DEFRA AND THE DEVOLVED ADMINISTRATIONS

ASSESSMENT OF UK AURN PARTICULATE MATTER MONITORING EQUIPMENT AGAINST THE JANUARY 2010 GUIDE TO DEMONSTRATION OF EQUIVALENCE

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Executive Summary

Between 2004 and 2006 a series of tests on ambient particulate analysers was undertaken by Bureau Veritas on behalf of Defra and the Devolved Administrations[1]. The purpose of the test programme was to test the overall performance of a number of "candidate" particulate matter samplers with that of the EU reference methods for PM_{10} and $PM_{2.5}$ particulate fractions. The primary aim of these tests was to assess the achievement of criteria of the Data Quality Objectives in Annex 1 of the Ambient Air Quality Directive 2008/50/EC.

For those particulate matter (PM) monitoring instruments that are in the UK compliance network – the Automatic Urban and Rural Network (AURN) - the previously reported 2006 equivalence trials data (as well as further data collected since) are herein reprocessed as per the January 2010 version of The Guide to Demonstration of Equivalence (GDE). This GDE supersedes a version previously published in November 2005. In relation to those instruments included in the original field trials and reported in June 2006, most conclusions, and therefore recommendations for deployment into the AURN, remain unchanged. Table A1 overleaf summarises the conclusions for each instrument tested.

Candidate instruments include:

- Filter Dynamic Measurement System (FDMS) 8500 series Models B, C and UK CB and BB variants;
- Partisol 2025 gravimetric samplers
- Tapered Element Oscillating Micro-balance (TEOM) units;
- Met-One Beta Attenuation Monitor (BAM)

While this report considers only those instruments deployed within the UK compliance based monitoring network, other instruments are available and proven equivalent for use within the UK.

It is policy within the UK that when using an unheated PM_{10} Met-One BAM at ambient conditions, that the concentrations are divided by 1.2 rather than 1.211. This approach was also proven to be valid. The $PM_{2.5}$ FDMS B has a significant slope and intercept, yet correction did not lead to a significant improvement in the comparisons, and it is recommended to continue reporting these data without correction.

As the results and recommendations for the 8500 FDMSs, Partisol 2025s and PM_{10} Unheated BAM 1020s deployed in the original tests are still valid this justifies the UK's use of these instruments within the AURN.

[1] UK Equivalence Programme for Monitoring of Particulate Matter, David Harrison, June 2006, Bureau Veritas Report Number: BV/AQ/AD202209/DH/2396. http://www.airquality.co.uk/reports/cat05/0606130952_UKPMEquivalence.pdf

Table A1: Summary of Candidate Instrument Tests against Particulate Matter Equivalence Criteria

Candidate Instrument	PM Size Fraction	Manufacturer	Equivalence Criteria Met?	Correction Required
8500 FDMS (B, C[†], CB and BB variants)	PM_{10}	Thermo Electron Corporation	Meets equivalence criteria.	No correction required.
8500 FDMS (B, C[†], CB and BB variants)	$PM_{2.5}$	Thermo Electron Corporation	Meets equivalence criteria.	No correction required.
Partisol 2025	PM_{10}	Thermo Electron Corporation	Meets equivalence criteria.	No correction required.
Partisol 2025	$PM_{2.5}$	Thermo Electron Corporation	Tests Ongoing	Tests Ongoing
1400AB TEOM	PM_{10}	Thermo Electron Corporation	Does not meet equivalence criteria.	Correction does not aid the adherence of equivalence criteria.
1400AB TEOM	$PM_{2.5}$	Thermo Electron Corporation	Limited Data	Limited Data.
Unheated BAM 1020	PM_{10}	Met-One	Meets equivalence criteria after application of a slope correction factor.	If flow reported at standard conditions: $BAM_{Corrected} = \frac{BAM}{1.211}$ If flow corrected to ambient conditions: $BAM_{Ambient\ Corrected} = \frac{BAM_{Ambient}}{1.273}$

[†] Some C series dryers require re-conditioning by the manufacturer in order to perform adequately. Care should be undertaken in the QAQC procedures..

1. Introduction

Between 2004 and 2006 a series of tests on ambient particulate analysers was undertaken by Bureau Veritas on behalf of Defra and the Devolved Administrations[2]. The purpose of the test programme was to test the overall performance of a number of "candidate" particulate matter samplers with that of the EU reference methods for PM_{10} and $PM_{2.5}$ particulate fractions. The primary aim of these tests was to assess the achievement of criteria of the Data Quality Objectives as set out in Annex 1 of the Ambient Air Quality Directive 2008/50/EC

For PM_{10} the following instrumentation was tested in 2006: Partisol 2025, TEOM, FDMS B, Opsis SM200 and Met-One BAM; along with the $PM_{2.5}$ FDMS B at the following locations against the PM_{10} KFG and $PM_{2.5}$ Leckel reference methods operating with Emfab filters (Table 1).

Table 1: Locations and Dates of Field Studies from 2004 to 2006.

Site Name	Location	Site Classification	Local Site Operator	Winter Dates	Summer Dates
Teddington	52°25' 28.32" N 0°20' 43.66" W 13 m ASL	Suburban	NPL	14th November 2004 to 21st March 2005	22nd March 2005 to 25th July 2005
Birmingham	52°27' 19.60" N 1°55' 44.07" W 144 m ASL	Urban Background	University of Birmingham	28th November 2004 to 22nd March 2005	23rd March 2005 to 22nd July 2005
East Kilbride	55°45' 19.50" N 4°10' 08.50" W 180 m ASL	Suburban	netcen	13th October 2005 to 12th January 2006	1st August 2005 to 12th October 2005
Bristol	51°26' 57.63" N 2°35' 04.66" W 10 m ASL	Roadside	Bristol City Council	13th October 2005 to 19th January 2006	10th August 2005 to 12th October 2005

The results were processed and reported using the [then] version of The Guide to Demonstration of Equivalence (GDE) from November 2005. After publication of the 2006 report, the use of these instruments within the UK was deemed appropriate in the absence of comments received by the European Commission.

Subsequent to the 2006 report a series of further tests have been undertaken. In 2007 and 2008 these test programmes were funded by Defra. However, from late 2008, the decision was taken to encourage instrument manufacturers to pay for all future testing through an adjunct to the Environment Agency's MCERTS programme for Continuous Ambient Measurement Systems (CAMS). In order to reduce costs to the manufacturers, the tests were combined with those ongoing and organised by TŰV Rheinland in Cologne, Germany, and the location of the instruments are swapped between countries approximately every six months. There was an additional test in 2003 organised by Working Group 15, and these data are considered herein for the $PM_{2.5}$ Partisol. Table 2 overleaf summarises those additional tests undertaken where the instruments tested are used within the UK AURN The Leckel, KFG and SEQ listed in Table 2 are the CEN reference instruments deployed in accordance with EN12341 and EN14907, for the measurement of particulate matter in the PM_{10} and $PM_{2.5}$ fractions, respectively. The Leckel is the single shot $PM_{2.5}$ sampler; The KFG is the single shot PM_{10} sampler; and the SEQ is an autochanging version of the PM_{10} KFG.

Herein the results from all of these studies for those instruments deployed in the UK compliance based PM monitoring network are re-assessed using the January 2010 version of The GDE[3]. This is heavily revised relative to the November 2005 version, but essentially identical to a version published in July 2009. This report is intended as an Addendum to the 2006 UK Equivalence report, and this

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[2] UK Equivalence Programme for Monitoring of Particulate Matter, David Harrison, June 2006, Bureau Veritas Report Number: BV/AQ/AD202209/DH/2396. http://www.airquality.co.uk/reports/cat05/0606130952_UKPMEquivalence.pdf

[3] Guidance for the Demonstration of Equivalence of Ambient Air Monitoring Methods, EC Equivalence Group, January 2010, http://ec.europa.eu/environment/air/quality/legislation/pdf/equivalence.pdf

should be consulted for the operating criteria of the instruments originally tested. Where conditions are different to those previously reported, these are included in this report.

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Table 2: Locations, dates and instruments for additional field studies incorporating instruments from the UK AURN since 2003.

Site	Dates		Instruments
Teddington 2003, UK	17th February 2003	8th May 2003	2 of $PM_{2.5}$ SEQ with Glass or quartz filters 2 of $PM_{2.5}$ Partisol with Glass or quartz filters
Teddington Summer 2007, UK	11th June 2007	11th September 2007	2 of PM_{10} KFG with Emfab filters 2 of $PM_{2.5}$ Leckel with Emfab filters 2 of PM_{10} FDMS B 2 of $PM_{2.5}$ FDMS B 2 of PM_{10} FDMS C 2 of $PM_{2.5}$ FDMS C 2 of $PM_{2.5}$ Partisol 2 of $PM_{2.5}$ TEOM
Teddington Summer 2008, UK	24th July 2008	15th October 2008	2 of PM_{10} KFG with Emfab filters 2 of $PM_{2.5}$ Leckel with Emfab filters 1 of PM_{10} FDMS C 1 of $PM_{2.5}$ FDMS C
Teddington Autumn 2008, UK	31st October 2008	5th December 2008	2 of PM_{10} KFG with Emfab filters 2 of $PM_{2.5}$ Leckel with Emfab filters 2 of PM_{10} FDMS B 2 of $PM_{2.5}$ FDMS B 2 of PM_{10} FDMS C 2 of $PM_{2.5}$ FDMS C 2 of PM_{10} FDMS CB 2 of $PM_{2.5}$ FDMS CB
Cologne Winter 2008-9, Germany	5th December 2008	27th March 2009	2 of PM_{10} KFG with Emfab filters 2 of $PM_{2.5}$ Leckel with Emfab filters 1 of PM_{10} KFG with quartz filters 1 of $PM_{2.5}$ Leckel with quartz filters 1 of PM_{10} FDMS C 1 of $PM_{2.5}$ FDMS C
Teddington Summer 2010, UK	27th April 2010	2nd July 2010	2 of $PM_{2.5}$ Leckel with Emfab filters 2 of $PM_{2.5}$ Partisol with Emfab Filters

While this report considers only those instruments deployed within the UK compliance based monitoring network, other instruments are available and proven equivalent for use within the UK. Namely: the PM_{10} Opsis SM200 by beta and by mass and the PM_{10} and $PM_{2.5}$ Dual Channel FAI SWAM and the $PM_{2.5}$ Smart Heated BAM.[4]

1405 series FDMS instruments are currently undergoing equivalence testing and this report only considers the 8500 series FDMS instruments.

[4] http://www.siraenvironmental.com/UserDocs/mcerts/MCERTSCertifiedProductsCAMS.pdf

2. Methodology

The January 2010 version of the GDE requires that only 2.5% of datapairs may be identified as outliers and removed from the reference method in order to account for errors due to weighing filters. None may be removed from the candidate. Calculations are then made in line with the requirements of The GDE, and the following criteria must then be met:

1. Of the full dataset at least 20% of the results obtained using the reference method shall be greater than 70% of the current annual limit value, *i.e.*: 28 µg m^{-3} for PM_{10} and currently 17 µg m^{-3} for $PM_{2.5}$ as specified in The GDE.
2. The intra instrument uncertainty of the candidate must be less than 2.5 µg m^{-3} for all data and for two sub datasets corresponding to all the data split greater than or equal to and lower than 30 µg m^{-3} or 18 µg m^{-3} for PM_{10} and $PM_{2.5}$ respectively.
3. The intra instrument uncertainty of the reference method must be less than 2.0 µg m^{-3}.
4. The expanded uncertainty (W_{CM})[5] is calculated at 50 µg m^{-3} for PM_{10} and 30 µg m^{-3} for $PM_{2.5}$ for each individual candidate instrument against the average results of the reference method. For each of the following permutations, the expanded uncertainty must be less than 25%:
    - Full dataset;
    - Datasets representing PM concentrations greater than or equal to 30 µg m^{-3} for PM_{10}, or concentrations greater than or equal to 18 µg m^{-3} for $PM_{2.5}$, provided that the subset contains 40 or more valid data pairs;
    - Datasets for each individual site.
5. Preconditions for acceptance of the full dataset are that: the slope b is insignificantly different from 1: |b-1| 2.u(b), and the intercept a is insignificantly different from 0: |a| 2.u(a); where u(a) and u(b) are the uncertainties of the intercept and slope respectively. If these preconditions are not met, the candidate method may be calibrated using the values obtained for slope and/or intercept of all paired instruments together.

While the mathematics required to calculate the orthogonal regression and expanded uncertainties are unchanged since November 2005, the rules of application are different. Most notably:

- Previously the number of data-pair outliers to be removed from the reference method was not specified. We had taken the decision to remove up to 3 data-pairs from each field study out of the typically 50 to 70 that were collected. In line with the new GDE, up to 1 data-pair was removed if there were fewer than 60 available, and up to 2 were removed if more than 60 were available. As with the original UK Equivalence Report, only paired reference method data were used in the orthogonal regression and expanded uncertainty calculations.
- Previously we had removed data-pairs from candidate instruments that required the manual handling of filters, namely the Partisol and Opsis by mass. In line with the new GDE, no data pair outliers were removed from these instruments. The extra affect of this is that non paired mass data are now use in the orthogonal regression and expanded uncertainty calculations, whereas previously only paired data were used.
- Previously, the expanded uncertainty of the candidate method was required to be less than 3 µg m^{-3} rather than 2.5 µg m^{-3}.
- Previously the limit values at which the expanded uncertainties were to be calculated were not specified. We had previously calculated PM_{10} at 18, 40 and 50 µg m^{-3}; and $PM_{2.5}$ at 12, 20, 25 and 35 µg m^{-3}. Specification of 50 µg m^{-3} for PM_{10} and 30 µg m^{-3} for $PM_{2.5}$ serve to greatly clarify the situation.
- Previously the average of the paired candidate data were used in the orthogonal regression and expanded uncertainty calculations, whereas these are calculated for individual candidate instruments in the January 2010 version of the GDE. It is therefore expected that at the

[5] For each test described above, for a candidate instrument to be considered equivalent, W_{CM} the expanded uncertainty at limit value should be less than or equal to the Data Quality Objective (DQO), which is 25 % for PM_{10} and $PM_{2.5}$ field measurements.

expanded uncertainty will be higher for at least one of the two candidate instruments than it was for the average.

- Previously, the acceptance for the full dataset was set that 20% of the data must be greater than half the limit value, though as the limit value was not specified this led to a lot of permutations, namely: PM_{10} at 9, 20 and 25 µg m^{-3}; and $PM_{2.5}$ at 6, 10, 12.5 and 17.5 µg m^{-3}. By setting the concentration at which 20% of the data should be greater than as 28 µg m-³ for PM_{10} and 17 µg m-³ for $PM_{2.5}$., the situation is greatly simplified; however, as concentrations have typically been low in the UK over recent years, it makes it more likely that these criteria will not be met.

Table 3 below is an example of the results obtained for the reanalysis, namely of the PM_{10} FDMS B data from the original equivalence trials. The text within the cells is shaded green or red if it passes or fails key criteria respectively. In this example, cells are also shaded corresponding to which of the 6 criteria they relate to in the above list of the requirements of the January 2010 version of the GDE.

Table 3: Colour coded example of the results of reanalysis.

PM_{10} FDMS B	14.5% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
Original Data Only	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	9.1	379	0.945	0.992 +/- 0.012	0.792 +/- 0.251	1.11	1.12
< 30 µg m-3	8.1	328	0.839	0.983 +/- 0.022	0.985 +/- 0.343	1.10	1.12
> 30 µg m-3	15.1	51	0.867	1.181 +/- 0.061	-7.258 +/- 2.509	1.12	1.10

SN 24431	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
		Orthogonal Regression				Limit Value of 50 µg m^{-3}	
Individual Datasets	Teddington Winter	48	0.975	0.990 +/- 0.023	-2.310 +/- 0.621	12.56	35.4
	Teddington Summer	56	0.938	0.929 +/- 0.032	1.472 +/- 0.716	12.54	16.1
	Bristol Summer	52	0.975	1.110 +/- 0.025	-0.479 +/- 0.624	21.10	23.1
	Bristol Winter	49	0.965	1.017 +/- 0.028	1.280 +/- 0.669	11.68	20.4
Combined Datasets	> 30 µg m^{-3}	45	0.836	1.127 +/- 0.069	-5.380 +/- 2.829	14.87	100.0
	All Data	205	0.936	1.014 +/- 0.018	0.007 +/- 0.444	11.12	23.4

SN 24447	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
		Orthogonal Regression				Limit Value of 50 µg m^{-3}	
Individual Datasets	Teddington Winter	36	0.978	0.994 +/- 0.025	-2.243 +/- 0.697	11.29	38.9
	Teddington Summer	56	0.943	0.882 +/- 0.029	1.475 +/- 0.650	19.54	16.1
	Bristol Summer	52	0.979	1.108 +/- 0.023	-1.482 +/- 0.573	16.64	23.1
	Bristol Winter	51	0.968	1.005 +/- 0.026	0.593 +/- 0.640	8.50	23.5
Combined Datasets	> 30 µg m^{-3}	44	0.849	1.106 +/- 0.066	-5.154 +/- 2.686	13.44	100.0
	All Data	195	0.949	1.001 +/- 0.016	-0.280 +/- 0.406	9.34	24.1

SN 04443	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
		Orthogonal Regression				Limit Value of 50 µg m^{-3}	
Individual Datasets	Birmingham Winter	47	0.942	1.067 +/- 0.038	-2.054 +/- 0.775	8.22	8.5
	Birmingham Summer	50	0.972	1.054 +/- 0.025	-0.381 +/- 0.499	10.74	10.0
	East Kilbride Summer	42	0.837	1.022 +/- 0.065	0.781 +/- 0.656	9.35	0.0
	East Kilbride Winter	48	0.949	1.059 +/- 0.035	0.642 +/- 0.428	15.12	2.1
Combined Datasets	> 30 µg m^{-3}	9	0.965	1.273 +/- 0.090	-9.986 +/- 3.855	15.43	100.0
	All Data	187	0.949	1.013 +/- 0.017	0.304 +/- 0.275	7.39	5.3

SN 25053	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
		Orthogonal Regression				Limit Value of 50 µg m^{-3}	
Individual Datasets	Birmingham Winter	59	0.966	1.060 +/- 0.026	-3.053 +/- 0.592	5.64	18.6
	Birmingham Summer	52	0.965	1.099 +/- 0.029	0.932 +/- 0.568	24.48	9.6
	East Kilbride Summer	45	0.837	1.112 +/- 0.068	2.117 +/- 0.716	31.64	0.0
	East Kilbride Winter	48	0.933	1.053 +/- 0.040	2.758 +/- 0.487	22.41	2.1
Combined Datasets	> 30 µg m^{-3}	15	0.875	1.306 +/- 0.126	-11.211 +/- 5.258	21.09	100.0
	All Data	204	0.904	0.988 +/- 0.022	1.796 +/- 0.381	11.90	8.3

KEY

Light cyan	Criterion 1
Grey	Criterion 2
Peach	Criterion 3
Pale yellow	Criterion 4
Light blue	Criterion 5
Orange-yellow	Other

While there is no specific requirement for any of the individual datasets to have greater than 40 datapoints (other than those greater than 30 µg m⁻³ or 18 µg m^{-3} for PM_{10} and $PM_{2.5}$ respectively), it is implied in the text of the GDE, and as such these cells are shaded yellow as part of criterion 5. In line with the original UK Equivalence Report, the text within the cells is shaded orange if there are between 30 and 40 datapoints, as an ‘n’ of 30 is normally considered sufficient for statistical analysis.

