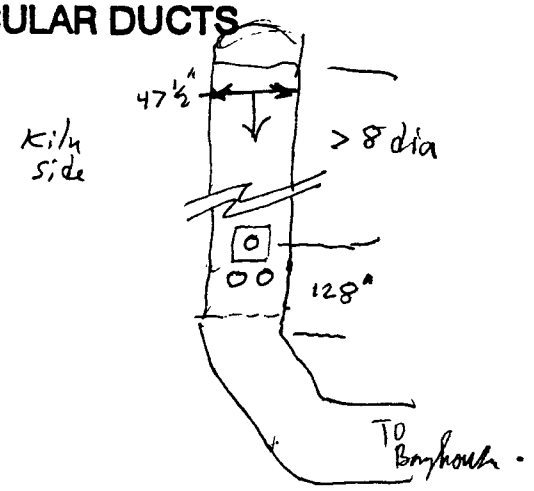
Distance Downstream from Flow Disturbance (Distance B): > 8

1080 ~~128~~ inches / Stack I.D. = ~~2.7~~ dd

Distance Upstream from Flow Disturbance (Distance A):

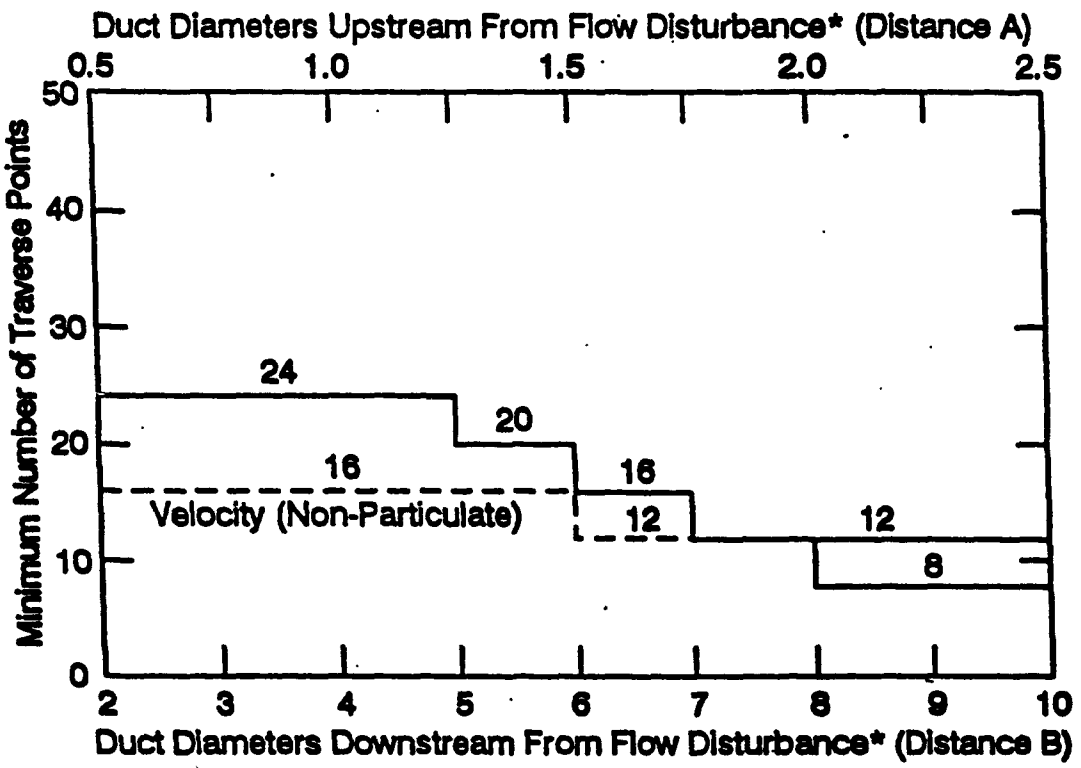
128 inches / Stack I.D. = 2.7 dd

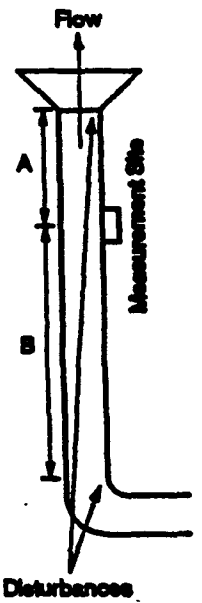
Calculated By:



Schematic of Sampling Location

Traverse Point Number	Fraction of Length	Length (inches)	Product of Columns 2 & 3 (To nearest 1/8")		Nipple Length (inches)	Traverse Point Location (Sum of Col. 4 & 5)	
1	0.044	47.5	2.09	2 1/8	10.75	12.84	12 7/8
2	0.146		6.935	6 7/8		17.685	17 5/8
3	0.296		14.06	14		24.81	24 3/4
4	0.704		33.44	33 1/2		44.19	44 1/4
5	0.854		40.565	40 5/8		51.315	51 3/8
6	0.956		45.41	45 3/8		56.16	56 1/8





LOCATION OF TRAVERSE POINTS IN CIRCULAR DUCTS
(Fraction of Stack Diameter from Inside Wall to Traverse Point)

Traverse Point Number on a Diameter	Number of Traverse Points on a Diameter				
	4	6	8	10	12
1	0.067	0.044	0.032	0.026	0.021
2	0.250	0.146	0.105	0.082	0.067
3	0.750	0.296	0.194	0.146	0.118
4	0.933	0.704	0.323	0.226	0.177
5		0.854	0.677	0.342	0.250
6		0.956	0.806	0.658	0.356
7			0.895	0.774	0.644
8			0.968	0.854	0.750
9				0.918	0.823
10				0.974	0.882
11					0.933
12					0.979

GAS VELOCITY ,CYCLONIC, AND VOLUMETRIC FLOW RATE

Plant:	chemical Lime Company (Marble Falls)	Date:	6-23-98
Sample Location:	Baghouse Inlet	Clock Time:	1200
Run No.:	Cyclonic flow Check	Operators:	DDH
Pbar, in. Hg:	29.5	Static Pressure, in. H_2O:	-.90
Moist, %:	3.4 - 5.0 est	Pitot Tube, Cp:	.84
Stack Dimension, in. Dia. 1:	47½"	Dia. 2:	—
Wet Bulb, °F:	—	Dry Bulb, °F:	—

Traverse Point Number	Velocity Head, in. H_2O	Stack Temp., °F	Cyclonic Flow Angle, %	Directon of Angle
A 1	.30	250	12	+
2	1.60	253	12	+
3	1.50	260	9	+
4	1.40	260	-2	-
5	1.40	260	0	-0-
6	1.20	255	-6	-

	sq.rt. dp	Stack Temp	Angle, °
Average			6.83

$\overline{\sqrt{\Delta P}}$ 1.42

K = 2.23

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} = \quad {}^oF = \quad {}^oR \ ({}^oF + 460)$

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps = \quad$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\ ({}^oR)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs = \quad$ ft/s

$As = \quad ft^2$

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs = \quad$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} = \quad$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Chemical Lime Company (Marble Falls) Date: 6-24-98
Sampling Location: Baghouse Inlet Clock Time: 0958
Run #: Preliminary flow study Baghouse Inlet Operators: DDH, EWS
Barometric Pressure, in. Hg: 29.20 Static Pressure, in. H_2O: ~0
Moisture, %: 3-5 % Molecular wt., Dry: 32.08 .84 Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 47½" Side 2: ——
Wet Bulb, °F: —— Dry Bulb, °F: ——

	Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
	0958	1.2	224
	09:59	1.2	229
	10:00	1.2	243
	10:01	1.2	244
	10:02	1.2	235
	10:03	1.2	237
	10:04	1.2	250
	10:05	1.2	294
	10:06	1.2	298
Alarm	10:07	1.2	312
—	1007:15	1.2	312
	1007:30	.50	302
	1007:45	.70	269
	1008:00	.65	230
	1008:15	.30	225
—	1008:30	.85	221
	1008:45	1.20	219
	1010	1.20	226
	1011	1.20	226
	1012	1.20	210
	1013	1.20	224
	1014	1.30	230
	1015	1.20	241
	1016	1.20	249
	1017	1.20	273
		$\overline{\sqrt{\Delta P}}$ =	$\overline{T_s}$ =

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$ ① −.55

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18(\frac{\%H_2O}{100})$ ② −.40

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18(\frac{\quad}{100})$ ③ −.37

$Ms =$ ④ −.25

$\overline{T_s} =$ °F = °R (°F + 460) ⑤ −.10

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$ ⑥ +.20

$Ps =$ in. Hg ⑦ +.30

$\overline{\sqrt{\Delta P}} =$ ⑧ +.30

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{T_s(°R)}{Ps \times Ms}}$ ⑨ +.48

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$ ⑩ +.50

$Vs =$ ft/s ⑪ +.55

$As =$ ft^2 ⑫ +.70

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Chemical Lime Company (Marble Falls) Date: 6-24-98
Sampling Location: Baghouse Inlet Clock Time: 0958-1023
Run #: Preliminary flow study Operators: DDH, EWS
Barometric Pressure, in. Hg: 29.20 Static Pressure, in. H_2O: -0
Moisture, %: 3-5 Molecular wt., Dry: 32.02 Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 47½" Side 2: ——
Wet Bulb, °F: —— Dry Bulb, °F: ——

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1018	1.20	283
1019	1.20	300
1019:15	.50	260
1019:30	.50	222
1019:45	.65	222
1020	.70	220
1020:15	.30	205
1020:30	.70	207
1021	1.2	215
1022	1.2	216
1023	1.2	217
	$\overline{\sqrt{\Delta P}}$ =	$\overline{Ts}$ =

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\ (°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

FIELD DATA SHEET

Plant: Chemical Lime Company
Sampling Location: Baghouse Inlet
Run Number: M23-I-1 Date: 6-25-98
Pretest Leak Rate: .001 (.000) cfm @ 15" (15") in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: N/A

Sample Type: M23 Operator: DDH
Pbar: 29.40 Ps: 29.4
CO2: 23.9 O2: 9.8
Probe Length/Type: 5' / S-2 Type Pitot #: 5-H
Stack Diameter: 47½" As: 12.31

Nozzle ID: VII-.217 Thermocouple #: 5-A
Assumed Bws: 7 Filter #: DF
Meter Box #: MB 10 Y: 1.001 ΔH@: 1.92
Post-Test Leak Rate: .001 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: N/A

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Outlet (Tm out °F)	Pump Vacuum (in. Hg)	XAD
	A 3	0	1520	116.400											
		7½	1527.5	122.500	1.20	2.04	2.04	300	250	250	48	110	110	6	52
		15	1535	128.510	1.50	2.61	2.61	265	250	255	49	109	111	7	52
151.900	4	22.5	1542.5	134.221	1.10	2.14	2.14	203	260	250	49	109	109	10	52
151.401		30	1550	139.850	1.20	2.13	2.13	269	260	250	51	109	109	11	52
stop 1605		37½	1557.5	145.475	1.10	2.06	2.06	230	225	270	51	109	109	13	52
	5	45	1605	151.201	1.20	2.05	2.05	300	245	265	53	111	111	14	54
restart 1616		52.5	1623.5	157.280	1.20	2.14	2.14	267	250	260	53	111	111	16	55
		60	1631	163.382	1.30	2.45	2.45	227	245	245	54	108	111	9	53
	6	67½	1638.5	168.775	1.10	1.87	1.87	299	255	250	53	110	110	12	54
186.210		75	1646	174.500	1.10	2.03	2.03	242	255	250	52	108	110	12	56
186.412		82.5	1653.5	180.100	1.10	2.06	2.06	230	260	260	56	110	110	13	56
stop 1701	7	90	1701	186.810	1.00	1.95	1.95	268	260	255	56	109	109	14	56
restart 1716		97.5	1708.5	191.740	1.10	2.05	2.05	230	250	260	57	108	108	9	58
		105	1731	197.640	1.20	2.21	2.21	240	255	260	58	109	109	9	59
	8	112.5	1738.5	203.375	1.20	2.20	2.20	242	260	260	59	108	108	10	55
220.582		120	1746	209.225	1.20	2.20	2.20	241	250	250	51	109	109	12	58
220.905		127.5	1753.5	215.075	1.20	2.15	2.15	260	250	250	51	109	109	12	52
	9	135	1801	220.582	1.20	2.15	2.15	260	255	256	52	109	109	12	52
stop 1801		142.5	1819.5	226.310	1.20	2.24	2.24	230	250	250	51	110	110	12	53
restart 1812		150	1827	231.920	1.20	2.08	2.08	284	250	255	52	110	110	14	52
	3	157.5	1834.5	237.823	1.20	2.16	2.16	256	250	260	52	110	110	15	52
		165	1842	243.390	1.20	2.19	2.19	247	250	250	53	110	110	16	52
		172.5	1849.5	248.410	1.20	2.19	2.19	248	250	260	52	110	110	18	52
		180	1857	253.810	1.00	1.81	1.81	251	250	260	52	110	110	18	52

Port Change - 1701 up top

ΔVm= _____ $\overline{\sqrt{\Delta p}}$= _____ $\overline{\Delta H}$= $\overline{T_s}$= $\overline{T_m}$=

SAMPLE RECOVERY DATA

PLANT Chemical Lime c. Marble Falls, Texas Run No. M23-1-1

DATE 6-24-98 Sample Box No. N 5 Job No. R012.003

SAMPLE LOCATION Inlet Filter No. Glass

TRAIN PREPARER GG/ DH

SAMPLE RECOVERY PERSON _____

COMMENTS T. Abernathy

FRONT HALF

Acetone Container No. _____ Liquid Level Marked _____ Sealed _____

Filter Container No. _____ Sealed _____

Description of Filter _____

Samples Stored and Locked _____

BACK HALF/MOISTURE

Container No. _____

Liquid Level Marked _____ Sealed _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	Empty	—	471.3	708.5	237.2
2	H_2O	100	690.7	686.3	-4.4
3	H_2O	100	~~683.7~~ 724.6	725.1	0.5
4	Empty	—	519.1	522.8	3.7
5	S/G	200	831.6	879.9	48.3
6	XAD Trap	—	325.9	341.7	15.8
TOTAL					306.1

Description of Impinger Catch: Clear

Appendix A.2

Raw Field Data

Vertical Kiln Baghouse Outlet

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant: Chemical Lime Co, Marble Falls

Date: 6-23-98

Sampling Location: Kiln Baghouse Stack, Port B

Inside of Far Wall to Outside of Nipple: 51 1/2"

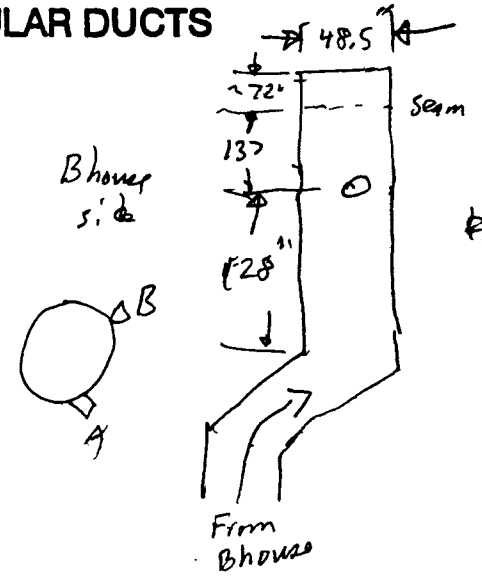
Inside of Near Wall to Outside of Nipple (Nipple Length): 3"

Stack I.D.: 48 1/2" (Port B)

Distance Downstream from Flow Disturbance (Distance B): 2.64
OWS ~ 128 inches / Stack I.D. = ~~4.31~~ dd

Distance Upstream from Flow Disturbance (Distance A): 4.31
OWS ~ 209 inches / Stack I.D. = ~~2.64~~ dd

Calculated By: DDH



Schematic of Sampling Location

Traverse Point Number	Fraction of Length	Length (inches)	Product of Columns 2 & 3 (To nearest 1/8")	Nipple Length (inches)	Traverse Point Location (Sum of Col. 4 & 5)
1	.021	48 1/2	1.02 1"	3	4"
2	.067	48 1/2	3.25 3 1/4"		6 1/4
3	.118	48 1/2	5.73 5 3/4		8 3/4
4	.177	48 1/2	8.58 8 5/8		11 5/8
5	.250	48 1/2	12.13 12 1/8		15 1/8
6	.356	48 1/2	17.27 17 1/4		20 1/4
7	.644	48 1/2	31.23 31 1/4		34 1/4
8	.750	48 1/2	36.38 36 3/8		39 3/8
9	.823	48 1/2	39.92 39 7/8		42 7/8
10	.882	48 1/2	~~45.25~~ 42.78 ~~45 3/4~~		45 3/4
11	.933	48 1/2	45.25 45 1/4		48 1/4
12	.979	48 1/2	47.48 47 1/2		50 1/2"

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant: CHEMICAL LIME CO MARBLE FALLS

Date: 6-23-98

Sampling Location: KILN BAGHOUSE STACK, Port A

Inside of Far Wall to Outside of Nipple: 49 3/16

Inside of Near Wall to Outside of Nipple (Nipple Length): 2

Stack I.D.: 47 3/16 (Port A)

Distance Downstream from Flow Disturbance (Distance B):

209 inches / Stack I.D. = 4.31 dd

Distance Upstream from Flow Disturbance (Distance A):

128 inches / Stack I.D. = 2.64 dd

Calculated By: _____

Schematic of Sampling Location

Traverse Point Number	Fraction of Length	Length (inches)	Product of Columns 2 & 3 (To nearest 1/8")	Nipple Length (inches)	Traverse Point Location (Sum of Col. 4 & 5)
1	.021	47 3/16	1	2	3
2	.067		3 1/8		5 1/8
3	.118		5 5/8		7 5/8
4	.177		8 3/8		10 3/8
5	.250		11 3/4		13 3/4
6	.356		16 3/4		18 3/4
7	.644		30 3/8		32 3/8
8	.750		35 3/8		37 3/8
9	.823		38 7/8		40 7/8
10	.882		41 5/8		43 5/8
11	.933		44		46
12	.979		46 1/4		48 1/4

.1875

GAS VELOCITY ,CYCLONIC, AND VOLUMETRIC FLOW RATE

Plant: Chemical Lime Company Marble Falls
Date: 6-24-98
Sample Location: Baghouse Stack
Clock Time: 0915
Run No.: Preliminary flow & Yaw Angle
Operators: DDH, FWS
Pbar, in. Hg: 29.5
Static Pressure, in. H_2O: -.35
Moist, %: 3.5 to 5
Pitot Tube, Cp: .84
Stack Dimension, in. Dia. 1: 47.84
Dia. 2: —
Wet Bulb, °F: —
Dry Bulb, °F: —

Traverse Point Number	Velocity Head, in. H_2O	Stack Temp., °F	Cyclonic Flow Angle, %	Directon of Angle
A 1			28	
2			26	
3			16	
4			3	
5			3	
6			-2	
7			0	
8			0	
9			0	
10			0	
11			-6	
12			-2	
B 1			0	
2			0	
3			3	
4			0	
5			0	
6			0	
7			-2	
8			0	
9			-6	
10			-20	
11			-30	
12			-28	

	sq.rt. dp	Stack Temp	Angle, °
Average			7.29

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\% H_2O}{100}) + 18 (\frac{\% H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} = \quad {}^oF = \quad {}^oR \ ({}^oF + 460)$

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps = \quad$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\ ({}^oR)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs = \quad$ ft/s

$As = \quad ft^2$

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs = \quad$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\% H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} = \quad$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Chemical Lime Company (Marble Falls) Date: 6-24-98
Sampling Location: Baghouse Outlet Stack Clock Time: 0915
Run #: Preliminary Flow & Yaw Angle Operators: DDH, EWS
Barometric Pressure, in. Hg: 29.5 Static Pressure, in. H_2O: -.35
(6 FCIR) Moisture, %: 3.4 Molecular wt., Dry: 32.02 Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 47.84 Side 2: ——
Wet Bulb, °F: —— Dry Bulb, °F: ——

	Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F	
6-24-98	A 1	1.40	220	28
	2	1.60	221	26
	3	1.50	219	16
	4	1.50	218	3
	5	1.30	217	3
	6	1.40	216	-2
	7	1.10	218	0
	8	1.20	221	0
	9	1.20	221	0
	10	.90	221	0
	11	—		-6
	12	—		-2
-23-98	B 1	1.60	204	0
	2	1.30	212	0
	3	1.30	224	3
	4	1.20	224	0
	5	1.20	224	0
	6	1.10	225	0
	7	1.20	225	-2
	8	1.20	224	0
	9	1.30	224	-6
	10	1.20	223	-20
	11	1.20	222	-30
	12	1.20	220	-28
		$\overline{\sqrt{\Delta P}}$ =	$\overline{Ts}$ =	

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\,(°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Chemical Lime Company Marble Falls Date: 6-24-98
Sampling Location: Baghouse Outlet Stack Clock Time: 1155 - 1213
Run #: Preliminary Velocity Study Operators: DDH, EWS
Barometric Pressure, in. Hg: 29.20 Static Pressure, in. H_2O: -.30
Moisture, %: 3-5% Molecular wt., Dry: 32.02 Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 47.84 Side 2: ____
Wet Bulb, °F: ____ Dry Bulb, °F: ____

	Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1155	A 6	1.10	214
1156		1.20	222
1157		1.20	222
1158		1.20	217
1159		.50	217
1159:15		.50	217
1159:30		.35	217
1159:45		.30	217
1200		1.10	217
1201		1.10	211
1202		1.10	211
1203		1.20	211
1204		1.20	211
1205		1.20	211
1206		1.20	210
1207		1.20	211
1208		1.20	214
1209		1.20	214
1210		1.20	216
1211		1.20	220
1211:15		.60	219
1211:30		.25	217
1211:45		.50	218
1212		.60	218
1212:15		.75	218
1212:30		$\overline{\sqrt{\Delta P}}$ = 1.20	$\overline{Ts}$ = 215
1213		1.20	215

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\,(°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs =$ x x 60

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} =$ x 17.647 x ____ x (1 - ____/100)

$Qs_{std} =$ dscfm

K=223

FIELD DATA SHEET

Plant: Chemical Lime Company Marble Falls
Sample Type: M23 Operator: GG/PS
Nozzle ID: .217 Thermocouple #: T6
Sampling Location: Bag House Outlet
Pbar: 29.90 Ps: -.30
Assumed Bws: 6 Filter #: — No #
Run Number: M23-01 Date: 6-25-91
CO2: 20 O2: 12
Meter Box #: EMO15 Y: 1.000 ΔH@: 1.96
Pretest Leak Rate: .004 cfm @ 15 in. Hg.
Probe Length/Type: 6' Glass Pitot #: 6A
Post-Test Leak Rate: .004 cfm @ 10 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: No
Stack Diameter: As:
Post-Test Leak Check: Pitot: ✓ Orsat: No

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)	
		0 (15:18)	318	803.042											Counter
	1	7.5	325	808.6	.95	1.6	1.6	236	255	256	68	90	90	7	60
	2	15	332	814.0	1.1	1.9	1.9	227	252	257	61	91	91	7	58
	3	22.5	340	819.7	1.1	1.9	1.9	235	253	251	61	91	91	7	59
	4	30	347	825.0	1.1	1.9	1.9	233	253	260	61	91	92	7	60
	5	37.5	356	831.0	1.1	1.9	1.9	231	256	259	61	91	92	7	60
STOP 404 9:14	6	45.0	403	836.0	1.1	1.9	1.9	241	254	257	62	91	92	7	61
	7	52.5	410	841.8	1.7	2.1	2.1	236	253	256	62	91	92	8	62
	8	60	417	847.3	1.7	2.1	2.1	228	252	256	62	91	92	8	59
	9	67.5	424	853.6	1.3	2.3	2.3	228	261	251	62	91	92	9	60
	10	75	428	859.6	1.3	2.3	2.3	230	253	256	62	91	93	9	60
	11	82.5	450	866.0	1.3	2.3	2.3	229	254	253	63	92	93	9	60
START	12	90	457	871.9	1.3	2.3	2.3	227	252	251	62	92	93	9	60
			513												
	1	97.5	521	878.1	1.2	2.1	2.1	230	252	252	66	92	92	9	56
	2	105	521	883.4	1.1	1.9	1.9	229	253	255	58	92	93	8	49
	3	112.5	536	889.6	1.1	1.9	1.9	227	254	258	59	92	94	8	52
	4	120	543	895.0	1.1	1.9	1.9	228	252	255	59	92	93	8	53
STOP 558	5	127.5	551	901.1	1.2	2.1	2.1	234	254	259	60	92	94	8	55
START 610	6	135	558	906.7	1.2	2.1	2.1	234	253	255	60	92	94	8	55
	7	142.5	617	912.9	1.2	2.1	2.1	234	255	258	61	92	94	8	56
	8	150.0	625	918.6	1.2	2.1	2.1	234	251	255	61	91	93	8	57
	9	157.5	632	925.0	1.3	2.3	2.3	223	252	254	62	92	94	8	59
	10	165	640	931.0	1.3	2.3	2.3	225	253	255	62	92	94	8	50
	11	172.5	647	938.0	1.5	2.6	2.6	232	255	252	63	91	93	10	52
	12	180	655	944.154	1.5	2.6	2.6	229	258	259	63	91	93	10	53
			1855												

military time

ΔVm= 141.112 $\overline{\sqrt{\Delta p}}$= 1.096 $\overline{\Delta H}$= _____ $\overline{Ts}$= 231 $\overline{Tm}$= _____

SAMPLE RECOVERY DATA

PLANT Chemical Lime Run No. M23-O-1

DATE 6-24-98 Sample Box No. N 10 Job No. R012.003

SAMPLE LOCATION Outlet Filter No. Glass

TRAIN PREPARER GG/DH

SAMPLE RECOVERY PERSON T. Abernathy

COMMENTS

FRONT HALF

Acetone Container No. _____ Liquid Level Marked _____ Sealed _____

Filter Container No. _____ Sealed _____

Description of Filter _____

Samples Stored and Locked _____

BACK HALF/MOISTURE

Container No. _____

Liquid Level Marked _____ Sealed _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	Empty	—	472.3	719.4	247.1
2	H_2O	100	703.4	702.2	-1.2
3	H_2O	100	709.2	709.2	0
4	Empty	—	591.4	594.1	2.7
5	S/G	200	830.4	870.2	39.8
6	XAD-Trap		319.1	341.6	22.5
TOTAL					310.9

Description of Impinger Catch: _____

FIELD DATA SHEET

Plant: Chemical Lime Company, Marble Falls
Sampling Location: Bag House Outlet
Run Number: FB-1 Date: 6-25-98
Pretest Leak Rate: .0005 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: NA Orsat: NA

Sample Type: M23 Operator: GG/BS
Pbar: 29.40 Ps: -.30
CO2: NA O2: NA
Probe Length/Type: 6' Glass Pitot #: 6A
Stack Diameter: _____ As: _____

Nozzle ID: .217 Thermocouple #: T6
Assumed Bws: 6 Filter #: NO #
Meter Box #: RM015 Y: 1.000 ΔH@: 1.90
Post-Test Leak Rate: _____ cfm @ ___ in. Hg.
Post-Test Leak Check: Pitot: NA Orsat: NA

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in °F)	Outlet (Tm out °F)	
			944.370										
			944.423										

ΔVm= _____ $\overline{\sqrt{\Delta p}}$= _____ $\overline{\Delta H}$= _____ $\overline{Ts}$= _____ $\overline{Tm}$= _____

SAMPLE RECOVERY DATA

PLANT Chemical-Lime; Marble Falls, Texas Run No. M23-FB-1

DATE 6-25-98 Sample Box No. 104-1 Job No. R012.003

SAMPLE LOCATION Field Blank-Inlet Filter No. Glass

TRAIN PREPARER T. Abernathy

SAMPLE RECOVERY PERSON T. Abernathy

COMMENTS

FRONT HALF

Acetone Container No. _____ Liquid Level Marked _____ Sealed _____

Filter Container No. _____ Sealed _____

Description of Filter _____

Samples Stored and Locked _____

BACK HALF/MOISTURE

Container No. _____

Liquid Level Marked _____ Sealed _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	Empty	—	492.3	492.3	0
2	H_2O	100	710.6	710.6	0
3	H_2O	100	724.6	724.6	0
4	Empty	—	617.1	617.1	0
5	Silica Gel	200	730.9	730.9	0
6	XAD-Trap	—	321.1	321.1	0
TOTAL					0

Description of Impinger Catch: _____

Appendix A.3

Raw Field Data

CEMs Summaries & Strip Charts

HCl Correction Worksheet
Marble Falls
Chemical Lime
25-June-98

OUTLET

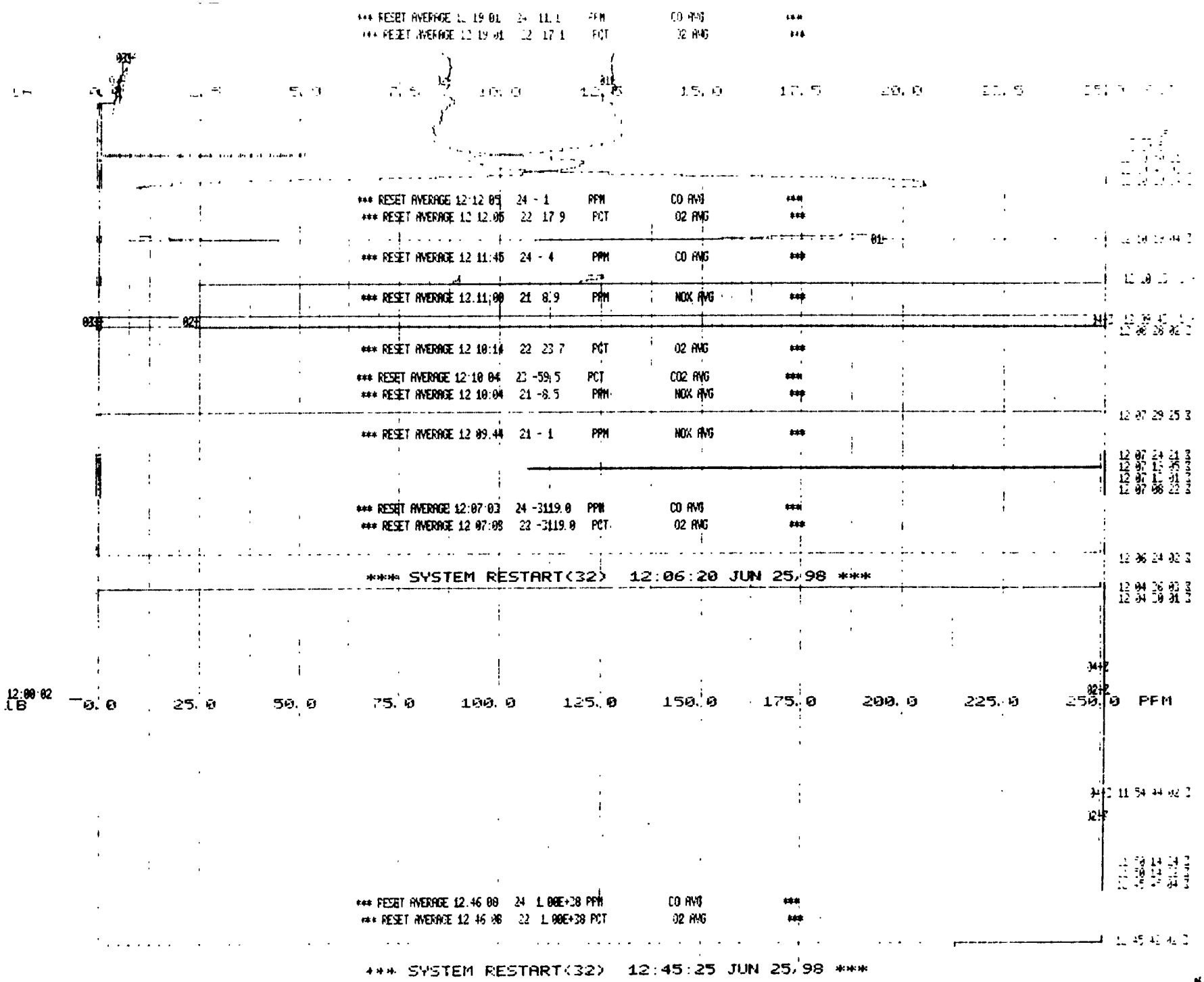
	Actual value	3 Point Cal	Pre Bias	Post Bias
zero	0	1.1	1.1	2.1
mid	46	47.4		
high	303	300.8	300.8	308.4
	slope (m)	0.988	0.989	1.011
	Y-Intercept (b)	1.49	1.10	2.10
	Avg conc:	15.5		
	Actual Conc:	**15.8**		

INLET

	Actual value	3 Point Cal	Pre Bias	Post Bias
zero	0	1.9	1.9	3
mid	46	44		
high	303	299.4	299.4	296.9
	slope (m)	0.986	0.982	0.970
	Y-Intercept (b)	0.41	1.90	3.00
	Avg conc:	20.9		
	Actual Conc:	**22.7**		

HCl Emission Measurements from a Vertical Kiln
Chemical LimeMarble Falls Plant
Marble Falls, Texas
6/25/98

Time	Date	Inlet/Outlet	HCl ppm	THC ppm	O2 %	CO2 %
15:19-15:38	6/25/98	Outlet	16.1	10.0	13.6	15.8
16:07-16:26			13.8	10.1	13.9	15.1
16:55-17:14			18.8	10.7	13.7	15.7
17:43-18:02			14.9	10.5	13.5	15.8
18:31-18:50			14.0	9.8	14.0	15.0
Average			**15.5**	**10.2**	**13.7**	**15.5**
15:43-16:02	6/25/98	Inlet	20.5	18.6	9.8	24.0
16:31-16:50			7.0	17.4	9.8	24.0
17:19-17:38			16.6	17.9	9.8	23.9
18:07-18:26			39.3	17.4	9.8	23.8
Average			**20.9**	**17.8**	**9.8**	**23.9**

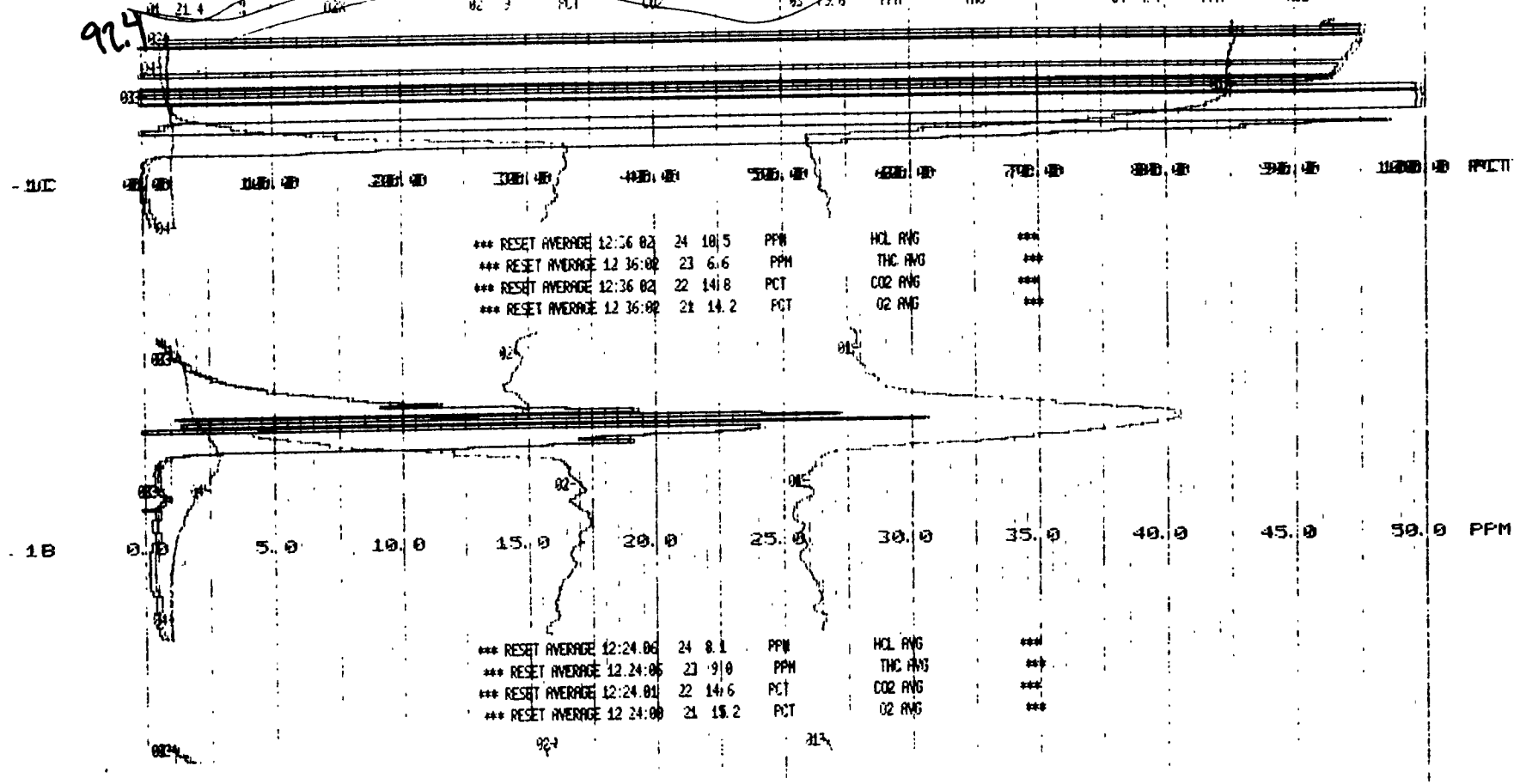

*** RESET AVERAGE 12 19 01 24 11.1 PPM CO AVG ***
*** RESET AVERAGE 12 19 01 22 17 1 PCT 02 AVG ***
*** RESET AVERAGE 12:12 05 24 - 1 PPM CO AVG ***
*** RESET AVERAGE 12 12.05 22 17 9 PCT 02 AVG ***
*** RESET AVERAGE 12 11:45 24 - 4 PPM CO AVG ***
*** RESET AVERAGE 12.11:00 21 8.9 PPM NOX AVG ***
*** RESET AVERAGE 12 10:14 22 23 7 PCT 02 AVG ***
*** RESET AVERAGE 12:10 04 23 -59.5 PCT CO2 AVG ***
*** RESET AVERAGE 12 10:04 21 -8.5 PPM NOX AVG ***
*** RESET AVERAGE 12 09.44 21 - 1 PPM NOX AVG ***
*** RESET AVERAGE 12:07:03 24 -3119.0 PPM CO AVG ***
*** RESET AVERAGE 12 07:03 22 -3119.0 PCT 02 AVG ***
**** SYSTEM RESTART(32) 12:06:20 JUN 25,98 ****
12:00:02
LB
0.0
25.0
50.0
75.0
100.0
125.0
150.0
175.0
200.0
225.0
250.0
PPM
*** RESET AVERAGE 12.46 00 24 1.00E+38 PPM CO AVG ***
*** RESET AVERAGE 12 46 00 22 1.00E+38 PCT 02 AVG ***
*** SYSTEM RESTART(32) 12:45:25 JUN 25,98 ****

THC 92.4

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 12:43 00 *** ENDS AT 12 43 40 JUN 25,98 ***

THC 92.4

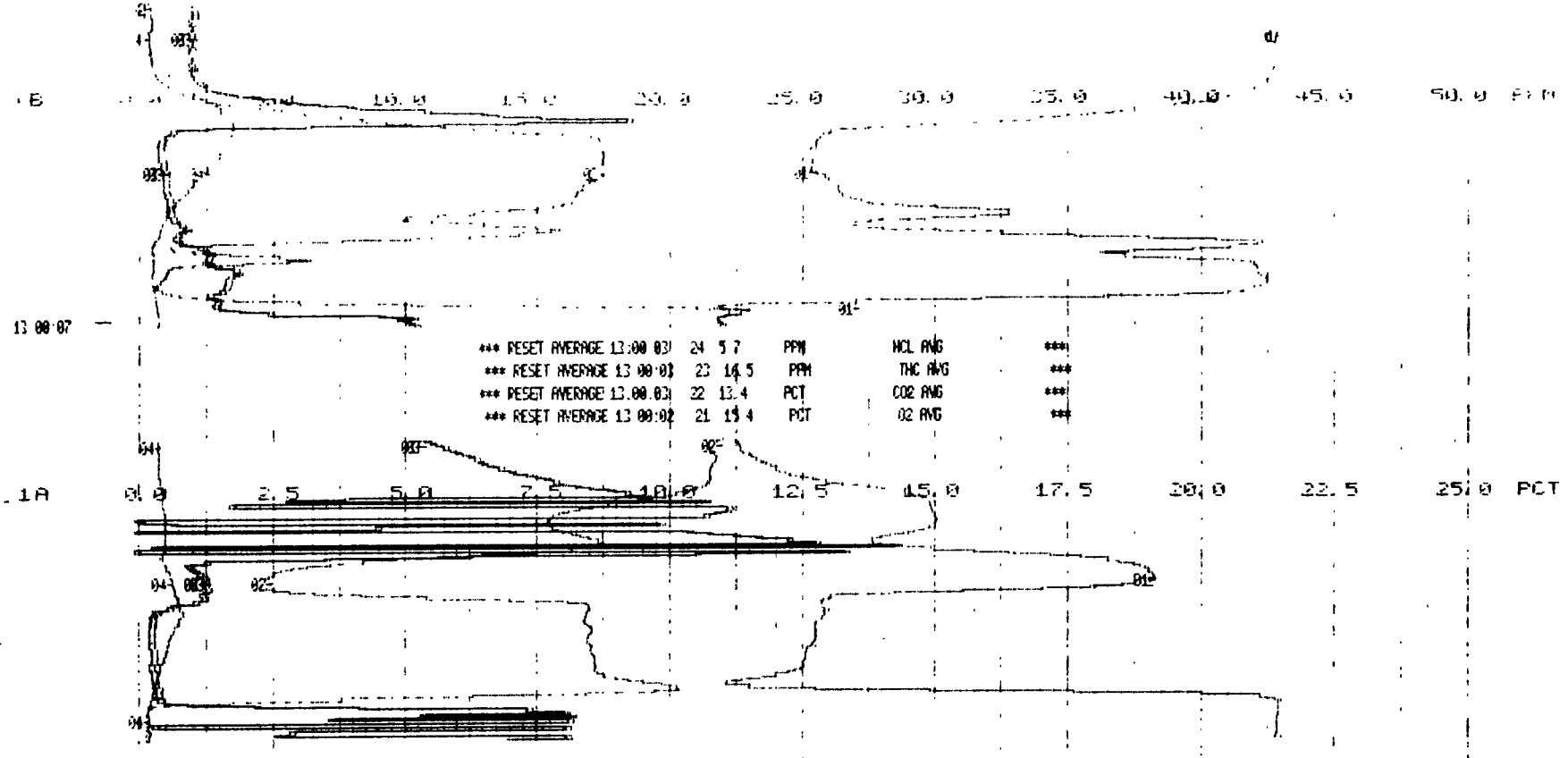
PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	21.4	%		O2%	02	9	PCT		CO2	03	29.8	PPM		THC	04	4.4	PPM		HCL



*** LOG GRP 1 *** UNIT 01 *** STARTS AT 12:23:13 *** ENDS AT 12:23:14 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	13.5	%		O2%	02	15.2	PCT		CO2	03	3.4	PPM		THC	04	6.9	PPM		HCL

*** RESET AVERAGE 12 12 02 21 17.7 PCT O2 AVG ***



*** LOG GRP 1 *** UNIT 01 *** STARTS AT 12:48:42 *** ENDS AT 12:48:48 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	21.5	%		O2%	02	2	PCT		CO2	03	32.7	PPM		THC	04	2.0	PPM		HCL

1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM

*** RESET AVERAGE 12.48.03 24 5.3 PPM HCL AVG ***
*** RESET AVERAGE 12 48:02 23 49.5 PPM THC AVG ***
*** RESET AVERAGE 12.48.02 22 5.0 PCT CO2 AVG ***
*** RESET AVERAGE 12.48.02 21 19.0 PCT O2 AVG ***

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 12:46.42 *** ENDS AT 12:46:43 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	20.3	%		O2%	02	6	PCT		CO2	03	-0	PPM		THC	04	3.2	PPM		HCL

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 12:44:59 *** ENDS AT 12:44.59 JUN 25,98 ***

THC

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	[illegible]	%		O2%	02	[illegible]	PCT		CO2	03	91.1	PPM		THC	04	1.2	PPM		HCL

THC 92.3

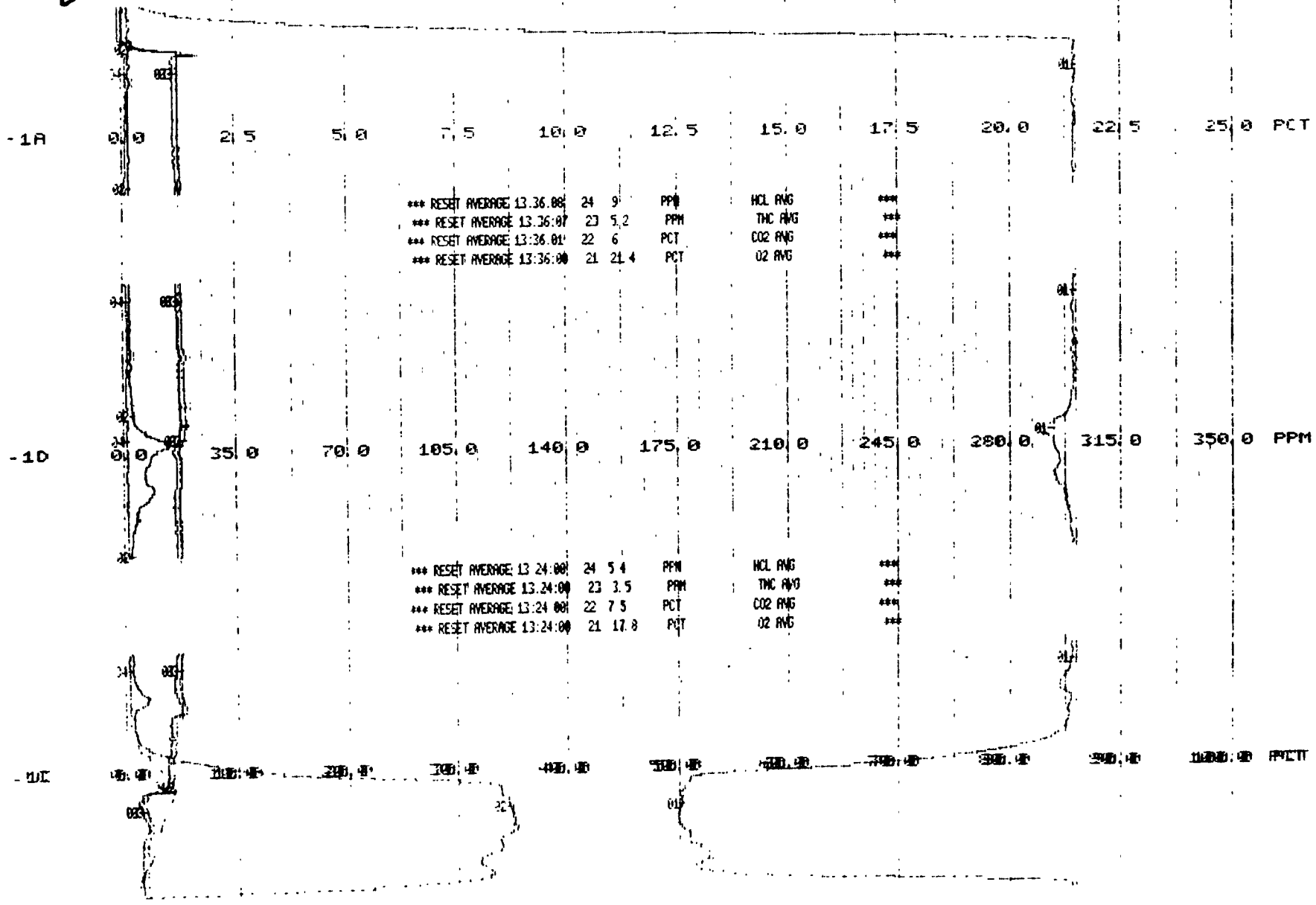
*** LOG GRP 1 *** UNIT 01 *** STARTS AT 13:44.38 *** ENDS AT 13:44.38 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	1	%		O2%	02	2	PCT		CO2	03	50.1	PPM		THC	04	1.0	PPM		HCL

IN ZERO

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 13:44.38 *** ENDS AT 13:44.38 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	3	%		O2%	02	2	PCT		CO2	03	0.0	PPM		THC	04	1	PPM		HCL



*** LOG GRP 1 *** UNIT 01 *** STARTS AT 14:09:19 *** ENDS AT 14 09 55 JUN 25,98 ***

OUT ZERO

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	1	%		O2%	02	2	PCT		CO2	03	0.0	PPM		THC	04	3.4	PPM		HCL

1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM

14 00.08

*** RESET AVERAGE 14:00 04	24	85.3	PPM	HCL AVG	***
*** RESET AVERAGE 14 00:04	23	16.8	PPM	THC AVG	***
*** RESET AVERAGE 14:00 04	22	7.7	PCT	CO2 AVG	***
*** RESET AVERAGE 14.00.03	21	10.2	PCT	O2 AVG	***

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 13:59:40 *** ENDS AT 13:59:48 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	0	%		O2%	02	2	PCT		CO2	03	0.0	PPM		THC	04	304.2	PPM		HCL

1UC 0.00 100.00 200.00 300.00 400.00 500.00 600.00 700.00 800.00 900.00 1000.00 PPCTT

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 13:50:59 *** ENDS AT 13:51:00 JUN 25,98 ***

THC 30.0

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	21.2	%		O2%	02	2	PCT		CO2	03	32.7	PPM		THC	04	1.7	PPM		HCL

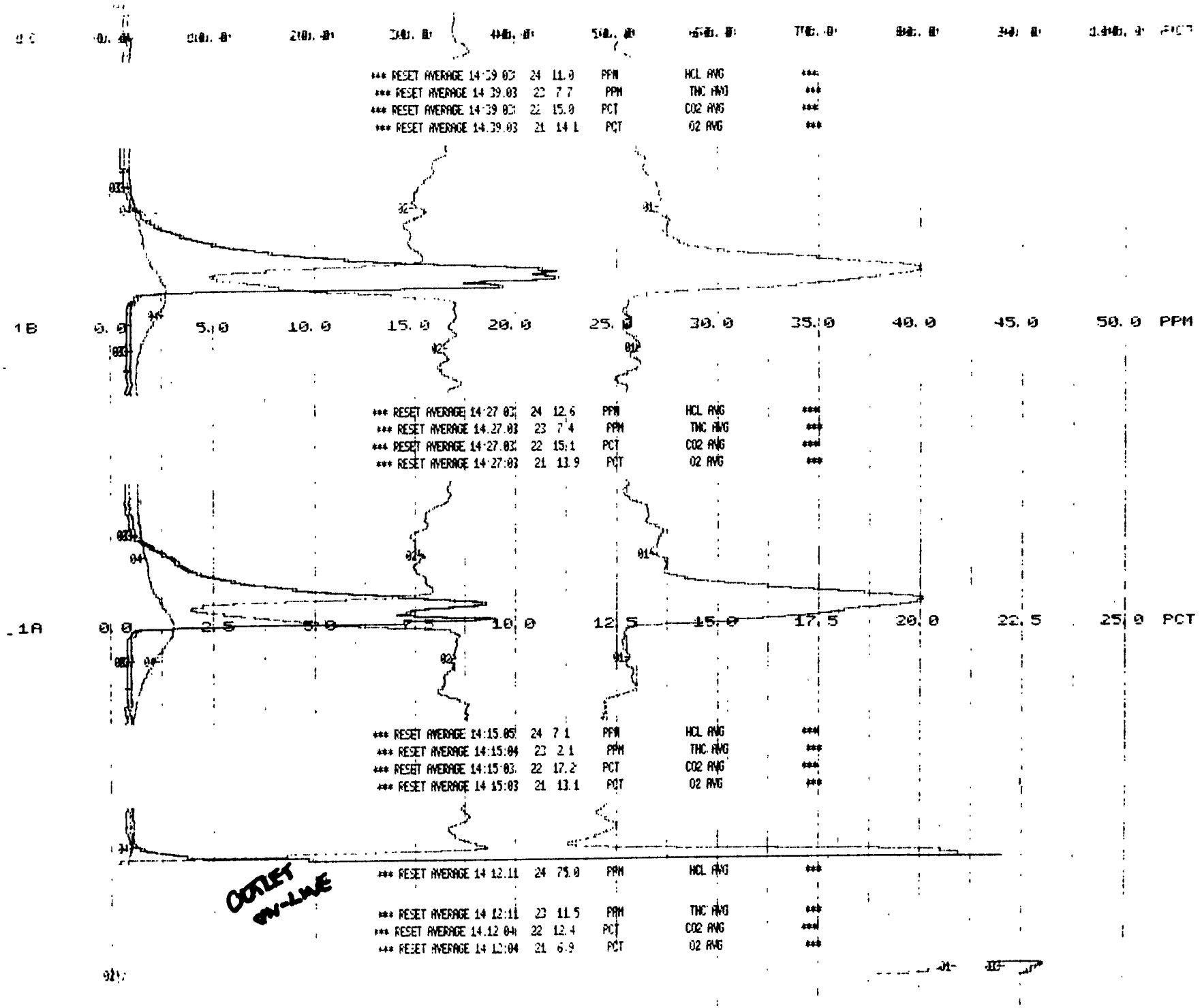
*** LOG GRP 1 *** UNIT 01 *** STARTS AT 13:49:23 *** ENDS AT 13:49:24 JUN 25,98 ***

THC 30.0

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	20.6	%		O2%	02	2	PCT		CO2	03	58.0	PPM		THC	04	2.3	PPM		HCL

1B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM

*** RESET AVERAGE 13 48 04	24	1.1	PPM	HCL AVG	***
*** RESET AVERAGE 13 48 04	23	24.5	PPM	THC AVG	***
*** RESET AVERAGE 13 48 04	22	[illegible]	PCT	CO2 AVG	***
*** RESET AVERAGE 13 48 03	21	16.5	PCT	O2 AVG	***


*** RESET AVERAGE 14:39:03 24 11.0 PPM HCL AVG ***
*** RESET AVERAGE 14:39:03 23 7.7 PPM THC AVG ***
*** RESET AVERAGE 14:39:03 22 15.0 PCT CO2 AVG ***
*** RESET AVERAGE 14:39:03 21 14.1 PCT O2 AVG ***
1B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM
*** RESET AVERAGE 14:27:03 24 12.6 PPM HCL AVG ***
*** RESET AVERAGE 14:27:03 23 7.4 PPM THC AVG ***
*** RESET AVERAGE 14:27:03 22 15.1 PCT CO2 AVG ***
*** RESET AVERAGE 14:27:03 21 13.9 PCT O2 AVG ***
1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT
*** RESET AVERAGE 14:15:05 24 7.1 PPM HCL AVG ***
*** RESET AVERAGE 14:15:04 23 2.1 PPM THC AVG ***
*** RESET AVERAGE 14:15:03 22 17.2 PCT CO2 AVG ***
*** RESET AVERAGE 14:15:03 21 13.1 PCT O2 AVG ***
OUTLET ON-LINE
*** RESET AVERAGE 14:12:11 24 75.0 PPM HCL AVG ***
*** RESET AVERAGE 14:12:11 23 11.5 PPM THC AVG ***
*** RESET AVERAGE 14:12:04 22 12.4 PCT CO2 AVG ***
*** RESET AVERAGE 14:12:04 21 6.9 PCT O2 AVG ***
*** LOG GRP 1 *** UNIT 01 *** STARTS AT 14:11:26 *** ENDS AT 14:11:27 JUN 25,98 ***
PT DATA UNITS ST LEGEND PT DATA UNITS ST LEGEND PT DATA UNITS ST LEGEND PT DATA UNITS ST LEGEND

STACK-OUTLET T-1

*** RESET AVERAGE 15.15 07 24 14.4 PPM HCL AVG ***
*** RESET AVERAGE 15.15 07 23 7.8 PPM THC AVG ***
*** RESET AVERAGE 15.15 04 22 15.6 PCT CO2 AVG ***
*** RESET AVERAGE 15 15:04 21 13.8 PCT O2 AVG ***

1B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM

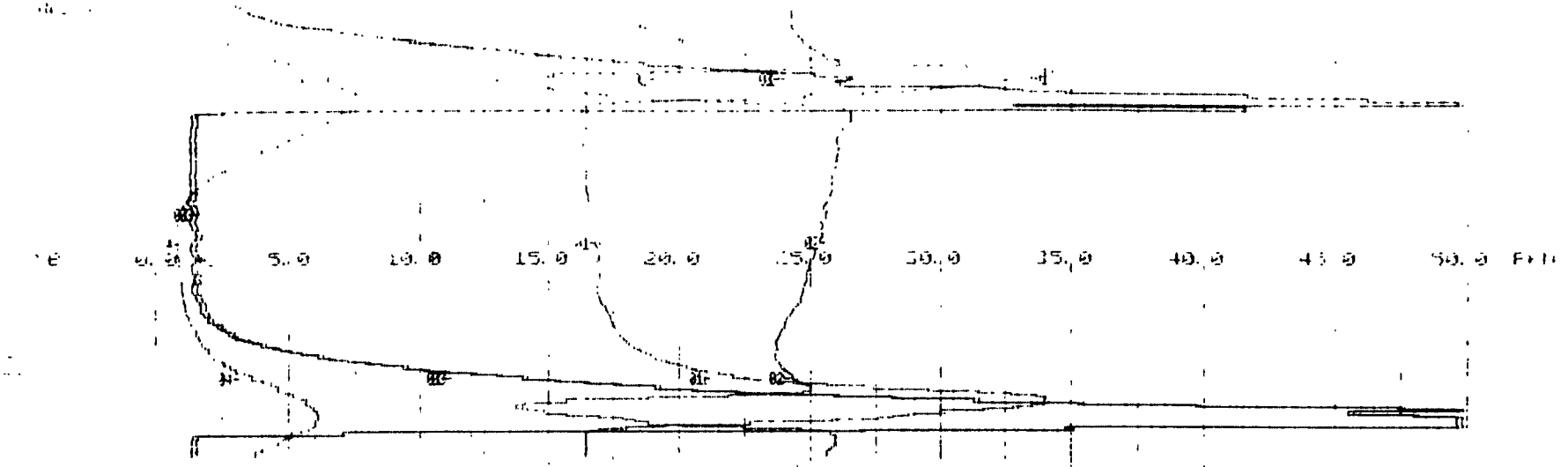
*** RESET AVERAGE 15:03.05 24 13.8 PPM HCL AVG ***
*** RESET AVERAGE 15:03:04 23 7.9 PPM THC AVG ***
*** RESET AVERAGE 15:03:04 22 15.4 PCT CO2 AVG ***
*** RESET AVERAGE 15 03:04 21 13.8 PCT O2 AVG ***

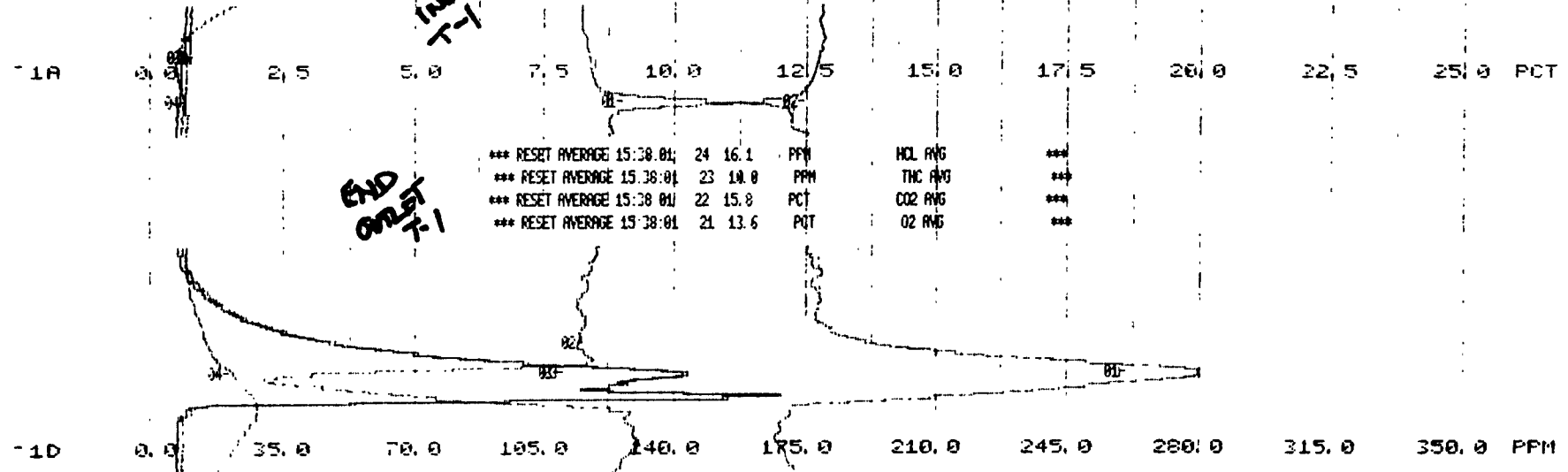
15:00:09
-1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT

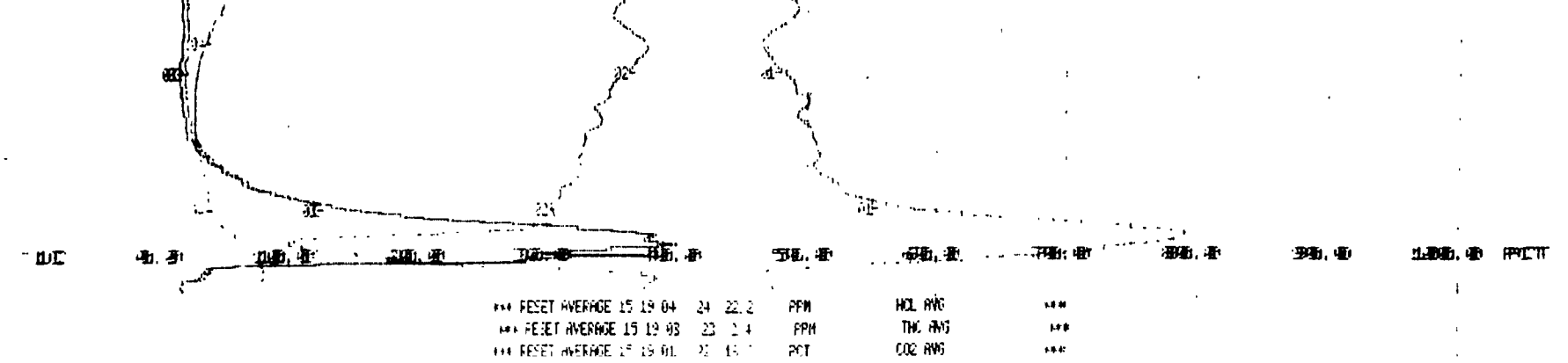
*** RESET AVERAGE 14:51 09 24 12.6 PPM HCL AVG ***
*** RESET AVERAGE 14.51.08 23 7.5 PPM THC AVG ***
*** RESET AVERAGE 14:51 03 22 15.6 PCT CO2 AVG ***
*** RESET AVERAGE 14 51:03 21 13.9 PCT O2 AVG ***

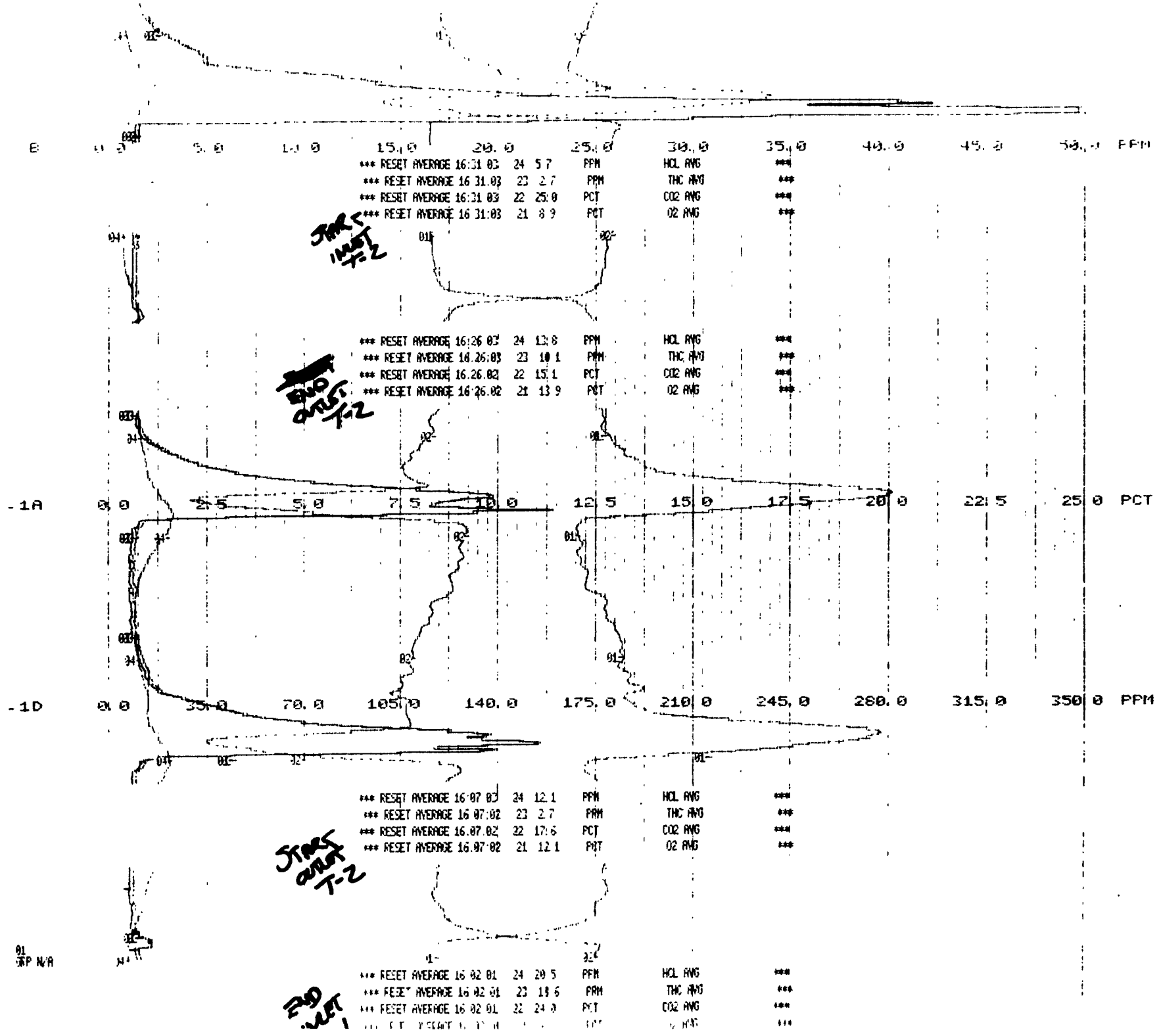
-1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM

-1C 0.0 100.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0 PCT


5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM
*** RESET AVERAGE 15:43:01 24 11.0 PPM HCL AVG ***
*** RESET AVERAGE 15:43:01 23 2.8 PPM THC AVG ***
*** RESET AVERAGE 15:43:01 22 25.1 PCT CO2 AVG ***
*** RESET AVERAGE 15:43:01 21 8.9 PCT O2 AVG ***


2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT
*** RESET AVERAGE 15:38:01 24 16.1 PPM HCL AVG ***
*** RESET AVERAGE 15:38:01 23 10.0 PPM THC AVG ***
*** RESET AVERAGE 15:38:01 22 15.8 PCT CO2 AVG ***
*** RESET AVERAGE 15:38:01 21 13.6 PCT O2 AVG ***


0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM
*** RESET AVERAGE 15:19:04 24 22.2 PPM HCL AVG ***
*** RESET AVERAGE 15:19:03 23 2.4 PPM THC AVG ***
*** RESET AVERAGE 15:19:01 22 13.7 PCT CO2 AVG ***


B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM
*** RESET AVERAGE 16:31 03 24 5.7 PPM HCL AVG ***
*** RESET AVERAGE 16:31 03 23 2.7 PPM THC AVG ***
*** RESET AVERAGE 16:31 03 22 25.0 PCT CO2 AVG ***
*** RESET AVERAGE 16:31 03 21 8.9 PCT O2 AVG ***
START INLET T-2
*** RESET AVERAGE 16:26 03 24 13.8 PPM HCL AVG ***
*** RESET AVERAGE 16:26 03 23 10.1 PPM THC AVG ***
*** RESET AVERAGE 16:26 02 22 15.1 PCT CO2 AVG ***
*** RESET AVERAGE 16:26 02 21 13.9 PCT O2 AVG ***
END OUTLET T-2
-1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT
-1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM
*** RESET AVERAGE 16:07 03 24 12.1 PPM HCL AVG ***
*** RESET AVERAGE 16:07 02 23 2.7 PPM THC AVG ***
*** RESET AVERAGE 16:07 02 22 17.6 PCT CO2 AVG ***
*** RESET AVERAGE 16:07 02 21 12.1 PCT O2 AVG ***
START OUTLET T-2
01 SP N/A
*** RESET AVERAGE 16:02 01 24 20.5 PPM HCL AVG ***
*** RESET AVERAGE 16:02 01 23 18.6 PPM THC AVG ***
*** RESET AVERAGE 16:02 01 22 24.0 PCT CO2 AVG ***
END INLET

INLET T-3

END OUTLET T-3

*** RESET AVERAGE 17 14 09 24 18.3 PPM HCL AVG ***
*** RESET AVERAGE 17 14.09 23 10 7 PPM THC AVG ***
*** RESET AVERAGE 17:14 05 22 15.7 PCT CO2 AVG ***
*** RESET AVERAGE 17 14:05 21 13 7 PCT O2 AVG ***

1B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM

1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT

17:00 04

STACK OUTLET T-3

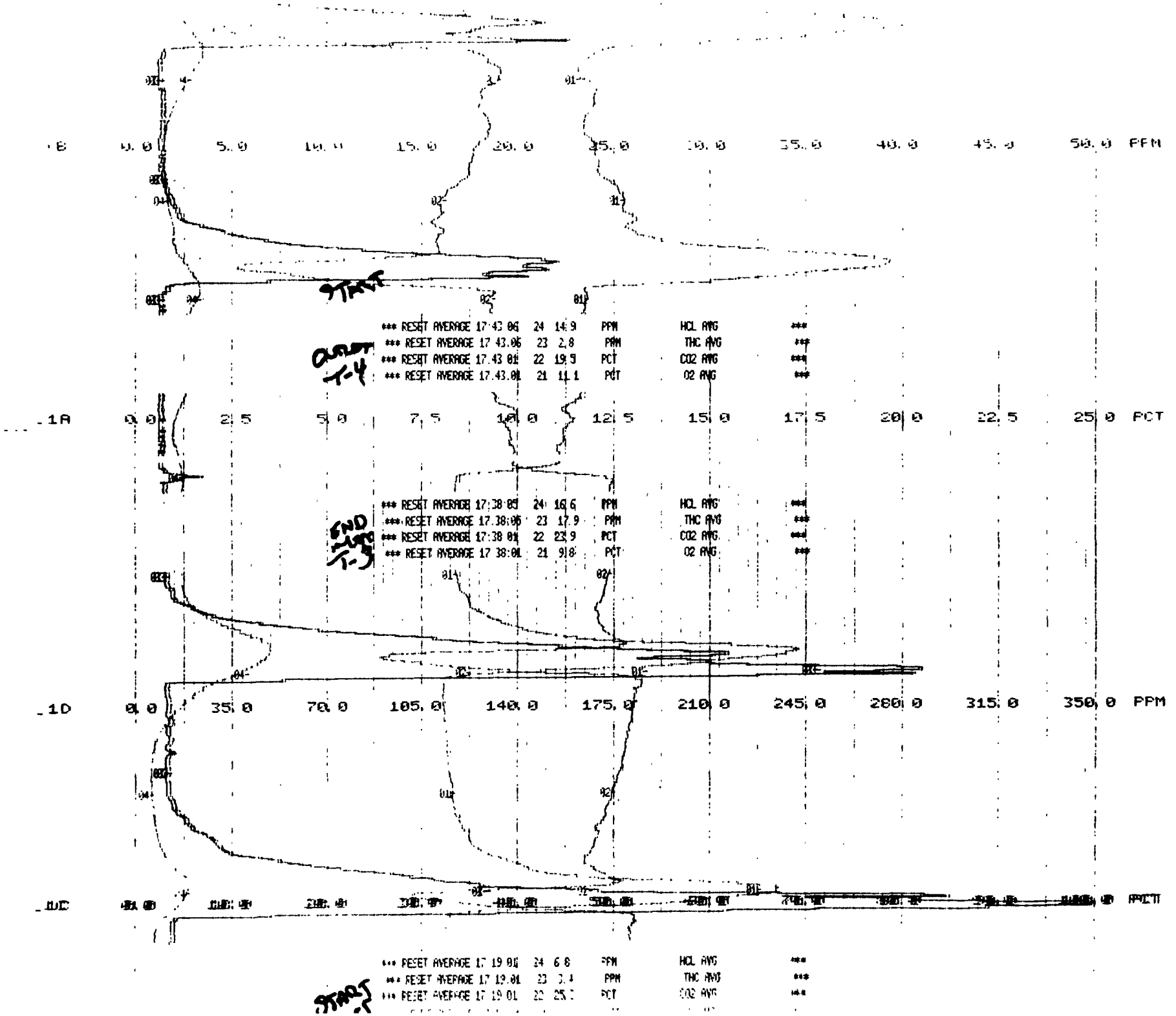
*** RESET AVERAGE 16:55.05 24 16.3 PPM HCL AVG ***
*** RESET AVERAGE 16:55:05 23 3.0 PPM THC AVG ***
*** RESET AVERAGE 16:55:05 22 17.9 PCT CO2 AVG ***
*** RESET AVERAGE 16:55:05 21 11.9 PCT O2 AVG ***

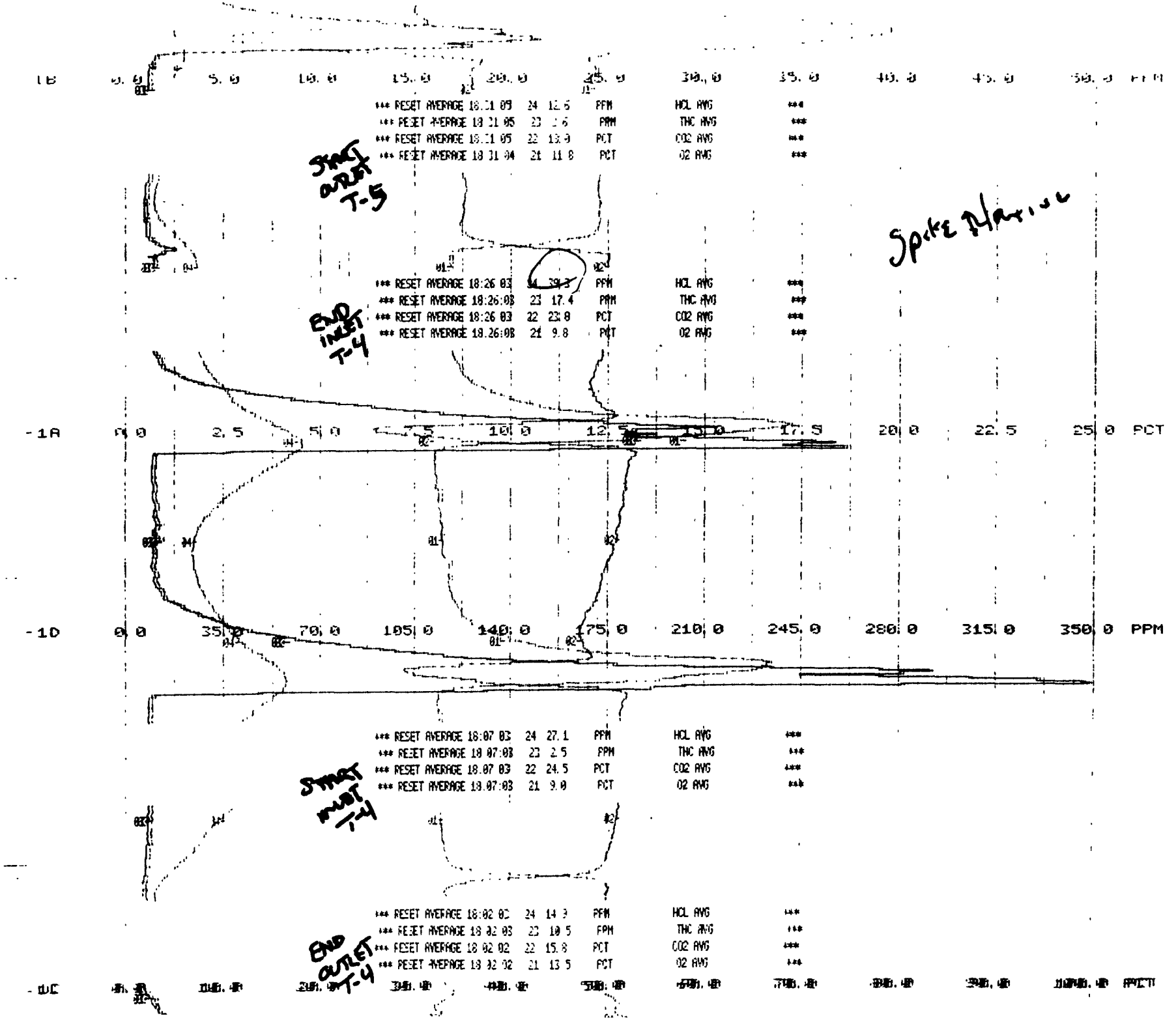
1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM

END INLET T-2

*** RESET AVERAGE 16 50 08 24 7 0 PPM HCL AVG ***
*** RESET AVERAGE 16 50:08 23 17 4 PPM THC AVG ***
*** RESET AVERAGE 16:50 03 22 24.0 PCT CO2 AVG ***
*** RESET AVERAGE 16 50.03 21 9 8 PCT O2 AVG ***

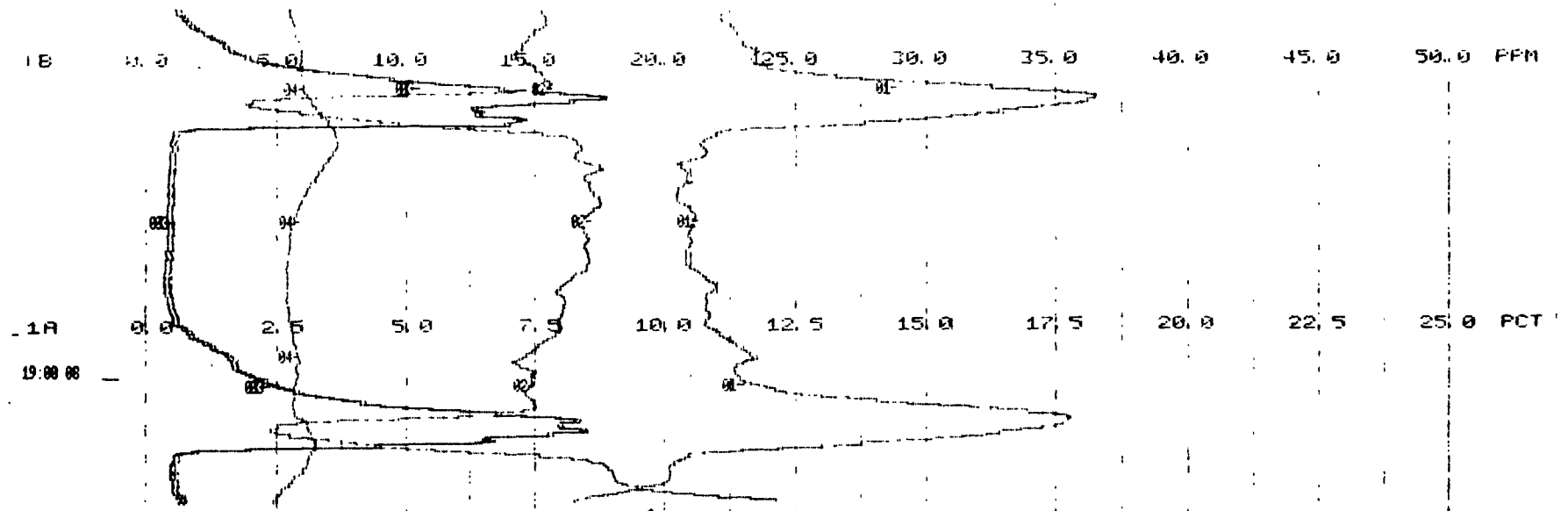
1C 0.0 100.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0 PPCTT


1B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM
START
*** RESET AVERAGE 17:43:06 24 14.9 PPM HCL AVG ***
*** RESET AVERAGE 17:43:06 23 2.8 PPM THC AVG ***
*** RESET AVERAGE 17:43:01 22 19.5 PCT CO2 AVG ***
*** RESET AVERAGE 17:43:01 21 11.1 PCT O2 AVG ***
START T-4
1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT
*** RESET AVERAGE 17:38:05 24 16.6 PPM HCL AVG ***
*** RESET AVERAGE 17:38:06 23 17.9 PPM THC AVG ***
*** RESET AVERAGE 17:38:01 22 23.9 PCT CO2 AVG ***
*** RESET AVERAGE 17:38:01 21 9.8 PCT O2 AVG ***
END T-3
1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM
*** RESET AVERAGE 17:19:01 24 6.8 PPM HCL AVG ***
*** RESET AVERAGE 17:19:01 23 3.4 PPM THC AVG ***
*** RESET AVERAGE 17:19:01 22 25.1 PCT CO2 AVG ***
START T-2


1B 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM
*** RESET AVERAGE 18:31 05 24 12.5 PPM HCL AVG ***
*** RESET AVERAGE 18:31 05 23 2.6 PPM THC AVG ***
*** RESET AVERAGE 18:31 05 22 13.0 PCT CO2 AVG ***
*** RESET AVERAGE 18:31 04 21 11.8 PCT O2 AVG ***
START OUTLET T-5
Spike Marine
*** RESET AVERAGE 18:26 03 24 39.3 PPM HCL AVG ***
*** RESET AVERAGE 18:26:03 23 17.4 PPM THC AVG ***
*** RESET AVERAGE 18:26 03 22 23.8 PCT CO2 AVG ***
*** RESET AVERAGE 18:26:03 21 9.8 PCT O2 AVG ***
END INLET T-4
-1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT
-1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM
*** RESET AVERAGE 18:07 03 24 27.1 PPM HCL AVG ***
*** RESET AVERAGE 18:07:03 23 2.5 PPM THC AVG ***
*** RESET AVERAGE 18:07 03 22 24.5 PCT CO2 AVG ***
*** RESET AVERAGE 18:07:03 21 9.0 PCT O2 AVG ***
START INLET T-4
*** RESET AVERAGE 18:02 02 24 14.3 PPM HCL AVG ***
*** RESET AVERAGE 18:02 03 23 10.5 PPM THC AVG ***
*** RESET AVERAGE 18:02 02 22 15.8 PCT CO2 AVG ***
*** RESET AVERAGE 18:02 02 21 13.5 PCT O2 AVG ***
END OUTLET T-4
-1C 0.0 100.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0 PPCTT

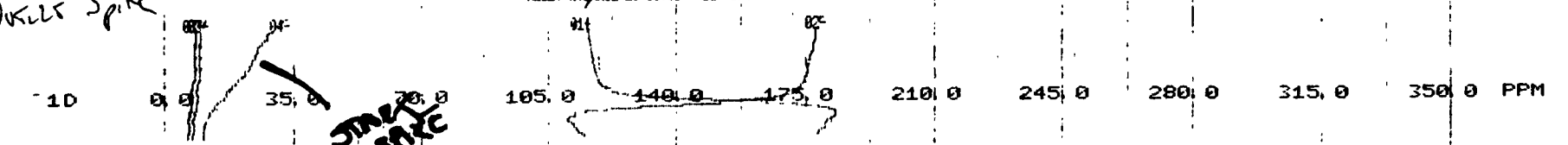
Spike Recovery

*** RESET AVERAGE 19.14 01 24 41.2 PPM HCL AVG ***
*** RESET AVERAGE 19 14 00 23 8.2 PPM THC AVG ***
*** RESET AVERAGE 19.14 00 22 14.8 PCT CO2 AVG ***
*** RESET AVERAGE 19 14.00 21 12.0 PCT O2 AVG ***



*** RESET AVERAGE 18:00:01 24 24.0 PPM HCL AVG ***
*** RESET AVERAGE 18:55:00 23 2.6 PPM THC AVG ***
*** RESET AVERAGE 18:55:00 22 24.4 PCT CO2 AVG ***
*** RESET AVERAGE 18:55:00 21 9.1 PCT O2 AVG ***

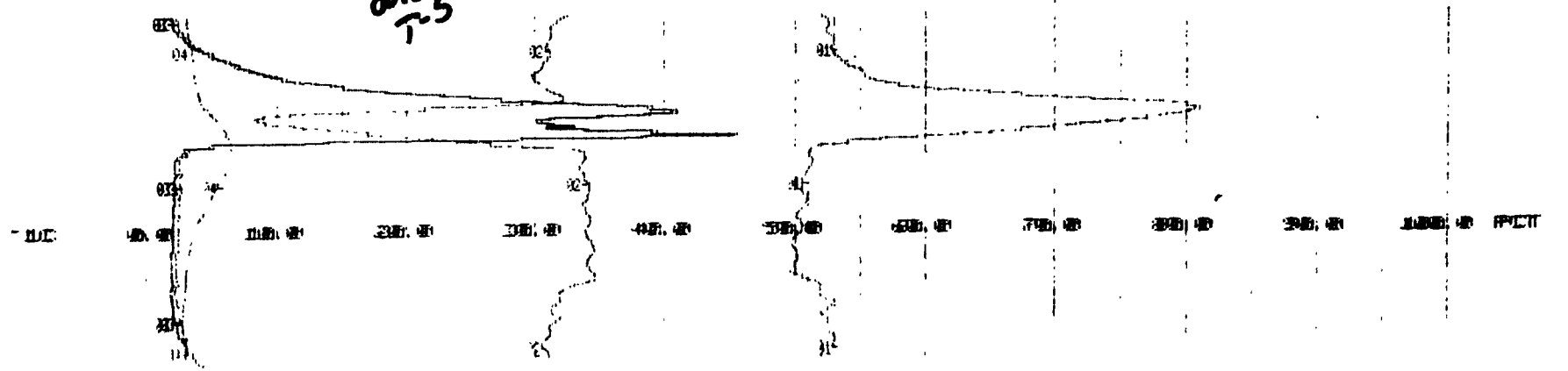
Overall Spike

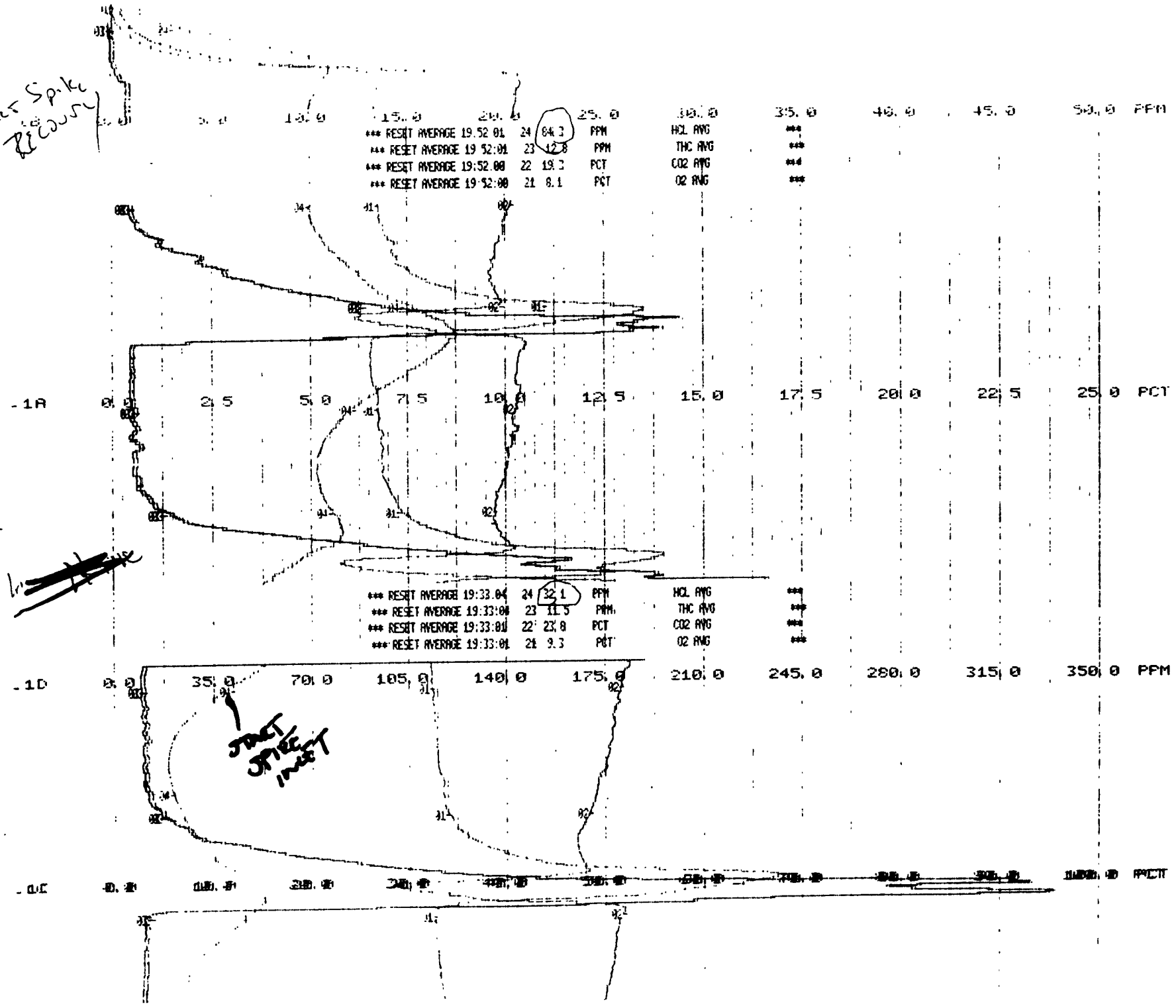


START SPIKE

END OUTLET T-5

*** RESET AVERAGE 18:50:05 24 14.0 PPM HCL AVG ***
*** RESET AVERAGE 18:50:05 23 9.8 PPM THC AVG ***
*** RESET AVERAGE 18:50:04 22 15.0 PCT CO2 AVG ***
*** RESET AVERAGE 18:50:04 21 14.0 PCT O2 AVG ***




Inlet Spike Recovery
*** RESET AVERAGE 19:52:01 24 84.3 PPM HCL AVG ***
*** RESET AVERAGE 19:52:01 23 12.8 PPM THC AVG ***
*** RESET AVERAGE 19:52:00 22 19.3 PCT CO2 AVG ***
*** RESET AVERAGE 19:52:00 21 8.1 PCT O2 AVG ***
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 PPM
-1A 0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 PCT
*** RESET AVERAGE 19:33:04 24 32.1 PPM HCL AVG ***
*** RESET AVERAGE 19:33:00 23 11.5 PPM THC AVG ***
*** RESET AVERAGE 19:33:01 22 23.8 PCT CO2 AVG ***
*** RESET AVERAGE 19:33:01 21 9.3 PCT O2 AVG ***
-1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM
Duct Spike Inlet
-1C 0.0 350.0 700.0 1050.0 1400.0 1750.0 2100.0 2450.0 2800.0 3150.0 3500.0 PPMCT

NO CO2 102

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20.18.14 *** ENDS AT 20.18 19 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	19 2	%		O2%	02	13.5	PCT		CO2	03	3 1	PPM		THC	04	23 0	PPM		HCL

NO THC 92.2

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:14.02 *** ENDS AT 20:14.16 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	20 8	%		O2%	02	3	PCT		CO2	03	98 3	PPM		THC	04	84.0	PPM		HCL

1D 0.0 35.0 70.0 105.0 140.0 175.0 210.0 245.0 280.0 315.0 350.0 PPM

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:11:29 *** ENDS AT 20:11:29 JUN 25,98 ***

HCl 303

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	1	%		O2%	02	.3	PCT		CO2	03	.2	PPM		THC	04	296.9	PPM		HCL

*** RESET AVERAGE	20:11 01	24	106.3	PPM	HCL AVG ***
*** RESET AVERAGE	20 11:01	23	.4	PPM	THC AVG ***
*** RESET AVERAGE	20:11.00	22	3 3	PCT	CO2 AVG ***
*** RESET AVERAGE	20:11:00	21	1.1	PCT	O2 AVG ***

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:02.43 *** ENDS AT 20:02:44 JUN 25,98 ***

ZERO

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	0	%		O2%	02	3	PCT		CO2	03	0.0	PPM		THC	04	3.0	PPM		HCL

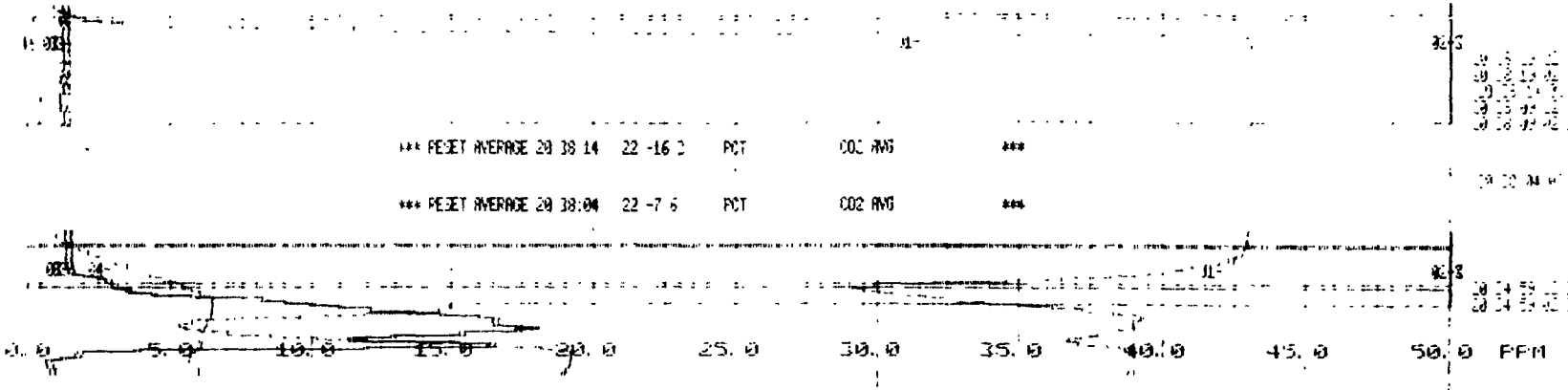
-1D [illegible] PPMCTT

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:01:43 *** ENDS AT 20:01:44 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	1	%		O2%	02	4	PCT		CO2	03	0.0	PPM		THC	04	3 4	PPM		HCL

20 00 09

*** PRINTER OFF 20 42 44 JUN 25.98 ***



*** RESET AVERAGE 20 38 14 22 -16 2 PCT CO2 AVG ***

*** RESET AVERAGE 20 38:04 22 -7 6 PCT CO2 AVG ***

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20 32.27 *** ENDS AT 20:32 33 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	19 5	%		O2%	02	18.8	PCT		CO2	03	2 0	PPM		THC	04	44.4	PPM		HCL

*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:30:15 *** ENDS AT 20:30:21 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	20 0	%		O2%	02	.3	PCT		CO2	03	92 3	PPM		THC	04	185.3	PPM		HCL

*** RESET AVERAGE 20 30:08 24 111.5 PPM HCL AVG ***

*** RESET AVERAGE 20.30:08 23 20 6 PPM THC AVG ***

*** RESET AVERAGE 20:30 01 22 3.6 PCT CO2 AVG ***

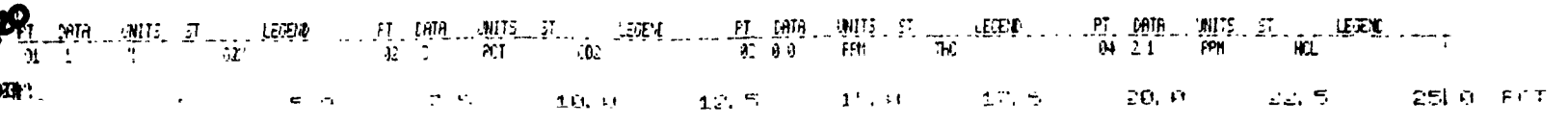
*** RESET AVERAGE 20 30:01 21 7.5 PCT O2 AVG ***

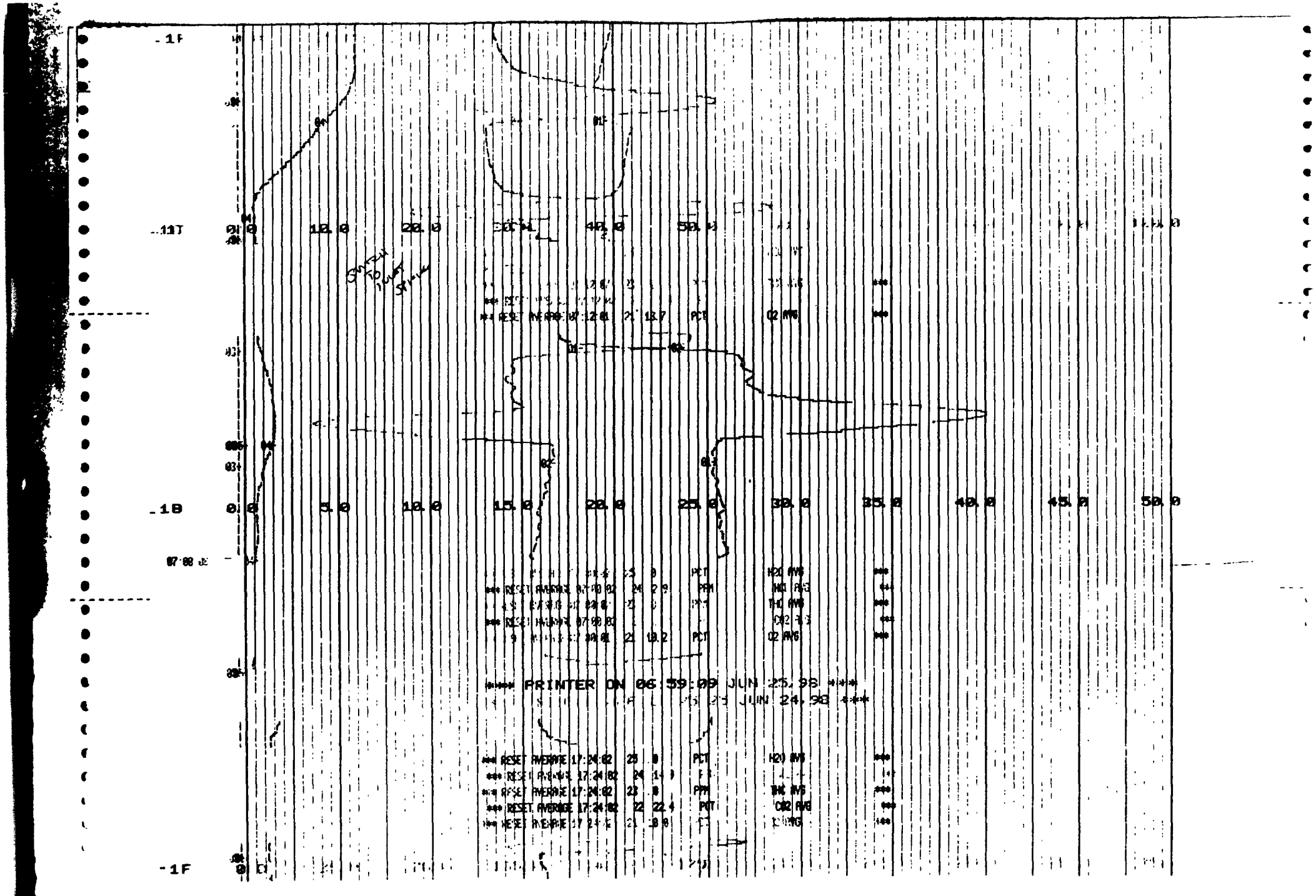
*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:28:31 *** ENDS AT 20:28:31 JUN 25,98 ***

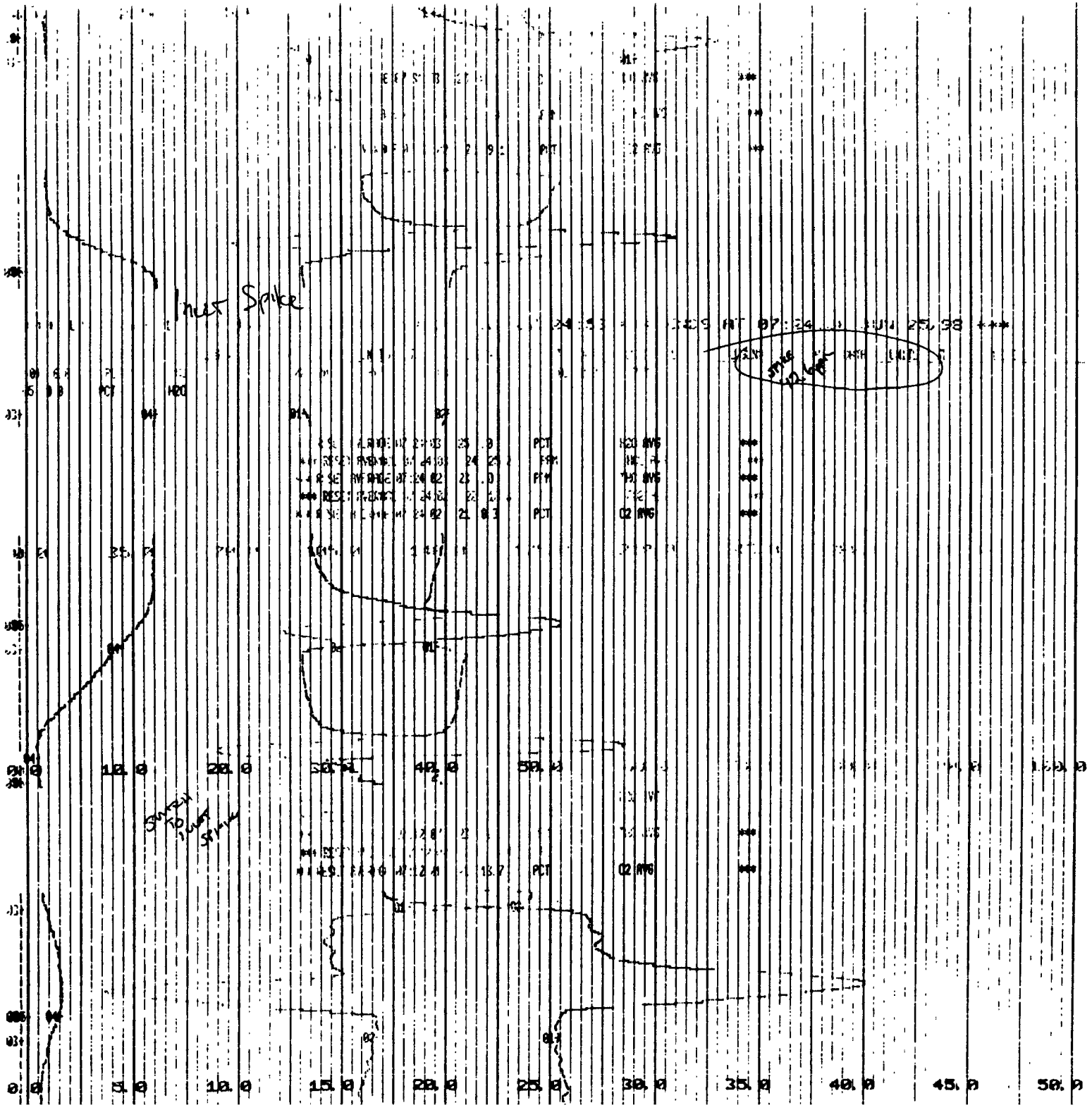
PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	1	%		O2%	02	2	PCT		CO2	03	0 0	PPM		THC	04	308.4	PPM		HCL

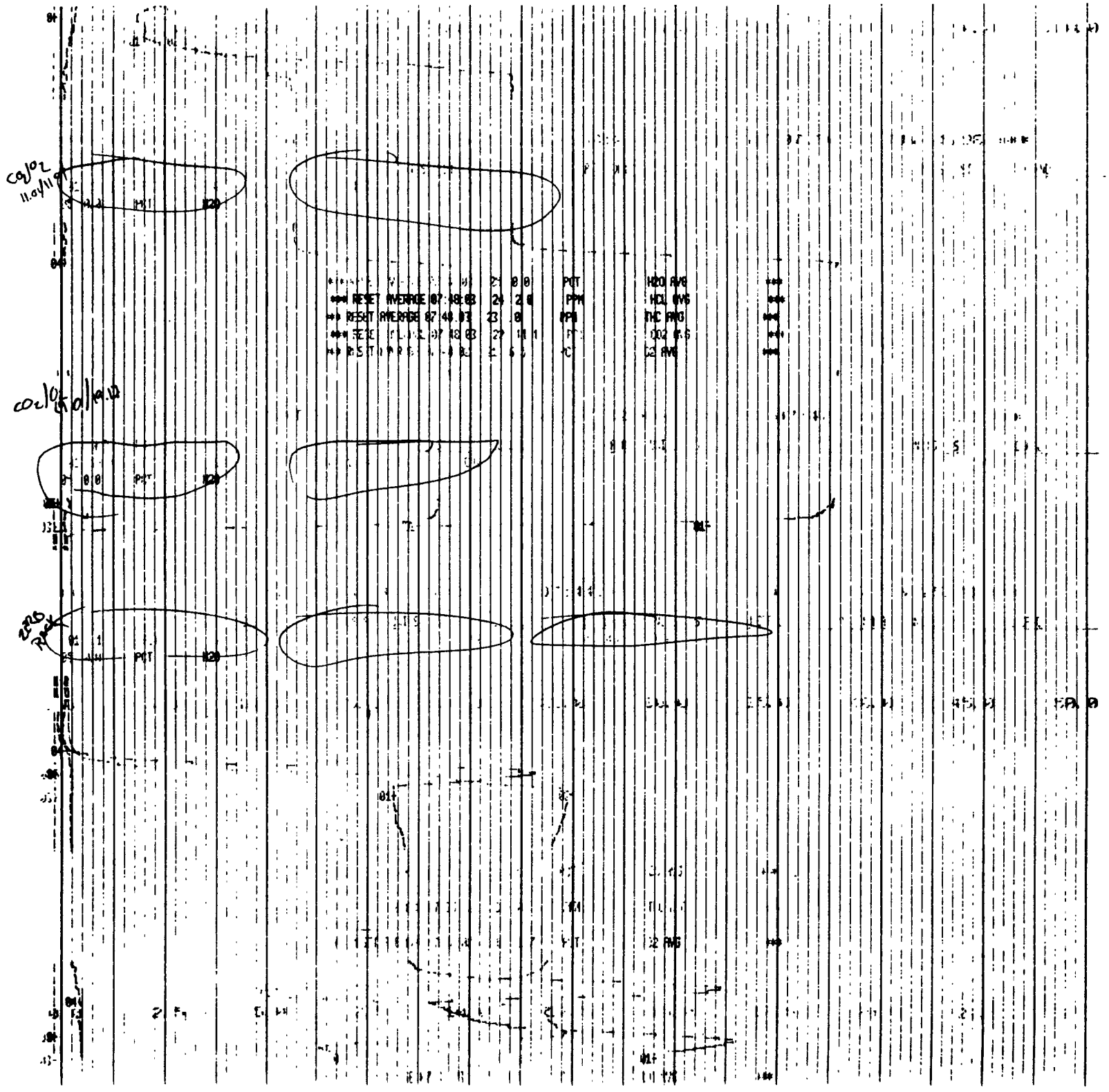
*** LOG GRP 1 *** UNIT 01 *** STARTS AT 20:24.08 *** ENDS AT 20:24.08 JUN 25,98 ***

PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND	PT	DATA	UNITS	ST	LEGEND
01	1	%		O2%	02	2	PCT		CO2	03	0 0	PPM		THC	04	2 1	PPM		HCL

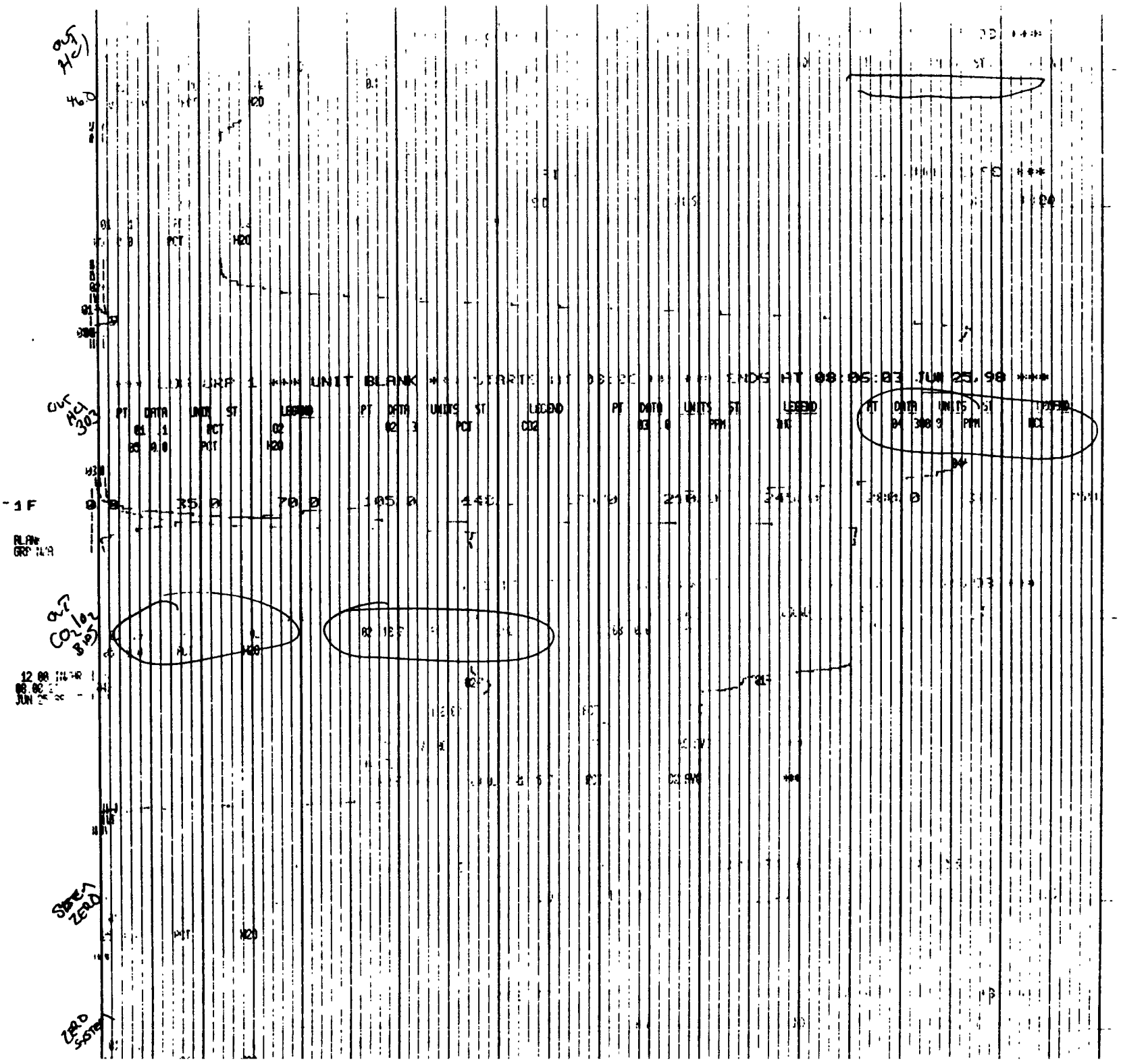


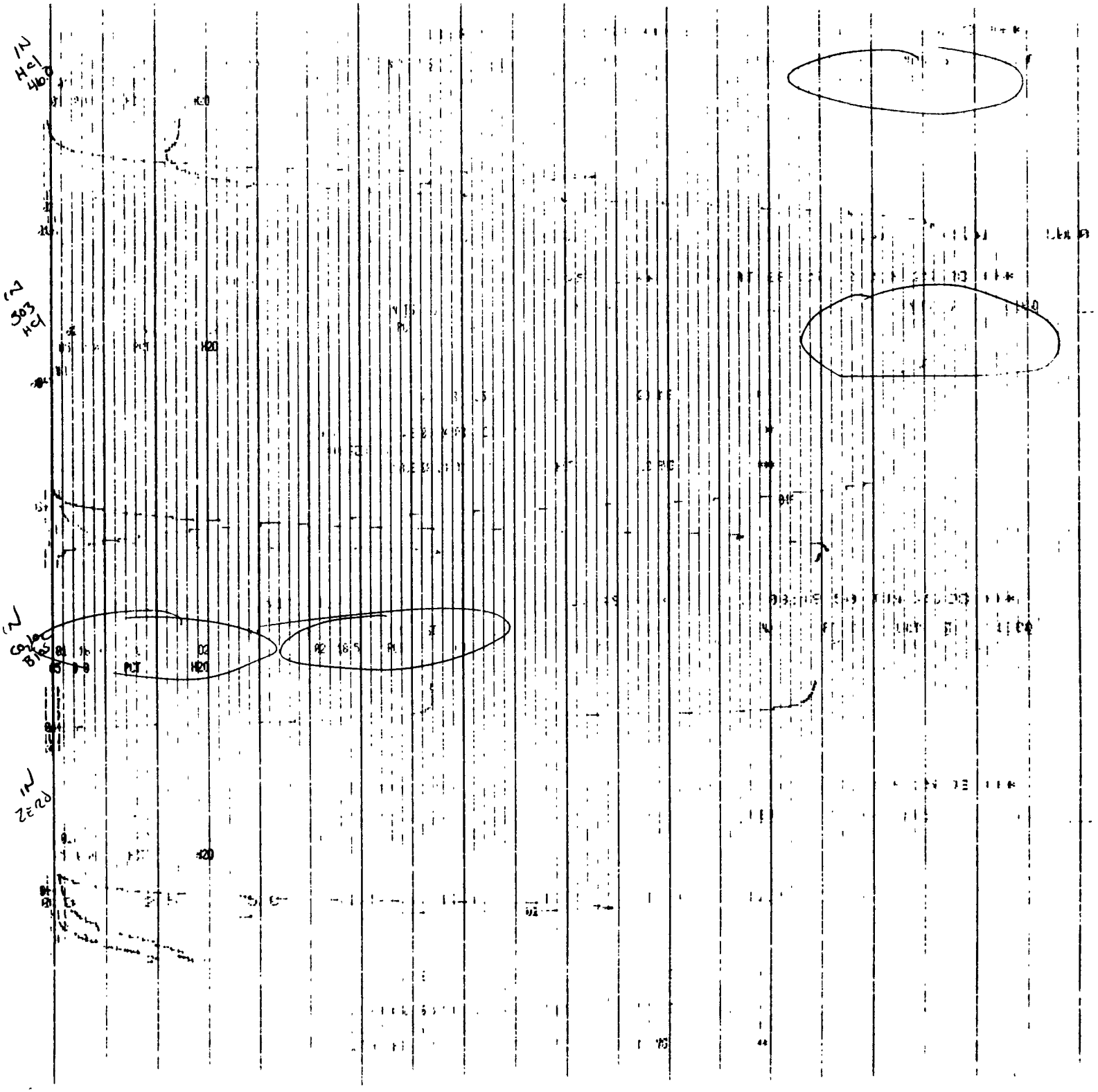

-1F
-11T
-1B
-1F
10.0
20.0
40.0
50.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
*** RESET AVERAGE 07:00:02 21 18.7 PCT O2 AVG
*** RESET AVERAGE 07:00:02 24 2.9 PPM
*** RESET AVERAGE 07:00:02 21 18.2 PCT O2 AVG
**** PRINTER ON 06:59:09 JUN 25, 98 ****
*** JUN 24, 98 ***
*** RESET AVERAGE 17:24:02 25 .0 PCT H2O AVG
*** RESET AVERAGE 17:24:02 24 1.9
*** RESET AVERAGE 17:24:02 23 .0 PPM
*** RESET AVERAGE 17:24:02 22 22.4 PCT CO2 AVG

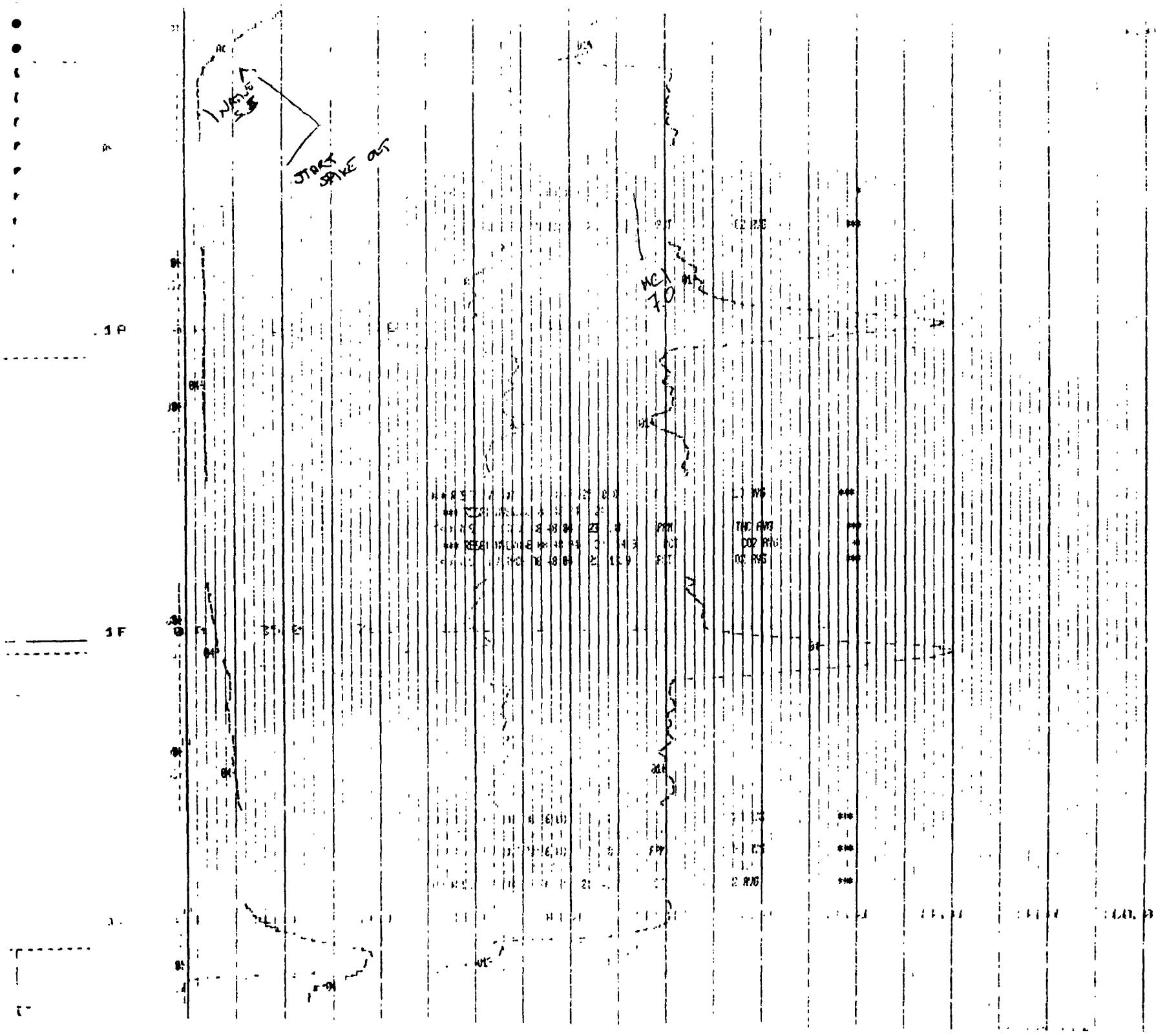

Inlet Spike
PCT
H2O AVG
CO2 AVG
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0

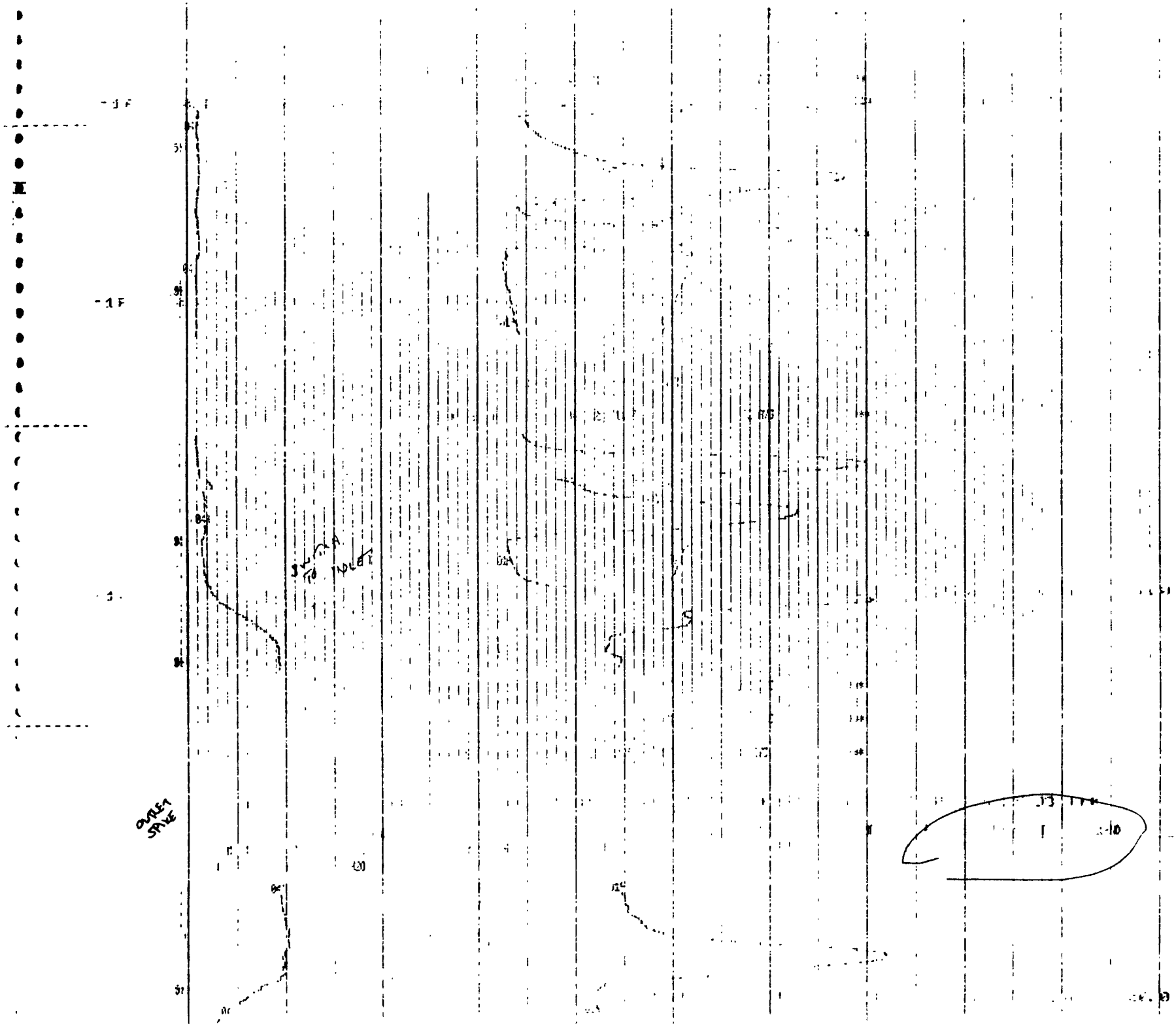

CO/O2
11.0/11.0
CO/O2 Calib.
ZERO Check
PCT
H2O
RESET AVERAGE 07:48:03
RESET AVERAGE 07:49:03
PPM
H2O AVG
HCL AVG
THC AVG
CO2 AVG
O2 AVG

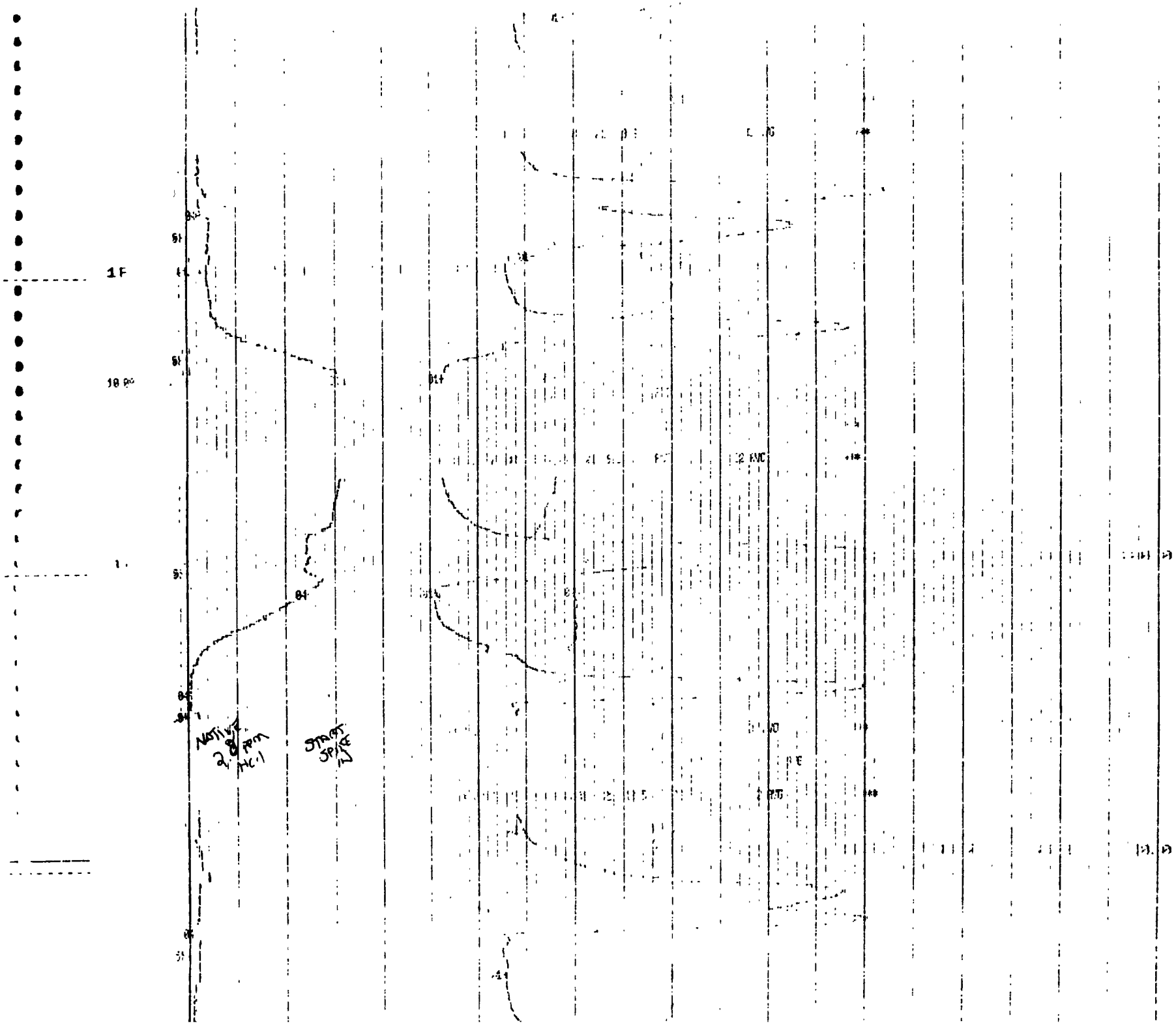
-1A


UNIT BLANK
PT DATA UNITS ST LEGEND
PCT
PPM
35.0
70.0
105.0
140.0
210.0
245.0
280.0
-1 F
BLANK GRAPH
12.00 HOUR
08.00
JUN
OUT HCl
OUT HCl 302
OUT CO2/O2 BIAS
SPEC ZERO
ZERO SYSTEM


1N HCl 40.0
1N 303 HCl
1N Gold Bars
1N ZEO


START SPIKE OUT
MC 70
1 P
1 F


OUTLET SPIKE


1 F
10 PM
1.
NATIVE
2.0 PPM
HCl
START
SPIKE
IN

APPENDIX B

METHOD 23 LABORATORY ANALYTICAL DATA

LabData

Summary of Method 23 Analytical Results
Air Emissions Screening Test
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet - Run M23-I-1

Congeners	Catches, ng/sample		
	Back Half	Front Half	Total
DIOXINS:			
2378 TCDD	0.0146	{0.0025}	{0.0171}
Total TCDD	1.247	0.1092	1.3562
12378 PeCDD	0.0181	{0.0034}	{0.0215}
Total PeCDD	0.477	0.0744	0.5514
123478 HxCDD	{0.0098}	0.0028	{0.0126}
123678 HxCDD	0.0155	{0.00536}	{0.0209}
123789 HxCDD	0.018	0.0072	0.0252
Total HxCDD	0.388	0.1384	0.5264
1234678 HpCDD	0.0301	0.0208	0.0509
Total HpCDD	0.0588	0.0376	0.0964
12346789 OCDD	0.0364	0.02	0.0564
OCDD+Totals PCDDs	2.2072	0.3796	2.5868
FURANS:			
2378 TCDF	0.17	0.0184	0.1884
Total TCDF	9.696	0.6276	10.3236
12378 PeCDF	0.109	0.0198	0.1288
23478 PeCDF	0.134	0.024	0.158
Total PeCDF	2.391	0.3208	2.7118
123478 HxCDF	0.129	0.0323	0.1613
123678 HxCDF	0.048	0.0132	0.0612
234678 HxCDF	0.0343	0.0114	0.0457
123789 HxCDF	0.0096	0.0031	0.0127
Total HxCDF	0.460	0.1076	0.5676
1234678 HpCDF	0.0469	0.0215	0.0684
1234789 HpCDF	{0.0049}	{0.00232}	{0.00722}
Total HpCDF	0.0616	0.0244	0.0860
12346789 OCDF	0.0066	{0.00308}	{0.00968}
OCDF+Totals PCDFs	12.6152	{1.0835}	{13.6987}
Total of Totals	14.8224	{1.4631}	{16.2855}

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

PARADIGM ANALYTICAL LABORATORIES, INC.
2627 Northchase Parkway S.E.
Wilmington, North Carolina 28405
(910) 350-1903
Fax (910) 350-1557

24 July 1998

Michael Maret
Pacific Environmental Services, Inc.
5001 S. Miami Blvd
Research Triangle Park, NC 27709-2077

Contract: 68D70002
Sub-Contract: R012-002
Work Assignment: 1-007

Subject: Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans Measurements (PAL Project No. **L-1070**)

Dear Mike;

Enclosed are the final results for the flue gas samples under your Project R012.003 Texas Lime Kiln. As you requested, we divided up the set of 17 samples into three separate projects (L-1070, L-1071, and L-1072). This report covers the first set under PAL L-1070. The analytical procedures conformed or exceeded the ones described in Method 23 using isotope-dilution high-resolution gas chromatography combined with high-resolution mass spectrometry. The **Level II** reporting format is described on the next page. A general summary of the analytical results is presented in Table 1. **Tables 2 and 3 summarize the results for the front-halve of the four inlet samples, expressed in absolute amount "ng" per sample, and in relative concentrations "part-per-trillion" based on the weight of dust collected.** Figures 1and 2 show the TEQs and total homologues corresponding to Table 1 data.

