

STACK EMISSIONS MONITORING REPORT



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Operator & Address:

Qioptiq Ltd
Glascoed Road
St Asaph
Denbighshire
LL17 0LL

Permit:

N/A - LAPPC DCC/PPC/6.4/036.0 Test

Release Point:

A1 - LAPPC Spray Booths

Sampling Date(s):

18th 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
Business Title:	MCERTS Level 2 - Business Manager
Technical Endorsements:	1, 2, 3 & 4
Signature:	



1015



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EXECUTIVE SUMMARY

MONITORING OBJECTIVES

Qioptiq Ltd operates a component spraying process at St Asaph which is subject to Permit LAPPCC DCC/PPC/6.4/036.0, 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 Permit, LAPPCC DCC/PPC/6.4/036.0.

Plant

A1 - LAPPCC Spray Booths

Operator

Qioptiq Ltd
Glascoed Road
St Asaph
Denbighshire
LL17 0LL

Permit: LAPPCC DCC/PPC/6.4/036.0

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.

This test report shall not be reproduced, except in full, without written approval of Environmental Scientifics Group Limited.

EXECUTIVE SUMMARY

EMISSIONS SUMMARY					
Parameter	Units	Result	Calculated Uncertainty +/-	Limit	MCERTS accredited result
Volatile Organic Compounds	mg/m ³	ND	-	75	✓
Volatile Organic Compounds Emission Rate	g/hr	-	-	-	✓
Stack Gas Temperature	°C	19.0	-	-	
Stack Gas Velocity	m/s	3.5	-	-	
Gas Volumetric Flow Rate (Actual)	m ³ /hr	4613	-	-	
Gas Volumetric Flow Rate (STP, Wet)	m ³ /hr	4258	-	-	
Gas Volumetric Flow Rate (STP, Dry)	m ³ /hr	4216	-	-	
Gas Volumetric Flow Rate at Reference Conditions	m ³ /hr	4258	-	-	

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
Volatile Organic Compounds Run 1	18 November 2014	12:05 - 13:05	60 minutes
Stack Gas Flow Rate & Temperature Run 1	18 November 2014	11:00	-

EXECUTIVE SUMMARY

PROCESS DETAILS	
Parameter	Process Details
Description of process	Component Spraying
Continuous or batch	Batch
Product Details	Variety of paints
Part of batch to be monitored (if applicable)	Any
Normal load, throughput or continuous rating	Normal throughput
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 +/- %
VOCs	SRM - BS EN 12619:2013	AE 102	1015	Yes	0.4 mg/m ³	N/A
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
-	-	-	-	-	-	-	-

ON-SITE TESTING							
Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	MCERTS Accredited Analysis	Laboratory	Data Archive Location	Archive Period
VOCs	Flame Ionisation Detection	AE 102	1015	Yes	ESG Stockport	ESG Stockport	5 years

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	2.83	m/s	-	-	-
Highest Gas Velocity	4.01	m/s	-	-	-
Ratio of Gas Velocities	1.41	: 1	$< 3 : 1$	Yes	BS EN 13284-1
Mean Velocity	3.53	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	0.68	m
Width	-	m
Area	0.36	m ²
Port Depth	0	mm

SAMPLING LINES & POINTS			
	Isokinetic (CEN Methods)	Isokinetic (ISO Methods)	Non-Iso & Gases
Sample port size	-	-	1.5 inch hole
Number of lines used	-	-	1
Number of points / line	-	-	1
Duct orientation	-	-	Vertical

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)	No
Platform has removable chains / self closing gates at the top of ladders	Yes
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 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
VOCs	SRM - BS EN 12619:2013	AE 102	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	LNO 21-09	Stack Thermocouple	LNO 10-DJH
Probe	-	Stackmaster	-	Mass Flow Controller	-
Probe Thermocouple	-	FTIR Heater Box for Heated Line	-	MFC Display module	-
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)	LNO 18-43
Callipers	-	Site temperature Logger	-	10m Heated Line (2)	-
Small DGM	-		-	15m Heated Line (1)	-
Heater Controller	-		-	20m Heated Line (1)	-
Inclinometer (Swirl Device)	-		-	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 +/- %
Propane	HPC788	BOC	81	-	2

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 2014

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

VOLATILE ORGANIC COMPOUNDS SUMMARY

Test	Sampling Times	Concentration mg/m ³	LOD mg/m ³	Limit mg/m ³	Emission Rate g/hr
Run 1	12:05 - 13:05 18 November 2014	ND	0.40	75	-

