Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

0394

Accredited to ISO/IEC 17025:2017

Trescal Limited (Trescal EMS – Rolls-Royce)

Issue No: 059 **Issue date:** 11 August 2020

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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 (Pride Park) Trescal EMS Unit 2, Riverside Road Pride Park Derby DE24 8HY **Local contact** Trevor Smith Tel: +44 (0) 1332 238102 Email: Trevor.smith@trescal.com	Dimensional Electrical Humidity Temperature Torque	Pride Park
Address (Ansty) Trescal EMS – Rolls-Royce Standards Room Building 6 Ansty Coventry CV7 9JR **Local contact** David Williams Tel: +44 (0) 2476 623625 Fax: +44 (0) 2476 623626 Email: David.williams2@rolls-royce.com	Torque Pressure	Ansty
Address (Inchinnan) Trescal EMS – Rolls-Royce Inchinnan Drive Inchinnan Renfrewshire PA4 9AF **Local contact** Robert Simpson Tel: +44 (0) 141 626 8540 Email: Robert.simpson@trescal.com	Dimensional Torque	Inchinnan
Address (Washington) Trescal EMS – Rolls-Royce Calibration Laboratory Radial Park Road Washington Tyne and Wear NE38 9DA **Local contact** Robert Simpson Steve Jones Tel: +44 (0) 191 297 3023 Email: Robert.simpson@trescal.com	Dimensional Torque	Washington

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	Trescal Limited (Trescal EMS - Rolls-Royce) **Issue No:** 059 **Issue date:** 11 August 2020

Calibration performed by the Organisation at the locations specified

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details		Activity	Location code
Address (Bristol) Trescal EMS – Rolls-Royce Metrology Laboratory (EW6/7) PO Box 3 Filton Bristol BS34 7QE	**Local contact** Mr M Viney Tel: +44 (0) 117 979 6099 Fax: +44 (0) 117 979 5038 Email: michael.viney@rolls-royce.com	Fuel Flow Torque	Bristol
Address (Solihull) Rolls-Royce Derwent Building 5000 Solihull Parkway Birmingham Business Park Birmingham B37 7YP	**Local contact** Jim Attwooll Tel +44 (0) 121 2732781 Email: jim.attwooll@rolls-royce.com	Electrical DC&LF Dimensional	Solihull

Site activities performed away from the locations listed above:

All Rolls-Royce sites: The site or premises must be suitable for the nature of the particular calibrations undertaken and will be the subject of contract review arrangements between the laboratory and the customer.	**Local contact** Trevor Smith Tel: +44 (0) 1332 238102 Email: Trevor.smith@trescal.com	Form Electrical	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
LENGTH				Pride Park
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Thread measuring cylinders	BS3777:1964 and BS 5590:1978 and specials 0.1 to 5.0 diameter	0.50 on diameter	NOTES 1 In addition to all items in the first column, other similar items, including parts of measuring instruments and machines, may be calibrated in accordance with the stated CMCs. 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 will be quoted.	
Plain plug gauges (parallel), cylindrical setting standards, gear measuring cylinders and rollers. See Note 6	1 to 50 diameter 50 to 100 100 to 150 150 to 200 200 to 300	0.50 0.80 1.0 1.2 1.6 on diameter		
Plain ring gauges (parallel) and setting standards	CCP 2.3.2, issue 11 1 to 50 diameter 50 to 100 diameter 100 to 150 diameter 150 to 200 diameter	0.80 1.2 1.8 2.5 on diameter		
Length gauges, flat and spherical ended See Note 6	0 m to 3 m	1.0 + (5.0 x length in m)	2 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.	
Length bars Inspection and workshop grades 1 and 2	BS 1790:1961 BS 5317:1976	0.45 + (1.1 x length in m)	3 All linear calibrations may be given in inch units.	
Plain gap gauges (parallel)	BS 969:2008 0.5 to 100 100 to 200 200 to 300	3.0 5.0 8.0	4 Single start symmetrical thread forms only. 5 Single start symmetrical thread forms only.	
Screw plug gauges (parallel) including check and setting plugs See Notes 5 and 6	1 to 100 diameter 100 to 300 diameter	2.5 5.0 On pitch diameter	6 By comparison with end standards using a length measuring machine.	
