

STACK EMISSIONS MONITORING REPORT



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Operator & Address:

Qioptiq Ltd
Glascoed Road
St Asaph
Denbighshire
LL17 0LL

Permit:

EPR Permit: EPR/BX4666IZ/V002

Release Point:

A11 - Solvent Cleaning Line

Sampling Date(s):

19th November 2014

ESG Job Number:	LNO 12115
Report Date:	19th December 2014
Version:	1
Report By:	Dominic Houghton
MCERTS Number:	MM 04 529
MCERTS Level:	MCERTS Level 2 - Team Leader
Technical Endorsements:	1, 2, 3 & 4
Report Approved By:	Mark Woodruff
MCERTS Number:	MM 03 164
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Technical Endorsements:	1, 2, 3 & 4
Signature:	



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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Qioptiq Ltd operates an optical lens cleaning process at St Asaph which is subject to EPR Permit EPR/BX4666IZ/V002, under the Environmental Permitting Regulations 2010.

Environmental Scientifics Group Limited were commissioned by Qioptiq Ltd to carry out stack emissions monitoring to determine the release of prescribed pollutants from the following Plant under normal operating conditions.

The results of these tests shall be used to demonstrate compliance with a set of emission limit values for prescribed pollutants as specified in the Plant's EPR Permit, EPR/BX4666IZ/V002.

Plant

A11 - Solvent Cleaning Line

Operator

Qioptiq Ltd
Glascoed Road
St Asaph
Denbighshire
LL17 0LL

EPR Permit: EPR/BX4666IZ/V002

Stack Emissions Monitoring Test House

Environmental Scientifics Group Limited - Stockport Laboratory
Unit 5 Crown Industrial Estate
Kenwood Road
Stockport
SK5 6PH
UKAS and MCERTS Accreditation Number: 1015

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
MCERTS accredited results will only be claimed where both the sampling and analytical stages are UKAS accredited.
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EXECUTIVE SUMMARY

EMISSIONS SUMMARY					
Parameter	Units	Result	Calculated Uncertainty +/-	Limit	MCERTS accredited result
VOC Screening	mg/m ³	2.4	2.0	75	✗
VOC Screening Emission Rate	g/hr	1.7	1.4	-	
Stack Gas Temperature	°C	31.7	-	-	✓
Stack Gas Velocity	m/s	3.0	-	-	
Gas Volumetric Flow Rate (Actual)	m ³ /hr	827	-	-	
Gas Volumetric Flow Rate (STP, Wet)	m ³ /hr	731	-	-	
Gas Volumetric Flow Rate (STP, Dry)	m ³ /hr	702	-	-	
Gas Volumetric Flow Rate at Reference Conditions	m ³ /hr	731	-	-	

ND = None Detected,

Results at or below the limit of detection are highlighted by bold italic text.

The above volumetric flow rate is calculated using data from the preliminary survey. Mass emissions for non isokinetic tests are calculated using these values. For all isokinetic testing the mass emission is calculated using test specific flow data and not the above values.

Reference conditions are 273K, 101.3kPa without correction for water vapour

EXECUTIVE SUMMARY

MONITORING TIMES			
Parameter	Sampling Date(s)	Sampling Times	Sampling Duration
VOC Screening Run 1	19 November 2014	08:50 - 09:20	30 minutes
Stack Gas Flow Rate & Temperature Run 1	19 November 2014	08:30	-

EXECUTIVE SUMMARY

PROCESS DETAILS	
Parameter	Process Details
Description of process	Optical Lens Cleaning
Continuous or batch	Batch
Product Details	Optical Lens Baths
Part of batch to be monitored (if applicable)	Any
Normal load, throughput or continuous rating	1 Lens per hour
Fuel used during monitoring	N/A
Abatement	None
Plume Appearance	None visible

EXECUTIVE SUMMARY

Monitoring Methods

The selection of standard reference / alternative methods employed by Environmental Scientifics Group Limited is determined, wherever possible by the hierarchy of method selection outlined in Environment Agency Technical Guidance Note (Monitoring) M2. i.e. CEN, ISO, BS, US EPA etc.

