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7. Abstract Tank 241-TY-101 headspace gas and vapor samples were collected and analyzed to help determine the potential risks to tank farm workers due to fugitive emissions from the tank. The drivers and objectives of waste tank headspace sampling and analysis are discussed in "Program Plan for the Resolution of Tank Vapor Issues" (Osborne and Huckaby 1994). Tank 241-TY-101 was vapor sampled in accordance with "Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution (Osborne et al., 1994).		

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Tank 241-TY-101 Vapor Sampling and Analysis Tank Characterization Report

X.0 INTRODUCTION

Tank TY-101 headspace gas and vapor samples were collected and analyzed to help determine the potential risks of fugitive emissions to tank farm workers. The drivers and objectives of waste tank headspace sampling and analysis are discussed in *Program Plan for the Resolution of Tank Vapor Issues* (Osborne and Huckaby 1994). The tank TY-101 headspace was sampled in accordance with *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution* (Osborne et al. 1994).

X.1 SAMPLING EVENT

Headspace gas and vapor samples were collected from tank TY-101 using the vapor sampling system (VSS) on April 6, 1995 by WHC Sampling and Mobile Laboratories (WHC 1995). Sample collection and analysis were performed as directed by *Tank 241-TY-101 Tank Characterization Plan* (Homi 1995). The tank headspace temperature was determined to be 15.6 °C. Air from the tank TY-101 headspace was withdrawn from a single elevation via a 5.5-m long heated sampling probe mounted in riser 3, and transferred via heated tubing to the VSS sampling manifold. All heated zones of the VSS were maintained at approximately 40 °C. All tank air samples were collected between 10:14 a.m. and 1:59 p.m., with no anomalies noted.

Sampling media were prepared and analyzed by WHC, Oak Ridge National Laboratories (ORNL), and Pacific Northwest Laboratories (PNL). The 40 tank air samples and 2 ambient air control samples collected are listed in Table X-1 by analytical laboratory. Table X-1 also lists the 14 trip blanks and 14 field blanks provided by the laboratories.

A general description of vapor sampling and sample analysis methods is given by Huckaby (1995). The sampling equipment, sample collection sequence, sorbent trap sample air flow rates and flow times, chain of custody information, and a discussion of the sampling event itself are given in WHC 1995 and references therein.

X.2 INORGANIC GASES AND VAPORS

Analytical results of sorbent trap and SUMMA^{TM,1} canister tank air samples for selected inorganic gases and vapors are given in Table X-2 in parts per

¹ SUMMA is a trademark of Molectrics, Inc., Cleveland, Ohio.

million by volume (ppmv). Inorganic analyte sorbent traps and SUMMA™ canisters were prepared and analyzed by PNL (Klinger et al. 1995).

X.2.1 Ammonia, Hydrogen, and Nitrous Oxide

The reported ammonia concentration, 16 ppmv, is less than the National Institute of Occupational Safety and Health (NIOSH) 8-hr recommended exposure limit (REL) of 25 ppmv for ammonia (NIOSH 1995). Ammonia has been observed in virtually all of the passively ventilated waste tanks sampled to date, at concentrations ranging from about 3 ppmv in tank C-108 (Lucke et al. 1995), to 1040 ppmv in BY-108 (McVeety et al. 1995).

The concentration of hydrogen in tank TY-101 was determined to be < 93 ppmv. Hydrogen in the waste tanks is of concern as a fuel. Given that the lower flammability limit (LFL) for hydrogen in air is about 4 % by volume, a 93 ppmv hydrogen concentration in tank TY-101 would correspond to about 0.23 % of its LFL. At this level, hydrogen is not a flammability concern in tank TY-101.

The reported nitrous oxide concentration in tank TY-101, 98 ppmv, is typical of other waste tanks sampled to date. It is about 4 times the NIOSH 8-hr REL of 25 ppmv for nitrous oxide (NIOSH 1995). Nitrous oxide, also known as laughing gas, has been detected in other passively ventilated waste tanks at average concentrations as low as about 9.4 ppmv in tank C-110 (Rasmussen 1994a), and as high as 763 ppmv in tank C-103 (Huckaby and Story 1994).

