Attachment E.1.A

- Report -Monitoring of emissions Process Stacks (A2-1 to A2-4)
- Report- Monitoring of emissions Gleitmo Coating Process Stack (A2-5)
- Application ford Drawing 4 site Services Plan
- Application form Drawing 8 Air Emission Point Elevations BU1 & Bu2
- Application form Drawing Drawing 9 Air Emission Point Elevations BU3

REC

Resource & Environmental Consultants Ltd

UKAS TESTING 2082

MONITORING OF EMISSIONS FROM THE CURING OVEN PROCESS STACKS (A2-1 TO A2-4)

10 JULY, 2014

Prepared for Environmental Efficiency Consultants Ltd on behalf G Bruss GmbH Dichtungstechnik Ltd

REC Report 71894p1r0

PPC: P0465-01

Issued: 5 August, 2014

REC Air Quality

safecontractor APPROVED

a CONCEPT LIFE SCIENCES company

REC Air Quality

UKAS TESTING 2082

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CONTENTS

		Page No.
EXECUTIVE SUMMARY		**4**
1.	**INTRODUCTION**	**5**
1.1	Background	5
1.2	Scope of the Survey	5
1.3	Sampling Personnel	5
2.	**METHODOLOGY**	**6**
2.1	Species & Techniques	6
2.2	Sampling & Analytical Methodology	6
2.3	Laboratory Analysis	7
3.	**SAMPLING AND OPERATIONAL DETAILS**	**8**
3.1	Process Description	8
3.2	Sampling Positions	8
3.3	Uncertainty	8
3.4	Emission Monitoring Survey Details	9
4.	**RESULTS AND DISCUSSION**	**10**
4.1	Initial Velocity and Temperature Traverse	10
4.2	Particulate Matter	10

TABLES (2 x Additional Pages)

1 Flow Data
2 Particulate Emission Data Summary – A2-1, A2-3 & A2-4
3 Particulate Emission Data Summary - A2-2

APPENDICES

1 Certificate of Analysis (5 x Additional Pages)
2 Diagrams of Sampling Points (2 x Additional Pages)
3 Calculations (1 x Additional Page)

EXECUTIVE SUMMARY

Resource & Environmental Consultants (REC) Ltd was commissioned by Environmental Efficiency Ltd to monitor emissions of particulate matter released from the Curing Oven process stacks A2-1 to A2-4 at their clients site, G Bruss Ltd in County Sligo, Ireland.

The following results were obtained from the emission monitoring survey and are compared with the current permit limit:-

Species	Emission Source	Accreditation Status	Emission Concentration (mg/Nm^3)	UOM[(2)] (mg/Nm^3)	Permit Limit (mg/Nm^3)
Particulate Matter	A2-1	D	<4.1	>± 1.0	150
Particulate Matter	A2-2	B	3.6	± 1.8	150
Particulate Matter	A2-3	D	10.4	± 2.6	150
Particulate Matter	A2-4	D	5.4	>± 1.4	150

NOTE 1: Data from all sources are expressed in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content.
NOTE 2: UOM is the uncertainty of the measurement expressed at a level of confidence of 95% in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content unless otherwise stated.
NOTE: UKAS Status:-. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd (D) REC Ltd not accredited for sampling, UKAS accredited analysis conducted by SAL Ltd.

1. INTRODUCTION

1.1 Background

Environmental Efficiency Ltd commissioned REC to conduct an emission monitoring survey on the Curing Oven process stacks at their clients site, G Bruss Ltd, County Sligo, Ireland.

The operations at G Bruss Ltd involve the production of rubber seals with the final step in this process being the curing of the rubber seals at temperatures of between 100 - 200ºC.

1.2 Scope of the Survey

An emission monitoring survey was required to determine the release concentrations of particulate matter from the curing oven process stacks A2-1 to A2-4.

Ancillary measurements of stack dimensions, temperature and velocity were also made.

Results were to be reported at 273K, 101.3kPa, without correction for moisture and oxygen content.

1.3 Sampling Personnel

Monitoring was conducted by the following REC Ltd permanent staff:-

- Aidan Wrynne - Team Leader, MM08 921, MCERTS Level 2, TE1, 3 & 4
- Craig Macdonald - Assistant, MM10 1036, MCERTS Trainee

2. METHODOLOGY

2.1 Species & Techniques

The following table shows the reference methods used for the emission monitoring survey:

Species	UKAS Status	Method	Uncertainty (±%)	Limit of Detection
Moisture	A	In house method MM0010 based on BS EN 14790	20	0.1%vol
Particulate Matter	B	In house method MM0004 based on BS EN 13284	10	1 mg/m^3
Particulate Matter	D	Based on BS 3405	25	1 mg/m^3

NOTE: UKAS Status:- (A) REC Ltd accredited for sampling and analysis. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd (D) REC Ltd not accredited for sampling, UKAS accredited analysis conducted by SAL Ltd.

2.2 Sampling & Analytical Methodology

Total Particulate Matter

To determine the concentration of particulate matter in emissions on stack A2-2, isokinetic stack sampling equipment satisfying the requirements of BS EN 13284 was utilised and in-house method MM0004 followed.

The Standard describes the methodology for measuring particulate matter under defined conditions and at discrete locations in the duct. Sampling is carried out under isokinetic sampling conditions i.e. the flowrate through the sampling nozzle is adjusted to equal the flowrate in the duct at the sampling positions. Velocity pressures were recorded throughout the monitoring period by means of an 'S' type pitot integral to the sampling probe and nozzle assembly.

A sample of the exhaust stream was removed from the stack via a titanium nozzle and titanium lined heated probe. It was then passed through a quartz fibre filter contained in a heated oven compartment. The temperature of the probe and filter box were maintained at 160ºC i.e. above the dew point of the stack gases, to ensure moisture did not condense on the filter. Each filter used complied with the requirements of Section 6.2.7 of BS EN 13284-1:2001 in that the efficiency was better than 99.5% for particles of 0.3µm diameter (or 99.9% for particles of 0.6µm diameter).

The impinger train was seated in a water bath to cool the gas stream and condense out less volatile gases and water vapour.

