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16. Abstract

Cabin air quality within commercial aircraft has persisted as an area of concern, specifically with regard to potential exposures of and health impacts to flight crew and/or passengers. Many efforts have focused on understanding quality of the air within aircraft and the potential risks of exposure to chemicals within cabin or engine bleed air; however, variability in collection and analytical methods, and samples themselves, in addition to the lack of validated sensors for accurate in-cabin measurements have left many questions unanswered.

This study was designed to assess engine bleed air for chemical contaminants following engine fluid contamination events and evaluate the potential risks for health-related effects should human exposure occur at the reported concentrations. Contamination events were simulated by injecting a variety of aircraft fluids, including oils, hydraulic fluids and a deicing fluid into an engine (for off aircraft engine stand tests) or a propulsion engine or APU (for ground-based on aircraft tests). A vast variety of chemical compounds were identified across the study, including volatile organic compounds, carbonyls and organophosphates. Interestingly, despite the study simulating contamination events by actively injecting aircraft fluids, the chemical compounds, while many, were identified at relatively low concentrations – on the order of parts per billion (ppb) or less – with none reaching the level of parts per million (ppm) where many exposure recommendations, limits and guidelines would start to restrict exposure in an effort to prevent the risk of potential health effects.

Only two compounds were found to have exceeded health exposure recommendations, limits, values and/or guidelines. Tridecane, a potential dermal irritant, was found at a very low concentration (14.86 ppb). This value exceeded tridecane's only established guideline, although the justification for the extremely low guideline could not be scientifically validated. The other compound that was found in concentrations that exceeded one exposure recommendation was formaldehyde; however, those formaldehyde concentrations (reaching ~100 ppb) did not exceed established/accepted exposure limits and guidelines, and likely present little to no health risk at concentrations ~100 ppb.

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Technical Report

Toxicological Evaluation of Chemical Compounds Identified in Air Samples Collected from Simulated Engine and Aircraft Contamination Events

Report prepared for:

Federal Aviation Administration Civil Aerospace Medical Institute (FAA/CAMI)

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October 2024

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Toxicological Evaluation of Chemical Compounds Identified in Air Samples Collected from Simulated Engine and Aircraft Contamination Events

EXECUTIVE SUMMARY

Cabin air quality within commercial aircraft has persisted as an area of concern, specifically with regard to potential exposures of and health impacts to flight crew and/or passengers. Many efforts have focused on understanding quality of the air within aircraft and the potential risks of exposure to chemicals within cabin or engine bleed air; however, variability in collection and analytical methods, and samples themselves, in addition to the lack of validated sensors for accurate in-cabin measurements have left many questions unanswered.

This study was designed to assess engine bleed air for chemical contaminants following engine fluid contamination events and evaluate the potential risks for health-related effects should human exposure occur at the reported concentrations. Contamination events were simulated by injecting a variety of aircraft fluids, including oils, hydraulic fluids and a deicing fluid into an engine (for off aircraft engine stand tests) or a propulsion engine or APU (for ground-based on aircraft tests). A vast variety of chemical compounds were identified across the study, including volatile organic compounds, carbonyls and organophosphates. Interestingly, despite the study simulating contamination events by actively injecting aircraft fluids, the chemical compounds, while many, were identified at relatively low concentrations – on the order of parts per billion (ppb) or less – with none reaching the level of parts per million (ppm) where many exposure recommendations, limits and guidelines would start to restrict exposure in an effort to prevent the risk of potential health effects.

Only two compounds were found to have exceeded health exposure recommendations, limits, values and/or guidelines. Tridecane, a potential dermal irritant, was found at a very low concentration (14.86 ppb). This value exceeded tridecane's only established guideline, although the justification for the extremely low guideline could not be scientifically validated. The other compound that was found in concentrations that exceeded one exposure recommendation was formaldehyde; however, those formaldehyde concentrations (reaching ~100 ppb) did not exceed established/accepted exposure limits and guidelines, and likely present little to no health risk at concentrations ~100 ppb.

BACKGROUND

Cabin air quality within commercial aircraft has persisted as an area of concern, specifically with regard to potential exposures of and health impacts to flight crew and/or passengers. Many efforts have focused on understanding quality of the air within aircraft and the potential risks of exposure to chemicals within cabin or engine bleed air (e.g., Chaturvedi 2011; Chen et al., 2021; Hayes et al., 2021); however, variability in collection and analytical methods, and samples themselves, in addition to the lack of validated sensors for accurate in-cabin measurements have left many questions unanswered.

Part c of Section 326 of the Federal Aviation Administration (FAA) Reauthorization Act of 2018 stated that the FAA was to "research to develop techniques to monitor bleed air quality" with the following specific four tasks to be the focus of further study: "(1) to identify and measure the constituents and levels of constituents resulting from bleed air in the cabins of a representative set of commercial aircraft in operation of the United States; (2) to assess the potential health effects of such constituents on passengers and cabin and flight deck crew; (3) to identify technologies suitable to provide reliable and accurate warning of bleed air contamination, including technologies to effectively monitor the aircraft air supply system when the aircraft is in flight; and (4) to identify potential techniques to prevent fume events."

In response to the direction by Congress, FAA Civil Aerospace Medical Institute (CAMI) initiated a multiyear airplane cabin air quality study to research the impact of contaminated air events onboard commercial aircraft. To address Tasks 1 and 2 above, a study was designed to assess engine bleed air for chemical contaminants following engine fluid contamination events and examine the potential for health-related risks of human exposure to chemicals generated during (simulated) contaminated air incidents. The Naval Medical Research Unit Dayton was requested to provide toxicological expertise to evaluate the chemical compounds, and levels thereof, identified through various methods and testing. Specifically, this report addresses whether the identified chemical compounds, at the concentrations reported, exceed any of six different health exposure recommendations, limits, values or guidelines considered.

APPROACH - SAMPLE COLLECTION AND ANALYSES

To identify and quantify potential chemical contaminants in aircraft engine bleed air, a series of engine stand and ground-based on aircraft (Boeing 747) tests were performed in May 2022 and May 2023, respectively. In each test, different commercial aircraft fluids were separately injected into an engine system. Different sampling media were used to collect air samples, and the media were analyzed by appropriate methods for identification and quantification of organophosphates, polycyclic aromatic hydrocarbons, volatile organic compounds (VOCs) and carbonyls.

Please see any conjunctive reports by Kansas State University and the Naval Air Warfare Center Aircraft Division for details with regard to injection events, sampling and chemical analyses, as those specifics are not included here given that this report is meant to focus on the toxicological evaluation. The general schemes for the injection events and sampling are briefly described below.

Engine Stand Tests

To identify potential chemical contaminants in aircraft engine bleed air, a series of engine stand tests were performed in May 2022 at Kansas State University where each of six different commercial aircraft fluids were separately injected into an engine system. The six different fluids were Eastman Turbo Oil 2389 (standard oil), Mobil Jet Oil II (standard oil), Mobil Jet Oil 387 (high thermal stability oil), HyJet IV-A Plus (hydraulic fluid), Skydrol PE-5 (hydraulic fluid), and Safewing MP/LFD 88 Dilute (deicing fluid).

Baseline samples (at 200°C) were collected prior to the introduction of the fluid into the engine. Fluids were injected individually at an injection site. Following injection, samples were collected at two locations – the inlet line and downstream at the bleed air line – and at two bleed air temperatures - 200°C and ~250-260°C. Samples were collected using different sampling media to capture and analyze different types of compounds. The samples were transferred to respective laboratories for appropriate analyses. Chemical analyses of samples were performed by both the RJ Lee Group, Inc. and the Naval Air Warfare Center Aircraft Division, with the latter being limited to analyses for VOCs.

Ground-Based On Aircraft Tests

The ground-based on aircraft tests were carried out on a Boeing 747 aircraft at the FAA William J. Hughes Technical Center (Atlantic City, NJ) with the intent of simulating fluid leaks on an airplane's Environmental Control System (ECS) by injecting aircraft fluids into either a propulsion engine (specifically Engine #3) or an Auxiliary Power Unit (APU). Tests took place in May of 2023.

The ground-based on aircraft tests involved injecting specific amounts of commercial aircraft fluids into the aircraft's ECS via either the propulsion engine or APU to simulate contamination events under different operating conditions. The different aircraft fluids were Mobil Jet Oil II (standard oil), Eastman Turbo Oil 2197 (high thermal stability oil), and Skydrol PE-5 (hydraulic fluid). The bleed air was sampled using different media at various locations at temperatures up to 315°C ("climb mode" operating condition).

The samples were transferred to respective laboratories for appropriate analyses. The media were then chemically analyzed to characterize the chemical composition of the individual samples. Chemical analyses of samples were performed by both the RJ Lee Group, Inc. and the Naval Air Warfare Center Aircraft Division, with the latter being limited to analyses for VOCs.

APPROACH - TOXICOLOGICAL CONSIDERATIONS

"All things are poison, and nothing is without poison; the dosage alone makes it so a thing is not a poison." — Paracelsus, 1538

Exposures to chemical compounds have the potential to result in a vast array of health effects - from mild irritation to headaches, or to severe or debilitating or permanent effects. However, whether a particular health effect is likely to occur is dependent on not only the chemical compound in question, but also the extent (amount) and duration of exposure. The basic tenet of toxicology is that "the dose makes the poison". That is to say that exposure to even the most toxic compounds can result in no adverse effect as long as they are present at an appropriately low level. This basic principle makes it possible to delineate exposure standards in the form of "exposure limits" and "guidelines" that serve as critical tools in risk assessments involving exposure to various chemicals. Exposure limits and guidelines define specific amounts/concentrations for a given chemical that would be considered safe if exposed to that amount/concentration over a given period of time. These limits or guidelines are typically developed for work environments and workshifts, but can be extrapolated for other uses, when appropriate. Further, it is generally regarded that limiting exposure to amounts/concentrations at or less than those described by an exposure limit/guideline, or for less than the time defined, would be considered safe. In other words, exposures at or below the exposure limit for the period of time (or less) defined by the limit should largely protect an individual from the adverse health effects that may otherwise be associated with exposure to a particular chemical compound at a higher concentration or longer period of time. That said, unfortunately, not every substance has a defined or published exposure limit or guideline available and not every substance for which a limit or guideline exists has a full complement of limits and guidelines.

Exposure limits and guidelines are generated by agencies or organizations knowledgeable in the fields of toxicology and risk assessment. These groups include the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), American Conference of Governmental Industrial Hygienists (ACGIH), Environmental Protection Agency (EPA), American Industrial Hygiene Association (AIHA), Occupational Alliance for Risk Science (OARS) and Department of Energy (DOE) Subcommittee on Consequence Assessment and Protective Actions (SCAPA). When evaluating the risk of potential health effects associated with the chemical compounds identified and quantified in FAA/CAMI's study, the below types of exposure limits and guidelines were considered, when available (not all, if any, are available for a given substance).

Of note, exposure limits and guidelines are typically reported as parts per million (ppm), where 1 ppm = 1,000 parts per billion (ppb). This is pertinent to emphasize given that the concentrations reported in this study are given in ppb units.

NIOSH's Recommended Exposure Limits (RELs)

NIOSH develops Recommended Exposure Limits (RELs) as *recommendations* for occupational exposure limits (OELs) with the intent to protect workers from adverse health effects related to an exposure. NIOSH develops RELs based on data from human and animal research and studies. RELs are not legal standards but are taken into consideration by OSHA for their development of Permissible Exposure Limits (PELs) which are legally enforceable standards.

RELs are developed as a time-weighted average (TWA) concentration for exposure to a chemical compound that is recommended as a safe exposure level. It is calculated as an average exposure over a

period of up to 10 hours over a 40-hour workweek. NIOSH may also *recommend* a Short-Term Exposure Limit (STEL) describing a concentration that is not to be exceeded during a 15-minute period. Additionally, a "Ceiling" REL, when applicable, is a concentration that should not be exceeded at any time.

It is important to note that while NIOSH RELs help to inform OSHA PELs, the two do not always match. In fact, NIOSH RELs may be more conservative (i.e., recommending a lower concentration) compared to OSHA's published PELs.

OSHA's Permissible Exposure Limits (PELs)

OSHA sets Permissible Exposure Limits (PELs) for hazardous substances as regulatory limits that are legally enforceable standards. PELs define the safe level of a substance by assessing exposure and adverse outcome data from both animal bioassays and human studies. OSHA PELs are based on an 8-hour TWA exposure (vs. NIOSH's 10-hour TWA) over a 40-hour workweek. Similar to NIOSH's recommended STEL, OSHA may also set a STEL for an exposure period of 15-minutes (unless otherwise noted). OSHA may also provide a "Ceiling" concentration that is not to be exceeded during any part of the workday.

ACGIH's Threshold Limit Values (TLVs®)

ACGIH determines Threshold Limit Values (TLVs®) that are defined by the ACGIH as "health-based values established by committees that review existing published and peer-reviewed literature in various scientific disciplines (e.g., industrial hygiene, toxicology, occupational medicine, and epidemiology)". TLVs® are considered as guidelines, not regulatory standards. TLVs® describe airborne concentrations of chemical compounds that nearly all workers may be repeatedly exposed to ("day after day, over a working lifetime") without experiencing adverse health effects. Specifically, a TLV®-TWA describes the exposures for a traditional 8-hour workday and a 40-hour workweek.

As with NIOSH and OSHA, ACGIH also considers a STEL for a 15-minute TWA exposure not to be exceeded at any point during the workday, regardless of the 8-hour TWA being within the TLV®-TWA. According to ACGIH "the TLV®-STEL is the concentration to which it is believed that nearly all workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, 3) dose-rate-dependent toxic effects, or 4) narcosis of sufficient degree to increase the likelihood of accidental injury, impaired self-rescue, or materially reduced work efficiency".

EPA's Acute Exposure Guidelines (AEGLs)

The EPA calculates Acute Exposure Guidelines (AEGLs) that describe concentrations of airborne chemicals at which health effects *may* occur in the general public, to include the elderly, children and susceptible individuals. AEGLs are categorized into three different levels (1, 2 and 3), according to the severity of effects that are predicted to occur in the general population at levels *above* the defined exposure concentration(s).

- Below AEGL-1: Airborne concentrations that are below the AEGL-1 describe exposures that may
 result in mild and transient, but "progressively increasing", and non-disabling odor, taste, and
 sensory irritation and/or other asymptomatic, non-sensory effects.
- Level 1 (AEGL-1): Exposure above this level (i.e., concentration) to a chemical compound or substance is predicted to potentially result in "notable discomfort, irritation, or certain asymptomatic non-sensory effects" (per the EPA). These effects are not to be disabling and would be transient in nature and reversible when the exposure ceases.
- Level 2 (AEGL-2): Exposure above this level (i.e., concentration) to a chemical compound or substance is predicted to potentially result in "irreversible or other serious, long-lasting adverse

health effects or an impaired ability to escape" (per the EPA). Exposure concentrations described for an AEGL-2 would inherently be higher than for an AEGL-1.

• Level 3 (AEGL-3): Exposure above this level (i.e., concentration) to a chemical compound or substance is predicted to potentially result in "life-threatening health effects or death" (per the EPA). Exposure concentrations described for an AEGL-3 would inherently be higher than for an AEGL-1 or an AEGL-2.

For each level of severity, guidelines are calculated for five non-repeated exposure periods that include 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours. For the purpose of this FAA/CAMI evaluation, only AEGL-1 values were considered and for an 8-hour period of time. These values encompass the most conservative level of exposure over the longest duration as a worst-case scenario.

AIHA's and OARS's Workplace Environmental Exposure Levels (WEELs)

AIHA and OARS, a volunteer group of toxicologists, define Workplace Environmental Exposure Levels (WEELs) as health-based guide values for chemicals. The WEELs intend to describe the airborne concentrations of a chemical that would protect the majority of workers from adverse health effects associated with an occupational chemical exposure at a given concentration. WEELs are defined for an 8-hour TWA exposure.

For the purpose of this FAA/CAMI evaluation, WEELs were generally only considered when other limits, values and guidelines were not available.

DOE/SCAPA's Protective Action Criteria (PACs)

The DOE's SCAPA derives Protective Action Criteria (PACs) as a means of knowing when/how to plan and respond to "uncontrolled releases" of hazardous chemicals. Similar to EPA's AEGLs, there are three levels of PAC values (1, 2 and 3) in which each value is associated with an increase in severity of effect from a higher level (i.e., concentration) of exposure. PAC-1, 2 and 3 values are most often based on the EPA's AEGL's themselves (see above) for the 1 hour AEGL value, and the various PAC values correlate to the severity of health effects, as described below:

- Level 1 (PAC-1): Mild, transient health effects.
- Level 2 (PAC-2): Irreversible or other serious health effects that could impair the ability to take protective action.
- Level 3 (PAC-3): Life-threatening health effects.

Given that PAC values are primarily for uncontrolled and unplanned releases, such as in the cases of accidents or disasters, PACs were rarely considered for the purpose of this FAA/CAMI evaluation. They were only considered when other limits, values and guidelines (including AEGLs) were not otherwise available.

EVALUATION OF COMPOUNDS WITH REGARD TO EXPOSURE LIMITS/GUIDELINES

The purpose of this report is to outline whether the identified chemical compounds, at the concentrations described, exceed health exposure limits or guidelines. A series of 21 tables describe the chemical compounds identified at different sample locations and under different conditions, their concentrations, appropriate exposure limits or guidelines for that chemical (if available) and whether or not (Y/N) any of the reported concentrations exceed a specific recommendation, limit or guideline. Tables are per aircraft fluid and represent either Engine Stand Tests or On-Aircraft tests. Instances where a chemical compound is listed more than once within the same table indicates that the chemical was

identified in more than one type of analyses (i.e., for organophosphates, polycyclic aromatic hydrocarbons, VOCs and carbonyls) or was tentatively identified more than once under a different retention time.

Chemicals Identified in Engine Stand Tests

Engine stand (off-aircraft) tests were performed with six different fluids were Eastman Turbo Oil 2389 (standard oil), Mobil Jet Oil II (standard oil), Mobil Jet Oil 387 (high thermal stability oil), Skydrol PE-5 (hydraulic fluid), HyJet IV-A Plus (hydraulic fluid), and Safewing MP/LFD 88 Dilute (deicing fluid). The following tables (Tables 1-12) describe the chemical compounds identified and their concentrations, exposure limits/guidelines and whether or not (Y/N) the concentrations reported exceed a given recommendation, limit or guideline. If a concentration exceeded a given recommendation, limit or guideline, that specific concentration is indicated by an asterisk (*) in the table.

Please note that chemical concentrations are provided in parts per billion by volume (ppbV) whereas exposure limits/guidelines are presented in parts per million (ppm), where 1 ppm is equal to 1,000 ppb.

Table 1: Summary of chemicals and concentrations identified following injection of <u>Eastman Turbo Oil</u> <u>2389</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	Concentration (ppbV, unless otherwise noted)									
Compound	Shipping	Field	Inlet	Bleed	Inlet	Bleed	Inlet	Bleed	Exposure Limit/Guideline (GL)	Exceeds
(CAS #)	Blank	Blank							, , , , , , , , , , , , , , , , , , , ,	Exposure Limit/GI (Y/N)
Triisobutyl phosphate (126-71-06)	NC	65.2	0.0226	0.0281	0.0232	0.0297	0.0236	0.0254	N/A	N/A
(126-71-06)									NIOSH: 0.2 ppm over a period of 10-h during a 40-	N
Tributyl phosphate	NC	171	0.127	0.267	0.0642	0.263	0.0569	0.240	hour work week OSHA: The permissible exposure limit (PEL) is 0.46	N
(126-73-8)									ppm (5 mg/m³) averaged over an 8-h workshift	
									ACGIH: 0.2 ppm averaged over 8 h NIOSH: The recommended airborne exposure limit	N Y
									(REL) is 0.016 ppm averaged over a 10-h workshift,	
Formaldehyde (50-00-0)	<rl< td=""><td><rl< td=""><td>3.25</td><td>16.9*</td><td>3.51</td><td>8.25</td><td>3.11</td><td>24.5*</td><td>and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>3.25</td><td>16.9*</td><td>3.51</td><td>8.25</td><td>3.11</td><td>24.5*</td><td>and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm</td><td>N</td></rl<>	3.25	16.9*	3.51	8.25	3.11	24.5*	and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm	N
(30-00-0)									averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period	
									EPA AEGL-1 (interim): 0.90 ppm over 8 h	N
Acetaldehyde	<rl< td=""><td><rl< td=""><td>1.34</td><td>5.82</td><td>1.28</td><td>3.41</td><td>1.27</td><td>13.5</td><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td> N</td></rl<></td></rl<>	<rl< td=""><td>1.34</td><td>5.82</td><td>1.28</td><td>3.41</td><td>1.27</td><td>13.5</td><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td> N</td></rl<>	1.34	5.82	1.28	3.41	1.27	13.5	NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift	 N
(75-07-0)				0.02	1120	0.41		10.0	ACGIH: Not to exceed 25 ppm (Ceiling)	N
									NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min	N
Acrolein									period	
(107-02-8)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.16</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<>	1.16	OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit	N N
									is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h	N
									NIOSH: The REL is 250 ppm averaged over a 10-h	N
									workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h	N
Acetone	0.097 µg/	0.113 μg/	2.71	3.82	2.56	3.46	2.47	5.77	workshift	
(67-64-1)	sample	sample	2.,,	0.02	2.00	0.40	2.47	0.77	ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the	N
									short-term exposure limit (STEL) is 500 ppm	
									EPA AEGL-1 (interim): 200 ppm over 8 h ACGIH: The recommended airborne exposure limit	N N
Propionaldehyde (123-38-6)	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.08</td><td><rl< td=""><td>.964</td><td><rl< td=""><td>3.13</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.08</td><td><rl< td=""><td>.964</td><td><rl< td=""><td>3.13</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.08</td><td><rl< td=""><td>.964</td><td><rl< td=""><td>3.13</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<>	1.08	<rl< td=""><td>.964</td><td><rl< td=""><td>3.13</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N</td></rl<></td></rl<>	.964	<rl< td=""><td>3.13</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N</td></rl<>	3.13	is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h	N
									NIOSH: Recommended time-weighted average	N N
Crotonaldehyde	<rl< td=""><td><rl< td=""><td>0.614</td><td><rl< td=""><td>0.844</td><td><rl< td=""><td>0.992</td><td>0.286</td><td>(TWA) of 2 ppm in the air over a 10-h workday. <u>OSHA</u>: The PEL is 2 ppm averaged over an 8-h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.614</td><td><rl< td=""><td>0.844</td><td><rl< td=""><td>0.992</td><td>0.286</td><td>(TWA) of 2 ppm in the air over a 10-h workday. <u>OSHA</u>: The PEL is 2 ppm averaged over an 8-h</td><td>N</td></rl<></td></rl<></td></rl<>	0.614	<rl< td=""><td>0.844</td><td><rl< td=""><td>0.992</td><td>0.286</td><td>(TWA) of 2 ppm in the air over a 10-h workday. <u>OSHA</u>: The PEL is 2 ppm averaged over an 8-h</td><td>N</td></rl<></td></rl<>	0.844	<rl< td=""><td>0.992</td><td>0.286</td><td>(TWA) of 2 ppm in the air over a 10-h workday. <u>OSHA</u>: The PEL is 2 ppm averaged over an 8-h</td><td>N</td></rl<>	0.992	0.286	(TWA) of 2 ppm in the air over a 10-h workday. <u>OSHA</u> : The PEL is 2 ppm averaged over an 8-h	N
(4170-30-3)	1112	TILE	0.014	1112	0.044	1112	0.332	0.200	workshift	
									ACGIH: 0.3 ppm, not to be exceeded at any time MEK NIOSH: The REL is 200 ppm averaged over a 10-	N N
									h workday, and 300 ppm as a short-term exposure	
									limit (STEL) not to be exceeded during any 15-min work period	
Methyl ethyl ketone									MEK OSHA: The PEL is 200 ppm averaged over an 8- h workday	N
(MEK) & Butyraldehyde (78-93-3)	<rl< td=""><td><rl< td=""><td>0.600</td><td>1.49</td><td>0.537</td><td>1.27</td><td>0.613</td><td>4.95</td><td>MEK ACGIH: The recommended exposure limit is</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.600</td><td>1.49</td><td>0.537</td><td>1.27</td><td>0.613</td><td>4.95</td><td>MEK ACGIH: The recommended exposure limit is</td><td>N</td></rl<>	0.600	1.49	0.537	1.27	0.613	4.95	MEK ACGIH: The recommended exposure limit is	N
(123-72-8)									200 ppm averaged over an 8-h workday, and 300 ppm as a STEL	
									MEK EPA AEGL-1: 200 ppm over 8 h	N
									Butyraldehyde OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25	N
Benzaldehyde									ppm OARS WEEL: An 8-h time-weighted average (TWA) of	N
(100-52-7)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<></td></rl<>	<rl< td=""><td>0.274</td><td>2 ppm; STEL of 4 ppm over 15-min</td><td></td></rl<>	0.274	2 ppm; STEL of 4 ppm over 15-min	
Valeraldehyde	0.131	0.117							NIOSH: The recommended airborne exposure limit is 50 ppm averaged over a 10-h workshift	N
(110-62-3)	μg/ sample	μg/ sample	1.05	1.75	0.551	0.151	1.36	4.09	ACGIH: The recommended airborne exposure limit	N
m-Tolualdehyde	-		4DI	4DI	0.400	4DI	0.050	0.405	is 50 ppm averaged over an 8-h workshift	NI/A
(620-23-5) Hexaldehyde	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.199</td><td><rl< td=""><td>0.058</td><td>0.105</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.199</td><td><rl< td=""><td>0.058</td><td>0.105</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.199</td><td><rl< td=""><td>0.058</td><td>0.105</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.199</td><td><rl< td=""><td>0.058</td><td>0.105</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	0.199	<rl< td=""><td>0.058</td><td>0.105</td><td>N/A</td><td>N/A</td></rl<>	0.058	0.105	N/A	N/A
(66-25-1)	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.594</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>2.34</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.594</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>2.34</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.594</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>2.34</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	0.594	<rl< td=""><td><rl< td=""><td><rl< td=""><td>2.34</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>2.34</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>2.34</td><td>N/A</td><td>N/A</td></rl<>	2.34	N/A	N/A
Chloromethane	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.08</td><td>1.00</td><td><rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.08</td><td>1.00</td><td><rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.08</td><td>1.00</td><td><rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average</td><td>N</td></rl<></td></rl<>	1.08	1.00	<rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average</td><td>N</td></rl<>	OSHA: PEL is 100 ppm over 8 h time-weighted average	N
(74-87-3)									ACGIH: 50 ppm TWA over 8 h	N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 250 ppm as STEL during any 15-min	N
Methanol									period OSHA: The PEL is 200 ppm averaged over an 8-hour	N
(67-56-1)	NC	NC	9.50	<rl< td=""><td>9.87</td><td><rl< td=""><td>8.91</td><td>10.2</td><td>workday</td><td></td></rl<></td></rl<>	9.87	<rl< td=""><td>8.91</td><td>10.2</td><td>workday</td><td></td></rl<>	8.91	10.2	workday	
									ACGIH: 200 ppm as an 8-h TLV®-TWA exposure, and 250 ppm as a STEL (with a skin notation)	N
			1	1		1	1	1	EPA AEGL-1 (interim): 270 ppm over 8 h	N
									NIOSH: The REL is 250 ppm averaged over a 10-h workshift	N
									OSHA: The PEL is 1,000 ppm averaged over an 8-h	N
Acetone (67-64-1)	NC	NC	<rl< td=""><td>3.08</td><td>3.83</td><td>3.48</td><td>9.39</td><td>5.19</td><td>workshift ACGIH: The threshold limit value-time weighted</td><td>N</td></rl<>	3.08	3.83	3.48	9.39	5.19	workshift ACGIH: The threshold limit value-time weighted	N
•									average (TLV*-TWA) concentration is 250 ppm; the STEL is 500 ppm	
									EPA AEGL-1 (interim): 200 ppm over 8 h	N
2-Propanol	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>53.3</td><td>NIOSH: The REL is 400 ppm averaged over a 10-h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>53.3</td><td>NIOSH: The REL is 400 ppm averaged over a 10-h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>53.3</td><td>NIOSH: The REL is 400 ppm averaged over a 10-h</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>53.3</td><td>NIOSH: The REL is 400 ppm averaged over a 10-h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>53.3</td><td>NIOSH: The REL is 400 ppm averaged over a 10-h</td><td>N</td></rl<>	53.3	NIOSH: The REL is 400 ppm averaged over a 10-h	N
(67-63-0)	INC	INC	¬n∟	¬n∟	-nL	>n∟	>nL	55.5	workshift, not to exceed 500 ppm during any 15-min work period	