No. of Samples Received:	**4**
No. of Samples Analyzed:	**5**
No. of Lab. Method Blanks:	**1**
Your Project Number:	**R012.003 Texas Lime Kiln**
PAL Project No.:	**L-1070**

Remarks:

- **Data meet QA/QC requirements with the exception of sample *M23-I-1* for which the sampling standards recoveries for four out of five standards are lower than the 70 percent limit. No simple explanation can be offered here for this observation.**
- **The FH of sample M23-I-1 contained 15.6 g of dust, and was processed as a separate sample. The results are reported in two ways:**
  - **a) Absolute amount in "ng" per sample,**
  - **b) Relative concentration in parts-per-trillion (ppt) based on the weight of dust.**
- **No analytical difficulties to be reported.**

We wanted to thank you for the opportunity to serve you. Please, feel free to contact us if you have questions or should you need additional technical support.

Sincerely,

Yves Tondeur, Ph.D.

Project No. R012.003; Project Name: US EPA Lime Kiln Screening, Texas Lime;
Sample and Project Identifications.

PES Sample ID	PAL Sample ID	PAL Project No.
M23-I-1	1070-1	L-1070
M23-O-1	1070-2	L-1070
M23-FB-1	1070-3	L-1070
M23-RB	1070-4	L-1070
M23-I-1-FH (DUST & FILTER)	***1070-5***	***L-1070***
M23-I-2	1071-1	L-1071
M23-O-2	1071-2	L-1071
M23-FB-2	1071-3	L-1071
M23-I-2-FH (DUST & FILTER)	***1071-4***	***l-1071***
M23-I-3	1072-1	L-1072
M23-O-3	1072-2	L-1072
M23-FB-3	1072-3	L-1072
M23-I-3-FH (DUST & FILTER)	***1072-7***	***L-1072***
M23-I-4	1072-4	L-1072
M23-O-4	1072-5	L-1072
M23-FB-4	1072-6	L-1072
M23-I-4-FH (DUST & FILTER)	***1072-8***	***L-1072***

Level II Report

Section 1: **Cover Letter**, contains a brief description of the project, the client and PAL Project Numbers, the number and type of samples, the methodology used to process the samples, QC remarks where any analytical difficulties are discussed and the impact on the quality of the data presented, a summary table with the analyte concentrations, detection limits, the client sample identification numbers, units to report the concentrations, and a graphical representation of the TEQs and totals.

Section 2: **Project Synopsis**, contains the Sample Tracking & Management Forms, Communications Form, any correspondence, chain-of-custody and the last page is always a copy of the sample injection log(s). This section is designed to help the laboratory and the data reviewer with an overall view of the entire analytical procedure, the initials and dates of who did what when on which sample. Spiking solution IDs are recorded along with the batch numbers of the supplies and reagents used.

Section 3: **Analytical Results**, contains the sample results topsheets (one set of two per sample), the raw data (i.e., the selected ion current profiles, the areas, heights, ion abundance ratios, signal-to-noise ratios, and retention times of the GC peaks).

Section 4: **System Performance**, contains the documentation on the GC/MS system performance. In particular, the mass resolution checks, GC column performance checks, initial and continuing calibration summary tables and, when applicable, associated raw data for both column types.

Table 1: Analyte Concentrations in "ng" per Sampling Train
(FH of the inlet sample shown in Tables 2 and 3).

Analyte	R023-01 LMB	[illegible]	R024-01 [illegible]	[illegible]	[illegible]
2,3,7,8-TCDD	[0.00094]	0.015	0.012	[0.00095]	0.001
1,2,3,7,8-PeCDD	[0.00052]	0.018	0.009	(0.000)	(0.000)
1,2,3,4,7,8-HxCDD	(0.001)	[0.00976]	0.003	(0.001)	(0.001)
1,2,3,6,7,8-HxCDD	(0.001)	0.016	0.005	[0.00092]	[0.00096]
1,2,3,7,8,9-HxCDD	(0.001)	0.018	0.004	[0.00088]	0.001
1,2,3,4,6,7,8-HpCDD	0.003	0.030	0.007	0.004	0.003
OCDD	0.009	0.036	0.024	0.016	0.010
2,3,7,8-TCDF[a]	[0.00104]	0.170	0.160	0.003	(0.001)
1,2,3,7,8-PeCDF	(0.000)	0.109	0.087	(0.000)	(0.000)
2,3,4,7,8-PeCDF	(0.000)	0.134	0.086	(0.000)	(0.000)
1,2,3,4,7,8-HxCDF	[0.00112]	0.129	0.047	0.001	0.001
1,2,3,6,7,8-HxCDF	0.001	0.048	0.017	[0.00044]	(0.000)
2,3,4,6,7,8-HxCDF	(0.000)	0.034	0.011	(0.000)	(0.000)
1,2,3,7,8,9-HxCDF	(0.000)	0.010	0.004	(0.000)	(0.000)
1,2,3,4,6,7,8-HpCDF	0.003	0.047	0.017	0.007	0.003
1,2,3,4,7,8,9-HpCDF	(0.001)	[0.00492]	0.002	(0.001)	(0.001)
OCDF	0.002	0.007	0.010	0.006	0.003
Total TCDDs	[0.0009]	1.247	1.102	0.002	0.001
Total PeCDDs	[0.0004]	0.477	0.264	0.002	(0.000)
Total HxCDDs	[0.0016]	0.388	0.116	0.004	0.002
Total HpCDDs	0.003	0.059	0.013	0.008	0.003
Total TCDFs	0.001	9.696	9.120	0.011	(0.001)
Total PeCDFs	(0.000)	2.391	1.590	[0.0016]	(0.000)
Total HxCDFs	0.000	0.460	0.166	0.002	0.001
Total HpCDFs	0.003	0.062	0.023	0.007	0.003
Total PCDD/Fs[b]	**0.019**	**14.822**	**12.428**	**0.058**	**0.023**
TEQ (ND=0)[c]	0.000	0.139	0.090	0.001	0.001
TEQ (ND=1/2)[d]	0.001	0.139	0.090	0.001	0.002
TEQ EMPC(ND=0)[e]	0.002	0.140	0.090	0.002	0.002
TEQ EMPC (ND=1/2)	0.002	0.140	0.090	0.002	0.002

a) Result obtained from the DB-225 analysis.
b) Total PCDD/Fs represent the sum of all polychlorinated dibenzo-p-dioxins & dibenzofurans.
c) TEQ computed using ITEF and setting non detected analytes with a "Zero" concentration.
d) TEQ computed using ITEF and setting non detected analytes with a concentration half the calculated detection limit.
e) TEQ computed using ITEF and setting the concentration of EMPC analytes to the EMPC value.

NOTE:
( ) = ND using DL value.
[ ] = EMPC value.

06 AUG 98 Revision

Table 2: Analyte Concentrations in "ng" per Front-Half Sampling Train (i.e., filter and dust) for **all** runs.

Analyte	[illegible]	[illegible]	[illegible]	[illegible]
2,3,7,8-TCDD	[0.0025]	[0.00156]	[0.00099]	[0.00108]
1,2,3,7,8-PeCDD	[0.0034]	(0.0003)	(0.0003)	(0.0004)
1,2,3,4,7,8-HxCDD	0.0028	(0.0007)	(0.0005)	(0.0007)
1,2,3,6,7,8-HxCDD	[0.00536]	0.0010	(0.0004)	(0.0005)
1,2,3,7,8,9-HxCDD	0.0072	0.0016	[0.00088]	[0.00108]
1,2,3,4,6,7,8-HpCDD	0.0208	0.0028	[0.00168]	0.0018
OCDD	0.0200	0.0060	0.0051	0.0046
2,3,7,8-TCDF[a]	0.0184	0.0180	[0.00124]	0.0126
1,2,3,7,8-PeCDF	0.0198	0.0184	(0.0004)	[0.0044]
2,3,4,7,8-PeCDF	0.0240	0.0124	[0.00064]	0.0052
1,2,3,4,7,8-HxCDF	0.0323	0.0102	[0.0008]	0.0024
1,2,3,6,7,8-HxCDF	0.0132	0.0066	[0.00032]	[0.00084]
2,3,4,6,7,8-HxCDF	0.0114	[0.00376]	(0.0003)	(0.0004)
1,2,3,7,8,9-HxCDF	0.0031	(0.0008)	(0.0003)	(0.0004)
1,2,3,4,6,7,8-HpCDF	0.0215	0.0061	0.0006	0.0012
1,2,3,4,7,8,9-HpCDF	[0.00232]	[0.00176]	(0.0006)	(0.0006)
OCDF	[0.00308]	(0.0008)	(0.0006)	(0.0008)
Total TCDDs	0.1092	0.0348	[0.003]	0.0012
Total PeCDDs	0.0744	0.0060	(0.0003)	[0.002]
Total HxCDDs	0.1384	0.0024	0.0016	0.0056
Total HpCDDs	0.0376	0.0028	0.0008	0.0016
Total TCDFs	0.6276	0.3548	[0.001]	0.0948
Total PeCDFs	0.3208	0.1644	[0.001]	0.0280
Total HxCDFs	0.1076	0.0348	[0.001]	0.0040
Total HpCDFs	0.0244	0.0092	0.0008	0.0012
Total PCDD/Fs[b]	**1.4600**	**0.6152**	**0.0083**	**0.1410**
TEQ (ND=0)[c]	0.0220	0.0110	0.0000	0.0040
TEQ (ND=1/2)[d]	0.0230	0.0110	0.0010	0.0050
TEQ EMPC(ND=0)[e]	0.0270	0.0130	0.0020	0.0060
TEQ EMPC (ND=1/2)	0.0270	0.0130	0.0020	0.0060

a) Result obtained from the DB-225 analysis.
b) Total PCDD/Fs represent the sum of all polychlorinated dibenzo-p-dioxins & dibenzofurans.
c) TEQ computed using ITEF and setting non detected analytes with a "Zero" concentration.
d) TEQ computed using ITEF and setting non detected analytes with a concentration half the calculated detection limit.
e) TEQ computed using ITEF and setting the concentration of EMPC analytes to the EMPC value.

NOTE:

( ) = ND using DL value.
[ ] = EMPC value.

Table 3: Analyte Concentrations in "parts-per-trillion" for the Front-Half Sampling Trains (i.e., filter and dust).

Analyte	[illegible]	[illegible]	[illegible]	[illegible]
2,3,7,8-TCDD	[0.16055]	[0.04808]	[0.07707]	[0.03639]
1,2,3,7,8-PeCDD	[0.21809]	(0.009)	(0.026)	(0.014)
1,2,3,4,7,8-HxCDD	0.180	(0.021)	(0.038)	(0.023)
1,2,3,6,7,8-HxCDD	[0.34381]	0.030	(0.027)	(0.016)
1,2,3,7,8,9-HxCDD	0.464	0.049	[0.06843]	[0.03645]
1,2,3,4,6,7,8-HpCDD	1.332	0.085	[0.13064]	0.059
OCDD	1.280	0.186	0.395	0.154
2,3,7,8-TCDF[a]	1.178	0.553	[0.09642]	0.424
1,2,3,7,8-PeCDF	1.270	0.568	(0.031)	[0.1485]
2,3,4,7,8-PeCDF	1.539	0.382	[0.04977]	0.176
1,2,3,4,7,8-HxCDF	2.073	0.314	[0.06221]	0.080
1,2,3,6,7,8-HxCDF	0.849	0.204	[0.02488]	[0.02835]
2,3,4,6,7,8-HxCDF	0.731	[0.11576]	(0.021)	(0.013)
1,2,3,7,8,9-HxCDF	0.198	(0.024)	(0.025)	(0.015)
1,2,3,4,6,7,8-HpCDF	1.380	0.187	0.050	0.042
1,2,3,4,7,8,9-HpCDF	[0.14881]	[0.05419]	(0.049)	(0.020)
OCDF	[0.19756]	(0.026)	(0.045)	(0.025)
Total TCDDs	7.004	1.071	[0.249]	0.041
Total PeCDDs	4.772	0.185	(0.026)	[0.054]
Total HxCDDs	8.877	0.074	0.124	0.189
Total HpCDDs	2.412	0.086	0.062	0.054
Total TCDFs	40.257	10.924	[0.093]	3.199
Total PeCDFs	20.577	5.062	[0.062]	0.945
Total HxCDFs	6.902	1.071	[0.093]	0.135
Total HpCDFs	1.565	0.283	0.062	0.041
Total PCDD/Fs[b]	**93.647**	**18.942**	**0.644**	**4.757**
TEQ (ND=0)[c]	1.429	0.337	0.001	0.139
TEQ (ND=1/2)[d]	1.457	0.352	0.042	0.156
TEQ EMPC(ND=0)[e]	1.735	0.397	0.129	0.190
TEQ EMPC (ND=1/2)	1.735	0.402	0.142	0.197

a) Result obtained from the DB-225 analysis.
b) Total PCDD/Fs represent the sum of all polychlorinated dibenzo-p-dioxins & dibenzofurans.
c) TEQ computed using ITEF and setting non detected analytes with a "Zero" concentration.
d) TEQ computed using ITEF and setting non detected analytes with a concentration half the calculated detection limit.
e) TEQ computed using ITEF and setting the concentration of EMPC analytes to the EMPC value.

NOTE:

( ) = ND using DL value.
[ ] = EMPC value.

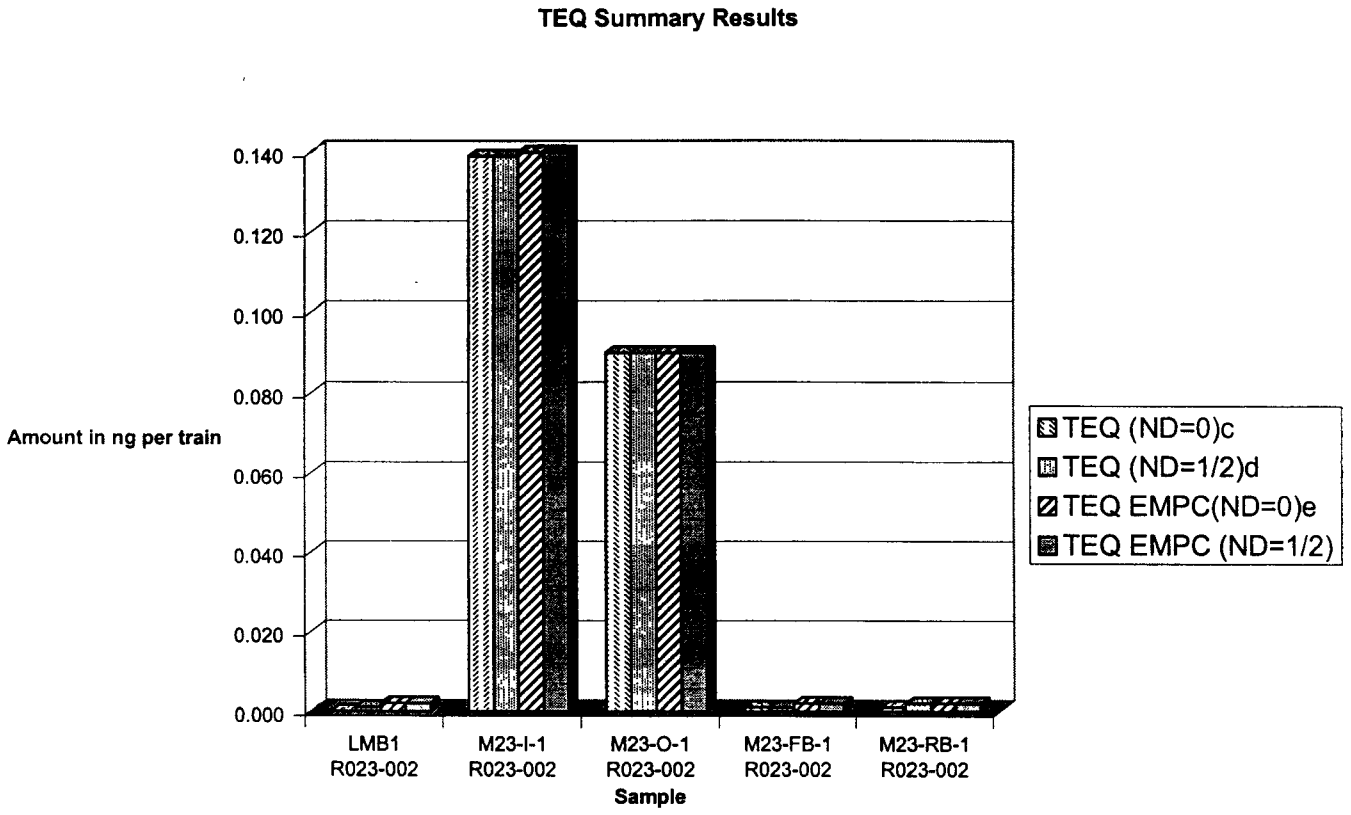


Figure 1: Graphical representation of the TEQs

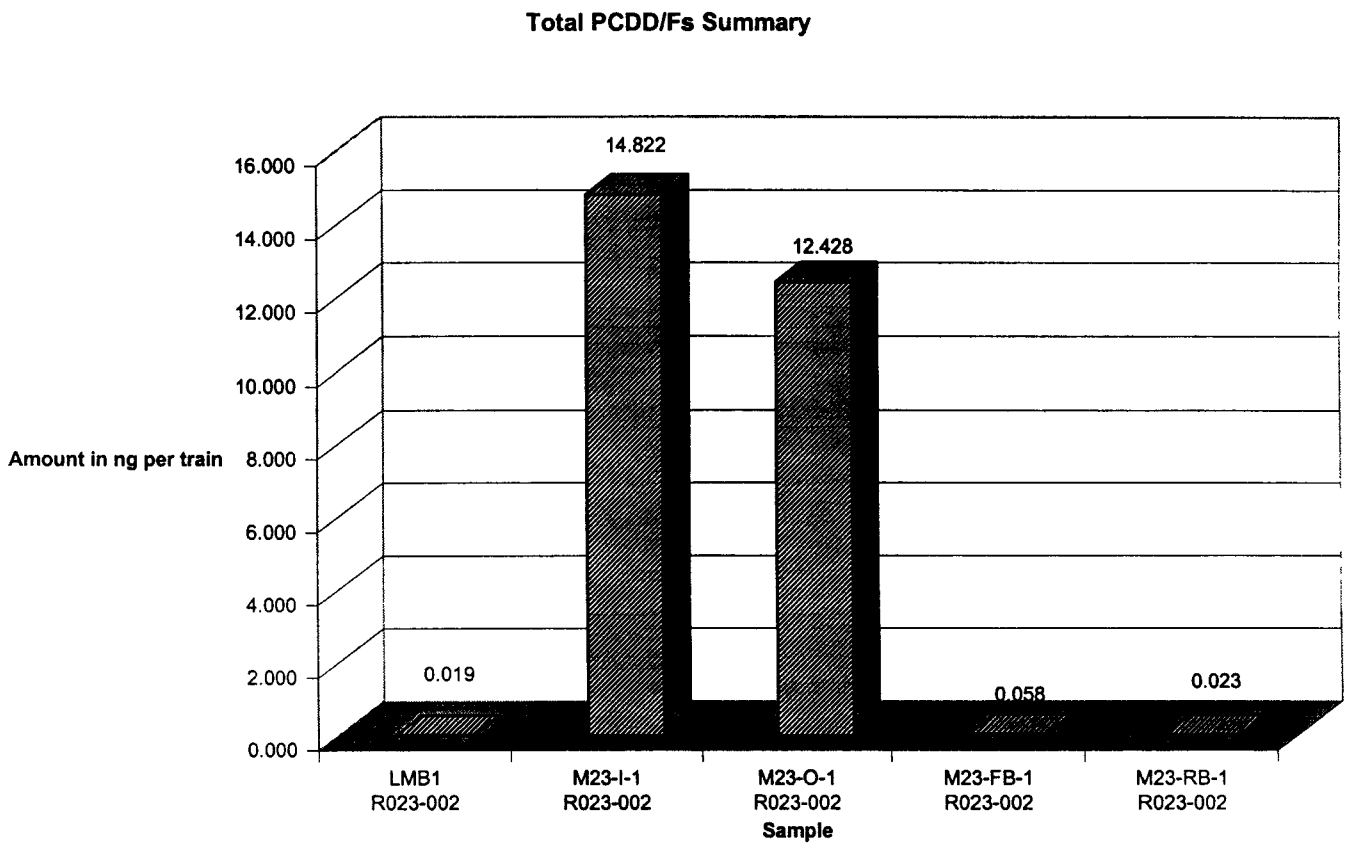


Figure 2: Graphical representation of the totals (tetra- through octachlorinated congeners)

Contract: 68D70002
Sub-Contract: R012-002
Work Assignment: 1-007

PAL Project No.: L-1070

Paradigm Analytical Labs

Section 2

Project Overview

&

Sample Tracking & Communication Forms

Project Overview for the Analysis of Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

No. of Field Samples: 4 +1
No. of Billable Samples: 4 +1

PAL Project No.: L-1070

Date Received: 08 JUL 98
Due Date: 29 JUL 98
Client Project ID: R012.003 TX LIME KILN

Method 23 | *Method 23* | *Method 23* | *Method 23* | *Method 23*

Probe Rinse → **Concentration** *SOP SP-N-02*

Filter

XAD
Sampling Modules Prep. Project No.: L-1043

Add *M23-ES-*~~063098~~*-S02-* 96
Vol.: 40 µL; Conc.: 0.1 ng/µL *SOP SP-S-01*

Spike Profile

ES:	23	4 ng (1-2)
SS:	23	4 ng (1-1)
JS:	23	2 ng (1)

Tridecane batch No.:	05-MAR-96
Thimbles batch No.:	08 JUL 98
Toluene batch No.:	977754
Pre-Soxhlet:	1000hrs
Others:	

Soxhlet 16 H Toluene *SOP SP-E-01*

Concentration & Solvent Exchange *SOP SP-N-01*

Split Extract *SOP SP-D-01*

Hexane batch No.:	977270
CH_2Cl_2 batch No.:	96/4716
Silica batch No.:	10 MAY 98
Alumina batch No.:	NA
PCU-F batch No.:	SP1407
Na_2SO_4 batch No.:	10 MAR 98

Archive 50% *SOP SP-D-01*

Fractionation *SOP SP-U-03*

Concentration *SOP SP-N-01*

S02 amc 7/17/98

Add *M23-JS-*07/79/98*-*~~S01~~*-* 114
Vol.: 20 µL; Conc.: 0.1 ng/µL *SOP SP-S-01*

HRGC - HRMS *SOP SP-A-01*

Special Instructions:
1) Note that the FH of the Inlet sample is treated as a separate sample => Method 8290
2) Weigh DUST! (without the filters)
3) Add CS to Filter/Dust extract before PCU-F

600

Project Overview for the Analysis of Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

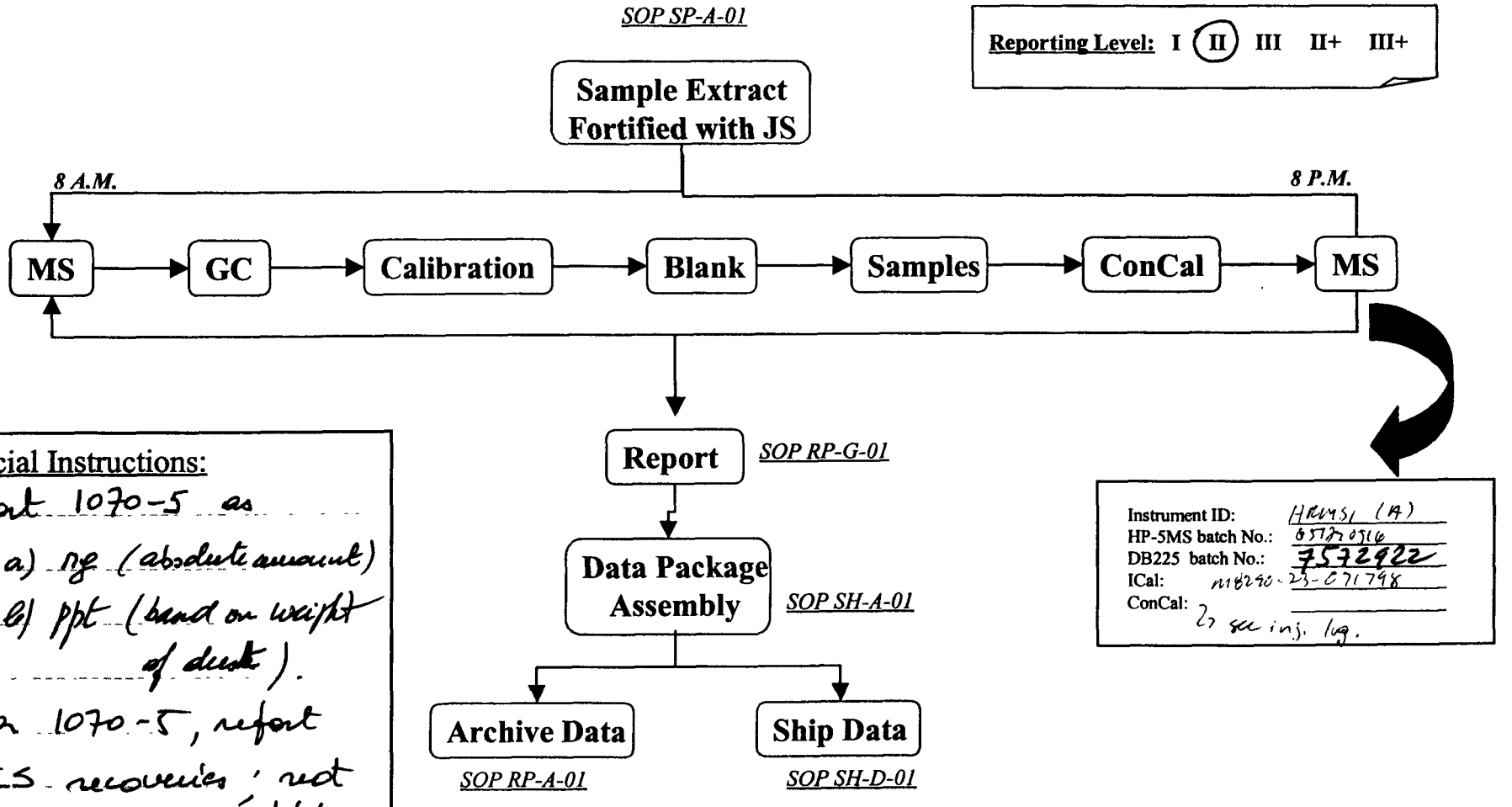
No. of Field Samples: 4+1
No. of Billable Samples: 4+1

PAL Project No.: L-1070

Date Received: 08 JUL 98
Due Date: 29 JUL 98
Client Project ID: R012.003 TX LIME KILN

Method 23 *Method 23* *Method 23* *Method 23* *Method 23*

Reporting Level: I (II) III II+ III+



Special Instructions:
1) Report 1070-5 as
a) ng (absolute amount)
b) ppt (based on weight of dust).
2) For 1070-5, report CS recoveries, not SS recoveries!!!

Instrument ID: HRMS1 (A)
HP-5MS batch No.: 0572 0516
DB225 batch No.: 7572922
ICal: M18290-23-C71798
ConCal: → see inj. log.

010

Sample Tracking for the Analysis of Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

No. of Field Samples: 4+1
Page 1 of 1

PAL Project No.: L-1070

Date Received: 08 JUL 98
Due Date: 29 JUL 98
Client Project ID: R012.003 TX
LIME KILN

Method 23		Method 23	Method 23				Method 23			Method 23
Lab Sample ID	Client Sample ID	Observations (use attached communication exchanges form if needed)	ES	SDS	Conc. S.Ex.	Split Arch.	PCU	Conc.	JS	TCDF	Misc.
L-1070-0	Lab Method Blank		7/10	7/10	7/13	7/13	7/14	7/14	7/17	N/A	
L-1070-1	M23-I-1 (*)	3 Filters + ~10 g white solid; ~400 mL Acetone + particulates; ~200 mL Toluene	↓	↓	↓	↓	↓	↓	↓	Needs CF ✓7/21	
L-1070-2	M23-O-1	1 Filter, no particulates; ~50 mL Acetone; ~100 mL Toluene;	↓	↓	↓	↓	↓	↓	↓	Needs CF ✓7/21	
L-1070-3	M23-FB-1	1 Filter; ~50 mL Acetone; ~100 mL Toluene;	↓	↓	↓	↓	↓	↓	↓	N/A	
L-1070-4	M23-RB-1	2 Filters; ~100 mL Acetone; ~100 mL Toluene;	↓	↓	↓	↓	↓	↓	↓	N/A	
L-1070-5	M23-I-1-FH	DUST WEIGHT: 15.59 g	↓	↓	↓	↓	↓	↓	↓	Needs CF ✓7/21	

(*) 1070-1 or M23-I-1: Use ONLY the Rinse + rinses. The filter(s) + dust are SDS'd using toluene & treated as separate samples - Method 8290. Add the CS after the SDS extraction of the Filter(s) + dust + before the fractionation by PCU-F.

YT. 23 Jul 98

23 JUL 98

011

Communication Exchanges Form for the Analysis of PCDD/PCDFs

No. of Field Samples: 4+1
Page 1 of 1

PAL Project No.: L-1070

Date Received: 08 JUL 98
Due Date: 29 JUL 98
Client Project ID: R012.003 TX
LIME KILN

Method 23	Method 23	Method 23	Method 23	Method 23

1070-1: Amount of particulates should be OK in SDS set up. See letter remailed to Mike Naut on 08 Jul 98. Y.T.
Mike Naut called back 09 Jul 98 authorizing the treatment of the 4 inlet FH samples as separate samples and report results as described in the letter dated 08 Jul 98. Y.T.
1071-5: weight of jar before opening: 186.30 g; after removal of 4 filters: 183.99 g; after emptying contents: 168.40 g
note: Pictures from Inlets (L1070, L-1071 + L-1072) show "dust" residues. → "Extract" dust in toluene in sonic bath for 30-40 min. before transfer into the thimble. Usually, a fraction of the dust goes in suspension, the rest remains "glued" to the bottom of the glass container. Y.T. 10 Jul 98.

23 Jul 98

012

By email

Contract No.: **68D70002**
Subcontract No.: **R012-002**
Work Assignment: **1-007**

08 July 1998

Michael Maret
Pacific Environmental Services, Inc.
5001 S. Miami Blvd
P.O. Box 12077
Research Triangle Park, NC 27709-2077

Reference: Project No. R012.003; Project Name: US EPA Lime Kiln Screening, Texas Lime

Subject: Inlet Samples Heavy Particulate Load

Dear Mike:

The thirteen Method 23 samples were received in good condition and no discrepancies were noted between the sample labels and the chain-of-custody. As we discussed, we organized the samples into three separate projects, each assigned a specific PAL Project No. Table 1 summarizes the sample identification and their associated PAL Project Nos.

The object of this letter is to bring to your attention the following concerns. Following a description of the issues, possible solutions are discussed for your consideration.

The issue pertains to the "inlet" samples. Each of the four inlet samples shows relatively high levels of dust (particulates). Depending on the sample, we estimated the amount of solids to range from 10 g to 35 g.

The first concern is a practical one. Indeed, the capacity of a normal Soxhlet extraction set up is exceeded if we want to combine the front- and back-halves of the sampling train (FH & BH). Two separate extractions would be required for each of the inlet samples. This leads to the following two options:

1. Combine the two extracts and process the FH and BH as a single sample.
   - The question remains as to where the Method 23 internal standards are added.

2. Treat the FH and BH as two separate samples.
   - Each sample receives a normal dose of Method 23 internal standards before the extraction.
   - This option resembles Method 0023A's and results in four additional samples.

The second concern is related to generating "meaningful" results for your client's study. Reporting PCDD/F results in "ng /dscm" in the flue gas in such circumstances -- where particulate levels are so high -- may be of no value to your client. We recommend Option 2 above and propose to report the analytical results for the inlet samples in two ways: a) absolute amount (e.g., ng per FH) of the PCDD/Fs and, b) relative concentrations of PCDD/Fs expressed in parts-per-trillion (ppt) or picogram per gram of "dust" recovered in the inlet sample. Note that this approach can only be achieved if Option 2 is selected, which amounts to treating the inlet FH as a solid sample rather than as a flue gas sample.

Please, let us know if you have questions and we are waiting for a decision on how you would like us to handle these particular inlet samples. I can be reached at 910-350-2839.

Sincerely,

Yves Tondeur, Ph.D.

Permission to select Option 2
granted by phone by Mike Maret on 09JUL98
(a revised subcontract is on its way to us).
→ 4 additional billable samples.

Table 1: Project No. R012.003; Project Name: US EPA Lime Kiln Screening, Texas Lime; Sample and Project Identification.

PES Sample ID	PAL Sample ID	PAL Project No.
M23-I-1	1070-1	L-1070
M23-O-1	1070-2	L-1070
M23-FB-1	1070-3	L-1070
M23-RB	1070-4	L-1070
M23-I-2	1071-1	L-1071
M23-O-2	1071-2	L-1071
M23-FB-2	1071-3	L-1071
M23-I-3	1072-1	L-1072
M23-O-3	1072-2	L-1072
M23-FB-3	1072-3	L-1072
		L-1072
M23-I-4	1072-4	L-1072
M23-O-4	1072-5	L-1072
M23-FB-4	1072-6	L-1072

THREE DIFFERENT PROJECTS

13 SAMPLES

L-1070 : 4 Samples (I, O, FB, RB)
L-1071 : 3 Samples (I, O, FB)
L-1072 : 6 Samples (2I, 2O, 2FB)

Account # 1027

PACIFIC ENVIRONMENTAL SERVICES, INC.

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Chain of Custody Record

Project Num: R012.003

Project Name: US EPA Lime Kiln Screening - Texas Lime

Samplers: Abernathy, Gay, Maret, D.D Holzschuh, Siegal, Stewart

Date	Time	Field Sample ID	Sample Description	Analysis Requested							Remarks
6/25/98	1518	M23-I-1-1	Container No. 1 - Filter	•	•						L-1070 1070-1
6/25/98	1518	M23-I-1-2	Container No. 2 - Train Acetone Rinse	•	•						1070-1
6/25/98	1518	M23-I-1-3	Container No. 3 - Train Toluene Rinse	•	•						1070-1
6/25/98	1518	M23-I-1-4	Container No. 4 - XAD Sorbent Resin	•	•						1070-1
6/28/98	1033	[redacted]	Container No. 1 - Filter	[redacted]	•						L-1071 1071-1
6/28/98	1033	[redacted]	Container No. 2 - Train Acetone Rinse	[redacted]	•						1071-1
6/28/98	1033	[redacted]	Container No. 3 - Train Toluene Rinse	[redacted]	•						1071-1
6/28/98	1033	[redacted]	Container No. 4 - XAD Sorbent Resin	[redacted]	•						1071-1
6/30/98	1247	[redacted]	Container No. 1 - Filter	[redacted]	•						L-1072 1072-1
6/30/98	1247	[redacted]	Container No. 2 - Train Acetone Rinse	[redacted]	•						1072-1
6/30/98	1247	[redacted]	Container No. 3 - Train Toluene Rinse	[redacted]	•						1072-1
6/30/98	1247	[redacted]	Container No. 4 - XAD Sorbent Resin	[redacted]	•						1072-1
7/1/98	1414	M23-I-4-1	Container No. 1 - Filter	[redacted]	•						1072-4
7/1/98	1414	M23-I-4-2	Container No. 2 - Train Acetone Rinse	[redacted]	•						1072-4
7/1/98	1414	M23-I-4-3	Container No. 3 - Train Toluene Rinse	[redacted]	•						1072-4
7/1/98	1414	M23-I-4-4	Container No. 4 - XAD Sorbent Resin	[redacted]	•						1072-4
6/25/98	1518	M23-O-1-1	Container No. 1 - Filter	•	•						1070-2
6/25/98	1518	M23-O-1-2	Container No. 2 - Train Acetone Rinse	•	•						1070-2
6/25/98	1518	M23-O-1-3	Container No. 3 - Train Toluene Rinse	•	•						1070-2

7/7/98

PACIFIC ENVIRONMENTAL SERVICES, INC.

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Chain of Custody Record

Project Num	Project Name			Analysis Requested							Remarks
R012.003	US EPA Lime Kiln Screening - Texas Lime										
Samplers: Abernathy, Gay, Maret, D.D Holzschuh, Siegal, Stewart											
Date	Time	Field Sample ID	Sample Description								
6/25/98	1518	M23-O-1-4	Container No. 4 - XAD Sorbent Resin	•	•						1070-2
6/28/98	1033	[redacted]	Container No. 1 - Filter	[redacted]	•						1071-2
6/28/98	1033	[redacted]	Container No. 2 - Train Acetone Rinse	[redacted]	•						1071-2
6/28/98	1033	[redacted]	Container No. 3 - Train Toluene Rinse	[redacted]	•						1071-2
6/28/98	1033	[redacted]	Container No. 4 - XAD Sorbent Resin	[redacted]	•						1071-2
6/30/98	1247	[redacted]	Container No. 1 - Filter	[redacted]	•						1072-2
6/30/98	1247	[redacted]	Container No. 2 - Train Acetone Rinse	[redacted]	•						1072-2
6/30/98	1247	[redacted]	Container No. 3 - Train Toluene Rinse	[redacted]	•						1072-2
6/30/98	1247	[redacted]	Container No. 4 - XAD Sorbent Resin	[redacted]	•						1072-2
7/1/98	1414	M23-O-4-1	Container No. 1 - Filter	[redacted]	•						1072-5
7/1/98	1414	M23-O-4-2	Container No. 2 - Train Acetone Rinse	[redacted]	•						1072-5
7/1/98	1414	M23-O-4-3	Container No. 3 - Train Toluene Rinse	[redacted]	•						1072-5
7/1/98	1414	M23-O-4-4	Container No. 4 - XAD Sorbent Resin	[redacted]	•						1072-5
6/25/98		M23-FB-1-1	Container No. 1 - Filter	•	•						FIELD BLANK 1 1070-3
6/25/98		M23-FB-1-2	Container No. 2 - Train Acetone Rinse	•	•						FIELD BLANK 1 1070-3
6/25/98		M23-FB-1-3	Container No. 3 - Train Toluene Rinse	•	•						FIELD BLANK 1 1070-3
6/25/98		M23-FB-1-4	Container No. 4 - XAD Sorbent Resin	•	•						FIELD BLANK 1 1070-3
6/27/98		[redacted]	Container No. 1 - Filter	[redacted]	•						FIELD BLANK 2 1071-3
6/27/98		[redacted]	Container No. 2 - Train Acetone Rinse	[redacted]	•						FIELD BLANK 2 1071-3

7/7/98

016

PACIFIC ENVIRONMENTAL SERVICES, INC.

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Chain of Custody Record

Project Num: R012.003

Project Name: US EPA Lime Kiln Screening - Texas Lime

Samplers: Abernathy, Gay, Maret, D.D Holzschuh, Siegal, Stewart

Date	Time	Field Sample ID	Sample Description								Remarks
6/27/98		[redacted]	Container No. 3 - Train Toluene Rinse	[redacted]	•						FIELD BLANK 2 1071-3
6/27/98		[redacted]	Container No. 4 - XAD Sorbent Resin	[redacted]	•						FIELD BLANK 2 1071-3
6/30/98		[redacted]	Container No. 1 - Filter	[redacted]	•						FIELD BLANK 3 1072-3
6/30/98		[redacted]	Container No. 2 - Train Acetone Rinse	[redacted]	•						FIELD BLANK 3 1072-3
6/30/98		[redacted]	Container No. 3 - Train Toluene Rinse	[redacted]	•						FIELD BLANK 3 1072-3
6/30/98		[redacted]	Container No. 4 - XAD Sorbent Resin	[redacted]	•						FIELD BLANK 3 1072-3
7/1/98		M23-FB-4-1	Container No. 1 - Filter	[redacted]	•						FIELD BLANK 4 1072-5
7/1/98		M23-FB-4-2	Container No. 2 - Train Acetone Rinse	[redacted]	•						FIELD BLANK 4 1072-5
7/1/98		M23-FB-4-3	Container No. 3 - Train Toluene Rinse	[redacted]	•						FIELD BLANK 4 1072-5
7/1/98		M23-FB-4-4	Container No. 4 - XAD Sorbent Resin	[redacted]	•						FIELD BLANK 4 1072-5
7/7/98		M23-RB-1	Container No. 1 - Filter	•	•						REAGENT BLANK 1070-4
7/7/98		M23-RB-2	Container No. 2 - Train Acetone Rinse	•	•						REAGENT BLANK 1070-4
7/7/98		M23-RB-3	Container No. 3 - Train Toluene Rinse	•	•						REAGENT BLANK 1070-4
7/7/98		M23-RB-4	Container No. 4 - XAD Sorbent Resin	•	•						REAGENT BLANK 1070-4

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for lab by: (Signature)	REMARKS
MP MARET	7/9/98 0830	YVET TONDEUR 08JUL98	

7/7/98

Preparation of the XAD-2 Resin for Method 23 Sampling Session

No. Sampling Modules: 15
No. Filters: 25

PAL Project No.: L-1043

Order Received: 04 JUN 98
Due Date: 22 JUN 98
Client Project ID: TX Lime Kilns
P.O. No.:
Ph.: (512)-693-5122

PES.

To ensure proper handling of the samples, please return this form with the field samples to:

Paradigm Analytical Labs
2627 Northchase Pkwy S.E.
Wilmington, NC 28405

Thank you for your cooperation. Our phone number is 910-350-2839. (Fax: 910-350-1557)

Method 23 Sampling ***Method 23 Sampling*** ***Method 23 Sampling***

Mailing Address: Best western
Attn.: Mike Maret
1403 Hiway 281 N
Marble Falls, TX 78654-4505
Ph.: (512)693-5122

Special Instructions:

Note: An amount of resin equal to one module was fortified as described above, retained by the laboratory and kept at 4°C. Upon return of the field samples, this aliquot will be used to process the Laboratory Method Blank QC sample.

Filters

Batch No.: ~~09-JAN-98~~ 09-JUN-98 6/22/98
Size: 83 mm diameter

Type: (Glass Fiber) Quartz

XAD-2 Resin Modules

Batch No.: 1037
Type: Ball/Socket (O-Ring Ball/Socket) Screw Cap

Add *M23-SS-~~062298~~-SO2-03*
Vol.: 40 µL; Conc.: 0.1 ng/µL
Preparation Date: 6/22/98
[Two-week holding time]

Analyst:

Paradigm
Sample Receipt Checklist

Client: 1027

Client Project ID: R012.003

Lab Project: L1070

No	Check	Description	Notes
1	YES / NO YES / NO	Shipped Hand Delivered	
2	YES / NO YES / NO	COC Present on Receipt Additional Transmittal Form	
3	YES / NO	COC Tape on Shipping Container	
4	YES / NO	Samples Intact	
5	A °C	Temperature	
6	YES / NO	Sufficient Sample Submitted	
7	YES / NO YES / NO	Samples Preserved Correctly No Preservative Noted N/A (none recommeded)	
8	YES / NO	Received within Holding time N/A	
9	YES / NO	Discrepancies between COC & Label N/A (no COC Received)	

Note : Use this form to record, comment and report any damages, observations (be specific) of signficance or potentially important for the resolution of downstream problems.

Additional Comments:

Inspected & Logged in by: M.T.

Date: 08/06/98

Time: 9:20 AM.

Paradigm Analytical Labs

Login Report (ln01)

Jul. 08, 1998

10:01 AM

Login Number: L1070

Account: 1027 Pacific Environmental Services,

Project: R012.003 Texas Lime Kiln

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	PR	Due Date	Comments
L1070-1	M23-I-1	25-JUN-98	08-JUL-98		29-JUL-98	Good Condition
StackAir	~~S-M0010-8270-AS~~ Y.T. 08 Jul 98 Hold: 09-JUL-98					
L1070-2	M23-O-1	25-JUN-98	08-JUL-98		29-JUL-98	
L1070-3	M23-FB-1	25-JUN-98	08-JUL-98		29-JUL-98	Y.T.
L1070-4	M23-RB-1	25-JUN-98	08-JUL-98		29-JUL-98	08 JUL 98

Signature : _____

Date : 08 JUL 98

Paradigm Analytical Labs

Login Report (ln01)

Jul. 13, 1998

11:42 AM

Login Number: L1070

Account: 1027 Pacific Environmental Services, Ir

Project: R012.003 Texas Lime Kiln

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	PR	Due Date	Comments
L1070-1	M23-I-1	25-JUN-98	08-JUL-98		29-JUL-98	
StackAir	P 23-TO	Hold:				
StackAir	C 8290-TO-FT	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
StackAir	C 8290-TO-SL	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
L1070-2	M23-O-1	25-JUN-98	08-JUL-98		29-JUL-98	
StackAir	P 23-TO	Hold:				
StackAir	C 8290-TO-FT	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
StackAir	C 8290-TO-SL	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
L1070-3	M23-FB-1	25-JUN-98	08-JUL-98		29-JUL-98	
StackAir	P 23-TO	Hold:				
StackAir	C 8290-TO-FT	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
StackAir	C 8290-TO-SL	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
L1070-4	M23-RB-1	25-JUN-98	08-JUL-98		29-JUL-98	
StackAir	P 23-TO	Hold:				
StackAir	C 8290-TO-FT	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	
StackAir	C 8290-TO-SL	Hold: 02-JUL-98	4 oz. Glass	1	Bottles	

Signature : Guy Dickinson - Relog -

Date : 13-Jul-98.

Paradigm Sample Log

Data File	S	Sample ID	Acq. Date	Time
a17jul98b	1	DB-5 Retchk	17-JUL-98	16:45:56
a17jul98b	2	FE CS3	17-JUL-98	17:31:00
a17jul98b	3	098-M23 x1/2	17-JUL-98	18:16:05
a17jul98b	4	598-M23 x1/2	17-JUL-98	19:01:10
a17jul98b	5	SB	17-JUL-98	19:46:16
a17jul98b	6	[redacted]	17-JUL-98	20:31:20
a17jul98b	7	1072-0 x1/2	17-JUL-98	21:16:26
a17jul98b	8	1072-2 x1/2	17-JUL-98	22:01:31
a17jul98b	9	1072-3 x1/2	17-JUL-98	22:46:36
a17jul98b	10	[redacted]	17-JUL-98	23:31:42
a17jul98b	11	[redacted]	18-JUL-98	00:16:48
a17jul98b	12	[redacted]	18-JUL-98	01:01:55
a17jul98b	13	[redacted]	18-JUL-98	01:47:01
a17jul98b	14	[redacted]	18-JUL-98	02:32:07
a17jul98b	15	BE CS3	18-JUL-98	03:17:11

Paradigm Sample Log

Data File	S	Sample ID	Acq. Date	Time
A21JUL98A	1	Sand QC	21-JUL-98	11:08:47
A21JUL98B	1	B-225 Retchk	21-JUL-98	16:44:01
A21JUL98C	1	B-225 Retchk	21-JUL-98	17:52:30
A21JUL98C	2	CS3	21-JUL-98	18:29:30
A21JUL98C	3	sb	21-JUL-98	19:06:30
A21JUL98D	1	B-225 Retchk	21-JUL-98	19:59:35
A21JUL98E	1	B-225 Retchk	21-JUL-98	20:01:06
A21JUL98F	1	B-225 Retchk	21-JUL-98	20:06:58
A21JUL98F	2	CS3	21-JUL-98	20:43:56
A21JUL98F	3	sb	21-JUL-98	21:20:54
A21JUL98F	4	[redacted]	21-JUL-98	21:57:56
A21JUL98F	5	[redacted]	21-JUL-98	22:34:59
A21JUL98F	6	[redacted]	21-JUL-98	23:12:05
A21JUL98F	7	1072-2 x1/2	21-JUL-98	23:49:03
A21JUL98F	8	1068-1 x1/2	22-JUL-98	00:26:13
A21JUL98F	9	1069-1 x1/2	22-JUL-98	01:03:12
A21JUL98F	10	1069-2 x1/2	22-JUL-98	01:40:19
A21JUL98F	11	1069-3 x1/2	22-JUL-98	02:17:20
A21JUL98F	12	1072-1 x1/2	22-JUL-98	02:54:34
A21JUL98F	13	1071-2 x1/2	22-JUL-98	03:31:35
A21JUL98F	14	1072-4 x1/2	22-JUL-98	04:08:35
A21JUL98F	15	1072-5 x1/2	22-JUL-98	04:46:12
A21JUL98F	16	1072-8 x1/2	22-JUL-98	05:23:13
A21JUL98F	17	CS3	22-JUL-98	06:01:17

Paradigm Analytical Labs

Section 3

Analytical Results

Documentation for the Analysis

of

Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

Method 23
LMB
PES

Analytical Data Summary Sheet

Analyte	Concentration (ng)	DL (ng)	EMPC (ng)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	EMPC	0.0004	0.0009	28:28	1.25	
1,2,3,7,8-PeCDD	EMPC	0.0003	0.0005	32:37	1.12	
1,2,3,4,7,8-HxCDD	ND	0.0007		34:42	2.81	
1,2,3,6,7,8-HxCDD	ND	0.0006		34:46	1.23	
1,2,3,7,8,9-HxCDD	ND	0.0006		34:59	2.76	
1,2,3,4,6,7,8-HpCDD	0.0032	0.0003		37:10	1.14	
OCDD	0.0093	0.0008		40:03	0.86	
2,3,7,8--TCDF	EMPC	0.0006	0.0010	27:29	1.06	
1,2,3,7,8-PeCDF	ND	0.0004				
2,3,4,7,8-PeCDF	ND	0.0004		32:24	2.69	
1,2,3,4,7,8-HxCDF	EMPC	0.0003	0.0011	34:11	1.63	
1,2,3,6,7,8-HxCDF	0.0006	0.0003		34:15	1.3	
2,3,4,6,7,8-HxCDF	ND	0.0003		34:38	0.95	
1,2,3,7,8,9-HxCDF	ND	0.0004				
1,2,3,4,6,7,8-HpCDF	0.0027	0.0006		36:22	1.00	
1,2,3,4,7,8,9-HpCDF	ND	0.0007				
OCDF	0.0021	0.0007		40:10	0.84	
Total TCDDs	ND	0.0004	0.0009			
Total PeCDDs	ND	0.0003	0.0004			
Total HxCDDs	ND	0.0006	0.0016			
Total HpCDDs	0.0032	0.0003	0.0056			
Total TCDFs	0.0012	0.0006	0.0024			
Total PeCDFs	ND	0.0004				
Total HxCDFs	0.0004	0.0003	0.0020			
Total HpCDFs	0.0028	0.0006				
TEQ (ND=0)	0.0001		0.0015			ITEF
TEQ (ND=1/2)	0.0007		0.0018			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: LMB

Laboratory Information

Project ID: L1070
Sample ID: 1070-0

Collection Date: NA
Receipt Date: NA
Extraction Date: 10-Jul-98
Analysis Date: 17-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-6
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

C2

Method 23

LMB

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	3.79	94.6	28:27	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	4.08	101.9	32:37	1.56	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.85	96.3	34:45	1.26	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	3.67	91.8	37:10	1.05	
$^{13}C_{12}$-OCDD	8	6.90	86.2	40:01	0.88	
$^{13}C_{12}$-2,3,7,8-TCDF	4	3.65	91.4	27:25	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	3.53	88.1	31:56	1.57	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	4.03	100.8	34:15	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	2.98	74.5	36:21	0.44	
Sampling Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	4.17	104.4	28:28		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	4.38	109.4	32:24	1.57	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	4.12	103.0	34:42	1.25	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	3.83	95.8	34:10	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	3.91	97.7	37:31	0.44	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:09	0.78	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:58	1.24	

Client Information

Project Name: Texas Lime Kiln
Sample ID: LMB

Laboratory Information

Project ID: L1070
Sample ID: 1070-0

Collection Date: NA
Receipt Date: NA
Extraction Date: 10-Jul-98
Analysis Date: 17-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-6
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: Y.T.

Date Reviewed: 23Jul98

F' 026

Filename ; a17jul98b
Sample ; 6
Acquired ; 17-JUL-98 20:31:20
Processed ; 20-JUL-98 09:03:15
Sample ID ; 1070-0 x1/2
Cal Table ; m8290-23-071798
Results Table ; M8290-23-071798B
Comments ;

Typ	Name	Resp	Ion 1	Ion 2	RA;?;	RT;	Conc;	DL;	S/N1;?;	S/N2;? ;	mod?
Unk	2,3,7,8-TCDD	3.64e+05	5.69e+04	3.07e+05	0.18;n;	28:28	0.084	0.0098	10;y;	39;y ;	no
Unk	1,2,3,7,8-PeCDD	4.85e+04	2.56e+04	2.29e+04	1.12;n;	32:37	0.013	0.0069	5;y;	7;y ;	no
Unk	1,2,3,4,7,8-HxCDD	4.63e+04	3.41e+04	1.22e+04	2.81;n;	34:42	0.019	0.0180	4;y;	1;n ;	no
Unk	1,2,3,6,7,8-HxCDD	8.08e+04	4.46e+04	3.62e+04	1.23;y;	34:46	0.026	0.0142	6;y;	3;n ;	no
Unk	1,2,3,7,8,9-HxCDD	6.15e+04	4.51e+04	1.63e+04	2.76;n;	34:59	0.020	0.0140	6;y;	2;n ;	no
Unk	1,2,3,4,6,7,8-HpCDD	1.83e+05	9.75e+04	8.53e+04	1.14;y;	37:10	0.079	0.0085	35;y;	26;y ;	no
Unk	OCDD	4.55e+05	2.11e+05	2.44e+05	0.86;y;	40:03	0.233	0.0204	25;y;	63;y ;	no
Unk	2,3,7,8-TCDF	1.33e+05	6.85e+04	6.46e+04	1.06;n;	27:29	0.026	0.0137	8;y;	3;y ;	no
Unk	1,2,3,7,8-PeCDF	*	*	*	*;n;	NotFnd	*	0.0100	*;n;	*;n ;	no
Unk	2,3,4,7,8-PeCDF	8.21e+04	5.98e+04	2.23e+04	2.69;n;	32:24	0.020	0.0097	22;y;	3;n ;	no
Unk	1,2,3,4,7,8-HxCDF	1.07e+05	6.62e+04	4.06e+04	1.63;n;	34:11	0.028	0.0082	8;y;	9;y ;	no
Unk	1,2,3,6,7,8-HxCDF	7.03e+04	3.97e+04	3.06e+04	1.30;y;	34:15	0.015	0.0065	5;y;	6;y ;	no
Unk	2,3,4,6,7,8-HxCDF	1.94e+04	9.41e+03	9.96e+03	0.95;n;	34:38	0.005	0.0076	2;n;	3;n ;	no
Unk	1,2,3,7,8,9-HxCDF	*	*	*	*;n;	NotFnd	*	0.0087	*;n;	*;n ;	no
Unk	1,2,3,4,6,7,8-HpCDF	1.70e+05	8.54e+04	8.51e+04	1.00;y;	36:22	0.068	0.0140	11;y;	22;y ;	no
Unk	1,2,3,4,7,8,9-HpCDF	*	*	*	*;n;	NotFnd	*	0.0170	*;n;	*;n ;	no
Unk	OCDF	1.09e+05	5.00e+04	5.91e+04	0.84;y;	40:10	0.052	0.0163	10;y;	10;y ;	no
ES/RT	13C-2,3,7,8-TCDD	4.43e+08	1.94e+08	2.50e+08	0.78;y;	28:27	94.630	0.0335	5479;y;	13615;y ;	no
ES	13C-1,2,3,7,8-PeCDD	3.33e+08	2.03e+08	1.30e+08	1.56;y;	32:37	101.898	0.0317	14436;y;	19123;y ;	no
ES	13C-1,2,3,6,7,8-HxCDD	3.65e+08	2.03e+08	1.61e+08	1.26;y;	34:45	96.241	0.0417	7530;y;	7892;y ;	no
ES	13C-1,2,3,4,6,7,8-HpCDD	2.58e+08	1.32e+08	1.26e+08	1.05;y;	37:10	91.828	0.0319	6744;y;	6370;y ;	no
ES	13C-OCDD	3.90e+08	1.83e+08	2.07e+08	0.88;y;	40:01	172.398	0.0143	17487;y;	34203;y ;	no
ES/RT	13C-2,3,7,8-TCDF	5.37e+08	2.36e+08	3.01e+08	0.78;y;	27:25	91.338	0.0215	12736;y;	12195;y ;	no
ES	13C-1,2,3,7,8-PeCDF	4.51e+08	2.75e+08	1.76e+08	1.57;y;	31:56	88.116	0.0082	88252;y;	31811;y ;	no
ES	13C-1,2,3,6,7,8-HxCDF	4.41e+08	1.51e+08	2.90e+08	0.52;y;	34:15	100.761	0.2929	1214;y;	1122;y ;	no
ES	13C-1,2,3,4,6,7,8-HpCDF	1.98e+08	6.08e+07	1.37e+08	0.44;y;	36:21	74.472	0.1413	2809;y;	1065;y ;	no
JS	13C-1,2,3,4-TCDD	4.27e+08	1.88e+08	2.39e+08	0.78;y;	28:09	88.482	-	5439;y;	13386;y ;	no
JS	13C-1,2,3,7,8,9-HxCDD	3.53e+08	1.96e+08	1.57e+08	1.24;y;	34:58	89.034	-	6617;y;	6801;y ;	no
CS	37Cl-2,3,7,8-TCDD	4.24e+08	4.24e+08	-	-;-	28:28	98.685	0.0239	12073;y;	-; -;	no
CS	13C-2,3,4,7,8-PeCDF	4.82e+08	2.94e+08	1.88e+08	1.57;y;	32:24	96.355	0.0084	98823;y;	35003;y ;	no
CS	13C-1,2,3,4,7,8-HxCDD	2.53e+08	1.41e+08	1.13e+08	1.25;y;	34:42	99.268	0.0619	6521;y;	6558;y ;	no
CS	13C-1,2,3,4,7,8-HxCDF	3.32e+08	1.13e+08	2.19e+08	0.52;y;	34:10	97.332	0.3759	1069;y;	1008;y ;	no
CS	13C-1,2,3,4,7,8,9-HpCDF	1.51e+08	4.60e+07	1.05e+08	0.44;y;	37:31	72.753	0.1805	1869;y;	720;y ;	no
SS	37Cl-2,3,7,8-TCDD	4.24e+08	4.24e+08	-	-;-	28:28	104.344	0.0259	12073;y;	-; -;	no
SS	13C-2,3,4,7,8-PeCDF	4.82e+08	2.94e+08	1.88e+08	1.57;y;	32:24	109.389	0.0059	98823;y;	35003;y ;	no
SS	13C-1,2,3,4,7,8-HxCDD	2.53e+08	1.41e+08	1.13e+08	1.25;y;	34:42	103.011	0.0577	6521;y;	6558;y ;	no
SS	13C-1,2,3,4,7,8-HxCDF	3.32e+08	1.13e+08	2.19e+08	0.52;y;	34:10	95.831	0.3311	1069;y;	1008;y ;	no
SS	13C-1,2,3,4,7,8,9-HpCDF	1.51e+08	4.60e+07	1.05e+08	0.44;y;	37:31	97.728	0.2918	1869;y;	720;y ;	no

Ent: 39 Name: Total Tetra-Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:3

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.05 of which 0.03 named and 0.03 unnamed
Conc: 0.05 of which 0.03 named and 0.03 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	24:51	1.6e+04	0.45 n	0.00					
			1.6e+04			4.8e+03	1.4e+03	1.1e+00	n	n
						1.1e+04	2.8e+03	8.1e-01	n	n
	2	25:46	1.3e+05	0.80 y	0.03					
			1.3e+05			5.7e+04	1.2e+04	9.2e+00	y	n
						7.1e+04	1.6e+04	4.6e+00	y	n
2,3,7,8-TCDF	3	27:29	1.3e+05	1.06 n	0.03					
			1.3e+05			6.9e+04	1.1e+04	8.4e+00	y	n
						6.5e+04	1.1e+04	3.4e+00	y	n

Ent: 40 Name: Total Tetra-Dioxins F:1 Mass: 319.897 321.894 Mod? no #Hom:2

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.09 of which 0.08 named and 0.01 unnamed
Conc: 0.09 of which 0.08 named and 0.01 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	25:16	3.6e+04	1.29 n	0.01					
			3.6e+04			2.0e+04	3.8e+03	3.1e+00	y	n
						1.6e+04	3.7e+03	2.3e+00	n	n
2,3,7,8-TCDD	2	28:28	3.6e+05	0.18 n	0.08					
			3.6e+05			5.7e+04	1.2e+04	9.6e+00	y	n
						3.1e+05	6.5e+04	3.9e+01	y	n

Ent: 41 Name: Total Penta-Furans F:2 Mass: 339.860 341.857 Mod? no #Hom:1

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.02 of which 0.02 named and * unnamed
Conc: 0.02 of which 0.02 named and * unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
2,3,4,7,8-PeCDF	1	32:24	8.2e+04	2.69 n	0.02					
			8.2e+04			6.0e+04	2.0e+04	2.2e+01	y	n
						2.2e+04	8.8e+03	2.6e+00	n	n

Ent: 42 Name: Total Penta-Dioxins F:2 Mass: 355.855 357.852 Mod? no #Hom:5

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15

Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.05 of which 0.01 named and 0.03 unnamed
Conc: 0.05 of which 0.01 named and 0.03 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	31:30	2.1e+04	0.79 n	0.01					
			2.1e+04			9.1e+03	3.8e+03	2.0e+00	n	n
						1.2e+04	4.4e+03	4.3e+00	y	n
	2	31:57	6.4e+04	10.28n	0.02					
			6.4e+04			5.8e+04	1.6e+04	8.4e+00	y	n
						5.7e+03	1.6e+03	1.6e+00	n	n
	3	32:04	1.3e+04	0.81 n	0.00					
			1.3e+04			5.9e+03	2.5e+03	1.3e+00	n	n
						7.3e+03	3.0e+03	2.9e+00	n	n
1,2,3,7,8-PeCDD	4	32:37	4.8e+04	1.12 n	0.01					
			4.8e+04			2.6e+04	9.2e+03	4.9e+00	y	n
						2.3e+04	7.5e+03	7.3e+00	y	n
	5	32:55	2.4e+04	2.71 n	0.01					
			2.4e+04			1.8e+04	6.0e+03	3.2e+00	y	n
						6.6e+03	2.2e+03	2.2e+00	n	n

Ent: 43 Name: Total Hexa-Furans F:3 Mass: 373.821 375.818 Mod? no #Hom:9

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.08 of which 0.05 named and 0.03 unnamed
Conc: 0.08 of which 0.05 named and 0.03 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	33:31	2.1e+04	1.85 n	0.01					
			2.1e+04			1.4e+04	5.4e+03	2.1e+00	n	n
						7.4e+03	3.0e+03	2.0e+00	n	n
	2	33:38	5.2e+04	1.58 n	0.01					
			5.2e+04			3.2e+04	9.6e+03	3.8e+00	y	n
						2.0e+04	6.5e+03	4.3e+00	y	n
1,2,3,4,7,8-HxCDF	3	34:11	1.1e+05	1.63 n	0.03					
			1.1e+05			6.6e+04	2.1e+04	8.3e+00	y	n
						4.1e+04	1.4e+04	8.9e+00	y	n
1,2,3,6,7,8-HxCDF	4	34:15	7.0e+04	1.30 y	0.01					
			7.0e+04			4.0e+04	1.4e+04	5.5e+00	y	n
						3.1e+04	9.0e+03	5.9e+00	y	n
2,3,4,6,7,8-HxCDF	5	34:38	1.9e+04	0.95 n	0.00					
			1.9e+04			9.4e+03	4.2e+03	1.6e+00	n	n
						1.0e+04	4.1e+03	2.7e+00	n	n
	6	34:44	1.1e+04	0.42 n	0.00					
			1.1e+04			3.3e+03	1.3e+03	5.2e-01	n	n
						7.8e+03	1.7e+03	1.1e+00	n	n
	7	34:46	2.1e+04	1.68 n	0.01					
			2.1e+04			1.3e+04	2.9e+03	1.1e+00	n	n
						7.8e+03	1.7e+03	1.1e+00	n	n
	8	34:56	2.6e+03	1.41 y	0.00					
			2.6e+03			1.5e+03	8.9e+02	3.5e-01	n	n
						1.1e+03	5.1e+02	3.4e-01	n	n
	9	34:59	1.0e+04	2.12 n	0.00					
			1.0e+04			7.1e+03	2.2e+03	8.8e-01	n	n
						3.3e+03	1.3e+03	8.7e-01	n	n

Ent: 44 Name: Total Hexa-Dioxins F:3 Mass: 389.816 391.813 Mod? no #Hom:10

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.19 of which 0.06 named and 0.12 unnamed
Conc: 0.19 of which 0.06 named and 0.12 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	33:52	3.0e+04	1.27 y	0.01					
			3.0e+04			1.7e+04	7.4e+03	3.4e+00	y	n
						1.3e+04	4.9e+03	1.4e+00	n	n
	2	33:56	3.8e+03	0.47 n	0.00					
			3.8e+03			1.2e+03	6.0e+02	2.8e-01	n	n
						2.6e+03	1.1e+03	3.2e-01	n	n
	3	34:03	1.3e+04	1.02 n	0.00					
			1.3e+04			6.3e+03	1.9e+03	8.8e-01	n	n
						6.2e+03	2.2e+03	6.3e-01	n	n
	4	34:10	1.2e+05	2.49 n	0.04					
			1.2e+05			8.3e+04	2.6e+04	1.2e+01	y	n
						3.3e+04	1.2e+04	3.3e+00	y	n
	5	34:15	9.8e+04	3.07 n	0.03					
			9.8e+04			7.4e+04	2.3e+04	1.1e+01	y	n

```
                                                    2.4e+04 7.6e+03 2.2e+00 n  n
                    6  34:20 8.1e+04  1.35 y    0.03
                             8.1e+04                4.6e+04 1.3e+04 6.0e+00 y  n
                                                    3.4e+04 9.5e+03 2.7e+00 n  n
                    7  34:32 1.2e+04  2.22 n    0.00
                             1.2e+04                8.1e+03 2.1e+03 9.6e-01 n  n
                                                    3.6e+03 1.4e+03 4.1e-01 n  n
1,2,3,4,7,8-HxCDD   8  34:42 4.6e+04  2.81 n    0.02
                             4.6e+04                3.4e+04 9.6e+03 4.4e+00 y  n
                                                    1.2e+04 5.1e+03 1.5e+00 n  n
1,2,3,6,7,8-HxCDD   9  34:46 8.1e+04  1.23 y    0.03
                             8.1e+04                4.5e+04 1.4e+04 6.3e+00 y  n
                                                    3.6e+04 9.5e+03 2.7e+00 n  n
1,2,3,7,8,9-HxCDD   10 34:59 6.1e+04  2.76 n    0.02
                             6.1e+04                4.5e+04 1.4e+04 6.5e+00 y  n
                                                    1.6e+04 7.1e+03 2.0e+00 n  n
```



```
 Ent: 45 Name: Total Hepta-Furans  F:4  Mass: 407.782 409.779 Mod? no   #Hom:1

 Run: 11 File: a17jul98b    S:6  Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
 Tables: Run: a17jul98b  Analyte: m8290-23-»  Cal: m8290-23-»Results: M8290-23»
 Version: V3.5 17-APR-1997 11:14:34  Sample text: 1070-0 x1/2

   Amount: 0.07    of which 0.07    named and *       unnamed
     Conc: 0.07    of which 0.07    named and *       unnamed
   Tox #1: -           Tox #2: -         Tox #3: -

Name                #     RT Respnse     RA    Conc    Area  Height    S/N  Mod?

1,2,3,4,6,7,8-HpCDF1  36:22 1.7e+05  1.00 y    0.07
                             1.7e+05                8.5e+04 2.4e+04 1.1e+01 y  n
                                                    8.5e+04 2.8e+04 2.2e+01 y  n
```

Ent: 46 Name: Total Hepta-Dioxins F:4 Mass: 423.777 425.774 Mod? no #Hom:3

Run: 11 File: a17jul98b S:6 Acq:17-JUL-98 20:31:20 Proc:20-JUL-98 09:03:15
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-0 x1/2

Amount: 0.14 of which 0.08 named and 0.06 unnamed
Conc: 0.14 of which 0.08 named and 0.06 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	36:21	6.5e+04	2.78 n	0.03					
			6.5e+04			4.8e+04	1.4e+04	1.9e+01	y	n
						1.7e+04	5.4e+03	5.5e+00	y	n
	2	36:35	7.0e+04	1.28 n	0.03					
			7.0e+04			3.9e+04	1.3e+04	1.7e+01	y	n
						3.1e+04	8.8e+03	9.0e+00	y	n
1,2,3 4,6,7,8-HpCDD3		37:10	1.8e+05	1.14 y	0.08					
			1.8e+05			9.8e+04	2.6e+04	3.5e+01	y	n
						8.5e+04	2.6e+04	2.6e+01	y	n

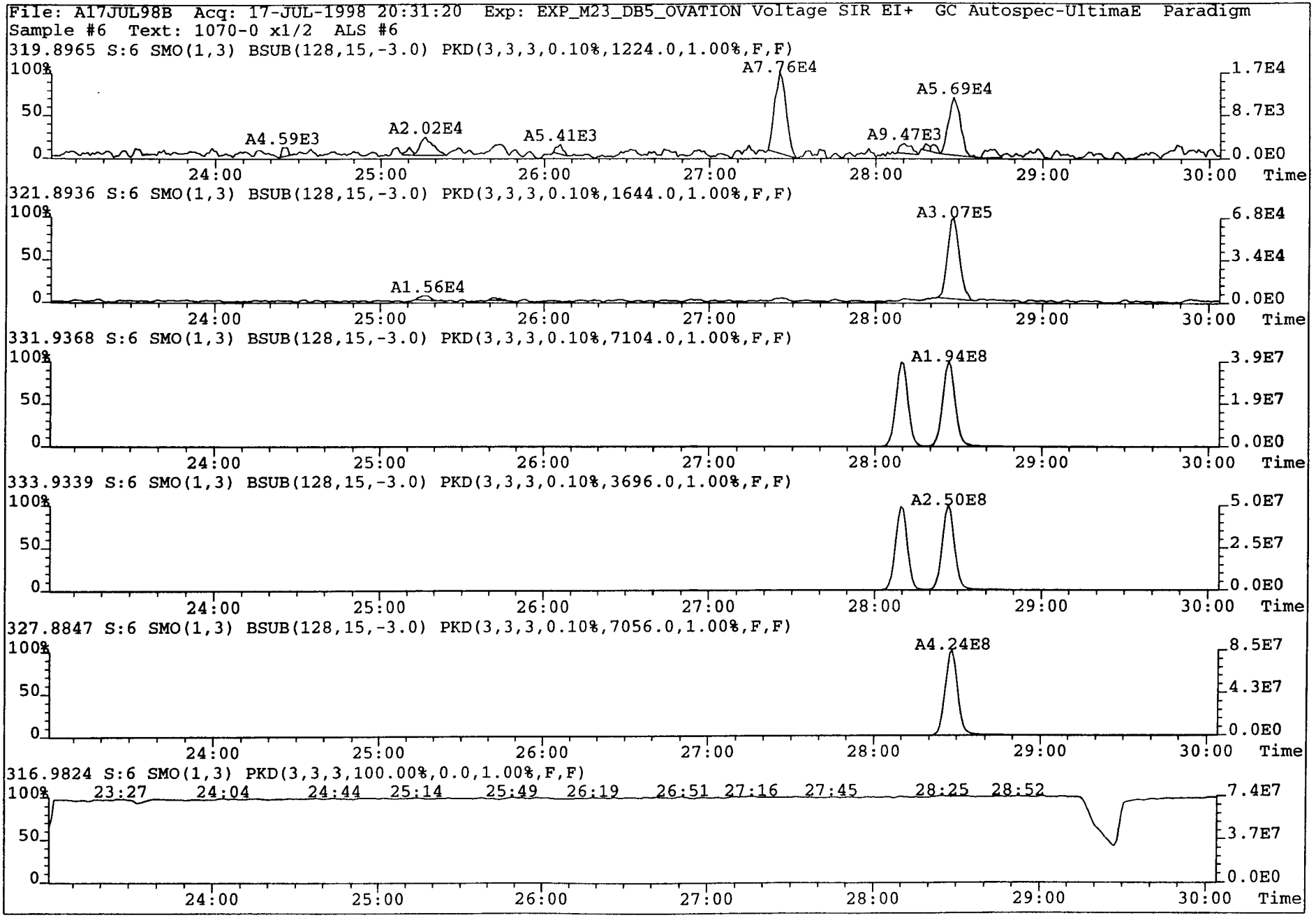
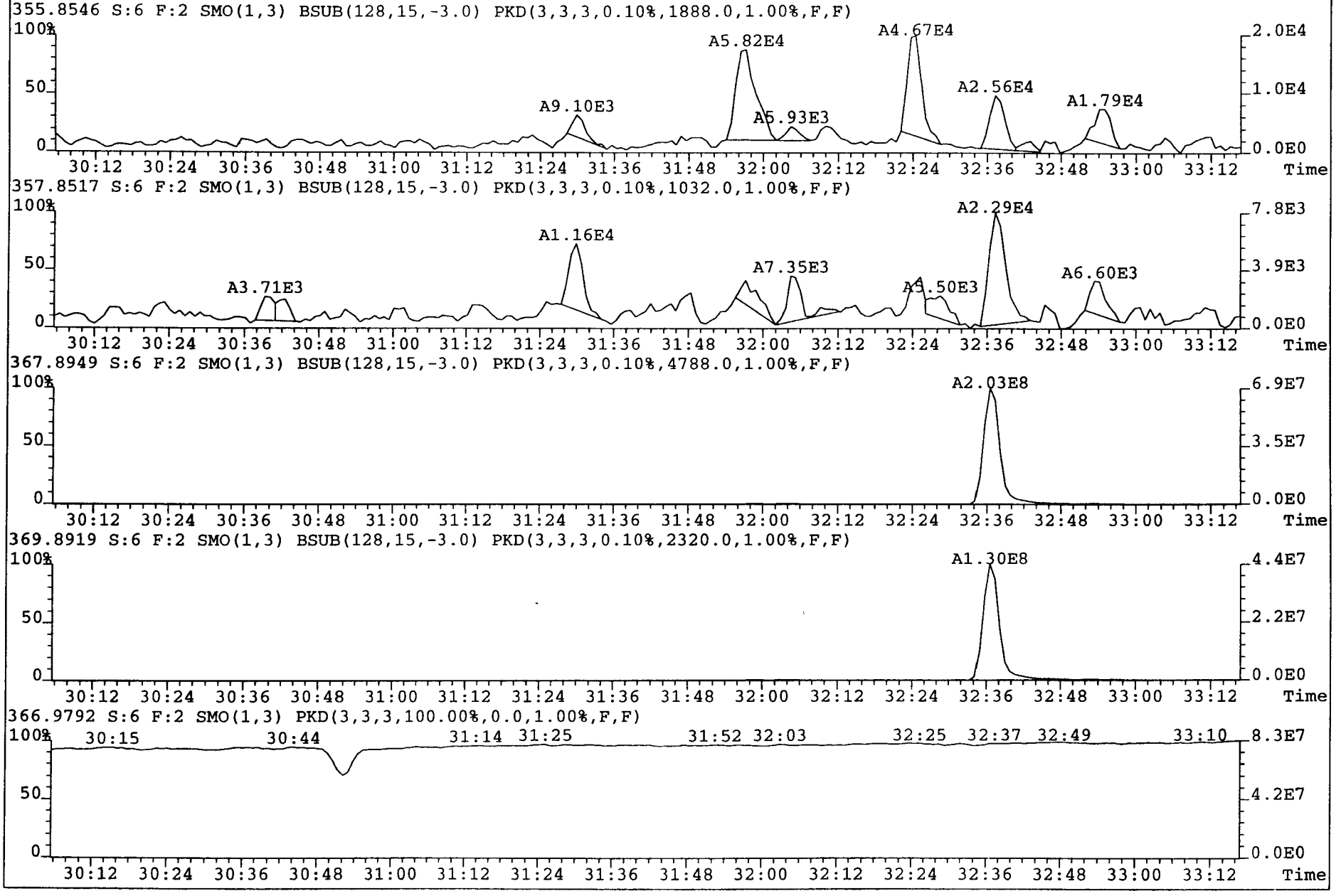
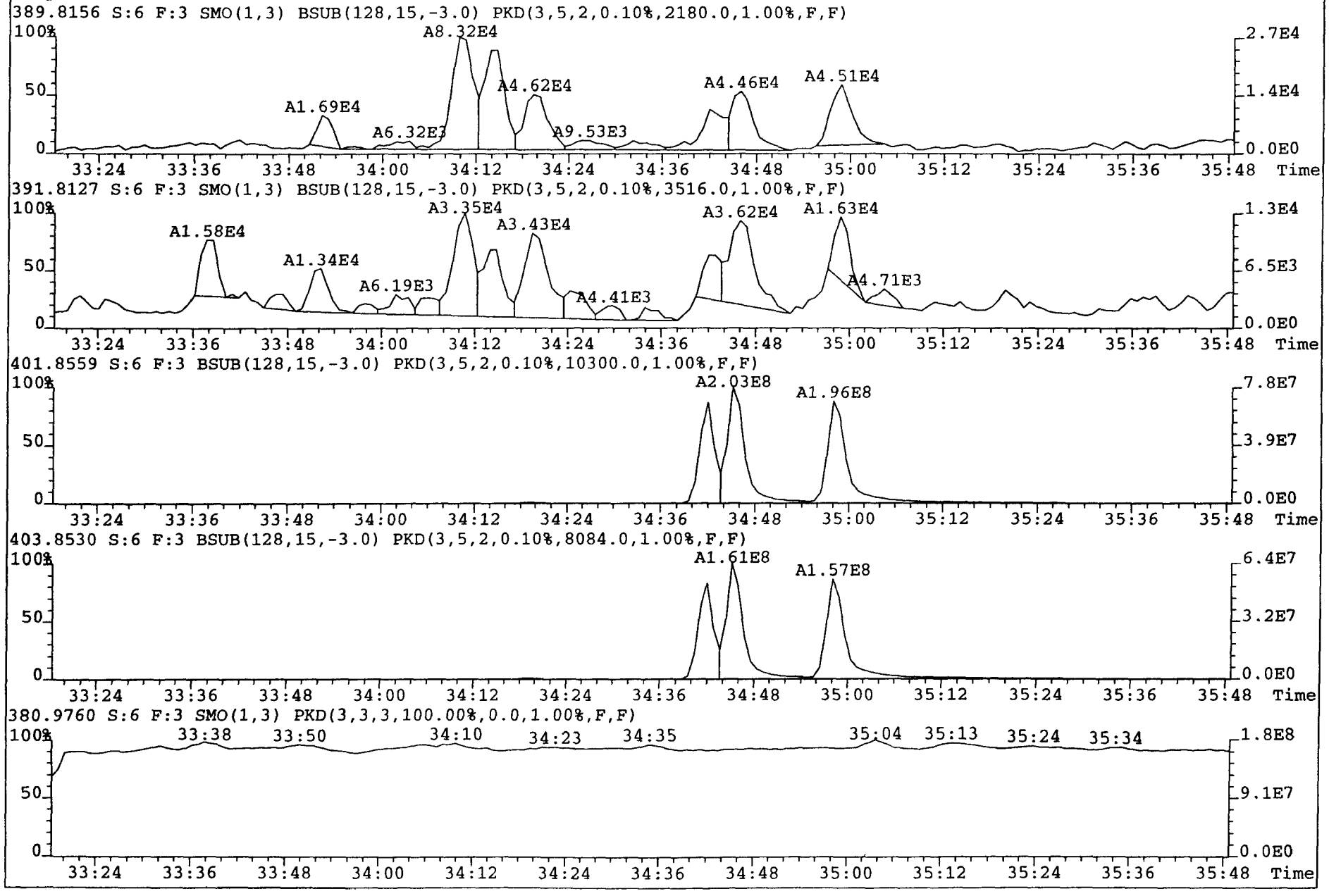

File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6
319.8965 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1224.0,1.00%,F,F)
A4.59E3
A2.02E4
A5.41E3
A7.76E4
A9.47E3
A5.69E4
321.8936 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1644.0,1.00%,F,F)
A1.56E4
A3.07E5
331.9368 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,7104.0,1.00%,F,F)
A1.94E8
333.9339 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3696.0,1.00%,F,F)
A2.50E8
327.8847 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,7056.0,1.00%,F,F)
A4.24E8
316.9824 S:6 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
23:27 24:04 24:44 25:14 25:49 26:19 26:51 27:16 27:45 28:25 28:52
100%
50
0
24:00 25:00 26:00 27:00 28:00 29:00 30:00 Time
1.7E4
8.7E3
0.0E0
6.8E4
3.4E4
3.9E7
1.9E7
5.0E7
2.5E7
8.5E7
4.3E7
7.4E7
3.7E7

Fig. 033

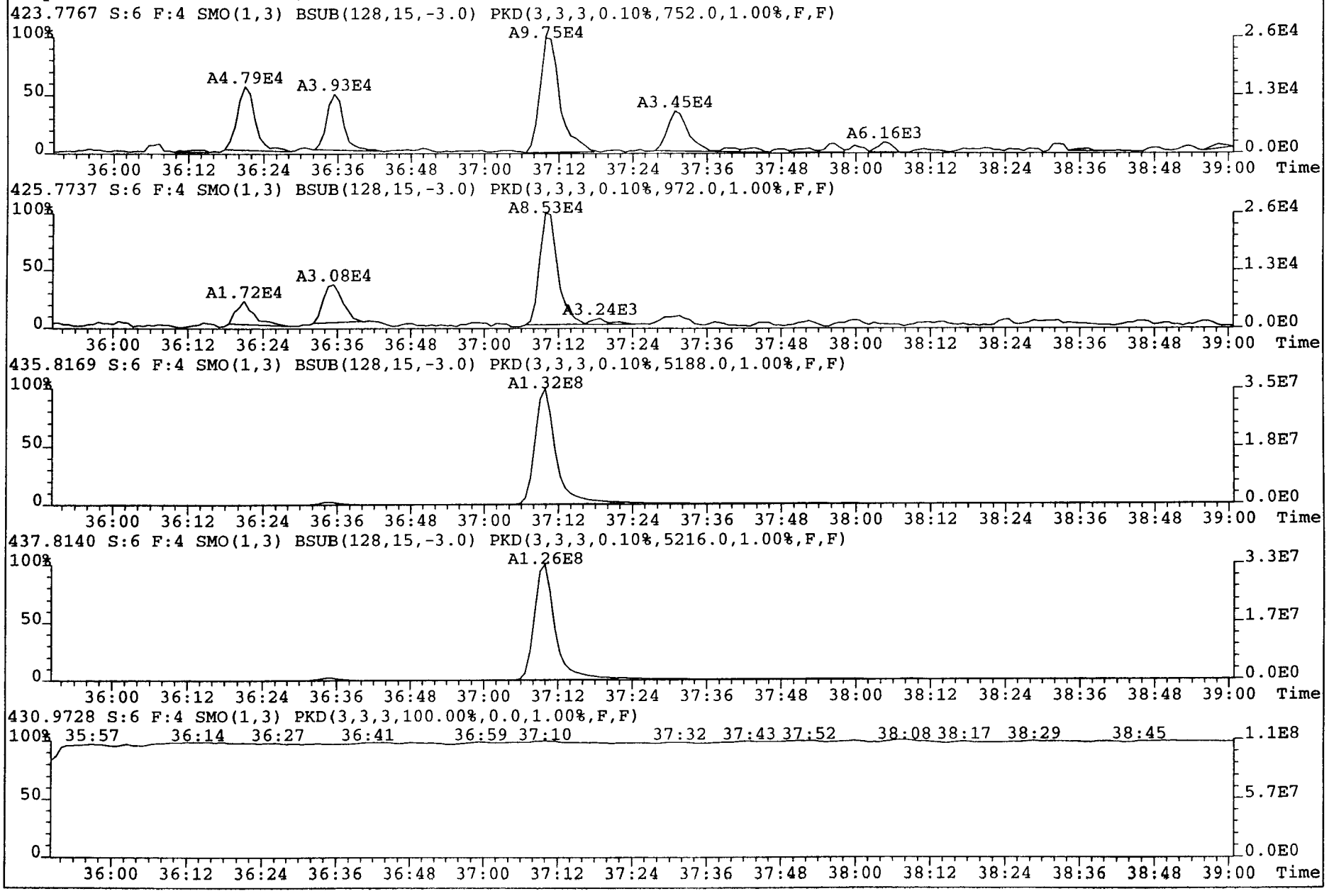
File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6



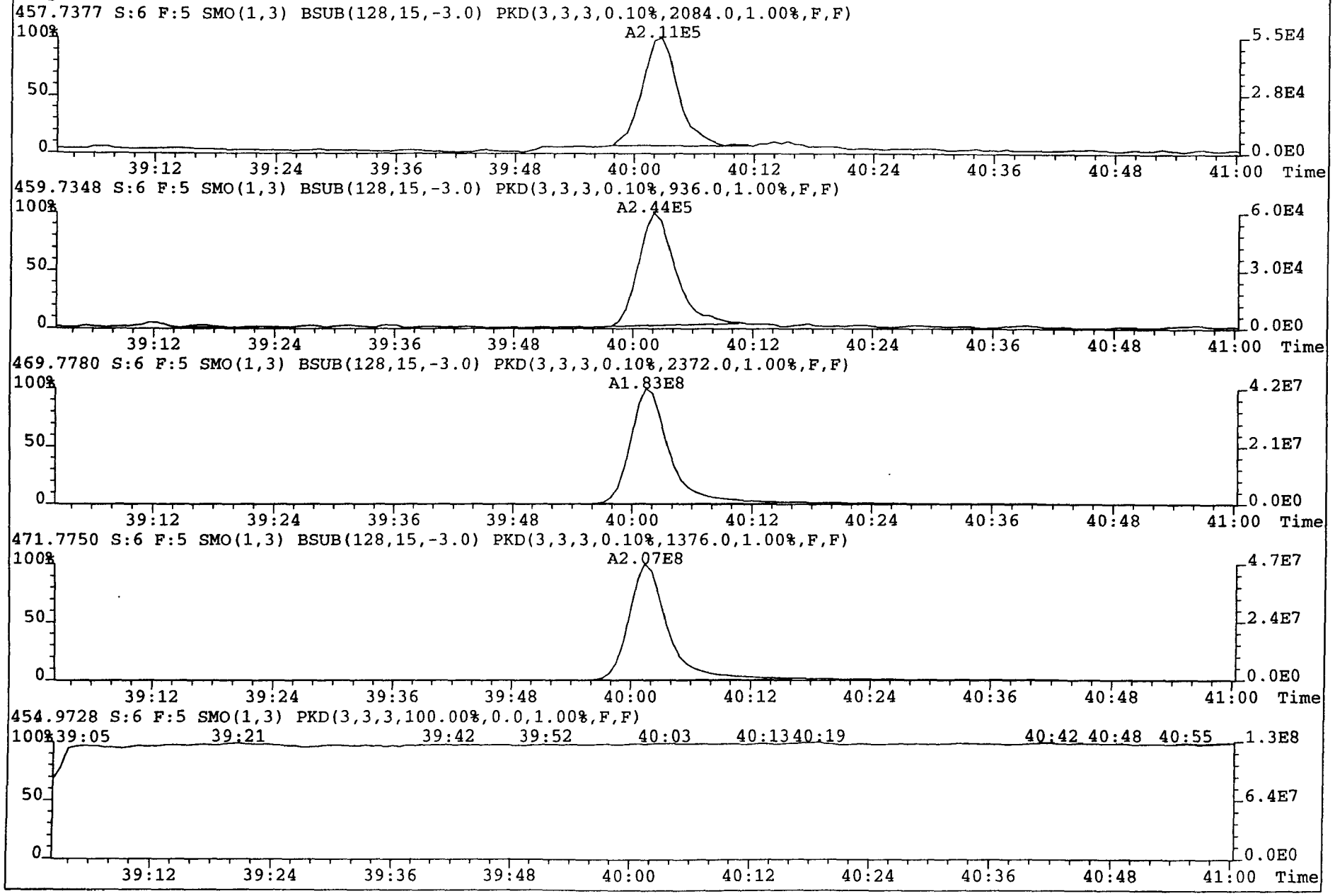
File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6



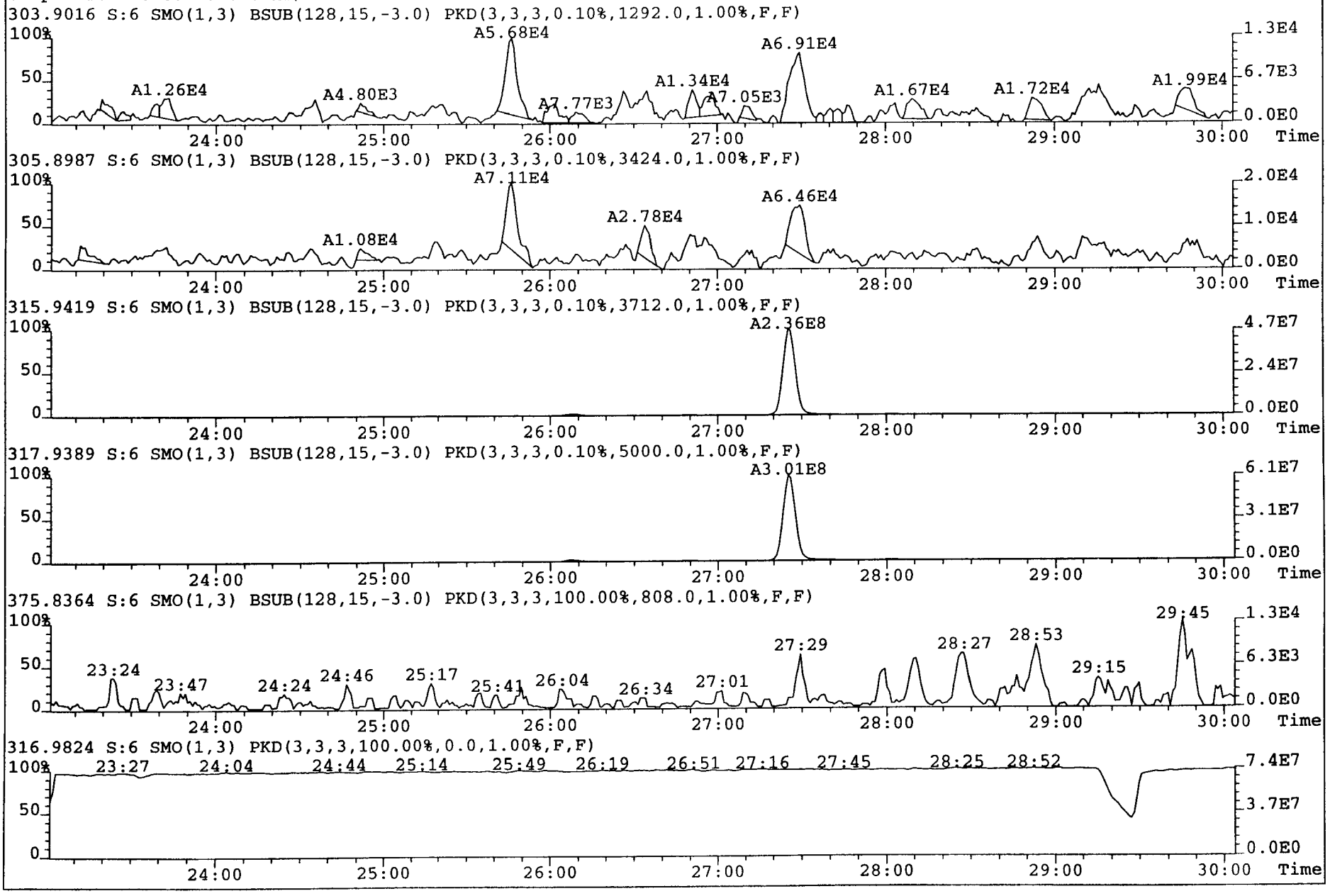
File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6



File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6

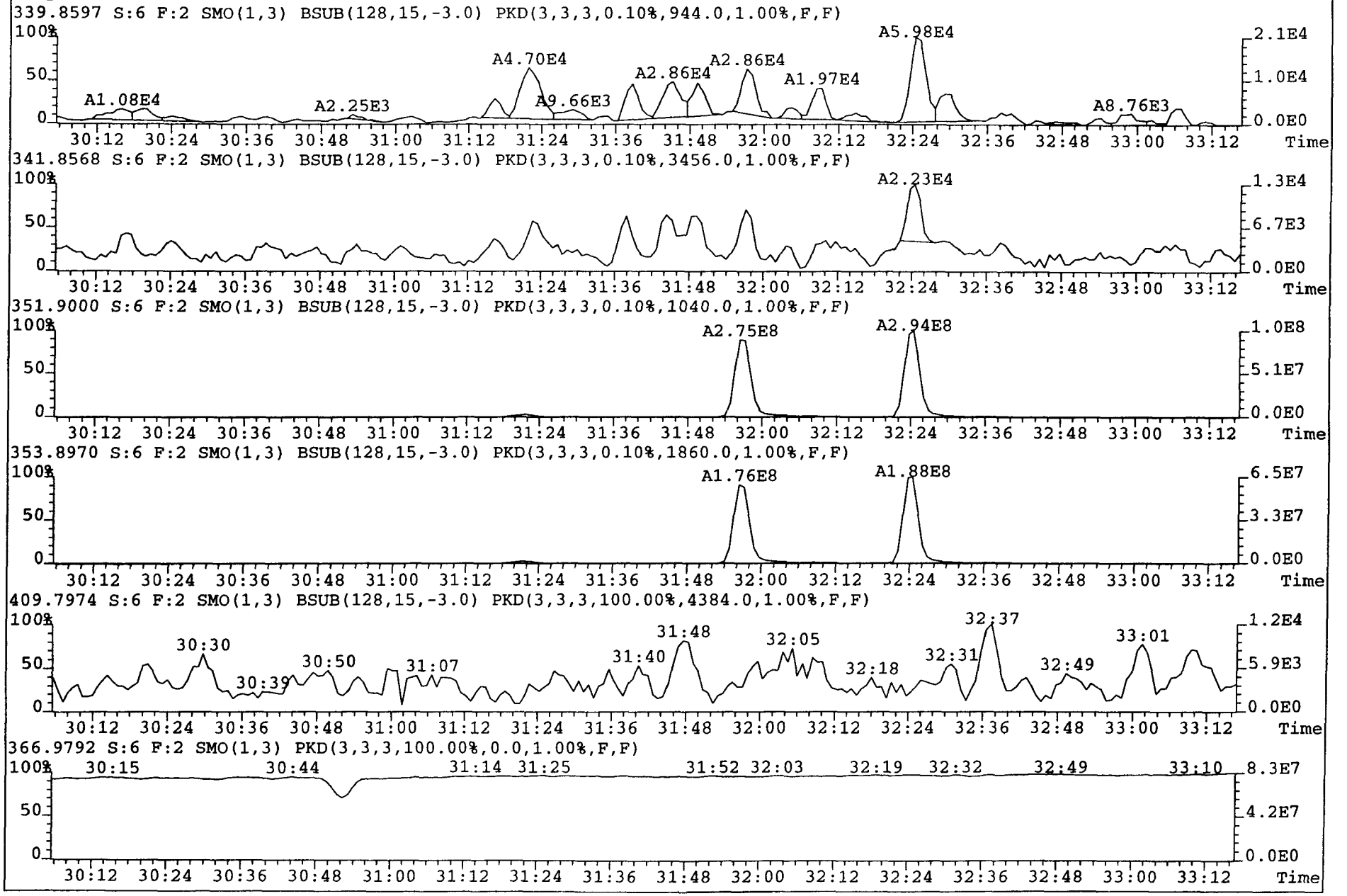


File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6

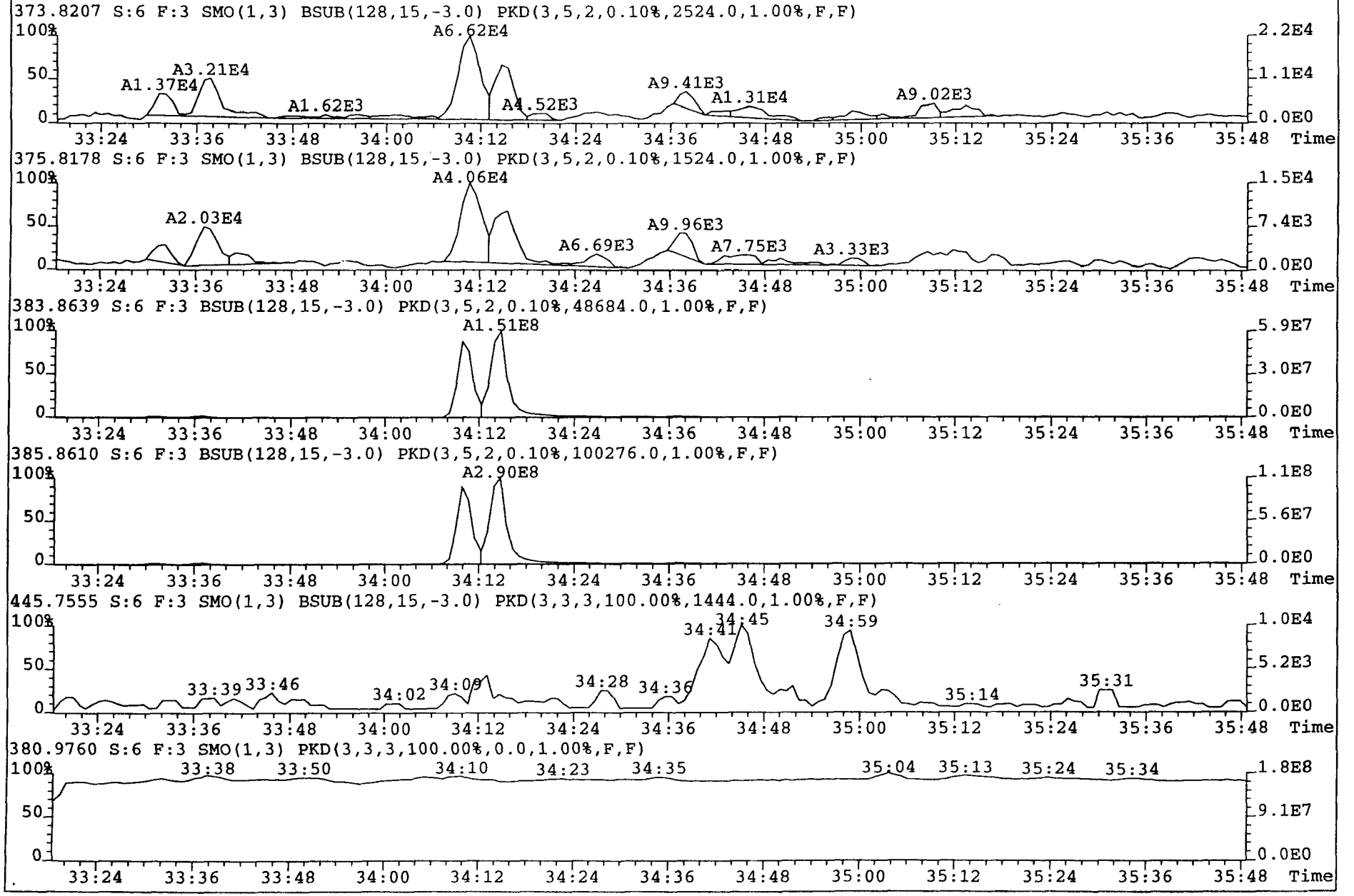


038

File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6



File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6



File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6

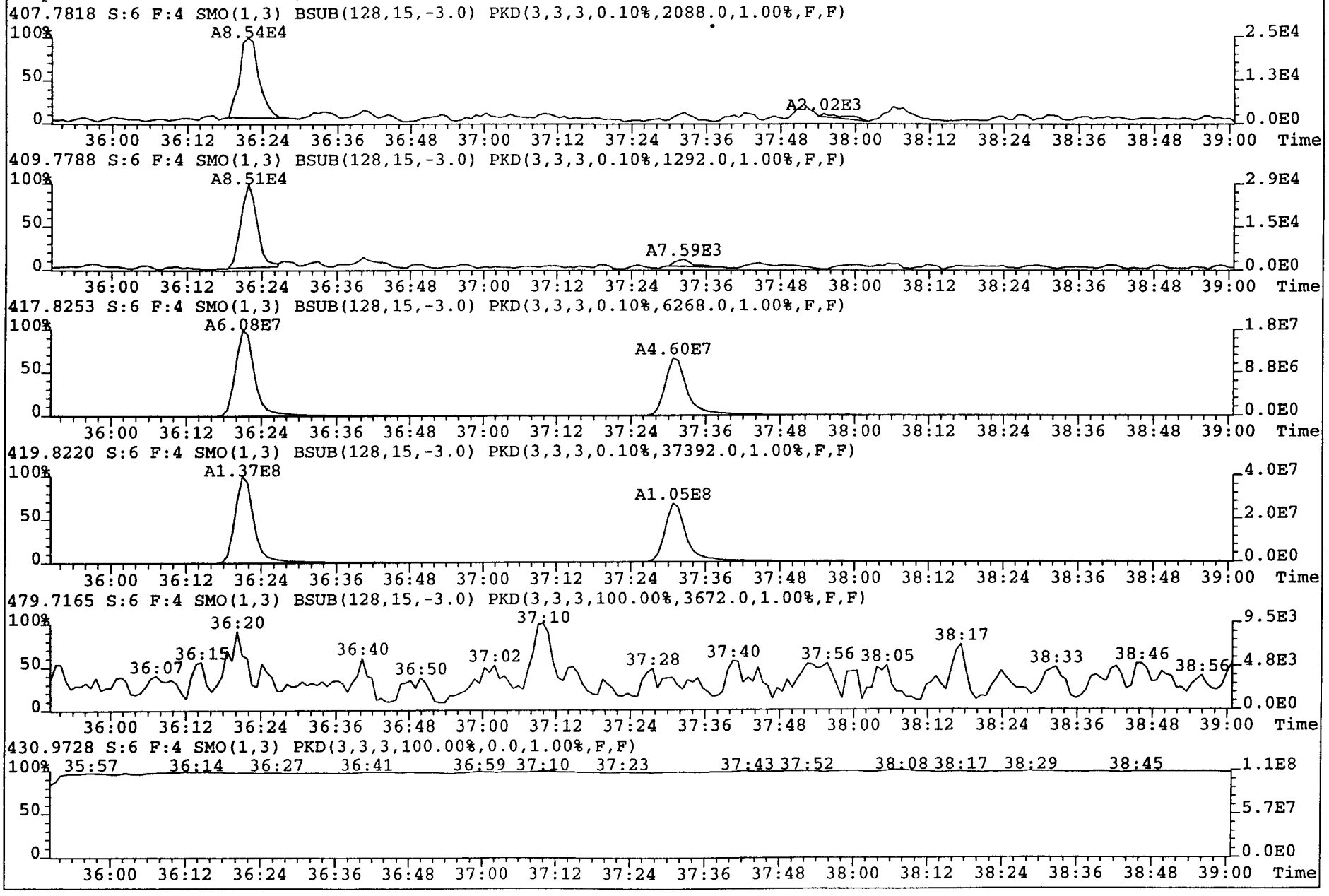
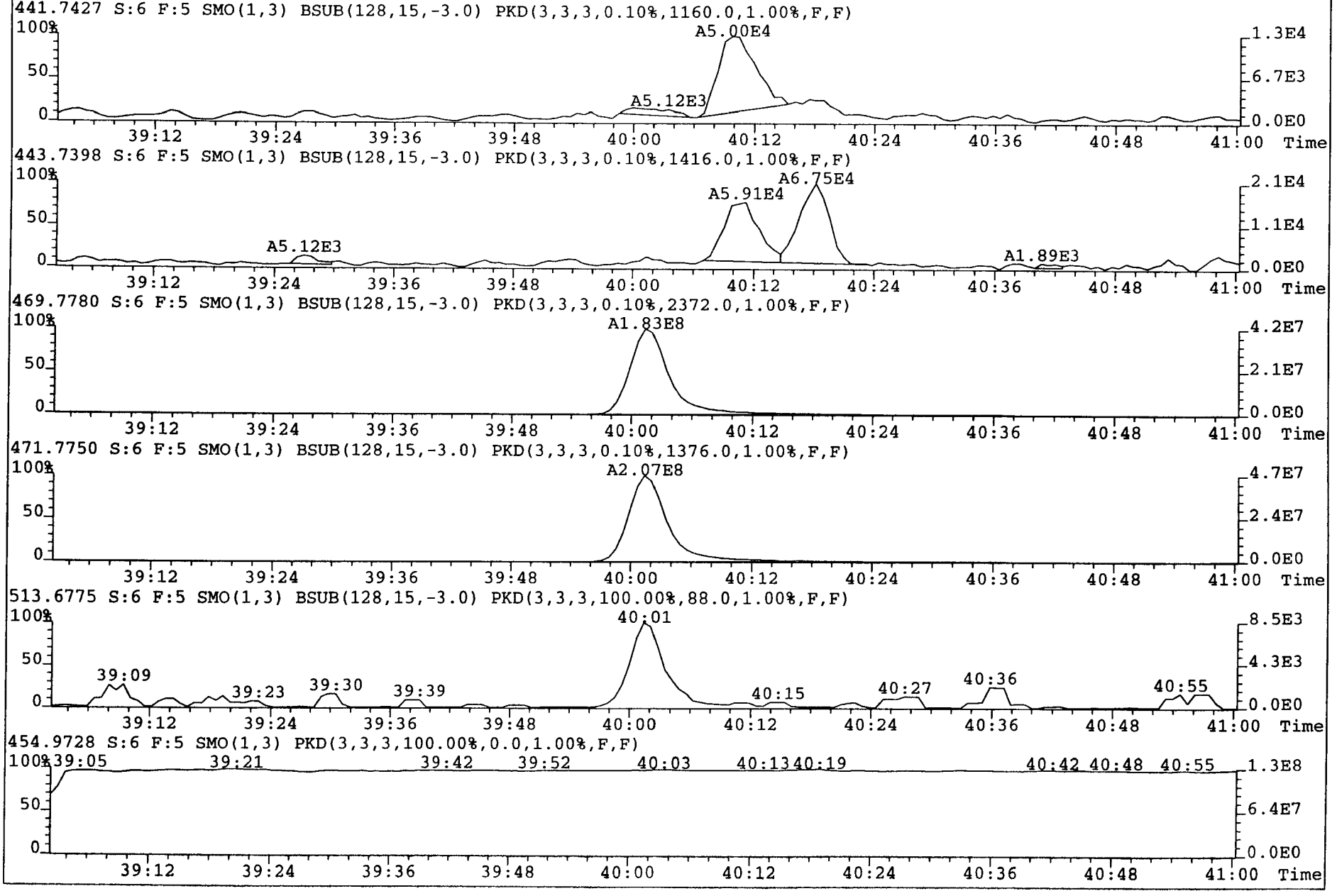


Fig. 04

File: A17JUL98B Acq: 17-JUL-1998 20:31:20 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-0 x1/2 ALS #6



Method 23

M23-I-1

PBS

Analytical Data Summary Sheet

Analyte	Concentration (ng)	DL (ng)	EMPC (ng)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	0.0146	0.0005		28:28	0.83	
1,2,3,7,8-PeCDD	0.0181	0.0004		32:37	1.49	
1,2,3,4,7,8-HxCDD	EMPC	0.0016	0.0098	34:43	1.67	
1,2,3,6,7,8-HxCDD	0.0155	0.0012		34:46	1.13	
1,2,3,7,8,9-HxCDD	0.0180	0.0012		34:59	1.28	
1,2,3,4,6,7,8-HpCDD	0.0301	0.0007		37:11	1.13	
OCDD	0.0364	0.0006		40:03	0.87	
2,3,7,8-TCDF	0.170	0.0018		27:29	0.77	
1,2,3,7,8-PeCDF	0.109	0.0018		31:57	1.63	
2,3,4,7,8-PeCDF	0.134	0.0018		32:24	1.55	
1,2,3,4,7,8-HxCDF	0.129	0.0013		34:11	1.23	
1,2,3,6,7,8-HxCDF	0.0480	0.0011		34:15	1.24	
2,3,4,6,7,8-HxCDF	0.0343	0.0012		34:38	1.31	
1,2,3,7,8,9-HxCDF	0.0096	0.0014		35:12	1.26	
1,2,3,4,6,7,8-HpCDF	0.0469	0.0011		36:22	1.02	
1,2,3,4,7,8,9-HpCDF	EMPC	0.0013	0.0049	37:32	1.24	
OCDF	0.0066	0.0008		40:10	0.95	
Total TCDDs	1.25	0.0005	1.26			
Total PeCDDs	0.477	0.0004	0.499			
Total HxCDDs	0.388	0.0012	0.406			
Total HpCDDs	0.0588	0.0007				
Total TCDFs	9.70	0.0018	9.73			
Total PeCDFs	2.39	0.0018				
Total HxCDFs	0.460	0.0011				
Total HpCDFs	0.0616	0.0011	0.0664			
TEQ (ND=0)	0.139		0.140			ITEF
TEQ (ND=1/2)	0.139		0.140			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-I-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-1

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 17-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-10
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial_Cal: m8290-23-071798

Method 23

M23-I-1

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	3.79	94.8	28:27	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	4.35	108.8	32:37	1.56	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.54	88.6	34:46	1.25	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	3.75	93.7	37:10	1.04	
$^{13}C_{12}$-OCDD	8	6.72	84.0	40:02	0.89	
$^{13}C_{12}$-2,3,7,8-TCDF	4	3.82	95.4	27:26	0.79	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	3.84	95.9	31:57	1.56	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	3.22	80.6	34:15	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	3.15	78.8	36:22	0.44	
Sampling Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	2.77	69.2	28:28		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	2.44	61.0	32:24	1.56	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	3.01	75.3	34:42	1.24	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	2.25	56.2	34:11	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	1.33	33.2	37:32	0.43	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:09	0.79	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:59	1.25	

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-I-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-1

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 17-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-10
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: M.T. Date Reviewed: 23 Jul 98

00' 045

Filename ; a17jul98b
Sample ; 10
Acquired ; 17-JUL-98 23:31:42
Processed ; 20-JUL-98 09:06:13
Sample ID ; 1070-1 x1/2
Cal Table ; m8290-23-071798
Results Table ; M8290-23-071798B
Comments ;

CF = 4.254

Typ	Name	Resp	Ion 1	Ion 2	RA;?	RT	Conc	DL	S/N1;?	S/N2;?	mod?
Unk	2,3,7,8-TCDD	1.80e+06	7.37e+05	1.06e+06	0.69;y	28:28	0.405	0.0122	89;y	107;y	no
Unk	1,2,3,7,8-PeCDD	1.82e+06	1.09e+06	7.33e+05	1.49;y	32:37	0.452	0.0095	143;y	156;y	no
Unk	1,2,3,4,7,8-HxCDD	6.60e+05	4.13e+05	2.48e+05	1.67;n	34:43	0.244	0.0389	23;y	16;y	no
Unk	1,2,3,6,7,8-HxCDD	1.33e+06	7.06e+05	6.24e+05	1.13;y	34:46	0.388	0.0307	36;y	27;y	no
Unk	1,2,3,7,8,9-HxCDD	1.56e+06	8.77e+05	6.82e+05	1.28;y	34:59	0.451	0.0304	35;y	25;y	no
Unk	1,2,3,4,6,7,8-HpCDD	2.12e+06	1.12e+06	1.00e+06	1.13;y	37:11	0.752	0.0171	207;y	94;y	no
Unk	OCDD	2.07e+06	9.62e+05	1.11e+06	0.87;y	40:03	0.909	0.0144	165;y	233;y	no
Unk	2,3,7,8-TCDF	1.53e+08	6.66e+07	8.65e+07	0.77;y	27:29	28.155	0.0443	1176;y	1732;y	no
Unk	1,2,3,7,8-PeCDF	1.19e+07	7.35e+06	4.52e+06	1.63;y	31:57	2.728	0.0457	216;y	239;y	no
Unk	2,3,4,7,8-PeCDF	1.51e+07	9.17e+06	5.92e+06	1.55;y	32:24	3.351	0.0442	235;y	258;y	no
Unk	1,2,3,4,7,8-HxCDF	1.18e+07	6.49e+06	5.26e+06	1.23;y	34:11	3.233	0.0333	210;y	188;y	no
Unk	1,2,3,6,7,8-HxCDF	5.51e+06	3.05e+06	2.46e+06	1.24;y	34:15	1.200	0.0264	104;y	94;y	no
Unk	2,3,4,6,7,8-HxCDF	3.38e+06	1.92e+06	1.47e+06	1.31;y	34:38	0.858	0.0307	52;y	48;y	no
Unk	1,2,3,7,8,9-HxCDF	8.23e+05	4.59e+05	3.64e+05	1.26;y	35:12	0.240	0.0353	13;y	12;y	no
Unk	1,2,3,4,6,7,8-HpCDF	3.71e+06	1.87e+06	1.84e+06	1.02;y	36:22	1.173	0.0271	121;y	142;y	no
Unk	1,2,3,4,7,8,9-HpCDF	3.21e+05	1.77e+05	1.43e+05	1.24;n	37:32	0.123	0.0328	10;y	11;y	no
Unk	OCDF	4.03e+05	1.97e+05	2.06e+05	0.95;y	40:10	0.166	0.0195	33;y	25;y	no
ES/RT	13C-2,3,7,8-TCDD	4.52e+08	1.98e+08	2.54e+08	0.78;y	28:27	94.746	0.0328	5611;y	13814;y	no
ES	13C-1,2,3,7,8-PeCDD	3.61e+08	2.20e+08	1.41e+08	1.56;y	32:37	108.756	0.0242	26720;y	18804;y	no
ES	13C-1,2,3,6,7,8-HxCDD	4.02e+08	2.24e+08	1.78e+08	1.25;y	34:46	88.602	0.0333	7648;y	7795;y	no
ES	13C-1,2,3,4,6,7,8-HpCDD	3.15e+08	1.61e+08	1.54e+08	1.04;y	37:10	93.683	0.0230	5707;y	17845;y	no
ES	13C-OCDD	4.55e+08	2.14e+08	2.40e+08	0.89;y	40:02	167.968	0.0112	20398;y	34679;y	no
ES/RT	13C-2,3,7,8-TCDF	5.71e+08	2.52e+08	3.19e+08	0.79;y	27:26	95.373	0.0222	9170;y	18445;y	no
ES	13C-1,2,3,7,8-PeCDF	4.99e+08	3.04e+08	1.95e+08	1.56;y	31:57	95.901	0.0144	48034;y	22227;y	no
ES	13C-1,2,3,6,7,8-HxCDF	4.22e+08	1.45e+08	2.77e+08	0.52;y	34:15	80.565	0.0990	4022;y	2424;y	no
ES	13C-1,2,3,4,6,7,8-HpCDF	2.51e+08	7.68e+07	1.74e+08	0.44;y	36:22	78.818	0.0384	3554;y	5227;y	no
JS	13C-1,2,3,4-TCDD	4.34e+08	1.92e+08	2.43e+08	0.79;y	28:09	90.053	-	5603;y	13533;y	no
JS	13C-1,2,3,7,8,9-HxCDD	4.23e+08	2.35e+08	1.88e+08	1.25;y	34:59	106.614	-	8240;y	8615;y	no
CS	37Cl-2,3,7,8-TCDD	2.86e+08	2.86e+08	-	-;-	28:28	65.473	0.0117	16203;y	-; -	no
CS	13C-2,3,4,7,8-PeCDF	2.98e+08	1.81e+08	1.16e+08	1.56;y	32:24	58.436	0.0147	30676;y	13931;y	no
CS	13C-1,2,3,4,7,8-HxCDD	2.04e+08	1.13e+08	9.12e+07	1.24;y	34:42	66.782	0.0494	4987;y	5246;y	no
CS	13C-1,2,3,4,7,8-HxCDF	1.86e+08	6.34e+07	1.23e+08	0.52;y	34:11	45.629	0.1270	1736;y	1050;y	no
CS	13C-1,2,3,4,7,8,9-HpCDF	6.52e+07	1.97e+07	4.55e+07	0.43;y	37:32	26.175	0.0491	839;y	1229;y	no
SS	37Cl-2,3,7,8-TCDD	2.86e+08	2.86e+08	-	-;-	28:28	69.143	0.0127	16203;y	-; -	no
SS	13C-2,3,4,7,8-PeCDF	2.98e+08	1.81e+08	1.16e+08	1.56;y	32:24	60.955	0.0093	30676;y	13931;y	no
SS	13C-1,2,3,4,7,8-HxCDD	2.04e+08	1.13e+08	9.12e+07	1.24;y	34:42	75.275	0.0577	4987;y	5246;y	no
SS	13C-1,2,3,4,7,8-HxCDF	1.86e+08	6.34e+07	1.23e+08	0.52;y	34:11	56.187	0.1359	1736;y	1050;y	no
SS	13C-1,2,3,4,7,8,9-HpCDF	6.52e+07	1.97e+07	4.55e+07	0.43;y	37:32	33.221	0.0838	839;y	1229;y	no

11.