The first two impingers encountered by the gas stream contained deionised water. The third impinger was left empty and the fourth contained anhydrous silica gel which was used to dry the gas stream before passing it through a dry gas meter (DGM) to measure the volume of gas sampled.

All the impingers were weighed before and after the sampling run in order to determine the mass of water condensed by the impinger train (in house Method MM0010).

The sample volume collected was in excess of the minimum requirement stated in MM0004.

The minimum sample volume ensures the results would be representative of normal plant operating conditions.

Upon completion of sampling, the filter was removed to a clean petri dish, labelled and sealed. The probe and filter housing were rinsed with acetone and water. The washings were collected in a container and submitted for analysis along with the filter.

To determine the concentrations of particulate matter in emissions from stacks A2-1, A2-3 & A2-4, SKC stack sampling equipment satisfying the requirements of BS 3405 was utilised. The Standard describes the methodology for measuring particulate matter under defined conditions and at discrete locations in the duct. Sampling was carried out under non-isokinetic sampling conditions and to a withdrawn method and this work is not covered under our scope of UKAS accreditation.

A sample of the exhaust stream was removed from the stack via a stainless steel probe and passed through a quartz fibre filter contained in a stainless steel filter housing located outside the stack. Each filter used complied with the requirements of Section 6.2.7 of BS EN 13284-1:2001 in that the efficiency was better than 99.5% for particles of 0.3µm diameter (or 99.9% for particles of 0.6µm diameter).

Emissions then passed into an impinger train seated in an iced water bath to cool the gas stream and condense out less volatile gases and water vapour before passing through a dry gas meter (DGM) to measure the volume of gas sampled.

All the impingers were weighed before and after the sampling run in order to determine the mass of water condensed by the impinger train (in house Method MM0010).

Upon completion of sampling, the filter was removed to a clean petri dish, labelled and sealed. The probe and filter housing were rinsed with acetone and water. The washings were collected in a container and submitted for analysis along with the filter.

Stack Temperature and Velocity

To determine the stack temperature, a calibrated thermocouple and digital indicator were employed. The exhaust gas velocity was investigated using a pitot static probe (to MM0004) and digital manometer.

2.3 Laboratory Analysis

An approved UKAS accredited sub-contractor, SAL Ltd, undertook the sample analysis for Total Particulate Matter.

A copy of their Certificate of Analysis is enclosed in Appendix 1.

3. SAMPLING AND OPERATIONAL DETAILS

3.1 Process Description

The operations at G Bruss Ltd are authorised under an IPPC licence issued by the Irish Environmental Protection Agency (EPA). The process is therefore under EPA regulation and must demonstrate compliance with the emission limits stipulated in the site permit (P0465-01).

The following Guidance Notes apply: - EPA Air Emissions Monitoring Guidance Notes AG1 and AG2.

The process involves the heating of batches of rubber seals in Curing Ovens operating at temperatures of between 100 and 200ºC for approximately 4 hours. The resulting fumes are passed through electrostatic precipitator filters prior to discharge to atmosphere.

3.2 Sampling Positions

On stack A2-1, 2 x 5" BSP sampling ports were installed, in a horizontal plane. However the proximity of these ports to an outside roof prevented their use and so a single four inch hole in a different location was utilised for sampling. Also access issues prevented the use of isokinetic stack sampling equipment to EN 13284. The sampling point used was greater than 5 x hydraulic diameters downstream and upstream from potential flow disturbances. The sampling point size and location does not satisfy EA Guidance M1 and EPA Guidance AG1.

On stack A2-2, 2 x 5" BSP sampling ports were installed. The sampling points provided were less than 4 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane. Only one sample line and one sample point was accessible due to access restrictions and obstructions behind the sample ports. The sampling point location does not fully satisfy EA Guidance M1 and EPA Guidance AG1.

On stack A2-3, 2 x 5" BSP sampling ports were installed on a horizontal plane. The sampling points provided were greater than five hydraulic diameters both upstream and downstream from flow disturbances. Only one sample line and one sample point could be accessed due to the location of the ports, although given the size of the stack (<35cm) only single point sampling was required. Access issues prevented the use of isokinetic stack sampling equipment to EN 13284. The sampling point size and location does not satisfy EA Guidance M1 and EPA Guidance AG1.

On stack A2-4, 2 x 5" BSP sampling ports were installed in the same horizontal plane. However these ports were inaccessible due to their proximity to the internal ceiling. An alternative 2 inch hole was utilised which was located greater than 5 hydraulic diameters both upstream and downstream away from potential flow disturbances. Access issues prevented the use of isokinetic stack sampling equipment to EN 13284. The sampling point size and location does not satisfy EA Guidance M1 and EPA Guidance AG1.

3.3 Uncertainty

Due to access restrictions port size and location, sampling from each source could only be conducted through one sampling port and at one sample point, though for A2-3 single point sampling was only required due to the diameter being < 0.35m.

REC has calculated uncertainty budgets for all of the pollutants listed in the Method Details Table in Section 2.1 above and for which we have accreditation, in accordance with calculations and methodology supplied by the Source Testing Association (STA). These uncertainties are quoted in the Tables section of this report.

For the non-accredited test the uncertainty if BS 3405 was followed is ±25% at best but the limited number of sample ports on A2-1 and A2-4 would increase this uncertainty.

3.4 Emission Monitoring Survey Details

The emission monitoring survey was carried out on the Curing Oven process stacks on 10 July, 2014. The table below summarises the actual sampling periods.

SAMPLING PERIODS

Stack Ref.	Parameter	Sample Time (& Date)
A2-1	Particulate Matter	12:31 -13:11 (10/7/14)
A2-2	Particulate Matter	10:52 -11:32 (10/7/14)
A2-3	Particulate Matter	16:29 -17:09 (10/7/14)
A2-4	Particulate Matter	15:13 -15:53 (10/7/14)

4. RESULTS AND DISCUSSION

4.1 Initial Velocity and Temperature Traverse

An initial pitot-static pressure and temperature traverse was carried out. From these data stack velocity, expressed in metres per second (m/s), and volumetric flowrates expressed in cubic metre per hour (m^3/hr) have been calculated.