Screw ring gauges (parallel) See Notes 4 and 6	5 to 75 diameter 100 to 150 diameter 150 to 300 diameter	4.0 5.0 8.0		
Screw pitch	0.2 to 8	1.5	Using a length measuring machine.	
Screw flank angle	0º to 50º	5.0 minutes of arc	Using a projector.	
Parallels	BS 906:Parts 1 and 2:1992 5 to (50 x 100 x 400)	1.5 to 5.0		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
LENGTH (continued)				Pride Park
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Gauge blocks		Class (see note)	Note	
Inch (Steel)	BS 4311-1:2007 0 in to 0.4 in 0.4 in to 1 in Size 2 in 3 in 4 in	C D 3.0 µ in 4.0 µ in 4.0 µ in 5.0 µ in 5.0 µ in 6.0 µ in 7.0 µ in	Class C uncertainties apply to the measurement of length by comparison with grade K standards of a similar material. Class D uncertainties apply to the measurement of length by comparison with grade K standards of a dissimilar material. The uncertainties apply to new and used grade 0, 1 and 2 gauges to BS EN ISO 3650:1999 and BS 4311-1:2007.	
Millimetre (Steel)	BS EN ISO 3650:1999 0 to 10 10 to 25 Size 30, 40, 50 60, 70, 75 80, 90, 100	C D 0.080 0.10 0.10 0.13 0.12 0.15 0.18		
Vee blocks	BS 3731:1987 20 to 150 diameter, Vee capacity	2.5 to 5.0		
Receiver, position and profile gauges, jigs, fixtures	1500 x 750 x 750	From first principles: Dependant on size and features Minimum per co-ordinate: 3.0 + (10 x length in m)		
	1500 x 3200 x 1100	Using CMM: Dependant on size and features Minimum per co-ordinate: 5.0 + (10 x length in m)		
ANGLE				
Squares				
Blade type	BS 939;2007, CCP 2.4.17 issue 10 50 to 300 300 to 600	 3.0 5.0		
Cylindrical	BS 939:2007, CCP 2.4.17 issue 10 75 to 300 300 to 600	 2.0 On squareness 4.0 *See* Note 2		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ANGLE (continued)				Pride Park
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Block	BS 939:2007 50 to 300 300 to 600	3.0 5.0		
Angle gauges	NPL type Other types	2.0 seconds of arc 3.0 seconds of arc	In-house methods based on MOY/SCMI/18	
Sine bars and tables	BS 3064:1978 100 to 500 length	Linear dimensions: 1.0 + (10 x length in m) Overall performance: 3.0 seconds of arc		
Sine centres	100 to 500 length or between centres	Linear dimensions: 1.0+ (10 x length in m) Overall performance	In-house methods based on BS 3064:1978	
Compound sine tables	100 to 500 length	5.0 seconds of arc		
FORM				
Straightedges Cast iron Steel Granite	BS 5204:Part 1:1975 and BS 5204:Part 2:1977 0 m to 2m	1.0 + (2.0 x length in m) See Note 2		
Roundness External Internal	BS 3730:Part 2:1982 0 to 350 diameter 3 to 350 diameter	 0.050 on radius 0.050 on radius		
Steel balls	1 to 25 diameter	0.50 on diameter	By comparison with end standards using a length measuring machine.	
MEASURING INSTRUMENTS AND MACHINES				
Micrometers				
External	BS 870:2008, CCP 2.4.1 issue 12 0 to 600	Heads: 2.0 Setting and		
Internal	BS 959:2008 0 to 300	Extension rods: 1.0		
Depth	BS 6468:2008 0 to 300	+ (5.0 x length in m)		
Micrometer heads	BS 1734:1951; 0 to 100	1.0		
Bench micrometer	0 to 100	Overall performance 1.0	In-house method based on MOY/SCMI/22	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
MEASURING INSTRUMENTS AND MACHINES (continued)				Pride Park
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Height setting micrometer	0 to 300	Heads 1.0 Stepped column 1.6 Overall performance 2.0	By comparison with end standards.	
Riser Blocks	150 300	1.0 2.0	By comparison with end standards.	
