RESEARCH TRIANGLE INSTITUTE

STATUS REPORT #9

STABILITY OF PARTS-PER-MILLION ORGANIC CYLINDER GASES AND RESULTS OF SOURCE TEST ANALYSIS AUDITS

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EPA Contract No.: 68-02-4125

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NOTICE

FOREWORD

Source measurement and monitoring efforts are designed to anticipate potential environmental problems, to support regulatory actions by developing data bases needed in developing regulations and to provide means of monitoring compliance with regulations. The Environmental Monitoring Systems Laboratory, Research Triangle Park, North Carolina, has the responsibility for implementation of agency-wide Quality Assurance programs for air pollution measurement systems; and supplying technical support to other groups in the Agency including the Office of Air and Radiation, the Office of Toxic Substances, and the Office of Enforcement.

The need for reliable standards for auditing and documenting the accuracy of source emission measurement of gaseous hydrocarbons, halocarbons, and sulfur compounds is well established. The Quality Assurance Division of EPA's Environmental Monitoring Systems Laboratory has responded to this need through the development of organic compounds in the parts-per-million (PPM) levels in compressed gas cylinders. The primary objectives of this ongoing project are (1) to provide accurate gas mixtures to EPA, state/local agencies, or their contractors for performance audits to assess the accuracy of source emission measurements in certain organic chemical manufacturing industries, (2) to verify the vendor's certified analysis of the gas mixtures, (3) to determine the stability of gas mixtures with time, and (4) to develop new audit materials as requested by EPA. This report describes the current status of this project. Included in the report are (1) a description of the experimental procedures used for the analyses of gas mixtures, (2) a description of the audit procedure, and (3) currently available audit results and stability data.

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ABSTRACT

The U.S. Environmental Protection Agency has evaluated the suitability of 45 gaseous compounds including hydrocarbons, halocarbons, oxygenated, and sulfurous species for use as standards for measuring stationary source emissions. The main objectives of this on-going project are (1) to provide gas mixtures to EPA, state/local agencies, or their contractors, as performance audit standards to assess the accuracy of measuring source emissions from certain organic chemical manufacturing industries, (2) to corroborate the vendor's certified analysis of the gas mixtures by in-house analysis, (3) to determine the stability of the gas mixtures with time by in-house analysis, and (4) to explore the feasibility of new audit materials as requested by EPA.

Thus far, 31 mixtures have been used to conduct 214 different audits. The results of these audits, a description of the experimental procedures used for analyses, and available stability data are presented in this status report.

Compound stabilities have been determined through multiple analyses of the cylinders containing them. Stability data for up to 8 years is available for many compounds and over 5 years for most compounds. Compounds that are unstable and not suitable for use as an audit material are identified.

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SECTION 1
INTRODUCTION

OBJECTIVES

The need for reliable standards for auditing source emission measurement of gaseous hydrocarbons, halocarbons, oxygenated, and sulfurous compounds is well established. The Research Triangle Institute (RTI), under contract to the U.S. Environmental Protection Agency (EPA), has responded to this need through the development of cylinder gases for 39 compounds. The primary objectives of this ongoing project are (1) to provide accurate gas mixtures to EPA, state/local agencies, or their contractors for performance audits to assess the relative accuracy of source emission measurements in certain organic chemical manufacturing industries, (2) to examine the vendor's certified analysis of the gas mixtures by in-house analysis, (3) to determine the stability of the gas mixtures with time by in-house analysis, and (4) to develop new audit materials, as requested by EPA.

This report describes the current status of this project. Included are (1) a description of the experimental procedures used for initial cylinder analyses and collection of stability data, (2) a description of the audit procedure, and (3) currently available audit results and stability data. Complete details of the study with statistical analyses for ten (10) halocarbons and eight (8) other organics are presented in two journal publications (1,2).

AUDIT MATERIALS CURRENTLY AVAILABLE

Currently, 45 gaseous compounds have been investigated as audit materials. Six compounds have been found to be unstable in cylinders and not suitable as audit materials. The other 39 gaseous compounds in compressed gas cylinders are suitable for conducting performance audits during source testing. The compounds were selected based on the anticipated needs of the Emission Measurement Branch, Office of Air Quality Planning and Standards, U.S. EPA. Table 1 lists the 45 compounds, the concentration ranges and the number of cylinders containing these compounds currently in the repository, and the cylinder construction material. In Table 1, the audit materials fall into two concentration ranges. The low concentration range, between 5 and 50 parts-per-million (ppm), simulates possible emission standard levels. The high concentration range, between 50 and 700 ppm, simulates expected source emission levels. The balance gas for all gas mixtures is pure nitrogen.

TABLE 1. AUDIT MATERIALS CURRENTLY AVAILABLE

Compound	Low Concentration Range			High Concentration Range		
	No. of Cylinders	Concentration Range (ppm)	Cylinder Construction*	No. of Cylinders	Concentration Range (ppm)	Cylinder Construction*
Benzene	7	5 - 20	S	10	60 - 400	S
Ethylene	3	5 - 20	Al	4	300 - 700	Al
				6	3000 - 20,000	Al
Propylene	3	5 - 20	Al	3	300 - 700	Al
Methane/Ethane	-	———	-	4	1000 - 9000(M), 200 - 800(E)	Al
Propane	3	5 - 20	Al	3	300 - 700	Al
				4	1000 - 20,000	Al
Toluene	4	5 - 20	Al	4	100 - 700	LS
Hydrogen Sulfide	6	5 - 50	Al	7	100 - 700	Al
Meta-Xylene	2	5 - 20	S	2	300 - 700	LS
Methyl Acetate	2	5 - 20	S	2	300 - 700	S
Chloroform	4	5 - 20	S	1	300 - 700	S
Carbonyl Sulfide	1	5 - 20	Al	4	100 - 400	Al
Methyl Mercaptan	3	3 - 10	Al	-	———	-
Hexane	2	20 - 90	Al	-	———	-
1,2-Dichloroethane	4	5 - 20	Al	4	100 - 600	Al
Cyclohexane	-	———	-	1	80 - 200	Al
Methyl Ethyl Ketone	4	5 - 50	Al	-	———	-
Methanol	1	30 - 80	Al	-	———	-
1,2-Dichloropropane	2	3 - 20	Al	2	300 - 700	Al
Trichloroethylene	2	5 - 20	Al	2	100 - 600	Al
1,1-Dichloroethylene	2	5 - 20	Al	2	100 - 600	Al
**1,2-Dibromoethylene	-	———	-	-	———	-
Perchloroethylene	2	5 - 20	S	2	300 - 700	LS
Vinyl Chloride	8	5 - 30	S	-	———	-
1,3-Butadiene	3	5 - 60	Al	-	———	-
Acrylonitrile	3	5 - 20	Al	1	300 - 500	Al
**Aniline	-	———	-	-	———	-
Methyl Isobutyl Ketone	1	5 - 20	Al	-	———	-

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinders are no longer available; the compounds were found to be unstable in the cylinders.

(Continued)

TABLE 1. AUDIT MATERIALS CURRENTLY AVAILABLE

Compound	Low Concentration Range			High Concentration Range		
	No. of Cylinders	Concentration Range (ppm)	Cylinder Construction*	No. of Cylinders	Concentration Range (ppm)	Cylinder Construction*
**Para-dichlorobenzene	-	—	-	-	—	-
**Ethylamine	-	—	-	-	—	-
**Formaldehyde	-	—	-	-	—	-
Methylene Chloride	4	1 - 20	Al	-	—	-
Carbon Tetrachloride	4	5 - 20	Al	-	—	-
Freon 113	1	5 - 20	Al	-	—	-
Methyl Chloroform	1	5 - 20	Al	-	—	-
Ethylene Oxide	5	5 - 20	Al	-	—	-
Propylene Oxide	1	5 - 20	Al	1	75 - 200	Al
Allyl Chloride	1	5 - 20	S	1	75 - 200	S
Acrolein	1	5 - 20	Al	1	100 - 300	Al
Chlorobenzene	3	5 - 20	Al	-	—	-
Carbon Disulfide	-	—	-	1	75 - 200	Al
**Cyclohexanone	-	—	-	-	—	-
***EPA Method 25 Mixture	6	100 - 200	Al	4	750 - 2000	Al
Ethylene Dibromide	2	5 - 20	S	2	50 - 300	S
Tetrachloroethane	1	5 - 20	S	-	—	-

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinders are no longer available; the compounds were found to be unstable in the cylinders.

***The gas mixture contains an aliphatic hydrocarbon, an aromatic hydrocarbon, and carbon dioxide in nitrogen. Concentrations shown are in ppmC.

SECTION 2
EXPERIMENTAL PROCEDURES

Analysis of the cylinder gases is required to corroborate the concentrations reported by the company which prepared the gas mixtures and also to measure concentration changes with time, that is, estimate stability of the compounds.

INSTRUMENTATION

Analyses are presently performed with (1) a Perkin-Elmer Sigma 4 Gas Chromatograph with a flame ionization detector (FID), and (2) a Tracor 560 Gas Chromatograph with a flame photometric detector. The flame photometric detector has principally been used for measurement of the sulfur-containing species. Gaseous samples are injected onto the appropriate column by means of Valco gas sampling valves constructed of Hastalloy C (high nickel content and low adsorptive properties). These valves are equipped with interchangeable sample loops to allow the injection of variable volumes of gas.

The gas chromatographic parameters used in the measurement of individual compounds and any problems with the analysis are listed in Attachment 1.

CALIBRATION

Calibration of the gas chromatographs is accomplished using appropriate calibration standards comprised of known concentrations of gases in air or nitrogen. The source or method of preparation of calibration standards varies depending on the gas involved.

National Bureau of Standards, Standard Reference Materials (NBS-SRMs) of methane and propane in nitrogen or air were used for the calibration of the GC for the measurement of methane, ethane, propane, ethylene, and propylene audit materials. An NBS-SRM of benzene in nitrogen was used for calibration of the GC for the measurement of benzene audit cylinder concentrations and an NBS-SRM of perchloroethylene in nitrogen was used for the measurement of perchloroethylene audit cylinder concentrations.

A second method for preparation of calibration standards involves the use of gravimetrically calibrated permeation tubes. For example, the calibration gases for hydrogen sulfide and ethylene oxide have been generated in this manner. The permeation tube is placed in a temperature-controlled chamber and nitrogen is passed over the permeation tube at a known flow rate. The resultant gaseous mixture is further diluted, if necessary, using additional nitrogen in a glass dilution bulb. The final mixture is collected in a gas sampling syringe and analyzed by GC-FID. The permeation rates of the tubes are determined by periodic weight loss measurements.

A third method for developing a calibration standard is the pressure-dilution technique. A known volume of the compound, either gas or liquid, is injected into an evacuated glass bulb or stainless steel sphere of known volume. (The volume of the bulb or sphere is determined gravimetrically.) The bulb or sphere is then pressurized with a balance gas of choice. If a pure liquid is injected, total vaporization is assumed and the concentration is calculated by using the ideal gas law. Additional dilutions are also made, if necessary, by partially evacuating to a known pressure and pressurizing with a balance gas to a known pressure.

With each of these approaches, multipoint calibration curves are prepared each time a cylinder mixture is analyzed.

QUALITY CONTROL

Replicate injections of both audit cylinder gases and calibration standards are performed until no trends in the detector response are observed and the relative standard deviation of replicate injections is less than 1 percent.

As a quality control check on the accuracy of calibration mixtures prepared by the pressure-dilution technique, NBS-SRMs of benzene in nitrogen or propane in nitrogen were analyzed by GC-FID against selected compound calibration standards. The prepared calibration mixture was used to establish the detector response on an area per ppm-carbon basis. This calibration was then used to determine the ppm-carbon concentration of the analyzed NBS-SRM. Concentrations were converted to ppm by volume before comparison with certified values. The results of these analyses are shown in Table 2. Validation of the pressure-dilution technique for these five compounds provides a high level of confidence in the results for other compounds since the same technique and preparation system were used.

TABLE 2. PRESSURE-DILUTION QUALITY CONTROL RESULTS

		NBS-SRM Analysis		
Calibration Standard	Compound	NBS Conc., ppm	RTI Measured Conc., ppm	Percent[a] Difference
Toluene	Benzene	9.78	10.1	3.3
M-Xylene	Benzene	9.78	9.79	0.1
Hexane	Propane	98.5	100	1.5
Cyclohexane	Propane	98.5	100	1.5
1,3-Butadiene	Propane	98.5	101	2.5

[a] $\frac{\text{RTI Conc.} - \text{NBS Conc.}}{\text{NBS Conc.}} \times 100$

Two different cylinders containing hydrogen sulfide in nitrogen were received from the National Bureau of Standards and analyzed along with the audit cylinders as a quality control check. The analysis results are shown in Table 3.

TABLE 3. HYDROGEN SULFIDE ANALYSIS QUALITY CONTROL RESULTS

Cylinder Number	NBS Certified H_2S Conc., ppm	RTI Measured Conc., ppm	Percent Difference
1	5.14	4.84	-5.8
2	15.4	15.2	-1.3

SECTION 3

PERFORMANCE AUDITS

RTI supplies cylinder gases for audits upon request from the EPA, state or local agencies or contractors. A contractor must be performing source emission tests at the request of EPA or a state or local agency in order to qualify for the performance audit. When a request is received, the contents of the cylinders are analyzed, the tank pressures are measured and the cylinders are shipped by overland carrier. Tank regulators are also provided when requested. A letter is included with the cylinders which provides general instructions for performance of the audit. The audit material concentration and cylinder pressure are provided to the requesting agency audit coordinator.

To date, 214 individual audits have been initiated, and 194 are complete. The audit results currently available are presented in Table 4. The results of the audits show that most auditee reported concentrations agree within 15 percent of the audit material concentrations measured by RTI, although the difference for some compounds is sometimes quite substantial. This indicates the importance of the performance audit program and the need for reliable quality assurance calibration standards by the laboratories being audited.

