Organisme belge d'Accréditation
Belgische Accreditatieinstelling
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EA MLA Signatory

Bijlage bij accreditatie-certificaat
Annexe au certificat d'accréditation
Annex to the accreditation certificate
Beilage zur Akkreditierungszertifikat

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EN ISO/IEC 17025:2017

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La Présidente du Bureau d'Accréditation
Chair of the Accreditation Board
Vorsitzende des Akkreditierungsbüro

De accreditatie werd uitgereikt aan / L'accréditation est délivrée à / The accreditation is granted to / Die akkreditierung wurde erteilt für:

TRESCAL nv
Vosstraat, 200
2600 Antwerpen

Activiteitencentra / Sites d'activités / Sites of activities / Standorte mit aktivitäten:

Locatie 1: BERCHEM	Vosstraat 200 2600 Antwerpen
Locatie 2: WELLIN	Rue Jean Meunier, 2 6922 Wellin
Locatie 3: LOUVAIN-LA-NEUVE	Rue du Bosquet, 7 1348 Ottignies-Louvain-la-Neuve

DCLF Electricity Berchem (In House or Onsite)

Calibration and Measurement Capabilities

Direct voltage
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
± 100 mV	DC	$5{,}0 \times 10^{-6} \times U$	• Transfer standard in "30 day" loop • Fixed points • positive /negative • measuring	RP/02/KC/E.06
± 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	$3{,}0 \times 10^{-6} \times U$		
± 1000 V	DC	$3{,}0 \times 10^{-6} \times U$		

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 mV to 200 mV	DC	$7{,}0 \times 10^{-6} \times U$ or 0,1 µV[1]	• measure • positive / negative	P2-02-E.019
0,2 V to 2 V	DC	$5{,}0 \times 10^{-6} \times U$		
2 V to 20 V	DC	$4{,}5 \times 10^{-6} \times U$		
20 V to 200 V	DC	$5{,}5 \times 10^{-6} \times U$		
200 V to 1000 V	DC	$5{,}5 \times 10^{-6} \times U$		
1 kV to 75 kV	DC	$3{,}0 \times 10^{-4} \times U$	Measure	P2-02-E.016
0,2 V to 11 V	DC	$1{,}0 \times 10^{-4} \times U$	Loop calibration	P2-02-E.019

[1] Whichever is greater

- - -

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 mV to 200 mV	DC	$18 \times 10^{-6} \times U$ or 0,5 µV[1]	• generate • positive / negative	P2-02-E.005
0,2 V to 2 V	DC	$8{,}0 \times 10^{-6} \times U$		
2 V to 20 V	DC	$4{,}5 \times 10^{-6} \times U$		
20 V to 200 V	DC	$7{,}0 \times 10^{-6} \times U$		
200 V to 1100 V	DC	$10 \times 10^{-6} \times U$		
1,1 kV to 40 kV	DC	$3{,}0 \times 10^{-4} \times U$	Generate	P2-02-E.016
0,2 V to 11 V	DC	$1{,}0 \times 10^{-4} \times U$	Loop calibration	P2-02-E.005

[1] Whichever is greater

Direct current
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
±100 µA	DC	$24 \times 10^{-6} \times I$	• Transfer standard in "30 day" loop • Fixed points • positive / negative • Measurement	RP/02/KC/E.06
±1 mA	DC	$16 \times 10^{-6} \times I$		
±10 mA	DC	$16 \times 10^{-6} \times I$		
±100 mA	DC	$19 \times 10^{-6} \times I$		
±1 A	DC	$31 \times 10^{-6} \times I$		
±10 A	DC	$60 \times 10^{-6} \times I$		

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 µA to 200 µA	DC	$12 \times 10^{-6} \times I$ or 0,5 nA[1]	• measure • in the lowest possible range • positive / negative	P2-02-E.019
0,2 mA to 2 mA	DC	$11 \times 10^{-6} \times I$		
2 mA to 20 mA	DC	$9{,}0 \times 10^{-6} \times I$		
20 mA to 200 mA	DC	$16 \times 10^{-6} \times I$		
0,2 A to 2 A	DC	$90 \times 10^{-6} \times I$		
2 A to 20 A	DC	$90 \times 10^{-6} \times I$		
0,2 mA to 24 mA	DC	$1{,}0 \times 10^{-4} \times I$	Loop calibration	P2-02-E.019
				- - -

[1] Whichever is greater

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
20 A to 1000 A	DC	$5{,}0 \times 10^{-3} \times I$	• with current coils	P2-02-E.021

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 µA to 20 µA	DC	1,5 nA	• generate • positive / negative	P2-02-E.005
20 µA to 200 µA	DC	$1{,}7 \times 10^{-4} \times I$		
0,2 mA to 200 mA	DC	$0{,}70 \times 10^{-4} \times I$		
0,2 A to 2 A	DC	$1{,}9 \times 10^{-4} \times I$		
2 A to 11 A	DC	$2{,}7 \times 10^{-4} \times I$		
11 A to 20 A	DC	$6{,}0 \times 10^{-4} \times I$		
0,2 mA to 24 mA	DC	$1{,}0 \times 10^{-4} \times I$	Loop calibration	P2-02-E.005