The January 2010 version of the GDE is ambiguous with respect to which slope and intercept should be used to correct a candidate should it fail the test for equivalence. After communication with Theo Hafkenscheid (Chair of the EC Working Group on Equivalence), it was decided that the requirements of the November 2005 version of the GDE are still valid, and that the slope and intercept from the orthogonal regression of all the paired data should be used. These are shaded gold and marked ‘other’ in the key on the above diagram.

There is also no longer a requirement that the paired candidate data be tested for equivalence. However, the results from this analysis are included in the tables and are also shaded gold and marked ‘other’ in the key on the above diagram. These expanded uncertainties most closely represent those found using the November 2005 version of the GDE, yet differ in that only up to 2.5% of outliers were removed, and the calculations were performed at limit values of 50 µg m^{-3} or 30 µg m^{-3} for PM_{10} and $PM_{2.5}$ respectively.

Very slightly different expanded uncertainties can be calculated based upon whether the between instrument uncertainty of the reference method data includes those days when the candidate been assessed was not running. These days were included in the original UK Equivalence Report and are also included in the results presented herein.

The results are compared against the five criteria and are shaded in the following Section as follows:

Red: Criterion not met.

Orange: Criterion partially met.

Green: Criterion met.

3. Results and Discussion

3.1 PM_{10} and $PM_{2.5}$ 8500 FDMS

3.1.1 FDMS B Series

The 8500 FDMS was originally developed with B series Nafion Driers as manufactured by Permapure. These use bundles of hollow Nafion tubes to dry the ambient air stream.

The PM_{10} FDMS B was included in the original equivalence trials, though was at the time referred to as just PM_{10} FDMS, as the C dryer was not then available (See Section 3.1.2 below). The instrument was also tested during the Teddington 2007 field trial. Figures 1 and 2 in the Appendix show the comparisons of the PM_{10} FDMS B with and without the Teddington 2007 data respectively. In both cases, when following the five criteria in turn:

1. Fewer than 20% of the data are greater than 28 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. The majority of the expanded uncertainties are below 25%. However, the East Kilbride Summer dataset is greater than 25% for SN25053.

In accordance with the original Equivalence Report, as the concentrations in East Kilbride were very low a high expanded uncertainty at this site was not considered sufficient evidence for a candidate instrument to be excluded. Rather, it reflects the problems associated with regression calculations where there is significant scatter on data that are restricted to within a narrow range.

5. The majority of the intercepts and slopes of the all data datasets of the individual instruments are not statistically significant; however, the intercept of the 'All Data' comparison for SN25053 is significant.

In line with the original Equivalence Report, as some of the 'All Data' intercepts are greater than zero, and some are less, there should be no need to correct the data for this intercept offset.

As with the PM_{10} FDMS B, the $PM_{2.5}$ FDMS B was included in the original equivalence trials, though was at the time referred to as just $PM_{2.5}$ FDMS, as the C dryer was not then available. The instrument was also tested during the Teddington 2007 field trial. Figures 3 and 4 in the Appendix show the comparisons with and without the Teddington 2007 data respectively. In both cases, when following the five criteria in turn:

1. Greater than 20% of the data are greater than 17 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. The majority of the expanded uncertainties are below 25%. However, the East Kilbride Winter datasets are both greater than 25%.

In accordance with the original Equivalence Report, as the concentrations in East Kilbride were very low a high expanded uncertainty at this site was not considered sufficient evidence for a candidate instrument to be excluded. Rather, it reflects the problems associated with regression calculations where there is significant scatter on data that are restricted to within a narrow range.

5. The majority of the intercepts of the all data datasets are significantly below zero, and most of the slopes are significantly greater than 1.

In line with the original Equivalence Report, as all of the intercepts are less than zero, and all of the slopes are greater than 1, the instrument should be corrected for both slope and intercept.

Figure 5 in the Appendix shows the comparison including the Teddington 2007 data that has been corrected for both slope and intercept of the 'All Data' comparison using paired data only, *i.e.* corrected by adding 1.464 then dividing by 1.036. This does not seem to improve the comparisons to any significant affect, and so the recommendation remains to report the $PM_{2.5}$ FDMS B without correction.

3.1.2 FDMS C Series

In 2007, Thermo discontinued the B series and replaced these with the C series. These use parallel plate Nafion Driers as manufactured by Thermo (and not Permapure).

The PM_{10} FDMS C was tested in 2007 at Teddington. Subsequently, the instrument was included on the MCERTS tests in Teddington Summer 2008 and Cologne Winter 2008-9. Figure 6 in the Appendix summarises the comparison of the PM_{10} FDMS C against the reference method. As only one instrument was deployed in these two tests, they are not included in the paired data calculations in the top section of the Table in Figure 6, and the results should be treated with caution. Between the two MCERTS tests, paired PM_{10} FDMS Cs were deployed in the Teddington Autumn 2008 test. When following the five criteria in turn:

1. Fewer than 20% of the data are greater than 28 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. One expanded uncertainties is greater than 25%.
5. Some of the slopes and intercepts of the 'All Data' comparisons are significantly different from 1 and 0 respectively.

Correcting for slope and intercept drops the expanded uncertainty of SN24447 from 27.93 to 27.82. Correcting the data does not lead to an improvement and it is recommended to report the data without correction.

Figure 7 in the Appendix summarises the comparison of the $PM_{2.5}$ FDMS C against the reference method. As with the PM_{10} FDMS C, this was initially tested in Teddington 2007. Subsequently, the instrument was included on the MCERTS tests in Teddington summer 2008 and Cologne Winter 2008-9. As only one instrument was deployed in these 2 tests, they are not included in the paired data calculations in the top section of the Table in Figure 7, and the results should be treated with caution. Between the 2 MCERTS tests, paired $PM_{2.5}$ FDMS Cs were deployed in the Teddington Autumn 2008 test. When following the five criteria in turn:

1. Fewer than 20% of the data are greater than 17 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. Several of the expanded uncertainties are significantly greater than 25%.
5. Some of the slopes and intercepts of the 'All Data' comparisons are significantly different from 1 and 0 respectively.

Figure 8 in the Appendix shows the results obtained by correcting for slope and intercept (*i.e.* by subtracting 2.654 and then dividing by 0.852). Many of the expanded uncertainties are still greater than 25%. Importantly, the 'All Data' correction was only calculated for where there were paired candidate instruments at Teddington 2007 and Teddington Autumn 2008, yet correction for slope and intercept does not lead to a situation where the Teddington 2007 expanded uncertainties are lower than 25%.

It is thought that the quality of the C type dryers is very variable, and that this leads to inconsistencies with results. Thermo Fisher have subsequently identified and eliminated two problems with the C dryers[6]. One was that insufficient glue was being used which allowed the drying air stream to bypass the back edge of the Nafion membrane and therefore reduced the drying efficiency. This has been rectified by applying more glue. Additionally, the Nafion membrane used was found to leach N-butylbenzenesulphonamide into the system, which could add mass to the baseline reading of the instrument. The Nafion is now tested for N-butylbenzenesulphonamide as it leaves the manufacturing facility in Franklin, USA. These problems are not believed to affect all C series dryers, and Thermo

[6] 8500 FDMS/1405 FDMS AQUILA Presentation, Presented by Thermo Fisher to AQUILA (November 2009) ies.jrc.ec.europa.eu/uploads/fileadmin/H04/Air_Quality/AQUILA/N%20157%20DRAFT%20Minutes%2014th%20meeting.pdf

now offer a service where affected C dryers can be refurbished at their facility in Breda (in The Netherlands) to eliminate these problems. General opinion amongst the CMCU and QA/QC units for the AURN is that these procedures have improved the performance of the dryers although it should be noted that no referenceable evidence has been made available to confirm this.

3.1.3 FDMS BB and FDMS CB

As concern was expressed regarding the fundamental change to the dryer configuration and the lack of available data to suggest that FDMS C was equivalent to the B. Following the requirement within the AURN to commence deployment of PM analysers in response to the requirements of the Ambient Air Quality Directive (2008/50/EC) FDMS Bs were instead preferred. The contract for supply was awarded to Air Monitors UK Ltd who replaced the C Driers with a FDMS B to create a hybrid model version - FDMS CB. Similarly, as the dryers in the existing B instruments were aging, the B dryers were also installed in the FDMS Bs to form an instrument referred to as an FDMS BB.

These were all tested together in a short test in Teddington during Autumn 2008, where the PM_{10} and $PM_{2.5}$ permutations were tested by addition and removal of a Sharp Cut Cyclone. Figures 9-12 in the Appendix show the comparison for PM_{10} FDMS BB; $PM_{2.5}$ FDMS BB; PM_{10} FDMS CB; and $PM_{2.5}$ FDMS CB respectively. In all cases, the results look promising; however one of the PM_{10} FDMS CBs (SN 27244) was observed to over-read the reference method slightly when configured as PM_{10}, but not as $PM_{2.5}$. The BB and CB variants differ only slightly from the B variants: The BB has a slightly different fitting before the dryer than does the B, and the CB additionally has a different type of bypass filter holder to the B variant. While these minor difference are not expected to affect the data, the BB and CB are referred to by the separate names for record keeping purposes. Therefore, as the CB and BB configurations are both effectively FDMS Bs for which a full set of tests have been performed (Section 3.1), it is proposed that this is sufficient evidence for the PM_{10} FDMS BB; $PM_{2.5}$ FDMS BB; PM_{10} FDMS CB; and $PM_{2.5}$ FDMS CB to be declared as equivalent methods for use within the UK.

3.1.4 Summary of UK FDMS Configurations

In light of the evidence collected during the field studies, all FDMS C instruments in the core Defra owned network have been upgraded to the CB variant. Several C variant FDMSs in the local authority owned Affiliate sites have not as yet been upgraded, and these data have been reported to the Commission for 2009. Within the UK, a high level of QA/QC is undertaken to ensure that the instruments are operating correctly. Specifically, this involves comparing the volatile mass fraction from many FDMSs on a regional scale. In doing so, it is possible to identify those sites where the dryer is not operating to the required specifications and rebuild or replace the dryer as required It is therefore suggested that subject to a high level of QA/QC (primarily in the comparison of the volatile component on a regional basis), that all 8500 series FDMS variants are considered equivalent to the reference methods for compliance based monitoring within the UK.

3.2 PM_{10} and $PM_{2.5}$ Partisol 2025

The PM_{10} Partisol was included in the original equivalence trials, and no further comparison data have been collected since. In the original UK Equivalence Report 3 outliers per dataset were deleted though this is not allowed in the January 2010 version of the GDE, even though the filters are weighed in the same way as the reference method. A single data pair from Birmingham Winter was 18.2 µg m^{-3} and 161.5 µg m^{-3}. From comparison with other instruments, it is clear that there was a problem with the higher concentration filter. Even though there was nothing obviously wrong when the filter was examined it has still been removed from the comparison as it was skewing the results heavily. Figure 13 in the Appendix shows the comparison after the removal of this filter, and when following the five criteria in turn:

1. Fewer than 20% of the data are greater than 28 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. All of the expanded uncertainties are below 25%.
5. The majority of the intercepts and slopes of the 'All Data' comparisons of the individual instruments are not significant; however, the intercept of the 'All Data' comparison for SN21017 is significant as is the slope of the 'All Data' comparison for SN21215.

In line with the original Equivalence Report, as some of the 'All Data' slopes are greater than 1, and some are less, there should be no need to correct the data for this slope offset. All of the 'All Data' intercepts are slightly greater than zero, however there is no need to correct the data by subtracting the intercept of the all data comparison of paired data (0.603 µg m^{-3}) as all of the expanded uncertainties are significantly less than 25%.

The $PM_{2.5}$ Partisol 2025 has been tested in Teddington during 2007 and again in 2010 both times operating with quartz filters. The concentration range was very low during both of these field tests, making it difficult to draw conclusions as to the operation of the instrument.

Working Group 15 organised a series of nine tests in European cities from 2000 to 2003[7]. One site was at Teddington during 2003 when there was a significant period of high $PM_{2.5}$ concentrations: on one day exceeding 100 µg m^{-3}. The reference methods were operated on alternate weeks with quartz and glass fibre filters. The Partisol was operated using the same filter media at the same time as the reference method. It is not known whether this procedure was followed at the other eight European sites and, as such, these non-UK data are not considered in this report. Two reference method candidates were tested during the 2000 to 2003 UK field tests. At Teddington, the Leckel was not operational for a period of nine days. In order to increase the number of datapairs, the automated version of the reference method (the SEQ) was used for the data comparisons.

Figure 14 in the Appendix shows the comparison of the $PM_{2.5}$ Partisol against the reference method. To date, only three datasets have been collected for the comparison. As the Partisol is based on filter weighing it is not covered by the proposed Automatic Measurements Standard, it may not be required to do a full series of four field tests for this instrument. The UK is currently seeking clarification on this matter from EC Working Group 15. A further dataset will be collected in Cologne beginning in January 2011.

[7] CEN/TC 264/WG 15 $PM_{2,5}$ Field test experiments to validate the CEN standard measurement method for $PM_{2,5}$ Final Report July 2006

3.3 PM_{10} and $PM_{2.5}$ TEOM

The PM_{10} TEOM was included in the original equivalence trials and no further comparison data have been collected since. The instruments were shown to significantly underestimate the reference method at high PM_{10} concentrations. Many methods were tried to correct the TEOM using simple mathematical equations – none were successful, however the closest approximation was achieved by removing the inbuilt A and B correction factors (to create a permutation referred to as TEOM(0,1,1)) then correcting for the slope and intercept. Figure 15 in the Appendix shows the comparison for TEOM(0,1,1) corrected by the slope and intercept of the 'All Data' comparison of paired data found using the January 2010 version of the GDE – *i.e.* corrected by subtracting 2.980 then dividing by 0.535. When following the five criteria in turn:

1. Fewer than 20% of the data are greater than 28 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. Most of the expanded uncertainties are greater than 25%.
5. Some of the slopes and intercepts of the 'All Data' comparisons are significantly different from 1 and 0 respectively.

As most of the expanded uncertainties are greater than 25% even after correction, the policy of not being able to use simple mathematical correction of TEOM data is still valid. The UK now uses a Volatile Correction Model (VCM) to correct TEOM data using the reference fraction of FDMSs close by[8]. As of time of writing (9th November 2010), there are only 5 such VCM corrected TEOMs in the AURN. All are expected to be converted or replaced to operate under the FDMS system during 2011, thereby negating the need to correct TEOM data via the use of VCM in the relevant reporting of measurements to the European Commission for the calendar year 2012.

The $PM_{2.5}$ TEOM has been tested in a single trial at Teddington during 2007. As most of the volatile PM fraction has an aerodynamic fraction below 2.5 microns, it is expected that the $PM_{2.5}$ TEOM will not behave in a linear fashion at high PM concentrations as does the PM_{10} TEOM (Section 3.6). Figure 16 in the Appendix shows the comparison against the reference method. There was a single data point with high $PM_{2.5}$ concentrations where the TEOM is underestimating the reference method significantly. This implies that there was a high volatile component on that day, and that the $PM_{2.5}$ cannot be corrected using a simple mathematical function; however, the results are non-conclusive given the small number of data-points collected.

[8] http://www.volatile-correction-model.info/

3.4 PM_{10} Unheated Met-One BAM

The PM_{10} unheated Met-One BAM was included in the original equivalence trials, and no further comparison data have been collected since. The standard UK configuration of the instrument does not measure ambient temperature and pressure and therefore does not correct the data to ambient conditions. A variant of the unheated BAM is available with a Mass Flow Controller that does correct to ambient conditions. To simulate this, the data were subsequently corrected to ambient based on temperature and pressure measured by other collocated instruments. The BAM was compared to the reference method both with and without correction to ambient conditions.

Figure 17 in the Appendix shows the comparison of the unheated BAM without correction to ambient conditions. As with the previous analysis in the original equivalence report, all datasets significantly overestimate the reference method. The previous report recommended the data be divided by 1.211. The slope of all the paired data in the current study is actually 1.210, and is slightly different as fewer PM_{10} outliers were deleted from the reference method in line with the January 2010 version of the GDE. It is policy within the UK to divide the unheated PM_{10} BAM by 1.2, and this comparison is shown in Figure 18. When following the five criteria in turn:

1. Fewer than 20% of the data are greater than 28 µg m^{-3}; however, greater than 20% of the minimum number of datapoints were greater than 28 µg m^{-3}.
2. The intra instrument uncertainty of the candidate is less than 2.5 µg m^{-3}.
3. The intra instrument uncertainty of the reference method is less than 2.0 µg m^{-3}.
4. The majority of the expanded uncertainties are below 25%. However, some of the East Kilbride datasets are greater than 25%.

In accordance with the original Equivalence Report, as the concentrations in East Kilbride were very low, a high expanded uncertainty at this site was not considered sufficient evidence for a candidate instrument to be excluded. Rather, it reflects the problems associated with regression calculations where there is significant scatter on data that are restricted to within a narrow range.

5. Some of the intercepts and slopes of the ‘All Data’ comparisons of the individual instruments are significant.

As the data have already been corrected, it is not possible to correct the data further, and the PM_{10} unheated BAM should continue to be corrected by dividing by 1.2.

The ambient corrected BAM data also significantly overestimate the reference method. In the original Equivalence Report, these data were corrected by dividing by 1.273, and the results of this comparison are shown in Figure 19. Considering the 5 criteria, the results are exactly as for the non ambient corrected BAM after dividing by 1.2. As such, it is recommended that the ambient corrected BAM data are still divided by 1.273.

4. Conclusions and Recommendations to EC Working Group 15

All of the results of the original tests are still valid and this justifies the UK's use of FDMSs and Partisols within the AURN. Those instruments tested since the original trials either require more testing (e.g. Partisol $PM_{2.5}$) or are proven to be suitable for use in the UK without the need to correct the results further (e.g. FAI SWAM Dual Channel and the Met-One $PM_{2.5}$ Smart Heated BAM both not covered in this report).

In general, the January 2010 version of the GDE is much improved over the November 2005 version as it is more specific with regards to removal of outliers and which limit values to use.

