

Resene Paints Limited, Upper Hutt



AIR DISCHARGE MONITORING OF THE FACTORY EXTRACTION SYSTEM,
DECEMBER 2017

Issue

February 2018

Resene Paints Limited, Upper Hutt

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Approved by

Name	Title	Signature
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Tests indicated as not accredited are outside the scope of the laboratory's accreditation

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Executive Summary

Source Testing New Zealand Limited (STNZ) was commissioned by Resene Paints Limited (Resene) to undertake air discharge monitoring of their Upper Hutt factory extraction manufacturing facility. The objective of the monitoring is to confirm compliances with the Company's Resource Consent (WGN160337[34175]).

The particulate discharge concentrations from the Resene Upper Hutt factory extraction system measured on 4 December 2017 ranged from <0.4 to 1.7 mg/m³ adjusted to 0 °C, one atmosphere pressure and dry gas basis (mg/Sm³) with an average of 0.8 mg/Sm³. The particulate matter mass emission ranged from <0.005 to 0.020 kg/hr with an average of 0.010 kg/hr.

All three test results were below the particulate discharge limit of 10 mg/Sm³ stipulated in Condition 8 of the Company's Air Discharge Permit.

The Total VOCs (expressed as Toluene) discharge concentrations from the Resene Upper Hutt factory extraction system measured on 4 December 2017 ranged from 116 to 664 mg/m³ adjusted to 0 °C, one atmosphere pressure and dry gas basis (mg/Sm³) with an average of 407 mg/Sm³. The Total VOCs (expressed as Toluene) mass emission ranged from 1.53 to 7.54 kg/hr with an average of 4.80 kg/hr.

The average Total VOCs (expressed as toluene) concentration measured at the Resene Upper Hutt factory extraction system on 23 January 2018 was 407 mg/Sm³, which exceeds the discharge limit of 150 mg/Sm³ stipulated in Condition 8 of the Company's Air Discharge Permit.

1. Introduction

Source Testing New Zealand Limited (STNZ) was commissioned by Resene Paints Limited (Resene) to undertake air discharge monitoring of their Upper Hutt factory extraction manufacturing facility. The objective of the monitoring is to confirm compliances with the Company's Resource Consent (WGN160337[34175]). The following conditions of the consent relate to the air discharge monitoring:

Discharge Limits

8. Notwithstanding conditions 1 and 3, discharges to air relating to the exercise of this consent shall not exceed the following concentrations from the paint production plant extraction system as measured at the monitoring position on the stack:

- *Total particulate: 10 mg/m³ (at STP, dry gas basis)*
- *Total VOCs (expressed as Toluene): 150 mg/m³ (at STP, dry gas basis)*

The concentration shall be determined according to the requirements defined in Condition 9 of this consent.

Air emission testing

9. The consent holder shall conduct an emission testing programme annually for the first 5 (five) years of this consent within one month of the anniversary of the granting of the consent, and thereafter at intervals to be determined by consultation with, and to the satisfaction of, the Manager, Environmental Regulation, Wellington Regional Council; following the assessment of the year 5 (2021) Air Emission Testing Report detailed in condition 11.

The emission testing programme shall be to the satisfaction of, the Manager, Environmental Regulation, Wellington Regional Council; and shall quantify the discharges of particulates and VOCs from the plant. The consent holder shall ensure that the following contaminants will be sampled in the stack for:

- *Total particulate and VOC concentrations from the stack (to be reported as mg/m³ for each sample and as a mean of all samples for each stack)*
- *Stack gas volumetric flow rate from each stack (to be reported at actual and standard condition for each sample and as a mean of all samples for each stack)*
- *Stack gas velocity from each stack (to be reported at actual condition for each sample and as a mean of all samples for each stack)*
- *The mass emission rate shall be determined as the mean of a minimum of three samples, each collected as per United States Environmental Protection Agency (USEPA) Test Methods 5 and 18.*

10. All sampling techniques employed in respect of the conditions of this consent shall be to the satisfaction of, the Manager, Environmental Regulation, Wellington Regional Council. All analysis shall be performed by an International Accreditation New Zealand (IANZ) registered laboratory or otherwise specifically approved by the Manager, Environmental Regulation, Wellington Regional Council.

Matthew Newby, Senior Air Quality Scientist with STNZ performed the testing on 4 December 2017. Matthew has over 20 year's air quality monitoring and consulting experience and is designated as a Key Technical Person under STNZ's IANZ accreditation. Matthew is also a Certified Air Quality Professional (CAQP) under the Clean Air Society of Australia and New Zealand (CASANZ) certification process. This report presents the air discharge monitoring results and compares them to the Company's Air Discharge Permit.

2. Sampling Methodologies

Table 1 summarises the testing methodologies used by STNZ for VOC discharge monitoring. Three separate samples were collected in accordance with USEPA protocols.

The air discharge monitoring was performed in accordance with the USEPA Methods set out in Table 1. Three separate samples were collected in accordance with USEPA protocols. Particulate matter analysis was conducted by STNZ staff in Wellington in accordance with the below methods while the VOC analysis was conducted by R J Hill Laboratories, Hamilton.

