Schedule of Accreditation
issued by
United Kingdom Accreditation Service
2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

UKAS CALIBRATION 0401 Accredited to ISO/IEC 17025:2017	**Ricardo-AEA Limited (Trading as Ricardo Energy & Environment)** **Issue No:** 027 **Issue date:** 02 December 2020	
	Ricardo-AEA **The Gemini Building** **Fermi Avenue** **Harwell** **OX11 0QR**	**Contact: Mr S Eaton** **Tel: +44 (0)1235 753212** **E-Mail: stewart.eaton@ricardo.com** **Website: https://ee.ricardo.com/**
Calibration performed by the Organisations at the locations specified below		

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details		Activity	Location code
Address Ricardo Energy & Environment Ludbridge Mill East Hendred Wantage OX12 8LN	**Local contact** Mr S Eaton Tel: +44 (0)1235 753212 Email: stewart.eaton@ricardo.com	Certified Reference Gases for Air Quality Monitoring Environmental Air Quality Monitoring Instruments Local Office for Site Activities	Harwell
Address Ricardo Energy & Environment 18 Blythswood Square Glasgow G2 4AD	**Local contact** Ms Susannah Telfer Tel: +44 (0)1235 753523 Email: susannah.telfer@ricardo.com	Environmental Air Quality Monitoring Instruments Local Office for Site Activities	Glasgow
Address First Floor, Bright Building, Pencroft Way, Manchester Science Park, Manchester M15 6GZ	**Local contact** Tim Bevington Tel: +44 (0)1235 753125 Email: tim.bevington@ricardo.com	Environmental Air Quality Monitoring Instruments Local Office for Site Activities	Manchester

Site activities performed away from the locations listed above:

Calibration performed by the Organisation at the locations specified

Location details	Activity	Location code
Air Quality Monitoring Stations	Environmental Air Quality Monitoring Instruments	Site
Clients Premises	Particle Number Counting Calibration	Site

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k* = 2)	Remarks	Location Code
COMPRESSED GAS MIXTURES FOR AIR QUALITY MONITORING				Harwell
Carbon monoxide (CO) in air or nitrogen	2 ppm to 5 ppm 5 ppm to 50 ppm	4.5 % 2.0 %	NOTE ppm = parts per million by mole fraction ppb = parts per billion by mole fraction	
Nitric oxide (NO) in nitrogen	0.1 ppm to 0.2 ppm 0.2 ppm to 1 ppm	3.5 % 3.0 %		
Nitrogen dioxide (NO_2) in air	0.1 ppm to 0.2 ppm 0.2 ppm to 1 ppm	4.0 % 3.5 %		
Sulphur dioxide (SO_2) in air	0.1 ppm to 0.2 ppm 0.2 ppm to 1 ppm	3.0 % 2.5 %		
ENVIRONMENTAL INSTRUMENTS FOR AIR QUALITY MONITORING				Harwell Glasgow Manchester
Ozone photometers	10 ppb to 400 ppb			
Calibration factor		3.5 %		
Zero response		3.0 ppb		
Ozone calibrators	10 ppb to 400 ppb	3.5 % + 3.0 ppb		
Particle Counters				
Airborne particle number concentration. Calibration factor for condensation particle counters CPC/PNC	Concentration range 0 cm^{-3} to 100,000 cm^{-3} depending upon particle size	7.3%	Comparison against a traceable reference condensation particle counter at diameters from 10 nm to 200 nm	Harwell and Site
Particle Dilution Systems				
Particle Concentration Reduction Factor (PCRF) measurements of volatile particle removers (VPR)	Dilution factors of the system calibrated at particle diameters from 10 nm to 200 nm	7.5%	Comparison of the particle concentration upstream and downstream of the dilution system.	Harwell and Site

Calibration performed by the Organisation at the locations specified

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k* = 2)	Remarks	Location Code
AIR QUALITY MONITORING STATIONS				Site
Carbon monoxide (CO) analysers	2.0 ppm to 5 ppm 5 ppm to 50 ppm	10 % 2.0 %		
Zero response		0.20 ppm		
Chemiluminescent analysers for nitric oxide and nitrogen dioxide (NO and NO_2)	50 ppb to 2000 ppb			
Calibration factor		3.5 %		
Zero response		2.0 ppb		
Ultraviolet fluorescence analysers for sulphur dioxide (SO_2)	50 ppb to 2000 ppb			
Calibration factor		2.5 %		
Zero response		2.0 ppb		
Ultraviolet absorption analysers for ozone (O_3)				
Calibration factor	0 ppb to 100 ppb 100 ppb to 400 ppb	3.0 ppb 3.0 %		
Zero response		3 ppb		
Determination of particle analyser flow rate	1 litre/min to 18 litre/min	2.2 %		
Determination of Non Automatic hydrocarbon sampler flow rate	10 ml/min to 30 ml/min Flow difference of 0 ml/min to 20 ml/min	1.3 % + 0.37 ml/min 1.7 % + 0.002 ml/min		
Determination of TEOM analyser spring constant (k_0)	4000 g/s^2 to 25000 g/s^2	1.0 %		

