



Performance Standards for Indicative Ambient Particulate Monitors

**Environment Agency
July 2009**



Foreword

We set up our Monitoring Certification Scheme (MCERTS) to provide a framework of standards you can use to monitor things that affect the environment. MCERTS covers:

- the standards of performance that your monitoring equipment must meet;
- the level your staff must be qualified to; and
- accrediting laboratories and inspecting sites in line with European and International standards.

This document sets out the performance standard for indicative ambient dust monitors. The standard is based on International and European standards.

Indicative dust monitors are used to make measurements of ambient dust on a qualitative or quantitative basis, as explained in section 5.9. They have a role in environmental regulation for the analysis of particulate pollution trends, source identification studies based on pollution roses etc, and other measurements where an indicative result is acceptable.

MCERTS is a formal certification scheme under European Standard EN 45011. Sira Environmental Ltd runs this scheme on our behalf. Appendix 1 provides more information on MCERTS product certification.

Your equipment must be tested by laboratories and test organisations that are accredited to EN ISO/IEC 17025, which is the internationally recognised standard for testing laboratories. Sira assesses the results of the laboratory and field tests, using a group of independent experts known as the Certification Committee.

The benefits of this standard

- The standard gives you certification of your equipment that is formally recognised in the UK and is accepted internationally.
- Regulators can be confident that monitoring equipment which meets the standard provides reliable monitoring data.
- You can be confident that the equipment you use to monitor air pollution has been thoroughly tested and meets standards that are accepted by UK regulators.
- The standard gives manufacturers an independent approval of the equipment they produce, which will improve their access to international markets and increase their sales in the UK.
- The standard helps make sure the public are given accurate and reliable information about air quality.

If you have any questions about the certification process, or would like more information about how to apply, please contact:

Sira Certification Service
12 Acorn Industrial Park
Crayford Road
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Dartford
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DA1 4AL.

Phone: 01322 520508
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If you have any general questions about MCERTS, please contact:

Environment Agency
National Monitoring Services
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You can get more information on MCERTS, including the latest version of this standard from our website at www.mcerts.net.

If you have any comments on this document please contact John Tipping at john.tipping@environment-agency.gov.uk .

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MCERTS FOR INDICATIVE AMBIENT PARTICULATE MONITORS

1. INTRODUCTION

- 1.1 This document describes the MCERTS performance standards for indicative measurements of dust in ambient air.
- 1.2 For the purpose of this document, instruments for ambient dust monitoring are instrumental systems that:
 - continuously monitor ambient pollutant concentrations in situ and automatically produce results;
 - their operation can be based on non-gravimetric analysis, for example, light scattering and/or other optical or non-optical principles, or a gravimetric technique.
- 1.3 Indicative dust monitors are used to make measurements of ambient dust on a qualitative or quantitative basis – see section 5.9. They have a role in environmental regulation for the analysis of particulate pollution trends, source identification studies based on pollution roses etc, and other measurements where an indicative result is acceptable. They cannot be used as a substitute for continuous ambient air quality monitoring systems (CAMs) employed in national air quality monitoring networks for the EU Air Quality Directive. For such applications CAMs should be certified to the MCERTS performance standard for continuous ambient air monitoring systems – see www.mcerts.net.
- 1.4 The main instrument performance characteristics against which an indicative dust monitoring system will be assessed are determined by field and laboratory testing including:
 - field performance against a reference method;
 - measurement uncertainty;
 - constancy of sample volumetric flow;
 - tightness of the sampling system;
 - maintenance interval.
- 1.5 The definitions of the performance characteristics (and other terms used in this document) are given in Section 4.
- 1.6 The general requirements and the performance standards to be met by the indicative dust monitoring instruments are presented in this document in Section 5. More information on MCERTS product certification is given in Appendix 1. The main published and draft international and national standards on which these performance standards are based are presented in Appendix 2.
- 1.7 Throughout this document the terms “MCERTS certificate” and “certificate” refer to the MCERTS product-conformity certificate.

2. AIR QUALITY LIMIT VALUES AND OPERATIONAL CONDITIONS

2.1 Air quality limit values

2.1.1 The performance standards specified in this document are generally expressed as measurement results from which the values of standard uncertainties can be derived. Table 2.1 gives the standards from the Air Quality Strategy for England, Scotland, Wales and Northern Ireland⁽³⁾ and the European Union air-quality limit values⁽⁴⁾ in absolute concentration units.