Alternating voltage

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
1 mV	20 Hz to 20 kHz	$3{,}0 \times 10^{-4} \times U + 2\ \mu V$	• Transfer standard in "30 day" loop • Fixed points • measuring	RP/02/KC/E.06
	30 kHz & 50 kHz	$4{,}0 \times 10^{-4} \times U + 2\ \mu V$		
	100 kHz	$6{,}5 \times 10^{-4} \times U + 2\ \mu V$		
10 mV	20 Hz to 20 kHz	$1{,}7 \times 10^{-4} \times U + 2\ \mu V$		
	30 kHz & 50 kHz	$2{,}5 \times 10^{-4} \times U + 2\ \mu V$		
	100 kHz	$4{,}5 \times 10^{-4} \times U + 2\ \mu V$		
100 mV	20 Hz to 20 kHz	$1{,}2 \times 10^{-4} \times U + 2\ \mu V$		
	30 kHz & 50 kHz	$2{,}0 \times 10^{-4} \times U + 2\ \mu V$		
	100 kHz	$4{,}0 \times 10^{-4} \times U + 2\ \mu V$		
1 V	10 Hz to 30 Hz	$4{,}0 \times 10^{-5} \times U$		
	40 Hz to 30 kHz	$3{,}0 \times 10^{-5} \times U$		
	50 kHz	$4{,}0 \times 10^{-5} \times U$		
	100 kHz	$5{,}0 \times 10^{-5} \times U$		
	300 kHz	$12 \times 10^{-5} \times U$		
	500 kHz	$25 \times 10^{-5} \times U$		
	1 MHz	$60 \times 10^{-5} \times U$		
10 V	10 Hz to 30 Hz	$4{,}0 \times 10^{-5} \times U$	• Transfer standard in "30 day" loop • Fixed points • measuring	RP/02/KC/E.06
	40 Hz to 30 kHz	$3{,}0 \times 10^{-5} \times U$		
	50 kHz	$3{,}5 \times 10^{-5} \times U$		
	100 kHz	$4{,}0 \times 10^{-5} \times U$		
	300 kHz	$11 \times 10^{-5} \times U$		
	500 kHz	$22 \times 10^{-5} \times U$		
	1 MHz	$60 \times 10^{-5} \times U$		
19 V	1 kHz	$4{,}0 \times 10^{-5} \times U$		
100 V	10 Hz to 30 Hz	$4{,}5 \times 10^{-5} \times U$		
	40 Hz & 55 Hz	$4{,}0 \times 10^{-5} \times U$		
	300 Hz to 20 kHz	$3{,}0 \times 10^{-5} \times U$		
	30 kHz	$3{,}5 \times 10^{-5} \times U$		
	50 kHz	$4{,}5 \times 10^{-5} \times U$		
	100 kHz	$7{,}4 \times 10^{-5} \times U$		
1000 V	40 Hz to 1 kHz	$4{,}0 \times 10^{-5} \times U$		
	10 kHz	$4{,}5 \times 10^{-5} \times U$		
	20 kHz	$5{,}0 \times 10^{-5} \times U$		
	30 kHz	$7{,}5 \times 10^{-5} \times U$		
700 V	50 kHz	$13 \times 10^{-5} \times U$		
	100 kHz	$35 \times 10^{-5} \times U$		

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0,7 mV to 2,2 mV	10 Hz to 20 Hz	$17 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$7{,}4 \times 10^{-4} \times U + 1{,}3\ \mu V$		
	40 Hz to 20 kHz	$4{,}2 \times 10^{-4} \times U + 1{,}3\ \mu V$		
	20 kHz to 50 kHz	$8{,}2 \times 10^{-4} \times U + 2{,}0\ \mu V$		
	50 kHz to 100 kHz	$12 \times 10^{-4} \times U + 2{,}5\ \mu V$		
	100 kHz to 300 kHz	$23 \times 10^{-4} \times U + 4{,}0\ \mu V$		
	300 kHz to 500 kHz	$26 \times 10^{-4} \times U + 8{,}0\ \mu V$		
	500 kHz to 1 MHz	$50 \times 10^{-4} \times U + 8{,}0\ \mu V$		
2 mV to 7 mV	10 Hz to 20 Hz	$8{,}5 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$3{,}7 \times 10^{-4} \times U + 1{,}3\ \mu V$		
	40 Hz to 20 kHz	$2{,}1 \times 10^{-4} \times U + 1{,}3\ \mu V$		
	20 kHz to 50 kHz	$4{,}1 \times 10^{-4} \times U + 2{,}0\ \mu V$		
	50 kHz to 100 kHz	$6{,}1 \times 10^{-4} \times U + 2{,}5\ \mu V$		
	100 kHz to 300 kHz	$12 \times 10^{-4} \times U + 4{,}0\ \mu V$		
	300 kHz to 500 kHz	$14 \times 10^{-4} \times U + 8{,}0\ \mu V$		
	500 kHz to 1 MHz	$36 \times 10^{-4} \times U + 8{,}0\ \mu V$		
7 mV to 22 mV	10 Hz to 20 Hz	$2{,}9 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$1{,}9 \times 10^{-4} \times U + 1{,}3\ \mu V$		
	40 Hz to 20 kHz	$1{,}1 \times 10^{-4} \times U + 1{,}3\ \mu V$		
	20 kHz to 50 kHz	$2{,}1 \times 10^{-4} \times U + 2{,}0\ \mu V$		
	50 kHz to 100 kHz	$3{,}1 \times 10^{-4} \times U + 2{,}5\ \mu V$		
	100 kHz to 300 kHz	$8{,}2 \times 10^{-4} \times U + 4{,}0\ \mu V$		
	300 kHz to 500 kHz	$10 \times 10^{-4} \times U + 8{,}0\ \mu V$		
	500 kHz to 1 MHz	$26 \times 10^{-4} \times U + 8{,}0\ \mu V$		
22 mV to 70 mV	10 Hz to 20 Hz	$2{,}4 \times 10^{-4} \times U + 1{,}5\ \mu V$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$1{,}3 \times 10^{-4} \times U + 1{,}5\ \mu V$		
	40 Hz to 20 kHz	$0{,}69 \times 10^{-4} \times U + 1{,}5\ \mu V$		
	20 kHz to 50 kHz	$1{,}3 \times 10^{-4} \times U + 2{,}0\ \mu V$		
	50 kHz to 100 kHz	$2{,}6 \times 10^{-4} \times U + 2{,}5\ \mu V$		
	100 kHz to 300 kHz	$5{,}3 \times 10^{-4} \times U + 4{,}0\ \mu V$		
	300 kHz to 500 kHz	$6{,}8 \times 10^{-4} \times U + 8{,}0\ \mu V$		
	500 kHz to 1 MHz	$13 \times 10^{-4} \times U + 8{,}0\ \mu V$		
70 mV to 220 mV	10 Hz to 20 Hz	$21 \times 10^{-5} \times U + 1{,}5\ \mu V$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$8{,}7 \times 10^{-5} \times U + 1{,}5\ \mu V$		
	40 Hz to 20 kHz	$4{,}3 \times 10^{-5} \times U + 1{,}5\ \mu V$		
	20 kHz to 50 kHz	$7{,}3 \times 10^{-5} \times U + 2{,}0\ \mu V$		
	50 kHz to 100 kHz	$16 \times 10^{-5} \times U + 2{,}5\ \mu V$		
	100 kHz to 300 kHz	$28 \times 10^{-5} \times U + 4{,}0\ \mu V$		
	300 kHz to 500 kHz	$40 \times 10^{-5} \times U + 8{,}0\ \mu V$		
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U + 8{,}0\ \mu V$		
220 mV to 700 mV	10 Hz to 20 Hz	$21 \times 10^{-5} \times U + 1{,}5\ \mu V$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$8{,}7 \times 10^{-5} \times U + 1{,}5\ \mu V$		
	40 Hz to 20 kHz	$3{,}8 \times 10^{-5} \times U + 1{,}5\ \mu V$		
	20 kHz to 50 kHz	$5{,}6 \times 10^{-5} \times U + 2{,}0\ \mu V$		
	50 kHz to 100 kHz	$8{,}4 \times 10^{-5} \times U + 2{,}5\ \mu V$		
	100 kHz to 300 kHz	$21 \times 10^{-5} \times U + 4{,}0\ \mu V$		
	300 kHz to 500 kHz	$34 \times 10^{-5} \times U + 8{,}0\ \mu V$		
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U + 8{,}0\ \mu V$		