The results are reported at actual stack conditions and the volumetric flowrate is further expressed at the standard reference conditions of 273K, 101.3kPa i.e. standard temperature and pressure (STP). The results are summarised in Table 1.

4.2 Particulate Matter

The results of the non-isokinetic particulate sampling runs carried using the SKC kit (non-accredited) on A2-1, A2-3 and A2-4 are summarised in Table 2. From the mass of particulate matter on the filter and in the acetone/water wash residue and volume sampled an emission concentration was calculated.

The results of the isokinetic particulate sampling run carried out to EN 13284 (accredited) on A2-2 are summarised in Table 3. From the mass of particulate matter on the filter and in the acetone/water wash residue and volume sampled an emission concentration was calculated.

All results are expressed in mg/m^3 at 273K, 101.3kPa without correction for water vapour and oxygen content.

====== End of Report Text ======

TABLES

TABLE 1

FLOW DATA

Stack Ref.	Stack Temp	Av Pitot ΔP	Duct Diam	X-Sect. Area	Velocity (actual)	Volume Flow (m^3/hr)	
	(^{0}C)	(Pa)	(cm)	(m^2)	(m/s)	(actual)	(@ ntp)
A2-1	45	24	40	0.126	6.5	2,969	2,552
A2-2	46	13	40	0.126	4.7	2,157	1,847
A2-3	61	51	40	0.126	9.8	4,435	3,631
A2-4	49	71	20	0.031	11.5	1,284	1,090

TABLE 2

PARTICULATE EMISSION DATA SUMMARY – A2-1, A2-3 & A2-4

Sampling Data	A2-1	A2-3	A2-4
Start Time/Date	12:31, 10/07/14	16:29, 10/07/14	15:13, 10/07/14
End Time/Date	13:11, 10/07/14	17:09, 10/07/14	15:53, 10/07/14
Sampling Period (min)	40	40	40
DGM start (dry m^3)	17.655	17.822	17.770
DGM end (dry m^3)	17.745	17.996	17.881
Volume Sampled (dry m^3)	0.090	0.174	0.111
Ambient Temp (^{o}C)	18	18	18
Ambient Press (kPa)	101.8	101.8	101.8
Wt of Water (g)	2.6	2.2	2.8
Volume Water (m^3)	0.003	0.003	0.003
Volume Sampled, 273K, 101.3kPa (dry m^3)	0.085	0.164	0.105
Volume Sampled, 273K, 101.3kPa (wet m^3)	0.088	0.167	0.108
Analytical Data			
Wt gain filter (mg)	<0.05	1.40	0.26
Wt acetone wash (mg)	<0.30	<0.30	<0.30
Total particulate matter (mg)	<0.35	1.70	0.56
Emission Concentration Data			
Moisture (%vol)	3.7	1.6	3.2
Particulates (mg/m^3)	<4.1	10.4	5.4

TABLE 3

PARTICULATE EMISSION DATA SUMMARY – A2-2

DATE: 10/7/14 **10:52 -11:32**

Sampling Data	
Run Time (min)	40
Total mass H_2O collected (g)	1.9
Pitot tube constant, Cp	0.86
Dry gas meter (DGM) volume (m^3)	0.782
Temperature DGM (^oC)	26
Temperature stack (^oC)	46
Mean pitot tube pressure drop, delta P (mm H_2O)	1.3
Orifice meter pressure drop, delta H (mm H_2O)	25.2
Barometric Pressure (kPa)	101.8
X-sectional area of stack (m^2)	0.126
Nozzle size (mm)	10.04
Flow Data	
Velocity, actual (m/s)	4.0
Velocity, ntp (m/s)	3.5
Vol. Flow, actual (m^3/hr)	1,832
Vol. Flow, ntp (m^3/hr)	1,573
Volume sampled, ntp, dry gas (m^3)	0.645
Volume sampled, ntp, wet gas (m^3)	0.647
Analytical Data	
Filter Weight Gain (mg)	1.7
Acetone Wash Residue Weight (mg)	0.9
Total Particulates (mg)	2.6
Partics Field Blank (mg)	0.4
Blank % of ELV	0.4
Emission Data	
H_2O (% vol)	0.4
Percentage Isokinetic	98.0
Particulates (mg/m^3)	4.0
Uncertainty (± mg/m^3)	1.8

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 013**
Customer Sample Reference	**71894/13 FRONT**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	(195) 1800
VOC (Total excluding targets)	GC/MS	1	µg	N	11
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	A series of unresolved aliphatic/cyclic hydrocarbons circa C8 - C10 **6700**

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 023**
Customer Sample Reference	**71894/9 BACK**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	<5
VOC (Total excluding targets)	GC/MS	1	µg	N	<1
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 025**
Customer Sample Reference	**71894/11 BACK**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	**180**
VOC (Total excluding targets)	GC/MS	1	µg	N	**4**
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 027**
Customer Sample Reference	**71894/13 BACK**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	**15**
VOC (Total excluding targets)	GC/MS	1	µg	N	**2**
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

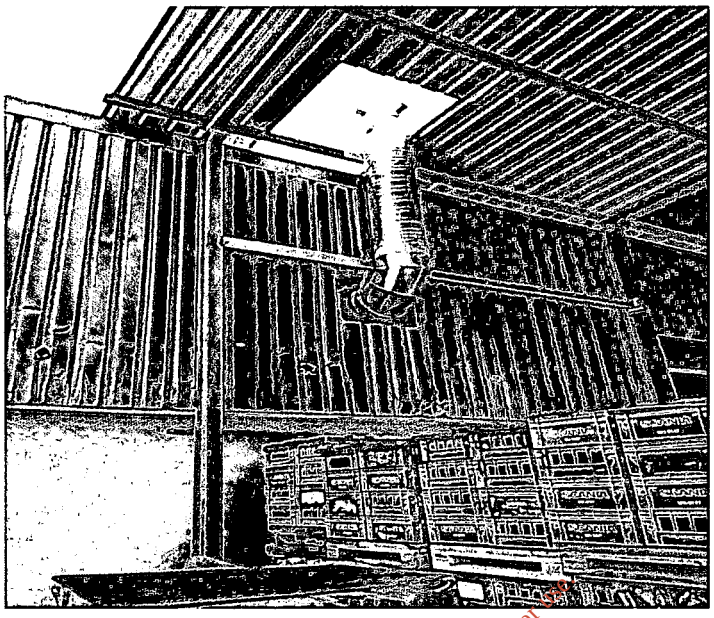
Index to symbols used in 408893-2

Value	Description
AR	As Received
N.D.	Not Detected
195	Due to levels found in the sample that are outside of the normal calibration range of the instrument, analysis was conducted on a diluted sample
2	LOD Raised Due to Matrix Interference
44	Filter received damaged, may lead to erroneous results.
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