X.2.2 Carbon Monoxide and Carbon Dioxide

Carbon monoxide in the tank TY-101 headspace, characterized as < 12 ppmv, is below the NIOSH 8-hr REL of 35 ppmv for carbon monoxide. In ambient air it typically ranges from 0.05 to 0.15 ppmv. Because different analytical methods have been used to measure carbon monoxide in the waste tanks sampled to date, the information on carbon monoxide has varied from tank to tank. However, elevated waste tank headspace carbon monoxide concentrations are common, and are thought to be due to the decomposition of organic waste in the tanks. Carbon monoxide has not been measured at very high levels in any of the waste tanks, the highest level measured to date was 26.7 ppmv in tank C-103 (Huckaby and Story 1994).

The carbon dioxide concentration in the tank TY-101 headspace, measured at an average 83 ppmv, is significantly lower than it is in ambient air. Carbon dioxide is normally present in the ambient air at a concentration of 350 to 400 ppmv, and is typically lower than ambient in the waste tank headspaces. The 2 ambient air samples collected at the start of the tank TY-101 gas and vapor sampling event, for example, were measured to have an average 374 ppmv of carbon dioxide.

Carbon dioxide introduced by air exchange with the atmosphere is readily absorbed by caustic supernatant and interstitial liquids of the waste tanks, and converted to carbonate in solution. The 83 ppmv of carbon dioxide in the

tank TY-101 headspace is typical of values for other waste tanks sampled to date.

X.2.3 Nitric Oxide, Nitrogen Dioxide, Water and Tritium

Nitric oxide and nitrogen dioxide concentrations in the tank TY-101 headspace were determined to be 0.11 ppmv and ≤ 0.04 ppmv, respectively. These are acid gases that would have very low equilibrium concentrations above the high pH sludge in tank TY-101. The measurable presence of nitric oxide is not uncommon in the waste tank headspaces, and may be due to its formation from oxygen and nitrogen in the radiation field of the headspace. The NIOSH 8-hr REL is 25 ppmv for nitric oxide, and the 15-minute short term exposure limit (STEL) for nitrogen dioxide is 1 ppmv.

The water vapor concentration of tank TY-101 was determined to be about 10.3 mg/L, at the measured tank headspace temperature of 15.6 °C and pressure of 982.8 mbar (737.3 torr), (WHC 1995). This corresponds to a water vapor partial pressure of 13.7 mbar (10.3 torr), to a dew point of 11.7 °C, and to a relative humidity of 77 %.

Silica gel sorbent traps were used to test for tritium. It is assumed that tritium produced by the waste combines with hydroxide ions to form tritium-substituted water. Evaporation of the tritium-substituted water would then result in airborne radioactive contamination. Silica gel sorbent traps adsorb virtually all (normal and tritium-substituted) water vapor from the sampled tank air, and are analyzed at the WHC 222-S laboratory. Radiochemical analysis of the silica gel trap indicated the total activity of the headspace to be less than 50 pCi/L (WHC 1995).

X.2.4 Discussion of Inorganic Gases and Vapors

Aside from water vapor, the most abundant waste constituents in the tank TY-101 headspace are nitrous oxide and ammonia. These have been detected in most tank headspaces sampled to date and, along with hydrogen, are usually the dominate waste species. The concentration of nitrous oxide in tank TY-101 is typical of the tanks that have been sampled, but the ammonia concentration in TY-101 is relatively low.

The relative standard deviations of the inorganic gas and vapor results given in the last column in Table X-2 are good for the methods used. Relative standard deviations range from 5 % for carbon dioxide to about 18 % for nitric oxide results. The relatively poor precision of the nitric oxide results is probably due to the variability of background contamination present in the sorbent traps. Because the precision reported depends both on sampling parameters (e.g., sample flow rate and flow time for sorbent traps) and analytical parameters (e.g., sample preparation, dilutions, etc.), small relative standard deviations suggest proper control was maintained both in the field and in the laboratories.