In most cases the comparisons realised by the new GDE yield the same conclusions as the previous version; however, as individual candidates are assessed rather than the average of collocated pairs, there is an increased chance that instruments will require correction.

It was previously reported in the 2006 UK equivalence report, that the GDE, emphasis on the statistical significance of the slope and intercept is relied on too heavily, and even for the PM_{10} Partisol whose performance is excellent and should not require correction, some of the slopes and intercepts are statistically significant from 1 and zero respectively. This has not been changed in the implementation of the Januray 2010 version of the GDE. It is recommended therefore that applied slope and offset corrections, as well as compliance with the DQO need to be considered pragmatically on a case by case basis, rather than relying too heavily on the rules set down by the GDE.

Previously, the acceptance for the full dataset was set that 20% of the data must be greater than half the limit value, though as the limit value was not specified this led to a lot of permutations, namely: PM_{10} at 9, 20 and 25 µg m^{-3}; and $PM_{2.5}$ at 6, 10, 12.5 and 17.5 µg m^{-3}. By increasing the concentration for which at least 20% of the data collected should be greater than to 28 µg m^{-3} for PM_{10} and 17 µg m^{-3} for $PM_{2.5}$, there is an increased chance that there will not be sufficiently high enough concentrations, as is seen for PM_{10} in most of the cases herein. This requirement should be relaxed.

GLOSSARY

2008/50/EC	The Ambient Air Quality Directive
a	Intercept
AURN	Automatic Urban and Rural Network
b	Slope
BAM	Beta Attenuation Monitor
CAMS	Continuous Ambient air Monitoring Systems
CEN	Comité Européen de Normalisation
CM	Checkweight Mass
CMCU	Central Management and Co-ordination Unit of the AURN
Defra	Department for the Environment, Food and Rural Affairs
EC	European Commission
EN12341	CEN PM_{10} Standard
EN14907	CEN $PM_{2.5}$ Standard
ET	Enviro Technology
EU	European Union
FDMS	Filter Dynamics Measurement System
GDE	Guide to Demonstration of Equivalence
KFG	Klein Filtergerat
LV	Limit Value
MCERTS	Monitoring CERTification Scheme
n_{c_s}	Number of candidate against reference datapairs
Partisol 2025	Candidate method
PM	Particulate Matter
PM_{10}	Concentration of particles less than 10 microns in diameter
PM_{10} FDMS	FDMS with PM_{10} inlet candidate method
PM_{10} KFG	PM_{10} reference method
$PM_{2.5}$	Concentration of particles less than 2.5 microns in diameter

$PM_{2.5}$ FDMS	FDMS with $PM_{2.5}$ inlet candidate method
$PM_{2.5}$ Leckel	$PM_{2.5}$ reference method
QA/QC	Quality Assurance/ Quality Control unit of the AURN
SEQ	Sequential version of reference method sold by Sven Leckel
Smart BAM	BAM with heated inlet
TEOM	Tapered Element Oscillating Microbalance
u_a	Uncertainty of Intercept
u_b	Uncertainty of Slope
UK	United Kingdom
W_{CM}	Expanded Uncertainty
WG	Working Group

Appendix of Graphs and Tables of comparisons against the Reference Method.

Figure 1. Analysis of the PM_{10} FDMS B for the original Equivalence Trials data only.

PM_{10} FDMS B	14.5% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
Original Data Only	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	9.1	379	0.945	0.992 +/- 0.012	0.792 +/- 0.251	1.11	1.12
< 30 µg m-3	8.1	328	0.839	0.983 +/- 0.022	0.985 +/- 0.343	1.10	1.12
> 30 µg m-3	15.1	51	0.867	1.181 +/- 0.061	-7.258 +/- 2.509	1.12	1.10

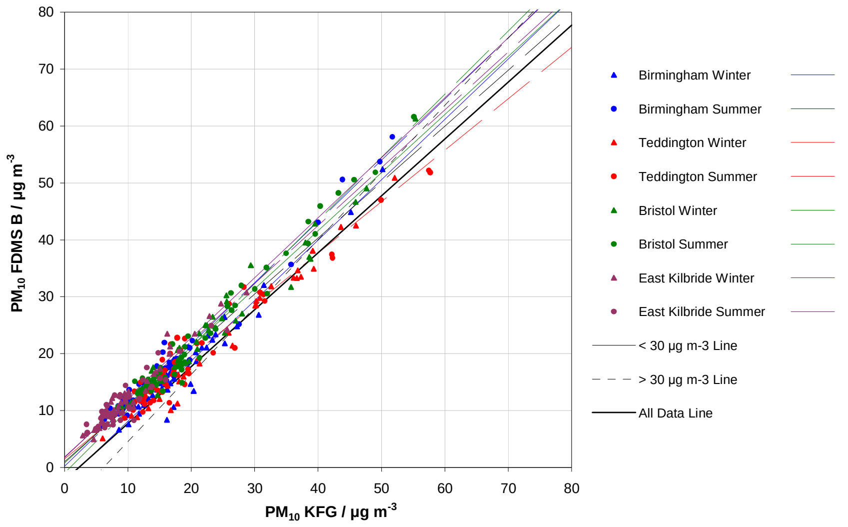
SN 24431	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	48	0.975	0.990 +/- 0.023	-2.310 +/- 0.621	12.56	35.4
	Teddington Summer	56	0.938	0.929 +/- 0.032	1.472 +/- 0.716	12.54	16.1
	Bristol Summer	52	0.975	1.110 +/- 0.025	-0.479 +/- 0.624	21.10	23.1
	Bristol Winter	49	0.965	1.017 +/- 0.028	1.280 +/- 0.669	11.68	20.4
Combined Datasets	> 30 µg m^{-3}	45	0.836	1.127 +/- 0.069	-5.380 +/- 2.829	14.87	100.0
	All Data	205	0.936	1.014 +/- 0.018	0.007 +/- 0.444	11.12	23.4

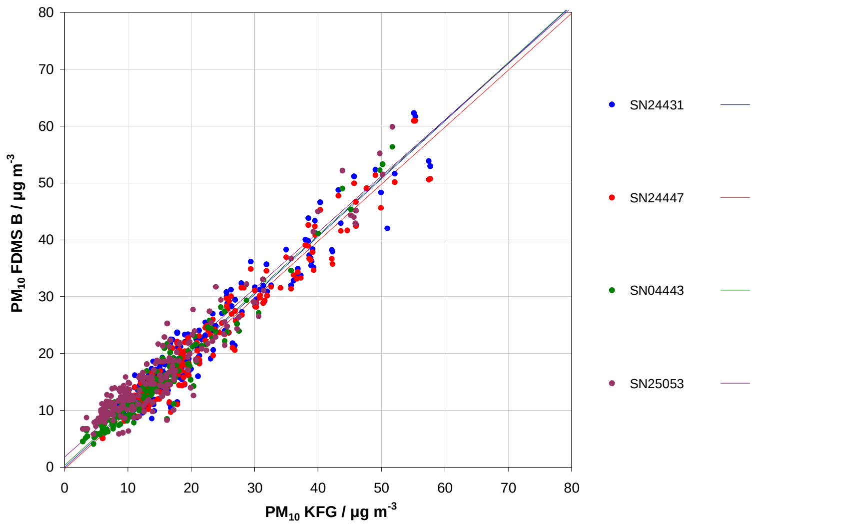
SN 24447	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	36	0.978	0.994 +/- 0.025	-2.243 +/- 0.697	11.29	38.9
	Teddington Summer	56	0.943	0.882 +/- 0.029	1.475 +/- 0.650	19.54	16.1
	Bristol Summer	52	0.979	1.108 +/- 0.023	-1.482 +/- 0.573	16.64	23.1
	Bristol Winter	51	0.968	1.005 +/- 0.026	0.593 +/- 0.640	8.50	23.5
Combined Datasets	> 30 µg m^{-3}	44	0.849	1.106 +/- 0.066	-5.154 +/- 2.686	13.44	100.0
	All Data	195	0.949	1.001 +/- 0.016	-0.280 +/- 0.406	9.34	24.1

SN 04443	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	47	0.942	1.067 +/- 0.038	-2.054 +/- 0.775	8.22	8.5
	Birmingham Summer	50	0.972	1.054 +/- 0.025	-0.381 +/- 0.499	10.74	10.0
	East Kilbride Summer	42	0.837	1.022 +/- 0.065	0.781 +/- 0.656	9.35	0.0
	East Kilbride Winter	48	0.949	1.059 +/- 0.035	0.642 +/- 0.428	15.12	2.1
Combined Datasets	> 30 µg m^{-3}	9	0.965	1.273 +/- 0.090	-9.986 +/- 3.855	15.43	100.0
	All Data	187	0.949	1.013 +/- 0.017	0.304 +/- 0.275	7.39	5.3

SN 25053	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.966	1.060 +/- 0.026	-3.053 +/- 0.592	5.64	18.6
	Birmingham Summer	52	0.965	1.099 +/- 0.029	0.932 +/- 0.568	24.48	9.6
	East Kilbride Summer	45	0.837	1.112 +/- 0.068	2.117 +/- 0.716	31.64	0.0
	East Kilbride Winter	48	0.933	1.053 +/- 0.040	2.758 +/- 0.487	22.41	2.1
Combined Datasets	> 30 µg m^{-3}	15	0.875	1.306 +/- 0.126	-11.211 +/- 5.258	21.09	100.0
	All Data	204	0.904	0.988 +/- 0.022	1.796 +/- 0.381	11.90	8.3

Figure 1 Continued. Analysis of the PM_{10} FDMS B for the original Equivalence Trials data only.





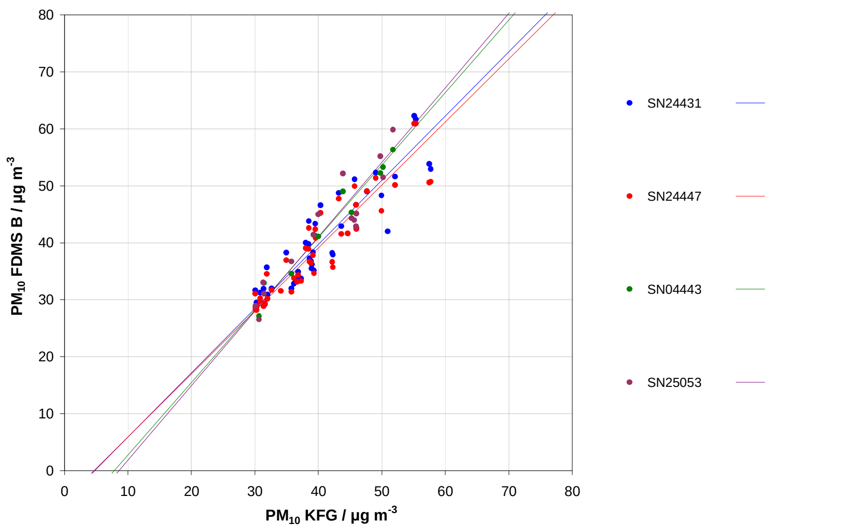


Figure 2. Analysis of the PM_{10} FDMS B for the original Equivalence Trials data and the Teddington 2007 dataset.

PM_{10} FDMS B Including Teddington 2007	12.9% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	8.7	434	0.947	0.994 +/- 0.011	0.753 +/- 0.221	1.11	1.15
< 30 µg m-3	8.0	383	0.855	0.994 +/- 0.019	0.816 +/- 0.295	1.11	1.15
> 30 µg m-3	15.1	51	0.867	1.181 +/- 0.061	-7.258 +/- 2.509	1.12	1.10

SN 24431	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	48	0.975	0.990 +/- 0.023	-2.310 +/- 0.621	12.56	35.4
	Teddington Summer	56	0.938	0.929 +/- 0.032	1.472 +/- 0.716	12.54	16.1
	Bristol Summer	52	0.975	1.110 +/- 0.025	-0.479 +/- 0.624	21.10	23.1
	Bristol Winter	49	0.965	1.017 +/- 0.028	1.280 +/- 0.669	11.68	20.4
	Teddington 2007	56	0.889	1.095 +/- 0.049	-1.124 +/- 0.579	15.36	1.8
Combined Datasets	> 30 µg m^{-3}	45	0.836	1.135 +/- 0.067	-5.674 +/- 2.764	14.88	100.0
	All Data	261	0.945	1.022 +/- 0.015	-0.194 +/- 0.335	10.45	18.8

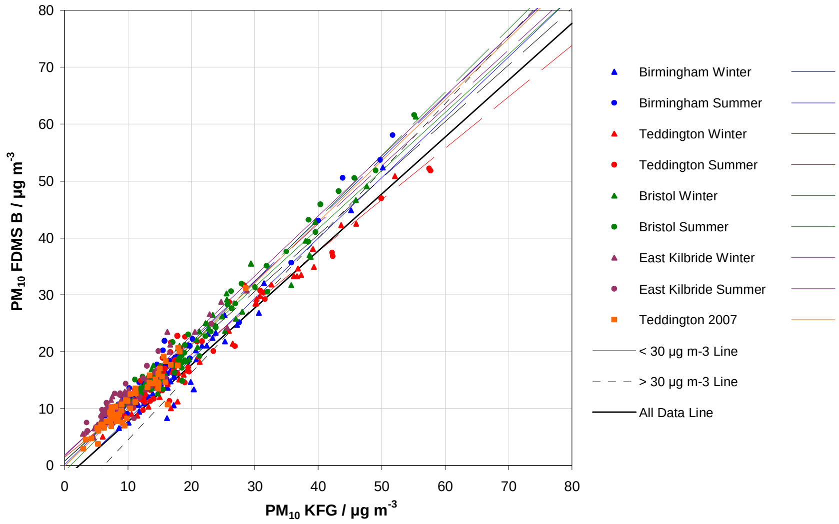
SN 24447	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	36	0.978	0.994 +/- 0.025	-2.243 +/- 0.697	11.29	38.9
	Teddington Summer	56	0.943	0.882 +/- 0.029	1.475 +/- 0.650	19.54	16.1
	Bristol Summer	52	0.979	1.108 +/- 0.023	-1.482 +/- 0.573	16.64	23.1
	Bristol Winter	51	0.968	1.005 +/- 0.026	0.593 +/- 0.640	8.50	23.5
Combined Datasets	> 30 µg m^{-3}	44	0.849	1.106 +/- 0.066	-5.154 +/- 2.686	13.44	100.0
	All Data	195	0.949	1.001 +/- 0.016	-0.280 +/- 0.406	9.34	24.1

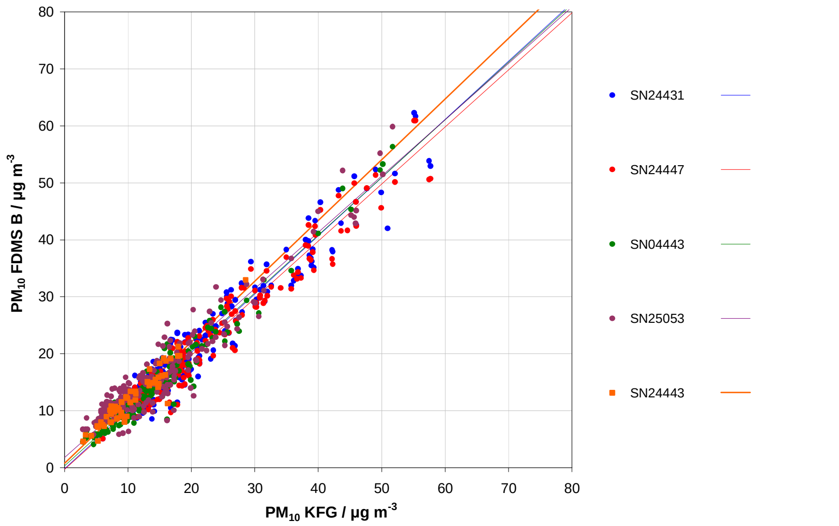
SN 04443	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	47	0.942	1.067 +/- 0.038	-2.054 +/- 0.775	8.22	8.5
	Birmingham Summer	50	0.972	1.054 +/- 0.025	-0.381 +/- 0.499	10.74	10.0
	East Kilbride Summer	42	0.837	1.022 +/- 0.065	0.781 +/- 0.656	9.35	0.0
	East Kilbride Winter	48	0.949	1.059 +/- 0.035	0.642 +/- 0.428	15.12	2.1
Combined Datasets	> 30 µg m^{-3}	9	0.965	1.273 +/- 0.090	-9.986 +/- 3.855	15.43	100.0
	All Data	187	0.949	1.013 +/- 0.017	0.304 +/- 0.275	7.39	5.3

SN 25053	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.966	1.060 +/- 0.026	-3.053 +/- 0.592	5.64	18.6
	Birmingham Summer	52	0.965	1.099 +/- 0.029	0.932 +/- 0.568	24.48	9.6
	East Kilbride Summer	45	0.837	1.112 +/- 0.068	2.117 +/- 0.716	31.64	0.0
	East Kilbride Winter	48	0.933	1.053 +/- 0.040	2.758 +/- 0.487	22.41	2.1
Combined Datasets	> 30 µg m^{-3}	15	0.875	1.306 +/- 0.126	-11.211 +/- 5.258	21.09	100.0
	All Data	204	0.904	0.988 +/- 0.022	1.796 +/- 0.381	11.90	8.3

SN 24443	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Datasets	> 30 µg m-3	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	Teddington 2007 (All Data)	55	0.908	1.066 +/- 0.044	0.771 +/- 0.521	16.76	1.8

Figure 2 Continued. Analysis of the PM_{10} FDMS B for the original Equivalence Trials data and the Teddington 2007 dataset.





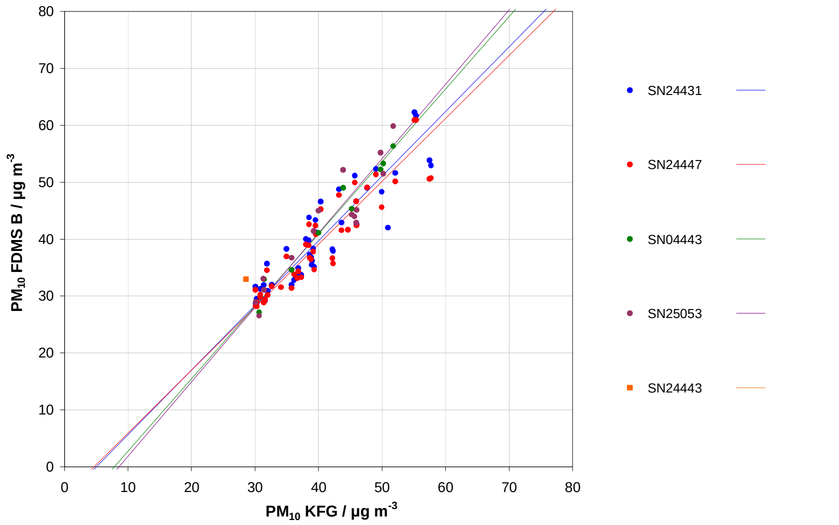


Figure 3. Analysis of the $PM_{2.5}$ FDMS B for the original Equivalence Trials data only.

