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Tank 241-B-103 Vapor Sampling and Analysis Tank Characterization Report (WHC-SD-WM-ER-438)		ECN No.

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7. Abstract

Tank 241-B-103 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-B-103 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-B-103 Vapor Sampling and Analysis Tank Characterization Report

X.0 INTRODUCTION

Tank B-103 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 1995). Tank B-103 was vapor sampled in accordance with *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution* (Osborne et al. 1994). Results presented here represent the best available data on the headspace constituents of tank B-103.

X.1 SAMPLING EVENT

Headspace gas and vapor samples were collected from tank B-103 using the vapor sampling system (VSS) on February 8, 1995 by WHC Sampling and Mobile Laboratories (WHC 1995). Sample collection and analysis were performed as directed by *Tank 241-B-103 Tank Characterization Plan* (the TCP), (Carpenter 1995). The tank headspace temperature was determined to be 15.2 °C. Air from the B-103 headspace was withdrawn from a single elevation via a 7.9-m long heated sampling probe mounted in riser 2, and transferred via heated tubing to the VSS sampling manifold. All heated zones of the VSS were maintained at approximately 50 °C. All tank air samples were collected between 12:03 p.m. and 4:25 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 2 field blanks provided by the laboratories.

A general description of vapor sampling and sample analysis methods is given by Huckaby (1995a). 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™,[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 (Ligotke et al. 1995).

X.2.1 Ammonia, Hydrogen, and Nitrous Oxide

The reported ammonia concentration, 8.8 ppmv, is among the lowest measured in the waste tanks to date. It 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. 1995a), to 1040 ppmv in BY-108 (McVeety et al. 1995).

The concentration of hydrogen in tank B-103 was determined to be < 99 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, 99 ppmv of hydrogen corresponds to about 0.25 % of its LFL. At this level, hydrogen is not a flammability concern in tank B-103.

The nitrous oxide concentration in tank B-103, 77.5 ppmv, is about 3 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 12 ppmv in tank TX-105 (Klinger 1995), 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 B-103 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 reported average carbon dioxide concentration in tank B-103 headspace SUMMA™ samples, 432 ppmv, is higher 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. 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. Typical waste tank carbon dioxide concentrations are in the 20 to 200 ppmv range, however, elevated levels of carbon dioxide have been measured in tanks C-101 and C-107 (Huckaby 1995b, 1995c).

The ambient air SUMMA™ sample collected at the beginning of the tank B-103 sampling event and upwind of the sampling equipment was measured to have 333 ppmv of carbon dioxide, and the ambient air SUMMA™ sample collected using the VSS manifold was measured to have 361 ppmv of carbon dioxide. While the difference between these 2 ambient air carbon dioxide measurements is probably not significant given the analytical method (8 % relative difference), the tank headspace carbon dioxide average result, 432 ppmv, may indeed be significantly above the ambient air results (about 20 % higher than the 361 ppmv ambient air result).

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

Nitric oxide and nitrogen dioxide concentrations in the tank B-103 headspace were determined to be 0.46 ppmv and ≤ 0.02 ppmv, respectively. These are both acid gases that would have very low equilibrium concentrations above the high pH sludge in tank B-103. The measurable presence of nitric oxide 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 B-103 was determined to be about 9.9 mg/L, at the measured tank headspace temperature of 15.2 °C and pressure of 1000 mbar (750.2 torr), (WHC 1995). This corresponds to a water vapor partial pressure of 13.2 mbar (9.9 torr), to a dew point of 11.1 °C, and to a relative humidity of 76 %.

Silica gel sorbent traps were used to sample 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

The relative standard deviations of the inorganic gas and vapor results given in the last column in Table X-2 are very good. Relative standard deviations range from less than 1 % for carbon dioxide to 13 % for nitrous oxide results. 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.), the small relative standard deviations suggest proper control was maintained both in the field and in the laboratories.

Aside from water and carbon dioxide, the most abundant waste constituents in the tank B-103 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 ammonia concentration in tank B-103 is, however, lower than most other tanks sampled to date. The 4 passively ventilated waste tanks sampled to date having the lowest ammonia concentrations are tanks C-108, C-111, B-103, and C-109, which were measured to have 2.7, 5.6, 8.8, and 10.1 ppmv of ammonia, respectively (Lucke et al. 1995a, 1995b, Pool et al. 1995). The waste in each of these tanks is classified as sludge, and none have a total waste inventory of more than 250 kL (250 kL is about 12 % of the capacity of these tanks), (Hanlon 1995). In general, however, there does not appear to be any simple relationship between measured ammonia concentrations and the tank waste type, temperature, or humidity.

X.3 ORGANIC VAPORS

Organic vapors in the tank B-103 headspace were sampled using SUMMA™ canisters, which were analyzed by PNL, and triple sorbent traps (TSTs), which were analyzed by ORNL. Gas chromatography (GC) and mass spectroscopy (MS) 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 Ligotke et al. (1995).

SUMMA™ sample results should be considered to be the primary organic vapor data for tank B-103. ORNL analyses of TST samples from this and other waste tanks generally agree with, support, and augment the SUMMA™ 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 when known compounds were analyzed. 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 SUMMA™ samples. SUMMA™ organic analyses were performed according to the TO-14 methodology, except for methane analysis, which was analyzed with the inorganic gases (Ligotke et al. 1995). Only 1 of the 39 TO-14 target analytes 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 SUMMA™ canister samples.

