RPT-71248-002, Rev. 1
PNNL-27816, Rev. 1

Pacific Northwest
NATIONAL LABORATORY

NUCON Thermal Oxidation System Performance on Hanford Tank Farm Chemicals of Potential Concern

January 2019 – Rev. 1

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

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Richland, Washington 99352

Revision History

Revision Number	Interim Change No.	Effective Date	Description of Change
0	0	September 2018	Initial issue.
1	0	January 2019	The report was updated to include the off-line sampling analytical results in Section 5.8 and in Appendices H, I, J, K and L. The update also resulted in additions to the Executive Summary, Conclusions, and Section 1.4, Quality. The off-line media results did not change the original findings of the report. Additionally, the term of art "vapor abatement unit" has been changed to "thermal oxidation system" through-out the report. The title of the report was also change to replace "vapor abatement unit" with "thermal oxidation system".

Executive Summary

Pacific Northwest National Laboratory (PNNL) assessed the performance of a NUCON International, Inc., thermal oxidation system[1] (TOS) prototype for the reduction of Hanford tank farm vapors associated chemicals of potential concern (COPCs). The engineering-scale test was conducted in compliance with the *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs)* test plan at PNNL in Richland, WA.[2] Performance testing started on May 4, 2018, and continued through June 13, 2018.

NUCON developed a novel toxic vapor thermal oxidation technology, known as the NUCON TOS (see Figure S.1). In deployment, it is envisioned that the TOS will pull gas from the headspace of a single-shell tank (SST) and treat it through a sequential series of activated carbon, diesel engine combustion (diesel generator), and exhaust aftertreatment (oxidation catalyst and particulate filter). The TOS prototype in this test included a 15 kVA diesel generator with a nominal inlet flowrate of 50 cfm. Under study in this test were the diesel generator and exhaust aftertreatment; i.e., MERSORB® was not included because it is a mature commercial product with a high Technology Readiness Level and large body of knowledge regarding COPC removal performance.

Figure S.1. Engineering-Scale Prototype of NUCON Thermal Oxidation System

[1] The NUCON Thermal Oxidation System had a Catalytic Oxidation unit added to the final test unit. The Catalytic Oxidation unit significantly improved the destructive performance of the system. So the tested unit can be considered a Thermal Catalytic Oxidation System.

[2] Rappe KG. 2018. *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs)*. Test Plan TP-71248-01, Rev. 0, April 2018, Pacific Northwest National Laboratory, Richland, Washington.

Eleven COPCs were chosen for testing to represent 59 of the 61 identified COPCs (less elemental mercury and dimethyl mercury).[1] The test COPCs are shown in Table S.1, and were chosen due to (i) their frequency and/or significant concentrations found in Hanford high-level waste SST vapor emissions, (ii) their use as a surrogate to represent a class of COPC compounds, or (iii) both i and ii. Testing performed on each COPC can be summarized as follows:

- Test 1 – Validation of analytical readiness in the TOS exhaust.
- Test 2 – Determination of the COPC concentration in select locations of the TOS with the COPC supplied to the engine inlet at 200% the Hanford Tank Farm Occupational Exposure Limits ($_{HTF}$OEL) as shown in Table S.1.
- Test 3 – Determination of the COPC concentration in select locations of the TOS with the COPC supplied at a higher concentration (performed only for NDMA, furan, ammonia, and nitrous oxide), also shown in Table S.1.

[1] The data to complete a preliminary assessment of MERSORB® performance was provided in the MERSORB® Mercury Adsorbents Bulletin 11B28-2012, *MERSORB® Mercury Adsorbents Design and Performance Characteristics,* by NUCON International Columbus, Ohio. MERSORB® has also been evaluated for removal of dimethyl mercury and was selected as the best available control technology for mercury abatement (both elemental mercury and dimethyl mercury) in the AP stack (*Evaluation of Best Available Control Technology for Toxics (tBACT) Double Shell Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations*. RPP-ENV-46679, Rev. 0, prepared by Washington River Protection Solutions for the U.S. Department of Energy, Office of River Protection, Richland, Washington).

Table S.1. Summary of Chemicals of Potential Concern and Targeted Test Concentrations

CAS	Name	Maximum[1] Conc. SWIHD/TWINS (COPC or surrogate)	200% $_{HTF}$OEL[a] Test	High Concentration Test	Analytical Method
75-07-0	Acetaldehyde	39 ppm	50 ppm	– [b]	PTR-MS
75-05-8	Acetonitrile	18.8 ppm	40 ppm	– [b]	PTR-MS
71-43-2	Benzene	0.189 ppm	1 ppm	– [b]	PTR-MS
107-12-0	Propanenitrile	0.78 ppm	12 ppm	– [b]	PTR-MS
106-99-0	1,3-Butadiene	3.38 ppm	3.4 ppm[c]	– [c]	PTR-MS
50-00-0	Formaldehyde	0.157 ppm	0.6 ppm	– [b]	PTR-MS
108-47-4	2,4-Dimethylpyridine	0.147 ppm	1 ppm	– [b]	PTR-MS
62-75-9	N-Nitrosodimethylamine	0.0621 ppm	0.0006 ppm	0.062 ppm	PTR-MS
110-00-9	Furan	0.721 ppm[c]	0.002 ppm	0.017 ppm	PTR-MS
7664-41-7	Ammonia	2,502 ppm[d]	50 ppm	630 ppm	FTIR
10024-97-2	Nitrous Oxide	831 ppm	100 ppm	831 ppm	FTIR

[a] Hanford tank farm occupational exposure limit ($_{HTF}$OEL).

[b] No maximum concentration test required since the testing conditions at 200% OEL already bounded the high concentration test conditions.

[c] Due to comparatively similar values for 1,3-butadiene for 200% OEL concentration and the maximum applicable observed concentration, it was decided to increase the concentration of 1,3-butadiene employed in the 200% OEL to be inclusive of both values.

PTR-MS = proton transfer reaction mass spectrometer instrument; FTIR = Fourier-transform infrared spectroscopy instrument.

The target criteria for analytical readiness in Test 1 was to detect each of the COPCs at or below 10% of their respective $_{HTF}$OELs in a relatively complex diesel exhaust matrix. This also ensured the ability to detect down to the exhaust purification target for each COPC in subsequent Tests 2 and 3. This test is of particular importance for the ultra-trace level (<1 ppb) detection and quantification of NDMA and furan that was required of the analytical system. Target criteria for TOS performance in Tests 2 and 3 were defined as (i) COPC destruction/removal efficiency (DRE) ≥ 95%, and (ii) exhaust purified to an outlet concentration of ≤ 10% $_{HTF}$OEL for each COPC.

Results of the NUCON TOS tests are shown in Table S.2. These results can be summarized as follows:

- **Eight of the eleven COPCs successfully achieved all of the TOS target removal (i.e., DRE) and purification performance (i.e., % OEL) criteria, including acetaldehyde, acetonitrile, benzene, propanenitrile, 1,3-butadiene, 2,4-dimethylpyridine, furan, and ammonia.**
- **Only nitrous oxide did not meet any target performance (removal or purification) criteria for any of its tests. However, it was consistently reduced by >72% in the engine.**
- **The TOS achieved target removal for NDMA at high concentration, and reduced NDMA exhaust concentration to a very low level in that test. However, it failed to reach target performance metrics for NDMA at 200% OEL. The accuracy of the ultra-trace analysis required for <50% OEL NDMA measurement is likely a factor in these results governing TOS**

[1] Mahoney et.al. 2018. *Maximum Concentration Values Review for Use in NUCON Vapor Abatement Unit Testing*. RPT-71248-001, Rev. 0; PNNL-27368, Pacific Northwest National Laboratory, Richland, Washington.

perceived performance. This is because these measurements are at the limit of analytical capability for NDMA detection, and the estimated error associated with those measurements is of similar order of magnitude to the NDMA concentration values.

- **Formaldehyde removal and purification results were controlled by a persistent exhaust background level that was not increased by COPC injection. In other words, the TOS successfully reduced incoming formaldehyde to pre-existing exhaust levels.**

Table S.2. Summary of NUCON TOS Destruction Efficiencies and Exhaust Concentrations as % OEL

		COPC Removal & Purification Performance			
		200% OEL		High Concentration Test	
COPC	Detection Validation	DRE	[Exhaust] % OEL	DRE	[Exhaust] % OEL
Acetaldehyde	**9.7%**	**99.6%**	**1.1%**	-[e]	-[e]
Acetonitrile	**10.4%**	**>99.9%**	**0.1%**	-[e]	-[e]
Benzene	**2.9%**	**97.3%**	**4.7%**	-[e]	-[e]
Propanenitrile	**1.3%**	**>99.9%**	**0.2%**	-[e]	-[e]
1,3-Butadiene	**9.3%**	**99.7%**	**2.6%**	-[e]	-[e]
Formaldehyde[a]	**10.1%**	45.7%	242%	-[e]	-[e]
2,4-Dimethylpyridine	-[d]	**99.3%**	**1.4%**	-[e]	-[e]
NDMA[b,c]	49.6%	55.6%	50.4%	**>99.9%**	13.9%
Furan[c]	**4.9%**	**99.3%**	**1.7%**	**99.8%**	**3.5%**
Ammonia	**7.9%**	**98.7%**	**2.8%**	**>99.9%**	**1.3%**
Nitrous Oxide	**5.8%**	72.7%	57.9%	69.5%	521%

[a] The inlet background in the 200% OEL injection test was >250% OEL.
[b] Prohibitively high background in the exhaust at m/Z 74 prevented 10% OEL detection validation.
[c] COPC results (removal and purification) reflect the combination of PTR-MS and TOFWERK ultra-high resolution VOCUS-PTR measurements; see Section 5.5.2 for additional detail and explanation.
[d] 10% OEL detection validation was unsuccessful due to prohibitively long passivation time required. Test 3.2 indicated that the analytical system was capable of measuring ~1.4% OEL.
[e] No test performed.

During testing, gas samples were collected and analyzed before and after the applicable TOS components, including the diesel engine, the diesel oxidation catalyst (DOC), and the diesel particulate filter (DPF). This enabled determination of the contribution of each component to overall TOS performance. The DPF, although an extremely important device for the removal of noxious soot and ash from diesel engine exhaust, had very little impact on COPC concentrations. Conversely, testing revealed that the diesel engine was successful at reducing incoming COPC concentrations significantly for 9 of the 11 COPCs, excluding only formaldehyde and furan, which were conversely generated in the engine.

Testing also revealed that the DOC was a critical component for enabling the TOS to successfully meet the target criteria for 7 of the 11 COPCs, including acetaldehyde, acetonitrile, benzene, propanenitrile, 1,3-butadiene, furan, and ammonia. 2,4-Dimethylpyridine at 200% OEL and NDMA at high concentration were both removed at >95% DRE by the diesel engine alone; conversely, formaldehyde and furan, which were both generated by the engine in comparatively large quantities, were reduced solely by the oxidation catalyst with high efficiency. Thus, both the diesel engine and catalytic converter contributed significantly to successful TOS performance for COPC removal and exhaust purification.

In addition to real-time analysis performed by PTR-MS and FTIR, samples were collected by SUMMA® canister and sampling media and sent to accredited laboratories for confirmatory analysis using approved

methods from the U.S. Environmental Protection Agency and the National Institute for Occupational Safety and Health. The results from these analyses were consistent with the PTR-MS and FTIR results summarized in Table S.2, and are provided in detail in Section 5.8.

Acronyms and Abbreviations

200% OEL	two times the Hanford tank farm occupational exposure limit concentration
CAS	Chemical Abstract Service Registry Number
CGB	compressed (or cylinder) gas bottle
CI	chemical ionization
COPC	chemical of potential concern
DEP	diethylphthalate
DL	detection limit
DOC	diesel oxidation catalyst
DOE	U.S. Department of Energy
DPF	diesel particulate filter
DRE	destruction/removal efficiency
EPA	U.S. Environmental Protection Agency
FTIR	Fourier-transform infrared spectroscopy instrument
GC/MS	gas chromatography mass spectrometry instrument
GC/MSD	gas chromatography mass selective detector instrument
GC/TEA	gas chromatography thermal energy analyser instrument
HDI	How Do I…?
$_{HTF}$OEL	Hanford tank farm occupational exposure limit
kVA	kilovolt-ampere
LCS	laboratory control samples
M&TE	measurement and testing equipment
NDEA	N-Nitrosodiethylamine
NDMA	N-nitrosodimethylamine
NUCON	NUCON International, Inc.
OEL	occupational exposure limit concentration as established by the Hanford Tank Farm Operations Contractor Washington River Protection Solutions
ORP	Office of River Protection
PFD	process flow diagram
PID	photoionizer instrument detector
PLC	programmable logic controller
PNNL	Pacific Northwest National Laboratory
ppb	parts per billion (= $10^3 \cdot$ppm)
ppm	parts per million
ppt	parts per trillion (= $10^6 \cdot$ppm)
PTR-MS	proton transfer reaction mass spectrometer instrument
QA	quality assurance
RSD	relative standard deviation
scfm	standard cubic feet per minute
SST	single-shell tank (located in the Hanford tank farms)
SWIHD HS	Site-Wide Industrial Hygiene Database for Headspace
TEA	thermal energy analyser instrument used with gas chromatography
TIC	tentatively identified compound

TOS	thermal oxidation system or thermal catalytic oxidation system
TWINS IH	Tank Waste Information Network System Industrial Hygiene database
TWINS HS	Tank Waste Information Network System Headspace database
VOC	volatile organic compound
WAI	Wastren Advantage, Inc.
WRPS	Washington River Protection Solutions

Contents

Figures

Tables

1.0 Introduction

The purpose of the Pacific Northwest National Laboratory (PNNL) and NUCON International, Inc. (NUCON) testing was to assess the performance of the NUCON thermal oxidation system[1] (TOS) prototype with the diesel engine and control system update for the abatement of Hanford tank farm vapors. The *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs)* test plan[2] covers the methodology and approach towards determining the abatement of 11 specific chemicals of potential concern (COPCs) when processed through the TOS.

The NUCON TOS is a novel toxic vapor thermal oxidation technology developed by NUCON. PNNL conducted an engineering-scale evaluation of the fate of COPCs passing through a NUCON TOS prototype. The purpose of the test is to evaluate the TOS vapor destruction efficiency for a selection of 11 COPCs that have been measured in Hanford high-level waste (HLW) single-shell tank (SST) passive breather vapor emissions. At this time, the NUCON TOS is expected to be used on passively ventilated SSTs.

1.1 Background

The Tank Vapor Assessment Team (Wilmarth 2014) identified the need to provide engineered controls to protect tank farm workers from toxic organic vapor emissions from Hanford HLW tanks. In response to this need, NUCON presented a proposal to the 2016 U.S. Department of Energy (DOE) Office of River Protection (ORP) Grand Challenge competition. This proposal presented a novel thermal oxidation system that is intended to combust HLW tank vapors within an internal combustion engine. This proposal was the Grand Challenge winner. As a result, NUCON has developed a prototype of the proposed system and has conducted proof-of-concept tests. Upon successful completion of the NUCON proof-of-concept testing, Washington River Protection Solutions (WRPS) began preparations for more rigorous engineering-scale evaluation of the TOS prototype in FY17 and FY18.

The initial NUCON TOS proof-of-concept testing was based on a propane engine and an 11.4 kVA generator. A safety and operational review of the propane-based option was evaluated and compared to other fuel types (diesel, natural gas). Due to safety and operational issues identified for the propane-based system, a decision was made to terminate further testing with propane and proceed directly to diesel.[3] For the purpose of the engineering-scale performance evaluation, the TOS was modified, replacing the propane generator with a 15 kVA diesel generator. A diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF) were added to the exhaust train to further reduce vapor emissions.

[1] The NUCON Thermal Oxidation System had a Catalytic Oxidation unit added to the final test unit. The Catalytic Oxidation unit significantly improved the destructive performance of the system. So the tested unit can be considered a Thermal Catalytic Oxidation System.

[2] Rappe KG. 2018. *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs)*. Test Plan TP-71248-01, Rev. 0, April 2018, Pacific Northwest National Laboratory, Richland, Washington.

[3] *NUCON Vapor Abatement Unit Propane Prototype Testing Decision Paper*, October 2017, Washington River Protection Solutions, Richland, Washington

1.2 Initial Laboratory Efforts

This work covers an assessment of the performance of the NUCON TOS as operated by WRPS subcontractors. Initial laboratory efforts were aligned with developing and validating the analytical methods to assess the COPC concentrations in the engine exhaust to criteria levels, developing COPC injection and exhaust sampling systems to support TOS testing, and the use of those methods and systems to assess the COPC destruction performance of the TOS.

The core scope of this test was the determination of the performance of the NUCON TOS as an off-gas abatement technology and its feasibility to reach specific COPC removal and purification targets using real-time instrumentation. Also included in this test were methods for collecting off-line samples from the TOS process (e.g., sorbent tubes and SUMMA® canister samples) to provide secondary confirmation of COPC removal in the NUCON TOS and to inform future WRPS design and permitting efforts. These efforts did not modify or optimize performance of the NUCON TOS in an attempt to reach a specific performance target.

1.3 Test Objectives and Target Performance Criteria

The performance targets for the TOS are as follows:

1. COPCs reduced to 10% Hanford tank farm occupational exposure limit (OEL) concentrations ($_{HTF}$OEL) or less, and/or
2. COPCs destroyed and/or removed with 95% or greater efficiency.

The performance target of ≤10% $_{HTF}$OEL was selected since this concentration level is considered safe for any exposure duration and is below a value that qualifies a compound to be a COPC. The performance target of ≥95% destruction and/or removal efficiency (DRE) was selected since it is consistent with both competing technologies (Strobic Air) and the predicted DREs for the TOS technology. The COPC injection concentration of 200% OEL was selected since a ≤10% $_{HTF}$OEL will be achieved if a DRE of ≥95% is achieved. The high-concentration tests were selected based on the highest concentrations observed in SSTs following stabilization. It is not expected (although it is desired) that all COPCs will be destroyed to below 10% $_{HTF}$OEL in the high-concentration tests since the injection concentrations are 1 to 2 orders of magnitude higher than the $_{HTF}$OEL.

To determine if these success criteria have been meet, the test plan established the test objectives and respective acceptance criteria presented in Table 1.

Table 1. Test Objectives and Target Performance Criteria

	Test Objective	Acceptance Criteria		
1	Validation of detection of selected COPCs in TOS exhaust at or below the following 10% OEL concentration	CAS	Name	10% OEL
		7664-41-7	Ammonia	2.5 ppm
		10024-97-2	Nitrous Oxide	5.0 ppm
		106-99-0	1,3-Butadiene	0.1 ppm
		71-43-2	Benzene	0.050 ppm
		50-00-0	Formaldehyde	0.030 ppm
		75-07-0	Acetaldehyde	2.5 ppm
		110-00-9	Furan	0.00010 ppm
		75-05-8	Acetonitrile	2.0 ppm
		107-12-0	Propanenitrile	0.60 ppm
		62-75-9	N-Nitrosodimethylamine	0.000030 ppm
		108-47-4	2,4-Dimethylpyridine	0.050 ppm
2	Analysis of selected COPCs in the TOS exhaust using the validated method while injecting the "low-level" concentration of that COPC	Complete TOS exhaust analysis of each COPC at low-level injection to calculate destruction efficiency of TOS		
3	Analysis of selected COPCs in the TOS exhaust using the validated method while injecting the "high-level" concentration of that COPC	Complete TOS exhaust analysis of each COPC at high-level injection to calculate destruction efficiency of TOS		
4	Calculation of the DRE for each COPC in (2) and (3) above	Assess abatement feasibility for each COPC in relation to WRPS target of ≥ 95% DRE and < 10% OEL		
5	Acquisition of samples from the TOS process (e.g., sorbent tubes, canister samples, or Tedlar® bag samples) to provide secondary confirmation of COPC removal in the TOS and to inform subsequent WRPS design and permitting activities	Sample acquisition and data compilation		

1.4 Quality Assurance

The WRPS Quality Assurance (QA) requirements (included in requisition 302351, Rev. 2) specified work be completed using a "Basic Research" approach under the PNNL QA program requirements drawn from NQA-1-2000.

This report was developed under the *NUCON Vapor Abatement Unit Testing Quality Assurance Plan*, 71248-QA-001, Rev. 0 (Meier 2018). The PNNL QA Program is based upon the requirements as defined in DOE Order 414.1D, *Quality Assurance*, and 10 CFR 830, *Energy/Nuclear Safety Management*, Subpart A, "Quality Assurance Requirements." PNNL has chosen to implement the following consensus standards in a graded approach:

- ASME NQA-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, Part I, "Requirements for Quality Assurance Programs for Nuclear Facilities."
- ASME NQA-1-2000, Part II, Subpart 2.7, "Quality Assurance Requirements for Computer Software for Nuclear Facility Applications," including problem reporting and corrective action.
- ASME NQA-1-2000, Part IV, Subpart 4.2, "Guidance on Graded Application of Quality Assurance (QA) for Nuclear-Related Research and Development."

The PNNL Quality Assurance Program Description / Quality Management M&O Program Description describes the Laboratory-level QA program that applies to all work performed by PNNL. Laboratory-level procedures for implementing the QA requirements described in the standards identified above are deployed through PNNL's web-based "How Do I…?" (HDI) system, a standards-based system for managing and deploying requirements and procedures to PNNL staff. The HDI procedures (called Workflows and Work Controls) provide detailed guidance for performing some types of tasks, such as protecting classified information and procuring items and services, as well as general guidelines for performing research-related tasks, such as preparing and reviewing calculations and calibrating and controlling measuring and testing equipment (M&TE).

The technology maturity of the work is considered scoping in nature, and the NUCON project used PNNL HDI to meet the Basic Research requirements of the *NUCON Vapor Abatement Unit Testing Quality Assurance Plan*. This determination is based on the revised WRPS Quality Assurance Requirements (QAR) form, revision 1a, signed 2/5/2018 by the WRPS quality and project engineers.

Off-line sampling media was sent to the 222-S laboratory, where Wastren Advantage, Inc. (WAI), a DOE contractor, performed the required analytical services under their (WAI) QA program. This program supports compliance with the U.S. Environmental Protection Agency (EPA) methods and protocols identified in this report. WAI subcontractors, such as RJ Lee, also conducted chemical analysis for the 222-S laboratory in compliance with the WAI QA Program.

Off-line samples sent to Aerodyne Research for measurements were done under research-level controls as the VOCUS processes and methodologies are still being finalized. The Aerodyne results were used to adjust the furan and N-nitrosodimethylamine (NDMA) measurements made by the performance-calibrated Quadrupole proton transfer reaction mass spectrometer instrument (PTR-MS) as detailed in Section 5.5.

NUCON provided the TOS as a full system for this performance evaluation. The instrumentation, operational controls, and components were not designed or calibrated to the NQA-1 requirements, so information in Section 5.10 is noted as For Information Only. When instrumentation and measurements were required to establish the system's performance related to this testing effort, Category 1[1] or Category 2[2] calibrations were conducted on the M&TE. The team replaced key thermocouples with NQA-1

[1] Category 1: M&TE that cannot be calibrated by the staff member due to the lack of expertise and/or lack of required standard equipment, processes, or materials needed for the calibration; therefore, equipment is calibrated by a certified supplier. Examples of Category 1 M&TE: flow meter, thermocouple.
[2] Category 2: M&TE that can be calibrated by the staff member based on their expertise, and performed with material/equipment that is traceable to a nationally or internationally recognized standard or physical constant. Examples of Category 2 M&TE: gas chromatograph, mass spectrometer.

calibrated thermocouples (see the M&TE list in Section 4.0) and the performance calibrations using methane tracers to establish exhaust flow rates (see Appendix E).

Data generated during testing was collected following the *Data Management Plan PNNL Assessment of NUCON Vapor Abatement Unit*, DMP-NUCON-001. Additional record documents include the Laboratory Record Book BNW-62516, the Sample Log, and the Test Data Packages.

Testing deviations included the following:

- The Anasorb 747 tubes used were SKC-226-81A type tubes that were not coated with sulfuric acid, which acts as a capture assist agent for ammonia. This was different than the standard Anasorb 747, SK-226-29 tubes specified in the test plan. The different tube caused a quality non-conformance that was documented in Problem Evaluation Request WRPS-PER-2018-1318. The ammonia tubes could not be used for ammonia analysis.
- The PTR-MS was only able to distinguish NDMA at 50% of the OEL and did not reach the 10% of the OEL target. This was after reconfiguring the PTR-MS to obtain improved resolution by using NO+ (see Section 5.5).
- The data files from the AreaRAE were not recoverable, so manually recorded data was used. Additionally, the 1:1 dilution fitting when connected to the pressurized side of the Fourier-transform infrared spectroscopy instrument (FTIR) pump was determined to have a 1 part exhaust to 9.17 parts ambient air dilution rate. The manually collected data and the analysis are in Section 5.8.
- The AreaRAE pump was unable to collect gases from the master sample given the pressure differentials between the sample header and the AreaRAE pump (which was designed for just ambient air collection). Data that was suspect during Tests 6.2 and 6.3 has been designated in Appendix D as “do not use.” After Test 6.3, the suction inlet to the AreaRAE was moved to the pressurized side of the FTIR pump.
- The ThermoSorb/N cartridges used for sampling NDMA were initially installed incorrectly (first 30 minutes of 320-minute total collection period) during Test 4.2 with sample gas flowing in the outlet and out the inlet. The port A ThermoSorb/N cartridge was not reinstalled after the initial 30 minutes due to a loss of sorbent material in the sampling pump inlet line; but ports B, C, and D cartridges were correctly reinstalled for the remainder of the collection period. The ThermoSorb/N cartridges are a two-stage sorbent media with the first stage designed to retain amines and the second stage designed to retain nitrosamines. This eliminates the potential for artifact formation (reaction of nitrogen oxides and amines in the nitrosamine sorbent creating additional nitrosamines during collection, storage, and analysis). With the cartridges installed backwards, the ThermoSorb/N NDMA results can be artificially high. This appeared to be the case when compared to NDMA analysis by PTR-MS, and as such the ThermoSorb/N NDMA results for Test 4.2 are considered unusable. These data have been designated as “do not use” in Appendix L. This quality non-conformance is documented in an Issue Tracking System (ITS) report (see Appendix L).
- Several complications were reported by RJ Lee in the analysis of nitrosamine samples from Tests 4.2 and 4.3, including 1) contamination of the gas chromatograph (GC) inlet line and column, 2) contamination of the thermal energy analyzer (TEA) cell, 3) higher concentrations of nitrosamines observed on re-extracted and re-run samples, 4) sticking of the autosampler needle, and 5) high laboratory control sample (LCS) recovery (see RJ Lee Group Supplemental Nitrosamine Report in Appendix L). At least one of these complications (item 3) may be consistent with the quality

condition associated with reverse installation of the cartridges in Test 4.2 (see bullet above). These data (nitrosamine data from Test 4.2) were previously considered to be unusable and thus are not impacted by anomalies in the analysis process. The fact that the LCS sample recovery was approximately 130% was traced to a standard vial used for spiking that had undergone gradual solvent evaporation. RJ Lee suggested (Appendix L page L.16) that "WRPS may want to consider revising the analytical result upward by a factor determined from the averaging of the three LCS control samples for each specific analyte." RJ Lee was able to mitigate the other complications by using GC/MS instead of TEA and by performing multiple blank injections between samples to eliminate carryover.

- The high acetonitrile levels measured in the SUMMA® canisters on May 18, 2018, indicate that the media treatment solvent (specifically acetonitrile) in the DNPH Treated Silica Gel, SKC-226-119 sample tubes contaminated the SUMMA® canister during the sample collection process.[1] Review of the PTR-MS results for Test 3.2 confirmed that the high levels of acetonitrile in the SUMMA samples were from contamination from the DNPH sorbant tubes. In Phase 3 testing, the DNPH Treated Silica Gel, SKC-226-119 sample tubes should be isolated from the SUMMA® canister sample collection process.

[1] Similar conditions were identified in Lessons Learned Berkeley Analytical Associates, 815 Harbour Way South, Unit 6 Richmond, CA 94804-3612, www.berkeleyanalytical.com, *Collection of Samples for Analysis of Formaldehyde and Other Carbonyls in Indoor Air Using DNPH Cartridges,* BAA Guide 07-02, October 1, 2007. Summary: Their samplers contain residual acetonitrile that is used as the solvent in the coating of the silica with DNPH. During sampling, this acetonitrile is volatilized. If air samples also are being collected for the analysis of volatile organic compounds (VOCs), the acetonitrile emitted to the air may contaminate the VOC samples.

2.0 Selected Chemicals of Potential Concern

2.1 COPC Selection Considerations

The 11 COPCs employed in the NUCON TOS tests were chosen to adequately represent the worst-case scenario of DRE for the different classes of compounds in the Hanford tank farm COPC list. The list of Hanford tank farm COPCs includes 61 compounds[1] consisting of inorganic compounds, hydrocarbons (primary olefinic species), alcohols, ketones, aldehydes, furans and substituted furans, phthalates, nitriles, amines, nitrosamines, organophosphates and organophosphonates, halogenated hydrocarbons, pyridines, organonitrites, organonitrates, and isocyanates. The basis for selection of the 11 COPCs was as follows:

- Both ammonia and nitrous oxide were selected as part of the test due to their unique and somewhat unpredictable chemical behavior in combustion and catalytic systems.
- 1,3-butadiene and benzene were chosen to represent two comparatively recalcitrant hydrocarbon species and aromatic species.
- Formaldehyde and acetaldehyde were both selected to represent the most recalcitrant carbonyl groups, and thus adequately represent ketones as well. Additionally, aldehydes will conservatively predict alcohols as an aldehyde represents a more recalcitrant analog of an alcohol.
- Furan was chosen as the most recalcitrant furanic component.
- Benzene was chosen to represent phthalates. Phthalates are comparatively much less stable than benzene. The aromatic ring is the most recalcitrant portion of the phthalate molecule, and thus is adequately represented by benzene.
- Acetonitrile and propanenitrile were both chosen to represent the very unique and recalcitrant nitrile-functionality. The nitrile-functionality adequately represents the amine functionality as it is a comparatively more recalcitrant analog.
- NDMA was chosen to represent the nitrosamine functionality. A nitrosamine was chosen because there is not adequate information available to predict how a nitrosamine will decompose in combustion chemistry. With two methyl-groups, NDMA is comparatively more recalcitrant than one or two ethyl groups or a cyclic species, which are represented by the other nitrosamines on the COPC list.
- Regarding halogenated hydrocarbons, the presence of a halogen within a hydrocarbon molecule almost always destabilizes that structure within combustion chemistry. For this reason, halogenated hydrocarbons were not considered for inclusion in this study.
- A pyridine was chosen to represent the unique pyridine aromatic functionality. Since the behavior of pyridine is expected to be very similar to, yet slightly less recalcitrant than, benzene, 2,4-dimethyl pyridine was chosen for comparison.
- Organophosphates and -phosphonates, organonitrites and -nitrates, and organoisocyanates are all molecules containing hydrocarbon cation complexes and inorganic anions. The very strongly dominating electronic nature of the anionic portion of these molecules dominates their behavior in

[1] Way KJ. Interoffice Memorandum, September 21, 2017. "Tank Operations Contractor – Chemicals of Potential Concern." Rev. 1, WRPS-1604188.1, Washington River Protection Solutions, Richland, Washington.

combustion chemistry and renders them highly reactive and very non-recalcitrant. This knowledge base has been built on a large amount of experience with vehicle-based combustion chemistry dealing with, for example, phosphate derivatives such as lube oil components and organic sulfates as fuel-derived lubricants.

- Mercury compounds were excluded from the NUCON TOS testing since the understanding of the MERSORB® filter media has already been established in industrial applications.[1]

The full list of Hanford tank farm COPCs and the associated COPC test surrogate is shown in Table G.1 in Appendix G.

Table 2 provides a list of the 11 COPCs selected for testing. Note that the Chemical Abstract Service (CAS) numbers referenced in this test plan are considered definitive. Common chemical names are provided only for convenience and readability.

Table 2. COPCs Selected for NUCON TOS Testing

COPC #	Name	CAS #	Formula	$_{HTF}$OEL (ppm)
20	Ammonia	7664-41-7	NH_3	25
51	Nitrous Oxide	10024-97-2	N_2O	50
2	1,3-Butadiene	106-99-0	C_4H_6	1
21	Benzene	71-43-2	C_6H_6	0.5
30	Formaldehyde	50-00-0	CH_2O	0.3
18	Acetaldehyde	75-07-0	C_2H_4O	25
31	Furan	110-00-9	C_4H_4O	0.001
19	Acetonitrile	75-05-8	C_2H_3N	20
57	Propanenitrile	107-12-0	C_3H_5N	6
6	2,4-Dimethylpyridine	108-47-4	C_7H_9N	0.5
53	N-Nitrosodimethylamine (NDMA)	62-75-9	$C_2H_6N_2O$	0.0003

$_{HTF}$OEL = Hanford tank farm occupational exposure limit concentrations

2.2 Maximum Concentrations

The 2018 tests of the NUCON TOS are intended to ensure that the feed gas for the system test includes concentrations of certain selected Hanford tank COPC vapors that are bounding both for those vapors and for other COPC vapors, those for which the test feed vapors are surrogates. To determine the bounding feed concentrations applicable to planned NUCON TOS operations, several vapor databases were

[1] The data to complete a preliminary assessment of MERSORB® performance was provided in the MERSORB® Mercury Adsorbents Bulletin 11B28-2012, *MERSORB® Mercury Adsorbents Design and Performance Characteristics,* by NUCON International Columbus, Ohio. MERSORB® has also been evaluated for removal of dimethyl mercury and was selected as the best available control technology for mercury abatement (both elemental mercury and dimethyl mercury) in the AP stack (*Evaluation of Best Available Control Technology for Toxics (tBACT) Double Shell Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations*. RPP-ENV-46679, Rev. 0, prepared by Washington River Protection Solutions for the U.S. Department of Energy, Office of River Protection, Richland, Washington).

examined to determine the currently relevant maxima for the types of tanks on which the system will be used.

The data sets from which relevant subsets of vapor concentration data were extracted were Tank Waste Information System (TWINS) Headspace (TWINS HS), TWINS Industrial Hygiene (TWINS IH), and SWIHD Headspace (SWIHD HS), as follows:

- TWINS HS concentrations measured in tank headspaces between 1994 and 2005
- TWINS IH concentrations measured between 2005 and July 2017 in stacks, exhausters, breather filters, inlet filters, and a variety of other sources connected to Hanford waste tanks
- SWIHD HS concentrations measured in Hanford waste tank headspaces between 2014 and July 2017

Some of the data were not considered for maxima because they had analytical data quality flags that made them suspect (Hoppe et al. 2016). In cases where there were data for two or more sorbent tubes in series on the same sampled stream of gas, the concentrations for the individual tubes were summed to give the total concentration for the sample.

Two constraints were applied to reduce these data sets by removing measurements that were not applicable to the NUCON TOS system operations.

First, all data that were not from SSTs were removed from consideration because the NUCON TOS system is intended for use only on SST gas/vapor streams from Hanford waste tank headspaces. SST data were also removed in this step if they were not clearly headspace data – for example, if they were drillstring gas or measured at "sources around" a tank or farm.

Second, SST data were removed from consideration if they had been measured before the tank's waste was last modified by remediation or retrieval operations. Pre-stabilization and pre-retrieval data were considered to be out of date and unrepresentative of possible headspace conditions under which the NUCON TOS system would be used. In two cases, C-105 and C-106, the Best Basis Inventory tank activity databases[1] were used to supply latest-activity dates where other sources did not give retrieval end dates. The *Maximum Concentration Values Review for Use in NUCON Vapor Abatement Unit Testing* report (Mahoney et al. 2018) shows the cutoff dates that were used and the online sources of information[2] on which they were based; however, the stabilization report (Swaney 2005) was the preferred basis.

The above-reporting-limit measurements in the reduced data sets were searched for the maximum concentration of each of the COPCs that were within the scope of NUCON TOS testing.[3] As a cross-check, these maxima were compared to the ones that had been reported in PNNL-13366, Rev. 1 (Stock

[1] These databases can be found at
https://twins.labworks.org/twinsdata/Forms/BuildQuery.aspx?SourceName=txfr.dbo.p_TWINS_Get_Transfer_Events&whatsnew=Tank|Transfers
https://twins.labworks.org/twinsdata/Forms/BuildQuery.aspx?SourceName=tcd.dbo.transfers_denorm&whatsnew=Tank|Transfers

[2] Phoenix Tank Farms Dashboard: https://phoenix.pnnl.gov/apps/tankfarm/index.html
Phoenix Waste Tank Summary Report: https://phoenix.pnnl.gov/apps/tanksummary/summary.html

[3] For reasons discussed in Section 2.0, the COPCs that did not need to be considered were organic nitrates and nitrites, organic nitro compounds, mercury, dimethylmercury, methyl isocyanate, tributyl phosphate, dibutyl butylphosphonate, poly-chlorinated biphenyls, and 2-fluoro-1-propene.

and Huckaby 2004). In many cases, the maxima reported in that July 2004 report were no longer applicable because of remediation or retrieval, or had been superseded by later, higher maxima. Table 3 shows the test-applicable maximum concentrations of the COPCs that are within the scope of NUCON TOS testing.

The subset of COPCs that were used in NUCON TOS test are listed below, together with comments on their maximum concentrations.

- Ammonia: The maximum of 2502 ppm may have been the result of post-stabilization evaporation from liquid left behind in exposed pores of the waste, although stabilization had been completed 4 years before. There are no later measurements from the same tank to confirm this. Headspace ammonia concentrations for other SSTs in SWIHD HS, covering 2014-2017, are less than 500 ppm.
- Nitrous oxide: The maximum was 831 ppm.
- 1,3-butadiene: The maximum was 3.38 ppm.
- Benzene, for itself and as a surrogate for the other aromatic COPCs, which are biphenyl and diethylphthalate (DEP): The maximum benzene was 0.189 ppm, considerably higher than the maximum biphenyl concentration of 0.00142 ppm and also higher than the maximum DEP concentration of 0.064 ppm.
- Formaldehyde and acetaldehyde, for themselves and as surrogates for other oxygenated aliphatic COPCs including alcohols, aldehydes, and ketones: The maxima for these two aldehydes were 0.157 and 2.82 ppm, respectively. While the maxima for other aldehydes and for ketones are in this same range, the alcohols had much higher maxima, 63.5 ppm for 1-butanol (measured in 1994) and 39 ppm for methanol (measured in 2004, 4 years after stabilization). For comparison, the $_{HTF}$OELs of formaldehyde and acetaldehyde are 0.3 and 25 ppm, respectively. The 1994 maximum of 1-butanol was not used, as it appears to have decreased substantially, based on several later data points in the same tank. In addition, the methanol maximum may have decreased as the time since stabilization has increased, but data to corroborate this assumption are not available.
- Furan, for itself and as a surrogate for other COPCs with furan rings: Two of the furan compounds have higher maxima than any of the others. These higher maxima are 0.547 ppm for furan and 0.721 ppm for 2,5-dihydrofuran.
- Acetonitrile and propanenitrile, for themselves and as surrogates for other nitrile COPCs and for ethylamine: The maxima for these two nitriles are 18.8 and 0.517 ppm, respectively. The propanenitrile maximum is higher than that for any of the longer-chain nitriles, though lower than the ethylamine (ethanamine) maximum of 0.78 ppm. The acetonitrile maximum is much higher. For comparison, the $_{HTF}$OELs of acetonitrile and propanenitrile are 20 and 6 ppm, respectively.
- NDMA, for itself and as a surrogate for other nitrosamine COPCs: The highest maximum among the nitrosamine COPCs is for NDMA, 0.0621 ppm. The next highest maximum is for N-nitrosomorpholine, 0.00495 ppm.
- 2,4-dimethylpyridine, for itself and as a surrogate for pyridine: Pyridine has the higher of the two maxima, 0.147 ppm versus 0.0338 ppm for 2,4-dimethylpyridine. The $_{HTF}$OEL for 2,4-dimethylpyridine is 0.5 ppm, higher than either of the maxima.

2.3 COPC Test Conditions

Testing of the NUCON TOS used "high inlet spike" concentrations to represent the maximum measured headspace concentrations for SSTs at Hanford. An evaluation of the maximum COPC values for SSTs in all the historical databases was completed in the *Maximum Concentration Values Review for Use in NUCON Vapor Abatement Unit Tests* (Mahoney et.al. 2018) report and is summarized in Section 2.2. Measurements made prior to interim waste stabilization or waste retrieval were not considered in the verification of maximum measured concentrations as they are not representative of current tank farm conditions. Data for surrogate COPCs were also considered in determining the "high inlet spike" concentrations. Table 3 shows the summary of COPC concentrations used during testing.

Table 3. COPC Concentrations for 200% OEL and High-Concentration Tests (original and revised test concentrations based on reevaluation of SWIHD and TWINS data)

CAS	Name	Maximum Conc. SWIHD/TWINS (COPC or surrogate)	200% OEL Test	High Concentration Test
75-07-0	Acetaldehyde	39 ppm	50 ppm	None
75-05-8	Acetonitrile	18.8 ppm	40 ppm	None
71-43-2	Benzene	0.189 ppm	1 ppm	None
107-12-0	Propanenitrile	0.78 ppm	12 ppm	None
106-99-0	1,3-Butadiene	3.38 ppm	3.4 ppm	None
50-00-0	Formaldehyde	0.157 ppm	0.6 ppm	None
108-47-4	2,4-Dimethylpyridine	0.147 ppm	1 ppm	None
62-75-9	NDMA	0.0621 ppm	0.0006 ppm	0.062 ppm
110-00-9	Furan	0.721 ppm	0.002 ppm	0.017 ppm[a]
7664-41-7	Ammonia	2,502 ppm	50 ppm	630 ppm
10024-97-2	Nitrous Oxide	831 ppm	100 ppm	831 ppm

[a] The maximum for furan will be tested in the next phase of testing. The in-tank farm test will be on waste tank BY-108, which at the time of testing was believed to be in cascade with BY-107, where the listed maximum furan sample was collected. Drawings H-2-1308, H-2-1318, H-2-132, and H-2-601in addition to RPP-RPT-50840 showed connected and open cascading overflow lines between BX107, BX108, BX109, BY107, BY108, and BY109. In August 2018 (after testing was complete), a construction implementation drawing H-2-36490 (from 1972) identified the planned isolation of the cascade lines to BY-108, though it is not clear if the isolation effort has completed.

Additional information on the concentration selection process can be found in the *Maximum Concentration Values Review for Use in NUCON Vapor Abatement Unit Tests* report (Mahoney et al. 2018).

3.0 Test Equipment and Methods

While NUCON was procuring and fabricating the additional diesel engine skid to be used for this phase of testing, PNNL was bench testing the analytical equipment to be used during assessment testing. The bench efforts developed the calibration methods and trace analytical methods for detecting COPCs at the identified thresholds, nominally 10% of the OEL in an engine exhaust stream. Additionally, the design and fabrication of the COPC gas injection systems and the sample collection systems were completed.

NUCON TOS performance assessment included three major tests. Test 1 was to confirm the performance of the analytical instrumentation, followed by tests 2 and 3, which evaluated the DRE and resulting exhaust purification for a selection of 11 COPCs that have been measured in Hanford HLW SST passive breather vapor emissions.

The tests were as follows:

- Test 1 – COPC injection into the exhaust stream of the TOS to reach 10% OEL concentration and confirmation of its detection for the 11 COPCs being tested
- Test 2 – COPC injection into the air-intake stream of the TOS to reach 200% OEL concentration for determining TOS DRE for each COPC at that concentration
- Test 3 (where applicable) – COPC injection into the air-intake stream of the TOS to reach a pre-determined high concentration (see Table 3) for determining TOS DRE for the COPC at that concentration.

3.1 Test Equipment

3.1.1 The NUCON TOS Skid

Multiple components on two skids make up the NUCON TOS unit (Figure 1) that was tested by PNNL. The first skid was the original propane TOS unit, consisting of a propane generator and TOS balance-of-plant. The second skid was the diesel engine generator, catalytic converter (diesel oxidation catalyst), particulate filter, and piping for integration to the balance-of-plant on the first skid. During testing on the Q Avenue Pad on the PNNL Richland, Washington Campus, the two skids were referred to as the "NUCON TOS." The propane generator set was disconnected from the TOS piping and was not a component in this testing effort.

A general TOS and diesel skid image is given below. Images of the NUCON TOS components are in Appendix A.

Figure 1. Photo of the NUCON TOS

The NUCON TOS components are listed below in order of their sequence to the air/exhaust flow stream in the system:

1. Metal particulate screen (60 x 150 mm) connected to the three-way valve (also see Figure A.5). This was the sole path through which ambient air was introduced to the system during steady state testing.
2. Piping on the skid was SA-316/316L stainless steel WLD 2-in. schedule 10S.
3. Referred to as the demister, the first HEPA housing had a particulate HEPA filter installed that was left in from the Ohio testing campaign. The HEPA housing's outside dimensions were 14-in.-diameter x 14-in.-tall.
    a. The internal HEPA media is an American Air Filter Astrocel®[1] I HEPA Filter part 12A26J6P0A1 (900-895-503) S/N 41621250. The listed test results had a penetration of 0.006%, resistance of 0.8 in. water gauge, at the flow rate of 50 cfm. Size 8" x 8" x 5 7/8".
4. A Fox Thermal Instruments, Inc. Model FT1-06IDDP1 serial # F00780 Flow Meter set to 0 to 60 standard cubic feet per minute (scfm) per vendor-approved change (FT-101).
5. Yellow K type Thermocouple TT-102 before the flow is warmed in the heat exchanger (K48U-006-4).
6. Ambient air inlet to the heat exchanger that used exhaust air to heat the ambient air before going into the MERSORB®[2] filter. The heat exchanger is to reduce the inlet air relative humidity before entering the filter media (see Figure A.4).
7. Yellow K type Thermocouple TT-103 outlet air temperature after the heat exchanger (McMaster 330-995-5909, SO 1209450-1, S/N CBBC74).
8. A particulate HEPA filter was left in the as-measured 14-in.-diameter x 14-in.-tall (outside housing dimensions) filter housing.

[1] Astrocel is a registered trademark of American Air Filter Company, Inc.
[2] MERSORB is a registered trademark of Selective Absorption Associates Inc.

a. The internal media is an American Air Filter Astrocel® I HEPA Filter part 12A26J6P0A1 (900-895-503). The listed test results for the sister filter (item 3) had a penetration of 0.006%, resistance of 0.8 in. water gauge, at the flow rate of 50 cfm. Size 8" x 8" x 5 7/8".

9. MERSORB® absorbent container made of 24-in.-diameter schedule 10S A-312/SA-312 stainless steel with a length of 64 in. NUCON had not removed the 73 kg of MERSORB® absorbent that had been tested in Ohio for ~45 minutes with mercury. (Inlet air was near the bottom and release air from the column came out near the top.)
10. AMETEK 0.5 HP Sealed Regenerative Blower with XP Motor part EN303AG91L/038026.
    a. The motor is a Baldor-Reliance 854609767 S/N W17011605 (catalog number 515635).
11. Yellow K type Thermocouple TT-109 (label illegible).
12. Omega Model PX419-10WCGI (S/N 472875) Pressure sensor – pressure range +/- 10 output 12-20 12mA zero. Used to control the blower via the programmable logic controller (PLC).
13. Kohler KDI1903ESM Diesel Engine Spec 6D08E1-1 (S/N 4728402750) rated at 28 BHP at1800 rpm with Decision-Maker 3000 controls. Engine power 19-37 KW with 1.861 liters displacement (engine family HKHXL2.49ESM).
    a. Connected to a Kohler 15REOZK 15 kVA Generator (S/N SGM32LMWJ).
14. 4SX-15REOZK Catalytic Purifier muffler emissions control device manufactured by Catalytic Exhaust Products (i.e., DOC).[1]
15. Yellow K type Thermocouple TT-111 (K48U-006-4).
16. Diesel Particulate Filter 758SXS-SC by Catalytic Exhaust Products.[1]
17. Heat exchanger (same as component 6).
18. 2-in. exhaust muffler.
19. Yellow K type Omega Thermocouple TT-112(0226).

Note: A 10-ft-long, 2-in. exhaust pipe was added to the muffler.

20. The circuit breaker box that powers the PLC and the human-machine interface controller and data collection.
21. The Powerhouse Manufacturing (model 11.3-.25-240-1) switch box and 11.25-kVA load bank. This is switched to the full 11.25-kVA load during steady state testing on the diesel engine.

[1] Parts numbers were from the John Stekar, Catalytic Exhaust Products Limited, November 8, 2017 letter, *Diesel Exhaust Emissions Control Devices for Kohler 15REOZK Diesel Generator Sets*.

Key interfaces between the other systems and the NUCON TOS include the following:

1. A COPC injection system that delivered measured amounts of COPCs to multiple points on the TOS for Cylinder Gas Bottles and liquid COPC sources.
2. A sampling system that interfaced with the TOS at multiple locations to measure overall and component performance, including provisions for effective particulate (i.e., soot) filtration, required temperature control, and, where necessary, highly accurate exhaust and dilute-inert flow control.
3. A data acquisition and control system that controlled and recorded performance of both systems.

A diagram of the intake air and exhaust handling system for the TOS is shown in Figure 2, and the TOS ports are identified in Table 4 along with their respective functions. Note that injection of COPCs for the TOS evaluation occurred downstream from the MERSORB® unit in SP517-519 as noted in Table 4. The rationale behind this approach was to ensure accurate and timely evaluation of the TOS under equilibrium conditions. Comparatively, if a COPC test gas had been introduced upstream of the MERSORB® unit, it would have resulted in a non-equilibrium condition to the volume of the MERSORB® unit combined with a transient affinity of the MERSORB® for each COPC. A non-equilibrium condition for an injected COPC would therefore be transient until the free volume was swept and the MERSORB® achieved equilibrium with the COPC. This could extend over hours, perhaps days, prior to reaching equilibration. For this reason, the injection of COPCs occurred downstream of the MERSORB® unit in SP517-519.

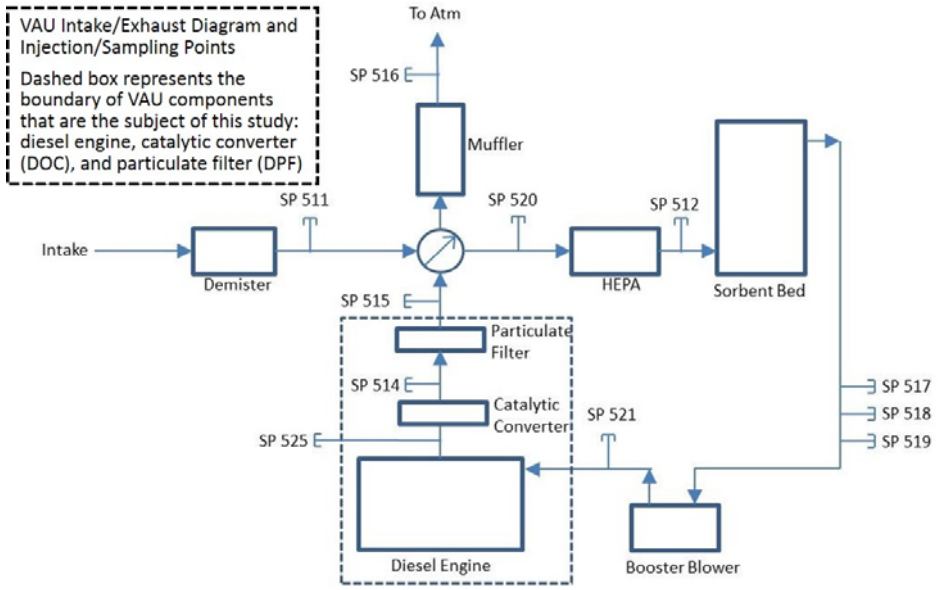

Figure 2. TOS Intake Air and Exhaust Handling System

Table 4. TOS Port Identification and Description of Function

TOS Port	Stream	Precedent	Antecedent	Planned Use
SP511	Intake	Demister	Heat exchanger	Reserved
SP520	Intake	Heat exchanger	HEPA	Reserved
SP512	Intake	HEPA	Sorbent bed	Reserved
SP517	Intake	Sorbent bed	Booster blower	Injection: Tests #2, #3 (DRE)
SP518	Intake	Sorbent bed	Booster blower	Injection: Tests #2, #3 (DRE)
SP519	Intake	Sorbent bed	Booster blower	Injection: Tests #2, #3 (DRE)
SP521	Intake	Booster blower	Engine	Sample: Inlet for Tests #2, #3
SP525	Exhaust	Engine	Catalytic converter	Component DRE sampling
SP514	Exhaust	Catalytic convertor	Particulate filter	Component DRE sampling
SP515	Exhaust	Cat conv/ Particulate filter	Heat exchanger	Injection: Test #1 (detection)
SP516	Exhaust	Muffler	Exhaust outfall	Sample: TOS outlet for all tests

3.1.2 Test Instrumentation

The COPCs were analyzed by appropriate instrumentation, identified in Table 5, that provided the necessary level of detection in the TOS exhaust stream for real-time analysis. The methods used for analysis of each COPC were developed and verified on the bench-scale in PNNL laboratory space.

Table 5. COPC Low Detection Limit Target Instrumentation for Real-Time Analysis

COPC	CAS	Target Instrument	Notes
Ammonia	7664-41-7	FTIR	
Nitrous Oxide	10024-97-2	FTIR	
1,3-Butadiene	106-99-0	PTR-MS	
Benzene	71-43-2	PTR-MS	
Formaldehyde	50-00-0	PTR-MS	
Acetaldehyde	75-07-0	PTR-MS	FTIR for corroboration
Furan	110-00-9	PTR-MS	
Acetonitrile	75-05-8	PTR-MS	
Propanenitrile	107-12-0	PTR-MS	
N-Nitrosodimethylamine	62-75-9	PTR-MS	Preconcentration as required
2,4-Dimethylpyridine	108-47-4	PTR-MS	Preconcentration as required

Details of the instruments used during testing are described below.

1. Ionicon Analytik PTR-MS

   The PTR-MS used in the tests was a PNNL-modified version of an Ionicon Analytik PTR-MS (S/N 44096535).

This PTR-MS was selected based on previous work at PNNL by Lizabeth Alexander and others (Jobson et al. 2005) using the same PTR-MS being deployed in this project, since significant interferences were not expected at the concentration levels being measured for 1,3-butadiene, acetaldehyde, acetonitrile, benzene, or 2,4-dimethylpyridine. However, there was the potential for interference on propanenitrile, and the potential for interferences increases significantly for the compounds at ~1 ppb or less. However, in the previous cited work, a post-combustion catalytic converter (three-way catalyst) was not employed. The TOS comprises a post-combustion catalytic converter (diesel oxidation catalyst); thus, the potential for interferences is reduced but not eliminated.

Matrix interferences in the engine exhaust stream and ultra-trace level detection requirements represent the primary challenges to accurate COPC analysis. In addition to the catalytic converter, other mitigation approaches were employed. These include use of different ionization methods using NO+, long averaging cycles, direct injection compared to no injected exhausts, and other operational strategies developed to improve the COPC measurements in the exhaust.

2. Low-level concentration requirements – volatile organic compound (VOC) pre-concentration option

Although a variety of pre-concentration approaches and methodologies exist, including that described in EPA Method TO-12, this testing was planned and bench tested to deploy an approach similar to that described by Erickson.[1] During instrumentation bench testing, a commercial liquid nitrogen cryogenic trap from Scientific Instrument Services, Inc. was interfaced to the PTR-MS as an approach to pre-concentration of the exhaust effluent prior to the PTR-MS analysis to enhance lower detection limits. Use of the liquid nitrogen cryogenic trap was intended to concentrate the sampled gas stream and effectively enhance the lower detection limits for the PTR-MS.

Qualification of the preconcentrator (i.e., cryogenic trap) was performed early in project as part of the instrument readiness activity and method development. As there are multiple potential options for equipment and operating strategy, qualification testing is necessary to ensure that the range of potential options can be reduced before the design is finalized. Consequently, the final strategy was based on the ability to concentrate exhaust effluent and its components, as well as the ability of design and operational methodology to manage water during the trapping phase. The qualification of a preconcentrator was assessed in conjunction with the PTR-MS for the ability of these two integrated components to reliably measure the application COPC(s) at the necessary level(s).

The Agilent 6890N Gas Chromatograph (S/N US10443076) was installed for use as a component of the pre-concentrator operations to rapidly heat the cryogenic trap.

The use of the preconcentration system was expected to be limited to the testing of the furans and the reliable detection of 0.03 ppb NDMA.

Given the high diesel backgrounds for NDMA and furan, the use of the preconcentration systems was not implemented during tests 5.1, 5.2, or 5.3. So, while it was developed during the bench phase of instrumentation development, it was not used during the TOS performance testing.

[1] Matthew Howard Erickson, *Measuring Diesel Exhaust Gas Phase Organics With A Thermal Desorption Proton Transfer Reaction Mass Spectrometer*. A dissertation submitted for the Doctor of Philosophy, Washington State University, July 2013.

3. FTIR

   The FTIR used in testing was an MKS-2030 MultiGas Analyzer (S/N 01858) specifically designed for exhaust gas temperatures. FTIR spectroscopy was used as the primary detection method for a selection of COPCs and corroboratory (to PTR-MS) detection for additional COPCs as shown in Table 1. FTIR spectroscopy was also used during shakedown as primary analysis for a selection of emission criteria pollutants of specific interest to engine exhaust applications, including moisture, NO, NO_2, and CO. Vendor-supplied methods and certified calibrations were used for COPC identification and quantification. Additionally, FTIR spectroscopy was used to assist with the identification of other components in the exhaust stream.

4. Gas chromatography/mass spectrometry (GC/MS)

   The Agilent 6890N Gas Chromatograph (S/N US10411048) with the Agilent 5973 Mass Selective Detector (S/N US40630240) were used to assist with primary component analysis, chemical interference assessment, and sensitivity improvement. Although a variety of GC detectors can be used for NDMA determination, GC/MS with chemical ionization and MS/MS was the process that was utilized.

   Given the high diesel backgrounds for NDMA and furan, the use of the GC/MS was not implemented during tests 5.1, 5.2, or 5.3. So, while it was developed during the bench phase of instrumentation development, it was not used during the TOS performance testing.

5. AreaRAE PGM-5020 Photoionizer instrument detector (PID)

   A PID was provided by WRPS and was used to measure VOCs. The total VOC concentration was measured in the exhaust. DREs for the VOC data available are calculated and reported using PID results. The AreaRAE PGM-5020 Photoionizer detector serial number is 295-00393.

3.1.3 COPC Injection System

The injection system was designed to deliver measured amounts of COPC test gases to different points on the TOS depending on the phase of testing. A process flow diagram (PFD) of the COPC injection systems is shown in Figure 3. The test gas injection points were as follows:

1. Test 1 (demonstration/validation of 10% OEL detection in exhaust) – SP515 downstream of the DPF, but upstream of the heat exchanger
2. Test 2 and test 3 (DRE testing) – SP517-519 downstream of MERSORB® unit, but upstream of intake staging pump

The initial equipment and component considerations included tubing, mass flow controllers, valves, physical support structure, and considerations for control and thermal management. Wetted parts were in the inerted form (using SilcoNert™ tubing[1]) to minimize unwanted chemistry or retention of compounds

[1] SilcoNert is a trademark of SilcoTek, which is the world's leading provider of high-performance coatings applied by chemical vapor deposition.

on the surface of the injection system. Depending on the selected concentration of the COPC test gases, thermal management (e.g., heat trace/insulation) was required to prevent condensation of COPCs.

As shown in Figure 3, the injection system was designed to provide multiple COPC test gases simultaneously manifolded prior to the final injection, with potential consideration for remote switching and purging of the test lines when changing among COPCs or between test phases.

Provisions in the design also provide flow measurement of the inlet air (used For Information Only measurements) to the TOS.

The assembled system was performance tested and QA-affecting mass flow controllers were user-calibrated using DryCal[1] units.

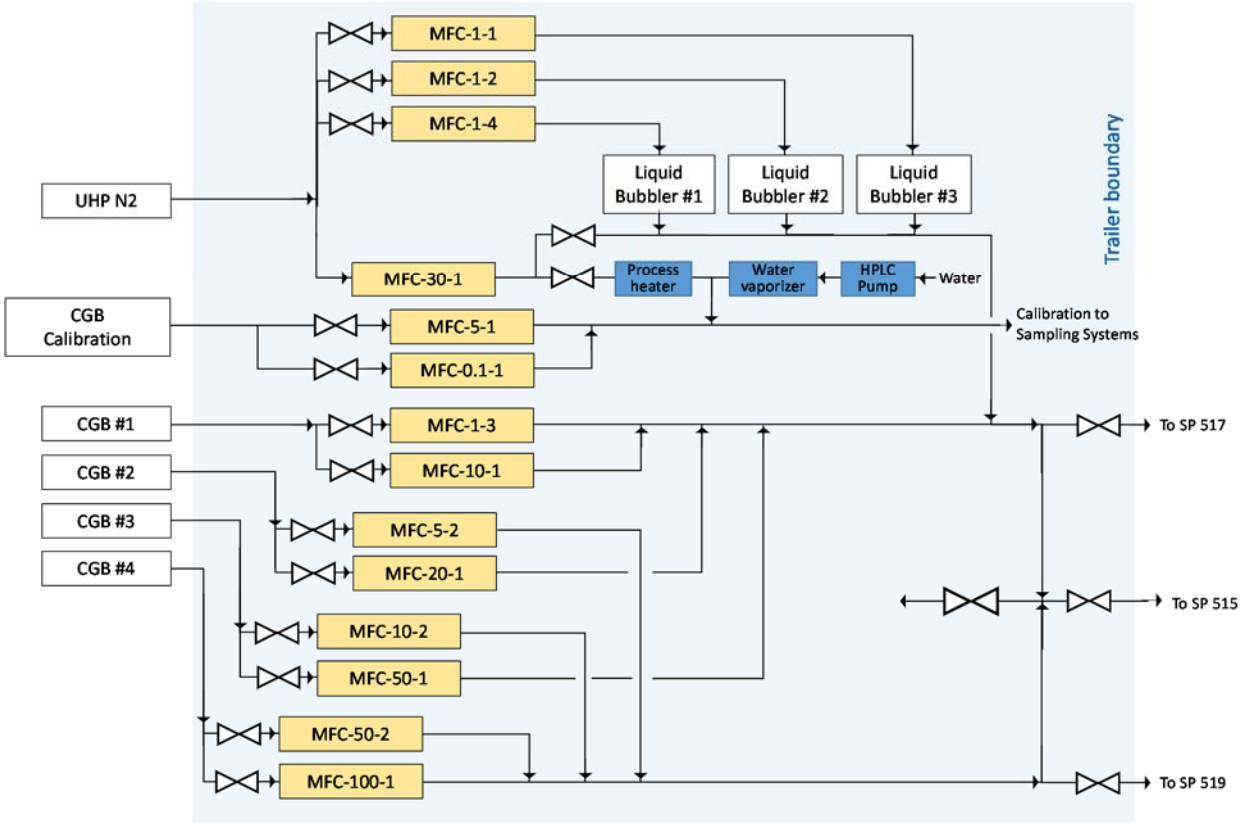

Figure 3. Process Flow Diagram of TOS COPC Injection System

3.1.4 Sampling System

The PFD for the sample acquisition and delivery system is shown in Figure 4, and is designed to deliver a TOS exhaust stream from one of several sampling ports on the TOS skid. The system design provided both filtered and conditioned exhaust to the primary analytical systems, and unfiltered exhaust when needed to the particulate analysis system. The system released the instrumentation exhaust gases through

[1] A product of Mesa Labs.

stacks on the trailer roof. Note that the PTR-MS was also used to analyze unconditioned exhaust, while the other instruments required pre-filtration.

The two sampling points required to accurately assess the performance of the TOS are as follows:

1. The sample port downstream of the muffler (SP516), which is the source for all exhaust samples. This port was also used during the 10% OEL detection testing prior to use in all phases of DRE testing.
2. The sample port after the booster blower and immediately before the engine (SP521), which is the sample location for validating the COPC inlet concentration during DRE testing.

Additionally, some samples at ports after the diesel engine (SP525) and after the catalytic converter (SP514) were collected and analyzed on-line to help understand the contribution of individual system components to the TOS performance.

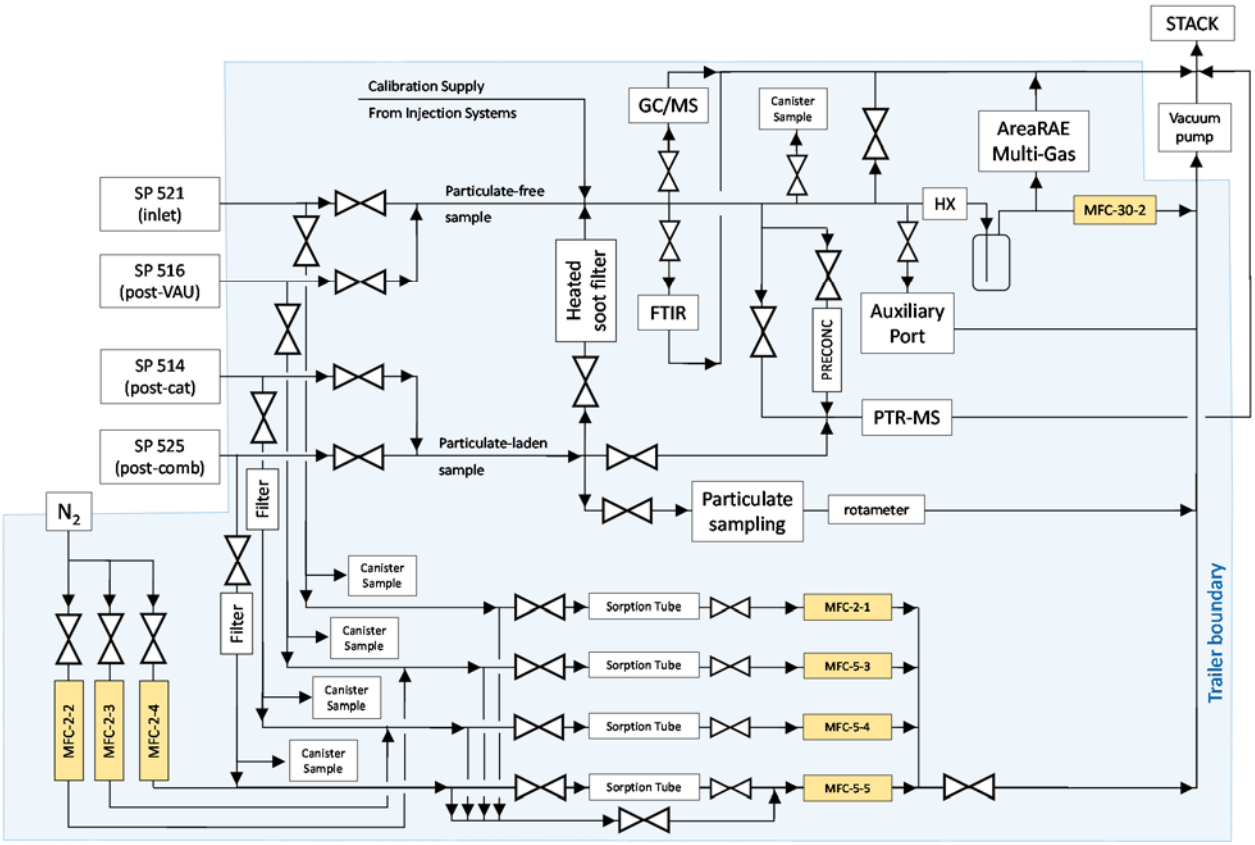

Figure 4. PFD of TOS Exhaust Sampling System and Analytical Systems

The exhaust sampling port considerations included the need for a port that would be most representative of the exhaust outfall (i.e., to atmosphere/environment) and the need for at least one upstream port separated by sufficient mixing to be used for injection of test gases for the 10% OEL detection validation. The post-muffler port, SP516, met both criteria as being the nearest port to the stack outfall and being upstream of port SP515, which was used to inject test gas to achieve the 10% OEL detection validation necessary to demonstrate confidence in sample analysis. SP516 and SP515 are separated by the heat exchanger and the muffler that represent mixing chambers without significant expected changes to or treatment of the compounds represented in the exhaust stream. While the heat exchanger is tube-in-tube,

the muffler represents a tortuous path to mix the exhaust stream with test gases injected at SP515 prior to sampling.

The other sample point used for this test was intake sample port SP521, immediately upstream of the engine. This port was used to validate the concentration of test gas that was fed to the engine during the DRE testing phases. The SP521 port is downstream of the booster blower, which is downstream of the main test gas inlet (port SP517). The active operation of the booster blower provides mechanical mixing of the intake stream with the injected test gases in order to provide a representative sample of the intake air to the engine.

A baseline air sample was collected from intake sample port SP521 prior to injection of test gases. This provided an accurate baseline of the air that exits the MERSORB® tank and enters the engine.
The sampling system was designed with particulate management, both to protect the analytical instrumentation from particulates in the TOS exhaust and to determine if the particulate stream contains a measurable amount of COPCs. The particulate management was configured to allow for switching between filter units as well as recovery of particulates from the filters. The particulate sampling included an alternative system in the event that the conditioning and sampling objectives could be combined efficiently into a single unit operation.

Thermal management was required for the sample streams to ensure that the sample was provided to the analytical instrumentation at an appropriate temperature, nominally ~190°C. Primary considerations for thermal management include temperature compatibility of the analytical instrumentation and minimization of adsorption or condensation of any exhaust species or reaction product. This required design considerations for active heating. The active heating consisted of sections of vendor-supplied heated tubing that was controlled by the data acquisition and control system.

As shown in Figure 4, a primary sample loop was designed into the system using a vacuum pump to provide a continuous loop of TOS exhaust through the sampling lines and out to a safe exhaust point. This provided sufficient amounts of sample to the sampling lines for each instrument to draw upon (actively or passively).

3.1.5 Off-Line Sampling System

The TOS sampling system also included the capability for acquiring samples for off-line analysis from the four sample locations (one inlet and three exhaust). Samples acquired at the TOS inlet at SP521 and TOS outlet (i.e., tailpipe) at SP516 support TOS DRE corroboration; samples acquired at the diesel engine outlet at SP525 (before the catalyst) and catalyst outlet at SP514 (before the DPF) were for TOS component assessment to support subsequent WRPS design and permitting efforts (herein referred to as "engineering samples"). Sample acquisition for each COPC for off-line analysis came in the following forms:

1. Sorbent tube sample acquisition and analysis by approved method (as detailed in Table 6) and certified laboratory analysis. This supported analysis of formaldehyde, NDMA, and ammonia.
2. SUMMA® canister sample acquisition and analysis by EPA Method TO-15 and certified laboratory analysis. This supported analysis of nitrous oxide, 1,3-butadiene, benzene, acetaldehyde, furan, acetonitrile, propanenitrile, and 2,4-dimethylpyridine. (The SUMMA® canisters included a 1-hour flow restrictor on the inlet. The restrictor design had an increased suction flow when first opened and would decrease in flow as the vacuum in the SUMMA® canister reduced over time.)

During TOS testing, samples collected for analysis at the inlet and tailpipe of the TOS included at a minimum real-time analysis (by PTR-MS or FTIR) ***AND*** one method of off-line analysis as described above. Also during TOS testing, samples collected for analysis after the engine and after the catalyst included real-time analysis ***OR*** one method of off-line analysis as described above. Thus, only a single analysis (i.e., without corroboration) was required for the latter engineering samples, and included either (i) real-time analysis by PTR-MS or FTIR, (ii) sorbent tube, or (iii) canister sample. However, it is important to note that during testing priority was directed towards ensuring with high confidence the real-time analyses at the TOS inlet and TOS outlet (i.e., tailpipe) at SP521 and SP516, respectively. Typically during most of the testing (with two exceptions), samples at SP525 and SP514 were successfully analyzed on-line to help understand the contribution of individual system components to the TOS performance. In two situations, testing was not able to accommodate with high confidence a real-time measurement after the catalyst and before the DPF (port C, SP514). However, the DPF was demonstrated during testing to have little to no impact on COPC removal performance, and thus in the two situations where a port C real-time analysis sample was not feasible, the difference between post-engine (port B) and tailpipe (port D) results can be confidently attributed to catalyst performance versus the DPF.

Solid adsorbents in metal or glass tubes (i.e., sorption tubes) and/or specially-prepared stainless steel SUMMA® canisters designed to collect the relevant COPC samples for most tests were used to collect samples from the engine inlet air, after the engine, after the catalytic converter, and after the particulate filter (i.e., after the TOS). The absorption tubes and/or canisters were used per the detail shown in Table 7 for required capture media (e.g., SUMMA® canister and/or sorbent tube type) and analytical method for that COPC. The sorption tube and canister samples were analyzed by an ORP subcontractor (WAI at 222-S laboratory) with established analytical methods, protocols, and programs. The assignment of field blanks, travel blanks, and duplicate samples was established prior to testing with WRPS. Additionally, the preliminary target collection parameters for sorption tubes (e.g., flow rates) in Table 7 are based on a collection cycle that is valid with the addition of nitrogen dilution for moisture control and temperature adjustments.

Table 6. Sorption Tubes for TOS DRE Corroboration and TOS Component Assessment

COPC	Sorption Tube Type	Exhaust Volume (L)	Target Flow Rate (mL/min)	Analytical Method
Ammonia	Anasorb® [a] 747 (sulfuric acid), SKC-226-81 [b]	24.01+/- 0.70	200	OSHA-ID-188 IC
Formaldehyde	DNPH Treated Silica Gel, SKC-226-119	24.63 +/- 6.57	200	EPA TO-11A HPLC
NDMA	Thermosorb® [c]/N	241.48 +/- 9.74	2000	NIOSH-2522 Modified GC-TEA

[a] Anasorb is a registered trademark of SKC, Inc.

[b] While the Test Plan was based on Anasorb® 747 (sulfuric acid), SKC-226-29 tube, actual testing used the SKC-226-81 model that resulted in a non-conformance condition discussed in Section 5.6.

[c] Thermo-Sorb is a registered trademark of the Carboline Company

Table 7. Sorption Tube Collection Times

COPC	Test	Flow Rate (mL/min)	Inlet Conc (ppm)	Inlet Test Time (min)	Exhaust Conc (ppm)	Outlet Test Time (min)
Ammonia	Test #2	200	50	45	2.5	135
Ammonia	Test #3	200	630	45	2.5	135
Formaldehyde	Test #2	200	0.6	20	0.03	80
NDMA	Test #2	2000	0.0006	80	0.00003	320
NDMA	Test #3	2000	0.062	80	0.00003	320

Notes:

62-75-9 NDMA	Diluted with 3 parts N_2 gas per 1 part exhaust when sucked through the tube. It should also be noted on the NDMA test #2 a media failure in the inlet tube did not allow the collection of that sample.
50-00-0 Formaldehyde	Diluted with 3 parts N_2 gas per 1 part exhaust when sucked through the tube.
7664-41-7 Ammonia	Diluted with 2 parts N_2 gas per 1 part exhaust when sucked through the tube. Slight in-line moisture was observed after 4 hours of sample collection on the last duplicate tube sample. Additional dilution gas was added to later formaldehyde and NDMA sampling.

For the off-line sampling, sorption tube traveler and blank QA samples were collected for each sampling event. Additionally, random (locations pulled from a hat) duplicate off-line media samples were collected as listed below.

- Duplicate SUMMA® canisters were collected from the 200% OEL tests from the following:
  - The acetaldehyde/acetonitrile test from ports SP521 and SP516
  - The 1,3-butadiene/formaldehyde/2,4-dimethylpyridine test from port SP521
  - The ammonia/nitrous oxide test from port SP516
  - The NDMA/furan test from port SP514
- Duplicate sorption tubes were collected from the 200% OEL tests as follows:
  - A DNPH Treated Silica Gel, SKC-226-119 tube was pulled during the 1,3-butadiene/ formaldehyde/2,4-dimethylpyridine test from port SP514.
  - Four Anasorb 747 (sulfuric acid), SKC-226-81[1] tubes were pulled during the ammonia/nitrous oxide testing. One was from port SP521, one from SP225, one from port SP514, and the one from port SP516.

Collection of Condensable Gases in the Exhaust Stream

Engine exhaust contains condensable gases (including a significant amount of water), which can result in condensation formation and unknown collection efficiencies when cooling the exhaust to the required temperature for sorbent tube collection. To mitigate this effect, during sorption tube collection the exhaust gas was *diluted* to a level where supersaturation of water was avoided as dilution is preferred over H_2O separation to avoid the inadvertent removal of COPCs with H_2O separation. Additionally, dilution

[1] While the Test Plan was based on Anasorb® 747 (sulfuric acid), SKC-226-29 tube, actual testing used the SKC-226-81 model that resulted in a non-conformance condition discussed in Section 5.6.

allowed for the sorption tube samples to be collected at a sample temperature that was within an appropriate range per manufacturer recommendations.

3.2 Test Methods

Test objectives included the following:

- Demonstrate detection of each COPC in the TOS exhaust stream to 10% OEL concentration.
- Measure COPC concentration at the TOS inlet and TOS outlet for TOS DRE assessment, and acquire samples (sorbent tube or canister) for off-line analysis for corroboration.
- Provide means for determining COPC concentration at post-engine and post-catalyst locations by either on-line analysis or sample acquisition (sorbent tube or canister) for off-line analysis.

Testing of the COPC in the NUCON TOS and associated sampling systems was performed in two phases:

1. Post-combustion injection (test 1) using single-component COPC compressed gas bottle (CGB) blends
2. Pre-combustion injection (tests 2 and 3) using either single-component COPC CGB blends or COPC delivery from a liquid bubbler

Each test injected one to three COPCs simultaneously to facilitate extended duration analysis dwell times for maximizing signal-to-noise ratio. This allowed highly efficient comparison of the signal with and without the COPC injection. This strategy was useful for quantifying ultra-trace level COPCs to a high-confidence level.

3.2.1 Post-combustion COPC Injection for Analytical Sensitivity Validation (Test 1)

Table 8 shows the tests for test 1 – post-combustion COPC injection to ≤10% of the OEL concentration for validation of COPC detection in the engine exhaust. The results of test 1 for each COPC are documented in Section 5.0. Each test number in Table 8 corresponds to the respective test number in the test matrix (Section 4.1) and the corresponding sample matrix (Section 4.2). These tests were performed to demonstrate the detection efficacy of the real-time sampling and analysis system under operating conditions. For these tests, SP515 was used to inject individual or groups of COPCs into the TOS exhaust immediately after the DPF to ≤10% the OEL of each COPC. Then, SP516 was used to obtain the TOS exhaust sample (including the injected COPC) after the heat exchanger and muffler (see Figure 2). Sample acquisition for off-line analysis was not performed during these tests.

Table 8. Test 1 – 10% of OEL Detection/Validation

10% of OEL concentration in exhaust COPC detection/validation						
Test	CAS	Name	Conc.	Instrument	Inj. Port	Samp. Port
1.1	75-07-0	Acetaldehyde	2.5 ppm	PTR-MS or FTIR	SP515	SP516
1.1	75-05-8	Acetonitrile	2.0 ppm	PTR-MS or FTIR	SP515	SP516
2.1	71-43-2	Benzene	0.050 ppm	PTR-MS	SP515	SP516
2.1	107-12-0	Propanenitrile	0.60 ppm	PTR-MS	SP515	SP516
3.1	106-99-0	1,3-Butadiene	0.10 ppm	PTR-MS	SP515	SP516
3.1	50-00-0	Formaldehyde	0.030 ppm	PTR-MS	SP515	SP516
3.1	108-47-4	2,4-Dimethylpyridine	0.050 ppm	PTR-MS	SP515	SP516
4.1	62-75-9	NDMA	0.000030 ppm	PTR-MS	SP515	SP516
5.1	110-00-9	Furan	0.00010 ppm	PTR-MS	SP515	SP516
6.1	7664-41-7	Ammonia	2.5 ppm	FTIR	SP515	SP516
6.1	10024-97-2	Nitrous Oxide	5.0 ppm	FTIR	SP515	SP516

The concentrations of 10% OEL shown in Table 8, represent the target detection thresholds for each COPC. Experience with the PTR-MS has demonstrated sensitivity to ~0.1 ppb for each COPC in the absence of specific interferences.

Each of the analytical instruments was used to analyze a specific subset of the test COPCs during testing. Test log books and data sheets were used to record time and date of test activities to enable accurate integration of the data from the various test systems and test activities as described in the Laboratory Record Book and data packages. For each of the 10% OEL exhaust detection/validation tests, the following steps were taken:

1. Staff performed pre-job and system readiness check.
2. Analytical equipment was warmed up and calibrated/checked, and a baseline air evaluation was completed as needed. Some of this was concurrent with TOS startup and warmup.
3. The TOS system was started and operated to steady state[1] conditions.
4. The steady state baseline exhaust profile was captured at the stack exhaust sampling port (SP516) prior to COPC injection.
5. Measurements were taken on the exhaust to calculate the amount of COPC test gases required to be injected to achieve the target concentration in the exhaust stream. Refer to the testing matrix in Table 8.
6. The injection system was brought on-line to provide nominally one to three target COPCs at 10% OEL concentration in the exhaust stream using the post-catalytic converter port (SP515).
7. A series of samples was taken with the target analytical equipment, depending on the target COPCs used. Analysis was performed up to 5 to 10 times (or cycles) per set.

[1] Steady state conditions were identified when the TOS exhaust gas temperatures after the catalytic converter and after the muffler were stable and no longer increasing (normally achieved after 1 hour of operation). Then the FTIR and/or the PTR-MS was used to evaluate if the exhaust gases from port D had reached steady emission levels.

8. The injection of the COPC test gas was stopped.
9. Calibration of the instrument was re-verified and logged if necessary.
10. If needed, upon achieving steady state after stopping the final injection, the baseline exhaust and/or baseline air was checked.
11. In most cases, the systems were shut down since calibration and detection testing normally consumed a full day. In cases where the 200% OEL tests could also be completed, testing would proceed to step 6 in the 200% OEL process.

3.2.2 Pre-combustion COPC Injection for DRE Evaluation (Test 2 and Test 3)

Tests 2 and 3 were performed to determine the efficacy of the NUCON TOS for removal of COPCs under the defined operating conditions, and to inform subsequent WRPS design and permitting activities.

For tests 2 and 3, SP517 was used to inject the COPCs into the TOS air inlet before the booster blower. Testing was performed at 200% OEL injected concentration in test 2 for each COPC as shown in Table 9. Each test number in Table 9 corresponds to the respective test number in the test matrix (Section 4.1) and the corresponding sample matrix (Section 4.2). On-line analysis compared the results from the TOS inlet (SP521 after the booster blower) to the TOS outlet (SP516) to determine a DRE for each COPC using the target instrument identified in Table 9.

Testing was performed at a high concentration injected level in test 3 for a selection of the COPCs as detailed in Table 10. Similarly, the test number in Table 10 corresponds to the respective test number in the test matrix (Section 4.1) and the corresponding sample matrix (Section 4.2). On-line analysis similarly compared the results from the TOS inlet to the TOS outlet to determine a DRE for each COPC using the target instrument identified in Table 10.

As discussed prior, samples were acquired for off-line analysis at the TOS inlet and TOS outlet (i.e., tailpipe) for TOS DRE confirmation (to on-line analysis) in the form of either sorption tube (per the detail in Table 6 and Table 7) or SUMMA® canister samples. Additionally, engineering samples were acquired between the diesel engine and the DOC (SP525) and between the DOC and the DPF (SP514), in the form of on-line instrumentation, sorption tube samples, or canister samples.

Table 9. Test 2 –200% OEL Intake Concentrations for DRE Assessment

200% OEL Intake Concentration COPC Testing						
Test	CAS	Name	Conc.	Target Instrument	Inj. Port	Samp. Port
1.2	75-07-0	Acetaldehyde	50 ppm	PTR-MS	SP517	SP516
1.2	75-05-8	Acetonitrile	40 ppm	PTR-MS	SP517	SP516
2.2	71-43-2	Benzene	1.0 ppm	PTR-MS	SP517	SP516
2.2	107-12-0	Propanenitrile	12 ppm	PTR-MS	SP517	SP516
3.2	106-99-0	1,3-Butadiene	3.4 ppm	PTR-MS	SP517	SP516
3.2	50-00-0	Formaldehyde	0.60 ppm	PTR-MS	SP517	SP516
3.2	108-47-4	2,4-Dimethylpyridine	1.0 ppm	PTR-MS	SP517	SP516
4.2	62-75-9	N-Nitrosodimethylamine	0.00060 ppm	PTR-MS	SP517	SP516
5.2	110-00-9	Furan	0.0020 ppm	PTR-MS	SP517	SP516
6.2	7664-41-7	Ammonia	50 ppm	FTIR	SP517	SP516
6.2	10024-97-2	Nitrous Oxide	100 ppm	FTIR	SP517	SP516

Table 10. Test 3 – High Intake Concentration for DRE Assessment

High Intake Concentration COPC Testing						
Test	CAS	Name	Conc.	Target Instrument	Inj. Port	Samp. Port
-	75-07-0	Acetaldehyde	<test not required>			
-	75-05-8	Acetonitrile	<test not required>			
-	71-43-2	Benzene	<test not required>			
-	107-12-0	Propanenitrile	<test not required>			
-	106-99-0	1,3-Butadiene	<test not required>			
-	50-00-0	Formaldehyde	<test not required>			
3.3	108-47-4	2,4-Dimethylpyridine	<test not required>			
4.3	62-75-9	N-Nitrosodimethylamine	0.062 ppm	PTR-MS	SP517	SP516
5.3	110-00-9	Furan	0.017 ppm	PTR-MS	SP517	SP516
6.3	7664-41-7	Ammonia	630 ppm	FTIR	SP517	SP516
6.3	10024-97-2	Nitrous Oxide	830 ppm	FTIR	SP517	SP516
Test not required since the testing conditions at 200% OEL already bounded the high-concentration test conditions.						

TOS DREs for each COPC were calculated as discussed in Section 5 on the actual exhaust profile collected during testing as follows:

$$DRE = 1 - \frac{[Concentration\ of\ COPC\ in\ exhaust]}{[Concentration\ of\ COPC\ in\ intake]} \quad (1)$$

The DRE calculations do not compensate for COPCs produced from the engine (i.e., without injection) nor do they compensate for COPCs present in the baseline air. Thus, this potentially resulted in an apparent lower destruction efficiency if the COPC was formed by engine combustion. In extreme cases, this resulted in negative DRE values. Similarly, this can present a perceived COPC mass imbalance of

% DRE and relation to % OEL remaining in the TOS outlet. Thus, for clarity, the results in Appendix F and Section 5.5.2 should be referenced for detailed COPC assessment.

In cases where interfering components were found during testing (i.e., not the COPC) in the PTR-MS data, the DRE required background subtraction of the interference in addition to a larger number of analyses to confidently quantify the remaining target COPC in the exhaust above the signal from the interference.

Each of the analytical instruments was employed to analyze only its specific subset of the full COPC list during the post-combustion testing. For each set of tests for a specific set of COPCs, the following steps were taken:

1. Staff performed pre-job and system readiness check.
2. Analytical equipment was warmed up and calibrated/checked, and baseline air evaluation was completed as needed. Some of this was concurrent with TOS startup and warmup.
3. The TOS system was started and operated to steady state conditions.[1]
4. The steady state baseline exhaust profile was captured at the stack exhaust sampling port prior to COPC injection at SP516.
5. Measurements were taken on the intake to calculate the amount of COPC test gases required to be injected to achieve the target COPC concentrations in the intake stream. Refer to the testing matrices.
6. The injection system was brought on-line to provide nominally one to three target COPCs at the indicated concentrations in an intake injector port downstream (after) the MERSORB® bed, nominally SP517 through SP519.
7. Concentration of the injected COPC mix in the intake was analyzed at SP521.
8. A series of samples was taken with the target analytical equipment, exact configuration depending on the target COPC and the concentration. Analysis was performed up to 5 to 10 times per set.
9. The injection of the COPC test gas was stopped.
10. Calibration of the instrument was re-verified and logged if necessary.
11. If needed, upon achieving steady state after stopping the final injection, the baseline exhaust and/or baseline air was checked.
12. Systems were shut down, as testing always finished at the end of the work day.

3.2.3 Multi-component DRE Testing

At the conclusion of COPC-specific testing, the Test Plan included a multi-component DRE test on a sub-set of COPCs as shown in Section 4.1, test 7.1. This test was intended to assess the relation of COPC DRE to the presence of different combinations and concentrations of other COPCs. It is a single test using only on-line analytical instrumentation with no sample collection for off-line analysis.

[1] Steady state conditions were identified when the TOS exhaust gas temperatures after the catalytic converter and after the muffler were stable and no longer increasing (normally achieved after 1 hour of operation). Then the FTIR and/or the PTR-MS was used to evaluate if the exhaust gases from port D had reached steady emission levels.

Given the results of the COPC-specific testing, the fact that many of the COPCs had been tested with other COPCs in the same injection, and the operational limits for the PTR-MS (needing to operate in either the NO+ or H_3O+ mode), the additional value of this test became very limited. On June 11, 2018, WRPS, ORP, and PNNL determined that the multi-component DRE test would not be conducted during this phase of testing. The impact of multiple gas interactions is to be observed during future testing in the tank farms on Hanford waste tank BY-108.