0,7 V to 2,2 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$6,9 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$2,9 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$5,2 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$7,6 \times 10^{-5} \times U$		
	100 kHz to 300 kHz	$20 \times 10^{-5} \times U$		
	300 kHz to 500 kHz	$31 \times 10^{-5} \times U$		
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U$		
2,2 V to 7 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$7,0 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$2,9 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$5,3 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$8,8 \times 10^{-5} \times U$		
	100 kHz to 300 kHz	$22 \times 10^{-5} \times U$		
	300 kHz to 500 kHz	$47 \times 10^{-5} \times U$		
	500 kHz to 1 MHz	$150 \times 10^{-5} \times U$		
7 V to 22 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$7,0 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$3,1 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$5,3 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$8,5 \times 10^{-5} \times U$		
	100 kHz to 300 kHz	$22 \times 10^{-5} \times U$		
	300 kHz to 500 kHz	$47 \times 10^{-5} \times U$		
	500 kHz to 1 MHz	$150 \times 10^{-5} \times U$		
22 V to 70 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$7,2 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$3,9 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$6,3 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$11 \times 10^{-5} \times U$		
	100 kHz to 300 kHz	$22 \times 10^{-5} \times U$		
	300 kHz to 500 kHz	$51 \times 10^{-5} \times U$		
	500 kHz to 1 MHz	$150 \times 10^{-5} \times U$		
70 V to 220 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$7,2 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$3,8 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$7,7 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$11 \times 10^{-5} \times U$		
	100 kHz to 300 kHz	$26 \times 10^{-5} \times U$		
	300 kHz to 500 kHz	$70 \times 10^{-5} \times U$		
220 V to 700 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$11 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$4,7 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$15 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$85 \times 10^{-5} \times U$		
700 V to 1000 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure	P2-02-E.019
	20 Hz to 40 Hz	$11 \times 10^{-5} \times U$		
	40 Hz to 20 kHz	$4,4 \times 10^{-5} \times U$		
	20 kHz to 50 kHz	$15 \times 10^{-5} \times U$		
	50 kHz to 100 kHz	$85 \times 10^{-5} \times U$		
1 kV to 53 kV	50 / 60 Hz	$3,0 \times 10^{-3} \times U$	• measure	P2-02-E.016

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
2 mV to 20 mV	1 kHz to10 kHz	$7{,}0 \times 10^{-4} \times U$	• generate	P2-02-E.005
	10 kHz to100 kHz	$11 \times 10^{-4} \times U$		
20 mV to 200 mV	10 Hz to 300 Hz	$2{,}1 \times 10^{-4} \times U$	• generate	P2-02-E.005
	300 Hz to 10 kHz	$1{,}8 \times 10^{-4} \times U$		
	10 kHz to 30 kHz	$2{,}8 \times 10^{-4} \times U$		
	30 kHz to 100 kHz	$6{,}1 \times 10^{-4} \times U$		
0,2 V to 2 V	10 Hz to 300 Hz	$1{,}6 \times 10^{-4} \times U$	• generate	P2-02-E.005
	300 Hz to 1 kHz	$1{,}1 \times 10^{-4} \times U$		
	1 kHz to 30 kHz	$0{,}70 \times 10^{-4} \times U$		
	30 kHz to 100 kHz	$1{,}6 \times 10^{-4} \times U$		
	100 kHz to 300 kHz	$6{,}0 \times 10^{-4} \times U$		
	300 kHz to 1 MHz	$30 \times 10^{-4} \times U$		
2 V to 20 V	10 Hz to 300 Hz	$1{,}6 \times 10^{-4} \times U$	• generate	P2-02-E.005
	300 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times U$		
	1 kHz to 10 kHz	$0{,}80 \times 10^{-4} \times U$		
	10 kHz to 30 kHz	$0{,}70 \times 10^{-4} \times U$		
	30 kHz to 100 kHz	$1{,}7 \times 10^{-4} \times U$		
	100 kHz to 300 kHz	$6{,}0 \times 10^{-4} \times U$		
	300 kHz to 1 MHz	$30 \times 10^{-4} \times U$		
20 V to 200 V	10 Hz to 300 Hz	$1{,}6 \times 10^{-4} \times U$	• generate	P2-02-E.005
	300 Hz to 1 kHz	$1{,}2 \times 10^{-4} \times U$		
	1 kHz to 10 kHz	$1{,}0 \times 10^{-4} \times U$		
	10 kHz to 30 kHz	$1{,}1 \times 10^{-4} \times U$		
	30 kHz to 100 kHz	$2{,}1 \times 10^{-4} \times U$		
200 V to 1000 V	40 Hz to 300 Hz	$2{,}3 \times 10^{-4} \times U$	• generate	P2-02-E.005
	300 Hz to 1 kHz	$2{,}3 \times 10^{-4} \times U$		
	1 kHz to 10 kHz	$1{,}7 \times 10^{-4} \times U$		
	10 kHz to 30 kHz	$2{,}2 \times 10^{-4} \times U$		
200 V to 750 V	30 kHz to 100 kHz	$15 \times 10^{-4} \times U$	• generate	P2-02-E.005
1 kV to 45 kV	50 / 60 Hz	$3{,}0 \times 10^{-3} \times U$	• generate	P2-02-E.016

