PG 9/109

Report for the Periodic Monitoring of Emissions to Air

Part 1. Executive Summary

1506

Permit Number:	PPC/156
Operator:	Meggitt Aircraft Braking Systems
Installation:	Coventry Site
Monitoring Date:	03 March 2010
E.E. Report Ref.:	42732
Client Name:	Meggitt Aircraft Braking Systems
Client Address:	Holbrook Lane Coventry West Midlands CV6 4AA
Monitoring Organisation:	Environmental Evaluation Ltd. (Head Office) Lawton Square Delph Oldham OL3 5DT
Date of Report:	17 March 2010
Report Written by:	S White
Function:	Trainee
Report Approved By:	T Ledwith
MCERTS Registration No.:	MM 03 425
Technical Endorsements:	TE1, TE2, TE3, TE4
Signed:	[redacted]

Contents

1 Part 1: Executive Summary

1.1 Monitoring Objectives

Meggitt Aircraft Braking Systems has been authorised under the Environmental Protection Act and associated legislation to operate various processes at their Coventry Site site, and a condition of that authorisation is that emission monitoring is undertaken on a regular basis to prove compliance or otherwise against prescribed emission limit values.

This report details the testing undertaken in: March 2010

The substance monitoring requirements for each emission point are detailed below.

Substances Monitored	Emission Point Identification
	Plating Area Main Stack
Flow	✓
Temperature	✓
Oxides of Nitrogen	✓
Fluorides	✓

1.2 Monitoring Results

Emission Point	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty	Units	Reference Conditions	Date of Monitoring	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Plating Area Main Stack	Oxides of Nitrogen	400	1.2	± 33.4	mgm^{-3}	273K and 101.3 kPa, No Oxygen Correction, Dry Basis	03/03/2010	11:30 - 12:00	BS EN 14792:2005	UKAS MCERTS	Normal
Plating Area Main Stack	Fluorides	10	1.4	± 0.1	mgm^{-3}	273K and 101.3 kPa, No Oxygen Correction, Dry Basis	03/03/2010	14:33 - 15:03	BS ISO 15713:2006	UKAS MCERTS	Normal

1 hr limit ?

1.3 Operating Information

Emission Point Reference	Date	Process Type	Process Duration	Feedstock	Abatement
Plating Area Main Stack	03 March 2010	Metal Plating Process	Batch	Metal parts to be plated	One large and one smaller wet scrubber systems

1.4 Monitoring Deviations

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
Plating Area Main Stack	None	The blank for fluorides was slightly above 10% of the Emission Limit Value at $1.1mgm^{-3}$.	Homogeneity test was carried out for Nox

explain this?

"normal operating conditions"

normally use 7 therefore min flow 35 m3/min for year.

Report for the Periodic Monitoring of Emissions to Air

Part 2. Supporting Information

1506

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Signed:	[redacted]

APPENDICES

Appendix A: General Information

A1. Environmental Evaluation Limited Staff Details

Team Leader:	T Ledwith
MCERTS No.	MM 03 425
Certification Level:	MCERTS Level 2
Technical Endorsements:	TE1, TE2, TE3, TE4
Site Technician:	S White
MCERTS No.	MM 06 776
Certification Level:	MCERTS Level 1
Technical Endorsements:	TE1

A2. Environmental Evaluation Limited Method Details

The indicated substances were measured by the standards and in house methods specified in the table below:

Substance	Standard	EE. Reference
Flow	BS EN 13284:2002	EE/P/002 & 2a
Temperature	BS EN 13284:2002	EE/P/002 & 2a
Oxides of Nitrogen	BS EN 14792:2005	EE/P/009
Fluorides	BS ISO 15713:2006	EE/P/017

A3. Sub-Contract

Analysis was subcontracted to a UKAS accredited laboratory.