4.0 Test Matrix, Sampling Matrix, and Calibrated Equipment

The details of the testing sequence (or test matrix), the sampling matrix, and the calibrated instrumentation are in this section. This shows the testing that was completed and establishes a framework for understanding the detailed test results in Section 5.0.

4.1 Test Matrix

The test matrix from the test plan and the original planned test execution are show in Table 11.

Table 11. NUCON TOS Master Test Matrix from the Test Plan

Test	COPC name	CAS	Conc (ppm)	Evaluation	CGB Flow (SLPM)	Bubbler Flow (SLPM)	COPC Injection Port
0.1	(multiple)	(multiple)	(n/a)	Shakedown - baseline air	(n/a)	(n/a)	(n/a)
0.2	(multiple)	(multiple)	(n/a)	Shakedown - baseline engine	(n/a)	(n/a)	(n/a)
1.1.a	Acetaldehyde	75-07-0	2.5	Detection	15.0	(n/a)	SP 515
1.1.b	Acetonitrile	75-05-8	2	Detection	9.97	(n/a)	SP 515
1.2.a	Acetaldehyde	75-07-0	50	DRE	(n/a)	0.059	SP 517-9
1.2.b	Acetonitrile	75-05-8	40	DRE	(n/a)	0.506	SP 517-9
1.3.a	Acetaldehyde	75-07-0	(no test)	(no test)	(no test)	(no test)	(no test)
1.3.b	Acetonitrile	75-05-8	(no test)	(no test)	(no test)	(no test)	(no test)
2.1.a	Benzene	71-43-2	0.05	Detection	0.374	(n/a)	SP 515
2.1.b	Propanenitrile	107-12-0	0.6	Detection	5.98	(n/a)	SP 515
2.2.a	Benzene	71-43-2	1	DRE	5.8	(n/a)	SP 517-9
2.2.b	Propanenitrile	107-12-0	12	DRE	93.4	(n/a)	SP 517-9
2.3.a	Benzene	71-43-2	(no test)	(no test)	(no test)	(no test)	(no test)
2.3.b	Propanenitrile	107-12-0	(no test)	(no test)	(no test)	(no test)	(no test)
3.1.a	1,3-Butadiene	106-99-0	0.1	Detection	1.50	(n/a)	SP 515
3.1.b	Formaldehyde	50-00-0	0.03	Detection	1.50	(n/a)	SP 515
3.1.c	2,4-Dimethylpyridine	108-47-4	0.05	Detection	14.96	(n/a)	SP 515
3.2.a	1,3-Butadiene	106-99-0	3.4	DRE	39.8	(n/a)	SP 517-9
3.2.b	Formaldehyde	50-00-0	0.6	DRE	23.4	(n/a)	SP 517-9
3.2.c	2,4-Dimethylpyridine	108-47-4	1	DRE	(n/a)	0.282	SP 517-9
3.3.a	1,3-Butadiene	106-99-0	(no test)	(no test)	(no test)	(no test)	(no test)
3.3.b	Formaldehyde	50-00-0	(no test)	(no test)	(no test)	(no test)	(no test)
3.3.c	2,4-Dimethylpyridine	108-47-4	(no test)	(no test)	(no test)	(no test)	(no test)
4.1.a	N-Nitrosodimethylamine	62-75-9	0.00003	Detection	0.045	(n/a)	SP 515
4.2.a	N-Nitrosodimethylamine	62-75-9	0.0006	DRE	0.700	(n/a)	SP 517-9
4.3.a	N-Nitrosodimethylamine	62-75-9	0.062	DRE	72.3	(n/a)	SP 517-9
5.1.a	Furan	110-00-9	0.0001	Detection	0.150	(n/a)	SP 515
5.2.a	Furan	110-00-9	0.002	DRE	2.34	(n/a)	SP 517-9
5.3.a	Furan	110-00-9	0.017	DRE	19.5	(n/a)	SP 517-9
6.1.a	Ammonia	7664-41-7	2.5	Detection	0.125	(n/a)	SP 515
6.1.b	Nitrous Oxide	10024-97-2	5	Detection	0.249	(n/a)	SP 515
6.2.a	Ammonia	7664-41-7	50	DRE	1.95	(n/a)	SP 517-9
6.2.b	Nitrous Oxide	10024-97-2	100	DRE	3.89	(n/a)	SP 517-9
6.3.a	Ammonia	7664-41-7	630	DRE	24.5	(n/a)	SP 517-9
6.3.b	Nitrous Oxide	10024-97-2	831	DRE	32.4	(n/a)	SP 517-9
7.1.a	Acetonitrile	75-05-8	40	Multi-component DRE	(n/a)	0.506	SP 517-9
7.1.b	2,4-Dimethylpyridine	108-47-4	1	Multi-component DRE	(n/a)	0.282	SP 517-9
7.1.c	Ammonia	7664-41-7	630	Multi-component DRE	24.5	(n/a)	SP 517-9
7.1.d	Nitrous Oxide	10024-97-2	100	Multi-component DRE	3.89	(n/a)	SP 517-9
7.1.e	N-Nitrosodimethylamine	62-75-9	0.062	Multi-component DRE	72.3	(n/a)	SP 517-9
7.1.f	Furan	110-00-9	0.017	Multi-component DRE	19.5	(n/a)	SP 517-9

4.2 Sampling Matrix

The sampling matrix from the test plan is detailed in Table 12 and shows both on-line and off-line analytical samples. In the performance testing, Furan was collected by SUMMA® canister and not by the TDU Tenex TA tube due to positive SUMMA® sampling results during bench testing and expected exhaust compound fouling concerns on the Tenex tube.

Table 12. NUCON TOS Master Sampling Matrix from the Test Plan

Test	COPC name	CAS	PTR-MS	Precon/ PTR-MS	FT-IR	AreaRAE Multi-Gas	GC/ MS	Particulate	Canister Sample (e.g., SUMMA®)	DNPH Treated Silica Gel, SKC-226-119	Thermosorb /N	TDU Tenax TA	Anasorb 747 (sulfuric acid) SKC-226-29
0.1	All 11 Test COPCs	(multiple)		SP 521	SP 521	SP 521							
0.2	All 11 Test COPCs	(multiple)	SP 516	SP 516	SP 516	SP 516							
1.1	Acetonitrile Acetaldehyde	75-05-8 75-07-0	SP 516		SP 516								
1.2	Acetonitrile Acetaldehyde	75-05-8 75-07-0	SP 521 SP 516		SP 521 SP 516	SP 521 SP 516		SP 525 SP 514	SP 521 SP 525 SP 514 SP 516				
2.1	Benzene Propanenitrile	71-43-2 107-12-0	SP 516		SP 516								
2.2	Benzene Propanenitrile	71-43-2 107-12-0	SP 521 SP 516		SP 521 SP 516	SP 521 SP 516		SP 525 SP 514	SP 521 SP 525 SP 514 SP 516				
3.1	1,3-Butadiene Formaldehyde 2,4-Dimethylpyridine	106-99-0 50-00-0 108-47-4	SP 516										
3.2	1,3-Butadiene Formaldehyde 2,4-Dimethylpyridine	106-99-0 50-00-0 108-47-4	SP 521 SP 516			SP 521 SP 516		SP 525 SP 514	SP 521 SP 525 SP 514 SP 516	SP 521 SP 525 SP 514 SP 516			
4.1	N-Nitrosodimethylamine	62-75-9		SP 516									
4.2	N-Nitrosodimethylamine	62-75-9	SP 521	SP 516		SP 521 SP 516		SP 525 SP 514			SP 521 SP 525 SP 514 SP 516		
4.3	N-Nitrosodimethylamine	62-75-9	SP 521	SP 516		SP 521 SP 516		SP 525 SP 514			SP 521 SP 525 SP 514 SP 516		
5.1	Furan	110-00-9		SP 516									
5.2	Furan	110-00-9	SP 521	SP 516		SP 521 SP 516		SP 525 SP 514				SP 521 SP 525 SP 514 SP 516	
5.3	Furan	110-00-9	SP 521	SP 516		SP 521 SP 516		SP 525 SP 514				SP 521 SP 525 SP 514 SP 516	
6.1	Ammonia Nitrous Oxide	7664-41-7 10024-97-2			SP 516								
6.2	Ammonia Nitrous Oxide	7664-41-7 10024-97-2			SP 521 SP 516	SP 521 SP 516		SP 525 SP 514	SP 521 SP 525 SP 514 SP 516				SP 521 SP 525 SP 514 SP 516
6.3	Ammonia Nitrous Oxide	7664-41-7 10024-97-2			SP 521 SP 516	SP 521 SP 516		SP 525 SP 514	SP 521 SP 525 SP 514 SP 516				SP 521 SP 525 SP 514 SP 516
7.1	Acetonitrile 2,4-Dimethylpyridine Ammonia Nitrous Oxide N-Nitrosodimethylamine Furan	(multiple)	SP 521 SP 516	SP 516	SP 521 SP 516	SP 521 SP 516							

4.3 Calibrated Equipment

An M&TE list was used to track all calibrated equipment used during testing (see Table 13). The M&TE list identifies the instrument and the calibration type for the instrument. The types of calibrations are as follows:

- Cat 1 M&TE: all M&TE calibrated externally by a qualified calibration laboratory
- Cat 2 M&TE: all M&TE that is user-calibrated
- Cat 3 M&TE: commercial measuring devices that are not adjustable and provide adequate accuracy
- Cat FIO M&TE: “For Information Only”; Cat 1 and 2 M&TE that is not being used for quality-affecting measurement

Table 13. NUCON TOS List of Calibrated Equipment

M&TE Name	Serial #	PNNL Property #	Calibration # / Calibration Sticker ID / Lot #	Calibration Expires	Location/ Comments	Category 1, 2, 3, FIO
6890N Gas Chromatograph, Agilent (GC/MS)	US10411048	WD81253	NA	NA	Q Ave Pad Test Trailer	2
5973 Mass Selective Detector, Agilent (GC/MS)	US90432021	NA	NA	NA	Q Ave Pad Test Trailer	2
6890N Gas Chromatograph, Agilent (Precon)	US10443076	WD47408	NA	NA	Q Ave Pad Test Trailer	2
MKS MultiGas 2030 FTIR Continuous Gas Analyzer	01858	Rented	NA	NA	Q Ave Pad Test Trailer	2
Ionicon Analytik PTR-MS	44096535	Rented	NA	NA	Q Ave Pad Test Trailer	2
AreaRAE PGM-5020 Photoionizer detector (PID)	295-00393	NA	NA	NA	Q Ave Pad Test Trailer	FIO
DryCal FlexCal, Low Flow (5 – 500 sccm)	143298	NA	143298	03/2019	Q Ave Pad On Demand	1
DryCal FlexCal, Medium Flow, (50 – 5,000 sccm)	135623	NA	135623	07/2018	Q Ave Pad On Demand	1
DryCal FlexCal, High Flow (300 – 30,000 sccm)	143371	NA	143371	03/2019	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – 9 component gas mix	Cylinder # CC2017706893	NA	Lot# 18028.1	02/2019	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – 9 component gas mix	Cylinder # CC2017709006	NA	Lot# 18028.2	02/2019	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – 6 component gas mix	Cylinder # CC508261	NA	Lot# 18058.2		Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – 6 component gas mix	Cylinder # CC508266	NA	Lot# 18058.1		Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – NH_3/N_2 gas mix	Cylinder # EB0096054	NA	Lot# 7-352-105	12/2019	Q Ave Pad On Demand	1

M&TE Name	Serial #	PNNL Property #	Calibration # / Calibration Sticker ID / Lot #	Calibration Expires	Location/ Comments	Category 1, 2, 3, FIO
Certified Compressed Gas Bottle – N_2O/N_2 gas mix	Cylinder # CC704001	NA	Lot# 7-352-123	12/2020	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – N_2O/N_2 gas mix	Cylinder # CC704012	NA	Lot# 7-352-122	12/2020	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – CH_4/N_2 gas mix	Cylinder # TW00-279245	NA	Lot#8-085-200	3/2021	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle – CH_4/N_2 gas mix	Cylinder # MLK-000746	NA	Lot#8-085-201	3/2021	Q Ave Pad On Demand	1
MFC-30-1, MKS Mass Flow Controller, Injection/Calibration	021773073	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-5-1, MKS Mass Flow Controller, Calibration	001333065	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-0.1-1, MKS Mass Flow Controller, Calibration	021582322	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-20-1, MKS Mass Flow Controllers, Injection	783570	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-2-2, MKS Mass Flow Controllers, Sampling	021575979	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-2-3, MKS Mass Flow Controllers, Sampling	021575978	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-2-4, MKS Mass Flow Controllers, Sampling	001146981	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-2-1, MKS Mass Flow Controller, Sampling	021575980	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-5-3, MKS Mass Flow Controller, Sampling	788541	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-5-4, MKS Mass Flow Controller, Sampling	021575982	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-5-5, MKS Mass Flow Controllers, Sampling	660821	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-30-2, MKS Mass Flow Controllers, Sampling	017327638	NA	NA	NA	Q Ave Pad Test Trailer	2

M&TE Name	Serial #	PNNL Property #	Calibration # / Calibration Sticker ID / Lot #	Calibration Expires	Location/ Comments	Category 1, 2, 3, FIO
MFC-1-1, MKS Mass Flow Controllers, Injection	001146978	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-1-2, MKS Mass Flow Controllers, Injection	001339187	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-1-3, MKS Mass Flow Controller, Injection	000298914	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-1-4, MKS Mass Flow Controller, Injection	001146983	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-10-1, MKS Mass Flow Controllers, Injection	487551	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-50-1, Brooks Mass Flow Controller, Injection	0199090114644001	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-5-2, MKS Mass Flow Controller, Injection	001218810	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-10-2, MKS Mass Flow Controller, Injection	487550	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-50-2, Brooks Mass Flow Controller, Injection	0109100401006001	NA	NA	NA	Q Ave Pad Test Trailer	2
MFC-100-1, MKS Mass Flow Controller, Injection	000926067	NA	NA	NA	Q Ave Pad Test Trailer	2
Thermocouple- Type K, OMEGA	0226	NA	0226	02/26/2020	Q Ave Pad TOS SP 516, Port TE-112	1
MKS Type 247D, 4 Channel Readout	00160077	NA	NA	NA	Q Ave Pad Test Trailer	2
MKS Type 247D, 4 Channel Readout	001055002	NA	NA	NA	Q Ave Pad Test Trailer	2
MKS Type 247D, 4 Channel Readout	001149018	NA	NA	NA	Q Ave Pad Test Trailer	2
MKS Multi gas Controller, 647C	000818648	WD32984	NA	NA	Q Ave Pad Test Trailer	2

M&TE Name	Serial #	PNNL Property #	Calibration # / Calibration Sticker ID / Lot #	Calibration Expires	Location/ Comments	Category 1, 2, 3, FIO
Brooks Micro Processor Control & Read Out Unit, 0154BEC2A11A	0199120124922001	NA	NA	NA	Q Ave Pad Test Trailer	2
Fox Model FT1Thermal Gas Mass Flow Meter, TOS Air Flow Meter, FT1-061DDP1	F00780	NA	F00780	Calibrated 12/5/2016 Recalibration date not provided	Q Ave Pad TOS SP 521 3rd party property	FIO
Fluke 787 Process meter	6850044	NA	6850044	10/24/2018	Q Ave Pad On Demand	1
Fluke T/C Calibrator	3179173	NA	3179173	10/19/2018	Q Ave Pad On Demand	1
Certified Compressed Gas Bottle –Propionitrile	Cylinder # CC2018713342 Installed 5/14/18	NA	Lot# 18077.4	03/2019	Q Ave Pad On Demand	1
MKS Model 247D	000729217	NA	NA	NA	Q Ave Pad Test Trailer	2
MKS Type 247, 4 Channel Readout	001127162	NA	NA	NA	Q Ave Pad Test Trailer	2

5.0 Test Results

Testing results are shown in the following subsections identified by the test numbers from the test matrix in Table 11 [taken from the test plan, *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs)*[1]], including modifications made during the actual testing. This starts with ambient air and diesel engine exhaust baselines (test 0). The dates when each test was conducted are provided in Table 14.

Table 14. List of Tests Conducted

Test Data Package	Description	Test	Date(s)	Notes
Test 0.1	Shakedown Test		4/30/18	
Test 0.2	Shakedown Practice Baseline		5/1/18	
Test 0.2a	Collection of Exhaust and Ambient Baselines	Baselines	5/4/18	
Test 1.1	Acetaldehyde & Acetonitrile	10% Detection	6/1/18	
Test 1.2	Acetaldehyde & Acetonitrile	200% OEL DRE	6/4/18	
Test 2.1	Benzene & Propanenitrile	10% Detection	5/14/18	
Test 2.2	Benzene & Propanenitrile	200% OEL DRE	5/15/18	
Test 3.1-3.2	1,3-Butadiene, Formaldehyde, & 2,4-Dimethylpyridine	10% Detection & 200% OEL DRE	5/17/18-5/18/18	Test and measurement process required a redesign – Test was redone
Test 3.2a	1,3-Butadiene & Formaldehyde	200% OEL DRE	5/30/18	Gases injected individually
Test 3.2b	2,4-Dimethylpyridine	200% OEL DRE	5/31/18	
Test 4.1 & 5.1	Furan & NDMA	10% Detection	6/6/18-6/7/18	
Test 4.2 & 5.2	Furan & NDMA	200% OEL DRE	6/11/18	
Test 4.3 & 5.3	Furan & NDMA	High Concentration DRE	6/13/18	
Test 6.1	Ammonia & Nitrous Oxide	10% Detection	5/7/18	
Test 6.2	Ammonia & Nitrous Oxide	200% OEL DRE	5/9/18	
Test 6.3	Ammonia & Nitrous Oxide	High Concentration DRE	5/10/18	

5.1 Ambient Air and Diesel Engine Exhaust Baselines (Test 0)

Test 0.2a was conducted on May 4, 2018. The test included ambient air measurements from outside of the instrumentation trailer (north of the TOS skid), TOS inlet air baseline measurements from port A, and TOS diesel engine exhaust measurements from port D. Ambient air measurements were made by the PTR-MS in real-time. Additionally, an ambient air SUMMA® canister sample was collected and sent to 222-S for analysis. TOS measurements of inlet air at port A and exhaust at port D were made by the PTR-MS and FTIR in real-time, with the results provided in Table 15. Additionally, SUMMA® canister

[1] Rappe KG. 2018. *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs).* Test Plan TP-71248-01, Rev. 0, April 2018, Pacific Northwest National Laboratory, Richland, Washington.

samples were collected from all four sample ports (A, B, C, and D) and sent to 222-S laboratory for analysis.

Table 15. Baseline COPCs Measurements from Test 0.1/0.2

		Ambient Air		TOS Inlet (port A)		TOS Outlet (Port D)	
COPC	Test	PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)
Acetaldehyde	0.1, 0.2	0.036	0.652	0.042	0.632	0.605	1.69
Acetonitrile	0.1, 0.2	0.001	-	0.001	-	0.052	-
Benzene	0.1, 0.2	0.00103	-	0.00115	-	0.07097	-
Propanenitrile	0.1, 0.2	0.0023	-	0.0022	-	0.0123	-
1,3-Butadiene	0.1, 0.2	-[a]	-	-[a]	-	-[a]	-
Formaldehyde	0.1, 0.2	0.0889	< 0	0.094	< 0	0.522	0.430
2,4-Dimethylpyridine	0.1, 0.2	-[a]	-	-[a]	-	-[a]	-
NDMA	0.1, 0.2	-[a]	-	-[a]	-	-[a]	-
Furan	0.1, 0.2	0.0060	-	0.0065	-	0.0907	-
Ammonia	0.1, 0.2	-	< 0	-	0.005	-	< 0
Nitrous Oxide	0.1, 0.2	-	0.20	-	0.19	-	0.78

Other Compounds	Test	FTIR (ppm)	FTIR (ppm)	FTIR (ppm)
Carbon Monoxide	0.1, 0.2	0.04	0.04	79.0
Carbon Dioxide	0.1, 0.2	320.5	356	74571
Water	0.1, 0.2	11861	10854	63428
Nitric Oxide	0.1, 0.2	0.03	0.04	307.9
Nitrogen Dioxide	0.1, 0.2	0	0	111.0
Methane	0.1, 0.2	3.1	3.1	1.9
Other NMHC[b], C_1	0.1, 0.2	2.1	1.3	35.2

[a] PTR-MS in H_3O+ ionization mode; quantification not feasible due to signal interference.
[b] Non-methane hydrocarbon

All of the test 0.2a measurements with the PTR-MS were made using water in the discharge to create H_3O+ for the PTR-MS chemical ionization process. The fuel for the TOS was 50% ultra-low sulfur on-road winter diesel fuel and 50% ultra-low sulfur off-road summer diesel fuel. Additional inlet and exhaust baseline measurements were collected during each specific COPC test and can be found in Appendix F, with a selection of exhaust baseline measurements key for subsequent analysis shown in Table 16.

Table 16. Baseline COPCs Exhaust Measurements from Other Testing

		Exhaust Background		
COPC	Test	PTR-MS (ppm)	FTIR (ppm)	Instrument
Acetaldehyde	1.1	0.26	0.082	PTR-MS (H_3O+)
Acetonitrile	1.1	0.011	-	PTR-MS (H_3O+)
Benzene	2.2	0.0025	-	PTR-MS (H_3O+)
Propanitrile	2.2	0.0009	-	PTR-MS (H_3O+)
1,3-Butadiene	3.1	0.0008	-	PTR-MS (NO+)
Formaldehyde	3.2a	0.72	-	PTR-MS (H_3O+)
2,4-Dimethylpyridine	3.2b	0.0053	-	PTR-MS (NO+)
NDMA	4.3	0.0010	-	PTR-MS (NO+)
Furan	5.3	0.00022	-	PTR-MS (NO+)
Ammonia	6.1	-	0.06	FTIR
Nitrous Oxide	6.1	-	0.85	FTIR

5.2 Acetaldehyde and Acetonitrile (Test 1)

Test 1.1 confirmed the ability to detect acetaldehyde and acetonitrile in the exhaust at ~10% of the OEL concentration for each, with the results presented in Table 17 and Appendix E. This was performed with PTR-MS as the primary analysis instrument; additionally, in this and subsequent testing of acetaldehyde and acetonitrile, the PTR-MS employed water in the discharge to create H_3O+ for the chemical ionization process. The FTIR provided corroboration of the PTR-MS acetaldehyde analysis. A calculated 2.44 ppm of acetaldehyde and 2.08 ppm of acetonitrile were injected into the TOS exhaust, with 3.07 ppm and 3.2 ppm subsequently measured, respectively, on top of comparatively small concentrations pre-existing in the exhaust. Both of these measurements were confidently detected above the pre-existing baseline exhaust concentrations for each, which were comparatively small, thus confirming the ability to proceed with subsequent acetaldehyde and acetonitrile testing.

Table 17. Acetaldehyde and Acetonitrile 10% Detection Results

		All in ppm				
				Measured at Port D		
COPC	Test	10% OEL Target	Calculated Exhaust Spike	PTR-MS	FTIR	Exhaust Baseline
Acetaldehyde[a,b]	1.1	2.5	2.44	4.0	3.07	0.26
Acetonitrile	1.1	2	2.08	3.2	-	0.01

[a] FTIR results are "For Information Only"
[b] CO_2 interference impacted accuracy of measurements in the PTR-MS. Later testing was not impacted.

Test 1.2 evaluated COPC removal performance of the TOS with 200% OEL injection of acetaldehyde and acetonitrile into the inlet of the diesel engine. PTR-MS and FTIR measurements were made from all sample ports, with the results presented in Table 18 and Appendix F. Additionally, SUMMA® canister samples were collected from all sample ports along with duplicate SUMMA® canister samples from ports A and D and sent to 222-S laboratory for analysis.

Table 18. Acetaldehyde and Acetonitrile: 200% OEL DRE Results

		200% OEL	Measured at Inlet (port A)		Measured at Outlet (port D)			95% DRE	10% OEL	Port B	Port C
COPC	Test	Inlet Target	PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)	TOS DRE	Target Met?	Target Met?	PTR-MS (ppm)	PTR-MS (ppm)
Acetaldehyde[a]	1.2	50	61.9	75.5	0.28	0.73	99.6%	Yes	Yes	6.2	0.53
Acetonitrile	1.2	40	40.8	-	0.014	-	>99.9%	Yes	Yes	7.1	0.23

[a] FTIR results are For Information Only.

In test 1.2, 61.9 ppm acetaldehyde and 40.8 ppm acetonitrile were measured at the engine inlet with injection, and 0.28 ppm acetaldehyde and 0.014 ppm acetonitrile were measured at the TOS tailpipe. This calculates to a TOS DRE of 99.6% for acetaldehyde and >99.9% for acetonitrile. Thus, the TOS met both the ≤10% OEL purification targets (≤ 2.5 ppm acetaldehyde and ≤ 2.0 ppm acetonitrile) and ≥95% DRE targets for acetaldehyde and acetonitrile removal.

The measurements from ports B and C in test 1.2 were 6.2 ppm and 0.53 ppm for acetaldehyde, respectively, and 7.1 ppm and 0.23 ppm for acetonitrile, respectively. Thus, as shown in Table 49 and Appendix F, the diesel engine contributed 90.0% DRE for acetaldehyde and 82.6% DRE acetonitrile, and the catalyst (and DPF) provided an additional 9.1% (and 0.4%) DRE for acetaldehyde and 16.9% (and

0.5%) DRE for acetonitrile. These results demonstrate that the TOS engine reduced concentration significantly, though it would not have met target performance criteria for acetaldehyde or acetonitrile during the test without the catalyst.

5.3 Benzene and Propanenitrile (Test 2)

Test 2.1 confirmed the ability to detect benzene and propanenitrile in the exhaust at <10% of the OEL concentration for each, with the results presented in Table 19 and Appendix E. In this and subsequent benzene and propanenitrile testing, the PTR-MS provided primary analysis using H_3O+ ionization. A calculated 0.014 ppm of benzene and 0.077 ppm of propanenitrile were injected into the TOS exhaust, with 0.014 ppm and 0.20 ppm subsequently measured at port D, respectively. Both of these measurements were confidently detected above the pre-existing exhaust baseline concentrations for each, which were comparatively small, thus confirming the ability to proceed with subsequent benzene and propanenitrile testing.

Table 19. Benzene and Propanenitrile: 10% Detection Results

		All in ppm				
				Measured at Port D		
COPC	Test	10% OEL Target	Calculated Exhaust Spike	PTR-MS	FTIR	Exhaust Baseline
Benzene	2.1	0.05	0.014	0.014	-	0.002
Propanenitrile	2.1	0.6	0.077	0.205	-	0.0009

Test 2.2 evaluated COPC removal performance of the TOS with 200% OEL injection of benzene and propanenitrile into the inlet of the engine. PTR-MS measurements were made from all sample ports, with the results presented in Table 20 and Appendix F. SUMMA® canister samples were collected from all sample ports and sent to 222-S laboratory for analysis. Additionally, an ambient air sample was collected in a SUMMA® canister and sent to RJLee for analysis.

Table 20. Benzene and Propanenitrile: 200% OEL DRE Results

		200% OEL Inlet Target	Measured at Inlet (port A)		Measured at Outlet (port D)			95% DRE Target met?	10% OEL Target met?	Port B PTR-MS (ppm)	Port C PTR-MS (ppm)
COPC	Test		PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)	TOS DRE				
Benzene	2.2	1	0.86	-	0.023	-	97.3%	Yes	Yes	0.34	0.034
Propanenitrile	2.2	12	16.4	-	0.010	-	>99.9%	Yes	Yes	2.0	0.062

In test 2.2, 0.86 ppm benzene and 16.4 ppm propanenitrile were measured at the engine inlet with injection, and 0.023 ppm benzene and 0.010 ppm propanenitrile were measured at the TOS tailpipe. This calculates to a TOS DRE of 97.3% for benzene and >99.9% for propanenitrile. Thus, the TOS met both the ≥95% DRE targets and ≤10% OEL targets (≤ 0.05 ppm benzene and ≤ 0.6 ppm propanenitrile) for benzene and propanenitrile removal and purification.

The measurements from ports B and C in test 2.2 were 0.34 ppm and 0.034 ppm benzene, respectively, and 2.0 ppm and 0.062 ppm propanenitrile, respectively. Thus, as shown in Table 49 and Appendix F, the diesel engine contributed DREs of 60.5% for benzene and 87.6% for propanenitrile, and the catalyst (and DPF) provided an additional 35.6% (and 1.2%) DRE for benzene and 12.0% (and 0.3%) DRE for propanenitrile. These results show similarly that the TOS would not have met either target performance criteria for benzene or propanenitrile during the test without the catalyst, and was imperative for high benzene removal.

5.4 1,3-Butadiene, Formaldehyde, and 2,4-Dimethylpyridine (Test 3)

Test 3.1 efforts performed on May 18, 2018, confirmed the ability to detect formaldehyde in the exhaust at ~10% of the OEL concentration using the PTR-MS with H_3O+ ionization, with the results presented in Table 21 and Appendix E. A calculated 0.030 ppm of formaldehyde was injected into the TOS exhaust, with 0.558 ppm subsequently measured at port D; this was on top of 0.516 ppm that was pre-existing in the baseline TOS exhaust. Nonetheless, the 0.030 ppm injection was confidently detected above the exhaust baseline and confirmed the ability to proceed with subsequent formaldehyde testing.

During test 3.1 on May 18, 2018, 1,3-butadiene and 2,4-dimethylpyridine were also injected into the exhaust at ~10% OEL each but not confidently measured for reasons that will be discussed in more detail later in this section. One of those reasons included the inadequacy of the PTR-MS to accurately quantify 1,3-butadiene and 2,4-dimethylpyridine in the exhaust under H_3O+ ionization mode. This prompted a modification to the PTR-MS to employ an NO+ ionization strategy for measurement of 1,3-butadiene and 2,4-dimethylpyridine in the TOS.

Subsequently, test 3.1 efforts continued on May 30, 2018, and confirmed the ability to detect 1,3-butadiene in the exhaust at ~10% of the OEL concentration using the PTR-MS with NO+ ionization, with the results also presented in Table 21 and Appendix E. A calculated 0.093 ppm of 1,3-butadiene was injected into the TOS exhaust, with 0.174 ppm subsequently measured at port D. This was confidently detected above the pre-existing exhaust baseline concentration for 1,3-butadiene, which was comparatively small, thus similarly confirming the ability to proceed with subsequent 1,3-butadiene testing.

As previously mentioned, 2,4-dimethylpyridine was not accurately quantified using the PTR-MS in H_3O+ ionization mode, requiring its measurement under NO+ ionization mode. 2,4-Dimethylpyridine testing difficulties were also compounded by extremely long required passivation times to reach steady state during testing. For this reason, analytical validation for 2,4-dimethylpyridine was chosen to be addressed during test 3.2.

Table 21. 1,3-Butadiene, Formaldehyde, and 2,4-Dimethylpyridine: 10% Detection Results

		All in ppm				
				Measured at Port D		Exhaust Baseline
COPC	Test	10% OEL Target	Calculated Exhaust Spike	PTR-MS	FTIR	
1,3-Butadiene	3.1	0.1	0.093	0.174	-	0.0008
Formaldehyde [a]	3.1	0.03	0.030	0.558	0.0189	0.516
2,4-Dimethylpyridine [b]	3.1	0.05	0.047	*n.d.*	-	*n.d.*

[a] FTIR results are "For Information Only."
[b] The test identified that modified analytical methods would be required for accurate measurement.
n.d.- not detected, i.e., no elevation of the PTR-MS signal observed above background/baseline levels

Test 3.2 efforts were started on May 18, 2018, to attempt to measure COPC removal performance of the TOS with 200% OEL TOS inlet injections of 1,3-butadiene, formaldehyde, and 2,4-dimethylpyridine. Shortly into testing, observations were made that questioned the accuracy and reliability of the results, and elucidated the need to modify the PTR-MS ionization mode. These observations included the collection and release of water clusters inside the PTR-MS, and very "sticky" release trends from the 2,4-dimethylpyridine. In subsequent test 3.2 testing discussed below, these analytical and testing challenges were further characterized and understood to allow accurate TOS performance assessment.

In test 3.2 on May 18, 2018, it was determined that off-line media sampling would not be adversely impacted by the challenges in collecting on-line measurements in the PTR-MS, and thus could proceed in confidence. The media samples collected included SUMMA® canisters from ports A, B, C, and D, and DNPH treated silica gel tubes (SKC-226-119, for formaldehyde analysis) from ports A, B, C, and D. A duplicate SUMMA® sample was collected from port D and a duplicate DNPH treated silica gel tube was collected from port A.

Evaluations of test 3.2 operations and results on May 18, 2018, led to the following changes in test strategy and in PTR-MS operation for subsequent test 3.2 efforts:

1. *1,3-Butadiene and 2,4-dimethylpyridine quantification* – The PTR-MS was modified to use zero air in the discharge to create NO+ for the chemical ionization process. The change from water to zero air significantly improved analysis stability and reduced the interference of water clusters on the PTR-MS analysis.
2. *Test 3.2 strategy* – Testing strategy was modified to inject a single COPC at a time for TOS assessment in subsequent test 3.2 efforts.
3. *2,4-Dimethylpyridine test strategy* – Longer dwell times were allowed for 2,4-dimethylpyridine breakthrough and stabilization during TOS assessment to accommodate the "stickiness" and passivation requirements for 2,4-dimethylpyridine to reach steady-state.

Test 3.2 continued on May 30 and 31, 2018 (a.k.a. tests 3.2a and 3.2b, respectively), with the changes made discussed above. Testing assessed COPC removal performance of the TOS for 1,3-butadiene, formaldehyde, and 2,4-dimethylpyridine when injected at the inlet individually at 200% OEL for each. PTR-MS and FTIR measurements were made from all sample ports, with the results presented in Table 22 and Appendix F.

Table 22. 1,3-Butadiene, Formaldehyde, and 2,4-Dimethylpyridine: 200% OEL DRE Results

COPC	Test	200% OEL Inlet Target	Measured at Inlet (port A) PTR-MS (ppm)	Measured at Inlet (port A) FTIR (ppm)	Measured at Outlet (port D) PTR-MS (ppm)	Measured at Outlet (port D) FTIR (ppm)	TOS DRE	95% DRE Target met?	10% OEL Target met?	Port B PTR-MS (ppm)	Port C PTR-MS (ppm)
1,3-Butadiene[a]	3.2	3.4	8.05	-	0.026	-	99.7%	Yes	Yes	0.98	*N.M.*
Formaldehyde[a,b]	3.2	0.6	1.34	0.38	0.727	0.031	45.7%	No	No	2.74	0.83
2,4-Dimethylpyridine[a]	3.2	1	0.98	-	0.0071	-	99.3%	Yes	Yes	0.021	*N.M.*

[a] Tested individually for TOS performance assessment.
[b] FTIR results are "For Information Only."
N.M. - not measured

During test 3.2a, as shown in Table 22, using the PTR-MS in NO+ ionization mode, 8.05 ppm 1,3-butadiene was measured at port A and 0.026 ppm was measured at port D for a DRE of 99.7%, thus meeting the ≤0.1 ppm 1.3-butadiene purification target and the ≥95% DRE target for 1,3-butadiene removal. A concentration of 0.98 ppm 1,3-butadiene was measured at port B, showing that the engine provided 87.8% DRE and the catalyst (and DPF) provided an additional 11.8% DRE as shown in Table 49 and Appendix F. This demonstrates that the TOS engine removed 1,3-butadiene significantly, though it would not have met either target performance criteria without the catalyst.

Test 3.2a continued with the PTR-MS in H_3O+ ionization mode to test TOS removal performance for formaldehyde. With a calculated ~0.6 ppm formaldehyde injection, 1.34 ppm was measured at the TOS inlet; as shown in Appendix F; this was a combination of 0.88 ppm pre-existing prior to injection and an additional 0.43 ppm with injection; 0.727 ppm of formaldehyde was measured at the TOS tailpipe, resulting in a TOS DRE of only 45.7%. Thus, the TOS did not meet the 10% OEL target of ≤0.03 ppm formaldehyde or the ≥95% DRE target. The formaldehyde measurements from ports B and C were 2.74 ppm (corroborated by the FTIR) and 0.83 ppm, thus demonstrating that the diesel engine produces comparatively large amounts of formaldehyde that are largely removed subsequently by the oxidation catalysts.

Although the TOS did not reduce formaldehyde concentrations to a low enough level to achieve the performance goals for the system, it is worth noting that this is due to the pre-existence of 0.725 ppm formaldehyde in the TOS exhaust at tailpipe. Diesel engines are well known for producing ppm-quantities of small aldehydes, and thus it is not surprising that this diesel engine produced significant quantities of formaldehyde. This was also demonstrated in test 0.2, where 0.522 ppm formaldehyde was measured at the TOS tailpipe (Table 15). At the TOS tailpipe prior to injection in test 3.2a, 0.725 ppm of formaldehyde was shown to persist through the oxidation catalyst and be present at the TOS tailpipe. Thus, of the 1.34 ppm formaldehyde that was measured at the inlet, if one considers the pre-existing formaldehyde separately, then almost all of the injected amount was removed through the TOS. A DRE metric becomes less meaningful for a situation such as this where the formaldehyde concentration persisting through the TOS to the tailpipe is insensitive to formaldehyde injection at the TOS inlet.

During test 3.2b, as shown in Table 22, using the PTR-MS in NO+ ionization mode, 0.98 ppm 2,4-dimethylpyridine was measured at the TOS inlet at port A and 0.0071 ppm was measured at port D for a DRE of 99.3%, thus meeting the 10% OEL target of ≤0.05 ppm and the ≥95% DRE target for TOS performance. Results from this testing provided indication that the analytical system was successful in measuring ≤1.4% OEL for 2,4-dimethylpyridine. As shown in Table 22 and Appendix F, 0.021 ppm 2,4-dimethylpyridine was measured at port B and showed that the engine provided 97.8% DRE and the

catalyst and DPF provided an additional 1.4% DRE. In contrast to prior results, this shows that the engine combustion was sufficient for 2,4-dimethylpyridine removal and did not require exhaust aftertreatment.

SUMMA® canister samples were collected from all sample ports and sent to RJLee for analysis of furan and NDMA in support of future testing needs. Duplicate SUMMA® canister samples were collected from all sample ports and were sent to 222-S for analysis of 2,4-dimethylpyridine. To confirm sample collection on port A, an additional duplicate port A sample using a canister without particulate filtration and without flow restriction was collected and sent to 222-S.

5.5 N-Nitrosodimethylamine and Furan (Test 4 and Test 5)

The testing of the NDMA in test 4 was combined with test 5 for furan evaluation in the TOS. By combining the tests, the project was able to reduce costs and schedule.

The following is a description of the test events and results that led to the determination that the injection of the NDMA and furan could be tested at the same time.

> *On May 4, 2018, emission baseline testing in test 0.2a proceeded with the PTR-MS under H_3O+ mode chemical ionization. The measurements made at Port D for furan and NDMA were prohibitively high and problematic (14 ppb furan and 20.5 ppb NDMA) to continue testing in the current configuration and as prescribed in the test plan. This also prohibited the use of pre-concentration, since ultra-trace level analysis was not possible in the prohibitively high background exhaust. Thus, alternatives to preconcentration were evaluated as the test program proceeded through May.*
>
> *Samples of the baseline (i.e., no COPC injection) inlet air at port A and the diesel exhaust at ports B, C, and D were collected on May 31, 2018, during test 3.2b. These samples were sent to RJLee for evaluation on a Time of Flight PTR-MS (Ionicon 4000) using H_3O+ ionization, with the results presented in Table 23. The results gave clear indication that a significant amount of the furan and NDMA signal (56-80%) coming from the test stand PTR-MS in H_3O+ ionization mode are from masking compounds (i.e., attributed to compounds other than the COPCs).*

Table 23. Masking on Furan and NDMA from the TOF PTR-MA Ionicon 4000 Analysis

Sample Port	m69.335 (furan ppbv)	M69.0699 (isoprene ppbv)	Combined (ppbv)	Furan as a Percent of Combined
A	0.58	2.32	2.9	20%
B	119.6	311.7	431.3	28%
C	5.41	12.84	18.25	30%
D	4.62	14.82	19.44	24%
Sample Port	m75.0441 (ethyl acetate ppbv)	M75.0558 (NDMA ppbv)	Combined (ppbv)	NDMA as a Percent of Combined
A	2.42	2.13	4.55	47%
B	79.6	69	148.6	46%
C	28.1	23.6	51.7	46%
D	26.71	23.35	50.06	47%

In parallel, evaluations for using the test stand's quadrupole PTR-MS in NO+ ionization mode were conducted on May 30, 2018, during test 3.2a. These results demonstrated the ability to detect furan at 2 ppb in the exhaust and NDMA at 1.3ppb in the exhaust and confirmed improved COPC identification from background compounds in the exhaust.

Thus, the use of NO+ with long averaging times and targeted calibration without pre-concentration was proposed for test 5.1. Differentials between injection runs in the exhaust and non-injection exhaust runs were also included in testing. On June 5, 2018, WRPS, PNNL, and NUCON agreed to the following testing path:

- Test 5 will combine furan and NDMA testing and will operate the PTR-MS in NO+ ionization mode.
- Test 5.1 furan and NDMA 10% OEL detection test
  - Furan (0.0001 ppm) and NDMA (0.00003 ppm)
  - No SUMMA® canisters or tubes (as normal)
- Test 5.2 furan and NDMA 200% OEL DRE test
  - Furan (0.002 ppm) and NDMA (0.0006 ppm)
  - SUMMA® canisters ports A, B, C, D (duplicate on port C)
  - Thermosorb/N tube samples will be collected from ports A, B, C, and D for 320 minutes to obtain 3:1 dilution and the total vacuum should be set to 2000 mL/min. No duplicate samples should be collected on the tubes.
  - Additional SUMMA® canisters (with no filters or flow restrictors) will be collected and then sent for analysis on the new TOF WERK VOCUS PTR-MS
- Test 5.3 furan and NDMA high concentration DRE test
  - Furan (0.017 ppm) and NDMA (0.062 ppm)
  - SUMMA® canisters port A, B, C, D
  - Thermosorb/N tube samples will be collected from ports A, B, C, D for 320 minutes to obtain 3:1 dilution and the total vacuum should be set to 2000 mL/min. No duplicate samples should be collected on the tubes.

Test 4.1 confirmed the ability to detect NDMA in the TOS exhaust at ~50% of the OEL. The divergence from 10% OEL is elaborated on below. Test 5.1 confirmed the ability to detect furan in the TOS exhaust at <10% OEL. The results are presented in Table 24 and Appendix E. In this and subsequent NDMA and furan testing, the PTR-MS provided primary analysis using NO+ ionization as described prior. A calculated 0.000149 ppm of NDMA was injected into the TOS exhaust, with 0.000781 ppm confidently measured by the PTR-MS at port D on top of a pre-existing 0.000686 ppm NDMA baseline in the TOS exhaust. Similarly, a calculated 0.000049 ppm of furan was injected into the TOS exhaust, with 0.000148 ppm confidently measured by the PTR-MS at port D on top of a pre-existing 0.000104 ppm furan baseline. These results confirmed the ability to proceed with subsequent furan testing.

Analytical validation for NDMA (i.e., test 4.1) started with establishing the PTR-MS detection sensitivities for measuring NDMA. The first step was to measure the pre-existing exhaust baseline for NDMA; this was 0.000686 ppm NDMA. 10% OEL exhaust injection was then started for NDMA (~30 ppt), but that amount of NDMA was not confidently discernable from the comparatively large pre-existing exhaust baseline signal. The rate of NDMA injection was then raised to 100% OEL (~300 ppt)

and detection was confidently established. NDMA injection was then sequentially lowered to the minimum value that could be confidently detected above the pre-existing baseline signal, which was 0.000149 ppm (i.e., 149 ppt, ~50% OEL), establishing the sensitivity for NDMA in the TOS exhaust with the PTR-MS. WRPS was present at the test site and confirmed testing could proceed with 50% OEL sensitivity for NDMA.

Table 24. NDMA and Furan: 10% Detection Results

		All in ppm				
				Measured at Port D		Exhaust
COPC	Test	10% OEL Target	Calculated Exhaust Spike	PTR-MS	FTIR	Baseline
NDMA	4.1	0.000030	0.000149	0.000781	-	0.000686
Furan	5.1	0.000100	0.000049	0.000148	-	0.000104

Test 4.2 evaluated COPC removal performance of the TOS with 200% OEL injection of NDMA into the inlet of the engine, and simultaneously test 5.2 evaluated analogous TOS performance for furan. PTR-MS measurements were made from all sample ports, with the results presented in Appendix F. SUMMA® canister samples were collected from all sample ports and sent to 222-S laboratory for analysis, along with duplicate SUMMA® canister samples collected from port C. NDMA was sampled onto ThermoSorb/N tubes from ports B, C, and D, which were sent to 222-S laboratory for analysis. A ThermoSorb/N tube was placed on the tube port A sampling system, though early in the testing the media from the tube was expelled and damaged the mass flow control to the collection vacuum on-line A. Thus, a tube sample for port A was not collected at that time.

Also during tests 4.2 and 5.2, five special SUMMA® canisters without particulate filters and without flow restrictors were used to collect two baseline samples (i.e., no COPC injection) from ports A and D and three samples during testing (i.e., with NDMA and furan injection) from ports A, B, and D. These samples were subsequently analyzed by Aerodyne Research, Inc. using the TOFWERK ultra-high-resolution VOCUS-PTR. The purpose of this testing was to quantitatively identify interfering compounds at the furan and NMDA masses measured by the quadrupole to determine the fraction of the test stand PTR-MS signal that is attributed to the COPC. The VOCUS-PTR results and accompanying summary are provided in Sections 5.5.1 and 5.5.2 and Table 28.

The combined results of the PTR-MS analysis and the TOFWERK ultra-high-resolution VOCUS-PTR measurements are shown in Table 25. As mentioned above, the PTR-MS results alone (i.e., without combination with the results of the TOFWERK ultra-high-resolution VOCUS-PTR) can be found in Appendix F.

Table 25. NDMA and Furan: 200% OEL DRE Results

		200% OEL	Measured at Inlet (port A)		Measured at Outlet (port D)			95% DRE	10% OEL	Port B	Port C
		Inlet	PTR-MS	FTIR	PTR-MS	FTIR	TOS	Target	Target	PTR-MS	PTR-MS
COPC	Test	Target	(ppm)	(ppm)	(ppm)	(ppm)	DRE	Met?	Met?	(ppm)	(ppm)
NDMA[a]	4.2	0.0006	0.00034	-	0.000151	-	55.6%	No	No	0.00025	0.00018
Furan[a]	5.2	0.002	0.00234	-	0.000017	-	99.3%	Yes	Yes	0.0578	0.00011

[a] PTR-MS reflects combined results from PNNL PTR-MS and TOFWERK ultra-high resolution VOCUS-PTR.

During test 4.2, as shown in Table 25, 0.000340 ppm NDMA was measured at port A and 0.000151 ppm (151 ppt) was measured at port D. This did not meet the ≤10% OEL target of 0.000030 ppm (30 ppt) NDMA in the TOS exhaust, and yielded an NDMA DRE of 55.6%. Thus, neither criteria for TOS performance were met for NDMA at 200% OEL injection. It should be noted that the estimated error associated with the NDMA concentration measurements at this low ultra-trace level (~10-50% OEL) is of similar order of magnitude to the concentration values reported. Thus, this error may be a significant factor in the results presented in Table 25 for NDMA, and may have dictated the perceived performance of the TOS.

Although the PTR-MS signal without VOCUS PTR-TOF combination reflected a value close to the expected injected NDMA amount, the combined result of the PTR-MS and the VOCUS PTR-TOF was lower than the NDMA injected amount. Reasons for this may include 1) an impact from the blower between the injection port and the sampling port or 2) the lower moisture level in the inlet sample adversely impacting the recovery of the NDMA from the SUMMA® canister.

In test 5.2, as shown in Table 25, 0.00234 ppm furan was measured at port A and 0.000017 ppm was measured at port D, yielding a 99.3% TOS DRE value. This met both the ≤10% OEL target of 0.00010 ppm furan and the ≥95% DRE target for TOS removal performance. The furan measurements from ports B and C were 0.0578 ppm and 0.00011 ppm, respectively. Thus, as shown in Table 49 and Appendix F, the diesel engine produced comparatively large amounts of furan that required the catalyst to remove, which it did so with very high efficiency.

Tests 4.3 and 5.3 evaluated COPC removal performance of the TOS with simultaneous high concentration injection of NDMA and furan into the inlet of the engine. PTR-MS measurements and SUMMA® canister samples were taken from all sample ports, with the latter sent to 222-S laboratory for analysis. A duplicate SUMMA® canister sample was collected from port C and accompanied the other samples. NDMA was sampled onto ThermoSorb/N tubes from all sample ports, which were also sent to 222-S laboratory for analysis. The results for tests 4.3 and 5.3 shown in Table 26 are a product of the PTR-MS measurements in this test and the TOFWERK ultra-high-resolution VOCUS-PTR measurements made in the prior test. This is accomplished by subtracting the concentrations of interfering species identified from the prior analysis from the PTR-MS results measured in this test. Additional detail is presented in Section 5.5.2 and Table 29.

Table 26. NDMA and Furan: High Concentration Results

			Measured at Inlet (port A)		Measured at Outlet (port D)			95% DRE	10% OEL	Port B	Port C
COPC	Test	High Inlet Target	PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)	TOS DRE	Target met?	Target met?	PTR-MS (ppm)	PTR-MS (ppm)
NDMA	4.3	0.062	0.060	-	0.000042	-	>99.9%	Yes	No	0.00205	-[b]
Furan	5.3	0.017	0.021	-	0.000035	-	99.8%	Yes	Yes	0.087	-[b]

[a] PTR-MS reflects combined results from PTR-MS and VOCUS PTR-TOF; see Section 5.5.2.
[b] VOCUS PTR-TOF results not available.

During test 4.3, as shown in Table 26, 0.060 ppm NDMA was measured at port A and 0.000042 ppm was measured at port D. This calculates to a DRE of >99.9%, thus far exceeding the TOS performance target for NDMA removal and almost achieving the ≤10% OEL target of 0.000030 ppm NDMA for exhaust purification. Again, it is worth noting that the estimated error associated with NDMA concentration measurement at this level in the exhaust is of similar order of magnitude as this reported value, and thus may be a factor in the result. At port B, 0.00205 ppm of NDMA was measured, demonstrating that the engine alone removed >95% of the incoming NDMA during high injection.

NDMA DRE performance was observed to improve from 55.6% at 200% OEL inlet injection to >99.9% at high concentration injection. This is the opposite of what is expected when governed solely by homogeneous combustion chemistry where a DRE would remain constant across a wide concentration of inlet COPC concentration. It should be emphasized that ultra-trace level COPC measurement and behavior in lean heterogeneous combustion (i.e., diesel) and catalytic systems is highly complex. A large number of factors could be influencing the results, the vast majority of which are outside of the scope of this test effort. However, the NDMA result that carries the highest level of confidence is the high concentration DRE measurement of >99.9% that reflects no greater than ~2% error.

During test 5.3 (also shown in Table 26), 0.021 ppm furan was measured at port A and 0.000035 ppm was measured at port D. This calculates to a DRE of 99.8% and meets TOS performance target criteria of >95% removal and purification to below 0.0001 ppm. At port B, 0.087 ppm furan was measured. This showed again that the diesel engine produced comparatively large amounts of furan that required the catalyst to remove, which it did so with high efficiency.

5.5.1 High-Resolution Mass Spectra of Nominal Masses for Furan and NDMA using NO+ Ionization

Supplemental SUMMA® canister analysis was provided by Aerodyne Research, Inc. using the TOFWERK ultra-high-resolution VOCUS-PTR. This was to help identify competing compounds at the furan and NMDA masses measured by the quadrupole. The canisters sent to AeroDyne Research had port A and port D gases before injections and port A, port B, and port D gases collected during NDMA and furan injection.

Normal operation of the PTR-MS using proton transfer from H_3O^+ to a target analyte was successful for many of the organic COPCs. However, it was not feasible for 1,3-butadiene and NDMA because both were observed to have a baseline signal that was highly dependent on the moisture content of the sample. This was prohibitive to confident calibration and measurement in the exhaust stream. In the case of 1,3-butadiene, this is due to an interference at the protonated m/Z of 55 from the second water cluster $H_3O^+(H_2O)_2$, which is present as a byproduct of the formation process for H_3O^+ itself. Under normal conditions, this cluster can be minimized by increasing the electric field in the PTR-MS drift tube. However, the high water levels in the exhaust produced levels of $H_3O^+(H_2O)_2$ that could not be reduced sufficiently in this manner. NDMA, which has a protonated m/Z of 75, also displayed a high dependence on humidity. This resulted in the decision to operate the PTR-MS in an alternate mode using NO^+ as the chemical ionization (CI) agent instead of H_3O^+ as described previously in this report. Use of NO^+ in the PTR-MS was first reported by Knighton et al. (2009) as a method for detecting trace levels of 1,3-butadiene in ambient air at levels in the low ppt range. In addition to using NO^+ as a CI agent for 1,3-butadiene in this work, it was discovered that calibration and detection of NDMA was insensitive to

variations in water concentration and could be calibrated down to 30 ppt. Detection levels of furan and 2,4-dimethylpyridine were also found to be lower with NO^+ ionization. Thus, furan and 2,4-dimethylpyridine measurements were also performed in the NO^+ mode.

Despite the high sensitivity observed in calibration with furan and NDMA standards, there were background interferences in the exhaust at the masses m/Z 68 for furan and m/Z 74 for NDMA at the very low OEL levels for these compounds. The unit mass resolution of the quadrupole PTR-MS used for measurements in this study was insufficient to resolve this issue. In order to determine the ratio of COPC to interferences for the nominal masses 68 and 74, the project team employed a recently developed high-resolution VOCUS PTR-TOF (Tofwerk AG) mass spectrometer operating with NO^+ as the CI agent, operated by Aerodyne Research, Inc. To accomplish this, SUMMA® canisters were used to sample the TOS inlet at sample port A and the TOS exhaust at sample ports B and D while furan and NDMA were injected into the inlet during the 200% OEL test (test 4.2/5.2). These canisters were then sent to Aerodyne Research Inc. for analysis. Port A was also sampled without injection and sent. Compounds that would be interferences for the quadrupole PTR-MS were cleanly resolved with the VOCUS. Although capable of a resolution of 15,000, the resolution for these measurements was 11,000 due to the instrument tuned for other work at Aerodyne. It is important to note that resources such as calibration standards were not available for the VOCUS measurements, and only a limited amount of time was available on the VOCUS. As a result, although the ratios of species measured from a given summa canister are accurate, absolute values between canisters are only semi-quantitative.

Figure 5 shows the high-resolution spectrum at nominal mass 68 for furan from the sample pulled from the TOS outlet (port D) during 200% OEL injection (test 5.2). In this and subsequent results, the VOCUS background has been subtracted. As can be seen, furan as $C_4H_4O^+$ is cleanly resolved from interfering peaks, which have a number of isomeric possibilities. Identification is not in the scope of this work nor is it necessary. The fraction of the nominal mass due to furan is determined by integrating the peak area for furan and dividing by the total integrated signal at nominal m/Z 68, including the unidentified shoulder around 68.08. The result is 6.4% as the contribution from furan that was observed with the quadrupole PTR-MS in the real-time engine measurements.

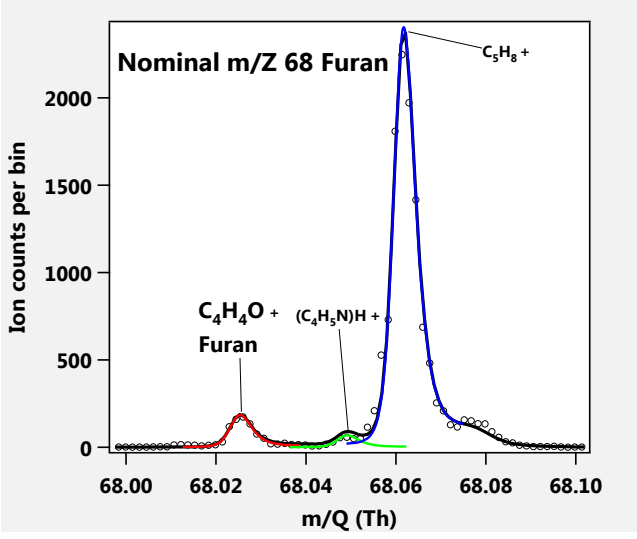

Figure 5. High-Resolution VOCUS Spectrum of m/Z 68 from TOS Outlet (port D) during Injection

Figure 6 shows the high-resolution spectrum at nominal mass 74 for NDMA from the sample pulled from the TOS outlet (port D) during 200% OEL injection (test 4.2). As can be seen, NDMA as $C_2H_6N_2O^+$ is sufficiently resolved from interfering peaks to allow a high confidence fit of the peak. There are more interferences than for furan, and these have a number of isomeric possibilities. Again, identification is not in the scope of this work, nor is it necessary to determine the fraction of the nominal mass due to NDMA. However, it is noted that the presence of peaks such as $(NO)C_3H_8^+$ are adducts of NO^+ rather than products of charge transfer reaction. The peak to the right of $(NO)C_3H_8^+$ that is not fit is due to an isotopic peak from m/Z 73. Integrating the peak area for NDMA and dividing by the total integrated signal at nominal m/Z 74 gives 13.4% as the contribution from NDMA that was observed with the quadrupole PTR-MS in the real-time engine measurements.

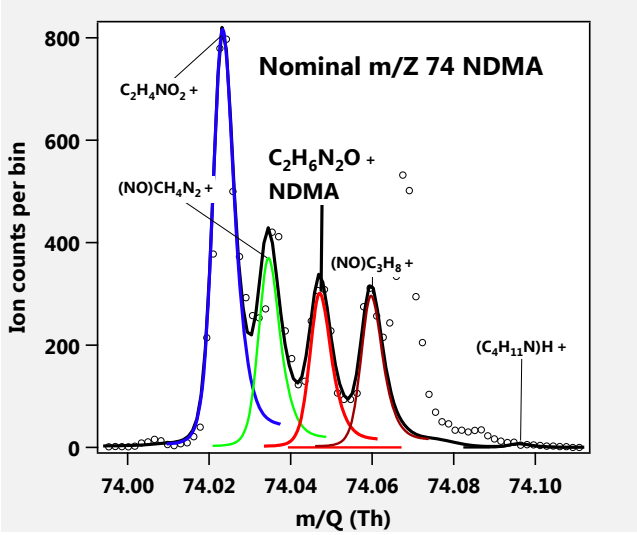

Figure 6. High-Resolution VOCUS Spectrum of m/Z 74 from TOS Outlet (port D) during Injection

High-resolution measurements using the VOCUS were also made of the samples acquired from the TOS inlet at port A with and without furan injection during test 5.2. Figure 7 shows the results of these measurements, with a) showing without injection and b) showing with injection.

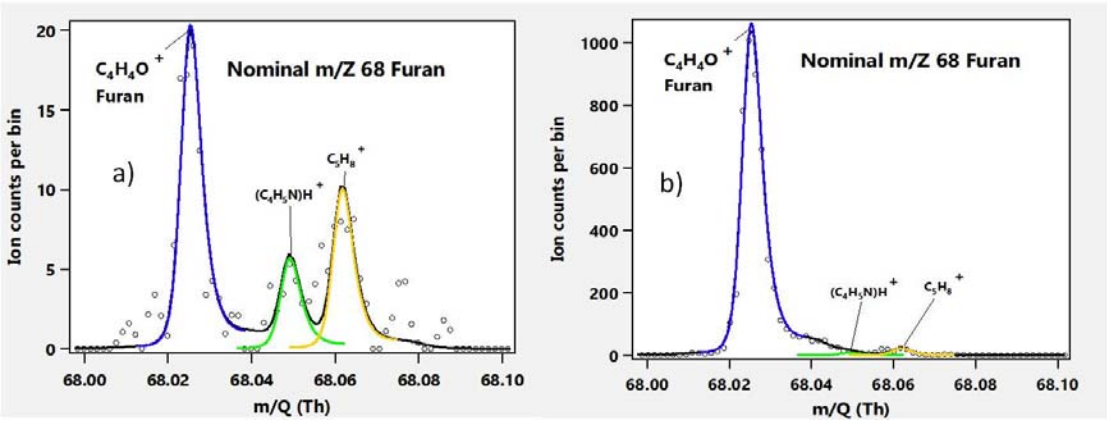

Figure 7. High-Resolution VOCUS Spectrum of m/Z 68 for a) Port A without Injection and b) Port A with Injection

Figure 7a shows that there were trace levels of furan and other species at the nominal mass 68 pre-existing at the inlet prior to injection, and peak integration yields 55.8% contribution from furan as the fraction of the unit mass signal detected by the quadrupole PTR-MS. Figure 7b shows that the vast majority (94.3%) of the quadrupole signal at m/Z 68 is due to the furan with injection. Assignment of the signals from $(C_4H_5N)H^+$ and $C_5H_8^+$ is outside the scope of this work. However, we do note that the same masses were present in the samples from the TOS exhaust exhaust sample.

Figure 8 gives the same results for NDMA sampled from the TOS inlet during test 4.2 a) without injection, and b) with injection. Figure 8a shows the same interfering compounds that were observed in the TOS exhaust sample. These levels are somewhat higher than the background for furan (i.e., at m/Z 68), but are still at a near-trace level with NDMA comprising 26.3% of the signal. Figure 8b shows the levels during injection of NDMA. The NDMA peak increases by a factor of ~5 during injection while background peaks stay the same, resulting in net fraction of 56.7% for NDMA at port A during injection. As before, the peak to the right of $(NO)C_3H_8^+$ that is not fit is due to an isotopic peak from m/Z 73 and was accounted for in peak integration and calculation of the percent NDMA.

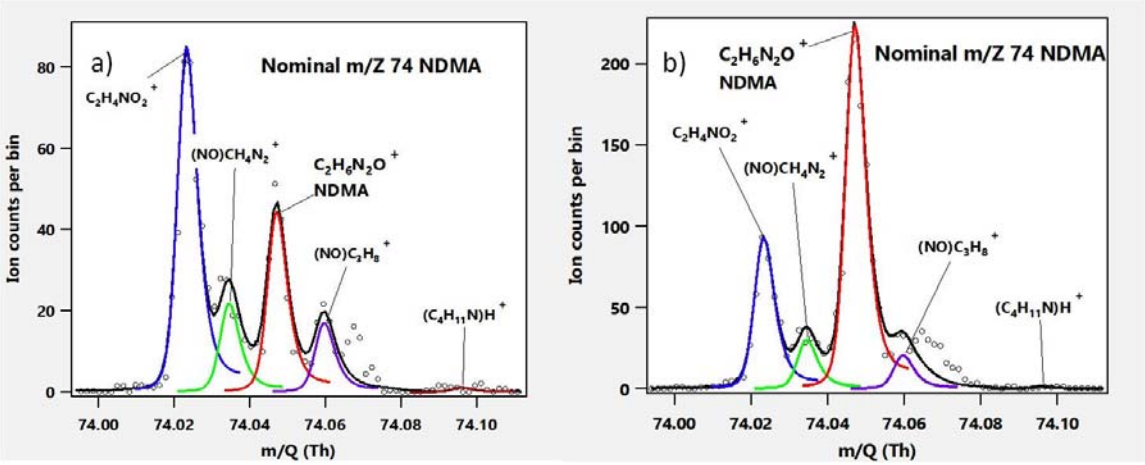

Figure 8. High-Resolution VOCUS Spectrum of m/Z 74 for a) Port A without Injection and b) Port A with Injection

Figure 9 shows the VOCUS spectrum of the TOS exhaust sample from port B after the diesel engine during injection in test 4.2/5.2. In this analysis, NDMA contributed 6.0% of the unit mass signal detected by the quadrupole PTR-MS at m/Z 74, and furan contributed 78.9% of the unit mass signal detected by the quadrupole PTR-MS at m/Z 68.

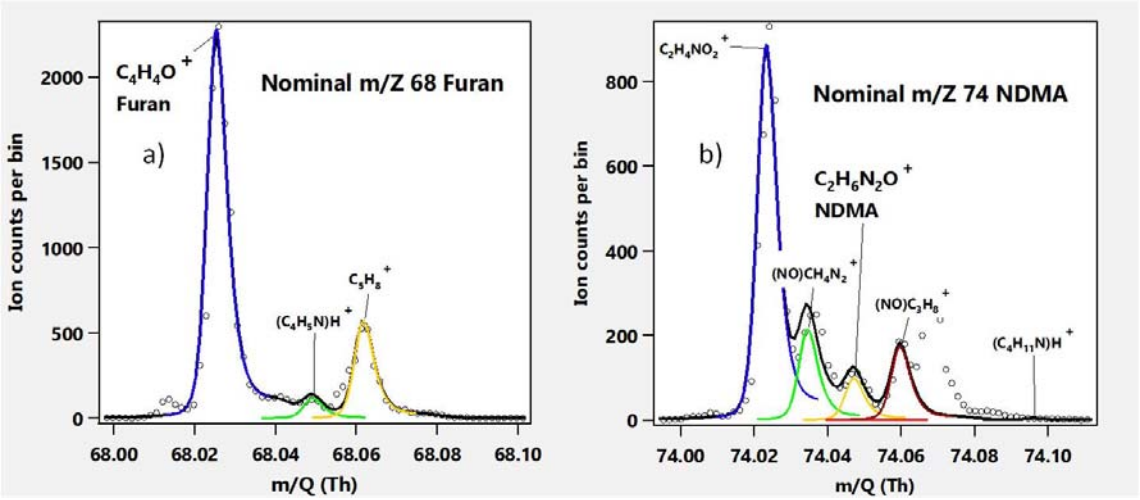

Figure 9. High-Resolution VOCUS Spectrum during Injection for Sampling at Port B for a) m/Z and b) m/Z 74.

5.5.2 Summary of High-Resolution VOCUS PTR-TOF Measurements and Impact on NDMA and Furan Concentrations

The results of the VOCUS PTR-TOF measurements for tests 4.2 and 5.2 are summarized in Table 27; these reflect the discussion from above in this section. Those measurements combined with the PTR-MS measurements from tests 4.2 and 5.2 provide the results in Table 28, which reflect the total, COPC, and interference concentrations measured at m/Z 74 and m/Z 68 for NDMA and furan, respectively. The COPC concentrations in Table 28 are calculated by multiplying the VOCUS PTR-TOF measurements in Table 27 with the PTR-MS response (i.e., m/Z total) from tests 4.2/5.2 in Table 28. Then, the interference concentrations at m/Z 74 and 68 in Table 28 are calculated as the difference between the total and COPC concentrations. The interference concentrations at m/Z 74 and 68 in Table 28 from tests 4.2/5.2 are then used to calculate the respective COPC concentrations in Table 29 by subtracting the interference concentrations from the PTR-MS response (i.e., m/Z total) from tests 4.3/5.3.

In summary, the use of the high-resolution VOCUS PTR-TOF operating on NO^+ provided a measurement that can be accurately used to determine the contribution of furan to m/Z 68 and NDMA to m/Z 74 as measured by the PTR-MS. The results for COPC concentrations in Table 28 and Table 29 are used to determine the results shown for tests 4.2/5.2 in Table 25 and tests 4.3/5.3 in Table 26.

Table 27. TOFWORKS High-Resolution VOCUS PTR-TOF Results

	VOCUS PTR-TOF Measured Contribution of COPC to PTR-MS Signal in Tests 4.2 & 5.2					
	Without COPC Injection		With COPC Injection			
COPC	TOS Inlet	TOS Outlet	TOS Inlet	Port B	Port C	TOS Outlet
Furan	55.8%	*n.m.*	94.3%	78.9%	*n.m.*	6.4%
NDMA	26.3%	*n.m.*	56.7%	6.0%	*n.m.*	13.4%
n.m. - not measured						

Table 28. Total, COPC, and Interference Concentrations Measured at m/Z 74 and 68 in Tests 4.2/5.2

	m/Z Total Measured Concentration, & COPC and m/Z Interference Calculated Concentrations in Tests 4.2 & 5.2			
	With COPC Injection			
COPC	TOS Inlet	Port B	Port C [a]	TOS Outlet
	(all in ppm)			
Total m/Z 68	0.00249	0.0733	0.00178	0.00026
Furan	0.00234	0.0578	-	0.000017
Interference m/Z 68	0.00014	0.0155	-	0.00024
Total m/Z 74	0.00060	0.00421	0.00135	0.00113
NDMA	0.00034	0.00025	-	0.000151
Interference m/Z 74	0.00026	0.00396	-	0.00098

[a] PTR-MS signal provided for reference only; VOCUS PTR-TOF not measured for this sample.

Table 29. Total and COPC Concentrations at m/Z 74 and 68 in Tests 4.3/5.3

	m/Z Total Measured Concentration, and COPC Calculated Concentration in Tests 4.3 & 5.3			
	With COPC Injection			
COPC	TOS Inlet	Port B	Port C [a]	TOS Outlet
	(all in ppm)			
Total m/Z 68	0.0213	0.102	0.00006	0.00028
Furan	0.0212	0.087	-	0.000035
Total m/Z 74	0.0606	0.00601	*n.d.*	0.00102
NDMA	0.0603	0.00205	-	0.000042

[a] PTR-MS signal provided for reference only; VOCUS PTR-TOF not measured for this sample
n.d. - not detected, i.e., PTR-MS signal less than pre-determined instrument baseline

5.6 Ammonia and Nitrous Oxide (Test 6)

Test 6.1 confirmed the ability to detect ammonia and nitrous oxide in the exhaust at nominally 10% or less of the OEL, with the results presented in Table 30 and Appendix E. This was performed with FTIR as primary analysis. A targeted 2.5 ppm of ammonia and 5.0 ppm of nitrous oxide were injected into the TOS exhaust after the DPF, with 1.36 ppm and 3.57 ppm measured at the TOS tailpipe, respectively. Both of these measurements were confidently detected above the pre-existing baseline exhaust concentrations for each, which were comparatively small, thus confirming the ability to proceed with subsequent ammonia and nitrous oxide testing.

Table 30. Ammonia and Nitrous Oxide: 10% Detection Results

		All in ppm				
		10% OEL	Calculated	Measured at Port D		Exhaust
COPC	Test	Target	Exhaust Spike	PTR-MS	FTIR	Baseline
Ammonia	6.1	2.5	1.97	-	1.36	0.07
Nitrous Oxide	6.1	5	2.92	-	3.57	0.80

Test 6.2 evaluated COPC removal performance of the TOS with 200% OEL of ammonia and nitrous oxide injected into the inlet of the engine. FTIR measurements were made from all sample ports, with the results presented in Table 31 and Appendix F. SUMMA® canister samples were collected from all sample ports and sent to 222-S laboratory for analysis. A duplicate SUMMA® canister sample was collected from

the TOS exhaust (port D). Additionally, ammonia was sampled onto Anasorb 747 tubes with duplicates (on all ports) from all sample ports and sent to 222-S laboratory for analysis.

The Anasorb 747 tubes used were SKC-226-81A type tubes that were not coated with sulfuric acid, which acts as a capture assist agent for ammonia. This was different than the standard Anasorb 747, SK-226-29 tubes specified in the test plan. The different tube caused a quality non-conformance that was documented in Problem Evaluation Request WRPS-PER-2018-1318. The ammonia tubes could not be used for ammonia analysis.

Table 31. Ammonia and Nitrous Oxide: 200% OEL DRE Results (Test 6.2)

		200% OEL	Measured at Inlet (port A)		Measured at Outlet (port D)			95% DRE	10% OEL	Port B	Port C
COPC	Test	Inlet Target	PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)	TOS DRE	Target met?	Target met?	FTIR (ppm)	FTIR (ppm)
Ammonia	6.2	50	-	54.9	-	0.70	98.7%	Yes	Yes	3.2	0.11
Nitrous Oxide	6.2	100	-	105.9	-	28.9	72.7%	No	No	27.9	29.3

During test 6.2, as shown in Table 31, 54.9 ppm ammonia and 105.9 ppm nitrous oxide were measured at the engine inlet (port A), with 0.70 ppm ammonia and 28.9 ppm nitrous oxide measured at the TOS tailpipe. This resulted in a TOS DRE of 98.7% for ammonia, thus meeting both the 10% OEL target of 2.5 ppm and the 95% DRE target for ammonia. Neither the 10% OEL target of 5 ppm nor the 95% DRE target were met for nitrous oxide. This is expected, as nitrous oxide is well-known to the transportation industry to be a problematic and persistent greenhouse gas exhaust effluent. The measurements from ports B and C for ammonia were 3.2 ppm and 0.11 ppm, respectively. The diesel engine provided most of the ammonia removal performance at 94.2% DRE as shown in Table 38 and Appendix F. Thus, the TOS would have just barely not met target performance criteria for ammonia during the test without the catalyst.

Test 6.3 evaluated COPC removal performance of the TOS with high concentration injection of ammonia and nitrous oxide into the inlet of the engine. FTIR measurements were made from ports A, B, C, and D, with the results presented in Table 32 and Appendix F. SUMMA® canister samples were collected from ports A, B, C, and D and sent to 222-S laboratory for analysis. Finally, ammonia was sampled onto Anasorb 747 tubes with duplicates (on all ports) from ports A, B, C, and D, which were sent to 222-S laboratory for analysis.

The Anasorb 747 tubes used were SKC-226-81A type tubes that were not coated with sulfuric acid, which acts as a capture assist agent for ammonia. This was different that the standard Anasorb 747, SK-226-29 tubes specified in the test plan. The different tube caused a quality non-conformance that was documented in Problem Evaluation Request WRPS-PER-2018-1318. The ammonia tubes were not able to be used for ammonia analysis.

Table 32. Ammonia and Nitrous Oxide: High Concentration DRE Results (Test 6.3)

		High	Measured at Inlet (port A)		Measured at Outlet (port D)			95% DRE	10% OEL	Port B	Port C
COPC	Test	Inlet Target	PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)	TOS DRE	Target met?	Target met?	FTIR (ppm)	FTIR (ppm)
Ammonia	6.3	630	-	665	-	0.3	>99.9%	Yes	Yes	76.3	0.9
Nitrous Oxide	6.3	831	-	853	-	261	69.5%	No	No	236	259

During test 6.3, as shown in Table 32, 853 ppm nitrous oxide and 665 ppm ammonia were measured at the engine inlet (port A), with 261 ppm nitrous oxide and 0.30 ppm ammonia measured at the TOS tailpipe. This resulted in a TOS DRE of >99.9% for ammonia, thus meeting both the 10% OEL target of 2.5 ppm and the 95% DRE target for ammonia. Again, neither the 10% OEL target of 5 ppm nor the 95% DRE target were met for nitrous oxide. The measurements from ports B and C for ammonia were 76.3 ppm and 0.9 ppm, respectively. Thus, as shown in Table 38 and Appendix F, the diesel engine contributed 88.5% DRE with an additional 11.3% from the catalyst. This shows that oxidation catalyst was critical for enabling the TOS to meet performance criteria for ammonia removal with high concentration ammonia injection.

5.7 Multi-component Performance Sensitivity Testing (Test 7)

The multi-gas test in the test plan combined six of the COPC gases at high concentrations to evaluate the performance of the TOS under high stress conditions. The six gases considered for this testing were as follows:

1. Acetonitrile (75-05-8) at 40 ppm
2. 2,4- Dimethylpyridine (108-47-4) at 1 ppm
3. Ammonia (7664-41-7) at 630 ppm
4. Nitrous Oxide (10024-97-2) at 100 ppm
5. N-Nitroso-dimethylamine (62-75-9) at 0.062 ppm
6. Furan (110-00-9) at 0.017 ppm

On June 6, WRPS provided the following discussion related to the multi-gas test:

> *These gasses have already been run and DRE's have been calculated. The tests were typically done with two gasses run simultaneously. Based on previous testing, we don't expect changes of DRE based on interaction between compounds. Further, the next step in the technology maturation process is a pilot-scale demonstration on BY-108. The full mixture of vapors in BY-108 will be tested in this phase of testing. The BY-108 vapor mixture will be much more challenging than the proposed engineering-scale multi-gas test. The multi-gas test is a duplication and should be deleted.*

Given the results of the COPC-specific testing, the fact that many of the COPCs had been tested with other COPCs in the same injection, and the operational limits for the PTR-MS (needing to operate in either the NO+ or H_3O+ mode), the additional value of this test became very limited. On June 11, WRPS, ORP, and PNNL determined that the multi-component DRE test would not be conducted during this phase of tests. The impact of multiple gas interactions is to be observed during future testing in the tank farms on Hanford waste tank BY-108.

5.8 Off-line Sample Analysis Results

Off-line analyses results are provided in this section, and include collection by SUMMA® canister and sorption media (DNPH-treated silica gel and Thermosorb/N). In addition to the injected COPC results, results from a large number of ancillary compounds are also reported. These ancillary compounds

provide an indication of other organics that may be present as a result of incomplete combustion of the diesel fuel and injected COPCs. Only those compounds that were detected above reporting limits are presented in this section, whereas the entire list of analytes measured by the various off-line analytical methods can be seen in Appendix I through Appendix L.

5.8.1 Off-line Gas Sample Concentrations with Comparisons to On-line Results

Off-line sample results for injected COPCs are provided in Table 44 along with comparisons to the on-line results reported above. In general, the off-line results compared well with on-line results for all sampling ports, especially considering the ultra trace levels of COPCs in ports B, C and D. In the cases where a duplicate result was available from either on-line or off-line sampling (shown as a range in Table 33), the single result from the alternative sampling method often fell within the range. In the case of 1,3-butadiene, the off-line results are reported separately from the on-line results. This is because these tests were performed on different days with different injected concentrations, and both the off-line and on-line analyses matched very well with the targeted inlet concentration.

There are two notable exceptions to the above generalizations.

1. The duplicate off-line formaldehyde results at port A in Test 3.2 were more than an order of magnitude lower than the corresponding on-line results. Further, the on-line results are consistent with the quantitatively injected amount. The calculated concentration from the formaldehyde injection in test 3.2 was 0.59 ppm, compared to the off-line results ranging from 0.017 to 0.039 ppm. The off-line formaldehyde results for ports B, C, and D compare reasonably well to the on-line results. This suggests that the offline formaldehyde results from port A are erroneous, and efforts to determine the underlying cause of the erroneous offline port A results have been unsuccessful.

2. The offline results for 2,4-dimethylpyridine were all below reporting limits (RL) with RL values well below the known and measured concentrations in ports A and B. The cause of this erroneous result is believed to be adhesion of 2,4-dimethylpyridine to the inside of the SUMMA® canisters. 2,4-Dimethylpyridine was found to be extremely “sticky” to the sampling system internals during tests 3.2 and 3.2b.

5.8.2 DREs Calculated from Offline Sample Analyses

DREs generated from offline sample results are provided in Table 34 along with comparison to on-line analyses. The TOS DREs generated from offline data compare very well with DREs generated from on-line data. The offline analyses yield the same result as the on-line analyses with regards to target criteria for overall TOS performance, with one exception: Test 5.3 offline analysis measured 0.43 ppbv furan in the TOS exhaust (versus 0.035 ppbv for on-line analysis), exceeding the 10% OEL threshold of 0.1 ppbv furan in the exhaust. Test 5.3 offline analyses did corroborate the on-line analysis result of >98% DRE for furan. Thus, since the success criteria allows for one or both of the targets to be met, the TOS met the overall performance criteria for furan. In this regard, the offline results are confirmatory of the on-line results.

Table 33. Offline Sample Analysis Results and Comparison to On-line Results

			Measured at Inlet (port A)			Measured at Port B			Measured at Port C			Measured at Outlet (port D)		
COPC	Test	Inlet Target (ppm)	On-line Analysis (ppm)	Offline Analysis (ppm)	Offline Baseline Test 0.2a (ppm)	On-line Analysis (ppm)	Offline Analysis (ppm)	Offline Baseline Test 0.2a (ppm)	On-line Analysis (ppm)	Offline Analysis (ppm)	Offline Baseline Test 0.2a (ppm)	On-line Analysis (ppm)	Offline Analysis (ppm)	Offline Baseline Test 0.2a (ppm)
Acetaldehyde[a]	1.2	50	61.9 - 75.5	63.3 - 124	<0.012	5.1 - 6.2	5.2	1.4	0.53 - 0.79	0.16	0.32	0.28 - 0.73	0.035 - 0.103	0.024
Acetonitrile	1.2	40	40.8	51.2 - 80.5	<0.012	7.1	4.9	0.01	0.23	0.13	<0.01	0.014	0.026 - 0.060	<0.012
Benzene	2.2	1	0.86	0.83	<0.011	0.34	0.20	0.15	0.034	0.016	<0.011	0.023	<0.01	<0.01
Propanenitrile	2.2	12	16.4	29.9	<0.0001	2.0	0.85	0.002	0.062	0.023	0.0013	0.010	0.0007	0.0002
1,3-Butadiene	3.2	3.4	NR	3.11	<0.01	NR	<0.01	<0.01	NR	<0.01	<0.01	NR	<0.01	<0.01
1,3-Butadiene	3.2a	7.1	8.05	NM	NM	0.98	NM	NM	NM	NM	NM	0.03	NM	NM
Formaldehyde[a]	3.2	0.6	0.38 - 1.34	0.02 - 0.04	NM	2.74 - 3.58	3.00	NM	0.29 - 0.83	0.47	NM	0.03 - 0.73	0.15	NM
2,4-Dimethylpyridine	3.2	1	0.98	<0.05	<0.05	0.021	<0.05	<0.10	NM	<0.05	<0.10	0.01	<0.05	<0.05
NDMA[b, c]	4.2	0.0006	0.00034	NR	NM	0.00025	NR	NM	NM	NR	NM	0.000151	NR	NM
	4.3	0.062	0.0603	0.0511	NM	0.00205	<0.00002	NM	0.00018	0.000044	NM	0.000042	0.000144	NM
Furan[b]	5.2	0.002	0.0023	0.0027	<0.0001	0.0578	0.0039	0.0178	NM	<0.0001	0.0029	0.000017	<0.0001	<0.0001
	5.3	0.017	0.0212	0.0224	<0.0001	0.0869	0.0069	0.0178	NM	<0.0001	0.0029	0.000035	0.00043	<0.0001
Ammonia	6.2	50	55	NM	NM	3.2	NM	NM	0.11	NM	NM	0.70	NM	NM
	6.3	630	665	NM	NM	76.3	NM	NM	0.9	NM	NM	0.32	NM	NM
Nitrous Oxide	6.2	100	106	99	<10	27.9	23	<10	29.3	19	<10	29	15 - 20	<10
	6.3	831	853	1300	<10	236	310	<10	259	320	<10	261	320	<10

[a] Range of concentrations shown for on-results reflect combined results from PRT-MS and FTIR (FTIR results in these ranges are For Information Only).
[b] On-line results reflect combined results from the PTR-MS and the TOFWERK VOCUS-PTR.
[c] NDMA Offline results corrected for high recoveries on laboratory control samples per recommendation of RJ Lee (see Section 1.4).
Test 4.2 (NDMA) and 6.2/6.3 (ammonia) are omitted from this table because the offline results were not usable.
NM = not measured
NR = data not reportable

Table 34. Offline Sample Analysis Results and Comparison to On-line Results

		Overall TOS DRE		A → B DRE		B → C DRE		C → D DRE		95% Overall DRE Target met?		10% OEL Target met?	
COPC	Test	On-line Analysis	Off-line Samples	On-line Analysis	Off-line Samples	On-line Analysis	Off-line Samples	On-line Analysis	Off-line Samples	On-line Analysis	Off-line Samples	On-line Analysis	Off-line Samples
Acetaldehyde	1.2	99.6%	>99.9%	90%	94%	9%	5%	0%	0%	Yes	Yes	Yes	Yes
Acetonitrile	1.2	>99.9%	>99.9%	83%	93%	17%	7%	1%	0%	Yes	Yes	Yes	Yes
Benzene	2.2	97%	>98.8%	60%	76%	36%	22%	1%	1%	Yes	Yes	Yes	Yes
Propanenitrile	2.2	>99.9%	>99.9%	88%	97%	12%	3%	0%	0%	Yes	Yes	Yes	Yes
1,3-Butadiene	3.2	99.7%	>99.7%	88%	>99.7%	-	-	12%	-	Yes	Yes	Yes	Yes
Formaldehyde	3.2	46%	74%[b]	-105%	-408%[b]	143%	429%[b]	8%	53%[b]	No	No	No	No
2,4-Dimethylpyridine	3.2	99%	NR	98%	NR	-	NR	1%	NR	Yes	NR	Yes	NR
NDMA[a]	4.3	>99.9%	99.7%	97%	100%	-	-0.1%	3%	-0.2%	Yes	Yes	No	Yes
Furan[a]	5.2	99%	>96.2%	-2367%	-47%	-	143%	2466%	-	Yes	Yes	Yes	Yes
	5.3	99.8%	98%	-311%	69%	-	30%	411%	-1%	Yes	Yes	Yes	No
Nitrous Oxide	6.2	73%	82%	74%	77%	-1%	4%	0%	2%	No	No	No	No
	6.3	69%	75%	72%	76%	-3%	-1%	0%	0%	No	No	No	No

[a] Reflects combined results from the PTR-MS and the TOFWERK VOCUS-PTR.
[b] The theoretical, calculated formaldehyde inlet concentration of 0.59 ppm was used for calculation of DREs using offline results.
Tests 4.2 (NDMA) and 6.2/6.3 (ammonia) are omitted from this table because the offline results were not usable.
NR = Data Not Reportable

5.8.3 Repeatability of Offline Results

Random duplicate sampling was conducted for offline samples to determine repeatability and total variability of the offline sampling and analysis methods. All duplicate results greater than reporting limits are shown for comparison in Table 35 along with the relative standard deviation (RSD) for each of the duplicate pairs. Here, RSD is calculated as the standard deviation (calculated as the square-root of the variance of the results with Bessel's correction) divided by the average. Six of the seven duplicate sample pairs came from SUMMA® canisters, and the seventh duplicate pair was from a silica gel tube. The analytes that were being injected during the sampling event are shaded in grey. Other analytes were there as contaminants, generated by the diesel engine, catalytic convertor or particulate filter, or a byproduct of COPC injection. For analytes being injected, the RSDs ranged from 20% to 70%; those not being injected did not exceed 100%.

The offline sample analysis ranges and comparisons represent several sources of potential variability in the tests, and can include sampling and handling variability and analytical preparation and instrumentation variability. Analytical uncertainty under ideal conditions for EPA method TO-15 (SUMMA® canister samples) and EPA Method TO-11A HPLC (silica gel sorbent samples) can be estimated from recoveries on laboratory control samples (LCS), and is also shown in Table 35. All LCS recoveries for the analytes shown are within ±18% of the certified standard concentrations. Therefore, the analytical uncertainty represents a minor part of the total uncertainty, with the remaining uncertainty largely due to non-ideal sample matrices, test variability, and sampling/handling variability. More data would be required to quantify contributions to the total sample result variability.

Table 35. Results from Duplicate Offline Sample Analyses

Test # Test Activity Sample Port - Sampling Method	Sample ID	Duplicate Sample ID	Analyte	Units	Result	Duplicate Result	Relative Standard Deviation of Duplicates	Laboratory Control Sample Recovery
Test 1.2 Acetaldehyde/Acetonitrile Injection Port A - SUMMA® Canister	1OL0CNA0	1OL1CNA0	Furan	PPBV	2.17	1.90	9%	115%
			Propanenitrile	PPBV	2.24	0.39	99%	115%
			Acetaldehyde	*PPMV*	*124*	*63.3*	*46%*	*105%*
			Acetonitrile	*PPMV*	*80.5*	*51.2*	*31%*	*103%*
Test 1.2 Acetaldehyde/Acetonitrile Injection Port D - SUMMA® Canister	1OL0CND0	1OL1CND0	Furan	PPBV	0.0998	0.35	79%	115%
			Propanenitrile	PPBV	0.29	1.68	100%	115%
			Acetaldehyde	*PPBV*	*34.8*	*103*	*70%*	*104%*
			Acetonitrile	*PPBV*	*25.8*	*59.6*	*56%*	*104%*
Test 3.2 1,3-Butadiene/Formaldehyde/ 2,4-Dimethylpyridine Injection Port C - SUMMA® Canister	3OL0CNC0	3OL1CNC0	Propanenitrile	PPBV	1.69	0.322	96%	83%
			Acetaldehyde	PPBV	112	50	54%	107%
			Acetone	PPBV	33.9	12.8	64%	108%
Test 3.2 Diesel Background Port A - SUMMA® Canister	3OL2CNA0	3OL3CNA0	Acetaldehyde	PPBV	25.9	85.1	75%	104%
			Methanol	PPBV	22.0	53.6	59%	109%
Test 4.2/5.2 NDMA/Furan Injection Port C - SUMMA® Canister	5OL0CNC0	5OL1CNC0	Propanenitrile	PPBV	0.16	0.16	0%	115%-118%
			Acetaldehyde	PPBV	20.4	25.7	16%	107%
Test 6.2 Nitrous Oxide/Ammonia Injection Port D - SUMMA® Canister	6OL0CND	6OL1CND	*Nitrous Oxide*	*PPMV*	*20*	*15*	*20%*	*97%*
			Propanenitrile	PPBV	0.5	0.18	67%	84%
			Acetaldehyde	PPBV	49.9	21.4	57%	111%
Test 3.2 1,3-Butadiene/Formaldehyde/ 2,4-Dimethylpyridine Injection Port A - Silica Gel Tube	3OL0FHA0	3OL1FHA0	*Formaldehyde*	*PPBV*	*16.6*	*38.9*	*57%*	*99%-101%*
			Acetaldehyde	PPBV	5.82	9.76	36%	95%-99%

Shaded cells are injected compounds

5.8.4 Non-Injected Analytes in Offline Samples

Each of the offline analytical methods produced a significant number of detectable, calibrated analytes that were ancillary to the injected compounds. These ancillary compounds provide an indication of chemicals of concern and benign products that may be generated by the diesel engine and/or result from COPC injection.

