

Proposal by Exova Catalyst to meet the Improvement Condition, IC4

IC4	<p>The operator shall submit a written proposal to Natural Resources Wales to carry out tests to determine the size distribution of the particulate matter in the exhaust gas emissions to air from emission points A1 and A2, identifying the fractions within the PM10 and PM2.5 ranges. The proposal shall include a proposed timetable to carry out such tests and produce a report on the results.</p> <p>On receipt of written approval by Natural Resources Wales to the proposal and timetable, the operator shall carry out the tests and submit to Natural Resources Wales a report on the results.</p>	<p>Within 6 months of completion of commissioning.</p>
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Report Date: 1st April 2015

Report Ref: CSW-SD-002

Report By: Stuart Davidson

MCERTS Status: MCERTS Level II Team Leader + TE1, TE2, TE3 & TE4

Proposal

The Environment Agency's recommended method for determining PM₁₀ and PM_{2.5} emissions, as stated in their Technical Guidance Note, M2, is BS EN ISO 23210. Exova Catalyst is UKAS, MCERTS & ISO 17025 accredited for this method, and will undertake the tests in accordance with the corresponding Technical Procedure, TP-18 – copy attached.

M2: Monitoring of Stack Emissions to Air

Table S2.34. Particulate matter size fractionation¹

Type of monitoring	Monitoring technique	Monitoring standard	Further information
Manual	Impaction based on a round nozzle two stage impactor	BS EN ISO 23210	Allows simultaneous measurement of <PM ₁₀ to >PM _{2.5} concentrations and <PM _{2.5} concentrations using a cascade impactor. The standard does not measure the contribution of stack gas emissions to the formation of secondary particulate matter in ambient air. It was primarily developed for measurements of mass concentrations below 40 mg/m ³ at STP. However, it states that it is applicable for particulate concentrations between 1 – 50 mg/m ³ . The standard also specifies limitations on stack gas temperature, pressure and humidity ² . It is suitable for combustion sources, cement and steel processes. It cannot be used to measure stack gases that are saturated with water vapour. It is not applicable to stack gases where the majority of particulates are greater than PM ₁₀ . It cannot be used for the measurement of total mass concentration of particulates.

¹EA TGN M15 provides guidance on size fractionation measurements. It also provides further information on the use of BS EN ISO 23210. TGN M15 is available from www.mcerts.net.

²For stack gas emissions with particulate concentrations above 50 mg/m³ the following are available:

- BS ISO 25597: Test method for determining PM_{2.5} and PM₁₀ mass in stack gases using cyclone samplers and sample dilution.
- BS ISO 13271: Determination of PM₁₀ / PM_{2.5} mass concentration in flue gas - Measurement at higher concentrations by use of virtual impactors.

The testing for PM₁₀ and PM_{2.5} will be undertaken during the one of the sets of quarterly routine, compliance testing, during the Plant's first year of operation.

<u>Parameter(s)</u>	<u>Method(s)</u>	<u>Duration(s)</u>
1.) PM ₁₀	BS EN ISO 23210 MCERTS Accredited	1 x 60 Mins
2.) PM _{2.5}	BS EN ISO 23210 MCERTS Accredited	1 x 60 Mins

Permit Number: EPR/DP3030XA/V002

Reference Conditions: dry, 273K, 101.3kPa, 11% oxygen

Please find attached the following supporting documentation:

- Technical Procedure CAT-TP-18
- UKAS MCERTS Schedule Version 36
- MCERTS Personal Competency Certificates
- Sampling Train Calibration Certificate



Technical Procedure

CAT-TP-18

(VERSION H)

Determination of PM₁₀ & PM_{2.5} using a 3-Stage Cascade Impactor
(EN ISO 23210)

Authorised By:

James Harmer
Technical Manager

CAT-TP-18

Key Sampling Issues

Key Sampling Issue	Further Information
Range	Suitable where total particulate emissions are <40 mg/m ³ .
Inapplicability of the Method to Saturated Gas Streams	This method is not suitable for PM ₁₀ and PM _{2.5} determination in saturated gas streams (i.e. where water droplets are present). This is because in-stack sampling is required and with no heating the filters will quickly become wet, invalidating the test. If particle size determination is still required, it is worth offering the client an alternative which is to perform a Standard EN 13284 test and send both the filter and rinse off for Particle Size Distribution Analysis.
Location of Filter	In-stack all instances. Cannot be used in gas streams where temperatures are >250°C due to the limitations of the PTFE thread seal used to prevent leaks in the impactor.
Nozzle Size	The nozzle used must be in the range 6 - 18mm (as per ISO 23210, paragraph 7.2.1). There is also a requirement to use a nozzle close to the "ideal" nozzle size which is calculated by CAT-RT. It is better to use the nozzle which is the next size down, instead of the one above <u>unless</u> the one above is no more than 0.1mm different in size to the "ideal" size.
Minimum Sampling Time	No minimum, though 30 to 120 minutes should be employed.
Probe Temperature	Set the probe to 120°C (or 20K above the stack gas dew point) to prevent condensation in the probe and running back into the cascade impactor.
Filter Type	Pre-conditioned Quartz Fibre (See [CAT-TP-03, Gravimetric Determination of Particulate Matter]).
Orientation of Filter	The filter should be installed in the filter cartridges with the bobbly side facing towards the stack gas i.e. the bobbly side captures the particulate matter.
Orientation of Impactor	The impactor should be used in the vertical orientation where possible, however if the sampling location does not allow, it may be used in the horizontal orientation with a gooseneck. Horizontal orientation has been validated by weighing the PM collected in the gooseneck nozzle of 3 separate jobs – all were <10% of the PM ₁₀ .
Sample Flow Rate	Determined by the calculations in CAT-RT. The flow rate is critical to the cascade impactor correctly sizing the particulates.
Blank	One blank sample (defined as 3 filters) should be taken per day, per stack (same as a Particulate Matter blank requirements)
Samples at the end of the test	<ul style="list-style-type: none"> i. Three blank filters per day, per stack ii. Three sample filters per sample run

