Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

0295

Accredited to ISO/IEC 17025:2017

Haven Automation Limited

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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
ELECTRICAL			
DC Resistance			
Measurement	0 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 kΩ 2 kΩ to 20 kΩ 20 kΩ to 200 kΩ 200 kΩ to 2 MΩ 2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 1 GΩ	20 ppm + 70 μΩ 15 ppm 10 ppm 12 ppm 20 ppm 25 ppm 100 ppm 200 ppm + 15 kΩ 0.06 % + 0.60 MΩ	Generation of these quantities with the same or similar CMCs may be undertaken over the same ranges by the use of a transfer method.
Generation	0 Ω to 40 Ω 40 Ω to 400 Ω 400 Ω to 4 kΩ 4 kΩ to 40 kΩ 40 kΩ to 400 kΩ 400 kΩ to 4 MΩ 4 MΩ to 40 MΩ 40 MΩ to 400 MΩ	180 ppm + 100 μΩ 85 ppm 55 ppm 75 ppm 95 ppm 120 ppm 300 ppm 240 ppm	Using multi-function calibrator.
DC Voltage			
Measurement	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1 kV 1 kV to 5 kV	1.5 μV 10 ppm 8.0 ppm 10 ppm 15 ppm 1.2 %	Generation of these quantities with the same or similar CMCs may be undertaken over the same ranges by the use of a transfer method.
Generation	0 mV to 320 mV 320 mV to 3.2 V 3.2 V to 32 V 32 V to 320 V 320 V to 1050 V	45 ppm + 2.5 μV 60 ppm 70 ppm 80 ppm 60 ppm	Using multi-function calibrator.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
ELECTRICAL (continued)			
DC Current			
Measurement	0 μA to 200 μA 0.2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	65 ppm + 10 nA 55 ppm + 10 nA 80 ppm 150 ppm	Generation of these quantities with the same or similar CMCs may be undertaken over the same ranges by the use of a transfer method.
Generation	0 μA to 320 μA 320 μA to 3.2 mA 3.2 mA to 32 mA 32 mA to 320 mA 320 mA to 3 A 3 A to 10 A	120 ppm + 6.0 nA 210 ppm 260 ppm 400 ppm 400 ppm 420 ppm	Using multi-function calibrator.
AC Voltage			
Generation	*40 Hz to 30 kHz* 32 mV to 320 mV 320 mV to 320 V *40 Hz to 10 kHz* 320 V to 750 V 750 V to 1050 V	 0.040 % 0.050 % 0.040 % 0.050 %	Using multi-function calibrator.
Measurement	*40 Hz to 30 kHz* 200 mV to 2 V 2 V to 20 V 20 V to 200 V *40 Hz to 10 kHz* 20 mV to 200 mV 200 V to 1000 V *50 Hz* 1 kV to 5 kV	 0.030 % 0.030 % 0.028 % 59 μV 0.040 % 1.8 %	Generation of these quantities with the same or similar CMCs may be undertaken over the same ranges by the use of a transfer method.
AC Current			
Generation	32 μA to 320 mA *10 Hz to 110 Hz* *110 Hz to 3 kHz* 320 mA to 3 A *40 Hz to 110 Hz* *110 Hz to 3 kHz* 3 A to 10 A *40 Hz to 110 Hz* *110 Hz to 3 kHz*	 0.045 % 0.070 % 0.060 % 0.080 % 0.080 % 0.080 %	Using multi-function calibrator.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
ELECTRICAL (continued)			
AC Current (continued)			
Measurement	*40 Hz to 1 kHz* 100 μA to 200 μA 0.2 mA to 2 mA 2 mA to 20 m A 20 mA to 200 mA *55 Hz to 300 Hz* 200 mA to 500 mA 500 mA to 2 A	 0.035 μA 0.030 % + 0.25 μA 0.030 % + 2.5 μA 0.030 % + 25 μA 0.25 % 0.10 %	Generation of these quantities with the same or similar CMCs may be undertaken over the same ranges by the use of a transfer method.
AC Resistance	*At 50 Hz* 0.05 Ω and 0.1 Ω 0.2 Ω, 0.5 Ω, 1 Ω, 5 Ω, 10 Ω, 50 Ω, 100 Ω, 500 Ω and 1 kΩ	 0.40 % 0.30 %	For the calibration of the earth bond function on Portable Appliance Testers.
Capacitance			
Generation	1 nF to 4 nF 4 nF to 40 nF 40 nF to 400 nF 400 nF to 4 μF 4 μF to 40 μF 40 μF to 400 μF 400 μF to 4 mF 4 mF to 30 mF	0.30 % 0.20 % 0.20 % 0.20 % 0.20 % 0.20 % 0.35 % 0.35 %	
Frequency			
Generation	0.5 Hz to 200 kHz	0.0012 % + 0.010 Hz	
Temperature indicators, calibration by electrical simulation			
Base metal thermocouple	-50 °C to +1320 °C -50 °C to +1320 °C	0.30 °C 0.060 °C	Including cold junction compensation Excluding cold junction compensation
Noble metal thermocouple	-50 °C to +1800 °C -50 °C to +600 °C 600 °C to 1800 °C	0.70 °C 0.50 °C to 0.17 °C 0.17 °C	Including cold junction compensation Excluding cold junction compensation
Resistance thermometer (Pt 100)	-200 °C to 0 °C 0 °C to 250 °C 250 °C to 800 °C	0.0020 °C to 0.012 °C 0.012 °C to 0.025 °C 0.025 °C to 0.030 °C	
Cold junction compensation	21 °C to 25 °C	0.15 °C	Lab ambient temperature