X.3 ORGANIC VAPORS

Organic vapors in the tank TY-101 headspace were sampled using SUMMATM canisters, which were analyzed by PNL, and triple sorbent traps (TSTs), which were analyzed by ORNL. A gas chromatograph (GC) equipped with a mass spectrometer (MS) detector were used by PNL and ORNL to separate, identify, and quantitate the analytes. Descriptions of sample device cleaning, sample preparations, and analyses are given by Jenkins et al. (1995) and Klinger et al. (1995).

SUMMATM sample results should be considered to be the primary organic vapor data for tank TY-101. ORNL analyses of TST samples from this and other waste tanks generally agree with, support, and augment the SUMMATM sample results. However, because certain WHC quality assurance requirements were not satisfied by ORNL, the quality assurance assessment of ORNL by Hendrickson (1995) should be reviewed before results unique to the TST samples are used for decision making.

X.3.1 Positively Identified Organic Compounds

Positive identification of organic analytes using the methods employed by PNL and ORNL involves matching the GC retention times and MS data from a sample with that obtained by analysis of standards. The concentration of an analyte in the sample is said to be quantitatively measured if the response of the GC/MS has been established at several known concentrations of that analyte (i.e., the GC/MS has been calibrated for that analyte), and the MS response to the analyte in the sample is between the lowest and highest responses to the known concentrations (i.e., the analyte is within the calibration range).

ORNL and PNL were assigned different lists of organic compounds, or target analytes, to positively identify and measure quantitatively. The ORNL target analyte list was derived from a review of the tank C-103 headspace constituents by a panel of toxicology experts (Mahlum et al. 1994). The PNL target analyte list included 39 compounds in the Environmental Protection Agency (EPA) task order 14 (TO-14) method, which are primarily halocarbons and common industrial solvents (EPA 1988), plus 14 analytes selected mainly from the toxicology panel's review of tank C-103.

Table X-3 lists the organic compounds positively identified and quantitated in SUMMATM samples. SUMMATM analyses were performed according to the TO-14 methodology, except for methane analysis, which was analyzed with the inorganic gases (Klinger et al. 1995). Only 2 of the 39 TO-14 target analytes (trichlorofluoromethane and tetrachloromethane) and only 4 of the 14 additional target analytes were measured to be above the 0.005 ppmv detection limit of the analyses. Averages reported are from analyses of 3 SUMMATM canister samples.

Jenkins et al. (1995) report the positive identification of 23 of the 27 target analytes in TST samples. Dichloromethane, n-heptane, dibutyl butylphosphonate, and tributyl phosphate were the only TST target analytes not

detected. The average concentrations of the detected target analytes, from the analysis of 4 TSTs, are given in Table X-4. Despite calibration of the instrument over about a 20-fold concentration range, 17 of the 23 compounds listed in Table X-4 were outside of the calibration range in at least 2 of the TST samples.

Both PNL and ORNL report target analyte concentrations in ppmv of analyte in dry air. To correct for the measured water vapor content of tank TY-101 and obtain concentration in ppmv of analyte in moist tank air, multiply the dry-air ppmv concentrations by 0.986.

Eleven target analytes were common to both TST and SUMMATM analyses. Table X-5 lists these, and their reported average concentrations in TST and SUMMATM samples. Results from these 2 sampling and analytical methods agree fairly well. As indicated in Table X-5, the reported concentrations of acetone, acetonitrile, and propanenitrile are higher in SUMMATM samples than in TST samples. However, the target analytes are generally only present at very low concentrations, and none are near levels of concern. Benzene, propanenitrile, and acetonitrile have the lowest NIOSH RELs of the 11 compounds in Table X-5, being 0.1, 6, and 20 ppmv, respectively.

The only analyte in either Tables X-3 or X-4 above 0.1 ppmv is acetone, measured to be an average 0.14 ppmv in SUMMATM samples. At the reported concentrations, the target analytes do not individually or collectively represent a flammability hazard.