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
1	A	Ethylene oxide production	Ethylene in N_2 Ethylene in N_2	3,240 21,200	-22.5 -20.0	B
2	A	Ethy·ene oxide production	Methane/ethane in N_2 Methane/ethane in N_2	1,710Me/220Et 8,130Me/597Et	+9/-20 +9/-1.00	B
3	A	Ethylene oxide production	Methane/ethane in N_2 Methane/ethane in N_2	1,021Me/315Et 6,207Me/773Et	+21.5/-4.50 +23.5/-4.50	B
4	A	Acetone production	Benzene in N_2 Benzene in N_2	79.0 374.0	-19.0 -11.0	B
5	A	Maleic anhydride production	Benzene in N_2 Benzene in N_2	138 300	-9.40 +4.70	B
6	A	Ethylene oxide production	Ethylene in N_2 Ethylene in N_2	5,440 18,900	-27.0 -33.0	B
7	B	Maleic anhydride production	Benzene in N_2 Benzene in N_2	80.0 355	+2.30 +27.5	B
8	C	Maleic anhydride production	Benzene in N_2 Benzene in N_2	101 387	+12.9 +14.5	B
9	D	Ethyl benzene styrene manufacturer	Benzene in N_2 Benzene in N_2	71.0 229	-2.80 -3.90	B
10	E	Gasoline bulk terminal	Benzene in N_2 Benzene in N_2	62.0 80.0	+3.80 +3.40	B
11	F	Gasoline transfer terminal	Benzene in N_2 Benzene in N_2	142 294	-3.50 +3.20	B
12	F	Gasoline transfer terminal	Benzene in N_2 Benzene in N_2	268 343	-11.8 -1.00	B

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI Audit conc. (ppm)	Client Audit % bias (Avg.)*	Status of audit**
13	F	Gasoline transfer terminal	Benzene in N_2	129	+4.70	B
			Benzene in N_2	318	+8.70	
14	F	Gasoline transfer terminal	Benzene in N_2	10.7	+2.60	B
15	C	Nitrobenzene manufacturing	Benzene in N_2	9.73	-4.60	B
			Benzene in N_2	269	-2.60	
16	F	Gasoline bulk terminal	Benzene in N_2	8.20	-2.30	B
			Benzene in N_2	140	-1.80	
17a	F	Gasoline bulk terminal	Benzene in N_2	9.50	+10.4	B
			Benzene in N_2	127	-2.80	
17b	F	Gasoline bulk terminal	Benzene in N_2	9.50	+12.5	B
			Benzene in N_2	127	-6.30	
18	G	Coke oven	Hydrogen sulfide in N_2	7.05	-24.8	B
			Hydrogen sulfide in N_2	9.73	-22.9	
19	F	Gasoline bulk terminal	Benzene in N_2	12.0	-0.80	B
			Benzene in N_2	218	+7.30	
20	F	Gasoline bulk terminal	Benzene in N_2	7.65	+16.3	B
			Benzene in N_2	396	+1.50	
21	F	Linear alkyl-benzene manu-facturing	Benzene in N_2	98.0	+5.70	B
			Benzene in N_2	294	+6.80	
			Benzene in N_2	331	+4.50	
22	F	Gasoline bulk terminal	Benzene in N_2	9.85	-4.10	B
			Benzene in N_2	81.0	-6.80	
23	F	Gasoline bulk terminal	Benzene in N_2	10.2	+4.60	B
			Benzene in N_2	61.0	-9.50	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
24	H	Industrial surface coating process	Toluene in N_2	14.8	-1.90	B
			Propylene in N_2	474	+0.20	
			Propane in N_2	20.3	-2.30	
			Methane/ethane in N_2	1,640Me/195et	-13.5(as methane)	
25	C	Acrylic acid and ester Production	Propane in N_2	10.1	+8.60	B
			Propane in N_2	710	+5.60	
26	C	Acrylic acid and ester Production	Propane in N_2	5.1	+17.6	B
			Propane in N_2	607	-3.60	
27	E	Maleic anhydride	Benzene in N_2	10.2	NA	C
			Benzene in N_2	218	NA	
28A	A	Carbon adsorber	Toluene in N_2	8.55	-6.40	B
			Toluene in N_2	405	-1.00	
28B	A	Carbon adsorber	Toluene in N_2	8.55	+4.10	B
			Toluene in N_2	405	NA	
28C	A	Carbon adsorber	Toluene in N_2	8.55	-8.80	B
			Toluene in N_2	405	NA	
29	EPA, QAD	Instrument check-out	Ethylene in N_2	4.75	+4.00	B
			Ethylene in N_2	19.6	+3.10	
			Ethylene in N_2	312	-0.80	
			Ethylene in N_2	3020	+5.30	
			Ethylene in N_2	20400	-8.60	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI Audit conc. (ppm)	Client Audit % bias (Avg.)*	Status of audit**
30	EPA, QAD	Instrument check-out	Benzene in N_2	8.20	+0.30	B
			Benzene in N_2	78.0	-0.90	
			Benzene in N_2	133	-4.00	
			Benzene in N_2	348	-0.90	
31	EPA, QAD	Instrument check-out	Toluene in N_2	405	+3.20	B
			Toluene in N_2	579	+1.00	
32	EPA, QAD	Instrument check-out	Methyl acetate in N_2	6.80	-2.60	B
			Methyl acetate in N_2	17.2	+1.70	
			Methyl acetate in N_2	326	-1.50	
			Methyl acetate in N_2	455	-1.30	
33	EPA, QAD	Instrument check-out	Propylene in N_2	4.90	-22.4	B
			Propylene in N_2	19.7	-7.80	
			Propylene in N_2	300	+1.00	
			Propylene in N_2	685	-1.80	
34	EPA, QAD	Instrument check-out	Propane in N_2	14.6	-0.70	B
			Propane in N_2	303	+7.60	
			Propane in N_2	439	+6.20	
35a	I	Vegetable oil plant	Hexane in N_2	82.2	+8.10	B
			Hexane in N_2	1980	+3.00	
35b	I	Vegetable oil plant	Hexane in N_2	82.2	-1.20	B
			Hexane in N_2	1980	-1.30	
36	A	Carbon adsorber	Toluene in N_2	8.20	-2.40	B

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
37	B	Coke oven	Benzene in N_2	12.1	+0.80	B
			Benzene in N_2	105	+2.90	
38	D	Ethylbenzene/ styrene	Benzene in N_2	9.90	+5.70	B
			Benzene in N_2	77.9	+3.60	
			Benzene in N_2	345	+1.50	
39	B	Coke oven	Benzene in N_2	8.20	-2.60	B
		Byproduct	Benzene in N_2	85.4	-8.70	
40	D	Coke oven	Benzene in N_2	10.9	+20.0	
		Byproduct	Benzene in N_2	147	+6.80	
41	H	Paint spray	Benzene in N_2	10.8	NA	C
			m-Xylene in N_2	16.4	NA	
42	H	Tire manufacturing	Cyclohexane in N_2	93.4	-11.1	B
43	B	Coke oven	Benzene in N_2	7.54	+0.10	B
			Benzene in N_2	225	+0.40	
44	D	Ethylbenzene/ styrene	Benzene in N_2	8.20	-3.40	B
			Benzene in N_2	74.5	-0.20	
			Propane in N_2	10.6	-3.00	
45	F	Industrial surface coating	Propane in Air	316	-3.20	B
			Propane in Air	450	-2.00	
46	EPA, QAD	Tire manufacturing	Propane in Air	15.0	NA	C
			Propane in Air	316	NA	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
47	EPA, QAD	Tire manufacturing	Propane in air	20.8	-18.4	B
			Propane in air	453	+13.4	
48	D	Dimethyl terephthalate production	Meta-xylene in N_2	487	-2.10	B
49	EPA, QAD	Instrument check-out	Toluene in N_2	61.5	NA	C
			Methanol in N_2	55.2	NA	
50	EPA, QAD	Tire oven manufacturing	Propane in air	4.90	-48.8	B
			Propane in air	613	+16.9	
			Propane in air	718	+16.8	
51	EPA, QAD	Instrument check-out	Propane in air	20.8	+20.0	B
			Propane in air	316	-9.20	
52	D	Styrene manufacturing	Benzene in N_2	106	-4.90	B
			Benzene in N_2	358	-3.70	
			1,3-Butadiene in N_2	20.9	+23.8	
53	I	Veg. oil manufacturing	Cyclohexane in N_2	99.0	-3.50	B
54	M	Research	Chloroform in N_2	16.5	NA	C
			Chloroform in N_2	531	NA	
55	J	Research	Ethylene in N_2	300	+1.40	B

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
56	K	Reactivity of vent activated charcoal	Chloroform in N_2	8.11	NA	C
57	EPA, QAD	Instrument check-out	Hydrogen sulfide in N_2	16.2	NA	C
58	C	Coil coating	Propane in Air	5.20	NA	B
			Propane in Air	472	-8.40	
59	L	Maleic anhydride	Benzene in N_2	9.45	NA	C
			Benzene in N_2	341	NA	
60	M	Research	Audit not initiated	—	—	—
61	EPA (State of Conn.)	Maleic anhydride	Benzene in N_2	133	NA	C
62	O		Meta-xylene in N_2	760	NA	C
			Hexane in N_2	1990	NA	
63	M	Paper and pulp	Methyl mercaptan in N_2	4.44	NA	C
64	P	Research	Benzene in N_2	13.4	NA	C
			Methyl ethyl ketone in N_2	44.5	NA	
65	E	Coke oven Byproduct Recovery	Benzene in N_2	7.93	-2.90	B
			Benzene in N_2	132	+1.39	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
66	D	Rubber manufacturing	Benzene in N_2	12.0	+14.2	B
			Benzene in N_2	10.2	0	
			Benzene in N_2	100	+6.40	
			Benzene in N_2	335	+6.00	
			Hexane in N_2	79.8	+1.80	
			Hexane in N_2	3080	-7.50	
			Propane in Air	9.97	-3.20	
			Propane in Air	314	-10.8	
67	E	Coke oven Byproduct Recovery	Benzene in N_2	8.29	-2.20	B
			Benzene in N_2	75.7	-2.50	
68	EPA, Region II	Vinyl chloride manufacturing	Vinyl chloride in N_2	5.74	NA	C
			Vinyl chloride in N_2	28.3	NA	
69	EPA, QAD	Instrument Check	Propylene in N_2	328	-7.00	B
			Propylene in N_2	725	-8.30	
70	EPA, Region I	Vinyl chloride manufacturing	Vinyl chloride in N_2	7.50	NA	C
71	E	Degreasing vent	Trichloroethylene in N_2	14.9	-0.40	B
			Trichloroethylene in N_2	566	-8.70	
72	EPA, QAD	Instrument check-out	Hexane in N_2	3080	NA	C
73	EPA, QAD	Combustion efficiency test	Hydrogen sulfide in N_2	16.2	-7.50	B
			Methyl mercaptan in N_2	8.22	-8.90	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
74	E	Vinyl chloride manufacturing	1,2-Dichloroethane in N_2	9.30	+6.00	B
			1,2-Dichloroethane in N_2	462	+3.70	
75	N	Coil coating	Propane in air	10.0	NA	C
			Propane in air	309	NA	
76	F	Coil coating	Propane in air	10.0	NA	C
			Propane in air	309	NA	
77	D	Maleic anhydride	Benzene in N_2	9.46	-6.60	B
			Benzene in N_2	66.9	-11.7	
78	EPA, Region VII	Instrument checkout	Benzene in N_2	120	NA	C
			Hexane in N_2	30.2	NA	
79	D	Maleic anhydride	Benzene in N_2	9.46	-4.60	B
			Benzene in N_2	128	+12.5	
80	F	Plywood/veneer drying	Propylene in N_2	14.8	-4.70	B
			Propylene in N_2	328	+4.40	
			Toluene in N_2	430	-0.80	
81	P	Plywood/veneer drying	Propylene in N_2	20.3	+18.2	B
			Propylene in N_2	479	-22.5	
			Toluene in N_2	487	+32.5	
82	J	Polypropylene manufacturing	Propylene in N_2	9.63	-0.35	B
			Propane in N_2	19.7	+0.84	
			Propane in N_2	296	+0.45	
83	I	Coke oven	Hydrogen sulfide in N_2	437	+4.90	B
			Hydrogen sulfide in N_2	647	-16.5	
			Carbonyl sulfide	101	+1.98	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
84	J	Compliance testing	Benzene in N_2	7.45	23.0	B
			Hexane in N_2	72.6	0.6	
			Toluene in N_2	15.0	-8.7	
			Methyl mercaptan in N_2	5.40	NA	
85	I	Steel manufacturing	Hydrogen sulfide in N_2	647	5.0	B
			Carbonyl sulfide in N_2	9.08	1.0	
86	I	Oil shale	Hydrogen sulfide in N_2	437	-3.0	B
			Carbonyl sulfide in N_2	117	-4.6	
			Methyl mercaptan in N_2	8.42	-13.3	
87	Q	Maleic Anhydride Production	Benzene in N_2	55.7	+528.4	B
			Hexane in N_2	324	+20.5	
88	R	Refining	Hydrogen sulfide in N_2	17.5	21.1	B
			Hydrogen sulfide in N_2	437	22.0	
89	Air Quality Bureau, New Mexico	Refining	Hydrogen sulfide in N_2	647	NA	C
90	S	Oil shale	Carbonyl sulfide in N_2	117	-29.1	B
			Methyl mercaptan in N_2	8.42	-14.8	
			Hydrogen sulfide in N_2	437	-3.65	
91	F	Compliance testing & demonstration	Trichlorethylene in N_2	94.6	NA	B
			Propane in N_2	10.0	NA	
			Propane in N_2	309	-54.0	
			Propane in N_2	73.8	8.7	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
92	EPA, Region I	Research Method Development	Toluene in N_2	347	NA	C
93	D	Method Validation	Hydrogen sulfide in N_2	8.32	NA	C
94	USEPA, Region I	Research-Method Development	Vinyl chloride in N_2	8.39	-20.2	B
			1,1-dichloroethylene in N_2	14.2	+10.6	
			Trichloroethylene in N_2	13.5	+55.6	
			Perchloroethylene in N_2	7.94	+48.1	
95	E	Acrylonitrile Production	Acrylonitrile in N_2	413	NA	B
			Acrylonitrile in N_2	10.8	6.94	
96	USEPA, Region I	Resource Recovery Garbage Burning Emissions	Propane in N_2	10.0	-35.0	B
			Propane in N_2	296	-17.2	
97	Tewksbury State Hospital, MA	Research-Method Development	Vinyl chloride in N_2	8.39	+57	B
			1,1-dichloroethylene in N_2	14.2	-9.9	
			Trichloroethylene in N_2	13.5	-4.4	
			Tetrachloroethylene in N_2	7.94	+48.6	
98	T	Plywood Veneer	Method 25 gas in N_2	102 as C	NA	C
			Method 25 gas in N_2	1940 as C	NA	
99	U	Hazardous Materials Incineration	Trichloroethylene in N_2	8.91	NA	C
			Perchloroethylene in N_2	7.94	NA	
			Chloroform in N_2	16.5	NA	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
100	USEPA, Region I	Research Method Development	Chlorobenzene in N_2	9.20	NA	C
			Benzene in N_2	128	NA	
			Hexane in N_2	30.2	NA	
			Meta-xylene in N_2	6.82 (cold bulb)	NA	
				2.68 (warm bulb)		
101	U	Hazardous Materials Incineration	Trichloroethylene in N_2	13.5	NA	C
			Perchloroethylene in N_2	14.5	NA	
102	Allegheny County	Solvent Coating	Toluene in N_2	8.51	NA	C
			Methyl ethyl ketone in N_2	38.7	NA	
			Acrylonitrile in N_2	11.6	NA	
			Methyl isobutyl ketone in N_2	9.49	NA	
103	I	Hazardous Waste Incineration	Vinylidiene chloride in N_2	14.2	12.3	B
104	I	Hazardous Waste Incineration	Vinylidiene chloride in N_2	9.00	10.0	B
105	USEPA, Region VI	Plastics	Vinyl chloride in N_2	8.41	NA	C
106	USEPA, Region VI	Vinyl Chloride Manufacturing	Vinyl chloride in N_2	8.44	NA	C
107	V	Instrument Check	Methyl chloroform in N_2	10.2	+7.8	B
			Perchloroethylene in N_2	7.94	+15.9	
108	Q	Gasoline Terminal	Propane in air	1.18%	-4.2	B
109	P	Chemicals Manufacturing	Toluene in N_2	16.4	17.3	B
			Benzene in N_2	7.3	NA	
			1,2-dichloroethane in N_2	8.1	NA	
110	MD Dept. of Health	Instrument Check	Benzene in N_2	9.64	-6.6	B
			Perchloroethylene in N_2	14.5	+60.1	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
111	V	Instrument Check	Chloroform in N_2	16.5	+3	B
			Carbon tetrachloride in N_2	10.5	+33.0	
			Trichloroethylene in N_2	13.5	+4.0	
			Freon 113 in N_2	9.76	0	
112	J	Research, Method Development	Propane in N_2	628	+0.6	B
			Toluene in N_2	347	+2.0	
113	GA State EPA	Plastics	Vinyl chloride in N_2	8.44	+10.2	B
114	Sacramento County, California	Instrument Check	Ethylene oxide in N_2	10.1	NA	C
115	W	Instrument Check	Benzene in N_2	389	-35.7	B
			Chlorobenzene in N_2	9.20	-43.1	
116	V	Instrument Check	Methanol in N_2	55.2	NA	C
117	X	Carbon Adsorption	Toluene in N_2	16.1	NA	C
			Methyl ethyl ketone in N_2	38.7	NA	
			Methylene chloride in N_2	9.67	NA	
118	F	Surface Coating	Method 25 gas in N_2	96.8 as C	+127.3	B
119	K	Instrument Check	Freon 113 in N_2	9.76	NA	C
120	Z	Solvent Coating	Toluene in N_2	8.51	+38.8	B
			Toluene in N_2	558	-3.1	
121	K	Instrument Check	Perchloroethylene in N_2	7.94	NA	C
122	LA State EPA	Plastic Manufacturing	Benzene in N_2	9.64	-30.5	B
			Vinyl chloride in N_2	8.44	191.5	
			1,2-dichloroethane in N_2	13.8	-37.0	
			Carbon tetrachloride in N_2	10.5	-40.0	
123	C	Paper Manufacturing	Vinyl chloride in N_2	6.60	NA	C