Height gauges - (Simple) including vernier, dial and digital types	BS EN ISO 13225:2012 0 to 300	4.0		
Vernier gauges				
Caliper Height	BS 887:2008 BS 1643:2008 0 to 1200	Overall performance: 10 + (30 x length in m)		
Depth	BS 6365:2008 0 to 600			
Dial gauges and dial test indicators	BS 907:2008 and BS 2795:1981 0 to 50	1.0		
Dividing heads and Rotary tables	100 to 750 capacity	Linear dimensions 1.0 + (10 x length in m) Overall angular performance 3.0 seconds of arc	By comparison, using angle standards and autocollimator.	
Spirit levels	BS 958:1968 and BS 3509:1962 Nominal sensitivity 5 seconds of arc to 60 minutes of arc	Mean sensitivity: 10 % of nominal; minimum 0.50 seconds of arc		
Clinometers	0° to 360°	10 seconds of arc	In-house method based on MOY/SCMI/36	
Levels, electronic	0 seconds of arc to 10 minutes of arc	1.0 % of range minimum 0.50 seconds of arc	The quoted uncertainty will be particularly dependent on the sensitivity of the device. Using small angle generator.	
Orifice plates	BS EN ISO 5167-2:2003 (and similar devices) Bore d diameter 1.0 mm to 1 m	4.0 + (6.0 x length in m)		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
TORQUE Hand torque tools (excluding torque screwdrivers)	BS EN ISO 6789:2017 And BS EN ISO 6789:2003 (withdrawn and superseded) and CCP 3.6.6 Issue 9.0 1.0 N·m to 1000 N·m	1.0 %	The quoted uncertainty will be particularly dependent on the repeatability of the unit under test.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL MEASUREMENTS				Pride Park
DC VOLTAGE				
Measurement	Up to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1 000 V	6.5 ppm + 1.3 µV 5.1 ppm 6.1 ppm 9.4 ppm 9.6 ppm		
Generation	0 mV to 2 mV 2 mV to 20 mV 20 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1100 V	1.3 µV 1.3 µV 1.3 µV 2.8 ppm + 0.90 µV 2.2 ppm + 2.5 µV 3.2 ppm + 39 µV 5.6ppm + 0.39 mV		
DC RESISTANCE				
Measurement	0 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 200 kΩ 200 kΩ to 2 MΩ 2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 2 GΩ	30 ppm + 20 µΩ 13 ppm 14 ppm 24 ppm 55 ppm 450 ppm 0.50%	The stated CMCs are for a four-terminal configuration and may be increased if a two-terminal configuration is necessary.	
Generation				
Four terminal configuration	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	5.7 ppm 3.9 ppm 3.6 ppm 3.2 ppm 4.5 ppm 10 ppm 19 ppm 65 ppm		
Two terminal configuration	0 Ω, 10 Ω and 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	10 mΩ 79 ppm 8.3 ppm 4.5 ppm 10 ppm 19 ppm 65 ppm		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DC CURRENT				Pride Park
Measurement	10 µA to 200 µA 200 µA to 200 mA 200 mA to 2 A	100 ppm 100 ppm 170 ppm		
Generation	10 µA to 200 µA 200 µA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	22 ppm +1.6 nA 15 ppm + 7.8 nA 15 ppm + 78 nA 15 ppm + 0.78 µA 26 ppm + 16 µA		
AC VOLTAGE				
Measurement	10 mV to 200 mV *10 Hz to 10 kHz* *10 kHz to 30 kHz* *30 kHz to 50 kHz*	 390 ppm 640 ppm 0.17%		
	200 mV to 2 V *10 Hz to 10 kHz* *10 kHz to 30 kHz* *30 kHz to 50 kHz*	 190 ppm 270 ppm 870 ppm		
	2 V to 20 V *10 Hz to 10 kHz* *10 kHz to 30 kHz* *30 kHz to 50 kHz*	 180 ppm 270 ppm 870 ppm		
