Schedule of Accreditation

issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

0556

Accredited to ISO/IEC 17025:2017

Horiba MIRA Limited

Issue No: 027 **Issue date:** 18 August 2020

Calibration Centre
Watling Street
Nuneaton
Warwickshire
CV10 0TU

Contact: Mr Philip Macleod
Tel: +44 (0)2476 355643
Fax: +44 (0)2476 358225
E-Mail: calibration.centre@horiba-mira.com
Website: www.horiba-mira.com

Calibration performed at the above address only

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
PRESSURE			Methods consistent with EURAMET CG3.
<u>Gas Pressure Gauge</u>			
Calibration of pressure indicating instruments and gauges	- 90 kPa to 0 Pa 0 to 2 MPa	0.024 % + 0.59 kPa 0.024 % + 0.59 kPa	Calibration of pressure devices with an electrical output can be undertaken
<u>Gas Pressure Absolute</u>			
Calibration of pressure indicating instruments and gauges	10 kPa to 200 kPa 200 kPa to 2.1 MPa	0.15 kPa 0.022 % + 0.59 kPa	
<u>Hydraulic Pressure Gauge</u>			
Calibration of pressure indicating instruments and gauges	0 to 50 MPa	0.016 % + 0.11 MPa	
Values and uncertainties listed below are applicable for the calibration of both measurement instruments and for instruments with an output. the method used is by direct comparison unless otherwise stated in the remarks column.			
ELECTRICAL			
DC VOLTAGE			
Generation	0 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V 330 V to 1000 V	20 ppm + 1.0 µV 11 ppm + 2.0 µV 12 ppm + 20 µV 18 ppm + 150 µV 18 ppm + 1.5 mV	
Measurement	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	47 ppm + 1.2 µV 31 ppm + 4.0 µV 31 ppm + 80 µV 47 ppm + 600 µV 51 ppm + 6.0 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC VOLTAGE			
Generation	1 mV to 33 mV		
	0.2 Hz to 10 Hz	800 ppm + 100 µV	
	10 Hz to 45 Hz	800 ppm + 100 µV	
	45 Hz to 10 kHz	150 ppm + 100 µV	
	10 kHz to 20 kHz	200 ppm + 100 µV	
	20 kHz to 50 kHz	0.10 % + 100 µV	
	50 kHz to 100 kHz	0.35 % + 110 µV	
	100 kHz to 500 kHz	0.80 % + 150 µV	
	33 mV to 330 mV		
	0.2 Hz to 10 Hz	300 ppm + 120 µV	
	10 Hz to 45 Hz	300 ppm + 120 µV	
	45 Hz to 10 kHz	150 ppm + 120 µV	
	10 kHz to 20 kHz	160 ppm + 120 µV	
	20 kHz to 50 kHz	350 ppm + 120 µV	
	50 kHz to 100 kHz	800 ppm + 140 µV	
	100 kHz to 500 kHz	0.20 % + 190 µV	
	0.33 V to 3.3 V		
	0.2 Hz to 10 Hz	300 ppm + 400 µV	