Table 2.1 National air quality objectives for particulates and European Directive limit and target values for the protection of human health

Pollutant	Applies	Objective	Concentration measured as	Date to be achieved and maintained thereafter	European obligations	Date to be achieved and maintained thereafter	New or existing	
Particles PM ₁₀	UK	50µg.m ⁻³ not to be exceeded more than 35 times per year	24 hour mean	31 December 2004	50µg.m ⁻³ not to be exceeded more than 35 times per year	1 January 2005	Retain existing	
	UK	40µg.m ⁻³	annual mean	31 December 2004	40µg.m ⁻³	1 January 2005		
	Indicative 2010 objectives for PM ₁₀ (from the 2000 Strategy and 2003 Addendum) have been replaced by an exposure reduction for PM _{2.5} (except in Scotland)							
	Scotland	50µg.m ⁻³ not to be exceeded more than 7 times per year	24 hour mean	31 December 2010				Retain existing
	Scotland	18µg.m ⁻³	annual mean	31 December 2010				
Particles PM _{2.5} Exposure reduction	UK (except Scotland)	25µg.m ⁻³	annual mean	2020	Target value 25µg.m ⁻³	2010	New (European obligations still under negotiations)	
	Scotland	12µg.m ⁻³		2020	Limit value 25µg.m ⁻³	2015		
	UK urban areas	Target of 15% reduction in concentrations at urban background		Between 2010 and 2020	Target of 20% reduction in concentrations at urban background	Between 2010 and 2020		

The EU limit values are, in general, very similar to the concentrations given in the UK's Air Quality Strategy. The limit values that have been used to derive the performance characteristics specified in this document are given in Table 2.2.

Table 2.2 Limit value used for MCERTS performance standards for particulates

Pollutant	Limit value
Particulate matter (PM ₁₀)	50.0 µg/m ³
Particulate matter (PM _{2.5})	25.0 µg/m ³

2.2 Operational conditions

2.2.1 Indicative monitors should be assessed under conditions which are representative of the most challenging intended application for which certification is sought. In rural and remote sites, low concentration levels may be encountered, and monitors should have appropriate detection limits and minimal zero and span drift characteristics. In urban locations, including kerbside sites, monitors are expected to monitor rapidly varying concentrations, over a wide dynamic range.

2.2.2 Typical levels of particulate PM₁₀ concentrations measured in the UK are given in Table 2.3.

Table 2.3: Typical concentrations of particulates at different locations

Pollutant	Rural		Kerbside	
	Short term	Long term	Short term	Long term
Particulates (PM ₁₀)	30 µg/m ³ hourly average	20 µg/m ³ annual average	45 µg/m ³ annual average	35 µg/m ³ annual average

3. REFERENCES

- 1 Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe.
- 2 European Air Quality Framework and First Daughter Directives, Framework Directive, 96/62 EC, Daughter Directive for SO₂, NO₂, PM₁₀ and Lead, 1999/30/EC, 22 April 1999.
- 3 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, (Volume 1) DEFRA, July 2007.
- 4 Statutory Instruments 2007, No.64 Environmental Protection, The Air Quality Standards Regulations 2007.
- 5 Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1st ed, Geneva, Switzerland, ISO, 1993.
- 6 Guide to the Demonstration of Equivalence of Ambient Air Monitoring Methods-

4. DEFINITIONS OF PERFORMANCE CHARACTERISTICS AND OTHER TERMS

Availability: Fraction of the total monitoring time for which data of acceptable quality have been collected (excluding servicing and calibrations).

Averaging time: Period of time over which an arithmetic or time weighted average of concentrations is calculated [T_a – is the averaging period used by the CAM; T_{ra} is the required data averaging period, eg prescribed by legislation].

Measurement uncertainty: Uncertainty calculated by comparing the measurement results with a standard reference method assuming linear relationship between both measurements and applying orthogonal regression calculations.

Detection limit: The concentration value of determinand substance above which there is at least a 95 % degree of confidence that the measured value is different from zero.

Maintenance interval: Time in the operating environment in the field over which the CAM's does not require maintenance operations.

Constancy of sample volumetric flow: Sample volumetric flow averaged over the sampling time at different filter dust loading.

Tightness of the sampling system: Leak rate of the sampling system measured either by volume flow differential or by the pressure drop method.