A4. Equipment Used in the Monitoring Campaign

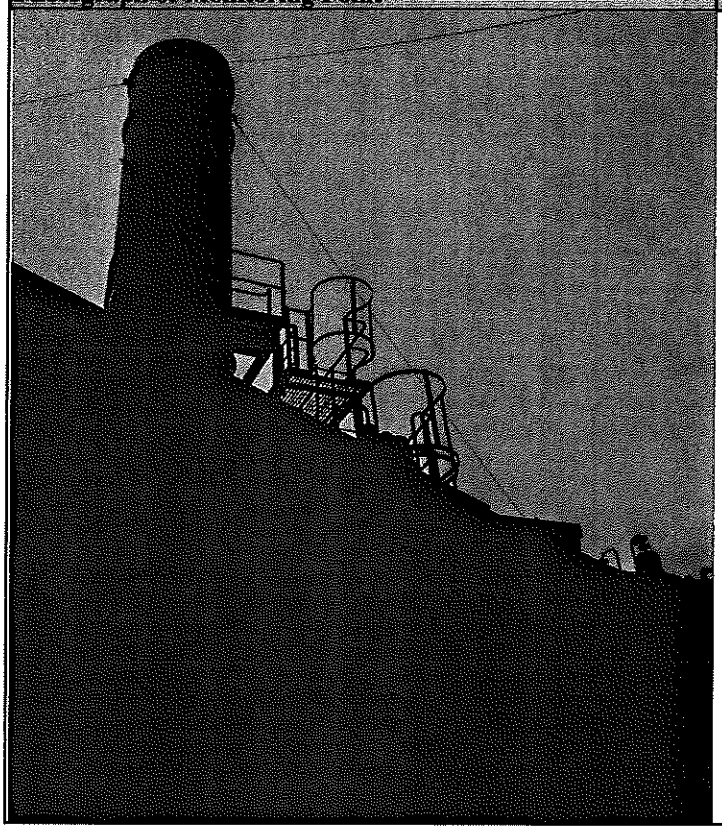
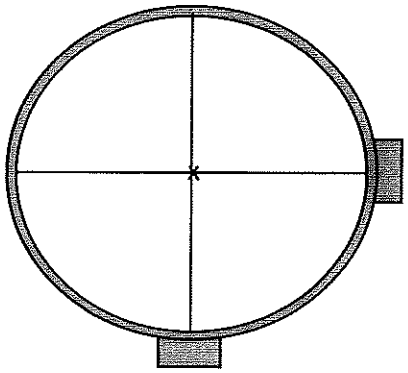
Equipment checklists appropriate to the methods were used.

Equipment Type	EE Equipment Reference Code
Gas Meter	LCL 44
Combustion Gas Analyser	LCL 20 1M L Type
Manometer	LCL 26
Thermosensor	LCL 15
Thermocouple	LCL 17
Tape Measure	LCL 18
Barometer	LCL 23
Vernier Callipers	LCL 14
Stop Watch	LCL 25
Combustion Gas Analyser	LCL 52
Combustion Gas Analyser	B01

Appendix B: Emission Information

B1 - Plating Area Main Stack Information

B1.1 Diagrams Showing the Dimensions and Monitoring Facilities of Plating Area Main Stack

Photograph of Monitoring Point	Schematic of Sample Plane
	

B1.2 Preliminary Velocity and Temperature Measurement of Plating Area Main Stack

Traverse Point	Sample Line A			Sample Line B			Sample Line C			Sample line D		
	Stack Temp. (°C)	ΔP (mmH2O)	Swirl Angle (o)	Stack Temp. (°C)	ΔP (mmH2O)	Swirl Angle (o)	Stack Temp. (°C)	ΔP (mmH2O)	Swirl Angle (o)	Stack Temp. (°C)	ΔP (mmH2O)	Swirl Angle (o)
1	19	90	0	19	96	0						
2	19	92	0	19	101	0						
3	19	103	0	19	116	0						
4	19	118	0	19	119	0						
5	19	116	0	19	124	0						
6	19	114	0	19	124	0						
7	19	115	0	19	122	0						
8	19	116	0	19	124	0						
9	19	112	0	19	121	0						
10	19	109	0	19	119	0						
	$\Sigma\Delta P_A$	1085		$\Sigma\Delta P_B$	1166		$\Sigma\Delta P_C$			$\Sigma\Delta P_D$		