Jenkins et al. (1995) report the positive identification of 24 of 27 target analytes in TST samples. 1,1-Dichloroethene, dibutyl butylphosphonate, and tributyl phosphate were the only TST target analytes not detected in the TST samples. The average concentrations of the detected target analytes, from the analysis of 3 TSTs, are given in Table X-4. Despite calibration of the instrument over about a 20-fold concentration range, 13 of the compounds listed in Table X-4 were outside of the calibration range in at least 2 of the TST samples.

Eleven target analytes were common to both TST and SUMMA™ analyses. Table X-5 lists these, and their reported average concentrations in TST and SUMMA™ samples. The data given in Table X-5 indicate these methods agree that the 1,1-dichloroethene, dichloromethane, benzene, and n-decane concentrations are below the 0.005 ppmv detection limit of the SUMMA™ sample analysis. The methods are also in fair agreement on the concentration of n-heptane. However, ethanenitrile, propanenitrile, butanenitrile, toluene, and n-hexane were each measured in TST samples to be well above their SUMMA™ sample analysis detection limits. Conversely, SUMMA™ sample analyses indicate over twice as much acetone to be in the headspace as do the TST samples. While the differences are significant in terms of the accuracy specified by the TCP, until the reasons for the discrepancies are determined at the laboratories, it is advisable to use the higher reported results. None of these compounds appear to be at levels of concern. For example, the NIOSH 8-hr RELs for acetone, acetonitrile, and toluene are 250, 20, and 100 ppmv, respectively.

The most abundant analytes in Tables X-3 and X-4 are acetone, tetrahydrofuran, 1-butanol, trichlorofluoromethane, 2-butanone, and n-tridecane, each of which was measured to be at or above 0.1 ppmv. 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 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 SUMMA™ 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 SUMMA™ samples has been problematic.

The list of tentatively identified compounds recovered from SUMMA™ samples, with estimated concentrations, is given in Table X-6. Compounds are listed in Table X-6 in the order by which they eluted chromatographically, and only non-zero results are included in the reported averages. 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 the eluted chromatographically. The averages reported by ORNL in Table X-7 are all 3-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.

Because the list of tentatively identified compounds detected in TST samples is relatively long and difficult to review in Table X-7, the list of compounds has been sorted alphanumerically and is presented in Table X-8. In Table X-8 the "Cmpd #" of the first column is the same as in Table X-7.

The ORNL and PNL methods used to tentatively identify and estimate concentrations are described by Jenkins et al. (1995) and Ligotke et al. (1995), respectively, and should be reviewed before this data is used for decision making. The quantitative measurement of all observed analytes is outside the scope and budget of these analyses, and the estimation of concentrations involves several important assumptions. The validity of each assumption depends on the analyte, and such factors as the specific configuration of the analytical instrumentation.

Concentrations given in Tables X-6 and X-7 should be considered rough estimates. Results in Tables X-6 and X-7 are presented in terms of observed peaks, and are not adjusted for the occurrence of split chromatographic peaks or the assignment of the same identity to different peaks (e.g., Cmpd # 93, 98, and 112 in Table X-7). In these instances, the estimated concentration of a compound appearing in different peaks is simply the sum of the individual peak estimates.

X.3.4 Discussion of Organic Compounds

A convenient way to consider the organic compounds listed in Tables X-3 through X-7 is to separate them into 2 categories: 1) Organic compounds added

to tank B-103 as waste that are still evaporating; and 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 branched and straight-chain alkanes, which were used as diluents of tributyl phosphate in various plutonium extraction processes. The semivolatile straight-chain 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).

The semivolatile alkane character of tank B-103 is different from that of the 241-BY and 241-C farm tanks, which are the best known at this time. Specifically, as is best shown in Table X-8, there are numerous alkyl-substituted cyclohexanes, and the 14-carbon alkanes (i.e., n-tetradecane, methyltridecanes, and dimethyldodecanes) are prominent. Another distinction is that decahydronaphthalene and methyl-substituted decahydronaphthalenes, common in the 241-BY and 241-C farm tanks, are almost undetected in tank B-103, Cmpd # 75 in Table X-7 being the only representative of this class of bicyclics. These differences in the character of the organic vapors are probably due to the different waste histories of these tanks.

The tentatively identified cyclosiloxanes (i.e., Cmpd # 31 and 52 in Table X-7) may also be in the category of waste additions. Small quantities of siloxanes may have been used as surfactants in various processes, and would have been introduced to the waste tank with other wastes. They may also be present in the headspace due to their use in liquid traps at the tank's breather riser.

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, ketones, nitriles, alkenes, alkyl nitrates, volatile alkanes, and very low volatility alkanes, all of which have been associated with the degradation of the NPHs. While both larger and smaller molecules are generated from the waste, the most abundant of these in the headspace are the smaller, short-chain volatile compounds.

The presence of the NPHs and their degradation products in tank B-103 is reason to expect trace amounts of tributyl phosphate to be present in the tank waste. Also, 1-butanol, known to be a product of the hydrolysis of tributyl phosphate, is one of the most abundant organic compounds detected in tank B-103 vapor samples. The low volatility of tributyl phosphate, and its tendency to adsorb on glass fiber filters during sampling, apparently preclude its measurement in the tank B-103 samples. Given these considerations, there is good reason to expect trace levels of tributyl phosphate do exist in the waste and in the headspace, despite the fact that it was not detected in any vapor samples.

The total organic vapor concentration of tank B-103 was estimated by Jenkins et al. to be about 9.8 mg/m^3. This is the summation of concentrations of positively and tentatively identified compounds in 3 TST samples by GC/MS. A similar summation of the positively and tentatively identified organic compounds in SUMMA™ samples provides the estimate of 13.6 mg/m^3. While these estimates 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. TO-12 method TNMOC measurements of other waste tanks have ranged from as high as 5,000 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 1994), while the TNMOC concentration of clean ambient air ranges from about 0.03 to 0.1 mg/m^3.