Ent: 39 Name: Total Tetra-Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:25

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 243.37 of which 28.16 named and 215.22 unnamed
Conc: 243.37 of which 28.16 named and 215.22 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	23:41	9.8e+07	0.76 y	18.08				
			9.8e+07			4.3e+07	9.1e+06	1.1e+03	y n
						5.6e+07	1.2e+07	1.6e+03	y n
	2	24:15	4.8e+07	0.76 y	8.82				
			4.8e+07			2.1e+07	4.5e+06	5.2e+02	y n
						2.7e+07	6.1e+06	8.0e+02	y n
	3	24:34	4.4e+07	0.77 y	8.12				
			4.4e+07			1.9e+07	4.2e+06	4.8e+02	y n
						2.5e+07	5.4e+06	7.1e+02	y n
	4	24:52	2.0e+08	0.76 y	36.88				
			2.0e+08			8.7e+07	1.7e+07	2.0e+03	y n
						1.1e+08	2.2e+07	2.9e+03	y n
	5	24:59	5.1e+07	0.76 y	9.31				
			5.1e+07			2.2e+07	3.3e+06	3.8e+02	y n
						2.9e+07	4.3e+06	5.7e+02	y n
	6	25:11	4.7e+07	0.76 y	8.58				
			4.7e+07			2.0e+07	4.5e+06	5.2e+02	y n
						2.7e+07	5.8e+06	7.7e+02	y n
	7	25:17	1.4e+08	0.77 y	24.92				
			1.4e+08			5.9e+07	7.9e+06	9.1e+02	y n
						7.7e+07	1.0e+07	1.4e+03	y n
	8	25:41	4.2e+07	0.75 y	7.79				
			4.2e+07			1.8e+07	4.9e+06	5.6e+02	y n
						2.4e+07	6.4e+06	8.4e+02	y n
	9	25:45	7.3e+07	0.77 y	13.47				
			7.3e+07			3.2e+07	6.3e+06	7.3e+02	y n
						4.1e+07	8.2e+06	1.1e+03	y n
	10	26:01	3.7e+07	0.76 y	6.76				
			3.7e+07			1.6e+07	3.4e+06	4.0e+02	y n
						2.1e+07	4.5e+06	5.9e+02	y n
	11	26:09	5.8e+07	0.77 y	10.76				
			5.8e+07			2.5e+07	5.4e+06	6.3e+02	y n
						3.3e+07	7.0e+06	9.2e+02	y n
	12	26:26	1.1e+08	0.76 y	19.64				
			1.1e+08			4.6e+07	9.0e+06	1.0e+03	y n
						6.1e+07	1.2e+07	1.6e+03	y n
	13	26:34	9.2e+07	0.76 y	16.96				
			9.2e+07			4.0e+07	8.3e+06	9.6e+02	y n
						5.2e+07	1.1e+07	1.4e+03	y n
	14	26:51	5.3e+07	0.76 y	9.70				
			5.3e+07			2.3e+07	4.6e+06	5.3e+02	y n
						3.0e+07	6.0e+06	7.8e+02	y n
	15	27:04	2.9e+06	0.76 y	0.53				
			2.9e+06			1.2e+06	3.3e+05	3.8e+01	y n
						1.6e+06	4.1e+05	5.4e+01	y n
	16	27:11	2.5e+07	0.76 y	4.60				
			2.5e+07			1.1e+07	2.3e+06	2.6e+02	y n
						1.4e+07	3.0e+06	3.9e+02	y n
2,3,7,8-TCDF	17	27:29	1.5e+08	0.77 y	28.16				
			1.5e+08			6.7e+07	1.0e+07	1.2e+03	y n
						8.7e+07	1.3e+07	1.7e+03	y n
	18	28:03	3.0e+07	0.76 y	5.45				
			3.0e+07			1.3e+07	2.6e+06	3.0e+02	y n
						1.7e+07	3.4e+06	4.4e+02	y n
	19	28:20	1.7e+07	0.74 y	3.19				
			1.7e+07			7.4e+06	1.4e+06	1.7e+02	y n
						1.0e+07	1.9e+06	2.5e+02	y n

```
20 28:33 3.1e+06  0.75 y    0.58
         3.1e+06                1.4e+06 2.6e+05 3.0e+01 y  n
                                1.8e+06 3.5e+05 4.6e+01 y  n
21 28:53 5.7e+05  1.04 n    0.11
         5.7e+05                2.9e+05 5.9e+04 6.8e+00 y  n
                                2.8e+05 5.7e+04 7.5e+00 y  n
22 29:05 2.4e+05  0.74 y    0.04
         2.4e+05                1.0e+05 3.0e+04 3.5e+00 y  n
                                1.4e+05 4.1e+04 5.3e+00 y  n
23 29:18 5.0e+05  0.82 y    0.09
         5.0e+05                2.2e+05 6.0e+04 6.9e+00 y  n
                                2.7e+05 7.0e+04 9.2e+00 y  n
24 29:48 4.2e+06  1.19 n    0.77
         4.2e+06                2.3e+06 4.1e+05 4.8e+01 y  n
                                1.9e+06 3.6e+05 4.7e+01 y  n
25 30:00 3.1e+05  1.12 n    0.06
         3.1e+05                1.7e+05 3.8e+04 4.4e+00 y  n
                                1.5e+05 3.8e+04 5.0e+00 y  n
```

Ent: 40 Name: Total Tetra-Dioxins F:1 Mass: 319.897 321.894 Mod? no #Hom:15

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 31.42 of which 0.41 named and 31.01 unnamed
Conc: 31.42 of which 0.41 named and 31.01 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	25:16	5.6e+07	0.77 y	12.69				
			5.6e+07			2.5e+07	5.3e+06	3.3e+03	y n
						3.2e+07	6.8e+06	3.4e+03	y n
	2	25:41	2.8e+07	0.77 y	6.40				
			2.8e+07			1.2e+07	2.6e+06	1.6e+03	y n
						1.6e+07	3.4e+06	1.7e+03	y n
	3	26:04	4.9e+06	0.80 y	1.09				
			4.9e+06			2.2e+06	4.5e+05	2.8e+02	y n
						2.7e+06	5.7e+05	2.9e+02	y n
	4	26:55	1.8e+07	0.78 y	3.95				
			1.8e+07			7.7e+06	1.4e+06	8.5e+02	y n
						9.8e+06	1.8e+06	8.9e+02	y n
	5	27:08	3.5e+06	0.81 y	0.79				
			3.5e+06			1.6e+06	2.4e+05	1.5e+02	y n
						1.9e+06	3.1e+05	1.5e+02	y n
	6	27:17	4.6e+06	0.79 y	1.03				
			4.6e+06			2.0e+06	4.0e+05	2.5e+02	y n
						2.6e+06	5.1e+05	2.6e+02	y n
	7	27:24	9.1e+05	1.02 n	0.21				
			9.1e+05			4.6e+05	1.0e+05	6.4e+01	y n
						4.5e+05	1.1e+05	5.3e+01	y n
	8	27:46	3.9e+06	0.81 y	0.88				
			3.9e+06			1.7e+06	3.6e+05	2.2e+02	y n
						2.2e+06	4.5e+05	2.3e+02	y n
	9	28:11	4.8e+06	0.77 y	1.09				
			4.8e+06			2.1e+06	4.3e+05	2.7e+02	y n
						2.7e+06	5.4e+05	2.7e+02	y n
	10	28:20	8.3e+06	0.77 y	1.87				
			8.3e+06			3.6e+06	6.9e+05	4.3e+02	y n
						4.7e+06	8.7e+05	4.4e+02	y n
2,3,7,8-TCDD	11	28:28	1.8e+06	0.69 y	0.41				
			1.8e+06			7.4e+05	1.4e+05	8.9e+01	y n
						1.1e+06	2.1e+05	1.1e+02	y n
	12	28:40	1.7e+06	0.79 y	0.37				
			1.7e+06			7.3e+05	1.4e+05	8.9e+01	y n
						9.3e+05	1.9e+05	9.3e+01	y n
	13	28:58	1.8e+06	0.80 y	0.40				
			1.8e+06			8.0e+05	1.6e+05	9.9e+01	y n
						9.9e+05	2.0e+05	1.0e+02	y n
	14	29:18	5.8e+05	0.77 y	0.13				
			5.8e+05			2.5e+05	5.5e+04	3.4e+01	y n
						3.3e+05	6.7e+04	3.4e+01	y n
	15	29:54	4.7e+05	0.69 y	0.11				
			4.7e+05			1.9e+05	3.9e+04	2.4e+01	y n
						2.8e+05	5.9e+04	3.0e+01	y n

Ent: 41 Name: Total Penta-Furans F:2 Mass: 339.860 341.857 Mod? no #Hom:16

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 59.75 of which 6.08 named and 53.67 unnamed
Conc: 59.75 of which 6.08 named and 53.67 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	30:17	3.3e+07	1.52 y	7.40					
			3.3e+07			2.0e+07	3.8e+06	2.7e+02	y	n
						1.3e+07	2.5e+06	3.0e+02	y	n
	2	31:16	1.8e+07	1.57 y	4.08					
			1.8e+07			1.1e+07	3.8e+06	2.7e+02	y	n
						7.0e+06	2.4e+06	2.9e+02	y	n
	3	31:22	7.7e+07	1.53 y	17.38					
			7.7e+07			4.6e+07	1.4e+07	1.0e+03	y	n
						3.0e+07	9.4e+06	1.1e+03	y	n
	4	31:30	1.2e+07	1.53 y	2.77					
			1.2e+07			7.4e+06	2.1e+06	1.5e+02	y	n
						4.8e+06	1.4e+06	1.7e+02	y	n
	5	31:36	1.7e+06	1.43 y	0.38					
			1.7e+06			9.8e+05	3.9e+05	2.8e+01	y	n
						6.8e+05	2.6e+05	3.1e+01	y	n
	6	31:39	1.7e+06	1.77 y	0.39					
			1.7e+06			1.1e+06	3.8e+05	2.7e+01	y	n
						6.3e+05	2.2e+05	2.6e+01	y	n
	7	31:45	3.7e+07	1.50 y	8.33					
			3.7e+07			2.2e+07	7.1e+06	5.0e+02	y	n
						1.5e+07	4.8e+06	5.8e+02	y	n
	8	31:55	1.7e+07	1.47 y	3.94					
			1.7e+07			1.0e+07	3.5e+06	2.5e+02	y	n
						7.1e+06	2.3e+06	2.8e+02	y	n
1,2,3,7,8-PeCDF	9	31:57	1.2e+07	1.63 y	2.73					
			1.2e+07			7.3e+06	3.1e+06	2.2e+02	y	n
						4.5e+06	2.0e+06	2.4e+02	y	n
	10	32:04	6.9e+06	1.48 y	1.57					
			6.9e+06			4.1e+06	1.5e+06	1.1e+02	y	n
						2.8e+06	1.0e+06	1.2e+02	y	n
	11	32:08	1.5e+07	1.53 y	3.44					
			1.5e+07			9.2e+06	3.3e+06	2.3e+02	y	n
						6.0e+06	2.2e+06	2.6e+02	y	n
2,3,4,7,8-PeCDF	12	32:24	1.5e+07	1.55 y	3.35					
			1.5e+07			9.2e+06	3.3e+06	2.4e+02	y	n
						5.9e+06	2.2e+06	2.6e+02	y	n
	13	32:30	1.4e+07	1.46 y	3.23					
			1.4e+07			8.5e+06	2.9e+06	2.1e+02	y	n
						5.8e+06	2.0e+06	2.3e+02	y	n
	14	32:36	7.5e+05	1.47 y	0.17					
			7.5e+05			4.5e+05	1.7e+05	1.2e+01	y	n
						3.0e+05	1.1e+05	1.3e+01	y	n
	15	32:39	1.7e+06	1.49 y	0.38					
			1.7e+06			1.0e+06	3.5e+05	2.5e+01	y	n
						6.8e+05	2.3e+05	2.8e+01	y	n
	16	32:58	1.0e+06	1.52 y	0.23					
			1.0e+06			6.0e+05	2.2e+05	1.5e+01	y	n
						4.0e+05	1.5e+05	1.7e+01	y	n

Ent: 42 Name: Total Penta-Dioxins F:2 Mass: 355.855 357.852 Mod? no #Hom:11

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 12.48 of which 0.45 named and 12.03 unnamed
Conc: 12.48 of which 0.45 named and 12.03 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	31:30	1.6e+07	1.51 y	3.88					
			1.6e+07			9.4e+06	3.1e+06	1.1e+03	y	n
						6.2e+06	2.0e+06	1.2e+03	y	n
	2	31:49	1.0e+06	1.53 y	0.25					
			1.0e+06			6.1e+05	2.2e+05	8.1e+01	y	n
						4.0e+05	1.5e+05	8.6e+01	y	n
	3	32:00	1.3e+07	1.54 y	3.21					
			1.3e+07			7.9e+06	2.8e+06	1.0e+03	y	n
						5.1e+06	1.8e+06	1.1e+03	y	n
	4	32:04	1.8e+06	1.43 y	0.44					
			1.8e+06			1.0e+06	3.8e+05	1.4e+02	y	n
						7.3e+05	2.6e+05	1.5e+02	y	n
	5	32:10	7.8e+06	1.49 y	1.95					
			7.8e+06			4.7e+06	1.7e+06	6.1e+02	y	n
						3.2e+06	1.1e+06	6.7e+02	y	n
	6	32:20	2.2e+06	1.10 n	0.55					
			2.2e+06			1.2e+06	3.6e+05	1.3e+02	y	n
						1.1e+06	2.3e+05	1.3e+02	y	n
	7	32:26	3.8e+06	1.60 y	0.94					
			3.8e+06			2.3e+06	8.5e+05	3.1e+02	y	n
						1.5e+06	5.4e+05	3.2e+02	y	n
	8	32:30	1.6e+06	1.67 y	0.39					
			1.6e+06			9.9e+05	3.6e+05	1.3e+02	y	n
						6.0e+05	2.2e+05	1.3e+02	y	n
1,2,3,7,8-PeCDD	9	32:37	1.8e+06	1.49 y	0.45					
			1.8e+06			1.1e+06	4.0e+05	1.4e+02	y	n
						7.3e+05	2.7e+05	1.6e+02	y	n
	10	32:43	9.3e+05	1.62 y	0.23					
			9.3e+05			5.7e+05	2.0e+05	7.2e+01	y	n
						3.5e+05	1.2e+05	7.0e+01	y	n
	11	32:54	7.4e+05	1.42 y	0.18					
			7.4e+05			4.3e+05	1.6e+05	5.9e+01	y	n
						3.1e+05	1.1e+05	6.4e+01	y	n

Ent: 43 Name: Total Hexa-Furans F:3 Mass: 373.821 375.818 Mod? no #Hom:12

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 11.52 of which 5.53 named and 5.99 unnamed
Conc: 11.52 of which 5.53 named and 5.99 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:32	5.5e+06	1.18 y	1.41				
			5.5e+06			3.0e+06	1.1e+06	1.1e+02 y	n
						2.5e+06	9.2e+05	1.1e+02 y	n
	2	33:38	1.3e+07	1.24 y	3.37				
			1.3e+07			7.3e+06	2.6e+06	2.7e+02 y	n
						5.9e+06	2.0e+06	2.4e+02 y	n
	3	33:43	8.3e+05	1.32 y	0.21				
			8.3e+05			4.7e+05	1.5e+05	1.5e+01 y	n
						3.6e+05	1.1e+05	1.3e+01 y	n
	4	33:49	9.8e+05	1.33 y	0.25				
			9.8e+05			5.6e+05	1.9e+05	1.9e+01 y	n
						4.2e+05	1.4e+05	1.7e+01 y	n
	5	33:55	5.3e+05	1.33 y	0.14				
			5.3e+05			3.1e+05	1.0e+05	1.1e+01 y	n
						2.3e+05	8.7e+04	1.0e+01 y	n
	6	34:03	2.3e+04	1.73 n	0.01				
			2.3e+04			1.5e+04	5.9e+03	6.2e-01 n	n
						8.5e+03	3.3e+03	3.8e-01 n	n
1,2,3,4,7,8-HxCDF	7	34:11	1.2e+07	1.23 y	3.23				
			1.2e+07			6.5e+06	2.0e+06	2.1e+02 y	n
						5.3e+06	1.6e+06	1.9e+02 y	n
1,2,3,6,7,8-HxCDF	8	34:15	5.5e+06	1.24 y	1.20				
			5.5e+06			3.1e+06	1.0e+06	1.0e+02 y	n
						2.5e+06	8.1e+05	9.4e+01 y	n
	9	34:20	1.1e+06	1.38 y	0.29				
			1.1e+06			6.5e+05	2.1e+05	2.1e+01 y	n
						4.7e+05	1.6e+05	1.8e+01 y	n
	10	34:28	1.2e+06	1.39 y	0.31				
			1.2e+06			7.1e+05	1.7e+05	1.8e+01 y	n
						5.1e+05	1.2e+05	1.4e+01 y	n
2,3,4,6,7,8-HxCDF	11	34:38	3.4e+06	1.31 y	0.86				
			3.4e+06			1.9e+06	4.9e+05	5.2e+01 y	n
						1.5e+06	4.1e+05	4.8e+01 y	n
1,2,3,7,8,9-HxCDF	12	35:12	8.2e+05	1.26 y	0.24				
			8.2e+05			4.6e+05	1.3e+05	1.3e+01 y	n
						3.6e+05	1.0e+05	1.2e+01 y	n

Ent: 44 Name: Total Hexa-Dioxins F:3 Mass: 389.816 391.813 Mod? no #Hom:10

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 10.16 of which 1.08 named and 9.08 unnamed
Conc: 10.16 of which 1.08 named and 9.08 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:52	2.0e+06	1.21 y	0.63				
			2.0e+06			1.1e+06	3.9e+05	6.1e+01 y	n
						9.1e+05	3.2e+05	4.7e+01 y	n
	2	34:11	2.3e+07	1.25 y	7.08				
			2.3e+07			1.3e+07	4.3e+06	6.7e+02 y	n

							1.0e+07	3.5e+06	5.1e+02	y	n
	3	34:20	3.7e+06	1.23	y	1.15					
			3.7e+06				2.0e+06	6.5e+05	1.0e+02	y	n
							1.6e+06	5.2e+05	7.6e+01	y	n
	4	34:26	6.7e+05	1.48	n	0.21					
			6.7e+05				4.0e+05	1.1e+05	1.7e+01	y	n
							2.7e+05	8.4e+04	1.2e+01	y	n
1,2,3,4,7,8-HxCDD	5	34:43	6.6e+05	1.67	n	0.24					
			6.6e+05				4.1e+05	1.5e+05	2.3e+01	y	n
							2.5e+05	1.1e+05	1.6e+01	y	n
1,2,3,6,7,8-HxCDD	6	34:46	1.3e+06	1.13	y	0.39					
			1.3e+06				7.1e+05	2.3e+05	3.6e+01	y	n
							6.2e+05	1.9e+05	2.7e+01	y	n
1,2,3,7,8,9-HxCDD	7	34:59	1.6e+06	1.28	y	0.45					
			1.6e+06				8.8e+05	2.2e+05	3.5e+01	y	n
							6.8e+05	1.7e+05	2.5e+01	y	n
	8	35:06	3.8e+04	0.58	n	0.01					
			3.8e+04				1.4e+04	5.9e+03	9.2e-01	n	n
							2.4e+04	6.5e+03	9.6e-01	n	n
	9	35:12	6.5e+03	0.31	n	0.00					
			6.5e+03				1.5e+03	8.1e+02	1.3e-01	n	n
							4.9e+03	1.8e+03	2.7e-01	n	n
	10	35:16	1.1e+04	2.70	n	0.00					
			1.1e+04				7.9e+03	2.2e+03	3.4e-01	n	n
							2.9e+03	1.6e+03	2.4e-01	n	n

Ent: 45 Name: Total Hepta-Furans F:4 Mass: 407.782 409.779 Mod? no #Hom:4

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 1.67 of which 1.30 named and 0.37 unnamed
Conc: 1.67 of which 1.30 named and 0.37 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
1,2,3,4,6,7,8-HpCDF1		36:22	3.7e+06	1.02 y	1.17					
			3.7e+06			1.9e+06	5.4e+05	1.2e+02	y	n
						1.8e+06	5.5e+05	1.4e+02	y	n
	2	36:34	5.7e+05	0.97 y	0.20					
			5.7e+05			2.8e+05	8.0e+04	1.8e+01	y	n
						2.9e+05	8.3e+04	2.2e+01	y	n
	3	36:40	5.0e+05	1.08 y	0.17					
			5.0e+05			2.6e+05	6.8e+04	1.5e+01	y	n
						2.4e+05	6.9e+04	1.8e+01	y	n
1,2,3,4,7,8,9-HpCDF4		37:32	3.2e+05	1.24 n	0.12					
			3.2e+05			1.8e+05	4.5e+04	1.0e+01	y	n
						1.4e+05	4.1e+04	1.1e+01	y	n

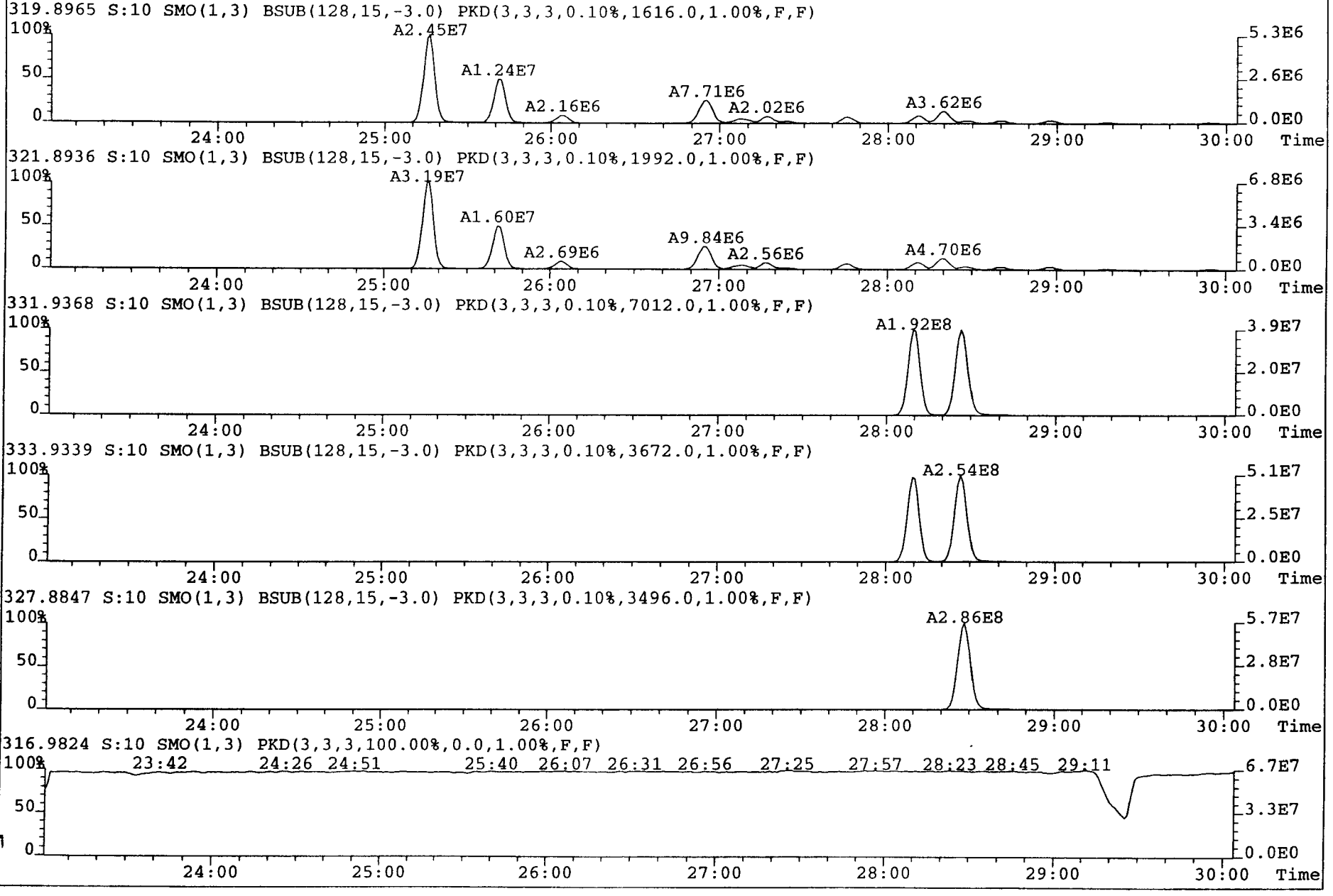
Ent: 46 Name: Total Hepta-Dioxins F:4 Mass: 423.777 425.774 Mod? no #Hom:4

Run: 15 File: a17jul98b S:10 Acq:17-JUL-98 23:31:42 Proc:20-JUL-98 09:06:13
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

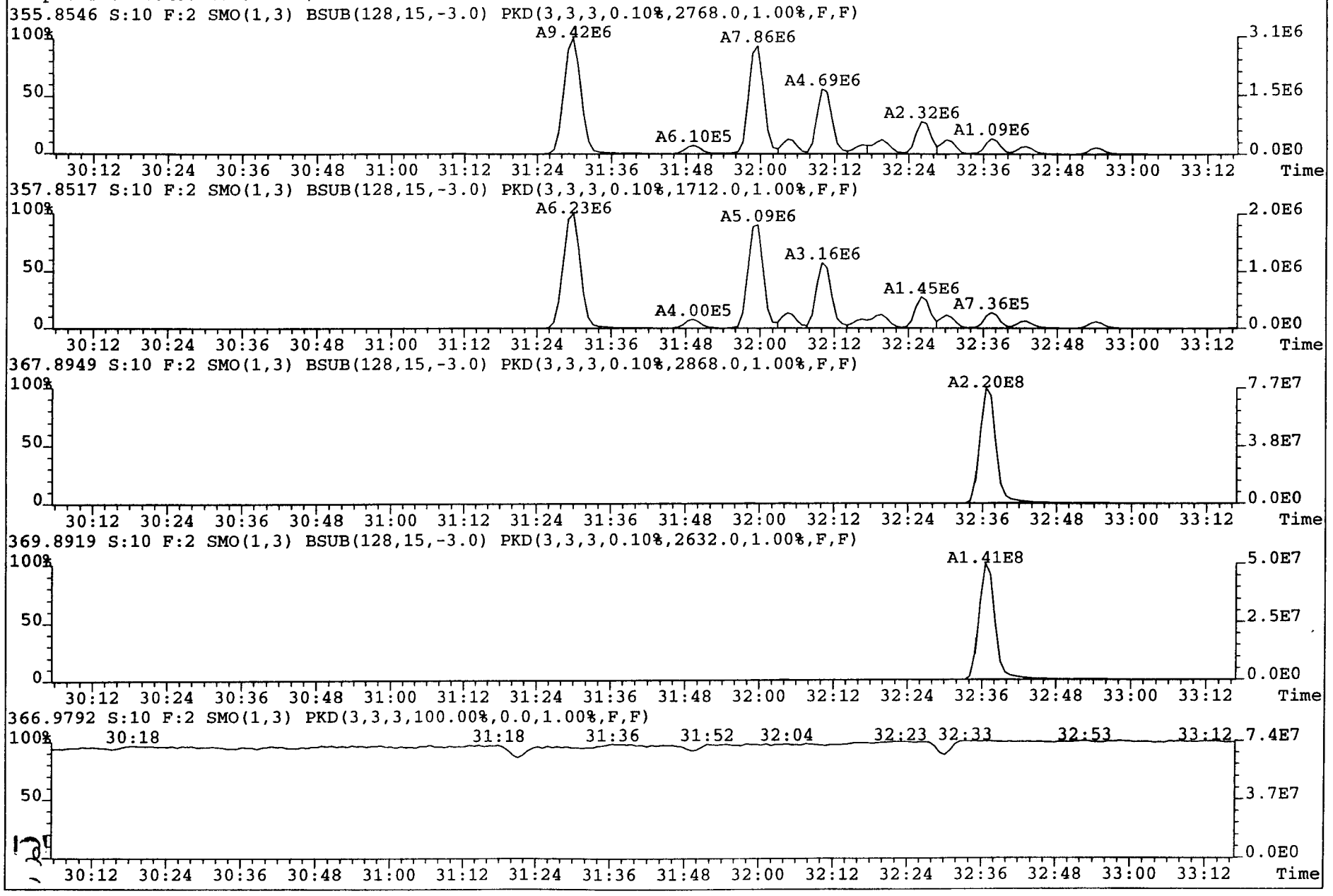
Amount: 1.51 of which 0.75 named and 0.76 unnamed
Conc: 1.51 of which 0.75 named and 0.76 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	36:22	7.7e+04	4.63 n	0.03					
			7.7e+04			6.3e+04	1.9e+04	1.2e+01	y	n
						1.4e+04	5.2e+03	1.8e+00	n	n
	2	36:35	2.0e+06	0.99 y	0.72					
			2.0e+06			1.0e+06	3.0e+05	2.0e+02	y	n
						1.0e+06	3.0e+05	1.0e+02	y	n
	3	36:49	2.9e+04	0.81 n	0.01					
			2.9e+04			1.3e+04	4.3e+03	2.8e+00	n	n
						1.6e+04	4.0e+03	1.4e+00	n	n
1,2,3,4,6,7,8-HpCDD4		37:11	2.1e+06	1.13 y	0.75					
			2.1e+06			1.1e+06	3.1e+05	2.1e+02	y	n
						1.0e+06	2.7e+05	9.4e+01	y	n

File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10

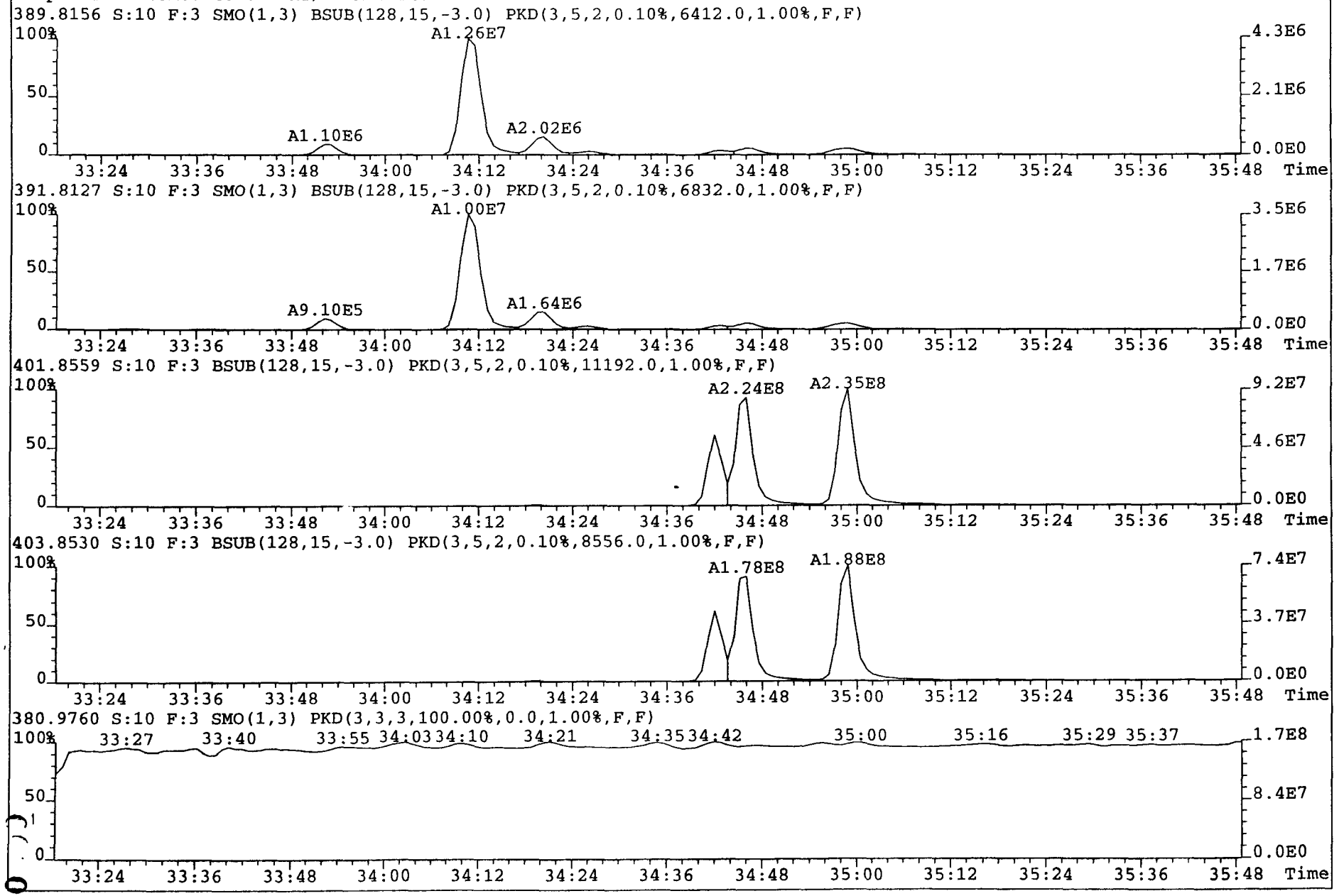


File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10

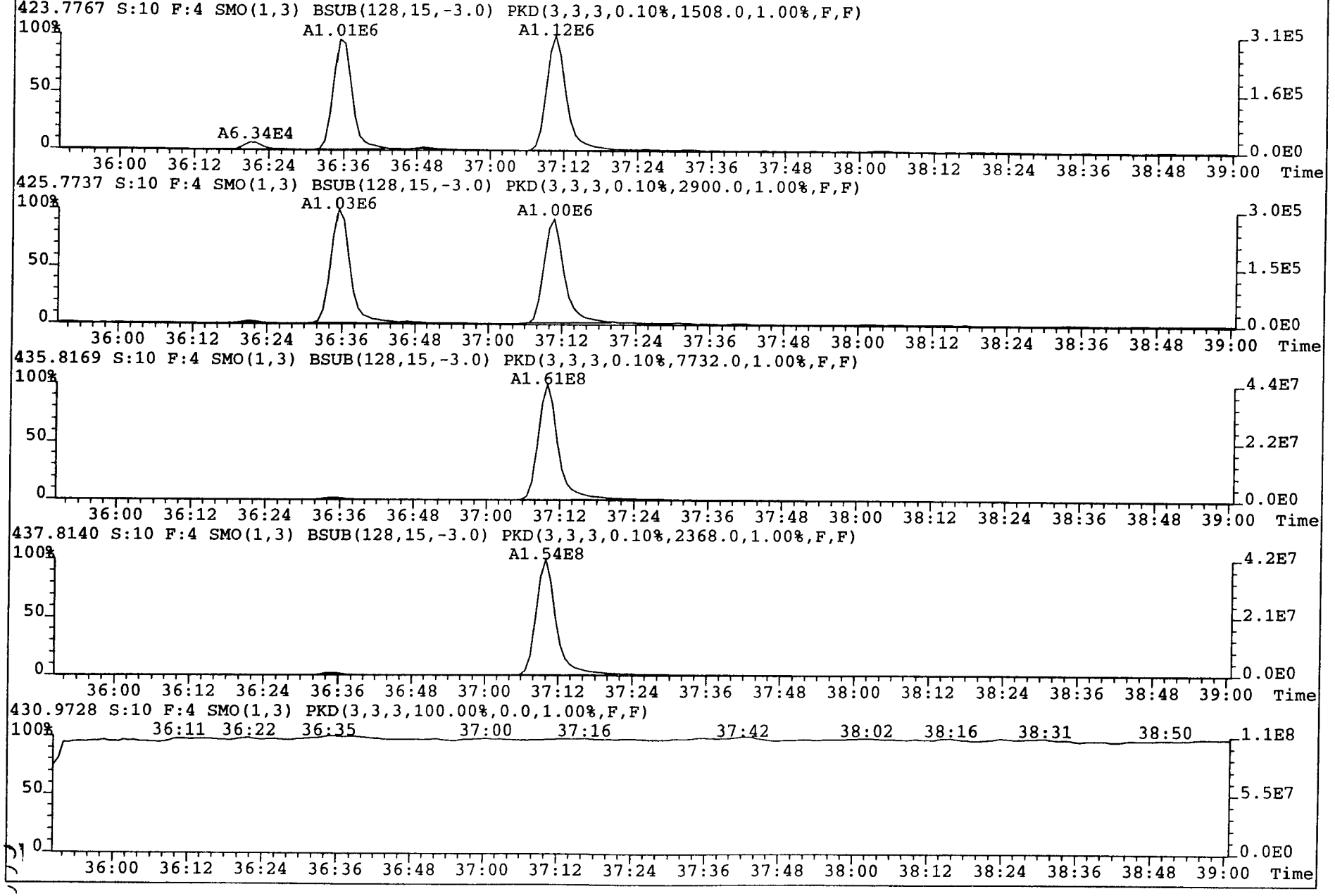


055

File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP M23 DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10

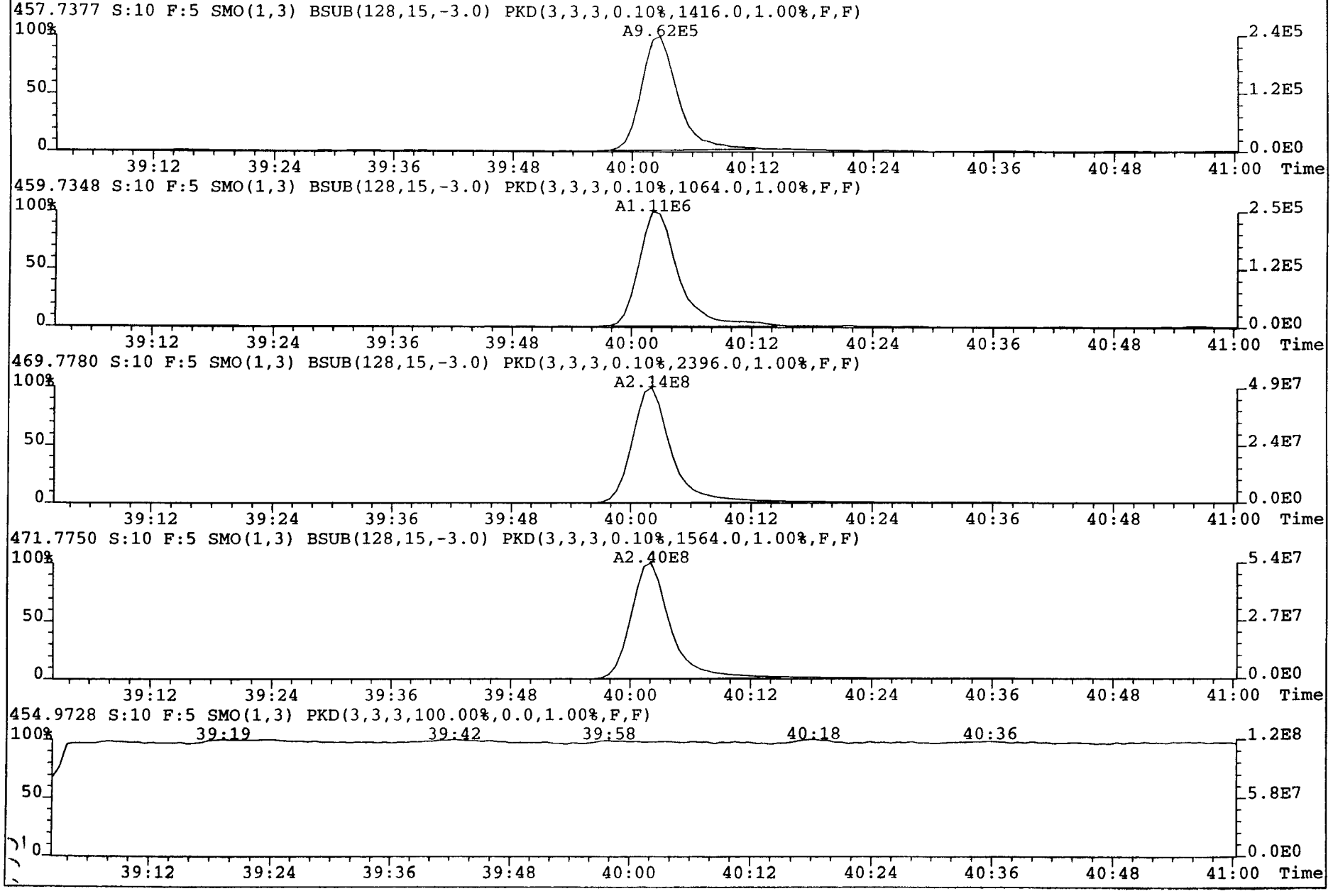


File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10



057

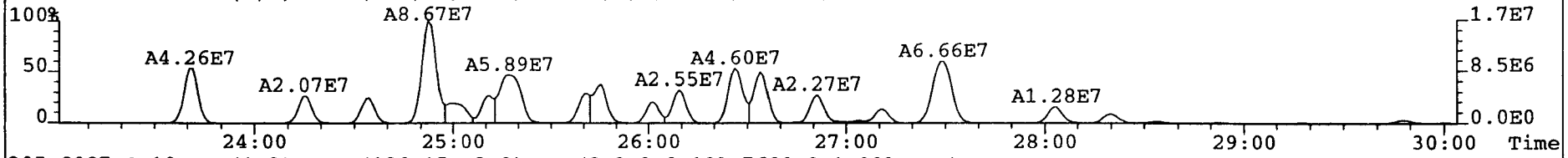
File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10



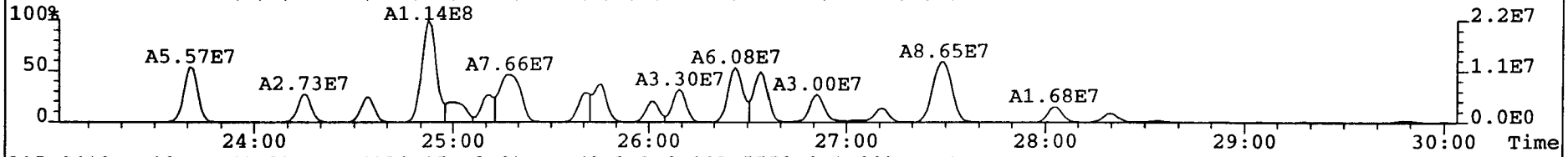
058

File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10

303.9016 S:10 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,8648.0,1.00%,F,F)



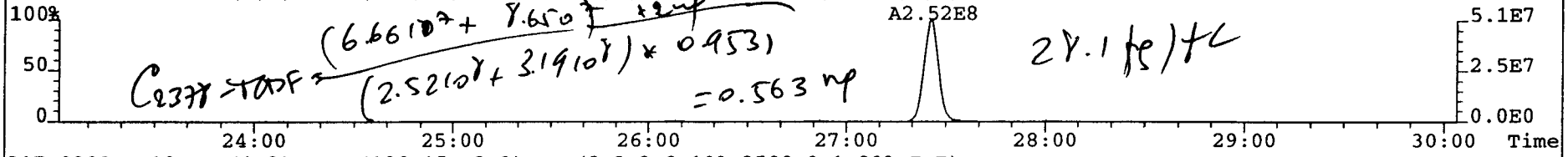
305.8987 S:10 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,7600.0,1.00%,F,F)



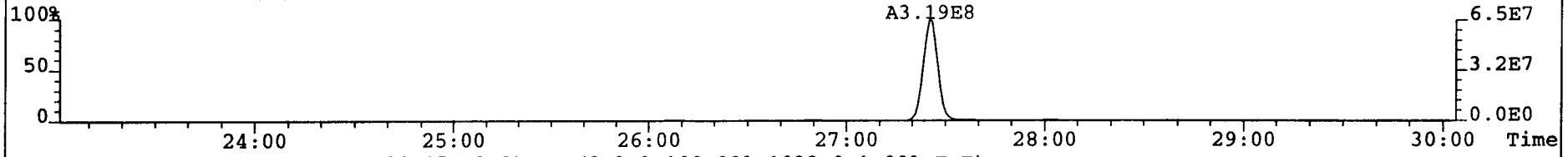
315.9419 S:10 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,5552.0,1.00%,F,F)

$C_{2377-TCDF} = \frac{(6.66\,10^7 + 7.65\,10^7 + \text{trace})}{(2.52\,10^7 + 3.19\,10^7) \times 0.953} = 0.563$ ng

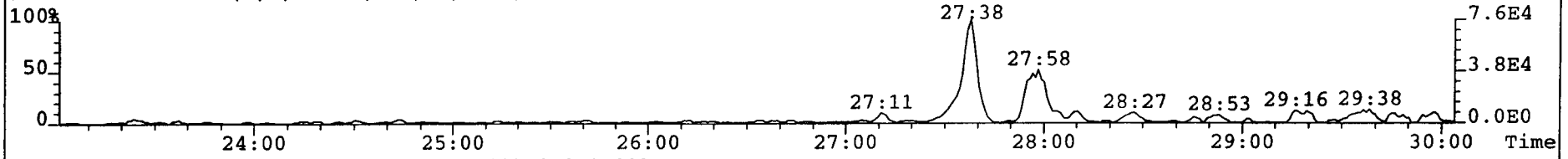
27.1 pg/µL



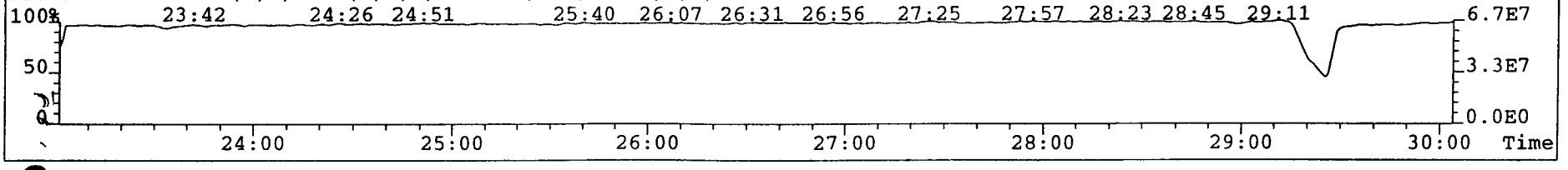
317.9389 S:10 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3500.0,1.00%,F,F)



375.8364 S:10 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,1032.0,1.00%,F,F)

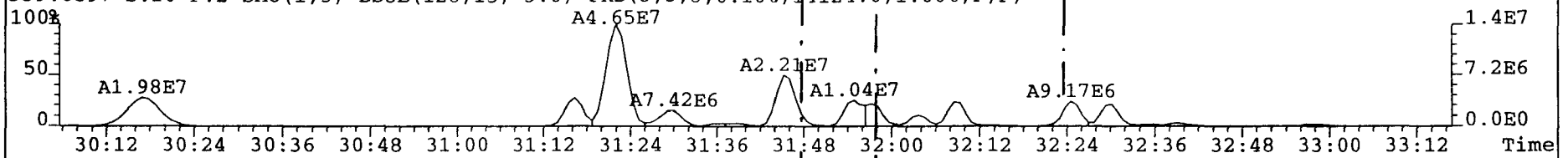


316.9824 S:10 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)

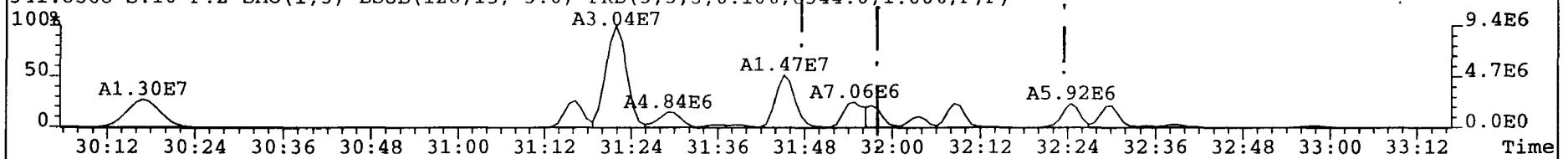


File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10

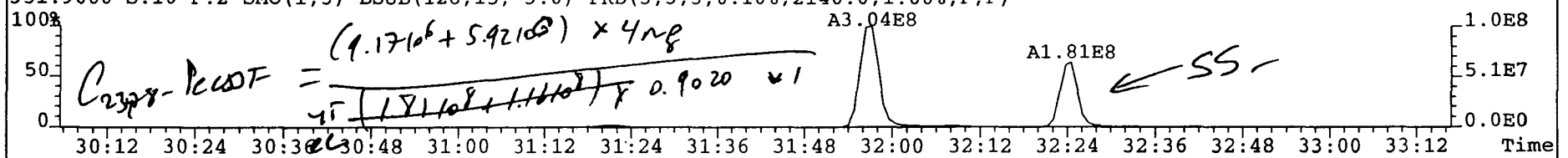
339.8597 S:10 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,14124.0,1.00%,F,F)



341.8568 S:10 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,8344.0,1.00%,F,F)



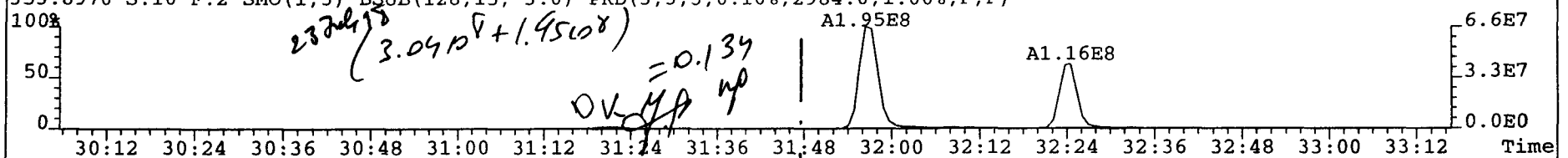
351.9000 S:10 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2140.0,1.00%,F,F)



C_{2378}-PeCDF = $\frac{(1.17\cdot10^6 + 5.92\cdot10^6) \times 4ng}{(1.71\cdot10^8 + 1.16\cdot10^8) \times 0.9020 \times 1}$ = 0.134 ng

SS

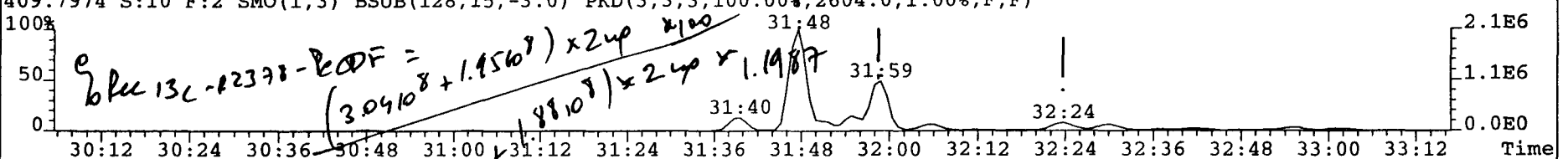
353.8970 S:10 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2984.0,1.00%,F,F)



2378-PeCDF $(3.04\cdot10^8 + 1.95\cdot10^8)$

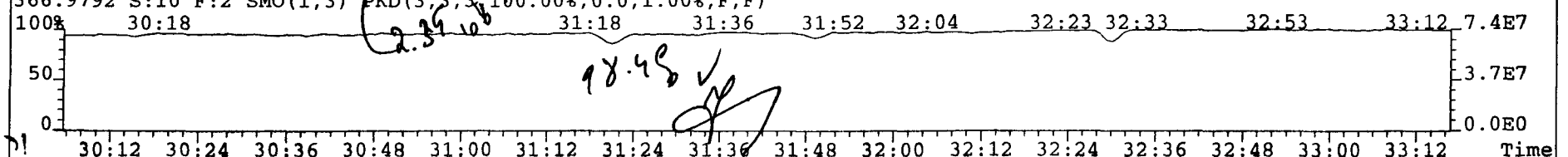
OK

409.7974 S:10 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,2604.0,1.00%,F,F)



^{13}C-2378-PeCDF = $\frac{(3.04\cdot10^8 + 1.95\cdot10^8) \times 2ng \times 100}{(1.88\cdot10^8) \times 2ng \times 1.1987}$

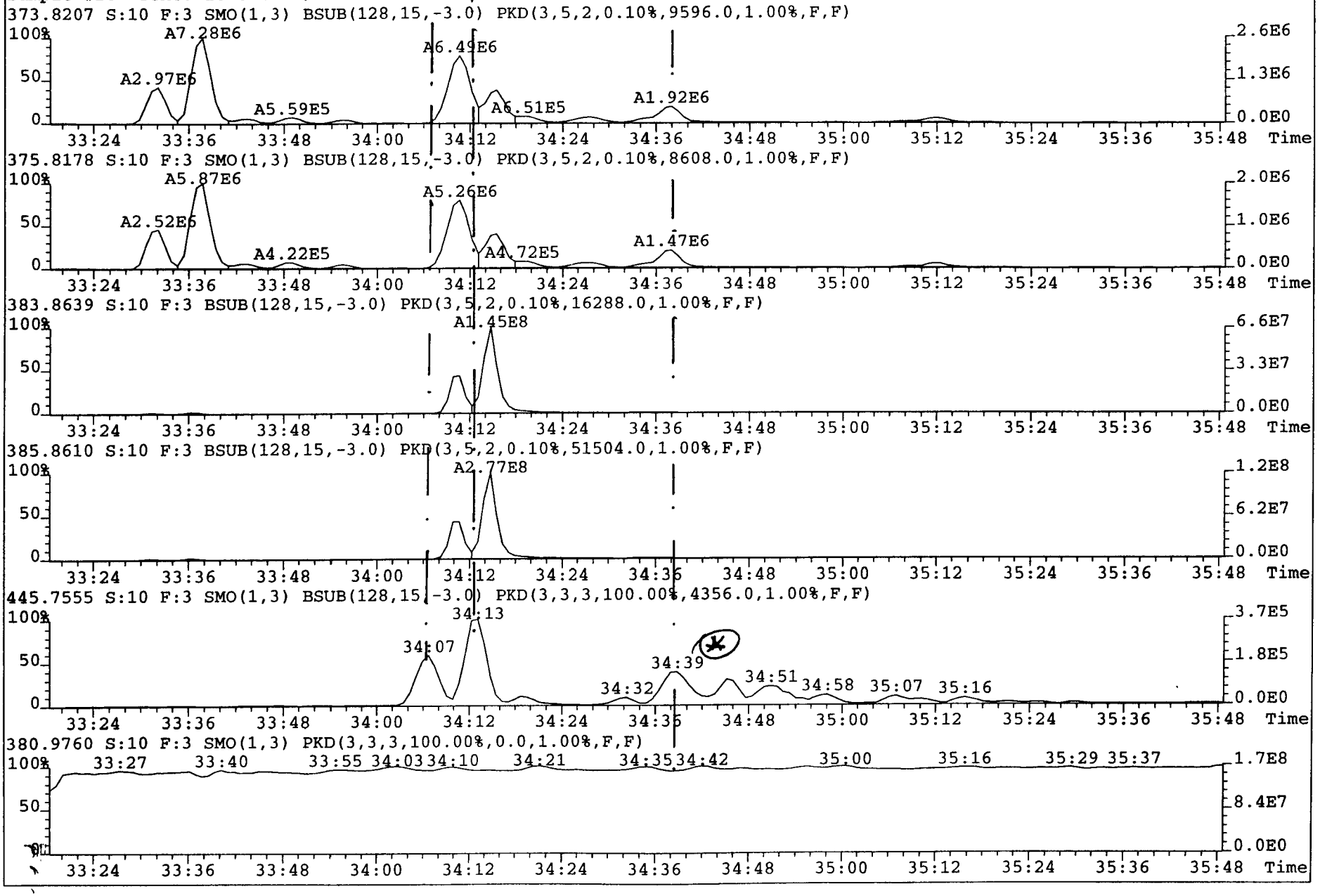
366.9792 S:10 F:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)



98.4% ✓

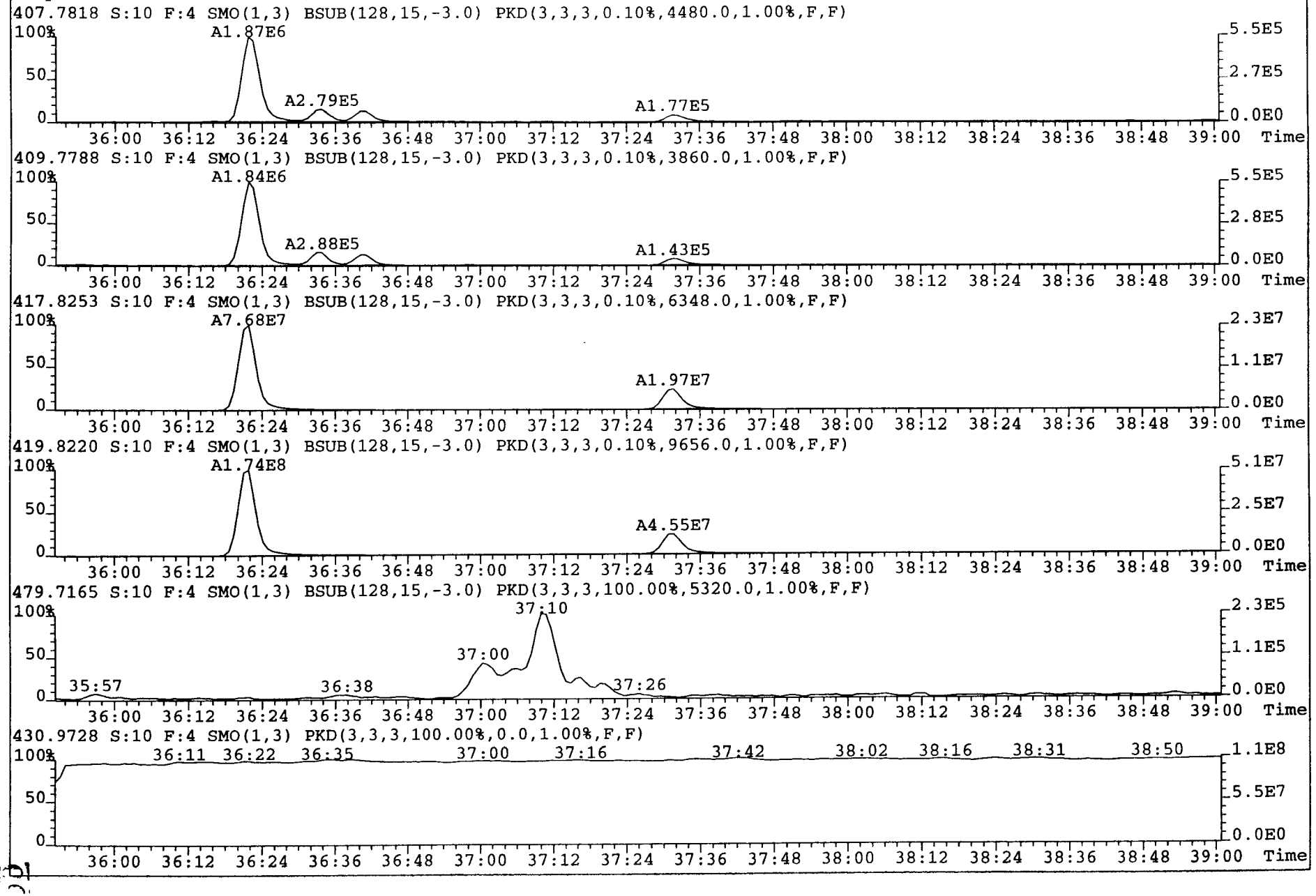
060

File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10

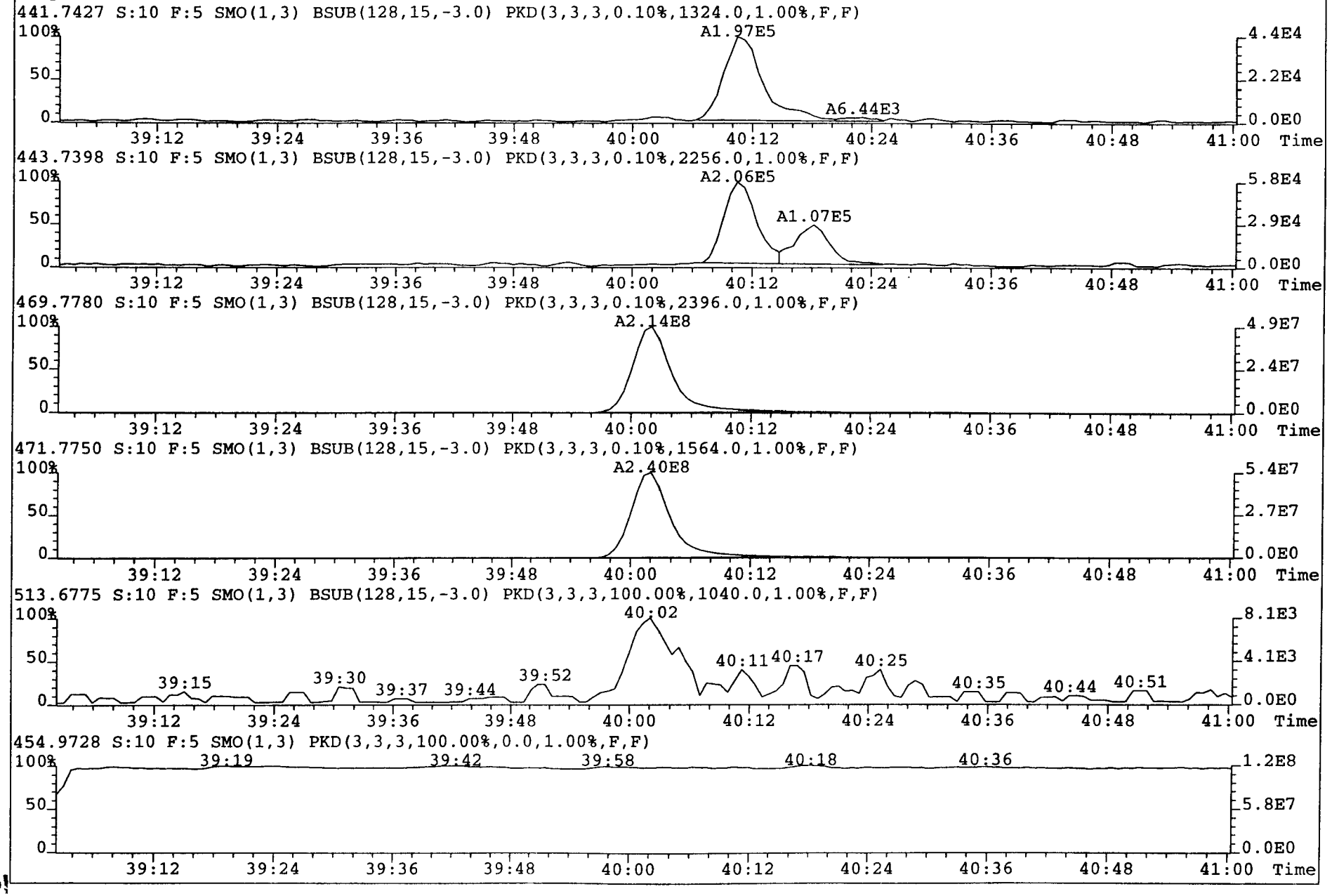


061

File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10



File: A17JUL98B Acq: 17-JUL-1998 23:31:42 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #10 Text: 1070-1 x1/2 ALS #10



```
        Filename ; a21jul98f
          Sample ; 4
        Acquired ; 21-JUL-98  21:57:56
       Processed ; 22-JUL-98  08:31:58
       Sample ID ; 1070-1 x1/2
       Cal Table ; 07feb-m23conf
   Results Table ; M8290-23-072198F
        Comments ;
Typ  ;                  Name;     Resp;    Ion 1;    Ion 2;   RA;?;    RT;      Conc;      DL;    S/N1;?;    S/N2;? ; mod?
Unk  ;           2,3,7,8-TCDF; 5.65e+07; 2.47e+07; 3.18e+07; 0.78;y; 27:56;     4.254;  0.0271;     486;y;     543;y ;   no
ES/RT;       13C-2,3,7,8-TCDF; 1.40e+09; 6.14e+08; 7.84e+08; 0.78;y; 27:53;   342.587;       -;    3149;y;    2895;y ;   no
Total;           Tetra Furans; 2.82e+09; 1.00e+08; 1.31e+08; 0.76;y; 18:12;   212.616;  0.0271;    3216;y;    3579;y ;   no
DPE  ;                HxCDPE;        *;        *                  ;NotFnd;         *;       -;       *;n            ;   no
LMC  ;     QC CHK ION (Tetra);        *;        *                  ;NotFnd;         *;       -;    Div0;n            ;   no

                                                  ;        -;    -;-; 27:56

                                                  ;        -;    -;-; 27:56                                ;       -; -;   no
```

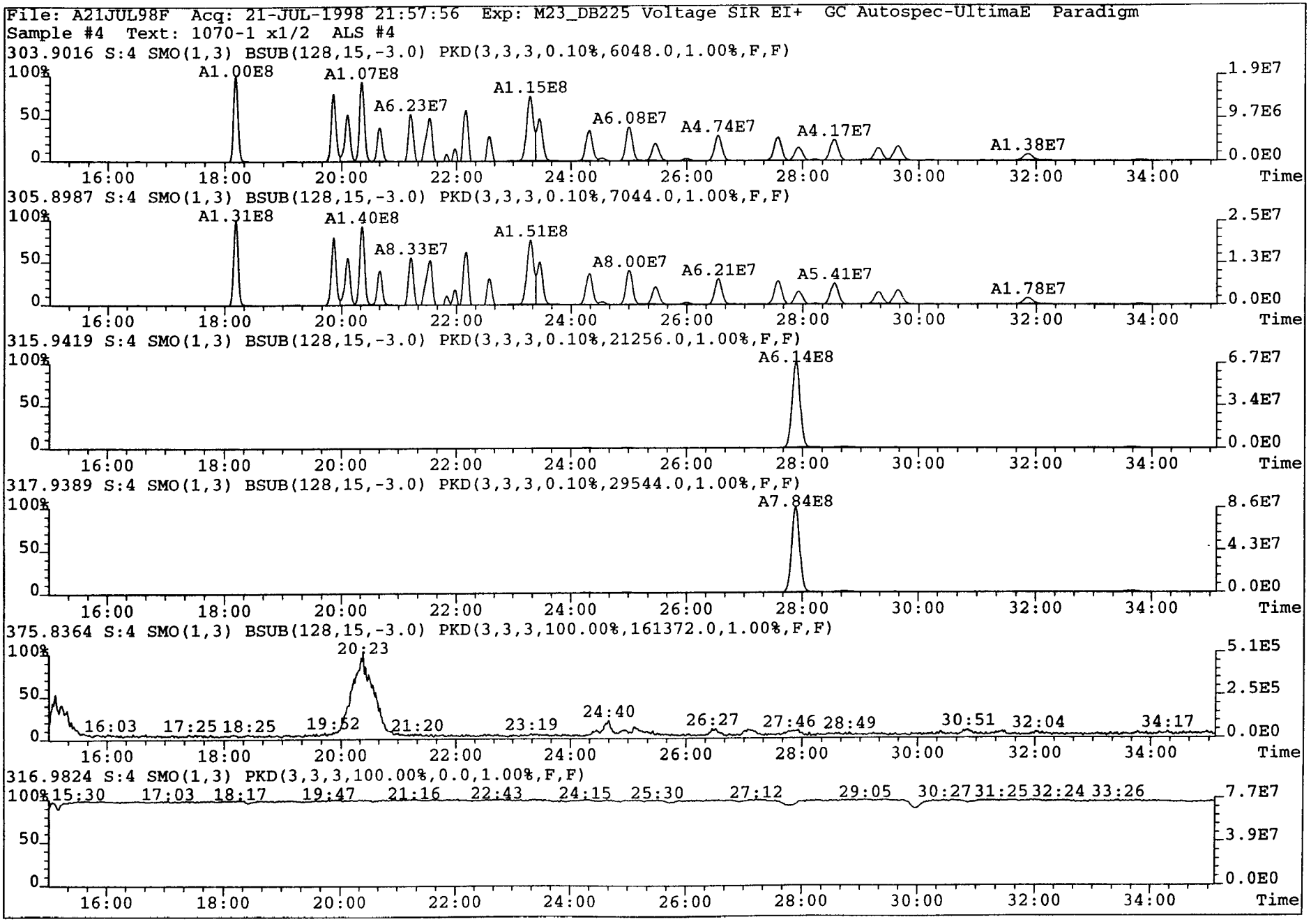
Ent: 3 Name: Tetra Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:30

Run: 9 File: a21jul98f S:4 Acq:21-JUL-98 21:57:56 Proc:22-JUL-98 08:31:58
Tables: Run: a21jul98b Analyte: m23_conf Cal: 07feb-m23»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-1 x1/2

Amount: 212.62 of which 4.25 named and 208.36 unnamed
Conc: 212.62 of which 4.25 named and 208.36 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	18:12	2.3e+08	0.76 y	17.41					
			2.3e+08			1.0e+08	1.9e+07	3.2e+03	y	n
						1.3e+08	2.5e+07	3.6e+03	y	n
	2	19:52	1.9e+08	0.77 y	14.65					
			1.9e+08			8.5e+07	1.5e+07	2.5e+03	y	n
						1.1e+08	2.0e+07	2.8e+03	y	n
	3	20:06	1.5e+08	0.77 y	11.58					
			1.5e+08			6.7e+07	1.1e+07	1.7e+03	y	n
						8.7e+07	1.4e+07	2.0e+03	y	n
	4	20:21	2.5e+08	0.76 y	18.61					
			2.5e+08			1.1e+08	1.8e+07	3.0e+03	y	n
						1.4e+08	2.3e+07	3.3e+03	y	n
	5	20:40	1.0e+08	0.76 y	7.85					
			1.0e+08			4.5e+07	7.6e+06	1.3e+03	y	n
						5.9e+07	1.0e+07	1.4e+03	y	n
	6	21:13	1.5e+08	0.75 y	10.96					
			1.5e+08			6.2e+07	1.1e+07	1.8e+03	y	n
						8.3e+07	1.4e+07	2.0e+03	y	n
	7	21:32	1.7e+08	0.73 y	12.83					
			1.7e+08			7.2e+07	9.8e+06	1.6e+03	y	n
						9.9e+07	1.3e+07	1.9e+03	y	n
	8	21:50	1.6e+07	0.48 n	1.22					
			1.6e+07			5.3e+06	1.6e+06	2.6e+02	y	n
						1.1e+07	2.7e+06	3.8e+02	y	n
	9	21:59	3.0e+07	0.55 n	2.29					
			3.0e+07			1.1e+07	2.8e+06	4.7e+02	y	n
						2.0e+07	4.5e+06	6.3e+02	y	n
	10	22:10	1.5e+08	0.71 y	11.34					
			1.5e+08			6.3e+07	1.1e+07	1.9e+03	y	n
						8.8e+07	1.6e+07	2.2e+03	y	n
	11	22:35	7.5e+07	0.73 y	5.66					
			7.5e+07			3.2e+07	5.7e+06	9.4e+02	y	n
						4.3e+07	7.6e+06	1.1e+03	y	n
	12	22:55	2.4e+05	1.26 n	0.02					
			2.4e+05			1.4e+05	6.1e+04	1.0e+01	y	n
						1.1e+05	5.9e+04	8.3e+00	y	n
	13	23:17	2.7e+08	0.76 y	20.06					
			2.7e+08			1.2e+08	1.5e+07	2.4e+03	y	n
						1.5e+08	1.9e+07	2.7e+03	y	n
	14	23:27	1.5e+08	0.77 y	11.58					
			1.5e+08			6.7e+07	9.5e+06	1.6e+03	y	n
						8.7e+07	1.3e+07	1.8e+03	y	n
	15	24:19	1.2e+08	0.76 y	9.24					
			1.2e+08			5.3e+07	6.9e+06	1.1e+03	y	n
						7.0e+07	9.1e+06	1.3e+03	y	n
	16	24:32	9.2e+06	0.74 y	0.69					
			9.2e+06			3.9e+06	5.6e+05	9.2e+01	y	n
						5.3e+06	7.4e+05	1.0e+02	y	n
	17	25:01	1.4e+08	0.76 y	10.60					
			1.4e+08			6.1e+07	7.7e+06	1.3e+03	y	n
						8.0e+07	1.0e+07	1.4e+03	y	n
	18	25:27	7.4e+07	0.77 y	5.59					
			7.4e+07			3.2e+07	3.9e+06	6.4e+02	y	n
						4.2e+07	5.1e+06	7.3e+02	y	n
	19	25:59	7.4e+06	0.73 y	0.56					
			7.4e+06			3.1e+06	4.3e+05	7.0e+01	y	n
						4.3e+06	5.6e+05	7.9e+01	y	n

	20	26:32	1.1e+08	0.76 y	8.24					
			1.1e+08			4.7e+07	5.7e+06	9.3e+02	y	n
						6.2e+07	7.4e+06	1.1e+03	y	n
	21	27:35	1.1e+08	0.77 y	7.92					
			1.1e+08			4.6e+07	5.2e+06	8.7e+02	y	n
						5.9e+07	6.7e+06	9.6e+02	y	n
2,3,7,8-TCDF	22	27:56	5.7e+07	0.78 y	4.25					
			5.7e+07			2.5e+07	2.9e+06	4.9e+02	y	n
						3.2e+07	3.8e+06	5.4e+02	y	n
	23	28:12	2.3e+06	0.90 n	0.17					
			2.3e+06			1.1e+06	1.8e+05	2.9e+01	y	n
						1.2e+06	2.2e+05	3.1e+01	y	n
	24	28:33	9.6e+07	0.77 y	7.21					
			9.6e+07			4.2e+07	4.7e+06	7.8e+02	y	n
						5.4e+07	6.1e+06	8.7e+02	y	n
	25	29:02	4.3e+05	0.29 n	0.03					
			4.3e+05			9.7e+04	3.1e+04	5.0e+00	y	n
						3.3e+05	7.6e+04	1.1e+01	y	n
	26	29:18	5.5e+07	0.78 y	4.16					
			5.5e+07			2.4e+07	2.6e+06	4.4e+02	y	n
						3.1e+07	3.4e+06	4.8e+02	y	n
	27	29:38	6.8e+07	0.77 y	5.14					
			6.8e+07			3.0e+07	3.1e+06	5.2e+02	y	n
						3.9e+07	4.1e+06	5.8e+02	y	n
	28	31:52	3.2e+07	0.78 y	2.38					
			3.2e+07			1.4e+07	1.3e+06	2.2e+02	y	n
						1.8e+07	1.7e+06	2.4e+02	y	n
	29	33:45	2.2e+06	0.20 n	0.16					
			2.2e+06			3.7e+05	1.2e+05	2.0e+01	y	n
						1.8e+06	2.0e+05	2.9e+01	y	n
	30	33:48	2.6e+06	0.45 n	0.20					
			2.6e+06			8.1e+05	1.5e+05	2.4e+01	y	n
						1.8e+06	2.0e+05	2.9e+01	y	n


File: A21JUL98F Acq: 21-JUL-1998 21:57:56 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #4 Text: 1070-1 x1/2 ALS #4
303.9016 S:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,6048.0,1.00%,F,F)
A1.00E8
A1.07E8
A6.23E7
A1.15E8
A6.08E7
A4.74E7
A4.17E7
A1.38E7
305.8987 S:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,7044.0,1.00%,F,F)
A1.31E8
A1.40E8
A8.33E7
A1.51E8
A8.00E7
A6.21E7
A5.41E7
A1.78E7
315.9419 S:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,21256.0,1.00%,F,F)
A6.14E8
317.9389 S:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,29544.0,1.00%,F,F)
A7.84E8
375.8364 S:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,161372.0,1.00%,F,F)
20:23
16:03 17:25 18:25 19:52 21:20 23:19 24:40 26:27 27:46 28:49 30:51 32:04 34:17
316.9824 S:4 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
15:30 17:03 18:17 19:47 21:16 22:43 24:15 25:30 27:12 29:05 30:27 31:25 32:24 33:26
100%
50
0
1.9E7
9.7E6
0.0E0
2.5E7
1.3E7
6.7E7
3.4E7
8.6E7
4.3E7
5.1E5
2.5E5
7.7E7
3.9E7
16:00 18:00 20:00 22:00 24:00 26:00 28:00 30:00 32:00 34:00
Time

Method 23

M23-O-1

PES

Analytical Data Summary Sheet

Analyte	Concentration (ng)	DL (ng)	EMPC (ng)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	0.0124	0.0007		28:27	0.74	
1,2,3,7,8-PeCDD	0.0087	0.0005		32:37	1.56	
1,2,3,4,7,8-HxCDD	0.0027	0.0006		34:42	1.31	
1,2,3,6,7,8-HxCDD	0.0049	0.0005		34:46	1.22	
1,2,3,7,8,9-HxCDD	0.0043	0.0005		34:58	1.20	
1,2,3,4,6,7,8-HpCDD	0.0073	0.0004		37:10	1.12	
OCDD	0.0243	0.0013		40:02	0.84	
2,3,7,8-TCDF	0.160	0.0010		27:29	0.77	
1,2,3,7,8-PeCDF	0.0874	0.0022		31:57	1.58	
2,3,4,7,8-PeCDF	0.0864	0.0021		32:24	1.51	
1,2,3,4,7,8-HxCDF	0.0474	0.0006		34:10	1.24	
1,2,3,6,7,8-HxCDF	0.0171	0.0005		34:15	1.28	
2,3,4,6,7,8-HxCDF	0.0114	0.0005		34:37	1.13	
1,2,3,7,8,9-HxCDF	0.0037	0.0006		35:12	1.32	
1,2,3,4,6,7,8-HpCDF	0.0170	0.0005		36:22	1.00	
1,2,3,4,7,8,9-HpCDF	0.0016	0.0006		37:32	0.91	
OCDF	0.0103	0.0007		40:10	0.78	
Total TCDDs	1.10	0.0007	1.11			
Total PeCDDs	0.264	0.0005				
Total HxCDDs	0.116	0.0005				
Total HpCDDs	0.0132	0.0004	0.0144			
Total TCDFs	9.12	0.0010	9.15			
Total PeCDFs	1.59	0.0021				
Total HxCDFs	0.166	0.0005	0.170			
Total HpCDFs	0.0228	0.0005				
TEQ (ND=0)	0.0897		0.0897			ITEF
TEQ (ND=1/2)	0.0897		0.0897			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-O-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-2

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-11
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial_Cal: m8290-23-071798

Method 23

M23-O-1

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	3.89	97.4	28:27	0.77	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	4.52	113.1	32:37	1.55	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.75	93.8	34:45	1.27	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	4.09	102.1	37:09	1.03	
$^{13}C_{12}$-OCDD	8	7.40	92.4	40:01	0.88	
$^{13}C_{12}$-2,3,7,8-TCDF	4	3.94	98.6	27:25	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	4.05	101.2	31:56	1.57	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	3.77	94.2	34:14	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	3.32	82.9	36:21	0.45	
Sampling Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	3.81	95.3	28:27		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	3.94	98.5	32:24	1.58	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	4.39	109.6	34:41	1.26	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	3.85	96.3	34:10	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	3.68	92.0	37:31	0.45	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:09	0.79	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:58	1.26	

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-O-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-2

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-11
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: Y.T.

Date Reviewed: 23 JUL 98

Filename ; a17jul98b
Sample ; 11
Acquired ; 18-JUL-98 00:16:48
Processed ; 20-JUL-98 09:06:58
Sample ID ; 1070-2 x1/2
Cal Table ; m8290-23-071798
Results Table ; M8290-23-071798B
Comments ;

CF=3.995

Typ	Name	Resp	Ion 1	Ion 2	RA;?;	RT	Conc	DL	S/N1;?;	S/N2;?	mod?
Unk	2,3,7,8-TCDD	1.45e+06	5.22e+05	9.28e+05	0.56;n;	28:27	0.364	0.0175	40;y	100;y	no
Unk	1,2,3,7,8-PeCDD	7.98e+05	4.87e+05	3.11e+05	1.56;y;	32:37	0.218	0.0126	51;y	60;y	no
Unk	1,2,3,4,7,8-HxCDD	1.58e+05	8.97e+04	6.86e+04	1.31;y;	34:42	0.068	0.0146	11;y	15;y	no
Unk	1,2,3,6,7,8-HxCDD	3.58e+05	1.97e+05	1.62e+05	1.22;y;	34:46	0.122	0.0115	20;y	29;y	no
Unk	1,2,3,7,8,9-HxCDD	3.18e+05	1.73e+05	1.45e+05	1.20;y;	34:58	0.107	0.0114	14;y	21;y	no
Unk	1,2,3,4,6,7,8-HpCDD	4.57e+05	2.41e+05	2.16e+05	1.12;y;	37:10	0.183	0.0095	53;y	64;y	no
Unk	OCDD	1.24e+06	5.65e+05	6.76e+05	0.84;y;	40:02	0.608	0.0323	40;y	95;y	no
Unk	2,3,7,8-TCDF	1.26e+08	5.50e+07	7.14e+07	0.77;y;	27:29	25.775	0.0257	1605;y	3203;y	no
Unk	1,2,3,7,8-PeCDF	8.75e+06	5.35e+06	3.40e+06	1.58;y;	31:57	2.185	0.0541	125;y	115;y	no
Unk	2,3,4,7,8-PeCDF	8.96e+06	5.39e+06	3.56e+06	1.51;y;	32:24	2.160	0.0523	128;y	121;y	no
Unk	1,2,3,4,7,8-HxCDF	4.09e+06	2.27e+06	1.82e+06	1.24;y;	34:10	1.184	0.0148	159;y	167;y	no
Unk	1,2,3,6,7,8-HxCDF	1.87e+06	1.05e+06	8.17e+05	1.28;y;	34:15	0.428	0.0117	87;y	97;y	no
Unk	2,3,4,6,7,8-HxCDF	1.06e+06	5.65e+05	4.98e+05	1.13;y;	34:37	0.284	0.0136	37;y	40;y	no
Unk	1,2,3,7,8,9-HxCDF	3.01e+05	1.71e+05	1.30e+05	1.32;y;	35:12	0.092	0.0157	11;y	12;y	no
Unk	1,2,3,4,6,7,8-HpCDF	1.15e+06	5.73e+05	5.73e+05	1.00;y;	36:22	0.424	0.0118	95;y	131;y	no
Unk	1,2,3,4,7,8,9-HpCDF	8.82e+04	4.19e+04	4.63e+04	0.91;y;	37:32	0.040	0.0143	6;y	10;y	no
Unk	OCDF	5.60e+05	2.46e+05	3.14e+05	0.78;y;	40:10	0.258	0.0183	53;y	38;y	no
ES/RT	13C-2,3,7,8-TCDD	4.05e+08	1.77e+08	2.28e+08	0.77;y;	28:27	97.357	0.0362	5044;y	12882;y	no
ES	13C-1,2,3,7,8-PeCDD	3.28e+08	1.99e+08	1.28e+08	1.55;y;	32:37	113.079	0.0429	14085;y	12766;y	no
ES	13C-1,2,3,6,7,8-HxCDD	3.46e+08	1.93e+08	1.53e+08	1.27;y;	34:45	93.785	0.0436	7638;y	6805;y	no
ES	13C-1,2,3,4,6,7,8-HpCDD	2.79e+08	1.42e+08	1.37e+08	1.03;y;	37:09	102.118	0.0248	6613;y	12636;y	no
ES	13C-OCDD	4.07e+08	1.91e+08	2.16e+08	0.88;y;	40:01	184.886	0.0159	17880;y	24221;y	no
ES/RT	13C-2,3,7,8-TCDF	5.14e+08	2.26e+08	2.89e+08	0.78;y;	27:25	98.576	0.0220	8772;y	21972;y	no
ES	13C-1,2,3,7,8-PeCDF	4.60e+08	2.81e+08	1.79e+08	1.57;y;	31:56	101.207	0.0086	92375;y	37965;y	no
ES	13C-1,2,3,6,7,8-HxCDF	4.01e+08	1.38e+08	2.63e+08	0.52;y;	34:14	94.199	0.1858	1601;y	1780;y	no
ES	13C-1,2,3,4,6,7,8-HpCDF	2.15e+08	6.66e+07	1.48e+08	0.45;y;	36:21	82.921	0.0595	1559;y	6492;y	no
JS	13C-1,2,3,4-TCDD	3.79e+08	1.67e+08	2.11e+08	0.79;y;	28:09	78.542	-	5036;y	12545;y	no
JS	13C-1,2,3,7,8,9-HxCDD	3.44e+08	1.92e+08	1.52e+08	1.26;y;	34:58	86.631	-	6703;y	6079;y	no
CS	37Cl-2,3,7,8-TCDD	3.53e+08	3.53e+08	-	-;-	28:27	92.703	0.0219	12278;y	-; -	no
CS	13C-2,3,4,7,8-PeCDF	4.43e+08	2.71e+08	1.72e+08	1.58;y;	32:24	99.672	0.0088	92625;y	37844;y	no
CS	13C-1,2,3,4,7,8-HxCDD	2.56e+08	1.43e+08	1.13e+08	1.26;y;	34:41	102.934	0.0647	5463;y	4956;y	no
CS	13C-1,2,3,4,7,8-HxCDF	3.03e+08	1.04e+08	2.00e+08	0.52;y;	34:10	91.390	0.2384	1315;y	1446;y	no
CS	13C-1,2,3,4,7,8,9-HpCDF	1.54e+08	4.76e+07	1.07e+08	0.45;y;	37:31	76.257	0.0761	970;y	4134;y	no
SS	37Cl-2,3,7,8-TCDD	3.53e+08	3.53e+08	-	-;-	28:27	95.272	0.0236	12278;y	-; -	no
SS	13C-2,3,4,7,8-PeCDF	4.43e+08	2.71e+08	1.72e+08	1.58;y;	32:24	98.518	0.0052	92625;y	37844;y	no
SS	13C-1,2,3,4,7,8-HxCDD	2.56e+08	1.43e+08	1.13e+08	1.26;y;	34:41	109.613	0.0614	5463;y	4956;y	no
SS	13C-1,2,3,4,7,8-HxCDF	3.03e+08	1.04e+08	2.00e+08	0.52;y;	34:10	96.249	0.2233	1315;y	1446;y	no
SS	13C-1,2,3,4,7,8,9-HpCDF	1.54e+08	4.76e+07	1.07e+08	0.45;y;	37:31	91.999	0.1170	970;y	4134;y	no

Ent: 39 Name: Total Tetra-Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:21

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 228.67 of which 25.77 named and 202.89 unnamed
Conc: 228.67 of which 25.77 named and 202.89 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	23:39	8.4e+07	0.77 y	17.18					
			8.4e+07			3.7e+07	8.0e+06	1.5e+03	y	n
						4.8e+07	1.1e+07	3.1e+03	y	n
	2	24:14	4.0e+07	0.77 y	8.19					
			4.0e+07			1.7e+07	3.9e+06	7.3e+02	y	n
						2.3e+07	5.1e+06	1.5e+03	y	n
	3	24:34	3.7e+07	0.76 y	7.63					
			3.7e+07			1.6e+07	3.5e+06	6.6e+02	y	n
						2.1e+07	4.6e+06	1.3e+03	y	n
	4	24:51	1.8e+08	0.77 y	36.11					
			1.8e+08			7.7e+07	1.5e+07	2.8e+03	y	n
						1.0e+08	1.9e+07	5.6e+03	y	n
	5	24:59	4.5e+07	0.79 y	9.14					
			4.5e+07			2.0e+07	2.9e+06	5.4e+02	y	n
						2.5e+07	3.7e+06	1.1e+03	y	n
	6	25:10	3.9e+07	0.72 y	7.91					
			3.9e+07			1.6e+07	3.9e+06	7.3e+02	y	n
						2.3e+07	5.2e+06	1.5e+03	y	n
	7	25:16	1.2e+08	0.77 y	24.45					
			1.2e+08			5.2e+07	6.8e+06	1.3e+03	y	n
						6.8e+07	9.0e+06	2.6e+03	y	n
	8	25:40	4.1e+07	0.75 y	8.29					
			4.1e+07			1.7e+07	4.2e+06	7.9e+02	y	n
						2.3e+07	5.5e+06	1.6e+03	y	n
	9	25:44	5.6e+07	0.78 y	11.49					
			5.6e+07			2.5e+07	5.2e+06	9.8e+02	y	n
						3.2e+07	6.8e+06	2.0e+03	y	n
	10	26:01	3.2e+07	0.79 y	6.54					
			3.2e+07			1.4e+07	3.0e+06	5.6e+02	y	n
						1.8e+07	3.9e+06	1.1e+03	y	n
	11	26:09	5.0e+07	0.75 y	10.28					
			5.0e+07			2.2e+07	4.6e+06	8.6e+02	y	n
						2.9e+07	5.9e+06	1.7e+03	y	n
	12	26:26	8.5e+07	0.76 y	17.40					
			8.5e+07			3.7e+07	7.5e+06	1.4e+03	y	n
						4.8e+07	9.6e+06	2.8e+03	y	n
	13	26:34	8.1e+07	0.77 y	16.53					
			8.1e+07			3.5e+07	7.0e+06	1.3e+03	y	n
						4.6e+07	9.1e+06	2.7e+03	y	n
	14	26:51	4.2e+07	0.76 y	8.65					
			4.2e+07			1.8e+07	3.6e+06	6.8e+02	y	n
						2.4e+07	4.8e+06	1.4e+03	y	n
	15	27:03	2.7e+06	0.77 y	0.56					
			2.7e+06			1.2e+06	2.7e+05	5.1e+01	y	n
						1.5e+06	3.4e+05	1.0e+02	y	n
	16	27:11	2.0e+07	0.77 y	4.17					
			2.0e+07			8.9e+06	1.8e+06	3.4e+02	y	n
						1.2e+07	2.4e+06	6.9e+02	y	n
2,3,7,8-TCDF	17	27:29	1.3e+08	0.77 y	25.77					
			1.3e+08			5.5e+07	8.5e+06	1.6e+03	y	n
						7.1e+07	1.1e+07	3.2e+03	y	n
	18	28:03	2.3e+07	0.79 y	4.77					
			2.3e+07			1.0e+07	2.1e+06	4.0e+02	y	n
						1.3e+07	2.7e+06	7.7e+02	y	n
	19	28:20	1.2e+07	0.79 y	2.52					
			1.2e+07			5.4e+06	1.1e+06	2.0e+02	y	n
						6.9e+06	1.4e+06	4.0e+02	y	n

```
20 28:33 2.1e+06  0.81 y    0.42
         2.1e+06                9.3e+05 2.2e+05 4.2e+01 y  n
                                1.1e+06 2.6e+05 7.5e+01 y  n
21 29:47 3.3e+06  1.25 n    0.67
         3.3e+06                1.8e+06 3.3e+05 6.1e+01 y  n
                                1.5e+06 2.8e+05 8.1e+01 y  n
```

Ent: 40 Name: Total Tetra-Dioxins F:1 Mass: 319.897 321.894 Mod? no #Hom:15

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 27.85 of which 0.36 named and 27.49 unnamed
Conc: 27.85 of which 0.36 named and 27.49 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	25:15	4.7e+07	0.78 y	11.90					
			4.7e+07			2.1e+07	4.5e+06	1.6e+03	y	n
						2.7e+07	5.8e+06	3.0e+03	y	n
	2	25:41	2.2e+07	0.77 y	5.59					
			2.2e+07			9.7e+06	2.1e+06	7.5e+02	y	n
						1.3e+07	2.6e+06	1.4e+03	y	n
	3	26:03	3.8e+06	0.78 y	0.95					
			3.8e+06			1.7e+06	3.4e+05	1.2e+02	y	n
						2.1e+06	4.6e+05	2.4e+02	y	n
	4	26:54	1.4e+07	0.78 y	3.41					
			1.4e+07			6.0e+06	1.1e+06	4.0e+02	y	n
						7.6e+06	1.4e+06	7.5e+02	y	n
	5	27:07	2.7e+06	0.77 y	0.67					
			2.7e+06			1.2e+06	1.7e+05	6.1e+01	y	n
						1.5e+06	2.3e+05	1.2e+02	y	n
	6	27:17	3.4e+06	0.79 y	0.84					
			3.4e+06			1.5e+06	3.0e+05	1.1e+02	y	n
						1.9e+06	3.8e+05	2.0e+02	y	n
	7	27:23	7.3e+05	0.98 n	0.18					
			7.3e+05			3.6e+05	7.6e+04	2.8e+01	y	n
						3.7e+05	8.2e+04	4.3e+01	y	n
	8	27:45	2.7e+06	0.77 y	0.67					
			2.7e+06			1.2e+06	2.4e+05	8.7e+01	y	n
						1.5e+06	3.2e+05	1.7e+02	y	n
	9	28:10	4.2e+06	0.78 y	1.05					
			4.2e+06			1.8e+06	3.8e+05	1.4e+02	y	n
						2.4e+06	4.8e+05	2.5e+02	y	n
	10	28:19	5.8e+06	0.78 y	1.45					
			5.8e+06			2.5e+06	4.8e+05	1.7e+02	y	n
						3.2e+06	6.1e+05	3.2e+02	y	n
2,3,7,8-TCDD	11	28:27	1.5e+06	0.56 n	0.36					
			1.5e+06			5.2e+05	1.1e+05	4.0e+01	y	n
						9.3e+05	1.9e+05	1.0e+02	y	n
	12	28:40	1.1e+06	0.77 y	0.28					
			1.1e+06			4.8e+05	1.0e+05	3.6e+01	y	n
						6.2e+05	1.2e+05	6.5e+01	y	n
	13	28:57	1.3e+06	0.80 y	0.31					
			1.3e+06			5.6e+05	1.2e+05	4.2e+01	y	n
						7.0e+05	1.4e+05	7.5e+01	y	n
	14	29:18	4.6e+05	0.80 y	0.12					
			4.6e+05			2.0e+05	4.2e+04	1.5e+01	y	n
						2.5e+05	6.0e+04	3.1e+01	y	n
	15	29:54	2.4e+05	0.94 n	0.06					
			2.4e+05			1.1e+05	2.4e+04	8.6e+00	y	n
						1.2e+05	2.9e+04	1.5e+01	y	n

Ent: 41 Name: Total Penta-Furans F:2 Mass: 339.860 341.857 Mod? no #Hom:15

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 39.73 of which 4.35 named and 35.39 unnamed
Conc: 39.73 of which 4.35 named and 35.39 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	30:16	2.1e+07	1.52 y	5.17				
			2.1e+07			1.3e+07	2.6e+06	1.7e+02	y n
						8.4e+06	1.7e+06	1.6e+02	y n
	2	31:15	1.2e+07	1.60 y	3.04				
			1.2e+07			7.6e+06	2.5e+06	1.7e+02	y n
						4.8e+06	1.7e+06	1.6e+02	y n
	3	31:21	4.4e+07	1.51 y	10.90				
			4.4e+07			2.7e+07	7.2e+06	4.7e+02	y n
						1.8e+07	4.8e+06	4.6e+02	y n
	4	31:29	7.9e+06	1.56 y	1.94				
			7.9e+06			4.8e+06	1.4e+06	9.1e+01	y n
						3.1e+06	8.9e+05	8.5e+01	y n
	5	31:36	2.2e+06	1.51 y	0.55				
			2.2e+06			1.3e+06	2.8e+05	1.8e+01	y n
						8.9e+05	1.9e+05	1.8e+01	y n
	6	31:45	2.4e+07	1.51 y	5.82				
			2.4e+07			1.4e+07	4.8e+06	3.2e+02	y n
						9.5e+06	3.1e+06	3.0e+02	y n
	7	31:54	9.9e+06	1.44 y	2.43				
			9.9e+06			5.8e+06	2.3e+06	1.5e+02	y n
						4.1e+06	1.5e+06	1.5e+02	y n
1,2,3,7,8-PeCDF	8	31:57	8.7e+06	1.58 y	2.19				
			8.7e+06			5.4e+06	1.9e+06	1.3e+02	y n
						3.4e+06	1.2e+06	1.2e+02	y n
	9	32:04	4.4e+06	1.46 y	1.08				
			4.4e+06			2.6e+06	9.3e+05	6.1e+01	y n
						1.8e+06	6.0e+05	5.7e+01	y n
	10	32:08	9.3e+06	1.43 y	2.27				
			9.3e+06			5.5e+06	2.1e+06	1.4e+02	y n
						3.8e+06	1.4e+06	1.4e+02	y n
2,3,4,7,8-PeCDF	11	32:24	9.0e+06	1.51 y	2.16				
			9.0e+06			5.4e+06	1.9e+06	1.3e+02	y n
						3.6e+06	1.3e+06	1.2e+02	y n
	12	32:29	6.7e+06	1.53 y	1.64				
			6.7e+06			4.0e+06	1.4e+06	9.2e+01	y n
						2.6e+06	9.4e+05	9.0e+01	y n
	13	32:35	4.6e+05	1.47 y	0.11				
			4.6e+05			2.8e+05	1.0e+05	6.8e+00	y n
						1.9e+05	7.3e+04	7.0e+00	y n
	14	32:39	1.2e+06	1.55 y	0.29				
			1.2e+06			7.2e+05	2.6e+05	1.7e+01	y n
						4.6e+05	1.7e+05	1.6e+01	y n
	15	32:57	6.1e+05	1.74 y	0.15				
			6.1e+05			3.9e+05	1.4e+05	9.2e+00	y n
						2.2e+05	8.8e+04	8.4e+00	y n

Ent: 42 Name: Total Penta-Dioxins F:2 Mass: 355.855 357.852 Mod? no #Hom:12

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 6.59 of which 0.22 named and 6.37 unnamed
Conc: 6.59 of which 0.22 named and 6.37 unnamed

Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	31:29	8.0e+06	1.54 y	2.19				
			8.0e+06			4.8e+06	1.6e+06	4.3e+02	y n
						3.2e+06	1.0e+06	5.2e+02	y n
	2	31:49	3.6e+05	1.49 y	0.10				
			3.6e+05			2.1e+05	8.0e+04	2.2e+01	y n
						1.4e+05	5.3e+04	2.7e+01	y n
	3	31:59	6.5e+06	1.56 y	1.77				
			6.5e+06			3.9e+06	1.4e+06	4.0e+02	y n
						2.5e+06	9.4e+05	4.7e+02	y n
	4	32:04	8.8e+05	1.59 y	0.24				
			8.8e+05			5.4e+05	1.9e+05	5.3e+01	y n
						3.4e+05	1.2e+05	6.0e+01	y n
	5	32:10	3.5e+06	1.57 y	0.95				
			3.5e+06			2.1e+06	7.7e+05	2.1e+02	y n
						1.3e+06	5.0e+05	2.5e+02	y n
	6	32:16	3.8e+05	1.43 y	0.10				
			3.8e+05			2.2e+05	9.4e+04	2.6e+01	y n
						1.6e+05	6.8e+04	3.4e+01	y n
	7	32:20	7.4e+05	1.64 y	0.20				
			7.4e+05			4.6e+05	1.5e+05	4.1e+01	y n
						2.8e+05	8.6e+04	4.3e+01	y n
	8	32:26	1.8e+06	1.62 y	0.49				
			1.8e+06			1.1e+06	4.0e+05	1.1e+02	y n
						6.9e+05	2.5e+05	1.2e+02	y n
	9	32:30	5.9e+05	1.46 y	0.16				
			5.9e+05			3.5e+05	1.3e+05	3.6e+01	y n
						2.4e+05	9.3e+04	4.7e+01	y n
1,2,3,7,8-PeCDD	10	32:37	8.0e+05	1.56 y	0.22				
			8.0e+05			4.9e+05	1.8e+05	5.1e+01	y n
						3.1e+05	1.2e+05	6.0e+01	y n
	11	32:42	4.0e+05	1.47 y	0.11				
			4.0e+05			2.4e+05	7.6e+04	2.1e+01	y n
						1.6e+05	5.7e+04	2.9e+01	y n
	12	32:54	2.5e+05	1.37 y	0.07				
			2.5e+05			1.4e+05	5.2e+04	1.4e+01	y n
						1.1e+05	3.8e+04	1.9e+01	y n

Ent: 43 Name: Total Hexa-Furans F:3 Mass: 373.821 375.818 Mod? no #Hom:17

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 4.28 of which 1.99 named and 2.30 unnamed
Conc: 4.28 of which 1.99 named and 2.30 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:31	2.1e+06	1.21 y	0.56				
			2.1e+06			1.1e+06	4.2e+05	9.8e+01	y n
						9.4e+05	3.6e+05	1.1e+02	y n
	2	33:37	4.5e+06	1.15 y	1.22				
			4.5e+06			2.4e+06	8.6e+05	2.0e+02	y n
						2.1e+06	7.4e+05	2.4e+02	y n
	3	33:43	3.1e+05	1.20 y	0.08				
			3.1e+05			1.7e+05	5.8e+04	1.4e+01	y n
						1.4e+05	4.9e+04	1.5e+01	y n
	4	33:48	4.1e+05	1.16 y	0.11				
			4.1e+05			2.2e+05	7.2e+04	1.7e+01	y n
						1.9e+05	6.4e+04	2.0e+01	y n
	5	33:55	1.8e+05	1.09 y	0.05				
			1.8e+05			9.2e+04	3.5e+04	8.3e+00	y n
						8.5e+04	2.8e+04	9.0e+00	y n
	6	34:01	1.4e+04	0.39 n	0.00				
			1.4e+04			3.9e+03	2.1e+03	4.9e-01	n n
						1.0e+04	3.4e+03	1.1e+00	n n
1,2,3,4,7,8-HxCDF	7	34:10	4.1e+06	1.24 y	1.18				
			4.1e+06			2.3e+06	6.7e+05	1.6e+02	y n
						1.8e+06	5.3e+05	1.7e+02	y n
1,2,3,6,7,8-HxCDF	8	34:15	1.9e+06	1.28 y	0.43				
			1.9e+06			1.0e+06	3.7e+05	8.7e+01	y n
						8.2e+05	3.0e+05	9.7e+01	y n
	9	34:19	4.3e+05	1.00 n	0.12				
			4.3e+05			2.2e+05	8.1e+04	1.9e+01	y n
						2.1e+05	7.0e+04	2.2e+01	y n
	10	34:27	5.2e+05	1.13 y	0.14				
			5.2e+05			2.7e+05	7.0e+04	1.7e+01	y n
						2.4e+05	5.6e+04	1.8e+01	y n
2,3,4,6,7,8-HxCDF	11	34:37	1.1e+06	1.13 y	0.28				
			1.1e+06			5.7e+05	1.6e+05	3.7e+01	y n
						5.0e+05	1.3e+05	4.0e+01	y n
1,2,3,7,8,9-HxCDF	12	35:12	3.0e+05	1.32 y	0.09				
			3.0e+05			1.7e+05	4.7e+04	1.1e+01	y n
						1.3e+05	3.6e+04	1.2e+01	y n
	13	35:23	3.8e+03	0.71 n	0.00				
			3.8e+03			1.6e+03	7.2e+02	1.7e-01	n n
						2.2e+03	1.1e+03	3.5e-01	n n
	14	35:27	4.0e+03	0.15 n	0.00				
			4.0e+03			5.1e+02	4.3e+02	1.0e-01	n n
						3.5e+03	1.4e+03	4.6e-01	n n
	15	35:31	1.7e+04	0.29 n	0.00				
			1.7e+04			3.7e+03	1.9e+03	4.5e-01	n n
						1.3e+04	3.4e+03	1.1e+00	n n
	16	35:39	1.1e+04	0.67 n	0.00				
			1.1e+04			4.6e+03	2.2e+03	5.1e-01	n n
						6.9e+03	2.7e+03	8.6e-01	n n
	17	35:46	6.9e+03	0.46 n	0.00				
			6.9e+03			2.2e+03	6.6e+02	1.6e-01	n n
						4.7e+03	1.9e+03	6.0e-01	n n

Ent: 44 Name: Total Hexa-Dioxins F:3 Mass: 389.816 391.813 Mod? no #Hom:12

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 2.92 of which 0.30 named and 2.62 unnamed
Conc: 2.92 of which 0.30 named and 2.62 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	33:52	5.2e+05	1.20 y	0.19					
			5.2e+05			2.9e+05	1.1e+05	3.5e+01	y	n
						2.4e+05	8.4e+04	4.6e+01	y	n
	2	34:11	5.5e+06	1.28 y	2.02					
			5.5e+06			3.1e+06	1.0e+06	3.4e+02	y	n
						2.4e+06	8.2e+05	4.5e+02	y	n
	3	34:20	9.3e+05	1.38 y	0.34					
			9.3e+05			5.4e+05	1.7e+05	5.5e+01	y	n
						3.9e+05	1.2e+05	6.7e+01	y	n
	4	34:26	1.5e+05	1.34 y	0.05					
			1.5e+05			8.6e+04	2.5e+04	8.2e+00	y	n
						6.5e+04	1.8e+04	9.9e+00	y	n
	5	34:36	6.8e+03	0.39 n	0.00					
			6.8e+03			1.9e+03	8.5e+02	2.8e-01	n	n
						4.9e+03	2.0e+03	1.1e+00	n	n
1,2,3,4,7,8-HxCDD	6	34:42	1.6e+05	1.31 y	0.07					
			1.6e+05			9.0e+04	3.4e+04	1.1e+01	y	n
						6.9e+04	2.7e+04	1.5e+01	y	n
1,2,3,6,7,8-HxCDD	7	34:46	3.6e+05	1.22 y	0.12					
			3.6e+05			2.0e+05	6.0e+04	2.0e+01	y	n
						1.6e+05	5.3e+04	2.9e+01	y	n
1,2,3,7,8,9-HxCDD	8	34:58	3.2e+05	1.20 y	0.11					
			3.2e+05			1.7e+05	4.1e+04	1.4e+01	y	n
						1.4e+05	3.8e+04	2.1e+01	y	n
	9	35:04	2.6e+04	1.01 n	0.01					
			2.6e+04			1.3e+04	2.7e+03	9.0e-01	n	n
						1.3e+04	4.6e+03	2.5e+00	n	n
	10	35:12	5.8e+03	1.19 y	0.00					
			5.8e+03			3.1e+03	1.4e+03	4.7e-01	n	n
						2.6e+03	8.6e+02	4.7e-01	n	n
	11	35:17	8.4e+03	1.40 y	0.00					
			8.4e+03			4.9e+03	1.4e+03	4.6e-01	n	n
						3.5e+03	1.3e+03	7.0e-01	n	n
	12	35:23	1.1e+04	4.00 n	0.00					
			1.1e+04			9.0e+03	2.9e+03	9.5e-01	n	n
						2.2e+03	1.2e+03	6.5e-01	n	n

Ent: 45 Name: Total Hepta-Furans F:4 Mass: 407.782 409.779 Mod? no #Hom:4

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 0.57 of which 0.46 named and 0.11 unnamed
Conc: 0.57 of which 0.46 named and 0.11 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
1,2,3,4,6,7,8-HpCDF1		36:22	1.1e+06	1.00 y	0.42					
			1.1e+06			5.7e+05	1.8e+05	9.5e+01	y	n
						5.7e+05	1.7e+05	1.3e+02	y	n
	2	36:34	1.3e+05	0.92 y	0.05					
			1.3e+05			6.2e+04	2.2e+04	1.2e+01	y	n
						6.7e+04	2.1e+04	1.6e+01	y	n
	3	36:40	1.4e+05	1.02 y	0.06					
			1.4e+05			7.1e+04	2.1e+04	1.1e+01	y	n
						7.0e+04	2.1e+04	1.6e+01	y	n
1,2,3,4,7,8,9-HpCDF4		37:32	8.8e+04	0.91 y	0.04					
			8.8e+04			4.2e+04	1.1e+04	5.9e+00	y	n
						4.6e+04	1.3e+04	1.0e+01	y	n

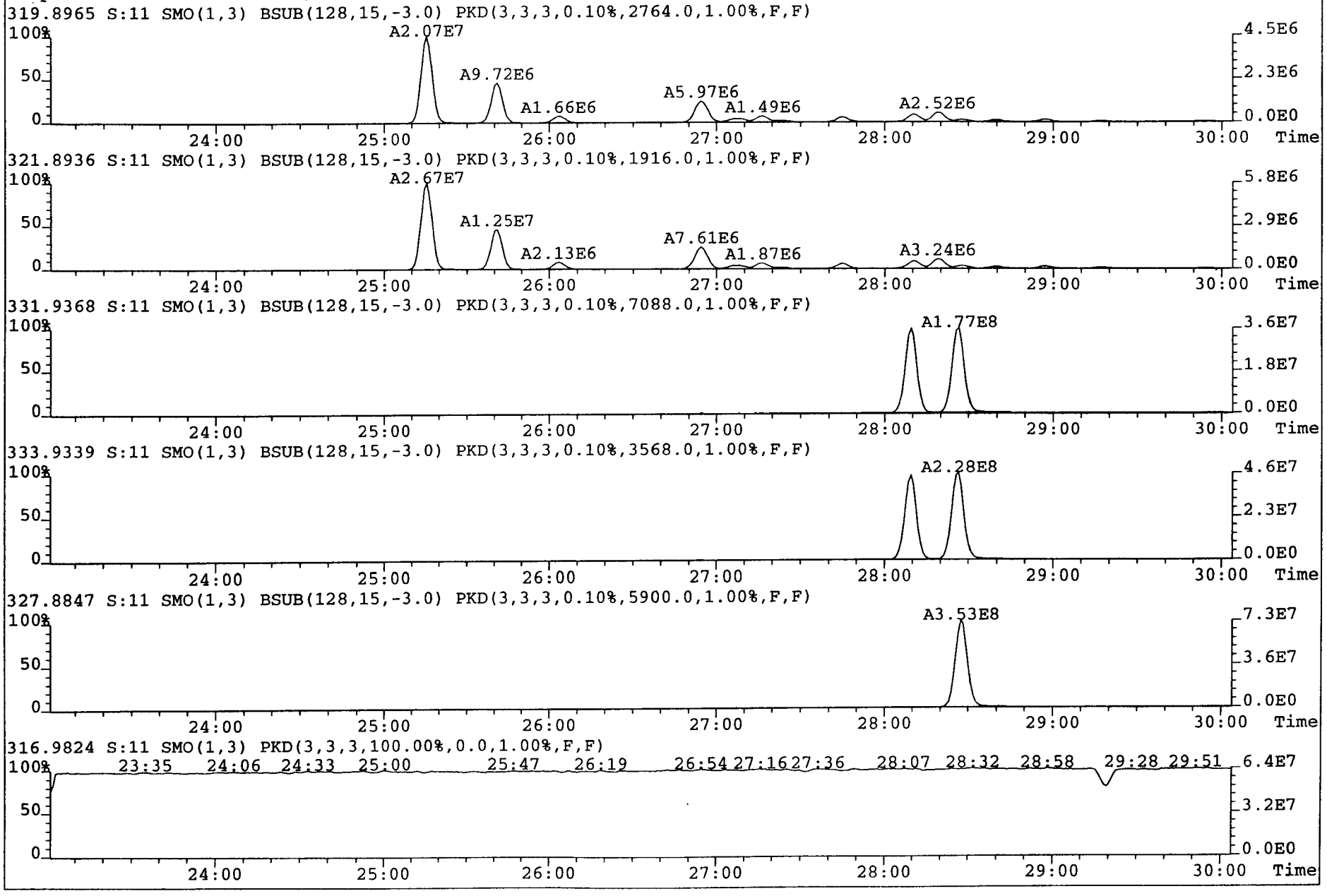
Ent: 46 Name: Total Hepta-Dioxins F:4 Mass: 423.777 425.774 Mod? no #Hom:4

Run: 16 File: a17jul98b S:11 Acq:18-JUL-98 00:16:48 Proc:20-JUL-98 09:06:58
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 0.38 of which 0.18 named and 0.19 unnamed
Conc: 0.38 of which 0.18 named and 0.19 unnamed
Tox #1: - Tox #2: - Tox #3: -

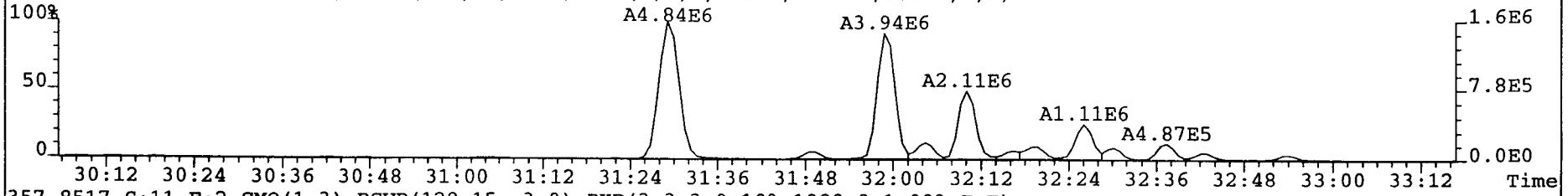
Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	36:21	7.0e+04	3.06 n	0.03					
			7.0e+04			5.3e+04	1.8e+04	1.5e+01	y	n
						1.7e+04	5.8e+03	6.4e+00	y	n
	2	36:35	3.7e+05	1.04 y	0.15					
			3.7e+05			1.9e+05	5.4e+04	4.5e+01	y	n
						1.8e+05	5.5e+04	6.0e+01	y	n
1,2,3,4,6,7,8-HpCDD3		37:10	4.6e+05	1.12 y	0.18					
			4.6e+05			2.4e+05	6.5e+04	5.3e+01	y	n
						2.2e+05	5.9e+04	6.4e+01	y	n
	4	37:31	4.5e+04	3.93 n	0.02					
			4.5e+04			3.6e+04	9.1e+03	7.5e+00	y	n
						9.2e+03	2.4e+03	2.6e+00	n	n

File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11

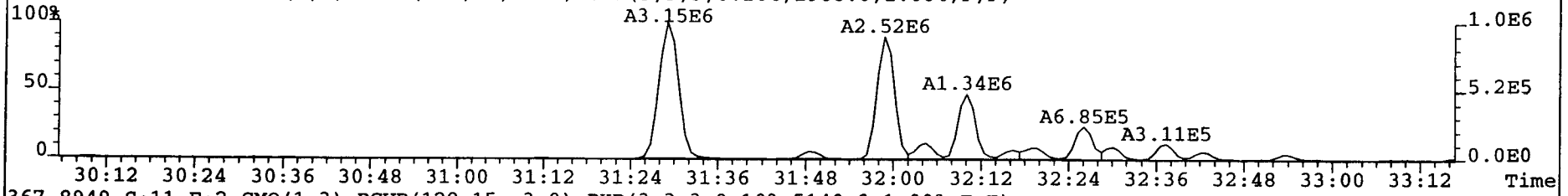


File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11

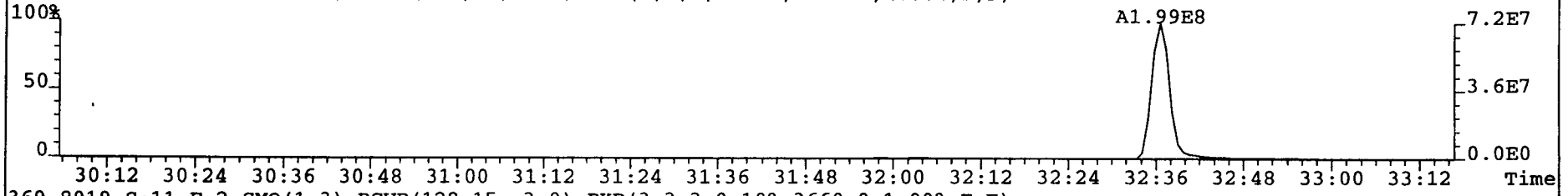
355.8546 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3608.0,1.00%,F,F)



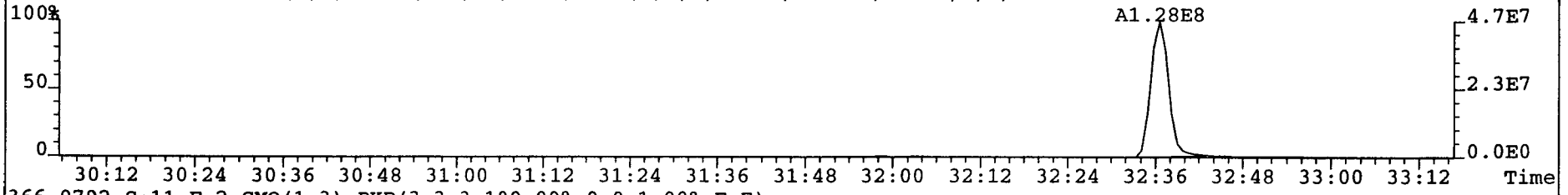
357.8517 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1988.0,1.00%,F,F)



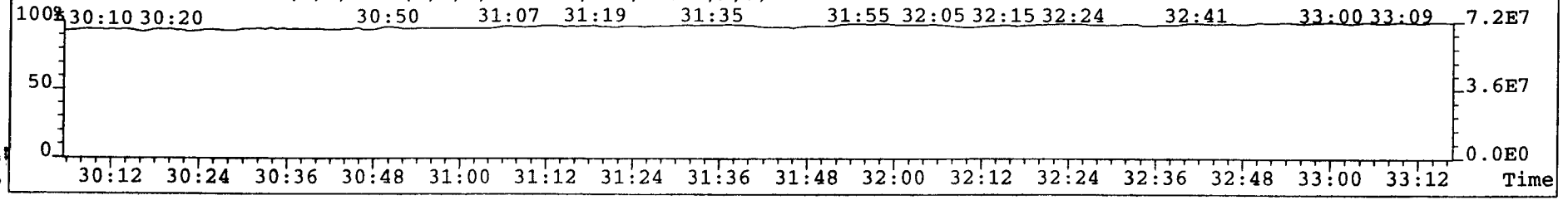
367.8949 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,5140.0,1.00%,F,F)



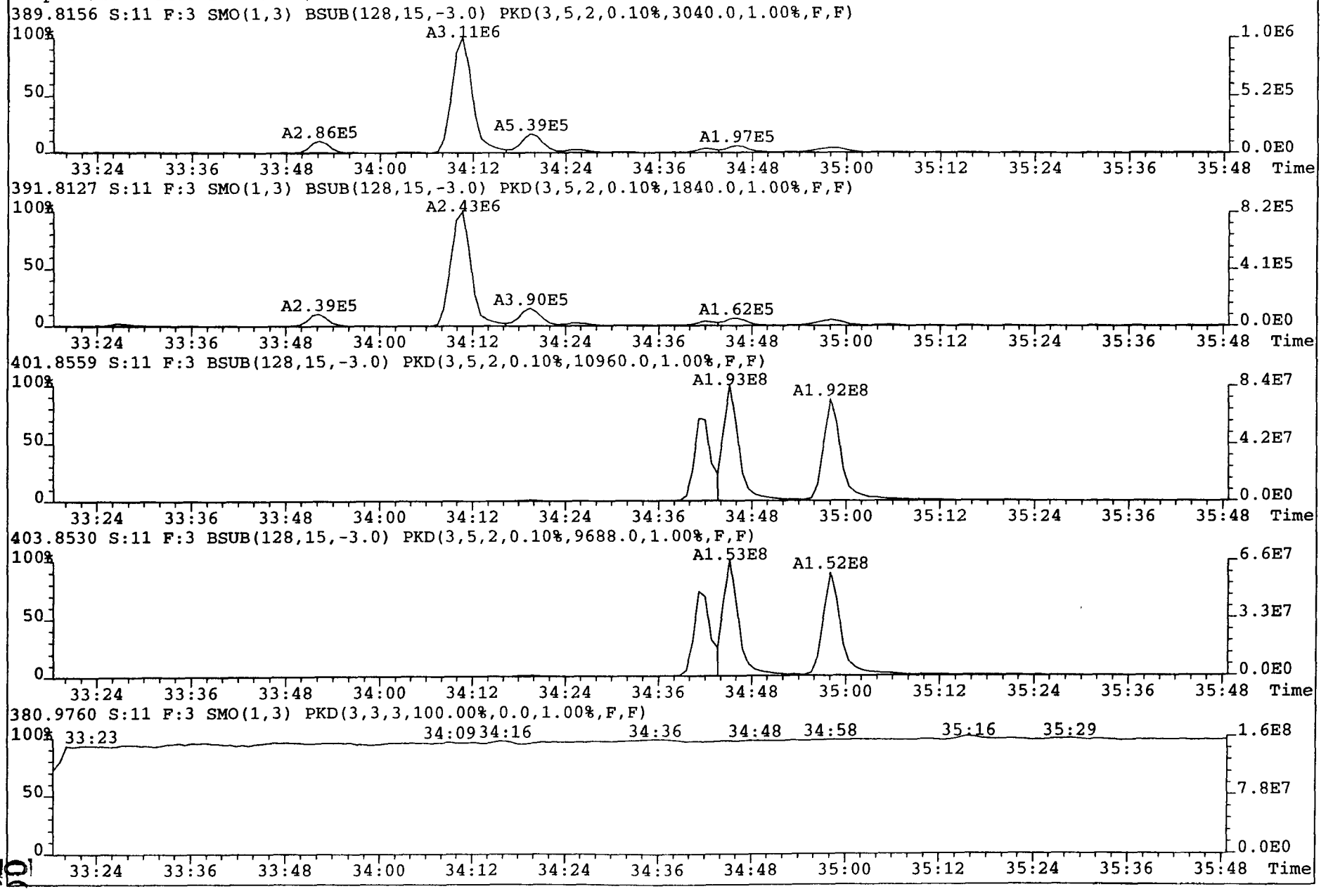
369.8919 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3660.0,1.00%,F,F)



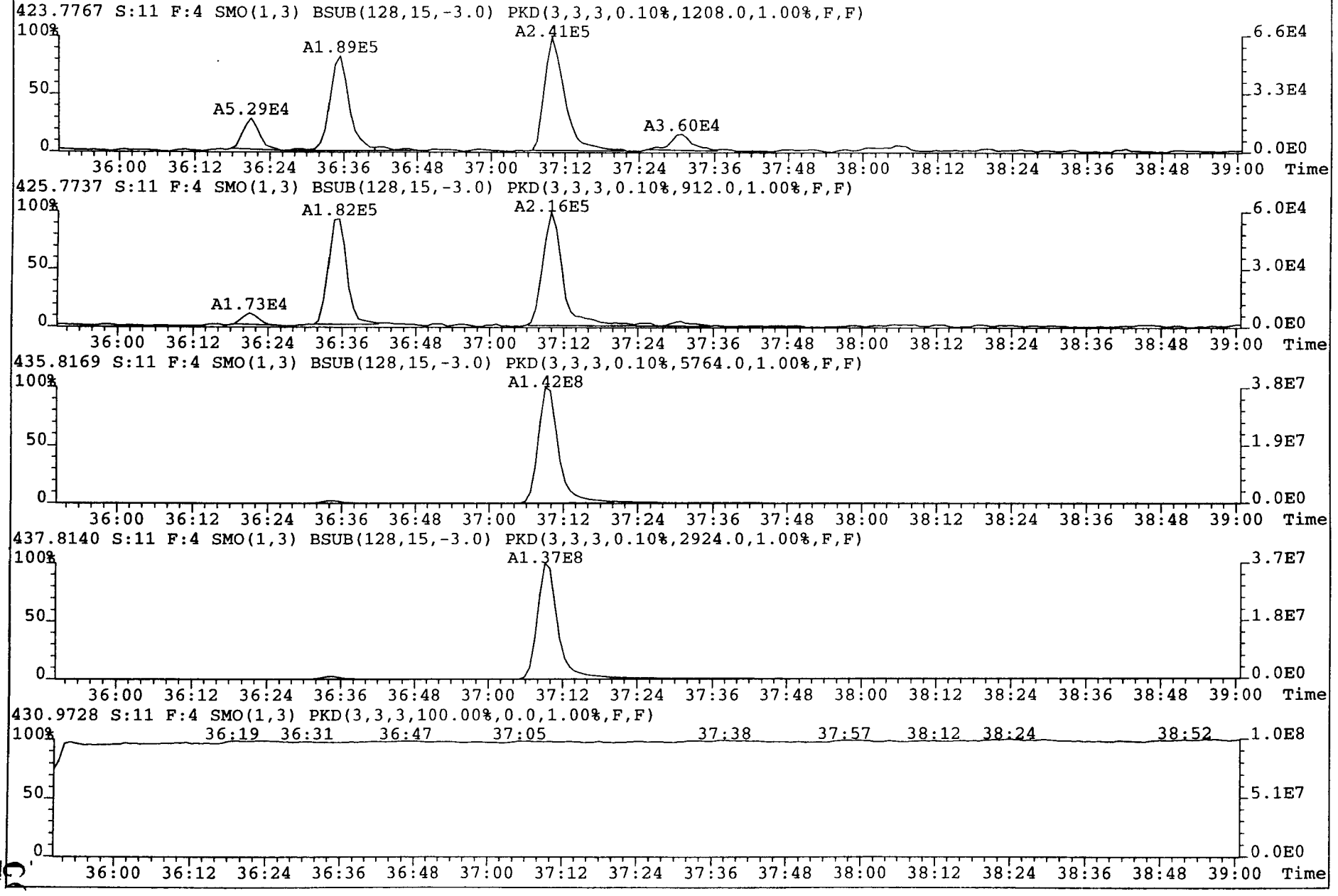
366.9792 S:11 F:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)

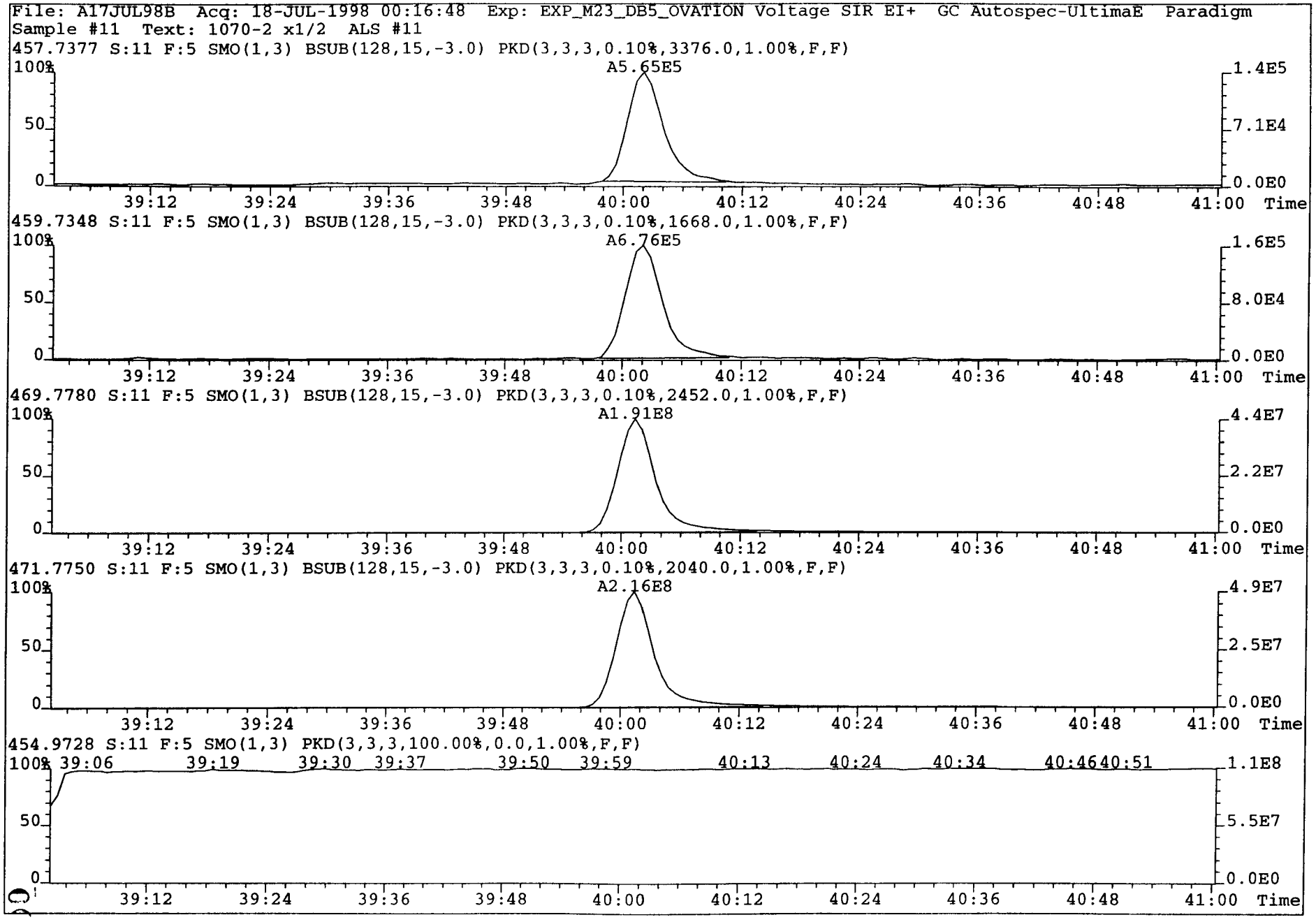


File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11

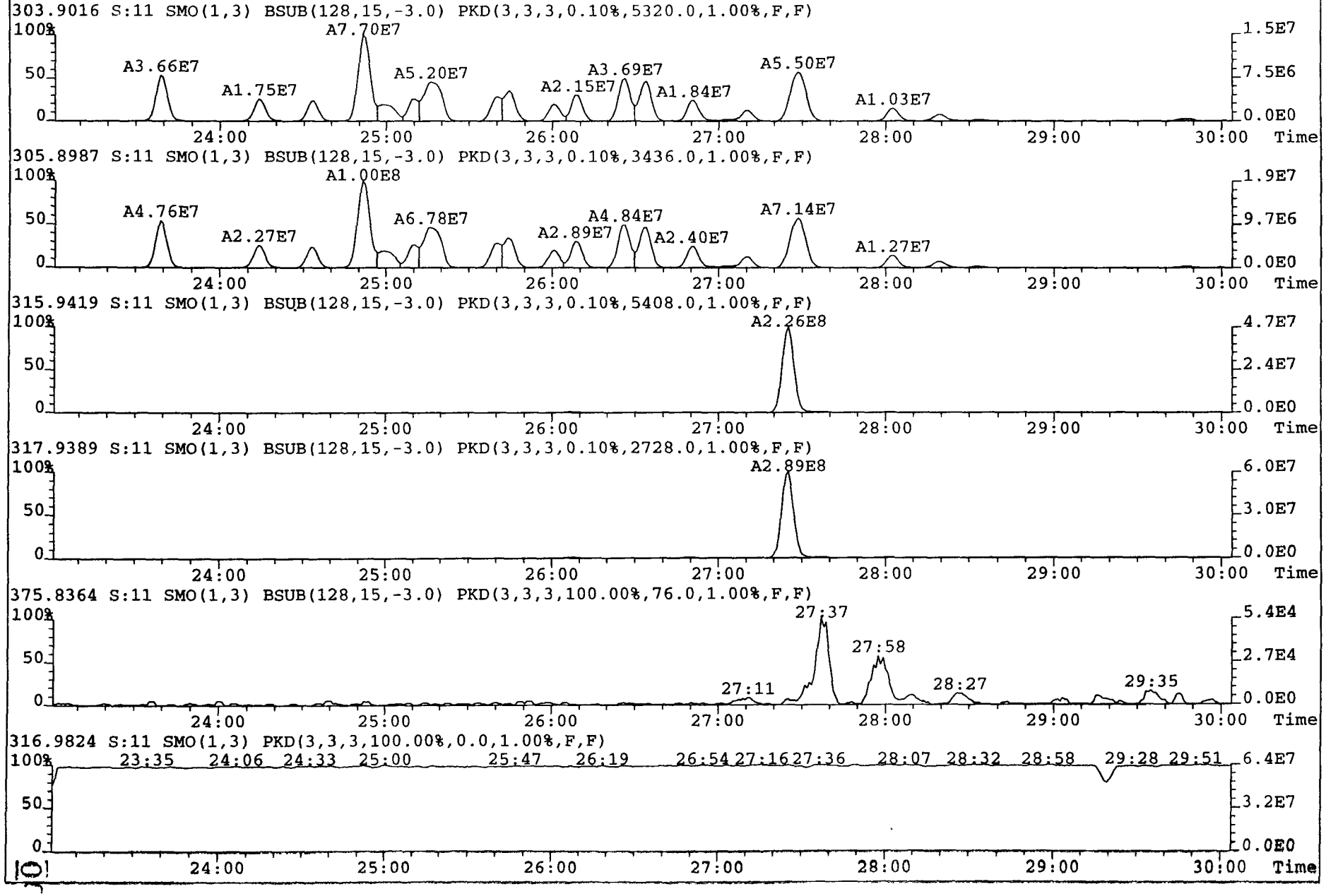


File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11



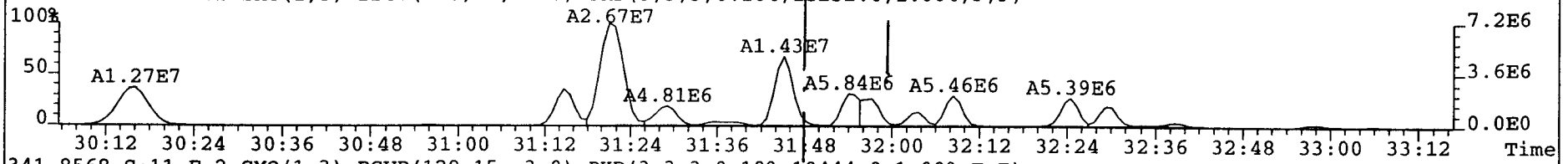

File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11
457.7377 S:11 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3376.0,1.00%,F,F)
A5.65E5
1.4E5
7.1E4
0.0E0
459.7348 S:11 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1668.0,1.00%,F,F)
A6.76E5
1.6E5
8.0E4
0.0E0
469.7780 S:11 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2452.0,1.00%,F,F)
A1.91E8
4.4E7
2.2E7
0.0E0
471.7750 S:11 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2040.0,1.00%,F,F)
A2.16E8
4.9E7
2.5E7
0.0E0
454.9728 S:11 F:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
39:06 39:19 39:30 39:37 39:50 39:59 40:13 40:24 40:34 40:46 40:51
1.1E8
5.5E7
0.0E0
100%
50
0
39:12 39:24 39:36 39:48 40:00 40:12 40:24 40:36 40:48 41:00 Time

File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11

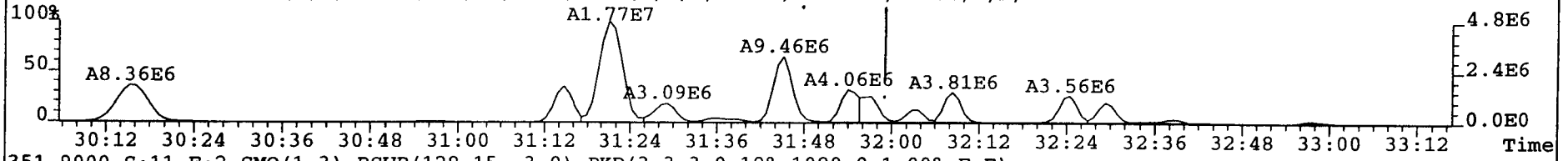


File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11

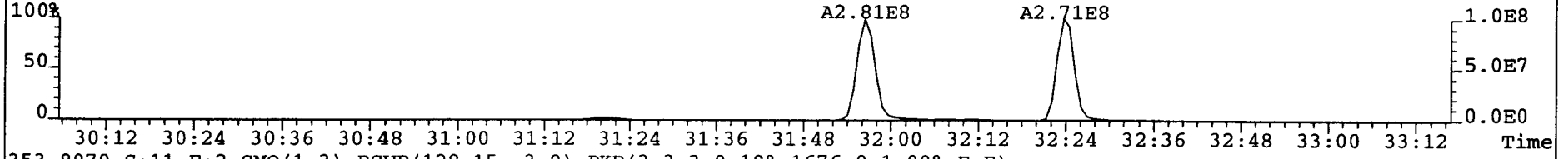
339.8597 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,15232.0,1.00%,F,F)



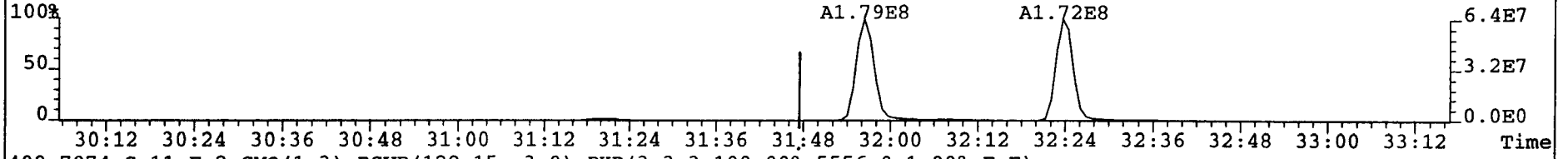
341.8568 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,10444.0,1.00%,F,F)



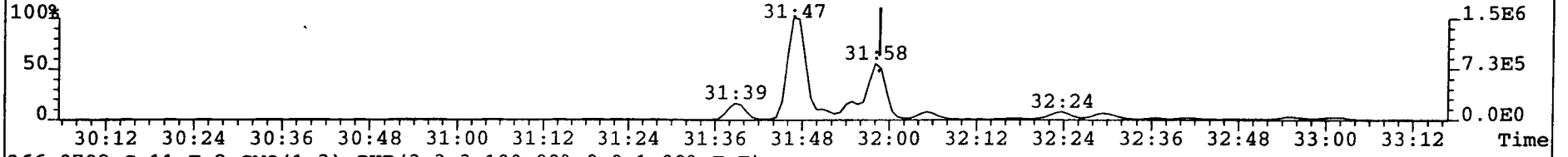
351.9000 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1080.0,1.00%,F,F)



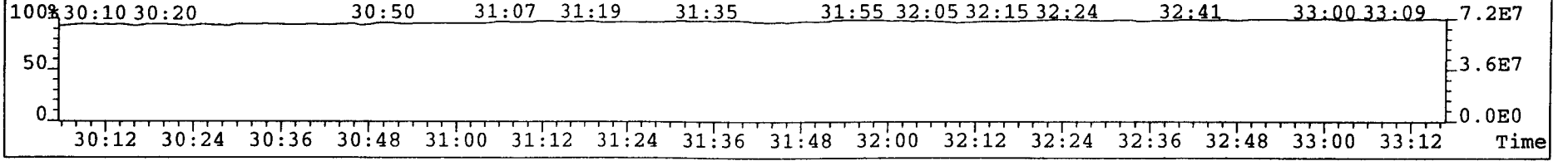
353.8970 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1676.0,1.00%,F,F)



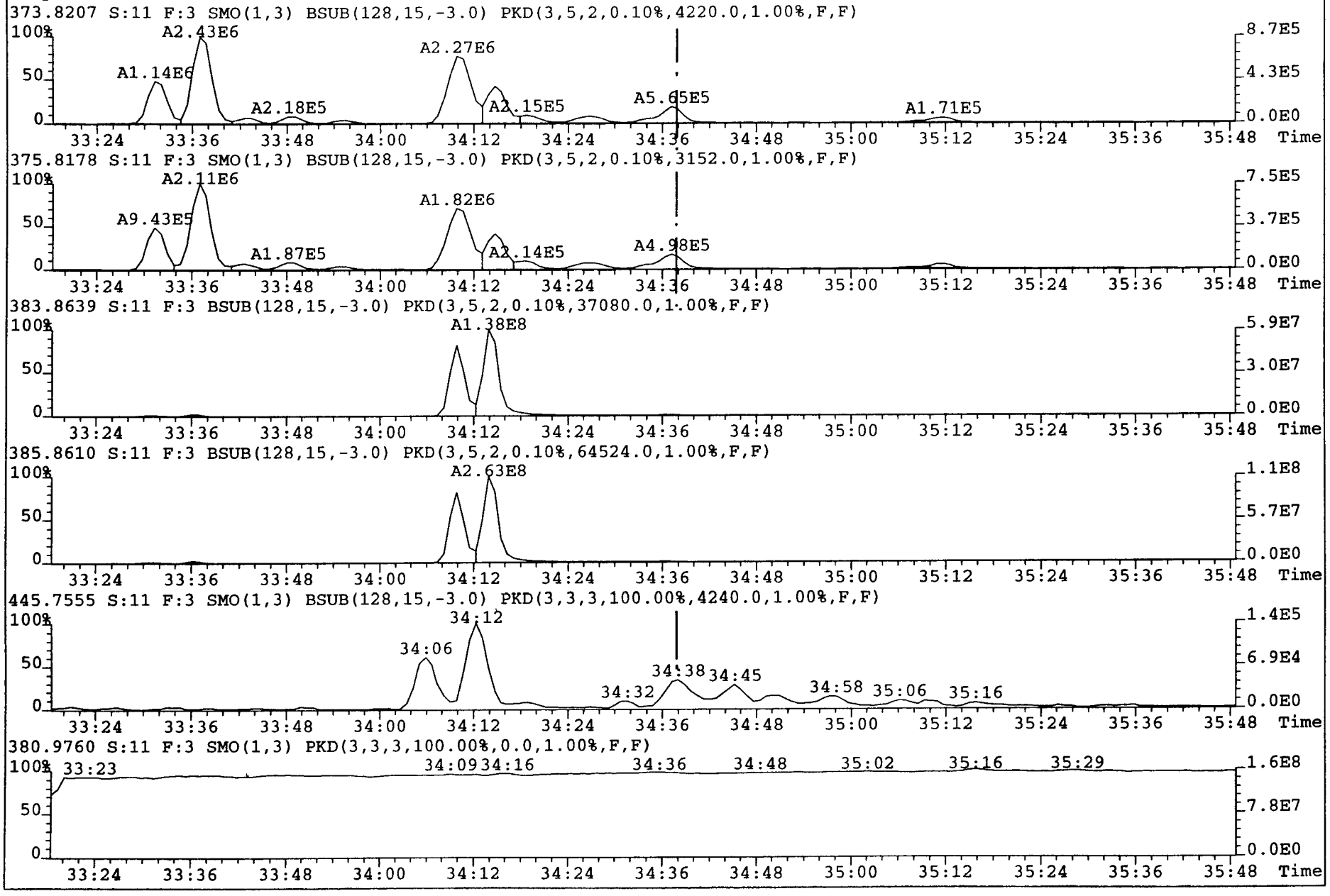
409.7974 S:11 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,5556.0,1.00%,F,F)