$PM_{2.5}$ FDMS B	27.3% > 17 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
Original Data Only	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	15.6	373	0.955	1.067 +/- 0.012	-2.359 +/- 0.203	0.65	0.96
< 18 µg m-3	14.7	278	0.787	1.116 +/- 0.031	-2.643 +/- 0.292	0.57	0.92
> 18 µg m-3	21.2	95	0.913	1.136 +/- 0.034	-4.750 +/- 1.045	0.85	0.84

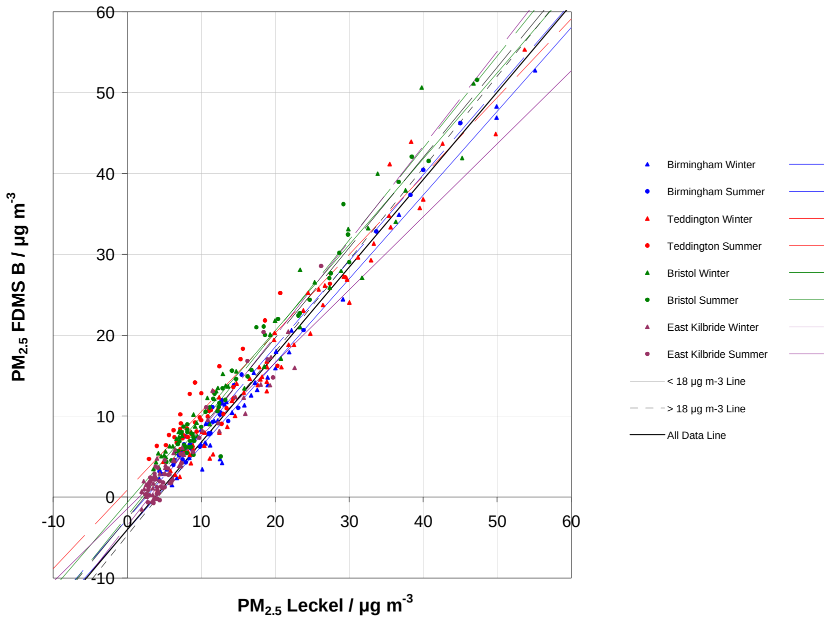
SN 25081	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Winter	64	0.968	1.094 +/- 0.025	-4.418 +/- 0.566	17.69	53.1
	Teddington Summer	47	0.847	1.044 +/- 0.061	-0.974 +/- 0.770	15.91	12.8
	Bristol Summer	53	0.968	1.132 +/- 0.028	-1.805 +/- 0.528	18.47	32.1
	Bristol Winter	53	0.963	1.073 +/- 0.029	-0.222 +/- 0.578	20.62	35.8
Combined Datasets	> 18 µg m^3	72	0.885	1.183 +/- 0.048	-5.300 +/- 1.438	22.52	100.0
	All Data	217	0.944	1.076 +/- 0.017	-1.772 +/- 0.336	17.85	35.0

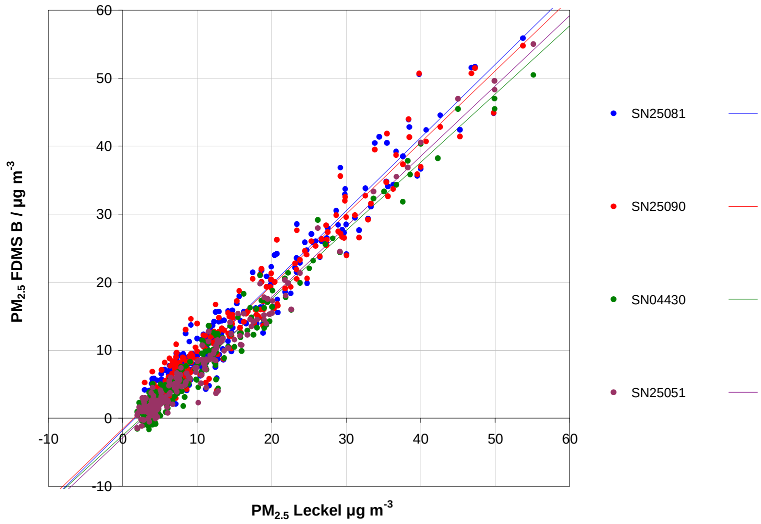
SN 25090	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Winter	64	0.970	1.071 +/- 0.024	-3.707 +/- 0.539	17.02	53.1
	Teddington Summer	40	0.840	0.938 +/- 0.061	1.770 +/- 0.763	14.52	12.5
	Bristol Summer	53	0.977	1.146 +/- 0.024	-2.896 +/- 0.453	13.40	32.1
	Bristol Winter	52	0.962	1.068 +/- 0.029	-1.278 +/- 0.582	16.81	34.6
Combined Datasets	> 18 µg m^3	70	0.892	1.144 +/- 0.045	-4.614 +/- 1.367	21.22	100.0
	All Data	209	0.948	1.053 +/- 0.017	-1.546 +/- 0.323	16.50	35.4

SN 04430	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Birmingham Winter	64	0.981	0.991 +/- 0.017	-2.965 +/- 0.357	23.84	37.5
	Birmingham Summer	44	0.983	1.038 +/- 0.021	-2.190 +/- 0.339	11.16	13.6
	East Kilbride Summer	49	0.900	1.225 +/- 0.056	-4.046 +/- 0.461	22.54	8.2
	East Kilbride Winter	44	0.899	0.899 +/- 0.044	-1.356 +/- 0.422	31.40	11.4
Combined Datasets	> 18 µg m^3	35	0.957	1.028 +/- 0.037	-3.485 +/- 1.129	23.29	100.0
	All Data	201	0.966	1.004 +/- 0.013	-2.500 +/- 0.198	19.96	19.4

SN 25051	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Birmingham Winter	38	0.980	1.084 +/- 0.026	-5.085 +/- 0.536	20.96	36.8
	Birmingham Summer	33	0.991	1.080 +/- 0.018	-2.969 +/- 0.312	7.67	15.2
	East Kilbride Summer	52	0.939	1.137 +/- 0.040	-3.102 +/- 0.318	11.57	7.7
	East Kilbride Winter	46	0.941	0.912 +/- 0.034	-1.592 +/- 0.313	29.55	10.9
Combined Datasets	> 18 µg m^3	25	0.977	1.117 +/- 0.035	-5.442 +/- 1.074	18.40	100.0
	All Data	169	0.970	1.035 +/- 0.014	-2.846 +/- 0.196	16.34	16.6

Figure 3 Continued. Analysis of the $PM_{2.5}$ FDMS B for the original Equivalence Trials data only.





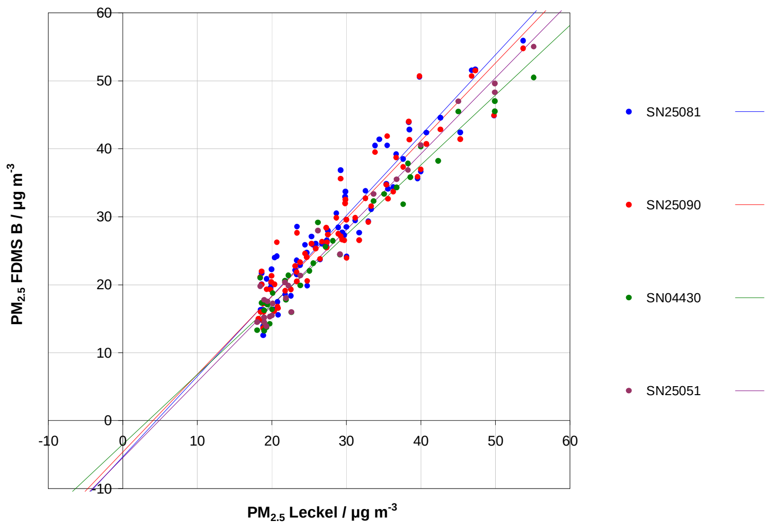


Figure 4. Analysis of the $PM_{2.5}$ FDMS B for the original Equivalence Trials data and the Teddington 2007 dataset.

$PM_{2.5}$ FDMS B including Teddington 2007	23.6% > 17 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	16.4	436	0.946	1.036 +/- 0.011	-1.464 +/- 0.187	0.62	0.98
< 18 µg m-3	15.0	340	0.736	1.026 +/- 0.029	-1.272 +/- 0.255	0.54	0.99
> 18 µg m-3	21.1	96	0.914	1.135 +/- 0.034	-4.726 +/- 1.036	0.86	0.84

SN 25081	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Winter	64	0.968	1.094 +/- 0.025	-4.418 +/- 0.566	17.69	53.1
	Teddington Summer	47	0.847	1.044 +/- 0.061	-0.974 +/- 0.770	15.91	12.8
	Bristol Summer	53	0.968	1.132 +/- 0.028	-1.805 +/- 0.528	18.47	32.1
	Bristol Winter	53	0.963	1.073 +/- 0.029	-0.222 +/- 0.578	20.62	35.8
Combined Datasets	> 18 µg m^3	72	0.885	1.183 +/- 0.048	-5.300 +/- 1.438	22.52	100.0
	All Data	217	0.944	1.076 +/- 0.017	-1.772 +/- 0.336	17.85	35.0

SN 25090	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Winter	64	0.970	1.071 +/- 0.024	-3.707 +/- 0.539	17.02	53.1
	Teddington Summer	40	0.840	0.938 +/- 0.061	1.770 +/- 0.763	14.52	12.5
	Bristol Summer	53	0.977	1.146 +/- 0.024	-2.896 +/- 0.453	13.40	32.1
	Bristol Winter	52	0.962	1.068 +/- 0.029	-1.278 +/- 0.582	16.81	34.6
	Teddington 2007	64	0.950	1.015 +/- 0.029	0.640 +/- 0.182	8.92	1.6
Combined Datasets	> 18 µg m^3	71	0.893	1.144 +/- 0.045	-4.587 +/- 1.349	21.03	100.0
	All Data	273	0.952	1.018 +/- 0.014	-0.613 +/- 0.233	15.23	27.5

SN 04430	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Birmingham Winter	64	0.981	0.991 +/- 0.017	-2.965 +/- 0.357	23.84	37.5
	Birmingham Summer	44	0.983	1.038 +/- 0.021	-2.190 +/- 0.339	11.16	13.6
	East Kilbride Summer	49	0.900	1.225 +/- 0.056	-4.046 +/- 0.461	22.54	8.2
	East Kilbride Winter	44	0.899	0.899 +/- 0.044	-1.356 +/- 0.422	31.40	11.4
Combined Datasets	> 18 µg m^3	35	0.957	1.028 +/- 0.037	-3.485 +/- 1.129	23.29	100.0
	All Data	201	0.966	1.004 +/- 0.013	-2.500 +/- 0.198	19.96	19.4

SN 25051	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Birmingham Winter	38	0.980	1.084 +/- 0.026	-5.085 +/- 0.536	20.96	36.8
	Birmingham Summer	33	0.991	1.080 +/- 0.018	-2.969 +/- 0.312	7.67	15.2
	East Kilbride Summer	52	0.939	1.137 +/- 0.040	-3.102 +/- 0.318	11.57	7.7
	East Kilbride Winter	46	0.941	0.912 +/- 0.034	-1.592 +/- 0.313	29.55	10.9
	Teddington 2007	63	0.930	1.014 +/- 0.034	2.168 +/- 0.213	18.47	1.6
Combined Datasets	> 18 µg m^3	26	0.976	1.115 +/- 0.035	-5.301 +/- 1.057	17.98	100.0
	All Data	232	0.911	0.990 +/- 0.019	-1.110 +/- 0.244	19.54	12.5

Figure 4 Continued. Analysis of the $PM_{2.5}$ FDMS B for the original Equivalence Trials data and the Teddington 2007 dataset.

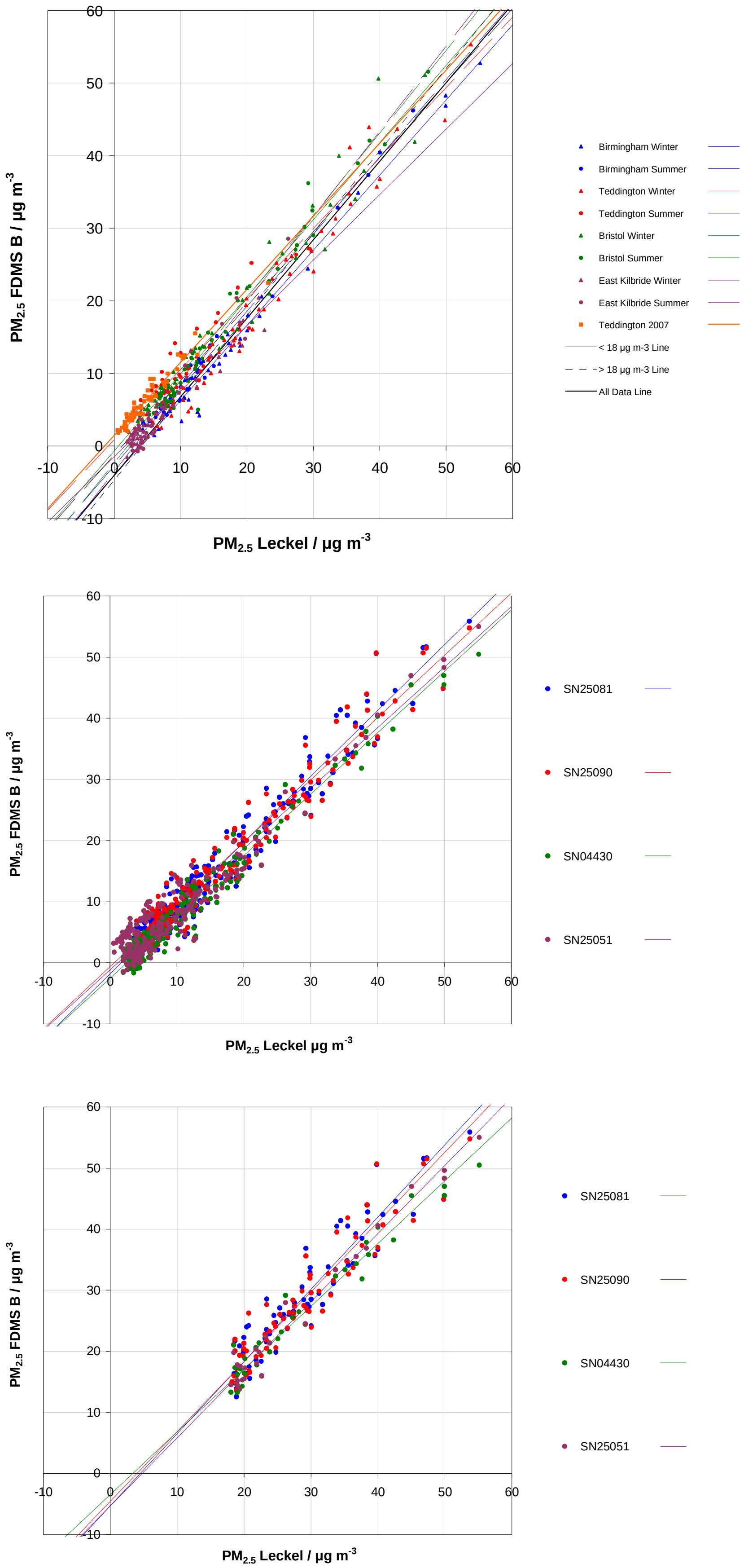


Figure 5. Analysis of the $PM_{2.5}$ FDMS B for the original Equivalence Trials data and the Teddington 2007 dataset corrected by adding 1.464 then dividing by 1.036.

$PM_{2.5}$ FDMS B including Teddington 2007 corrected by adding 1.464 then dividing by 1.036.	23.6% > 17 µg m-3	Orthogonal Regression							Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/- u_a	Reference	Candidate
All Data	14.0	436	0.956	0.985	+/-	0.010	0.405	+/- 0.160	0.62	0.93
< 18 µg m-3	12.2	340	0.807	0.993	+/-	0.024	0.440	+/- 0.212	0.54	0.94
> 18 µg m-3	19.5	96	0.914	1.061	+/-	0.032	-2.150	+/- 0.970	0.86	0.79

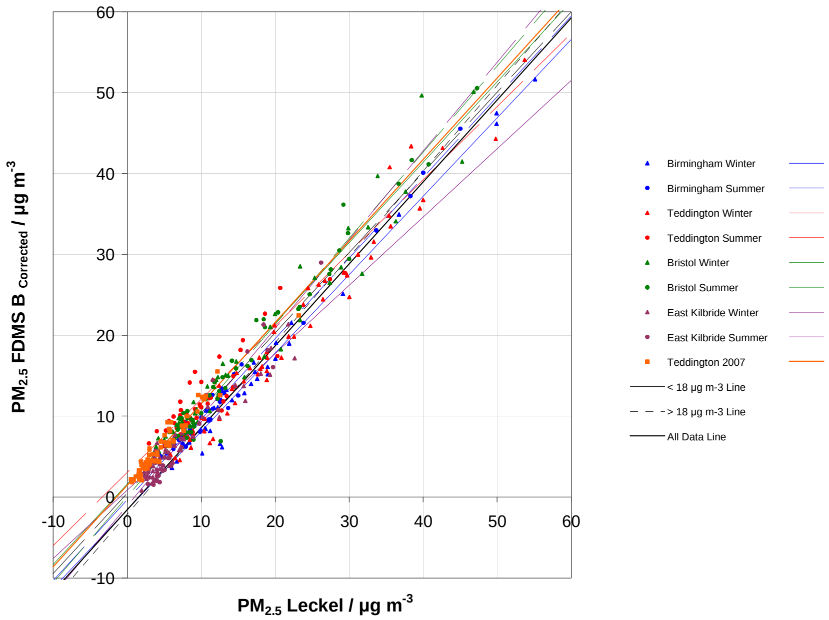
SN 25081	Dataset	Orthogonal Regression							Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Winter	64	0.968	1.025	+/-	0.023	-1.909	+/- 0.530	15.54	53.1
	Teddington Summer	47	0.847	0.973	+/-	0.057	1.360	+/- 0.722	15.34	12.8
	Bristol Summer	53	0.968	1.060	+/-	0.026	0.536	+/- 0.495	18.96	32.1
	Bristol Winter	53	0.963	1.004	+/-	0.027	2.022	+/- 0.542	20.78	35.8
Combined Datasets	> 18 µg m^3	72	0.885	1.104	+/-	0.045	-2.627	+/- 1.347	21.32	100.0
	All Data	217	0.944	1.006	+/-	0.016	0.581	+/- 0.315	17.29	35.0