Barometric Pressure (mmHg)	755	Port Depth (mm)	100
Static Pressure (mmH_2O)	1.63	Port Seal Adaptor Depth (mm)	
Diameter (m)	1.50	Assumed CO_2 (%)	0.0
---		Assumed O_2 (%)	20.9
Stack Area (m^2)	1.767	Assumed CO (%)	0.0
Port Size (mm)	110	Assumed H_2O (%)	0.0

Appendix B1.3 - Combustion Gases - Plating Area Main Stack

Company	Meggitt Aircraft Braking System	**Test Conducted by**	T Ledwith & S White
Site	Coventry Site	**Date of Test**	03 March 2010
Plant Identification	Plating Area Main Stack	**File Name**	

Choice of Measurement Range and Span Gas Concentration

Parameter	ELV mgm^{-3}	ELV ppm	2% of ELV ppm	Repeatability at Zero ppm	Ideal Analyser Range	Actual Analyser Range	Ideal Span Gas Conc.
NOx	400	194.8	3.9	2.5	292	500	250 - 450
SO_2							
CO							
CO_2		---					
O_2	20.9	---	0.418	0.125	31.35	25	12.5 - 22.5

Analyser and System, Zero and Span Checks

Parameter	Actual Zero Gas Value	Actual Span Gas Value	Analyser Zero	Analyser Span	Analyser Zero Check	Time	10:57	Time	13:02
						Pre Test System Zero Check	Pre-Test System Span Check	Post Test System Zero Check	Post Test System Span Check
NOx (ppm)	0	150	0	150	0	0.1	150	0.2	151
SO_2 (ppm)									
CO (ppm)									
CO_2 (%)									
O_2 (%)	0	20.9	0	20.9	0	0.02	20.92	0.04	20.84

Zero, Span and Drift Checks

Parameter	Pre-Test Analyser Zero Check		Zero Drift Check		Span Drift Check		Overall Calibration Acceptability
NOx (ppm)	0	Pass	0.1	Pass	1	Pass	Pass
SO_2 (ppm)							
CO (ppm)							
CO_2 (%)							
O_2 (%)	0	Pass	0.02	Pass	-0.08	Pass	Pass

Correction of Data for Drift Affect

Parameter		Adjustment	Check	Deviation	Drift Per Minute
NOx (ppm)	Span	1.0007	0.9947	-0.0060	0.0000
	Zero	-0.1001	-0.1989	-0.0989	-0.0008
SO_2 (ppm)	Span				
	Zero				
CO (ppm)	Span				
	Zero				
CO_2 (%)	Span				
	Zero				
O_2 (%)	Span	1.0000	1.0048	0.0048	0.0000
	Zero	-0.0200	-0.0402	-0.0202	-0.0002

Appendix B1.3 - Combustion Gases - Plating Area Main Stack

As Determined Concentrations Dry Basis		CO (ppm)	SO_2 (ppm)	NO_X (ppm)	CO_2 (%)	O_2 (%)
$C_{ppm} = \frac{\sum 1-n}{n}$	=			1		20.8
where:						
Σ 1 - n is the sum of the readings	=			75		2585
n is the total number of readings	=			124		124

Concentrations at 273k and 101.3kPa Dry Basis		CO mgm^{-3}	SO_2 mgm^{-3}	NO_2 mgm^{-3}	CO_2 (%)	O_2 (%)
$C_{mgm-3} = C_{ppm} \times \frac{mw}{22.4}$	=			1.2		20.8
where:						
C_{ppm} is the average concentration in ppm	=			0.6	---	---
mw is the molecular weight of the gas under test	=			46	---	---
22.4 is the volume of 1 mole at STP (litres)	=			22.4	---	---

Concentrations at 273k and 101.3kPa Wet Basis		CO mgm^{-3}	SO_2 mgm^{-3}	NO_2 mgm^{-3}	CO_2 (%)	O_2 (%)
$C_{mgm-3(wet)} = C_{mgm-3} \times \frac{(100-Wv)}{100}$	=			1.2		20.8
where:						
Concentrations at 273k and 101.3kPa Dry Basis	=			1.2		20.8
Wv is the water vapour content %	=			0.0		0.0