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
124	LA State EPA	Instrument Check	Toluene in N_2	8.51	-34.2	B
			Methylene chloride in N_2	9.67	96.8	
125	Y	Surface Coating	Method 25 gas in N_2	107 as C	80.4	B
			Method 25 gas in N_2	775 as C	39.5	
126	I	Oil Shale	Carbonyl sulfide in N_2	10.7	NA	C
			Carbonyl sulfide in N_2	116	NA	
			Hydrogen sulfide	627	NA	
			Methyl mercaptan	8.42	NA	
127	F	Surface Coating	Method 25 gas in N_2	775 as C	-26.5, -18.7	B
128	Y	Surface Coating	Method 25 gas in N_2	205 as C	21.5	B
			Method 25 gas in N_2	1040 as C	18.9	
129	J	Research, Method Development	Methyl ethyl ketone in N_2	38.7	NA	C
130	Region VII	Instrument Check	Acrylonitrile in N_2	11.6	-29.3	B
131A	South Coast Air Quality Management District	Hazardous Waste Landfill	Benzene in N_2	134	-28	B
			Methane in N_2	6460	+0.6	
131B	South Coast Air Quality Management District	Hazardous Waste Landfill	Methane in N_2	6460	-2.5	B
132	Maryland Dept. of Health	Instrument Check	Benzene in N_2	7.9	-11.1	B
			Trichloroethylene in N_2	9.4	-31.6	
			Hexane in N_2	32.8	-18.5	
			Methyl isobutyl ketone in N_2	8.4	+15.4	
			1,2-Dichloroethane in N_2	13.9	-2.1	
133	State of California Air Resources Board	Quality Assurance Audit of Standards	Methylene chloride in N_2	9.2	+7.6	B
			Chloroform in N_2	4.6	+2.2	
			Perchloroethylene in N_2	10.5	+14.3	
			Carbon tetrachloride in N_2	9.6	+1.0	
			Trichloroethylene in N_2	14.0	+7.1	
			Freon-113 in N_2	11.0	-9.1	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
134	AA	Wood Stove Emissions	Benzene in N_2	310	+5.2	B
135	FF	Polyester Resin Production	Method 25 gas in N_2	103.8 as C	+28.1	B
136	J	Instrument Check	Benzene in N_2 Benzene in N_2	10.3 121	+12.2 +6.2	B
137	I	Coil Coating	Method 25 gas in N_2	195 as C	−18.3	B
138	F	Compliance Testing	Methanol in N_2	48.8	+10.7	B
139	BB	Coil Coating	Methyl ethyl ketone in N_2 Method 25 gas in N_2	40.4 1060 as C	−5.9 −4.0	B
140	EPA Region II	Metal Refining	Benzene in N_2	376	−11.2	B
141	Commonwealth of Massachusetts	Instrument Check	Benzene in N_2 Trichloroethylene in N_2 Methyl ethyl ketone in N_2	7.9 14.0 40.4	+5.1 −4.3 +31.2	B
142	EPA Region II	Methane Recovery Plant	Benzene in N_2	7.8	−5.1	B
143	State of Delaware	Plastic Manufacturing	Vinyl chloride in N_2 Vinyl chloride in N_2	7.75 20.3	−11.0 −10.3	B
144	EE	Plastic Manufacturing	Method 25 gas in N_2 Propane in air	96.1 as C 10.9	−24.5 −4.6	B
145	DD	Paper Coating	Toluene in N_2	546	−8.6	B
146	State of Delaware	Instrument Check	Benzene in N_2	7.9	−20.6	B
147	CC	Gasoline Terminal	Propane in N_2	2052	NA	C
148	F	Vinyl Coating	Propane in N_2	308	−1.0	B
149	BB	Plastic Manufacturing	Methyl ethyl ketone in N_2 Method 25 gas in N_2	40.4 764 as C	−25 −9.3	B

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
150	EPA Region I	Wire Coating	Method 25 gas in N_2	187 as C	+52.0	B
151	EPA Region II	Instrument Check	Benzene in N_2	9.90	-5.4	B
			Method 25 gas in N_2	1930 as C	-71.0	
			Method 25 gas in N_2	95.8 as C	-73.1	
			Methyl ethyl ketone in N_2	40.4	+220	
152	EPA Region II	Chemical Feedstock Formulation	Benzene in N_2	96.0	-5.5	B
			Benzene in N_2	10.2	+3.0	
			1,1-Dichloroethylene in N_2	8.78	NA	
			1,1-Dichloroethylene in N_2	479	NA	
153	Commonwealth of Massachusetts	Paper Coating	Propane in N_2	10.9	NA	B
			Propane in N_2	607	+3.1	
154	J	Instrument Check	1,2-Dichloroethane in N_2	14.1	-11.3	B
			Trichloroethylene in N_2	9.40	-1.1	
			Perchloroethylene in N_2	13.3	-2.3	
155	EPA Region I	Paper Coating	Toluene in N_2	184	NA	C
156	EPA Region II	Wire Coating	Method 25 gas in N_2	1020 as C	-48.2	B
157	EPA Region I	Wire Coating	Hexane in N_2	88.2	NA	C
158	Allegheny County	Instrument Check	Benzene in N_2	11.9	-2.5	B
			Toluene in N_2	8.70	NA	
			Trichloroethylene in N_2	14.0	NA	
			Perchloroethylene in N_2	6.88	-93.0	
			Propane in N_2	10.9	NA	
			Hydrogen Sulfide in N_2	30.5	NA	
159	Minnesota Pollution Control Agency	Instrument Check	Benzene in N_2	10.3	-37	B
			Toluene in N_2	18.9	-30	
160	J	Methylene Chloride Manufacturing	Methylene Chloride in N_2	10.4	-4.0	B
			Methylene Chloride in N_2	6.01	-3.7	

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
161	Florida Dept. of Health, Welfare and Bioenvironmental Services	Printing Operation	Method 25 gas in N_2 Method 25 gas in N_2	1930 as C 187 as C	+16 +55	B
162	Texas Air Control Board	Instrument Check	Benzene in N_2 Acrylonitrile in N_2	97.3 424	+2.8 -33	B
163	Pennsylvania Dept. of Environmental Resources	Printing Press	Method 25 gas in N_2 Method 25 gas in N_2	1093 as C 99.2 as C	-11 +69	B
164	GG	Printing Operation	Method 25 gas in N_2	196 as C	NA	C
165	EPA Region I	Paper Coating	Toluene in N_2 Toluene in N_2	618 368	+36.9 +11.4	B
166	Texas Air Control Board	Instrument Check	Method 25 gas in N_2	99.6 as C	+5.7	B
167	W	Plastics Manufacturing	Vinyl Chloride in N_2 Vinyl Chloride in N_2	8.15 20.6	+0.6 +0.5	B
168	J	Instrument Check	Benzene in N_2	7.89	-9.6	B
169	N	Solvent Ink Coating Process	Method 25 gas in N_2 Method 25 gas in N_2	196 as C 1093 as C	+30.6 +13.4	B
170	W	Surface Coating				B
		Instrument 1	Method 25 gas in N_2	99.2 as C	+7	
		Instrument 2			+150	
		Instrument 1	Method 25 gas in N_2	806 as C	+5	
		Instrument 2			+21	
171	J	Methylene Chloride Manufacturing	Methylene Chloride in N_2 Methylene Chloride in N_2	1.13 10.4	+22 +4	B
172	N	Solvent Coating	Method 25 gas in N_2 Method 25 gas in N_2	196 as C 806 as C	+25 +3	B

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
173	HH	Steam Stripping	1,2-Dichloroethane in N_2	422	+71	B
			Vinyl Chloride in N_2	7.75	-36	
			Methylene Chloride in N_2	6.01	+45	
174	EPA/ASRL	Lab #1, Inst. #1	Benzene in N_2	7.89	+0.6	B
			Toluene in N_2	10.2	-14.4	
			1,3-Butadiene in N_2	13.4	-9.2	
			Meta-Xylene in N_2	11.1	-10.8	
		Lab #1, Inst. #2	Benzene in N_2	7.89	-3.2	B
			Toluene in N_2	10.2	-8.6	
			1,3-Butadiene in N_2	13.4	-10.8	
			Meta-Xylene in N_2	11.1	-9.2	
		Lab #2, Inst. #1	Benzene in N_2	7.89	+1	B
			Toluene in N_2	10.2	-1	
			1,3-Butadiene in N_2	13.4	0	
			Meta-Xylene in N_2	11.1	+6	
		Lab #2, Inst. #2	Benzene in N_2	7.89	+5	B
			Toluene in N_2	10.2	-8	
			1,3-Butadiene in N_2	13.4	+1	
			Meta-Xylene in N_2	11.1	+10	
175	II	Instrument Check	Method 25 gas in N_2	806 as C	+24	B
176	L	Synthetic Rubber Manufacturing	Chloroform in N_2	9.08	+7	B
			Carbon Tetrachloride in N_2	5.88	+28	
			Carbon Tetrachloride in N_2	18.1	+21	
			Chloroform in N_2	22.1	-1	
177	L	Synthetic Rubber Manufacturing	1,3-Butadiene in N_2	52.9	-6	B
			1,3-Butadiene in N_2	32.3	-4	
178	MM	Asphalt Plant	Method 25 gas in N_2	99.6 as C	NA	C
			Method 25 gas in N_2	806 as C	NA	C

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
179	U	Plastics Manufacture	Hexane in N_2	2139	-2	B
180	HH	Steam Stripping Process	1,2-Dichloroethane in N_2 1,1-Dichloroethylene in N_2 Vinyl Chloride in N_2	97.2 15.2 6.1	-90 -44 -5	B
181	BB	Lignite Power Plant	Method 25 gas in N_2	99.2 as C	-33	B
182	L	Synthetic Rubber Manufacturing Plant	Carbon Tetrachloride in N_2 Carbon Tetrachloride in N_2	21.8 as C 10.6 as C	0 -2	B
183	KK	Can Coating Operation	Method 25 gas in N_2	1093 as C	-53	B
184	F	Surface Coating Operation;				B
		Instrument #1	Methyl Ethyl Ketone in N_2	45	+20	
		Instrument #2	Methyl Ethyl Ketone in N_2	45	+16	
185	V	Instrument Check	Methylene Chloride in N_2	6.01	-17	B
186	OO	Instrument Check	Method 25 gas in N_2	1904 as C	+2	B
187	F	Vinyl Coating Manufacturing	Toluene in N_2	618	+3	B
188	BB	Can Coating Operation	Method 25 gas in N_2	99.6 as C	NA	C
189	BB	Can Coating Operation	Method 25 gas in N_2	1968 as C	NA	C
190	KK	Can Coating Operation	Method 25 gas in N_2	806 as C	+17	B