	20 V to 200 V *10 Hz to 10 kHz* *10 kHz to 30 kHz* *30 kHz to 50 kHz*	 190 ppm 270 ppm 870 ppm		
	200 V to 300 V *40 Hz to 10 kHz* *10 kHz to 30 kHz*	 250 ppm 390 ppm		
	300 V to 1 kV *40 Hz to 10 kHz* *10 kHz to 30 kHz*	 0.11 % 0.12 %		
	200 V to 1 kV *30 kHz to 50 kHz*	 0.20 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC VOLTAGE (continued)				Pride Park
Generation	1 mV to 2 mV			
	20 Hz to 100 kHz	0.74% + 4.2 µV		
	2 mV to 20 mV			
	20 Hz to 100 kHz	0.032% + 4.2 µV		
	20 mV to 200 mV			
	20 Hz to 50 kHz	130 ppm + 7.0 µV		
	50 kHz to 100 kHz	0.044%		
	100 kHz to 300 kHz	0.17%		
	300 kHz to 1 MHz	0.83%		
	200 mV to 2 V			
	10 Hz to 20 Hz	310 ppm		
	20 Hz to 50 kHz	89 ppm		
	50 kHz to 100 kHz	180 ppm		
	100 kHz to 300 kHz	0.13 %		
	300 kHz to 1 MHz	0.52%		
	2 V to 20 V			
	10 Hz to 20 Hz	290 ppm		
	20 Hz to 50 kHz	73 ppm		
	50 kHz to 100 kHz	240 ppm		
	100 kHz to 300 kHz	0.12%		
	300 kHz to 1 MHz	0.52%		
	20 V to 200 V			
	10 Hz to 20 Hz	220 ppm		
	20 Hz to 50 kHz	100 ppm		
	50 kHz to 100 kHz	200 ppm		
	200 V to 1 kV			
	45 Hz to 33 kHz	130 ppm		
AC CURRENT				
Measurement	*40 Hz to 1 kHz:*			
	10 µA to 200 µA	370 ppm + 16 nA		
	200 µA to 200 mA	840 ppm		
	200 mA to 2 A	660 ppm + 310 µA		
Generation	*40 Hz to 1 kHz:*			
	10 µA to 200 µA	90 ppm + 7.8 nA		
	200 µA to 2 mA	85 ppm + 78 nA		
	2 mA to 20 mA	85 ppm + 0.78 µA		
	20 mA to 200 mA	110 ppm + 7.8 µA		
	200 mA to 2 A	370 ppm + 78 µA		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
FREQUENCY				Pride Park
Specific Values	1 MHz and 10 MHz	1.2 parts in 10^9	For calibrating oscillators	
Other Values	0.1 Hz to 1 Hz	1.5 parts in 10^3	Measurement capability only above 60 MHz	
	1 Hz to 10 Hz	1.5 parts in 10^4		
	10 Hz to 100 Hz	1.5 parts in 10^5		
	100 Hz to 1 kHz	1.5 parts in 10^6		
	1 kHz to 10 kHz	1.5 parts in 10^7		
	10 kHz to 100 kHz	1.7 parts in 10^8		
	100 kHz to 1 MHz	3.9 parts in 10^9		
	1 MHz to 60 MHz	2.5 parts in 10^9		
	60 MHz to 100 MHz	1.2 parts in 10^9		
	100 MHz to 150 MHz	2.4 parts in 10^9		
	150 MHz to 500 MHz	1.4 parts in 10^9		
ELAPSED TIME				
Stop watches (mechanical and electronic)	± 0.5 s error / 24 hours	0.062 s	Time reference measurement per 24 hour period	
	± 2.0 s error / 24 hours	0.090 s	per 24 hour period	
	10 s to 24 hours	0.41 s	Real time measurement	
TEMPERATURE SIMULATION				
Temperature indicators and simulators (thermocouple type), calibration by electrical simulation				
Base metal thermocouples	Type J, -210 °C to 0 °C	0.064 °C	excluding cold junction compensation	
	Type J, 0 °C to 1200 °C	0.018 °C		
	Type K, -270 °C to -200 °C	0.23 °C	excluding cold junction compensation	
	Type K, -200 °C to 0 °C	0.070 °C		
	Type K, 0 °C to 1370 °C	0.022 °C		
	Type N, -270 °C to -200 °C	0.62 °C	excluding cold junction compensation	
	Type N, -200 °C to 0 °C	0.084 °C		
	Type N, 0 °C to 1300 °C	0.027 °C		
	Type T, -270 °C to -200 °C	0.19 °C		
	Type T, -200 °C to 0 °C	0.070 °C	excluding cold junction compensation	
	Type T, 0 °C to 400 °C	0.020 °C		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
Temperature indicators and simulators (thermocouple type), calibration by electrical simulation (continued)				Pride Park