QC Requirements

QC Requirement	Further Information
Leak Check (Blank and Sample/s)	The leak should be <2% of the expected sampled flow rate, at a vacuum no less than the maximum expected. VERY IMPORTANT: DO NOT PERFORM A POST TEST LEAK CHECK AS THIS MAY DISTURB THE PM FRACTIONS.
Valid Isokinetic Range	90% to 130%.
Cut off diameter	Needs to be between 9 - 11 µm for PM ₁₀ and 2.25 - 2.75 for PM _{2.5} .
Blank	The blank concentration/s should be <10% of the daily ELV. Do not report any value below the blank result.

Principle of the Standard

A sample of stack gas is extracted from the sample stream via a sampling train. Constant flow rate sampling is employed as the critical part of the testing is the velocity at which the stack gas enters the cascade impactor. The efficiency of the particulate sizing depends on the velocity through the nozzle plates which are located inside the cascade impactor. Total particulate matter is collected on 3 plane filters installed in the cascade impactor. Each plane filter captures a different size of particulate:

Stage 1 filter: $>10\mu\text{m}$

Stage 2 filter: $10\mu\text{m}$ to $2.5\mu\text{m}$

Stage 3 filter: $\leq 2.5\mu\text{m}$

No rinsing of parts upstream of the filters is employed. The recovered filters are then weighed, and compared with the sampled volume of stack gas drawn through the sample train gas meter to give a concentration in mg/m^3 at the appropriate reference conditions.

For PM_{10} determination, the filters from Stages 2 & 3 are weighed.

For $\text{PM}_{2.5}$ determination, the filter from just Stage 3 is weighed.

It is not permissible to weigh Stage 1 and use this method as a replacement for EN 13284-1, or ISO 9096.

Measurement Uncertainty is calculated by the Catalyst Report Template.

This Procedure should be used in conjunction with the references as specified at the back of this Procedure.

Compliance with AG2

This technical procedure meets all the technical requirements of Irish EPA Guidance Note AG2.

Equipment Required for Test

All equipment should be clean, both inside and out, with any previous markings removed. The inside of the equipment in contact with the stack gas should be cleaned as per the Catalyst Equipment Cleaning Procedure. (See [CAT-RM, Equipment Cleaning Procedure]). In addition, all equipment should have been tested (heating elements heat up, batteries for Tablet PCs are charged etc.) and checked for evidence of calibration and PAT Test stickers before going to site. The following table lists the equipment required:

Equipment Type	Further Details
Method 5 Control Box & Pump	N/A.
Catch pot and Filter	To protect Method 5 Type Control Box from silica and moisture infiltration.
Umbilical	To consist of 5 thermocouple connectors, heater box connector, Pitot lines and suction tube.
Measuring Rod	Rod for measuring duct depth / diameter.
Moisture Trap	To comply with EN 14790. (See [CAT-RM, Water Vapour Trap])
Dry Silica and Tap Water	Enough to enable multiple sample runs to be performed.
Impinger / Water Trap Bucket	To hold the water trap.
Ice	Enough to ensure the moisture trap is kept cold for all sample runs.
Scales	Capacity to weigh all parts of water trap. Resolution 0.1g.
Heated Sampling Probe	Required for out-stack sampling only, or where risk of condensation occurring in the probe during in-stack sampling is high. With built in thermocouple.
Probe Clamp (Assorted Fittings)	For holding probe and sampling train securely in place.
Probe Liner	Material: Stainless Steel / Titanium.
Cascade Impactor	Material: Stainless Steel / Titanium.
Quartz Fibre Filters	Pre-loaded into filter cartridges, transported in Petri Dishes. (Filter Type: 47mm Whatman QMA).
S-Type Pitot	Built into sampling probe.
Selection of Nozzles	In good condition with gooseneck attachment (if required).
Manometer / Temperature Meter	Liquid-incline built into Method 5 control box. If the pressure in the stack is < 1.3mmH ₂ O, a digital manometer should be used instead.
Barometer	Calibrated, capable of measuring atmospheric pressure to within 30 mbar.
Protractor	Calibrated with fixing kit to Pitot.
Toolbox	Containing tools, tape measure, marker pens, electrical tape, tie wraps, 10mm Swagelok Nuts, Unions and Ferrules etc.
Ruggedised Tablet PC	Latest version of Catalyst Report Template, Reference Manual and Technical Procedures installed.
Acetone and De-Ionised Water	In squeegee bottles to allow easy rinsing of parts in contact with particulates, in between sample runs.
Selection of brushes	For mechanically cleaning equipment if previous testing has had high particulate loadings.

Work Instruction (Page 1 of 2)

1. Discuss the nature of the Plant process with site personnel. Try to test under steady state conditions.
2. Perform a pre-sampling Risk Assessment.
3. Setup the Method 5 control box.

[CAT-RM, Method 5 Control Box Setup]

4. Measure stack dimensions and refer to SSP for sample run duration. If there is no SSP available, run durations can be taken from the Catalyst Reference Manual.

[CAT-RM, Measurement of Stack Dimensions] and [CAT-RM, Recommended Sampling Times and Sample Flowrates].

