Schedule of Accreditation

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Trescal Limited

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Calibration performed at the above address only

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
PRESSURE			Methods consistent with EURAMET CG3 and CG17
Hydraulic Pressure (Gauge)			
"Pressure equivalent" calibration of Dead Weight Testers (pressure balances supplied with an associated mass set)	0.5 MPa to 7 MPa 7 MPa to 140 MPa 140 MPa to 500 MPa	0.0040 % 0.0053 % 0.011 %	Calibration of pressure measuring devices with an electrical output may be undertaken. Devices may be calibrated using the digital communication protocol including Fieldbus
Calibration of pressure indicating instruments and gauges			
Hydraulic Pressure (Absolute)			
Calibration of pressure indicating instruments and gauges	0.6 MPa to 7 MPa 7 MPa to 140 MPa 140 MPa to 500 MPa	0.0040 % + 25 Pa 0.0053 % 0.011 %	
Gas Pressure (Gauge)			
Calibration of pressure indicating instruments and gauges	-100 kPa to -2.5 kPa -2.5 kPa to 2.5 kPa 2.5 kPa to 7 MPa	0.0040 % 0.012 % + 0.035 Pa 0.0034 %	
"Pressure equivalent" calibration of Dead Weight Testers (pressure balances supplied with an associated mass set and Ametek gas Pressure standards)	7 MPa to 21 MPa 21 MPa to 80 MPa	0.0036 % 0.0055 %	
Gas pressure (Absolute)			
"Pressure Equivalent" calibration or dead-weight testers	2.5 kPa to 7 MPa	0.0041 %	
Calibration of pressure indicating instruments and gauges	2.5 kPa to 21 MPa 21 MPa to 80 MPa	0.0039 % 0.0055 %	Thommen and capsule pressure gauges can be calibrated. Aneroid Barometers without a pressure port can be calibrated

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
PRESSURE (continued)			
Gas Pressure (Differential)			
Calibration of pressure indicating instruments and gauges	0 Pa to 1 MPa (line pressure 0 Pa to 40 MPa)	0.50 ppm/MPa of line pressure, plus 0.0040 % of differential pressure, plus 5 Pa	Differential pressure cells may be calibrated using the digital communication protocol including Fieldbus
ELECTRICAL MEASUREMENTS and electrical simulations listed below can be both sourced and measured at the same uncertainty unless otherwise stated and so are applicable for the calibration of both measuring instruments and for those instruments with an output. the method used is by direct comparison unless otherwise stated in the remarks column.			
DC VOLTAGE			
Specific Values			
	10 mV 100 mV 1 V 10 V 19 V 100 V 1 kV	10 ppm 6.0 ppm 4.0 ppm 4.0 ppm 4.0 ppm 5.0 ppm 5.0 ppm	
Other Values			
	0 V to 200 mV 200 mV to 20 V 20 V to 1 kV	10 ppm + 0.60 μV 11 ppm 24 ppm	
HIGH VOLTAGE	1 kV to 20 kV 20 kV to 30 kV	0.30 % 0.50 %	
	30 kV to 50 kV	0.50 %	Measurement only