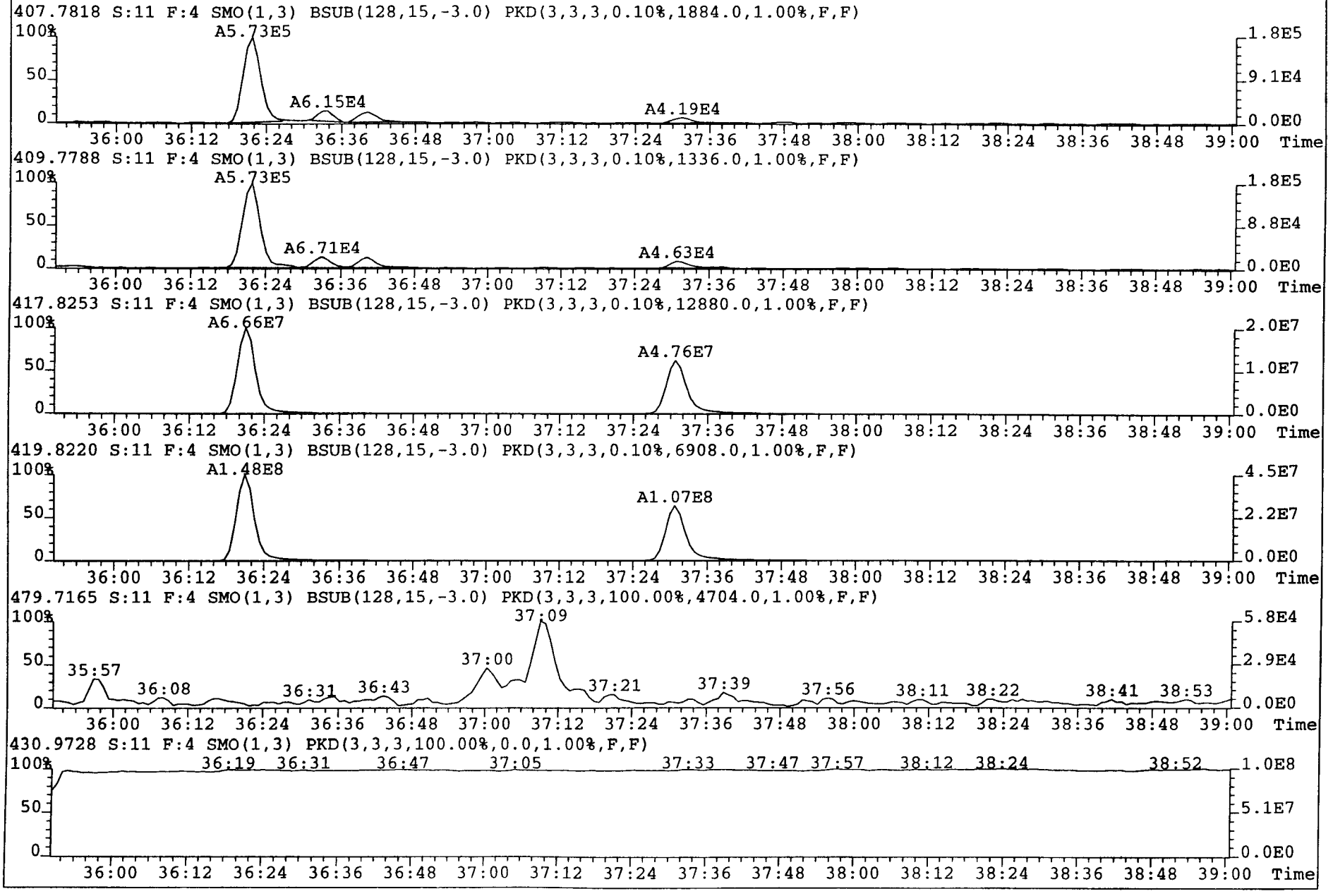
366.9792 S:11 F:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)



File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP M23 DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11

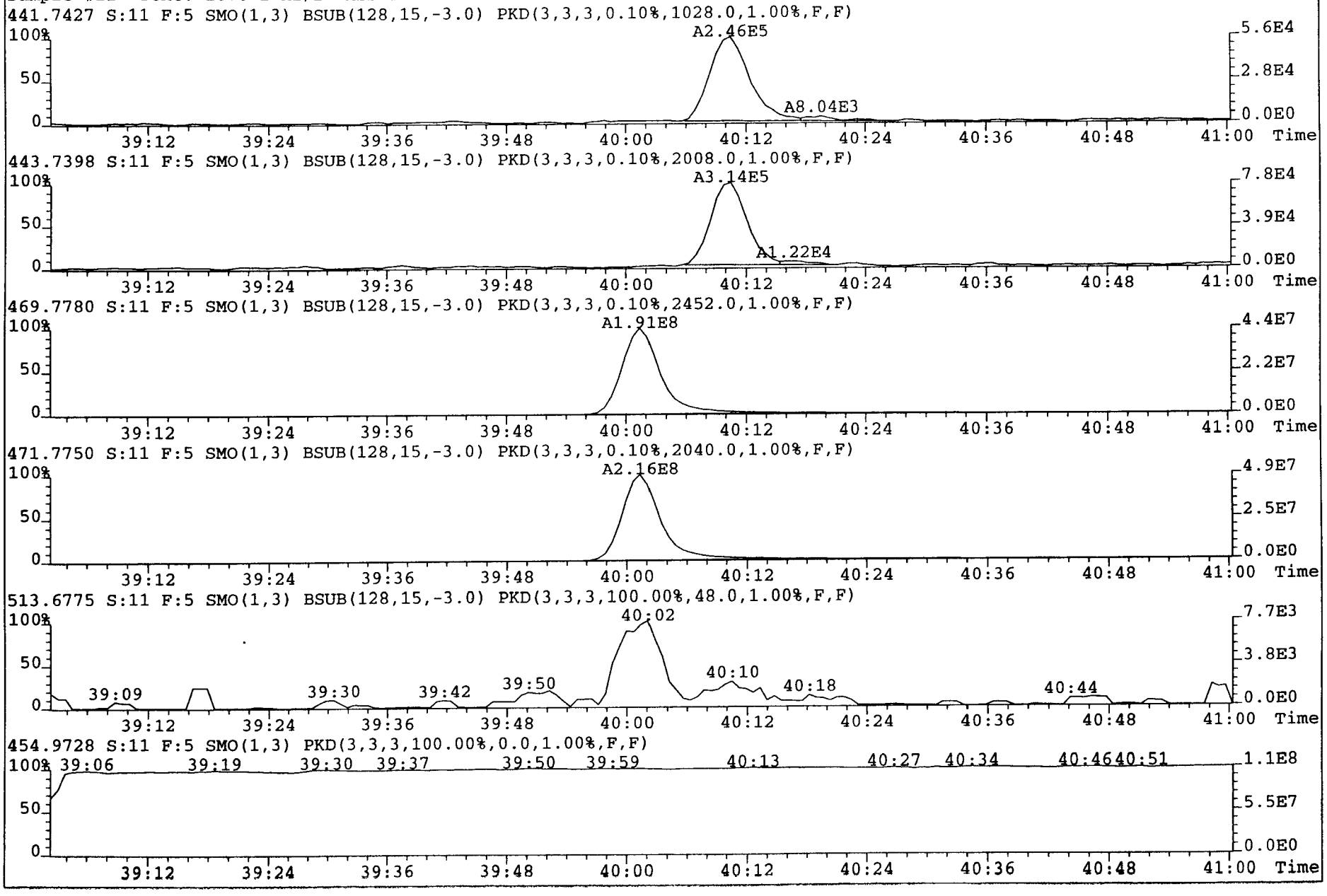


File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11



087

File: A17JUL98B Acq: 18-JUL-1998 00:16:48 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #11 Text: 1070-2 x1/2 ALS #11



```
        Filename ; a21jul98f
          Sample ; 5
        Acquired ; 21-JUL-98  22:34:59
       Processed ; 22-JUL-98  08:32:14
       Sample ID ; 1070-2 x1/2
       Cal Table ; 07feb-m23conf
   Results Table ; M8290-23-072198F
        Comments ;
Typ  ;                  Name;     Resp;    Ion 1;    Ion 2;   RA;?;    RT;      Conc;      DL;    S/N1;?;    S/N2;? ; mod?
Unk  ;           2,3,7,8-TCDF; 5.42e+07; 2.36e+07; 3.06e+07; 0.77;y; 27:55;     3.995;  0.0156;     711;y;     877;y ;   no
ES/RT;       13C-2,3,7,8-TCDF; 1.43e+09; 6.27e+08; 8.01e+08; 0.78;y; 27:53;   350.023;       -;    3005;y;    4676;y ;   no
Total;           Tetra Furans; 2.81e+09; 1.02e+08; 1.33e+08; 0.77;y; 18:12;   206.789;  0.0156;    5256;y;    6445;y ;   no
DPE  ;                 HxCDPE;        *;        *                  ;NotFnd;         *;       -;       *;n            ;   no
LMC  ;     QC CHK ION (Tetra);        *;        *                  ;NotFnd;         *;       -;    Div0;n            ;   no

                                                  ;        -;    -;-; 27:55

                                                  ;        -;    -;-; 27:55                                ;       -; -;   no
```

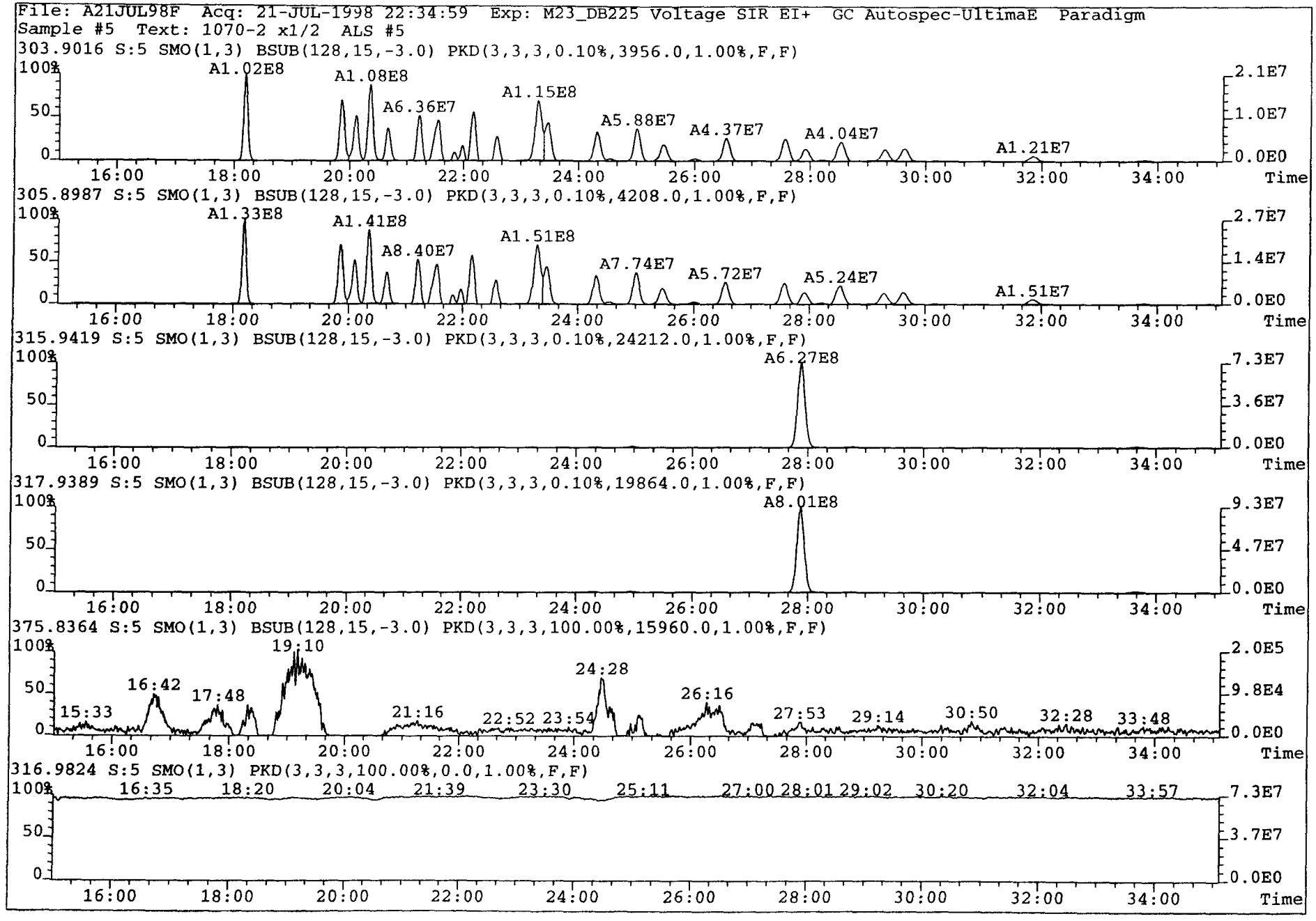
Ent: 3 Name: Tetra Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:30

Run: 10 File: a21jul98f S:5 Acq:21-JUL-98 22:34:59 Proc:22-JUL-98 08:32:14
Tables: Run: a21jul98b Analyte: m23_conf Cal: 07feb-m23»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-2 x1/2

Amount: 206.79 of which 3.99 named and 202.79 unnamed
Conc: 206.79 of which 3.99 named and 202.79 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	18:12	2.4e+08	0.77 y	17.32				
			2.4e+08			1.0e+08	2.1e+07	5.3e+03	y n
						1.3e+08	2.7e+07	6.4e+03	y n
	2	19:52	2.0e+08	0.77 y	14.40				
			2.0e+08			8.5e+07	1.5e+07	3.7e+03	y n
						1.1e+08	1.9e+07	4.5e+03	y n
	3	20:06	1.5e+08	0.77 y	11.39				
			1.5e+08			6.7e+07	1.1e+07	2.7e+03	y n
						8.7e+07	1.4e+07	3.3e+03	y n
	4	20:22	2.5e+08	0.77 y	18.40				
			2.5e+08			1.1e+08	1.8e+07	4.6e+03	y n
						1.4e+08	2.4e+07	5.6e+03	y n
	5	20:40	1.1e+08	0.77 y	7.90				
			1.1e+08			4.7e+07	7.8e+06	2.0e+03	y n
						6.1e+07	1.0e+07	2.4e+03	y n
	6	21:13	1.5e+08	0.76 y	10.87				
			1.5e+08			6.4e+07	1.1e+07	2.8e+03	y n
						8.4e+07	1.4e+07	3.4e+03	y n
	7	21:33	1.7e+08	0.76 y	12.60				
			1.7e+08			7.4e+07	9.8e+06	2.5e+03	y n
						9.7e+07	1.3e+07	3.0e+03	y n
	8	21:50	2.0e+07	0.71 y	1.47				
			2.0e+07			8.3e+06	2.0e+06	5.0e+02	y n
						1.2e+07	2.7e+06	6.5e+02	y n
	9	21:59	3.7e+07	0.74 y	2.72				
			3.7e+07			1.6e+07	3.5e+06	8.9e+02	y n
						2.1e+07	4.7e+06	1.1e+03	y n
	10	22:10	1.5e+08	0.75 y	11.22				
			1.5e+08			6.5e+07	1.2e+07	3.0e+03	y n
						8.7e+07	1.6e+07	3.7e+03	y n
	11	22:35	7.7e+07	0.75 y	5.64				
			7.7e+07			3.3e+07	5.8e+06	1.5e+03	y n
						4.4e+07	7.7e+06	1.8e+03	y n
	12	22:56	1.4e+05	0.80 y	0.01				
			1.4e+05			6.3e+04	3.9e+04	9.8e+00	y n
						7.8e+04	4.8e+04	1.1e+01	y n
	13	23:18	2.7e+08	0.76 y	19.55				
			2.7e+08			1.1e+08	1.4e+07	3.6e+03	y n
						1.5e+08	1.9e+07	4.5e+03	y n
	14	23:28	1.5e+08	0.77 y	11.13				
			1.5e+08			6.6e+07	9.2e+06	2.3e+03	y n
						8.5e+07	1.2e+07	2.9e+03	y n
	15	24:19	1.2e+08	0.77 y	8.83				
			1.2e+08			5.2e+07	6.9e+06	1.8e+03	y n
						6.8e+07	9.2e+06	2.2e+03	y n
	16	24:33	8.9e+06	0.75 y	0.66				
			8.9e+06			3.8e+06	5.4e+05	1.4e+02	y n
						5.1e+06	7.2e+05	1.7e+02	y n
	17	25:01	1.4e+08	0.76 y	10.04				
			1.4e+08			5.9e+07	7.8e+06	2.0e+03	y n
						7.7e+07	1.0e+07	2.4e+03	y n
	18	25:27	7.3e+07	0.77 y	5.35				
			7.3e+07			3.1e+07	3.8e+06	9.7e+02	y n
						4.1e+07	5.0e+06	1.2e+03	y n
	19	26:00	7.5e+06	0.76 y	0.55				
			7.5e+06			3.2e+06	4.4e+05	1.1e+02	y n
						4.2e+06	5.7e+05	1.3e+02	y n

	20	26:33	1.0e+08	0.76	y	7.43					
			1.0e+08				4.4e+07	5.4e+06	1.4e+03	y	n
							5.7e+07	7.1e+06	1.7e+03	y	n
	21	27:34	1.0e+08	0.78	y	7.50					
			1.0e+08				4.4e+07	5.2e+06	1.3e+03	y	n
							5.7e+07	6.8e+06	1.6e+03	y	n
2,3,7,8-TCDF	22	27:55	5.4e+07	0.77	y	3.99					
			5.4e+07				2.4e+07	2.8e+06	7.1e+02	y	n
							3.1e+07	3.7e+06	8.8e+02	y	n
	23	28:13	2.5e+06	1.57	n	0.18					
			2.5e+06				1.5e+06	2.3e+05	5.8e+01	y	n
							9.7e+05	2.8e+05	6.7e+01	y	n
	24	28:32	9.3e+07	0.76	y	6.87					
			9.3e+07				4.0e+07	4.5e+06	1.1e+03	y	n
							5.3e+07	5.9e+06	1.4e+03	y	n
	25	29:03	1.0e+06	0.39	n	0.08					
			1.0e+06				2.9e+05	6.7e+04	1.7e+01	y	n
							7.4e+05	1.7e+05	4.1e+01	y	n
	26	29:18	5.3e+07	0.70	y	3.91					
			5.3e+07				2.2e+07	2.5e+06	6.4e+02	y	n
							3.1e+07	3.4e+06	8.1e+02	y	n
	27	29:37	6.3e+07	0.75	y	4.63					
			6.3e+07				2.7e+07	2.9e+06	7.2e+02	y	n
							3.6e+07	3.8e+06	8.9e+02	y	n
	28	31:51	2.7e+07	0.80	y	2.01					
			2.7e+07				1.2e+07	1.2e+06	3.0e+02	y	n
							1.5e+07	1.5e+06	3.5e+02	y	n
	29	33:46	7.6e+05	0.95	n	0.06					
			7.6e+05				3.7e+05	1.0e+05	2.5e+01	y	n
							3.9e+05	1.2e+05	3.0e+01	y	n
	30	33:48	1.2e+06	0.80	y	0.09					
			1.2e+06				5.2e+05	1.1e+05	2.7e+01	y	n
							6.5e+05	1.4e+05	3.2e+01	y	n


File: A21JUL98F Acq: 21-JUL-1998 22:34:59 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #5 Text: 1070-2 x1/2 ALS #5
303.9016 S:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3956.0,1.00%,F,F)
A1.02E8
A1.08E8
A6.36E7
A1.15E8
A5.88E7
A4.37E7
A4.04E7
A1.21E7
305.8987 S:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,4208.0,1.00%,F,F)
A1.33E8
A1.41E8
A8.40E7
A1.51E8
A7.74E7
A5.72E7
A5.24E7
A1.51E7
315.9419 S:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,24212.0,1.00%,F,F)
A6.27E8
317.9389 S:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,19864.0,1.00%,F,F)
A8.01E8
375.8364 S:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,15960.0,1.00%,F,F)
15:33
16:42
17:48
19:10
21:16
22:52
23:54
24:28
26:16
27:53
29:14
30:50
32:28
33:48
316.9824 S:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
16:35
18:20
20:04
21:39
23:30
25:11
27:00
28:01
29:02
30:20
32:04
33:57
100%
50
0
2.1E7
1.0E7
0.0E0
2.7E7
1.4E7
7.3E7
3.6E7
9.3E7
4.7E7
2.0E5
9.8E4
3.7E7
16:00
18:00
20:00
22:00
24:00
26:00
28:00
30:00
32:00
34:00
Time

Method 23

M23-FB-1

PBS

Analytical Data Summary Sheet

Analyte	Concentration (ng)	DL (ng)	EMPC (ng)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	EMPC	0.0005	0.0010	28:29	1.40	
1,2,3,7,8-PeCDD	ND	0.0003				
1,2,3,4,7,8-HxCDD	ND	0.0005		34:43	0.29	
1,2,3,6,7,8-HxCDD	EMPC	0.0004	0.0009	34:47	0.98	
1,2,3,7,8,9-HxCDD	EMPC	0.0004	0.0009	35:00	0.87	
1,2,3,4,6,7,8-HpCDD	0.0045	0.0004		37:11	1.1	
OCDD	0.0162	0.0010		40:03	0.90	
2,3,7,8--TCDF	0.0030	0.0005		27:28	0.7	
1,2,3,7,8-PeCDF	ND	0.0005				
2,3,4,7,8-PeCDF	ND	0.0004				
1,2,3,4,7,8-HxCDF	0.0014	0.0003		34:11	1.39	
1,2,3,6,7,8-HxCDF	EMPC	0.0002	0.0004	34:16	1.85	
2,3,4,6,7,8-HxCDF	ND	0.0002		34:38	1.67	
1,2,3,7,8,9-HxCDF	ND	0.0003		35:10	0.78	
1,2,3,4,6,7,8-HpCDF	0.0071	0.0007		36:23	1.04	
1,2,3,4,7,8,9-HpCDF	ND	0.0008				
OCDF	0.0059	0.0008		40:11	1.01	
Total TCDDs	0.0016	0.0005	0.0034			
Total PeCDDs	0.0016	0.0003	0.0024			
Total HxCDDs	0.0040	0.0004	0.0080			
Total HpCDDs	0.0080	0.0004	0.0092			
Total TCDFs	0.0108	0.0005	0.0132			
Total PeCDFs	ND	0.0004	0.0016			
Total HxCDFs	0.0024	0.0002	0.0032			
Total HpCDFs	0.0072	0.0007	0.0080			
TEQ (ND=0)	0.0006		0.0017			ITEF
TEQ (ND=1/2)	0.0011		0.0020			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-FB-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-3

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-12
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Method 23

M23-FB-1

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	3.50	87.4	28:27	0.77	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	4.04	100.9	32:37	1.56	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.78	94.6	34:46	1.26	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	3.82	95.6	37:10	1.05	
$^{13}C_{12}$-OCDD	8	6.97	87.1	40:02	0.89	
$^{13}C_{12}$-2,3,7,8-TCDF	4	3.53	88.2	27:25	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	3.48	87.1	31:57	1.55	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	3.79	94.8	34:15	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	3.01	75.2	36:22	0.44	
Sampling Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	3.78	94.4	28:29		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	3.91	97.8	32:25	1.56	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	3.61	90.2	34:42	1.24	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	3.19	79.6	34:11	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	3.11	77.8	37:32	0.44	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:10	0.79	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:59	1.26	

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-FB-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-3

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-12
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: T.T.

Date Reviewed: 23Jul98

094

Filename ; a17jul98b
Sample ; 12
Acquired ; 18-JUL-98 01:01:55
Processed ; 20-JUL-98 09:07:42
Sample ID ; 1070-3 x1/2
Cal Table ; m8290-23-071798
Results Table ; M8290-23-071798B
Comments ;

Typ ;	Name;	Resp;	Ion 1;	Ion 2;	RA;?;	RT;	Conc;	DL;	S/N1;?;	S/N2;? ;	mod?
Unk ;	2,3,7,8-TCDD;	2.94e+05;	5.23e+04;	2.41e+05;	0.22;n;	28:29;	0.078;	0.0122;	7;y;	39;y ;	no
Unk ;	1,2,3,7,8-PeCDD;	*;	*;	*;	*;n;	NotFnd;	*;	0.0080;	*;n;	*;n ;	no
Unk ;	1,2,3,4,7,8-HxCDD;	1.76e+04;	3.94e+03;	1.36e+04;	0.29;n;	34:43;	0.008;	0.0125;	1;n;	2;n ;	no
Unk ;	1,2,3,6,7,8-HxCDD;	6.96e+04;	3.44e+04;	3.52e+04;	0.98;n;	34:47;	0.023;	0.0099;	7;y;	5;y ;	no
Unk ;	1,2,3,7,8,9-HxCDD;	6.67e+04;	3.10e+04;	3.57e+04;	0.87;n;	35:00;	0.022;	0.0098;	6;y;	4;y ;	no
Unk ;	1,2,3,4,6,7,8-HpCDD;	2.61e+05;	1.37e+05;	1.24e+05;	1.10;y;	37:11;	0.112;	0.0105;	29;y;	40;y ;	no
Unk ;	OCDD;	7.76e+05;	3.67e+05;	4.08e+05;	0.90;y;	40:03;	0.404;	0.0240;	36;y;	105;y ;	no
Unk ;	2,3,7,8-TCDF;	3.46e+05;	1.42e+05;	2.04e+05;	0.70;y;	27:28;	0.075;	0.0122;	12;y;	15;y ;	no
Unk ;	1,2,3,7,8-PeCDF;	*;	*;	*;	*;n;	NotFnd;	*;	0.0115;	*;n;	*;n ;	no
Unk ;	2,3,4,7,8-PeCDF;	*;	*;	*;	*;n;	NotFnd;	*;	0.0111;	*;n;	*;n ;	no
Unk ;	1,2,3,4,7,8-HxCDF;	1.18e+05;	6.83e+04;	4.93e+04;	1.39;y;	34:11;	0.034;	0.0064;	10;y;	11;y ;	no
Unk ;	1,2,3,6,7,8-HxCDF;	4.65e+04;	3.02e+04;	1.63e+04;	1.85;n;	34:16;	0.011;	0.0051;	5;y;	5;y ;	no
Unk ;	2,3,4,6,7,8-HxCDF;	2.31e+04;	1.45e+04;	8.66e+03;	1.67;n;	34:38;	0.006;	0.0059;	2;n;	2;n ;	no
Unk ;	1,2,3,7,8,9-HxCDF;	1.06e+04;	4.62e+03;	5.94e+03;	0.78;n;	35:10;	0.003;	0.0068;	1;n;	2;n ;	no
Unk ;	1,2,3,4,6,7,8-HpCDF;	4.37e+05;	2.22e+05;	2.14e+05;	1.04;y;	36:23;	0.178;	0.0169;	26;y;	46;y ;	no
Unk ;	1,2,3,4,7,8,9-HpCDF;	*;	*;	*;	*;n;	NotFnd;	*;	0.0204;	*;n;	*;n ;	no
Unk ;	OCDF;	3.03e+05;	1.52e+05;	1.51e+05;	1.01;y;	40:11;	0.148;	0.0200;	45;y;	17;y ;	no
ES/RT;	13C-2,3,7,8-TCDD;	3.82e+08;	1.67e+08;	2.15e+08;	0.77;y;	28:27;	87.423;	0.0457;	3515;y;	9897;y ;	no
ES ;	13C-1,2,3,7,8-PeCDD;	3.07e+08;	1.87e+08;	1.20e+08;	1.56;y;	32:37;	100.876;	0.0268;	17251;y;	22604;y ;	no
ES ;	13C-1,2,3,6,7,8-HxCDD;	3.48e+08;	1.94e+08;	1.54e+08;	1.26;y;	34:46;	94.602;	0.0316;	8162;y;	10571;y ;	no
ES ;	13C-1,2,3,4,6,7,8-HpCDD;	2.61e+08;	1.34e+08;	1.27e+08;	1.05;y;	37:10;	95.601;	0.0291;	6834;y;	7219;y ;	no
ES ;	13C-OCDD;	3.82e+08;	1.80e+08;	2.02e+08;	0.89;y;	40:02;	174.250;	0.2296;	637;y;	30364;y ;	no
ES/RT;	13C-2,3,7,8-TCDF;	4.83e+08;	2.12e+08;	2.71e+08;	0.78;y;	27:25;	88.212;	0.0225;	11770;y;	11292;y ;	no
ES ;	13C-1,2,3,7,8-PeCDF;	4.15e+08;	2.53e+08;	1.63e+08;	1.55;y;	31:57;	87.104;	0.0111;	46692;y;	32634;y ;	no
ES ;	13C-1,2,3,6,7,8-HxCDF;	4.03e+08;	1.37e+08;	2.66e+08;	0.52;y;	34:15;	94.834;	0.1568;	1653;y;	2517;y ;	no
ES ;	13C-1,2,3,4,6,7,8-HpCDF;	1.94e+08;	5.97e+07;	1.35e+08;	0.44;y;	36:22;	75.219;	0.0536;	2222;y;	4153;y ;	no
JS ;	13C-1,2,3,4-TCDD;	3.98e+08;	1.75e+08;	2.22e+08;	0.79;y;	28:10;	82.464;	-;	3867;y;	10575;y ;	no
JS ;	13C-1,2,3,7,8,9-HxCDD;	3.43e+08;	1.91e+08;	1.52e+08;	1.26;y;	34:59;	86.455;	-;	7930;y;	10371;y ;	no
CS ;	37Cl-2,3,7,8-TCDD;	3.30e+08;	3.30e+08;	-;	-;-;	28:29;	82.479;	0.0219;	11127;y;	-; -;	no
CS ;	13C-2,3,4,7,8-PeCDF;	3.97e+08;	2.42e+08;	1.55e+08;	1.56;y;	32:25;	85.112;	0.0113;	47310;y;	33089;y ;	no
CS ;	13C-1,2,3,4,7,8-HxCDD;	2.12e+08;	1.17e+08;	9.47e+07;	1.24;y;	34:42;	85.426;	0.0469;	6286;y;	8406;y ;	no
CS ;	13C-1,2,3,4,7,8-HxCDF;	2.52e+08;	8.58e+07;	1.66e+08;	0.52;y;	34:11;	76.121;	0.2012;	1118;y;	1681;y ;	no
CS ;	13C-1,2,3,4,7,8,9-HpCDF;	1.18e+08;	3.60e+07;	8.22e+07;	0.44;y;	37:32;	58.518;	0.0685;	1187;y;	2232;y ;	no
SS ;	37Cl-2,3,7,8-TCDD;	3.30e+08;	3.30e+08;	-;	-;-;	28:29;	94.398;	0.0261;	11127;y;	-; -;	no
SS ;	13C-2,3,4,7,8-PeCDF;	3.97e+08;	2.42e+08;	1.55e+08;	1.56;y;	32:25;	97.746;	0.0077;	47310;y;	33089;y ;	no
SS ;	13C-1,2,3,4,7,8-HxCDD;	2.12e+08;	1.17e+08;	9.47e+07;	1.24;y;	34:42;	90.183;	0.0490;	6286;y;	8406;y ;	no
SS ;	13C-1,2,3,4,7,8-HxCDF;	2.52e+08;	8.58e+07;	1.66e+08;	0.52;y;	34:11;	79.631;	0.1787;	1118;y;	1681;y ;	no
SS ;	13C-1,2,3,4,7,8,9-HpCDF;	1.18e+08;	3.60e+07;	8.22e+07;	0.44;y;	37:32;	77.826;	0.1170;	1187;y;	2232;y ;	no

Ent 39 Name: Total Tetra-Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:17

Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

Amount: 0.36 of which 0.08 named and 0.28 unnamed
Conc: 0.36 of which 0.08 named and 0.28 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	23:41	8.3e+04	0.92 n	0.02					
			8.3e+04			4.0e+04	9.5e+03	5.1e+00	y	n
						4.3e+04	1.0e+04	5.4e+00	y	n
	2	24:34	9.6e+04	0.44 n	0.02					
			9.6e+04			2.9e+04	6.9e+03	3.8e+00	y	n
						6.7e+04	1.4e+04	7.1e+00	y	n
	3	24:53	1.5e+05	0.69 y	0.03					
			1.5e+05			6.1e+04	1.6e+04	8.5e+00	y	n
						8.8e+04	1.9e+04	9.9e+00	y	n
	4	25:00	1.1e+04	0.60 n	0.00					
			1.1e+04			4.0e+03	2.1e+03	1.2e+00	n	n
						6.6e+03	1.9e+03	1.0e+00	n	n
	5	25:03	1.7e+04	1.60 n	0.00					
			1.7e+04			1.1e+04	2.5e+03	1.3e+00	n	n
						6.6e+03	1.9e+03	1.0e+00	n	n
	6	25:09	2.6e+04	0.38 n	0.01					
			2.6e+04			7.3e+03	3.1e+03	1.7e+00	n	n
						1.9e+04	4.8e+03	2.4e+00	n	n
	7	25:20	1.1e+05	0.74 y	0.02					
			1.1e+05			4.5e+04	9.2e+03	5.0e+00	y	n
						6.1e+04	9.0e+03	4.6e+00	y	n
	8	25:42	8.2e+04	0.75 y	0.02					
			8.2e+04			3.5e+04	7.6e+03	4.1e+00	y	n
						4.7e+04	1.0e+04	5.3e+00	y	n
	9	25:46	8.3e+04	0.95 n	0.02					
			8.3e+04			4.0e+04	9.3e+03	5.0e+00	y	n
						4.3e+04	1.0e+04	5.3e+00	y	n
	10	26:00	2.7e+04	0.46 n	0.01					
			2.7e+04			8.6e+03	2.5e+03	1.3e+00	n	n
						1.9e+04	5.0e+03	2.6e+00	n	n
	11	26:09	1.4e+05	0.75 y	0.03					
			1.4e+05			5.9e+04	1.2e+04	6.3e+00	y	n
						8.0e+04	1.9e+04	9.6e+00	y	n
	12	26:27	1.4e+05	0.66 y	0.03					
			1.4e+05			5.4e+04	1.0e+04	5.5e+00	y	n
						8.2e+04	1.2e+04	6.2e+00	y	n
	13	26:35	9.8e+04	0.88 y	0.02					
			9.8e+04			4.6e+04	9.0e+03	4.9e+00	y	n
						5.2e+04	1.2e+04	6.2e+00	y	n
	14	26:52	1.8e+05	0.73 y	0.04					
			1.8e+05			7.6e+04	1.4e+04	7.5e+00	y	n
						1.0e+05	2.1e+04	1.1e+01	y	n
2,3,7,8-TCDF	15	27:28	3.5e+05	0.70 y	0.08					
			3.5e+05			1.4e+05	2.3e+04	1.2e+01	y	n
						2.0e+05	2.9e+04	1.5e+01	y	n
	16	28:03	4.2e+04	0.41 n	0.01					
			4.2e+04			1.2e+04	4.0e+03	2.2e+00	n	n
						3.0e+04	6.1e+03	3.1e+00	y	n
	17	29:49	2.1e+04	0.56 n	0.00					
			2.1e+04			7.6e+03	1.7e+03	9.1e-01	n	n
						1.3e+04	5.0e+03	2.6e+00	n	n

Ent: 40 Name: Total Tetra-Dioxins F:1 Mass: 319.897 321.894 Mod? no #Hom:4

Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

Amount: 0.14 of which 0.08 named and 0.06 unnamed
Conc: 0.14 of which 0.08 named and 0.06 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	25:16	1.4e+05	0.83 y	0.04					
			1.4e+05			6.1e+04	1.4e+04	8.1e+00	y	n
						7.4e+04	1.6e+04	1.2e+01	y	n
	2	25:41	5.8e+04	0.56 n	0.02					
			5.8e+04			2.1e+04	5.8e+03	3.5e+00	y	n
						3.7e+04	7.2e+03	5.3e+00	y	n
	3	28:11	2.5e+04	1.30 n	0.01					
			2.5e+04			1.4e+04	3.5e+03	2.1e+00	n	n
						1.1e+04	3.3e+03	2.4e+00	n	n
2,3,7,8-TCDD	4	28:29	2.9e+05	0.22 n	0.08					
			2.9e+05			5.2e+04	1.1e+04	6.6e+00	y	n
						2.4e+05	5.3e+04	3.9e+01	y	n

Ent: 41 Name: Total Penta-Furans F:2 Mass: 339.860 341.857 Mod? no #Hom:3

Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

Amount: 0.06 of which * named and 0.06 unnamed
Conc: 0.06 of which * named and 0.06 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	31:22	1.6e+05	1.86 n	0.04					
			1.6e+05			1.0e+05	2.8e+04	2.5e+01	y	n
						5.4e+04	1.6e+04	4.3e+00	y	n
	2	31:46	4.7e+04	2.68 n	0.01					
			4.7e+04			3.4e+04	1.0e+04	9.2e+00	y	n
						1.3e+04	4.9e+03	1.3e+00	n	n
	3	32:30	2.9e+04	0.78 n	0.01					
			2.9e+04			1.3e+04	4.6e+03	4.1e+00	y	n
						1.6e+04	5.0e+03	1.3e+00	n	n

Ent: 42 Name: Total Penta-Dioxins F:2 Mass: 355.855 357.852 Mod? no #Hom:5

Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

Amount: 0.07 of which * named and 0.07 unnamed
Conc: 0.07 of which * named and 0.07 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	31:30	1.2e+05	1.64 y	0.04				
			1.2e+05			7.5e+04	2.6e+04	1.3e+01	y n
						4.6e+04	1.7e+04	1.4e+01	y n
	2	32:05	2.2e+04	0.76 n	0.01				
			2.2e+04			9.3e+03	4.1e+03	2.1e+00	n n
						1.2e+04	4.5e+03	3.7e+00	y n
	3	32:12	2.5e+04	1.15 n	0.01				
			2.5e+04			1.3e+04	4.9e+03	2.5e+00	n n
						1.2e+04	4.0e+03	3.3e+00	y n
	4	32:20	2.4e+04	0.76 n	0.01				
			2.4e+04			1.1e+04	4.4e+03	2.2e+00	n n
						1.4e+04	4.3e+03	3.5e+00	y n
	5	32:25	5.2e+04	2.69 n	0.02				
			5.2e+04			3.8e+04	1.3e+04	6.8e+00	y n
						1.4e+04	3.9e+03	3.2e+00	y n

Ent: 43 Name: Total Hexa-Furans F:3 Mass: 373.821 375.818 Mod? no #Hom:15

Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

Amount: 0.12 of which 0.05 named and 0.07 unnamed
Conc: 0.12 of which 0.05 named and 0.07 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:32	4.5e+04	0.97 n	0.01				
			4.5e+04			2.2e+04	8.6e+03	4.5e+00	y n
						2.3e+04	9.0e+03	6.1e+00	y n
	2	33:38	1.1e+05	1.30 y	0.03				
			1.1e+05			6.1e+04	2.1e+04	1.1e+01	y n
						4.7e+04	1.8e+04	1.2e+01	y n
	3	33:55	2.4e+04	2.83 n	0.01				
			2.4e+04			1.7e+04	6.3e+03	3.3e+00	y n
						6.1e+03	2.4e+03	1.6e+00	n n
1,2,3,4,7,8-HxCDF	4	34:11	1.2e+05	1.39 y	0.03				
			1.2e+05			6.8e+04	2.0e+04	1.0e+01	y n
						4.9e+04	1.6e+04	1.1e+01	y n
1,2,3,6,7,8-HxCDF	5	34:16	4.6e+04	1.85 n	0.01				
			4.6e+04			3.0e+04	9.6e+03	5.0e+00	y n
						1.6e+04	6.9e+03	4.6e+00	y n
	6	34:21	5.5e+03	4.41 n	0.00				
			5.5e+03			4.5e+03	1.8e+03	9.2e-01	n n
						1.0e+03	7.3e+02	4.9e-01	n n
	7	34:36	1.9e+04	1.25 y	0.01				
			1.9e+04			1.1e+04	3.0e+03	1.6e+00	n n
						8.7e+03	3.3e+03	2.3e+00	n n
2,3,4,6,7,8-HxCDF	8	34:38	2.3e+04	1.67 n	0.01				
			2.3e+04			1.4e+04	4.4e+03	2.3e+00	n n
						8.7e+03	3.3e+03	2.3e+00	n n
	9	34:44	9.7e+03	5.13 n	0.00				
			9.7e+03			8.1e+03	2.2e+03	1.2e+00	n n

							1.6e+03	5.3e+02	3.6e-01	n	n
	10	34:47	9.5e+03	1.48	n	0.00					
			9.5e+03				5.7e+03	2.1e+03	1.1e+00	n	n
							3.8e+03	7.5e+02	5.1e-01	n	n
	11	35:01	1.2e+04	2.17	n	0.00					
			1.2e+04				8.3e+03	1.5e+03	7.7e-01	n	n
							3.8e+03	1.0e+03	6.9e-01	n	n
	12	35:06	7.8e+03	0.73	n	0.00					
			7.8e+03				3.3e+03	1.3e+03	7.0e-01	n	n
							4.5e+03	1.5e+03	9.9e-01	n	n
1,2,3,7,8,9-HxCDF	13	35:10	1.1e+04	0.78	n	0.00					
			1.1e+04				4.6e+03	2.0e+03	1.0e+00	n	n
							5.9e+03	2.3e+03	1.6e+00	n	n
	14	35:13	1.6e+04	1.65	n	0.00					
			1.6e+04				9.8e+03	3.2e+03	1.7e+00	n	n
							5.9e+03	2.3e+03	1.6e+00	n	n
	15	35:22	7.0e+03	0.65	n	0.00					
			7.0e+03				2.8e+03	1.2e+03	6.1e-01	n	n
							4.2e+03	1.1e+03	7.3e-01	n	n

Ent: 44 Name: Total Hexa-Dioxins F:3 Mass: 389.816 391.813 Mod? no #Hom:11

Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

Amount: 0.24 of which 0.05 named and 0.18 unnamed
Conc: 0.24 of which 0.05 named and 0.18 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:53	1.5e+05	1.39 y	0.05				
			1.5e+05			8.8e+04	3.0e+04	1.9e+01	y n
						6.3e+04	2.4e+04	1.1e+01	y n
	2	34:04	4.9e+03	0.52 n	0.00				
			4.9e+03			1.7e+03	6.4e+02	4.1e-01	n n
						3.2e+03	1.2e+03	5.4e-01	n n
	3	34:11	1.6e+05	1.50 n	0.06				
			1.6e+05			9.3e+04	3.1e+04	2.0e+01	y n
						6.2e+04	1.5e+04	6.6e+00	y n
	4	34:20	1.5e+05	1.33 y	0.05				
			1.5e+05			8.6e+04	2.7e+04	1.7e+01	y n
						6.5e+04	2.0e+04	8.8e+00	y n
	5	34:26	2.2e+04	0.77 n	0.01				
			2.2e+04			9.5e+03	3.3e+03	2.1e+00	n n
						1.2e+04	3.4e+03	1.5e+00	n n
	6	34:30	6.1e+03	0.59 n	0.00				
			6.1e+03			2.3e+03	8.7e+02	5.5e-01	n n
						3.8e+03	2.0e+03	9.1e-01	n n
	7	34:33	8.5e+03	1.20 y	0.00				
			8.5e+03			4.6e+03	1.5e+03	9.4e-01	n n
						3.8e+03	2.0e+03	9.1e-01	n n
1,2,3,4,7,8-HxCDD	8	34:43	1.8e+04	0.29 n	0.01				
			1.8e+04			3.9e+03	1.9e+03	1.2e+00	n n
						1.4e+04	4.0e+03	1.8e+00	n n
1,2,3,6,7,8-HxCDD	9	34:47	7.0e+04	0.98 n	0.02				
			7.0e+04			3.4e+04	1.2e+04	7.4e+00	y n
						3.5e+04	1.0e+04	4.6e+00	y n
1,2,3,7,8,9-HxCDD	10	35:00	6.7e+04	0.87 n	0.02				
			6.7e+04			3.1e+04	9.0e+03	5.7e+00	y n
						3.6e+04	9.9e+03	4.4e+00	y n
	11	35:07	4.2e+03	0.59 n	0.00				
			4.2e+03			1.6e+03	7.0e+02	4.4e-01	n n
						2.7e+03	1.1e+03	4.7e-01	n n

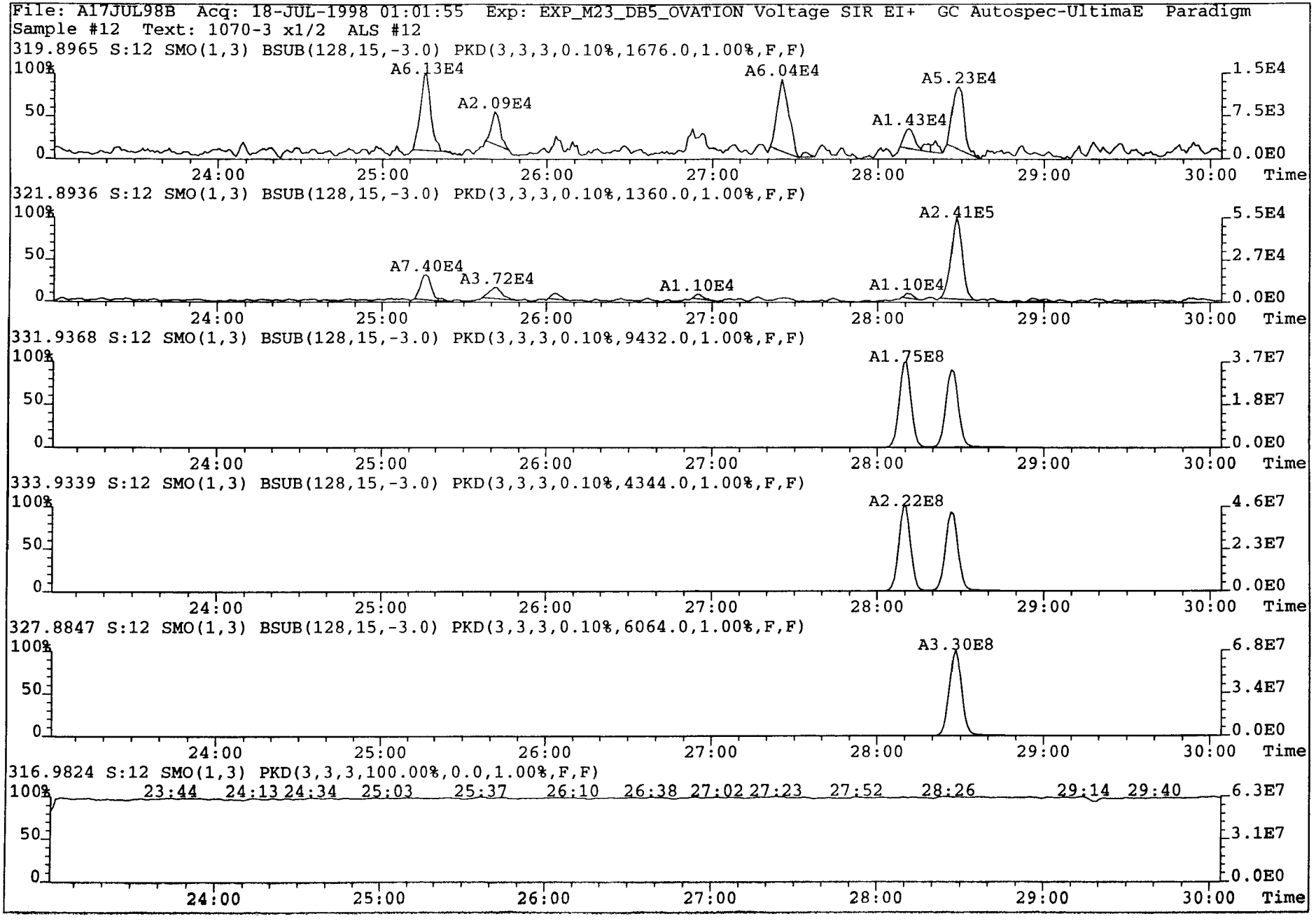
Ent: 45 Name: Total Hepta-Furans F:4 Mass: 407.782 409.779 Mod? no #Hom:3

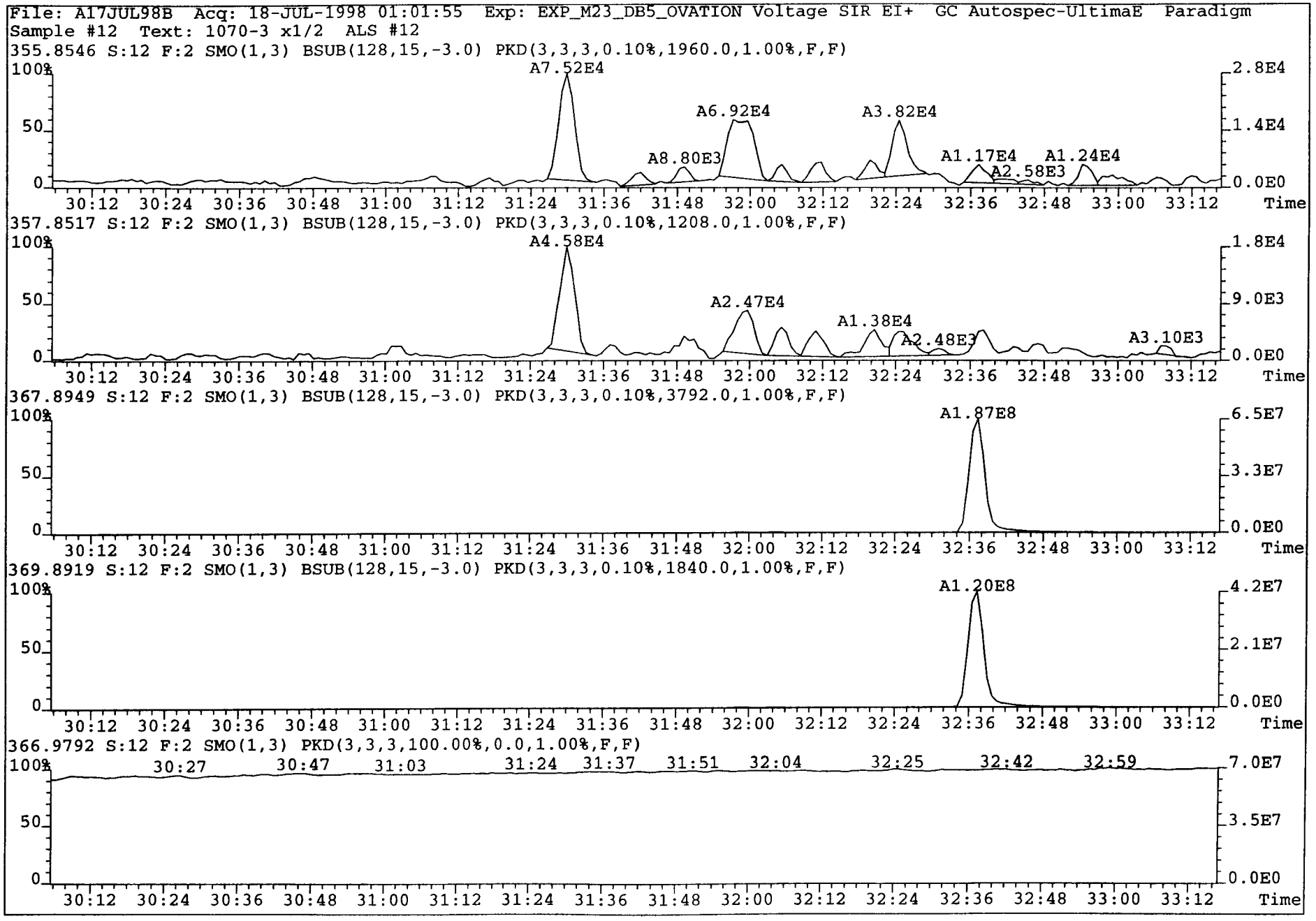
Run: 17 File: a17jul98b S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-3 x1/2

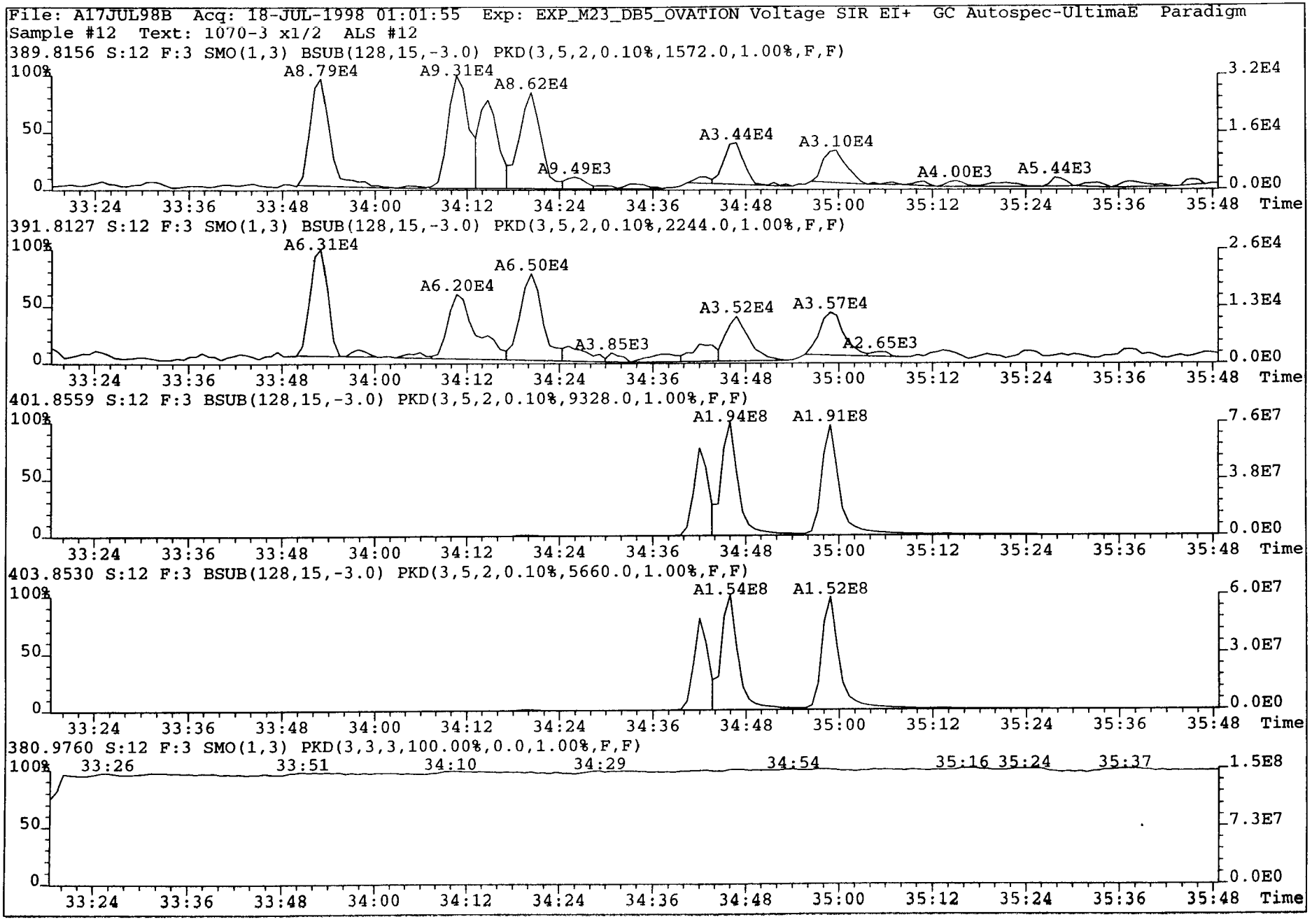
Amount: 0.21 of which 0.18 named and 0.03 unnamed
Conc: 0.21 of which 0.18 named and 0.03 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
1,2,3,4,6,7,8-HpCDF1		36:23	4.4e+05	1.04 y	0.18				
			4.4e+05			2.2e+05	7.0e+04	2.6e+01	y n
						2.1e+05	6.7e+04	4.6e+01	y n
	2	36:34	1.8e+04	2.78 n	0.01				
			1.8e+04			1.3e+04	5.0e+03	1.9e+00	n n
						4.7e+03	1.8e+03	1.3e+00	n n
	3	36:41	4.4e+04	2.59 n	0.02				
			4.4e+04			3.2e+04	8.9e+03	3.3e+00	y n

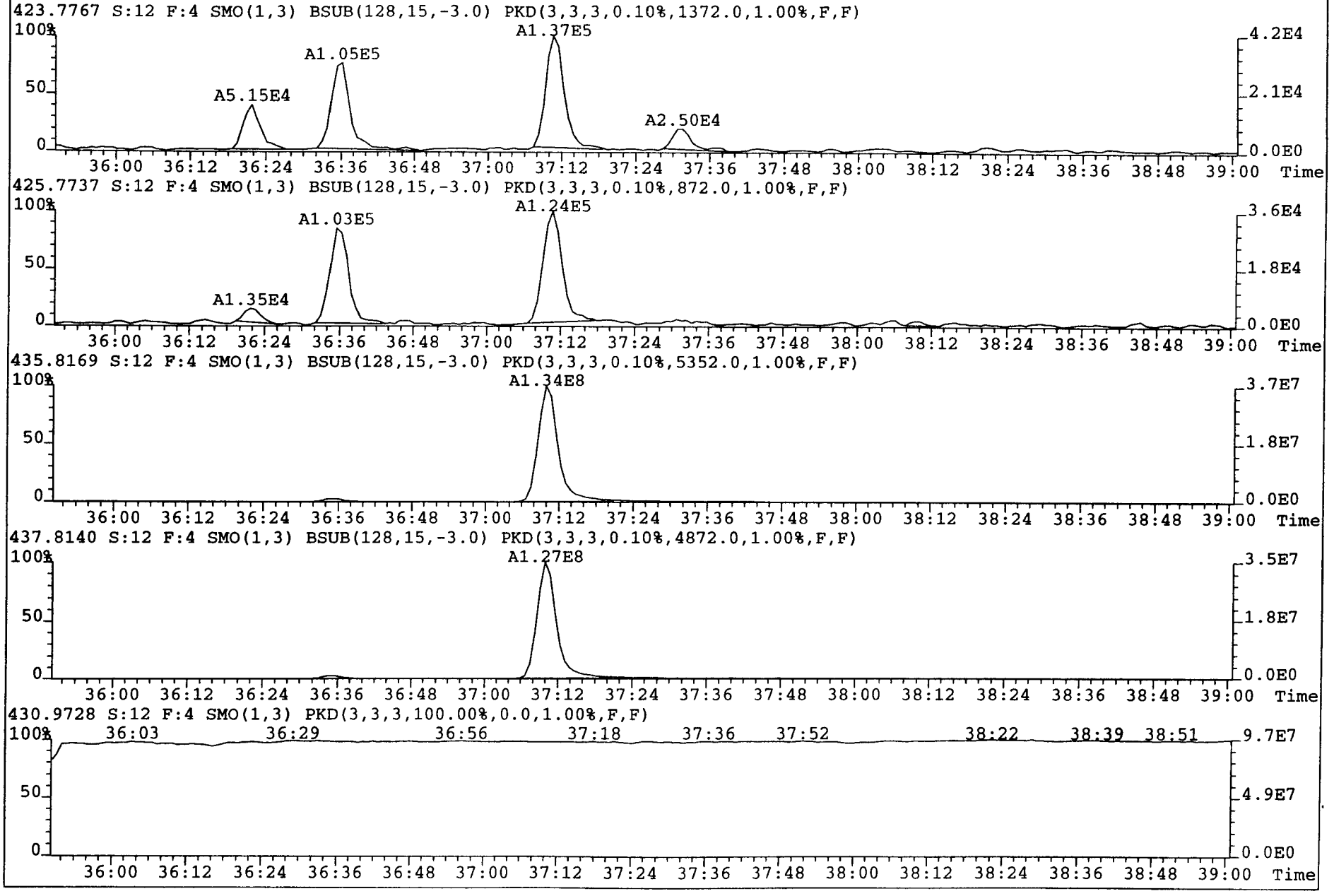
```
                                                    1.2e+04 4.7e+03 3.3e+00 y  n


                                                                      Page 8 of 8

 Ent: 46 Name: Total Hepta-Dioxins F:4  Mass: 423.777 425.774 Mod? no   #Hom:3

 Run: 17 File: a17jul98b    S:12 Acq:18-JUL-98 01:01:55 Proc:20-JUL-98 09:07:42
 Tables: Run: a17jul98b  Analyte: m8290-23-»  Cal: m8290-23-»Results: M8290-23»
 Version: V3.5 17-APR-1997 11:14:34  Sample text: 1070-3 x1/2

   Amount: 0.23    of which 0.11    named and 0.12    unnamed
     Conc: 0.23    of which 0.11    named and 0.12    unnamed
   Tox #1: -            Tox #2: -         Tox #3: -

Name                #     RT Respnse     RA    Conc    Area  Height    S/N  Mod?

                    1  36:22 6.5e+04  3.80 n    0.03
                             6.5e+04                 5.1e+04 1.6e+04 1.2e+01 y  n
                                                     1.4e+04 4.3e+03 5.0e+00 y  n
                    2  36:36 2.1e+05  1.02 y    0.09
                             2.1e+05                 1.1e+05 3.1e+04 2.3e+01 y  n
                                                     1.0e+05 3.0e+04 3.5e+01 y  n
1,2,3,4,6,7,8-HpCDD3  37:11 2.6e+05  1.10 y    0.11
                             2.6e+05                 1.4e+05 4.0e+04 2.9e+01 y  n
                                                     1.2e+05 3.5e+04 4.0e+01 y  n
```


File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
319.8965 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1676.0,1.00%,F,F)
A6.13E4
A2.09E4
A6.04E4
A1.43E4
A5.23E4
321.8936 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1360.0,1.00%,F,F)
A7.40E4
A3.72E4
A1.10E4
A1.10E4
A2.41E5
331.9368 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,9432.0,1.00%,F,F)
A1.75E8
333.9339 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,4344.0,1.00%,F,F)
A2.22E8
327.8847 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,6064.0,1.00%,F,F)
A3.30E8
316.9824 S:12 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
23:44 24:13 24:34 25:03 25:37 26:10 26:38 27:02 27:23 27:52 28:26 29:14 29:40
100%
50
0
24:00 25:00 26:00 27:00 28:00 29:00 30:00 Time
1.5E4
7.5E3
0.0E0
5.5E4
2.7E4
3.7E7
1.8E7
4.6E7
2.3E7
6.8E7
3.4E7
6.3E7
3.1E7


File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
355.8546 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1960.0,1.00%,F,F)
A7.52E4
A6.92E4
A3.82E4
A8.80E3
A1.17E4
A1.24E4
A2.58E3
357.8517 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1208.0,1.00%,F,F)
A4.58E4
A2.47E4
A1.38E4
A2.48E3
A3.10E3
367.8949 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3792.0,1.00%,F,F)
A1.87E8
369.8919 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1840.0,1.00%,F,F)
A1.20E8
366.9792 S:12 F:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
30:27 30:47 31:03 31:24 31:37 31:51 32:04 32:25 32:42 32:59
Time


File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
389.8156 S:12 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,1572.0,1.00%,F,F)
A8.79E4
A9.31E4
A8.62E4
A9.49E3
A3.44E4
A3.10E4
A4.00E3
A5.44E3
391.8127 S:12 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,2244.0,1.00%,F,F)
A6.31E4
A6.20E4
A6.50E4
A3.85E3
A3.52E4
A3.57E4
A2.65E3
401.8559 S:12 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,9328.0,1.00%,F,F)
A1.94E8
A1.91E8
403.8530 S:12 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,5660.0,1.00%,F,F)
A1.54E8
A1.52E8
380.9760 S:12 F:3 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
33:26
33:51
34:10
34:29
34:54
35:16
35:24
35:37
100%
50
0
3.2E4
1.6E4
0.0E0
2.6E4
1.3E4
7.6E7
3.8E7
6.0E7
3.0E7
1.5E8
7.3E7
33:24
33:36
33:48
34:00
34:12
34:24
34:36
34:48
35:00
35:12
35:24
35:36
35:48
Time

File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12



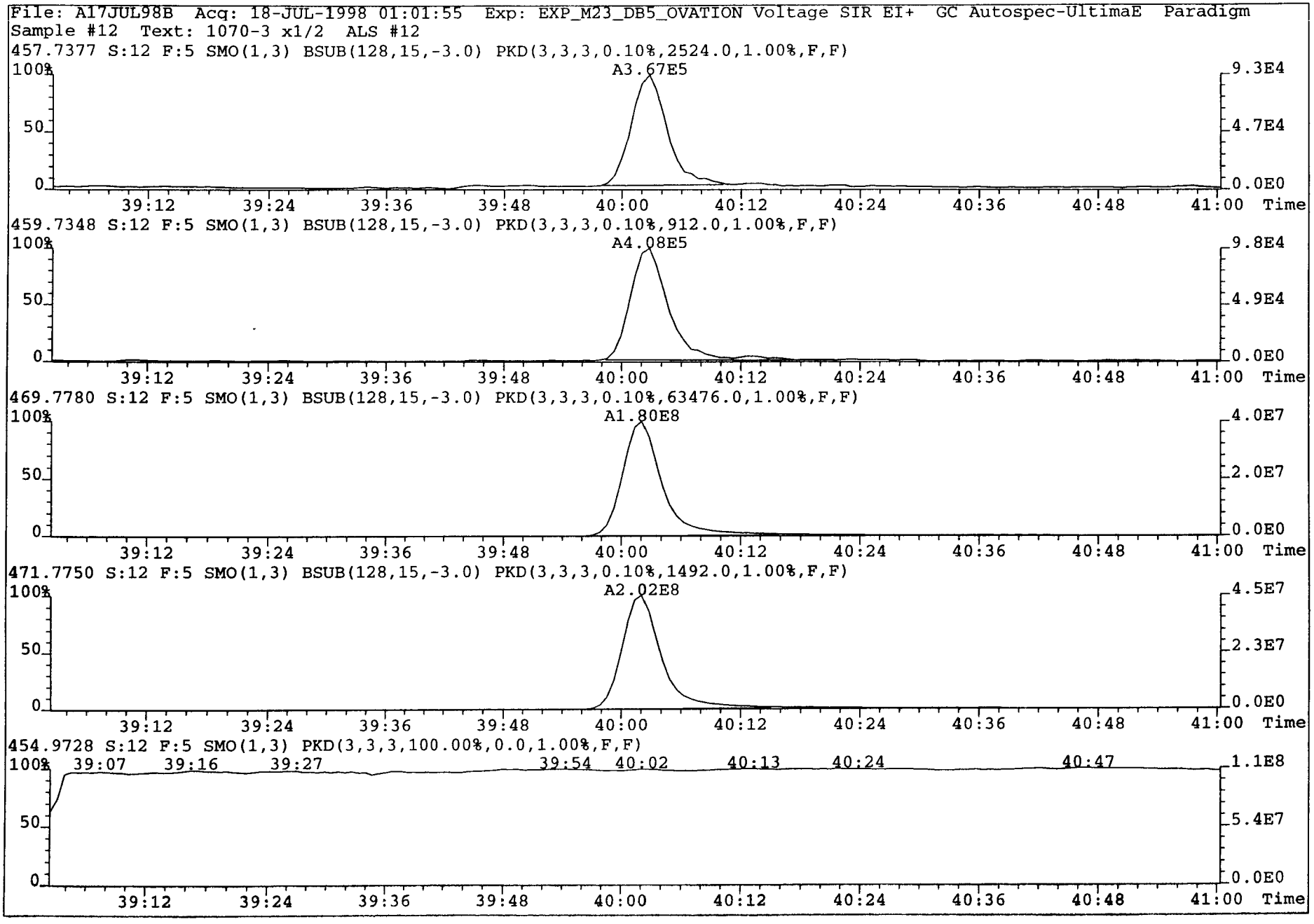
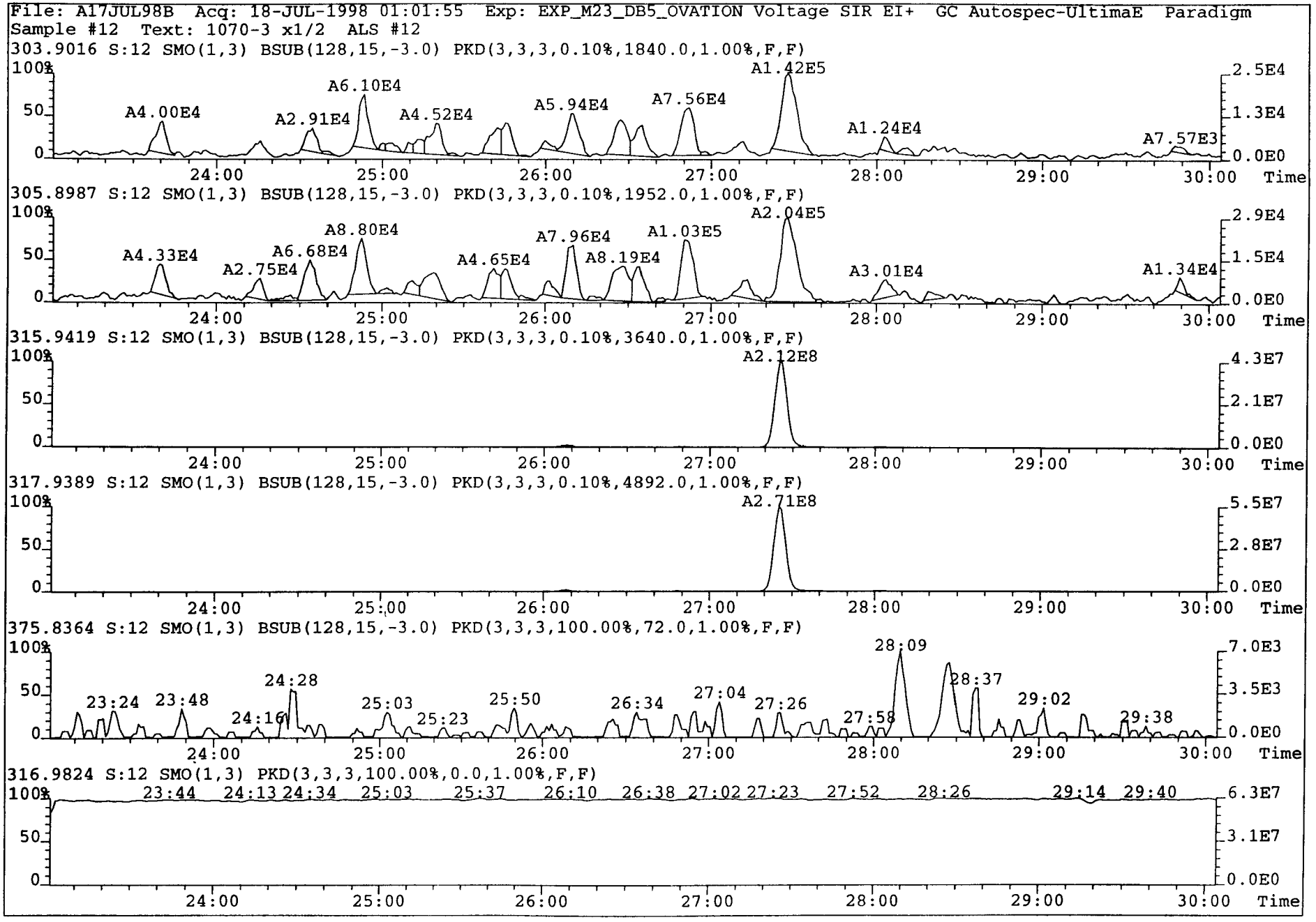
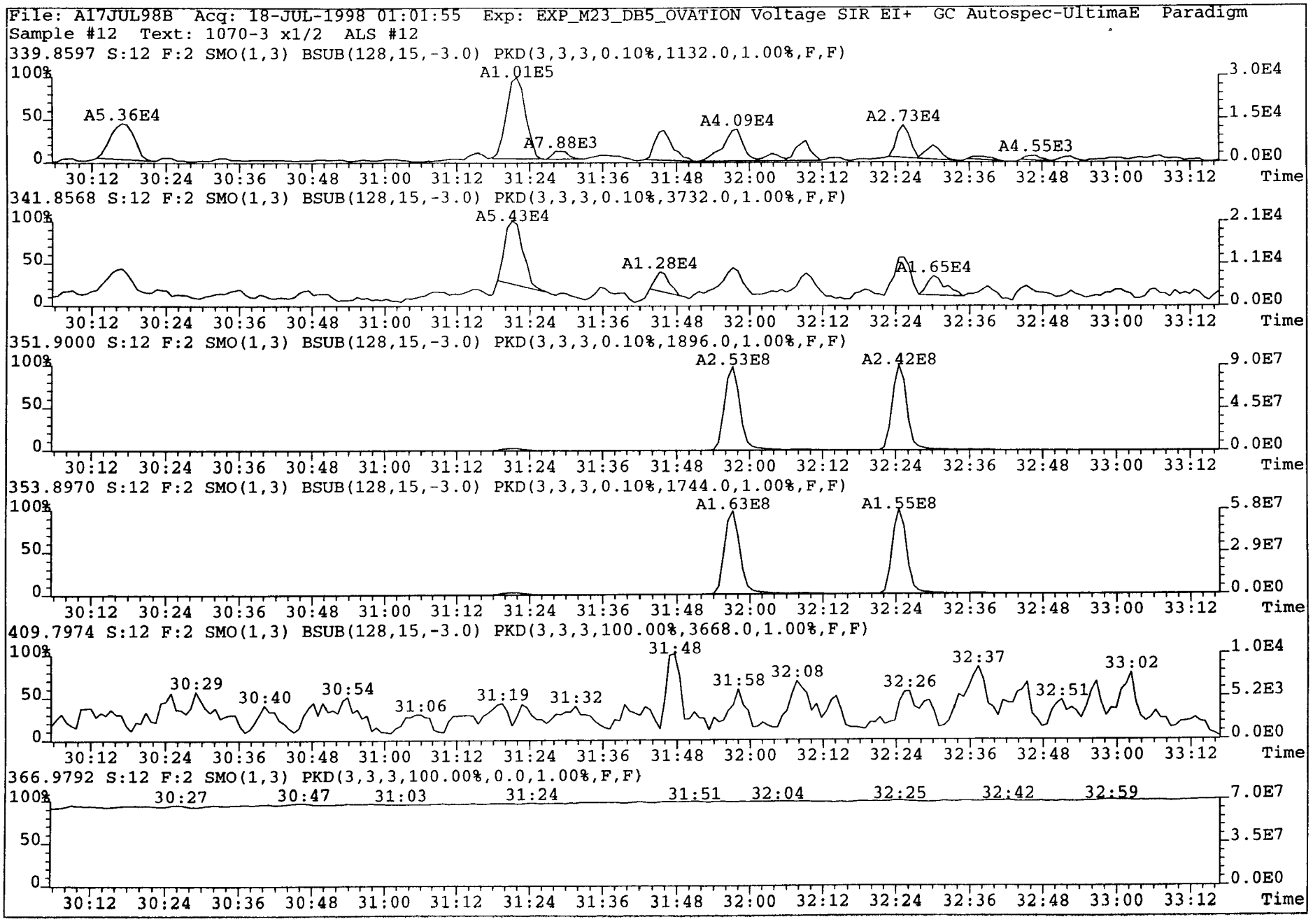
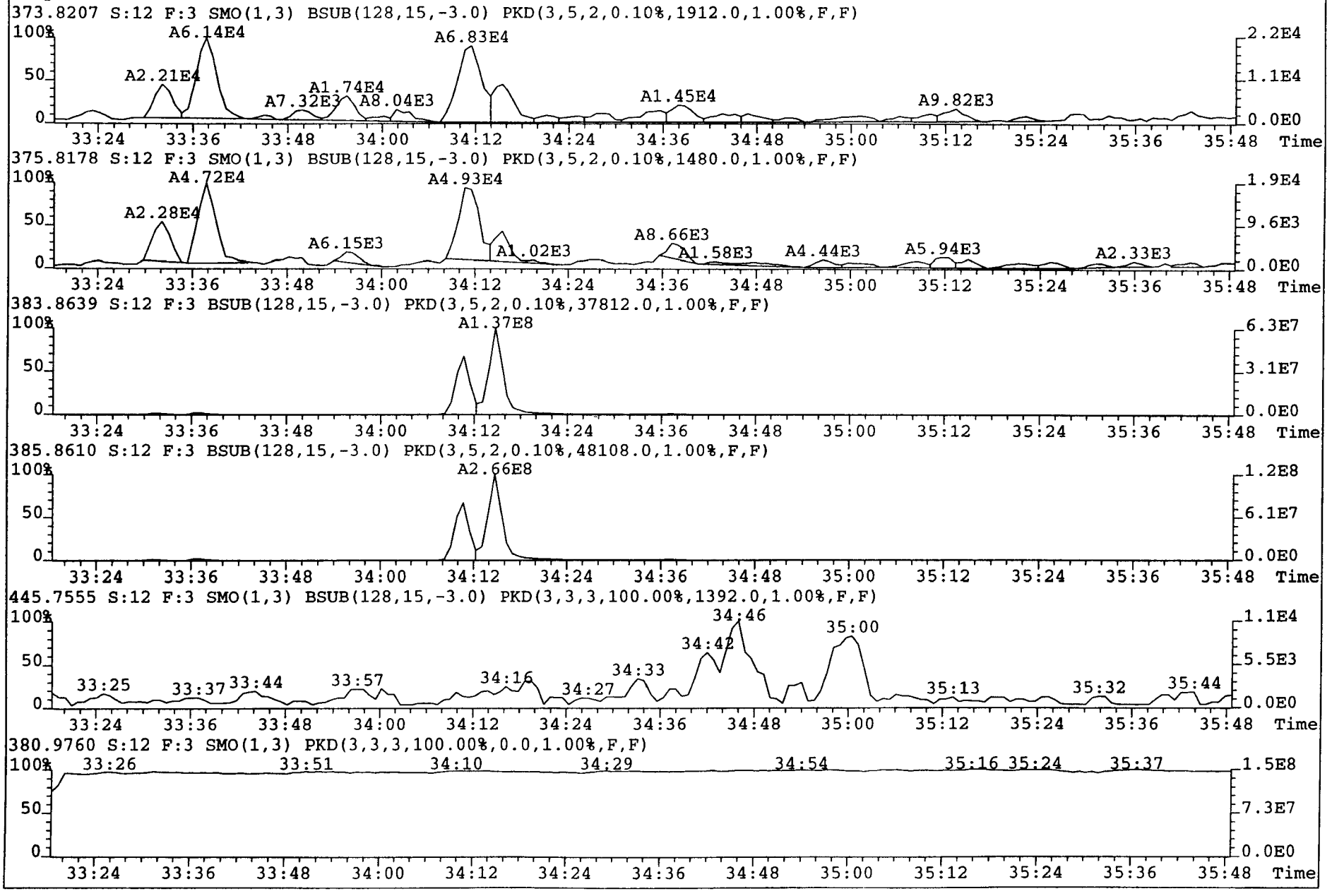

File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
457.7377 S:12 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2524.0,1.00%,F,F)
A3.67E5
9.3E4
4.7E4
0.0E0
459.7348 S:12 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,912.0,1.00%,F,F)
A4.08E5
9.8E4
4.9E4
0.0E0
469.7780 S:12 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,63476.0,1.00%,F,F)
A1.80E8
4.0E7
2.0E7
0.0E0
471.7750 S:12 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1492.0,1.00%,F,F)
A2.02E8
4.5E7
2.3E7
0.0E0
454.9728 S:12 F:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
39:07 39:16 39:27 39:54 40:02 40:13 40:24 40:47
1.1E8
5.4E7
0.0E0
100%
50
0
39:12 39:24 39:36 39:48 40:00 40:12 40:24 40:36 40:48 41:00 Time

Fig. 106


File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
303.9016 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1840.0,1.00%,F,F)
A4.00E4
A2.91E4
A6.10E4
A4.52E4
A5.94E4
A7.56E4
A1.42E5
A1.24E4
A7.57E3
305.8987 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1952.0,1.00%,F,F)
A4.33E4
A2.75E4
A6.68E4
A8.80E4
A4.65E4
A7.96E4
A8.19E4
A1.03E5
A2.04E5
A3.01E4
A1.34E4
315.9419 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3640.0,1.00%,F,F)
A2.12E8
317.9389 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,4892.0,1.00%,F,F)
A2.71E8
375.8364 S:12 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,72.0,1.00%,F,F)
23:24 23:48 24:16 24:28 25:03 25:23 25:50 26:34 27:04 27:26 27:58 28:09 28:37 29:02 29:38
316.9824 S:12 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
23:44 24:13 24:34 25:03 25:37 26:10 26:38 27:02 27:23 27:52 28:26 29:14 29:40
100%
50
0
24:00 25:00 26:00 27:00 28:00 29:00 30:00 Time
2.5E4
1.3E4
0.0E0
2.9E4
1.5E4
4.3E7
2.1E7
5.5E7
2.8E7
7.0E3
3.5E3
6.3E7
3.1E7


File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
339.8597 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1132.0,1.00%,F,F)
A5.36E4
A1.01E5
A7.88E3
A4.09E4
A2.73E4
A4.55E3
341.8568 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3732.0,1.00%,F,F)
A5.43E4
A1.28E4
A1.65E4
351.9000 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1896.0,1.00%,F,F)
A2.53E8
A2.42E8
353.8970 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1744.0,1.00%,F,F)
A1.63E8
A1.55E8
409.7974 S:12 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,3668.0,1.00%,F,F)
30:29
30:40
30:54
31:06
31:19
31:32
31:48
31:58
32:08
32:26
32:37
32:51
33:02
366.9792 S:12 F:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
30:27
30:47
31:03
31:24
31:51
32:04
32:25
32:42
32:59
Time

File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12



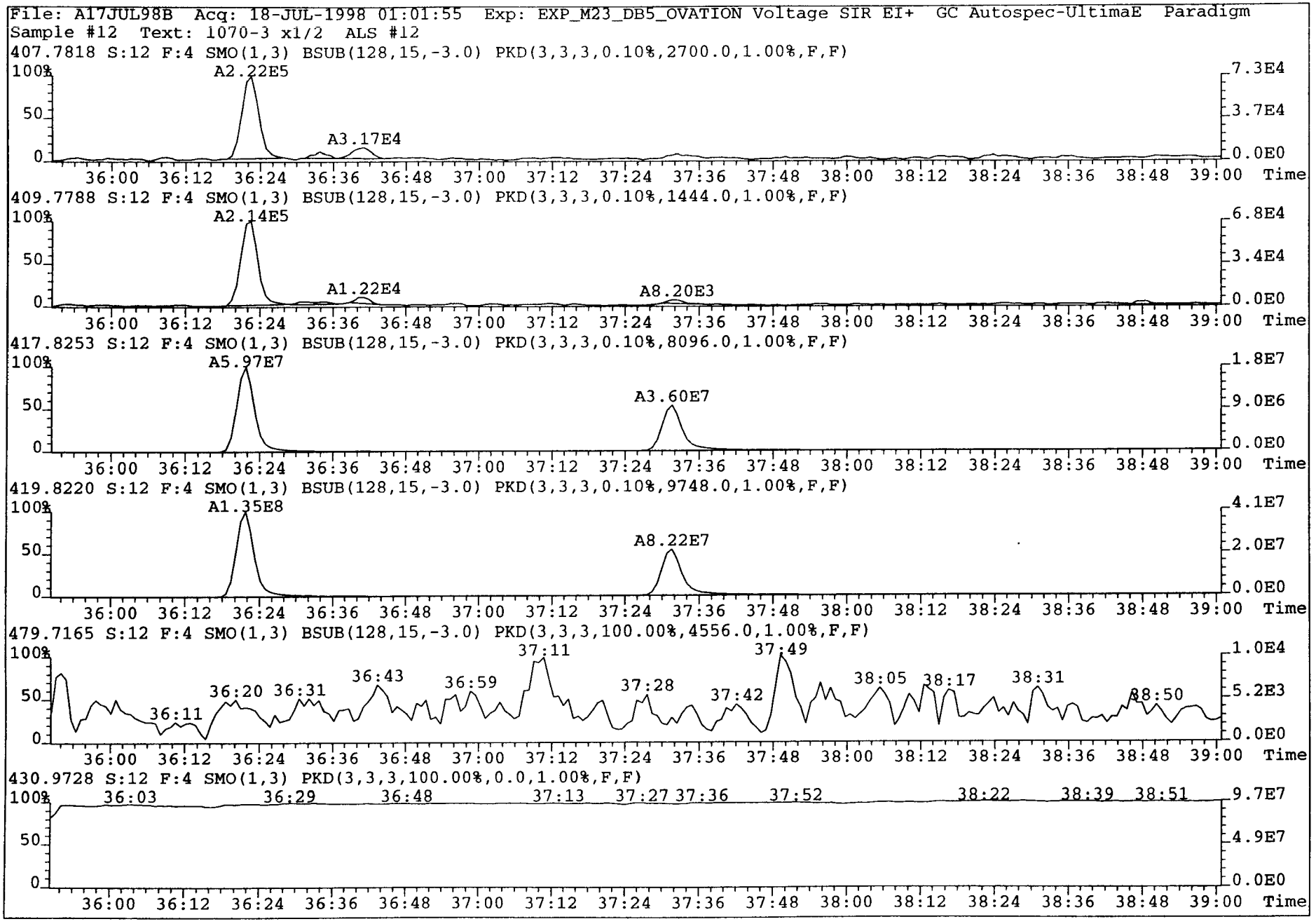
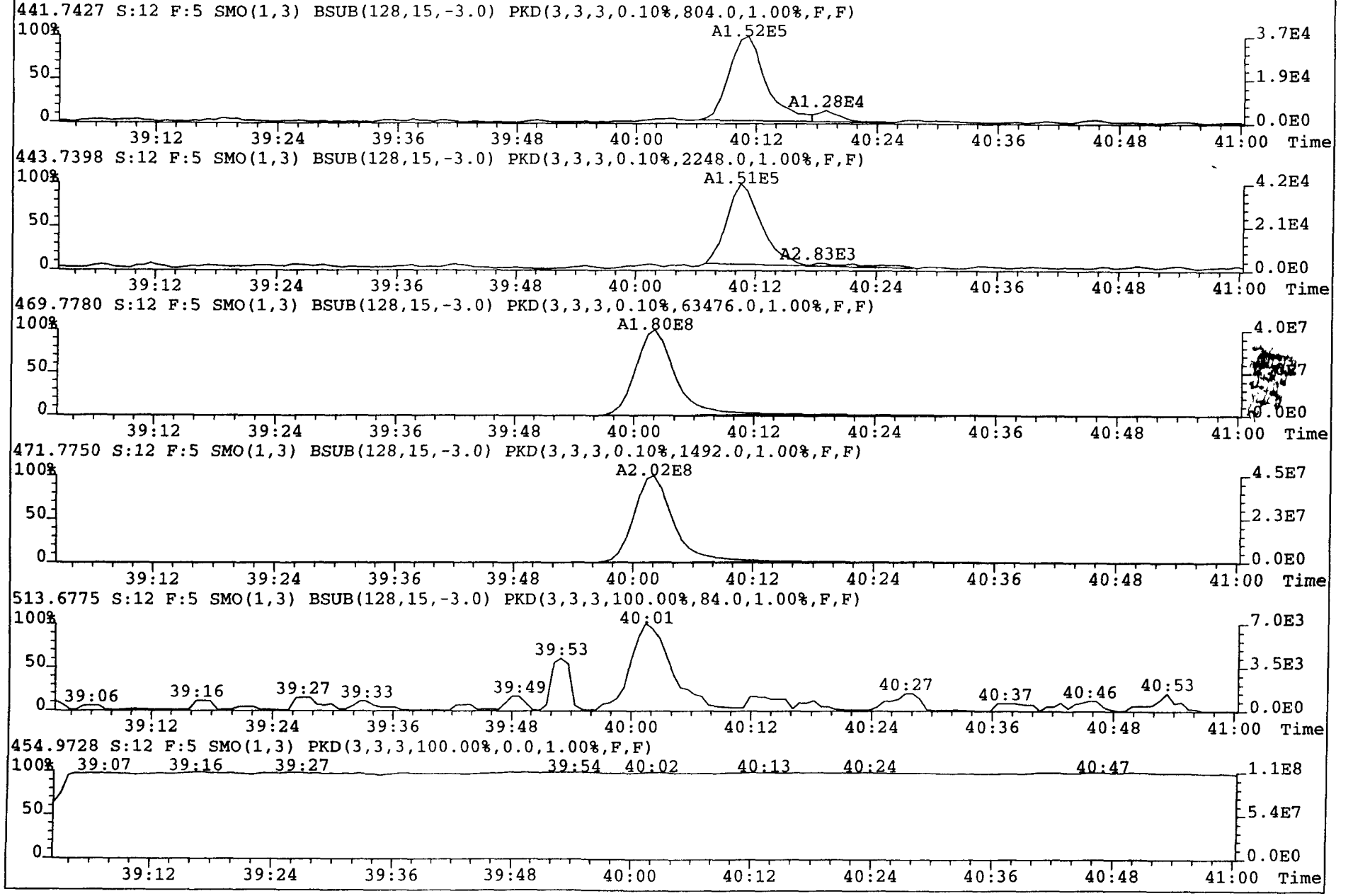

File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12
407.7818 S:12 F:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2700.0,1.00%,F,F)
A2.22E5
A3.17E4
409.7788 S:12 F:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1444.0,1.00%,F,F)
A2.14E5
A1.22E4
A8.20E3
417.8253 S:12 F:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,8096.0,1.00%,F,F)
A5.97E7
A3.60E7
419.8220 S:12 F:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,9748.0,1.00%,F,F)
A1.35E8
A8.22E7
479.7165 S:12 F:4 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,4556.0,1.00%,F,F)
36:11 36:20 36:31 36:43 36:59 37:11 37:28 37:42 37:49 38:05 38:17 38:31 38:50
430.9728 S:12 F:4 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
36:03 36:29 36:48 37:13 37:27 37:36 37:52 38:22 38:39 38:51
100%
50
0
7.3E4
3.7E4
0.0E0
6.8E4
3.4E4
1.8E7
9.0E6
4.1E7
2.0E7
1.0E4
5.2E3
9.7E7
4.9E7
36:00 36:12 36:24 36:36 36:48 37:00 37:12 37:24 37:36 37:48 38:00 38:12 38:24 38:36 38:48 39:00 Time

Fig. 110

File: A17JUL98B Acq: 18-JUL-1998 01:01:55 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #12 Text: 1070-3 x1/2 ALS #12



Method 23

M23-RB-1

PES

Analytical Data Summary Sheet

Analyte	Concentration (ng)	DL (ng)	EMPC (ng)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	0.0011	0.0005		28:28	0.78	
1,2,3,7,8-PeCDD	ND	0.0004		32:38	1.41	
1,2,3,4,7,8-HxCDD	ND	0.0006		34:43	3.28	
1,2,3,6,7,8-HxCDD	EMPC	0.0005	0.0010	34:47	1.65	
1,2,3,7,8,9-HxCDD	0.0014	0.0005		35:00	1.11	
1,2,3,4,6,7,8-HpCDD	0.0031	0.0005		37:11	1.05	
OCDD	0.0096	0.0014		40:03	0.93	
2,3,7,8--TCDF	ND	0.0006		27:27	1.08	
1,2,3,7,8-PeCDF	ND	0.0004				
2,3,4,7,8-PeCDF	ND	0.0004				
1,2,3,4,7,8-HxCDF	0.0008	0.0004		34:11	1.15	
1,2,3,6,7,8-HxCDF	ND	0.0003		34:15	1.32	
2,3,4,6,7,8-HxCDF	ND	0.0003				
1,2,3,7,8,9-HxCDF	ND	0.0004				
1,2,3,4,6,7,8-HpCDF	0.0030	0.0005		36:23	1.00	
1,2,3,4,7,8,9-HpCDF	ND	0.0006				
OCDF	0.0028	0.0008		40:10	0.91	
Total TCDDs	0.0011	0.0005				
Total PeCDDs	ND	0.0004				
Total HxCDDs	0.0024	0.0005	0.0048			
Total HpCDDs	0.0032	0.0005	0.0048			
Total TCDFs	ND	0.0006				
Total PeCDFs	ND	0.0004				
Total HxCDFs	0.0008	0.0003				
Total HpCDFs	0.0032	0.0005				
TEQ (ND=0)	0.0014		0.0015			ITEF
TEQ (ND=1/2)	0.0018		0.0018			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-RB-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-4

Collection Date: 07-Jul-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-13
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial_Cal: m8290-23-071798

Method 23

M23-RB-1

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	3.45	86.4	28:27	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	3.76	94.1	32:37	1.56	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.50	87.4	34:46	1.26	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	3.69	92.3	37:10	1.06	
$^{13}C_{12}$-OCDD	8	6.69	83.6	40:02	0.88	
$^{13}C_{12}$-2,3,7,8-TCDF	4	3.51	87.7	27:26	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	3.26	81.5	31:57	1.56	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	3.67	91.8	34:15	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	2.95	73.7	36:22	0.44	
Sampling Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	3.86	96.4	28:28		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	3.93	98.2	32:24	1.57	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	4.40	110.1	34:42	1.23	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	3.53	88.2	34:11	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	3.27	81.6	37:32	0.44	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:10	0.79	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:59	1.25	

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-RB-1

Laboratory Information

Project ID: L1070
Sample ID: 1070-4

Collection Date: 07-Jul-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1
Moisture / Lipids: 0.0 %

Filename: a17jul98b-13
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: Y.T.

Date Reviewed: 23Jul98

Filename ; a17jul98b
Sample ; 13
Acquired ; 18-JUL-98 01:47:01
Processed ; 20-JUL-98 09:08:26
Sample ID ; 1070-4 x1/2
Cal Table ; m8290-23-071798
Results Table ; M8290-23-071798B
Comments ;

Typ	Name	Resp	Ion 1	Ion 2	RA;?;	RT	Conc	DL	S/N1;?;	S/N2;?	mod?
Unk	2,3,7,8-TCDD	2.83e+05	4.15e+04	2.41e+05	0.17;n;	28:28	0.084	0.0114	6;y	34;y	no
Unk	1,2,3,7,8-PeCDD	1.92e+04	1.12e+04	7.97e+03	1.41;y;	32:38	0.007	0.0105	2;n	3;n	no
Unk	1,2,3,4,7,8-HxCDD	2.77e+04	2.13e+04	6.48e+03	3.28;n;	34:43	0.015	0.0156	3;n	2;n	no
Unk	1,2,3,6,7,8-HxCDD	5.81e+04	3.62e+04	2.19e+04	1.65;n;	34:47	0.024	0.0123	5;y	4;y	no
Unk	1,2,3,7,8,9-HxCDD	8.43e+04	4.44e+04	3.99e+04	1.11;y;	35:00	0.035	0.0122	5;y	6;y	no
Unk	1,2,3,4,6,7,8-HpCDD	1.53e+05	7.85e+04	7.44e+04	1.05;y;	37:11	0.077	0.0112	19;y	28;y	no
Unk	OCDD	3.90e+05	1.87e+05	2.02e+05	0.93;y;	40:03	0.241	0.0351	14;y	46;y	no
Unk	2,3,7,8-TCDF	6.34e+04	3.30e+04	3.04e+04	1.08;n;	27:27	0.015	0.0152	5;y	3;n	no
Unk	1,2,3,7,8-PeCDF	*	*	*	*;n;	NotFnd	*	0.0091	*;n	*;n	no
Unk	2,3,4,7,8-PeCDF	*	*	*	*;n;	NotFnd	*	0.0088	*;n	*;n	no
Unk	1,2,3,4,7,8-HxCDF	6.12e+04	3.27e+04	2.85e+04	1.15;y;	34:11	0.021	0.0089	4;y	7;y	no
Unk	1,2,3,6,7,8-HxCDF	3.75e+04	2.14e+04	1.61e+04	1.32;y;	34:15	0.010	0.0070	4;y	3;n	no
Unk	2,3,4,6,7,8-HxCDF	*	*	*	*;n;	NotFnd	*	0.0082	*;n	*;n	no
Unk	1,2,3,7,8,9-HxCDF	*	*	*	*;n;	NotFnd	*	0.0094	*;n	*;n	no
Unk	1,2,3,4,6,7,8-HpCDF	1.61e+05	8.01e+04	8.05e+04	1.00;y;	36:23	0.076	0.0126	15;y	27;y	no
Unk	1,2,3,4,7,8,9-HpCDF	*	*	*	*;n;	NotFnd	*	0.0152	*;n	*;n	no
Unk	OCDF	1.20e+05	5.69e+04	6.28e+04	0.91;y;	40:10	0.069	0.0190	15;y	10;y	no
ES/RT	13C-2,3,7,8-TCDD	3.44e+08	1.51e+08	1.93e+08	0.78;y;	28:27	86.342	0.0487	3589;y	8202;y	no
ES	13C-1,2,3,7,8-PeCDD	2.61e+08	1.59e+08	1.02e+08	1.56;y;	32:37	94.107	0.0273	17216;y	19494;y	no
ES	13C-1,2,3,6,7,8-HxCDD	2.83e+08	1.58e+08	1.25e+08	1.26;y;	34:46	87.419	0.0430	6066;y	7523;y	no
ES	13C-1,2,3,4,6,7,8-HpCDD	2.22e+08	1.14e+08	1.08e+08	1.06;y;	37:10	92.327	0.0276	5293;y	10514;y	no
ES	13C-OCDD	3.23e+08	1.51e+08	1.72e+08	0.88;y;	40:02	167.134	0.0208	13121;y	15246;y	no
ES/RT	13C-2,3,7,8-TCDF	4.38e+08	1.92e+08	2.46e+08	0.78;y;	27:26	87.672	0.0241	8853;y	13263;y	no
ES	13C-1,2,3,7,8-PeCDF	3.54e+08	2.16e+08	1.38e+08	1.56;y;	31:57	81.511	0.0144	43021;y	19577;y	no
ES	13C-1,2,3,6,7,8-HxCDF	3.43e+08	1.18e+08	2.25e+08	0.52;y;	34:15	91.739	0.1787	1389;y	2083;y	no
ES	13C-1,2,3,4,6,7,8-HpCDF	1.67e+08	5.13e+07	1.16e+08	0.44;y;	36:22	73.664	0.0977	3242;y	1476;y	no
JS	13C-1,2,3,4-TCDD	3.63e+08	1.60e+08	2.03e+08	0.79;y;	28:10	75.191	-	3900;y	8653;y	no
JS	13C-1,2,3,7,8,9-HxCDD	3.02e+08	1.68e+08	1.34e+08	1.25;y;	34:59	76.109	-	5940;y	7373;y	no
CS	37Cl-2,3,7,8-TCDD	3.04e+08	3.04e+08	-	-;-	28:28	83.199	0.0202	12478;y	-; -	no
CS	13C-2,3,4,7,8-PeCDF	3.40e+08	2.08e+08	1.33e+08	1.57;y;	32:24	79.976	0.0148	42528;y	19472;y	no
CS	13C-1,2,3,4,7,8-HxCDD	2.10e+08	1.16e+08	9.41e+07	1.23;y;	34:42	96.382	0.0639	4471;y	5760;y	no
CS	13C-1,2,3,4,7,8-HxCDF	2.38e+08	8.10e+07	1.57e+08	0.52;y;	34:11	81.509	0.2293	1039;y	1526;y	no
CS	13C-1,2,3,4,7,8,9-HpCDF	1.07e+08	3.26e+07	7.43e+07	0.44;y;	37:32	60.110	0.1249	1790;y	827;y	no
SS	37Cl-2,3,7,8-TCDD	3.04e+08	3.04e+08	-	-;-	28:28	96.414	0.0238	12478;y	-; -	no
SS	13C-2,3,4,7,8-PeCDF	3.40e+08	2.08e+08	1.33e+08	1.57;y;	32:24	98.151	0.0105	42528;y	19472;y	no
SS	13C-1,2,3,4,7,8-HxCDD	2.10e+08	1.16e+08	9.41e+07	1.23;y;	34:42	110.111	0.0670	4471;y	5760;y	no
SS	13C-1,2,3,4,7,8-HxCDF	2.38e+08	8.10e+07	1.57e+08	0.52;y;	34:11	88.145	0.2151	1039;y	1526;y	no
SS	13C-1,2,3,4,7,8,9-HpCDF	1.07e+08	3.26e+07	7.43e+07	0.44;y;	37:32	81.631	0.2158	1790;y	827;y	no

Ent: 39 Name: Total Tetra-Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:1

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.02 of which 0.02 named and * unnamed
Conc: 0.02 of which 0.02 named and * unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
2,3,7,8-TCDF	1	27:27	6.3e+04	1.08 n	0.02				
			6.3e+04			3.3e+04	7.7e+03	4.7e+00	y n
						3.0e+04	7.7e+03	2.9e+00	n n

Ent: 40 Name: Total Tetra-Dioxins F:1 Mass: 319.897 321.894 Mod? no #Hom:2

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.09 of which 0.08 named and 0.01 unnamed
Conc: 0.09 of which 0.08 named and 0.01 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	25:16	2.4e+04	1.67 n	0.01				
			2.4e+04			1.5e+04	3.3e+03	2.6e+00	n n
						8.8e+03	2.7e+03	2.0e+00	n n
2,3,7,8-TCDD	2	28:28	2.8e+05	0.17 n	0.08				
			2.8e+05			4.1e+04	6.9e+03	5.6e+00	y n
						2.4e+05	4.5e+04	3.4e+01	y n

Ent: 41 Name: Total Penta-Furans F:2 Mass: 339.860 341.857 Mod? no #Hom:4

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.02 of which * named and 0.02 unnamed
Conc: 0.02 of which * named and 0.02 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	31:23	2.2e+04	1.35 y	0.01				
			2.2e+04			1.3e+04	3.6e+03	3.7e+00	y n
						9.4e+03	2.8e+03	1.2e+00	n n
	2	32:31	1.7e+04	1.13 n	0.01				
			1.7e+04			9.0e+03	2.9e+03	3.0e+00	n n
						7.9e+03	2.0e+03	8.5e-01	n n
	3	32:57	1.3e+04	0.27 n	0.00				
			1.3e+04			2.8e+03	1.2e+03	1.2e+00	n n
						1.0e+04	4.3e+03	1.9e+00	n n
	4	33:01	1.3e+04	0.28 n	0.00				
			1.3e+04			2.9e+03	1.1e+03	1.1e+00	n n
						1.0e+04	4.3e+03	1.9e+00	n n

Ent: 42 Name: Total Penta-Dioxins F:2 Mass: 355.855 357.852 Mod? no #Hom:3

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.03 of which 0.01 named and 0.03 unnamed
Conc: 0.03 of which 0.01 named and 0.03 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	31:57	3.8e+04	3.76 n	0.01					
			3.8e+04			3.0e+04	9.3e+03	4.0e+00	y	n
						8.1e+03	3.5e+03	2.7e+00	n	n
	2	32:24	4.1e+04	7.00 n	0.01					
			4.1e+04			3.6e+04	1.2e+04	5.3e+00	y	n
						5.1e+03	2.0e+03	1.5e+00	n	n
1,2,3,7,8-PeCDD	3	32:38	1.9e+04	1.41 y	0.01					
			1.9e+04			1.1e+04	3.7e+03	1.6e+00	n	n
						8.0e+03	3.8e+03	2.9e+00	n	n

Ent: 43 Name: Total Hexa-Furans F:3 Mass: 373.821 375.818 Mod? no #Hom:3

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.04 of which 0.03 named and 0.01 unnamed
Conc: 0.04 of which 0.03 named and 0.01 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	33:38	2.0e+04	1.23 y	0.01					
			2.0e+04			1.1e+04	4.3e+03	1.8e+00	n	n
						9.1e+03	4.0e+03	2.6e+00	n	n
1,2,3,4,7,8-HxCDF	2	34:11	6.1e+04	1.15 y	0.02					
			6.1e+04			3.3e+04	1.0e+04	4.5e+00	y	n
						2.8e+04	1.0e+04	6.6e+00	y	n
1,2,3,6,7,8-HxCDF	3	34:15	3.8e+04	1.32 y	0.01					
			3.8e+04			2.1e+04	8.3e+03	3.6e+00	y	n
						1.6e+04	4.4e+03	2.8e+00	n	n

Ent: 44 Name: Total Hexa-Dioxins F:3 Mass: 389.816 391.813 Mod? no #Hom:12

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.21 of which 0.07 named and 0.14 unnamed
Conc: 0.21 of which 0.07 named and 0.14 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	33:53	3.6e+04	0.90 n	0.02					
			3.6e+04			1.7e+04	6.6e+03	2.9e+00	n	n
						1.9e+04	7.3e+03	4.0e+00	y	n
	2	33:59	2.1e+03	0.40 n	0.00					
			2.1e+03			6.1e+02	3.6e+02	1.6e-01	n	n
						1.5e+03	6.2e+02	3.4e-01	n	n
	3	34:06	6.1e+03	4.17 n	0.00					
			6.1e+03			5.0e+03	1.2e+03	5.1e-01	n	n
						1.2e+03	7.2e+02	3.9e-01	n	n
	4	34:11	9.4e+04	2.47 n	0.04					
			9.4e+04			6.7e+04	2.3e+04	9.8e+00	y	n
						2.7e+04	9.1e+03	5.0e+00	y	n
	5	34:15	6.8e+04	5.10 n	0.03					
			6.8e+04			5.7e+04	1.9e+04	8.4e+00	y	n
						1.1e+04	4.0e+03	2.2e+00	n	n
	6	34:20	7.0e+04	1.35 y	0.03					
			7.0e+04			4.0e+04	1.2e+04	5.4e+00	y	n
						3.0e+04	8.9e+03	4.9e+00	y	n
	7	34:24	9.1e+03	0.81 n	0.00					
			9.1e+03			4.1e+03	1.8e+03	8.0e-01	n	n
						5.0e+03	1.6e+03	8.7e-01	n	n
	8	34:28	1.1e+04	1.03 n	0.00					
			1.1e+04			5.3e+03	2.0e+03	8.7e-01	n	n
						5.2e+03	1.7e+03	9.6e-01	n	n
	9	34:31	1.1e+04	1.07 y	0.00					
			1.1e+04			5.6e+03	1.9e+03	8.4e-01	n	n
						5.2e+03	1.7e+03	9.6e-01	n	n
1,2,3,4,7,8-HxCDD	10	34:43	2.8e+04	3.28 n	0.01					
			2.8e+04			2.1e+04	5.8e+03	2.5e+00	n	n
						6.5e+03	3.1e+03	1.7e+00	n	n
1,2,3,6,7,8-HxCDD	11	34:47	5.8e+04	1.65 n	0.02					
			5.8e+04			3.6e+04	1.1e+04	4.7e+00	y	n
						2.2e+04	7.0e+03	3.9e+00	y	n
1,2,3,7,8,9-HxCDD	12	35:00	8.4e+04	1.11 y	0.03					
			8.4e+04			4.4e+04	1.1e+04	4.7e+00	y	n
						4.0e+04	1.1e+04	5.8e+00	y	n

Ent: 45 Name: Total Hepta-Furans F:4 Mass: 407.782 409.779 Mod? no #Hom:1

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.08 of which 0.08 named and * unnamed
Conc: 0.08 of which 0.08 named and * unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
1,2,3,4,6,7,8-HpCDF1		36:23	1.6e+05	1.00 y	0.08					
			1.6e+05			8.0e+04	2.6e+04	1.5e+01	y	n
						8.0e+04	2.6e+04	2.7e+01	y	n

Ent: 46 Name: Total Hepta-Dioxins F:4 Mass: 423.777 425.774 Mod? no #Hom:5

Run: 18 File: a17jul98b S:13 Acq:18-JUL-98 01:47:01 Proc:20-JUL-98 09:08:26
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-4 x1/2

Amount: 0.15 of which 0.08 named and 0.07 unnamed
Conc: 0.15 of which 0.08 named and 0.07 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	36:22	3.4e+04	6.09 n	0.02					
			3.4e+04			2.9e+04	9.1e+03	7.7e+00	y	n
						4.8e+03	1.8e+03	2.3e+00	n	n
	2	36:35	7.7e+04	1.21 n	0.04					
			7.7e+04			4.2e+04	1.2e+04	1.0e+01	y	n
						3.5e+04	1.0e+04	1.3e+01	y	n
	3	36:42	8.1e+03	0.74 n	0.00					
			8.1e+03			3.4e+03	1.3e+03	1.1e+00	n	n
						4.7e+03	1.3e+03	1.6e+00	n	n
1,2,3,4,6,7,8-HpCDD4	37:11		1.5e+05	1.05 y	0.08					
			1.5e+05			7.9e+04	2.3e+04	1.9e+01	y	n
						7.4e+04	2.2e+04	2.8e+01	y	n
	5	37:32	3.0e+04	4.70 n	0.02					
			3.0e+04			2.5e+04	6.1e+03	5.1e+00	y	n
						5.2e+03	2.1e+03	2.6e+00	n	n

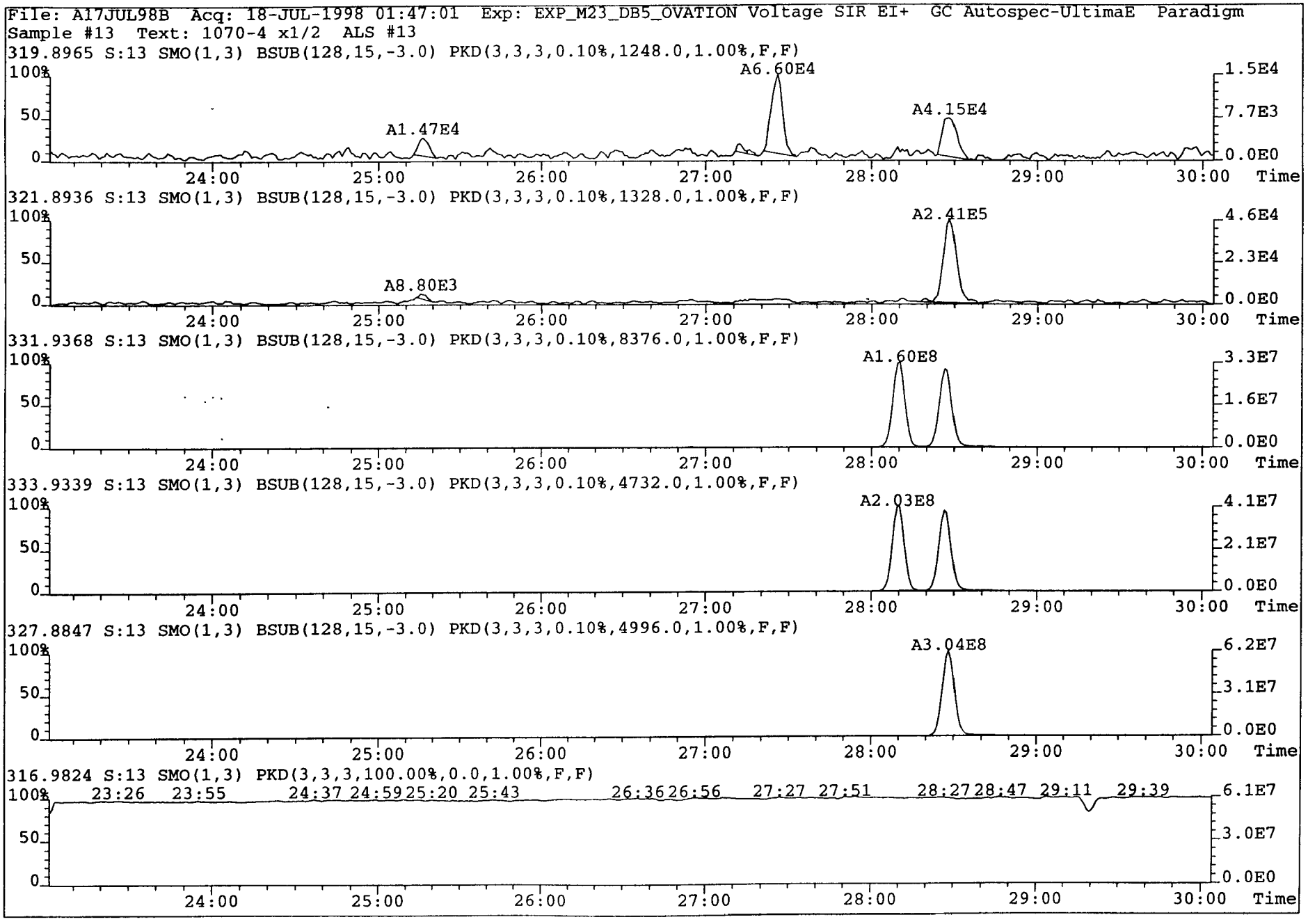
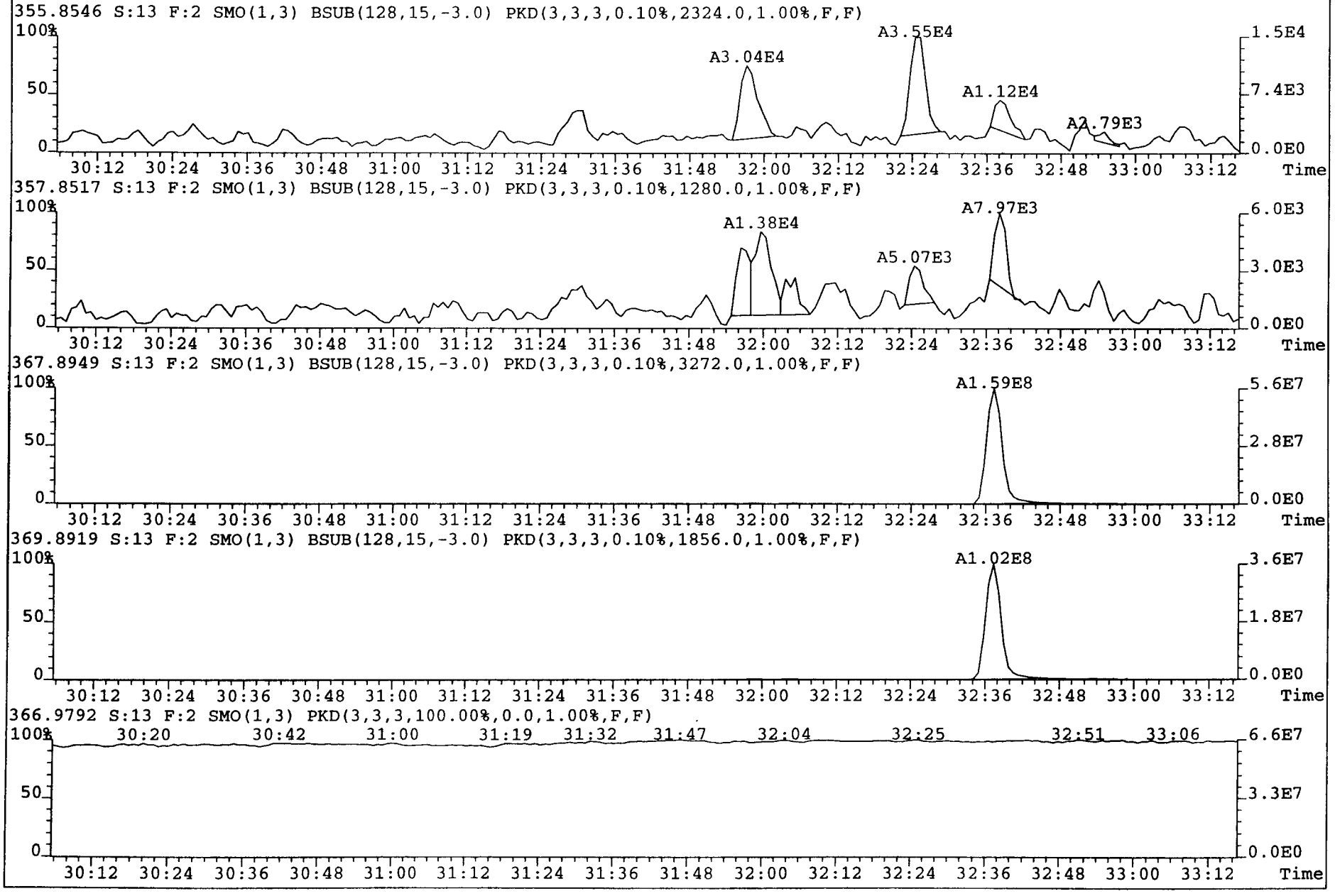
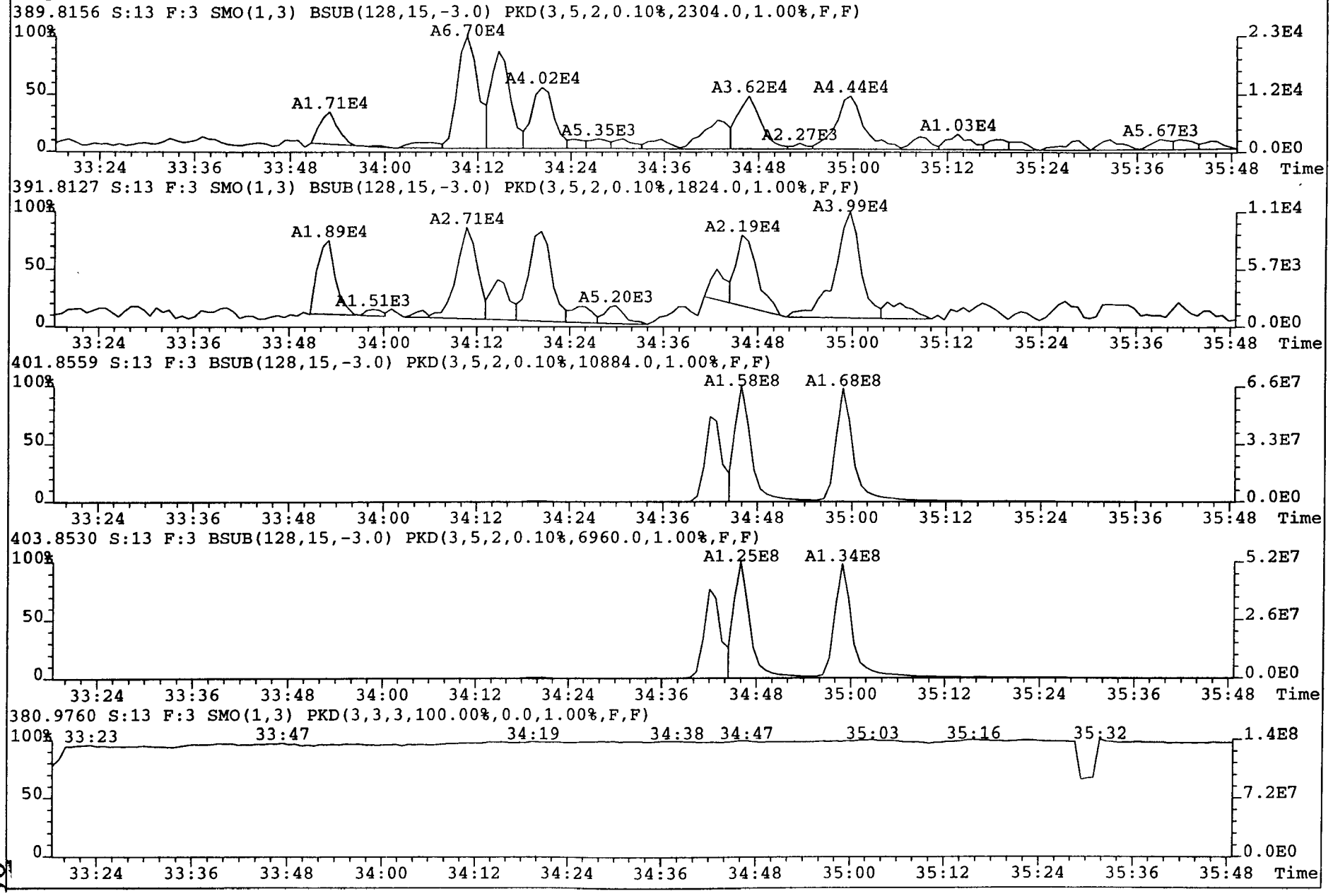

File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13
319.8965 S:13 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1248.0,1.00%,F,F)
A1.47E4
A6.60E4
A4.15E4
321.8936 S:13 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1328.0,1.00%,F,F)
A8.80E3
A2.41E5
331.9368 S:13 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,8376.0,1.00%,F,F)
A1.60E8
333.9339 S:13 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,4732.0,1.00%,F,F)
A2.03E8
327.8847 S:13 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,4996.0,1.00%,F,F)
A3.04E8
316.9824 S:13 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
23:26 23:55 24:37 24:59 25:20 25:43 26:36 26:56 27:27 27:51 28:27 28:47 29:11 29:39
100%
50
0
24:00 25:00 26:00 27:00 28:00 29:00 30:00 Time
1.5E4
7.7E3
0.0E0
4.6E4
2.3E4
3.3E7
1.6E7
4.1E7
2.1E7
6.2E7
3.1E7
6.1E7
3.0E7

Fig 119

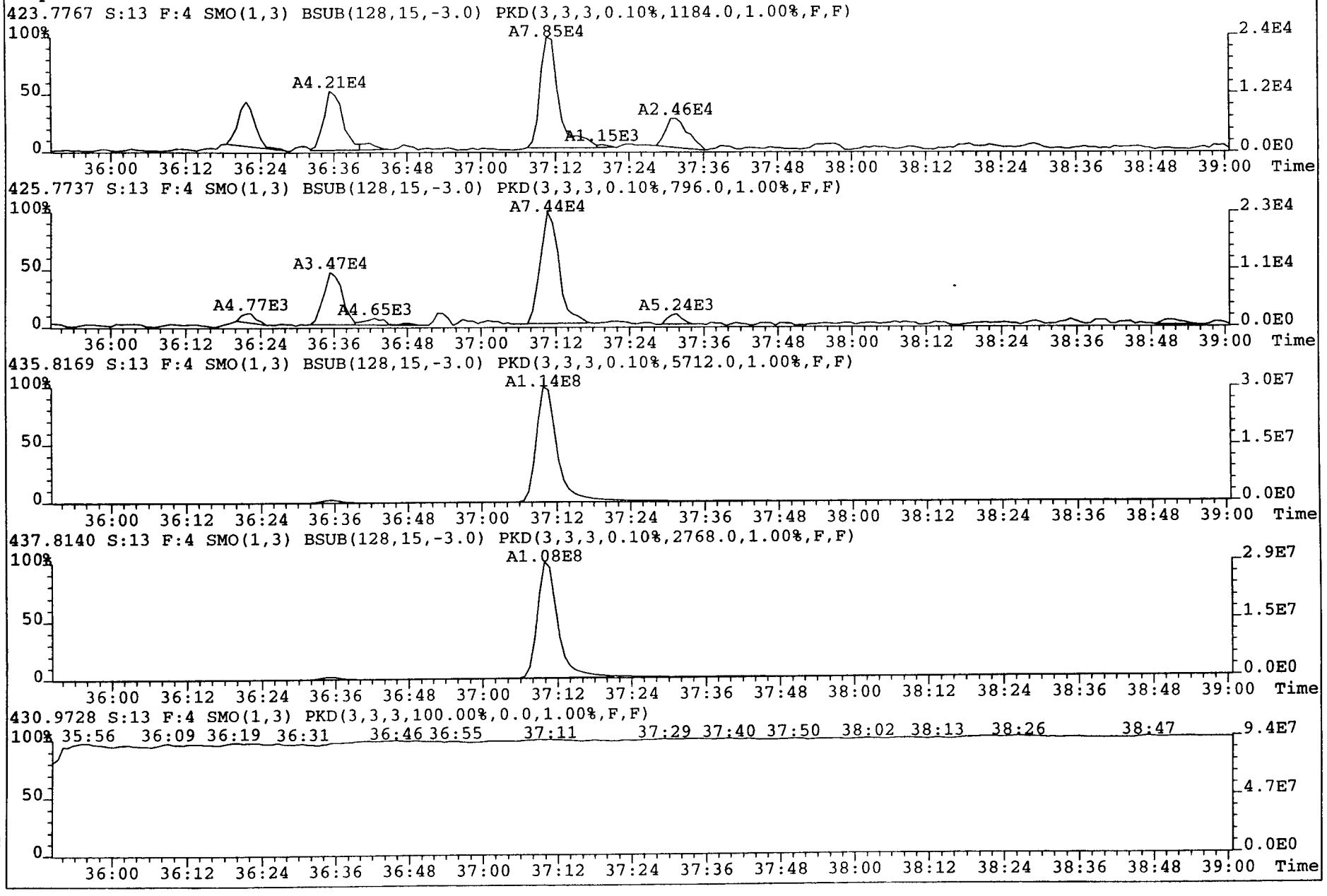
File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13



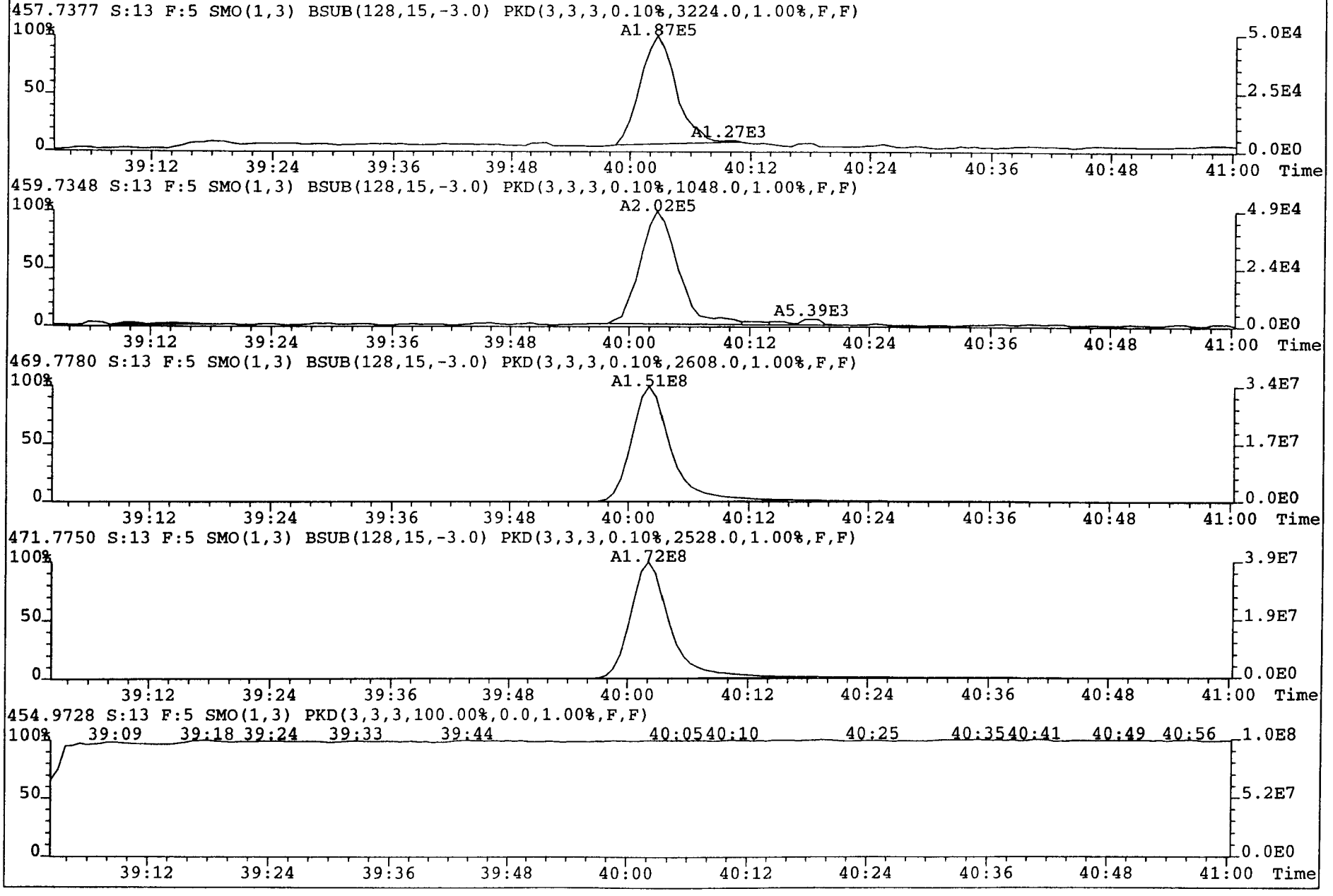
File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13



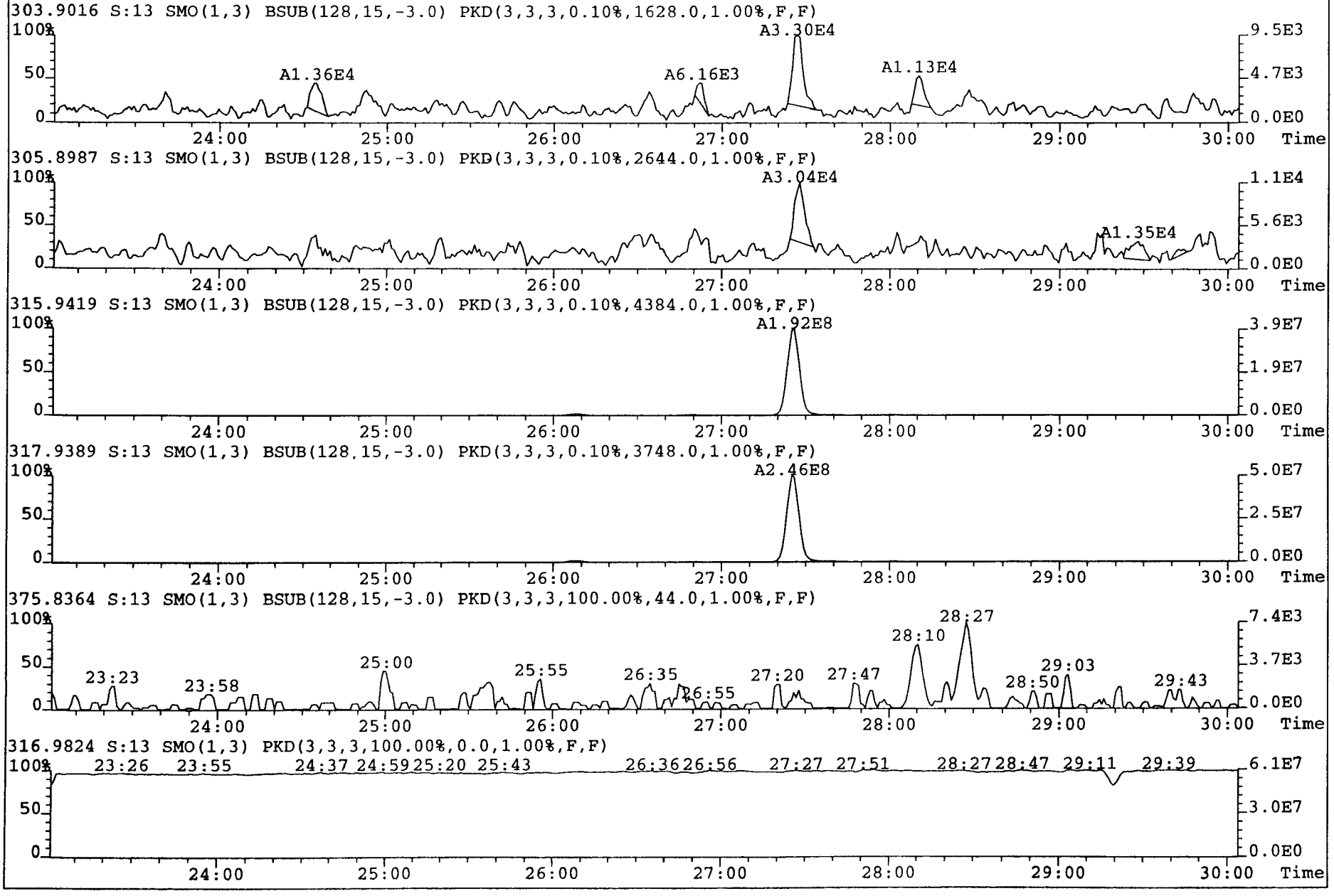
File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13



