Acc.nr.: 004 - CAL

Addendum to the accreditation certificate BELAC n° 004-CAL

Stork INTERMES N.V.

Version nr. 7

Issue date : 2010-03-15

Valid until : 2013-04-21

In the name of the Accreditation office,
The chairman,

Nicole Meurée-Vanlaethem

BELAC

Secretariaat :

FEDERALE OVERHEIDSDIENST ECONOMIE, K.M.O., MIDDENSTAND & ENERGIE

Algemene Directie Kwaliteit en Veiligheid - Accreditatie

Koning Albert II-laan, 16 – 5de verdieping – BE-1000 BRUSSEL

Tel. : +32 2 277 54 34 Fax : +32 2 277 54 41

Website : http://belac.fgov.be – E-mail : belac@economie.fgov.be

Detail of accreditation

Pressure	Pressure, vacuum & on site
Temperature	Temperature & on site
Electrical	Direct voltage (generate & measure)
	Alternating voltage (generate & measure)
	Resistance (generate & measure)
	Direct current (generate & measure)
	Alternating current (generate & measure)
	Calibration of current clamps (AC / DC)
	Calibration of resistors & insulation meters
	Power (generate & measure)
	High voltage
	Oscilloscopes
	Capacity & inductance
Time & frequency	Time, tachometry & frequency
Humidity	Relative humidity & dew point
Mass	Weights & mass pieces
Density	Density / volume
Scales	Scales (on site)
Torque	Torque tools & torque measuring devices
Force	Force measuring devices in tension & compression
Dimensional	Dimensional calibration: - gauge blocks, length gauges, length measuring instrument - diameter, distance, form, surface texture - thread measurement (internal & external) - combined measuring devices - translation deviations - angle gauges, angle measuring devices Dimensional measurement: - product measurement
Volume	Measuring cups, liquid pipettes

1. PRESSURE

a) Activity : pressure

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Gauges, digital indicators, plotters, calibrators, liquid column, transmitters, transducers and dead weight testers for relative and absolute[1] pressures	0 Pa tot 4800 Pa	$1 \times 10^{-4} \times p$ minimum 0,03 Pa	By comparison with a low pressure standard
	from -100 kPa to -1,5 kPa from 1,5 kPa to 5 kPa from 5 kPa to 1900 kPa from 1900 kPa to 7600 kPa from 7,6 MPa to 12 MPa	$8 \times 10^{-5} \times p$ $8 \times 10^{-5} \times p$ $3,5 \times 10^{-5} \times p$ $5 \times 10^{-5} \times p$ $6 \times 10^{-5} \times p$	By comparison with a gas dead weight tester Pneumatic?
	from 12 MPa to 60 MPa from 60 MPa to 120 MPa from 120 MPa to 400 MPa	$6 \times 10^{-5} \times p$ $7 \times 10^{-5} \times p$ $2,5 \times 10^{-4} \times p$	By comparison with a liquid dead weight tester Hydraulic?
Barometers	from 5 kPa to 350 kPa abs	$3,5 \times 10^{-5} \times p$	By comparison with a gas dead weight tester
Piston / cylindre unit (effective surface)[2]	from 5 kPa to 1900 kPa from 1900 kPa to 7600 kPa from 7,6 MPa to 12 MPa from 0,3MPa to 60 MPa	$3,5 \times 10^{-5} \times p$ $5 \times 10^{-5} \times p$ $6 \times 10^{-5} \times p$ $6 \times 10^{-5} \times p$	By comparison with a gas dead weight tester
	from 60 MPa to 120 MPa	$7 \times 10^{-5} \times p$	By comparison with a liquid dead weight tester

[1] For absolute pressures the uncertainty of the atmospheric pressure is added to the Total uncertainty.
[2] The masses are calibrated in our mass laboratory.

b) Activity : vacuum

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Absolute pressure	1 Pa - 5 kPa 1 mPa - 1 Pa	$2 \times 10^{-2} \times p$ $2,5 \times 10^{-2} \times p + 5$ mPa	By comparison with capacitive pressure indicators

c) Activity : Pressure on site

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Relative pressures	20 kPa - 60 MPa	$1 \times 10^{-3} \times p$	By comparison with digital pressure indicators

2. TEMPERATURE

a) Activity : Temperature

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Platinum resistance thermometers which meet the specifications of the ITS-90 or close to these specifications	-38,8344 °C 0,01 °C 29,7646 °C 156,5985 °C 231,928 °C 419,527 °C 660,323 °C	0,004 °C 0,004 °C 0,004 °C 0,005 °C 0,005 °C 0,006 °C 0,015 °C	**Fixed points:** Triple point of mercury Triple point of water Melting point of gallium Freeze point of indium Freeze point of tin Freeze point of zinc Freeze point of aluminium
Resistance thermometers	-196 °C	0,025 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure
Resistance thermometers	-100 °C to -40 °C -40 °C to 0 °C 0 °C to 280 °C 250 °C to 660 °C	0,05 °C 0,025 °C 0,015 °C 0,04 °C	By comparison with reference standards

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
			Fixed points:
Temperature indicators with resistance probe	-38,8344 °C	0,004 °C	Triple point of mercury
	0,01 °C	0,004 °C	Triple point of water
	29,7646 °C	0,004 °C	Melting point of gallium
	156,5985 °C	0,005 °C	Freeze point of indium
	231,928 °C	0,005 °C	Freeze point of tin
	419,527 °C	0,006 °C	Freeze point of zinc
	660,323 °C	0,015 °C	Freeze point of aluminium
Temperature indicators with resistance probe	-196 °C	0,025 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure
Temperature indicators with resistance probe	-100 °C tot -40 °C	0,05 °C	By comparison with reference standards
	-40 °C tot 0 °C	0,025 °C	
	0 °C tot 280 °C	0,015 °C	
	250 °C tot 660 °C	0,04 °C	
Thermocouples R & S	-50 °C to 660 °C	0,6 °C	By comparison with reference standards
	660 °C to 1300 °C	2,6 °C	
Thermocouples	-196 °C	0,2 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure
	-100 °C to 660 °C	0,2 °C	By comparison with reference standards
	660 °C to 1300 °C	2,6 °C	
Temperature indicators with thermocouple probes R & S	-50 °C to 660 °C	0,6 °C	By comparison with reference standards
	660 °C to 1300 °C	2,6 °C	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Temperature indicators with thermocouple probes	-196 °C	0,2 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure
	-100 °C to 660 °C 660 °C to 1300 °C	0,2 °C 2,6 °C	By comparison with reference standards
Analogue thermometers	-100 °C to 0 °C 0 °C to 280 °C	0,06 °C 0,025 °C	By comparison with reference standards
Block calibrators	-100 °C to 650 °C	0,05 °C+ 0,0005·|t|	Full evaluation following DOC EM/CG/13.01 Guidelines on the Calibration of Temperature Block Calibrators" Or calibration with known evaluation information