Table 36 through Table 39 provide a summary of the ancillary compounds found in ports A through D for each test. Only compounds that showed a positive result (i.e., > reporting limit) in at least one of the ports/tests are shown. A total list of analytes measured, including those that were not detected, can be reviewed in Appendix J (TO-15 = 51 total analytes, TO-11A = 14 total analytes, and NIOSH 2522 = 8 total analytes). The number of ancillary analytes detected in port B are much larger than the other ports (port A = 12 compounds, port B = 27 compounds, port C = 13 compounds, port D = 13 compounds). This is because the number and amount of organic compounds that are produced in the engine and subsequently destroyed in the diesel oxidation catalyst are large. It is also noted that nitrosamines are destroyed in the engine and created to a lesser extent in the DPF. N-butyl acetate is the only other compound that was detected in the TOS exhaust (port D) but not in the oxidation catalyst outlet (port C).

The last column of Table 39 provides the maximum observed concentration of each ancillary compound observed in the exhaust (port D) as a percentage of its $_{HTF}$OEL. The ancillary compounds are all below 10% of their $_{HTF}$OEL, with two exceptions. N-Nitrosodiethylamine (NDEA) was found at 16%, and furan at 56% of their $_{HTF}$OEL.

To differentiate which compounds are being created as a result of diesel combustion versus destruction of injected COPCs, one might compare the diesel baseline values to those of the injection tests. In general, it appears that most of the ancillary compounds in the injection tests were also found in the diesel background for the same ports (note that diesel baseline samples were not analyzed with TO-11A or NIOSH 2522 methods).

Table 36. Non-Injected Analytes in Port A Offline Samples

			Test 0.2A		Test 3.2		Test 1.2		Test 2.2	Test 3.2	Test 4.2/5.2	Test 4.3/5.3	Test 6.2	Test 6.3
			None Diesel Off	None (Diesel Baseline)	None (Diesel Baseline)		Acetonitrile & Acetaldehyde		Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine	Furan & NDMA	Furan & NDMA	Ammonia & Nitrous Oxide	Ammonia & Nitrous Oxide
TO-15 ANALYTE	CAS #	UNIT	AB0CNU	DB0CNA	3OL2CNA0	3OL3CNA0	1OL0CNA0	1OL1CNA0	2OL0CNA0	3OL0CNA0	5OL0CNA0	5MX0CNA0	6OL0CNA	6MX0CNA
Furan	110-00-9	PPBV	<0.100	<0.100	0.150	<0.100	2.17	1.90	<0.100	5.58	Injected	Injected	<0.100	0.340
Propanenitrile	107-12-0	PPBV	<0.100	<0.100	3.70	<0.110	2.24	0.390	Injected	20.0	0.160	<0.110	<0.100	0.420
Acetaldehyde	75-07-0	PPBV	<11.8	<11.8	25.9	85.1	Injected	Injected	12.9	53.9	<11.8	<11.8	<11.8	43.4
Acetone	67-64-1	PPBV	200	1.16E+03	<11.2	<11.2	<11.2	691	<11.6	23.5	<11.2	154	<11.4	12.4
Acetonitrile	75-05-8	PPBV	<11.5	<11.5	<11.7	<11.7	Injected	Injected	<11.0	Note 1	<11.7	<11.7	<11.5	<11.0
Acrolein	107-02-8	PPBV	<11.3	<11.3	<11.2	<11.2	<11.2	<11.2	<11.5	48.4	<11.2	<11.2	<11.3	<11.5
Ethanol	64-17-5	PPBV	<11.7	<11.7	<11.9	491	<11.9	<11.9	<11.1	<11.1	<11.9	<11.9	<11.7	<11.1
Methanol	67-56-1	PPBV	13.9	129	22.0	53.6	14.8	<12.0	35.4	256	25.9	17.6	17.7	<10.2
TO-11A ANALYTE										3OL0FHA0	3OL1FHA0			
Acetaldehyde	75-07-0	PPBV								5.823	9.762			
NIOSH 2522 ANALYTE[a]												EL23302		
N-Nitrosodimethylamine	62-75-9	PPBV										Injected		
N-Nitrosodi-n-butylamine	924-16-3	PPBV										0.0602		
N-Nitrosodi-n-propylamine	621-64-7	PPBV										0.0380		
N-Nitrosomethylethylamine	10595-95-6	PPBV										0.0279		

[a] NDMA Offline results corrected for high recoveries on laboratory control samples per recommendation of RJ Lee (see Section 1.4)

Shaded cells are results above reporting limits

Note 1 – The SUMMA® canister analysis reported 2.84 ppm of acetonitrile in the inlet stream. These results were compared to the PTR-MS “For Information Only” measurements of 3.5 ppb. Further investigation indicated that the media treatment chemicals (specifically acetonitrile) in the DNPH Treated Silica Gel, SKC-226-119 sample tubes were captured in the SUMMA® canister during the sample collection process.

Table 37. Non-Injected Analytes in Port B Offline Samples

			Test 0.2A	Test 3.2	Test 1.2	Test 2.2	Test 3.2	Test 4.2/5.2	Test 4.3/5.3	Test 6.2 Ammoina & Nitrous Oxide	Test 6.3 Ammoina & Nitrous Oxide
TO-15 ANALYTE	CAS #	UNIT	None (Diesel Baseline) DB0CNB	None (Diesel Baseline) 3OL2CNB0	Acetonitrile & Acetaldehyde 1OL0CNB0	Benzene & Propanenitrile 2OL0CNB0	1,3 Butadiene, Formaldehyde & Dimethylpyridine 3OL0CNB0	Furan & NDMA 5OL0CNB0	Furan & NDMA 5MX0CNB0	Ammonia & Nitrous Oxide 6OL0CNB	Ammonia & Nitrous Oxide 6MX0CNB
Furan	110-00-9	PPBV	17.8	35.5	29.0	49.4	42.9	Injected	Injected	21.5	45.1
Propanenitrile	107-12-0	PPBV	2.20	6.54	8.30	Injected	18.0	0.410	0.326	2.13	3.52
1-Butanol	71-36-3	PPBV	<11.7	16.1	<12.0	47.2	20.8	<12.0	<12.2	<11.7	<11.1
2-Butanone	78-93-3	PPBV	42.3	42.2	30.1	40.0	39.1	<11.5	<11.7	47.2	56.6
2-Heptanone	110-43-0	PPBV	<10.2	<10.4	<10.4	<10.2	<9.73	<10.4	<10.6	<10.2	<10.2
2-Hexanone	591-78-6	PPBV	12.0	<11.0	<11.0	<10.9	<10.4	<11.0	<11.2	12.5	<10.9
3-Buten-2-one	78-94-4	PPBV	74.6	58.8	41.6	62.6	77.4	<11.5	13.0	83.1	67.2
3-Heptanone	106-35-4	PPBV	<10.6	<10.4	<10.4	<10.4	13.0	<10.4	<10.6	<10.6	<10.4
Acetaldehyde	75-07-0	PPBV	1.44E+03	1.33E+03	Injected	1.28E+03	1.41E+03	133	152	1.98E+03	1.62E+03
Acetone	67-64-1	PPBV	181	287	347	315	289	27.2	32.5	184	1.92E+03
Acetonitrile	75-05-8	PPBV	12.9	31.3	Injected	40.9	22.8	73.9	<11.9	13.5	14.0
Acrolein	107-02-8	PPBV	281	142	84.6	407	428	51.9	70.4	383	70.0
Acrylonitrile	107-13-1	PPBV	<11.6	<11.5	<11.5	467	<11.2	<11.5	<11.7	<11.6	<11.7
Benzene	71-43-2	PPBV	147	170	144	Injected	139	34.4	42.7	152	170
Butanal	123-72-8	PPBV	47.6	61.6	39.7	84.4	68.3	<12.0	<12.2	66.8	68.0
Decane	124-18-5	PPBV	30.2	36.4	33.1	22.6	<9.92	<10.7	<10.9	25.5	26.8
Ethylbenzene	100-41-4	PPBV	10.9	<10.8	<10.8	<10.6	<10.1	<10.8	<11.0	<10.5	<10.6
Toluene	108-88-3	PPBV	54.7	47.5	40.5	47.9	36.9	<10.8	12.5	53.1	48.3
n-Butyl acetate	123-86-4	PPBV	<10.8	<10.9	<10.9	<10.7	11.8	<10.9	<11.1	<10.8	<10.7
TO-11A ANALYTE							3OL0FHB0				
Acetaldehyde	75-07-0	PPBV					549				
Acrolein	107-02-8	PPBV					42.3				
Propionaldehyde	123-38-6	PPBV					63.7				
Crotonaldehyde	123-73-9	PPBV					74.4				
Butanal	123-72-8	PPBV					65.7				
Benzaldehyde	100-52-7	PPBV					53.6				
Valeraldehyde	110-62-3	PPBV					29.2				
m,p-Tolualdehyde	620-23-5	PPBV					3.6				

Shaded cells are results above reporting limits

Table 38. Non-Injected Analytes in Port C Offline Samples

			Test 0.2A	Test 3.2	Test 1.2	Test 2.2	Test 3.2		Test 4.2/5.2		Test 4.3/5.3	Test 6.2 Ammoina & Nitrous Oxide	Test 6.3 Ammoina & Nitrous Oxide
			None (Diesel Baseline)	None (Diesel Baseline)	Acetonitrile & Acetaldehyde	Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine		Furan & NDMA		Furan & NDMA	Ammonia & Nitrous Oxide	Ammonia & Nitrous Oxide
TO-15 ANALYTE	CAS #	UNIT	DB0CNC	3OL2CNC0	1OL0CNC0	2OL0CNC0	3OL0CNC0	3OL1CNC0	5OL0CNC0	5OL1CNC0	5MX0CNC0	6OL0CNC	6MX0CNC
Furan	110-00-9	PPBV	2.94	0.560	0.400	1.32	0.380	<0.0977	Injected	Injected	Injected	1.46	1.17
Propanenitrile	107-12-0	PPBV	1.34	1.70	0.740	Injected	1.69	0.322	0.160	0.160	<0.110	0.510	0.740
1-Butanol	71-36-3	PPBV	19.9	<12.0	<12.0	14.2	<10.8	<10.8	<12.0	<12.0	<12.0	<11.7	<11.1
Acetaldehyde	75-07-0	PPBV	324	139	Injected	149	112	50.0	20.4	25.7	13.9	111	103
Acetone	67-64-1	PPBV	2.12E+03	36.2	111	2.24E+03	33.9	12.8	<11.2	1.77E+03	393	21.6	58.0
Acetonitrile	75-05-8	PPBV	<11.5	<11.7	Injected	11.7	11.3	<10.8	<11.7	<11.7	<11.7	<11.5	<11.0
Acrolein	107-02-8	PPBV	19.7	<11.2	<11.2	12.9	<11.2	<11.2	<11.2	<11.2	<11.2	12.2	<11.5
Benzene	71-43-2	PPBV	<10.5	<10.9	<10.9	Injected	11.9	<10.6	<10.9	<10.9	<10.9	<10.5	<10.8
Butanal	123-72-8	PPBV	15.9	<12.0	<12.0	<9.89	<9.64	<9.68	<12.0	<12.0	<12.0	<11.8	<9.90
Ethyl acetate	141-78-6	PPBV	<10.7	<11.2	<11.2	<10.4	11.5	<10.2	<11.2	<11.2	<11.2	<10.7	<10.4
TO-11A ANALYTE							3OL0FHC0						
Acetaldehyde	75-07-0	PPBV					33.2						
Acrolein	107-02-8	PPBV					9.2						
Butanal	123-72-8	PPBV					14.4						

Shaded cells are results above reporting limits

Table 39. Non-Injected Analytes in Port D Offline Samples

			Test 0.2A	Test 3.2	Test 1.2		Test 2.2	Test 3.2	Test 4.2/5.2	Test 4.3/5.3	Test 6.2		Test 6.3	$_{HTF}$OEL	% $_{HTF}$OEL
			None (Diesel Baseline)	None (Diesel Baseline)	Acetonitrile & Acetaldehyde		Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine	Furan & NDMA	Furan & NDMA	Ammonia & Nitrous Oxide		Ammonia & Nitrous Oxide		
TO-15 ANALYTE	CAS #	UNIT	DB0CND	3OL2CND0	1OL0CND0	1OL1CND0	2OL0CND0	3OL0CND0	5OL0CND0	5MX0CND0	6OL0CND	6OL1CND	6MX0CND	(PPB)	Maximum
Furan	110-00-9	PPBV	<0.100	0.560	0.0998	0.350	0.200	0.349	Injected	Injected	<0.100	<0.100	0.360	1	56%
Propanenitrile	107-12-0	PPBV	0.18	1.67	0.290	1.68	Injected	9.26	0.200	0.570	0.500	0.180	0.440	6000	0.2%
1-Butanol	71-36-3	PPBV	<11.7	<12.0	<12.0	<12.0	26.2	<11.1	<12.0	<12.0	58.3	<11.7	26.4	20000	0.3%
Acetaldehyde	75-07-0	PPBV	24.4	94.6	Injected	Injected	72.7	51.9	<11.8	44.3	49.9	21.4	50.3	25000	0.4%
Acetone	67-64-1	PPBV	<11.4	22.0	<11.2	17.2	23.3	26.2	216	304	11.4	<11.4	918		
Acetonitrile	75-05-8	PPBV	<11.5	28.6	Injected	Injected	<11.0	Note 1	<11.7	<11.7	<11.5	<11.5	40.9	20000	N/A
Butanal	123-72-8	PPBV	<11.8	<12.0	<12.0	12.5	<9.90	<9.88	<12.0	<12.0	<11.8	<11.8	<9.90	25000	0.05%
Ethyl acetate	141-78-6	PPBV	<10.7	<11.2	<11.2	<11.2	<10.4	15.2	<11.2	<11.2	<10.7	<10.7	<10.4		
n-Butyl acetate	123-86-4	PPBV	<10.8	<10.9	<10.9	<10.9	14.5	19.7	<10.9	<10.9	14.9	<10.8	<10.7		
TO-11A ANALYTE								3OL0FHD0							
Acetaldehyde	75-07-0	PPBV						14.6						25000	0.06%
Acrolein	107-02-8	PPBV						8.558						100	8.6%
NIOSH 2522 ANALYTE[a]										EL23319					
N-Nitrosodiethylamine	55-18-5	PPBV								0.0163				0.1	16%
N-Nitrosodi-n-butylamine	924-16-3	PPBV								0.0165					

[a] NDMA Offline results corrected for high recoveries on laboratory control samples per recommendation of RJ Lee (see Section 1.4)

Shaded cells are results above reporting limits

Note 1 – The SUMMA® canister analysis reported 66 ppm of acetonitrile in the final exhaust stream. These results were compared to the PTR-MS “For Information Only” measurements of between 10 and 11 ppb. Further investigation indicated that the media treatment chemicals (specifically acetonitrile) in the DNPH Treated Silica Gel, SKC-226-119 sample tubes were captured in the SUMMA® canister during the sample collection process.

5.8.5 Tentatively Identified Compounds

Tentatively identified compounds (TICs) were reported by the analytical laboratory for most SUMMA® canister samples (EPA Method TO-15). TICs are ancillary analytes that were detected by the analytical instrument (GC/mass selective detector) and matched to a library of mass fragmentation. The TIC results are considered to be qualitative because the instrument is not calibrated for TIC analytes.

It can be noted that some of the primary calibrated analytes reported in Sections 5.8.1 through 5.8.4 are also included in the TIC analytical reports (e.g., formaldehyde, NDMA, furan, propanenitrile, nitrous oxide). This is because the TIC analysis by EPA TO-15 was performed using a different method than the primary analysis (formaldehyde by TO-11A and NDMA by NIOSH 2522) or multiple runs were made on the GC/MSD using EPA TO-15. For example, the primary results for furan and propanenitrile were obtained using a dedicated calibration run on the GC/MSD, whereas the TIC results for these compounds were obtained from a repeat analysis on the GC/MSD where other compounds were calibrated. TIC results can be considered confirmatory of the primary analyses reported in Sections 5.8.1 through 5.8.4, but the calibrated results in these sections are considered to be more accurate.

Table 40 through Table 43 provide a summary of the TICs found in ports A through D for each of the tests (TICs reported as "unknown" are not included in the tables but can be found in the analytical reports in Appendix K). Most of the TICs reported are non-injected compounds. For convenience, the cells are shaded where the TIC was an injected compound in the test. The three injected compounds measured as TICs in port A samples (see Table 40) showed rough agreement with the known injected concentrations (furan at 11 ppb versus 17 ppb injected, NDMA at 17 ppb versus 62 ppb injected, and propanenitrile at 1.8 ppm versus 12 ppm injected). One notable omission is the lack of formaldehyde measured as a TIC in port A of test 3.2 (see Table 40). Formaldehyde was found as a TIC in ports B, C, and D samples for test 3.2 (see Table 41, Table 42, and Table 43). The lack of detected formaldehyde in the inlet during this test (sample 3OL0CNA0) corroborates the EPA TO-11A anomalous result on samples 3OL0FHA0 and 3OL1FHA0.

The bulk of the TICs produced by the diesel engine are products of the incomplete combustion of diesel fuel, with the exception of the oxides of nitrogen (i.e., NOx = nitric oxide, nitrogen dioxide), which are a known result of conventional lean diesel combustion. Thus, port B samples (untreated diesel exhaust) had the largest number of TICs identified since this sample preceded the oxidation catalyst, and included 186 compounds versus 18 TICs identified at port A (inlet), 19 TICs at port C (post oxidation catalyst), and 24 TICs at port D (post DPF). Most of the non-injected TICs were detected in trace quantities ($\leq$ 100 ppb) in all four ports. Only 8 TICs were found exceeding 0.1 ppm at port B in one or more tests (excluding NOx), and included 1-butene, 1-hexene, 1-pentene, 2-methyl-1-propene, formaldehyde, propene, trimethylsilyl fluoride, and undecane. Only 2 TICs were found exceeding 0.1 ppm at port D in one of more tests (excluding NOx), and included formaldehyde and methyl nitrate.

Three of the TICs identified in port D (treated exhaust) are $_{HTF}$COPCs (formaldehyde, methyl nitrite, and nitrous oxide) and were all found at levels below their $_{HTF}$OELs. Formaldehyde and nitrous oxide TIC concentrations in port D were consistent with port D concentrations during injection studies as measured by PTR-MS, FTIR, TO-11A, and TO-15 (see Table 33). From the TIC analysis, methyl nitrite was found to be between 12% and 99% of the $_{HTF}$OEL in port D, and is an expected acid gas produced from the

diesel engine. Future test plans on the NUCON TOS should consider adding methyl nitrite to the formal calibrated analyte list.

Table 40. Tentatively Identified Compounds in Port A Offline EPA TO-15 Samples

			Test 3.2	Test 1.2		Test 2.2	Test 3.2	Test 4.3/5.3	Test 6.3 Ammoina & Nitrous Oxide
			None (Diesel Baseline)	Acetonitrile & Acetaldehyde		Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine	Furan & NDMA	Ammonia & Nitrous Oxide
TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	3OL3CNA0	1OL0CNA0	1OL1CNA0	2OL0CNA0	3OL0CNA0	5MX0CNA0	6MX0CNA
1-Butene	106-98-9	PPBV							13
1-Propene-1-thiol	925-89-3	PPBV				65	30		
2-Butenal	4170-30-3	PPBV			10				
2-Propanol, 2-methyl-	75-65-0	PPBV							10
Benzoic acid, 2-[(trimethylsilyl)oxy]-, trimethylsilyl ester	3789-85-3	PPBV							46
Cyclohexene, 4-ethenyl-	100-40-3	PPBV					11		
Cyclotetrasiloxane, octamethyl-	556-67-2	PPBV				45	29		140
Cyclotrisiloxane, hexamethyl-	541-05-9	PPBV							13
Disiloxane, hexamethyl-	107-46-0	PPBV							23
Ethylene oxide	75-21-8	PPBV			220				
Formamide	75-12-7	PPBV		2.1E+03					
Furan	110-00-9	PPBV						11	
Methyl nitrate	598-58-3	PPBV	130		170				
Nitric oxide	10102-43-9	PPBV	23		35				72
N-Nitrosodimethylamine	62-75-9	PPBV						17	
Propanenitrile	107-12-0	PPBV				1.8E+03			
Silanol, dimethyl-	5906-76-3	PPBV							20
t-Butyl nitrite	540-80-7	PPBV							10

Shaded cells are injected compounds

Table 41. Tentatively Identified Compounds in Port B Offline EPA TO-15 Samples

			Test 0.2A	Test 3.2	Test 1.2	Test 2.2	Test 3.2	Test 4.2/5.2	Test 4.3/5.3	Test 6.2	Test 6.3
TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	None (Diesel Baseline) DB0CNB	None (Diesel Baseline) 3OL2CNB0	Acetonitrile & Acetaldehyde 1OL0CNB0	Benzene & Propanenitrile 2OL0CNB0	1,3 Butadiene, Formaldehyde & Dimethylpyridine 3OL0CNB0	Furan & NDMA 5OL0CNB0	Furan & NDMA 5MX0CNB0	Ammonia & Nitrous Oxide 6OL0CNB	Ammonia & Nitrous Oxide 6MX0CNB
(E)-1,3-Butadien-1-ol	70411-98-2	PPBV				36					33
1,2,3,4-tetrahydronaphthalene	119-64-2	PPBV		23	20						
1,2,4,5-Tetroxane, 3,3,6,6-tetramethyl-	1073-91-2	PPBV								17	
1,2-Ethanediol, dinitrate	628-96-6	PPBV		13	14						
1,3-Pentadiene, 3-methyl-, (E)-	2787-43-1	PPBV				16	13				
1,3-Propanediol, 2-dodecyl	10395-09-2	PPBV									10
1,4-Heptadiene	5675-22-9	PPBV					11				
1,4-Pentadiene	591-93-5	PPBV				11				26	12
1-Butanol, 2-ethyl-	97-95-0	PPBV	13	30							
1-Butene	106-98-9	PPBV	15			260		17	23		220
1-Butene, 3-methyl-	563-45-1	PPBV				19					
1-Butyne, 3-methyl-	598-23-2	PPBV					12				
1-Cyclohexylheptene	114614-83-4	PPBV					16				
1-Cyclohexylnonene	114614-84-5	PPBV									13
1-Decanol, 2-hexyl-	2425-77-6	PPBV		14	15	18	17				
1-ethyl-3-methylbenzene	620-14-4	PPBV			23						
1-Heptadecyne	26186-00-5	PPBV				24					30
1-Heptene	592-76-7	PPBV	56	35	27	52	47			56	55
1-Heptene, 4-methyl-	13151-05-8	PPBV				11					
1-Heptene, 6-methyl-	5026-76-6	PPBV					10				
1-Hexanol, 2-ethyl-	104-76-7	PPBV				33	27				
1-Hexene	592-41-6	PPBV	89			120	110			76	110
1-Hexene, 2-methyl-	6094-02-6	PPBV				12					
1-Hexene, 3,4-dimethyl-	16745-94-1	PPBV					17				19
1-Hexene, 3,5-dimethyl-	7423-69-0	PPBV				40					41
1-Hexene, 5-methyl-	3524-73-0	PPBV				17					
1-methyl-3-propylbenzene	1074-43-7	PPBV			11						
1-Methyldecahydronaphthalene	2958-75-0	PPBV		19	17						
1-methyl-2-(1-methylethyl)-benzene	527-84-4	PPBV		10							
1-methyl-4-propylbenzene	1074-55-1	PPBV		12							
1-Nonene	124-11-8	PPBV				32	30				31
1-Octanol, 2-butyl-	3913-02-8	PPBV				17	19				14
1-Octene	111-66-0	PPBV	46							40	
1-Octene, 3,7-dimethyl-	4984-01-4	PPBV		26	19	19					21
1-Octene, 6-methyl-	13151-10-5	PPBV									16
1-Pentanol, 2-ethyl-	27522-11-8	PPBV				11	11				
1-Pentene	109-67-1	PPBV	10			120	96			11	100
1-Pentene, 3-methyl-	760-20-3	PPBV									35
1-Pentene, 4-methyl-	691-37-2	PPBV		21	19	26	50		11		
1-Propanol, 2,2-dimethyl-, benzoate	3581-70-2	PPBV					23				
1-Propene, 2-methyl-	115-11-7	PPBV	150	66	60	14	260			140	10
1-Tridecanol	112-70-9	PPBV				14					16
2,3-Dimethyldecane	17312-44-6	PPBV		17	14						
2,4,6,8-Tetramethyl-1-undecene	59920-26-2	PPBV		16	12						

Table 41 (cont'd). Tentatively Identified Compounds in Port B Offline EPA TO-15 Samples

TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	Test 0.2A None (Diesel Baseline) DB0CNB	Test 3.2 None (Diesel Baseline) 3OL2CNB0	Test 1.2 Acetonitrile & Acetaldehyde 1OL0CNB0	Test 2.2 Benzene & Propanenitrile 2OL0CNB0	Test 3.2 1,3 Butadiene, Formaldehyde & Dimethylpyridine 3OL0CNB0	Test 4.2/5.2 Furan & NDMA 5OL0CNB0	Test 4.3/5.3 Furan & NDMA 5MX0CNB0	Test 6.2 Ammonia & Nitrous Oxide 6OL0CNB	Test 6.3 Ammonia & Nitrous Oxide 6MX0CNB
2,4-Dimethylstyrene	2234-20-0	PPBV					15				
2,4-Nonadiyne	63621-15-8	PPBV			41						
2,6-Dimethyldecane	13150-81-7	PPBV	58	42	38	12					20
2,7-dimethyl-1,2,3,4-tetrahydronaphthalene	13065-07-1	PPBV		13							
2-Butanone, 3-methyl-	563-80-4	PPBV				11	11				16
2-Butenal	4170-30-3	PPBV	34	30	21	43				48	26
2-Butenal, (E)-	123-73-9	PPBV					41				
2-Butene	107-01-7	PPBV		47	39	23	21			13	21
2-Butene, (E)-	624-64-6	PPBV					14				
2-Butene, 2,3-dimethyl-	563-79-1	PPBV				14	13				
2-Cyclohexen-1-ol, 2-methyl-5-(1-methylethenyl)-	99-48-9	PPBV					11				
2-Decen-1-ol	22104-80-9	PPBV				30					
2-Ethyl-1-dodecanol	19780-33-7	PPBV		11	11						
2-Hexene, 5,5-dimethyl-, (Z)-	39761-61-0	PPBV				14	15				
2-Hexyl-1-octanol	19780-79-1	PPBV	30	12	10	15	13				11
2-Methyl-1-butene	563-46-2	PPBV				32	16				18
2-Methyl-1-undecanol	10522-26-6	PPBV		21	19	21	16				21
2-methyl-decahydronaphthalene	2958-76-1	PPBV		22	25						
2-Nonenal, (Z)-	60784-31-8	PPBV					24				
2-Pentene	109-68-2	PPBV									14
2-Pentene, (E)-	646-04-8	PPBV					22				
2-Pentene, 3-methyl-, (Z)-	922-62-3	PPBV					24				
2-Pentene, 4,4-dimethyl-	26232-98-4	PPBV								23	
2-Propanol, 2-methyl-	75-65-0	PPBV				24	12				
2-Undecenal	53448-07-0	PPBV					19				
3-Decen-1-ol, (E)-	10339-60-3	PPBV				21					23
3-Decyn-2-ol	69668-93-5	PPBV					20				
3-Hepten-1-ol	10606-47-0	PPBV				12					15
3-Hexene	592-47-2	PPBV									10
4-Dodecene, E-	7206-15-7	PPBV		15	12						
4-Pentenal, 2-methyl-	5187-71-3	PPBV			23						
6-methyl-1,2,3,4-tetrahydronaphthalene	1680-51-9	PPBV					11				
9-Octadecenal, (Z)-	2423-10-1	PPBV									11
Acetic acid ethenyl ester	108-05-4	PPBV		14	10						
Acetophenone	98-86-2	PPBV				51					
Allene	463-49-0	PPBV	28			12	11			27	11
Benzaldehyde	100-52-7	PPBV				35	27				34
Benzene, (1-azido-1-methylethyl)-	32366-26-0	PPBV				15					
Benzene, 1-(1-methylethenyl)-3-(1-methylethyl)-	1129-29-9	PPBV									12
Benzene, 1,2,3,5-tetramethyl-	527-53-7	PPBV		20	15						
Benzene, 1,2,3-trimethyl-	526-73-8	PPBV	57	14	13				12	50	19
Benzene, 1,4-diethyl-	105-05-5	PPBV		18	15						
Benzene, 1-ethyl-2,4-dimethyl-	874-41-9	PPBV									19
Benzene, 1-ethyl-3-methyl-	620-14-4	PPBV		24	23	20	18				23
Benzene, 1-ethyl-4-methyl-	622-96-8	PPBV		11	11						20

Table 41 (cont'd). Tentatively Identified Compounds in Port B Offline EPA TO-15 Samples

			Test 0.2A	Test 3.2	Test 1.2	Test 2.2	Test 3.2	Test 4.2/5.2	Test 4.3/5.3	Test 6.2	Test 6.3
			None (Diesel Baseline)	None (Diesel Baseline)	Acetonitrile & Acetaldehyde	Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine	Furan & NDMA	Furan & NDMA	Ammonia & Nitrous Oxide	Ammonia & Nitrous Oxide
TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	DB0CNB	3OL2CNB0	1OL0CNB0	2OL0CNB0	3OL0CNB0	5OL0CNB0	5MX0CNB0	6OL0CNB	6MX0CNB
Benzene, 1-methyl-2-(1-methylethyl)-	527-84-4	PPBV		10		14					22
Benzene, 1-methyl-4-propyl-	1074-55-1	PPBV		12							11
Benzene, 2-ethenyl-1,3,5-trimethyl-	769-25-5	PPBV		15	13						10
Benzene, propyl-	103-65-1	PPBV					12				15
Benzocycloheptene	1075-16-7	PPBV				15					19
Butane, 2,3-dimethyl-	79-29-8	PPBV	12							18	
cis-4-Decene	19398-88-0	PPBV		15	14						
cis-9,10-Epoxyoctadecan-1-ol	13980-12-6	PPBV					12				
Cyanic acid, 2-methylpropyl ester	1768-25-8	PPBV					20				
Cyclobutane, methyl-	598-61-8	PPBV	86	49	46			10		71	
Cyclobutene, 2-propenylidene-	52097-85-5	PPBV				95	74				100
Cyclohexane, 1,2-dimethyl-	583-57-3	PPBV				11					
Cyclohexane, 1-ethyl-2-methyl-	3728-54-9	PPBV		16	14	11	11				
Cyclohexane, 1-ethyl-4-methyl-, trans-	6236-88-0	PPBV									13
Cyclohexane, 1-methyl-2-propyl-	4291-79-6	PPBV				19					20
Cyclohexane, ethyl-	1678-91-7	PPBV		13	10						13
Cyclohexane, methyl-	108-87-2	PPBV	22								11
Cyclohexane, propyl-	1678-92-8	PPBV					13				11
Cyclohexane,1-ethyl-2-methyl-, cis-	4923-77-7	PPBV				16					
Cyclohexene	110-83-8	PPBV	11	13		14	10			12	12
Cyclooctane, 1,2-dimethyl-	13151-94-5	PPBV				16					
Cyclooctane, butyl-	16538-93-5	PPBV									13
Cyclooctane, methyl-	1502-38-1	PPBV				11	10				10
Cyclopentadecanone, 4-methyl-	34894-60-5	PPBV					19				
Cyclopentane	287-92-3	PPBV							19		
Cyclopentane, (3-methylbutyl)-	1005-68-1	PPBV				10					
Cyclopropane, (1,2-dimethylpropyl)-	6976-27-8	PPBV				19					23
Cyclopropane, 1,1,2,2-tetramethyl-	4127-47-3	PPBV		19	16						
Cyclopropane, 1,1-dimethyl-	1630-94-0	PPBV	19								
Cyclopropane, 1,2-dimethyl-, cis-	930-18-7	PPBV					32			19	11
Cyclopropane, ethylidene-	18631-83-9	PPBV				60					
Cyclopropane, pentyl-	2511-91-3	PPBV			23						
Cyclotetrasiloxane, octamethyl-	556-67-2	PPBV						24	10	42	50
Cyclotrisiloxane, hexamethyl-	541-05-9	PPBV									43
Decane, 2,4,6-trimethyl-	62108-27-4	PPBV	40							40	
Decane, 2,5,6-trimethyl-	62108-23-0	PPBV					84				
Dimethylketene	598-26-5	PPBV		10							
Dodecanal	112-54-9	PPBV		12	11		18				
Ethane	74-84-0	PPBV						18			
Ethanone, 2,2-dihydroxy-1-phenyl-	1075-06-5	PPBV		51							

Table 41 (cont'd). Tentatively Identified Compounds in Port B Offline EPA TO-15 Samples

TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	Test 0.2A None (Diesel Baseline) DB0CNB	Test 3.2 None (Diesel Baseline) 3OL2CNB0	Test 1.2 Acetonitrile & Acetaldehyde 1OL0CNB0	Test 2.2 Benzene & Propanenitrile 2OL0CNB0	Test 3.2 1,3 Butadiene, Formaldehyde & Dimethylpyridine 3OL0CNB0	Test 4.2/5.2 Furan & NDMA 5OL0CNB0	Test 4.3/5.3 Furan & NDMA 5MX0CNB0	Test 6.2 Ammonia & Nitrous Oxide 6OL0CNB	Test 6.3 Ammonia & Nitrous Oxide 6MX0CNB
Formaldehyde	50-00-0	PPBV	150			57	65			200	
Formic acid hydrazide	624-84-0	PPBV				33	31				
Furan	110-00-9	PPBV		12	11	33	35				29
Furan, 2,5-dihydro-	1708-29-8	PPBV					45				
Furan, tetrahydro-2-methyl-	96-47-9	PPBV					16				15
Heptadecane, 2,6-dimethyl-	54105-67-8	PPBV		28	24						
Heptanal	111-71-7	PPBV				27					28
Heptane, 3,5-dimethyl-	926-82-9	PPBV				11					11
Heptane, 3-ethyl-	15869-80-4	PPBV				18	13				12
Heptane, 4-azido-	27126-22-3	PPBV		12	11						
Heptane, 4-propyl-	3178-29-8	PPBV					10				
Hexanal	66-25-1	PPBV		27		34	22				33
Hydroperoxide, hexyl	4312-76-9	PPBV									19
Hydroxylamine, O-decyl-	29812-79-1	PPBV		10		65					11
Isobutyl nitrite	542-56-3	PPBV				62					
Methacrolein	78-85-3	PPBV	32							35	
Methane, nitro-	75-52-5	PPBV	68	50	62	90	73	12	12	63	63
Methyl nitrate	598-58-3	PPBV	12	21						10	24
Methyl nitrite	624-91-9	PPBV		71	77	70	69	82	53		
Naphthalene	91-20-3	PPBV	34	29	23	29	42			33	30
Naphthalene, 1, 2,3,4-tetrahydro-5-methyl-	2809-64-5	PPBV		19							14
Naphthalene, 1,2,3,4-tetrahydro-	119-64-2	PPBV		23		14	14				16
Naphthalene, 1-methyl-	90-12-0	PPBV		13		15					13
Naphthalene, 2-methyl-	91-57-6	PPBV		19	12						
Naphthalene,1,2,3,4-tetrahydro-6-methyl-	1680-51-9	PPBV		17			11				14
Nitric acid, ethyl ester	625-58-1	PPBV									13
Nitric oxide	10102-43-9	PPBV		150	220			150	250		110
Nitrogen dioxide	10102-44-0	PPBV			64				110		
Nitrous acid, butyl ester	544-16-1	PPBV					51				
Nonane	111-84-2	PPBV	36	42	36	74	69			37	72
Nonane, 2,6-dimethyl-	17302-28-2	PPBV									24
Nonane, 2-methyl-	871-83-0	PPBV				11	10				
Octadecanal	638-66-4	PPBV				11					12
Octane	111-65-9	PPBV	17	12	11	20	17			14	22
Octane, 2,3,6-trimethyl-	62016-33-5	PPBV		16	13						

Table 41 (cont'd). Tentatively Identified Compounds in Port B Offline EPA TO-15 Samples

TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	Test 0.2A None (Diesel Baseline) DB0CNB	Test 3.2 None (Diesel Baseline) 3OL2CNB0	Test 1.2 Acetonitrile & Acetaldehyde 1OL0CNB0	Test 2.2 Benzene & Propanenitrile 2OL0CNB0	Test 3.2 1,3 Butadiene, Formaldehyde & Dimethylpyridine 3OL0CNB0	Test 4.2/5.2 Furan & NDMA 5OL0CNB0	Test 4.3/5.3 Furan & NDMA 5MX0CNB0	Test 6.2 Ammonia & Nitrous Oxide 6OL0CNB	Test 6.3 Ammonia & Nitrous Oxide 6MX0CNB
Octane, 2,6-dimethyl-	2051-30-1	PPBV					20				
Octane, 2-methyl-	3221-61-2	PPBV	83	65	55	11	11	14	16	52	14
Octane, 3,3-dimethyl-	4110-44-5	PPBV				14					19
Octane, 3,6-dimethyl-	15869-94-0	PPBV		15		22					
Octane, 3-ethyl-	5881-17-4	PPBV			13						
Octane, 4-ethyl-	15869-86-0	PPBV			15						
Oxirane, hexyl-	2984-50-1	PPBV				13					
Oxiranemethanol, 2-phenyl-	141248-89-7	PPBV					24				
o-Xylene	95-47-6	PPBV		58	50	15	22		13		16
Pentafluoropropionic acid, dodecyl ester	6222-04-4	PPBV					13				
Pentanal	110-62-3	PPBV	36	27	19	32	30			45	36
Propanal	123-38-6	PPBV	20	19	15						
Propanenitrile	107-12-0	PPBV				190					
Propene	115-07-1	PPBV	330	230	250	480	440	55	130	280	460
Propyne	74-99-7	PPBV	11	18	16	26	29			13	32
p-Xylene	106-42-3	PPBV		19	18		17				
Silane, trichlorodocosyl-	7325-84-0	PPBV					16				
t-Butyl nitrite	540-80-7	PPBV				34	13				
trans-3-Decene	19150-21-1	PPBV	36				48		11	41	
trans-decahydronaphthalene	493-02-7	PPBV		22	17						
Trichloroacetic acid, dodecyl ester	74339-50-7	PPBV				15					
Tridecane	629-50-5	PPBV					51				
Trimethylene oxide	503-30-0	PPBV				27	24				26
Trimethylsilyl fluoride	420-56-4	PPBV				140	98				11
Undecanal	112-44-7	PPBV	39	36	31	20				43	16
Undecane	1120-21-4	PPBV				47				120	60
Undecane, 2,6-dimethyl-	17301-23-4	PPBV				32					55

Shaded cells are injected compounds

Table 42. Tentatively Identified Compounds in Port C Offline EPA TO-15 Samples

TO-15 Tentatively Identified Compounds	CAS #	UNIT	Test 0.2A	Test 1.2	Test 2.2	Test 3.2		Test 4.2/5.2		Test 4.3/5.3	Test 6.2 Ammonia & Nitrous Oxide	Test 6.3 Ammonia & Nitrous Oxide
			None (Diesel Baseline)	Acetonitrile & Acetaldehyde	Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine		Furan & NDMA		Furan & NDMA	Ammonia & Nitrous Oxide	Ammonia & Nitrous Oxide
			DB0CNC	1OL0CNC0	2OL0CNC0	3OL0CNC0	3OL1CNC0	5OL0CNC0	5OL1CNC0	5MX0CNC0	6OL0CNC	6MX0CNC
1-Hexanol, 2-ethyl-	104-76-7	PPBV			25	26						
1-Propene, 2-methyl-	115-11-7	PPBV			16							
2,6-Dimethyldecane	13150-81-7	PPBV	12								12	
Benzoic acid, 2-[(trimethylsilyl)oxy]-, trimethylsilyl ester	3789-85-3	PPBV										10
Carbonyl sulfide	463-58-1	PPBV					11					
Cyclotetrasiloxane, octamethyl-	556-67-2	PPBV	100			25		20	27		63	24
Cyclotrisiloxane, hexamethyl-	541-05-9	PPBV										21
Disiloxane, hexamethyl-	107-46-0	PPBV			35	33						
Formaldehyde	50-00-0	PPBV	130			41	60				200	
Formic acid hydrazide	624-84-0	PPBV			15	16		13				
Hexane, 3,3,4,4-tetrafluoro-	648-36-2	PPBV										29
Methane, nitro-	75-52-5	PPBV		11	94	79						10
Methyl nitrate	598-58-3	PPBV		120								50
Methyl nitrite	624-91-9	PPBV			86	36	20	32	63	24	25	14
Nitric oxide	10102-43-9	PPBV		200				130	150	220		83
Nitrogen dioxide	10102-44-0	PPBV		210					22	140		
Nitrous acid, butyl ester	544-16-1	PPBV				32	13					
Propanenitrile	107-12-0	PPBV			11							
Propene	115-07-1	PPBV			25	19						12
Trimethylsilyl fluoride	420-56-4	PPBV		11	140	170	27				14	39

Shaded cells are injected compounds

Table 43. Tentatively Identified Compounds in Port D Offline EPA TO-15 Samples

			Test 0.2A	Test 3.2	Test 1.2		Test 2.2	Test 3.2	Test 4.2/5.2	Test 4.3/5.3	Test 6.2		Test 6.3	$_{HTF}$OEL	% $_{HTF}$OEL
			None (Diesel Baseline)	None (Diesel Baseline)	Acetonitrile & Acetaldehyde		Benzene & Propanenitrile	1,3 Butadiene, Formaldehyde & Dimethylpyridine	Furan & NDMA	Furan & NDMA	Ammonia & Nitrous Oxide		Ammonia & Nitrous Oxide		
TO-15 Tentatively Identifeid Compounds	CAS #	UNIT	DB0CND	3OL2CND0	1OL0CND0	1OL1CND0	2OL0CND0	3OL0CND0	5OL0CND0	5MX0CND0	6OL0CND	6OL1CND	6MX0CND	(PPB)	Maximum
1,2-Propanediol, 3,3`-oxydi-, tetranitrate	20600-96-8	PPBV											52		
1-Hexanol, 2-ethyl-	104-76-7	PPBV						42					17		
2,4,6,8-Tetramethyl-1-undecene	59920-26-2	PPBV		13											
2-Butenal	4170-30-3	PPBV													
3-Methylheptyl acetate	72218-58-7	PPBV			14		19								
Acetic acid, 2-ethylhexyl ester	103-09-3	PPBV						34							
Cyclotetrasiloxane, octamethyl-	556-67-2	PPBV											11		
Cyclotrisiloxane, hexamethyl-	541-05-9	PPBV											11		
Ethanol, 2-nitro-, nitrate (ester)	4528-34-1	PPBV		21	100										
Ethylene oxide	75-21-8	PPBV													
Formaldehyde	50-00-0	PPBV	180				67	97			180	160		300	60%
Formic acid hydrazide	624-84-0	PPBV		12		12	33	43					10		
Hexane, 3,3,4,4-tetrafluoro-	648-36-2	PPBV											26		
Isobutyl nitrite	542-56-3	PPBV					31	12							
Methyl nitrate	598-58-3	PPBV		24	120					180			51		
Methyl nitrite	624-91-9	PPBV		49			23	99	39			36	12	100	99%
Nitric oxide	10102-43-9	PPBV		270	100	200			190	39			92		
Nitrogen dioxide	10102-44-0	PPBV		610	160	110									
Nitrous acid, butyl ester	544-16-1	PPBV						38							
Nitrous Oxide	10024-97-2	PPBV		43		12			11					50,000	0.1%
Octanal	124-13-0	PPBV		11											
Propene	115-07-1	PPBV					12	12					13		
Silane, difluorodimethyl-	353-66-2	PPBV									24				
Trimethylsilyl fluoride	420-56-4	PPBV					10	32					16		

Shaded cells are injected compounds

5.9 Total Volatile Organic Compounds

The VOCs were measured during testing using the AreaRAE PGM-5020 Photoionizer detector, with key results shown in Table 44 and resulting DREs shown in Table 45. The PID was added to the analytical instrumentation setup as a result of comments to the test plan. A special set of DREs for this test are calculated and reported using PID results, but are much less accurate and sensitive than results from the other analytical methods. The PID results are appropriately used to report total VOC concentrations in the exhaust.

Since the AreaRAE requires ≥15% O_2 to function properly and diesel engine exhaust is expected to contain 8–12% O_2, a 1:1 manufacturer dilution fitting was added to the sampling line. An evaluation of the average O_2 levels (18.05%) measured by the AreaRAE during the nitrogen sweep cycles indicates that the dilution was actually greater that this, and that the ratio of exhaust to ambient dilution air (20.95% O_2) was 1:6.15. This difference was not pursued, but could have been caused by being used on the down-stream side of the FTIR pump which may have been slight pressurized versus ambient pressure that the dilution fitting is designed for.

Table 44. Maximum Exhaust VOC Measurements recorded by PID

Test	Sample Port	VOC as Measured (ppm)	VOC Adjusted for Dilution (1:6.15)
2.1 Benzene & Propanenitrile	D	4.3	26.4
5.1 Furan & NDMA	D	3.7	22.8
5.2 Furan & NDMA	D	4.9	30.13
5.2 Furan & NDMA	D	2.6	16.
5.3 Furan & NDMA	D	3.1	19.1
6.3 Ammonia & Nitrous Oxide	D	35.5	218.3
6.3 Duplicate Ammonia & Nitrous Oxide	D	34.8	214.
Additional AreaRAE readings are in Appendix D.			

Table 45. DREs derived from AreaRAE VOC Measurements are Not Meaningful

		VOC in PPM (as recorded, i.e., not adjusted for dilution)			
Test #	Description	Port A Recorded Value	Port A Valued at the Resolution Limit (0.1 ppm)	Port D Recorded Value	TOS System DRE From AreaRAE VOC
2.2	Benzene & Propanenitrile	<DL	0.1	4.3	-4200% Not Meaningful
3.2b	Formaldehyde	4.8		2.7	44%
5.2	Furan & NDMA	<DL	0.1	2.6	-2500% Not Meaningful
5.2	Furan & NDMA	<DL	0.1	2.8	-2700% Not Meaningful
5.2	Furan & NDMA	<DL	0.1	2.7	-2600% Not Meaningful
5.2	Furan & NDMA	<DL	0.1	3.4	-3300% Not Meaningful
5.2	Furan & NDMA	<DL	0.1	2.6	-2500% Not Meaningful
5.3	Furan & NDMA	<DL	0.1	2.3	-2200% Not Meaningful
5.3	Furan & NDMA	<DL	0.1	1.9	-1899% Not Meaningful
5.3	Furan & NDMA	<DL	0.1	3.1	-3000% Not Meaningful
5.3	Furan & NDMA	<DL	0.1	2.2	-2100% Not Meaningful
5.3	Furan & NDMA	<DL	0.1	2.3	-2200% Not Meaningful
5.3	Furan & NDMA	<DL	0.1	2.2	-2100% Not Meaningful
6.3	Ammonia & Nitrous Oxide	0.5		8.4	-1580%

DL = detection limit; VOC = volatile organic compound

The analysis of the DREs from the AeraRAE Model 200-GM-AE-502G data was conducted. The AreaRAE Wireless Multi-Gas Monitor (which includes AreaRAE Steel) Operational & Maintenance Manual[1] (Document 029-4034-000, Revision B, May 2008) provides the following from Tables 1.2 and 1.4 of the manual:

- The VOC range is from 0 to 200 ppm (in the mode it was operated for testing).
- The VOC resolution (and estimated detection limit) is 0.1 ppm (in the mode it was operated).
- Confirmed the oxygen sensor should read 0% with a sweep of nitrogen gas (pages 4-12).

The DRE results are shown in Table 45. The minimum resolution values (or nondetects) were assigned the minimum VOC resolution of 0.01 ppm for purposes of the DRE calculations.

[1] From RAE Systems by Honeywell

The highest recorded VOC measurement from the AreaRAE at the NUCON TOS tailpipe (SP 516, port D) was 218.3 ppm.

In general, the hand-recorded measurements indicate that the NUCON TOS increases the VOCs. While the increases look large on a percentage basis, the maximum measured VOC during testing was 218.3 ppm. The high percentages of VOC increase are driven by the very low injection levels. (Note: The AreaRAE does not include ammonia in the VOC measurement.)

Prior to testing, it was expected that DRE calculation from VOC measurements made with PID would be problematic due to a number of reasons, including (1) the comparatively large background VOC concentration in the exhaust generated by the diesel engine as shown in Table 15, (2) the comparatively low COPC injection concentrations, (3) the relatively high detection limit (DL) of the PID used in this test, and (4) the fact that different compounds exhibit different responses in a PID. For the latter, this is significant, and response factors can vary up to 2.5 orders of magnitude (≤0.47 to ≥100 when normalized against isobutylene). This requires prior knowledge of hydrocarbon composition in the gas stream for accurate quantification, and thus is not suitable for accurate analysis of a gas stream of unknown composition. The results from this test demonstrated the problems in using a PID to measure DREs in the TOS. First, injection levels were nearly all below detection with the PID. Theoretical injection levels could not be determined because PID correction factors are not known for many of the test COPCs. Second, since the vast majority of VOCs in the exhaust are from the pre-existing background diesel emissions, the noise to signal ratio is very high. Third, as alluded to above, the PID does not speciate; thus, the generation of any byproducts of injection could skew the number significantly. Therefore, it is recommended that PIDs not be used for estimating DRE values in future testing of the TOS.

Total VOCs generated by the TOS with and without injection can be used to compare against generic criteria for diesel engine exhaust using a PID. PID should not be used to compare to VOCs calculated from a different analytical technique (e.g., FTIR), since the PID compares a composite response of all VOCs normalized to a single response factor (usually isobutylene). Since diesel exhaust is a complex mixture of VOCs, PID measurements should only be compared to PID criteria.

5.10 Thermal Oxidation System Operations

Fuel employed in the TOS during testing was as follows:

- Tests 1.1 and 1.2 – 13% ultra-low sulfur on-road winter diesel fuel and 87% ultra-low sulfur off-road summer diesel fuel.
- Tests 2.1 and 2.2 – 50% ultra-low sulfur on-road winter diesel fuel and 50% ultra-low sulfur off-road summer diesel fuel.
- Tests 3.1 and 3.2 – 13% ultra-low sulfur on-road winter diesel and 87% ultra-low sulfur off-road summer diesel.
- Tests 5.1, 5.2, and 5.3 – 2.5% ultra-low sulfur on-road winter diesel and 97.5% ultra-low sulfur off-road summer diesel.
- Tests 6.1, 6.2, and 6.3 – 50% ultra-low sulfur on-road winter diesel and 50% ultra-low sulfur off-road summer diesel

During TOS break-in and testing operations, numerous items were documented, the most important being flow, temperatures, temperature stabilization, operating pressure, pressure change across the DPF, when power was engaged with the corresponding amount of power applied, operating hours on the unit, and oil level within the generator. All proceeding measurements are "For Information Only" (FIO) since the instrumentation on the TOS was not calibrated to the NQA-1 requirements.

Initial TOS operations began in March of 2018. These operations included the shakedown period and extended into the break-in period for the generator. Testing began after the shakedown period had been completed with ~32 hours of runtime on the engine. This time frame was determined by several factors, which included fixing leaks within the system and allowing the DPF to de-green (i.e., complete a break-in period). After 20 hours of operation, the break-in period for the generator had been completed. At the start of test 0.2, the engine was at 32.9 total operating hours. At 62.4 hours of total runtime on the engine, the oil and the oil filter in the diesel engine were changed. Testing then continued through June 13, 2018. During that time frame, 146.5 hours of runtime had been logged on the diesel engine and the generator.

The typical steady-state inlet air flow to the TOS engine ranged from 49 to 47 scfm. The normal flow to the TOS engine was nominally 52 scfm[1] when power was initially engaged, which then decreased to between 49 to 47.5 scfm after the TOS had warmed up (~1 hour). On one occasion, it was documented that the flow rate had reached a minimum of 42.5 scfm following a benzene injection during steady state operations. These inlet air flow rates were not substantially affected by the ambient weather, but were dependent on the power load applied.

Exhaust flows were measured by using a methane tracer (see Appendix E). Methane was used for its highly recalcitrant nature and resistance to thermal decomposition in the TOS exhaust system, and accurate quantification by the FTIR. A calibrated flow rate of methane of known concentration was injected into the TOS exhaust just after the DPF. The subsequent well-mixed concentration of methane was measured at the TOS tailpipe by the FTIR. The ratio of source methane concentration to measured methane concentration at the tailpipe multiplied by the methane tracer flow rate allows for the accurate calculation of total exhaust flow rate. The calculated exhaust flow rates ranged from 52.1 to 57.5 scfm.

Temperatures were monitored in various locations throughout the unit during all operations. These locations included the following: TT-102 was prior to the heat exchange on inlet side, TT-103 was after the heat exchanger on the inlet side, TT-109 was before entering the generator, TT-111 was after the generator and catalytic converter but prior to the DPF and heat exchanger, and last was TT-112, which monitored the exhaust stack temperature. Due to the TOS internal temperatures being very susceptible to changes in ambient weather, it was normal to see steady state temperatures declared at roughly 735°F (TT-111) on cooler days and 770°F (TT-111) on warmer days. All temperatures were closely monitored to ensure TT-109 did not exceed 125°F. Once steady state operation was declared, it was typical to see a jump of 15°F to 30°F from TT-102 to TT-103, while the TT-111 and TT-112 temperatures differed by ~180°F to 200°F. Minor fluctuations from these values were noted during testing, with maximum temperatures at TT-111 exceeding 800°F on select occasions.

As mentioned before, leaks had occurred in the TOS's exhaust systems that were present around the DPF, catalytic converter, and expansion joints. These leaks were mitigated with a high-temperature RTV

[1] The Fox Thermal Instruments, Inc. Model FT1-06IDDP1 serial # F00780 Flow Meter was set to display standard cubic feet per minute (adjusted for pressure and temperature) over the range of 0 to 60 scfm.

sealant that was applied to the leaking joints while the unit was non-operational. After the leaks had been fixed, the pressure drop from the inlet side of the DPF to the exit side changed substantially from roughly 2 inches of water column (in. w.c.) during the shakedown period to roughly 4 in. w.c. during testing at normal steady state operations. It was typical for the operating pressure measured at PT-108 located after the blower to range from -2 in. w.c. at startup and level out at -1.5 to -0.1 in. w.c.

Additional notes include the following:

- Oil levels dropped from high to a medium-high level prior to the first oil change. Upon changing the oil, the level remained consistently around the high level mark on the generator oil dipstick.
- The load bank was always operated at full capacity (11.25 kVA) during testing, which resulted in the 15-kVA diesel/generator set having a 75% load with respect to the generator.
- Fuel usage is shown in Table 46.
- Maintenance and operations of the TOS were conducted by TerraGraphics.

Table 46. TOS Diesel Fuel Usage during Testing

Fill-Up Date	Gallons Added	Fuel Type	Notes
2/18/18			Unit was empty
2/19/18	73	Ultralow Sulfur #2 Winter On-Road Diesel	Gauge read slightly higher than full
5/2/18	24.6	Ultralow Sulfur #2 Summer Dyed Diesel	
5/16/18	43.6	Ultralow Sulfur #2 Summer Dyed Diesel	
6/5/18	50	Ultralow Sulfur #2 Summer Dyed Diesel	
6/13/18	~26 left in tank		35% on the fuel gauge at the end of testing
Fuel Used in Testing	165		Engine operating hours at the end of testing 146.5 hours
Fuel usage was ~ 1.13 gallons per hour with a 75% load on the generator			

6.0 Conclusions

PNNL evaluated the performance of the NUCON TOS prototype for the removal of 11 COPCs. The 11 COPCs tested were chosen out of the 61 COPCs[1] measured in Hanford HLW SST vapor emissions either (i) due to the importance of that COPC, (ii) as a surrogate to represent of a class of COPC compounds, or (iii) both. The tests were performed to compare the NUCON TOS performance to the COPC removal target of ≥95% DRE and the COPC purification target of ≤10% Hanford tank farm OEL.

The results from the tests can be summarized by the following three key objectives:

- Validation of detection of the COPCs in the TOS exhaust at or below the target performance criteria concentration, defined as ≤10% of the Hanford tank farm OELs, or higher concentration if necessary due to background interference.
- Determination of the DRE and exhaust purification achieved by the TOS for each COPC supplied at 200% the Hanford tank farm OEL.
- Determination of the DRE and exhaust purification achieved by the TOS for a selection of the COPCs supplied at the maximum concentration observed in Hanford single-shell tanks (including the entire class of compounds that the COPC represents for the types of tanks on which the system will be used). For additional detail see Section 2.2.

PNNL demonstrated the ability to detect 10 of the 11 test COPCs at ≤10% OEL concentration in the NUCON TOS exhaust at tailpipe, with the results summarized in Table 47. The ability to detect 2,4-dimethylpyridine at <2% OEL in the exhaust was demonstrated in test 3.2 with modified analytical methods and extended testing dwell times. The ability to detect NDMA in the NUCON TOS exhaust in PNNL testing was limited to ~50% OEL concentration due to the prohibitively high background interference associated with NDMA detection on the PNNL PTR-MS in the NUCON TOS diesel engine exhaust. For additional detail see Section 5.5.

As summarized in Table 48, the NUCON TOS successfully met target performance criteria for 8 of the 11 COPCs, including acetaldehyde, acetonitrile, benzene, proprionitrile, 1,3-butadiene, 2,4-dimethylpyridine, furan, and ammonia. This included both COPC removal of ≥95% of the COPC amount at the engine inlet, and exhaust purification to ≤10% the OEL.TOS performance criteria were not met for nitrous oxide in either test. This is not surprising since nitrous oxide is well-known as a problematic and persistent greenhouse effluent in the exhaust of combustion systems. The TOS achieved >99.9% removal efficiency for NDMA in the high concentration test. However, TOS target performance metrics failed in the NDMA 200% OEL test, reaching only 50% OEL in the TOS exhaust. The estimated error associated with NDMA concentration measurement at 10-50% OEL is of similar order of magnitude as the calibrated concentration. And thus, NDMA results considering this ultra-trace level are less certain. Formaldehyde removal and purification results were affected by a pre-existing exhaust background concentration that was not impacted by formaldehyde injection. The TOS successfully reduced injected formaldehyde back down to this pre-existing exhaust level.

[1] Rappe KG. 2018. *PNNL Assessment of NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs).* Test Plan TP-71248-01, Rev. 0, April 2018, Pacific Northwest National Laboratory, Richland, Washington.

Table 47. Summary of COPC Detection at 10% OEL in the NUCON TOS Exhaust

		All in ppm				
				Measured at Port D		
COPC	Test	10% OEL Target	Calculated Exhaust Spike	PTR-MS	FTIR	Exhaust Baseline
Acetaldehyde[a]	1.1	2.5	2.44	4.0	3.07	0.26
Acetonitrile	1.1	2	2.08	3.2	-	0.01
Benzene	2.1	0.05	0.014	0.014	-	0.002
Propanenitrile	2.1	0.6	0.077	0.205	-	0.0009
1,3-Butadiene	3.1	0.1	0.093	0.174	-	0.0008
Formaldehyde [a]	3.1	0.03	0.030	0.558	0.0189	0.516
2,4-Dimethylpyridine [b]	3.1	0.05	0.047	*n.d.*	-	*n.d.*
NDMA [c]	4.1	0.000030	0.000149	0.000781	-	0.000686
Furan [c]	5.1	0.000100	0.000049	0.000148	-	0.000104
Ammonia	6.1	2.5	1.97	-	1.36	0.07
Nitrous Oxide	6.1	5	2.92	-	3.57	0.80

[a] FTIR results are "For Information Only."
[b] The test identified that modified analytical methods would be required for accurate measurement.
[c] PTR-MS results only for detection; VOCUS PTR-TOF results only used for accurate COPC quantification
n.d.- not detected, i.e., no elevation of the PTR-MS signal observed above background/baseline levels

Table 48. Summary of DRE Values Determined from PNNL Testing of the NUCON TOS

			95% DRE	Measured at Outlet (port D)		
COPC	Test	TOS DRE	Target Met?	PTR-MS (ppm)	FTIR (ppm)	10% OEL Target Met?
Acetaldehyde[a]	1.2	99.6%	Yes	0.28	0.7	Yes
Acetonitrile	1.2	>99.9%	Yes	0.014	-	Yes
Benzene	2.2	97.3%	Yes	0.023	-	Yes
Propanenitrile	2.2	>99.9%	Yes	0.010	-	Yes
1,3-Butadiene	3.2	99.7%	Yes	0.026	-	Yes
Formaldehyde[a]	3.2	45.7%	No	0.73	0.03	No
2,4-Dimethylpyridine	3.2	99.3%	Yes	0.0071	-	Yes
NDMA[b]	4.2	55.6%	No	0.00015	-	No
	4.3	>99.9%	Yes	0.000042	-	No
Furan[b]	5.2	99.3%	Yes	0.000017	-	Yes
	5.3	99.8%	Yes	0.000035	-	Yes
Ammonia	6.2	98.7%	Yes	-	0.7	Yes
	6.3	>99.9%	Yes	-	0.3	Yes
Nitrous Oxide	6.2	72.7%	No	-	29	No
	6.3	69.5%	No	-	261	No

[a] FTIR results are "For Information Only."
[b] Reflects combined results from the PTR-MS and the TOFWERK VOCUS-PTR

The component information was measured at the following ports:

- Port A – The inlet port before the diesel engine, a.k.a. SP521.
- Port B – After the engine and before the DOC, a.k.a. SP525; combined with port A, allowed for measuring the contribution of the diesel engine to overall TOS performance.
- Port C – After the DOC and before the DPF, a.k.a. SP514; combined with port B, allowed for measuring the contribution of the oxidation catalyst (DOC) to overall TOS performance.

- Port D – Tailpipe location after the muffler and DPF and before release of exhaust to the environment, a.k.a. SP516; combined with port A, allowed for measuring overall TOS performance, and combined with port C, allowed for measuring the contribution of the DPF (DPF) to overall TOS performance (assuming no impact of the muffler or heat exchanger).

Table 49 shows the contribution of the individual TOS components to the overall TOS removal performance.

Table 49. TOS Component Contribution to the Overall TOS Removal Efficiency

		DRE Contribution by Component			
COPC	Test	Engine	Oxidation Catalyst	Diesel Particulate Filter	Overall TOS DRE
Acetaldehyde	1.2	90.0%	9.1%	0.4%	99.6%
Acetonitrile	1.2	82.6%	16.9%	0.5%	>99.9%
Benzene	2.2	60.5%	35.6%	1.2%	97.3%
Propanenitrile	2.2	87.6%	12.0%	0.3%	>99.9%
1,3-Butadiene	3.2	87.8%	11.8%		99.7%
Formaldehyde	3.2	-105%	143%	7.8%	45.7%
2,4-Dimethylpyridine	3.2	97.8%	1.4%		99.3%
NDMA	4.2	25.7%	29.9%		55.6%
	4.3	96.6%	3.3%		>99.9%
Furan	5.2	-2367%	2466%		99.3%
	5.3	-311%	411%		99.8%
Ammonia	6.2	94.2%	5.6%	-1%	98.7%
	6.3	88.5%	11.3%	0.1%	>99.9%
Nitrous Oxide	6.2	73.7%	-1%	0.4%	72.7%
	6.3	72.3%	-3%	-0.2%	69.5%

Both the NUCON TOS diesel engine and catalytic converter contributed significantly to performance for COPC removal and exhaust purification. Nine of the eleven COPCs were reduced significantly by the diesel engine, excluding only formaldehyde and furan. The diesel engine alone provided >95% removal efficiency for 2,4-dimethylpyridine and NDMA (at high concentration), and was the only TOS treatment step to significantly reduce nitrous oxide (>72%).

The oxidation catalyst was extremely important to overall TOS performance, and was critical at enabling the TOS to reach removal and purification criteria for 7 of the 11 COPCs, including acetaldehyde, acetonitrile, benzene, propanenitrile, 1,3-butadiene, furan, and ammonia. Both formaldehyde and furan were produced in comparatively large amounts in the diesel engine but removed with high efficiency by the oxidation catalyst. NDMA was also removed efficiently by the oxidation catalyst in the high-concentration test, but that was not required to reach the TOS removal performance metric. Nitrous oxide was minimally impacted by the oxidation catalyst or the DPF.

The highest recorded VOC measured by the AreaRAE at the NUCON TOS tailpipe was 218.3 ppm.

Testing and working with the NUCON TOS has highlighted the following considerations related to the future design of a TOS to be used in the Hanford SST farms:

1. Consider redesigning the MERSORB® media containment to allow for easier media removal when operating in a radioactive environment.

2. Enhancing the load cell for higher resistance levels (over 11.25 kVA) and ensuring that the wiring meets code requirements for the final application in the tank farm.
3. Heating all sampling lines > 150°C.

6.1 Recommendations for Additional Testing

Although the TOS failed to meet all removal and purification criteria for formaldehyde, NDMA and nitrous oxide, it was shown to significantly reduce concentrations of all of the test compounds. Further, 8 of the 11 test compounds met all test acceptance criteria. Of the three COPCs that failed:

- Nitrous oxide is known to persist through engine exhaust aftertreatment (including oxidation catalysts) but nonetheless was shown to be reduced by >72% in the engine. If further reduction of nitrous oxide is required, there are additional methods that could be incorporated in the TOS for treatment; this may include selective catalytic reduction, target-specific activated carbon filtering (i.e., a MERSORB® additive), or other methods.
- Formaldehyde is known as a by-product of diesel combustion and a persistent emission species. Thus, the fact that the TOS demonstrated a consistent low level of formaldehyde in the exhaust is not surprising. However, the test demonstrated that test injections in the TOS inlet did not add to normal emission levels.
- Regarding NDMA, removal criteria were met at high concentration of NDMA. At ultra-trace concentration levels, the variability of the data makes it difficult to determine whether either of the NDMA tests met the purification criteria. In any case, further testing is warranted.

This test program was predicated on continuing test efforts on a Hanford SST. WRPS has selected tank BY-108 to be the site for such a demonstration based on its worst case concentration of COPCs, specifically being in cascade with BY-107, which is the highest in furan, among SSTs and its availability of utilities and real estate. Initiation of detailed design and permitting is planned for FY 2019.

When doing the pilot-scale tests, it is advised to consider reactions on the MERSORB® bed carbon sorbent that will improve removal efficiency for several compounds. The expected reductions of nitrous oxide, ammonia, and formaldehyde on the carbon (due to cross-reactions) can be further investigated during this phase of system demonstration and operation.

Offline sampling and analysis for this test generated five lessons learned that should be carried forward to the on-site demonstration test as follows:

- Ammonia was sampled using the wrong type of Anasorb 747 tube that was not coated with sulfuric acid, which acts as a capture assist agent for ammonia. Care should be taken in future testing to ensure that Anasorb 747, SK-226-29 tubes be used for ammonia sampling, which has the proper coating.
- In Phase 3 testing, the DNPH Treated Silica Gel, SKC-226-119 sample tubes should be isolated from the SUMMA canister sample collection process.
- 2,4-dimethylpyridine was sampled in a SUMMA® canister and analyzed per EPA method TO-15, which did not yield any detectable quantities. In future testing alternative sampling methods (e.g., sorbent tubes) should be explored for 2,4-dimethylpyridine.

- Methyl nitrite was observed via TIC analysis to be a component of the TOS exhaust that potentially approaches its $_{HTF}$OEL value, and should be added to the formal, calibrated analyte list in future testing.
- Given the variety of samples and media types (tubes, canisters, cartridges) and their connections, each unique sampling strategy and media type should be practiced during shakedown/dry-run testing.

6.2 Confirmatory Results from Off-line Sampling and Analysis

Offline media sampling and analysis confirmed the results and conclusions of on-line sampling and analysis as discussed in Section 6.0, and included EPA method TO-15 for volatile organics, EPA method TO-11A for aldehydes, and NIOSH method 2522 for nitrosamines. For 9 of the 11-COPCs tested, the offline results reached the identical conclusions as the on-line results with respect to the TOS performance targets (>95% DRE and/or less than 10% OEL in exhaust). Ammonia and 2,4-dimethylpyridine were the exceptions, as offline results for ammonia and 2,4 dimethylamine were not available due to incompatibility with the sampling media. Thus, the test results demonstrate that offline sampling analysis per regulatory approved methods can be used as a confirmatory means to effectively measure TOS performance relative to its targets.

Random, duplicate sampling was conducted for offline samples to determine the repeatability and total variability of the offline sampling and analysis methods. RSDs of the duplicate analyses ranged from 20% to 70% for injected analytes and 0% to 99.8% for non-injected analytes. Although these errors appear high on a relative basis, the absolute standard deviations do not have a significant impact on DREs in the target range (>95%). For example, a 100% RSD of two measurements of an exhaust analyte with a 95% DRE average would result in a ±3.5% DRE range, and a 100% RSD of two measurements of an exhaust analyte with a 99% DRE average results in a ±0.7% DRE range.

Each of the offline analytical methods produced a significant number of ancillary (non-injected) and tentatively identified compounds. These results provide an indication of the types and concentrations of chemicals of concern and benign compounds that may be generated by the diesel engine or by decomposition of the chemicals being injected. All ancillary and tentatively identified compounds were below their $_{HTF}$OEL with the exception of acetonitrile. Further investigation determined high likelihood of acetonitrile contamination in SUMMA® canister samples collected during DNPH Treated Silica Gel SKC-226-119 sample tube collection, which was corroborated by PTR-MS measurements of <0.6% $_{HTF}$OEL.

7.0 References

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Appendix A

NUCON Thermal Oxidation System Components

Appendix A

NUCON Thermal Oxidation System Components

Figure A.1. The NUCON thermal oxidation system(looking north) next to the Test Instrumentation Trailer. Includes the southern placed diesel skid assembly and the original northern placed propane skid.

Figure A.2. (Looking south) The metal particulate screen (60 mm x 150 mm) connected to the three-way valve. This was the sole path through which ambient air was introduced to the system during steady state testing. The piping on the skid was 316/316L Stainless Steel WLD 2–in. schedule 10S. Also visible is the first particulate HEPA which is also called the demister (14-in.-diameter x 14-in.-tall outside housing dimensions) filter housing. Both HEPA filter housings have an installed Astrocel® I High Efficiency Particulate Air (HEPA) Filter flow tested for 50 cfm (size 8” x 8” x 5 7/8” part number 12A26J6P0A1, 900-895-503) with nominally 0.8 inches of water resistance. The filters are made by American Air Filter (see image of the west HEPA filter below). Note that one filter is in the HEPA filter housing on the east side of the skid and the second filter in inside the HEPA housing on the west side of the skid.

Figure A.3. (Looking west) Inlet air pipe wrap around the skid. A Fox Thermal Instruments, Inc. Model FT1-06IDDP1 serial # F00780 Flow Meter set to 0 to 60 scfm per vendor-approved change. (FT-101). Then the Yellow K type Thermocouple TT-102 before the flow is warmed in the heat exchanger. The tan box houses the propane engine and generator that were disconnected for the testing.

Figure A.4. (Looking northeast) Under the white and tan insulation fiberglass wrap is the ambient air inlet to the heat exchanger that used exhaust air to heat the ambient air before going into the MERSOB® filter. This is followed by the Yellow K type Thermocouple TT-103 outlet air temperature after the heat exchanger and the second particulate HEPA filter housing.

Figure A.5. (Looking southwest) MERSOB® Absorbant container made of 24-in.-diameter schedule 10S A-312/SA-312 stainless steel with a length of 64 in. NUCON had not removed the 73 kg of Mersorb® Absorbent that had been tested in Ohio for a ~45 minute test with mercury. (Inlet air was near the bottom and release air from the column came out near the top.

Figure A.6. The Kohler KDI1903ESM Diesel Engine Spec 6D08E1-1 (S/N 4728402750) rated at 28 BHP at 1800 rpm with Decision-Maker 3000 controls. Engine power 19-37KW with 1.861 liters displacement. (Engine family HKHXL2.49ESM.) On the lower right image is the connected Kohler 15REOZK 15 kVA Generator (S/N SGM32LMWJ).

Figure A.7. Directly behind the label is the 4SX-15REOZK Catalytic Purifier muffler emissions control device (i.e., diesel oxidation catalyst) manufactured by Catalytic Exhaust Products with the second photo being the diesel particulate filter 758SXS-SC by Catalytic Exhaust Products.

Figure A.8. Exhaust gases then exit the 2-in. exhaust muffler and then out the extended a 10-ft-long 2-in. exhaust pipe that was added to the muffler

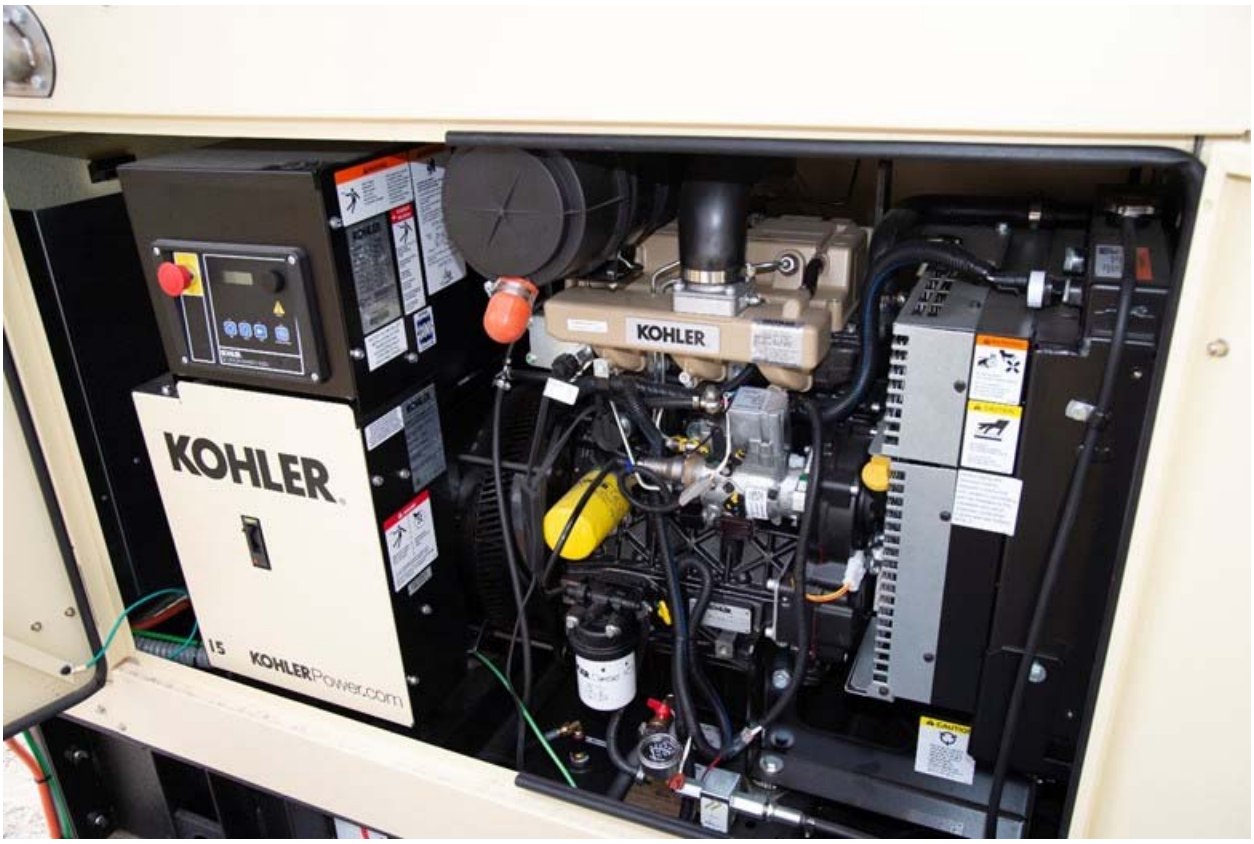

Figure A.9. The engine and generator controls.

Figure A.10. Connected to the electrical output from the generator are the circuit breaker box that powers the PLC controller and the Human Machine Interface (HMI) controller and data collection.

Figure A.11. The Powerhouse Manufacturing (model 11.3-.25-240-1) switch box and 11.25 kVA load bank. This is switched to the full 11.25 kVA load during steady state testing on the diesel engine.

Figure A.12. The repair of the diesel particulate filter soot leak with the high-temperature seal. The insulation was removed during this pretesting repair.

Figure A.13. The top connection to the 4SX-15REOZK Catalytic Purifier muffler emissions control device (i.e., diesel oxidation catalyst) with the insulation pulled back.

Figure A.14. The instrument trailer and the support electrical rack on the Q Avenue Pad.

Figure A.15. Electrical supply rack used for the testing

Appendix B

Instrumentation Trailer

Appendix B

Instrumentation Trailer

Figure B.1. Most of the instrumentation was along the east wall of the trailer. (Left to right) MKS FTIR, PTR-MS, the GC for pre-concentration (not used), the GC-MS (not used), the spare pumps and Mass Spectrometer (under the table and not used), heat tape controllers for the primary analytical sample loop lines (top of the cart), the chiller for sample temperature control (used only in the early testing), the injection system (top of the rack), and the sample collection controls (bottom of the rack).

Figure B.2. The MKS-2030 Multi-Gas Fourier-transform Infrared Analyzer

Figure B.3. The Ionicon Analytik Proton Transfer Reaction Mass Spectrometer (PTR-MS)

Figure B.4. The Agilent 6890N Gas Chromatograph set up as a pre-concentrator (left) for the PTR-MS. The second unit is the Agilent 6890N Gas Chromatograph with an Agilent 5973 Mass Selective Detector (right). Neither device was needed to support final testing.

Figure B.5. The NESLAB RTE-211 was used to cool key sample lines as part of potential temperature controls along the exhaust sampling lines. It was used during shakedown and it was determined not to be necessary in later testing. The heat tape controllers on the top of the cart are part of the seven to ten tapes (depending on the test) that were operated at 120°C to 200°C during testing. They were on the primary analytical sample loop tubes and lines (as well as the intake sample lines) to limit moisture condensation as the exhaust cooled coming from the NUCON TOS. The orange insulation over the heat tape on the sampling header can be seen on the back wall.

Note: The controllers for the exhaust sample lines were in the box under the table along the south wall of the trailer.

Figure B.6. Orange insulation over the heat tape on sample lines B and C can be seen going past the Magnehelic® delta pressure gauge that was added to the Diesel Particulate filter. Exhaust sample line D was also heat taped (shown below).

Figure B.7. The AreaRAE steel PGM-5020 Photoionizer detector (part PGM 5520 s/n 295-003913 WTP# 200-6M-AE-502G) was initially connected to the sample header during the ammonia testing. A post-test review identified that that the vacuum in the TOS in-let caused ambient air to be sucked into the AreaRAE. In later testing, the AreaRAE was connected to the pressurized out-let of the MKS FTIR and readings were manually collected.

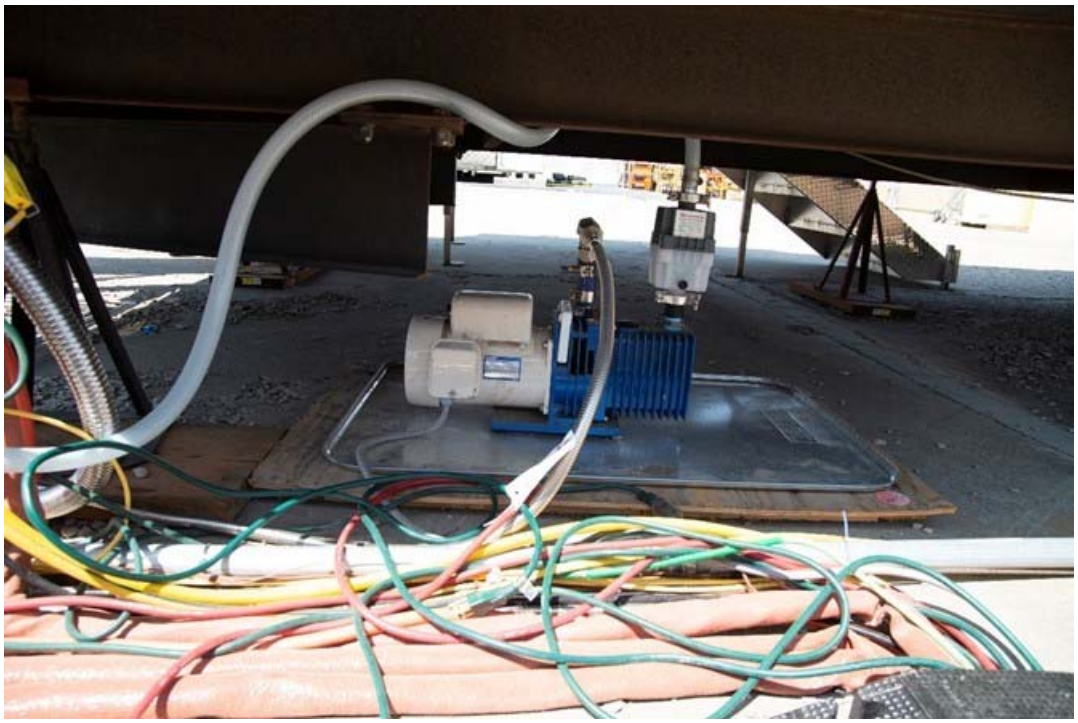

Figure B.8. In addition to the FTIR vacuum pump, a second vacuum pump was located under the trailer to supply mass flow controlled suction to the header, the media tubes, and for general cleaning gas sweeps.

The injection system process flow diagram is in Section 3.1.3. Some of the components of the injection system are shown here.

Figure B.9. Left Image - Outside bottle rack and controls (COPC # 3 & COPC #4, Ultra-Pure Nitrogen, Zero Air, Helium and other support gases). Right Image – Inside Northeast bottle rack and manifold for (COPC #1 through 4, calibration gases A and B). Below is the manifold detail.

Figure B.10. Inside the trailer north end East end valve manifold (COPC#1, 3 &4).

Figure B.11. Inside the trailer north end bottle rack and valves (COPC#1, 3 &4).

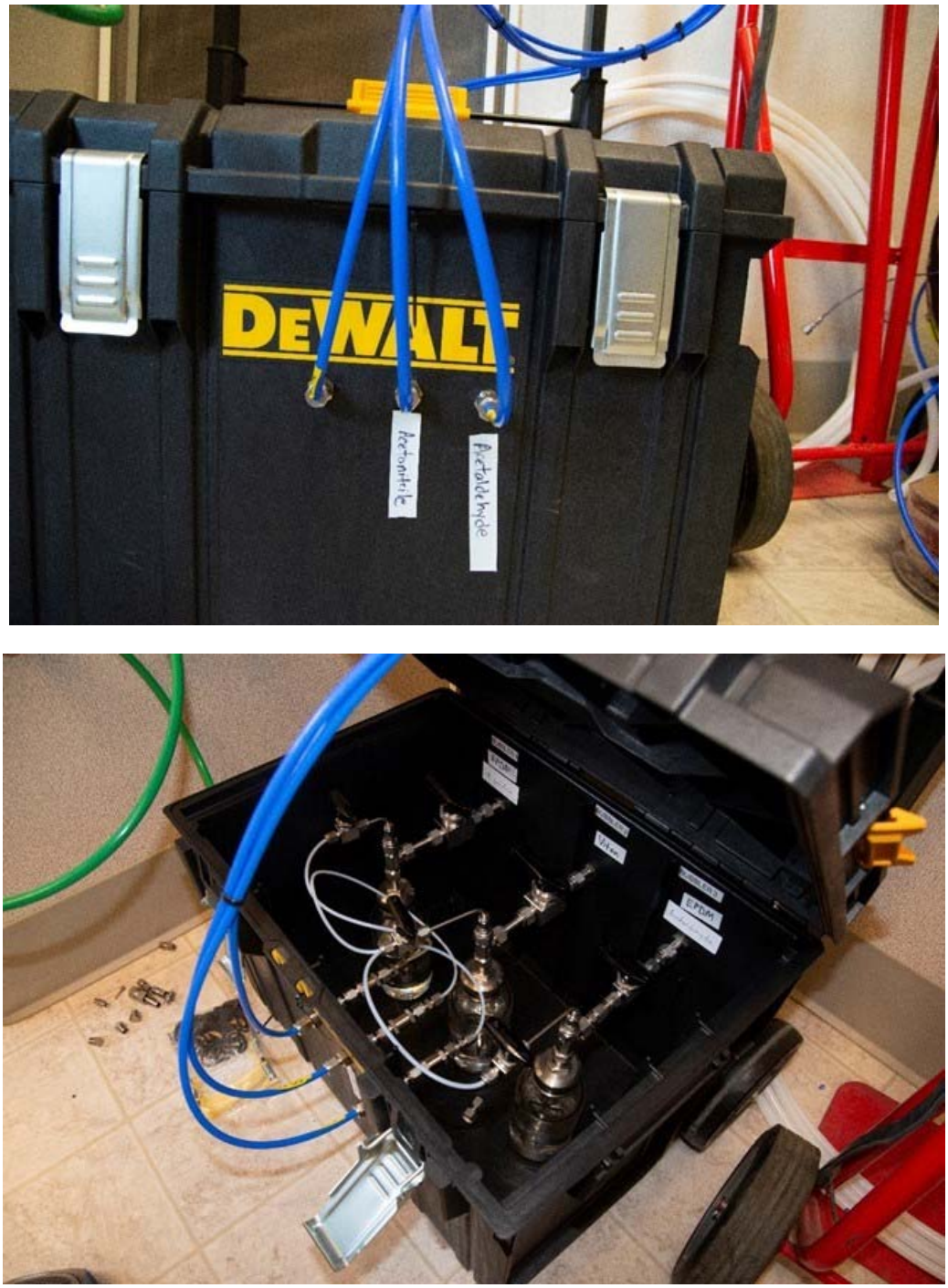

Figure B.12. The liquid bubbler system (on the Northwest wall inside the trailer).

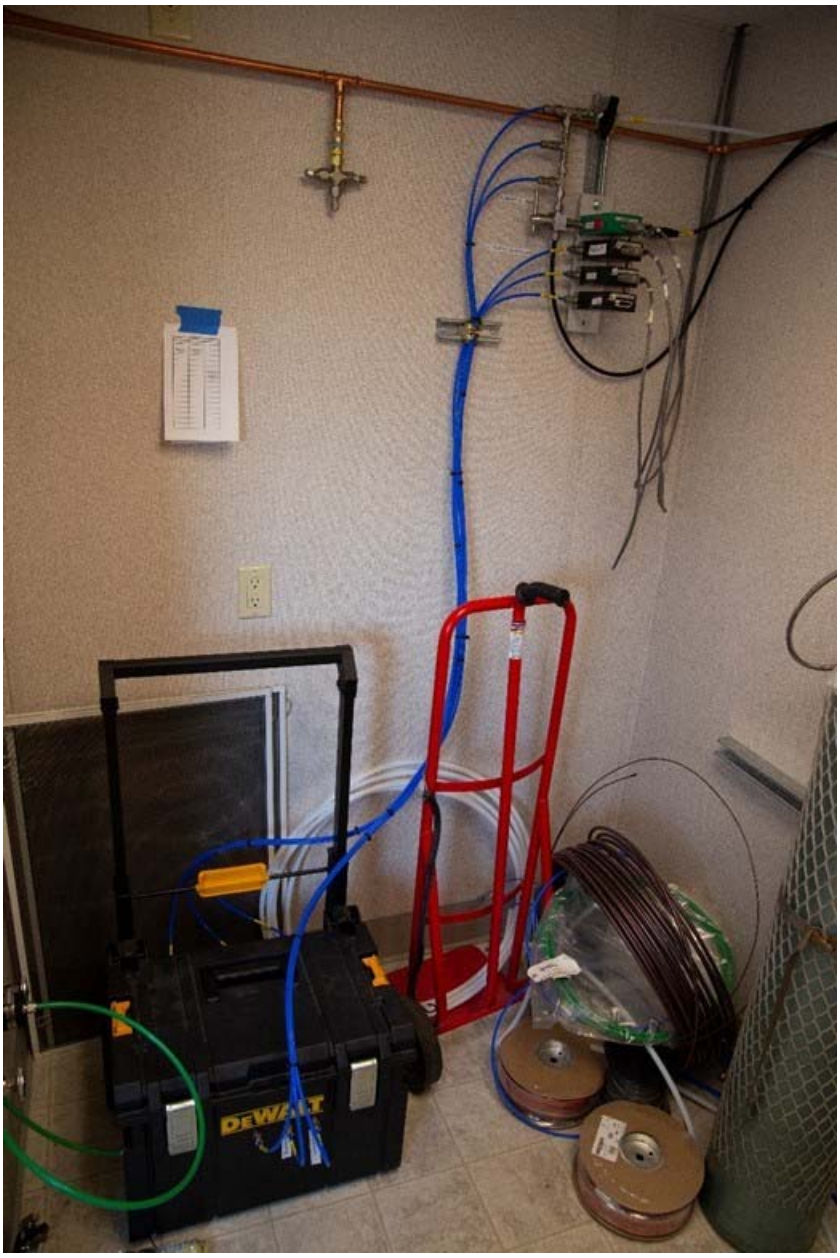

Figure B.13. The mass flow controllers for the bubblers are mounted in the upper right corner.