Concentration at 273k and 101.3kPa, Uncorrected for Oxygen, Dry Basis		CO mgm^{-3}	SO_2 mgm^{-3}	NO_2 mgm^{-3}	CO_2 (%)	O_2 (%)
$C_{at X\%} = C_{mgm-3} \times \frac{20.9-O_{2ref}}{20.9-O_{2meas}}$	=			1.2		
where:						
20.9 is the atmospheric concentration of oxygen	=			20.9	---	---
O_{2ref} is the reference concentration	=			N/A	---	---
$O_{2\ meas}$ is the measured concentration	=			20.8	---	---

Actual Rates of Discharge		CO ghr^{-1}	SO_2 ghr^{-1}	NO_2 ghr^{-1}	CO_2 ghr^{-1}	O_2 ghr^{-1}
$E_{g/hr} = C \times Q_{std} \times \frac{60}{1000}$	=			315.0		
where:						
C is the dry concentration at STP	=			1.2		
Q_{std} is the dry flow rate at STP	=			4227.2		
60/1000 is the conversion factor	=			0.060		

Appendix B1.3 - Combustion Gases - Plating Area Main Stack

Uncertainty Calculation of Oxides of Nitrogen to BS EN 14792:2005							
Symbol	Source of Uncertainty	Value +/- ppm	Probability Distribution	Divisor	Ci	Ui( ) +/- ppm	V_i or V_{eff}
U_{LD}	Linearity Deviation	10	Normal(K=2)	2	1	5	
U_R	Repeatability	5	Normal(K=2)	2	1	2.5	
U_{ZD}	Zero Drift	5	Normal(K=2)	2	1	2.5	
U cg	Span Drift	5	Normal(K=2)	2	1	2.5	
U_{CG}	Error in calibration	10	Normal(K=2)	2	1	5	
U_C( )	Combined standard		normal			8.29	
U	Expanded		enter coverage	1.96		16.25	ppm
U	Expanded		enter coverage	1.96		33.37	mgm^{-3}

Uncertainty Calculation of Oxygen to BS EN 14789:2005							
Symbol	Source of Uncertainty	Value +/- %	Probability Distribution	Divisor	Ci	Ui( ) +/- %vol	V_i or V_{eff}
U_{LD}	Linearity Deviation	0.5	Normal(K=2)	2	1	0.25	
U_R	Repeatability	0.125	Normal(K=2)	2	1	0.0625	
U_R	Span Drift	0.25	Normal(K=2)	2	1	0.125	
U_{ZD}	Zero Drift	0.25	Normal(K=2)	2	1	0.125	
U cg	Calibration gas	0.5	Normal(K=2)	2	1	0.25	
U_C( )	Combined standard		normal			0.40	
U	Expanded		enter coverage	1.96		0.77	%

Appendix B1.4 - Gaseous Fluorides to BS ISO 15713:2006 - Plating Area Main Stack

Company	Meggitt Aircraft Braking Syster	**Test Conducted by**	T Ledwith & S White
Site	Coventry Site	**Date of Test**	03 March 2010
Plant Identification	Plating Area Main Stack		

Volume of Gas Metered, Standard Conditions V_{mstd}

$$V_{mstd} = Y_d \times V_m \times 0.3592 \times \frac{P_m}{(273 + T_m)}$$

	Blank 1	Test 1		
=	**0.0538**	**0.0538**		**m^3**

Sample reference number - first Impinger	=	42732/HF2/3-3-10	42732/HF1/3-3-10		---
Sample reference number - second Impinger	=	---	---		---
Meter calibration factor Y_d	=	0.9162	0.9162		---
Test start time	=	---	14:33		---
Test end time	=	---	15:03		---
Test Duration	=	30	30		minutes
Initial meter reading	=	---	0		litres
Final meter reading	=	---	60		litres
Total meter volume V_m	=	0.0600	0.0600		m^3
Meter Pressure P_m	=	755	755		mm.Hg
Final meter temperature	=	---	4.0		(°C)
Initial meter temperature	=	---	4.0		(°C)
Average meter temperature T_m	=	4.0	4.0		(°C)
Correction to standard conditions	=	0.3592	0.3592		

Hydrogen Fluoride Concentration $Cmgm^{-3}$ - Dry Basis

$$C_{mgm^{-3}} = \frac{M_n}{V_{mstd}}$$

	Blank	Test 1		
=	**1.1**	**1.4**		**mgm^{-3}**

Where:

Impinger reference numbers	=	42732/HF2/3-3-10	42732/HF1/3-3-10		
Solution Concentration Impinger 1		0.26	0.32		mgl^{-1}
Solution Volume Impinger 1		220	230		ml
Mn1 is the Hydrogen Fluoride mass in Impinger	=	0.0572	0.0736		mg
V_{mstd} is the volume of gas metered, standard con	=	0.0538	0.0538		m^3

Gaseous Fluoride Concentration at STP - Wet Basis - mgm^{-3}

$$C_{mgm-3(wet)} = C_{mgm-3} \times \frac{(100 - Wv)}{100}$$

	Blank 1	Test 1		
=	**1.1**	**1.4**		**mgm^{-3}**

Gaseous concentration at STP - Dry Basis	=	1.1	1.4		mgm^{-3}
Wv is the water vapour content	=	0.0	0.0		%

Appendix B1.4 - Gaseous Fluorides to BS ISO 15713:2006 - Plating Area Main Stack

Concentration at 273k and 101.3kPa, Uncorrected for Oxygen, Dry Basis					
$C_{atX\%} = C_{mgm-3} \frac{20.9 - O_{2ref}}{20.9 - O_{2meas}}$	=	Blank 1 **1.1**	Test 1 **1.4**		**mgm^{-3}**
Gaseous concentration at STP	=	1.1	1.4		mgm^{-3}
Atmospheric oxygen concentration	=	20.9	20.9		%
O_{2ref} is the reference oxygen concentration	=	N/A	N/A		%
O_{2meas} is the measured oxygen concentration	=	20.8	20.8		%

Gaseous Fluoride Rate of Discharge ghr^{-1}					
$E_{g/hr} = C \times Q_{std} \times \frac{60}{1000}$	=	Blank 1 **270**	Test 1 **347**		**ghr^{-1}**
Gaseous concentration at STP - Dry Basis	=	1.1	1.4		mgm^{-3}
Dry Total Flow Rate of Stack Gas Q_{std}	=	4227.2	4227.2		m^3min^{-1}
60/1000 Conversion factor	=	0.06	0.06		

Comments on Compliance with BS ISO 15713:2006	
Hydrogen Fluoride absorption efficiency >95%	Pass
Temperature maintained above 150°C	Pass
Leak Rate <2%	Pass
Overall Blank Value <10% of the LV[a]	Fail
Duct gas flow with regard to stack axis <15°	Pass
Duct gas flow: negative velocity - not permitted	Pass
Duct gas flow: differential pressure at the pitot tube >5pa	Pass
Duct gas flow: ratio of max to min velocity <3:1	Pass

Were all of the requirements of BS ISO 15713:2003 fulfilled during the test?

	Yes	No
		X

Appendix B1.4 - Gaseous Fluorides to BS ISO 15713:2006 - Plating Area Main Stack

Uncertainty Calculations					
Measurement Data					
Measured Quantities	**Symbol**	**Value**	**Standard Uncertainty**		**Units**
Sampled Volume	V_m	0.0600	(1%) uV_m	0.00060	m^3
Sampled Gas Temperature	T_m	277.0	uT_m	3	k
Sampled Gas Pressure	ρ_m	100.6	$u\rho_m$	0.1	kPa
Sampled Gas Humidity	H_m	0.0	uH_m	0.1	% by volume
Oxygen Content	$O_{2,m}$	20.8	$uO_{2,m}$	0.01	% by volume
Mass	m	1.37	um_m	0.07	mg
Leak	L	2	%	0.02	
Uncollected Mass	UCM	0			mg
Intermediate Calculation to Correct for Standardisation of Conditions					
Factor for Std Conditions	fs	0.98			
Uncertainty Components	symbol	Sensitivity Coefficient		u (in units of fs)	
	ρ_m	0.010		0.001	
	H_m	0.010		0.001	
	T_m	0.004		0.011	
	ufs			0.011	
Corrected Volume	V	0.06	uV	0.001	m^3
Intermediate Calculation to Correct for Oxygen Correction					
Factor for O_2 Correction	fc	1.00			
Uncertainty Components	symbol	Sensitivity Coefficient		u (in units of fc)	
	$O_{2,m}$	1.00		0.010	
Factor for O_2 Correction	ufc	1.00		0.010	%