5. GENERAL INSTRUMENT REQUIREMENTS

5.1 General requirements for indicative particulate monitors

5.1.1 Manufacturers are required to submit the following:

- two identical, complete particulate monitoring systems;
- all necessary components for operation under field conditions;
- all sampling components (including the sampling head, if provided);

5.1.2 The particulate concentrations measured are generally expressed in density units (mass of determinand per unit volume of the ambient atmosphere). Results reported in units of mass per unit volume shall be expressed at measured temperature and pressure.

5.1.3 Instruments that have output readings sensitive to ambient air temperature and/or pressure shall be able to make corrections for changes in these parameters. These corrections may be carried out by using in-built pressure and temperature sensors or by using external sensors. The manufacturer shall provide the test house with

information as to whether any in-built temperature and pressure corrections are being applied. Where no internal corrections are applied, the manufacturer or supplier shall provide the test house with any algorithms that are required for the conversion of the instrument readings to different ambient temperatures and pressures.

5.2 Response times

- 5.2.1 For the response times RT_{rise} and RT_{fall} as defined in Section 4 (not determined as part of the performance tests) relevant estimates can be provided by the manufacturer.

5.3 Averaging times

- 5.3.1 Most of the performance requirements given in this document apply to results produced by particulate analysers that are averaged values of the pollutant concentration over a period defined as the averaging time T_a . In cases where the monitor internally produces averaged results and where the averaging time T_a is selectable, then it shall be selected by the manufacturer or supplier, in consultation with the MCERTS Certification Committee and the test house(s). In most cases the averaging times specified for air quality monitoring given in Table 5.1 should be used. The averaging times actually used will be stated on the MCERTS certificate. Shorter averaging times may be required when the particulate monitors are used to assess individual source impact on ambient air quality in conjunction with the meteorological information. Table 5.1 lists examples of the averaging times used in the UK for collecting ambient air quality information.

Table 5.1: Examples of averaging times used for sampling

Pollutant	Typical averaging time (T_a^a)
Particulates (PM ₁₀)	24 hours(legislative)
Particulates (PM _{2.5})	24 hours(legislative)
Particulates (PM ₁₀)	1 hour (in source impact studies)
Particulates (PM _{2.5})	1 hour (in source impact studies)

^adefined in Section 4.

5.4 Certification range

- 5.4.1 The instrument manufacturer or supplier shall specify and agree with the MCERTS Certification Committee a certification range of concentrations over which the instrument is to be tested.
- 5.4.2 Each certification range shall be generally between zero and a maximum value of the particulate concentration. These values shall be agreed by the MCERTS Certification Committee as being fit for the intended purpose.
- 5.4.3 Typical values of the certification range for indicative monitors are given in Table 5.2. These ranges are recommended unless the monitor manufacturer or supplier and the Certification Committee agree that there is a strong justification for selecting