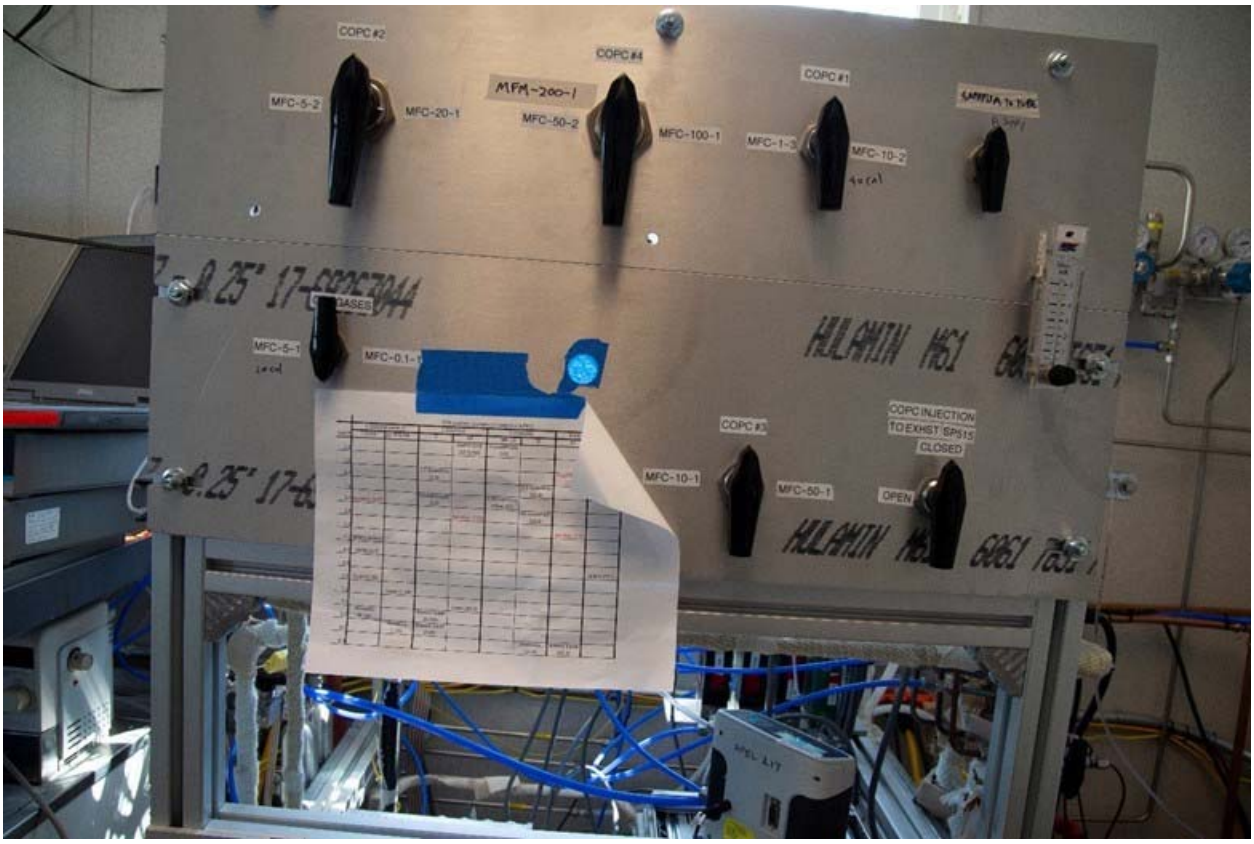

Figure B.14. The upper portion of the gas control rack. The combined top and bottom portions of the rack provide the valving for calibration gases, injection gases, and sampling gas pathways.

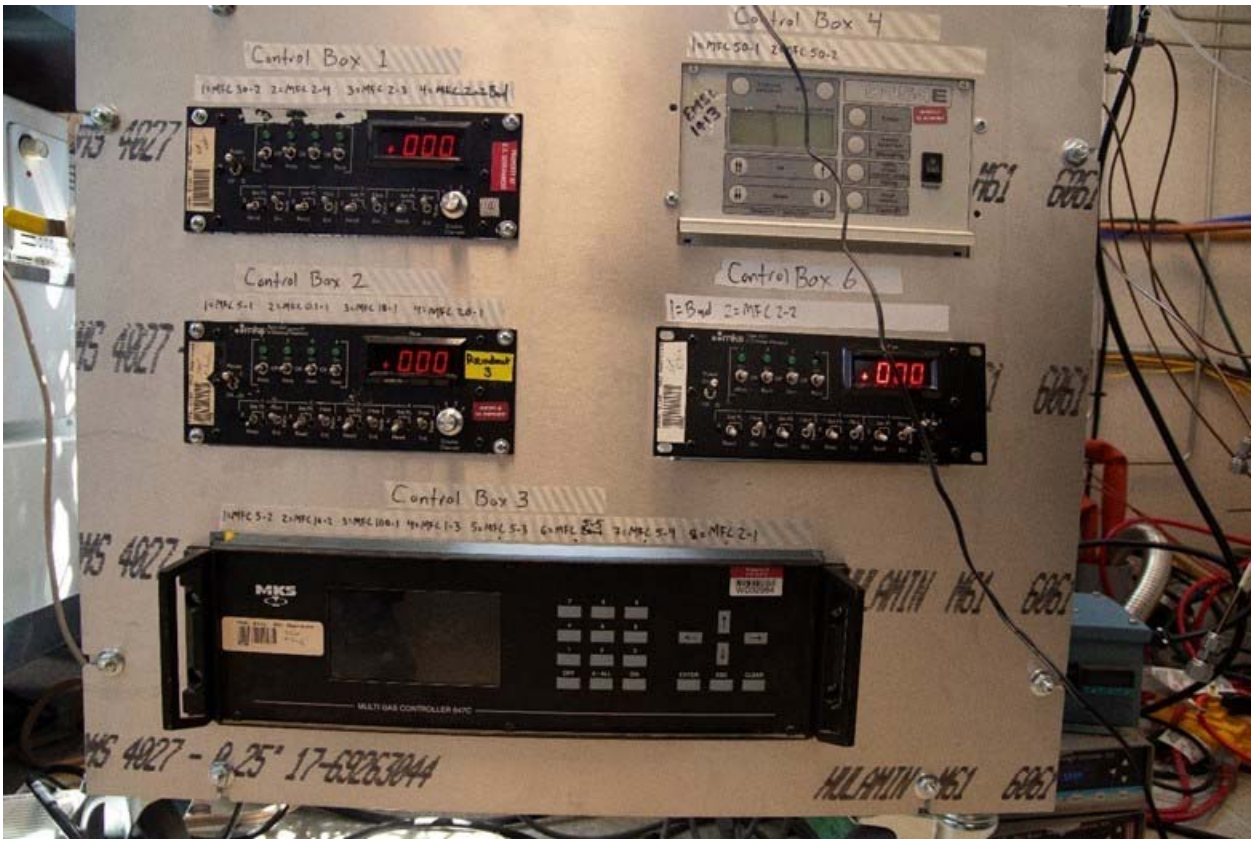

Figure B.15. The lower portion of the gas control rack. The combined top and bottom portions of the rack provide the control (via control boxes) of the many mass flow controls (detailed in Sections 3.1.3 and 3.1.4) for the injection gases, calibration gases, support gases, dilution gases, and for vent/sweep functions. Additional control boxes for the bubblers and the nitrogen are below.

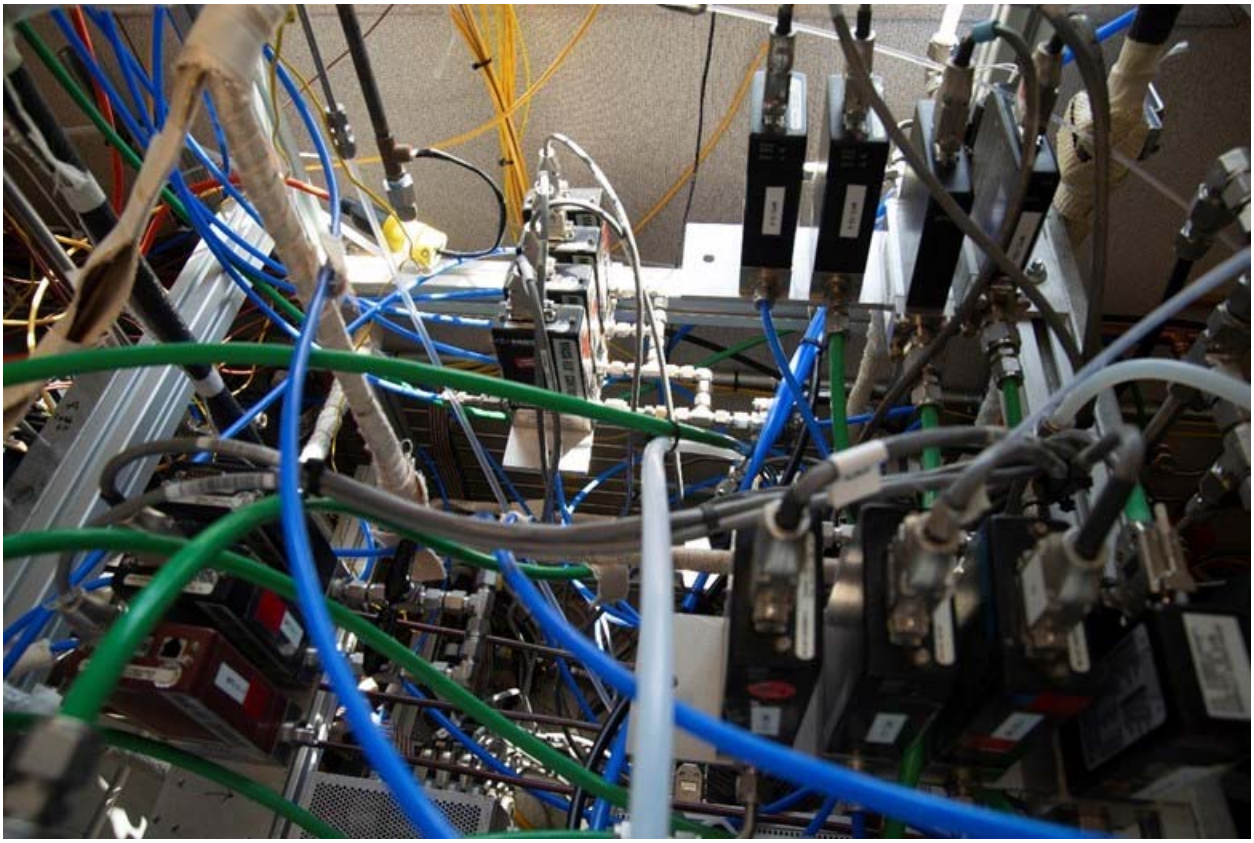

Figure B.16. Inside the gas control rack are mounted the mass flow controllers and many tube pathways to meter/direct the injection and sampling flows.

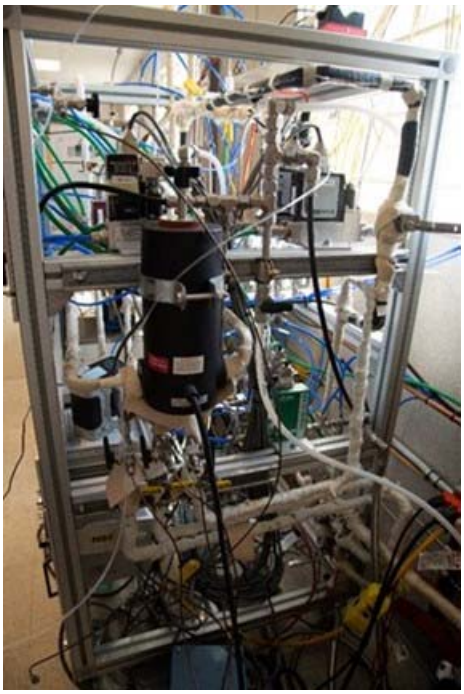

Figure B.17. Valves for the SUMMA® Canister sample collections are on the south side of the rack. Below the Standard 6 liter SUMMA® Canister sent to 222-S with the particulate filter and the 1 hour flow restrictor attached. On the right is the special condition 6 liter SUMMA® Canister that does not have a particulate filter or a flow restrictor. The special canisters were analyzed at either RJLee (with an Ionicon TOF[1]-4000), 222-S, AeroDyne Research Inc. (with a TOFWERK Vocus™ PTR-TOF[1]-12000), or at PNNL.

[1] The TOF units are time-of-flight Proton transfer reaction mass spectrometer devices.
VOCUS is a trademark of TOFWERK AG (Thun, Germany)

Figure B.18. A Kent Scientific "Gene" syringe pump (s/n 207032) was mounted to the top of the rack to supply moisture as needed to the PTR-MS calibration gas runs. The syringe pump was only used initially and was replaced with the HPTLC pump (bottom) when the syringe pump was found to be unreliable (kept stalling under large backpressure). The HPTLC moisture pump (see below) that was used later in testing was the RoHS (part number 310SFT01 s/n 20046277).

Figure B.19. The north side of the gas control rack included the sorption tube sample collection system.

Some of the things not shown were the heat tape controllers for the FTIR, PTRMS, heated soot filter, nitrogen preheater, water vaporizer, and exhaust lines from the TOS.

Appendix C

Mass Flow Controller Calibrations

Appendix C

Mass Flow Controller Calibrations

MFC Label	MFC-0.1-2	Control box	2
Function	COPC calibration	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	0.1080
LRB ref	BNW-62516-72,-73	Intercept	-0.00202
Dry Cal	Low range	RSQ	1.0000
Date	6/6/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SCCM]	Flow #2 [SCCM]	Flow #3 [SCCM]	AVG Flow [SLPM]
850	85.0%	85.0%	89.92	89.64		0.090
180	18.0%	18.0%	17.42			0.017
66	6.6%	6.6%	4.913	5.050		0.005
300	30.0%	30.0%	30.64			0.031
500	50.0%	50.0%	51.93			0.052

MFC Label	MFC-1-1	Control box	7
Function	Bubbler carrier	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	0.9566
LRB ref	BNW-62516-46, -47, -48	Intercept	0.01782
Dry Cal	L (M for 600, 950)	RSQ	0.9976
Date	5/16/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2.0%	1.9%	0.020137			0.020
200	20.0%	19.8%	0.21521			0.215
400	40.0%	39.9%	0.427			0.427
600	60.0%	59.8%	0.582			0.582
950	95.0%	94.8%	0.921			0.921

MFC Label	MFC-1-2	Control box	7
Function	Bubbler carrier	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	0.9615
LRB ref	BNW-62516-46, -47, -48	Intercept	0.01400
Dry Cal	L (M for 600, 950)	RSQ	0.9985
Date	5/16/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.7%	0.017101			0.017
200	20%	19.7%	0.2135			0.214
400	40%	39.3%	0.422			0.422
600	60%	58.8%	0.582			0.582
950	95%	93.4%	0.927			0.927
900	90%	88.4%	0.874			0.874

MFC Label	MFC-1-3	Control box	3
Function	COPC injection	Channel	4
MFC Mfg	MKS Instruments, Inc.	Slope	0.9645
LRB ref	BNW-62516-46, -47, -48	Intercept	0.01450
Dry Cal	L (M for 60, 95)	RSQ	0.9983
Date	5/16/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
2	2%	2.0%	0.019436			0.019
20	20%	20.0%	0.2123			0.212
40	40%	40.0%	0.42267			0.423
60	60%	60.0%	0.58563			0.586
95	95%	94.9%	0.92537			0.925

MFC Label	MFC-1-4	Control box	5
Function	Bubbler carrier	Channel	3
MFC Mfg	MKS Instruments, Inc.	Slope	0.9655
LRB ref	BNW-62516-46, -47, -48	Intercept	0.01979
Dry Cal	L (M for 600, 950)	RSQ	0.9977
Date	5/16/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.9%	0.022532			0.023
200	20%	19.9%	0.21893			0.219
400	40%	39.9%	0.43208			0.432
600	60%	59.8%	0.58912			0.589
950	95%	94.8%	0.93135			0.931

MFC Label	MFC-2-1	Control box	3
Function	Port A tube sample	Channel	8
MFC Mfg	MKS Instruments, Inc.	Slope	2.001
LRB ref	BNW-62516-46, -47, -48	Intercept	0.00475
Dry Cal	L (M for 60, 90)	RSQ	0.9999
Date	5/8/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
2	2.0%	2.0%	0.040			0.040
10	10.0%	10.0%	0.215			0.215
40	40.0%	40.0%	0.803			0.803
60	60.0%	60.0%	1.196			1.196
90	90.0%	90.0%	1.812			1.812

MFC Label	MFC-2-2	Control box	6
Function	Port B tube dilution	Channel	2
MFC Mfg	MKS Instruments, Inc.	Slope	1.958
LRB ref	BNW-62516-46, -47, -48	Intercept	0.000221
Dry Cal	M	RSQ	1.0000
Date	5/11/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.8%	0.035153			0.035
100	10%	9.9%	0.19855			0.199
400	40%	39.7%	0.78597			0.786
600	60%	59.8%	1.1762			1.176
900	90%	89.7%	1.7601			1.760

MFC Label	MFC-2-3	Control box	1
Function	Port C tube dilution	Channel	3
MFC Mfg	MKS Instruments, Inc.	Slope	2.029
LRB ref	BNW-62516-46, -47, -48	Intercept	0.00553
Dry Cal	M	RSQ	0.9999
Date	5/8/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.7%	0.037403			0.037
100	10%	9.6%	0.21588			0.216
400	40%	39.7%	0.81953			0.820
600	60%	59.7%	1.2254			1.225
900	90%	89.6%	1.829			1.829

MFC Label	MFC-2-4	Control box	1
Function	Port D tube dilution	Channel	2
MFC Mfg	MKS Instruments, Inc.	Slope	2.110
LRB ref	BNW-62516-46, -47, -48	Intercept	0.01692
Dry Cal	M	RSQ	0.9999
Date	5/8/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.9%	0.048149			0.048
100	10%	10.0%	0.23825			0.238
400	40%	40.2%	0.86449			0.864
600	60%	60.2%	1.2812			1.281
900	90%	90.6%	1.9142			1.914

MFC Label	MFC-5-1	Control box	2
Function	COPC calibration	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	5.546
LRD ref	BNW-62516-7	Intercept	-0.00531
Dry Cal	L	RSQ	0.9997
Date	4/24/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SCCM]	Flow #2 [SCCM]	Flow #3 [SCCM]	AVG Flow [SLPM]
20	2.0%		106.220	106.420	106.810	0.106
10	1.0%		49.312	50.009	49.052	0.049
30	3.0%		160.870	159.720	160.710	0.160
19	1.9%		100.440	100.470	100.750	0.101

MFC Label	MFC-5-1	Control box	2
Function	COPC calibration	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	4.964
LRB ref	BNW-62516-46, -47, -48	Intercept	0.00686
Dry Cal	M	RSQ	0.9999
Date	5/2/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
10	1.0%	0.9%	0.040			0.040
100	10.0%	9.9%	0.511			0.511
400	40.0%	39.8%	2.010			2.010
600	60.0%	59.9%	2.988			2.988
800	80.0%	79.8%	3.967			3.967

MFC Label	MFC-5-2	Control box	3
Function	COPC injection	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	4.940
LRB ref	BNW-62516-46, -47, -48	Intercept	-0.00191
Dry Cal	M	RSQ	0.9999
Date	5/8/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
2	2.0%	2.0%	0.074			0.074
20	20.0%	20.0%	0.998			0.998
40	40.0%	40.0%	1.993			1.993
60	60.0%	60.0%	2.968			2.968
90	90.0%	90.0%	4.429			4.429

MFC Label	MFC-5-3	Control box	3
Function	Port B tube sample	Channel	5
MFC Mfg	MKS Instruments, Inc.	Slope	4.935
LRB ref	BNW-62516-33, -46, -47, -48	Intercept	0.08028
Dry Cal	M	RSQ	0.9999
Date	5/9/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
2	2.0%	2.0%	0.162			0.162
20	20.0%	20	1.079			1.079
40	40.0%	40	2.0711			2.071
60	60.0%	60	3.037			3.037
90	90.0%	90	4.5155			4.516

MFC Label	MFC-5-4	Control box	3
Function	Port C tube sample	Channel	7
MFC Mfg	MKS Instruments, Inc.	Slope	4.949
LRB ref	BNW-62516-46, -47, -48	Intercept	0.02204
Dry Cal	M	RSQ	1.0000
Date	5/8/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
2	2.0%	2.0%	0.117			0.117
10	10.0%	10.0%	0.521			0.521
40	40.0%	40.0%	2.006			2.006
60	60.0%	60.0%	2.986			2.986
90	90.0%	90.0%	4.478			4.478

MFC Label	MFC-5-5	Control box	3
Function	Port D tube sample	Channel	6
MFC Mfg	MKS Instruments, Inc.	Slope	5.035
LRB ref	BNW-62516-33, -46, -47, -48	Intercept	0.06687
Dry Cal	M	RSQ	1.0000
Date	5/9/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
2	2.0%	2.0%	0.154			0.154
20	20.0%	20.0%	1.0879			1.088
40	40.0%	40.0%	2.0864			2.086
60	60.0%	60.0%	3.086			3.086
90	90.0%	90.0%	4.5938			4.594

MFC Label	MFC-10-1	Control box	2
Function	COPC injection	Channel	3
MFC Mfg	MKS Instruments, Inc.	Slope	10.69
LRB ref	BNW-62516-46, -47, -48	Intercept	-0.0747
Dry Cal	M (H for 600, 900)	RSQ	0.9989
Date	5/14/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.9%	0.20			0.2047
100	10%	9.9%	1.0			1.0305
400	40%	39.9%	4.0			3.9807
600	60%	59.9%	6.4			6.4236
900	90%	89.9%	9.59			9.5879

MFC Label	MFC-10-2	Control box	3
Function	CH4 tracer injection	Channel	2
MFC Mfg	MKS Instruments, Inc.	Slope	10.22
LRD ref	BNW-62516-26	Intercept	-0.0499
Dry Cal	H	RSQ	0.9999
Date	5/7/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SCCM]	Flow #2 [SCCM]	Flow #3 [SCCM]	AVG Flow [SLPM]
10	10%	10.0%	972.92	973.42	974.11	0.9735
30	30%	30.0%	3063.4	3068.4	3066.9	3.066
50	50%	50.0%	5082.3	5084.6	5082.2	5.083
85	85%	85.0%	8609.3	8600.0	8600.0	8.603
2	2%	2.0%	110.22	107.47	108.93	0.1089

MFC Label	MFC-20-1	Control box	2
Function	COPC injection	Channel	4
MFC Mfg	MKS Instruments, Inc.	Slope	20.69
LRD ref	BNW-62516-46, -47, -48	Intercept	-0.0404
Dry Cal	M (H for 600, 950)	RSQ	0.9996
Date	5/8/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
20	2%	1.8%	0.38			0.379
200	20%	19.8%	3.9			3.911
400	40%	39.8%	8.4			8.411
600	60%	59.9%	12.5			12.477
950	95%	94.9%	19.51			19.510

MFC Label	MFC-30-1	Control box	5
Function	Dilution, carrier	Channel	2
MFC Mfg	MKS Instruments, Inc.	Slope	33.98
LRD ref	BNW-62516-6	Intercept	0.2382
Dry Cal	H	RSQ	0.9998
Date	4/24/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
50	5%		1.842	1.872	1.892	1.869
100	10%		3.889	3.900	3.907	3.899
200	20%		7.061	7.067	7.049	7.059
300	30%		10.384	10.340	10.272	10.332
400	40%		13.718	13.727	13.725	13.723
500	50%		17.075	17.169	17.105	17.116
600	60%		20.511	20.589	20.560	20.553
700	70%		23.972	24.023	24.016	24.004
800	80%		27.616	27.631	27.653	27.633

MFC Label	MFC-30-1	Control box	5
Function	Dilution, carrier	Channel	2
MFC Mfg	MKS Instruments, Inc.	Slope	34.17
LRB ref	BNW-62516-46, -47, -48	Intercept	0.1185
Dry Cal	H	RSQ	0.9998
Date	5/3/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
50	5%	4.80%	1.783			1.783
200	20%	19.80%	7.107			7.107
400	40%	39.80%	13.736			13.736
600	60%	59.80%	20.429			20.429
800	80%	79.90%	27.592			27.592

MFC Label	MFC-30-2	Control box	1
Function	Primary sample loop flow	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	32.89
LRD ref	BNW-62516-8	Intercept	0.4049
Dry Cal	H	RSQ	0.9997
Date	4/26/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
50	5%	4.8%	1.819	1.821	1.822	1.821
100	10%	9.8%	3.604	3.612	3.651	3.622
200	20%	19.9%	7.057	7.067	7.070	7.065
300	30%	29.8%	10.438	10.442	10.442	10.441
400	40%	39.8%	13.721	13.733	13.733	13.729
500	50%	49.9%	16.913	16.914	16.912	16.913
600	60%	59.9%	20.132	20.129	20.136	20.132
700	70%	69.9%	23.479	23.439	23.449	23.456
800	80%	79.9%	26.518	26.512	26.505	26.512

MFC Label	MFC-30-2	Control box	1
Function	Primary sample loop flow	Channel	1
MFC Mfg	MKS Instruments, Inc.	Slope	32.84
LRB ref	BNW-62516-46, -47, -48	Intercept	0.3872
Dry Cal	H	RSQ	0.9997
Date	5/11/2018		

set point (0 - 1000)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
50	5%	4.8%	1.821			1.821
200	20%	19.8%	7.065			7.065
400	40%	39.8%	13.729			13.729
600	60%	59.8%	20.132			20.132
800	80%	79.8%	26.512			26.512

MFC Label	MFC-100-1	Control box	3
Function	COPC injection	Channel	3
MFC Mfg	MKS Instruments, Inc.	Slope	106.6
LRB ref	BNW-62516-46, -47, -48	Intercept	-4.5955
Dry Cal	H	RSQ	1.000
Date	5/8/2018		

set point (0 - 100)	set point %	reading %	Flow #1 [SLPM]	Flow #2 [SLPM]	Flow #3 [SLPM]	AVG Flow [SLPM]
5	5%	5.0%	0.65			0.6516
10	10%	10.0%	6.0947			6.0947
15	15%	15.0%	11.49			11.4900
25	25%	24.9%	22.071			22.0710
30	30%	30.0%	27.331			27.3310

Appendix D

AreaRAE Data

Appendix D

AREARAE Data

The direct instrument readings recorded in the table have not been adjusted for the effects of the 1:1 dilution fitting. This fitting allowed 1 part of the sample to be blended with 1 part atmospheric air. The dilution was required for the exhaust gases since they had less than the required 15% O_2 required to accurately run the AreaRAE. The dilution fitting was used for all AreaRAE measurements during testing.

An evaluation of the average O_2 levels (18.05%) measured by the AreaRAE during the nitrogen sweep cycles indicates that the ratio of exhaust to ambient air (20.95% O_2) may be closer to 1: 6.15. This difference may be caused by being used on the pressurized side of the Fourier-transform infrared spectroscopy instrument (FTIR) pump, which is different than the ambient pressure that the dilution fitting is designed for.

The “N” port designation means the header line was closed to the thermal oxidation system(TOS) and being sweeped by the nitrogen purge gas to clear the header and instrument lines.

The AreaRAE was a model 200-GM-AE-502G Multi-Gas Multi-Detector AreaRAE PGM5520 with the serial number 295-003913.

Table D.1. Manually Recorded AreaRAE Measurements

Time	Date	Test	Port	NH_3 ppm	VOC ppm	CO ppm	LEL gas %	O_2 %	Notes
13:53	4/30/18	0.1	D	DNR	2.32	DNR	DNR	DNR	no injection LRB 62516-11
14:45	4/30/18	0.1	D	DNR	0.2	DNR	DNR	DNR	no injection LRB 62516-11
16:08	4/30/18	0.1	A	DNR	0	DNR	DNR	DNR	no injection LRB 62516-11
19:25	5/9/2018	6.2	N/A	DNR	DNR	DNR	DNR	DNR	Area RAE date and time: 09/09/2017 23:36
8:32	5/10/2018	6.3	N/A	DNR	DNR	DNR	DNR	DNR	sync Area RAE clock to computer
12:29	5/10/2018	6.3	B	5	0	DNR	DNR	20.5	MFC-100-1 = 45.6 to achieve 44 SLPM (619 - 623 ppm nitrous oxide). Vacuum pump pulling outside air into area RAE
12:38	5/10/2018	6.3	B	0	34.8	141	3	12.3	vacuum off
15:01	5/10/2018	6.3	D	1	8.4	0	2	18.5	MFC-100-1 = 34.8; MFC-5-5 = 2.6; MFC-2-4 = 056; MFC-5-4 = 3.6; MFC-2-3 = 064. Just turned vacuum pump off, MFC-30-2 was set to ~248 previously. Acts like it is reading ambient air from under trailer.
16:14	5/10/2018	6.3	A	~~2~~	~~0~~	~~0~~	~~DNR~~	~~20.9~~	MFC-100-1 = 34.8; MFC-5-5 = 2.6; MFC-2-4 = 056; MFC-5-4 = 3.6; MFC-2-3 = 064. Possible suction of atmosphere through area RAE given low pressure in inlet line at port A. This data should not be used
16:27	5/10/2018	6.3	C	0	35.4	1	3	14.7	connected to summa port
16:39	5/10/2018	6.3	C	0	35.7	1	3	14.8	connected to summa port
16:42	5/10/2018	6.3	A	~~1~~	~~0.5~~	~~0~~	~~2~~	~~20.5~~	connected to summa port This data should not be used
17:40	5/10/2018	6.3	D	DNR	DNR	DNR	DNR	DNR	Area RAE not reading correctly when moved to summa D
18:06	5/10/2018	6.3	A	DNR	DNR	DNR	DNR	DNR	17:40 - 18:06 not collecting a sample when connected to port A

Time	Date	Test	Port	NH_3 ppm	VOC ppm	CO ppm	LEL gas %	O_2 %	Notes
									This data should not be used
18:43	5/10/2018	6.3	N/A	DNR	DNR	DNR	DNR	DNR	Disconnected from port D summa. Determined to move area RAE to a pressurized tube off the FTIR pump outlet
				Prior to testing on May 14 the sample array was moved to the pressurized side of the FTIR pump					
15:27	5/14/2018	2.1	D	DNR	4.3	1	DNR	DNR	N2 set to 25.95 SLPM (MFC-30-1 = 726)
16:13	5/14/2018	2.1	N	0	DNR	1	DNR	18.9	
8:45	5/15/2018	2.2	N/A	DNR	DNR	DNR	DNR	DNR	sync Area RAE clock to computer; as found times matched
12:23	5/15/2018	2.2	A	1	0	0	0	20.9	
10:55	5/17/2018	3.1	N/A	DNR	DNR	DNR	DNR	DNR	sync Area RAE clock to computer; as found times matched
13:54	5/18/2018	3.1	N/A	DNR	DNR	DNR	DNR	DNR	sync Area RAE clock to computer; as found times matched
10:06	5/30/2018	3.2A	N/A	DNR	DNR	DNR	DNR	DNR	sync Area RAE clock to computer
12:43	5/31/2018	3.2B	N/A	DNR	DNR	DNR	DNR	DNR	sync Area RAE clock to computer; as found Area RAE clock = 12:42
13:59	5/31/2018	3.2B	D	0	2.7	0	0	19.6	Area Rae was changing through the morning
14:26	5/31/2018	3.2B	D	0	3	0	0	19.5	
15:16	5/31/2018	3.2B	A/B	~~0~~	4.8	19	0	19.4	Transition from Port B to Port A at 15:15 computer clock time
15:47	5/31/2018	3.2B	A	0	0	0	0	20.9	
16:25	5/31/2018	3.2B	A	0	0	0	0	20.9	
17:02	5/31/2018	3.2B	A	0	0	0	0	20.9	
17:18	5/31/2018	3.2B		1	0	0	0	20.9	N_2 sweep (suspect)
9:15	6/6/2018	5.1	N	1	0	0	0	18	
9:40	6/6/2018	5.1	N	1	0	0	0	18	

Time	Date	Test	Port	NH_3 ppm	VOC ppm	CO ppm	LEL gas %	O_2 %	Notes
10:05	6/6/2018	5.1	N	1	0	0	0	17.4	
10:57	6/6/2018	5.1	N	1	0	0	0	18.1	
11:37	6/6/2018	5.1	N	1	0	0	0	18.1	
12:25	6/6/2018	5.1	N	1	0	0	0	18.2	
13:02	6/6/2018	5.1	N	1	0	0	0	17.6	
13:45	6/6/2018	5.1	N	1	0	0	0	17.9	
14:17	6/6/2018	5.1	D	0	2.6	0	0	19.6	
15:00	6/6/2018	5.1	D	0	3.2	0	0	19.6	
15:40	6/6/2018	5.1	D	0	3.5	0	0	19.6	
16:21	6/6/2018	5.1	D	0	3.7	0	0	19.5	
8:55	6/7/2018	5.1	A	1	0.4	0	0	20.5	
9:23	6/7/2018	5.1	N	2	0.4	0	0	17.8	
10:00	6/7/2018	5.1	N	2	0	0	0	18	
11:54	6/7/2018	5.1	D	0	3.4	1	0	19.7	
12:50	6/7/2018	5.1	D	0	3.2	0	0	19.8	
13:43	6/7/2018	5.1	N	0	0	0	0	18.3	
8:54	6/12/2018	5.2	N	1	0	0	0	18.1	
10:15	6/12/2018	5.2	B	0	3.8	9	0	17	
11:01	6/12/2018	5.2	D	0	2.6	0	0	19.9	
12:16	6/12/2018	5.2	D	0	2.8	0	0	19.6	
13:04	6/12/2018	5.2	C	0	3.2	0	0	19.6	
14:04	6/12/2018	5.2	B	0	4.7	19	0	19.5	
15:15	6/12/2018	5.2	D	0	2.7	0	0	19.6	
16:02	6/12/2018	5.2	D	0	3.4	0	0	19.6	
17:45	6/12/2018	5.2	D	0	2.6	0	0	19.7	
8:29	6/13/2018	5.3	N	1	0.4	0	0	18.1	
8:57	6/13/2018	5.3	N	2	0.5	0	0	18.2	
10:03	6/13/2018	5.3	A	1	0	0	0	20.9	
11:05	6/13/2018	5.3	D	0	2.3	0	0	19.8	

Time	Date	Test	Port	NH_3 ppm	VOC ppm	CO ppm	LEL gas %	O_2 %	Notes
11:53	6/13/2018	5.3	C	0	2.4	0	0	19.7	
12:58	6/13/2018	5.3	D	0	1.9	0	0	19	
14:14	6/13/2018	5.3	D	0	3.1	0	0	19.4	
15:00	6/13/2018	5.3	D	0	2.2	0	0	19.8	
15:52	6/13/2018	5.3	D	0	2.3	0	0	19.8	
16:23	6/13/2018	5.3	D	0	2.2	0	0	19.9	

The AreaRAE data file was not recoverable at the end of testing.

DNR = Did Not Record

Appendix E

COPC Calibrations, Methane Tracer Measurements for Exhaust Flow Determination, and Test Data

Appendix E

COPC Calibrations, Methane Tracer Measurements for Exhaust Flow Determination, and Test Data

Table E.1. FTIR Calibration – Ammonia and Nitrous Oxide

Date	Time Start	COPC	Source	MFC-30-1		MFC-5-1		% H_2O (FTIR)	[COPC] Delivered	FTIR response		Notes
			[ppm]	Set	Flow [SLPM]	Set	Flow [SLPM]		[ppm]	[ppm]	$STD_{[ppm]}$	
7-May-18	12:24	Ammonia	1260	40.0%	12.8	1.0%	0.047	0%	4.6	4.5	0.026	
7-May-18	12:16	Ammonia	1260	80.0%	25.5	1.0%	0.047	0%	2.3	2.2	0.013	
9-May-18	9:59	Ammonia	1260	28.9%	9.3	9.8%	0.500	0%	64.0	64.9	0.187	• Source: single-component mix
9-May-18	10:14	Ammonia	1260	18.1%	5.9	1.8%	0.088	0%	18.4	18.5	0.030	• PTR-MS not used
9-May-18	10:27	Ammonia	1260	80.0%	25.5	1.0%	0.047	0%	2.3	2.6	0.020	
10-May-18	10:52	Ammonia	1260	28.9%	9.3	9.8%	0.500	0%	64.0	66.6	0.098	
10-May-18	11:20	Ammonia	1260	10.6%	3.6	79.8%	4.104	0%	674	662.5	0.923	
7-May-18		Nitrous oxide	1260			0%	0	0%				
7-May-18	11:16	Nitrous oxide	1260	61.1%	19.5	1.0%	0.047	0%	3.0	3.4	0.076	
7-May-18	11:36	Nitrous oxide	1260	36.5%	11.7	1.8%	0.088	0%	9.4	9.9	0.103	
7-May-18	16:36	Nitrous oxide	1260	61.1%	19.5	1.0%	0.047	0%	3.00	3.5	0.046	
9-May-18	8:52	Nitrous oxide	1260	61.1%	19.5	1.0%	0.047	0%	3.0	3.0	0.048	
9-May-18	9:14	Nitrous oxide	1260	36.5%	11.7	1.8%	0.088	0%	9.4	9.7	0.030	
9-May-18	9:31	Nitrous oxide	1260	28.9%	9.3	19.8%	1.015	0%	123.5	131.8	0.187	• Source: single-component mix
10-May-18	8:40	Nitrous oxide	1260	0%	0	80.0%	4.114	0%	1260	747.8	2.057	• PTR-MS not used
10-May-18	8:52	Nitrous oxide	1260	11.3%	3.8	80.0%	4.114	0%	656	516.0	0.706	
10-May-18	9:00	Nitrous oxide	1260	11.3%	3.8	39.8%	2.044	0%	442	395.3	0.317	
10-May-18	9:15	Nitrous oxide	1260	5.5%	2.0	79.8%	4.104	0%	853	617.7	1.512	
10-May-18	9:26	Nitrous oxide	1260	15.2%	5.0	19.8%	1.015	0%	212	200.1	0.332	
10-May-18	10:24	Nitrous oxide	1260	28.9%	9.3	19.8%	1.015	0%	123	131.0	0.145	
10-May-18	10:36	Nitrous oxide	1260	28.9%	9.3	9.8%	0.500	0%	64.0	69.0	0.087	

Table E.2. PTR-MS Calibration – Benzene and Propanenitrile

Date	Time Start	COPC	Source [ppm]	MFC-30-1 Set	MFC-30-1 Flow [SLPM]	MFC-5-1 Set	MFC-5-1 Flow [SLPM]	MFC-0.1-1 Set	MFC-0.1-1 Flow [SLPM]	% H_2O (FTIR)	[COPC] Delivered [ppm]	PTR-MS discharge	PTR-MS response [cts]	PTR-MS response $STD_{[cts]}$	Notes
14-May-18	11:09	Benzene	2.5	28.7%	9.3	0.8%	0.036	0%	0	0%	0.0097		390	39	
14-May-18	12:26	Benzene	2.5	13.5%	4.5	6.8%	0.344	0%	0	0%	0.178		4647	118	
14-May-18	12:45	Benzene	2.5	14.0%	4.6	1.8%	0.088	0%	0	0%	0.046		1774	62	
14-May-18	13:05	Benzene	2.5	14.1%	4.7	0.8%	0.036	0%	0	0%	0.019	H_3O+	776	44	• Source: 6-component mix
14-May-18	13:18	Benzene	2.5	2.6%	1.0	79.8%	3.969	0%	0	0%	1.98		87627	364	
14-May-18	13:24	Benzene	2.5	11.3%	3.8	19.8%	0.990	0%	0	0%	0.52		19928	215	
14-May-18	13:39	Benzene	2.5	11.3%	3.8	0%	0	0%	0	0%	0		0	13	
14-May-18	13:53	Propionitrile	150	11.3%	3.8	0%	0	0%	0	0%	0		0	37	
14-May-18	13:57	Propionitrile	150	72.6%	23.1	0.8%	0.036	0%	0	0%	0.23		14241	199	
14-May-18	14:07	Propionitrile	150	72.5%	23.1	1.8%	0.088	0%	0	0%	0.57		32392	324	
14-May-18	14:12	Propionitrile	150	72.2%	23.0	3.8%	0.191	0%	0	0%	1.23	H_3O+	68420	546	• Source: single-component mix
14-May-18	14:18	Propionitrile	150	69.8%	22.2	19.8%	1.015	0%	0	0%	6.5		321922	1968	
14-May-18	14:30	Propionitrile	150	66.9%	21.3	39.8%	2.044	0%	0	0%	13.1		557448	2330	

Table E.3. PTR-MS Calibration (and FTIR Corroboration) – 1,3-Butadiene, Formaldehyde, and 2,4-Dimethylpyridine

Date	Time Start	COPC	Source [ppm]	MFC-30-1 Set	MFC-30-1 Flow [SLPM]	MFC-5-1 Set	MFC-5-1 Flow [SLPM]	% H_2O (FTIR)	[COPC] Delivered [ppm]	PTR-MS discharge	PTR-MS response [cts]	PTR-MS response $STD_{[cts]}$	FTIR response [ppm]	FTIR response $STD_{[ppm]}$	Notes
30-May-18	11:00	1,3-Butadiene	5.2	10.9%	3.7	79.8%	4.104	2.2%	2.69		29126	0	-	-	
30-May-18	11:19	1,3-Butadiene	5.2	21.7%	7.1	5.9%	0.299	2.7%	0.21		2395	123	-	-	
30-May-18	11:25	1,3-Butadiene	5.2	16.7%	5.5	39.8%	2.044	3.2%	1.37	NO+	15999	310	-	-	• Source: 6-component mix
30-May-18	11:30	1,3-Butadiene	5.2	22.4%	7.3	1.0%	0.047	2.6%	0.032		366.4	19	-	-	
30-May-18	11:35	1,3-Butadiene	5.2	22.6%	7.4	0%	0	2.3%	0		2.2	12	-	-	
30-May-18	13:12	Formaldehyde	1.2	10.9%	3.7	79.8%	4.104	2.1%	0.62		3326	109.4	0.467	0.079	
30-May-18	13:20	Formaldehyde	1.2	16.7%	5.5	39.8%	2.044	1.9%	0.32		1823	55.3	0.207	0.062	• Source: 6-component mix
30-May-18	13:26	Formaldehyde	1.2	19.7%	6.4	19.8%	1.015	2.2%	0.16	H_3O+	931.6	48.6	0.137	0.065	• FTIR data F.I.O.
30-May-18	13:34	Formaldehyde	1.2	22.3%	7.3	1.8%	0.088	2.2%	0.014		148.6	27.7	0.002	0.070	
30-May-18	13:47	Formaldehyde	1.2	22.3%	7.3	0.0%	0	2.2%	0		74.5	23.0	-	-	
31-May-18	10:03	2,4-Dimethylpyridine	5	28.9%	9.3	1.8%	0.088	4.9%	0.044	NO+	1749.0	80.0	-	-	• Source: 6-component mix

Table E.4. PTR-MS Calibration (and FTIR Corroboration) – Acetaldehyde and Acetonitrile

Date	Time Start	COPC	Source [ppm]	MFC-30-1 Set	MFC-30-1 Flow [SLPM]	MFC-5-1 Set	MFC-5-1 Flow [SLPM]	% H_2O (FTIR)	[COPC] Delivered [ppm]	PTR-MS discharge	PTR-MS response [cts]	PTR-MS response $STD_{[cts]}$	FTIR response [ppm]	FTIR response $STD_{[ppm]}$	Notes
1-Jun-18	9:44	Acetaldehyde	100	18.6%	6.1	0%	0	2.1%	0		0	0			
1-Jun-18	10:31	Acetaldehyde	100	18.6%	6.1	1.0%	0.047	2.1%	0.74		24917	322	0.94	0.17	
1-Jun-18	10:59	Acetaldehyde	100	18.5%	6.1	1.8%	0.088	2.2%	1.40		48247	408	1.6	0.10	• Source: 9-component mix
1-Jun-18	11:30	Acetaldehyde	100	18.2%	6.0	3.8%	0.191	2.2%	3.03	H_3O+	97373	591	2.9	0.18	• FTIR data F.I.O.
1-Jun-18	11:35	Acetaldehyde	100	17.9%	5.9	5.8%	0.294	2.2%	4.7		148995	1207	4.2	0.13	
1-Jun-18	11:51	Acetaldehyde	100	15.9%	5.2	19.8%	1.015	2.1%	15.9		407808	2795	13.0	0.14	
1-Jun-18	12:04	Acetaldehyde	100	8.0%	2.7	73.2%	3.764	2.1%	56.6		823586	3982	48.0	0.18	
1-Jun-18	9:44	Acetonitrile	80	18.6%	6.1	0%	0.000	2.1%	0		0	0	-	-	
1-Jun-18	10:31	Acetonitrile	80	18.6%	6.1	1.0%	0.047	2.1%	0.59		25053	333	-	-	
1-Jun-18	10:59	Acetonitrile	80	18.5%	6.1	1.8%	0.088	2.2%	1.12		48571	870	-	-	
1-Jun-18	11:30	Acetonitrile	80	18.2%	6.0	3.8%	0.191	2.2%	2.43	H_3O+	94982	784	-	-	• Source: 9-component mix
1-Jun-18	11:35	Acetonitrile	80	17.9%	5.9	5.8%	0.294	2.2%	3.73		154116	2434	-	-	
1-Jun-18	11:51	Acetonitrile	80	15.9%	5.2	19.8%	1.015	2.1%	12.7		447869	2320	-	-	
1-Jun-18	12:04	Acetonitrile	80	8.0%	2.7	73.2%	3.764	2.1%	45.3		991208	6913	-	-	

Table E.5. PTR-MS Calibration – NDMA and Furan

Date	Time Start	COPC	Source [ppm]	MFC-30-1 Set	MFC-30-1 Flow [SLPM]	MFC-5-1 Set	MFC-5-1 Flow [SLPM]	MFC-0.1-1 Set	MFC-0.1-1 Flow [SLPM]	% H_2O (FTIR)	[COPC] Delivered [ppm]	PTR-MS discharge	PTR-MS response [cts]	PTR-MS response $STD_{[cts]}$	Notes
6-Jun-18	10:35	NDMA	0.1	5.5%	2.0	79.8%	4.104	0%	0	0	0.068		4325.8	42.7	
6-Jun-18	12:08	NDMA	0.1	11.3%	3.8	79.8%	4.104	0%	0	0	0.052		3210.1	58.6	
6-Jun-18	12:15	NDMA	0.1	14.3%	4.7	9.8%	0.500	0%	0	0	0.0095		674.3	38.0	
6-Jun-18	12:25	NDMA	0.1	27.4%	8.9	9.8%	0.500	0%	0	0	0.0053		390.6	15.2	
6-Jun-18	12:32	NDMA	0.1	28.6%	9.2	1.8%	0.088	0%	0	0	0.00094	NO+	108.0	10.2	• Source: 6-component mix
6-Jun-18	12:40	NDMA	0.1	52.0%	16.6	0%	0	85.0%	0.084	0	0.00050		34.9	6.5	
6-Jun-18	12:52	NDMA	0.1	52.0%	16.6	0%	0	18.0%	0.017	0	0.000102		12.9	4.8	
6-Jun-18	13:02	NDMA	0.1	52.0%	16.6	0%	0	6.6%	0.006	0	0.000033		5.1	4.9	
6-Jun-18	13:02	NDMA	0.1	52.0%	16.6	0%	0	0%	0	0	0		0.0	4.3	
6-Jun-18	10:35	Furan	0.1	5.5%	2.0	79.8%	4.104	0%	0	0	0.068		8664.6	60.5	
6-Jun-18	12:08	Furan	0.1	11.3%	3.8	79.8%	4.104	0%	0	0	0.052		6428.3	69.2	
6-Jun-18	12:15	Furan	0.1	14.3%	4.7	9.8%	0.500	0%	0	0	0.0095		1126.3	26.1	
6-Jun-18	12:25	Furan	0.1	27.4%	8.9	9.8%	0.500	0%	0	0	0.0053		701.4	16.9	
6-Jun-18	12:32	Furan	0.1	28.6%	9.2	1.8%	0.088	0%	0	0	0.00094	NO+	121.8	8.5	• Source: 6-component mix
6-Jun-18	12:40	Furan	0.1	52.0%	16.6	0%	0	85.0%	0.084	0	0.00050		69.0	6.7	
6-Jun-18	12:52	Furan	0.1	52.0%	16.6	0%	0	18.0%	0.017	0	0.000102		13.8	4.4	
6-Jun-18	13:02	Furan	0.1	52.0%	16.6	0%	0	6.6%	0.006	0	0.000033		3.0	3.9	
6-Jun-18	13:15	Furan	0.1	52.0%	16.6	0%	0	0%	0	0	0		0.0	4.0	

Table E.6. Methane Tracer Measurements for Exhaust Flow Determination

Date	Time	Test	Tracer	Source	MFC-10-2		FTIR response		Calculated Exhaust Flow		Notes
					Set	Flow					
				[ppm]		[SLPM]	[ppm]	$STD_{[ppm]}$	[SLPM]	[SCFM]	
5/7/2018	12:39	6.1	Methane	30000	0%	0.000	1.8	0.4	-	-	• Methane background
5/7/2018	12:47	6.1	Methane	30000	20%	1.851	35.9	0.4	1630	57.5	• Exhaust flow measurement
5/7/2018	14:47	6.1	Methane	30000	20%	1.851	38.6	0.4	1511	53.3	• Exhaust flow measurement
5/14/2018	15:27	2.1	Methane	30000	0%	0.000	1.7	0.3	-	-	• Methane background
5/14/2018	15:35	2.1	Methane	30000	20%	1.851	39.3	0.4	1475	52.1	• Exhaust flow measurement
6/1/2018	12:40	1.1	Methane	30000	20%	1.851	39.0	0.5	1485	52.4	• Exhaust flow measurement

Table E.7. Test 1.1 – Acetaldehyde and Acetonitrile

Date	Time Start	Test	COPC	Source	MFC-10-2		MFC-20-1		Exhaust Flow	Exhaust Spike	PTR-MS Ionization Mode	PTR-MS response			FTIR response		Injection Location	Sample Port	Notes
					Set	Flow	Set	Flow											
				[ppm]		[SLPM]		[SLPM]	[SLPM]	[ppm]		[cts]	[ppm]	$STD_{[ppm]}$	[ppm]	$STD_{[ppm]}$			
6/1/2018	12:40	1.1	Acetaldehyde	250	0%	0	0%	0	1484.7	0		8194	0.3	0.01	0.29	0.08	*<none>*	D	• Exhaust baseline
6/1/2018	12:52	1.1	Acetaldehyde	250	0%	0	74.9%	14.47	1484.7	2.44	H_3O+	126887	4.0	0.1	3.07	0.18	Exhaust	D	
6/1/2018	13:14	1.1	Acetaldehyde	250	0%	0	0%	0	1484.7	0		0	0	0	0.38	0.13	*<none>*	D	• Exhaust baseline
6/1/2018	12:40	1.1	Acetonitrile	300	0%	0	0%	0	1484.7	0		405	0.01	0.002	-	-	*<none>*	D	• Exhaust baseline
6/1/2018	12:52	1.1	Acetonitrile	300	103.4%	10.29	0%	0	1484.7	2.08	H_3O+	120612	3.2	0.1	-	-	Exhaust	D	
6/1/2018	13:14	1.1	Acetonitrile	300	0%	0	0%	0	1484.7	0		0	0	0	-	-	*<none>*	D	• Exhaust baseline

Table E.8. Test 1.2 – Acetaldehyde and Acetonitrile

Date	Time Start	Test	COPC	Source	Inlet Flow	Predicted Inlet	PTR-MS Ionization Mode	PTR-MS response H_3O+ ionization mode			FTIR response		Injection Location	Sample Port	Notes
				[ppm]	[SLPM]	[ppm]		[cts]	[ppm]	$STD_{[ppm]}$	[ppm]	$STD_{[ppm]}$			
6/4/2018	9:51	1.2	Acetaldehyde	bubbler	1373.5	0		8916	0.26	0.01	0.08	0.09	*<none>*	D	• Exhaust baseline
6/4/2018	10:08	1.2	Acetaldehyde	bubbler	1373.5	0		574	0.015	0.001	0.34	0.12	*<none>*	A	• Inlet baseline
6/4/2018	10:41	1.2	Acetaldehyde	bubbler	1373.5	-		881565	62.3	0.8	85.7	0.34	Inlet	A	
6/4/2018	11:51	1.2	Acetaldehyde	bubbler	1359.4	-	H_3O+	17706	0.53	0.01	0.79	0.09	Inlet	C	
6/4/2018	12:05	1.2	Acetaldehyde	bubbler	1359.4	-		183988	6.2	0.05	5.1	0.15	Inlet	B	
6/4/2018	12:12	1.2	Acetaldehyde	bubbler	1359.4	-		874438	61.6	0.8	75.5	0.40	Inlet	A	
6/4/2018	13:17	1.2	Acetaldehyde	bubbler	1373.5	-		9405	0.28	0.01	0.73	0.14	Inlet	D	
6/4/2018	9:51	1.2	Acetonitrile	bubbler	1373.5	0		262	0.006	0.001	-	-	*<none>*	D	• Exhaust baseline
6/4/2018	10:08	1.2	Acetonitrile	bubbler	1373.5	0		57	0.001	0.0002	-	-	*<none>*	A	• Inlet baseline
6/4/2018	10:41	1.2	Acetonitrile	bubbler	1373.5	-		924161	41.2	0.2	-	-	Inlet	A	
6/4/2018	11:51	1.2	Acetonitrile	bubbler	1359.4	-	H_3O+	9504	0.23	0.003	-	-	Inlet	C	
6/4/2018	12:05	1.2	Acetonitrile	bubbler	1359.4	-		264752	7.1	0.0	-	-	Inlet	B	
6/4/2018	12:12	1.2	Acetonitrile	bubbler	1359.4	-		908675	40.3	0.3	-	-	Inlet	A	
6/4/2018	13:17	1.2	Acetonitrile	bubbler	1373.5	-		593	0.014	0.001	-	-	Inlet	D	

Table E.8. Test 2.1 – Benzene and Propanenitrile

Date	Time Start	Test	COPC	Source [ppm]	MFC-5-2 Set	MFC-5-2 Flow [SLPM]	MFC-10-1 Set	MFC-10-1 Flow [SLPM]	Exhaust Flow [SLPM]	Exhaust Spike [ppm]	PTR-MS Ionization Mode	PTR-MS response H_3O+ ionization mode [cts]	[ppm]	$STD_{[ppm]}$	Injection Location	Sample Port	Notes
5/14/2018	16:27	2.1	Benzene	200	0.0%	0	0.0%	0	1474.9	0	H_3O+	109.6	0.0025	0.0006	*<none>*	D	• Exhaust baseline
5/14/2018	16:42	2.1	Benzene	200	2.2%	0.107	0.0%	0	1474.9	0.014		608.7	0.014	0.001	Exhaust	D	
5/14/2018	16:27	2.1	Propanenitrile	150	0.0%	0	0.0%	0	1474.9	0	H_3O+	36.9	0.0009	0.0011	*<none>*	D	• Exhaust baseline
5/14/2018	16:42	2.1	Propanenitrile	150	0.0%	0	7.4%	0.758	1474.9	0.077		8778	0.205	0.005	Exhaust	D	

Table E.9. Test 2.2 – Benzene and Propanenitrile

Date	Time Start	Test	COPC	Source [ppm]	MFC-10-1 Set	MFC-10-1 Flow [SLPM]	MFC-20-1 Set	MFC-20-1 Flow [SLPM]	MFC-100-1 Set	MFC-100-1 Flow [SLPM]	Inlet Flow [SLPM]	Predicted Inlet [ppm]	PTR-MS Ionization Mode	PTR-MS response H_3O+ ionization mode [cts]	[ppm]	$STD_{[ppm]}$	Injection Location	Sample Port	Notes
15-May-18	12:27	2.2	Benzene	200	0%	0	0%	0	0%	0	1345.2	0	H_3O+	270	0.0061	0.0007	*<none>*	A	• Inlet baseline
15-May-18	13:38	2.2	Benzene	200	0%	0	0%	0	0%	0	1342.4	0		110	0.0025	0.0006	*<none>*	D	• Exhaust baseline
15-May-18	14:45	2.2	Benzene	200	63.5%	6.296	0%	0	0%	0	1345.2	0.93		38764	0.87	0.01	Inlet	A	
15-May-18	14:49	2.2	Benzene	200	63.5%	6.296	0%	0	0%	0	1274.4	0.98		1033	0.023	0.001	Inlet	D	
15-May-18	15:10	2.2	Benzene	200	63.5%	6.296	0%	0	0%	0	1345.2	0.93		15129	0.34	0.004	Inlet	B	
15-May-18	15:14	2.2	Benzene	200	63.5%	6.296	0%	0	0%	0	1345.2	0.93		1520	0.034	0.001	Inlet	C	
15-May-18	15:29	2.2	Benzene	200	63.5%	6.296	0%	0	0%	0	1345.2	0.93		1052	0.024	0.001	Inlet	D	
15-May-18	15:38	2.2	Benzene	200	63.5%	6.296	0%	0	0%	0	1274.4	0.98		37743	0.85	0.01	Inlet	A	
15-May-18	12:27	2.2	Propanenitrile	150	0%	0	0%	0	0%	0	1345.2	0	H_3O+	337	0.0079	0.0011	*<none>*	A	• Inlet baseline
15-May-18	13:38	2.2	Propanenitrile	150	0%	0	0%	0	0%	0	1342.4	0		37	0.0009	0.0011	*<none>*	D	• Exhaust baseline
15-May-18	14:58	2.2	Propanenitrile	150	0%	0	92.0%	17.72	110%	104.6	1345.2	12.5		558795	13.0	0.1	Inlet	A	
15-May-18	14:49	2.2	Propanenitrile	150	0%	0	92.0%	17.72	110%	104.6	1274.4	13.1		500	0.0117	0.0014	Inlet	D	
15-May-18	15:10	2.2	Propanenitrile	150	0%	0	92.0%	17.72	110%	104.6	1345.2	12.5		87419	2.04	0.01	Inlet	B	
15-May-18	15:14	2.2	Propanenitrile	150	0%	0	92.0%	17.72	110%	104.6	1345.2	12.5		2643	0.062	0.002	Inlet	C	
15-May-18	15:29	2.2	Propanenitrile	150	0%	0	92.0%	17.72	110%	104.6	1345.2	12.5		358	0.0083	0.0010	Inlet	D	
15-May-18	15:38	2.2	Propanenitrile	150	0%	0	92.0%	17.72	110%	104.6	1274.4	13.1		848920	19.8	0.3	Inlet	A	

Table E.10. Test 3.1 – 1,3-Butadiene, Formaldehyde, and 2,4-Dimethylpyridine

Date	Time Start	Test	COPC	Source [ppm]	MFC-10-2 Set	MFC-10-2 Flow [SLPM]	MFC-20-1 Set	MFC-20-1 Flow [SLPM]	MFC-100-1 Set	MFC-100-1 Flow [SLPM]	Exhaust Flow [SLPM]	Exhaust Spike [ppm]	PTR-MS Ionization Mode	PTR-MS response [cts]	[ppm]	$STD_{[ppm]}$	FTIR response [ppm]	$STD_{[ppm]}$	Injection Location	Sample Port	Notes
5/30/2018	9:52	3.1	1,3-Butadiene	100	0%	0	0%	0	0.0%	0	1484.7	0	NO+	11.7	0.0008	0.0047	-	-	*<none>*	D	• Exhaust baseline
5/30/2018	10:02	3.1	1,3-Butadiene	100	0%	0	0%	0	5.7%	1.375	1484.7	0.093		2096.0	0.174	0.008	-	-	Exhaust	D	
5/18/2018	15:30	3.1	Formaldehyde	30	16.3%	1.498	0%	0	0%	0	1484.7	0.030	H_3O+	3022.5	0.558	0.022	0.0189	0.0617	Exhaust	D	• FTIR data F.I.O.
5/18/2018	15:43	3.1	Formaldehyde	30	0%	0	0%	0	0%	0	1484.7	0		2806.3	0.516	0.015	-0.0119	0.0497	*<none>*	D	• Exhaust baseline
5/18/2018	15:30	3.1	2,4-Dimethylpyridine	5	0%	0	0%	0	18.4%	13.94	1484.7	0.047	H_3O+	-	-	-	-	-	Exhaust	D	• PTR-MS data not usable

Table E.11. Test 3.2 – 1,3-Butadiene, Formaldehyde, and 2,4-Dimethylpyridine

Date	Time Start	Test	COPC	Source	MFC-10-1		MFC-10-2		MFC-20-1		MFC-100-1		Inlet Flow	Predicted Inlet	PTR-MS Ionization Mode	PTR-MS response			FTIR response		Injection Location	Sample Port	Notes
				[ppm]	Set	Flow [SLPM]	Set	Flow [SLPM]	Set	Flow [SLPM]	Set	Flow [SLPM]	[SLPM]	[ppm]		[cts]	[ppm]	$STD_{[ppm]}$	[ppm]	$STD_{[ppm]}$			
5/30/2018	9:15	3.2	1,3-Butadiene	100	0%	0	0%	0	0%	0	0%	0	1376.4	0		3.2	0.00009	0.0009	-	-	*<none>*	A	• Inlet baseline
5/30/2018	9:28	3.2	1,3-Butadiene	100	0%	0	0%	0	0%	0	0%	0	1376.4	0		11.7	0.00084	0.0047	-	-	*<none>*	D	• Exhaust baseline
5/30/2018	10:28	3.2	1,3-Butadiene	100	63.5%	6.296	0%	0	0%	0	105%	99.6	1376.4	7.1	NO+	88244.2	8.05	0.11	-	-	Inlet	A	
5/30/2018	10:31	3.2	1,3-Butadiene	100	63.5%	6.296	0%	0	0%	0	105%	99.6	1376.4	7.1		103.3	0.027	0.002	-	-	Inlet	D	
5/30/2018	10:37	3.2	1,3-Butadiene	100	63.5%	6.296	0%	0	0%	0	105%	99.6	1376.4	7.1		10901.7	0.98	0.03	-	-	Inlet	B	
5/30/2018	10:39	3.2	1,3-Butadiene	100	63.5%	6.296	0%	0	0%	0	105%	99.6	1376.4	7.1		89.3	0.026	0.001	-	-	Inlet	D	
5/30/2018	14:27	3.2	Formaldehyde	30	0%	0	0%	0	0%	0	0%	0	1359.4	0		4735.0	0.88	0.02	-0.031	0.065	*<none>*	A	• Inlet baseline
5/30/2018	14:43	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1359.4	0.59		6959.6	1.31	0.03	0.376	0.069	Inlet	A	• FTIR data F.I.O.
5/30/2018	14:51	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1359.4	0.59		3907.5	0.726	0.05	0.020	0.059	Inlet	D	
5/30/2018	15:05	3.2	Formaldehyde	30	0%	0	0%	0	0%	0	0%	0	1359.4	0		3902.1	0.725	0.05	0.038	0.049	*<none>*	D	• Exhaust baseline
5/30/2018	15:39	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1359.4	0.59	H_3O+	7296.2	1.37	0.03	0.39	0.05	Inlet	A	
5/30/2018	15:56	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1345.2	0.59		4052.9	0.753	0.05	-0.01	0.05	Inlet	D	
5/30/2018	16:05	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1345.2	0.59		14507.2	2.74	0.04	3.58	0.28	Inlet	B	
5/30/2018	16:11	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1345.2	0.59		4464.7	0.83	0.02	0.29	0.07	Inlet	C	
5/30/2018	16:22	3.2	Formaldehyde	30	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1345.2	0.59		3777.2	0.701	0.04	0.04	0.05	Inlet	D	
5/30/2018	16:32	3.2	Formaldehyde	30	0%	0	0%	0	0%	0	0%	0	1345.2	0		3613.2	0.670	0.04	0.01	0.05	*<none>*	D	• Exhaust baseline
5/31/2018	12:15	3.2	2,4-Dimethylpyridine	bubbler	0%	0	0%	0	0%	0	0%	0	1373.5	-		211.2	0.0053	0.0005	-	-	*<none>*	D	• Exhaust baseline
5/31/2018	12:19	3.2	2,4-Dimethylpyridine	bubbler	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1373.5	-		278.8	0.0071	0.0005	-	-	Inlet	D	• No PTR-MS background
5/31/2018	14:44	3.2	2,4-Dimethylpyridine	bubbler	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1350.9	-	NO+	838.3	0.021	0.001	-	-	Inlet	B	
5/31/2018	15:15	3.2	2,4-Dimethylpyridine	bubbler	0%	0	89.2%	8.858	95.0%	18.29	0%	0	1359.4	-		119.1	0.0030	0.0004	-	-	*<none>*	A	• Inlet baseline
5/31/2018	17:12	3.2	2,4-Dimethylpyridine	bubbler	0%	0	0%	0	0.0%	0	0%	0	1376.4	-		38626.7	0.978	0.096	-	-	Inlet	A	

Table E.12. Tests 4.1/5.1, 4.2/5.2, & 4.3/5.3 – N-Nitrosodimethylamine (NDMA) and Furan

Date	Time Start	Test	COPC	Source	MFC-1-3		MFC-5-2		Exhaust Flow	Exhaust Spike	PTR-MS Ionization Mode		PTR-MS response				Injection Location	Sample Port	Notes
				[ppm]	Set	Flow [SLPM]	Set	Flow [SLPM]	[SLPM]	[ppm]		[cts] R	[cts]	[ppm]	$STD_{[ppm]}$				
6/6/2018	14:09	4.1	NDMA	1	0%	0	0%	0	1484.7	0		94.9	73.6	0.000683	0.000130	*<none>*	D	• Exhaust baseline
6/7/2018	10:12	4.1	NDMA	1	0%	0	0%	0	1484.7	0	NO+	95.7	74.3	0.000690	0.000118	*<none>*	D	• Exhaust baseline
6/7/2018	12:54	4.1	NDMA	1	22.6%	0.221	0%	0	1484.7	0.000149		106.3	84.9	0.000781	0.000110	Exhaust	D	• 50% OEL
6/7/2018	14:09	5.1	Furan	1	0%	0	0%	0	1484.7	0		53.3	14.3	0.000108	0.000037	*<none>*	D	• Exhaust baseline
6/7/2018	10:12	5.1	Furan	1	0%	0	0%	0	1484.7	0	NO+	52.4	13.4	0.000101	0.000037	*<none>*	D	• Exhaust baseline
6/7/2018	12:54	5.1	Furan	1	0%	0	1.5%	0.072	1484.7	0.000049		58.6	19.6	0.000148	0.000039	Exhaust	D	• 10% OEL

Table E.13. Tests 4.2/5.2 – N-Nitrosodimethylamine (NDMA) and Furan

Date	Time Start	Test	COPC	Source [ppm]	MFC-1-3 Set	MFC-1-3 Flow [SLPM]	MFC-5-2 Set	MFC-5-2 Flow [SLPM]	Inlet Flow [SLPM]	Predicted Inlet [ppm]	PTR-MS Ionization Mode	PTR-MS response [cts]	PTR-MS response [ppm]	PTR-MS response $STD_{[ppm]}$	Injection Location	Sample Port	Notes
6/12/2018	9:36	4.2	NDMA	1	0%	0	0%	0	1373.5	0	NO+	32.5	0.000459	0.000089	*<none>*	A	• Inlet baseline
6/12/2018	9:52	4.2	NDMA	1	92.9%	0.906	0%	0	1373.5	0.00066		38.9	0.000619	0.000098	Inlet	A	
6/12/2018	10:21	4.2	NDMA	1	92.9%	0.906	0%	0	1359.4	0.00067		67.9	0.00108	0.00010	Inlet	D	
6/12/2018	10:21	4.2	NDMA	1	92.9%	0.906	0%	0	1359.4	0.00067		69.9	0.00111	0.00010	Inlet	D	
6/12/2018	12:45	4.2	NDMA	1	92.9%	0.906	0%	0	1359.4	0.00067		79.3	0.00126	0.00010	Inlet	C	
6/12/2018	13:25	4.2	NDMA	1	92.9%	0.906	0%	0	1359.4	0.00067		72.5	0.00115	0.00020	Inlet	D	
6/12/2018	13:40	4.2	NDMA	1	92.9%	0.906	0%	0	1359.4	0.00067		264.6	0.00421	0.00008	Inlet	B	
6/12/2018	14:10	4.2	NDMA	1	92.9%	0.906	0%	0	1345.2	0.00067		36.5	0.000580	0.000093	Inlet	A	
6/12/2018	14:47	4.2	NDMA	1	92.9%	0.906	0%	0	1345.2	0.00067		73.0	0.00116	0.00009	Inlet	D	
6/12/2018	15:52	4.2	NDMA	1	92.9%	0.906	0%	0	1345.2	0.00067		90.0	0.00143	0.00009	Inlet	C	
6/12/2018	17:25	4.2	NDMA	1	0%	0	0%	0	1345.2	0		69.5	0.00111	0.00004	<none>	D	• Exhaust baseline
6/12/2018	18:08	4.2	NDMA	1	0%	0	0%	0	1359.4	0		5.8	0.000040	0.000145	<none>	A	• Inlet baseline
6/12/2018	9:21	5.2	Furan	1	0%	0	0%	0	1373.5	0	NO+	68.5	0.000499	0.000084	*<none>*	D	• Exhaust baseline
6/12/2018	9:36	5.2	Furan	1	0%	0	0%	0	1373.5	0		61.1	0.000437	0.000055	*<none>*	A	• Inlet baseline
6/12/2018	9:52	5.2	Furan	1	0%	0	59.5%	2.937	1373.5	0.00213		298.7	0.00228	0.00012	Inlet	A	
6/12/2018	10:21	5.2	Furan	1	0%	0	59.5%	2.937	1359.4	0.00216		31.8	0.000195	0.000046	Inlet	D	
6/12/2018	10:21	5.2	Furan	1	0%	0	59.5%	2.937	1387.7	0.00211		35.1	0.000222	0.000061	Inlet	D	
6/12/2018	12:45	5.2	Furan	1	0%	0	59.5%	2.937	1416.0	0.00207		199.5	0.00158	0.00010	Inlet	C	
6/12/2018	13:25	5.2	Furan	1	0%	0	59.5%	2.937	1444.3	0.00203		44.8	0.000303	0.000061	Inlet	D	
6/12/2018	13:40	5.2	Furan	1	0%	0	59.5%	2.937	1359.4	0.00216		9455.0	0.0733	0.0014	Inlet	B	• Above PTR-MS calibration
6/12/2018	14:10	5.2	Furan	1	0%	0	59.5%	2.937	1345.2	0.00218		352.4	0.00269	0.00011	Inlet	A	
6/12/2018	14:47	5.2	Furan	1	0%	0	59.5%	2.937	1345.2	0.00218		47.6	0.000326	0.000050	Inlet	D	
6/12/2018	15:52	5.2	Furan	1	0%	0	59.5%	2.937	1345.2	0.00218		247.6	0.00198	0.00011	Inlet	C	
6/12/2018	17:25	5.2	Furan	1	0%	0	0%	0	1345.2	0		73.7	0.000542	0.000040	*<none>*	D	• Exhaust baseline
6/12/2018	18:08	5.2	Furan	1	0%	0	0%	0	1359.4	0		25.7	0.000188	0.000034	*<none>*	A	• Inlet baseline

Table E.14. Tests 4.3/5.3 – N-Nitrosodimethylamine (NDMA) and Furan

Date	Time Start	Test	COPC	Source [ppm]	MFC-10-1 Set	MFC-10-1 Flow [SLPM]	MFC-100-1 Set	MFC-100-1 Flow [SLPM]	Inlet Flow [SLPM]	Predicted Inlet [ppm]	PTR-MS Ionization Mode	PTR-MS response [cts]	PTR-MS response [ppm]	PTR-MS response $STD_{[ppm]}$	Injection Location	Sample Port	Notes
6/13/2018	9:41	4.3	NDMA	10	0%	0	0%	0	1345.2	0	NO+	82.6	0.00131	0.00012	*<none>*	A	• Inlet baseline
6/13/2018	10:20	4.3	NDMA	10	80.2%	7.944	0%	0	1345.2	0.05906		3112.6	0.0495	0.0006	Inlet	A	
6/13/2018	10:45	6.3	NDMA	10	80.2%	7.944	0%	0	1345.2	0.05906		360.8	0.00574	0.00038	Inlet	B	
6/13/2018	10:48	4.3	NDMA	10	80.2%	7.944	0%	0	1345.2	0.05906		73.8	0.00117	0.00009	Inlet	D	
6/13/2018	11:43	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		0	0	0	Inlet	C	• PTR-MS < baseline
6/13/2018	12:22	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		3758.5	0.0598	0.0006	Inlet	A	
6/13/2018	13:04	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		3852.5	0.0613	0.0008	Inlet	A	
6/13/2018	13:23	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		394.1	0.00627	0.00086	Inlet	B	
6/13/2018	13:40	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		64.6	0.00103	0.00008	Inlet	D	
6/13/2018	14:59	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		65.6	0.00104	0.00009	Inlet	D	
6/13/2018	15:42	4.3	NDMA	10	80.2%	7.944	0%	0	1316.9	0.06033		61.7	0.000982	0.000081	Inlet	D	
6/13/2018	16:11	4.3	NDMA	10	0%	0	0%	0	1316.9	0		60.3	0.000959	0.000081	<none>	D	• Exhaust baseline
6/13/2018	9:41	5.3	Furan	1	0%	0	0%	0	1345.2	0	NO+	1.6	0.000018	0.00003	*<none>*	A	• Inlet baseline
6/13/2018	10:20	5.3	Furan	1	0%	0	26.3%	21.76	1345.2	0.0159		1589.5	0.0133	0.00031	Inlet	A	
6/13/2018	10:45	5.3	Furan	1	0%	0	26.3%	21.76	1345.2	0.0159		8082.0	0.0636	0.00254	Inlet	B	• Above PTR-MS calibration
6/13/2018	10:48	5.3	Furan	1	0%	0	26.3%	21.76	1345.2	0.0159		25.6	0.000187	0.00005	Inlet	D	
6/13/2018	11:43	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		7.9	0.000065	0.00014	Inlet	C	• PTR-MS < baseline
6/13/2018	12:22	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		2552.5	0.0210	0.00030	Inlet	A	
6/13/2018	13:04	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		2632.6	0.0216	0.00034	Inlet	A	
6/13/2018	13:23	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		13595.2	0.102	0.00568	Inlet	B	• Above PTR-MS calibration
6/13/2018	13:40	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		42.0	0.000279	0.00005	Inlet	D	
6/13/2018	14:59	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		37.1	0.000239	0.00005	*<none>*	D	• Exhaust baseline
6/13/2018	15:42	5.3	Furan	1	0%	0	26.3%	21.76	1316.9	0.0163		37.2	0.000240	0.00007	*<none>*	D	• Exhaust baseline
6/13/2018	16:11	5.3	Furan	1	0%	0	0%	0	1316.9	0		29.8	0.000218	0.00005	<none>	D	• Exhaust baseline

Table E.15. Test 6.1 – Nitrous Oxide and Ammonia

Date	Time Start	Test	COPC	Source [ppm]	MFC-1-3 Set	MFC-1-3 Flow [SLPM]	MFC-10-1 Set	MFC-10-1 Flow [SLPM]	Exhaust Flow [SLPM]	Exhaust Spike [ppm]	FTIR response [ppm]	FTIR response $STD_{[ppm]}$	Injection Location	Sample Port	Notes
5/7/2018	12:55	6.1	Nitrous oxide	30000	0%	0	0%	0	1629.8	0	0.80	0.02	*<none>*	D	• Exhaust baseline
5/7/2018	16:00	6.1	Nitrous oxide	30000	20.1%	0.197	0%	0	1510.5	3.91	4.58	0.03	Exhaust	D	
5/7/2018	16:14	6.1	Nitrous oxide	30000	15.0%	0.147	0%	0	1510.5	2.92	3.57	0.04	Exhaust	D	
5/7/2018	12:55	6.1	Ammonia	30000	0%	0	0%	0	1629.8	0	0.07	0.03	*<none>*	D	• Exhaust baseline
5/7/2018	15:22	6.1	Ammonia	30000	10.1%	0.099	0%	0	1510.5	1.97	1.36	0.02	Exhaust	D	
5/7/2018	15:33	6.1	Ammonia	30000	20.0%	0.196	0%	0	1510.5	3.89	2.93	0.02	Exhaust	D	

Table E.16. Test 6.2 – Nitrous Oxide and Ammonia

Date	Time Start	Test	COPC	Source [ppm]	MFC-10-1 Set	MFC-10-1 Flow [SLPM]	MFC-100-1 Set	MFC-100-1 Flow [SLPM]	Inlet Flow [SLPM]	Predicted Inlet [ppm]	FTIR response [ppm]	FTIR response $STD_{[ppm]}$	Injection Location	Sample Port	Notes
5/9/2018	10:43	6.2	Nitrous oxide	30000	0%	0	0%	0	1373.5	0	0.32	0.03	*<none>*	A	• Inlet baseline
5/9/2018	11:53	6.2	Nitrous oxide	30000	0%	0	0%	0	1373.5	0	0.90	0.02	<none>	D	• Exhaust baseline
5/9/2018	12:18	6.2	Nitrous oxide	30000	0%	0	8.7%	4.344	1373.5	94.6	103.4	0.2	Inlet	A	
5/9/2018	12:32	6.2	Nitrous oxide	30000	0%	0	8.7%	4.344	1373.5	94.6	28.7	0.05	Inlet	D	
5/9/2018	15:27	6.2	Nitrous oxide	30000	0%	0	8.7%	4.344	1373.5	94.6	27.9	0.1	Inlet	B	
5/9/2018	16:10	6.2	Nitrous oxide	30000	0%	0	8.7%	4.344	1373.5	94.6	29.3	0.1	Inlet	C	
5/9/2018	16:48	6.2	Nitrous oxide	30000	0%	0	8.7%	4.344	1373.5	94.6	108.5	0.3	Inlet	A	
5/9/2018	17:15	6.2	Nitrous oxide	30000	0%	0	8.7%	4.344	1373.5	94.6	29.2	0.4	Inlet	D	
5/9/2018	10:43	6.2	Ammonia	30000	0%	0	0%	0	1373.5	0	3.2	0.6	*<none>*	A	• Inlet baseline
5/9/2018	11:53	6.2	Ammonia	30000	0%	0	0%	0	1373.5	0	0.04	0.02	<none>	D	• Exhaust baseline
5/9/2018	12:18	6.2	Ammonia	30000	21.7%	2.170	0%	0	1373.5	47.3	54.8	0.1	Inlet	A	
5/9/2018	12:32	6.2	Ammonia	30001	21.7%	2.170	0%	0	1373.5	47.3	1.3	0.1	Inlet	D	
5/9/2018	15:27	6.2	Ammonia	30002	21.7%	2.170	0%	0	1373.5	47.3	3.2	0.3	Inlet	B	
5/9/2018	16:10	6.2	Ammonia	30003	21.7%	2.170	0%	0	1373.5	47.3	0.11	0.07	Inlet	C	
5/9/2018	16:48	6.2	Ammonia	30004	21.7%	2.170	0%	0	1373.5	47.3	54.9	0.2	Inlet	A	
5/9/2018	17:15	6.2	Ammonia	30000	21.7%	2.170	0%	0	1373.5	47.3	0.06	0.03	Inlet	D	

Table E.17. Test 6.3 – Nitrous Oxide and Ammonia

Date	Time Start	Test	COPC	Source [ppm]	MFC-100-1 Set	MFC-100-1 Flow [SLPM]	Inlet Flow [SLPM]	Predicted Inlet [ppm]	FTIR response [ppm]	FTIR response $STD_{[ppm]}$	Injection Location	Sample Port	Notes
5/10/2018	11:56	6.3	Nitrous oxide	30000	45.6%	40.86	1359.4	875.5	865.0	1.6	Inlet	A	
5/10/2018	12:01	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	259.6	0.9	Inlet	D	
5/10/2018	12:04	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	257.3	0.4	Inlet	C	
5/10/2018	12:10	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	236.2	0.8	Inlet	B	
5/10/2018	12:45	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	261.6	0.9	Inlet	D	
5/10/2018	13:04	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	260.4	0.9	Inlet	C	
5/10/2018	13:15	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	841.7	2.0	Inlet	A	
5/10/2018	13:22	6.3	Nitrous oxide	30000	45.6%	40.86	1345.2	884.4	4.6	0.7	*<none>*	A	• Inlet baseline
5/10/2018	13:24	6.3	Ammonia	30000	0%	0	1359.4	0	-0.1	0.6	<none>	A	• Inlet baseline
5/10/2018	13:43	6.3	Ammonia	30000	34.8%	30.17	1359.4	651.4	654.2	1.1	Inlet	A	
5/10/2018	14:13	6.3	Ammonia	30000	34.8%	30.17	1359.4	651.4	76.3	1.1	Inlet	B	
5/10/2018	15:05	6.3	Ammonia	30000	34.8%	30.17	1359.4	651.4	0.32	0.04	Inlet	D	
5/10/2018	16:15	6.3	Ammonia	30000	34.8%	30.17	1359.4	651.4	675.4	1.1	Inlet	A	
5/10/2018	17:20	6.3	Ammonia	30000	34.8%	30.17	1359.4	651.4	0.95	0.11	Inlet	C	
5/10/2018	18:00	6.3	Ammonia	30000	34.8%	30.17	1359.4	651.4	0.3	0.04	Inlet	D	

Appendix F

Additional Test Summary and Results

Appendix F

Additional Test Summary and Results

Table F.1. Select Inlet Background COPC Concentrations

COPC	Test	Inlet Background PTR-MS (ppm)	Inlet Background FTIR (ppm)	Instrument
Acetaldehyde	1.2	0.015	0.34	PTR-MS (H_3O+)
Acetonitrile	1.2	0.0014	-	PTR-MS (H_3O+)
Benzene	2.2	0.0061	-	PTR-MS (H_3O+)
Propanenitrile	2.2	0.0079	-	PTR-MS (H_3O+)
1,3-Butadiene	3.2	0.00009	-	PTR-MS (NO+)
Formaldehyde	3.2	0.88	-	PTR-MS (H_3O+)
2,4-Dimethylpyridine	3.2	0.0030	-	PTR-MS (NO+)
NDMA	4.2	0.00012	-	PTR-MS (NO+) + VOCUS PTR-TOF
Furan	5.2	0.00024	-	PTR-MS (NO+) + VOCUS PTR-TOF
Ammonia	0.1	-	1.6	FTIR
Nitrous Oxide	0.1	-	2.4	FTIR

Table F.2. Detailed Summary Test Results

COPC	Test	200% OEL Inlet Target	Measured at Inlet (port A)		Measured at Port B		A → B DRE	Measured at Port C		B → C DRE	Measured at Outlet (port D)		C → D DRE	TOS DRE	95% DRE Target Met?	10% OEL Target Met?
			PTR-MS (ppm)	FTIR (ppm)	PTR-MS (ppm)	FTIR (ppm)		PTR-MS (ppm)	FTIR (ppm)		PTR-MS (ppm)	FTIR (ppm)				
Acetaldehyde[a]	1.2	50	61.9	75.5	6.2	5.1	90.0%	0.53	0.79	9.1%	0.28	0.73	0.4%	99.6%	Yes	Yes
Acetonitrile	1.2	40	40.8	-	7.1	-	82.6%	0.23	-	16.9%	0.014	-	0.5%	>99.9%	Yes	Yes
Benzene	2.2	1	0.86	-	0.34	-	60.5%	0.034	-	35.6%	0.023	-	1.2%	97.3%	Yes	Yes
Propanenitrile	2.2	12	16.4	-	2.0	-	87.6%	0.062	-	12.0%	0.010	-	0.3%	>99.9%	Yes	Yes
1,3-Butadiene	3.2	3.4	8.05	-	0.98	-	87.8%	*N.M.*	-	-	0.026	-	11.8%	99.7%	Yes	Yes
Formaldehyde[a]	3.2	0.6	1.34	0.38	2.74	3.58	-105%	0.83	0.29	143%	0.727	0.031	7.8%	45.7%	No	No
2,4-Dimethylpyridine	3.2	1	0.98	-	0.021	-	97.8%	*N.M.*	-	-	0.0071	-	1.4%	99.3%	Yes	Yes
NDMA[b]	4.2	0.0006	0.00034	-	0.00025	-	25.7%	-	-	-	0.000151	-	29.9%	55.6%	No	No
	4.3	0.062	0.0603	-	0.00205	-	96.6%	-b	-	-	0.000042	-	3.3%	>99.9%	Yes	No
Furan[b]	5.2	0.002	0.00234	-	0.0578	-	-2367%	-	-	-	0.000017	-	2466%	99.3%	Yes	Yes
	5.3	0.017	0.0212	-	0.0869	-	-311%	-b	-	-	0.000035	-	411%	99.8%	Yes	Yes
Ammonia	6.2	50	-	54.9	-	3.2	94.2%	-	0.11	5.6%	-	0.70	-1%	98.7%	Yes	Yes
	6.3	630	-	665	-	76.3	88.5%	-	0.9	11.3%	-	0.32	0.1%	>99.9%	Yes	Yes
Nitrous Oxide	6.2	100	-	105.9	-	27.9	73.7%	-	29.3	-1%	-	28.9	0.4%	72.7%	No	No
	6.3	831	-	853	-	236	72.3%	-	259	-3%	-	261	-0.2%	69.5%	No	No

[a] FTIR results are For Information Only.
[b] Reflects combined results from the PTR-MS and the TOFWERK VOCUS-PTR
N.M. - not measured

Table F.3. Engine + Exhaust Aftertreatment (DOC + DPF) Individual DREs

COPC	Test	Individual Component DRE		200% OEL Overall DRE
		Engine	Combined DOC + DPF	
Acetaldehyde	1.2	90.0%	95.5%	99.6%
Acetonitrile	1.2	82.6%	99.8%	>99.9%
Benzene	2.2	60.5%	93.1%	97.3%
Propanitrile	2.2	87.6%	99.5%	>99.9%
1,3-Butadiene	3.2	87.8%	97.4%	99.7%
Formaldehyde	3.2	-105%	73.5%	45.7%
2,4-Dimethylpyridine	3.2	97.8%	66.7%	99.3%
NDMA	4.2	26%	40.2%	56%
NDMA	4.3	97%	98.0%	>99.9%
Furan	5.2	-2367%	2466%	99.3%
Furan	5.3	-311%	411%	99.8%
Ammonia	6.2	94.2%	77.7%	98.7%
Ammonia	6.3	88.5%	99.6%	>99.9%
Nitrous Oxide	6.2	73.7%	-4%	72.7%
Nitrous Oxide	6.3	72.3%	-10%	69.5%

Table F.4. Effect of Exhaust Background Subtraction on Overall TOS DRE

		200% OEL	
COPC	Test	No Subtraction	Exhaust Background Subtracted
Acetaldehyde	1.2	99.6%	99.97%
Acetonitrile	1.2	>99.9%	> 99.99%
Benzene	2.2	97.3%	97.6%
Propanenitrile	2.2	>99.9%	99.94%
1,3-Butadiene	3.2	99.7%	99.7%
Formaldehyde	3.2	45.7%	99.9%
2,4-Dimethylpyridine	3.2	99.3%	99.8%
NDMA	4.2	55.6%	99.2%
NDMA	4.3	>99.9%	99.99%
Furan	5.2	99.3%	> 99.99%
Furan	5.3	99.8%	99.99%
Ammonia	6.2	98.7%	98.8%
Ammonia	6.3	>99.9%	99.96%
Nitrous Oxide	6.2	72.7%	73.5%
Nitrous Oxide	6.3	69.5%	69.6%

Appendix G

Hanford Tank Farm COPCs and Test Surrogate

Appendix G

Hanford Tank Farm COPCs and Test Surrogate

Table G.1. Hanford Tank Farm COPCs and Test Surrogate

COPC #	Chemical Name	CAS #	OEL[1]	Test Surrogate
1	1,1'-Biphenyl	92-52-4	0.2 ppm	Benzene, Acetaldehyde
2	1,3-Butadiene	106-99-0	1 ppm	1,3-Butadiene
3	1,3-Dinitrate-1,2,3-propantriol	623-87-0	0.05 ppm	Formaldehyde, Acetaldehyde
4	1,4-Butanediol dinitrate	3457-91-8	0.05 ppm	1,3-Butadiene
5	1-Butanol	71-36-3	20 ppm	Formaldehyde, Acetaldehyde
6	2,4-Dimethylpyridine	108-47-4	0.5 ppm	2,4-Dimethylpyridine
7	2,4-Pentadienenitrile	1615-70-9	0.3 ppm	Acetonitrile, Propanenitrile
8	2-Ethylhex-2-enal	645-62-5	0.1 ppm	Formaldehyde, Acetaldehyde
9	2-Fluoropropene	1184-60-7	0.1 ppm	1,3-Butadiene
10	2-Hexanone	591-78-6	5 ppm	Formaldehyde, Acetaldehyde
11	2-Methylbut-2-enal	1115-11-3	0.03 ppm	Formaldehyde, Acetaldehyde
12	2-Methylene butanenitrile	1647-11-6	0.3 ppm	Acetonitrile, Propanenitrile
13	2-Nitro-2-methylpropane	594-70-7	0.3 ppm	1,3-Butadiene
14	3-Buten-2-one	78-94-4	0.2 ppm	Formaldehyde, Acetaldehyde
15	3-Methyl-3-buten-2-one	814-78-8	0.02 ppm	Formaldehyde, Acetaldehyde
16	4-Methyl-2-hexanone	105-42-0	0.5 ppm	Formaldehyde, Acetaldehyde
17	6-Methyl-2-heptanone	928-68-7	8 ppm	Formaldehyde, Acetaldehyde
18	Acetaldehyde	75-07-0	25 ppm	Acetaldehyde
19	Acetonitrile	75-05-8	20 ppm	Acetonitrile
20	Ammonia	7664-41-7	25 ppm	Ammonia
21	Benzene	71-43-2	0.5 ppm	Benzene
22	Butanal	123-72-8	25 ppm	Formaldehyde, Acetaldehyde
23	Butanenitrile	109-74-0	8 ppm	1,3-Butadiene
24	Butyl nitrate	928-45-0	8 ppm	1,3-Butadiene
25	Butyl nitrite	544-16-1	0.1 ppm	1,3-Butadiene
26	Chlorinated biphenyls	---	0.03 mg/m^3	Benzene
27	Dibutyl butylphosphonate	78-46-6	0.007 ppm	1,3-Butadiene
28	Diethyl phthalate	84-66-2	5 mg/m^3	Benzene
29	Ethylamine	75-04-7	5 ppm	Acetonitrile, Propanenitrile

[1] COPC Hanford Tank Farm occupational exposure limit form Appendix A of the Test Plan. Rappe KG. 2018. PNNL Assessment of "*NUCON Vapor Abatement Unit for Single-Shell Tank (SST) Farm Off-Gas Chemicals of Potential Concern (COPCs)*". Test Plan TP-71248-01, Rev. 0, April 2018, Pacific Northwest National Laboratory, Richland, Washington.