5. Unless already done, perform a Pre-Test Survey. This survey is used to determine the single representative sampling point. This is done by sampling at a point in the stack which is closest to the average of the velocity across the whole of the sampling plane, and where the angle of swirl meets the 15° requirement.

[CAT-TP-41, Determination of Stack Gas Velocity, Temperature and Volumetric Flow Rate] and [CAT-RM, Suitability of Sampling Location]

6. Unless already known, determine the flue gas composition and insert into the relevant cells in the report template (Water Vapour, Oxygen and Carbon Dioxide).
7. Select a suitable size of sample probe to enable the sampling point to be reached.
8. Mark up the sampling probe with the single point.

[Calculation: Sample Probe Marking]

9. Select a suitable nozzle, based upon the “ideal” nozzle calculated in the Catalyst Report Template.
IMPORTANT: To ensure Isokinetic sampling is achieved, choose a nozzle one size smaller than the ideal, unless the available nozzle is within 0.1 mm. i.e. if the ideal is 6.7 mm, choose a 6 mm. If the ideal is 6.9 mm, choose a 7 mm.

10. Complete all Pre-Test boxes in the Catalyst Report Template.
11. Assemble the sampling train.

[CAT-RM, Sample Train Assembly: PM₁₀ and PM_{2.5} (Cascade Impactor)]

12. Perform a Blank Test.

DO NOT PERFORM A POST BLANK LEAK CHECK, AS THIS IS NOT A REQUIREMENT FOR THE SAMPLE RUN.

[CAT-RM, Blank Test (Isokinetic)]

13. Perform sample recovery after the Blank Test.

[CAT-RM, Sample Recovery: PM₁₀ and PM_{2.5} (Cascade Impactor)]

14. Re-assemble the sampling train.

[CAT-RM, Sample Train Assembly: PM₁₀ and PM_{2.5} (Cascade Impactor)]

Work Instruction (Page 2 of 2)

15. Inspect the Pitot and then perform a Pitot Leak Test.

[CAT-RM, Pitot Inspection & Leak Test (L-Type and S-Type)]

16. Perform a pre-sample Leak Test.

[CAT-RM, Leak Test (DGM: Pre-Test)]

17. Ensure Plant is running under desired operating conditions, and then perform a sample run. ISO 23210 requires the stack gas pressure to be monitored and recorded at least every 5 minutes, along with the stack gas temperature. This data should be noted in the relevant cells in the Report Template. **It is important to maintain the flow rate to $\pm 5\%$ of the calculated target for the duration of the test.**

[CAT-RM, Sampling Run: PM₁₀ and PM_{2.5} (Cascade Impactor)]

18. **DO NOT PERFORM A POST TEST LEAK CHECK.** This may dislodge the particulate fractions between the plates.

19. Perform a post-test Pitot Leak Test.

[CAT-RM, Pitot Inspection & Leak Test (L-Type and S-Type)]

20. Perform sample recovery after the Sampling Run.

[CAT-RM, Sample Recovery: PM₁₀ and PM_{2.5} (Cascade Impactor)]

21. Whilst performing the sample recovery, run fresh air, by turning on the pump and opening the coarse gain valve, through the DGM to help maintain it in good condition.
22. For multiple Sampling Runs, repeat steps 10 to 17, ensuring that all parts, to be re-used, of the sampling train in front of the filters (i.e. nozzle, gooseneck and all parts of the cascade impactor) have been well rinsed with de-ionised water and acetone, and are therefore clean.
23. Ensure all boxes in the Catalyst Report Template have been completed.

End of Work Instruction.

Reference Document/s

Catalyst Reference Manual

Catalyst Report Template

[CAT-TP-41: Measurement of stack gas velocity, temperature and volumetric flow rate](#)

CAT-TP-05: Determination of water vapour in ducts

EN 13284-1:2002

EN ISO 23210

[EN ISO 16911-1:2013](#)

[MID 16911 \(V1.0\)](#)

Schedule of Accreditation

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United Kingdom Accreditation Service

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Unit C5 Emery Court The Embankment Business Park Heaton Mersey Stockport SK4 3GL	Contact: Mrs Rina Hare Tel: +44 (0)161 432 3286 (+44 (0)7971 550 160) Fax: +44 (0)161 432 3689 E-Mail: rina.hare@exova.com Website: www.exovacatalyst.com		
Testing performed by the Organisation at the locations specified below			

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details	Activity	Location code	
Address: Exova Catalyst Unit C5 Emery Court The Embankment Business Park Heaton Mersey Stockport SK4 3GL	Local contact Mr Alastair Wolff Tel: +44 (0)161 432 3286 Mobile: +44 (0)7886 533 130 Fax: +44 (0)161 432 3689 Email: alastair.wolff@exova.com Website: www.exovacatalyst.com	Support Functions: Quality System Quality Audit Administration Sampling and Testing: Physical Testing Environmental Chemistry	HO
Address: Exova Catalyst Unit C6 Emery Court The Embankment Business Park Heaton Mersey Stockport SK4 3GL	Local contact Mr Toby Campbell Tel: +44 (0)161 432 3286 Mobile: +44 (0)7825 130 074 Fax: +44 (0)161 432 3689 Email: toby.campbell@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CST
Address: Exova Catalyst 70 Montrose Avenue Hillington Park Glasgow G52 4LA	Local contact Mr Barry Grant Tel: +44 (0)141 941 2022 Mobile: +44 (0)7826 916 683 Fax: +44 (0)141 952 7099 Email: barry.grant@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CEK
Address: Exova Catalyst 11 Aspen Close Kembrey Trade Centre Swindon SN2 8AJ	Local contact Mr Stuart Davidson Tel: +44 (0)1793 497 902 Mobile: +44 (0)7957 554 956 Fax: +44 (0)1793 430 533 Email: stuart.davidson@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CSW