Calculation of Expanded Uncertainty						
Paramete		Value	Units	Sensitivity Coefficient	Uncertainty in Result	
Volume (Std conditions)	V	0.06	m^3	23.28	0.02	$mg.m^{-3}$
Mass	m	1.37	mg	1.00	0.07	$mg.m^{-3}$
Factor for O_2 Correction	fc	1.00		1.37	0.01	$mg.m^{-3}$
Leak	L	0.02	$mg.m^{-3}$	1.00	0.02	$mg.m^{-3}$
Uncollected mass	UCM	0.00	mg	0.00	0.00	$mg.m^{-3}$
Combined uncertainty					0.07	$mg.m^{-3}$
Expanded Uncertainty K=2					**10.88**	**%**
Expanded Uncertainty K=2					**0.15**	**$mg.m^{-3}$**

Homogeneity Test

Traverse Point	Concentration (ppm or mgm^{-3})							
	Sample Line A		Sample Line B		Sample Line C		Sample Line D	
	ppm/mgm^{-3}	ppm/mgm^{-3}	ppm/mgm^{-3}	ppm/mgm^{-3}	ppm/mgm^{-3}	ppm/mgm^{-3}	ppm/mgm^{-3}	ppm/mgm^{-3}
1	0.6	0.5	0.6	0.6				
2	0.6	0.5	0.6	0.6				
3	0.6	0.5	0.6	0.6				
4	0.5	0.6	0.6	0.6				
5	0.5	0.6	0.5	0.6				
6	0.6	0.5	0.5	0.7				
7	0.5	0.5	0.6	0.7				
8	0.6	0.5	0.6	0.6				
9	0.6	0.6	0.5	0.6				
10	0.6	0.6	0.6	0.6				

Mean Value	C_{grid}	C_{ref}	C_{grid}/C_{ref}
	0.6	0.6	99.5
Standard Deviation	S_{grid}	S_{ref}	
	0.0	0.1	
Number of Measurements	20		
Degrees of freedom	19		
Homogeneity Test:			
Test Value $(S_{grid}/S_{ref})^2$	0.58		
F95%	---		
Waste Gas	homogenous		
Standard Dev. of time S_{ref}	---		
Standard Dev. of position S_{pos}	---		
Permissable uncertainty U_{perm}	1		
$t_{N-1;0.95}$	---		
U_{pos}	---		
$U_{pos} \leq 0.5\ U_{perm}$	---		
Required Measurement Type	any point		
Representative measurement pt.	---		
C_{grid}/C_{ref} at representative point	---		

Test Certificates

SAL

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories

Certificate of Analysis

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Report Number: 193150-1

Date of Report: 15-Mar-2010

Customer: Environmental Evaluation
23 Pemberton Street
Birmingham
B18 6NY

Customer Contact: Mr Tony Ledwith

Customer Job Reference: 42732
Customer Purchase Order: 9533SW
Date Job Received at SAL: 09-Mar-2010
Date Analysis Started: 10-Mar-2010
Date Analysis Completed: 15-Mar-2010

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

UKAS TESTING
1549

Report checked
and authorised by :
Ms Jeanette Abbott
Project Manager

Issued by : Signature valid
Digitally signed by Jeanette Abbott
Date: 2010.03.15 17:37:57 GMT
Reason: Issued
Location: SAL

Index to symbols used in 193150-1

Value	Description
AR	As Received
13	Results have been blank corrected.
U	Analysis is UKAS accredited
N	Analysis is not accredited

SAL Reference: 193150
Customer Reference: 42732

Impinger (sodium hydroxide) — Analysed as Impinger (sodium hydroxide)

Miscellaneous

					SAL Reference	193150 001	193150 002
					Customer Sample Reference	42732/03/03/10/F1	42732/03/03/10/F2
					Test Sample	AR	AR
Determinand	Method	LOD	Units	Symbol			
Hydrogen Fluoride	IC	0.05	mg/l	U		(13) 0.32	(13) 0.26
Volume	Vol	1	ml	N		230	220