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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 The Calibration House Halesfield 7 Telford Shropshire TF7 4QL **Local contact** Mr R A Jones	Electrical and Dimensional calibrations	P

Site activities performed away from the locations listed above:

Location details	Activity	Location code
Customers' sites or premises The customers' 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** Mr R A Jones	Dimensional calibrations	S

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DC RESISTANCE				P
Specific values	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	3.9 ppm 2.4 ppm 1.2 ppm 1.3 ppm 1.5 ppm 2.2 ppm 2.2 ppm 6.1 ppm	Standard resistors available for application to resistance measuring instruments, in a 2-wire or 4-wire configuration as appropriate. Calibration of resistors by comparison with these standards can also be undertaken.	
Other Values	0 Ω to 0.5 Ω 0.5 Ω to 5 Ω 5 Ω to 50 Ω 50 Ω to 500 Ω 500 Ω to 5 kΩ 5 kΩ to 50 kΩ 50 kΩ to 500 kΩ 500 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 10 GΩ 10 GΩ to 100 GΩ 100 GΩ to 1 TΩ	7.5 ppm + 0.25 μΩ 7.4 ppm 5.4 ppm 5.4 ppm 5.4 ppm 5.4 ppm 5.4 ppm 5.4 ppm 7.2 ppm 25 ppm 33 ppm 73 ppm 400 ppm	Using voltage / current method.	
DC VOLTAGE	0 V to 11 V 11 V to 110 V 110 V to 1100 V	2.8 ppm + 0.30 μV 2.8 ppm 3.2 ppm	Known voltages for application to voltage measuring instruments. Measurements of the output voltages from sources may also be undertaken.	P
	1 kV to 70 kV	0.14 %	Using high voltage divider.	
DC CURRENT	100 nA to 10 μA 10 μA to 1 A 1 A to 2 A 2 A to 100 A	13 ppm + 5.0 pA 10 ppm 23 ppm 10 ppm	Known currents for application to current measuring instruments. Measurements of the output currents from sources may also be undertaken.	P
	10 mA to 5 A 5 A to 100 A 100 A to 2500 A	0.30 % + 1.0 mA 0.12 % + 20 mA 0.47 % + 0.52 A	For the calibration of clamp-on ammeters and similar devices using multi-turn coil method.	P

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC VOLTAGE				P
Generation	1 mV to 2.2 mV		Known voltages for application to voltage measuring instruments, using multi-function calibrator.	
	10 Hz to 100 kHz	0.14 % + 5.0 µV		
	100 kHz to 300 kHz	0.16 % + 10 µV		
	300 kHz to 500 kHz	0.23 % + 20 µV		
	500 kHz to 1 MHz	0.45 % + 20 µV		
	2.2 mV to 22 mV			
	10 Hz to 50 kHz	0.027 % + 4.0 µV		
	50 kHz to 100 kHz	0.051 % + 5.0 µV		
	100 kHz to 300 kHz	0.11 % + 10 µV		
	300 kHz to 500 kHz	0.15 % + 20 µV		
	500 kHz to 1.0 MHz	0.31 % + 20 µV		
	22 mV to 220 mV			
	10 Hz to 20 Hz	0.026 % + 12 µV		
	20 Hz to 20 kHz	0.010 % + 7.0 µV		
	20 kHz to 50 kHz	0.013 % + 7.0 µV		
	50 kHz to 100 kHz	0.033 % + 17 µV		
	100 kHz to 300 kHz	0.069 % + 20 µV		
	300 kHz to 500 kHz	0.14 % + 25 µV		