Alternating currect
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
100 µA	10 Hz to 30 Hz	$1{,}4 \times 10^{-4} \times I$	• Transfer standard in "30 day" loop • Fixed points • Measurement	RP/02/KC/E.06
	40 Hz to 1 kHz	$1{,}1 \times 10^{-4} \times I$		
	5 kHz	$1{,}7 \times 10^{-4} \times I$		
1 mA	10 Hz to 30 Hz	$1{,}3 \times 10^{-4} \times I$		
	40 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times I$		
	5 kHz	$1{,}5 \times 10^{-4} \times I$		
10 mA	10 Hz to 30 Hz	$1{,}3 \times 10^{-4} \times I$		
	40 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times I$		
	5 kHz	$1{,}5 \times 10^{-4} \times I$		
100 mA	10 Hz to 30 Hz	$1{,}3 \times 10^{-4} \times I$		
	40 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times I$		
	5 kHz	$1{,}5 \times 10^{-4} \times I$		
1 A	10 Hz to 30 Hz	$1{,}8 \times 10^{-4} \times I$		
	40 Hz to 1 kHz	$1{,}2 \times 10^{-4} \times I$		
	5 kHz	$2{,}3 \times 10^{-4} \times I$		
10 A	40 Hz	$3{,}0 \times 10^{-4} \times I$		
	50 Hz to 1 kHz	$2{,}9 \times 10^{-4} \times I$		
	5 kHz	$4{,}0 \times 10^{-4} \times I$		
	10 kHz	$7{,}0 \times 10^{-4} \times I$		

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
5 µA to 200 µA	10 Hz to 5 kHz	$1{,}6 \times 10^{-4} \times I$	• measure	P2-02-E.019
	5 kHz to 10 kHz	$5{,}0 \times 10^{-4} \times I$		
0,2 mA to 2 mA	10 Hz to 5 kHz	$0{,}60 \times 10^{-4} \times I$		
	5 kHz to 10 kHz	$1{,}3 \times 10^{-4} \times I$		
2 mA to 20 mA	10 Hz to 5 kHz	$1{,}0 \times 10^{-4} \times I$		
	5 kHz to 10 kHz	$5{,}0 \times 10^{-4} \times I$		
20 mA to 200 mA	10 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times I$		
	1 kHz to 10 kHz	$26 \times 10^{-4} \times I$		
0,2 A to 2 A	10 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times I$		
	1 kHz to 10 kHz	$4{,}0 \times 10^{-4} \times I$		
2 A to 20 A	10 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times I$		
	1 kHz to 5 kHz	$3{,}0 \times 10^{-4} \times I$		
	5 kHz to 10 kHz	$10 \times 10^{-4} \times I$		

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
20 A to 1000 A	45 Hz to 440 Hz	$5{,}0 \times 10^{-3} \times I$	• with current coils	P2-02-E.022

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
20 µA to 200 µA	10 Hz to 1 kHz	$4{,}0 \times 10^{-4} \times I$	• generate • in the lowest range possible	P2-02-E.005
	1 kHz to 5 kHz	$6{,}0 \times 10^{-4} \times I$		
0,2 mA to 2 mA	10 Hz to 1 kHz	$3{,}2 \times 10^{-4} \times I$		
	1 kHz to 5 kHz	$4{,}0 \times 10^{-4} \times I$		
2 mA to 20 mA	10 Hz to 1 kHz	$3{,}1 \times 10^{-4} \times I$		
	1 kHz to 5 kHz	$4{,}1 \times 10^{-4} \times I$		
20 mA to 200 mA	10 Hz to 1 kHz	$3{,}1 \times 10^{-4} \times I$		
	1 kHz to 5 kHz	$4{,}0 \times 10^{-4} \times I$		
0,2 A to 2 A	10 Hz to 1 kHz	$6{,}0 \times 10^{-4} \times I$		
	1 kHz to 5 kHz	$7{,}1 \times 10^{-4} \times I$		
2 A to 10 A	10 Hz to 1 kHz	$6{,}1 \times 10^{-4} \times I$		
	1 kHz to 5 kHz	$12 \times 10^{-4} \times I$		
	5 kHz to 10 kHz	$34 \times 10^{-4} \times I$		
10 A to 20 A	45 Hz to 100 Hz	$17 \times 10^{-4} \times I$		
	100 Hz to 1 kHz	$20 \times 10^{-4} \times I$		

Power and Energy

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
Mono phase , direct without measuring clamps				- - -
33 mV to 1000 V / 0,33 mA to 330 mA	DC	$3{,}0 \times 10^{-4} \times P$	11 µW to 330 W generate	P2-02-E.013
33 mV to 1000 V / 0,33 A to 3,3 A	DC	$5{,}0 \times 10^{-4} \times P$	3,3 kW generate	
33 mV to 1000 V / 3,3 A to 10,5 A	DC	$6{,}0 \times 10^{-4} \times P$	10,5 kW generate	
33 mV to 1000 V / 10,5 A to 20,5 A	DC	$11 \times 10^{-4} \times P$	20,5 kW generate	
33 mV to 1000 V / 0,1 mA to 20,5A	45 Hz to 1 kHz	$15 \times 10^{-4} \times P$	3,3 µW to 20,5 kW / kVA(r) generate cosphi/sinphi > 0,5	
33 mV to 1000 V / 0,1 mA to 20,5A	45 Hz to 1 kHz	$40 \times 10^{-4} \times P$	3,3 µW to 20,5 kW / kVA(r) generate cosphi/sinphi > 0,25	
Mono phase , direct with measuring clamps				- - -
33 mV to 1000 V / 20 A to 500 A	DC	$10 \times 10^{-3} \times P$	0,66 W to 500 kW / kVA(r) generate	P2-02-E.013 P2-02-E.022
33 mV to 1000 V / 20 A to 500 A	45 Hz to 100 Hz	$11 \times 10^{-3} \times P$	0,66 W to 500 kW / kVA(r) generate cosphi/sinphi > 0,25	
33 mV to 1000 V / 20 A to 500 A	100 Hz to 440 Hz	$16 \times 10^{-3} \times P$	0,66 W to 500 kW / kVA(r) generate cosphi/sinphi > 0,25	