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Liquid in glass thermometers with a resolution of	From -100 °C to 0 °C		By comparison with reference standards (totally or partially submerged) Partially submerged thermometers have a bigger CMC than mentioned
5 °C		2,0 °C	
2 °C		0,8 °C	
1 °C		0,4 °C	
0,5 °C		0,20 °C	
0,2 °C		0,09 °C	
0,1 °C		0,06 °C	
0,05 °C		0,06 °C	
Liquid in glass thermometers with a resolution of	from 0 °C to 275 °C		By comparison with reference standards (totally or partially submerged) Partially submerged thermometers have a bigger CMC than mentioned
5 °C		2,0 °C	
2 °C		0,8 °C	
1 °C		0,4 °C	
0,5 °C		0,20 °C	
0,2 °C		0,07 °C	
0,1 °C		0,05 °C	
0,05 °C		0,025 °C	

b) Activity : temperature on site

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Temperature probe with or without readout	-18 °C to 200 °C	0,25 °C	By comparison in Block calibrators with external reference standards

3. ELEKTRICAL

a) TABEL I : Measure direct voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
±100 mV	DC	$5 \times 10^{-6} \times U$	• Transfer standard in "30 day" loop • Fixed points • positive /negative • measuring
±1 V	DC	$2,7 \times 10^{-6} \times U$	
±10 V	DC	$2,1 \times 10^{-6} \times U$	
±19 V	DC	$2,3 \times 10^{-6} \times U$	
±100 V	DC	$3 \times 10^{-6} \times U$	
±1000 V	DC	$3 \times 10^{-6} \times U$	

b) TABEL II : Measure alternating voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
1 mV	20 Hz to 20 kHz	$3 \times 10^{-4} \times U + 2\ \mu V$	• Transfer standard in "30 day" loop • Fixed points • positive /negative • measuring
	30 kHz & 50 kHz	$4 \times 10^{-4} \times U + 2\ \mu V$	
	100 kHz	$65 \times 10^{-5} \times U + 2\ \mu V$	
10 mV	20 Hz to 20 kHz	$17 \times 10^{-5} \times U + 2\ \mu V$	
	30 kHz & 50 kHz	$25 \times 10^{-5} \times U + 2\ \mu V$	
	100 kHz	$45 \times 10^{-5} \times U + 2\ \mu V$	
100 mV	20 Hz to 20 kHz	$12 \times 10^{-5} \times U + 2\ \mu V$	
	30 kHz & 50 kHz	$2 \times 10^{-4} \times U + 2\ \mu V$	
	100 kHz	$4 \times 10^{-4} \times U + 2\ \mu V$	
1 V	10 Hz to 30 Hz	$4 \times 10^{-5} \times U$	
	40 Hz to 30 kHz	$3 \times 10^{-5} \times U$	
	50 kHz	$4 \times 10^{-5} \times U$	
	100 kHz	$5 \times 10^{-5} \times U$	

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
	300 kHz	$12 \times 10^{-5} \times U$	
	500 kHz	$25 \times 10^{-5} \times U$	
	1 MHz	$6 \times 10^{-4} \times U$	
10 V	10 Hz to 30 Hz	$4 \times 10^{-5} \times U$	
	40 Hz to 30 kHz	$3 \times 10^{-5} \times U$	
	50 kHz	$35 \times 10^{-6} \times U$	
	100 kHz	$4 \times 10^{-5} \times U$	
	300 kHz	$11 \times 10^{-5} \times U$	
	500 kHz	$22 \times 10^{-5} \times U$	
	1 MHz	$6 \times 10^{-4} \times U$	
19 V	1 kHz	$4 \times 10^{-5} \times U$	
100 V	10 Hz to 30 Hz	$45 \times 10^{-6} \times U$	
	40 Hz & 55 Hz	$4 \times 10^{-5} \times U$	
	300 Hz to 20 kHz	$3 \times 10^{-5} \times U$	
	30 kHz	$35 \times 10^{-6} \times U$	
	50 kHz	$45 \times 10^{-6} \times U$	
	100 kHz	$74 \times 10^{-6} \times U$	
1000 V	40 Hz to 1 kHz	$4 \times 10^{-5} \times U$	
	10 kHz	$45 \times 10^{-6} \times U$	
	20 kHz	$5 \times 10^{-5} \times U$	
	30 kHz	$75 \times 10^{-6} \times U$	
700 V	50 kHz	$125 \times 10^{-6} \times U$	
	100 kHz	$35 \times 10^{-5} \times U$	

c) TABEL III : Measure resistance

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
1 Ω	DC	11 x 10^{-6} x R	• Transfer standard in "30 day" loop • Fixed points • Measuring • 4-wire resistance measurement • Negligible dissipated power
10 Ω	DC	9,5 x 10^{-6} x R	
100 Ω	DC	6,5 x 10^{-6} x R	
1 kΩ	DC	4,5 x 10^{-6} x R	
10 kΩ	DC	4,5 x 10^{-6} x R	
100 kΩ	DC	7,5 x 10^{-6} x R	
1 MΩ	DC	14 x 10^{-6} x R	
10 MΩ	DC	25 x 10^{-6} x R	
100 MΩ	DC	20 x 10^{-5} x R	

d) TABEL IV : Measure direct current

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
±100 µA	DC	23,5 x 10^{-6} x I	• Transfer standard in "30 day" loop • Fixed points • positive / negative • Measurement
±1 mA	DC	15,5 x 10^{-6} x I	
±10 mA	DC	16 x 10^{-6} x I	
±100 mA	DC	19 x 10^{-6} x I	
±1 A	DC	31 x 10^{-6} x I	
±10 A	DC	6 x 10^{-5} x I	