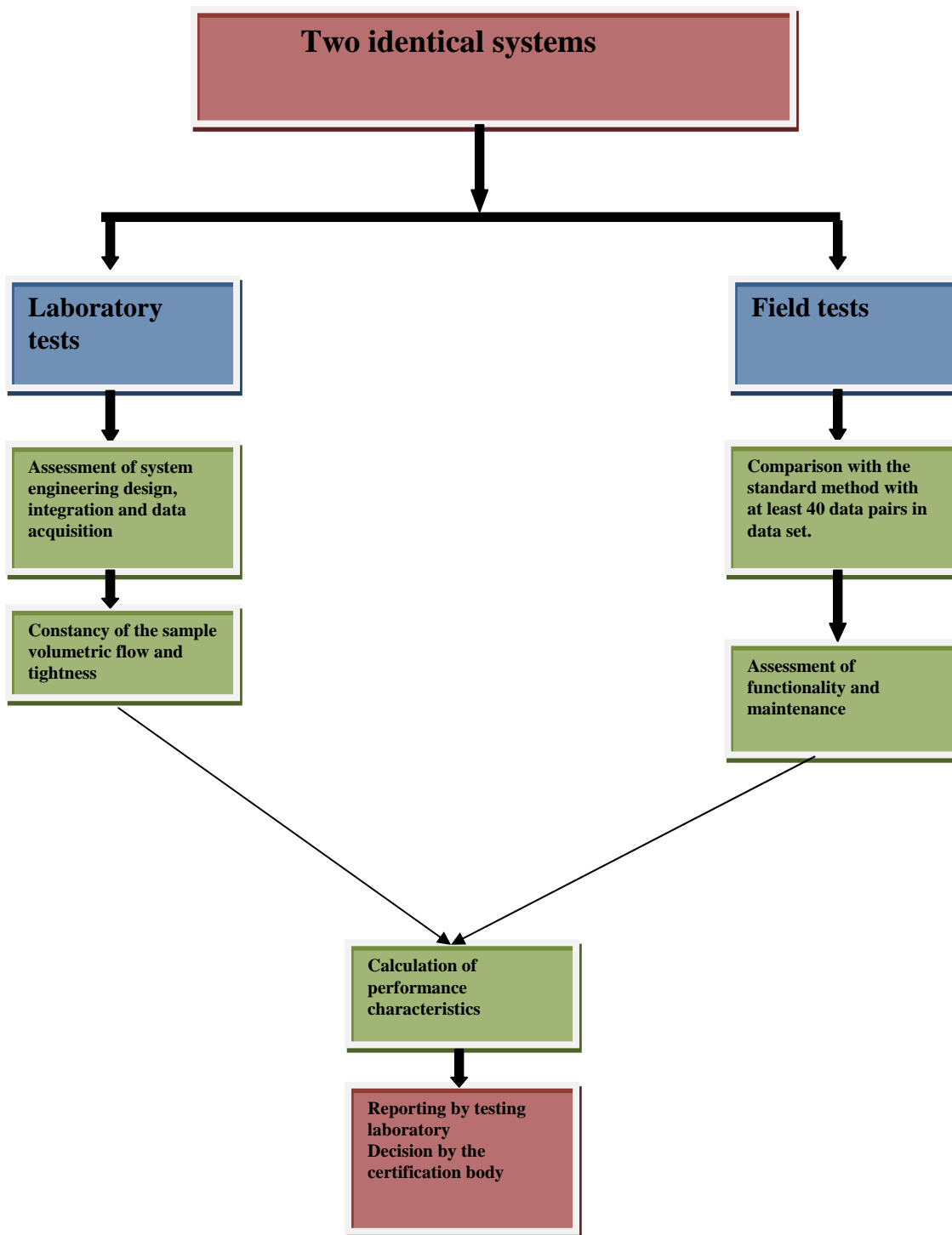
different ranges. If a manufacturer or supplier wishes to demonstrate performance over different ranges, additional testing will be required for each range.

Table 5.2: Typical certification ranges for indicative monitors

	Rural and remote sites (Category 1)		Urban background/centre, suburban, kerbside, roadside and industrial sites (Category 2)	
	Scale min.	Scale max.	Scale min.	Scale max.
PM ₁₀	0.0 µg/m ³	75 µg/m ³	0.0 µg/m ³	150 µg/m ³
PM _{2.5}	0.0 µg/m ³	50 µg/m ³	0.0 µg/m ³	75 µg/m ³

- 5.4.4 Where the instrument has user-selectable settings, range for example, these would be chosen by the instrument manufacturer or supplier and agreed with the Certification Committee in conjunction with the test house(s), to be appropriate for the certification range. In practice, the range selected is likely to be similar to the certification range, although this is not essential. However, the instrument will be tested only over the certification range. The settings, once chosen, will not be altered during the tests. The settings used will be stated on the certificate.
- 5.4.5 The certificate will list all the ranges certified and the instrument settings used, and will state explicitly the performance characteristics tested and the application category or which each range is certified, together with any relevant limit value (where applicable).
- 5.5 Performance standards for indicative monitors measuring particulate matter (PM10 and PM2.5)**
- 5.5.1 Indicative monitors measure particulate material over a defined averaging time (T_a) and:
- apply a non-gravimetric measurement principle such as for example light scattering or laser nephelometry;
 - use a gravimetric technique;
 - measure different particulate fractions, either using sampling heads or simulating the required cut-off characteristics through a software algorithm.
- 5.5.2 The sampling system is an inherent component of gravimetric particulate monitors, as they require size-selective sampling heads to collect particulate material preferentially according to its aerodynamic size. Two categories of particulate material are currently monitored, PM₁₀ and PM_{2.5}. These refer to the aerodynamic size of ambient particulates collected with sampling heads for which a 50% cut-off is achieved. In instruments not equipped with sampling heads the cut off characteristic may be simulated by the relevant software.
- 5.5.3 The test procedure for indicative monitors is shown in Figure 1.