COPC #	Chemical Name	CAS #	OEL[1]	Test Surrogate
30	Formaldehyde	50-00-0	0.3 ppm	Formaldehyde
31	Furan	110-00-9	0.001 ppm	Furan
32	2,3-Dihydrofuran	1191-99-7	0.001 ppm	Furan
33	2,5-Dihydrofuran	1708-29-8	0.001 ppm	Furan
34	2-Methylfuran	534-22-5	0.001 ppm	Furan
35	2,5-Dimethylfuran	625-86-5	0.001 ppm	Furan
36	2-Ethyl-5-methylfuran	1703-52-2	0.001 ppm	Furan
37	4-(1-Methylpropyl)-2,3-dihydrofuran	34379-54-9	0.001 ppm	Furan
38	3-(1,1-Dimethylethyl)-2,3-dihydrofuran	34314-82-4	0.001 ppm	Furan
39	2-Pentylfuran	3777-69-3	0.001 ppm	Furan
40	2-Heptylfuran	3777-71-7	0.001 ppm	Furan
41	2-Propylfuran	4229-91-8	0.001 ppm	Furan
42	2-Octylfuran	4179-38-8	0.001 ppm	Furan
43	2-(3-Oxo-3-phenylprop-1-enyl)furan	717-21-5	0.001 ppm	Benzene, Acetaldehyde, Furan
44	2-(2-Methyl-6-oxoheptyl)furan	51595-87-0	0.001 ppm	Furan, Acetaldehyde
45	Heptanenitrile	629-08-3	6 ppm	Acetonitrile, Propanenitrile
46	Hexanenitrile	628-73-9	6 ppm	Acetonitrile, Propanenitrile
47	Mercury	7439-97-6	0.025 mg/m^3	Not Tested[1]
48	Methanol	67-56-1	200 ppm	Formaldehyde
49	Methyl isocyanate	624-83-9	0.02 ppm	Formaldehyde, Acetaldehyde
50	Methyl nitrite	624-91-9	0.1 ppm	Formaldehyde
51	Nitrous oxide (N_2O)	10024-97-2	50 ppm	Nitrous oxide (N_2O)
52	N-Nitrosodiethylamine	55-18-5	0.0001 ppm	N-Nitrosodimethylamine
53	N-Nitrosodimethylamine	62-75-9	0.0003 ppm	N-Nitrosodimethylamine
54	N-Nitrosomethylethylamine	10595-95-6	0.0003 ppm	N-Nitrosodimethylamine
55	N-Nitrosomorpholine	59-89-2	0.0006 ppm	N-Nitrosodimethylamine
56	Pentanenitrile	110-59-8	6 ppm	Acetonitrile, Propanenitrile
57	Propanenitrile	107-12-0	6 ppm	Acetonitrile, Propanenitrile
58	Pyridine	110-86-1	1 ppm	Benzene, 2,4-Dimethylpyridine
59	Tributyl phosphate	126-73-8	0.2 ppm	1,3-Butadiene, Benzene
60	Dimethylmercury	593-74-8	0.01 mg/m^3	Not Tested[2]
61	2-Propenal	107-02-8	0.1 ppm	Formaldehyde, Acetaldehyde

[1] The data to complete a preliminary assessment of MERSORB® performance was provided in the MERSORB® Mercury Adsorbents Bulletin 11B28-2012 "MERSORB® Mercury Adsorbents Design and Performance Characteristics" by NUCON International Columbus, Ohio.

[2] MERSORB® has also been evaluated for removal of dimethyl mercury and was selected as the best available control technology for mercury abatement (both elemental mercury and dimethyl mercury) in the AP stack (Evaluation of Best Available Control Technology for Toxics (tBACT) Double Shell Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations, RPP-ENV-46679, Rev. 0).

Appendix H

Calculations for Converting EPA TO-11A and NIOSH 2522 Results from µg to ppb

Appendix H
Calculations for Converting EPA TO-11A and NIOSH 2522 Results from µg to ppb

Table H.1. Calculations for Converting EPA TO-11A and NIOSH 2522 Results from µg to ppb

Date	Time Start	Time Stop	Test	COPC	MW	Sample Name	Sample Port	Total Tube Flow			Dilution Flow			Uncorrected Sample Flow	Gas Correction Factor (GCF)	GCF-corrected Sample Flow	Sample Time	Sample Volume	COPC Mass (measured by 222-S)	Volume of COPC	COPC Concentration in Sample	Notes
								MFC	Set	Flow [SLPM]	MFC	Set	Flow [SLPM]	[SLPM]		[SLPM]	[min]	[std L]	[µg]	[std-µL]	[ppb]	
5/18/2018	16:54	17:27	3.2	Formaldehyde	30.031	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.13	0.097	16.573	• Inlet
5/18/2018	16:54	18:14	3.2	Formaldehyde	30.031	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	19.00	14.17	2999.1	• Post engine
5/18/2018	16:57	18:14	3.2	Formaldehyde	30.031	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	2.30	1.72	466.82	• Post catalyst
5/18/2018	16:54	18:14	3.2	Formaldehyde	30.031	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.79	0.59	153.91	• Tailpipe
5/18/2018	17:29	17:49	3.2	Formaldehyde	30.031	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.19	0.14	38.867	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Acetaldehyde	44.05	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.067	0.034	5.823	• Inlet
5/18/2018	16:54	18:14	3.2	Acetaldehyde	44.05	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	5.10	2.59	548.817	• Post engine
5/18/2018	16:57	18:14	3.2	Acetaldehyde	44.05	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.24	0.12	33.209	• Post catalyst
5/18/2018	16:54	18:14	3.2	Acetaldehyde	44.05	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.11	0.06	14.610	• Tailpipe
5/18/2018	17:29	17:49	3.2	Acetaldehyde	44.05	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.07	0.04	9.762	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Acetone	58.08	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.019	3.296	• Inlet
5/18/2018	16:54	18:14	3.2	Acetone	58.08	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.05	0.02	4.081	• Post engine
5/18/2018	16:57	18:14	3.2	Acetone	58.08	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.02	5.247	• Post catalyst
5/18/2018	16:54	18:14	3.2	Acetone	58.08	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.02	5.037	• Tailpipe
5/18/2018	17:29	17:49	3.2	Acetone	58.08	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.02	5.289	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Acrolein	56.06	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.020	3.415	• Inlet
5/18/2018	16:54	18:14	3.2	Acrolein	56.06	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.50	0.20	42.279	• Post engine
5/18/2018	16:57	18:14	3.2	Acrolein	56.06	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.09	0.03	9.242	• Post catalyst
5/18/2018	16:54	18:14	3.2	Acrolein	56.06	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.08	0.03	8.558	• Tailpipe
5/18/2018	17:29	17:49	3.2	Acrolein	56.06	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.02	5.479	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Propionaldehyde	58.08	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.87	0.050	0.019	3.288	• Inlet
5/18/2018	16:54	18:14	3.2	Propionaldehyde	58.08	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.78	0.30	63.661	• Post engine
5/18/2018	16:57	18:14	3.2	Propionaldehyde	58.08	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.02	5.247	• Post catalyst
5/18/2018	16:54	18:14	3.2	Propionaldehyde	58.08	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.02	5.037	• Tailpipe
5/18/2018	17:29	17:49	3.2	Propionaldehyde	58.08	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.02	5.289	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Crotonaldehyde	70.0898	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.016	2.731	• Inlet
5/18/2018	16:54	18:14	3.2	Crotonaldehyde	70.0898	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	1.10	0.35	74.394	• Post engine
5/18/2018	16:57	18:14	3.2	Crotonaldehyde	70.0898	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.02	4.348	• Post catalyst
5/18/2018	16:54	18:14	3.2	Crotonaldehyde	70.0898	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.11	0.04	9.182	• Tailpipe
5/18/2018	17:29	17:49	3.2	Crotonaldehyde	70.0898	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.02	4.382	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Butanal	72.11	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.016	2.655	• Inlet
5/18/2018	16:54	18:14	3.2	Butanal	72.11	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	1.00	0.31	65.737	• Post engine
5/18/2018	16:57	18:14	3.2	Butanal	72.11	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.17	0.05	14.369	• Post catalyst
5/18/2018	16:54	18:14	3.2	Butanal	72.11	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.02	4.057	• Tailpipe
5/18/2018	17:29	17:49	3.2	Butanal	72.11	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.02	4.260	• Inlet (repeat)

Table H.2 (Cont'd). Calculations for Converting EPA TO-11A and NIOSH 2522 Results from µg to ppb

Date	Time Start	Time Stop	Test	COPC	MW	Sample Name	Sample Port	Total Tube Flow			Dilution Flow			Uncorrected Sample Flow	Gas Correction Factor (GCF)	GCF-corrected Sample Flow	Sample Time	Sample Volume	COPC Mass (measured by 222-S)	Volume of COPC	COPC Concentration in Sample	Notes
								MFC	Set	Flow [SLPM]	MFC	Set	Flow [SLPM]	[SLPM]		[SLPM]	[min]	[std L]	[µg]	[std-µL]	[ppb]	
5/18/2018	16:54	17:27	3.2	Benzaldehyde	106.121	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.011	1.804	• Inlet
5/18/2018	16:54	18:14	3.2	Benzaldehyde	106.121	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	1.20	0.25	53.602	• Post engine
5/18/2018	16:57	18:14	3.2	Benzaldehyde	106.121	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.01	2.872	• Post catalyst
5/18/2018	16:54	18:14	3.2	Benzaldehyde	106.121	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.01	2.757	• Tailpipe
5/18/2018	17:29	17:49	3.2	Benzaldehyde	106.121	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.01	2.894	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Isovaleraldehyde	86.13	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.013	2.222	• Inlet
5/18/2018	16:54	18:14	3.2	Isovaleraldehyde	86.13	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.05	0.01	2.752	• Post engine
5/18/2018	16:57	18:14	3.2	Isovaleraldehyde	86.13	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.01	3.538	• Post catalyst
5/18/2018	16:54	18:14	3.2	Isovaleraldehyde	86.13	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.01	3.396	• Tailpipe
5/18/2018	17:29	17:49	3.2	Isovaleraldehyde	86.13	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.01	3.566	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Valeraldehyde	86.13	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.013	2.222	• Inlet
5/18/2018	16:54	18:14	3.2	Valeraldehyde	86.13	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.53	0.14	29.169	• Post engine
5/18/2018	16:57	18:14	3.2	Valeraldehyde	86.13	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.01	3.538	• Post catalyst
5/18/2018	16:54	18:14	3.2	Valeraldehyde	86.13	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.01	3.396	• Tailpipe
5/18/2018	17:29	17:49	3.2	Valeraldehyde	86.13	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.01	3.566	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	m,p-Tolualdehyde	120.151	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.009	1.593	• Inlet
5/18/2018	16:54	18:14	3.2	m,p-Tolualdehyde	120.151	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.09	0.02	3.551	• Post engine
5/18/2018	16:57	18:14	3.2	m,p-Tolualdehyde	120.151	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.01	2.536	• Post catalyst
5/18/2018	16:54	18:14	3.2	m,p-Tolualdehyde	120.151	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.01	2.435	• Tailpipe
5/18/2018	17:29	17:49	3.2	m,p-Tolualdehyde	120.151	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.01	2.556	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	o-Tolualdehyde	120.151	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.050	0.009	1.593	• Inlet
5/18/2018	16:54	18:14	3.2	o-Tolualdehyde	120.151	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.05	0.01	1.973	• Post engine
5/18/2018	16:57	18:14	3.2	o-Tolualdehyde	120.151	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.05	0.01	2.536	• Post catalyst
5/18/2018	16:54	18:14	3.2	o-Tolualdehyde	120.151	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.05	0.01	2.435	• Tailpipe
5/18/2018	17:29	17:49	3.2	o-Tolualdehyde	120.151	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.05	0.01	2.556	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	Hexanal	100.16	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.100	0.022	3.822	• Inlet
5/18/2018	16:54	18:14	3.2	Hexanal	100.16	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.10	0.02	4.733	• Post engine
5/18/2018	16:57	18:14	3.2	Hexanal	100.16	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.10	0.02	6.085	• Post catalyst
5/18/2018	16:54	18:14	3.2	Hexanal	100.16	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.10	0.02	5.841	• Tailpipe
5/18/2018	17:29	17:49	3.2	Hexanal	100.16	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.10	0.02	6.133	• Inlet (repeat)
5/18/2018	16:54	17:27	3.2	2,5-dimethylbenzaldehyde	134.178	3OL0FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	32.2	5.85	0.100	0.017	2.853	• Inlet
5/18/2018	16:54	18:14	3.2	2,5-dimethylbenzaldehyde	134.178	3OL0FHB0	B	MFC-5-5	2.6%	0.198	MFC-2-2	7.0%	0.137	0.060	0.9584	0.060	79.1	4.73	0.10	0.02	3.533	• Post engine
5/18/2018	16:57	18:14	3.2	2,5-dimethylbenzaldehyde	134.178	3OL0FHC0	C	MFC-5-4	3.6%	0.200	MFC-2-3	7.2%	0.152	0.049	0.9584	0.048	76.5	3.68	0.10	0.02	4.543	• Post catalyst
5/18/2018	16:54	18:14	3.2	2,5-dimethylbenzaldehyde	134.178	3OL0FHD0	D	MFC-5-3	2.4%	0.199	MFC-2-4	6.3%	0.150	0.049	0.9584	0.048	79.1	3.83	0.10	0.02	4.360	• Tailpipe
5/18/2018	17:29	17:49	3.2	2,5-dimethylbenzaldehyde	134.178	3OL1FHA0	A	MFC-2-1	9.8%	0.182	-	-	-	0.182	0.9975	0.182	20.1	3.65	0.10	0.02	4.578	• Inlet (repeat)

Table H.3 (Cont'd). Calculations for Converting EPA TO-11A and NIOSH 2522 Results from µg to ppb

Date	Time Start	Time Stop	Test	COPC	MW	Sample Name	Sample Port	Total Tube Flow			Dilution Flow			Uncorrected Sample Flow	Gas Correction Factor (GCF)	GCF-corrected Sample Flow	Sample Time	Sample Volume	COPC Mass (measured by 222-S)	Volume of COPC	COPC Concentration in Sample	Notes
								MFC	Set	Flow [SLPM]	MFC	Set	Flow [SLPM]	[SLPM]		[SLPM]	[min]	[std L]	[µg]	[std-µL]	[ppb]	
6/12/2018	11:00	17:20	4.2	NDMA	74.08	EL23310	B	MFC-5-5	0.384	2.00	MFC-2-2	0.745	1.46	0.541	0.9584	0.535	380.1	207.1	2.760	0.835	4.02924	• Post engine
6/12/2018	10:54	17:20	4.2	NDMA	74.08	EL23307	C	MFC-5-4	0.4	2.00	MFC-2-3	0.747	1.52	0.480	0.9584	0.475	386.1	187.3	6.809	2.06	10.9930	• Post catalyst
6/12/2018	10:44	17:00	4.2	NDMA	74.08	EL23309	D	MFC-5-3	0.389	2.00	MFC-2-4	0.706	1.51	0.494	0.9584	0.489	376.0	186.88	9.696	2.93	15.6887	• Tailpipe
6/13/2018	10:51	12:11	4.3	NDMA	74.08	EL23302	A	MFC-5-2	0.389	1.92	-	-	-	1.9	0.9975	1.915	80.0	153.20	20.067	6.07	39.6080	• Inlet
6/13/2018	10:51	16:11	4.3	NDMA	74.08	EL23303	B	MFC-5-5	0.384	2.00	MFC-2-2	0.745	1.46	0.5	0.9584	0.535	320.0	171.28	0.008	0.00242	0.01412	• Post engine
6/13/2018	10:51	16:11	4.3	NDMA	74.08	EL23318	C	MFC-5-4	0.400	2.00	MFC-2-3	0.747	1.52	0.5	0.9584	0.475	320.0	152.09	0.017	0.0051	0.033797	• Post catalyst
6/13/2018	10:51	16:11	4.3	NDMA	74.08	EL23319	D	MFC-5-3	0.389	2.00	MFC-2-4	0.706	1.51	0.5	0.9584	0.489	320.0	156.37	0.058	0.0175	0.112153	• Tailpipe
6/13/2018	10:51	12:11	4.3	NDEA	102.137	EL23302	A	MFC-5-2	0.389	1.92	-	-	-	1.9	0.9975	1.915	80.0	153.20	0.008	0.00	0.0115	• Inlet
6/13/2018	10:51	16:11	4.3	NDEA	102.137	EL23303	B	MFC-5-5	0.384	2.00	MFC-2-2	0.745	1.46	0.5	0.9584	0.535	320.0	171.28	0.008	0.00175	0.01024	• Post engine
6/13/2018	10:51	16:11	4.3	NDEA	102.137	EL23318	C	MFC-5-4	0.400	2.00	MFC-2-3	0.747	1.52	0.5	0.9584	0.475	320.0	152.09	0.008	0.0018	0.011536	• Post catalyst
6/13/2018	10:51	16:11	4.3	NDEA	102.137	EL23319	D	MFC-5-3	0.389	2.00	MFC-2-4	0.706	1.51	0.5	0.9584	0.489	320.0	156.37	0.009	0.0020	0.012622	• Tailpipe
6/13/2018	10:51	12:11	4.3	N-Nitrosodi-n-butylamine	158.245	EL23302	A	MFC-5-2	0.389	1.92	-	-	-	1.9	0.9975	1.915	80.0	153.20	0.050	0.01	0.0462	• Inlet
6/13/2018	10:51	16:11	4.3	N-Nitrosodi-n-butylamine	158.245	EL23303	B	MFC-5-5	0.384	2.00	MFC-2-2	0.745	1.46	0.5	0.9584	0.535	320.0	171.28	0.008	0.00113	0.0066	• Post engine
6/13/2018	10:51	16:11	4.3	N-Nitrosodi-n-butylamine	158.245	EL23318	C	MFC-5-4	0.400	2.00	MFC-2-3	0.747	1.52	0.5	0.9584	0.475	320.0	152.09	0.008	0.0011	0.007446	• Post catalyst
6/13/2018	10:51	16:11	4.3	N-Nitrosodi-n-butylamine	158.245	EL23319	D	MFC-5-3	0.389	2.00	MFC-2-4	0.706	1.51	0.5	0.9584	0.489	320.0	156.37	0.014	0.0020	0.012673	• Tailpipe
6/13/2018	10:51	12:11	4.3	N-Nitrosodi-n-propylamine	130.191	EL23302	A	MFC-5-2	0.389	1.92	-	-	-	1.9	0.9975	1.915	80.0	153.20	0.026	0.00	0.0292	• Inlet
6/13/2018	10:51	16:11	4.3	N-Nitrosodi-n-propylamine	130.191	EL23303	B	MFC-5-5	0.384	2.00	MFC-2-2	0.745	1.46	0.5	0.9584	0.535	320.0	171.28	0.008	0.00138	0.00804	• Post engine
6/13/2018	10:51	16:11	4.3	N-Nitrosodi-n-propylamine	130.191	EL23318	C	MFC-5-4	0.400	2.00	MFC-2-3	0.747	1.52	0.5	0.9584	0.475	320.0	152.09	0.008	0.0014	0.009050	• Post catalyst
6/13/2018	10:51	16:11	4.3	N-Nitrosodi-n-propylamine	130.191	EL23319	D	MFC-5-3	0.389	2.00	MFC-2-4	0.706	1.51	0.5	0.9584	0.489	320.0	156.37	0.008	0.0014	0.008802	• Tailpipe
6/13/2018	10:51	12:11	4.3	NMEA	88.11	EL23302	A	MFC-5-2	0.389	1.92	-	-	-	1.9	0.9975	1.915	80.0	153.20	0.013	0.00	0.0216	• Inlet
6/13/2018	10:51	16:11	4.3	NMEA	88.11	EL23303	B	MFC-5-5	0.384	2.00	MFC-2-2	0.745	1.46	0.5	0.9584	0.535	320.0	171.28	0.008	0.00203	0.0119	• Post engine
6/13/2018	10:51	16:11	4.3	NMEA	88.11	EL23318	C	MFC-5-4	0.400	2.00	MFC-2-3	0.747	1.52	0.5	0.9584	0.475	320.0	152.09	0.008	0.0020	0.013372	• Post catalyst
6/13/2018	10:51	16:11	4.3	NMEA	88.11	EL23319	D	MFC-5-3	0.389	2.00	MFC-2-4	0.706	1.51	0.5	0.9584	0.489	320.0	156.37	0.008	0.0020	0.013006	• Tailpipe

Appendix I

EPA TO-11A Offline Sample Analysis Reports

Appendix I

EPA TO-11A Offline Sample Analysis Reports

Table I.1. EPA TO-11 Sample Number Key

Test	Gasses Tested	Port	Condition	Sample Number	Lab Sample ID	Media Type
3.2	1,3 Butadiene, Formaldehyde, and 2,4 Dimethylpyridine					
		Blank	200%OEL	30L0FHX0	S187019863	Silica Gel SKC-226-119 tube
		Traveler	200%OEL	30L0FHT0	S187019864	Silica Gel SKC-226-119 tube
		A	200%OEL	30L0FHA0	S187019865	Silica Gel SKC-226-119 tube
		B	200%OEL	30L0FHB0	S187019866	Silica Gel SKC-226-119 tube
		C	200%OEL	30L0FHC0	S187019867	Silica Gel SKC-226-119 tube
		D	200%OEL	30L0FHD0	S187019868	Silica Gel SKC-226-119 tube
		Dup A	200%OEL	30L**1**FHA0	S187019869	Silica Gel SKC-226-119 tube

ANALYTICAL REPORT

Report Date: June 22, 2018

Robert (Buddy) Sosa
Washington River Protection So
PO Box 850, MSIN T6-02
Richland, WA 99352

Phone: (509) 373-1262

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Workorder: **34-1815636**
Client Project ID: 20181608 051818
Purchase Order: 55502 Rel15
Project Manager: Rand Potter

Analytical Results

Sample ID: **S187019863** Collected: 05/18/2018
Lab ID: 1815636001 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: Air Volume Not Provided **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	<0.050	NA	NA	0.050
Acetaldehyde	<0.050	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050
Acrolein	<0.050	NA	NA	0.050
Propionaldehyde	<0.050	NA	NA	0.050
Crotonaldehyde	<0.050	NA	NA	0.050
Butyraldehyde	<0.050	NA	NA	0.050
Benzaldehyde	<0.050	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	<0.050	NA	NA	0.050
m,p-Tolualdehyde	<0.050	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

Sample ID: **S187019864** Collected: 05/18/2018
Lab ID: 1815636002 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: Air Volume Not Provided **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	<0.050	NA	NA	0.050
Acetaldehyde	<0.050	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-1815636**
Client Project ID: 20181608 051818
Purchase Order: 55502 Rel15
Project Manager: Rand Potter

Analytical Results

Sample ID: **S187019864** Collected: 05/18/2018
Lab ID: 1815636002 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: **Air Volume Not Provided** **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Acrolein	<0.050	NA	NA	0.050
Propionaldehyde	<0.050	NA	NA	0.050
Crotonaldehyde	<0.050	NA	NA	0.050
Butyraldehyde	<0.050	NA	NA	0.050
Benzaldehyde	<0.050	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	<0.050	NA	NA	0.050
m,p-Tolualdehyde	<0.050	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

Sample ID: **S187019865** Collected: 05/18/2018
Lab ID: 1815636003 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: **Air Volume Not Provided** **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	**0.13**	NA	NA	0.050
Acetaldehyde	**0.067**	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050
Acrolein	<0.050	NA	NA	0.050
Propionaldehyde	<0.050	NA	NA	0.050
Crotonaldehyde	<0.050	NA	NA	0.050
Butyraldehyde	<0.050	NA	NA	0.050
Benzaldehyde	<0.050	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	<0.050	NA	NA	0.050
m,p-Tolualdehyde	<0.050	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

ANALYTICAL REPORT

Workorder: **34-1815636**
Client Project ID: 20181608 051818
Purchase Order: 55502 Rel15
Project Manager: Rand Potter

Analytical Results

Sample ID: **S187019866** Collected: 05/18/2018
Lab ID: 1815636004 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: Air Volume Not Provided **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	**19**	NA	NA	0.050
Acetaldehyde	**5.1**	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050
Acrolein	**0.50**	NA	NA	0.050
Propionaldehyde	**0.78**	NA	NA	0.050
Crotonaldehyde	**1.1**	NA	NA	0.050
Butyraldehyde	**1.0**	NA	NA	0.050
Benzaldehyde	**1.2**	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	**0.53**	NA	NA	0.050
m,p-Tolualdehyde	**0.088**	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

Sample ID: **S187019867** Collected: 05/18/2018
Lab ID: 1815636005 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: Air Volume Not Provided **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	**2.3**	NA	NA	0.050
Acetaldehyde	**0.24**	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050
Acrolein	**0.085**	NA	NA	0.050
Propionaldehyde	<0.050	NA	NA	0.050
Crotonaldehyde	<0.050	NA	NA	0.050
Butyraldehyde	**0.17**	NA	NA	0.050
Benzaldehyde	<0.050	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	<0.050	NA	NA	0.050
m,p-Tolualdehyde	<0.050	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

ANALYTICAL REPORT

Workorder: **34-1815636**
Client Project ID: 20181608 051818
Purchase Order: 55502 Rel15
Project Manager: Rand Potter

Analytical Results

Sample ID: **S187019868** Collected: 05/18/2018
Lab ID: 1815636006 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: Air Volume Not Provided **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	**0.79**	NA	NA	0.050
Acetaldehyde	**0.11**	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050
Acrolein	**0.082**	NA	NA	0.050
Propionaldehyde	<0.050	NA	NA	0.050
Crotonaldehyde	<0.050	NA	NA	0.050
Butyraldehyde	<0.050	NA	NA	0.050
Benzaldehyde	<0.050	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	<0.050	NA	NA	0.050
m,p-Tolualdehyde	<0.050	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

Sample ID: **S187019869** Collected: 05/18/2018
Lab ID: 1815636007 Sampling Location: Nucon Study Received: 06/05/2018

Method: EPA TO-11A **Media:** SKC 226-119, Silica Gel (2,4-Dinitrophenylhydrazine) **Instrument:** HPLC19
Sampling Info: Air Volume Not Provided **Analyzed:** 06/20/2018 (216441)

Analyte	Result (ug/sample)	Result (mg/m³)	Result (ppm)	RL (ug/sample)
Formaldehyde	**0.19**	NA	NA	0.050
Acetaldehyde	**0.070**	NA	NA	0.050
Acetone	<0.050	NA	NA	0.050
Acrolein	<0.050	NA	NA	0.050
Propionaldehyde	<0.050	NA	NA	0.050
Crotonaldehyde	<0.050	NA	NA	0.050
Butyraldehyde	<0.050	NA	NA	0.050
Benzaldehyde	<0.050	NA	NA	0.050
Isovaleraldehyde	<0.050	NA	NA	0.050
Valeraldehyde	<0.050	NA	NA	0.050
m,p-Tolualdehyde	<0.050	NA	NA	0.050
o-Tolualdehyde	<0.050	NA	NA	0.050
Hexanal	<0.10	NA	NA	0.10
2,5-Dimethylbenzaldehyde	<0.10	NA	NA	0.10

ANALYTICAL REPORT

Workorder: **34-1815636**
Client Project ID: 20181608 051818
Purchase Order: 55502 Rel15
Project Manager: Rand Potter

Comments

Quality Control: EPA TO-11A - (HBN: 216441)

EPA TO-11A: LMB was used to blank correct QC and field samples for acetone.

EPA TO-11A: Due to QC spike shortage, a lower volume of spike was used resulting in lower QC results.

EPA TO-11A: Due to low signal for hexanaldehyde and 2, 5 dimethylbenzaldehyde reporting linits were raised to 0.1.

EPA TO-11A: The LCS failed low for acetone, benzaldehyde, isovaleraldehyde, and 2, 5-dimethylbenzaldehyde. The LCSD failed high for acetone and failed low for acrolein, benzaldehyde, isovaleraldehyde, and 2, 5-dimethylbenzaldehyde. NCR 1537 was initiated on 06/22/18 by DLG. No further action was taken.

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
EPA TO-11A	/S/ Daryka Gress 06/21/2018 15:25	/S/ Easton Welcher 06/22/2018 16:42

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: **34-1815636**
Client Project ID: 20181608 051818
Purchase Order: 55502 Rel15
Project Manager: Rand Potter

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L17-288	http://www.pjlabs.com
	PJLA (ISO 17025)	L17-291	http://www.pjlabs.com
	Utah (TNI)	DATA1	http://health.utah.gov/lab/labimp/
	Nevada	UT00009	http://ndep.nv.gov/bsdw/labservice.htm
	Oklahoma	UT00009	http://www.deq.state.ok.us/CSDnew/
	Iowa	IA# 376	http://www.iowadnr.gov/InsideDNR/RegulatoryWater.aspx
	Florida (TNI)	E871067	http://www.dep.state.fl.us/labs/bars/sas/qa/
	Texas (TNI)	T104704456-11-1	http://www.tceq.texas.gov/field/qa/lab_accred_certif.html
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Lead Testing:			
CPSC	PJLA (ISO 17025)	L17-291	http://www.pjlabs.com
Soil, Dust, Paint	AIHA (ISO 17025, AIHA ELLAP and NLLAP)	101574	http://www.aihaaccreditedlabs.org
Dietary Supplements	PJLA (ISO 17025)	L17-291	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< This testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

ALS Envrionmental certifies this analytical report is in compliance with the Hanford SOW, both technically and for completeness. Release of the data contained in this report has been electronically authorized by the following laboratory representative:

Rand Potter, Project Manager, ALS Environmental

Quality Control Sample
Batch Report

Analysis Information

Workorder: 1815636

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA TO-11A
Batch: ILC/19273 (HBN: 216441)
Analyzed By: Daryka Gress

Blank

LMB: 604659
Analyzed: 06/20/2018 15:10
Units: ug/sample

Analyte	Result	MDL	RL
Formaldehyde	ND	NA	0.0500
Acetaldehyde	ND	NA	0.0500
Acetone	1.49	NA	0.0500
Acrolein	ND	NA	0.0500
Propionaldehyde	ND	NA	0.0500
Crotonaldehyde	ND	NA	0.0500
Butyraldehyde	ND	NA	0.0500
Benzaldehyde	ND	NA	0.0500
Isovaleraldehyde	ND	NA	0.0500
Valeraldehyde	ND	NA	0.0500
m,p-Tolualdehyde	ND	NA	0.0500
o-Tolualdehyde	ND	NA	0.0500
Hexanal	ND	NA	0.100
2,5-Dimethylbenzaldehyde	ND	NA	0.100

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 604660
Analyzed: 06/20/2018 15:10
Dilution: 1
Units: ug/sample

LCSD: 604661
Analyzed: 06/20/2018 15:10
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Formaldehyde	0.754	0.750	101	87.8	116.8	0.745	99.3	1.20	0.0	20.0
Acetaldehyde	0.742	0.750	98.9	94.7	110.5	0.714	95.2	3.85	0.0	20.0
Acetone	0.290	0.750 *	38.7	69.2	119.9	1.90 *	253 *	147	0.0	20.0
Acrolein	0.631	0.750	84.1	83.5	120.2	0.572 *	76.3	9.81	0.0	20.0
Propionaldehyde	0.778	0.750	104	92.2	117.2	0.777	104	0.129	0.0	20.0
Crotonaldehyde	0.793	0.750	106	93.1	114.8	0.781	104	1.52	0.0	20.0
Butyraldehyde	0.675	0.750	90.0	86.6	120.8	0.698	93.1	3.35	0.0	20.0
Benzaldehyde	0.699	0.750 *	93.2	96.0	112.3	0.677 *	90.3	3.20	0.0	20.0
Isovaleraldehyde	0.570	0.750 *	76.0	95.4	121.6	0.601 *	80.1	5.29	0.0	20.0
Valeraldehyde	0.690	0.750	92.0	85.3	120.4	0.718	95.7	3.98	0.0	20.0
m,p-Tolualdehyde	0.719	0.750	95.9	80.0	120.0	0.729	97.2	1.38	0.0	20.0
o-Tolualdehyde	0.708	0.750	94.4	91.6	111.4	0.712	94.9	0.563	0.0	20.0
Hexanal	0.730	0.750	97.3	85.4	127.6	0.715	95.3	2.08	0.0	20.0
2,5-Dimethylbenzaldehyde	0.882	0.750	118	99.6	118.7	0.733 *	97.7	18.5	0.0	20.0

Comments

EPA TO-11A: LMB was used to blank correct QC and field samples for acetone.

Quality Control Sample
Batch Report

Analysis Information

Workorder: 1815636

Limits: Historical/Performance	**Preparation:** NA	**Analysis:** EPA TO-11A
Basis: ALS Laboratory Group	**Batch:** NA	**Batch:** ILC/19273 (HBN: 216441)
	Prepared By: NA	**Analyzed By:** Daryka Gress

Comments

EPA TO-11A: Due to QC spike shortage, a lower volume of spike was used resulting in lower QC results.

EPA TO-11A: Due to low signal for hexanaldehyde and 2, 5 dimethylbenzaldehyde reporting linits were raised to 0.1.

EPA TO-11A: The LCS failed low for acetone, benzaldehyde, isovaleraldehyde, and 2, 5-dimethylbenzaldehyde. The LCSD failed high for acetone and failed low for acrolein, benzaldehyde, isovaleraldehyde, and 2, 5-dimethylbenzaldehyde. NCR 1537 was initiated on 06/22/18 by DLG. No further action was taken.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Daryka Gress	/S/ Easton Welcher
06/21/2018 15:25	06/22/2018 16:42

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ◆ - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

1815636

1815636

Assembler
N/A

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. No. 20181608
Page 1 of 1

Collector: ZACHER	Contact/Requestor: CARL HOWALD IV	Telephone No. 373-6861	MSIN T6-05 FAX 372-1878
SAF No.: N/A	Sample Origin: NUCON STUDY	Purchase Order/Charge Code: 203213	
Project Title: NUCON	Logbook/ Work Package No.: N/A	Ice Chest No.: WTS-009	Temp.: ON ICE
Shipped To (Lab): ALS	Method of Shipment	Bill of Lading/Air Bill No.: 772385402190/44105	
Protocol: N/A	Data Turnaround: 10 DAYS	Parts and Return No.: 44105	

Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis	Preservative
1	S187019863	VA	05/18/18	17:27	SILICA GEL	Aldehyde 3OL0FHX0	25C or low
2	S187019864	VA	05/18/18	17:27	SILICA GEL	Aldehyde 3OL0FHT0	25C or low
3	S187019865	VA	05/18/18	17:27	SILICA GEL	Aldehyde 3OL0FHA0	25C or low
4	S187019866	VA	05/18/18	18:14	SILICA GEL	Aldehyde 3OL0FHB0	25C or low
5	S187019867	VA	05/18/18	18:14	SILICA GEL	Aldehyde 3OL0FHC0	25C or low
6	S187019868	VA	05/18/18	18:14	SILICA GEL	Aldehyde 3OL0FHD0	25C or low
7	S187019869	VA	05/18/18	17:50	SILICA GEL	Aldehyde 3OL1FHA0	25C or low

POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS ○ Yes ◉ No

SPECIAL INSTRUCTIONS — Hold Time

Send Results to Carl Howald IV & Keisha Garcia
Carl_W_Howald@rl.gov and Keisha_R_Garcia@rl.gov see SOW for email

CONTRACT 55502
RELEASE 15

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
Sharon L Wolbr	6.4.18 0840	JA Gradiona	6/4/18 0840
JA Gradiona	6/4/18 1400	FEDEX	
Fedex		Dsweethill	06/05/18 10:20

Matrix*

S = Soil		DL = Drum Liquids	
SE = Sediment		T = Tissue	
SO = Solid		WI = Wipe	
SL = Sludge		L = Liquid	
W = Water		V = Vegetation	
O = Oil		VA = Vapor	
A = Air		X = Other	
DS = Drum Solids			

FINAL SAMPLE DISPOSITION — Disposal Method (e.g., Return to customer, per lab procedure, used in process): Returned to Sender — Disposed By: Samples consumed — Date/Time: 6/11/18 1510

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6003-962 (03/05)

Appendix J

EPA TO-15 Offline Sample Analysis Reports

Appendix J

EPA TO-15 Offline Sample Analysis Reports

Table J.1. EPA TO-11 Sample Number Key

Test	Gasses Tested	Port	Condition	Sample Number	Media Type
0.2A	Ambient Inlet Air	from port A	Bench Testing	AB0CNU	SUMMA
	Diesel Baselines	A	Bench Testing	DB0CNA	SUMMA
		B	Bench Testing	DB0CNB	SUMMA
		C	Bench Testing	DB0CNC	SUMMA
		D	Bench Testing	DB0CND	SUMMA
1.2	Acetonitrile & Acetaldehyde	A	200%OEL	10L0CNA0	SUMMA
		B	200%OEL	10L0CNB0	SUMMA
		C	200%OEL	10L0CNC0	SUMMA
		D	200%OEL	10L0CND0	SUMMA
		Dup A	200%OEL	10L**1**CNA0	SUMMA
		Dup D	200%OEL	10L**1**CND0	SUMMA
2.2	Benzene & Propanenitrile	A	200%OEL	20L0CNA0	SUMMA
		B	200%OEL	20L0CNB0	SUMMA
		C	200%OEL	20L0CNC0	SUMMA
		D	200%OEL	20L0CND0	SUMMA
3.2	1,3 Butadiene, Formaldehyde, and 2,4 Dimethylpyridine	A	200%OEL	30L0CNA0	SUMMA - 3.2
		B	200%OEL	30L0CNB0	SUMMA - 3.2
		C	200%OEL	30L0CNC0	SUMMA - 3.2
		D	200%OEL	30L0CND0	SUMMA - 3.2
		Field Dup C	200%OEL	30L**1**CNC0	SUMMA - 3.2
		rerun A	200%OEL	30L2CNA0	SUMMA - background (RJLee)
		rerun B	200%OEL	30L2CNB0	SUMMA - background (RJLee)
		rerun C	200%OEL	30L2CNC0	SUMMA - background (RJLee)
		rerun D	200%OEL	30L2CNDO	SUMMA - background (RJLee)
		second rerun A	200%OEL	30L3CNA0	SUMMA - background (RJLee)
4.2/5.2	FURAN & NDMA	A	200%OEL	50L0CNA0	SUMMA
		B	200%OEL	50L0CNB0	SUMMA
		C	200%OEL	50L0CNC0	SUMMA
		D	200%OEL	50L0CND0	SUMMA
		Dup C	200%OEL	50L**1**CNC0	SUMMA
4.3/5.3	FURAN & NDMA	A	Max Concentration	5MX0CNA0	SUMMA
		B	Max Concentration	5MX0CNB0	SUMMA
		C	Max Concentration	5MX0CNC0	SUMMA
		D	Max Concentration	5MX0CND0	SUMMA
6.2	Ammonia & Nitrous Oxide	A	200%OEL	60L0CNA	SUMMA
		B	200%OEL	60L0CNB	SUMMA
		C	200%OEL	60L0CNC	SUMMA
		D	200%OEL	60L0CND	SUMMA
		Dup D	200%OEL	60L**1**CND	SUMMA
6.3	Ammonia & Nitrous Oxide	A	Max Concentration	6MX0CNA0	SUMMA
		B	Max Concentration	6MX0CNB0	SUMMA
		C	Max Concentration	6MX0CNC0	SUMMA
		D	Max Concentration	6MX0CND0	SUMMA

18-oct-2018 16:16:20
NUCON
Data Summary of All
Customer Group or SDG

Customer Sample ID	SAMPLE_R	CAS #	ANALYTE	RESULT_UNIT	STANDARD	BLANK	RESULT	Det Limit	QUALIFIER	SAMPLE_GROUP
ABOCNU	S18T017533	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	<10	3.9		20181360
ABOCNU	S18T017533	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181360
ABOCNU	S18T017533	110-00-9	Furan	PPBV	80.6	<0.100	<0.100	0.0100		20181360
ABOCNU	S18T017533	107-12-0	Propanenitrile	PPBV	83.5	<0.100	<0.100	0.0100		20181360
ABOCNU	S18T017533	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	115	<5.25	<10.5	0.360		20181360
ABOCNU	S18T017533	79-00-5	1,1,2-Trichloroethane	PPBV	120	<5.30	<10.6	0.360		20181360
ABOCNU	S18T017533	75-34-3	1,1-Dichloroethane	PPBV	89.6	<5.25	<10.5	0.300		20181360
ABOCNU	S18T017533	75-35-4	1,1-Dichloroethene	PPBV	88.6	<5.40	<10.8	0.400		20181360
ABOCNU	S18T017533	107-06-2	1,2-Dichloroethane	PPBV	92.2	<5.20	<10.4	0.260		20181360
ABOCNU	S18T017533	106-99-0	1,3-Butadiene	PPBV	122	<5.25	<10.5	0.540		20181360
ABOCNU	S18T017533	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181360
ABOCNU	S18T017533	106-46-7	1,4-Dichlorobenzene	PPBV	98.6	<5.20	<10.4	0.840		20181360
ABOCNU	S18T017533	123-91-1	1,4-Dioxane	PPBV	105	<5.35	<10.7	0.300		20181360
ABOCNU	S18T017533	71-36-3	1-Butanol	PPBV	95.1	<5.85	<11.7	0.340		20181360
ABOCNU	S18T017533	71-23-8	1-Propanol	PPBV	118	<5.80	<11.6	0.320		20181360
ABOCNU	S18T017533	78-93-3	2-Butanone	PPBV	110	<5.40	<10.8	0.380		20181360
ABOCNU	S18T017533	110-43-0	2-Heptanone	PPBV	107	<5.10	<10.2	1.40		20181360
ABOCNU	S18T017533	591-78-6	2-Hexanone	PPBV	130	<5.40	<10.8	0.460		20181360
ABOCNU	S18T017533	78-94-4	3-Buten-2-one	PPBV	86.5	<5.75	<11.5	0.280		20181360
ABOCNU	S18T017533	106-35-4	3-Heptanone	PPBV	101	<5.30	<10.6	0.380		20181360
ABOCNU	S18T017533	108-10-1	4-Methyl-2-Pentanone	PPBV	130	<5.35	<10.7	0.480		20181360
ABOCNU	S18T017533	75-07-0	Acetaldehyde	PPBV	117	<5.90	<11.8	0.700		20181360
ABOCNU	S18T017533	67-64-1	Acetone	PPBV	85.0	<5.70	200	0.320		20181360
ABOCNU	S18T017533	75-05-8	Acetonitrile	PPBV	111	<5.75	<11.5	1.88		20181360
ABOCNU	S18T017533	107-02-8	Acrolein	PPBV	80.5	<5.65	<11.3	0.460		20181360
ABOCNU	S18T017533	107-13-1	Acrylonitrile	PPBV	87.1	<5.80	<11.6	0.500		20181360
ABOCNU	S18T017533	107-05-1	Allyl Chloride	PPBV	85.4	<5.50	<11.0	0.340		20181360
ABOCNU	S18T017533	71-43-2	Benzene	PPBV	90.8	<5.25	<10.5	0.420		20181360
ABOCNU	S18T017533	123-72-8	Butanal	PPBV	114	<5.90	<11.8	0.300		20181360
ABOCNU	S18T017533	56-23-5	Carbon tetrachloride	PPBV	102	<5.15	<10.3	0.400		20181360
ABOCNU	S18T017533	108-90-7	Chlorobenzene	PPBV	114	<5.35	<10.7	0.540		20181360
ABOCNU	S18T017533	75-00-3	Chloroethane	PPBV	89.4	<5.10	<10.2	0.760		20181360
ABOCNU	S18T017533	67-66-3	Chloroform	PPBV	100	<5.10	<10.2	0.260		20181360
ABOCNU	S18T017533	110-82-7	Cyclohexane	PPBV	88.3	<5.20	<10.4	0.260		20181360
ABOCNU	S18T017533	124-18-5	Decane	PPBV	102	<5.25	<10.5	0.420		20181360
ABOCNU	S18T017533	64-17-5	Ethanol	PPBV	117	<5.85	<11.7	0.560		20181360
ABOCNU	S18T017533	141-78-6	Ethyl acetate	PPBV	107	<5.35	<10.7	0.740		20181360
ABOCNU	S18T017533	100-41-4	Ethylbenzene	PPBV	113	<5.25	<10.5	0.440		20181360
ABOCNU	S18T017533	110-54-3	Hexane	PPBV	88.4	<5.30	<10.6	0.300		20181360
ABOCNU	S18T017533	67-56-1	Methanol	PPBV	148	<5.90	13.9	0.900	a	20181360
ABOCNU	S18T017533	75-09-2	Methylene Chloride	PPBV	117	<5.30	<10.6	0.280		20181360
ABOCNU	S18T017533	100-42-5	Styrene	PPBV	113	<5.10	<10.2	0.400		20181360
ABOCNU	S18T017533	127-18-4	Tetrachloroethene	PPBV	98.4	<5.20	<10.4	0.480		20181360
ABOCNU	S18T017533	109-99-9	Tetrahydrofuran	PPBV	90.1	<5.35	<10.7	0.360		20181360
ABOCNU	S18T017533	108-88-3	Toluene	PPBV	108	<5.30	<10.6	0.460		20181360
ABOCNU	S18T017533	79-01-6	Trichloroethene	PPBV	109	<5.15	<10.3	0.420		20181360
ABOCNU	S18T017533	75-69-4	Trichlorofluoromethane	PPBV	102	<5.20	<10.4	0.500		20181360
ABOCNU	S18T017533	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.6	<4.90	<9.80	0.380		20181360
ABOCNU	S18T017533	123-86-4	n-Butyl acetate	PPBV	97.3	<5.40	<10.8	0.460		20181360
ABOCNU	S18T017533	142-82-5	n-Heptane	PPBV	93.7	<5.25	<10.5	0.300		20181360
ABOCNU	S18T017533	10061-02-6	trans-1,3-Dichloropropene	PPBV	92.7	<4.70	<9.40	0.360		20181360
DBOCNA	S18T017534	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	<10	3.9		20181360
DBOCNA	S18T017534	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181360
DBOCNA	S18T017534	110-00-9	Furan	PPBV	80.6	<0.100	<0.100	0.0100		20181360
DBOCNA	S18T017534	107-12-0	Propanenitrile	PPBV	83.5	<0.100	<0.100	0.0100		20181360
DBOCNA	S18T017534	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	115	<5.25	<10.5	0.360		20181360
DBOCNA	S18T017534	79-00-5	1,1,2-Trichloroethane	PPBV	120	<5.30	<10.6	0.360		20181360
DBOCNA	S18T017534	75-34-3	1,1-Dichloroethane	PPBV	89.6	<5.25	<10.5	0.300		20181360
DBOCNA	S18T017534	75-35-4	1,1-Dichloroethene	PPBV	88.6	<5.40	<10.8	0.400		20181360
DBOCNA	S18T017534	107-06-2	1,2-Dichloroethane	PPBV	92.2	<5.20	<10.4	0.260		20181360
DBOCNA	S18T017534	106-99-0	1,3-Butadiene	PPBV	122	<5.25	<10.5	0.540		20181360
DBOCNA	S18T017534	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181360
DBOCNA	S18T017534	106-46-7	1,4-Dichlorobenzene	PPBV	98.6	<5.20	<10.4	0.840		20181360
DBOCNA	S18T017534	123-91-1	1,4-Dioxane	PPBV	105	<5.35	<10.7	0.300		20181360
DBOCNA	S18T017534	71-36-3	1-Butanol	PPBV	95.1	<5.85	<11.7	0.340		20181360
DBOCNA	S18T017534	71-23-8	1-Propanol	PPBV	118	<5.80	<11.6	0.320		20181360
DBOCNA	S18T017534	78-93-3	2-Butanone	PPBV	110	<5.40	<10.8	0.380		20181360
DBOCNA	S18T017534	110-43-0	2-Heptanone	PPBV	107	<5.10	<10.2	1.40		20181360
DBOCNA	S18T017534	591-78-6	2-Hexanone	PPBV	130	<5.40	<10.8	0.460		20181360

DB0CNA	S18T017534	78-94-4	3-Buten-2-one	PPBV	86.5	<5.75	<11.5	0.280		20181360
DB0CNA	S18T017534	106-35-4	3-Heptanone	PPBV	101	<5.30	<10.6	0.380		20181360
DB0CNA	S18T017534	108-10-1	4-Methyl-2-Pentanone	PPBV	130	<5.35	<10.7	0.480		20181360
DB0CNA	S18T017534	75-07-0	Acetaldehyde	PPBV	117	<5.90	<11.8	0.700		20181360
DB0CNA	S18T017534	67-64-1	Acetone	PPBV	86.1	<5.70	1.16E+03	6.40		20181360
DB0CNA	S18T017534	75-05-8	Acetonitrile	PPBV	111	<5.75	<11.5	1.88		20181360
DB0CNA	S18T017534	107-02-8	Acrolein	PPBV	80.5	<5.65	<11.3	0.460		20181360
DB0CNA	S18T017534	107-13-1	Acrylonitrile	PPBV	87.1	<5.80	<11.6	0.500		20181360
DB0CNA	S18T017534	107-05-1	Allyl Chloride	PPBV	85.4	<5.50	<11.0	0.340		20181360
DB0CNA	S18T017534	71-43-2	Benzene	PPBV	90.8	<5.25	<10.5	0.420		20181360
DB0CNA	S18T017534	123-72-8	Butanal	PPBV	114	<5.90	<11.8	0.300		20181360
DB0CNA	S18T017534	56-23-5	Carbon tetrachloride	PPBV	102	<5.15	<10.3	0.400		20181360
DB0CNA	S18T017534	108-90-7	Chlorobenzene	PPBV	114	<5.35	<10.7	0.540		20181360
DB0CNA	S18T017534	75-00-3	Chloroethane	PPBV	89.4	<5.10	<10.2	0.760		20181360
DB0CNA	S18T017534	67-66-3	Chloroform	PPBV	100	<5.10	<10.2	0.260		20181360
DB0CNA	S18T017534	110-82-7	Cyclohexane	PPBV	88.3	<5.20	<10.4	0.260		20181360
DB0CNA	S18T017534	124-18-5	Decane	PPBV	102	<5.25	<10.5	0.420		20181360
DB0CNA	S18T017534	64-17-5	Ethanol	PPBV	117	<5.85	<11.7	0.560		20181360
DB0CNA	S18T017534	141-78-6	Ethyl acetate	PPBV	107	<5.35	<10.7	0.740		20181360
DB0CNA	S18T017534	100-41-4	Ethylbenzene	PPBV	113	<5.25	<10.5	0.440		20181360
DB0CNA	S18T017534	110-54-3	Hexane	PPBV	88.4	<5.30	<10.6	0.300		20181360
DB0CNA	S18T017534	67-56-1	Methanol	PPBV	148	<5.90	129	0.900	a	20181360
DB0CNA	S18T017534	75-09-2	Methylene Chloride	PPBV	117	<5.30	<10.6	0.280		20181360
DB0CNA	S18T017534	100-42-5	Styrene	PPBV	113	<5.10	<10.2	0.400		20181360
DB0CNA	S18T017534	127-18-4	Tetrachloroethene	PPBV	98.4	<5.20	<10.4	0.480		20181360
DB0CNA	S18T017534	109-99-9	Tetrahydrofuran	PPBV	90.1	<5.35	<10.7	0.360		20181360
DB0CNA	S18T017534	108-88-3	Toluene	PPBV	108	<5.30	<10.6	0.460		20181360
DB0CNA	S18T017534	79-01-6	Trichloroethene	PPBV	109	<5.15	<10.3	0.420		20181360
DB0CNA	S18T017534	75-69-4	Trichlorofluoromethane	PPBV	102	<5.20	<10.4	0.500		20181360
DB0CNA	S18T017534	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.6	<4.90	<9.80	0.380		20181360
DB0CNA	S18T017534	123-86-4	n-Butyl acetate	PPBV	97.3	<5.40	<10.8	0.460		20181360
DB0CNA	S18T017534	142-82-5	n-Heptane	PPBV	93.7	<5.25	<10.5	0.300		20181360
DB0CNA	S18T017534	10061-02-6	trans-1,3-Dichloropropene	PPBV	92.7	<4.70	<9.40	0.360		20181360
DB0CNB	S18T017535	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	<10	3.9		20181360
DB0CNB	S18T017535	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<100	n/a	Y	20181360
DB0CNB	S18T017535	110-00-9	Furan	PPBV	76.3	<0.100	17.8	0.0200		20181360
DB0CNB	S18T017535	107-12-0	Propanenitrile	PPBV	79.8	<0.100	2.20	0.0200		20181360
DB0CNB	S18T017535	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	115	<5.25	<10.5	0.360		20181360
DB0CNB	S18T017535	79-00-5	1,1,2-Trichloroethane	PPBV	120	<5.30	<10.6	0.360		20181360
DB0CNB	S18T017535	75-34-3	1,1-Dichloroethane	PPBV	89.6	<5.25	<10.5	0.300		20181360
DB0CNB	S18T017535	75-35-4	1,1-Dichloroethene	PPBV	88.6	<5.40	<10.8	0.400		20181360
DB0CNB	S18T017535	107-06-2	1,2-Dichloroethane	PPBV	92.2	<5.20	<10.4	0.260		20181360
DB0CNB	S18T017535	106-99-0	1,3-Butadiene	PPBV	122	<5.25	<10.5	0.540		20181360
DB0CNB	S18T017535	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181360
DB0CNB	S18T017535	106-46-7	1,4-Dichlorobenzene	PPBV	98.6	<5.20	<10.4	0.840		20181360
DB0CNB	S18T017535	123-91-1	1,4-Dioxane	PPBV	105	<5.35	<10.7	0.300		20181360
DB0CNB	S18T017535	71-36-3	1-Butanol	PPBV	95.1	<5.85	<11.7	0.340		20181360
DB0CNB	S18T017535	71-23-8	1-Propanol	PPBV	118	<5.80	<11.6	0.320		20181360
DB0CNB	S18T017535	78-93-3	2-Butanone	PPBV	110	<5.40	42.3	0.380		20181360
DB0CNB	S18T017535	110-43-0	2-Heptanone	PPBV	107	<5.10	<10.2	1.40		20181360
DB0CNB	S18T017535	591-78-6	2-Hexanone	PPBV	130	<5.40	12.0	0.460		20181360
DB0CNB	S18T017535	78-94-4	3-Buten-2-one	PPBV	86.5	<5.75	74.6	0.280		20181360
DB0CNB	S18T017535	106-35-4	3-Heptanone	PPBV	101	<5.30	<10.6	0.380		20181360
DB0CNB	S18T017535	108-10-1	4-Methyl-2-Pentanone	PPBV	130	<5.35	<10.7	0.480		20181360
DB0CNB	S18T017535	75-07-0	Acetaldehyde	PPBV	117	<5.90	1.44E+03	14.0		20181360
DB0CNB	S18T017535	67-64-1	Acetone	PPBV	85.0	<5.70	181	0.320		20181360
DB0CNB	S18T017535	75-05-8	Acetonitrile	PPBV	111	<5.75	12.9	1.88		20181360
DB0CNB	S18T017535	107-02-8	Acrolein	PPBV	80.5	<5.65	281	1.84		20181360
DB0CNB	S18T017535	107-13-1	Acrylonitrile	PPBV	87.1	<5.80	<11.6	0.500		20181360
DB0CNB	S18T017535	107-05-1	Allyl Chloride	PPBV	85.4	<5.50	<11.0	0.340		20181360
DB0CNB	S18T017535	71-43-2	Benzene	PPBV	90.8	<5.25	147	0.420		20181360
DB0CNB	S18T017535	123-72-8	Butanal	PPBV	114	<5.90	47.6	0.300		20181360
DB0CNB	S18T017535	56-23-5	Carbon tetrachloride	PPBV	102	<5.15	<10.3	0.400		20181360
DB0CNB	S18T017535	108-90-7	Chlorobenzene	PPBV	114	<5.35	<10.7	0.540		20181360
DB0CNB	S18T017535	75-00-3	Chloroethane	PPBV	89.4	<5.10	<10.2	0.760		20181360
DB0CNB	S18T017535	67-66-3	Chloroform	PPBV	100	<5.10	<10.2	0.260		20181360
DB0CNB	S18T017535	110-82-7	Cyclohexane	PPBV	88.3	<5.20	<10.4	0.260		20181360
DB0CNB	S18T017535	124-18-5	Decane	PPBV	102	<5.25	30.2	0.420		20181360
DB0CNB	S18T017535	64-17-5	Ethanol	PPBV	117	<5.85	<11.7	0.560		20181360
DB0CNB	S18T017535	141-78-6	Ethyl acetate	PPBV	107	<5.35	<10.7	0.740		20181360
DB0CNB	S18T017535	100-41-4	Ethylbenzene	PPBV	113	<5.25	10.9	0.440		20181360
DB0CNB	S18T017535	110-54-3	Hexane	PPBV	88.4	<5.30	<10.6	0.300		20181360
DB0CNB	S18T017535	67-56-1	Methanol	PPBV	148	<5.90	<11.8	0.900	a	20181360
DB0CNB	S18T017535	75-09-2	Methylene Chloride	PPBV	117	<5.30	<10.6	0.280		20181360
DB0CNB	S18T017535	100-42-5	Styrene	PPBV	113	<5.10	<10.2	0.400		20181360
DB0CNB	S18T017535	127-18-4	Tetrachloroethene	PPBV	98.4	<5.20	<10.4	0.480		20181360

DB0CNB	S18T017535	109-99-9	Tetrahydrofuran	PPBV	90.1	<5.35	<10.7	0.360		20181360
DB0CNB	S18T017535	108-88-3	Toluene	PPBV	108	<5.30	54.7	0.460		20181360
DB0CNB	S18T017535	79-01-6	Trichloroethene	PPBV	109	<5.15	<10.3	0.420		20181360
DB0CNB	S18T017535	75-69-4	Trichlorofluoromethane	PPBV	102	<5.20	<10.4	0.500		20181360
DB0CNB	S18T017535	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.6	<4.90	<9.80	0.380		20181360
DB0CNB	S18T017535	123-86-4	n-Butyl acetate	PPBV	97.3	<5.40	<10.8	0.460		20181360
DB0CNB	S18T017535	142-82-5	n-Heptane	PPBV	93.7	<5.25	<10.5	0.300		20181360
DB0CNB	S18T017535	10061-02-6	trans-1,3-Dichloropropene	PPBV	92.7	<4.70	<9.40	0.360		20181360
DB0CNC	S18T017536	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	<10	3.9		20181360
DB0CNC	S18T017536	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<100	n/a	Y	20181360
DB0CNC	S18T017536	110-00-9	Furan	PPBV	76.3	<0.100	2.94	0.0200		20181360
DB0CNC	S18T017536	107-12-0	Propanenitrile	PPBV	79.8	<0.100	1.34	0.0200		20181360
DB0CNC	S18T017536	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	115	<5.25	<10.5	0.360		20181360
DB0CNC	S18T017536	79-00-5	1,1,2-Trichloroethane	PPBV	120	<5.30	<10.6	0.360		20181360
DB0CNC	S18T017536	75-34-3	1,1-Dichloroethane	PPBV	89.6	<5.25	<10.5	0.300		20181360
DB0CNC	S18T017536	75-35-4	1,1-Dichloroethene	PPBV	88.6	<5.40	<10.8	0.400		20181360
DB0CNC	S18T017536	107-06-2	1,2-Dichloroethane	PPBV	92.2	<5.20	<10.4	0.260		20181360
DB0CNC	S18T017536	106-99-0	1,3-Butadiene	PPBV	122	<5.25	<10.5	0.540		20181360
DB0CNC	S18T017536	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181360
DB0CNC	S18T017536	106-46-7	1,4-Dichlorobenzene	PPBV	98.6	<5.20	<10.4	0.840		20181360
DB0CNC	S18T017536	123-91-1	1,4-Dioxane	PPBV	105	<5.35	<10.7	0.300		20181360
DB0CNC	S18T017536	71-36-3	1-Butanol	PPBV	95.1	<5.85	19.9	0.340		20181360
DB0CNC	S18T017536	71-23-8	1-Propanol	PPBV	118	<5.80	<11.6	0.320		20181360
DB0CNC	S18T017536	78-93-3	2-Butanone	PPBV	110	<5.40	<10.8	0.380		20181360
DB0CNC	S18T017536	110-43-0	2-Heptanone	PPBV	107	<5.10	<10.2	1.40		20181360
DB0CNC	S18T017536	591-78-6	2-Hexanone	PPBV	130	<5.40	<10.8	0.460		20181360
DB0CNC	S18T017536	78-94-4	3-Buten-2-one	PPBV	86.5	<5.75	<11.5	0.280		20181360
DB0CNC	S18T017536	106-35-4	3-Heptanone	PPBV	101	<5.30	<10.6	0.380		20181360
DB0CNC	S18T017536	108-10-1	4-Methyl-2-Pentanone	PPBV	130	<5.35	<10.7	0.480		20181360
DB0CNC	S18T017536	75-07-0	Acetaldehyde	PPBV	117	<5.90	324	2.80		20181360
DB0CNC	S18T017536	67-64-1	Acetone	PPBV	86.1	<5.70	2.12E+03	6.40		20181360
DB0CNC	S18T017536	75-05-8	Acetonitrile	PPBV	111	<5.75	<11.5	1.88		20181360
DB0CNC	S18T017536	107-02-8	Acrolein	PPBV	80.5	<5.65	19.7	0.460		20181360
DB0CNC	S18T017536	107-13-1	Acrylonitrile	PPBV	87.1	<5.80	<11.6	0.500		20181360
DB0CNC	S18T017536	107-05-1	Allyl Chloride	PPBV	85.4	<5.50	<11.0	0.340		20181360
DB0CNC	S18T017536	71-43-2	Benzene	PPBV	90.8	<5.25	<10.5	0.420		20181360
DB0CNC	S18T017536	123-72-8	Butanal	PPBV	114	<5.90	15.9	0.300		20181360
DB0CNC	S18T017536	56-23-5	Carbon tetrachloride	PPBV	102	<5.15	<10.3	0.400		20181360
DB0CNC	S18T017536	108-90-7	Chlorobenzene	PPBV	114	<5.35	<10.7	0.540		20181360
DB0CNC	S18T017536	75-00-3	Chloroethane	PPBV	89.4	<5.10	<10.2	0.760		20181360
DB0CNC	S18T017536	67-66-3	Chloroform	PPBV	100	<5.10	<10.2	0.260		20181360
DB0CNC	S18T017536	110-82-7	Cyclohexane	PPBV	88.3	<5.20	<10.4	0.260		20181360
DB0CNC	S18T017536	124-18-5	Decane	PPBV	102	<5.25	<10.5	0.420		20181360
DB0CNC	S18T017536	64-17-5	Ethanol	PPBV	117	<5.85	<11.7	0.560		20181360
DB0CNC	S18T017536	141-78-6	Ethyl acetate	PPBV	107	<5.35	<10.7	0.740		20181360
DB0CNC	S18T017536	100-41-4	Ethylbenzene	PPBV	113	<5.25	<10.5	0.440		20181360
DB0CNC	S18T017536	110-54-3	Hexane	PPBV	88.4	<5.30	<10.6	0.300		20181360
DB0CNC	S18T017536	67-56-1	Methanol	PPBV	148	<5.90	<11.8	0.900	a	20181360
DB0CNC	S18T017536	75-09-2	Methylene Chloride	PPBV	117	<5.30	<10.6	0.280		20181360
DB0CNC	S18T017536	100-42-5	Styrene	PPBV	113	<5.10	<10.2	0.400		20181360
DB0CNC	S18T017536	127-18-4	Tetrachloroethene	PPBV	98.4	<5.20	<10.4	0.480		20181360
DB0CNC	S18T017536	109-99-9	Tetrahydrofuran	PPBV	90.1	<5.35	<10.7	0.360		20181360
DB0CNC	S18T017536	108-88-3	Toluene	PPBV	108	<5.30	<10.6	0.460		20181360
DB0CNC	S18T017536	79-01-6	Trichloroethene	PPBV	109	<5.15	<10.3	0.420		20181360
DB0CNC	S18T017536	75-69-4	Trichlorofluoromethane	PPBV	102	<5.20	<10.4	0.500		20181360
DB0CNC	S18T017536	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.6	<4.90	<9.80	0.380		20181360
DB0CNC	S18T017536	123-86-4	n-Butyl acetate	PPBV	97.3	<5.40	<10.8	0.460		20181360
DB0CNC	S18T017536	142-82-5	n-Heptane	PPBV	93.7	<5.25	<10.5	0.300		20181360
DB0CNC	S18T017536	10061-02-6	trans-1,3-Dichloropropene	PPBV	92.7	<4.70	<9.40	0.360		20181360
DB0CND	S18T017537	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	<10	3.9		20181360
DB0CND	S18T017537	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181360
DB0CND	S18T017537	110-00-9	Furan	PPBV	80.6	<0.100	<0.100	0.0100		20181360
DB0CND	S18T017537	107-12-0	Propanenitrile	PPBV	83.5	<0.100	0.180	0.0100		20181360
DB0CND	S18T017537	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	115	<5.25	<10.5	0.360		20181360
DB0CND	S18T017537	79-00-5	1,1,2-Trichloroethane	PPBV	120	<5.30	<10.6	0.360		20181360
DB0CND	S18T017537	75-34-3	1,1-Dichloroethane	PPBV	89.6	<5.25	<10.5	0.300		20181360
DB0CND	S18T017537	75-35-4	1,1-Dichloroethene	PPBV	88.6	<5.40	<10.8	0.400		20181360
DB0CND	S18T017537	107-06-2	1,2-Dichloroethane	PPBV	92.2	<5.20	<10.4	0.260		20181360
DB0CND	S18T017537	106-99-0	1,3-Butadiene	PPBV	122	<5.25	<10.5	0.540		20181360
DB0CND	S18T017537	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181360
DB0CND	S18T017537	106-46-7	1,4-Dichlorobenzene	PPBV	98.6	<5.20	<10.4	0.840		20181360
DB0CND	S18T017537	123-91-1	1,4-Dioxane	PPBV	105	<5.35	<10.7	0.300		20181360
DB0CND	S18T017537	71-36-3	1-Butanol	PPBV	95.1	<5.85	<11.7	0.340		20181360
DB0CND	S18T017537	71-23-8	1-Propanol	PPBV	118	<5.80	<11.6	0.320		20181360
DB0CND	S18T017537	78-93-3	2-Butanone	PPBV	110	<5.40	<10.8	0.380		20181360
DB0CND	S18T017537	110-43-0	2-Heptanone	PPBV	107	<5.10	<10.2	1.40		20181360

DB0CND	S18T017537	591-78-6	2-Hexanone	PPBV	130	<5.40	<10.8	0.460		20181360
DB0CND	S18T017537	78-94-4	3-Buten-2-one	PPBV	86.5	<5.75	<11.5	0.280		20181360
DB0CND	S18T017537	106-35-4	3-Heptanone	PPBV	101	<5.30	<10.6	0.380		20181360
DB0CND	S18T017537	108-10-1	4-Methyl-2-Pentanone	PPBV	130	<5.35	<10.7	0.480		20181360
DB0CND	S18T017537	75-07-0	Acetaldehyde	PPBV	117	<5.90	24.4	0.700		20181360
DB0CND	S18T017537	67-64-1	Acetone	PPBV	85.0	<5.70	<11.4	0.320		20181360
DB0CND	S18T017537	75-05-8	Acetonitrile	PPBV	111	<5.75	<11.5	1.88		20181360
DB0CND	S18T017537	107-02-8	Acrolein	PPBV	80.5	<5.65	<11.3	0.460		20181360
DB0CND	S18T017537	107-13-1	Acrylonitrile	PPBV	87.1	<5.80	<11.6	0.500		20181360
DB0CND	S18T017537	107-05-1	Allyl Chloride	PPBV	85.4	<5.50	<11.0	0.340		20181360
DB0CND	S18T017537	71-43-2	Benzene	PPBV	90.8	<5.25	<10.5	0.420		20181360
DB0CND	S18T017537	123-72-8	Butanal	PPBV	114	<5.90	<11.8	0.300		20181360
DB0CND	S18T017537	56-23-5	Carbon tetrachloride	PPBV	102	<5.15	<10.3	0.400		20181360
DB0CND	S18T017537	108-90-7	Chlorobenzene	PPBV	114	<5.35	<10.7	0.540		20181360
DB0CND	S18T017537	75-00-3	Chloroethane	PPBV	89.4	<5.10	<10.2	0.760		20181360
DB0CND	S18T017537	67-66-3	Chloroform	PPBV	100	<5.10	<10.2	0.260		20181360
DB0CND	S18T017537	110-82-7	Cyclohexane	PPBV	88.3	<5.20	<10.4	0.260		20181360
DB0CND	S18T017537	124-18-5	Decane	PPBV	102	<5.25	<10.5	0.420		20181360
DB0CND	S18T017537	64-17-5	Ethanol	PPBV	117	<5.85	<11.7	0.560		20181360
DB0CND	S18T017537	141-78-6	Ethyl acetate	PPBV	107	<5.35	<10.7	0.740		20181360
DB0CND	S18T017537	100-41-4	Ethylbenzene	PPBV	113	<5.25	<10.5	0.440		20181360
DB0CND	S18T017537	110-54-3	Hexane	PPBV	88.4	<5.30	<10.6	0.300		20181360
DB0CND	S18T017537	67-56-1	Methanol	PPBV	148	<5.90	<11.8	0.900	a	20181360
DB0CND	S18T017537	75-09-2	Methylene Chloride	PPBV	117	<5.30	<10.6	0.280		20181360
DB0CND	S18T017537	100-42-5	Styrene	PPBV	113	<5.10	<10.2	0.400		20181360
DB0CND	S18T017537	127-18-4	Tetrachloroethene	PPBV	98.4	<5.20	<10.4	0.480		20181360
DB0CND	S18T017537	109-99-9	Tetrahydrofuran	PPBV	90.1	<5.35	<10.7	0.360		20181360
DB0CND	S18T017537	108-88-3	Toluene	PPBV	108	<5.30	<10.6	0.460		20181360
DB0CND	S18T017537	79-01-6	Trichloroethene	PPBV	109	<5.15	<10.3	0.420		20181360
DB0CND	S18T017537	75-69-4	Trichlorofluoromethane	PPBV	102	<5.20	<10.4	0.500		20181360
DB0CND	S18T017537	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.6	<4.90	<9.80	0.380		20181360
DB0CND	S18T017537	123-86-4	n-Butyl acetate	PPBV	97.3	<5.40	<10.8	0.460		20181360
DB0CND	S18T017537	142-82-5	n-Heptane	PPBV	93.7	<5.25	<10.5	0.300		20181360
DB0CND	S18T017537	10061-02-6	trans-1,3-Dichloropropene	PPBV	92.7	<4.70	<9.40	0.360		20181360

J - Estimated
a - LCS Outside Range
T - Tentatively Identified Compound
B - Blank Contamination
Y - Comment
NA = Not Analyzed, ND = Not Detected
DSRSpreadsheetWOLimits 3.0.13a
DSR.Jar v. 3.0.14

DSRComment 3.0.13
DSR.Jar v. 3.0.14

NUCON
17-oct-2018 08:03:06

Verification Sample Comments

Sample: S18T017533 Group: 20181360
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T017534 Group: 20181360
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T017535 Group: 20181360
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T017536 Group: 20181360
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T017537 Group: 20181360
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

18-oct-2018 16:20:45
NUCON
Data Summary of All Results
Customer Group or SDG

Customer Sample ID	SAMPLE_R	CAS #	ANALYTE	RESULT_ UNIT	STANDARD	BLANK	RESULT	Det Limit	QUALIFIER	SAMPLE_ GROUP
6OL0CNA	S18T018161	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	99	3.9		20181427
6OL0CNA	S18T018161	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181427
6OL0CNA	S18T018161	110-00-9	Furan	PPBV	80.6	<0.100	<0.100	0.0100		20181427
6OL0CNA	S18T018161	107-12-0	Propanenitrile	PPBV	83.5	<0.100	<0.100	0.0100		20181427
6OL0CNA	S18T018161	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	123	<5.25	<10.5	0.360		20181427
6OL0CNA	S18T018161	79-00-5	1,1,2-Trichloroethane	PPBV	125	<5.30	<10.6	0.360		20181427
6OL0CNA	S18T018161	75-34-3	1,1-Dichloroethane	PPBV	91.8	<5.25	<10.5	0.300		20181427
6OL0CNA	S18T018161	75-35-4	1,1-Dichloroethene	PPBV	91.7	<5.40	<10.8	0.400		20181427
6OL0CNA	S18T018161	107-06-2	1,2-Dichloroethane	PPBV	92.6	<5.20	<10.4	0.260		20181427
6OL0CNA	S18T018161	106-99-0	1,3-Butadiene	PPBV	113	<5.25	<10.5	0.540		20181427
6OL0CNA	S18T018161	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181427
6OL0CNA	S18T018161	106-46-7	1,4-Dichlorobenzene	PPBV	105	<5.20	<10.4	0.840		20181427
6OL0CNA	S18T018161	123-91-1	1,4-Dioxane	PPBV	110	<5.35	<10.7	0.300		20181427
6OL0CNA	S18T018161	71-36-3	1-Butanol	PPBV	98.1	<5.85	<11.7	0.340		20181427
6OL0CNA	S18T018161	71-23-8	1-Propanol	PPBV	120	<5.80	<11.6	0.320		20181427
6OL0CNA	S18T018161	78-93-3	2-Butanone	PPBV	112	<5.40	<10.8	0.380		20181427
6OL0CNA	S18T018161	110-43-0	2-Heptanone	PPBV	110	<5.10	<10.2	1.40		20181427
6OL0CNA	S18T018161	591-78-6	2-Hexanone	PPBV	133	<5.40	<10.8	0.460	LQY	20181427
6OL0CNA	S18T018161	78-94-4	3-Buten-2-one	PPBV	89.6	<5.75	<11.5	0.280		20181427
6OL0CNA	S18T018161	106-35-4	3-Heptanone	PPBV	104	<5.30	<10.6	0.380		20181427
6OL0CNA	S18T018161	108-10-1	4-Methyl-2-Pentanone	PPBV	133	<5.35	<10.7	0.480	LQY	20181427
6OL0CNA	S18T018161	75-07-0	Acetaldehyde	PPBV	111	<5.90	<11.8	0.700		20181427
6OL0CNA	S18T018161	67-64-1	Acetone	PPBV	85.9	<5.70	<11.4	0.320		20181427
6OL0CNA	S18T018161	75-05-8	Acetonitrile	PPBV	114	<5.75	<11.5	1.88		20181427
6OL0CNA	S18T018161	107-02-8	Acrolein	PPBV	82.0	<5.65	<11.3	0.460		20181427
6OL0CNA	S18T018161	107-13-1	Acrylonitrile	PPBV	90.7	<5.80	<11.6	0.500		20181427
6OL0CNA	S18T018161	107-05-1	Allyl Chloride	PPBV	87.5	<5.50	<11.0	0.340		20181427
6OL0CNA	S18T018161	71-43-2	Benzene	PPBV	91.6	<5.25	<10.5	0.420		20181427
6OL0CNA	S18T018161	123-72-8	Butanal	PPBV	115	<5.90	<11.8	0.300		20181427
6OL0CNA	S18T018161	56-23-5	Carbon tetrachloride	PPBV	103	<5.15	<10.3	0.400		20181427
6OL0CNA	S18T018161	108-90-7	Chlorobenzene	PPBV	117	<5.35	<10.7	0.540		20181427
6OL0CNA	S18T018161	75-00-3	Chloroethane	PPBV	87.1	<5.10	<10.2	0.760		20181427
6OL0CNA	S18T018161	67-66-3	Chloroform	PPBV	103	<5.10	<10.2	0.260		20181427
6OL0CNA	S18T018161	110-82-7	Cyclohexane	PPBV	91.8	<5.20	<10.4	0.260		20181427
6OL0CNA	S18T018161	124-18-5	Decane	PPBV	106	<5.25	<10.5	0.420		20181427
6OL0CNA	S18T018161	64-17-5	Ethanol	PPBV	120	<5.85	<11.7	0.560		20181427
6OL0CNA	S18T018161	141-78-6	Ethyl acetate	PPBV	110	<5.35	<10.7	0.740		20181427
6OL0CNA	S18T018161	100-41-4	Ethylbenzene	PPBV	117	<5.25	<10.5	0.440		20181427
6OL0CNA	S18T018161	110-54-3	Hexane	PPBV	91.1	<5.30	<10.6	0.300		20181427
6OL0CNA	S18T018161	67-56-1	Methanol	PPBV	139	<5.90	17.7	0.900	a	20181427
6OL0CNA	S18T018161	75-09-2	Methylene Chloride	PPBV	120	<5.30	<10.6	0.280		20181427
6OL0CNA	S18T018161	100-42-5	Styrene	PPBV	117	<5.10	<10.2	0.400		20181427
6OL0CNA	S18T018161	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.480		20181427
6OL0CNA	S18T018161	109-99-9	Tetrahydrofuran	PPBV	93.1	<5.35	<10.7	0.360		20181427
6OL0CNA	S18T018161	108-88-3	Toluene	PPBV	113	<5.30	<10.6	0.460		20181427
6OL0CNA	S18T018161	79-01-6	Trichloroethene	PPBV	112	<5.15	<10.3	0.420		20181427
6OL0CNA	S18T018161	75-69-4	Trichlorofluoromethane	PPBV	86.5	<5.20	<10.4	0.500		20181427
6OL0CNA	S18T018161	10061-01-5	cis-1,3-Dichloropropene	PPBV	99.2	<4.90	<9.80	0.380		20181427
6OL0CNA	S18T018161	123-86-4	n-Butyl acetate	PPBV	104	<5.40	<10.8	0.460		20181427
6OL0CNA	S18T018161	142-82-5	n-Heptane	PPBV	94.4	<5.25	<10.5	0.300		20181427
6OL0CNA	S18T018161	10061-02-6	trans-1,3-Dichloropropene	PPBV	99.6	<4.70	<9.40	0.360		20181427
6OL0CNB	S18T018162	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	23	3.9		20181427
6OL0CNB	S18T018162	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181427
6OL0CNB	S18T018162	110-00-9	Furan	PPBV	80.6	<0.100	21.5	0.0100	E	20181427
6OL0CNB	S18T018162	107-12-0	Propanenitrile	PPBV	83.5	<0.100	2.13	0.0100		20181427
6OL0CNB	S18T018162	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	123	<5.25	<10.5	0.360		20181427
6OL0CNB	S18T018162	79-00-5	1,1,2-Trichloroethane	PPBV	125	<5.30	<10.6	0.360		20181427
6OL0CNB	S18T018162	75-34-3	1,1-Dichloroethane	PPBV	91.8	<5.25	<10.5	0.300		20181427
6OL0CNB	S18T018162	75-35-4	1,1-Dichloroethene	PPBV	91.7	<5.40	<10.8	0.400		20181427
6OL0CNB	S18T018162	107-06-2	1,2-Dichloroethane	PPBV	92.6	<5.20	<10.4	0.260		20181427
6OL0CNB	S18T018162	106-99-0	1,3-Butadiene	PPBV	113	<5.25	<10.5	0.540		20181427
6OL0CNB	S18T018162	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181427
6OL0CNB	S18T018162	106-46-7	1,4-Dichlorobenzene	PPBV	105	<5.20	<10.4	0.840		20181427
6OL0CNB	S18T018162	123-91-1	1,4-Dioxane	PPBV	110	<5.35	<10.7	0.300		20181427
6OL0CNB	S18T018162	71-36-3	1-Butanol	PPBV	98.1	<5.85	<11.7	0.340		20181427
6OL0CNB	S18T018162	71-23-8	1-Propanol	PPBV	120	<5.80	<11.6	0.320		20181427
6OL0CNB	S18T018162	78-93-3	2-Butanone	PPBV	112	<5.40	47.2	0.380		20181427

6OL0CNB	S18T018162	110-43-0	2-Heptanone	PPBV	110	<5.10	<10.2	1.40		20181427
6OL0CNB	S18T018162	591-78-6	2-Hexanone	PPBV	133	<5.40	12.5	0.460	LQY	20181427
6OL0CNB	S18T018162	78-94-4	3-Buten-2-one	PPBV	89.6	<5.75	83.1	0.280		20181427
6OL0CNB	S18T018162	106-35-4	3-Heptanone	PPBV	104	<5.30	<10.6	0.380		20181427
6OL0CNB	S18T018162	108-10-1	4-Methyl-2-Pentanone	PPBV	133	<5.35	<10.7	0.480	LQY	20181427
6OL0CNB	S18T018162	75-07-0	Acetaldehyde	PPBV	111	<5.90	1.98E+03	14.0		20181427
6OL0CNB	S18T018162	67-64-1	Acetone	PPBV	85.9	<5.70	184	0.320		20181427
6OL0CNB	S18T018162	75-05-8	Acetonitrile	PPBV	114	<5.75	13.5	1.88		20181427
6OL0CNB	S18T018162	107-02-8	Acrolein	PPBV	82.0	<5.65	383	1.84		20181427
6OL0CNB	S18T018162	107-13-1	Acrylonitrile	PPBV	90.7	<5.80	<11.6	0.500		20181427
6OL0CNB	S18T018162	107-05-1	Allyl Chloride	PPBV	87.5	<5.50	<11.0	0.340		20181427
6OL0CNB	S18T018162	71-43-2	Benzene	PPBV	91.6	<5.25	152	0.420		20181427
6OL0CNB	S18T018162	123-72-8	Butanal	PPBV	115	<5.90	66.8	0.300		20181427
6OL0CNB	S18T018162	56-23-5	Carbon tetrachloride	PPBV	103	<5.15	<10.3	0.400		20181427
6OL0CNB	S18T018162	108-90-7	Chlorobenzene	PPBV	117	<5.35	<10.7	0.540		20181427
6OL0CNB	S18T018162	75-00-3	Chloroethane	PPBV	87.1	<5.10	<10.2	0.760		20181427
6OL0CNB	S18T018162	67-66-3	Chloroform	PPBV	103	<5.10	<10.2	0.260		20181427
6OL0CNB	S18T018162	110-82-7	Cyclohexane	PPBV	91.8	<5.20	<10.4	0.260		20181427
6OL0CNB	S18T018162	124-18-5	Decane	PPBV	106	<5.25	25.5	0.420		20181427
6OL0CNB	S18T018162	64-17-5	Ethanol	PPBV	120	<5.85	<11.7	0.560		20181427
6OL0CNB	S18T018162	141-78-6	Ethyl acetate	PPBV	110	<5.35	<10.7	0.740		20181427
6OL0CNB	S18T018162	100-41-4	Ethylbenzene	PPBV	117	<5.25	<10.5	0.440		20181427
6OL0CNB	S18T018162	110-54-3	Hexane	PPBV	91.1	<5.30	<10.6	0.300		20181427
6OL0CNB	S18T018162	67-56-1	Methanol	PPBV	139	<5.90	<11.8	0.900	a	20181427
6OL0CNB	S18T018162	75-09-2	Methylene Chloride	PPBV	120	<5.30	<10.6	0.280		20181427
6OL0CNB	S18T018162	100-42-5	Styrene	PPBV	117	<5.10	<10.2	0.400		20181427
6OL0CNB	S18T018162	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.480		20181427
6OL0CNB	S18T018162	109-99-9	Tetrahydrofuran	PPBV	93.1	<5.35	<10.7	0.360		20181427
6OL0CNB	S18T018162	108-88-3	Toluene	PPBV	113	<5.30	53.1	0.460		20181427
6OL0CNB	S18T018162	79-01-6	Trichloroethene	PPBV	112	<5.15	<10.3	0.420		20181427
6OL0CNB	S18T018162	75-69-4	Trichlorofluoromethane	PPBV	86.5	<5.20	<10.4	0.500		20181427
6OL0CNB	S18T018162	10061-01-5	cis-1,3-Dichloropropene	PPBV	99.2	<4.90	<9.80	0.380		20181427
6OL0CNB	S18T018162	123-86-4	n-Butyl acetate	PPBV	104	<5.40	<10.8	0.460		20181427
6OL0CNB	S18T018162	142-82-5	n-Heptane	PPBV	94.4	<5.25	<10.5	0.300		20181427
6OL0CNB	S18T018162	10061-02-6	trans-1,3-Dichloropropene	PPBV	99.6	<4.70	<9.40	0.360		20181427
6OL0CNC	S18T018163	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	19	3.9		20181427
6OL0CNC	S18T018163	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181427
6OL0CNC	S18T018163	110-00-9	Furan	PPBV	80.6	<0.100	1.46	0.0100		20181427
6OL0CNC	S18T018163	107-12-0	Propanenitrile	PPBV	83.5	<0.100	0.510	0.0100		20181427
6OL0CNC	S18T018163	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	123	<5.25	<10.5	0.360		20181427
6OL0CNC	S18T018163	79-00-5	1,1,2-Trichloroethane	PPBV	125	<5.30	<10.6	0.360		20181427
6OL0CNC	S18T018163	75-34-3	1,1-Dichloroethane	PPBV	91.8	<5.25	<10.5	0.300		20181427
6OL0CNC	S18T018163	75-35-4	1,1-Dichloroethene	PPBV	91.7	<5.40	<10.8	0.400		20181427
6OL0CNC	S18T018163	107-06-2	1,2-Dichloroethane	PPBV	92.6	<5.20	<10.4	0.260		20181427
6OL0CNC	S18T018163	106-99-0	1,3-Butadiene	PPBV	113	<5.25	<10.5	0.540		20181427
6OL0CNC	S18T018163	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181427
6OL0CNC	S18T018163	106-46-7	1,4-Dichlorobenzene	PPBV	105	<5.20	<10.4	0.840		20181427
6OL0CNC	S18T018163	123-91-1	1,4-Dioxane	PPBV	110	<5.35	<10.7	0.300		20181427
6OL0CNC	S18T018163	71-36-3	1-Butanol	PPBV	98.1	<5.85	<11.7	0.340		20181427
6OL0CNC	S18T018163	71-23-8	1-Propanol	PPBV	120	<5.80	<11.6	0.320		20181427
6OL0CNC	S18T018163	78-93-3	2-Butanone	PPBV	112	<5.40	<10.8	0.380		20181427
6OL0CNC	S18T018163	110-43-0	2-Heptanone	PPBV	110	<5.10	<10.2	1.40		20181427
6OL0CNC	S18T018163	591-78-6	2-Hexanone	PPBV	133	<5.40	<10.8	0.460	LQY	20181427
6OL0CNC	S18T018163	78-94-4	3-Buten-2-one	PPBV	89.6	<5.75	<11.5	0.280		20181427
6OL0CNC	S18T018163	106-35-4	3-Heptanone	PPBV	104	<5.30	<10.6	0.380		20181427
6OL0CNC	S18T018163	108-10-1	4-Methyl-2-Pentanone	PPBV	133	<5.35	<10.7	0.480	LQY	20181427
6OL0CNC	S18T018163	75-07-0	Acetaldehyde	PPBV	111	<5.90	111	0.700		20181427
6OL0CNC	S18T018163	67-64-1	Acetone	PPBV	85.9	<5.70	21.6	0.320		20181427
6OL0CNC	S18T018163	75-05-8	Acetonitrile	PPBV	114	<5.75	<11.5	1.88		20181427
6OL0CNC	S18T018163	107-02-8	Acrolein	PPBV	82.0	<5.65	12.2	0.460		20181427
6OL0CNC	S18T018163	107-13-1	Acrylonitrile	PPBV	90.7	<5.80	<11.6	0.500		20181427
6OL0CNC	S18T018163	107-05-1	Allyl Chloride	PPBV	87.5	<5.50	<11.0	0.340		20181427
6OL0CNC	S18T018163	71-43-2	Benzene	PPBV	91.6	<5.25	<10.5	0.420		20181427
6OL0CNC	S18T018163	123-72-8	Butanal	PPBV	115	<5.90	<11.8	0.300		20181427
6OL0CNC	S18T018163	56-23-5	Carbon tetrachloride	PPBV	103	<5.15	<10.3	0.400		20181427
6OL0CNC	S18T018163	108-90-7	Chlorobenzene	PPBV	117	<5.35	<10.7	0.540		20181427
6OL0CNC	S18T018163	75-00-3	Chloroethane	PPBV	87.1	<5.10	<10.2	0.760		20181427
6OL0CNC	S18T018163	67-66-3	Chloroform	PPBV	103	<5.10	<10.2	0.260		20181427
6OL0CNC	S18T018163	110-82-7	Cyclohexane	PPBV	91.8	<5.20	<10.4	0.260		20181427
6OL0CNC	S18T018163	124-18-5	Decane	PPBV	106	<5.25	<10.5	0.420		20181427
6OL0CNC	S18T018163	64-17-5	Ethanol	PPBV	120	<5.85	<11.7	0.560		20181427
6OL0CNC	S18T018163	141-78-6	Ethyl acetate	PPBV	110	<5.35	<10.7	0.740		20181427
6OL0CNC	S18T018163	100-41-4	Ethylbenzene	PPBV	117	<5.25	<10.5	0.440		20181427
6OL0CNC	S18T018163	110-54-3	Hexane	PPBV	91.1	<5.30	<10.6	0.300		20181427