■ Table 1: Sampling Methods

Contaminant	STNZ Standard Test Methods	IANZ Accredited
Sampling Points	Method 1 "Sample and Velocity Traverse for Stationary Sources"	Yes
Velocity & Volumetric Flow Rate	Method 2 "Determination of Stack Gas Velocity and Volumetric Flow rate (Type "S" Pitot Tube)"	Yes
Dry Molecular Weight Determination	Method 3 "Gas Analysis For The Determination Of Dry Molecular Weight"	Yes
Moisture Content Determination	Method 4 "Determination of Moisture Content in Stack Gases"	Yes
Total Particulate Matter Determination	Method 5 "Determination of Particulate Emissions From Stationary Sources"	Yes
Determination of Volatile Organic Compounds	Method 18 "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"	Yes

2.1.1 Stack Sampling Locations

Table 2 describes the sampling point characteristics of the Upper Hutt Factory extraction system outlet. The sampling port was located approximately 3 m downstream from a silencer and approximately 2 m upstream of the outlet of the stack. The sampling location met the requirements of USEPA Method 1 provided a total of 12 points were sampled. The observed flow distribution was even, allowing for the collection of representative samples.

■ Table 2 Sampling Locations

Source	Port	Dimensions	Up Stream from Disturbances (Equ Stack Dia)		Down Stream from Disturbances (Equ Stack Dia)		No. of Sampling Lines	No. of Sampling Points	
Extraction system outlet	2 x 100 mm BSP	Circular 0.45 m	4.4	2.0	7.8	8	2	6	12

Note: Values highlighted in grey represent the method ideal requirement.

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2.1.2 Stack Gas Velocity

Stack temperatures were measured using a K Type thermocouple connected to a digital thermometer. Stack gas velocities were measured at specific points across the duct using an S Type Pitot tube connected to a digital manometer in accordance with USEPA Methods 1 & 2. These measurements were conducted prior to the collection of each of the three samples. The gas velocities were used to determine volumetric flow rates and mass discharge rates for each sample.

2.1.3 Gaseous Products of Combustion

As the stack gas was primarily ambient air, USEPA Method 3 was used to determine the molecular weight based on an oxygen and carbon dioxide concentration of 20.8 % and 0.0 % respectively.

2.1.4 Particulate Matter

Particulate matter was withdrawn isokinetically from the source and collected on a glass fibre filter maintained at a temperature of $120\text{ }^{\circ}\text{C} \pm 14\text{ }^{\circ}\text{C}$. The particulate mass was determined gravimetrically, after the removal of un-combined water. This approach conforms to USEPA Method 5 “Determination of Particulate Matter from Stationary Sources”. Particulate analysis was performed by STNZ staff in Wellington.

2.1.5 Volatile Organic Compounds

Air discharge monitoring for Total VOCs (expressed as Toluene) was conducted in accordance with Method 18 – “Measurement of Gaseous Organic Compounds Emissions by Gas Chromatography” with analysis performed in accordance with NIOSH Method 1500 “Hydrocarbons”.

Stack gases were withdrawn from the source using a stainless-steel sampling manifold. The sample stream was passed through dual charcoal sorbent tubes in parallel at a rate of approximately 1.5 L/min. As per the method requirements, one of the tubes had been spiked with 3,500 μg to help identify any matrix interferences. The samples were then forwarded to R. J. Hill Laboratories, Hamilton where carbon disulphide was used to desorb VOC. The extract was subsequently analysed by Gas Chromatography – Flame Ionisation Detector/ Flame Ionisation Detector (GC-FID/FID).

While STNZ is IANZ accredited for the sampling portion of Method 18, R. J. Hill Laboratories are not IANZ accredited for Total VOCs (expressed as toluene) analysis. However, R. J. Hill Laboratories are a well-respected IANZ accredited laboratory and STNZ has worked with the air quality department for over 20 years.

3. Plant Operating Conditions

On 4 December 2017, the plant was operating normally producing a range of solvent born paints and coatings. During sampling the following products were being manufactured:

- True Prime Pacific Blue;
- Woodsman Wood Oil Stain;
- Vinyl Wallpaper Sealer;
- Auckland Drum Black;
- RAPC A/Thane 805 White; and
- Rali Etch Reducer.

4. Air Discharge Monitoring Results

4.1 Particulate Air Discharge Monitoring Results

Presented below are the results of the particulate air discharge monitoring of the Resene Upper Hutt factory extraction system conducted on 4 December 2017. Table 4 presents the results of the particulate emission testing with Table 5 outlining a summary of the relevant stack data. Appendix A presents the raw sampling data. Appendix B contains the moisture content and mass determination calculations.

■ Table 3: Particulate Matter Discharge Results, December 2017

Sampling Run	Sampling Date	Sampling Period	Volume Sampled (m ³)	Stack Flow Rate (m ³ /h) ¹	Mass (mg)	Conc, (mg/m ³) ¹	Emission Rate (kg/h)
PM Run 1	04-12-17	9:05 - 10:13	1.230	13,124	<0.5	<0.4	<0.005
PM Run 2	04-12-17	11:06 - 12:12	1.169	12,098	0.4	0.4	0.005
PM Run 3	04-12-17	13:38 - 13:43	1.125	11,358	2.0	1.7	0.020

1. Corrected to 0 °C, 101.3 kPa, dry gas basis.

■ Table 4: Summary of Stack Conditions, December 2017

Source	Average Temp. (°C)	Average Moisture Content (% v/v)	Average Velocity (m/s)	Average Volumetric Flow Rate (m ³ /hr)
Factory Extraction System	24.7	1.1	23.4	13,416

1. Actual conditions

The particulate discharge concentrations from the Resene Upper Hutt factory extraction system measured on 4 December 2017 ranged from <0.4 to 1.7 mg/m³ adjusted to 0 °C, one atmosphere pressure and dry gas basis (mg/Sm³) with an average of 0.8 mg/Sm³. The particulate matter mass emission ranged from <0.005 to 0.020 kg/hr with an average of 0.010 kg/hr.

