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East Boundary Road Crumb Rubber Asphalt Trial Emissions Monitoring Report

Department of Transport

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Contents

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Summary

The Victorian Department of Transport (DoT) is investigating the use of crumb rubber derived from end of life tyres in asphalt.

In March 2020, a demonstration crumb rubber asphalt project involving the placement of various types of asphalt surfacings was undertaken. The project was delivered by DoT with significant funding contribution from Tyre Stewardship Australia (TSA) and technical support from the Australia Road Research Board (ARRB). The project involved the resurfacing of a section of the southbound carriageway of East Boundary Road, East Bentleigh. This trial will assist DoT in meeting the objectives of the Victorian Government's Recycled First Policy, which seeks to increase the use of recycled materials in road construction.

The project involved the placement of four types of asphalt containing crumb rubber and two conventional Stone Mastic Asphalt mixes containing polymer modified bitumen. The asphalt mixes were supplied from three different manufactures. All asphalt was placed by an independent asphalt contractor. As part of this project, emissions monitoring was undertaken during the placement of all mixes.

AMCOSH Pty Ltd was engaged to undertake personal monitoring of three asphalting crew members – the Paver Driver, Spotter and Level Hand, to assess the exposures to airborne contaminants during placement of the asphalt mixes. Monitoring took place on the nights of 15th to 18th March 2020 and the 22nd to 23rd March 2020. Results of the monitoring and an assessment of the results against prescribed standards or recommendations was undertaken, including a summary of qualitative feedback from the monitored asphalt crew members.

Acknowledgement

DoT acknowledges the significant contribution to the Project from the TSA.

TSA has been formed to implement the national Tyre Product Stewardship Scheme to promote the development of viable markets for end-of-life tyres. TSA made a significant contribution towards this project and allowed an emissions monitoring program to be implemented. The TSA is a voluntary scheme which consists of representatives from the tyre supply chain including retailers, manufacturers, recyclers and collectors.

TSA has committed significant support to a wide range of local, State and National projects using waste tyres including road sector applications, explosive resistant buildings, horse racing tracks, car parks, sporting grounds and playgrounds.

TSA works closely with the road sector because the increased, reliable and consistent annual demand into this market incentivises investment in sophisticated recycling infrastructure. This creates more local processing capacity and competition creating a valuable use for the millions of tyres used on Australian roads that are disposed of every year.

1 Introduction

Victoria, through the Department of Transport (DoT) and its predecessors, has been over many decades an industry leader and significant user of crumb rubber derived from end of life tyres in spray seals for road surfacing.

Until recently, the use of crumb rubber in asphalt by the DoT was restricted to High Binder Crumb Rubber (HBCR) Asphalt. The use of HBCR asphalt has been limited due to the nature and cost of the product. As such there is significant opportunity to increase the use of crumb rubber in asphalt, more so in urban areas where the demand for asphalt is high. Recently the DoT released a new technical specification, Light Traffic Crumb Rubber Asphalt, which is expected to result in an increase in the use of crumb rubber in asphalt.

To further investigate the use of crumb rubber in asphalt, in 2019, DoT (then VicRoads) and the Australia Road Research Board (ARRB) were successful in securing funding from the Tyre Stewardship Australia (TSA) Fund for Demonstration and Infrastructure, to undertake a crumb rubber asphalt (CRA) demonstration project. The project took place on a section of the southbound carriageway of East Boundary Road, East Bentleigh. The objectives of the project included:

- Identifying and evaluating CRA alternatives to currently used asphalt surfacing types.
- Increasing industry understanding in CRA technology including issues relating to performance, safety and cost.
- Increasing the use of crumb rubber derived from end of life tyres in asphalt.

As part of the development of the project scope, DoT and ARRB engaged with industry to discuss the proposed works, specification requirements, procurement options and the emissions monitoring that would be undertaken.

The results of emissions monitoring are presented in this report.

2 Project Scope

Industry consultation commenced at a meeting held in July 2019 attended by asphalt producers, DoT, TSA, ARRB and Australian Asphalt Pavement Association (AAPA) representatives. The meeting discussed trial objectives, site information, proposed submission requirements, asphalt mix selection process, procurement plan and evaluation criteria. Following on from the meeting and subsequent discussions, the agreed project scope included the following:

- Four different CRA mixes would be placed alongside two conventional stone mastic asphalt (SMA) mixes (referred to as ‘Control Mixes’ in this report).
- Asphalt suppliers would not be constrained by existing asphalt mix design specification requirements and could nominate and design any asphalt mix type.
- Asphalt suppliers would be required to submit asphalt mix designs and all volumetric and performance testing results to DoT.
- Asphalt suppliers would be responsible for their product performance for a two-year period assuming correct placement had been undertaken.
- The two Control Mixes would comprise DoT approved SMAN and SMAH.
- All results associated with the project would remain anonymous in all reporting of the project outcomes.
- An independent, prequalified asphalt contractor would be engaged to place all six mixes, to the supplier’s requirements (e.g. roller routines). The placement contractor was required to manage all workplace health and safety (WHS) requirements and make provision for engineering controls to manage any fuming.

3 Emissions Monitoring

AMCOSH Pty Ltd was engaged to undertake personal monitoring of three asphalting crew members – the Paver Driver, Spotter and Level Hand, to assess the exposures to airborne contaminants during placement of four CRA and two Control Mixes.

AMCOSH Pty Ltd is an independent, privately owned company established in 2003 which provides advice in Occupational Health and Safety, specialising in Occupational Hygiene to clients both in the public and private sector. AMCOSH conducted monitoring for bitumen fume exposures on road paving crews in the late 1990s as part of the AAPA SBS Fume Monitoring Project and has also conducted monitoring of a number of different asphalt road paving products for various industry clients over the past 25 years.

The purpose of the monitoring was to assess the operator exposures to volatile organic compounds (VOCs) / petroleum hydrocarbons, total suspended particulates (TSP), Polycyclic Aromatic Hydrocarbons (PAHs) and Benzothiazole (BZ) during laying of the different asphalt products and to qualitatively assess any feedback of symptoms/irritations amongst the three crew members.

An assessment has been undertaken against Safe Work Australia nominated workplace exposure standards for any of the monitored airborne contaminants. Safe Work Australia is an Australian government statutory body established to develop national policy relating to WHS and workers' compensation.

Results of emissions monitoring is provided in the AMCOSH Pty Ltd report, included as Appendix A.

4. Key Findings

The key findings of the AMCOSH report are:

Volatile Organic Compounds (VOCs)

- No significant amounts of VOCs were detected in any of the samples. All levels were well below the Time-Weighted Average SafeWork Australia Workplace Exposure Standards.

Benzothiazole (BZ)

- There are no exposure standards set for Benzothiazole (BZ) in the working environment in Australia or in most other nations.
- The highest breathing zone benzothiazole levels were measured whilst laying the CRA 2 Mix with the Spotter having the highest exposure of the three operators monitored. This coincided with reported symptoms of light-headedness and sore throat from the Level Hand. The Spotter did not report any symptoms.
- There did not appear to be a correlation between BZ levels and symptoms in this study.

Total Suspended Particulates (TSPs)

- All TSP levels were below the SafeWork Australia recommended guideline value for Dusts Not Otherwise Classified (DNOS) of 10 mg/m^3 and the Australian Institute of Occupational Hygienists (AIOH) trigger value for DNOS of 5 mg/m^3.
- TSP exposure were significantly higher for the Control Mixes than for any of the CRA mixes. The highest TSP exposure levels were for the Paver Driver for the control mixes.

Bitumen Fumes

- The results indicate that the bitumen fume exposure monitoring of the three members of the asphalting crew were generally higher for the Control Mixes than for the CRA mixes.

- Most of the CRA mixes had non-detectable to barely detectable levels of bitumen fume exposure, except for CRA 1 Mix.

- All bitumen fume levels were well below the SafeWork Australia time-weighted average workplace exposure standard for bitumen fume of 5 mg/m^3.

Polycyclic Aromatic Hydrocarbons (PAHs)

- The major PAHs compounds detected were naphthalene, fluorene, phenanthrene, anthracene and pyrene, none of which are classified as carcinogenic PAHs.

- SafeWork Australia has set a workplace exposure standard for only one PAH, naphthalene (a non-carcinogenic and the most volatile PAH), at 52 mg/m^3 (52,000 µg/m^3). Naphthalene was the most prominent PAH detected and was well below the SafeWork Australia workplace exposure standard.

- AIOH recommends that a workplace exposure standard for benzo(a)pyrene (the most potent carcinogenic PAH) be set at 0.2 µg/m^3. Benz(a)pyrene was not detected in any of the samples for either the Control or CRA mixes.

Qualitative Monitoring

- It was difficult for AMCOSH to interpret the results of the qualitative monitoring in terms of reported symptoms due to the varied use of respiratory protection, variations in the amount of mix from night-to-night, weather conditions on each night such as air temperature, wind speed and direction and the use of the Paver-mounted pedestal fans for some mixes and not others.

- Of the 18 surveys completed (three operators per night for six nights), there were four responses of symptoms/irritations made, of which two were during the placement of crumb rubber mixes and two during the placement of the Control Mixes. These were in the form of light headedness, sore throat and dry/stinging eyes.

Appendix A – AMCOSH Pty Ltd Report

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Report on an Assessment of Exposure of a Road Paving Crew to Airborne Emissions from Crumb-Rubber Asphalt during a Demonstration CRA Project November 2020

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Project Number 014173

Contents

Introduction

In March 2020, a demonstration crumb rubber asphalt project involving the placement of various types of asphalt surfacings was undertaken. The project was delivered by the Department of Transport (DoT) and jointly funded between the DoT, Tyre Stewardship Australia (TSA) and the Australian Road Research Board (ARRB).

AMCOSH Pty Ltd was engaged to undertake personal monitoring of three BituMill asphalting crew – the Paver Driver, Spotter and Level Hand, to assess the exposures to airborne contaminants during placement of four crumb rubber asphalt mixes (CRA) and two control asphalt mixes. Monitoring took place on the nights of 15th to 18th March 2020 and the 22nd to 23rd March 2020 during paving of approximately 200 metre stretches each night of East Boundary Road, between Omeo Court and South Road, East Bentleigh. For the purposes of reporting, the naming convention adopted is as follows:-

Product
CRA 1 Mix
CRA 2 Mix
CRA 3 Mix
CRA 4 Mix
Control 1 Mix
Control 2 Mix

Note: The naming convention does not relate to the order that the asphalt mixes were placed.

The purpose of the monitoring was to assess whether there were any quantitative differences in the operator exposures to volatile organic compounds (VOCs) / petroleum hydrocarbons, Total Suspended Particulates (TSP), Polycyclic Aromatic Compounds (PAHs) and Benzothiazole (BZ) during laying of the different asphalt products and to qualitatively assess any feedback of symptoms amongst the three crew members. For the purpose of consistency and to reduce any variables related to work practices, the same three crew members were monitored on each night (as far as reasonably practicable). Despite this, there were a number of variables between the nights of the trial related to work practices which were not controlled which may have affected potential exposures to airborne contaminants. These included use of pedestal fans on the paver to disperse fumes on some nights and use of respiratory protective devices by crew members. There were also a number of uncontrollable variables related to differences in asphalt materials and conditions of paving which may have affected the results of exposure monitoring such as the temperatures of the asphalt mixes arriving on site, delays in delivery times of asphalt to the paver and atmospheric conditions including ambient temperatures and wind strength and direction on each night. These variables have been recorded in the tables in the Results section of this report.

Methodology

Monitoring for volatile organic compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAHs) Total Suspended Particulates (TSP) and Benzothiazole (BZ) was undertaken simultaneously on the Paver Driver, Spotter and Level Hand during paving operations. The operators wore backpacks over the duration of the monitoring period (Figure 1), into which were installed three personal sampling pumps required for sampling the airborne contaminants. The sampling pumps were connected by tygon tubing to the appropriate sampling media placed in the breathing zone of the operator (the breathing zone is defined as a hemisphere of 300 mm radius extending to the front of the face, measured from the midpoint of an imaginary line joining the ears - see Figure 2 below).