The tank B-103 headspace has a moderate level of organic vapors compared to other waste tanks sampled to date. While having many of the same organic vapors as NPH-rich tanks, the character of the semivolatile alkanes in tank B-103 differs from that of the 241-BY and 241-C farm waste tanks.

Table X-1
Tank B-103 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 B-103 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	8.8	0.8	9
Carbon Dioxide, CO_2	124-38-9	SUMMA™	3	432	0.6	0.1
Carbon Monoxide, CO	630-08-0	SUMMA™	3	< 12	--	--
Hydrogen, H_2	1333-74-0	SUMMA™	3	< 99	--	--
Nitric Oxide, NO	10102-43-9	Sorbent Trap	6	0.46	0.06	13
Nitrogen Dioxide, NO_2	10102-44-0	Sorbent Trap	6	≤ 0.02	--	--
Nitrous Oxide, N_2O	10024-97-2	SUMMA™	3	77.5	1.6	2.1
Water Vapor, H_2O	7732-18-5	Sorbent Trap	6	13,200 (9.9 mg/L)	350 (0.3 mg/L)	2.7

1. CAS = Chemical Abstracts Service.

2. RSD = relative standard deviation.

Table X-3
Tank B-103 Positively Identified Organic Compounds in SUMMA™ Samples

Cmpd #	Compound	CAS[1] Number	Average (ppmv)	Standard Deviation (ppmv)	RSD[2] (%)
1	Trichlorofluoromethane	75-69-4	0.20	0.03	15
2	2-Butanone	78-93-3	0.14	0.01	4
3	Propanone (acetone)	67-64-1	0.28	0.05	19
4	n-Heptane	142-82-5	0.044	0.0004	1
5	Tetrahydrofuran	109-99-9	0.22	0.001	0.4
6	Methane	74-82-8	< 61	--	--
Sum of positively identified compounds:			3.28	mg/m^3	

1. CAS = Chemical Abstract Service.

2. RSD = relative standard deviation.

Table X-4
Tank B-103 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	0.072	0.014	20
2	Propanone (acetone)	67-64-1	0.13	0.012	9
3	Dichloromethane[3] (methylene chloride)	75-09-2	0.0014	0.0009	66
4	Propanenitrile[3]	107-12-0	0.011	0.002	18
5	Butanal	123-72-8	0.092	0.020	21
6	n-Hexane	110-54-3	0.030	0.001	2
7	Benzene[3]	71-43-2	0.004	0.0003	6
8	1-Butanol[3]	71-36-3	0.20	0.03	16
9	Butanenitrile	109-74-0	0.011	0.002	22
10	2-Pentanone	107-87-9	0.0082	0.0008	9
11	n-Heptane	142-82-5	0.034	0.002	6
12	Toluene	108-88-3	0.011	0.0003	3
13	Pentanenitrile[3]	110-59-8	0.0049	0.0006	13
14	2-Hexanone[3]	591-78-6	0.0041	0.0006	15
15	n-Octane	111-65-9	0.0066	0.0010	15
16	Hexanenitrile[3]	628-73-9	0.0037	0.0004	12
17	2-Heptanone[3]	110-43-0	0.0039	0.0003	9
18	n-Nonane[3]	111-84-2	0.0030	0.0007	23
19	Heptanenitrile[3]	629-08-3	0.0032	0.0002	6
20	2-Octanone[3]	111-13-7	0.0014	0.0001	7
21	n-Decane[3]	124-18-5	0.0031	0.0004	12
22	n-Undecane	1120-21-4	0.013	0.001	10
23	n-Dodecane	112-40-3	0.037	0.004	11
24	n-Tridecane[3]	629-50-5	0.12	0.02	17
Sum of positively identified compounds:			3.4 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 B-103 Comparison of Positively Identified 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	< 0.0023	< 0.005
Dichloromethane (methylene chloride)	75-09-2	0.0014	< 0.005
Propanone (acetone)	67-64-1	0.13	0.28
Ethanenitrile (acetonitrile)	75-05-8	0.072	< 0.005
Propanenitrile	107-12-0	0.011	< 0.005
Butanenitrile	109-74-0	0.011	< 0.005
Benzene	71-43-2	0.004	< 0.005
Toluene	108-88-3	0.011	< 0.005
n-Hexane	110-54-3	0.030	< 0.005
n-Heptane	142-82-5	0.034	0.044
n-Decane	124-18-5	0.0031	< 0.005