All three test results were below the particulate discharge limit of 10 mg/Sm³ stipulated in Condition 8 of the Company's Air Discharge Permit.

4.1.1 Particulate Quality Control Data

Tables 6 and 7 present the relevant quality control parameters for the particulate emission testing. In addition, all equipment was calibrated and maintained as per the STNZ Air Quality Equipment Manual (available on request).

■ **Table 5: Sampling Quality Control Data**

Sampling Run	Pre-Test Leak Check Vacuum (kPa)	Pre-Test Leak Rate (cc/min)	Post-Test Leak Check Vacuum (kPa)	Post-Test Leak Rate (cc/min)	Isokinetic Deviation (%)
Method Specs	> -70	<570	> -70	<570	+/-10
PM Run 1	69	0	69	100	3.9
PM Run 2	69	160	69	290	-1.7
PM Run 3	69	270	69	300	0.79

■ **Table 6: Mass Determination Quality Control Data**

	Field Blank Mass (g)	Acetone Blank (g)
Pre	0.0580	99.9335
Post	0.0580	99.9330
Diff	0.0000	-0.0005

All quality control parameters were within the methods specification.

4.2 VOC Air Discharge Monitoring Results

Presented below are the results of the Total VOCs (expressed as Toluene) air discharge monitoring of the Resene Paints Ltd, Upper Hutt factory extraction system measured on 4 December 2017. Table 7 presents the VOC (expressed as Toluene) air discharge monitoring results with the raw sampling data presented in Appendix C, with Appendix D containing the raw analytical report.

■ **Table 7: Total VOCs (expressed as Toluene) Discharge Results, December 2017**

Sampling Run	Sampling Date	Sampling Period	Volume Sampled (m ³)	Stack Flow Rate (m ³ /h) ¹	Mass (mg)	Conc, (mg/m ³) ¹	Emission Rate (kg/h)
VOC Run 1	04-12-17	9:05 - 10:13	0.0920	13,124	10.7	116	1.53
VOC Run 2	04-12-17	11:06 - 12:12	0.0862	12,091	38.1	442	5.34
VOC Run 3	04-12-17	13:38 - 14:40	0.0754	11,358	50.0	664	7.54

1. Corrected to 0 °C, 101.3 kPa, dry gas basis.

The Total VOCs (expressed as Toluene) discharge concentrations from the Resene Upper Hutt factory extraction system measured on 4 December 2017 ranged from 116 to 664 mg/m³ adjusted to 0 °C, one atmosphere pressure and dry gas basis (mg/Sm³) with an average of 407 mg/Sm³. The Total VOCs (expressed as Toluene) mass emission ranged from 1.53 to 7.54 kg/hr with an average of 4.80 kg/hr.

The average Total VOCs (expressed as toluene) concentration measured at the Resene Upper Hutt factory extraction system on 4 December 2017 was 407 mg/Sm³, which exceeds the discharge limit of 150 mg/Sm³ stipulated in Condition 8 of the Company's Air Discharge Permit.

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4.2.1 Total VOCs Sampling Quality Control

To ensure the quality of the obtained test result a field blank and field spike were performed. The results of the field blank show the concentration of VOC to be less than the method detection limit indicating the sorbent tubes had not been contaminated. The results of the field and laboratory spikes showed excellent desorption (recovery) efficiencies of 100 % and 99 % respectively. Furthermore, while VOCs were detected in the back half of the sorbent tubes, the masses were all less than 1 % of the front half indicating no significant breakthrough had occurred.

However, only the sample spike for Run 3 met the recovery requirements of 0.7 to 1.3. This was most likely due to the high mass of toluene added to the spikes masking some of the matrix effects. Given the good blank and spike recoveries, the sample masses only were used to calculate the Total VOCs (expressed as Toluene) emissions. While not ideal, the observed concentrations were low when compared with the consent limits and the approach was deemed acceptable.

Appendix A Raw Particulate Sampling Data

This appendix contains 5 page including cover

The data presented in the Tecora G4 data sheets are based on assumed moisture contents. The tabulated data presented is based on actual measured moisture content. As a result, the corrected volumetric flow rates may differ between the two data sheets.

Sample Description:	PM Run 1	PM Run 2	PM Run 3	Averages
Sampling Date:	04-12-17	04-12-17	04-12-17	
Filter ID:	ST1228	ST1229	ST1012	
Sampling Period:	9:05 - 10:13	11:06 - 12:12	13:38 - 13:43	
Total Sample Time (minutes)	55	60	60	
Nozzle Diameter (mm)	4.46	4.46	4.46	
Nozzle Area (m ²)	0.0000156	0.0000156	0.0000156	
DGM Calibration Factor	0.995	0.995	0.995	
Initial DGM Reading	1536.1252	1538.7685	1540.7704	
Final DGM Reading	1538.6446	1540.7612	1542.6134	
DGM Sample Volume (m ³):	2.5194	1.9927	1.8430	
DGM Std. Sample Volume (m ³):	1.2295	1.1687	1.1249	
Initial Leak Test Vacuum (kPa):	69	69	69	
Initial Leak Test Flow Rate (cc/min):	0	160	270	
Final Leak Test Vacuum (kPa):	69	69	69	
Final Leak Test Flow Rate (cc/min):	100	290	300	
Moisture Collected (g):	10.4	11.3	11.0	
Moisture Content (%):	1.0	1.2	1.2	1.1
TCR DGM Sample Volume (m ³):	2.4179	1.9687	1.7893	
Sampling Plane Mean Velocity (m/s):	25.4	22.8	22.1	23.4
TCR Isokinetic Deviation (%):	NA	-1.8	-0.8	
Actual Isokinetic Deviation (%):	3.9	-1.7	0.8	
Duct Volumetric Flow Rates				
Moist (m ³ /h):	14,534	13,059	12,656	13,416
Moist Standards (m ³ /h):	13,262	12,236	11,497	
Dry Standard (m ³ /h):	13,124	12,091	11,358	
Mean Temperatures				
At Sampling Plane (°C):	26.9	19.1	28.2	24.7
At DGM (°C):	35.3	31.4	29.8	
Ambient Pressure (kPa):	101.566	101.573	101.562	
Stack Absolute Pressure (kPa)	101.643	101.554	101.530	
Dry Gas Meter Pressure (kPa)	56.127	66.599	68.927	