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
ELECTRICAL (continued)			
Temperature simulators, calibration by electrical simulation			
Base metal thermocouple	-50 °C to +1320 °C	0.35 °C	Including cold junction compensation
	-50 °C to +1320 °C	0.075 °C to 0.16 °C	Excluding cold junction compensation
Noble metal thermocouple	-50 °C to +1800 °C	0.90 °C	Including cold junction compensation
	-50 °C to +1800 °C	0.65 °C to 0.30 °C	Excluding cold junction compensation
Resistance thermometer (Pt 100)	-200 °C to 0 °C 0 °C to 250 °C 250 °C to 800 °C	0.0020 °C to 0.012 °C 0.012 °C to 0.025 °C 0.025 °C to 0.030 °C	
Cold junction compensation	21 °C to 25 °C	0.15 °C	Lab ambient temperature
PRESSURE			Methods consistent with EURAMET CG3
<u>Hydraulic pressure (gauge)</u>			1 Calibrations may be undertaken expressed in other units of pressure as required.
Calibration of pressure indicating instruments and gauges	500 kPa to 7 MPa 7 MPa to 110 MPa	0.0070 % + 0.15 kPa 0.010 %	2 Calibration of pressure measuring devices with an electrical output may be undertaken.
<u>Gas pressure (gauge)</u>			
Calibration of pressure indicating instruments and gauges	-90 kPa to -2.5 kPa 1.5 kPa to 2.5 kPa 2.5 kPa to 100 kPa 100 kPa to 690 kPa 690 kPa to 3.5 MPa	0.011 % 0.032 % 0.011 % 0.006 0 % 0.007 0 %	
TEMPERATURE			
Resistance Thermometers	-50 °C to 0 °C	0.070 °C	Calibration performed within Liquid Baths
	0 °C 0 °C to 230 °C 230 °C to 420 °C 420 °C to 650 °C	0.060 °C 0.10 °C 0.10 °C 0.10 °C	
Thermocouples			
Base metal (Type J, K, T & N)	-50 °C to +650 °C	0.42 °C	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
TEMPERATURE (continued)			
Electronic thermometers with sensors		As for sensor type	
Temperature loggers with integral probes	-50 °C to 0 °C 0 °C to 150 °C	0.070 °C 0.10 °C	
Metal Block calibrators	-50 °C to +300 °C 300 °C to 650 °C	0.20 °C 0.35 °C	Method consistent with Euramet CG13
Liquid Baths	-40 °C to +250 °C	0.20 °C	
Furnaces and ovens	50 °C to 600 °C	3.0 °C	Single or Multipoint monitoring probes. Time dependent temperature profiling, also referred to as spatial temperature surveying or mapping
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.