OEH Group Limited
253 – 255 Great Lister Street
Birmingham
West Midlands
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REPORT FOR THE PERIODIC MONITORING

OF

EMISSIONS TO AIR FROM PART B PROCESSES

at

SANDVIK HARD MATERIALS LIMITED
PO BOX 89
TORRINGTON AVENUE
COVENTRY
WARWICKSHIRE
CV4 9XG

PART 1: EXECUTIVE SUMMARY

REPORT NO:	OEH/34258/STAK/SS70	**CLIENT REF:**	Purchase Order No: 1020209
DATE OF VISIT:	15 to 16 August 2005	**CONTACT ON SITE:**	Phil Moran
DATE OF REPORT:	19 September 2005	**DISK REFERENCE:**	N:\GenAdmin$\Divisional Reports\2005\Air Quality\Reports\Sandvik\OEH34258\OEH34258 CS F.doc

DATA PROTECTION ACT REGISTRATION NO: B0479 03 4

CONFIDENTIALITY UNDERTAKING

We undertake that we will not knowingly make use or disclose any confidential information or photographs relating to your business which may have come to our knowledge or attention as a result of our visit on site or otherwise as a result of the work carried out by us in connection with the preparation of this report. If you have any queries or comments regarding this report, please contact the Customer Services, OEH Group Limited Tel: 0121 359 5361.

Reported by:

[redacted]

Paul Calland
MCERTS No. MM 03212
Senior Environmental Scientist.

Approved by:

[redacted]

Andy Barnes
MCERT No. MM 03235
Divisional Manager – Air Quality

for OEH Group Limited

If you have any queries or comments regarding this report, please contact Customer Services, OEH Group Ltd. Tel: 0121 359 5361.

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1 MONITORING OBJECTIVES

The monitoring at this installation was carried out as part of the compliance check monitoring of emissions to air in accordance with the requirements of Local Authority Permit/Authorisation Number; PPC 025. The substances requested for monitoring at each emission point are listed in the table below.

Substances to be monitored	**Emission Point Identification**			
	LEV 002	**LEV 12A**	**LEV 16**	**LEV 20**
	South Site Vent 30	**South Site Vent 28**	**South Site Vent 37**	**South Site Vent 19**
Total Particulates	√	√	√	√
Cobalt	√	√	√	√
Tungsten	√	√	√	√
Substances to be monitored	**Emission Point Identification**			
	LEV 23	**LEV 27**	**LEV 45**	**LEV 3**
	South Site Vent 26	**South Site Vent 23**	**South Site Vent 24**	**North Site Vent 7**
Total Particulates	√	√	√	√
Cobalt	√	√	√	√
Tungsten	√	√	√	√
Substances to be monitored	**Emission Point Identification**			
	LEV 8	**North Site – New Small Filter (B5 Furnaces & Cake Breaking)**	**North Site – New Large Filter (B5 Ball Mills)**	
	North Site Vent 3			
Total Particulates	√	√	√	
Cobalt	√	√	√	
Tungsten	√	√	√	

1.1 Terms of Reference

Sandvik Hard Materials Limited, PO Box 89, Torrington Avenue, Coventry, Warwickshire, CV4 9XG, has commissioned OEH Group Limited to carry out the work described in this report. Monitoring was carried out on 15th and 16th August 2005 by Andy Barnes and Paul Calland at the request of Phil Moran

The work was carried out in accordance with the site specific sampling protocols outlined in OEH Proposal ref: EFH-11757, dated 8th July 2005. The client instructions are set out in Purchase Order 1020209.

OEH Group is accredited under ISO-9000:2000 for the provision of health, safety and environmental consultancy services. The work described in this report was carried out in accord with the Company's Standard Operating Procedures and Level III: Consultancy Work Instructions. Field personnel hold Level 2 MCERTs certification.

2 MONITORING RESULTS

2.1 Emission Point Reference: South Site – LEV 002

Process Status	**Processes Running as Normal**					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.42 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	09:31 – 10:01 & 10:05 – 10:35
Tungsten	n/a	0.034 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.003 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

Notes:	
Emission Limit Value	The emission limit value is that stated in the permit, and is expressed as a concentration [$mg.Nm^{-3}$] or a mass emission [$kg.hr^{-1}$]. Otherwise "unknown" is stated.
Periodic Monitoring Result	The result given is expressed in the same terms and units as the emission limit value, where available.
Reference Conditions	Where NTP is stated, all results are expressed at reference conditions of 273 K and 101.3kPa. The results are not corrected for oxygen or moisture content unless otherwise stated.
Monitoring Method Reference	The method stated is in accordance with the Environment Agency Technical Guidance Note M2 or other method approved/requested by the Environment Agency.
Accreditation for use of	All Methods are Not UKAS Accredited (Accreditation pending for particulates).
Method Process Status	The details indicate the feedstock and the loading rate of the plant during monitoring.

2.2 Emission Point Reference: South Site – LEV 12A

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	1.08 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	09:15 – 09:45 & 09:49 – 10:19
Tungsten	n/a	0.140 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.010 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

2.3 Emission Point Reference: South Site – LEV 15

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.55 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	13:15 – 14:03 & 14:05 – 15:05
Tungsten	n/a	0.139 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.002 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

2.4 Emission Point Reference: South Site – LEV 20

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.47 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	11:58 – 12:33 & 12:35 – 13:10
Tungsten	n/a	0.062 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.006 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

2.5 Emission Point Reference: South Site – LEV 23

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.04 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	12:18 – 12:54 & 12:58 – 13:34
Tungsten	n/a	0.059 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.004 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

2.6 Emission Point Reference: South Site – LEV 27

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.16 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	10:58 – 11:28 & 11:35 – 12:05
Tungsten	n/a	0.097 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.003 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

2.7 Emission Point Reference: South Site – LEV 45

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.17 $mg.m^{-3}$	NTP	BS EN 13284	15/08/05	13:47 – 14:17 & 14:20 – 15:00
Tungsten	n/a	0.038 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	
Cobalt	n/a	0.005 $mg.m^{-3}$	NTP	BS EN 14385	15/08/05	

2.8 Emission Point Reference: North Site – LEV 3

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	1.39 $mg.m^{-3}$	NTP	BS EN 13284	16/08/05	12:00 – 12:40 & 12:43 – 13:23
Tungsten	n/a	0.090 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	
Cobalt	n/a	0.058 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	

2.9 Emission Point Reference: North Site – LEV 8

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.07 $mg.m^{-3}$	NTP	BS EN 13284	16/08/05	12:51 – 13:31 & 13:40 – 14:22
Tungsten	n/a	0.022 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	
Cobalt	n/a	0.007 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	

2.10 Emission Point Reference: North Site – Small New Filter (B5 Furnaces)

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.17 $mg.m^{-3}$	NTP	BS EN 13284	16/08/05	09:30 – 10:10 & 10:14 – 10:54
Tungsten	n/a	0.074 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	
Cobalt	n/a	0.001 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	

2.11 Emission Point Reference: North Site – Large New Filter (B5 Ball Mills)

Process Status	Processes Running as Normal					
Parameter	**Emission Limit Value**	**Periodic Monitoring Result**	**Reference Conditions**	**Method Reference**	**Sampling Date**	**Sampling Time**
Particulates	50 $mg.m^{-3}$	0.09 $mg.m^{-3}$	NTP	BS EN 13284	16/08/05	11:01 – 11:37 & 11:41 – 12:25
Tungsten	n/a	0.069 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	
Cobalt	n/a	0.002 $mg.m^{-3}$	NTP	BS EN 14385	16/08/05	

3 PLANT AND OPERATING INFORMATION

Plant and operating conditions prevailing on the date of the survey were described as normal in all cases.

4 MONITORING DEVIATIONS

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
South Site – LEV 16	Total Particulate, Tungsten & Cobalt	Not Sampled	Process served by LEV 16 was not operating (under repairs) – LEV 15 was sampled instead.
South Site – LEV 002	Total Particulate	Only 1 sample line used.	Sample ports fitted incorrectly, increased number of sample points used on 1 line.
South Site – LEV 12A	Total Particulate	Non-isokinetic sampling was used	No stack is fitted so sampling made at filter outlet.
South Site – LEV 15	Total Particulate	Only 1 sample line used.	Sample ports fitted incorrectly, increased number of sample points used on 1 line.
South Site – LEV 45	Total Particulate	Non-isokinetic sampling was used	No stack is fitted so sampling made at wet collector outlet.