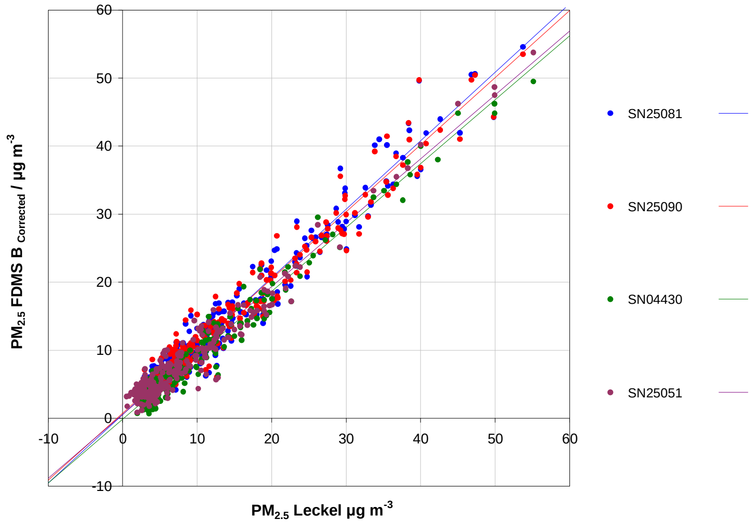
SN 25090	Dataset	Orthogonal Regression							Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Winter	64	0.970	1.003	+/-	0.022	-1.244	+/- 0.505	14.87	53.1
	Teddington Summer	40	0.840	0.874	+/-	0.057	3.926	+/- 0.715	13.81	12.5
	Bristol Summer	53	0.977	1.073	+/-	0.023	-0.491	+/- 0.425	14.17	32.1
	Bristol Winter	52	0.962	0.999	+/-	0.028	1.033	+/- 0.545	16.61	34.6
	Teddington 2007	64	0.950	1.015	+/-	0.029	0.640	+/- 0.182	9.32	1.6
Combined Datasets	> 18 µg m^3	71	0.893	1.069	+/-	0.042	-2.010	+/- 1.264	19.64	100.0
	All Data	273	0.958	0.986	+/-	0.012	0.778	+/- 0.212	14.08	27.5

SN 04430	Dataset	Orthogonal Regression							Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Birmingham Winter	64	0.981	0.929	+/-	0.016	-0.558	+/- 0.334	20.60	37.5
	Birmingham Summer	44	0.983	0.972	+/-	0.020	0.166	+/- 0.318	9.63	13.6
	East Kilbride Summer	49	0.900	1.144	+/-	0.053	-1.556	+/- 0.432	22.52	8.2
	East Kilbride Winter	44	0.899	0.839	+/-	0.042	0.961	+/- 0.395	27.94	11.4
Combined Datasets	> 18 µg m^3	35	0.957	0.962	+/-	0.035	-1.016	+/- 1.058	20.39	100.0
	All Data	201	0.966	0.939	+/-	0.012	-0.120	+/- 0.186	17.32	19.4

SN 25051	Dataset	Orthogonal Regression							Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Birmingham Winter	38	0.980	1.015	+/-	0.024	-2.544	+/- 0.503	18.12	36.8
	Birmingham Summer	33	0.991	1.012	+/-	0.017	-0.568	+/- 0.292	6.91	15.2
	East Kilbride Summer	52	0.939	1.063	+/-	0.037	-0.682	+/- 0.298	12.27	7.7
	East Kilbride Winter	46	0.941	0.853	+/-	0.031	0.731	+/- 0.293	26.01	10.9
	Teddington 2007	63	0.930	1.014	+/-	0.034	2.168	+/- 0.213	18.66	1.6
Combined Datasets	> 18 µg m^3	26	0.977	1.045	+/-	0.032	-2.790	+/- 0.978	15.63	100.0
	All Data	232	0.947	0.939	+/-	0.014	0.595	+/- 0.178	15.09	12.5

Figure 5 Continued. Analysis of the $PM_{2.5}$ FDMS B for the original Equivalence Trials data and the Teddington 2007 dataset corrected by adding 1.464 then dividing by 1.036.





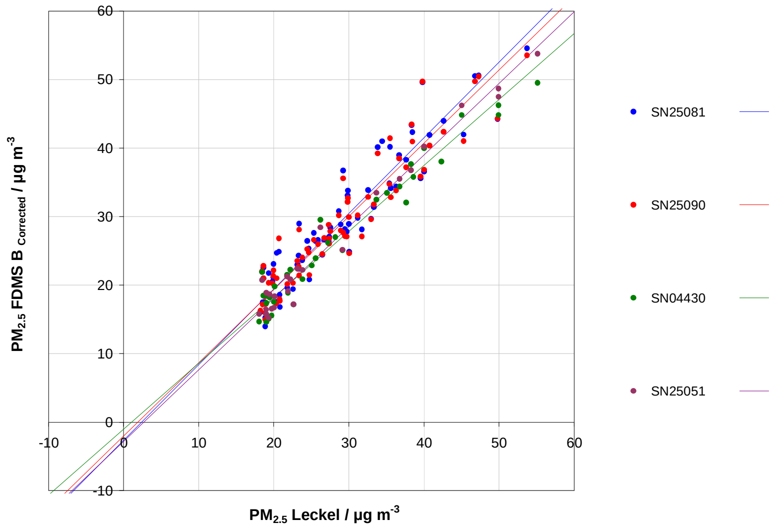


Figure 6. Analysis of the PM_{10} FDMS C.

PM_{10} FDMS C	4.6% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	6.5	65	0.924	0.950 +/- 0.033	3.170 +/- 0.465	1.09	0.74
< 30 µg m-3	9.6	63	0.883	0.980 +/- 0.043	2.862 +/- 0.548	1.10	0.74
> 30 µg m-3	N/A	2	1.000	2.343 +/- N/A	-49.350 +/- N/A	0.56	1.12

SN 25053	Dataset	Orthogonal Regression				Limit Value of 50 µg m³	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m³
Combined Datasets	> 30 µg m³	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	56	0.922	1.071 +/- 0.041	2.160 +/- 0.476	23.02	1.8

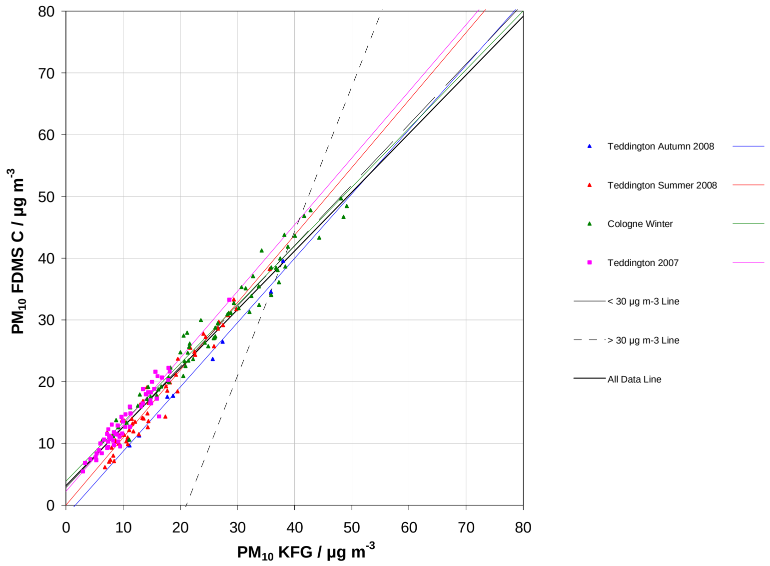
SN 24447	Dataset	Orthogonal Regression				Limit Value of 50 µg m³	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m³
Combined Datasets	> 30 µg m³	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	56	0.922	1.094 +/- 0.041	2.252 +/- 0.486	27.93	1.8

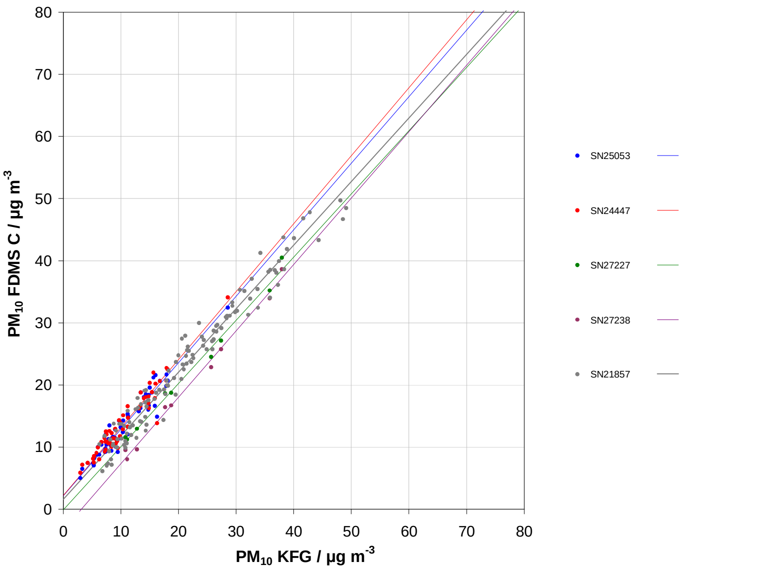
SN 27227	Dataset	Orthogonal Regression				Limit Value of 50 µg m³	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m³
Combined Datasets	> 30 µg m³	2	1.000	2.480 +/- N/A	-53.634 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	9	0.990	1.017 +/- 0.039	-0.077 +/- 0.933	5.07	22.2

SN 27238	Dataset	Orthogonal Regression				Limit Value of 50 µg m³	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m³
Combined Datasets	> 30 µg m³	2	1.000	2.206 +/- N/A	-45.067 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	9	0.992	1.069 +/- 0.036	-3.317 +/- 0.868	3.70	22.2

SN 21857	Dataset	Orthogonal Regression				Limit Value of 50 µg m³	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m³
Individual Datasets	Teddington Summer 2008	54	0.954	1.094 +/- 0.033	-0.022 +/- 0.557	19.86	7.4
	Cologne Winter	66	0.964	0.952 +/- 0.023	3.884 +/- 0.642	9.86	43.9
Combined Datasets	> 30 µg m³	26	0.798	0.997 +/- 0.091	2.061 +/- 3.473	12.64	100.0
	All Data	120	0.966	1.023 +/- 0.017	1.599 +/- 0.416	13.65	27.5

Figure 6 Continued. Analysis of the PM_{10} FDMS C.





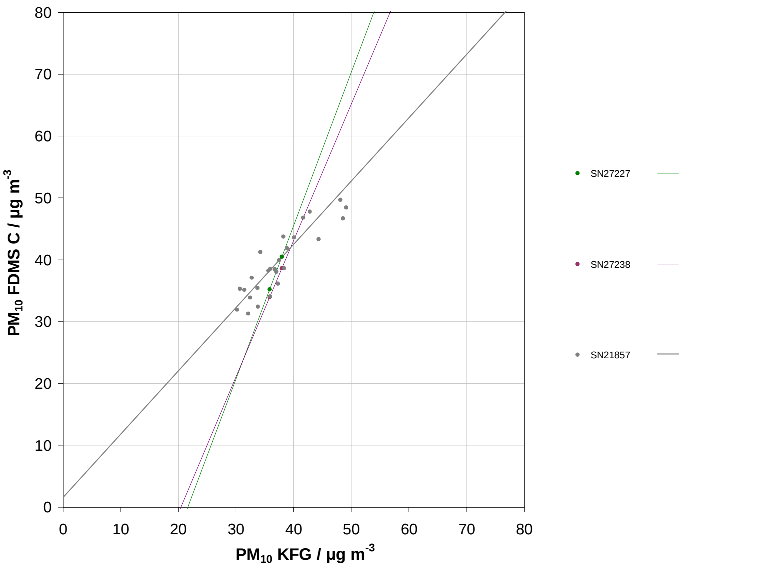


Figure 7. Analysis of the $PM_{2.5}$ FDMS C.

$PM_{2.5}$ FDMS C	2.5% > 17 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	16.7	81	0.790	0.852 +/- 0.045	2.654 +/- 0.337	0.55	1.19
< 18 µg m-3	14.0	79	0.715	0.879 +/- 0.055	2.526 +/- 0.371	0.55	0.95
> 18 µg m-3	N/A	2	1.000	1.538 +/- N/A	-13.391 +/- N/A	0.59	1.63

SN 27227	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	56	0.950	1.122 +/- 0.034	2.487 +/- 0.185	41.24	0.0

SN 27238	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	1	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	64	0.955	1.017 +/- 0.028	2.809 +/- 0.174	22.69	1.6

SN 24430	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	2	1.000	1.388 +/- N/A	-8.982 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.963	0.934 +/- 0.038	0.614 +/- 0.410	9.99	8.0

SN 25081	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	2	1.000	1.688 +/- N/A	-17.799 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.963	0.918 +/- 0.037	-1.397 +/- 0.403	25.95	8.0

SN 24116	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Summer 2008	49	0.973	0.940 +/- 0.023	1.761 +/- 0.259	6.44	18.4
	Cologne Winter	47	0.896	1.251 +/- 0.060	-4.300 +/- 1.172	31.31	53.2
Combined Datasets	> 18 µg m^3	28	0.764	1.498 +/- 0.136	-11.108 +/- 3.384	36.36	100.0
	All Data	96	0.915	1.079 +/- 0.032	-0.370 +/- 0.518	22.36	35.4

Figure 7 Continued. Analysis of the $PM_{2.5}$ FDMS C.

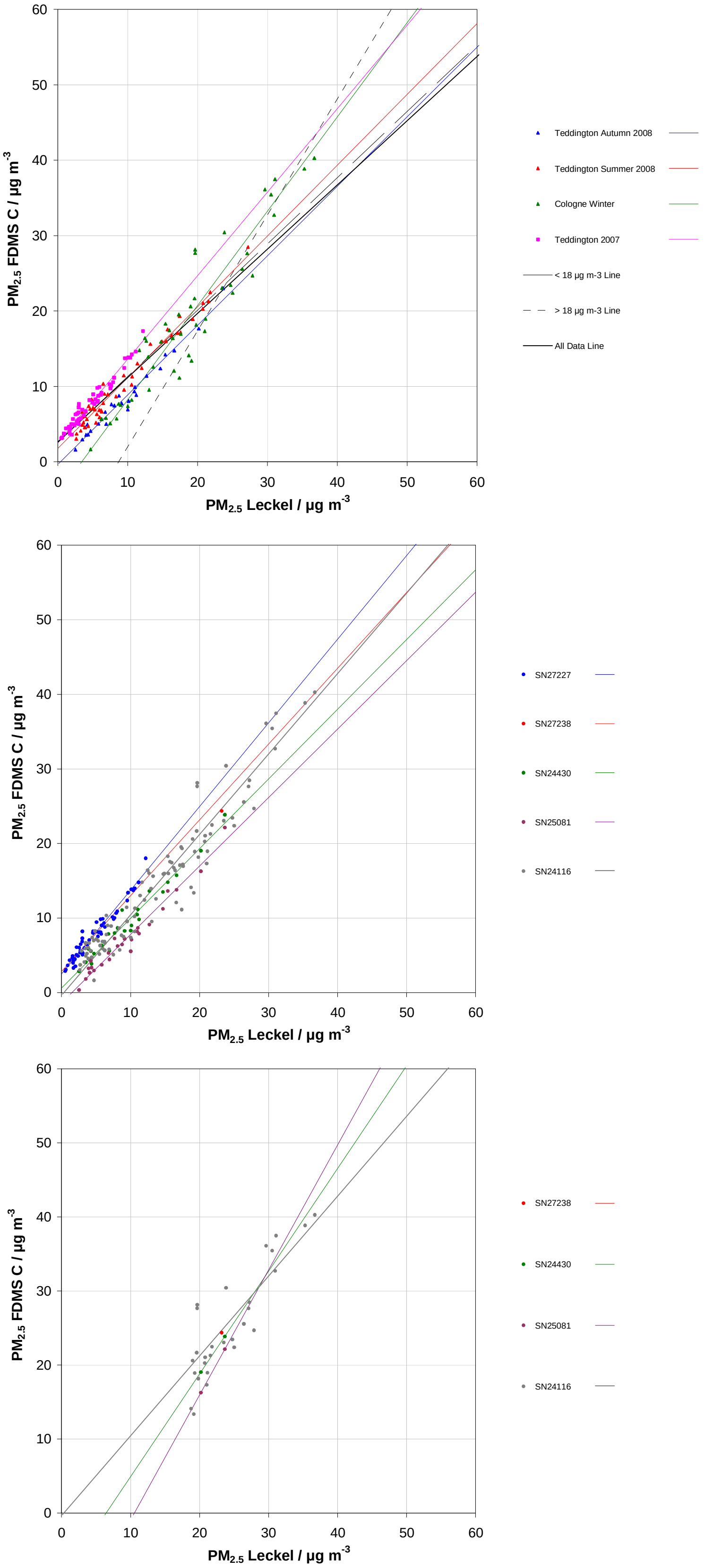


Figure 8. Analysis of the $PM_{2.5}$ FDMS C Corrected by subtracting 2.654 then dividing by 0.852.