									OSHA: The PEL is 400 ppm averaged over an 8-h workshift	N
									ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-h work shift, and 400 ppm as a STEL	N
									For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-	N
m & p-xylene (108-88-3) (106-42-3)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.91</td><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.91</td><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.91</td><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.91</td><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	1.91	<rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
,									ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
									EPA AEGL-1: 130 ppm over 8 h For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h	N N
									workshift, and not to exceed 150 ppm during any 15- min work period	N
o-xylene (95-47-6)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.00</td><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.00</td><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.00</td><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.00</td><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	1.00	<rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
									ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL EPA AEGL-1: 130 ppm over 8 h	N N
4-Ethyltoluene (622-96-8)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.88</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.88</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.88</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.88</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<>	0.88	<rl< td=""><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<>	DOE/SCAPA PAC-1: 3.1 ppm	N
1,2,4-Trimethylbenzene (95-63-6)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.56</td><td><rl< td=""><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.56</td><td><rl< td=""><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.56</td><td><rl< td=""><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.56</td><td><rl< td=""><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	1.56	<rl< td=""><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<>	NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u> : 45 ppm over 8 h	N N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period	N
Methyl ethyl ketone (78-93-3)	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.381</td><td><rl< td=""><td><rl< td=""><td>0.148</td><td>0.400</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.381</td><td><rl< td=""><td><rl< td=""><td>0.148</td><td>0.400</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.381</td><td><rl< td=""><td><rl< td=""><td>0.148</td><td>0.400</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	0.381	<rl< td=""><td><rl< td=""><td>0.148</td><td>0.400</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.148</td><td>0.400</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<>	0.148	0.400	OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
									ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL	N
									EPA AEGL-1: 200 ppm over 8 h NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL	N N
Tetrahydrofuran (109-99-9)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.175</td><td><rl< td=""><td>0.366</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.175</td><td><rl< td=""><td>0.366</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.175</td><td><rl< td=""><td>0.366</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.175</td><td><rl< td=""><td>0.366</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	0.175	<rl< td=""><td>0.366</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	0.366	<rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<>	OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
(109-99-9)									ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL	N
Cyclohexane	<rl< td=""><td><rl< td=""><td>0.162</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.164</td><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.162</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.164</td><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.162	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.164</td><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.164</td><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.164</td><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	0.164	<rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift	N N
(110-82-7)	\nL	\nL	0.162	\nL	SAL.	SAL.	0.164	\nL	ACGIH: The threshold limit value (TLV®-TWA) is 100 ppm averaged over an 8-h workshift	N
Heptane (142-82-5)	<rl< td=""><td><rl< td=""><td>0.131</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.143</td><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.131</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.143</td><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.131	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.143</td><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.143</td><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.143</td><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<>	0.143	<rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<>	NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period	N
Toluene (108-88-3)	<rl< td=""><td>1.96</td><td>0.629</td><td>0.303</td><td>0.205</td><td>0.263</td><td>0.523</td><td>0.188</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8-h workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<>	1.96	0.629	0.303	0.205	0.263	0.523	0.188	NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8-h workshift EPA AEGL-1: 67 ppm over 8 h	N N
2-Hexanone (591-78-6)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.379</td><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	0.379	NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N N
									NIOSH: The REL is 75 ppm averaged over a 10-h workshift OSHA: The PEL is 75 ppm averaged over an 8-h	N N
Chlorobenzene (108-90-7)	<rl< td=""><td>0.530</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.530	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>workshift ACGIH: The threshold limit value (TLV®-TWA) is 10</td><td>N</td></rl<>	workshift ACGIH: The threshold limit value (TLV®-TWA) is 10	N
									ppm averaged over an 8-h workshift <u>EPA AEGL-1:</u> 10 ppm over 8 h	N
Ethyl Benzene									NIOSH: The REL is 100 ppm averaged over a 10-h workshift, not to be exceed 125 ppm during any 15- min work period	N
(100-41-4)	<rl< td=""><td><rl< td=""><td>0.205</td><td><rl< td=""><td>0.223</td><td>0.160</td><td>0.477</td><td>0.260</td><td>OSHA: 100 ppm over an 8-h workday ACGIH: 20 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.205</td><td><rl< td=""><td>0.223</td><td>0.160</td><td>0.477</td><td>0.260</td><td>OSHA: 100 ppm over an 8-h workday ACGIH: 20 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	0.205	<rl< td=""><td>0.223</td><td>0.160</td><td>0.477</td><td>0.260</td><td>OSHA: 100 ppm over an 8-h workday ACGIH: 20 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	0.223	0.160	0.477	0.260	OSHA: 100 ppm over an 8-h workday ACGIH: 20 ppm averaged over an 8-h workshift	N N
									EPA AEGL-1 (interim): 33 ppm over 8 h For Xylenes:	N
m & p-Xylene									NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15- min work period	N
(108-88-3) (106-42-3)	<rl< td=""><td><rl< td=""><td>0.950</td><td>0.738</td><td>1.08</td><td>0.783</td><td>2.31</td><td>1.27</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.950</td><td>0.738</td><td>1.08</td><td>0.783</td><td>2.31</td><td>1.27</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	0.950	0.738	1.08	0.783	2.31	1.27	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
									ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
Nonane (111-84-2)	<rl< td=""><td><rl< td=""><td>1.79</td><td>1.48</td><td>2.48</td><td>1.92</td><td>5.38</td><td>3.11</td><td>EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N N</td></rl<></td></rl<>	<rl< td=""><td>1.79</td><td>1.48</td><td>2.48</td><td>1.92</td><td>5.38</td><td>3.11</td><td>EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N N</td></rl<>	1.79	1.48	2.48	1.92	5.38	3.11	EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N N N
· · · - · -/									Eor Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-	N
o-Xylene (95-47-6)	<rl< td=""><td><rl< td=""><td>0.505</td><td>0.381</td><td>0.575</td><td>0.413</td><td>1.18</td><td>0.631</td><td>min work period <u>OSHA:</u> The PEL is 100 ppm averaged over an 8-h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.505</td><td>0.381</td><td>0.575</td><td>0.413</td><td>1.18</td><td>0.631</td><td>min work period <u>OSHA:</u> The PEL is 100 ppm averaged over an 8-h</td><td>N</td></rl<>	0.505	0.381	0.575	0.413	1.18	0.631	min work period <u>OSHA:</u> The PEL is 100 ppm averaged over an 8-h	N
· · · -/									workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
									EPA AEGL-1: 130 ppm over 8 h NIOSH: The REL is 50 ppm averaged over a 10-h	N N
Cumene	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.241</td><td><rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.241</td><td><rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.241</td><td><rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.241</td><td><rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.241</td><td><rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.241</td><td><rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	0.241	<rl< td=""><td>workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday</td><td>N</td></rl<>	workday <u>OSHA:</u> The PEL is 50 ppm averaged over an 8-h workday	N
(98-82-8)									ACGIH: The TLV®-TWA is 50 ppm averaged over an 8-h workday	N
n-Propylbenzene (103-65-1)	<rl< td=""><td><rl< td=""><td>0.193</td><td>0.169</td><td>0.236</td><td>0.195</td><td>0.439</td><td>0.257</td><td>EPA AEGL-1 (interim): 50 ppm over 8 h DOE/SCAPA PAC-1: 3.7 ppm</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.193</td><td>0.169</td><td>0.236</td><td>0.195</td><td>0.439</td><td>0.257</td><td>EPA AEGL-1 (interim): 50 ppm over 8 h DOE/SCAPA PAC-1: 3.7 ppm</td><td>N N</td></rl<>	0.193	0.169	0.236	0.195	0.439	0.257	EPA AEGL-1 (interim): 50 ppm over 8 h DOE/SCAPA PAC-1: 3.7 ppm	N N
4-Ethyltoluene (622-96-8)	<rl< td=""><td><rl< td=""><td>0.245</td><td>0.203</td><td>0.239</td><td>0.210</td><td>0.418</td><td>0.257</td><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.245</td><td>0.203</td><td>0.239</td><td>0.210</td><td>0.418</td><td>0.257</td><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<>	0.245	0.203	0.239	0.210	0.418	0.257	DOE/SCAPA PAC-1: 3.1 ppm	N
1,3,5-Trimethylbenzene	<rl< td=""><td><rl< td=""><td>0.350</td><td>0.350</td><td>0.361</td><td>0.345</td><td>0.539</td><td>0.357</td><td>NIOSH: 25 ppm averaged over a 10-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.350</td><td>0.350</td><td>0.361</td><td>0.345</td><td>0.539</td><td>0.357</td><td>NIOSH: 25 ppm averaged over a 10-h workday</td><td>N</td></rl<>	0.350	0.350	0.361	0.345	0.539	0.357	NIOSH: 25 ppm averaged over a 10-h workday	N

(108-67-8)									EPA AEGL-1: 45 ppm over 8 h	N
1,2,4-Trimethylbenzene (95-63-5)	<rl< td=""><td><rl< td=""><td>1.35</td><td>1.43</td><td>1.28</td><td>1.22</td><td>1.55</td><td>1.10</td><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.35</td><td>1.43</td><td>1.28</td><td>1.22</td><td>1.55</td><td>1.10</td><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N N</td></rl<>	1.35	1.43	1.28	1.22	1.55	1.10	NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u> : 45 ppm over 8 h	N N

NC - Not collected, not reported or otherwise not specified

N/A – Not available

<RL – Below Reporting Limit

ppb – Parts per billion (=0.001 ppm)

ppbV – Parts per billion by volume ppm – Parts per million (= 1,000 ppb)

Per Table 1, among the many compounds identified and quantified from the engine stand test with Eastman Turbo Oil 2389, was formaldehyde (CAS # 50-00-0) that was found at levels that, at face-value, exceeded NIOSH's *recommended* exposure limit (REL). NIOSH's REL recommends an average of 0.016 ppm (16 ppb) over a period of a 10-hour workshift. Formaldehyde was measured at 16.9 ppbV in the bleed air at baseline at 200°C (prior to injection of the fluid) and at 24.5 ppbV in the bleed air at 260°C post-injection. Since formaldehyde was already found and measured during the baseline (pre-injection) collection, its presence or levels cannot entirely be attributed to the oil (i.e., Eastman Turbo Oil 2389).

This finding will be elaborated further within the "Discussion" section.

Table 2: Summary of Tentatively Identified VOCs and concentrations identified following injection of <u>Eastman Turbo Oil 2389</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

		bV; toluene-equivalent)		
Compound (CAS #)	200°C	263°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
2-ethylacrolein (922-63-4)	<dl< td=""><td>23.45</td><td>N/A</td><td>N/A</td></dl<>	23.45	N/A	N/A
Benzene (71-43-2)	<dl< td=""><td>2.30</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 1 ppm in a 15-min work period OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period ACGIH: The TLV®-TWA is 0.5 ppm averaged over an 8-h workshift and 2.5 ppm as a STEL</td><td>N N</td></dl<>	2.30	NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 1 ppm in a 15-min work period OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period ACGIH: The TLV®-TWA is 0.5 ppm averaged over an 8-h workshift and 2.5 ppm as a STEL	N N
Pentanal			EPA AEGL-1 (interim): 9 ppm over 8 h	N
(110-62-3)	<dl< td=""><td>5.79</td><td>N/A</td><td>N/A</td></dl<>	5.79	N/A	N/A
Hexanal (66-25-1)	2.10	6.37	DOE/SCAPA PAC-1: 1.3 ppm	N
Pentanoic acid (109-52-4)	<dl< td=""><td>9.76</td><td>DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm</td><td>N</td></dl<>	9.76	DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm	N
p-xylene (106-42-3)	<dl< td=""><td>2.53</td><td>For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL</td><td>N N N</td></dl<>	2.53	For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N N N
Heptanal			EPA AEGL-1: 130 ppm over 8-h	N
(111-71-7)	0.37	9.67	N/A	N/A
Nonane (111-84-2)	0.35	6.08	NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N N
2,6-dimethyloctane (2051-30-1)	<dl< td=""><td>4.21</td><td>N/A</td><td>N/A</td></dl<>	4.21	N/A	N/A
1-ethyl-2-methyl-benzene (611-14-3)	0.23	2.44	For Ethyl Benzene:	

			NIOSH: The REL is 100 ppm averaged over a 10-h workshift, not to be exceed 125 ppm during any 15-min work period	N
			OSHA: 100 ppm over an 8-h workday ACGIH: 20 ppm averaged over an 8-h workshift	N N
			EPA AEGL-1 (interim): 33 ppm over 8 h	N
Octanal (124-13-0)	<dl< td=""><td>5.61</td><td>DOE/SCAPA PAC-1: 3.2 ppm</td><td>N</td></dl<>	5.61	DOE/SCAPA PAC-1: 3.2 ppm	N
1,2,3-trimethylbenzene	1.22	16.42	NIOSH: The recommended airborne exposure limit (REL) is 25 ppm averaged over a 10-h workday OSHA: The PEL is 25 ppm averaged over an	N N
(526-73-8)	1.23	16.42	8-h workday ACGIH: The recommended airborne exposure limit is 25 ppm averaged over an 8-h workday	N
Decane (124-18-5)	<dl< td=""><td>12.46</td><td>DOE/SCAPA PAC-1: 6.6 ppm</td><td>N</td></dl<>	12.46	DOE/SCAPA PAC-1: 6.6 ppm	N
2,6-dimethylnonane (17302-28-2)	<dl< td=""><td>2.61</td><td>N/A</td><td>N/A</td></dl<>	2.61	N/A	N/A
p-cresol	<dl< td=""><td>11.79</td><td>NIOSH: The REL is 2.3 ppm averaged over a 10-h workday OSHA: The PEL is 5 ppm averaged over an 8-h workshift</td><td>N N</td></dl<>	11.79	NIOSH: The REL is 2.3 ppm averaged over a 10-h workday OSHA: The PEL is 5 ppm averaged over an 8-h workshift	N N
(106-44-5)			ACGIH: Recommends an airborne exposure limit of 5 ppm averaged over an 8-h workday	N
Heptanoic acid (111-14-8)	<dl< td=""><td>28.43</td><td>DOE/SCAPA PAC-1: 3.9 ppm</td><td>N</td></dl<>	28.43	DOE/SCAPA PAC-1: 3.9 ppm	N
Nonanal (124-19-6)	<dl< td=""><td>5.57</td><td>DOE/SCAPA PAC-1: 2.6 ppm</td><td>N</td></dl<>	5.57	DOE/SCAPA PAC-1: 2.6 ppm	N
Undecane (1120-21-4)	3.37	10.25	DOE/SCAPA PAC-1: 0.37 ppm	N
Octanoic acid	<dl< td=""><td>25.43</td><td>DOE/SCAPA PAC-1: 5.1 ppm</td><td>N</td></dl<>	25.43	DOE/SCAPA PAC-1: 5.1 ppm	N
p-cymene	1.20	5.00	DOE/SCAPA PAC-1: 22 ppm	N
(99-87-6) 4,7-dimethylundecane	0.78	0.99	N/A	N/A
(17301-32-5) Dodecane	14.75	4.39	DOE/SCAPA PAC-1: 0.12 ppm	N
(112-40-3) 2,6-dimethylundecane (17301-23-4)	3.84	1.44	N/A	N/A
(1,3- dimethylbutyl)cyclohexane (61142-19-6)	0.64	0.57	N/A	N/A
Tridecane (629-50-5)	1.38	4.77	DOE/SCAPA PAC-1: 0.0073 ppm	N
Tetradecane (629-59-4)	9.17	1.13	DOE/SCAPA PAC-1: 3.1 ppm	N
Pentadecane (629-62-9)	<dl< td=""><td>0.66</td><td>DOE/SCAPA PAC-1: 1.3 ppm</td><td>N</td></dl<>	0.66	DOE/SCAPA PAC-1: 1.3 ppm	N
Hexadecane	<dl< td=""><td>0.78</td><td>DOE/SCAPA PAC-1: 3.8 ppm</td><td>N</td></dl<>	0.78	DOE/SCAPA PAC-1: 3.8 ppm	N
(544-76-3)			NIOSH: 0.2 ppm over a period of 10-h	N
Tributyl phosphate (126-73-8)	<dl< td=""><td>2.46</td><td>during a 40-hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift</td><td>N</td></dl<>	2.46	during a 40-hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift	N
Dibutyl phenyl phosphate (2528-36-1)	<dl< td=""><td>0.73</td><td>ACGIH: 0.2 ppm averaged over 8 h NIOSH: The REL is 1ppm averaged over a 10-h workshift, and a STEL of 2 ppm, not to be exceeded during any 15-min work period</td><td>N N</td></dl<>	0.73	ACGIH: 0.2 ppm averaged over 8 h NIOSH: The REL is 1ppm averaged over a 10-h workshift, and a STEL of 2 ppm, not to be exceeded during any 15-min work period	N N
o-terphenyl (84.15-1)	<dl< td=""><td>3.31</td><td>NIOSH: The recommended airborne exposure limit Ceiling is 0.5 ppm (5 mg/m³), not be exceeded at any time OSHA: The legal airborne permissible exposure limit Ceiling is 1 ppm (9 mg/m³), not to be exceeded at any time</td><td>N N</td></dl<>	3.31	NIOSH: The recommended airborne exposure limit Ceiling is 0.5 ppm (5 mg/m³), not be exceeded at any time OSHA: The legal airborne permissible exposure limit Ceiling is 1 ppm (9 mg/m³), not to be exceeded at any time	N N
p-dicyclohexylbenzene (1087-02-1)	<dl< td=""><td>4.14</td><td>N/A</td><td>N/A</td></dl<>	4.14	N/A	N/A
(1,1'-Bicyclohexyl)-4- ylbenzene (20273-27-2)	<dl< td=""><td>3.54</td><td>N/A</td><td>N/A</td></dl<>	3.54	N/A	N/A

Heptanoic acid, anhydride (626-27-7)	<dl< th=""><th>3.03</th><th>N/A</th><th>N/A</th></dl<>	3.03	N/A	N/A
1-cyclohexyl-4-				
phenylbenezene	<dl< td=""><td>0.85</td><td>N/A</td><td>N/A</td></dl<>	0.85	N/A	N/A
(1000401-12-4)				

[100401-12-4]

* Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available

CD – Below Detection Limit
ppb – Parts per billion (=0.001 ppm)
pptV – Parts per billion (=0.001 ppm)
pptV – Parts per million (= 1,000 ppb)

All the concentrations described in Table 2 are relatively low and none exceeded any recommended value, limit or guideline.

Table 3: Summary of chemicals and concentrations identified following injection of <u>Mobil Jet Oil II</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	Con	trole		ration (ppbV, L e (200°C)	ınless otherwi	o°C	200	0°C	1	
Compound	Shipping	trols Field	Inlet	Bleed	Inlet	0°C Bleed	Inlet	Bleed	Exposure Limit/Guideline (GL)	Exceeds
(CAS #)	Blank	Blank							,	Exposure Limit/GI (Y/N)
Triisobutyl phosphate (126-71-06)	NC	NC	0.0196	0.0232	NC	0.0211	NC	0.0208	N/A	N/A
(120-71-00)									NIOSH: 0.2 ppm over a period of 10-h during a 40-	N
Tributyl phosphate (126-73-8)	NC	NC	0.0434	0.197	NC	0.147	NC	0.169	hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N
Tri-m-cresyl phosphate (563-04-02)	NC	NC	<rl< td=""><td><rl< td=""><td>NC</td><td>0.107</td><td>NC</td><td>0.163</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>0.107</td><td>NC</td><td>0.163</td><td>N/A</td><td>N/A</td></rl<>	NC	0.107	NC	0.163	N/A	N/A
Tri-p-cresyl phosphate	NC	NC	<rl< td=""><td><rl< td=""><td>NC</td><td>0.113</td><td>NC</td><td>0.176</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>0.113</td><td>NC</td><td>0.176</td><td>N/A</td><td>N/A</td></rl<>	NC	0.113	NC	0.176	N/A	N/A
(78-32-0)	.,,,					0.110		0.170	NIOSH: The recommended airborne exposure limit	Y
Formaldehyde (50-00-0)	<rl< td=""><td>NC</td><td>4.69</td><td>5.60</td><td>3.67</td><td>6.59</td><td>4.70</td><td>20.1*</td><td>(REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Pemissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period EPA AEGL-1 (interim): 0.90 ppm over 8 h</td><td>N</td></rl<>	NC	4.69	5.60	3.67	6.59	4.70	20.1*	(REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Pemissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period EPA AEGL-1 (interim): 0.90 ppm over 8 h	N
Acetaldehyde									NIOSH: Lowest feasible concentration	
(75-07-0)	<rl< td=""><td>NC</td><td>1.58</td><td>2.50</td><td>1.45</td><td>4.35</td><td>1.84</td><td>7.49</td><td>OSHA: 200 ppm averaged over an 8-h workshift ACGIH: Not to exceed 25 ppm (Ceiling)</td><td>2 2</td></rl<>	NC	1.58	2.50	1.45	4.35	1.84	7.49	OSHA: 200 ppm averaged over an 8-h workshift ACGIH: Not to exceed 25 ppm (Ceiling)	2 2
Acrolein	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.828</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.828</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.828</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.828</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.828</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.828</td><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h</td><td>N N</td></rl<>	0.828	NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period OSHA: The PEL is 0.1 ppm averaged over 8 h	N N
(107-02-8)									ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h	N N
									NIOSH: The REL is 250 ppm averaged over a 10-h workshift	N
Acetone	0.097								OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N
(67-64-1)	μg/ sample	NC	3.96	3.50	4.63	3.86	4.85	4.75	ACGIH: The threshold limit value-time weighted average (TLV®-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	N
B :									EPA AEGL-1 (interim): 200 ppm over 8 h ACGIH: The recommended airborne exposure limit	N N
Propionaldehyde (123-38-6)	<rl< td=""><td>NC</td><td>0.755</td><td>0.898</td><td>0.674</td><td>2.24</td><td>0.739</td><td>2.03</td><td>is 20 ppm averaged over an 8-h workshift <u>EPA AEGL-1 (interim)</u>: 45 ppm over 8 h</td><td>N</td></rl<>	NC	0.755	0.898	0.674	2.24	0.739	2.03	is 20 ppm averaged over an 8-h workshift <u>EPA AEGL-1 (interim)</u> : 45 ppm over 8 h	N
Crotonaldehyde (4170-30-3)	<rl< td=""><td>NC</td><td>0.557</td><td><rl< td=""><td>0.623</td><td><rl< td=""><td>0.672</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	NC	0.557	<rl< td=""><td>0.623</td><td><rl< td=""><td>0.672</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	0.623	<rl< td=""><td>0.672</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	0.672	<rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h workshift	N N
Madeanalain									ACGIH: 0.3 ppm, not to be exceeded at any time	N
Methacrolein (78-85-3)	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.493</td><td>DOE/SCAPA PAC-1: 0.20 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.493</td><td>DOE/SCAPA PAC-1: 0.20 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.493</td><td>DOE/SCAPA PAC-1: 0.20 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.493</td><td>DOE/SCAPA PAC-1: 0.20 ppm</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.493</td><td>DOE/SCAPA PAC-1: 0.20 ppm</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.493</td><td>DOE/SCAPA PAC-1: 0.20 ppm</td><td>N</td></rl<>	0.493	DOE/SCAPA PAC-1: 0.20 ppm	N
Methyl ethyl ketone (MEK) & Butyraldehyde (78-93-3) (123-72-8)	<rl< td=""><td>NC</td><td>0.929</td><td>1.09</td><td>1.17</td><td>2.12</td><td>1.38</td><td>2.82</td><td>MEK NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK ACGHH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK AEGAL-1; 200 ppm over 8 h</td><td>N N N</td></rl<>	NC	0.929	1.09	1.17	2.12	1.38	2.82	MEK NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK ACGHH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK AEGAL-1; 200 ppm over 8 h	N N N
									Butyraldehyde OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm NIOSH: The recommended airborne exposure limit	N N
Valeraldehyde (110-62-3)	0.131 µg/ sample	NC	1.524	15.8	1.33	2.10	2.36	4.21	is 50 ppm averaged over a 10-h workshift ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift	N
m-Tolualdehyde (620-23-5)	<rl< td=""><td>0.520</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.520	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>N/A</td><td>N/A</td></rl<>	N/A	N/A
Hexaldehyde (66-25-1)	<rl< td=""><td>NC</td><td>0.380</td><td>0.372</td><td>0.391</td><td>0.573</td><td>0.420</td><td>1.02</td><td>N/A</td><td>N/A</td></rl<>	NC	0.380	0.372	0.391	0.573	0.420	1.02	N/A	N/A
Propene	NC	NC	<rl< td=""><td><rl< td=""><td>2.37</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: The TLV®-TWA is 500 ppm averaged over an</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>2.37</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: The TLV®-TWA is 500 ppm averaged over an</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	2.37	<rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: The TLV®-TWA is 500 ppm averaged over an</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>ACGIH: The TLV®-TWA is 500 ppm averaged over an</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>ACGIH: The TLV®-TWA is 500 ppm averaged over an</td><td>N</td></rl<>	ACGIH: The TLV®-TWA is 500 ppm averaged over an	N
(115-07-01) Chloromethane									8-h workshift OSHA: PEL is 100 ppm over 8 h time-weighted	N
(74-87-3)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.72</td><td>average ACGIH: 50 ppm over 8 h TWA</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.72</td><td>average ACGIH: 50 ppm over 8 h TWA</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.72</td><td>average ACGIH: 50 ppm over 8 h TWA</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.72</td><td>average ACGIH: 50 ppm over 8 h TWA</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.72</td><td>average ACGIH: 50 ppm over 8 h TWA</td><td>N</td></rl<>	0.72	average ACGIH: 50 ppm over 8 h TWA	N
Methanol (67-56-1)	NC	NC	15.1	12.3	18.1	15.6	12.7	15.6	NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 250 ppm as STEL during any 15-min period OSHA: The PEL is 200 ppm averaged over an 8-hour workday ACGH: 200 ppm as an 8-h TLV®-TWA exposure, and 250 ppm as a STEL (with a skin notation)	N N N
	1				ļ	ļ			EPA AEGL-1 (interim): 270 ppm over 8 h	N
Ethanol (64-17-5)	NC	NC	5.33	<rl< td=""><td>12.9</td><td>5.43</td><td>36.8</td><td>48.9</td><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	12.9	5.43	36.8	48.9	NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N N