For PM Run 1 there was an intermittent issue with the stack gas thermocouple. Data calculated based on the incorrect temperature was removed from the data set.

Resene Paints Limited
 Air Discharge Monitoring of the Factory Extraction System
 December 2017

Resene Run 1
Isokinetic sampling 04/12/2017 09:08:47

MACHINE INFORMATION

Master Firmware v1.9.2000
 Master Serial Number 11420234P
 Slave Firmware v0.7.7000
 Slave Serial Number 11420234P
 Last calibration date Refer to the STNZ Equipment Register
 Comments: Intermittant issues wit the stack gas thermocouple resulted in inaccurate data being recorded. This data has been removed for calculation purposes.

CV GAMMA [η] CALIBRATION

Point	Flowrate	Gamma
1	0	1

POINT LIST

start ts [timestamp]	Port [##]	Point [##]	Distance [c.m]	Elapsed Time [hh:mm:ss]	t _{stack} avg [°C]	t _{egm} avg [°C]	P _{stat} avg [kPa]	P _c avg [kPa]	dP pitot avg [Pa]	P _{inc} avg [kPa]	P _{amb} avg [kPa]	v _s avg [m/s]	qVn avg [m ³ /min]	DI [%]	v _n avg [m/s]	Q _{Va} [m ³ /s]	Q _{Vn} [m ³ /s]	Q _{Vn} [m ³ /s]	V _{gn} [H]	V _{gp} [H]	V _{dgm} [H]
04-12-17 9:08:50	1	1	2	0:05:00	19.846	23.907	0.005	101.571	526.106	55.064	101.566	25.055	22.287	-3.1	24.263	14345	13408	13207	111.59	120.89	222.7
04-12-17 9:13:53	1	2	6.6	0:05:00																	
04-12-17 9:24:30	1	3	13.4	0:05:00	25.567	24.962	0.063	101.629	530.539	55.831	101.566	25.405	22.203	-2.9	24.643	14545	13343	13143	111.09	122.67	219.5
04-12-17 9:29:34	1	4	31.7	0:05:00	25.952	25.549	0.07	101.636	523.446	56.525	101.566	25.251	22.133	-2.5	24.595	14457	13246	13047	111.21	122.94	217.45
04-12-17 9:34:40	1	5	38.5	0:05:00																	
04-12-17 9:39:42	1	6	43.1	0:00:13																	
04-12-17 9:42:17	2	1	2	0:05:01	28.535	27.095	0.081	101.647	524.429	56.423	101.566	25.381	22.076	-2.5	24.745	14532	13201	13003	110.8	123.55	218.2
04-12-17 9:47:23	2	2	6.6	0:05:00	30.626	27.37	0.092	101.658	530.435	56.845	101.566	25.614	22.037	-2.9	24.867	14665	13232	13034	109.93	123.35	214.95
04-12-17 9:52:26	2	3	13.4	0:05:01	28.924	27.722	0.091	101.657	524.795	56.653	101.566	25.407	22.012	-2.7	24.697	14546	13199	13001	110.8	123.61	217.6
04-12-17 9:57:30	2	4	31.7	0:05:00	27.082	27.976	0.097	101.663	526.855	55.667	101.566	25.377	22.171	-2.5	24.722	14529	13265	13066	111.63	123.71	223.2
04-12-17 10:02:39	2	5	38.5	0:05:00	27.379	28.194	0.109	101.675	529.985	56.225	101.566	25.464	22.031	-3.4	24.591	14579	13299	13100	110.61	122.81	219.35
04-12-17 10:07:45	2	6	43.1	0:05:00	28.336	28.505	0.097	101.663	530.24	55.86	101.566	25.511	22.065	-3.1	24.71	14606	13280	13081	110.94	123.6	221.7

NORMALIZATION FACTOR

T _{norm}	[K]	273
P _{norm}	[kPa]	101.3

PITOT DATA SPECIFICATION

Name			828
Velocity	[m/s]	2.03	0.845
Velocity	[m/s]	7.14	0.828
Velocity	[m/s]	11.13	0.826
Velocity	[m/s]	14.11	0.829
Velocity	[m/s]	17.17	0.829

DUCT AND GAS SPECIFICATION

Name		RESENE
Section		Circular
Diameter	[m]	0.45
Area	[m ²]	0.159
Port	B	# 2
Points	P	# 6
Dry gas density	ρ _n	[kg/m ³] 1.286 [1.286; 1.286]
Carbon dioxide	CO ₂	[%] 0 [0.000; 0.000]
Oxygen	O ₂	[%] 21 [21.000; 21.000]
Water vapor ratio	rw	[0;1] 0.015 [0.015; 0.015]
Nozzle	nz	[mm] 4.6
Turbulence factor	ft	[sec] 3