$PM_{2.5}$ FDMS C corrected by subtrating 2.654 then dividing by 0.852	2.5% > 17 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	17.1	81	0.790	1.020 +/- 0.052	-0.123 +/- 0.396	0.55	1.40
< 18 µg m-3	19.9	79	0.715	1.062 +/- 0.064	-0.324 +/- 0.435	0.55	1.12
> 18 µg m-3	N/A	2	1.000	1.806 +/- N/A	-18.839 +/- N/A	0.59	1.91

SN 27227	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	56	0.950	1.323 +/- 0.040	-0.220 +/- 0.217	64.02	0.0

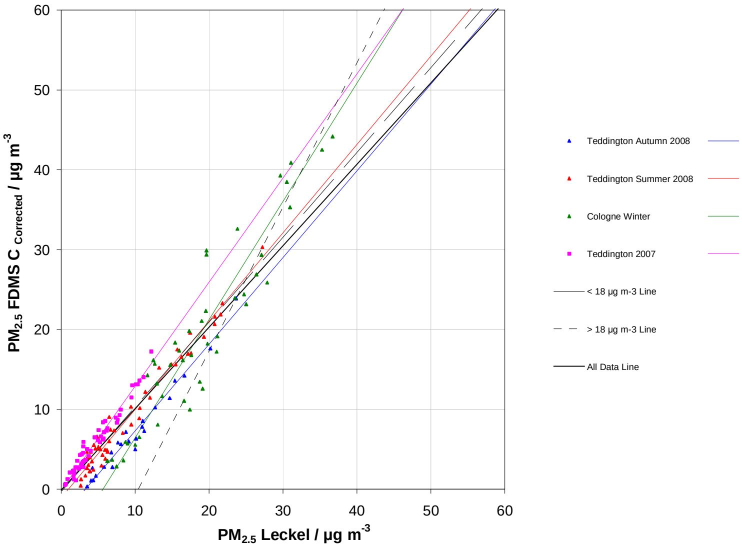
SN 27238	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	1	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	64	0.955	1.199 +/- 0.032	0.160 +/- 0.204	42.29	1.6

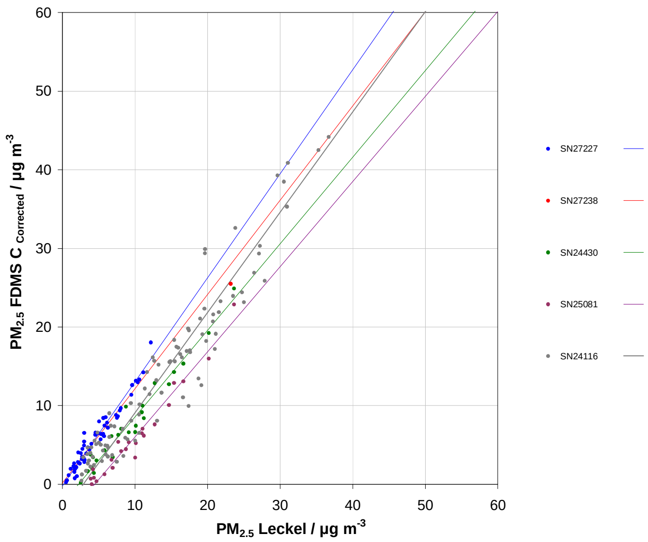
SN 24430	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	2	1.000	1.630 +/- N/A	-13.663 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.963	1.101 +/- 0.044	-2.427 +/- 0.481	11.65	8.0

SN 25081	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	2	1.000	1.982 +/- N/A	-24.016 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.963	1.082 +/- 0.044	-4.788 +/- 0.473	18.99	8.0

SN 24116	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Individual Datasets	Teddington Summer 2008	49	0.973	1.106 +/- 0.027	-1.071 +/- 0.304	18.46	18.4
	Cologne Winter	47	0.896	1.481 +/- 0.070	-8.383 +/- 1.376	49.33	53.2
Combined Datasets	> 18 µg m^3	28	0.764	1.792 +/- 0.160	-16.961 +/- 3.974	55.58	100.0
	All Data	96	0.915	1.275 +/- 0.038	-3.674 +/- 0.609	38.41	35.4

Figure 8 Continued. Analysis of the $PM_{2.5}$ FDMS C Corrected by subtracting 2.654 then dividing by 0.852.





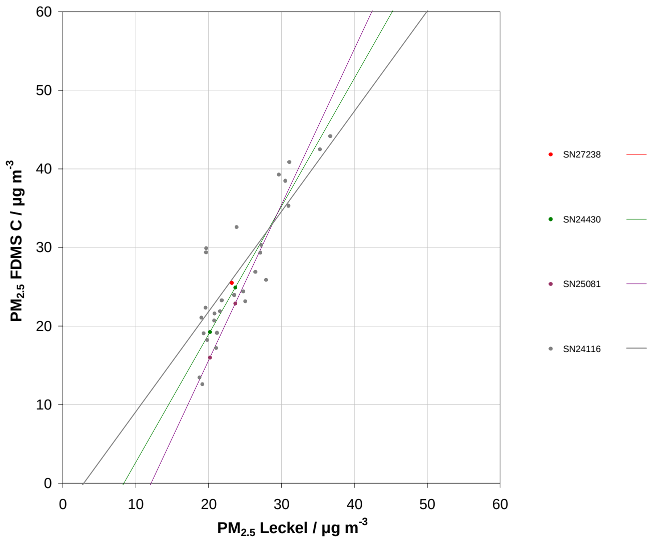
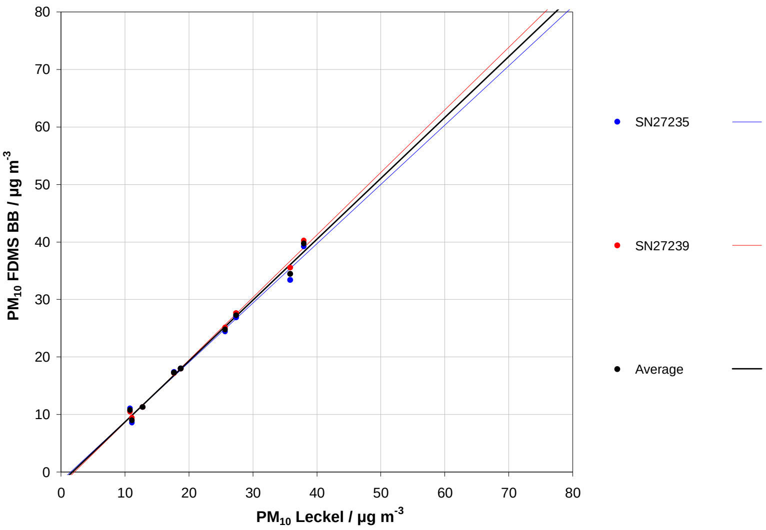


Figure 9. Analysis of the PM_{10} FDMS BB.

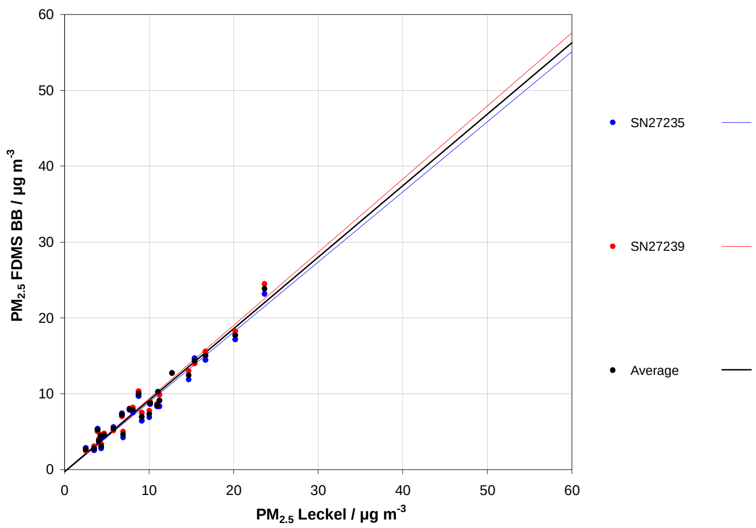


PM_{10} FDMS BB	22.2% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	5.54	9	0.992	1.059 +/- 0.035	-1.885 +/- 0.848	0.52	0.62
< 30 µg m-3	3.97	7	0.991	1.051 +/- 0.045	-1.716 +/- 0.852	0.51	0.39
> 30 µg m-3	N/A	2	1.000	1.061 +/- N/A	-2.035 +/- N/A	0.56	1.19

SN 27235	Dataset	Orthogonal Regression				Limit Value of 50 µg m-3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m-3
Combined Datasets	< 30 µg m-3	7	0.984	1.034 +/- 0.059	-1.530 +/- 1.108	3.42	0.0
	> 30 µg m-3	2	1.000	2.733 +/- N/A	-64.507 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	9	0.987	1.031 +/- 0.044	-1.538 +/- 1.053	4.67	22.2

SN 27239	Dataset	Orthogonal Regression				Limit Value of 50 µg m-3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m-3
Combined Datasets	< 30 µg m-3	7	0.995	1.069 +/- 0.033	-1.925 +/- 0.630	6.09	0.0
	> 30 µg m-3	2	1.000	2.210 +/- N/A	-43.624 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	9	0.995	1.087 +/- 0.028	-2.247 +/- 0.663	8.81	22.2

Figure 10. Analysis of the $PM_{2.5}$ FDMS BB.

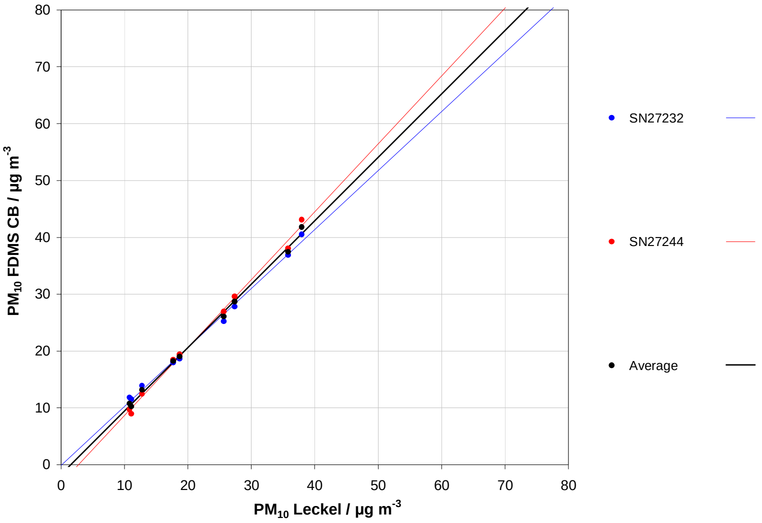


$PM_{2.5}$ FDMS BB	8% > 17 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	14.50	25	0.952	0.943 +/- 0.043	-0.276 +/- 0.469	0.77	0.94
< 18 µg m-3	21.38	23	0.919	0.891 +/- 0.056	0.124 +/- 0.518	0.85	0.48
> 18 µg m-3	N/A	2	1.000	1.764 +/- N/A	-17.908 +/- N/A	0.21	0.85

SN 27235	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	< 18 µg m-3	23	0.888	0.884 +/- 0.065	-0.005 +/- 0.604	23.95	0.0
	> 18 µg m-3	2	1.000	1.736 +/- N/A	-17.889 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.937	0.924 +/- 0.049	-0.317 +/- 0.528	18.69	8.0

SN 27239	Dataset	Orthogonal Regression				Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	< 18 µg m-3	23	0.937	0.903 +/- 0.049	0.211 +/- 0.459	18.22	0.0
	> 18 µg m-3	2	1.000	1.792 +/- N/A	-17.927 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.961	0.964 +/- 0.040	-0.259 +/- 0.433	10.19	8.0

Figure 11. Analysis of the PM_{10} FDMS CB.

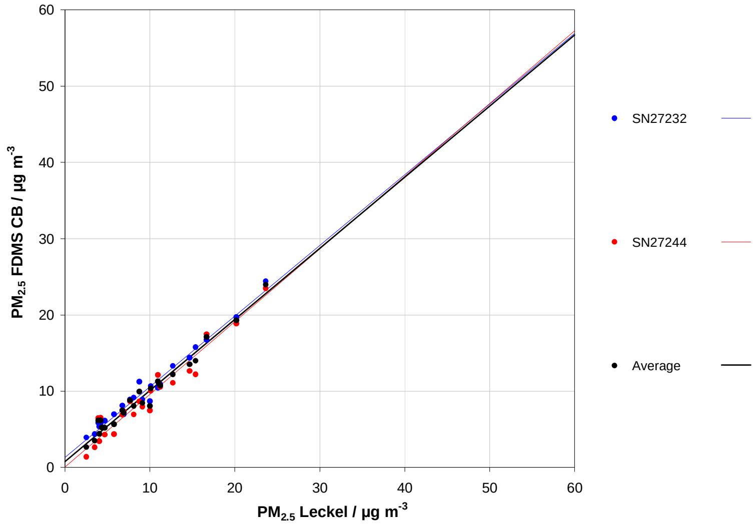


PM_{10} FDMS CB	22.2% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	16.35	9	0.997	1.115 +/- 0.024	-1.684 +/- 0.589	0.52	1.15
< 30 µg m-3	10.95	7	0.997	1.076 +/- 0.028	-1.044 +/- 0.525	0.51	1.19
> 30 µg m-3	N/A	2	1.000	1.132 +/- N/A	-2.120 +/- N/A	0.56	1.43

SN 27232	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Combined Datasets	< 30 µg m-3	7	0.996	0.948 +/- 0.028	1.319 +/- 0.525	5.17	0.0
	> 30 µg m-3	2	1.000	1.702 +/- N/A	-24.106 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	9	0.994	1.037 +/- 0.029	-0.107 +/- 0.705	7.48	22.2

SN 27244	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Combined Datasets	< 30 µg m-3	7	0.995	1.205 +/- 0.038	-3.435 +/- 0.710	27.31	0.0
	> 30 µg m-3	2	1.000	2.376 +/- N/A	-47.077 +/- N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	9	0.996	1.195 +/- 0.030	-3.303 +/- 0.712	25.86	22.2

Figure 12. Analysis of the $PM_{2.5}$ FDMS CB.



$PM_{2.5}$ FDMS CB	8% > 17 µg m-3	Orthogonal Regression								Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b			Intercept (a) +/- u_a			Reference	Candidate
All Data	8.83	25	0.971	0.932	+/-	0.033	0.770	+/-	0.359	0.77	1.15
< 18 µg m-3	14.65	23	0.948	0.891	+/-	0.044	1.086	+/-	0.412	0.85	1.18
> 18 µg m-3	N/A	2	1.000	1.347	+/-	N/A	-7.895	+/-	N/A	0.21	0.64

SN 27232	Dataset	Orthogonal Regression								Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b			Intercept (a) +/- u_a			W_{CM} / %	% > 17 µg m^3
Combined Datasets	< 18 µg m-3	23	0.959	0.883	+/-	0.039	1.655	+/-	0.366	12.35	0.0
	> 18 µg m-3	2	1.000	1.354	+/-	N/A	-7.612	+/-	N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.976	0.927	+/-	0.030	1.326	+/-	0.325	5.94	8.0

SN 27244	Dataset	Orthogonal Regression								Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b			Intercept (a) +/- u_a			W_{CM} / %	% > 17 µg m^3
Combined Datasets	< 18 µg m-3	23	0.877	0.928	+/-	0.071	0.268	+/-	0.664	14.57	0.0
	> 18 µg m-3	2	1.000	1.339	+/-	N/A	-8.177	+/-	N/A	N/A	100.0
	All Data (Teddington Autumn 2008)	25	0.936	0.953	+/-	0.051	0.074	+/-	0.549	11.57	8.0

Figure 13. Analysis of the PM_{10} Partisol 2025 after the removal of an outlier.

PM_{10} Partisol 2025 Outlier Removed	16.2% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	8.0	390	0.959	0.998 +/- 0.010	0.603 +/- 0.224	1.11	1.95
< 30 µg m-3	12.5	332	0.879	1.053 +/- 0.020	-0.106 +/- 0.322	1.10	1.29
> 30 µg m-3	10.7	58	0.895	1.082 +/- 0.047	-3.372 +/- 1.912	1.12	1.69

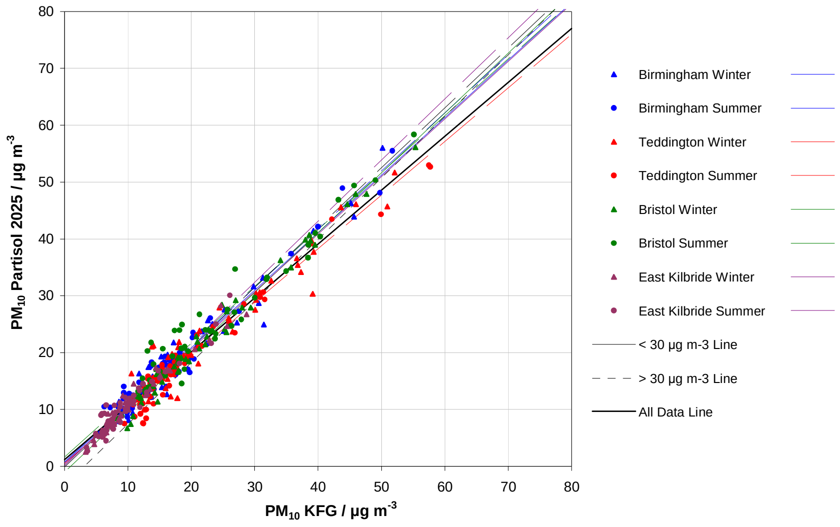
SN 21218	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Teddington Winter	48	0.948	0.955 +/- 0.032	0.704 +/- 0.869	10.93	35.4
	Teddington Summer	60	0.967	0.923 +/- 0.022	0.672 +/- 0.490	13.87	15.0
	Bristol Summer	51	0.944	0.996 +/- 0.034	1.829 +/- 0.864	11.51	23.5
	Bristol Winter	50	0.974	1.059 +/- 0.024	-1.254 +/- 0.616	10.06	24.0
Combined Datasets	> 30 µg m^3	47	0.904	1.032 +/- 0.048	-1.872 +/- 1.952	9.59	100.0
	All Data	209	0.950	0.995 +/- 0.015	0.231 +/- 0.384	9.08	23.9

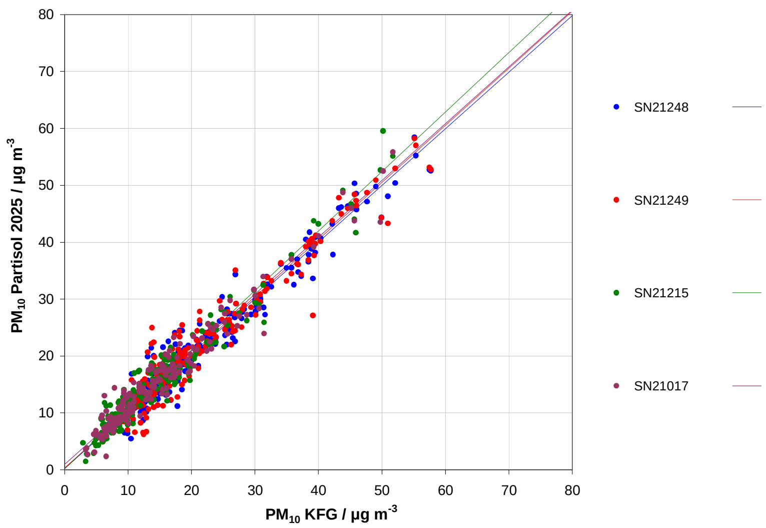
SN 21249	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Teddington Winter	48	0.889	0.942 +/- 0.047	1.680 +/- 1.242	14.89	33.3
	Teddington Summer	59	0.936	0.967 +/- 0.032	0.279 +/- 0.706	10.78	13.6
	Bristol Summer	51	0.931	1.008 +/- 0.038	1.363 +/- 0.972	13.05	23.5
	Bristol Winter	51	0.989	1.049 +/- 0.016	-0.831 +/- 0.388	7.79	23.5
Combined Datasets	> 30 µg m^3	45	0.871	1.034 +/- 0.057	-1.672 +/- 2.322	11.56	100.0
	All Data	209	0.934	1.003 +/- 0.018	0.344 +/- 0.441	10.89	23.0

SN 21215	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Birmingham Winter	46	0.920	1.004 +/- 0.043	1.048 +/- 1.021	11.81	21.7
	Birmingham Summer	58	0.953	1.076 +/- 0.031	-0.418 +/- 0.604	15.58	8.6
	East Kilbride Summer	47	0.909	1.108 +/- 0.050	-0.295 +/- 0.552	21.20	0.0
	East Kilbride Winter	46	0.942	1.024 +/- 0.037	0.237 +/- 0.458	7.69	2.2
Combined Datasets	> 30 µg m^3	14	0.887	1.338 +/- 0.128	-12.393 +/- 5.295	22.32	100.0
	All Data	197	0.949	1.045 +/- 0.017	0.148 +/- 0.295	12.24	8.1

SN 21017	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Birmingham Winter	41	0.945	0.982 +/- 0.037	0.994 +/- 0.871	7.54	22.0
	Birmingham Summer	58	0.947	0.981 +/- 0.030	1.750 +/- 0.585	8.20	8.6
	East Kilbride Summer	47	0.894	1.075 +/- 0.052	0.157 +/- 0.578	16.70	0.0
	East Kilbride Winter	40	0.953	1.010 +/- 0.036	0.456 +/- 0.453	6.02	2.5
Combined Datasets	> 30 µg m^3	13	0.857	1.201 +/- 0.135	-8.165 +/- 5.548	15.76	100.0
	All Data	186	0.953	0.998 +/- 0.016	0.964 +/- 0.279	7.46	8.1

Figure 13 Continued. Analysis of the PM_{10} Partisol 2025 after the removal of an outlier.