									ACGIH: Threshold limit value (TLV®-TWA) is 1,000 ppm as a STEL	N
									NIOSH: The REL is 250 ppm averaged over a 10-h	N
									workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h	N
Acetone (67-64-1)	NC	NC	4.70	<rl< td=""><td>11.1</td><td>7.28</td><td>6.12</td><td>6.87</td><td>workshift <u>ACGIH:</u> The threshold limit value-time weighted average (TLV®-TWA) concentration is 250 ppm; the</td><td>N</td></rl<>	11.1	7.28	6.12	6.87	workshift <u>ACGIH:</u> The threshold limit value-time weighted average (TLV®-TWA) concentration is 250 ppm; the	N
									short-term exposure limit (STEL) is 500 ppm <u>EPA AEGL-1 (interim)</u> : 200 ppm over 8 h	N
									NIOSH: The REL is 400 ppm averaged over a 10-h workshift, not to exceed 500 ppm during any 15-min	N
2-Propanol (67-63-0)	NC	NC	43.1	<rl< td=""><td>101</td><td><rl< td=""><td>86.8</td><td>71.8</td><td>work period OSHA: The PEL is 400 ppm averaged over an 8-h work shift</td><td>N</td></rl<></td></rl<>	101	<rl< td=""><td>86.8</td><td>71.8</td><td>work period OSHA: The PEL is 400 ppm averaged over an 8-h work shift</td><td>N</td></rl<>	86.8	71.8	work period OSHA: The PEL is 400 ppm averaged over an 8-h work shift	N
,									ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-h work shift, and 400 ppm as a STEL	N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min	N
Methyl ethyl ketone (78-93-3)	NC	NC	<rl< td=""><td><rl< td=""><td>3.79</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>3.79</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	3.79	<rl< td=""><td><rl< td=""><td><rl< td=""><td>work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<>	work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday	N
(70 00 0)									ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL	N
Hexane									EPA AEGL-1; 200 ppm over 8 h NIOSH: The REL is 50 ppm as a TWA over 10-h	N N
(110-54-3)	NC	NC	1.67	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 100 ppm as a TWA over 10 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 100 ppm as a TWA over 10 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 100 ppm as a TWA over 10 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 100 ppm as a TWA over 10 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 100 ppm as a TWA over 10 h</td><td>N N</td></rl<>	OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 100 ppm as a TWA over 10 h	N N
Toluene (108-88-3)	NC	NC	<rl< td=""><td><rl< td=""><td>1.16</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.16</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	1.16	<rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<>	OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h	N N
Hexane (110-54-3)	<rl< td=""><td>NC</td><td>1.72</td><td>0.338</td><td>NC</td><td>0.593</td><td>0.124</td><td>0.195</td><td>NIOSH: The REL is 50 ppm as a TWA over 10-h OSHA: The PEL is 500 ppm as a TWA over 8 h</td><td>N N</td></rl<>	NC	1.72	0.338	NC	0.593	0.124	0.195	NIOSH: The REL is 50 ppm as a TWA over 10-h OSHA: The PEL is 500 ppm as a TWA over 8 h	N N
,									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min	N
Methyl ethyl ketone	<rl< td=""><td>NC</td><td>0.217</td><td>0.193</td><td>NC</td><td>0.540</td><td>0.326</td><td>0.457</td><td>work period OSHA: The PEL is 200 ppm averaged over an 8-h</td><td>N</td></rl<>	NC	0.217	0.193	NC	0.540	0.326	0.457	work period OSHA: The PEL is 200 ppm averaged over an 8-h	N
(78-93-3)									workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL	N
									EPA AEGL-1: 200 ppm over 8 h	N N
Tetrahydrofuran									NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL OSHA: The PEL is 200 ppm averaged over an 8-h	N N
(109-99-9)	<rl< td=""><td>NC</td><td>0.186</td><td><rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workday <u>ACGIH</u>: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	NC	0.186	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workday <u>ACGIH</u>: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td>workday <u>ACGIH</u>: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>workday <u>ACGIH</u>: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>workday <u>ACGIH</u>: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<>	workday <u>ACGIH</u> : The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL	N
									NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 1 ppm in a 15-min work	N
Benzene	<rl< td=""><td>NC</td><td>2.21</td><td><rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>period OSHA: Time-weighted average (TWA) is 1 ppm for an</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	NC	2.21	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>period OSHA: Time-weighted average (TWA) is 1 ppm for an</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td>period OSHA: Time-weighted average (TWA) is 1 ppm for an</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>period OSHA: Time-weighted average (TWA) is 1 ppm for an</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>period OSHA: Time-weighted average (TWA) is 1 ppm for an</td><td>N</td></rl<>	period OSHA: Time-weighted average (TWA) is 1 ppm for an	N
(71-43-2)									8-h workday, STEL is 5 ppm for any 15-min period <u>ACGIH:</u> The TLV*-TWA is 0.5 ppm averaged over an 8-h workshift and 2.5 ppm as a STEL	N N
Heptane (142-82-5)	<rl< td=""><td>NC</td><td>0.281</td><td><rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	NC	0.281	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<>	EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period	N
Toluene (108-88-3)	<rl< td=""><td>NC</td><td>1.98</td><td>0.545</td><td>NC</td><td>0.375</td><td>0.663</td><td>0.295</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</td><td>N N</td></rl<>	NC	1.98	0.545	NC	0.375	0.663	0.295	NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift	N N
, ,									EPA AEGL-1: 67 ppm over 8 h NIOSH: The REL is 1 ppm as a TWA over 10 h	N N
2-Hexanone (591-78-6)	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td>NC</td><td>0.190</td><td><rl< td=""><td>0.214</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td>NC</td><td>0.190</td><td><rl< td=""><td>0.214</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>0.190</td><td><rl< td=""><td>0.214</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	NC	0.190	<rl< td=""><td>0.214</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	0.214	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
Ethyl Benzene	<rl< td=""><td>NC</td><td>0.572</td><td>0.195</td><td>NC</td><td><rl< td=""><td>0.185</td><td>0.116</td><td>NIOSH: The REL is 100 ppm averaged over a 10 h workshift, not to be exceed 125 ppm during any 15- min work period</td><td>N</td></rl<></td></rl<>	NC	0.572	0.195	NC	<rl< td=""><td>0.185</td><td>0.116</td><td>NIOSH: The REL is 100 ppm averaged over a 10 h workshift, not to be exceed 125 ppm during any 15- min work period</td><td>N</td></rl<>	0.185	0.116	NIOSH: The REL is 100 ppm averaged over a 10 h workshift, not to be exceed 125 ppm during any 15- min work period	N
(100-41-4)	\nL	NO	0.372	0.193	NO	SAL	0.165	0.110	OSHA: 100 ppm over an 8-h workday ACGIH: 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 33 ppm over 8 h	N N N
									For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-	N
m & p-xylene (108-88-3) (106-42-3)	<rl< td=""><td>NC</td><td>1.71</td><td>0.700</td><td>NC</td><td>0.428</td><td>0.678</td><td>0.593</td><td>min work period <u>OSHA:</u> The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	NC	1.71	0.700	NC	0.428	0.678	0.593	min work period <u>OSHA:</u> The PEL is 100 ppm averaged over an 8-h workshift	N
(100-42-5)									ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
Nonane	<rl< td=""><td>NC</td><td>0.628</td><td>0.610</td><td>NC</td><td>0.473</td><td>0.257</td><td>1.44</td><td>EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift</td><td>N N</td></rl<>	NC	0.628	0.610	NC	0.473	0.257	1.44	EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift	N N
(111-84-2)						2.770			ACGIH: 200 ppm averaged over an 8-h workshift Eor Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h	N N
o-xylene	<rl< td=""><td>NC</td><td>0.594</td><td>0.278</td><td>NC</td><td>0.183</td><td>0.274</td><td>0.302</td><td>workshift, and not to exceed 150 ppm during any 15- min work period OSHA: The PEL is 100 ppm averaged over an 8-h</td><td>N</td></rl<>	NC	0.594	0.278	NC	0.183	0.274	0.302	workshift, and not to exceed 150 ppm during any 15- min work period OSHA: The PEL is 100 ppm averaged over an 8-h	N
(95-47-6)	·								workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
n-Propylbenzene									EPA AEGL-1: 130 ppm over 8 h	N
(103-65-1)	<rl< td=""><td>NC</td><td>0.158</td><td><rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td>0.134</td><td>DOF/SCAPA PAC-1: 3.7 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	NC	0.158	<rl< td=""><td>NC</td><td><rl< td=""><td><rl< td=""><td>0.134</td><td>DOF/SCAPA PAC-1: 3.7 ppm</td><td>N</td></rl<></td></rl<></td></rl<>	NC	<rl< td=""><td><rl< td=""><td>0.134</td><td>DOF/SCAPA PAC-1: 3.7 ppm</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.134</td><td>DOF/SCAPA PAC-1: 3.7 ppm</td><td>N</td></rl<>	0.134	DOF/SCAPA PAC-1: 3.7 ppm	N
4-Ethyltoluene (622-96-8)	<rl< td=""><td>NC</td><td>0.222</td><td><rl< td=""><td>NC</td><td><rl< td=""><td>0.113</td><td>0.166</td><td>DOF/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<></td></rl<>	NC	0.222	<rl< td=""><td>NC</td><td><rl< td=""><td>0.113</td><td>0.166</td><td>DOF/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<></td></rl<>	NC	<rl< td=""><td>0.113</td><td>0.166</td><td>DOF/SCAPA PAC-1: 3.1 ppm</td><td>N</td></rl<>	0.113	0.166	DOF/SCAPA PAC-1: 3.1 ppm	N
1,3,5-Trimethylbenzene	<rl< td=""><td>NC</td><td>0.253</td><td>0.150</td><td>NC</td><td><rl< td=""><td>0.172</td><td>0.243</td><td>NIOSH; 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h</td><td>N</td></rl<></td></rl<>	NC	0.253	0.150	NC	<rl< td=""><td>0.172</td><td>0.243</td><td>NIOSH; 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h</td><td>N</td></rl<>	0.172	0.243	NIOSH; 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h	N

-											
Г	1,2,4-Trimethylbenzene	<rl< td=""><td>NC</td><td>0.889</td><td>0.603</td><td>NC</td><td>0.505</td><td>0.750</td><td>0.877</td><td>NIOSH: 25 ppm averaged over a 10-h workday</td><td>N</td></rl<>	NC	0.889	0.603	NC	0.505	0.750	0.877	NIOSH: 25 ppm averaged over a 10-h workday	N
1	(95-63-6)	\nL	NC	0.009	0.603	NC	0.505	0.750	0.677	EPA AEGL-1: 45 ppm over 8 h	N

NC - Not collected, not reported or otherwise not specified

N/A – Not available

<RL - Below Reporting Limit

ppb – Parts per billion (=0.001 ppm)

ppm – Parts per million (= 1,000 ppb)

Per Table 3, the engine stand test with Mobil Jet Oil II yielded a variety of chemical compounds, albeit all in low concentrations that, with the exception of formaldehyde, did not exceed exposure limits or guidelines. Again, similar to the engine stand test performed with Eastman Turbo Oil 2389, formaldehyde (CAS # 50-00-0) was found at a level that, at face-value (20.1 ppbV), exceeded NIOSH's *recommended* exposure limit (REL). NIOSH's REL recommends an average of 0.016 ppm (16 ppb) over a period of a 10-hour workshift. Formaldehyde was also found under baseline conditions at lower concentrations; therefore, the presence of formaldehyde is likely not entirely attributed to the oil (i.e., Mobil Jet Oil II). However, the highest concentration identified was in the bleed air at 260°C post-injection.

This finding will be elaborated further within the "Discussion" section.

Table 4: Summary of Tentatively Identified VOCs and concentrations identified following injection of Mobil Jet Oil II (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

Compound (CAS #)	200°C	250°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL
Benzene (71-43-2)	1.95	3.11	NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 1 ppm in a 15-min work period OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period ACGIH: The TLV®-TWA is 0.5 ppm averaged over an 8-h workshift and 2.5 ppm as a STEL EPA AEGL-1 (interim): 9 ppm over 8 h	(Y/N) N N N
Pentanal (110-62-3)	3.21	3.08	N/A	N/A
Toluene (108-88-3)	1.10	1.44	NIOSH: The REL is 100 ppm as a TWA over 10-h OSHA: The PEL is 200 ppm averaged over an 8-h workshift EPA AEGL-1: 67 ppm over 8 h	N N N
Hexanal (66-25-1)	3.16	2.65	DOE/SCAPA PAC-1: 1.3 ppm	N
2-methylbutanoic acid (116-53-0)	2.35	4.99	N/A	N/A
Pentanoic acid (109-52-4)	16.50	16.74	DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm	N
Heptanal (111-71-7)	0.98	4.52	N/A	N/A
Nonane (111-84-2)	<dl< td=""><td>7.64</td><td>NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N</td></dl<>	7.64	NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N N
2,6-dimethyloctane (2051-30-1)	<dl< td=""><td>3.82</td><td>N/A</td><td>N/A</td></dl<>	3.82	N/A	N/A
1,2,3-trimethylbenzene (526-73-8)	0.79	11.02	NIOSH: The recommended airborne exposure limit (REL) is 25 ppm averaged over a 10-h workday OSHA: The PEL is 25 ppm averaged over an 8-h workday	N

			ACGIH: The recommended airborne exposure limit is 25 ppm averaged over an 8-h workday	N
Decane (124-18-5)	<dl< td=""><td>6.35</td><td>DOE/SCAPA PAC-1: 6.6 ppm</td><td>N</td></dl<>	6.35	DOE/SCAPA PAC-1: 6.6 ppm	N
p-cresol	<dl< td=""><td>10.50</td><td>NIOSH: The REL is 2.3 ppm averaged over a 10-h workday OSHA: The PEL is 5 ppm averaged over an</td><td>N N</td></dl<>	10.50	NIOSH: The REL is 2.3 ppm averaged over a 10-h workday OSHA: The PEL is 5 ppm averaged over an	N N
(106-44-5)	-52	10.00	8-h workshift ACGIH: Recommends an airborne exposure limit of 5 ppm averaged over an 8-h workday	N
Heptanoic acid (111-14-8)	8.32	29.45	DOE/SCAPA PAC-1: 3.9 ppm	N
Undecane (1120-21-4)	1.99	4.84	DOE/SCAPA PAC-1: 0.37 ppm	N
Octanoic acid (124-07-2)	8.63	13.74	DOE/SCAPA PAC-1: 5.1 ppm	N
p-cymene (99-87-6)	1.82	2.30	DOE/SCAPA PAC-1: 22 ppm	N
4,7-dimethylundecane (17301-32-5)	1.42	2.08	N/A	N/A
Dodecane (112-40-3)	9.96	11.66	DOE/SCAPA PAC-1: 0.12 ppm	N
2,6-dimethylundecane (17301-23-4)	3.94	3.56	N/A	N/A
(1,3- dimethylbutyl)cyclohexane (61142-19-6)	3.47	1.45	N/A	N/A
2,6-dimethyloctane (2051-30-1)	6.45	6.08	N/A	N/A
Tridecane (629-50-5)	8.30	14.86*	DOE/SCAPA PAC-1: 0.0073 ppm	Y
3,5-dimethyldodecane (107770-99-0)	<dl< td=""><td>2.27</td><td>N/A</td><td>N/A</td></dl<>	2.27	N/A	N/A
n-decanoic acid (334-48-5)	3.39	6.24	N/A	N/A
Oxalic acid, 6-ethyloct-3-yl isohexyl ester (1000309-34-3)	<dl< td=""><td>2.50</td><td>For Oxalic Acid: NIOSH: The REL for oxalic acid is 1 mg/m³ averaged over a 10-h workshift, not to exceed 2 mg/m³ during any 15-min work period OSHA: PEL 1 mg/m³ as a TWA over an 8-h workshift ACGIH: The TLV®-TWA is 1 mg/m³ for oxalic acid averaged over an 8-h workshift, and a STEL of 2 mg/m³</td><td>N N N</td></dl<>	2.50	For Oxalic Acid: NIOSH: The REL for oxalic acid is 1 mg/m³ averaged over a 10-h workshift, not to exceed 2 mg/m³ during any 15-min work period OSHA: PEL 1 mg/m³ as a TWA over an 8-h workshift ACGIH: The TLV®-TWA is 1 mg/m³ for oxalic acid averaged over an 8-h workshift, and a STEL of 2 mg/m³	N N N
2,6,10-trimethyldodecane (3891-98-3)	1.23	2.67	N/A	N/A
Tetradecane (629-59-4)	2.88	7.77	DOE/SCAPA PAC-1: 3.1 ppm	N
2,6,10,14- tetramethylheptadecane (18344-37-1)	<dl< td=""><td>1.49</td><td>N/A</td><td>N/A</td></dl<>	1.49	N/A	N/A
Pentadecane (629-62-9)	0.10	2.71	DOE/SCAPA PAC-1: 1.3 ppm	N
Nonadecane (629-92-5)	0.14	0.15	N/A	N/A
Tributyl phosphate (126-73-8)	1.20	0.33	NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift	N N
Dibutyl phenyl phosphate (2528-36-1)	<dl< td=""><td>1.50</td><td>ACGIH: 0.2 ppm averaged over 8 h NIOSH: The REL is 1 ppm averaged over a 10-h workshift, and a STEL of 2 ppm, not to be exceeded during any 15-min work period</td><td>N N</td></dl<>	1.50	ACGIH: 0.2 ppm averaged over 8 h NIOSH: The REL is 1 ppm averaged over a 10-h workshift, and a STEL of 2 ppm, not to be exceeded during any 15-min work period	N N
Allyl stearate (6289-31-2)	<dl< td=""><td>1.50</td><td>N/A</td><td>N/A</td></dl<>	1.50	N/A	N/A
p-dicyclohexylbenzene (1087-02-1)	<dl< td=""><td>0.12</td><td>N/A</td><td>N/A</td></dl<>	0.12	N/A	N/A
(1,1'-Bicyclohexyl)-4- ylbenzene (20273-27-2)	0.19	0.32	N/A	N/A
Heptanoic acid, anhydride	2.12	11.41	N/A	N/A

(626-27-7)				
1-cyclohexyl-4-				
phenylbenezene	1.08	1.23	N/A	N/A
(1000401-12-4)				
2,7-dimethyl-3,5-Octanedione	<dl< td=""><td>11.33</td><td>N/A</td><td>N/A</td></dl<>	11.33	N/A	N/A
(7307-07-5)	\DL	11.33	IN/A	IN/A

* Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified

N/A - Not available

VNA – Not available

<DL – Below Detection Limit</p>
ppb – Parts per billion (=0.001 ppm)
ppbV – Parts per billion by volume
ppm – Parts per million (= 1,000 ppb)

As seen in Table 4, the only exceedance noted is for the chemical compound tridecane (CAS # 629-50-5) where the higher temperature yielded a measured concentration (14.86 ppbV) that did exceed the PAC-1 value of 0.0073 ppm (7.3 ppb).

This finding will be elaborated further within the "Discussion" section.

Table 5: Summary of chemicals and concentrations identified following injection of <u>Mobil Jet Oil 387</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

		tuala		ration (ppbV, ι e (200°C)			050	260°C	1	
Compound	Con Shipping	trols Field	Baseline Inlet	e (200°C) Bleed	20 Inlet	0°C Bleed	250-2 Inlet	260°C Bleed	Exposure Limit/Guideline (GL)	Exceeds
(CAS#)	Blank	Blank	intet	ыееа	intet	ыееа	met	ьцееа	exposure Limit/Guidenne (GL)	Exceeds Exposur Limit/GI (Y/N)
Triisobutyl phosphate (126-71-06)	NC	57.8	0.0187	0.0232	0.0184	0.0202	0.0190	0.0196	N/A	N/A
Tributyl phosphate (126-73-8)	NC	314	0.0899	0.289	0.0976	0.141	0.158	0.132	NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week OSHA: The permissible exposure limit (PEL) is 0.46	N N
Tri-m-cresyl phosphate									ppm (5 mg/m³) averaged over an 8-h workshift <u>ACGIH:</u> 0.2 ppm averaged over 8 h	N
(563-04-02)	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.0579</td><td><rl< td=""><td>0.164</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.0579</td><td><rl< td=""><td>0.164</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.0579</td><td><rl< td=""><td>0.164</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.0579</td><td><rl< td=""><td>0.164</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	0.0579	<rl< td=""><td>0.164</td><td>N/A</td><td>N/A</td></rl<>	0.164	N/A	N/A
Tri-p-cresyl phosphate (78-32-0)	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.0652</td><td><rl< td=""><td>0.151</td><td>N/A</td><td>N/A N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.0652</td><td><rl< td=""><td>0.151</td><td>N/A</td><td>N/A N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.0652</td><td><rl< td=""><td>0.151</td><td>N/A</td><td>N/A N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.0652</td><td><rl< td=""><td>0.151</td><td>N/A</td><td>N/A N</td></rl<></td></rl<>	0.0652	<rl< td=""><td>0.151</td><td>N/A</td><td>N/A N</td></rl<>	0.151	N/A	N/A N
Formaldehyde (50-00-0)	<rl< td=""><td><rl< td=""><td>6.19</td><td>9.30</td><td>8.30</td><td>10.1</td><td>5.08</td><td>12.0</td><td>NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period EPA AEGL-1 (interim): 0.90 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>6.19</td><td>9.30</td><td>8.30</td><td>10.1</td><td>5.08</td><td>12.0</td><td>NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period EPA AEGL-1 (interim): 0.90 ppm over 8 h</td><td>N N</td></rl<>	6.19	9.30	8.30	10.1	5.08	12.0	NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period EPA AEGL-1 (interim): 0.90 ppm over 8 h	N N
Acetaldehyde (75-07-0)	<rl< td=""><td><rl< td=""><td>2.08</td><td>3.22</td><td>2.40</td><td>3.06</td><td>1.91</td><td>5.20</td><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td> N</td></rl<></td></rl<>	<rl< td=""><td>2.08</td><td>3.22</td><td>2.40</td><td>3.06</td><td>1.91</td><td>5.20</td><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td> N</td></rl<>	2.08	3.22	2.40	3.06	1.91	5.20	NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift	 N
(75-07-0)									ACGIH: Not to exceed 25 ppm (Ceiling) NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min	N N
Acrolein (107-02-8)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.584</td><td>0.171</td><td>0.564</td><td>period OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, out to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.584</td><td>0.171</td><td>0.564</td><td>period OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, out to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.584</td><td>0.171</td><td>0.564</td><td>period OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, out to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.584</td><td>0.171</td><td>0.564</td><td>period OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, out to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.584</td><td>0.171</td><td>0.564</td><td>period OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, out to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<>	0.584	0.171	0.564	period OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, out to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h	N N
									NIOSH: The REL is 250 ppm averaged over a 10-h workshift	N
Acetone	0.097	0.098							OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N
(67-64-1)	μg/ sample	μg/ sample	4.60	4.65	6.17	6.03	4.60	5.76	ACGIH: The threshold limit value-time weighted average (TLV®-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	N
									EPA AEGL-1 (interim): 200 ppm over 8 h ACGIH: The recommended airborne exposure limit	N N
Propionaldehyde (123-38-6)	<rl< td=""><td><rl< td=""><td>0.555</td><td>0.753</td><td>0.563</td><td>1.01</td><td>0.584</td><td>1.39</td><td>is 20 ppm averaged over an 8-h workshift <u>EPA AEGL-1 (interim)</u>: 45 ppm over 8 h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.555</td><td>0.753</td><td>0.563</td><td>1.01</td><td>0.584</td><td>1.39</td><td>is 20 ppm averaged over an 8-h workshift <u>EPA AEGL-1 (interim)</u>: 45 ppm over 8 h</td><td>N</td></rl<>	0.555	0.753	0.563	1.01	0.584	1.39	is 20 ppm averaged over an 8-h workshift <u>EPA AEGL-1 (interim)</u> : 45 ppm over 8 h	N
Crotonaldehyde (4170-30-3)	<rl< td=""><td><rl< td=""><td>0.971</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.897</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.971</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.897</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.971	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.897</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.897</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.897</td><td><rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	0.897	<rl< td=""><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift	N
Methacrolein	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.561</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.561</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.561</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.561</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	0.561	<rl< td=""><td><rl< td=""><td><rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<>	ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm	N N
(78-85-3)	SNL	\nL	SAL.	NL.	0.301	\nL	SNL	\nL	MEK NIOSH: The REL is 200 ppm averaged over a 10-	N
Methyl ethyl ketone (MEK) & Butyraldehyde (78-93-3) (123-72-8)	<rl< td=""><td><rl< td=""><td>1.08</td><td>1.20</td><td>0.986</td><td>1.38</td><td>1.05</td><td>1.94</td><td>Interview in the Lis 200 para as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK_OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK_ACGH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as STEL</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.08</td><td>1.20</td><td>0.986</td><td>1.38</td><td>1.05</td><td>1.94</td><td>Interview in the Lis 200 para as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK_OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK_ACGH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as STEL</td><td>N N</td></rl<>	1.08	1.20	0.986	1.38	1.05	1.94	Interview in the Lis 200 para as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK_OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK_ACGH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as STEL	N N
									MEK EPA AEGL-1: 200 ppm over 8 h <u>Butyraldehyde OARS WEEL:</u> RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	N N
Valeraldehyde (110-62-3)	0.131 µg/ sample	0.197 µg/ sample	5.24	<rl< td=""><td>1.62</td><td>1.30</td><td>1.13</td><td>1.95</td><td>NIOSH: The recommended airborne exposure limit is 50 ppm averaged over a 10-h workshift ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	1.62	1.30	1.13	1.95	NIOSH: The recommended airborne exposure limit is 50 ppm averaged over a 10-h workshift ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift	N N
Hexaldehyde (66-25-1)	<rl< td=""><td><rl< td=""><td>0.299</td><td>0.463</td><td>0.381</td><td>0.469</td><td><rl< td=""><td>0.633</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.299</td><td>0.463</td><td>0.381</td><td>0.469</td><td><rl< td=""><td>0.633</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	0.299	0.463	0.381	0.469	<rl< td=""><td>0.633</td><td>N/A</td><td>N/A</td></rl<>	0.633	N/A	N/A
Chloromethane (74-87-3)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.96</td><td><rl< td=""><td>1.68</td><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.96</td><td><rl< td=""><td>1.68</td><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.96</td><td><rl< td=""><td>1.68</td><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<>	0.96	<rl< td=""><td>1.68</td><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<>	1.68	OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA	N N
Methanol	N-0	h:0	45.5	45.5	410	46.1	40.7	47.0	NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 250 ppm as STEL during any 15-min period OSHA: The PEL is 200 ppm averaged over an 8-hour	N N
(67-56-1)	NC	NC	15.5	15.5	14.8	12.1	12.7	17.0	workday ACGIH: 200 ppm as an 8-h TLV*-TWA exposure, and 250 ppm as a STEL (with a skin notation) EPA AEGL-1 (interim): 270 ppm over 8 h	N N
Chloroethane (75-00-3)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.01</td><td>NIOSH: The REL is 100 ppm averaged over a 10-h workday OSHA: The PEL is 100 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.01</td><td>NIOSH: The REL is 100 ppm averaged over a 10-h workday OSHA: The PEL is 100 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.01</td><td>NIOSH: The REL is 100 ppm averaged over a 10-h workday OSHA: The PEL is 100 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.01</td><td>NIOSH: The REL is 100 ppm averaged over a 10-h workday OSHA: The PEL is 100 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.01</td><td>NIOSH: The REL is 100 ppm averaged over a 10-h workday OSHA: The PEL is 100 ppm averaged over an 8-h workday</td><td>N N</td></rl<>	1.01	NIOSH: The REL is 100 ppm averaged over a 10-h workday OSHA: The PEL is 100 ppm averaged over an 8-h workday	N N
Ethanol (64-17-5)	NC	NC	<rl< td=""><td>3.19</td><td>4.76</td><td><rl< td=""><td><rl< td=""><td>3.49</td><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	3.19	4.76	<rl< td=""><td><rl< td=""><td>3.49</td><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>3.49</td><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	3.49	NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N N

ACSIH: Threshold limit value (TLV*-TWA) is 1,000 ppm as a STEL	N N N
Acetone (67-64-1) NC NC 6.59 7.28 6.06 15.3 4.35 72.9 Acetone (67-64-1) NC NC 6.59 7.28 6.06 15.3 4.35 72.9 Acetone (67-64-1) NC NC NC RL 38.7 4.8 4.35 72.9 Acetone (67-64-1) NC NC NC RL 38.7 4.8 4.35 72.9 Acetone (67-63-0) NC NC RL 38.7 4.8 4.35 72.9 Acetone (67-63-0) NC NC RL 38.7 4.8 4.35 72.9 Acetone (67-63-0) NC NC RL 38.7 4.8 4.35 72.9 Acetone (67-63-0) NC NC RL 38.7 4.8 4.35 72.9 Acetone (67-63-0) NC NC RL 38.7 4.8 4.8 4.8 4.8 4.8 4.8 4.8 4.8 4.8 4.8	N N
Acstone	N
ACGIH: The REL is 500 ppm strenged over an 8-h workday, and 300 ppm as a TWA over 8 h Hexane (110-54-3)	
short-term exposure limit (STEL) is 500 ppm EPA AEGL-1 (Interim): 200 ppm over 8 h NC NC < RL 38.7 < RL < RL < RL 10.6 SHA: The REL is 400 ppm averaged over a 10-h workshift, not to exceed 500 ppm during any 15-m work shift, and 40 ppm as a STEL NC NC < RL < RL < RL 3.38 < RL 23.9 Methyl ethyl ketone (78-93-3) NC NC < RL < RL < RL 3.38 < RL 23.9 Methyl ethyl ketone (78-93-3) NC NC < RL 3.38 < RL 23.9 Work shift ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-h work shift, and 40 ppm as a STEL NIOSH: The REL is 200 ppm averaged over an 8-h work shift ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ACGIH: The REL is 500 ppm as a TWA over 10 h OSHA: The PEL is 500 ppm as a TWA over 10 h OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a TWA over 8 h NIOSH: The REL is 500 ppm as a	N
2-Propanol (67-63-0) NC NC < RL 38.7	N
2-Propanol (67-63-0) NC NC SRL 38.7 SRL	N
2-Propanol (67-63-0) NC NC < RL 38.7	
Methyl ethyl ketone (78-93-3) Methyl ethyl ketone (78-93-3) NC NC SRL	N
Section Sect	N
Methyl ethyl ketone (78-93-3) NC NC SRL SRL SRL SRL S.3.38 SRL SRL S.3.9 Hexane (10-54-3) NC NC SRL	
Methyl ethyl ketone (78-93-3) NC NC NC NC NC NC NC NC NC N	N
Methyl ethyl ketone (78-93-3)	
(78-93-3) NC NC KL KL KL S.3.9 Workday ACGH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm: a STEL EPA AEGL-1: 200 ppm over 8 h Hexane (110-54-3) NC NC KL 2.61 KRL	
Hexane	N
A STEL EPA AEGL-1; 200 ppm over 8 h	N
Hexane	
10-54-3)	N
4-Methyl-2-pentanone (MiBK)	N N
4-Methyl-2-pentanone (MiBK) NC NC RL RL RL RL RL RL 3.74 min STEL of 75 ppm OSHA; The PEL is 100 ppm averaged over an 8-h workshift ACGIH: 50 ppm for 8-hour time weighted average (TLV*-TWA) and 75 ppm for the 15-min STEL	N
workshift ACGIH: 50 ppm for 8-hour time weighted average (TLV*-TWA) and 75 ppm for the 15-min STEL	
ACGIH: 50 ppm for 8-hour time weighted average (TLV*-TWA) and 75 ppm for the 15-min STEL	N
	N
1,2,4-Trimethylbenzene NC NC 0.87 <rl <rl="" se<="" sel="" td=""><td>N</td></rl>	N
(95-63-6) EFA AEGL-1: 45 ppm over 8 n	N N
(110-54-3) < KL	N
NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure	N
limit (STEL) not to be exceeded during any 15-min	
Methyl ethyl ketone	N
(78-93-3)	N
ppm averaged over an 8-h workday, and 300 ppm a	
a STEL EPA AEGL-1: 200 ppm over 8 h	N
NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL	N
Tetrahydrofuran CDI	N
(109-99-9) CRL	N
is 50 ppm averaged over an 8-h workday and 100	.,
ppm as a STEL NIOSH: The REL is 100 ppm as a TWA over 10 h	N
Toluene (108-88-3)	N
EPA AEGL-1: 67 ppm over 8 h	N
OSHA: The PEL is 100 ppm averaged over an 8-h workday. The Ceiling concentration is 200 ppm, ar	N
Tetrachloroethylene the maximum peak exposure is 300 ppm for up to	
(127-18-4) CRL	N
an 8-h workday, and the STEL is 100 ppm EPA AEGL-1 (interim): 35 ppm over 8 h	N
NIOSH: REL is 100 ppm averaged over a 10 h	N
Ethyl Benzene workshift and 125 ppm not to be exceeded during any 15-minute work period	
(100-41-4)	N N
EPA AEGL-1 (interim); 33 ppm over 8 h	N
Eor Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h	N
workshift, and not to exceed 150 ppm during any 1	
m & p-xylene min work period min work period min work period O.888 O.586 O.855 O.583 O.264 O.260 O.841; The PEL is 100 ppm averaged over an 8-h	N
(106-42-3) workshift ACGIH: The TLV®-TWA is 100 ppm averaged over a	N
8-h workshift, and 150 ppm as a STEL	
Nonane	N N
(111-84-2) < RL <rl 0.643="" 0.781="" 1.51="" 1.80="" 2.91="" 200="" 3.26="" 8-h="" acgih:="" an="" averaged="" for="" over="" ppm="" td="" workshift="" xulenes:<="" =""><td>N</td></rl>	N
NIOSH: The REL is 100 ppm averaged over a 10-h	N
workshift, and not to exceed 150 ppm during any 1	
0-xylene (95-47-6)	N
Workslift ACGIH: The TLV*-TWA is 100 ppm averaged over a	N
8-h workshift, and 150 ppm as a STEL EPA AEGL-1: 130 ppm over 8 h	N
EFM ALGETI, 100 DDITOVELOTI	N
NIOSH: The REL is 50 ppm averaged over a 10-h	N
NIOSH: The REL is 50 ppm averaged over a 10-h workday OSHA: The PEL is 50 ppm averaged over an 8-h	1
Cumene Cumene Cu	NI.
Cumene (98-82-8) Cumene (98-8	
Cumene (98-82-8)	N N

4-Ethyltoluene (622-96-8)	<rl< th=""><th><rl< th=""><th>0.279</th><th>0.173</th><th>0.270</th><th>0.155</th><th><rl< th=""><th><rl< th=""><th>DOE/SCAPA PAC-1: 3.1 ppm</th><th>N</th></rl<></th></rl<></th></rl<></th></rl<>	<rl< th=""><th>0.279</th><th>0.173</th><th>0.270</th><th>0.155</th><th><rl< th=""><th><rl< th=""><th>DOE/SCAPA PAC-1: 3.1 ppm</th><th>N</th></rl<></th></rl<></th></rl<>	0.279	0.173	0.270	0.155	<rl< th=""><th><rl< th=""><th>DOE/SCAPA PAC-1: 3.1 ppm</th><th>N</th></rl<></th></rl<>	<rl< th=""><th>DOE/SCAPA PAC-1: 3.1 ppm</th><th>N</th></rl<>	DOE/SCAPA PAC-1: 3.1 ppm	N
1,3,5-Trimethylbenzene (108-67-8)	<rl< td=""><td><rl< td=""><td>0.404</td><td>0.273</td><td>0.390</td><td>0.233</td><td>0.152</td><td>0.138</td><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.404</td><td>0.273</td><td>0.390</td><td>0.233</td><td>0.152</td><td>0.138</td><td>NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u>: 45 ppm over 8 h</td><td>N</td></rl<>	0.404	0.273	0.390	0.233	0.152	0.138	NIOSH: 25 ppm averaged over a 10-h workday <u>EPA AEGL-1</u> : 45 ppm over 8 h	N
1,2,4-Trimethylbenzene (95-63-6)	<rl< td=""><td><rl< td=""><td>1.29</td><td>1.09</td><td>1.46</td><td>0.823</td><td>0.626</td><td>0.585</td><td>NIOSH: 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.29</td><td>1.09</td><td>1.46</td><td>0.823</td><td>0.626</td><td>0.585</td><td>NIOSH: 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h</td><td>N N</td></rl<>	1.29	1.09	1.46	0.823	0.626	0.585	NIOSH: 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h	N N

NC - Not collected, not reported or otherwise not specified

N/A – Not available

<RL - Below Reporting Limit

ppb – Parts per billion (=0.001 ppm)

ppbV - Parts per billion by volume ppm – Parts per million (= 1,000 ppb)

The data presented in Table 5 for the engine stand test with Mobil Jet Oil 387 did not reveal exceedances of recommendations, limits, values or guidelines for any of the chemical compounds identified.