e) TABEL V : Measure alternating current

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
100 µA	10 Hz to 30 Hz	$135 \times 10^{-6} \times I$	• Transfer standard in "30 day" loop • Fixed points • Measurement
	40 Hz to 1 kHz	$11 \times 10^{-5} \times I$	
	5 kHz	$165 \times 10^{-6} \times I$	
1 mA	10 Hz to 30 Hz	$13 \times 10^{-5} \times I$	
	40 Hz to 1 kHz	$1 \times 10^{-4} \times I$	
	5 kHz	$15 \times 10^{-5} \times I$	
10 mA	10 Hz to 30 Hz	$13 \times 10^{-5} \times I$	
	40 Hz to 1 kHz	$1 \times 10^{-4} \times I$	
	5 kHz	$15 \times 10^{-5} \times I$	
100 mA	10 Hz to 30 Hz	$13 \times 10^{-5} \times I$	
	40 Hz to 1 kHz	$1 \times 10^{-4} \times I$	
	5 kHz	$15 \times 10^{-5} \times I$	
1 A	10 Hz to 30 Hz	$175 \times 10^{-6} \times I$	
	40 Hz to 1 kHz	$12 \times 10^{-5} \times I$	
	5 kHz	$225 \times 10^{-6} \times I$	
10 A	40 Hz	$3 \times 10^{-4} \times I$	
	50 Hz to 1 kHz	$285 \times 10^{-6} \times I$	
	5 kHz	$4 \times 10^{-4} \times I$	
	10 kHz	$7 \times 10^{-4} \times I$	

f) TABEL VI : Generate direct voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
0 mV tot 200 mV	DC	18 x 10^{-6} x U of 0,5 µV[1]	• generate • positive / negative
0,2 V tot 2 V	DC	8 x 10^{-6} x U	
2 V tot 20 V	DC	4,5 x 10^{-6} x U	
20 V tot 200 V	DC	7 x 10^{-6} x U	
200 V tot 1100 V	DC	10 x 10^{-6} x U	

[1] Whichever is greater

g) TABEL VII : Generate alternating voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
2 mV tot 20 mV	1 kHz -10 kHz	7 x 10^{-4} x U	• Generate in the lowest range possible
	10 kHz -100 kHz	11 x 10^{-4} x U	
20 mV tot 200 mV	10 Hz - 300 Hz	21 x 10^{-5} x U	
	300 Hz - 10 kHz	18 x 10^{-5} x U	
	10 kHz - 30 kHz	28 x 10^{-5} x U	
	30 kHz - 100 kHz	61 x 10^{-5} x U	
0,2 V tot 2 V	10 Hz - 300 Hz	16 x 10^{-5} x U	
	300 Hz - 1 kHz	11 x 10^{-5} x U	
	1 kHz -30 kHz	7 x 10^{-5} x U	
	30 kHz - 100 kHz	16 x 10^{-5} x U	
	100 kHz - 300 kHz	6 x 10^{-4} x U	
	300 kHz - 1 MHz	3 x 10^{-3} x U	
2 V tot 20 V	10 Hz - 300 Hz	16 x 10^{-5} x U	
	300 Hz - 1 kHz	10 x 10^{-5} x U	

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
	1 kHz -10 kHz	$8 \times 10^{-5} \times U$	
	10 kHz - 30 kHz	$7 \times 10^{-5} \times U$	
	30 kHz - 100 kHz	$17 \times 10^{-5} \times U$	
	100 kHz - 300 kHz	$6 \times 10^{-4} \times U$	
	300 kHz - 1 MHz	$3 \times 10^{-3} \times U$	
20 V tot 200 V	10 Hz - 300 Hz	$16 \times 10^{-5} \times U$	
	300 Hz - 1 kHz	$12 \times 10^{-5} \times U$	
	1 kHz -10 kHz	$10 \times 10^{-5} \times U$	
	10 kHz - 30 kHz	$11 \times 10^{-5} \times U$	
	30 kHz - 100 kHz	$21 \times 10^{-5} \times U$	
200 V tot 1000 V	40 Hz - 300 Hz	$23 \times 10^{-5} \times U$	
	300 Hz - 1 kHz	$23 \times 10^{-5} \times U$	
	1 kHz -10 kHz	$17 \times 10^{-5} \times U$	
	10 kHz - 30 kHz	$22 \times 10^{-5} \times U$	
200 V tot 750 V	30 kHz - 100 kHz	$15 \times 10^{-4} \times U$	

h) TABEL VIII : Generate Resistance

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
0 Ω	DC	100 μΩ	• generate • fixed points • 4-wire resistance measurement • Negligible dissipated power in the lowest range possible
10 Ω	DC	39 x 10^{-6} x R	
100 Ω	DC	13 x 10^{-6} x R	
1 kΩ	DC	16 x 10^{-6} x R	
10 kΩ	DC	14 x 10^{-6} x R	
100 kΩ	DC	14 x 10^{-6} x R	
1 MΩ	DC	36 x 10^{-6} x R	
10 MΩ	DC	65 x 10^{-6} x R	
100 MΩ	DC	34 x 10^{-5} x R	
1 Ω	DC	6 x 10^{-7} x R	• generate • standard resistors • also combinations of these resistors[1] • 4-wire resistance measurement • maximum dissipated power 10 mW
10 Ω	DC	6 x 10^{-7} x R	
25 Ω	DC	6 x 10^{-7} x R	
50 Ω	DC	6 x 10^{-7} x R	
75 Ω	DC	6 x 10^{-7} x R	
100 Ω	DC	6 x 10^{-7} x R	
378 Ω	DC	2 x 10^{-6} x R	
1 Ω	75 Hz	1 x 10^{-5} x R	• generate • standard resistors • also combinations of these resistors[1] • 4- wire resistance measurement • maximum dissipated power 10 mW
10 Ω	75 Hz	3 x 10^{-6} x R	
25 Ω	75 Hz	1,5 x 10^{-6} x R	
50 Ω	75 Hz	1,5 x 10^{-6} x R	
75 Ω	75 Hz	1,5 x 10^{-6} x R	
100 Ω	75 Hz	1,5 x 10^{-6} x R	
378 Ω	75 Hz	3 x 10^{-6} x R	

[1] the uncertainty varies as the combinations and the dissipated power are different.