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DC CURRENT			
Specific Values			
	100 μA	30 ppm	
	1 mA	20 ppm	
	10 mA	20 ppm	
	100 mA	22 ppm	
	1 A	50 ppm	
	10 A	70 ppm	
Other Values			
	0 A to 200 μA	77 ppm + 7.0 nA	
	200 μA to 200 mA	75 ppm	
	200 mA to 2 A	86 ppm	
	2 A to 10 A	240 ppm	Clamp-on ammeters can be calibrated up to 2000 A with increased uncertainties.
	10 A to 20 A	300 ppm	
	20 A to 100 A	190 ppm	
AC VOLTAGE			
Specific Values			
	1 mV		
	20 Hz, 30 Hz, 40 Hz, 55 Hz, 300 Hz, 1 kHz and 10 kHz	700 ppm	
	20 kHz, 30 kHz and 50 kHz	700 ppm	
	100 kHz	0.10 %	
	10 mV		
	20 Hz, 30 Hz, 40 Hz, 300 Hz, 1 kHz, 10 kHz and 20 kHz	220 ppm	
	55 Hz	240 ppm	
	30 kHz and 50 kHz	270 ppm	
	100 kHz	0.0011 %	
	100 mV		
	10 Hz, 20 Hz, 30 Hz, 40 Hz and 55 Hz	130 ppm	
	300 Hz, 1 kHz and 10 kHz	110 ppm	
	20 kHz	120 ppm	
	30 kHz and 50 kHz	180 ppm	
	100 kHz	340 ppm	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC VOLTAGE			
Specific Values continued	1 V		
	10 Hz, 20 Hz and 30 Hz	40 ppm	
	40 Hz, 55 Hz, 300 Hz, 1 kHz, 10 kHz, 20 kHz and 30 kHz	29 ppm	
	50 kHz	34 ppm	
	100 kHz	37 ppm	
	300 kHz	140 ppm	
	500 kHz	330 ppm	
	1 MHz	0.11 %	
	10 V		
	10 Hz, 20 Hz, 30 Hz and 40 Hz 55 Hz, 300 Hz, 1 kHz, 10 kHz, 20 kHz, 30 kHz, 50 kHz and 100 kHz	45 ppm	
	300 kHz	35 ppm	
	500 kHz	120 ppm	
	1 MHz	320 ppm	
	19 V	0.11 %	
	1 kHz	40 ppm	
	100 V		
	10 Hz, 20 Hz, 30 Hz, 40 Hz and 55 Hz	50 ppm	
	300 Hz, 1 kHz, 10 kHz, 20 kHz and 30 kHz	45 ppm	
	50 kHz	50 ppm	
	100 kHz	80 ppm	
	700 V		
	50 kHz	150 ppm	
	100 kHz	500 ppm	
	1 kV		
	40 Hz, 55 Hz, 300 Hz and 1 kHz	50 ppm	
	10 kHz, 20 kHz	60 ppm	
	30 kHz	90 ppm	
Other values	100 mV to 200 mV		
	40 Hz to 30 kHz	200 ppm + 12 μV	
	200 mV to 2 V		
	40 Hz to 30 kHz	170 ppm	
	2 V to 200 V		
	40 Hz to 30 kHz	180 ppm	
	200 V to 1 kV		
	40 Hz to 30 kHz	440 ppm	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
HIGH VOLTAGE	1 kV to 20 kV *50 Hz*	0.80 %	For the calibration of high voltage probes, meters and sources
	20 kV to 35 kV *50 Hz*	0.90 %	
AC CURRENT			
Specific Values			
	100 μA		
	10 Hz and 20 Hz	130 ppm	
	30 Hz	120 ppm	
	40 Hz, 55 Hz, 300 Hz and 1 kHz	90 ppm	
	5 kHz	140 ppm	
	1 mA		
	10 Hz and 20 Hz	120 ppm	
	30 Hz	110 ppm	
	40 Hz, 55 Hz, 300 Hz and 1 kHz	90 ppm	
	5 kHz	140 ppm	
	10 mA		
	10 Hz and 20 Hz	120 ppm	
	30 Hz	110 ppm	
	40 Hz, 55 Hz, 300 Hz and 1 kHz	90 ppm	
	5 kHz	140 ppm	
	100 mA		
	10 Hz and 20 Hz	120 ppm	
	30 Hz	110 ppm	
	40 Hz, 55 Hz and 300 Hz	90 ppm	
	1 kHz	90 ppm	