F**igure 1** – Operators wearing backpacks with sampling pumps and devices during asphalt paving.

Figure 2 – Breathing zone (taken from SafeWork Australia https://www.safeworkaustralia.gov.au/assessing-risk)

The sampling pump and sampling device flowrates were set to those recommended in the methods and measured and recorded immediately prior to the commencement of monitoring and re-measured immediately after sampling was completed. Observations of weather conditions, visible fume levels and asphalt temperatures were also recorded. At the completion of sampling, the operators were asked to describe the impressions of the fume levels and whether they experienced any symptoms. They were also questioned about their symptoms prior to paving the next night. These observations were recorded on the sampling proforma. The following methods were used for the sampling of airborne contaminants on each night of the monitoring trial. The individual laboratory certificates of analysis are included in Appendix 1 of this report.

Volatile Organic Compounds (VOCs)

Sampling for VOCs in the breathing zone of the operators was undertaken by drawing air through activated coconut shell charcoal tubes (SKC Part Number 226-01) at a flowrate of between 0.09 and 0.15 litres per minute in accordance with NIOSH Method 1500 (Hydrocarbons, BP 36°-216 °C), NIOSH Method 1501 (Hydrocarbons, Aromatic) and Australian Standard AS 2986.1-2003: Workplace air quality - Sampling and analysis of volatile organic compounds by solvent desorption/gas chromatography - Pumped sampling method.

Following sampling, the samples were refrigerated until they were dispatched for laboratory analysis. All VOC samples were analysed by TestSafe Australia (the chemical analysis branch of Safework NSW) by the method of solvent desorption with carbon disulphide and analysis by gas chromatography/mass spectrometry by method WCA.2.07 Analysis of Volatile Organic Compounds in Workplace Air by Gas Chromatography/Mass Spectrometry. TestSafe Australia is NATA accredited for this method (Accreditation No 3726) in compliance with ISO/IEC Standard 17025-Testing. The analytical method has a limit of quantitation of 5 micrograms (µg) for aromatic and aliphatic hydrocarbons.

Polycyclic Aromatic Hydrocarbons (PAHs) and Total Suspended Particulates (TSP)/Cyclohexane-Soluble Fraction (Bitumen Fume)

Bitumen Fume is a generic term used to describe the total aerosol/particulate emissions from heated bitumen and products. It is a mixture of solid particles, condensed vapours and bitumen liquid droplets. Bitumen fume exposures have been measured and characterised in a number of different ways including determining the exposures to Total Suspended Particulates (TSP) (also know as Total Suspended Matter – TSM), Benzene (or Cyclohexane) – Soluble Fraction (BSF) of the total particulate and to both total and individual Polycyclic Aromatic Hydrocarbons (PAHs). In this report, unless otherwise specified, the term “Bitumen Fume” will be used to describe the cyclohexane (or benzene) soluble matter extracted from the Total Suspended Particulate (TSP) samples which is a measure of the exposure to organic aerosols emitted from the hot asphalt products with the exclusion of inorganic particles generated from road dust and other potential sources.

Sampling of PAHs and TSP in the breathing zone of the three operators was undertaken by drawing air at approximately 2 litres per minute through a pre-weighed PTFE filter to collect particulate matter with an XAD-2 solid sorbent sampling tube connected at the rear of the filter cassette to collect volatile (gaseous) PAHs in accordance with NIOSH Method 5800 Polycyclic Aromatic Compounds, Total (PACs).

Following sampling, the samples were refrigerated until they were dispatched for laboratory analysis. The samples were analysed for TSP gravimetrically by SIMTARS Analytical Laboratory Services (part of the Safety in Mines Testing and Research Station – a Queensland Government operated facility). The filters and XAD-2 resin sampling tubes were then extracted with cyclohexane and analysed gravimetrically for total Cyclohexane Soluble Fraction (Bitumen Fumes) and then analysed for 16 priority PAHs by the method of High-Performance Liquid Chromatography/Fluorescence Detection. The limit of reporting (LOR) for the TSP analysis was 0.01 mg per filter. For Cyclohexane Soluble Fraction (CSF) the LOR was 0.05 mg per filter and for the individual PAHs the LOR ranged from 0.05 µg to 0.5 µg per filter/tube. SIMTARS is NATA accredited for this analysis (Accreditation No 2681) in compliance with ISO/IEC Standard 17025-Testing.

Benzothiazole (BZ)

Sampling for benzothiazole was undertaken by drawing air at approximately 2 litres per minute through a PTFE filter to collect particulate matter with an XAD-2 solid sorbent sampling tube connected at the rear of the filter cassette to collect volatile BZ in accordance with NIOSH Method 2550 Benzothiazole in Asphalt Fume.

Following sampling, the samples were refrigerated until they were dispatched for laboratory analysis. The samples were analysed by Leeder Analytical laboratory by the method of solvent extraction with hexane followed by analysis by gas-chromatography/tandem mass spectrometry (GC/MS/MS). The practical quantitation limit (PQL) of BZ n the samples was 0.005 µg (5 nanograms) per filter/tube. Laboratory recoveries (analysis of filters and tubes spiked with pure BZ) ranged from 81 to 86% for samples spiked at 0.25 µg and 1 µg per sample respectively.

Results Tables: Crumb Rubber Asphalt Study

1. CRA 1 Mix

Asphalt Parameters:

Supplier	Mix Temperature	Laid Temperature	Total Tonnage	Laying Time
CRA 1 Mix	160 - 175 °C	135 - 166 °C	189.9 ton	21:15 to 02:25

Weather Parameters:

Air Temperature	Relative Humidity	Wind Speed	Paving Direction
7.8 to 10.1°C	77 to 86%	0 kph to 9 kph ESE	North to South

Sampling Parameters:

Operator	Sampling Times	Total Sampling Period (min)	VOCs		PAHs/TSP		Benzothiazole		Comments
			Average Flowrate mL/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	
Spotter	22:22 to 02:25	243	96.0	23.3	2.200	534.5	2.001	486.2	Paver pedestal fans off No respirators worn. Moderate fume level. No symptoms reported
Level Hand	22:47 to 02:25	218	100.4	21.9	2.171	473.2	2.032	443.0	
Paver Driver	22:24 to 02:25	241	119.8	28.9	2.160	520.4	2.005	483.1	

Monitoring Results:

Volatile Organic Compounds

Operator	Total Volume Sampled (L)	Breathing zone VOC concentration (mg/m^3)			Comments
		Aliphatic Hydrocarbons	Aromatic Hydrocarbons	VOC's	
Spotter	23.3	<0.22	<0.04	<2.2	No VOC's detected above the detection limit
Level Hand	21.9	<0.23	<0.05	<2.3	No VOC's detected above the detection limit
Paver Driver	28.9	<0.17	<0.03	<1.7	No VOC's detected above the detection limit

Benzothiazole

Operator	Total Volume Sampled (L)	Breathing Zone Benzothiazole Concentration ($\mu g/m^3$)
Spotter	486.2	18
Level Hand	443.0	52
Paver Driver	483.1	24

Total Suspended Particulates (TSP), Bitumen Fumes - cyclohexane soluble & Polycyclic Aromatic Hydrocarbons- cyclohexane soluble (PAHs)

Operator	Total Volume Sampled (L)	TSP (mg/m^3)	Bitumen Fumes (mg/m^3)	Polycyclic Aromatic Hydrocarbons ($\mu g/m^3$)									
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Pyrene	Benz(a)anthracene	Chrysene	Other
Spotter	534.5	0.3	0.11	2.1	<0.9	<0.9	<0.09	0.41	0.15	<0.09	<0.09	<0.09	No other PAHs detected.
Level Hand	473.2	0.8	0.5	3.2	<1.1	1.9	0.21	1.4	0.38	0.15	0.15	<0.11	No other PAHs detected.
Paver Driver	520.4	0.4	0.23	1.9	<1.0	<1.0	<0.1	0.62	0.17	<0.1	<0.1	<0.1	No other PAHs detected.

2. CRA 2 Mix

Asphalt Parameters:

Supplier	Mix Temperature	Laid Temperature	Total Tonnage	Laying Time
CRA 2 Mix	160 to 163°C	145 - 155 °C	162.1 ton	21:50 to 00:53

Weather Parameters:

Air Temperature	Relative Humidity	Wind Speed	Paving Direction
22.0 to 22.5°C	46 to 47%	19 kph N to 22 kph N	North to South

Sampling Parameters:

Operator	Sampling Times	Total Sampling Period (min)	VOCs		PAHs/TSP		Benzothiazole		Comments
			Average Flowrate mL/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	
Spotter	22:07 to 00:55	166	123.4	20.5	2.316	384.5	2.188	363.2	Paver pedestal fans on. No respirators worn. Moderate fuming. Rubber odour evident. Level Hand described light-headedness and sore throat which persisted into the next day.
Level Hand	22:10 to 00:55	165	105.6	17.4	2.318	382.5	2.290	377.8	
Paver Driver	22:06 to 00:55	167	107.8	18.0	2.225	371.5	2.042	334.9	

Monitoring Results:

Volatile Organic Compounds

Operator	Total Volume Sampled (L)	Breathing zone VOC concentration (mg/m^3)			Comments
		Aliphatic Hydrocarbons	Aromatic Hydrocarbons	VOC's	
Spotter	20.5	<0.24	<0.05	<2.4	No VOC's detected above the detection limit
Level Hand	17.4	<0.28	<0.06	<2.8	No VOC's detected above the detection limit
Paver Driver	18.0	<0.28	<0.06	<2.8	No VOC's detected above the detection limit

Benzothiazole

Operator	Total Volume Sampled (L)	Breathing Zone Benzothiazole Concentration ($\mu g/m^3$)
Spotter	363.2	95
Level Hand	377.8	46
Paver Driver	334.9	29

Total Suspended Particulates (TSP), Bitumen Fumes - cyclohexane soluble & Polycyclic Aromatic Hydrocarbons- cyclohexane soluble (PAHs)

Operator	Total Volume Sampled (L)	TSP (mg/m^3)	Bitumen Fumes (mg/m^3)	Polycyclic Aromatic Hydrocarbons ($\mu g/m^3$)									
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Pyrene	Benz(a)anthracene	Chrysene	Other
Spotter	384.5	0.4	<0.1	1.3	<1.3	<1.3	1.4	1.4	0.28	0.15	0.13	<0.1	No other PAHs detected.
Level Hand	382.5	0.2	<0.1	<1.3	<1.3	<1.3	0.47	0.29	<0.1	<0.1	<0.1	<0.1	No other PAHs detected.
Paver Driver	371.5	0.3	<0.1	<1.3	<1.3	<1.3	0.57	0.22	<0.1	<0.1	<0.1	<0.1	No other PAHs detected.