1. CAS = Chemical Abstract Service.

Table X-6
Tank B-103 Tentatively Identified Organic Compounds in SUMMA™ Samples

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation[2] (mg/m^3)
1	Propane	74-98-6	0.47	0.07
2	Cyclopropane	75-19-4	0.35	0.06
3	Ethanal (acetaldehyde)	75-07-0	0.22	0.05
4	n-Butane	106-97-8	0.82	0.12
5	2-Methyl-1-propene	115-11-7	0.17	0.02
6	Ethanol[3]	64-17-5	0.12	--
7	Ethanenitrile[3] (acetonitrile)	75-05-8	0.12	--
8	n-Pentane	109-66-0	0.34	0.07
9	Methyl nitrate	598-58-3	0.17	0.11
10	2-Methyl-pentane	107-83-5	0.15	0.004
11	Butanal	123-72-8	0.29	0.01
12	Nitric acid, ethyl ester[3]	625-58-1	0.30	--
13	Formic acid, 2-methyl-propyl ester[4]	542-55-2	0.30	< 0.17
14	1-Butanol	71-36-3	0.99	0.13
15	Nitric acid, propyl ester	627-13-4	0.69	0.01
16	Nitric acid, butyl ester	928-45-0	0.28	0.004
17	3-Heptanone[4]	106-35-4	0.12	< 0.015
18	Unknown Alkyl Nitrate		0.36	0.01
19	n-Undecane	1120-21-4	0.16	0.01
20	n-Dodecane	112-40-3	0.70	0.03
21	2,6-Dimethyl-undecane	17301-23-4	0.15	0.004
22	Unknown Alkane		0.34	0.02
23	n-Tridecane	629-50-5	1.67	0.13
24	Unknown C15 Alkane		0.42	0.04
25	n-Tetradecane	629-59-4	0.95	0.10
26	Unknown C20 Alkane		0.15	0.01

Sum of tentatively identified compounds:	10.27

1. CAS = Chemical Abstract Service.

2. When the analyte was detected in only 2 samples, the entry is the relative difference (i.e., their difference divided by 2).

3. Detected in only one sample.

4. Detected in only two samples.

Table X-7
Tank B-103 Tentatively Identified Organic Compounds in TST Samples

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
1	Cyclopropane	75-19-4	0.056	0.017
2	Isobutane	75-28-5	0.0055	0.0095
3	1-Propene, 2-methyl-	115-11-7	0.078	0.009
4	Butane	106-97-8	0.15	0.02
5	1-Propene, 2-methyl-	115-11-7	0.037	0.010
6	Ethanol	64-17-5	0.039	0.012
7	Butane, 2-methyl-	78-78-4	0.031	0.002
8	Trichlorofluoromethane	75-69-4	0.25	0.11
9	1-Pentene	109-67-1	0.0050	0.0087
10	Methyl nitrate	598-58-3	0.014	0.012
11	Pentane, 2-methyl-	107-83-5	0.039	0.001
12	1-Propanol	71-23-8	0.10	0.02
13	Pentane, 3-methyl-	96-14-0	0.0046	0.0080
14	3-Buten-2-one	78-94-4	0.022	0.002
15	2-Butanone	78-93-3	0.044	0.009
16	Nitric acid, ethyl ester	625-58-1	0.092	0.019
17	Furan, tetrahydro-	109-99-9	0.034	0.003
18	Formic acid, butyl ester	592-84-7	0.012	0.011
19	3-Heptene	592-78-9	0.026	0.007
20	2-Heptene	592-77-8	0.021	0.003
21	2-Heptene, (E)-	14686-13-6	0.021	0.019
22	Cyclopropane, butyl	930-57-4	0.021	0.001
23	Nitric acid, propyl ester	627-13-4	0.090	0.015
24	Propane, 2-methyl-2-nitro-	594-70-7	0.022	0.002
25	Heptane, 3-methyl-	589-81-1	0.048	0.001
26	trans-1-Butyl-2-methylcyclopropane	38851-70-6	0.0036	0.0063

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
27	2-Pentanone, 4,4-dimethyl-	590-50-1	0.0067	0.0059
28	Hexanal	66-25-1	0.0058	0.0100
29	Furan, tetrahydro-2, 4-dimethyl-, trans	39168-02-0	0.014	0.001
30	Tetrachloroethylene	127-18-4	0.036	0.001
31	Cyclotrisiloxane, hexamethyl	541-05-9	0.033	0.008
32	Nitric acid, butyl ester	928-45-0	0.13	0.01
33	Cyclohexane, 1,1,3-trimethyl-	3073-66-3	0.0032	0.0056
34	Cyclopentanone, 2,2,5-trimethyl-	4573-09-5	0.0097	0.0086
35	Ethylbenzene	100-41-4	0.016	0.001
36	Pentane, 2,3-dimethyl-	565-59-3	0.033	0.002
37	p-Xylene	106-42-3	0.043	0.006
38	3-Heptanone	106-35-4	0.084	0.004
39	3-Heptanol	589-82-2	0.070	0.002
40	Benzene, 1,3-dimethyl-	108-38-3	0.015	0.001
41	Heptanal	111-71-7	0.018	0.005
42	1-Heptene	592-76-7	0.013	0.012
43	2,5-Pyrrolidinedione, 1-methyl-	1121-07-9	0.028	0.001
44	1,5-Pentanediol, dinitrate	3457-92-9	0.028	0.001
45	4-Heptanone, 3-methyl-	15726-15-5	0.020	0.001
46	2,2'-Bioxepane	74793-02-5	0.036	0.002
47	2-Pentene, 2,4-dimethyl-	625-65-0	0.037	0.002
48	2-Heptanone, 6-methyl-	928-68-7	0.11	0.01
49	5-Decene, (E)-	7433-56-9	0.015	0.014
50	1-Hexanol, 2-ethyl-	104-76-7	0.011	0.018