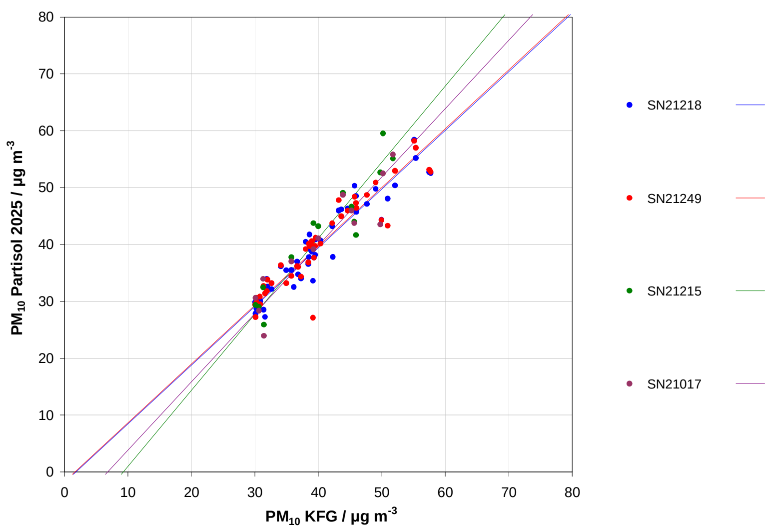


Figure 14. Analysis of the $PM_{2.5}$ Partisol 2025.

$PM_{2.5}$ Partisol 2025	8.9% > 17 µg m-3	Orthogonal Regression			Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b / Intercept (a) +/- u_a	Reference	Candidate
All Data	11.0	135	0.986	1.054 +/- 0.011 / -2.196 +/- 0.186	0.77	1.29
< 18 µg m-3	12.7	124	0.893	1.017 +/- 0.030 / -1.921 +/- 0.241	0.54	0.90
> 18 µg m-3	25.9	11	0.979	1.091 +/- 0.053 / -4.331 +/- 2.792	1.68	3.43

SN Unknown1	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Limit Value of 30 µg m^3: W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	10	0.961	1.057 +/- 0.074	-3.995 +/- 4.098	35.55	100.0
	All Data (Teddington 2003)	29	0.981	1.015 +/- 0.027	-1.137 +/- 0.897	21.42	34.5

SN Unknown2	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Limit Value of 30 µg m^3: W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m^3	15	0.969	1.122 +/- 0.054	-5.094 +/- 2.991	26.24	100.0
	All Data (Teddington 2003)	38	0.985	1.066 +/- 0.022	-1.592 +/- 0.771	19.93	39.5

SN 21017	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Limit Value of 30 µg m^3: W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m-3	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	64	0.815	0.902 +/- 0.050	-1.218 +/- 0.272	28.70	0.0

SN 21215	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Limit Value of 30 µg m^3: W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m-3	0	N/A	N/A +/- N/A	N/A +/- N/A	N/A	N/A
	All Data (Teddington 2007)	64	0.801	0.982 +/- 0.056	-1.675 +/- 0.305	17.15	0.0

SN 21249	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Limit Value of 30 µg m^3: W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m-3	1	N/A	N/A +/- N/A	N/A +/- N/A	N/A	100.0
	All Data (Teddington 2010)	43	0.940	0.998 +/- 0.038	-2.235 +/- 0.379	16.49	4.7

SN 21912	Dataset	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Limit Value of 30 µg m^3: W_{CM} / %	% > 17 µg m^3
Combined Datasets	> 18 µg m-3	1	N/A	N/A +/- N/A	N/A +/- N/A	N/A	100.0
	All Data (Teddington 2010)	54	0.916	0.950 +/- 0.038	-2.226 +/- 0.376	25.85	3.7

Figure 14 Continued. Analysis of the $PM_{2.5}$ Partisol 2025.

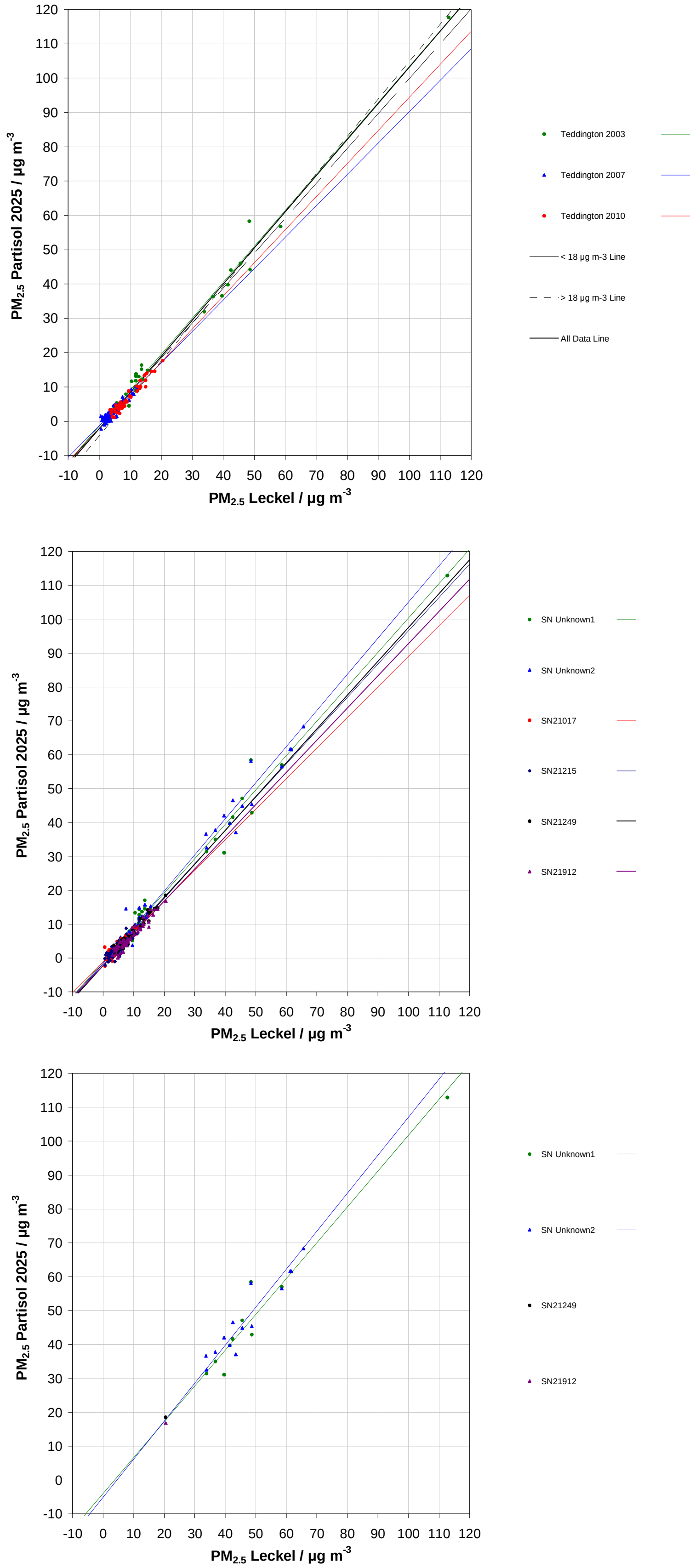


Figure 15. Analysis of the PM_{10} TEOM(0,1,1) corrected by subtracting 2.980 then dividing by 0.535.

PM_{10} TEOM corrected by subtracting 2.980 then dividing by 0.535	16.4% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	23.5	396	0.794	1.072 +/- 0.024	-1.334 +/- 0.527	1.11	0.96
< 30 µg m-3	76.9	336	0.736	1.519 +/- 0.040	-7.272 +/- 0.641	1.10	0.70
> 30 µg m-3	38.9	60	0.225	1.291 +/- 0.131	-14.035 +/- 5.366	1.12	0.87

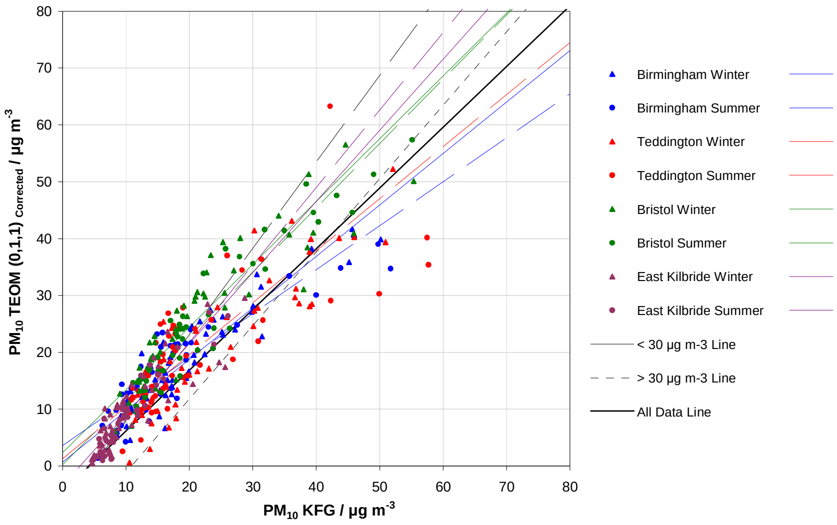
SN 25018	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	49	0.805	1.079 +/- 0.069	-4.445 +/- 1.856	22.46	34.7
	Teddington Summer	57	0.577	0.894 +/- 0.081	1.855 +/- 1.819	30.66	15.8
	Bristol Summer	46	0.912	1.121 +/- 0.050	0.359 +/- 1.268	29.54	23.9
	Bristol Winter	50	0.819	1.081 +/- 0.066	2.975 +/- 1.648	35.48	24.0
Combined Datasets	> 30 µg m^{-3}	46	0.236	1.443 +/- 0.158	-18.676 +/- 6.476	45.11	100.0
	All Data	202	0.732	1.080 +/- 0.039	-0.555 +/- 0.974	29.30	24.3

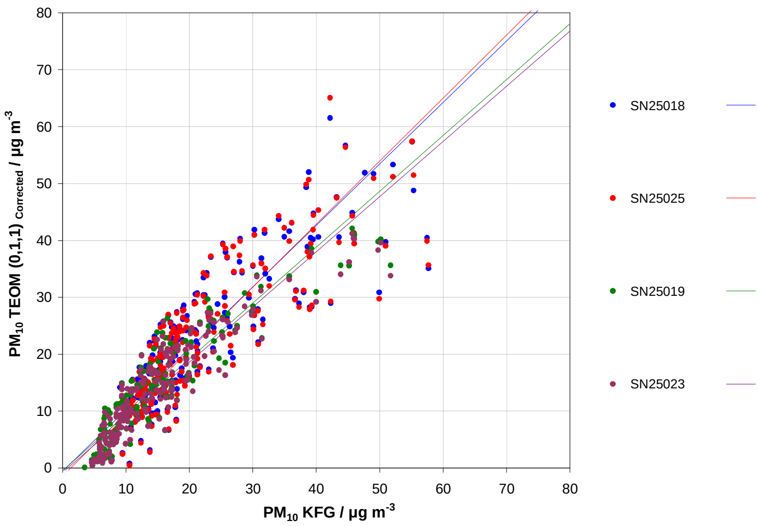
SN 25025	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	49	0.820	1.057 +/- 0.065	-4.569 +/- 1.755	22.13	34.7
	Teddington Summer	59	0.578	0.941 +/- 0.082	0.570 +/- 1.833	29.97	15.3
	Bristol Summer	48	0.891	1.173 +/- 0.057	-0.671 +/- 1.431	36.24	22.9
	Bristol Winter	49	0.829	1.116 +/- 0.067	1.960 +/- 1.621	37.37	22.4
Combined Datasets	> 30 µg m^{-3}	45	0.215	1.542 +/- 0.166	-22.782 +/- 6.780	49.43	100.0
	All Data	205	0.726	1.107 +/- 0.040	-1.439 +/- 0.987	30.75	23.4

SN 25019	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.873	0.913 +/- 0.043	0.637 +/- 1.000	19.69	18.6
	Birmingham Summer	45	0.793	0.793 +/- 0.056	3.512 +/- 1.156	31.62	11.1
	East Kilbride Summer	44	0.900	1.406 +/- 0.068	-5.619 +/- 0.756	59.36	0.0
	East Kilbride Winter	48	0.743	1.330 +/- 0.096	-3.607 +/- 1.163	54.18	2.1
Combined Datasets	> 30 µg m^{-3}	15	0.552	0.628 +/- 0.131	9.597 +/- 5.456	38.68	100.0
	All Data	196	0.840	0.982 +/- 0.028	-0.472 +/- 0.505	16.10	8.7

SN 25023	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.873	0.896 +/- 0.043	0.752 +/- 0.981	21.70	18.6
	Birmingham Summer	56	0.747	0.773 +/- 0.055	3.697 +/- 1.067	34.43	8.9
	East Kilbride Summer	44	0.901	1.318 +/- 0.063	-5.319 +/- 0.708	43.22	0.0
	East Kilbride Winter	48	0.752	1.173 +/- 0.084	-3.334 +/- 1.025	25.50	2.1
Combined Datasets	> 30 µg m^{-3}	15	0.500	0.602 +/- 0.136	9.866 +/- 5.677	42.82	100.0
	All Data	207	0.836	0.969 +/- 0.027	-0.764 +/- 0.487	17.41	8.2

Figure 15 Continued. Analysis of the PM_{10} TEOM(0,1,1) corrected by subtracting 2.980 then dividing by 0.535.





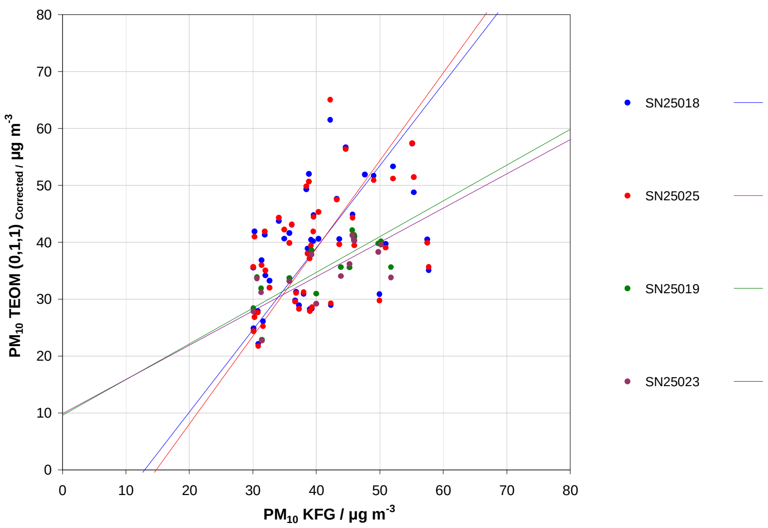
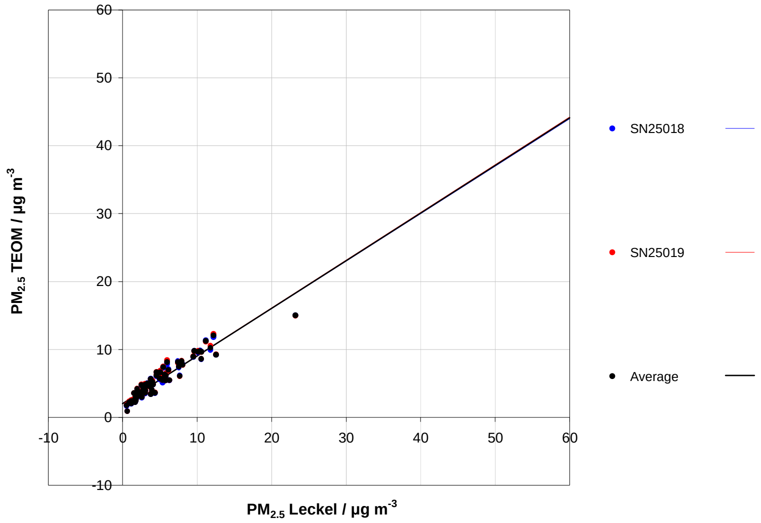


Figure 16. Analysis of the $PM_{2.5}$ TEOM.



$PM_{2.5}$ TEOM	1.5% > 17 µg m-3	Orthogonal Regression								Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/-	u_a	Reference	Candidate
All Data	46.39	67	0.901	0.701	+/-	0.028	2.042	+/-	0.177	0.43	0.18
< 18 µg m-3	32.10	66	0.909	0.785	+/-	0.030	1.694	+/-	0.172	0.39	0.19
> 18 µg m-3	N/A	1	N/A	N/A	+/-	N/A	N/A	+/-	N/A	1.48	0.04

SN 21017	Dataset	Orthogonal Regression								Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/-	u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	< 18 µg m-3	67	0.906	0.780	+/-	0.030	1.681	+/-	0.171	33.12	0.0
	> 18 µg m-3	1	N/A	N/A	+/-	N/A	N/A	+/-	N/A	N/A	N/A
	All Data (Teddington 2007)	68	0.900	0.699	+/-	0.028	2.017	+/-	0.175	46.99	1.5

SN 21215	Dataset	Orthogonal Regression								Limit Value of 30 µg m^3	
		n_{c-s}	r^2	Slope (b)	+/-	u_b	Intercept (a)	+/-	u_a	W_{CM} / %	% > 17 µg m^3
Combined Datasets	< 18 µg m-3	66	0.906	0.789	+/-	0.031	1.722	+/-	0.175	31.07	0.0
	> 18 µg m-3	1	N/A	N/A	+/-	N/A	N/A	+/-	N/A	N/A	N/A
	All Data (Teddington 2007)	67	0.897	0.703	+/-	0.029	2.080	+/-	0.182	45.79	1.5

Figure 17. Analysis of the PM_{10} BAM.