Cold junction compensation	At ambient temperature of 20 °C ± 2.0 °C	0.13 °C		
Base metal thermocouples	Type J, -210 °C to 0 °C	0.14 °C		
	Type J, 0 °C to 1200 °C	0.13 °C	including cold junction compensation	
	Type K, -270 °C to -200 °C	0.24 °C		
	Type K, -200 °C to 0 °C	0.15 °C	including cold junction compensation	
	Type K, 0 °C to 1370 °C	0.13 °C		
	Type N, -270 °C to -200 °C	0.53 °C		
	Type N, -200 °C to 0 °C	0.15 °C	including cold junction compensation	
	Type N, 0 °C to 1300 °C	0.13 °C		
	Type T, -270 °C to - 200 °C	0.21 °C		
	Type T, -200 °C to 0 °C	0.15 °C	including cold junction compensation	
	Type T, 0 °C to 400 °C	0.13 °C		
Noble metal thermocouples	-50 °C to 0 °C	0.19 °C		
	0 °C to 250 °C	0.17 °C	excluding cold junction compensation	
	250 °C to 1760 °C	0.089 °C		
Cold junction compensation	At ambient temperature of 20 °C ± 2 °C	0.17 °C		
Temperature indicators and simulators (thermocouple type), calibration by electrical simulation				
Noble metal thermocouples	-50 °C to 0 °C	0.24 °C		
	0 °C to 250 °C	0.22 °C	including cold junction compensation	
	250 °C to 1760 °C	0.18 °C		
PRT simulation (Pt 100)	-200 °C to 0 °C	0.017 °C		
	0 ºC to 100 ºC	0.018 ºC		
	100 ºC to 400 ºC	0.020 ºC		
	400 ºC to 630 ºC	0.023 ºC		
	630 °C to 850 °C	0.026 °C		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
TEMPERATURE				Pride Park
Thermocouples				
Base metal	-20 °C to +200 °C	0.45 °C	Calibration within both liquid and metal medium	
Noble metal	-20 °C to 200 °C	0.92 °C	Calibration within both liquid and metal medium	
Resistance thermometers	-20 ºC to +200 ºC	0.070 °C	Calibration within both liquid and metal medium	
Electronic thermometers with sensors; analogue or digital	Ranges as per sensor	As per sensor type	Calibration within both liquid and metal medium	
HUMIDITY			By comparison with dew-point hygrometer and Platinum Resistance Thermometers	
Dew point	-10 °C to 0 °C 0 °C to 20 °C	0.12 °C dp 0.10 °C dp		
Relative Humidity	5 %rh to 95 %rh	2.0 %rh	At air temperature 5 °C to 60 °C	
Air Temperature	5 °C to 60 °C	0.4 °C		
PRESSURE			Methods consistent with EURAMET CG3	Ansty
Hydraulic pressure (Gauge)				
Pressure indicating instruments and gauges	600 kPa to 120 MPa	0.010 %	Calibration of pressure measuring devices with an electrical output may be undertaken.	
Pneumatic pressure (Gauge)				
Pressure indicating instruments and gauges	3.70 kPa to 3.5 MPa	0.010 %		
Pneumatic pressure (Absolute)				
Pressure indicating instruments and gauges	3.70 kPa to 3.5 MPa 75 kPa to 120 kPa	0.010 % + 5.0 Pa 17 Pa		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
TORQUE				Ansty
Hand torque tools	CCP 3.6.6 issue 9.0 0.113 N·m to 1356 N·m	1.0 %	The quoted uncertainty will be particularly dependent on the repeatability of the unit under test.	
LENGTH				Inchinnan
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Thread measuring cylinders	BS3777:1964 and BS 5590:1978 and specials 0.1 to 5.0 diameter	0.50 on diameter		
Plain plug gauges (parallel), cylindrical setting standards, gear measuring cylinders and rollers	1 to 50 diameter 50 to 100 diameter 100 to 150 diameter	0.50 0.80 1.0 on diameter	By comparison with end standards using a length measuring machine.	