3-phase, direct without measuring clamps				- - -
1 V to 300 V / 0,3 A to 100 A	50 Hz & 60 Hz	$2{,}0 \times 10^{-3} \times P$	0,3 W to 30 kW / kVA(r) generate cosphi/sinphi > 0,5	P2-02-E.018
1 V to 300 V / 0,3 A to 100 A	50 Hz & 60 Hz	$4{,}0 \times 10^{-3} \times P$	0,3 W to 30 kW / kVA(r) generate cosphi/sinphi > 0,25	
1 V to 1000 V / 0,3 A to 100 A	10 Hz to 1 kHz	$2{,}0 \times 10^{-3} \times P$	0,3 W to 100 kW / kVA(r) measure cosphi/sinphi > 0,5	
1 V to 1000 V / 0,3 A to 100 A	10 Hz to 1 kHz	$4{,}0 \times 10^{-3} \times P$	0,3 W to 100 kW / kVA(r) measure cosphi/sinphi > 0,25	
3-phase, direct with measuring clamps				- - -
1 V to 300 V / 20 A to 500 A	50 Hz & 60 Hz	$11 \times 10^{-3} \times P$	20 W to 150 kW / kVA(r) generate cosphi/sinphi > 0,25	P2-02-E.013 P2-02-E.022
1 V to 1000 V / 20 A to 100 A	15 Hz to 440 Hz	$16 \times 10^{-3} \times P$	20 W to 100 kW / kVA(r) measure cosphi/sinphi > 0,25	
Phase / phase angle				- - -
Cosphi/sinphi -1 to 1	10 Hz to 1 kHz	0,000 40	measure / generate	P2-02-E.018
Phase angle -180 to 180 °	10 Hz to 1 kHz	0,02°	measure / generate	
P indicates active,reactive as well as apparent power.				- - -

RF Power

Range amplitude	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
-67 dBm to -19 dBm	20 kHz to 100 MHz	0,056 dB	• measure	P2-02-E.036
	100 MHz to 4 GHz	0,047 dB		
-19 dBm to 1 dBm	20 kHz to 100 MHz	0,066 dB	• measure	P2-02-E.036
	100 MHz to 4 GHz	0,058 dB		
1 dBm to 23 dBm	20 kHz to 100 MHz	0,083 dB	• measure	P2-02-E.036
	100 MHz to 4 GHz	0,072 dB		
24 dBm to 20 dBm	10 Hz to 20 kHz	0,050 dB	• generate	P2-02-E.035
	20 kHz to 100 kHz	0,050 dB		
	100 kHz to 10 MHz	0,050 dB		
	10 MHz to 125 MHz	0,050 dB		
20 dBm to 14 dBm	10 Hz to 20 kHz	0,050 dB	• generate	P2-02-E.035
	20 kHz to 100 kHz	0,050 dB		
	100 kHz to 10 MHz	0,050 dB		
	10 MHz to 125 MHz	0,050 dB		
	125 MHz to 300 MHz	0,10 dB		
	300 MHz to 1,4 GHz	0,25 dB		
14 dBm to -17 dBm	10 Hz to 20 kHz	0,050 dB	• generate	P2-02-E.035
	20 kHz to 100 kHz	0,050 dB		
	100 kHz to 10 MHz	0,050 dB		
	10 MHz to 125 MHz	0,050 dB		
	125 MHz to 300 MHz	0,10 dB		
	300 MHz to 1,4 GHz	0,25 dB		
	1,4 GHz to 3 GHz	0,30 dB		
	3 GHz to 4 GHz	0,50 dB		

-17 dBm to -48 dBm	10 Hz to 20 kHz	0,050 dB	• generate	P2-02-E.035
	20 kHz to 100 kHz	0,050 dB		
	100 kHz to 10 MHz	0,050 dB		
	10 MHz to 125 MHz	0,050 dB		
	125 MHz to 300 MHz	0,10 dB		
	300 MHz to 1,4 GHz	0,50 dB		
	1,4 GHz to 3 GHz	0,50 dB		
	3 GHz to 4 GHz	0,50 dB		
-48 dBm to -74 dBm	100 kHz to 10 MHz	0,20 dB	• generate	P2-02-E.035
	10 MHz to 125 MHz	0,20 dB		
	125 MHz to 300 MHz	0,20 dB		
	300 MHz to 1,4 GHz	0,50 dB		
	1,4 GHz to 3 GHz	0,50 dB		
	3 GHz to 4 GHz	0,50 dB		
-74 dBm to -84 dBm	100 kHz to 10 MHz	0,50 dB	• generate	P2-02-E.035
	10 MHz to 125 MHz	0,50 dB		
	125 MHz to 300 MHz	0,50 dB		
	300 MHz to 1,4 GHz	1,0 dB		
	1,4 GHz to 3 GHz	1,0 dB		
	3 GHz to 4 GHz	1,0 dB		
-84 dBm to -94 dBm	100 kHz to 10 MHz	0,50 dB	• generate	P2-02-E.035
	10 MHz to 125 MHz	0,50 dB		
	125 MHz to 300 MHz	0,50 dB		
	300 MHz to 1,4 GHz	1,0 dB		
	1,4 GHz to 3 GHz	1,0 dB		
-94 dBm to -124 dBm	100 kHz to 10 MHz	1,5 dB	• generate	P2-02-E.035
	10 MHz to 125 MHz	1,5 dB		
	125 MHz to 300 MHz	1,5 dB		
	300 MHz to 1,4 GHz	1,5 dB		
	1,4 GHz to 3 GHz	1,5 dB		

Impedance (DC/LF)
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
1 Ω	DC	$11 \times 10^{-6} \times R$	• Transfer standard in "30 day" loop • Fixed points • Measuring • 4-wire resistance measurement • Negligible dissipated power	RP/02/KC/E.06
10 Ω	DC	$9{,}5 \times 10^{-6} \times R$		
100 Ω	DC	$6{,}5 \times 10^{-6} \times R$		
1 kΩ	DC	$4{,}5 \times 10^{-6} \times R$		
10 kΩ	DC	$4{,}5 \times 10^{-6} \times R$		
100 kΩ	DC	$7{,}5 \times 10^{-6} \times R$		
1 MΩ	DC	$14 \times 10^{-6} \times R$		
10 MΩ	DC	$25 \times 10^{-6} \times R$		
100 MΩ	DC	$200 \times 10^{-6} \times R$		