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
North Site – LEV 13	Total Particulate	Only 1 sample line used.	Sample ports fitted incorrectly, increased number of sample points used on 1 line.
North Site – LEV 8	Total Particulate	Non-isokinetic sampling was used	No stack is fitted so sampling made at filter outlets.
North Site – New Small Filter	Total Particulate	Non-isokinetic sampling was used	No stack is fitted so sampling made at filter outlet.
Notes:			
Substance Deviations	State any substance not monitored during the monitoring campaign, together with the reason for the omission from the monitoring campaign. If not applicable state "N/A"		
Monitoring Deviations	State any deviation from the standard method, the consequences, and the reason for the deviation. If not applicable state "N/A"		
Other Relevant Issues	State any other information relevant to the monitoring campaign. If not applicable state "N/A"		

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PART 2: SUPPORTING INFORMATION

REPORT NO:	OEH/34258/STAK/SS70	**CLIENT REF:**	Purchase Order No: 1020209
DATE OF VISIT:	15 to 16 August 2005	**CONTACT ON SITE:**	Phil Moran
DATE OF REPORT:	19 September 2005	**DISK REFERENCE:**	N:\GenAdmin$\Divisional Reports\2005\Air Quality\Reports\Sandvik\OEH34258\OEH34258 CS F.doc

DATA PROTECTION ACT REGISTRATION NO: B0479 03 4

Reported by:

[redacted]

Paul Calland
MCERTS No. MM 03212
Senior Environmental Scientist.

Approved by:

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Andy Barnes
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Divisional Manager – Air Quality

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5 APPENDIX I

5.1 Field Staff Used

Name	MCERTS Registration No:	MCERTS Qualifications	Function
Andrew Barnes	MM 03235	Level 2, TE1, TE3 & TE4	Team Leader
Paul Calland	MM 03212	Level 2 & TE1 & TE4	Assistant

5.2 Field Monitoring Methods Used

5.2.1 Stack Velocity & Temperature Measurements

Stack velocity was measured using a pitot tube, conforming to the design specifications of ISO 3966-1977, coupled to an electronic manometer. Temperature measurements were taken using a K-type thermocouple connected to an electronic thermometer. Measurements were made using OEH technical procedure AQSOP 200, which is designed to fulfil the requirements of ISO10780:1994.

5.2.2 Particulate Matter

Periodic extractive sampling for particulate matter was conducted using two off Stackmite sampling trains, with the in-stack filter configuration. Measurements were made using OEH technical procedure AQSOP 201, which is designed to fulfil the requirements of BS EN 13284-1:2002 & Environment Agency MID1.

5.2.3 Metals (Tungsten and Cobalt)

Periodic extractive sampling for particulate and vapour phase metals was conducted using the Stackmite sampling trains above, backed up by an impinger train containing solutions of nitric acid/ hydrogen peroxide. Measurements were made using a procedure designed to fulfil the requirements of BS EN 14385:2004.

5.3 Monitoring Equipment Used

Equipment	Serial Number	Description/ Type	Calibration Certificate	Calibration Expires
Stackmite unit(s)	AQ 001	1008/1854	In House	31/10/2005
Stackmite unit(s)	AQ 003	386769	In House	04/11/05
Thermometer	AQ 004	6497	In House	27/04/06
Pitot tube	AQ 095	Airflow 1.8m	N8907/05	04/05/2006
Manometer	AQ 064	30208024	LCM4426/05/7	15/04/2006
Calipers	AQ 168	04414420	113451	03/05/2006
Tape Measure	AQ 049	5 metre	In House	28/04/2006

6 APPENDIX II

6.1 Analysis

6.1.1 Blank Analysis.

The following table gives details of the blank filter and impinger solution analysis results.

Blank Media	Sample Number	Blank Values		
		Particulate	Cobalt	Tungsten
Filter	GF 10163	<20 µg	<1 µg	<1 µg
Impinger Solution	OH 797/ 798	n/a	<1 µg	<1 µg

6.1.2 Techniques & Detection Limits

Analyte	Analysis Technique	Detection Limit	Analytical Precision, %	Method Reference
TPM	Gravimetric	20 µg	1	LSOP 202
Metals	Atomic Absorption	1 µg	1	LSOP 300

6.1.3 Accreditation

Service Category	ISO-9002	UKAS[1]
Consultancy	Yes	No
Analysis		
- Dusts (air filter samples); Lab Method LSOP 202.	Yes	Yes
- Metals Lab Method LSOP 300/ 301	Yes	Yes
[1]UKAS lab number 1821		
Stack sampling team is a member of the Source Testing Association		

7 APPENDIX III

7.1 Total Particulate Matter & Flowrate Calculation Spreadsheets

Plant Type	**South Site - LEV 002**	Stack Area (m²)	0.283
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Diameter (cm)	60
Date	**15th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
		Stack Pressure (Pa)	11
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	5.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Distance From Near Wall (D)	0.065	0.150	0.250	0.350	0.450	0.550	0.650	0.750	0.850	0.935
Pitot Reading (Pa)	*45*	*55*	*58*	*60*	*65*	*70*	*65*	*62*	*55*	*45*
Temperature (°C)	*25*	*25*	*25*	*25*	*25*	*25*	*25*	*25*	*25*	*25*
Duct Velocity (m/s)	8.7	9.6	9.9	10.1	10.5	10.9	10.5	10.2	9.6	8.7

Absolute Mean Duct Velocity (m/s)	**9.9**
Absolute Flow Rate (m³/hr)	**10057**
Normalised Flow Rate (Nm³/hr)	**9214**

Sampling Run 1 **Time: 09:31 - 10:01**

Sampling Point	A2	A2	A7	A9
Sampling Rate (l/min)	*11.5*	*12.1*	*12.6*	*11.5*
Sampling Duration (mins)	*7.5*	*7.5*	*7.5*	*7.5*
Filter No	*10187*	*10187*	*10187*	*10187*
Volume Sampled (m³)	Meter	0.345	Expectec	0.358

Initial Meter Reading (l)	476183
Final Meter Reading (l)	476528
Volume Sampled (l)	345
Isokineticity Error (%)	-3.6
(Maximum Allowed Error = -5 to +15%)	

Corrected Volume = 0.31 Nm³ (at NTP)

Sampling Run 2 **Time: 10:05 - 10:35**

Sampling Point	A2	A2	A7	A9
Sampling Rate (l/min)	*11.5*	*12.1*	*12.6*	*11.5*
Sampling Duration (mins)	*7.5*	*7.5*	*7.5*	*7.5*
Filter No	*10189*	*10189*	*10189*	*10189*
Volume Sampled (m³)	Meter	0.345	Expectec	0.358

Initial Meter Reading (l)	476530
Final Meter Reading (l)	476875
Volume Sampled (l)	345
Isokineticity Error (%)	-3.6
(Maximum Allowed Error = -5 to +15%)	

Corrected Volume = 0.31 Nm³ (at NTP)

	FILTER WEIGHTS			WASHINGS WEIGHTS		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10187	56.43	56.62	0.00	0.00	0.19
2	10189	56.31	56.38	0.00	0.00	0.07

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.61**	**0.23**	**0.42**
Mass Emission (g/hr)	**5.6**	**2.1**	**3.9**

Plant Type	**South Site - LEV 12A**	Stack Area (m²)	0.488
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Grille Dimensions (cm)	65 x 75
Date	**15th August 2005**	Pitot Factor	
		Pitot Factor (sqrt)	
		Stack Pressure (Pa)	0
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	5.00

PITOT SURVEY

There is no stack fitted and so sampling made non-isokinetically from outlet grille of filter

No accurate flow measurements are possible

Sampling Run 1 **Time: 09:15 - 09:45**

Sampling Point	CP			Initial Meter Reading (l)	989748
Sampling Rate (l/min)	*14.0*			Final Meter Reading (l)	990183
Sampling Duration (mins)	*30*			Volume Sampled (l)	435
Filter No	*10188*				
Volume Sampled (m³)	Meter	0.435	Expectec 0.420		

Corrected Volume = 0.39 Nm³ (at NTP)

Sampling Run 2 **Time: 09:49 - 10:19**

Sampling Point	CP			Initial Meter Reading (l)	990183
Sampling Rate (l/min)	*14.0*			Final Meter Reading (l)	990618
Sampling Duration (mins)	*30*			Volume Sampled (l)	435
Filter No	*10190*				
Volume Sampled (m³)	Meter	0.435	Expectec 0.420		

Corrected Volume = 0.39 Nm³ (at NTP)

	FILTER WEIGHTS			**WASHINGS WEIGHTS**		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10188	54.99	55.80	0.00	0.00	0.81
2	10190	55.31	55.35	0.00	0.00	0.04

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**2.07**	**0.10**	**1.08**
Mass Emission (g/hr)	-	-	-

Plant Type	**South Site - LEV 15**	Stack Area (m²)	0.126
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Diameter (cm)	40
Date	**15th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
		Stack Pressure (Pa)	5
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	7.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Distance From Near Wall (D)	0.065	0.150	0.250	0.350	0.450	0.550	0.650	0.750	0.850	0.935
Pitot Reading (Pa)	*5*	*5*	*5*	*5*	*5*	*6*	*5*	*5*	*5*	*5*
Temperature (°C)	*25*	*25*	*25*	*25*	*25*	*25*	*25*	*25*	*25*	*25*
Duct Velocity (m/s)	2.9	2.9	2.9	2.9	2.9	3.2	2.9	2.9	2.9	2.9