3. CRA 3 Mix

Asphalt Parameters:

Supplier	Mix Temperature	Laid Temperature	Total Tonnage	Laying Time
CRA 3 Mix	154 – 156°C	130 - 150 °C	170.50 ton	22:00 to 01:10

Weather Parameters:

Air Temperature	Relative Humidity	Wind Speed	Paving Direction
11.0 to 14.0°C	76 to 85%	9 kph SE to 17 kph SSE	North to South

Sampling Parameters:

Operator	Sampling Times	Total Sampling Period (min)	VOCs		PAHs/TSP		Benzothiazole		Comments
			Average Flowrate mL/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	
Spotter	21:44 to 01:15	211	138.85	29.3	2.117	446.7	2.181	460.1	Low visible fume. Paver pedestal fans on. Wearing A1P2 respirator.
Level Hand	21:50 to 01:15	205	102.5	21.0	2.255	462.3	2.374	486.6	
Paver Driver	21:42 to 1:15	213	113.6	24.2	1.985	406.9	2.234	475.7	

Monitoring Results:

Volatile Organic Compounds

Operator	Total Volume Sampled (L)	Breathing zone VOC concentration (mg/m^3)			Comments
		Aliphatic Hydrocarbons	Aromatic Hydrocarbons	Total VOC's	
Spotter	29.3	<0.17	<0.03	<1.7	No VOC's detected above the detection limit
Level Hand	21.0	<0.24	<0.05	<2.3	No VOC's detected above the detection limit
Paver Driver	24.2	<0.21	<0.04	<2.1	No VOC's detected above the detection limit

Benzothiazole

Operator	Total Volume Sampled (L)	Breathing Zone Benzothiazole Concentration ($\mu g/m^3$)
Spotter	460.1	8.7
Level Hand	486.6	2.5
Paver Driver	475.7	27

Total Suspended Particulates (TSP), Bitumen Fumes - cyclohexane soluble & Polycyclic Aromatic Hydrocarbons- cyclohexane soluble (PAHs)

Operator	Total Volume Sampled (L)	TSP (mg/m^3)	Bitumen Fumes (mg/m^3)	Polycyclic Aromatic Hydrocarbons ($\mu g/m^3$)									
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Pyrene	Benz(a)anthracene	Chrysene	Other
Spotter	446.7	0.2	<0.1	1.8	<1.1	<1.1	0.58	0.40	<0.1	<0.1	<0.1	<0.1	No other PAHs detected.
Level Hand	462.3	0.2	<0.1	1.1	<1.1	<1.1	0.43	0.47	<0.1	<0.1	<0.1	<0.1	No other PAHs detected.
Paver Driver	406.9	0.2	<0.1	1.5	<1.1	<1.1	0.86	0.56	0.2	<0.1	<0.1	<0.1	No other PAHs detected.

4. CRA 4 Mix

Asphalt Parameters:

Supplier	Mix Temperature	Laid Temperature	Total Tonnage	Laying Time
CRA 4 Mix	155 to 175°C	150-162 °C	191.7 ton	21:50 to 02:05

Weather Parameters:

Air Temperature	Relative Humidity	Wind Speed	Paving Direction
19.7 to 21.2°C	65 to 77%	0 kph to 9 kph W	North to South

Sampling Parameters:

Operator	Sampling Times	Total Sampling Period (min)	VOCs		PAHs/TSP		Benzothiazole		Comments
			Average Flowrate mL/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	
Spotter	22:21 to 01:43	202	101.0	20.4	2.039	411.8	2.047	413.4	Paver pedestal fans on. No respirators worn. Moderate fume level. Level Hand described light-headedness.
Level Hand	22:20 to 01:43	203	127.3	25.8	2.208	448.2	2.069	419.9	
Paver Driver	22:20 to 01:43	203	110.0	22.3	2.204	447.3	1.994	404.7	

Monitoring Results:

Volatile Organic Compounds

Operator	Total Volume Sampled (L)	Breathing zone VOC concentration (mg/m^3)			Comments
		Aliphatic Hydrocarbons	Aromatic Hydrocarbons	VOC's	
Spotter	20.4	<0.25	<0.01	<2.5	No VOC's detected above the detection limit
Level Hand	25.8	<0.19	<0.08	<1.9	No VOC's detected above the detection limit
Paver Driver	22.3	<0.22	<0.04	<2.2	No VOC's detected above the detection limit

Benzothiazole

Operator	Total Volume Sampled (L)	Breathing Zone Benzothiazole Concentration ($\mu g/m^3$)
Spotter	413.4	6.1
Level Hand	419.9	10
Paver Driver	404.7	9.1

Total Suspended Solid (TSP), Bitumen Fumes - cyclohexane soluble & Polycyclic Aromatic Hydrocarbons- cyclohexane soluble (PAHs)

Operator	Total Volume Sampled (L)	TSP (mg/m^3)	Bitumen Fumes (mg/m^3)	Polycyclic Aromatic Hydrocarbons ($\mu g/m^3$)									
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Pyrene	Benz(a)anthracene	Chrysene	Other
Spotter	411.8	0.3	<0.1	<1.2	<1.2	<1.2	<0.12	0.34	<0.12	<0.12	<0.12	<0.12	No other PAHs detected.
Level Hand	448.2	0.4	<0.1	<1.1	<1.1	<1.1	<0.11	0.33	0.20	<0.11	<0.11	<0.11	No other PAHs detected.
Paver Driver	447.3	0.3	0.1	1.3	<1.1	<1.1	<0.11	0.26	0.15	<0.11	<0.11	<0.11	No other PAHs detected.

5. Control 1 Mix

Asphalt Parameters:

Supplier	Mix Temperature	Laid Temperature	Total Tonnage	Laying Time
Control 1 Mix	173 - 175 °C	149-174 °C	310 ton	23:02 to 03:45

Weather Parameters:

Air Temperature	Relative Humidity	Wind Speed	Paving Direction
12.4 to 14.5°C	60 to 67%	11 kph SSE to 19 kph SSE	North to South

Sampling Parameters:

Operator	Sampling Times	Total Sampling Period (min)	VOCs		PAHs/TSP		Benzothiazole		Comments
			Average Flowrate mL/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	
Spotter	23:16 to 03:45	259	104.3	27.0	2.197	569.0	2.063	534.3	Paver pedestal fans off No respirators worn. High fume level. Paver Driver described sore throat.
Level Hand	23:26 to 03:45	249	98.2	24.4	2.265	563.9	2.042	508.3	
Paver Driver	23:21 to 03:45	254	130.1	33.0	2.175	552.5	2.048	520.1	

Monitoring Results:

Volatile Organic Compounds

Operator	Total Volume Sampled (L)	Breathing zone VOC concentration (mg/m^3)			Comments
		Aliphatic Hydrocarbons	Aromatic Hydrocarbons	VOC's	
Spotter	27.0	<0.19	<0.04	<1.9	No VOC's detected above the detection limit
Level Hand	24.4	<0.20	<0.04	<2.0	No VOC's detected above the detection limit
Paver Driver	33.0	<0.15	<0.03	<1.5	No VOC's detected above the detection limit

Benzothiazole

Operator	Total Volume Sampled (L)	Breathing Zone Benzothiazole Concentration ($\mu g/m^3$)
Spotter	534.3	0.29
Level Hand	508.3	0.30
Paver Driver	520.1	0.56

Total Suspended Particulates (TSP), Bitumen Fumes - cyclohexane soluble & Polycyclic Aromatic Hydrocarbons- cyclohexane soluble (PAHs)

Operator	Total Volume Sampled (L)	TSP (mg/m^3)	Bitumen Fumes (mg/m^3)	Polycyclic Aromatic Hydrocarbons ($\mu g/m^3$)									
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Pyrene	Benz(a)anthracene	Chrysene	Other
Spotter	569.0	0.3	0.16	1.1	<0.9	<0.9	0.26	0.21	0.12	<0.09	<0.09	<0.09	No other PAHs detected.
Level Hand	563.9	0.8	0.5	2.3	<0.9	<0.9	<0.09	0.69	0.25	<0.09	0.16	<0.09	No other PAHs detected.
Paver Driver	552.5	1.5	1.2	4.2	2.4	<0.9	2.4	1.7	0.62	0.09	0.38	0.09	No other PAHs detected.

6. Control 2 Mix

Asphalt Parameters:

Supplier	Mix Temperature	Laid Temperature	Total Tonnage	Laying Time
Control 2 Mix	160 to 167°C	130 - 165 °C	208.5 ton	21:45 to 02:45 1hr 45min delay between truck 8 and 9

Weather Parameters:

Air Temperature	Relative Humidity	Wind Speed	Paving Direction
12.8 to 16.1°C	71 to 82%	6 kph E to 17 kph ESE	North to South Plus turn lane

Sampling Parameters:

Operator	Sampling Times	Total Sampling Period (min)	VOCs		PAHs/TSP		Benzothiazole		Comments
			Average Flowrate mL/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	Average Flowrate L/min	Total Volume Sampled (L)	
Spotter	22:56 to 03:05	144*	110.2	15.9	2.248	323.7	2.403	346.0	Moderate Visible Fume Paver pedestal fans off. No respirators worn. Level Hand described dry / stinging eyes.
Level Hand	23:20 to 03:05	120*	102.4	12.3	2.125	255.0	1.988	238.6	
Paver Driver	22:52 to 03:05	148*	135.1	20.0	2.295	339.7	2.284	338.0	

*** Sampling time adjusted downward for 1hr45min delay between trucks 8 and 9 and no asphalting**

Monitoring Results:

Volatile Organic Compounds

Operator	Total Volume Sampled (L)	Breathing zone VOC concentration (mg/m³)			Comments
		Aliphatic Hydrocarbons	Aromatic Hydrocarbons	Total VOC's	
Spotter	15.9	<0.31	<0.06	<3.1	No VOC's detected above the detection limit
Level Hand	12.3	<0.40	<0.08	<4.0	No VOC's detected above the detection limit
Paver Driver	20.0	<0.25	<0.04	<2.5	No VOC's detected above the detection limit

Benzothiazole

Operator	Total Volume Sampled (L)	Breathing Zone Benzothiazole Concentration (µg/m³)
Spotter	346.0	0.9
Level Hand	238.6	0.6
Paver Driver	338.0	2.4

Total Suspended Particulates (TSP), Bitumen Fumes - cyclohexane soluble & Polycyclic Aromatic Hydrocarbons- cyclohexane soluble (PAHs)

Operator	Total Volume Sampled (L)	TSP (mg/m³)	Bitumen Fumes (mg/m³)	Polycyclic Aromatic Hydrocarbons (µg/m³)									
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Pyrene	Benz(a)anthracene	Chrysene	Other
Spotter	323.7	0.7	0.21	3.4	<1.5	<1.5	0.40	1.6	0.18	<0.2	<0.2	<0.2	No other PAHs detected.
Level Hand	255.0	0.5	<0.2	<2.0	<2.0	<2.0	0.51	0.39	<0.2	<0.2	<0.2	<0.2	No other PAHs detected.
Paver Driver	339.7	1.5	0.82	6.5	<1.5	<1.5	1.4	1.5	0.41	<0.2	0.32	<0.2	No other PAHs detected.