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Testing performed by the Organisation at the locations specified

Location details	Activity	Location code
Address: Exova Catalyst Ireland Unit 18 Tallaght Business Centre Whitestown Business Park Tallaght Dublin 24 Local contact Mr Nick Kenny Tel: +353 (86) 853 8247 Fax: +353 (0)1 458 5218 Email: nick.kenny@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CDU
Address: Exova Catalyst Unit 22 Century Park Network Centre Dearne Lane Rotherham S63 5DE Local contact Mr Toby Campbell Tel: +44 (0)161 432 3286 Mobile: +44 (0)7825 130 074 Fax: +44 (0)161 432 3689 Email: toby.campbell@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CRO
Address: Exova Catalyst Unit 37 Evans Business Centre Western Industrial Estate Caerphilly CF83 1BE Local contact Mr Stuart Davidson Tel: +44 (0)1793 497 902 +44 (0)7957 554 956 Fax: +44 (0)1793 430 533 Email: stuart.davidson@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CCA
Address: Exova Catalyst Shields Road Newcastle Upon Tyne Tyne & Wear NE6 2YD Local contact Barry Grant Tel: +44 (0) 141 941 2022 Mobile: +44 (0)7826 916683 Fax: +44 (0) 141 952 7099 Email: barry.grant@exova.com Website: www.exovacatalyst.com	Support Functions: Administration Sampling and Testing: Stack Emissions Testing	CNE

Site activities performed away from the locations listed above:

Location details	Activity	Location code
Customer Sites requiring Stack Emissions Testing	Stack Emissions Testing	All
Customer Landfill Sites requiring sampling	Sampling Landfill Gases	All



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Testing performed by the Organisation at the locations specified

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory</u>	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Total Particulate Matter	BS EN 13284-1:2002 (CAT-TP-01)	All
	Particulate Matter <10 micron (PM ₁₀ and PM _{2.5})	BS EN ISO 23210:2009 (CAT-TP-18)	All
	Odour (direct sampling of dry stacks and dynamic dilution sampling of hot wet stacks)	BS EN 13725:2003 (CAT-TP-30)	All
	Oil mist, Tar and bitumen fume	BS EN 13284-1:2002 & MDHS 84 (CAT-TP-37)	All
	Hydrogen Chloride	BS EN 1911:2010 (CAT-TP-11)	All
	Hydrogen Fluoride	BS ISO 15713:2006 (CAT-TP-10)	All
	Sulphur Dioxide	BS EN 14791:2005 (CAT-TP-09)	All
	Ammonia	BS EN 14791:2005 (CAT-TP-14)	All
	Hydrogen Sulphide	US EPA Method 11 (CAT-TP-15)	All
	Hydrogen Cyanide	US EPA OTM 029 (CAT-TP-12)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory (cont'd)</u>	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	<u>Halides and Halogens</u> Hydrogen Bromide Chlorine Bromine	US EPA Methods 26 and 26a (CAT-TP-13)	All
	Metals	BS EN 14385:2004 (CAT-TP-06)	All
	Mercury	BS EN 13211:2001 (CAT-TP-06)	All
	Dioxins and Furans	BS EN 1948-1:2006 (CAT-TP-07)	All
	Dioxin-like Polychlorinated Biphenyls (PCBs)	BS EN 1948-4:2010 (CAT-TP-07)	All
	Polycyclic Aromatic Hydrocarbons (PAHs)	BS ISO 11338-1:2003 (CAT-TP-08)	All
	Isocyanates	US EPA CTM 036 (CAT-TP-17)	All
	Speciated VOCs (carbon and other suitable tubes) (direct sampling of dry stacks and dynamic dilution sampling of hot wet stacks) Mercaptans Amines and Amides Phenols Cresols Carboxylic Acids Aldehydes	CEN TS 13649:20142 (CAT-TP-16)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory</u> (cont'd)	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	Total Aldehydes and Formaldehyde	US EPA Method 316 (CAT-TP-19)	All
	Total Oxides of Nitrogen (NO, NO ₂ and nitric acid vapour)	US EPA Method 7D (CAT-TP-35)	All
	Bioaerosols	VDI 4257 part 2:2011 (Method CAT-TP-36)	CST
	<u>Sampling and On-Site Analysis</u>		
	Water Vapour	BS EN 14790:2005 (CAT-TP-05)	All
	<u>Sampling and On-Line Analysis</u>		
	Water Vapour*	EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Pressure, Temperature and Velocity (point velocity method)	BS EN 16911-1:2013 & MID (CAT-TP-41) - using differential pressure device (pitot tube) method	All
	Ammonia*	EA TGN M22 (CAT-TP-22b - FTIR analyser)	All



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Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Site Analysis</u> (cont'd)	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	Carbon Monoxide*	BS EN 15058:2006 (CAT-TP-21 - NDIR analyser) (CAT-TP-25 - NDIR analyser) (CAT-TP-39 - NDIR analyser) EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Carbon Dioxide*	ISO 12039:2001 (CAT-TP-21 - NDIR analyser) (CAT-TP-39 - NDIR analyser) EA TGN M22 (CAT-TP-22b - FTIR analyser)	All
	Nitrogen Monoxide (NO)*	BS EN 14792:2005 (CAT-TP-21 - Chemiluminescent analyser) (CAT-TP-32 - Chemiluminescent analyser) (CAT-TP-39 - Chemiluminescent analyser) EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Nitrogen Dioxide (NO ₂)*	BS EN 14792:2005 (CAT-TP-32 - Chemiluminescent analyser) EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All