i) TABEL IX : Generate direct current

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
0 µA tot 20 µA	DC	1,5 nA	• generate • positive / negative
20 µA tot 200 µA	DC	17 x 10^{-5} x I	
0,2 mA tot 200 mA	DC	7 x 10^{-5} x I	
0,2 A tot 2 A	DC	19 x 10^{-5} x I	
2 A tot 11 A	DC	27 x 10^{-5} x I	
11 A tot 20 A	DC	6 x 10^{-4} x I	

j) TABEL X : Generate alternating current

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
20 µA tot 200 µA	10 Hz - 1 kHz	4 x 10^{-4} x I	• generate • in the lowest range possible
	1 kHz - 5 kHz	6 x 10^{-4} x I	
0,2 mA tot 2 mA	10 Hz - 1 kHz	32 x 10^{-5} x I	
	1 kHz - 5 kHz	40 x 10^{-5} x I	
2 mA tot 20 mA	10 Hz - 1 kHz	31 x 10^{-5} x I	
	1 kHz - 5 kHz	41 x 10^{-5} x I	
20 mA tot 200 mA	10 Hz - 1 kHz	31 x 10^{-5} x I	
	1 kHz - 5 kHz	40 x 10^{-5} x I	
0,2 A tot 2 A	10 Hz - 1 kHz	60 x 10^{-5} x I	
	1 kHz - 5 kHz	71 x 10^{-5} x I	
2 A tot 10 A	10 Hz - 1 kHz	61 x 10^{-5} x I	
	1 kHz - 5 kHz	12 x 10^{-4} x I	
	5 kHz - 10 kHz	34 x 10^{-4} x I	

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
10 A tot 20 A	45 Hz - 100 Hz	$17 \times 10^{-4} \times I$	
	100 Hz - 1 kHz	$2 \times 10^{-3} \times I$	

k) TABEL XI : Measure direct voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
0 mV tot 200 mV	DC	7×10^{-6} x U of 0,1µV[1]	• measure • positive / negative
0,2 V tot 2 V	DC	5×10^{-6} x U	
2 V tot 20 V	DC	$4,5 \times 10^{-6}$ x U	
20 V tot 200 V	DC	$5,5 \times 10^{-6}$ x U	
200 V tot 1000 V	DC	$5,5 \times 10^{-6}$ x U	

[1] Whichever is greater.

l) TABEL XII : Measure alternating voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
20 mV tot 200 mV	10 Hz - 10 kHz	65×10^{-6} x U	• measure
	10 kHz - 30 kHz	14×10^{-5} x U	
	30 kHz - 100 kHz	15×10^{-5} x U	
0,2 V tot 2 V	10 Hz - 10 kHz	6×10^{-5} x U	
	10 kHz - 60 kHz	10×10^{-5} x U	
	60 kHz -100 kHz	18×10^{-5} x U	
	100 kHz - 1 MHz	4×10^{-3} x U	
2 V tot 20 V	10 Hz - 10 kHz	9×10^{-5} x U	
	10 kHz - 100 kHz	18×10^{-5} x U	
	100 kHz -1 MHz	17×10^{-4} x U	
20 V tot 200 V	10 Hz - 30 kHz	15×10^{-5} x U	
	30 kHz - 100 kHz	3×10^{-4} x U	
200 V tot 1000 V	40 Hz - 60 kHz	18×10^{-5} x U	

m) TABEL XIII : Measure resistance

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
0 Ω tot 2 Ω	DC	18 x 10^{-6} x R of 20 μΩ[1]	• measure • 4-wire resistance measurement • Negligible dissipated power
2 Ω tot 20 Ω	DC	3,1 x 10^{-6} x R	
20 Ω tot 200 Ω	DC	5,5 x 10^{-6} x R	
0,2 kΩ tot 2 kΩ	DC	2 x 10^{-6} x R	
2 kΩ tot 20 kΩ	DC	5 x 10^{-6} x R	
20 kΩ tot 200 kΩ	DC	6,3 x 10^{-6} x R	
0,2 MΩ tot 2 MΩ	DC	6 x 10^{-6} x R	
2 MΩ tot 20 MΩ	DC	11 x 10^{-6} x R	
20 MΩ tot 200 MΩ	DC	6 x 10^{-5} x R	
200 MΩ tot 2 GΩ	DC	12 x 10^{-4} x R	

[1] Whichever is greater

n) TABEL XIV: Measure direct current

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
0 μA tot 200 μA	DC	12 x 10^{-6} x I of 0,5 nA	• measure • in the lowest possible range • positive / negative
0,2 mA tot 2 mA	DC	11 x 10^{-6} x I	
2 mA tot 20 mA	DC	9 x 10^{-6} x I	
20 mA tot 200 mA	DC	16 x 10^{-6} x I	
0,2 A tot 2 A	DC	9 x 10^{-5} x I	
2 A tot 20 A	DC	9 x 10^{-5} x I	

o) TABEL XV : Measure alternating current

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
5 µA tot 200 µA	10 Hz - 5 kHz	16 x 10^{-5} x I	• measurement
5 µA tot 200 µA	5 kHz - 10 kHz	4 x 10^{-2} x I	
0,2 mA tot 2 mA	10 Hz - 5 kHz	6 x 10^{-5} x I	
0,2 mA tot 2 mA	5 kHz - 10 kHz	13 x 10^{-5} x I	
2 mA tot 20 mA	10 Hz - 5 kHz	1 x 10^{-4} x I	
2 mA tot 20 mA	5 kHz - 10 kHz	5 x 10^{-4} x I	
20 mA tot 200 mA	10 Hz - 1 kHz	1 x 10^{-4} x I	
20 mA tot 200 mA	1 kHz - 10 kHz	26 x 10^{-4} x I	
0,2 A tot 2 A	10 Hz - 1 kHz	1 x 10^{-4} x I	
0,2 A tot 2 A	1 kHz - 10 kHz	4 x 10^{-4} x I	
2 A tot 20 A	10 Hz - 1 kHz	1 x 10^{-4} x I	
2 A tot 20 A	1 kHz - 5 kHz	3 x 10^{-4} x I	
2 A tot 20 A	5 kHz - 10 kHz	10 x 10^{-4} x I	

p) TABEL XVI : Calibration of current clamps AC / DC

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
20 - 500 A	45 - 100 Hz	10 x 10^{-3} x I	With current coils
20 - 500 A	100 - 440 Hz	15 x 10^{-3} x I	
20 - 500 A	DC	10 x 10^{-3} x I	

q) TABEL XVII : Calibration of resistors / insulation meters

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
50 V – 250 V	10 kΩ - 40 MΩ	1 x 10^{-4} x R	
50 V - 250 V	40 MΩ - 200 MΩ	5 x 10^{-4} x R	