Discussion of Results

VOC Result Comparison

Operator	CRA 1 Mix			CRA 2 Mix			CRA 3 Mix			CRA 4 Mix			Control 1 Mix			Control 2 Mix		
	Aliphatic Hydrocarbons (mg/m³)	Aromatic Hydrocarbons (mg/m³)	Total VOC's (mg/m³)	Aliphatic Hydrocarbons (mg/m³)	Aromatic Hydrocarbons (mg/m³)	Total VOC's (mg/m³)	Aliphatic Hydrocarbons (mg/m³)	Aromatic Hydrocarbons (mg/m³)	Total VOC's (mg/m³)	Aliphatic Hydrocarbons (mg/m³)	Aromatic Hydrocarbons (mg/m³)	Total VOC's (mg/m³)	Aliphatic Hydrocarbons (mg/m³)	Aromatic Hydrocarbons (mg/m³)	Total VOC's (mg/m³)	Aliphatic Hydrocarbons (mg/m³)	Aromatic Hydrocarbons (mg/m³)	Total VOC's (mg/m³)
Spotter	<0.22	<0.04	<2.2	<0.24	<0.05	<2.4	<0.17	<0.03	<1.7	<0.25	<0.01	<2.5	<0.19	<0.04	<1.9	<0.31	<0.06	<3.1
Level Hand	<0.23	<0.05	<2.3	<0.28	<0.06	<2.8	<0.24	<0.05	<2.3	<0.19	<0.08	<1.9	<0.20	<0.04	<2.0	<0.40	<0.08	<4.0
Paver Driver	<0.17	<0.03	<1.7	<0.28	<0.06	<2.8	<0.21	<0.04	<2.1	<0.22	<0.04	<2.2	<0.15	<0.03	<1.5	<0.25	<0.04	<2.5

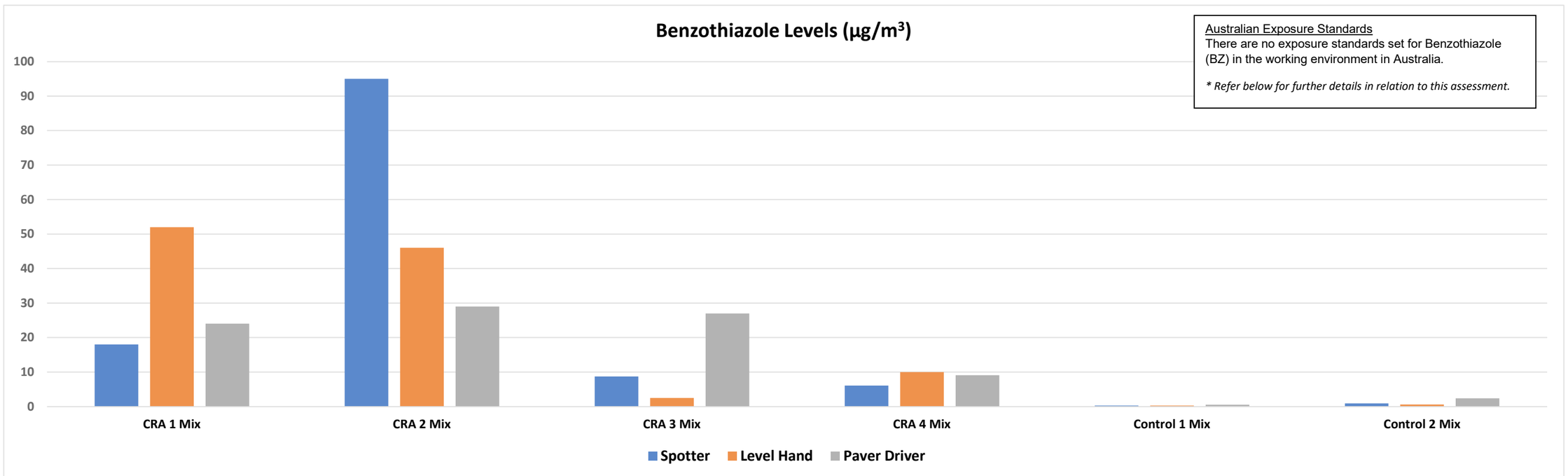
SafeWork Australia Workplace Exposure Standards for selected VOCs

Chemical	Time-weighted Average (TWA)* Workplace Exposure Standard (mg/m³)
Pentane	1770
Hexanes	1760
n-hexane	72
Cyclohexane	350
Methyl Cyclohexane	1610
n-heptane	1640
Octane	1400
Nonane	1050
Benzene	3.2
Toluene	191
Xylene	350
Ethylbenzene	434
Styrene	213
Cumene	125
Trimethylbenzene	123
Total VOC (as White Spirit)	790

*TWA = Average concentration over an 8-hour shift

Conclusion: No significant amounts of volatile organic compounds were detected in any of the samples on the 6 nights of monitoring. All levels were well below the Time-Weighted Average SafeWork Australia Workplace Exposure Standards.

Operator	Breathing Zone Benzothiazole Concentration (µg/m³)					
	CRA 1 Mix	**CRA 2 Mix**	**CRA 3 Mix**	**CRA 4 Mix3/2020**	**Control 1 Mix**	**Control 2 Mix**
Spotter	18	95	8.7	6.1	0.29	0.9
Level Hand	52	46	2.5	10	0.30	0.6
Paver Driver	24	29	27	9.1	0.56	2.4
Comment	Paver pedestal fans off No respirators worn. Moderate fume level. No symptoms reported.	Paver pedestal fans on. No respirators worn. Moderate fuming. Rubber odour evident. Level Hand described light-headedness and sore throat which persisted into the next day.	Low visible fume. Paver pedestal fans on. Operators wearing A1P2 respirators. No symptoms reported.	Paver pedestal fans on. No respirators worn. Moderate fume level. Level Hand described light-headedness.	Paver pedestal fans off No respirators worn. High visible fume level. Paver Driver described sore throat.	Moderate Visible Fume Paver pedestal fans off. No respirators worn. Level Hand described dry/stinging eyes.
Photographs						



Benzothiazole Result Summary

Comments: There are no exposure standards set for Benzothiazole (BZ) in the working environment in Australia or in most other nations. Benzothiazole is classified under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) as a Category 2 Eye Irritant. There is limited evidence from overseas studies on asphalt crews that the breathing zone levels of Benzothiazole are higher when laying crumb rubber modified asphalt (CRA) compared with conventional (stone mastic) asphalt. There is also some evidence that benzothiazole levels are positively correlated with symptoms of eye and respiratory tract irritation, but it has not been established whether the correlation is causal (NIOSH 1996, Burr et al 2001, Nilsson et al 2018, Xu et al 2018,

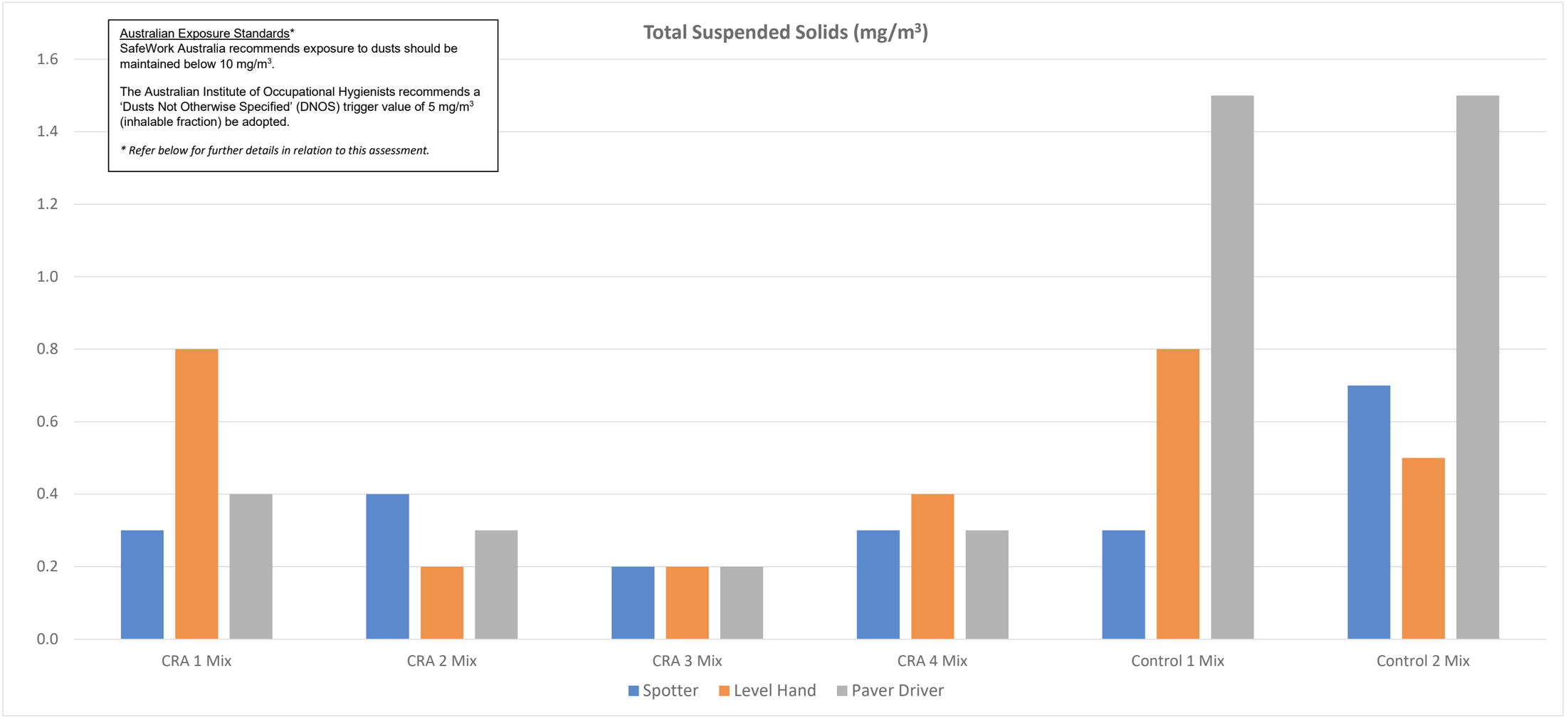
Conclusion: Operators' breathing zone concentrations of benzothiazole were significantly higher when laying CRA than the control asphalt mixes. The results are consistent with those of overseas studies where measurement of benzothiazole exposures have been undertaken on crews undertaking CRA paving, both in terms of exposure patterns (i.e. CRA resulting in approximately 10 times higher exposures to benzothiazole) and the magnitude of the exposures.

The highest breathing zone benzothiazole levels were measured whilst laying the CRA 2 Mix with the Spotter having the highest exposure of the three operators monitored. This coincided with reported symptoms of light-headedness and sore throat from the Level Hand when questioned. The Spotter did not report symptoms. The CRA 2 Mix had a distinct rubber odour, which was not evident with other CRA mixes.

It is difficult to interpret the results of the monitoring in terms of reported symptoms due to the varied use of respiratory protection, variations in the amount of mix from night-to-night, weather conditions on each night such as air temperature, wind speed and direction, the use of the Paver-mounted pedestal fans for some mixes and not others and the side of the Paver that the Level Hand was operating from (e.g. the Level Hand operated from the right-hand side of the Paver on 18/3/2020 and on the left-hand side on other nights). However, as symptoms of sore throat and stinging eyes were reported for both the control asphalt mixes (where benzothiazole levels were low) and some of the CRA mixes (with elevates BZ exposures) and no symptoms for other CRA mixes where BZ levels were similar, there did not appear to be a correlation between BZ levels and symptoms in this study.

Total Suspended Particulates (TSP) Result Comparison

Operator	Breathing Zone TSP Concentration (mg/m^3)					
	CRA 1 Mix	CRA 2 Mix	CRA 3 Mix	CRA 4 Mix	Control 1 Mix	Control 2 Mix
Spotter	0.3	0.4	0.2	0.3	0.3	0.7
Level Hand	0.8	0.2	0.2	0.4	0.8	0.5
Paver Driver	0.4	0.3	0.2	0.3	1.5	1.5



Total Suspended Particulates (TSP) Result Summary

Comments: TSP can be made up of aerosols consisting of solids (e.g. dust) and condensed liquids (e.g. mineral oils and other semi-volatile organic compounds) suspended in air. Because the composition of TSP can vary greatly, depending on its source, there are no specific exposure standards set in the working environment in Australia. SafeWork Australia recommends that, where no specific exposure standard has been assigned and the substance is both of inherently low toxicity and free from toxic impurities, exposure to dusts (not otherwise classified (DNOC) should be maintained below 10 mg/m^3, measured as inhalable dust (8-hour TWA). Inhalable dust is that size range which can be inhaled and is nominally composed of particles of a size range 50% of which are less than 100 microns in mean equivalent aerodynamic diameter. TSP is of a wide range of particle sizes, some of which are in the inhalable range and also includes particles too large to be inhaled. The Australian Institute of Occupational Hygienists recommends a 'Dusts Not Otherwise Specified' (DNOS) trigger value of 5 mg/m^3 (inhalable fraction) be adopted to protect workers from potentially serious health effects due to insoluble or poorly water-soluble dusts of inherently low toxicity and free from toxic impurities and for which there is no other applicable Workplace Exposure Standard specified.