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
51	1-Heptanol	111-70-6	0.030	0.003
52	Cyclotetrasiloxane, octamethyl	556-67-2	0.11	0.04
53	.alpha.-Methylstyrene	98-83-9	0.0091	0.0079
54	3-Heptene, 4-propyl-	4485-13-6	0.0042	0.0073
55	Butanoic acid, butyl ester	109-21-7	0.033	0.004
56	Octanal	124-13-0	0.018	0.006
57	1-Decene	872-05-9	0.016	0.003
58	Decane, 4-methyl-	2847-72-5	0.0096	0.0015
59	Nitric acid, hexyl ester	20633-11-8	0.014	0.002
60	1-Hexanol, 2-ethyl-	104-76-7	0.049	0.008
61	2-Pentene, 4,4-dimethyl-, (E) & others		0.013	0.001
62	Tridecane, 4-methyl-	26730-12-1	0.0067	0.0061
63	Nitric acid, pentyl ester	1002-16-0	0.12	0.04
64	5-Undecene, (Z)-	764-96-5	0.0099	0.0012
65	2-Heptanone, 6-methyl-	928-68-7	0.0097	0.0018
66	1-Octanol	111-87-5	0.0062	0.0055
67	3-t-Pentylcyclopentanone and others		0.011	0.003
68	Nonanenitrile	2243-27-8	0.021	0.003
69	Hexyl n-valerate	1117-59-5	0.017	0.001
70	2-Nonanone	821-55-6	0.0062	0.0054
71	Nonanal	124-19-6	0.025	0.005
72	Undecane, 2-methyl-	7045-71-8	0.013	0.001
73	Benzoic acid, 2-[(trimethylsilyl)oxyl]-, trimethylsilyl ester	3789-85-3	0.021	0.019
74	n-Amylcyclohexane	29949-27-7	0.021	0.003

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
75	Naphthalene, decahydro-2-methyl-	2958-76-1	0.011	0.001
76	Undecane, 6-methyl-	17302-33-9	0.011	0.002
77	Undecane, 4-methyl-	2980-69-0	0.010	0.002
78	Decane, 3-methyl-	13151-34-3	0.018	0.002
79	Decane, 3,8-dimethyl-	17312-55-9	0.016	0.002
80	Nonanol	28473-21-4	0.0069	0.0120
81	Nonanenitrile	2243-27-8	0.023	0.003
82	Cyclohexane, 1-methyl-2-pentyl	54411-01-7	0.033	0.004
83	C6-cyclohexane		0.031	0.005
84	Undecane, 2,6-dimethyl-	17301-23-4	0.15	0.02
85	Undecane, 2,4-dimethyl-	17312-80-0	0.030	0.005
86	1-Undecene		0.014	0.002
87	Cyclohexane, 2-butyl-1, 1,3-trimethyl-	54676-39-0	0.054	0.004
88	Cyclohexane, octyl	1795-15-9	0.10	0.01
89	Cyclohexane, 2-butyl-1, 1,3-trimethyl-	54676-39-0	0.012	0.010
90	Dodecane, 4-methyl-	6117-97-1	0.036	0.005
91	Undecane, 2,10-dimethyl-	17301-27-8	0.048	0.006
92	Cyclohexane, 1,1'-(1-methylethylidene)bis-	54934-90-6	0.023	0.001
93	Tridecane, 7-methyl-	26730-14-3	0.26	0.03
94	Cyclohexane, 1,2-diethyl-3-methyl-	50876-32-9	0.033	0.004
95	2(3H)-benzofuranone, 3a,4,5,6-tetrahydro-3a, 6,6-trimethyl	16778-26-0	0.021	0.005
96	3-Undecanone & undecanenitrile		0.0089	0.0079
97	Undecane, 4,8-dimethyl-	17301-33-6	0.012	0.003

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
98	Tridecane, 7-methyl-	26730-14-3	0.024	0.006
99	Tridecane, 6-methyl-	13287-21-3	0.12	0.02
100	Cyclohexane,(2-ethyl-1-methylbutyl)-	74810-41-6	0.0086	0.0084
101	Cyclohexane, 1,1,3-trimethyl-	3073-66-3	0.0039	0.0068
102	Cyclohexane, (1,2-dimethylbutyl)-		0.0055	0.0048
103	Dodecane, 2,5-dimethyl-	56292-65-0	0.031	0.006
104	Tridecane, 4-methyl-	26730-12-1	0.12	0.02
105	Tridecane, 2-methyl-	1560-96-9	0.075	0.012
106	Tetradecane, 4-methyl	25117-24-2	0.064	0.012
107	Dodecane, 4,6-dimethyl-	61141-72-8	0.43	0.06
108	3-Dodecanone	1534-27-6	0.020	0.020
109	Tetradecane	629-59-4	0.72	0.13
110	Tridecane, 4,8-dimethyl-	55030-62-1	0.096	0.010
111	Cyclohexane, 1,1,3- trimethyl-2-(3-methylpentyl)-	54965-05-8	0.091	0.017
112	Tridecane, 7-methyl-	26730-14-3	0.0081	0.0071
113	Tetradecane, 4-methyl-	25117-24-2	0.021	0.004
114	Tetradecane, 3-methyl	18435-22-8	0.029	0.002
115	6-Tridecanone	22026-12-6	0.069	0.013
116	5-Decanol	5205-34-5	0.025	0.007
117	3-Tridecanone	1534-26-5	0.061	0.013
118	Pentadecane	629-62-9	0.31	0.11
119	1,1'-Biphenyl, 3-chloro-	2051-61-8	0.036	0.006
120	3-Octanol, 6-ethyl-	19781-27-2	0.0060	0.0052
121	Hexadecane,7,9-dimethyl-	21164-95-4	0.0083	0.0075
122	Tetradecane, 4,11-dimethyl-	55045-12-0	0.0099	0.0020