Table 6: Summary of Tentatively Identified VOCs and concentrations identified following injection of Mobil Jet Oil 387 (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (pp	bV; toluene-equivalent)		
Compound (CAS #)	200°C	250°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
Benzene (71-43-2)	0.13	1.34	NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 1 ppm in a 15-min work period OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period ACGIH: The TLV®-TWA is 0.5 ppm averaged over an 8-h workshift and 2.5 ppm as a STEL EPA AEGL-1 (interim): 9 ppm over 8 h	N N N
Pentanal (110-62-3)	<dl< td=""><td>1.05</td><td>N/A</td><td>N/A</td></dl<>	1.05	N/A	N/A
Hexanal (66-25-1)	0.71	1.37	DOE/SCAPA PAC-1: 1.3 ppm	N
Pentanoic acid (109-52-4)	7.89	16.52	DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm	N
Heptanal (111-71-7)	<dl< td=""><td>1.57</td><td>N/A</td><td>N/A</td></dl<>	1.57	N/A	N/A
Heptanoic acid (111-14-8)	7.88	10.36	DOE/SCAPA PAC-1: 3.9 ppm	N
Octanoic acid (124-07-2)	3.66	4.87	DOE/SCAPA PAC-1: 5.1 ppm	N
Dodecane (112-40-3)	<dl< td=""><td>0.29</td><td>DOE/SCAPA PAC-1: 0.12 ppm</td><td>N</td></dl<>	0.29	DOE/SCAPA PAC-1: 0.12 ppm	N
n-decanoic acid (334-48-5)	3.84	3.55	N/A	N/A
Tributyl phosphate (126-73-8)	0.19	0.29	NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N N
Heptanoic acid, anhydride (626-27-7)	3.59	<dl< td=""><td>N/A</td><td>N/A</td></dl<>	N/A	N/A
Butyl diphenyl phosphate (2752-95-6)	0.89	1.04	N/A	N/A
2,7-dimethyl-3,5-Octanedione (7307-07-5)	12.44	6.74	N/A	N/A

^{*} Value exceeds a given exposure limit/guideline

NC - Not collected, not reported or otherwise not specified

N/A – Not available

<DL – Below Detection Limit ppb – Parts per billion (=0.001 ppm) ppbV – Parts per billion by volume

ppm – Parts per million (= 1,000 ppb)

The data from Naval Air Warfare Center Aircraft Division presented in Table 6 for the engine stand test with Mobil Jet Oil 387 did not reveal exceedances of recommendations, limits, values or guidelines for any of the chemical compounds identified.

Table 7: Summary of chemicals and concentrations identified following injection of <u>HyJet IV-A</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	C	trols		ration (ppbV, ι e (200°C)		o°C	1 00	0°C	-	
Compound	Shipping	trois Field	Inlet	Bleed	Inlet	Bleed	Inlet	Bleed	Exposure Limit/Guideline (GL)	Exceeds
(CAS#)	Blank	Blank	inter	biccu	inter	Diccu	inter	Diccu	Exposure Elillo Guideulle (GE)	Exposure Limit/GL (Y/N)
Triisobutyl phosphate	NC	64.2	0.0324	0.499	0.0575	0.217	0.0324	0.0774	N/A	N/A
(126-71-06)									NIOSH: 0.2 ppm over a period of 10-h during a 40-	N
Tributyl phosphate (126-73-8)	NC	631	0.826	10.9	1.39	12.2	2.04	9.73	hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift	N
Formaldehyde (50-00-0)	<rl< td=""><td>0.188 μg/</td><td>11.1</td><td>10.2</td><td>11.0</td><td>13.3</td><td>8.13</td><td>18.7*</td><td>ACGIH: 0.2 ppm averaged over 8h NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm</td><td>N Y N</td></rl<>	0.188 μg/	11.1	10.2	11.0	13.3	8.13	18.7*	ACGIH: 0.2 ppm averaged over 8h NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm	N Y N
		sample							averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period EPA AEGL-1 (interim): 0.90 ppm over 8 h	N
Acetaldehyde (75-07-0)	<rl< td=""><td><rl< td=""><td>1.48</td><td>1.73</td><td>1.37</td><td>3.58</td><td>1.33</td><td>9.80</td><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td> N</td></rl<></td></rl<>	<rl< td=""><td>1.48</td><td>1.73</td><td>1.37</td><td>3.58</td><td>1.33</td><td>9.80</td><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td> N</td></rl<>	1.48	1.73	1.37	3.58	1.33	9.80	NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift	 N
·									ACGIH: Not to exceed 25 ppm (Ceiling) NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period	N N
Acrolein (107-02-8)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.987</td><td><rl< td=""><td>2.71</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.987</td><td><rl< td=""><td>2.71</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.987</td><td><rl< td=""><td>2.71</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.987</td><td><rl< td=""><td>2.71</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.987</td><td><rl< td=""><td>2.71</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	0.987	<rl< td=""><td>2.71</td><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h</td><td>N N</td></rl<>	2.71	OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time EPA AEGL-1: 0.030 ppm over 8 h	N N
Acetone	0.097	0.164	4.72	4.54	4.31	5.14	4.16	6.50	NIOSH: The REL is 250 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N N
(67-64-1)	μg/ sample	µg/ sample	4.72	4.04	4.31	3.14	4.10	0.30	ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm EPA AEGL-1 (interim): 200 ppm over 8 h	N N
Propionaldehyde (123-38-6)	<rl< td=""><td><rl< td=""><td>0.527</td><td>0.583</td><td><rl< td=""><td>1.13</td><td><rl< td=""><td>5.17</td><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.527</td><td>0.583</td><td><rl< td=""><td>1.13</td><td><rl< td=""><td>5.17</td><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	0.527	0.583	<rl< td=""><td>1.13</td><td><rl< td=""><td>5.17</td><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	1.13	<rl< td=""><td>5.17</td><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<>	5.17	ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h	N N
Crotonaldehyde (4170-30-3)	<rl< td=""><td><rl< td=""><td>0.853</td><td><rl< td=""><td>0.790</td><td><rl< td=""><td>0.885</td><td>0.588</td><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.853</td><td><rl< td=""><td>0.790</td><td><rl< td=""><td>0.885</td><td>0.588</td><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	0.853	<rl< td=""><td>0.790</td><td><rl< td=""><td>0.885</td><td>0.588</td><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	0.790	<rl< td=""><td>0.885</td><td>0.588</td><td>NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	0.885	0.588	NIOSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday OSHA: The PEL is 2 ppm averaged over an 8-h workshift	N N
Methacrolein	<rl< td=""><td><rl< td=""><td>1.53</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.474</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.53</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.474</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	1.53	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.474</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.474</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.474</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.474</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm</td><td>N N</td></rl<>	0.474	ACGIH: 0.3 ppm, not to be exceeded at any time DOE/SCAPA PAC-1: 0.20 ppm	N N
(78-85-3)	<kl< td=""><td><kl< td=""><td>1.53</td><td><kl< td=""><td><kl< td=""><td><kl< td=""><td><kl< td=""><td>0.474</td><td></td><td>N N</td></kl<></td></kl<></td></kl<></td></kl<></td></kl<></td></kl<>	<kl< td=""><td>1.53</td><td><kl< td=""><td><kl< td=""><td><kl< td=""><td><kl< td=""><td>0.474</td><td></td><td>N N</td></kl<></td></kl<></td></kl<></td></kl<></td></kl<>	1.53	<kl< td=""><td><kl< td=""><td><kl< td=""><td><kl< td=""><td>0.474</td><td></td><td>N N</td></kl<></td></kl<></td></kl<></td></kl<>	<kl< td=""><td><kl< td=""><td><kl< td=""><td>0.474</td><td></td><td>N N</td></kl<></td></kl<></td></kl<>	<kl< td=""><td><kl< td=""><td>0.474</td><td></td><td>N N</td></kl<></td></kl<>	<kl< td=""><td>0.474</td><td></td><td>N N</td></kl<>	0.474		N N
Methyl ethyl ketone (MEK) & Butyraldehyde (78-93-3) (123-72-8)	<rl< td=""><td>0.046 µg/ sample</td><td>0.967</td><td>1.70</td><td>0.903</td><td>2.28</td><td>0.888</td><td>4.43</td><td>MEK.NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK.OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK.ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK.PEA.REGLH: 200 ppm over 8 h Butyraldehyde OARS.WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm</td><td>Z Z Z Z Z</td></rl<>	0.046 µg/ sample	0.967	1.70	0.903	2.28	0.888	4.43	MEK.NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK.OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK.ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK.PEA.REGLH: 200 ppm over 8 h Butyraldehyde OARS.WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	Z Z Z Z Z
Valeraldehyde (110-62-3)	0.131 μg/ sample	0.039 µg/ sample	0.743	0.644	0.706	1.22	0.430	2.02	NIOSH: The recommended airborne exposure limit is 50 ppm averaged over a 10-h workshift ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift	N N
Hexaldehyde (66-25-1)	<rl< td=""><td><rl< td=""><td>0.320</td><td>0.384</td><td><rl< td=""><td>0.616</td><td>0.313</td><td>0.929</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.320</td><td>0.384</td><td><rl< td=""><td>0.616</td><td>0.313</td><td>0.929</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	0.320	0.384	<rl< td=""><td>0.616</td><td>0.313</td><td>0.929</td><td>N/A</td><td>N/A</td></rl<>	0.616	0.313	0.929	N/A	N/A
Triisobutyl phosphate (126-71-06)	<rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>1.09</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>1.09</td><td>N/A</td><td>N/A</td></rl<>	NC	NC	NC	NC	NC	1.09	N/A	N/A
Tributyl phosphate (126-73-8)	<rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>61.1</td><td>NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m²) averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>NC</td><td>61.1</td><td>NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m²) averaged over an 8-h workshift</td><td>N N</td></rl<>	NC	NC	NC	NC	NC	61.1	NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m²) averaged over an 8-h workshift	N N
Propene (115-07-1)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>2.15</td><td>ACGIH: 0.2 ppm averaged over 8 h ACGIH: The TLV®-TWA is 500 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>2.15</td><td>ACGIH: 0.2 ppm averaged over 8 h ACGIH: The TLV®-TWA is 500 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>2.15</td><td>ACGIH: 0.2 ppm averaged over 8 h ACGIH: The TLV®-TWA is 500 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>2.15</td><td>ACGIH: 0.2 ppm averaged over 8 h ACGIH: The TLV®-TWA is 500 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>2.15</td><td>ACGIH: 0.2 ppm averaged over 8 h ACGIH: The TLV®-TWA is 500 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	2.15	ACGIH: 0.2 ppm averaged over 8 h ACGIH: The TLV®-TWA is 500 ppm averaged over an 8-h workshift	N N
Chloromethane (74-87-3)	NC	NC	0.79	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.14</td><td><rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.14</td><td><rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.14</td><td><rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<>	1.14	<rl< td=""><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<>	OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA	N N
Methanol									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 250 ppm as STEL during any 15-min period OSHA: The PEL is 200 ppm averaged over an 8-hour	N N
(67-56-1)	NC	NC	93.6	17.0	16.0	11.4	12.3	13.2	ACGIH: 200 ppm as an 8-h TLV®-TWA exposure, and 250 ppm as a STEL (with a skin notation) EPA AEGL-1 (interim): 270 ppm over 8 h	N N

Ethanol									NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h	N N
(64-17-5)	NC	NC	15.1	<rl< td=""><td><rl< td=""><td><rl< td=""><td>3.87</td><td>4.91</td><td>workshift ACGIH: Threshold limit value (TLV®-TWA) is 1,000</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>3.87</td><td>4.91</td><td>workshift ACGIH: Threshold limit value (TLV®-TWA) is 1,000</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>3.87</td><td>4.91</td><td>workshift ACGIH: Threshold limit value (TLV®-TWA) is 1,000</td><td>N</td></rl<>	3.87	4.91	workshift ACGIH: Threshold limit value (TLV®-TWA) is 1,000	N
									ppm as a STEL NIOSH: The REL is 250 ppm averaged over a 10-h	N
									workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h	N
Acetone (67-64-1)	NC	NC	7.39	4.10	<rl< td=""><td>3.50</td><td><rl< td=""><td>6.47</td><td>workshift ACGIH: The threshold limit value-time weighted</td><td>N</td></rl<></td></rl<>	3.50	<rl< td=""><td>6.47</td><td>workshift ACGIH: The threshold limit value-time weighted</td><td>N</td></rl<>	6.47	workshift ACGIH: The threshold limit value-time weighted	N
(67 64 1)									average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	.,
									EPA AEGL-1 (interim): 200 ppm over 8 h	N N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure	N
									limit (STEL) not to be exceeded during any 15-min work period	
Methyl ethyl ketone (78-93-3)	NC	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>2.19</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>2.19</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>2.19</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>2.19</td><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	2.19	<rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<>	OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
									ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as	N
									a STEL <u>EPA AEGL-1:</u> 200 ppm over 8 h	N
									NIOSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift	N
Ethyl acetate (141-78-6)	NC	NC	3.83	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<>	OSHA: The PEL is 400 ppm averaged over an 8-H workshift	N
									ACGIH: The recommended airborne exposure limit is 400 ppm averaged over an 8-H workshift	N
Toluene									NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8-	N N
(108-88-3)	NC	NC	2.22	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<>	workshift EPA AEGL-1: 67 ppm over 8 h	N
									NIOSH: The recommended airborne exposure limit is 200 ppm averaged over a 10-h workshift	N
Trans-1,2- Dichloroethene	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.368</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	0.368	OSHA: The PEL is 200 ppm averaged over an 8-h workshift	N
(156-60-5)									ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-hour workshift	N
Hexane	<rl< td=""><td><rl< td=""><td>0.461</td><td>0.358</td><td>1.62</td><td>1.02</td><td>0.198</td><td>0.242</td><td>NIOSH: The REL is 50 ppm as a TWA over 10 h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.461</td><td>0.358</td><td>1.62</td><td>1.02</td><td>0.198</td><td>0.242</td><td>NIOSH: The REL is 50 ppm as a TWA over 10 h</td><td>N</td></rl<>	0.461	0.358	1.62	1.02	0.198	0.242	NIOSH: The REL is 50 ppm as a TWA over 10 h	N
(110-54-3)									OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 200 ppm averaged over a 10-h	N N
									workday, and 300 ppm as a STEL not to be exceeded during any 15-min work period	
Methyl ethyl ketone (78-93-3)	<rl< td=""><td><rl< td=""><td>0.200</td><td>0.269</td><td>0.131</td><td>0.323</td><td>0.157</td><td>0.384</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.200</td><td>0.269</td><td>0.131</td><td>0.323</td><td>0.157</td><td>0.384</td><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<>	0.200	0.269	0.131	0.323	0.157	0.384	OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
(78-93-3)									ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as	N
									a STEL EPA AEGL-1: 200 ppm over 8 h	N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL	N
Tetrahydrofuran	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.248</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.248</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.248</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.248</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	0.248	<rl< td=""><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The PEL is 200 ppm averaged over an 8-h workday</td><td>N</td></rl<>	OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
(109-99-9)	- NE	112		NIL.	0.240	- TIL	- TIL	112	ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100	N
									ppm as a STEL NIOSH: The REL is 300 ppm averaged over a 10-h	N N
Cyclohexane	4DI	0.050	4DI	*DI	4DI	4DI	*DI	0.404	workshift	
(110-82-7)	<rl< td=""><td>0.650</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.184</td><td>OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.650	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.184</td><td>OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.184</td><td>OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.184</td><td>OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.184</td><td>OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.184</td><td>OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100</td><td>N N</td></rl<>	0.184	OSHA: The PEL is 300 averaged over an 8-h workshift ACGIH: The threshold limit value (TLV®-TWA) is 100	N N
									ppm averaged over an 8-h workshift NIOSH: The REL is 0.1 ppm averaged over a 10-h	N
									workshift, not to exceed 1 ppm in a 15-min work period	
Benzene (71-43-2)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.428</td><td><rl< td=""><td><rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.428</td><td><rl< td=""><td><rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.428</td><td><rl< td=""><td><rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.428</td><td><rl< td=""><td><rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.428</td><td><rl< td=""><td><rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<></td></rl<></td></rl<>	0.428	<rl< td=""><td><rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period</td><td>N</td></rl<>	OSHA: Time-weighted average (TWA) is 1 ppm for an 8-h workday, STEL is 5 ppm for any 15-min period	N
									ACGIH: The TLV®-TWA is 0.5 ppm averaged over an 8-h workshift and 2.5 ppm as a STEL	N
Hontono									EPA AEGL-1 (interim): 9 ppm over 8 h NIOSH: The recommended airborne exposure limit	N N
Heptane (142-82-5)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.158</td><td>0.150</td><td>0.268</td><td>is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.158</td><td>0.150</td><td>0.268</td><td>is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.158</td><td>0.150</td><td>0.268</td><td>is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.158</td><td>0.150</td><td>0.268</td><td>is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td></td></rl<></td></rl<>	<rl< td=""><td>0.158</td><td>0.150</td><td>0.268</td><td>is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td></td></rl<>	0.158	0.150	0.268	is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period	
Toluene	4DI	4DI	4DI	4DI	0.040	0.450	0.000	0.055	NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8-	N N
(108-88-3)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.340</td><td>0.458</td><td>0.238</td><td>0.355</td><td>workshift <u>EPA AEGL-1:</u> 67 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.340</td><td>0.458</td><td>0.238</td><td>0.355</td><td>workshift <u>EPA AEGL-1:</u> 67 ppm over 8 h</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.340</td><td>0.458</td><td>0.238</td><td>0.355</td><td>workshift <u>EPA AEGL-1:</u> 67 ppm over 8 h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.340</td><td>0.458</td><td>0.238</td><td>0.355</td><td>workshift <u>EPA AEGL-1:</u> 67 ppm over 8 h</td><td>N</td></rl<>	0.340	0.458	0.238	0.355	workshift <u>EPA AEGL-1:</u> 67 ppm over 8 h	N
									For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h	N
m & p-xylene									workshift, and not to exceed 150 ppm during any 15- min work period	••
(108-88-3) (106-42-3)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.438</td><td>0.443</td><td>0.276</td><td>0.311</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.438</td><td>0.443</td><td>0.276</td><td>0.311</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.438</td><td>0.443</td><td>0.276</td><td>0.311</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.438</td><td>0.443</td><td>0.276</td><td>0.311</td><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	0.438	0.443	0.276	0.311	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
(.50 42 0)									ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
Nonane					ļ	0.845			EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift	N N
(111-84-2)	<rl< td=""><td><rl< td=""><td>0.218</td><td>0.167</td><td>0.860</td><td>0.045</td><td>0.626</td><td>0.582</td><td>ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.218</td><td>0.167</td><td>0.860</td><td>0.045</td><td>0.626</td><td>0.582</td><td>ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	0.218	0.167	0.860	0.045	0.626	0.582	ACGIH: 200 ppm averaged over an 8-h workshift	N N
									For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h	N
o-xylene									workshift, and not to exceed 150 ppm during any 15- min work period	
(95-47-6)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.169</td><td>0.173</td><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.169</td><td>0.173</td><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.169</td><td>0.173</td><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.169</td><td>0.173</td><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	0.169	0.173	<rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
									ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N
4-Ethyltoluene	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.139</td><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N N</td></rl<>	0.139	EPA AEGL-1: 130 ppm over 8 h	N N
(622-96-8) 1,3,5-Trimethylbenzene	+					-			DOE/SCAPA PAC-1: 3.1 ppm NIOSH: 25 ppm averaged over a 10-h workday	N N
(108-67-8) 1,2,4-Trimethylbenzene	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.145</td><td>0.150</td><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.145</td><td>0.150</td><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.145</td><td>0.150</td><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.145</td><td>0.150</td><td><rl< td=""><td><rl< td=""><td>EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<></td></rl<></td></rl<>	0.145	0.150	<rl< td=""><td><rl< td=""><td>EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<>	EPA AEGL-1: 45 ppm over 8 h NIOSH: 25 ppm averaged over a 10-h workday	N N
(95-63-6)	<rl< td=""><td><rl< td=""><td>0.284</td><td>0.225</td><td>0.564</td><td>0.545</td><td>0.393</td><td>0.342</td><td>EPA AEGL-1: 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.284</td><td>0.225</td><td>0.564</td><td>0.545</td><td>0.393</td><td>0.342</td><td>EPA AEGL-1: 45 ppm over 8 h</td><td>N N</td></rl<>	0.284	0.225	0.564	0.545	0.393	0.342	EPA AEGL-1: 45 ppm over 8 h	N N

* Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available
<RL – Below Reporting Limit
ppb – Parts per billion (=0.001 ppm)
ppbV – Parts per billion by volume
ppm – Parts per million (= 1,000 ppb)

As shown in Table 7, the engine stand test with HyJet IV-A hydraulic fluid resulted in a variety of chemical compounds; however, these were all found in concentrations lower than their respective exposure recommendations, limits and/or guidelines, again with the exception of formaldehyde (CAS # 50-00-0). As before, the "higher" concentration of formaldehyde was found at the higher temperature bleed air post-injection, although formaldehyde was present in lower concentrations in pre-injection baseline samples.

This finding will be elaborated further within the "Discussion" section.

Table 8: Summary of Tentatively Identified VOCs and concentrations identified following injection of HyJet IV-A (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppl	bV; toluene-equivalent)		
Compound (CAS#)	200°C	250°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
2-butene (624-64-6)	<dl< td=""><td>8.87</td><td>ACGIH: The TLV®-TWA is 250 ppm for butenes for 8 h</td><td>N</td></dl<>	8.87	ACGIH: The TLV®-TWA is 250 ppm for butenes for 8 h	N
1-hexanol (111-27-3)	<dl< td=""><td>9.86</td><td>DOE/SCAPA PAC-1: 10 ppm</td><td>N</td></dl<>	9.86	DOE/SCAPA PAC-1: 10 ppm	N
Nonane (111-84-2)	<dl< td=""><td>3.33</td><td>NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N</td></dl<>	3.33	NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N
2,6-dimethyloctane (2051-30-1)	<dl< td=""><td>2.17</td><td>N/A</td><td>N/A</td></dl<>	2.17	N/A	N/A
n-butyl methacrylate (97-88-1)	0.99	14.62	DOE/SCAPA PAC-1: 3.3 ppm	N
1,2,3-trimethylbenzene (526-73-8)	0.32	4.05	NIOSH: The recommended airborne exposure limit (REL) is 25 ppm averaged over a 10-h workday OSHA: The PEL is 25 ppm averaged over an 8-h workday ACGIH: The recommended airborne exposure limit is 25 ppm averaged over an 8-h workday	N N N
Decane (124-18-5)	0.16	4.07	DOE/SCAPA PAC-1: 6.6 ppm	N
Undecane (1120-21-4)	0.23	3.83	DOE/SCAPA PAC-1: 0.37 ppm	N
Dodecane (112-40-3)	0.27	2.57	DOE/SCAPA PAC-1: 0.12 ppm	N
Tridecane (629-50-5)	<dl< td=""><td>3.61</td><td>DOE/SCAPA PAC-1: 0.0073 ppm</td><td>N</td></dl<>	3.61	DOE/SCAPA PAC-1: 0.0073 ppm	N
Tetradecane (629-59-4)	<dl< td=""><td>2.11</td><td>DOE/SCAPA PAC-1: 3.1 ppm</td><td>N</td></dl<>	2.11	DOE/SCAPA PAC-1: 3.1 ppm	N
2,6,10,14- tetramethylheptadecane (18344-37-1)	1.43	0.43	N/A	N/A
Triisobutyl phosphate (126-71-06)	<dl< td=""><td>0.46</td><td>N/A</td><td>N/A</td></dl<>	0.46	N/A	N/A
Pentadecane (629-62-9)	0.33	0.43	DOE/SCAPA PAC-1: 1.3 ppm	N
Butylated hydroxytoluene (128-37-0)	1.21	3.72	NIOSH: Recommended 10 mg/m³ time- weighted average (TWA) airborne exposure limit over a 10-h workshift	N

			OSHA: Exposure limit is 10 mg/m³ as a	N
			time-weighted average (TWA) over 8 h	
			ACGIH: TWA exposure limit 2 mg/m ³	N
			NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week	N
Tributyl phosphate (126-73-8)	<dl< td=""><td>117.23</td><td>OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift</td><td>N</td></dl<>	117.23	OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift	N
			ACGIH: 0.2 ppm averaged over 8 h	N
Allyl stearate (6289-31-2)	0.97	0.91	N/A	N/A
Heptanoic acid, anhydride (626-27-7)	2.26	7.15	N/A	N/A
2,7-dimethyl-3,5-Octanedione (7307-07-5)	1.05	2.89	N/A	N/A
* Value exceeds a given exposure limit/guideline NC – Not collected, not reported or otherwise no N/A – Not available «DL – Below Detection Limit pp – Parts per billion (=0.001 ppm) ppbV – Parts per billion by volume ppm – Parts per million (=1,000 ppb)				

The data presented in Table 8 did not reveal any exceedances for any of the chemical compounds' recommendations, limits, values or guidelines.