Figure 1 - MCERTS certification of indicative particulate monitors



5.5.4 The laboratory tests depend on the measurement technique employed by the indicative monitor. The requirements are specified in section 5.6.

5.6 Laboratory tests for indicative particulate monitors

Laboratory testing of instruments measuring concentrations of particulate matter in ambient air is limited to parameters related to stability of flow through the filter or the measurement cell and the provision of a representative sample. The following parameters shall be tested:

- constancy of sample volumetric flow;
- tightness of the sampling system.

The performance criteria related to the above parameters are given in Table 5.3

Table 5.3 Performance requirements for indicative particulate CAMS (laboratory tests)

Parameter	Performance requirement
Constancy of sample volumetric flow	Sample volumetric flow averaged over the sampling time to remain constant within $\pm 3\%$ of the rated value. All instantaneous values to remain within $\pm 5\%$ of the rated value.
Tightness of the sampling system	Leakage not to exceed 2 % of the sampled volume.

5.6.1 Constancy of sample volumetric flow

If the instruments are equipped with an air filter system for calibration the testing shall be carried out providing loaded filters, volumetric flow measuring device and a pressure measuring device. Three pre-loaded filters with the particulate load of approximately 0%, 50%, and 80% of the maximum permissible filter loading shall be used. For each filter the constancy of the sample volumetric flow shall be recorded every 30 minutes as a 3 minute average over the time period of at least 24 hours.

5.6.2 Tightness of the sampling system

The testing is normally carried out with the help of a pressure measuring device and a volumetric flow measuring system. The leak rate of the entire instrument shall be determined if it is feasible. This includes the inlet as well as the whole sampling system and the measuring system. If because of the instrument design the complete system tightness cannot be measured the leak rate can be determined separately for the sampling part and the measuring part. The leak rate can be measured by the determination of volume flow at the inlet and outlet of the system or by the pressure drop method. In the latter case the system is sealed at the inlet and evacuated by a built in or separate pump and the pressure increase due to leaks is measured over the period of 5 minutes. The leak rate V_L determination shall be repeated three times. It is calculated from the following formula:

$$V_L = \frac{\Delta P \cdot V_g}{P_0 \cdot \Delta t}$$

where: ΔP – pressure drop determined over the time interval Δt
 P_0 - pressure at time t_0
 V_g - estimated total volume of the system
 Δt - time interval of the pressure increment

5.7 Field testing of indicative particulate monitors

5.7.1 General principles

Field tests are performed using two test instruments operated side by side with two standard reference method units. The purpose of the measurements is to assess the uncertainty of the test instruments through the use of two instruments working in parallel and the comparability of the instruments with the standard reference methods, also working in parallel.

Results of existing studies can be used provided that the requirements of the relevant sampling standards have been met.

Performance criteria for field test results are given in Table 5.4. The tests, calculations of the performance characteristics and calibration procedures shall be conducted in accordance with the Guide to the demonstration of equivalence of ambient air monitoring methods⁽⁶⁾.

Table 5.4 Performance standards for indicative CAMs measuring PM₁₀ and PM_{2.5} (field tests)

Performance characteristic	Performance standard
Between sampler/instrument uncertainty for the complete data set	$\leq 5 \mu\text{g}/\text{m}^3$
Between sampler/instrument uncertainty for two data sets obtained by splitting the full data set into values below and above 50% of the limit value	$\leq 5 \mu\text{g}/\text{m}^3$
Highest resulting uncertainty estimate comparison against data quality objective (measurement uncertainty)	$W_{CM} \leq W_{dqo}$ Measurement uncertainty defined as $W_{dqo} = 50\%$ for indicative instruments
Maintenance interval	Two weeks. This performance characteristic shall be stated by the manufacturer and verified during the field tests.

Note: Calculation algorithms of W_{CM} and W_{dqo} criterion are defined in Guide to the demonstration of equivalence of ambient air monitoring methods⁽⁶⁾.

5.7.2 Experimental conditions

The test sites selected for the field tests should be representative of the conditions under which the instruments are likely to operate. Occurrences of possible episodes of high concentrations are desirable. One comparison run consisting of 40 paired results should be carried out with the emphasis on the following variables:

- composition of the PM fraction, preferably including high and low fractions;
- high and low air temperature and humidity;
- large variations of wind speed to cover the impact on sampling inlet performance.