Absolute Mean Duct Velocity (m/s)	**2.9**
Absolute Flow Rate (m³/hr)	**1328**
Normalised Flow Rate (Nm³/hr)	**1217**

Sampling Run 1 **Time: 13:15 - 14:03**

Sampling Point	A2	A4	A7	A9
Sampling Rate (l/min)	*8.5*	*8.5*	*8.5*	*8.5*
Sampling Duration (mins)	*12*	*12*	*12*	*12*
Filter No	*10193*	*10193*	*10193*	*10193*
Volume Sampled (m³)	Meter	0.420	Expectec	0.408

Initial Meter Reading (l)	991382
Final Meter Reading (l)	991802
Volume Sampled (l)	420
Isokineticity Error (%)	2.9
(Maximum Allowed Error = -5 to +15%)	

Corrected Volume = 0.38 Nm³ (at NTP)

Sampling Run 2 **Time: 14:05 - 15:05**

Sampling Point	A2	A4	A7	A9
Sampling Rate (l/min)	*8.5*	*8.5*	*8.5*	*8.5*
Sampling Duration (mins)	*15*	*15*	*15*	*15*
Filter No	*10194*	*10194*	*10194*	*10194*
Volume Sampled (m³)	Meter	0.550	Expectec	0.510

Initial Meter Reading (l)	991802
Final Meter Reading (l)	992352
Volume Sampled (l)	550
Isokineticity Error (%)	7.8
(Maximum Allowed Error = -5 to +15%)	

Corrected Volume = 0.50 Nm³ (at NTP)

	FILTER WEIGHTS			**WASHINGS WEIGHTS**		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10193	56.61	56.81	0.00	0.00	0.20
2	10194	56.40	56.68	0.00	0.00	0.28

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.53**	**0.57**	**0.55**
Mass Emission (g/hr)	**0.6**	**0.7**	**0.7**

Plant Type	**South Site - LEV 20**	Stack Area (m²)	0.071
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Diameter (cm)	30
Date	**15th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
		Stack Pressure (Pa)	130
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	4.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Distance From Near Wall (D)	0.065	0.150	0.250	0.350	0.450	0.550	0.650	0.750	0.850	0.935
Pitot Reading (Pa)	*115*	*113*	*112*	*115*	*113*	*113*	*110*	*111*	*109*	*105*
Temperature (°C)	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Duct Velocity (m/s)	14.1	13.9	13.9	14.1	13.9	13.9	13.7	13.8	13.7	13.4
Traverse Point	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Distance From Near Wall (D)	0.065	0.150	0.250	0.350	0.450	0.550	0.650	0.750	0.850	0.935
Pitot Reading (Pa)	*116*	*114*	*115*	*115*	*114*	*113*	*112*	*113*	*110*	*103*
Temperature (°C)	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Duct Velocity (m/s)	14.1	14.0	14.1	14.1	14.0	13.9	13.9	13.9	13.7	13.3

Absolute Mean Duct Velocity (m/s)	**13.9**
Absolute Flow Rate (m³/hr)	**3532**
Normalised Flow Rate (Nm³/hr)	**3186**

Sampling Run 1 **Time: 11:58 - 12:33**

Sampling Point	CP			Initial Meter Reading (l)	990627
Sampling Rate (l/min)	*10.6*			Final Meter Reading (l)	991004
Sampling Duration (mins)	*35*			Volume Sampled (l)	377
Filter No	*10191*			Isokineticity Error (%)	1.6
Volume Sampled (m³)	Meter	0.377	Expectec 0.371	*(Maximum Allowed Error = -5 to +15%)*	

Corrected Volume = 0.34 Nm³ (at NTP)

Sampling Run 2 **Time: 12:35 - 13:10**

Sampling Point	CP			Initial Meter Reading (l)	991005
Sampling Rate (l/min)	*10.6*			Final Meter Reading (l)	991382
Sampling Duration (mins)	*35*			Volume Sampled (l)	377
Filter No	*10192*			Isokineticity Error (%)	1.6
Volume Sampled (m³)	Meter	0.377	Expectec 0.371	*(Maximum Allowed Error = -5 to +15%)*	

Corrected Volume = 0.34 Nm³ (at NTP)

	FILTER WEIGHTS			WASHINGS WEIGHTS		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10191	56.40	56.60	0.00	0.00	0.20
2	10192	56.45	56.57	0.00	0.00	0.12

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.59**	**0.35**	**0.47**
Mass Emission (g/hr)	**1.9**	**1.1**	**1.5**

Plant Type	**South Site - LEV 23**	Stack Area (m²)	0.018
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Diameter (cm)	15
Date	**15th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
		Stack Pressure (Pa)	30
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	5.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5
Distance From Near Wall (D)	0.150	0.250	0.500	0.750	0.850
Pitot Reading (Pa)	*95*	*99*	*100*	*97*	*94*
Temperature (°C)	*70*	*70*	*70*	*70*	*70*
Duct Velocity (m/s)	13.6	13.9	13.9	13.7	13.5
Traverse Point	B1	B2	B3	B4	B5
Distance From Near Wall (D)	0.150	0.250	0.500	0.750	0.850
Pitot Reading (Pa)	*98*	*99*	*100*	*98*	*93*
Temperature (°C)	*70*	*70*	*70*	*70*	*70*
Duct Velocity (m/s)	13.8	13.9	13.9	13.8	13.4

Absolute Mean Duct Velocity (m/s)	**13.8**
Absolute Flow Rate (m³/hr)	**875**
Normalised Flow Rate (Nm³/hr)	**697**

Sampling Run 1 **Time: 12:18 - 12:54**

Sampling Point	CP			
Sampling Rate (l/min)	*14.5*			
Sampling Duration (mins)	*36*			
Filter No	*10147*			
Volume Sampled (m³)	Meter	0.530	Expectec 0.522	

Initial Meter Reading (l) 477940
Final Meter Reading (l) 478470
Volume Sampled (l) 530
Isokineticity Error (%) 1.5
(Maximum Allowed Error = -5 to +15%)

Corrected Volume = 0.48 Nm³ (at NTP)

Sampling Run 2 **Time: 12:58 - 13:34**

Sampling Point	CP			
Sampling Rate (l/min)	*14.5*			
Sampling Duration (mins)	*36*			
Filter No	*10148*			
Volume Sampled (m³)	Meter	0.530	Expectec 0.522	

Initial Meter Reading (l) 478470
Final Meter Reading (l) 479000
Volume Sampled (l) 530
Isokineticity Error (%) 1.5
(Maximum Allowed Error = -5 to +15%)

Corrected Volume = 0.48 Nm³ (at NTP)

FILTER WEIGHTS **WASHINGS WEIGHTS**

Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10147	53.80	53.82	0.00	0.00	0.02
2	10148	54.29	54.31	0.00	0.00	0.02

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.04**	**0.04**	**0.04**
Mass Emission (g/hr)	**0.03**	**0.03**	**0.03**

Plant Type	**South Site - LEV 27**	Stack Area (m²)	0.018
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Diameter (cm)	15
Date	**15th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
		Stack Pressure (Pa)	1250
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	3.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5
Distance From Near Wall (D)	0.150	0.250	0.500	0.750	0.850
Pitot Reading (Pa)	*835*	*842*	*850*	*863*	*856*
Temperature (°C)	*45*	*45*	*45*	*45*	*45*
Duct Velocity (m/s)	38.8	39.0	39.1	39.4	39.3

Absolute Mean Duct Velocity (m/s)	**39.1**
Absolute Flow Rate (m³/hr)	**2490**
Normalised Flow Rate (Nm³/hr)	**2164**

Sampling Run 1 **Time: 10:58 - 11:28**

Sampling Point	CP			Initial Meter Reading (l)	476875
Sampling Rate (l/min)	*16.0*			Final Meter Reading (l)	477355
Sampling Duration (mins)	*30*			Volume Sampled (l)	480
Filter No	*9993*			Isokineticity Error (%)	0.0
Volume Sampled (m³)	Meter	0.480	Expectec 0.480	*(Maximum Allowed Error = -5 to +15%)*	

Corrected Volume = 0.43 Nm³ (at NTP)

Sampling Run 2 **Time: 11:35 - 12:05**

Sampling Point	CP			Initial Meter Reading (l)	477355
Sampling Rate (l/min)	*16.0*			Final Meter Reading (l)	477835
Sampling Duration (mins)	*30*			Volume Sampled (l)	480
Filter No	*9994*			Isokineticity Error (%)	0.0
Volume Sampled (m³)	Meter	0.480	Expectec 0.480	*(Maximum Allowed Error = -5 to +15%)*	