250 V - 1000 V	100 kΩ - 200 MΩ	$1 \times 10^{-4} \times R$	
250 V - 1000V	200 MΩ - 1000 MΩ	$3 \times 10^{-4} \times R$	
1 kV – 10 kV	1 MΩ - 10 GΩ	$6 \times 10^{-3} \times R$	

r) TABEL XVIII : Calibration of power generation / measurement

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
Mono phase , direct without measuring clamps			
33 mV - 1000 V / 0,33 - 330 mA	DC	$3 \times 10^{-4} \times P$	11 µW - 330 W generate
33 mV - 1000 V / 0,33 - 3,3 A	DC	$5 \times 10^{-4} \times P$	3,3 kW generate
33 mV - 1000 V / 3,3 - 10,5 A	DC	$6 \times 10^{-4} \times P$	10,5 kW generate
33 mV - 1000 V / 10,5 - 20,5 A	DC	$11 \times 10^{-4} \times P$	20,5 kW generate
33 mV - 1000 V / 0,1 mA – 20,5A	45 Hz – 1 kHz	$15 \times 10^{-4} \times P$	3,3 µW – 20,5 kW / kVA(r) generate cos/sin > 0,5
33 mV - 1000 V / 0,1 mA – 20,5A	45 Hz – 1 kHz	$4 \times 10^{-3} \times P$	3,3 µW– 20,5 kW / kVA(r) generate cos/sin > 0,25
Mono phase , direct with measuring clamps			
33 mV - 1000 V / 20 A – 500 A	DC	$10 \times 10^{-3} \times P$	0,66 W – 500 kW / kVA(r) generate
33 mV - 1000 V / 20 A – 500 A	45 Hz - 100 Hz	$11 \times 10^{-3} \times P$	0,66 W – 500 kW / kVA(r) generate cos/sin > 0,25
33 mV - 1000 V / 20 A – 500 A	100 Hz – 440 Hz	$16 \times 10^{-3} \times P$	0,66 W – 500 kW / kVA(r) generate cos/sin > 0,25
3-phase, direct without measuring clamps			
1 V – 300 V / 0,3 A - 100 A	50 Hz & 60 Hz	$2 \times 10^{-3} \times P$	0,3 W - 30 kW / kVA(r) generate cos / sin > 0,5
1 V – 300 V / 0,3 A - 100 A	50 Hz & 60 Hz	$4 \times 10^{-3} \times P$	0,3 W - 30 kW / kVA(r) generate cos / sin > 0,25
1 V – 1000 V / 0,3 A – 100 A	10 Hz – 1 kHz	$2 \times 10^{-3} \times P$	0,3 W - 100 kW / kVA(r)

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
			measure cos / sin > 0,5
1 V – 1000 V / 0,3 A – 100 A	10 Hz – 1 kHz	4 x 10^{-3} x P	0,3 W - 100 kW / kVA(r) measure cos / sin > 0,25
3-phase, direct with measuring clamps			
1 V - 300 V / 20 A - 500 A	50 Hz & 60 Hz	11 x 10^{-3} x P	20 W – 150 kW / kVA(r) generate cos / sin > 0,25
1 V - 1000 V / 20 A - 100 A	15 Hz - 440 Hz	16 x 10^{-3} x P	20 W – 100 kW / kVA(r) measure cos / sin > 0,25
Phase / phase angle			
Cos / sin -1 tot 1	10 Hz – 1 kHz	0,0004	Measure / generate
Phase angle -180 tot 180 °	10 Hz – 1 kHz	0,02°	Measure / generate

P indicates active,reactive aswell as apparent power.

s) TABEL XIX : High voltage

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
1 – 75 kV	DC	3 x 10^{-4} x U	measure
1 - 40 kV	DC	3 x 10^{-4} x U	generate
1 - 53 kV	50 Hz	3 x 10^{-3} x U	measure
1 - 45 kV	50 Hz	3 x 10^{-3} x U	generate

t) TABEL XX : Oscilloscope (on screen) – input impedance 50 Ω en 1 MΩ

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
± 1 mV – 200 V	DC	0,025 % x U + 25 µV	50 Ω tot 5,56 V
1 mVpp – 21 mVpp	10 Hz – 10 kHz	0,25 % x U + 10 µV	Square wave
21 mVpp – 556 mVpp	10 Hz – 10 kHz	0,1 % x U + 10 µV	Square wave

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
556 mVpp – 210 Vpp	10 Hz – 10 kHz	0,05 % x U + 10 µV	Square wave 50 Ω tot 5,56 V
4,44 mVpp – 5,56 Vpp	100 mHz – 100 MHz	1,5 % x U	Sine wave
4,44 mVpp – 5,56 Vpp	100 MHz – 550 MHz	3 % x U	Sine wave
4,44 mVpp – 3,35 Vpp	550 MHz – 1 GHz	4 % x U	Sine wave
4,44 mVpp – 3,54 Vpp	1 GHz – 4 GHz	6 % x U	Sine wave
500 ps	-	40 ps	Rise/ fall time (max. 3 V)
250 ps – 10 ks	-	5×10^{-9} x t	Time base
40 Ω - 90 Ω	1 kHz	0,1 % x Z	Input impedance
0,8 MΩ - 1,2 MΩ			
10 Ω – 150 Ω	1 kHz	0,5 % x Z	Input impedance
50 kΩ - 12 MΩ			
	0,1 Hz – 100 MHz	0,15 dB	Weakening at bandwidth
	100 MHz – 550 MHz	0,3 dB	Weakening at bandwidth
	550 MHz – 1 GHz	0,4 dB	Weakening at bandwidth
	1 GHz – 4 GHz	0,5 dB	Weakening at bandwidth

Oscilloscope with digital readout can also be calibrated as digital multimeter.

u) TABEL XXI : Capacity

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
10 pF – 100 pF	1 kHz	15×10^{-4} x C	Measure / generate
100 pF – 1000 nF	1 kHz	10×10^{-4} x C	Measure / generate
1000 nF	100 Hz	4×10^{-4} x C	Measure / generate

v) TABEL XXII : Inductances

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
100 µH – 1 H	1 kHz	$10 \times 10^{-4} \times L$	Measure / generate
1 H – 10 H	1 kHz	$20 \times 10^{-4} \times L$	Measure / generate