Table 9: Summary of chemicals and concentrations identified following injection of <u>Skydrol PE-5</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

		trols		ration (ppbV, ι e (200°C)		ise noted) 0°C	050 /	260°C	1	
Compound	Shipping	trols Field	Inlet	Bleed	Inlet	0°C Bleed	Inlet	Bleed	Exposure Limit(s)	Exceeds
(CAS#)	Blank	Blank	inter	Bleed	inter	Bleed	inter	bleed	(in ppm)	Exposure Limit (Y/N)
Triisobutyl phosphate	NC	64.2	0.0190	0.0211	0.0392	3.56	0.168	1.80	N/A	N/A
(126-71-06)									NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week	N
Tributyl phosphate (126-73-8)	NC	631	0.0581	0.155	0.148	4.39	1.86	12.1	OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N
Formaldehyde (50-00-0)	<rl< td=""><td>0.188 μg/ sample</td><td>1.42</td><td>7.21</td><td>4.30</td><td>6.77</td><td>7.48</td><td>9.70</td><td>NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period QSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period</td><td>N</td></rl<>	0.188 μg/ sample	1.42	7.21	4.30	6.77	7.48	9.70	NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period QSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period	N
Acetaldehyde (75-07-0)	<rl< td=""><td><rl< td=""><td>1.56</td><td>2.39</td><td>1.85</td><td>2.23</td><td>1.85</td><td>5.14</td><td>EPA AEGL-1 (interim): 0.90 ppm over 8 h NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.56</td><td>2.39</td><td>1.85</td><td>2.23</td><td>1.85</td><td>5.14</td><td>EPA AEGL-1 (interim): 0.90 ppm over 8 h NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	1.56	2.39	1.85	2.23	1.85	5.14	EPA AEGL-1 (interim): 0.90 ppm over 8 h NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift	N N
(73-07-0)									ACGIH: Not to exceed 25 ppm (Ceiling) NIOSH: The REL is 250 ppm averaged over a 10-h	N N
Acetone (67-64-1)	0.097 μg/ sample	0.164 μg/ sample	3.04	3.35	3.49	3.60	4.14	5.37	MALE THE RELESTAGE AND A SEASON OF T	N N
									EPA AEGL-1 (interim): 200 ppm over 8 h	N
Propionaldehyde (123-38-6)	<rl< td=""><td><rl< td=""><td>1.44</td><td>1.59</td><td>1.41</td><td>1.39</td><td>1.15</td><td>3.91</td><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.44</td><td>1.59</td><td>1.41</td><td>1.39</td><td>1.15</td><td>3.91</td><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<>	1.44	1.59	1.41	1.39	1.15	3.91	ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h	N N
									NIOSH: Recommended time-weighted average	N
Crotonaldehyde (4170-30-3)	<rl< td=""><td><rl< td=""><td>2.35</td><td>2.61</td><td>4.22</td><td>4.15</td><td>3.30</td><td>2.15</td><td>(TWA) of 2 ppm in the air over a 10-h workday <u>OSHA</u>: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>2.35</td><td>2.61</td><td>4.22</td><td>4.15</td><td>3.30</td><td>2.15</td><td>(TWA) of 2 ppm in the air over a 10-h workday <u>OSHA</u>: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	2.35	2.61	4.22	4.15	3.30	2.15	(TWA) of 2 ppm in the air over a 10-h workday <u>OSHA</u> : The PEL is 2 ppm averaged over an 8-h workshift	N
Methyl ethyl ketone (MEK) & Butyraldehyde (78-93-3) (123-72-8)	<rl< td=""><td>0.046 μg/ sample</td><td>1.14</td><td>1.29</td><td>1.19</td><td>1.38</td><td>1.27</td><td>3.47</td><td>ACGIH: 0.3 ppm, not to be exceeded at any time MEK.NIOSH:. The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK.OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK.ACGIH:. The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK.PEA.EGL-1: 200 ppm over 8 h Butyraldehyde.OARS.WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm</td><td>N N N N N N N N N N N N N N N N N N N</td></rl<>	0.046 μg/ sample	1.14	1.29	1.19	1.38	1.27	3.47	ACGIH: 0.3 ppm, not to be exceeded at any time MEK.NIOSH:. The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK.OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK.ACGIH:. The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK.PEA.EGL-1: 200 ppm over 8 h Butyraldehyde.OARS.WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	N N N N N N N N N N N N N N N N N N N
Benzaldehyde	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.888</td><td>AIHA WEEL: An 8-h time-weighted average (TWA) of</td><td>N</td></rl<>	0.888	AIHA WEEL: An 8-h time-weighted average (TWA) of	N
(100-52-7) Valeraldehyde (110-62-3)	0.131 µg/ sample	0.039 µg/ sample	0.579	0.681	0.646	0.579	0.682	1.18	2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit is 50 ppm averaged over a 10-h workshift AGGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift	N N
m-Tolualdehyde (620-23-5)	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.466</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.423</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.466</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.423</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.466</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.423</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	0.466	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.423</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.423</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>0.423</td><td>N/A</td><td>N/A</td></rl<>	0.423	N/A	N/A
Hexaldehyde (66-25-1)	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.431</td><td>0.295</td><td>0.373</td><td>0.320</td><td>0.552</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.431</td><td>0.295</td><td>0.373</td><td>0.320</td><td>0.552</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>0.431</td><td>0.295</td><td>0.373</td><td>0.320</td><td>0.552</td><td>N/A</td><td>N/A</td></rl<>	0.431	0.295	0.373	0.320	0.552	N/A	N/A
Triisobutyl phosphate (126-71-06)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>12.3</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>12.3</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>12.3</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>12.3</td><td>N/A</td><td>N/A</td></rl<>	NC	NC	NC	12.3	N/A	N/A
Tributyl phosphate (126-73-8)	104	115	<rl< td=""><td>0.0566</td><td>NC</td><td>NC</td><td>NC</td><td>19.0</td><td>NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week QSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h</td><td>N N N</td></rl<>	0.0566	NC	NC	NC	19.0	NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week QSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N N
Chlorodifluoromethane (75-45-6)	NC	NC	0.82	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift, not to be exceed 1,250 ppm during any 15-min work period ACCIH: TLV*-TWA is 1,000 ppm averaged over an 8-h workshift.</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift, not to be exceed 1,250 ppm during any 15-min work period ACCIH: TLV*-TWA is 1,000 ppm averaged over an 8-h workshift.</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift, not to be exceed 1,250 ppm during any 15-min work period ACCIH: TLV*-TWA is 1,000 ppm averaged over an 8-h workshift.</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift, not to be exceed 1,250 ppm during any 15-min work period ACCIH: TLV*-TWA is 1,000 ppm averaged over an 8-h workshift.</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift, not to be exceed 1,250 ppm during any 15-min work period ACCIH: TLV*-TWA is 1,000 ppm averaged over an 8-h workshift.</td><td>N N</td></rl<>	NIOSH: The REL is 1,000 ppm averaged over a 10-h workshift, not to be exceed 1,250 ppm during any 15-min work period ACCIH: TLV*-TWA is 1,000 ppm averaged over an 8-h workshift.	N N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 250 ppm as STEL during any 15-min period	N
Methanol (67-56-1)	NC	NC	17.7	16.1	18.0	14.0	12.4	14.1	OSHA: The PEL is 200 ppm averaged over an 8-hour workday ACGIH: 200 ppm as an 8-h TLV®-TWA exposure, and 250 ppm as a STEL (with a skin notation)	N
					-	-			EPA AEGL-1 (interim): 270 ppm over 8 h NIOSH: The REL is 1,000 ppm averaged over a 10-h	N N
Ethanol (64-17-5)	NC	NC	3.41	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: Threshold limit value (TLV*-TWA) is 1,000</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: Threshold limit value (TLV*-TWA) is 1,000</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: Threshold limit value (TLV*-TWA) is 1,000</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: Threshold limit value (TLV*-TWA) is 1,000</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: Threshold limit value (TLV*-TWA) is 1,000</td><td>N N</td></rl<>	workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: Threshold limit value (TLV*-TWA) is 1,000	N N
Acetone	NC	NC	6.52	4.51	2.00	2.20	<rl< td=""><td>5.47</td><td>ppm as a STEL NIOSH: The REL is 250 ppm averaged over a 10-h</td><td>N</td></rl<>	5.47	ppm as a STEL NIOSH: The REL is 250 ppm averaged over a 10-h	N
(67-64-1)	NC	NC	6.53	4.51	3.66	3.28	<kl< td=""><td>5.47</td><td>workshift</td><td>ı</td></kl<>	5.47	workshift	ı

									OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	N
									EPA AEGL-1 (interim): 200 ppm over 8 h	N
Hexane	<rl< td=""><td><rl< td=""><td>0.300</td><td>0.563</td><td><rl< td=""><td>11.9</td><td><rl< td=""><td>0.731</td><td>NIOSH: The REL is 50 ppm as a TWA over 10 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.300</td><td>0.563</td><td><rl< td=""><td>11.9</td><td><rl< td=""><td>0.731</td><td>NIOSH: The REL is 50 ppm as a TWA over 10 h</td><td>N</td></rl<></td></rl<></td></rl<>	0.300	0.563	<rl< td=""><td>11.9</td><td><rl< td=""><td>0.731</td><td>NIOSH: The REL is 50 ppm as a TWA over 10 h</td><td>N</td></rl<></td></rl<>	11.9	<rl< td=""><td>0.731</td><td>NIOSH: The REL is 50 ppm as a TWA over 10 h</td><td>N</td></rl<>	0.731	NIOSH: The REL is 50 ppm as a TWA over 10 h	N
(110-54-3)									OSHA: The PEL is 500 ppm as a TWA over 8 h NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure	N N
Methyl ethyl ketone (78-93-3)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.173</td><td>0.418</td><td>0.131</td><td>0.472</td><td>limit (STEL) not to be exceeded during any 15-min work period QSHA: The PEL is 200 ppm averaged over an 8-h workday <u>ACGIH</u>: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.173</td><td>0.418</td><td>0.131</td><td>0.472</td><td>limit (STEL) not to be exceeded during any 15-min work period QSHA: The PEL is 200 ppm averaged over an 8-h workday <u>ACGIH</u>: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.173</td><td>0.418</td><td>0.131</td><td>0.472</td><td>limit (STEL) not to be exceeded during any 15-min work period QSHA: The PEL is 200 ppm averaged over an 8-h workday <u>ACGIH</u>: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>0.173</td><td>0.418</td><td>0.131</td><td>0.472</td><td>limit (STEL) not to be exceeded during any 15-min work period QSHA: The PEL is 200 ppm averaged over an 8-h workday <u>ACGIH</u>: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as</td><td>N N</td></rl<>	0.173	0.418	0.131	0.472	limit (STEL) not to be exceeded during any 15-min work period QSHA: The PEL is 200 ppm averaged over an 8-h workday <u>ACGIH</u> : The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as	N N
									a STEL	
									EPA AEGL-1: 200 ppm over 8 h NIOSH: The recommended airborne exposure limit	N N
Ethyl acetate (141-78-6)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.318</td><td><rl< td=""><td><rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.318</td><td><rl< td=""><td><rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.318</td><td><rl< td=""><td><rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.318</td><td><rl< td=""><td><rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.318</td><td><rl< td=""><td><rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<></td></rl<>	0.318	<rl< td=""><td><rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift</td><td>N</td></rl<>	NICSH: The recommended airborne exposure limit is 400 ppm averaged over a 10-H workshift OSHA: The PEL is 400 ppm averaged over an 8-H workshift	N
(141-70-0)									ACGIH: The recommended airborne exposure limit is 400 ppm averaged over an 8-H workshift	N
Tetrahydrofuran									NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL OSHA: The PEL is 200 ppm averaged over an 8-h	N N
(109-99-9)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.95</td><td><rl< td=""><td>0.197</td><td>workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>1.95</td><td><rl< td=""><td>0.197</td><td>workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>1.95</td><td><rl< td=""><td>0.197</td><td>workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>1.95</td><td><rl< td=""><td>0.197</td><td>workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>1.95</td><td><rl< td=""><td>0.197</td><td>workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<></td></rl<>	1.95	<rl< td=""><td>0.197</td><td>workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL</td><td>N</td></rl<>	0.197	workday ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100 ppm as a STEL	N
Cyclohexane	<rl< td=""><td>0.650</td><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.945</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	0.650	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.945</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.945</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.945</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	0.945	<rl< td=""><td><rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: The REL is 300 ppm averaged over a 10-h workshift OSHA: The PEL is 300 averaged over an 8-h workshift	N N
(110-82-7)	VII.	0.000	3112	3112	1112	0.545	SILE	NIE.	ACGIH: The threshold limit value (TLV®-TWA) is 100 ppm averaged over an 8-h workshift	N
2,2,4-Trimethylpentane (540-84-1)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.130</td><td><rl< td=""><td><rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.130</td><td><rl< td=""><td><rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.130</td><td><rl< td=""><td><rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.130</td><td><rl< td=""><td><rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.130</td><td><rl< td=""><td><rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<></td></rl<>	0.130	<rl< td=""><td><rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday</td><td>N N</td></rl<>	OSHA: The time-weighted average (TWA) exposure limit is 300 ppm over a period of 8 h ACGIH: Recommended airborne exposure limit is 300 ppm averaged over an 8-h workday	N N
Heptane (142-82-5)	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.200</td><td><rl< td=""><td>0.458</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.200</td><td><rl< td=""><td>0.458</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.200</td><td><rl< td=""><td>0.458</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	0.200	<rl< td=""><td>0.458</td><td><rl< td=""><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<></td></rl<>	0.458	<rl< td=""><td><rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<>	NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period	N
Toluene (108-88-3)	<rl< td=""><td><rl< td=""><td>0.700</td><td>0.883</td><td><rl< td=""><td>3.26</td><td><rl< td=""><td>0.216</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.700</td><td>0.883</td><td><rl< td=""><td>3.26</td><td><rl< td=""><td>0.216</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</td><td>N N</td></rl<></td></rl<></td></rl<>	0.700	0.883	<rl< td=""><td>3.26</td><td><rl< td=""><td>0.216</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</td><td>N N</td></rl<></td></rl<>	3.26	<rl< td=""><td>0.216</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</td><td>N N</td></rl<>	0.216	NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift	N N
						-			EPA AEGL-1: 67 ppm over 8 h NIOSH: The REL is 100 ppm averaged over a 10 h	N N
Ethyl Benzene (100-41-4)	<rl< td=""><td><rl< td=""><td>0.227</td><td>0.223</td><td><rl< td=""><td>0.240</td><td><rl< td=""><td><rl< td=""><td>workshift, not to be exceed 125 ppm during any 15- min work period OSHA: 100 ppm over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.227</td><td>0.223</td><td><rl< td=""><td>0.240</td><td><rl< td=""><td><rl< td=""><td>workshift, not to be exceed 125 ppm during any 15- min work period OSHA: 100 ppm over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	0.227	0.223	<rl< td=""><td>0.240</td><td><rl< td=""><td><rl< td=""><td>workshift, not to be exceed 125 ppm during any 15- min work period OSHA: 100 ppm over an 8-h workday</td><td>N</td></rl<></td></rl<></td></rl<>	0.240	<rl< td=""><td><rl< td=""><td>workshift, not to be exceed 125 ppm during any 15- min work period OSHA: 100 ppm over an 8-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>workshift, not to be exceed 125 ppm during any 15- min work period OSHA: 100 ppm over an 8-h workday</td><td>N</td></rl<>	workshift, not to be exceed 125 ppm during any 15- min work period OSHA: 100 ppm over an 8-h workday	N
(100 41 4)									ACGIH: 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 33 ppm over 8 h	N N
m & p-xylene									For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15- min work period	N
(108-88-3) (106-42-3)	<rl< td=""><td><rl< td=""><td>0.823</td><td>0.777</td><td>0.257</td><td>0.835</td><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.823</td><td>0.777</td><td>0.257</td><td>0.835</td><td><rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an</td><td>N N</td></rl<></td></rl<></td></rl<>	0.823	0.777	0.257	0.835	<rl< td=""><td><rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an</td><td>N N</td></rl<>	OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an	N N
									8-h workshift, and 150 ppm as a STEL	
Nonane	 					-			EPA AEGL-1: 130 ppm over 8 h NIOSH: 200 ppm averaged over a 10-h workshift	N N
(111-84-2)	<rl< td=""><td><rl< td=""><td>0.904</td><td>0.643</td><td>0.341</td><td>0.365</td><td>0.243</td><td>0.209</td><td>ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.904</td><td>0.643</td><td>0.341</td><td>0.365</td><td>0.243</td><td>0.209</td><td>ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	0.904	0.643	0.341	0.365	0.243	0.209	ACGIH: 200 ppm averaged over an 8-h workshift	N
									NIOSH: The REL is 50 ppm averaged over a 10-h shift, and the STEL is 100 ppm OSHA: The PEL is 100 ppm averaged over an 8-h	N N
Styrene (100-42-5)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.468</td><td><rl< td=""><td><rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.468</td><td><rl< td=""><td><rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.468</td><td><rl< td=""><td><rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.468</td><td><rl< td=""><td><rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.468</td><td><rl< td=""><td><rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<></td></rl<></td></rl<>	0.468	<rl< td=""><td><rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is</td><td>N</td></rl<>	shift, the STEL is 200 ppm, and the Ceiling limit is 600 ppm for a 5-minute peak in any 3-hour period ACGIH: The TLV*-TWA is 20 ppm averaged over an 8-h shift, and the 15-min short-term exposure limit is	N
									40 ppm EPA AEGL-1 (interim): 20 ppm over 8 h	N
									For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-	N
o-xylene (95-47-6)	<rl< td=""><td><rl< td=""><td>0.327</td><td>0.290</td><td><rl< td=""><td>0.320</td><td><rl< td=""><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.327</td><td>0.290</td><td><rl< td=""><td>0.320</td><td><rl< td=""><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	0.327	0.290	<rl< td=""><td>0.320</td><td><rl< td=""><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<></td></rl<>	0.320	<rl< td=""><td><rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
									ACGIH: The TLV*-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL EPA AEGL-1: 130 ppm over 8 h	N N
1,2,4-Trimethylbenzene	<rl< td=""><td><rl< td=""><td>0.612</td><td>0.583</td><td>0.368</td><td>0.543</td><td>0.333</td><td>0.294</td><td>NIOSH: 25 ppm averaged over a 10-h workday</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.612</td><td>0.583</td><td>0.368</td><td>0.543</td><td>0.333</td><td>0.294</td><td>NIOSH: 25 ppm averaged over a 10-h workday</td><td>N</td></rl<>	0.612	0.583	0.368	0.543	0.333	0.294	NIOSH: 25 ppm averaged over a 10-h workday	N
(95-63-6)	-nL	-nL	0.012	0.000	0.000	0.040	0.000	0.234	EPA AEGL-1: 45 ppm over 8 h	N

(95-63-6)

* Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available

<RL – Below Reporting Limit
ppb – Parts per billion (=0.001 ppm)
ppbV – Parts per billion (=0.001 ppm)
ppm – Parts per million (=1,000 ppb)

The data presented in Table 9 did not reveal exceedances of any recommendation, limit, value or guideline for any of the chemical compounds identified.

Table 10: Summary of Tentatively Identified VOCs and concentrations identified following injection of Skydrol PE-5 (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppl	bV; toluene-equivalent)		
Compound (CAS #)	200°C	250°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
n-butyl methacrylate (97-88-1)	<dl< td=""><td>4.07</td><td>DOE/SCAPA PAC-1: 3.3 ppm</td><td>N</td></dl<>	4.07	DOE/SCAPA PAC-1: 3.3 ppm	N
Triisobutyl phosphate (126-71-06)	3.49	20.24	N/A	N/A
Butylated hydroxytoluene (128-37-0)	<dl< td=""><td>0.29</td><td>NIOSH: Recommended 10 mg/m³ time- weighted average (TWA) airborne exposure limit over a 10-h workshift OSHA: Exposure limit is 10 mg/m³ as a time-weighted average (TWA) over 8 h ACGIH: TWA exposure limit 2 mg/m³</td><td>N N N</td></dl<>	0.29	NIOSH: Recommended 10 mg/m³ time- weighted average (TWA) airborne exposure limit over a 10-h workshift OSHA: Exposure limit is 10 mg/m³ as a time-weighted average (TWA) over 8 h ACGIH: TWA exposure limit 2 mg/m³	N N N
Tributyl phosphate (126-73-8)	2.21	41.83	NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N N
3-cyclopentylpropionic acid, 2-ethylhexyl ester (1000293-47-0)	<dl< td=""><td>1.50</td><td>N/A</td><td>N/A</td></dl<>	1.50	N/A	N/A
Dibutyl phenyl phosphate (2528-36-1)	<dl< td=""><td>0.44</td><td>NIOSH: The REL is 1 ppm averaged over a 10-h workshift, and a STEL of 2 ppm, not to be exceeded during any 15-min work period</td><td>N</td></dl<>	0.44	NIOSH: The REL is 1 ppm averaged over a 10-h workshift, and a STEL of 2 ppm, not to be exceeded during any 15-min work period	N
Heptanoic acid, anhydride (626-27-7)	0.26	1.49	N/A	N/A
2-Tetradecanol octanoate (55193-79-8)	0.17	1.23	N/A	N/A

^{*} Value exceeds a given exposure limit/guideline

The data from Naval Air Warfare Center Aircraft Division presented in Table 10 for the engine stand test performed with Skydrol PE-5 hydraulic fluid did not reveal exceedances of recommendations, limits, values or guidelines for any of the chemical compounds identified.

NC – Not collected, not reported or otherwise not specified N/A – Not available

<DL – Below Detection Limit ppb – Parts per billion (=0.001 ppm)

ppbV – Parts per billion by volume ppm – Parts per million (= 1,000 ppb)

Table 11: Summary of chemicals and concentrations identified following injection of <u>Safewing MP/LFD</u> 88 Dilute (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

				ration (ppbV, ι				202		I
0	Con		Baseline			0°C		260°C		Formata
Compound (CAS#)	Shipping Blank	Field Blank	Inlet	Bleed	Inlet	Bleed	Inlet	Bleed	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
Triisobutyl phosphate	NC	NC	0.0236	0.450	0.0245	0.523	NC	NC	N/A	N/A
(126-71-06)									NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week	N
Tributyl phosphate (126-73-8)	NC	NC	1.23	11.0	0.838	12.2	NC	NC	OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N
Formaldehyde (50-00-0)	<rl< td=""><td>0.332 µg/ sample</td><td>6.03</td><td>9.00</td><td>6.85</td><td>8.25</td><td>NC</td><td>NC</td><td>NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA; Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period</td><td>N</td></rl<>	0.332 µg/ sample	6.03	9.00	6.85	8.25	NC	NC	NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period OSHA; Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm during any 15-min period	N
Acetaldehyde	4DI	4DI	4.00	0.40	4.00	4.00	110	NO	EPA AEGL-1 (interim): 0.90 ppm over 8 h NIOSH: Lowest feasible concentration	 N
(75-07-0)	<rl< td=""><td><rl< td=""><td>1.86</td><td>2.43</td><td>1.96</td><td>4.38</td><td>NC</td><td>NC</td><td>OSHA: 200 ppm averaged over an 8-h workshift ACGIH: Not to exceed 25 ppm (Ceiling) NIOSH: The REL is 250 ppm averaged over a 10-h</td><td>N N N</td></rl<></td></rl<>	<rl< td=""><td>1.86</td><td>2.43</td><td>1.96</td><td>4.38</td><td>NC</td><td>NC</td><td>OSHA: 200 ppm averaged over an 8-h workshift ACGIH: Not to exceed 25 ppm (Ceiling) NIOSH: The REL is 250 ppm averaged over a 10-h</td><td>N N N</td></rl<>	1.86	2.43	1.96	4.38	NC	NC	OSHA: 200 ppm averaged over an 8-h workshift ACGIH: Not to exceed 25 ppm (Ceiling) NIOSH: The REL is 250 ppm averaged over a 10-h	N N N
Acetone (67-64-1)	0.097 µg/ sample	0.262 μg/ sample	3.10	3.51	3.12	4.32	NC	NC	workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the	N N
									short-term exposure limit (STEL) is 500 ppm EPA AEGL-1 (interim): 200 ppm over 8 h ACGIH: The recommended airborne exposure limit	N N
Propionaldehyde (123-38-6)	<rl< td=""><td><rl< td=""><td>1.64</td><td>1.77</td><td>1.72</td><td>1.61</td><td>NC</td><td>NC</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>1.64</td><td>1.77</td><td>1.72</td><td>1.61</td><td>NC</td><td>NC</td><td>is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N N</td></rl<>	1.64	1.77	1.72	1.61	NC	NC	is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h	N N
Crotonaldehyde (4170-30-3)	<rl< td=""><td><rl< td=""><td>2.81</td><td>3.03</td><td>3.14</td><td>2.70</td><td>NC</td><td>NC</td><td>NIQSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday QSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>2.81</td><td>3.03</td><td>3.14</td><td>2.70</td><td>NC</td><td>NC</td><td>NIQSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday QSHA: The PEL is 2 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	2.81	3.03	3.14	2.70	NC	NC	NIQSH: Recommended time-weighted average (TWA) of 2 ppm in the air over a 10-h workday QSHA: The PEL is 2 ppm averaged over an 8-h workshift	N N
									ACGIH: 0.3 ppm, not to be exceeded at any time MEK NIOSH: The REL is 200 ppm averaged over a 10-	N N
Methyl ethyl ketone (MEK) & Butyraldehyde (78-93-3) (123-72-8)	<rl< td=""><td>0.066 μg/ sample</td><td>1.10</td><td>1.61</td><td>1.19</td><td>1.65</td><td>NC</td><td>NC</td><td>h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK.OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK.ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK.AEGL-1; 200 ppm over 8 h Buttyraldehyde OARS WEEL: RECOMMENDED in</td><td>N N N</td></rl<>	0.066 μg/ sample	1.10	1.61	1.19	1.65	NC	NC	h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period MEK.OSHA: The PEL is 200 ppm averaged over an 8-h workday MEK.ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL MEK.AEGL-1; 200 ppm over 8 h Buttyraldehyde OARS WEEL: RECOMMENDED in	N N N
Benzaldehyde									2014 - An 8-h time-weighted average (TWA) of 25 ppm AIHA WEEL: An 8-h time-weighted average (TWA) of	N
(100-52-7)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.638</td><td>NC</td><td>NC</td><td>2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>0.638</td><td>NC</td><td>NC</td><td>2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.638</td><td>NC</td><td>NC</td><td>2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.638</td><td>NC</td><td>NC</td><td>2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>0.638</td><td>NC</td><td>NC</td><td>2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit</td><td>N</td></rl<>	0.638	NC	NC	2 ppm; STEL of 4 ppm over 15-min NIOSH: The recommended airborne exposure limit	N
Valeraldehyde (110-62-3)	0.131 μg/ sample	0.042 µg/ sample	0.703	0.697	0.906	3.44	NC	NC	is 50 ppm averaged over a 10-h workshift <u>ACGIH:</u> The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift	N
m-Tolualdehyde (620-23-5)	<rl< td=""><td><rl< td=""><td>0.653</td><td>0.507</td><td>0.796</td><td>0.490</td><td>NC</td><td>NC</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>0.653</td><td>0.507</td><td>0.796</td><td>0.490</td><td>NC</td><td>NC</td><td>N/A</td><td>N/A</td></rl<>	0.653	0.507	0.796	0.490	NC	NC	N/A	N/A
Hexaldehyde (66-25-1)	<rl< td=""><td><rl< td=""><td>0.409</td><td>0.420</td><td>0.356</td><td>0.395</td><td>NC</td><td>NC</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	<rl< td=""><td>0.409</td><td>0.420</td><td>0.356</td><td>0.395</td><td>NC</td><td>NC</td><td>N/A</td><td>N/A</td></rl<>	0.409	0.420	0.356	0.395	NC	NC	N/A	N/A
Chloromethane (74-87-3)	NC	NC	0.80	<rl< td=""><td>NC</td><td><rl< td=""><td>NC</td><td>NC</td><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<></td></rl<>	NC	<rl< td=""><td>NC</td><td>NC</td><td>OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA</td><td>N N</td></rl<>	NC	NC	OSHA: PEL is 100 ppm over 8 h time-weighted average ACGIH: 50 ppm over 8 h TWA	N N
									NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 250 ppm as STEL during any 15-min period	N
Methanol (67-56-1)	NC	NC	13.5	18.8	NC	19.2	NC	NC	OSHA: The PEL is 200 ppm averaged over an 8-hour workday ACGIH: 200 ppm as an 8-h TLV*-TWA exposure, and 250 ppm as a STEL (with a skin notation)	N N
Acetone	NC	NC	4.37	6.60	NC	7.47	NC	NC	EPA AEGL-1 (Interim): 270 ppm over 8 h NIOSH: The REL is 250 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGH: The threshold limit value-time weighted	N N N
(67-64-1)									ACGIH: Ine threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the STEL is 500 ppm EPA AEGL-1 (interim): 200 ppm over 8 h	N
0.000									NIOSH: The REL is 400 ppm averaged over a 10-h workshift, not to exceed 500 ppm during any 15-min work period	N
2-Propanol (67-63-0)	NC	NC	9.53	<rl< td=""><td>NC</td><td><rl< td=""><td>NC</td><td>NC</td><td>OSHA: The PEL is 400 ppm averaged over an 8-h work shift ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-h work shift, and 400 ppm as a STEL</td><td>N N</td></rl<></td></rl<>	NC	<rl< td=""><td>NC</td><td>NC</td><td>OSHA: The PEL is 400 ppm averaged over an 8-h work shift ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-h work shift, and 400 ppm as a STEL</td><td>N N</td></rl<>	NC	NC	OSHA: The PEL is 400 ppm averaged over an 8-h work shift ACGIH: The recommended airborne exposure limit is 200 ppm averaged over an 8-h work shift, and 400 ppm as a STEL	N N