DUCT FLOW RATE

Dry actual	QV _s	[m ³ /s] NA
Moist actual	QV _s	[m ³ /s] 14534
Moist standard [T _{norm} P _{norm}]	QV _n	[m ³ /s] 13275
Dry standard [T _{norm} P _{norm}]	QV _n	[m ³ /s] 13076

AVERAGE VALUES

Total Points		[#] 12
Velocity	v _s	[m/s] 25.385
Stack temperature	t _{stack}	[°C] 26.916
Stack Absolute Pressure	P _c	[kPa] 101.643
Stack Static Pressure	P _{stat}	[kPa] 0.077
Isokinetic Deviation	DI	[%] NA
Velocity at nozzle	v _{ni}	[m/s] NA
Stack Differential Pitot Pressure	dP _{pitot}	[Pa] 527.426
Ambient Pressure	P _{amb}	[kPa] 101.566

SAMPLED VOLUMES

Elapsed time	et	[hh:mm:ss] 0:55:15
Total encoder impulses		[#] 48296
Standard Volume [T _{norm} P _{norm}]	V _{gn}	[m ³] 1.2124
Moist Volume at stack conditions	V _{gp}	[m ³] 1.5488
Volume at dgm conditions	V _{dgm}	[m ³] 2.4179
Gas meter temperature	t _{egm}	[°C] 35.342 [23.774; 650.887]
Gas Meter Pressure	P _{egm}	[kPa] 56.127 [43.032; 99.220]

SOURCE TESTING NZ

Resene Paints Limited
 Air Discharge Monitoring of the Factory Extraction System
 December 2017

Resene Run 2
Isokinetic sampling 04/12/2017 11:06:35

MACHINE INFORMATION

Master Firmware v1.9.2000
 Master Serial Number 11420234P
 Slave Firmware v0.7.7000
 Slave Serial Number 11420234P
 Last calibration date Refer to the STNZ Equipment Register

CV GAMMA [g] CALIBRATION

Point	Flowrate	Gamma
1	0	1

POINT LIST

start ts [time:stamp]	Port [##]	Point [##]	Distance [cm]	Elapsed Time [hh:mm:ss]	t _{amb} avg [°C]	t _{isgm} avg [°C]	P _{stat} avg [kPa]	P _c avg [kPa]	dP pitot avg [Pa]	P _{inc} avg [kPa]	P _{amb} avg [kPa]	v _a avg [m/s]	qV _a avg [m³/s]	DI [%]	v _n avg [m/s]	QV _a [m³/s]	QV _n [m³/s]	QV _n [m³/s]	V _{gm} [L]	V _{pt} [L]	V _{dgm} [L]
04-12-17 11:07:21	1	1	2	0:05:00	19.875	59.989	-0.028	101.545	519.788	59.472	101.573	24.541	20.498	-2.7	23.878	14051	13129	12932	102.55	102.68	196.35
04-12-17 11:12:30	1	2	6.6	0:05:00	28.954	28.662	-0.038	101.535	520.408	64.71	101.573	25.316	20.891	-1.3	24.967	14494	13135	12938	104.43	116.8	180.35
04-12-17 11:17:33	1	3	13.4	0:05:00	29.266	28.337	-0.051	101.522	518.435	64.446	101.573	25.27	20.932	-0.8	25.045	14468	13096	12899	103.97	116.36	180
04-12-17 11:22:38	1	4	31.7	0:05:00	29.312	28.063	-0.023	101.55	381.517	74.692	101.573	21.674	17.91	-1.1	21.428	12409	11233	11065	89	99.76	133.05
04-12-17 11:27:41	1	5	38.5	0:05:00	22.102	27.717	-0.009	101.564	338.915	73.573	101.573	20.013	17.986	4.7	20.96	11458	10627	10468	89.96	98.37	136.3
04-12-17 11:32:50	1	6	43.1	0:05:00	29.374	27.733	0.044	101.617	258.338	82.493	101.573	17.798	14.841	-0.2	17.747	10190	9229	9090	74.12	83.07	100.25
04-12-17 11:40:13	2	1	2	0:05:00	13.447	27.807	-0.032	101.541	488.34	65.17	101.573	23.642	20.009	-4.8	22.5	13536	12931	12737	101.98	107.84	173.8
04-12-17 11:47:34	2	2	6.6	0:05:00	5.916	27.89	-0.023	101.55	486.389	64.193	101.573	23.113	20.365	-3.8	22.232	13233	12984	12789	102.86	105.65	177.6
04-12-17 11:52:43	2	3	13.4	0:05:00	-8.105	28.121	-0.022	101.551	500.095	59.455	101.573	22.64	20.527	-4.3	21.662	12962	13392	13191	108.67	104.5	199.85
04-12-17 11:57:59	2	4	31.7	0:05:01	8.854	28.515	-0.021	101.552	495.539	64.589	101.573	23.538	19.994	-4.8	22.388	13476	13085	12889	103.62	108.04	179
04-12-17 12:03:11	2	5	38.5	0:05:01	25	28.867	-0.008	101.565	444.509	69.247	101.573	23.231	19.579	-0.6	23.086	13301	12217	12033	98.11	108.27	158.45
04-12-17 12:08:15	2	6	43.1	0:05:00	25	29.026	-0.015	101.558	433.674	70.187	101.573	22.947	19.247	-1	22.697	13138	12066	11885	96.41	106.4	153.7