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
123	Pentadecane, 2-methyl	1560-93-6	0.0071	0.0062
124	Cyclohexane, octyl-	1795-15-9	0.022	0.028
125	6-Dodecanone	6064-27-3	0.035	0.032
126	6-Dodecanol	6836-38-0	0.014	0.004
127	Hexadecane	544-76-3	0.073	0.024
128	2-Tetradecanone	2345-27-9	0.032	0.009
129	Undecane, 4,6-dimethyl-	17312-82-2	0.014	0.006
130	6-Dodecanone	6064-27-3	0.011	0.004
131	Heptadecane	629-78-7	0.0049	0.0084
132	Hexadecane, 2,6,10,14-tetramethyl-	638-36-8	0.0073	0.0068
133	Tetradecanoic acid	544-63-8	0.022	0.020
134	Nonadecane, 9-methyl-	13287-24-6	0.0079	0.0069
135	Benzenesulfonamide, N-butyl-	3622-84-2	0.018	0.001
136	Pentadecanoic acid	1002-84-2	0.0049	0.0085
137	Hexanedioic acid, mono(2-ethyhexyl) ester	4337-65-9	0.010	0.017
138	Hexadecanoic acid	57-10-3	0.0065	0.0113
139	Isopropyl Palmitate	142-91-6	0.012	0.001
Sum of Tentatively Identified Compounds:			6.35	

1. CAS = Chemical Abstract Service.

Table X-8
Tank B-103 Tentatively Identified Organic Compounds in TST Samples Sorted Alphanumerically

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
53	.alpha.-Methylstyrene	98-83-9	0.0091	0.0079
5	1-Propene, 2-methyl-	115-11-7	0.037	0.010
42	1-Heptene	592-76-7	0.013	0.012
86	1-Undecene		0.014	0.002
60	1-Hexanol, 2-ethyl-	104-76-7	0.049	0.008
3	1-Propene, 2-methyl-	115-11-7	0.078	0.009
66	1-Octanol	111-87-5	0.0062	0.0055
12	1-Propanol	71-23-8	0.10	0.02
9	1-Pentene	109-67-1	0.0050	0.0087
50	1-Hexanol, 2-ethyl-	104-76-7	0.011	0.018
57	1-Decene	872-05-9	0.016	0.003
51	1-Heptanol	111-70-6	0.030	0.003
119	1,1'-Biphenyl, 3-chloro-	2051-61-8	0.036	0.006
44	1,5-Pentanediol, dinitrate	3457-92-9	0.028	0.001
27	2-Pentanone, 4,4-dimethyl-	590-50-1	0.0067	0.0059
70	2-Nonanone	821-55-6	0.0062	0.0054
20	2-Heptene	592-77-8	0.021	0.003
65	2-Heptanone, 6-methyl-	928-68-7	0.0097	0.0018
21	2-Heptene, (E)-	14686-13-6	0.021	0.019
61	2-Pentene, 4,4-dimethyl-, (E) & others		0.013	0.001
48	2-Heptanone, 6-methyl-	928-68-7	0.11	0.01
47	2-Pentene, 2,4-dimethyl-	625-65-0	0.037	0.002
15	2-Butanone	78-93-3	0.044	0.009
128	2-Tetradecanone	2345-27-9	0.032	0.009

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
95	2(3H)-benzofuranone, 3a,4,5,6-tetrahydro-3a, 6,6-trimethyl	16778-26-0	0.021	0.005
46	2,2'-Bioxepane	74793-02-5	0.036	0.002
43	2,5-Pyrrolidinedione, 1-methyl-	1121-07-9	0.028	0.001
14	3-Buten-2-one	78-94-4	0.022	0.002
117	3-Tridecanone	1534-26-5	0.061	0.013
19	3-Heptene	592-78-9	0.026	0.007
67	3-t-Pentylcyclopentanone and others		0.011	0.003
120	3-Octanol, 6-ethyl-	19781-27-2	0.0060	0.0052
96	3-Undecanone & undecanenitrile		0.0089	0.0079
38	3-Heptanone	106-35-4	0.084	0.004
39	3-Heptanol	589-82-2	0.070	0.002
54	3-Heptene, 4-propyl-	4485-13-6	0.0042	0.0073
108	3-Dodecanone	1534-27-6	0.020	0.020
45	4-Heptanone, 3-methyl-	15726-15-5	0.020	0.001
64	5-Undecene, (Z)-	764-96-5	0.0099	0.0012
116	5-Decanol	5205-34-5	0.025	0.007
49	5-Decene, (E)-	7433-56-9	0.015	0.014
125	6-Dodecanone	6064-27-3	0.035	0.032
130	6-Dodecanone	6064-27-3	0.011	0.004
126	6-Dodecanol	6836-38-0	0.014	0.004
115	6-Tridecanone	22026-12-6	0.069	0.013
40	Benzene, 1,3-dimethyl-	108-38-3	0.015	0.001
135	Benzenesulfonamide, N-butyl-	3622-84-2	0.018	0.001

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
73	Benzoic acid, 2-[(trimethylsilyl)oxyl]-, trimethylsilyl ester	3789-85-3	0.021	0.019
7	Butane, 2-methyl-	78-78-4	0.031	0.002
4	Butane	106-97-8	0.15	0.02
55	Butanoic acid, butyl ester	109-21-7	0.033	0.004
83	C6-cyclohexane		0.031	0.005
101	Cyclohexane, 1,1,3-trimethyl-	3073-66-3	0.0039	0.0068
111	Cyclohexane, 1,1,3- trimethyl-2-(3-methylpentyl)-	54965-05-8	0.091	0.017
92	Cyclohexane, 1,1'-(1-methylethylidene)bis-	54934-90-6	0.023	0.001
33	Cyclohexane, 1,1,3-trimethyl-	3073-66-3	0.0032	0.0056
102	Cyclohexane, (1,2-dimethylbutyl)-		0.0055	0.0048
94	Cyclohexane, 1,2-diethyl-3-methyl-	50876-32-9	0.033	0.004
88	Cyclohexane, octyl	1795-15-9	0.10	0.01
87	Cyclohexane, 2-butyl-1,1,3-trimethyl-	54676-39-0	0.054	0.004
124	Cyclohexane, octyl-	1795-15-9	0.022	0.028
89	Cyclohexane, 2-butyl-1,1,3-trimethyl-	54676-39-0	0.012	0.010
82	Cyclohexane, 1-methyl-2-pentyl	54411-01-7	0.033	0.004
100	Cyclohexane,(2-ethyl-1-methylbutyl)-	74810-41-6	0.0086	0.0084
34	Cyclopentanone, 2,2,5-trimethyl-	4573-09-5	0.0097	0.0086
22	Cyclopropane, butyl	930-57-4	0.021	0.001