Corrected Volume = 0.43 Nm³ (at NTP)

	FILTER WEIGHTS			WASHINGS WEIGHTS		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	9993	54.03	54.15	0.00	0.00	0.12
2	9994	55.18	55.20	0.00	0.00	0.02

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.28**	**0.05**	**0.16**
Mass Emission (g/hr)	**0.60**	**0.10**	**0.35**

Plant Type	**South Site - LEV 45**	Stack Area (m²)	
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Grille Dimensions (cm)	
Date	**15th August 2005**	Pitot Factor	
		Pitot Factor (sqrt)	
		Stack Pressure (Pa)	0
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	5.00

PITOT SURVEY

There is no stack fitted and so sampling made non-isokinetically from outlet grille of wet collector

No accurate flow measurements are possible

Sampling Run 1 **Time: 13:47 - 14:17**

Sampling Point	CP			Initial Meter Reading (l)	479001
Sampling Rate (l/min)	*15.0*			Final Meter Reading (l)	479451
Sampling Duration (mins)	*30*			Volume Sampled (l)	450
Filter No	*10150*				
Volume Sampled (m³)	Meter	0.450	Expectec 0.450		

Corrected Volume = 0.41 Nm³ (at NTP)

Sampling Run 2 **Time: 14:20 - 15:00**

Sampling Point	CP			Initial Meter Reading (l)	479451
Sampling Rate (l/min)	*15.0*			Final Meter Reading (l)	480021
Sampling Duration (mins)	*40*			Volume Sampled (l)	570
Filter No	*10151*				
Volume Sampled (m³)	Meter	0.570	Expectec 0.600		

Corrected Volume = 0.51 Nm³ (at NTP)

	FILTER WEIGHTS			WASHINGS WEIGHTS		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10150	55.80	55.87	0.00	0.00	0.07
2	10151	55.93	56.02	0.00	0.00	0.09

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.17**	**0.18**	**0.17**
Mass Emission (g/hr)	-	-	-

Plant Type	**North Site - LEV 3**	Stack Area (m²)	0.165
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Dimensions (cm)	55 x 30
Date	**16th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
		Stack Pressure (Pa)	250
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	5.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Distance From Near Wall (D)	0.065	0.125	0.250	0.375	0.450	0.550	0.625	0.750	0.875	0.935
Pitot Reading (Pa)	*61*	*58*	*59*	*63*	*64*	*65*	*65*	*63*	*62*	*55*
Temperature (°C)	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Duct Velocity (m/s)	10.2	10.0	10.1	10.4	10.5	10.6	10.6	10.4	10.3	9.7

Absolute Mean Duct Velocity (m/s)	**10.3**
Absolute Flow Rate (m³/hr)	**6104**
Normalised Flow Rate (Nm³/hr)	**5513**

Sampling Run 1 **Time: 12:00 - 12:40**

Sampling Point	A2	A4	A7	A9	Initial Meter Reading (l)	994604
Sampling Rate (l/min)	*12.0*	*12.8*	*13.0*	*12.6*	Final Meter Reading (l)	995090
Sampling Duration (mins)	*10*	*10*	*10*	*10*	Volume Sampled (l)	486
Filter No	*10141*	*10141*	*10141*	*10141*	Isokineticity Error (%)	-3.6
Volume Sampled (m³)	Meter	0.486	Expectec	0.504	*(Maximum Allowed Error = -5 to +15%)*	

Corrected Volume = 0.44 Nm³ (at NTP)

Sampling Run 2 **Time: 12:43 - 13:23**

Sampling Point	A2	A4	A7	A9	Initial Meter Reading (l)	995091
Sampling Rate (l/min)	*12.0*	*12.8*	*13.0*	*12.6*	Final Meter Reading (l)	995601
Sampling Duration (mins)	*10*	*10*	*10*	*10*	Volume Sampled (l)	510
Filter No	*10142*	*10142*	*10142*	*10142*	Isokineticity Error (%)	1.2
Volume Sampled (m³)	Meter	0.510	Expectec	0.504	*(Maximum Allowed Error = -5 to +15%)*	

Corrected Volume = 0.46 Nm³ (at NTP)

	FILTER WEIGHTS			**WASHINGS WEIGHTS**		
Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10141	53.81	54.49	0.00	0.00	0.68
2	10142	54.10	54.66	0.00	0.00	0.56

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**1.55**	**1.22**	**1.39**
Mass Emission (g/hr)	**8.6**	**6.7**	**7.6**

Plant Type	**North Site - LEV 8**	Stack Area (m²)	
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Grille Dimensions (cm)	
Date	**16th August 2005**	Pitot Factor	
		Pitot Factor (sqrt)	
		Stack Pressure (Pa)	0
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	5.00

PITOT SURVEY

There is no stack fitted and so sampling made non-isokinetically from outlet grilles of the filters

There are two filters units connected to the same extraction, one test was made from each.

No accurate flow measurements are possible

Sampling Run 1 **Time: 12:51 - 13:31**

Sampling Point	CP (RHS)		
Sampling Rate (l/min)	*14.0*		
Sampling Duration (mins)	*40*		
Filter No	*10161*		
Volume Sampled (m³)	Meter 0.525	Expectec 0.560	
Corrected Volume =	0.47 Nm³ (at NTP)		

Initial Meter Reading (l)	482125
Final Meter Reading (l)	482650
Volume Sampled (l)	525

Sampling Run 2 **Time: 13:40 - 14:22**

Sampling Point	CP (LHS)		
Sampling Rate (l/min)	*14.0*		
Sampling Duration (mins)	*40*		
Filter No	*10162*		
Volume Sampled (m³)	Meter 0.548	Expectec 0.560	
Corrected Volume =	0.49 Nm³ (at NTP)		

Initial Meter Reading (l)	482652
Final Meter Reading (l)	483200
Volume Sampled (l)	548

FILTER WEIGHTS **WASHINGS WEIGHTS**

Test Number	Filter No	Pre-Weight (mg)	Post-Weight (mg)	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10161	55.16	55.20	0.00	0.00	0.04
2	10162	55.67	55.70	0.00	0.00	0.03

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.08**	**0.06**	**0.07**
Mass Emission (g/hr)	-	-	-

Plant Type	**North Site - New Filter**	Stack Area (m²)	0.126
Job Number	**OEH 34258**	Meter Temp (C)	30
Client Name	**Sandvik**	Stack Diameter (cm)	40
Date	**16th August 2005**	Pitot Factor	1.00
		Pitot Factor (sqrt)	1.00
Large Filter Unit With Stack - Ball Mills in B5		Stack Pressure (Pa)	50
		Ambient Pressure (kPa)	101.3
		Nozzle Size (mm)	6.00

PITOT SURVEY

Traverse Point	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Distance From Near Wall (D)	0.065	0.150	0.250	0.350	0.450	0.550	0.650	0.750	0.850	0.935
Pitot Reading (Pa)	*26*	*30*	*30*	*30*	*31*	*32*	*31*	*30*	*30*	*25*
Temperature (°C)	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Duct Velocity (m/s)	6.7	7.2	7.2	7.2	7.3	7.4	7.3	7.2	7.2	6.6
Traverse Point	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Distance From Near Wall (D)	0.065	0.150	0.250	0.350	0.450	0.550	0.650	0.750	0.850	0.935
Pitot Reading (Pa)	*28*	*30*	*29*	*28*	*30*	*31*	*32*	*31*	*30*	*25*
Temperature (°C)	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*30*
Duct Velocity (m/s)	6.9	7.2	7.1	6.9	7.2	7.3	7.4	7.3	7.2	6.6

Absolute Mean Duct Velocity (m/s)	**7.1**
Absolute Flow Rate (m³/hr)	**3217**
Normalised Flow Rate (Nm³/hr)	**2900**

Sampling Run 1 **Time: 11:01 - 11:37**

Sampling Point	A2	A9	B2	B9
Sampling Rate (l/min)	*12.2*	*12.2*	*12.2*	*12.2*
Sampling Duration (mins)	*9*	*9*	*9*	*9*
Filter No	*10159*	*10159*	*10159*	*10159*
Volume Sampled (m³)	Meter	0.425	Expectec	0.439

Initial Meter Reading (l)	481160
Final Meter Reading (l)	481585
Volume Sampled (l)	425
Isokineticity Error (%)	-3.2
(Maximum Allowed Error = -5 to +15%)	

Corrected Volume = 0.38 Nm³ (at NTP)

Sampling Run 2 **Time: 11:41 - 12:25**

Sampling Point	A2	A9	B2	B9
Sampling Rate (l/min)	*12.2*	*12.2*	*12.2*	*12.2*
Sampling Duration (mins)	*11*	*11*	*11*	*11*
Filter No	*10160*	*10160*	*10160*	*10160*
Volume Sampled (m³)	Meter	0.540	Expectec	0.537

