


Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>8211</p> <p>Accredited to ISO/IEC 17025:2017</p>	DM Systems and Test Limited Issue No: 010 Issue date: 26 June 2020	
	Icon House 3 Icen Court Icknield Way Letchworth Garden City Hertfordshire SG6 1TN United Kingdom	Contact: Mr Chris Augier Tel: +44 (0)1462 650620 Fax: +44 (0)1462 650622 E-Mail: Info@dplusm.co.uk Website: www.dplusm.co.uk
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
Values and uncertainties listed below are applicable for the calibration of both measurement instruments and for instruments with an output. the method used is by direct comparison unless otherwise stated in the remarks column			
DC VOLTAGE	0 V to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	5.8 ppm + 1.5 μ V 15 ppm 6 ppm 11 ppm 21 ppm	
DC CURRENT	0 to 100 nA 100 nA to 1 μ A 1 μ A to 10 μ A 10 μ A to 100 μ A 100 μ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 20 A	35 ppm + 60 pA 520 ppm 175 ppm 120 ppm 85 ppm 85 ppm 100 ppm 250 ppm 650 ppm	
Simulation	20 A to 1000 A	0.20 % + 100 mA	Simulation using a multturn coil – for the calibration of clampmeters only
DC RESISTANCE	0 Ω to 100 m Ω 100 m Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1k Ω 1 k 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 100 M Ω to 1 G Ω	660 ppm + 0.15 μ Ω 18 ppm + 60 μ Ω 15 ppm + 0.6 m Ω 20 ppm 20 ppm 20 ppm 45 ppm 180 ppm 700 ppm 0.60 %	



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AC VOLTAGE	<i>1 Hz to 40 Hz</i> 3 μ 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 700 V <i>40 Hz to 1 kHz</i> 1 μ 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 700 V <i>1 kHz to 20 kHz</i> 1 μ 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 700 V <i>20 kHz to 100 kHz</i> 1 μ 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 700 V <i>100 kHz to 300 kHz</i> 1 μ V to 10 mV 10 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V <i>300 kHz to 1 MHz</i> 1 μ V to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V	350 ppm + 3.6 μ V 550 ppm 550 ppm 550 ppm 700 ppm 930 ppm 240 ppm + 1.5 μ V 320 ppm 320 ppm 320 ppm 470 ppm 700 ppm 350 ppm + 1.5 μ V 400 ppm 400 ppm 400 ppm 470 ppm 930 ppm 0.58 % + 1.5 μ V 0.12 % 0.12 % 0.12 % 0.17 % 0.37 % 4.6 % + 1.5 μ V 0.47 % 0.47 % 0.47 % 0.58 % 1.2 % + 2.5 μ V 1.30 % 1.30 % 1.90 %	
Generation only	<i>45 Hz to 10 kHz</i> 700 V to 1020 V	0.24 %	



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AC CURRENT	<p><i>10 Hz to 20 Hz</i> 0.01 µA to 100 µA 100 µA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A</p> <p><i>20 Hz to 45 Hz</i> 0.01 µA to 100 µA 100 µA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A</p> <p><i>45 Hz to 100 Hz</i> 0.01 µA to 100 µA 100 µA to 0.5 mA 0.5 mA to 1 mA 1 mA to 5 mA 5 mA to 10 mA 10 mA to 50 mA 50 mA to 100 mA 100 mA to 1 A 1 A to 20 A</p> <p><i>100 Hz to 1 kHz</i> 0.01 µA to 100 µA 100 µA to 0.5 mA 0.5 mA to 1 mA 1 mA to 5 mA 5 mA to 10 mA 10 mA to 50 mA 50 mA to 100 mA 100 mA to 1 A 1 A to 20 A</p> <p><i>1 kHz to 5 kHz</i> 0.01 µA to 100 µA 100 µA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A</p> <p><i>5 kHz to 20 kHz</i> 100 µA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A</p> <p><i>20 kHz to 50 kHz</i> 100 µA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A</p>	<p>0.47 % + 50 nA 0.70 % 0.70 % 0.70 % 0.70 %</p> <p>0.18 % + 50 nA 0.41 % 0.41 % 0.41 % 0.42 %</p> <p>700 ppm + 50 nA 0.31 % 0.13 % 0.31 % 0.12 % 0.18 % 0.12 % 0.065 % 0.075 %</p> <p>700 ppm + 50 nA 0.27 % 0.088 % 0.27 % 0.082 % 0.27 % 0.082 % 0.065 % 0.075%</p> <p>700 ppm + 50 nA 0.27 % 0.27 % 0.27 % 0.35 %</p> <p>770 ppm + 0.40 µA 0.31 % 0.31 % 0.58 %</p> <p>0.47 % + 0.60 µA 0.93 % 0.93 % 1.6 %</p>	