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Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	Nitrous Oxide (N ₂ O)*	BS EN ISO 21258:2010 (CAT-TP-40 - NDIR analyser) EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Oxides of nitrogen (NO _x)*	BS EN 14792:2005 (CAT-TP-21 - Chemiluminescent analyser) (CAT-TP-32 - Chemiluminescent analyser) (CAT-TP-39 - Chemiluminescent analyser) EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Sulphur Dioxide*	EA TGN M21 (CAT-TP-21 - NDIR analyser)EA TGN M22 (CAT-TP-22b - FTIR analyser)	All
	Sulphur Trioxide*	EA TGN M22 (CAT-TP-22b - FTIR analyser)	All
	Hydrogen Chloride*	EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Hydrogen Cyanide*	EA TGN M22 (CAT-TP-22b - FTIR analyser)	All
	Hydrogen Fluoride*	EA TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All



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Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007 (cont'd)	
	Oxygen*	BS EN 14789:2005 (CAT-TP-21 - Validated Zirconium cell analyser) (CAT-TP-22 - Validated Zirconium cell analyser) (CAT-TP-25 - Paramagnetic analyser) (CAT-TP-33 - Paramagnetic analyser) (CAT-TP-39 - Paramagnetic analyser)	All
	Total Gaseous Organic* Carbon (TOC / VOC) (0 to 1000 mg/m ³)	BS EN 12619:2013 (CAT-TP-20 - FID Analyser)	All
	Halides and Halogens* Speciated VOCs* Other inorganic gases* The organisation holds a flexible scope of accreditation for these tests. Please contact the organisation for details of the individual gaseous compounds they can sample and analyse using this method.	EA TGN M22 (CAT-TP-22b - FTIR analyser)	All

* - The scale range of the analyser used for this test must be that detailed on its current MCERTS certificate or a range validated by the organisation to meet MCERTS requirements.



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Exova (UK) Ltd
Trading as Exova Catalyst and Exova Catalyst Ireland
Issue No: 036 Issue date: 17 March 2015