4. TIME AND FREQUENCY

a) TABEL I : Measure time

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
Electronic chronometers	NA	0,1 s / 24 h	Direct measurement
Mechanic chronometers	NA	5 s / 24 h	Direct measurement
Electronic & mechanic chronometers	Standard 0 h .. 72 h	0,5 s / 24 h with minimum 0,3 s	By comparison with a standard chronometer via a digital-optic recorder
Signal-triggered chronometers	Standard 0 h .. 72 h	0,15 s / 24 h with minimum 0,06 s	By comparison with a frequency standard

b) TABEL II : Measure Tachometry

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
Tachometers, stroboscope,	1,2 min^{-1} to 100 000 min^{-1}	3 x 10^{-7} x n	By comparison with a frequency standard

n number of rotations in min^{-1}

c) TABEL III : Measure frequency

Measuring range or point	Frequency	Calibration and Measurement Capability (CMC)	Remarks
Frequency meters, frequency generators, counters	1 Hz	$5 \times 10^{-11} \times f$	generate fixed points Calculated at 600 s measuring time.
	1 MHz	$5 \times 10^{-11} \times f$	
	5 MHz	$5 \times 10^{-11} \times f$	
	10 MHz	$5 \times 10^{-11} \times f$	
	0,0001 Hz - 3 GHz	$6 \times 10^{-11} \times f$	measure CMC calculated at 600 s measuring time.
	0,0001 Hz - 4 GHz	$5 \times 10^{-9} \times f$	generate CMC calculated at 600 s measuring time.

5. HUMIDITY

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Dew point meter	–60 / +15 °C	0,35 °C	By comparison with mirror dew point meter
RH meters with sensor type: resistive, capacitive, electrolytic, impedance,…	15 - 85 % RV	1 % RV	By comparison with two pressure humidity generator
RH meters with sensor type: resistive, capacitive, electrolytic, impedance,…	+/- 11 % RV	1,5 % RV	By comparison with salt capsules / standards
	+/- 23 % RV	1,8 % RV	
	+/- 33 % RV	1,7 % RV	
	+/- 54 % RV	2,1 % RV	
	+/- 75 % RV	1,9 % RV	
	+/- 81 % RV	2,4 % RV	
	+/- 90 % RV	2,5 % RV	
Ambient thermometer / humidity meters with sensor type: resistive, capacitive, electrolytic, impedance,…	30 - 85 % RV 0 - 40 °C	4 % RV 0,1 °C	By comparison with standard sensor in a climate chamber

6. MASS

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Weights and mass pieces	1 mg	2 µg	
	2 mg	2 µg	
	5 mg	2 µg	
	10 mg	3 µg	
	20 mg	3 µg	
	50 mg	4 µg	
	100 mg	5 µg	
	200 mg	6 µg	
	500 mg	8 µg	
	1 g	10 µg	
	2 g	12 µg	
	5 g	15 µg	
	10 g	20 µg	
	20 g	25 µg	
	50 g	30 µg	
	100 g	50 µg	
	200 g	100 µg	
	500 g	250 µg	
	1 kg	500 µg	
	2 kg	1 mg	
	5 kg	2,5 mg	
	10 kg	5 mg	
	20 kg	30 mg	
	50 kg	600 mg	
	100 kg	1000 mg	
	150 kg	1600 mg	

7. DENSITY

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Density or calculated volume of mass	1 g - 50 g	60 kg/m^3	Method A1 B1 acc. to OIML 111-1
	100 g, 200 g, 500 g	5 kg/m^3	
	1 kg, 2 kg, 5kg, 10 kg	2 kg/m^3	

8. SCALES (AT THE PLACE OF USE)

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Non automatic weighing machines	1 mg - 645 kg 0,5 t - 10 t 20 t by substitution	see note 1 $2 \times 10^{-5} \times m$	Available weights: class E2: 1 mg to 5 kg class F1: 1 g to 20 kg class M1: 1 g to 500 kg

1: The uncertainty depends on the performance of the weighing machine and can not be better than the uncertainty of the weights used for the calibration.

9. TORQUE

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Torque tools	0,1 Nm - 2700 Nm	$8 \times 10^{-3} \times M$	ISO 6789:2003
Torque measuring devices	0,1 Nm - 1 Nm 1 Nm - 200 Nm 200 Nm - 4000 Nm	$2,5 \times 10^{-3} \times M$ $1 \times 10^{-3} \times M$ $5 \times 10^{-4} \times M$	With torque arm and weights

10. FORCE

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Push pull force measuring devices in tension and compression	0,8 - 2 500 N	$2 \times 10^{-4} \times F$	Dead weights
Tension Compression	2 kN - 200 kN 2 kN - 1 MN	$1 \times 10^{-3} \times F$ $1 \times 10^{-3} \times F$	By comparison with standard load cells.

11. DIMENSIONAL

a) Length calibrations :

Gauge blocks

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Central length steel Central length tungsten carbide Central length ceramic	0,5 mm - 100 mm 0,02 inch - 4 inch	$0,06\ \mu m + 0,9 \times 10^{-6} \times \ell$ $0,06\ \mu m + 0,7 \times 10^{-6} \times \ell$ $0,06\ \mu m + 0,8 \times 10^{-6} \times \ell$	Fixed sizes
		$0,06\ \mu m + 1,2 \times 10^{-6} \times \ell$	Reference steel
Central length steel, ceramic, tungsten carbide	0,05 mm - 500 mm 0,005 inch - 20 inch	$0,1\ \mu m + 2 \times 10^{-6} \times \ell$	All sizes
Length variation steel, ceramic, tungsten carbide	0,5 mm - 100 mm 0,02 inch - 4 inch	0,05 µm	
Step gauge	Up to 1200 mm	$1,2\ \mu m + 4 \times 10^{-6} \times \ell$	

Graduated rule

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Ruler (all models)	Up to 200 mm Up to 400 mm Up to 3000 mm Up to 100 m	$1,5\ \mu m + 3 \times 10^{-6} \times \ell$ $2,0\ \mu m + 3 \times 10^{-6} \times \ell$ $3,0\ \mu m + 3 \times 10^{-6} \times \ell$ $6,0\ \mu m + 5 \times 10^{-6} \times \ell$	

Length measuring instruments

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Hand held tools for external measurements	0 mm - 200 mm 200 mm - 2000 mm	0,45 µm + 0,5 x R + 25 x 10^{-6} x ℓ 4 µm + 0,5 x R + 5 x 10^{-6} x ℓ	(1) e.g. Vernier / micrometer
Hand held tools for internal measurements 2-point 2- or 3-point	 0 mm - 200 mm 200 mm - 400 mm 0 mm - 250 mm	 0,7 µm + 0,5 x R + 25 x 10^{-6} x ℓ 5 µm + 0,5 x R + 4 x 10^{-6} x ℓ 1,5 µm + 0,5 x R + 25 x 10^{-6} x ℓ	 (1)
Hand held tools for height and depth measurements	0 mm - 500 mm	0,7 µm + 0,5 x R + 25 x 10^{-6} x ℓ	(1)
Linear displacement sensor	Up to100 mm	0,3 µm + 0,7 x R + 12 x 10^{-6} x ℓ	(1)
Height gauge	Up to 800 mm	0,8 µm + 0,7 x R + 2,5 x 10^{-6} x ℓ	(1)
Film thickness gauge	Up to 2 mm	1 µm + 2 x 10^{-3} x ℓ	(1)

