Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

UKAS CALIBRATION 0785 **Accredited to ISO/IEC 17025:2017**	**Trescal Limited (Trescal EMS)** **Issue No:** 031 **Issue date:** 07 January 2021	
	Leigh Commerce Park **Greenfold Way** **Leigh** **Greater Manchester** **WN7 3XJ**	**Contact: Mr Matt Gypps** **Tel: + 44 (0)1438 212500** **E-Mail: matt.gypps@trescal.com** **Website: www.trescal.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 Collins Aerospace Stafford Road Fordhouses Wolverhampton West Midlands WV10 7EH	**Local contact** Paul Bradley or Dave Moore Tel +44 (0) 1902 624 644 Fax +44 (0) 1902 624 463 Email: paul.bradley@trescal.com	Capabilities: Electrical DC and LF Dimensional	Wolverhampton
Address BAE Systems Warton Aerodrome Lytham Road Preston Lancashire PR4 1AX	**Local contact** Dave Gresty Tel +44 (0) 161 406 7878 Email: david.gresty@trescal.com	Capabilities: Dimensional	Warton
Address Airbus Broughton Building 10 Chester Road Broughton CH4 0DR	**Local contact** Paul Cashin Tel +44 (0) 1244 523920 Fax +44 (0) 1244 524189 Email: Paul.cashin@trescal.com	Capabilities: Dimensional	Airbus Broughton

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
ELECTRICAL MEASUREMENTS			Electrical Calibrations are performed as a comparison against a reference standard	
DC RESISTANCE Measurement				Wolverhampton
	0 Ω to 20 Ω	28 ppm + 25 μΩ		
	20 Ω to 200 Ω	16 ppm + 100 μΩ		
	200 Ω to 2 kΩ	13 ppm + 1.0 mΩ		
	2 kΩ to 20 kΩ	13 ppm + 10 mΩ		
	20 kΩ to 200 kΩ	16 ppm + 100 mΩ		
	200 kΩ to 2 MΩ	27 ppm + 2.0 Ω		
	2 MΩ to 20 MΩ	75 ppm + 100 Ω		
	20 MΩ to 200 MΩ	500 ppm + 12 kΩ		
	200 MΩ to 1 GΩ	1.0 % + 1.1 MΩ		
DC VOLTAGE Measurement				
	0 mV to 200 mV	11 ppm + 1.2 µV		
	200 mV to 2 V	8.5 ppm + 0.9 µV		
	2 V to 20 V	8.5 ppm + 4.0 µV		
	20 V to 200 V	13 ppm + 60 µV		
	200 V to 1 kV	13 ppm + 600 µV		
DC CURRENT Measurement				
	0 µA to 200 µA	140 ppm + 0.60 nA		
	200 µA to 2 mA	130 ppm + 6.0 nA		
	2 mA to 20 mA	130 ppm + 60 nA		
	20 mA to 200 mA	130 ppm + 1.3 µA		
	200 mA to 2 A	240 ppm + 25 µA		
	2 A to 10 A	0.060 %		
	10 A to 100 A	0.14 %		
AC VOLTAGE Measurement				
	10 mV to 200 mV *40 Hz to 10 kHz*	320 ppm + 5.0 µV		
	200 mV to 2 V *40 Hz to 10 kHz*	210 ppm + 25 µV		
	2 V to 20 V *40 Hz to 10 kHz*	210 ppm + 250 µV		
	20 V to 200 V *40 Hz to 10 kHz*	210 ppm + 2.5 mV		