6OL0CNC	S18T018163	67-56-1	Methanol	PPBV	139	<5.90	<11.8	0.900	a	20181427
6OL0CNC	S18T018163	75-09-2	Methylene Chloride	PPBV	120	<5.30	<10.6	0.280		20181427
6OL0CNC	S18T018163	100-42-5	Styrene	PPBV	117	<5.10	<10.2	0.400		20181427
6OL0CNC	S18T018163	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.480		20181427
6OL0CNC	S18T018163	109-99-9	Tetrahydrofuran	PPBV	93.1	<5.35	<10.7	0.360		20181427
6OL0CNC	S18T018163	108-88-3	Toluene	PPBV	113	<5.30	<10.6	0.460		20181427
6OL0CNC	S18T018163	79-01-6	Trichloroethene	PPBV	112	<5.15	<10.3	0.420		20181427
6OL0CNC	S18T018163	75-69-4	Trichlorofluoromethane	PPBV	86.5	<5.20	<10.4	0.500		20181427
6OL0CNC	S18T018163	10061-01-5	cis-1,3-Dichloropropene	PPBV	99.2	<4.90	<9.80	0.380		20181427
6OL0CNC	S18T018163	123-86-4	n-Butyl acetate	PPBV	104	<5.40	<10.8	0.460		20181427
6OL0CNC	S18T018163	142-82-5	n-Heptane	PPBV	94.4	<5.25	<10.5	0.300		20181427
6OL0CNC	S18T018163	10061-02-6	trans-1,3-Dichloropropene	PPBV	99.6	<4.70	<9.40	0.360		20181427
6OL0CND	S18T018164	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	20	3.9		20181427
6OL0CND	S18T018164	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181427
6OL0CND	S18T018164	110-00-9	Furan	PPBV	80.6	<0.100	<0.100	0.0100		20181427
6OL0CND	S18T018164	107-12-0	Propanenitrile	PPBV	83.5	<0.100	0.500	0.0100		20181427
6OL0CND	S18T018164	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	123	<5.25	<10.5	0.360		20181427
6OL0CND	S18T018164	79-00-5	1,1,2-Trichloroethane	PPBV	125	<5.30	<10.6	0.360		20181427
6OL0CND	S18T018164	75-34-3	1,1-Dichloroethane	PPBV	91.8	<5.25	<10.5	0.300		20181427
6OL0CND	S18T018164	75-35-4	1,1-Dichloroethene	PPBV	91.7	<5.40	<10.8	0.400		20181427
6OL0CND	S18T018164	107-06-2	1,2-Dichloroethane	PPBV	92.6	<5.20	<10.4	0.260		20181427
6OL0CND	S18T018164	106-99-0	1,3-Butadiene	PPBV	113	<5.25	<10.5	0.540		20181427
6OL0CND	S18T018164	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181427
6OL0CND	S18T018164	106-46-7	1,4-Dichlorobenzene	PPBV	105	<5.20	<10.4	0.840		20181427
6OL0CND	S18T018164	123-91-1	1,4-Dioxane	PPBV	110	<5.35	<10.7	0.300		20181427
6OL0CND	S18T018164	71-36-3	1-Butanol	PPBV	98.1	<5.85	58.3	0.340		20181427
6OL0CND	S18T018164	71-23-8	1-Propanol	PPBV	120	<5.80	<11.6	0.320		20181427
6OL0CND	S18T018164	78-93-3	2-Butanone	PPBV	112	<5.40	<10.8	0.380		20181427
6OL0CND	S18T018164	110-43-0	2-Heptanone	PPBV	110	<5.10	<10.2	1.40		20181427
6OL0CND	S18T018164	591-78-6	2-Hexanone	PPBV	133	<5.40	<10.8	0.460	LQY	20181427
6OL0CND	S18T018164	78-94-4	3-Buten-2-one	PPBV	89.6	<5.75	<11.5	0.280		20181427
6OL0CND	S18T018164	106-35-4	3-Heptanone	PPBV	104	<5.30	<10.6	0.380		20181427
6OL0CND	S18T018164	108-10-1	4-Methyl-2-Pentanone	PPBV	133	<5.35	<10.7	0.480	LQY	20181427
6OL0CND	S18T018164	75-07-0	Acetaldehyde	PPBV	111	<5.90	49.9	0.700		20181427
6OL0CND	S18T018164	67-64-1	Acetone	PPBV	85.9	<5.70	11.4	0.320		20181427
6OL0CND	S18T018164	75-05-8	Acetonitrile	PPBV	114	<5.75	<11.5	1.88		20181427
6OL0CND	S18T018164	107-02-8	Acrolein	PPBV	82.0	<5.65	<11.3	0.460		20181427
6OL0CND	S18T018164	107-13-1	Acrylonitrile	PPBV	90.7	<5.80	<11.6	0.500		20181427
6OL0CND	S18T018164	107-05-1	Allyl Chloride	PPBV	87.5	<5.50	<11.0	0.340		20181427
6OL0CND	S18T018164	71-43-2	Benzene	PPBV	91.6	<5.25	<10.5	0.420		20181427
6OL0CND	S18T018164	123-72-8	Butanal	PPBV	115	<5.90	<11.8	0.300		20181427
6OL0CND	S18T018164	56-23-5	Carbon tetrachloride	PPBV	103	<5.15	<10.3	0.400		20181427
6OL0CND	S18T018164	108-90-7	Chlorobenzene	PPBV	117	<5.35	<10.7	0.540		20181427
6OL0CND	S18T018164	75-00-3	Chloroethane	PPBV	87.1	<5.10	<10.2	0.760		20181427
6OL0CND	S18T018164	67-66-3	Chloroform	PPBV	103	<5.10	<10.2	0.260		20181427
6OL0CND	S18T018164	110-82-7	Cyclohexane	PPBV	91.8	<5.20	<10.4	0.260		20181427
6OL0CND	S18T018164	124-18-5	Decane	PPBV	106	<5.25	<10.5	0.420		20181427
6OL0CND	S18T018164	64-17-5	Ethanol	PPBV	120	<5.85	<11.7	0.560		20181427
6OL0CND	S18T018164	141-78-6	Ethyl acetate	PPBV	110	<5.35	<10.7	0.740		20181427
6OL0CND	S18T018164	100-41-4	Ethylbenzene	PPBV	117	<5.25	<10.5	0.440		20181427
6OL0CND	S18T018164	110-54-3	Hexane	PPBV	91.1	<5.30	<10.6	0.300		20181427
6OL0CND	S18T018164	67-56-1	Methanol	PPBV	139	<5.90	<11.8	0.900	a	20181427
6OL0CND	S18T018164	75-09-2	Methylene Chloride	PPBV	120	<5.30	<10.6	0.280		20181427
6OL0CND	S18T018164	100-42-5	Styrene	PPBV	117	<5.10	<10.2	0.400		20181427
6OL0CND	S18T018164	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.480		20181427
6OL0CND	S18T018164	109-99-9	Tetrahydrofuran	PPBV	93.1	<5.35	<10.7	0.360		20181427
6OL0CND	S18T018164	108-88-3	Toluene	PPBV	113	<5.30	<10.6	0.460		20181427
6OL0CND	S18T018164	79-01-6	Trichloroethene	PPBV	112	<5.15	<10.3	0.420		20181427
6OL0CND	S18T018164	75-69-4	Trichlorofluoromethane	PPBV	86.5	<5.20	<10.4	0.500		20181427
6OL0CND	S18T018164	10061-01-5	cis-1,3-Dichloropropene	PPBV	99.2	<4.90	<9.80	0.380		20181427
6OL0CND	S18T018164	123-86-4	n-Butyl acetate	PPBV	104	<5.40	14.9	0.460		20181427
6OL0CND	S18T018164	142-82-5	n-Heptane	PPBV	94.4	<5.25	<10.5	0.300		20181427
6OL0CND	S18T018164	10061-02-6	trans-1,3-Dichloropropene	PPBV	99.6	<4.70	<9.40	0.360		20181427
6OL1CND	S18T018165	10024-97-2	Nitrous Oxide	PPMV	97	<5.0	15	3.9		20181427
6OL1CND	S18T018165	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181427
6OL1CND	S18T018165	110-00-9	Furan	PPBV	80.6	<0.100	<0.100	0.0100		20181427
6OL1CND	S18T018165	107-12-0	Propanenitrile	PPBV	83.5	<0.100	0.180	0.0100		20181427
6OL1CND	S18T018165	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	123	<5.25	<10.5	0.360		20181427
6OL1CND	S18T018165	79-00-5	1,1,2-Trichloroethane	PPBV	125	<5.30	<10.6	0.360		20181427
6OL1CND	S18T018165	75-34-3	1,1-Dichloroethane	PPBV	91.8	<5.25	<10.5	0.300		20181427
6OL1CND	S18T018165	75-35-4	1,1-Dichloroethene	PPBV	91.7	<5.40	<10.8	0.400		20181427
6OL1CND	S18T018165	107-06-2	1,2-Dichloroethane	PPBV	92.6	<5.20	<10.4	0.260		20181427
6OL1CND	S18T018165	106-99-0	1,3-Butadiene	PPBV	113	<5.25	<10.5	0.540		20181427
6OL1CND	S18T018165	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.40	0.360		20181427

6OL1CND	S18T018165	106-46-7	1,4-Dichlorobenzene	PPBV	105	<5.20	<10.4	0.840		20181427
6OL1CND	S18T018165	123-91-1	1,4-Dioxane	PPBV	110	<5.35	<10.7	0.300		20181427
6OL1CND	S18T018165	71-36-3	1-Butanol	PPBV	98.1	<5.85	<11.7	0.340		20181427
6OL1CND	S18T018165	71-23-8	1-Propanol	PPBV	120	<5.80	<11.6	0.320		20181427
6OL1CND	S18T018165	78-93-3	2-Butanone	PPBV	112	<5.40	<10.8	0.380		20181427
6OL1CND	S18T018165	110-43-0	2-Heptanone	PPBV	110	<5.10	<10.2	1.40		20181427
6OL1CND	S18T018165	591-78-6	2-Hexanone	PPBV	133	<5.40	<10.8	0.460	LQY	20181427
6OL1CND	S18T018165	78-94-4	3-Buten-2-one	PPBV	89.6	<5.75	<11.5	0.280		20181427
6OL1CND	S18T018165	106-35-4	3-Heptanone	PPBV	104	<5.30	<10.6	0.380		20181427
6OL1CND	S18T018165	108-10-1	4-Methyl-2-Pentanone	PPBV	133	<5.35	<10.7	0.480	LQY	20181427
6OL1CND	S18T018165	75-07-0	Acetaldehyde	PPBV	111	<5.90	21.4	0.700		20181427
6OL1CND	S18T018165	67-64-1	Acetone	PPBV	85.9	<5.70	<11.4	0.320		20181427
6OL1CND	S18T018165	75-05-8	Acetonitrile	PPBV	114	<5.75	<11.5	1.88		20181427
6OL1CND	S18T018165	107-02-8	Acrolein	PPBV	82.0	<5.65	<11.3	0.460		20181427
6OL1CND	S18T018165	107-13-1	Acrylonitrile	PPBV	90.7	<5.80	<11.6	0.500		20181427
6OL1CND	S18T018165	107-05-1	Allyl Chloride	PPBV	87.5	<5.50	<11.0	0.340		20181427
6OL1CND	S18T018165	71-43-2	Benzene	PPBV	91.6	<5.25	<10.5	0.420		20181427
6OL1CND	S18T018165	123-72-8	Butanal	PPBV	115	<5.90	<11.8	0.300		20181427
6OL1CND	S18T018165	56-23-5	Carbon tetrachloride	PPBV	103	<5.15	<10.3	0.400		20181427
6OL1CND	S18T018165	108-90-7	Chlorobenzene	PPBV	117	<5.35	<10.7	0.540		20181427
6OL1CND	S18T018165	75-00-3	Chloroethane	PPBV	87.1	<5.10	<10.2	0.760		20181427
6OL1CND	S18T018165	67-66-3	Chloroform	PPBV	103	<5.10	<10.2	0.260		20181427
6OL1CND	S18T018165	110-82-7	Cyclohexane	PPBV	91.8	<5.20	<10.4	0.260		20181427
6OL1CND	S18T018165	124-18-5	Decane	PPBV	106	<5.25	<10.5	0.420		20181427
6OL1CND	S18T018165	64-17-5	Ethanol	PPBV	120	<5.85	<11.7	0.560		20181427
6OL1CND	S18T018165	141-78-6	Ethyl acetate	PPBV	110	<5.35	<10.7	0.740		20181427
6OL1CND	S18T018165	100-41-4	Ethylbenzene	PPBV	117	<5.25	<10.5	0.440		20181427
6OL1CND	S18T018165	110-54-3	Hexane	PPBV	91.1	<5.30	<10.6	0.300		20181427
6OL1CND	S18T018165	67-56-1	Methanol	PPBV	139	<5.90	<11.8	0.900	a	20181427
6OL1CND	S18T018165	75-09-2	Methylene Chloride	PPBV	120	<5.30	<10.6	0.280		20181427
6OL1CND	S18T018165	100-42-5	Styrene	PPBV	117	<5.10	<10.2	0.400		20181427
6OL1CND	S18T018165	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.480		20181427
6OL1CND	S18T018165	109-99-9	Tetrahydrofuran	PPBV	93.1	<5.35	<10.7	0.360		20181427
6OL1CND	S18T018165	108-88-3	Toluene	PPBV	113	<5.30	<10.6	0.460		20181427
6OL1CND	S18T018165	79-01-6	Trichloroethene	PPBV	112	<5.15	<10.3	0.420		20181427
6OL1CND	S18T018165	75-69-4	Trichlorofluoromethane	PPBV	86.5	<5.20	<10.4	0.500		20181427
6OL1CND	S18T018165	10061-01-5	cis-1,3-Dichloropropene	PPBV	99.2	<4.90	<9.80	0.380		20181427
6OL1CND	S18T018165	123-86-4	n-Butyl acetate	PPBV	104	<5.40	<10.8	0.460		20181427
6OL1CND	S18T018165	142-82-5	n-Heptane	PPBV	94.4	<5.25	<10.5	0.300		20181427
6OL1CND	S18T018165	10061-02-6	trans-1,3-Dichloropropene	PPBV	99.6	<4.70	<9.40	0.360		20181427

J - Estimated
a - LCS Outside Range
T - Tentatively Identified Compound
B - Blank Contamination
E - Outside Calibration Range
Y - Comment
L - LLS Outside Range
N - Named TIC
Q - Qualitative
NA = Not Analyzed, ND = Not Detected
DSRSpreadsheetWOLimits 3.0.13a
DSR.Jar v. 3.0.14

Verification QC Analysis Comments
Analysis: S1805210018-000 Method: VAPOR-SUMMA VOA #2
Matrix: VAPOR Replicate: 0
Y= CCV failed for 2-hexanone and methyl isobutylketone.

MS 6/20/18

Verification Sample Comments
Sample: S18T018161 Group: 20181427
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard.
kak 09/16/18
Y= CCV failed for 2-hexanone and methyl isobutylketone.

MS 6/20/18
Sample: S18T018162 Group: 20181427
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard.
kak 09/16/18
Y= CCV failed for 2-hexanone and methyl isobutylketone.

MS 6/20/18
Sample: S18T018163 Group: 20181427
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard.
kak 09/16/18
Y= CCV failed for 2-hexanone and methyl isobutylketone.

MS 6/20/18
Sample: S18T018164 Group: 20181427
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard.
kak 09/16/18
Y= CCV failed for 2-hexanone and methyl isobutylketone.

MS 6/22/18
Sample: S18T018165 Group: 20181427
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard.
kak 09/16/18
Y= CCV failed for 2-hexanone and methyl isobutylketone.

MS 6/22/18

DSRComment 3.0.13
DSR.Jar v. 3.0.14

NUCON
17-oct-2018 08:08:30

22-oct-2018 10:21:58
NUCON
Data Summary of All
Customer Group or SDG

Customer Sample ID	SAMPLE_R	CAS #	ANALYTE	RESULT_ UNIT	STANDARD	BLANK	RESULT	Det Limit	QUALIFIER	SAMPLE_ GROUP
2OL0CNA0	S18T018597	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	<10	3.9		20181468
2OL0CNA0	S18T018597	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
2OL0CNA0	S18T018597	110-00-9	Furan	PPBV	87.1	<0.100	<0.100	0.0100		20181468
2OL0CNA0	S18T018597	107-12-0	Propanenitrile	PPBV	83.3	0.110	2.99E+04	32.0	B	20181468
2OL0CNA0	S18T018597	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
2OL0CNA0	S18T018597	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
2OL0CNA0	S18T018597	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
2OL0CNA0	S18T018597	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
2OL0CNA0	S18T018597	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
2OL0CNA0	S18T018597	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
2OL0CNA0	S18T018597	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
2OL0CNA0	S18T018597	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
2OL0CNA0	S18T018597	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
2OL0CNA0	S18T018597	71-36-3	1-Butanol	PPBV	102	<5.55	<11.1	0.480		20181468
2OL0CNA0	S18T018597	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
2OL0CNA0	S18T018597	78-93-3	2-Butanone	PPBV	96.0	<5.60	<11.2	0.620		20181468
2OL0CNA0	S18T018597	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468
2OL0CNA0	S18T018597	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468
2OL0CNA0	S18T018597	78-94-4	3-Buten-2-one	PPBV	104	<5.70	<11.4	0.480		20181468
2OL0CNA0	S18T018597	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
2OL0CNA0	S18T018597	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
2OL0CNA0	S18T018597	75-07-0	Acetaldehyde	PPBV	104	<5.45	12.9	0.440		20181468
2OL0CNA0	S18T018597	67-64-1	Acetone	PPBV	110	<5.80	<11.6	0.400		20181468
2OL0CNA0	S18T018597	75-05-8	Acetonitrile	PPBV	106	<5.50	<11.0	0.340		20181468
2OL0CNA0	S18T018597	107-02-8	Acrolein	PPBV	116	<5.75	<11.5	0.520		20181468
2OL0CNA0	S18T018597	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440		20181468
2OL0CNA0	S18T018597	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
2OL0CNA0	S18T018597	71-43-2	Benzene	PPBV	102	<5.40	834	2.40		20181468
2OL0CNA0	S18T018597	123-72-8	Butanal	PPBV	102	<4.95	<9.90	0.280		20181468
2OL0CNA0	S18T018597	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
2OL0CNA0	S18T018597	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
2OL0CNA0	S18T018597	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
2OL0CNA0	S18T018597	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
2OL0CNA0	S18T018597	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
2OL0CNA0	S18T018597	124-18-5	Decane	PPBV	92.2	<5.20	<10.4	0.460		20181468
2OL0CNA0	S18T018597	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
2OL0CNA0	S18T018597	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
2OL0CNA0	S18T018597	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
2OL0CNA0	S18T018597	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
2OL0CNA0	S18T018597	67-56-1	Methanol	PPBV	81.0	<5.10	35.4	0.940		20181468
2OL0CNA0	S18T018597	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
2OL0CNA0	S18T018597	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468
2OL0CNA0	S18T018597	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468
2OL0CNA0	S18T018597	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
2OL0CNA0	S18T018597	108-88-3	Toluene	PPBV	96.3	<5.40	<10.8	0.560		20181468
2OL0CNA0	S18T018597	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
2OL0CNA0	S18T018597	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
2OL0CNA0	S18T018597	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
2OL0CNA0	S18T018597	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520		20181468
2OL0CNA0	S18T018597	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
2OL0CNA0	S18T018597	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
2OL0CNB0	S18T018598	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	<10	3.9		20181468
2OL0CNB0	S18T018598	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
2OL0CNB0	S18T018598	110-00-9	Furan	PPBV	87.1	<0.100	49.4	0.100		20181468
2OL0CNB0	S18T018598	107-12-0	Propanenitrile	PPBV	83.3	0.110	852	1.00	B	20181468
2OL0CNB0	S18T018598	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
2OL0CNB0	S18T018598	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
2OL0CNB0	S18T018598	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
2OL0CNB0	S18T018598	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
2OL0CNB0	S18T018598	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
2OL0CNB0	S18T018598	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
2OL0CNB0	S18T018598	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
2OL0CNB0	S18T018598	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
2OL0CNB0	S18T018598	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
2OL0CNB0	S18T018598	71-36-3	1-Butanol	PPBV	102	<5.55	47.2	0.480		20181468
2OL0CNB0	S18T018598	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
2OL0CNB0	S18T018598	78-93-3	2-Butanone	PPBV	96.0	<5.60	40.0	0.620		20181468
2OL0CNB0	S18T018598	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468
2OL0CNB0	S18T018598	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468

20L0CNB0	S18T018598	78-94-4	3-Buten-2-one	PPBV	104	<5.70	62.6	0.480		20181468
20L0CNB0	S18T018598	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
20L0CNB0	S18T018598	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
20L0CNB0	S18T018598	75-07-0	Acetaldehyde	PPBV	104	<5.45	1.28E+03	2.93		20181468
20L0CNB0	S18T018598	67-64-1	Acetone	PPBV	110	<5.80	315	2.67		20181468
20L0CNB0	S18T018598	75-05-8	Acetonitrile	PPBV	106	<5.50	40.9	0.340		20181468
20L0CNB0	S18T018598	107-02-8	Acrolein	PPBV	116	<5.75	407	3.47		20181468
20L0CNB0	S18T018598	107-13-1	Acrylonitrile	PPBV	106	<5.85	467	2.93		20181468
20L0CNB0	S18T018598	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
20L0CNB0	S18T018598	71-43-2	Benzene	PPBV	102	<5.40	200	0.480		20181468
20L0CNB0	S18T018598	123-72-8	Butanal	PPBV	102	<4.95	84.4	0.280		20181468
20L0CNB0	S18T018598	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
20L0CNB0	S18T018598	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
20L0CNB0	S18T018598	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
20L0CNB0	S18T018598	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
20L0CNB0	S18T018598	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
20L0CNB0	S18T018598	124-18-5	Decane	PPBV	92.2	<5.20	22.6	0.460		20181468
20L0CNB0	S18T018598	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
20L0CNB0	S18T018598	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
20L0CNB0	S18T018598	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
20L0CNB0	S18T018598	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
20L0CNB0	S18T018598	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.940		20181468
20L0CNB0	S18T018598	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
20L0CNB0	S18T018598	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468
20L0CNB0	S18T018598	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468
20L0CNB0	S18T018598	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
20L0CNB0	S18T018598	108-88-3	Toluene	PPBV	96.3	<5.40	47.9	0.560		20181468
20L0CNB0	S18T018598	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
20L0CNB0	S18T018598	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
20L0CNB0	S18T018598	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
20L0CNB0	S18T018598	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520		20181468
20L0CNB0	S18T018598	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
20L0CNB0	S18T018598	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
20L0CNC0	S18T018599	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	<10	3.9		20181468
20L0CNC0	S18T018599	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
20L0CNC0	S18T018599	110-00-9	Furan	PPBV	87.1	<0.100	1.32	0.0400		20181468
20L0CNC0	S18T018599	107-12-0	Propanenitrile	PPBV	83.3	0.110	23.1	0.0400	B	20181468
20L0CNC0	S18T018599	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
20L0CNC0	S18T018599	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
20L0CNC0	S18T018599	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
20L0CNC0	S18T018599	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
20L0CNC0	S18T018599	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
20L0CNC0	S18T018599	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
20L0CNC0	S18T018599	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
20L0CNC0	S18T018599	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
20L0CNC0	S18T018599	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
20L0CNC0	S18T018599	71-36-3	1-Butanol	PPBV	102	<5.55	14.2	0.480		20181468
20L0CNC0	S18T018599	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
20L0CNC0	S18T018599	78-93-3	2-Butanone	PPBV	96.0	<5.60	<11.2	0.620		20181468
20L0CNC0	S18T018599	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468
20L0CNC0	S18T018599	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468
20L0CNC0	S18T018599	78-94-4	3-Buten-2-one	PPBV	104	<5.70	<11.4	0.480		20181468
20L0CNC0	S18T018599	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
20L0CNC0	S18T018599	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
20L0CNC0	S18T018599	75-07-0	Acetaldehyde	PPBV	104	<5.45	149	0.440		20181468
20L0CNC0	S18T018599	67-64-1	Acetone	PPBV	110	<5.80	2.24E+03	7.99		20181468
20L0CNC0	S18T018599	75-05-8	Acetonitrile	PPBV	106	<5.50	11.7	0.340		20181468
20L0CNC0	S18T018599	107-02-8	Acrolein	PPBV	116	<5.75	12.9	0.520		20181468
20L0CNC0	S18T018599	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440		20181468
20L0CNC0	S18T018599	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
20L0CNC0	S18T018599	71-43-2	Benzene	PPBV	102	<5.40	16.2	0.480		20181468
20L0CNC0	S18T018599	123-72-8	Butanal	PPBV	102	<4.95	<9.89	0.280		20181468
20L0CNC0	S18T018599	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
20L0CNC0	S18T018599	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
20L0CNC0	S18T018599	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
20L0CNC0	S18T018599	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
20L0CNC0	S18T018599	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
20L0CNC0	S18T018599	124-18-5	Decane	PPBV	92.2	<5.20	<10.4	0.460		20181468
20L0CNC0	S18T018599	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
20L0CNC0	S18T018599	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
20L0CNC0	S18T018599	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
20L0CNC0	S18T018599	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
20L0CNC0	S18T018599	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.939		20181468
20L0CNC0	S18T018599	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
20L0CNC0	S18T018599	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468
20L0CNC0	S18T018599	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468

2OL0CNC0	S18T018599	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
2OL0CNC0	S18T018599	108-88-3	Toluene	PPBV	96.3	<5.40	<10.8	0.560		20181468
2OL0CNC0	S18T018599	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
2OL0CNC0	S18T018599	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
2OL0CNC0	S18T018599	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
2OL0CNC0	S18T018599	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520		20181468
2OL0CNC0	S18T018599	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
2OL0CNC0	S18T018599	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
2OL0CND0	S18T018600	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	<10	3.9		20181468
2OL0CND0	S18T018600	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
2OL0CND0	S18T018600	110-00-9	Furan	PPBV	87.1	<0.100	0.200	0.0100		20181468
2OL0CND0	S18T018600	107-12-0	Propanenitrile	PPBV	83.3	0.110	0.690	0.0100	B	20181468
2OL0CND0	S18T018600	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
2OL0CND0	S18T018600	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
2OL0CND0	S18T018600	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
2OL0CND0	S18T018600	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
2OL0CND0	S18T018600	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
2OL0CND0	S18T018600	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
2OL0CND0	S18T018600	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
2OL0CND0	S18T018600	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
2OL0CND0	S18T018600	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
2OL0CND0	S18T018600	71-36-3	1-Butanol	PPBV	102	<5.55	26.2	0.480		20181468
2OL0CND0	S18T018600	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
2OL0CND0	S18T018600	78-93-3	2-Butanone	PPBV	96.0	<5.60	<11.2	0.620		20181468
2OL0CND0	S18T018600	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468
2OL0CND0	S18T018600	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468
2OL0CND0	S18T018600	78-94-4	3-Buten-2-one	PPBV	104	<5.70	<11.4	0.480		20181468
2OL0CND0	S18T018600	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
2OL0CND0	S18T018600	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
2OL0CND0	S18T018600	75-07-0	Acetaldehyde	PPBV	104	<5.45	72.7	0.440		20181468
2OL0CND0	S18T018600	67-64-1	Acetone	PPBV	110	<5.80	23.3	0.400		20181468
2OL0CND0	S18T018600	75-05-8	Acetonitrile	PPBV	106	<5.50	<11.0	0.340		20181468
2OL0CND0	S18T018600	107-02-8	Acrolein	PPBV	116	<5.75	<11.5	0.520		20181468
2OL0CND0	S18T018600	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440		20181468
2OL0CND0	S18T018600	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
2OL0CND0	S18T018600	71-43-2	Benzene	PPBV	102	<5.40	<10.8	0.480		20181468
2OL0CND0	S18T018600	123-72-8	Butanal	PPBV	102	<4.95	<9.90	0.280		20181468
2OL0CND0	S18T018600	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
2OL0CND0	S18T018600	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
2OL0CND0	S18T018600	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
2OL0CND0	S18T018600	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
2OL0CND0	S18T018600	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
2OL0CND0	S18T018600	124-18-5	Decane	PPBV	92.2	<5.20	<10.4	0.460		20181468
2OL0CND0	S18T018600	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
2OL0CND0	S18T018600	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
2OL0CND0	S18T018600	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
2OL0CND0	S18T018600	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
2OL0CND0	S18T018600	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.940		20181468
2OL0CND0	S18T018600	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
2OL0CND0	S18T018600	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468
2OL0CND0	S18T018600	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468
2OL0CND0	S18T018600	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
2OL0CND0	S18T018600	108-88-3	Toluene	PPBV	96.3	<5.40	<10.8	0.560		20181468
2OL0CND0	S18T018600	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
2OL0CND0	S18T018600	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
2OL0CND0	S18T018600	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
2OL0CND0	S18T018600	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	14.5	0.520		20181468
2OL0CND0	S18T018600	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
2OL0CND0	S18T018600	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
6MX0CNA	S18T018593	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	1.3E+03	39		20181468
6MX0CNA	S18T018593	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
6MX0CNA	S18T018593	110-00-9	Furan	PPBV	87.1	<0.100	0.340	0.0100		20181468
6MX0CNA	S18T018593	107-12-0	Propanenitrile	PPBV	83.3	0.110	0.420	0.0100	B	20181468
6MX0CNA	S18T018593	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
6MX0CNA	S18T018593	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
6MX0CNA	S18T018593	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
6MX0CNA	S18T018593	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
6MX0CNA	S18T018593	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
6MX0CNA	S18T018593	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
6MX0CNA	S18T018593	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
6MX0CNA	S18T018593	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
6MX0CNA	S18T018593	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
6MX0CNA	S18T018593	71-36-3	1-Butanol	PPBV	102	<5.55	<11.1	0.480		20181468
6MX0CNA	S18T018593	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
6MX0CNA	S18T018593	78-93-3	2-Butanone	PPBV	96.0	<5.60	<11.2	0.620		20181468
6MX0CNA	S18T018593	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468

6MX0CNA	S18T018593	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468
6MX0CNA	S18T018593	78-94-4	3-Buten-2-one	PPBV	104	<5.70	<11.4	0.480		20181468
6MX0CNA	S18T018593	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
6MX0CNA	S18T018593	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
6MX0CNA	S18T018593	75-07-0	Acetaldehyde	PPBV	104	<5.45	43.4	0.440		20181468
6MX0CNA	S18T018593	67-64-1	Acetone	PPBV	110	<5.80	12.4	0.400		20181468
6MX0CNA	S18T018593	75-05-8	Acetonitrile	PPBV	106	<5.50	<11.0	0.340		20181468
6MX0CNA	S18T018593	107-02-8	Acrolein	PPBV	116	<5.75	<11.5	0.520		20181468
6MX0CNA	S18T018593	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440		20181468
6MX0CNA	S18T018593	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
6MX0CNA	S18T018593	71-43-2	Benzene	PPBV	102	<5.40	<10.8	0.480		20181468
6MX0CNA	S18T018593	123-72-8	Butanal	PPBV	102	<4.95	<9.90	0.280		20181468
6MX0CNA	S18T018593	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
6MX0CNA	S18T018593	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
6MX0CNA	S18T018593	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
6MX0CNA	S18T018593	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
6MX0CNA	S18T018593	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
6MX0CNA	S18T018593	124-18-5	Decane	PPBV	92.2	<5.20	<10.4	0.460		20181468
6MX0CNA	S18T018593	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
6MX0CNA	S18T018593	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
6MX0CNA	S18T018593	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
6MX0CNA	S18T018593	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
6MX0CNA	S18T018593	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.940		20181468
6MX0CNA	S18T018593	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
6MX0CNA	S18T018593	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468
6MX0CNA	S18T018593	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468
6MX0CNA	S18T018593	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
6MX0CNA	S18T018593	108-88-3	Toluene	PPBV	96.3	<5.40	<10.8	0.560		20181468
6MX0CNA	S18T018593	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
6MX0CNA	S18T018593	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
6MX0CNA	S18T018593	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
6MX0CNA	S18T018593	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520		20181468
6MX0CNA	S18T018593	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
6MX0CNA	S18T018593	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
6MX0CNB	S18T018594	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	310	20		20181468
6MX0CNB	S18T018594	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
6MX0CNB	S18T018594	110-00-9	Furan	PPBV	87.1	<0.100	45.1	0.100		20181468
6MX0CNB	S18T018594	107-12-0	Propanenitrile	PPBV	83.3	0.110	3.52	0.0100	B	20181468
6MX0CNB	S18T018594	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
6MX0CNB	S18T018594	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
6MX0CNB	S18T018594	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
6MX0CNB	S18T018594	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
6MX0CNB	S18T018594	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
6MX0CNB	S18T018594	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
6MX0CNB	S18T018594	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
6MX0CNB	S18T018594	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
6MX0CNB	S18T018594	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
6MX0CNB	S18T018594	71-36-3	1-Butanol	PPBV	102	<5.55	<11.1	0.480		20181468
6MX0CNB	S18T018594	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
6MX0CNB	S18T018594	78-93-3	2-Butanone	PPBV	96.0	<5.60	56.6	0.620		20181468
6MX0CNB	S18T018594	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468
6MX0CNB	S18T018594	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468
6MX0CNB	S18T018594	78-94-4	3-Buten-2-one	PPBV	104	<5.70	67.2	0.480		20181468
6MX0CNB	S18T018594	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
6MX0CNB	S18T018594	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
6MX0CNB	S18T018594	75-07-0	Acetaldehyde	PPBV	104	<5.45	1.62E+03	8.80		20181468
6MX0CNB	S18T018594	67-64-1	Acetone	PPBV	110	<5.80	1.92E+03	8.00		20181468
6MX0CNB	S18T018594	75-05-8	Acetonitrile	PPBV	106	<5.50	14.0	0.340		20181468
6MX0CNB	S18T018594	107-02-8	Acrolein	PPBV	116	<5.75	70.0	0.520		20181468
6MX0CNB	S18T018594	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440		20181468
6MX0CNB	S18T018594	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
6MX0CNB	S18T018594	71-43-2	Benzene	PPBV	102	<5.40	170	0.480		20181468
6MX0CNB	S18T018594	123-72-8	Butanal	PPBV	102	<4.95	68.0	0.280		20181468
6MX0CNB	S18T018594	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
6MX0CNB	S18T018594	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
6MX0CNB	S18T018594	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
6MX0CNB	S18T018594	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
6MX0CNB	S18T018594	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
6MX0CNB	S18T018594	124-18-5	Decane	PPBV	92.2	<5.20	26.8	0.460		20181468
6MX0CNB	S18T018594	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
6MX0CNB	S18T018594	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
6MX0CNB	S18T018594	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
6MX0CNB	S18T018594	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
6MX0CNB	S18T018594	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.940		20181468
6MX0CNB	S18T018594	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
6MX0CNB	S18T018594	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468

6MX0CNB	S18T018594	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468
6MX0CNB	S18T018594	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
6MX0CNB	S18T018594	108-88-3	Toluene	PPBV	96.3	<5.40	48.3	0.560		20181468
6MX0CNB	S18T018594	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
6MX0CNB	S18T018594	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
6MX0CNB	S18T018594	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
6MX0CNB	S18T018594	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520		20181468
6MX0CNB	S18T018594	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
6MX0CNB	S18T018594	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
6MX0CNC	S18T018595	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	320	20		20181468
6MX0CNC	S18T018595	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
6MX0CNC	S18T018595	110-00-9	Furan	PPBV	87.1	<0.100	1.17	0.0100		20181468
6MX0CNC	S18T018595	107-12-0	Propanenitrile	PPBV	83.3	0.110	0.740	0.0100	B	20181468
6MX0CNC	S18T018595	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
6MX0CNC	S18T018595	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
6MX0CNC	S18T018595	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
6MX0CNC	S18T018595	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
6MX0CNC	S18T018595	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
6MX0CNC	S18T018595	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
6MX0CNC	S18T018595	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
6MX0CNC	S18T018595	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
6MX0CNC	S18T018595	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
6MX0CNC	S18T018595	71-36-3	1-Butanol	PPBV	102	<5.55	<11.1	0.480		20181468
6MX0CNC	S18T018595	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
6MX0CNC	S18T018595	78-93-3	2-Butanone	PPBV	96.0	<5.60	<11.2	0.620		20181468
6MX0CNC	S18T018595	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340		20181468
6MX0CNC	S18T018595	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520		20181468
6MX0CNC	S18T018595	78-94-4	3-Buten-2-one	PPBV	104	<5.70	<11.4	0.480		20181468
6MX0CNC	S18T018595	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380		20181468
6MX0CNC	S18T018595	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520		20181468
6MX0CNC	S18T018595	75-07-0	Acetaldehyde	PPBV	104	<5.45	103	0.440		20181468
6MX0CNC	S18T018595	67-64-1	Acetone	PPBV	110	<5.80	58.0	0.400		20181468
6MX0CNC	S18T018595	75-05-8	Acetonitrile	PPBV	106	<5.50	<11.0	0.340		20181468
6MX0CNC	S18T018595	107-02-8	Acrolein	PPBV	116	<5.75	<11.5	0.520		20181468
6MX0CNC	S18T018595	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440		20181468
6MX0CNC	S18T018595	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620		20181468
6MX0CNC	S18T018595	71-43-2	Benzene	PPBV	102	<5.40	<10.8	0.480		20181468
6MX0CNC	S18T018595	123-72-8	Butanal	PPBV	102	<4.95	<9.90	0.280		20181468
6MX0CNC	S18T018595	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420		20181468
6MX0CNC	S18T018595	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440		20181468
6MX0CNC	S18T018595	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440		20181468
6MX0CNC	S18T018595	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520		20181468
6MX0CNC	S18T018595	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460		20181468
6MX0CNC	S18T018595	124-18-5	Decane	PPBV	92.2	<5.20	<10.4	0.460		20181468
6MX0CNC	S18T018595	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540		20181468
6MX0CNC	S18T018595	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480		20181468
6MX0CNC	S18T018595	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360		20181468
6MX0CNC	S18T018595	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380		20181468
6MX0CNC	S18T018595	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.940		20181468
6MX0CNC	S18T018595	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400		20181468
6MX0CNC	S18T018595	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420		20181468
6MX0CNC	S18T018595	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380		20181468
6MX0CNC	S18T018595	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520		20181468
6MX0CNC	S18T018595	108-88-3	Toluene	PPBV	96.3	<5.40	<10.8	0.560		20181468
6MX0CNC	S18T018595	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480		20181468
6MX0CNC	S18T018595	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480		20181468
6MX0CNC	S18T018595	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380		20181468
6MX0CNC	S18T018595	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520		20181468
6MX0CNC	S18T018595	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460		20181468
6MX0CNC	S18T018595	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360		20181468
6MX0CND	S18T018596	10024-97-2	Nitrous Oxide	PPMV	99	<5.0	320	20		20181468
6MX0CND	S18T018596	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	Y	20181468
6MX0CND	S18T018596	110-00-9	Furan	PPBV	87.1	<0.100	0.360	0.0100		20181468
6MX0CND	S18T018596	107-12-0	Propanenitrile	PPBV	83.3	0.110	0.440	0.0100	B	20181468
6MX0CND	S18T018596	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	92.8	<5.30	<10.6	0.220		20181468
6MX0CND	S18T018596	79-00-5	1,1,2-Trichloroethane	PPBV	96.6	<5.30	<10.6	0.440		20181468
6MX0CND	S18T018596	75-34-3	1,1-Dichloroethane	PPBV	109	<5.25	<10.5	0.440		20181468
6MX0CND	S18T018596	75-35-4	1,1-Dichloroethene	PPBV	112	<5.45	<10.9	0.440		20181468
6MX0CND	S18T018596	107-06-2	1,2-Dichloroethane	PPBV	106	<5.20	<10.4	0.500		20181468
6MX0CND	S18T018596	106-99-0	1,3-Butadiene	PPBV	105	<5.35	<10.7	0.380		20181468
6MX0CND	S18T018596	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.360		20181468
6MX0CND	S18T018596	106-46-7	1,4-Dichlorobenzene	PPBV	88.8	<5.25	<10.5	0.580		20181468
6MX0CND	S18T018596	123-91-1	1,4-Dioxane	PPBV	98.2	<5.60	<11.2	0.580		20181468
6MX0CND	S18T018596	71-36-3	1-Butanol	PPBV	102	<5.55	26.4	0.480		20181468
6MX0CND	S18T018596	71-23-8	1-Propanol	PPBV	99.4	<5.65	<11.3	0.440		20181468
6MX0CND	S18T018596	78-93-3	2-Butanone	PPBV	96.0	<5.60	<11.2	0.620		20181468

6MX0CND	S18T018596	110-43-0	2-Heptanone	PPBV	93.7	<5.10	<10.2	0.340	20181468
6MX0CND	S18T018596	591-78-6	2-Hexanone	PPBV	92.1	<5.45	<10.9	0.520	20181468
6MX0CND	S18T018596	78-94-4	3-Buten-2-one	PPBV	104	<5.70	<11.4	0.480	20181468
6MX0CND	S18T018596	106-35-4	3-Heptanone	PPBV	94.9	<5.20	<10.4	0.380	20181468
6MX0CND	S18T018596	108-10-1	4-Methyl-2-Pentanone	PPBV	91.9	<5.20	<10.4	0.520	20181468
6MX0CND	S18T018596	75-07-0	Acetaldehyde	PPBV	104	<5.45	50.3	0.440	20181468
6MX0CND	S18T018596	67-64-1	Acetone	PPBV	110	<5.80	918	2.00	20181468
6MX0CND	S18T018596	75-05-8	Acetonitrile	PPBV	106	<5.50	40.9	0.340	20181468
6MX0CND	S18T018596	107-02-8	Acrolein	PPBV	116	<5.75	<11.5	0.520	20181468
6MX0CND	S18T018596	107-13-1	Acrylonitrile	PPBV	106	<5.85	<11.7	0.440	20181468
6MX0CND	S18T018596	107-05-1	Allyl Chloride	PPBV	108	<5.50	<11.0	0.620	20181468
6MX0CND	S18T018596	71-43-2	Benzene	PPBV	102	<5.40	<10.8	0.480	20181468
6MX0CND	S18T018596	123-72-8	Butanal	PPBV	102	<4.95	<9.90	0.280	20181468
6MX0CND	S18T018596	56-23-5	Carbon tetrachloride	PPBV	104	<5.30	<10.6	0.420	20181468
6MX0CND	S18T018596	108-90-7	Chlorobenzene	PPBV	97.3	<5.40	<10.8	0.440	20181468
6MX0CND	S18T018596	75-00-3	Chloroethane	PPBV	110	<5.30	<10.6	0.440	20181468
6MX0CND	S18T018596	67-66-3	Chloroform	PPBV	104	<5.35	<10.7	0.520	20181468
6MX0CND	S18T018596	110-82-7	Cyclohexane	PPBV	103	<5.30	<10.6	0.460	20181468
6MX0CND	S18T018596	124-18-5	Decane	PPBV	92.2	<5.20	<10.4	0.460	20181468
6MX0CND	S18T018596	64-17-5	Ethanol	PPBV	103	<5.55	<11.1	0.540	20181468
6MX0CND	S18T018596	141-78-6	Ethyl acetate	PPBV	102	<5.20	<10.4	0.480	20181468
6MX0CND	S18T018596	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.360	20181468
6MX0CND	S18T018596	110-54-3	Hexane	PPBV	109	<5.40	<10.8	0.380	20181468
6MX0CND	S18T018596	67-56-1	Methanol	PPBV	81.0	<5.10	<10.2	0.940	20181468
6MX0CND	S18T018596	75-09-2	Methylene Chloride	PPBV	105	<5.30	<10.6	0.400	20181468
6MX0CND	S18T018596	100-42-5	Styrene	PPBV	94.3	<5.25	<10.5	0.420	20181468
6MX0CND	S18T018596	127-18-4	Tetrachloroethene	PPBV	100	<5.20	<10.4	0.380	20181468
6MX0CND	S18T018596	109-99-9	Tetrahydrofuran	PPBV	102	<5.45	<10.9	0.520	20181468
6MX0CND	S18T018596	108-88-3	Toluene	PPBV	96.3	<5.40	<10.8	0.560	20181468
6MX0CND	S18T018596	79-01-6	Trichloroethene	PPBV	99.0	<5.25	<10.5	0.480	20181468
6MX0CND	S18T018596	75-69-4	Trichlorofluoromethane	PPBV	109	<5.20	<10.4	0.480	20181468
6MX0CND	S18T018596	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.380	20181468
6MX0CND	S18T018596	123-86-4	n-Butyl acetate	PPBV	94.4	<5.35	<10.7	0.520	20181468
6MX0CND	S18T018596	142-82-5	n-Heptane	PPBV	98.7	<5.35	<10.7	0.460	20181468
6MX0CND	S18T018596	10061-02-6	trans-1,3-Dichloropropene	PPBV	101	<5.05	<10.1	0.360	20181468

J - Estimated
T - Tentatively Identified Compound
B - Blank Contamination
Y - Comment
N - Named TIC
NA = Not Analyzed, ND = Not Detected
DSRSpreadsheetWOLimits 3.0.13a
DSR.Jar v. 3.0.14

DSRComment 3.0.13
DSR.Jar v. 3.0.14

NUCON
22-oct-2018 10:07:02

Verification Sample Comments

Sample: S18T018593 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018594 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018595 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018596 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018597 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018598 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018599 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T018600 Group: 20181468
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

22-oct-2018 10:58:02
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	CAS #	ANALYTE	RESULT_ UNIT	STANDARD	BLANK	RESULT	Det Limit	QUALIFIER	SAMPLE_ GROUP
3OL0CNA0	S18T019728	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181597
3OL0CNA0	S18T019728	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<49.9	n/a	Y	20181597
3OL0CNA0	S18T019728	110-00-9	Furan	PPBV	87.1	<0.100	5.58	9.98E-03		20181597
3OL0CNA0	S18T019728	107-12-0	Propanenitrile	PPBV	77.8	<0.100	20.0	0.0399		20181597
3OL0CNA0	S18T019728	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	101	<5.30	<10.6	0.220		20181597
3OL0CNA0	S18T019728	79-00-5	1,1,2-Trichloroethane	PPBV	99.8	<5.30	<10.6	0.439		20181597
3OL0CNA0	S18T019728	75-34-3	1,1-Dichloroethane	PPBV	107	<5.25	<10.5	0.439		20181597
3OL0CNA0	S18T019728	75-35-4	1,1-Dichloroethene	PPBV	113	<5.45	<10.9	0.439		20181597
3OL0CNA0	S18T019728	107-06-2	1,2-Dichloroethane	PPBV	105	<5.20	<10.4	0.499		20181597
3OL0CNA0	S18T019728	106-99-0	1,3-Butadiene	PPBV	108	<5.35	3.11E+03	7.58		20181597
3OL0CNA0	S18T019728	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.359		20181597
3OL0CNA0	S18T019728	106-46-7	1,4-Dichlorobenzene	PPBV	99.8	<5.25	<10.5	0.579		20181597
3OL0CNA0	S18T019728	123-91-1	1,4-Dioxane	PPBV	97.9	<5.60	<11.2	0.579		20181597
3OL0CNA0	S18T019728	71-36-3	1-Butanol	PPBV	102	<5.55	<11.1	0.479		20181597
3OL0CNA0	S18T019728	71-23-8	1-Propanol	PPBV	103	<5.65	<11.3	0.439		20181597
3OL0CNA0	S18T019728	78-93-3	2-Butanone	PPBV	96.4	<5.60	<11.2	0.619		20181597
3OL0CNA0	S18T019728	110-43-0	2-Heptanone	PPBV	94.4	<5.10	<10.2	0.339		20181597
3OL0CNA0	S18T019728	591-78-6	2-Hexanone	PPBV	96.2	<5.45	<10.9	0.519		20181597
3OL0CNA0	S18T019728	78-94-4	3-Buten-2-one	PPBV	101	<5.70	<11.4	0.479		20181597
3OL0CNA0	S18T019728	106-35-4	3-Heptanone	PPBV	96.5	<5.20	<10.4	0.379		20181597
3OL0CNA0	S18T019728	108-10-1	4-Methyl-2-Pentanone	PPBV	95.2	<5.20	<10.4	0.519		20181597
3OL0CNA0	S18T019728	75-07-0	Acetaldehyde	PPBV	107	<5.45	53.9	0.439		20181597
3OL0CNA0	S18T019728	67-64-1	Acetone	PPBV	108	<5.80	23.5	0.399		20181597
3OL0CNA0	S18T019728	75-05-8	Acetonitrile	PPBV	107	<5.50	2.84E+03	6.79		20181597
3OL0CNA0	S18T019728	107-02-8	Acrolein	PPBV	113	<5.75	48.4	0.519		20181597
3OL0CNA0	S18T019728	107-13-1	Acrylonitrile	PPBV	104	<5.85	<11.7	0.439		20181597
3OL0CNA0	S18T019728	107-05-1	Allyl Chloride	PPBV	106	<5.50	<11.0	0.619		20181597
3OL0CNA0	S18T019728	71-43-2	Benzene	PPBV	102	<5.40	<10.8	0.479		20181597
3OL0CNA0	S18T019728	123-72-8	Butanal	PPBV	105	<4.95	<9.88	0.279		20181597
3OL0CNA0	S18T019728	56-23-5	Carbon tetrachloride	PPBV	102	<5.30	<10.6	0.419		20181597
3OL0CNA0	S18T019728	108-90-7	Chlorobenzene	PPBV	98.9	<5.40	<10.8	0.439		20181597
3OL0CNA0	S18T019728	75-00-3	Chloroethane	PPBV	112	<5.30	<10.6	0.439		20181597
3OL0CNA0	S18T019728	67-66-3	Chloroform	PPBV	102	<5.35	<10.7	0.519		20181597
3OL0CNA0	S18T019728	110-82-7	Cyclohexane	PPBV	101	<5.30	<10.6	0.459		20181597
3OL0CNA0	S18T019728	124-18-5	Decane	PPBV	98.1	<5.20	<10.4	0.459		20181597
3OL0CNA0	S18T019728	64-17-5	Ethanol	PPBV	108	<5.55	<11.1	0.539		20181597
3OL0CNA0	S18T019728	141-78-6	Ethyl acetate	PPBV	101	<5.20	<10.4	0.479		20181597
3OL0CNA0	S18T019728	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.359		20181597
3OL0CNA0	S18T019728	110-54-3	Hexane	PPBV	105	<5.40	<10.8	0.379		20181597
3OL0CNA0	S18T019728	67-56-1	Methanol	PPBV	86.7	<5.10	256	9.38		20181597
3OL0CNA0	S18T019728	75-09-2	Methylene Chloride	PPBV	104	<5.30	<10.6	0.399		20181597
3OL0CNA0	S18T019728	100-42-5	Styrene	PPBV	96.5	<5.25	<10.5	0.419		20181597
3OL0CNA0	S18T019728	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.379		20181597
3OL0CNA0	S18T019728	109-99-9	Tetrahydrofuran	PPBV	99.4	<5.45	<10.9	0.519		20181597
3OL0CNA0	S18T019728	108-88-3	Toluene	PPBV	100	<5.40	<10.8	0.559		20181597
3OL0CNA0	S18T019728	79-01-6	Trichloroethene	PPBV	98.4	<5.25	<10.5	0.479		20181597
3OL0CNA0	S18T019728	75-69-4	Trichlorofluoromethane	PPBV	113	<5.20	<10.4	0.479		20181597
3OL0CNA0	S18T019728	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.379		20181597
3OL0CNA0	S18T019728	123-86-4	n-Butyl acetate	PPBV	96.4	<5.35	<10.7	0.519		20181597
3OL0CNA0	S18T019728	142-82-5	n-Heptane	PPBV	98.5	<5.35	<10.7	0.459		20181597
3OL0CNA0	S18T019728	10061-02-6	trans-1,3-Dichloropropene	PPBV	100	<5.05	<10.1	0.359		20181597
3OL0CNB0	S18T019729	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<9.5	3.7	Y	20181597
3OL0CNB0	S18T019729	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<47.7	n/a	Y	20181597
3OL0CNB0	S18T019729	110-00-9	Furan	PPBV	79.8	<0.100	42.9	0.0763		20181597
3OL0CNB0	S18T019729	107-12-0	Propanenitrile	PPBV	77.8	<0.100	18.0	0.0763		20181597
3OL0CNB0	S18T019729	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	101	<5.30	<10.1	0.210	Y	20181597
3OL0CNB0	S18T019729	79-00-5	1,1,2-Trichloroethane	PPBV	99.8	<5.30	<10.1	0.420	Y	20181597
3OL0CNB0	S18T019729	75-34-3	1,1-Dichloroethane	PPBV	107	<5.25	<10.0	0.420	Y	20181597
3OL0CNB0	S18T019729	75-35-4	1,1-Dichloroethene	PPBV	113	<5.45	<10.4	0.420	Y	20181597
3OL0CNB0	S18T019729	107-06-2	1,2-Dichloroethane	PPBV	105	<5.20	<9.92	0.477	Y	20181597
3OL0CNB0	S18T019729	106-99-0	1,3-Butadiene	PPBV	108	<5.35	<10.2	0.363	Y	20181597
3OL0CNB0	S18T019729	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.64	0.343	Y	20181597
3OL0CNB0	S18T019729	106-46-7	1,4-Dichlorobenzene	PPBV	99.8	<5.25	<10.0	0.553	Y	20181597
3OL0CNB0	S18T019729	123-91-1	1,4-Dioxane	PPBV	97.9	<5.60	<10.7	0.553	Y	20181597
3OL0CNB0	S18T019729	71-36-3	1-Butanol	PPBV	102	<5.55	20.8	0.458	Y	20181597
3OL0CNB0	S18T019729	71-23-8	1-Propanol	PPBV	103	<5.65	<10.8	0.420	Y	20181597
3OL0CNB0	S18T019729	78-93-3	2-Butanone	PPBV	96.4	<5.60	39.1	0.592	Y	20181597
3OL0CNB0	S18T019729	110-43-0	2-Heptanone	PPBV	94.4	<5.10	<9.73	0.324	Y	20181597
3OL0CNB0	S18T019729	591-78-6	2-Hexanone	PPBV	96.2	<5.45	<10.4	0.496	Y	20181597

3OL0CNB0	S18T019729	78-94-4	3-Buten-2-one	PPBV	101	<5.70	77.4	0.458	Y		20181597
3OL0CNB0	S18T019729	106-35-4	3-Heptanone	PPBV	96.5	<5.20	13.0	0.363	Y		20181597
3OL0CNB0	S18T019729	108-10-1	4-Methyl-2-Pentanone	PPBV	95.2	<5.20	<9.92	0.496	Y		20181597
3OL0CNB0	S18T019729	75-07-0	Acetaldehyde	PPBV	107	<5.45	1.41E+03	4.20	Y		20181597
3OL0CNB0	S18T019729	67-64-1	Acetone	PPBV	108	<5.80	289	1.53	Y		20181597
3OL0CNB0	S18T019729	75-05-8	Acetonitrile	PPBV	107	<5.50	22.8	0.324	Y		20181597
3OL0CNB0	S18T019729	107-02-8	Acrolein	PPBV	113	<5.75	428	1.98	Y		20181597
3OL0CNB0	S18T019729	107-13-1	Acrylonitrile	PPBV	104	<5.85	<11.2	0.420	Y		20181597
3OL0CNB0	S18T019729	107-05-1	Allyl Chloride	PPBV	106	<5.50	<10.5	0.592	Y		20181597
3OL0CNB0	S18T019729	71-43-2	Benzene	PPBV	102	<5.40	139	0.458	Y		20181597
3OL0CNB0	S18T019729	123-72-8	Butanal	PPBV	105	<4.95	68.3	0.267	Y		20181597
3OL0CNB0	S18T019729	56-23-5	Carbon tetrachloride	PPBV	102	<5.30	<10.1	0.401	Y		20181597
3OL0CNB0	S18T019729	108-90-7	Chlorobenzene	PPBV	98.9	<5.40	<10.3	0.420	Y		20181597
3OL0CNB0	S18T019729	75-00-3	Chloroethane	PPBV	112	<5.30	<10.1	0.420	Y		20181597
3OL0CNB0	S18T019729	67-66-3	Chloroform	PPBV	102	<5.35	<10.2	0.496	Y		20181597
3OL0CNB0	S18T019729	110-82-7	Cyclohexane	PPBV	101	<5.30	<10.1	0.439	Y		20181597
3OL0CNB0	S18T019729	124-18-5	Decane	PPBV	98.1	<5.20	<9.92	0.439	Y		20181597
3OL0CNB0	S18T019729	64-17-5	Ethanol	PPBV	108	<5.55	<10.6	0.515	Y		20181597
3OL0CNB0	S18T019729	141-78-6	Ethyl acetate	PPBV	101	<5.20	<9.92	0.458	Y		20181597
3OL0CNB0	S18T019729	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.1	0.343	Y		20181597
3OL0CNB0	S18T019729	110-54-3	Hexane	PPBV	105	<5.40	<10.3	0.363	Y		20181597
3OL0CNB0	S18T019729	67-56-1	Methanol	PPBV	86.7	<5.10	<9.73	0.897	Y		20181597
3OL0CNB0	S18T019729	75-09-2	Methylene Chloride	PPBV	104	<5.30	<10.1	0.382	Y		20181597
3OL0CNB0	S18T019729	100-42-5	Styrene	PPBV	96.5	<5.25	<10.0	0.401	Y		20181597
3OL0CNB0	S18T019729	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<9.92	0.363	Y		20181597
3OL0CNB0	S18T019729	109-99-9	Tetrahydrofuran	PPBV	99.4	<5.45	<10.4	0.496	Y		20181597
3OL0CNB0	S18T019729	108-88-3	Toluene	PPBV	100	<5.40	36.9	0.534	Y		20181597
3OL0CNB0	S18T019729	79-01-6	Trichloroethene	PPBV	98.4	<5.25	<10.0	0.458	Y		20181597
3OL0CNB0	S18T019729	75-69-4	Trichlorofluoromethane	PPBV	113	<5.20	<9.92	0.458	Y		20181597
3OL0CNB0	S18T019729	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<10.5	0.363	Y		20181597
3OL0CNB0	S18T019729	123-86-4	n-Butyl acetate	PPBV	96.4	<5.35	11.8	0.496	Y		20181597
3OL0CNB0	S18T019729	142-82-5	n-Heptane	PPBV	98.5	<5.35	<10.2	0.439	Y		20181597
3OL0CNB0	S18T019729	10061-02-6	trans-1,3-Dichloropropene	PPBV	100	<5.05	<9.64	0.343	Y		20181597
3OL0CNC0	S18T019730	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<9.7	3.8			20181597
3OL0CNC0	S18T019730	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<48.7	n/a	Y		20181597
3OL0CNC0	S18T019730	110-00-9	Furan	PPBV	87.1	<0.100	0.380	9.74E-03			20181597
3OL0CNC0	S18T019730	107-12-0	Propanenitrile	PPBV	83.3	0.130	1.69	9.74E-03	B		20181597
3OL0CNC0	S18T019730	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	101	<5.30	<10.3	0.214			20181597
3OL0CNC0	S18T019730	79-00-5	1,1,2-Trichloroethane	PPBV	99.8	<5.30	<10.3	0.429			20181597
3OL0CNC0	S18T019730	75-34-3	1,1-Dichloroethane	PPBV	107	<5.25	<10.2	0.429			20181597
3OL0CNC0	S18T019730	75-35-4	1,1-Dichloroethene	PPBV	113	<5.45	<10.6	0.429			20181597
3OL0CNC0	S18T019730	107-06-2	1,2-Dichloroethane	PPBV	105	<5.20	<10.1	0.487			20181597
3OL0CNC0	S18T019730	106-99-0	1,3-Butadiene	PPBV	108	<5.35	<10.4	0.370			20181597
3OL0CNC0	S18T019730	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.84	0.351			20181597
3OL0CNC0	S18T019730	106-46-7	1,4-Dichlorobenzene	PPBV	99.8	<5.25	<10.2	0.565			20181597
3OL0CNC0	S18T019730	123-91-1	1,4-Dioxane	PPBV	97.9	<5.60	<10.9	0.565			20181597
3OL0CNC0	S18T019730	71-36-3	1-Butanol	PPBV	102	<5.55	<10.8	0.468			20181597
3OL0CNC0	S18T019730	71-23-8	1-Propanol	PPBV	103	<5.65	<11.0	0.429			20181597
3OL0CNC0	S18T019730	78-93-3	2-Butanone	PPBV	96.4	<5.60	<10.9	0.604			20181597
3OL0CNC0	S18T019730	110-43-0	2-Heptanone	PPBV	94.4	<5.10	<9.94	0.331			20181597
3OL0CNC0	S18T019730	591-78-6	2-Hexanone	PPBV	96.2	<5.45	<10.6	0.506			20181597
3OL0CNC0	S18T019730	78-94-4	3-Buten-2-one	PPBV	101	<5.70	<11.1	0.468			20181597
3OL0CNC0	S18T019730	106-35-4	3-Heptanone	PPBV	96.5	<5.20	<10.1	0.370			20181597
3OL0CNC0	S18T019730	108-10-1	4-Methyl-2-Pentanone	PPBV	95.2	<5.20	<10.1	0.506			20181597
3OL0CNC0	S18T019730	75-07-0	Acetaldehyde	PPBV	107	<5.45	112	0.429			20181597
3OL0CNC0	S18T019730	67-64-1	Acetone	PPBV	108	<5.80	33.9	0.390			20181597
3OL0CNC0	S18T019730	75-05-8	Acetonitrile	PPBV	107	<5.50	11.3	0.331			20181597
3OL0CNC0	S18T019730	107-02-8	Acrolein	PPBV	113	<5.75	<11.2	0.506			20181597
3OL0CNC0	S18T019730	107-13-1	Acrylonitrile	PPBV	104	<5.85	<11.4	0.429			20181597
3OL0CNC0	S18T019730	107-05-1	Allyl Chloride	PPBV	106	<5.50	<10.7	0.604			20181597
3OL0CNC0	S18T019730	71-43-2	Benzene	PPBV	102	<5.40	11.9	0.468			20181597
3OL0CNC0	S18T019730	123-72-8	Butanal	PPBV	105	<4.95	<9.64	0.273			20181597
3OL0CNC0	S18T019730	56-23-5	Carbon tetrachloride	PPBV	102	<5.30	<10.3	0.409			20181597
3OL0CNC0	S18T019730	108-90-7	Chlorobenzene	PPBV	98.9	<5.40	<10.5	0.429			20181597
3OL0CNC0	S18T019730	75-00-3	Chloroethane	PPBV	112	<5.30	<10.3	0.429			20181597
3OL0CNC0	S18T019730	67-66-3	Chloroform	PPBV	102	<5.35	<10.4	0.506			20181597
3OL0CNC0	S18T019730	110-82-7	Cyclohexane	PPBV	101	<5.30	<10.3	0.448			20181597
3OL0CNC0	S18T019730	124-18-5	Decane	PPBV	98.1	<5.20	<10.1	0.448			20181597
3OL0CNC0	S18T019730	64-17-5	Ethanol	PPBV	108	<5.55	<10.8	0.526			20181597
3OL0CNC0	S18T019730	141-78-6	Ethyl acetate	PPBV	101	<5.20	11.5	0.468			20181597
3OL0CNC0	S18T019730	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.3	0.351			20181597
3OL0CNC0	S18T019730	110-54-3	Hexane	PPBV	105	<5.40	<10.5	0.370			20181597
3OL0CNC0	S18T019730	67-56-1	Methanol	PPBV	86.7	<5.10	<9.94	0.916			20181597
3OL0CNC0	S18T019730	75-09-2	Methylene Chloride	PPBV	104	<5.30	<10.3	0.390			20181597
3OL0CNC0	S18T019730	100-42-5	Styrene	PPBV	96.5	<5.25	<10.2	0.409			20181597
3OL0CNC0	S18T019730	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.1	0.370			20181597

3OL0CNC0	S18T019730	109-99-9	Tetrahydrofuran	PPBV	99.4	<5.45	<10.6	0.506			20181597
3OL0CNC0	S18T019730	108-88-3	Toluene	PPBV	100	<5.40	<10.5	0.545			20181597
3OL0CNC0	S18T019730	79-01-6	Trichloroethene	PPBV	98.4	<5.25	<10.2	0.468			20181597
3OL0CNC0	S18T019730	75-69-4	Trichlorofluoromethane	PPBV	113	<5.20	<10.1	0.468			20181597
3OL0CNC0	S18T019730	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<10.7	0.370			20181597
3OL0CNC0	S18T019730	123-86-4	n-Butyl acetate	PPBV	96.4	<5.35	<10.4	0.506			20181597
3OL0CNC0	S18T019730	142-82-5	n-Heptane	PPBV	98.5	<5.35	<10.4	0.448			20181597
3OL0CNC0	S18T019730	10061-02-6	trans-1,3-Dichloropropene	PPBV	100	<5.05	<9.84	0.351			20181597
3OL0CND0	S18T019731	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9			20181597
3OL0CND0	S18T019731	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<49.9	n/a		Y	20181597
3OL0CND0	S18T019731	110-00-9	Furan	PPBV	79.8	<0.100	0.349	9.98E-03			20181597
3OL0CND0	S18T019731	107-12-0	Propanenitrile	PPBV	77.8	<0.100	9.26	9.98E-03			20181597
3OL0CND0	S18T019731	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	101	<5.30	<10.6	0.219			20181597
3OL0CND0	S18T019731	79-00-5	1,1,2-Trichloroethane	PPBV	99.8	<5.30	<10.6	0.439			20181597
3OL0CND0	S18T019731	75-34-3	1,1-Dichloroethane	PPBV	107	<5.25	<10.5	0.439			20181597
3OL0CND0	S18T019731	75-35-4	1,1-Dichloroethene	PPBV	113	<5.45	<10.9	0.439			20181597
3OL0CND0	S18T019731	107-06-2	1,2-Dichloroethane	PPBV	105	<5.20	<10.4	0.499			20181597
3OL0CND0	S18T019731	106-99-0	1,3-Butadiene	PPBV	108	<5.35	<10.7	0.379			20181597
3OL0CND0	S18T019731	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.1	0.359			20181597
3OL0CND0	S18T019731	106-46-7	1,4-Dichlorobenzene	PPBV	99.8	<5.25	<10.5	0.579			20181597
3OL0CND0	S18T019731	123-91-1	1,4-Dioxane	PPBV	97.9	<5.60	<11.2	0.579			20181597
3OL0CND0	S18T019731	71-36-3	1-Butanol	PPBV	102	<5.55	<11.1	0.479			20181597
3OL0CND0	S18T019731	71-23-8	1-Propanol	PPBV	103	<5.65	<11.3	0.439			20181597
3OL0CND0	S18T019731	78-93-3	2-Butanone	PPBV	96.4	<5.60	<11.2	0.619			20181597
3OL0CND0	S18T019731	110-43-0	2-Heptanone	PPBV	94.4	<5.10	<10.2	0.339			20181597
3OL0CND0	S18T019731	591-78-6	2-Hexanone	PPBV	96.2	<5.45	<10.9	0.519			20181597
3OL0CND0	S18T019731	78-94-4	3-Buten-2-one	PPBV	101	<5.70	<11.4	0.479			20181597
3OL0CND0	S18T019731	106-35-4	3-Heptanone	PPBV	96.5	<5.20	<10.4	0.379			20181597
3OL0CND0	S18T019731	108-10-1	4-Methyl-2-Pentanone	PPBV	95.2	<5.20	<10.4	0.519			20181597
3OL0CND0	S18T019731	75-07-0	Acetaldehyde	PPBV	107	<5.45	51.9	0.439			20181597
3OL0CND0	S18T019731	67-64-1	Acetone	PPBV	108	<5.80	26.2	0.399			20181597
3OL0CND0	S18T019731	75-05-8	Acetonitrile	PPBV	107	<5.50	6.63E+04	136			20181597
3OL0CND0	S18T019731	107-02-8	Acrolein	PPBV	113	<5.75	<11.5	0.519			20181597
3OL0CND0	S18T019731	107-13-1	Acrylonitrile	PPBV	104	<5.85	<11.7	0.439			20181597
3OL0CND0	S18T019731	107-05-1	Allyl Chloride	PPBV	106	<5.50	<11.0	0.619			20181597
3OL0CND0	S18T019731	71-43-2	Benzene	PPBV	102	<5.40	<10.8	0.479			20181597
3OL0CND0	S18T019731	123-72-8	Butanal	PPBV	105	<4.95	<9.88	0.279			20181597
3OL0CND0	S18T019731	56-23-5	Carbon tetrachloride	PPBV	102	<5.30	<10.6	0.419			20181597
3OL0CND0	S18T019731	108-90-7	Chlorobenzene	PPBV	98.9	<5.40	<10.8	0.439			20181597
3OL0CND0	S18T019731	75-00-3	Chloroethane	PPBV	112	<5.30	<10.6	0.439			20181597
3OL0CND0	S18T019731	67-66-3	Chloroform	PPBV	102	<5.35	<10.7	0.519			20181597
3OL0CND0	S18T019731	110-82-7	Cyclohexane	PPBV	101	<5.30	<10.6	0.459			20181597
3OL0CND0	S18T019731	124-18-5	Decane	PPBV	98.1	<5.20	<10.4	0.459			20181597
3OL0CND0	S18T019731	64-17-5	Ethanol	PPBV	108	<5.55	<11.1	0.539			20181597
3OL0CND0	S18T019731	141-78-6	Ethyl acetate	PPBV	101	<5.20	15.2	0.479			20181597
3OL0CND0	S18T019731	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.6	0.359			20181597
3OL0CND0	S18T019731	110-54-3	Hexane	PPBV	105	<5.40	<10.8	0.379			20181597
3OL0CND0	S18T019731	67-56-1	Methanol	PPBV	86.7	<5.10	<10.2	0.938			20181597
3OL0CND0	S18T019731	75-09-2	Methylene Chloride	PPBV	104	<5.30	<10.6	0.399			20181597
3OL0CND0	S18T019731	100-42-5	Styrene	PPBV	96.5	<5.25	<10.5	0.419			20181597
3OL0CND0	S18T019731	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.4	0.379			20181597
3OL0CND0	S18T019731	109-99-9	Tetrahydrofuran	PPBV	99.4	<5.45	<10.9	0.519			20181597
3OL0CND0	S18T019731	108-88-3	Toluene	PPBV	100	<5.40	<10.8	0.559			20181597
3OL0CND0	S18T019731	79-01-6	Trichloroethene	PPBV	98.4	<5.25	<10.5	0.479			20181597
3OL0CND0	S18T019731	75-69-4	Trichlorofluoromethane	PPBV	113	<5.20	<10.4	0.479			20181597
3OL0CND0	S18T019731	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<11.0	0.379			20181597
3OL0CND0	S18T019731	123-86-4	n-Butyl acetate	PPBV	96.4	<5.35	19.7	0.519			20181597
3OL0CND0	S18T019731	142-82-5	n-Heptane	PPBV	98.5	<5.35	<10.7	0.459			20181597
3OL0CND0	S18T019731	10061-02-6	trans-1,3-Dichloropropene	PPBV	100	<5.05	<10.1	0.359			20181597
3OL1CNC0	S18T019732	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<9.8	3.8			20181597
3OL1CNC0	S18T019732	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<48.9	n/a		Y	20181597
3OL1CNC0	S18T019732	110-00-9	Furan	PPBV	87.1	<0.100	<0.0977	9.77E-03			20181597
3OL1CNC0	S18T019732	107-12-0	Propanenitrile	PPBV	83.3	0.130	0.322	9.77E-03	B		20181597
3OL1CNC0	S18T019732	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	101	<5.30	<10.4	0.215			20181597
3OL1CNC0	S18T019732	79-00-5	1,1,2-Trichloroethane	PPBV	99.8	<5.30	<10.4	0.430			20181597
3OL1CNC0	S18T019732	75-34-3	1,1-Dichloroethane	PPBV	107	<5.25	<10.3	0.430			20181597
3OL1CNC0	S18T019732	75-35-4	1,1-Dichloroethene	PPBV	113	<5.45	<10.7	0.430			20181597
3OL1CNC0	S18T019732	107-06-2	1,2-Dichloroethane	PPBV	105	<5.20	<10.2	0.489			20181597
3OL1CNC0	S18T019732	106-99-0	1,3-Butadiene	PPBV	108	<5.35	<10.5	0.371			20181597
3OL1CNC0	S18T019732	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.87	0.352			20181597
3OL1CNC0	S18T019732	106-46-7	1,4-Dichlorobenzene	PPBV	99.8	<5.25	<10.3	0.567			20181597
3OL1CNC0	S18T019732	123-91-1	1,4-Dioxane	PPBV	97.9	<5.60	<10.9	0.567			20181597
3OL1CNC0	S18T019732	71-36-3	1-Butanol	PPBV	102	<5.55	<10.8	0.469			20181597
3OL1CNC0	S18T019732	71-23-8	1-Propanol	PPBV	103	<5.65	<11.0	0.430			20181597
3OL1CNC0	S18T019732	78-93-3	2-Butanone	PPBV	96.4	<5.60	<10.9	0.606			20181597
3OL1CNC0	S18T019732	110-43-0	2-Heptanone	PPBV	94.4	<5.10	<9.97	0.332			20181597

3OL1CNC0	S18T019732	591-78-6	2-Hexanone	PPBV	96.2	<5.45	<10.7	0.508	20181597
3OL1CNC0	S18T019732	78-94-4	3-Buten-2-one	PPBV	101	<5.70	<11.1	0.469	20181597
3OL1CNC0	S18T019732	106-35-4	3-Heptanone	PPBV	96.5	<5.20	<10.2	0.371	20181597
3OL1CNC0	S18T019732	108-10-1	4-Methyl-2-Pentanone	PPBV	95.2	<5.20	<10.2	0.508	20181597
3OL1CNC0	S18T019732	75-07-0	Acetaldehyde	PPBV	107	<5.45	50.0	0.430	20181597
3OL1CNC0	S18T019732	67-64-1	Acetone	PPBV	108	<5.80	12.8	0.391	20181597
3OL1CNC0	S18T019732	75-05-8	Acetonitrile	PPBV	107	<5.50	<10.8	0.332	20181597
3OL1CNC0	S18T019732	107-02-8	Acrolein	PPBV	113	<5.75	<11.2	0.508	20181597
3OL1CNC0	S18T019732	107-13-1	Acrylonitrile	PPBV	104	<5.85	<11.4	0.430	20181597
3OL1CNC0	S18T019732	107-05-1	Allyl Chloride	PPBV	106	<5.50	<10.8	0.606	20181597
3OL1CNC0	S18T019732	71-43-2	Benzene	PPBV	102	<5.40	<10.6	0.469	20181597
3OL1CNC0	S18T019732	123-72-8	Butanal	PPBV	105	<4.95	<9.68	0.274	20181597
3OL1CNC0	S18T019732	56-23-5	Carbon tetrachloride	PPBV	102	<5.30	<10.4	0.410	20181597
3OL1CNC0	S18T019732	108-90-7	Chlorobenzene	PPBV	98.9	<5.40	<10.6	0.430	20181597
3OL1CNC0	S18T019732	75-00-3	Chloroethane	PPBV	112	<5.30	<10.4	0.430	20181597
3OL1CNC0	S18T019732	67-66-3	Chloroform	PPBV	102	<5.35	<10.5	0.508	20181597
3OL1CNC0	S18T019732	110-82-7	Cyclohexane	PPBV	101	<5.30	<10.4	0.450	20181597
3OL1CNC0	S18T019732	124-18-5	Decane	PPBV	98.1	<5.20	<10.2	0.450	20181597
3OL1CNC0	S18T019732	64-17-5	Ethanol	PPBV	108	<5.55	<10.8	0.528	20181597
3OL1CNC0	S18T019732	141-78-6	Ethyl acetate	PPBV	101	<5.20	<10.2	0.469	20181597
3OL1CNC0	S18T019732	100-41-4	Ethylbenzene	PPBV	100	<5.30	<10.4	0.352	20181597
3OL1CNC0	S18T019732	110-54-3	Hexane	PPBV	105	<5.40	<10.6	0.371	20181597
3OL1CNC0	S18T019732	67-56-1	Methanol	PPBV	86.7	<5.10	<9.97	0.919	20181597
3OL1CNC0	S18T019732	75-09-2	Methylene Chloride	PPBV	104	<5.30	<10.4	0.391	20181597
3OL1CNC0	S18T019732	100-42-5	Styrene	PPBV	96.5	<5.25	<10.3	0.410	20181597
3OL1CNC0	S18T019732	127-18-4	Tetrachloroethene	PPBV	101	<5.20	<10.2	0.371	20181597
3OL1CNC0	S18T019732	109-99-9	Tetrahydrofuran	PPBV	99.4	<5.45	<10.7	0.508	20181597
3OL1CNC0	S18T019732	108-88-3	Toluene	PPBV	100	<5.40	<10.6	0.547	20181597
3OL1CNC0	S18T019732	79-01-6	Trichloroethene	PPBV	98.4	<5.25	<10.3	0.469	20181597
3OL1CNC0	S18T019732	75-69-4	Trichlorofluoromethane	PPBV	113	<5.20	<10.2	0.469	20181597
3OL1CNC0	S18T019732	10061-01-5	cis-1,3-Dichloropropene	PPBV	100	<5.50	<10.8	0.371	20181597
3OL1CNC0	S18T019732	123-86-4	n-Butyl acetate	PPBV	96.4	<5.35	<10.5	0.508	20181597
3OL1CNC0	S18T019732	142-82-5	n-Heptane	PPBV	98.5	<5.35	<10.5	0.450	20181597
3OL1CNC0	S18T019732	10061-02-6	trans-1,3-Dichloropropene	PPBV	100	<5.05	<9.87	0.352	20181597

J - Estimated
T - Tentatively Identified Compounc
B - Blank Contaminatior
Y - Comment
N - Named TIC
NA = Not Analyzed, ND = Not Detectec
DSRSpreadsheetWOLimits 3.0.13ε
DSR.Jar v. 3.0.14

DSRComment 3.0.13
DSR.Jar v. 3.0.14

NUCON
22-oct-2018 10:49:52

Verification Sample Comments

Sample: S18T019728 Group: 20181597

Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T019729 Group: 20181597

Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Y flag: Canister for this sample was used at day 32 after re-evacuation.