Plain ring gauges (parallel) and setting standards	CCP 2.3.2 1 to 50 diameter 50 to 100 diameter 100 to 150 diameter	0.80 1.2 1.8 on diameter		
Length gauges, flat and spherical ended	0 m to 1 m	1.0 + (5.0 x length in m)	By comparison with end standards using a length measuring machine	
Plain gap gauges (parallel)	BS 969:2008 0.5 to 100 100 to 200	3.0 5.0		
Screw plug gauges (parallel) excluding check and setting plugs	1 to 100 diameter	2.5 on pitch diameter	Single start symmetrical thread forms only. By comparison with end standards using a length measuring machine.	
Parallels	BS 906:Parts 1 and 2:1992 5 to (50 x 100 x 400)	1.5 to 5.0, dependant on size and grade		

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 Granite Cast iron	BS 817:2008 160 x 100 to 4 m x 4 m	1.5 + (0.80 x diagonal in m) See Note 2		
Straightedges Cast iron Steel Granite	BS 5204:Part 1:1975 and BS 5204:Part 2:1977 0 m to 2 m	1 .0 + (2.0 x length in m) See Note 2		
MEASURING INSTRUMENTS AND MACHINES				
LENGTH				
Micrometers External Internal Depth	BS 870:2008, CCP 2.4.1 issue12 0 to 300 BS 959:2008 0 to 300 BS 6468:2008 0 to 300	Heads: 2.0 Setting and Extension rods: 1.0 + (5.0 x length in m)		
Micrometer heads	BS 1734:1951 0 to 100	1.0		
Bench micrometer	0 to 100	Overall performance 1.0	In-house method based on MOY/SCMI/22	
Height setting micrometer	0 to 300	Heads 1.0 Stepped column 1.6 Overall performance 2.0	By comparison with end standards.	
Riser Blocks for above	150 300	1.0 2.0	By comparison with end standards.	
Vernier gauges Caliper Height Depth	BS 887:2008 0 to 300 BS 1643:2008 0 to 300 BS 6365:2008 0 to 300	Overall performance: 10 + (30 x length in m)		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
MEASURING INSTRUMENTS AND MACHINES (continued) LENGTH (continued)				Inchinnan
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Dial gauges and dial test indicators	BS 907:2008 and BS 2795:1981 0 to 50	1.0		
Dividing heads / Rotary tables	0 to 750 capacity	Linear dimensions 1.0 + (10 x length in m) Overall angular performance 3 seconds of arc	By comparison, using angle standards and autocollimator.	
TORQUE				
Hand torque tools	CCP 3.6.6 issue 9.0 0.136 N·m to 677.91 N·m	1.0 %	The quoted uncertainty will be particularly dependent on the repeatability of the unit under test	
LENGTH				Washington
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Micrometers External Internal Depth	BS 870:2008, CCP 2.4.1 issue12 0 to 600 BS 959:2008; 0 to 150 BS 6468:2008; 0 to 150	Heads: 2.0 Setting and Extension rods: 1.0 + (5.0 x length in m)		
Vernier gauges Caliper Depth	BS 887:2008; 0 to 600 BS 6365:2008; 0 to 150	Overall performance: 10 + (30 x length in m)		
Dial gauges and dial test indicators	BS 907:2008 and BS 2795:1981 0 to 50	1.5		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
TORQUE				Washington
Hand torque tools	CCP 3.6.6 issue 9.0 0.1 N·m to 1000 N·m	1.0 %	The quoted uncertainty will be particularly dependent on the repeatability of the unit under test	
FUEL FLOW			Piston prover method	Bristol
Flow rate - volume Flow rate - mass	5 l/hr to 27000 l/hr 4 kg/hr to 21330 kg/hr	0.10 % 0.20 %	Calibration fluid AVTUR (Aviation fuel)	
TORQUE				
Hand torque tools	CCP 3.6.6 issue 9.0 0.1 N·m to 1000 N·m	1.0 %	The quoted uncertainty will be particularly dependent on the repeatability of the unit under test	