MONITORING METHODS						
Species	Method Standard Reference Method / Alternative Method	ESG Technical Procedure	UKAS Lab Number	MCERTS Accredited Method	Limit of Detection (LOD)	Calculated MU +/- %
VOC Screening	SRM - BS EN 13649	AE 118	1015	Yes	0.83 mg/m ³	84.3 %
Flow Rate / Temp.	SRM - BS EN 13284-1	AE 122	1015	Yes	5 pa	-

EXECUTIVE SUMMARY

Analytical Methods

The following tables list the analytical methods employed together with the custody and archiving details:

SAMPLING METHODS WITH SUBSEQUENT ANALYSIS							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	UKAS Accredited Lab Analysis	Analysis Lab (ESG or Subcontract)	Sample Archive Location	Archive Period
VOC Screening	GC/MS	ASC/SOP/213	1015	No	Bretby	Bretby	3 months

ON-SITE TESTING							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	MCERTS Accredited Analysis	Laboratory	Data Archive Location	Archive Period
-	-	-	-	-	-	-	-

EXECUTIVE SUMMARY

SAMPLING LOCATION					
Sampling Plane Validation Criteria	Value	Units	Requirement	Compliant	Method
Lowest Differential Pressure	6	Pa	≥ 5 Pa	Yes	BS EN 13284-1
Lowest Gas Velocity	2.89	m/s	-	-	-
Highest Gas Velocity	3.34	m/s	-	-	-
Ratio of Gas Velocities	1.16	: 1	$< 3 : 1$	Yes	BS EN 13284-1
Mean Velocity	3.04	m/s	-	-	-
Maximum angle of flow with regard to duct axis	$< 15^\circ$	$^\circ$	$< 15^\circ$	Yes	BS EN 13284-1
No local negative flow	Yes	-	-	Yes	BS EN 13284-1

DUCT CHARACTERISTICS		
	Value	Units
Shape	Circular	-
Depth	0.31	m
Width	-	m
Area	0.08	m ²
Port Depth	0	mm

SAMPLING LINES & POINTS			
	Isokinetic (CEN Methods)	Isokinetic (ISO Methods)	Non-Iso & Gases
Sample port size	-	-	1cm Hole
Number of lines used	-	-	1
Number of points / line	-	-	1
Duct orientation	-	-	Vertical
Filtration	-	-	Out Stack

SAMPLING PLATFORM	
General Platform Information	
Permanent / Temporary Platform / Ground level / Floor Level / Roof	Roof
Inside / Outside	Outside

M1 Platform requirements	
Is there a sufficient working area so work can be performed in a compliant manner	Yes
Platform has 2 levels of handrails (approximately 0.5 m & 1.0 m high)	Yes
Platform has vertical base boards (approximately 0.25 m high)	Yes
Platform has removable chains / self closing gates at the top of ladders	N/A
Handrail / obstructions do not hamper insertion of sampling equipment	Yes
Depth of Platform = $>$ Stack depth / diameter + wall and port thickness + 1.5m	Yes

Sampling Platform Improvement Recommendations (if applicable)

The sampling location meets all the requirements as specified in EA Guidance Note M1.

EXECUTIVE SUMMARY

Sampling & Analytical Method Deviations

In this instance there were no deviations from the sampling and analytical methods employed.

APPENDICES

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APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 3 - Measurement Uncertainty Budget Calculations

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

MONITORING SCHEDULE					
Species	Method Standard Reference Method / Alternative Method	ESG Technical Procedure	UKAS Lab Number	MCERTS Accredited Method	Number of Samples
VOC Screening	SRM - BS EN 13649	AE 118	1015	Yes	1
Flow Rate / Temp.	SRM - BS EN 13284-1	AE 122	1015	Yes	1