During the tests the following information should be collected and recorded:

- setting-up procedures, equipment and intervals;
- results of the quality assurance checks;
- temperature and pressure of the sampled air;
- humidity and other relevant conditions;
- events likely to affect the measurement results.

A minimum of 40 measurement results, each averaged over a period of 24 hours constitutes a comparison run. The site selected for testing should have a dust composition representative of the intended application and the range of concentrations should be appropriate for the certification range. The Certification Committee will confirm the suitability of the selected site.

5.7.3 Calculation of performance characteristics

The uncertainty between the instruments should be determined:

- for the complete data set;
- for two data sets obtained by splitting the whole data set according to PM concentrations; above or below 50% of the limit value;
- for the standard reference method instruments.

5.7.4 Comparison with the standard reference method

For the evaluation of uncertainty due to the lack of comparability between the instrument under tests and the standard reference method it is assumed that the relationship between both measurements can be described by a linear function described in Guide to the Demonstration of Equivalence of Ambient Air Monitoring Methods⁽⁶⁾.

The equation coefficients are calculated using a regression technique involving symmetrical treatment of both variables. A commonly applied computational technique is that of orthogonal regression. The regression equation is calculated for:

- each of the instruments individually;
- data sets for each individual site if data from different sites are used.

5.8 Evaluation of data from indicative particulate monitor tests

5.8.1 Data evaluation procedures

Evaluation of the collected data involves the following stages:

- Evaluation of suitability of data sets;
- Calculation of performance characteristics including between sampler/instrument uncertainty and comparison with the standard method (two units);
- Calculation of the expanded uncertainty of the sampler/instrument under tests;
- Application of the calibration functions (if required);
- Application of the pass-fail criteria based on the comparison of the highest expanded uncertainty of the test results with the data quality objective.

The highest resulting uncertainty estimate W_{CM} is compared with the expanded relative uncertainty based on the data quality objectives W_{dqo} . The criteria for acceptance or rejection are as follows:

- $W_{CM} \leq W_{dqo}$ the instrument is accepted as indicative;
 $W_{CM} > W_{dqo}$ the instrument is not accepted as indicative.

Data may be removed from the data set when there are sound technical reasons for doing so. This data ratification process applies in particular to spikes that can be considered unrealistic for a particular data set. The data ratification process cannot deplete the data set below the data capture level of 90%. The calculation procedures and formulae for evaluation of the data sets are given in the Guide⁽⁶⁾. The flow chart illustrating the data evaluation process is given in Figure 2.