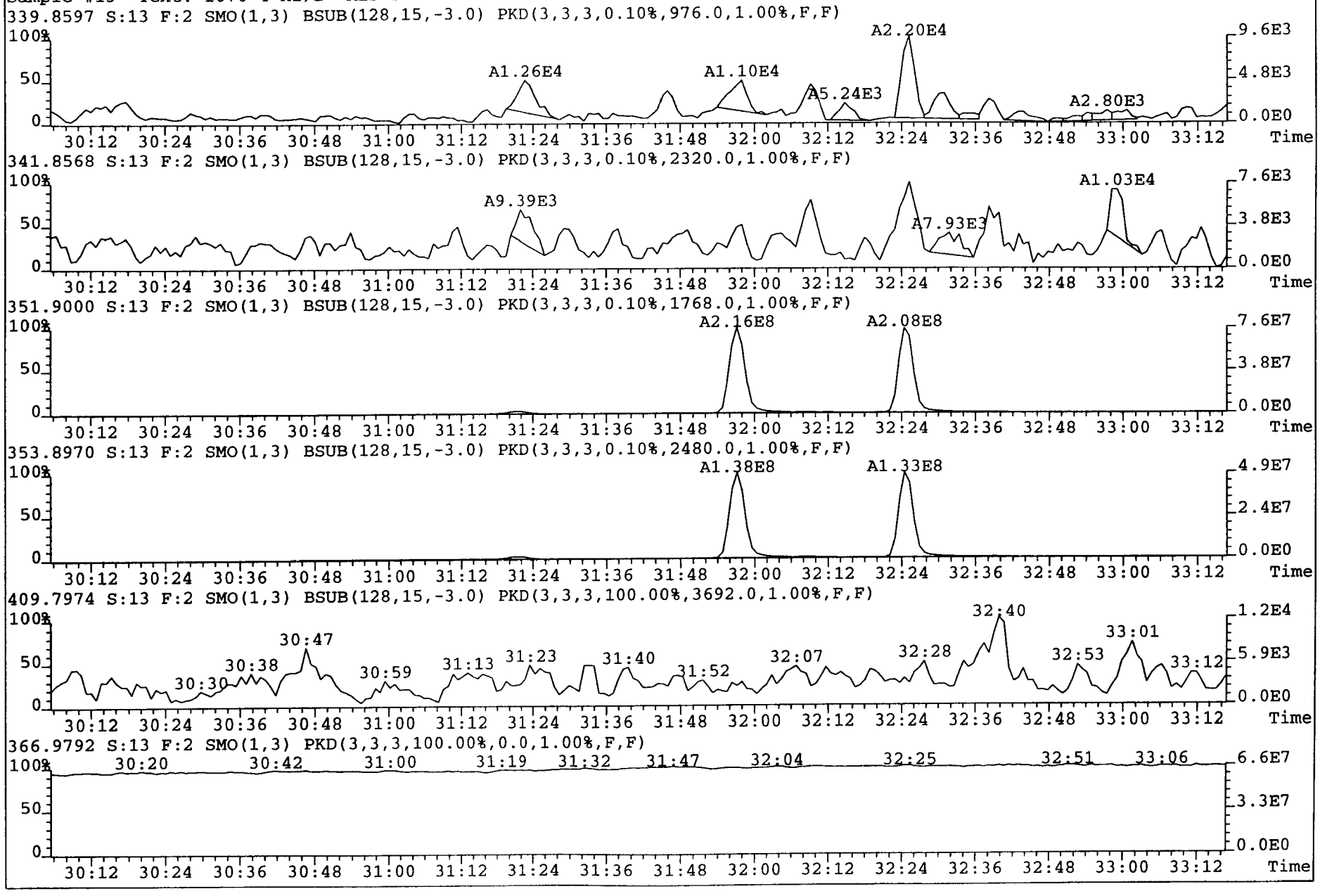
File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13

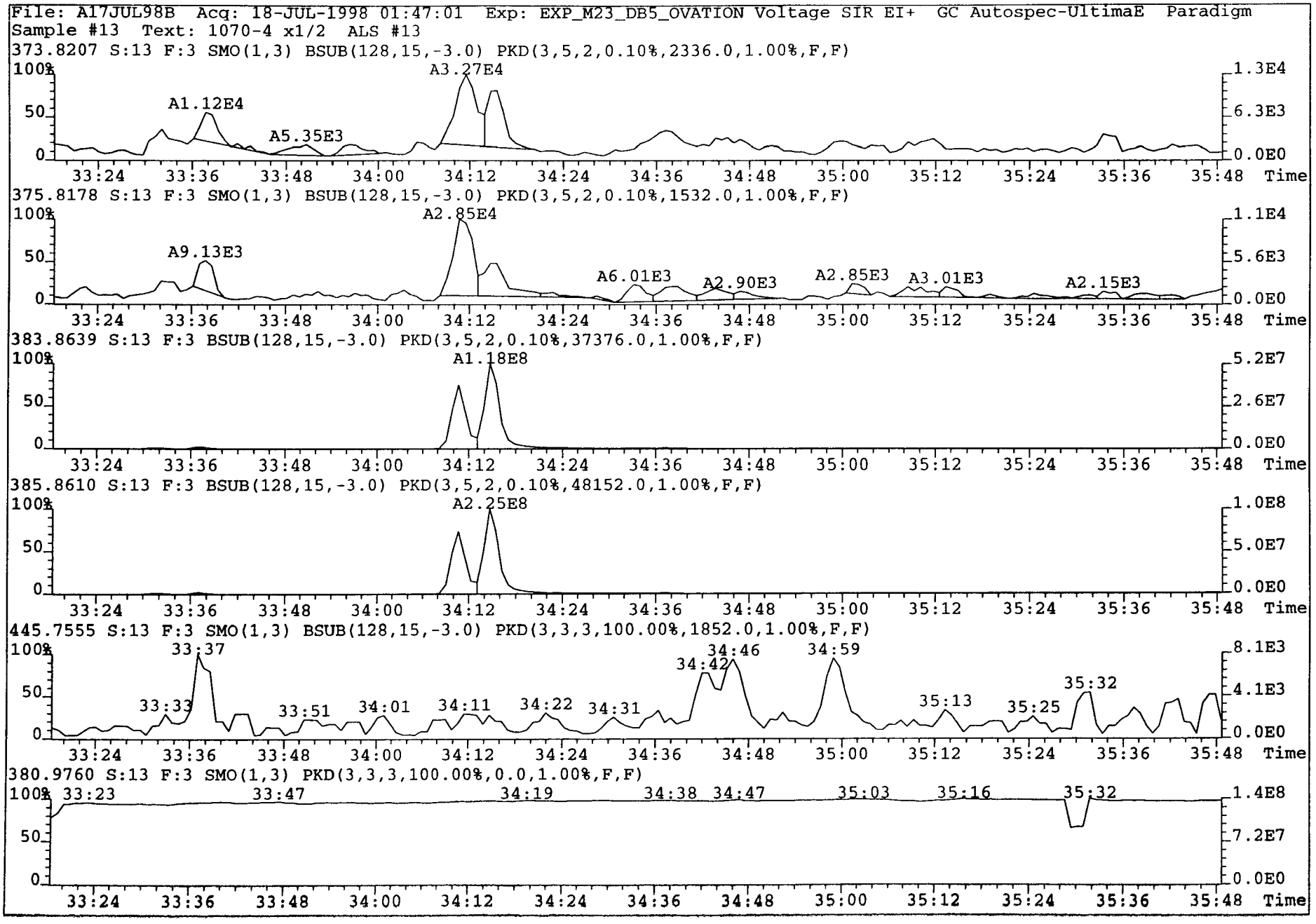


File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13

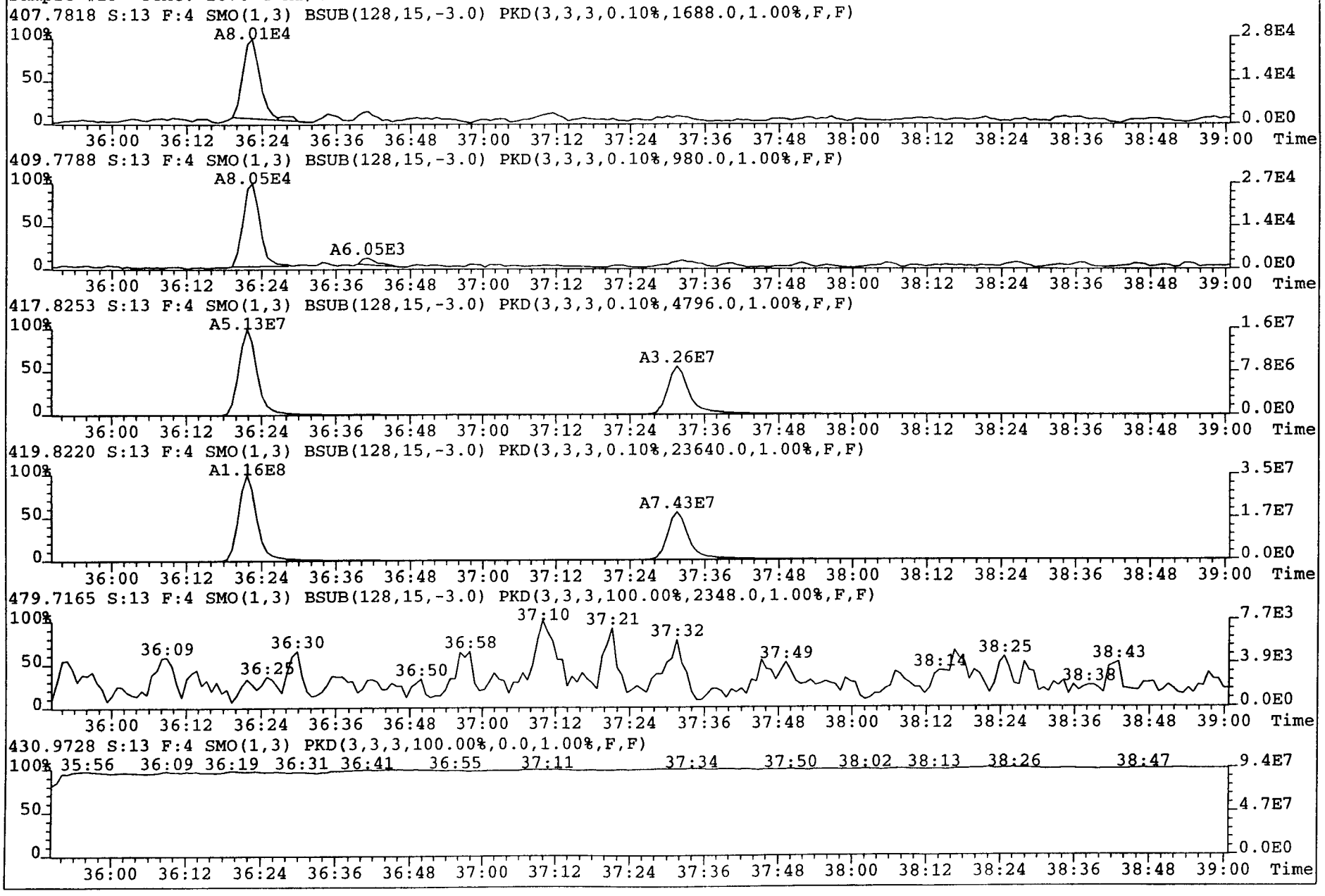


File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13




File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13
373.8207 S:13 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,2336.0,1.00%,F,F)
A1.12E4
A5.35E3
A3.27E4
1.3E4
6.3E3
0.0E0
375.8178 S:13 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,1532.0,1.00%,F,F)
A9.13E3
A2.85E4
A6.01E3
A2.90E3
A2.85E3
A3.01E3
A2.15E3
1.1E4
5.6E3
0.0E0
383.8639 S:13 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,37376.0,1.00%,F,F)
A1.18E8
5.2E7
2.6E7
0.0E0
385.8610 S:13 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,48152.0,1.00%,F,F)
A2.25E8
1.0E8
5.0E7
0.0E0
445.7555 S:13 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,1852.0,1.00%,F,F)
33:37
33:33
33:51
34:01
34:11
34:22
34:31
34:42
34:46
34:59
35:13
35:25
35:32
8.1E3
4.1E3
0.0E0
380.9760 S:13 F:3 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
33:23
33:47
34:19
34:38
34:47
35:03
35:16
35:32
1.4E8
7.2E7
0.0E0
100%
50
0
33:24
33:36
33:48
34:00
34:12
34:24
34:36
34:48
35:00
35:12
35:24
35:36
35:48
Time

File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13



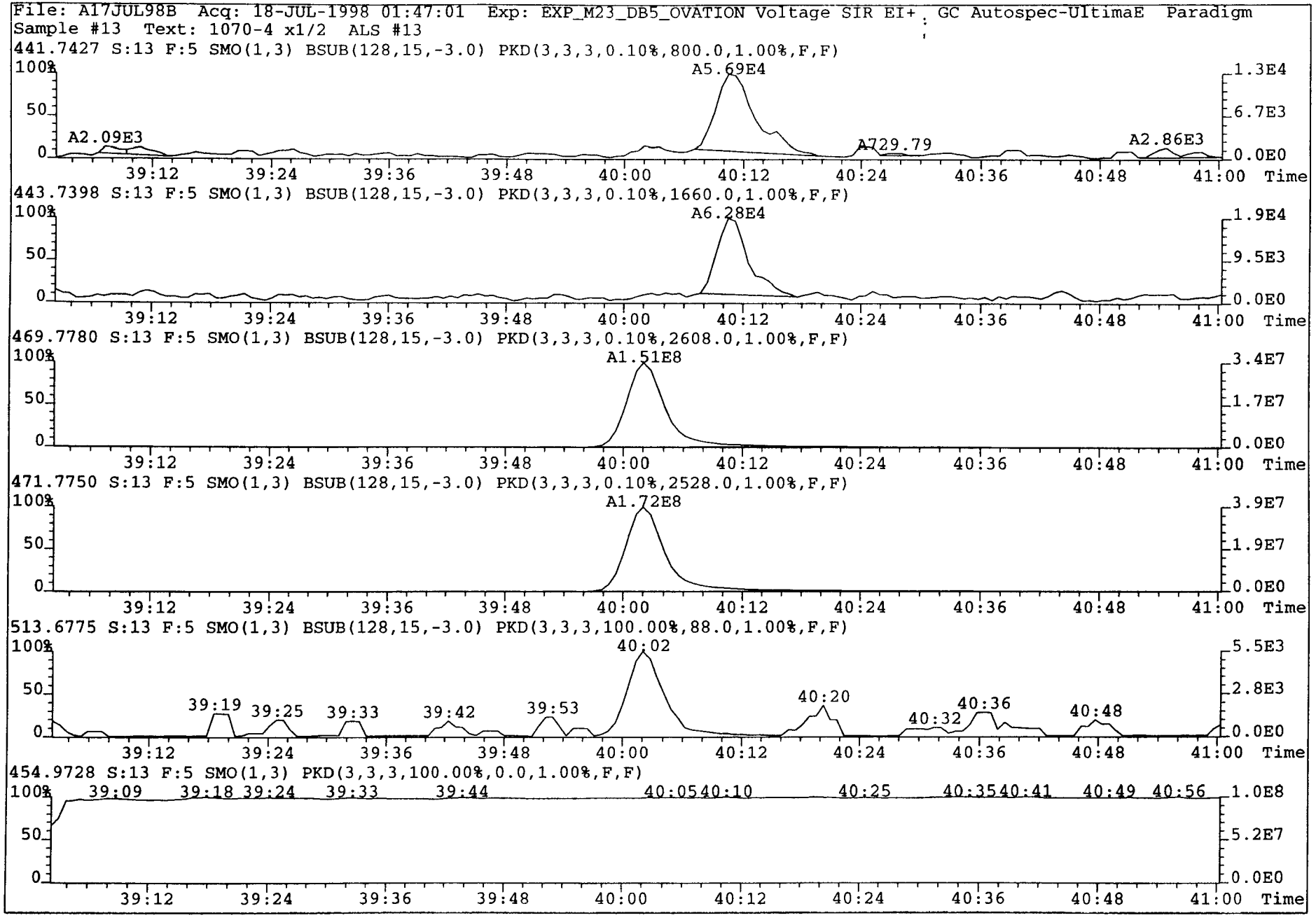

File: A17JUL98B Acq: 18-JUL-1998 01:47:01 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #13 Text: 1070-4 x1/2 ALS #13
441.7427 S:13 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,800.0,1.00%,F,F)
A5.69E4
A2.09E3
A729.79
A2.86E3
443.7398 S:13 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1660.0,1.00%,F,F)
A6.28E4
469.7780 S:13 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2608.0,1.00%,F,F)
A1.51E8
471.7750 S:13 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2528.0,1.00%,F,F)
A1.72E8
513.6775 S:13 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,88.0,1.00%,F,F)
40:02
39:19 39:25 39:33 39:42 39:53 40:20 40:32 40:36 40:48
454.9728 S:13 F:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
39:09 39:18 39:24 39:33 39:44 40:05 40:10 40:25 40:35 40:41 40:49 40:56
100% 50 0
1.3E4 6.7E3 0.0E0
1.9E4 9.5E3 0.0E0
3.4E7 1.7E7 0.0E0
3.9E7 1.9E7 0.0E0
5.5E3 2.8E3 0.0E0
1.0E8 5.2E7 0.0E0
39:12 39:24 39:36 39:48 40:00 40:12 40:24 40:36 40:48 41:00 Time

Fig. 128

Method 23

M23-I-1FH

PES

Analytical Data Summary Sheet

Analyte	Amount (ng)	DL (ng)	EMPC (ng)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	EMPC	0.0006	0.0025	28:27	0.62	
1,2,3,7,8-PeCDD	EMPC	0.0004	0.0034	32:37	1.79	
1,2,3,4,7,8-HxCDD	0.0028	0.0007		34:42	1.34	
1,2,3,6,7,8-HxCDD	EMPC	0.0006	0.0054	34:46	1.55	
1,2,3,7,8,9-HxCDD	0.0072	0.0006		34:58	1.39	
1,2,3,4,6,7,8-HpCDD	0.0208	0.0008		37:10	0.98	
OCDD	0.0200	0.0008		40:02	0.95	
2,3,7,8-TCDF	0.0184	0.0009		27:29	0.78	
1,2,3,7,8-PeCDF	0.0198	0.0006		31:57	1.59	
2,3,4,7,8-PeCDF	0.0240	0.0006		32:25	1.52	
1,2,3,4,7,8-HxCDF	0.0323	0.0005		34:10	1.25	
1,2,3,6,7,8-HxCDF	0.0132	0.0004		34:15	1.22	
2,3,4,6,7,8-HxCDF	0.0114	0.0004		34:37	1.28	
1,2,3,7,8,9-HxCDF	0.0031	0.0005		35:12	1.26	
1,2,3,4,6,7,8-HpCDF	0.0215	0.0009		36:22	0.95	
1,2,3,4,7,8,9-HpCDF	EMPC	0.0010	0.0023	37:32	1.47	
OCDF	EMPC	0.0010	0.0031	40:11	0.67	
Total TCDDs	0.109	0.0006	0.123			
Total PeCDDs	0.0744	0.0004	0.0840			
Total HxCDDs	0.138	0.0006	0.147			
Total HpCDDs	0.0376	0.0008				
Total TCDFs	0.628	0.0009	0.714			
Total PeCDFs	0.321	0.0006	0.326			
Total HxCDFs	0.108	0.0004	0.109			
Total HpCDFs	0.0244	0.0009	0.0300			
TEQ (ND=0)	0.0223		0.0270			ITEF
TEQ (ND=1/2)	0.0227		0.0270			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-I-1FH

Laboratory Information

Project ID: L1070
Sample ID: 1070-5

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1 Grams
Moisture / Lipids: 0.0 %
Original pH : NA

Filename: a17jul98b-14
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Method 23

M23-I-1FH

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	2.98	74.4	28:27	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	3.36	83.9	32:37	1.57	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.07	76.8	34:45	1.25	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	3.13	78.3	37:09	1.05	
$^{13}C_{12}$-OCDD	8	5.32	66.5	40:01	0.88	
$^{13}C_{12}$-2,3,7,8-TCDF	4	2.77	69.2	27:25	0.79	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	2.53	63.3	31:56	1.55	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	2.45	61.2	34:14	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	2.14	53.5	36:21	0.45	
Cleanup Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	4.01	100.2	28:27		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	4.28	107.0	32:24	1.57	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	4.43	110.7	34:42	1.25	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	4.15	103.7	34:10	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	4.37	109.1	37:31	0.44	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:09	0.79	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:58	1.25	

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-I-1FH

Laboratory Information

Project ID: L1070
Sample ID: 1070-5

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 1 Grams
Moisture / Lipids: 0.0 %
Original pH : NA

Filename: a17jul98b-14
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: Y.T.

Date Reviewed: 23 Jul 98

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Method 23

M23-I-1FH

PES

Analytical Data Summary Sheet

Analyte	Amount (ppt)	DL (ppt)	EMPC (ppt)	RT (min.)	Ratio	Qualifier
2,3,7,8-TCDD	EMPC	0.0377	0.161	28:27	0.62	
1,2,3,7,8-PeCDD	EMPC	0.0269	0.218	32:37	1.79	
1,2,3,4,7,8-HxCDD	0.180	0.0467		34:42	1.34	
1,2,3,6,7,8-HxCDD	EMPC	0.0370	0.344	34:46	1.55	
1,2,3,7,8,9-HxCDD	0.464	0.0364		34:58	1.39	
1,2,3,4,6,7,8-HpCDD	1.33	0.0495		37:10	0.98	
OCDD	1.28	0.0531		40:02	0.95	
2,3,7,8-TCDF	1.18	0.0577		27:29	0.78	
1,2,3,7,8-PeCDF	1.27	0.0408		31:57	1.59	
2,3,4,7,8-PeCDF	1.54	0.0395		32:25	1.52	
1,2,3,4,7,8-HxCDF	2.07	0.0308		34:10	1.25	
1,2,3,6,7,8-HxCDF	0.849	0.0244		34:15	1.22	
2,3,4,6,7,8-HxCDF	0.731	0.0285		34:37	1.28	
1,2,3,7,8,9-HxCDF	0.198	0.0326		35:12	1.26	
1,2,3,4,6,7,8-HpCDF	1.38	0.0547		36:22	0.95	
1,2,3,4,7,8,9-HpCDF	EMPC	0.0662	0.149	37:32	1.47	
OCDF	EMPC	0.0636	0.198	40:11	0.67	
Total TCDDs	7.00	0.0377	7.90			
Total PeCDDs	4.77	0.0269	5.36			
Total HxCDDs	8.88	0.0364	9.42			
Total HpCDDs	2.41	0.0495				
Total TCDFs	40.3	0.0577	45.8			
Total PeCDFs	20.6	0.0395	20.9			
Total HxCDFs	6.90	0.0244	6.98			
Total HpCDFs	1.57	0.0547	1.92			
TEQ (ND=0)	1.43		1.73			ITEF
TEQ (ND=1/2)	1.46		1.73			ITEF

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-I-1FH

Laboratory Information

Project ID: L1070
Sample ID: 1070-5

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 15.59 Grams
Moisture / Lipids: 0.0 %
Original pH : NA

Filename: a17jul98b-14
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Method 23

M23-I-1FH

PES

Analytical Data Summary Sheet

Labeled Standard	Expected Amount (ng)	Measured Amount (ng)	Percent Recovery (%)	RT (min.)	Ratio	Qualifier
Extraction Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	4	2.98	74.4	28:27	0.78	
$^{13}C_{12}$-1,2,3,7,8-PeCDD	4	3.36	83.9	32:37	1.57	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	4	3.07	76.8	34:45	1.25	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	4	3.13	78.3	37:09	1.05	
$^{13}C_{12}$-OCDD	8	5.32	66.5	40:01	0.88	
$^{13}C_{12}$-2,3,7,8-TCDF	4	2.77	69.2	27:25	0.79	
$^{13}C_{12}$-1,2,3,7,8-PeCDF	4	2.53	63.3	31:56	1.55	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	4	2.45	61.2	34:14	0.52	
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	4	2.14	53.5	36:21	0.45	
Cleanup Standards						
$^{37}Cl_4$-2,3,7,8-TCDD	4	4.01	100.2	28:27		
$^{13}C_{12}$-2,3,4,7,8-PeCDF	4	4.28	107.0	32:24	1.57	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	4	4.43	110.7	34:42	1.25	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	4	4.15	103.7	34:10	0.52	
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	4	4.37	109.1	37:31	0.44	
Injection Standards						
$^{13}C_{12}$-1,2,3,4-TCDD				28:09	0.79	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD				34:58	1.25	

Client Information

Project Name: Texas Lime Kiln
Sample ID: M23-I-1FH

Laboratory Information

Project ID: L1070
Sample ID: 1070-5

Collection Date: 25-Jun-98
Receipt Date: 08-Jul-98
Extraction Date: 10-Jul-98
Analysis Date: 18-Jul-98

Sample Information

Matrix: Air
Weight / Volume: 15.59 Grams
Moisture / Lipids: 0.0 %
Original pH : NA

Filename: a17jul98b-14
Retchk: a17jul98b-1
Begin ConCal: a17jul98b-2
End ConCal: a17jul98b-15
Initial Cal: m8290-23-071798

Reviewed by: Y. T. Date Reviewed: 23 Jul 98

Filename ; a17jul98b
Sample ; 14
Acquired ; 18-JUL-98 02:32:07
Processed ; 20-JUL-98 09:09:09
Sample ID ; 1070-5 x1/2
Cal Table ; m8290-23-071798
Results Table ; M8290-23-071798B
Comments ;

CF2,489

Typ ;	Name;	Resp;	Ion 1;	Ion 2;	RA;?;	RT;	Conc;	DL;	S/N1;?;	S/N2;? ;	mod?
Unk ;	2,3,7,8-TCDD;	4.16e+05;	7.15e+04;	3.44e+05;	0.21;n;	28:27;	0.140;	0.0147;	10;y;	56;y ;	no
Unk ;	1,2,3,7,8-PeCDD;	2.24e+05;	1.44e+05;	8.01e+04;	1.79;n;	32:37;	0.085;	0.0105;	25;y;	24;y ;	no
Unk ;	1,2,3,4,7,8-HxCDD;	1.24e+05;	7.09e+04;	5.28e+04;	1.34;y;	34:42;	0.070;	0.0182;	11;y;	11;y ;	no
Unk ;	1,2,3,6,7,8-HxCDD;	3.02e+05;	1.83e+05;	1.18e+05;	1.55;n;	34:46;	0.134;	0.0144;	22;y;	21;y ;	no
Unk ;	1,2,3,7,8,9-HxCDD;	4.10e+05;	2.38e+05;	1.72e+05;	1.39;y;	34:58;	0.181;	0.0142;	26;y;	25;y ;	no
Unk ;	1,2,3,4,6,7,8-HpCDD;	9.28e+05;	4.59e+05;	4.70e+05;	0.98;y;	37:10;	0.519;	0.0193;	55;y;	163;y ;	no
Unk ;	OCDD;	6.83e+05;	3.34e+05;	3.50e+05;	0.95;y;	40:02;	0.499;	0.0207;	88;y;	63;y ;	no
Unk ;	2,3,7,8-TCDF;	8.75e+06;	3.84e+06;	4.91e+06;	0.78;y;	27:29;	2.613;	0.0225;	315;y;	243;y ;	no
Unk ;	1,2,3,7,8-PeCDF;	1.21e+06;	7.39e+05;	4.66e+05;	1.59;y;	31:57;	0.495;	0.0159;	115;y;	75;y ;	no
Unk ;	2,3,4,7,8-PeCDF;	1.51e+06;	9.12e+05;	6.00e+05;	1.52;y;	32:25;	0.600;	0.0154;	142;y;	96;y ;	no
Unk ;	1,2,3,4,7,8-HxCDF;	1.69e+06;	9.38e+05;	7.51e+05;	1.25;y;	34:10;	0.808;	0.0120;	144;y;	133;y ;	no
Unk ;	1,2,3,6,7,8-HxCDF;	8.73e+05;	4.80e+05;	3.93e+05;	1.22;y;	34:15;	0.331;	0.0095;	72;y;	68;y ;	no
Unk ;	2,3,4,6,7,8-HxCDF;	6.46e+05;	3.62e+05;	2.84e+05;	1.28;y;	34:37;	0.285;	0.0111;	53;y;	45;y ;	no
Unk ;	1,2,3,7,8,9-HxCDF;	1.51e+05;	8.43e+04;	6.68e+04;	1.26;y;	35:12;	0.077;	0.0127;	11;y;	10;y ;	no
Unk ;	1,2,3,4,6,7,8-HpCDF;	8.74e+05;	4.26e+05;	4.48e+05;	0.95;y;	36:22;	0.538;	0.0213;	66;y;	89;y ;	no
Unk ;	1,2,3,4,7,8,9-HpCDF;	7.79e+04;	4.64e+04;	3.15e+04;	1.47;n;	37:32;	0.058;	0.0258;	8;y;	6;y ;	no
Unk ;	OCDF;	1.12e+05;	4.48e+04;	6.70e+04;	0.67;n;	40:11;	0.077;	0.0248;	11;y;	10;y ;	no
ES/RT;	13C-2,3,7,8-TCDD;	3.01e+08;	1.31e+08;	1.70e+08;	0.78;y;	28:27;	74.379;	0.0426;	3338;y;	8191;y ;	no
ES ;	13C-1,2,3,7,8-PeCDD;	2.37e+08;	1.45e+08;	9.20e+07;	1.57;y;	32:37;	83.935;	0.0205;	23082;y;	17838;y ;	no
ES ;	13C-1,2,3,6,7,8-HxCDD;	2.64e+08;	1.47e+08;	1.17e+08;	1.25;y;	34:45;	76.811;	0.0339;	9483;y;	5440;y ;	no
ES ;	13C-1,2,3,4,6,7,8-HpCDD;	1.99e+08;	1.02e+08;	9.75e+07;	1.05;y;	37:09;	78.297;	0.0124;	10663;y;	17074;y ;	no
ES ;	13C-OCDD;	2.73e+08;	1.28e+08;	1.45e+08;	0.88;y;	40:01;	133.080;	0.0155;	11857;y;	19215;y ;	no
ES/RT;	13C-2,3,7,8-TCDF;	3.51e+08;	1.55e+08;	1.97e+08;	0.79;y;	27:25;	69.167;	0.0215;	8595;y;	10041;y ;	no
ES ;	13C-1,2,3,7,8-PeCDF;	2.80e+08;	1.70e+08;	1.10e+08;	1.55;y;	31:56;	63.264;	0.0099;	34158;y;	30128;y ;	no
ES ;	13C-1,2,3,6,7,8-HxCDF;	2.43e+08;	8.35e+07;	1.59e+08;	0.52;y;	34:14;	61.146;	0.1718;	1381;y;	1132;y ;	no
ES ;	13C-1,2,3,4,6,7,8-HpCDF;	1.29e+08;	4.01e+07;	8.88e+07;	0.45;y;	36:21;	53.443;	0.1030;	1537;y;	1118;y ;	no
JS ;	13C-1,2,3,4-TCDD;	3.69e+08;	1.62e+08;	2.06e+08;	0.79;y;	28:09;	76.468;	-;	4328;y;	10379;y ;	no
JS ;	13C-1,2,3,7,8,9-HxCDD;	3.20e+08;	1.78e+08;	1.42e+08;	1.25;y;	34:58;	80.780;	-;	10837;y;	6346;y ;	no
CS ;	37Cl-2,3,7,8-TCDD;	3.72e+08;	3.72e+08;	-;	-;-;	28:27;	100.214;	0.0153;	19251;y;	-; -;	no
CS ;	13C-2,3,4,7,8-PeCDF;	4.63e+08;	2.83e+08;	1.80e+08;	1.57;y;	32:24;	107.006;	0.0101;	58412;y;	51435;y ;	no
CS ;	13C-1,2,3,4,7,8-HxCDD;	2.57e+08;	1.43e+08;	1.14e+08;	1.25;y;	34:42;	110.726;	0.0504;	9289;y;	5383;y ;	no
CS ;	13C-1,2,3,4,7,8-HxCDF;	3.21e+08;	1.09e+08;	2.11e+08;	0.52;y;	34:10;	103.709;	0.2204;	2048;y;	1644;y ;	no
CS ;	13C-1,2,3,4,7,8,9-HpCDF;	2.06e+08;	6.28e+07;	1.43e+08;	0.44;y;	37:31;	109.124;	0.1317;	2152;y;	1580;y ;	no
SS ;	37Cl-2,3,7,8-TCDD;	3.72e+08;	3.72e+08;	-;	-;-;	28:27;	134.810;	0.0215;	19251;y;	-; -;	no
SS ;	13C-2,3,4,7,8-PeCDF;	4.63e+08;	2.83e+08;	1.80e+08;	1.57;y;	32:24;	169.200;	0.0095;	58412;y;	51435;y ;	no
SS ;	13C-1,2,3,4,7,8-HxCDD;	2.57e+08;	1.43e+08;	1.14e+08;	1.25;y;	34:42;	143.966;	0.0623;	9289;y;	5383;y ;	no
SS ;	13C-1,2,3,4,7,8-HxCDF;	3.21e+08;	1.09e+08;	2.11e+08;	0.52;y;	34:10;	168.265;	0.3181;	2048;y;	1644;y ;	no
SS ;	13C-1,2,3,4,7,8,9-HpCDF;	2.06e+08;	6.28e+07;	1.43e+08;	0.44;y;	37:31;	204.264;	0.3148;	2152;y;	1580;y ;	no

Ent: 39 Name: Total Tetra-Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:22

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 17.84 of which 2.61 named and 15.23 unnamed
Conc: 17.84 of which 2.61 named and 15.23 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA		Conc	Area	Height	S/N		Mod?
	1	23:39	3.4e+06	0.77	y	1.03					
			3.4e+06				1.5e+06	3.2e+05	1.6e+02	y	n
							1.9e+06	4.2e+05	1.3e+02	y	n
	2	24:14	1.9e+06	0.75	y	0.58					
			1.9e+06				8.3e+05	1.8e+05	9.4e+01	y	n
							1.1e+06	2.4e+05	7.8e+01	y	n
	3	24:34	2.2e+06	0.76	y	0.65					
			2.2e+06				9.4e+05	1.9e+05	9.9e+01	y	n
							1.2e+06	2.6e+05	8.3e+01	y	n
	4	24:52	7.8e+06	0.80	y	2.34					
			7.8e+06				3.5e+06	6.7e+05	3.4e+02	y	n
							4.4e+06	8.4e+05	2.7e+02	y	n
	5	24:58	1.8e+06	0.38	n	0.53					
			1.8e+06				4.9e+05	1.5e+05	7.7e+01	y	n
							1.3e+06	1.9e+05	6.1e+01	y	n
	6	25:10	1.8e+06	0.74	y	0.54					
			1.8e+06				7.7e+05	1.8e+05	9.1e+01	y	n
							1.0e+06	2.3e+05	7.4e+01	y	n
	7	25:17	5.4e+06	0.75	y	1.63					
			5.4e+06				2.3e+06	3.0e+05	1.6e+02	y	n
							3.1e+06	4.1e+05	1.3e+02	y	n
	8	25:40	1.9e+06	0.63	n	0.57					
			1.9e+06				7.4e+05	2.1e+05	1.1e+02	y	n
							1.2e+06	2.7e+05	8.6e+01	y	n
	9	25:44	3.1e+06	0.92	n	0.92					
			3.1e+06				1.5e+06	2.7e+05	1.4e+02	y	n
							1.6e+06	3.4e+05	1.1e+02	y	n
	10	26:01	1.5e+06	0.78	y	0.46					
			1.5e+06				6.7e+05	1.5e+05	7.5e+01	y	n
							8.6e+05	1.8e+05	5.7e+01	y	n
	11	26:09	3.1e+06	0.78	y	0.92					
			3.1e+06				1.3e+06	2.8e+05	1.4e+02	y	n
							1.7e+06	3.5e+05	1.1e+02	y	n
	12	26:26	5.5e+06	0.81	y	1.64					
			5.5e+06				2.5e+06	4.7e+05	2.4e+02	y	n
							3.0e+06	5.9e+05	1.9e+02	y	n
	13	26:34	4.1e+06	0.74	y	1.22					
			4.1e+06				1.7e+06	3.6e+05	1.9e+02	y	n
							2.3e+06	4.7e+05	1.5e+02	y	n
	14	26:50	2.5e+06	0.83	y	0.75					
			2.5e+06				1.1e+06	2.3e+05	1.2e+02	y	n
							1.4e+06	2.9e+05	9.1e+01	y	n
	15	27:03	1.3e+05	2.14	n	0.04					
			1.3e+05				8.6e+04	1.7e+04	8.5e+00	y	n
							4.0e+04	1.5e+04	4.7e+00	y	n
	16	27:11	1.2e+06	0.78	y	0.36					
			1.2e+06				5.3e+05	1.1e+05	5.5e+01	y	n
							6.8e+05	1.3e+05	4.3e+01	y	n
2,3,7,8-TCDF	17	27:29	8.8e+06	0.78	y	2.61					
			8.8e+06				3.8e+06	6.1e+05	3.1e+02	y	n
							4.9e+06	7.6e+05	2.4e+02	y	n
	18	27:41	1.3e+04	0.52	n	0.00					
			1.3e+04				4.5e+03	1.9e+03	9.8e-01	n	n
							8.7e+03	2.0e+03	6.4e-01	n	n
	19	28:03	1.9e+06	0.81	y	0.56					
			1.9e+06				8.3e+05	1.7e+05	8.6e+01	y	n
							1.0e+06	2.1e+05	6.7e+01	y	n

```
20 28:19 1.3e+06  0.83 y    0.40
         1.3e+06                6.1e+05 1.1e+05 5.8e+01 y  n
                                7.3e+05 1.4e+05 4.6e+01 y  n
21 28:33 1.3e+05  1.35 n    0.04
         1.3e+05                7.7e+04 1.4e+04 7.0e+00 y  n
                                5.7e+04 1.3e+04 4.0e+00 y  n
22 29:46 2.5e+05  1.60 n    0.07
         2.5e+05                1.5e+05 2.6e+04 1.3e+01 y  n
                                9.5e+04 1.9e+04 6.0e+00 y  n
```

Ent: 40 Name: Total Tetra-Dioxins F:1 Mass: 319.897 321.894 Mod? no #Hom:15

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 3.10 of which 0.14 named and 2.96 unnamed
Conc: 3.10 of which 0.14 named and 2.96 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	25:15	3.5e+06	0.79 y	1.19				
			3.5e+06			1.6e+06	3.4e+05	2.1e+02	y n
						2.0e+06	4.2e+05	3.4e+02	y n
	2	25:41	2.0e+06	0.73 y	0.66				
			2.0e+06			8.3e+05	1.7e+05	1.0e+02	y n
						1.1e+06	2.3e+05	1.9e+02	y n
	3	26:04	3.1e+05	0.86 y	0.10				
			3.1e+05			1.4e+05	2.9e+04	1.8e+01	y n
						1.7e+05	3.1e+04	2.5e+01	y n
	4	26:54	9.5e+05	0.78 y	0.32				
			9.5e+05			4.1e+05	7.7e+04	4.6e+01	y n
						5.3e+05	9.8e+04	7.8e+01	y n
	5	27:08	2.1e+05	0.85 y	0.07				
			2.1e+05			9.5e+04	1.5e+04	9.0e+00	y n
						1.1e+05	1.8e+04	1.4e+01	y n
	6	27:17	2.9e+05	0.87 y	0.10				
			2.9e+05			1.3e+05	2.4e+04	1.5e+01	y n
						1.5e+05	3.0e+04	2.4e+01	y n
	7	27:25	1.1e+05	1.84 n	0.04				
			1.1e+05			7.3e+04	1.6e+04	9.7e+00	y n
						3.9e+04	8.8e+03	7.0e+00	y n
	8	27:45	2.8e+05	0.72 y	0.09				
			2.8e+05			1.2e+05	2.6e+04	1.5e+01	y n
						1.6e+05	3.3e+04	2.6e+01	y n
	9	28:10	3.4e+05	0.67 y	0.12				
			3.4e+05			1.4e+05	2.8e+04	1.7e+01	y n
						2.0e+05	4.2e+04	3.3e+01	y n
	10	28:20	4.9e+05	0.94 n	0.17				
			4.9e+05			2.4e+05	4.8e+04	2.9e+01	y n
						2.6e+05	5.2e+04	4.1e+01	y n
2,3,7,8-TCDD	11	28:27	4.2e+05	0.21 n	0.14				
			4.2e+05			7.2e+04	1.6e+04	9.5e+00	y n
						3.4e+05	6.9e+04	5.6e+01	y n
	12	28:40	1.0e+05	0.67 y	0.04				
			1.0e+05			4.2e+04	1.0e+04	6.3e+00	y n
						6.2e+04	1.4e+04	1.1e+01	y n
	13	28:57	1.2e+05	0.82 y	0.04				
			1.2e+05			5.3e+04	1.3e+04	7.9e+00	y n
						6.5e+04	1.5e+04	1.2e+01	y n
	14	29:18	4.2e+04	1.69 n	0.01				
			4.2e+04			2.7e+04	6.0e+03	3.7e+00	y n
						1.6e+04	5.2e+03	4.1e+00	y n
	15	29:54	4.8e+04	0.48 n	0.02				
			4.8e+04			1.6e+04	4.8e+03	2.9e+00	n n
						3.3e+04	5.9e+03	4.7e+00	y n

Ent: 41 Name: Total Penta-Furans F:2 Mass: 339.860 341.857 Mod? no #Hom:15

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 8.16 of which 1.09 named and 7.07 unnamed
Conc: 8.16 of which 1.09 named and 7.07 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	30:15	2.3e+06	1.54 y	0.93				
			2.3e+06			1.4e+06	2.9e+05	1.3e+02 y	n
						9.1e+05	1.9e+05	8.4e+01 y	n
	2	31:15	1.2e+06	1.56 y	0.47				
			1.2e+06			7.1e+05	2.4e+05	1.0e+02 y	n
						4.5e+05	1.5e+05	6.7e+01 y	n
	3	31:21	5.0e+06	1.57 y	2.03				
			5.0e+06			3.1e+06	8.1e+05	3.6e+02 y	n
						2.0e+06	5.4e+05	2.4e+02 y	n
	4	31:29	8.9e+05	1.39 y	0.36				
			8.9e+05			5.2e+05	1.6e+05	7.0e+01 y	n
						3.7e+05	1.1e+05	4.9e+01 y	n
	5	31:36	2.5e+05	1.43 y	0.10				
			2.5e+05			1.5e+05	2.7e+04	1.2e+01 y	n
						1.0e+05	1.9e+04	8.2e+00 y	n
	6	31:45	3.1e+06	1.51 y	1.24				
			3.1e+06			1.8e+06	6.1e+05	2.7e+02 y	n
						1.2e+06	4.0e+05	1.7e+02 y	n
	7	31:54	1.2e+06	1.49 y	0.47				
			1.2e+06			6.9e+05	2.6e+05	1.1e+02 y	n
						4.6e+05	1.7e+05	7.3e+01 y	n
1,2,3,7,8-PeCDF	8	31:57	1.2e+06	1.59 y	0.49				
			1.2e+06			7.4e+05	2.6e+05	1.1e+02 y	n
						4.7e+05	1.7e+05	7.5e+01 y	n
	9	32:04	5.6e+05	1.69 y	0.22				
			5.6e+05			3.5e+05	1.2e+05	5.2e+01 y	n
						2.1e+05	7.0e+04	3.1e+01 y	n
	10	32:08	1.3e+06	1.54 y	0.52				
			1.3e+06			7.8e+05	2.8e+05	1.2e+02 y	n
						5.1e+05	1.8e+05	7.8e+01 y	n
2,3,4,7,8-PeCDF	11	32:25	1.5e+06	1.52 y	0.60				
			1.5e+06			9.1e+05	3.3e+05	1.4e+02 y	n
						6.0e+05	2.2e+05	9.6e+01 y	n
	12	32:29	1.5e+06	1.56 y	0.59				
			1.5e+06			9.0e+05	3.1e+05	1.4e+02 y	n
						5.7e+05	2.0e+05	9.0e+01 y	n
	13	32:35	6.0e+04	2.37 n	0.02				
			6.0e+04			4.2e+04	1.6e+04	6.8e+00 y	n
						1.8e+04	9.1e+03	4.0e+00 y	n
	14	32:38	1.6e+05	1.22 n	0.06				
			1.6e+05			8.8e+04	2.9e+04	1.3e+01 y	n
						7.2e+04	2.0e+04	8.6e+00 y	n
	15	32:57	1.3e+05	1.25 n	0.05				
			1.3e+05			7.2e+04	2.7e+04	1.2e+01 y	n
						5.8e+04	1.8e+04	7.9e+00 y	n

Ent: 42 Name: Total Penta-Dioxins F:2 Mass: 355.855 357.852 Mod? no #Hom:11

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 2.10 of which 0.08 named and 2.01 unnamed
Conc: 2.10 of which 0.08 named and 2.01 unnamed

Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	31:29	1.7e+06	1.57 y	0.65					
			1.7e+06			1.1e+06	3.3e+05	1.6e+02	y	n
						6.7e+05	2.2e+05	1.8e+02	y	n
	2	31:59	1.4e+06	1.59 y	0.51					
			1.4e+06			8.4e+05	3.0e+05	1.5e+02	y	n
						5.2e+05	2.0e+05	1.7e+02	y	n
	3	32:04	1.5e+05	1.68 y	0.06					
			1.5e+05			9.6e+04	3.1e+04	1.5e+01	y	n
						5.7e+04	2.0e+04	1.7e+01	y	n
	4	32:10	1.1e+06	1.51 y	0.40					
			1.1e+06			6.4e+05	2.3e+05	1.1e+02	y	n
						4.2e+05	1.5e+05	1.3e+02	y	n
	5	32:16	9.4e+04	2.03 n	0.04					
			9.4e+04			6.3e+04	2.9e+04	1.4e+01	y	n
						3.1e+04	1.2e+04	1.0e+01	y	n
	6	32:20	1.8e+05	1.79 n	0.07					
			1.8e+05			1.2e+05	3.3e+04	1.6e+01	y	n
						6.5e+04	2.2e+04	1.8e+01	y	n
	7	32:26	4.0e+05	1.62 y	0.15					
			4.0e+05			2.5e+05	7.5e+04	3.6e+01	y	n
						1.5e+05	5.5e+04	4.6e+01	y	n
	8	32:30	1.4e+05	1.68 y	0.05					
			1.4e+05			8.9e+04	3.2e+04	1.6e+01	y	n
						5.3e+04	2.1e+04	1.8e+01	y	n
1,2,3,7,8-PeCDD	9	32:37	2.2e+05	1.79 n	0.08					
			2.2e+05			1.4e+05	5.1e+04	2.5e+01	y	n
						8.0e+04	2.9e+04	2.4e+01	y	n
	10	32:43	9.6e+04	1.39 y	0.04					
			9.6e+04			5.6e+04	1.7e+04	8.1e+00	y	n
						4.0e+04	1.3e+04	1.1e+01	y	n
	11	32:54	1.2e+05	2.18 n	0.04					
			1.2e+05			8.0e+04	2.5e+04	1.2e+01	y	n
						3.7e+04	1.2e+04	1.0e+01	y	n

Ent: 43 Name: Total Hexa-Furans F:3 Mass: 373.821 375.818 Mod? no #Hom:12

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 2.73 of which 1.50 named and 1.23 unnamed
Conc: 2.73 of which 1.50 named and 1.23 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:31	6.7e+05	1.32 y	0.30				
			6.7e+05			3.8e+05	1.4e+05	7.0e+01 y	n
						2.9e+05	1.1e+05	6.5e+01 y	n
	2	33:37	1.6e+06	1.25 y	0.71				
			1.6e+06			8.9e+05	3.2e+05	1.6e+02 y	n
						7.1e+05	2.5e+05	1.5e+02 y	n
	3	33:43	8.9e+04	1.21 y	0.04				
			8.9e+04			4.9e+04	1.5e+04	7.7e+00 y	n
						4.0e+04	1.3e+04	7.8e+00 y	n
	4	33:49	1.2e+05	1.36 y	0.06				
			1.2e+05			7.2e+04	2.3e+04	1.2e+01 y	n
						5.3e+04	1.8e+04	1.0e+01 y	n
	5	33:55	7.7e+04	0.98 n	0.03				
			7.7e+04			3.8e+04	1.3e+04	6.8e+00 y	n
						3.9e+04	1.2e+04	7.1e+00 y	n
1,2,3,4,7,8-HxCDF	6	34:10	1.7e+06	1.25 y	0.81				
			1.7e+06			9.4e+05	2.8e+05	1.4e+02 y	n
						7.5e+05	2.2e+05	1.3e+02 y	n
1,2,3,6,7,8-HxCDF	7	34:15	8.7e+05	1.22 y	0.33				
			8.7e+05			4.8e+05	1.4e+05	7.2e+01 y	n
						3.9e+05	1.2e+05	6.8e+01 y	n
	8	34:27	1.7e+05	1.23 y	0.08				
			1.7e+05			9.5e+04	2.4e+04	1.2e+01 y	n
						7.7e+04	1.8e+04	1.1e+01 y	n
2,3,4,6,7,8-HxCDF	9	34:37	6.5e+05	1.28 y	0.28				
			6.5e+05			3.6e+05	1.0e+05	5.3e+01 y	n
						2.8e+05	7.6e+04	4.5e+01 y	n
	10	34:47	2.6e+04	1.02 n	0.01				
			2.6e+04			1.3e+04	3.9e+03	2.0e+00 n	n
						1.3e+04	3.3e+03	2.0e+00 n	n
1,2,3,7,8,9-HxCDF	11	35:12	1.5e+05	1.26 y	0.08				
			1.5e+05			8.4e+04	2.1e+04	1.1e+01 y	n
						6.7e+04	1.6e+04	9.5e+00 y	n
	12	35:19	6.0e+03	1.14 y	0.00				
			6.0e+03			3.2e+03	9.9e+02	5.1e-01 n	n
						2.8e+03	1.5e+03	8.8e-01 n	n

Ent: 44 Name: Total Hexa-Dioxins F:3 Mass: 389.816 391.813 Mod? no #Hom:10

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 3.69 of which 0.38 named and 3.30 unnamed
Conc: 3.69 of which 0.38 named and 3.30 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	33:52	3.7e+05	1.19 y	0.18				
			3.7e+05			2.0e+05	7.5e+04	2.9e+01 y	n
						1.7e+05	5.9e+04	3.2e+01 y	n
	2	34:11	5.6e+06	1.28 y	2.68				
			5.6e+06			3.2e+06	1.1e+06	4.2e+02 y	n

							2.5e+06	8.3e+05	4.6e+02	y	n
	3	34:20	7.3e+05	1.38	y	0.35					
			7.3e+05				4.2e+05	1.3e+05	5.0e+01	y	n
							3.1e+05	9.7e+04	5.4e+01	y	n
	4	34:26	1.7e+05	0.91	n	0.08					
			1.7e+05				7.9e+04	2.5e+04	9.9e+00	y	n
							8.7e+04	2.1e+04	1.1e+01	y	n
1,2,3,4,7,8-HxCDD	5	34:42	1.2e+05	1.34	y	0.07					
			1.2e+05				7.1e+04	2.8e+04	1.1e+01	y	n
							5.3e+04	2.0e+04	1.1e+01	y	n
1,2,3,6,7,8-HxCDD	6	34:46	3.0e+05	1.55	n	0.13					
			3.0e+05				1.8e+05	5.8e+04	2.2e+01	y	n
							1.2e+05	3.9e+04	2.1e+01	y	n
1,2,3,7,8,9-HxCDD	7	34:58	4.1e+05	1.39	y	0.18					
			4.1e+05				2.4e+05	6.6e+04	2.6e+01	y	n
							1.7e+05	4.4e+04	2.5e+01	y	n
	8	35:04	2.2e+04	0.68	n	0.01					
			2.2e+04				8.8e+03	3.6e+03	1.4e+00	n	n
							1.3e+04	3.7e+03	2.1e+00	n	n
	9	35:41	8.2e+03	1.87	n	0.00					
			8.2e+03				5.3e+03	2.4e+03	9.2e-01	n	n
							2.8e+03	7.8e+02	4.3e-01	n	n
	10	35:43	6.5e+03	1.28	y	0.00					
			6.5e+03				3.6e+03	1.7e+03	6.7e-01	n	n
							2.8e+03	7.8e+02	4.3e-01	n	n

Ent: 45 Name: Total Hepta-Furans F:4 Mass: 407.782 409.779 Mod? no #Hom:4

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 0.75 of which 0.60 named and 0.15 unnamed
Conc: 0.75 of which 0.60 named and 0.15 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
1,2,3,4,6,7,8-HpCDF1		36:22	8.7e+05	0.95 y	0.54					
			8.7e+05			4.3e+05	1.3e+05	6.6e+01	y	n
						4.5e+05	1.4e+05	8.9e+01	y	n
	2	36:34	1.1e+05	1.00 y	0.07					
			1.1e+05			5.5e+04	1.4e+04	7.2e+00	y	n
						5.5e+04	1.6e+04	1.1e+01	y	n
	3	36:40	1.2e+05	1.42 n	0.08					
			1.2e+05			6.9e+04	1.9e+04	9.8e+00	y	n
						4.8e+04	1.5e+04	9.9e+00	y	n
1,2,3,4,7,8,9-HpCDF4		37:32	7.8e+04	1.47 n	0.06					
			7.8e+04			4.6e+04	1.5e+04	7.8e+00	y	n
						3.1e+04	8.6e+03	5.6e+00	y	n

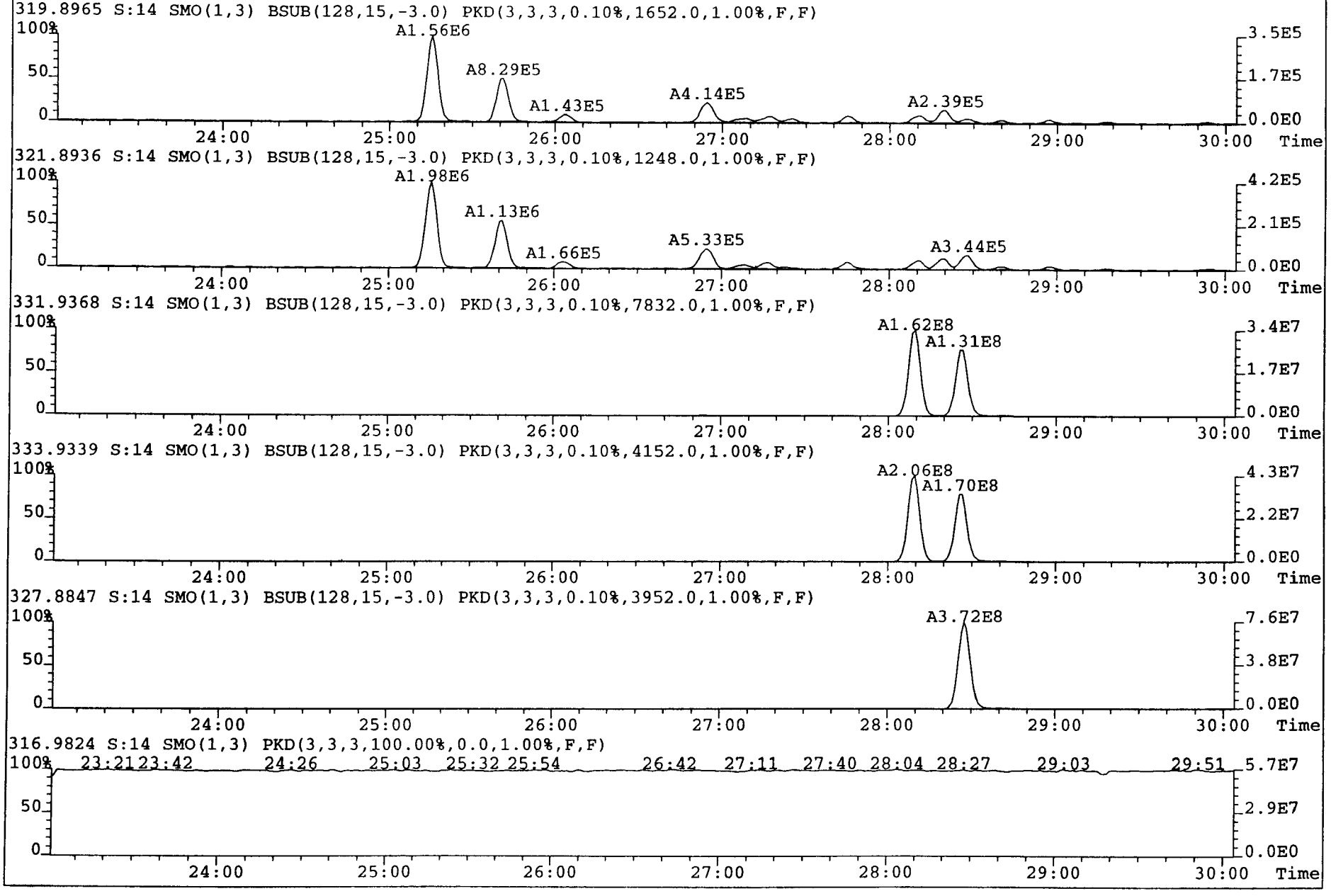
Ent: 46 Name: Total Hepta-Dioxins F:4 Mass: 423.777 425.774 Mod? no #Hom:3

Run: 19 File: a17jul98b S:14 Acq:18-JUL-98 02:32:07 Proc:20-JUL-98 09:09:09
Tables: Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

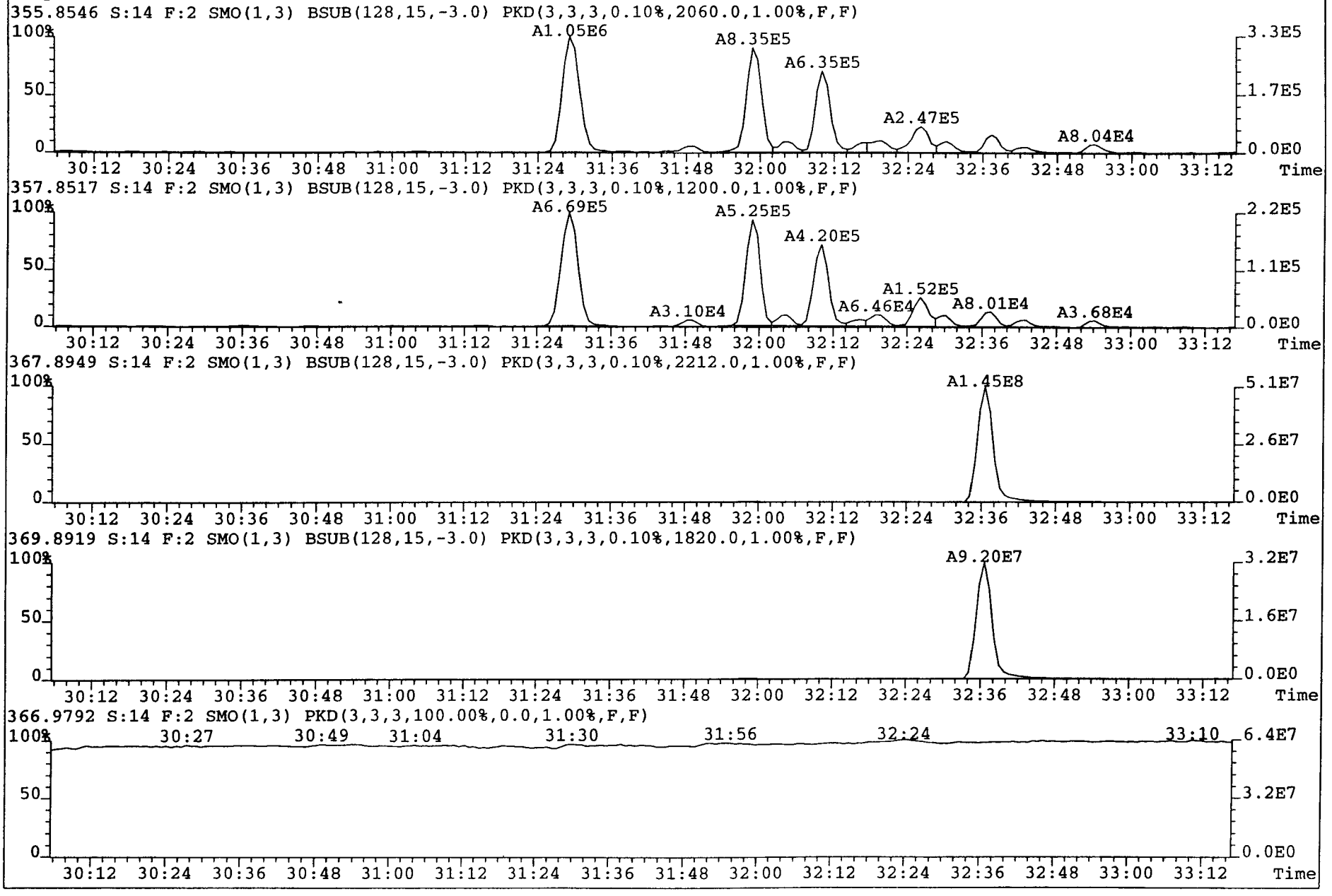
Amount: 0.96 of which 0.52 named and 0.44 unnamed
Conc: 0.96 of which 0.52 named and 0.44 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	36:21	3.7e+04	3.10 n	0.02					
			3.7e+04			2.8e+04	9.1e+03	4.0e+00	y	n
						9.1e+03	2.0e+03	2.6e+00	n	n
	2	36:35	7.5e+05	0.98 y	0.42					
			7.5e+05			3.7e+05	1.1e+05	4.8e+01	y	n
						3.8e+05	1.1e+05	1.5e+02	y	n
1,2,3,4,6,7,8-HpCDD3		37:10	9.3e+05	0.98 y	0.52					
			9.3e+05			4.6e+05	1.3e+05	5.5e+01	y	n
						4.7e+05	1.3e+05	1.6e+02	y	n

File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14



File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14



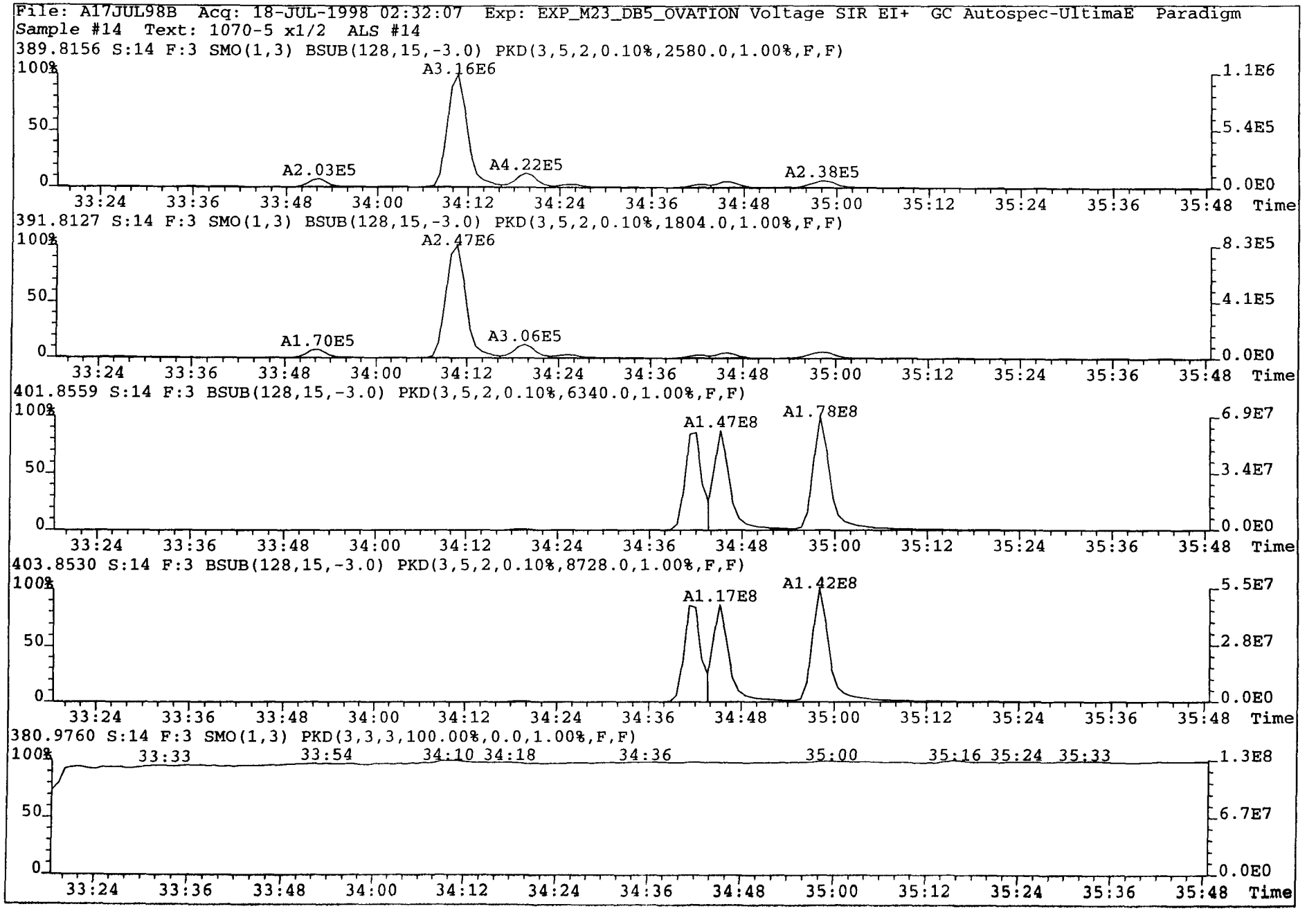
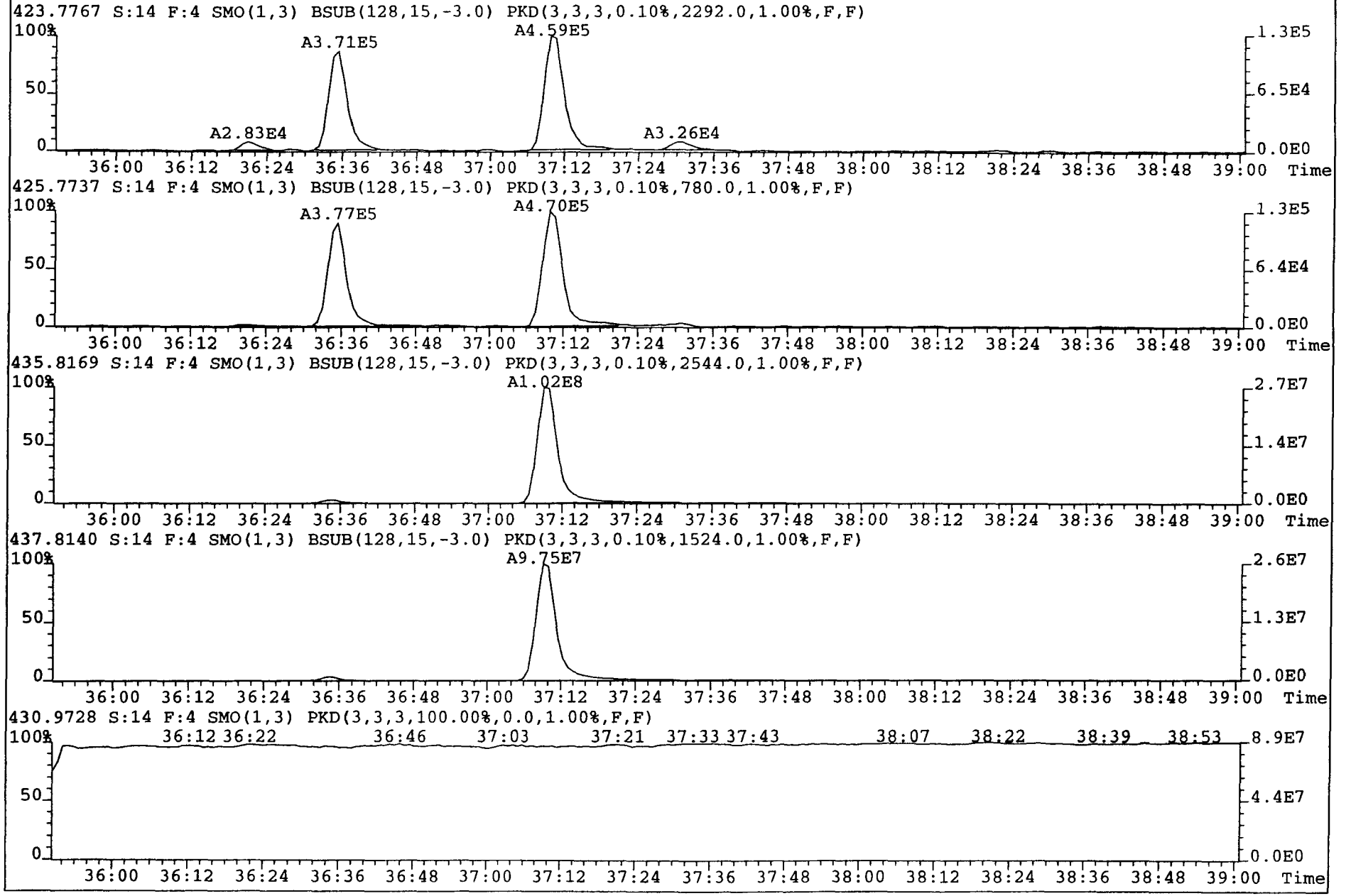
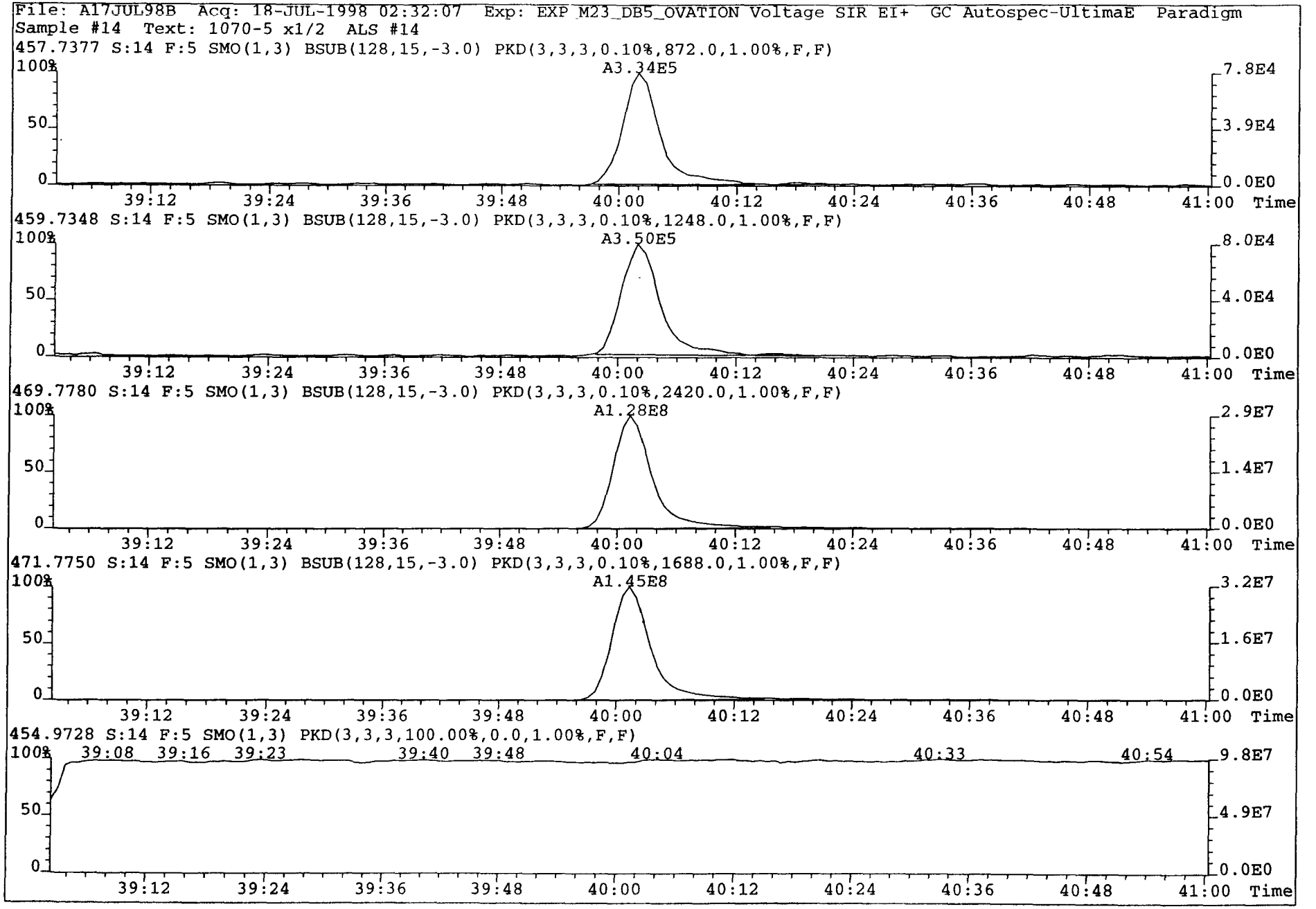

File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14
389.8156 S:14 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,2580.0,1.00%,F,F)
A3.16E6
A2.03E5
A4.22E5
A2.38E5
391.8127 S:14 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,1804.0,1.00%,F,F)
A2.47E6
A1.70E5
A3.06E5
401.8559 S:14 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,6340.0,1.00%,F,F)
A1.47E8
A1.78E8
403.8530 S:14 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,8728.0,1.00%,F,F)
A1.17E8
A1.42E8
380.9760 S:14 F:3 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
33:33 33:54 34:10 34:18 34:36 35:00 35:16 35:24 35:33
100%
50
0
1.1E6
5.4E5
0.0E0
8.3E5
4.1E5
6.9E7
3.4E7
5.5E7
2.8E7
1.3E8
6.7E7
33:24 33:36 33:48 34:00 34:12 34:24 34:36 34:48 35:00 35:12 35:24 35:36 35:48 Time

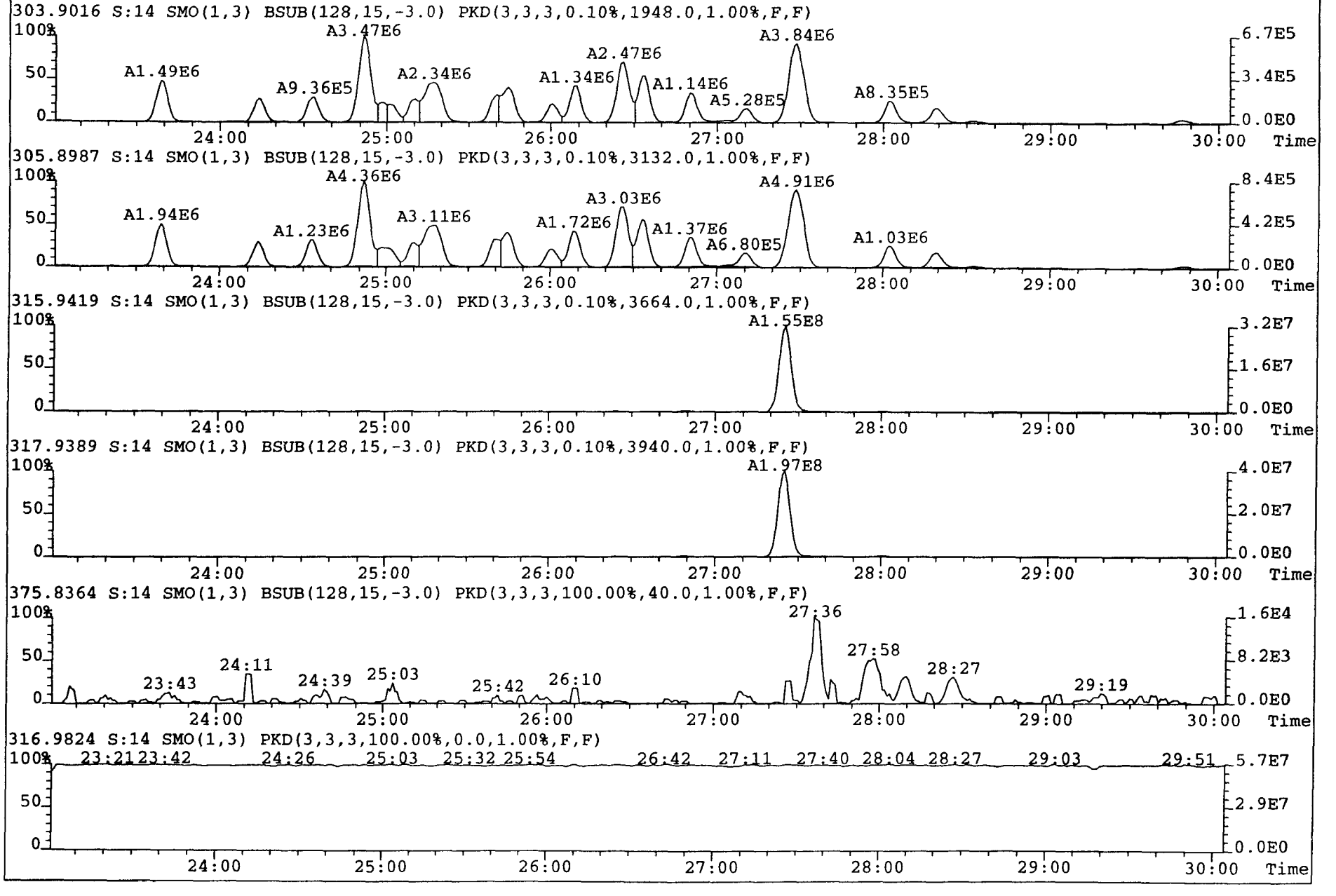
Fig. 144

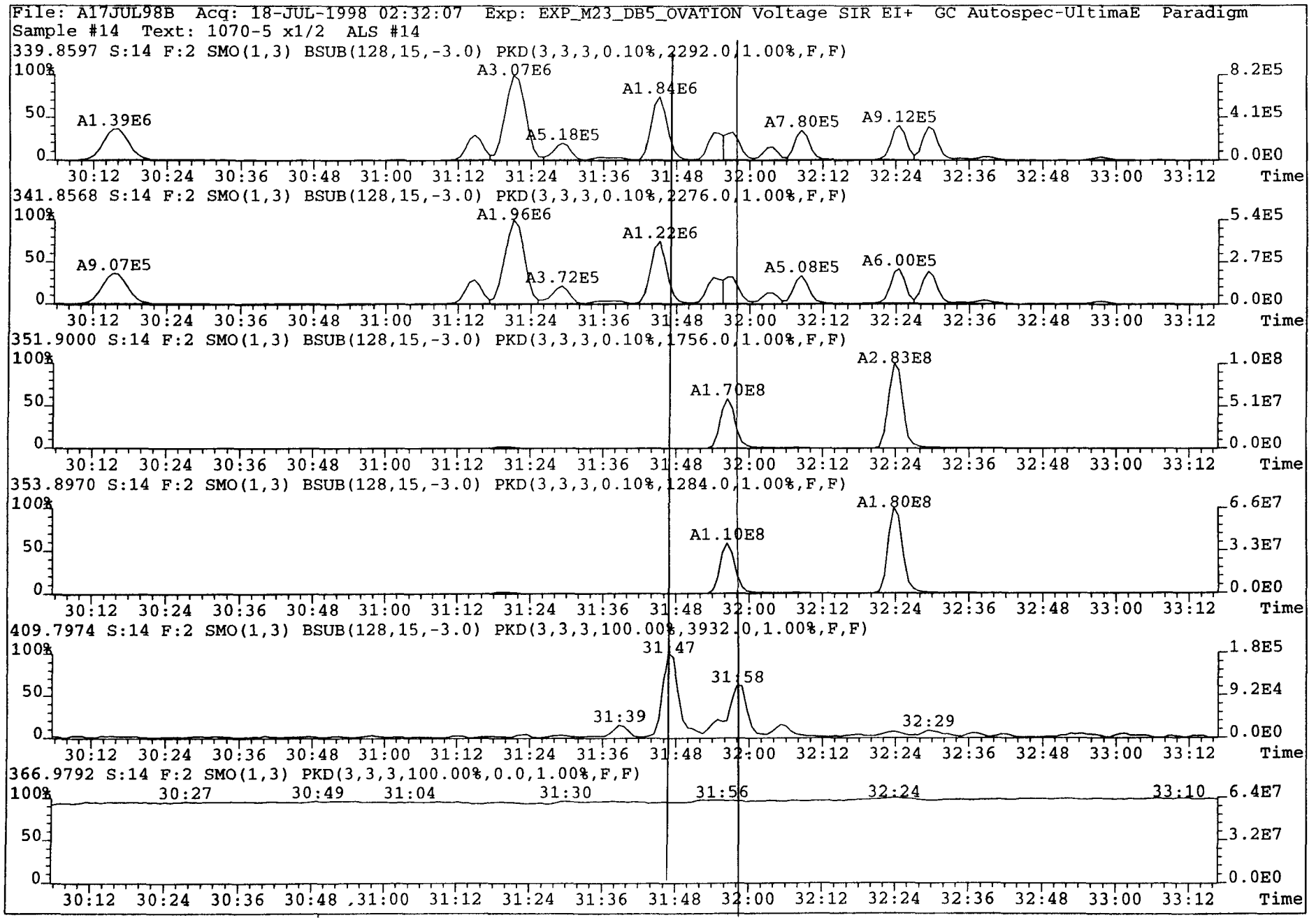
File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14

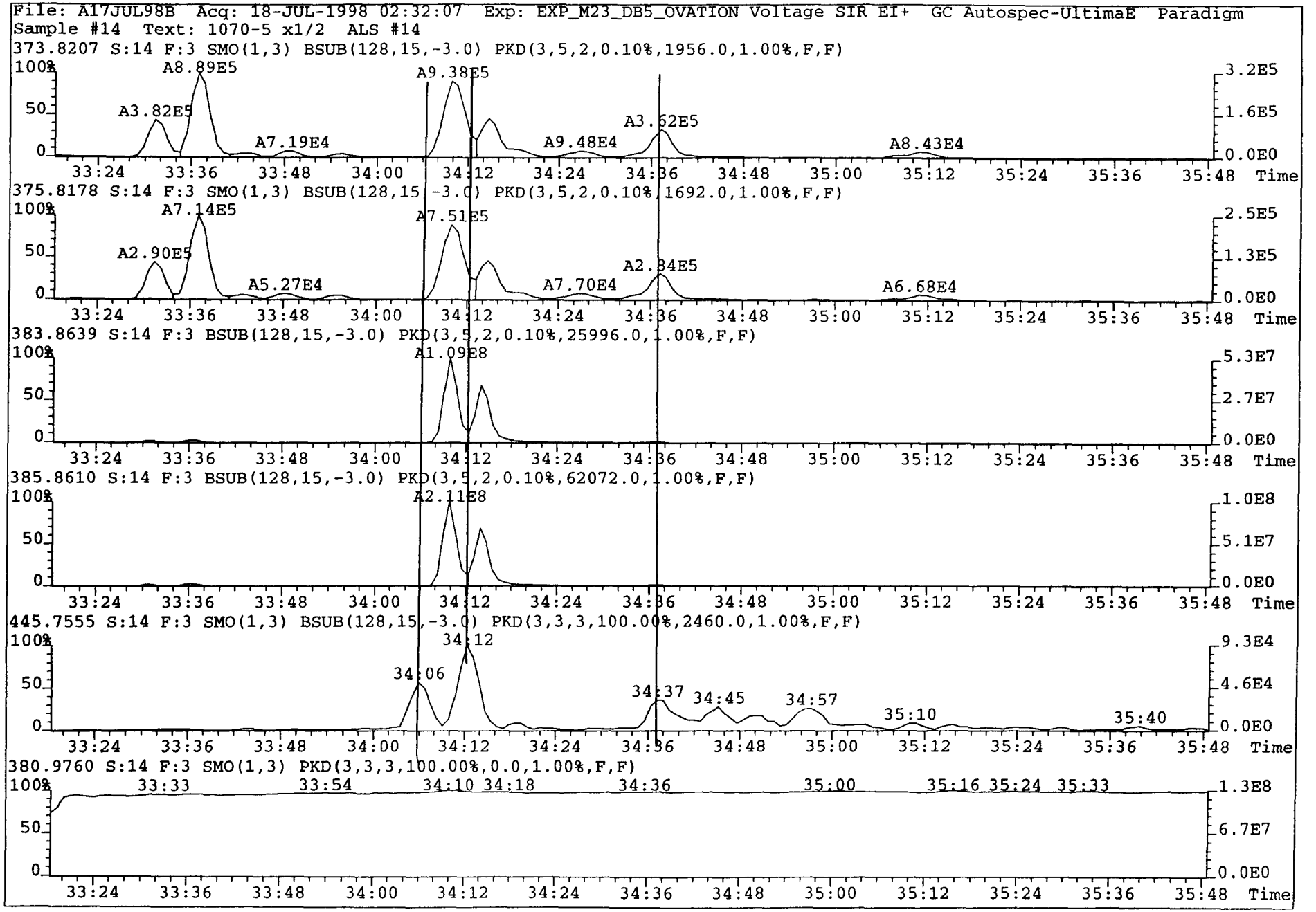



File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14
457.7377 S:14 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,872.0,1.00%,F,F)
A3.34E5
7.8E4
3.9E4
0.0E0
459.7348 S:14 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1248.0,1.00%,F,F)
A3.50E5
8.0E4
4.0E4
0.0E0
469.7780 S:14 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2420.0,1.00%,F,F)
A1.28E8
2.9E7
1.4E7
0.0E0
471.7750 S:14 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1688.0,1.00%,F,F)
A1.45E8
3.2E7
1.6E7
0.0E0
454.9728 S:14 F:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
39:08 39:16 39:23 39:40 39:48 40:04 40:33 40:54
9.8E7
4.9E7
0.0E0
100%
50
0
39:12 39:24 39:36 39:48 40:00 40:12 40:24 40:36 40:48 41:00 Time

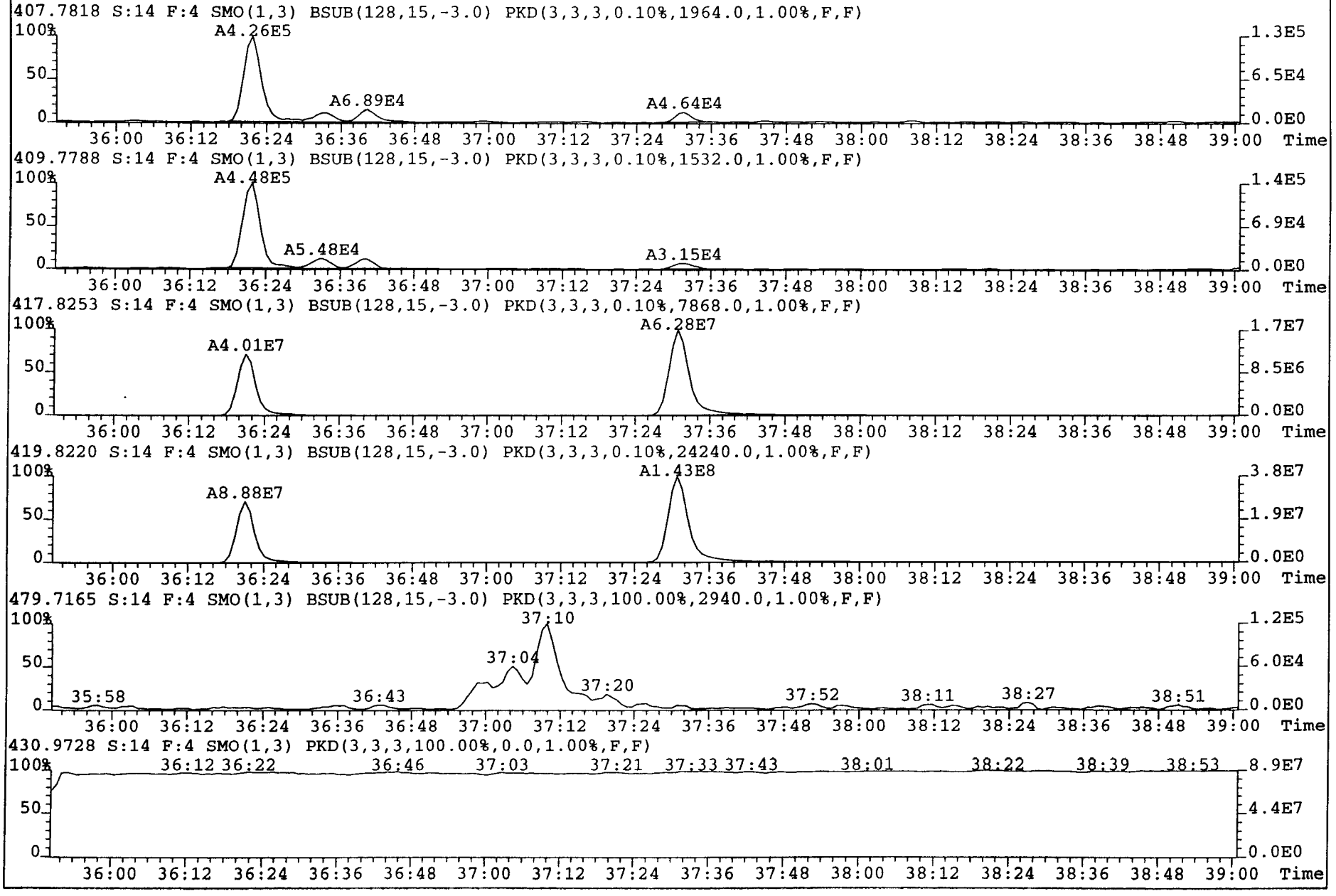
File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14



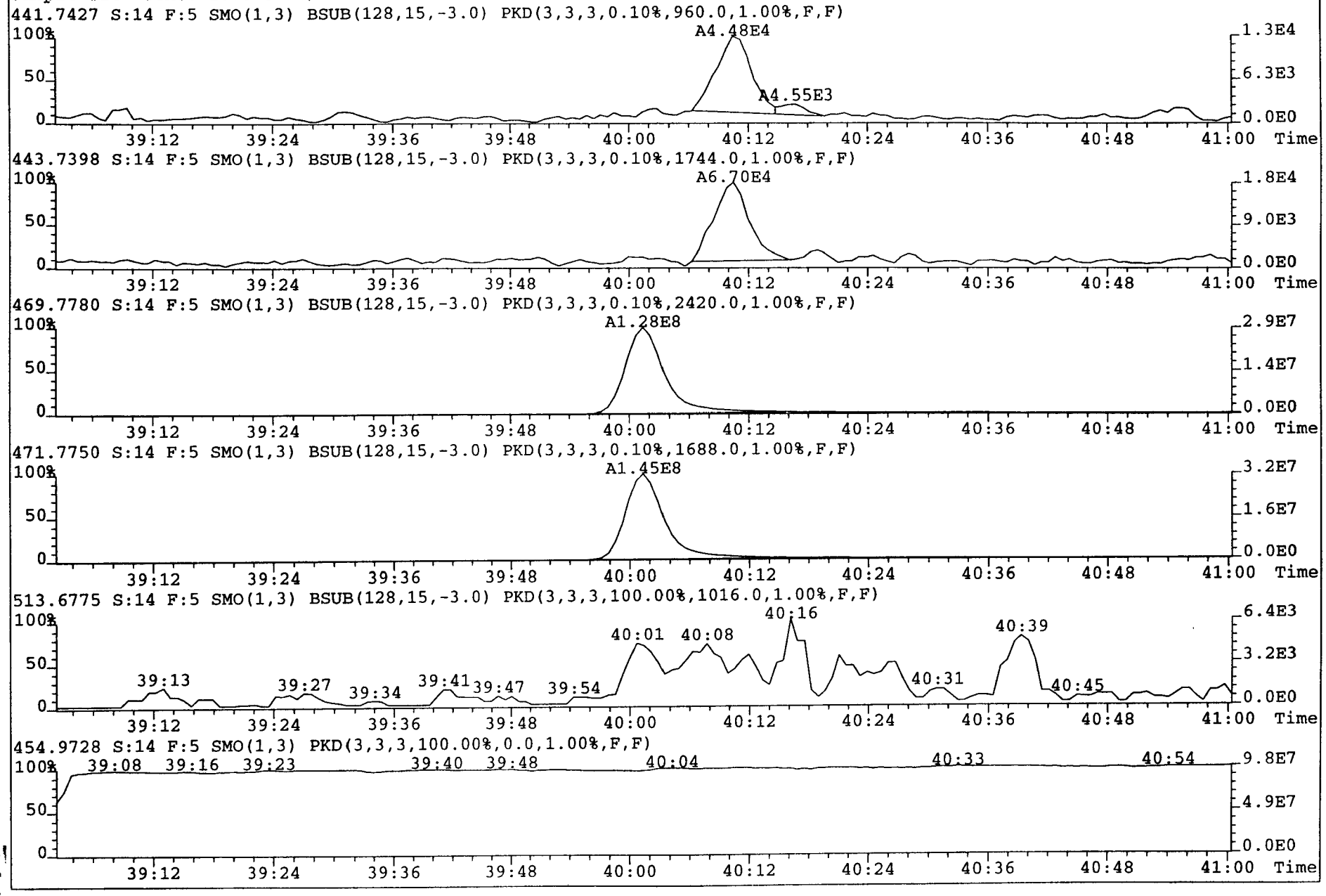

File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14
339.8597 S:14 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2292.0,1.00%,F,F)
A1.39E6
A3.07E6
A5.18E5
A1.84E6
A7.80E5
A9.12E5
8.2E5
4.1E5
0.0E0
341.8568 S:14 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2276.0,1.00%,F,F)
A9.07E5
A1.96E6
A3.72E5
A1.22E6
A5.08E5
A6.00E5
5.4E5
2.7E5
0.0E0
351.9000 S:14 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1756.0,1.00%,F,F)
A1.70E8
A2.83E8
1.0E8
5.1E7
0.0E0
353.8970 S:14 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1284.0,1.00%,F,F)
A1.10E8
A1.80E8
6.6E7
3.3E7
0.0E0
409.7974 S:14 F:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,3932.0,1.00%,F,F)
31:39
31:47
31:58
32:29
1.8E5
9.2E4
0.0E0
366.9792 S:14 F:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
30:27
30:49
31:04
31:30
31:56
32:24
33:10
6.4E7
3.2E7
0.0E0
100%
50
0
30:12 30:24 30:36 30:48 31:00 31:12 31:24 31:36 31:48 32:00 32:12 32:24 32:36 32:48 33:00 33:12
Time


File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14
373.8207 S:14 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,1956.0,1.00%,F,F)
A8.89E5
A9.38E5
A3.82E5
A3.62E5
A7.19E4
A9.48E4
A8.43E4
375.8178 S:14 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,5,2,0.10%,1692.0,1.00%,F,F)
A7.14E5
A7.51E5
A2.90E5
A2.84E5
A5.27E4
A7.70E4
A6.68E4
383.8639 S:14 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,25996.0,1.00%,F,F)
A1.09E8
385.8610 S:14 F:3 BSUB(128,15,-3.0) PKD(3,5,2,0.10%,62072.0,1.00%,F,F)
A2.11E8
445.7555 S:14 F:3 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,2460.0,1.00%,F,F)
34:12
34:06
34:37
34:45
34:57
35:10
35:40
380.9760 S:14 F:3 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
33:33
33:54
34:10 34:18
34:36
35:00
35:16 35:24 35:33
100%
50
0
3.2E5
1.6E5
0.0E0
2.5E5
1.3E5
5.3E7
2.7E7
1.0E8
5.1E7
9.3E4
4.6E4
1.3E8
6.7E7
33:24 33:36 33:48 34:00 34:12 34:24 34:36 34:48 35:00 35:12 35:24 35:36 35:48 Time

File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14



File: A17JUL98B Acq: 18-JUL-1998 02:32:07 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #14 Text: 1070-5 x1/2 ALS #14



```
        Filename ; a21jul98f
          Sample ; 6
        Acquired ; 21-JUL-98  23:12:05
       Processed ; 22-JUL-98  08:32:29
       Sample ID ; 1070-5 x1/2
       Cal Table ; 07feb-m23conf
   Results Table ; M8290-23-072198F
        Comments ;
Typ  ;                  Name;     Resp;    Ion 1;    Ion 2;   RA;?;    RT;      Conc;      DL;    S/N1;?;    S/N2;? ; mod?
Unk  ;           2,3,7,8-TCDF; 3.73e+06; 1.67e+06; 2.06e+06; 0.81;y; 27:56;     0.459;  0.0259;      94;y;      45;y ;   no
ES/RT;       13C-2,3,7,8-TCDF; 8.56e+08; 3.75e+08; 4.81e+08; 0.78;y; 27:53;   209.890;       -;    1215;y;    1959;y ;   no
Total;           Tetra Furans; 1.30e+08; 3.54e+06; 4.59e+06; 0.77;y; 18:11;    15.967;  0.0259;     315;y;     165;y ;   no
DPE  ;                 HxCDPE;        *;        *                  ;NotFnd;         *;       -;       *;n            ;   no
LMC  ;     QC CHK ION (Tetra);        *;        *                  ;NotFnd;         *;       -;    Div0;n            ;   no

                                                  ;        -;    -;-; 27:56

                                                  ;        -;    -;-; 27:56                                ;       -; -;   no
```

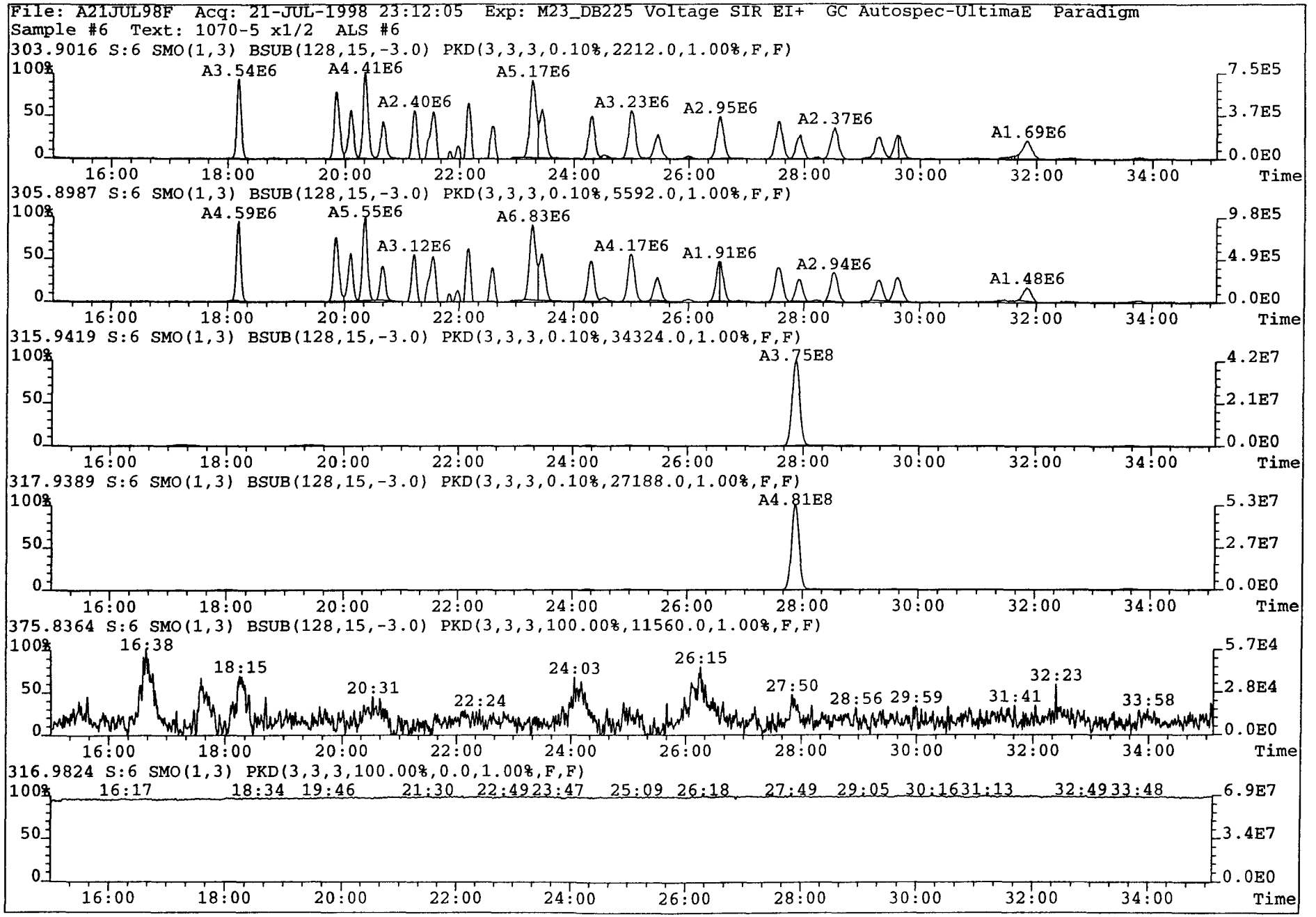
Ent: 3 Name: Tetra Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:28

Run: 11 File: a21jul98f S:6 Acq:21-JUL-98 23:12:05 Proc:22-JUL-98 08:32:29
Tables: Run: a21jul98b Analyte: m23_conf Cal: 07feb-m23»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: 1070-5 x1/2

Amount: 15.97 of which 0.46 named and 15.51 unnamed
Conc: 15.97 of which 0.46 named and 15.51 unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?
	1	18:11	8.1e+06	0.77 y	1.00				
			8.1e+06			3.5e+06	7.0e+05	3.1e+02	y n
						4.6e+06	9.2e+05	1.6e+02	y n
	2	18:20	1.9e+04	1.95 n	0.00				
			1.9e+04			1.3e+04	5.8e+03	2.6e+00	n n
						6.6e+03	3.8e+03	6.9e-01	n n
	3	19:51	7.6e+06	0.78 y	0.94				
			7.6e+06			3.3e+06	5.8e+05	2.6e+02	y n
						4.3e+06	7.4e+05	1.3e+02	y n
	4	20:06	5.9e+06	0.81 y	0.72				
			5.9e+06			2.6e+06	4.2e+05	1.9e+02	y n
						3.2e+06	5.5e+05	9.8e+01	y n
	5	20:21	1.0e+07	0.79 y	1.22				
			1.0e+07			4.4e+06	7.4e+05	3.4e+02	y n
						5.6e+06	9.7e+05	1.7e+02	y n
	6	20:39	4.5e+06	0.84 y	0.55				
			4.5e+06			2.0e+06	3.2e+05	1.4e+02	y n
						2.4e+06	3.9e+05	7.0e+01	y n
	7	21:12	5.4e+06	0.79 y	0.67				
			5.4e+06			2.4e+06	4.2e+05	1.9e+02	y n
						3.0e+06	5.4e+05	9.6e+01	y n
	8	21:32	6.8e+06	0.78 y	0.83				
			6.8e+06			3.0e+06	4.1e+05	1.8e+02	y n
						3.8e+06	5.2e+05	9.3e+01	y n
	9	21:49	5.0e+05	0.70 y	0.06				
			5.0e+05			2.0e+05	6.4e+04	2.9e+01	y n
						2.9e+05	9.0e+04	1.6e+01	y n
	10	21:58	9.3e+05	0.84 y	0.11				
			9.3e+05			4.2e+05	1.1e+05	5.0e+01	y n
						5.1e+05	1.3e+05	2.3e+01	y n
	11	22:09	6.0e+06	0.79 y	0.74				
			6.0e+06			2.6e+06	4.8e+05	2.2e+02	y n
						3.3e+06	6.1e+05	1.1e+02	y n
	12	22:34	3.8e+06	0.77 y	0.47				
			3.8e+06			1.7e+06	2.8e+05	1.3e+02	y n
						2.2e+06	3.9e+05	6.9e+01	y n
	13	23:17	1.2e+07	0.76 y	1.47				
			1.2e+07			5.2e+06	6.7e+05	3.0e+02	y n
						6.8e+06	8.7e+05	1.6e+02	y n
	14	23:27	6.6e+06	0.82 y	0.81				
			6.6e+06			3.0e+06	4.2e+05	1.9e+02	y n
						3.6e+06	5.4e+05	9.6e+01	y n
	15	24:19	6.2e+06	0.78 y	0.76				
			6.2e+06			2.7e+06	3.7e+05	1.7e+02	y n
						3.5e+06	4.6e+05	8.3e+01	y n
	16	24:31	4.2e+05	0.47 n	0.05				
			4.2e+05			1.3e+05	3.2e+04	1.5e+01	y n
						2.9e+05	4.4e+04	7.8e+00	y n
	17	25:00	7.4e+06	0.77 y	0.91				
			7.4e+06			3.2e+06	4.1e+05	1.9e+02	y n
						4.2e+06	5.4e+05	9.7e+01	y n
	18	25:27	3.7e+06	0.81 y	0.46				
			3.7e+06			1.7e+06	2.1e+05	9.4e+01	y n
						2.1e+06	2.6e+05	4.7e+01	y n
	19	26:33	4.9e+06	1.54 n	0.60				
			4.9e+06			2.9e+06	3.6e+05	1.6e+02	y n
						1.9e+06	4.5e+05	8.1e+01	y n

```
                    20 27:33 6.2e+06  0.78 y    0.76
                             6.2e+06                2.7e+06 3.2e+05 1.5e+02 y  n
                                                    3.5e+06 3.9e+05 7.0e+01 y  n
2,3,7,8-TCDF        21 27:56 3.7e+06  0.81 y    0.46
                             3.7e+06                1.7e+06 2.1e+05 9.4e+01 y  n
                                                    2.1e+06 2.5e+05 4.5e+01 y  n
                    22 28:14 5.2e+04  2.15 n    0.01
                             5.2e+04                3.5e+04 1.3e+04 6.0e+00 y  n
                                                    1.7e+04 9.1e+03 1.6e+00 n  n
                    23 28:32 5.3e+06  0.81 y    0.65
                             5.3e+06                2.4e+06 2.7e+05 1.2e+02 y  n
                                                    2.9e+06 3.3e+05 5.9e+01 y  n
                    24 29:17 3.8e+06  0.87 y    0.47
                             3.8e+06                1.8e+06 1.9e+05 8.5e+01 y  n
                                                    2.0e+06 2.3e+05 4.2e+01 y  n
                    25 29:36 3.5e+06  0.40 n    0.43
                             3.5e+06                9.9e+05 2.0e+05 9.2e+01 y  n
                                                    2.5e+06 2.7e+05 4.9e+01 y  n
                    26 29:38 3.4e+06  0.35 n    0.41
                             3.4e+06                8.7e+05 1.9e+05 8.6e+01 y  n
                                                    2.5e+06 2.7e+05 4.9e+01 y  n
                    27 31:24 4.4e+04  7.94 n    0.01
                             4.4e+04                3.9e+04 1.1e+04 5.1e+00 y  n
                                                    4.9e+03 4.7e+03 8.4e-01 n  n
                    28 31:51 3.2e+06  1.15 n    0.39
                             3.2e+06                1.7e+06 1.6e+05 7.1e+01 y  n
                                                    1.5e+06 1.6e+05 2.8e+01 y  n
```


File: A21JUL98F Acq: 21-JUL-1998 23:12:05 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #6 Text: 1070-5 x1/2 ALS #6
303.9016 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2212.0,1.00%,F,F)
A3.54E6
A4.41E6
A2.40E6
A5.17E6
A3.23E6
A2.95E6
A2.37E6
A1.69E6
7.5E5
3.7E5
0.0E0
305.8987 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,5592.0,1.00%,F,F)
A4.59E6
A5.55E6
A3.12E6
A6.83E6
A4.17E6
A1.91E6
A2.94E6
A1.48E6
9.8E5
4.9E5
0.0E0
315.9419 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,34324.0,1.00%,F,F)
A3.75E8
4.2E7
2.1E7
0.0E0
317.9389 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,27188.0,1.00%,F,F)
A4.81E8
5.3E7
2.7E7
0.0E0
375.8364 S:6 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,11560.0,1.00%,F,F)
16:38
18:15
20:31
22:24
24:03
26:15
27:50
28:56
29:59
31:41
32:23
33:58
5.7E4
2.8E4
0.0E0
316.9824 S:6 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
16:17
18:34
19:46
21:30
22:49
23:47
25:09
26:18
27:49
29:05
30:16
31:13
32:49
33:48
6.9E7
3.4E7
0.0E0
100%
50
0
16:00
18:00
20:00
22:00
24:00
26:00
28:00
30:00
32:00
34:00
Time

Section 4

System Performance

Paradigm Analytical Labs

Section 4-1

Mass Spectrometer Performance Check

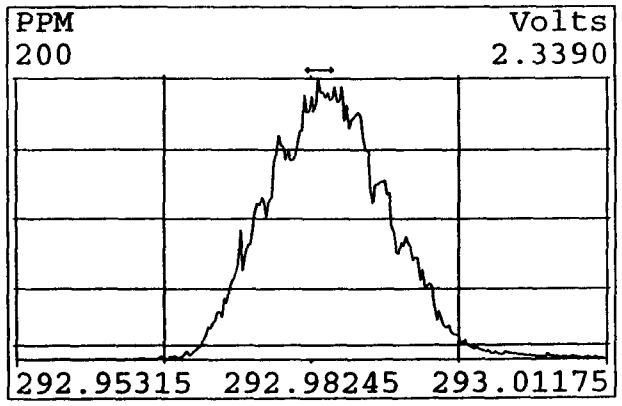
Mass Resolution

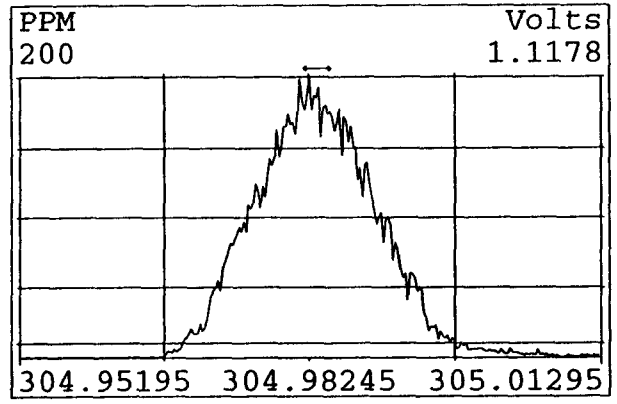
Documentation for the Analysis

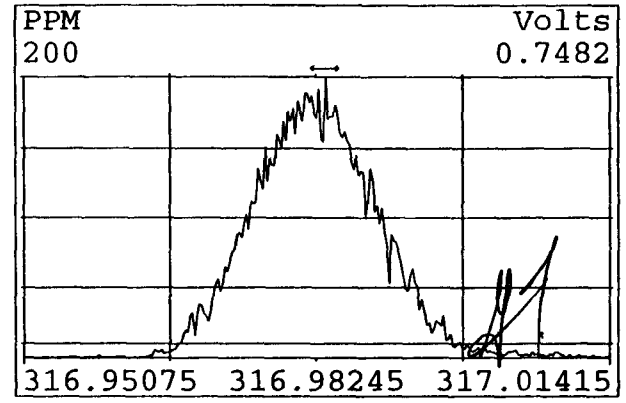
of

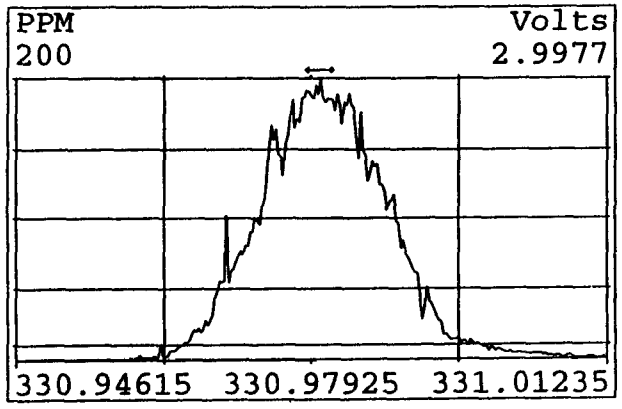
Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

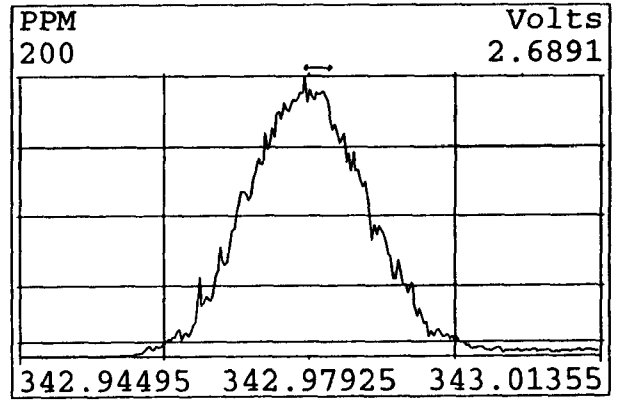
Peak Locate Examination:17-JUL-1998:16:42 File:A17JUL98B
Experiment:EXP_M23_DB5_OVATION Function:1 Reference:PFK317

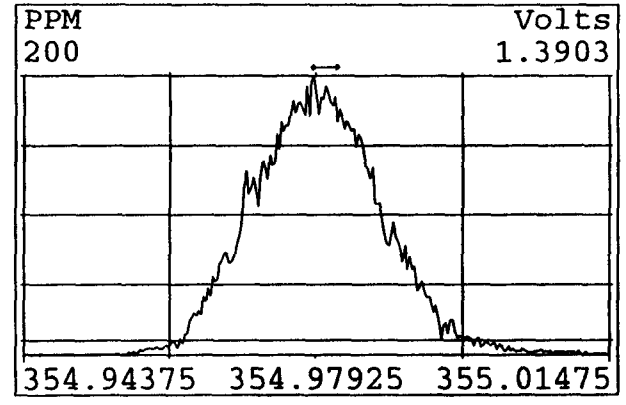


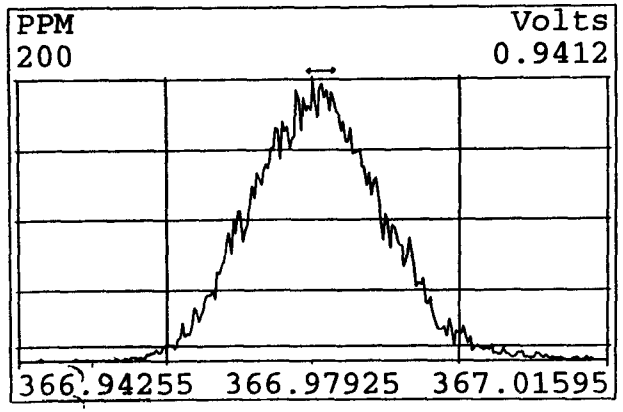


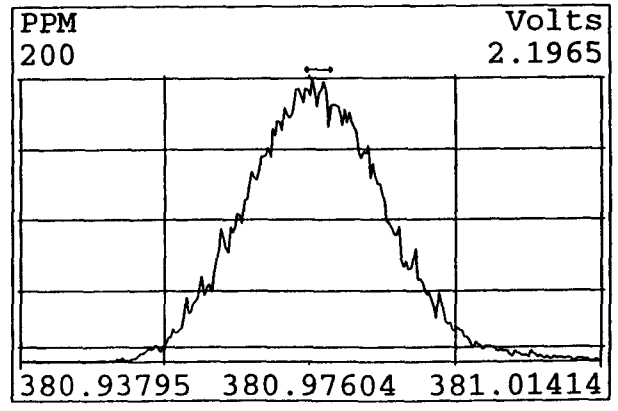




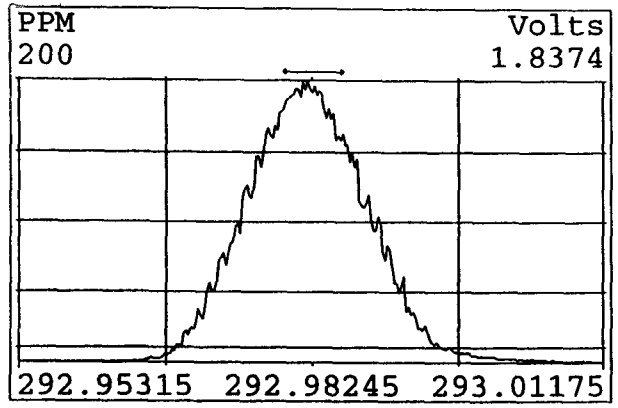


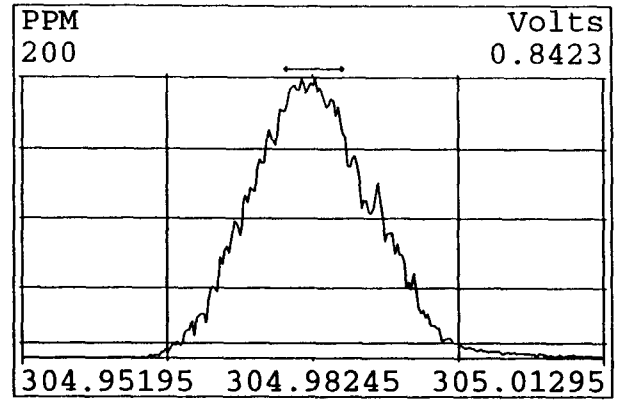


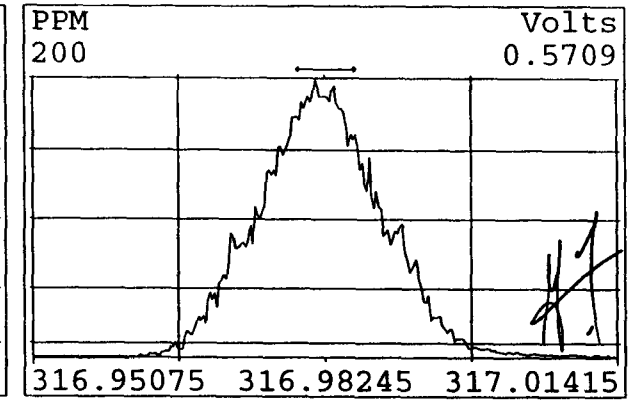


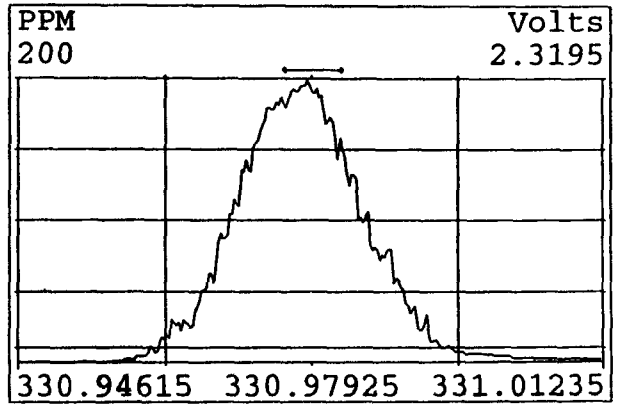


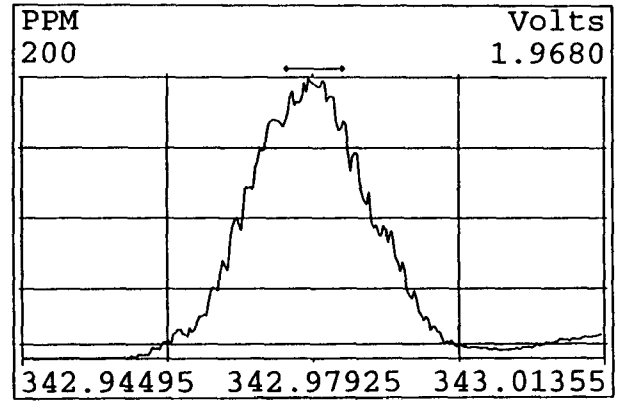
Peak Locate Examination:18-JUL-1998:04:00 File:A17JUL98B
Experiment:EXP_M23_DB5_OVATION Function:1 Reference:PFK317

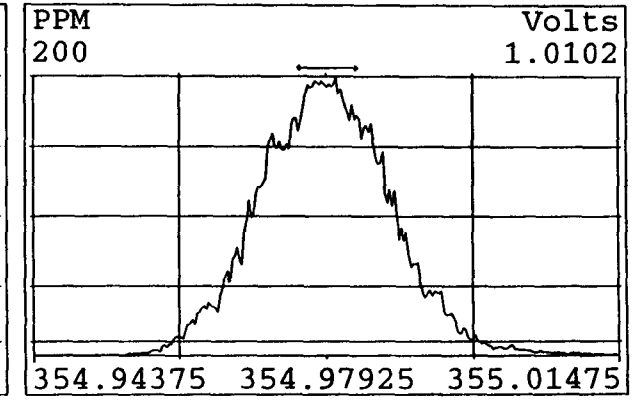


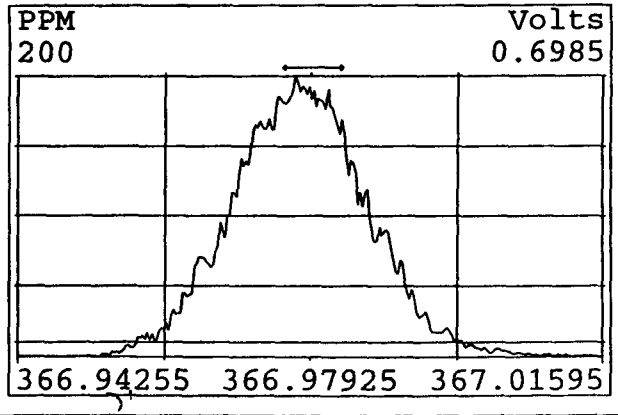


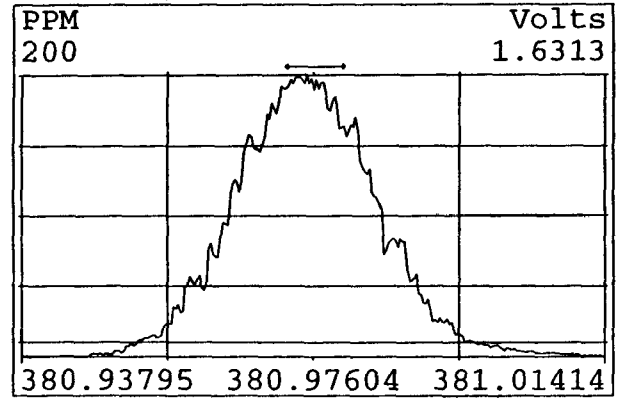




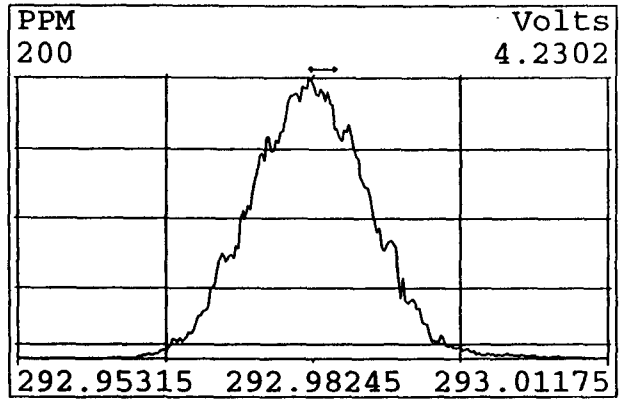


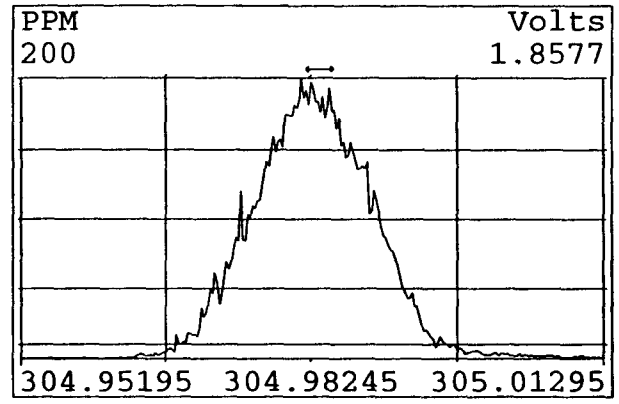


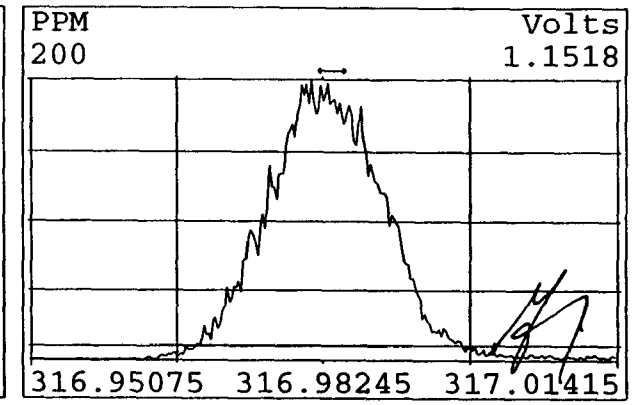


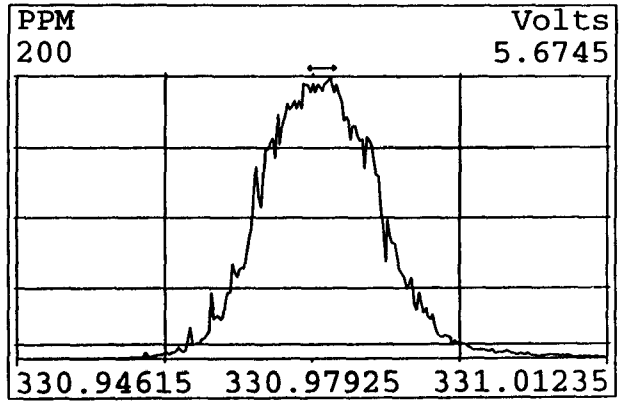


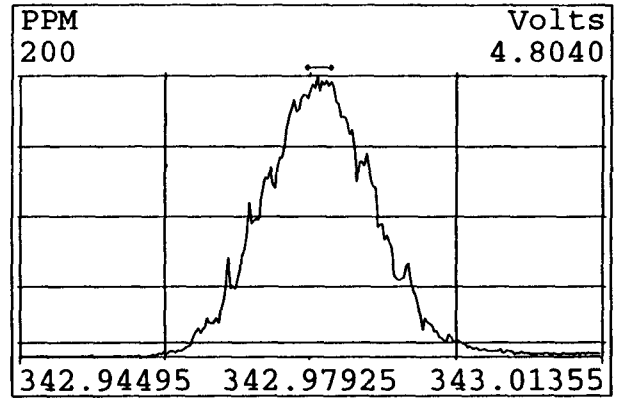
Peak Locate Examination:21-JUL-1998:20:06 File:A21JUL98F
Experiment:M23_DB225 Function:1 Reference:PFK317