Carbon disulfide (75-15-0)	NC	NC	<rl< td=""><td>3.66</td><td>NC</td><td><rl< td=""><td>NC</td><td>NC</td><td>NIOSH: The REL is 1 ppm averaged over a 10-h workday, with a maximum of 10 ppm for any 15-min period OSHA: The PEL is 20 ppm averaged over an 8-h workday, with a ceiling of 30 ppm and a maximum peak of 100 ppm for any 30-min period</td><td>N</td></rl<></td></rl<>	3.66	NC	<rl< td=""><td>NC</td><td>NC</td><td>NIOSH: The REL is 1 ppm averaged over a 10-h workday, with a maximum of 10 ppm for any 15-min period OSHA: The PEL is 20 ppm averaged over an 8-h workday, with a ceiling of 30 ppm and a maximum peak of 100 ppm for any 30-min period</td><td>N</td></rl<>	NC	NC	NIOSH: The REL is 1 ppm averaged over a 10-h workday, with a maximum of 10 ppm for any 15-min period OSHA: The PEL is 20 ppm averaged over an 8-h workday, with a ceiling of 30 ppm and a maximum peak of 100 ppm for any 30-min period	N
Vinyl acetate (108-05-4)	NC	<rl< td=""><td><rl< td=""><td><rl< td=""><td>0.162</td><td><rl< td=""><td>NC</td><td>NC</td><td>NIOSH: Recommends a ceiling limit of 4 ppm for a 15-min exposure OSHA: Sets a limit of 10 ppm in workroom air over an 8-h shift and a STEL of 20 ppm for 15-min ACGIH: Recommends a threshold limit (TW*-TWA) of 10 ppm averaged over an 8-h shift and STEL of 15 ppm EPA AEGL-1: 6.7 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>0.162</td><td><rl< td=""><td>NC</td><td>NC</td><td>NIOSH: Recommends a ceiling limit of 4 ppm for a 15-min exposure OSHA: Sets a limit of 10 ppm in workroom air over an 8-h shift and a STEL of 20 ppm for 15-min ACGIH: Recommends a threshold limit (TW*-TWA) of 10 ppm averaged over an 8-h shift and STEL of 15 ppm EPA AEGL-1: 6.7 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>0.162</td><td><rl< td=""><td>NC</td><td>NC</td><td>NIOSH: Recommends a ceiling limit of 4 ppm for a 15-min exposure OSHA: Sets a limit of 10 ppm in workroom air over an 8-h shift and a STEL of 20 ppm for 15-min ACGIH: Recommends a threshold limit (TW*-TWA) of 10 ppm averaged over an 8-h shift and STEL of 15 ppm EPA AEGL-1: 6.7 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	0.162	<rl< td=""><td>NC</td><td>NC</td><td>NIOSH: Recommends a ceiling limit of 4 ppm for a 15-min exposure OSHA: Sets a limit of 10 ppm in workroom air over an 8-h shift and a STEL of 20 ppm for 15-min ACGIH: Recommends a threshold limit (TW*-TWA) of 10 ppm averaged over an 8-h shift and STEL of 15 ppm EPA AEGL-1: 6.7 ppm over 8 h</td><td>N N</td></rl<>	NC	NC	NIOSH: Recommends a ceiling limit of 4 ppm for a 15-min exposure OSHA: Sets a limit of 10 ppm in workroom air over an 8-h shift and a STEL of 20 ppm for 15-min ACGIH: Recommends a threshold limit (TW*-TWA) of 10 ppm averaged over an 8-h shift and STEL of 15 ppm EPA AEGL-1: 6.7 ppm over 8 h	N N
Hexane (110-54-3)	NC	1.77	0.295	0.367	0.148	0.243	NC	NC	NIOSH: The REL is 50 ppm as a TWA over 10-h OSHA: The PEL is 500 ppm as a TWA over 8 h	N N
Methyl ethyl ketone (78-93-3)	NC	<rl< td=""><td>0.161</td><td>0.270</td><td><rl< td=""><td>0.180</td><td>NC</td><td>NC</td><td>OSHA: The PFL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period OSHA: The PFL is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ESHA CGIH: 200 ppm over 8 h</td><td>N N N</td></rl<></td></rl<>	0.161	0.270	<rl< td=""><td>0.180</td><td>NC</td><td>NC</td><td>OSHA: The PFL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period OSHA: The PFL is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ESHA CGIH: 200 ppm over 8 h</td><td>N N N</td></rl<>	0.180	NC	NC	OSHA: The PFL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period OSHA: The PFL is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday ESHA CGIH: 200 ppm over 8 h	N N N
Cyclohexane (110-82-7)	NC	1.01	0.141	<rl< td=""><td><rl< td=""><td>0.172</td><td>NC</td><td>NC</td><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift QSHA: The PEL is 300 averaged over an 8-h workshift ACGLIL: The threshold limit value (TLV*-TWA) is 100 ppm averaged over an 8-h workshift</td><td>N N N</td></rl<></td></rl<>	<rl< td=""><td>0.172</td><td>NC</td><td>NC</td><td>NIOSH: The REL is 300 ppm averaged over a 10-h workshift QSHA: The PEL is 300 averaged over an 8-h workshift ACGLIL: The threshold limit value (TLV*-TWA) is 100 ppm averaged over an 8-h workshift</td><td>N N N</td></rl<>	0.172	NC	NC	NIOSH: The REL is 300 ppm averaged over a 10-h workshift QSHA: The PEL is 300 averaged over an 8-h workshift ACGLIL: The threshold limit value (TLV*-TWA) is 100 ppm averaged over an 8-h workshift	N N N
Heptane (142-82-5)	NC	<rl< td=""><td>0.268</td><td>0.317</td><td>0.104</td><td>0.120</td><td>NC</td><td>NC</td><td>NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period</td><td>N</td></rl<>	0.268	0.317	0.104	0.120	NC	NC	NIOSH: The recommended airborne exposure limit is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period	N
Toluene (108-88-3)	NC	<rl< td=""><td>0.611</td><td>0.797</td><td>0.234</td><td>0.265</td><td>NC</td><td>NC</td><td>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h</td><td>N N</td></rl<>	0.611	0.797	0.234	0.265	NC	NC	NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift EPA AEGL-1: 67 ppm over 8 h	N N
Ethyl benzene (100-41-4)	NC	<rl< td=""><td>0.164</td><td>0.250</td><td><rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>OSHA: Permissible exposure limit: 100 parts per million (ppm) as an average over an 8-hour workday, 40-hour workweek EPA AEGL-1 (interim): 33 ppm over 8 h</td><td>N N</td></rl<></td></rl<></td></rl<>	0.164	0.250	<rl< td=""><td><rl< td=""><td>NC</td><td>NC</td><td>OSHA: Permissible exposure limit: 100 parts per million (ppm) as an average over an 8-hour workday, 40-hour workweek EPA AEGL-1 (interim): 33 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	<rl< td=""><td>NC</td><td>NC</td><td>OSHA: Permissible exposure limit: 100 parts per million (ppm) as an average over an 8-hour workday, 40-hour workweek EPA AEGL-1 (interim): 33 ppm over 8 h</td><td>N N</td></rl<>	NC	NC	OSHA: Permissible exposure limit: 100 parts per million (ppm) as an average over an 8-hour workday, 40-hour workweek EPA AEGL-1 (interim): 33 ppm over 8 h	N N
m & p-xylene (108-88-3) (106-42-3)	NC	<rl< td=""><td>0.575</td><td>0.857</td><td>0.268</td><td>0.291</td><td>NC</td><td>NC</td><td>FEA.RCIC I (Intellin): 35 ppint over a 11-fb rox /xlense: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-min work period QSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL FEA.ACGI-1: 130 ppm over 8 h</td><td>N N N</td></rl<>	0.575	0.857	0.268	0.291	NC	NC	FEA.RCIC I (Intellin): 35 ppint over a 11-fb rox /xlense: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-min work period QSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL FEA.ACGI-1: 130 ppm over 8 h	N N N
Nonane (111-84-2)	NC	<rl< td=""><td>0.557</td><td>0.563</td><td>0.206</td><td>0.185</td><td>NC</td><td>NC</td><td>NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	0.557	0.563	0.206	0.185	NC	NC	NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N N
o-xylene (95-47-6)	NC	<rl< td=""><td>0.234</td><td>0.293</td><td>0.106</td><td>0.117</td><td>NC</td><td>NC</td><td>For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL EPA ACGL-1: 130 ppm over 8 h</td><td>N N N</td></rl<>	0.234	0.293	0.106	0.117	NC	NC	For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-min work period OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL EPA ACGL-1: 130 ppm over 8 h	N N N
1,2,4-Trimethylbenzene	NC	<rl< td=""><td>0.407</td><td>0.493</td><td>0.318</td><td>0.322</td><td>NC</td><td>NC</td><td>NIOSH: 25 ppm averaged over a 10-h workday</td><td>N N</td></rl<>	0.407	0.493	0.318	0.322	NC	NC	NIOSH: 25 ppm averaged over a 10-h workday	N N

(95-63-6) NC CRL

*Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available
<RL – Below Reporting Limit
ppb – Parts per billion (e0.001 ppm)
ppbV – Parts per billion (e1.001 ppm)
ppm – Parts per million (e1.000 ppb)

The data presented in Table 11 for the engine stand test with the deicing fluid did not reveal concentrations that exceeded any recommendations, limits, values or guidelines for the chemical compounds identified.

Table 12: Summary of Tentatively Identified VOCs and concentrations identified following injection of <u>Safewing MP/LFD 88 Dilute</u> (Engine Stand Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppb)	/; toluene-equivalent)		
Compound (CAS #)	200°C	250°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
3-hydroxy-2-butanone (513-86-0)	32.82	NC	For 2-butanone: NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period OSHA: The PEL is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL AEGL-1: 200 ppm over 8 h	N N N
Propylene glycol (57-55-6)	128.4	NC	AIHA WEEL: 3.2 ppm (10 mg/m³) averaged over an 8-h workshift	N
Propylene glycol (57-55-6)	40.99	NC	AIHA WEEL: 3.2 ppm (10 mg/m³) averaged over an 8-h workshift	N
Heptanoic acid, anhydride (626-27-7)	0.59	NC	N/A	N/A

NC - Not collected, not reported or otherwise not specified

N/A – Not available

<DL - Below Detection Limit

ppb - Parts per billion (=0.001 ppm)

ppbV – Parts per billion by volume

The data from Naval Air Warfare Center Aircraft Division identified very few compounds in the bleed air from the deicing fluid injection engine stand test. As shown in Table 12, only three different compounds were identified, one (Heptanoic acid, anhydride CAS # 626-27-7) does not have exposure limits/guidelines developed, the other two, 3-hydroxy-2-butanone (CAS # 513-86-0) and propylene glycol (CAS # 57-55-6) did not exceed their recommendations, limits or guidelines.

Chemicals Identified in Ground-Based On Aircraft Tests

The ground-based aircraft tests were performed with three different fluids: Mobil Jet Oil II (standard oil), Eastman Turbo Oil 2197 (high thermal stability oil), and Skydrol PE-5 (hydraulic fluid).

The following tables (Tables 13-21) describe the chemical compounds identified and their concentrations, exposure limits/guidelines and whether or not (Y/N) the concentrations reported exceeded a given recommendation, limit or guideline, the concentration of which is indicated by an asterisk (*) in the table.

Please note that chemical concentrations are provided in parts per billion by volume (ppbV) whereas exposure limits/guidelines are presented in parts per million (ppm) where 1 ppm is equal to 1,000 ppb.

Table 13: Summary of chemicals and concentrations identified following injection of 5 ppm Mobil Jet Oil II into the APU (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	Fie	eld Blank Cond	centration (pp	bv)	Baseline	(220°C)	22	0°C		Exceeds Exposure Limit/GL (Y/N)
Compound (CAS#)	Ambient Air (APU inlet)	Ozone/ VOC converter (Inlet)	Ozone/ VOC converter (Exit)	Pack Exit	Sample Location	Conc. (ppbv)	Sample Location	Conc. (ppbv)	Exposure Limit/Guideline (GL)	
Tributyl phosphate					Ambient Air (APU inlet)	0.112	Ambient Air (APU inlet)	0.059	NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week OSHA: The permissible exposure limit (PEL) is 0.46	N N
(126-73-8)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.011</td><td>Ozone/ VOC converter (Inlet)</td><td>0.080</td><td>ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.011</td><td>Ozone/ VOC converter (Inlet)</td><td>0.080</td><td>ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h</td><td>N</td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.011</td><td>Ozone/ VOC converter (Inlet)</td><td>0.080</td><td>ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h</td><td>N</td></rl<></td></rl<>	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.011</td><td>Ozone/ VOC converter (Inlet)</td><td>0.080</td><td>ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h</td><td>N</td></rl<>	Ozone/ VOC converter (Inlet)	0.011	Ozone/ VOC converter (Inlet)	0.080	ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N
					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>0.135</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	0.135		
					Pack Exit	0.041	Pack Exit	0.10		
					Ambient Air (APU inlet)	0.011	Ambient Air (APU inlet)	<rl< td=""><td></td><td></td></rl<>		
Tris(2-butoxyethyl) phosphate	0.11	<rl< td=""><td><rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 0.55 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 0.55 ppm</td><td>N</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 0.55 ppm</td><td>N</td></rl<></td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>DOE/SCAPA PAC-1: 0.55 ppm</td><td>N</td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>DOE/SCAPA PAC-1: 0.55 ppm</td><td>N</td></rl<>	DOE/SCAPA PAC-1: 0.55 ppm	N
(78-51-3)	(78-51-3)			Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>			
					Pack Exit	0.037	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td></td><td></td></rl<>		
Tri-m-cresyl phosphate (563-04-02)	<rl< td=""><td><rl< td=""><td><rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.058</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.058</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<></td></rl<>	<rl< td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.058</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl<>	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.058</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.058</td><td>N/A</td><td>N/A</td></rl<>	Ozone/ VOC converter (Inlet)	0.058	N/A	N/A
					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>0.0215</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	0.0215		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.0748</td><td></td><td></td></rl<>	Pack Exit	0.0748		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td></td><td></td></rl<>		
Tri-p-cresyl phosphate (78-32-0)	<rl <rl<="" td=""><td><rl< td=""><td><rl <rl<="" td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.065</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl></td></rl<></td></rl>	<rl< td=""><td><rl <rl<="" td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.065</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl></td></rl<>	<rl <rl<="" td=""><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.065</td><td>N/A</td><td>N/A</td></rl<></td></rl<></td></rl>	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.065</td><td>N/A</td><td>N/A</td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.065</td><td>N/A</td><td>N/A</td></rl<>	Ozone/ VOC converter (Inlet)	0.065	N/A	N/A
v 9/					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>0.0232</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	0.0232		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.0759</td><td></td><td></td></rl<>	Pack Exit	0.0759		

NC – Not collected, not reported or otherwise not specified

N/A – Not available

<RL – Below Reporting Limit ppb – Parts per billion (=0.001 ppm)

ppbV – Parts per billion by volume ppm – Parts per million (= 1,000 ppb)

Only four compounds were identified and quantified in the ground-based on aircraft test following injection of 5 ppmW of Mobil Jet Oil II into the APU. Of those four compounds, two (m- and p-cresyl phosphate) do not have specific exposure limits/guidelines, while the other two did not exceed their recommendation, limit, value or guideline, as shown in Table 13.

Table 14: Summary of chemicals and concentrations identified following injection of <u>10 ppm Mobil Jet Oil II into the APU</u> (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	Fie	eld Blank Con	centration (pp	bV)	Baseline	e (220°C)	22	0°C	1	
Compound (CAS#)	Ambient Air (APU inlet)	Ozone/ VOC converter (Inlet)	Ozone/ VOC converter (Exit)	Pack Exit	Sample Location	Conc. (ppbV)	Sample Location	Conc. (ppbV)	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
					Ambient Air (APU inlet) Ozone/ VOC	NC	Ambient Air (APU inlet) Ozone/ VOC	NC	NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m²) averaged over an 8-h workshift	N N
Tributyl phosphate (126-73-8)	<rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>converter (Inlet) </td><td>NC</td><td>converter (Inlet) Ozone/ VOC</td><td>0.07</td><td>ACGIH: 0.2 ppm averaged over 8 h</td><td>N</td></rl<>	NC	NC	NC	converter (Inlet) 	NC	converter (Inlet) Ozone/ VOC	0.07	ACGIH: 0.2 ppm averaged over 8 h	N
					converter (Exit) Pack Exit	NC NC	converter (Exit) Pack Exit	<rl 0.036</rl 		
					Ambient Air (APU inlet) Ozone/	NC	Ambient Air (APU inlet) Ozone/	NC		
Tri-m-cresyl phosphate (563-04-02)	<rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>VOC converter (Inlet) Ozone/</td><td>NC</td><td>VOC converter (Inlet) Ozone/</td><td>0.70</td><td>N/A</td><td>N/A</td></rl<>	NC	NC	NC	VOC converter (Inlet) Ozone/	NC	VOC converter (Inlet) Ozone/	0.70	N/A	N/A
					VOC converter (Exit)	NC NC	VOC converter (Exit) Pack Exit	0.112		
					Ambient Air (APU inlet)	NC	Ambient Air (APU inlet)	NC		
Tri-p-cresyl phosphate	<rl< td=""><td>NC</td><td>NC</td><td>NC</td><td>Ozone/ VOC converter (Inlet)</td><td>NC</td><td>Ozone/ VOC converter (Inlet)</td><td>0.78</td><td>N/A</td><td>N/A</td></rl<>	NC	NC	NC	Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	0.78	N/A	N/A
(78-32-0)					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	0.200		
					Pack Exit	NC	Pack Exit	0.298		
					Ambient Air (APU inlet) Ozone/	NC	Ambient Air (APU inlet) Ozone/	0.276	NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period	N
Methyl ethyl ketone (78-93-3)	NC	NC	NC	NC	VOC converter (Inlet)	NC	VOC converter (Inlet)	1.10	OSHA: The PEL is 200 ppm averaged over an 8-h workday ACGIH: The recommended exposure limit is 200	N N
					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	8.30	ppm averaged over an 8-h workday, and 300 ppm as a STEL EPA AEGL-1: 200 ppm over 8 h	N
					Pack Exit Ambient	NC	Pack Exit Ambient	4.64	NIOSH: The recommended airborne exposure limit	N
					Air (APU inlet) Ozone/	NC	Air (APU inlet) Ozone/	0.178	is 85 ppm averaged over a 10-h workshift, not to exceed 440 ppm during any 15-min work period	
Heptane (142-82-5)	NC	NC	NC	NC	VOC converter (Inlet)	NC	VOC converter (Inlet)	<rl< td=""><td></td><td></td></rl<>		
					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>		
					Pack Exit Ambient	NC	Pack Exit Ambient	<rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h</td><td>N</td></rl<>	NIOSH: The REL is 1 ppm as a TWA over 10 h	N
					Air (APU inlet) Ozone/	NC	Air (APU inlet) Ozone/	<rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N</td></rl<>	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
2-Hexanone (591-78-6)	NC	NC	NC	NC	VOC converter (Inlet)	NC	VOC converter (Inlet) Ozone/	0.256		
					VOC converter (Exit)	NC	VOC converter (Exit)	1.19		
					Pack Exit Ambient	NC	Pack Exit Ambient	0.923	For Xylenes:	
					Air (APU inlet) Ozone/	NC	Air (APU inlet) Ozone/	0.330	NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15- min work period	N
m & p-Xylene (108-88-3) (106-42-3)	NC	NC	NC	NC	VOC converter (Inlet)	NC	VOC converter (Inlet)	<rl< td=""><td>OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL</td><td>N N</td></rl<>	OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV®-TWA is 100 ppm averaged over an 8-h workshift, and 150 ppm as a STEL	N N
					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	<rl< td=""><td>EPA AEGL-1: 130 ppm over 8 h</td><td>N</td></rl<>	EPA AEGL-1: 130 ppm over 8 h	N
Nonono	-				Pack Exit Ambient	NC	Pack Exit Ambient	<rl< td=""><td>NIOSH: 200 ppm averaged over a 10-h workshift</td><td>N</td></rl<>	NIOSH: 200 ppm averaged over a 10-h workshift	N
Nonane (111-84-2)	NC	NC	NC	NC	Air (APU inlet)	NC	Air (APU inlet)	1.14	ACGIH: 200 ppm averaged over an 8-h workshift	N

					Ozone/ VOC converter (Inlet) Ozone/ VOC converter (Exit)	NC NC	Ozone/ VOC converter (Inlet) Ozone/ VOC converter (Exit)	0.193 <rl< th=""><th></th><th></th></rl<>		
					Pack Exit	NC	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (APU inlet)	NC	Ambient Air (APU inlet)	0.175	For Xylenes: NIOSH: The REL is 100 ppm averaged over a 10-h workshift, and not to exceed 150 ppm during any 15-	N
o-Xylene (95-47-6)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>min work period QSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an</td><td>N N</td></rl<>	min work period QSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: The TLV*-TWA is 100 ppm averaged over an	N N
(33-47-0)					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	<rl< td=""><td>8-h workshift, and 150 ppm as a STEL EPA AEGL-1: 130 ppm over 8 h</td><td>N</td></rl<>	8-h workshift, and 150 ppm as a STEL EPA AEGL-1: 130 ppm over 8 h	N
					Pack Exit	NC	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (APU inlet)	NC	Ambient Air (APU inlet)	0.552	NIOSH: 25 ppm averaged over a 10-h workday EPA AEGL-1: 45 ppm over 8 h	N N
1,2,4-Trimethylbenzene (95-63-6)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td></td><td></td></rl<>		
(55-05-0)					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>		
* Value evocede a given evoce					Pack Exit	NC	Pack Exit	<rl< td=""><td></td><td></td></rl<>		

^{*} Value exceeds a given exposure limit/guideline

The data presented from the on aircraft test with injection of 10 ppmW Mobil Jet Oil II into the APU (Table 14) did not reveal exceedances of any recommendations, limits, values or guidelines for the chemical compounds identified.

Table 15: Summary of Tentatively Identified VOCs and concentrations identified following injection of Mobil Jet Oil II into the APU (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppl	bV; toluene-equivalent)		
Compound (CAS #)	180°C (5 ppmW injected)	180°C (10 ppmW injected)	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
Acetone (67-64-1)	2.9	2.0	NIOSH: The REL is 250 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	N N N
Methacrolein (78-85-3)	2.6	4.4	EPA AEGL-1 (interim): 200 ppm over 8 h DOE/SCAPA PAC-1: 0.20 ppm	N N
Butanal (123-72-8)	6.2	4.6	OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	N
Acetic acid (64-19-7)	25.4	17.3	NIOSH: The REL is 10 ppm averaged over a 10-h workshift, not to exceed 15 ppm during any 15-min work period OSHA: The PEL is 10 ppm over an 8-h workshift ACGIH: The TLV®-TWA is 10 ppm for an 8-h workday, and 15 ppm for periods not exceeding 15 min	N N N
Pentanal (110-62-3)	7.2	8.1	N/A	N/A
Butanoic acid (107-92-6)	4.1	3.0	DOE/SCAPA PAC-1: 1.7 ppm	N

NC - Not collected, not reported or otherwise not specified

N/A – Not available <RL – Below Reporting Limit

ppb – Parts per billion (=0.001 ppm) ppbV – Parts per billion by volume

ppm – Parts per million (= 1,000 ppb)

			NIOSH: The REL is 1 ppm as a TWA over 10	N
2-Hexanone (591-78-6)	1.9	2.1	h OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
Butynediol (110-65-6)	12.8	30.0	DOE/SCAPA PAC-1: 0.31 ppm	N
Hexanal (66-25-1)	10.9	14.5	DOE/SCAPA PAC-1: 1.3 ppm	N
2-Methylbutanoic acid (116-53-0)	58.2	102.3	N/A	N/A
Heptanal (111-71-7)	4.0	8.3	N/A	N/A
Pentanoic acid (109-52-4)	136.3	347.5	DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm	N
2(3H)-Furanone, dihydro-5- methyl- (108-29-2)	2.4	2.2	N/A	N/A
Hexanoic acid (142-62-1)	15.0	20.8	DOE/SCAPA PAC-1: 0.46 ppm	N
Octanal (124-13-0)	1.9	2.7	DOE/SCAPA PAC-1: 3.2 ppm	N
2-Methylhexanoic acid (4536-23-6)	5.4	6.2	N/A	N/A
			DOE/SCAPA PAC-1: For all isomers of cresol, 14 ppm For p-cresol:	N
p/m/o-cresol (1319-77-3)	7.5	20.7	NIOSH: The REL is 2.3 ppm averaged over a 10-h workday	N
			OSHA: The PEL is 5 ppm averaged over an 8-h workshift	N
			ACGIH: Recommends an airborne exposure limit of 5 ppm averaged over an 8-h workday	N
Heptanoic acid (111-14-8)	160.7	515.8	DOE/SCAPA PAC-1: 3.9 ppm	N
Nonanal (124-19-6)	3.0	3.8	DOE/SCAPA PAC-1: 2.6 ppm	N
2(3H)-Furanone, dihydro-5- propyl- (105-21-5)	3.3	2.8	N/A	N/A
3,5,5-Trimethylhexanoic acid (3302-10-1)	<dl< td=""><td>14.6</td><td>N/A</td><td>N/A</td></dl<>	14.6	N/A	N/A
Octanoic acid (124-07-2)	64.0	139.5	DOE/SCAPA PAC-1: 5.1 ppm	N
3,5-Dimethyl-4-heptanone (19549-84-9)	10.0	32.5	For 4-heptanone: NIOSH: 50 ppm averaged over a 10-h workshift ACGIH: 50 ppm averaged over an 8-h	N N
			workshift	IN .
Allyl isovalerate (2835-39-4)	12.5	44.0	N/A	N/A
2(3H)-Furanone, 5- butyldihydro- (104-50-7)	1.5	1.2	N/A	N/A
Nonanoic acid (112-05-0)	1.0	7.9	DOE/SCAPA PAC-1: 2.3 ppm	N
Decanoic acid (334-48-5)	24.0	34.3	N/A	N/A
Allyl heptanoate (142-19-8)	10.8	49.4	N/A	N/A
Allyl octanoate (4230-97-1)	5.7	11.0	N/A	N/A
Allyl decanoate (57856-81-2)	<dl< td=""><td>3.8</td><td>N/A</td><td>N/A</td></dl<>	3.8	N/A	N/A
N-phenyl-1-naphthalenamine (90-30-2)	<dl< td=""><td>3.8</td><td>N/A</td><td>N/A</td></dl<>	3.8	N/A	N/A
* Value exceeds a given exposure limit/guideline		1		

<sup>Yolue exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available
OL – Below Detection Limit
ppb – Parts per billion (=0.001 ppm)
ppbV – Parts per billion by volume
ppm – Parts per million (=1,000 ppb)
ppmW – Parts per million by weight</sup>

Data from Naval Air Warfare Center Aircraft Division identifying compounds found in the on aircraft test with Mobil Jet Oil II identified a number of chemical compounds for which there are no specified exposure recommendation, limit or guideline (Table 15). For those compounds that did have exposure recommendations, limits or guidelines, none were exceeded.

