


Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>UKAS CALIBRATION</p> <p>0809</p> <p>Accredited to ISO/IEC 17025:2005</p>	<h3>Seaward Electronic Ltd</h3> <p>Issue No: 020 Issue date: 10 August 2018</p>	
	<p>Bracken Hill South West Industrial Estate Peterlee Co Durham SR8 2SW United Kingdom</p>	<p>Contact: Mr Malcolm Steele Tel: +44 (0) 191 586 3511 Fax: +44 (0) 191 586 0227 E-Mail: MalcolmS@seaward.co.uk Website: www.seaward.co.uk</p>
<p>Calibration performed by the Organisation at the locations specified</p>		

Locations covered by the organisation and their relevant activities

Laboratory location:

Location details	Activity	Location code
<p>Address</p> <p>South West Industrial Estate Peterlee SR8 2SW United Kingdom</p> <p>Local contact:</p> <p>Malcolm Steele Tel: +44 (0) 191 586 3511 Fax: +44 (0) 191 586 0227 E-Mail: MalcolmS@seaward.co.uk Website: www.seaward.co.uk</p>	<p>Electrical calibration Pressure calibration</p>	<p>Peterlee</p>

Site activities performed away from the location listed above:

Location details	Activity	Location code
<p>Customers' sites or premises</p> <p>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.</p> <p>Local contact:</p> <p>Malcolm Steele Tel: +44 (0) 191 586 3511 Fax: +44 (0) 191 586 0227 E-Mail: MalcolmS@seaward.co.uk Website: www.seaward.co.uk</p>	<p>Electrical calibration</p>	<p>Customers' premises</p>



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DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location Code	
CALIBRATIONS CONDUCTED AT THE PERMANENT LABORATORY					
ELECTRICAL CALIBRATION					
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 1000 V	32 ppm + 3.6 μ V 32 ppm + 4.6 μ V 26 ppm + 46 μ V 32 ppm + 460 μ V 32 ppm + 4.6 mV		Peterlee	
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	7.3 ppm + 1.3 μ V 7.6 ppm + 1.2 μ V 4.8 ppm + 3.3 μ V 7.6 ppm + 46 μ V 8.0 ppm + 230 μ V			
DC RESISTANCE					
Generation	10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω 1 G Ω	6.9 m Ω 12 m Ω 93 m Ω 930 m Ω 9.4 Ω 160 Ω 4.6 k Ω 590 k Ω 14 M Ω	Nominal values obtained from a multi- function calibrator for calibration of multimeters, resistance meters etc.		
	1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω	15 ppm 8.0 ppm 7.6 ppm 6.9 ppm 6.6 ppm 13 ppm 7.7 ppm 10 ppm 6.5 ppm 7.9 ppm			Standard resistors available for calibration of resistance bridges, long-scale multimeters etc.



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DC RESISTANCE (continued)				
Measurement	1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω	47 ppm 24 ppm 10 ppm 8.9 ppm 9.2 ppm 12 ppm 9.2 ppm 11 ppm 9.1 ppm 8.9 ppm	Calibration of standard resistors	Peterlee
	0 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 k Ω 2 k Ω to 20 k Ω 20 k Ω to 200 k Ω 200 k Ω to 2 M Ω 2 M Ω to 20 M Ω 20 M Ω to 200 M Ω 200 M Ω to 2 G Ω	14 ppm + 38 $\mu\Omega$ 9.2 ppm + 0.21 m Ω 7.0 ppm + 2.3 m Ω 7.0 ppm + 21 m Ω 7.4 ppm + 0.22 Ω 12 ppm + 4.0 Ω 23 ppm + 110 Ω 0.023 % + 11 k Ω 0.23 % + 1.1 k Ω	Calibration of standard resistors, decade resistance boxes etc.	
High resistance/high voltage Measurement	1.0 k Ω to 100 k Ω 0.1 M Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 M Ω to 1 G Ω 1 G Ω to 10 G Ω 10 G Ω to 100 G Ω 100 G Ω to 1 T Ω	0.038 % 0.060 % 0.059 % 0.061 % 0.053 % 0.054 % 0.072 % 0.25 %	The applied voltages will be in the range 10 V to 1000 V DC	
	1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 M Ω to 1 G Ω 1 G Ω to 10 G Ω 10 G Ω to 100 G Ω 100 G Ω to 1 T Ω	0.32 % 0.31 % 0.31 % 0.31 % 0.37 % 0.44 %	The applied voltages will be in the range 1 kV to 5 kV DC	



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AC VOLTAGE Measurement	20 mV to 200 mV 45 Hz to 10 kHz	0.036 % + 4.6 μ V		Peterlee
	200 mV to 2 V 45 Hz to 2 kHz 2 kHz to 10 kHz	0.014 % + 23 μ V 0.021 % + 23 μ V		
	2 V to 20 V 45 Hz to 100 Hz 100 Hz to 10 kHz	0.014 % + 230 μ V 0.021 % + 230 μ V		
	20 V to 200 V 45 Hz to 2 kHz	0.027 % + 2.3 mV		
	200 V to 1000 V 45 Hz to 2 kHz	0.078 % + 12 mV		
Generation	20 mV to 200 mV 45 Hz to 1 kHz 1 kHz to 10 kHz	0.062 % + 34 μ V 0.11 % + 50 μ V		
	200 mV to 2 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.049 % + 270 μ V 0.11 % + 300 μ V		
	2 V to 20 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.048 % + 2.5 mV 0.085 % + 2.8 mV		
	20 V to 200 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.070 % + 22 mV 0.13 % + 53 mV		
	200 V to 1000 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.077 % + 89 mV 0.20 % + 0.46 V	Minimum frequency 46 Hz above 700 V	



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location Code
DC CURRENT				
Generation	0 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 2 A 2 A to 20 A 20 A to 30 A	93 ppm + 35 nA 81 ppm + 55 nA 47 ppm + 400 nA 0.012 % + 4.0 μ A 0.014 % + 41 μ A 0.020 % + 41 μ A 0.036 % + 410 μ A 0.12 % + 410 μ A		
	30 A to 1500 A	0.54 % + 490 mA	Hall effect clamps	
Measurement	0 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 2 A to 20 A	29 ppm + 2.1 nA 29 ppm + 8.4 nA 29 ppm + 84 nA 58 ppm + 1.4 μ A 0.017 % + 25 μ A 0.082 % + 12 μ A		
AC CURRENT				
Generation	45 Hz to 500 Hz 20 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	0.12 % + 290 nA 0.10 % + 550 nA 0.10 % + 5.5 μ A 0.10 % + 55 μ A 0.12 % + 550 μ A		
	45 Hz to 100 Hz 2 A to 20 A 20 A to 30 A	0.079 % + 2.3 mA 0.14 % + 2.3 mA		
Calibration of clamp-on ammeters using multi-turn coil	50 to 60 Hz 30 A to 1500 A 30 A to 1500 A	0.34 % + 0.12 A 0.55 % + 0.50 A	Hall effect clamps Wound clamps	
Measurement	45 Hz to 200 Hz: 2 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	0.023 % + 31 nA 0.023 % + 360 nA 0.023 % + 3.1 μ A 0.023 % + 31 μ A 0.058 % + 0.50 mA		
	45 Hz to 100 Hz 2 A to 20 A	0.16 % + 0.23 mA		

Peterlee



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FREQUENCY	1 Hz to 1 GHz	3.0 ppm	Can be reported as 1/f for repetitive timing events E.G. RPM	Peterlee
Elapsed time	1 s to 12 hrs	69 ms	Manual start stop	
Calibration of Portable Appliance Testers				
Earth Bond	<i>At 50 Hz:</i> 0.05 Ω 0.09 Ω 0.1 Ω 0.115 Ω 0.2 Ω 0.33 Ω 0.45 Ω 0.5 Ω 0.575 Ω 1.0 Ω 3.3 Ω 5.0 Ω 10 Ω 15 Ω 18 Ω	1.2 % 0.67 % 0.62 % 0.54 % 0.34 % 0.30 % 0.28 % 0.24 % 0.25 % 0.20 % 0.29 % 0.24 % 0.19 % 0.18 % 0.18 %		
Insulation Resistance	<i>At DC:</i> 0.25 M Ω 0.5 M Ω 1.0 M Ω 2.0 M Ω 4.0 M Ω 5.0 M Ω 6.0 M Ω 10 M Ω 15 M Ω 18 M Ω 50 M Ω 90 M Ω	0.25 % 0.13 % 0.077 % 0.060 % 0.062 % 0.066 % 0.052 % 0.051 % 0.068 % 0.064 % 0.083 % 0.12 %		
Insulation Resistance Test Voltage	100 V 250 V 500 V 1000 V	0.094 % 0.073 % 0.13 % 0.11 %		
Leakage Current	<i>DC:</i> 0 μ A to 320 μ A 320 μ A to 3.2 mA 3 mA to 32 mA	0.12 % + 0.051 μ A 0.069 % + 0.23 μ A 0.11 % + 2.3 μ A		



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Calibration of Portable Appliance Testers (continued)				
Leakage Current (continued)	<i>50 Hz to 60 Hz:</i> 0 mA to 1.6 mA 1.6 mA to 16 mA 16 mA to 20 mA	0.29 % + 0.40 μ A 0.35 % + 3.8 μ A 0.35 % + 39 μ A	These capabilities also apply to flash testers and high voltage meters.	Peterlee
Flash Test	<i>DC, 50 Hz and 60 Hz:</i> Current (0 mA to 32 mA) Voltage (<i>AC, 50 Hz and 60 Hz</i>) 1 kV 1.5 kV 2 kV 3 kV 4 kV 5 kV Voltage (<i>DC</i>) 1 kV 2 kV 3 kV 4 kV 5 kV 6 kV	See <i>Leakage Current</i> above 12 V 13 V 17 V 21 V 28 V 35 V 10 V 12 V 13 V 14 V 20 V 32 V		
Load Test	<i>At 50 Hz:</i> 1 kVA and 3 kVA nominal	1.5 % + 0.015 kVA		
Calibration of RCD Testers				
Trip Current	<i>At 50 Hz:</i> 10 mA to 100 mA 100 mA to 2 A	1.4 % + 0.083 mA 1.4 % + 0.83 mA		
Trip Time	20 ms to 100 ms 100 ms to 400 ms 400 ms to 700 ms 700 ms to 900 ms	0.96 ms 1.5 ms 4.8 ms 8.5 ms		
Calibration of Loop Testers				
Loop impedance	<i>At 50 Hz:</i> 0.5 Ω to 1 Ω 5 Ω 10 Ω 100 Ω 1 k Ω	12 m Ω 36 m Ω 65 m Ω 0.65 Ω 6.1 Ω		



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Calibration of Seaward PV100/PV150 solar installation meters			The accreditation for calibration of these instruments includes the expression of opinions relating to the effects of storage periods of up to six months on the calibration validity.	Peterlee
Insulation Resistance	0.5 M Ω 1 M Ω 10 M Ω 90 M Ω 190 M Ω	10 k Ω 10 k Ω 100 k Ω 100 k Ω 1.0 M Ω	At 500 V DC	
	0.25 M Ω 90 M Ω	10 k Ω 1.0 M Ω	At 250 V DC	
	1 M Ω	10 k Ω	At 1000 V DC	
Insulation Voltage	250 V 500 V	1.0 V 1.0 V	Into 1 mA load Into 1 mA load	
Continuity Resistance	0.67 Ω 1.2 Ω 10.5 Ω 100 Ω 190 Ω	10 m Ω 10 m Ω 100 m Ω 1.0 Ω 1.0 Ω		
Current clamp input	100 mV (10 A simulation) 199 mV (20 A simulation) 500 mV (50 A simulation)	100 mA 100 mA 100 mA	Simulation of current clamp at 100 A/V	
RPE Voltage	110 V 240 V 420 V	1.0 V 1.0 V 1.0 V		
Open circuit panel voltage	10.9 V 49.9 V 202 V 440 V 640 V 900 V	100 mV 100 mV 1.0 V 1.0 V 1.0 V 1.0 V	DC Voltage	
Short circuit current	0.97 A 2.7 A 8 A	10 mA 20 mA 50 mA	DC Current	



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Calibration of defibrillator testers				Peterlee
Energy	20 J to 70 J 70 J to 100 J 100 J to 360 J	1.5 % to 1.3 % 1.3 % to 1.2 % 1.2 %		
Calibration of temperature indicators By electrical simulation				
Supporting ambient temperature measurement	17 °C to 23 °C	0.22 °C		
PT100 indicators	-125 °C to 0 °C 0 °C to 130 °C 130 °C to 266 °C 266 °C to 408 °C 408 °C to 558 °C 558 °C to 715 °C 715 °C to 883 °C	0.0025 °C to 0.0047 °C 0.0047 °C to 0.0070 °C 0.0070 °C to 0.0096 °C 0.0096 °C to 0.012 °C 0.012 °C to 0.015 °C 0.015 °C to 0.018 °C 0.018 °C to 0.021 °C		
PT25 indicators	5 °C to 408 °C 408 °C to 883 °C	0.0056 °C to 0.013 °C 0.013 °C to 0.024 °C		
Type K thermocouple indicator simulation	-270 °C to -220 °C -200 °C to -70 °C -70 °C to 1370 °C	2.4 °C 0.83 °C 0.75 °C	Including reference junction compensation	
Calibration of Medical Safety Analysers				
Earth Bond Resistance	At 50 Hz 0.1 Ω 0.33 Ω 0.5 Ω 1 Ω 1.8 Ω 18 Ω	0.024 Ω 0.047 Ω 0.058 Ω 0.025 Ω 0.047 Ω 0.085 Ω		
Earth Bond Current	2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A 2 A to 20 A	0.12 % + 0.58 mA 0.12 % + 5.8 mA 0.19 % + 6.1 mA 0.23 % + 24 mA		



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Calibration of Medical Safety Analysers (continued)					
Insulation Resistance	<i>At DC</i> 0.01 MΩ to 5 MΩ 5 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 2000 MΩ	0.35 % + 5.8 kΩ 3.5 % + 5.8 kΩ 3.5 % + 15 kΩ 3.5 % + 0.37 MΩ		Peterlee	
Insulation Resistance Test Voltage	100 V to 1000 V	0.35 % + 67 mV			
Leakage Current	<i>DC</i> 0 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA	0.021 % + 0.58 μA 0.018 % + 0.60 μA 0.018 % + 1.6 μA			
	<i>AC 50 to 60 Hz</i> 20 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA	0.12 % + 1.0 μA 0.14 % + 2.3 μA 0.13 % + 36 μA			
Voltage Measurement	<i>AC 50 to 60 Hz</i> 20 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V	0.10 % + 0.58 mV 0.093 % + 0.73 mV 0.081 % + 7.2 mV 0.093 % + 48 mV			
Load	0.13 kVA	0.010 kVA			
Calibration of Seaward Apollo 600 Portable Appliance Testers					
Earth Bond Resistance	0.05 Ω to 19.99 Ω	0.015 % + 6.0 mΩ	The accreditation for calibration of these instruments includes the expression of opinions relating to the effects of storage periods of up to six months on the calibration validity.		
Earth Bond Test Current	0 mA to 250 mA DC	0.037 % + 0.58 mA			
Earth Bond Test Voltage	0 V to 10 VDC	42 ppm + 0.58 mV			
Insulation Resistance	0.1 MΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 20 MΩ	0.019 % + 5.8 kΩ 0.065 % + 5.8 kΩ 0.91 % + 7.5 kΩ			
Insulation Voltage	0 V to 750 V DC	0.012 % + 0.058 V			
Insulation Current	0 mA to 2 mA DC	0.014 % + 5.8 μA			
Differential Leakage Current	0.20 mA to 10mA DC 10mA to 20 mA DC	0.14 % + 5.6 μA 0.13 % + 64 μA			
Touch Leakage Current	0.10 mA to 3.50 mA DC	0.14 % + 5.6 μA			



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Calibration of Seaward Apollo 600 Portable Appliance Testers (continued)					
Substitute Leakage Current	0.20 mA to 20 mA, 50 Hz	0.14 % + 24 μ A		Peterlee	
Substitute Leakage Test Voltage	0 V to 50 V, 50 Hz	0.069 % + 25 mV			
Load Test Voltage	0 V to 250 V, 50 Hz	0.069 + 0.63 V			
Load Test Current	0 A to 16 A, 50 Hz	1.2 % + 0.24 A			
RCD Test Time	10 ms 20 ms 500 ms	0.13 ms 0.26 ms 4.5 ms			
RCD Test Current	0 mA to 165 mA, 50 Hz	0.25 % + 47 μ A			
Calibration of HV Neon Indicators					
Leakage Current	0 μ A to 600 μ A 600 μ A to 6000 μ A	1.4 % + 1.6 μ A 1.4 % + 14 μ A			
Calibration of DC Power Supplies					
Output Voltage	0 V to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	52 ppm + 0.58 mV 48 ppm + 0.58 mV 61 ppm + 1.0 mV 61 ppm + 59 mV			
Output Current	0 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 10 A 10A to 20 A	0.060 % + 0.58 mA 0.059 % + 0.58 mA 0.12 % + 0.59 mA 0.068 % + 4.9 mA 0.068 % + 7.9 mA			
PRESSURE CALIBRATION					
Gas Pressure, Gauge & Absolute					
<u>Calibration of pressure indicating instruments and gauges</u>	-85 kPa to 0.0 Pa 0.0 Pa to 50 kPa 50 kPa to 3.5 MPa	110 ppm 33 Pa 300 ppm	These gauge pressure ranges can be calibrated in absolute mode subject to an additional uncertainty of +/- 24 Pa.		



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CALIBRATIONS CONDUCTED AT CUSTOMERS' PREMISES						
ELECTRICAL CALIBRATION						
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 1000V	84 ppm + 7.0 μ V 73 ppm + 55 μ V 73 ppm + 0.47 mV 74 ppm + 4.7 mV 74 ppm + 31 mV	Nominal values obtained from a multi- function calibrator for calibration of multimeters, resistance meters etc.	Customers' premises and Peterlee		
Measurement	Up to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	68 ppm + 5.7 μ V 58 ppm + 10 μ V 51 ppm + 82 μ V 63 ppm + 0.91 mV 63 ppm + 13 mV				
DC RESISTANCE						
Generation	10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω	59 m Ω 67 m Ω 0.17 Ω 1.2 Ω 12 Ω 0.24 k Ω 12 k Ω 0.24 M Ω				
Measurement	Up to 100 Ω 100 Ω to 1 k Ω 1 Ω to 10 k Ω 10 k Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω	0.12 % + 13 m Ω 0.12 % + 95 m Ω 0.12 % + 0.95 Ω 0.12 % + 9.5 Ω 0.12 % + 0.16 k Ω 0.47 % + 4.6 k Ω 1.1 % + 0.60 M Ω				
AC VOLTAGE						
Generation	20 mV to 200 mV 45 Hz to 1 kHz 1 kHz to 2 kHz 2 kHz to 10 kHz	0.056 % + 49 μ V 0.092 % + 67 μ V 0.15 % + 0.30 mA				
	200 mV to 2 V 45 Hz to 1 kHz 1 kHz to 2 kHz 2 kHz to 10 kHz	0.070 % + 0.53 mV 0.095 % + 0.55 mV 0.13 % + 0.94 mV				
	2 V to 20 V 45 Hz to 1 kHz 1 kHz to 2 kHz 2 kHz to 10 kHz	0.069 % + 5.3 mV 0.087 % + 5.5 mV 0.15 % + 9.4 mV				



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AC VOLTAGE (continued) Generation (continued)	20 V to 200 V 45 Hz to 1 kHz 1 kHz to 2 kHz 2 kHz to 10 kHz	0.087 % + 53 mV 0.12 % + 70 mV 0.19 % + 0.10 mV		Customers' premises and Peterlee
Measurement	200 V to 1000 V 45 Hz to 1 kHz	0.080 % + 0.30 V		
	10 mV to 100 mV 45 Hz to 1 kHz 1 kHz to 10 kHz	0.082 % + 57 μ V 0.11 % + 72 μ V		
	100 mV to 1 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.080 % + 0.38 mV 0.10 % + 0.40 mV		
	1 V to 10 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.080 % + 3.8 mV 0.096 % + 4.0 mV		
	10 V to 100 V 45 Hz to 1 kHz 1 kHz to 10 kHz	0.080 % + 37 mV 0.11 % + 59 mV		
	100 V to 750 V 45 Hz to 1 kHz	0.080 % + 0.29 mV		
	5 kV to 50 kV 50 Hz	1.0 % + 2.0 V		
DC CURRENT				
Generation	0 A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A 2 A to 20 A	0.019 % + 40 nA 0.017 % + 0.17 μ A 0.017 % + 1.6 μ A 0.018 % + 19 μ A 0.069 % + 0.36 mA 0.055 % + 1.4 mA		
Calibration of clamp-on ammeters using multi-turn coil	20A to 200 A 200 A to 1000A	0.53 % + 0.49 A 0.53 % + 0.49 A	Hall Effect Clamps	
Measurement	0 A to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 3 A	0.058 % + 7.3 μ A 0.059 % + 19 μ A 0.12 % + 0.13 mA 0.14 % + 0.87 mA		



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AC CURRENT				Customers' premises and Peterlee
Generation	45 Hz to 200 Hz 20 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	0.13 % + 0.57 μ A 0.079 % + 1.9 μ A 0.078 % + 35 μ A 0.085 % + 0.19 mA 0.12 % + 1.8 mA		
	45 Hz to 200 Hz 2 A to 20 A	0.19% + 9.3 mA		
Calibration of clamp-on ammeters using multi-turn coil	50 to 60 Hz 20 A to 200 A 200 A to 1000A	0.33 % + 46 mA 0.32 % + 46 mA	Wound Clamp	
	20 A to 200 A 200 A to 1000 A	0.56 % + 0.49 A 0.55 % + 0.60 A	Hall Effect Clamps	
Measurement	45 Hz to 500 Hz 50 mA to 1 A 1 A to 2 A	0.16 % + 0.68 mA 0.20 % + 2.2 mA		
Frequency				
Measurement	1 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 100 MHz 100 MHz to 1 GHz	17 ppm + 1.3 mHz 17 ppm + 1.3 mHz 17 ppm + 1.2 mHz 17 ppm + 1.2 mHz 17 ppm + 1.4 mHz 17 ppm + 8.3 mHz 17 ppm + 82 mHz 17 ppm + 0.82 Hz 17 ppm + 8.2 Hz		
Calibration of Oscilloscopes				
Vertical Deflection	2 mV / division 5 mV / division 10 mV / division 20 mV / division 50 mV / division 100 mV / division 200 mV / division 500 mV / division 1 V / division 2 V / division 5 V / division 10 V / division 20 V / division 50 V / division	34 μ V 40 μ V 51 μ V 80 μ V 0.18 mV 0.35 mV 0.70 mV 1.7 mV 3.5 mV 7.0 mV 17 mV 35 mV 82 mV 0.20 V		



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Seaward Electronic Ltd
Issue No: 020 Issue date: 10 August 2018

Calibration performed by the Organisation at the locations specified

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location Code	
Calibration of Oscilloscopes (continued)				Customers' premises and Peterlee	
Timebase	5 ns / division 10 ns / division 20 ns / division 50 ns / division 100 ns / division 200 ns / division 500 ns / division 1 μ s / division 2 μ s / division 5 μ s / division 10 μ s / division 20 μ s / division 50 μ s / division 100 μ s / division 200 μ s / division 500 μ s / division 1 ms / division 2 ms / division 5 ms / division 10 ms / division 20 ms / division 50 ms / division 100 ms / division 200 ms / division 500 ms / division 1 s / division	0.085 % 0.083 % 0.083 % 0.085 % 0.083 % 0.083 % 0.085 % 0.083 % 0.083 % 0.085 % 0.083 % 0.083 % 0.085 % 0.083 % 0.083 % 0.085 % 0.083 % 0.083 % 0.085 % 0.083 % 0.083 % 0.085 % 0.084 % 0.089 % 0.11 % 0.17 %			
Calibration of Portable Appliance Testers					
Earth Bond	At 50 to 60 Hz 0.05 Ω 0.1 Ω 0.5 Ω 1 Ω 1.8 Ω 10 Ω 18 Ω	1.0 m Ω 1.0 m Ω 1.4 m Ω 2.3 m Ω 8.9 m Ω 23 m Ω 36 m Ω			
Insulation Resistance	At DC 10 k Ω to 2 M Ω 2 M Ω to 20 M Ω 20 M Ω to 200 M Ω 200 M Ω to 2 G Ω	0.12 % + 0.58 k Ω 1.2 % + 0.66 k Ω 1.2 % + 15 k Ω 1.2 % + 0.37 M Ω	These capabilities also apply to insulation testers.		
Insulation Resistance Test Voltage	100 V to 1000 V	0.19 % + 0.58 V			



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location Code		
Calibration of Portable Appliance Testers (continued)						
Leakage Current	<i>At DC</i> 0 mA to 1 mA 1 mA to 10 mA 10 mA to 20 mA <i>At 50 Hz to 60 Hz</i> Up to 1 mA 1 mA to 10 mA 10 mA to 20 mA	0.16 % + 0.82 μ A 0.16 % + 6.3 μ A 0.16 % + 63 μ A 0.35 % + 0.83 μ A 0.21 % + 8.3 μ A 0.21 % + 83 μ A	<div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; height: 100px; width: 100%;"></div> <p align="center">These capabilities also apply to flash testers and high voltage meters.</p>	Customers' premises and Peterlee		
Flash Test	DC, 50 Hz to 60 Hz Current (0 mA to 20 mA)	See <i>Leakage Current</i> above.				
	Voltage (DC) 100 V to 1000 V 1000 V to 6000 V	0.19 % + 0.58 V 0.20 % + 11 V				
	Voltage (AC; 50 Hz to 60 Hz) 100 V to 1000 V 1000 V to 5000 V	0.37 % + 0.60 V 0.64 % + 7.8 V				
Load Test	0 kVA to 3 kVA	0.78 % + 0.27 kVA				
Calibration of RCD Testers						
Trip Current	At 50 Hz 10 mA to 100 mA 100 mA to 2 A	1.4 % + 0.083 mA 1.4 % + 0.83 mA				
Trip Time	20 ms to 100 ms 100 ms to 400 ms 400 ms to 700ms 700 ms to 900 ms	0.96 ms 1.5 ms 4.8 ms 8.5 ms				
Calibration of Loop Testers						
Loop Impedance	At 50 Hz 0.5 Ω to 1 k Ω	(0.60 % to 0.80 %) + 4.6 m Ω				
Calibration of Defibrillator Analysers						
Energy	20 J to 70 J 70 J to 100 J 100 J to 360 J	1.5 % to 1.3 % 1.3 % to 1.2 % 1.2 %				
END						



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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, and an indication of how they are to be interpreted, are shown below.

DC voltage, 100 mV to 1 V: $0.0025 \% + 5.0 \mu\text{V}$:

Over the range 100 mV to 1 V, the CMC is $0.0025 \% \cdot V + 5.0 \mu\text{V}$, where V is the measured voltage.

Hydraulic pressure, 0.5 MPa to 140 MPa: $0.0036 \% + 0.12 \text{ ppm/MPa} + 4.0 \text{ Pa}$

Over the range 0.5 MPa to 140 MPa, the CMC is $0.0036 \% \cdot p + (0.12 \cdot 10^{-6} \cdot p \cdot 10^{-6}) + 4.0 \text{ Pa}$, 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.