	5 kHz	140 ppm	
	1 A		
	10 Hz and 20 Hz	160 ppm	
	30 Hz	150 ppm	
	40 Hz, 55 Hz, 300 Hz and 1 kHz	120 ppm	
	5 kHz	230 ppm	
	3 A		
	40 Hz, 95 Hz, 110 Hz and 440 Hz	470 ppm	
	3 kHz	470 ppm	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC CURRENT			
	10 A		
Specific Values	*10 Hz, 20 Hz and 30 Hz*	270 ppm	
	40 Hz	250 ppm	
	55 Hz	240 ppm	
	95 Hz	470 ppm	
	300 Hz	240 ppm	
	440 Hz	470 ppm	
	1 kHz	240 ppm	
	5 kHz	300 ppm	
	10 kHz	420 ppm	
Other Values	100 μA to 200 μA		
	40 Hz to 1 kHz	200 ppm + 3.0 nA	
	1 kHz to 5 kHz	400 ppm + 4.0 nA	
	200 μA to 200 mA		
	40 Hz to 1 kHz	200 ppm	
	200 μA to 20 mA		
	1 kHz to 5 kHz	380 ppm	
	20 mA to 200 mA		
	1 kHz to 5 kHz	400 ppm	
	200 mA to 2 A		
	40 Hz to 1 kHz	900 ppm	
	1 kHz to 5 kHz	0.20 %	
	40 Hz to 60 Hz:		
	2 A to 10 A	0.19 %	Clamp-on ammeters can be calibrated up to 2000 A ac with increased uncertainties.
	10 A to 20 A	350 ppm	
	20 A to 100 A	390 ppm	
DC RESISTANCE			
Specific values			
	10 Ω	0.60 ppm	For the calibration of fixed resistors, including those comprising the resistance function of multifunction calibrators.
	100 Ω	0.65 ppm	
	1 k Ω	0.65 ppm	
	10 k Ω	3.5 ppm	
	100 kΩ	8.5 ppm	
	1 MΩ	13 ppm	
	10 MΩ	26 ppm	
	100 MΩ	110 ppm	
	1 GΩ	70 ppm	
	10 GΩ	140 ppm	
	100 GΩ	730 ppm	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DC RESISTANCE			
Other values			
	0 Ω to 10 Ω	33 ppm + 12 μΩ	The capability shown is for measurement of unknown resistance values. Known resistances within this range can be generated, but the uncertainties will be increased.
	10 Ω to 1kΩ	0.65 ppm	
	1k Ω to 2 kΩ	11 ppm	
	2 kΩ to 20 kΩ	11 ppm	
	20 kΩ to 200 kΩ	16 ppm	
	200 kΩ to 2 MΩ	32 ppm	
	2 MΩ to 20 MΩ	80 ppm	
	20 MΩ to 100 MΩ	260 ppm + 9.0 kΩ	
	100 μΩ to 10 Ω Maximum current 100 A	130 ppm	4 terminal resistors in the range 100 μΩ to 10 Ω can be measured using a dc voltage and current technique. The uncertainty quoted will be the sum of the corresponding voltage and current uncertainties attributable to the resistor under test. Generation of resistance in the range 100 μΩ to 10 Ω will be at an increased uncertainty to the dc voltage/current technique uncertainties.
	100 MΩ to 1GΩ 1GΩ to 10 GΩ 10 GΩ to 100 GΩ Voltages >250 V dc	70 ppm 140 ppm 730 ppm	100 MΩ to 100 GΩ can be measured using a dc voltage and current technique. The uncertainty quoted will be the sum of the corresponding voltage and current uncertainties. Values from 100 MΩ to 1GΩ can be generated with increased uncertainties.