X.3.2 Tentatively Identified Organic Compounds

In addition to the target analytes, the ORNL and PNL analytical procedures allow the tentative identification of other organic compounds. Tentative identification of analytes was performed by comparing the MS molecular fragmentation patterns with a library of known MS fragmentation patterns. This method allows an organic analyte to be identified (with reasonable certainty) as an alkane, a ketone, an aldehyde, etc., and may also determine its molecular weight. The method usually does not, however, allow the unambiguous identification of structural isomers, and this ambiguity increases with analyte molecular weight. Many analytes can be tentatively identified with reasonable confidence without having to inject standards of each into the GC/MS to determine their GC retention times or specific MS patterns.

By the nature of the sampling devices, virtually all organic vapors present in the tank headspace are collected by both TST and SUMMATM samples. Analyses of the samples are designed to recover, separate, and identify the organic vapors in the samples. TSTs are not good for collecting highly volatile compounds (i.e., molecules more volatile than propane), but are quite good for most others. In contrast, the recovery of very low volatility compounds (i.e., molecules with more than about 15 carbon atoms) and some polar compounds with moderate volatility (i.e., butanal) from SUMMATM samples has been problematic.

The sole tentatively identified compound reported in SUMMA™ samples, methanol, with its estimated concentration, is given in Table X-6. The list of tentatively identified compounds detected in TST samples, and their estimated concentrations, is given in Table X-7. Compounds are listed in Table X-7 according to the order by which they eluted chromatographically. The averages reported by ORNL in Table X-7 are all 4-sample averages, and if an analyte was not detected in a sample, its concentration in that sample was considered to be zero for averaging purposes. Estimated concentrations are in mg/m^3 , based on dry air at 0 °C and 1.01 bar.

The ORNL and PNL methods used to tentatively identify and estimate concentrations are described by Jenkins et al. (1995) and Klinger et al. (1995), respectively, and should be reviewed before this data is used for decision making. Concentrations given in Tables X-6 and X-7 should be considered rough estimates.

X.3.4 Discussion of Organic Compounds

The organic compounds listed in Tables X-3 through X-7 may be classified as either 1) organic compounds added to tank TY-101 as waste that are still evaporating, or 2) organic compounds that have been generated by reactions of the original waste.

The first category encompasses all organic compounds that were placed into the tank as waste. It includes the semivolatile straight-chain alkanes, which were used as diluents of tributyl phosphate in various plutonium extraction processes. These alkanes (i.e., n-undecane, n-dodecane, n-tridecane, n-tetradecane, and n-pentadecane) are often referred to in Hanford site literature as the normal paraffinic hydrocarbons (NPHs). Though NPHs are positively identified in tank TY-101, their concentrations are very low compared to other NPH-rich tanks in the 241-BY and 241-C farms.

The tentatively identified cyclosiloxanes (i.e., Cmpd # 17 and 24 in Table X-7) may also have been sent to tank TY-101 with other wastes. Small quantities of organo-silicon compounds may have been introduced to the waste tank through their use as defoaming agents, but they may also be present in the headspace due to their use in liquid traps at the tank's breather riser. Several of these have been observed in TST blanks, however, and they may be present as artifacts of the gas chromatography process. Chlorotrimethylsilane (Cmpd # 5 in Table X-7) reacts very rapidly with water, and it is not reasonable to think it actually exists in the TY-101 headspace.

The absence of tributyl phosphate in the tank TY-101 samples does not necessarily indicate it is not present in the headspace or the waste. The identification of the tributyl phosphate diluents and their degradation products is reason to expect tributyl phosphate may be present in the tank waste. 1-Butanol, which was positively identified in tank TY-101 TST samples, is known to be a product of the hydrolysis of tributyl phosphate. Furthermore, informal tests by ORNL indicate that tributyl phosphate is adsorbed by the glass fiber filters used during sampling to protect the

samples from radiolytic particulate contamination. Based on these considerations, the lack of tributyl phosphate in the tank TY-101 headspace samples should not be taken as proof it is not present in the headspace or the waste.