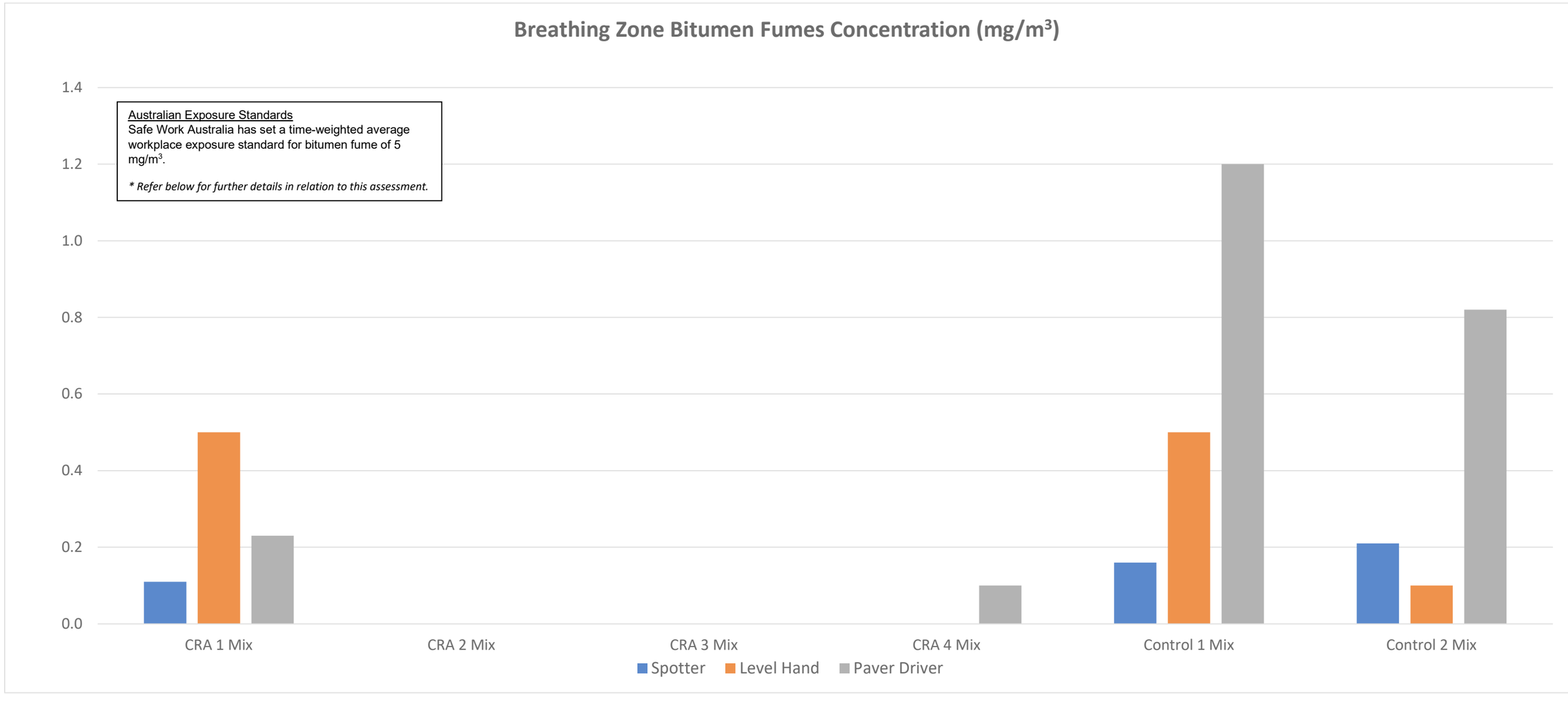
Conclusion: The results indicate that the TSP exposure of the three members of the asphalting crew were significantly higher for the two Control asphalt mixes (range 0.3 mg/m^3 to 1.5 mg/m^3) than for any of the CRA mixes (range 0.2 mg/m^3 to 0.8 mg/m^3). Previous overseas have shown similar results for the mean total suspended particulate (TSP) exposure levels between crews undertaking conventional asphalt and CRA paving operations (Burr et al2001, Nilsson et al2018)

The highest TSP exposure levels were for the Paver Driver for the control mixes (1.5 mg/m^3 for both mixes). Observations indicated that the Paver Driver sits elevated above the hot asphalt and is consistently in the plume of Bitumen Fume from both the hopper and screed board. Additionally, the roof of the Paver acts to trap fumes in the breathing zone of the driver who is fixed in position whilst the Level Hand and Spotter are free to move away from the plume.

All TSP levels were below the SafeWork Australia recommended guideline value for Dusts Not Otherwise Classified (DNOS) of 10 mg/m^3 and the AIOH trigger value for DNOS of 5 mg/m^3.

Bitumen Fumes

Operator	Breathing Zone Bitumen Fumes Concentration (mg/m^3)					
	CRA 1 Mix	CRA 2 Mix	CRA 3 Mix	CRA 4 Mix	Control 1 Mix	Control 2 Mix
Spotter	0.11	<0.1	<0.1	<0.1	0.16	0.21
Level Hand	0.5	<0.1	<0.1	<0.1	0.5	<0.2
Paver Driver	0.23	<0.1	<0.1	0.1	1.2	0.82



Bitumen Fumes Result Summary

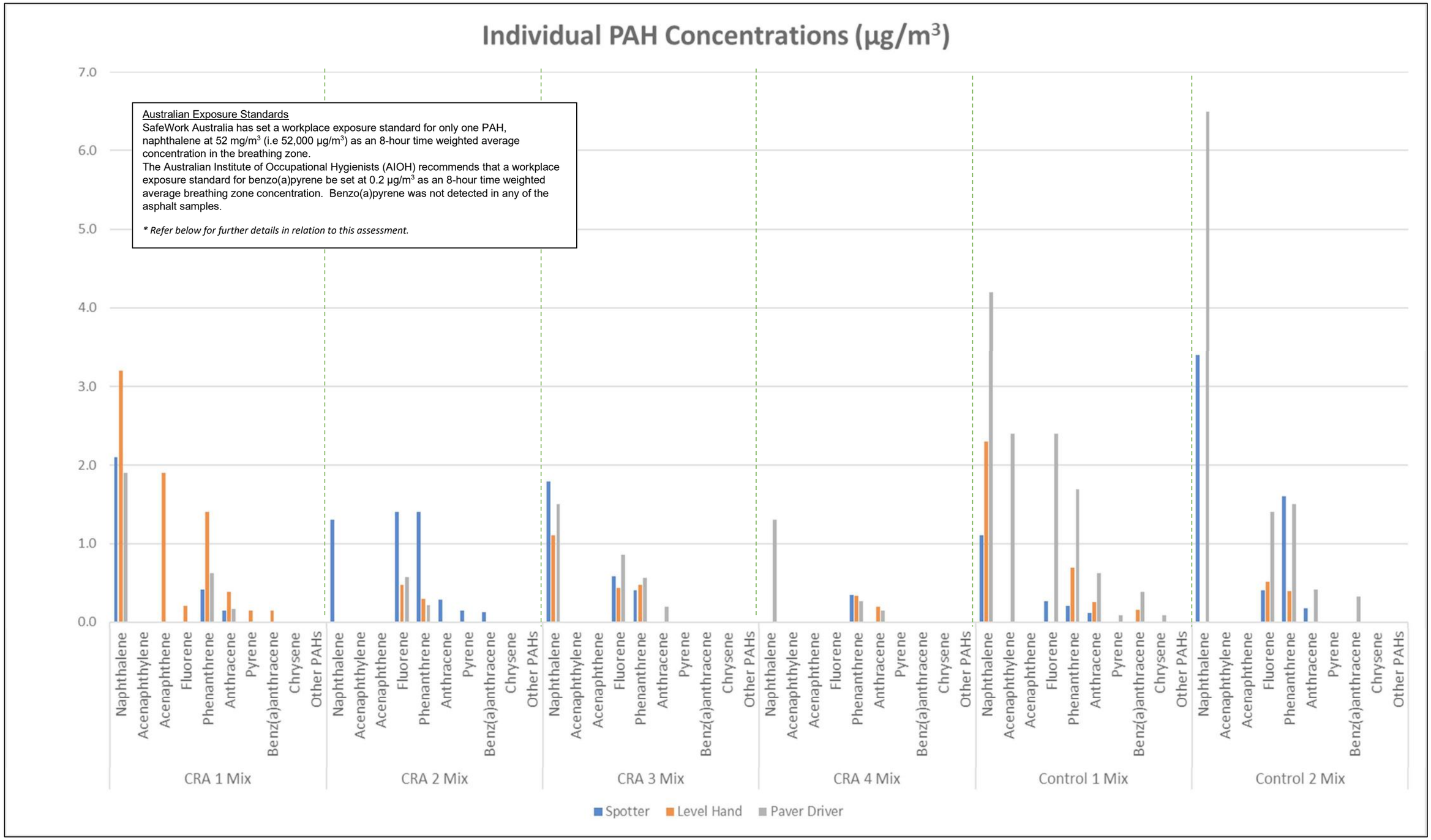
Comments: A number of studies asphalts working populations suggest that bitumen fumes are irritating to mucous membranes and that these symptoms increase with increasing temperature of the asphalt (Raulf-Heimsoth et al 2007, Moo et al 2019, IARC 2013). Safe Work Australia has set a time-weighted average workplace exposure standard for bitumen fume of 5 mg/m$^{3.}$

Conclusion: The results indicate that the bitumen fume exposure monitoring of the three members of the asphalting crew were generally higher for the two control mixes (range 0.16 mg/m^3 to 1.2 mg/m^3) than for any of the CRA mixes (range <0.1 mg/m^3 to 0.5 mg/m^3). Burr et al(2001) found no significant differences in bitumen fume exposure levels between crews paving with conventional asphalt mixes compared with CRA mixes.

Similarly to the TSP results, the highest bitumen exposure levels were for the Paver Driver for the control mixes (0.82 to 1.2 mg/m^3). This most likely indicates that bitumen fume particles constitute a significant portion of the TSP. Laying of most of the CRA mixes had non-detectable to barely detectable levels of bitumen fume exposure, except for the CRA 1 Mix, which showed exposure levels between 0.11 mg/m^3 to 0.5 mg/m^3. All bitumen fume levels were well below the SafeWork Australia bitumen fume workplace exposure standard over the monitoring period and, when calculated as 8-hour time-weighted average exposures, would be below approximately 10% of the standard.