Specific Values			
	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ	15 ppm 7.5 ppm 4.5 ppm 4.5 ppm 9.0 ppm 16 ppm 29 ppm 110 ppm 70 ppm 140 ppm 730 ppm	For the calibration of the dc resistance ranges of multimeters, analogue and digital, and similar devices.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC RESISTANCE NON-INDUCTIVE			
Specific Values	1 mΩ to 1 kΩ *40 Hz to 140 Hz*	800 ppm	Uncertainties are dependent on the test voltage, current and frequency employed
DC POWER	100 mV to 1 kV 5 mA to 100 A 20 W to 2 MW (simulated)	The sum of the individual voltage and current uncertainties	
AC POWER			Voltage up to 1 kV and Current up to 1 kA giving product power up to a maximum of 1 MW
	5 W to 1 MW *40 Hz to 100 Hz*	0.16 %	At unity power factor
	5 W to 1 MW *40 Hz to 100 Hz*	0.20 %	At power factors from 1 to 0
PHASE	0° To 360° *40 Hz to 1 kHz*	0.020°	
CAPACITANCE			
Values at 1 kHz	50 pF to 100 nF 100 nF to 1 μF	0.070 % + 0.80 pF 0.47 %	Sources up to 250 V Other frequencies (100 Hz to 10 kHz) can be accommodated at increased uncertainties. 2 or 3 wire devices.
At 1 kHz	10 pF to 100 pF 100 pF to 1 μF 1 μF to 10 μF 10 μF to 100 μF	2.2 % 0.21 % 0.22 % 0.32 %	These values can be measured

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
FREQUENCY			
	10 mHz to 1.2 GHz	2.0 parts in 10^9	
PERIODIC TIME	20 ns to 100 s	2.0 parts in 10^9 + 3.0 ns	The uncertainties quoted for these parameters are particularly dependent on the stability and waveform.
TIME INTERVAL AVERAGE	60 ns to 100 s	2.0 parts in 10^9 + 5.0 ns	
Stop Watches	0 s to 10^4 s	0.025 s/d	Error and uncertainty expressed as seconds per day: (s/d) this uncertainty will be larger for mechanical devices, depending on stability.
Additional Parameters suitable for Oscilloscope calibration			
Rise Time	150 ps nominal *At 50 mV, 250 mV, 500 mV and 2.5 V*	50 ps	
	500 ps nominal *At 50 mV, 250 mV, 500 mV and 2.5 V*	60 ps	
Bandwidth	1 Hz to 1 GHz at 100 mV nominal	2.5 %	
AC Level flatness	With respect to a set point at a nominal 1 V, 1 kHz being the 0 dB reference. 1 kHz to 1 MHz	0.040 dB	
Parameters specific to 16th & 17th Edition equipment testing, not covered in the main schedule headings			
Trip times	20 ms to 900 ms	0.60 ms	
Trip Current	10 mA, 30 mA, 90 mA, 100 mA and 110 mA 300 mA, 1 A & 2 A	0.50 mA 1.0 mA	
AC resistance	*At 50 Hz:* Residual loop impedance and up to 1.5 Ω 5 Ω 10 Ω 100 Ω 1 kΩ	50 mΩ 150 mΩ 500 mΩ 1.2 Ω 3.5 Ω	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Charge Amplifiers	0.1 pC to 10 000 pC		
	20 Hz to 10 kHz	0.050 %	
	10 kHz to 50 kHz	0.11 %	
Temperature indicators, calibration by electrical simulation			
Resistance thermometers (PT 100)	-200 °C to +800 °C	0.020 °C	
Thermocouples: Internal reference junction disabled			
Type K	-200 °C to +1300 °C	0.052 °C	
Type T	-200 °C to +400 °C	0.050 °C	
Type J	-200 °C to +1200 °C	0.043 °C	
Type E	-200 °C to +1000 °C	0.040 °C	
Type N	-200 °C to +1300 °C	0.069 °C	
Type R	500 °C to +1760 °C	0.13 °C	
Type S	500 °C to +1760 °C	0.13 °C	
Type B	500 °C to +1800 °C	0.17 °C	
Thermocouples: Internal reference junction enabled.			