END

Appendix - Calibration and Measurement Capabilities

Introduction

The definitive statement of the accreditation status of a calibration laboratory is the Accreditation Certificate and the associated Schedule of Accreditation. This Schedule of Accreditation is a critical document, as it defines the measurement capabilities, ranges and boundaries of the calibration activities for which the organisation holds accreditation.

Calibration and Measurement Capabilities (CMCs)

The capabilities provided by accredited calibration laboratories are described by the Calibration and Measurement Capability (CMC), which expresses the lowest uncertainty of measurement that can be achieved during a calibration. If a particular device under calibration itself contributes significantly to the uncertainty (for example, if it has limited resolution or exhibits significant non-repeatability) then the uncertainty quoted on a calibration certificate will be increased to account for such factors. The CIPM-ILAC definition of the CMC is as follows:

A CMC is a calibration and measurement capability available to customers under normal conditions:
(a) as published in the BIPM key comparison database (KCDB) of the CIPM MRA; or
(b) as described in the laboratory's scope of accreditation granted by a signatory to the ILAC Arrangement.

The CMC is normally used to describe the uncertainty that appears in an accredited calibration laboratory's schedule of accreditation and is the uncertainty for which the laboratory has been accredited using the procedure that was the subject of assessment. The CMC is calculated according to the procedures given in M3003 and is normally stated as an expanded uncertainty at a coverage probability of 95 %, which usually requires the use of a coverage factor of k = 2. An accredited laboratory is not permitted to quote an uncertainty that is smaller than the published CMC in certificates issued under its accreditation.

The CMC may be described using various methods in the Schedule of Accreditation:

As a single value that is valid throughout the range.
As an explicit function of the measurand or of a parameter (see below).
As a range of values. The range is stated such that the customer can make a reasonable estimate of the likely uncertainty at any point within the range.
As a matrix or table where the CMCs depend on the values of the measurand and a further quantity.
In graphical form, providing there is sufficient resolution on each axis to obtain at least two significant figures for the CMC.

Expression of CMCs - symbols and units

In general, only units of the SI and those units recognised for use with the SI are used to express the values of quantities and of the associated CMCs. Nevertheless, other commonly used units may be used where considered appropriate for the intended audience. For example, the term "ppm" (part per million) is frequently used by manufacturers of test and measurement equipment to specify the performance of their products. Terms like this may be used in Schedules of Accreditation where they are in common use and understood by the users of such equipment, providing their use does not introduce any ambiguity in the capability that is being described.

When the CMC is expressed as an explicit function of the measurand or of a parameter, this often comprises a relative term (e.g., percentage) and an absolute term, i.e. one expressed in the same units as those of the measurand. This form of expression is used to describe the capability that can be achieved over a range of values. Some examples are shown below. It should be noted that these expressions are *not* mathematical formulae but are instead written in a commonly used shorthand for expressing uncertainties - therefore, for purposes of clarity, an indication of how they are to be interpreted is also provided below.

<u>DC voltage, 100 mV to 1 V</u>: 0.0025 % + 5.0 µV

Over the range 100 mV to 1 V, the CMC is 0.0025 %·V + 5.0 µV, where V is the measured voltage.

<u>Hydraulic pressure, 0.5 MPa to 140 MPa</u>: 0.0036 % + 0.12 ppm/MPa + 4.0 Pa

Over the range 0.5 MPa to 140 MPa, the CMC is 0.0036 %·p + ($0.12 \cdot 10^{-6} \cdot p \cdot 10^{-6}$) + 4.0 Pa, where p is the measured pressure in Pa.

It should be noted that the percentage symbol (%) simply represents the number 0.01. In cases where the CMC is stated only as a percentage, this is to be interpreted as meaning percentage of the measured value or indication.

Thus, for example, a CMC of 1.5 % means 1.5 · 0.01 · i, where i is the instrument indication.