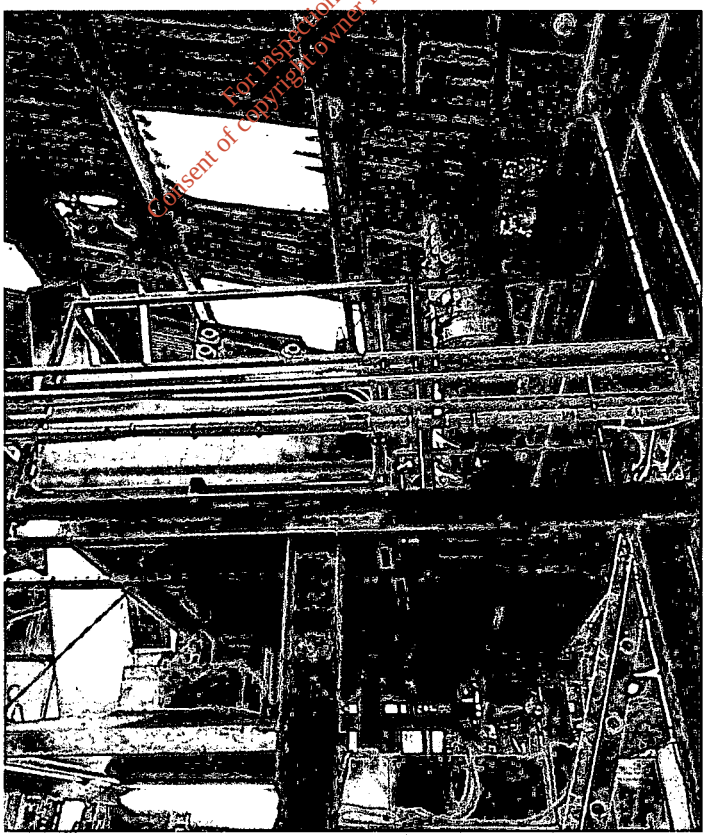
APPENDIX 2

Diagrams of Sampling Points

A2-1



A2-2



A2-3

A2-4

APPENDIX 3

Calculations

Conversion Factors

ppm ® mg/Nm³ (at 273K, 101.3kPa: STP)

CO	x	1.25	
SO_2	x	2.86	
VOC's	x	1.61	(ppm as C_3H_8 to mg/Nm^3 as C)
NO_X	x	2.05	(ppm NO + NO_2 to mg/m^3 as NO_2)

Oxygen Correction to Reference Value

Concentration at (STP) -> Concentration at 273K, 101.3kPa, reference O_2 and Dry Gas, i.e.

Concentration X ((20.9-O_2 ref)/(20.9-O_2 measured)) = Concentration at ref Oxygen state.

Example Calculation

SO_2 concentration at STP	=	170.7 mg/Nm³
Oxygen percentage in gas stream	=	13.8%
Reference Oxygen	=	11%
SO_2 concentration at reference O_2 conditions	=	170.7 ((20.9-11)/(20.9-13.8))
	=	238 mg/Nm³ at 273K, 101.3kPa, 11% O_2 and Dry Gas

Moisture Correction (Wet to Dry)

Concentration of Gas Dry = Concentration of x 100/100-Bws Gas Wet

Concentration of Gas Wet = Concentration of x 100-Bws/100 Gas Dry

Where Bws = moisture content of gas stream in percent (Vol/Vol).

Example

VOC concentration	=	25 mg/Nm³ (Wet)
Moisture Content	=	27.1%
Concentration of VOC	=	25 (100/(100-27.1))

Carbon (C) to Trichloethylene (TCE)

ppm TCE = ppm C x 0.6715

TCE in mg/m^3 = TCE ppm x 5.864 (Mol Wt/22.4)

REC

Resource & Environmental Consultants Ltd

UKAS TESTING 2082

MONITORING OF EMISSIONS FROM THE GLEITMO COATING PROCESS STACK (A2-5)

10 JULY, 2014

Prepared for Environmental Efficiency Consultants Ltd on behalf G Bruss GmbH Dichtungstechnik Ltd

REC Report 71894p2r0

Issued: 7 August, 2014

REC Air Quality

safecontractor APPROVED

a CONCEPT LIFE SCIENCES company

REC Air Quality

UKAS TESTING 2082

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Paul Furmston, Director

CONTENTS

		Page No.
EXECUTIVE SUMMARY		**4**
1.	**INTRODUCTION**	**5**
1.1	Background	5
1.2	Scope of the Survey	5
1.3	Sampling Personnel	5
2.	**METHODOLOGY**	**6**
2.1	Species & Techniques	6
2.2	Sampling & Analytical Methodology	6
2.3	Laboratory Analysis	7
3.	**SAMPLING AND OPERATIONAL DETAILS**	**8**
3.1	Process Description	8
3.2	Sampling Positions	8
3.3	Uncertainty	8
3.4	Emission Monitoring Survey Details	8
4.	**RESULTS AND DISCUSSION**	**10**
4.1	Initial Velocity and Temperature Traverse	10
4.2	Propan-2-ol	10
4.3	VOC Screen	10
4.4	Dibutyl Tin	10

TABLES (3 x Additional Pages)

1 Flow Data
2 Propan-2-ol Emission Data Summary
3 VOC Screen Emission Data Summary
4 Dibutyl Tin Emission Data Summary

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1 Certificate of Analysis (5 x Additional Pages)
2 Diagrams of Sampling Points (2 x Additional Pages)
3 Calculations (1 x Additional Page)

EXECUTIVE SUMMARY

Resource & Environmental Consultants (REC) Ltd was commissioned by Environmental Efficiency Ltd to monitor emissions of pollutants potentially released from the Gleitmo Coating process stack at their clients site, G Bruss Ltd, County Sligo, Ireland.