Testing performed by the Organisation at the locations specified

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Stack Emissions - Continuous Emissions Monitoring Systems (CEMS)	QAL 2 and the Annual Surveillance Test (AST) for CEMS	Documented in house procedure CAT-TP-29 to meet the requirements of BS EN 14181:2004, Environment Agency MID 14181 and other requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	CSW CST CEK
Testing of Stack Emissions to Atmosphere	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory</u>	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007	
	Total Particulate Matter	IS EN 13284-1:2002 including Environment Agency (England) MID 13284-1 (CAT-TP-01)	All
	Particulate Matter <10 micron (PM ₁₀ and PM _{2.5})	IS EN ISO 23210:2009 (CAT-TP-18)	All
	Odour (direct sampling of dry stacks and dynamic dilution sampling of hot wet stacks)	IS EN 13725:2003 including Environment Agency (England) MID 13725 (CAT-TP-30)	All
	Oil mist, Tar and bitumen fume	IS EN 13284-1:2002 & MDHS 84 (CAT-TP-37)	All
	Hydrogen Chloride	IS EN 1911:2010 (CAT-TP-11)	All
	Hydrogen Fluoride	IS ISO 15713:2006 2006 including Environment Agency (England) MID 15713 (CAT-TP-10)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory</u> (cont'd)	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007 (cont'd)	
	Sulphur Dioxide	IS EN 14791:2005 (CAT-TP-09)	All
	Ammonia	IS EN 14791:2005 (CAT-TP-14)	All
	Hydrogen Sulphide	US EPA Method 11 (CAT-TP-15)	All
	Hydrogen Cyanide	US EPA OTM 029 (CAT-TP-12)	All
	<u>Halides and Halogens</u> Hydrogen Bromide Chlorine Bromine	US EPA Methods 26 and 26a (CAT-TP-13)	All
	Metals	IS EN 14385:2004 including Environment Agency (England) MID 14385 (CAT-TP-06)	All
	Mercury	IS EN 13211:2001 including Environment Agency (England) MID 14385 (CAT-TP-06)	All
	Dioxins and Furans	IS EN 1948-1:2006 including Environment Agency (England) MID 1948 (CAT-TP-07)	All
	Dioxin-like Polychlorinated Biphenyls (PCBs)	IS EN 1948-4:2010 including Environment Agency (England) MID 1948 (CAT-TP-07)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory</u> (cont'd)	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007 (cont'd)	
	Polycyclic Aromatic Hydrocarbons (PAHs)	IS ISO 11338-1:2003 (CAT-TP-08)	All
	Isocyanates	US EPA CTM 036 (CAT-TP-17)	All
	Speciated VOCs (carbon and other suitable tubes) (direct sampling of dry stacks and dynamic dilution sampling of hot wet stacks) Mercaptans Amines and Amides Phenols Cresols Carboxylic Acids Aldehydes	CEN TS 13649:2014 (CAT-TP-16)	All
	Total Aldehydes and Formaldehyde	US EPA Method 316 (CAT-TP-19)	All
	Total Oxides of Nitrogen (NO, NO ₂ and nitric acid vapour)	US EPA Method 7D (CAT-TP-35)	All
	Bioaerosols	VDI 4257 part 2:2011 (Method CAT-TP-36)	CST
	<u>Sampling and On-Site Analysis</u>		
	Water Vapour	IS EN 14790:2005 (CAT-TP-05)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007 (cont'd)	
	Water Vapour†	Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Pressure, Temperature and Velocity (point velocity method)	IS EN 16911-1:2013 including Environment Agency (England) MID 16911-1 (CAT-TP-41) - using differential pressure device (pitot tube) method	All
	Ammonia†	Environment Agency (England) TGN M22 (CAT-TP-22b - FTIR analyser)	All
	Carbon Monoxide†	IS EN 15058:2006 (CAT-TP-21 - NDIR analyser) (CAT-TP-25 - NDIR analyser) (CAT-TP-39 - NDIR analyser) Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Carbon Dioxide†	ISO 12039:2001 (CAT-TP-21 - NDIR analyser) (CAT-TP-39 - NDIR analyser) Environment Agency (England) TGN M22 (CAT-TP-22b - FTIR analyser)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007 (cont'd)	
	Nitrogen Monoxide (NO)†	IS EN 14792:2005 including Environment Agency (England) MID 14792 (CAT-TP-21 - Chemiluminescent analyser) (CAT-TP-32 - Chemiluminescent analyser) (CAT-TP-39 - Chemiluminescent analyser)	All
	Nitrogen Dioxide (NO ₂)†	Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Nitrous Oxide (N ₂ O)†	IS EN 14792:2005 including Environment Agency (England) MID 14792 (CAT-TP-32 - Chemiluminescent analyser)	All
		Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	
		IS EN ISO 21258:2010 (CAT-TP-40 - NDIR analyser) Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007 (cont'd)	
	Oxides of nitrogen (NO _x)†	IS EN 14792:2005 2005 including Environment Agency (England) MID 14792 (CAT-TP-21 - Chemiluminescent analyser) (CAT-TP-32 - Chemiluminescent analyser) (CAT-TP-39 - Chemiluminescent analyser)	All
		Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	
	Sulphur Dioxide†	Environment Agency (England) TGN M21 (CAT-TP-21 - NDIR analyser)	All
		Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	
	Sulphur Trioxide†	Environment Agency (England) TGN M22 (CAT-TP-22b - FTIR analyser)	All
	Hydrogen Chloride†	Environment Agency (England) TGN M22 (CAT-TP-22b - Validated FTIR analyser)	All
	Hydrogen Cyanide†	Environment Agency (England) TGN M22 (CAT-TP-22b - FTIR analyser)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	<u>Sampling and On-Line Analysis</u> (cont'd)	National, European, International and Irish Environmental Protection Agency specified standards and Documented In-House work instructions to meet the requirements of Irish Environmental Protection Agency Publications AG1 and AG2 and DD CEN/TS 15675:2007/ IS EN 15259:2007 (cont'd)	
	Hydrogen Fluoride†	Environment Agency (England) TGN M22 (CAT-TP-22b – Validated FTIR analyser)	All
	Oxygen†	IS EN 14789:2005 (CAT-TP-21 - Validated Zirconium cell analyser) (CAT-TP-22 - Validated Zirconium cell analyser) (CAT-TP-25 - Paramagnetic analyser) (CAT-TP-33 - Paramagnetic analyser) (CAT-TP-39 - Paramagnetic analyser)	All
	Total Gaseous Organic† Carbon (TOC / VOC) (0 to 1000 mg/m³)	IS EN 12619:2013 (CAT-TP-20 - FID Analyser)	All
	Halides and Halogens† Speciated VOCs† Other inorganic gases† The organisation holds a flexible scope of accreditation for these tests. Please contact the organisation for details of the individual gaseous compounds they can sample and analyse using this method.	Environment Agency (England) TGN M22 (CAT-TP-22b - FTIR analyser)	All

† - The scale range of the analyser used for this test must meet the specific requirements specified in the Irish Environmental Protection Agency document "AG2 Index of Preferred Methods"



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Testing of Stack Emissions to Atmosphere	<u>Sampling with subsequent analysis by an ISO/IEC 17025 Accredited Laboratory</u>	National, International and other recognised standards using documented In-House work instructions to meet the requirements of DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Total Particulate Matter 20 to 1000mg/m ³	BS ISO 9096:2003	All
	Particulate Matter <10 micron (PM ₁₀ and PM _{2.5})	US EPA Method 201A (CAT-TP-26)	All
	Condensable VOC's (sector specific to DEFRA sector guidance note SG1-06 and operator permit)	Based on BS EN 14791 (CAT-TP-23)	All
	Particulate and gaseous fluoride content	Based on BS ISO 15713:2006. Method number CAT-TP-10b.	CDU CEK
	Total acids	Based on BS EN 1911:2010. Method number CAT-TP-31.	CDU CEK
	Pressure, Temperature and Velocity	ISO 10780:1994 BS EN 13284-1:2002 (CAT-TP-04)	All
LANDFILL SITES	<u>Sampling of Landfill Gas for Subsequent Analysis by an ISO/IEC 17025 Accredited Laboratory</u>	Documented In-House Procedures Based on Environment Agency guidance document LFTGN04	
	Trace Components by Sorbent Tubes: Priority Trace Components: 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethene 1,3-Butadiene 1-Butanethiol 1-Pentene	Based on CEN TS 13649:2014 (CAT-TP-16)	All