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

CALIBRATEABLE EQUIPMENT CHECKLIST					
Extractive Sampling		Instrumental Analyser/s		Miscellaneous	
Equipment	Equipment I.D.	Equipment	Equipment I.D.	Equipment	Equipment I.D.
Control Box DGM	-	Horiba PG-250 Analyser	-	Laboratory Balance	LNO 00-12/00-13
Box Thermocouples	-	FT-IR	-	Tape Measure	LNO 24-DJH
Meter In Thermocouple	-	FT-IR Oven Box	-	Stopwatch	LNO 17-DJH
Meter Out Thermocouple	-	Bernath 3006 FID	-	Protractor	-
Control Box Timer	-	Signal 3030 FID	-	Barometer	LNO 08-DJH
Oven Box	-	Servomex	-	Digital Micromanometer	LNO 01-DJH
Probe	-	JCT Heated Head Filter	-	Digital Temperature Meter	LNO 03-DJH
Probe Thermocouple	-	Thermo FID	-	Stack Thermocouple	-
Probe	-	Stackmaster	-	Mass Flow Controller	LNO 29-67/29-65
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	LNO 29-08
S-Pitot	-	Anemometer	-	1m Heated Line (1)	-
L-Pitot	LNO 10-104	Ecophysix NOx Analyser	-	1m Heated Line (2)	-
Site Balance	-	Chiller (JCT/MAK 10)	-	1m Heated Line (3)	-
Last Impinger Arm	-	Heated Line Controller (1)	-	5m Heated Line (1)	-
Dioxins Cond. Thermocouple	-	Heated Line Controller (2)	-	10m Heated Line (1)	-
Callipers	-	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-		-	15m Heated Line (1)	-
Heater Controller	-		-	20m Heated Line (1)	-
Inclinometer (Swirl Device)	LNO 23-DJH		-	20m Heated Line (2)	-

NOTE: If the equipment I.D is represented by a dash (-), then this piece of equipment has not been used for this test.

CALIBRATION GASES					
Gas (traceable to ISO 17025)	Cylinder I.D Number	Supplier	ppm	%	Analytical Tolerance +/- %
-	-	-	-	-	-

APPENDIX 1 - Monitoring Schedule, Calibration Checklist & Monitoring Team

STACK EMISSIONS MONITORING TEAM

Team Leader

Dominic Houghton
MCERTS Level 2, Technical Endorsements 1, 2, 3 & 4
MM 04 529
MCERTS Expiry Date - Dec 2016
H&S Expiry Date - Sep 2019

Technician

Mark Derbyshire
MCERTS Level 1, Technical Endorsement 1
MM 07 824
MCERTS Expiry Date - Dec 2017
H&S Expiry Date - Apr 2017

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

VOC SCREENING SUMMARY					
Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	Limit mg/m ³	Emission Rate g/hr
Run 1	08:50 - 09:20 19 November 2014	2.4	0.83	75	1.7
Field Blank	-	0.83	-	-	-

Reference conditions are 273K, 101.3kPa without correction for water vapour

VOC SCREENING RESULTS							
Substance	LOD (ug)	Run 1 (ug)		Run 1 (mg/m ³)			Mass Emission (g/hr)
		Front	Back	Front	Back	Total	
Acetone	5	9.1	5	1.5	0.83	2.4	1.7
Total	5	9.1	5	1.5	0.83	2.4	1.7

VOC SCREENING RESULTS BLANK			
Substance	LOD (ug)	Blank (ug)	
		(ug)	mg/m ³
Acetone	5	5	0.8
Total	5	5	0.8

VOC SCREENING QUALITY ASSURANCE

Leak Test Results	Mean Sampling Rate l/min	Pre sampling leak rate l/min	Post sampling leak rate l/min	Acceptable leak rate l/min	Leak Tests Acceptable?
Run 1	0.2	0.002	0.002	0.004	Yes

	Type of tube	Max. Tube Temperature °C	Max. Storage / Transit Temp. °C
Run 1	Charcoal	12	18

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	0.31	m
Stack Width, W	-	m
Stack Area, A	0.08	m ²
Average stack gas temperature	32	°C
Stack static pressure	0.008	kPa
Barometric Pressure	100	kPa
Pitot tube calibration coefficient, K_{pt}	0.90	-