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
191	JJ	Instrument Check	Method 25 gas in N_2	99.2 as C	-1	B
192	LL	Organic Emissions From Building Materials	Hexane in N_2	92.1	-7	B
			Toluene in N_2	21.6	+1	
			Toluene in N_2	303	0	
			Chlorobenzene in N_2	14.4	+6	
			Hexane in N_2	34.8	-10	
193	W	Paint Shop Incinerator	Method 25 gas in N_2	1904	+9	B
			Method 25 gas in N_2	1093	-14	
			Method 25 gas in N_2	196	-11	
194	PP	Limestone Quarry	Propane in N_2	10.1	-21	B
195	QQ	Bulk Gasoline Terminal	Propane in N_2	21300	-1	B
196	RR	Research Method Development;				
		Instrument #1	Hydrogen Sulfide in N_2	537	-10	B
		Instrument #2	Hydrogen Sulfide in N_2	537	-5	B
197	DD	Manufacturer of Vinyl Wall Coverings	Methyl Ethyl Ketone in N_2	45.0		A
			Methyl Isobutyl Ketone in N_2	10.2		
			Methanol in N_2	56.8		
198	MM	Asphalt Plant	Method 25 gas in N_2	1093 as C		A
			Method 25 gas in N_2	196 as C		
199	J	Method Development Research	1,3-Butadiene in N_2	52.9		A
200	LL	Instrument Check	Ethane in N_2	300		A
			Ethylene in N_2	4.72		
			Toluene in N_2	10.2		
201	BB	Municipal Incinerator	Propane in N_2	14.6		A

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS (Continued)

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
202	F	Paper Coating Process	Methyl Acetate in N_2	437	NA	C
203	W	Catalytic Incinerator	Method 25 gas in N_2 Method 25 gas in N_2	1968 196		A
204	SS	Coke Oven Emissions	Hydrogen Sulfide in N_2	787		A
205	L	Instrument Check	Trichloroethylene in N_2	101	-1	B
206	J	Instrument Check	Ethylene Oxide in N_2 Ethylene Oxide in N_2	0.868 9.09	-1 +10	B
207	TT	Instrument Check	Perchloroethylene in N_2 Perchloroethylene in N_2	7.83 551	NA NA	C
208	UU	Instrument Check	Carbonyl Sulfide in N_2 Carbonyl Disulfide in N_2	103.3 105		A
209	VV	Municipal Incinerator	Method 25 gas in N_2	806 as C	+9	B
210	H	Paper Coating Process	Method 25 gas in N_2	196 as C		B
211	Q	Oven Incinerator Auto Assembly	Method 25 gas in N_2 Method 25 gas in N_2	146 as C 1904 as C		A
212	WW	Industrial Manufacturing	Benzene in N_2	395		A

TABLE 4. SUMMARY OF PERFORMANCE AUDIT RESULTS

Audit No.	Client***	Industry	Audit material	RTI audit conc. (ppm)	Client audit % bias (Avg.)*	Status of audit**
213	DD	Paper Coating Process	Toluene in N_2	264		A
214	XX	Paint Manufacturing	Vinyl Chloride in N_2	8.13		A

NA = Not Analyzed

$$\text{*Client \% Bias} = 100 \times \frac{\text{Client-Measured Concentration} - \text{RTI-Measured Concentration}}{\text{RTI-Measured Concentration}}$$

**Status Codes:
A = Audit in progress;
B = Audit complete;
C = Audit complete without analysis of audit materials by client.

***Whenever the auditee is known, an alphabetical letter is shown. Whenever the auditee is unknown or the request is for a self-audit, the name of the agency requesting the audit is shown.

1977 - Audits 1-8	1982 - Audits 83-86
1978 - Audits 9-28	1983 - Audits 87-106
1979 - Audits 29-49	1984 - Audits 107-130
1980 - Audits 50-75	1985 - Audits 131-159
1981 - Audits 76-82	1986 - Audits 160-176
	1987 - Audits 177-214

SECTION 4
STABILITY STUDIES

An ideal calibration standard or audit material should be both accurate and stable over its total time of usage. The stabilities of the compounds were studied through periodic reanalyses of the cylinder contents. In this project, the cylinder gas mixtures are initially analyzed upon receipt from the specialty gas vendor to assess the vendor's analysis. The gas mixtures are again analyzed at 1 month, at 2 months, and at one year following the initial analysis to determine the stability of the gas mixtures. In some cases, analyses are not performed on the dates specified above; however, every attempt is made to acquire the data on this schedule. Some cylinders have also been analyzed yearly after completion of the new cylinder stability study, providing additional data for estimating stability.

As the number of analyses per cylinder increases, statistical stability analyses will be performed. The results of the statistical analyses will be presented in a future report. Statistical stability analyses for ten (10) halocarbons and eight (8) other organics have been published in the open literature (1,2).

Absolute accuracies of the cylinder analyses have not been determined due to the lack of NBS standards above one ppm for most of the organic gas mixtures. An examination of the data in Attachment 1 shows that values for individual cylinder analyses usually vary less than 10 percent between analyses for 4-8 analyses over 2-6 years. This variation may indicate changes in cylinder contents (i.e., instability), the imprecision of the measurement process, or both. Possible sources of experimental error that could result in apparent differences in concentrations include (1) the variability of the analytical technique used for analysis, (2) stability of calibration standards, and (3) the accuracy of independently producing calibration standards where NBS-SRMs do not exist. These sources of variability contribute to the net uncertainty of the resulting data presented in Attachment 1. Estimates of day-to-day measurement uncertainty (repeatability) for all compounds have not been performed. However, the measurement uncertainties for ten halocarbons have been published (2). The measurement uncertainty varied from less than 1 percent to 10 percent depending on the compound, and the major portion of the uncertainty was attributed to the method of preparation of the calibration standard. The uncertainty for the gas chromatographic analysis was determined to be less than 2 percent by multiple injections of the gas during same day analysis.

For the most recent analyses (1987) shown in Attachment 1, the uncertainty in the concentration has been estimated based on consideration of the uncertainties of several parameters associated with the measurement and calibration procedures. The equation below was then used to estimate the total uncertainty based on the individual uncertainties.

$$\text{Total Uncertainty} = 2\left(\sum_{i=1}^{n} e_i^2\right)^{1/2}$$

Where:

2 = two standard deviations (95 percent confidence limit)

e_i = individual component error, (percent coefficient of variation)

n = total number of error components.

For analyses involving the use of NBS-SRMs as calibration standards, the total uncertainty is estimated to be 3.5 percent; for analyses using permeation tube based calibration standards - 5.3 percent; and for analyses using pressure/dilution based calibration standards - 5.6 percent.

SECTION 5
SUMMARY AND CONCLUSIONS

Cylinder gases of hydrocarbons, halocarbons, sulfurous, and oxygenated species have been used successfully as audit materials to assess the relative accuracy of gas chromatographic systems used to measure source emissions. Absolute accuracy has not been determined due to the lack of NBS standards for most of the organic gas mixtures above 1 ppm; instead an estimated interlaboratory bias between the audit results and RTI results has been reported for the performance audits conducted during source testing. This interlaboratory bias has been generally less than 15 percent for both low and high concentration gases (Table 4).

Of the 45 gaseous compounds studied or currently under study, 39 have demonstrated sufficient stability in cylinders to be used further as audit materials. Five compounds (ethylamine, paradichlorobenzene, cyclohexanone, 1,2-dibromoethylene, and aniline) are not recommended as audit materials for various reasons as discussed in Attachment 1. One compound (formaldehyde) was ordered but the speciality gas manufacturer indicated that cylinder gases of this compound could not be prepared. Detailed statistical analyses which separate statistical deviations from true concentration changes with time for 18 gaseous compounds have been published in a journal publication; statistical analyses for the remaining compounds will be presented in a future report.

REFERENCES

1. R. K. M. Jayanty, C. Parker, C. E. Decker, W. F. Gutknecht, J. E. Knoll and D. J. VonLehmden, "Quality Assurance for Emissions Analysis Systems," Environmental Science and Technology, 17 (6), 257-263A (1983).

2. G. B. Howe, R. K. M. Jayanty, A. V. Rao, W. F. Gutknecht, C. E. Decker and D. J. VonLehmden, "Evaluation of Selected Gaseous Halocarbons for Use in Source Test Performance Audits," J. of Air Pollution Control Association, 33 (9), 823-826 (1983).

ATTACHMENT 1

Stability Data
as of
September 1987

1.0 BENZENE

2.0 ETHYLENE

3.0 PROPYLENE

4.0 METHANE/ETHANE

5.0 PROPANE

6.0 TOLUENE

7.0 HYDROGEN SULFIDE

8.0 META-XYLENE

9.0 METHYL ACETATE

10.0 CHLOROFORM

11.0 CARBONYL SULFIDE

12.0 METHYL MERCAPTAN

13.0 HEXANE

14.0 1,2-DICHLOROETHANE

15.0 CYCLOHEXANE

16.0 METHYL ETHYL KETONE

17.0 METHANOL

18.0 1,2-DICHLOROPROPANE

19.0 TRICHLOROETHYLENE

20.0 1,1-DICHLOROETHYLENE

21.0 1,2-DIBROMOETHYLENE

22.0 PERCHLOROETHYLENE

23.0 VINYL CHLORIDE

24.0 1,3-BUTADIENE

25.0 ACRYLONITRILE

26.0 ANILINE

27.0 METHYL ISOBUTYL KETONE

28.0 CYCLOHEXANONE

29.0 PARADICHLOROBENZENE

30.0 ETHYLAMINE

31.0 FORMALDEHYDE

32.0 METHYLENE CHLORIDE

33.0 CARBON TETRACHLORIDE

34.0 FREON 113

35.0 METHYL CHLOROFORM

36.0 ETHYLENE OXIDE

37.0 PROPYLENE OXIDE

38.0 ALLYL CHLORIDE

39.0 ACROLEIN

40.0 CHLOROBENZENE

41.0 CARBON DISULFIDE

42.0 METHOD 25 GAS MIXTURE

43.0 ETHYLENE DIBROMIDE

44.0 1,1,2,2-TETRACHLOROETHANE

NOTE: PPM concentrations shown in Attachment 1 are expressed on a mole/mole basis, except for EPA Method 25 mixture which is on a mole carbon/mole basis.

1.0 BENZENE STABILITY STUDY

Cylinder No. Cylinder Construction*		1A Al	1B Al	1C Al	1D Al	1E S	1F S	1G S
Manufacturer Concentration	ppm	65.4	324	200	117	61.0	71.0	80.0
	Date	7/27/77	7/27/77	7/27/77	7/27/77	2/10/78	2/10/78	2/10/78
	ppm	(79.0)	(374)	(241)	(138)	(62.0)	(71.0)	(80.0)
	Day	136	136	247	29	78	232	78
	ppm	(74.0)	(337)	(216)	(144)	(62.0)	(73.0)	(81.0)
	Day	156	156	252	157	216	385	216
	ppm	(78.0)	(350)	(215)	(134)	(61.0)	(75.0)	(81.0)
	Day	167	167	381	252	385	586	385
	ppm	(80.0)	(355)	(218)	(129)	(65.0)	(74.5)	(84.0)
	Day	630	402	**	290	722	882	504
	ppm	(77.9)	(331)		(127)	(66.9)	(75.7)	(85.4)
RTI	Day	**	433		414	1337	1292	1292
Concentration	ppm		(343)		(127)	(55.7)	(65.7)	(74.0)
	Day		969		1247	1858	2246	2246
	ppm		(358)		(132)	(58.7)	(70.0)	(78.3)
	Day		1274		2438	2246	2867	2867
	ppm		(348)		(121)	(60.4)	(72.0)	(80.7)
	Day		1491		3065	2867	3410	3410
	ppm		(324)		(125)	(62.3)	(71.3)	(81.1)
	Day		2056		3609	3409		
	ppm		(305)		(127)	(62.5)		
	Day		2438					
	ppm		(319)					
	Day		3065					
	ppm		(326)					
	Day		3716					
	ppm		(338)					

*Al = Aluminum; S = Steel; LS = Low-Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 100 degrees Celsius.

CALIBRATION: An NBS-SRM of benzene in nitrogen is used to calibrate the detector response.