Diameter

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Setting rings and ring gauges	Ø 1 mm - Ø 250 mm	0,7 µm + 2 x 10^{-6} x ℓ	
cylindrical setting pins	Up to 200 mm	0,7 µm + 2 x 10^{-6} x ℓ	
Plain plug gauges	Up to 200 mm	0,7 µm + 2 x 10^{-6} x ℓ	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Thread wires	Up to 20 mm	0,7 µm + 2 x 10^{-6} x ℓ	
Radius gauge	Up to Ø 200 mm	3 µm + 5 x 10^{-6} x ℓ	
Other diameters	Up to 300 mm 300 mm - 500 mm	0,7 µm + 2 x 10^{-6} x ℓ 1,2 µm + 0,6 x 10^{-6} x ℓ	

Distance of 2 parallel planes

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Feeler gauges	Up to 5 mm	0,5 µm + 2 x 10^{-6} x ℓ	
Setting standards for external micrometers	Up to 300 mm 300 - 500 mm 500 - 3000 mm	0,5 µm + 2 x 10^{-6} x ℓ 0,9 µm + 0,6 x 10^{-6} x ℓ 3 µm + 3 x 10^{-6} x ℓ	
Other distances of 2 parallel planes	Up to 300 mm 300 - 500 mm 500 - 3000 mm	0,5 µm + 2 x 10^{-6} x ℓ 0,9 µm + 0,6 x 10^{-6} x ℓ 3 µm + 3 x 10^{-6} x ℓ	

Form

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Knife edge straight-edges	Up to 300 mm	0,3 µm	
Straight-edges	Up to 6000 mm	0,5 µm + 0,5 x 10^{-6} x ℓ	(1)
Surface plate	Up to 6 000 x 10 000 mm^2	0,3 µm + 1,6 x 10^{-6} x ℓ	ℓ = longest side of the surface plate
Roundness tester	Up to 300 µm	0,05 µm + 0,5 x R	(1)

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Roundness standard	Up to Ø 300 mm	0,05 µm + 0,02 x A	A = measured roundness
Flick standard	Up to 1 mm	0,25 µm	

Surface texture

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Surface texture measurement instruments	Ra: 0,05 µm - 5 µm	0,04 x A + 0,5 x R (minimum 0,03 µm)	(1) A = Ra-value of the reference
	Rz: 0,1 µm - 10 µm	0,06 x A + 0,5 x R (minimum 0,05 µm)	(1) A = Rz- value of the reference
	Rmax: 0,1 µm - 10 µm	0,06 x A + 0,5 x R (minimum 0,05 µm)	(1) A = Rmax- value of the reference
Roughness standards	Ra: up to 10 µm	0,025 µm + 0,06 x A	A = measured Ra-value
	Rz: up to 15 µm	0,03 µm + 0,09 x A	A = measured Rz-value
	Rmax: up to 15 µm	0,03 µm + 0,09 x A	A = measured Rmax-value

Thread external

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Pitch	Up to 10 mm	2 µm	
Profile angle	Up to 180°	(0,5 + 12/ ℓ) bgmin	ℓ = leg length in mm
Simple pitch diameter	Ø1 mm - Ø100 mm	α = 30°: (6,0 – 9,7 µm) α = 60°: (3,2 – 5,9 µm) α = 90°: (2,6 – 5,5 µm)	acc. to RvA—I4.05, method 1a of 1b

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Pitch diameter	Ø1 mm - Ø100 mm	α = 30°: (6,0 – 9,7 µm) α = 60°: (3,2 – 5,9 µm) α = 90°: (2,6 – 5,5 µm)	acc. to RvA—I4.05, method 2a, 2b of 2c

Thread internal

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
pitch	Up to 10 mm	2 µm	
Profile angle	Up to 180°	(0,5 + 12/ ℓ) bgmin	ℓ = leg length in mm
Simple pitch diameter	Ø 4 mm - Ø 100 mm	α = 30°: (9,0 – 14,0 µm) α = 60°: (3,6 – 7,0 µm) α = 90°: (3,1 – 6,2 µm)	acc. to RvA—I4.05, method 1a of 1b
Pitch diameter	Ø 4 mm - Ø 100 mm	α = 30°: (9,0 – 14,0 µm) α = 60°: (3,6 – 7,0 µm) α = 90°: (3,1 – 6,2 µm)	acc. to RvA—I4.05, method 2a, 2b of 2c

Measuring instruments and machines (combined)

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
1D-, 2D- en 3D-measuring machines	Up to 20 m	0,15 µm + 0,7 x R + 1 x 10^{-6} x ℓ 0,15 µm + 0,7 x R + 1,3 x 10^{-6} x ℓ 0,15 µm + 0,7 x R + 1,6 x 10^{-6} x ℓ	Machine with: Zerodur scale; (1) Glass scale; (1) Steel scale; (1)

Deviations on translations

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Deviation of nominal displacement	Up to 20 m		e.g. 1D/2D/3D measuring machine with:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
		0,15 µm + 0,7 x R + 1,0 x 10^{-6} x ℓ 0,15 µm + 0,7 x R + 1,3 x 10^{-6} x ℓ 0,15 µm + 0,7 x R + 1,6 x 10^{-6} x ℓ	Zerodur scaled; (1) Glass scale; (1) Steel scale; (1)
	Up tot 400 mm	0,3 µm + 2,3 x 10^{-6} x ℓ	with glass scale; (1)
Deviations transverse to the translation direction	Up to 0,5 mm	0,3 µm + 3 x 10^{-6} x ℓ + 0,005 x A	A = measured deviation Up to 3000 mm; (1)
Rotation deviations around the translation direction	Up to 400 bgsec	0,5 arcsec + 3,5 x 10^{-3} x H	H = measured angle; only horizontal translation; (1)
Other rotation deviations	Up to 7200 bgsec	0,5 arcsec + 1,6 x 10^{-3} x H	H = measured angle; (1); up to 4500 mm