ELECTRICAL MEASUREMENTS				Solihull
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	28 ppm + 25 μΩ 16 ppm + 100 μΩ 13 ppm + 1.0 mΩ 13 ppm + 10 mΩ 16 ppm + 100 mΩ 27 ppm + 2.0 Ω 75 ppm + 100 Ω 500 ppm + 12 kΩ 1.0 % + 1.1 MΩ		
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	11 ppm + 1.2 μV 8.5 ppm + 0.9 μV 8.5 ppm + 4.0 μV 13 ppm + 60 μV 13 ppm + 600 μV		
DC CURRENT Measurement	0 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	140 ppm + 0.60 nA 130 ppm + 6.0 nA 130 ppm + 60 nA 130 ppm + 1.3 μA 240 ppm + 25 μA		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC VOLTAGE Measurement	10 mV to 200 mV *40 Hz to 10 kHz*	320 ppm + 5.0 µV		Solihull
	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		
	200 V to 1 kV *55 Hz to 1 kHz* *1 kHz to 10 kHz*	360 ppm + 50 mV 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		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DC RESISTANCE Generation				Solihull
Specific Values	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 M Ω 10 MΩ 100 MΩ	35 ppm 15 ppm 15 ppm 15 ppm 15 ppm 18 ppm 80 ppm 180 ppm		
Other Values	0 Ω to 11 Ω 11 Ω to 33 Ω 33 Ω to 110 Ω 110 Ω to 330 Ω 330 Ω to 1.1 kΩ 1.1 kΩ to 3.3 kΩ 3.3 kΩ to 11 kΩ 11 kΩ to 33 kΩ 33 kΩ to 110 kΩ 110 kΩ to 330 kΩ 330 kΩ to 1.1 MΩ 1.1 MΩ to 3.3 MΩ 3.3 MΩ to 11 MΩ 11 MΩ to 33 MΩ 33 MΩ to 110 MΩ 110 MΩ to 330 MΩ	180 ppm + 11 mΩ 150 ppm + 19 mΩ 110 ppm + 19 mΩ 110 ppm + 19 mΩ 110 ppm + 90 mΩ 110 ppm + 90 mΩ 110 ppm + 900 mΩ 110 ppm + 900 mΩ 140 ppm + 9.0 Ω 150 ppm + 9.0 Ω 180 ppm + 80 Ω 200 ppm + 80 Ω 710 ppm + 800 Ω 0.14 % + 800 Ω 0.60 % + 8.0 kΩ 0.60 % + 21 kΩ		
DC VOLTAGE Generation	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	12 ppm + 1.0 µV 7.5 ppm + 1.5 µV 6.0 ppm + 5.0 µV 8.0 ppm + 70 µV 10 ppm + 700 µV		
DC CURRENT Generation	0 µA to 220 µA 220 µA to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 220 mA to 2.2 A 2.2 A to 11 A	70 ppm + 10 nA 60 ppm + 12 nA 60 ppm + 120 nA 70 ppm + 1.2 µA 100 ppm + 35 µA 710 ppm + 510 µA		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC VOLTAGE Generation	*40 Hz to 10 kHz* 0.22 mV to 2.2 mV 2.2 mV to 22 mV 22 mV to 220 mV 220 mV to 2.2 V 2.2 V to 22 V 22 V to 220 V *55 Hz to 1 kHz* 220 V to 1 kV	 700 ppm + 6.0 µV 230 ppm + 7.0 µV 140 ppm + 10 µV 100 ppm + 14 µV 100 ppm + 130 µV 110 ppm + 1.5 mV 120 ppm + 8.0 mV		Solihull
AC CURRENT **Generation**	*55 Hz to 1 kHz* 10 µA to 220 µA *220* µA to 2.2 mA *2.2 mA to 22 mA* *22 mA to 220 mA* *220 mA to to 2.2 A*	 260 ppm + 20 nA 250 ppm + 55 nA 200 ppm + 550 nA 200 ppm + 5.5 µA 800 ppm + 55 µA		
MEASURING INSTRUMENTS AND MACHINES				
Micrometers				
External Depth	As BS 870:2008 and above As BS 6468:2008	Heads: 2.0 between any two points Setting and extension rods: 1.0 + 5.0 x length in m		
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)		
Dial gauges and dial test indicators	As BS 907:2008 and BS 2795:1981	1.0		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
FORM				Site
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Surface plates Granite Cast iron	As BS 817:2008 160 x 100 to 4 m x 4 m	1.5 + (0.80 x diagonal in m) See Note 2		
ELECTRICAL				
Temperature indicators and simulators (thermocouple type), calibration by electrical simulation:			Internal Reference junction enabled. Ambient temperature range 18 °C to 22°C (controlled customer environment).	