A relatively large number of halogenated organic compounds were detected in samples from tank TY-101, including dichlorofluoromethane, trichlorofluoromethane (which is frequently detected in the waste tanks), tetrachloromethane, 1,1,1-trichloroethane, and tetrachloroethene. These compounds may have been used as cleaning solvents and may have been sent to the waste tanks when they became radiologically contaminated. Cmpd # 40 in Table X-7 (2,3,3',5'-tetrachloro-1,1'-biphenyl) is a polychlorinated biphenyl (PCB).

The second category includes all organic compounds that have been generated via radiolytic and chemical reactions of the waste. The majority of compounds listed in Tables X-3 through X-7 fall into this category, including the alcohols, aldehydes, alkenes, ketones, nitriles, and volatile alkanes, all of which have been associated with the degradation of the NPHs.

The total organic vapor concentration of tank TY-101 was estimated by Jenkins et al. to be about 1.0 mg/m^3 from the analysis of 3 TST samples by GC/MS. A similar summation of organic compounds measured in SUMMATM samples from tank TY-101 provides an estimated total organic vapor concentration of 1.65 mg/m^3 .

Though these estimated total organic vapor concentrations are not completely equivalent to the total nonmethane organic compound (TNMOC) concentration obtained using the EPA task order 12 (TO-12) method, they are comparable. TNMOC measurements of other waste tanks have ranged from as high as about $5,000 \text{ mg/m}^3$ in tank C-103 (Rasmussen and Einfeld 1994), to as low as 0.18 mg/m^3 in tank C-111 (Rasmussen 1994b), while the TNMOC concentration of clean ambient air ranges from about 0.03 to 0.1 mg/m^3 . This comparison indicates that the organic vapor concentrations in tank TY-101 are relatively low.

The organic vapors in tank TY-101 clearly indicate the presence of the semivolatile NPHs and their degradation products in the tank waste, though the NPHs are at trace levels. Tributyl phosphate was not detected in any of the headspace samples, but there is strong evidence that it is also present in the waste.

Table X-1
Tank TY-101 Gas and Vapor Sample Type and Number

Laboratory	Sampling Device	Nominal Sample Volume (L)	Target Analytes	Number of Samples
Oak Ridge National Laboratories	Triple Sorbent Trap	0.2, 1.0, and 4.0	Organic vapors	12 tank air samples, + 2 trip blanks + 2 field blanks
Pacific Northwest Laboratories	Acidified Carbon Sorbent Trap	3.0	Ammonia	6 tank air samples + 3 trip blank
	Triethanolamine Sorbent Trap	3.0	Nitrogen Dioxide	6 tank air samples + 3 trip blank
	Oxidation Bed + Triethanolamine Sorbent Trap	3.0	Nitric Oxide	6 tank air samples + 3 trip blank
	Silica Gel Sorbent Trap	3.0	Water vapor	6 tank air samples + 3 trip blanks
	SUMMA™ canister	6.0	Carbon Dioxide, Carbon Monoxide, Hydrogen, Methane, Nitrous Oxide, Organic vapors	3 tank air samples + 2 ambient air samples
WHC 222-S Laboratory	Silica Gel Sorbent Trap	1.0	Tritium-Substituted Water Vapor	1 tank air sample

Table X-2
Tank TY-101 Inorganic Gas and Vapor Concentrations

Compound	CAS ¹ number	Sample Type	Number of samples	Average (ppmv)	Standard Deviation (ppmv)	RSD ² (%)
Ammonia, NH ₃	7664-41-7	Sorbent Trap	6	16	1	6
Carbon Dioxide, CO ₂	124-38-9	SUMMA TM	3	83	4	5
Carbon Monoxide, CO	630-08-0	SUMMA TM	3	< 12	--	--
Hydrogen, H ₂	1333-74-0	SUMMA TM	3	< 93	--	--
Nitric Oxide, NO	10102-43-9	Sorbent Trap	6	0.11	0.02	18
Nitrogen Dioxide, NO ₂	10102-44-0	Sorbent Trap	6	≤ 0.04	--	--
Nitrous Oxide, N ₂ O	10024-97-2	SUMMA TM	3	98	6	6
Water Vapor, H ₂ O	7732-18-5	Sorbent Trap	6	14,000 (10.3 mg/L)	200 (0.1 mg/L)	1.3