	500 kHz to 1 MHz	0.29 % + 45 µV		
	220 mV to 2.2 V			
	10 Hz to 20 Hz	0.026 % + 40 µV		
	20 Hz to 40 Hz	0.010 % + 15 µV		
	40 Hz to 20 kHz	0.006 % + 8.0 µV		
	20 kHz to 50 kHz	0.008 % + 10 µV		
	50 kHz to 100 kHz	0.010 % + 30 µV		
	100 kHz to 300 kHz	0.038 % + 80 µV		
	300 kHz to 500 kHz	0.10 % + 0.20 mV		
	500 kHz to 1 MHz	0.19 % + 0.30 mV		
	2.2 V to 22 V			
	10 Hz to 20 Hz	0.025 % + 0.40 mV		
	20 Hz to 40 Hz	0.010 % + 0.15 mV		
	40 Hz to 20 kHz	0.0060 % + 0.050 mV		
	20 kHz to 50 kHz	0.0080 % + 0.10 mV		
	50 kHz to 100 kHz	0.011 % + 0.20 mV		
	100 kHz to 300 kHz	0.038 % + 0.60 mV		
	300 kHz to 500 kHz	0.11 % + 2.0 mV		
	500 kHz to 1 MHz	0.19 % + 3.2 mV		
	22 V to 220 V			
	10 Hz to 20 Hz	0.026 % + 4.0 mV		
	20 Hz to 40 Hz	0.010 % + 1.5 mV		
	40 Hz to 20 kHz	0.007 % + 0.60 mV		
	20 kHz to 50 kHz	0.010 % + 1.0 mV		
	50 kHz to 100 kHz	0.017 % + 2.5 mV		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC VOLTAGE (continued)				P
Generation (continued)	220 V to 1100 V			
	15 Hz to 40 Hz	0.030 % + 16 mV		
	40 Hz to 1 kHz	0.010 % + 4.0 mV		
	1 kHz to 20 kHz	0.017 % + 6.0 mV		
	20 kHz to 30 kHz	0.060 % + 11 mV		
	220 V to 750 V			
	30 kHz to 50 kHz	0.060 % + 11 mV		
	50 kHz to 100 kHz	0.24 % + 45 mV		
	1 kV to 30 kV *50 Hz to 60 Hz*	0.42 %	Using high voltage divider.	P
AC VOLTAGE				
Measurement				
NOTE: Two systems are available for AC Voltage measurements. Both employ digital multimeters for the calibration of AC Voltage sources. As two multimeters are in general use, each resulting in different and overlapping CMCs, the capabilities for each multimeter are described in this section.				
SYSTEM 1 - using Model 3458A multimeter				P
	1 mV to 10 mV			
	40 Hz to 1 kHz	0.037 % + 1.3 µV		
	1 kHz to 20 kHz	0.046 % + 1.3 µV		
	20 kHz to 100 kHz	0.59 % + 1.3 µV		
	100 kHz to 300 kHz	4.7 % + 2.3 µV		
	10 mV to 100 mV			
	40 Hz to 1 kHz	0.011 % + 2.3 µV		
	1 kHz to 20 kHz	0.018 % + 2.3 µV		
	20 kHz to 100 kHz	0.10 % + 2.3 µV		
	100 kHz to 300 kHz	0.35 % + 12 µV		
	100 mV to 1 V			
	40 Hz to 1 kHz	0.010 % + 0.023 mV		
	1 kHz to 20 kHz	0.018 % + 0.023 mV		
	20 kHz to 50 kHz	0.037 % + 0.023 mV		
	50 kHz to 100 kHz	0.10 % + 0.023 mV		
	100 kHz to 300 kHz	0.35 % + 0.12 mV		
	300 kHz to 1 MHz	1.2 % + 0.12 mV		
	1 V to 10 V			
	40 Hz to 1 kHz	0.010 % + 0.23 mV		
	1 kHz to 20 kHz	0.018 % + 0.23 mV		
	20 kHz to 50 kHz	0.037 % + 0.23 mV		
	50 kHz to 100 kHz	0.094 % + 0.23 mV		
	100 kHz to 300 kHz	0.35 % + 1.2 mV		
	300 kHz to 1 MHz	1.2 % + 1.2 mV		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC VOLTAGE (continued)				P
SYTEM 1 - using Model 3458A multimeter (continued)	10 V to 100 V			
	40 Hz to 1 kHz	0.025 % + 2.3 mV		
	1 kHz to 20 kHz	0.027 % + 2.3 mV		
	20 kHz to 50 kHz	0.043 % + 2.3 mV		