	10 Hz to 45 Hz	300 ppm + 400 µV	
	45 Hz to 10 kHz	150 ppm + 400 µV	
	10 kHz to 20 kHz	190 ppm + 400 µV	
	20 kHz to 50 kHz	300 ppm + 400 µV	
	50 kHz to 100 kHz	700 ppm + 460 µV	
	100 kHz to 500 kHz	0.24 % + 1.2 mV	
	3.3 V to 10.23 V		
	0.2 Hz to 10 Hz	300 ppm + 4.5 mV	
	3.3 V to 33 V		
	10 Hz to 45 Hz	300 ppm + 4.0 mV	
	45 Hz to 10 kHz	150 ppm + 4.0 mV	
	10 kHz to 20 kHz	240 ppm + 4.0 mV	
	20 kHz to 50 kHz	350 ppm + 4.0 mV	
	50 kHz to 100 kHz	900 ppm + 5.0 mV	
	33 V to 330 V		
	10 Hz to 45 Hz	190 ppm + 30 mV	
	45 Hz to 10 kHz	200 ppm + 30 mV	
	10 kHz to 20 kHz	250 ppm + 30 mV	
	20 kHz to 50 kHz	300 ppm + 30 mV	
	50 kHz to 100 kHz	0.20 % + 80 mV	
	330 V to 1020 V		
	45 Hz to 1 kHz	300 ppm + 120 mV	
	1 kHz to 5 kHz	250 ppm + 120 mV	
	5 kHz to 10 kHz	300 ppm + 120 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC VOLTAGE (cont'd) Measurement	20 mV to 200 mV		
	0.2 Hz to 10 Hz	0.40 %	
	1 mV to 200 mV		
	10 Hz to 50 Hz	0.30 % + 30 µV	
	50 Hz to 100 Hz	0.080 % + 30 µV	
	100 Hz to 30 kHz	0.060 % + 30 µV	
	30 kHz to 50 kHz	0.070 % + 30 µV	
	50 kHz to 100 kHz	0.36 % + 30 µV	
	100 kHz to 200 kHz	0.91 % + 50 µV	
	200 kHz to 1 MHz	2.0 % + 200 µV	
	1 MHz to 2 MHz	5.0 % + 400 µV	
	0.2 V to 2 V		
	0.2 Hz to 10 Hz	0.40 %	
	10 Hz to 50 Hz	0.31 % + 300 µV	
	50 Hz to 100 Hz	0.080 % + 300 µV	
	100 Hz to 30 kHz	0.060 % + 300 µV	
	30 kHz to 50 kHz	0.060 % + 300 µV	
	50 kHz to 100 kHz	0.36 % + 300 µV	
	100 kHz to 200 kHz	0.91 % + 500 µV	
	200 kHz to 1 MHz	2.0 % + 2.0 mV	
	1 MHz to 2 MHz	5.0 % + 4.0 mV	
	2 V to 20 V		
	0.2 Hz to 10 Hz	0.40%	
	10 Hz to 50 Hz	0.30 % + 3.0 mV	
	50 Hz to 100 Hz	0.080 % + 3.0 mV	
	100 Hz to 2 kHz	0.070 % + 3.0 mV	
	2 kHz to 10 kHz	0.10 % + 3.0 mV	
	30 kHz to 50 kHz	0.060 % + 30 µV	
	50 kHz to 100 kHz	0.30 % + 300 µV	
	10 kHz to 30 kHz	0.15 % + 3.0 mV	
	30 kHz to 50 kHz	0.16 % + 3.0 mV	
	50 kHz to 100 kHz	0.36 % + 3.0 mV	
	100 kHz to 200 kHz	0.90 % + 5.0 mV	
	200 kHz to 1 MHz	4.0 % + 40 mV	
	1 MHz to 2 MHz	7.0 % + 40 mV	
	20 V to 200 V		
	0.2 Hz to 10 Hz	0.40%	
	10 Hz to 50 Hz	0.31 % + 30 mV	
	50 Hz to 100 Hz	0.08 % + 30 mV	
	100 Hz to 2 kHz	0.08 % + 30 mV	
	2 kHz to 10 kHz	0.11 % + 30 mV	
	10 kHz to 30 kHz	0.15 % + 30 mV	
	30 kHz to 50 kHz	0.16 % + 30 mV	
	50 kHz to 100 kHz	0.37 % + 30 mV	
	100 kHz to 200 kHz	0.90 % + 5.0 mV	
	200 kHz to 1 MHz	4.0 % + 40 mV	