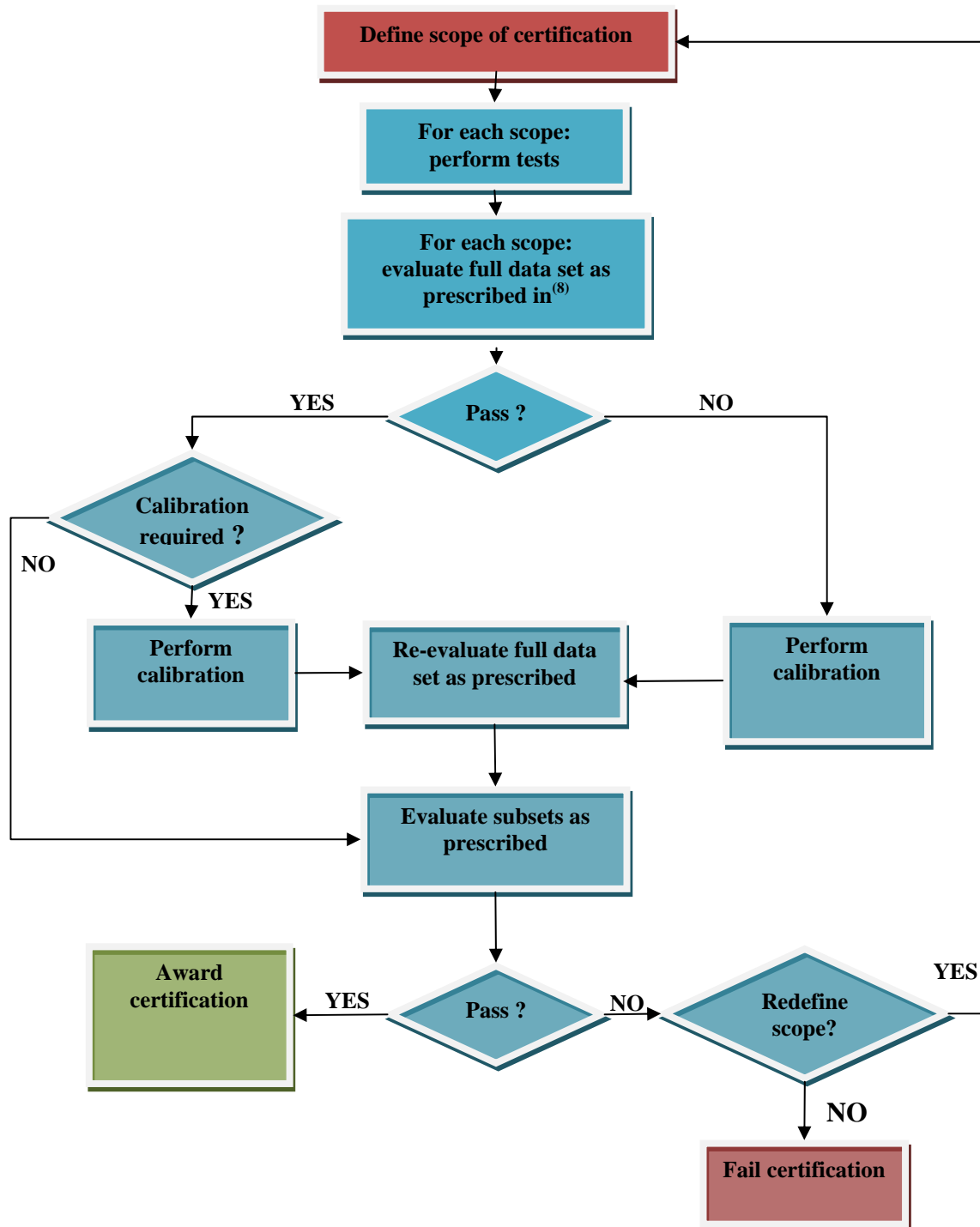
5.8.2 Summary of acceptable deviations from strict adherence to the Guide to the demonstration of equivalence of ambient air monitoring methods

Recent UK experience in testing particulate monitoring instrumentation for the purpose of national network has revealed ambiguities in the treatment of data required by the Guide⁽⁶⁾. The current MCERTS performance standards accept the following recommendations resulting from this work:

- The Guide states that precondition of data acceptance of a dataset is that the slope and intercept should not be significantly different from 1 and zero for any of the individual or combined datasets. These criteria may have the effect of punishing instruments with low scatter while rewarding instruments with relatively large scatter.
- When an instrument fails on W_{CM} (expanded uncertainty) for the \square 50% of the limit value dataset alone either before or after the slope and/or intercept correction this is not sufficient grounds for rejection.
- If standard reference method is used during the field tests it should be noted that the requirements of EN 14907 for maximum 15 days filter storage before weighing and filter rejection if the difference between the masses of the two pre-weighings and two post-weighings is greater than 40 and 60 μg , respectively are too restrictive and may result in severe impact on the capture

of data. Advice shall be sought from the Certification Committee before application of such criteria.

Figure 2 - Evaluation of data during MCERTS certification of indicative particulate monitors



5.9 Operational conditions for the validity of MCERTS measurement results

When certified the indicative dust monitoring analysers can be operated in one of two ways:

For qualitative measurements

Providing qualitative measurement data for the analysis of particulate pollution trends, and source identification studies based on pollution roses etc. Such application can rely on instrument factory calibration only.

For quantitative measurements

Providing measurement data with the uncertainty defined for indicative instruments ($\pm 50\%$). This can be achieved on condition that each instrument used for measurement has been calibrated on the specific site where monitoring is taking place against a standard reference method for a period of two weeks and the resulting slope and intercept have been used for instrument calibration. Using non-standard filters and procedures for this purpose is not acceptable.

To maintain the validity of data this calibration has to be repeated at least every twelve months or when the instrument is moved to a different site. Consistent results of the calibration may lead to less frequent repetition of the calibration process, in agreement with the Certification Committee.

APPENDIX 1 – MCERTS PRODUCT CERTIFICATION

A1.1 Certification process

MCERTS product certification comprises two phases. These are:

- Laboratory and field testing: used to determine performance characteristics, where such testing requires a highly controlled environment;
- Surveillance: initial and continuing – which comprises an audit of the manufacturing process to confirm that the manufacturer has provisions to ensure reproducibility and to control any design changes in such a way that they do not degrade performance below the MCERTS standards.