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
LANDFILL SITES (cont'd)	<p><u>Sampling of Landfill Gas for Subsequent Analysis by an ISO/IEC 17025 Accredited Laboratory</u> (cont'd)</p> <p>Trace Components by Sorbent Tubes (cont'd): Priority Trace Components:</p> <p>1-Propanethiol 2-Butoxy Ethanol Arsenic (as As) Benzene Butyric Acid Carbon Disulphide Chloroethane Chloroethene (Vinyl Chloride) Dichloromethane Dimethyl Disulphide Dimethyl Sulphide Ethanal (Acetaldehyde) Ethanethiol Ethyl Butyrate Furan (1,4-Epoxy-1,3-Butadiene) Mercury (as Hg) Methanal (Formaldehyde) Methanethiol PCDDs/PCDFs Styrene 1,1,2,2 - Tetrachloroethane Tetrachloroethene Tetrachloromethane Toluene Trichloroethene Trimethylbenzene</p> <p><u>Siloxanes</u> Decamethylcyclopentasiloxane Decamethyltetrasiloxane Dodecamethylcyclohexasiloxane Dodecamethylpentasiloxane Hexamethylcyclotrisiloxane</p>	<p>Documented In-House Procedures Based on Environment Agency guidance document LFTGN04 (cont'd)</p> <p>Based on CEN TS 13649:2014 (CAT-TP-16) & (CAT-TP-27)</p>	All



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LANDFILL SITES (cont'd)	<u>Sampling of Landfill Gas for Subsequent Analysis by an ISO/IEC 17025 Accredited Laboratory (cont'd)</u> <u>Siloxanes</u> Hexamethyldisiloxane Octamethylcyclotetrasiloxane Octamethyltrisiloxane Trimethylsilanol Trace and Bulk Components By Tedlar Bags: Hydrogen Sulphide Carbon Monoxide Carbon Dioxide Oxygen Methane Nitrogen	Documented In-House Procedures Based on Environment Agency guidance document LFTGN04 (cont'd) CAT-TP-27	All
ATMOSPHERIC POLLUTANTS AND EFFLUENTS – STACK GAS SAMPLES Impinger Solutions (hydrogen peroxide) Impinger Solutions (sodium hydroxide) Impinger Solutions (water) Impinger Solutions (water)	<u>Chemical Tests</u> Sulphur Dioxide Hydrogen Fluoride Hydrogen Chloride Nitrate Sulphate Fluoride	Documented In-House Methods based on the following national, international and other recognised standards. BS EN 14791:2005 using Ion Chromatography analysis (CAT-AP-01) BS ISO 15713:2006 (modified) using Ion Chromatography analysis (CAT-AP-01) BS EN 1911:2010 using Ion Chromatography analysis (CAT-AP-01) In house method using Ion Chromatography analysis (CAT-AP-01)	HO HO HO HO



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ATMOSPHERIC POLLUTANTS AND EFFLUENTS – STACK GAS SAMPLES (cont'd)	<u>Chemical Tests (cont'd)</u>	Documented In-House Methods based on the following national, international and other recognised standards. (cont'd)	
Filter Papers and Rinse Solutions	Weighing of Particulate Matter	BS EN 13284-1:2002 BS ISO 9096:2003 (CAT-TP-03)	HO
	Weighing of Particulate Matter <10 micron (PM ₁₀ and PM _{2.5})	US EPA Method 201A (CAT-TP-03) BS EN ISO 23210:2009 (CAT-TP-03)	HO
Impinger Solutions (water)	Formaldehyde	USEPA Method 316 (in-house method CAT-AP-05) by UV/VIS Spectroscopy	HO
END			

Certificate of Personnel Competence

This is to certify that

Martin Futter

has been assessed by Sira Certification Service and
has demonstrated competence to the required standard of

Level 2 (team leader)

as defined in

**MCERTS Personnel Competency Standard
for Manual Stack-Emission Monitoring : October 2012, Version 8.1**

for the following Technical Endorsements:

TE1 - Particulate monitoring by isokinetic sampling techniques	expires Nov 2018
TE2 - Multi-phase sampling techniques	expires Jun 2019
TE3 - Gases/vapours by manual techniques	expires Mar 2016
TE4 - Gases/vapours by instrumental techniques	expires Mar 2015

Level 2 personnel may be required to retake the oral examination if the MCERTS Examination Board receives and upholds a complaint about them of a serious nature. The use of this certificate and the Sira Certification Mark are subject to the Regulations Applicable to Holders of Sira Certificates. The certificate holder agrees to comply with the MCERTS Code of Conduct. This certificate remains valid until the expiry date shown below.

Certificate issued : Mar 2014
Level 2 renewal date : Nov 2018
H&S renewal date : Sep 2015

Certificate No : Sira MP03 145 /12
Registration No : MM03 216

Certificate expiry date : Mar 2015


R Cooper 1 Eng MInstMC
Technical Director

MCERTS is operated on behalf on the Environment Agency by

Sira Certification Service

12 Acorn Industrial Park, Crayford Road,
Crayford, Dartford, Kent DA1 4AL
Tel: +44 (0)1322 520500 Fax: +44 (0)1322 520501

This certificate remains the property of Sira and shall be returned when requested.

It may only be reproduced in its entirety and without change.