	50 kHz to 100 kHz	0.143 % + 2.3 mV		
	100 V to 1000 V			
	40 Hz to 1 kHz	0.050 % + 23 mV		
SYSTEM 2 - using Model 8508A multimeter				P
	10 mV to 200 mV			
	10 Hz to 10 kHz	0.012 % + 4.0 µV		
	10 kHz to 30 kHz	0.030 % + 8.0 µV		
	30 kHz to 100 kHz	0.070 % + 20 µV		
	200 mV to 2 V			
	10 Hz to 40 Hz	0.010 % + 20 µV		
	40 Hz to 10 kHz	0.0080 % + 20 µV		
	10 kHz to 30 kHz	0.020 % + 40 µV		
	30 kHz to 100 kHz	0.050 % + 0.20 mV		
	100 kHz 300 kHz	0.30 % + 2.0 mV		
	300 kHz to 1 MHz	1.4 % + 20 mV		
	20 V to 200 V			
	10 Hz to 40 Hz	0.011 % + 2.0 mV		
	40 Hz to 10 kHz	0.0090 % + 2.0 mV		
	10 kHz to 30 kHz	0.020 % + 4.0 mV		
	30 kHz to 100 kHz	0.050 % + 20 mV		
	200 V to 1000 V			
	10 Hz to 10 kHz	0.010 % + 21 mV		
	10 kHz to 30 kHz	0.021 % + 42 mV		
AC High Voltage measurements	1 kV to 30 kV			P
	50 Hz to 60 Hz	0.42 %	Using high voltage divider.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC CURRENT				
Generation	20 µA to 220 µA		Known currents for application to current measuring instruments.	P
	10 Hz to 20 Hz	0.025 % + 0.016 µA		
	20 Hz to 40 Hz	0.016 % + 0.010 µA		
	40 Hz to 1 kHz	0.011 % + 0.0080 µA		
	1 kHz to 5 kHz	0.028 % + 0.012 µA		
	5 kHz to 10 kHz	0.11 % + 0.065 µA		
	220 µA to 2.2 mA			
	10 Hz to 20 Hz	0.025 % + 0.040 µA		
	20 Hz to 40 Hz	0.016 % + 0.040 µA		
	40 Hz to 1 kHz	0.011 % + 0.040 µA		
	1 kHz to 5 kHz	0.020 % + 0.11 µA		
	5 kHz to 10 kHz	0.11 % + 0.65 µA		
	2.2 mA to 22 mA			
	10 Hz to 20 Hz	0.025 % + 0.40 µA		
	20 Hz to 40 Hz	0.016 % + 0.40 µA		
	40 Hz to 1 kHz	0.011 % + 0.40 µA		
	1 kHz to 5 kHz	0.020 % + 0.60 µA		
	5 kHz to 10 kHz	0.11 % + 5.0 µA		
	22 mA to 220 mA			
	10 Hz to 20 Hz	0.025 % + 4.0 µA		
	20 Hz to 40 Hz	0.016 % + 4.0 µA		
	40 Hz to 1 kHz	0.011 % + 3.0 µA		
	1 kHz to 5 kHz	0.020 % + 4.0 µA		
	5 kHz to 10 kHz	0.11 % + 10 µA		
	220 mA to 2.2 A			
	20 Hz to 1 kHz	0.025 % + 40 µA		
	1 kHz to 5 kHz	0.046 % + 80 µA		
	5 kHz to 10 kHz	0.70 % + 160 µA		
	2.2 A to 11 A			
	40 Hz to 1 kHz	0.047 % + 0.20 mA		
	1 kHz to 5 kHz	0.096 % + 0.40 mA		
	5 kHz to 10 kHz	0.36 % + 0.80 mA		
	2 A to 100 A		Using transconductance amplifier	P
	50 Hz to 60 Hz	0.030 %		
	50Hz to 60 Hz		For the calibration of clamp-on ammeters and similar devices using multi-turn coil method.	P
	10 mA to 5 A	0.044 % + 0.58 mA		
	5 A to 100 A	0.052 % + 0.017 A		
	100 A to 2500 A	0.44 % + 0.52 A		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC CURRENT				P
Measurement				
NOTE: Two systems are available for AC Current measurements. Both employ digital multimeters for the calibration of AC Current sources. As two multimeters are in general use, each resulting in different and overlapping CMCs, the capabilities for each multimeter are described in this section.				