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

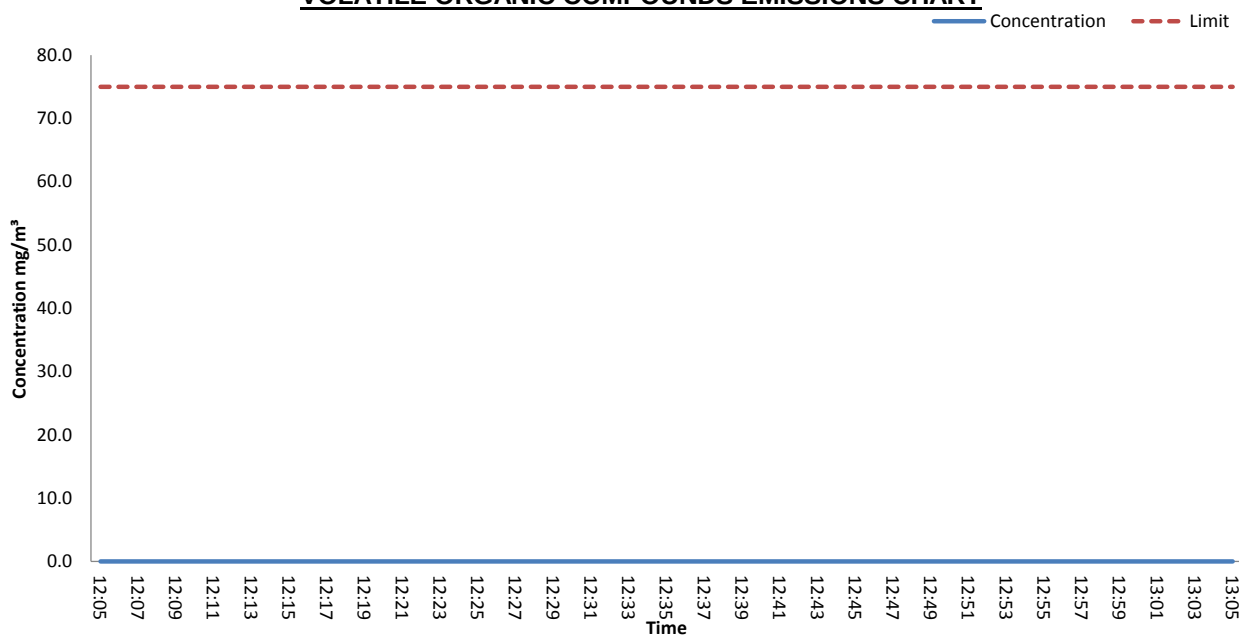
INSTRUMENTAL SPAN & ZERO CHECKS

PRE-SAMPLING CALIBRATION CHECKS RUN 1								
Date	18 November 2014							
Start Time	10:25							
End Time	10:45							
Gas	Gas Conc (ppm)	Range	Instrument Zero Reading	Instrument Span Reading	Instrument Zero Reading	Zero Down line reading	Span down line reading	Leak Rate (%)
Propane	81	100	0.0	81	0.0	0.2	81	0.00

Zero and Span gas contained 20.5% Oxygen

POST-SAMPLING CALIBRATION CHECKS RUN 1				
Date	18 November 2014			
Start Time	13:05			
End Time	13:15			
Gas	Zero down line reading	Span down line reading	Zero Drift (%)	Span Drift (%)
Propane	0.3	80	0.12	-1.36

VOLATILE ORGANIC COMPOUNDS EMISSIONS CHART



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

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

Stack Characteristics		
Stack Diameter / Depth, D	0.68	m
Stack Width, W	-	m
Stack Area, A	0.36	m ²
Average stack gas temperature	19	°C
Stack static pressure	0.025	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	0.029700	0.000297	0.000583
O ₂	32	1.427679	20.950000	0.209500	0.299099	20.740500	0.207405	0.296108
N ₂	28	1.249219	79.020000	0.790200	0.987133	78.229800	0.782298	0.977262
H ₂ O	18	0.803070	-	-	-	1.000000	0.010000	0.008031

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}	1.2820	kg/m ³
Dry Density (Actual), P_{Actual}	1.1879	kg/m ³
Average Wet Density (Actual), $P_{ActualW}$	1.183	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	18 November 2014
Time of Survey	11:00
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	0.03	0.8	7.8	19	3.27	-	<15
2	0.10	0.8	7.8	19	3.27	-	<15
3	0.17	0.6	5.9	19	2.83	-	<15
4	0.24	1.0	9.8	19	3.66	-	<15
5	0.31	1.0	9.8	19	3.66	-	<15
6	0.37	0.8	7.8	19	3.27	-	<15
7	0.44	1.0	9.8	19	3.66	-	<15
8	0.51	1.2	11.8	19	4.01	-	<15
9	0.58	1.2	11.8	19	4.01	-	<15
10	0.65	1.0	9.8	19	3.66	-	<15
Mean	-	0.9	9.2	19	3.53	-	
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	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
Mean	-	-	-	-	-	-	