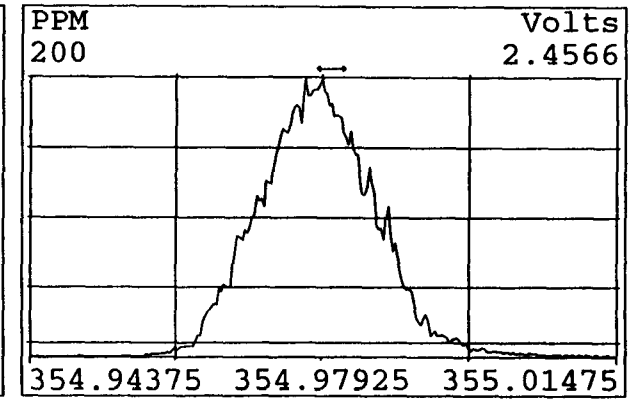


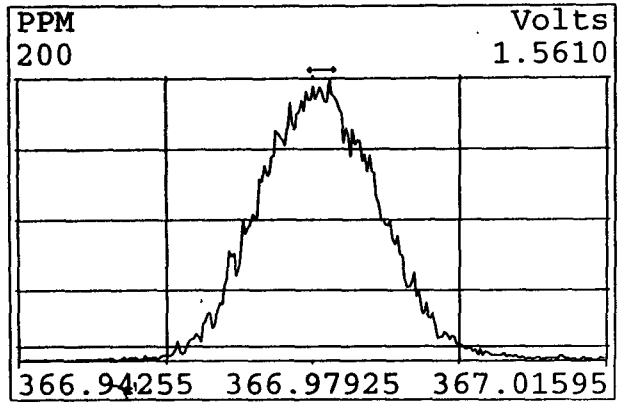


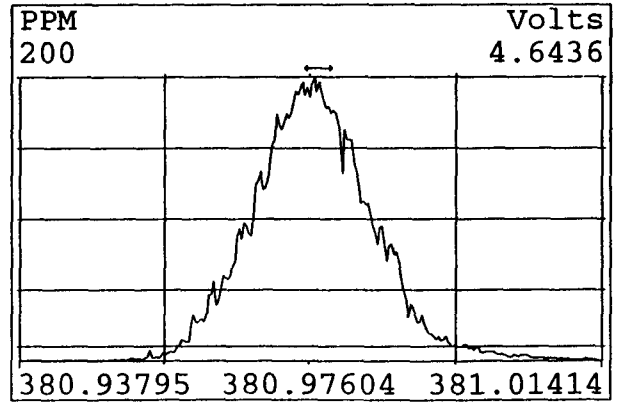




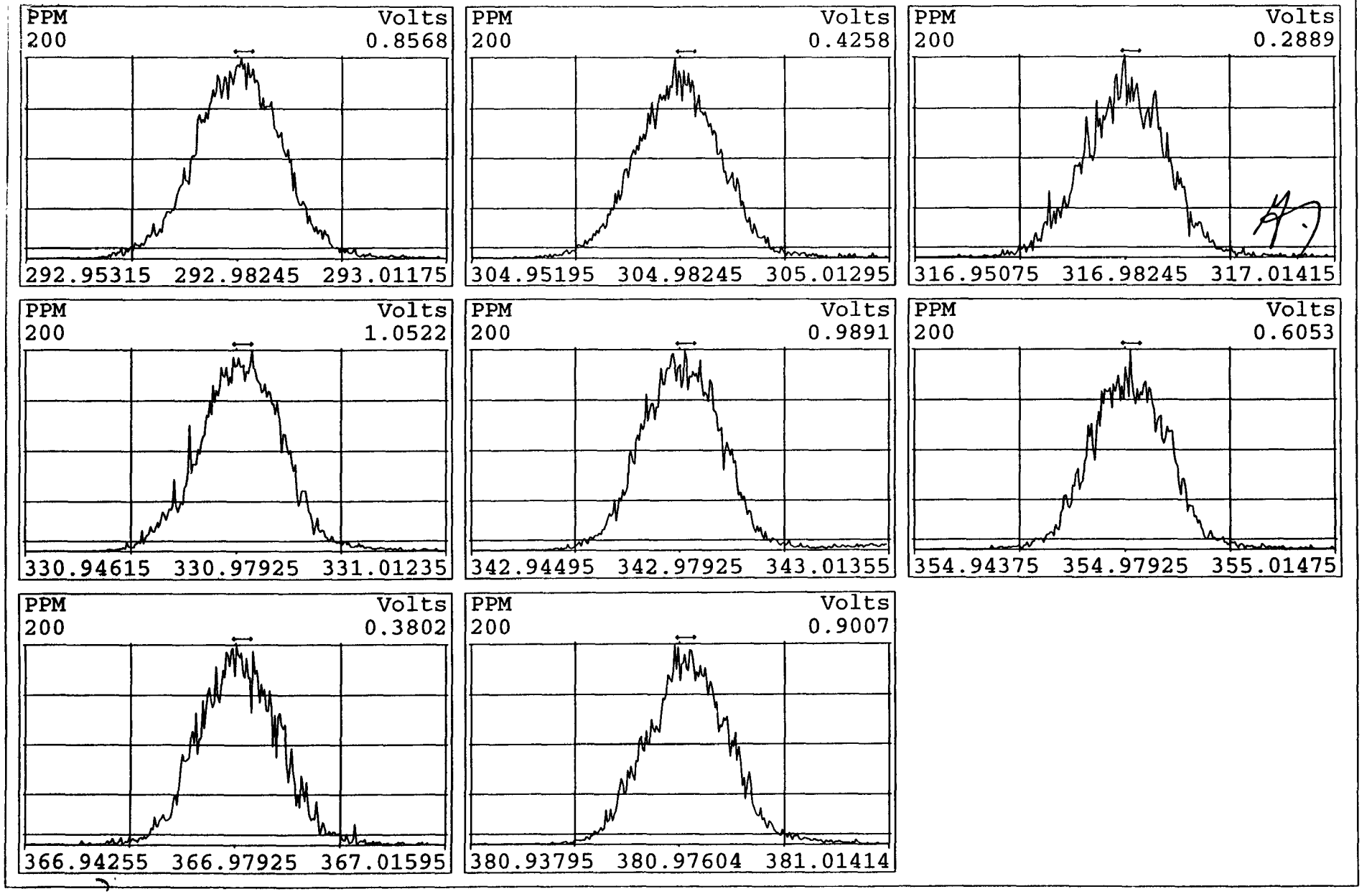








Peak Locate Examination:22-JUL-1998:08:11 File:A21JUL98S
Experiment:M23_DB225 Function:1 Reference:PFK317



Section 4

System Performance

Paradigm Analytical Labs

Section 4-2

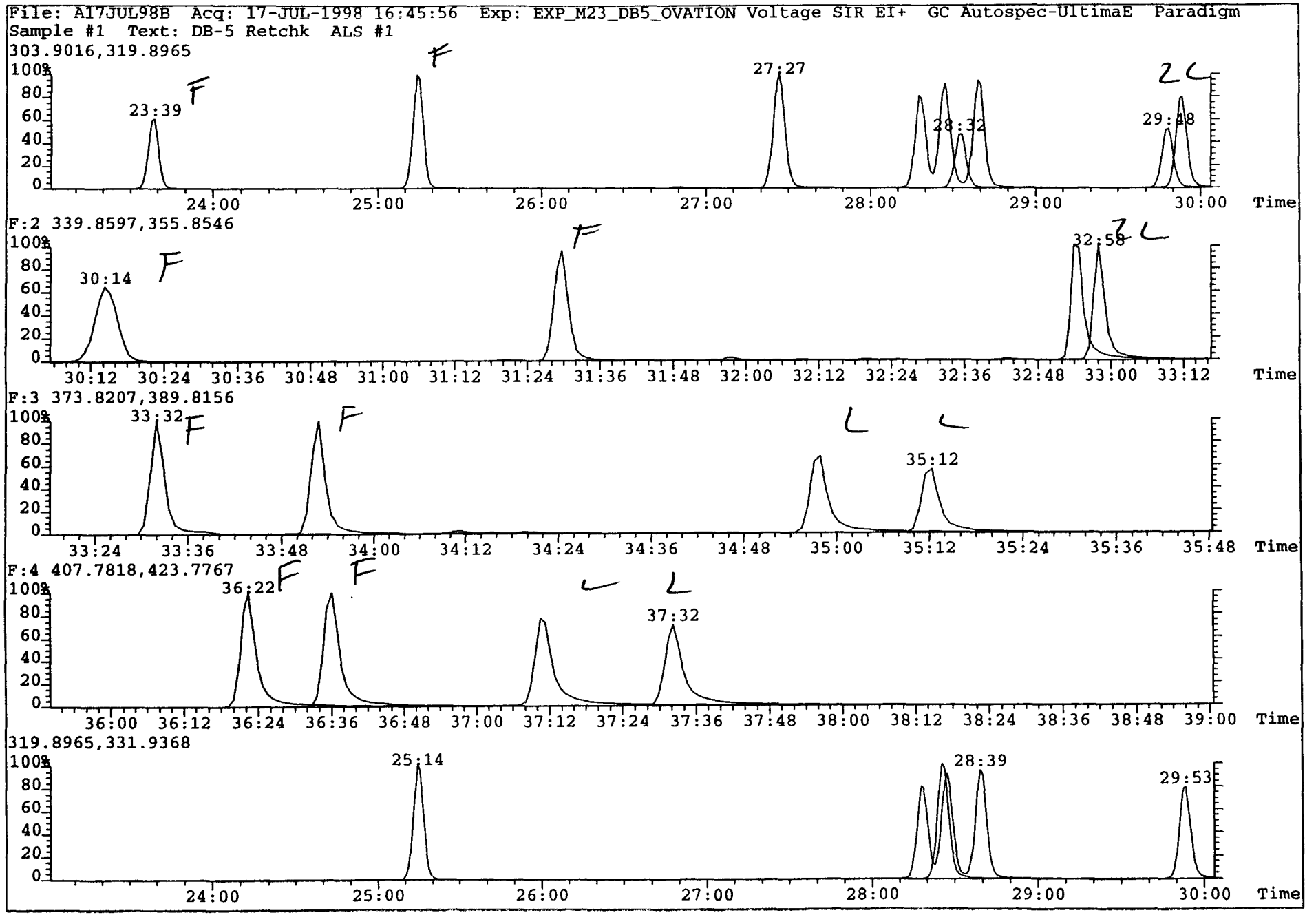
Gas Chromatography Performance Check

Isomer Specificity & Retention Time Windows

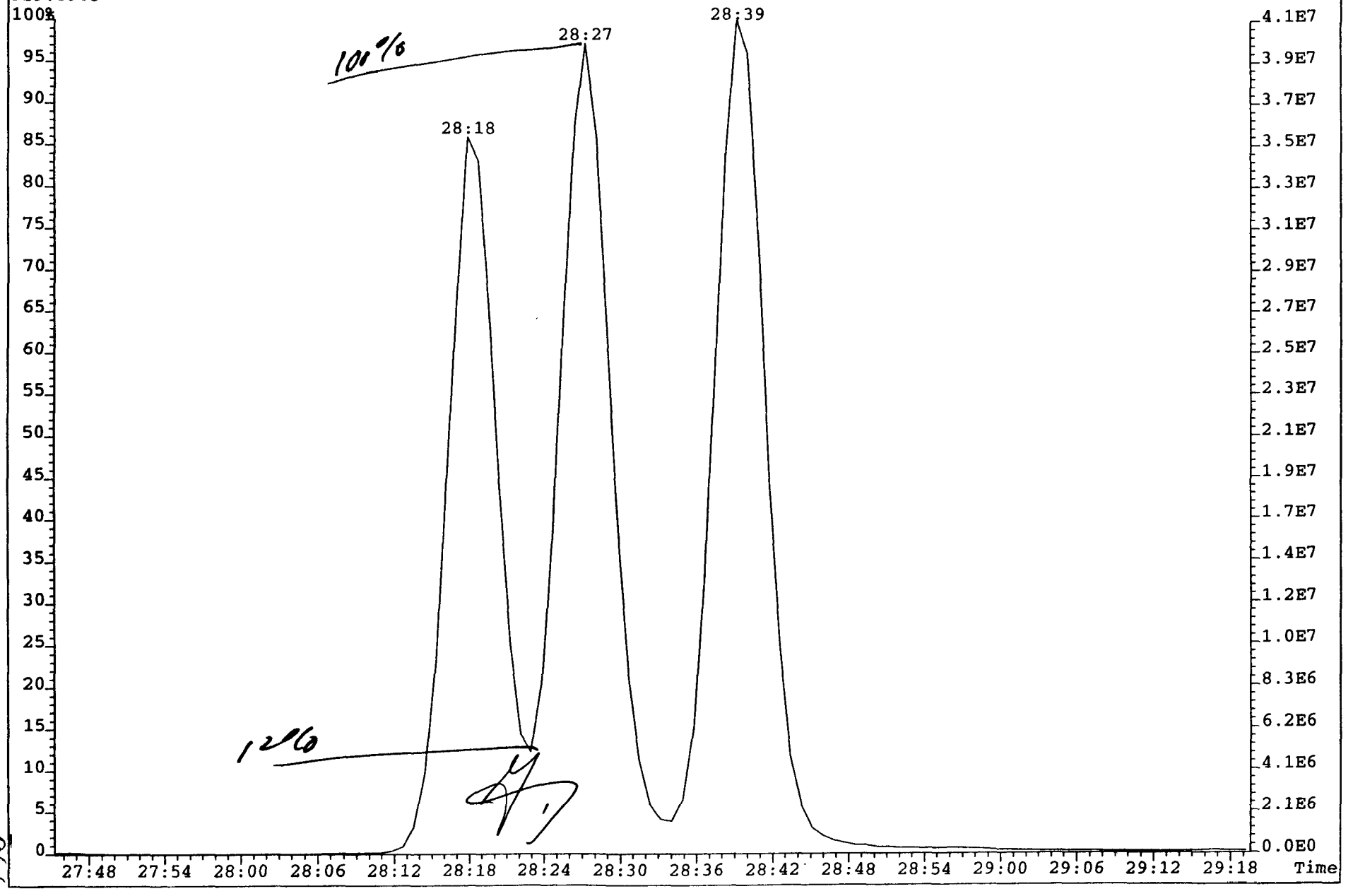
Documentation for the Analysis

of

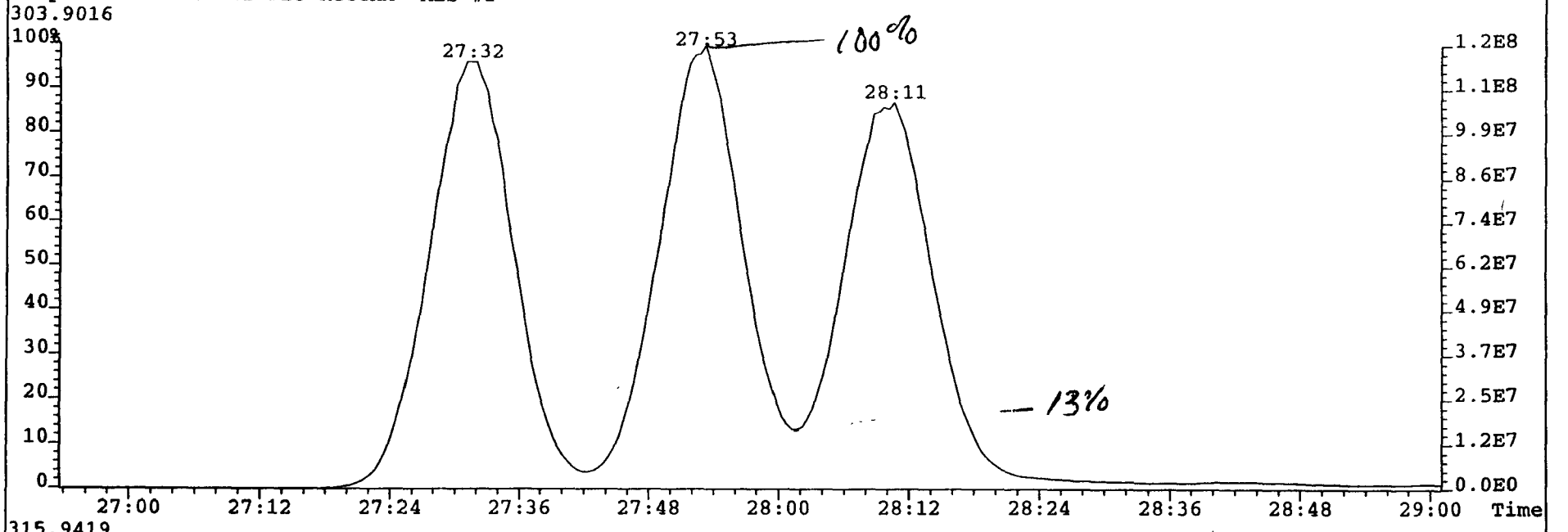
Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

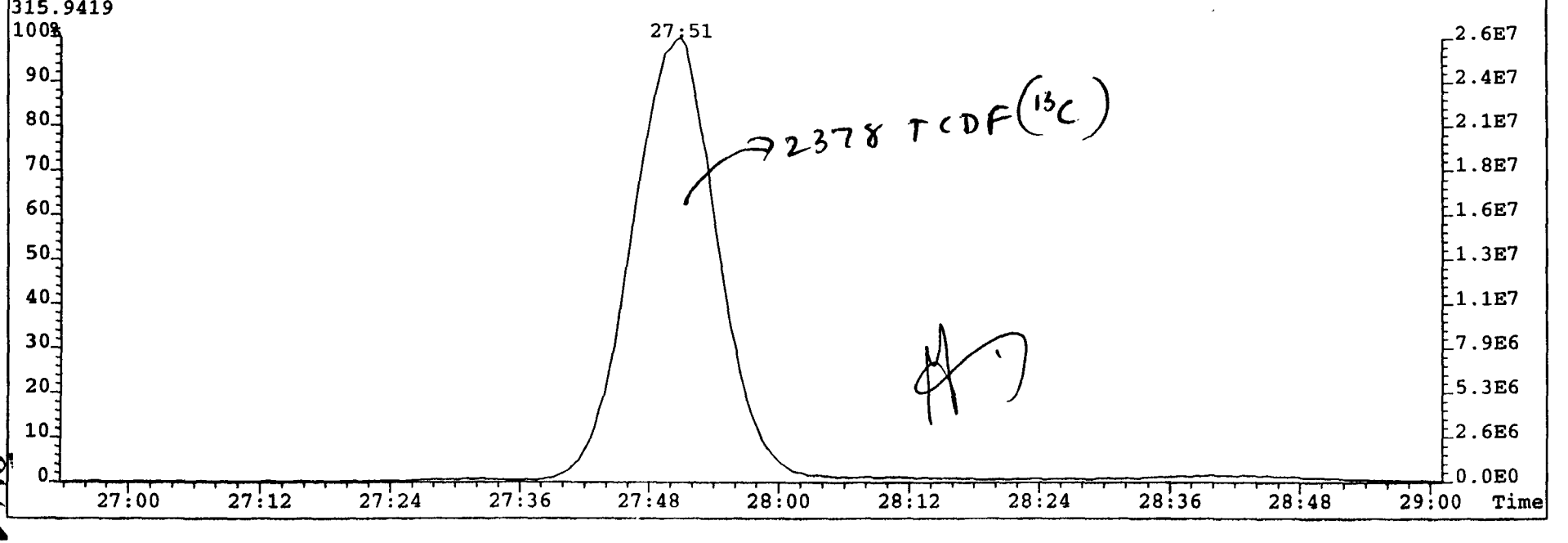

File: A17JUL98B Acq: 17-JUL-1998 16:45:56 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #1 Text: DB-5 Retchk ALS #1
303.9016,319.8965
23:39
27:27
28:32
29:48
F:2 339.8597,355.8546
30:14
32:58
F:3 373.8207,389.8156
33:32
35:12
F:4 407.7818,423.7767
36:22
37:32
319.8965,331.9368
25:14
28:39
29:53
Time

File: A17JUL98B Acq: 17-JUL-1998 16:45:56 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #1 Text: DB-5 Retchk ALS #1
319.8965



File: A21JUL98F Acq: 21-JUL-1998 20:06:58 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #1 Text: DB-225 Retchk ALS #1





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Section 4

System Performance

Paradigm Analytical Labs

Section 4-3

Initial Calibrations

(HP-5MS & DB-225 Columns)

Documentation for the Analysis

of

Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

Run: 0716crv Analyte: m8290-23-» Cal: m8290-23-» Results: Version: V3.5 17 APR-1997 11:14:34

Name	Mean RRF	S. D.	%RSD	17jul98a S3 RRF#1	SD	17jul98a S4 RRF#2	SD	17jul98a S5 RRF#3	SD	17jul98a S6 RRF#4	SD	17jul98a S7 RRF#5	SD
2,3,7,8-TCDD	0.9843	0.011	1.14 %	1.00	1.1	0.97	-1.2	0.97	-0.9	0.99	0.6	0.99	0.3
1,2,3,7,8-PeCDD	1.1157	0.016	1.46 %	1.14	1.2	1.11	-0.2	1.13	0.6	1.11	-0.2	1.09	-1.4
1,2,3,4,7,8-HxCDD	0.6718	0.023	3.35 %	0.67	-0.1	0.68	0.3	0.70	1.4	0.64	-1.4	0.67	-0.2
1,2,3,6,7,8-HxCDD	0.8518	0.119	13.96 %	0.96	0.9	0.94	0.7	0.91	0.5	0.71	-1.2	0.74	-1.0
1,2,3,7,8,9-HxCDD	0.8597	0.115	13.32 %	0.95	0.8	0.95	0.8	0.93	0.6	0.72	-1.2	0.75	-1.0
1,2,3,4,6,7,8-HpCDD	0.8965	0.011	1.21 %	0.89	-0.1	0.88	-1.6	0.90	0.2	0.90	0.7	0.91	0.9
OCDD	1.0033	0.004	0.40 %	1.00	0.1	1.00	-1.0	1.00	-1.0	1.01	1.0	1.01	0.9
2,3,7,8-TCDF	0.9531	0.008	0.86 %	0.96	1.4	0.95	-0.9	0.95	-0.5	0.96	0.7	0.95	-0.7
1,2,3,7,8-PeCDF	0.8711	0.009	1.04 %	0.87	-0.3	0.87	0.3	0.88	1.1	0.87	0.4	0.86	-1.5
2,3,4,7,8-PeCDF	0.9020	0.023	2.50 %	0.88	-0.9	0.87	-1.2	0.91	0.3	0.93	1.0	0.92	0.8
1,2,3,4,7,8-HxCDF	0.8611	0.047	5.49 %	0.87	0.1	0.89	0.6	0.92	1.2	0.83	-0.8	0.80	-1.2
1,2,3,6,7,8-HxCDF	1.0877	0.183	16.79 %	1.25	0.9	1.20	0.6	1.20	0.6	0.90	-1.0	0.88	-1.2
2,3,4,6,7,8-HxCDF	0.9347	0.129	13.85 %	1.03	0.7	1.04	0.8	1.02	0.7	0.80	-1.0	0.78	-1.2
1,2,3,7,8,9-HxCDF	0.8123	0.082	10.14 %	0.87	0.8	0.88	0.8	0.86	0.6	0.73	-1.0	0.72	-1.1
1,2,3,4,6,7,8-HpCDF	1.2600	0.040	3.15 %	1.23	-0.9	1.22	-1.0	1.25	-0.2	1.28	0.6	1.32	1.4
1,2,3,4,7,8,9-HpCDF	1.0402	0.103	9.89 %	0.93	-1.1	0.96	-0.7	1.01	-0.3	1.12	0.8	1.17	1.3
OCDF	1.0684	0.040	3.72 %	1.03	-0.8	1.02	-1.2	1.08	0.2	1.10	0.8	1.11	1.1
13C-2,3,7,8-TCDD	1.0970	0.024	2.18 %	1.07	-1.2	1.08	-0.6	1.09	-0.4	1.12	0.9	1.12	1.2
13C-1,2,3,7,8-PeCDD	0.7648	0.056	7.28 %	0.71	-1.0	0.73	-0.6	0.74	-0.5	0.81	0.9	0.83	1.3
13C-1,2,3,6,7,8-HxCDD	1.0729	0.161	14.99 %	0.95	-0.8	0.95	-0.8	0.98	-0.6	1.27	1.2	1.23	1.0
13C-1,2,3,4,6,7,8-HpCDD	0.7951	0.020	2.49 %	0.78	-0.6	0.78	-0.9	0.78	-0.6	0.82	1.0	0.82	1.2
13C-OCDD	0.6399	0.032	5.03 %	0.63	-0.4	0.61	-0.9	0.61	-0.8	0.68	1.2	0.67	1.0
13C-2,3,7,8-TCDF	1.3772	0.039	2.82 %	1.36	-0.5	1.34	-1.1	1.36	-0.6	1.42	1.1	1.42	1.1
13C-1,2,3,7,8-PeCDF	1.1987	0.086	7.14 %	1.13	-0.8	1.14	-0.6	1.14	-0.7	1.26	0.8	1.32	1.4
13C-1,2,3,6,7,8-HxCDF	1.2388	0.206	16.62 %	1.08	-0.8	1.07	-0.8	1.11	-0.6	1.45	1.0	1.48	1.2
13C-1,2,3,4,6,7,8-HpCDF	0.7529	0.010	1.36 %	0.76	0.6	0.74	-1.0	0.75	-0.4	0.77	1.4	0.75	-0.7
13C-1,2,3,4-TCDD	-	-	- %	-	-	-	-	-	-	-	-	-	-
13C-1,2,3,7,8,9-HxCDD	-	-	- %	-	-	-	-	-	-	-	-	-	-
37Cl-2,3,7,8-TCDD	1.0062	0.058	5.74 %	0.92	-1.5	0.99	-0.3	1.01	0.1	1.06	0.8	1.06	0.9
13C-2,3,4,7,8-PeCDF	1.1724	0.095	8.13 %	1.13	-0.4	1.08	-0.9	1.10	-0.8	1.26	0.9	1.29	1.2
13C-1,2,3,4,7,8-HxCDD	0.7230	0.114	15.80 %	0.64	-0.7	0.58	-1.2	0.73	0.1	0.80	0.6	0.86	1.2
13C-1,2,3,4,7,8-HxCDF	0.9654	0.104	10.79 %	0.90	-0.6	0.84	-1.2	0.95	-0.2	1.06	0.9	1.09	1.2
13C-1,2,3,4,7,8,9-HpCDF	0.5892	0.084	14.34 %	0.53	-0.8	0.49	-1.1	0.58	-0.1	0.67	1.0	0.68	1.1
37Cl-2,3,7,8-TCDD	0.9166	0.035	3.84 %	0.86	-1.7	0.91	-0.2	0.93	0.4	0.94	0.7	0.94	0.7
13C-2,3,4,7,8-PeCDF	0.9777	0.025	2.55 %	1.01	1.2	0.95	-1.3	0.96	-0.7	1.00	0.7	0.98	0.1
13C-1,2,3,4,7,8-HxCDD	0.6747	0.056	8.32 %	0.67	0.0	0.62	-1.1	0.75	1.4	0.63	-0.8	0.70	0.5
13C-1,2,3,4,7,8-HxCDF	0.7855	0.054	6.85 %	0.83	0.8	0.79	0.0	0.85	1.2	0.73	-1.0	0.73	-1.0
13C-1,2,3,4,7,8,9-HpCDF	0.7823	0.109	13.97 %	0.69	-0.8	0.66	-1.1	0.77	-0.1	0.87	0.8	0.91	1.2
Total Tetra-Furans	0.9531	0.008	0.86 %	0.96	1.4	0.95	-0.9	0.95	-0.5	0.96	0.7	0.95	-0.7
Total Tetra-Dioxins	0.9843	0.011	1.14 %	1.00	1.1	0.97	-1.2	0.97	-0.9	0.99	0.6	0.99	0.3
Total Penta-Furans	0.8866	0.012	1.31 %	0.87	-1.0	0.87	-1.0	0.90	0.7	0.90	1.2	0.89	0.2

Run: 07FEB98 Analyte: M23_CONF Cal: 225-07feb Results: Version: V3.5 17-APR-1997 11:14:34

Name	Mean RRF	S. D.	%RSD	07feb98d RRF#1	S4 SD	07feb98d RRF#2	S5 SD	07feb98d RRF#3	S6 SD	07feb98d RRF#4	S7 SD	07feb98d RRF#5	S8 SD
2,3,7,8-TCDF	0.9472	0.033	3.49 %	1.00	1.5	0.91	-1.3	0.94	-0.4	0.95	0.0	0.95	0.1
13C-2,3,7,8-TCDF	-	-	- %	-	-	-	-	-	-	-	-	-	-
HxCDPE	-	-	- %	-	-	-	-	-	-	-	-	-	-
QC CHK ION (Tetra)	-	-	- %	-	-	-	-	-	-	-	-	-	-

Section 4

System Performance

Paradigm Analytical Labs

Section 4-4

Continuing Calibrations

Documentation for the Analysis

of

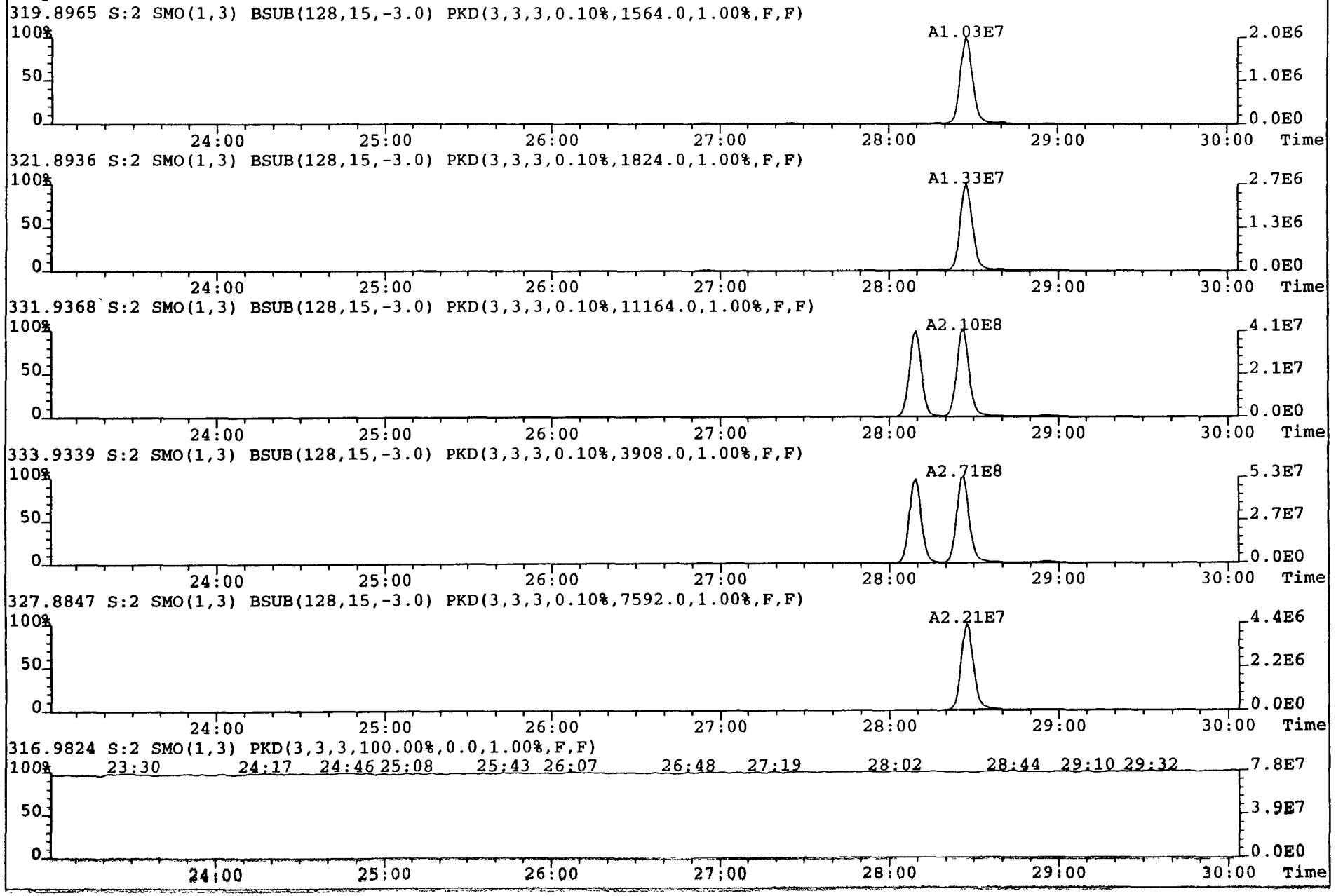
Polychlorinated Dibenzo-*p*-Dioxins & Dibenzofurans

Run #6 Filename a17jul98b S: 2 I: 1 Acquired: 17-JUL-98 17:31:00 Processed: 20-JUL-98 08:49:43
Run: a17jul98b Analyte: m8290-23-» Cal: m8290-23-» Results: m8290-23-» Quan : V3.5 17-APR-1997 11:14:34
Sample text: FE CS3 Comments: 7/21/98 OPUS : A3.6/8X 18-MAR-1998 16:12:42

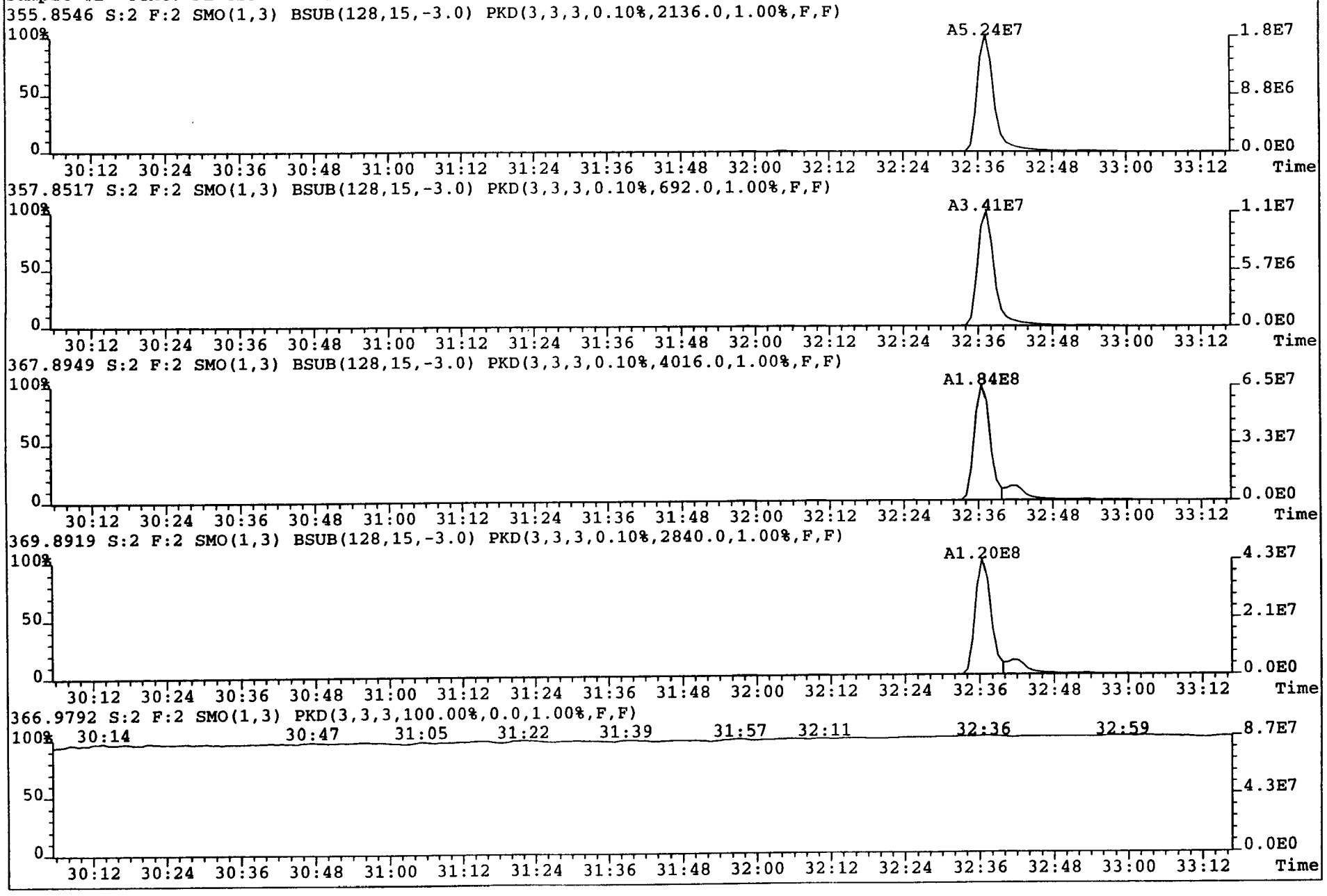
Typ	Name	Resp	RA		RT	Conc	Dev'n	Mod?
Unk	2,3,7,8-TCDD	2.4e+07	0.77	y	28:27	5.00	0.0	n
Unk	1,2,3,7,8-PeCDD	8.6e+07	1.54	y	32:37	25.5	2.1	n
Unk	1,2,3,4,7,8-HxCDD	5.9e+07	1.26	y	34:42	26.0	4.1	y
Unk	1,2,3,6,7,8-HxCDD	7.3e+07	1.24	y	34:46	25.6	2.6	y
Unk	1,2,3,7,8,9-HxCDD	7.7e+07	1.23	y	34:59	26.6	6.5	n
Unk	1,2,3,4,6,7,8-HpCDD	5.8e+07	1.06	y	37:11	25.0	-0.1	n
Unk	OCDD	1.0e+08	0.90	y	40:02	51.2	2.3	n
Unk	2,3,7,8-TCDF	2.9e+07	0.77	y	27:26	5.07	1.3	n
Unk	1,2,3,7,8-PeCDF	1.1e+08	1.52	y	31:57	25.8	3.3	n
Unk	2,3,4,7,8-PeCDF	1.1e+08	1.52	y	32:24	24.8	-0.7	n
Unk	1,2,3,4,7,8-HxCDF	8.2e+07	1.38	y	34:11	24.7	-1.2	n
Unk	1,2,3,6,7,8-HxCDF	1.2e+08	1.14	y	34:15	27.6	10.5	n
Unk	2,3,4,6,7,8-HxCDF	9.6e+07	1.23	y	34:37	26.8	7.2	n
Unk	1,2,3,7,8,9-HxCDF	8.1e+07	1.24	y	35:08	26.1	4.6	n
Unk	1,2,3,4,6,7,8-HpCDF	7.7e+07	1.01	y	36:22	24.6	-1.6	n
Unk	1,2,3,4,7,8,9-HpCDF	6.2e+07	1.02	y	37:32	24.1	-3.8	n
Unk	OCDF	1.1e+08	0.90	y	40:10	51.5	3.0	n
ES/RT	13C-2,3,7,8-TCDD	4.8e+08	0.77	y	28:26	98.2	-1.8	n
ES	13C-1,2,3,7,8-PeCDD	3.0e+08	1.54	y	32:36	88.9	-11.1	n
ES	13C-1,2,3,6,7,8-HxCDD	3.3e+08	1.26	y	34:45	92.7	-7.3	n
ES	13C-1,2,3,4,6,7,8-HpCDD	2.6e+08	1.04	y	37:10	96.3	-3.7	n
ES	13C-OCDD	3.9e+08	0.89	y	40:01	182	-9.0	n
ES/RT	13C-2,3,7,8-TCDF	6.0e+08	0.78	y	27:25	97.6	-2.4	n
ES	13C-1,2,3,7,8-PeCDF	4.8e+08	1.57	y	31:56	89.1	-10.9	n
ES	13C-1,2,3,6,7,8-HxCDF	3.8e+08	0.52	y	34:14	92.0	-8.0	n
ES	13C-1,2,3,4,6,7,8-HpCDF	2.5e+08	0.44	y	36:21	98.1	-1.9	n
JS	13C-1,2,3,4-TCDD	4.5e+08	0.79	y	28:09	92.6	-	n
JS	13C-1,2,3,7,8,9-HxCDD	3.4e+08	1.26	y	34:58	84.9	-	n
CS	37Cl-2,3,7,8-TCDD	2.2e+07	1.57	y	28:27	4.91	-1.7	n
CS	13C-2,3,4,7,8-PeCDF	1.1e+08	1.24	y	32:24	21.8	-12.7	n
CS	13C-1,2,3,4,7,8-HxCDD	5.1e+07	0.52	y	34:42	20.8	-16.6	n
CS	13C-1,2,3,4,7,8-HxCDF	7.2e+07	0.45	y	34:10	22.0	-12.0	n
CS	13C-1,2,3,4,7,8,9-HpCDF	4.8e+07			37:31	24.3	-2.9	n
			1.57	y				
SS	37Cl-2,3,7,8-TCDD	2.2e+07	1.24	y	28:27	5.01	0.1	n
SS	13C-2,3,4,7,8-PeCDF	1.1e+08	0.52	y	32:24	24.5	-2.0	n
SS	13C-1,2,3,4,7,8-HxCDD	5.1e+07	0.45	y	34:42	22.5	-10.2	n
SS	13C-1,2,3,4,7,8-HxCDF	7.2e+07			34:10	23.7	-5.0	n
SS	13C-1,2,3,4,7,8,9-HpCDF	4.8e+07			37:31	24.8	-0.9	n
DPE	HxCDPE	*			NotFnd	*	-	n
DPE	HpCDPE	*			NotFnd	*	-	n

M. Thomas 7/20/98

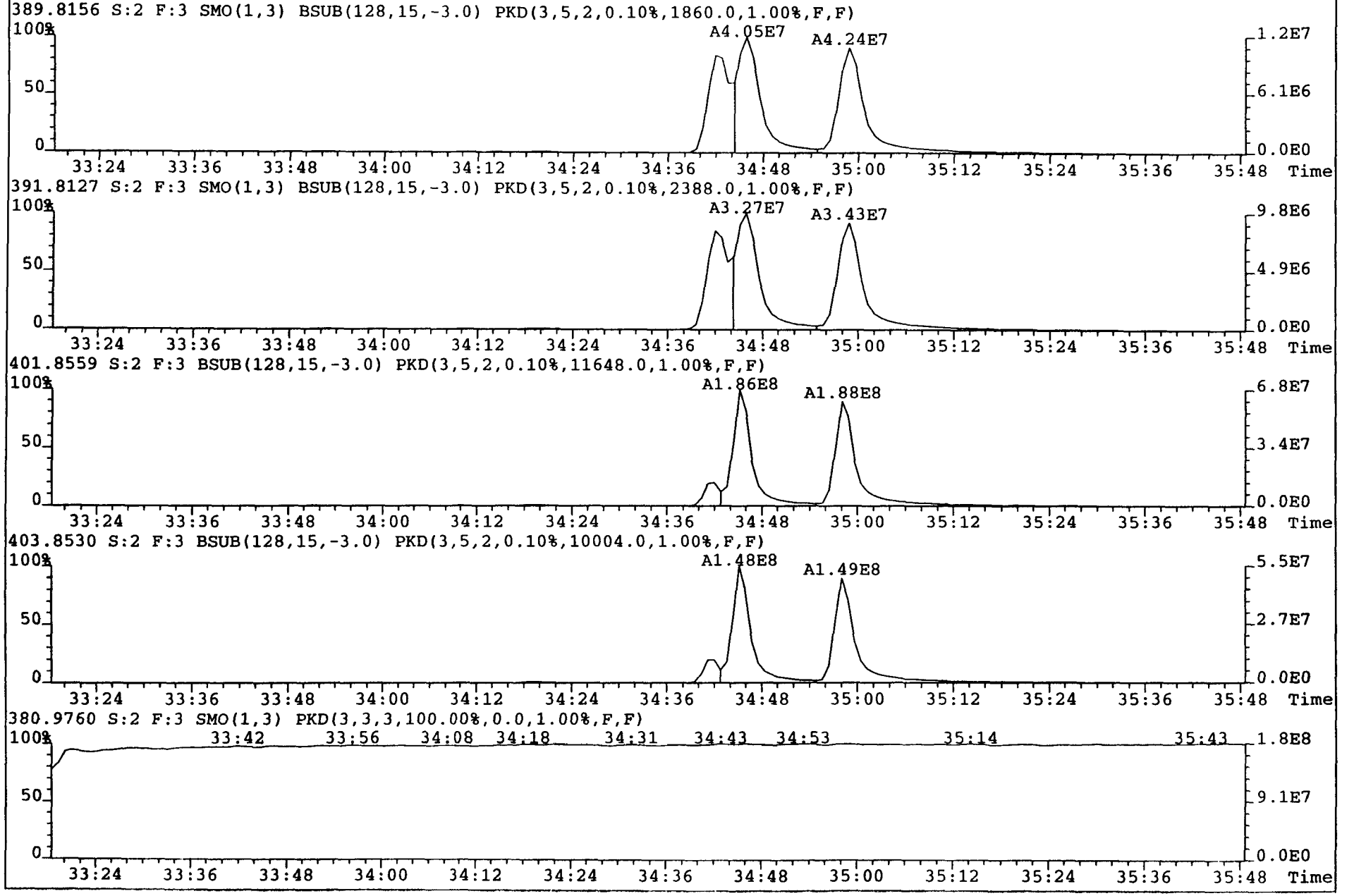
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



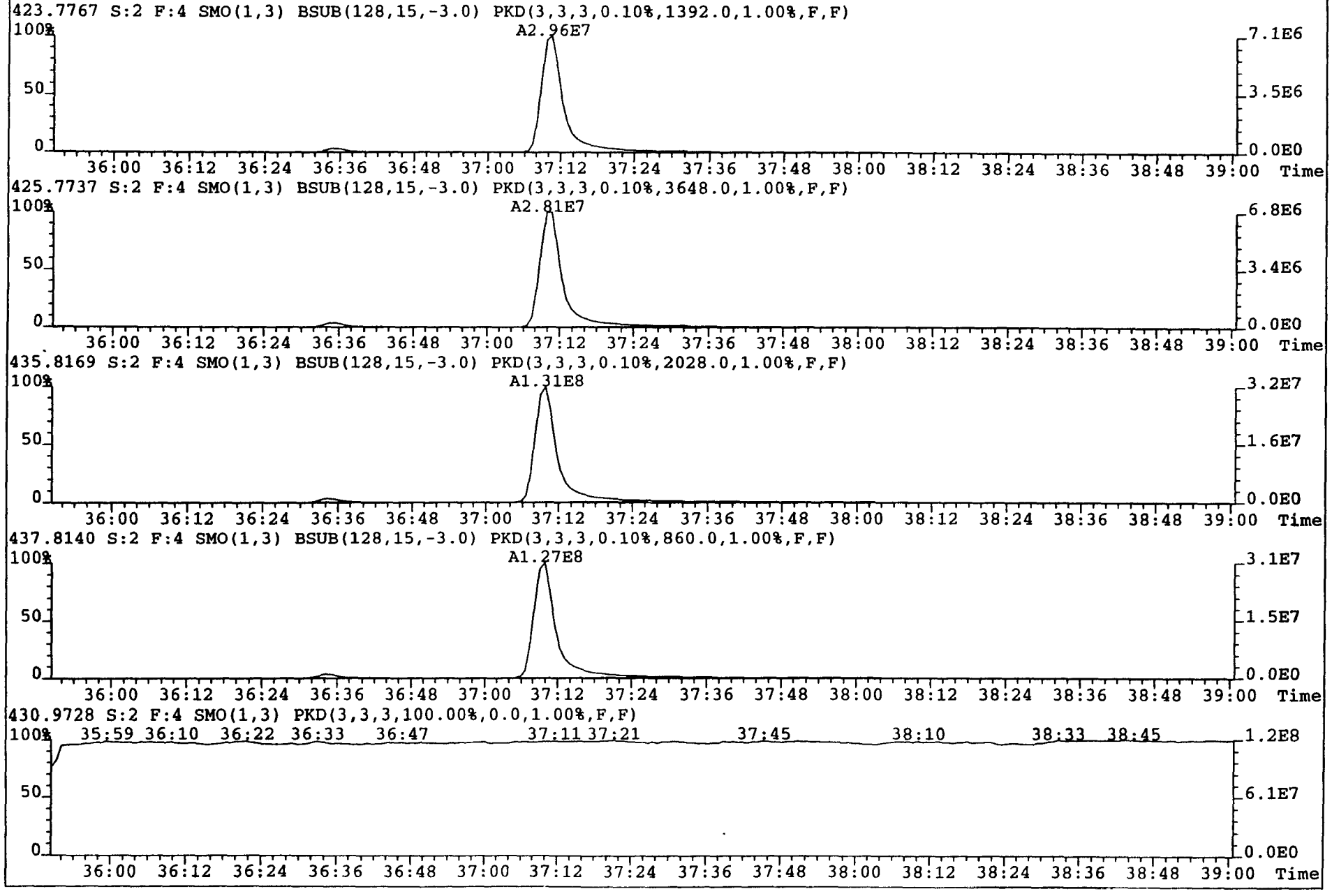
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



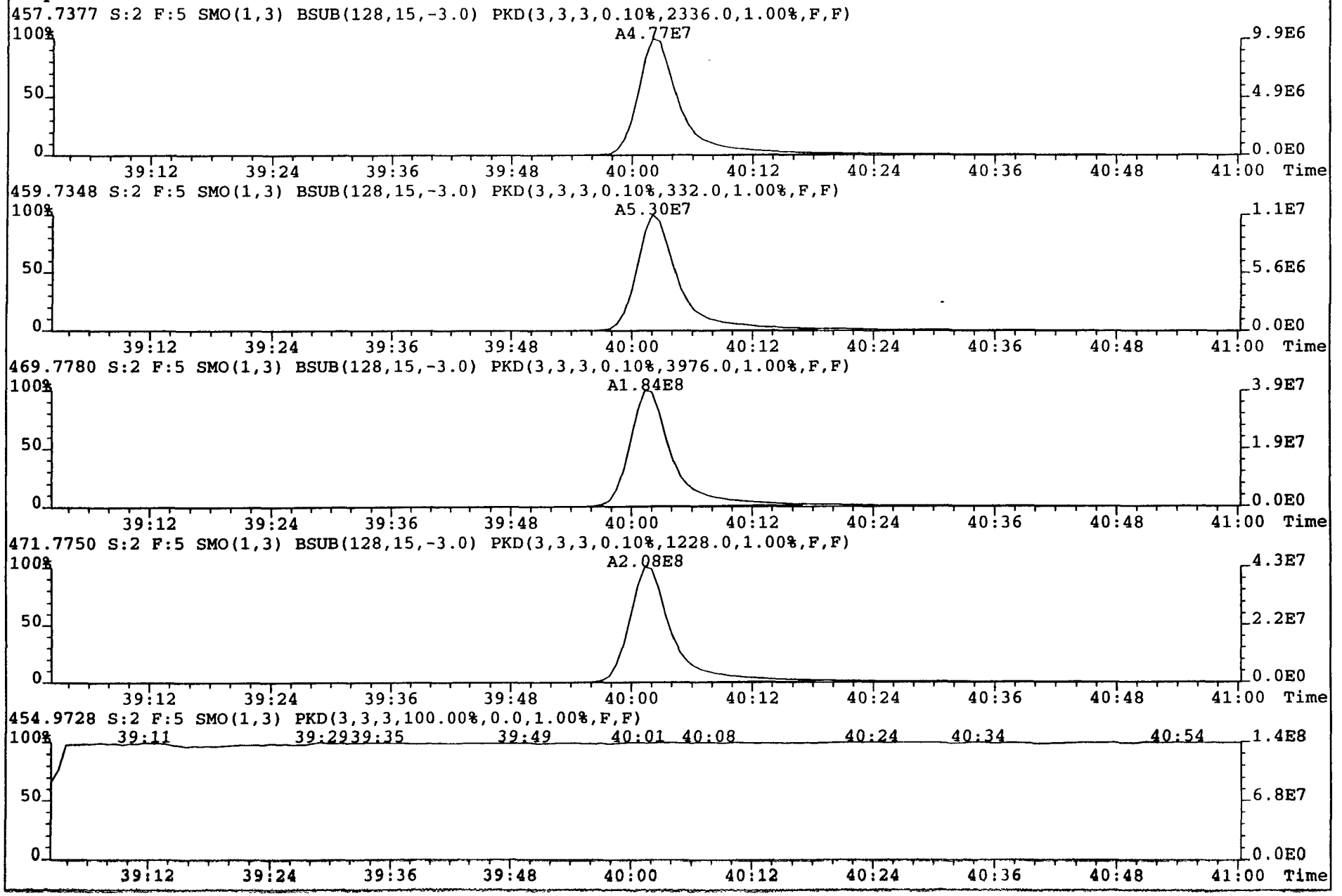
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



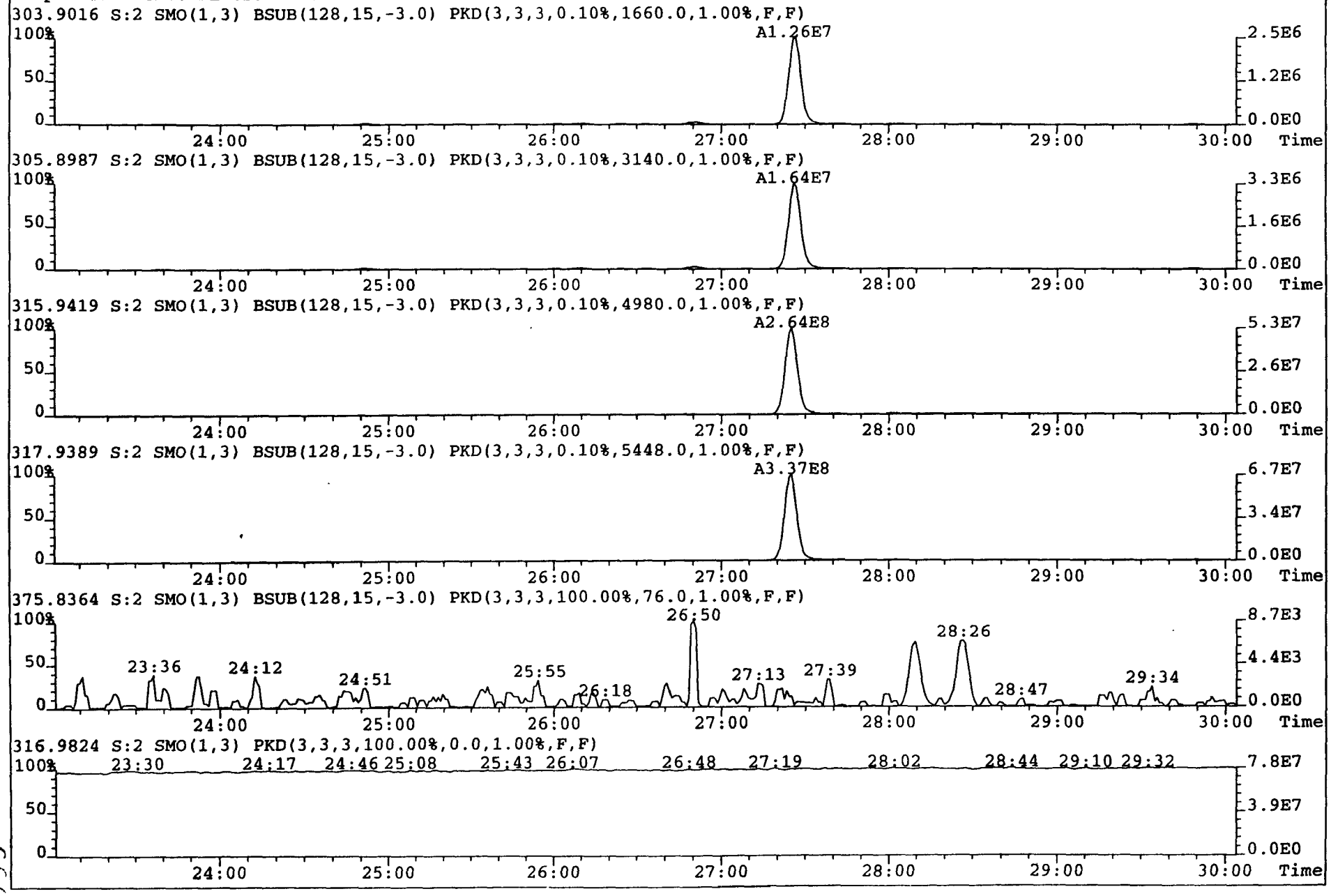
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



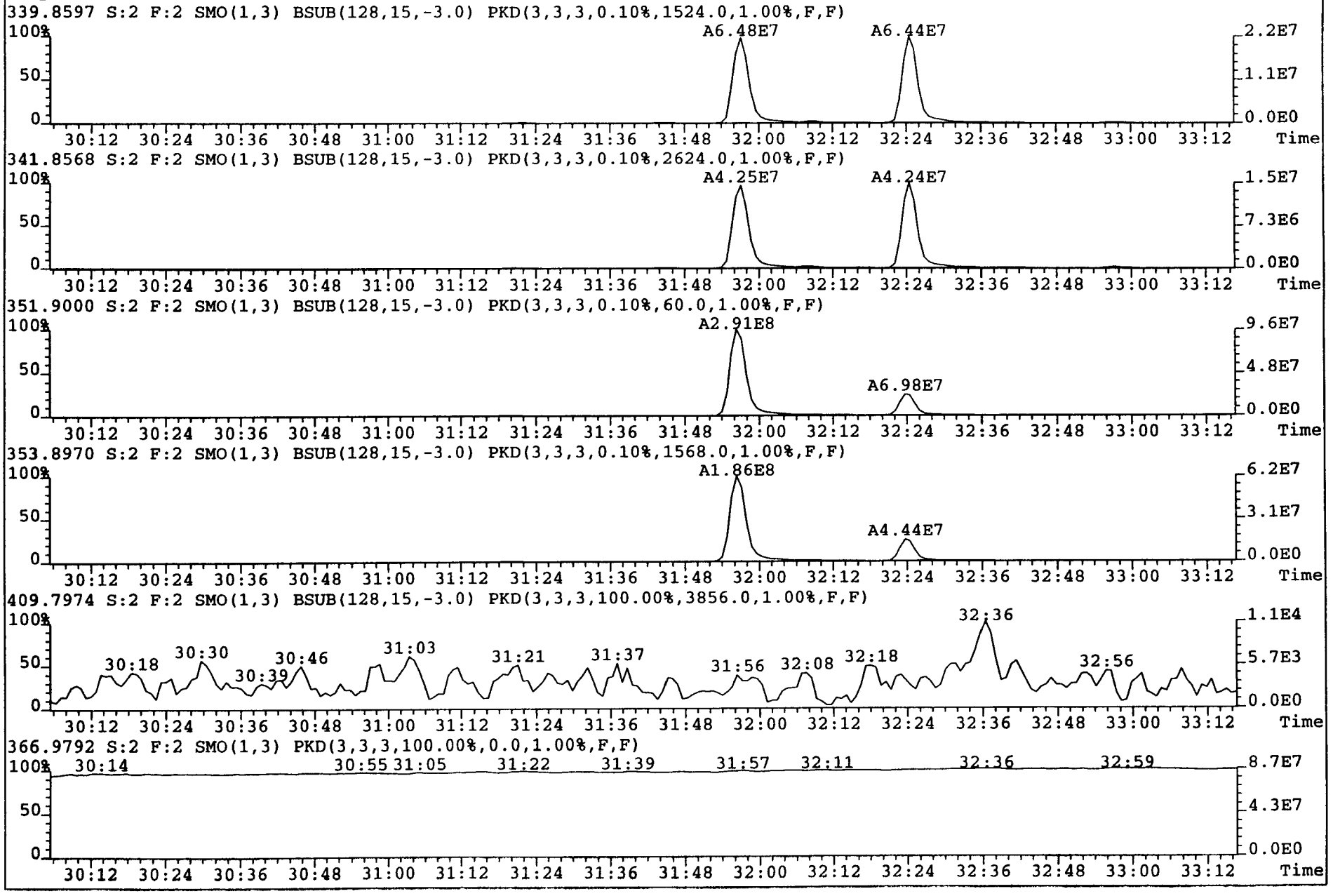
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



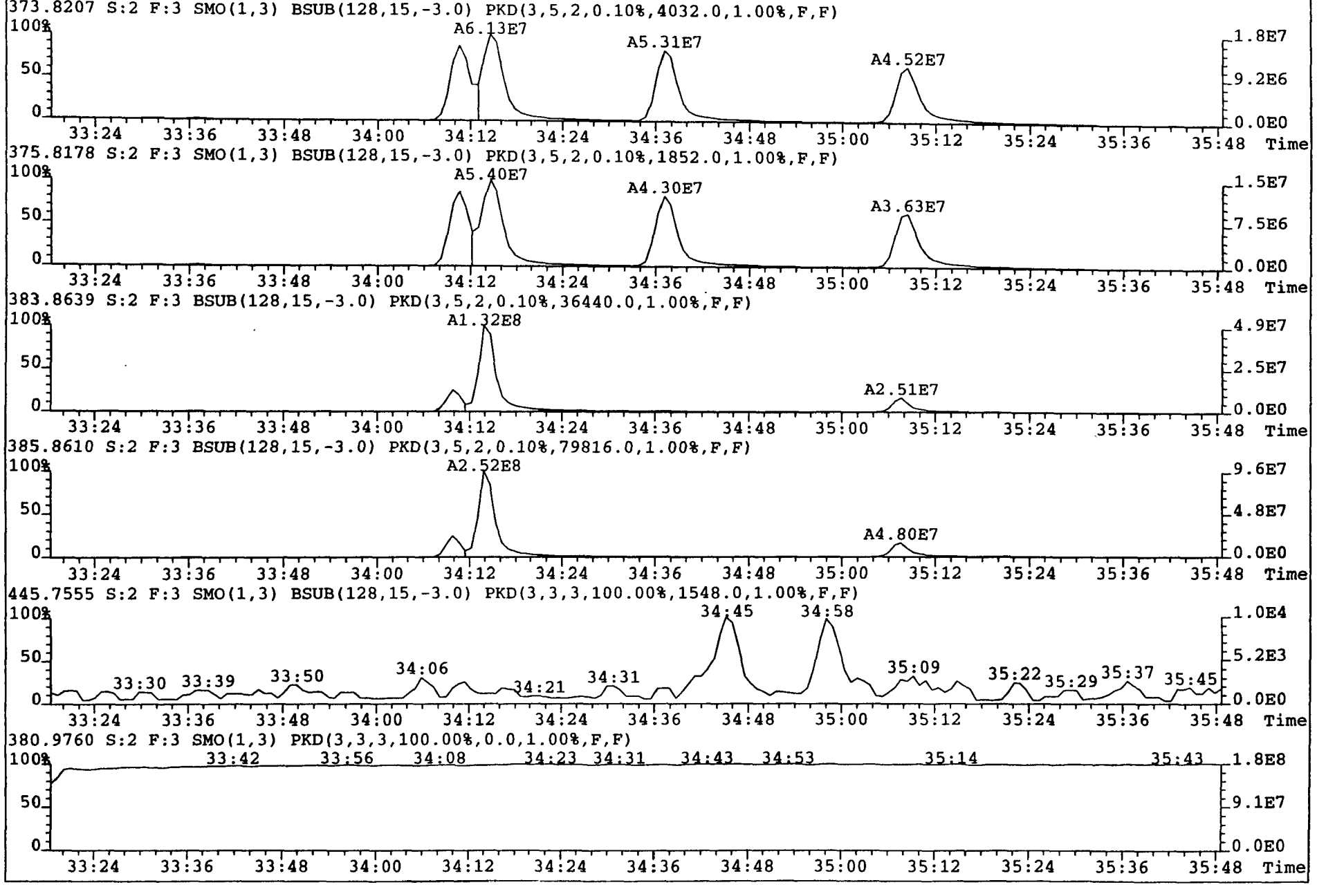
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



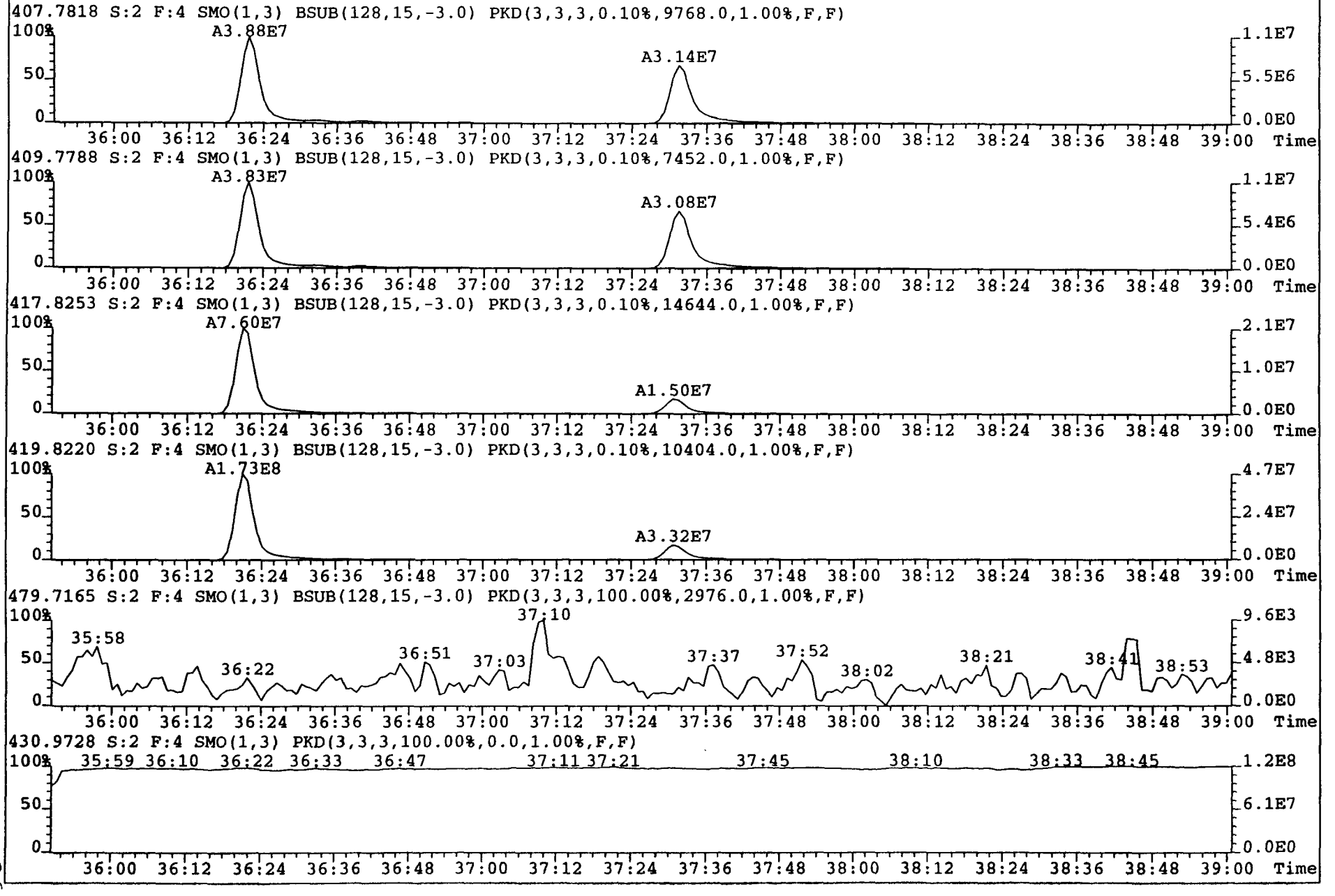
File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2

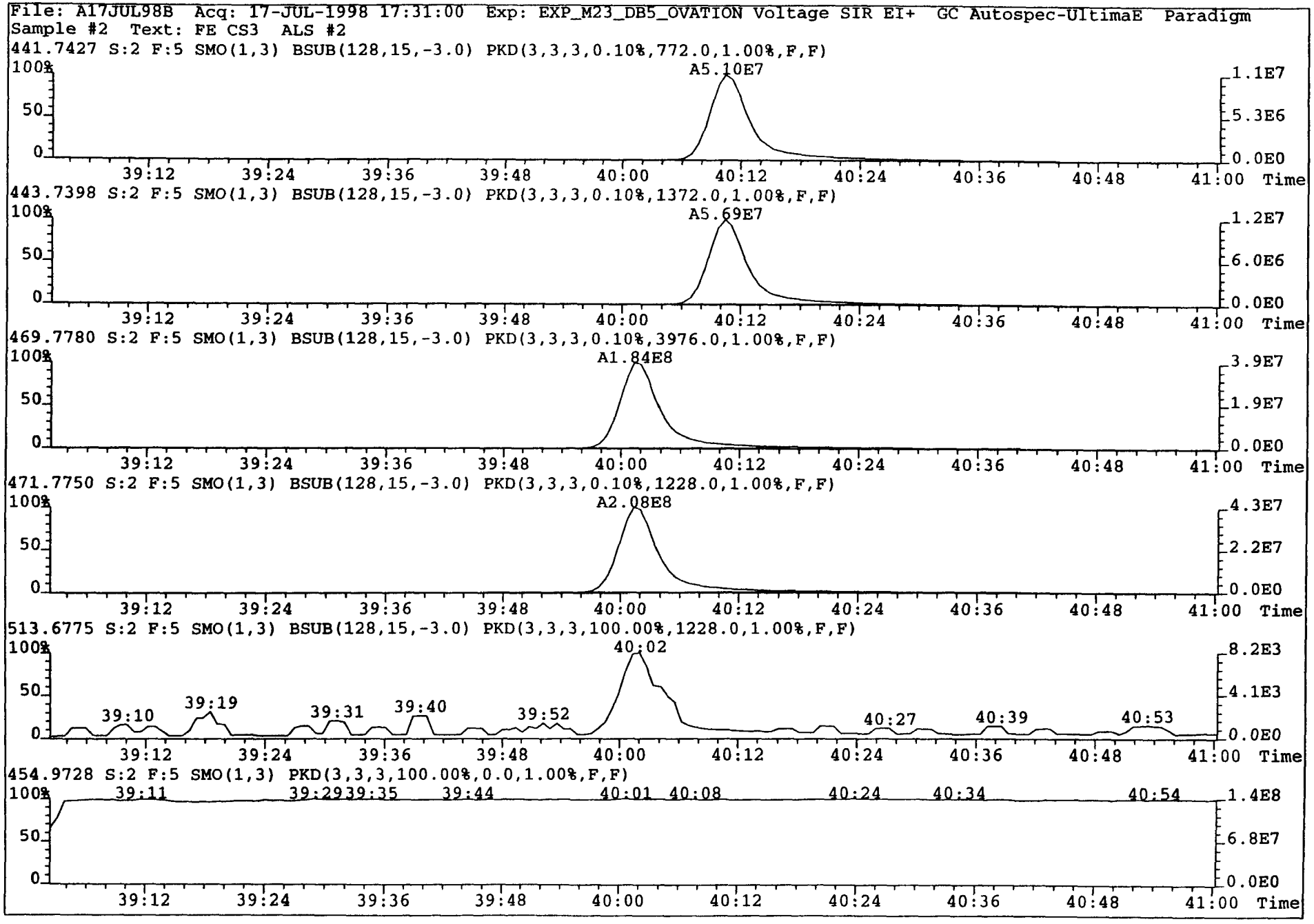


File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2



File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2

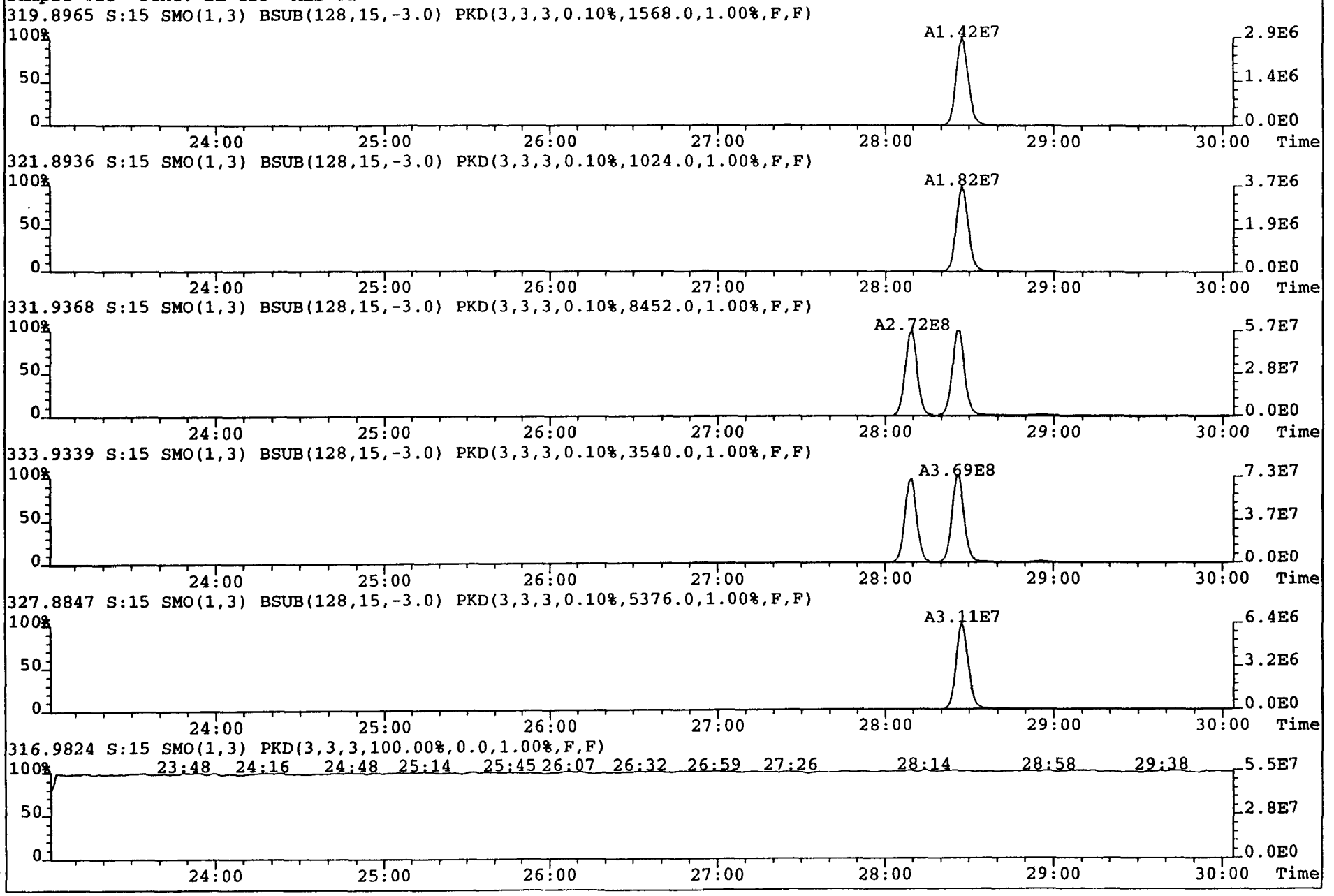



File: A17JUL98B Acq: 17-JUL-1998 17:31:00 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: FE CS3 ALS #2
441.7427 S:2 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,772.0,1.00%,F,F)
A5.10E7
1.1E7
5.3E6
0.0E0
443.7398 S:2 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1372.0,1.00%,F,F)
A5.69E7
1.2E7
6.0E6
0.0E0
469.7780 S:2 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3976.0,1.00%,F,F)
A1.84E8
3.9E7
1.9E7
0.0E0
471.7750 S:2 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1228.0,1.00%,F,F)
A2.08E8
4.3E7
2.2E7
0.0E0
513.6775 S:2 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,1228.0,1.00%,F,F)
40:02
39:10
39:19
39:31
39:40
39:52
40:27
40:39
40:53
8.2E3
4.1E3
0.0E0
454.9728 S:2 F:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
39:11
39:29
39:35
39:44
40:01
40:08
40:24
40:34
40:54
1.4E8
6.8E7
0.0E0
100%
50
0
39:12
39:24
39:36
39:48
40:00
40:12
40:24
40:36
40:48
41:00
Time

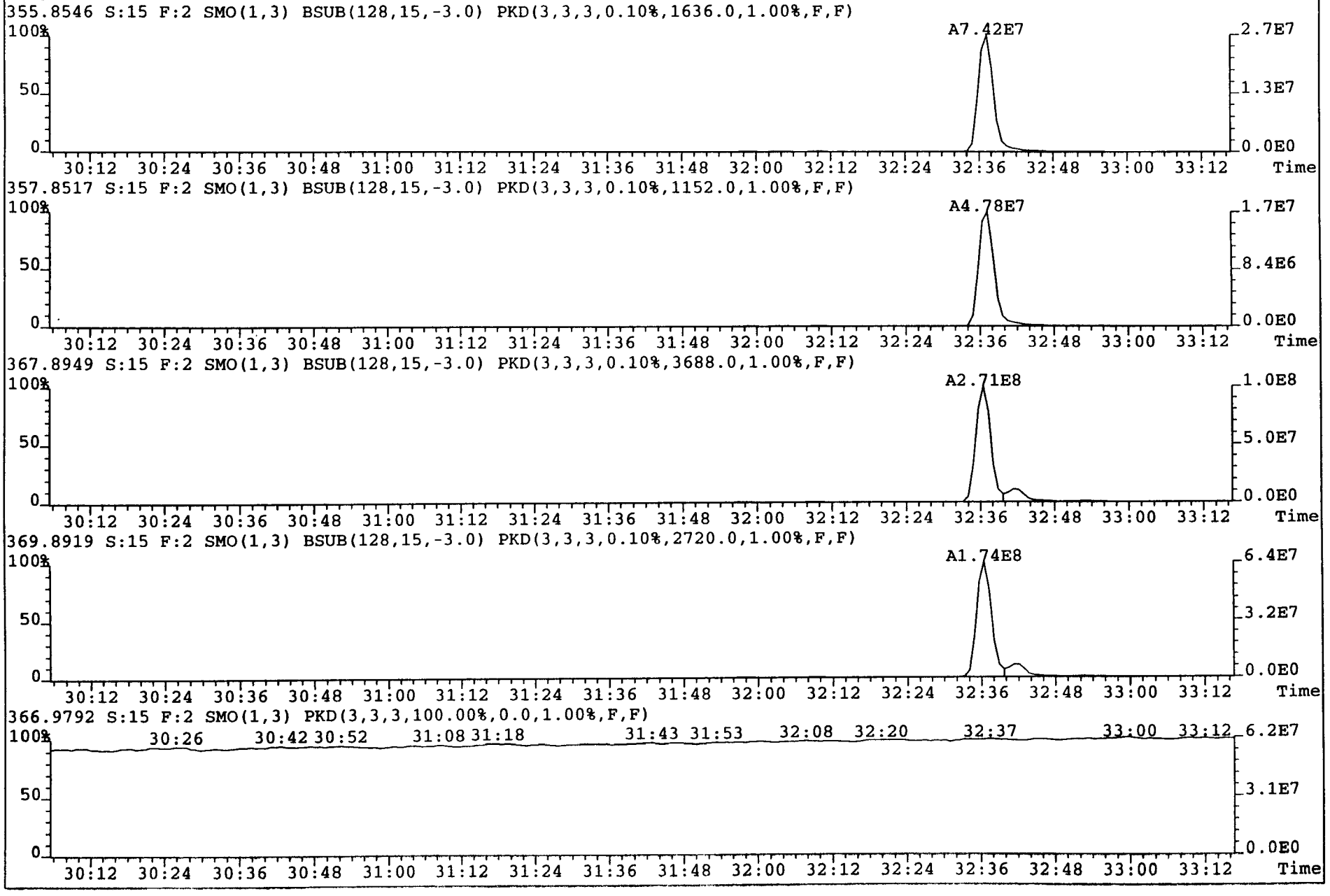
Run #7 Filename a17jul98b S: 15 I: 1 Acquired: 18-JUL-98 03:17:11 Processed: 20-JUL-98 08:49:48
Run: 0716crv Analyte: m8290-23-» Cal: m8290-23-» Results: Quan : V3.5 17-APR-1997 11:14:34
Sample text: BE CS3 Comments: ↳ 07/7/98 OPUS : A3.6/8X 18-MAR-1998 16:12:42

Typ	Name	Resp	RA		RT	Conc	Dev'n	Mod?
Unk	2,3,7,8-TCDD	3.2e+07	0.78	y	28:27	5.04	0.7	n
Unk	1,2,3,7,8-PeCDD	1.2e+08	1.55	y	32:37	24.6	-1.6	n
Unk	1,2,3,4,7,8-HxCDD	7.8e+07	1.22	y	34:42	25.0	0.1	n
Unk	1,2,3,6,7,8-HxCDD	1.1e+08	1.27	y	34:46	28.2	12.8	n
Unk	1,2,3,7,8,9-HxCDD	1.1e+08	1.25	y	34:59	26.6	6.4	n
Unk	1,2,3,4,6,7,8-HpCDD	8.4e+07	1.01	y	37:10	24.9	-0.3	n
Unk	OCDD	1.5e+08	0.88	y	40:02	50.3	0.6	n
Unk	2,3,7,8-TCDF	4.0e+07	0.78	y	27:26	5.03	0.6	n
Unk	1,2,3,7,8-PeCDF	1.5e+08	1.53	y	31:57	26.0	4.0	n
Unk	2,3,4,7,8-PeCDF	1.5e+08	1.53	y	32:24	25.1	0.5	n
Unk	1,2,3,4,7,8-HxCDF	1.2e+08	1.21	y	34:11	25.7	2.9	n
Unk	1,2,3,6,7,8-HxCDF	1.5e+08	1.23	y	34:15	27.2	8.7	n
Unk	2,3,4,6,7,8-HxCDF	1.3e+08	1.21	y	34:37	25.8	3.2	n
Unk	1,2,3,7,8,9-HxCDF	1.2e+08	1.22	y	35:08	27.4	9.7	n
Unk	1,2,3,4,6,7,8-HpCDF	1.1e+08	1.02	y	36:22	25.1	0.4	n
Unk	1,2,3,4,7,8,9-HpCDF	9.5e+07	1.03	y	37:31	25.3	1.2	n
Unk	OCDF	1.6e+08	0.89	y	40:10	51.7	3.5	n
ES/RT	13C-2,3,7,8-TCDD	6.5e+08	0.78	y	28:26	96.9	-3.1	n
ES	13C-1,2,3,7,8-PeCDD	4.4e+08	1.56	y	32:36	94.4	-5.6	n
ES	13C-1,2,3,6,7,8-HxCDD	4.6e+08	1.26	y	34:45	92.1	-7.9	n
ES	13C-1,2,3,4,6,7,8-HpCDD	3.8e+08	1.04	y	37:09	101	0.7	n
ES	13C-OCDD	5.8e+08	0.89	y	40:01	194	-2.9	n
ES/RT	13C-2,3,7,8-TCDF	8.3e+08	0.79	y	27:25	97.9	-2.1	n
ES	13C-1,2,3,7,8-PeCDF	6.8e+08	1.56	y	31:56	91.6	-8.4	n
ES	13C-1,2,3,6,7,8-HxCDF	5.2e+08	0.52	y	34:14	89.1	-10.9	n
ES	13C-1,2,3,4,6,7,8-HpCDF	3.6e+08	0.45	y	36:21	102	2.5	n
JS	13C-1,2,3,4-TCDD	6.2e+08	0.79	y	28:09	128	-	n
JS	13C-1,2,3,7,8,9-HxCDD	4.7e+08	1.26	y	34:58	119	-	n
CS	37Cl-2,3,7,8-TCDD	3.1e+07	1.56	y	28:27	5.01	0.3	n
CS	13C-2,3,4,7,8-PeCDF	1.6e+08	1.23	y	32:24	22.5	-10.1	n
CS	13C-1,2,3,4,7,8-HxCDD	8.3e+07	0.52	y	34:41	24.3	-2.9	n
CS	13C-1,2,3,4,7,8-HxCDF	1.1e+08	0.45	y	34:10	24.3	-3.0	n
CS	13C-1,2,3,4,7,8,9-HpCDF	7.4e+07			37:31	26.5	6.2	n
			1.56	y				
SS	37Cl-2,3,7,8-TCDD	3.1e+07	1.23	y	28:27	5.18	3.5	n
SS	13C-2,3,4,7,8-PeCDF	1.6e+08	0.52	y	32:24	24.6	-1.8	n
SS	13C-1,2,3,4,7,8-HxCDD	8.3e+07	0.45	y	34:41	26.3	5.3	n
SS	13C-1,2,3,4,7,8-HxCDF	1.1e+08			34:10	27.0	8.0	n
SS	13C-1,2,3,4,7,8,9-HpCDF	7.4e+07			37:31	25.9	3.6	n
DPE	HxCDPE	*			NotFnd	*	-	n
DPE	HpCDPE	*			NotFnd	*	-	n

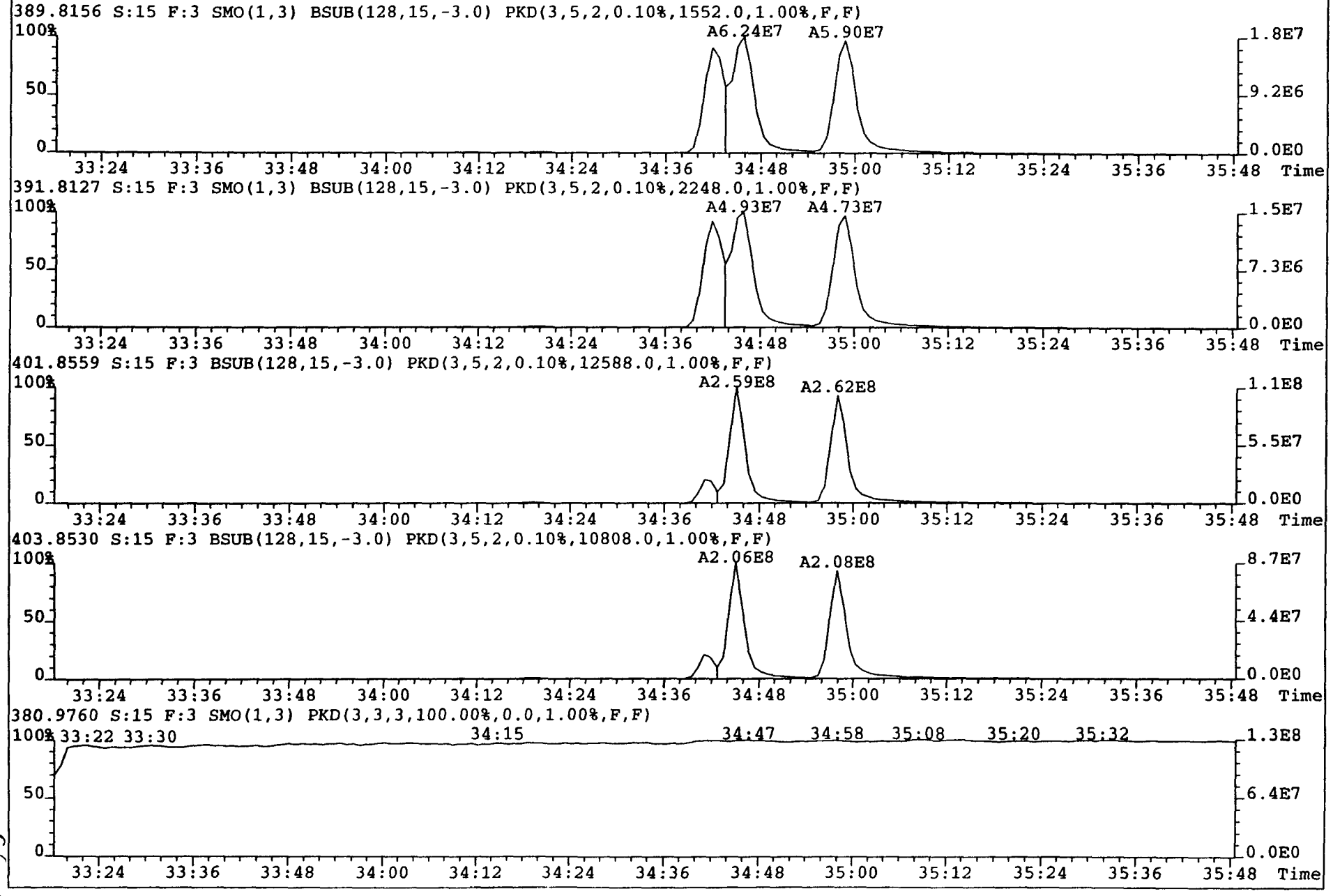
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



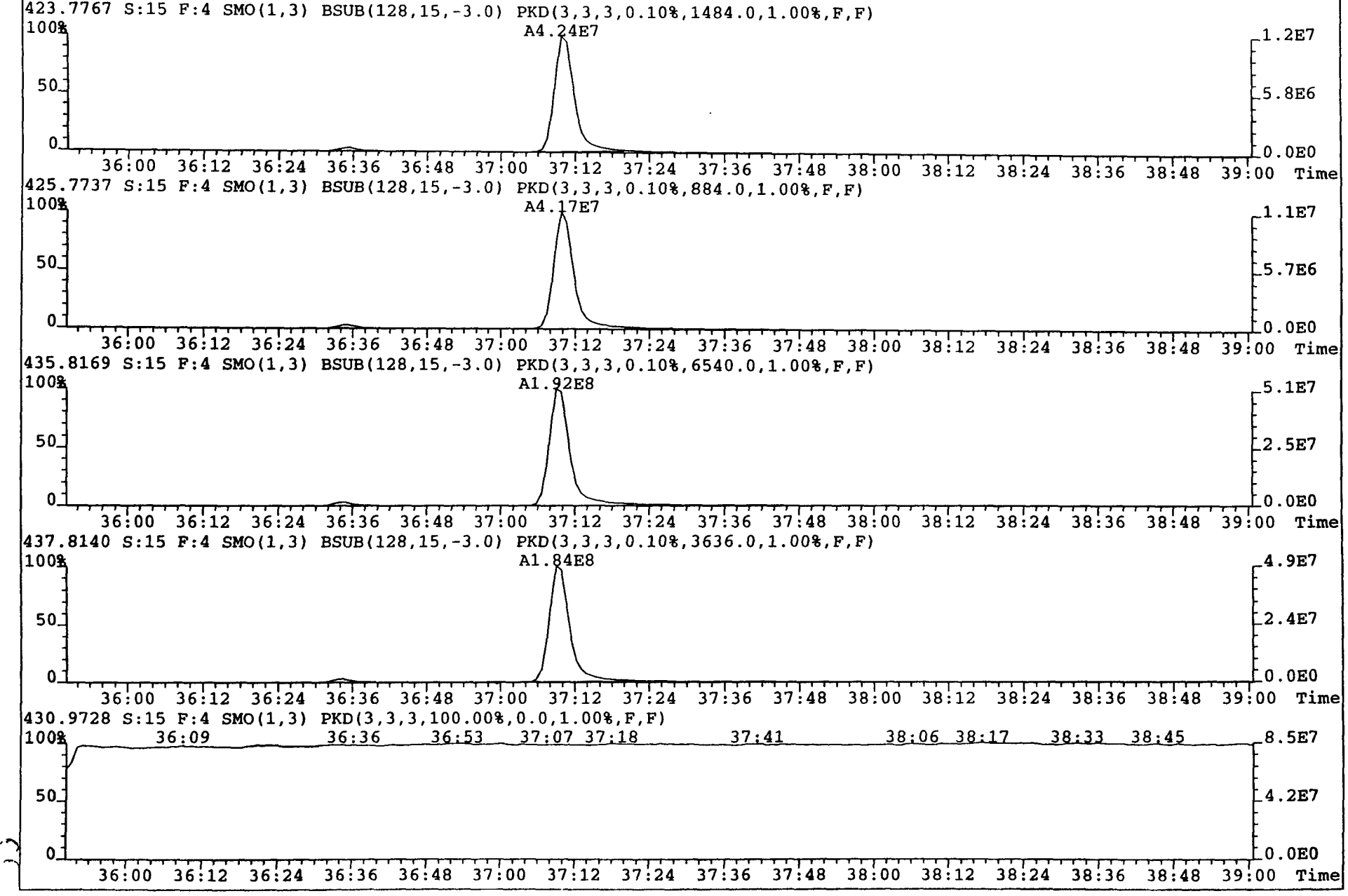
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



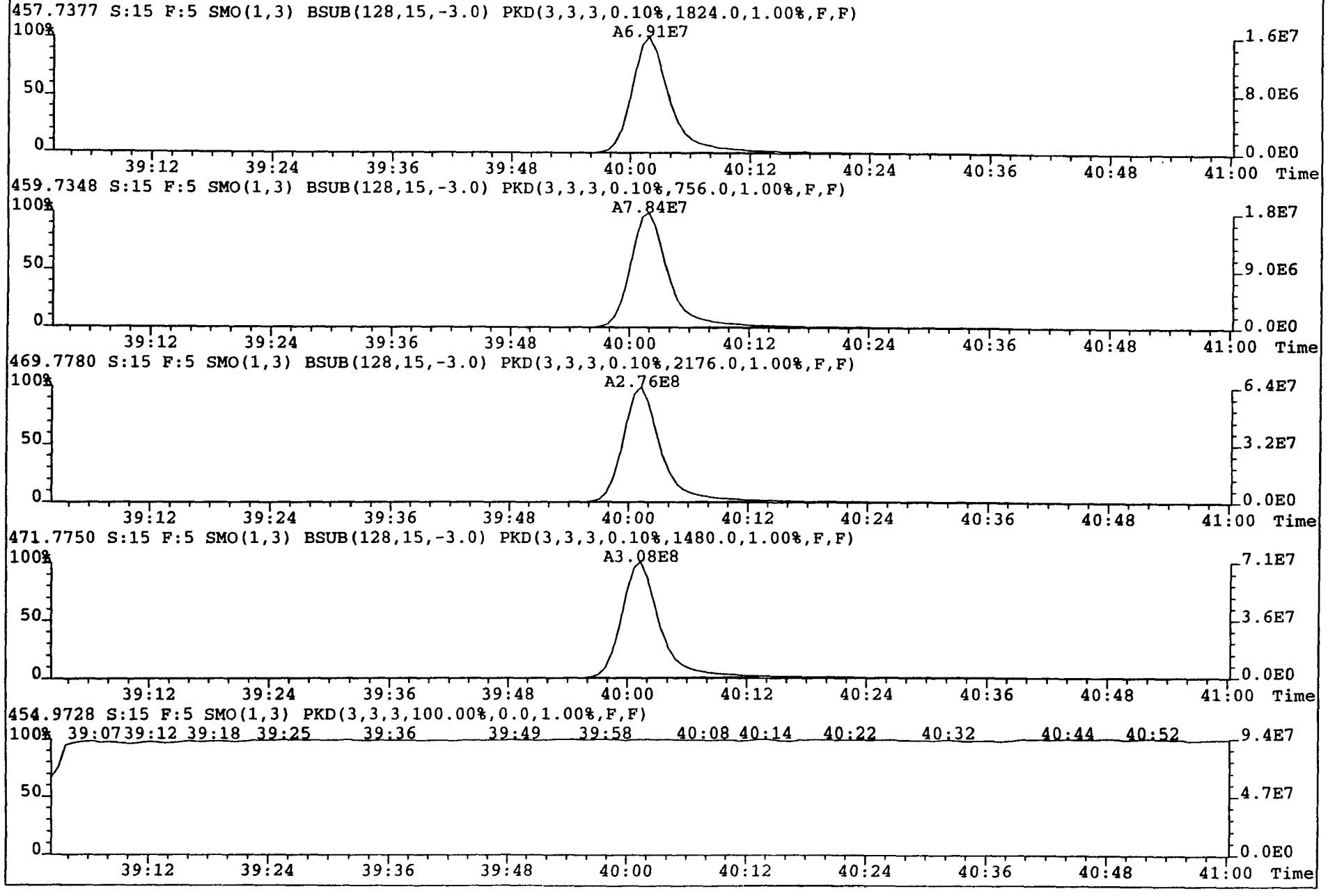
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



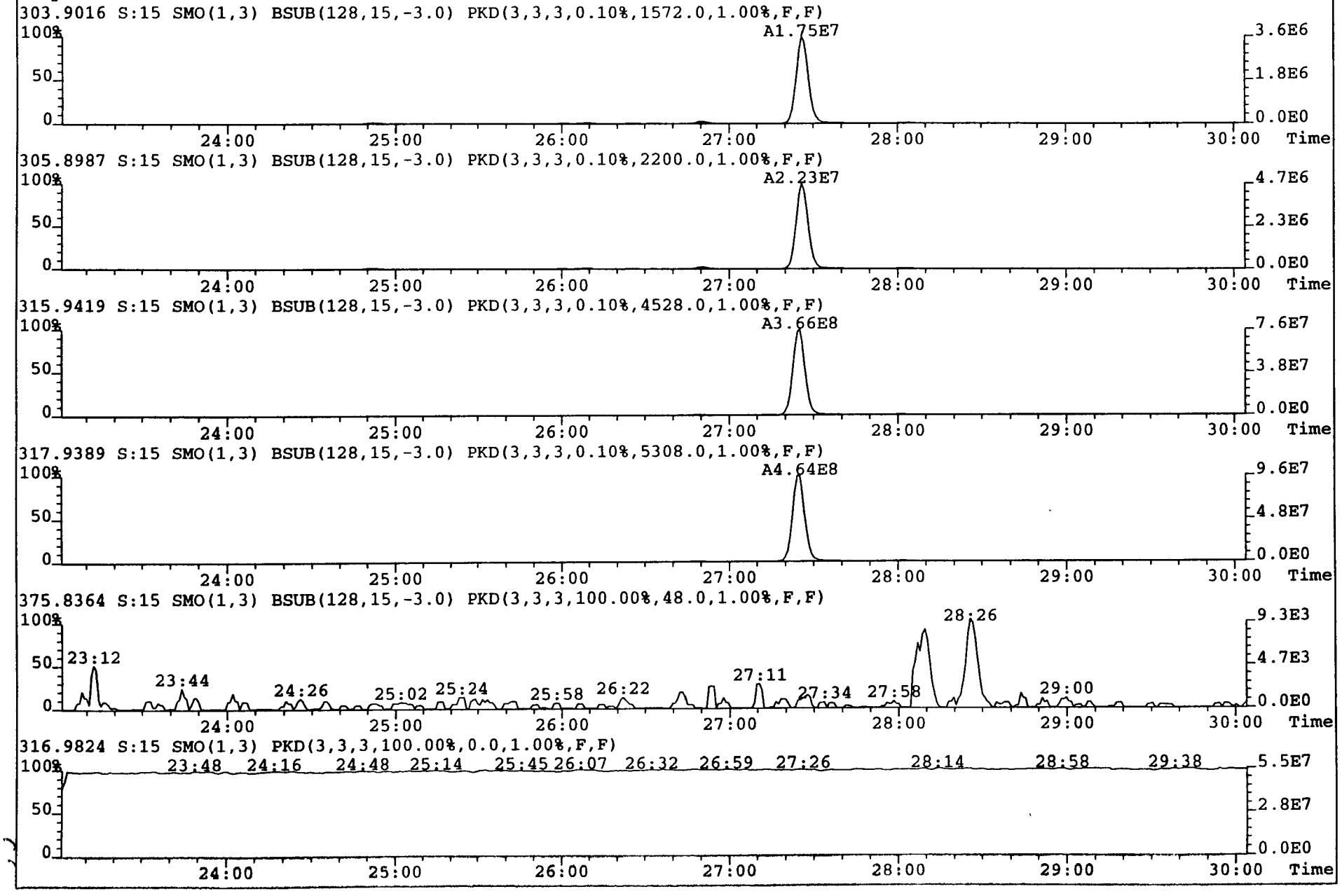
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



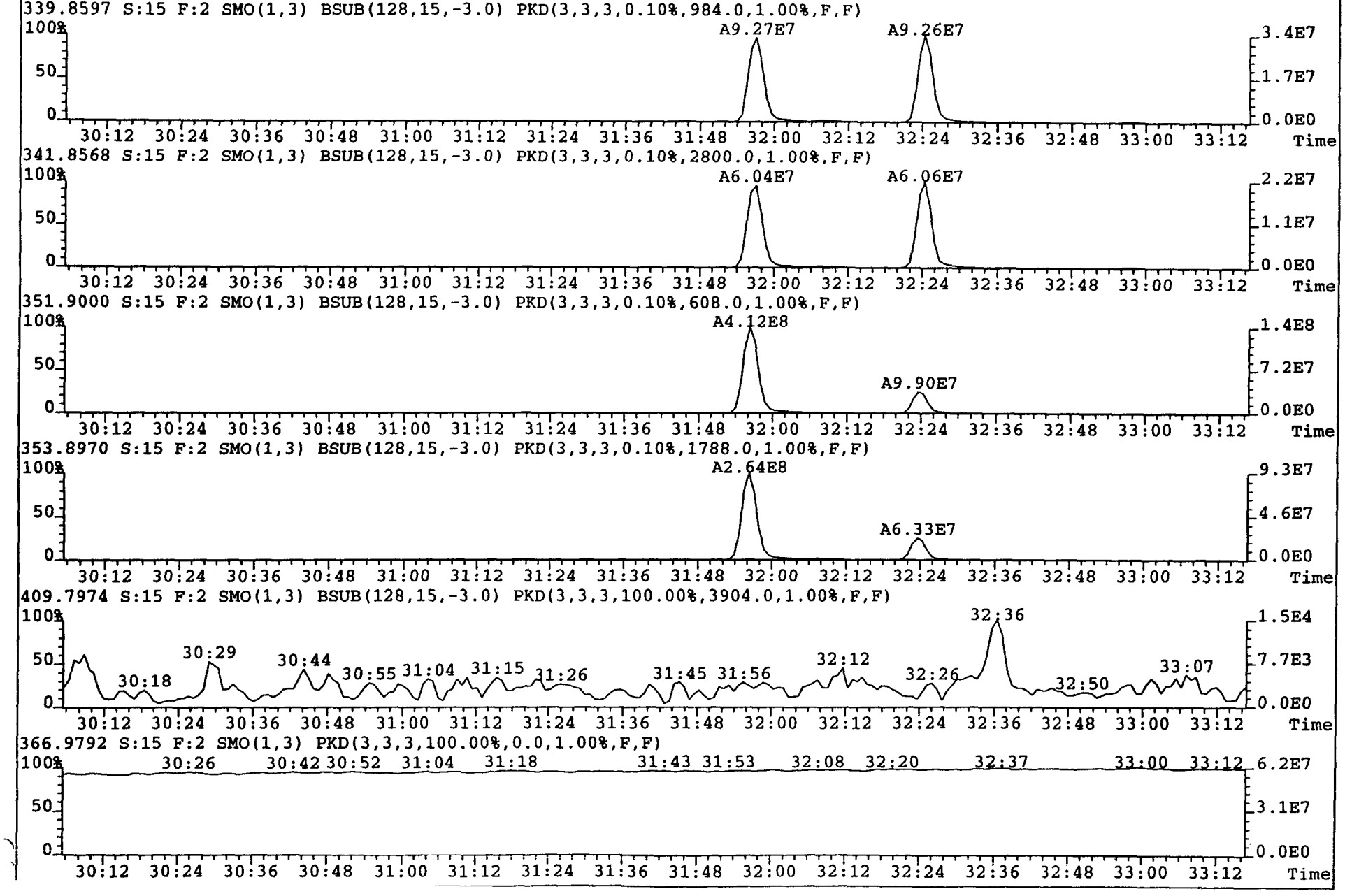
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



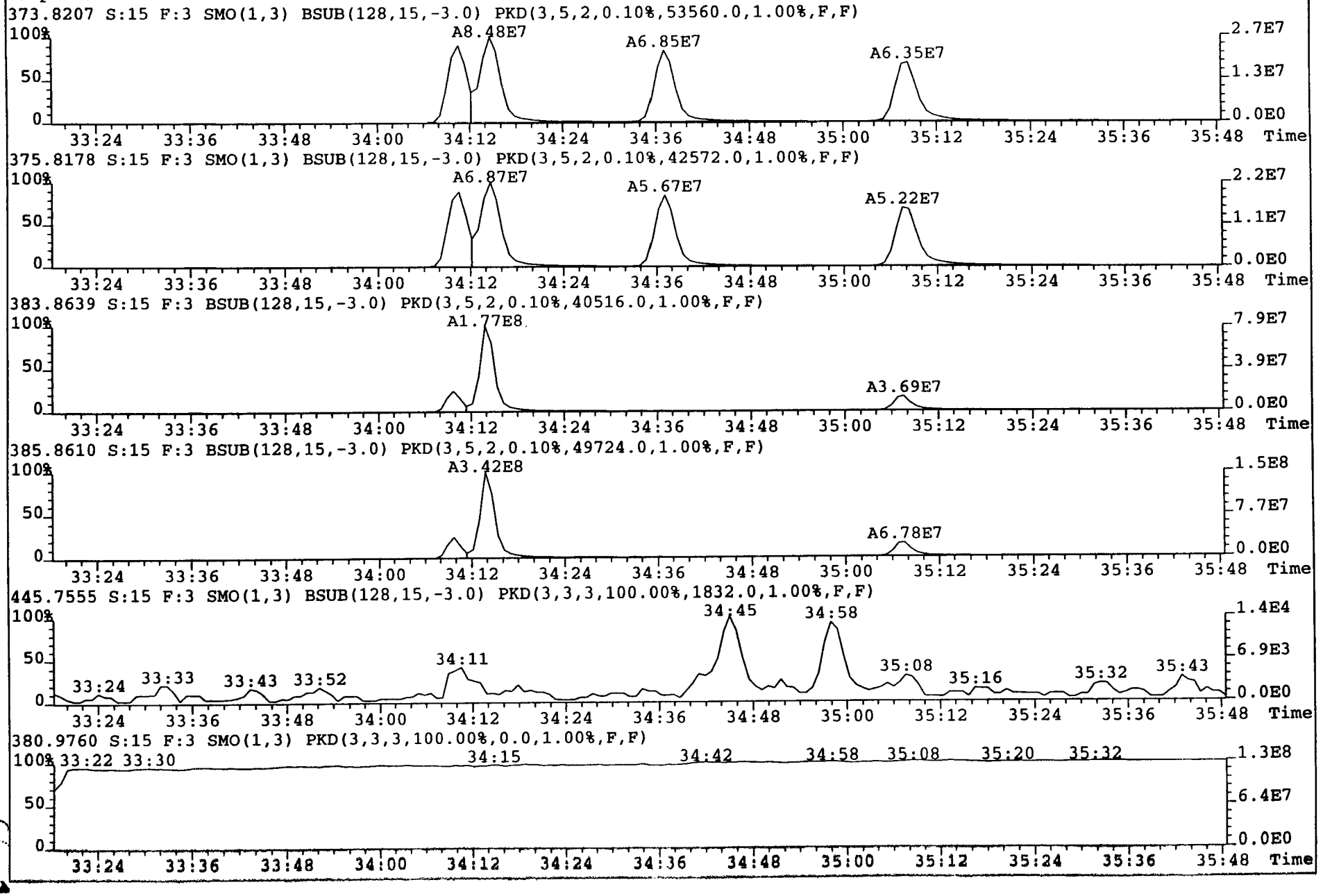
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



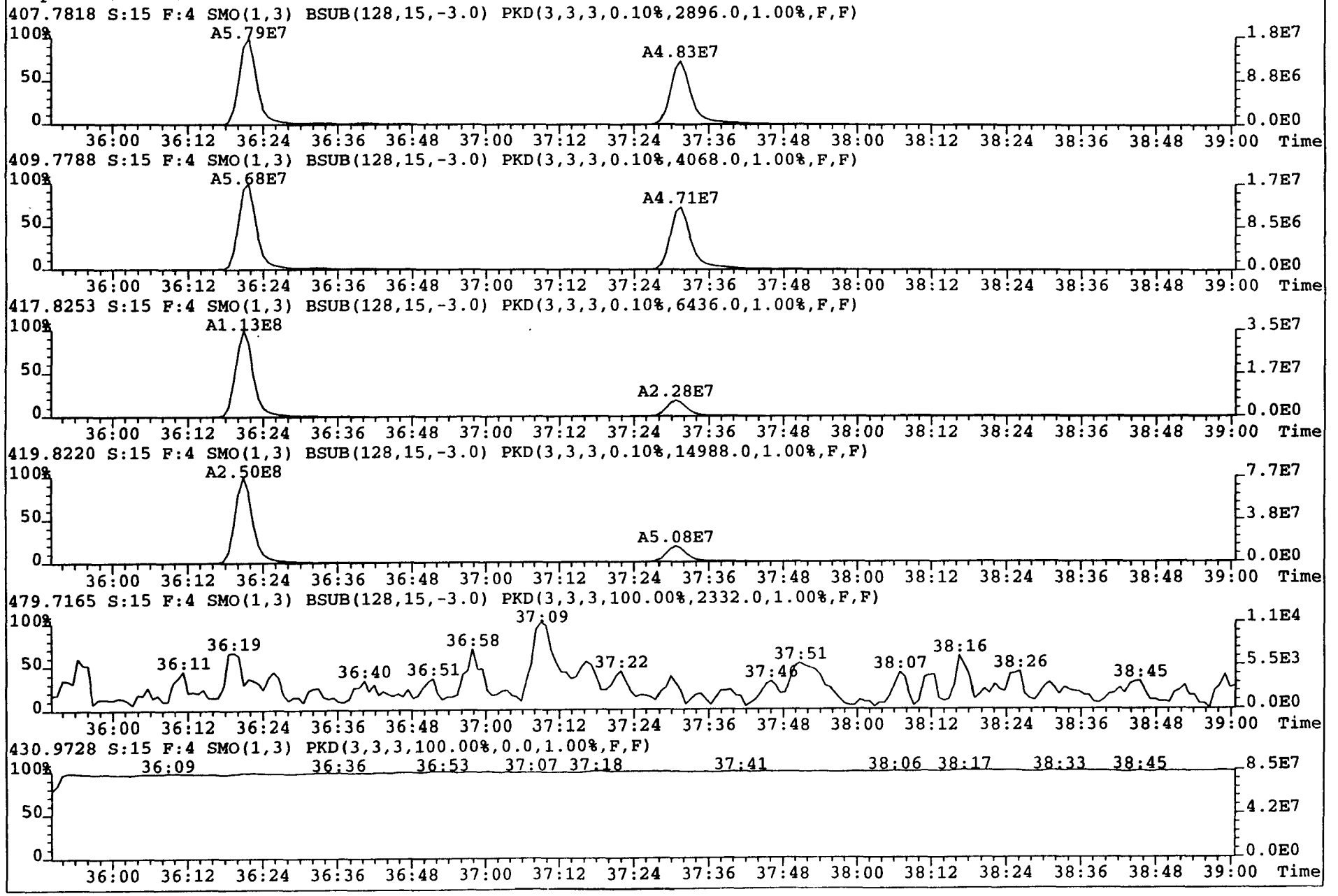
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2

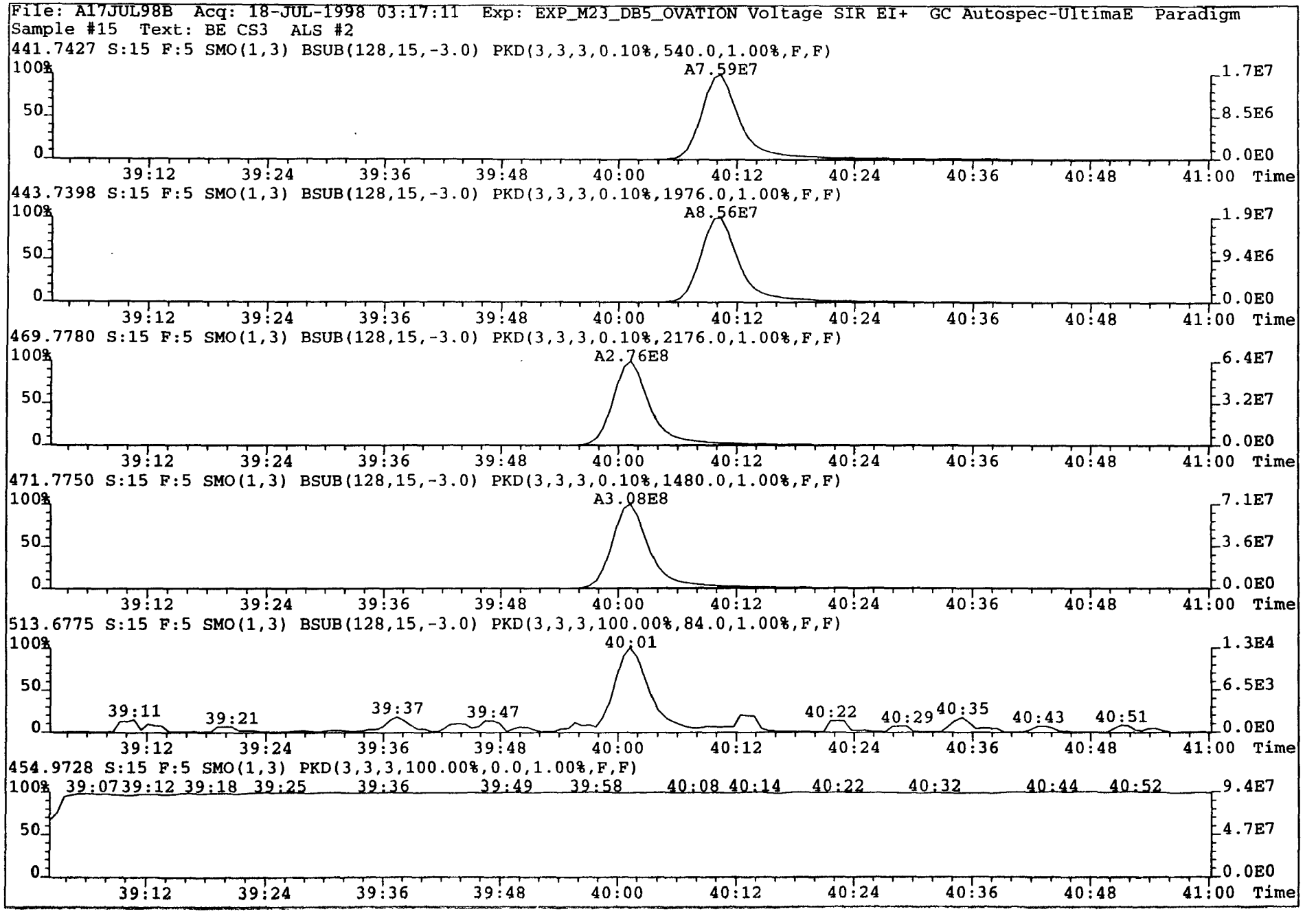


File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2



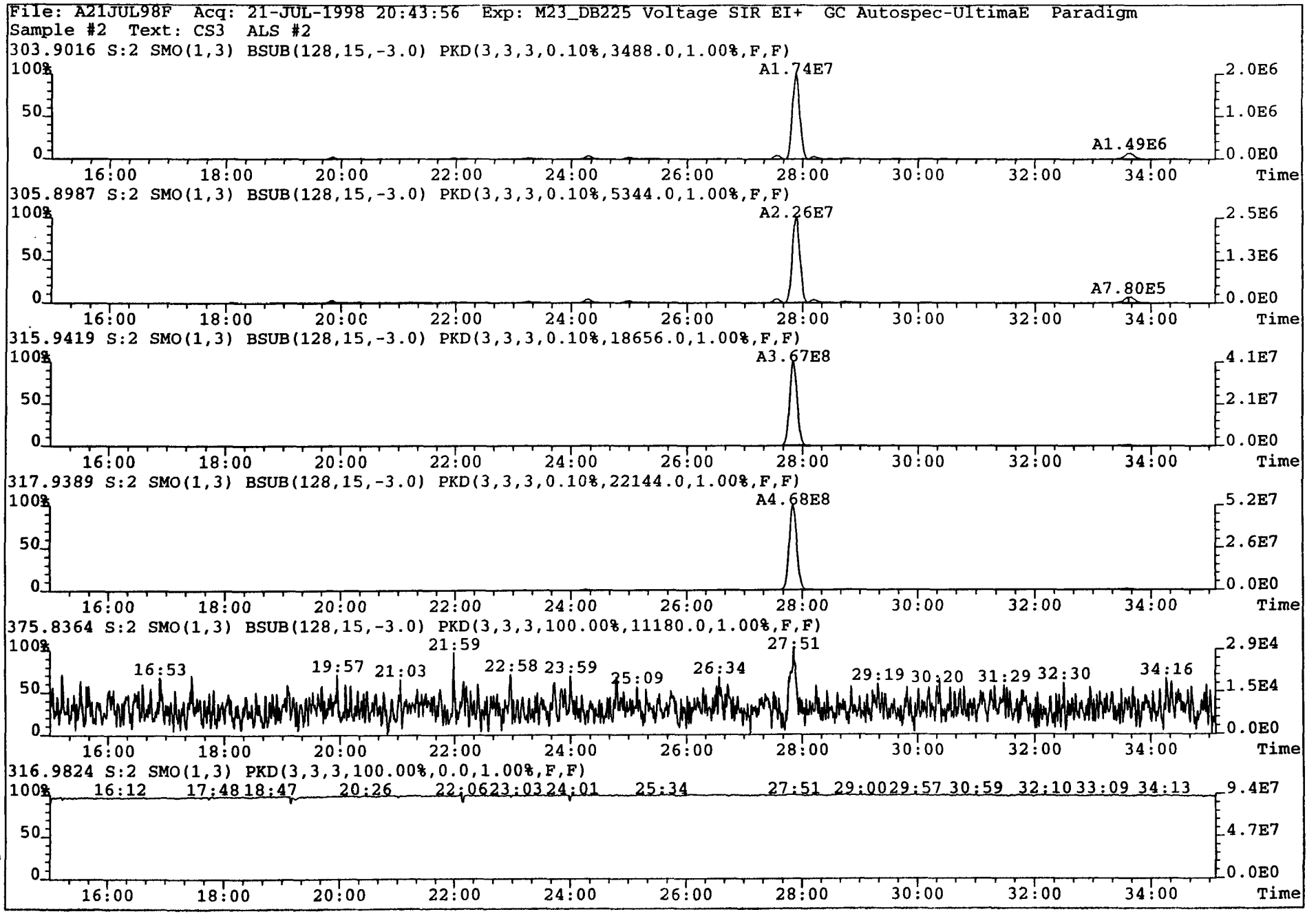
File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2




File: A17JUL98B Acq: 18-JUL-1998 03:17:11 Exp: EXP_M23_DB5_OVATION Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #15 Text: BE CS3 ALS #2
441.7427 S:15 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,540.0,1.00%,F,F)
A7.59E7
1.7E7
8.5E6
0.0E0
443.7398 S:15 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1976.0,1.00%,F,F)
A8.56E7
1.9E7
9.4E6
0.0E0
469.7780 S:15 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,2176.0,1.00%,F,F)
A2.76E8
6.4E7
3.2E7
0.0E0
471.7750 S:15 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,1480.0,1.00%,F,F)
A3.08E8
7.1E7
3.6E7
0.0E0
513.6775 S:15 F:5 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,84.0,1.00%,F,F)
40:01
39:11
39:21
39:37
39:47
40:22
40:29
40:35
40:43
40:51
1.3E4
6.5E3
0.0E0
454.9728 S:15 F:5 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
39:07 39:12 39:18 39:25 39:36 39:49 39:58 40:08 40:14 40:22 40:32 40:44 40:52
9.4E7
4.7E7
0.0E0
100%
50
0
39:12 39:24 39:36 39:48 40:00 40:12 40:24 40:36 40:48 41:00 Time

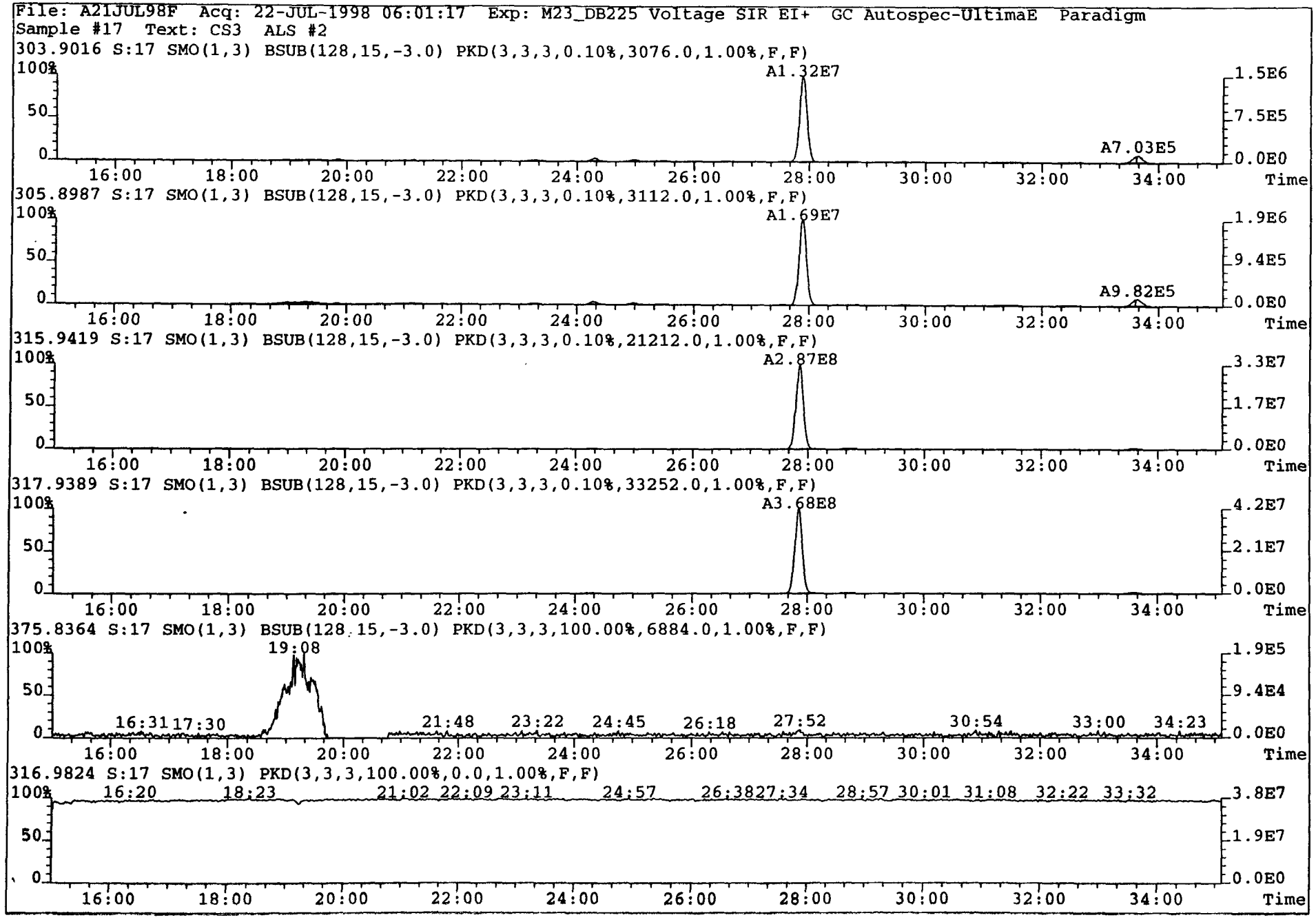
Run #7 Filename a21jul98f S: 2 I: 1 Acquired: 21-JUL-98 20:43:56 Processed: 22-JUL-98 08:22:02
Run: a07feb98f Analyte: Cal: 07feb-m23» Results: Quan : V3.5 17-APR-1997 11:14:34
Sample text: CS3 Comments: OPUS : V3.5X 17-APR-1997 11:31:23

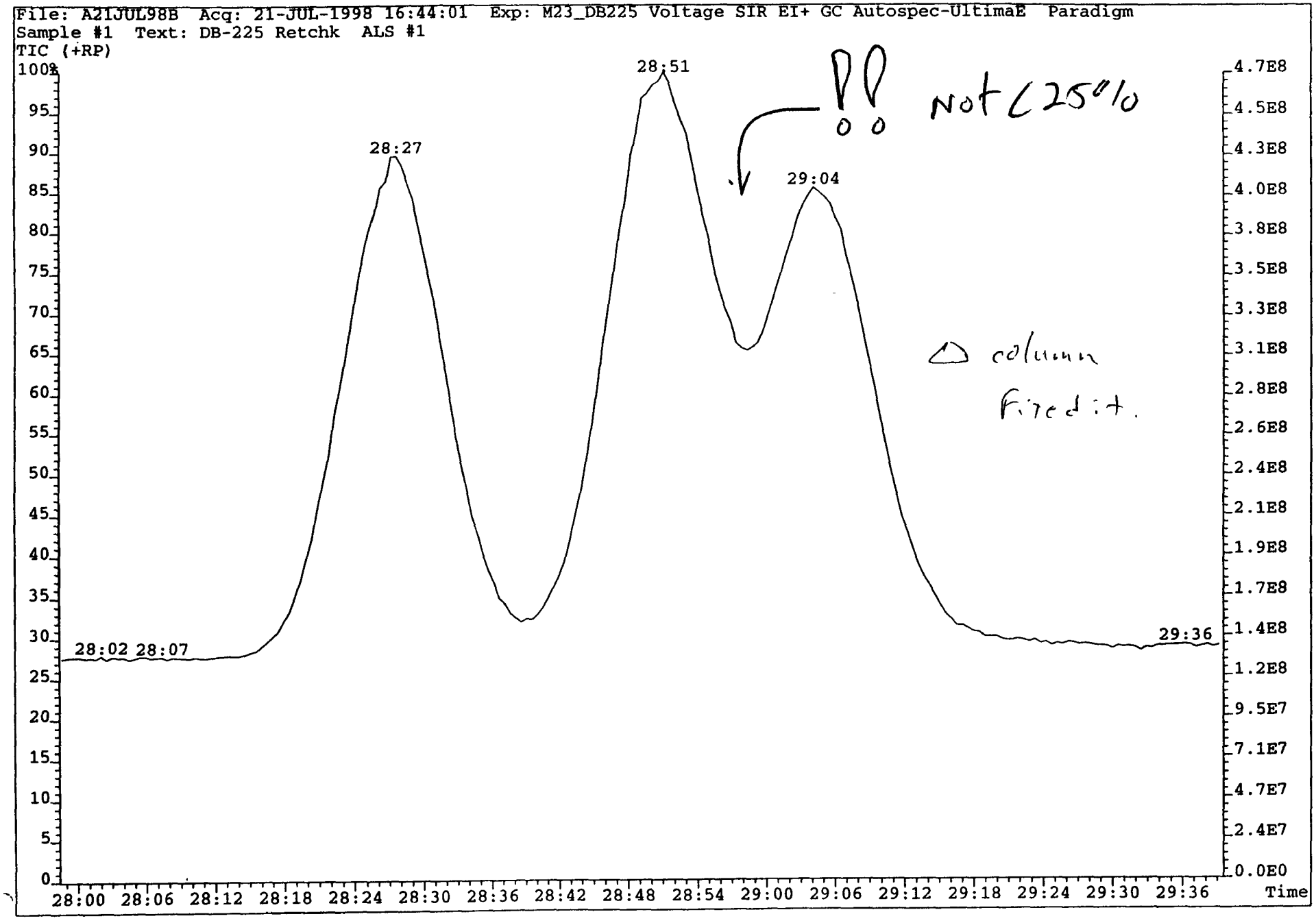
Typ	Name	Resp	RA		RT	Conc	Dev'n	Mod?
Unk	2,3,7,8-TCDF	4.0e+07	0.77	y	27:53	5.04	0.8	n
ES/RT	13C-2,3,7,8-TCDF	8.4e+08	0.78	y	27:51	205	-	n
Total	Tetra Furans	4.7e+07	1.74	n	19:51	5.96	0.8	n
DPE	HxCDPE	*			NotFnd	*	-	n
LMC	QC CHK ION (Tetra)	*			NotFnd	*	-	n


File: A21JUL98F Acq: 21-JUL-1998 20:43:56 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #2 Text: CS3 ALS #2
303.9016 S:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3488.0,1.00%,F,F)
A1.74E7
A1.49E6
305.8987 S:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,5344.0,1.00%,F,F)
A2.26E7
A7.80E5
315.9419 S:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,18656.0,1.00%,F,F)
A3.67E8
317.9389 S:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,22144.0,1.00%,F,F)
A4.68E8
375.8364 S:2 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,11180.0,1.00%,F,F)
16:53 19:57 21:03 21:59 22:58 23:59 25:09 26:34 27:51 29:19 30:20 31:29 32:30 34:16
316.9824 S:2 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
16:12 17:48 18:47 20:26 22:06 23:03 24:01 25:34 27:51 29:00 29:57 30:59 32:10 33:09 34:13
100%
50
0
16:00 18:00 20:00 22:00 24:00 26:00 28:00 30:00 32:00 34:00
Time
2.0E6
1.0E6
0.0E0
2.5E6
1.3E6
4.1E7
2.1E7
5.2E7
2.6E7
2.9E4
1.5E4
9.4E7
4.7E7

Run #8 Filename a21jul98f S: 17 I: 1 Acquired: 22-JUL-98 06:01:17 Processed: 22-JUL-98 08:24:11
Run: a07feb98f Analyte: Cal: 07feb-m23» Results: Quan : V3.5 17-APR-1997 11:14:34
Sample text: CS3 Comments: OPUS : V3.5X 17-APR-1997 11:31:23

Typ	Name	Resp	RA		RT	Conc	Dev'n	Mod?
Unk	2,3,7,8-TCDF	3.0e+07	0.78	y	27:53	4.85	-3.0	n
ES/RT	13C-2,3,7,8-TCDF	6.6e+08	0.78	y	27:51	161	-	n
Total	Tetra Furans	3.5e+07	1.11	n	17:59	5.55	-3.0	n
DPE	HxCDPE	*			NotFnd	*	-	n
LMC	QC CHK ION (Tetra)	*			NotFnd	*	-	n


File: A21JUL98F Acq: 22-JUL-1998 06:01:17 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #17 Text: CS3 ALS #2
303.9016 S:17 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3076.0,1.00%,F,F)
A1.32E7
A7.03E5
305.8987 S:17 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,3112.0,1.00%,F,F)
A1.69E7
A9.82E5
315.9419 S:17 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,21212.0,1.00%,F,F)
A2.87E8
317.9389 S:17 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,0.10%,33252.0,1.00%,F,F)
A3.68E8
375.8364 S:17 SMO(1,3) BSUB(128,15,-3.0) PKD(3,3,3,100.00%,6884.0,1.00%,F,F)
19:08
16:31 17:30 21:48 23:22 24:45 26:18 27:52 30:54 33:00 34:23
316.9824 S:17 SMO(1,3) PKD(3,3,3,100.00%,0.0,1.00%,F,F)
16:20 18:23 21:02 22:09 23:11 24:57 26:38 27:34 28:57 30:01 31:08 32:22 33:32
100%
50
0
16:00 18:00 20:00 22:00 24:00 26:00 28:00 30:00 32:00 34:00
Time
1.5E6
7.5E5
0.0E0
1.9E6
9.4E5
3.3E7
1.7E7
4.2E7
2.1E7
1.9E5
9.4E4
3.8E7
1.9E7


File: A21JUL98B Acq: 21-JUL-1998 16:44:01 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #1 Text: DB-225 Retchk ALS #1
TIC (+RP)
28:27
28:51
29:04
28:02 28:07
29:36
!!
Not <25%
column
Fixed it.
Time

```
        Filename ; a21jul98f
          Sample ; 3
        Acquired ; 21-JUL-98  21:20:54
       Processed ; 22-JUL-98  08:31:41
       Sample ID ; sb
       Cal Table ; 07feb-m23conf
   Results Table ; M8290-23-072198F
        Comments ;
Typ  ;                  Name;     Resp;    Ion 1;    Ion 2;   RA;?;     RT;      Conc;      DL;    S/N1;?;    S/N2;? ; mod?
Unk  ;           2,3,7,8-TCDF; 2.23e+05; 1.10e+05; 1.12e+05; 0.98;n; 27:53;        *;       *;       6;y;       9;y ;   no
ES/RT;       13C-2,3,7,8-TCDF;        *;        *;        *;    *;n;NotFnd;        *;       -;       *;n;       *;n ;   no
Total;           Tetra Furans; 2.67e+06; 2.62e+05; 6.62e+04; 3.95;n; 17:56;        *;       *;      14;y;       7;y ;   no
DPE  ;                HxCDPE;        *;        *                   ;NotFnd;        *;       -;       *;n            ;   no
LMC  ;     QC CHK ION (Tetra);        *;        *                   ;NotFnd;        *;       -;    Div0;n            ;   no

                                                ;        -;    -;-; 27:53

                                                ;        -;    -;-; 27:53                          ;       -; -;   no
```

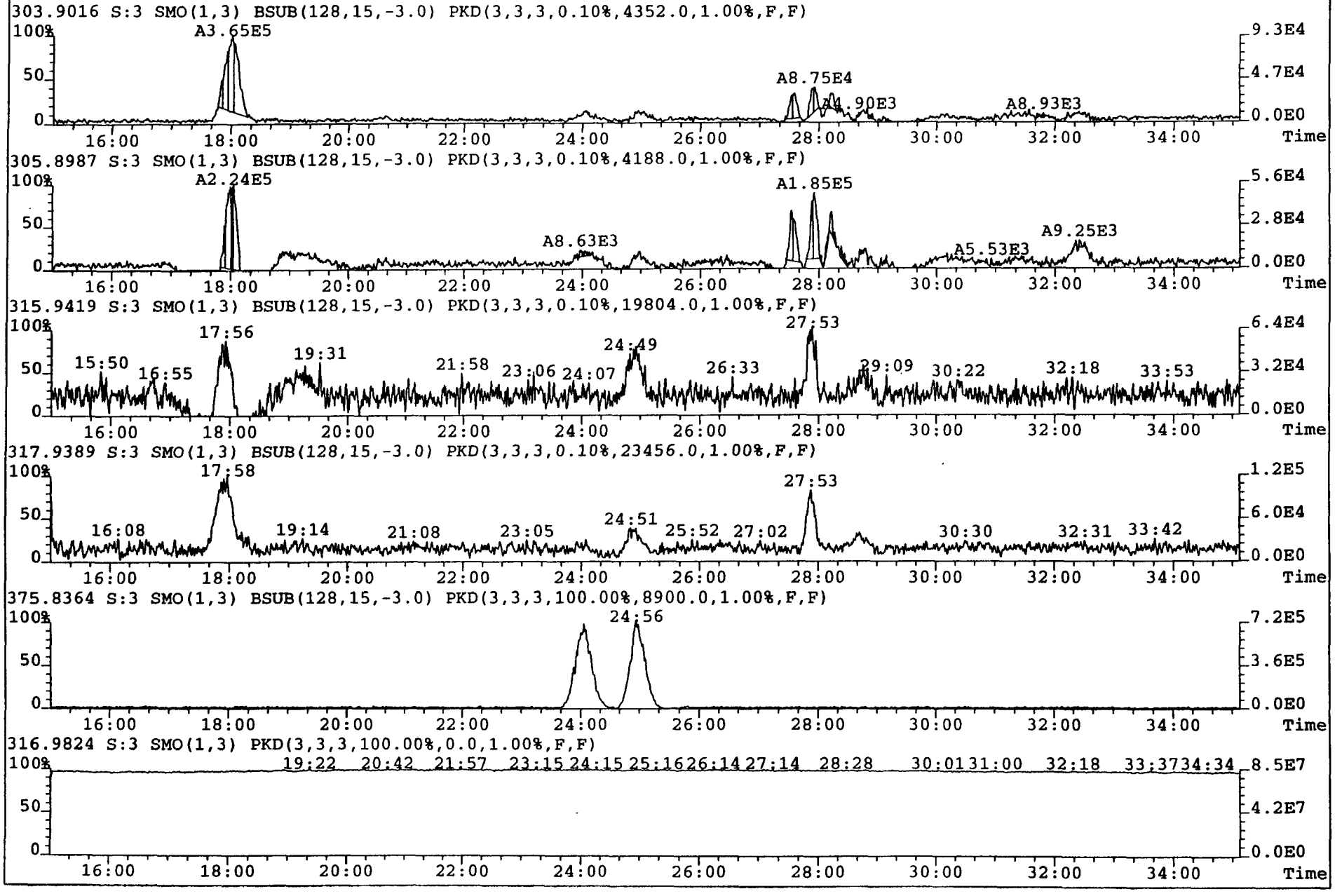
Ent: 3 Name: Tetra Furans F:1 Mass: 303.902 305.899 Mod? no #Hom:8

Run: 8 File: a21jul98f S:3 Acq:21-JUL-98 21:20:54 Proc:22-JUL-98 08:31:41
Tables: Run: a21jul98b Analyte: m23_conf Cal: 07feb-m23»Results: M8290-23»
Version: V3.5 17-APR-1997 11:14:34 Sample text: sb

Amount: * of which * named and * unnamed
Conc: * of which * named and * unnamed
Tox #1: - Tox #2: - Tox #3: -

Name	#	RT	Respnse	RA	Conc	Area	Height	S/N	Mod?	
	1	17:56	3.3e+05	3.95 n	*					
			3.3e+05			2.6e+05	6.3e+04	1.4e+01	y	n
						6.6e+04	2.8e+04	6.6e+00	y	n
	2	18:01	5.9e+05	1.63 n	*					
			5.9e+05			3.6e+05	8.0e+04	1.8e+01	y	n
						2.2e+05	5.5e+04	1.3e+01	y	n
	3	18:02	7.1e+05	2.16 n	*					
			7.1e+05			4.8e+05	7.3e+04	1.7e+01	y	n
						2.2e+05	5.5e+04	1.3e+01	y	n
	4	27:32	2.0e+05	0.76 y	*					
			2.0e+05			8.7e+04	2.5e+04	5.7e+00	y	n
						1.1e+05	3.3e+04	7.8e+00	y	n
	5	27:35	2.4e+05	1.08 n	*					
			2.4e+05			1.2e+05	2.7e+04	6.2e+00	y	n
						1.1e+05	2.8e+04	6.6e+00	y	n
2,3,7,8-TCDF	6	27:53	2.2e+05	0.98 n	*					
			2.2e+05			1.1e+05	2.8e+04	6.4e+00	y	n
						1.1e+05	3.8e+04	9.1e+00	y	n
	7	27:55	2.7e+05	0.47 n	*					
			2.7e+05			8.7e+04	2.7e+04	6.1e+00	y	n
						1.8e+05	4.3e+04	1.0e+01	y	n
	8	28:13	1.1e+05	2.12 n	*					
			1.1e+05			7.8e+04	1.6e+04	3.7e+00	y	n
						3.7e+04	1.5e+04	3.5e+00	y	n

File: A21JUL98F Acq: 21-JUL-1998 21:20:54 Exp: M23_DB225 Voltage SIR EI+ GC Autospec-UltimaE Paradigm
Sample #3 Text: sb ALS #3



APPENDIX C

CALCULATIONS & COMPUTER SUMMARIES

Summary of Stack Gas Parameters and Test Results
Air Emissions Screening Test
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet

	RUN NUMBER	**M23-I-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1520-1857**
	MEASURED DATA	
γ	Meter Box Correction Factor	1.021
ΔH	Avg Meter Orifice Pressure, in. H_2O	2.12
P_{bar}	Barometric Pressure, inches Hg	29.40
V_m	Sample Volume, ft^3	136.787
T_m	Average Meter Temperature, °F	109.5
P_{static}	Stack Static Pressure, inches H_2O	0.00
T_s	Average Stack Temperature, °F	254
V_{lc}	Condensate Collected, ml	301.1
CO_2	Carbon Dioxide content, % by volume	24.6
O_2	Oxygen content, % by volume	9.8
N_2	Nitrogen content, % by volume	65.6
C_p	Pitot Tube Coefficient	0.84
$\Delta p^{1/2}$	Average Square Root Δp, (in. $H_2O)^{1/2}$	1.0831
Θ	Sample Run Duration, minutes	180
D_n	Nozzle Diameter, inches	0.217
	CALCULATED DATA	
A_n	Nozzle Area, ft^2	0.00026
$V_{m(std)}$	Standard Meter Volume, dscf	127.849
$V_{m(std)m3}$	Standard Meter Volume, dscm	3.620
P_s	Stack Pressure, inches Hg	29.40
B_{ws}	Moisture, % by volume	10.0
V_{wstd}	Standard Water Vapor Volume, ft^3	14.173
$1-B_{ws}$	Dry Mole Fraction	0.9002
M_d	Molecular Weight (d.b.), lb/lb•mole	32.33
M_s	Molecular Weight (w.b.), lb/lb•mole	30.90
V_s	Stack Gas Velocity, ft/s	68.94
A	Stack Area, ft^2	12.306
Q_a	Stack Gas Volumetric flow, acfm	50,903
Q_s	Stack Gas Volumetric flow, dscfm	33,297
$Q_{s(cmm)}$	Stack Gas Volumetric flow, dscmm	943
I	Isokinetic Sampling Ratio, %	102.2

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet

	RUN NUMBER	**M23-I-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1520-1857**
	EMISSIONS DATA	
	DIOXINS:	
	2378 TCDD	
ng	Catch, ng	{0.0171}
ng/dscm	Concentration, ng/dscm, as measured	{0.00472}
µg/hr	Emission Rate, µg/hr	{0.267}
	Total TCDD	
ng	Catch, ng	1.356
ng/dscm	Concentration, ng/dscm, as measured	0.375
µg/hr	Emission Rate, µg/hr	21.2
	12378 PeCDD	
ng	Catch, ng	{0.0215}
ng/dscm	Concentration, ng/dscm, as measured	{0.00594}
µg/hr	Emission Rate, µg/hr	{0.336}
	Total PeCDD	
ng	Catch, ng	0.5514
ng/dscm	Concentration, ng/dscm, as measured	0.152
µg/hr	Emission Rate, µg/hr	8.62
	123478 HxCDD	
ng	Catch, ng	{0.0126}
ng/dscm	Concentration, ng/dscm, as measured	{0.00348}
µg/hr	Emission Rate, µg/hr	{0.197}
	123678 HxCDD	
ng	Catch, ng	{0.02086}
ng/dscm	Concentration, ng/dscm, as measured	{0.00576}
µg/hr	Emission Rate, µg/hr	{0.326}

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet

	RUN NUMBER	**M23-I-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1520-1857**
	EMISSIONS DATA -Continued	
	DIOXINS - Continued	
	123789 HxCDD	
ng	Catch, ng	0.0252
ng/dscm	Concentration, ng/dscm, as measured	0.00696
µg/hr	Emission Rate, µg/hr	0.394
	Total HxCDD	
ng	Catch, ng	0.5264
ng/dscm	Concentration, ng/dscm, as measured	0.145
µg/hr	Emission Rate, µg/hr	8.23
	1234678 HpCDD	
ng	Catch, ng	0.0509
ng/dscm	Concentration, ng/dscm, as measured	0.0141
µg/hr	Emission Rate, µg/hr	0.795
	Total HpCDD	
ng	Catch, ng	0.0964
ng/dscm	Concentration, ng/dscm, as measured	0.0266
µg/hr	Emission Rate, µg/hr	1.51
	OCDD	
ng	Catch, ng	0.0564
ng/dscm	Concentration, ng/dscm, as measured	0.0156
µg/hr	Emission Rate, µg/hr	0.881
	Total PCDD	
ng	Catch, ng	2.587
ng/dscm	Concentration, ng/dscm, as measured	0.715
µg/hr	Emission Rate, µg/hr	40.4

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet

	RUN NUMBER	**M23-I-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1520-1857**
	EMISSIONS DATA - Continued	
	FURANS	
	2378 TCDF	
ng	Catch, ng	0.1884
ng/dscm	Concentration, ng/dscm, as measured	0.0520
µg/hr	Emission Rate, µg/hr	2.94
	Total TCDF	
ng	Catch, ng	10.324
ng/dscm	Concentration, ng/dscm, as measured	2.85
µg/hr	Emission Rate, µg/hr	161
	12378 PeCDF	
ng	Catch, ng	0.129
ng/dscm	Concentration, ng/dscm, as measured	0.0356
µg/hr	Emission Rate, µg/hr	2.01
	23478 PeCDF	
ng	Catch, ng	0.158
ng/dscm	Concentration, ng/dscm, as measured	0.0436
µg/hr	Emission Rate, µg/hr	2.47
	Total PeCDF	
ng	Catch, ng	2.712
ng/dscm	Concentration, ng/dscm, as measured	0.749
µg/hr	Emission Rate, µg/hr	42.4
	123478 HxCDF	
ng	Catch, ng	0.1613
ng/dscm	Concentration, ng/dscm, as measured	0.0446
µg/hr	Emission Rate, µg/hr	2.52

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet

	RUN NUMBER	**M23-I-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1520-1857**
	EMISSIONS DATA - Continued	
	Furans - Continued	
	123678 HxCDF	
ng	Catch, ng	0.0612
ng/dscm	Concentration, ng/dscm, as measured	0.0169
µg/hr	Emission Rate, µg/hr	0.956
	234678 HxCDF	
ng	Catch, ng	0.0457
ng/dscm	Concentration, ng/dscm, as measured	0.0126
µg/hr	Emission Rate, µg/hr	0.714
	123789 HxCDF	
ng	Catch, ng	0.0127
ng/dscm	Concentration, ng/dscm, as measured	0.00351
µg/hr	Emission Rate, µg/hr	0.198
	Total HxCDF	
ng	Catch, ng	0.5676
ng/dscm	Concentration, ng/dscm, as measured	0.157
µg/hr	Emission Rate, µg/hr	8.87
	1234678 HpCDF	
ng	Catch, ng	0.0684
ng/dscm	Concentration, ng/dscm, as measured	0.0189
µg/hr	Emission Rate, µg/hr	1.07
	1234789 HpCDF	
ng	Catch, ng	{0.00722}
ng/dscm	Concentration, ng/dscm, as measured	{0.00199}
µg/hr	Emission Rate, µg/hr	{0.113}

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Inlet

	RUN NUMBER	**M23-I-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1520-1857**
	EMISSIONS DATA - Continued	
	Furans - Continued	
	Total HpCDF	
ng	Catch, ng	0.0860
ng/dscm	Concentration, ng/dscm, as measured	0.0238
µg/hr	Emission Rate, µg/hr	1.34
	OCDF	
ng	Catch, ng	{0.00968}
ng/dscm	Concentration, ng/dscm, as measured	{0.00267}
µg/hr	Emission Rate, µg/hr	{0.151}
	Total PCDF	
ng	Catch, ng	{13.6987}
ng/dscm	Concentration, ng/dscm, as measured	{3.78}
µg/hr	Emission Rate, µg/hr	{214}
	Total PCDD + PCDF	
ng	Catch, ng	{16.2855}
ng/dscm	Concentration, ng/dscm, as measured	{4.50}
µg/hr	Emission Rate, µg/hr	{254}

{ } Estimated Maximum Possible Concentration. EMPC values are included in totals.