NORMALIZATION FACTOR

T_{norm} [K] 273
 P_{norm} [kPa] 101.3

PITOT DATA SPECIFICATION

Name 828
 Velocity [m/s] 2.03 0.845
 Velocity [m/s] 7.14 0.828
 Velocity [m/s] 11.13 0.826
 Velocity [m/s] 14.11 0.829
 Velocity [m/s] 17.17 0.829

DUCT AND GAS SPECIFICATION

Name RESENE
 Section Circular
 Diameter [m] 0.45
 Area [m²] 0.159
 Port B [m] 2
 Points P [m] 6
 Dry gas density ρ_n [kg/m³] 1.286 [1.286; 1.286]
 Carbon dioxide CO₂ [%] 0 [0.000; 0.000]
 Oxygen O₂ [%] 21 [21.000; 21.000]
 Water vapor ratio rw [0;1] 0.015 [0.015; 0.015]
 Nozzle nz [mm] 4.46
 Turbulence factor ft [sec] 3

DUCT FLOW RATE

Dry actual QV_a [m³/s] 12863 [2916; 19370]
 Moist actual QV_a [m³/s] 13059 [10190; 14494]
 Moist standard [T_{norm} P_{norm}] QV_n [m³/s] 12260 [9229; 13392]
 Dry standard [T_{norm} P_{norm}] QV_n [m³/s] 12076 [9090; 13191]

AVERAGE VALUES

Total Points [#] 12
 Velocity v_a [m/s] 22.81 [5.171; 34.347]
 Stack temperature t_{amb} [°C] 19.082 [241.585; 273.124]
 Stack Absolute Pressure P_c [kPa] 101.554 [101.433; 101.652]
 Stack Static Pressure P_{stat} [kPa] -0.019 [-0.140; 0.079]
 Isokinetic Deviation DI [%] -1.8
 Velocity at nozzle v_n [m/s] 22.382 [0.000; 45.608]
 Stack Differential Pitot Pressure dP_{pitot} [Pa] 444.787 [170.342; 605.695]
 Ambient Pressure P_{amb} [kPa] 101.573 [101.573; 101.573]

SAMPLED VOLUMES

Elapsed time et [hh:mm:ss] 1:00:02
 Total encoder impulses [#] 39374
 Standard Volume [T_{norm} P_{norm}] V_{gm} [m³] 1.1757
 Moist Volume at stack conditions V_{pt} [m³] 1.2575
 Volume at dgm conditions V_{dgm} [m³] 1.9687
 Gas meter temperature t_{isgm} [°C] 31.435 [7.077; 572.421]
 Gas Meter Pressure P_{isgm} [kPa] 66.599 [38.016; 99.869]

SOURCE TESTING NZ

Resene Paints Limited
 Air Discharge Monitoring of the Factory Extraction System
 December 2017

Resene Run 3
Isokinetic sampling 04/12/2017 12:38:40

MACHINE INFORMATION

Master Firmware v1.9.2000
 Master Serial Number 11420234P
 Slave Firmware v0.7.7000
 Slave Serial Number 11420234P
 Last calibration date Refer to the STNZ Equipment Register

CV GAMMA [g] CALIBRATION

Point	Flowrate	Gamma
1	0	1

POINT LIST

start ts (timestamp)	Port [##]	Point [###]	Distance [cm]	Elapsed Time [hh:mm:ss]	t _{amb} avg [°C]	t _{gas} avg [°C]	P _{stat} avg [kPa]	P _c avg [kPa]	dP pitot avg [Pa]	P _{inc} avg [kPa]	P _{amb} avg [kPa]	V _a avg [m ³ /s]	qV _a avg [m ³ /s]	DI [%]	v _n avg [m/s]	Q _{Va} [m ³ /s]	Q _{Vn} [m ³ /s]	Q _{Vn} [m ³ /s]	V _{gn} [t]	V _{gt} [t]	V _{dgm} [t]
04-12-17 12:39:03	1	1	2	0:05:00	30.21	30.135	-0.028	101.574	453.809	68.971	101.602	23.655	19.24	-2.4	23.082	13543	12227	12043	95.67	107.46	155.85
04-12-17 12:44:07	1	2	6.6	0:05:00	30.745	29.918	-0.011	101.591	488.225	66.052	101.602	24.581	20.271	-0.9	24.357	14073	12685	12495	100.01	112.49	169.95
04-12-17 12:49:09	1	3	13.4	0:05:00	28.476	29.956	-0.073	101.506	247.938	72.733	101.579	13.948	12.026	3.2	14.396	7986	7246	7137	59.61	66.49	91.85
04-12-17 12:58:03	1	4	31.7	0:05:01	9.66	29.635	0.003	101.555	437.214	58.774	101.552	22.175	20.627	3.2	22.887	12696	12293	12108	103.03	107.7	196.25
04-12-17 13:03:07	1	5	38.5	0:05:00	29.898	31.125	-0.005	101.547	430.619	69.952	101.552	23.042	19.074	-0.7	22.858	13192	11919	11740	95.16	106.67	153.15
04-12-17 13:08:13	1	6	43.1	0:05:00	30	29.499	-0.026	101.526	431.264	69.808	101.552	23.077	19.042	-1	22.839	13212	11931	11752	94.8	106.46	152.25
04-12-17 13:13:18	2	1	2	0:05:00	30	29.472	-0.025	101.527	429.149	70.614	101.552	23.02	18.806	-2	22.555	13180	11901	11723	93.39	104.9	148.3
04-12-17 13:18:23	2	2	6.6	0:05:00	30	29.537	-0.027	101.525	383.111	73.73	101.552	20.771	16.762	-3.2	20.103	11892	10738	10577	84.1	94.44	127.9
04-12-17 13:23:28	2	3	13.4	0:05:00	30	29.556	-0.017	101.535	463.616	67.963	101.552	23.936	19.573	-1.9	23.473	13704	12376	12190	97.89	109.87	161.45
04-12-17 13:28:31	2	4	31.7	0:05:00	30	29.537	-0.057	101.495	401.342	71.324	101.552	22.26	18.619	0.3	22.338	12745	11505	11332	92.42	103.79	145.25
04-12-17 13:33:37	2	5	38.5	0:05:00	30	29.398	-0.058	101.494	399.403	71.797	101.552	22.204	18.293	-1.1	21.947	12713	11476	11304	91.65	102.98	143.1
04-12-17 13:38:39	2	6	43.1	0:05:00	30	29.226	-0.067	101.485	413.604	71.474	101.552	22.597	18.515	-1.6	22.215	12938	11678	11503	91.81	103.19	143.95