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	2.83	m/s	-	-
Highest Gas Velocity	4.01	m/s	-	-
Ratio of Gas Velocities	1.41	-	< 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	3.53	m/s

Calculation of Stack Gas Volumetric Flowrate, Q			
Duct gas flow conditions	Actual	Reference	Units
Temperature	19	0	°C
Total Pressure	100.025	101.3	kPa
Oxygen	21.0	21	%
Moisture	1.00	1.00	%

Gas Volumetric Flowrate	Result	Units
Average Stack Gas Velocity (V_a)	3.53	m/s
Stack Area (A)	0.36	m ²
Gas Volumetric Flowrate (Actual), Q_{Actual}	4613	m ³ /hr
Gas Volumetric Flowrate (STP, Wet), Q_{STP}	4258	m ³ /hr
Gas Volumetric Flowrate (STP, Dry), $Q_{STP,Dry}$	4216	m ³ /hr
Gas Volumetric Flowrate (REF), Q_{Ref}	4258	m ³ /hr

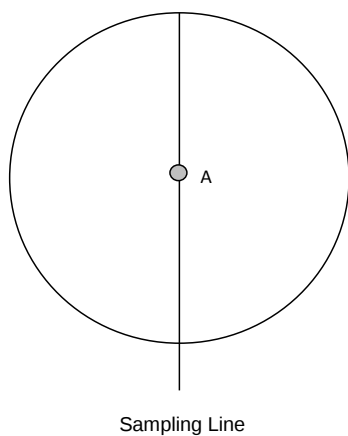
Where:
 $Q_{Actual} = V_a \times A \times 3600$
 $Q_{STP} = Q_{Actual} \times (T_s / T_a) \times (P_a / P_s) \times 3600$
 $Q_{STP,Dry} = Q_{STP} / (100 - (100 / Ma)) \times 3600$
 $Q_{Ref} = Q_{STP} \times ((100 - Ma) / (100 - Ms)) \times ((20.9 - O_{2a}) / (20.9 - O_{2s}))$

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	0.68	m
Stack Width	-	m
Area	0.36	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	0.34	m

[illegible]

SAMPLING LOCATION



APPENDIX 3 - Measurement Uncertainty Budget Calculations

MEASUREMENT UNCERTAINTY BUDGET - VOLATILE ORGANIC COMPOUNDS RUN 1

Measured Concentration	ND	mg/m ³
Limit	75	mg/m ³
Calibration Gas Concentration	129.6	mg/m ³
Range	160	mg/m ³

Performance characteristics	Value	Units	specification	MU Met?
Response time	30	seconds	<180	Yes
Logger sampling interval	60	seconds	-	-
Measurement period	60	minutes	-	-
Number of readings in measurement	60	-	-	-
Repeatability at zero	0.25	% full scale	<1 % range	Yes
Repeatability at span level	0.15	% full scale	<2 % range	Yes
Deviation from linearity	0.70	% of value	<2 % range	Yes
Zero drift	0.12	% full scale	<2% range / 24hr	Yes
Span drift	-1.36	% full scale	<2% range / 24hr	Yes
volume or pressure flow dependence	0.02	% of full scale/3 kPa	<2 % / 3 kPa	Yes
atmospheric pressure dependence	0.80	% of full scale/2 kPa	<3% / 2 kPa	Yes
ambient temperature dependence	0.01	% full scale/10K	<3% range / 10 K	Yes
dependence on voltage	0.10	% full scale/10V	< 0.1%vol /10 volt	Yes
losses in the line (leak)	0.00	% of value	< 2% of span gas value	Yes
Uncertainty of calibration gas	2.0	% of value	< 2% of value	Yes

Performance characteristic	Uncertainty	Value of uncertainty quantity
Standard deviation of repeatability at zero	ur0	0.02
Standard deviation of repeatability at span level	urs	0.02
Lack of fit	ufit	N/A
Drift	u0dr	N/A
volume or pressure flow dependence	uspres	N/A
atmospheric pressure dependence	uapres	N/A
ambient temperature dependence	utemp	N/A
Dependence on voltage	uvolt	N/A
losses in the line (leak)	uleak	N/A
Uncertainty of calibration gas	ucalib	N/A
Uncertainty in factor	uf	N/A

Measurement uncertainty Measured Concentration	ND	mg/m ³
Combined uncertainty	-	mg/m ³
Expanded uncertainty	-	mg/m ³

Expanded uncertainty expressed with a level of confidence of 95%	-	% ELV
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Expanded uncertainty expressed with a level of confidence of 95%	-	mg/m ³
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Expanded uncertainty expressed with a level of confidence of 95%	-	% value
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Developed for the STA by R Robinson, NPL

END OF REPORT