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
1	Cyclopropane	75-19-4	0.056	0.017
52	Cyclotetrasiloxane, octamethyl	556-67-2	0.11	0.04
31	Cyclotrisiloxane, hexamethyl	541-05-9	0.033	0.008
78	Decane, 3-methyl-	13151-34-3	0.018	0.002
79	Decane, 3,8-dimethyl-	17312-55-9	0.016	0.002
58	Decane, 4-methyl-	2847-72-5	0.0096	0.0015
107	Dodecane, 4,6-dimethyl-	61141-72-8	0.43	0.06
90	Dodecane, 4-methyl-	6117-97-1	0.036	0.005
103	Dodecane, 2,5-dimethyl-	56292-65-0	0.031	0.006
6	Ethanol	64-17-5	0.039	0.012
35	Ethylbenzene	100-41-4	0.016	0.001
18	Formic acid, butyl ester	592-84-7	0.012	0.011
29	Furan, tetrahydro-2, 4-dimethyl-, trans	39168-02-0	0.014	0.001
17	Furan, tetrahydro-	109-99-9	0.034	0.003
131	Heptadecane	629-78-7	0.0049	0.0084
41	Heptanal	111-71-7	0.018	0.005
25	Heptane, 3-methyl-	589-81-1	0.048	0.001
132	Hexadecane, 2,6,10,14-tetramethyl-	638-36-8	0.0073	0.0068
127	Hexadecane	544-76-3	0.073	0.024
121	Hexadecane,7,9-dimethyl-	21164-95-4	0.0083	0.0075
138	Hexadecanoic acid	57-10-3	0.0065	0.0113
28	Hexanal	66-25-1	0.0058	0.0100
137	Hexanedioic acid, mono(2-ethyhexyl) ester	4337-65-9	0.010	0.017
69	Hexyl n-valerate	1117-59-5	0.017	0.001
2	Isobutane	75-28-5	0.0055	0.0095

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
139	Isopropyl Palmitate	142-91-6	0.012	0.001
10	Methyl nitrate	598-58-3	0.014	0.012
74	n-Amylcyclohexane	29949-27-7	0.021	0.003
75	Naphthalene, decahydro-2-methyl-	2958-76-1	0.011	0.001
63	Nitric acid, pentyl ester	1002-16-0	0.12	0.04
23	Nitric acid, propyl ester	627-13-4	0.090	0.015
59	Nitric acid, hexyl ester	20633-11-8	0.014	0.002
32	Nitric acid, butyl ester	928-45-0	0.13	0.01
16	Nitric acid, ethyl ester	625-58-1	0.092	0.019
134	Nonadecane, 9-methyl-	13287-24-6	0.0079	0.0069
71	Nonanal	124-19-6	0.025	0.005
81	Nonanenitrile	2243-27-8	0.023	0.003
68	Nonanenitrile	2243-27-8	0.021	0.003
80	Nonanol	28473-21-4	0.0069	0.0120
56	Octanal	124-13-0	0.018	0.006
37	p-Xylene	106-42-3	0.043	0.006
118	Pentadecane	629-62-9	0.31	0.11
123	Pentadecane, 2-methyl	1560-93-6	0.0071	0.0062
136	Pentadecanoic acid	1002-84-2	0.0049	0.0085
11	Pentane, 2-methyl-	107-83-5	0.039	0.001
13	Pentane, 3-methyl-	96-14-0	0.0046	0.0080
36	Pentane, 2,3-dimethyl-	565-59-3	0.033	0.002
24	Propane, 2-methyl-2-nitro-	594-70-7	0.022	0.002
30	Tetrachloroethylene	127-18-4	0.036	0.001
106	Tetradecane, 4-methyl	25117-24-2	0.064	0.012
114	Tetradecane, 3-methyl	18435-22-8	0.029	0.002
109	Tetradecane	629-59-4	0.72	0.13

Cmpd #	Compound	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
122	Tetradecane, 4,11-dimethyl-	55045-12-0	0.0099	0.0020
113	Tetradecane, 4-methyl-	25117-24-2	0.021	0.004
133	Tetradecanoic acid	544-63-8	0.022	0.020
26	trans-1-Butyl-2-methylcyclopropane	38851-70-6	0.0036	0.0063
8	Trichlorofluoromethane	75-69-4	0.25	0.11
99	Tridecane, 6-methyl-	13287-21-3	0.12	0.02
110	Tridecane, 4,8-dimethyl-	55030-62-1	0.096	0.010
98	Tridecane, 7-methyl-	26730-14-3	0.024	0.006
112	Tridecane, 7-methyl-	26730-14-3	0.0081	0.0071
104	Tridecane, 4-methyl-	26730-12-1	0.12	0.02
105	Tridecane, 2-methyl-	1560-96-9	0.075	0.012
93	Tridecane, 7-methyl-	26730-14-3	0.26	0.03
62	Tridecane, 4-methyl-	26730-12-1	0.0067	0.0061
91	Undecane, 2,10-dimethyl-	17301-27-8	0.048	0.006
84	Undecane, 2,6-dimethyl-	17301-23-4	0.15	0.02
77	Undecane, 4-methyl-	2980-69-0	0.010	0.002
76	Undecane, 6-methyl-	17302-33-9	0.011	0.002
129	Undecane, 4,6-dimethyl-	17312-82-2	0.014	0.006
97	Undecane, 4,8-dimethyl-	17301-33-6	0.012	0.003
85	Undecane, 2,4-dimethyl-	17312-80-0	0.030	0.005
72	Undecane, 2-methyl-	7045-71-8	0.013	0.001