The monitoring works was to be used to assess emissions as part of an application for the addition of this process to their site permit and undertaken for the following potential pollutants:-

- Target VOC (Propan-2-ol)
- VOC Screen excluding above target VOC
- Dibutyl Tin

The following results were obtained from the emission monitoring survey:-

Emission Source	Species	UKAS Status[1]	Emission Concentration (mg/Nm^3)	Permit Limit (mg/Nm^3)
A2-5 Inlet Pre Carbon Filter	Propan-2-ol	B	121.0	None set
	VOC Screen[2]	C	493.3	None set
	Dibutyl Tin	C	0.3	None set
A2-5 Outlet Post Carbon Filter	Propan-2-ol	B	76.3	None set
	VOC Screen[2]	C	281.7	None set
	Dibutyl Tin	C	<0.3	None set

NOTE : Data from all sources are expressed in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content.
NOTE (1): UKAS Status:-. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd (C) REC Ltd accredited for sampling, non UKAS accredited analysis conducted by SAL ltd.
NOTE (2): The VOCs identified in the GC/MS screen comprised a series of unresolved aliphatic/cyclic hydrocarbons circa C_8-C_{10}.

1. INTRODUCTION

1.1 Background

Environmental Efficiency Ltd commissioned REC to conduct an emission monitoring survey on the Gleitmo coating process stack at their clients site, G Bruss Ltd, County Sligo, Ireland.

Operations at G Bruss Ltd involve the production of rubber seals. The Gleitmo process involves the application of a solvent based coating using a spray gun and wash drum.

1.2 Scope of the Survey

An emission monitoring survey was required to determine the release concentrations of various pollutants from the Gleitmo coating process. Concentrations of the following pollutants were quantified during the survey:

- Target VOC (Propan -2-ol)
- VOC Screen excluding above target VOC
- Dibutyl Tin

Ancillary measurements of stack dimensions, temperature and velocity were also made.

Results were to be reported at 273K, 101.3kPa, without correction for moisture and oxygen content.

1.3 Sampling Personnel

Monitoring was conducted by the following REC Ltd permanent staff:-

- Aidan Wrynne - Team Leader, MM08 921, MCERTS Level 2, TE1-4
- Craig Macdonald - Assistant, MM10 1036, MCERTS Trainee

2. METHODOLOGY

2.1 Species & Techniques

The following table shows the reference methods used for the emission monitoring survey:

Species	UKAS Status	Method	Uncertainty (±%)	Limit of Detection
Target VOCs	B/C	In house method MM0011 based on BS EN 13649	30	0.1 mg/m^3
VOC Screen	C	In house method MM0011 based on BS EN 13649	33 -300	0.1 mg/m^3
Dibutyl Tin	C	In house method MM0011 based on BS EN 13649 & NIOSH 5504 using XAD tubes	30	0.1 mg/m^3

NOTE: UKAS Status:- (A) REC Ltd accredited for sampling and analysis. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd (C) REC Ltd accredited for sampling, non UKAS accredited analysis conducted by SAL Ltd.

2.2 Sampling & Analytical Methodology

Target VOC (Propan-2-ol)

Sampling for Propan-2-ol was carried out using charcoal adsorption tubes using methodology as per BS EN 13649 (in house method MM0011). The tubes were connected to a low flow sampling pump which in turn was connected to a calibrated dry gas meter to determine the volume sampled. Upon completion of sampling the tubes were capped and transported back to the laboratory in a sealed cool box.

The tubes were then chemically desorbed and analysed by a high resolution GC/MS operating in the target mode to identify and quantify the compounds of interest against prepared standards.

VOC GC/MS Screen

Sampling for the VOC screen was carried out using charcoal adsorption tubes using methodology as per BS EN 13649 (in house method MM0011). The tubes were connected to a low flow sampling pump which in turn was connected to a calibrated dry gas meter to determine the volume sampled. Upon completion of sampling the tubes were capped and transported back to the laboratory in a sealed cool box.

Upon receipt at the laboratory the tubes were chemically desorbed and analysed by a high resolution GC/MS operating in the scanning mode to identify and semi-quantify the compounds of interest.

The main VOCs detected are identified against the instruments vast spectral library and concentrations "semi-quantified" against the deuterated toluene internal standard. This technique is semi-quantitative in that the compounds are quantified against an internal standard as opposed to the compounds themselves.

This increases the systematic errors and the true result, in 95% of cases, actually lies between a factor of ⅓ and three times the concentration quoted.

Dibutyl Tin

Sampling for Dibutyl Tin was carried out using XAD 2 adsorption tubes based upon NIOSH Method 5504 and sampling to methodology as per BS EN 13649 (in house method MM0011). The tubes were connected to a low flow sampling pump which in turn was connected to a calibrated dry gas meter to determine the volume sampled. Upon completion of sampling the tubes were capped and transported back to the laboratory in a sealed cool box.

Upon arrival at the laboratory, the tubes were chemically desorbed and derivatized before being analysed via a GC/MS technique.

Stack Temperature and Velocity

To determine the stack temperature, a calibrated thermocouple and digital indicator were employed. The exhaust gas velocity was investigated using a pitot static probe (to MM0004) and digital manometer.

2.3 Laboratory Analysis

An approved UKAS accredited sub-contractor, SAL Ltd, undertook the sample analysis for the Propan-2-ol, VOC Screen and Dibutyl Tin. However, only analysis for Propan-2-ol was covered under their scope of accreditation

A copy of their Certificate of Analysis is enclosed in Appendix 1.

3. SAMPLING AND OPERATIONAL DETAILS

3.1 Process Description

The operations at G Bruss Ltd are authorised under an IPPC licence issued by the Irish EPA. The Gleitmo coating process is a new installation within the plant and the emission tests are being conducted as part of an application to vary their site licence to include this process.

The following Guidance Notes apply: - EPA Air Emissions Monitoring Guidance Notes AG1 and AG2.