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AC CURRENT (continued)	50 kHz to 100 kHz 100 μ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA	0.64 % + 1.8 μ A 2.4 % 2.4 %	
Simulation	45 Hz to 60 Hz 20 A to 500 A	0.50 % + 100 mA	Simulation using a multiturn coil – for the calibration of clampmeters only
CAPACITANCE Generation	DC, 50 Hz to 1 kHz 500 pF to 1.1 nF 1.1 nF to 3.3 nF 3.3 nF to 11 nF 11 nF to 33 nF 33 nF to 110 nF 110 nF to 330 nF 330 nF to 1.1 μ F 1.1 μ F to 3.3 μ F DC, 50 Hz to 400 Hz 3.3 μ F to 11 μ F 11 μ F to 33 μ F DC, 50 Hz to 100 Hz 33 μ F to 110 μ F 110 μ F to 330 μ F	2.9 % 1.7 % 0.94 % 1.4 % 0.66 % 0.61 % 0.66 % 0.73 % 0.76 % 0.79 % 0.94 % 1.2 %	
FREQUENCY	0.1 Hz to 1 Hz 1 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 1 MHz 1 MHz to 10 GHz 10 GHz to 40 GHz 1 MHz and 10 MHz	1 x 10 ⁻³ 1 x 10 ⁻⁴ 1 x 10 ⁻⁵ 1 x 10 ⁻⁶ 2 x 10 ⁻⁷ 2 x 10 ⁻⁸ 2 x 10 ⁻⁹ 2 x 10 ⁻¹⁰ 5 x 10 ⁻¹²	Calibration of stable fixed value oscillators.
TIME INTERVAL	1 s to 12 days	40 nS	



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OSCILLOSCOPE CHARACTERISTICS			
Vertical deflection as a Voltage	0 to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 11 V 11 V to 130 V	580 ppm + 52 μ V 0.25 % 0.15 % 800 ppm 0.13 %	Into 1 M Ω
	0 to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 6.6 V	0.29 % + 47 μ V 0.48 % 0.35 % 0.30 %	Into 50 Ω
Square wave peak to peak Voltage	0 V to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 11 V 11 V to 130 V	580 ppm + 52 μ V 0.31 % 0.19 % 0.13 % 0.16 %	Into 1 M Ω
	0 to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 6.6 V	0.29 % + 53 μ V 0.48 % 0.35 % 0.30 %	Into 50 Ω
Level sine wave flatness for bandwidth with respect to set point value.	50 kHz to 100 MHz 50 kHz to 300 MHz 100 kHz to 2 GHz	2.5 % 3.0 % 3.0 %	3 dB point uncertainty will be reported as a frequency
Resistance	40 Ω to 60 Ω 500 k Ω to 1.5 M Ω	0.12 % 0.12 %	
Capacitance	5 pF to 50 pF	0.90 pF	
Time Markers	2 ns to 20 ns 50 ns to 100 ns 100 ns to 1 s 1 s to 5 s	4.0 ppm 150 ppm 0.12 % 0.59 %	
Risetime	250 ps Nominal 1 kHz to 10 MHz 250 mV to 500 mV pp	100 ps	
ELECTRICAL SIMULATION			
PRT Indicators			
Resistance thermometer (PT 100)	0 $^{\circ}$ C to 250 $^{\circ}$ C	0.42 $^{\circ}$ C	



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TEMPERATURE INDICATORS BY ELECTRICAL SIMULATION Including 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	0.42 °C 0.27 °C 0.25 °C 0.34 °C 0.49 °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	0.36 °C 0.25 °C 0.23 °C 0.26 °C 0.31 °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	0.61 °C 0.25 °C 0.23 °C 0.25 °C 0.29 °C	
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.58 °C 0.46 °C 0.41 °C 0.43 °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	0.51 °C 0.31 °C 0.28 °C 0.27 °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	0.72 °C 0.46 °C 0.43 °C 0.50 °C	
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.61 °C 0.47 °C 0.47 °C 0.57 °C	