Initial Meter Reading (l)	481585
Final Meter Reading (l)	482125
Volume Sampled (l)	540
Isokineticity Error (%)	0.6
(Maximum Allowed Error = -5 to +15%)	

Corrected Volume = 0.49 Nm³ (at NTP)

FILTER WEIGHTS **WASHINGS WEIGHTS**

Test Number	Filter No	Pre-Weight (mg	Post-Weight (mg	Pre-Weight (mg)	Post-Weight (mg)	Gain (mg)
1	10159	55.56	55.60	0.00	0.00	0.04
2	10160	56.34	56.38	0.00	0.00	0.04

TEST RESULTS

	Test 1	Test 2	Mean
Particulate Concentration(mg/Nm³)	**0.10**	**0.08**	**0.09**
Mass Emission (g/hr)	**0.3**	**0.2**	**0.3**

8 APPENDIX IV

8.1 Metals Determination Spreadsheet

OEH Group Limited - Metals Determination Spreadsheet

Client: Sandvik Hard Materials - Coventry - Part B Processes

Stack Reference	Test Number	Filter Ref	Volume (l)	Soln Ref	Total Cobalt (µg)	Cobalt Conc (mg.m-3)	Total Tungsten (µg)	Tungsten Conc (mg.m-3)
South Site	1	10187	310	757/ 58	1	0.003	1	0.003
LEV 002	2	10189	310	759/ 60	1	0.003	20	0.065
	Mean					0.003		0.034
South Site	1	10188	390	761/ 62	6	0.015	51	0.131
LEV 12A	2	10190	390	763/ 64	2	0.005	58	0.149
	Mean					0.010		0.140
South Site	1	10193	380	769/ 70	1	0.003	89	0.234
LEV 15	2	10194	500	771/ 72	1	0.002	22	0.044
	Mean					0.002		0.139
South Site	1	10191	340	765/ 66	3	0.009	41	0.121
LEV 20	2	10192	340	767/ 68	1	0.003	1	0.003
	Mean					0.006		0.062
South Site	1	10147	480	841/ 42	1	0.002	16	0.033
LEV 23	2	10148	480	843/ 44	3	0.006	41	0.085
	Mean					0.004		0.059
South Site	1	9993	430	799/ 800	2	0.005	47	0.109
LEV 27	2	9994	430	801/ 02	1	0.002	36	0.084
	Mean					0.003		0.097
South Site	1	10150	410	845/ 46	2	0.005	20	0.049
LEV 45	2	10151	510	847/ 48	3	0.006	14	0.027
	Mean					0.005		0.038
North Site	1	10141	440	781/ 82	24	0.055	34	0.077
LEV 3	2	10142	460	783/ 84	28	0.061	47	0.102
	Mean					0.058		0.090
North Site	1	10161	470	857/ 58	5	0.011	20	0.043
LEV 8	2	10162	490	859/ 60	2	0.004	1	0.002
	Mean					0.007		0.022
North Site	1	10157	490	849/ 50	1	0.002	10	0.020
Small New	2	10158	530	851/ 52	0	0.000	68	0.128
Filter	Mean					0.001		0.074
North Site	1	10159	380	853/ 54	1	0.003	25	0.066
Large New	2	10160	490	855/ 56	1	0.002	35	0.071
Filter	Mean					0.002		0.069

9 APPENDIX V

9.1 Equipment Calibration Certificates

AQ168

CERTIFICATE OF CALIBRATION

Issued by: RS Components Ltd

Date of Issue: 03-May-2005 Certificate No. 113451

UKAS CALIBRATION
0310

RS Calibration

Calibration and Repair Service

Venture Close, Lammas Rd, Corby,
Northants NN17 5UB

Tel: 01536 405545
Fax: 01536 401590

Approved signatory

[redacted]
K.O'Malley

Client	OEH GROUP LTD. BIRMINGHAM B7 4BS
Instrument :	Mitutoyo 150 mm Digital Caliper
Procedure ID.	MLCP01
Serial No.	04414420
Client ID	AQ168
Date Received	29-Apr-2005
Date of Calibration	03-May-2005

Remarks
The reported results are for the instrument as received.

The measured results were found to be within the tolerances specified by the manufacturer.

Uncertainties
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Stackmite Reference:	***AQ 001***	**Reference Gas Meter No:**	AQ 046
Test Date:	01/08/2005	**Reference Gas Meter Certificate:**	N 112 5959F
		Reference Gas Meter Calibration Date:	20/08/2004

Section 1: Calibration Record

Leak Check (Y/N) Y **Warm up Period Start:** 08:10 **Finish:** 08:40

Flow Setting, lpm	Time Period, min			Test Stackmite Gas Meter Reading, litres			Reference Gas Meter Readings, litres			Rotameter Flow, lpm		Test Stackmite Gas Meter Temperature (◦C)		Reference Gas Meter Temperature (◦C)	
	Start	Finish	Δ	Start	Finish	Δ (NTP)	Start	Finish	Δ (NTP)	Stackmite	Reference (Calculated)	Start	Finish	Start	Finish
20	08:45	09:30	45	493180	494125	828	51295	52197	829	20	20.04	37.8	39.4	23.5	24.7
15	09:35	10:20	45	494131	494840	617	52200	52878	621	15	15.07	40.6	41.7	25.1	25.4
10	10:25	11:20	45	494850	495322	409	52885	53333	410	10	9.96	41.7	42.2	25.4	25.5
5	11:25	12:25	60	495330	495644	272	53340	53637	272	5	4.95	41.7	42.2	25.5	25.6

Section 2: Calculations

Stackmite flow setting, lpm	20	15	10	5
Indicated rotameter flow, lpm	20	15	10	5
Actual rotameter flow, lpm	20.04	15.07	9.96	4.95
% Difference Test:Reference	-0.22%	-0.44%	0.45%	1.01%
Stackmite gas meter volume, l	828	617	409	272
Reference gas meter volume, l	828.8	620.6	409.8	271.6
% Difference Test:Reference	-0.11%	-0.65%	-0.16%	0.22%

The overall uncertainty of measurements was 2.52 %

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2.00, providing a level of confidence of approximately 95%.

All must be < +/- 2% **PASS**

All must be < +/- 2% **PASS**

Calibrated By: [redacted]

Signature: [redacted]

Stackmite Reference:	AQ 003	Reference Gas Meter No:	AQ 046
Test Date:	05/08/2005	Reference Gas Meter Certificate:	N 112 5959F
		Reference Gas Meter Calibration Date:	20/08/2004

Section 1: Calibration Record

Leak Check (Y/N): Y Warm up Period Start: 07:45 Finish: 08:30

Flow Setting, lpm	Time Period, min			Test Stackmite Gas Meter Reading, litres			Reference Gas Meter Readings, litres			Rotameter Flow, lpm		Test Stackmite Gas Meter Temperature (°C)		Reference Gas Meter Temperature (°C)	
	Start	Finish	Δ	Start	Finish	Δ (NTP)	Start	Finish	Δ (NTP)	Stackmite	Reference (Calculated)	Start	Finish	Start	Finish
20	08:35	09:05	30	1012216	1012820	552	57688	58291	555	20	20.10	25.0	26.0	23.2	23.6
15	09:10	09:55	45	1012035	1012717	623	58305	58977	618	15	14.93	25.0	27.0	23.5	24.1
10	10:00	10:50	50	1012730	1013237	461	58990	59487	457	10	9.94	26.0	28.0	23.9	24.3
5	10:55	12:00	65	1013250	1013580	300	59501	59825	297	5	4.98	27.0	28.0	24.1	24.9

Section 2: Calculations

Stackmite flow setting, lpm	20	15	10	5
Indicated rotameter flow, lpm	20	15	10	5
Actual rotameter flow, lpm	20.10	14.93	9.94	4.98
% Difference Test:Reference	-0.50%	0.45%	0.60%	0.31%
Stackmite gas meter volume, l	552	623	461	300
Reference gas meter volume, l	555.4	618.1	456.7	297.3
% Difference Test:Reference	-0.54%	0.74%	1.03%	0.84%

The overall uncertainty of measurements was 2.52 %

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2.00, providing a level of confidence of approximately 95%.

All must be < +/- 2% **PASS**

All must be < +/- 2% **PASS**

Calibrated By: [redacted]

Signature: [redacted]

EQUIPMENT CALIBRATION
THERMOCOUPLE READERS

Test Thermocouple Reader Reference:	**AQ 004**
Calibration Date:	**28/04/05**

Reference Thermocouple Simulator No:	**AQ 67**
Calibrated Date:	**11/05/04**
Simulator Calibration Certificate No:	**22350**

Simulator Temperature (degrees C)	Test Reader Response (degrees C)	% Difference (Test:Ref) (Maximum Allowed +/- 1.0%) (Kelvin)	Pass/Fail
0	-0.1	-0.04	Pass
100	99.7	-0.08	Pass
500	499.4	-0.08	Pass
1000	999.5	-0.04	Pass

The overall uncertainty of measurements was 0.14 units %

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2.00, providing a level of confidence of approximately 95%.