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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
AC VOLTAGE Measurement continued	200 V to 1 kV			Wolverhampton
	55 Hz to 1 kHz	360 ppm + 50 mV		
	1 kHz to 10 kHz	450 ppm + 50 mV		
AC CURRENT Measurement	10 µA to 200 µA			
	55 Hz to 1 kHz	600 ppm + 25 nA		
	200 µA to 2 mA			
	55 Hz to 1 kHz	400 ppm + 250 nA		
	2 mA to 20 mA			
	55 Hz to 1 kHz	400 ppm + 2.5 µA		
	20 mA to 200 mA			
	55 Hz to 1 kHz	400 ppm + 25 µA		
	200 mA to 2 A			
	55 Hz to 1 kHz	900 ppm + 500 µA		
DC RESISTANCE Generation	0 Ω to 11 Ω	180 ppm + 11 mΩ		Wolverhampton
	11 Ω to 33 Ω	150 ppm + 19 mΩ		
	33 Ω to 110 Ω	110 ppm + 19 mΩ		
	110 Ω to 330 Ω	110 ppm + 19 mΩ		
	330 Ω to 1.1 kΩ	110 ppm + 90 mΩ		
	1.1 kΩ to 3.3 kΩ	110 ppm + 90 mΩ		
	3.3 kΩ to 11 kΩ	110 ppm + 900 mΩ		
	11 kΩ to 33 kΩ	110 ppm + 900 mΩ		
	33 kΩ to 110 kΩ	140 ppm + 9.0 Ω		
	110 kΩ to 330 kΩ	150 ppm + 9.0 Ω		
	330 kΩ to 1.1 MΩ	180 ppm + 80 Ω		
	1.1 MΩ to 3.3 MΩ	200 ppm + 80 Ω		
	3.3 MΩ to 11 MΩ	710 ppm + 800 Ω		
	11 MΩ to 33 MΩ	0.14 % + 800 Ω		
	33 MΩ to 110 MΩ	0.60 % + 8.0 kΩ		
	110 MΩ to 330 MΩ	0.60 % + 21 kΩ		
DC VOLTAGE Generation	0 mV to 330 mV	75 ppm + 6.0 µV		
	330 mV to 3.3 V	60 ppm + 13 µV		
	3.3 V to 33 V	60 ppm + 130 µV		
	33 V to 330 V	70 ppm + 1.3 mV		
	330 V to 1 kV	70 ppm + 11 mV		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k* = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
DC CURRENT Generation	0 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 2.2 A 2.2 A to 10 A 10 A to 100 A	160 ppm + 130 nA 130 ppm + 1.1 µA 130 ppm + 12 µA 370 ppm + 120 µA 0.060 % 0.14 %		Wolverhampton
AC VOLTAGE Generation	1 mV to 33 mV *45 Hz to 10 kHz*	1650 ppm + 27 µV		
	33 mV to 330 mV *45 Hz to 10 kHz*	600 ppm + 29 µV		
	330 mV to 3.3 V *45 Hz to 10 kHz*	360 ppm + 130 µV		
	3.3 V to 33 V *45 Hz to 10 kHz*	470 ppm + 1.3 mV		
	33 V to 330 V *45 Hz to 1 kHz* *1 kHz to 10 kHz*	600 ppm + 14 mV 900 ppm + 22 mV		
	330 V to 1 kV *45 Hz to 1 kHz* *1 kHz to 5 kHz* *5 kHz to 10 kHz*	600 ppm + 150 mV 2100 ppm + 170 mV 2100 ppm + 600 mV		Wolverhampton
AC CURRENT Generation	29 µA to 0.33 mA *45 Hz to 1 kHz*	0.18 % + 320 nA		
	0.33 mA to 3.3 mA *45 Hz to 1 kHz*	0.12 % + 380 nA		
	3.3 mA to 33 mA *45 Hz to 1 kHz*	0.11 % + 3.8 µA		
	33 mA to 330 mA *45 Hz to 1 kHz*	0.11 % + 38 µA		
	330 mA to 2.2 A *45 Hz to 1 kHz*	0.12 % + 380 µA		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
AC CURRENT Generation continued	2.2 A to 11 A			Wolverhampton
	45 Hz to 500 Hz	0.13 % + 2.7 mA		
	500 Hz to 1 kHz	0.38 % + 2.7 mA		
DC CONDUCTANCE	10 mS to 10 nS	1.0 %		
CAPACITANCE	10 µF to 1 mF			
	100 Hz	1.5 %		
	10 pF to 1 µF			
	1 kHz	0.060 %		
	100 pF to 1 µF			
	10 kHz	0.080 %		
INDUCTANCE	10 µH to 100 µH			
	1 kHz	0.50 %		
	100 µH to 10 H			
	1 kHz	0.10 %		
FREQUENCY	0.1 Hz to 10 Hz	35 ppm		Wolverhampton
	10 Hz to 100 Hz	3.5 ppm		
	100 Hz to 1 kHz	0.70 ppm		
	1 kHz to 10 kHz	8.0 parts in 10^8		
	10 kHz to 10 MHz	2.0 parts in 10^8		
DIMENSIONAL MEASUREMENTS				
LENGTH				