1.0 BENZENE STABILITY STUDY (Continued)

Cylinder No. / Cylinder Construction*		1H	1I	1J	1K	1L	1M	1N
		S	S	S	S	S	S	S
Manufacturer Concentration	ppm	100	139	232	265	296	326	344
RTI Concentration	Date	2/8/78	2/9/78	2/9/78	2/9/78	2/9/78	2/9/78	2/9/78
	ppm	(101)	(139)	(229)	(264)	(295)	(319)	(332)
	Day	65	49	233	49	49	49	49
	ppm	(102)	(139)	(237)	(261)	(292)	(316)	(327)
	Day	206	50	386	50	51	51	54
	ppm	(98.0)	(142)	(243)	(268)	(294)	(318)	(342)
	Day	237	96	557	69	93	96	69
	ppm	(101)	(139)	(225)	(254)	(298)	(323)	(335)
	Day	434	127	**	84	205	433	809
	ppm	(105)	(140)		(269)	(294)	(345)	(342)
	Day	773	205		**	237	830	**
	ppm	(106)	(138)			(302)	(335)	
	Day	831	505			809	1294	
	ppm	(100)	(147)			(295)	(320)	
	Day	1294	1293			1294	2379	
	ppm	(92.0)	(128)			(290)	(310)	
	Day	2380	1338			2379	2868	
	ppm	(96.0)	(128)			(285)	(316)	
	Day	2925	2380			2868	3412	
	ppm	(99.2)	(134)			(293)	(332)	
	Day	3412	2868			3412		
	ppm	(101)	(137)			(301)		
	Day		3412					
	ppm		(138)					

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

1.0 BENZENE STABILITY STUDY (Continued)

Cylinder No.		1O	1P	1Q	1R	1S	1T	1U
Cylinder Construction*		S	S	S	S	S	S	S
Manufacturer Concentration	ppm	389	8.04	9.85	9.89	9.93	10.0	10.9
	Date	2/9/78	4/21/78	4/21/78	4/21/78	4/21/78	4/21/78	4/21/78
	ppm	(387)	(8.37)	(9.99)	(10.0)	(10.0)	(10.7)	(11.5)
	Day	64	4	5	4	4	25	4
	ppm	(369)	(8.33)	(9.88)	(10.1)	(10.1)	(10.2)	(10.7)
	Day	205	25	25	13	26	146	25
	ppm	(396)	(8.20)	(10.1)	(9.73)	(9.80)	(9.20)	(10.8)
	Day	809	26	332	332	56	362	332
	ppm	(396)	(8.34)	(9.71)	(9.77)	(9.50)	(9.90)	(10.7)
	Day	1294	56	**	1018	146	1222	434
RTI Concentration	ppm	(389)	(8.19)		(9.46)	(8.90)	(9.56)	(10.9)
	Day	2247	134		1270	628	**	759
	ppm	(376)	(7.81)		(9.64)	(9.57)		(10.2)
	Day	2868	434		2797	738		1222
	ppm	(386)	(8.21)		(9.75)	(9.45)		(9.69)
	Day	3412	766		3339	**		2175
	ppm	(395)	(7.93)		(9.68)			(9.90)
	Day		1222					2853
	ppm		(7.68)					(10.2)
	Day		2175					3339
	ppm		(7.90)					(10.4)
	Day		2797					
	ppm		(8.20)					
	Day		3339					
	ppm		(8.22)					

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

Cylinder No.		1V	1W	1X	1Y	1Z	1AA	1AB
Cylinder Construction*		S	S	S	S	S	S	S
Manufacturer Concentration	ppm	12.2	8.09	11.0	11.2	8.09	9.14	270
	Date	4/25/78	5/19/78	5/4/78	5/4/78	5/4/78	5/4/78	7/27/77
	ppm	(12.7)	(8.10)	(11.2)	(10.9)	(8.20)	(9.10)	(300)
	Day	1	105	132	132	132	132	29
	ppm	(12.5)	(7.70)	(10.2)	(9.90)	(7.04)	(7.80)	(319)
	Day	21	287	**	302	302	302	157
	ppm	(12.3)	(8.10)		(10.7)	(7.70)	(8.50)	(312)
RTI Concentration	Day	109	488		393	473	1005	2056
	ppm	(12.0)	(8.20)		(10.8)	(7.54)	(8.17)	(305)
	Day	358	784		2162	**	1209	**
	ppm	(12.1)	(8.30)		(10.3)		(8.42)	
	Day	755	1194		2840		2162	
	ppm	(12.0)	(7.45)		(10.6)		(8.40)	
	Day	1218	2147		3326		2784	
	ppm	(11.7)	(7.80)		(10.6)		(8.72)	
	Day	2171	2769				3326	
	ppm	(11.9)	(7.89)				(8.88)	
	Day	2849	3311					
	ppm	(12.2)	(8.00)					
	Day	3335						
	ppm	(12.3)						

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

2.0 ETHENE (ETHYLENE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		2A Al	2B Al	2C Al	2D Al	2E Al	2F Al	2G Al
Manufacturer Concentration	ppm	2920	3000	4960	4970	19900	19900	4.95
RTI Concentration	Date	2/23/78	2/23/78	2/23/78	2/23/78	2/24/78	2/24/78	4/27/78
	ppm	(3070)	(3130)	(5210)	(5200)	(20400)	(20600)	(4.70)
	Day	49	49	48	48	48	48	29
	ppm	(3120)	(3180)	(5340)	(5280)	(20800)	(20800)	(4.70)
	Day	198	198	201	201	200	200	106
	ppm	(2880)	(2940)	(4660)	(4910)	(20200)	(20300)	(4.85)
	Day	809	809	809	809	808	808	741
	ppm	(3200)	(3270)	(5380)	(5340)	(18900)	(19000)	(4.62)
	Day	2291	2291	2291	2291	2290	2290	1180
	ppm	(3280)	(3350)	(5520)	(5480)	(20600)	(20700)	(5.12)
	Day	2856	2856	2856	2856	2855	2855	2224
	ppm	(3120)	(3180)	(5310)	(5270)	(20400)	(20600)	(4.50)
	Day	3241	3241	3241	3241	3240	3240	2804
	ppm	(3080)	(3150)	(5240)	(5220)	(20600)	(20800)	(4.72)
	Day							3176
	ppm							(4.82)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, Durapak n-octane on Porasil C column at 30 degrees Celsius.

CALIBRATION: An NBS-SRM of propane in nitrogen is used to calibrate the detector response.

2.0 ETHENE (ETHYLENE) STABILITY STUDY (Continued)

Cylinder No. / Cylinder Construction*		2H / Al	2I / Al	2J / Al	2K / Al	2L / Al	2M / Al	2N / Al
Manufacturer Concentration	ppm	10.0	15.0	19.9	300	448	603	701
RTI Concentration	Date	4/27/78	4/28/78	4/28/78	4/28/78	4/28/78	4/28/78	4/28/78
	ppm	(9.70)	(14.4)	(19.2)	(306)	(468)	(629)	(740)
	Day	29	28	28	33	33	34	34
	ppm	(9.60)	(14.4)	(19.3)	(319)	(493)	(646)	(749)
	Day	106	104	104	105	104	104	104
	ppm	(9.90)	(14.9)	(20.3)	(312)	(473)	(636)	(737)
	Day	740	739	739	728	740	740	740
	ppm	(8.40)	(18.0)	(21.5)	(300)	(457)	(606)	(703)
	Day	1180	1179	1179	2225	2225	2225	2225
	ppm	(10.0)	(14.4)	(18.9)	(291)	(435)	(583)	(678)
	Day	2224	2223	2223	2793	2793	2793	2793
	ppm	(9.50)	(14.2)	(18.9)	(290)	(437)	(590)	(684)
	Day	2587	2803	**	3177	3177	3177	3177
	ppm	(9.54)	(14.5)		(293)	(439)	(587)	(683)
	Day	2804	3177					
	ppm	(9.76)	(14.6)					
	Day	3176						
	ppm	(9.81)						

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

3.0 PROPENE (PROPYLENE) STABILITY STUDY

Cylinder No.		3A	3B	3C	3D	3E	3F	3G	3H
Cylinder Construction*		Al	Al	Al	Al	Al	Al	Al	Al
Manufacturer Concentration	ppm	4.94	9.91	14.8	20.0	298	446	585	683
RTI Concentration	Date	4/27/78	4/27/78	4/27/78	4/27/78	4/27/78	4/27/78	4/27/78	4/27/78
	ppm	(4.86)	(9.83)	(14.6)	(19.8)	(296)	(442)	(577)	(672)
	Day	26	26	26	27	27	27	27	27
	ppm	(4.94)	(9.85)	(14.5)	(19.0)	(286)	(428)	(560)	(655)
	Day	27	104	104	104	104	105	104	105
	ppm	(4.78)	(10.3)	(14.8)	(20.0)	(317)	(474)	(629)	(729)
	Day	104	749	749	749	750	750	750	750
	ppm	(4.98)	(9.76)	(14.8)	(20.3)	(324)	(479)	(620)	(721)
	Day	749	1250	**	2229	820	2229	2229	820
	ppm	(4.93)	(9.63)		(19.7)	(328)	(444)	(579)	(725)
	Day	2229	2229		2804	**	2794	2794	2229
	ppm	(4.80)	(9.80)		(19.8)		(449)	(589)	(676)
	Day	2601	2804		3178		3178	3178	2794
	ppm	(4.75)	(9.81)		(19.8)		(441)	(578)	(688)
	Day	2804							3178
	ppm	(4.78)							(674)
	Day	3178							
	ppm	(4.88)							

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, Durapak n-octane on Porasil C column at 30 degrees Celsius

CALIBRATION: An NBS-SRM of propane in nitrogen is used to calibrate the detector response.

4.0 METHANE/ETHANE STABILITY STUDY

		4A		4B		4C		4D	
Cylinder No.		4A		4B		4C		4D	
Cylinder Construction*		Al		Al		Al		Al	
Audit Material**		M	E	M	E	M	E	M	E
Manufacturer Concentration	ppm	6000	714	8130	597	1000	295	1670	202
RTI Concentration	Date	7/21/78	7/21/78	7/21/78	7/21/78	7/21/77	7/21/77	7/21/77	7/21/77
	ppm	(6210)	(773)	(8130)	(654)	(1020)	(315)	(1710)	(220)
	Day	264	163	35	35	264	163	35	29
	ppm	(5980)	(715)	(7550)	(663)	(983)	(292)	(1560)	(218)
	Day	662	264	264	163	1027	264	264	157
	ppm	(6580)	(684)	(7820)	(606)	(1290)	(283)	(1640)	(202)
	Day	2145	662	662	264	2510	1027	1027	258
	ppm	(6460)	(703)	(8590)	(577)	(1068)	(284)	(1950)	(195)
	Day	2722	2145	2145	662	3087	2510	2510	1027
	ppm	(6525)	(730)	(8430)	(598)	(1059)	(300)	(1770)	(206)
	Day	3097	2722	2722	2145	3097	3087	3087	2510
	ppm	(6440)	(746)	(8553)	(619)	(1050)	(300)	(1755)	(207)
	Day		3097	3097	2722		3097		3087
	ppm		(751)	(8410)	(632)		(296)		(207)
	Day				3097				
	ppm				(628)				

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**M = Methane; E = Ethane.

ANALYTICAL CONDITIONS: Flame ionization detector, Durapak n-octane on Porasil C column at 30 degrees Celsius.

CALIBRATION: An NBS-SRM of propane in nitrogen is used to calibrate the detector response.

5.0 PROPANE STABILITY STUDY

Cylinder No. Cylinder Construction*		5A Al	5B Al	5C Al	5D Al	5E Al	5F Al	5G Al	5H Al
Manufacturer Concentration	ppm	5.01	10.0	14.6	20.0	303	439	604	708
	Date	4/25/78	4/25/78	4/25/78	4/25/78	4/26/78	4/26/78	4/26/78	4/27/78
	ppm	(4.90)	(9.70)	(14.3)	(19.5)	(304)	(441)	(615)	(730)
	Day	24	24	25	25	24	24	27	26
	ppm	(4.90)	(9.80)	(14.5)	(19.8)	(301)	(436)	(615)	(723)
	Day	108	108	108	108	107	107	107	106
	ppm	(5.10)	(10.1)	(14.9)	(20.3)	(305)	(440)	(607)	(710)
	Day	605	513	582	582	530	530	604	603
	ppm	(4.89)	(10.6)	(15.0)	(20.8)	(316)	(450)	(613)	(718)
	Day	729	752	736	736	581	581	735	734
RTI Concentration	ppm	(5.20)	(10.0)	(14.7)	(20.1)	(316)	(453)	(628)	(734)
	Day	**	914	2220	1252	735	728	2218	2218
	ppm		(10.0)	(14.8)	(19.7)	(313)	(472)	(607)	(715)
	Day		2220	2589	2220	752	**	2795	2794
	ppm		(10.9)	(14.8)	(20.0)	(314)		(617)	(717)
	Day		2851	2806	2806	913		3179	3178
	ppm		(10.1)	(14.6)	(20.0)	(309)		(612)	(713)
	Day		3184	3179	3179	1251			
	ppm		(10.1)	(14.8)	(20.2)	(296)			
	Day					2219			
	ppm					(308)			
	Day					2795			
	ppm					(308)			
	Day					3178			
	ppm					(308)			

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, Durapak n-octane on Porasil C column at 30 degrees Celsius.

CALIBRATION: An NBS-SRM of propane in nitrogen is used to calibrate the detector response.

5.0 PROPANE STABILITY STUDY (Continued)

Cylinder No. Cylinder Construction*		5I Al	5J Al	5K Al	5L Al
Manufacturer Concentration	ppm	1000	2000	10,000	20,000
RTI Concentration	Date	3/3/83	3/3/83	3/3/83	3/3/83
	ppm	(1027)	(2100)	(11800)	(20700)
	Day	452	452	452	452
	ppm	(1070)	(2180)	(13000)	(21000)
	Day	734	734	734	734
	ppm	(1006)	(2052)	(13021)	(21302)
	Day	1022	1022	1022	1022
	ppm	(1040)	(2060)	(12500)	(21300)
	Day	1407	1407	1407	1407
	ppm	(1020)	(2050)	(12600)	(21200)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

6.0 TOLUENE STABILITY STUDY

Cylinder No. / Cylinder Construction*		6A LS	6B LS	6C S	6D S	6E S	6F S
Manufacturer Concentration	ppm	408	606	16.2	9.11	9.00	430
RTI Concentration	Date	12/6/78	12/6/78	10/3/78	10/3/78	3/29/83	7/1/80
	ppm	(405)	(585)	(17.3)	(9.62)	(8.51)	(430)
	Day	3	3	48	64	744	861
	ppm	(405)	(579)	(14.9)	(8.50)	(8.04)	(347)
	Day	86	86	365	66	1063	1115
	ppm	(394)	(577)	(15.0)	(8.60)	(9.07)	(338)
	Day	100	358	1373	160	1548	1505
	ppm	(393)	(615)	(14.8)	(8.20)	(9.37)	(427)***
	Day	**	2079	**	**		1765
	ppm		(663)***				(351)
	Day		2338				2059
	ppm		(603)				(368)
	Day		2632				**
	ppm		(618)				

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

***Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, Porasil C column at 200 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for generation of a series of standards from reagent grade toluene.