	1 MHz to 2 MHz	4.0 % + 40 mV	
	200 V to 750 V		
	50 Hz to 100 Hz	0.39 % + 110 mV	
	100 Hz to 2 kHz	0.19 % + 110 mV	
	2 kHz to 10 kHz	0.23 % + 110 mV	
	10 kHz to 25 kHz	0.28 % + 110 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DC CURRENT			
Generation	0 µA to 330 µA	150 ppm + 25 nA	
	330 µA to 3.3 mA	110 ppm + 100 nA	
	3.3 mA to 33 mA	100 ppm + 2.0 µA	
	33 mA to 330 mA	100 ppm + 20 µA	
	330 mA to 1.1 A	210 ppm + 80 µA	
	1.1 A to 3 A	390 ppm + 1.0 mA	
	3 A to 11 A	510 ppm + 2.5 mA	
	11 A to 20.5 A	0.10 % + 4.0 mA	
	10 A to 16.5 A	0.25 % + 3.0 mA	For the calibration of toroidal clamp-on ammeters
	16.5 A to 150 A	0.25 % + 1.0 A	
	150 A to 1025 A	0.25 % +1.5 A	
Measurement	0 µA to 200 µA	610 ppm + 5.0 nA	
	200 µA to 2 mA	480 ppm + 40 nA	
	2 mA to 20 mA	480 ppm + 0.40 µA	
	20 mA to 200 mA	600 ppm + 4.0 µA	
	200 mA to 2 A	0.11 % + 40 µA	
AC CURRENT			
Generation	29 µA to 330 µA		
	10 Hz to 20 Hz	0.20 % + 730 nA	
	20 Hz to 45 Hz	0.15 % + 700 nA	
	45 Hz to 1 kHz	0.13 % + 700 nA	
	1 kHz to 5 kHz	0.30 % + 700 nA	
	5 kHz to 10 kHz	0.80 % + 870 nA	
	10 kHz to 30 kHz	1.6 % + 2.0 µA	
	330 µA to 3.3 mA		
	10 Hz to 20 Hz	0.20 % + 2,0 µA	
	20 Hz to 45 Hz	0.13 % + 2.0 µA	
	45 Hz to 1 kHz	0.10 % + 2.0 µA	
	1 kHz to 5 kHz	0.20 % + 2.0 µA	
	5 kHz to 10 kHz	0.50 % + 2.2 µA	
	10 kHz to 30 kHz	1.0 % + 2.5 µA	
	3.3 mA to 33 mA		
	10 Hz to 20 Hz	0.18 % + 10 µA	
	20 Hz to 45 Hz	0.090 % + 10 µA	
	45 Hz to 1 kHz	0.040 % + 10 µA	
	1 kHz to 5 kHz	0.080 % + 10 µA	
	5 kHz to 10 kHz	0.20 % + 15 µA	
	10 kHz to 30 kHz	0.40 % + 15 µA	
	33 mA to 330 mA		
	10 Hz to 20 Hz	0.18 % + 100 µA	
	20 Hz to 45 Hz	0.090 % + 100 µA	
	45 Hz to 1 kHz	0.040 % + 100 µA	
	1 kHz to 5 kHz	0.10 % + 120 µA	
	5 kHz to 10 kHz	0.20 % + 200 µA	
	10 kHz to 30 kHz	0.40 % + 300 µA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC CURRENT (cont'd)			
Generation (cont'd)	330 mA to 1.1 A		
	10 Hz to 45 Hz	0.18 % + 780 µA	
	45 Hz to 1 kHz	0.050 % + 780 µA	
	1 kHz to 5 kHz	0.60 % + 1.8 mA	
	5 kHz to 10 kHz	2.5 % + 6.0 mA	
	1.1 A to 3 A		
	10 Hz to 45 Hz	0.18 % + 1.3 mA	
	45 Hz to 1 kHz	0.060 % + 1.3 mA	
	1 kHz to 5 kHz	0.60 % + 2.2 mA	
	5 kHz to 10 kHz	2.5 % + 6.2 mA	
	3 A to 11 A		
	45 Hz to 100 Hz	0.060 % + 9.0 mA	
	100 Hz to 1 kHz	0.10 % + 9.0 mA	
	1 kHz to 5 kHz	3.0 % + 9.0 mA	
	11 A to 20 A		
	45 Hz to 100 Hz	0.12 % + 15 mA	