Polycyclic Aromatic Hydrocarbons - cyclohexane soluble (PAHs)

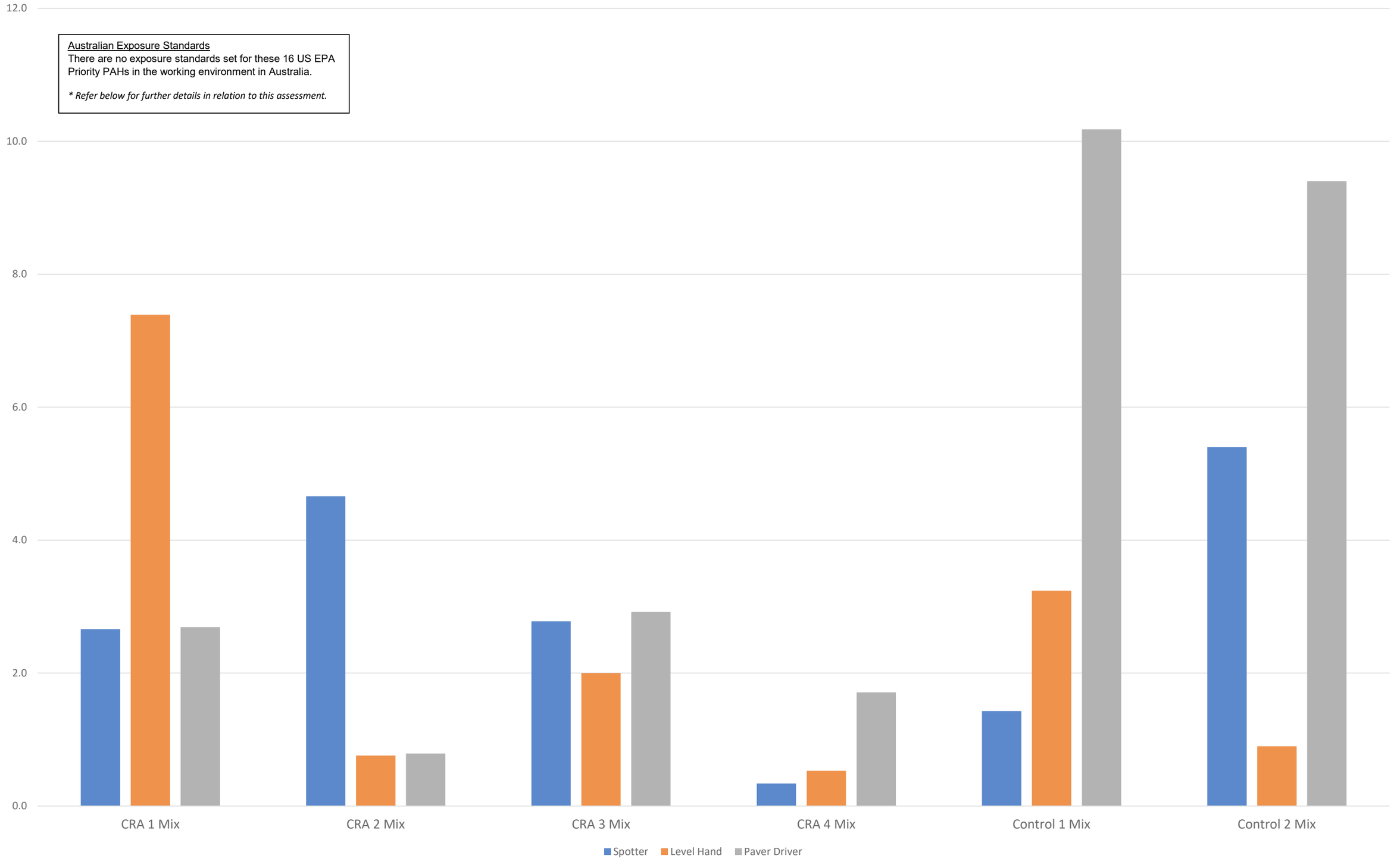
Trail	PAH	Breathing Zone PAH Concentration (µg/m³)		
		Spotter	Level Hand	Paver Driver
CRA 1 Mix	Naphthalene	2.1	3.2	1.9
	Acenaphthylene	<0.9	<1.1	<1.0
	Acenaphthene	<0.9	1.9	<1.0
	Fluorene	<0.09	0.21	<0.1
	Phenanthrene	0.41	1.4	0.62
	Anthracene	0.15	0.38	0.17
	Pyrene	<0.09	0.15	<0.1
	Benz(a)anthracene	<0.09	0.15	<0.1
	Chrysene	<0.09	<0.11	<0.1
	Other PAHs	ND	ND	ND
	TOTAL PAHs	2.66	7.39	2.69
CRA 2 Mix	Naphthalene	1.3	<1.3	<1.3
	Acenaphthylene	<1.3	<1.3	<1.3
	Acenaphthene	<1.3	<1.3	<1.3
	Fluorene	1.4	0.47	0.57
	Phenanthrene	1.4	0.29	0.22
	Anthracene	0.28	<0.1	<0.1
	Pyrene	0.15	<0.1	<0.1
	Benz(a)anthracene	0.13	<0.1	<0.1
	Chrysene	<0.1	<0.1	<0.1
	Other PAHs	ND	ND	ND
	TOTAL PAHs	4.66	0.76	0.79
CRA 3 Mix	Naphthalene	1.8	1.1	1.5
	Acenaphthylene	<1.1	<1.1	<1.1
	Acenaphthene	<1.1	<1.1	<1.1
	Fluorene	0.58	0.43	0.86
	Phenanthrene	0.40	0.47	0.56
	Anthracene	<0.1	<0.1	0.2
	Pyrene	<0.1	<0.1	<0.1
	Benz(a)anthracene	<0.1	<0.1	<0.1
	Chrysene	<0.1	<0.1	<0.1
	Other PAHs	ND	ND	ND
	TOTAL PAHs	2.78	2.0	2.92
CRA 4 Mix	Naphthalene	<1.2	<1.1	1.3
	Acenaphthylene	<1.2	<1.1	<1.1
	Acenaphthene	<1.2	<1.1	<1.1
	Fluorene	<0.12	<0.11	<0.11
	Phenanthrene	0.34	0.33	0.26
	Anthracene	<0.12	0.20	0.15
	Pyrene	<0.12	<0.11	<0.11
	Benz(a)anthracene	<0.12	<0.11	<0.11
	Chrysene	<0.12	<0.11	<0.11
	Other PAHs	ND	ND	ND
	TOTAL PAHs	0.34	0.53	1.71
Control 1 Mix	Naphthalene	1.1	2.3	4.2
	Acenaphthylene	<0.9	<0.9	2.4
	Acenaphthene	<0.9	<0.9	<0.9
	Fluorene	0.26	<0.09	2.4
	Phenanthrene	0.21	0.69	1.7
	Anthracene	0.12	0.25	0.62
	Pyrene	<0.09	<0.09	0.09
	Benz(a)anthracene	<0.09	0.16	0.38
	Chrysene	<0.09	<0.09	0.09
	Other PAHs	ND	ND	ND
	TOTAL PAHs	1.43	3.24	10.18
Control 2 Mix	Naphthalene	3.4	<2.0	6.5
	Acenaphthylene	<1.5	<2.0	<1.5
	Acenaphthene	<1.5	<2.0	<1.5
	Fluorene	0.40	0.51	1.4
	Phenanthrene	1.6	0.39	1.5
	Anthracene	0.18	<0.2	0.41
	Pyrene	<0.2	<0.2	<0.2
	Benz(a)anthracene	<0.2	<0.2	0.32
	Chrysene	<0.2	<0.2	<0.2
	Other PAHs	ND	ND	ND
	TOTAL PAHs	5.4	0.9	9.4


Individual PAH Concentrations (µg/m3)
Australian Exposure Standards
SafeWork Australia has set a workplace exposure standard for only one PAH, naphthalene at 52 mg/m3 (i.e 52,000 µg/m3) as an 8-hour time weighted average concentration in the breathing zone.
The Australian Institute of Occupational Hygienists (AIOH) recommends that a workplace exposure standard for benzo(a)pyrene be set at 0.2 µg/m3 as an 8-hour time weighted average breathing zone concentration. Benzo(a)pyrene was not detected in any of the asphalt samples.
* Refer below for further details in relation to this assessment.
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Pyrene
Benz(a)anthracene
Chrysene
Other PAHs
CRA 1 Mix
CRA 2 Mix
CRA 3 Mix
CRA 4 Mix
Control 1 Mix
Control 2 Mix
Spotter
Level Hand
Paver Driver

Total of 16 US EPA Priority PAHs µg/m³

Australian Exposure Standards
There are no exposure standards set for these 16 US EPA Priority PAHs in the working environment in Australia.

** Refer below for further details in relation to this assessment.*



Polycyclic Aromatic Hydrocarbons (PAH) Results Summary

Comments: Polycyclic Aromatic Compounds (PAHs) are molecules containing fused benzene ring systems. This structure includes the most basic two-ring naphthalene or four-ring pyrene and higher five-ring benzo(a)pyrene (B[a]P) and six-ring dibenzo(a,e)pyrene molecular compounds which are found in hundreds of PAH compounds. PAHs are wide spread in the environment and exposure may occur due to combustion processes such as bushfires, volcanic activity, automobile exhaust, cooking and cigarette smoking. PAHs are present in crude oils and crude oil products in low concentrations. Bitumen consists of a complex mixture of organic compounds, including polycyclic aromatic hydrocarbons (PAHs), which may vary in characteristics depending on the origin of the crude oil, refinery process, and additives. PAHs present in bitumen may become airborne and result in exposure to crews during paving operations. Measurement of PAHs is undertaken by quantifying 16 PAHs identified by the US EPA as posing the greatest concern, several of which are known to be potentially carcinogenic to humans.

An overseas study of asphalting crews have generally indicated that PAH exposure during conventional asphalt paving is similar to those during CRA paving, whilst others have indicated that CRA paving results in slightly higher PAH exposures to crews compared with conventional asphalt (Nilsson, 2018). Cavallari et al (2012) showed that PAH emissions from asphalt during paving are temperature-dependant.

SafeWork Australia has set a workplace exposure standard for only one PAH, naphthalene – the simplest PAH - at 52 mg/m^3 (10 ppm) as an 8-hour time weighted average concentration in the breathing zone. The Australian Institute of Occupational Hygienists (AIOH) recommends that a workplace exposure standard for benzo(a)pyrene (the most potent carcinogenic PAH) be set at 0.2 µg/m^3 as an 8-hour time weighted average breathing zone concentration.

Conclusion: The results of PAH monitoring indicate that the exposure of the three members of the asphalting crew to total 16 USEPA Priority PAHs were generally higher for the two control asphalt mixes (range 0.9 µg/m^3 to 10.18 µg/m^3) than for any of the CRA mixes (range 0.34 µg/m^3 to 7.39 µg/m^3). This is in contrast to the results of previous studies (Watt et al, 1998) and may reflect the slightly higher average temperatures of the Control mixes compared with the CRA mixes and the variations on weather conditions. The Paver Driver showed the highest median PAH exposures over all of the trials of the three crew members tested followed by the Spotter and then Level Hand. It should be noted that all three operators were smokers and therefore there is a potential contribution of PAH exposures from smoking in addition to that from asphalt fume exposure.

Naphthalene (a non-carcinogenic and the most volatile PAH) was the most prominent PAH with the highest levels measured being 6.6 µg/m^3 for the Paver Driver during laying of Control 2 Mix and 3.2µg/m^3 for the CRA 1 Mix. All levels of naphthalene were well below the SafeWork Australia workplace exposure standard of 52 mg/m^3 (52,000 µg/m^3). The major PAHs compounds detected were naphthalene, fluorene, phenanthrene, anthracene and pyrene, none of which are classified as carcinogenic PAHs. Three samples showed detectable levels of benz(a)anthracene (a carcinogenic PAH) being during the Control 2 Mix - Paver Driver 0.32 µg/m^3; Control 1 Mix – Paver Driver 0.38 µg/m^3 and CRA 2 Mix– Spotter 0.13 µg/m^3. Benz(a)pyrene (the most carcinogenically potent PAH) was not detected in any of the samples for either the Control or CRA mixes.

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Appendix 1 – Certificates of Analysis

NSW GOVERNMENT | SafeWork NSW

Test Safe AUSTRALIA

Robert Golec
AMCOSH Occupational Health Services
PO Box 686
WERRIBEE VIC 3030

Lab. Reference: 2020-1527

Samples analysed as received

SAMPLE ORIGIN: Job no. 9206 ARRB CRA Project

DATE OF INVESTIGATION: Various **DATE RECEIVED:** 1/04/20

ANALYSIS REQUIRED: VOC screen

REPORT OF ANALYSIS

See attached sheet(s) for sample description and test results.

The results of this report have been approved by the signatory whose signature appears below.

For all administrative or account details please contact the Laboratory.

Increment and total pagination can be seen on the following pages.