6.0 TOLUENE STABILITY STUDY (Continued)

Cylinder No. / Cylinder Construction*		6G Al	6H Al	6I Al	6J Al	6K LS	6L LS
Manufacturer Concentration	ppm	18.2	9.0	10.3	21.7	196	310
RTI Concentration	Date	7/27/83	7/1/80	12/11/84	12/11/84	12/11/84	12/11/84
	ppm	(16.1)	(8.50)	(9.27)	(20.3)	(183)	(290)
	Day	383	1505	192	121	141	141
	ppm	(19.1)***	(9.40)	(8.70)	(18.9)	(184)	(281)
	Day	**	2064	440	440	436	436
	ppm		(8.15)	(10.2)	(21.6)	(195)	(303)
	Day		2549	926	926	926	1021
	ppm		(8.72)	(9.80)	(21.0)	(180)	(335)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

***Questionable value.

7.0 HYDROGEN SULFIDE STABILITY STUDY

Cylinder No.		7A	7B	7C	7D	7E	7F	7G
Cylinder Construction*		Al	Al	Al	Al	Al	Al	Al
Manufacturer Concentration	ppm	399	9.15	16.7	649	6.95	6.45	671
RTI Concentration	Date	10/1/78	7/7/78	10/1/78	10/1/78	10/1/78	10/1/78	3/2/83
	ppm	(371)	(9.73)	(16.1)	(641)	(7.05)	(4.94)	(628)
	Day	38	87	38	38	87	38	687
	ppm	(424)	(6.72)	(16.5)	(655)	(5.75)	(5.14)	(683)
	Day	111	124	111	111	124	111	833
	ppm	(414)	(7.11)	(15.7)	(690)	(5.62)	(4.81)	(654)
	Day	1030	197	580	1030	197	580	1182
	ppm	(437)	(6.36)	(16.2)	(647)	(5.23)	(4.35)	(737)
	Day	2270	696	1030		696	1030	1436
	ppm	(444)	(6.23)	(17.5)	**	(5.14)	(3.71)	(715)
	Day	2446	1116	2270		1116	2325	
	ppm	(401)	(8.32)	(14.5)		(5.38)	(4.3)	
	Day	2795	2399	2300		2325	2446	
	ppm	(395)	(8.00)	(15.3)		(4.6)	(4.1)	
	Day	3047	2424	2446		2446	2762	
	ppm	(411)	(6.60)	(15.6)		(4.4)	(3.03)	
	Day		2545	2762		2762	3032	
	ppm		(6.00)	(16.0)		(3.88)	(3.56)	
	Day		2848	3298		3032		
	ppm		(5.75)	(14.0)		(4.28)		
	Day		3118					
	ppm		(6.44)					

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame photometric detector, Chromosil 330 column at 50 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for generation of a series of standards from pure hydrogen sulfide. A permeation tube is used for generation of calibration mixtures for lower level (<100 ppm) cylinder analyses.

ANALYTICAL PROBLEMS: Only a Teflon® column and Teflon® sample loop should be used. The air-to-hydrogen ratio is critical to the sensitivity of the FPD.

Cylinder No. / Cylinder Construction*		7H Al	7I Al	7J Al	7K Al	7L Al	7M Al	7N Al	7O Al
Manufacturer Concentration	ppm	20.77	29.27	39.14	97.31	206.3	323.2	417	503.2
RTI Concentration	Date	1/17/85	1/17/85	1/17/85	1/17/85	1/16/85	1/16/85	1/16/85	1/16/85
	ppm	(17.7)	(22.6)	(31.6)	(83.7)	(200)	(291)	(398)	(489)
	Day	25	25	25	146	147	147	147	147
	ppm	(20.6)	(30.4)	(42.4)	(92.1)	(210)	(320)	(415)	(514)
	Day	146	146	146	495	496	496	496	496
	ppm	(21.0)	(30.5)	(40.5)	(97.8)	(198)	(306)	(420)	(537)
	Day	462	462	462	746	758	758	750	750
	ppm	(21.2)	(29.0)	(39.8)	(101)	(200)	(324)	(424)	(538)
	Day	734	734	**					
	ppm	(20.1)	(30.2)						

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

8.0 1,3-DIMETHYLBENZENE (M-XYLENE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		8A / LS	8B / LS	8C / S	8D / S	8E / LS	8F / LS	8G / Al
Manufacturer Concentration	ppm	405	613	17.3	7.33	601.0	351.4	12.1
RTI Concentration	Date	10/5/78	10/5/78	10/5/78	10/5/78	6/7/85	6/7/85	6/7/85
	ppm	(480)	(720)	(16.6)	(6.20)	(596)	(362)	(11.5)
	Day	63	63	63	63	257	257	257
	ppm	(445)	(676)	(17.2)	(6.81)	(552)	(344)	(11.1)
	Day	158	158	166	166	749	749	749
	ppm	(425)	(656)	(20.8)	(6.82)	(438)	(328)	(10.1)
	Day	412	606	302	1036			
	ppm	(487)	(760)	(16.4)	(5.66)			
	Day	606	2140	1036	2694			
	ppm	(507)	(598)	(19.0)	(4.39)			
		**	**	**				

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

CALIBRATION: A pressure-dilution technique is used for generation of a series of standards from reagent grade m-xylene.

ANALYTICAL CONDITIONS: Flame ionization detector, Porasil C column at 250 degrees Celsius.

9.0 METHYL ESTER ACETIC ACID (METHYL ACETATE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		9A / S	9B / S	9C / S	9D / S
Manufacturer Concentration	ppm	326	455	6.84	17.2
RTI Concentration	Date	10/13/78	10/13/78	10/13/78	10/13/78
	ppm	(271)	(428)	(5.29)	(12.9)**
	Day	230	230	230	230
	ppm	(340)	(437)	(4.86)	(12.5)**
	Day	286	286	286	286
	ppm	(324)	(442)	(5.02)	(11.8)**
	Day	629	629	630	630
	ppm	(348)	(479)	(5.88)	(12.5)**
	Day	2442	2442	2442	2442
	ppm	(336)	(470)	(5.32)	(17.2)
	Day	2742	2742	2742	2742
	ppm	(320)	(437)	(5.89)	(16.5)
	Day	3183	3268	3183	3183
	ppm	(310)	(462)	(5.36)	(15.4)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 125 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for generation of a series of standards from reagent grade methyl acetate.

10.0 TRICHLOROMETHANE (CHLOROFORM) STABILITY STUDY

Cylinder No.		10A	10B	10C	10D	10E	10F
Cylinder Construction*		S	S	S	S	Al	Al
Manufacturer Concentration	ppm	520	348	8.70	16.9	9.81	22.0
RTI Concentration	Date	10/17/78	10/17/78	10/17/78	10/17/78	1/10/86	1/10/86
	ppm	(529)	(345)	(8.08)	(17.6)	(8.92)	(21.1)
	Day	161	161	161	161	534	534
	ppm	(515)	(351)	(7.39)	(16.5)	(9.45)	(21.8)
	Day	256	256	256	256		
	ppm	(514)	(340)	(7.50)	(16.2)		
	Day	553	975	553	553		
	ppm	(531)	(325)	(8.11)	(16.5)		
	Day	**	2422	2422	2422		
	ppm		(333)	(4.26)	(14.9)		
	Day		2642	2642	2642		
	ppm		(326)	(4.52)	(15.0)		
	Day		3176	3176	3176		
	ppm		(344)	(4.76)	(14.9)		

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, Porasil C column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for generation of a series of standards from reagent grade chloroform.

11.0 CARBONYL SULFIDE STABILITY STUDY

Cylinder No. / Cylinder Construction*		11A / S	11B / S	11C / S	11D / S	11E / AL	11F / AL
Manufacturer Concentration	ppm	251	100	9.96	7.03	9.54	101
RTI Concentration	Date	11/3/78	11/3/78	11/3/78	11/3/78	9/18/81	9/18/81
	ppm	(276)	(109)	(9.10)	(6.81)	(12.9)	(111)
	Day	78	78	78	78	35	35
	ppm	(281)	(111)	(8.66)	(6.48)	(12.5)	(117)
	Day	185	185	185	185	222	**
	ppm	(275)	(95.0)	(8.23)	(6.41)	(9.08)	
		**	**	**	**	**	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame photometric detector, Carbopack B column at 50 degrees Celsius or Chromosil 330 column at 60 degrees Celsius.

CALIBRATION: A pressure-dilution technique is used for generation of a series of standards from pure carbonyl sulfide.

ANALYTICAL PROBLEMS: Only a Teflon® column and Teflon® sample loop should be used. The air-to-hydrogen ratio is critical to the sensitivity of the FPD.

Cylinder No. Cylinder Construction*		11G Al	11H Al	11I Al	11J Al	11K Al
Manufacturer Concentration	ppm	99.2	225	414	10.71	101
RTI Concentration	Date ppm	1/11/85 (101)	1/11/85 (228)	1/11/85 (423)	1/11/85 (9.3)	1/11/85 (99.0)
	Day ppm	150 (96.5)	150 (199)	150 (404)	150 (10.0)	150 (98.0)
	Day ppm	517 (105)	517 (205)	517 (420)	517 (11.7)	517 (105)
	Day ppm	**	985 (206)	985 (472)	985 (12.1)	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

12.0 METHANETHIOL (METHYL MERCAPTAN) STABILITY STUDY

Cylinder No.		12A	12B	12C	12D
Cylinder Construction*		Al	Al	Al	Al
Manufacturer Concentration	ppm	8.03	10.0	3.55	4.22
RTI Concentration	Date	1/24/79	1/24/79	1/24/79	1/24/79
	ppm	(5.66)	(7.94)	(3.65)	(4.23)
	Day	104	104	104	104
	ppm	(5.60)	(8.10)	(3.50)	(4.76)
	Day	139	139	139	139
	ppm	(5.65)	(7.90)	(3.56)	(4.54)
	Day	985	985	985	**
	ppm	(5.40)	(8.42)	(3.64)	
	Day	2194	2194	2194	
	ppm	(5.45)	(8.00)	(3.80)	
	Day	2331	2331	2331	
	ppm	(4.70)	(8.00)	(3.40)	
	Day	2690	2690	2690	
	ppm	(5.70)	(9.84)	(3.73)	
	Day	2938	2938	2938	
	ppm	(4.78)	(9.21)	(3.75)	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame photometric detector, Chromosil 330 column at 60 degrees Celsius.

CALIBRATION: A permeation tube is used for generation of calibration mixtures.

ANALYTICAL PROBLEMS: Only a Teflon® column and Teflon® sampling loop should be used. The air-to-hydrogen ratio is critical to the sensitivity of the FPD.

13.0 HEXANE STABILITY STUDY

Cylinder No.		13A	13B	13C	13D	13E
Cylinder Construction*		LS	LS	Al	Al	Al
Manufacturer Concentration	ppm	1975	2973	30.6	79.2	80.0
RTI Concentration	Date	2/6/79	2/6/79	2/6/79	2/6/79	3/25/83
	ppm	(2170)	(3070)	(30.8)	(82.2)	(83.2)
	Day	6	6	296	296	376
	ppm	(1980)	(2860)	(30.1)	(81.0)	(88.2)
	Day	337	338	337	337	1117
	ppm	(2070)	(2950)	(30.6)	(81.3)	(92.1)
	Day	469	469	469	469	1558
	ppm	(1990)	(3080)	(32.0)	(79.8)	(84.6)
	Day	1886	1886	523	835	
	ppm	(1990)	(2980)	(30.0)	(80.2)	
	Day	2586	**	835	1247	
	ppm	(2139)		(30.2)	(82.7)	
	Day	**		1886	**	
	ppm			(32.8)		
	Day			2586		
	ppm			(34.8)		
	Day			3066		
	ppm			(29.2)		

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, Porasil C column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade hexane.

14.0 1,2-DICHLOROETHANE STABILITY STUDY

Cylinder No.		14A	14B	14C	14D	14E	14F	14G	14H
Cylinder Construction*		Al	Al	Al	Al	Al	Al	Al	Al
Manufacturer Concentration	ppm	14.4	9.64	100	526	6.92	12.5	97.9	439
RTI Concentration	Date	1/19/79	1/19/79	1/19/79	1/19/79	4/5/79	4/5/79	4/5/79	4/5/79
	ppm	(14.1)	(9.20)	(96.2)	(498)	(10.0)	(15.2)	(102)	(463)
	Day	58	58	58	58	30	30	30	30
	ppm	(15.2)	(10.8)	(103)	(534)	(9.42)	(14.7)	(105)	(451)
	Day	155	155	155	155	69	69	69	69
	ppm	(14.9)	(10.0)	(98.2)	(524)	(9.30)	(14.3)	(99.0)	(462)
	Day	811	811	501	501	586	811	425	589
	ppm	(14.2)	(9.56)	(87.3)	(592)***	(9.14)	(14.5)	(87.3)	(432)
	Day	835	835	920	920	811	835	844	697
	ppm	(13.5)	(9.19)	(102)	(502)	(9.70)	(13.8)	(101)	(451)
	Day	1964	1964	1964	1964	835	1888	1888	844
	ppm	(13.9)	(9.68)	(94.9)	(477)	(9.16)	(13.9)	(92.4)	(453)
	Day	2333	2333	2333	2333	2247	2247	2247	1888
	ppm	(14.1)	(9.30)	(96.7)	(496)	(9.32)	(14.3)	(96.0)	(416)
	Day	2546	2546	2546	2546	2470	2470	2470	2247
	ppm	(13.6)	(8.65)	(97.5)	(490)	(8.85)	(13.8)	(97.2)	(427)
	Day	3083	3083	3083	**	3007	3007	3007	2470
	ppm	(14.4)	(9.75)	(97.0)		(9.91)	(14.6)	(95.8)	(422)
	Day								3007
	ppm								(424)

*Al = Aluminum: S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

***Questionable value

ANALYTICAL CONDITIONS: Flame ionization detector, Porasil C column of 225 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade 1,2-dichloroethane.

15.0 CYCLOHEXANE STABILITY STUDY

Cylinder No.		15A
Cylinder Construction*		Al
Manufacturer Concentration	ppm	99.1
	Date	3/19/79
	ppm	(106)
	Day	147
	ppm	(93.4)
RTI Concentration	Day	394
	ppm	(99.0)
	Day	926
	ppm	(102)
	Day	1966
	ppm	(95.9)
	Day	2559
	ppm	(100)
	Day	3025
	ppm	(100)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, Porasil C column at 125 degrees Celsius.

CALIBRATION: A pressure-dilution technique is used for making a series of standards from reagent grade cyclohexane.

16.0 2-BUTANONE (METHYL ETHYL KETONE) STABILITY STUDY

Cylinder No.		16A	16B	16C	16D
Cylinder Construction*		S			
Manufacturer Concentration	ppm	43.7	5.00	30.0	15.1
RTI Concentration	Date ppm	5/23/79 (42.3)	7/1/87 (5.19)	7/1/87 (29.5)	7/1/87 (16.0)
	Day ppm	28 (40.0)			
	Day ppm	58 (39.9)			
	Day ppm	380 (44.5)			
	Day ppm	653 (38.7)			
	Day ppm	1847 (40.4)			
	Day ppm	2520 (45.0)			

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade methyl ethyl ketone.