1. CAS = Chemical Abstract Service.

X.4 REFERENCES

Carpenter, B. C., 1995, *Tank 241-B-103 Tank Characterization Plan*, WHC-SD-WM-TP-250, Westinghouse Hanford Company, Richland, Washington.

EPA 1988, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, PB90-127374, U.S. Environmental Protection Agency, Washington, D.C.

Hanlon, B. M., 1995, *Waste Tank Summary for Month Ending December 31, 1994*, WHC-EP-0182-81, Westinghouse Hanford Company, Richland, Washington.

Hendrickson, R. W., 1995, *Tank Vapor Characterization Oak Ridge National Laboratories Quality Assurance Assessment*, TWRSQA-95-0012, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., 1995a, *Waste Tank Headspace Gas and Vapor Characterization Reference Guide*, WHC-SD-WM-ER-430 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., 1995b, *Tank 241-C-101 Vapor Sampling and Analysis Tank Characterization Report*, WHC-SD-WM-ER-458, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., 1995c, *Tank 241-C-107 Vapor Sampling and Analysis Tank Characterization Report*, WHC-SD-WM-ER-445, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., and M. S. Story, 1994, *Vapor Characterization of Tank 241-C-103*, WHC-EP-0780 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Jenkins, R. A, A. B. Dindal, C. Y. Ma, M. A. Palausky, J. T. Skeen, and C. K. Bayne, 1995, *Analysis of Tank 241-B-103 Headspace Components*, ORNL-CASD-FR-241B103.95 Rev. 0, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Klinger, G. S., T. W. Clauss, M. W. Ligotke, K. H. Pool, R. B. Lucke, B. D. McVeety, O. P. Bredt, J. S. Young, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995, *Vapor Space Characterization of Waste Tank 241-TX-105: Results from Samples Collected Through the Vapor Sampling System on 12/20/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Ligotke, M. W., K. H. Pool, R. B. Lucke, B. D. McVeety, G. S. Klinger, T. W. Clauss, K. B. Olsen, O. P. Bredt, J. S. Fruchter, and S. C. Goheen, 1995, *Vapor Space Characterization of Waste Tank 241-B-103: Results from Samples Collected on 2/8/95*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Lucke, R. B., M. W. Ligotke, K. H. Pool, T. W. Clauss, A. K. Sharma, B. D. McVeety, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995a, *Vapor Space Characterization of Waste Tank 241-C-108: Results from Samples Collected Through the Vapor Sampling System on 8/5/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Lucke, R. B., T. W. Clauss, M. W. Ligotke, K. H. Pool, B. D. McVeety, J. S. Young, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995b, *Vapor Space Characterization of Waste Tank 241-C-111: Results from Samples Collected with the Vapor Sampling System on 9/13/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Mahlum, D. D., J. Y. Young, and R. E. Weller, 1994, *Toxicologic Evaluation of Analytes from Tank 231-C-103*, PNL-10189, Pacific Northwest Laboratory, Richland, Washington.

McVeety, B. D., T. W. Clauss, M. W. Ligotke, K. H. Pool, R. B. Lucke, G. S. Klinger, J. S. Young, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995, *Vapor Space Characterization of Waste Tank 241-BY-108: Results from Samples Collected on 10/27/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

NIOSH 1995, *NIOSH Pocket Guide to Chemical Hazards*, U.S. Department of Health and Human Resources, National Institute for Occupational Safety and Health, Cincinnati, Ohio.

Osborne, J. W., and J. L. Huckaby, 1994, *Program Plan for the Resolution of Tank Vapor Issues*, WHC-EP-0562 Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Osborne, J. W., J. L. Huckaby, T. P. Rudolph, E. R. Hewitt, D. D. Mahlum, J. Y. Young, and C. M. Anderson, 1994, *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution*, WHC-SD-WM-DQO-002, Westinghouse Hanford Company, Richland, Washington.

Pool, K. H., T. W. Clauss, M. W. Ligotke, R. B. Lucke, B. D. McVeety, A. K. Sharma, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1994, *Vapor Space Characterization of Waste Tank 241-C-109: Results from Samples Collected on 8/10/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Rasmussen, R. A., 1994, *Air Samples Collected at Waste Tank 241-C-111 on September 13, 1994 by Westinghouse Hanford in 6-L SS SUMMA® Canisters*, Oregon Graduate Institute of Science and Technology, Beaverton, Oregon.

Rasmussen, R. A., and W. Einfeld, 1994, *Hanford Tank 103-C Analyses and Method Validation Development Phase*, SAND94-1807, Sandia National Laboratories, Albuquerque, New Mexico.

WHC 1995, *Vapor and Gas Sampling of Single-Shell Tank 241-B-103 Using the Vapor Sampling System*, WHC-SD-WM-RPT-133, Westinghouse Hanford Company, Richland, Washington.