SYSTEM 1 - using Model 3458A multimeter				P
	45 Hz to 1 kHz			
	10 µA to 100 µA	0.083 % + 0.035 µA		
	100 µA to 1 mA	0.077 % + 0.23 µA		
	1 mA to 10 mA	0.072 % + 2.3 µA		
	10 mA to 100 mA	0.072 % + 23 µA		
	100 mA to 1 A	0.12 % + 0.23 mA		
SYSTEM 2 - using Model 8508A multimeter				P
	20 µA to 200 µA			
	10 Hz to 5 kHz	0.035 % + 20 nA		
	5 kHz to 10 kHz	0.047 % + 20 nA		
	200 µA to 2 mA			
	10 Hz to 10 kHz	0.027 % + 0.20 µA		
	2 mA to 20 mA			
	10 Hz to 10 kHz	0.026 % + 2.0 µA		
	20 mA to 200 mA			
	10 Hz to 10 kHz	0.026 % + 20 µA		
	200 mA to 2 A			
	10 Hz to 2 kHz	0.060 % + 0.20 mA		
	2 kHz to 10 kHz	0.073 % + 0.20 mA		
	2 A to 20 A			
	10 Hz to 2 kHz	0.11 % + 2.0 mA		
	2 kHz to 10 kHz	0.33 % + 2.0 mA		
	50 Hz to 60 Hz		Using	
	2 A to 100 A	0.030 %	transconductance amplifier	
	50Hz to 60 Hz		For the calibration of	
	20 mA to 5 A	0.044 % + 0.58 mA	clamp-on ammeters	
	5 A to 100 A	0.052 % + 0.017 A	and similar devices	
	100 A to 2500 A	0.44 % + 0.52 A	using multi-turn coil method.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
AC POWER	*50 Hz to 60 Hz, 400 Hz, 5 kHz* 50 mW to 4 kW 4 kW to 10 kW	 0.052 % 0.20 %	At unity power factor, using a phantom load technique. Measurements can also be made at power factors of 0.9, 0.5, 0.1 and 0.01 but the quoted uncertainties will be increased.	P
FREQUENCY				P
Specific value	10 MHz	1.0 in 10^{10}	By comparison with house standard.	
Other values	0.1 Hz to 1 Hz 1 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 10 kHz	5.0 in 10^{4} 5.0 in 10^{5} 5.0 in 10^{6} 5.0 in 10^{7}	Multi-period measurement using counter timer.	
	10 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 150 MHz 150 MHz to 1 GHz 1 GHz to 20 GHz	1.0 in 10^{6} 1.0 in 10^{7} 1.0 in 10^{8} 1.0 in 10^{9} 1.0 in 10^{9} 3.0 in 10^{10}	Frequency measurement using counter timer.	
PHASE ANGLE	*50 Hz to 10 kHz* 0° to 360°	 0.050°	Using digital phasemeter.	P
CAPACITANCE			Standard capacitors available for application to capacitance measuring instruments. Calibration of capacitors by comparison with these standards can also be undertaken.	P
Specific values and frequencies	*100 Hz* 1 nF 10 nF 100 nF 1 µF 10 µF 100 µF	 0.051 % 0.023 % 0.023 % 0.017 % 0.046 % 0.046 %		
	1 kHz 1 pF 10 pF 100 pF 1 nF 10 nF 100 nF 1 µF 10 µF 100 µF	 0.27 % 0.045 % 0.041 % 0.017 % 0.010 % 0.021 % 0.015 % 0.046 % 0.046 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
CAPACITANCE (continued)				P
	10 kHz			
	1 nF	0.017 %		
	10 nF	0.013 %		
	100 nF	0.028 %		
	1 µF	0.017 %		
	1 MHz			
	1 pF	0.27 %		
	10 pF	0.042 %		
	100 pF	0.041 %		
	1 nF	0.048 %		
Other Values and Frequencies	1 nF to 1 µF *100 Hz to 10 kHz*	0.11 %		
INDUCTANCE			Standard inductors available for application to inductance measuring instruments. Calibration of inductors by comparison with these standards can also be undertaken.	P
Specific values and frequencies	*100 Hz*			
	10 µH	0.41 %		
	100 µH	0.20 %		
	1 mH	0.11 %		
	10 mH	0.060 %		
	100 mH	0.11 %		
	1 H	0.020 %		
	1 kHz			
	1 µH	0.38 %		
	10 µH	0.18 %		
	100 µH	0.018 %		
	1 mH	0.020 %		
	10 mH	0.020 %		
	100 mH	0.021 %		
	1 H	0.020 %		
	10 kHz			
	1 µH	0.38 %		
	10 µH	0.18 %		
	100 µH	0.024 %		
	1 mH	0.020 %		
	10 mH	0.020 %		
	100 mH	0.030 %		
	1 H	0.80 %		
	100 Hz to 1 kHz			
	1 H	0.080 %		
	1 kHz to 10 kHz			
	10 µH	0.42 %		
	100 µH	0.18 %		
	1 mH to 100 mH	0.16 %		
	100 Hz to 1 kHz			
	1 H	0.080 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL SIMULATION OF TEMPERATURE				
Temperature indicator calibration			By electrical simulation.	