	100 Hz to 1 kHz	0.15 % + 15 mA	
	1 kHz to 5 kHz	3.0 % + 15 mA	
	10 A to 16.5 A		
	45 Hz to 65 Hz	0.28 % + 3.0 mA	For the calibration of toroidal clamp-on ammeters
	65 Hz to 440 Hz	0.79 % + 3.0 mA	
	16.5 A to 150 A		
	45 Hz to 65 Hz	0.28 % + 13 mA	For the calibration of toroidal clamp-on ammeters
	65 Hz to 440 Hz	0.79 % + 13 mA	
	150 A to 1025 A		
	45 Hz to 65 Hz	0.28 % + 40 mA	For the calibration of toroidal clamp-on ammeters
	65 Hz to 440 Hz	0.79 % + 40 mA	
Measurement	0 µA to 200 µA		
	40 Hz to 50 Hz	0.42 % + 30 nA	
	50 Hz to 200 Hz	0.24 % + 30 nA	
	200 Hz to 1 kHz	0.48 % + 30 nA	
	1 kHz to 10 kHz	0.57 % + 30 nA	
	200 µA to 2 mA		
	40 Hz to 50 Hz	0.36 % + 300 nA	
	50 Hz to 1 kHz	0.18 % + 300 nA	
	1 kHz Hz to 10 kHz	0.15 % + 300 nA	
	10 kHz to 30 kHz	0.15 % + 300 nA	
	30 kHz to 50 kHz	0.30 % + 300 nA	
	50 kHz to 100 kHz	0.50 % + 300 nA	
	2 mA to 20 mA		
	40 Hz to 50 Hz	0.36 % + 3.0 µA	
	50 Hz to 200 Hz	0.18 % + 3.0 µA	
	200 Hz to 1 kHz	0.15 % + 3.0 µA	
	1 kHz to 10 kHz	0.15 % + 3.0 µA	
	10 kHz to 30 kHz	0.25 % + 3.0 µA	
	30 kHz to 50 kHz	0.30 % + 3.0 µA	
	50 kHz to 100 kHz	0.50 % + 3.0 µA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC CURRENT (cont'd)			
Measurement (cont'd)	20 mA to 200 mA		
	40 Hz to 50 Hz	0.36 % + 30 µA	
	50 Hz to 200 Hz	0.18 % + 30 µA	
	200 Hz to 1 kHz	0.15 % + 30 µA	
	1 kHz to 10 kHz	0.21 % + 30 µA	
	10 kHz to 30 kHz	0.50 % + 30 µA	
	30 kHz to 50 kHz	1.0 % + 30 µA	
	50 kHz to 100 kHz	3.0 % + 30 µA	
	0.2 A to 2 A		
	40 Hz to 50 Hz	0.42 % + 300 µA	
	50 Hz to 200 Hz	0.24 % + 300 µA	
	200 Hz to 1 kHz	0.36 % + 300 µA	
	1 kHz to 10 kHz	0.52 % + 300 µA	
	10 kHz to 30 kHz	1.5 % + 300 µA	
	30 kHz to 50 kHz	4.0 % + 300 µA	
DC RESISTANCE			
Generation	0 Ω to 11 Ω	40 ppm + 2.0 mΩ	
	11 Ω to 33 Ω	30 ppm + 3.1 mΩ	
	33 Ω to 110 Ω	28 ppm + 4.0 mΩ	
	110 Ω to 330 Ω	28 ppm + 6.3 mΩ	
	330 Ω to 1.1 kΩ	28 ppm + 20 mΩ	
	1.1 kΩ to 3.3 kΩ	28 ppm + 51 mΩ	
	3.3 kΩ to 11 kΩ	28 ppm + 150 mΩ	
	11 kΩ to 33 kΩ	28 ppm + 480 mΩ	
	33 kΩ to 110 kΩ	28 ppm + 550 mΩ	
	110 kΩ to 330 kΩ	32 ppm + 14 Ω	
	330 kΩ to 1.1 MΩ	32 ppm + 24 Ω	
	1.1 MΩ to 3.3 MΩ	60 ppm + 110 Ω	
	3.3 MΩ to 11 MΩ	130 ppm + 360 Ω	
	11 MΩ to 33 MΩ	250 ppm + 4.1 kΩ	
	33 MΩ to 110 MΩ	500 ppm + 19 kΩ	
	110 MΩ to 330 MΩ	0.30 % + 230 kΩ	
	330 MΩ to 1.1 GΩ	1.5 % + 1.2 MΩ	
Measurement	0 Ω to 20 Ω	94 ppm + 6.1 mΩ	