Table 16: Summary of chemicals and concentrations identified following injection of <u>Mobil Jet Oil II into the Engine</u> (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

Compound (CAS #)	Ambient Air (APU inlet)	Ozone/ VOC converter (Inlet)	Ozone/ VOC converter	Pack Exit	Sample	(315°C) Conc.	Sample	e (315°C) Conc.	Exposure Limit/Guideline (GL)	Exceeds
Tributyl phosphate			(Exit)		Location	(ppbV)	Location	(ppbV)	Exposure Ellino Guideane (GE)	Exposure Limit/GL
Tributyl phosphate					Ambient Air (APU inlet)	0.007	Ambient Air (APU inlet)	NC	NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week	(Y/N) N
(126-73-8)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h</td><td>N N</td></rl<>	OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift ACGIH: 0.2 ppm averaged over 8 h	N N
(120-73-8)					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>NC</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	NC		
					Pack Exit	0.022	Pack Exit	0.023		
					Ambient Air (APU inlet)	0.012	Ambient Air (APU inlet)	NC		
Tri-m-cresyl phosphate	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	0.034	N/A	N/A
(563-04-02)					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>NC</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	NC		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.055</td><td></td><td></td></rl<>	Pack Exit	0.055		
					Ambient Air (APU inlet)	0.021	Ambient Air (APU inlet)	NC		
Tri-p-cresyl phosphate (78-32-0)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	0.044	N/A	N/A
(76-32-0)					Ozone/ VOC converter (Exit)	0.005	Ozone/ VOC converter (Exit)	NC		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.052</td><td></td><td></td></rl<>	Pack Exit	0.052		
					Ambient Air	2.91	Ambient Air	4.25	NIOSH: The recommended airborne exposure limit (REL) is 0.016 ppm averaged over a 10-h workshift,	Y
					(APU inlet) Ozone/ VOC	7.20	(APU inlet) Ozone/ VOC	14.3	and no more than 0.1 ppm during any 15-min period OSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm	N
Formaldehyde (50-00-0)	NC	NC	NC	NC	converter (Inlet) Ozone/		converter (Inlet) Ozone/	50.44	during any 15-min period <u>EPA AEGL-1 (interim)</u> : 0.90 ppm over 8 h	N
					VOC converter (Exit)	27.4* 21.9*	VOC converter (Exit)	58.1* 72.5*		
					Pack Exit Ambient		Pack Exit Ambient		NIOSH: Lowest feasible concentration	
					Air (APU inlet) Ozone/	1.51	Air (APU inlet) Ozone/	1.64	OSHA: 200 ppm averaged over an 8-h workshift ACGIH: Not to exceed 25 ppm (Ceiling)	N N
Acetaldehyde (75-07-0)	NC	NC	NC	NC	VOC converter (Inlet)	2.41	VOC converter (Inlet)	7.56		
					Ozone/ VOC converter (Exit)	12.7	Ozone/ VOC converter (Exit)	40.0		
					Pack Exit	11.3	Pack Exit	28.9		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period</td><td>N</td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period</td><td>N</td></rl<>	NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min period	N
Acrolein	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time</td><td>N N</td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time</td><td>N N</td></rl<>	OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit is 0.1 ppm, not to be exceeded at any time	N N
(107-02-8)	-				Ozone/ VOC converter	0.597	Ozone/ VOC converter	1.03	EPA AEGL-1: 0.030 ppm over 8 h	N
					(Exit)	<rl< td=""><td>(Exit) Pack Exit</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	(Exit) Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Pack Exit Ambient Air		Ambient Air		NIOSH: The REL is 250 ppm averaged over a 10-h	N
					(APU inlet) Ozone/	3.48	(APU inlet) Ozone/	1.82	workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N
Acetone (67-64-1)	NC	NC	NC	NC	VOC converter (Inlet)	3.54	VOC converter (Inlet)	1.84	ACGIH: The threshold limit value-time weighted average (TLV®-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	N
					Ozone/ VOC converter (Exit)	5.50	Ozone/ VOC converter (Exit)	5.03	EPA AEGL-1 (interim): 200 ppm over 8 h	N

					Ambient Air (APU inlet)	0.696	Ambient Air (APU inlet)	1.47	ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift EPA AEGL-1 (interim): 45 ppm over 8 h	N N
Propionaldehyde					Ozone/ VOC converter	1.02	Ozone/ VOC converter	3.73	ETA NECE T (Intellin). 40 ppm over 611	
(123-38-6)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC converter	1.92	Ozone/ VOC	10.6		
					(Exit)		(Exit)			
					Pack Exit Ambient	2.70	Pack Exit Ambient	11.0	NIOSH: Recommended time-weighted average	N
					Air (APU inlet)	2.32	Air (APU inlet)	4.38	(TWA) of 2 ppm in the air over a 10-h workday.	
					Ozone/		Ozone/		OSHA: The PEL is 2 ppm averaged over an 8-h workshift	N
Crotonaldehyde	NC	NC	NC	NC	VOC converter (Inlet)	0.311	VOC converter (Inlet)	3.00	ACGIH: 0.3 ppm, not to be exceeded at any time	N
(4170-30-3)	NO	NC	NC	NO	Ozone/		Ozone/			
					VOC converter	0.675	VOC converter	1.66		
					(Exit) Pack Exit	4.49	(Exit) Pack Exit	5.05		
					Ambient		Ambient			
					(APU inlet)	0.474	(APU inlet)	1.08		
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td></td><td></td></rl<>		
Methacrolein (78-85-3)	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		DOE/SCAPA PAC-1: 0.20 ppm	N
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td>1.76</td><td></td><td></td></rl<>	Ozone/ VOC	1.76		
					converter (Exit)		converter (Exit)			
					Pack Exit	0.640	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (APU inlet)	1.35	Ambient Air (APU inlet)	0.793	MEK NIOSH: The REL is 200 ppm averaged over a 10- h workday, and 300 ppm as a short-term exposure	N
					Ozone/		Ozone/		limit (STEL) not to be exceeded during any 15-min work period	
Methyl ethyl ketone					VOC converter	1.13	VOC converter	2.64	MEK OSHA: The PEL is 200 ppm averaged over an 8- h workday	N
(MEK) & Butyraldehyde (78-93-3)	NC	NC	NC	NC	(Inlet) Ozone/		(Inlet) Ozone/		MEK ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300	N
(123-72-8)					VOC converter	3.35	VOC converter	14.8	ppm as a STEL	N
					(Exit)		(Exit)		MEK EPA AEGL-1: 200 ppm over 8 h Butyraldehyde OARS WEEL: RECOMMENDED in	N N
					Pack Exit	3.44	Pack Exit	7.85	2014 - An 8-h time-weighted average (TWA) of 25 ppm	
					Ambient Air	0.934	Ambient Air	0.772	NIOSH: The recommended airborne exposure limit is 50 ppm averaged over a 10-h workshift	N
					(APU inlet) Ozone/		(APU inlet) Ozone/		ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workshift	N
Valeraldehyde					VOC converter	0.926	VOC converter	3.11		
(110-62-3)	NC	NC	NC	NC	(Inlet) Ozone/		(Inlet) Ozone/			
					VOC converter	1.51	VOC converter	3.91		
					(Exit)		(Exit)			
					Pack Exit Ambient	1.45	Pack Exit Ambient	6.02		
					Air (APU inlet)	<rl< td=""><td>Air (APU inlet)</td><td>0.546</td><td></td><td></td></rl<>	Air (APU inlet)	0.546		
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td></td><td></td></rl<>		
m-Tolualdehyde (620-23-5)	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		N/A	N/A
(020-20-0)					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td></td><td></td></rl<>		
					converter (Exit)	\nL	converter (Exit)	\nL		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (ABIL inlot)	<rl< td=""><td>Ambient Air (ABILiplot)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ambient Air (ABILiplot)	<rl< td=""><td></td><td></td></rl<>		
					(APU inlet) Ozone/		(APU inlet) Ozone/			
Hexaldehyde					VOC converter	<rl< td=""><td>VOC converter</td><td>0.695</td><td></td><td></td></rl<>	VOC converter	0.695		
(66-25-1)	NC	NC	NC	NC	(Inlet) Ozone/		(Inlet) Ozone/		N/A	N/A
					VOC converter	0.338	VOC converter	3.34		
					(Exit)	-5.	(Exit)			
			 	 	Pack Exit Ambient	<rl< td=""><td>Pack Exit Ambient</td><td>3.04</td><td>NIOSH: The REL is 200 ppm averaged over a 10-h</td><td>N</td></rl<>	Pack Exit Ambient	3.04	NIOSH: The REL is 200 ppm averaged over a 10-h	N
					Air (APU inlet)	0.523	Air (APU inlet)	0.565	workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min	
					Ozone/ VOC	0.585	Ozone/ VOC	2.15	work period OSHA: The PEL is 200 ppm averaged over an 8-h	N
Methyl ethyl ketone (78-93-3)	NC	NC	NC	NC	converter (Inlet)	2.300	converter (Inlet)		workday ACGIH: The recommended exposure limit is 200	N
(10-30-0)					Ozone/ VOC	2.22	Ozone/ VOC	<rl< td=""><td>ppm averaged over an 8-h workday, and 300 ppm as</td><td>N</td></rl<>	ppm averaged over an 8-h workday, and 300 ppm as	N
					converter (Exit)	2.22	converter (Exit)	\r\L	a STEL EPA AEGL-1: 200 ppm over 8 h	N
			<u> </u>		Pack Exit	2.61	Pack Exit	7.35		
	•	•	•	•	•	•	•	•		

					Ambient Air (APU inlet)	<rl< th=""><th>Ambient Air (APU inlet)</th><th><rl< th=""><th>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</th><th>N N</th></rl<></th></rl<>	Ambient Air (APU inlet)	<rl< th=""><th>NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift</th><th>N N</th></rl<>	NIOSH: The REL is 100 ppm as a TWA over 10 h OSHA: The PEL is 200 ppm averaged over an 8- workshift	N N
Toluene (108-88-3)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>EPA AEGL-1: 67 ppm over 8 h</td><td>N</td></rl<>	EPA AEGL-1: 67 ppm over 8 h	N
(100-00-3)					Ozone/ VOC converter (Exit)	0.744	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N N
2-Hexanone (591-78-6)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td>0.453</td><td></td><td></td></rl<>	Ozone/ VOC converter (Inlet)	0.453		
(Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.965</td><td></td><td></td></rl<>	Pack Exit	0.965		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N N
Nonane (111-84-2)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td></td><td></td></rl<>		
(111-04-2)					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.260</td><td></td><td></td></rl<>	Pack Exit	0.260		

As seen in Table 16, formaldehyde (CAS # 50-00-0) was again quantified at levels that technically exceed the NIOSH recommended exposure limit (REL) of 0.016 ppm (16 ppb), if the concentrations measured here (22-73 ppbV) were maintained over a 10-h duration. Of note, the concentrations of formaldehyde identified here do not exceed OSHA's PEL (0.75 ppm (750 ppb) over 8 h) or the EPA's AEGL-1 value (0.90 ppm (900 ppb) over 8h).

This finding will be further elaborated within the "Discussion" section.

Table 17: Summary of Tentatively Identified VOCs and concentrations identified following injection of Mobil Jet Oil II into the Engine (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppb	V; toluene-equivalent)		
Compound (CAS #)	220°C	315°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
			NIOSH: The REL is 250 ppm averaged over a 10-h workshift	N
Acetone			OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N
(67-64-1)	1.7	2.3	ACGIH: The threshold limit value-time weighted average (TLV®-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	N
			EPA AEGL-1 (interim): 200 ppm over 8 h	N
Methacrolein (78-85-3)	0.8	1.4	DOE/SCAPA PAC-1: 0.20 ppm	N
Butanal (123-72-8)	1.1	5.0	OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	N
2-Butanone (78-93-3)	2.8	8.9	NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min work period	N
			OSHA: The PEL is 200 ppm averaged over an 8-h workday	N

NC - Not collected, not reported or otherwise not specified

<RL - Below Reporting Limit

ppb – Parts per billion (=0.001 ppm) ppbV - Parts per billion by volume

ppm – Parts per million (= 1,000 ppb)

			ACGIH: The recommended exposure limit is	N
			200 ppm averaged over an 8-h workday, and 300 ppm as a STEL EPA AEGL-1: 200 ppm over 8 h	N
			NIOSH: The REL is 10 ppm averaged over a 10-h workshift, not to exceed 15 ppm during any 15-min work period	N
Acetic acid (64-19-7)	6.5	15.6	OSHA: The PEL is 10 ppm over an 8-h workshift	N
			ACGIH: The TLV®-TWA is 10 ppm for an 8-h workday, and 15 ppm for periods not exceeding 15 min	N
Pentanal (110-62-3)	2.2	3.7	N/A	N/A
Butanoic acid (107-92-6)	1.2	4.5	DOE/SCAPA PAC-1: 1.7 ppm	N
Butynediol (110-65-6)	7.5	6.8	DOE/SCAPA PAC-1: 0.31 ppm	N
Hexanal (66-25-1)	4.2	5.6	DOE/SCAPA PAC-1: 1.3 ppm	N
2-Methylbutanoic acid (116-53-0)	33.4	50.3	N/A	N/A
Pentanoic acid (109-52-4)	73.3	118.9	DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm	N
Heptanal (111-71-7)	0.9	2.21	N/A	N/A
2(3H)-Furanone, dihydro-5- methyl- (108-29-2)	1.1	2.2	N/A	N/A
Hexanoic acid (142-62-1)	6.5	7.2	DOE/SCAPA PAC-1: 0.46 ppm	N
2-Methylhexanoic acid (4536-23-6)	2.1	2.2	N/A	N/A
p/m/o-cresol	10.2	5.4	DOE/SCAPA PAC-1: For all isomers of cresol, 14 ppm For p-cresol: NIOSH: The REL is 2.3 ppm averaged over a 10-h workday OSHA: The PEL is 5 ppm averaged over an 8-h workshift ACGIH: Recommends an airborne exposure	N N N
Heptanoic acid	96.0	152.7	limit of 5 ppm averaged over an 8-h workday DOE/SCAPA PAC-1: 3.9 ppm	N
(111-14-8) Nonanal	0.6	0.9	DOE/SCAPA PAC-1: 2.6 ppm	N
(124-19-6) 2(3H)-Furanone, dihydro-5- propyl- (105-21-5)	1.4	2.5	N/A	N/A
Octanoic acid (124-07-2)	32.6	41.8	DOE/SCAPA PAC-1: 5.1 ppm	N
3,5-Dimethyl-4-heptanone (19549-84-9)	6.3	9.3	For 4-heptanone: NIOSH: 50 ppm averaged over a 10-h workshift	N
,			ACGIH: 50 ppm averaged over an 8-h workshift	N
Allyl isovalerate (2835-39-4)	8.4	12.7	N/A	N/A
Decanoic acid (334-48-5)	9.2	12.7	N/A	N/A
Allyl heptanoate (142-19-8)	7.7	11.4	N/A	N/A
Allyl octanoate (4230-97-1)	3.3	1.8	N/A	N/A
Allyl decanoate (57856-81-2)	1.1	<dl< td=""><td>N/A</td><td>N/A</td></dl<>	N/A	N/A

<sup>(57856-81-2)

*</sup>Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available

OL – Below Detection Limit
ppb – Parts per billion (=0.001 ppm)
ppbV – Parts per billion by volume
ppm – Parts per million (= 1,000 ppb)

The data from Naval Air Warfare Center Aircraft Division presented in Table 17 did not reveal exceedances of any recommendation, limit, value or guideline for any of the chemical compounds identified from injection of Mobil Jet Oil II into the engine for the on aircraft test.

Table 18: Summary of chemicals and concentrations identified following injection of <u>Eastman Turbo Oil 2197 into the Engine</u> (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	Ei.	eld Blank Con	centration (nn	hV)	Rocolin	e (315°C)	#3 Engin	e (315°C)	-	
Compound (CAS#)	Ambient Air (APU inlet)	Ozone/ VOC converter (Inlet)	Ozone/ VOC converter (Exit)	Pack Exit	Sample Location	Conc. (ppbV)	Sample Location	Conc. (ppbV)	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL
		(inter)	(EXIL)						NICON A CONTRACTOR OF THE CONT	(Y/N)
					Ambient Air	NC	Ambient Air	NC	NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week	N
					(APU inlet)		(APU inlet)		OSHA: The permissible exposure limit (PEL) is 0.46	N
					Ozone/ VOC	0.128	Ozone/ VOC	0.0127	ppm (5 mg/m³) averaged over an 8-h workshift <u>ACGIH</u> : 0.2 ppm averaged over 8 h	N
Tributyl phosphate	NO	NO	NO	NO	converter	0.120	converter	0.0127	ACGIT. 0.2 ppm averaged over 6 m	IN .
(126-73-8)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td></td><td></td></rl<>		
					converter (Exit)		converter (Exit)			
						0.0483		0.0614		
					Pack Exit Ambient	0.0463	Pack Exit Ambient	0.0614		
					Air (APU inlet)	NC	Air (APU inlet)	NC		
					Ozone/		Ozone/			
					voc	<rl< td=""><td>voc</td><td>0.3530</td><td></td><td></td></rl<>	voc	0.3530		
Tri-m-cresyl phosphate	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		N/A	N/A
(563-04-02)					Ozone/		Ozone/			
					voc	<rl< td=""><td>voc</td><td>0.0087</td><td></td><td></td></rl<>	voc	0.0087		
					converter (Exit)		converter (Exit)			
					Pack Exit	0.0100	Pack Exit	0.0515		
					Ambient		Ambient			
					Air (APU inlet)	NC	Air (APU inlet)	NC		
					Ozone/		Ozone/			
					voc	<rl< td=""><td>voc</td><td>0.3836</td><td></td><td></td></rl<>	voc	0.3836		
Tri-p-cresyl phosphate	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		N/A	N/A
(78-32-0)					Ozone/		Ozone/			
					voc	<rl< td=""><td>voc</td><td>0.0094</td><td></td><td></td></rl<>	voc	0.0094		
					converter (Exit)		converter (Exit)			
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.0505</td><td></td><td></td></rl<>	Pack Exit	0.0505		
					Ambient		Ambient Air		NIOSH: The recommended airborne exposure limit	Υ
					Air (APU inlet)	NC	(APU inlet)	1.41	(REL) is 0.016 ppm averaged over a 10-h workshift, and no more than 0.1 ppm during any 15-min period	
					Ozone/		Ozone/		OSHA: Permissible exposure limit (PEL) is 0.75 ppm	N
					VOC converter	6.87	VOC converter	8.40	averaged over an 8-h workshift, not to exceed 2 ppm	
Formaldehyde (50-00-0)	NC	NC	NC	NC	(Inlet)		(Inlet)		during any 15-min period <u>EPA AEGL-1 (interim)</u> : 0.90 ppm over 8 h	N
(55 55 5)					Ozone/		Ozone/		=	
					VOC	33.8*	VOC converter	97.8*		
					(Exit)		(Exit)			
					Pack Exit	1.38	Pack Exit	NC		
					Ambient Air	NC	Ambient Air	<rl< td=""><td>NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: Lowest feasible concentration OSHA: 200 ppm averaged over an 8-h workshift	N N
					(APU inlet)	INC	(APU inlet)	\nL	ACGIH: Not to exceed 25 ppm (Ceiling)	N N
					Ozone/		Ozone/			
Acetaldehyde					VOC converter	2.14	VOC converter	2.54		
(75-07-0)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC	0.61	Ozone/ VOC	20.0		
					converter	9.61	converter	28.0		
					(Exit)		(Exit)			
	1	-		-	Pack Exit Ambient	0.422	Pack Exit Ambient	NC	NIOCH, The DELie O. 1 ppg	
					Air	NC	Air	<rl< td=""><td>NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min</td><td>N</td></rl<>	NIOSH: The REL is 0.1 ppm averaged over a 10-h workshift, not to exceed 0.3 ppm during any 15-min	N
					(APU inlet)		(APU inlet)		period	
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td>OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit</td><td>N N</td></rl<>	OSHA: The PEL is 0.1 ppm averaged over 8 h ACGIH: The recommended airborne exposure limit	N N
Acrolein		NO	NO	NO.	converter (Inlet)	-nL	converter (Inlet)	-nL	is 0.1 ppm, not to be exceeded at any time	
(107-02-8)	NC	NC	NC	NC					EPA AEGL-1: 0.030 ppm over 8 h	N
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td>1.94</td><td></td><td></td></rl<>	Ozone/ VOC	1.94		
					converter (Exit)	"-	converter (Exit)			
						<rl< td=""><td></td><td>NC</td><td></td><td></td></rl<>		NC		
	1				Pack Exit Ambient	- TIL	Pack Exit Ambient	110	NIOSH: The REL is 250 ppm averaged over a 10-h	N
					Air (APU inlet)	NC	Air (APU inlet)	3.35	workshift	
									OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift	N
					Ozone/ VOC	3.74	Ozone/ VOC	4.07	ACGIH: The threshold limit value-time weighted	N
Acetone	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		average (TLV®-TWA) concentration is 250 ppm; the	
(67-64-1)	1				Ozone/		Ozone/		short-term exposure limit (STEL) is 500 ppm <u>EPA AEGL-1 (interim)</u> : 200 ppm over 8 h	N
					voc	2.50	voc	4.39	<u></u>	"
					converter (Exit)		converter (Exit)			
						1.97		NC		
	l	<u> </u>	l	1	Pack Exit	1.97	Pack Exit	NC		L

					Ambient Air (APU inlet)	NC	Ambient Air (APU inlet)	<rl< td=""><td>ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift	N N
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td>0.793</td><td>EPA AEGL-1 (interim): 45 ppm over 8 h</td><td>N</td></rl<>	Ozone/ VOC	0.793	EPA AEGL-1 (interim): 45 ppm over 8 h	N
Propionaldehyde (123-38-6)	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)			
					Ozone/ VOC	1.57	Ozone/ VOC	10.6		
					(Exit)		(Exit)			
					Pack Exit Ambient	<rl< td=""><td>Pack Exit Ambient</td><td>NC</td><td>NIOSH: Recommended time-weighted average</td><td>N</td></rl<>	Pack Exit Ambient	NC	NIOSH: Recommended time-weighted average	N
					Air (APU inlet)	NC	Air (APU inlet)	<rl< td=""><td>(TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h</td><td>N</td></rl<>	(TWA) of 2 ppm in the air over a 10-h workday. OSHA: The PEL is 2 ppm averaged over an 8-h	N
					Ozone/ VOC converter	<rl< td=""><td>Ozone/ VOC converter</td><td><rl< td=""><td>workshift ACGIH: 0.3 ppm, not to be exceeded at any time</td><td>N</td></rl<></td></rl<>	Ozone/ VOC converter	<rl< td=""><td>workshift ACGIH: 0.3 ppm, not to be exceeded at any time</td><td>N</td></rl<>	workshift ACGIH: 0.3 ppm, not to be exceeded at any time	N
Crotonaldehyde (4170-30-3)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC converter	0.746	Ozone/ VOC converter	0.711		
					(Exit)	<rl< td=""><td>(Exit)</td><td>NC</td><td></td><td></td></rl<>	(Exit)	NC		
					Pack Exit Ambient Air		Pack Exit Ambient Air			
					(APU inlet)	NC	(APU inlet)	<rl< td=""><td></td><td></td></rl<>		
Methacrolein					Ozone/ VOC converter	<rl< td=""><td>Ozone/ VOC converter</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter	<rl< td=""><td></td><td></td></rl<>		
(78-85-3)	NC	NC	NC	NC	(Inlet) Ozone/		(Inlet) Ozone/		DOE/SCAPA PAC-1: 0.20 ppm	N
					VOC converter	<rl< td=""><td>VOC converter</td><td>1.04</td><td></td><td></td></rl<>	VOC converter	1.04		
					(Exit) Pack Exit	<rl< td=""><td>(Exit) Pack Exit</td><td>NC</td><td></td><td></td></rl<>	(Exit) Pack Exit	NC		
					Ambient Air	NC	Ambient Air	<rl< td=""><td>MEK NIOSH: The REL is 200 ppm averaged over a 10- h workday, and 300 ppm as a short-term exposure</td><td>N</td></rl<>	MEK NIOSH: The REL is 200 ppm averaged over a 10- h workday, and 300 ppm as a short-term exposure	N
					(APU inlet) Ozone/		(APU inlet) Ozone/		limit (STEL) not to be exceeded during any 15-min work period	
Methyl ethyl ketone					VOC converter	0.458	VOC converter	1.12	MEK OSHA: The PEL is 200 ppm averaged over an 8- h workday	N
(MEK) & Butyraldehyde (78-93-3)	NC	NC	NC	NC	(Inlet) Ozone/		(Inlet) Ozone/		MEK ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300	N
(123-72-8)					VOC converter	2.44	VOC converter	12.7	ppm as a STEL MEK EPA AEGL-1: 200 ppm over 8 h	N
					(Exit) Pack Exit	<rl< td=""><td>(Exit) Pack Exit</td><td>NC</td><td>Butyraldehyde OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25</td><td>N</td></rl<>	(Exit) Pack Exit	NC	Butyraldehyde OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25	N
					Ambient		Ambient		ppm NIOSH: The recommended airborne exposure limit	N
					Air (APU inlet)	NC	Air (APU inlet)	0.859	is 50 ppm averaged over a 10-h workshift ACGIH: The recommended airborne exposure limit	N
					Ozone/ VOC converter	0.792	Ozone/ VOC converter	<rl< td=""><td>is 50 ppm averaged over an 8-h workshift</td><td></td></rl<>	is 50 ppm averaged over an 8-h workshift	
Valeraldehyde (110-62-3)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC converter	1.62	Ozone/ VOC converter	3.61		
					(Exit) Pack Exit	0.374	(Exit) Pack Exit	NC		
					Ambient Air	NC	Ambient Air	<rl< td=""><td></td><td></td></rl<>		
					(APU inlet) Ozone/	INC	(APU inlet) Ozone/	\nL		
m-Tolualdehyde					VOC converter	<rl< td=""><td>VOC converter</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	VOC converter	<rl< td=""><td></td><td></td></rl<>		
(620-23-5)	NC	NC	NC	NC	(Inlet) Ozone/		(Inlet) Ozone/		N/A	N/A
					VOC converter	0.481	VOC converter	1.18		
					(Exit) Pack Exit	<rl< td=""><td>(Exit) Pack Exit</td><td>NC</td><td></td><td></td></rl<>	(Exit) Pack Exit	NC		
					Ambient Air	NC	Ambient Air	<rl< td=""><td></td><td></td></rl<>		
					(APU inlet) Ozone/		(APU inlet) Ozone/			
Hexaldehyde	NC	NC	NC	NC	VOC converter (Inlet)	<rl< td=""><td>VOC converter (Inlet)</td><td><rl< td=""><td>N/A</td><td>N/A</td></rl<></td></rl<>	VOC converter (Inlet)	<rl< td=""><td>N/A</td><td>N/A</td></rl<>	N/A	N/A
(66-25-1)	INC	INC	NC	NC	Ozone/		Ozone/		I IV/S	IN/A
					VOC converter (Exit)	0.320	VOC converter (Exit)	3.27		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>NC</td><td></td><td></td></rl<>	Pack Exit	NC		
					Ambient Air (APU inlet)	NC	Ambient Air (APU inlet)	NC	NIOSH: The REL is 0.1 mg/m³ averaged over a 10-h workday (applies to coal tar pitch volatiles)	N
					Ozone/	45.	Ozone/	451	OSHA: The PEL is 0.2 mg/m³ (Coal Tar Pitch Volatiles – as the Benzene soluble fraction)) averaged over an	N
Pyrene	NC	NC	NC	NC	VOC converter (Inlet)	<rl< td=""><td>VOC converter (Inlet)</td><td><rl< td=""><td>8-h workshift ACGIH: The TLV®-TWA is 0.2 mg/m³ (Coal Tar Pitch Volatiles – as the Benzene soluble aerosol) averaged</td><td>N</td></rl<></td></rl<>	VOC converter (Inlet)	<rl< td=""><td>8-h workshift ACGIH: The TLV®-TWA is 0.2 mg/m³ (Coal Tar Pitch Volatiles – as the Benzene soluble aerosol) averaged</td><td>N</td></rl<>	8-h workshift ACGIH: The TLV®-TWA is 0.2 mg/m³ (Coal Tar Pitch Volatiles – as the Benzene soluble aerosol) averaged	N
(129-00-0)					Ozone/ VOC	0.0005	Ozone/ VOC	<rl< td=""><td>over an 8-h workshift</td><td></td></rl<>	over an 8-h workshift	
					converter (Exit)	0.0005	converter (Exit)	SIL		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Pack Exit	<rl< td=""><td></td><td></td></rl<>		

					Ambient Air (APU inlet)	0.193	Ambient Air (APU inlet)	0.189	NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure limit (STEL) not to be exceeded during any 15-min	N
Methyl ethyl ketone	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	0.313	Ozone/ VOC converter (Inlet)	0.327	work period <u>OSHA:</u> The PEL is 200 ppm averaged over an 8-h workday	N
(78-93-3)	NO	NC	NO	NO	Ozone/ VOC converter	1.66	Ozone/ VOC converter	1.46	ACGIH: The recommended exposure limit is 200 ppm averaged over an 8-h workday, and 300 ppm as a STEL EPA AEGL-1: 200 ppm over 8 h	N N
					(Exit) Pack Exit	1.56	(Exit) Pack Exit	1.39		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N N
2-Hexanone (591-78-6)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td></td><td></td></rl<>		
(391-78-0)					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>0.418</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	0.418		
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.400</td><td></td><td></td></rl<>	Pack Exit	0.400		

As shown in Table 18, formaldehyde (CAS # 50-00-0) was again quantified at levels that exceed the NIOSH recommended exposure limit (REL) of 0.016 ppm (16 ppb), if the concentrations measured here (34 and 98 ppb) were maintained over a 10-h duration. They do not, however, exceed NIOSH's recommended 15-min exposure limit of 0.1 ppm (100 ppb), nor do they exceed the accepted OSHA PEL of 0.75 ppm (750 ppb) over 8 h or the EPA AEGL-1 value of 0.90 ppm (900 ppb) over 8 h.

This finding will be further elaborated within the "Discussion" section.

Table 19: Summary of Tentatively Identified VOCs and concentrations identified following injection of Eastman Turbo Oil 2197 into the Engine (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppb	V; toluene-equivalent)		
Compound (CAS #)	220°C	315°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
Acetone (67-64-1)	<dl< td=""><td>3.6</td><td>NIOSH: The REL is 250 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm EPA AEGL-1 (interim): 200 ppm over 8 h</td><td>N N N</td></dl<>	3.6	NIOSH: The REL is 250 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm EPA AEGL-1 (interim): 200 ppm over 8 h	N N N
Methacrolein (78-85-3)	0.5	1.5	DOE/SCAPA PAC-1: 0.20 ppm	N
Butanal (123-72-8)	1.4	3.2	OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	N
Acetic acid (64-19-7)	3.2	14.8	NIOSH: The REL is 10 ppm averaged over a 10-h workshift, not to exceed 15 ppm during any 15-min work period OSHA: The PEL is 10 ppm over an 8-h workshift ACGIH: The TLV®-TWA is 10 ppm for an 8-h workday, and 15 ppm for periods not exceeding 15 min	N N N
Pentanal (110-62-3)	0.9	3.0	N/A	N/A
Butanoic acid (107-92-6)	1.5	3.9	DOE/SCAPA PAC-1: 1.7 ppm	N

^{*} Value exceeds a given exposure limit/guideline NC – Not collected, not reported or otherwise not specified

N/A – Not available <RL – Below Reporting Limit

ppb – Parts per billion (=0.001 ppm) ppbV – Parts per billion by volume

ppm – Parts per million (= 1,000 ppb)

4,4-Dimethyl-2-pentanone (590-50-1)	0.4	4.1	For 4-Methyl-2-pentanone: NIOSH: Recommended exposure limit time-weighted average (TWA) of 50 ppm over 8 h and 15-min STEL of 75 ppm OSHA: The PEL is 100 ppm averaged over an 8-h workshift ACGIH: 50 ppm for 8-hour time weighted average (TLV®-TWA) and 75 ppm for the 15-min STEL	N N N
Butynediol (110-65-6)	5.2	7.6	DOE/SCAPA PAC-1: 0.31 ppm	N
Hexanal (66-25-1)	1.1	4.4	DOE/SCAPA PAC-1: 1.3 ppm	N
2-Methylbutanoic acid (116-53-0)	1.5	3.1	N/A	N/A
Pentanoic acid (109-52-4)	137.3	198.3	DOE/SCAPA PAC-1 for n-Pentanoic acid is 3.6 ppm	N
2(3H)-Furanone, dihydro-5- methyl- (108-29-2)	0.8	2.5	N/A	N/A
Hexanoic acid (142-62-1)	0.8	2.4	DOE/SCAPA PAC-1: 0.46 ppm	N
Octanal (124-13-0)	0.8	2.4	DOE/SCAPA PAC-1: 3.2 ppm	N
p/m/o-cresol	3.7	2.7	DOE/SCAPA PAC-1: For all isomers of cresol, 14 ppm For p-cresol: NIOSH: The REL is 2.3 ppm averaged over a 10-h workday OSHA: The PEL is 5 ppm averaged over an 8-h workshift ACGIH: Recommends an airborne exposure limit of 5 ppm averaged over an 8-h workday	z z z z
Heptanoic acid (111-14-8)	69.9	106.5	DOE/SCAPA PAC-1: 3.9 ppm	N
3,5,5-Trimethylhexanoic acid (3302-10-1)	17.5	43.6	N/A	N/A
Octanoic acid (124-07-2)	2.4	5.7	DOE/SCAPA PAC-1: 5.1 ppm	N
Allyl isovalerate (2835-39-4)	17.5	26.4	N/A	N/A
Nonanoic acid (112-05-0)	17.0	43.0	DOE/SCAPA PAC-1: 2.3 ppm	N
Decanoic acid (334-48-5)	0.3	2.4	N/A	N/A
Allyl heptanoate (142-19-8)	5.9	10.2	N/A	N/A
Allyl octanoate (4230-97-1)	2.7	6.2	N/A	N/A
Allyl decanoate (57856-81-2)	0.4	2.4	N/A	N/A

* Value exceeds a given exposure limit/guideline

NC – Not collected, not reported or otherwise not specified

N/A – Not available

<DL - Below Detection Limit

ppb – Parts per billion (=0.001 ppm)

ppbV – Parts per billion by volume ppm – Parts per million (= 1,000 ppb)

The Naval Air Warfare Center Aircraft Division data presented in Table 19 for tentatively identified VOCs identified following injection of Eastman Turbo Oil 2197 into the Engine (on aircraft test) did not reveal exceedances of recommendations, limits, values or guidelines for any of the chemical compounds identified. A number of compounds did not have established or published recommendations, limits, values or guidelines; however, the concentrations overall were very low and are unlikely to be a cause for concern.