Type K	-200 °C to +1300 °C	0.30 °C	
Type T	-200 °C to +400 °C	0.30 °C	
Type J	-200 °C to +1200 °C	0.30 °C	
Type E	-200 °C to +1300 °C	0.30 °C	
Type N	-200 °C to +1300 °C	0.31 °C	
Type R	500 °C to +1760 °C	0.33 °C	
Type S	500 °C to +1760 °C	0.33 °C	
Type B	500 °C to +1800 °C	0.34 °C	
Temperature simulators, calibration by electrical simulation			
Resistance thermometers (PT 100)	-200 °C to +800 °C	0.020 °C	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
ELECTRICAL MEASUREMENT (continued)			
Temperature simulators, calibration by electrical simulation (continued)			
Thermocouples: Internal reference junction disabled			
Type K	-200 °C to +1300 °C	0.087 °C	
Type T	-200 °C to +400 °C	0.083 °C	
Type J	-200 °C to +1200 °C	0.065 °C	
Type E	-200 °C to +1000 °C	0.059 °C	
Type N	-200 °C to +1300 °C	0.13 °C	
Type R	500 °C to +1760 °C	0.16 °C	
Type S	500 °C to +1760 °C	0.17 °C	
Type B	500 °C to +1800 °C	0.27 °C	
Thermocouples: Internal reference junction enabled.			
Type K	-200 °C to +1300 °C	0.31 °C	
Type T	-200 °C to +400 °C	0.31 °C	
Type J	-200 °C to +1200 °C	0.31 °C	
Type E	-200 °C to +1300 °C	0.31 °C	
Type N	-200 °C to +1300 °C	0.33 °C	
Type R	500 °C to +1760 °C	0.34 °C	
Type S	500 °C to +1760 °C	0.35 °C	
Type B	500 °C to +1800 °C	0.40 °C	
Cold Junction Compensation	Nominal Ambient 17 °C to 23 °C	0.10 °C	
TEMPERATURE			Calibration by comparison with reference thermometers
Resistance thermometers	-80 °C to -38 °C -38 °C to 0 °C 0 °C to 200 °C 200 °C to 300 °C 300 °C to 550 °C	0.010 °C 0.010 °C 0.015 °C 0.015 °C 0.054 °C	within Fluid Baths
	550 °C to 660 °C	0.30 °C	within Tube Furnaces
	0.01 °C (triple point of water) 29.7646 °C (melting point of Gallium)	0.0010 °C 0.0050 °C	within Fixed Points
Electronic temperature indicators with sensors	-80 °C to +660 °C	As for resistance thermometers …	Devices may be calibrated using the digital communication protocol including Fieldbus
	660 °C to 1100 °C	As for thermocouples ... … plus ½ scale division for analogue indicators.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
TEMPERATURE (continued)			
Thermocouples Noble metal type	-50 °C to +200 °C 200 °C to 550 °C	0.40 °C 0.45 °C	Within Fluid Baths
	550 °C to 660 °C 660 °C to 900 °C 900 °C to 1100 °C	0.70 °C 1.8 °C 2.0 °C	Within Tube Furnace
Thermocouples	-80 °C to +200 °C	0.40 °C	Within Fluid Baths
Base Metal	200 °C to 550 °C	0.55 °C	
	550 °C to 660 °C 660 °C to 900 °C 900 °C to 1100 °C	0.80 °C 1.8 °C 2.0 °C	Within Tube Furnace
Liquid-in-glass thermometers	-80 °C to +0 °C 0 °C to 100 °C 100 °C to 300 °C	0.023 °C 0.015 °C 0.024 °C plus ¼ scale division	Within Fluid baths
Temperature block calibrators and portable liquid baths	-80 °C to -38 °C -38 °C to +200 °C 200 °C to 660 °C 660 °C to 1100 °C	0.040 °C 0.040 °C 0.060 °C 1.2 °C	
Temperature in air	-70 °C to -25 °C -25 °C to -5 °C -5 °C to +70 °C 70 °C to 100 °C	0.40 °C 0.28 °C 0.15 °C 0.28 °C	
Radiation thermometers (Pyrometers)	-15 °C to 0 °C 0 °C to 120 °C 120 °C to 150 °C 150 °C to 250 °C 250 °C to 350 °C 350 °C to 500 °C	2.0 °C 1.5 °C 2.0 °C 2.5 °C 3.5 °C 4.5 °C	Calibration by comparison with a reference Pyrometer Only thermometers operating at an emissivity setting of 0.95 can be calibrated