Martin Mazereeuw
Manager

Date: 6/04/20

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Accreditation No. 3726

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NSW GOVERNMENT | SafeWork NSW

Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 372 **Reference Number le : 2020-1527-1**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert* -Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 373 **Reference Number ie : 2020-1527-2**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 &/ 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 374 **Reference Number ie : 2020-1527-3**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 & 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 378 **Reference Number le : 2020-1527-4**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 & 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 932 **Reference Number le : 2020-1527-5**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 &/or 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 376 **Reference Number le : 2020-1527-6**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 & 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 371 **Reference Number le : 2020-1527-7**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 934 **Reference Number le : 2020-1527-8**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 &/ 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 933 **Reference Number le : 2020-1527-9**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 & 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 380 **Reference Number : 2020-1527-10**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 /& 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 936 **Reference Number : 2020-1527-11**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 & 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 937 **Reference Number : 2020-1527-12**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 931 **Reference Number : 2020-1527-13**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert* -Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 465 **Reference Number : 2020-1527-14**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 &/ 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 470 **Reference Number : 2020-1527-15**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	1	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 464 **Reference Number : 2020-1527-16**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 &/ 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 375 **Reference Number : 2020-1527-17**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 &/ 108-38-3	3	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	1	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	**Below**	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Test Safe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 462 **Reference Number : 2020-1527-18**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	*78-78-4*	ND	ND	39	Benzene	*71-43-2*	ND	ND
2	n-Pentane	*109-66-0*	ND	ND	40	Ethylbenzene	*100-41-4*	ND	ND
3	2-Methylpentane	*107-83-5*	ND	ND	41	Isopropylbenzene	*98-82-8*	ND	ND
4	3-Methylpentane	*96-14-0*	ND	ND	42	1,2,3-Trimethylbenzene	*526-73-8*	ND	ND
5	Cyclopentane	*287-92-3*	ND	ND	43	1,2,4-Trimethylbenzene	*95-63-6*	ND	ND
6	Methylcyclopentane	*96-37-7*	ND	ND	44	1,3,5-Trimethylbenzene	*108-67-8*	ND	ND
7	2,3-Dimethylpentane	*565-59-3*	ND	ND	45	Styrene	*100-42-5*	ND	ND
8	n-Hexane	*110-54-3*	ND	ND	46	Toluene	*108-88-3*	ND	ND
9	3-Methylhexane	*589-34-4*	ND	ND	47	p-Xylene &/or m-Xylene	*106-42-3 &/ 108-38-3*	ND	ND
10	Cyclohexane	*110-82-7*	ND	ND	48	o-Xylene	*95-47-6*	ND	ND
11	Methylcyclohexane	*108-87-2*	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	*540-84-1*	ND	ND	49	Acetone	*67-64-1*	ND	ND
13	n-Heptane	*142-82-5*	ND	ND	50	Acetoin	*513-86-0*	ND	ND
14	n-Octane	*111-65-9*	ND	ND	51	Diacetone alcohol	*123-42-2*	ND	ND
15	n-Nonane	*111-84-2*	ND	ND	52	Cyclohexanone	*108-94-1*	ND	ND
16	n-Decane	*124-18-5*	ND	ND	53	Isophorone	*78-59-1*	ND	ND
17	n-Undecane	*1120-21-4*	ND	ND	54	Methyl ethyl ketone (MEK)	*78-93-3*	ND	ND
18	n-Dodecane	*112-40-3*	ND	ND	55	Methyl isobutyl ketone (MIBK)	*108-10-1*	ND	ND
19	n-Tridecane	*629-50-5*	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	*629-59-4*	ND	ND	56	Ethyl alcohol	*64-17-5*	ND	ND
21	α-Pinene	*80-56-8*	ND	ND	57	n-Butyl alcohol	*71-36-3*	ND	ND
22	β-Pinene	*127-91-3*	ND	ND	58	Isobutyl alcohol	*78-83-1*	ND	ND
23	D-Limonene	*138-86-3*	ND	ND	59	Isopropyl alcohol	*67-63-0*	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	*104-76-7*	ND	ND
24	Dichloromethane	*75-09-2*	ND	ND	61	Cyclohexanol	*108-93-0*	ND	ND
25	1,1-Dichloroethane	*75-34-3*	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	*107-06-2*	ND	ND	62	Ethyl acetate	*141-78-6*	ND	ND
27	Chloroform	*67-66-3*	ND	ND	63	n-Propyl acetate	*109-60-4*	ND	ND
28	1,1,1-Trichloroethane	*71-55-6*	ND	ND	64	n-Butyl acetate	*123-86-4*	ND	ND
29	1,1,2-Trichloroethane	*79-00-5*	ND	ND	65	Isobutyl acetate	*110-19-0*	ND	ND
30	Trichloroethylene	*79-01-6*	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	*56-23-5*	ND	ND	66	Ethyl ether	*60-29-7*	ND	ND
32	Perchloroethylene	*127-18-4*	ND	ND	67	*tert* -Butyl methyl ether (MTBE)	*1634-04-4*	ND	ND
33	1,1,2,2-Tetrachloroethane	*79-34-5*	ND	ND	68	Tetrahydrofuran (THF)	*109-99-9*	ND	ND
34	Chlorobenzene	*108-90-7*	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	*95-50-1*	ND	ND	69	PGME	*107-98-2*	ND	ND
36	1,4-Dichlorobenzene	*106-46-7*	ND	ND	70	Ethylene glycol diethyl ether	*629-14-1*	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	*108-65-6*	ND	ND
37	Acetonitrile	*75-05-8*	ND	ND	72	Cellosolve acetate	*111-15-9*	ND	ND
38	n-Vinyl-2-pyrrolidinone	*88-12-0*	ND	ND	73	DGMEA	*112-15-2*	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Robert Golec **Date Sampled : Various**

Sample ID : 8111113 515 **Reference Number : 2020-1527-19**

No	Compounds	CAS No	Front µg/section	Back µg/section	No	Compounds	CAS No	Front µg/section	Back µg/section
	Aliphatic hydrocarbons (LOQ = 5µg/compound/section)					**Aromatic hydrocarbons** (LOQ = 1µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND	39	Benzene	71-43-2	ND	ND
2	n-Pentane	109-66-0	ND	ND	40	Ethylbenzene	100-41-4	ND	ND
3	2-Methylpentane	107-83-5	ND	ND	41	Isopropylbenzene	98-82-8	ND	ND
4	3-Methylpentane	96-14-0	ND	ND	42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
5	Cyclopentane	287-92-3	ND	ND	43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND	44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND	45	Styrene	100-42-5	ND	ND
8	n-Hexane	110-54-3	ND	ND	46	Toluene	108-88-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND	47	p-Xylene &/or m-Xylene	106-42-3 & 108-38-3	ND	ND
10	Cyclohexane	110-82-7	ND	ND	48	o-Xylene	95-47-6	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND		**Ketones** (LOQ #49, #54 & #55 =5µg/c/s; #50, #51, #52 & #53 =25µg/c/s)			
12	2,2,4-Trimethylpentane	540-84-1	ND	ND	49	Acetone	67-64-1	ND	ND
13	n-Heptane	142-82-5	ND	ND	50	Acetoin	513-86-0	ND	ND
14	n-Octane	111-65-9	ND	ND	51	Diacetone alcohol	123-42-2	ND	ND
15	n-Nonane	111-84-2	ND	ND	52	Cyclohexanone	108-94-1	ND	ND
16	n-Decane	124-18-5	ND	ND	53	Isophorone	78-59-1	ND	ND
17	n-Undecane	1120-21-4	ND	ND	54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
18	n-Dodecane	112-40-3	ND	ND	55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
19	n-Tridecane	629-50-5	ND	ND		**Alcohols** (LOQ = 25µg/compound/section)			
20	n-Tetradecane	629-59-4	ND	ND	56	Ethyl alcohol	64-17-5	ND	ND
21	α-Pinene	80-56-8	ND	ND	57	n-Butyl alcohol	71-36-3	ND	ND
22	β-Pinene	127-91-3	ND	ND	58	Isobutyl alcohol	78-83-1	ND	ND
23	D-Limonene	138-86-3	ND	ND	59	Isopropyl alcohol	67-63-0	ND	ND
	Chlorinated hydrocarbons (LOQ = 5µg/compound/section)				60	2-Ethyl hexanol	104-76-7	ND	ND
24	Dichloromethane	75-09-2	ND	ND	61	Cyclohexanol	108-93-0	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND		**Acetates** (LOQ = 25µg/compound/section)			
26	1,2-Dichloroethane	107-06-2	ND	ND	62	Ethyl acetate	141-78-6	ND	ND
27	Chloroform	67-66-3	ND	ND	63	n-Propyl acetate	109-60-4	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND	64	n-Butyl acetate	123-86-4	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND	65	Isobutyl acetate	110-19-0	ND	ND
30	Trichloroethylene	79-01-6	ND	ND		**Ethers** (LOQ = 25µg/compound/section)			
31	Carbon tetrachloride	56-23-5	ND	ND	66	Ethyl ether	60-29-7	ND	ND
32	Perchloroethylene	127-18-4	ND	ND	67	*tert*-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	68	Tetrahydrofuran (THF)	109-99-9	ND	ND
34	Chlorobenzene	108-90-7	ND	ND		**Glycols** (LOQ = 25µg/compound/section)			
35	1,2-Dichlorobenzene	95-50-1	ND	ND	69	PGME	107-98-2	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND	70	Ethylene glycol diethyl ether	629-14-1	ND	ND
	Miscellaneous (LOQ #37= 5µg & #38=25µg/compound/section)				71	PGMEA	108-65-6	ND	ND
37	Acetonitrile	75-05-8	ND	ND	72	Cellosolve acetate	111-15-9	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND	73	DGMEA	112-15-2	ND	ND
	Total VOCs (LOQ =50µg/compound/section)		ND	ND		Worksheet check		yes	yes

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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

ND = Not Detected

Method : Analysis of Volatile Organic Compounds in Workplace Air by Gas Chromatography/Mass Spectrometry
Method Number : WCA.207
Limit of Quantitation : 5µg/section; 25µg/section for oxygenated hydrocarbons except acetone, MEK and MIBK at 5µg/section.
Brief Description : Volatile organic compounds are trapped from the workplace air onto charcoal tubes by the use of a personal air monitoring pump. The volatile organic compounds are then desorbed from the charcoal in the laboratory with CS_2. An aliquot of the desorbant is analysed by capillary gas chromatography with mass spectrometry detection.

PGME : Propylene Glycol Monomethyl Ether
PGMEA : Propylene Glycol Monomethyl Ether Acetate
DGMEA : Diethylene Glycol Monoethyl Ether Acetate

Measurement Uncertainty
The measurement uncertainty is an estimate that characterises the range of values within which the true value is asserted to lie. The uncertainty estimate is an expanded uncertainty using a coverage factor of 2, which gives a level of confidence of approximately 95%. The estimate is compliant with the "ISO Guide to the Expression of Uncertainty in Measurement" and is a full estimate based on in-house method validation and quality control data.

Quality Assurance
In order to ensure the highest degree of accuracy and precision in our analytical results, we undertake extensive intra- and inter-laboratory quality assurance (QA) activities. Within our own laboratory, we analyse laboratory and field blanks and perform duplicate and repeat analysis of samples. Spiked QA samples are also included routinely in each run to ensure the accuracy of the analyses. WorkCover Laboratory Services has participated for many years in several national and international inter-laboratory comparison programs listed below:-

- Workplace Analysis Scheme for Proficiency (WASP) conducted by the Health & Safety Executive UK;
- Quality Management in Occupational and Environmental Medicine QA Program, conducted by the Institute for Occupational, Social and Environmental Medicine, University of Erlangen – Nuremberg, Germany;
- Quality Control Technologies QA Program, Australia;
- Royal College of Pathologists QA Program, Australia.

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e enquiries@leeder-analytical.com

AMCOSH Pty Ltd
Suit 3&4/112 Synnot Street
Werribee
VIC 3030
Attn: Robert Golec

REPORT NUMBER: L200120A
Your Reference: Back Section
Order No: 9206
Date: 28th April 2020

CERTIFICATE OF ANALYSIS

SAMPLES: Seven samples were received for analysis of back section

DATE SAMPLES RECEIVED: 1st April 2020

DATE ANALYSIS REQUESTED: 27th April 2020

METHOD: LAA-405-Benzothiazole by GC/MS/MS

RESULTS:

Please refer to attached pages for the results.