17.0 METHANOL STABILITY STUDY

Cylinder No.		17A
Cylinder Construction*		Al
Manufacturer Concentration	ppm	50.0
	Date	5/17/79
	ppm	(58.8)
	Day	21
	ppm	(52.3)
	Day	51
RTI Concentration	ppm	(51.1)
	Day	196
	ppm	(55.2)
	Day	2020
	ppm	(48.8)
	Day	2224
	ppm	(45.8)
	Day	2660
	ppm	(56.8)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, Chromosorb 101 column at 50 degrees Celsius or 0.2% Carbowax 1500 plus 0.1% SP-2100 on Carbowax C at 60 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade methanol.

18.0 1,2-DICHLOROPROPANE (PROPYLENE DICHLORIDE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		18A Al	18B Al	18C Al	18D Al
Manufacturer Concentration	ppm	7.07	14.6	476	664
RTI Concentration	Date	7/10/79	7/10/79	7/10/79	7/10/79
	ppm	(6.06)	(15.6)	(496)	(685)
	Day	28	28	28	28
	ppm	(5.52)	(16.4)	(455)	(621)
	Day	48	48	48	48
	ppm	(5.94)	(15.0)	(480)	(675)
	Day	497	749	372	372
	ppm	(6.03)	(16.3)	(497)	(685)
	Day	749	1793	1793	1793
	ppm	(5.59)	(12.1)	(402)	(557)
	Day	1793	1845	1845	1845
	ppm	(3.12)	(13.2)	(424)	(574)
	Day	1845	2155	2155	2155
	ppm	(3.86)	(13.3)	(441)	(594)
	Day	2155	2387	2387	2387
	ppm	(3.49)	(12.9)	(429)	(576)
	Day	2387	2914	2914	2914
	ppm	(3.25)	(14.4)	(451)	(630)
	Day	2914			
	ppm	(4.11)			

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade 1,2-dichloropropane.

19.0 TRICHLOROETHENE (TRICHLOROETHYLENE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		19A Al	19B Al	19C Al	19D Al
Manufacturer Concentration	ppm	9.23	14.7	100	505
RTI Concentration	Date	5/24/79	5/24/79	5/24/79	5/24/79
	ppm	(9.58)	(14.3)	(102)	(506)
	Day	77	77	77	77
	ppm	(10.2)	(15.1)	(103)	(503)
	Day	92	92	92	92
	ppm	(9.78)	(14.9)	(100)	(499)
	Day	683	683	810	810
	ppm	(9.03)	(13.6)	(105)	(522)
	Day	820	820	820	820
	ppm	(8.91)	(13.5)	(94.6)	(490)
	Day	1853	1853	1853	1853
	ppm	(9.40)	(14.0)	(105)	(523)
	Day	2493	2493	2493	2493
	ppm	(10.2)	(15.5)	(101)	(494)
	Day	2961	2961	3045	2961
	ppm	(10.5)	(15.2)	(98.8)	(502)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is used for making a series of standards from reagent grade trichloroethylene.

20.0 1,1-DICHLOROETHYLENE (VINYLIDENE CHLORIDE) STABILITY STUDY

Cylinder No. Cylinder Construction*		20A Al	20B Al	20C Al	20D Al
Manufacturer Concentration	ppm	9.58	14.8	96.8	490
	Date ppm	6/1/79 (10.3)	6/1/79 (15.6)	6/1/79 (101)	6/1/79 (524)
	Day ppm	35 (9.90)	35 (15.1)	35 (99.0)	35 (510)
	Day ppm	62 (10.1)	62 (15.5)	62 (102)	62 (505)
RTI Concentration	Day ppm	404 (11.5)**	404 (17.1)**	817 (94.0)	404 (498)
	Day ppm	818 (9.00)	818 (14.2)	1831 (98.4)	1831 (488)
	Day ppm	1831 (9.00)	1831 (13.2)	2190 (94.7)	2190 (479)
	Day ppm	2190 (8.78)	2190 (14.1)	2490 (97.4)	2490 (478)
	Day ppm	2490 (9.87)	2490 (15.2)	2957 (108)	2957 (553)
	Day ppm	2957 (11.1)	2957 (17.2)		

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 80 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade 1,1-dichloroethene.

21.0 1,2-DIBROMOETHYLENE STABILITY STUDY

Cylinder No. / Cylinder Construction*		21A LS	21B LS	21C LS	21D LS
Manufacturer Concentration	ppm	10.0	14.9	99.9	301
RTI Concentration	Date	6/18/79	6/18/79	6/1/79	6/18/79
	ppm	(7.90)	(12.2)	(110)	(265)
	Day	61	61	61	61
	ppm	(7.80)	(12.0)	(107)	(266)
	Day	89	89	89	89
	ppm	(7.40)	(11.6)	(105)	(257)
	Day	722	772	787	643
	ppm	(7.72)	(8.02)	(99.2)	(309)
		**	**	**	**

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinders returned due to partial conversion to an unknown compound.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 100 degrees Celsius.

CALIBRATION: Reagent grade "1,2-Dibromoethylene" pure liquid is used as a standard. Pressure-dilution technique is utilized for making series of standards for calibration.

ANALYTICAL PROBLEMS: The gas mixtures and the calibration standards contain substantial amounts of both the cis and the trans isomers of 1,2-Dibromoethylene. The first three sets of analyses are questionable because only one isomer was measured during the calibrations and cylinder analyses. During the GC analyses on Day 1864, it was found that dibromoethylene partially converted to an unknown compound. Hence, dibromoethylene is not practical as an audit material.

22.0 TETRACHLOROETHENE (PERCHLOROETHYLENE) STABILITY STUDY

Cylinder No.		22A	22B	22C	22D
Cylinder Construction*		S	S	LS	LS
Manufacturer Concentration	ppm	7.98	13.0	487	629
	Date	7/6/79	7/6/79	7/6/79	7/6/79
	ppm	(8.40)	(15.0)	(419)	(624)
	Day	35	35	35	35
	ppm	(7.97)	(14.9)	(453)	(642)
	Day	52	52	52	52
	ppm	(7.92)	(14.7)	(440)	(619)
RTI Concentration	Day	376	376	677	677
	ppm	(7.94)	(14.5)	(361)	(542)
	Day	1818	1818	713	713
	ppm	(6.88)	(13.7)	(387)	(571)
	Day	2162	2162	1818	1818
	ppm	(6.88)	(13.3)	(349)	(557)
	Day	2440	2440	2162	2162
	ppm	(7.83)	(13.5)	(353)	(564)
	Day	2901	2901	2450	2450
	ppm	(7.68)	(14.5)	(357)	(551)
	Day			2901	2901
	ppm			(372)	(607)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 150 degrees Celsius.

CALIBRATION: An NBS-SRM of perchloroethylene in nitrogen is used to calibrate the detector response.

23.0 CHLOROETHENE (VINYL CHLORIDE) STABILITY STUDY

		23A	23B	23C	23D	23E	23F	23G	23H	23I
Cylinder No. / Cylinder Construction*		S	S	S	S	S	S	S	S	S
Manufacturer Concentration	ppm	5.94	8.00	8.03	8.52	20.0	20.1	30.0	30.3	7.98
RTI Concentration	Date	10/1/79	10/1/79	10/1/79	10/1/79	10/1/79	10/1/79	10/1/79	10/1/79	10/1/79
	ppm	(5.87)	(7.71)	(7.82)	(7.85)	(19.7)	(20.1)	(29.6)	(29.8)	(7.31)
	Day	18	18	18	18	18	18	18	18	18
	ppm	(5.74)	(7.50)	(7.45)	(7.61)	(19.1)	(19.3)	(28.3)	(28.7)	(7.12)
	Day	700	**	700	700	700	700	700	700	700
	ppm	(6.60)		(8.44)	(8.41)	(20.7)	(20.9)	(29.4)	(29.4)	(8.39)
	Day	1812		1812	1812	1812	1812	1812	1812	1812
	ppm	(6.10)		(8.10)	(8.15)	(20.3)	(20.6)	(30.3)	(30.6)	(7.75)
	Day	2524		2524	2524	2524	2524	2524	2524	
	ppm	(6.09)		(8.05)	(8.13)	(20.4)	(20.6)	(30.3)	(31.1)	
	Day	2914		2914	2914	2914	2914	2914	2914	2914
	ppm	(5.62)		(7.54)	(7.60)	(18.6)	(19.8)	(28.6)	(28.9)	(7.18)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 90 degrees Celsius.

CALIBRATION: A pressure-dilution technique is used for generation of a series of standards from pure vinyl chloride.

24.0 1,3-BUTADIENE STABILITY STUDY

Cylinder No.		24A	24B	24C	24D
Cylinder Construction*		S	Al	Al	Al
Manufacturer Concentration	ppm	22.6	52.8	31.9	13.3
RTI Concentration	Date	3/21/80	2/12/86	2/12/86	2/12/86
	ppm	(20.9)	(52.9)	(32.3)	(13.4)
	Date	95	511	511	
	ppm	(23.1)	(53.4)	(32.6)	
	Day	480			
	ppm	(24.0)			
	Day	1718			
	ppm	(22.9)			
		**			

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 90 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from pure 1,3-butadiene.

25.0 2-PROPENENITRILE (ACRYLONITRILE) STABILITY STUDY

Cylinder No. Cylinder Construction*		25A LS	25B LS	25C LS	25D LS	25E AL	25F AL	25G Al	25H Al
Manufacturer Concentration	ppm	20.1	348	11.7	638	400	10.0	18.0	22.3
RTI Concentration	Date	7/24/79	7/24/79	7/24/79	7/24/79	11/8/82	11/18/82	1/23/86	1/23/86
	ppm	(14.6)	(411)	(6.38)	(678)	(413)	(10.8)	(15.0)	(20.2)
	Day	185	185	185	185	134	139	532	532
	ppm	(12.7)	(416)	(3.35)	(699)	(410)	(11.7)	(15.7)	(20.2)
	Day	349	349	349	349	787	787		
	ppm	(13.2)	(441)	(2.87)	(703)	(421)	(10.8)		
	Day	841	841	841	841	1172	1162		
	ppm	(9.96)	(397)	(4.05)	(667)	(424)	(9.14)		
	Day	**	**	**	**	1786	1704		
	ppm					(384)	(9.87)		

*Al = Aluminum; S = Steel; LS= Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, Porapak Q column at 225 degrees Celsius.

CALIBRATION: A pressure-dilution technique is used to make a series of standards from reagent grade acrylonitrile.

ANALYTICAL PROBLEMS: The large changes noted at the low concentration levels are, at least in part, a result of difficulty in making precise measurements at these levels.

26.0 ANILINE STABILITY STUDY

		26A	26B
Cylinder No.		26A	26B
Cylinder Construction*		Al	Al
Manufacturer Concentration	ppm	11.3	18.4
RTI Analysis		See Analytical Problems	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 250 degrees Celsius.

CALIBRATION: Reagent grade "Aniline" pure liquid is used as a standard. "Glass bulb" dilution technique is utilized for making series of standards for calibration.

ANALYTICAL PROBLEMS: Because aniline has an extremely high boiling point (186°C), special handling would be required to measure this compound. A completely heated system for sampling in the vapor phase and for preparing standards would be required. Temperature-dependent condensation in the cylinder and the regulator causes the amount of aniline which is delivered by the cylinder to vary. As a result, aniline is not considered to be practical as an audit material.

27.0 4-METHYL-2-PENTANONE (METHYL ISOBUTYL KETONE) STABILITY STUDY

Cylinder No.*		27A	27C
Cylinder Construction*		Al	Al
Manufacturer Concentration	ppm	9.51	72.9
RTI Concentration	Date	12/18/80	7/8/81
	ppm	(10.2)	(75.4)
	Day	27	See Analytical Problems
	ppm	(10.6)	
	Day	83	
	ppm	(9.53)	
	Day	202	
	ppm	(9.49)	
	Day	1275	
	ppm	(8.40)	
	Day	1643	
	ppm	(10.3)	
	Day	1946	
	ppm	(10.2)	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 0.1% SP-1000 on Carbopack C column at 180 degrees Celsius.

CALIBRATION: A pressure-dilution technque is utilized for making a series of standards from reagent grade methyl isobutyl ketone.

ANALYTICAL PROBLEMS: Methyl isobutyl ketone at high concentrations is not practicas as an audit material because pressurization of the cylinder above approximately 200 psi results in condensation of the analyte.

28.0 CYCLOHEXANONE STABILITY STUDY

Cylinder No.		28A	28B
Cylinder Construction*		Al	Al
Manufacturer Concentration	ppm	10.1	19.0
RTI Analysis	Date	12/11/80	12/11/80
	ppm	(8.19)	(25.5)
	Day	85	85
	ppm	(3.26)	(17.1)
		See Analytical Problems.	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% SP-1000 on Supelcoport column at 200 degrees Celsius.

CALIBRATION: Reagent grade "Cyclohexanone" liquid is used as a standard. Pressure-dilution technique is used for making series of standards for calibration.

ANALYTICAL PROBLEMS: The analysis of cyclohexanone gas is dependent on the temperatures of the cylinder and the regulator and on the length of the sampling line between the regulator and the gas chromatograph. The concentration in the cylinder decreases with time. Therefore, cyclohexanone is not practical as an audit material.

29.0 PARADICHLOROBENZENE STABILITY STUDY

Cylinder No.		29A	29B
Cylinder Construction*		S	S
Manufacturer Concentration	ppm	15.6	38.1
RTI Analysis		See Analytical Problems	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% SP-1000 on Supelcoport column at 200 degrees Celsius.

CALIBRATION: Reagent grade "Paradichlorobenzene" is used as a standard. "Glass bulb" technique is used for making series of standards for calibration.

ANALYTICAL PROBLEMS: The stability study for this compound was terminated bacause of analytical difficulties and because the cylinder pressure was less than 200 psig. Paradichlorobenzene is a solid at room temperature with a melting point of 54°C. Condensation in the cylinder, regulator and sampling lines was extreme. Paradichlorobenzene is not practical as an audit material.