Sample: S18T019730 Group: 20181597

Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T019731 Group: 20181597

Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

Sample: S18T019732 Group: 20181597

Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/16/18

22-oct-2018 11:16:58
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	CAS #	ANALYTE	RESULT_UNIT	STANDARD	BLANK	RESULT	Det Limit	QUALIFIER	SAMPLE_ GROUP
1OL0CNA0	S18T020369	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
1OL0CNA0	S18T020369	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
1OL0CNA0	S18T020369	110-00-9	Furan	PPBV	115	<0.100	2.17	9.99E-03	H	20181649
1OL0CNA0	S18T020369	107-12-0	Propanenitrile	PPBV	115	<0.110	2.24	9.99E-03	H	20181649
1OL0CNA0	S18T020369	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
1OL0CNA0	S18T020369	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
1OL0CNA0	S18T020369	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
1OL0CNA0	S18T020369	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
1OL0CNA0	S18T020369	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
1OL0CNA0	S18T020369	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
1OL0CNA0	S18T020369	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.99	0.360	H	20181649
1OL0CNA0	S18T020369	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.839	H	20181649
1OL0CNA0	S18T020369	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
1OL0CNA0	S18T020369	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
1OL0CNA0	S18T020369	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
1OL0CNA0	S18T020369	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
1OL0CNA0	S18T020369	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
1OL0CNA0	S18T020369	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
1OL0CNA0	S18T020369	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
1OL0CNA0	S18T020369	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
1OL0CNA0	S18T020369	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
1OL0CNA0	S18T020369	75-07-0	Acetaldehyde	PPBV	105	<5.90	1.24E+05	560	H	20181649
1OL0CNA0	S18T020369	67-64-1	Acetone	PPBV	118	<5.60	<11.2	0.320	H	20181649
1OL0CNA0	S18T020369	75-05-8	Acetonitrile	PPBV	103	<5.85	8.05E+04	1.50E+03	H	20181649
1OL0CNA0	S18T020369	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
1OL0CNA0	S18T020369	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
1OL0CNA0	S18T020369	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
1OL0CNA0	S18T020369	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
1OL0CNA0	S18T020369	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
1OL0CNA0	S18T020369	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
1OL0CNA0	S18T020369	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
1OL0CNA0	S18T020369	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
1OL0CNA0	S18T020369	67-66-3	Chloroform	PPBV	86.2	<5.00	<9.99	0.260	H	20181649
1OL0CNA0	S18T020369	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
1OL0CNA0	S18T020369	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
1OL0CNA0	S18T020369	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
1OL0CNA0	S18T020369	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
1OL0CNA0	S18T020369	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
1OL0CNA0	S18T020369	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
1OL0CNA0	S18T020369	67-56-1	Methanol	PPBV	109	<6.00	14.8	0.899	H	20181649
1OL0CNA0	S18T020369	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
1OL0CNA0	S18T020369	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
1OL0CNA0	S18T020369	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
1OL0CNA0	S18T020369	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
1OL0CNA0	S18T020369	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
1OL0CNA0	S18T020369	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
1OL0CNA0	S18T020369	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.59	0.500	H	20181649
1OL0CNA0	S18T020369	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
1OL0CNA0	S18T020369	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
1OL0CNA0	S18T020369	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
1OL0CNA0	S18T020369	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<9.99	0.360	H	20181649
1OL0CNB0	S18T020370	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
1OL0CNB0	S18T020370	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
1OL0CNB0	S18T020370	110-00-9	Furan	PPBV	118	<0.100	29.0	0.0800	H	20181649
1OL0CNB0	S18T020370	107-12-0	Propanenitrile	PPBV	115	<0.110	8.30	0.0100	H	20181649
1OL0CNB0	S18T020370	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
1OL0CNB0	S18T020370	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
1OL0CNB0	S18T020370	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
1OL0CNB0	S18T020370	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
1OL0CNB0	S18T020370	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
1OL0CNB0	S18T020370	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
1OL0CNB0	S18T020370	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
1OL0CNB0	S18T020370	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
1OL0CNB0	S18T020370	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
1OL0CNB0	S18T020370	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
1OL0CNB0	S18T020370	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
1OL0CNB0	S18T020370	78-93-3	2-Butanone	PPBV	124	<5.75	30.1	0.380	H	20181649
1OL0CNB0	S18T020370	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
1OL0CNB0	S18T020370	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
1OL0CNB0	S18T020370	78-94-4	3-Buten-2-one	PPBV	119	<5.75	41.6	0.280	H	20181649
1OL0CNB0	S18T020370	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
1OL0CNB0	S18T020370	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
1OL0CNB0	S18T020370	75-07-0	Acetaldehyde	PPBV	105	<5.90	5.22E+03	35.0	H	20181649
1OL0CNB0	S18T020370	67-64-1	Acetone	PPBV	115	<5.60	347	1.28	H	20181649

1OL0CNB0	S18T020370	75-05-8	Acetonitrile	PPBV	103	<5.85	4.89E+03	94.0	H	20181649
1OL0CNB0	S18T020370	107-02-8	Acrolein	PPBV	110	<5.60	84.6	0.460	H	20181649
1OL0CNB0	S18T020370	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
1OL0CNB0	S18T020370	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
1OL0CNB0	S18T020370	71-43-2	Benzene	PPBV	93.4	<5.45	144	0.420	H	20181649
1OL0CNB0	S18T020370	123-72-8	Butanal	PPBV	113	<6.00	39.7	0.300	H	20181649
1OL0CNB0	S18T020370	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
1OL0CNB0	S18T020370	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
1OL0CNB0	S18T020370	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
1OL0CNB0	S18T020370	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
1OL0CNB0	S18T020370	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
1OL0CNB0	S18T020370	124-18-5	Decane	PPBV	92.2	<5.35	33.1	0.420	H	20181649
1OL0CNB0	S18T020370	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
1OL0CNB0	S18T020370	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
1OL0CNB0	S18T020370	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
1OL0CNB0	S18T020370	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
1OL0CNB0	S18T020370	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.900	H	20181649
1OL0CNB0	S18T020370	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
1OL0CNB0	S18T020370	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
1OL0CNB0	S18T020370	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
1OL0CNB0	S18T020370	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
1OL0CNB0	S18T020370	108-88-3	Toluene	PPBV	90.1	<5.40	40.5	0.460	H	20181649
1OL0CNB0	S18T020370	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
1OL0CNB0	S18T020370	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
1OL0CNB0	S18T020370	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
1OL0CNB0	S18T020370	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
1OL0CNB0	S18T020370	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
1OL0CNB0	S18T020370	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
1OL0CNC0	S18T020371	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
1OL0CNC0	S18T020371	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
1OL0CNC0	S18T020371	110-00-9	Furan	PPBV	115	<0.100	0.400	0.0100	H	20181649
1OL0CNC0	S18T020371	107-12-0	Propanenitrile	PPBV	115	<0.110	0.740	0.0100	H	20181649
1OL0CNC0	S18T020371	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
1OL0CNC0	S18T020371	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
1OL0CNC0	S18T020371	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
1OL0CNC0	S18T020371	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
1OL0CNC0	S18T020371	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
1OL0CNC0	S18T020371	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
1OL0CNC0	S18T020371	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
1OL0CNC0	S18T020371	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
1OL0CNC0	S18T020371	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
1OL0CNC0	S18T020371	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
1OL0CNC0	S18T020371	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
1OL0CNC0	S18T020371	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
1OL0CNC0	S18T020371	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
1OL0CNC0	S18T020371	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
1OL0CNC0	S18T020371	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
1OL0CNC0	S18T020371	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
1OL0CNC0	S18T020371	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
1OL0CNC0	S18T020371	75-07-0	Acetaldehyde	PPBV	104	<5.90	157	0.700	H	20181649
1OL0CNC0	S18T020371	67-64-1	Acetone	PPBV	118	<5.60	111	0.320	H	20181649
1OL0CNC0	S18T020371	75-05-8	Acetonitrile	PPBV	104	<5.85	126	1.88	H	20181649
1OL0CNC0	S18T020371	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
1OL0CNC0	S18T020371	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
1OL0CNC0	S18T020371	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
1OL0CNC0	S18T020371	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
1OL0CNC0	S18T020371	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
1OL0CNC0	S18T020371	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
1OL0CNC0	S18T020371	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
1OL0CNC0	S18T020371	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
1OL0CNC0	S18T020371	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
1OL0CNC0	S18T020371	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
1OL0CNC0	S18T020371	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
1OL0CNC0	S18T020371	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
1OL0CNC0	S18T020371	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
1OL0CNC0	S18T020371	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
1OL0CNC0	S18T020371	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
1OL0CNC0	S18T020371	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.900	H	20181649
1OL0CNC0	S18T020371	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
1OL0CNC0	S18T020371	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
1OL0CNC0	S18T020371	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
1OL0CNC0	S18T020371	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
1OL0CNC0	S18T020371	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
1OL0CNC0	S18T020371	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
1OL0CNC0	S18T020371	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
1OL0CNC0	S18T020371	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
1OL0CNC0	S18T020371	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
1OL0CNC0	S18T020371	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
1OL0CNC0	S18T020371	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
1OL0CND0	S18T020372	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
1OL0CND0	S18T020372	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<49.9	n/a	HY	20181649

1OL0CND0	S18T020372	110-00-9	Furan	PPBV	115	<0.100	0.0998	9.98E-03	H	20181649
1OL0CND0	S18T020372	107-12-0	Propanenitrile	PPBV	115	<0.110	0.290	9.98E-03	H	20181649
1OL0CND0	S18T020372	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.359	H	20181649
1OL0CND0	S18T020372	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.359	H	20181649
1OL0CND0	S18T020372	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
1OL0CND0	S18T020372	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.399	H	20181649
1OL0CND0	S18T020372	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
1OL0CND0	S18T020372	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.539	H	20181649
1OL0CND0	S18T020372	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.98	0.359	H	20181649
1OL0CND0	S18T020372	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.839	H	20181649
1OL0CND0	S18T020372	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
1OL0CND0	S18T020372	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.339	Ha	20181649
1OL0CND0	S18T020372	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.319	H	20181649
1OL0CND0	S18T020372	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.379	H	20181649
1OL0CND0	S18T020372	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
1OL0CND0	S18T020372	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.459	H	20181649
1OL0CND0	S18T020372	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
1OL0CND0	S18T020372	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.379	H	20181649
1OL0CND0	S18T020372	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.479	H	20181649
1OL0CND0	S18T020372	75-07-0	Acetaldehyde	PPBV	104	<5.90	34.8	0.699	H	20181649
1OL0CND0	S18T020372	67-64-1	Acetone	PPBV	118	<5.60	<11.2	0.319	H	20181649
1OL0CND0	S18T020372	75-05-8	Acetonitrile	PPBV	104	<5.85	25.8	1.88	H	20181649
1OL0CND0	S18T020372	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.459	H	20181649
1OL0CND0	S18T020372	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.499	H	20181649
1OL0CND0	S18T020372	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.339	H	20181649
1OL0CND0	S18T020372	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.419	H	20181649
1OL0CND0	S18T020372	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
1OL0CND0	S18T020372	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.399	H	20181649
1OL0CND0	S18T020372	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.539	H	20181649
1OL0CND0	S18T020372	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.759	H	20181649
1OL0CND0	S18T020372	67-66-3	Chloroform	PPBV	86.2	<5.00	<9.98	0.260	H	20181649
1OL0CND0	S18T020372	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
1OL0CND0	S18T020372	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.419	H	20181649
1OL0CND0	S18T020372	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.559	H	20181649
1OL0CND0	S18T020372	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.739	H	20181649
1OL0CND0	S18T020372	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.439	H	20181649
1OL0CND0	S18T020372	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
1OL0CND0	S18T020372	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.899	H	20181649
1OL0CND0	S18T020372	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
1OL0CND0	S18T020372	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.399	H	20181649
1OL0CND0	S18T020372	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.479	H	20181649
1OL0CND0	S18T020372	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.359	H	20181649
1OL0CND0	S18T020372	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.459	H	20181649
1OL0CND0	S18T020372	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.419	H	20181649
1OL0CND0	S18T020372	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.58	0.499	H	20181649
1OL0CND0	S18T020372	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.379	H	20181649
1OL0CND0	S18T020372	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.459	H	20181649
1OL0CND0	S18T020372	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
1OL0CND0	S18T020372	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<9.98	0.359	H	20181649
1OL1CNA0	S18T020373	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
1OL1CNA0	S18T020373	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
1OL1CNA0	S18T020373	110-00-9	Furan	PPBV	115	<0.100	1.90	9.99E-03	H	20181649
1OL1CNA0	S18T020373	107-12-0	Propanenitrile	PPBV	115	<0.110	0.390	9.99E-03	H	20181649
1OL1CNA0	S18T020373	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
1OL1CNA0	S18T020373	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
1OL1CNA0	S18T020373	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
1OL1CNA0	S18T020373	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
1OL1CNA0	S18T020373	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
1OL1CNA0	S18T020373	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
1OL1CNA0	S18T020373	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.99	0.360	H	20181649
1OL1CNA0	S18T020373	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.839	H	20181649
1OL1CNA0	S18T020373	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
1OL1CNA0	S18T020373	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
1OL1CNA0	S18T020373	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
1OL1CNA0	S18T020373	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
1OL1CNA0	S18T020373	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
1OL1CNA0	S18T020373	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
1OL1CNA0	S18T020373	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
1OL1CNA0	S18T020373	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
1OL1CNA0	S18T020373	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
1OL1CNA0	S18T020373	75-07-0	Acetaldehyde	PPBV	105	<5.90	6.33E+04	560	H	20181649
1OL1CNA0	S18T020373	67-64-1	Acetone	PPBV	115	<5.60	691	2.56	H	20181649
1OL1CNA0	S18T020373	75-05-8	Acetonitrile	PPBV	103	<5.85	5.12E+04	1.50E+03	H	20181649
1OL1CNA0	S18T020373	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
1OL1CNA0	S18T020373	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
1OL1CNA0	S18T020373	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
1OL1CNA0	S18T020373	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
1OL1CNA0	S18T020373	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
1OL1CNA0	S18T020373	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
1OL1CNA0	S18T020373	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
1OL1CNA0	S18T020373	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.759	H	20181649

1OL1CNA0	S18T020373	67-66-3	Chloroform	PPBV	86.2	<5.00	<9.99	0.260	H	20181649
1OL1CNA0	S18T020373	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
1OL1CNA0	S18T020373	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
1OL1CNA0	S18T020373	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
1OL1CNA0	S18T020373	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
1OL1CNA0	S18T020373	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
1OL1CNA0	S18T020373	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
1OL1CNA0	S18T020373	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.899	H	20181649
1OL1CNA0	S18T020373	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
1OL1CNA0	S18T020373	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
1OL1CNA0	S18T020373	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
1OL1CNA0	S18T020373	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
1OL1CNA0	S18T020373	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
1OL1CNA0	S18T020373	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
1OL1CNA0	S18T020373	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.59	0.500	H	20181649
1OL1CNA0	S18T020373	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
1OL1CNA0	S18T020373	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
1OL1CNA0	S18T020373	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
1OL1CNA0	S18T020373	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<9.99	0.360	H	20181649
1OL1CND0	S18T020374	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
1OL1CND0	S18T020374	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
1OL1CND0	S18T020374	110-00-9	Furan	PPBV	115	<0.100	0.350	0.0100	H	20181649
1OL1CND0	S18T020374	107-12-0	Propanenitrile	PPBV	115	<0.110	1.68	0.0100	H	20181649
1OL1CND0	S18T020374	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
1OL1CND0	S18T020374	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
1OL1CND0	S18T020374	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
1OL1CND0	S18T020374	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
1OL1CND0	S18T020374	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
1OL1CND0	S18T020374	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
1OL1CND0	S18T020374	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
1OL1CND0	S18T020374	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
1OL1CND0	S18T020374	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
1OL1CND0	S18T020374	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
1OL1CND0	S18T020374	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
1OL1CND0	S18T020374	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
1OL1CND0	S18T020374	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
1OL1CND0	S18T020374	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
1OL1CND0	S18T020374	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
1OL1CND0	S18T020374	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
1OL1CND0	S18T020374	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
1OL1CND0	S18T020374	75-07-0	Acetaldehyde	PPBV	104	<5.90	103	0.700	H	20181649
1OL1CND0	S18T020374	67-64-1	Acetone	PPBV	118	<5.60	17.2	0.320	H	20181649
1OL1CND0	S18T020374	75-05-8	Acetonitrile	PPBV	104	<5.85	59.6	1.88	H	20181649
1OL1CND0	S18T020374	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
1OL1CND0	S18T020374	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
1OL1CND0	S18T020374	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
1OL1CND0	S18T020374	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
1OL1CND0	S18T020374	123-72-8	Butanal	PPBV	113	<6.00	12.5	0.300	H	20181649
1OL1CND0	S18T020374	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
1OL1CND0	S18T020374	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
1OL1CND0	S18T020374	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
1OL1CND0	S18T020374	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
1OL1CND0	S18T020374	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
1OL1CND0	S18T020374	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
1OL1CND0	S18T020374	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
1OL1CND0	S18T020374	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
1OL1CND0	S18T020374	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
1OL1CND0	S18T020374	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
1OL1CND0	S18T020374	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.900	H	20181649
1OL1CND0	S18T020374	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
1OL1CND0	S18T020374	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
1OL1CND0	S18T020374	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
1OL1CND0	S18T020374	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
1OL1CND0	S18T020374	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
1OL1CND0	S18T020374	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
1OL1CND0	S18T020374	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
1OL1CND0	S18T020374	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
1OL1CND0	S18T020374	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
1OL1CND0	S18T020374	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
1OL1CND0	S18T020374	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
3OL2CNA0	S18T020364	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
3OL2CNA0	S18T020364	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
3OL2CNA0	S18T020364	110-00-9	Furan	PPBV	115	<0.100	0.150	0.0100	H	20181649
3OL2CNA0	S18T020364	107-12-0	Propanenitrile	PPBV	115	<0.110	3.70	0.0100	H	20181649
3OL2CNA0	S18T020364	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
3OL2CNA0	S18T020364	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
3OL2CNA0	S18T020364	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
3OL2CNA0	S18T020364	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
3OL2CNA0	S18T020364	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
3OL2CNA0	S18T020364	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
3OL2CNA0	S18T020364	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649

3OL2CNA0	S18T020364	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
3OL2CNA0	S18T020364	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
3OL2CNA0	S18T020364	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
3OL2CNA0	S18T020364	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
3OL2CNA0	S18T020364	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
3OL2CNA0	S18T020364	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
3OL2CNA0	S18T020364	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
3OL2CNA0	S18T020364	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
3OL2CNA0	S18T020364	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
3OL2CNA0	S18T020364	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
3OL2CNA0	S18T020364	75-07-0	Acetaldehyde	PPBV	104	<5.90	25.9	0.700	H	20181649
3OL2CNA0	S18T020364	67-64-1	Acetone	PPBV	118	<5.60	<11.2	0.320	H	20181649
3OL2CNA0	S18T020364	75-05-8	Acetonitrile	PPBV	104	<5.85	<11.7	1.88	H	20181649
3OL2CNA0	S18T020364	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
3OL2CNA0	S18T020364	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
3OL2CNA0	S18T020364	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
3OL2CNA0	S18T020364	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
3OL2CNA0	S18T020364	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
3OL2CNA0	S18T020364	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
3OL2CNA0	S18T020364	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
3OL2CNA0	S18T020364	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
3OL2CNA0	S18T020364	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
3OL2CNA0	S18T020364	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
3OL2CNA0	S18T020364	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
3OL2CNA0	S18T020364	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
3OL2CNA0	S18T020364	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
3OL2CNA0	S18T020364	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
3OL2CNA0	S18T020364	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
3OL2CNA0	S18T020364	67-56-1	Methanol	PPBV	109	<6.00	22.0	0.900	H	20181649
3OL2CNA0	S18T020364	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
3OL2CNA0	S18T020364	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
3OL2CNA0	S18T020364	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
3OL2CNA0	S18T020364	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
3OL2CNA0	S18T020364	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
3OL2CNA0	S18T020364	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
3OL2CNA0	S18T020364	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
3OL2CNA0	S18T020364	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
3OL2CNA0	S18T020364	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
3OL2CNA0	S18T020364	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
3OL2CNA0	S18T020364	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
3OL2CNB0	S18T020365	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
3OL2CNB0	S18T020365	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
3OL2CNB0	S18T020365	110-00-9	Furan	PPBV	118	<0.100	35.5	0.0800	H	20181649
3OL2CNB0	S18T020365	107-12-0	Propanenitrile	PPBV	115	<0.110	6.54	0.0100	H	20181649
3OL2CNB0	S18T020365	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
3OL2CNB0	S18T020365	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
3OL2CNB0	S18T020365	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
3OL2CNB0	S18T020365	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
3OL2CNB0	S18T020365	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
3OL2CNB0	S18T020365	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
3OL2CNB0	S18T020365	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
3OL2CNB0	S18T020365	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
3OL2CNB0	S18T020365	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
3OL2CNB0	S18T020365	71-36-3	1-Butanol	PPBV	143	<6.00	16.1	0.340	Ha	20181649
3OL2CNB0	S18T020365	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
3OL2CNB0	S18T020365	78-93-3	2-Butanone	PPBV	124	<5.75	42.2	0.380	H	20181649
3OL2CNB0	S18T020365	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
3OL2CNB0	S18T020365	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
3OL2CNB0	S18T020365	78-94-4	3-Buten-2-one	PPBV	119	<5.75	58.8	0.280	H	20181649
3OL2CNB0	S18T020365	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
3OL2CNB0	S18T020365	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
3OL2CNB0	S18T020365	75-07-0	Acetaldehyde	PPBV	105	<5.90	1.33E+03	5.60	H	20181649
3OL2CNB0	S18T020365	67-64-1	Acetone	PPBV	115	<5.60	287	2.56	H	20181649
3OL2CNB0	S18T020365	75-05-8	Acetonitrile	PPBV	104	<5.85	31.3	1.88	H	20181649
3OL2CNB0	S18T020365	107-02-8	Acrolein	PPBV	110	<5.60	142	0.460	H	20181649
3OL2CNB0	S18T020365	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
3OL2CNB0	S18T020365	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
3OL2CNB0	S18T020365	71-43-2	Benzene	PPBV	93.4	<5.45	170	0.420	H	20181649
3OL2CNB0	S18T020365	123-72-8	Butanal	PPBV	113	<6.00	61.6	0.300	H	20181649
3OL2CNB0	S18T020365	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
3OL2CNB0	S18T020365	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
3OL2CNB0	S18T020365	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
3OL2CNB0	S18T020365	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
3OL2CNB0	S18T020365	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
3OL2CNB0	S18T020365	124-18-5	Decane	PPBV	92.2	<5.35	36.4	0.420	H	20181649
3OL2CNB0	S18T020365	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
3OL2CNB0	S18T020365	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
3OL2CNB0	S18T020365	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
3OL2CNB0	S18T020365	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
3OL2CNB0	S18T020365	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.900	H	20181649
3OL2CNB0	S18T020365	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649

3OL2CNB0	S18T020365	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
3OL2CNB0	S18T020365	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
3OL2CNB0	S18T020365	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
3OL2CNB0	S18T020365	108-88-3	Toluene	PPBV	90.1	<5.40	47.5	0.460	H	20181649
3OL2CNB0	S18T020365	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
3OL2CNB0	S18T020365	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
3OL2CNB0	S18T020365	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
3OL2CNB0	S18T020365	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
3OL2CNB0	S18T020365	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
3OL2CNB0	S18T020365	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
3OL2CNC0	S18T020366	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
3OL2CNC0	S18T020366	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
3OL2CNC0	S18T020366	110-00-9	Furan	PPBV	115	<0.100	0.560	0.0100	H	20181649
3OL2CNC0	S18T020366	107-12-0	Propanenitrile	PPBV	115	<0.110	1.70	0.0100	H	20181649
3OL2CNC0	S18T020366	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
3OL2CNC0	S18T020366	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
3OL2CNC0	S18T020366	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
3OL2CNC0	S18T020366	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
3OL2CNC0	S18T020366	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
3OL2CNC0	S18T020366	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
3OL2CNC0	S18T020366	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
3OL2CNC0	S18T020366	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
3OL2CNC0	S18T020366	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
3OL2CNC0	S18T020366	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
3OL2CNC0	S18T020366	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
3OL2CNC0	S18T020366	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
3OL2CNC0	S18T020366	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
3OL2CNC0	S18T020366	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
3OL2CNC0	S18T020366	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
3OL2CNC0	S18T020366	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
3OL2CNC0	S18T020366	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
3OL2CNC0	S18T020366	75-07-0	Acetaldehyde	PPBV	104	<5.90	139	0.700	H	20181649
3OL2CNC0	S18T020366	67-64-1	Acetone	PPBV	118	<5.60	36.2	0.320	H	20181649
3OL2CNC0	S18T020366	75-05-8	Acetonitrile	PPBV	104	<5.85	<11.7	1.88	H	20181649
3OL2CNC0	S18T020366	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
3OL2CNC0	S18T020366	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
3OL2CNC0	S18T020366	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
3OL2CNC0	S18T020366	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
3OL2CNC0	S18T020366	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
3OL2CNC0	S18T020366	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
3OL2CNC0	S18T020366	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
3OL2CNC0	S18T020366	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
3OL2CNC0	S18T020366	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
3OL2CNC0	S18T020366	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
3OL2CNC0	S18T020366	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
3OL2CNC0	S18T020366	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
3OL2CNC0	S18T020366	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
3OL2CNC0	S18T020366	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
3OL2CNC0	S18T020366	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
3OL2CNC0	S18T020366	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.900	H	20181649
3OL2CNC0	S18T020366	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
3OL2CNC0	S18T020366	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
3OL2CNC0	S18T020366	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
3OL2CNC0	S18T020366	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
3OL2CNC0	S18T020366	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
3OL2CNC0	S18T020366	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
3OL2CNC0	S18T020366	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
3OL2CNC0	S18T020366	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
3OL2CNC0	S18T020366	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
3OL2CNC0	S18T020366	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
3OL2CNC0	S18T020366	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
3OL2CND0	S18T020367	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
3OL2CND0	S18T020367	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
3OL2CND0	S18T020367	110-00-9	Furan	PPBV	115	<0.100	0.560	0.0100	H	20181649
3OL2CND0	S18T020367	107-12-0	Propanenitrile	PPBV	115	<0.110	1.67	0.0100	H	20181649
3OL2CND0	S18T020367	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
3OL2CND0	S18T020367	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
3OL2CND0	S18T020367	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
3OL2CND0	S18T020367	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
3OL2CND0	S18T020367	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
3OL2CND0	S18T020367	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
3OL2CND0	S18T020367	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
3OL2CND0	S18T020367	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
3OL2CND0	S18T020367	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
3OL2CND0	S18T020367	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
3OL2CND0	S18T020367	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
3OL2CND0	S18T020367	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
3OL2CND0	S18T020367	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
3OL2CND0	S18T020367	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
3OL2CND0	S18T020367	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
3OL2CND0	S18T020367	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649

3OL2CND0	S18T020367	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
3OL2CND0	S18T020367	75-07-0	Acetaldehyde	PPBV	104	<5.90	94.6	0.700	H	20181649
3OL2CND0	S18T020367	67-64-1	Acetone	PPBV	118	<5.60	22.0	0.320	H	20181649
3OL2CND0	S18T020367	75-05-8	Acetonitrile	PPBV	104	<5.85	28.6	1.88	H	20181649
3OL2CND0	S18T020367	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
3OL2CND0	S18T020367	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
3OL2CND0	S18T020367	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
3OL2CND0	S18T020367	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
3OL2CND0	S18T020367	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
3OL2CND0	S18T020367	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
3OL2CND0	S18T020367	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
3OL2CND0	S18T020367	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
3OL2CND0	S18T020367	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
3OL2CND0	S18T020367	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
3OL2CND0	S18T020367	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
3OL2CND0	S18T020367	64-17-5	Ethanol	PPBV	119	<5.95	<11.9	0.560	H	20181649
3OL2CND0	S18T020367	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
3OL2CND0	S18T020367	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
3OL2CND0	S18T020367	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
3OL2CND0	S18T020367	67-56-1	Methanol	PPBV	109	<6.00	<12.0	0.900	H	20181649
3OL2CND0	S18T020367	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
3OL2CND0	S18T020367	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
3OL2CND0	S18T020367	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
3OL2CND0	S18T020367	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
3OL2CND0	S18T020367	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
3OL2CND0	S18T020367	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
3OL2CND0	S18T020367	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
3OL2CND0	S18T020367	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
3OL2CND0	S18T020367	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
3OL2CND0	S18T020367	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649
3OL2CND0	S18T020367	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649
3OL3CNA0	S18T020368	10024-97-2	Nitrous Oxide	PPMV	100	<5.0	<10	3.9		20181649
3OL3CNA0	S18T020368	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181649
3OL3CNA0	S18T020368	110-00-9	Furan	PPBV	115	<0.100	<0.100	0.0100	H	20181649
3OL3CNA0	S18T020368	107-12-0	Propanenitrile	PPBV	115	<0.110	<0.110	0.0100	H	20181649
3OL3CNA0	S18T020368	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	91.9	<5.30	<10.6	0.360	H	20181649
3OL3CNA0	S18T020368	79-00-5	1,1,2-Trichloroethane	PPBV	85.3	<5.50	<11.0	0.360	H	20181649
3OL3CNA0	S18T020368	75-34-3	1,1-Dichloroethane	PPBV	85.0	<5.45	<10.9	0.300	H	20181649
3OL3CNA0	S18T020368	75-35-4	1,1-Dichloroethene	PPBV	92.1	<5.40	<10.8	0.400	H	20181649
3OL3CNA0	S18T020368	107-06-2	1,2-Dichloroethane	PPBV	90.2	<5.35	<10.7	0.260	H	20181649
3OL3CNA0	S18T020368	106-99-0	1,3-Butadiene	PPBV	90.2	<5.35	<10.7	0.540	H	20181649
3OL3CNA0	S18T020368	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360	H	20181649
3OL3CNA0	S18T020368	106-46-7	1,4-Dichlorobenzene	PPBV	89.5	<5.30	<10.6	0.840	H	20181649
3OL3CNA0	S18T020368	123-91-1	1,4-Dioxane	PPBV	119	<5.65	<11.3	0.300	H	20181649
3OL3CNA0	S18T020368	71-36-3	1-Butanol	PPBV	143	<6.00	<12.0	0.340	Ha	20181649
3OL3CNA0	S18T020368	71-23-8	1-Propanol	PPBV	124	<6.00	<12.0	0.320	H	20181649
3OL3CNA0	S18T020368	78-93-3	2-Butanone	PPBV	124	<5.75	<11.5	0.380	H	20181649
3OL3CNA0	S18T020368	110-43-0	2-Heptanone	PPBV	124	<5.20	<10.4	1.40	H	20181649
3OL3CNA0	S18T020368	591-78-6	2-Hexanone	PPBV	130	<5.50	<11.0	0.460	H	20181649
3OL3CNA0	S18T020368	78-94-4	3-Buten-2-one	PPBV	119	<5.75	<11.5	0.280	H	20181649
3OL3CNA0	S18T020368	106-35-4	3-Heptanone	PPBV	123	<5.20	<10.4	0.380	H	20181649
3OL3CNA0	S18T020368	108-10-1	4-Methyl-2-Pentanone	PPBV	124	<5.45	<10.9	0.480	H	20181649
3OL3CNA0	S18T020368	75-07-0	Acetaldehyde	PPBV	104	<5.90	85.1	0.700	H	20181649
3OL3CNA0	S18T020368	67-64-1	Acetone	PPBV	118	<5.60	<11.2	0.320	H	20181649
3OL3CNA0	S18T020368	75-05-8	Acetonitrile	PPBV	104	<5.85	<11.7	1.88	H	20181649
3OL3CNA0	S18T020368	107-02-8	Acrolein	PPBV	110	<5.60	<11.2	0.460	H	20181649
3OL3CNA0	S18T020368	107-13-1	Acrylonitrile	PPBV	120	<5.75	<11.5	0.500	H	20181649
3OL3CNA0	S18T020368	107-05-1	Allyl Chloride	PPBV	91.8	<5.50	<11.0	0.340	H	20181649
3OL3CNA0	S18T020368	71-43-2	Benzene	PPBV	93.4	<5.45	<10.9	0.420	H	20181649
3OL3CNA0	S18T020368	123-72-8	Butanal	PPBV	113	<6.00	<12.0	0.300	H	20181649
3OL3CNA0	S18T020368	56-23-5	Carbon tetrachloride	PPBV	85.4	<5.25	<10.5	0.400	H	20181649
3OL3CNA0	S18T020368	108-90-7	Chlorobenzene	PPBV	82.9	<5.40	<10.8	0.540	H	20181649
3OL3CNA0	S18T020368	75-00-3	Chloroethane	PPBV	85.3	<5.25	<10.5	0.760	H	20181649
3OL3CNA0	S18T020368	67-66-3	Chloroform	PPBV	86.2	<5.00	<10.0	0.260	H	20181649
3OL3CNA0	S18T020368	110-82-7	Cyclohexane	PPBV	90.6	<5.10	<10.2	0.260	H	20181649
3OL3CNA0	S18T020368	124-18-5	Decane	PPBV	92.2	<5.35	<10.7	0.420	H	20181649
3OL3CNA0	S18T020368	64-17-5	Ethanol	PPBV	106	<5.95	491	2.24	H	20181649
3OL3CNA0	S18T020368	141-78-6	Ethyl acetate	PPBV	119	<5.60	<11.2	0.740	H	20181649
3OL3CNA0	S18T020368	100-41-4	Ethylbenzene	PPBV	86.4	<5.40	<10.8	0.440	H	20181649
3OL3CNA0	S18T020368	110-54-3	Hexane	PPBV	94.5	<5.50	<11.0	0.300	H	20181649
3OL3CNA0	S18T020368	67-56-1	Methanol	PPBV	109	<6.00	53.6	0.900	H	20181649
3OL3CNA0	S18T020368	75-09-2	Methylene Chloride	PPBV	79.8	<5.10	<10.2	0.280	H	20181649
3OL3CNA0	S18T020368	100-42-5	Styrene	PPBV	89.4	<5.30	<10.6	0.400	H	20181649
3OL3CNA0	S18T020368	127-18-4	Tetrachloroethene	PPBV	86.0	<5.20	<10.4	0.480	H	20181649
3OL3CNA0	S18T020368	109-99-9	Tetrahydrofuran	PPBV	115	<5.35	<10.7	0.360	H	20181649
3OL3CNA0	S18T020368	108-88-3	Toluene	PPBV	90.1	<5.40	<10.8	0.460	H	20181649
3OL3CNA0	S18T020368	79-01-6	Trichloroethene	PPBV	86.8	<5.20	<10.4	0.420	H	20181649
3OL3CNA0	S18T020368	75-69-4	Trichlorofluoromethane	PPBV	96.1	<4.80	<9.60	0.500	H	20181649
3OL3CNA0	S18T020368	10061-01-5	cis-1,3-Dichloropropene	PPBV	94.4	<5.25	<10.5	0.380	H	20181649
3OL3CNA0	S18T020368	123-86-4	n-Butyl acetate	PPBV	131	<5.45	<10.9	0.460	H	20181649
3OL3CNA0	S18T020368	142-82-5	n-Heptane	PPBV	97.2	<5.40	<10.8	0.300	H	20181649

3OL3CNA0	S18T020368	10061-02-6	trans-1,3-Dichloropropene	PPBV	96.9	<5.00	<10.0	0.360	H	20181649

J - Estimated
a - LCS Outside Range
T - Tentatively Identified Compound
B - Blank Contamination
Y - Comment
N - Named TIC
H - Missed Holdtime
NA = Not Analyzed, ND = Not Detected
DSRSpreadsheetWOLimits 3.0.13a
DSR.Jar v. 3.0.14

DSRComment 3.0.13
DSR.Jar v. 3.0.14

NUCON
22-oct-2018 11:06:12

Verification Sample Comments

Sample: S18T020364 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020365 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020366 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020368 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020370 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020371 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020372 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020373 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T020374 Group: 20181649
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

22-oct-2018 11:24:47
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	CAS #	ANALYTE	RESULT_ UNIT	STANDARD	BLANK	RESULT	Det Limit	QUALIFIER	SAMPLE_ GROUP
5MX0CNA0	S18T023381	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5MX0CNA0	S18T023381	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5MX0CNA0	S18T023381	110-00-9	Furan	PPBV	118	<0.100	22.4	0.0800	H	20181853
5MX0CNA0	S18T023381	107-12-0	Propanenitrile	PPBV	115	<0.110	<0.110	0.0100	H	20181853
5MX0CNA0	S18T023381	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5MX0CNA0	S18T023381	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5MX0CNA0	S18T023381	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5MX0CNA0	S18T023381	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5MX0CNA0	S18T023381	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5MX0CNA0	S18T023381	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5MX0CNA0	S18T023381	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5MX0CNA0	S18T023381	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5MX0CNA0	S18T023381	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5MX0CNA0	S18T023381	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5MX0CNA0	S18T023381	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5MX0CNA0	S18T023381	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5MX0CNA0	S18T023381	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5MX0CNA0	S18T023381	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5MX0CNA0	S18T023381	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5MX0CNA0	S18T023381	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5MX0CNA0	S18T023381	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5MX0CNA0	S18T023381	75-07-0	Acetaldehyde	PPBV	107	<5.90	<11.8	0.700		20181853
5MX0CNA0	S18T023381	67-64-1	Acetone	PPBV	120	<5.60	154	0.320		20181853
5MX0CNA0	S18T023381	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5MX0CNA0	S18T023381	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5MX0CNA0	S18T023381	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5MX0CNA0	S18T023381	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5MX0CNA0	S18T023381	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5MX0CNA0	S18T023381	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5MX0CNA0	S18T023381	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5MX0CNA0	S18T023381	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5MX0CNA0	S18T023381	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5MX0CNA0	S18T023381	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5MX0CNA0	S18T023381	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5MX0CNA0	S18T023381	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5MX0CNA0	S18T023381	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5MX0CNA0	S18T023381	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5MX0CNA0	S18T023381	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5MX0CNA0	S18T023381	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5MX0CNA0	S18T023381	67-56-1	Methanol	PPBV	102	<6.00	17.6	0.900		20181853
5MX0CNA0	S18T023381	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5MX0CNA0	S18T023381	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853
5MX0CNA0	S18T023381	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853
5MX0CNA0	S18T023381	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5MX0CNA0	S18T023381	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5MX0CNA0	S18T023381	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5MX0CNA0	S18T023381	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5MX0CNA0	S18T023381	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5MX0CNA0	S18T023381	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5MX0CNA0	S18T023381	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5MX0CNA0	S18T023381	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5MX0CNB0	S18T023382	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	4.0		20181853
5MX0CNB0	S18T023382	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.9	n/a	HY	20181853
5MX0CNB0	S18T023382	110-00-9	Furan	PPBV	115	<0.100	6.89	0.0102	H	20181853
5MX0CNB0	S18T023382	107-12-0	Propanenitrile	PPBV	115	<0.110	0.326	0.0102	H	20181853
5MX0CNB0	S18T023382	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.8	0.366		20181853
5MX0CNB0	S18T023382	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.2	0.366		20181853
5MX0CNB0	S18T023382	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<11.1	0.305		20181853
5MX0CNB0	S18T023382	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<11.0	0.407		20181853
5MX0CNB0	S18T023382	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.9	0.265		20181853
5MX0CNB0	S18T023382	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.9	0.550		20181853
5MX0CNB0	S18T023382	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.2	0.366		20181853
5MX0CNB0	S18T023382	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.8	0.855		20181853
5MX0CNB0	S18T023382	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.5	0.305		20181853
5MX0CNB0	S18T023382	71-36-3	1-Butanol	PPBV	132	<6.00	<12.2	0.346		20181853
5MX0CNB0	S18T023382	71-23-8	1-Propanol	PPBV	120	<6.00	<12.2	0.326		20181853
5MX0CNB0	S18T023382	78-93-3	2-Butanone	PPBV	115	<5.75	<11.7	0.387		20181853
5MX0CNB0	S18T023382	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.6	1.43		20181853
5MX0CNB0	S18T023382	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.2	0.468		20181853

5MX0CNB0	S18T023382	78-94-4	3-Buten-2-one	PPBV	109	<5.75	13.0	0.285		20181853
5MX0CNB0	S18T023382	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.6	0.387		20181853
5MX0CNB0	S18T023382	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<11.1	0.489		20181853
5MX0CNB0	S18T023382	75-07-0	Acetaldehyde	PPBV	107	<5.90	152	0.713		20181853
5MX0CNB0	S18T023382	67-64-1	Acetone	PPBV	120	<5.60	32.5	0.326		20181853
5MX0CNB0	S18T023382	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.9	1.91		20181853
5MX0CNB0	S18T023382	107-02-8	Acrolein	PPBV	105	<5.60	70.4	0.468		20181853
5MX0CNB0	S18T023382	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.7	0.509		20181853
5MX0CNB0	S18T023382	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.2	0.346		20181853
5MX0CNB0	S18T023382	71-43-2	Benzene	PPBV	87.1	<5.45	42.7	0.428		20181853
5MX0CNB0	S18T023382	123-72-8	Butanal	PPBV	101	<6.00	<12.2	0.305		20181853
5MX0CNB0	S18T023382	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.7	0.407		20181853
5MX0CNB0	S18T023382	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<11.0	0.550		20181853
5MX0CNB0	S18T023382	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.7	0.774		20181853
5MX0CNB0	S18T023382	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.2	0.265		20181853
5MX0CNB0	S18T023382	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.4	0.265		20181853
5MX0CNB0	S18T023382	124-18-5	Decane	PPBV	88.6	<5.35	<10.9	0.428		20181853
5MX0CNB0	S18T023382	64-17-5	Ethanol	PPBV	113	<5.95	<12.1	0.570		20181853
5MX0CNB0	S18T023382	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.4	0.753		20181853
5MX0CNB0	S18T023382	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<11.0	0.448		20181853
5MX0CNB0	S18T023382	110-54-3	Hexane	PPBV	90.6	<5.50	<11.2	0.305		20181853
5MX0CNB0	S18T023382	67-56-1	Methanol	PPBV	102	<6.00	<12.2	0.916		20181853
5MX0CNB0	S18T023382	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.4	0.285		20181853
5MX0CNB0	S18T023382	100-42-5	Styrene	PPBV	87.2	<5.30	<10.8	0.407		20181853
5MX0CNB0	S18T023382	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.6	0.489		20181853
5MX0CNB0	S18T023382	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.9	0.366		20181853
5MX0CNB0	S18T023382	108-88-3	Toluene	PPBV	82.0	<5.40	12.5	0.468		20181853
5MX0CNB0	S18T023382	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.6	0.428		20181853
5MX0CNB0	S18T023382	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.77	0.509		20181853
5MX0CNB0	S18T023382	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.7	0.387		20181853
5MX0CNB0	S18T023382	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<11.1	0.468		20181853
5MX0CNB0	S18T023382	142-82-5	n-Heptane	PPBV	86.4	<5.40	<11.0	0.305		20181853
5MX0CNB0	S18T023382	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.2	0.366		20181853
5MX0CNC0	S18T023383	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5MX0CNC0	S18T023383	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5MX0CNC0	S18T023383	110-00-9	Furan	PPBV	115	<0.100	<0.100	0.0100	H	20181853
5MX0CNC0	S18T023383	107-12-0	Propanenitrile	PPBV	118	<0.110	<0.110	0.0100	H	20181853
5MX0CNC0	S18T023383	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5MX0CNC0	S18T023383	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5MX0CNC0	S18T023383	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5MX0CNC0	S18T023383	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5MX0CNC0	S18T023383	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5MX0CNC0	S18T023383	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5MX0CNC0	S18T023383	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5MX0CNC0	S18T023383	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5MX0CNC0	S18T023383	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5MX0CNC0	S18T023383	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5MX0CNC0	S18T023383	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5MX0CNC0	S18T023383	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5MX0CNC0	S18T023383	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5MX0CNC0	S18T023383	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5MX0CNC0	S18T023383	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5MX0CNC0	S18T023383	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5MX0CNC0	S18T023383	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5MX0CNC0	S18T023383	75-07-0	Acetaldehyde	PPBV	107	<5.90	13.9	0.700		20181853
5MX0CNC0	S18T023383	67-64-1	Acetone	PPBV	120	<5.60	393	1.28	H	20181853
5MX0CNC0	S18T023383	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5MX0CNC0	S18T023383	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5MX0CNC0	S18T023383	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5MX0CNC0	S18T023383	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5MX0CNC0	S18T023383	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5MX0CNC0	S18T023383	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5MX0CNC0	S18T023383	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5MX0CNC0	S18T023383	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5MX0CNC0	S18T023383	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5MX0CNC0	S18T023383	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5MX0CNC0	S18T023383	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5MX0CNC0	S18T023383	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5MX0CNC0	S18T023383	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5MX0CNC0	S18T023383	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5MX0CNC0	S18T023383	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5MX0CNC0	S18T023383	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5MX0CNC0	S18T023383	67-56-1	Methanol	PPBV	102	<6.00	<12.0	0.900		20181853
5MX0CNC0	S18T023383	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5MX0CNC0	S18T023383	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853
5MX0CNC0	S18T023383	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853

5MX0CNC0	S18T023383	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5MX0CNC0	S18T023383	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5MX0CNC0	S18T023383	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5MX0CNC0	S18T023383	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5MX0CNC0	S18T023383	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5MX0CNC0	S18T023383	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5MX0CNC0	S18T023383	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5MX0CNC0	S18T023383	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5MX0CND0	S18T023384	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5MX0CND0	S18T023384	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	H	20181853
5MX0CND0	S18T023384	110-00-9	Furan	PPBV	115	<0.100	0.430	0.0100	H	20181853
5MX0CND0	S18T023384	107-12-0	Propanenitrile	PPBV	118	<0.110	0.570	0.0100	H	20181853
5MX0CND0	S18T023384	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5MX0CND0	S18T023384	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5MX0CND0	S18T023384	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5MX0CND0	S18T023384	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5MX0CND0	S18T023384	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5MX0CND0	S18T023384	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5MX0CND0	S18T023384	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5MX0CND0	S18T023384	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5MX0CND0	S18T023384	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5MX0CND0	S18T023384	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5MX0CND0	S18T023384	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5MX0CND0	S18T023384	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5MX0CND0	S18T023384	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5MX0CND0	S18T023384	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5MX0CND0	S18T023384	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5MX0CND0	S18T023384	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5MX0CND0	S18T023384	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5MX0CND0	S18T023384	75-07-0	Acetaldehyde	PPBV	107	<5.90	44.3	0.700		20181853
5MX0CND0	S18T023384	67-64-1	Acetone	PPBV	120	<5.60	304	1.28	H	20181853
5MX0CND0	S18T023384	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5MX0CND0	S18T023384	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5MX0CND0	S18T023384	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5MX0CND0	S18T023384	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5MX0CND0	S18T023384	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5MX0CND0	S18T023384	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5MX0CND0	S18T023384	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5MX0CND0	S18T023384	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5MX0CND0	S18T023384	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5MX0CND0	S18T023384	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5MX0CND0	S18T023384	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5MX0CND0	S18T023384	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5MX0CND0	S18T023384	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5MX0CND0	S18T023384	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5MX0CND0	S18T023384	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5MX0CND0	S18T023384	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5MX0CND0	S18T023384	67-56-1	Methanol	PPBV	102	<6.00	<12.0	0.900		20181853
5MX0CND0	S18T023384	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5MX0CND0	S18T023384	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853
5MX0CND0	S18T023384	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853
5MX0CND0	S18T023384	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5MX0CND0	S18T023384	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5MX0CND0	S18T023384	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5MX0CND0	S18T023384	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5MX0CND0	S18T023384	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5MX0CND0	S18T023384	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5MX0CND0	S18T023384	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5MX0CND0	S18T023384	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5OL0CNA0	S18T023376	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5OL0CNA0	S18T023376	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5OL0CNA0	S18T023376	110-00-9	Furan	PPBV	115	<0.100	2.66	0.0100	H	20181853
5OL0CNA0	S18T023376	107-12-0	Propanenitrile	PPBV	115	<0.110	0.160	0.0100	H	20181853
5OL0CNA0	S18T023376	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5OL0CNA0	S18T023376	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5OL0CNA0	S18T023376	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5OL0CNA0	S18T023376	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5OL0CNA0	S18T023376	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5OL0CNA0	S18T023376	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5OL0CNA0	S18T023376	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5OL0CNA0	S18T023376	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5OL0CNA0	S18T023376	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5OL0CNA0	S18T023376	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5OL0CNA0	S18T023376	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5OL0CNA0	S18T023376	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5OL0CNA0	S18T023376	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853

5OL0CNA0	S18T023376	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5OL0CNA0	S18T023376	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5OL0CNA0	S18T023376	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5OL0CNA0	S18T023376	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5OL0CNA0	S18T023376	75-07-0	Acetaldehyde	PPBV	107	<5.90	<11.8	0.700		20181853
5OL0CNA0	S18T023376	67-64-1	Acetone	PPBV	120	<5.60	<11.2	0.320		20181853
5OL0CNA0	S18T023376	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5OL0CNA0	S18T023376	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5OL0CNA0	S18T023376	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5OL0CNA0	S18T023376	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5OL0CNA0	S18T023376	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5OL0CNA0	S18T023376	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5OL0CNA0	S18T023376	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5OL0CNA0	S18T023376	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5OL0CNA0	S18T023376	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5OL0CNA0	S18T023376	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5OL0CNA0	S18T023376	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5OL0CNA0	S18T023376	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5OL0CNA0	S18T023376	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5OL0CNA0	S18T023376	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5OL0CNA0	S18T023376	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5OL0CNA0	S18T023376	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5OL0CNA0	S18T023376	67-56-1	Methanol	PPBV	102	<6.00	25.9	0.900		20181853
5OL0CNA0	S18T023376	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5OL0CNA0	S18T023376	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853
5OL0CNA0	S18T023376	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853
5OL0CNA0	S18T023376	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5OL0CNA0	S18T023376	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5OL0CNA0	S18T023376	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5OL0CNA0	S18T023376	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5OL0CNA0	S18T023376	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5OL0CNA0	S18T023376	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5OL0CNA0	S18T023376	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5OL0CNA0	S18T023376	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5OL0CNB0	S18T023377	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5OL0CNB0	S18T023377	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5OL0CNB0	S18T023377	110-00-9	Furan	PPBV	115	<0.100	3.91	0.0100	H	20181853
5OL0CNB0	S18T023377	107-12-0	Propanenitrile	PPBV	115	<0.110	0.410	0.0100	H	20181853
5OL0CNB0	S18T023377	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5OL0CNB0	S18T023377	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5OL0CNB0	S18T023377	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5OL0CNB0	S18T023377	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5OL0CNB0	S18T023377	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5OL0CNB0	S18T023377	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5OL0CNB0	S18T023377	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5OL0CNB0	S18T023377	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5OL0CNB0	S18T023377	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5OL0CNB0	S18T023377	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5OL0CNB0	S18T023377	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5OL0CNB0	S18T023377	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5OL0CNB0	S18T023377	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5OL0CNB0	S18T023377	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5OL0CNB0	S18T023377	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5OL0CNB0	S18T023377	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5OL0CNB0	S18T023377	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5OL0CNB0	S18T023377	75-07-0	Acetaldehyde	PPBV	107	<5.90	133	0.700		20181853
5OL0CNB0	S18T023377	67-64-1	Acetone	PPBV	120	<5.60	27.2	0.320		20181853
5OL0CNB0	S18T023377	75-05-8	Acetonitrile	PPBV	96.1	<5.85	73.9	1.88		20181853
5OL0CNB0	S18T023377	107-02-8	Acrolein	PPBV	105	<5.60	51.9	0.460		20181853
5OL0CNB0	S18T023377	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5OL0CNB0	S18T023377	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5OL0CNB0	S18T023377	71-43-2	Benzene	PPBV	87.1	<5.45	34.4	0.420		20181853
5OL0CNB0	S18T023377	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5OL0CNB0	S18T023377	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5OL0CNB0	S18T023377	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5OL0CNB0	S18T023377	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5OL0CNB0	S18T023377	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5OL0CNB0	S18T023377	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5OL0CNB0	S18T023377	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5OL0CNB0	S18T023377	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5OL0CNB0	S18T023377	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5OL0CNB0	S18T023377	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5OL0CNB0	S18T023377	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5OL0CNB0	S18T023377	67-56-1	Methanol	PPBV	102	<6.00	<12.0	0.900		20181853
5OL0CNB0	S18T023377	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5OL0CNB0	S18T023377	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853

5OL0CNB0	S18T023377	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853
5OL0CNB0	S18T023377	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5OL0CNB0	S18T023377	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5OL0CNB0	S18T023377	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5OL0CNB0	S18T023377	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5OL0CNB0	S18T023377	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5OL0CNB0	S18T023377	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5OL0CNB0	S18T023377	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5OL0CNB0	S18T023377	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5OL0CNC0	S18T023378	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5OL0CNC0	S18T023378	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5OL0CNC0	S18T023378	110-00-9	Furan	PPBV	115	<0.100	<0.100	0.0100	H	20181853
5OL0CNC0	S18T023378	107-12-0	Propanenitrile	PPBV	115	<0.110	0.160	0.0100	H	20181853
5OL0CNC0	S18T023378	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5OL0CNC0	S18T023378	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5OL0CNC0	S18T023378	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5OL0CNC0	S18T023378	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5OL0CNC0	S18T023378	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5OL0CNC0	S18T023378	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5OL0CNC0	S18T023378	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5OL0CNC0	S18T023378	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5OL0CNC0	S18T023378	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5OL0CNC0	S18T023378	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5OL0CNC0	S18T023378	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5OL0CNC0	S18T023378	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5OL0CNC0	S18T023378	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5OL0CNC0	S18T023378	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5OL0CNC0	S18T023378	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5OL0CNC0	S18T023378	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5OL0CNC0	S18T023378	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5OL0CNC0	S18T023378	75-07-0	Acetaldehyde	PPBV	107	<5.90	20.4	0.700		20181853
5OL0CNC0	S18T023378	67-64-1	Acetone	PPBV	120	<5.60	<11.2	0.320		20181853
5OL0CNC0	S18T023378	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5OL0CNC0	S18T023378	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5OL0CNC0	S18T023378	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5OL0CNC0	S18T023378	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5OL0CNC0	S18T023378	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5OL0CNC0	S18T023378	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5OL0CNC0	S18T023378	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5OL0CNC0	S18T023378	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5OL0CNC0	S18T023378	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5OL0CNC0	S18T023378	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5OL0CNC0	S18T023378	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5OL0CNC0	S18T023378	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5OL0CNC0	S18T023378	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5OL0CNC0	S18T023378	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5OL0CNC0	S18T023378	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5OL0CNC0	S18T023378	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5OL0CNC0	S18T023378	67-56-1	Methanol	PPBV	102	<6.00	<12.0	0.900		20181853
5OL0CNC0	S18T023378	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5OL0CNC0	S18T023378	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853
5OL0CNC0	S18T023378	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853
5OL0CNC0	S18T023378	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5OL0CNC0	S18T023378	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5OL0CNC0	S18T023378	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5OL0CNC0	S18T023378	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5OL0CNC0	S18T023378	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5OL0CNC0	S18T023378	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5OL0CNC0	S18T023378	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5OL0CNC0	S18T023378	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5OL0CND0	S18T023379	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5OL0CND0	S18T023379	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5OL0CND0	S18T023379	110-00-9	Furan	PPBV	115	<0.100	<0.100	0.0100	H	20181853
5OL0CND0	S18T023379	107-12-0	Propanenitrile	PPBV	115	<0.110	0.200	0.0100	H	20181853
5OL0CND0	S18T023379	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5OL0CND0	S18T023379	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5OL0CND0	S18T023379	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5OL0CND0	S18T023379	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5OL0CND0	S18T023379	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5OL0CND0	S18T023379	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5OL0CND0	S18T023379	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<10.0	0.360		20181853
5OL0CND0	S18T023379	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.840		20181853
5OL0CND0	S18T023379	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5OL0CND0	S18T023379	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5OL0CND0	S18T023379	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5OL0CND0	S18T023379	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853

5OL0CND0	S18T023379	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5OL0CND0	S18T023379	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5OL0CND0	S18T023379	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5OL0CND0	S18T023379	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5OL0CND0	S18T023379	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5OL0CND0	S18T023379	75-07-0	Acetaldehyde	PPBV	107	<5.90	<11.8	0.700		20181853
5OL0CND0	S18T023379	67-64-1	Acetone	PPBV	120	<5.60	216	0.320		20181853
5OL0CND0	S18T023379	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5OL0CND0	S18T023379	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5OL0CND0	S18T023379	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5OL0CND0	S18T023379	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5OL0CND0	S18T023379	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5OL0CND0	S18T023379	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5OL0CND0	S18T023379	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5OL0CND0	S18T023379	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5OL0CND0	S18T023379	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.760		20181853
5OL0CND0	S18T023379	67-66-3	Chloroform	PPBV	89.9	<5.00	<10.0	0.260		20181853
5OL0CND0	S18T023379	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5OL0CND0	S18T023379	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5OL0CND0	S18T023379	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5OL0CND0	S18T023379	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.740		20181853
5OL0CND0	S18T023379	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5OL0CND0	S18T023379	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5OL0CND0	S18T023379	67-56-1	Methanol	PPBV	102	<6.00	<12.0	0.900		20181853
5OL0CND0	S18T023379	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853
5OL0CND0	S18T023379	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400		20181853
5OL0CND0	S18T023379	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480		20181853
5OL0CND0	S18T023379	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360		20181853
5OL0CND0	S18T023379	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460		20181853
5OL0CND0	S18T023379	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420		20181853
5OL0CND0	S18T023379	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.60	0.500		20181853
5OL0CND0	S18T023379	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380		20181853
5OL0CND0	S18T023379	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460		20181853
5OL0CND0	S18T023379	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300		20181853
5OL0CND0	S18T023379	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<10.0	0.360		20181853
5OL1CNC0	S18T023380	10024-97-2	Nitrous Oxide	PPMV	95	<5.0	<10	3.9		20181853
5OL1CNC0	S18T023380	108-47-4	2,4-Dimethylpyridine	PPBV	n/a	n/a	<50.0	n/a	HY	20181853
5OL1CNC0	S18T023380	110-00-9	Furan	PPBV	115	<0.100	<0.0999	9.99E-01	H	20181853
5OL1CNC0	S18T023380	107-12-0	Propanenitrile	PPBV	118	<0.110	0.160	9.99E-01	H	20181853
5OL1CNC0	S18T023380	79-34-5	1,1,2,2-Tetrachloroethane	PPBV	88.2	<5.30	<10.6	0.360		20181853
5OL1CNC0	S18T023380	79-00-5	1,1,2-Trichloroethane	PPBV	82.5	<5.50	<11.0	0.360		20181853
5OL1CNC0	S18T023380	75-34-3	1,1-Dichloroethane	PPBV	87.4	<5.45	<10.9	0.300		20181853
5OL1CNC0	S18T023380	75-35-4	1,1-Dichloroethene	PPBV	89.1	<5.40	<10.8	0.400		20181853
5OL1CNC0	S18T023380	107-06-2	1,2-Dichloroethane	PPBV	87.6	<5.35	<10.7	0.260		20181853
5OL1CNC0	S18T023380	106-99-0	1,3-Butadiene	PPBV	93.2	<5.35	<10.7	0.540		20181853
5OL1CNC0	S18T023380	542-75-6	1,3-Dichloropropene (Total)	PPBV	n/a	n/a	<9.99	0.360		20181853
5OL1CNC0	S18T023380	106-46-7	1,4-Dichlorobenzene	PPBV	87.1	<5.30	<10.6	0.839		20181853
5OL1CNC0	S18T023380	123-91-1	1,4-Dioxane	PPBV	110	<5.65	<11.3	0.300		20181853
5OL1CNC0	S18T023380	71-36-3	1-Butanol	PPBV	132	<6.00	<12.0	0.340		20181853
5OL1CNC0	S18T023380	71-23-8	1-Propanol	PPBV	120	<6.00	<12.0	0.320		20181853
5OL1CNC0	S18T023380	78-93-3	2-Butanone	PPBV	115	<5.75	<11.5	0.380		20181853
5OL1CNC0	S18T023380	110-43-0	2-Heptanone	PPBV	119	<5.20	<10.4	1.40		20181853
5OL1CNC0	S18T023380	591-78-6	2-Hexanone	PPBV	113	<5.50	<11.0	0.460		20181853
5OL1CNC0	S18T023380	78-94-4	3-Buten-2-one	PPBV	109	<5.75	<11.5	0.280		20181853
5OL1CNC0	S18T023380	106-35-4	3-Heptanone	PPBV	118	<5.20	<10.4	0.380		20181853
5OL1CNC0	S18T023380	108-10-1	4-Methyl-2-Pentanone	PPBV	108	<5.45	<10.9	0.480		20181853
5OL1CNC0	S18T023380	75-07-0	Acetaldehyde	PPBV	107	<5.90	25.7	0.700		20181853
5OL1CNC0	S18T023380	67-64-1	Acetone	PPBV	120	<5.60	1.77E+03	3.20	H	20181853
5OL1CNC0	S18T023380	75-05-8	Acetonitrile	PPBV	96.1	<5.85	<11.7	1.88		20181853
5OL1CNC0	S18T023380	107-02-8	Acrolein	PPBV	105	<5.60	<11.2	0.460		20181853
5OL1CNC0	S18T023380	107-13-1	Acrylonitrile	PPBV	115	<5.75	<11.5	0.500		20181853
5OL1CNC0	S18T023380	107-05-1	Allyl Chloride	PPBV	89.2	<5.50	<11.0	0.340		20181853
5OL1CNC0	S18T023380	71-43-2	Benzene	PPBV	87.1	<5.45	<10.9	0.420		20181853
5OL1CNC0	S18T023380	123-72-8	Butanal	PPBV	101	<6.00	<12.0	0.300		20181853
5OL1CNC0	S18T023380	56-23-5	Carbon tetrachloride	PPBV	88.5	<5.25	<10.5	0.400		20181853
5OL1CNC0	S18T023380	108-90-7	Chlorobenzene	PPBV	83.7	<5.40	<10.8	0.540		20181853
5OL1CNC0	S18T023380	75-00-3	Chloroethane	PPBV	92.1	<5.25	<10.5	0.759		20181853
5OL1CNC0	S18T023380	67-66-3	Chloroform	PPBV	89.9	<5.00	<9.99	0.260		20181853
5OL1CNC0	S18T023380	110-82-7	Cyclohexane	PPBV	87.7	<5.10	<10.2	0.260		20181853
5OL1CNC0	S18T023380	124-18-5	Decane	PPBV	88.6	<5.35	<10.7	0.420		20181853
5OL1CNC0	S18T023380	64-17-5	Ethanol	PPBV	113	<5.95	<11.9	0.560		20181853
5OL1CNC0	S18T023380	141-78-6	Ethyl acetate	PPBV	117	<5.60	<11.2	0.739		20181853
5OL1CNC0	S18T023380	100-41-4	Ethylbenzene	PPBV	87.3	<5.40	<10.8	0.440		20181853
5OL1CNC0	S18T023380	110-54-3	Hexane	PPBV	90.6	<5.50	<11.0	0.300		20181853
5OL1CNC0	S18T023380	67-56-1	Methanol	PPBV	102	<6.00	<12.0	0.899		20181853
5OL1CNC0	S18T023380	75-09-2	Methylene Chloride	PPBV	80.8	<5.10	<10.2	0.280		20181853

5OL1CNC0	S18T023380	100-42-5	Styrene	PPBV	87.2	<5.30	<10.6	0.400	20181853
5OL1CNC0	S18T023380	127-18-4	Tetrachloroethene	PPBV	86.5	<5.20	<10.4	0.480	20181853
5OL1CNC0	S18T023380	109-99-9	Tetrahydrofuran	PPBV	114	<5.35	<10.7	0.360	20181853
5OL1CNC0	S18T023380	108-88-3	Toluene	PPBV	82.0	<5.40	<10.8	0.460	20181853
5OL1CNC0	S18T023380	79-01-6	Trichloroethene	PPBV	87.8	<5.20	<10.4	0.420	20181853
5OL1CNC0	S18T023380	75-69-4	Trichlorofluoromethane	PPBV	94.5	<4.80	<9.59	0.500	20181853
5OL1CNC0	S18T023380	10061-01-5	cis-1,3-Dichloropropene	PPBV	88.1	<5.25	<10.5	0.380	20181853
5OL1CNC0	S18T023380	123-86-4	n-Butyl acetate	PPBV	108	<5.45	<10.9	0.460	20181853
5OL1CNC0	S18T023380	142-82-5	n-Heptane	PPBV	86.4	<5.40	<10.8	0.300	20181853
5OL1CNC0	S18T023380	10061-02-6	trans-1,3-Dichloropropene	PPBV	85.7	<5.00	<9.99	0.360	20181853

J - Estimated
T - Tentatively Identified Compound
B - Blank Contamination
Y - Comment
N - Named TIC
H - Missed Holdtime
NA = Not Analyzed, ND = Not Detected
DSRSpreadsheetWOLimits 3.0.13a
DSR.Jar v. 3.0.14

DSRComment 3.0.13
DSR.Jar v. 3.0.14

NUCON
22-oct-2018 11:23:45

Verification Sample Comments

Sample: S18T023376 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023377 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023378 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023379 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023380 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023381 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023382 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023383 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Sample: S18T023384 Group: 20181853
Y flag: 2,4-dimethylpyridine does not have a completed calibration, mdl and lls study; reporting limit is estimated based on current data; found concentrations are calculated using the response factor from a representative 100ppbv standard. kak 09/13/18

Appendix K

EPA TO-15 Tentatively Identified Compound Reports

Appendix K

EPA TO-15 Tentatively Identified Compound Reports

See Appendix J for sample legend and analytical notes.

18-oct-2018 16:16:20
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	ANALYTE	CAS NO.	RETENTION TIME	RESULT_ UNIT	RESULT	QUALIFIER	SAMPLE_ GROUP
DB0CNB	S18T017535	Formaldehyde	50-00-0	1.97	PPBV	150	JNT	20181360
DB0CNB	S18T017535	Propene	115-07-1	2.22	PPBV	330	JNT	20181360
DB0CNB	S18T017535	Propyne	74-99-7	2.39	PPBV	11	JNT	20181360
DB0CNB	S18T017535	Allene	463-49-0	2.43	PPBV	28	JNT	20181360
DB0CNB	S18T017535	Unknown		2.51	PPBV	45	JT	20181360
DB0CNB	S18T017535	1-Propene, 2-methyl-	115-11-7	2.77	PPBV	150	JNT	20181360
DB0CNB	S18T017535	1-Butene	106-98-9	2.95	PPBV	15	JNT	20181360
DB0CNB	S18T017535	Cyclobutane, methyl-	598-61-8	4.22	PPBV	86	JNT	20181360
DB0CNB	S18T017535	Cyclopropane, 1,1-dimethyl-	1630-94-0	4.39	PPBV	19	JNT	20181360
DB0CNB	S18T017535	1-Pentene	109-67-1	4.66	PPBV	10	JNT	20181360
DB0CNB	S18T017535	Propanal	123-38-6	5.29	PPBV	20	JNT	20181360
DB0CNB	S18T017535	Unknown		5.37	PPBV	25	JT	20181360
DB0CNB	S18T017535	Unknown		6.44	PPBV	32	JT	20181360
DB0CNB	S18T017535	Methyl nitrate	598-58-3	7.47	PPBV	12	JNT	20181360
DB0CNB	S18T017535	Unknown		7.93	PPBV	7.8	JT	20181360
DB0CNB	S18T017535	1-Hexene	592-41-6	8.24	PPBV	89	JNT	20181360
DB0CNB	S18T017535	Methacrolein	78-85-3	8.87	PPBV	32	JNT	20181360
DB0CNB	S18T017535	Unknown		10.70	PPBV	62	JT	20181360
DB0CNB	S18T017535	Methane, nitro-	75-52-5	11.11	PPBV	68	JNT	20181360
DB0CNB	S18T017535	Cyclohexene	110-83-8	14.67	PPBV	11	JNT	20181360
DB0CNB	S18T017535	Butane, 2,3-dimethyl-	79-29-8	15.00	PPBV	12	JNT	20181360
DB0CNB	S18T017535	1-Heptene	592-76-7	15.36	PPBV	56	JNT	20181360
DB0CNB	S18T017535	2-Butenal	4170-30-3	15.63	PPBV	34	JNT	20181360
DB0CNB	S18T017535	Cyclohexane, methyl-	108-87-2	17.41	PPBV	22	JNT	20181360
DB0CNB	S18T017535	Pentanal	110-62-3	17.82	PPBV	36	JNT	20181360
DB0CNB	S18T017535	1-Butanol, 2-ethyl-	97-95-0	19.04	PPBV	13	JNT	20181360
DB0CNB	S18T017535	1-Octene	111-66-0	20.26	PPBV	46	JNT	20181360
DB0CNB	S18T017535	Octane	111-65-9	20.43	PPBV	17	JNT	20181360
DB0CNB	S18T017535	Unknown		21.54	PPBV	30	JT	20181360
DB0CNB	S18T017535	Nonane	111-84-2	23.04	PPBV	36	JNT	20181360
DB0CNB	S18T017535	trans-3-Decene	19150-21-1	24.88	PPBV	36	JNT	20181360
DB0CNB	S18T017535	Benzene, 1,2,3-trimethyl-	526-73-8	25.44	PPBV	57	JNT	20181360
DB0CNB	S18T017535	Undecanal	112-44-7	26.47	PPBV	39	JNT	20181360
DB0CNB	S18T017535	Octane, 2-methyl-	3221-61-2	26.53	PPBV	83	JNT	20181360
DB0CNB	S18T017535	2,6-Dimethyldecane	13150-81-7	27.92	PPBV	58	JNT	20181360
DB0CNB	S18T017535	2-Hexyl-1-octanol	19780-79-1	28.10	PPBV	30	JNT	20181360
DB0CNB	S18T017535	Naphthalene	91-20-3	28.87	PPBV	34	JNT	20181360
DB0CNB	S18T017535	Decane, 2,4,6-trimethyl-	62108-27-4	29.18	PPBV	40	JNT	20181360
DB0CNC	S18T017536	Formaldehyde	50-00-0	1.97	PPBV	130	JNT	20181360
DB0CNC	S18T017536	Unknown		2.51	PPBV	71	JT	20181360
DB0CNC	S18T017536	Cyclotetrasiloxane, octamethyl-	556-67-2	24.47	PPBV	100	JNT	20181360
DB0CNC	S18T017536	Unknown		24.95	PPBV	16	JT	20181360
DB0CNC	S18T017536	2,6-Dimethyldecane	13150-81-7	27.92	PPBV	12	JNT	20181360
DB0CND	S18T017537	Formaldehyde	50-00-0	1.97	PPBV	180	JNT	20181360
DB0CND	S18T017537	Unknown		2.51	PPBV	39	JT	20181360

Y - Comment
N - Named TIC
T - Tentatively Identified Compound
a - LCS Outside Range
J - Estimated
NA = Not Analyzed, ND = Not Detected
DSRTICSpreadsheet3.0.14
DSR.Jar v. 3.0.14

18-oct-2018 16:20:45
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	ANALYTE	CAS NO.	RETENTION TIME	RESULT_ UNIT	RESULT	QUALIFIER	SAMPLE_ GROUP
6OL0CNB	S18T018162	Formaldehyde	50-00-0	1.98	PPBV	200	JNT	20181427
6OL0CNB	S18T018162	Propene	115-07-1	2.23	PPBV	280	JNT	20181427
6OL0CNB	S18T018162	Propyne	74-99-7	2.40	PPBV	13	JNT	20181427
6OL0CNB	S18T018162	Allene	463-49-0	2.44	PPBV	27	JNT	20181427
6OL0CNB	S18T018162	1-Propene, 2-methyl-	115-11-7	2.78	PPBV	140	JNT	20181427
6OL0CNB	S18T018162	2-Butene	107-01-7	2.96	PPBV	13	JNT	20181427
6OL0CNB	S18T018162	Cyclobutane, methyl-	598-61-8	4.23	PPBV	71	JNT	20181427
6OL0CNB	S18T018162	Cyclopropane, 1,2-dimethyl-, cis-	930-18-7	4.40	PPBV	19	JNT	20181427
6OL0CNB	S18T018162	1-Pentene	109-67-1	4.67	PPBV	11	JNT	20181427
6OL0CNB	S18T018162	1,4-Pentadiene	591-93-5	6.46	PPBV	26	JNT	20181427
6OL0CNB	S18T018162	Methyl nitrate	598-58-3	7.49	PPBV	10	JNT	20181427
6OL0CNB	S18T018162	1-Hexene	592-41-6	8.25	PPBV	76	JNT	20181427
6OL0CNB	S18T018162	Methacrolein	78-85-3	8.89	PPBV	35	JNT	20181427
6OL0CNB	S18T018162	Unknown		10.72	PPBV	66	JT	20181427
6OL0CNB	S18T018162	Methane, nitro-	75-52-5	11.13	PPBV	63	JNT	20181427
6OL0CNB	S18T018162	Cyclohexene	110-83-8	14.68	PPBV	12	JNT	20181427
6OL0CNB	S18T018162	Butane, 2,3-dimethyl-	79-29-8	15.02	PPBV	18	JNT	20181427
6OL0CNB	S18T018162	1-Heptene	592-76-7	15.37	PPBV	56	JNT	20181427
6OL0CNB	S18T018162	2-Butenal	4170-30-3	15.65	PPBV	48	JNT	20181427
6OL0CNB	S18T018162	2-Pentene, 4,4-dimethyl-	26232-98-4	17.42	PPBV	23	JNT	20181427
6OL0CNB	S18T018162	1,2,4,5-Tetroxane, 3,3,6,6-tetramethyl-	1073-91-2	17.54	PPBV	17	JNT	20181427
6OL0CNB	S18T018162	Pentanal	110-62-3	17.83	PPBV	45	JNT	20181427
6OL0CNB	S18T018162	1-Octene	111-66-0	20.27	PPBV	40	JNT	20181427
6OL0CNB	S18T018162	Octane	111-65-9	20.44	PPBV	14	JNT	20181427
6OL0CNB	S18T018162	Unknown		21.55	PPBV	44	JT	20181427
6OL0CNB	S18T018162	Nonane	111-84-2	23.05	PPBV	37	JNT	20181427
6OL0CNB	S18T018162	Cyclotetrasiloxane, octamethyl-	556-67-2	24.48	PPBV	42	JNT	20181427
6OL0CNB	S18T018162	trans-3-Decene	19150-21-1	24.89	PPBV	41	JNT	20181427
6OL0CNB	S18T018162	Benzene, 1,2,3-trimethyl-	526-73-8	25.45	PPBV	50	JNT	20181427
6OL0CNB	S18T018162	Undecanal	112-44-7	26.48	PPBV	43	JNT	20181427
6OL0CNB	S18T018162	Undecane	1120-21-4	26.54	PPBV	120	JNT	20181427
6OL0CNB	S18T018162	Octane, 2-methyl-	3221-61-2	27.93	PPBV	52	JNT	20181427
6OL0CNB	S18T018162	Naphthalene	91-20-3	28.88	PPBV	33	JNT	20181427
6OL0CNB	S18T018162	Decane, 2,4,6-trimethyl-	62108-27-4	29.19	PPBV	40	JNT	20181427
6OL0CNC	S18T018163	Formaldehyde	50-00-0	1.97	PPBV	200	JNT	20181427
6OL0CNC	S18T018163	Unknown		2.23	PPBV	14	JT	20181427
6OL0CNC	S18T018163	Methyl nitrite	624-91-9	2.51	PPBV	25	JNT	20181427
6OL0CNC	S18T018163	Trimethylsilyl fluoride	420-56-4	3.16	PPBV	14	JNT	20181427
6OL0CNC	S18T018163	Unknown		13.43	PPBV	11	JT	20181427
6OL0CNC	S18T018163	Cyclotetrasiloxane, octamethyl-	556-67-2	24.49	PPBV	63	JNT	20181427
6OL0CNC	S18T018163	2,6-Dimethyldecane	13150-81-7	27.71	PPBV	12	JNT	20181427
6OL0CND	S18T018164	Formaldehyde	50-00-0	1.98	PPBV	180	JNT	20181427
6OL0CND	S18T018164	Silane, difluorodimethyl-	353-66-2	2.52	PPBV	24	JNT	20181427
6OL1CND	S18T018165	Formaldehyde	50-00-0	1.98	PPBV	160	JNT	20181427
6OL1CND	S18T018165	Methyl nitrite	624-91-9	2.51	PPBV	36	JNT	20181427

Y - Comment
L - LLS Outside Range
N - Named TIC
T - Tentatively Identified Compound
a - LCS Outside Range
J - Estimated
E - Outside Calibration Range
Q - Qualitative
NA = Not Analyzed, ND = Not Detected
DSRTICSpreadsheet3.0.14
DSR.Jar v. 3.0.14

22-oct-2018 10:21:58
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	ANALYTE	CAS NO.	RETENTION TIME	RESULT_ UNIT	RESULT	QUALIFIER	SAMPLE_ GROUP
2OL0CNA0	S18T018597	Propanenitrile	107-12-0	12.38	PPBV	1.8E+03	JNT	20181468
2OL0CNA0	S18T018597	Cyclotetrasiloxane, octamethyl-	556-67-2	19.98	PPBV	45	JNT	20181468
2OL0CNA0	S18T018597	1-Propene-1-thiol	925-89-3	21.78	PPBV	65	JNT	20181468
2OL0CNB0	S18T018598	Formaldehyde	50-00-0	3.68	PPBV	57	JNT	20181468
2OL0CNB0	S18T018598	Propene	115-07-1	4.14	PPBV	480	JNT	20181468
2OL0CNB0	S18T018598	Unknown		4.22	PPBV	18	JT	20181468
2OL0CNB0	S18T018598	Allene	463-49-0	4.44	PPBV	12	JNT	20181468
2OL0CNB0	S18T018598	Propyne	74-99-7	4.49	PPBV	26	JNT	20181468
2OL0CNB0	S18T018598	Methyl nitrite	624-91-9	4.63	PPBV	70	JNT	20181468
2OL0CNB0	S18T018598	1-Butene	106-98-9	5.09	PPBV	260	JNT	20181468
2OL0CNB0	S18T018598	2-Butene	107-01-7	5.41	PPBV	23	JNT	20181468
2OL0CNB0	S18T018598	1-Propene, 2-methyl-	115-11-7	5.70	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	Trimethylsilyl fluoride	420-56-4	5.75	PPBV	140	JNT	20181468
2OL0CNB0	S18T018598	Formic acid hydrazide	624-84-0	6.14	PPBV	33	JNT	20181468
2OL0CNB0	S18T018598	1-Butene, 3-methyl-	563-45-1	6.40	PPBV	19	JNT	20181468
2OL0CNB0	S18T018598	1,4-Pentadiene	591-93-5	7.10	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	1-Pentene	109-67-1	7.30	PPBV	120	JNT	20181468
2OL0CNB0	S18T018598	2-Methyl-1-butene	563-46-2	7.52	PPBV	32	JNT	20181468
2OL0CNB0	S18T018598	Unknown		7.85	PPBV	39	JT	20181468
2OL0CNB0	S18T018598	Furan	110-00-9	8.04	PPBV	33	JNT	20181468
2OL0CNB0	S18T018598	Trimethylene oxide	503-30-0	8.48	PPBV	27	JNT	20181468
2OL0CNB0	S18T018598	Unknown		8.55	PPBV	15	JT	20181468
2OL0CNB0	S18T018598	Cyclopropane, ethylidene-	18631-83-9	9.53	PPBV	60	JNT	20181468
2OL0CNB0	S18T018598	2-Butene, 2,3-dimethyl-	563-79-1	9.88	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	2-Propanol, 2-methyl-	75-65-0	10.00	PPBV	24	JNT	20181468
2OL0CNB0	S18T018598	t-Butyl nitrite	540-80-7	10.50	PPBV	34	JNT	20181468
2OL0CNB0	S18T018598	1-Hexene	592-41-6	10.67	PPBV	120	JNT	20181468
2OL0CNB0	S18T018598	2-Butenal	4170-30-3	11.03	PPBV	43	JNT	20181468
2OL0CNB0	S18T018598	1-Pentene, 4-methyl-	691-37-2	11.15	PPBV	26	JNT	20181468
2OL0CNB0	S18T018598	1,3-Pentadiene, 3-methyl-, (E)-	2787-43-1	11.52	PPBV	16	JNT	20181468
2OL0CNB0	S18T018598	Methane, nitro-	75-52-5	12.09	PPBV	90	JNT	20181468
2OL0CNB0	S18T018598	Propanenitrile	107-12-0	12.35	PPBV	190	JNT	20181468
2OL0CNB0	S18T018598	Isobutyl nitrite	542-56-3	12.55	PPBV	62	JNT	20181468
2OL0CNB0	S18T018598	1-Hexene, 5-methyl-	3524-73-0	13.29	PPBV	17	JNT	20181468
2OL0CNB0	S18T018598	Cyclohexene	110-83-8	13.98	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	1-Hexene, 2-methyl-	6094-02-6	14.03	PPBV	12	JNT	20181468
2OL0CNB0	S18T018598	1-Heptene	592-76-7	14.10	PPBV	52	JNT	20181468
2OL0CNB0	S18T018598	(E)-1,3-Butadien-1-ol	70411-98-2	14.30	PPBV	36	JNT	20181468
2OL0CNB0	S18T018598	2-Hexene, 5,5-dimethyl-, (Z)-	39761-61-0	14.87	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	2-Butanone, 3-methyl-	563-80-4	15.19	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Pentanal	110-62-3	15.40	PPBV	32	JNT	20181468
2OL0CNB0	S18T018598	3-Hepten-1-ol	10606-47-0	15.91	PPBV	12	JNT	20181468
2OL0CNB0	S18T018598	1-Heptene, 4-methyl-	13151-05-8	16.12	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Cyclopropane, (1,2-dimethylpropyl)-	6976-27-8	16.82	PPBV	19	JNT	20181468
2OL0CNB0	S18T018598	Cyclohexane, 1,2-dimethyl-	583-57-3	16.83	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Cyclobutene, 2-propenylidene-	52097-85-5	16.93	PPBV	95	JNT	20181468
2OL0CNB0	S18T018598	Octane	111-65-9	17.06	PPBV	20	JNT	20181468
2OL0CNB0	S18T018598	Hexanal	66-25-1	17.90	PPBV	34	JNT	20181468
2OL0CNB0	S18T018598	1-Pentanol, 2-ethyl-	27522-11-8	18.29	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Octane, 2-methyl-	3221-61-2	18.38	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Cyclooctane, methyl-	1502-38-1	18.45	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Heptane, 3,5-dimethyl-	926-82-9	18.52	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	1-Nonene	124-11-8	18.91	PPBV	32	JNT	20181468
2OL0CNB0	S18T018598	Nonane	111-84-2	18.99	PPBV	74	JNT	20181468
2OL0CNB0	S18T018598	Cyclohexane,1-ethyl-2-methyl-, cis-	4923-77-7	19.05	PPBV	16	JNT	20181468
2OL0CNB0	S18T018598	Unknown		19.10	PPBV	16	JT	20181468
2OL0CNB0	S18T018598	Cyclohexane, 1-ethyl-2-methyl-	3728-54-9	19.41	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	o-Xylene	95-47-6	19.45	PPBV	15	JNT	20181468
2OL0CNB0	S18T018598	Octane, 3,6-dimethyl-	15869-94-0	19.54	PPBV	22	JNT	20181468
2OL0CNB0	S18T018598	Heptanal	111-71-7	19.67	PPBV	27	JNT	20181468
2OL0CNB0	S18T018598	Heptane, 3-ethyl-	15869-80-4	19.92	PPBV	18	JNT	20181468
2OL0CNB0	S18T018598	Nonane, 2-methyl-	871-83-0	19.95	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Cyclooctane, 1,2-dimethyl-	13151-94-5	20.16	PPBV	16	JNT	20181468
2OL0CNB0	S18T018598	1-Hexene, 3,5-dimethyl-	7423-69-0	20.36	PPBV	40	JNT	20181468
2OL0CNB0	S18T018598	Hydroxylamine, O-decyl-	29812-79-1	20.42	PPBV	65	JNT	20181468
2OL0CNB0	S18T018598	Cyclohexane, 1-methyl-2-propyl-	4291-79-6	20.45	PPBV	19	JNT	20181468
2OL0CNB0	S18T018598	Cyclopentane, (3-methylbutyl)-	1005-68-1	20.63	PPBV	10	JNT	20181468
2OL0CNB0	S18T018598	2-Methyl-1-undecanol	10522-26-6	20.67	PPBV	21	JNT	20181468
2OL0CNB0	S18T018598	Octane, 3,3-dimethyl-	4110-44-5	20.71	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	Benzene, 1-ethyl-3-methyl-	620-14-4	20.85	PPBV	20	JNT	20181468
2OL0CNB0	S18T018598	Benzaldehyde	100-52-7	20.88	PPBV	35	JNT	20181468
2OL0CNB0	S18T018598	Undecanal	112-44-7	21.02	PPBV	20	JNT	20181468

2OL0CNB0	S18T018598	1-Tridecanol	112-70-9	21.07	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	Trichloroacetic acid, dodecyl ester	74339-50-7	21.10	PPBV	15	JNT	20181468
2OL0CNB0	S18T018598	Unknown		21.15	PPBV	15	JT	20181468
2OL0CNB0	S18T018598	1-Decanol, 2-hexyl-	2425-77-6	21.27	PPBV	18	JNT	20181468
2OL0CNB0	S18T018598	1-Hexanol, 2-ethyl-	104-76-7	21.33	PPBV	33	JNT	20181468
2OL0CNB0	S18T018598	Benzene, (1-azido-1-methylethyl)-	32366-26-0	21.49	PPBV	15	JNT	20181468
2OL0CNB0	S18T018598	1-Octene, 3,7-dimethyl-	4984-01-4	21.53	PPBV	19	JNT	20181468
2OL0CNB0	S18T018598	Undecane	1120-21-4	21.57	PPBV	47	JNT	20181468
2OL0CNB0	S18T018598	3-Decen-1-ol, (E)-	10339-60-3	21.64	PPBV	21	JNT	20181468
2OL0CNB0	S18T018598	Oxirane, hexyl-	2984-50-1	21.76	PPBV	13	JNT	20181468
2OL0CNB0	S18T018598	Benzene, 1-methyl-2-(1-methylethyl)-	527-84-4	21.87	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	Acetophenone	98-86-2	22.13	PPBV	51	JNT	20181468
2OL0CNB0	S18T018598	1-Heptadecyne	26186-00-5	22.24	PPBV	24	JNT	20181468
2OL0CNB0	S18T018598	2-Decen-1-ol	22104-80-9	22.52	PPBV	30	JNT	20181468
2OL0CNB0	S18T018598	Undecane, 2,6-dimethyl-	17301-23-4	22.60	PPBV	32	JNT	20181468
2OL0CNB0	S18T018598	2-Hexyl-1-octanol	19780-79-1	22.75	PPBV	15	JNT	20181468
2OL0CNB0	S18T018598	Octadecanal	638-66-4	22.85	PPBV	11	JNT	20181468
2OL0CNB0	S18T018598	Naphthalene, 1,2,3,4-tetrahydro-	119-64-2	22.99	PPBV	14	JNT	20181468
2OL0CNB0	S18T018598	1-Octanol, 2-butyl-	3913-02-8	23.24	PPBV	17	JNT	20181468
2OL0CNB0	S18T018598	Naphthalene	91-20-3	23.53	PPBV	29	JNT	20181468
2OL0CNB0	S18T018598	Benzocycloheptene	1075-16-7	23.58	PPBV	15	JNT	20181468
2OL0CNB0	S18T018598	2,6-Dimethyldecane	13150-81-7	23.65	PPBV	12	JNT	20181468
2OL0CNB0	S18T018598	Naphthalene, 1-methyl-	90-12-0	24.90	PPBV	15	JNT	20181468
2OL0CNC0	S18T018599	Propene	115-07-1	4.14	PPBV	25	JNT	20181468
2OL0CNC0	S18T018599	Methyl nitrite	624-91-9	4.63	PPBV	86	JNT	20181468
2OL0CNC0	S18T018599	1-Propene, 2-methyl-	115-11-7	5.08	PPBV	16	JNT	20181468
2OL0CNC0	S18T018599	Trimethylsilyl fluoride	420-56-4	5.75	PPBV	140	JNT	20181468
2OL0CNC0	S18T018599	Formic acid hydrazide	624-84-0	6.14	PPBV	15	JNT	20181468
2OL0CNC0	S18T018599	Methane, nitro-	75-52-5	12.09	PPBV	94	JNT	20181468
2OL0CNC0	S18T018599	Propanenitrile	107-12-0	12.33	PPBV	11	JNT	20181468
2OL0CNC0	S18T018599	Unknown		12.55	PPBV	21	JT	20181468
2OL0CNC0	S18T018599	Disiloxane, hexamethyl-	107-46-0	13.55	PPBV	35	JNT	20181468
2OL0CNC0	S18T018599	1-Hexanol, 2-ethyl-	104-76-7	21.33	PPBV	25	JNT	20181468
2OL0CND0	S18T018600	Formaldehyde	50-00-0	3.69	PPBV	67	JNT	20181468
2OL0CND0	S18T018600	Propene	115-07-1	4.14	PPBV	12	JNT	20181468
2OL0CND0	S18T018600	Methyl nitrite	624-91-9	4.62	PPBV	23	JNT	20181468
2OL0CND0	S18T018600	Trimethylsilyl fluoride	420-56-4	5.75	PPBV	10	JNT	20181468
2OL0CND0	S18T018600	Formic acid hydrazide	624-84-0	6.13	PPBV	33	JNT	20181468
2OL0CND0	S18T018600	Isobutyl nitrite	542-56-3	12.54	PPBV	31	JNT	20181468
2OL0CND0	S18T018600	1-Hexanol, 2-ethyl-	104-76-7	21.33	PPBV	26	JNT	20181468
2OL0CND0	S18T018600	3-Methylheptyl acetate	72218-58-7	22.37	PPBV	19	JNT	20181468
6MX0CNA	S18T018593	Nitric oxide	10102-43-9	3.70	PPBV	72	JNT	20181468
6MX0CNA	S18T018593	1-Butene	106-98-9	5.10	PPBV	13	JNT	20181468
6MX0CNA	S18T018593	2-Propanol, 2-methyl-	75-65-0	10.03	PPBV	10	JNT	20181468
6MX0CNA	S18T018593	t-Butyl nitrite	540-80-7	10.51	PPBV	10	JNT	20181468
6MX0CNA	S18T018593	Silanol, dimethyl-	5906-76-3	12.10	PPBV	20	JNT	20181468
6MX0CNA	S18T018593	Disiloxane, hexamethyl-	107-46-0	13.57	PPBV	23	JNT	20181468
6MX0CNA	S18T018593	Cyclotrisiloxane, hexamethyl-	541-05-9	17.32	PPBV	13	JNT	20181468
6MX0CNA	S18T018593	Cyclotetrasiloxane, octamethyl-	556-67-2	19.99	PPBV	140	JNT	20181468
6MX0CNA	S18T018593	Benzoic acid, 2-[(trimethylsilyl)oxy]-, trimethylsilyl ester	3789-85-3	21.79	PPBV	46	JNT	20181468
6MX0CNB	S18T018594	Nitric oxide	10102-43-9	3.70	PPBV	110	JNT	20181468
6MX0CNB	S18T018594	Propene	115-07-1	4.15	PPBV	460	JNT	20181468
6MX0CNB	S18T018594	Allene	463-49-0	4.46	PPBV	11	JNT	20181468
6MX0CNB	S18T018594	Propyne	74-99-7	4.50	PPBV	32	JNT	20181468
6MX0CNB	S18T018594	Unknown		4.64	PPBV	38	JT	20181468
6MX0CNB	S18T018594	1-Butene	106-98-9	5.11	PPBV	220	JNT	20181468
6MX0CNB	S18T018594	2-Butene	107-01-7	5.43	PPBV	21	JNT	20181468
6MX0CNB	S18T018594	1-Propene, 2-methyl-	115-11-7	5.71	PPBV	10	JNT	20181468
6MX0CNB	S18T018594	Trimethylsilyl fluoride	420-56-4	5.78	PPBV	11	JNT	20181468
6MX0CNB	S18T018594	2-Methyl-1-butene	563-46-2	6.42	PPBV	18	JNT	20181468
6MX0CNB	S18T018594	1,4-Pentadiene	591-93-5	7.12	PPBV	12	JNT	20181468
6MX0CNB	S18T018594	1-Pentene	109-67-1	7.32	PPBV	100	JNT	20181468
6MX0CNB	S18T018594	Cyclopropane, 1,2-dimethyl-, cis-	930-18-7	7.53	PPBV	11	JNT	20181468
6MX0CNB	S18T018594	2-Pentene	109-68-2	7.85	PPBV	14	JNT	20181468
6MX0CNB	S18T018594	Unknown		7.87	PPBV	11	JT	20181468
6MX0CNB	S18T018594	Furan	110-00-9	8.07	PPBV	29	JNT	20181468
6MX0CNB	S18T018594	Trimethylene oxide	503-30-0	8.50	PPBV	26	JNT	20181468
6MX0CNB	S18T018594	1-Pentene, 3-methyl-	760-20-3	9.54	PPBV	35	JNT	20181468
6MX0CNB	S18T018594	Methyl nitrate	598-58-3	10.23	PPBV	24	JNT	20181468
6MX0CNB	S18T018594	1-Hexene	592-41-6	10.69	PPBV	110	JNT	20181468
6MX0CNB	S18T018594	2-Butenal	4170-30-3	11.05	PPBV	26	JNT	20181468
6MX0CNB	S18T018594	3-Hexene	592-47-2	11.17	PPBV	10	JNT	20181468
6MX0CNB	S18T018594	Methane, nitro-	75-52-5	12.11	PPBV	63	JNT	20181468
6MX0CNB	S18T018594	Unknown		12.57	PPBV	43	JT	20181468
6MX0CNB	S18T018594	Nitric acid, ethyl ester	625-58-1	13.26	PPBV	13	JNT	20181468
6MX0CNB	S18T018594	1-Hexene, 3,4-dimethyl-	16745-94-1	13.31	PPBV	19	JNT	20181468
6MX0CNB	S18T018594	Cyclohexene	110-83-8	14.00	PPBV	12	JNT	20181468
6MX0CNB	S18T018594	Furan, tetrahydro-2-methyl-	96-47-9	14.06	PPBV	15	JNT	20181468