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 Ω to 2 Ω	DC	$18 \times 10^{-6} \times R$ or 20 μΩ[1]	• measure • 4-wire resistance measurement • negligible dissipated power	P2-02-E.019
2 Ω to 20 Ω	DC	$3{,}1 \times 10^{-6} \times R$		
20 Ω to 200 Ω	DC	$5{,}5 \times 10^{-6} \times R$		
0,2 kΩ to 2 kΩ	DC	$2{,}6 \times 10^{-6} \times R$		
2 kΩ to 20 kΩ	DC	$5{,}0 \times 10^{-6} \times R$		
20 kΩ to 200 kΩ	DC	$6{,}3 \times 10^{-6} \times R$		
0,2 MΩ to 2 MΩ	DC	$6{,}0 \times 10^{-6} \times R$		
2 MΩ to 20 MΩ	DC	$11 \times 10^{-6} \times R$		
20 MΩ to 200 MΩ	DC	$60 \times 10^{-6} \times R$		
0,2 GΩ to 2 GΩ	DC	$1{,}2 \times 10^{-3} \times R$		

[1] Whichever is greater

- - -

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 Ω	DC	100 μΩ	• generate • fixed points • 4-wire resistance • Negligible dissipated power in the lowest range possible	P2-02-E.005
10 Ω	DC	$39 \times 10^{-6} \times R$		
100 Ω	DC	$13 \times 10^{-6} \times R$		
1 kΩ	DC	$16 \times 10^{-6} \times R$		
10 kΩ	DC	$14 \times 10^{-6} \times R$		
100 kΩ	DC	$14 \times 10^{-6} \times R$		
1 MΩ	DC	$36 \times 10^{-6} \times R$		
10 MΩ	DC	$65 \times 10^{-6} \times R$		
100 MΩ	DC	$340 \times 10^{-6} \times R$		
10 Ω	DC	$0{,}6 \times 10^{-6} \times R$	• generate • standard resistors • also combinations of these resistors[1] • 4-wire resistance	P2-02-E.005
25 Ω	DC	$0{,}6 \times 10^{-6} \times R$		
100 Ω	DC	$0{,}6 \times 10^{-6} \times R$		
378 Ω	DC	$2{,}0 \times 10^{-6} \times R$		
10 Ω	75 Hz	$3{,}0 \times 10^{-6} \times R$	• generate • standard resistors • also combinations of these resistors[1] • 4- wire resistance	P2-02-E.005
25 Ω	75 Hz	$1{,}5 \times 10^{-6} \times R$		
100 Ω	75 Hz	$1{,}5 \times 10^{-6} \times R$		
378 Ω	75 Hz	$3{,}0 \times 10^{-6} \times R$		

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

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Calibration of resistor / insulation meters

Measuring range or point	Resistance	expanded uncertainty (*)	Remark	Calibration procedure
50 V to 250 V	10 kΩ to 40 MΩ	$1{,}0 \times 10^{-4} \times R$		RP/02/KC/E.17
	40 MΩ to 200 MΩ	$5{,}0 \times 10^{-4} \times R$		
250 V to 1000 V	100 kΩ to 200 MΩ	$1{,}0 \times 10^{-4} \times R$		
	200 MΩ to 1000 MΩ	$3{,}0 \times 10^{-4} \times R$		
1 kV to 10 kV	1 MΩ to 10 GΩ	$60 \times 10^{-4} \times R$		

Capacity

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
10 pF to 100 pF	1 kHz	$15 \times 10^{-4} \times C$	Measure / generate	P2-02-E.010
100 pF to 1000 nF	1 kHz	$10 \times 10^{-4} \times C$	Measure / generate	
1000 nF	100 Hz	$4{,}0 \times 10^{-4} \times C$	Measure / generate	
10 pF, 100 pF, 1 nF, 10 nF	1 kHz	$1{,}0 \times 10^{-4} \times C$	Generate	P2-02-E.040
100 nF, 1 µF	1 kHz	$1{,}5 \times 10^{-4} \times C$		
10 µF	1 kHz	$3{,}0 \times 10^{-4} \times C$		
100 µF	1 kHz	$5{,}0 \times 10^{-4} \times C$		
1 µF	100 Hz	$2{,}0 \times 10^{-4} \times C$		
10 µF	100 Hz	$3{,}0 \times 10^{-4} \times C$		
100 µF	100 Hz	$5{,}0 \times 10^{-4} \times C$		

Inductance

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	calibration/procedure
100 µH to 1 H	1 kHz	$10 \times 10^{-4} \times L$	Measure / generate	P2-02-E.010
1 H to 10 H	1 kHz	$20 \times 10^{-4} \times L$	Measure / generate	
100 µH, 1 mH, 10 mH, 100 mH, 1H	1 kHz	$5{,}0 \times 10^{-4} \times L$	Generate	P2-02-E.040
10 H	100 Hz, 1 kHz	$7{,}0 \times 10^{-4} \times L$		

Oscilloscopes (on screen) – input impedance 50 Ω and 1 MΩ

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
± 1 mV to 200 V	DC	$2{,}5 \times 10^{-4} \times U + 25\ \mu V$	50 Ω to 5,56 V	P2-02-E.007
1 mVpp to 21 mVpp	10 Hz to 10 kHz	$25 \times 10^{-4} \times U + 10\ \mu V$	Square wave	
21 mVpp to 556 mVpp	10 Hz to 10 kHz	$10 \times 10^{-4} \times U + 10\ \mu V$	Square wave	
556 mVpp to 210 Vpp	10 Hz to 10 kHz	$5{,}0 \times 10^{-4} \times U + 10\ \mu V$	Square wave 50 Ω to 5,56 V	
4,44 mVpp to 5,56 Vpp	100 mHz to 100 MHz	$1{,}5 \times 10^{-2} \times U$	Sine wave	
4,44 mVpp to 5,56 Vpp	100 MHz to 550 MHz	$3{,}0 \times 10^{-2} \times U$	Sine wave	
4,44 mVpp to 3,35 Vpp	550 MHz to 1 GHz	$4{,}0 \times 10^{-2} \times U$	Sine wave	
4,44 mVpp to 3,54 Vpp	1 GHz to 4 GHz	$6{,}0 \times 10^{-2} \times U$	Sine wave	
500 ps	-	40 ps	Rise/ falltime (max. 3 V)	
250 ps to 10 ks	-	$5{,}0 \times 10^{-9} \times t$	Time base	
40 Ω to 90 Ω	1 kHz	$1{,}0 \times 10^{-3} \times Z$	Input impedance	
0,8 MΩ to 1,2 MΩ				
10 Ω to 150 Ω	1 kHz	$5{,}0 \times 10^{-3} \times Z$	Input impedance	
50 kΩ to 12 MΩ				
	0,1 Hz to 100 MHz	0,15 dB	Attenuation at bandwidth	
	100 MHz to 550 MHz	0,30 dB	Attenuation at bandwidth	
	550 MHz to 1 GHz	0,40 dB	Attenuation at bandwidth	
	1 GHz to 4 GHz	0,50 dB	Attenuation at bandwidth	P2-02-E.035