Calibrated By: [redacted]

Signature: [redacted]

AQ095.

CERTIFICATE OF CALIBRATION

ISSUED BY Littlebrook Calibration Manufacturing

UKAS CALIBRATION 0436

DATE OF ISSUE: **04 May 2005** CERTIFICATE NUMBER: **N8907/05**

Littlebrook Calibration & Manufacturing Ltd
Littlebrook Complex
Manor Way
Dartford
Kent, DA1 5PU
Telephone (01322) 280038 Facsimile (01322) 284835

[redacted]
APPROVED SIGNATORY

CUSTOMER DETAILS **LCM REF: LCM4426/05/1**

Company	: **OEH Group Limited**
Address	: 253-255 Great Lister Street Birmingham, B7 4BS
Order number	: 4295

UNIT CALIBRATED

Manufacturer	: Airflow Developments
Model	: L-Type Pitot tube
Range	: 3 to 30 m/s
Serial number	: AQ095
Date unit received	: 12/04/2005
Date calibrated	: 04/05/2005

LABORATORY CONDITIONS : Temperature 23°C ± 2°C

CALIBRATION PROCEDURES : PROC0025

The uncertainties reported relate only to the measured values and do not imply any long-term performance for the instrument.

UKAS Calibration For Air Velocity.

Approved Signatory (Print): A M Sidgwick

CERTIFICATE OF CALIBRATION

ISSUED BY

AQ064

DATE OF ISSUE: **05 May 2005** CERTIFICATE NUMBER: **N8913/05**

UKAS CALIBRATION
0436

Littlebrook Calibration & Manufacturing Ltd
Littlebrook Complex
Manor Way
Dartford
Kent, DA1 5PU
Telephone (01322) 280038 Facsimile (01322) 284835

[redacted]
APPROVED SIGNATORY

CUSTOMER DETAILS **LCM REF: LCM4426/05/7**

Company : **OEH Group Ltd**
Address : 253-255.Great Lister Street
Birmingham
B7 4BS

Order number : 4295

UNIT CALIBRATED

Manufacturer : Testo
Model : 512 Digital Manometer
Range : 0 to 20 mbar differential
Serial number : 30208024 (AQ064)
Date unit received : 12/04/2005
Date calibrated : 15/04/2005

LABORATORY CONDITIONS : Temperature 20.1°C ± 1.5°C

CALIBRATION PROCEDURE : PROC0023

The uncertainties reported relate only to the measured values and do not imply any long-term performance for the instrument.

UKAS Calibration For Pressure.

Approved Signatory (Print): J L Whalin

EQUIPMENT CALIBRATION
MEASURING TAPES

OEH Group Limited

Test Tape Reference:	AQ 49
Calibration Date:	28/04/2005

Reference Ruler No:	AQ 45
Calibration Date:	18/04/2005
Reference Ruler Certificate No:	113111

Test Tape Interval, mm	Test Tape Nominal Length, mm	Reference Ruler Reading, mm	% Difference (Test:Ref) (Maximum Allowed +/- 0.5%)	Pass/Fail
0 - 10	10	10	0.00	Pass
0 - 50	50	50	0.00	Pass
0 - 100	100	100	0.00	Pass
0 - 250	250	250	0.00	Pass
0 - 500	500	500	0.00	Pass
0 - 750	750	750	0.00	Pass
0 - 1000	1000	1000	0.00	Pass
1000 - 1010	10	10	0.00	Pass
1000 - 1050	50	50	0.00	Pass
1000 - 1100	100	100	0.00	Pass
1000 - 1250	250	250	0.00	Pass
1000 - 1500	500	500	0.00	Pass
1000 - 1750	750	750	0.00	Pass
1000 - 2000	1000	1000	0.00	Pass
2000 - 2010	10	10	0.00	Pass
2000 - 2050	50	50	0.00	Pass
2000 - 2100	100	100	0.00	Pass
2000 - 2250	250	250	0.00	Pass
2000 - 2500	500	500	0.00	Pass
2000 - 2750	750	750	0.00	Pass
2000 - 3000	1000	1000	0.00	Pass

The overall uncertainty of measurements was 0.00 units %

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2.00, providing a level of confidence of approximately 95%.

Calibrated By: [redacted]

Signature: [redacted]

10 APPENDIX VI

10.1 Uncertainty Calculations

Uncertainty of Measurement Method for Total Particulate Matter Sampling at Sandvik

The following method for determining the total uncertainty of the Total particulate matter sampling has been devised based on the "QGN001 R1 - Guidance on Assessing Measurement Uncertainty in Stack Monitoring" – Second Edition – Issued September 2004.

This guidance sets outs three possible approaches to assessing uncertainty as follows:

Approach A: Carry out tests on a certified reference material.
Approach B: Carry out repeat measurements using paired instruments.
Approach C: Build an uncertainty budget from estimates of component uncertainties.

QGN001 R1 contains a decision tree for determining which of the three approaches above would be most appropriate.

Following the questions on the decision tree leads down the path stated below:

Can the measurement be carried out using a standard method ? - Yes
Does the standard state a measurement uncertainty ? – No
Can tests on reference material be carried out? – No (not for entire method)
Can experimental assessment be carried out? – No (not for entire method)

Decision – We must build up an uncertainty budget based on manufacturer's specifications, calibration certificates e.t.c. (Approach C)

Approach C

In this approach, an uncertainty budget is built from the *component* uncertainties and then these are combined to obtain an estimate of the *overall* uncertainty. Quantifying the component uncertainties can prove challenging and it is useful to concentrate on those making the most significant contribution: by convention, those components smaller than one-third of the largest need not be evaluated in detail. Once a shortlist is obtained, thought needs to be given on the most appropriate way to quantify the individual component uncertainties. Some of the uncertainties can be evaluated from sources such as suppliers information (e.g. instrument specifications, calibration certificates, tolerances), QA/QC data (e.g. control charts), inter-laboratory studies and proficiency-testing schemes. (In certain circumstances, the standard deviation of the results obtained from repeated rounds provides a good estimate of uncertainty.)

In our case we have the following list of uncertainties stated on calibration certificates from external suppliers.

Equipment Type	Expanded Uncertainty (as per certificate)	Standard Uncertainty (= expanded uncertainty/2)
Calipers	± 0.015 mm	0.13% at 6mm Nozzle
Ruler	± 0.015 mm	0.0015% at 500mm
Dry Gas Meter	± 0.35 %	0.175%
Manometer	± 0.05 % + 1pa	0.025%
Pitots	± 0.15 % + 0.25 pa	0.075%

The following equipment is calibrated in house and uncertainties have been calculated based on repeated measurements.

Equipment Type	Expanded Uncertainty	Standard Uncertainty (= expanded uncertainty/2)
Stackmite Gas Meters	2.52 %	1.26 %
Thermocouple Readers	0.14 %	0.07 %
Nozzles	0.18 %	0.09 %
Tape Measures	<0.01 %	<0.01 %
Barometers	0.28 %	0.14 %

We must also include the uncertainty contribution from the weighing procedure.

At the weighing limit of detection, the filter weighing expanded uncertainty is 52.97 % and the probe wash sample expended uncertainty is 30.18 %. From the tables above, none of the uncertainties from the other contributors are anywhere near a third of this value, so at the weighing detection limit for total particulate matter, the expanded uncertainty will be made up of weighing uncertainties only. Calculated as follows: (Using the simplified approach for combining uncertainties as in the Eurachem guidance – $U_{combined} = \sqrt{(u_1^2 + u_2^2 + u_3^2 ..... u_n^2)}$)

$\sqrt{((30.18/2)^2 + (52.97/2)^2)} = \sqrt{(227.71+701.46)} = \sqrt{(929.17)} = 30.48\%$ = standard uncertainty at method LOD.

Expanded uncertainty for entire method = 61.0% at weighing LOD

At reasonable levels of particulate, the filter weighing expanded uncertainty is 3.22 % and the probe wash sample expended uncertainty is 5.88 %. The weighings contribution to the total uncertainty of the method will be as follows:

$\sqrt{((3.22/2)^2 + (5.88/2)^2)} = \sqrt{(2.59 + 8.64)} = \sqrt{(11.23)} = 3.35\%$ = standard uncertainty with significant weight gain.

Expanded uncertainty of weighings only = 6.70% at moderate levels of particulate.

The only other contributor to the total uncertainty at % levels at or above 1/3rd of the greatest contributor is that from the stackmite meter calibrations – the expanded uncertainty of these is 2.52%. So for the entire method we only need to include the following contributory uncertainties.