6MX0CNB	S18T018594	1-Heptene	592-76-7	14.12 PPBV	55	JNT	20181468
6MX0CNB	S18T018594	(E)-1,3-Butadien-1-ol	70411-98-2	14.32 PPBV	33	JNT	20181468
6MX0CNB	S18T018594	2-Butanone, 3-methyl-	563-80-4	15.21 PPBV	16	JNT	20181468
6MX0CNB	S18T018594	Cyclohexane, methyl-	108-87-2	15.35 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	Pentanal	110-62-3	15.41 PPBV	36	JNT	20181468
6MX0CNB	S18T018594	3-Hepten-1-ol	10606-47-0	15.92 PPBV	15	JNT	20181468
6MX0CNB	S18T018594	Cyclopropane, (1,2-dimethylpropyl)-	6976-27-8	16.83 PPBV	23	JNT	20181468
6MX0CNB	S18T018594	Cyclobutene, 2-propenylidene-	52097-85-5	16.94 PPBV	100	JNT	20181468
6MX0CNB	S18T018594	Octane	111-65-9	17.07 PPBV	22	JNT	20181468
6MX0CNB	S18T018594	Cyclotrisiloxane, hexamethyl-	541-05-9	17.32 PPBV	43	JNT	20181468
6MX0CNB	S18T018594	Hexanal	66-25-1	17.91 PPBV	33	JNT	20181468
6MX0CNB	S18T018594	Cyclohexane, ethyl-	1678-91-7	18.09 PPBV	13	JNT	20181468
6MX0CNB	S18T018594	Cyclooctane, butyl-	16538-93-5	18.16 PPBV	13	JNT	20181468
6MX0CNB	S18T018594	Hydroperoxide, hexyl	4312-76-9	18.31 PPBV	19	JNT	20181468
6MX0CNB	S18T018594	Octane, 2-methyl-	3221-61-2	18.39 PPBV	14	JNT	20181468
6MX0CNB	S18T018594	Cyclooctane, methyl-	1502-38-1	18.46 PPBV	10	JNT	20181468
6MX0CNB	S18T018594	Heptane, 3,5-dimethyl-	926-82-9	18.54 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	1-Nonene	124-11-8	18.92 PPBV	31	JNT	20181468
6MX0CNB	S18T018594	Nonane	111-84-2	19.00 PPBV	72	JNT	20181468
6MX0CNB	S18T018594	Cyclohexane, 1-ethyl-4-methyl-, trans-	6236-88-0	19.06 PPBV	13	JNT	20181468
6MX0CNB	S18T018594	1-Octene, 6-methyl-	13151-10-5	19.14 PPBV	16	JNT	20181468
6MX0CNB	S18T018594	Unknown		19.42 PPBV	13	JT	20181468
6MX0CNB	S18T018594	o-Xylene	95-47-6	19.46 PPBV	16	JNT	20181468
6MX0CNB	S18T018594	Nonane, 2,6-dimethyl-	17302-28-2	19.55 PPBV	24	JNT	20181468
6MX0CNB	S18T018594	Heptanal	111-71-7	19.68 PPBV	28	JNT	20181468
6MX0CNB	S18T018594	1-Cyclohexylnonene	114614-84-5	19.71 PPBV	13	JNT	20181468
6MX0CNB	S18T018594	Cyclohexane, propyl-	1678-92-8	19.75 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	1-Octanol, 2-butyl-	3913-02-8	19.87 PPBV	14	JNT	20181468
6MX0CNB	S18T018594	Heptane, 3-ethyl-	15869-80-4	19.93 PPBV	12	JNT	20181468
6MX0CNB	S18T018594	Cyclotetrasiloxane, octamethyl-	556-67-2	19.98 PPBV	50	JNT	20181468
6MX0CNB	S18T018594	Benzene, propyl-	103-65-1	20.29 PPBV	15	JNT	20181468
6MX0CNB	S18T018594	1-Hexene, 3,5-dimethyl-	7423-69-0	20.37 PPBV	41	JNT	20181468
6MX0CNB	S18T018594	Cyclohexane, 1-methyl-2-propyl-	4291-79-6	20.46 PPBV	20	JNT	20181468
6MX0CNB	S18T018594	Benzene, 1-ethyl-4-methyl-	622-96-8	20.68 PPBV	20	JNT	20181468
6MX0CNB	S18T018594	Octane, 3,3-dimethyl-	4110-44-5	20.72 PPBV	19	JNT	20181468
6MX0CNB	S18T018594	Benzene, 1-ethyl-3-methyl-	620-14-4	20.86 PPBV	23	JNT	20181468
6MX0CNB	S18T018594	Benzaldehyde	100-52-7	20.89 PPBV	34	JNT	20181468
6MX0CNB	S18T018594	Undecanal	112-44-7	21.03 PPBV	16	JNT	20181468
6MX0CNB	S18T018594	1-Tridecanol	112-70-9	21.08 PPBV	16	JNT	20181468
6MX0CNB	S18T018594	2-Methyl-1-undecanol	10522-26-6	21.11 PPBV	21	JNT	20181468
6MX0CNB	S18T018594	Unknown		21.16 PPBV	16	JT	20181468
6MX0CNB	S18T018594	Hydroxylamine, O-decyl-	29812-79-1	21.20 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	Benzene, 1,2,3-trimethyl-	526-73-8	21.28 PPBV	19	JNT	20181468
6MX0CNB	S18T018594	Unknown		21.42 PPBV	14	JT	20181468
6MX0CNB	S18T018594	Benzene, 1-methyl-4-propyl-	1074-55-1	21.46 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	Benzene, 1-ethyl-2,4-dimethyl-	874-41-9	21.50 PPBV	19	JNT	20181468
6MX0CNB	S18T018594	1-Octene, 3,7-dimethyl-	4984-01-4	21.54 PPBV	21	JNT	20181468
6MX0CNB	S18T018594	Undecane	1120-21-4	21.58 PPBV	60	JNT	20181468
6MX0CNB	S18T018594	3-Decen-1-ol, (E)-	10339-60-3	21.65 PPBV	23	JNT	20181468
6MX0CNB	S18T018594	1,3-Propanediol, 2-dodecyl	10395-09-2	21.71 PPBV	10	JNT	20181468
6MX0CNB	S18T018594	Unknown		21.78 PPBV	31	JT	20181468
6MX0CNB	S18T018594	Benzene, 1-methyl-2-(1-methylethyl)-	527-84-4	21.88 PPBV	22	JNT	20181468
6MX0CNB	S18T018594	Unknown		22.02 PPBV	17	JT	20181468
6MX0CNB	S18T018594	Unknown		22.15 PPBV	35	JT	20181468
6MX0CNB	S18T018594	Unknown		22.21 PPBV	14	JT	20181468
6MX0CNB	S18T018594	1-Heptadecyne	26186-00-5	22.26 PPBV	30	JNT	20181468
6MX0CNB	S18T018594	2-Hexyl-1-octanol	19780-79-1	22.33 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	Unknown		22.48 PPBV	10	JT	20181468
6MX0CNB	S18T018594	Unknown		22.54 PPBV	12	JT	20181468
6MX0CNB	S18T018594	Undecane, 2,6-dimethyl-	17301-23-4	22.61 PPBV	55	JNT	20181468
6MX0CNB	S18T018594	Octadecanal	638-66-4	22.74 PPBV	12	JNT	20181468
6MX0CNB	S18T018594	Unknown		22.76 PPBV	20	JT	20181468
6MX0CNB	S18T018594	Unknown		22.78 PPBV	16	JT	20181468
6MX0CNB	S18T018594	Naphthalene, 1,2,3,4-tetrahydro-	119-64-2	23.00 PPBV	16	JNT	20181468
6MX0CNB	S18T018594	Unknown		23.24 PPBV	11	JT	20181468
6MX0CNB	S18T018594	9-Octadecenal, (Z)-	2423-10-1	23.28 PPBV	11	JNT	20181468
6MX0CNB	S18T018594	Naphthalene	91-20-3	23.55 PPBV	30	JNT	20181468
6MX0CNB	S18T018594	Benzocycloheptene	1075-16-7	23.60 PPBV	19	JNT	20181468
6MX0CNB	S18T018594	2,6-Dimethyldecane	13150-81-7	23.66 PPBV	20	JNT	20181468
6MX0CNB	S18T018594	Unknown		23.70 PPBV	12	JT	20181468
6MX0CNB	S18T018594	Benzene, 2-ethenyl-1,3,5-trimethyl-	769-25-5	23.87 PPBV	10	JNT	20181468
6MX0CNB	S18T018594	Naphthalene,1,2,3,4-tetrahydro-6-methyl-	1680-51-9	24.16 PPBV	14	JNT	20181468
6MX0CNB	S18T018594	Naphthalene, 1, 2,3,4-tetrahydro-5-methyl-	2809-64-5	24.57 PPBV	14	JNT	20181468
6MX0CNB	S18T018594	Benzene, 1-(1-methylethenyl)-3-(1-methylethyl)-	1129-29-9	24.79 PPBV	12	JNT	20181468
6MX0CNB	S18T018594	Naphthalene, 1-methyl-	90-12-0	24.91 PPBV	13	JNT	20181468
6MX0CNC	S18T018595	Nitric oxide	10102-43-9	3.69 PPBV	83	JNT	20181468
6MX0CNC	S18T018595	Methyl nitrate	598-58-3	4.09 PPBV	50	JNT	20181468
6MX0CNC	S18T018595	Propene	115-07-1	4.15 PPBV	12	JNT	20181468

6MX0CNC	S18T018595	Methyl nitrite	624-91-9	4.63	PPBV	14	JNT	20181468
6MX0CNC	S18T018595	Trimethylsilyl fluoride	420-56-4	5.77	PPBV	39	JNT	20181468
6MX0CNC	S18T018595	Unknown		7.88	PPBV	14	JT	20181468
6MX0CNC	S18T018595	Unknown		11.46	PPBV	16	JT	20181468
6MX0CNC	S18T018595	Methane, nitro-	75-52-5	12.10	PPBV	10	JNT	20181468
6MX0CNC	S18T018595	Hexane, 3,3,4,4-tetrafluoro-	648-36-2	12.57	PPBV	29	JNT	20181468
6MX0CNC	S18T018595	Cyclotrisiloxane, hexamethyl-	541-05-9	17.32	PPBV	21	JNT	20181468
6MX0CNC	S18T018595	Cyclotetrasiloxane, octamethyl-	556-67-2	19.99	PPBV	24	JNT	20181468
6MX0CNC	S18T018595	Benzoic acid, 2-[(trimethylsilyl)oxy]-, trimethylsilyl ester	3789-85-3	21.79	PPBV	10	JNT	20181468
6MX0CND	S18T018596	Nitric oxide	10102-43-9	3.69	PPBV	92	JNT	20181468
6MX0CND	S18T018596	Methyl nitrate	598-58-3	4.09	PPBV	51	JNT	20181468
6MX0CND	S18T018596	Propene	115-07-1	4.14	PPBV	13	JNT	20181468
6MX0CND	S18T018596	Methyl nitrite	624-91-9	4.63	PPBV	12	JNT	20181468
6MX0CND	S18T018596	Trimethylsilyl fluoride	420-56-4	5.76	PPBV	16	JNT	20181468
6MX0CND	S18T018596	Formic acid hydrazide	624-84-0	6.15	PPBV	10	JNT	20181468
6MX0CND	S18T018596	Hexane, 3,3,4,4-tetrafluoro-	648-36-2	12.57	PPBV	26	JNT	20181468
6MX0CND	S18T018596	Cyclotrisiloxane, hexamethyl-	541-05-9	17.32	PPBV	11	JNT	20181468
6MX0CND	S18T018596	1,2-Propanediol, 3,3`-oxydi-, tetranitrate	20600-96-8	19.67	PPBV	52	JNT	20181468
6MX0CND	S18T018596	Cyclotetrasiloxane, octamethyl-	556-67-2	19.98	PPBV	11	JNT	20181468
6MX0CND	S18T018596	1-Hexanol, 2-ethyl-	104-76-7	21.34	PPBV	17	JNT	20181468

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DSRTICSpreadsheet3.0.14
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22-oct-2018 10:58:02
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	ANALYTE	CAS NO.	RETENTION TIME	RESULT_ UNIT	RESULT	QUALIFIER	SAMPLE_ GROUP
3OL0CNA0	S18T019728	Unknown		4.22	PPBV	13	JT	20181597
3OL0CNA0	S18T019728	Cyclohexene, 4-ethenyl-	100-40-3	18.18	PPBV	11	JNT	20181597
3OL0CNA0	S18T019728	Cyclotetrasiloxane, octamethyl-	556-67-2	19.97	PPBV	29	JNT	20181597
3OL0CNA0	S18T019728	1-Propene-1-thiol	925-89-3	21.77	PPBV	30	JNT	20181597
3OL0CNB0	S18T019729	Formaldehyde	50-00-0	3.68	PPBV	65	JNTY	20181597
3OL0CNB0	S18T019729	Propene	115-07-1	4.13	PPBV	440	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		4.21	PPBV	14	JTY	20181597
3OL0CNB0	S18T019729	Allene	463-49-0	4.43	PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	Propyne	74-99-7	4.48	PPBV	29	JNTY	20181597
3OL0CNB0	S18T019729	Methyl nitrite	624-91-9	4.62	PPBV	69	JNTY	20181597
3OL0CNB0	S18T019729	1-Propene, 2-methyl-	115-11-7	5.08	PPBV	260	JNTY	20181597
3OL0CNB0	S18T019729	2-Butene	107-01-7	5.40	PPBV	21	JNTY	20181597
3OL0CNB0	S18T019729	2-Butene, (E)-	624-64-6	5.70	PPBV	14	JNTY	20181597
3OL0CNB0	S18T019729	Trimethylsilyl fluoride	420-56-4	5.74	PPBV	98	JNTY	20181597
3OL0CNB0	S18T019729	Formic acid hydrazide	624-84-0	6.13	PPBV	31	JNTY	20181597
3OL0CNB0	S18T019729	2-Methyl-1-butene	563-46-2	6.39	PPBV	16	JNTY	20181597
3OL0CNB0	S18T019729	1-Pentene	109-67-1	7.29	PPBV	96	JNTY	20181597
3OL0CNB0	S18T019729	Cyclopropane, 1,2-dimethyl-, cis-	930-18-7	7.50	PPBV	32	JNTY	20181597
3OL0CNB0	S18T019729	2-Pentene, (E)-	646-04-8	7.81	PPBV	22	JNTY	20181597
3OL0CNB0	S18T019729	Furan	110-00-9	8.03	PPBV	35	JNTY	20181597
3OL0CNB0	S18T019729	Trimethylene oxide	503-30-0	8.47	PPBV	24	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		8.54	PPBV	11	JTY	20181597
3OL0CNB0	S18T019729	1-Pentene, 4-methyl-	691-37-2	9.49	PPBV	50	JNTY	20181597
3OL0CNB0	S18T019729	2-Butene, 2,3-dimethyl-	563-79-1	9.86	PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	2-Propanol, 2-methyl-	75-65-0	9.98	PPBV	12	JNTY	20181597
3OL0CNB0	S18T019729	1-Butyne, 3-methyl-	598-23-2	10.19	PPBV	12	JNTY	20181597
3OL0CNB0	S18T019729	t-Butyl nitrite	540-80-7	10.48	PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	1-Hexene	592-41-6	10.65	PPBV	110	JNTY	20181597
3OL0CNB0	S18T019729	Furan, 2,5-dihydro-	1708-29-8	11.02	PPBV	45	JNTY	20181597
3OL0CNB0	S18T019729	Cyanic acid, 2-methylpropyl ester	1768-25-8	11.13	PPBV	20	JNTY	20181597
3OL0CNB0	S18T019729	1,3-Pentadiene, 3-methyl-, (E)-	2787-43-1	11.50	PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	Methane, nitro-	75-52-5	12.08	PPBV	73	JNTY	20181597
3OL0CNB0	S18T019729	Nitrous acid, butyl ester	544-16-1	12.53	PPBV	51	JNTY	20181597
3OL0CNB0	S18T019729	1-Hexene, 3,4-dimethyl-	16745-94-1	13.28	PPBV	17	JNTY	20181597
3OL0CNB0	S18T019729	Cyclohexene	110-83-8	13.97	PPBV	10	JNTY	20181597
3OL0CNB0	S18T019729	Furan, tetrahydro-2-methyl-	96-47-9	14.02	PPBV	16	JNTY	20181597
3OL0CNB0	S18T019729	1-Heptene	592-76-7	14.09	PPBV	47	JNTY	20181597
3OL0CNB0	S18T019729	2-Butenal, (E)-	123-73-9	14.29	PPBV	41	JNTY	20181597
3OL0CNB0	S18T019729	2-Hexene, 5,5-dimethyl-, (Z)-	39761-61-0	14.86	PPBV	15	JNTY	20181597
3OL0CNB0	S18T019729	2-Butanone, 3-methyl-	563-80-4	15.18	PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	Pentanal	110-62-3	15.39	PPBV	30	JNTY	20181597
3OL0CNB0	S18T019729	1,4-Heptadiene	5675-22-9	15.90	PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	1-Heptene, 6-methyl-	5026-76-6	16.11	PPBV	10	JNTY	20181597
3OL0CNB0	S18T019729	2-Pentene, 3-methyl-, (Z)-	922-62-3	16.81	PPBV	24	JNTY	20181597
3OL0CNB0	S18T019729	Cyclobutene, 2-propenylidene-	52097-85-5	16.93	PPBV	74	JNTY	20181597
3OL0CNB0	S18T019729	Octane	111-65-9	17.05	PPBV	17	JNTY	20181597
3OL0CNB0	S18T019729	Hexanal	66-25-1	18.02	PPBV	22	JNTY	20181597
3OL0CNB0	S18T019729	1-Pentanol, 2-ethyl-	27522-11-8	18.53	PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	Octane, 2-methyl-	3221-61-2	18.66	PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	Cyclooctane, methyl-	1502-38-1	18.76	PPBV	10	JNTY	20181597
3OL0CNB0	S18T019729	Heptane, 4-propyl-	3178-29-8	18.87	PPBV	10	JNTY	20181597
3OL0CNB0	S18T019729	o-Xylene	95-47-6	19.38	PPBV	22	JNTY	20181597
3OL0CNB0	S18T019729	1-Nonene	124-11-8	19.48	PPBV	30	JNTY	20181597
3OL0CNB0	S18T019729	Nonane	111-84-2	19.61	PPBV	69	JNTY	20181597
3OL0CNB0	S18T019729	Cyclohexane, 1-ethyl-2-methyl-	3728-54-9	19.70	PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		20.33	PPBV	11	JTY	20181597
3OL0CNB0	S18T019729	p-Xylene	106-42-3	20.41	PPBV	17	JNTY	20181597
3OL0CNB0	S18T019729	Octane, 2,6-dimethyl-	2051-30-1	20.60	PPBV	20	JNTY	20181597
3OL0CNB0	S18T019729	2-Nonenal, (Z)-	60784-31-8	20.84	PPBV	24	JNTY	20181597
3OL0CNB0	S18T019729	Cyclohexane, propyl-	1678-92-8	20.97	PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	Heptane, 3-ethyl-	15869-80-4	21.36	PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	Nonane, 2-methyl-	871-83-0	21.44	PPBV	10	JNTY	20181597
3OL0CNB0	S18T019729	Benzene, propyl-	103-65-1	22.08	PPBV	12	JNTY	20181597
3OL0CNB0	S18T019729	trans-3-Decene	19150-21-1	22.22	PPBV	48	JNTY	20181597
3OL0CNB0	S18T019729	Decane, 2,5,6-trimethyl-	62108-23-0	22.29	PPBV	84	JNTY	20181597
3OL0CNB0	S18T019729	2-Methyl-1-undecanol	10522-26-6	22.51	PPBV	16	JNTY	20181597
3OL0CNB0	S18T019729	1-Octanol, 2-butyl-	3913-02-8	22.54	PPBV	19	JNTY	20181597
3OL0CNB0	S18T019729	Benzene, 1-ethyl-3-methyl-	620-14-4	22.64	PPBV	18	JNTY	20181597
3OL0CNB0	S18T019729	Benzaldehyde	100-52-7	22.67	PPBV	27	JNTY	20181597
3OL0CNB0	S18T019729	Dodecanal	112-54-9	22.77	PPBV	18	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		22.83	PPBV	30	JTY	20181597
3OL0CNB0	S18T019729	1-Decanol, 2-hexyl-	2425-77-6	22.86	PPBV	17	JNTY	20181597

3OL0CNB0	S18T019729	Unknown		22.89 PPBV	12	JTY	20181597
3OL0CNB0	S18T019729	Unknown		22.95 PPBV	26	JTY	20181597
3OL0CNB0	S18T019729	1-Hexanol, 2-ethyl-	104-76-7	23.00 PPBV	27	JNTY	20181597
3OL0CNB0	S18T019729	Pentafluoropropionic acid, dodecyl ester	6222-04-4	23.14 PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	Tridecane	629-50-5	23.16 PPBV	51	JNTY	20181597
3OL0CNB0	S18T019729	1-Cyclohexylheptene	114614-83-4	23.22 PPBV	16	JNTY	20181597
3OL0CNB0	S18T019729	Silane, trichlorodocosyl-	7325-84-0	23.29 PPBV	16	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		23.37 PPBV	14	JTY	20181597
3OL0CNB0	S18T019729	Unknown		23.47 PPBV	13	JTY	20181597
3OL0CNB0	S18T019729	1-Propanol, 2,2-dimethyl-, benzoate	3581-70-2	23.56 PPBV	23	JNTY	20181597
3OL0CNB0	S18T019729	Oxiranemethanol, 2-phenyl-	141248-89-7	23.58 PPBV	24	JNTY	20181597
3OL0CNB0	S18T019729	cis-9,10-Epoxyoctadecan-1-ol	13980-12-6	23.62 PPBV	12	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		23.66 PPBV	17	JTY	20181597
3OL0CNB0	S18T019729	2-Undecenal	53448-07-0	23.71 PPBV	19	JNTY	20181597
3OL0CNB0	S18T019729	3-Decyn-2-ol	69668-93-5	23.83 PPBV	20	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		23.87 PPBV	40	JTY	20181597
3OL0CNB0	S18T019729	2-Cyclohexen-1-ol, 2-methyl-5-(1-methylethenyl)-	99-48-9	23.92 PPBV	11	JNTY	20181597
3OL0CNB0	S18T019729	Cyclopentadecanone, 4-methyl-	34894-60-5	23.98 PPBV	19	JNTY	20181597
3OL0CNB0	S18T019729	2,4-Dimethylstyrene	2234-20-0	24.05 PPBV	15	JNTY	20181597
3OL0CNB0	S18T019729	1,2,3,4-tetrahydronaphthalene	119-64-2	24.21 PPBV	14	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		24.26 PPBV	13	JTY	20181597
3OL0CNB0	S18T019729	2-Hexyl-1-octanol	19780-79-1	24.44 PPBV	13	JNTY	20181597
3OL0CNB0	S18T019729	Naphthalene	91-20-3	24.64 PPBV	42	JNTY	20181597
3OL0CNB0	S18T019729	Unknown		24.75 PPBV	12	JTY	20181597
3OL0CNB0	S18T019729	6-methyl-1,2,3,4-tetrahydronaphthalene	1680-51-9	25.11 PPBV	11	JNTY	20181597
3OL0CNC0	S18T019730	Formaldehyde	50-00-0	3.67 PPBV	41	JNT	20181597
3OL0CNC0	S18T019730	Propene	115-07-1	4.13 PPBV	19	JNT	20181597
3OL0CNC0	S18T019730	Methyl nitrite	624-91-9	4.62 PPBV	36	JNT	20181597
3OL0CNC0	S18T019730	Trimethylsilyl fluoride	420-56-4	5.74 PPBV	170	JNT	20181597
3OL0CNC0	S18T019730	Formic acid hydrazide	624-84-0	6.13 PPBV	16	JNT	20181597
3OL0CNC0	S18T019730	Methane, nitro-	75-52-5	12.08 PPBV	79	JNT	20181597
3OL0CNC0	S18T019730	Nitrous acid, butyl ester	544-16-1	12.54 PPBV	32	JNT	20181597
3OL0CNC0	S18T019730	Disiloxane, hexamethyl-	107-46-0	13.54 PPBV	33	JNT	20181597
3OL0CNC0	S18T019730	Cyclotetrasiloxane, octamethyl-	556-67-2	19.97 PPBV	25	JNT	20181597
3OL0CNC0	S18T019730	1-Hexanol, 2-ethyl-	104-76-7	21.33 PPBV	26	JNT	20181597
3OL0CND0	S18T019731	Formaldehyde	50-00-0	3.69 PPBV	97	JNT	20181597
3OL0CND0	S18T019731	Propene	115-07-1	4.13 PPBV	12	JNT	20181597
3OL0CND0	S18T019731	Methyl nitrite	624-91-9	4.62 PPBV	99	JNT	20181597
3OL0CND0	S18T019731	Trimethylsilyl fluoride	420-56-4	5.74 PPBV	32	JNT	20181597
3OL0CND0	S18T019731	Formic acid hydrazide	624-84-0	6.13 PPBV	43	JNT	20181597
3OL0CND0	S18T019731	Isobutyl nitrite	542-56-3	11.13 PPBV	12	JNT	20181597
3OL0CND0	S18T019731	Nitrous acid, butyl ester	544-16-1	12.53 PPBV	38	JNT	20181597
3OL0CND0	S18T019731	1-Hexanol, 2-ethyl-	104-76-7	21.33 PPBV	42	JNT	20181597
3OL0CND0	S18T019731	Acetic acid, 2-ethylhexyl ester	103-09-3	22.36 PPBV	34	JNT	20181597
3OL1CNC0	S18T019732	Formaldehyde	50-00-0	3.68 PPBV	60	JNT	20181597
3OL1CNC0	S18T019732	Methyl nitrite	624-91-9	4.61 PPBV	20	JNT	20181597
3OL1CNC0	S18T019732	Trimethylsilyl fluoride	420-56-4	5.75 PPBV	27	JNT	20181597
3OL1CNC0	S18T019732	Carbonyl sulfide	463-58-1	6.13 PPBV	11	JNT	20181597
3OL1CNC0	S18T019732	Nitrous acid, butyl ester	544-16-1	12.54 PPBV	13	JNT	20181597

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DSR.Jar v. 3.0.14

22-oct-2018 11:16:58
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	ANALYTE	CAS NO.	RETENTION TIME	RESULT_ UNIT	RESULT	QUALIFIER	SAMPLE_ GROUP
1OL0CNA0	S18T020369	Formamide	75-12-7	3.05	PPBV	2.1E+03	HJNT	20181649
1OL0CNB0	S18T020370	Nitric oxide	10102-43-9	1.98	PPBV	220	HJNT	20181649
1OL0CNB0	S18T020370	Propene	115-07-1	2.23	PPBV	250	HJNT	20181649
1OL0CNB0	S18T020370	Nitrogen dioxide	10102-44-0	2.27	PPBV	64	HJNT	20181649
1OL0CNB0	S18T020370	Propyne	74-99-7	2.44	PPBV	16	HJNT	20181649
1OL0CNB0	S18T020370	Methyl nitrite	624-91-9	2.51	PPBV	77	HJNT	20181649
1OL0CNB0	S18T020370	1-Propene, 2-methyl-	115-11-7	2.78	PPBV	60	HJNT	20181649
1OL0CNB0	S18T020370	Unknown		3.40	PPBV	27	HJT	20181649
1OL0CNB0	S18T020370	Cyclobutane, methyl-	598-61-8	4.23	PPBV	46	HJNT	20181649
1OL0CNB0	S18T020370	Furan	110-00-9	4.86	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	Propanal	123-38-6	5.31	PPBV	15	HJNT	20181649
1OL0CNB0	S18T020370	1-Pentene, 4-methyl-	691-37-2	6.46	PPBV	19	HJNT	20181649
1OL0CNB0	S18T020370	Unknown		7.50	PPBV	24	HJT	20181649
1OL0CNB0	S18T020370	2-Butene	107-01-7	8.25	PPBV	39	HJNT	20181649
1OL0CNB0	S18T020370	Unknown		10.72	PPBV	36	HJT	20181649
1OL0CNB0	S18T020370	Methane, nitro-	75-52-5	11.13	PPBV	62	HJNT	20181649
1OL0CNB0	S18T020370	1,2-Ethanediol, dinitrate	628-96-6	13.45	PPBV	14	HJNT	20181649
1OL0CNB0	S18T020370	1-Heptene	592-76-7	15.21	PPBV	27	HJNT	20181649
1OL0CNB0	S18T020370	2-Butenal	4170-30-3	15.50	PPBV	21	HJNT	20181649
1OL0CNB0	S18T020370	Cyclopropane, 1,1,2,2-tetramethyl-	4127-47-3	17.19	PPBV	16	HJNT	20181649
1OL0CNB0	S18T020370	Acetic acid ethenyl ester	108-05-4	17.31	PPBV	10	HJNT	20181649
1OL0CNB0	S18T020370	Pentanal	110-62-3	17.60	PPBV	19	HJNT	20181649
1OL0CNB0	S18T020370	Cyclopropane, pentyl-	2511-91-3	19.87	PPBV	23	HJNT	20181649
1OL0CNB0	S18T020370	Octane	111-65-9	20.02	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	4-Pentenal, 2-methyl-	5187-71-3	21.01	PPBV	23	HJNT	20181649
1OL0CNB0	S18T020370	Cyclohexane, ethyl-	1678-91-7	21.10	PPBV	10	HJNT	20181649
1OL0CNB0	S18T020370	Heptane, 4-azido-	27126-22-3	21.63	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	o-Xylene	95-47-6	22.24	PPBV	50	HJNT	20181649
1OL0CNB0	S18T020370	Nonane	111-84-2	22.35	PPBV	36	HJNT	20181649
1OL0CNB0	S18T020370	Cyclohexane, 1-ethyl-2-methyl-	3728-54-9	22.70	PPBV	14	HJNT	20181649
1OL0CNB0	S18T020370	p-Xylene	106-42-3	22.76	PPBV	18	HJNT	20181649
1OL0CNB0	S18T020370	Octane, 4-ethyl-	15869-86-0	22.99	PPBV	15	HJNT	20181649
1OL0CNB0	S18T020370	Undecanal	112-44-7	23.11	PPBV	31	HJNT	20181649
1OL0CNB0	S18T020370	2,4,6,8-Tetramethyl-1-undecene	59920-26-2	23.36	PPBV	12	HJNT	20181649
1OL0CNB0	S18T020370	Octane, 3-ethyl-	5881-17-4	23.61	PPBV	13	HJNT	20181649
1OL0CNB0	S18T020370	1-ethyl-3-methylbenzene	620-14-4	23.88	PPBV	23	HJNT	20181649
1OL0CNB0	S18T020370	1-Octene, 3,7-dimethyl-	4984-01-4	23.97	PPBV	19	HJNT	20181649
1OL0CNB0	S18T020370	cis-4-Decene	19398-88-0	23.98	PPBV	14	HJNT	20181649
1OL0CNB0	S18T020370	Benzene, 1-ethyl-4-methyl-	622-96-8	24.23	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	Octane, 2,3,6-trimethyl-	62016-33-5	24.39	PPBV	13	HJNT	20181649
1OL0CNB0	S18T020370	2,4-Nonadiyne	63621-15-8	24.45	PPBV	41	HJNT	20181649
1OL0CNB0	S18T020370	2-Hexyl-1-octanol	19780-79-1	24.65	PPBV	10	HJNT	20181649
1OL0CNB0	S18T020370	Dodecanal	112-54-9	24.71	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	Unknown		24.76	PPBV	19	HJT	20181649
1OL0CNB0	S18T020370	Benzene, 1,2,3-trimethyl-	526-73-8	24.94	PPBV	13	HJNT	20181649
1OL0CNB0	S18T020370	2,3-Dimethyldecane	17312-44-6	25.08	PPBV	14	HJNT	20181649
1OL0CNB0	S18T020370	1-methyl-3-propylbenzene	1074-43-7	25.21	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	Benzene, 1,4-diethyl-	105-05-5	25.28	PPBV	15	HJNT	20181649
1OL0CNB0	S18T020370	trans-decahydronaphthalene	493-02-7	25.34	PPBV	17	HJNT	20181649
1OL0CNB0	S18T020370	4-Dodecene, E-	7206-15-7	25.39	PPBV	12	HJNT	20181649
1OL0CND0	S10T020370	Octane, 2-methyl-	3221-61-2	25.45	PPDV	55	IJNT	20101649
1OL0CNB0	S18T020370	Unknown		26.00	PPBV	24	HJT	20181649
1OL0CNB0	S18T020370	2-methyl-decahydronaphthalene	2958-76-1	26.09	PPBV	25	HJNT	20181649
1OL0CNB0	S18T020370	2-Methyl-1-undecanol	10522-26-6	26.14	PPBV	19	HJNT	20181649
1OL0CNB0	S18T020370	Benzene, 1,2,3,5-tetramethyl-	527-53-7	26.24	PPBV	15	HJNT	20181649
1OL0CNB0	S18T020370	1-Methyldecahydronaphthalene	2958-75-0	26.33	PPBV	17	HJNT	20181649
1OL0CNB0	S18T020370	2,6-Dimethyldecane	13150-81-7	26.69	PPBV	38	HJNT	20181649
1OL0CNB0	S18T020370	2-Ethyl-1-dodecanol	19780-33-7	26.85	PPBV	11	HJNT	20181649
1OL0CNB0	S18T020370	1,2,3,4-tetrahydronaphthalene	119-64-2	26.93	PPBV	20	HJNT	20181649
1OL0CNB0	S18T020370	Naphthalene	91-20-3	27.47	PPBV	23	HJNT	20181649
1OL0CNB0	S18T020370	1-Decanol, 2-hexyl-	2425-77-6	27.52	PPBV	15	HJNT	20181649
1OL0CNB0	S18T020370	Unknown		27.66	PPBV	14	HJT	20181649
1OL0CNB0	S18T020370	Heptadecane, 2,6-dimethyl-	54105-67-8	27.81	PPBV	24	HJNT	20181649
1OL0CNB0	S18T020370	5-methyl-1,2,3,4-tetrahydronaphthalene	2809-64-5	28.11	PPBV	13	HJNT	20181649
1OL0CNB0	S18T020370	2-ethenyl-1,3,5-trimethylbenzene	769-25-5	28.46	PPBV	13	HJNT	20181649
1OL0CNB0	S18T020370	Naphthalene, 2-methyl-	91-57-6	28.73	PPBV	12	HJNT	20181649
1OL0CNB0	S18T020370	Unknown		28.87	PPBV	11	HJT	20181649
1OL0CNC0	S18T020371	Nitric oxide	10102-43-9	1.97	PPBV	200	HJNT	20181649

1OL0CNC0	S18T020371	Nitrogen dioxide	10102-44-0	2.28	PPBV	210	HJNT	20181649
1OL0CNC0	S18T020371	Unknown		2.51	PPBV	32	HJT	20181649
1OL0CNC0	S18T020371	Trimethylsilyl fluoride	420-56-4	3.16	PPBV	11	HJNT	20181649
1OL0CNC0	S18T020371	Unknown		3.40	PPBV	11	HJT	20181649
1OL0CNC0	S18T020371	Methane, nitro-	75-52-5	11.11	PPBV	11	HJNT	20181649
1OL0CNC0	S18T020371	Unknown		13.38	PPBV	13	HJT	20181649
1OL0CNC0	S18T020371	Methyl nitrate	598-58-3	23.64	PPBV	120	HJNT	20181649
1OL0CND0	S18T020372	Nitric oxide	10102-43-9	1.97	PPBV	100	HJNT	20181649
1OL0CND0	S18T020372	Nitrogen dioxide	10102-44-0	2.26	PPBV	160	HJNT	20181649
1OL0CND0	S18T020372	Unknown		2.51	PPBV	16	HJT	20181649
1OL0CND0	S18T020372	Unknown		2.53	PPBV	16	HJT	20181649
1OL0CND0	S18T020372	Ethanol, 2-nitro-, nitrate (ester)	4528-34-1	23.42	PPBV	100	HJNT	20181649
1OL0CND0	S18T020372	Methyl nitrate	598-58-3	23.60	PPBV	120	HJNT	20181649
1OL0CND0	S18T020372	3-Methylheptyl acetate	72218-58-7	26.53	PPBV	14	HJNT	20181649
1OL1CNA0	S18T020373	Nitric oxide	10102-43-9	1.98	PPBV	35	HJNT	20181649
1OL1CNA0	S18T020373	Ethylene oxide	75-21-8	3.81	PPBV	220	HJNT	20181649
1OL1CNA0	S18T020373	2-Butenal	4170-30-3	15.48	PPBV	10	HJNT	20181649
1OL1CNA0	S18T020373	Methyl nitrate	598-58-3	23.64	PPBV	170	HJNT	20181649
1OL1CND0	S18T020374	Nitric oxide	10102-43-9	1.97	PPBV	200	HJNT	20181649
1OL1CND0	S18T020374	Nitrous Oxide	10024-97-2	2.17	PPBV	12	HJNT	20181649
1OL1CND0	S18T020374	Nitrogen dioxide	10102-44-0	2.23	PPBV	110	HJNT	20181649
1OL1CND0	S18T020374	Unknown		2.51	PPBV	42	HJT	20181649
1OL1CND0	S18T020374	Unknown		3.41	PPBV	21	HJT	20181649
1OL1CND0	S18T020374	Formic acid hydrazide	624-84-0	5.92	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	Nitric oxide	10102-43-9	1.97	PPBV	150	HJNT	20181649
3OL2CNB0	S18T020365	Propene	115-07-1	2.23	PPBV	230	HJNT	20181649
3OL2CNB0	S18T020365	Propyne	74-99-7	2.43	PPBV	18	HJNT	20181649
3OL2CNB0	S18T020365	Methyl nitrite	624-91-9	2.51	PPBV	71	HJNT	20181649
3OL2CNB0	S18T020365	1-Propene, 2-methyl-	115-11-7	2.78	PPBV	66	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		3.41	PPBV	37	HJT	20181649
3OL2CNB0	S18T020365	Cyclobutane, methyl-	598-61-8	4.23	PPBV	49	HJNT	20181649
3OL2CNB0	S18T020365	Furan	110-00-9	4.86	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	Propanal	123-38-6	5.30	PPBV	19	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		5.92	PPBV	14	HJT	20181649
3OL2CNB0	S18T020365	1-Pentene, 4-methyl-	691-37-2	6.45	PPBV	21	HJNT	20181649
3OL2CNB0	S18T020365	Methyl nitrate	598-58-3	7.49	PPBV	21	HJNT	20181649
3OL2CNB0	S18T020365	2-Butene	107-01-7	8.25	PPBV	47	HJNT	20181649
3OL2CNB0	S18T020365	Dimethylketene	598-26-5	8.90	PPBV	10	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		10.72	PPBV	46	HJT	20181649
3OL2CNB0	S18T020365	Methane, nitro-	75-52-5	11.12	PPBV	50	HJNT	20181649
3OL2CNB0	S18T020365	1,2-Ethanediol, dinitrate	628-96-6	13.44	PPBV	13	HJNT	20181649
3OL2CNB0	S18T020365	Cyclohexene	110-83-8	14.55	PPBV	13	HJNT	20181649
3OL2CNB0	S18T020365	1-Heptene	592-76-7	15.21	PPBV	35	HJNT	20181649
3OL2CNB0	S18T020365	2-Butenal	4170-30-3	15.49	PPBV	30	HJNT	20181649
3OL2CNB0	S18T020365	Cyclopropane, 1,1,2,2-tetramethyl-	4127-47-3	17.19	PPBV	19	HJNT	20181649
3OL2CNB0	S18T020365	Acetic acid ethenyl ester	108-05-4	17.31	PPBV	14	HJNT	20181649
3OL2CNB0	S18T020365	Pentanal	110-62-3	17.60	PPBV	27	HJNT	20181649
3OL2CNB0	S18T020365	1-Butanol, 2-ethyl-	97-95-0	19.87	PPBV	30	HJNT	20181649
3OL2CNB0	S18T020365	Octane	111-65-9	20.02	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	Hexanal	66-25-1	21.01	PPBV	27	HJNT	20181649
3OL2CNB0	S18T020365	Cyclohexane, ethyl-	1678-91-7	21.09	PPBV	13	HJNT	20181649
3OL2CNB0	S18T020365	Heptane, 4-azido-	27126-22-3	21.63	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	o-Xylene	95-47-6	22.24	PPBV	58	HJNT	20181649
3OL2CNB0	S18T020365	Nonane	111-84-2	22.35	PPBV	42	HJNT	20181649
3OL2CNB0	S18T020365	Cyclohexane, 1-ethyl-2-methyl-	3728-54-9	22.70	PPBV	16	HJNT	20181649
3OL2CNB0	S18T020365	p-Xylene	106-42-3	22.76	PPBV	19	HJNT	20181649
3OL2CNB0	S18T020365	Octane, 3,6-dimethyl-	15869-94-0	22.99	PPBV	15	HJNT	20181649
3OL2CNB0	S18T020365	Undecanal	112 44 7	23.11	PPBV	36	HJNT	20181649
3OL2CNB0	S18T020365	2,4,6,8-Tetramethyl-1-undecene	59920-26-2	23.36	PPBV	16	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		23.61	PPBV	12	HJT	20181649
3OL2CNB0	S18T020365	Benzene, 1-ethyl-3-methyl-	620-14-4	23.88	PPBV	24	HJNT	20181649
3OL2CNB0	S18T020365	1-Octene, 3,7-dimethyl-	4984-01-4	23.97	PPBV	26	HJNT	20181649
3OL2CNB0	S18T020365	cis-4-Decene	19398-88-0	23.99	PPBV	15	HJNT	20181649
3OL2CNB0	S18T020365	Benzene, 1-ethyl-4-methyl-	622-96-8	24.23	PPBV	11	HJNT	20181649
3OL2CNB0	S18T020365	Octane, 2,3,6-trimethyl-	62016-33-5	24.39	PPBV	16	HJNT	20181649
3OL2CNB0	S18T020365	Ethanone, 2,2-dihydroxy-1-phenyl-	1075-06-5	24.45	PPBV	51	HJNT	20181649
3OL2CNB0	S18T020365	2-Hexyl-1-octanol	19780-79-1	24.65	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	Dodecanal	112-54-9	24.71	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		24.76	PPBV	22	HJT	20181649
3OL2CNB0	S18T020365	Benzene, 1,2,3-trimethyl-	526-73-8	24.94	PPBV	14	HJNT	20181649
3OL2CNB0	S18T020365	Hydroxylamine, O-decyl-	29812-79-1	24.97	PPBV	10	HJNT	20181649
3OL2CNB0	S18T020365	2,3-Dimethyldecane	17312-44-6	25.08	PPBV	17	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		25.17	PPBV	11	HJT	20181649
3OL2CNB0	S18T020365	1-methyl-4-propylbenzene	1074-55-1	25.21	PPBV	12	HJNT	20181649
3OL2CNB0	S18T020365	Benzene, 1,4-diethyl-	105-05-5	25.28	PPBV	18	HJNT	20181649

3OL2CNB0	S18T020365	trans-decahydronaphthalene	493-02-7	25.34 PPBV	22	HJNT	20181649
3OL2CNB0	S18T020365	4-Dodecene, (E)-	7206-15-7	25.39 PPBV	15	HJNT	20181649
3OL2CNB0	S18T020365	Octane, 2-methyl-	3221-61-2	25.45 PPBV	65	HJNT	20181649
3OL2CNB0	S18T020365	1-methyl-2-(1-methylethyl)-benzene	527-84-4	25.72 PPBV	10	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		26.00 PPBV	30	HJT	20181649
3OL2CNB0	S18T020365	2-methyl-decahydronaphthalene	2958-76-1	26.09 PPBV	22	HJNT	20181649
3OL2CNB0	S18T020365	2-Methyl-1-undecanol	10522-26-6	26.14 PPBV	21	HJNT	20181649
3OL2CNB0	S18T020365	Benzene, 1,2,3,5-tetramethyl-	527-53-7	26.24 PPBV	20	HJNT	20181649
3OL2CNB0	S18T020365	1-Methyldecahydronaphthalene	2958-75-0	26.33 PPBV	19	HJNT	20181649
3OL2CNB0	S18T020365	2,6-Dimethyldecane	13150-81-7	26.69 PPBV	42	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		26.71 PPBV	10	HJT	20181649
3OL2CNB0	S18T020365	2-Ethyl-1-dodecanol	19780-33-7	26.85 PPBV	11	HJNT	20181649
3OL2CNB0	S18T020365	1,2,3,4-tetrahydronaphthalene	119-64-2	26.93 PPBV	23	HJNT	20181649
3OL2CNB0	S18T020365	Naphthalene	91-20-3	27.47 PPBV	29	HJNT	20181649
3OL2CNB0	S18T020365	1-Decanol, 2-hexyl-	2425-77-6	27.52 PPBV	14	HJNT	20181649
3OL2CNB0	S18T020365	6-methyl-1,2,3,4-tetrahydronaphthalene	1680-51-9	27.66 PPBV	17	HJNT	20181649
3OL2CNB0	S18T020365	Heptadecane, 2,6-dimethyl-	54105-67-8	27.81 PPBV	28	HJNT	20181649
3OL2CNB0	S18T020365	5-methyl-1,2,3,4-tetrahydronaphthalene	2809-64-5	28.11 PPBV	19	HJNT	20181649
3OL2CNB0	S18T020365	Benzene, 2-ethenyl-1,3,5-trimethyl-	769-25-5	28.46 PPBV	15	HJNT	20181649
3OL2CNB0	S18T020365	2,7-dimethyl-1,2,3,4-tetrahydronaphthalene	13065-07-1	28.68 PPBV	13	HJNT	20181649
3OL2CNB0	S18T020365	Naphthalene, 2-methyl-	91-57-6	28.73 PPBV	19	HJNT	20181649
3OL2CNB0	S18T020365	Unknown		28.87 PPBV	12	HJT	20181649
3OL2CNB0	S18T020365	Naphthalene, 1-methyl-	90-12-0	28.93 PPBV	13	HJNT	20181649
3OL2CNC0	S18T020366	Nitric oxide	10102-43-9	1.97 PPBV	180	HJNT	20181649
3OL2CNC0	S18T020366	Nitrogen dioxide	10102-44-0	2.23 PPBV	96	HJNT	20181649
3OL2CNC0	S18T020366	Unknown		2.51 PPBV	40	HJT	20181649
3OL2CNC0	S18T020366	Trimethylsilyl fluoride	420-56-4	3.16 PPBV	34	HJNT	20181649
3OL2CNC0	S18T020366	Unknown		3.41 PPBV	19	HJT	20181649
3OL2CNC0	S18T020366	Methane, nitro-	75-52-5	11.12 PPBV	26	HJNT	20181649
3OL2CND0	S18T020367	Nitric oxide	10102-43-9	1.98 PPBV	270	HJNT	20181649
3OL2CND0	S18T020367	Nitrous Oxide	10024-97-2	2.09 PPBV	43	HJNT	20181649
3OL2CND0	S18T020367	Nitrogen dioxide	10102-44-0	2.37 PPBV	610	HJNT	20181649
3OL2CND0	S18T020367	Methyl nitrite	624-91-9	2.51 PPBV	49	HJNT	20181649
3OL2CND0	S18T020367	Unknown		3.41 PPBV	26	HJT	20181649
3OL2CND0	S18T020367	Formic acid hydrazide	624-84-0	5.93 PPBV	12	HJNT	20181649
3OL2CND0	S18T020367	Methyl nitrate	598-58-3	23.69 PPBV	24	HJNT	20181649
3OL2CND0	S18T020367	Ethanol, 2-nitro-, nitrate (ester)	4528-34-1	23.75 PPBV	21	HJNT	20181649
3OL2CND0	S18T020367	2,4,6,8-Tetramethyl-1-undecene	59920-26-2	24.05 PPBV	13	HJNT	20181649
3OL2CND0	S18T020367	Octanal	124-13-0	24.72 PPBV	11	HJNT	20181649
3OL3CNA0	S18T020368	Nitric oxide	10102-43-9	1.98 PPBV	23	HJNT	20181649
3OL3CNA0	S18T020368	Unknown		3.43 PPBV	15	HJT	20181649
3OL3CNA0	S18T020368	Methyl nitrate	598-58-3	23.63 PPBV	130	HJNT	20181649

a - LCS Outside Range
J - Estimated
H - Missed Holdtime
Y - Comment
N - Named TIC
T - Tentatively Identified Compound
NA = Not Analyzed, ND = Not Detected
DSRTICSpreadsheet3.0.14
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22-oct-2018 11:24:47
NUCON
Data Summary of All Results
Customer Group or SDG Number

Customer Sample ID	SAMPLE_R	ANALYTE	CAS NO.	RETENTION TIME	RESULT_ UNIT	RESULT	QUALIFIER	SAMPLE_ GROUP
5MX0CNA0	S18T023381	Furan	110-00-9	4.84	PPBV	11	JNT	20181853
5MX0CNA0	S18T023381	N-Nitrosodimethylamine	62-75-9	20.59	PPBV	17	JNT	20181853
5MX0CNB0	S18T023382	Nitric oxide	10102-43-9	1.97	PPBV	250	JNT	20181853
5MX0CNB0	S18T023382	Propene	115-07-1	2.23	PPBV	130	JNT	20181853
5MX0CNB0	S18T023382	Nitrogen dioxide	10102-44-0	2.27	PPBV	110	JNT	20181853
5MX0CNB0	S18T023382	Methyl nitrite	624-91-9	2.51	PPBV	53	JNT	20181853
5MX0CNB0	S18T023382	1-Butene	106-98-9	2.77	PPBV	23	JNT	20181853
5MX0CNB0	S18T023382	Cyclopentane	287-92-3	4.22	PPBV	19	JNT	20181853
5MX0CNB0	S18T023382	1-Pentene, 4-methyl-	691-37-2	8.23	PPBV	11	JNT	20181853
5MX0CNB0	S18T023382	Methane, nitro-	75-52-5	11.08	PPBV	12	JNT	20181853
5MX0CNB0	S18T023382	o-Xylene	95-47-6	22.24	PPBV	13	JNT	20181853
5MX0CNB0	S18T023382	Cyclotetrasiloxane, octamethyl-	556-67-2	23.63	PPBV	10	JNT	20181853
5MX0CNB0	S18T023382	trans-3-Decene	19150-21-1	23.97	PPBV	11	JNT	20181853
5MX0CNB0	S18T023382	Benzene, 1,2,3-trimethyl-	526-73-8	24.45	PPBV	12	JNT	20181853
5MX0CNB0	S18T023382	Octane, 2-methyl-	3221-61-2	25.44	PPBV	16	JNT	20181853
5MX0CNB0	S18T023382	Unknown		26.68	PPBV	11	JT	20181853
5MX0CNC0	S18T023383	Nitric oxide	10102-43-9	1.97	PPBV	220	JNT	20181853
5MX0CNC0	S18T023383	Nitrogen dioxide	10102-44-0	2.24	PPBV	140	JNT	20181853
5MX0CNC0	S18T023383	Methyl nitrite	624-91-9	2.50	PPBV	24	JNT	20181853
5MX0CNC0	S18T023383	Unknown		4.16	PPBV	18	JT	20181853
5MX0CND0	S18T023384	Nitric oxide	10102-43-9	1.95	PPBV	39	JNT	20181853
5MX0CND0	S18T023384	Unknown		7.71	PPBV	13	JT	20181853
5MX0CND0	S18T023384	Methyl nitrate	598-58-3	23.69	PPBV	180	JNT	20181853
5OL0CNB0	S18T023377	Nitric oxide	10102-43-9	1.98	PPBV	150	JNT	20181853
5OL0CNB0	S18T023377	Propene	115-07-1	2.22	PPBV	55	JNT	20181853
5OL0CNB0	S18T023377	Ethane	74-84-0	2.31	PPBV	18	JNT	20181853
5OL0CNB0	S18T023377	Methyl nitrite	624-91-9	2.51	PPBV	82	JNT	20181853
5OL0CNB0	S18T023377	1-Butene	106-98-9	2.77	PPBV	17	JNT	20181853
5OL0CNB0	S18T023377	Cyclobutane, methyl-	598-61-8	4.22	PPBV	10	JNT	20181853
5OL0CNB0	S18T023377	Methane, nitro-	75-52-5	11.08	PPBV	12	JNT	20181853
5OL0CNB0	S18T023377	Cyclotetrasiloxane, octamethyl-	556-67-2	23.63	PPBV	24	JNT	20181853
5OL0CNB0	S18T023377	Octane, 2-methyl-	3221-61-2	25.44	PPBV	14	JNT	20181853
5OL0CNC0	S18T023378	Nitric oxide	10102-43-9	1.97	PPBV	130	JNT	20181853
5OL0CNC0	S18T023378	Methyl nitrite	624-91-9	2.50	PPBV	32	JNT	20181853
5OL0CNC0	S18T023378	Formic acid hydrazide	624-84-0	3.40	PPBV	13	JNT	20181853
5OL0CNC0	S18T023378	Cyclotetrasiloxane, octamethyl-	556-67-2	23.63	PPBV	20	JNT	20181853
5OL0CND0	S18T023379	Nitrous Oxide	10024-97-2	1.60	PPBV	11	JNT	20181853
5OL0CND0	S18T023379	Nitric oxide	10102-43-9	1.97	PPBV	190	JNT	20181853
5OL0CND0	S18T023379	Methyl nitrite	624-91-9	2.51	PPBV	39	JNT	20181853
5OL1CNC0	S18T023380	Nitric oxide	10102-43-9	1.97	PPBV	150	JNT	20181853
5OL1CNC0	S18T023380	Nitrogen dioxide	10102-44-0	2.17	PPBV	22	JNT	20181853
5OL1CNC0	S18T023380	Methyl nitrite	624-91-9	2.51	PPBV	63	JNT	20181853
5OL1CNC0	S18T023380	Cyclotetrasiloxane, octamethyl-	556-67-2	23.63	PPBV	27	JNT	20181853

J - Estimated
H - Missed Holdtime
Y - Comment
N - Named TIC
T Tentatively Identified Compound
NA = Not Analyzed, ND = Not Detected
DSRTICSpreadsheet3.0.14
DSR.Jar v. 3.0.14

Appendix L

NIOSH 2522 Offline Sample Analysis Reports

Appendix L

NIOSH 2522 Offline Sample Analysis Reports

Table J.1. NIOSH 2522 Sample Number Key

Test	Gasses Tested	Port	Condition	Sample Number	Media Type
4.2/5.2	FURAN & NDMA				
		Blank	200%OEL	EL23304	NIOSH-2522 mod GC-TEA tube
		Traveler	200%OEL	EL23313	NIOSH-2522 mod GC-TEA tube
		A	200%OEL	EL23311	NIOSH-2522 mod GC-TEA tube
		B	200%OEL	EL23310	NIOSH-2522 mod GC-TEA tube
		C	200%OEL	EL23307	NIOSH-2522 mod GC-TEA tube
		D	200%OEL	EL23309	NIOSH-2522 mod GC-TEA tube
4.3/5.3	FURAN & NDMA				
		Blank	Max Concentration	EL23300	NIOSH-2522 mod GC-TEA tube
		Traveler	Max Concentration	EL23301	NIOSH-2522 mod GC-TEA tube
		A	Max Concentration	EL23302	NIOSH-2522 mod GC-TEA tube
		B	Max Concentration	EL23303	NIOSH-2522 mod GC-TEA tube
		C	Max Concentration	EL2318	NIOSH-2522 mod GC-TEA tube
		D	Max Concentration	EL23319	NIOSH-2522 mod GC-TEA tube

RJ LEE GROUP

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2018 NUCON

08/21/18
Contract: 55503 R9

Subject: Nitrosamines Analysis Report, Group Number 20181852

Enclosed is the final report for group 20181852 number analyzed for Nitrosamines using NIOSH 2522-Modified. This group number 20181852 has been assigned a Columbia Basin Analytical Laboratories login order number of W806109. This report consists of a summary report of the samples, a single quality control report for the analysis batch, and a copy of the chain of custody.

General Set Comments

Columbia Basin Analytical Laboratories received 12 samples on 06/21/18 to be tested for Nitrosamines. The samples were analyzed in accordance with NIOSH 2522-Modified for N-Nitrosodimethylamine, N-Nitrosomethylethylamine, N-Nitrosodiethylamine, N-Nitrosodi-n-propylamine, N-Nitrosodi-n-butylamine, N-Nitrosopiperidine, N-Nitrosopyrrolidine,and N-Nitrosomorpholine. All results have been corrected for desorption efficiency and measurable levels in the blanks.

Results

There were detectable nitrosamines concentrations at or above the reporting limit in the samples.

SampleName | Lab ID	Analyzed	Analyte	CAS Number	Results	RL	Units	Flags
EL23304	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23304	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	H
EL23307	07/27/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23307	08/14/18	N-Nitrosodimethylamine	62-75-9	6.809	0.148	µg/tube	HQAS, D, H,
EL23307	07/27/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	HQ
EL23307	07/27/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23307	07/27/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	HQ
EL23307	08/14/18	N-Nitrosomorpholine	59-89-2	0.033	0.008	µg/tube	H AS, H, Q
EL23307	07/27/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23307	07/27/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ

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SampleName | Lab ID	Analyzed	Analyte	CAS Number	Results	RL	Units	Flags
EL23309	07/27/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23309	08/14/18	N-Nitrosodimethylamine	62-75-9	9.696	0.295	µg/tube	H QAS, D, Q
EL23309	08/14/18	N-Nitrosodi-n-butylamine	924-16-3	0.061	0.008	µg/tube	H QAS, Q
EL23309	07/27/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23309	07/27/18	N-Nitrosomethylethylamine	10595-95-6	0.012	0.008	µg/tube	HQ
EL23309	07/27/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23309	07/27/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23309	07/27/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ
EL23310	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23310	08/14/18	N-Nitrosodimethylamine	62-75-9	2.760	0.295	µg/tube	H QAS, D, Q
EL23310	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	HQ
EL23310	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23310	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	HQ
EL23310	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23310	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23310	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ
EL23311	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23311	07/28/18	N-Nitrosodimethylamine	62-75-9	0.026	0.008	µg/tube	HQ
EL23311	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	HQ
EL23311	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23311	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	HQ
EL23311	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23311	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23311	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ
EL23313	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23313	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23300	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	H

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SampleName | Lab ID	Analyzed	Analyte	CAS Number	Results	RL	Units	Flags
EL23301	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23301	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	H
EL23302	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23302	08/16/18	N-Nitrosodimethylamine	62-75-9	20.067	0.295	µg/tube	S, Q AS, D H
EL23302	08/13/18	N-Nitrosodi-n-butylamine	924-16-3	0.050	0.008	µg/tube	Q AS, H, [illegible]
EL23302	08/13/18	N-Nitrosodi-n-propylamine	621-64-7	0.026	0.008	µg/tube	AS, H, Q [illegible]
EL23302	07/28/18	N-Nitrosomethylethylamine	10595-95-6	0.013	0.008	µg/tube	HQ
EL23302	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23302	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23302	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ
EL23303	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23303	07/28/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	µg/tube	HQ
EL23303	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	HQ
EL23303	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23303	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	HQ
EL23303	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23303	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23303	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ
EL23318	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	µg/tube	H
EL23318	07/28/18	N-Nitrosodimethylamine	62-75-9	0.017	0.008	µg/tube	HQ
EL23318	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	µg/tube	HQ
EL23318	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23318	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	HQ
EL23318	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23318	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23318	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ
EL23319	07/28/18	N-Nitrosodiethylamine	55-18-5	0.009	0.008	µg/tube	H
EL23319	07/28/18	N-Nitrosodimethylamine	62-75-9	0.058	0.008	µg/tube	HQ
EL23319	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	0.014	0.008	µg/tube	HQ
EL23319	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	µg/tube	HQ
EL23319	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	µg/tube	HQ
EL23319	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	µg/tube	HQ
EL23319	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	µg/tube	H
EL23319	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	µg/tube	HQ

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Recovery Failures in the ICV, CCV, LCS, and MRL

There were no recovery failures in the CCV, ICV, MRL. There were recovery failures in the LCS.

RSD Failures in the LCS

There were no RSD failures between the laboratory control samples.

Measurable Blank Values

There were no measurable analytes in the blank samples.

Calibration Curves

The calibration curves for Nitrosamines had an R-value that was 0.995 or better, over a range of 5.00 ng/mL to 500.00 ng/mL.

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General Lab Comments

The results provided in this report relate only to the items tested. Samples were received in acceptable conditions unless otherwise noted in the comments above. Samples have not been field blank corrected unless otherwise noted in the general set comments above. This test report shall not be reproduced, except in full, without written approval of Columbia Basin Analytical Laboratories.

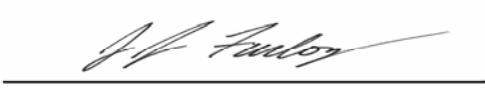
I certify that this analytical report is in compliance with the Hanford SOW, both technically and for completeness. Release of the data contained in this hard copy report has been authorized by the Laboratory Director or a designee as verified by the following signature.

09/04/18

Scientist II Dennese Smith

If you have any questions, please feel free to contact Dennese Smith at dennese.smith@rjleegroup.com or at 509-545-4989.

This report has been reviewed and approved by the following individual:



09/04/18

Office Manager JJ Furlong

RJ LEE GROUP

Carl Howald IV
Washington River Protection Solutions, LLC
P.O. Box 850 MSIN H1-40
Richland, WA 99352

Laboratory Report

NIOSH 2522-Modified
on
Summary Table

RJ Lee Work Order: W806109
COC No.: 20181852
Samples Received: 06/21/18
Extraction Date: 06/26/18
Report Date: 08/21/18

Client Project: 2018 NUCON

Sample Identification Client Sample ID	Sampling Date	Analysis Date	Analyte	CAS Number	Concentration	RL	Qualifiers
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23304 | S18T023364	06/12/18	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosodimethylamine	62-75-9	0.046	0.008	H Q
EL23307 | S18T023365	06/12/18	08/14/18	N-Nitrosodimethylamine	62-75-9	6.763	0.148	AS, D, H, Q
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H Q
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H Q
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23307 | S18T023365	06/12/18	08/14/18	N-Nitrosomorpholine	59-89-2	0.033	0.007	AS, H, Q
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23307 | S18T023365	06/12/18	07/27/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosodimethylamine	62-75-9	0.034	0.008	H Q
EL23309 | S18T023366	06/12/18	08/14/18	N-Nitrosodimethylamine	62-75-9	9.662	0.295	AS, D, H
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosodi-n-butylamine	924-16-3	0.019	0.008	H Q
EL23309 | S18T023366	06/12/18	08/14/18	N-Nitrosodi-n-butylamine	924-16-3	0.042	0.007	AS, H
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosomethylethylamine	10595-95-6	0.012	0.008	H Q
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23309 | S18T023366	06/12/18	07/27/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q

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Sample Identification Client Sample ID	Sampling Date	Analysis Date	Analyte	CAS Number	Concentration	RL	Qualifiers
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosodimethylamine	62-75-9	0.018	0.008	H Q
EL23310 | S18T023367	06/12/18	08/14/18	N-Nitrosodimethylamine	62-75-9	2.741	0.295	AS, D, H
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H Q
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H Q
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23310 | S18T023367	06/12/18	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosodimethylamine	62-75-9	0.026	0.008	H Q
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H Q
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H Q
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23311 | S18T023368	06/12/18	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23313 | S18T023369	06/12/18	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23300 | S18T023370	06/13/18	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23301 | S18T023371	06/13/18	08/07/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H

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Sample Identification Client Sample ID	Sampling Date	Analysis Date	Analyte	CAS Number	Concentration	RL	Qualifiers
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23302 | S18T023372	06/13/18	08/13/18	N-Nitrosodimethylamine	62-75-9	0.235	0.007	AS, H, Q
EL23302 | S18T023372	06/13/18	08/14/18	N-Nitrosodimethylamine	62-75-9	0.942	0.015	AS, D, H
EL23302 | S18T023372	06/13/18	08/16/18	N-Nitrosodimethylamine	62-75-9	18.889	0.295	D, H
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H Q
EL23302 | S18T023372	06/13/18	08/13/18	N-Nitrosodi-n-butylamine	924-16-3	0.050	0.007	AS, H, Q
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23302 | S18T023372	06/13/18	08/13/18	N-Nitrosodi-n-propylamine	621-64-7	0.026	0.007	AS, H, Q
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosomethylethylamine	10595-95-6	0.013	0.008	H Q
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23302 | S18T023372	06/13/18	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosodimethylamine	62-75-9	<0.008	0.008	H Q
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H Q
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H Q
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23303 | S18T023373	06/13/18	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosodiethylamine	55-18-5	<0.008	0.008	H
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosodimethylamine	62-75-9	0.017	0.008	H Q
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	<0.008	0.008	H Q
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H Q
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23318 | S18T023374	06/13/18	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosodiethylamine	55-18-5	0.009	0.008	H
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosodimethylamine	62-75-9	0.058	0.008	H Q
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosodi-n-butylamine	924-16-3	0.014	0.008	H Q
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosodi-n-propylamine	621-64-7	<0.008	0.008	H Q
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosomethylethylamine	10595-95-6	<0.008	0.008	H Q
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosomorpholine	59-89-2	<0.008	0.008	H Q
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosopiperidine	100-75-4	<0.008	0.008	H
EL23319 | S18T023375	06/13/18	07/28/18	N-Nitrosopyrrolidine	930-55-2	<0.008	0.008	H Q

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Washington River Protection Solutions, LLC
P.O. Box 850 MSIN H1-40
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Quality Control

NIOSH 2522-Modified

RJ Lee Work Order: W806109
COC No.: 20181852
Samples Received: 06/21/18
Extraction Date: 06/26/18
Report Date: 08/21/18

Client Project: 2018 NUCON

Analyte	CAS No.	Sample ID	Analyzed Date	Expected µg/tube	Result µg/tube	DE	DE Corrected	RSD %	REC %	Limits	Qualifier
N-Nitrosodiethylamine	55-18-5	LCS-1	06/26/18	0.200	0.253	1.24		1.68	126	70 - 130	
N-Nitrosodiethylamine	55-18-5	LCS-1	06/28/18	0.200	0.268	1.35		3.56	133	70 - 130	[2]
N-Nitrosodimethylamine	62-75-9	LCS-1	06/26/18	0.200	0.251	1.23		2.20	125	70 - 130	
N-Nitrosodimethylamine	62-75-9	LCS-1	06/28/18	0.200	0.266	1.35		3.79	133	70 - 130	[2]
N-Nitrosodi-n-butylamine	924-16-3	LCS-1	06/26/18	0.201	0.259	1.26		2.29	129	70 - 130	
N-Nitrosodi-n-butylamine	924-16-3	LCS-1	06/28/18	0.201	0.264	1.35		2.45	132	70 - 130	[2]
N-Nitrosodi-n-propylamine	621-64-7	LCS-1	06/26/18	0.200	0.255	1.25		2.06	127	70 - 130	
N-Nitrosodi-n-propylamine	621-64-7	LCS-1	06/28/18	0.200	0.269	1.35		1.77	134	70 - 130	[2]
N-Nitrosomethylethylamine	10595-95-6	LCS-1	06/26/18	0.200	0.255	1.24		2.41	127	70 - 130	
N-Nitrosomethylethylamine	10595-95-6	LCS-1	06/28/18	0.200	0.267	1.34		3.10	133	70 - 130	[2]
N-Nitrosomorpholine	59-89-2	LCS-1	06/26/18	0.200	0.259	1.26		2.53	129	70 - 130	
N-Nitrosomorpholine	59-89-2	LCS-1	06/28/18	0.200	0.270	1.36		2.30	135	70 - 130	[2]
N-Nitrosopiperidine	100-75-4	LCS-1	06/26/18	0.200	0.258	1.27		1.39	129	70 - 130	
N-Nitrosopiperidine	100-75-4	LCS-1	06/28/18	0.200	0.269	1.36		3.04	134	70 - 130	[2]
N-Nitrosopyrrolidine	930-55-2	LCS-1	06/26/18	0.200	0.259	1.24		3.16	129	70 - 130	
N-Nitrosopyrrolidine	930-55-2	LCS-1	06/28/18	0.200	0.267	1.35		5.26	133	70 - 130	[2]
N-Nitrosodiethylamine	55-18-5	LCS-2	06/26/18	0.200	0.245	1.24		1.68	122	70 - 130	
N-Nitrosodiethylamine	55-18-5	LCS-2	06/28/18	0.200	0.262	1.35		3.56	131	70 - 130	[2]
N-Nitrosodimethylamine	62-75-9	LCS-2	06/26/18	0.200	0.241	1.23		2.20	120	70 - 130	
N-Nitrosodimethylamine	62-75-9	LCS-2	06/28/18	0.200	0.265	1.35		3.79	132	70 - 130	[2]
N-Nitrosodi-n-butylamine	924-16-3	LCS-2	06/26/18	0.201	0.248	1.26		2.29	124	70 - 130	
N-Nitrosodi-n-butylamine	924-16-3	LCS-2	06/28/18	0.201	0.269	1.35		2.45	134	70 - 130	[2]
N-Nitrosodi-n-propylamine	621-64-7	LCS-2	06/26/18	0.200	0.245	1.25		2.06	122	70 - 130	
N-Nitrosodi-n-propylamine	621-64-7	LCS-2	06/28/18	0.200	0.268	1.35		1.77	134	70 - 130	[2]
N-Nitrosomethylethylamine	10595-95-6	LCS-2	06/26/18	0.200	0.244	1.24		2.41	122	70 - 130	
N-Nitrosomethylethylamine	10595-95-6	LCS-2	06/28/18	0.200	0.262	1.34		3.10	131	70 - 130	[2]
N-Nitrosomorpholine	59-89-2	LCS-2	06/26/18	0.200	0.246	1.26		2.53	123	70 - 130	
N-Nitrosomorpholine	59-89-2	LCS-2	06/28/18	0.200	0.269	1.36		2.30	134	70 - 130	[2]
N-Nitrosopiperidine	100-75-4	LCS-2	06/26/18	0.200	0.251	1.27		1.39	125	70 - 130	
N-Nitrosopiperidine	100-75-4	LCS-2	06/28/18	0.200	0.266	1.36		3.04	133	70 - 130	[2]
N-Nitrosopyrrolidine	930-55-2	LCS-2	06/26/18	0.200	0.244	1.24		3.16	122	70 - 130	
N-Nitrosopyrrolidine	930-55-2	LCS-2	06/28/18	0.200	0.258	1.35		5.26	129	70 - 130	

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Analyte	CAS No.	Sample ID	Analyzed Date	Expected µg/tube	Result µg/tube	DE	DE Corrected	RSD %	REC %	Limits	Qualifier
N-Nitrosodiethylamine	55-18-5	LCS-3	06/26/18	0.200	0.247	1.24		1.68	123	70 - 130	
N-Nitrosodiethylamine	55-18-5	LCS-3	06/28/18	0.200	0.281	1.35		3.56	140	70 - 130	[r]
N-Nitrosodimethylamine	62-75-9	LCS-3	06/26/18	0.200	0.249	1.23		2.20	125	70 - 130	
N-Nitrosodimethylamine	62-75-9	LCS-3	06/28/18	0.200	0.283	1.35		3.79	141	70 - 130	[r]
N-Nitrosodi-n-butylamine	924-16-3	LCS-3	06/26/18	0.201	0.250	1.26		2.29	125	70 - 130	
N-Nitrosodi-n-butylamine	924-16-3	LCS-3	06/28/18	0.201	0.277	1.35		2.45	138	70 - 130	[r]
N-Nitrosodi-n-propylamine	621-64-7	LCS-3	06/26/18	0.200	0.254	1.25		2.06	127	70 - 130	
N-Nitrosodi-n-propylamine	621-64-7	LCS-3	06/28/18	0.200	0.276	1.35		1.77	138	70 - 130	[r]
N-Nitrosomethylethylamine	10595-95-6	LCS-3	06/26/18	0.200	0.247	1.24		2.41	123	70 - 130	
N-Nitrosomethylethylamine	10595-95-6	LCS-3	06/28/18	0.200	0.278	1.34		3.10	139	70 - 130	[r]
N-Nitrosomorpholine	59-89-2	LCS-3	06/26/18	0.200	0.252	1.26		2.53	126	70 - 130	
N-Nitrosomorpholine	59-89-2	LCS-3	06/28/18	0.200	0.280	1.36		2.30	140	70 - 130	[r]
N-Nitrosopiperidine	100-75-4	LCS-3	06/26/18	0.200	0.254	1.27		1.39	127	70 - 130	
N-Nitrosopiperidine	100-75-4	LCS-3	06/28/18	0.200	0.282	1.36		3.04	141	70 - 130	[r]
N-Nitrosopyrrolidine	930-55-2	LCS-3	06/26/18	0.200	0.246	1.24		3.16	123	70 - 130	
N-Nitrosopyrrolidine	930-55-2	LCS-3	06/28/18	0.200	0.286	1.35		5.26	143	70 - 130	[r]
N-Nitrosodiethylamine	55-18-5	MB	06/26/18		<0.010	1.24	<0.010				
N-Nitrosodiethylamine	55-18-5	MB	06/28/18		<0.010	1.35	<0.010				
N-Nitrosodimethylamine	62-75-9	MB	06/26/18		<0.010	1.23	<0.010				
N-Nitrosodimethylamine	62-75-9	MB	06/28/18		<0.010	1.35	<0.010				
N-Nitrosodi-n-butylamine	924-16-3	MB	06/26/18		<0.010	1.26	<0.010				
N-Nitrosodi-n-butylamine	924-16-3	MB	06/28/18		<0.010	1.35	<0.010				
N-Nitrosodi-n-propylamine	621-64-7	MB	06/26/18		<0.010	1.25	<0.010				
N-Nitrosodi-n-propylamine	621-64-7	MB	06/28/18		<0.010	1.35	<0.010				
N-Nitrosomethylethylamine	10595-95-6	MB	06/26/18		<0.010	1.24	<0.010				
N-Nitrosomethylethylamine	10595-95-6	MB	06/28/18		<0.010	1.34	<0.010				
N-Nitrosomorpholine	59-89-2	MB	06/26/18		<0.010	1.26	<0.010				
N-Nitrosomorpholine	59-89-2	MB	06/28/18		<0.010	1.36	<0.010				
N-Nitrosopiperidine	100-75-4	MB	06/26/18		<0.010	1.27	<0.010				
N-Nitrosopiperidine	100-75-4	MB	06/28/18		<0.010	1.36	<0.010				
N-Nitrosopyrrolidine	930-55-2	MB	06/26/18		<0.010	1.24	<0.010				
N-Nitrosopyrrolidine	930-55-2	MB	06/28/18		<0.010	1.35	<0.010				
N-Nitrosodiethylamine	55-18-5	MRL	06/26/18	0.010	0.010	1.24	0.008		80.4	60 - 140	
N-Nitrosodiethylamine	55-18-5	MRL	06/28/18	0.010	0.010	1.35	0.007		70.4	60 - 140	
N-Nitrosodimethylamine	62-75-9	MRL	06/26/18	0.010	0.010	1.23	0.008		78.6	60 - 140	
N-Nitrosodimethylamine	62-75-9	MRL	06/28/18	0.010	0.014	1.35	0.010		101	60 - 140	
N-Nitrosodi-n-butylamine	924-16-3	MRL	06/26/18	0.010	0.012	1.26	0.009		93.3	60 - 140	
N-Nitrosodi-n-butylamine	924-16-3	MRL	06/28/18	0.010	0.010	1.35	0.008		76.2	60 - 140	
N-Nitrosodi-n-propylamine	621-64-7	MRL	06/26/18	0.010	0.009	1.25	0.007		72.0	60 - 140	
N-Nitrosodi-n-propylamine	621-64-7	MRL	06/28/18	0.010	0.009	1.35	0.006		63.4	60 - 140	
N-Nitrosomethylethylamine	10595-95-6	MRL	06/26/18	0.010	0.010	1.24	0.008		81.3	60 - 140	
N-Nitrosomethylethylamine	10595-95-6	MRL	06/28/18	0.010	0.009	1.34	0.007		67.4	60 - 140	
N-Nitrosomorpholine	59-89-2	MRL	06/26/18	0.010	0.010	1.26	0.008		80.4	60 - 140	
N-Nitrosomorpholine	59-89-2	MRL	06/28/18	0.010	0.009	1.36	0.007		65.0	60 - 140	
N-Nitrosopiperidine	100-75-4	MRL	06/26/18	0.010	0.011	1.27	0.008		84.0	60 - 140	
N-Nitrosopiperidine	100-75-4	MRL	06/28/18	0.010	0.008	1.36	0.006		62.4	60 - 140	
N-Nitrosopyrrolidine	930-55-2	MRL	06/26/18	0.010	0.011	1.24	0.009		84.8	60 - 140	
N-Nitrosopyrrolidine	930-55-2	MRL	06/28/18	0.010	0.010	1.35	0.007		70.4	60 - 140	

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Report Qualifiers:

A = Target analyte media breakthrough suspect, see analytical report
B = Analyte detected in the associated blank
C = Poor agreement between initial and confirmatory analyses, result should be considered qualitative only
D = Analyte analyzed in a dilution
d = Desorption efficiency outside of acceptable limits
E = Report concentration was above the instrument calibration range
H = Holding times for preparation or analysis exceeded
J = Analyte detected below quantitation limits, concentration is estimated
L = Sample condition at receipt out of compliance with method
P = Library spectrum match, rsd >90% w RT match defined conditions
Q = Result out of method specific acceptance QC criteria
R = % Relative Standard Deviation of LCS outside of acceptable limits
S = Spike Recovery outside accepted recovery limits
Ţ = LCS Spike Recovery limits above recovery limits
ţ = LCS Spike Recovery limits below recovery limits
Ḿ = MRL Spike Recovery limits above recovery limits
ṃ = MRL Spike Recovery limits below recovery limits
U = Analyte analyzed for but not detected
X = Analyte not detected upon confirmatory analysis
Z = Not ELAP accredited analyte
** = Analyte detected upon confirmatory analysis only*
N/A = Not Applicable
ND = Not Detected

W806109

Assembler	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST	C.O.C. No.
N/A		20181852
		Page 1 of 2

Collector: ZACHER	Contact/Requestor: CARL HOWALD IV	Telephone No. 373-6861	MSIN T6-05 FAX 372-1878
SAF No.: N/A	Sample Origin: NUCON	Purchase Order/Charge Code: 203213	
Project Title: NUCON	Logbook/ Work Package No.: N/A	Ice Chest No.	Temp. 25.1°C
Shipped To (Lab): CBAL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol: N/A	Data Turnaround: 10 DAYS	Parts and Return No.	

Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis	Preservative
	S18T023364	VA	06/12/18		Thermosorb-N	Nitrosamines EL23304	N/A
	S18T023365	VA	06/12/18		Thermosorb-N	Nitrosamines EL23307	N/A
	S18T023366	VA	06/12/18		Thermosorb-N	Nitrosamines EL23309	N/A
	S18T023367	VA	06/12/18		Thermosorb-N	Nitrosamines EL23310	N/A
	S18T023368	VA	06/12/18		Thermosorb-N	Nitrosamines EL23311	N/A
	S18T023369	VA	06/12/18		Thermosorb-N	Nitrosamines EL23313	N/A
	S18T023370	VA	06/13/18		Thermosorb-N	Nitrosamines EL23300	N/A
	S18T023371	VA	06/13/18		Thermosorb-N	Nitrosamines EL23301	N/A
	S18T023372	VA	06/13/18		Thermosorb-N	Nitrosamines EL23302	N/A
	S18T023373	VA	06/13/18		Thermosorb-N	Nitrosamines EL23303	N/A

POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS ○ Yes ◉ No

SPECIAL INSTRUCTIONS — Hold Time

Send Results to Carl Howald IV & Kiesha Garcia
Carl_W_Howald@rl.gov and
Kiesha_R_Garcia@rl.gov see SOW for email

CONTRACT 55503
RELEASE 9

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
[illegible]	6-21-18 0830	K.E. Rogers	6/21/18 0830
K.E. Rogers	6/21/18 10:55	[illegible]	06/21/18 1055

Matrix*

S = Soil		DL = Drum Liquids	
SE = Sediment		T = Tissue	
SO = Solid		WI = Wipe	
SL = Sludge		L = Liquid	
W = Water		V = Vegetation	
O = Oil		VA = Vapor	
A = Air		X = Other	
DS = Drum Solids			

FINAL SAMPLE DISPOSITION

Disposal Method (e.g., Return to customer, per lab procedure, used in process): CONSUMED

Disposed By: Krystin Kiha — Date/Time: 08/16/18

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6003-962 (03/05)

W806109

Assembler	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST	C.O.C. No. 20181852
N/A		Page 2 of 2

Collector: ZACHER	Contact/Requestor: CARL HOWALD IV	Telephone No.: 373-6861	MSIN: T6-05 FAX: 372-1878
SAF No.: N/A	Sample Origin: NUCON	Purchase Order/Charge Code: 203213	
Project Title: NUCON	Logbook/ Work Package No.: N/A	Ice Chest No.	Temp.
Shipped To (Lab): CBAL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol: N/A	Data Turnaround: 10 DAYS	Parts and Return No.	

Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis	Preservative
	S18T023374	VA	06/13/18		Thermosorb-N	Nitrosamines EL23318	N/A
	S18T023375	VA	06/13/18		Thermosorb-N	Nitrosamines EL23319	N/A

POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS ○ Yes ◉ No

SPECIAL INSTRUCTIONS

Send Results to Carl Howald IV & Kiesha Garcia
Carl_W_Howald@rl.gov and
Kiesha_R_Garcia@rl.gov see SOW for email

CONTRACT 55503
RELEASE 9

Hold Time

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
Don Dresson	6-21-18 0830	S.E. Rogers	6/21/18 0830
S.E. Rogers	6/21/18 1055	Jeanne Story	06/21/18 1055

Matrix*

S = Soil		DL = Drum Liquids	
SE = Sediment		T = Tissue	
SO = Solid		WI = Wipe	
SL = Sludge		L = Liquid	
W = Water		V = Vegetation	
O = Oil		VA = Vapor	
A = Air		X = Other	
DS = Drum Solids			

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time
	CONSUMED	Krystin Pika	08/16/18

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6003-962 (03/05)

RJ LEE GROUP
DELIVERING SCIENTIFIC RESOLUTION

September 4, 2018

Supplemental Nitrosamine Report

Group Number 20181852
2018 NUCON

Prepared For:

Carl Howald IV
Washington River Protection Solutions, LLC
P.O. Box 850 MSIN HI-40
Richland, WA 99352

This supplemental report for the nitrosamines analysis of Group Number 20181852 has been prepared to provide additional case narrative regarding the analysis of this set of samples. It should be noted that the reporting date of July 1, 2018 for this sample set is considerable overdue. This is due in part to the nature of the samples received and subsequent difficulties encountered during their analysis.

Columbia Basin Analytical Laboratories received 12 samples to be tested for nitrosamines on June 21, 2018. These samples were initially analyzed in accordance with NIOSH Method 2522 and CBAL SOP LAP-021 using gas chromatography and a thermal energy analyzer. It became immediately apparent that there was something unusual about some of the samples in this sample group with the initial analysis on the GC/TEA. The behavior was erratic and non-reproducible. The initial attempts to analyze the samples resulted in severe instrument contamination. The issues encountered included the following:

- Severe contamination of the GC inlet line and column. Extracted material from the sample cartridges resulted in the deposition of unusually large quantities of contaminants onto the injection port liner and column of the gas chromatograph. This was non-volatile material that coated the surfaces of the liner and column which also resulted in retention of the target analyte(s) and carryover to subsequent injections. Three blank solvent injections were required between samples to ensure that there was no carryover from one sample injection to the next.

- Severe contamination of the thermal energy analyzer reaction cell. Something in the sample extracts (non-nitrosamine) resulted in an exceptionally high response on the thermal energy analyzer that saturated the signal output. It also resulted in contamination of the reaction cell that led to high background signals for subsequent samples.

- High analyte concentrations. Some of the samples were found to have a high level of NDMA upon the analysis of the initial extracts. According to SOP-021, such samples are to undergo a re-extraction should the resulting concentration exceed 100 ng/mL. The samples were re-extracted and re-run on the instrument. For some samples, the 2nd extract exhibited a higher level of NDMA than the initial extract. This is an unexpected behavior of the sample cartridge which indicates that something unusual has happened to the support material inside the cartridge or that some other material has been coated onto the support material that interferes with the extraction process.

- Sticking of the autosampler needle. The unknown contaminant in the sample extracts tend to cause the syringe plunger in the autosample to stick and requires frequent cleaning (every 3-4 injections of samples) to ensure continued operation.

- High LCS recovery. The three LCSs associated with the sample batch all exhibited a high recovery of all eight compounds of interest. Generally, the recovery of the nitrosamines from the LCS spiked media is near 100%, resulting in a correction factor of unity being applied to the sample data. The high recovery in this sample batch (approximately 130%) was traced to a standard vial used for spiking that had undergone gradual solvent evaporation. This conclusion is supported by a visual examination of the vial contents, an analysis of the vial contents, and subsequent LCS recovery tracking through a control chart. The issue with the high LCS recovery is that all calculated sample results are based on the average of the recovery of the analyte from the three LCS control samples. The math used for the reporting of the sample data from the

LIMS will underestimate the sample concentration by approximately 30%. WRPS may want to consider revising the analytical result upward by a factor determined from the average of the three LCS control samples for each specific analyte.

It was decided to perform the analysis for nitrosamines for the samples in this group by GC/MS in selected ion monitoring mode. The contamination and carryover issues of the injection port and column and the sticking of the syringe plunger are not resolved by the choice of instrument, however, the analysis of the individual nitrosamines is greatly improved since the contamination does not affect the ionization process in the mass spectrometer.

All sample extracts and dilutions of those extracts were analyzed on a GC/MS system that had been specifically tuned and optimized to achieve sufficient sensitivity to run the same calibration curve used on the GC/TEA systems (calibration of 5 ng/mL to 500 ng/mL). Control standards were used to verify that the instrument configuration was capable of providing the same reporting limits as the GC/TEA. Multiple bank injections were made between samples to ensure no carryover occurred between sample extracts.

CBAL will use this data set as a 'lessons learned' experience and will apply the knowledge gained from the analysis of these types of samples to future samples submitted to this laboratory. All samples originating from either stack samples or the NUCON process will be treated differently from the normal area or personal samples to improve the efficiency of the analysis process and timely ness of reporting. This will include the following:

- Perform multiple extractions at the time of the initial sample preparation with the anticipation that the initial extract will be in excess of 100 ng/mL.
- Run appropriate dilutions of each sample extract with the initial instrument batch which will reduce or eliminate multiple batch reanalysis runs on the instrument.
- Perform all analyses for stack, NUCON, and cartridge breakthrough samples by GC/MS to prevent the costly and long term down time of the GC/TEA system.

As a final note to this report, CBAL is in the process of establishing a modified instrumental process for the analysis of nitrosamimes. The modified process is expected to lower the reporting limits by a factor of 10, thereby reducing the air collection requirements or provide our customers with lower overall reporting limits with the same air volumes. CBAL will be using the extracts from this sample group as a 'worst case scenario' for the validation of the modified process. This particular sample set has been the most challenging of the thousands of samples analyzed over the past 10 years. The new process will be exceptionally robust if it is capable of handling these samples extracts with no issues.

Please feel free to contact me if there are any questions.

Regards,

Joe Sears, Ph.D., Laboratory Organics Analysis Manager

Issue Tracking System (ITS) Report No. ITS A-02017

Title: Improper NDMA adsorption tube installation

Project: 71248

QA Program: NQA-1-2000, HDI, Basic Research Activity

Client: WRPS

PMOD: Steve Schlahta

Additional Notification: Michael Minette

Issue Owner: Ken Rappe

Issue graded in HDI Significance Chart as "low", based on "minor" impact and "possible" likelihood of recurring.

General Description:

The testing stand was operating in stable state when four NDMA ThermoSorb/N adsorption tubes needed to be installed. Due to time pressure, different configuration than expected (the NDMA media being in cartridges and not tubes), minimal/confusing markings on the cartridges, the adsorption tubes were installed in the backward flow direction for the first 30 min of a 320 min collection period. The suction line used for sampling Port A plugged with escaping adsorption material, the incorrect installation was noticed and corrected; the other three tubes (EL23310 Port B; EL23307 Port C; and EL23309 Port D) were reversed for the remaining test period. Port A remained inoperable so tube EL23311 was not reinstalled. Discussions later with the manufacturer showed that the cartridges are a 2-stage configuration with a pre-sorbent for amines. Reversing the cartridge in the flow will result in false positive/high results, as has been confirmed by analyses from an analytical laboratory. The notes from discussions with the manufacturer are summarized below:

> *The ThermoSorb/N manufacturer (Ellutia Chromatography) noted that the ThermoSorb/N cartridge has a pre-sorbent that removes amines prior to the nitrosamine sorbent material. This prevents artifact development in the cartridge yielding false positive results (formation of nitrosamines in the cartridge after sampling). If one reverses the cartridge, there is a potential for artificially high concentration results for nitrosamines. There is also a possibility for the results to be accurate. Given that the Test 4.2 samples were much higher in concentration than the Test 4.3 ThermoSorb/N results and Test 4.2 PTR-MS results from the same ports, it appears that the cartridges that were installed backwards (test 4.2) were not only suspect but erroneous.*

There were many elements that preceded the incorrect installation of the NMDA tubes including:

- Not testing with the NDMA media during shakedowns of the system due to schedule pressures.
- The in-availability of NDMA media until just the night before the test and having just enough media to run the tests so the project staff did not open the sealed NDMA media packages. (In addition, the client only had a limited supply of NDMA media.)

- Materials such as the NDMA cylinder gasses were limited and the project staff barely had enough for the 320 minute run planned. The limited amounts of gas were a result of having to rerun the test for a second day due to exhaust challenges with sticky pyridine gasses.
- The constant use by the client of the word NDMA "tube" when describing the media. The media was actually in a cartridge with different port connectors that caused a rapid modification of our testing processes within 15 minutes. Project staff had conducted many tests with sampling tubes (for ammonia and for aldehydes) so this process for NDMA "tubes" was not considered to be a testing risk.

The step that would have prevented this problem was to have included the testing of the NDMA tubes/cartridges during the shakedown of the test system. This step was not included in the pretest checklist or the shakedown steps due to scheduling pressures.

Corrective actions:

Action 1: Provide recommendations and reference to this ITS item in the quality assurance section of Revision 1 to the "NUCON Thermal Oxidation System Performance on Hanford Tank Farm Chemicals of Potential Concern" report (PNNL-27816 Rev 1 report). This L of the same report with the NDMA media results from the Test 4.2 tubes EL23311 Port A, EL23310 Port B, EL23307 Port C, and EL23309 Port D; this data will be marked as "Do not use".

Assigned to: Michael Minette, due by April 30, recommendation will document the handling of NDMA media so future testing teams will be aware of the problem and receive recommended steps to prevent it during future testing. Additionally a version of this write-up will be included in the Appendix

2019.

Action 2: NDMA data obtained from tubes EL23311 Port A, EL23310 Port B, EL23307 Port C, and EL23309 Port D are unusable and shall be identified as such in project records. Reference to this ITS item (e.g., copy of pdf of the current ITS item) will be placed in the project folder that includes the electronic NDMA results. Where possible, the data will be separated into a separate project records folder, insert "Do not Use" or such in the file name and watermark the data pages as "Do not Use".

Assigned to: Allan Zacher, due by November 30, 2018.

Action 3: NDMA data obtained from tubes EL23311 Port A, EL23310 Port B, EL23307 Port C, and EL23309 Port D will not be included in the summary tables or DRE calculations in the Rev 1 report.

Assigned to: Ken Rappe, due by April 30, 2019.

Other:

Completion of all corrective actions have to be verified. This is assigned to Kirsten Meier.

Action 1 from **ITS A-02017**

Recommendations for Phase 3 off-line media sampling

The phase 2 testing identified several lessons learned that need to be considered for phase 3 testing. These lessons are:

- Be sure to use the Anasorb 747, SK-226-29 tubes for the collection Ammonia samples.
- Be sure to fully run all forms of off-line media sampling tubes (ammonia and aldehyde), Cartridges (nitrosomine), and SUMMA canisters during the shakedown testing. The nitrosomine cartridges are not tubes and will need to be mofified on the inlet side to connect to a tube based mount. Establishing the required flow directions through the tube and cartridges should also be practiced during shakedown testing.
- Be sure to not have the aldehyde tubes connected to the sampling system when collect SUMMA canisters as the acetalnitrile on the tube media will contaminate the samples.

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ENERGY