PM_{10} BAM 1020	16.3% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	45.3	405	0.942	1.210 +/- 0.014	0.414 +/- 0.313	1.11	2.06
< 30 µg m-3	71.7	344	0.843	1.396 +/- 0.029	-2.132 +/- 0.465	1.10	1.69
> 30 µg m-3	40.1	61	0.855	1.194 +/- 0.058	-0.255 +/- 2.413	1.12	2.67

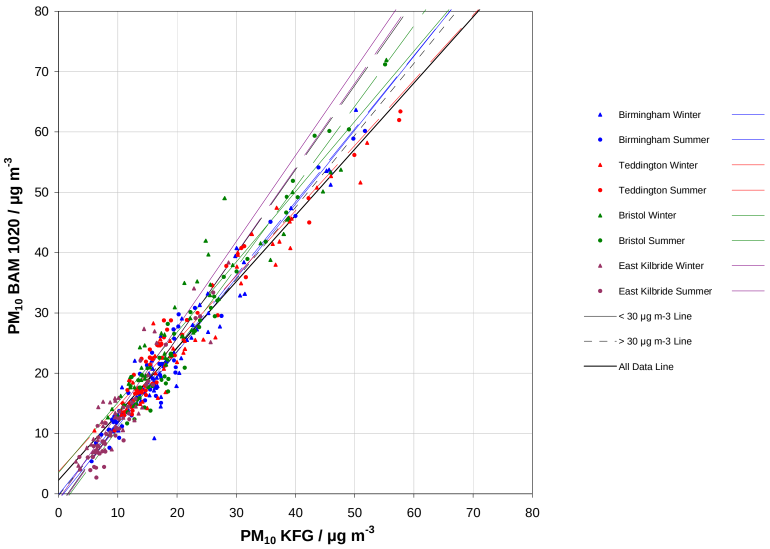
SND1428	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Teddington Winter	49	0.941	1.153 +/- 0.041	1.267 +/- 1.100	37.66	34.7
	Teddington Summer	58	0.951	1.155 +/- 0.034	2.963 +/- 0.761	44.11	15.5
	Bristol Summer	53	0.966	1.373 +/- 0.035	-3.001 +/- 0.887	63.35	22.6
	Bristol Winter	51	0.935	1.199 +/- 0.043	3.833 +/- 1.082	56.73	23.5
Combined Datasets	> 30 µg m^3	47	0.857	1.257 +/- 0.070	-1.306 +/- 2.854	48.41	100.0
	All Data	211	0.935	1.219 +/- 0.021	1.338 +/- 0.530	50.91	23.7

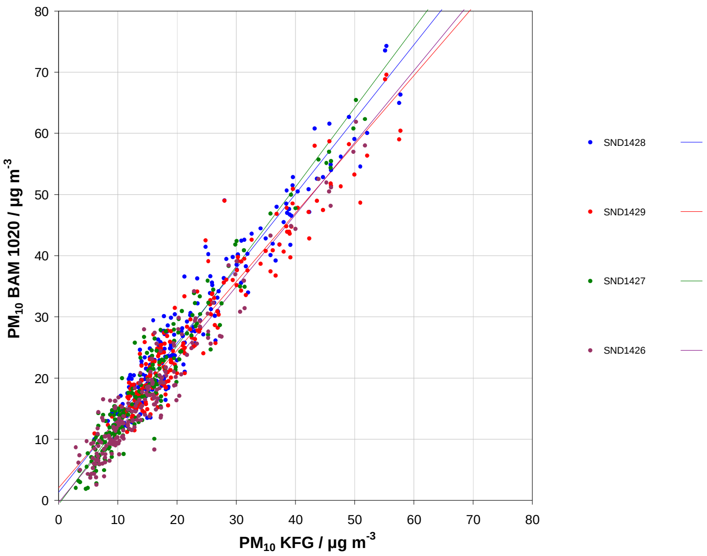
SND1429	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Teddington Winter	49	0.930	1.045 +/- 0.040	3.166 +/- 1.089	24.84	34.7
	Teddington Summer	56	0.945	1.014 +/- 0.032	4.236 +/- 0.729	21.89	16.1
	Bristol Summer	51	0.967	1.294 +/- 0.033	-2.312 +/- 0.837	50.52	21.6
	Bristol Winter	51	0.898	1.135 +/- 0.052	3.062 +/- 1.290	42.54	23.5
Combined Datasets	> 30 µg m^3	46	0.801	1.125 +/- 0.075	0.938 +/- 3.075	32.71	100.0
	All Data	207	0.925	1.123 +/- 0.021	2.068 +/- 0.533	35.46	23.7

SND1427	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Birmingham Winter	59	0.932	1.262 +/- 0.043	-0.011 +/- 1.000	53.90	18.6
	Birmingham Summer	56	0.967	1.239 +/- 0.031	0.467 +/- 0.596	50.19	8.9
	East Kilbride Summer	46	0.888	1.464 +/- 0.072	-2.379 +/- 0.808	83.73	0.0
	East Kilbride Winter	45	0.839	1.505 +/- 0.089	-2.890 +/- 1.041	90.41	2.2
Combined Datasets	> 30 µg m^3	15	0.927	1.252 +/- 0.093	-0.553 +/- 3.889	48.98	100.0
	All Data	206	0.943	1.297 +/- 0.021	-0.668 +/- 0.380	57.71	8.3

SND1426	Dataset	Orthogonal Regression				Limit Value of 50 µg m^3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^3
Individual Datasets	Birmingham Winter	59	0.945	1.195 +/- 0.037	-2.114 +/- 0.850	32.15	18.6
	Birmingham Summer	54	0.953	1.192 +/- 0.036	-0.781 +/- 0.707	36.47	9.3
	East Kilbride Summer	46	0.924	1.395 +/- 0.057	-2.860 +/- 0.640	67.89	0.0
	East Kilbride Winter	39	0.766	1.393 +/- 0.106	0.152 +/- 1.256	80.71	2.6
Combined Datasets	> 30 µg m^3	15	0.906	1.246 +/- 0.105	-4.523 +/- 4.383	32.84	100.0
	All Data	198	0.922	1.177 +/- 0.023	-0.340 +/- 0.417	35.91	8.6

Figure 17 Continued. Analysis of the PM_{10} BAM.





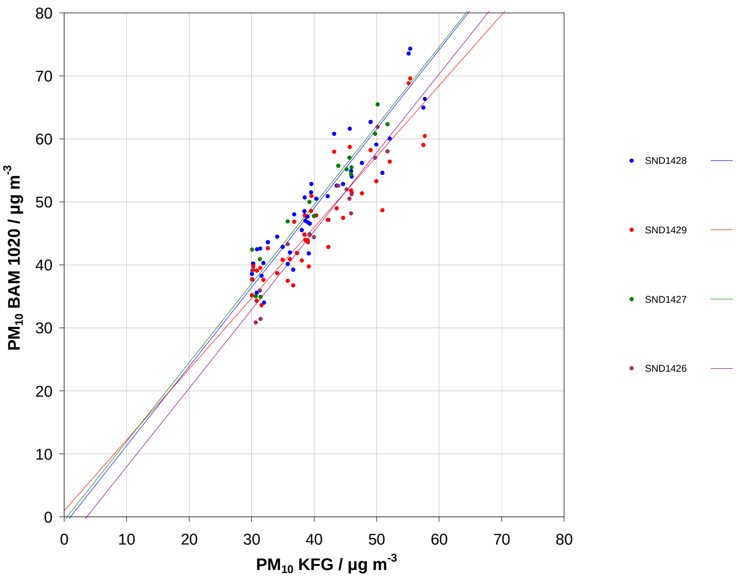


Figure 18. Analysis of the PM_{10} BAM after dividing by 1.2.

PM_{10} BAM 1020 corrected by dividing by 1.2	16.3% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	10.4	405	0.942	1.003 +/- 0.012	0.447 +/- 0.261	1.11	1.71
< 30 µg m-3	25.2	344	0.843	1.146 +/- 0.024	-1.513 +/- 0.387	1.10	1.41
> 30 µg m-3	11.5	61	0.855	0.980 +/- 0.049	0.379 +/- 2.011	1.12	2.22

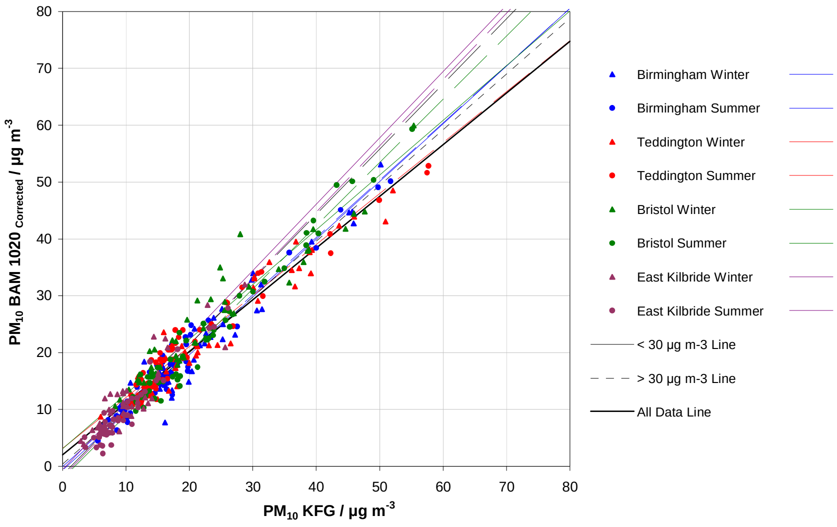
SND1428	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	49	0.941	0.955 +/- 0.034	1.188 +/- 0.917	11.05	34.7
	Teddington Summer	58	0.951	0.958 +/- 0.028	2.556 +/- 0.634	8.88	15.5
	Bristol Summer	53	0.966	1.141 +/- 0.029	-2.423 +/- 0.739	20.29	22.6
	Bristol Winter	51	0.935	0.993 +/- 0.036	3.331 +/- 0.902	16.65	23.5
Combined Datasets	> 30 µg m^{-3}	47	0.857	1.032 +/- 0.058	-0.488 +/- 2.378	13.10	100.0
	All Data	211	0.935	1.010 +/- 0.018	1.253 +/- 0.442	13.17	23.7

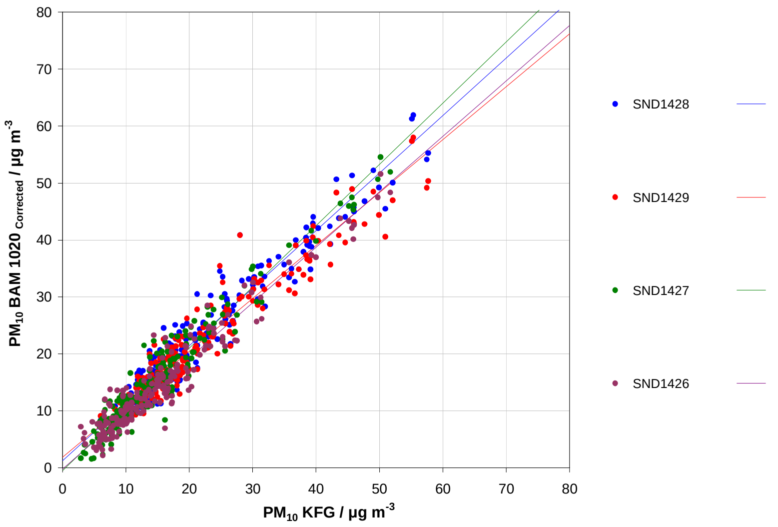
SND1429	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	49	0.930	0.865 +/- 0.034	2.782 +/- 0.907	18.79	34.7
	Teddington Summer	56	0.945	0.840 +/- 0.027	3.616 +/- 0.608	19.25	16.1
	Bristol Summer	51	0.967	1.075 +/- 0.028	-1.854 +/- 0.697	11.05	21.6
	Bristol Winter	51	0.898	0.936 +/- 0.043	2.764 +/- 1.075	14.06	23.5
Combined Datasets	> 30 µg m^{-3}	46	0.801	0.918 +/- 0.062	1.582 +/- 2.562	16.57	100.0
	All Data	207	0.925	0.929 +/- 0.018	1.874 +/- 0.444	13.05	23.7

SND1427	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.932	1.045 +/- 0.036	0.131 +/- 0.833	14.03	18.6
	Birmingham Summer	56	0.967	1.029 +/- 0.025	0.442 +/- 0.496	9.91	8.9
	East Kilbride Summer	46	0.888	1.207 +/- 0.060	-1.857 +/- 0.674	34.92	0.0
	East Kilbride Winter	45	0.839	1.235 +/- 0.074	-2.213 +/- 0.868	39.81	2.2
Combined Datasets	> 30 µg m^{-3}	15	0.927	1.036 +/- 0.078	-0.165 +/- 3.241	9.41	100.0
	All Data	206	0.943	1.075 +/- 0.018	-0.472 +/- 0.316	15.95	8.3

SND1426	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.945	0.991 +/- 0.031	-1.656 +/- 0.709	11.88	18.6
	Birmingham Summer	54	0.953	0.989 +/- 0.030	-0.576 +/- 0.589	8.98	9.3
	East Kilbride Summer	46	0.924	1.154 +/- 0.048	-2.303 +/- 0.533	22.49	0.0
	East Kilbride Winter	39	0.766	1.133 +/- 0.089	0.421 +/- 1.046	31.01	2.6
Combined Datasets	> 30 µg m^{-3}	15	0.906	1.029 +/- 0.087	-3.384 +/- 3.652	11.22	100.0
	All Data	198	0.922	0.973 +/- 0.019	-0.173 +/- 0.347	11.54	8.6

Figure 18 Continued. Analysis of the PM_{10} BAM after dividing by 1.2.





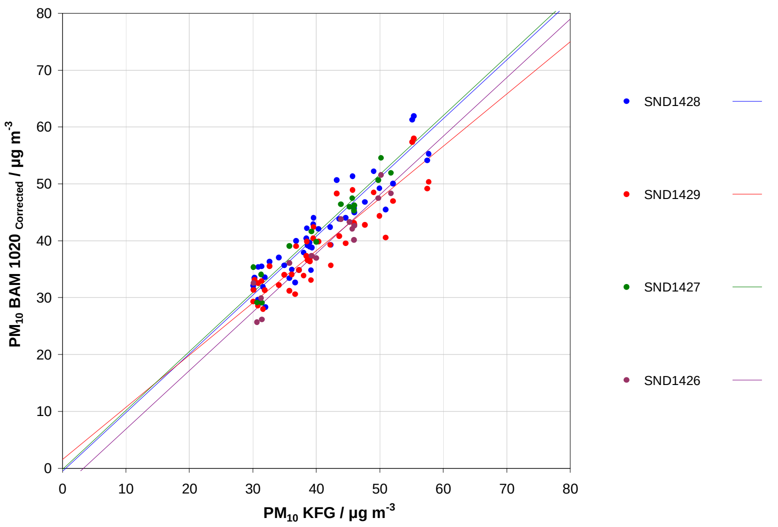


Figure 19. Analysis of the PM_{10} $BAM_{Ambient}$ after dividing by 1.273.

PM_{10} BAM 1020 Ambient corrected by dividing by 1.273	16.3% > 28 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	9.3	405	0.950	0.994 +/- 0.011	0.288 +/- 0.242	1.11	1.69
< 30 µg m-3	20.0	344	0.856	1.117 +/- 0.023	-1.411 +/- 0.363	1.10	1.38
> 30 µg m-3	11.1	61	0.878	0.933 +/- 0.043	1.994 +/- 1.762	1.12	2.21

SND1428	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	49	0.948	0.975 +/- 0.032	0.932 +/- 0.873	9.71	34.7
	Teddington Summer	58	0.954	0.933 +/- 0.027	2.609 +/- 0.597	8.58	15.5
	Bristol Summer	53	0.964	1.103 +/- 0.029	-2.245 +/- 0.739	14.35	22.6
	Bristol Winter	51	0.956	1.009 +/- 0.030	2.700 +/- 0.756	15.99	23.5
Combined Datasets	> 30 µg m^{-3}	47	0.882	0.998 +/- 0.051	0.712 +/- 2.092	10.97	100.0
	All Data	211	0.944	1.004 +/- 0.016	1.067 +/- 0.408	11.44	23.7

SND1429	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Teddington Winter	49	0.938	0.884 +/- 0.032	2.544 +/- 0.868	16.22	34.7
	Teddington Summer	56	0.951	0.818 +/- 0.025	3.648 +/- 0.562	23.10	16.1
	Bristol Summer	51	0.965	1.040 +/- 0.028	-1.694 +/- 0.698	8.02	21.6
	Bristol Winter	51	0.925	0.948 +/- 0.037	2.239 +/- 0.931	12.14	23.5
Combined Datasets	> 30 µg m^{-3}	46	0.831	0.880 +/- 0.055	2.939 +/- 2.271	16.82	100.0
	All Data	207	0.935	0.924 +/- 0.016	1.697 +/- 0.411	13.25	23.7

SND1427	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.938	1.030 +/- 0.034	0.227 +/- 0.782	11.72	18.6
	Birmingham Summer	56	0.971	0.997 +/- 0.023	0.387 +/- 0.450	5.54	8.9
	East Kilbride Summer	46	0.886	1.155 +/- 0.058	-1.708 +/- 0.651	25.27	0.0
	East Kilbride Winter	45	0.857	1.196 +/- 0.068	-2.056 +/- 0.794	32.61	2.2
Combined Datasets	> 30 µg m^{-3}	15	0.921	0.970 +/- 0.076	1.899 +/- 3.156	6.55	100.0
	All Data	206	0.948	1.055 +/- 0.017	-0.528 +/- 0.296	12.14	8.3

SND1426	Dataset	Orthogonal Regression				Limit Value of 50 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m^{-3}
Individual Datasets	Birmingham Winter	59	0.951	0.976 +/- 0.029	-1.539 +/- 0.660	13.27	18.6
	Birmingham Summer	54	0.957	0.958 +/- 0.028	-0.597 +/- 0.546	12.92	9.3
	East Kilbride Summer	46	0.919	1.108 +/- 0.047	-2.176 +/- 0.528	14.18	0.0
	East Kilbride Winter	39	0.795	1.086 +/- 0.080	0.584 +/- 0.947	22.69	2.6
Combined Datasets	> 30 µg m^{-3}	15	0.914	0.959 +/- 0.078	-1.105 +/- 3.257	14.37	100.0
	All Data	198	0.930	0.953 +/- 0.018	-0.218 +/- 0.322	13.63	8.6

Figure 19 Continued. Analysis of the PM_{10} $BAM_{Ambient}$ after dividing by 1.273.