Base metal thermocouple indicators	-270 °C to 0 °C 0 °C to 1370 °C	0.24 °C 0.16 °C	Excluding cold junction compensation	P
	-270 °C to 0 °C 0 °C to 1370 °C	0.26 °C 0.20 °C	Including cold junction compensation	
Noble metal thermocouple indicators	0 °C to 200 °C 200 °C to 800 °C 800 °C to 1760 °C	0.51 °C 0.50 °C 1.0 °C	Excluding cold junction compensation.	P
	0 °C to 200 °C 200 °C to 800 °C 800 °C to 1760 °C	0.60 °C 0.50 °C 1.0 °C	Including cold junction compensation.	
Cold junction compensation	At ambient of 23 °C	0.10 °C	Temperature measurement at cold junction.	P
RF POWER	-70 dBm to -65 dBm *10 MHz to 50 MHz* *50 MHz to 3 GHz* *3 GHz to 6 GHz* *6 GHz to 10 GHz* *10 GHz to 14 GHz* *14 GHz to 18 GHz*	 16 % 15 % 15 % 19 % 18 % 15 %	Using RF power meter and sensor, in 50 Ω coaxial systems only.	P
	-65 dBm to -60 dBm *10 MHz to 50 MHz* *50 MHz to 3 GHz* *3 GHz to 6 GHz* *6 GHz to 10 GHz* *10 GHz to 14 GHz* *14 GHz to 18 GHz*	 7.3 % 5.8 % 7.6 % 8.1 % 7.8 % 9.0 %		
	-60 dBm to -50 dBm *10 MHz to 50 MHz* *50 MHz to 3 GHz* *3 GHz to 6 GHz* *6 GHz to 10 GHz* *10 GHz to 14 GHz* *14 GHz to 18 GHz*	 5.6 % 4.4 % 4.4 % 4.4 % 4.4 % 4.4 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RF POWER (continued)	-50 dBm to -36 dBm			P
	10 MHz to 50 MHz	4.0 %		
	50 MHz to 3 GHz	4.0 %		
	3 GHz to 6 GHz	4.0 %		
	6 GHz to 10 GHz	4.0 %		
	10 GHz to 14 GHz	4.0 %		
	14 GHz to 18 GHz	4.2 %		
	-36 dBm to -14 dBm			P
	10 MHz to 50 MHz	2.1 %		
	50 MHz to 3 GHz	2.3 %		
	3 GHz to 6 GHz	2.2 %		
	6 GHz to 10 GHz	2.2 %		
	10 GHz to 14 GHz	2.5 %		
	14 GHz to 18 GHz	2.5 %		
	-14 dBm to +20 dBm			
	10 MHz to 50 MHz	2.8 %		
	50 MHz to 3 GHz	2.8 %		
	3 GHz to 6 GHz	2.8 %		
	6 GHz to 10 GHz	2.8 %		
	10 GHz to 14 GHz	3.0 %		
	14 GHz to 18 GHz	3.0 %		
	50 MHz at 0 dBm	1.7 %		
RF VOLTAGE	200 µV to 10 V		Using RF voltmeter, in 50 Ω coaxial systems only.	P
	9 kHz to 30 MHz	2.8 %		
	30 MHz to 100 MHz	2.5 %		
	100 MHz to 600 MHz	2.5 %		
	600 MHz to 1 GHz	2.1 %		
	1 GHz to 1.6 GHz	4.2 %		
	1.6 GHz to 2 GHz	6.8 %		
MODULATION MEASUREMENTS			Using modulation analyser.	P
Amplitude Modulation	20 % to 95 %	1.0 % of reading	f_c 50 kHz to 800 MHz f_{mod} 30 Hz to 100 kHz	
Frequency Modulation		1.4 %	f_c 50 kHz to 800 MHz f_{mod} 10 Hz to 200 kHz	
Phase Modulation	1 radian to 200 radian	1.7 %	f_c 50 kHz to 800 MHz f_{mod} 10 Hz to 200 kHz	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
VOLTAGE REFLECTION COEFFICIENT	*100 kHz to 1.3 GHz* 0.0 to 0.3 0.3 to 0.6 0.6 to 1.0 *1.3 GHz to 3 GHz* 0.0 to 0.3 0.3 to 0.6 0.6 to 1.0 *0.045 GHz to 2 GHz* 0.0 to 0.3 0.3 to 0.6 0.6 to 1.0 *2 GHz to 18 GHz* 0.0 to 0.3 0.3 to 0.6 0.6 to 1.0	 0.011 to 0.012 0.012 to 0.014 0.014 to 0.019 0.011 to 0.015 0.012 to 0.016 0.016 to 0.028 0.011 to 0.012 0.012 to 0.014 0.014 to 0.019 0.011 to 0.016 0.012 to 0.020 0.016 to 0.037	Using HP8753ES Type N connectors only. Results and uncertainties may also be quoted in terms of return loss (dB) or VSWR Using HP810C. Type N Connectors only. Results and uncertainties may also be quoted in terms of return loss (dB) or VSWR.	P