Summary of Stack Gas Parameters and Test Results
Air Emissions Screening Test
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Stack

	RUN NUMBER	**M23-O-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1518-1855**
	MEASURED DATA	
γ	Meter Box Correction Factor	1.000
ΔH	Avg Meter Orifice Pressure, in. H_2O	2.10
P_{bar}	Barometric Pressure, inches Hg	29.40
V_m	Sample Volume, ft^3	141.112
T_m	Average Meter Temperature, °F	92.0
P_{static}	Stack Static Pressure, inches H_2O	-0.30
T_s	Average Stack Temperature, °F	231
V_{lc}	Condensate Collected, ml	310.9
CO_2	Carbon Dioxide content, % by volume	15.7
O_2	Oxygen content, % by volume	13.6
N_2	Nitrogen content, % by volume	70.7
C_p	Pitot Tube Coefficient	0.84
$\Delta p^{1/2}$	Average Square Root Δp, (in. $H_2O)^{1/2}$	1.0968
Θ	Sample Run Duration, minutes	180.0
D_n	Nozzle Diameter, inches	0.217
	CALCULATED DATA	
A_n	Nozzle Area, ft^2	0.00026
$V_{m(std)}$	Standard Meter Volume, dscf	133.265
$V_{m(std)m3}$	Standard Meter Volume, dscm	3.774
P_s	Stack Pressure, inches Hg	29.38
B_{ws}	Moisture, % by volume	9.9
V_{wstd}	Standard Water Vapor Volume, ft^3	14.634
$1-B_{ws}$	Dry Mole Fraction	0.9011
M_d	Molecular Weight (d.b.), lb/lb•mole	31.06
M_s	Molecular Weight (w.b.), lb/lb•mole	29.76
V_s	Stack Gas Velocity, ft/s	70.0
A	Stack Area, ft^2	12.48
Q_a	Stack Gas Volumetric flow, acfm	52,443
Q_s	Stack Gas Volumetric flow, dscfm	35,448
$Q_{s(cmm)}$	Stack Gas Volumetric flow, dscmm	1,004
I	Isokinetic Sampling Ratio, %	101.6

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Stack

	RUN NUMBER	**M23-O-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1518-1855**
	EMISSIONS DATA	
	DIOXINS:	
	2378 TCDD	
ng	Catch, ng	0.012
ng/dscm	Concentration, ng/dscm, as measured	0.00318
µg/hr	Emission Rate, µg/hr	0.192
	Total TCDD	
ng	Catch, ng	1.102
ng/dscm	Concentration, ng/dscm, as measured	0.292
µg/hr	Emission Rate, µg/hr	17.6
	12378 PeCDD	
ng	Catch, ng	0.009
ng/dscm	Concentration, ng/dscm, as measured	0.00238
µg/hr	Emission Rate, µg/hr	0.144
	Total PeCDD	
ng	Catch, ng	0.264
ng/dscm	Concentration, ng/dscm, as measured	0.0700
µg/hr	Emission Rate, µg/hr	4.21
	123478 HxCDD	
ng	Catch, ng	0.003
ng/dscm	Concentration, ng/dscm, as measured	0.000795
µg/hr	Emission Rate, µg/hr	0.0479
	123678 HxCDD	
ng	Catch, ng	0.005
ng/dscm	Concentration, ng/dscm, as measured	0.00132
µg/hr	Emission Rate, µg/hr	0.0798

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Stack

	RUN NUMBER	**M23-O-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1518-1855**

EMISSIONS DATA -Continued

DIOXINS - Continued

	123789 HxCDD	
ng	Catch, ng	0.004
ng/dscm	Concentration, ng/dscm, as measured	0.00106
µg/hr	Emission Rate, µg/hr	0.0638
	Total HxCDD	
ng	Catch, ng	0.116
ng/dscm	Concentration, ng/dscm, as measured	0.0307
µg/hr	Emission Rate, µg/hr	1.85
	1234678 HpCDD	
ng	Catch, ng	0.007
ng/dscm	Concentration, ng/dscm, as measured	0.00185
µg/hr	Emission Rate, µg/hr	0.112
	Total HpCDD	
ng	Catch, ng	0.013
ng/dscm	Concentration, ng/dscm, as measured	0.00344
µg/hr	Emission Rate, µg/hr	0.207
	OCDD	
ng	Catch, ng	0.024
ng/dscm	Concentration, ng/dscm, as measured	0.00636
µg/hr	Emission Rate, µg/hr	0.383
	Total PCDD	
ng	Catch, ng	1.519
ng/dscm	Concentration, ng/dscm, as measured	0.403
µg/hr	Emission Rate, µg/hr	24.2

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Stack

	RUN NUMBER	**M23-O-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1518-1855**
	EMISSIONS DATA - Continued	
	FURANS	
	2378 TCDF	
ng	Catch, ng	0.160
ng/dscm	Concentration, ng/dscm, as measured	0.0424
µg/hr	Emission Rate, µg/hr	2.55
	Total TCDF	
ng	Catch, ng	9.120
ng/dscm	Concentration, ng/dscm, as measured	2.42
µg/hr	Emission Rate, µg/hr	146
	12378 PeCDF	
ng	Catch, ng	0.087
ng/dscm	Concentration, ng/dscm, as measured	0.0231
µg/hr	Emission Rate, µg/hr	1.39
	23478 PeCDF	
ng	Catch, ng	0.086
ng/dscm	Concentration, ng/dscm, as measured	0.0228
µg/hr	Emission Rate, µg/hr	1.37
	Total PeCDF	
ng	Catch, ng	1.590
ng/dscm	Concentration, ng/dscm, as measured	0.421
µg/hr	Emission Rate, µg/hr	25.4
	123478 HxCDF	
ng	Catch, ng	0.047
ng/dscm	Concentration, ng/dscm, as measured	0.0125
µg/hr	Emission Rate, µg/hr	0.750

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Stack

	RUN NUMBER	**M23-O-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1518-1855**
	EMISSIONS DATA - Continued	
	Furans - Continued	
	123678 HxCDF	
ng	Catch, ng	0.017
ng/dscm	Concentration, ng/dscm, as measured	0.00450
µg/hr	Emission Rate, µg/hr	0.271
	234678 HxCDF	
ng	Catch, ng	0.011
ng/dscm	Concentration, ng/dscm, as measured	0.00291
µg/hr	Emission Rate, µg/hr	0.176
	123789 HxCDF	
ng	Catch, ng	0.004
ng/dscm	Concentration, ng/dscm, as measured	0.00106
µg/hr	Emission Rate, µg/hr	0.064
	Total HxCDF	
ng	Catch, ng	0.166
ng/dscm	Concentration, ng/dscm, as measured	0.0440
µg/hr	Emission Rate, µg/hr	2.65
	1234678 HpCDF	
ng	Catch, ng	0.017
ng/dscm	Concentration, ng/dscm, as measured	0.00450
µg/hr	Emission Rate, µg/hr	0.271
	1234789 HpCDF	
ng	Catch, ng	0.002
ng/dscm	Concentration, ng/dscm, as measured	0.000530
µg/hr	Emission Rate, µg/hr	0.0319

Summary of Stack Gas Parameters and Test Results
Chemical Lime Company - Marble Falls, Texas
US EPA Test Method 23 - PCDDs / PCDFs
Vertical Kiln Baghouse Stack

	RUN NUMBER	**M23-O-1**
	RUN DATE	**6/25/98**
	RUN TIME	**1518-1855**
	EMISSIONS DATA - Continued	
	Furans - Continued	
	Total HpCDF	
ng	Catch, ng	0.023
ng/dscm	Concentration, ng/dscm, as measured	0.00609
µg/hr	Emission Rate, µg/hr	0.367
	OCDF	
ng	Catch, ng	0.010
ng/dscm	Concentration, ng/dscm, as measured	0.00265
µg/hr	Emission Rate, µg/hr	0.160
	Total PCDF	
ng	Catch, ng	10.909
ng/dscm	Concentration, ng/dscm, as measured	2.89
µg/hr	Emission Rate, µg/hr	174
	Total PCDD + PCDF	
ng	Catch, ng	12.428
ng/dscm	Concentration, ng/dscm, as measured	3.29
µg/hr	Emission Rate, µg/hr	198

APPENDIX D

EXAMPLE EQUATIONS

Nomenclature

γ	Meter Box Correction Factor
ΔH	Avg Meter Orifice Pressure, in. H_2O
P_{bar}	Barometric Pressure, inches Hg
V_m	Sample Volume, ft^3
t_m	Average Meter Temperature, °F
P_{static}	Stack Static Pressure, inches H_2O
t_s	Average Stack Temperature, °F
V_{lc}	Condensate Collected, ml
CO_2	Carbon Dioxide content, % by volume
O_2	Oxygen content, % by volume
N_2	Nitrogen content, % by volume
C_p	Pitot Tube Coefficient
$\Delta p_{1/2}$	Average Square Root Δp, (in. $H_2O)^{1/2}$
Θ	Sample Run Duration, minutes
D_n	Nozzle Diameter, inches
A_n	Nozzle Area, ft^2
$V_{m(std)}$	Standard Meter Volume, dscf
$V_{m(std)m3}$	Standard Meter Volume, dscm
P_s	Stack Pressure, inches Hg
B_{ws}	Moisture, % by volume
$V_{w(std)}$	Standard Water Vapor Volume, ft^3
$1-B_{ws}$	Dry Mole Fraction
M_d	Molecular Weight, dry, lb/lb•mole
M_s	Molecular Weight, wet, lb/lb•mole
v_s	Stack Gas Velocity, ft/s
A	Stack Area, ft^2
Q_a	Stack Gas Volumetric flow, acfm
$Q_{s(std)}$	Stack Gas Volumetric flow, dscfm
$Q_{s(cmm)}$	Stack Gas Volumetric flow, dscmm
I	Isokinetic Sampling Ratio, %
ng/dscm	Concentration, ng/dscm
ng/dscm@7%O_2	Concentration, ng/dscm adjusted to 7% oxygen
ug/hr	Emission Rate, ug/hr
ppm_d	Concentration, parts per million, dry
ppm_w	Concentration, parts per million, wet
lb/hr	Emission Rate, pounds per hour

Example Calculations
Chemical Lime Company - Marble Falls, Texas
US EPA Method 23-PCDD/PCDF
(Using Data from Run M23-I-1)

Note: Discrepancies may exist between the computer generated reported results, which use more significant figures, and the values manually calculated from the displayed values.

1. Volume of dry gas sampled corrected to standard conditions of 68°F, 29.92 in. Hg, ft^3.

$$V_{m(std)} = 17.64 V_m \gamma \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{460 + t_m} \right)$$

$$V_{m(std)} = (17.64)(136.787)(1.021) \left(\frac{29.4 + \frac{2.115}{13.6}}{460 + 109.52} \right)$$

$$V_{m(std)} = 127.849 \text{ dscf}$$

2. Volume of dry gas sampled corrected to standard conditions of 68°F, 29.92 in. Hg, m^3.

$$V_{m(std)m^3} = V_{m(std)}(0.028317)$$

$$V_{m(std)m^3} = (127.849)(0.028317)$$

$$V_{m(std)m^3} = 3.620 \text{ dscm}$$

3. Volume of water vapor at standard conditions, ft^3.

$$V_{w(std)} = 0.04707 V_{1c}$$

$$V_{w(std)} = (0.04707)(301.1)$$

$$V_{w(std)} = 14.173 \text{ scf}$$

4. Moisture content in stack gas.

$$B_{ws} = \frac{V_{w(std)}}{(V_{m(std)} + V_{w(std)})} (100)$$

$$B_{ws} = \frac{14.173}{127.849 + 14.173} (100)$$

$$B_{ws} = 9.98$$

5. Dry molecular weight of stack gas, lb/lb-mol.

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

$$M_d = 0.44(24.6) + 0.32(9.8) + 0.28(65.6 + 0)$$

$$M_d = 32.33 \text{ lb/lb·mol}$$

6. Molecular weight of stack gas, lb/lb-mol.

$$M_s = M_d(1 - B_{ws}/100) + 18(B_{ws}/100)$$

$$M_s = 32.33(1 - 9.98/100) + 18(9.98/100)$$

$$M_s = 32.33(0.9002) + 18(0.0998)$$

$$M_s = 29.1035 + 1.7964$$

$$M_s = 30.90 \text{ lb/lb·mol}$$

7. Absolute stack gas pressure, in. Hg.

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$

$$P_s = 29.4 + \frac{(0.0)}{13.6}$$

$$P_s = 29.4 \text{ inches Hg}$$

8. Stack velocity at stack conditions, fps.

$$v_s = 85.49\ C_p \left(\sqrt{\Delta p}\right)_{avg} \sqrt{\frac{t_s + 460}{M_s\ P_s}}$$

$$v_s = (85.49)(0.84)(1.0831) \sqrt{\frac{(253.7 + 460)}{(30.90)(29.4)}}$$

$$v_s = 68.94 \text{ fps}$$

9. Isokinetic Variation.

$$I = \frac{\left(V_{m(std)}\right)\left(t_s + 460\right)\left(17.32\right)}{\left(v_s\right)\left(D_n^2\right)\left(\theta\right)\left(P_s\right)\left(1 - B_{ws}/100\right)}$$

$$I = \frac{(127.849)\ (253.7 + 460)\ (17.32)}{(68.94)\ (0.217)^2\ (180)\ (29.4)\ (1 - 9.98/100)}$$

$$I = 102.2$$

10. Stack gas volumetric flow rate at stack conditions, acfm.

$$Q_a = (60)\ (A)\ (v_s)$$

$$Q_a = (60)\ (12.306)\ (68.94)$$

$$Q_a = 50{,}903 \text{ acfm}$$

11. Dry stack gas volumetric flow rate at standard conditions, dscfm.

$$Q_{s(std)} = 17.64\ Q_a \frac{P_s}{(t_s + 460)} \left(1 - B_{ws}/100\right)$$

$$Q_{s(std)} = (17.64)\ (50{,}903) \left(\frac{29.4}{253.7 + 460}\right) \left(1 - 9.98/100\right)$$

$$Q_{s(std)} = 33{,}297 \text{ dscfm}$$

12. Dry stack gas volumetric flow rate at standard conditions, dscmm.

$$Q_{s(cmm)} = Q_{s(std)}\ 0.028317$$

$$Q_{s(cmm)} = (33{,}297)\ (0.028317)$$

$$Q_{s(cmm)} = 943 \text{ dscmm}$$

13. Pollutant (2378 TCDD) concentration, ng/dscm.

$$\text{ng/dscm} = \frac{\text{ng}}{V_{m(std)m^3}}$$

$$\text{ng/dscm} = \frac{[\ 0.0171\ ]}{3.620}$$

$$\text{ng/dscm} = [\ 0.00472\ ]\ \text{ng/dscm}$$

14. Pollutant (2378 TCDD) concentration, ng/dscm adjusted to 7 percent oxygen.

$$\text{ng/dscm@7\%O}_2 = (\text{ng/dscm})\ \frac{(20.9\ -\ 7)}{(20.9\ -\ \%O_2)}$$

$$\text{ng/dscm@7\%O}_2 = ([0.00472])\ \frac{13.9}{(20.9\ -\ 9.8)}$$

$$\text{ng/dscm@7\%O}_2 = [0.00591]\ \text{ng/dscm@7\%O}_2$$

15. Pollutant (2378 TCDD) emission rate, μg/hr.

$$\mu\text{g/hr} = \frac{(60)\ (\text{ng})\ (Q_{s(std)})}{(10^3)\ (V_{m(std)})}$$

$$\mu\text{g/hr} = \frac{(60)\ ([0.0171])\ (33{,}297)}{(10^3)\ (127.849)}$$

$$\mu\text{g/hr} = [0.267]\ \mu\text{g/hr}$$

16. CEM Pollutant (HCl) Concentration, ppm_d

$$ppm_d = ppm_w / (1 - B_{ws}/100)$$

$$ppm_d = 22.7 / (1 - 9.98/100)$$

$$ppm_d = 25.2\ ppm_d$$

17. CEM Pollutant (HCl) Emission Rate, lb/hr.

$$lb/hr = \frac{(60)\ (ppm_d)\ (Fwt)\ (Q_{s(std)})}{(10^6)\ (385.3)}$$

$$lb/hr = \frac{(60)\ (25.2)\ (36.47)\ (33{,}300)}{(10^6)\ (385.3)}$$

$$lb/hr = 4.77\ lb/hr$$

18. Method 3A Calibration Error, %. Values are for the oxygen, high range.

$$\text{Cal Err \%} = (100)\ (\text{Instrument Response} - \text{Calibration Gas Concentration}) / \text{Span}$$

$$\text{Cal Err \%} = (100)\ (19.0 - 19.2) / 25$$

$$\text{Cal Err \%} = -0.8\ \%$$

19. Method 3A System Bias Check, %. Values are for the oxygen, final upscale check.

$$\text{Sys Bias \%} = (100)\ (\text{Instr. Response}_{CAL\ ERR} - \text{Instr. Response}_{SYS\ CAL}) / \text{Span}$$

$$\text{Sys Bias \%} = (100)\ (19.0 - 19.3) / 25$$

$$\text{Sys Bias \%} = -1.2\ \%$$

20. Method 3A Drift, %. Values are for the oxygen, upscale check.

$$\text{Drift } \% = (100)\,(\text{Instr. Response}_{\text{FINAL SYS CAL}} - \text{Instr. Response}_{\text{INIT SYS CAL}})/\text{Span}$$

$$\text{Drift } \% = (100)\ (19.3 - 18.9)\ /\ 25$$

$$\text{Drift } \% = 1.6\ \%$$

21. Method 3A Zero & Upscale Sampling System Check Adjustment. Values are for oxygen, %.

$$C_{gas} = (C_{avg} - C_O)\,\frac{C_{ma}}{C_m - C_O}$$

$$C_{gas} = (9.8 - 0.1)\,\frac{19.2}{19.1 - 0.1}$$

$$C_{gas} = 9.8\ \%$$

Where:

C_{gas} = Adjusted gas concentration, ppm or %
C_{avg} = Average unadjusted gas concentration from analyzer
C_O = Average of zero gas initial & final system cal. bias check
C_{ma} = Actual concentration of the upscale calibration gas
C_m = Average of upscale initial & final system cal. bias check

22. Method 322 Zero & Upscale System Bias Checks Adjustment To Analyzer HCl Average.

$$C_{gas} = \frac{(m_i + m_f)\left[\frac{(C_{avg} - b_c)}{m_c}\right] + (b_i + b_f)}{2}$$

$$C_{gas} = \frac{(0.989 + 1.011)\left[\frac{(20.49 - 1.49)}{0.988}\right] + (1.10 + 2.10)}{2}$$

$$C_{gas} = 22.7 \text{ ppm}$$

Where:

b_c = Y-intercept of the calibration least-squares line.
b_f = Y-intercept of the final bias check 2-point line.
b_i = Y-intercept of the initial bias check 2-point line.
C_{gas} = Effluent gas concentration, as measured, ppm.
C_{avg} = Average gas concentration indicated by gas analyzer, as measured, ppm.
m_c = Slope of the calibration least-squares line.
m_f = Slope of the final bias check 2-point line.
m_i = Slope of the initial bias check 2-point line.

23. Method 322 HCl Matrix Spike Recovery, Pretest

<u>In Situ HCl Expected (Predicted) Spike Concentration, ppm.</u>

$$C_E = (C_S)\ (Q_s/Q_{tot}) + (S_U)(1-(Q_s/Q_{tot}))$$

$$C_E = (303)\ (1.5/14.0) + (7.4)(1-(1.5/14.0))$$

$$C_E = 39.1 \text{ ppm}$$

Where:

C_E	=	Recovery efficiency of spiked HCl, %
C_S	=	Concentration of HCl in spike gas, ppm
Q_S	=	Spike gas (dilution) flow rate, lpm
Q_t	=	Sample gas (unspiked) flow rate, lpm
Q_{tot}	=	(Q_S+Q_t) Sum of the spike gas and the sample flow rates, lpm
S_U	=	Concentration of unspiked (native) sample gas

<u>In Situ HCl Spike Recovery Efficiency, %.</u>

$$\%R = (S_M/C_E)(100)$$

$$\%R = (42.6/39.1)(100)$$

$$\%R = 109\ \%$$

Where:

%R	=	Efficiency of recovery of spiked HCl, %
S_M	=	Observed concentration of spiked + sample gas, ppm
C_E	=	Expected or predicted concentration of HCl in spike gas, ppm

APPENDIX E

QA/QC DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.
Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Initial Dry Gas Meter Calibration Form (English Units)

Date: 9/1/97 Calibrator: Tom McDonald Meter Box No.: MB-10

P_{bar}, in Hg 30.16 Reference Meter Correction Factor: 1.0049 (8/28/96)

ΔH = 0.5

		Dry Gas Meter MB-10								
	Trial	Gas Volume			Meter Temperatures					
	Duration	Initial	Final	Net	Initial, Inlet	Final, Inlet	Avg. Inlet	Initial, Outlet	inal, Outle	Avg. Outlet
Trial	(min)	(ft^3)	(ft^3)	(ft^3)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)
1	19	994.409	1001.982	7.573	74	78	76	73	75	74
2	19	1001.982	1009.513	7.531	77	80	78.5	75	77	76
3	19	1009.513	1017.050	7.537	80	81	80.5	77	78	77.5

	Reference Meter						Meter Box	Reference
	Gas Volume			Meter Temperature			Correction	Orifice Press
	Initial	Final	Net	Initial	Final	Avg.	Factor	$\Delta H_@$
Trial	(ft^3)	(ft^3)	(ft^3)	(°F)	(°F)	(°F)	γ	(in. H_2O)
1	600.523	608.185	7.662	72	74	73	1.019	1.71
2	608.185	615.801	7.616	74	76	75	1.019	1.74
3	615.801	623.430	7.629	76	77	76.5	1.021	1.74

ΔH = 0.75

		Dry Gas Meter MB-10								
	Trial	Gas Volume			Meter Temperatures					
	Duration	Initial	Final	Net	Initial, Inlet	Final, Inlet	Avg. Inlet	Initial, Outlet	inal, Outle	Avg. Outlet
Trial	(min)	(ft^3)	(ft^3)	(ft^3)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)
1	15	17.220	24.350	7.130	80	82	81	78	79	78.5
2	15	24.350	31.563	7.213	82	83	82.5	79	79	79
3	15	31.563	38.780	7.217	82	83	82.5	79	81	80

	Reference Meter						Meter Box	Reference
	Gas Volume			Meter Temperature			Correction	Orifice Press
	Initial	Final	Net	Initial	Final	Avg.	Factor	$\Delta H_@$
Trial	(ft^3)	(ft^3)	(ft^3)	(°F)	(°F)	(°F)	γ	(in. H_2O)
1	623.622	630.833	7.211	77	77	77	1.020	1.82
2	630.833	638.141	7.308	78	78	78	1.021	1.77
3	638.141	645.425	7.284	78	78.5	78.25	1.018	1.79

ΔH = 1.0

		Dry Gas Meter MB-10								
	Trial	Gas Volume			Meter Temperatures					
	Duration	Initial	Final	Net	Initial, Inlet	Final, Inlet	Avg. Inlet	Initial, Outlet	inal, Outle	Avg. Outlet
Trial	(min)	(ft^3)	(ft^3)	(ft^3)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)
1	10	38.946	44.490	5.544	81	83	82	80	80	80
2	10	44.490	50.050	5.560	83	84	83.5	80	80	80
3	10	50.050	55.585	5.535	84	84	84	80	80	80

	Reference Meter						Meter Box	Reference
	Gas Volume			Meter Temperature			Correction	Orifice Press
	Initial	Final	Net	Initial	Final	Avg.	Factor	$\Delta H_@$
Trial	(ft^3)	(ft^3)	(ft^3)	(°F)	(°F)	(°F)	γ	(in. H_2O)
1	645.614	651.22	5.606	78	78	78	1.019	1.79
2	651.220	656.829	5.609	78	78	78	1.018	1.78
3	656.829	662.435	5.606	78	78	78	1.023	1.78

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ΔH = 2.0		Dry Gas Meter MB-10								
	Trial	Gas Volume			Meter Temperatures					
Trial	Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	10	55.868	63.519	7.651	84	86	85	81	81	81
2	10	63.519	71.182	7.663	86	86	86	81	81	81
3	10	71.182	78.845	7.663	86	87	86.5	81	81	81

	Reference Meter						Meter Box	Reference
	Gas Volume			Meter Temperature			Correction	Orifice Press
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	Factor γ	$\Delta H_@$ (in. H_2O)
1	662.729	670.472	7.743	78	78	78	1.021	1.87
2	670.472	678.244	7.772	78	78	78	1.025	1.86
3	678.244	686.010	7.766	78	78	78	1.024	1.86

ΔH = 4.0		Dry Gas Meter MB-10								
	Trial	Gas Volume			Meter Temperatures					
Trial	Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	8	79.058	86.620	7.562	85	88	86.5	81	82	81.5
2	8	86.620	94.185	7.565	87	89	88	82	82	82
3	8	94.185	101.754	7.569	89	89	89	82	82	82

	Reference Meter						Meter Box	Reference
	Gas Volume			Meter Temperature			Correction	Orifice Press
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	Factor γ	$\Delta H_@$ (in. H_2O)
1	686.208	693.895	7.687	78	78	78	1.023	2.44
2	693.895	701.558	7.663	78	78	78	1.021	2.45
3	701.558	709.244	7.686	78	78	78	1.025	2.43

Calibration Results

ΔH	γ	$\Delta H_@$
0.50	1.020	1.73
0.75	1.020	1.79
1.0	1.020	1.78
2.0	1.023	1.86
4.0	1.023	2.44

Dry Gas Meter MB-10 on 09/01/97	
Meter Box Calibration Factor	**1.021**
Meter Box Reference Orifice Pressure	**1.92**

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Posttest Dry Gas Meter Calibration Form (English Units)

Pretest Calibration Factor 1.021
System Vacuum Setting, (in Hg) 17
Reference Meter Correction Factor 1.0077
Date: 7/9/98 P_{bar}, in Hg 29.95 Calibrator: D. Holzschuh Meter Box No. MB-10

ΔH = 1.53

		Dry Gas Meter								
Trial	Duration (min)	Initial (ft³)	Final (ft³)	Net (ft³)	Initial, Inlet (°F)	Final, Inle (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	Final, Outlet (°F)	Avg. Outlet (°F)
1	10	611.3	618.025	6.725	79	77	78	79	78	78.5
2	11	618.025	625.403	7.378	77	77	77	78	77	77.5
3	10	625.403	632.111	6.708	77	77	77	77	77	77

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press
	Gas Volume			Meter Temperature				
Trial	Initial (ft³)	Final (ft³)	Net (ft³)	Initial (°F)	Final (°F)	Avg. (°F)	γ	$\Delta H_@$ (in. H2O)
1	432.055	438.894	6.839	77	79	78	1.021	1.85
2	438.894	446.392	7.498	79	77	78	1.019	1.87
3	446.392	453.2	6.808	77	77	77	1.019	1.87

[redacted]

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Initial Dry Gas Meter Calibration Form (English Units)

Date: 10/13/97 Calibrator: MMD Meter Box No.: RMB-15

P_{bar}, in Hg 29.86 Reference Meter Correction Factor: 1.0077 (10/5/97)

ΔH = 0.5

Trial	Trial Duration (min)	Dry Gas Meter RMB-15 Gas Volume Initial (ft^3)	Final (ft^3)	Net (ft^3)	Meter Temperatures Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	15	48.833	54.722	5.889	73	77	75	72	75	73.5
2	13	54.722	59.821	5.099	78	80	79	74	75	74.5
3	12	59.821	64.544	4.723	80	83	81.5	76	77	76.5

Trial	Reference Meter Gas Volume Initial (ft^3)	Final (ft^3)	Net (ft^3)	Meter Temperature Initial (°F)	Final (°F)	Avg. (°F)	Meter Box Correction Factor γ	Reference Orifice Press $\Delta H_@$ (in. H_2O)
1	34.044	39.829	5.785	70	70	70	0.997	1.86
2	39.829	44.843	5.014	71	70	70.5	1.001	1.86
3	44.843	49.463	4.620	71	71	71	0.999	1.86

ΔH = 0.75

Trial	Trial Duration (min)	Dry Gas Meter RMB-15 Gas Volume Initial (ft^3)	Final (ft^3)	Net (ft^3)	Meter Temperatures Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	8	69.524	73.327	3.803	74	74	74	77	75	76
2	21	73.327	83.322	9.995	77	83	80	76	77	76.5
3	13	83.322	89.571	6.249	78	82	80	78	74	76

Trial	Reference Meter Gas Volume Initial (ft^3)	Final (ft^3)	Net (ft^3)	Meter Temperature Initial (°F)	Final (°F)	Avg. (°F)	Meter Box Correction Factor γ	Reference Orifice Press $\Delta H_@$ (in. H_2O)
1	54.365	58.108	3.743	72	72	72	0.996	1.91
2	58.108	67.912	9.804	72	73	72.5	0.997	1.91
3	67.912	74.036	6.124	73	73	73	0.995	1.88

ΔH = 1.0

Trial	Trial Duration (min)	Dry Gas Meter RMB-15 Gas Volume Initial (ft^3)	Final (ft^3)	Net (ft^3)	Meter Temperatures Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	19	89.777	100.214	10.437	82	86	84	79	80	79.5
2	8	100.214	104.614	4.400	85	87	86	81	81	81
3	16	104.614	113.404	8.790	85	88	86.5	82	83	82.5

Trial	Reference Meter Gas Volume Initial (ft^3)	Final (ft^3)	Net (ft^3)	Meter Temperature Initial (°F)	Final (°F)	Avg. (°F)	Meter Box Correction Factor γ	Reference Orifice Press $\Delta H_@$ (in. H_2O)
1	74.254	84.44	10.186	73	73	73	0.997	1.92
2	84.440	88.743	4.303	73	73	73	1.002	1.91
3	88.743	97.302	8.559	73	73	73	1.000	1.92

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ΔH = 2.0

		Dry Gas Meter RMB-15								
	Trial	Gas Volume			Meter Temperatures					
Trial	Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	9	13.863	20.884	7.021	87	91	89	83	83	83
2	7	20.884	26.372	5.488	90	92	91	84	84	84
3	7	26.372	31.871	5.499	90	93	91.5	84	84	84

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	$\Delta H_@$ (in. H_2O)
1	97.749	104.591	6.842	73	73	73	1.001	1.90
2	104.591	109.929	5.338	73	73	73	1.002	1.89
3	109.929	115.281	5.352	73	74	73.5	1.002	1.88

ΔH = 4.0

		Dry Gas Meter RMB-15								
	Trial	Gas Volume			Meter Temperatures					
Trial	Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	6.5	32.371	39.484	7.113	92	94	93	85	85	85
2	15.5	39.484	56.484	17.000	93	97	95	87	87	87

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	$\Delta H_@$ (in. H_2O)
1	15.775	22.732	6.957	73	74	73.5	1.004	1.92
2	22.732	39.287	16.555	73	73	73	1.005	1.92

Calibration Results

ΔH	γ	$\Delta H_@$	
0.50	0.999	1.86	
0.75	0.996	1.90	
1.0	1.000	1.92	
2.0	1.002	1.89	
4.0	1.004	1.92	<—— Two Trial Average

Dry Gas Meter RMB-15 on 10/13/97

Meter Box Calibration Factor	**1.000**
Meter Box Reference Orifice Pressure	**1.90**

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Posttest Dry Gas Meter Calibration Form (English Units)

Pretest Calibration Factor 1.000
System Vacuum Setting, (in Hg) 16
Reference Meter Correction Factor 1.0077
Date: 7/9/98 P_{bar}, in Hg 29.95 Calibrator: DDH Meter Box No. RMB-15

ΔH = 1.39

		Dry Gas Meter								
Trial	Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inle (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	Final, Outlet (°F)	Avg. Outlet (°F)
1	10	356.55	362.922	6.372	77	77	77	77	77	77
2	10	362.922	369.302	6.380	77	77	77	77	77	77
3	10	369.302	375.662	6.360	77	77	77	77	77	77

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	$ΔH_@$ (in. H2O)
1	455.45	461.749	6.299	75	74	74.5	0.997	1.96
2	461.749	468.028	6.279	74	74	74	0.994	1.97
3	468.028	474.295	6.267	74	74	74	0.995	1.98

[redacted]

REFERENCE METER CALIBRATION
ENGLISH REFERENCE METER UNITS

DGM Serial # 6841495
Date 10/5/97

Filename: F:\DATAFILE\CALIBRAT\CAL_MENU.DSK\DGM_REF.
Revised: 06/08/95

Barometric Pressure 29.82
Meter Yw 1.00000
K (deg R/inches Hg) 17.64

Time (min)	Pressure (in. H20)	Dry Gas Meter (DGM) Meter Readings Initial	Final	Volume (cubic feet)	Temperature Initial (deg F)	Final (deg F)	Wet Test Meter (WTM) Meter Readings Initial	Final	Volume (cubic feet)	Temp (deg F)	DGM Coefficient Yds	Coefficient Variation Yds-(Avg.Yds)	Flow Rate (CFM)
20.50	-8.000	742.719	768.193	25.474	78.0	79.0	671.890	697.180	25.290	77.0	1.016	0.002	1.208
5.00	-8.000	768.193	774.402	6.209	79.0	79.0	697.180	703.325	6.145	77.0	1.013	0.000	1.204
13.00	-8.000	774.402	790.575	16.173	79.0	79.0	703.325	719.309	15.984	77.0	1.012	-0.002	1.204
									Max Yds - Min Yds =0.003626886 Must be no greater than 0.030				
									Average Yds =1.013636253 Must be between 0.95 to 1.05				
8.50	-5.400	790.575	798.821	8.246	79.0	79.0	719.309	727.485	8.176	77.0	1.009	0.001	0.942
27.50	-5.400	798.821	825.423	26.602	79.0	80.0	727.485	753.809	26.324	77.0	1.008	0.000	0.938
26.50	-5.400	825.423	850.983	25.560	80.0	81.0	753.809	779.025	25.216	77.0	1.006	-0.001	0.932
									Max Yds - Min Yds =0.002262496 Must be no greater than 0.030				
									Average Yds =1.007525980 Must be between 0.95 to 1.05				
14.00	-3.800	850.983	861.899	10.916	81.0	81.0	779.025	789.820	10.795	77.0	1.006	0.001	0.755
15.50	-3.800	861.899	873.960	12.061	81.0	82.0	789.820	801.740	11.920	77.0	1.006	0.001	0.753
12.50	-3.800	953.219	962.970	9.751	86.0	86.0	879.651	889.205	9.554	78.0	1.004	-0.001	0.747
									Max Yds - Min Yds =0.002245979 Must be no greater than 0.030				
									Average Yds =1.005164785 Must be between 0.95 to 1.05				
23.50	-2.400	962.970	976.611	13.641	86.0	87.0	889.205	902.599	13.394	78.0	1.003	-0.001	0.557
17.50	-2.400	976.611	986.740	10.129	87.0	87.0	902.599	912.545	9.946	78.0	1.004	0.000	0.556
15.00	-2.400	986.740	995.413	8.673	87.0	88.0	912.545	921.069	8.524	78.0	1.006	0.002	0.556
									Max Yds - Min Yds =0.002785363 Must be no greater than 0.030				
									Average Yds =1.004591811 Must be between 0.95 to 1.05				
32.00	-1.600	995.413	1008.596	13.183	88.0	89.0	921.069	934.025	12.956	78.0	1.006	-0.002	0.396
35.00	-1.600	1008.596	1022.986	14.390	89.0	89.0	934.025	948.175	14.150	78.0	1.007	0.000	0.395
15.00	-1.600	1022.986	1029.158	6.172	89.0	90.0	948.175	954.255	6.080	78.0	1.010	0.002	0.396
									Max Yds - Min Yds =0.004205886 Must be no greater than 0.030				
									Average Yds =1.007822494 Must be between 0.95 to 1.05				

Overall Average Yds =1.007748265

I certify that the above Dry Gas Meter was calibrated in accordance with E.P.A. Method 5 , paragraph 7.1 ;CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date 10-5-97

REFERENCE METER CALIBRATION
ENGLISH REFERENCE METER UNITS

Barometric Pressure 29.73
Meter Yw 1.00000
K (deg R/inches Hg) 17.64

DGM Serial # 6841495
Date 8/28/96

Filename: F:\DATAFILE\CALIBRAT\CAL_MENU.DSK\DGM_REF.
Revised: 06/08/95

Time (min)	Pressure (in. H20)	Dry Gas Meter (DGM) Meter Readings Initial	Final	Volume (cubic feet)	Temperature Initial (deg F)	Final (deg F)	Wet Test Meter (WTM) Meter Readings Initial	Final	Volume (cubic feet)	Temp (deg F)	DGM Coefficient Yds	Coefficient Variation Yds-(Avg.Yds)	Flow Rate (CFM)
6.00	-6.60	374.451	381.901	7.450	73.0	76.0	496.572	503.987	7.415	77.0	1.007	-0.004	1.207
24.00	-6.60	381.901	411.424	29.523	74.0	76.0	503.987	533.471	29.484	77.0	1.011	0.000	1.200
8.00	-6.60	411.424	421.233	9.809	76.0	76.0	533.471	543.279	9.808	77.0	1.015	0.004	1.197
									Max Yds - Min Yds =0.007489914			Must be no greater than 0.030	
									Average Yds =1.011058546			Must be between 0.95 to 1.05	
10.00	-4.00	421.233	430.675	9.442	76.0	77.0	543.279	552.761	9.482	77.0	1.013	0.009	0.926
35.00	-4.00	430.675	464.147	33.472	77.0	77.0	552.761	585.965	33.204	77.0	1.002	-0.003	0.926
16.50	-4.00	464.147	479.992	15.845	77.0	78.0	585.965	601.625	15.660	77.0	0.999	-0.006	0.927
									Max Yds - Min Yds =0.014197179			Must be no greater than 0.030	
									Average Yds =1.004786738			Must be between 0.95 to 1.05	
12.50	-2.80	479.992	489.698	9.706	78.0	78.0	601.625	611.270	9.645	77.0	1.003	0.002	0.754
14.00	-2.80	489.698	500.594	10.896	78.0	78.0	611.270	622.061	10.791	77.0	0.999	-0.002	0.753
58.50	-2.80	500.594	546.063	45.469	78.0	79.0	622.061	667.125	45.064	77.0	1.001	0.000	0.752
									Max Yds - Min Yds = 0.00338145			Must be no greater than 0.030	
									Average Yds =1.000808891			Must be between 0.95 to 1.05	
16.50	-1.60	574.496	583.672	9.176	79.0	79.0	695.390	704.530	9.140	77.0	1.004	0.000	0.541
42.00	-1.60	590.619	614.123	23.504	80.0	80.0	711.429	734.785	23.356	77.0	1.003	0.000	0.543
66.50	-1.60	614.123	651.520	37.397	80.0	81.0	734.785	771.901	37.116	77.0	1.003	0.000	0.545
									Max Yds - Min Yds =0.000835063			Must be no greater than 0.030	
									Average Yds =1.003302205			Must be between 0.95 to 1.05	
15.00	-1.00	651.520	657.572	6.052	81.0	82.0	771.901	777.994	6.093	78.0	1.016	0.011	0.396
13.50	-1.00	657.572	663.065	5.493	82.0	82.0	777.994	783.400	5.406	78.0	0.994	-0.010	0.390
35.00	-1.00	663.065	677.274	14.209	82.0	82.0	783.400	797.515	14.115	78.0	1.003	-0.001	0.393
									Max Yds - Min Yds =0.021724294			Must be no greater than 0.030	
									Average Yds =1.004344616			Must be between 0.95 to 1.05	

Overall Average Yds =1.004860199

I certify that the above Dry Gas Meter was calibrated in accordance with E.P.A. Method 5 , paragraph 7.1 ;CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature [illegible] (UHT) Date 9-28-96

TEMPERATURE SENSOR CALIBRATION FORM

DGM-IN

Temperature Sensor No. MB-10 Sensor Type K-TC Length 8"
Ambient Temp. °F 76 Barometric Pressure, "Hg 29.61"
Reference Temp. Sensor: _____

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
3-20-98	1	ICE H2O	33	34			
"	2	AMB. AIR	76	76	0		
"	3	BOIL. H2O	206	205			
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\%\ Temp.\ Diff = \frac{(Ref.\ Temp + 460) - (Test\ Temp. + 460)}{(Ref.\ Temp. + 460)} \times 100 \leq 1.5\ \%$$

TEMPERATURE SENSOR CALIBRATION FORM

DGM-OUT

Temperature Sensor No. MB-10 **Sensor Type** K-TC **Length** 12"
Ambient Temp. °F 76 **Barometric Pressure, "Hg** 29.61"
Reference Temp. Sensor: _____

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
3-20-98	1	ICE H_2O	32	34	.406	Y	WB
"	2	AMB, AIR	76	77	.186	Y	WB
"	3	BOIL H_2O	206	205	.150	Y	WB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\% \text{ Temp. Diff} = \frac{(\text{Ref. Temp} + 460) - (\text{Test Temp.} + 460)}{(\text{Ref. Temp.} + 460)} \times 100 \leq 1.5\ \%$$

TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RMB-15 DGM-1D Sensor Type K-TC Length 1'
Ambient Temp. °F 74 Barometric Pressure, "Hg 30.24"
Reference Temp. Sensor: _____

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
3-18-98	1	ICE H_2O	33	35	.406	Y	JWB
"	2	AMB. AIR	74	74	0	Y	JWB
"	3	Boil. H_2O	208	210	.299	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\%\ Temp.\ Diff = \frac{(Ref.\ Temp + 460) - (Test\ Temp. + 460)}{(Ref.\ Temp. + 460)} \times 100 \leq 1.5\ \%$$

TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RMB-15 DCM-OUT Sensor Type K-TC Length 2'
Ambient Temp. °F 74 Barometric Pressure, "Hg 30.24"
Reference Temp. Sensor: _____

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
3-18-98	1	ICE H_2O	33	33	0	Y	JWB
"	2	AMB AIR	74	75	.187	Y	JWB
"	3	BOIL. H_2O	208	208	0	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\% \text{ Temp. Diff} = \frac{(\text{Ref. Temp} + 460) - (\text{Test Temp.} + 460)}{(\text{Ref. Temp.} + 460)} \times 100 \leq 1.5\ \%$$

PACIFIC ENVIRONMENTAL SERVICES,INC.

4700 Duke Drive,
Suite 150
Mason, Ohio
Phone: (513) 398-2556
Fax: (513) 3983342
www.pes.com

TEMPERATURE SENSOR CALIBRATION DATA FOR STACK THERMOCOUPLES

THERMOCOUPLE NUMBER: T5A

DATE: 12/22/97

BAROMETRIC PRES.(In.Hg): 29.52

REFERENCE:
Mercury-in-glass: ASTM-3F

Other:

AMBIENT TEMP. °F: 72

CALIBRATOR: J.C.

Reference point number	Source[a] (Specify)	Reference Thermometer Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference,[b] %
1	Ambient Air	72	72	0.00
2	Cold Bath	44	44	0.00
3	Hot Bath	204	204	0.00
4	Hot Oil	400	400	0.00

[a]Type of calibration used.

[b]$\frac{(\text{ref. temp.}^\circ F+460)-(\text{test thermometer temp.}^\circ F+460)}{\text{ref temp.}^\circ F+460} \times 100$ $100 \leq 1.5\%$

Comments:

PACIFIC ENVIRONMENTAL SERVICES,INC.

4700 Duke Drive,
Suite 150
Mason, Ohio
Phone: (513) 398-2556
Fax: (513) 3983342
www.pes.com

TEMPERATURE SENSOR CALIBRATION DATA FOR STACK THERMOCOUPLES

THERMOCOUPLE NUMBER: T6F

DATE: 12/23/97

BAROMETRIC PRES.(In.Hg): 29.52

REFERENCE:
Mercury-in-glass: ASTM-3F

Other:

AMBIENT TEMP. °F: 74

CALIBRATOR: G.Gay

Reference point number	Source[a] (Specify)	Reference Thermometer Temperature,°F	Thermocouple Potentiometer Temperature,°F	Temperature Difference,[b] %
1	Ambient Air	74	74	0.00
2	Cold Bath	34	33	0.20
3	Hot Bath	172	172	0.00
4	Hot Oil	349	350	0.12

[a]Type of calibration used.

[b] $\frac{(\text{ref. temp.}°F+460)-(\text{test thermometer temp.}°F+460)}{\text{ref temp,}°F+460} \times 100$ 100≤1.5%

Comments:

PACIFIC ENVIRONMENTAL SERVICES, INC.

4700 Duke Drive,
Suite 150
Mason, Ohio 45040
Phone: (513) 398-2556
Fax (513) 398-3342
www.pes.com

Pitot Tube Number: 5H Date: 12/22/97

Effective Length: 59" Calibrated By: S. Simon

Pitot Tube Openings Damaged? YES **NO**

Pitot Tube Assembly Level? **YES** NO

α_1 = 0.7 °(< 10°) α_2 = 1.6 °(< 10°)

β_1 = 4 °(< 5°) β_2 = 3.3 °(< 5°)

Y = 0.6 θ = 0.4 A = 0.956

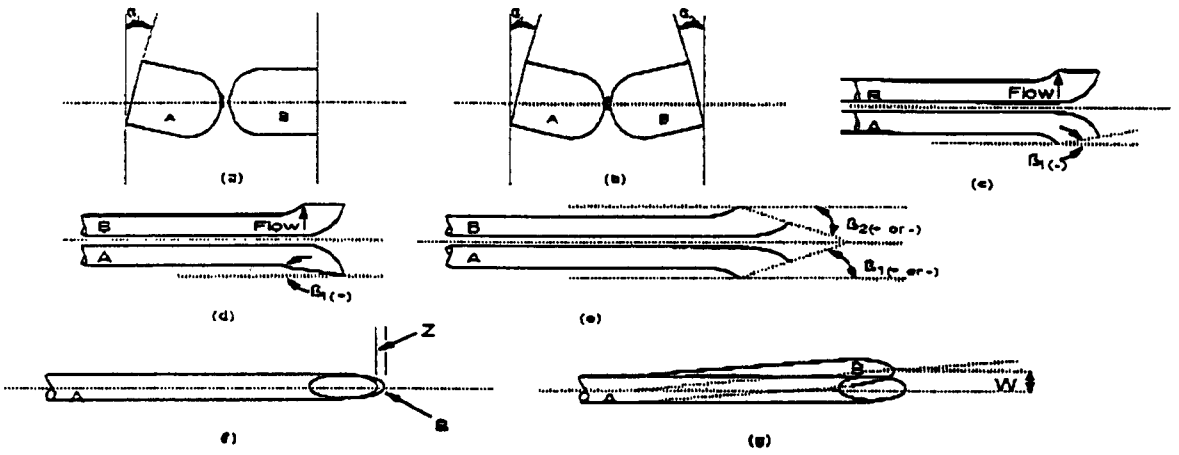
z = A sin γ = 0.0100 cm (in.) 0.32 cm (< 1/8 in.)

w = A sin θ = 0.0067 cm (in.) 0.08 cm (< 1/32 in.)

P_A = 0.478 cm (in.)

P_β = 0.478 cm (in.)

D_t = 0.375 cm (in.)



The types of face-opening misalignment shown above will not affect the baseline value of Cp(s) so long as α_1 and α_2 is less than or equal to 10°, β_1 and β_2 is less than or equal to 5°, z is less than or equal to 0.32 cm (1/8 in.), and w is less than or equal to 0.08 cm(1/32 in.) (reference 11.0 in Section 16.0)

6A

PACIFIC ENVIRONMENTAL SERVICES, INC.

4700 Duke Drive,
Suite 150
Mason, Ohio 45040
Phone: (513) 398-2556
Fax (513) 398-3342
www.pes.com

Pitot Tube Number: 6A Date: 12/23/97

Effective Length: 75.5" Calibrated By: S. Simon

Pitot Tube Openings Damaged? YES [NO]

Pitot Tube Assembly Level? [YES] NO

α_1 = 1 °(< 10°) α_2 = 0.2 °(< 10°)

β_1 = 0.2 °(< 5°) β_2 = 0.8 °(< 5°)

Y = 2.2 θ = 1.1 A = 1.006

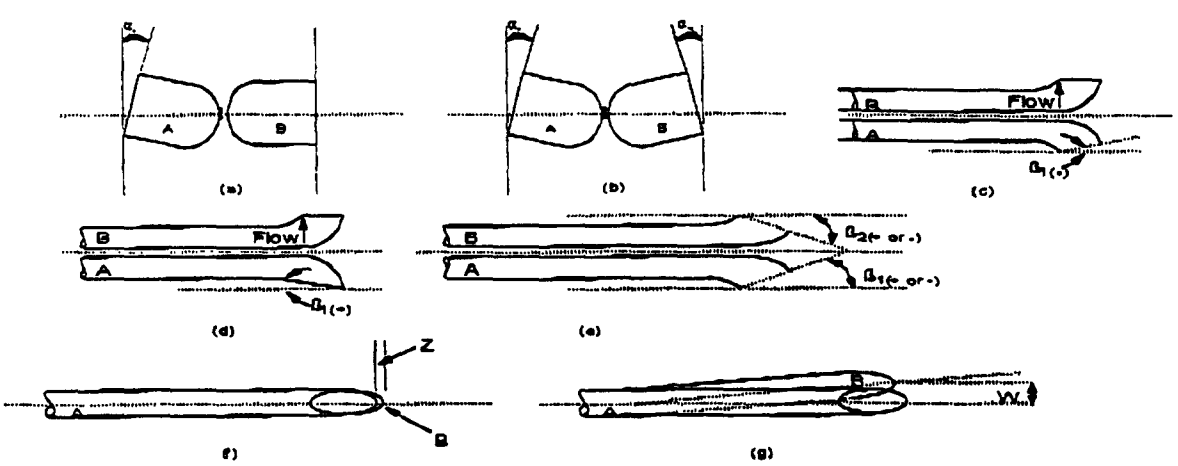
z = A sin Y = 0.039 cm (in.) 0.32 cm (< 1/8 in.)

w = A sin θ = 0.019 cm (in.) 0.08 cm (< 1/32 in.)

P_A = 0.504 cm (in.)

P_β = 0.505 cm (in.)

D_t = 0.375 cm (in.)



The types of face-opening misalignment shown above will not affect the baseline value of Cp(s) so long as α_1 and α_2 is less than or equal to 10°, β_1 and β_2 is less than or equal to 5°, z is less than or equal to 0.32 cm (1/8 in.), and w is less than or equal to 0.08 cm(1/32 in.) (reference 11.0 in Section 16.0)

NOZZLE CALIBRATION SHEET

DATE: 6-16-98 CALIBRATION BY: JWB

Nozzle Identification Number	D_1, in.	D_2, in.	D_3, in.	ΔD, in.	D_{avg}
GLASS VII	0.217	0.217	0.216	0.001	0.217

Where:

$D_{1,2,3}$ = nozzle diameter measured on a different diameter, in.
Tolerance = measure within 0.001 in.

ΔD = maximum difference in any two measurements, in.
Tolerance = 0.004 in.

D_{avg}= average of D_1, D_2, D_3.

NOZZLE CALIBRATION SHEET

DATE: 6-16-98 CALIBRATION BY: JWB

Nozzle Identification Number	D_1, in.	D_2, in.	D_3, in.	ΔD, in.	D_{avg}
GLASS XIX	0.216	0.218	0.217	0.002	0.217

Where:

$D_{1,2,3}$ = nozzle diameter measured on a different diameter, in.
Tolerance = measure within 0.001 in.

ΔD = maximum difference in any two measurements, in.
Tolerance = 0.004 in.

D_{avg}= average of D_1, D_2, D_3.

Airgas

Post-it® Fax Note 7671	Date 10/28/98	# of pages ▶
To EMILL STEWART	From TERRY / APCC	
Co./Dept.	Co.	
Phone #	Phone #	
Fax # (919) 941-0234	Fax # (860) 871-8675	

Airgas Specialty Gases
325 McCausland Court
Cheshire, CT 06410
Phone: (203) 250-6827
FAX: (203) 250-6842

Certificate of Analysis: E.P.A. Protocol Gas Mixture

Rec#	4149		
Cylinder No :	CC84329	Purchase Order #	139680
Cylinder Pressure:	2000	Expiration Date:	3/2/01
Certification Date	3/2/98	Laboratory:	Cheshire, CT

Reference Standard Information:

Type	Component	Cyl. Number	Concentration
GMIS	Carbon Dioxide	CC34977	14.08 %
GMIS	Oxygen	CC19914	20.98 %

Instrumentation:

Instrument/Model/Serial No.	Analytical Principle
Rosemount/NGA2000/Rack#1	NDIR
Servomex/244/701/488	Parmagnetic

Analytical Methodology does not require correction for analytical interferences.

Certified Concentrations:

Component	Concentration	Accuracy	Procedure
Carbon Dioxide	11.033 %	G1 2%	G1
Oxygen	11.04 %	1% 2%	G1
Nitrogen	Balance		

Analytical Results:

1st Component: Carbon Dioxide

1st Analysis Date: 2/16/98

R	3.259	S	2.912	Z	0.305	Conc	11.033 %
S	2.948	Z	0.256	R	3.305	Conc	11.041 %
Z	0.285	R	3.298	S	2.941	Conc	11.027 %
						AVG:	11.034 %

2nd Component: Oxygen

1st Analysis Date: 3/2/98

R	173.630	S	91.130	Z	1.460	Conc	11.057 %
S	91.110	Z	1.420	R	173.610	Conc	11.046 %
Z	1.890	R	173.630	S	91.150	Conc	11.017 %
						AVG:	11.040 %

Certification performed in accordance with "EPA Traceability Protocol (Jan, 1998)" using the assay procedures listed.

Approved for Release

Do not use cylinder below 150 psig.

Airgas

Airgas Specialty Gas

325 McCausland Court
Cheshire, CT 06410
Phone: (203) 250-6827
FAX: (203) 250-6842

Certificate of Analysis: E.P.A. Protocol Gas Mixture

Rec#	4150		
Cylinder No :	CC86922	Purchase Order #	13980
Cylinder Pressure:	2000	Expiration Date:	3/2/01
Certification Date	3/2/98	Laboratory:	Cheshire, CT

Reference Standard Information:

Type	Component	Cyl. Number	Concentration
GMIS	Carbon Dioxide	CC34977	14.08 %
GMIS	Oxygen	CC19914	20.98 %

Instrumentation:

Instrument/Model/Serial No.	Analytical Principle
Rosemount/NGA2000/Rack#1	NDIR
Servomex/244/701/488	Parmagnetic

Analytical Methodology does not require correction for analytical interferences.

Certified Concentrations:

Component	Concentration	Accuracy	Procedure
Carbon Dioxide	19.01 %	+/- 2%	G1
Oxygen	19.17 %	+/- 2%	G1
Nitrogen	Balance		

Analytical Results:

1st Component: Carbon Dioxide

1st Analysis Date: 2/16/98

R	3.259	S	3.726	Z	0.305	Conc	19.065 %
S	3.782	Z	0.258	R	3.305	Conc	19.006 %
Z	0.265	R	3.298	S	3.769	Conc	18.964 %
						AVG:	19.012 %

2nd Component: Oxygen

1st Analysis Date: 3/2/98

R	173.630	S	156.890	Z	1.460	Conc	19.175 %
S	156.970	Z	1.420	R	173.810	Conc	19.165 %
Z	1.890	R	173.630	S	157.030	Conc	19.158 %
						AVG:	19.166 %

Certification performed in accordance with "EPA Traceability Protocol (Jan. 1998)" using the assay procedures listed.

Do not use cylinder below 150 psig.

Approved for Release

Scott Specialty Gases

Shipped From: 1750 EAST CLUB BLVD
DURHAM NC 27704
Phone: 919-220-0803 Fax: 919-220-0808

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER

5001 SOUTH MIAMI
3RD FLOOR, SUITE #300
RESEARCH TRIANGLE PA NC 27709-2077

PROJECT #: 12-28662-001
PO#: 104-98-0178
ITEM #: 12023411 **CAL**
DATE: 5/01/98

CYLINDER #: AAL13302
FILL PRESSURE: 1400 PSIG

ANALYTICAL ACCURACY: +-1%
PRODUCT EXPIRATION: 5/01/2001

BLEND TYPE : RECERTIFICATION OF CYLINDER

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
PROPANE	30.	PPM	30.0	PPM
AIR		BALANCE		BALANCE

ANALYST: B.M. Becton
B.M. BECTON

Scott Specialty Gases

1750 EAST CLUB BOULEVARD, DURHAM, NC 27704 (919) 220-0803 FAX: (919) 220-0808

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
Pacific Environmental Services
Attn: Mr. Frank Meadows
P.O. Box 12077
Research Triangle Park, NC 27709

Assay Laboratory
Scott Specialty Gases, Inc.
1750 East Club Boulevard
Durham, NC 27704

Purchase Order 104-95-0121
Scott Project # 12-11271

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol Procedure #G1, issued September, 1993.

Cylinder Number AAL-13302 **Certification Date** 04-18-95 **Expiration Date** [redacted]
Cylinder Pressure 2000 PSIG **Previous Certification** None

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Propane	[redacted]	+/- 1% NIST Directly Traceable
Air		Balance

Do not use when cylinder pressure is less than 150 PSIG.

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
NIRM # 1668	06-96	ALM-032005	95.5 PPM Balance in Air

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
Varian /3400/16804	03-23-95	Gas Chromatography

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: Propane

First Triad Analysis

Date: 04-18-95 Response Units: Area
STD=1397517 SPL=436968
SPL=437952 SPL=438070
STD=1396975 STD=1395705

Second Triad Analysis

Date: Response Units:
STD= SPL=
SPL= SPL=
STD= STD=

Date: Response Units:
STD= SPL=
SPL= SPL=
STD= STD=

Date: Response Units:
STD= SPL=
SPL= SPL=
STD= STD=

Calibration Curve

Date: 03-23-95

Date:

Date: Response Units:
STD= SPL=
SPL= SPL=
STD= STD=

Date: Response Units:
STD= SPL=
SPL= SPL=
STD= STD=

Analyst: S. Vaughan

PROTOCOL

SPECIALTY GA. DEPARTMENT
12722 S. WENTWORTH AVENUE
CHICAGO, IL 60628

Certificate of Analysis - EPA Protocol Gas Standard

PERFORMED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS (PROCEDURE #G1)

Customer:
ROCHESTER - APCI
77 DEEP ROCK RD.
ROCHESTER NY 14624-

Notes:

PO: GALSON Rel:

Order No: 314-053317-
Batch No: 861-34622
Cylinder No: SG9151288BA
Bar Code No: DDJ496
Cylinder Pressure*: 2000 psig
Certification Date: 09/27/96
Expiration Date: 09/27/99

*** Certified Concentration ***			********* Reference Standards *********		********** Analytical Instrumentation *********			
Component	Certified Concentration	Cylinder #	Standard Number	Concentration	Instrument Make/Model	Serial Number	Last Calibration	Measurement Principal
PROPANE	58.3 ±.28 PPM	SG9128557BAL	GMIS	50.33 PPM	Gow-Mac 750	59405U	09/10/96	GC-FID

Balance Gas: AIR
Oxygen Concentration 19.9 %

* Standard should not be used below 150 psig

Analyst: Joe Estafanous

Approved By: Richard Fry

For Technical Information Call
1-800-752-1597

AIR PRODUCTS

Air Products and Chemicals, Inc. * 12722 S. Wentworth Avenue, Chicago, IL 60628

ISO CERTIFICATION: 9002

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS STANDARD

PERFORMED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS (PROCEDURE #G1)

Customer:
AIR PRODUCTS AND CHEMICALS, INC.
4822 INDUSTRY LANE
UDI BUSINESS PARK
DURHAM NC 27709

Order No: 833-075875-01
Batch No: 861-45269
PO:
Release:

Cylinder No: SG9170173BAL
Bar Code No: DDT476
Cylinder Pressure*: 2000 psig
Certification Date: 02/18/98
Expiration Date: 02/18/01

CERTIFIED CONCENTRATION		REFERENCE STANDARDS			ANALYTICAL INSTRUMENTATION			
Component	Certified Concentration	Cylinder Number	Standard Type	Standard Concentration	Instrument Make/Model	Serial Number	Last Calibration	Measurement Principal
PROPANE	92.4±.67 PPM	SG9128479BAL	GMIS	100.7 PPM	Gow-Mac 750	59405U	02/10/98	GC-FID
AIR	Balance Gas							

Contaminant

Oxygen Concentration 21.0 %

* STANDARD SHOULD NOT BE USED BELOW 150 PSIG

Approved By: James Laas

SPECTRA GASES
277 Coit Street • Irvington, NJ 07111 USA Tel: (973) 372-2060 • (800) 929-2427 • Fax: (973) 372-8551

SHIPPED FROM: 80 INDUSTRIAL DRIVE ALPHA, NJ. 08865 TEL: (908) 454-7455

SHIPPED TO: APCC LTD
60 Industrial Park Road West
Tolland, CT 06084

CERTIFICATE OF ANALYSIS

SGI ORDER # :	133817		
ITEM# :	3	CYLINDER # :	CC88470
CERTIFICATION DATE:	6/12/98	CYLINDER PRES:	2000 psig
P.O.# :	3426	CYLINDER VALVE:	CGA 330
BLEND TYPE:	CERTIFIED		

ANALYTICAL ACCURACY: + / - 5%

COMPONENT	REQUESTED GAS CONC	ANALYSIS
Hydrogen Chloride	42.0 ppm	46.0 ppm
Nitrogen	Balance	Balance

ANALYST: Ted Neerne

DATE: 6/12/98

RECEIVED JUN 1 7 [redacted]

SPECTRA GASES

277 Coit Street • Irvington, NJ 07111 USA Tel: (973) 372-2060 • (800) 929-2427 • Fax: (973) 372-8551

SHIPPED FROM: 80 INDUSTRIAL DRIVE ALPHA, NJ. 08865 TEL: (908) 454-7455

SHIPPED TO: APCC LTD
60 Industrial Park Road West
Tolland, CT 06084

CERTIFICATE OF ANALYSIS

SGI ORDER # :	133817		
ITEM# :	4	**CYLINDER # :**	1836637Y
CERTIFICATION DATE:	6/12/98	**CYLINDER PRES:**	2000 psig
P.O.# :	3426	**CYLINDER VALVE:**	CGA 330
BLEND TYPE:	CERTIFIED		

ANALYTICAL ACCURACY: + / - 5%

COMPONENT	REQUESTED GAS CONC	ANALYSIS
Hydrogen Chloride	300 ppm	303 ppm
Nitrogen	Balance	Balance

ANALYST: Mike Doyle

DATE: 6/12/98

TABLE C-3.2
Chemical Lime Calibration Table
25-June-98
INLET

Marble Falls,TX	CALIBRATION ERROR TEST			
THC	Range 0 - 100ppm			
	ACTUAL CONC	RESPONSE	PREDICTED	% CAL ERR
ZERO GAS	0.0	0.0	-	-
LOW RANGE	30.0	32.7	29.3	11.4%
MID RANGE	58.3	58.0	56.9	1.9%
HIGH RANGE	92.4	90.2	90.2	0.0%
O2	Range 0 - 25%			
	ACTUAL CONC	RESPONSE	DIFFERENCE	% SPAN
ZERO GAS	0.0	0.1	0.1	0.4%
MID RANGE	11.04	11.2	0.2	0.6%
HIGH RANGE	19.2	19.0	-0.2	-0.8%
CO2	Range 0 - 50%			
	ACTUAL CONC	RESPONSE	DIFFERENCE	% SPAN
ZERO GAS	0.0	0.3	0.3	0.6%
MID RANGE	11.03	11.3	0.3	0.5%
HIGH RANGE	19.0	19.0	0.0	0.0%
HCl	Range 0 - 350ppm			
	ACTUAL CONC	RESPONSE	DIFFERENCE	% SPAN
ZERO GAS	0.0	1.9	1.9	0.5%
MID RANGE	46.0	44	-2.0	-0.6%
HIGH RANGE	303.0	299.4	-3.6	-1.0%

Continuous Emissions Monitoring Data Sheet

EPA Methods 3A, 25A, and 322

Project Number	98042		
Firm Name	PES	**Testers**	-
Site Location	Marble Falls	**Ambient Temp**	100
Test Number	1	**Time**	15:43-18:26
Source	Inlet Chemical Lime		
Date	6/25/98		

Analyzer	Range		Rack Cal.	Pre Test Sys. Cal.	Cal. Bias % of Span	Post Test Sys. Cal.	Cal. Bias % of Span	Drift % of Span
Hydrogen Chloride	0-350ppm	zero	1.9	1.9	**0.0%**	3.0	**0.3%**	**-0.3%**
		upscale	299.4	299.4	**0.0%**	296.9	**-0.7%**	**0.7%**
Total Hydrocarbons	0-100ppm	zero	n/a	0.0	**n/a**	0.2	**n/a**	**-0.2%**
		upscale	n/a	90.2	**n/a**	90.3	**n/a**	**-0.1%**
Oxygen	0-25%	zero	0.1	0.2	**0.4%**	0.0	**-0.4%**	**0.8%**
		upscale	19.0	18.9	**-0.4%**	19.3	**1.2%**	**-1.6%**
Carbon Dioxide	0-50%	zero	0.3	0.3	**0.0%**	0.3	**0.0%**	**0.0%**
		upscale	19.0	18.5	**-1.0%**	18.5	**-1.0%**	**0.0%**
					±5%		±5%	±3%

Avg. Analyzer Response	Actual Gas Conc.
20.9	n/a
17.8	n/a
9.8	9.8
23.9	24.6

INLET

HCl In-Situ Matrix Spike
Recovery Efficiencies

Plant	**Chem LimeMarble Falls, TX**		
Date	25-Jun-98	Cs-Spike Gas Conc. (ppm)	303
Project No.	98042		
Test 1	Su-Native Concentration (ppm)	7.4	
Initial	Qt-Analyzer Flow (lpm)	12.5	
	Qs-Dilution Rate (lpm)	1.5	
	Sm-Observed Concentration (ppm)	42.6	
	Ce-Expected Concentration (ppm)	**39.1**	
	Spike Recovery (%)	**109%**	
	Su-Native Concentration (ppm)	39.3	
Final	Qt-Analyzer Flow (lpm)	11.7	
	Qs-Dilution Rate (lpm)	1.5	
	Sm-Observed Concentration (ppm)	84.3	
	Ce-Expected Concentration (ppm)	**69.3**	
	Spike Recovery (%)	**122%**	

TABLE C-3.1
Chemical Lime Calibration Table
25-June-98
OUTLET

Marble Falls,TX	CALIBRATION ERROR TEST			
THC	**Range 0 - 100ppm**			
	ACTUAL CONC	RESPONSE	PREDICTED	**% CAL ERR**
ZERO GAS	0.0	0.0	-	**-**
LOW RANGE	30.0	32.7	29.4	**10.8%**
MID RANGE	58.3	58.0	57.2	**1.3%**
HIGH RANGE	92.4	90.7	90.7	**0.0%**
O2	**Range 0 - 25%**			
	ACTUAL CONC	RESPONSE	DIFFERENCE	**% SPAN**
ZERO GAS	0.0	0.1	0.1	**0.4%**
MID RANGE	11.04	11.2	0.2	**0.6%**
HIGH RANGE	19.2	19.0	-0.2	**-0.8%**
CO2	**Range 0 - 50%**			
	ACTUAL CONC	RESPONSE	DIFFERENCE	**% SPAN**
ZERO GAS	0.0	0.3	0.3	**0.6%**
MID RANGE	11.03	11.3	0.3	**0.5%**
HIGH RANGE	19.0	19.0	0.0	**0.0%**
HCl	**Range 0 - 350ppm**			
	ACTUAL CONC	RESPONSE	DIFFERENCE	**% SPAN**
ZERO GAS	0.0	1.1	1.1	**0.3%**
MID RANGE	46.0	47.4	1.4	**0.4%**
HIGH RANGE	303.0	300.8	-2.2	**-0.6%**

Continuous Emissions Monitoring Data Sheet

EPA Methods 3A, 25A, and 322

Project Number	98042		
Firm Name	PES	**Testers**	-
Site Location	Marble Falls	**Ambient Temp**	100
Test Number	1	**Time**	15:19-18:50
Source	Outlet Chemical Lime		
Date	6/25/98		

Analyzer	Range		Rack Cal.	Pre Test Sys. Cal.	Cal. Bias % of Span	Post Test Sys. Cal.	Cal. Bias % of Span	Drift % of Span	Avg. Analyzer Response	Actual Gas Conc.
										-
Hydrogen Chloride	0-350ppm	zero	1.1	1.1	**0.0%**	2.1	**0.3%**	**-0.3%**	15.5	**n/a**
		upscale	300.8	300.8	**0.0%**	308.4	**2.2%**	**-2.2%**		
Total Hydrocarbons	0-100ppm	zero	n/a	0.0	**n/a**	0.0	**n/a**	**0.0%**	10.2	**n/a**
		upscale	n/a	90.7	**n/a**	92.8	**n/a**	**-2.1%**		
Oxygen	0-25%	zero	0.1	0.1	**0.0%**	0.1	**0.0%**	**0.0%**	13.7	**13.6**
		upscale	19.0	19	**0.0%**	19.5	**2.0%**	**-2.0%**		
Carbon Dioxide	0-50%	zero	0.3	0.3	**0.0%**	0.3	**0.0%**	**0.0%**	15.5	**15.7**
		upscale	19.0	18.7	**-0.6%**	18.8	**-0.4%**	**-0.2%**		
					±5%		±5%	±3%		

Outlet

HCl In-Situ Matrix Spike
Recovery Efficiencies

Plant	**Chem LimeMarble Falls, TX**		
Date	25-Jun-98	Cs-Spike Gas Conc. (ppm)	303
Project No.	98042		
Test 1	Su-Native Concentration (ppm)	6.5	
Initial	Qt-Analyzer Flow (lpm)	16.25	
	Qs-Dilution Rate (lpm)	1.5	
	Sm-Observed Concentration (ppm)	33.3	
	Ce-Expected Concentration (ppm)	**31.5**	
	Spike Recovery (%)	**106%**	
	Su-Native Concentration (ppm)	14.6	
Final	Qt-Analyzer Flow (lpm)	16.25	
	Qs-Dilution Rate (lpm)	1.5	
	Sm-Observed Concentration (ppm)	41.2	
	Ce-Expected Concentration (ppm)	**39.0**	
	Spike Recovery (%)	**106%**	

APPENDIX F

PROCESS DATA

Process data to be supplied to EPA EMC by
Research Triangle Institute under a separate work assignment.

APPENDIX G

SAMPLING & ANALYSIS METHODS
(EPA Methods 1, 2, 3A, 23 and proposed amendments, 25A, 322)

Appendix G.1

Sampling & Analysis Methods

EPA Method 1

Method 1 - Sample and Velocity Traverses for Stationary Sources

1. PRINCIPLE AND APPLICABILITY

1.1 Principle. To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

1.2 Applicability. This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) in cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured; failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases involving variants are subject to approval by the Administrator, U.S. Environmental Protection Agency.

2. PROCEDURE

2.1 Selection of Measurement Site. Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance. For a rectangular cross section, an equivalent diameter (D_e) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{(L + W)}$$

Eq. 1-1

Where
L = Length and W = width.

An alternative procedure is available for determining the acceptability of a measurement location not meeting the criteria above. This procedure,
determination of gas flow angles at the sampling points and comparing the results with acceptability criteria, is described in Section 2.5.

2.2 Determining the Number of Traverse Points.

2.2.1 Particulate Traverses. When the eight- and two-diameter criterion can be met, the minimum number of traverse points shall be: (1) twelve, for circular or rectangular stacks with diameters (or equivalent diameters) greater than 0.61 meter (24 in.); (2) eight, for circular stacks with diameters between 0.30 and 0.61 meter (12 and 24 in.); and (3) nine, for rectangular stacks with equivalent diameters between 0.30 and 0.61 meter (12 and 24 in.).

When the eight- and two-diameter criterion cannot be met, the minimum number of traverse points is determined from Figure 1-1. Before referring to the figure, however, determine the distances from the chosen measurement site to the nearest upstream and downstream disturbances, and divide each distance by the stack diameter or equivalent diameter, to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds: (1) to the number of duct diameters upstream; and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, so that for circular stacks the number is a multiple of 4, and for rectangular stacks, the number is one of those shown in Table 1-1.

2.2.2 Velocity (Non-Particulate) Traverses. When velocity or volumetric flow rate is to be determined (but not particulate matter), the same procedure as that used for particulate traverses (Section 2.2.1) is followed, except that Figure 1-2 may be used instead of Figure 1-1.

2.3 Cross-Sectional Layout and Location of Traverse Points.

2.3.1 Circular Stacks. Locate the traverse points on two perpendicular diameters according to Table 1-2 and the example shown in Figure 1-3. Any equation (for examples, see Citations 2 and 3 in the Bibliography) that gives the same values as those in Table 1-2 may be used in lieu of Table 1-2.

For particulate traverses, one of the diameters must be in a plane containing the greatest expected concentration variation, e.g., after bends, one diameter shall be in the plane of the bend. This requirement becomes less critical as the distance from the disturbance increases; therefore, other diameter locations may be used, subject to the approval of the Administrator.

In addition, for stacks having diameters greater than 0.61 m (24 in.), no traverse points shall be within 2.5 centimeters (1.00 in.) of the stack walls; and for stack diameters equal to or less than 0.61 m (24 in.), no traverse points shall be located within 1.3 cm (0.50 in.) of the stack walls. To meet these criteria, observe the procedures given below.

2.3.1.1 Stacks With Diameters Greater Than 0.61 m (24 in.). When any of the traverse points as located in Section 2.3.1 fall within 2.5 cm (1.00 in.) of the stack walls, relocate them away from the stack walls to: (1) a distance of 2.5 cm (1.00 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger. These relocated traverse points (on each end of a diameter) shall be the "adjusted" traverse points. Whenever two successive traverse points are combined to form a single adjusted traverse point, treat the adjusted point as two separate traverse points, both in the sampling (or velocity measurement) procedure, and in recording the data.

2.3.1.2 Stacks With Diameters Equal To or Less Than 0.61 m (24 in.). Follow the procedure in Section 2.3.1.1, noting only that any "adjusted" points should be relocated away from the stack walls to: (1) a distance of 1.3 cm (0.50 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger.

2.3.2 Rectangular Stacks. Determine the number of traverse points as explained in Sections 2.1 and 2.2 of this method. From Table 1-

1, determine the grid configuration. Divide the stack cross-section into as many equal rectangular elemental areas as traverse points, and then locate a traverse point at the centroid of each equal area according to the example in Figure 1-4.
If the tester desires to use more than the minimum number of traverse points, expand the "minimum number of traverse points" matrix (see Table 1-1) by adding the extra traverse points along one or the other or both legs of the matrix; the final matrix need not be balanced. For example, if a 4 x 3 "minimum number of points" matrix were expanded to 36 points, the final matrix could be 9 x 4 or 12 x 3, and would not necessarily have to be 6 x 6. After constructing the final matrix, divide the stack cross-section into as many equal rectangular, elemental areas as traverse points, and locate a traverse point at the centroid of each equal area. The situation of traverse points being too close to the stack walls is not expected to arise with rectangular stacks. If this problem should ever arise, the Administrator must be contacted for resolution of the matter.

2.4 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination. Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane; when the Type S pitot tube is in this position, it is at "0° reference." Note the differential pressure (Δp) reading at each traverse point. If a null (zero) pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0° reference, rotate the pitot tube (up to ±90° yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle (α) to the nearest degree. After the null technique
has been applied at each traverse point, calculate the average of the absolute values of α; assign α values of 0° to those points for which no rotation was required, and include these in the overall average. If the average value of α is greater than 20°, the overall flow condition in the stack is unacceptable, and alternative methodology, subject to the approval of the Administrator, must be used to perform accurate sample and velocity traverses. The alternative procedure described in Section 2.5 may be used to determine the rotation angles in lieu of the procedure

described above.

2.5 Alternative Measurement Site Selection Procedure. This alternative applies to sources where measurement locations are less than 2 equivalent or duct diameters downstream or less than one-half duct diameter upstream from a flow disturbance. The alternative should be limited to ducts larger than 24 in. in diameter where blockage and wall effects are minimal. A directional flow-sensing probe is used to measure pitch and yaw angles of the gas flow at 40 or more traverse points; the resultant angle is calculated and compared with acceptable criteria for mean and standard deviation.

NOTE: Both the pitch and yaw angles are measured from a line passing through the traverse point and parallel to the stack axis. The pitch angle is the angle of the gas flow component in the plane that INCLUDES the traverse line and is parallel to the stack axis. The yaw angle is the angle of the gas flow component in the plane PERPENDICULAR to the traverse line at the traverse point and is measured from the line passing through the traverse point and parallel to the stack axis.

2.5.1 Apparatus.

2.5.1.1 Directional Probe. Any directional probe, such as United Sensor Type DA Three-Dimensional Directional Probe, capable of measuring both the pitch and yaw angles of gas flows is acceptable. (**NOTE:** Mention of trade name or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.) Assign an identification number to the directional probe, and permanently mark or engrave the number on the body of the probe. The pressure holes of directional probes are susceptible to plugging when used in particulate-laden gas streams. Therefore, a system for cleaning the pressure holes by "back-purging" with pressurized air is required.

2.5.1.2 Differential Pressure Gauges. Inclined manometers, U-tube manometers, or other differential pressure gauges (e.g., magnehelic gauges) that meet the specifications described in Method 2, Section 2.2.

NOTE: If the differential pressure gauge produces both negative and positive readings, then both negative and positive pressure readings shall be calibrated at a minimum of three points as specified in Method 2, Section 2.2.

2.5.2 Traverse Points. Use a minimum of 40 traverse points for circular ducts and 42 points for rectangular ducts for the gas flow angle determinations. Follow Section 2.3 and Table 1-1 or 1-2 for

the location and layout of the traverse points. If the measurement location is determined to be acceptable according to the criteria in this alternative procedure, use the same traverse point number and locations for sampling and velocity measurements.

2.5.3 Measurement Procedure.

2.5.3.1 Prepare the directional probe and differential pressure gauges as recommended by the manufacturer. Capillary tubing or surge tanks may be used to dampen pressure fluctuations. It is recommended, but not required, that a pretest leak check be conducted. To perform a leak check, pressurize or use suction on the impact opening until a reading of at least 7.6 cm (3 in.) H_2O registers on the differential pressure gauge, then plug the impact opening. The pressure of a leak-free system will remain stable for at least 15 seconds.

2.5.3.2 Level and zero the manometers. Since the manometer level and zero may drift because of vibrations and temperature changes, periodically check the level and zero during the traverse.

2.5.3.3 Position the probe at the appropriate locations in the gas stream, and rotate until zero deflection is indicated for the yaw angle pressure gauge. Determine and record the yaw angle. Record the pressure gauge readings for the pitch angle, and determine the pitch angle from the calibration curve. Repeat this procedure for each traverse point. Complete a "back-purge" of the pressure lines and the impact openings prior to measurements of each traverse point.

A post-test check as described in Section 2.5.3.1 is required. If the criteria for a leak-free system are not met, repair the equipment, and repeat the flow angle measurements.

2.5.4 Calculate the resultant angle at each traverse point, the average resultant angle, and the standard deviation using the following equations. Complete the calculations retaining at least one extra significant figure beyond that of the acquired data. Round the values after the final calculations.

2.5.4.1 Calculate the resultant angle at each traverse point:

$$R_i = \text{arc cosine}[(\text{cosine}Y_i)(\text{cosine}P_i)]$$

Eq. 1-2

Where:

R_i = resultant angle at traverse point i, degree.
Y_i = yaw angle at traverse point i, degree.
P_i = pitch angle at traverse point i, degree.

2.5.4.2 Calculate the average resultant for the measurements:

$$\overline{R} = \frac{\Sigma R_i}{n}$$

Eq. 1-3

Where:

R_{avg} = average resultant angle, degree.
n = total number of traverse points.

2.5.4.3 Calculate the standard deviations:

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} (R_i - \overline{R})^2}{(n-1)}}$$

Eq. 1-4

Where:

S_d = standard deviation, degree.

2.5.5 The measurement location is acceptable if $R_{avg} \leq 20°$ and $S_d \leq 10°$.

2.5.6 Calibration. Use a flow system as described in Sections 4.1.2.1 and 4.1.2.2 of Method 2. In addition, the flow system shall have the capacity to generate two test-section velocities: one between 365 and 730 m/min (1200 and 2400 ft/min) and one between 730 and 1100 m/min (2400 and 3600 ft/min).

2.5.6.1 Cut two entry ports in the test section. The axes through the entry ports shall be perpendicular to each other and intersect in the centroid of the test section. The ports should be elongated slots parallel to the axis of the test section and of sufficient length to allow measurement of pitch angles while maintaining the pitot head position at the test-section centroid. To facilitate alignment of the directional probe during calibration, the test section should be constructed of plexiglass or some other transparent material. All calibration measurements should be made at the same point in the test section, preferably at the centroid of the test section.

2.5.6.2 To ensure that the gas flow is parallel to the central axis of the test section, follow the procedure in Section 2.4 for cyclonic flow determination to measure the gas flow angles at the centroid of the test section from two test ports located 90° apart. The gas flow angle measured in each port must be ±2° of 0°. Straightening vanes should be installed, if necessary, to meet this criterion.

2.5.6.3 Pitch Angle Calibration. Perform a calibration traverse according to the manufacturer's recommended protocol in 5° increments for angles from -60° to +60° at one velocity in each of the two ranges specified above. Average the pressure ratio values obtained for each angle in the two flow ranges, and plot a calibration curve with the average values of the pressure ratio (or other suitable measurement factor as recommended by the manufacturer) versus the pitch angle. Draw a smooth line through the data points. Plot also the data values for each traverse point. Determine the differences between the measured datavalues and the angle from the calibration curve at the same pressure ratio. The difference at each comparison must be within 2° for angles between 0° and 40° and within 3° for angles between 40° and 60°.

2.5.6.4 Yaw Angle Calibration. Mark the three-dimensional probe to allow the determination of the yaw position of the probe. This is usually a line extending the length of the probe and aligned with the impact opening. To determine the accuracy of measurements of the yaw angle, only the zero or null position need be calibrated as follows: Place the directional probe in the test section, and rotate the probe until the zero position is found. With a protractor or other angle measuring device, measure the angle indicated by the yaw angle indicator on the three-dimensional probe. This should be within 2° of 0°. Repeat this measurement for any other points along the length of the pitot where yaw angle measurements could be read in order to account for variations in the pitot markings used to indicate pitot head positions.

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Table 1-1. CROSS-SECTION LAYOUT FOR RECTANGULAR STACKS

Number of traverse points	Matrix layout
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5
30	6x5
36	6x6
42	7x6
49	7x7

TABLE 1-2
LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS
(Percent of stack diameter from inside wall to traverse point)

Traverse Point Number on a Diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	112.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7

15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

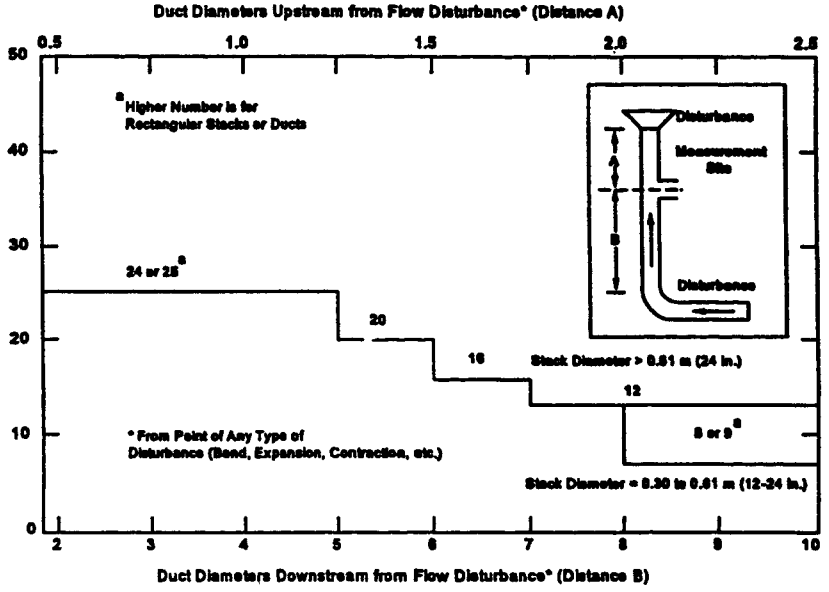

Figure 1-1. Minimum number of traverse points for particulate traverses.

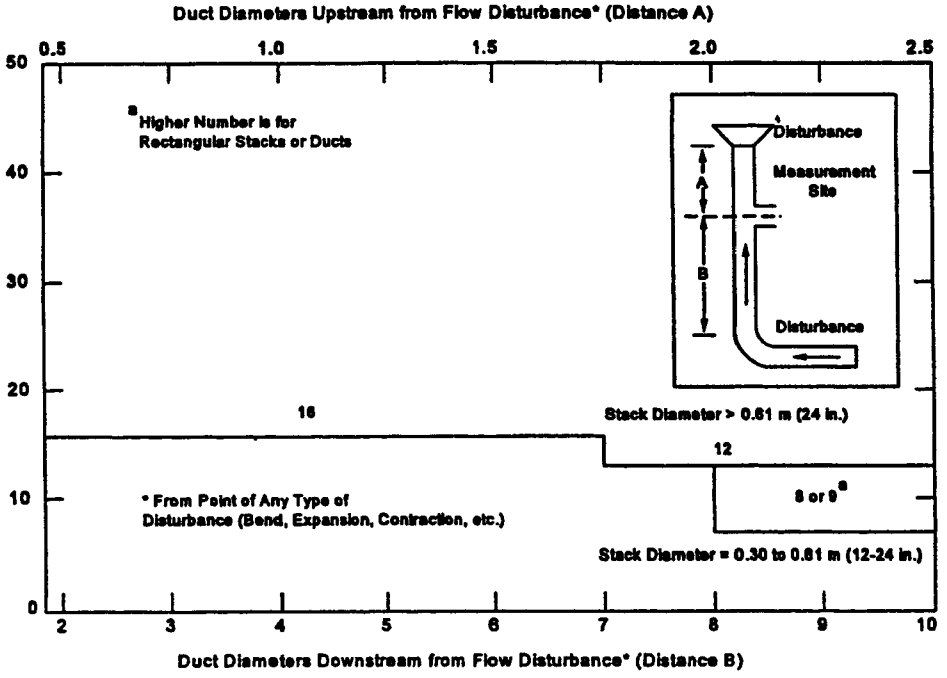

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

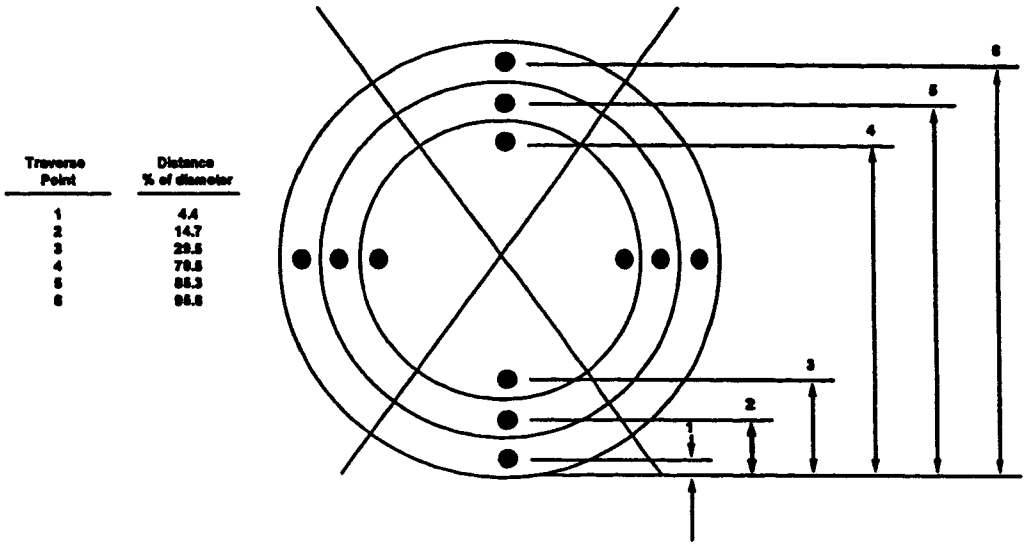

Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

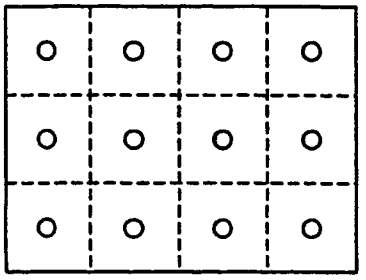

Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

Appendix G.2

Sampling & Analysis Methods

EPA Method 2

Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

1. PRINCIPLE AND APPLICABILITY

1.1 Principle. The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

This procedure is not applicable at measurement sites that fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions. When unacceptable conditions exist, alternative procedures, subject to the approval of the Administrator, U.S. Environmental Protection Agency, must be employed to make accurate flow rate determinations; examples of such alternative procedures are: (1) to install straightening vanes; (2) to calculate the total volumetric flow rate stoichiometrically, or (3) to move to another measurement site at which the flow is acceptable.

2. APPARATUS

Specifications for the apparatus are given below. Any other apparatus that has been demonstrated (subject to approval of the Administrator) to be capable of meeting the specifications will be considered acceptable.

2.1 Type S Pitot Tube. Pitot tube made of metal tubing (e.g., stainless steel) as shown in Figure 2-1. It is recommended that the external tubing diameter (dimension D_t, Figure 2-2b) be between 0.48 and 0.95 cm (3/16 and 3/8 inch). There shall be an equal distance from the base of each leg of the pitot tube to its face-opening plane (dimensions P_A and P_B, Figure 2-2b); it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned as shown in Figure 2-2; however, slight misalignments of the openings are permissible (see Figure 2-3).

The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4. An identification number shall be assigned to the pitot tube; this

number shall be permanently marked or engraved on the body of the tube. A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas streams. Therefore, whenever a standard pitot tube is used to perform a traverse, adequate proof must be furnished that the openings of the pitot tube have not plugged up during the traverse period; this can be done by taking a velocity head (Δp) reading at the final traverse point, cleaning out the impact and static holes of the standard pitot tube by "back-purging" with pressurized air, and then taking another Δp reading. If the Δp readings made before and after the air purge are the same (±5 percent), the traverse is acceptable. Otherwise, reject the run. Note that if Δp at the final traverse point is unsuitably low, another point may be selected. If "back-purging" at regular intervals is part of the procedure, then comparative Δp readings shall be taken, as above, for the last two back purges at which suitably high Δp readings are observed.

2.2 Differential Pressure Gauge. An inclined manometer or equivalent device. Most sampling trains are equipped with a 10-in. (water column) inclined-vertical manometer, having 0.01-in. H_2O divisions on the 0- to 1-in. inclined scale, and 0.1-in. H_2O divisions on the 1- to 10-in. vertical scale. This type of manometer (or other gauge of equivalent sensitivity) is satisfactory for the measurement of Δp values as low as 1.3 mm (0.05 in.) H_2O. However, a differential pressure gauge of greater sensitivity shall be used (subject to the approval of the Administrator), if any of the following is found to be true: (1) the arithmetic average of all Δp readings at the traverse points in the stack is less than 1.3 mm (0.05 in.) H_2O; (2) for traverses of 12 or more points, more than 10 percent of the individual Δp readings are below 1.3 mm (0.05 in.) H_2O; (3) for traverses of fewer than 12 points, more than one Δp reading is below 1.3 mm (0.05 in.) H_2O. Citation 18 in the Bibliography describes commercially available instrumentation for the measurement of low-range gas velocities.

As an alternative to criteria (1) through (3) above, the following calculation may be performed to determine the necessity of using a more sensitive differential pressure gauge:

$$T = \frac{\sum_{i=1}^{n} \sqrt{\Delta p_i + K}}{\sum_{i=1}^{n} \sqrt{\Delta p_i}}$$

Where:

Δp_i = Individual velocity head reading at a traverse point, mm (in.) H_2O.

n = Total number of traverse points.

K = 0.13 mm H_2O when metric units are used and 0.005 in. H_2O when English units are used.

If T is greater than 1.05, the velocity head data are unacceptable and a more sensitive differential pressure gauge must be used.

NOTE: If differential pressure gauges other than inclined manometers are used (e.g., magnehelic gauges), their calibration must be checked after each test series. To check the calibration of a differential pressure gauge, compare Δp readings of the gauge with those of a gauge-oil manometer at a minimum of three points, approximately representing the range of Δp values in the stack. If, at each point, the values of Δp as read by the differential pressure gauge and gauge-oil manometer agree to within 5 percent, the differential pressure gauge shall be considered to be in proper calibration. Otherwise, the test series shall either be voided, or procedures to adjust the measured Δp values and final results shall be used, subject to the approval of the Administrator.

2.3 Temperature Gauge. A thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other gauge capable of measuring temperature to within 1.5 percent of the minimum absolute stack temperature. The temperature gauge shall be attached to the pitot tube such that the sensor tip does not touch any metal; the gauge shall be in an interference-free arrangement with respect to the pitot tube face openings (see Figure 2-1 and also Figure 2-7 in Section 4). Alternative positions may be used if the pitot tube-temperature gauge system is calibrated according to the procedure of Section 4. Provided that a difference of not more than 1 percent in the average velocity measurement is introduced, the temperature gauge need not be attached to the pitot tube; this alternative is subject to the approval of the Administrator.

2.4 Pressure Probe and Gauge. A piezometer tube and mercury- or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm (0.1 in.) Hg. The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face opening planes positioned parallel to the gas flow may also be used as the pressure probe.

2.5 Barometer. A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg. See **NOTE** in Method 5, Section 2.1.9.

2.6 Gas Density Determination Equipment. Method 3 equipment, if needed (see Section 3.6), to determine the stack gas dry molecular weight, and Reference Method 4 or Method 5 equipment for moisture content determination; other methods may be used subject to approval of the Administrator.

2.7 Calibration Pitot Tube. When calibration of the Type S pitot tube is necessary (see Section 4), a standard pitot tube for a reference. The standard pitot tube shall, preferably, have a known coefficient, obtained either (1) directly from the National Bureau of Standards, Route 70 S, Quince Orchard Road, Gaithersburg, Maryland, or (2) by calibration against another standard pitot tube with an NBS-traceable coefficient. Alternatively, a standard pitot tube designed according to the criteria given in Sections 2.7.1 through 2.7.5 below and illustrated in Figure 2-4 (see also Citations 7, 8, and 17 in the Bibliography) may be used. Pitot tubes designed according to these specifications will have baseline coefficients of about 0.99 ± 0.01.

2.7.1 Hemispherical (shown in Figure 2-4) ellipsoidal, or conical tip.

2.7.2 A minimum of six diameters straight run (based upon D, the external diameter of the tube) between the tip and the static pressure holes.

2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90-degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 D), equally spaced in a piezometer ring configuration.

2.7.5 Ninety-degree bend, with curved or mitered junction.

2.8 Differential Pressure Gauge for Type S Pitot Tube Calibration. An inclined manometer or equivalent. If the single-velocity calibration technique is employed (see Section 4.1.2.3), the calibration differential pressure gauge shall be readable to the nearest 0.13 mm (0.005 in.) H_2O. For multivelocity calibrations, the gauge shall be readable to the nearest 0.13 mm (0.005 in.) H_2O for Δp values between 1.3 and 25 mm (0.05 and 1.0 in.) H_2O, and to the nearest 1.3 mm (0.05 in.) H_2O for Δp values above 25 mm (1.0 in.) H_2O. A special, more sensitive gauge will be required to read Δp values below 1.3 mm (0.05 in.) H_2O (see Citation 18 in the Bibliography).

3. PROCEDURE

3.1 Set up the apparatus as shown in Figure 2-1. Capillary tubing or surge tanks installed between the manometer and pitot tube may be used to dampen Δp fluctuations. It is recommended, but not required, that a pretest leak-check be conducted as follows: (1) blow through the pitot impact opening until at least

7.6 cm (3 in.) H_2O velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in.) H_2O. Other leak-check procedures, subject to the approval of the Administrator, may be used.

3.2 Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse. Record all necessary data as shown in the example data sheet (Figure 2-5).

3.3 Measure the velocity head and temperature at the traverse points specified by Method 1. Ensure that the proper differential pressure gauge is being used for the range of Δp values encountered (see Section 2.2). If it is necessary to change to a more sensitive gauge, do so, and remeasure the Δp and temperature readings at each traverse point. Conduct a post-test leak-check (mandatory), as described in Section 3.1 above, to validate the traverse run.

3.4 Measure the static pressure in the stack. One reading is usually adequate.

3.5 Determine the atmospheric pressure.

3.6 Determine the stack gas dry molecular weight. For combustion processes or processes that emit essentially CO_2, O_2, CO, and N_2, use Method 3. For processes emitting essentially air, an analysis need not be conducted; use a dry molecular weight of 29.0. For other processes, other methods, subject to the approval of the Administrator, must be used.

3.7 Obtain the moisture content from Reference Method 4 (or equivalent) or from Method 5.

3.8 Determine the cross-sectional area of the stack or duct at the sampling location. Whenever possible, physically measure the stack dimensions rather than using blueprints.

4. CALIBRATION

4.1 Type S Pitot Tube. Before its initial use, carefully examine the Type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated in Figure 2-2 or 2-3. The pitot tube shall not be used if it fails to meet these alignment specifications.

After verifying the face opening alignment, measure and record the following dimensions of the pitot tube: (a) the external tubing diameter (dimension D_t, Figure 2-2b); and (b) the base-to-opening plane distances (dimensions P_A and P_B, Figure 2-2b). If D_t is between 0.48 and 0.95 cm (3/16 and 3/8 in.), and if P_A and P_B are equal and between 1.05 and 1.50 D_t, there are two possible options: (1) the pitot tube may be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, or (2) a baseline (isolated tube) coefficient value of 0.84 may be assigned to the pitot tube. Note, however, that if the

pitot tube is part of an assembly, calibration may still be required, despite knowledge of the baseline coefficient value (see Section 4.1.1).

If D_t, R_A, and P are outside the specified limits, the pitot tube must be calibrated as outlined in Sections 4.1.2 through 4.1.5 below.

4.1.1 Type S Pitot Tube Assemblies. During sample and velocity traverses, the isolated Type S pitot tube is not always used; in many instances, the pitot tube is used in combination with other source-sampling components (thermocouple, sampling probe, nozzle) as part of an "assembly." The presence of other sampling components can sometimes affect the baseline value of the Type S pitot tube coefficient (Citation 9 in the Bibliography); therefore an assigned (or otherwise known) baseline coefficient value may or may not be valid for a given assembly. The baseline and assembly coefficient values will be identical only when the relative placement of the components in the assembly is such that aerodynamic interference effects are eliminated. Figures 2-6 through 2-8 illustrate interference-free component arrangements for Type S pitot tubes having external tubing diameters between 0.48 and 0.95 cm (3/16 and 3/8 in.). Type S pitot tube assemblies that fail to meet any or all of the specifications of Figures 2-6 through 2-8 shall be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, and prior to calibration, the values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) shall be measured and recorded.

NOTE: Do not use any Type S pitot tube assembly which is constructed such that the impact pressure opening plane of the pitot tube is below the entry plane of the nozzle (see Figure 2-6B).

4.1.2 Calibration Setup. If the Type S pitot tube is to be calibrated, one leg of the tube shall be permanently marked A, and the other, B. Calibration shall be done in a flow system having the following essential design features:

4.1.2.1 The flowing gas stream must be confined to a duct of definite cross-sectional area, either circular or rectangular. For circular cross sections, the minimum duct diameter shall be 30.5 cm (12 in.); for rectangular cross sections, the width (shorter side) shall be at least 25.4 cm (10 in.).

4.1.2.2 The cross-sectional area of the calibration duct must be constant over a distance of 10 or more duct diameters. For a rectangular cross section, use an equivalent diameter, calculated from the following equation, to determine the number of duct diameters:

$$D_e = \frac{2LW}{(L + W)}$$

Eq. 2-1

Where:

D_e = Equivalent diameter.
L = Length.
W = Width.

To ensure the presence of stable, fully developed flow patterns at the calibration site, or "test section," the site must be located at least eight diameters downstream and two diameters upstream from the nearest disturbances.

NOTE: The eight- and two-diameter criteria are not absolute; other test section locations may be used (subject to approval of the Administrator), provided that the flow at the test site is stable and demonstrably parallel to the duct axis.

4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during calibration. Note that Type S pitot tube coefficients obtained by single-velocity calibration at 915 m/min (3,000 ft/min) will generally be valid to ±3 percent for the measurement of velocities above 305 m/min (1,000 ft/min) and to ±5 to 6 percent for the measurement of velocities between 180 and 305 m/min (600 and 1,000 ft/min). If a more precise correlation between C_p and velocity is desired, the flow system shall have the capacity to generate at least four distinct, time-invariant test-section velocities covering the velocity range from 180 to 1,525 m/min (600 to 5,000 ft/min), and calibration data shall be taken at regular velocity intervals over this range (see Citations 9 and 14 in the Bibliography for details).

4.1.2.4 Two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same cross-sectional plane during calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.3 **Calibration Procedure.** Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

4.1.3.1 Make sure that the manometer is properly filled and that the oil is free from contamination and is of the proper density. Inspect and leak-check all pitot lines; repair or replace if necessary.

4.1.3.2 Level and zero the manometer. Turn on the fan, and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular care should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.4 Read Δp_{std}, and record its value in a data table similar to the one shown in Figure 2-9. Remove the standard pitot tube from the duct, and disconnect it from the manometer. Seal the standard entry port.

4.1.3.5 Connect the Type S pitot tube to the manometer. Open the Type S entry port. Check the manometer level and zero. Insert and align the Type S pitot tube so that its A side impact opening is at the same point as was the standard pitot tube and is pointed directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.6 Read Δp_s, and enter its value in the data table. Remove the Type S pitot tube from the duct, and disconnect it from the manometer.

4.1.3.7 Repeat Steps 4.1.3.3 through 4.1.3.6 above until three pairs of Δp readings have been obtained.

4.1.3.8 Repeat Steps 4.1.3.3 through 4.1.3.7 above for the B side of the Type S pitot tube.

4.1.3.9 Perform calculations, as described in Section 4.1.4 below.

4.1.4 Calculations.

4.1.4.1 For each of the six pairs of Δp readings (i.e., three from side A and three from side B) obtained in Section 4.1.3 above, calculate the value of the Type S pitot tube coefficient as follows:

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$

Eq. 2-2

Where:

$C_{p(s)}$ = Type S pitot tube coefficient.

$C_{p(std)}$ = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 2.7.1 to 2.7.5 of this method.

Δp_{std} = Velocity head measured by the standard pitot tube, cm (in.) H_2O.

Δp_s = Velocity head measured by the Type S pitot tube, cm (in.) H_2O.

4.1.4.2 Calculate $\overline{C}_p$ (side A), the mean A-side coefficient, and $\overline{C}_p$ (side B), the

mean B-side coefficient; calculate the difference between these two average values.

4.1.4.3 Calculate the deviation of each of the three A-side values of $C_{p(s)}$ from $\overline{C}_p$ (side A), and the deviation of each B-side values of $C_{p(s)}$ from $\overline{C}_p$ (side B). Use the following equation:

$$\text{Deviation} = C_{p_{(s)}} - \overline{C}_p(\text{A or B})$$

Eq. 2-3

4.1.4.4 Calculate σ, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

$$\sigma(\text{side A or B}) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \overline{C}_p(\text{A or B}) \right|}{3}$$

Eq. 2-4

4.1.4.5 Use the Type S pitot tube only if the values of σ (side A) and σ (side B) are less than or equal to 0.01 and if the absolute value of the difference between $\overline{C}_p$ (A) and $\overline{C}_p$ (B) is 0.01 or less.

4.1.5 Special Considerations.

4.1.5.1 Selection of Calibration Point.

4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., $\overline{C}_p$ (side A) and $\overline{C}_p$ (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components (nozzle, thermocouple, sample probe) in an arrangement that is free from aerodynamic interference effects (see Figures 2-6 through 2-8).

4.1.5.1.2 For Type S pitot tube-thermocouple combinations (without sample probe), select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The coefficients so obtained will be valid so long as the pitot tube-thermocouple combination is used by itself or with other components in an interference-free arrangement (Figures 2-6 and 2-8).

4.1.5.1.3 For assemblies with sample probes, the calibration point should be

located at or near the center of the duct; however, insertion of a probe sheath into a small duct may cause significant cross-sectional area blockage and yield incorrect coefficient values (Citation 9 in the Bibliography). Therefore, to minimize the blockage effect, the calibration point may be a few inches off-center if necessary. The actual blockage effect will be negligible when the theoretical blockage, as determined by a projected-area model of the probe sheath, is 2 percent or less of the duct cross-sectional area for assemblies without external sheaths (Figure 2-10a), and 3 percent or less for assemblies with external sheaths (Figure 2-10b).

4.1.5.2 For those probe assemblies in which pitot tube-nozzle interference is a factor (i.e., those in which the pitot-nozzle separation distance fails to meet the specification illustrated in Figure 2-6A), the value of $C_{p(s)}$ depends upon the amount of free-space between the tube and nozzle, and therefore is a function of nozzle size. In these instances, separate calibrations shall be performed with each of the commonly used nozzle sizes in place. Note that the single-velocity calibration technique is acceptable for this purpose, even though the larger nozzle sizes (>0.635 cm or 1/4 in.) are not ordinarily used for isokinetic sampling at velocities around 915 m/min (3,000 ft/min), which is the calibration velocity; note also that it is not necessary to draw an isokinetic sample during calibration (see Citation 19 in the Bibliography).

4.1.5.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (σ) value of 0.01 or less (see Section 4.1.4.4.)

4.1.6 Field Use and Recalibration.

4.1.6.1 Field Use.

4.1.6.1.1 When a Type S pitot tube (isolated or in an assembly) is used in the field, the appropriate coefficient value (whether assigned or obtained by calibration) shall be used to perform velocity calculations. For calibrated Type S pitot tubes, the A side coefficient shall be used when the A side of the tube faces the flow, and the B side coefficient shall be used when the B side faces the flow; alternatively, the arithmetic average of the A and B side coefficient values may be used, irrespective of which side faces the flow.

4.1.6.1.2 When a probe assembly is used to sample a small duct, 30.5 to 91.4 cm (12 to 36 in.) in diameter, the probe sheath sometimes blocks a significant part of the duct cross-section, causing a reduction in the effective value of $C_{p(s)}$. Consult Citation 9 in the Bibliography for details. Conventional pitot-sampling probe assemblies are not recommended for use in ducts having inside diameters smaller than 30.5 cm (12 in.) (see Citation 16 in the Bibliography).

4.1.6.2 Recalibration.

4.1.6.2.1 Isolated Pitot Tubes. After each field use, the pitot tube shall be

carefully reexamined in top, side, and end views. If the pitot face openings are still aligned within the specifications illustrated in Figure 2-2 or 2-3, it can be assumed that the baseline coefficient of the pitot tube has not changed. If, however, the tube has been damaged to the extent that it no longer meets the specifications of the Figure 2-2 or 2-3, the damage shall either be repaired to restore proper alignment of the face openings, or the tube shall be discarded.

4.1.6.2.2 Pitot Tube Assemblies. After each field use, check the face opening alignment of the pitot tube, as in Section 4.1.6.2.1; also, remeasure the intercomponent spacings of the assembly. If the intercomponent spacings have not changed and the face opening alignment is acceptable, it can be assumed that the coefficient of the assembly has not changed. If the face opening alignment is no longer within the specifications of Figure 2-2 or 2-3, either repair the damage or replace the pitot tube (calibrating the new assembly, if necessary). If the intercomponent spacings have changed, restore the original spacings, or recalibrate the assembly.

4.2 Standard Pitot Tube (if applicable). If a standard pitot tube is used for the velocity traverse, the tube shall be constructed according to the criteria of Section 2.7 and shall be assigned a baseline coefficient value of 0.99. If the standard pitot tube is used as part of an assembly, the tube shall be in an interference-free arrangement (subject to the approval of the Administrator).

4.3 Temperature Gauges. After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other gauges at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405°C (761°F), use an ASTM mercury-in-glass reference thermometer, or equivalent, as a reference; alternatively, either a reference thermocouple and potentiometer (calibrated by NBS) or thermometric fixed points, e.g., ice bath and boiling water (corrected for barometric pressure) may be used. For temperatures above 405°C (761°F), use an NBS-calibrated reference thermocouple-potentiometer system or an alternative reference, subject to the approval of the Administrator.

If, during calibration, the absolute temperature measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of the test results shall be made, subject to the approval of the Administrator.

4.4 Barometer. Calibrate the barometer used against a mercury barometer.

5. CALCULATIONS

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

C_p = Pitot tube coefficient, dimensionless.

K_p = Pitot tube constant,

$$34.97 \frac{m}{sec} \left[\frac{(g/g\text{-mole})\,(mmHg)}{(^\circ K)\ (mmH_2O)} \right]^{1/2}$$

for the metric system.

$$85.49 \frac{ft}{sec} \left[\frac{lb/lb\text{-mole})\ (in.Hg)}{(^\circ R)\ (in.H_2O)} \right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6), g/g-mole (lb/lb-mole).

M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$$= M_d(1-B_{ws}) + 18.0B_{ws}$$

Eq. 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).

P_g = Stack static pressure, mm Hg (in. Hg).

P_s = Absolute stack pressure, mm Hg (in. Hg),

$$= P_{bar} + P_g$$

Eq. 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dsm^3/hr (dscf/hr).

t_s = Stack temperature, °C (°F).

T_s = Absolute stack temperature, °K (°R).

$$= 273 + t_s$$

Eq. 2-7

for metric.

$$= 460 + t_s$$

Eq. 2-8

for English.

T_{std} = Standard absolute temperature, 293°K (528°R).

v_s = Average stack gas velocity, m/sec (ft/sec).

Δp = Velocity head of stack gas, mm H_2O (in. H_2O).

3,600= Conversion factor, sec/hr.

18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average Stack Gas Velocity.

$$v_s = K_p C_p \left(\sqrt{\Delta p}\right)_{avg} \sqrt{\frac{T_{s\,(avg)}}{P_s M_s}}$$

Eq. 2-9

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3,600(1 - B_{ws})\, v_s A \; \frac{T_{std}}{T_{s\,(avg)}} \; \frac{P_s}{P_{std}}$$

Eq. 2-10

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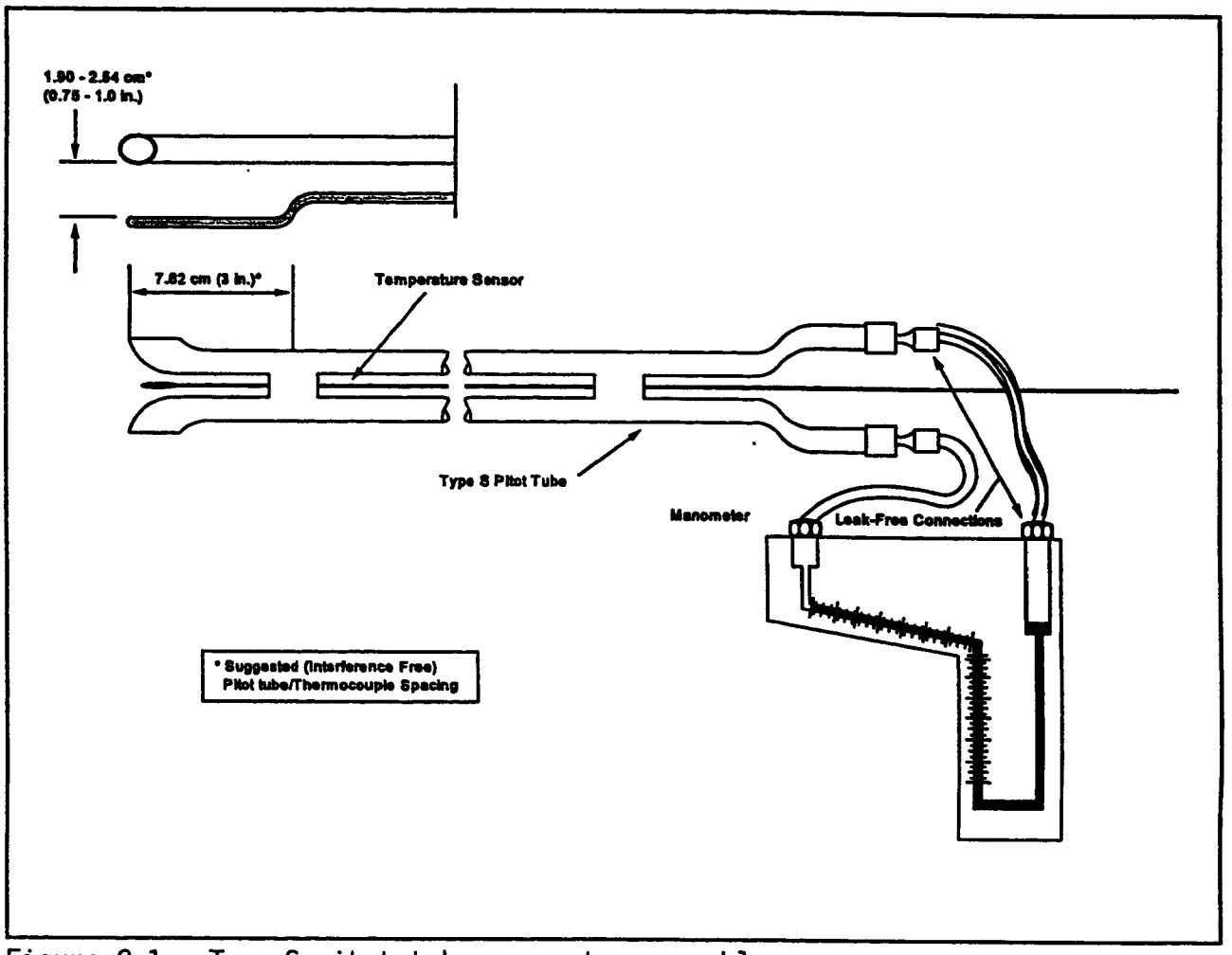

Figure 2-1. Type S pitot tube manometer assembly.

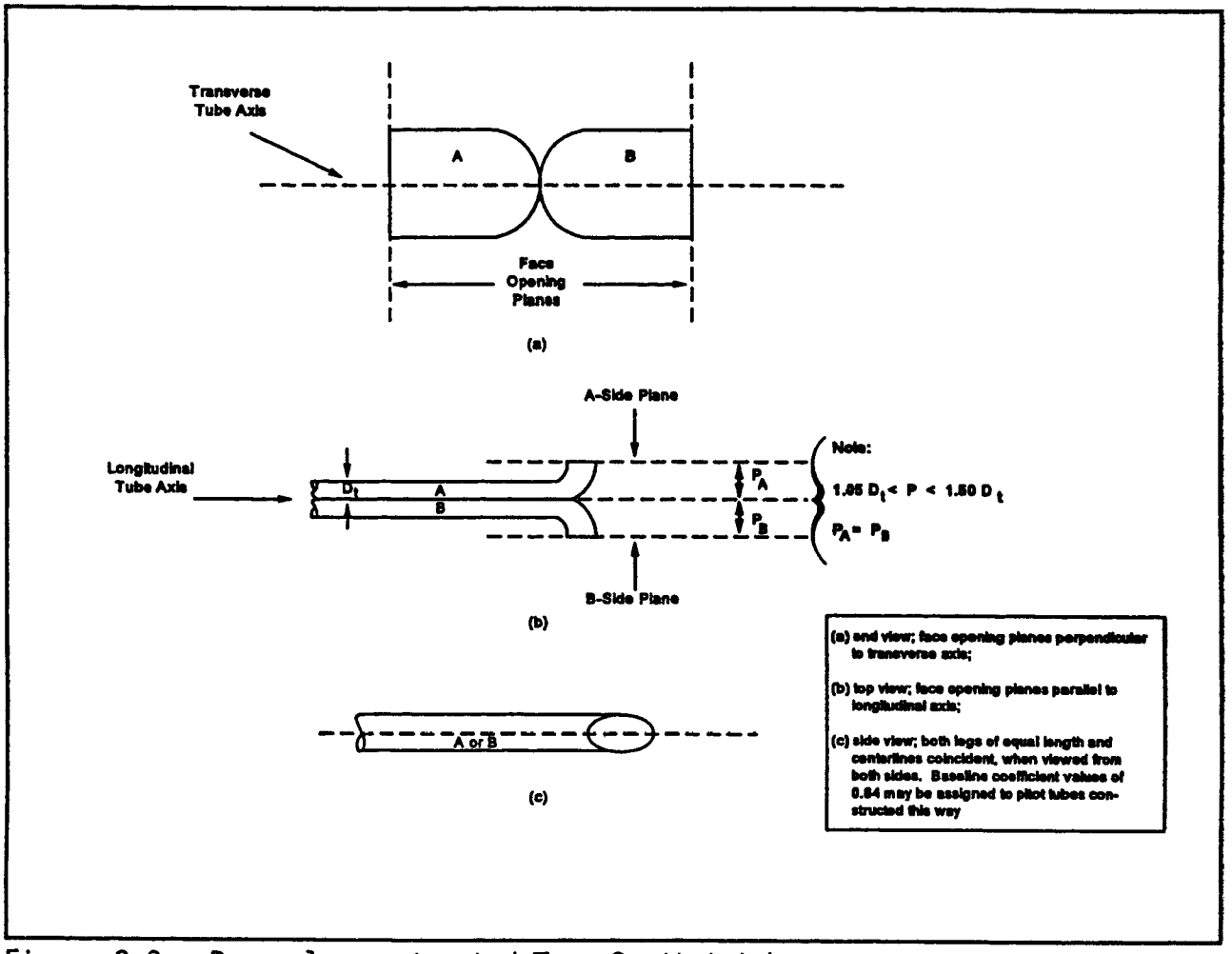

Figure 2-2. Properly constructed Type S pitot tube.