NORMALIZATION FACTOR

T_{norm} [K] 273
 P_{norm} [kPa] 101.3

PITOT DATA SPECIFICATION

Name 828
 Velocity [m/s] 2.03 0.845
 Velocity [m/s] 7.14 0.828
 Velocity [m/s] 11.13 0.826
 Velocity [m/s] 14.11 0.829
 Velocity [m/s] 17.17 0.829

DUCT AND GAS SPECIFICATION

Name RESENE
 Section Circular
 Diameter [m] 0.45
 Area [m²] 0.159
 Port B [m] 2
 Points P [m] 6
 Dry gas density ρ_n [kg/m³] 1.286 [1.286; 1.286]
 Carbon dioxide CO₂ [%] 0 [0.000; 0.000]
 Oxygen O₂ [%] 21 [21.000; 21.000]
 Water vapor ratio rw [0;1] 0.015 [0.015; 0.015]
 Nozzle nz [mm] 4.46
 Turbulence factor ft [sec] 3

DUCT FLOW RATE

Dry actual QV_a [m³/s] 12465 [0; 15236]
 Moist actual QV_a [m³/s] 12656 [7986; 14073]
 Moist standard [T_{norm} P_{norm}] QV_n [m³/s] 11497 [7246; 12685]
 Dry standard [T_{norm} P_{norm}] QV_n [m³/s] 11325 [7137; 12495]

AVERAGE VALUES

Total Points [#] 12
 Velocity v_a [m/s] 22.105 [0.000; 27.017]
 Stack temperature t_{amb} [°C] 28.249 [238.190; 106.380]
 Stack Absolute Pressure P_c [kPa] 101.53 [101.347; 101.684]
 Stack Static Pressure P_{stat} [kPa] -0.032 [-0.215; 0.122]
 Isokinetic Deviation DI [%] -0.8
 Velocity at nozzle v_n [m/s] 21.92 [0.000; 36.927]
 Stack Differential Pitot Pressure dP_{pitot} [Pa] 412.595 [0.000; 569.048]
 Ambient Pressure P_{amb} [kPa] 101.562 [101.552; 101.602]

SAMPLED VOLUMES

Elapsed time et [hh:mm:ss] 1:00:01
 Total encoder impulses [#] 35785
 Standard Volume [T_{norm} P_{norm}] V_{gn} [m³] 1.0995
 Moist Volume at stack conditions V_{gt} [m³] 1.2271
 Volume at dgm conditions V_{dgm} [m³] 1.7893
 Gas meter temperature t_{gas} [°C] 29.75 [29.074; 106.931]
 Gas Meter Pressure P_{gas} [kPa] 68.927 [39.826; 99.224]

SOURCE TESTING NZ

Appendix B Moisture Content and Particulate Mass Determinations

This Appendix contains 2 pages including cover

Moisture Content Determinations

Sampling Run	Moisture Mass Collected (g)	Gas Volume Sampled (m ³) ¹	Stack Moisture Content (%)
PM Run 1	10.4	1.230	1.0
PM Run 2	11.3	1.169	1.2
PM ₁ Run 3	11.0	1.125	1.2

1. Corrected to 0 °C, one atmosphere pressure, dry gas basis

■ Particulate Mass Determinations

Sampling Run	Sample ID	Filter ID/ Rinse Vol (ml)	Initial Weight (g)	Final Weight (g)	Mass (g)	Net Mass (g)	Total Mass (g)
PM Run 1	ST0669/01	ST1228	0.0599		-0.0599	-0.0599	-0.0005
	ST0669/02	50	104.4713	104.5305	0.0592	0.0594	
PM Run 2	ST0669/03	ST1229	0.0585		-0.0585	-0.0585	0.0004
	ST0669/04	50	102.2925	102.3512	0.0587	0.0589	
PM Run 3	ST0669/05	ST1012	0.0580		-0.0580	-0.0580	0.0020
	ST0669/06	50	96.8394	96.8991	0.0597	0.0600	
Filter Blank	ST0669/07	ST1007	0.0580	0.0580	0.0000		
Rinse Blank	ST0669/08	100	99.9335	99.9330	-0.0005		

Note:

Due to the small size of the filters used (37 mm), the filters are easily damaged and so were added to the acetone rinse to prevent sample loss.