DIRECTIVITY *of VRC bridges and couplers*	16 dB to 50 dB *10 MHz to 2 GHz* *2 GHz to 18 GHz*	 0.017 to 0.0060 0.019 to 0.010	This capability is for the measurement of directivity of 50 Ω VRC bridges and similar devices with Type N connectors. The CMCs are given in linear quantities (VRC) where the range applies to the range of measured directivity. The values and uncertainties may be reported in dB terms, calculated from the linear values and uncertainties.	P
RF ATTENUATION	*100 kHz to 1.3 GHz* 0 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 80 dB 80 dB to 84 dB *1.3 GHz to 3 GHz* 0 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 80 dB 80 dB to 84 dB	 0.028 dB to 0.064 dB 0.064 dB to 0.13 dB 0.13 dB to 0.84 dB 0.77 dB to 2.6 dB 2.4 dB to 4.2 dB 0.036 dB to 0.068 dB 0.067 dB to 0.14 dB 0.13 dB to 0.95 dB 0.84 dB to 2.9 dB 2.6 dB to 4.7 dB	Using HP8753ES network analyser. The uncertainties quoted are for devices fitted with Type N connectors only and which present a near match to the 50 Ω measurement system. Measurement of devices presenting significant mismatch will attract larger uncertainties.	P

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RF ATTENUATION (continued)	*45 MHz to 6 GHz* 0 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 80 dB 80 dB to 84 dB *6 GHz to 12 GHz* 0 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 80 dB 80 dB to 84 dB *12 GHz to 18 GHz* 0 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 80 dB 80 dB to 84 dB	 0.040 dB to 0.069 dB 0.069 dB to 0.14 dB 0.12 dB to 0.99 dB 0.64 dB to 3.1 dB 2.0 dB to 4.9 dB 0.043 dB to 0.073 dB 0.072 dB to 0.18 dB 0.15 dB to 1.4 dB 0.99 dB to 4.4 dB 3.1 dB to 6.9 dB 0.056 dB to 0.081 dB 0.081 dB to 0.18 dB 0.18 dB to 1.4 dB 1.4 dB to 4.4 dB 4.4 dB to 6.9 dB	Using HP8510C network analyser. The uncertainties quoted are for devices fitted with Type N connectors only and which present a near match to the 50 Ω measurement system. Measurement of devices presenting significant mismatch will attract larger uncertainties.	P
DIMENSIONAL MEASUREMENTS	All units for dimensional measurements are presented in millimetres unless otherwise stated.	All Dimensional uncertainties are presented in micrometres unless otherwise stated.	NOTES 1 The uncertainty quoted is for the departure from flatness, straightness, or squareness, ie, the distance separating the two parallel planes which just enclose the surface under consideration.	