Manufacturers seeking certification should contact the Certification Body who will advise on any specific requirements for the automatic monitor under consideration.

Only a complete monitor shall be certified. A monitor can be supplied with a number of options, for example mains or battery powered, or different enclosure options may be available. Two complete monitors shall undergo the full conformity tests.

In selecting the options to be tested, consideration should be given to the options likely to be used in the identified applications. For additional monitor configurations, it may be possible to extend certification by carrying out a subset of the full test programme.

A1.2 Certification Committee

- The role of the Certification Body is to assess and certify compliance with the MCERTS standard for defined applications and conditions.
- In performing this role the MCERTS scheme requires the Certification Body to consider the relevance of the procedures defined in the MCERTS standard to the specific product to be certified. The technology or defined application of a specific product may make certain of the documented tests inappropriate. The Certification Body is required by the MCERTS scheme to exercise its technical judgement when considering these matters.
- Any certification decision based on technical judgement of the standard shall be taken by an appropriately independent, competent person or group of persons, who in this MCERTS standard are referred to as the “Certification Committee”.
- When the Certification Body exercises its technical judgement the rationale supporting any such decision shall be appropriately documented.
- Any certificate issued by the Certification Body shall identify any variations from the normative MCERTS standard.

On request the Certification Body shall provide the MCERTS scheme owner with the rationale for any decision based on technical judgement, within the relevant confidentiality

constraints.

A1.3 Certification range

An automatic monitor will be certified over the range for which it is tested.

A1.4 Testing

Manufacturers may commission testing from any organisation, provided that the requirements for testing organisations can be met. Manufacturers' own test data may also be acceptable.

A1.5 Auditing and surveillance

An audit of the manufacturing process shall be conducted by the Certification Body to confirm that the manufacturer has provisions to ensure manufacturing reproducibility and to control any design changes that may affect product performance.

Subsequent surveillance audits are normally conducted annually until sufficient evidence of a well-proven, robust system has been collected. Once this has been established the Certification Body may extend the interval between audits or require submission of specific audit data for review off site.

A1.6 Modifications to certified automatic monitors

Modifications to certified monitors are allowable so long as manufacturers can demonstrate that these design changes do not degrade the performance of the monitor below the MCERTS performance standards.

Manufacturers must keep detailed records and drawings of all design changes to monitors, and have provisions for design verification, inspection and testing to ensure that the monitors still meet the required performance standards.

The Certification Body will conduct audits of the design changes to monitors to meet the requirements of product certification. Manufacturers must notify the Certification Body of any modifications to equipment that may have a significant effect on monitor performance.

Design modifications or extensions to the range of application of a monitor may require renewed testing. The extent of this renewed testing will depend upon the nature of the modifications to the monitor.

If there is evidence that a modification has only limited effects on the performance of the monitor, then it would not be necessary to retest a monitor completely. In such cases, only a supplementary test would be required to the applicable MCERTS performance standards. In the case of modifications to software, detailed documentation (for example, source code) must be presented to the Certification Body indicating the nature of the modification as well as resultant effects on operation and functionality. The Certification Body will then decide if further testing is required.

APPENDIX 2 - CEN ACTIVITIES SUPPORTING THIS STANDARD

A2.1 Main standards

Determinand	International standard used as basis for performance standards
General	ISO 6879 (1995) Air quality – Performance characteristics and related concepts for air quality measurements ISO 9169 (1994) Air quality –Determination of performance characteristics of measurement methods. Also Amendment 1 (CD) (1998)
Particulates	EN 12341 Air quality – Determination of the PM ₁₀ fraction of suspended particulate matter – Reference method and field test procedure to demonstrate reference equivalence of measurement methods EN 14907:2005 Ambient air quality - Reference gravimetric measurement method for the determination of the PM 2.5 mass fraction of suspended particulate matter
Uncertainty	Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1 st ed, Geneva, Switzerland,ISO,1993.
Equivalence	EC Working Group on Guidance for Demonstration of Equivalence- Guide to Demonstration of Equivalence of Ambient Air Monitoring Methods, October 2008.

A2.2 CEN technical committee and working groups

CEN technical committee and associated working groups	Title
CEN TC 264	Air Quality
WG 15	Reference Methods for PM _{2.5} Measurements in Ambient Air
WG22	Certification of Automatic Measuring Systems