1. CAS = Chemical Abstracts Service.

2. RSD = relative standard deviation.

Table X-3
Tank TY-101 Positively Identified Organic Compounds in SUMMA™ Samples

Cmpd #	Compound	CAS ¹ Number	Average (ppmv)	Standard Deviation (ppmv)	RSD ² (%)
1	Ethanenitrile (acetonitrile)	75-05-8	0.079	0.008	10
2	Propanone (acetone)	67-64-1	0.14	0.02	15
3	Trichlorofluoromethane	75-69-4	0.040	0.008	21
4	Propanenitrile	107-12-0	0.006	0.0007	12
5	Tetrachloromethane (carbon tetrachloride)	56-23-5	0.006	0.0001	2
6	2-Butanone ³	78-93-3	0.008	--	--
7	Methane	74-82-8	< 12	--	--
Sum of positively identified compounds:			0.86	mg/m ³	

1. CAS = Chemical Abstract Service.
2. RSD = relative standard deviation.
3. Detected in only 1 sample.

Table X-4
Tank TY-101 Positively Identified Organic Compounds in TST Samples

Cmpd #	Compound	CAS ¹ Number	Average (ppmv)	Standard Deviation (ppmv)	RSD ² (%)
1	Ethanenitrile (acetonitrile)	75-05-8	0.029	0.005	16
2	Propanone ³ (acetone)	67-64-1	0.084	0.011	13
3	1,1-Dichloroethene ³ (vinylidene chloride)	75-35-4	0.0024	0.0020	85
4	Propanenitrile	107-12-0	0.0038	0.0003	8
5	Butanal	123-72-8	0.0071	0.0010	15
6	n-Hexane ³	110-54-3	0.00015	0.00008	57
7	Benzene ³	71-43-2	0.00022	0.00018	81
8	1-Butanol	71-36-3	0.0027	0.0005	19
9	Butanenitrile ³	109-74-0	0.0012	0.0001	9
10	2-Pentanone ³	107-87-9	0.00064	0.00047	73
11	Toluene ³	108-88-3	0.00065	0.00054	82
12	Pentanenitrile ³	110-59-8	0.00036	0.00002	6
13	2-Hexanone ³	591-78-6	0.00033	0.00030	91
14	n-Octane ³	111-65-9	0.000055	0.000038	69
15	Hexanenitrile ³	628-73-9	0.00011	0.00008	67
16	2-Heptanone ³	110-43-0	0.00022	0.00008	38
17	n-Nonane ³	111-84-2	0.00011	0.00008	74
18	Heptanenitrile ³	629-08-3	0.000088	0.000059	67
19	2-Octanone ³	111-13-7	0.000085	0.000057	67
20	n-Decane ³	124-18-5	0.00015	0.00005	32
21	n-Undecane ³	1120-21-4	0.00036	0.00007	20
22	n-Dodecane	112-40-3	0.0041	0.0002	6
23	n-Tridecane	629-50-5	0.015	0.002	15
Sum of positively identified compounds:			0.49 mg/m ³		

1. CAS = Chemical Abstract Service.

2. RSD = relative standard deviation.
3. Two or more samples were outside the calibration range.

Table X-5
Tank TY-101 Comparison of Organic Compounds in TST and SUMMA™ Samples

Compound	CAS ¹ Number	TST Average (ppmv)	SUMMA™ Average (ppmv)
1,1-Dichloroethene (vinylidene chloride)	75-35-4	0.0024	< 0.005
Dichloromethane (methylene chloride)	75-09-2	< 0.0013	< 0.005
Propanone (acetone)	67-64-1	0.084	0.14
Ethanenitrile (acetonitrile)	75-05-8	0.029	0.079
Propanenitrile	107-12-0	0.0038	0.006
Butanenitrile	109-74-0	0.0012	< 0.005
Benzene	71-43-2	0.00022	< 0.005
Toluene	108-88-3	0.00065	< 0.005
n-Hexane	110-54-3	0.00015	< 0.005
n-Heptane	142-82-5	< 0.00011	< 0.005
n-Decane	124-18-5	0.00015	< 0.005