The coating process involves the application of a solvent based lubricant film to rubber seals. The coating is sprayed on to the rubber seals and then the seals are placed in to a dip/tumbler tank. The resulting waste fumes are passed through a carbon filter before being discharged to the atmosphere.

3.2 Sampling Positions

On the A2-5 Inlet (pre carbon filter), 1 x 5" BSP sampling port was installed, in a horizontal plane. The sampling points used were greater than 5 x hydraulic diameters downstream and upstream from potential flow disturbances.

On the A2-5 Outlet (post carbon filter), 1 x 5" BSP sampling port was installed, in a horizontal plane. The sampling point used was greater than 5 x hydraulic diameters downstream and upstream from potential flow disturbances and the flow criteria stipulated in EA TGN M1 and AG1 were also met.

Diagrams detailing the sampling positions and taken from Site Worksheets are provided in Appendix 2.

3.3 Uncertainty

The mass of Propan-2–ol detected on the rear back-up section of the charcoal tube on the A2-5 Inlet was slightly above the 5% stipulated in the EN 13649 standard, mainly due to the high concentrations although this was the first test undertaken and the potential concentrations were unknown. This result should therefore be treated as a non-accredited test.

For all the other tests the standard uncertainties will apply.

REC has calculated uncertainty budgets for all of the pollutants listed in the Method Details Table in Section 2.1 above in accordance with calculations and methodology supplied by the Source Testing Association (STA). These uncertainties are quoted in the Tables section of this report.

3.4 Emission Monitoring Survey Details

The emission monitoring survey was carried out on the Gleitmo coating process stack on 10 July, 2014. The table below summarises the actual sampling periods.

SAMPLING PERIODS

Stack Ref.	Parameter	Sample Time (& Date)
A2-5 (Inlet)	Propan-2–ol, VOC Screen, Dibutyl Tin	14:00 -14:40 (10/7/14)
A2-5 (Outlet)	Propan-2–ol, VOC screen, Dibutyl Tin	14:00 -14:40 (10/7/14)

4. RESULTS AND DISCUSSION

4.1 Initial Velocity and Temperature Traverse

An initial pitot-static pressure and temperature traverse was carried out. From these data stack velocity, expressed in metres per second (m/s), and volumetric flowrates expressed in cubic metre per hour (m^3/hr) have been calculated.

The results are reported at actual stack conditions and the volumetric flowrate is further expressed at the standard reference conditions of 273K, 101.3kPa i.e. standard temperature and pressure (STP). The results are summarised in Table 1.

4.2 Propan-2-ol

The results of the Propan-2-ol sampling runs on the inlet and outlet are summarised in Table 2. From the mass of Propan-2-ol detected on the tube in microgram (µg) and the volume sampled, an emission concentration was calculated.

The mass of Propan-2–ol detected on the rear back-up section of the charcoal tube on the A2-5 Inlet was slightly above the 5% stipulated in the EN 13649 standard, mainly due to the high concentrations although this was the first test undertaken and the potential concentrations were unknown. This result should therefore be treated as a non-accredited test.

The results are expressed in mg/m^3 at 273K, 101.3kPa without correction for water vapour and oxygen content.

4.3 VOC Screen

The results of the VOC screen tests on the inlet and outlet are summarised in Table 3. From the mass of each compound detected on the tube in micro grams and the volume sampled, an emission concentration was calculated. The main VOCs actually identified were a range of unresolved aliphatic/cyclic hydrocarbons circa C_8 to C_{10}.

The results are expressed in mg/m^3 at 273K, 101.3kPa without correction for water vapour and oxygen content

4.4 Dibutyl Tin

The results of the Dibutyl tin sampling runs on the inlet and outlet are summarised in Table 4. From the mass of Dibutyl tin detected on each tube in micro grams and the volume sampled, an emission concentration was calculated.

The results are expressed in mg/m^3 at 273K, 101.3kPa without correction for water vapour and oxygen content.

====== **End of Report Text** ======

TABLES

TABLE 1

FLOW DATA

Stack Ref.	Stack Temp	Av Pitot ΔP	Duct Diam	X-Sect. Area	Velocity (actual)	Volume Flow (m^3/hr)	
	(^{0}C)	(Pa)	(cm)	(m^2)	(m/s)	(actual)	(@ ntp)
A2-5 (Outlet)	20	114	10	0.008	13.7	388	362

TABLE 2

PROPAN- 2-OL EMISSION DATA SUMMARY

Sampling Data	A2-5 Inlet	A2-5 Outlet
DGM Ref (AQ No.)	335	336
Start Time	14:00	14:00
End Time	14:40	14:40
DGM Start (m^3)	26.1300	17.7440
DGM End (m^3)	26.1510	17.7694
Volume Sampled (litres)	21.000	25.400
Ambient Temp (^{o}C)	20	20
Ambient Press (kPa)	101.8	101.8
Volume Sampled, 273K, 101.3kPa (litres)	19.663	23.783
Analytical Data (µg/tube)	**71894/11**	**71894/13**
Mass Propan 2-ol on front section	2,200	1,800
Mass Propan 2 ol on rear section	180	15
Mass on Back-up Section (%)	7.6	0.8
Emission Concentration Data (mg/m^3)	**A2-5 Inlet**	**A2-5 Outlet**
Propan- 2 ol	121.0	76.3
Uncertainty (± mg/m^3)	36.3	22.9