HUMIDITY			Calibration by comparison with a reference hygrometer and reference thermometers
Relative Humidity	10 %rh to 40 %rh 40 %rh to 95 %rh for the temperature range -5 °C to 70 °C	0.6 %rh 1.3 % of reading	
Salt capsules	10 %rh and 95 %rh 20 °C ± 3.0 °C	1.6 %rh	
Dew point	-75 °C to - 50 °C -50 °C to - 20 °C -20 °C to 60 °C	0.30 °C 0.20 °C 0.15 °C	Including calculated units

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DENSITY			
Density transducers -Nitrogen Gas	0.5 kg/m^3 to 300 kg/m^3 300 kg/m^3 to 360 kg/m^3	0.030 % 0.60 %	By comparison with known gases at controlled temperatures and pressures
Density transducers - Argon gas	25 kg/m^3 to 400 kg/m^3	0.035 %	
Liquid Density	700 kg/m^3 to 1000 kg/m^3	0.064 kg/m^3	Liquids with viscosity up to 100 mPa.s by direct measurement
Density transducers - Liquid	700 kg/m^3 to 1000 kg/m^3	0.064 kg/m^3	By comparison with liquids of a known density
AIR VELOCITY			Method by comparison using an open jet wind tunnel
Calibration of anemometers	0.1 m/s to 0.47 m/s 0.47 m/s to 7.5 m/s 7.5 m/s to 10 m/s 10 m/s to 30 m/s	0.083 m/s 1.5 % + 0.050 m/s 1.0 % + 0.10 m/s 1.5 % + 0.050 m/s	Instruments up to 120 mm in diameter can be calibrated
Calibration of pitot tubes	As for anemometers	As for anemometers with the addition of 0.20 Pa + 0.53 % of the pitot pressure	Uncertainty obtained will be a combination of the pressure and velocity uncertainty
FLOW (Mass or volume)			Fluid temperature can be controlled from 10 °C to 80 °C depending on the ambient conditions.
<u>Hydrocarbon oils</u>			A range of oils is available covering the range 2 cSt to 150 cSt. Available oils: Kerosene, Gas oil, Shell Tellus 32, Shell Tellus 100. Devices with a Fieldbus output can be calibrated Gravimetric method
Mass - flow rate and quantity passed	0.6 kg/min to 60 kg/min 20 kg/min to 2000 kg/min 2000 kg/min to 2400 kg/min	0. 050 % 0.075 % 0.13 %	
Volume - flow rate and quantity passed	0.6 l/min to 75 l/min 25 l/min to 2500 l/min 2500 l/min to 3000 l/min	0.055 % 0.10 % 0.13 %	
<u>Water flow</u>			
Mass flow rate	0.6 kg/min to 4 kg/min 4 kg/min to 600 kg/min	0.27 % 0.20 %	Gravimetric method
Volume flow rate	0.6 l/min to 4 l/min 4 l/min to 600 l/min	0.27 % 0.20 %	
<u>Gas flow</u>			Volumetric prover and Reference meter methods
Flow-rate and quantity passed	0.2 l/min to 2 l/min 2 l/min to 1000 l/min	0.23 % 0.16 %	Calibration medium air Any inert gases may be used.
Flow rate	5 ml/min to 50 ml/min 50 ml/min to 500 ml/min 0.5 l/min to 5 l/min 3 l/min to 30 l/min 5 l/min to 100 l/min	0.25% + 0.01 ml/min 0.35% + 0.05 ml/min 0.32% + 0.002 l/min 0.39% + 0.02 l/min 0.37% + 0.03 l/min	Calibration medium nitrogen, dry air, argon

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DIMENSIONAL			
Orifice plates	BS EN ISO 5167-2:2003 Bore diameter d 12.5 mm to 750 mm	0.020 + (0.0060 x diameter in m) mm	
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 %·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.