Filter weighings.
Probe Wash Samples.
Stackmite Gas Meter Calibrations.

The calculation is as follows:

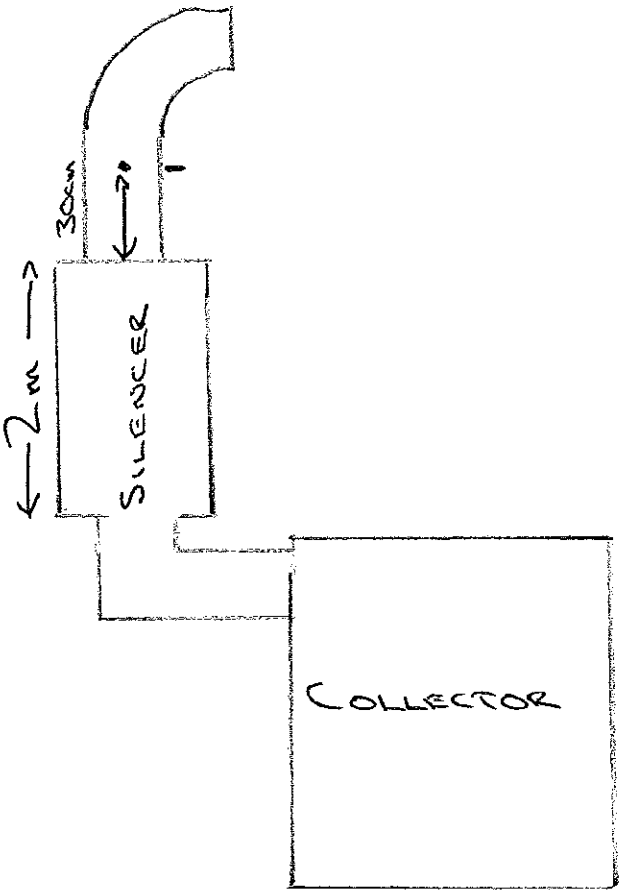
$\sqrt{((3.22/2)^2 + (5.88/2)^2 + (2.52/2)^2)} = \sqrt{(2.59 + 8.64 + 1.59)} = \sqrt{(12.82)} = 3.58\%$ = standard uncertainty with significant weight gain.

Expanded uncertainty for entire method = 7.2% at moderate levels of particulate.

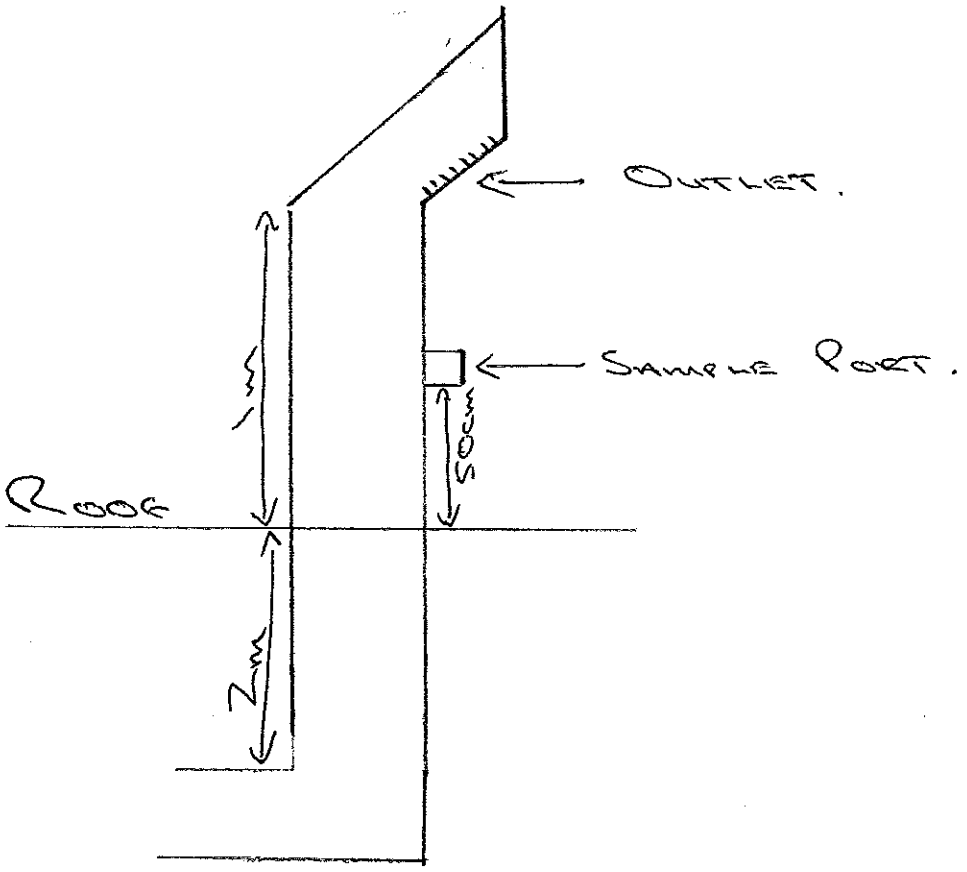
11 APPENDIX VII

11.1 Sampling Location Diagrams

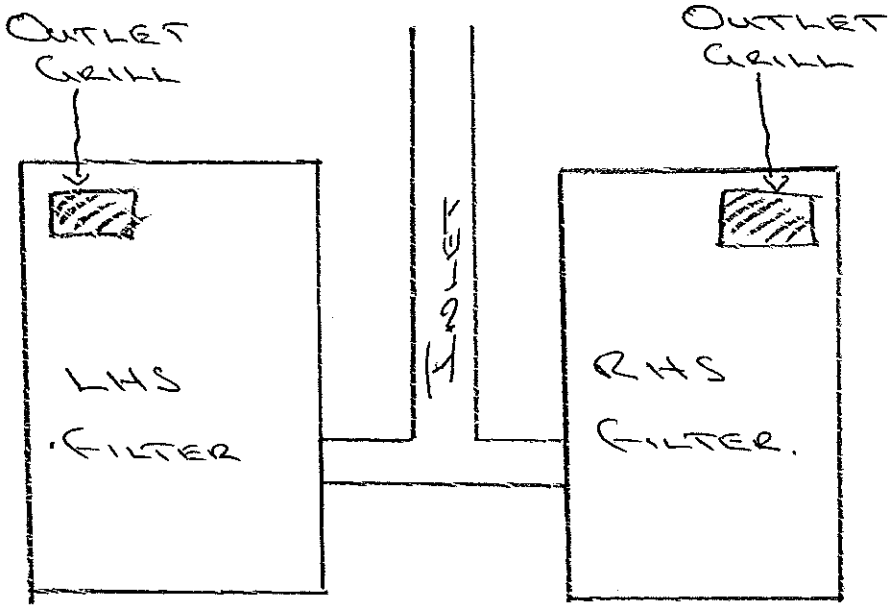
Sampling Location Diagram – LEV 002 – Sandvik Coventry



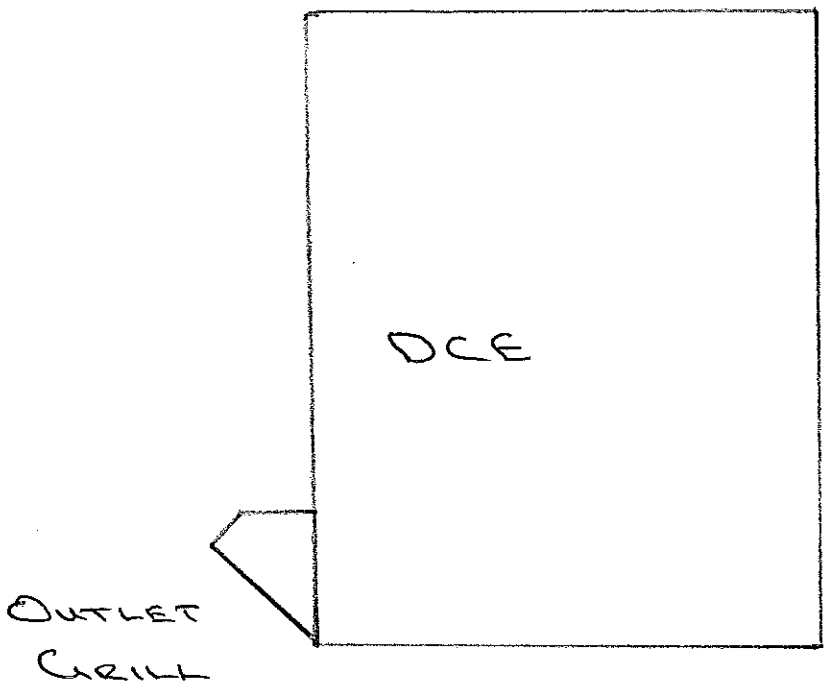
Sampling Location Diagram – LEV 3 – Sandvik Coventry