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TEMPERATURE INDICATORS BY ELECTRICAL SIMULATION (continued)			
Including Reference junction compensation (continued)			
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.77 °C 0.33 °C 0.25 °C 0.23 °C	
Excluding reference junction compensation			
Type K	-200 °C to -150 °C -150 °C to -100 °C -100 °C to 1370 °C	0.16 °C 0.12 °C 0.10 °C	
Type J	-200 °C to -150 °C -150 °C to -100 °C -100 °C to 1200 °C	0.12 °C 0.10 °C 0.090 °C	
Type T	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 400 °C	0.36 °C 0.15 °C 0.11 °C	
Type N	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 1300 °C	0.77 °C 0.24 °C 0.13 °C	
Type E	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 1300 °C	0.24 °C 0.11 °C 0.080 °C	
Type B	300 °C to 500 °C 500 °C to 1000 °C 1000 °C to 1820 °C	0.76 °C 0.46 °C 0.26 °C	



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TEMPERATURE INDICATORS BY ELECTRICAL SIMULATION (continued) Excluding Reference junction compensation (continued) Type R Type S Measurement of ambient in support of temperature simulation	 -50 °C to 100 °C 100 °C to 300 °C 300 °C to 1768 °C -50 °C to 100 °C 100 °C to 300 °C 300 °C to 1768 °C 18 °C to 30 °C	 0.62 °C 0.32 °C 0.25 °C 0.59 °C 0.32 °C 0.26 °C 0.10 °C	
RF ELECTRICAL MEASUREMENTS RF Power 1 mW reference Flatness at nominal 1 mW (0.8 mW to 1.2 mW) RF Power	 1 mW 50 MHz 100 kHz to 50 MHz 50 MHz to 5 GHz 5 GHz to 15 GHz 15 GHz to 18 GHz 100 KHz to 10 MHz 0.01 mW to 0.12 mW 0.12 mW to 0.8 mW 1.2 mW to 10 mW 10 mW to 100 mW 10 MHz to 18 GHz 0.01 µW to 1.2 µW 1.2 µW to 10 µW 0.01 mW to 0.12 mW 0.12 mW to 0.8 mW 1.2 mW to 10 mW 10 mW to 100 mW	 0.30 % 0.95 % 1.0 % 1.1 % 1.3 % 1.6 % 1.2 % 1.6 % 4.3 % 2.9 % 4.9 % 1.8 % 1.5 % 1.8 % 4.4 %	 For outputs with a VRC of up to 0.05



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RF ELECTRICAL MEASUREMENTS (continued) Calibration factor Nominal 1 mW	0.1 MHz 0.3 MHz 0.5 MHz 1 MHz 3 MHz 5 MHz 10 MHz 30 MHz 0.1 GHz 0.3 GHz 0.5 GHz 1.0 GHz 1.5 GHz 2.0 GHz 3.0 GHz 4.0 GHz 5.0 GHz 6.0 GHz 7.0 GHz 8.0 GHz 9.0 GHz 10.0 GHz 11.0 GHz 12.0 GHz 12.4 GHz 13.0 GHz 14.0 GHz 15.0 GHz 16.0 GHz 17.0 GHz 18.0 GHz	0.90 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.85 % 0.90 % 1.1 % 1.0 % 1.1 % 1.1 % 1.1 % 1.3 % 1.5 % 1.5 % 1.3 % 1.3 % 1.2 % 1.2 % 1.2 % 1.1 % 1.2 % 1.3 %	N type Male connectors with a VRC of less than 0.01 sensors with other connector types can be calibrated but at larger uncertainties.
MODULATION Carrier 10 MHz to 1.3 GHz Amplitude modulation Rate 50 Hz to 50 kHz Modulation Factor Frequency modulation Rate 50 Hz to 100 kHz Deviation	0.05 to 0.10 0.10 to 0.40 0.40 to 0.60 0.60 to 0.99 1 kHz to 400 kHz	0.0020 0.0050 0.0075 0.012 1.2 %	