Base metal thermocouple types	Type J, -210 °C to 0 °C Type J, 0 °C to 1200 °C	0.36 °C 0.28 °C		
	Type K, -270 °C to -200 °C Type K, -200 °C to 0 °C Type K, 0 °C to 1000 °C Type K, 1000 °C to 1370 °C	4.6 °C 0.37 °C 0.29 °C 0.27 °C		
	Type N, -270 °C to -200 °C Type N, -200 °C to -100 °C Type N, -100 °C to 0 °C Type N, 0 °C to 800 °C Type N, 800 °C to 1300 °C	1.9 °C 0.49 °C 0.34 °C 0.26 °C 0.24 °C		
	Type T, -270 °C to -200 °C Type T, -200 °C to 0 °C Type T, 0 °C to 400 °C	0.81 °C 0.36 °C 0.26 °C		
Noble metal thermocouple types	Type R, -50 °C to 0 °C Type R, 0 °C to 150 °C Type R, 150 °C to 400 °C Type R, 400 °C to 1768 ºC	0.91 °C 0.71 °C 0.51 °C 0.62 °C		
	Type S, -50 °C to 0 °C Type S, 0 °C to 100 °C Type S, 100 °C to 300 °C Type S, 300 °C to 1768 °C	0.80 °C 0.66 °C 0.55 °C 0.48 °C		
RTD Pt100	 Up to 0 °C Up to 0 °C	 0.072 °C 0.042 % + 0.072 °C	Ambient temperature range 18 °C to 28 °C -10 °C to +50 °C	
	0°C to 850 °C 0°C to 850 °C	0.029 % + 0.075 °C 0.051 % + 0.075 °C	18 °C to 28 °C -10 °C to +50 °C	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DC Voltage			Ambient temperature range	Site
	0 V to 150 mV	0.023 % + 5.0 µV	18 °C to 28 °C	
	0 V to 150 mV	0.048 % + 5.0 µV	-10 °C to +50 °C	
	0.15 V to 0.25 V	0.023 % + 8.4 µV	18 °C to 28 °C	
	0.15 V to 0.25 V	0.048 % + 8.4 µV	-10 °C to +50 °C	
	0.25 V to 1 V	0.023 % + 12 µV	18 °C to 28 °C	
	0.25 V to 1 V	0.048 % + 12 µV	-10 °C to +50 °C	
	1 V to 25 V	0.023 % + 0.65 mV	18 °C to 28 °C	
	1 V to 25 V	0.048 % + 0.65 mV	-10 °C to +50 °C	
	25 V to 60 V	0.023 % + 1.2 mV	18 °C to 28 °C	
	25 V to 60 V	0.048 % + 1.2 mV	-10 °C to +50 °C	
DC Current	0 to 25 mA	0.025 % + 1.7 µA	18 °C to 28 °C	
	0 to 25 mA	0.049 % + 1.7 µA	-10 °C to +50 °C	
	25 mA to 100 mA	0.025 % + 2.0 µA	18 °C to 28 °C	
	25 mA to 100 mA	0.049 % + 2.0 µA	-10 °C to +50 °C	
DC Resistance	0 Ω to 250 Ω	0.023 % + 4.3 mΩ	18 °C to 28 °C	
	0 Ω to 250 Ω	0.048 % + 4.3 mΩ	-10 °C to +50 °C	
	250 Ω to 2650 Ω	0.023 % + 11 mΩ	18 °C to 28 °C	
	250 Ω to 2650 Ω	0.048 % + 11 mΩ	-10 °C to +50 °C	
	2650 Ω to 4000 Ω	0.023 % + 100 mΩ	18 °C to 28 °C	
	2650 Ω to 4000 Ω	0.048 % + 100 mΩ	-10 °C to +50 °C	
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.