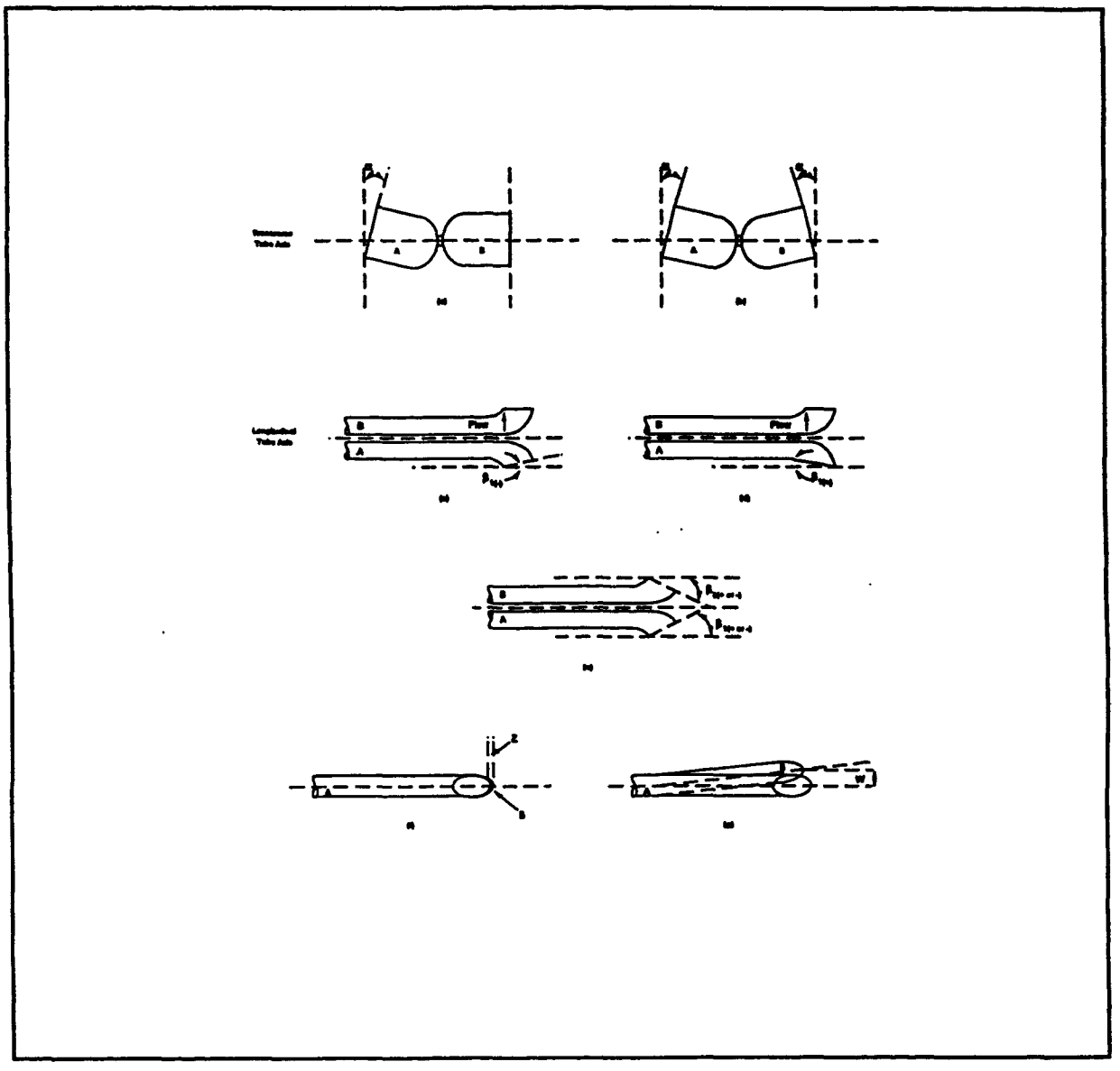

Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of Cp(s) so long as α^1 and α^2 $\leq 10°$, β^1 and β^2 $\leq 5°$, z ≤ 0.32 cm (1/8 in.) and w ≤ 0.08 cm (1/32 in.) (citation 11 in Bibliography).

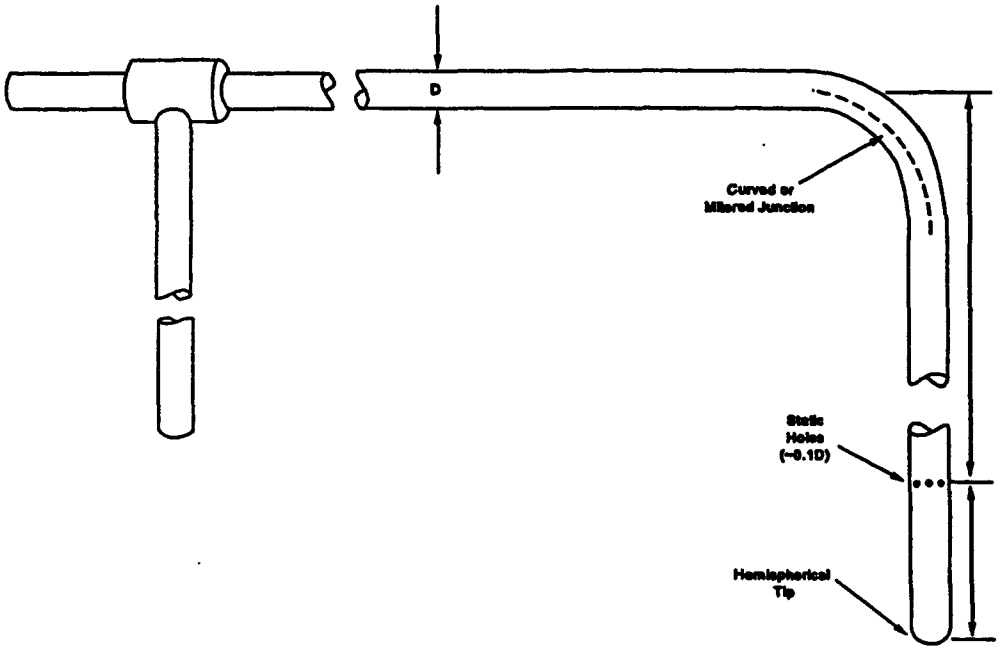

Figure 2-4. Standard pitot tube design specifications.

PLANT _____
DATE _____ RUN NO. _____STACK DIA. OR
DIMENSIONS, m (in.) _____ BAROMETRIC PRESS., mm Hg
(in. Hg) _____CROSS SECTIONAL AREA, m^2 (ft^2)_____
OPERATORS _____
PITOT TUBE I.D. NO. _____
AVG. COEFFICIENT, Cp = _____
LAST DATE CALIBRATED _____

SCHEMATIC OF STACK
CROSS SECTION

Traverse Pt. No.	Vel. Hd., Δp mm (in.) H_2O	Stack Temperature		P_g mm Hg (in.Hg)	$(\Delta p)^{1/2}$
		T_s, °C (°F)	T_s, °K (°R)		
		Average			

Figure 2-5. Velocity traverse data.

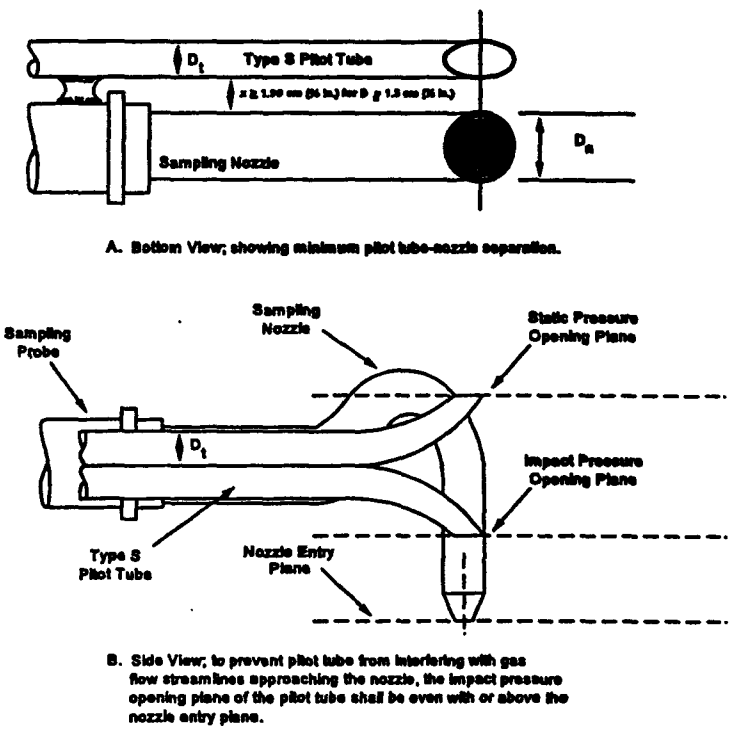

Figure 2-6. Proper pitot tube-sampling nozzle configuration to prevent aerodynamic interference; button-hook type nozzle; centers of nozzle and pitot opening aligned; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

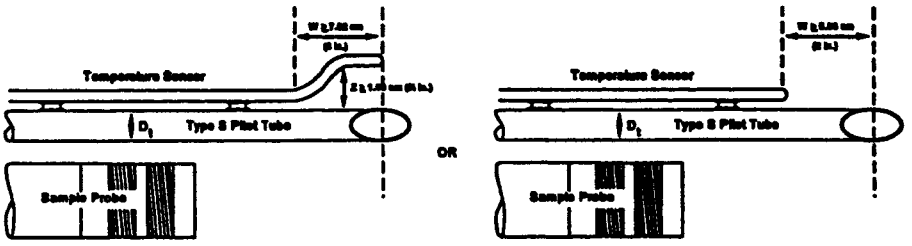

Figure 2-7. Proper thermocouple placement to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

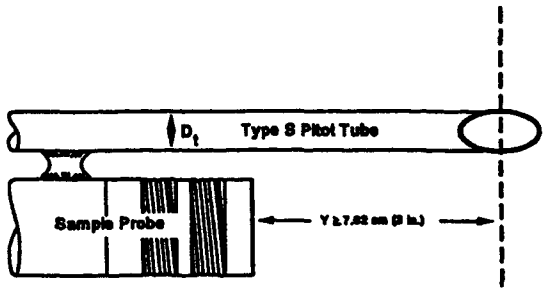

Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference: D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

PITOT TUBE IDENTIFICATION NUMBER: _____ DATE: _____CALIBRATED BY: _
_____

	"A" SIDE CALIBRATION			
RUN NO.	ΔP_{std} cm H_2O (in H_2O)	$\Delta P_{(s)}$ cm H_2O (in H_2O)	$C_{p(s)}$	Deviation $C_{p(s)}$ - C_p(A)
1				
2				
3				
		$C_{p,avg}$ (SIDE A)		

	"B" SIDE CALIBRATION			
RUN NO.	ΔP_{std} cm H_2O (in H_2O)	$\Delta P_{(s)}$ cm H_2O (in H_2O)	$C_{p(s)}$	Deviation $C_{p(s)}$ - C_p(B)
1				
2				
3				
		$C_{p,avg}$ (SIDE B)		

$$\text{Average Deviation} = \sigma_{(A\,or\,B)} = \frac{\sum_{i=1}^{3} \left| C_{p(s)} - \overline{C}_{p(A\,or\,B)} \right|}{3} \leftarrow \text{Must Be} \leq 0.01$$

$$\left| \overline{C}_p(\text{Side A}) - \overline{C}_p(\text{Side B}) \right| \leftarrow \text{Must Be} \leq 0.01$$

Figure 2-9. Pitot tube calibration data.

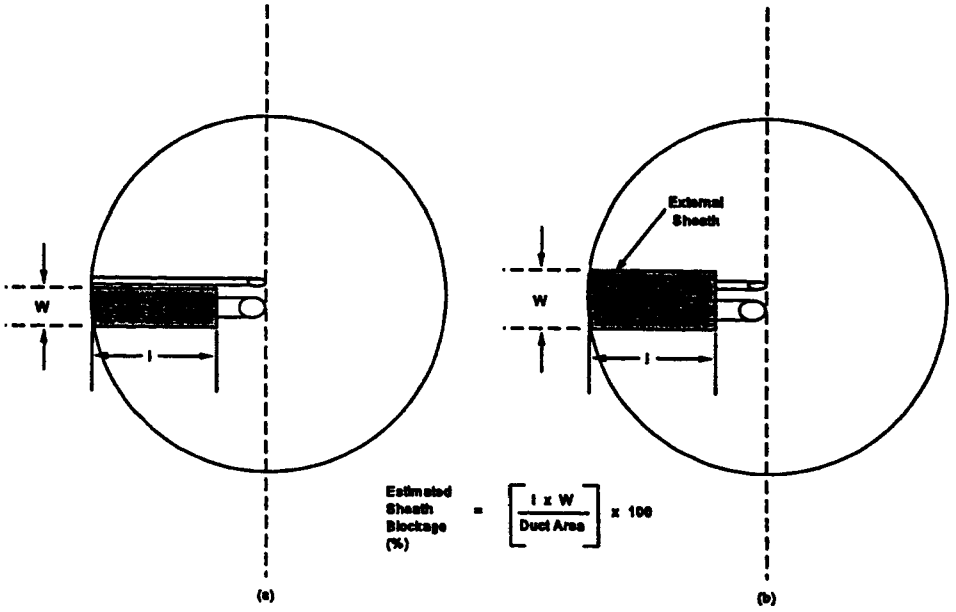

Figure 2-10. Projected-area models for typical pitot tube assemblies.

Appendix G.3

Sampling & Analysis Methods

EPA Method 3A

Method 3A - Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

1. APPLICABILITY AND PRINCIPLE

1.1 Applicability. This method is applicable to the determination of oxygen (O_2) and carbon dioxide (CO_2) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A sample is continuously extracted from the effluent stream: a portion of the sample stream is conveyed to an instrumental analyzer(s) for determination of O_2 and CO_2 concentration(s). Performance specifications and test procedures are provided to ensure reliable data.

2. RANGE AND SENSITIVITY

Same as in Method 6C, Sections 2.1 and 2.2, except that the span of the monitoring system shall be selected such that the average O_2 or CO_2 concentration is not less than 20 percent of the span.

3. DEFINITIONS

3.1 Measurement System. The total equipment required for the determination of the O_2 or CO_2 concentration. The measurement system consists of the same major subsystems as defined in Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, Response Time, and Calibration Curve. Same as in Method 6C, Sections 3.2 through 3.8, and 3.10.

3.3 Interference Response. The output response of the measurement system to a component in the sample gas, other than the gas component being measured.

4. MEASUREMENT SYSTEM PERFORMANCE SPECIFICATIONS

Same as in Method 6C, Sections 4.1 through 4.4.

5. APPARATUS AND REAGENTS

5.1 Measurement System. Any measurement system for O_2 or CO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe. A leak-free probe of sufficient length to traverse the sample points.

5.1.2 Sample Line. Tubing to transport the sample gas from the probe to the moisture removal system. A heated sample line is not required for systems that measure the O_2 or CO_2 concentration on a dry basis, or transport dry gases.

5.1.3 Sample Transport Line, Calibration Valve Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as in Method 6C, Sections 5.1.3 through 5.1.9, and 5.1.11, except that the requirements to use stainless steel, Teflon, and nonreactive glass filters do not apply.

5.1.4 Gas Analyzer. An analyzer to determine continuously the O_2 or CO_2 concentration in the sample gas stream. The analyzer must meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer. The requirements for measuring and controlling the analyzer for measuring and controlling the analyzer flow rate are not applicable if data are presented that demonstrate the analyzer is insensitive to flow variations over the range encountered during the test.

5.2 Calibration Gases. The calibration gases for CO_2 analyzers shall be CO_2 in N_2 or CO_2 in air. Alternatively, CO_2/SO_2, O_2/SO_2, or $O_2/CO_2/SO_2$ gas mixtures in N_2 may be used. Three calibration gases, as specified in Sections 5.3.1 through 5.3.4 of Method 6C, shall be used. For O_2 monitors that cannot analyze zero gas, a calibration gas concentration equivalent to less than 10 percent of the span may be used in place of zero gas.

6. MEASUREMENT SYSTEM PERFORMANCE TEST PROCEDURES

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 3 and change the acceptance criteria for agreement among Method 3 results to 5 percent (or 0.2 percent by volume, whichever is greater).

6.2 Interference Response. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if

changes are made in the instrumentation that could alter the interference response (e.g., changes in the type of gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, Response Time, and Sampling System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

7. EMISSION TEST PROCEDURE

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 3.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as that used during the response time test. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as for tests conducted using Method 3 plus twice the average system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed to determine the average effluent concentration.

7.3 Zero and Calibration Drift Test. Follow Section 7.4 of Method 6C.

8. QUALITY CONTROL PROCEDURES

The following quality control procedures are recommended when the results of this method are used for an emission rate correction factor, or excess air determination. The tester should select one of the following options for validating measurement results:

8.1 If both O_2 and CO are measured using Method 3A, the procedures described in Section 4.4 of Method 3 should be followed to validate the O_2 and CO measurement results.

8.2 If only O_2 is measured using Method 3A, measurements of the sample stream CO concentration should be obtained at the sample by-pass vent discharge using an Orsat or Fyrite analyzer, or equivalent. Duplicate samples should be obtained concurrent with at least one run. Average the duplicate Orsat or Fyrite analysis results for each run. Use the average CO_2 values for comparison with the O_2 measurements in accordance with the procedures described in Section 4.4 of Method 3.

8.3 If only CO_2 is measured using Method 3A, concurrent measurements of the sample stream CO_2 concentration should be obtained using an Orsat or Fyrite analyzer as described in Section 8.2. For each run, differences greater than 0.5 percent between the Method 3A results and the average of the duplicate Fyrite analysis should be investigated.

9. EMISSION CALCULATION

9.1 For all CO_2 analyzers, and for O_2 analyzers that can be calibrated with zero gas, follow Section 8 of Method 6C, except express all concentrations as percent, rather than ppm.

9.2 For O_2 analyzers that use a low-level calibration gas in place of a zero gas, lculate the effluent gas concentration using Equation 3A-1.

$$C_{gas} = \frac{C_{ma} - C_{oa}}{C_m - C_o} (\bar{C} - C_m) + C_{ma} \qquad \text{Eq. 3A-1}$$

Where:

C_{gas} = Effluent gas concentration, dry basis, percent.

C_{ma} = Actual concentration of the upscale calibration gas, percent.

C_{oa} = Actual concentration of the low-level calibration gas, percent.

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, percent.

C_o = Average of initial and final system calibration bias check responses for the low level gas, percent.

$\bar{C}$ = Average gas concentration indicated by the gas analyzer, dry basis, percent.

10. BIBLIOGRAPHY

Same as in Bibliography of Method 6C.

Appendix G.4

Sampling & Analysis Methods

EPA Method 23

6560-50

ENVIRONMENTAL PROTECTION AGENCY
40 CFR Part 60

[AD-FRL-]
STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES
Appendix A , Test Method 23

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed Rule.

SUMMARY: This rule amends Method 23, entitled "Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans from Stationary Sources," to correct existing errors in the method, to eliminate the methylene chloride rinse of the sampling train, and to clarify the quality assurance requirements of the method.

DATES: Comments. Comments must be received on or before _____ (90 days after publication in the FEDERAL REGISTER].

Public Hearing. If anyone contacts EPA requesting to speak at a public hearing by _____ (two weeks after publication in the FEDERAL REGISTER), a public hearing will be held on _____ (four weeks after publication in the FEDERAL REGISTER), beginning at 10:00 a.m. Persons interested in attending the hearing should call Ms. Lala Cheek at (919) 541-5545 to verify that a hearing will be held.

Request to Speak at Hearing. Persons wishing to present

oral testimony must contact EPA by _____ (two weeks after publication in the FEDERAL REGISTER).

ADDRESSES: Comments. Comments should be submitted (in duplicate if possible) to Public Docket No. A-94-2 at the following address: U. S. Environmental Protection Agency , Air and Radiation Docket and Information Center, Mail Code: 6102, 401 M Street, SW, Washington, DC 20460. The Agency requests that a separate copy also be sent to the contact person listed below. The docket is located at the above address in Room M-1500 Waterside Mall (ground floor), and may be inspected from 8:30 a.m. to Noon and 1:00 to 3:00 PM, Monday through Friday. The proposed regulatory text and other materials related to this rulemaking are available for review in the docket or copies may be mailed on request from the Air Docket by calling 202-260-7548. A reasonable fee may be charged for copying docket materials.

Public Hearing. If anyone contacts EPA requesting a public hearing, it will be held at EPA's Emission Measurement Laboratory, Research Triangle Park, North Carolina. Persons interested in attending the hearing or wishing to present oral testimony should notify Ms. Lala Cheek (MD-19), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5545.

Docket: A Docket, A-94-22, containing materials relevant to this rulemaking, is available for public inspection and copying between 8:30 a.m. and Noon and 1:00 and 3:00 p.m., Monday through Friday, in at EPA's Air Docket Section (LE-131), Room M-1500 Waterside Mall (ground floor) 401 M Street, S.W., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Gary McAlister, Emission Measurement Branch (MD-19), Emissions, Monitoring, and Analysis Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone (919) 541-1062.

SUPPLEMENTARY INFORMATION:

The proposed regulatory text of the proposed rule is not included in this Federal Register notice, but is available in Docket No. A-94-22 or by written or telephone request from the Air Docket (see ADDRESSES). If necessary, a limited number of copies of the Regulatory Text are available from the EPA contact persons designated earlier in this notice. This Notice with the proposed regulatory language is also available on the Technology Transfer Network (TTN), one of EPA's electronic bulletin boards. TTN provides information and technology exchange in various areas of air pollution control. The service is free except for the cost of the phone call. Dial (919) 541-5742 for up to a 14400

bps modem. If more information on TTN is needed, call the HELP line at (919) 541-5384.

I. SUMMARY

Method 23 was promulgated along with the New Source Performance Standard for municipal waste combustors (Subpart Ea). As promulgated, the method contained some errors. This action would correct those errors and would clarify some of the existing quality assurance requirements. In addition, the current procedure requires rinsing of the sampling train with two separate solvents which must be analyzed separately. Based on data the Agency has collected since promulgation of Method 23, we believe that one of these rinse steps and the resulting sample fraction can be eliminated. This could save as much as $2000 per test run in analytical costs.

II. THE RULEMAKING

This rulemaking does not impose emission measurement requirements beyond those specified in the current regulations nor does it change any emission standard. Rather, the rulemaking would simply amend an existing test method associated with emission measurement requirements in the current regulations that would apply irrespective of this rulemaking.

III. ADMINISTRATIVE REQUIREMENTS

A. Public Hearing

A public hearing will be held, if requested, to discuss the proposed amendment in accordance with section 307(d)(5)of the Clean Air Act. Persons wishing to make oral presentations should contact EPA at the address given in the ADDRESSES section of this preamble. Oral presentations will be limited to 15 minutes each. Any member of the public may file a written statement with EPA before, during, or within 30 days after the hearing. Written statements should be addressed to the Air Docket Section address given in the ADDRESSES section of this preamble.

A verbatim transcript of the hearing and written statements will be available for public inspection and copying during normal working hours at EPA's Air Docket Section in Washington, DC (see ADDRESSES section of this preamble).

B. Docket

The docket is an organized and complete file of all the information considered by EPA in the development of this rulemaking. The docket is a dynamic file, since material is added throughout the rulemaking development. The docketing system is intended to allow members of the public and industries involved to identify and locate documents readily so that they may effectively participate in the rulemaking process. Along

with the statement of basis and purpose of the proposed and promulgated test method revisions and EPA responses to significant comments, the contents of the docket, except for interagency review materials, will serve as the record in case of judicial review [Section 307(d)(7)(A)].

C. Executive Order 12291 Review

Under Executive Order 12291, EPA is required to judge whether a regulation is a "major rule" and, therefore, subject to the requirements of a regulatory impact analysis. This rulemaking does not impose emission measurement requirements beyond those specified in the current regulations, nor does it change any emission standard. The Agency has determined that this regulation would result in none of the adverse economic effects set forth in Section 1 of the Order as grounds for finding the regulation to be a "major rule." The Agency has, therefore, concluded that this regulation is not a "major rule" under Executive Order 12291.

D. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) of 1980 requires the identification of potentially adverse impacts of Federal regulations upon small business entities. The RFA specifically requires the completion of an analysis in those instances where

small business impacts are possible. This rulemaking does not impose emission measurement requirements beyond those specified in the current regulations, nor does it change any emission standard. Because this rulemaking imposes no adverse economic impacts, an analysis has not been conducted.

Pursuant to the provision of 5 U.S.C. 605(b), I hereby certify that the promulgated rule will not have an impact on small entities because no additional costs will be incurred.

E. Paperwork Reduction Act

This rule does not change any information collection requirements subject to Office of Management and Budget review under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq*.

F. Statutory Authority

The statutory authority for this proposal is provided by sections 111 and 301(a) of the Clean Air Act, as amended: 42 U.S.C., 7411 and 7601(a).

LIST OF SUBJECTS

Air pollution control, municipal waste combustors, polychorinated dibenzo-p-dioxins, sources.

Date The Administrator

It is proposed that 40 CFR Part 60 be amended as follows:

1. The authority citation for Part 60 continues to read as follows: Authority: Clean Air Act (42 U.S.C. 7401 [et seq.], as amended by Pub. L 101-549).

2. Replace test Method 23 of Appendix A, with the following:

Method 23 - Determination of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from Municipal Waste Combustors

1. APPLICABILITY AND PRINCIPLE

1.1 Applicability. This method is applicable to the determination of emissions of polychlorinated dibenzo-p-dioxins (PCDD's) and polychlorinated dibenzofurans (PCDF's) from municipal waste combustors. Calibration standards are selected for regulated emission levels for municipal waste combustors.

1.2 Principle. A sample is withdrawn isokinetically from the gas stream and collected in the sample probe, on a glass fiber filter, and on a packed column of adsorbent material. The sample cannot be separated into a particle and vapor fraction. The PCDD's and PCDF's are extracted from the sample, separated by high resolution gas chromatography (HRGC), and measured by high

resolution mass spectrometry (HRMS).

2. APPARATUS

2.1 Sampling. A schematic of the sampling train is shown in Figure 23-1. Sealing greases shall not be used in assembling the train. The train is identical to that described in Section 2.1 of Method 5 of this appendix with the following additions:

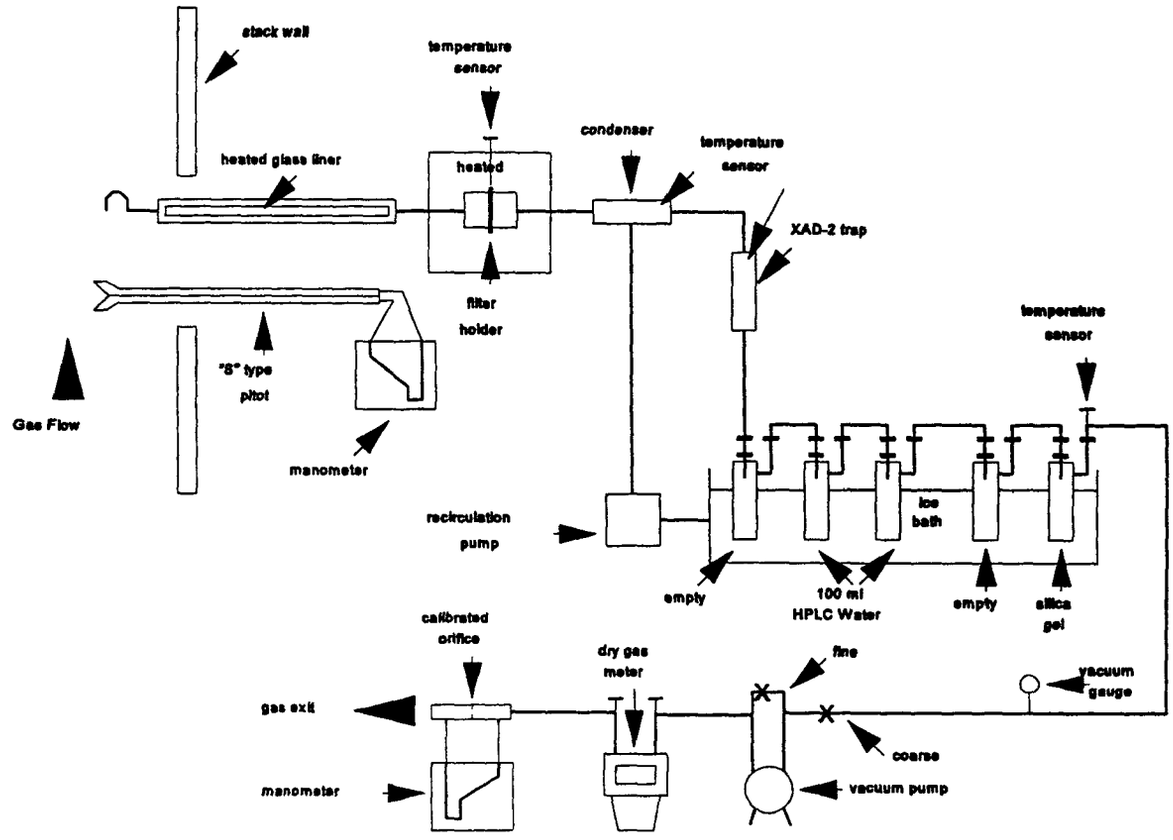

Figure 23.1 Sampling Train

2.1.1 Nozzle. The nozzle shall be made of nickel, nickel-plated stainless steel, quartz, or borosilicate glass.

2.1.2 Sample Transfer Lines. The sample transfer lines, if needed, shall be heat traced, heavy walled TFE (1/2 in. OD with 1/8 in. wall) with connecting fittings that are capable of forming leak-free, vacuum-tight connections without using sealing greases. The line shall be as short as possible and must be maintained at $\geq$120°C.

2.1.1 Filter Support. Teflon or Teflon-coated wire.

2.1.2 Condenser. Glass, coil type with compatible fittings. A schematic diagram is shown in Figure 23-2.

2.1.3 Water Bath. Thermostatically controlled to maintain the gas temperature exiting the condenser at $\leq$20°C (68°F).

2.1.4 Adsorbent Module. Glass container to hold up to 40 grams of resin adsorbent. A schematic diagram is shown in Figure 23-2. Other physical configurations of the water-jacketed resin trap/condenser assembly are acceptable. The connecting fittings shall form leak-free, vacuum tight seals. A coarse glass frit is included to retain the adsorbent in the water-jacketed sorbent module.

2.1.5 Probe Liner. The probe liner shall be made of glass and a Teflon ferrule or Teflon coated O-ring shall be used to make the seal at the nozzle end of the probe.

2.2 Sample Recovery.

2.2.1 Fitting Caps. Ground glass, Teflon tape, or aluminum foil (Section 2.2.6) to cap off the sample exposed sections of the train and sorbent module.

2.2.2 Wash Bottles. Teflon, 500-mL.

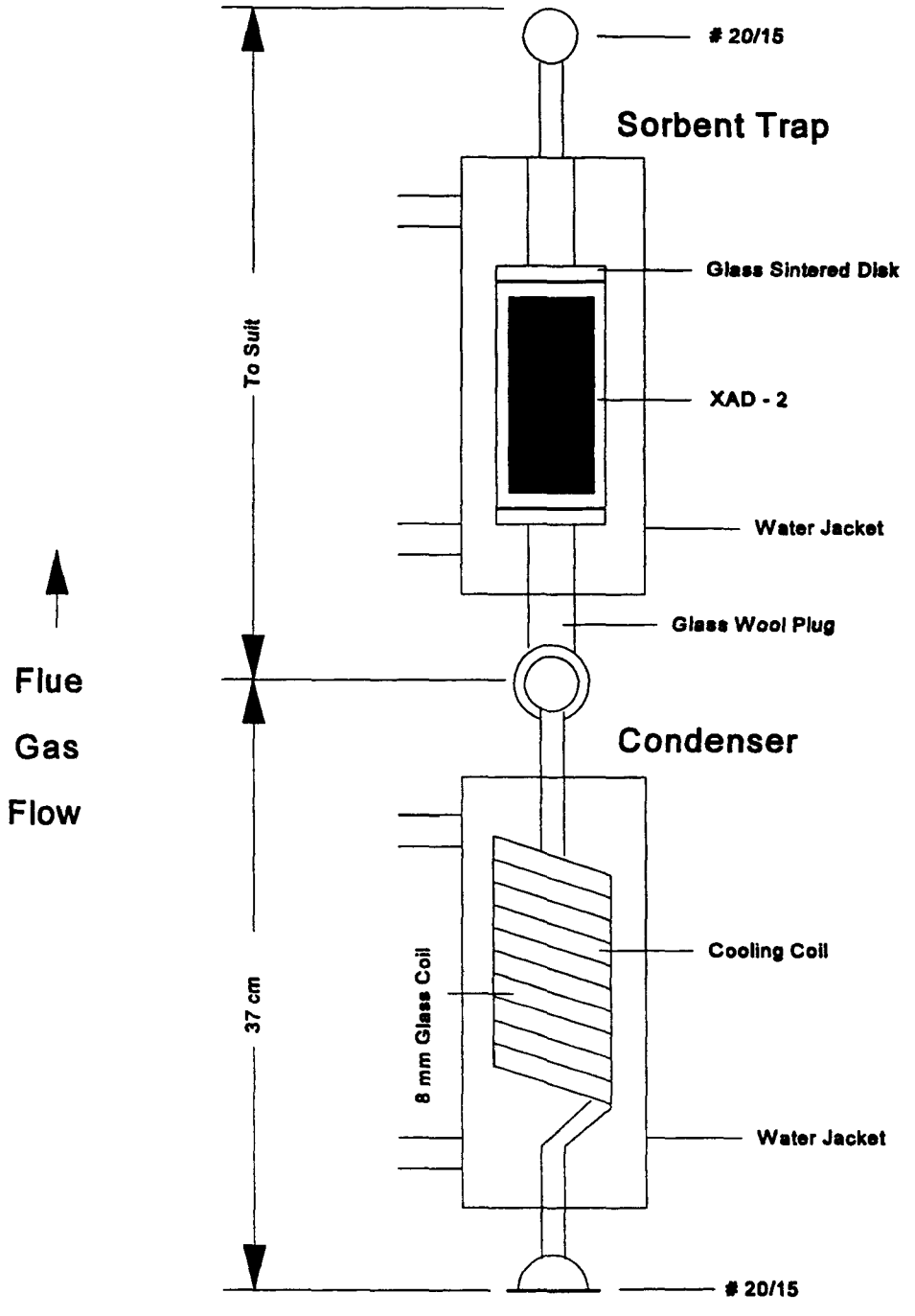

Figure 23.2 Condenser and Adsorbent Trap

2.2.3 Probe Liner, Probe Nozzle, and Filter Holder Brushes. Inert bristle brushes with precleaned stainless steel or Teflon handles. The probe brush shall have extensions of stainless steel or Teflon, at least as long as the probe. The brushes shall be properly sized and shaped to brush out the nozzle, probe liner, and transfer line, if used.

2.2.4 Filter Storage Container. Sealed filter holder, wide-mouth amber glass jar with Teflon-lined cap, glass petri dish, or Teflon baggie.

2.2.5 Balance. Triple beam.

2.2.6 Aluminum Foil. Heavy duty, hexane-rinsed (Do not use to wrap or ship filter samples, because it may react with particulate matter).

2.2.7 Metal Storage Container. Air tight container to store silica gel.

2.2.8 Graduated Cylinder. Glass, 250-mL with 2-mL graduations.

2.2.9 Glass Sample Storage Containers. Amber glass bottles for sample glassware washes, 500- or 1000-mL, with leak free Teflon-lined caps.

2.3 Analysis.

2.3.1 Sample Containers. 125- and 250-mL flint glass bottles with Teflon-lined caps.

2.3.2 **Test Tubes.** Glass.

2.3.3 **Soxhlet Extraction Apparatus.** Capable of holding 43 x 123 mm extraction thimbles.

2.3.4 **Extraction Thimble.** Glass, precleaned cellulosic, or glass fiber.

2.3.5 **Pasteur Pipettes.** For preparing liquid chromatographic columns.

2.3.6 **Reacti-vials.** Amber glass, 2-mL.

2.3.7 **Rotary Evaporator.** Buchi/Brinkman RF-121 or equivalent.

2.3.8 **Kuderna-Danish Concentrator Apparatus.**

2.3.9 **Nitrogen Evaporative Concentrator.** N-Evap Analytical Evaporator Model III or equivalent.

2.3.10 **Separatory Funnels.** Glass, 2-liter.

2.3.11 **Gas Chromatograph.** Consisting of the following components:

2.3.11.1 **Oven.** Capable of maintaining the separation column at the proper operating temperature ±10°C and performing programmed increases in temperature at rates of at least 40°C/min.

2.3.11.2 **Temperature Gauges.** To monitor column oven, detector, and exhaust temperatures ±1°C.

2.3.11.3 **Flow Systems.** Gas metering system to measure sample, fuel, combustion gas, and carrier gas flows.

2.3.11.4 Capillary Columns. A fused silica column, 60 x 0.25 mm inside diameter (ID), coated with DB-5 and a fused silica column, 30 m x 0.25 mm ID coated with DB-225. Other column systems may be substituted provided that the user is able to demonstrate, using calibration and performance checks, that the column system is able to meet the specifications of Section 6.1.2.2.

2.3.12 Mass Spectrometer. Capable of routine operation at a resolution of 1:10000 with a stability of ±5 ppm.

2.3.13 Data System. Compatible with the mass spectrometer and capable of monitoring at least five groups of 25 ions.

2.3.14 Analytical Balance. To measure within 0.1 mg.

3. REAGENTS

3.1 Sampling.

3.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3-micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Standard Method D 2986-71 (Reapproved 1978) (incorporated by reference - see §60.17).

3.1.1.1 Precleaning. All filters shall be cleaned before their initial use. Place a glass extraction thimble and 1 g of silica gel and a plug of glass wool into a Soxhlet apparatus,

charge the apparatus with toluene, and reflux for a minimum of 3 hours. Remove the toluene and discard it, but retain the silica gel. Place no more than 50 filters in the thimble onto the silica gel bed and top with the cleaned glass wool. Charge the Soxhlet with toluene and reflux for 16 hours. After extraction, allow the Soxhlet to cool, remove the filters, and dry them under a clean nitrogen (N_2) stream. Store the filters in a glass petri dishes and seal with Teflon tape.

3.1.2 Adsorbent Resin. Amberlite XAD-2 resin. Thoroughly cleaned before initial use. Do not reuse resin. If precleaned XAD-2 resin is purchased from the manufacturer, the cleaning procedure described in Section 3.1.2.1 is not required.

3.1.2.1 Cleaning. Procedure may be carried out in a giant Soxhlet extractor. An all-glass filter thimble containing an extra-coarse frit is used for extraction of XAD-2. The frit is recessed 10-15 mm above a crenelated ring at the bottom of the thimble to facilitate drainage. The resin must be carefully retained in the extractor cup with a glass wool plug and a stainless steel ring because it floats on methylene chloride. This process involves sequential extraction in the following order.

Solvent	Procedure
Water	Initial Rinse: Place resin in a beaker,

	rinse once with HPLC water, and discard water. Refill beaker with water, let stand overnight, and discard water.
Water	Extract with HPLC water for 8 hours.
Methanol	Extract with methanol for 22 hours.
Methylene Chloride	Extract with methylene chloride for 22 hours.
Methylene Chloride	Extract with methylene chloride for 22 hours.

3.1.2.2 Drying.

3.1.2.2.1 Drying Column. Pyrex pipe, 10.2 cm ID by 0.6 m long, with suitable retainers.

3.1.2.2.2 Procedure. The adsorbent must be dried with clean inert gas. Liquid nitrogen from a standard commercial liquid nitrogen cylinder has proven to be a reliable source for large volumes of gas free from organic contaminants. Connect the liquid nitrogen cylinder to the column by a length of cleaned copper tubing, 0.95 cm ID, coiled to pass through a heat source. A convenient heat source is a water-bath heated from a steam line. The final nitrogen temperature should only be warm to the touch and not over 40°C. Continue flowing nitrogen through the adsorbent until all the residual solvent is removed. The flow rate should be sufficient to gently agitate the particles, but

not so excessive as to cause the particles to fracture.

3.1.2.3 Quality Control Check. The adsorbent must be checked for residual methylene chloride ($MeCl_2$) as well as PCDDs and PCDFs prior to use. The analyst may opt to omit this check for precleaned XAD-2.

3.1.2.3.1 $MeCl_2$ Residue Extraction. Weigh a 1.0 g sample of dried resin into a small vial, add 3 mL of toluene, cap the vial, and shake it well.

3.1.2.3.2 $MeCl_2$ Residue Analysis. Inject a 2 μl sample of the extract into a gas chromatograph operated under the following conditions:

Column: 6 ft x 1/8 in stainless steel containing 10 percent OV-101™ on 100/120 Supelcoport.

Carrier Gas: Helium at a rate of 30 mL/min.

Detector: Flame ionization detector operated at a sensitivity of 4×10^{-11} A/mV.

Injection Port Temperature: 250°C.

Detector Temperature: 305°C.

Oven Temperature: 30°C for 4 min; programmed to rise at 40°C/min until it reaches 250°C; return to 30°C after 17 minutes.

Compare the results of the analysis to the results from the reference solution. Prepare the reference solution by injecting

4.0 µl of methylene chloride into 100 mL of toluene. This corresponds to 100 µg of methylene chloride per g of adsorbent. The maximum acceptable concentration is 1000 µg/g of adsorbent. If the adsorbent exceeds this level, drying must be continued until the excess methylene chloride is removed.

3.1.2.3.3 PCDD and PCDF Check. Extract the adsorbent sample as described in Section 5.1. Analyze the extract as described in Section 5.3. If any of the PCDDs or PCDFs (tetra through hexa) are present at concentrations above the target detection limits (TDLs), the adsorbent must be recleaned by repeating the last step of the cleaning procedure. The TDLs for the various PCDD/PCDF congeners are listed in Table 1.

3.1.2.4 Storage. After cleaning, the adsorbent may be stored in a wide mouth amber glass container with a Teflon-lined cap or placed in glass adsorbent modules tightly sealed with glass stoppers. It must be used within 4 weeks of cleaning. If precleaned adsorbent is purchased in sealed containers, it must be used within 4 weeks after the seal is broken.

3.1.3 Glass Wool. Cleaned by sequential immersion in three aliquots of methylene chloride, dried in a 110°C oven, and stored in a methylene chloride-washed glass container with a Teflon-lined screw cap.

3.1.4 Water. Deionized distilled and stored in a methylene

chloride-rinsed glass container with a Teflon-lined screw cap.

3.1.5 **Silica Gel.** Indicating type, 6 to 16 mesh. If previously used, dry at 175° C (350°F) for two hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

3.1.6 **Chromic Acid Cleaning Solution.** Dissolve 20 g of sodium dichromate in 15 mL of water, and then carefully add 400 mL of concentrated sulfuric acid.

3.1.7 **HPLC Water.**

3.2 **Sample Recovery.**

3.2.1 **Acetone.** Pesticide quality.

3.2.2 **Toluene.** Pesticide quality.

3.3 **Analysis.**

3.3.1 **Potassium Hydroxide.** ACS grade, 2-percent (weight/volume) in water.

3.3.2 **Sodium Sulfate.** Granulated, reagent grade. Purify prior to use by rinsing with methylene chloride and oven drying. Store the cleaned material in a glass container with a Teflon-lined screw cap.

3.3.3 **Sulfuric Acid.** Reagent grade.

3.3.4 **Sodium Hydroxide.** 1.0 N. Weigh 40 g of sodium hydroxide into a 1-liter volumetric flask. Dilute to 1 liter with water.

3.3.5 **Hexane.** Pesticide grade.

3.3.6 **Methylene Chloride.** Pesticide grade.

3.3.7 **Benzene.** Pesticide grade.

3.3.8 **Ethyl Acetate.**

3.3.9 **Methanol.** Pesticide grade.

3.3.10 **Toluene.** Pesticide grade.

3.3.11 **Nonane.** Pesticide grade.

3.3.12 **Cyclohexane.** Pesticide Grade.

3.3.13 **Basic Alumina.** Activity grade 1, 100-200 mesh. Prior to use, activate the alumina by heating for 16 hours at 130°C. Store in a desiccator. Pre-activated alumina may be purchased from a supplier and may be used as received.

3.3.14 **Silica Gel.** Bio-Sil A, 100-200 mesh. Prior to use, activate the silica gel by heating for at least 30 minutes at 180°C. After cooling, rinse the silica gel sequentially with methanol and methylene chloride. Heat the rinsed silica gel at 50°C for 10 minutes, then increase the temperature gradually to 180°C over 25 minutes and maintain it at this temperature for 90 minutes. Cool at room temperature and store in a glass container with a Teflon-lined screw cap.

3.3.15 **Silica Gel Impregnated with Sulfuric Acid.** Combine 100 g of silica gel with 44 g of concentrated sulfuric acid in a screw capped glass bottle and agitate thoroughly. Disperse the

solids with a stirring rod until a uniform mixture is obtained. Store the mixture in a glass container with a Teflon-lined screw cap.

3.3.16 **Silica Gel Impregnated with Sodium Hydroxide.** Combine 39 g of 1 N sodium hydroxide with 100 g of silica gel in a screw capped glass bottle and agitate thoroughly. Disperse solids with a stirring rod until a uniform mixture is obtained. Store the mixture in glass container with a Teflon-lined screw cap.

3.3.17 **Carbon/Celite.** Combine 10.7 g of AX-21 carbon with 124 g of Celite 545 in a 250-mL glass bottle with a Teflon-lined screw cap. Agitate the mixture thoroughly until a uniform mixture is obtained. Store in the glass container.

3.3.18 **Nitrogen.** Ultra high purity.

3.3.19 **Hydrogen.** Ultra high purity.

3.3.20 **Internal Standard Solution.** Prepare a stock standard solution containing the isotopically labelled PCDD's and PCDF's at the concentrations shown in Table 2 under the heading "Internal Standards" in 10 mL of nonane.

3.3.21 **Surrogate Standard Solution.** Prepare a stock standard solution containing the isotopically labelled PCDD's and PCDF's at the concentrations shown in Table 2 under the heading "Surrogate Standards" in 10 mL of nonane.

3.3.22 **Recovery Standard Solution.** Prepare a stock standard

solution containing the isotopically labelled PCDD's and PCDF's at the concentrations shown in Table 2 under the heading "Recovery Standards" in 10 mL of nonane.

4. PROCEDURE

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers and analysts should be trained and experienced with the procedures.

4.1.1 Pretest Preparation.

4.1.1.1 Cleaning Glassware. All glass components of the train upstream of and including the adsorbent module, shall be cleaned as described in Section 3A of the "Manual of Analytical Methods for the Analysis of Pesticides in Human and Environmental Samples." Special care shall be devoted to the removal of residual silicone grease sealants on ground glass connections of used glassware. Any residue shall be removed by soaking the glassware for several hours in a chromic acid cleaning solution prior to cleaning as described above.

4.1.1.2 Adsorbent Trap. The traps shall be loaded in a clean area to avoid contamination. They may not be loaded in the field. Fill a trap with 20 to 40 g of XAD-2. Follow the XAD-2 with glass wool and tightly cap both ends of the trap. Add 40 μl of the surrogate standard solution (Section 3.3.21) to each trap for a sample that will be split prior to analysis or 20 μl of the

surrogate standard solution (Section 3.3.21) to each trap for samples that will not be split for analysis (Section 5.1). After addition of the surrogate standard solution, the trap must be used within 14 days. Keep the spiked sorbent under refrigeration until use.

4.1.1.3 Sampling Train. It is suggested that all components be maintained according to the procedure described in APTD-0576.

4.1.1.4 Silica Gel. Weigh several 200 to 300 g portions of silica gel in air tight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel may be weighed directly in the fifth impinger just prior to sampling.

4.1.1.5 Filter. Check each filter against light for irregularities and flaws or pinhole leaks. Pack the filters flat in a clean glass container or Teflon baggie. Do not mark filter with ink or any other contaminating substance.

4.1.2 Preliminary Determinations. Same as Section 4.1.2 Method 5.

4.1.3 Preparation of Sampling Train.

4.1.3.1 During preparation and assembly of the sampling train, keep all train openings where contamination can enter, sealed until sampling is about to begin. Wrap sorbent module with aluminum foil to shield from radiant heat of sun light. (NOTE:

Do not use sealant grease in assembling the train.)

4.1.3.2 Place approximately 100 mL of water in the second and third impingers, leave the first and fourth impingers empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fifth impinger.

4.1.3.3 Place the silica gel container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus the fifth impinger may be determined to the nearest 0.5 g and recorded.

4.1.3.4 Assemble the sampling train as shown in Figure 23-1.

4.1.3.5 Turn on the adsorbent module and condenser coil recirculating pump and begin monitoring the adsorbent module gas entry temperature. Ensure proper sorbent gas entry temperature before proceeding and before sampling is initiated. It is extremely important that the XAD-2 adsorbent resin temperature never exceed 50°C because thermal decomposition and breakthrough of surrogate standards will occur. During testing, the XAD-2 temperature must not exceed 20°C for efficient capture of the PCDD's and PCDF's.

4.1.4 Leak-Check Procedure. Same as Method 5, Section 4.1.4.

4.1.5 Sampling Train Operation. Same as Method 5, Section 4.1.5.

4.2 Sample Recovery. Proper cleanup procedure begins as soon

as the probe is removed from the stack at the end of the sampling period. Seal the nozzle end of the sampling probe with Teflon tape or aluminum foil.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe. Remove the probe from the train and close off both ends with aluminum foil. Seal off the inlet to the train with Teflon tape, a ground glass cap, or aluminum foil.

Transfer the probe and impinger assembly to the cleanup area. This area shall be clean and enclosed so that the chances of losing or contaminating the sample are minimized. Smoking, which could contaminate the sample, shall not be allowed in the cleanup area. Cleanup personnel shall wash their hands prior to sample recovery.

Inspect the train prior to and during disassembly and note any abnormal conditions, e.g., broken filters, colored impinger liquid, etc. Treat the samples as follows:

4.2.1 Container No. 1. Either seal the filter holder or carefully remove the filter from the filter holder and place it in its identified container. Do not place the filter in aluminum foil. Use a pair of cleaned tweezers to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the

container any particulate matter and filter fibers which adhere to the filter holder gasket, by using a dry inert bristle brush and a sharp-edged blade. Seal the container with Teflon tape.

4.2.2 Adsorbent Module. Remove the module from the train, tightly cap both ends, label it, and store it on ice for transport to the laboratory.

4.2.3 Container No. 2. Quantitatively recover material deposited in the nozzle, probe transfer lines, the front half of the filter holder, and the cyclone, if used, first, by brushing while rinsing three times with acetone and then, by rinsing the probe three times with toluene. Collect all the rinses in Container No. 2.

Rinse the back half of the filter holder three times with acetone. Rinse the connecting line between the filter and the condenser three times with acetone. Soak the connecting line with three separate portions of toluene for 5 minutes each. If using a separate condenser and adsorbent trap, rinse the condenser in the same manner as the connecting line. Collect all the rinses in Container No. 2 and mark the level of the liquid on the container.

4.2.4 Impinger Water. Measure the liquid in the first four impingers to within 1 mL by using a graduated cylinder or by weighing it to within 0.5 g by using a balance. Record the

volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas. Discard the liquid after measuring and recording the volume or weight.

4.2.5 Silica Gel. Note the color of the indicating silica gel to determine if it has been completely spent and make a mention of its condition. Transfer the silica gel from the fifth impinger to its original container and seal.

5. ANALYSIS

All glassware shall be cleaned as described in Section 3A of the "Manual of Analytical Methods for the Analysis of Pesticides in Human and Environmental Samples." All samples must be extracted within 30 days of collection and analyzed within 45 days of extraction.

5.1 Sample Extraction. The analyst may choose to split the sample extract after the completion of sample extraction procedures. One half of the sample can then be archived. Sample preparation procedures are given for using the entire sample and for splitting the sample.

5.1.1 Extraction System. Place an extraction thimble (Section 2.3.4), 1 g of silica gel, and a plug of glass wool into the Soxhlet apparatus, charge the apparatus with toluene, and reflux for a minimum of 3 hours. Remove the toluene and discard it, but retain the silica gel. Remove the extraction thimble from the

extraction system and place it in a glass beaker to catch the solvent rinses.

5.1.2 Container No. 1 (Filter). Transfer the contents directly to the glass thimble of the extraction system and extract them simultaneously with the XAD-2 resin.

5.1.3 Adsorbent Cartridge. Suspend the adsorbent module directly over the extraction thimble in the beaker (See Section 5.1.1). The glass frit of the module should be in the up position. Using a Teflon squeeze bottle containing toluene, flush the XAD-2 into the thimble onto the bed of cleaned silica gel. Thoroughly rinse the glass module catching the rinsings in the beaker containing the thimble. If the resin is wet, effective extraction can be accomplished by loosely packing the resin in the thimble. Add the XAD-2 glass wool plug to the thimble.

5.1.4 Container No. 2 (Acetone and Toluene). Concentrate the sample to a volume of about 1-2 mL using a Kuderna-Danish concentrator apparatus, followed by N_2 blow down at a temperature of less than 37°C. Rinse the sample container three times with small portions of methylene chloride and add these to the concentrated solution and concentrate further to near dryness. This residue contains particulate matter removed in the rinse of the sampling train probe and nozzle. Add the concentrate to the

filter and the XAD-2 resin in the Soxhlet apparatus described in Section 5.1.1.

5.1.5 Extraction. For samples that are to be split prior to analysis add 40 µl of the internal standard solution (Section 3.3.20) to the extraction thimble containing the contents of the adsorbent cartridge, the contents of Container No. 1, and the concentrate from Section 5.1.4. Alternatively, 20 µl of the internal standard solution (Section 3.3.20) for samples that are not to be split prior to analysis. Cover the contents of the extraction thimble with the cleaned glass wool plug to prevent the XAD-2 resin from floating into the solvent reservoir of the extractor. Place the thimble in the extractor, and add the toluene contained in the beaker to the solvent reservoir. Add additional toluene to fill the reservoir approximately 2/3 full. Add Teflon boiling chips and assemble the apparatus. Adjust the heat source to cause the extractor to cycle three times per hour. Extract the sample for 16 hours. After extraction, allow the Soxhlet to cool. Transfer the toluene extract and three 10-mL rinses to the rotary evaporator. Concentrate the extract to approximately 10 mL. If decided to split the sample, store one half for future use, and analyze the other half according to the procedures in Sections 5.2 and 5.3. In either case, use a nitrogen evaporative

concentrator to reduce the volume of the sample being analyzed to near dryness. Dissolve the residue in 5 mL of hexane.

5.2 Sample Cleanup and Fractionation.

The following sample cleanup and fractionation procedures are recommended. Alternative procedures may be utilized providing acceptable identification criteria (Section 5.3.2.5) and quantification criteria (Section 5.3.2.6) are met.

5.2.1 Silica Gel Column. Pack one end of a glass column, 20 mm x 230 mm, with glass wool. Add in sequence, 1 g silica gel, 2 g of sodium hydroxide impregnated silica gel, 1 g silica gel, 4 g of acid-modified silica gel, and 1 g of silica gel. Wash the column with 30 mL of hexane and discard. Add the sample extract, dissolved in 5 mL of hexane to the column with two additional 5-mL rinses. Elute the column with an additional 90 mL of hexane and retain the entire eluate. Concentrate this solution to a volume of about 1 mL using the nitrogen evaporative concentrator (Section 2.3.9).

5.2.2 Basic Alumina Column. Shorten a 25-mL disposable Pasteur pipette to about 16 mL. Pack the lower section with glass wool and 12 g of basic alumina. Transfer the concentrated extract from the silica gel column to the top of the basic alumina column and elute the column sequentially with 120 mL of 0.5 percent methylene chloride in hexane followed by 120 mL of 35

percent methylene chloride in hexane. Discard the first 120 mL of eluate. Collect the second 120 mL of eluate and concentrate it to about 0.5 mL using the nitrogen evaporative concentrator. Transfer this extract with hexane to "13 mL tubes".

5.2.3 AX-21 Carbon/Celite 545 Column. Remove the bottom 0.5 in. from the tip of a 2-mL disposable Pasteur pipette. Insert a glass fiber filter disk or glass wool plug in the top of the pipette 2.5 cm from the constriction. Add sufficient carbon/Celite™ mixture to form a 2 cm column (the 0.6 mL mark column. Top with a glass wool plug. In some cases AX-21 carbon fines may wash through the glass wool plug and enter the sample. This may be prevented by adding a celite plug to the exit end of the column. Pre-elute the column with 5 mL toluene, followed by 1 mL of a 50:50 methylene chloride/cyclohexane mixture, followed by 5 mL of hexane. Load in sequence, the sample extract in 1 mL hexane, 2x0.5 mL rinses in hexane, 2 mL of 50 percent methylene chloride in hexane and 2 mL of 50 percent benzene in ethyl acetate and discard the eluates. Invert the column and elute in the reverse direction with 13 mL of toluene. Collect this eluate. Concentrate the eluate in a nitrogen evaporator at 45°C to about 1 mL. Transfer the concentrate to a Reacti-vial using a toluene rinses and concentrate to near dryness (less than 20 μl) using a stream of N_2. Store extracts at room temperature,

shielded from light, until the analysis is performed.

5.3 **Analysis.** Analyze the sample with a gas chromatograph coupled to a mass spectrometer (GC/MS) using the instrumental parameters in Sections 5.3.1 and 5.3.2. Immediately prior to analysis, add a 20 µl aliquot of the recovery standard solution from Table 2 to each sample. A 2 µl aliquot of the extract is injected into the GC. Sample extracts are first analyzed using the DB-5 capillary column to determine the concentration of each isomer of PCDD's and PCDF's (tetra-through octa-). If 2,3,7,8-TCDF is detected in this analysis, then analyze another aliquot of the sample in a separate run, using the DB-225 column to measure the 2,3,7,8 tetra-chloro dibenzofuran isomer. Other column systems may be used, provided that it can be demonstrated using calibration and performance checks that the column system is able to meet the specifications of Section 6.1.2.

5.3.1 **Gas Chromatograph Operating Conditions.** The recommended conditions are shown in Table 4.

5.3.2 **High Resolution Mass Spectrometer.**

5.3.2.1 **Resolution.** 10,000 resolving power or 100 ppm mass/mass.

5.3.2.2 **Ionization Mode.** Electron impact.

5.3.2.3 **Source Temperature 250°C.**

5.3.2.4 **Monitoring Mode.** Selected ion monitoring. A list of

the various ions to be monitored is presented in Table 5.

5.3.2.5 Identification Criteria. The following identification criteria shall be used for the characterization of polychlorinated dibenzodioxins and dibenzofurans.

1. The integrated ion-abundance ratio (M/M+2 or M+2/M+4) shall be within 15 percent of the theoretical value. The acceptable ion-abundance ratio ranges (±15%) for the identification of chlorine-containing compounds are given in Table 6. If the ion-abundance ratio ranges are the outside those in Table 6, the source has the option of using the results if the concentration is determined using procedures in Section 9.3 or redoing the analysis to eliminate the unacceptable ion-abundance ratio.

2. The retention time for the analytes must be within 3 seconds of the corresponding ^{13}C-labeled internal standard or surrogate standard.

3. The monitored ions, shown in Table 5 for a given analyte, shall reach their maximum within 2 seconds of each other.

4. The identification of specific isomers that do not have corresponding ^{13}C-labeled standards is done by comparison of the relative retention time (RRT) of the analyte to the nearest internal standard retention time with reference (i.e., within 0.005 RRT units) to the comparable RRT's found in the continuing calibration.

5. The signal to noise ratio for all monitored ions must be greater than 2.5.

6. The confirmation of 2, 3, 7, 8-TCDF shall satisfy all of the above identification criteria.

7. Any PCDF coeluting (±2 s) with a peak in the corresponding PCDPE channel, of intensity 10% or greater compared to the analyte peak is evidence of a positive interference, the source may opt keep the value to calculate CDD/CDF concentration or conduct a complete reanalysis in an effort to remove or shift the interference. If a reanalysis is conducted, all values from the reanalyzed sample will be used for CDD/CDF concentration calculations.

8. Set the mass spectrometer lock channels as specified in Table 5. Monitor the quality control check channels specified in Table 5 to verify instrument stability during the analysis. If the signal varies by more than 25 percent from the average response, results for all isomers at corresponding residence time shall be invalid. The source has the options of conducting additional cleanup procedures on the other portion of the sample for split samples or diluting the original sample or following other procedures recommended by the Administrator. When a complete reanalysis is conducted, all concentration calculations shall be based on the reanalyzed sample.

5.3.2.6 **Quantification.** The peak areas for the two ions monitored for each analyte are summed to yield the total response for each analyte. Each internal standard is used to quantify the indigenous PCDD's or PCDF's in its homologous series. For example, the $^{13}C_{12}$-2,3,7,8-tetra chlorinated dibenzodioxin is used to calculate the concentrations of all other tetra chlorinated isomers. Recoveries of the tetra- and penta- internal standards are calculated using the $^{13}C_{12}$-1,2,3,4-TCDD. Recoveries of the hexa- through octa- internal standards are calculated using $^{13}C_{12}$-1,2,3,7,8,9-HxCDD. Recoveries of the surrogate standards are calculated using the corresponding homolog from the internal standard. When no peak is detected, the noise level, as measured by the intensity of the noise in a clear zone of the chromatogram, is used to calculate the detection limit. Tables 7, 8, and 9 summarize the quantification relationships for the unlabeled analytes, internal standards and surrogate standards, respectively.

6. CALIBRATION

Same as Method 5 with the following additions.

6.1 GC/MS System.

6.1.1 **Initial Calibration.** Calibrate the GC/MS system using the set of five standards shown in Table 3. The relative standard deviation for the mean response factor from each of the

unlabeled analytes (Table 3) and of the internal and surrogate standards shall be less than or equal to the values in Table 6. The signal to noise ratio for the GC signal present in every selected ion current profile shall be greater than or equal to 10. The ion abundance ratios shall be within the control limits in Table 5.

6.1.2 Daily Performance Check.

6.1.2.1 Calibration Check. Inject 2 μl of solution Number 3 from Table 3. Calculate the relative response factor (RRF) for each compound and compare each RRF to the corresponding mean RRF obtained during the initial calibration. The analyzer performance is acceptable if the measured RRF's for the labeled and unlabeled compounds for the daily run are within the limits of the mean values shown in Table 10. In addition, the ion-abundance ratios shall be within the allowable control limits shown in Table 6.

6.1.2.2 Column Separation Check. Inject 2 μl of a solution of a mixture of PCDD's and PCDF's that documents resolution between 2,3,7,8-TCDD and other TCDD isomers. Resolution is defined as a valley between peaks that is less than 25 percent of the lower of the two peaks. Identify and record the retention time windows for each homologous series. Perform a similar resolution check on the confirmation column to document the resolution between

2,3,7,8 TCDF and other TCDF isomers.

6.2 Lock Channels. Set mass spectrometer lock channels as specified in Table 5. Monitor the quality control check channels specified in Table 5 to verify instrument stability during the analysis.

7. QUALITY CONTROL

7.1 Sampling Train Collection Efficiency Check. Add 40 μl of the surrogate standards in Table 2 for samples split for analysis or 20 μl of the surrogate standards for sample <u>not</u> split for analysis to the adsorbent cartridge of each train before collecting the field samples.

7.2 Internal Standard Percent Recoveries. A group of nine carbon-labeled PCDDs and PCDFs representing the tetra- through octachlorinated homologues, is added to every sample prior to extraction. The role of the internal standards is to quantify the native PCDD's and PCDF's present in the sample as well as to determine the overall method efficiency. Recoveries of the internal standards shall be between 40 to 130 percent for the tetra- through hexachlorinated compounds while the range is 25 to 130 percent for the hepta- and octachlorinated homologues.

7.3 Surrogate Standard Recoveries. The five surrogate compounds in Table 3 are added to the resin in the adsorbent sampling cartridge before the sample is collected. The surrogate

recoveries are measured relative to the internal standards and are a measure of the sampling train collection efficiency. They are not used to measure the native PCDD's and PCDF's. All surrogate standard recoveries shall be between 70 and 130 percent. Poor recoveries for all the surrogates may be an indication of breakthrough in the sampling train. If the recovery of all standards is below 70 percent, the sampling runs must be repeated. As an alternative, the sampling runs do not have to be repeated if the final results are divided by the fraction of surrogate recovery (on a homolog group basis). Poor recoveries of isolated surrogate compounds should not be grounds for rejecting an entire set of samples.

7.4 Toluene QA Rinse. Report the results of the toluene QA rinse separately from the total sample catch. Do not add it to the total sample.

7.5 Detection Limits. Calculate the detection limits using the equation in Section 9.8. If the detection limits meet the Target Detection Limits (TDLs) in Table 1, then they are considered acceptable. If the TDLs are not met, the impact of the detection limits shall be calculated using the procedures in Section 9.9. If the maximum potential value of the sum of the summed detection limits is less then 50 percent of the emission standard, the detection limits are acceptable. If the value is

greater than 50 percent of the emission standard, then the analysis and/or sampling and analysis must be repeated until acceptable detection limits are obtained.

8. QUALITY ASSURANCE

8.1 Applicability. When the method is used to analyze samples to demonstrate compliance with a source emission regulation, an audit sample must be analyzed, subject to availability.

8.2 Audit Procedure. Analyze an audit sample with each set of compliance samples. The audit sample contains tetra through octa isomers of PCDD and PCDF. Concurrently analyze the audit sample and a set of compliance samples in the same manner to evaluate the technique of the analyst and the standards preparation. The same analyst, analytical reagents, and analytical system shall be used both for the compliance samples and the EPA audit sample.

8.3 Audit Sample Availability. Audit samples will be supplied only to enforcement agencies for compliance tests. Audit samples may be obtained by writing:

Source Test Audit Coordinator (MD-77B)
Quality Assurance Division
Atmospheric Research and Exposure Assessment Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

or by calling the Source Test Audit Coordinator (STAC) at (919)

541-7834. The audit sample request must be made at least 30 days prior to the scheduled compliance sample analysis.

8.4 Audit Results. Calculate the audit sample concentration according to the calculation procedure provided in the audit instructions included with the audit sample. Fill in the audit sample concentration and the analyst's name on the audit response form included with the audit instructions. Send one copy to the EPA Regional Office or the appropriate enforcement agency and a second copy to the STAC. The EPA Regional office or the appropriate enforcement agency will report the results of the audit to the laboratory being audited. Include this response with the results of the compliance samples in relevant reports to the EPA Regional Office or the appropriate enforcement agency.

9. CALCULATIONS

Same as Method 5, Section 6 with the following additions.

9.1 Nomenclature.

A_{ai} = Integrated ion current of the noise at the retention time of the analyte.

A_{cij} = Integrated ion current of the two ions characteristic of compound i in the jth calibration standard.

A^*_{cij} = Integrated ion current of the two ions characteristic of the internal standard i in the jth calibration standard.

A_{csi} = Integrated ion current of the two ions characteristic of

surrogate compound i in the calibration standard.

A_i = Integrated ion current of the two ions characteristic of compound i in the sample.

A^*_i = Integrated ion current of the two ions characteristic of internal standard i in the sample.

A_{rs} = Integrated ion current of the two ions characteristic of the recovery standard.

A_{si} = Integrated ion current of the two ions characteristic of surrogate compound i in the sample.

C_i = Concentration of PCDD or PCDF i in the sample, pg/M^3.

C_T = Total concentration of PCDD's or PCDF's in the sample, pg/M^3.

DL = Detection limit, pg/sample.

DL_{hs} = Detection limit for each homologous series, pg/sample.

DL_{sum} = Sum of all isomers times the corresponding detection limit, ng/m^3.

H_{ai} = Summed heights of the noise at the retention time of the analyte in the two analyte channels.

m_{ci} = Mass of compound i in the calibration standard injected into the analyzer, pg.

m^*_{ci} = Mass of labeled compound i in the calibration standard injected into the analyzer, pg.

m^*_i = Mass of internal standard i added to the sample, pg.

m_{rs} = Mass of recovery standard in the calibration standard injected into the analyzer, pg.

m_s = Mass of surrogate compound in the sample to be analyzed, pg.

m_{si} = Mass of surrogate compound i in the calibration standard, pg.

RRF_i = Relative response factor for compound i.

RRF_{rs} = Recovery standard response factor.

RRF_s = Surrogate compound response factor.

$V_{m(std)}$ = Metered volume of sample run, dscm.

1000 = pg per ng.

9.2 Average Relative Response Factor.

$$RRF_i = \frac{1}{n}\sum_{j=1}^{n} \frac{A_{cij}\, m^*_{ci}}{A^*_{cij}\, m_{ci}} \qquad \text{Eq. 23-1}$$

9.3 Concentration of the PCDD's and PCDF's.

$$C_i = \frac{m^*_i\, A_i}{A^*_i\, RRF_i\, V_{m_{std}}} \qquad \text{Eq. 23-2}$$

9.4 Recovery Standard Response Factor.

$$RRF_{rs} = \frac{A^*_{ci}\, m_{rs}}{A_{rs}\, m^*_{ci}} \qquad \text{Eq. 23-3}$$

9.5 Recovery of Internal Standards (R*).

$$R^* = \frac{A^*_i\, m_{rs}}{A_{rs}\, RF_{rs}\, m^*_i} \times 100\% \qquad \text{Eq. 23-4}$$

9.6 Surrogate Compound Response Factor.

$$RRF_s = \frac{A^*_{ci}\, m_{si}}{A_{csi}\, m^*_{ci}} \qquad \text{Eq. 23-5}$$

9.7 Recovery of Surrogate Compounds (R_s).

$$R_s = \frac{A_{si}\, m^*_i}{A^*_i\, RRF_s\, m_s} \times 100\% \qquad \text{Eq. 23-6}$$

9.8 Detection Limit (DL). The detection limit can be calculated based on either the height of the noise or the area of

the noise using one of the two equations.

Detection limit using height for the DB-225 column. Three and one half times the height has been empirically determined to give area.

$$DL = \frac{2.5\ (3.5\ x\ H_{ai})\ m_i^*}{A_{ci}^*\ RRF_i} \qquad \text{Eq. 23-7}$$

Detection limit using height for the DB-5 column. Five times the height has been empirically determined to give area.

$$DL = \frac{2.5\ (5\ x\ H_{ai})\ m_i^*}{A_{ci}^*\ RRF_i} \qquad \text{Eq. 23-8}$$

Detection limit using area of the noise.

$$DL = \frac{2.5\ A_{ai}\ m_i^*}{A_{ci}^*\ RRF_i} \qquad \text{Eq. 23-9}$$

9.9 Summed Detection Limits. Calculate the maximum potential value of the summed detection limits. If the isomer (group of unresolved isomers) was not detected, use the value calculated for the detection limit in Section 9.8 above. If the isomer (group of unresolved isomers) was detected, use the value (target

detection limit) from Table 1.

$$DL_{sum} = (13\ DL_{TCDD} + 16\ DL_{TCDF} + 12\ DL_{PeCDD} + 14\ DL_{PeCDF} + 7\ DL_{HxCDD} + 12\ DL_{HxCDF} + 2\ DL_{HpCDD} + 4\ DL_{HpCDF} + DL_{OCDD} + DL_{OCDF})\ /\ 1000\ V_{m(std)} \qquad \text{Eq.23-10}$$

Note: The number of isomers used to calculate the summed detection limit represent the total number of isomers typically separated and not the actual number of isomers for each series.

9.10 Total Concentration of PCDD's and PCDF's in the Sample.

$$C_T = \sum_{i=1}^{n} C_i \qquad \text{Eq. 23-11}$$

Any PCDDs or PCDFs that are reported as not detected (below the DL) shall be counted as zero for the purpose of calculating the total concentration of PCDDs and PCDFs in the sample.

10. BIBLIOGRAPHY

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3. Thompson, J. R. (ed.). Analysis of Pesticide Residues in Human and Environmental Samples. U.S. Environmental Protection Agency. Research Triangle Park, NC. 1974.

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6. Personnel communications with R. L. Harless of U.S. EPA and Triangle Laboratory staff.

TABLE 23-1. TARGET DETECTION LIMITS (TDLs)

ANALYTE	TDL (pg/Sample Train)
TCDD/TCDF	50
PeCDD/PeCDF	250
HxCDD/HxCDF	250
HpCDD/HpCDF	250
OCDD/OCDF	500

TABLE 23-2. COMPOSITION OF THE SAMPLE FORTIFICATION AND RECOVERY STANDARDS SOLUTIONS*

ANALYTE	CONCENTRATION (pg/μL)
Internal Standards	
$^{13}C_{12}$-2,3,7,8-TCDD	100
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100
$^{13}C_{12}$-OCDD	100
$^{13}C_{12}$-2,3,7,8-TCDF	100
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100
Surrogate Standards	
$^{37}Cl_4$-2,3,7,8-TCDD	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100
Recovery Standards	

$^{13}C_{12}$-1,2,3,4-TCDD	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	100

*Calibration levels are specific for samples at the MWC compliance standard level.

TABLE 23-3. COMPOSITION OF THE INITIAL CALIBRATION SOLUTIONS

COMPOUND	CONCENTRATIONS (pg/µl)				
SOLUTION NO.	1	2	3	4	5
UNLABELED ANALYTES					
2,3,7,8-TCDD	0.5	1	5	50	100
2,3,7,8-TCDF	0.5	1	5	50	100
1,2,3,7,8-PeCDD	2.5	5	25	250	500
1,2,3,7,8-PeCDF	2.5	5	25	250	500
2,3,4,7,8-PeCDF	2.5	5	25	250	500
1,2,3,4,7,8-HxCDD	2.5	5	25	250	500
1,2,3,6,7,8-HxCDD	2.5	5	25	250	500
1,2,3,7,8,9-HxCDD	2.5	5	25	250	500
1,2,3,4,7,8-HxCDF	2.5	5	25	250	500
1,2,3,6,7,8-HxCDF	2.5	5	25	250	500
1,2,3,7,8,9-HxCDF	2.5	5	25	250	500
2,3,4,6,7,8-HxCDD	2.5	5	25	250	500
1,2,3,4,6,7,8-HpCDD	2.5	5	25	250	500
1,2,3,4,6,7,8-HpCDF	2.5	5	25	250	500
1,2,3,4,7,8,9-HpCDF	2.5	5	25	250	500
OCDD	5	10	50	500	1000
OCDF	5	10	50	500	1000
INTERNAL STANDARDS					
$^{13}C_{12}$-2,3,7,8-TCDD	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	100	100	100	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	100	100	100	100
$^{13}C_{12}$-OCDD	100	100	100	100	100

$^{13}C_{12}$-2,3,7,8-TCDF	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	100	100	100	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	100	100	100	100

TABLE 23-3. (Continued)

COMPOUND	CONCENTRATION (pg/μl)				
SOLUTION NO.	1	2	3	4	5
SURROGATE STANDARDS					
$^{37}Cl_4$-2,3,7,8-TCDD	60	80	100	120	140
$^{13}C_{12}$-2,3,4,7,8-PeCDF	60	80	100	120	140
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	60	80	100	120	140
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	60	80	100	120	140
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	60	80	100	120	140
RECOVERY STANDARDS					
$^{13}C_{12}$-1,2,3,4-TCDD	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	100	100	100	100	100

TABLE 23-4. RECOMMENDED GC OPERATING CONDITIONS

Column Type	DB-5	DB-225
Length (m)	60	30
i.d. (mm)	0.25	0.25
Film Thickness (μm)	0.25	0.25
Carrier Gas	Helium	Helium
Carrier Gas Flow (mL/min)	1-2	1-2
Injection Mode	<-- splitless -->	
Valve Time (min)	2.5	2.5
Initial Temperature (° C)	150	130
Initial Time (min)	0.5	2.5
Rate 1 (deg. C/min)	60	50
Temperature 2 (deg. C)	170	170
Rate 2 (deg. C/min)	3	4
Final Temperature (deg. C)	300	250

TABLE 23-5. ELEMENTAL COMPOSITIONS AND EXACT MASSES OF THE IONS MONITORED BY HIGH RESOLUTION MASS SPECTROMETRY FOR PCDD's AND PCDF's

DESCRIPTOR NUMBER	ACCURATE MASS	ION TYPE	ELEMENTAL COMPOSITION	ANALYTE
2	292.9825	LOCK	C_7F_{11}	PFK
	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl_3Cl^{37}O$	TCDF
	315.9419	M	$^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF(S)
	317.9389	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF(S)
	319.8965	M	$C_{12}H_4{}^{35}Cl_4O_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8847	M	$C_{12}H_4{}^{37}Cl_4O_2$	TCDD(S)
	330.9792	QC	C_7F_{13}	PFK
	331.9368	M	$^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD(S)
	333.9339	M+2	$^{13}C_{12}H_4{}^{35}Cl^{37}ClO_2$	TCDD(S)
	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF
	351.9000	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF(S)
	353.8970	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF(S)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_3{}^{37}ClO_2$	PeCDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD
	367.8949	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD(S)
	369.8919	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD(S)
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}ClO$	HxCDPE
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_6{}^{37}ClO$	HpCPDE
3	373.8208	M+2	$C_{12}H_2 35Cl_5{}^{37}ClO$	HxCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDF
	383.8639	M	$^{13}C_{12}H_2{}^{35}Cl_6O$	HxCDF(S)
	385.8610	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF(S)
	389.8157	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD
	392.9760	LOCK	C_9F_{15}	PFK

	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD(S)
	403.8529	M+4	$^{13}C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDD(S)
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_6{}^{37}Cl_2O$	OCDPE
	430.9729	QC	C_9F_{17}	PFK

TABLE 23-5. (Continued)

DESCRIPTOR NUMBER	ACCURATE MASS	ION TYPE	ELEMENTAL DESCRIPTION	ANALYTE
	407.7818	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF
	409.7789	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O$	HpCDF
	417.8253	M	$^{13}C_{12}H^{35}Cl_7O$	HpCDF(S)
	389.8157	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD
	392.9760	LOCK	C_9F_{15}	PFK
	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD(S)
	403.8529	M+4	$^{13}C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDD(S)
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_6{}^{37}Cl_2O$	OCDPE
	430.9729	QC	C_9F_{17}	PFK
	407.7818	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF
	409.7789	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O$	HpCDF
	417.8253	M	$^{13}C_{12}H^{35}Cl_7O$	HpCDF(S)
	419.8220	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF(S)
	423.7766	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD
	425.7737	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD
	435.8169	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD(S)
	437.8140	M+4	$^{13}C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD(S)
	479.7165	M+4	$C_{12}H^{35}Cl_7{}^{37}Cl_2O$	NCPDE
	430.9729	LOCK	C_9F_{17}	PFK
	441.7428	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO$	OCDF
	443.7399	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	$^{13}C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD(S)

	471.7750	M+4	$^{13}C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD(S)
	513.6775	M+4	$C_{12}{}^{35}Cl_8{}^{37}Cl_2O_2$	DCDPE
	442.9728	QC	$C_{10}F_{17}$	PFK

The following nuclidic masses were used:

H = 1.007825 O = 15.994914 C = 12.000000 ^{35}Cl = 34.968853

^{13}C = 13.003355 ^{37}Cl = 36.965903 F = 18.9984

S = Labeled Standard

QC = Ion selected for monitoring instrument stability during the GC/MS analysis.

TABLE 23-6. ACCEPTABLE RANGES FOR ION-ABUNDANCE RATIOS OF PCDD's AND PCDF's

Number of Chlorine Atoms	Ion Type	Theoretical Ratio	Control Limits	
			Lower	Upper
4	M/M+2	0.77	0.65	0.89
5	M+2/M+4	1.55	1.32	1.78
6	M+2/M+4	1.24	1.05	1.43
6[a]	M/M+2	0.51	0.43	0.59
7[b]	M?M+2	0.44	0.37	0.51
7	M+2/M+4	1.04	0.88	1.20
8	M+2/M+4	0.89	0.76	1.02

TABLE 23-7. UNLABELED ANALYTES QUANTIFICATION RELATIONSHIPS

ANALYTE	INTERNAL STANDARD USED
2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD
Other TCDD's	$^{13}C_{12}$-2,3,7,8-TCDD
1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,7,8-PeCDD
Other PeCDD's	$^{13}C_{12}$-1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
Other HxCDD's	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD
Other HpCDD's	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD
OCDD	$^{13}C_{12}$-OCDD
2,3,7,8-TCDF	$^{13}C_{12}$-2,3,7,8-TCDF
Other TCDF's	$^{13}C_{12}$-2,3,7,8-TCDF
1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF
Other PeCDF's	$^{13}C_{12}$-1,2,3,7,8-PeCDF
1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
2,3,4,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
Other HxCDF's	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF

1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF
OCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF

TABLE 23-8. INTERNAL STANDARDS QUANTIFICATION RELATIONSHIPS

INTERNAL STANDARD	STANDARD USED DURING PERCENT RECOVERY DETERMINATION
$^{13}C_{12}$-2,3,7,8-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-OCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-2,3,7,8-TCDF	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD

TABLE 23-9. SURROGATE STANDARDS QUANTIFICATION RELATIONSHIPS

SURROGATE STANDARD	STANDARD USED DURING PERCENT RECOVERY DETERMINATION
$^{37}Cl_4$-2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD
$^{13}C_{12}$-2,3,4,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF

TABLE 23-10. MINIMUM REQUIREMENTS FOR INITIAL AND DAILY CALIBRATION RESPONSE FACTORS

COMPOUND	RELATIVE RESPONSE FACTORS	
	INITIAL CALIBRATION (RSD)	DAILY CALIBRATION (% DIFFERENCE)
UNLABELED ANALYTES		
2,3,7,8-TCDD	25	25
2,3,7,8-TCDF	25	25
1,2,3,7,8-PeCDD	25	25
1,2,3,7,8-PeCDF	25	25
1,2,4,5,7,8-HxCDD	25	25
1,2,3,6,7,8-HxCDD	25	25
1,2,3,7,8,9-HxCDD	25	25
1,2,3,4,7,8-HxCDF	25	25
1,2,3,6,7,8-HxCDF	25	25
1,2,3,7,8,9-HxCDF	25	25
2,3,4,6,7,8-HxCDF	25	25
1,2,3,4,6,7,8-HpCDD	25	25
1,2,3,4,6,7,8-HpCDF	25	25
OCDD	25	25
OCDF	30	30
SURROGATE STANDARDS		
$^{37}Cl_4$-2,3,7,8-TCDD	25	25
$^{13}C_{12}$-2,3,4,7,8-PeCDF		
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD		
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF		
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF		

(Figure 1)

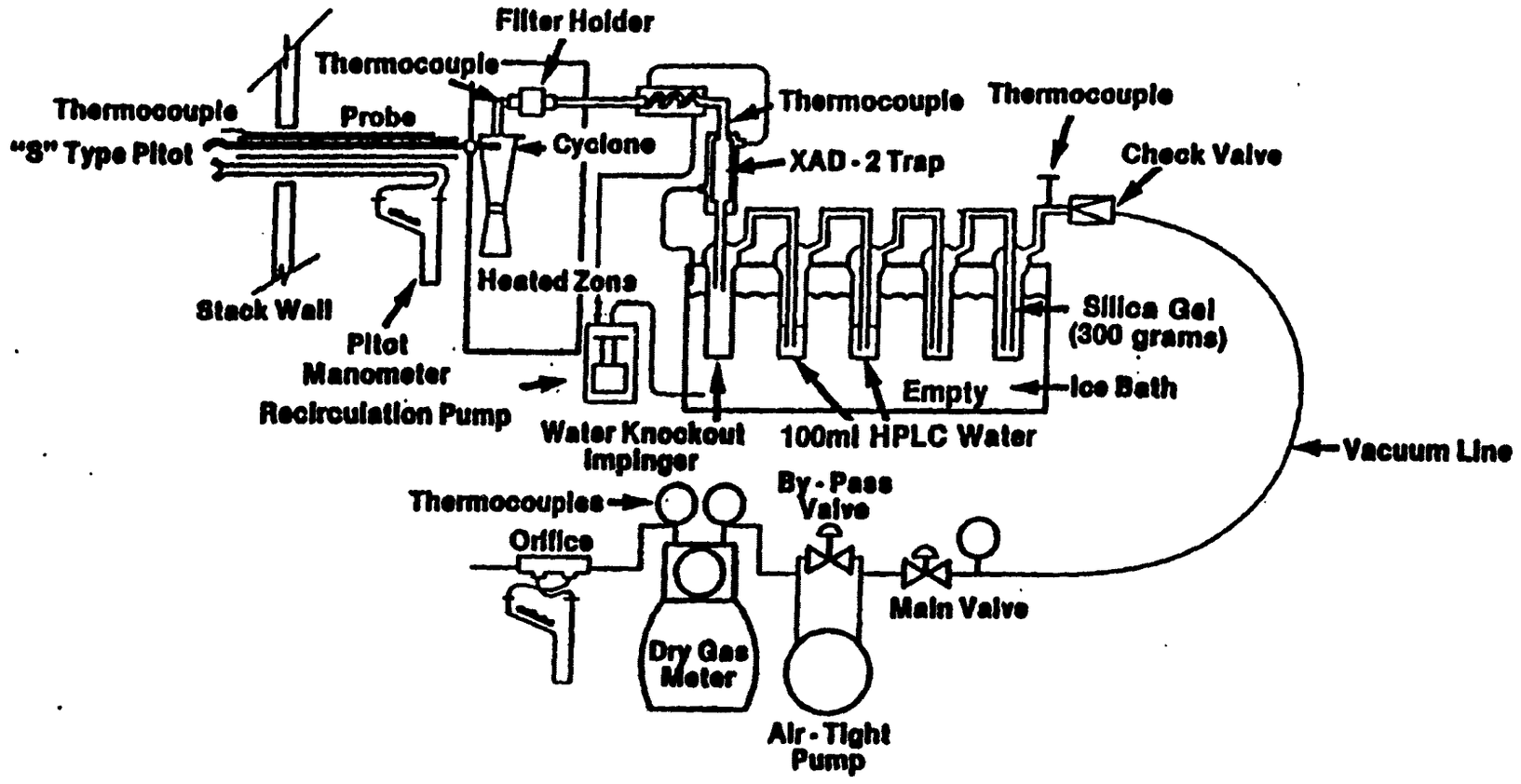

Figure 5-1. CDD/CDF Sampling Train Configuration

(Figure 2)

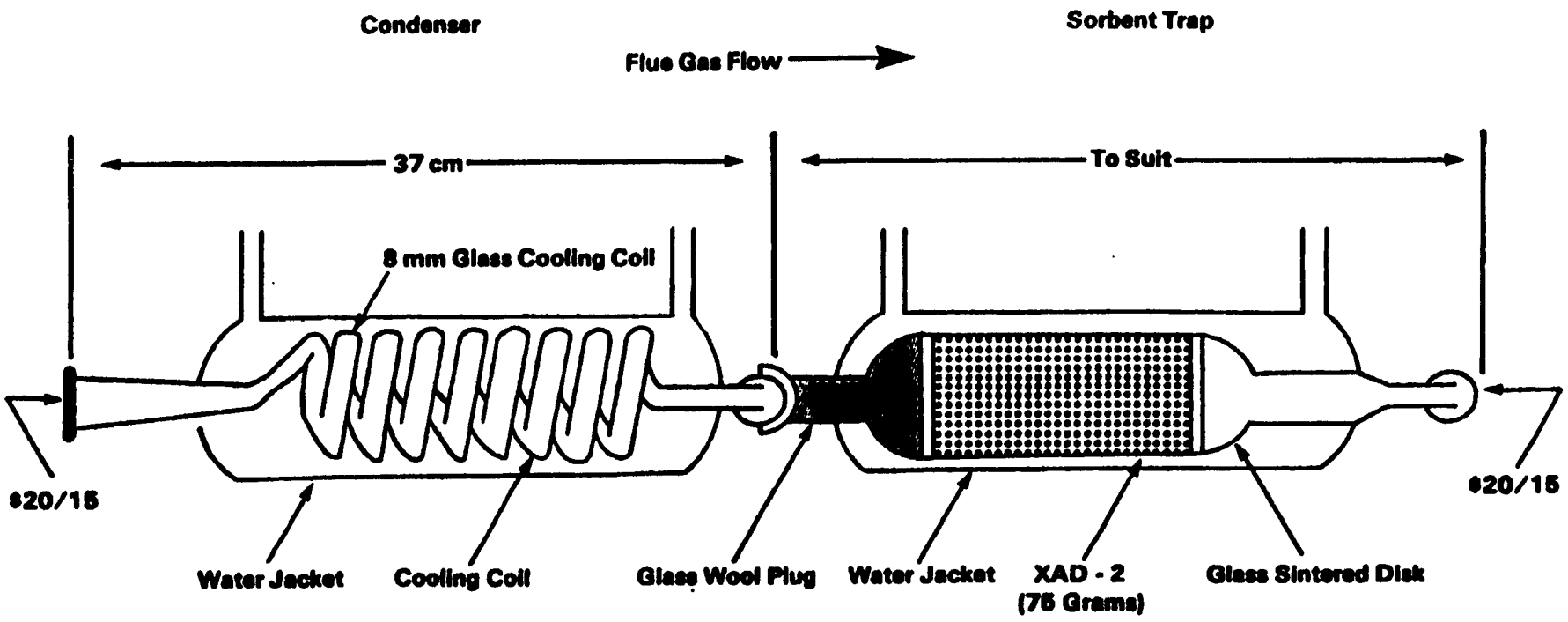

FIGURE 2. CONDENSER AND SORBENT TRAP FOR COLLECTION OF GASEOUS PCDDs AND PCDFs

Appendix G.5

Sampling & Analysis Methods

EPA Method 25A

METHOD 25A-DETERMINATION OF TOTAL GASEOUS ORGANIC CONCENTRATION USING A FLAME IONIZATION ANALYZER

1. Applicability and Principle

1.1 Applicability. This method applies to the measurement of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of carbon.

1.2 Principle. A gas sample is extracted from the source through a heated sample line, if necessary, and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

2. Definitions

2.1 Measurement Systems. The total equipment required for the determination of the gas concentration. The system consists of the following major subsystems:

2.1.1 Sample Interface. That portion of the system that is used for one or more of the following: sample acquisition, sample transportation, sample conditioning, or protection of the analyzer from the effects of the stack effluent.

2.1.2 Organic Analyzer. That portion of the system that senses organic concentration and generates an output proportional to the gas concentration.

2.2 Span Value. The upper limit of a gas concentration measurement range that is specified for affected source categories in the applicable part of the regulations. The span value is established in the applicable regulation and is usually 1.5 to 2.5 times the applicable emission limit. If no span value is provided, use a span value equivalent to 1.5 to 2.5 times the expected concentration. For convenience, the span value should correspond to 100 percent of the recorder scale.

2.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

2.4 Zero Drift. The difference in the measurement system response to a zero level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

2.5 Calibration drift. The difference in the measurement system response to a midlevel calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair or adjustment took place.

2.6 Response Time. The time interval from a step change in pollutant concentration at the inlet to the emission measurement system to the time at which 95 percent of the corresponding final value is reached as displayed on the recorder.

2.7 Calibration Error. The difference between the gas concentration indicated by the measurement system and the known concentration of the calibration gas.

3. Apparatus.

A schematic of an acceptable measurement system is shown in Figure 25A-1. The essential components of the measurement system are described below:

3.1 Organic Concentration Analyzer. A flame ionization analyzer (FIA) capable of meeting or exceeding the specifications in this method.

3.2 Sample Probe. Stainless steel, or equivalent, three-hole rake type. Sample holes shall be 4 mm in diameter or smaller and located at 16.7, 50, and 83.3 percent of the equivalent stack diameter. Alternatively, a single opening probe may be used so that a gas sample is collected from the centrally located 10 percent area of the stack cross-section.

3.3 Sample Line. Stainless steel or Teflon * tubing to transport the sample gas to the analyzer. The sample line should be heated, if necessary, to prevent condensation in the line.

3.4 Calibration Valve Assembly. A three way valve assembly to direct the zero and calibration gases to the analyzers is recommended. Other methods, such as quick-connect lines, to route calibration gas to the analyzers are applicable.

3.5 Particulate Filter. An in-stack or an out-of-stack glass fiber filter is recommended if exhaust gas particulate loading is significant. An out-of-stack filter should be heated to prevent any condensation.

* Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

3.6 Recorder. A strip-chart recorder, analog computer, or digital recorder for recording measurement data. The minimum data recording requirement is one measurement value per minute, Note: This method is often applied in highly explosive areas. Caution and care should be exercised in choice of equipment and installation.

4. Calibration and Other Gases.

Gases used for calibrations, fuel, and combustion air (if required) are

contained in compressed gas cylinders. Preparation of calibration gases shall be done according to the procedure in Protocol No. 1, listed in Citation 2 of Bibliography. Additionally, the manufacturer of the cylinder should provide a recommended shelf life for each calibration gas cylinder over which the concentration does not change more than ±2 percent from the certified value. For calibration gas values not generally available (i.e., organics between 1 and 10 percent by volume), alternative methods for preparing calibration gas mixtures, such as dilution systems, may be used with prior approval of the Administrator.

Calibration gases usually consist of propane in air or nitrogen and are determined in terms of the span value. Organic compounds other than propane can be used following the above guidelines and making the appropriate corrections for response factor.

4.1 Fuel. A 40 percent H_2/60 percent N_2 gas mixture is recommended to avoid an oxygen synergism effect that reportedly occurs when oxygen concentration varies significantly from a mean value.

4.2 Zero Gas. High purity air with less than 0.1 parts per million by volume (ppmv) of organic material (propane or carbon equivalent) or less than 0.1 percent of the span value, whichever is greater.

4.3 Low-level Calibration Gas. An organic calibration gas with a concentration equivalent to 25 to 35 percent of the applicable span value.

4.4 Mid-level Calibration Gas. An organic calibration gas with a concentration equivalent to 45 to 55 percent of the applicable span value.

4.5 High-level Calibration Gas. An organic calibration gas with a concentration equivalent to 80 to 90 percent of the applicable span value.

5. Measurement System Performance Specifications

5.1 Zero Drift. Less than ±3 percent of the span value.

5.2 Calibration Drift. Less than ±3 percent of span value.

5.3 Calibration Error. Less than ±5 percent of the calibration gas value.

6. Pretest Preparations

6.1 Selection of Sampling Site. The location of the sampling site is generally specified by the applicable regulation or purpose of the test; i.e., exhaust stack, inlet line, etc. The sample port shall be located at least 1.5 meters or 2 equivalent diameters upstream of the gas discharge to the atmosphere.

6.2 Location of Sample Probe. Install the sample probe so that the probe is centrally located in the stack, pipe, or duct and is sealed tightly at the stack port connection.

6.3 Measurement System Preparation. Prior to the emission test, assemble the measurement system following the manufacturer's written instructions in preparing the sample interface and the organic analyzer. Make the system operable.

FIA equipment can be calibrated for almost any range of total organics concentrations. For high concentrations of organics (>1.0 percent by volume as propane) modifications to most commonly available analyzers are necessary. One accepted method of equipment modification is to decrease the size of the sample to the analyzer through the use of a smaller diameter sample capillary. Direct and continuous measurement of organic concentration is a necessary consideration when determining any modification design.

6.4 Calibration Error Test. Immediately prior to the test series, (within 2 hours of the start of the test) introduce zero gas and high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level responses. Then introduce low-level and mid-level calibration gases successively to the measurement system. Record the analyzer responses for low-level and mid-level calibration gases and determine the differences between the measurement system responses and the predicted responses. These differences must be less than 5 percent of the respective calibration gas value. If not, the measurement system is not acceptable and must be replaced or repaired prior to testing. No adjustments to the measurement system shall be conducted after the calibration and before the drift check (Section 7.3). If adjustments are necessary before the completion of the test series, perform the drift checks prior to the required adjustments and repeat the calibration following the adjustments. If multiple electronic ranges are to be used, each additional range must be checked with a mid-level calibration gas to verify the multiplication factor.

6.5 Response Time Test. Introduce Zero gas into the measurement system at the calibration valve assembly. When the system output has stabilized, switch quickly to the high-level calibration gas. Record the time from the concentration change to the measurement system response equivalent to 95 percent of the step change. Repeat the test three times and average the results.

7. Emission Measurement Test Procedure

7.1 Organic Measurement. Begin sampling at the start of the test period, recording time and any required process information as appropriate. In particular, note on the recording chart periods of process interruption or cyclic operation.

7.2 Drift Determination. Immediately following the completion of the test period and hourly during the test period, reintroduce the zero and mid-level calibration gases, one at a time, to the measurement system at the calibration valve assembly. (Make no adjustments to the measurement system until after both the zero and calibration drift checks are made.) Record the analyzer response. If the drift values exceed the specified limits, invalidate the test results preceding the check and repeat the test following corrections to the measurement

system. Alternatively, recalibrate the test measurement system as in Section 6.4 and report the results using both sets of calibration data (i.e., data determined prior to the test period and data determined following the test period).

8. Organic Concentration calculations

Determine the average organic concentration in terms of ppmv as propane or other calibration gas. The average shall be determined by the integration of the output recording over the period specified in the applicable regulation. If results are required in terms of ppmv as carbon, adjust measured concentrations using Equation 25A-1.

$$C_c = KC_{meas} \qquad \text{Eq. 25A-1}$$

Where:

C_c = Organic concentration as carbon, ppmv.

C_{meas} = Organic concentration as measured, ppmv.

K = Carbon equivalent correction factor.

K = 2 for ethane.

K = 3 for propane.

K = 4 for butane.

K = Appropriate response factor for other organic calibration gases.

9. Bibliography

1. Measurement of Volatile Organic Compounds-Guideline Series. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-450/2-78-041. June 1978. p. 46-54.

2. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol No. 1). U.S. Environmental Protection Agency,

   Environmental Monitoring and Support Laboratory. Research Triangle Park, NC. June 1978.

3. Gasoline Vapor Emission Laboratory Evaluation-Part 2. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. EMB Report No. 75-GAS-6. August 1975.

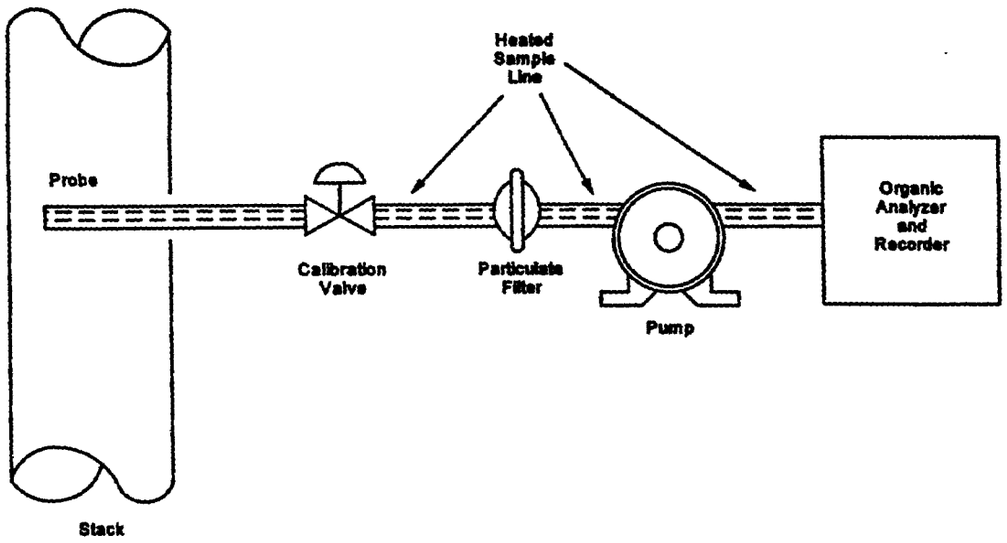

Figure 25A-1. Organic Concentration Measurement System.

Appendix G.6

Sampling & Analysis Methods

EPA Proposed Method 322

(PROPOSED) TEST METHOD 322 - MEASUREMENT OF HYDROGEN CHLORIDE EMISSIONS FROM PORTLAND CEMENT KILNS BY GFCIR

1.0 Applicability and Principle

1.1 Applicability. This method is applicable to the determination of hydrogen chloride (HCl) concentrations in emissions from portland cement kilns. This is an instrumental method for the measurement of HCl using an extractive sampling system and an infrared (IR) gas-filter correlation (GFC) analyzer. This method is intended to provide the cement industry with a direct interface instrumental method. A procedure for analyte spiking is included for quality assurance. This method is considered to be self-validating provided that the requirements in section 9 of this method are followed.

1.2 Principle. A gas sample is continuously extracted from a stack or duct over the test period using either a source-level hot/wet extractive subsystem or a dilution extractive subsystem. A nondispersive infrared gas filter correlation (NDIR-GFC) analyzer is specified for the measurement of HCl in the sample. The total measurement system is comprised of the extractive subsystem, the analyzer, and the data acquisition subsystem. Test system performance specifications are included in this method to provide for the collection of accurate, reproducible data.

1.3 Test System Operating Range. The measurement range (span) of the test system shall include the anticipated HCl concentrations of the effluent and spiked samples. The range should be selected so that the average of the effluent measurements is between 25 and 75 percent of span. If at any time during a test run, the effluent concentration exceeds the span value of the test system, the run shall be considered invalid.

2.0 Summary of Method

2.1 Sampling and Analysis. Kiln gas is continuously extracted from the stack or duct using either a source level, hot/wet extractive system, or an in-situ dilution probe or heated out-of-stack dilution system. The sample is then directed by a heated sample line maintained above 350°F to a GFC analyzer having a range appropriate to the type of sampling system. The gas filter correlation analyzer incorporates a gas cell filled with HCl. This gas cell is periodically moved into the path of an infrared measurement beam of the instrument to filter out essentially all of the HCl absorption wavelengths. Spectral filtering provides a reference from which the HCl concentration of the sample can be determined. Interferences are minimized in the analyzer by choosing a spectral band over which compounds such as CO_2 and H_2O either do not absorb significantly or do not match the spectral pattern of the HCl infrared absorption.

2.2 Operator Requirements. The analyst must be familiar with the specifications and test procedures of this method and follow them in order to obtain reproducible and accurate data.

3.0 Definitions

3.1 Measurement System. The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface. That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack gas.

3.1.2 Gas Analyzer. That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 Span. The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas (i.e., N_2).

3.4 Analyzer Calibration Error. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 Sampling System Bias. The sampling system bias is the difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and the known value of the calibration gas.

3.6 Response Time. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.7 Calibration Curve. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

3.8 Linearity. The linear response of the analyzer or test system to known calibration inputs covering the concentration range of the system.

3.9 Interference Rejection. The ability of the system to reject the effect of interferences in the analytical measurement processes of the test system.

4.0 Interferences

4.1 Sampling System Interferences. An important consideration in measuring HCl using an extractive measurement system is to ensure that a representative kiln gas sample is delivered to the gas analyzer. A sampling system interferant is a factor that inhibits an analyte from reaching the analytical instrumentation. Condensed water vapor is a strong sampling system interferant for HCl and other water soluble compounds.

"Cold spots" in the sampling system can allow water vapor in the sample to condense resulting in removal of HCl from the sample stream. The extent of HCl sampling system bias depends on concentrations of potential interferants, moisture content of the gas stream, temperature of the gas stream, temperature of sampling system components, sample flow rate, and reactivity of HCl with other species in the gas stream. For measuring HCl in a wet gas stream, the temperatures of the gas stream and sampling system components and the sample flow rate are of primary importance. In order to prevent problems with condensation in the sampling system, these parameters must be closely monitored.

4.1.1 System Calibration Checks. Performing these calibration checks where HCl calibration gas is injected through the entire system both before and after each test run demonstrates the integrity of the sampling system and capability of the analyzer for measuring this water soluble and otherwise unstable compound under ideal conditions (i.e., HCl in N_2).

4.1.2 Analyte Spiking Checks. For analyte spiking checks, HCl calibration gas is quantitatively added to the sample stream at a point upstream of the particulate filter and all other sample handling components both before and after each test run. The volume of HCl spike gas should not exceed 10 percent of the total sample volume so that the sample matrix is relatively unaffected. Successfully performing these checks demonstrates the integrity of the sampling system for measuring this water soluble and reactive compound under actual sample matrix conditions. Successfully performing these checks also demonstrates the adequacy of the interference rejection capability of the analyzer. (See section 9.3 of this method.)

4.2 Analytical Interferences. Analytical interferences are reduced by the GFC spectroscopic technique required by the method. The accuracy of HCl measurements provided by some GFC analyzers is known to be sensitive to the moisture content of the sample. This must be taken into account in order to acquire accurate results. These analyzers must be calibrated for the specific moisture content of the samples.

5.0 Safety

This method may involve sampling at locations having high positive or negative pressures, or high concentrations of hazardous or toxic pollutants, and cannot address all safety problems encountered under these diverse sampling conditions. It is the responsibility of the tester(s) to ensure proper safety and health practices, and to determine the applicability of regulatory limitations before performing this test method. Because HCl is a respiratory irritant, it is advisable to limit exposure to this compound.

6.0 Equipment and Supplies

Note: Mention of company or product names does not constitute endorsement by the U. S. Environmental Protection Agency.

6.1 Measurement System. Use any GFC measurement system for HCl that meets the specifications of this method. All sampling system components must be maintained above the kiln gas temperature, when possible, or at least 350°F. The length of sample transport line should be minimized and sampling rate should be as high as possible to minimize adsorption of HCl. The essential components of the measurement system are described in sections 6.1.1 through 6.1.12.

6.1.1 Sample Probe. Glass, stainless steel, Hastalloy™, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to a minimum of 350°F to prevent condensation. Dilution extractive systems must use a dilution ratio such that the average diluted concentrations are between 25 to 75 percent of the selected measurement range of the analyzer.

6.1.2 Calibration Valve Assembly. Use a heated, three-way valve assembly, or equivalent, for selecting either sample gas or introducing calibration gases to the measurement system or introducing analyte spikes into the measurement system at the outlet of the sampling probe before the primary particulate filter.

6.1.3 Particulate Filter. A coarse filter or other device may be placed at the inlet of the probe for removal of large particulate (10 microns or greater). A heated (Balston® or equivalent) filter rated at 1 micron is necessary for primary particulate removal, and shall be placed immediately after the heated probe. The filter/filter holder shall be maintained at 350°F or a higher temperature. Additional filters at the inlet of the gas analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of components. All filters shall be fabricated of materials that are nonreactive with HCl. Some types of glass filters are known to react with HCl.

6.1.4 Sample Transport Lines. Stainless steel or polytetrafluoroethylene (PTFE) tubing shall be heated to a minimum temperature of 350°F (sufficient to prevent condensation and to prevent HCl and NH_3 from combining into ammonium chloride in the sampling system) to transport the sample gas to the gas analyzer.

6.1.5 Sample Pump. Use a leak-free pump to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump components that contact the sample must be heated to a temperature greater than 350°F and must be constructed of a material that is nonreactive to HCl.

6.1.6 Sample Flow Rate Control. A sample flow rate control valve and rotameter, or equivalent, must be used to maintain a constant sampling rate within ±10 percent. These components must be heated to a temperature greater than 350°F. (Note: The tester may elect to install a back-pressure regulator to maintain

the sample gas manifold at a constant pressure in order to protect the analyzer(s) from over-pressurization, and to minimize the need for flow rate adjustments.)

6.1.7 Sample Gas Manifold. A sample gas manifold, heated to a minimum of 350°F, is used to divert a portion of the sample gas stream to the analyzer and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold must be constructed of material that is nonreactive to the gas being sampled.

6.1.8 Gas Analyzer. Use a nondispersive infrared analyzer utilizing the gas filter correlation technique to determine HCl concentrations. The analyzer shall meet the applicable performance specifications of section 8.0 of this method. (Note: Housing the analyzer in a clean, thermally-stable, vibration free environment will minimize drift in the analyzer calibration.) The analyzer (system) shall be designed so that the response of a known calibration input shall not deviate by more than ±3 percent from the expected value. The analyzer or measurement system manufacturer may provide documentation that the instrument meets this design requirement. Alternatively, a known concentration gas standard and calibration dilution system meeting the requirements of Method 205 of appendix M to part 51 of this chapter, "Verification of Gas Dilution Systems for Field Calibrations" (or equivalent procedure), may be used to develop a multi-point calibration curve over the measurement range of the analyzer.

6.1.9 Gas Regulators. Single stage regulator with cross purge assembly that is used to purge the CGA fitting and regulator before and after use. (This purge is necessary to clear the calibration gas delivery system of ambient water vapor after the initial connection is made, or after cylinder changeover, and will extend the life of the regulator.) Wetted parts are 316 stainless steel to handle corrosive gases.

6.1.10 Data Recorder. A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally-spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

6.1.11 Mass Flow Meters/Controllers. A mass flow meter having the appropriate calibrated range and a stated accuracy of

±2 percent of the measurement range is used to measure the HCl spike flow rate. This device must be calibrated with the major component of the calibration spike gas (e.g., nitrogen) using an NIST traceable bubble meter or equivalent. When spiking HCl, the mass flow meter/controller should be thoroughly purged before and after introduction of the gas to prevent corrosion of the interior parts.

6.1.12 System Flow Measurement. A measurement device or procedure to determine the total flow rate of sample gas within the measurement system. A rotameter, or mass flow meter calibrated relative to a laboratory standard to within ±2 percent of the measurement value at the actual operating temperature, moisture content, and sample composition (molecular weight) is acceptable. A system which ensures that the total sample flow rate is constant within ±2 percent and which relies on an intermittent measurement of the actual flow rate (e.g., calibrated gas meter) is also acceptable.

6.2 HCl Calibration Gases. The calibration gases for the gas analyzer shall be HCl in N_2. Use at least three calibration gases as specified below:

6.2.1 High-Range Gas. Concentration equivalent to 80 to 100 percent of the span.

6.2.2 Mid-Range Gas. Concentration equivalent to 40 to 60 percent of the span.

6.2.3 Zero Gas. Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter or through one or more impingers containing a solution of 3 percent H_2O_2.

6.2.4 Spike Gas. A calibration gas of known concentration (typically 100 to 200 ppm) used for analyte spikes in accordance with the requirements of section 9.3 of this method.

7.0 Reagents and Standards

7.1 Hydrogen Chloride. Hydrogen Chloride is a reactive gas and is available in steel cylinders from various commercial gas vendors. The stability is such that it is not possible to purchase a cylinder mixture whose HCl concentration can be certified at better than ±5 percent. The stability of the cylinder may be monitored over time by periodically analyzing cylinder samples. The cylinder gas concentration must be verified within 1 month prior to the use of the calibration gas. Due to the relatively high uncertainty of HCl calibration gas values, difficulties may develop in meeting the performance specifications if the mid-range and high-range calibration gases are not consistent with each other. Where problems are encountered, the consistency of the test gas standards may be determined: (1) by comparing analyzer responses for the test gases with the responses to additional certified calibration gas standards, (2) by reanalysis of the calibration gases in accordance with sections 7.2.1 or 7.2.2 of this method, or (3) by other procedures subject to the approval of EPA.

7.2 Calibration Gas Concentration Verification. There are two alternatives for establishing the concentrations of calibration gases. Alternative No. 1 is preferred.

7.2.1 Alternative No. 1. The value of the calibration gases may be obtained from the vendor's certified analysis within 1 month prior to the test. Obtain a certification from the gas manufacturer that identifies the analytical procedures and date of certification.

7.2.2 Alternative No. 2. Perform triplicate analyses of the gases using Method 26 of appendix A to part 60 of this chapter. Obtain gas mixtures with a manufacturer's tolerance not to exceed ±5 percent of the tag value. Within 1 month of the field test, analyze each of the calibration gases in triplicate using Method 26 of appendix A to part 60 of this chapter. The tester must follow all of the procedures in Method 26 (e.g., use midget impingers, heated Pallflex TX40H175 filter (TFE-glass mat), etc. if this analysis is performed. Citation 3 in section 13 of this method describes procedures and techniques that may be used for this analysis. Record the results on a data sheet. Each of the individual HCl analytical results for each calibration gas shall be within 5 percent (or 5 ppm, whichever is greater) of the triplicate set average; otherwise, discard the entire set and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree within 5 percent (or 5 ppm, whichever is greater) of the average. Then use this average for the cylinder value.

7.3 Calibration Gas Dilution Systems. Sample flow rates of approximately 15 L/min are typical for extractive HCl measurement systems. These flow rates coupled with response times of 15 to 30 minutes will result in consumption of large quantities of calibration gases. The number of cylinders and amount of calibration gas can be reduced by the use of a calibration gas dilution system in accordance with Method 205 of appendix M to part 51 of this chapter, "Verification of Gas Dilution Systems for Field Instrument Calibrations." If this option is used, the tester shall also introduce an undiluted calibration gas approximating the effluent HCl concentration during the initial calibration error test of the measurement system as a quality assurance check.

8.0 Test System Performance Specifications

8.1 Analyzer Calibration Error. This error shall be less than ±5 percent of the emission standard concentration or ±1 ppm, (whichever is greater) for zero, mid-, and high-range gases.

8.2 Sampling System Bias. This bias shall be less than ±7.5 percent of the emission standard concentration or ±1.5 ppm (whichever is greater) for zero and mid-range gases.

8.3 Analyte Spike Recovery. This recovery shall be between

70 to 130 percent of the expected concentration of spiked samples calculated with the average of the before and after run spikes.

9.0 Sample Collection, Preservation, and Storage

9.1 Pretest. Perform the procedures of sections 9.1.1 through 9.1.3.3 of this method before measurement of emissions (procedures in section 9.2 of this method). It is important to note that after a regulator is placed on an HCl gas cylinder valve, the regulator should be purged with dry N_2 or dry compressed air for approximately 10 minutes before initiating any HCl gas flow through the system. This purge is necessary to remove any ambient water vapor from within the regulator and calibration gas transport lines; the HCl in the calibration gas may react with this water vapor and increase system response time. A purge of the system should also be performed at the conclusion of a test day prior to removing the regulator from the gas cylinder. Although the regulator wetted parts are corrosion resistant, this will reduce the possibility of corrosion developing within the regulator and extend the life of the equipment.

9.1.1 Measurement System Preparation. Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. If necessary, adjust the instrument for the specific moisture content of the samples. Adjust system components to achieve correct sampling rates.

9.1.2 Analyzer Calibration Error. Conduct the analyzer calibration error check in the field by introducing calibration gases to the measurement system at any point upstream of the gas analyzer in accordance with sections 9.1.2.1 and 9.1.2.2 of this method.

9.1.2.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas. Note: A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

9.1.2.2 The analyzer calibration error check shall be considered invalid if the difference in gas concentration displayed by the analyzer and the concentration of the calibration gas exceeds ±5 percent of the emission standard concentration or ±1 ppm, (whichever is greater) for the zero, mid-, or high-range calibration gases. If an invalid calibration

is exhibited, cross-check or recertify the calibration gases, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

9.1.3 Sampling System Bias Check. For nondilution extractive systems, perform the sampling system bias check by introducing calibration gases either at the probe inlet or at a calibration valve installed at the outlet of the sampling probe. For dilution systems, calibration gases for both the analyzer calibration error check and the sampling system bias check must be introduced prior to the point of sample dilution. For dilution and nondilution systems, a zero gas and either a mid-range or high-range gas (whichever more closely approximates the effluent concentration) shall be used for the sampling system bias check.

9.1.3.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times and note the time required for the measurement system to reach 95 percent of the step change in the effluent concentration as the response time.

9.1.3.2 For nondilution systems, where the analyzer calibration error test is performed by introducing gases directly to the analyzer, the sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the sampling system bias check and the known gas concentration standard exceeds ±7.5 percent of the emission standard or ±1.5 ppm, (whichever is greater) for either the zero or the upscale calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

9.1.3.3 For dilution systems (and nondilution systems where all calibration gases are introduced at the probe), the comparison of the analyzer calibration error results and sampling system bias check results is not meaningful. For these systems, the sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the analyzer and the actual gas concentrations exceed ±7.5 percent of the emission standard or ±1.5 ppm, (whichever is greater) for either the zero or the upscale calibration gases. If an invalid

calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check.

9.2 Emission Test Procedures

9.2.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to Method 26 of appendix A to part 60 of this chapter.

9.2.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. Field test experience has shown that conditioning of the sample system is necessary for approximately 1-hour prior to conducting the first sample run. This conditioning period should be repeated after particulate filters are replaced and at the beginning of each new day or following any period when the sampling system is inoperative. Experience has also shown that prior to adequate conditioning of the system, the response to analyte spikes and/or the change from an upscale calibration gas to a representative effluent measurement may be delayed by more than twice the normal measurement system response time. It is recommended that the analyte spikes (see section 9.3 of this method) be performed to determine if the system is adequately conditioned. The sampling system is ready for use when the time required for the measurement system to equilibrate after a change from a representative effluent measurement to a representative spiked sample measurement approximates the calibration gas response time observed in section 9.1.3.1 of this method.

9.2.3 Sample Duration. After completing the sampling system bias checks and analyte spikes prior to a test run, constant rate sampling of the effluent should begin. For each run, use only those measurements obtained after all residual response to calibration standards or spikes are eliminated and representative effluent measurements are displayed to determine the average effluent concentration. At a minimum, this requires that the response time of the measurement system has elapsed before data are recorded for calculation of the average effluent concentration. Sampling should be continuous for the duration of the test run. The length of data collection should be at least as long as required for sample collection by Method 26 of part 60 of this chapter. One hour sampling runs using this method have provided reliable data for cement kilns.

9.2.4 Validation of Runs. Before and after each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in section 9.1.3 of this method. (Make no adjustments to the measurement system until after the drift checks are completed.)

Record the analyzer's responses.

9.2.4.1 If the post-run sampling system bias for either the zero or upscale calibration gas exceeds the sampling system bias specification, then the run is considered invalid. Take corrective action, and repeat both the analyzer calibration error check procedure (section 9.1.2 of this method) and the sampling system bias check procedure (section 9.1.3 of this method) before repeating the run.

9.2.4.2 If the post-run sampling system bias for both the zero and upscale calibration gas are within the sampling system bias specification, then construct two 2-point straight lines, one using the pre-run zero and upscale check values and the other using the post-run zero and upscale check values. Use the slopes and y-intercepts of the two lines to calculate the gas concentration for the run in accordance with equation 1 of this method.

9.3 Analyte Spiking—Self-Validating Procedure. Use analyte spiking to verify the effectiveness of the sampling system for the target compounds in the actual kiln gas matrix. Quality assurance (QA) spiking should be performed before and after each sample run. The spikes may be performed following the sampling system bias checks (zero and mid-range system calibrations) before each run in a series and also after the last run. The HCl spike recovery should be within ±30 percent as calculated using equations 1 and 2 of this method. Two general approaches are applicable for the use of analyte spiking to validate a GFC HCl measurement system: (1) two independent measurement systems can be operated concurrently with analyte spikes introduced to one of the systems, or (2) a single measurement system can be used to analyze consecutively, spiked and unspiked samples in an alternating fashion. The two-system approach is similar to Method 301 of this appendix and the measurement bias is determined from the difference in the paired concurrent measurements relative to the amount of HCl spike added to the spiked system. The two-system approach must employ identical sampling systems and analyzers and both measurement systems should be calibrated using the same mid- and high-range calibration standards. The two-system approach should be largely unaffected by temporal variations in the effluent concentrations if both measurement systems achieve the same calibration responses and both systems have the same response times. (See Method 301 of this appendix for appropriate calculation procedures.) The single measurement system approach is applicable when the concentration of HCl in the source does not vary substantially during the period of the test. Since the approach depends on the comparison of consecutive spiked and unspiked samples, temporal variations in the effluent HCl concentrations will introduce errors in determining the expected concentration of the spiked samples. If the effluent HCl concentrations vary by more than ±10 percent (or ±5 ppm,

whichever is greater) during the time required to obtain and equilibrate a new sample (system response time), it may be necessary to: (1) use a dual sampling system approach, (2) postpone testing until stable emission concentrations are achieved, (3) switch to the two-system approach [if possible] or, (4) rely on alternative QA/QC procedures. The dual-sampling system alternative uses two sampling lines to convey sample to the gas distribution manifold. One of the sample lines is used to continuously extract unspiked kiln gas from the source. The other sample line serves as the analyte spike line. One GFC analyzer can be used to alternately measure the HCl concentration from the two sampling systems with the need to purge only the components between the common manifold and the analyzer. This minimizes the time required to acquire an equilibrated sample of spiked or unspiked kiln gas. If the source varies by more than ±10 percent or ±5 ppm, (whichever is greater) during the time it takes to switch from the unspiked sample line to the spiked sample line, then the dual-sampling system alternative approach is not applicable. As a last option, (where no other alternatives can be used) a humidified nitrogen stream may be generated in the field which approximates the moisture content of the kiln gas. Analyte spiking into this humidified stream can be employed to assure that the sampling system is adequate for transporting the HCl to the GFC analyzer and that the analyzer's water interference rejection is adequate.

9.3.1 Spike Gas Concentration and Spike Ratio. The volume of HCl spike gas should not exceed 10 percent of the total sample volume (i.e., spike to total sample ratio of 1:10) to ensure that the sample matrix is relatively unaffected. An ideal spike concentration should approximate the native effluent concentration, thus the spiked sample concentrations would represent approximately twice the native effluent concentrations. The ideal spike concentration may not be achieved because the native HCl concentration cannot be accurately predicted prior to the field test, and limited calibration gas standards will be available during the field test. Some flexibility is available by varying the spike ratio over the range from 1:10 to 1:20. Practical constraints must be applied to allow the tester to spike at an anticipated concentration. Thus, the tester may use a 100 ppm calibration gas and a spike ratio of 1:10 as default values where information regarding the expected HCl effluent concentration is not available prior to the tests. Alternatively, the tester may select another calibration gas standard and/or lower spike ratio (e.g., 1:20) to more closely approximate the effluent HCl concentration.

9.3.2 Spike Procedure. Introduce the HCl spike gas mixture at a constant flow rate (±2 percent) at less than 10 percent of the total sample flow rate. (For example, introduce the HCl spike gas at 1 L/min (±20 cc/min) into a total sample flow rate of 10 L/min). The spike gas must be preheated before

introduction into the sample matrix to prevent a localized condensation of the gas stream at the spike introduction point. A heated sample transport line(s) containing multiple transport tubes within the heated bundle may be used to spike gas up through the sampling system to the spike introduction point. Use a calibrated flow device (e.g., mass flow meter/controller) to monitor the spike flow rate. Use a calibrated flow device (e.g., rotameter, mass flow meter, orifice meter, or other method) to monitor the total sample flow rate. Calculate the spike ratio from the measurements of spike flow and total flow. (See equation 2 and 3 in section 10.2 of this method.)

9.3.3 Analyte Spiking. Determine the approximate effluent HCl concentrations by examination of preliminary samples. For single-system approaches, determine whether the HCl concentration varies significantly with time by comparing consecutive samples for the period of time corresponding to at least twice the system response time. (For analyzers without sample averaging, estimate average values for two to five minute periods by observing the instrument display or data recorder output.) If the concentration of the individual samples varies by more than ±10 percent relative to the mean value or ±5 ppm, (whichever is greater), an alternate approach may be needed.

9.3.3.1 Adjust the spike flow rate to the appropriate level relative to the total flow by metering spike gas through a calibrated mass flow meter or controller. Allow spike flow to equilibrate within the sampling system for at least the measurement system response time and a steady response to the spike gas is observed before recording response to the spiked gas sample. Next, terminate the spike gas flow and allow the measurement system to sample only the effluent. After the measurement system response time has elapsed and representative effluent measurements are obtained, record the effluent unspiked concentration. Immediately calculate the spike recovery.

9.3.3.2 If the spike recovery is not within acceptable limits and a change in the effluent concentration is suspected as the cause for exceeding the recovery limit, repeat the analyte spike procedure without making any adjustments to the analyzer or sampling system. If the second spike recovery falls within the recovery limits, disregard the first attempt and record the results of the second spike.

9.3.3.3 Analyte spikes must be performed before and after each test run. Sampling system bias checks must also be performed before and after each test run. Depending on the particular sampling strategy and other constraints, it may be necessary to compare effluent data either immediately before or immediately after the spike sample to determine the spike recovery. Either method is acceptable provided a consistent approach is used for the test program. The average spike recovery for the pre- and post-run spikes shall be used to determine if spike recovery is between 70 and 130 percent.

10.0 Data Analysis and Emission Calculations

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with section 9.2.3 of this method. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1-hour, average measurements at 2-minute intervals or less, shall be used. For sampling run durations greater than 1-hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using equation 1.

$$C_{gas} = \frac{(m_i + m_f)\left[\frac{(C_{avg} - b_c)}{m_c}\right] + (b_i + b_f)}{2} \qquad \text{(Eq. 1)}$$

where:

b_c = Y-intercept of the calibration least-squares line.

b_f = Y-intercept of the final bias check 2-point line.

b_i = Y-intercept of the initial bias check 2-point line.

C_{gas} = Effluent gas concentration, as measured, ppm.

C_{avg} = Average gas concentration indicated by gas analyzer, as measured, ppm.

m_c = Slope of the calibration least-squares line.

m_f = Slope of the final bias check 2-point line.

m_i = Slope of the initial bias check 2-point line.

The following equations are used to determine the percent recovery (%R) for analyte spiking:

$$\%R = (S_M/C_E) \times 100 \qquad \text{(Eq. 2)}$$

where:

S_M = Mean concentration of duplicate analyte spiked samples (observed).

C_E = Expected concentration of analyte spiked samples (theoretical).

$$C_E = C_S(Q_S/Q_T) + S_U(1-Q_S/Q_T) \qquad \text{(Eq. 3)}$$

where:

C_S = Concentration of HCl spike gas (cylinder tag value).

Q_S = Spike gas flow rate.

Q_T = Total sample flow rate (effluent sample flow plus spike flow).

S_U = Native concentration of HCl in unspiked effluent samples.

Acceptable recoveries for analyte spiking are ±30 percent.

11.0 Pollution Prevention

Gas extracted from the source and analyzed or vented from the system manifold shall be either scrubbed, exhausted back into the stack, or discharged into the atmosphere where suitable dilution can occur to prevent harm to personnel health and welfare or plant or personal property.

12.0 Waste Management

Gas standards of HCl are handled as according to the instructions enclosed with the materials safety data sheets.

13.0 References

1. Peeler, J.W., Summary Letter Report to Ann Dougherty, Portland Cement Association, June 20, 1996.

2. Test Protocol, Determination of Hydrogen Chloride Emissions from Cement Kilns (Instrumental Analyzer Procedure) Revision 4; June 20, 1996.

3. Westlin, Peter R. and John W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. 3(3):5-15. September 1978.

APPENDIX H

PROJECT PARTICIPANTS

TECHNICAL REPORT DATA

Please read instructions on the reverse before completing

1. REPORT NO. EPA-454/R-00-010	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Final Report Manual Testing and Continuous Emissions Monitoring Vertical Lime Kiln Baghouse Inlet and Outlet Chemical Lime Company Marble Falls, Texas		5. REPORT DATE April 2000 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Franklin Meadows Emil W. Stewart		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Pacific Environmental Services, Inc. Post Office Box 12077 Research Triangle Park, North Carolina 27709-2077		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO. 68-D-98004
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Emissions, Monitoring and Analysis Division Research Triangle Park, North Carolina 27711		13. TYPE OF REPORT AND PERIOD COVERED Final 14. SPONSORING AGENCY CODE EPA/200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The United States Environmental Protection Agency (EPA) Emission Standards Division (ESD) is investigating the lime manufacturing industry to identify and quantify hazardous air pollutants (HAPs) emitted from lime kilns. ESD requested that EPA's Emissions, Monitoring and Analysis Division (EMAD) conduct the required testing. EMAD issued a work assignment to Pacific Environmental Services, Inc. (PES) to conduct a "screening" test to collect air emissions data as specified in the ESD test request. The primary objective of the testing program was to characterize HAP emissions from a vertical lime kiln at the Chemical Lime Company's facility located in Marble Falls, Texas. Based on the pollutant concentrations and emission rates calculated from the results of the screening tests, the kiln may be selected by EPA for further testing.

The tests were conducted to quantify the uncontrolled and controlled air emissions of hydrogen chloride (HCl), total hydorcarbons (THC), and polychlorinated dibenzo-*p*-dioxins and polyclorinated dibenzofurans (PCDDs/PCDFs). Emissions from the kiln were controlled by a baghouse. Testing was conducted at the baghouse inlet and outlet. Inlet and outlet runs were conducted simultaneously. Oxygen (O_2) and carbon dioxide (CO_2) were also monitored at each location.

During the testing program another EPA contractor monitored and recorded process and emission control system operating parameters, and prepared Section 3.0 of this report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTIONS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COASTI Field/Group
Baghouse Dioxins/Furans Hazardous Air Pollutants Hydrogen Chloride Total Hydrocarbons		
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