NOTES

1. In addition to the items listed above, other similar items, including parts of measuring instruments and machines, may be calibrated to the uncertainties stated. Where the item or part calibrated is of lower quality due to wear, errors in geometry or form, or poor surface texture, or where any other factor adversely affects the measurement capability, greater uncertainties must be quoted.

2. The uncertainty quoted if for the departure from flatness, straightness, or squareness, i.e. the distance separating the two parallel planes, which just enclose the surface under consideration.

3. Single start, symmetrical thread forms only.

Plain plug gauges (parallel) cylindrical setting standards and rollers	1 to 50 diameter 50 to 100 100 to 150	0.80 1.0 1.2	By comparison with end standards using a length measuring machine	Wolverhampton and Warton

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Plain ring gauges (parallel)	6 to 50 diameter 50 to 100 100 to 150	1.0 1.6 2.0	By comparison with master rings using a length measuring machine	Wolverhampton and Warton
Screw plug gauges (parallel) including check and setting plugs See Note 3	3 to 100 diameter	3.0 on pitch diameter	By comparison with end standards using a length measuring machine	Warton
Screw ring gauges (parallel) See Note 3	6 to 100 diameters	5.0 on pitch diameter	By comparison with end standards using a length measuring machine. Angle using projector.	Warton
Pitch: 1.5Flank angle: 2.0 + ((800/*MxP*)) Minutes of arc Where *M* is the projector magnification and *P* is pitch in mm				
Parallels	As BS 906:1972	Dependent on size and grade 1.5 to 5.0		Wolverhampton
ANGLE				
Squares Blade type	As BS 939:2007 up to 300 300 up to 600	3.0 on squareness 5.0 See note 2		Warton
Roundness	As BS 3730:1982			Warton
External Internal	0 to 350 diameter 3 to 350 diameter	0.050 on radius 0.050 on radius		Warton

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
MEASURING INSTRUMENTS AND MACHINES				
Micrometers				
External Internal Depth	As BS 870:2008 and above As BS 959:2008 As BS 6468:2008	Heads: 2.0 between any two points Setting and extension rods: 1.0 + 5.0 x length in m	Note: Internal micrometers not covered at Airbus.	Wolverhampton, Airbus and Warton
Bore micrometers (3 point)	0 mm to 100mm	Overall performance 5.0	Using master rings or adjustable setting gauge.	Wolverhampton and Airbus
Micrometer heads	As BS 1734:1951	1.0		Warton
Bench micrometer		Overall performance 2.0	In-house method based on MOY/SCMI/22	Warton
Height setting micrometer	0 to 300	Heads: 1.5 between any two points stepped column 2.5 Overall performance: 3.0	By comparison with end standards using surface table, indicator and length standards.	Wolverhampton and Warton
Riser blocks for above	150 300	2.5 5.0	By comparison with end standards	Wolverhampton and Warton
Vernier gauges Caliper Height Depth	 As BS 887:2008 As BS 1643:2008 As BS 6365:2008	 Overall performance: 10 + (30 x length in m)		Wolverhampton, Airbus and Warton
Dial gauges and dial test indicators	As BS 907:2008 and BS 2795:1981	1.0		Wolverhampton, Airbus and Warton
Bevel protractors	As BS 1685:2008	1.0 min of arc + 1.0 vernier division		Wolverhampton

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
FORM Surface Plates				Warton
NOTES 1. The uncertainty quoted is for the departure from flatness, straightness or squareness; i.e. the distance separating the two parallel planes, which just enclose the surface under consideration.				
Granite Cast iron	As BS 817:2008	1.5 + (0.8 x diagonal in m) See Note 1		Warton
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 $0.0036\ \%\cdot p + (0.12\cdot 10^{-6}\cdot p\cdot 10^{-6}) + 4.0$ 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.