Stack Gas Composition & Molecular Weights								
Component	Molar Mass M	Density kg/m ³ p	Conc Dry % Vol	Dry Volume Fraction r	Dry Conc kg/m ³ pi	Conc Wet % Vol	Wet Volume Fraction r	Wet Conc kg/m ³ pi
CO ₂	44	1.963059	0.030000	0.000300	0.000589	0.028800	0.000288	0.000565
O ₂	32	1.427679	20.950000	0.209500	0.299099	20.112000	0.201120	0.287135
N ₂	28	1.249219	79.020000	0.790200	0.987133	75.859200	0.758592	0.947648
H ₂ O	18	0.803070	-	-	-	4.000000	0.040000	0.032123

Where: $p = M / 22.41$ $pi = r \times p$

Calculation of Stack Gas Densities		
Determinand	Result	Units
Dry Density (STP), P_{STD}	1.2868	kg/m ³
Wet Density (STP), P_{STW}	1.2675	kg/m ³
Dry Density (Actual), P_{Actual}	1.1384	kg/m ³
Average Wet Density (Actual), $P_{ActualW}$	1.121	kg/m ³

Where:

P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

$P_{STW} = (P_{STD} + pi \text{ of H}_2\text{O}) / (1 + (pi \text{ of H}_2\text{O} / 0.8036))$

$P_{Actual} = P_{STD} \times (Ts / Ps) \times (Pa / Ta)$

$P_{ActualW} = P_{STW} \times (Ts / Ps) \times (Pa / Ta)$

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

TRAVERSE 1

Date of Survey	19 November 2014
Time of Survey	08:30
Velocity Measurement Device:	L-Type Pitot

Sampling Line A							
Traverse Point	Distance into duct (m)	ΔP pt mmH ₂ O	ΔP pt Pa	Temp °C	Velocity m/s	O ₂ % Vol	Angle of Swirl °
1	0.02	0.6	6	32	2.89	-	<15
2	0.05	0.6	6	32	2.89	-	<15
3	0.08	0.7	7	32	3.13	-	<15
4	0.11	0.7	7	32	3.13	-	<15
5	0.14	0.8	8	32	3.34	-	<15
6	0.17	0.8	8	32	3.34	-	<15
7	0.20	0.7	7	32	3.13	-	<15
8	0.23	0.7	7	32	3.13	-	<15
9	0.26	0.6	6	32	2.89	-	<15
10	0.29	0.6	6	32	2.89	-	<15
Mean	-	0.7	7	32	3.08	-	
Sampling Line B							
Traverse Point	Distance into duct (m)	ΔP pt mmH ₂ O	ΔP pt Pa	Temp °C	Velocity m/s	O ₂ % Vol	Angle of Swirl °
1	0.02	0.6	6	32	2.89	-	<15
2	0.05	0.7	7	32	3.13	-	<15
3	0.08	0.7	7	32	3.13	-	<15
4	0.11	0.7	7	31	3.12	-	<15
5	0.14	0.6	6	31	2.89	-	<15
6	0.17	0.6	6	31	2.89	-	<15
7	0.20	0.6	6	31	2.89	-	<15
8	0.23	0.8	8	31	3.34	-	<15
9	0.26	0.6	6	31	2.89	-	<15
10	0.29	0.6	6	31	2.89	-	<15
Mean	-	0.7	6	31	3.01	-	

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY (CONTINUED)

Sampling Plane Validation Criteria				
EA Technical Guidance Note (Monitoring) M1	Result	Units	Requirement	Compliant
Lowest Differential Pressure	5.88	Pa	>= 5 Pa	Yes
Lowest Gas Velocity	2.89	m/s	-	-
Highest Gas Velocity	3.34	m/s	-	-
Ratio of Gas Velocities	1.16	-	< 3 : 1	Yes
Maximum angle of flow with regard to duct axis	0	°	< 15°	Yes
No local negative flow	Yes	-	-	Yes