	20 Ω to 200 Ω	67 ppm + 7.4 mΩ	
	200 Ω to 2 kΩ	59 ppm + 14 mΩ	
	2 kΩ to 20 kΩ	69 ppm + 80 mΩ	
	20 kΩ to 200 kΩ	120 ppm + 900 mΩ	
	200 kΩ to 2 MΩ	190 ppm + 9.0 Ω	
	2 MΩ to 20 MΩ	0.11 % + 90 Ω	
	20 MΩ to 200 MΩ	2.4 % + 20 kΩ	
	200 MΩ to 1 GΩ	4.0 % + 200 kΩ	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
CALIBRATION OF CHARGE AMPLIFIERS	*1 pC to 33 pC*		
	200 mHz to 10 Hz	1.2%	
	10 Hz to 45 Hz	930 ppm + 0.0060 pC	
	63 Hz to 10 kHz	200 ppm + 0.0060 pC	
	33 pC to 330 pC		
	200 mHz to 10 Hz	1.2%	
	10 Hz to 45 Hz	360 ppm + 0.0080 pC	
	63 Hz to 10 kHz	200 ppm + 0.0080 pC	
	330 pC to 3300 pC		
	200 mHz to 10 Hz	1.2%	
	10 Hz to 45 Hz	360 ppm + 0.050 pC	
	63 Hz to 10 kHz	200 ppm + 0.060 pC	
	3300 pC to 33000 pC		
	200 mHz to 10 Hz	1.2%	
	10 Hz to 45 Hz	360 ppm + 0.65 pC	
	63 Hz to 10 kHz	200 ppm + 0.60 pC	
	33000 pC to 100000 pC		
	200 mHz to 10 Hz	1.2%	
	10 Hz to 45 Hz	240 ppm + 2.0 pC	
	63 Hz to 10 kHz	250 ppm + 6.0 pC	
Attenuation			
With reference to a set value of 3 V	0 dB to 30 dB *DC and 3 Hz to 10 kHz*	0.020 dB	
TEMPERATURE SIMULATION			
Thermocouple type			
K	-200 °C to 1300 °C	0.30 °C	Including reference junction compenstation
J	-210 °C to 1200 °C	0.26 °C	
N	-200 °C to 1300 °C	0.36 °C	
T	-250 °C to -150 °C	0.31 °C	
T	-150 °C to 400 °C	0.25 °C	
K	-200 °C to 1300 °C	0.23 °C	Excluding reference junction compenstation
J	-210 °C to 1200 °C	0.16 °C	
N	-200 °C to 1300 °C	0.30 °C	
T	-250 °C to -150 °C	0.23 °C	
T	-150 °C to 400 °C	0.16 °C	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
FREQUENCY			
Generation	10 mHz to 30 MHz	2.0 in 10^{11}	
Measurement	1 mHz to 225 MHz	0.05 ppm	
ANGULAR VELOCITY			
Calibration of angular velocity sensors			Ambient temperature 18 °C to 22 °C.
Applied angular velocity	10 °/s to 2000 °/s	0.13 % of angular velocity	
Output voltage measurement	0 V to 200 mV 200 mV to 2 V 2 V to 20 V	560 ppm + 150 µV 560 ppm + 150 µV 560 ppm + 170 µV	
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.

DC voltage, 100 mV to 1 V: 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.

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

Over the range 0.5 MPa to 140 MPa, the CMC is $0.0036\ \%\cdot p + (0.12\cdot 10^{-6}\cdot p\cdot 10^{-6}) + 4.0$ 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 $1.5 \cdot 0.01 \cdot i$, where i is the instrument indication.