Table 20: Summary of chemicals and concentrations identified following injection of <u>5 ppm Skydrol PE-5 into the APU</u> (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline.

	Fi	eld Blank Con	centration (nn	h\/)	Rasalina	e (220°C)	22	0°C	-	
Compound	Ambient	Ozone/	Ozone/	Pack Exit	Sample	Conc.	Sample	Conc.	Exposure Limit/Guideline (GL)	Exceeds
(CAS#)	Air (APU inlet)	VOC converter (Inlet)	VOC converter (Exit)		Location	(ppbV)	Location	(ppbV)	, , ,	Exposure Limit/GL (Y/N)
					Ambient		Ambient			(1/14)
					Air (APU inlet)	NC	Air (APU inlet)	NC		
					Ozone/		Ozone/			
					VOC converter	<rl< td=""><td>VOC converter</td><td>1.1286</td><td></td><td></td></rl<>	VOC converter	1.1286		
Triisobutyl phosphate (126-71-6)	NC	NC	NC	NC	(Inlet)		(Inlet)		N/A	N/A
(120-71-0)					Ozone/		Ozone/			
					VOC converter	<rl< td=""><td>VOC converter</td><td>0.2909</td><td></td><td></td></rl<>	VOC converter	0.2909		
					(Exit)		(Exit)			
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>1.5305</td><td></td><td></td></rl<>	Pack Exit	1.5305		
					Ambient Air	NC	Ambient Air	NC	NIOSH: 0.2 ppm over a period of 10-h during a 40- hour work week	N
					(APU inlet)	INC	(APU inlet)	INC	OSHA: The permissible exposure limit (PEL) is 0.46	N
					Ozone/		Ozone/		ppm (5 mg/m³) averaged over an 8-h workshift	
Tributyl phosphate					VOC converter	0.084	VOC converter	<rl< td=""><td>ACGIH: 0.2 ppm averaged over 8 h</td><td>N</td></rl<>	ACGIH: 0.2 ppm averaged over 8 h	N
(126-73-8)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC	0.000	Ozone/ VOC	4DI		
					converter	0.028	converter	<rl< td=""><td></td><td></td></rl<>		
					(Exit)		(Exit)			
	1				Pack Exit Ambient	0.033	Pack Exit Ambient	<rl< td=""><td>NIOSH: 3 mg/m³ averaged over a 10-h workday</td><td>N</td></rl<>	NIOSH: 3 mg/m³ averaged over a 10-h workday	N
					Air	NC	Air	NC	OSHA: 3 mg/m³ averaged over a 8-h workday	N N
					(APU inlet)		(APU inlet)			
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td>1.2360</td><td></td><td></td></rl<>	Ozone/ VOC	1.2360		
Triphenyl phosphate	NC	NC	NC	NC	converter (Inlet)	-112	converter (Inlet)	1.2000		
(115-86-6)	NO	NC	INC	INC						
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td>0.2236</td><td></td><td></td></rl<>	Ozone/ VOC	0.2236		
					converter (Exit)		converter (Exit)			
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.0673</td><td></td><td></td></rl<>	Pack Exit	0.0673		
					Ambient		Ambient			
					Air (APU inlet)	NC	Air (APU inlet)	NC		
					Ozone/		Ozone/			
Tris(2-butoxyethyl)					voc	<rl< td=""><td>voc</td><td>0.0164</td><td></td><td></td></rl<>	voc	0.0164		
phosphate	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		DOD/SCAPA PAC-1; 0.55 ppm	N/A
(78-51-3)					Ozone/		Ozone/			
					VOC converter	<rl< td=""><td>VOC converter</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	VOC converter	<rl< td=""><td></td><td></td></rl<>		
					(Exit)		(Exit)			
					Pack Exit	<rl< td=""><td>Pack Exit</td><td>0.0291</td><td></td><td></td></rl<>	Pack Exit	0.0291		
					Ambient Air	NC	Ambient Air	NC		
					(APU inlet)		(APU inlet)			
					Ozone/ VOC	0.063	Ozone/ VOC	0.0352		
Tri-m-cresyl phosphate	NC	NC	NC	NC	converter	0.003	converter	0.0332	N/A	N/A
(563-04-02)	NC.	INC	INC	INC	(Inlet)		(Inlet)		IN/A	IN/A
					Ozone/ VOC	0.166	Ozone/ VOC	0.0178		
					converter (Exit)		converter (Exit)			
					Pack Exit	<rl< td=""><td>Pack Exit</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient		Ambient			
					Air (APU inlet)	NC	Air (APU inlet)	NC		
					Ozone/		Ozone/			
					VOC	0.056	VOC	0.0242		
Tri-p-cresyl phosphate (78-32-0)	NC	NC	NC	NC	(Inlet)		(Inlet)		N/A	N/A
,					Ozone/		Ozone/			
					VOC converter	0.149	VOC converter	0.0172		
					(Exit)		(Exit)			
	+				Pack Exit Ambient	0.011	Pack Exit Ambient	<rl< td=""><td>NIOSH: The recommended airborne exposure limit</td><td>N</td></rl<>	NIOSH: The recommended airborne exposure limit	N
					Air (APU inlet)	NC	Air (APU inlet)	NC	(REL) is 0.016 ppm averaged over a 10-h workshift,	IN .
									and no more than 0.1 ppm during any 15-min period	
					Ozone/ VOC	NC	Ozone/ VOC	3.89	OSHA: Permissible exposure limit (PEL) is 0.75 ppm averaged over an 8-h workshift, not to exceed 2 ppm	N
Formaldehyde	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		during any 15-min period	
(50-00-0)	1								EPA AEGL-1 (interim): 0.90 ppm over 8 h	N
					Ozone/ VOC	NC	Ozone/ VOC	NC		
					converter (Exit)		converter (Exit)			
					Pack Exit	NC	Pack Exit	NC		
Acetaldehyde		N/O	N:0	110	Ambient		Ambient		NIOSH: Lowest feasible concentration	
(75-07-0)	NC	NC	NC	NC	Air (APU inlet)	NC	Air (APU inlet)	NC	OSHA: 200 ppm averaged over an 8-h workshift	N

									L ACCILLABORA CONTRACTOR CONTRACT	
					Ozone/ VOC converter (Inlet)	NC	Ozone/ VOC converter (Inlet)	1.74	ACGIH: Not to exceed 25 ppm (Ceiling)	N
					Ozone/ VOC converter (Exit)	NC	Ozone/ VOC converter (Exit)	NC		
					Pack Exit	NC	Pack Exit	NC		
					Ambient Air		Ambient Air		NIOSH: The REL is 250 ppm averaged over a 10-h	N
					(APU inlet)	NC	(APU inlet)	NC	workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h	N
					Ozone/ VOC	NC	Ozone/ VOC	4.28	workshift ACGIH: The threshold limit value-time weighted	N
Acetone (67-64-1)	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)	· ·	average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm	, "
(0, 04-1)					Ozone/ VOC	NC	Ozone/ VOC	NC	EPA AEGL-1 (interim): 200 ppm over 8 h	N
					converter (Exit)	NC	converter (Exit)	NC		
					Pack Exit	NC	Pack Exit	NC		
					Ambient Air	NC	Ambient Air	NC	ACGIH: The recommended airborne exposure limit is 20 ppm averaged over an 8-h workshift	N
					(APU inlet)		(APU inlet)		EPA AEGL-1 (interim): 45 ppm over 8 h	N
Dranianal					Ozone/ VOC converter	NC	Ozone/ VOC converter	2.14		
Propionaldehyde (123-38-6)	NC	NC	NC	NC	(Inlet)		(Inlet)			
					Ozone/ VOC	NC	Ozone/ VOC	NC		
					converter (Exit)		converter (Exit)			
					Pack Exit	NC	Pack Exit	NC	MENNOONE	
					Ambient Air (ARIL inlot)	NC	Ambient Air (ABILiplot)	NC	MEK NIOSH: The REL is 200 ppm averaged over a 10- h workday, and 300 ppm as a short-term exposure	N
					(APU inlet) Ozone/		(APU inlet) Ozone/		limit (STEL) not to be exceeded during any 15-min work period	
Methyl ethyl ketone					VOC converter	NC	VOC converter	2.41	MEK OSHA: The PEL is 200 ppm averaged over an 8- h workday	N
(MEK) & Butyraldehyde (78-93-3)	NC	NC	NC	NC	(Inlet)		(Inlet)		MEK ACGIH: The recommended exposure limit is	N
(123-72-8)					Ozone/ VOC	NC	Ozone/ VOC	NC	200 ppm averaged over an 8-h workday, and 300 ppm as a STEL	
					converter (Exit)		converter (Exit)		MEK EPA AEGL-1: 200 ppm over 8 h Butyraldehyde OARS WEEL: RECOMMENDED in	N N
					Pack Exit	NC	Pack Exit	NC	2014 - An 8-h time-weighted average (TWA) of 25 ppm	.,
					Ambient		Ambient		NIOSH: The recommended airborne exposure limit	N
					(APU inlet)	NC	(APU inlet)	NC	is 50 ppm averaged over a 10-h workshift ACGIH: The recommended airborne exposure limit	N
					Ozone/ VOC	NC	Ozone/ VOC	0.803	is 50 ppm averaged over an 8-h workshift	
Valeraldehyde	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)	0.000		
(110-62-3)					Ozone/		Ozone/			
					VOC converter	NC	VOC converter	NC		
					(Exit) Pack Exit	NC	(Exit) Pack Exit	NC		
					Ambient Air	NC	Ambient Air	NC	NIOSH: The REL is 10 ppm averaged over a 10-h workshift, not to exceed 15 ppm during any 15-min	N
					(APU inlet)	NC	(APU inlet)	INC	work period	
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td>OSHA: 10 ppm averaged over an 8-h workday and a 15-minute STEL of 15 ppm</td><td>N</td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td>OSHA: 10 ppm averaged over an 8-h workday and a 15-minute STEL of 15 ppm</td><td>N</td></rl<>	OSHA: 10 ppm averaged over an 8-h workday and a 15-minute STEL of 15 ppm	N
Naphthalene (91-20-3)	NC	NC	NC	NC	converter (Inlet)		converter (Inlet)		ACGIH: The TLV®-TWA for 8-h is 2 ppm	N
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td></td><td></td></rl<>		
					converter (Exit)	\nL	converter (Exit)	\nL		
	<u> </u>	<u> </u>		<u> </u>	Pack Exit	0.0020	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air	NC	Ambient Air	NC	NIOSH: The REL is 0.1 mg/m ³ averaged over a 10-h workday (applies to coal tar pitch volatiles)	N
					(APU inlet)		(APU inlet)		OSHA: The PEL is 0.2 mg/m³ (Coal Tar Pitch Volatiles	N
_					Ozone/ VOC converter	<rl< td=""><td>Ozone/ VOC converter</td><td>0.0007</td><td> as the Benzene soluble fraction)) averaged over an 8-h workshift </td><td></td></rl<>	Ozone/ VOC converter	0.0007	 as the Benzene soluble fraction)) averaged over an 8-h workshift 	
Pyrene (129-00-0)	NC	NC	NC	NC	(Inlet)		(Inlet)		ACGIH: The TLV®-TWA is 0.2 mg/m³ (Coal Tar Pitch Volatiles – as the Benzene soluble aerosol) averaged	N
•					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td><rl< td=""><td>over an 8-h workshift</td><td></td></rl<></td></rl<>	Ozone/ VOC	<rl< td=""><td>over an 8-h workshift</td><td></td></rl<>	over an 8-h workshift	
					converter (Exit)		converter (Exit)]		
					Pack Exit	NC	Pack Exit	<rl< td=""><td></td><td></td></rl<>		
					Ambient Air (ABIL inlot)	0.184	Ambient Air (ABILiplot)	0.175	NIOSH: The REL is 200 ppm averaged over a 10-h workday, and 300 ppm as a short-term exposure	N
					(APU inlet) Ozone/		(APU inlet) Ozone/		limit (STEL) not to be exceeded during any 15-min work period	
Methyl ethyl ketone					VOC converter	0.451	VOC converter	0.342	OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
(78-93-3)	NC	NC	NC	NC	(Inlet)		(Inlet)		ACGIH: The recommended exposure limit is 200	N
					Ozone/ VOC	2.83	Ozone/ VOC	1.34	ppm averaged over an 8-h workday, and 300 ppm as a STEL	
					converter (Exit)		converter (Exit)		EPA AEGL-1: 200 ppm over 8 h	N
					Pack Exit Ambient	NC	Pack Exit Ambient	1.05	NIOSH: The PEL in 200 page grounded ever a 10 h	NI NI
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL</td><td>N</td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL</td><td>N</td></rl<>	NIOSH: The REL is 200 ppm averaged over a 10-h workday and 250 ppm as a STEL	N
					Ozone/		Ozone/		OSHA: The PEL is 200 ppm averaged over an 8-h workday	N
Tetrahydrofuran (109-99-9)	NC	NC	NC	NC	VOC converter	<rl< td=""><td>VOC converter</td><td><rl< td=""><td>ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100</td><td>N</td></rl<></td></rl<>	VOC converter	<rl< td=""><td>ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100</td><td>N</td></rl<>	ACGIH: The recommended airborne exposure limit is 50 ppm averaged over an 8-h workday and 100	N
(.55-55-5)					(Inlet)		(Inlet)		ppm as a STEL	
					Ozone/ VOC	<rl< td=""><td>Ozone/ VOC</td><td>0.200</td><td></td><td></td></rl<>	Ozone/ VOC	0.200		

					converter (Exit)	NC	converter (Exit)	0.194		
					Pack Exit Ambient Air (APU inlet)	<rl< td=""><td>Pack Exit Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<></td></rl<>	Pack Exit Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift</td><td>N N</td></rl<>	NIOSH: The REL is 1 ppm as a TWA over 10 h OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N N
2-Hexanone (591-78-6)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td></td><td></td></rl<>		
(391-76-0)					Ozone/ VOC converter (Exit)	0.340	Ozone/ VOC converter (Exit)	0.292		
					Pack Exit	NC	Pack Exit	0.263		
					Ambient Air (APU inlet)	<rl< td=""><td>Ambient Air (APU inlet)</td><td><rl< td=""><td>NIOSH: The REL is 75 ppm averaged over a 10-h workshift OSHA: The PEL is 75 ppm averaged over an 8-h</td><td>N N</td></rl<></td></rl<>	Ambient Air (APU inlet)	<rl< td=""><td>NIOSH: The REL is 75 ppm averaged over a 10-h workshift OSHA: The PEL is 75 ppm averaged over an 8-h</td><td>N N</td></rl<>	NIOSH: The REL is 75 ppm averaged over a 10-h workshift OSHA: The PEL is 75 ppm averaged over an 8-h	N N
Chlorobenzene (108-90-7)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td>workshift ACGIH: The threshold limit value (TLV*-TWA) is 10 ppm averaged over an 8-h workshift EPA AEGI-1; 10 ppm over 8 h</td><td>N N</td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td>workshift ACGIH: The threshold limit value (TLV*-TWA) is 10 ppm averaged over an 8-h workshift EPA AEGI-1; 10 ppm over 8 h</td><td>N N</td></rl<>	workshift ACGIH: The threshold limit value (TLV*-TWA) is 10 ppm averaged over an 8-h workshift EPA AEGI-1; 10 ppm over 8 h	N N
, ,					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td>0.187</td><td></td><td></td></rl<>	Ozone/ VOC converter (Exit)	0.187		
					Pack Exit	NC	Pack Exit	0.171		
					Ambient Air (APU inlet)	0.238	Ambient Air (APU inlet)	0.232	NIOSH: 200 ppm averaged over a 10-h workshift ACGIH: 200 ppm averaged over an 8-h workshift	N N
Nonane (111-84-2)	NC	NC	NC	NC	Ozone/ VOC converter (Inlet)	<rl< td=""><td>Ozone/ VOC converter (Inlet)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Inlet)	<rl< td=""><td></td><td></td></rl<>		
,					Ozone/ VOC converter (Exit)	<rl< td=""><td>Ozone/ VOC converter (Exit)</td><td><rl< td=""><td></td><td></td></rl<></td></rl<>	Ozone/ VOC converter (Exit)	<rl< td=""><td></td><td></td></rl<>		
					Pack Exit	NC	Pack Exit	<rl< td=""><td></td><td></td></rl<>		

The data presented in Table 20 did not reveal exceedances of recommendations, limits, values or guidelines for any of the chemical compounds identified following the injection of Skydrol PE-5 into the APU for the on aircraft test.

Table 21: Summary of Tentatively Identified VOCs and concentrations identified following injection Skydrol PE-5 into the APU (On Aircraft Test), exposure limit/guideline(s) and determination as to if the levels exceed the specified limit/guideline. (Data from Naval Air Warfare Center Aircraft Division)

	Concentration (ppbV; toluene-equivalent)		
Compound (CAS#)	180°C	Exposure Limit/Guideline (GL)	Exceeds Exposure Limit/GL (Y/N)
Isobutylene (115-11-7)	65.9	ACGIH: The TLV®-TWA is 250 ppm for butenes for 8 h	N
Cis-2-butene (624-64-6)	16.0	ACGIH: The TLV®-TWA is 250 ppm for butenes for 8 h	N
Trans-2-butene (590-18-1)	15.6	ACGIH: The TLV®-TWA is 250 ppm for butenes for 8 h	N
Acetone (67-64-1)	1.3	NIOSH: The REL is 250 ppm averaged over a 10-h workshift OSHA: The PEL is 1,000 ppm averaged over an 8-h workshift ACGIH: The threshold limit value-time weighted average (TLV*-TWA) concentration is 250 ppm; the short-term exposure limit (STEL) is 500 ppm EPA AEGL-1 (interim): 200 ppm over 8 h	N N
Methacrolein (78-85-3)	1.3	DOE/SCAPA PAC-1: 0.20 ppm	N
Butanal (123-72-8)	13.7	OARS WEEL: RECOMMENDED in 2014 - An 8-h time-weighted average (TWA) of 25 ppm	N

NC - Not collected, not reported or otherwise not specified

N/A – Not available

<RL - Below Reporting Limit

ppb – Parts per billion (=0.001 ppm) ppbV – Parts per billion by volume ppm – Parts per million (= 1,000 ppb)

		NIOSH: The REL is 10 ppm averaged over a 10-h workshift, not to exceed 15 ppm	N
Acetic acid (64-19-7)	4.5	during any 15-min work period OSHA: The PEL is 10 ppm over an 8-h workshift	N
(04-19-7)		ACGIH: The TLV®-TWA is 10 ppm for an 8-h workday, and 15 ppm for periods not	N
		exceeding 15 min	
		NIOSH: The REL is 50 ppm, not be exceeded at any time	N
1-Butanol (71-36-3)	34.5	OSHA: The PEL is 100 ppm averaged over an 8-h workshift	N
		ACGIH: The threshold limit value (TLV®) is 20 ppm, not be exceeded at any time	N
		NIOSH: The REL is 5 ppm averaged over a 10-h workshift, not to be exceed 15.6 ppm	N
Phenol (108-95-2)	8.5	during any 15-min work period OSHA: The PEL is 5 ppm averaged over an 8-h workday	N
(100-93-2)		ACGIH: The TLV®-TWA is 5 ppm averaged over an 8-h work shift	N
		EPA AEGL-1: 6.3 ppm over 8 h	N
2-Ethylhexanol (104-76-7)	7.7	DOE/SCAPA PAC-1: 0.1 ppm	N
2,6-Di-tert-butylbenzoquinone (719-22-2)	3.4	N/A	N/A
Triisobutyl phosphate (126-71-06)	58.5	N/A	N/A
Butylated Hydroxytoluene (128-37-0)	6.3	NIOSH: Recommended 10 mg/m³ time- weighted average (TWA) airborne exposure limit over a 10-h workshift OSHA: Exposure limit is 10 mg/m³ as a	z z
, ,		time-weighted average (TWA) over 8 h ACGIH: TWA exposure limit 2 mg/m³	N
		NIOSH: 0.2 ppm over a period of 10-h during a 40-hour work week	N
Tributyl phosphate (126-73-8)	197.1	OSHA: The permissible exposure limit (PEL) is 0.46 ppm (5 mg/m³) averaged over an 8-h workshift	N
		ACGIH: 0.2 ppm averaged over 8 h	N
2-Ethylhexyl benzoate (5444-75-7)	7.4	N/A	N/A
2-Cyclopentylproprionic acid, 2-ethylhexyl ester (1000293-47-0)	13.2	N/A	N/A
2-Cyclopentylproprionic acid, 2-ethylhexyl ester (1000293-47-0)	8.7	N/A	N/A

[1000293-47-0]

* Value exceeds a given exposure limit/guideline
NC – Not collected, not reported or otherwise not specified
N/A – Not available

CDL – Below Detection Limit
ppb – Parts per billion (=0.001 ppm)
ppbV – Parts per billion (=1,000 ppb)

The data from Naval Air Warfare Center Aircraft Division shown in Table 21 did not reveal exceedances of recommendations, limits, values or guidelines for any of the chemical compounds identified following the injection of Skydrol PE-5 hydraulic fluid into the APU for the on aircraft test.

DISCUSSION

This study was designed to assess engine bleed air for chemical contaminants following engine fluid contamination events and evaluate the potential risks for health-related effects should human exposure occur at those levels. Contamination events were simulated by injecting a variety of aircraft fluids, including oils, hydraulic fluids and a deicing fluid into an engine (for off aircraft engine stand tests) or a propulsion engine or APU (for on aircraft tests). A vast variety of chemical compounds were identified across the study, including VOCs, carbonyls and organophosphates. Interestingly, despite the study simulating contamination events by actively injecting aircraft fluids, the chemical compounds were identified at relatively low concentrations – on the order of parts per billion (ppb) or less – with none reaching the level of parts per million (ppm) at which many exposure recommendations, limits and guidelines start to restrict exposure.

Throughout the course of the study, only two chemical compounds exceeded established or published exposure recommendations, limits and/or guidelines – tridecane exceeded its PAC-1 value in one scenario (see Table 4 for engine stand test data for Mobil Jet Oil II) and formaldehyde exceeded NIOSH's *recommended* exposure limit in five scenarios. These five scenarios for formaldehyde involved Eastman Turbo Oil 2389, Mobil Jet Oil II and HyJet IV-A hydraulic fluid in engine stand tests, and Mobil Jet Oil II and Eastman Turbo Oil 2187 in on aircraft tests (see Tables 1, 3, 7, 16 and 18 for details).

As reported in Table 4, tridecane (CAS # 629-50-5) was measured at a concentration of 14.86 ppbV that exceeds the PAC-1 value of 0.0073 ppm (7.3 ppb). However, it should be noted that no technical basis was described for the generation of this low PAC-1 value and therefore it is unclear if this value is scientifically justified. No other published recommendations, limits or guidelines were found for tridecane. Tridecane has been implicated in dermal irritation (Muhammad et al., 2005).

With regard to formaldehyde, despite it technically exceeding NIOSH's REL in five scenarios, with the concentrations ranging from 17-98 ppbV, several considerations should be kept in mind. First, these values only exceed NIOSH's REL if they are maintained at an average greater than 16 ppb for over a period of 10 hours. In other words, if they average to <16 ppb over a period of 10 hours, or do not exceed 100 ppb during any 15-min period, they are not in exceedance of NIOSH's REL. Second, NIOSH's REL is a *recommendation* only and, while it can most certainly be used as guidance, is not an enforceable limit until/unless it is accepted by OSHA as a permissible exposure limit (PEL). Third, OSHA's current legally enforceable PEL is 0.75 ppm (750 ppb) averaged over a period of 8 hours, a concentration nearly 50x greater than NIOSH's recommended 10-hour average and 7.5x higher than the highest concentration identified within this study. The values reported in this study would not be on track to exceed OSHA's 750 ppb 8-hour PEL, nor would they be close to exceeding OSHA's 2 ppm (2,000 ppb) 15-minute short-term exposure limit (STEL) for formaldehyde. Fourth, EPA's interim AEGL-1 level for formaldehyde describes a guideline value at 0.90 ppm (900 ppb) over 8 hours, which the values reported in this study are also far below.

Breathing formaldehyde concentrations as low as 0.1 to 0.5 ppm (100 to 500 ppb) has been reported to result nasal and eye irritation, neurological effects, and increased risk of asthma and/or allergy (ATSDR). Eczema and alterations in lung function have been found to occur at concentrations of 0.6 to 1.9 ppm (600 to 1,900 ppb). As far as whether formaldehyde is likely to cause short- or long-term health effects at the levels detected within this study, which were all below 100 ppb, it has been suggested that using a weight-of-evidence approach for formaldehyde exposure would recommend an indoor air limit of 0.1 ppm (100 ppb), presumably under continuous exposure. This recommended 100 ppb value should protect even susceptible individuals from both irritation and additional, potentially more severe, effects (Golden, 2011). Given that even 100 ppb would be protective for susceptible individuals, it is unlikely that higher levels of formaldehyde reported here (i.e., 17-98 ppbV) would result in adverse health effects.

It is pertinent to mention the levels of formaldehyde that can typically be found, both indoors and outdoors, for comparison to those measured within this study. According to the Agency for Toxic

Substances and Disease Registry, higher concentrations of formaldehyde are typically found in indoor air versus outdoor air and the levels of formaldehyde in indoor air ranges from 0.02 to 4 ppm (equivalent of 20 to 4,000 ppb) while outdoor air levels range from 0.0002 to 0.006 ppm (0.2 to 6 ppb) in rural and suburban areas and 0.001 to 0.02 ppm (1 to 20 ppb) in urban areas. Given this, the concentrations of formaldehyde reported in this study, even with the simulated contamination events, are within or lower than the range of formaldehyde concentrations typically found in indoor air and, to some extent, outdoor air. This is relevant given that if/when formaldehyde is found in aircraft environments, outdoor air cannot be ruled out as a source of the formaldehyde, as opposed to assuming contamination by an aircraft fluid such as oil or hydraulic fluid has occurred.

In sum, while many chemical compounds were identified and quantified over the course of this study, the reported concentrations were remarkably low, typically <100 ppb. Only two compounds, tridecane and formaldehyde, exceeded their published recommendations, limits or guidelines, as described in detail above. All other compounds for which established or published recommendations, limits or guidelines exist were well within acceptable concentrations with regard to anticipated exposure-related health effects.

ABBREVIATIONS

Abbreviation	Definition			
μg/m³	Micrograms per cubic meter			
ACGIH	American Conference of Governmental Industrial Hygienists			
AEGL	Acute Exposure Guideline Level			
AIHA	American Industrial Hygiene Association			
APU	Auxiliary Power Unit			
ATSDR	Agency for Toxic Substances and Disease Registry			
CAMI	Civil Aerospace Medical Institute			
CAS#	Chemical Abstracts Service Registry Number			
<dl< td=""><td>Below Detection Limit</td></dl<>	Below Detection Limit			
DOE	Department of Energy			
EPA	Environmental Protection Agency			
FAA	Federal Aviation Administration			
mg/m ³	Milligrams per cubic meter			
NIOSH	National Institute for Occupational Safety and Health			
OARS	Occupational Alliance for Risk Science			
OSHA	Occupational Safety and Health Administration			
PAC	Protective Action Criteria			
PEL	Permissible Exposure Limit			
ppb	Part(s) per billion			
ppbV	Part(s) per billion by volume			
ppm	Part(s) per million			
ppmW	Part(s) per million by weight			
REL	Recommended Exposure Limit			
<rl< td=""><td>Below Reporting Limit</td></rl<>	Below Reporting Limit			
SCAPA	Subcommittee on Consequence Assessment and Protective Actions			
STEL	Short-Term Exposure Limit			
TLV [®]	Threshold Limit Value®			
TWA	Time-Weighted Average			
VOCs	Volatile Organic Compounds			
WEEL	Workplace Environmental Exposure Level			

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