Length				P
Thread measuring cylinders	As BS 5590:1978 1 to 3 diameter 3 to 5	 0.60 0.90	Calibration as BS 5590:1978 using a length measuring machine	P
Plain plug gauges (parallel), cylindrical setting standards and rollers	10 to 25 diameter 3 to 100 100 to 150	0.60 1.0 1.5	Calibration using a length measuring machine	P
Length gauges (Flat and Spherical)	25 to 600	1.0 + (5.0 x length in m)	Calibration using a length measuring machine	P

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DIMENSIONAL MEASUREMENTS (continued)				
Plain ring gauges (parallel)	2 to 25 25 to 50 50 to 100 100 to 150 150 to 200	1.0 1.2 1.7 2.3 2.9	Calibration using a length measuring machine	P
Angle				P
Squares Blade type	As BS 939:2007 50 to 450	 5.0	See note 1. Calibration as BS 939:2007	
Block	As BS 939:2007 50 to 450	 5.0	Calibration as BS 939:2007	
Angle plates and box angle plates	As BS 5535:1978 50 to 450	Squareness: 4.2 + (1.0 per 100 mm) Parallelism: 1.0 + (1.0 per 100 mm)	See note 1. Calibration as BS 5535:1978	P
Form				
Surface plates Granite Cast iron	As BS 817:2008 160 x 100 to 4000 x 6000	1.7 + (0.80 x diagonal in m)	See note 1. Calibration as BS 817:2008	P & S
Measuring machines and instruments				
Micrometers				P
External	As BS 870:2008 0 to 450	Heads: 2.0 between any two points Setting: 1.9 + (7.0 x length in m)	Calibration as BS 870:2008	
Internal	As BS 959:2008 0 to 450	Heads: 2.0 between any two points Setting and extension rods: 1.0 + (5.0 x length in m)	Calibration as BS 959:2008	
Depth	As BS 6468:2008 0 to 450	Heads: 2.0 between any two points Setting and extension rods: 1.0 + (5.0 x length in m)	Calibration as BS 6468:2008	
Micrometer heads	As BS 1734:1951 0 to 100	1.3	Calibration as BS 1734:1951	P
Height setting micrometer	0 to 300	Heads: 2.0 between any two points Stepped column: 2.0 Overall performance: 3.0	By comparison with end standards	P
Riser blocks for above	150 300 600	1.5 2.2 3.7	By comparison with end standards	P

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DIMENSIONAL MEASUREMENTS (continued)				
Vernier gauges				
Caliper	As BS 887:2008 0 to 1000	10 + (30 x length in m)	Calibration as BS 887:2008	P
Height	As BS 1643:2008 0 to 1000	10 + (30 x length in m)	Calibration as BS 1643:2008	
Depth	As BS 6365:2008 0 to 600	10 + (30 x length in m)	Calibration as BS 6365:2008	
Dial gauges and dial test indicators	As BS 907:2008 and BS 2795:1981 0 to 50	1.0	Calibration as BS 907:2008 and BS 2795:1981	P
Comparators (external)	As BS 1054:1975 250 to 10,000 magnification	1.0 % of range Minimum 0.20	Calibration as BS 1054:1975	P
Feeler gauges	As BS 957:2008	3.0	Calibration as BS 957:2008	P
Steel rules	BS 4372:1968 0 to 1000	10.0 + (15 x length in m)	Calibration as BS 4372:1968	P
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 the 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 $1.5 \cdot 0.01 \cdot i$, where i is the instrument indication.