Results are based on the samples received and analysed by Leeder Analytical

This report cannot be reproduced except in full.

REPORT BY:

Dr John F Leeder (BAppSci, MBA, PhD, FRACI, CCHEM)

Principal

Analytical Results

Matrix: Filter and Tube Back Section		Leeder ID	L200120-5	L200120-13	L200120-15	L200120-17	L200120-31
		Client ID	153/3 7119703084 15/03/2020	173/1 7119703049 17/03/2020	173/2 7119703046 17/03/2020	173/3 7119703048 17/03/2020	233/1 7119703149 23/03/2020
ANALYTE	CAS No	PQL					
LAA-405 NIOSH							
Benzothiazole	95-16-9	0.005	1.9	6.6	2.4	1.0	0.84

		Leeder ID	L200120-33	L200120-35			
		Client ID	233/2 7119703146 23/03/2020	233/3 7119703151 23/03/2020			
ANALYTE	CAS No	PQL					
LAA-405 NIOSH							
Benzotriazole	95-16-9	0.005	2.8	0.6			

Results expressed in ug/tube on an as received basis.

PQL - Practical Quantitation Limit, nd-not detected, less than PQL.

Quality Control Results

Matrix: Filter and Tube

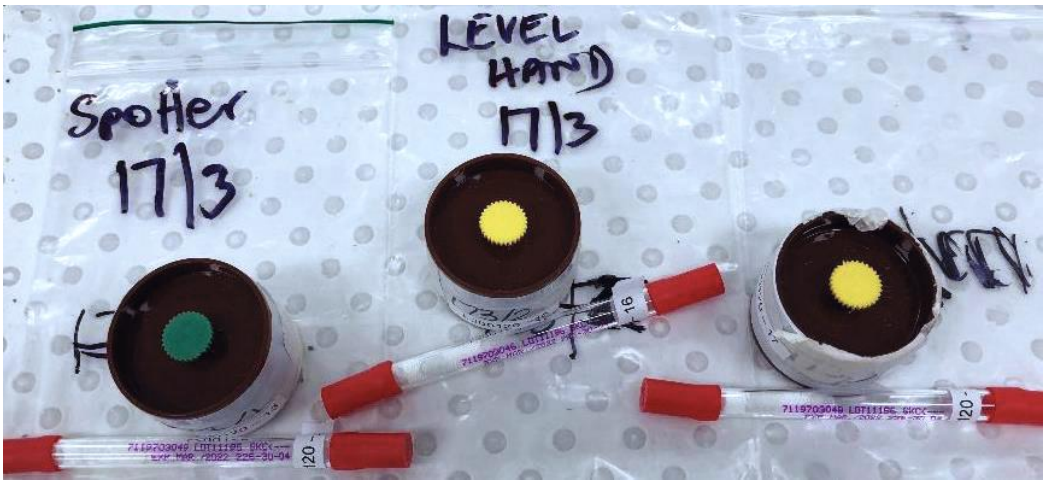
		Leeder ID					
		Client ID	Laboratory Control Sample	Laboratory Control Sample dup	Method Blank		
ANALYTE	CAS No						
Benzothiazole	95-16-9	% Recovery	93	87	nd		

Results expressed as percentage recovery

PQL - Practical Quantitation Limit, nd-not detected, less than PQL.

Leeder Analytical

APPENDIX 2 – PHOTOS



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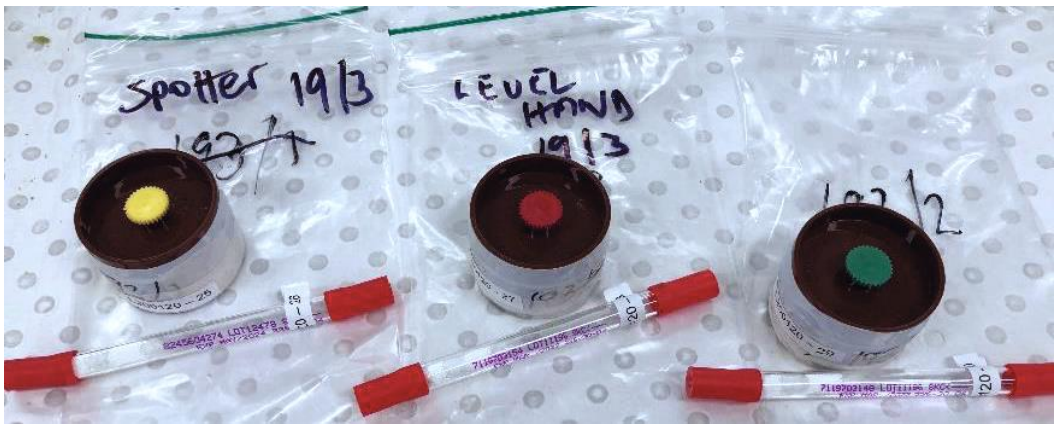
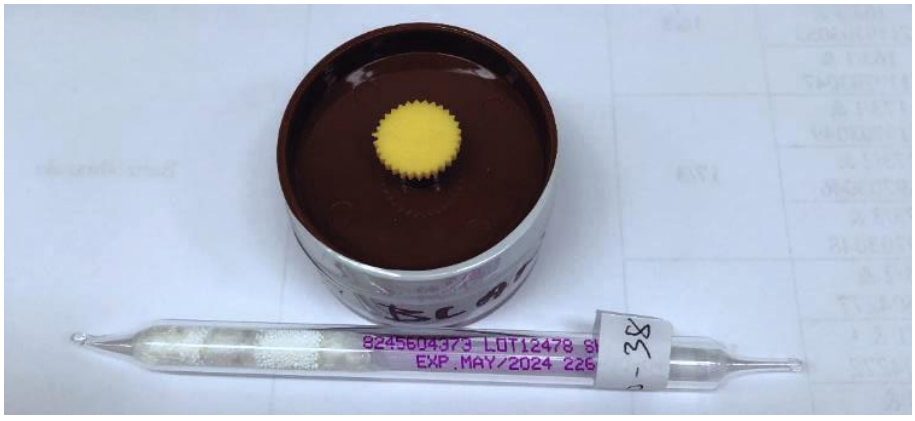


Leeder Analytical



Leeder Analytical

APPENDIX 3 – EXTRACTION & ANALYSIS DATES

Test Method	Date Extracted	Date Analysed
LAA-405 NIOSH Benzothiazole by GC/MS/MS	27/4/20	27/4/20

Simtars
Safety in Mines Testing and Research Station

2 Robert Smith Street, Redbank Q 4301
www.simtars.com.au

Analysis Report

Report Number	OL693974N1
Report Issue Date	May 26, 2020
Report To	Robert Golec AMCOSH Pty Ltd 3-4/112 Synnot Street, Werribee, VIC, 3030
Client Reference	Job/Order No.:9206
Job Description	18 x SKC 226-30-04 tubes for 16 x PAH Analysis 18 x Filters for CTPV Analysis (TPM, CSF and 16 x PAH's)
Date Received	April 6, 2020
Date Tested/Completed	April 24, 2020
Responsibility for Sampling	Client
Approved Signatory	Bryan Mead - Senior Chemist

Accredited for compliance with ISO/IEC 17025 Testing. Accreditation Number 2681.

Report Number: OL693974N1

Results for CTPV Analysis:

Laboratory Number	Sample Identification	Dust Weight (mg)	CSF (mg)	Naphthalene (µg)	Acenaphthylene (µg)	Acenaphthene (µg)	Fluorene (µg)	Phenanthrene (µg)	Anthracene (µg)	Fluoranthene (µg)	Pyrene (µg)	Benz(a)anthracene (µg)	Chrysene (µg)	Benzo(b)fluoranthene (µg)	Benzo(k)fluoranthene (µg)	Benzo(a)pyrene (µg)	Dibenz(a,h)anthracene (µg)	Benzo(g,h,i)perylene (µg)	Indeno(1,2,3-cd)pyrene (µg)
OL693974/01	L4477	0.07	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/02	L4482	0.09	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/03	L4484	0.09	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/04	L4480	0.23	0.07	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/05	L4468	0.12	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/06	L4467	0.50	0.28	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.11	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/07	L4472	0.17	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.06	0.05	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/08	L4485	0.07	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/09	L4466	0.08	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/10	L4475	0.12	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/11	L4476	0.18	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/12	L4470	0.15	0.06	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/13	L4481	0.19	0.09	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/14	L4465	0.42	0.28	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.09	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/15	L4473	0.84	0.69	<LOR	<LOR	<LOR	<LOR	0.07	<LOR	<LOR	0.05	0.21	0.05	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/16	L4464	0.16	0.06	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/17	L4486	0.37	0.22	<LOR	<LOR	<LOR	<LOR	0.07	<LOR	<LOR	0.06	0.07	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/18	L4469	0.18	0.12	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Limit of Reporting (LOR)		**0.01**	**0.05**	**0.5**	**0.5**	**0.5**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**

Reference:

Coal Tar Pitch Volatiles (CTPV) by gravimetric and HPLC using SIMTARS in-house procedure LP0183

Report Number: OL693974N1

Results for PAH Analysis:

Laboratory Number	Sample Identification	Naphthalene* (µg)	Acenaphthylene (µg)	Acenaphthene (µg)	Fluorene (µg)	Phenanthrene (µg)	Anthracene (µg)	Fluoranthene (µg)	Pyrene (µg)	Benz(a)anthracene (µg)	Chrysene (µg)	Benzo(b)fluoranthene (µg)	Benzo(k)fluoranthene (µg)	Benzo(a)pyrene (µg)	Dibenz(a,h)anthracene (µg)	Benzo(g,h,i)perylene (µg)	Indeno(1,2,3-cd)pyrene (µg)
OL693974/24	7119703075	*0.8**	<LOR	<LOR	0.26	0.18	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/25	7119703082	*0.5**	<LOR	<LOR	0.20	0.22	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/26	7119703079	*0.6**	<LOR	<LOR	0.35	0.23	0.06	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/27	7119703050	*1.1**	<LOR	<LOR	0.14	0.28	0.06	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/28	7119703045	*<LOR**	<LOR	<LOR	0.13	0.10	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/29	7119703080	*2.2**	<LOR	<LOR	0.49	0.51	0.14	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/30	7119703051	*0.5**	<LOR	<LOR	0.54	0.53	0.11	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/31	7119703054	*<LOR**	<LOR	<LOR	0.18	0.11	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/32	8245604273	*<LOR**	<LOR	<LOR	0.18	0.08	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/33	8245604275	*<LOR**	<LOR	<LOR	<LOR	0.14	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/34	8245604271	*<LOR**	<LOR	<LOR	<LOR	0.15	0.09	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/35	8245604279	*0.6**	<LOR	<LOR	<LOR	0.12	0.07	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/36	8245604278	*0.6**	<LOR	<LOR	0.15	0.12	0.07	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/37	7119703147	*1.3**	<LOR	<LOR	<LOR	0.39	0.14	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/38	8245604270	*2.3**	1.3	<LOR	1.31	0.87	0.34	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/39	7119703145	*1.1**	<LOR	<LOR	<LOR	0.22	0.08	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/40	7119703152	*1.5**	<LOR	0.9	0.10	0.58	0.18	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
OL693974/41	7119703153	*1.0**	<LOR	<LOR	<LOR	0.32	0.09	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Limit of Reporting (LOR)		***0.5***	**0.5**	**0.5**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**

** Naphthalene QC results for the independent calibration curve check standard included did not fall within acceptable limits. Naphthalene results should be considered qualitative and are given for indicative purposes only. (There is potentially some over-estimation of naphthalene. As a guide, it is possible real values may be as low as around 60% of figures given.) - Bryan Mead, Senior Chemist.*

Reference:
Polynuclear aromatic hydrocarbons (PAH) by HPLC using SIMTARS in-house procedure LP0196