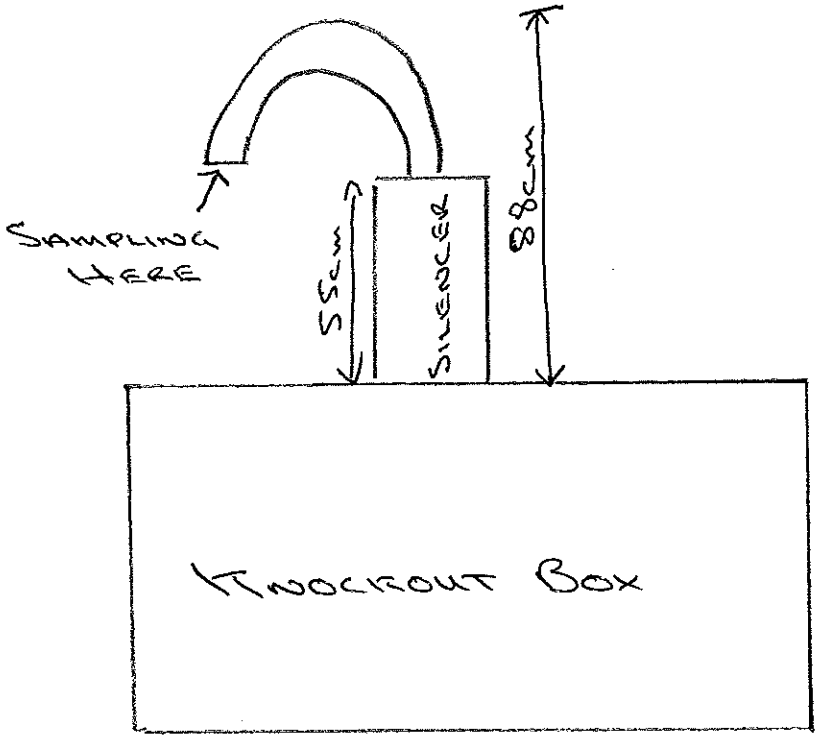
Sampling Location Diagram – LEV 8 – Sandvik Coventry



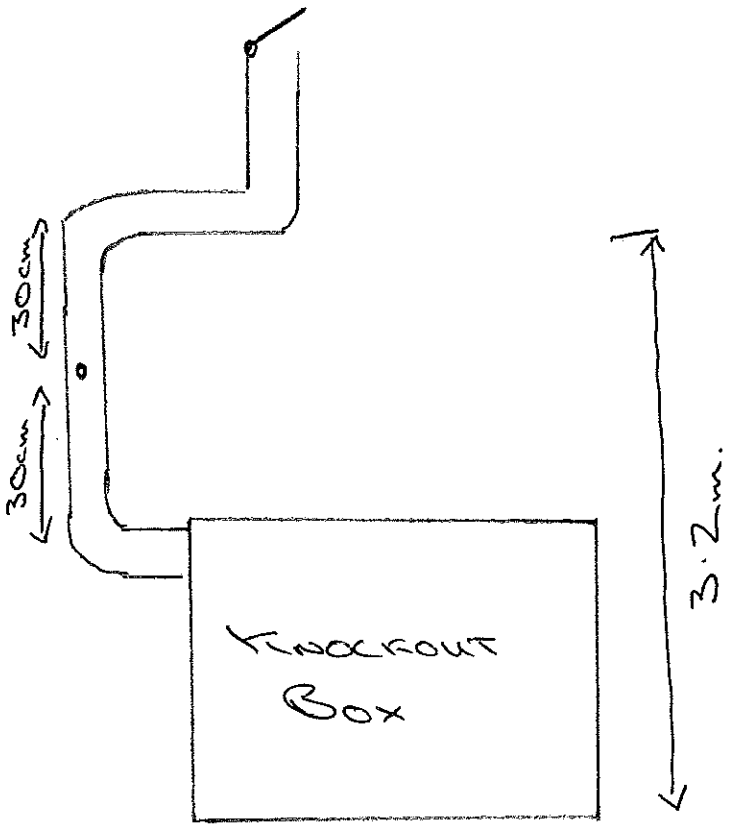
Sampling Location Diagram – LEV 12A – Sandvik Coventry



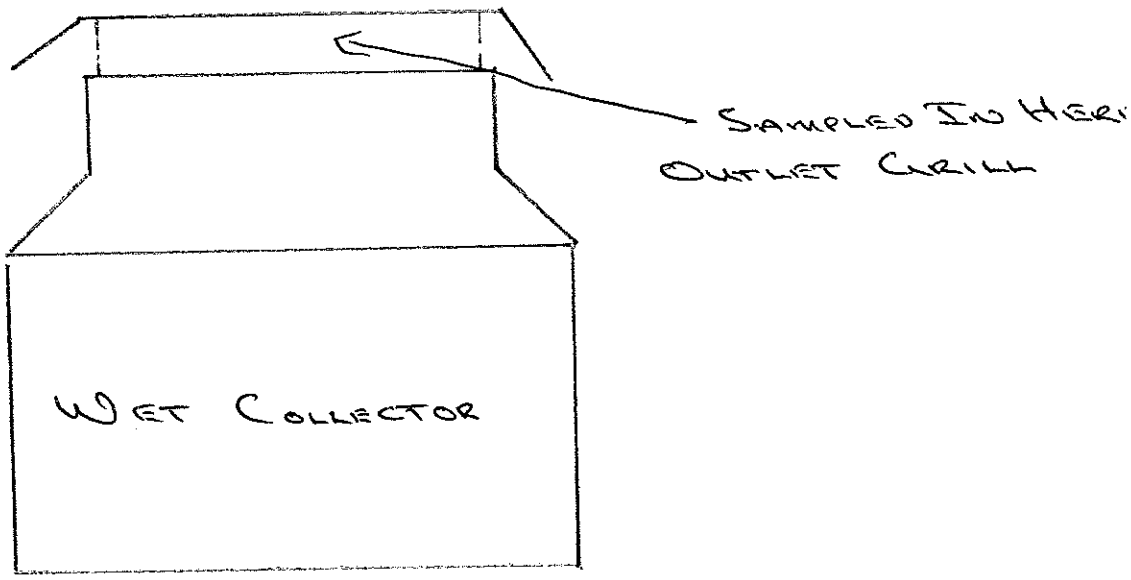
Sampling Location Diagram – LEV 23 – Sandvik Coventry



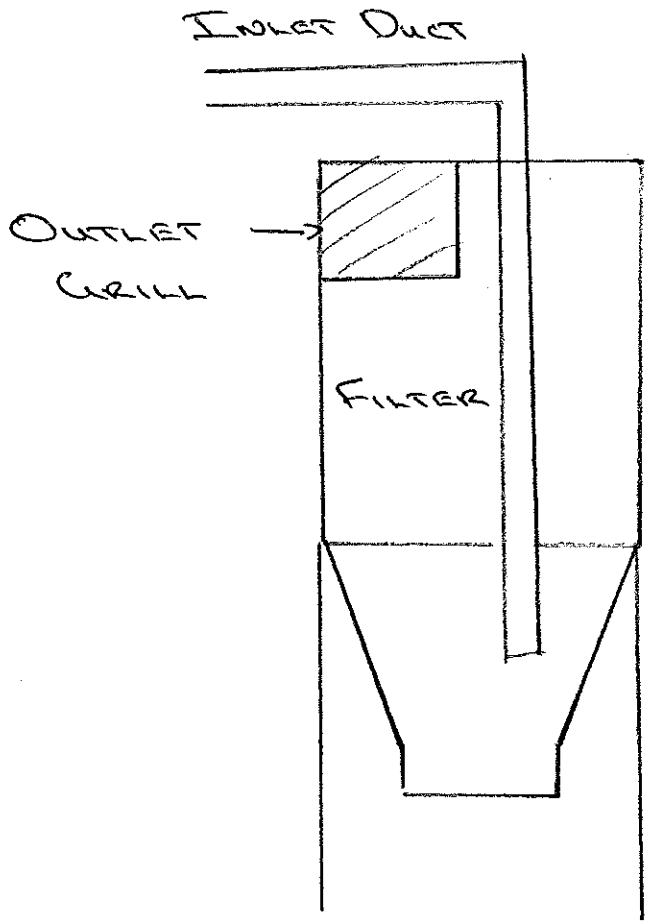
Sampling Location Diagram – LEV 27 – Sandvik Coventry



Sampling Location Diagram – LEV 45 – Sandvik Coventry



Sampling Location Diagram – New Filter (B5 Furnaces) – Sandvik Coventry



Sampling Location Diagram – New Filter (B5 Ball Mills – Sandvik Coventry