Bridge calibration

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
-2,5 mV / V to 2,5 mV / V	225 Hz	50×10^{-6} mV / V	5 V supply / 350 Ω bridges	

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

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Calibration and Measurement Capabilities

Direct voltage

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 mV to 200 mV	DC	$5{,}0 \times 10^{-6} \times U + 2{,}0\ \mu V$	• measure • positive / negative	P2-02-E.019
0,2 V to 2 V	DC	$5{,}0 \times 10^{-6} \times U + 2{,}0\ \mu V$		
2 V to 20 V	DC	$5{,}0 \times 10^{-6} \times U + 5{,}0\ \mu V$		
20 V to 200 V	DC	$5{,}5 \times 10^{-6} \times U + 60\ \mu V$		
200 V to 1000 V	DC	$6{,}0 \times 10^{-6} \times U + 550\ \mu V$		

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 mV to 220 mV	DC	$8{,}0 \times 10^{-6} \times U + 2{,}0\ \mu V$		
220 V to 2,2 V	DC	$8{,}0 \times 10^{-6} \times U + 2{,}0\ \mu V$		
2,2 V to 22 V	DC	$8{,}0 \times 10^{-6} \times U + 6{,}5\ \mu V$		
22 V to 220 V	DC	$9{,}0 \times 10^{-6} \times U + 80\ \mu V$		
220 V to 1100 V	DC	$11 \times 10^{-6} \times U + 500\ \mu V$		

Direct current

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 µA to 200 µA	DC	$12 \times 10^{-6} \times I + 1{,}0\ nA$	• measure • in the lowest possible range • positive / negative	P2-02-E.019
0,2 mA to 2,0 mA	DC	$12 \times 10^{-6} \times I + 6{,}0\ nA$		
2,0 mA to 20 mA	DC	$15 \times 10^{-6} \times I + 50\ nA$		
20 mA to 200 mA	DC	$55 \times 10^{-6} \times I + 2{,}5\ \mu A$		
0,2 A to 2 A	DC	$20 \times 10^{-5} \times I + 20\ \mu A$		
2 A to 20 A	DC	$41 \times 10^{-5} \times I + 450\ \mu mA$		
20 A to 100 A	DC	$1{,}5 \times 10^{-4} \times I$ or 2,0 mA[1]		

[1] Whichever is greater

- - -

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
20 A to 500 A	DC	$10 \times 10^{-3} \times I$	• with current coils	P2-02-E.021

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 µA to 2,2 mA	DC	$55 \times 10^{-6} \times I + 8{,}0\ nA$	• generate • positive / negative	P2-02-E.005
2,2 mA to 22 mA	DC	$55 \times 10^{-6} \times I + 80\ nA$		
22 mA to 220 mA	DC	$90 \times 10^{-6} \times I + 1{,}0\ \mu A$		
220 mA to 2,2 A	DC	$12 \times 10^{-5} \times I + 30\ \mu A$		
2,2 A to 11 A	DC	$38 \times 10^{-5} \times I + 490\ \mu A$		
11 A to 100 A	DC	$10 \times 10^{-4} \times I$		

Alternating voltage

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
10 mV to 200 mV	20 Hz to 10 kHz	$14 \times 10^{-5} \times U + 5{,}0\ \mu V$	• measure	P2-02-E.019
	10 kHz to 30 kHz	$35 \times 10^{-5} \times U + 10\ \mu V$		
	30 kHz to 100 kHz	$77 \times 10^{-5} \times U + 22\ \mu V$		
200 mV to 2 V	20 Hz to 10 kHz	$12 \times 10^{-5} \times U + 25\ \mu V$	• measure	P2-02-E.019
	10 kHz to 30 kHz	$25 \times 10^{-5} \times U + 50\ \mu V$		
	30 kHz to 100 kHz	$57 \times 10^{-5} \times U + 210\ \mu V$		
2 V to 20 V	20 Hz to 10 kHz	$12 \times 10^{-5} \times U + 200\ \mu V$	• measure	P2-02-E.019
	10 kHz to 30 kHz	$25 \times 10^{-5} \times U + 400\ \mu V$		
	30 kHz to 100 kHz	$58 \times 10^{-5} \times U + 2000\ \mu V$		
20 V to 200 V	20 Hz to 10 kHz	$12 \times 10^{-5} \times U + 2{,}0\ mV$	• measure	P2-02-E.019
	10 kHz to 30 kHz	$22 \times 10^{-5} \times U + 5{,}0\ mV$		
	30 kHz to 100 kHz	$57 \times 10^{-5} \times U + 22\ mV$		
200 V to 1000 V	50 Hz to 10 kHz	$30 \times 10^{-5} \times U + 50\ \mu V$	• measure	P2-02-E.019
	10 kHz to 30 kHz	$15 \times 10^{-4} \times U + 50\ mV$		

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
2,2 mV to 22 mV	20 Hz to 20 kHz	$13 \times 10^{-5} \times U + 6{,}0\ \mu V$	• generate	P2-02-E.005
	20 kHz to 100 kHz	$87 \times 10^{-5} \times U + 30\ \mu V$		
22 mV to 220 mV	20 Hz to 20 kHz	$13 \times 10^{-5} \times U + 9{,}0\ \mu V$	• generate	
	20 kHz to 100 kHz	$88 \times 10^{-5} \times U + 30\ \mu V$		
0,22 V to 2,2 V	20 Hz to 20 kHz	$10 \times 10^{-5} \times U + 10\ \mu V$	• generate	
	20 kHz to 100 kHz	$26 \times 10^{-5} \times U + 90\ \mu V$		
2,2 V to 22 V	40 Hz to 20 kHz	$11 \times 10^{-5} \times U + 70\ \mu V$	• generate	
	20 kHz to 100 kHz	$28 \times 10^{-5} \times U + 360\ \mu V$		
22 V to 220 V	40 Hz to 20 kHz	$11 \times 10^{-5} \times U + 1{,}0\ mV$	• generate	
	20 kHz to 100 kHz	$52 \times 10^{-5} \times U + 10\ mV$		
220 V to 1100 V	50 Hz to 1 kHz	$11 \times 10^{-5} \times U + 5{,}0\ mV$	• generate	
	1 kHz to 20 kHz	$18 \times 10^{-5} \times U + 8{,}0\ mV$		