TABLE 3

VOC SCREEN EMISSION DATA SUMMARY

Sampling Data	A2-5 Inlet	A2-5 Outlet
DGM Ref (AQ No.)	335	336
Start Time	14:00	14:00
End Time	14:40	14:40
DGM Start (m^3)	26.1300	17.7440
DGM End (m^3)	26.1510	17.7694
Volume Sampled (litres)	21.000	25.400
Ambient Temp (°C)	20	20
Ambient Press (kPa)	101.8	101.8
Volume Sampled, 273K, 101.3kPa (litres)	19.663	23.783
Analytical Data (µg/tube)	**71894/11**	**71894/13**
Mass C_8 -C_{10} Unresolved aliphatic/cyclic hydrocarbons front section	9,700	6,700
Mass C_8 -C_{10} Unresolved aliphatic/cyclic hydrocarbons rear section	<10.0	<10.0
Mass on Back-up Section (%)	0.1	0.2
Mass Total VOCs (exc. targets) on front section	9	11
Mass Total VOCs (exc. targets) on back section	4	2
Mass on Back-up Section (%)	30.8	15.4
Emission Concentration Data (mg/m^3)	**A2-5 Inlet**	**A2-5 Outlet**
C_8 -C_{10} Unresolved aliphatic/cyclic hydrocarbons	493.3	281.7
Measurement Range ($0.33x \leq x \leq 3.0$ mg/m^3)	162.8 - 1,479.9	92.96 - 845.1
Total VOCs (exc. targets)	0.7	0.5
Measurement Range ($0.33x \leq x \leq 3.0$ mg/m^3)	0.2 - 2.1	0.2 - 1.5

TABLE 4

DIBUTYL TIN EMISSION DATA SUMMARY

Sampling Data	A2-5 Inlet	A2-5 Outlet
Start Time	14:00	14:00
End Time	14:40	14:40
DGM Start	69.385	412.1730
DGM End	69.3972	412.1846
Volume Sampled (litres)	12.200	11.600
Ambient Temp (°C)	20	20
Ambient Press (kPa)	101.8	101.8
Volume Sampled, 273K, 101.3kPa (litres)	11.423	10.862
Analytical Data (µg/tube)	**71916/12**	**71916/14**
DiButyl Tin on front section	3	<3
Dibutyl Tin on rear section	<2	<2
Emission Concentration Data (mg/m^3)		
Dibutyl Tin	0.3	<0.3
Uncertainty (± mg/m^3)	0.1	0.1

APPENDIX 1

Certificate of Analysis

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2404

Report Number: 408893-2

Date of Report: 04-Aug-2014

Customer: Resource Environmental Consultants Ltd
Osprey House
Pacific Quay
Broadway
Salford
M50 2UE

Customer Contact: Mr Jon Connor

Customer Job Reference: 71894
Customer Site Reference: Date Collected: 10/7/14
Date Job Received at SAL: 15-Jul-2014
Date Analysis Started: 18-Jul-2014
Date Analysis Completed: 04-Aug-2014

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22

UKAS TESTING
1549

Report checked and authorised by :
James Allan
Project Manager

Issued by :
James Allan
Project Manager

Signature valid
Digitally signed by James Allan
Date: 2014.08.04 17:01:16 BST
Reason: Issued
Location: SAL

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (XAD) Analysed as Tube (XAD)
Miscellaneous

	SAL Reference	408893 010	408893 012	408893 014	408893 024	408893 026
	Customer Sample Reference	71894/10 FRONT	71894/12 FRONT	71894/14 FRONT	71894/10 BACK	71894/12 BACK
	Test Sample	AR	AR	AR	AR	AR
Determinand	**Method** / **LOD** / **Units** / **Symbol**					
Dibutyl tin	GC/MS (Deriv.) / 1 / µg / N	(2) <5	3	(2) <3	(2) <3	(2) <2

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (XAD) Analysed as Tube (XAD)
Miscellaneous

	SAL Reference	408893 028
	Customer Sample Reference	71894/14 BACK
	Test Sample	AR
Determinand	**Method** / **LOD** / **Units** / **Symbol**	
Dibutyl tin	GC/MS (Deriv.) / 1 / µg / N	(2) <2

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

	SAL Reference	408893 002	408893 004	408893 006	408893 008	408893 016
	Customer Sample Reference	71894/2	71894/4	71894/6	71894/8	71894/16
	Test Sample	AR	AR	AR	AR	AR
Determinand	**Method** / **LOD** / **Units** / **Symbol**					
Particulates (Total)	Grav / 0.3 / mg / U	<0.3	0.9	<0.3	<0.3	<0.3

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

	SAL Reference	408893 018	408893 020	408893 022
	Customer Sample Reference	71894/18	71894/20	71894/22
	Test Sample	AR	AR	AR
Determinand	**Method** / **LOD** / **Units** / **Symbol**			
Particulates (Total)	Grav / 0.3 / mg / U	<0.3	<0.3	<0.3

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Filter GFA 37mm Analysed as Filter GFA 37mm
Miscellaneous

	SAL Reference	408893 005	408893 007	408893 017	408893 019	408893 021
	Customer Sample Reference	71894/5	71894/7	71894/17	71894/19	71894/21
	Test Sample	AR	AR	AR	AR	AR
	Filter Reference	958	944	946	951	955
Determinand	**Method** / **LOD** / **Units** / **Symbol**					
Particulates (Total)	Grav (5 Dec) / 0.05 / mg / U	<0.05	(44) <0.05	(44) 0.26	<0.05	1.4

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Filter GFA 47mm Analysed as Filter GFA 47mm
Miscellaneous

SAL Reference	408893 015
Customer Sample Reference	71894/15
Test Sample	AR
Filter Reference	450

Determinand	Method	LOD	Units	Symbol	
Particulates (Total)	Grav (5 Dec)	0.05	mg	U	<0.05

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Filter Quartz 110mm Analysed as Filter Quartz 110mm
Miscellaneous

SAL Reference	408893 001	408893 003
Customer Sample Reference	71894/1	71894/3
Test Sample	AR	AR
Filter Reference	147	148

Determinand	Method	LOD	Units	Symbol		
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	<0.10	1.7

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	408893 009
Customer Sample Reference	71894/9 FRONT
Test Sample	AR

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	<5
VOC (Total excluding targets)	GC/MS	1	µg	N	<1
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	408893 011
Customer Sample Reference	71894/11 FRONT
Test Sample	AR

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	(195) 2200
VOC (Total excluding targets)	GC/MS	1	µg	N	9
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	A series of unresolved aliphatic/cyclic hydrocarbons circa C8 - C10 9700

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 013**
Customer Sample Reference	**71894/13 FRONT**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	(195) **1800**
VOC (Total excluding targets)	GC/MS	1	µg	N	**11**
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	A series of unresolved aliphatic/cyclic hydrocarbons circa C8 - C10 **6700**