Angle standards

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Angle gauge block	Up to 180°	2 arcsec	
Cylindrical square	Up to Ø 300 mm Maximum height 300 mm	0,3 µm + 2 x 10^{-6} x ℓ	Squareness
Square	Up to 300 mm leg length	0,3 µm + 2 x 10^{-6} x ℓ	Squareness
Angle plates	90°	0,5 arcsec	

Angle measuring instruments

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Spirit level	up to 12,5 mm/m	0,5 µm/m + 0,001 x A +	A = set angle

		0,7 x R	
	Up to 2600 arcsec	0,1 arcsec + 0,001 x A + 0,7 x R	
Autocollimator	Up to 12,5 mm/m	0,5 µm/m + 0,001 x A + 0,7 x R	A = set angle
	Up to 2600 arcsec	0,1 arcsec + 0,001 x A + 0,7 x R	
Polygon	Up to 360 °	2,1 arcsec	
Angle meters	0° - 360°	0,5 arcmin	e.g. protractor; (1)
Angle sensor	0° - 360°	2 bgsec	e.g. turntables; (1)

b) Length measurements

Product measurement

Measured Quantity Instrument or Gauge	**Range**	**Calibration and Measurement Capability (CMC)**	**Remarks**
Surface profile	Up to 10 x 100 mm^2	1 µm + 0,01 x A	A = measured profile height
Roughness value	R_a: - 10 µm	0,025 µm + 0,06 x A	A = measured R_a-value
	R_z: - 15 µm	0,03 µm + 0,09 x A	A = measured R_z-value
	R_{max}: - 15 µm	0,03 µm + 0,09 x A	A = measured R_{max}-value
Straightness	Up to 10 x 100 mm^2	1 µm + 0,01 x A	(1)
	Up to 300 mm	0,3 µm	A = measured profile height
	Up to 6000 mm	0,5 µm + 0,5 x 10^{-6} x ℓ	
Roundness			
external	Up to Ø 300 mm	0,05 µm + 0,02 x A	A = measured roundness
internal	Ø 0,7 mm - Ø 300 mm	0,05 µm + 0,02 x A	A = measured roundness
Cylindricity			
external	Up to Ø 300 mm	0,4 µm + 0,04 x A	A = measured cylindricity
	Maximum height 300 mm		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
internal	Ø 0,7 mm - Ø 300 mm Maximum height 300 mm	0,4 µm + 0,04 x A	A = measured cylindricity
Coaxiality and concentricity	Ø 0,7 mm - Ø300 mm Maximum height 300 mm	0,1 µm + 0,04 x A	A = measured Coaxiality and concentricity
Flatness	up to Ø 55 mm Up to Ø 150 mm Up to Ø 290 mm Up to 6 000 x 10 000 mm^2	0,05 µm 0,06 µm 0,15 µm 0,5 µm + 1,5 x 10^{-6} x ℓ	ℓ = longest side of the surface plate; (1)
Angles between edges or surfaces	Up to 180°	(0,5 + 12/ ℓ) bgmin	ℓ = leg length in mm; leg length up to 200 mm
		3 bgsec	Optical surfaces
Squareness	Up to 1200 x 550 mm	2,1 µm + 4 x 10^{-6} x ℓ	ℓ = leg length Ratio measured length : reference length = 1 : 1
Parallelism	Up to 1200 mm	1 µm + 2 x 10^{-6} x ℓ	ℓ = leg length
Diameter			
External	Up to 300 mm from 300 mm up to 500 mm from 500 mm up to 3000 mm	0,7 µm + 2 x 10^{-6} x ℓ 1,2 µm + 0,6 x 10^{-6} x ℓ 0,4 µm + 2 x 10^{-6} x ℓ	
Internal	Ø 1 mm - Ø 250 mm	0,5 µm + 2 x 10^{-6} x ℓ	
Distance of 2 parallel surfaces			
External	Up to 200 mm Up to 3000 mm	0,5 µm + 2 x 10^{-6} x ℓ 0,4 µm + 4 x 10^{-6} x ℓ	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Internal	Up to 1200 mm	1,2 µm + 4 x 10^{-6} x ℓ	
Thread external			
Pitch	To 10 mm	2 µm	
Profile angle	To 180°	(0,5 + 12/ ℓ) bgmin	ℓ = leg length in mm
Simple pitch diameter	Ø 1 mm to Ø 100 mm	α = 30°: (6,0 – 9,7 µm) α = 60°: (3,2 – 5,9 µm) α = 90°: (2,6 – 5,5 µm)	acc. to RvA—I4.05, method 1a of 1b
Pitch diameter	Ø 1 mm to Ø 100 mm	α = 30°: (6,0 – 9,7 µm) α = 60°: (3,2 – 5,9 µm) α = 90°: (2,6 – 5,5 µm)	acc. to RvA—I4.05, method 2a, 2b of 2c
Thread internal			
Pitch	To 10 mm	2 µm	
Profile angle	To 180°	(0,5 + 12/ ℓ) bgmin	ℓ = leg length in mm
Simple pitch diameter	Ø 4 mm to Ø 100 mm	α = 30°: (9,0 – 14,0 µm) α = 60°: (3,6 – 7,0 µm) α = 90°: (3,1 – 6,2 µm)	acc. to RvA—I4.05, method 1a of 1b
Pitch diameter	Ø 1 mm to Ø 100 mm	α = 30°: (9,0 – 14,0 µm) α = 60°: (3,6 – 7,0 µm) α = 90°: (3,1 – 6,2 µm)	acc. to RvA—I4.05, method 2a, 2b of 2c

([1]): Also on site, the CMC can be bigger on site

R: resolution of the instrument

ℓ : measured length

12. VOLUME

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC)	Remarks
Volume measuring devices, glass cups, recipients , …	from 50 ml to 100 ml	1 ml	Gravimetric method
	above 100 ml to 200 ml	1,5 ml	
	above 200 ml to 300 ml	2 ml	
	above 300 ml to 500 ml	2,5 ml	
	above 500 ml to 1000 ml	3 ml	
	Above 1 l to 5 l	3,5 ml	
Volume measuring devices, pipettes	from 10 µl to 50 µl	0,4 µl	Gravimetric method
	above 50 µl to 100 µl	0,5 µl	
	above 100 µl to 500 µl	0,6 µl	
	above 500 µl to 1 ml	1 µl	
	above 1 ml to 25 ml	20 µl	
	above 25 ml to 50 ml	50 µl	