Calculation of Stack Gas Velocity, V		
Velocity at Traverse Point, $V = K_{pt} \times (1-\epsilon) \times \sqrt{(2 \times \Delta P_{pt} / \rho_{ActualW})}$		
Where: K_{pt} = Pitot tube calibration coefficient $(1-\epsilon)$ = Compressibility correction factor, assumed at a constant 0.998		
Average Stack Gas Velocity, V_a	3.04	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	32	0	°C
Total Pressure	100.008	101.3	kPa
Oxygen	21.0	21	%
Moisture	4.00	4.00	%

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (V_a)	3.04	m/s
Stack Area (A)	0.08	m ²
Gas Volumetric Flowrate (Actual), Q_{Actual}	827	m ³ /hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	731	m ³ /hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	702	m ³ /hr
Gas Volumetric Flowrate (REF), Q_{Ref}	731	m ³ /hr

Where:

$$Q_{Actual} = V_a \times A \times 3600$$

$$Q_{STP} = Q_{Actual} \times (T_s / T_a) \times (P_a / P_s) \times 3600$$

$$Q_{STP,Dry} = Q_{STP} / (100 - (100 / Ma)) \times 3600$$

$$Q_{Ref} = Q_{STP} \times ((100 - Ma) / (100 - Ms)) \times ((20.9 - O_{2a}) / (20.9 - O_{2s}))$$

Nomenclature:

T_s = Absolute Temperature, Standard Conditions, 273 K

P_s = Absolute Pressure, Standard Conditions, 101.3 kPa

T_a = Absolute Temperature, Actual Conditions, K

P_a = Absolute Pressure, Actual Conditions, kPa

Ma = Water vapour, Actual Conditions, % Vol

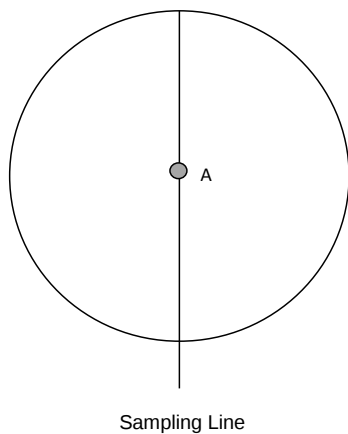
Ms = Water vapour, Reference Conditions, % Vol

O_{2a} = Oxygen, Actual Conditions, % Vol

O_{2s} = Oxygen, Reference Conditions, % Vol

STACK DIAGRAM

	Value	Units
Stack Depth	0.31	m
Stack Width	-	m
Area	0.08	m ²



- Isokinetic sampling point
- Isokinetic sampling points not used
- Non Isokinetic/Gases sampling point

Non-Isokinetic/Gases Sampling			
Sampling Point	Distance (% of Depth)	Distance into Stack	Units
A	50	0.16	m

[illegible]

SAMPLING LOCATION



APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VOC SCREENING

Standard Uncertainty

Run	Sampled Volume m ³	Sampled Gas Temp K	Sampled Gas Pressure kPa	Sampled Gas Humidity % by volume	Oxygen Content % by volume	Limit of Detection % by mass	Leak %	Uncollected Mass mg
MU required	≤ 2%	≤ 2%	≤ 1%	≤ 1%	≤ 10%	≤ 5% of ELV	≤ 2%	≤ 10% of ELV
Run 1	0	2	0.5	1	N/A	0.005	-	-
as a %	0.0000	0.7018	0.5000	1.0000	N/A	1.11	1.0000	0.0067
compliant?	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes

Run	Volume (STP) m ³	Mass of Total VOC mg	O ₂ Correction -	Leak mg/m ³	Uncollected Mass mg	Lab Uncertainty mg	Combined uncertainty
Run 1	0.006	0.014	1.000	0.014	0.003	-	-
MU as mg/m ³	0.000	0.833	-	0.014	0.481	0.235	0.991
MU as %	0.000	35.461	-	0.577	20.473	10.000	-

R1 - Uncertainty expressed at a 95% confidence level (where k = 2)	1.981	mg/m³	84.31	%
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Developed for the STA by R Robinson, NPL

END OF REPORT