Appendix C Raw VOC Sampling Data

This appendix includes 2 pages including the cover

Resene Paints Limited
 Air Discharge Monitoring of the Extraction System
 December 2017

Sample Description	Sampling Date	Sampling Period	Sample Duration (min)	Initial Flow (mL/min)	Final Flow (mL/min)	Ave Flow (mL/min)	Sample Vol (m ³)	DGM Temp (°C)	Ambient Press. (kPa)	Sample Vol (m ³) ¹
VOC Run 1 - Spike	04-12-17	9:05 - 10:13	60	1271.6	1221.6	1246.6	0.0748	26.9	101.6	0.0683
VOC Run 2 - Spike	04-12-17	11:06 - 12:12	60	1321.3	1334.0	1327.7	0.0797	19.1	101.6	0.0747
VOC Run 3 - Spike	04-12-17	13:38 - 14:40	60	1499.1	1504.7	1501.9	0.0901	28.2	101.6	0.0819
VOC Run 1 - Sample	04-12-2017	9:05 - 10:13	60	1665.1	1693.6	1679.4	0.1008	26.9	101.6	0.0920
VOC Run 2 - Sample	04-12-2017	11:06 - 12:12	60	1517.4	1547.5	1532.5	0.0919	19.1	101.6	0.0862
VOC Run 3 - Sample	04-12-2017	13:38 - 14:40	60	1384.8	1381.0	1382.9	0.0830	28.2	101.6	0.0754

1. Corrected to 0 °C, 101.3 kPa, dry gas basis

Appendix D Raw VOC Analytical Report

This appendix includes 3 pages including the cover



Hill Laboratories
 TRIED, TESTED AND TRUSTED

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ANALYSIS REPORT Page 1 of 2

Client: Source Testing NZ Limited	Lab No: 1884568 SPV1
Contact: Matthew Newby PO Box 32017 Lower Hutt 5050	Date Received: 28-Nov-2017
	Date Reported: 22-Dec-2017
	Quote No: 88854
	Order No: ST0699
	Client Reference: ST0699
	Submitted By: Matthew Newby

Sample Type: 400/200 mg CSC SKC 226-09

Sample Name:	Toluene Spike 1 [Resene VOC R1 Spike] 04-Dec-2017	Toluene Spike 2 [Resene VOC R2 Spike] 04-Dec-2017	Toluene Spike 3 [Resene VOC R3 Spike] 04-Dec-2017	Travel Blank	Lab (rig) Blank
Lab Number:	1884568.1	1884568.2	1884568.3	1884568.10	1884568.12
Volatile organic compounds reported as toluene equivalent					
Volatile organic compounds as toluene front	µg/sample	11,200	34,000	57,000	< 8
Volatile organic compounds as toluene back	µg/sample	< 4	34	44	< 4

Sample Name:	Resene VOC R1 Sample 04-Dec-2017	Resene VOC R2 Sample 04-Dec-2017	Resene VOC R3 Sample 04-Dec-2017
Lab Number:	1884568.14	1884568.15	1884568.16
Volatile organic compounds reported as toluene equivalent			
Volatile organic compounds as toluene front	µg/sample	10,700	38,000
Volatile organic compounds as toluene back	µg/sample	5	92

Sample Type: 400/200 mg CSC SKC 226-09 Desorption Efficiency

Sample Name:	Travel Spike	Lab Spike
Lab Number:	1884568.11	1884568.13
Toluene in large charcoal tubes by GC-FID/FID DE		
Toluene front	% recovery	100
Toluene back	% recovery	< 1

Analyst's Comments

Spikes were prepared to contain 3,500 micrograms per sample of toluene.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: 400/200 mg CSC SKC 226-09

Test	Method Description	Default Detection Limit	Sample No
Toluene in large charcoal tubes by GC-FID/FID	Break into fractions, desorption with CS ₂ , analysis by dual column GC-FID/FID, NIOSH Method 1003 (halogenated hydrocarbons), 1300 (ketones), 1500 (hydrocarbons), 1501 (aromatic hydrocarbons), 1450 (esters)	-	1-3, 10, 12, 14-16
Volatile organic compounds reported as toluene equivalent	Break into fractions, desorption with CS ₂ , analysis by dual column GC-FID/FID, NIOSH Method 1501 (aromatic hydrocarbons) Issue 3, 2003	4 - 8 µg/sample	1-3, 10, 12, 14-16
CS ₂ Miscellaneous Solvents in large tubes by GC-FID/FID (screen)	Break into fractions, desorption with CS ₂ , analysis by dual column GC-FID/FID, NIOSH Method 1003 (halogenated hydrocarbons), 1300 (ketones), 1500 (hydrocarbons), 1501 (aromatic hydrocarbons), 1450 (esters)	-	1-3, 10-16

Sample Type: 400/200 mg CSC SKC 226-09 Desorption Efficiency

Test	Method Description	Default Detection Limit	Sample No
------	--------------------	-------------------------	-----------

Sample Type: 400/200 mg CSC SKC 228-09 Desorption Efficiency			
Test	Method Description	Default Detection Limit	Sample No
Toluene in large charcoal tubes by GC-FID/FID DE	Break into fractions, desorption with CS ₂ , analysis by dual column GC-FID/FID, NIOSH Method 1003 (halogenated hydrocarbons), 1300 (ketones), 1500 (hydrocarbons), 1501 (aromatic hydrocarbons), 1450 (esters)	1 % recovery	11, 13

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental