


# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

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

 <p><b>UKAS</b> CALIBRATION 0199</p> <p>Accredited to <b>ISO/IEC 17025:2005</b></p>	<p><b>Avon-Dynamic Calibration Limited</b></p> <p>Issue No: 047    Issue date: 27 August 2019</p>	
	<p>Unit 1 &amp; Unit 2 The Old Mill Chapel lane Warmley Bristol BS15 4NQ</p>	<p>Contact: Mr J Castree Tel: +44 (0)117-9477846 Fax: +44 (0)117-9477831 E-Mail: info@avon-dynamic.co.uk Website: www.avon-dynamic.co.uk</p>
<p>Calibration performed by the Organisations at the locations specified below</p>		

### Locations covered by the organisation and their relevant activities

#### Laboratory locations:

Location details	Activity	Location code
<p><b>Address</b> Unit 1 &amp; Unit 2 The Old Mill Chapel lane Warmley Bristol BS15 4 NQ</p> <p><b>Local contact</b> Mr J Castree</p>	<p>Dimensional</p> <p>Electrical</p> <p>Pressure</p> <p>Temperature</p> <p>Torque</p>	<p>A</p> <p>A</p> <p>A</p> <p>A</p> <p>A</p>

#### Site activities performed away from the locations listed above:

Location details	Activity	Location code
<p>At customers premises</p> <p>Mr J Castree</p>	<p>Dimensional</p>	<p>B</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
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
LENGTH				
Gauge blocks		Class (see Notes)	NOTES	
Inch (steel - tungsten carbide)	As BS 4311:Part 1:2007  0.010 in to 0.4 in 0.4 in to 1 in Size 2 in Size 3 in Size 4 in	C  3.0 4.0 5.0 6.0 7.0	] μ inch	A
Millimetre (steel - tungsten carbide)	As BS EN ISO 3650:1999 0.5 to 10 10 to 25 Sizes 30, 40, 50, 60, 70, 75 80, 90, 100	0.080 0.10 0.12 0.15 0.18		A
Gauge blocks accessories	As BS 4311:Part 2: 2009 0.1 to 12.5	0.30	1 The uncertainty quoted is for the departure from either flatness, straightness, parallelism planes, which just enclose the surface under consideration.	A
Length bar accessories	As BS 1790:1961 and BS 5317:1976 10 to 25	0.30		A
Precision pins	0.05 to 10 diameter	0.50	2. Single start, symmetrical thread forms only.	A
Thread measuring cylinders	As BS 5590:1978 and specials 0.1 to 5	0.50 on diameter		A
Plain plug gauges (parallel), cylindrical standards and rollers	1 to 50 diameter 50 to 100 diameter 100 to 150 diameter 150 to 200 diameter 200 to 300 diameter	0.80 1.0 1.5 2.0 2.5	3. Single start symmetrical and asymmetrical thread forms only.  4. Includes use of check plugs for screw rings from 1 mm to 6mm diameter	
Plain ring gauges (parallel) and setting standards	1 to 50 50 to 100 100 to 275	1.5 2.0 2.5		5. Includes use of check plugs for screw rings (taper) from 5 mm to 50 mm diameter
Steel balls - steel	1 to 50	1.0	6. Functional test of size using setting plugs calibrated	A
Plain gap gauges (parallel)	0.5 to 100 100 to 200 200 to 300	3.0 5.0 8.0		



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<b>RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED</b>				
<b>LENGTH (Cont'd)</b>				
Screw plug gauges (parallel) including check and setting plugs See Note 3	1 to 100 diameter	3.0	7. Features and associated parts of these gauges can be measured to the uncertainties given	A
Screw plug gauges (taper) including check plugs See Note 2	1 to 100 diameter	4.0		
Screw ring gauges (parallel) See Notes 3 and 4	1 to 100 diameter	5.0 on pitch diameter		
Screw ring gauges (taper) See Notes 2 and 5	5 to 150 diameter	7.0 on pitch diameter		
Screw pitch Screw flank angle	0.2 to 8 0° to 52°	1.5 5.0 minutes of arc	8. Simple height gauges - vernier, dial and digital instruments designed only for measuring distances parallel to the beam.  9. Conformance statements cannot be made against specifications whose magnitudes are smaller than the specified CMC values	A
Screw thread adjustable calliper gauges (parallel) See Note 3	3 to 50 diameter	See Note 6		
Length gauges, flat and spherical ended	1 to 1000	1.0 + (8.0 x length in m)		
Engineers parallels	As BS 906:1972 5 to 50 x 100 x 400	1.5 to 5.0		
Vee blocks	As BS 3731:1987 20 to 150	2.5 to 5.0		
Receiver, position and profile gauges, jigs and fixtures	0 to 1000 x 600 x 600	See Note 7		
<b>ANGLE</b>				
Squares				
Blade type	As BS 939:2007 50 to 300 300 to 600	3.0 5.0		
Cylindrical	As BS 939:2007 75 to 300 300 to 600	2.0 5.0		



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
ANGLE (Cont'd)				
Block	As BS 939:2007 50 to 300 300 to 600	3.0 5.0 All on squareness See note 1		
Right angle and box angle plates	As BS 5535:1978 50 to 600	Squareness: 3.0 + (1.0 per 100 mm) Parallelism: 1.0 + (1.0 per 100 mm) See Note 1		A
Sine bars and tables	As BS 3064:1978 0 to 250 length	Linear dimensions 1.0 + (10 x length in m) Overall performance 3.0 seconds of arc		A
Electronic indicating levels	0 minutes of arc to 20 minutes of arc	1.0 % of range Minimum 0.50 seconds of arc		A
Spirit levels	As BS 3509:1962 and BS 958:1968 5 seconds of arc to 60 minutes of arc nominal sensitivity	Mean sensitivity 10% of nominal Minimum 0.50 seconds of arc		A
Clinometers	0° to 360°	10 seconds of arc		A
Thread measuring vee pieces (prisms)	As NPL Schedule MOY/SCMI/60 0 to 4.5	0.50		A
FORM				
Surface plates Granite Cast iron	As BS 817:2008 160 x 100 to 1600 x 1000	1.5 + (0.80 x diagonal in m) See Note 1		A, B
Straightedges Cast iron Steel Granite	As BS 5204:Part 1:1975 As BS 5204:Part 2:1977 Up to 1800	1.0 + (2.0 x length in m) See Note 1		A



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<b>RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED</b>				
<b>MEASURING INSTRUMENTS AND MACHINES</b>				
Micrometers				A
External	As BS 870:2008 0 to 600	Heads: 2.0  Setting and extension rods 2.0 + (7.0 x length in m)		
Internal	As BS 959:2008 0 to 900			
Depth	As BS 6468:2008 0 to 300			
Micrometer heads	As BS 1734:1951 0 to 100	1.0		A
Bore micrometers (three point)	0 to 150 diameter	5.0		A
Bench micrometers	As NPL MOY/SCMI 22 0 to 100	Overall performance 2.0		A
Height setting micrometer	0 to 300	Heads:1.2 Stepped column 2.0 Overall performance 2.5		A
Riser blocks for above	150 300	1.0 2.0		A
Vernier caliper, height and depth gauges	As BS 887:2008 0 to 1000 As BS 1643:2008 0 to 1000 As BS 6365:2008 0 to 600	Overall performance 10 + (30 x length in m)		A
Height gauges - (Simple) including vernier, dial and digital types (See note 8 and note 9)	As BS EN ISO 13225:2012 0 to 1000	Length measurement error (E): 10 + (30 x length in metres)		A
Comparators (external)	As BS 1054:1975 250 to 10 000 magnifications	1.0 % of range Minimum 0.20		A
Dial gauges and dial test indicators	As BS 907:2008 and BS 2795:1981 0 to 50	1.0		A
Bevel protractors	As BS 1685:2008 0° to 360°	6 0 minutes of arc		A
Thread diameter measuring	As NPL Schedules MOY/SCMI/1/ 9 and MOY/SCMI1 //12 0 to 200 capacity	Overall performance 1.5		A



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
<b>MEASURING INSTRUMENTS AND MACHINES (Cont'd)</b>				
Steel Rules	As BS 4372:1968 0 to 1000	15 + (20 X length in m)		A
Feeler Gauges	As BS 975:Part 1:1941 BS 957:Part 2:1969 0.025 to 1	3.0		A
Electronic Height Gauges with microprocessor control	0 to 1000	1.0 + (8.0 x length in m)		A, B
Cartesian Coordinate measuring machines (CMM)	As ISO 10360-2:2009 and ISO 10360-5:2010 (section 6.2) 0 to 1500 (longest diagonal using end standards)	2.0 + (2.0 x length in m)		B
Articulated Arm Coordinate measuring machines (CMM)	As ISO 10360-12:2016  Length measurement - $E_{Bi}$ $E_{Uni}$ 0 to 2750 (diameter using end standards)  Probing measurement - $P_{Size.SPH.1x25}$ $P_{Form.SPH.1x25}$ Using a 10 mm to 51 mm diameter test sphere  Articulated location measurement - $L_{Dia.5x5:Art}$ Using a 10 mm to 51 mm diameter test sphere	4.5 + (1.9 x length in m) 6.1 + (1.9 x length in m)  5.5 5.5  5.4		A, B
Profile projectors	10 to 100 magnification Linear 0 to 300 Angular 0° to 360°	125 at the screen 5.0 3.0 minutes of arc		B



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
ELECTRICAL	DC VOLTAGE Measurement	0 $\mu$ V to 10 mV  10 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1.1 kV	0.44 $\mu$ V  5.9 ppm + 0.35 $\mu$ V 5.5 ppm + 0.35 $\mu$ V 5.5 ppm + 0.65 $\mu$ V 8.2 ppm + 35 $\mu$ V 8.2 ppm + 200 $\mu$ V	A
	AC VOLTAGE Measurement	1.1 kV to 50 kV  1 mV to 10 mV 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz  10 mV to 100 mV 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz  100 mV to 1 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz  1 V to 10 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz  10 V to 100 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.15 %  870 ppm + 5 $\mu$ V 580 ppm + 5 $\mu$ V 650 ppm + 5 $\mu$ V 0.14 % + 5 $\mu$ V 0.59 % + 6 $\mu$ V 5.8 %  350 ppm + 14 $\mu$ V 160 ppm + 8.5 $\mu$ V 220 ppm + 8.5 $\mu$ V 440 ppm + 8.5 $\mu$ V 0.11 % + 8.5 $\mu$ V 0.38 % + 8.5 $\mu$ V 1.8 %  320 ppm + 150 $\mu$ V 120 ppm + 140 $\mu$ V 190 ppm + 140 $\mu$ V 380 ppm + 140 $\mu$ V 960 ppm + 140 $\mu$ V 0.36 % + 170 $\mu$ V 1.6 %  320 ppm + 1.5 mV 120 ppm + 1.4 mV 190 ppm + 1.4 mV 380 ppm + 1.4 mV 960 ppm + 1.4 mV 0.36 % + 1.6 mV 1.6 %  400 ppm + 14.8 mV 260 ppm + 14 mV 260 ppm + 14 mV 440 ppm + 14 mV 0.14 % + 14 mV	A



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AC VOLTAGE Measurement (cont'd)	100 to 1000 V 20 Hz to 10 kHz	310 ppm + 23 mV		A
	1 kV to 50 kV 50 Hz to 60 Hz	0.90 %		
DC CURRENT Measurement	0 A to 10 $\mu$ A 10 $\mu$ A to 100 $\mu$ A 100 $\mu$ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 10 A 10 A to 50 A	1.3 nA 28 ppm + 1.2 nA 28 ppm + 7.4 nA 28 ppm + 74 nA 51 ppm + 0.74 $\mu$ A 170 ppm + 16 $\mu$ A 0.020 % 0.35 %		A
AC CURRENT Measurement	10 $\mu$ A to 100 $\mu$ A 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 120 nA 0.17 % + 120 nA 720 ppm + 120 nA 720 ppm + 120 nA		A
	100 $\mu$ A to 1 mA 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 260 nA 0.17 % + 260 nA 720 ppm + 260 nA 450 ppm + 260 nA		
	1 mA to 10 mA 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 2.4 $\mu$ A 0.17 % + 2.4 $\mu$ A 710 ppm + 2.4 $\mu$ A 420 ppm + 2.4 $\mu$ A		
	10 mA to 100 mA 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 24 $\mu$ A 0.17 % + 24 $\mu$ A 710 ppm + 24 $\mu$ A 420 ppm + 24 $\mu$ A		
	100 mA to 1 A 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 240 $\mu$ A 0.18 % + 240 $\mu$ A 760 ppm + 240 $\mu$ A 630 ppm + 250 $\mu$ A		
Measurement and Generation	1 A to 10 A 50 Hz to 400 Hz	0.050 %		A





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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
RESISTANCE Measurement	0 $\Omega$ to 10 $\Omega$ 10 $\Omega$ to 100 $\Omega$ 100 $\Omega$ to 1 k $\Omega$ 1 k $\Omega$ 10 k $\Omega$ 10 k $\Omega$ to 100 k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ 1 M $\Omega$ to 10 M $\Omega$ 10 M $\Omega$ to 100 M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	20 ppm + 70 $\mu\Omega$ 15 ppm + 700 $\mu\Omega$ 13 ppm + 700 $\mu\Omega$ 13 ppm + 6.3 m $\Omega$ 13 ppm + 70 m $\Omega$ 22 ppm + 2.6 $\Omega$ 82 ppm + 130 $\Omega$ 0.08 % 1.00 %		A
Current Shunts Measurement and Generation	250 $\mu\Omega$ at 10 A 1 m $\Omega$ at 10 A 3 m $\Omega$ at 10 A 5 m $\Omega$ at 10 A 10 m $\Omega$ at 1 A 100 m $\Omega$ at 1 A	600 ppm 250 ppm 250 ppm 250 ppm 150 ppm 50 ppm		A
DC VOLTAGE Generation	0 V to 220 mV 220 mV to 2.2 V 2.2 V to 11 V 11 V to 22 V 22 V to 220 V 220 V to 1.1 kV  1.1 kV to 30 kV	9.0 ppm + 500 nV 6.0 ppm + 810 nV 4.5 ppm + 3.2 $\mu$ V 4.5 ppm + 4.8 $\mu$ V 5.9 ppm + 48 $\mu$ V 7.6 ppm + 480 $\mu$ V  0.40 %		A
AC VOLTAGE Generation	10 $\mu$ V to 2.2 mV 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  2.2 mV to 22 mV 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	520 ppm + 5.0 $\mu$ V 460 ppm + 5.0 $\mu$ V 450 ppm + 5.0 $\mu$ V 500 ppm + 5.0 $\mu$ V 730 ppm + 6.0 $\mu$ V 0.13 % + 12 $\mu$ V 0.17 % + 24 $\mu$ V 0.33 % + 24 $\mu$ V  300 ppm + 5.0 $\mu$ V 140 ppm + 5.0 $\mu$ V 130 ppm + 5.0 $\mu$ V 250 ppm + 5.0 $\mu$ V 590 ppm + 6.0 $\mu$ V 0.13 % + 12 $\mu$ V 0.17 % + 24 $\mu$ V 0.32 % + 24 $\mu$ V		A



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED					
AC VOLTAGE Generation (cont'd)	22 mV to 220 mV 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	320 ppm + 14 $\mu$ V 120 ppm + 8.5 $\mu$ V 110 ppm + 8.5 $\mu$ V 240 ppm + 8.5 $\mu$ V 540 ppm + 20 $\mu$ V 0.13 % + 12 $\mu$ V 0.17 % + 29 $\mu$ V 0.32 % + 52 $\mu$ V			
	220 mV to 2.2 V 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	290 ppm + 47 $\mu$ V 120 ppm + 18 $\mu$ V 110 ppm + 9.5 $\mu$ V 240 ppm + 12 $\mu$ V 540 ppm + 35 $\mu$ V 500 ppm + 93 $\mu$ V 0.12 % + 240 $\mu$ V 0.20 % + 350 $\mu$ V			
	2.2 V to 22 V 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	290 ppm + 470 $\mu$ V 110 ppm + 180 $\mu$ V 55 ppm + 58 $\mu$ V 90 ppm + 120 $\mu$ V 120 ppm + 240 $\mu$ V 330 ppm + 700 $\mu$ V 0.12 % + 2.3 mV 0.18 % + 3.5 mV			
	22 V to 220 V 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	290 ppm + 5.0 mV 110 ppm + 1.8 mV 64 ppm + 700 $\mu$ V 97 ppm + 1.2 mV 180 ppm + 3.0 mV			
	220 V to 1.1 kV 50 Hz to 1 kHz	97 ppm + 4.3 mV			
	1 kV to 6 kV 50 Hz to 60 Hz	1.0 %			
	DC CURRENT Generation	0 A to 220 $\mu$ A 220 $\mu$ A 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 3 A 3 A to 11 A 11 A to 20.5 A 20.5 A to 50 A	47 ppm + 7.0 nA 41 ppm + 8.2 nA 41 ppm + 48 nA 53 ppm + 0.82 $\mu$ A 93 ppm + 14 $\mu$ A 440 ppm + 1.2 mA 580 ppm + 12 mA 0.12 % + 14 mA 0.35 %		A



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Simulated current	10 A to 100 A 100 A to 1000 A	500 ppm + 12 mA 0.14 % + 700 mA	For the calibration of clamp meters only	A
AC CURRENT Generation	10 nA to 220 $\mu$ A 40 Hz to 1kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	210 ppm + 9.4 nA 390 ppm + 14 nA 0.14 % + 75 nA		
	220 $\mu$ A to 2.2 mA 40 Hz to 1kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	180 ppm + 43 nA 280 ppm + 130 nA 0.14 % + 750 nA		
	2.2 mA to 22 mA 40 Hz to 1kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	140 ppm + 420 nA 230 ppm + 650 nA 0.13 % + 5.8 $\mu$ A		
	22 mA to 220 mA 40 Hz to 1kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	140 ppm + 3.2 $\mu$ A 230 ppm + 4.3 $\mu$ A 0.13 % + 12 $\mu$ A		
	220 mA to 2.2 A 40 Hz to 1kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	300 ppm + 43 $\mu$ A 520 ppm + 94 $\mu$ A 0.81 % + 190 $\mu$ A		
	2.2 A to 3 A 10 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.35 % + 1.2 mA 0.15 % + 0.70 mA 0.40 % + 4.9 mA 3.7 % + 24 mA		
	3 A to 11 A 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz	0.25 % + 4.5 mA 0.17 % + 4.5 mA 3.6 % + 15 mA		
	11 A to 20.5 A 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz	0.30 % + 8.5 mA 0.25 % + 8.5 mA 3.6 % + 17 mA		
Simulated AC Current	10 A to 100 A 40 Hz to 100 Hz 100 Hz to 440 Hz	0.10 % 0.50 %	Multi turn coil For the calibration of clamp meters only	A
	100 A to 1000 A 40 Hz to 100 Hz	0.20 %		



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
RESISTANCE Generation Spot Values	0 $\Omega$ 1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$  100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$  10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$  1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	50 $\mu\Omega$ 110 ppm 112 ppm 28 ppm 29 ppm  13 ppm 14 ppm 11 ppm 11 ppm  11 ppm 11 ppm 14 ppm 15 ppm  24 ppm 29 ppm 47 ppm 60 ppm 124 ppm		A
RESISTANCE Generation Range values	0 $\Omega$ 0 $\Omega$ to 11 $\Omega$ 11 $\Omega$ to 33 $\Omega$ 33 $\Omega$ to 110 $\Omega$ 100 $\Omega$ to 330 $\Omega$  330 $\Omega$ to 1.1 k $\Omega$ 1.1 k $\Omega$ to 3.3 k $\Omega$ 3.3 k $\Omega$ to 11 k $\Omega$ 11 k $\Omega$ to 33 k $\Omega$ 33 k $\Omega$ to 110 k $\Omega$  110 k $\Omega$ to 330 k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ 1.1 M $\Omega$ to 3.3 M $\Omega$ 3.3 M $\Omega$ to 11 M $\Omega$ 11 M $\Omega$ to 33 M $\Omega$  33 M $\Omega$ to 110 M $\Omega$ 110 M $\Omega$ to 330 M $\Omega$ 330 M $\Omega$ to 1.1 G $\Omega$	1.2 m $\Omega$ 47 ppm + 1.2 m $\Omega$ 35 ppm + 1.7 m $\Omega$ 33 ppm + 1.8 m $\Omega$ 33 ppm + 2.6 m $\Omega$  33 ppm + 5.2 m $\Omega$ 33 ppm + 26 m $\Omega$ 33 ppm + 60 m $\Omega$ 33 ppm + 290 m $\Omega$ 33 ppm + 520 m $\Omega$  37 ppm + 2.9 $\Omega$ 37 ppm + 9.1 $\Omega$ 70 ppm + 48 $\Omega$ 150 ppm + 76 $\Omega$ 290 ppm + 1.6 k $\Omega$  580 ppm + 19 k $\Omega$ 0.35 % + 140 k $\Omega$ 1.7 % + 1.3 M $\Omega$		A



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issued by  
**United Kingdom Accreditation Service**  
2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

**Avon-Dynamic Calibration Limited**  
Issue No: 047 Issue date: 27 August 2019

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
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
RESISTANCE Generation Range values (cont'd)				
Attenuation	1 kHz to 20 kHz Set ref nominal 5 V 0 dB to 80 dB	0.0067 dB		A
Distortion	20 Hz to 20 kHz 50 mV to 300 V	1.3 dB		A
Phase angle	20 kHz to 100 kHz 50 mV to 300 V	2.4 dB		A
Voltage Voltage and Voltage Current:	10 Hz to 65 Hz 65 Hz to 500 Hz 500 Hz to 1 kHz	0.13 ° 0.35 ° 0.60 °		A
AC Power				A
Unity PF to 0.25 PF	45 Hz to 65 Hz 330 mV to 1 kV 3.3 mA to 2.2 A 2.2 A to 20.5 A	0.35 % + 1.2 mW 0.45 % + 1.2 mW		A
DC Power	33 mV to 1 kV 330 µA to 3 A 3 A to 20.5 A	500 ppm 0.12 %		A
OSCILLOSCOPE BANDWIDTH AND FREQUENCY RESPONSE Set points at 1 kHz				A
	20 µV to 1.1 mV 1.1 mV to 3 mV 3 mV to 11 mV 11 mV to 33 mV 33 mV to 110 mV 110 mV to 330 mV 330 mV to 1.1 V 1.1 V to 3.5 V	1.0 % + 2.4 µV 0.90 % + 3.5 µV 0.90 % + 9.3 µV 0.80 % + 19 µV 0.80 % + 46 µV 0.70 % + 120 µV 0.70 % + 460 µV 0.62 % + 580 µV		A



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Frequency Response Including set point	20 $\mu$ V to 1.1 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 1.2 kHz 1.2 kHz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz  <i>1.1 mV to 3 mV</i> 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 1.2 kHz 1.2 kHz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz  <i>3 mV to 11 mV</i> 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 1.2 kHz 1.2 kHz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz  <i>11 mV to 33 mV</i> 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 1.2 kHz 1.2 kHz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	1.1 % + 2.4 $\mu$ V 1.1 % + 2.4 $\mu$ V 1.1 % + 2.4 $\mu$ V 1.1 % + 2.4 $\mu$ V 1.1 % + 2.4 $\mu$ V 1.1 % + 4.2 $\mu$ V 1.1 % + 4.2 $\mu$ V 1.3 % + 4.2 $\mu$ V 1.3 % + 4.2 $\mu$ V 2.0% + 18 $\mu$ V  1.0 % + 3.5 $\mu$ V 0.95 % + 3.5 $\mu$ V 0.95 % + 3.5 $\mu$ V 0.95 % + 3.5 $\mu$ V 0.95 % + 3.5 $\mu$ V 0.95 % + 5.0 $\mu$ V 0.95 % + 5.0 $\mu$ V 1.0 % + 5.0 $\mu$ V 1.1 % + 5.0 $\mu$ V 2.0 % + 5.0 $\mu$ V  1.0 % + 9.3 $\mu$ V 0.95 % + 9.3 $\mu$ V 0.95 % + 9.3 $\mu$ V 0.95 % + 9.3 $\mu$ V 0.95 % + 9.3 $\mu$ V 0.95 % + 9.9 $\mu$ V 0.95 % + 9.9 $\mu$ V 0.95 % + 9.9 $\mu$ V 1.1 % + 9.9 $\mu$ V 1.5 % + 9.9 $\mu$ V  0.90 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.85 % + 19 $\mu$ V 0.95% + 19 $\mu$ V 1.4 % + 19 $\mu$ V		A



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Frequency Response Including set point (cont'd)	<i>33 mV to 110 mV</i>			A
	10 Hz to 30 Hz	0.90 % + 47 $\mu$ V		
	30 Hz to 120 Hz	0.85 % + 47 $\mu$ V		
	120 Hz to 1.2 kHz	0.85 % + 47 $\mu$ V		
	1.2 kHz to 12 kHz	0.85 % + 47 $\mu$ V		
	12 kHz to 120 kHz	0.85 % + 47 $\mu$ V		
	120 kHz to 1.2 MHz	0.85 % + 47 $\mu$ V		
	1.2 MHz to 2 MHz	0.85 % + 47 $\mu$ V		
	2 MHz to 10 MHz	0.85 % + 47 $\mu$ V		
	10 MHz to 20 MHz	0.95 % + 47 $\mu$ V		
	20 MHz to 30 MHz	1.4 % + 47 $\mu$ V		
	<i>110 mV to 330 mV</i>			
	10 Hz to 30 Hz	0.80 % + 120 $\mu$ V		
	30 Hz to 120 Hz	0.75 % + 120 $\mu$ V		
	120 Hz to 1.2 kHz	0.75 % + 120 $\mu$ V		
	1.2 kHz to 12 kHz	0.75 % + 120 $\mu$ V		
12 kHz to 120 kHz	0.75 % + 120 $\mu$ V			
120 kHz to 1.2 MHz	0.75 % + 120 $\mu$ V			
1.2 MHz to 2 MHz	0.75 % + 120 $\mu$ V			
2 MHz to 10 MHz	0.75 % + 120 $\mu$ V			
10 MHz to 20 MHz	0.85 % + 120 $\mu$ V			
20 MHz to 30 MHz	1.4 % + 120 $\mu$ V			
<i>330 mV to 1.1 V</i>				
10 Hz to 30 Hz	0.70 % + 460 $\mu$ V			
30 Hz to 120 Hz	0.80 % + 460 $\mu$ V			
120 Hz to 1.2 kHz	0.75 % + 460 $\mu$ V			
1.2 kHz to 12 kHz	0.75 % + 460 $\mu$ V			
12 kHz to 120 kHz	0.75 % + 460 $\mu$ V			
120 kHz to 1.2 MHz	0.75 % + 460 $\mu$ V			
1.2 MHz to 2 MHz	0.75 % + 460 $\mu$ V			
2 MHz to 10 MHz	0.75 % + 460 $\mu$ V			
10 MHz to 20 MHz	0.85 % + 460 $\mu$ V			
20 MHz to 30 MHz	1.4 % + 460 $\mu$ V			
<i>1.1 V to 3.5 V</i>				
10 Hz to 30 Hz	0.75 % + 580 $\mu$ V			
30 Hz to 120 Hz	0.65 % + 580 $\mu$ V			
120 Hz to 1.2 kHz	0.65 % + 580 $\mu$ V			
1.2 kHz to 12 kHz	0.65 % + 580 $\mu$ V			
12 kHz to 120 kHz	0.65 % + 580 $\mu$ V			
120 kHz to 1.2 MHz	0.65 % + 580 $\mu$ V			
1.2 MHz to 2 MHz	0.65 % + 580 $\mu$ V			
2 MHz to 10 MHz	0.70 % + 580 $\mu$ V			
10 MHz to 20 MHz	0.80 % + 580 $\mu$ V			
20 MHz to 30 MHz	1.3 % + 580 $\mu$ V			



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Bandwidth (cont'd) with respect to set point Into 50 $\Omega$	40 Hz to 600 MHz <i>100 mV to 3.5 V peak to peak</i>	2.0 %		A
	600 MHz to 1.1 GHz <i>Nominal 1.2 V peak to peak</i>	5.2 %		
Timebase accuracy	1 ns to 20 ms 20 ms to 2 s	3.0 ppm 0.20 %		A
RISE TIME	Nominal 1 ns	120 ps		A
CAPACITANCE				A
Measure and Generate	1 pF to 1 $\mu$ F <i>1 kHz</i>	50 ppm		
Simulation	1 $\mu$ F to 3.3 $\mu$ F 3.3 $\mu$ F to 11 $\mu$ F 11 $\mu$ F to 33 $\mu$ F 33 $\mu$ F to 110 $\mu$ F	0.30 % + 4.1 nF 0.30 % + 14 nF 0.50 % + 41 nF 0.55 % + 190 nF		
FREQUENCY				A
	10 MHz	4.5 in $10^{11}$	For stable oscillators by direct comparison	
	1 Hz to 18 GHz	4.6 in $10^{11}$ + 100 $\mu$ Hz		
TIME INTERVAL	1 s to 24 hours	2.0 ms 200 ms	Electronically triggered. Manual triggered	A





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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
ELECTRICAL SIMULATION OF TEMPERATURE READING INSTRUMENTS	Ambient 20 °C ± 3 °C	0.054 °C	Support measurement suitable for measurement of reference junction compensation devices	A
Thermocouple displays <b>Including</b> Reference Junction compensation.				
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.36 °C 0.23 °C 0.22 °C 0.30 °C 0.43 °C		A
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.35 °C 0.25 °C 0.25 °C 0.25 °C 0.30 °C		
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.50 °C 0.30 °C 0.30 °C 0.25 °C 0.35 °C		
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.70 °C 0.45 °C 0.45 °C 0.50 °C		
Type S	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.60 °C 0.45 °C 0.45 °C 0.55 °C		
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.75 °C 0.35 °C 0.25 °C 0.25 °C		
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.60 °C 0.25 °C 0.25 °C 0.25 °C 0.30 °C		



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
Thermocouple displays <b>Excluding</b> Reference Junction compensation.				A
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.35 °C 0.22 °C 0.21 °C 0.29 °C 0.43 °C		
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.34 °C 0.24 °C 0.24 °C 0.24 °C 0.29 °C		
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.50 °C 0.29 °C 0.29 °C 0.24 °C 0.34 °C		
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.70 °C 0.45 °C 0.45 °C 0.50 °C		
Type S	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.60 °C 0.45 °C 0.45 °C 0.55 °C		
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.75 °C 0.34 °C 0.24 °C 0.24 °C		
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.60 °C 0.24 °C 0.24 °C 0.24 °C 0.29 °C		
Resistance			(PT 100)	
Temperature simulators Temperature indicators	-200 °C to 800 °C -200 °C to 800 °C	0.050 °C 0.080 °C		



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
ADDITIONAL MEASUREMENTS IN SUPPORT OF IEE 17 <sup>TH</sup> EDITION TEST EQUIPMENT				
RCD				
Trip current	3 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 3 A	7.0 % + 20 $\mu$ A 7.0 % + 160 $\mu$ A 7.0 % + 840 $\mu$ A 7.0 % + 5.3 mA		
Trip time	20 ms to 390 ms 390 ms to 5 s	1.0 ms 8.9 ms		
AC RESISTANCE FOR LOOP				
50 Hz			Laboratory loop nominally 0.75 $\Omega$	
Nominal Ranges	0.05 $\Omega$ to 0.1 $\Omega$ 0.1 $\Omega$ to 0.22 $\Omega$ 0.22 $\Omega$ to 0.33 $\Omega$	0.80 % + 1.7 m $\Omega$ 0.80 % + 3.0 m $\Omega$ 0.80 % + 1.7 m $\Omega$		
	0.33 $\Omega$ to 0.5 $\Omega$ 0.5 $\Omega$ to 1 $\Omega$ 1 $\Omega$ to 5 $\Omega$	0.80 % + 2.0 m $\Omega$ 0.80 % + 2.0 m $\Omega$ 0.80 % + 5.0 m $\Omega$		
	5 $\Omega$ to 10 $\Omega$ 10 $\Omega$ to 100 $\Omega$ 100 $\Omega$ to 1 k $\Omega$	0.80 % + 6.2 m $\Omega$ 0.80 % + 26 m $\Omega$ 0.80 % + 1.1 $\Omega$		
EARTH BOND RESISTANCE				
EARTH BOND CURRENT 50 Hz	1 A to 10 A 10 A to 30 A	2.0 % + 26 mA 2.0 % + 30 mA		
PRESSURE				
Gas Pressure Gauge				
Calibration of pressure indicating instruments and gauges	-90 kPa to 0 Pa 0 Pa to 400 kPa 400 kPa to 2 MPa	250 Pa 140 Pa 250 Pa	Calibrations of pressure devices with an electrical output may be undertaken.	A
Hydraulic Pressure Gauge				
Calibration of pressure indicating instruments and gauges	500 kPa to 60 MPa 60 MPa to 140 MPa 140 MPa to 280 MPa	0.014 % + 1.0 kPa 60 kPa 90 kPa		



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RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				
TEMPERATURE				A
Resistance thermometers	-20 °C to 200 °C	0.065 °C	Calibrations of temperature transmitters may be undertaken.	
Temperature indicating instruments with probes	-20 °C to 200 °C	0.065 °C		
TORQUE				A
Hand Torque Tools (excluding torque screwdrivers)	BS EN ISO 6789-2:2017 0.04 N·m to 1500 N·m	1.0 %	Calibration results may also be reported in units of lbf·in and lbf·ft. The uncertainty quoted is for both the application of the calibration torque and the characteristics of the device being calibrated.	
	BS EN ISO 6789:2003 (Withdrawn) 0.04 N·m to 1500 N·m	1.0 %		
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  $\mu$ V:

Over the range 100 mV to 1 V, the CMC is 0.0025 %  $\cdot$  V + 5.0  $\mu$ V, 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<sup>-6</sup>  $\cdot$  p  $\cdot$  10<sup>-6</sup>) + 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.