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MODULATION (continued) Phase modulation Rate 200 Hz to 20 kHz Deviation	0.4 rad to 4 rad 4 rad to 400 rad	3.7 % 3.5 %	
VOLTAGE REFLECTION COEFFICIENT	<p><i>300 kHz to 3 GHz</i></p> 0 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.4 0.4 to 0.5 0.5 to 0.6 0.6 to 0.7 0.7 to 0.8 0.8 to 0.9 0.9 to 1.0 <p><i>3 GHz to 8 GHz</i></p> 0 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.4 0.4 to 0.5 0.5 to 0.6 0.6 to 0.7 0.7 to 0.8 0.8 to 0.9 0.9 to 1.0 <p><i>8 GHz to 18 GHz</i></p> 0 dB to 0.1 0.1 dB to 0.2 0.2 dB to 0.3 0.3 dB to 0.4 0.4 dB to 0.5 0.5 dB to 0.6 0.6 dB to 0.7 0.7 dB to 0.8 0.8 dB to 0.9 0.9 dB to 1.0	0.010 0.011 0.012 0.014 0.016 0.019 0.023 0.026 0.031 0.036 0.015 0.016 0.017 0.019 0.021 0.024 0.027 0.031 0.035 0.040 0.015 0.016 0.018 0.021 0.025 0.029 0.034 0.040 0.047 0.054	



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ATTENUATION	300 kHz to 3 GHz		System A
	0 dB to 20 dB	0.080 dB	
	20 dB to 40 dB	0.080 dB	
	40 dB to 60 dB	0.13 dB	
	60 dB to 70 dB	0.33 dB	
	2.5 MHz to 1.3 GHz		System B
	0 dB to 10 dB	0.060 dB	
	10 dB to 40 dB	0.080 dB	
	40 dB to 80 dB	0.080 dB	
	80 dB to 110 dB	0.080 dB	
	1.3 GHz to 8 GHz		0.17 dB
	0 dB to 10 dB	0.17 dB	
10 dB to 40 dB	0.13 dB		
40 dB to 95 dB	0.13 dB		
95 dB to 100 dB	0.25 dB		
8 GHz to 18 GHz		0.24 dB	
0 dB to 10 dB	0.24 dB		
10 dB to 40 dB	0.17 dB		
40 dB to 90 dB	0.17 dB		
90 dB to 100 dB	0.27 dB		
Impedance and Voltage division factor (LISNs and CDNs)			
IMPEDANCE 3 Ω to 250 Ω			
IMPEDANCE	9 kHz to 100 kHz	2.5 %	
	100 kHz to 10 MHz	2.5 %	
	10 MHz to 100 MHz	3.5 %	
	100 MHz to 230 MHz	4.5 %	
	230 MHz to 400 MHz	8.5 %	
IMPEDANCE PHASE 3 Ω to 100 Ω	9 kHz to 100 kHz	0.46 $^{\circ}$	
	100 kHz to 10 MHz	0.48 $^{\circ}$	
	10 MHz to 100 MHz	1.6 $^{\circ}$	
INSERTION LOSS / VDF 0 dB to 40 dB	9 kHz to 100 kHz	0.10 dB	
	100 kHz to 10 MHz	0.20 dB	
	10 MHz to 100 MHz	0.30 dB	
	100 MHz to 200 MHz	0.50 dB	
	200 MHz to 400 MHz	0.70 dB	
40 dB to 60 dB	9 kHz to 100 kHz	0.50 dB	
	100 kHz to 10 MHz	0.50 dB	
	10 MHz to 100 MHz	0.60 dB	
	100 MHz to 200 MHz	0.70 dB	
	200 MHz to 400 MHz	0.80 dB	



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INSERTION LOSS / VDF (continued) 60 dB to 80 dB	9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 100 MHz 100 MHz to 200 MHz 200 MHz to 400 MHz	0.90 dB 0.90 dB 1.0 dB 1.0 dB 1.1 dB	
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 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 μ V

Over the range 100 mV to 1 V, the CMC is 0.0025 %-V + 5.0 μ 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 %· p + (0.12·10⁻⁶· p ·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 · 0.01 · i , where i is the instrument indication.