Registered Office: Rake Lane, Eccleston, Chester CH4 9JN

CALIBRATION CERTIFICATE (CAT-CC-07 Dry Gas Meters)

CERTIFICATE NUMBER: CAT-CC-7.18 0115 Date: 19/01/2015 Valid to: 19/07/2015
(Format: CAT-CC-X.YY MMYYY)

Test Equipment:

Dry Gas Meter:

Manufacturer: Millennium Instruments
Type: Dry Gas Meter
Serial No: 16812882
CAT No: CAT 7.18
(Format: CAT X.YY)

UKAS Accredited 50 l/min MFC:

CAT No: CAT 1.7b
Manufacturer: MKS Instruments
Type: 50l MFC
Serial No: G569115G20
Certificate No: 2738, 2739
Date Calibrated: 04/07/2014
Valid to: 04/07/2015

2 l/min MFC:

(if non-UKAS MFC used, type over fields)

CAT No: CAT 1.6.2(b)
Manufacturer: MKS Instruments
Type: 2l MFC
Serial No: 021912431
Certificate No: 2547, 2548
Date Calibrated: 04/03/2014
Valid to: 04/03/2015

- ive Leak Check:	Pass
+ ive Leak Check:	Pass
Maximum Vacuum:	26

(in.Hg)

Reference Flow Rate (l/min)	7.5	10	15	20	25	30	35	40
MFC Y_D :	0.975	0.988	0.973	0.989	0.983	0.986	0.983	0.984
Initial DGM Volume (m ³)	9.6430	9.7410	9.9270	10.1310	10.3740	0.6980	1.2070	1.6300
Initial DGM Temperature (°C)	17.0	17.0	17.0	17.0	18.0	21.0	21.0	24.0
Initial ΔH (mm/H ₂ O)	11.0	16.5	32.0	50.0	80.0	110.0	152.0	196.0
Final DGM Volume (m ³)	9.7301	9.8550	10.1020	10.3580	10.6590	1.0348	1.6010	2.0860
Final DGM Temperature (°C)	17.0	17.0	17.0	18.0	21.0	18.0	21.0	26.0
Final ΔH (mm/H ₂ O)	11.0	16.5	32.0	50.0	80.0	110.0	152.0	196.0
Barometric Pressure (mbar)	1001	1001	1001	1001	1001	1001	1001	1001
Duration of Test (mins)	10	10	10	10	10	10	10	10
Vacuum Pressure (in/Hg)	24	22.5	20	18	16	15	13	12
Average DGM Temperature (°C)	17.0	17.0	17.0	17.5	19.5	19.5	21.0	25.0
Average ΔH (mm/H ₂ O)	11.0	16.5	32.0	50.0	80.0	110.0	152.0	196.0
Reference Volume @ STP (m ³)	0.0769	0.1013	0.1541	0.2023	0.2544	0.3044	0.3559	0.4064
Measured Volume @ STP (m ³)	0.0811	0.1062	0.1633	0.2118	0.2649	0.3140	0.3669	0.4207
Deviation (%)	5.5	4.9	5.9	4.7	4.1	3.1	3.1	3.5
Barometric Pressure (mm Hg)	750.9	750.9	750.9	750.9	750.9	750.9	750.9	750.9
Average DGM Temperature (°K)	290.0	290.0	290.0	290.5	292.5	292.5	294.0	298.0
Gas Meter Y_D ²	0.899	0.909	0.891	0.912	0.922	0.940	0.941	0.933
Duration of Test (min) ²	100	100	100	100	100	100	100	100
Measured DGM Volume (m ³) ²	0.0076	0.0130	0.0306	0.0515	0.0812	0.1134	0.1552	0.2079
STP Constant	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126
Y_D of Run	0.948	0.953	0.944	0.955	0.960	0.970	0.970	0.966
ΔH (mm/H ₂ O)	78.24	67.74	56.87	51.67	52.23	50.46	51.15	50.34
Minimum Y_D	0.944	Deviation from mean (%), (must be < 2)					1.50	Pass
Maximum Y_D	0.970	Deviation from mean (%), (must be < 2)					1.22	Pass
Average Y_D =	0.958	Average ΔH =		57.34				

Calibrated by: Wayne Rossouw

Signed: 

Date of Calibration: 19/01/2015

CALIBRATION CERTIFICATE (CAT-CC-07 Dry Gas Meters - Low Flow Check)

CERTIFICATE NUMBER: CAT-CC-7.18 0115 Date: 19/01/2015 Valid to: 19/07/2015
(Format: CAT-CC-X.YY MMYYY)

- ive Leak Check:	Pass
+ ive Leak Check:	Pass

Reference Flow Rate (l/min)	0.2	0.2	0.2
Reference MFC Y_d (non-UKAS = 1)	1.0000		
Initial DGM Volume (m ³)	0.24008	0.24240	0.24470
Initial DGM Temperature (°C)	22.0	22.0	22.0
Final DGM Volume (m ³)	0.24240	0.24470	0.24699
Final DGM Temperature (°C)	22.0	22.0	22.0
Barometric Pressure (mbar)	1001	1001	1001
Duration of Test (mins)	10	10	10
Vacuum Pressure (in.Hg)	2	2	2
Average DGM Temperature (°C)	22.0	22.0	22.0
Average ΔH (mm/H ₂ O)	0.0	0.0	0.0
Reference Volume @ STP (m ³)	0.00200	0.00200	0.00200
Measured Volume @ STP (m ³)	0.00212	0.00210	0.00209
Deviation (%)	5.9	5.2	4.7
Result (Allowable is -2% to + 50%)	Pass	Pass	Pass

The Calibration Sticker to be printed and applied should look like:
(Print Certificate, laminate and tape to back of Control Box front cover)

CAT 7.18, Due 19/07/2015
 $\Delta H = 57.34$, $Y_d = 0.958$

**PRINT USING
DYMO TAB**

Calibrated by: Wayne Rossouw

Signed: 

Date of Calibration: 19/01/2015

Is a Certificate and Sticker Check required by a senior member of staff?
[Check Catalyst Competency Matrix to see if a counter signature check is required]

NO