30.0 ETHYLAMINE STABILITY STUDY

Cylinder No.		30A	30B
Cylinder Construction*		S	S
Manufacturer Concentration	ppm	10	20
RTI Analysis		See Analytical Problems	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 250 degrees Celsius.

CALIBRATION: Reagent grade "Ethylamine" liquid is used as a standard. "Glass bulb" technique is utilized for making series of standards for calibration.

ANALYTICAL PROBLEMS: Because of vapor pressure considerations, the cylinders could not be fully pressurized. The pressure in the cylinder is less than 200 psi. A completely heated system for sampling in the vapor phase and for preparing standards would be required. Temperature-dependent condensation in the cylinder and the regulator causes the amount of ethylamine which is delivered by the cylinder to vary. As a result of these problems, ethylamine is not considered to be practical as an audit material.

31.0 FORMALDEHYDE STABILITY STUDY

RTI Requested Concentration	ppm	10	20

The speciality gas supplier indicated that they could not make gas mixtures containing formaldehyde.

32.0 DICHLOROMETHANE (METHYLENE CHLORIDE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		32A / Al	32B / Al	32C / Al	32D / Al
Manufacturer Concentration	ppm	10.2	1.25	6.13	9.94
RTI Concentration	Date	3/5/82	1/27/86	1/27/86	9/28/87
	ppm	(10.8)	(1.13)	(6.01)	(10.2)
	Day	31	528	528	
	ppm	(10.8)	(1.37)	(5.92)	
	Day	70			
	ppm	(10.6)			
	Day	96			
	ppm	(11.2)			
	Day	124			
	ppm	(11.4)			
	Day	160			
	ppm	(10.9)			
	Day	278			
	ppm	(10.2)			
	Day	381			
	ppm	(9.70)			
	Day	843			
	ppm	(9.20)**			
	Day	1198			
	ppm	(11.5)**			
	Day	1449			
	ppm	(10.4)			
	Day	***			
	ppm				

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

***Cylinder empty.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 100 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade methylene chloride.

33.0 TETRACHLOROMETHANE (CARBON TETRACHLORIDE) STABILITY STUDY

Cylinder No.		33A	33B	33C	33D
Cylinder Construction*		AL	Al	Al	Al
Manufacturer Concentration	ppm	11.3	23.3	5.82	18.6
	Date	3/4/82	1/16/86	1/16/86	1/16/86
	ppm	(12.7)	(21.8)	(5.88)	(18.1)
	Day	74	540	540	540
	ppm	(11.7)	(22.0)	(6.35)	(18.3)
	Day	74			
	ppm	(10.2)			
	Day	98			
	ppm	(11.1)			
RTI Concentration	Day	124			
	ppm	(10.6)			
	Day	161			
	ppm	(10.2)			
	Day	382			
	ppm	(10.5)			
	Day	832			
	ppm	(9.60)**			
	Day	1199			
	ppm	(12.2)			
	Day	1414			
	ppm	(10.6)			
	Day	1954			
	ppm	(11.3)			

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 100 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade carbon tetrachloride.

34.0 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (FREON 113) STABILITY STUDY

Cylinder No. Cylinder Construction*		34A Al
Manufacturer Concentration	ppm	10.4
RTI Concentration	Date ppm	3/3/82 (10.8)
	Day ppm	34 (10.1)
	Day ppm	70 (10.0)
	Day ppm	70 (9.60)
	Day ppm	98 (10.0)
	Day ppm	125 (10.0)
	Day ppm	162 (10.3)
	Day ppm	384 (9.80)
	Day ppm	857 (11.0)
	Day ppm	1200 (8.79)
	Day ppm	1506 (10.0)
	Day ppm	2036 (9.68)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column of 75 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade Freon 113.

35.0 1,1,1-TRICHLOROETHANE (METHYL CHLOROFORM) STABILITY STUDY

Cylinder No.		35A
Cylinder Construction*		Al
Manufacturer Concentration	ppm	10.2
RTI Concentration	Date	3/2/82
	ppm	(10.3)
	Day	70
	ppm	(11.8)
	Day	99
	ppm	(10.7)
	Day	136
	ppm	(10.6)
	Day	161
	ppm	(10.0)
	Day	381
	ppm	(10.4)
	Day	858
	ppm	(10.0)
	Day	1514
	ppm	(10.7)
	Day	2033
	ppm	(10.5)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 80 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade methyl chloroform.

36.0 1,2-EPOXYETHANE (ETHYLENE OXIDE) STABILITY STUDY

Cylinder No.		36A	36B	36C	36D	36E
Cylinder Construction*		Al	Al	Al	Al	Al
Manufacturer Concentration	ppm	10.0	1.0	4.5	14	19.0
RTI Concentration	Date	3/12/82	9/16/85	9/16/85	9/16/85	9/16/85
	ppm	(11.2)	(1.19)	(4.75)	(14.3)	(18.6)
	Day	73	78	78	78	78
	ppm	(9.60)	(0.868)	(4.35)	(14.2)	(17.7)
	Day	88	722	722	722	722
	ppm	(9.80)	(1.59)**	(4.68)	(14.9)	(18.5)
	Day	122				
	ppm	(9.60)				
	Day	157				
	ppm	(9.80)				
	Day	1012				
	ppm	(9.70)				
	Day	1362				
	ppm	(9.09)				
	Day	2006				
	ppm	(10.0)				

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 6 ft. x 1/8" SS column packed with 80/100 mesh Porapak QS at 150 degrees Celsius.

CALIBRATION: Ethylene oxide permeation tube is used for GC-FID calibration. Permeation tube is maintained at 30 degrees Celsius.

37.0 1,2-EPOXYPROPANE (PROPYLENE OXIDE) STABILITY STUDY

Cylinder No. / Cylinder Construction*		37A / Al	37B / Al
Manufacturer Concentration	ppm	9.48	96.0
RTI Concentration	Day	8/4/82	8/4/82
	ppm	(12.3)	(89.5)
	Day	55	55
	ppm	(11.8)	(86.9)
	Day	76	76
	ppm	(10.6)	(83.6)
	Day	743	121
	ppm	(8.10)**	(90.8)
	Day	844	743
	ppm	(9.24)	(75.7)**
	Day	1057	844
	ppm	(9.65)	(82.8)**
	Day	1357	1057
	ppm	(10.2)	(91.7)
	Day	1882	1357
	ppm	(10.7)	(95.2)
	Day		1882
	ppm		(98.2)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 120 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade propylene oxide.

38.0 3-CHLOROPROPENE (ALLYL CHLORIDE) STABILITY STUDY

Cylinder No.		38A	38B	38C	38D
Cylinder Construction*		S	S	S	S
Manufacturer Concentration	ppm	10.2	99.5	8.7	92.4
RTI Concentration	Date	8/13/82**	8/13/82**	4/24/85**	4/30/85
	ppm	(11.6)	(124)	(8.99)	(95.7)
	Day	75	74	364	358
	ppm	(5.25)	(87.2)	(6.14)	(94.2)
	Day	110	110	808	803
	ppm	(5.08)	(87.7)	(5.50)	(86.9)
	Day	167	167		
	ppm	(5.36)	(83.4)		
	Day	727	727		
	ppm	(4.53)	(53.6)		
		***	***		

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Initial analysis was questionable

***Returned due to impurities.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 Chromosorb WHP column at 135 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade allyl chloride.

39.0 PROPENAL (ACROLEIN) STABILITY STUDY

Cylinder No.		39A	39B
Cylinder Construction*		Al	Al
Manufacturer Concentration	ppm	10.2	107
RTI Concentration	Date	8/18/82	8/18/82
	ppm	(10.6)	(90.4)
	Day	28	28
	ppm	(11.0)	(103)
	Day	69	69
	ppm	(9.74)	(106)
	Day	728	728
	ppm	(6.90)**	(80.8)**
	Day	833	833
	ppm	(8.97)	(97.3)
	Day	1031	1031
	ppm	(9.11)	(98.4)
	Day	1346	1346
	ppm	(9.19)	(108)
	Day	1791	1791
	ppm	(8.78)	(94.7)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade acrolein.

40.0 CHLOROBENZENE STABILITY STUDY

		40A	40B	40C
Cylinder No.		40A	40B	40C
Cylinder Construction*		S	Al	Al
Manufacturer Concentration	ppm	9.66	14.8	4.89
RTI Concentration	Date	8/6/82	10/11/83	10/11/83
	ppm	(9.03)	(14.7)	(4.19)
	Day	39	612	612
	ppm	(9.15)	(13.4)	(4.74)
	Day	75	1059	1059
	ppm	(9.20)	(14.4)	(5.01)
	Day	380	1375	1375
	ppm	(9.62)	(12.9)	(4.61)
	Day	1043		
	ppm	(8.11)**		
	Day	1490		
	ppm	(9.22)		
	Day	1806		
	ppm	(8.50)		

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detection, 10% OV-101 on Chromosorb WHP column at 200 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade chlorobenzene.

41.0 CARBON DISULFIDE STABILITY STUDY

Cylinder No.		41A	41B
Cylinder Construction*		Al	Al
Manufacturer Concentration	ppm	108	108
RTI Concentration	Date	7/14/82	2/21/85
	ppm	(100)	(101)
	Day	34	110
	ppm	(114)	(98.0)
	Day	72	477
	ppm	(116)	(104)
		**	**

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Cylinder empty.

ANALYTICAL CONDITIONS: Flame photometric detector, 4.6' X 1/4" Teflon® column packed with Carbopack B HT 100 at 75 degrees Celsius.

CALIBRATION: A pressure-dilution technique is used for making a series of standards from reagent grade carbon disulfide.

ANALYTICAL PROBLEMS: There is significant peak "tailing" unless a very high flow rate is used. "Tailing" is also caused by "bleed" from the sample loop. Sample valve should be in the inject position for exactly 5 seconds and then switched back to the sampling position to attenuate tailing. All sample lines and regulators must be conditioned extensively.

42.0 EPA METHOD 25 GAS MIXTURE STABILITY STUDY*

Cylinder No. / Cylinder Construction***		42A Al	42B Al	42C Al	42D Al	42E Al	42F Al
Manufacturer Concentration	ppmC	100	100	200	750	1000	2000
RTI Concentration	Date	3/16/83	3/16/83	3/16/83	3/16/83	3/16/83	3/16/83
	ppmC	(102)	(107)	(205)	(775)	(1040)	(1940)
	Day	483	483	**	483	483	483
	ppmC	(97.9)	(104)		(779)	(1060)	(1930)
	Day	**	**		726	726	726
	ppmC				(765)	(1020)	(1930)
	Day				1079	1079	**
	ppmC				(806)	(1093)	
	Day				1657	**	
	ppmC				(826)		

*Gas Mixture contains an aliphatic hydrocarbon, an aromatic hydrocarbon, and carbon dioxide in nitrogen.

**Cylinder empty.

***Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, aliphatic hydrocarbon and aromatic hydrocarbon, 10% OV-101 on Chromosorb WHP column at 100 degrees Celsius.

CALIBRATION: An NBS-SRM is used as a standard for the aliphatic hydrocarbon. A pressure-dilution technique is utilized for generation of a series of standards from reagent grade liquid for the aromatic hydrocarbon.

Cylinder No. / Cylinder Construction***		42G / Al	42H / Al	42I / Al	42J / Al	42K / Al	42L / Al
Manufacturer Concentration	ppmC	96.7	98.6	147.6	151	198	197.5
RTI Concentration	Date	12/11/84	12/11/84	12/11/84	12/11/84	12/11/84	12/11/84
	ppmC	(96.4)	(98.9)	(149)	(153)	(195)	(195)
	Day	90	90	90	90	192	90
	ppmC	(95.8)	(93.3)	(144)	(145)	(183)****	(187)
	Day	443	443	443	443	443	443
	ppmC	(99.2)	(99.6)	(146)	(149)	(196)	(196)
	Day	**		948	948	948	1021
	ppmC			(163)	(161)	(210)	(206)

*Gas Mixture contains an aliphatic hydrocarbon, an aromatic hydrocarbon, and carbon dioxide in nitrogen.

**Cylinder empty.

***Al = Aluminum; S = Steel; LS = Low Pressure Steel.

****Questionable value.

42.0 EPA METHOD 25 GAS MIXTURE STABILITY STUDY* (Continued)

Cylinder No. / Cylinder Construction***		42M / Al	42N / Al
Manufacturer Concentration	ppmC	1973	1970
RTI Concentration	Date	9/4/86	9/4/86
	ppmC	(1968)	(1904)
	Day	316	316
	ppmC	(1982)	(1989)

*Gas Mixture contains an aliphatic hydrocarbon, an aromatic hydrocarbon, and carbon dioxide in nitrogen.

**Cylinder empty.

***Al = Aluminum; S = Steel; LS = Low Pressure Steel.

43.0 1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) STABILITY STUDY

Cylinder No.		43A	43B	43C	43D
Cylinder Construction*		S	S	S	S
Manufacturer Concentration	ppm	10	20	100	300
RTI Concentration	Date	10/24/84	10/24/84	10/24/84	10/24/84
	ppm	(9.3)	(17.5)	(96.1)	(266)
	Day	54	54	55	55
	ppm	(9.3)	(17.5)	(107)	(344)**
	Day	243	243	243	516
	ppm	(8.66)	(15.4)	(84.0)	(250)
	Day	516	518	518	994
	ppm	(9.27)	(15.9)	(75.1)	(262)
	Day	994	994	994	
	ppm	(9.70)	(16.4)	(83.6)	

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

**Questionable value.

ANALYTICAL CONDITIONS: Flame ionization detector, 10% OV-101 on Chromosorb WHP column at 150 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade ethylene dibromide.

44.0 1,1,2,2-TETRACHLOROETHANE STABILITY STUDY

Cylinder No.		44A
Cylinder Construction*		S
Manufacturer Concentration	ppm	12.2
RTI Concentration	Date	10/9/84
	ppm	(11.6)
	Day	533
	ppm	(10.9)
	Day	1085
	ppm	(10.5)

*Al = Aluminum; S = Steel; LS = Low Pressure Steel.

ANALYTICAL CONDITIONS: Flame ionization detector, 5% OV-101 on Chromosorb WHP column at 100 degrees Celsius.

CALIBRATION: A pressure-dilution technique is utilized for making a series of standards from reagent grade 1,1,2,2-tetrachloroethane.