1. CAS = Chemical Abstract Service.

Table X-6
Tank TY-101 Tentatively Identified Organic Compounds in SUMMA™ Samples

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
1	Methanol (methyl alcohol)	67-56-1	0.79	0.14

1. CAS = Chemical Abstract Service.

Table X-7
Tank TY-101 Tentatively Identified Organic Compounds in TST Samples

Cmpd #	Compounds	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
1	Methanol	79-14-1	0.050	0.036
2	Dichlorofluoromethane	75-43-4	0.00077	0.00090
3	Ethanol	64-17-5	0.0020	0.0013
4	Trichlorofluoromethane	75-69-4	0.042	0.009
5	Silane, chlorotrimethyl	75-77-4	0.0064	0.0091
6	2-Propanol (isopropyl alcohol)	67-63-0	0.0090	0.0023
7	Ethane, 1,1,2-trichloro-1, 2-2-trifluoro-	76-13-1	0.00043	0.00086
8	Hydrazine, methyl-	60-34-4	0.0021	0.0016
9	2-Butanone	78-93-3	0.00047	0.00094
10	Trichloromethane (chloroform)	67-66-3	0.00096	0.00111
11	Ethane, 1,1,1-trichloro-	71-55-6	0.00042	0.00084
12	Nitric acid, propyl ester	627-13-4	0.00033	0.00066
13	Propylene Glycol	57-55-6	0.072	0.070
14	Furan, 2,3-dihydro-	1191-99-7	0.00039	0.00078
15	Hexanal	66-25-1	0.0017	0.0012
16	Tetrachloroethylene	127-18-4	0.0080	0.0002
17	Cyclotrisiloxane, hexamethyl	541-05-9	0.036	0.051
18	Heptanal	111-71-7	0.0036	0.0014
19	Pentanol, 5-amino-	2508-29-4	0.0016	0.0011
20	2(3H)-Furanone, dihydro-5-methyl-	108-29-2	0.00036	0.00071
21	Cyclotetrasiloxane, octamethyl	556-67-2	0.017	0.021
22	Octanal	124-13-0	0.0021	0.0015
23	1-Hexanol, 2-ethyl-	104-76-7	0.0015	0.0010
24	2(3H)-Furanone, 5-ethyl-dihydro-	695-06-7	0.0014	0.0009
25	Nonanal	124-19-6	0.0025	0.0017
26	Benzoic acid, 2-[(trimethylsilyl)oxy]-trimethylsilyl ester	3789-85-3	0.0062	0.0090

Cmpd #	Compounds	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
27	3-Dodecene, (E)-	7206-14-6	0.00033	0.00067
28	Decanal	112-31-2	0.00069	0.00080
29	Methenamine	100-97-0	0.024	0.035
30	Cyclohexane, 2-butyl-1,1,3-trimethyl-	54676-39-0	0.0004	0.0007
31	2-Furancarboxylic acid, hexyl ester and others		0.0012	0.0008
32	2,2'-Bioxepane	74793-02-5	0.0015	0.0010
33	n-Tetradecane	629-59-4	0.052	0.004
34	6-Tridecanone	22026-12-6	0.0036	0.0032
35	n-Pentadecane	629-62-9	0.0039	0.0026
36	n-Hexadecane	544-76-3	0.00067	0.00077
37	Isopropyl Myristate	110-27-0	0.0066	0.0133
38	1-Pentadecanol	629-76-5	0.0053	0.0106
39	Benzenesulfonamide, N-butyl	3622-84-2	0.0079	0.0068
40	1,1'-Biphenyl, 2,3,3',5'-tetrachloro-	41464-49-7	0.0037	0.0025
41	Isopropyl Palmitate	142-91-6	0.13	0.26
42	Hexadecanoic acid	57-10-3	0.0034	0.0068
Sum of tentatively identified compounds:			0.51 mg/m ³	

1. CAS = Chemical Abstract Service.

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