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 023**
Customer Sample Reference	**71894/9 BACK**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	<5
VOC (Total excluding targets)	GC/MS	1	µg	N	<1
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 025**
Customer Sample Reference	**71894/11 BACK**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	**180**
VOC (Total excluding targets)	GC/MS	1	µg	N	**4**
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

SAL Reference: 408893
Project Site: Date Collected: 10/7/14
Customer Reference: 71894

Tube (Charcoal) Analysed as Tube (Charcoal 226-01)
Suite H

SAL Reference	**408893 027**
Customer Sample Reference	**71894/13 BACK**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Number of additional significant peaks	Calc			N	N.D.
Propan-2-ol	GC/MS	5	µg	U	**15**
VOC (Total excluding targets)	GC/MS	1	µg	N	**2**
Volatile Organic Compounds Screen (Top 10 screen)	GC/MS	10	µg	N	<10

Index to symbols used in 408893-2

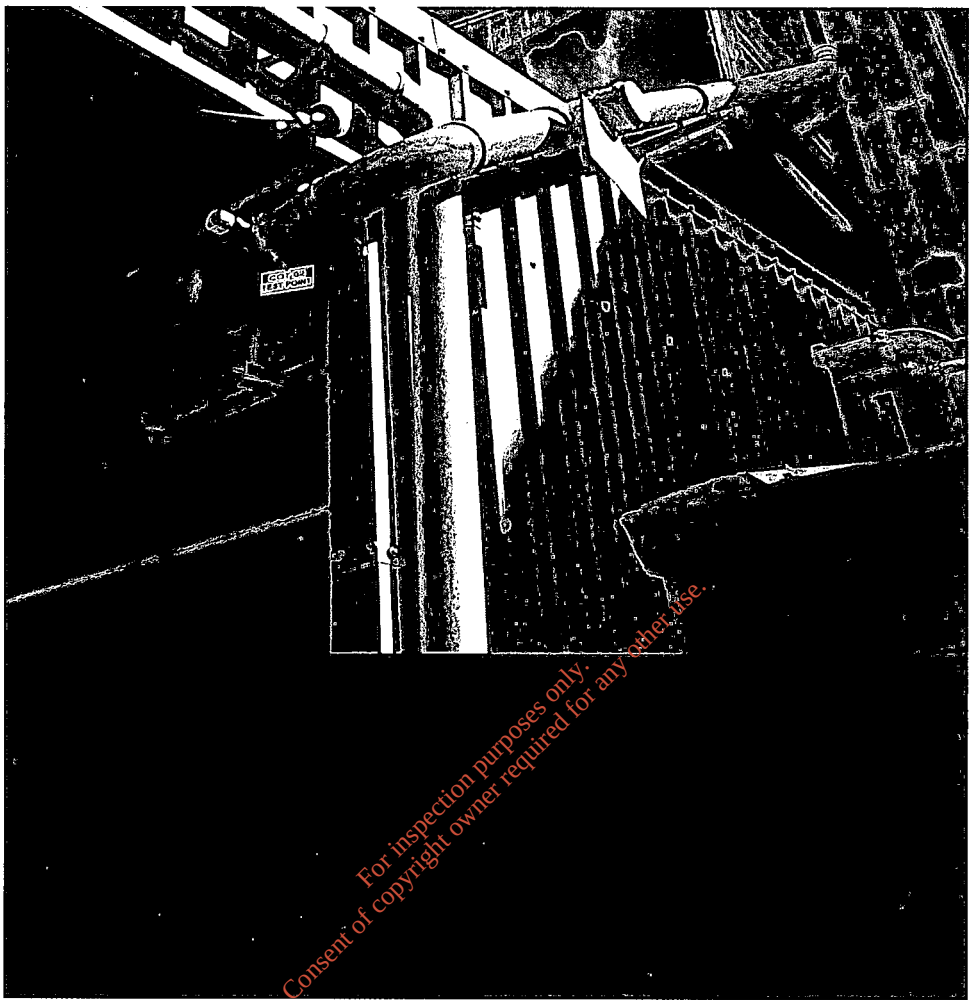
Value	Description
AR	As Received
N.D.	Not Detected
195	Due to levels found in the sample that are outside of the normal calibration range of the instrument, analysis was conducted on a diluted sample
2	LOD Raised Due to Matrix Interference
44	Filter received damaged, may lead to erroneous results.
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

APPENDIX 2

Diagrams & Photographs of Sampling Points

A2-5 Inlet

A2-5 Outlet



APPENDIX 3

Calculations

Conversion Factors

ppm @ mg/Nm³ (at 273K, 101.3kPa: STP)

CO	x	1.25	
SO_2	x	2.86	
VOC's	x	1.61	(ppm as C_3H_8 to mg/Nm^3 as C)
NO_X	x	2.05	(ppm NO + NO_2 to mg/m^3 as NO_2)

Oxygen Correction to Reference Value

Concentration at (STP) -> Concentration at 273K, 101.3kPa, reference O_2 and Dry Gas, i.e.

Concentration X ((20.9-O_2 ref)/(20.9-O_2 measured)) = Concentration at ref Oxygen state.

Example Calculation

SO_2 concentration at STP	=	170.7 mg/Nm³
Oxygen percentage in gas stream	=	13.8%
Reference Oxygen	=	11%
SO_2 concentration at reference O_2 conditions	=	170.7 ((20.9-11)/(20.9-13.8))
	=	238 mg/Nm³ at 273K, 101.3kPa, 11% O_2 and Dry Gas

Moisture Correction (Wet to Dry)

Concentration of Gas Dry = Concentration of x 100/100-Bws Gas Wet

Concentration of Gas Wet = Concentration of x 100-Bws/100 Gas Dry

Where Bws = moisture content of gas stream in percent (Vol/Vol).

Example

VOC concentration	=	25 mg/Nm³ (Wet)
Moisture Content	=	27.1%
Concentration of VOC	=	25 (100/(100-27.1))

Carbon (C) to Trichloethylene (TCE)

ppm TCE = ppm C x 0.6715

TCE in mg/m^3 = TCE ppm x 5.864 (Mol Wt/22.4)