Alternating currect

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
10 µA to 200 µA	50 Hz to 5 kHz	$31 \times 10^{-5} \times I + 40\ nA$	• measure	P2-02-E.019
0,2 mA to 2 mA	50 Hz to 5 kHz	$31 \times 10^{-5} \times I + 400\ nA$		
2 mA to 20 mA	50 Hz to 5 kHz	$31 \times 10^{-5} \times I + 2{,}5\ \mu A$		
20 mA to 200 mA	50 Hz to 5 kHz	$30 \times 10^{-5} \times I + 25\ \mu A$		
0,2 A to 2 A	50 Hz to 1 kHz	$63 \times 10^{-5} \times I + 25\ \mu A$		
	1 kHz to 5 kHz	$73 \times 10^{-5} \times I + 25\ \mu A$		
2 A to 20 A	50 Hz to 1 kHz	$85 \times 10^{-5} \times I + 250\ \mu A$		

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
20 A to 500 A	45 Hz to 100 Hz	$10 \times 10^{-3} \times I$	• with current coils	P2-02-E.021
20 A to 500 A	100 Hz to 440 Hz	$15 \times 10^{-3} \times I$	• with current coils	

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
10 µA to 220 µA	40 Hz to 1 kHz	$14 \times 10^{-5} \times I$ + 35 nA	• generate	P2-02-E.005
220 µA to 2,2 mA	40 Hz to 1 kHz	$20 \times 10^{-5} \times I$ + 35 nA		
2,2 mA to 22 mA	40 Hz to 1 kHz	$20 \times 10^{-5} \times I$ + 350 nA		
22 mA to 220 mA	40 Hz to 1 kHz	$20 \times 10^{-5} \times I$ + 3,5 µA		
220 mA to 2,2 A	40 Hz to 1 kHz	$70 \times 10^{-5} \times I$ + 35 nA		
2,2 A to 11 A	40 Hz to 1 kHz	$65 \times 10^{-5} \times I$ + 200 nA		

Power and Energy

Impedance (DC/LF)

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 Ω to 2 Ω	DC	($18 \times 10^{-6} \times R$ + 5,0 µΩ) or 20 µΩ[1]	• measure • 4-wire resistance measurement • negligible dissipated power	P2-02-E.019
2 Ω to 20 Ω	DC	$10 \times 10^{-6} \times R$ + 15 µΩ		
20 Ω to 200 Ω	DC	$10 \times 10^{-6} \times R$ + 50 µΩ		
200 Ω to 2 kΩ	DC	$10 \times 10^{-6} \times R$ + 500 µΩ		
2 kΩ to 20 kΩ	DC	$10 \times 10^{-6} \times R$ + 5 mΩ		
20 kΩ to 200 kΩ	DC	$10 \times 10^{-6} \times R$ + 50 mΩ		
0,2 MΩ to 2 MΩ	DC	$11 \times 10^{-6} \times R$ + 1,2 Ω		
2 MΩ to 20 MΩ	DC	$25 \times 10^{-6} \times R$ + 120 Ω		
20 MΩ to 200 MΩ	DC	$13 \times 10^{-5} \times R$ + 12 kΩ		
200 MΩ to 2 GΩ	DC	$16 \times 10^{-4} \times R$ + 1,2 MΩ		

[1] Whichever is greater

- - -

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 Ω	DC	100 µΩ	• generate • fixed points • 4-wire resistance • lowest possible power dissipation • * 2-wire resistance	P2-02-E.005
1 Ω, 1,9 Ω	DC	$12 \times 10^{-5} \times R$		
10 Ω, 19 Ω	DC	$35 \times 10^{-6} \times R$		
100 Ω, 190 Ω	DC	$20 \times 10^{-6} \times R$		
1 kΩ, 1,9 kΩ, 10 kΩ, 19 kΩ, 100 kΩ, 190 kΩ	DC	$17 \times 10^{-6} \times R$		
1 MΩ, 1,9 MΩ	DC	$30 \times 10^{-6} \times R$		
10 MΩ, 19 MΩ	DC	$60 \times 10^{-6} \times R$		
100 MΩ	DC	$15 \times 10^{-5} \times R$		

Calibration of resistor / insulation meters

Measuring range or point	Resistance	expanded uncertainty (*)	Remark	Calibration procedure
50 V to 250 V	10 kΩ to 40 MΩ	$1{,}0 \times 10^{-4} \times R$		RP/02/KC/E.17
	40 MΩ to 200 MΩ	$5{,}0 \times 10^{-4} \times R$		
250 V to 1000 V	100 kΩ to 200 MΩ	$1{,}0 \times 10^{-4} \times R$		
	200 MΩ to 1000 MΩ	$3{,}0 \times 10^{-4} \times R$		

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Time and Frequency Berchem
Calibration and Measurement Capabilities

Relative time

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Tachometers, stroboscopes (optical)	1,2 rpm to 100 000 rpm	$3{,}0 \times 10^{-7} \times n$		P2-02-E.041
Mechanical tachometers	10 rpm to 17 000 rpm	$0{,}050$ rpm $+ 10 \times 10^{-5} \times n$		

n: number of rotations in rpm

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Frequencymeters, frequencygenerators, counters	1 Hz	$5{,}0 \times 10^{-11} \times f$	• generate • fixed points • CMC calculated at 600 s measuring time	P2-02-E.004
	1 MHz	$5{,}0 \times 10^{-11} \times f$		
	5 MHz	$5{,}0 \times 10^{-11} \times f$		
	10 MHz	$5{,}0 \times 10^{-11} \times f$		
	0,002 Hz to 3 GHz	$6{,}0 \times 10^{-11} \times f$	• meassure • CMC calculated at 600 s measuring time	P2-02-E008
	0,002 Hz to 4 GHz	$5{,}0 \times 10^{-9} \times f$	• generate • CMC calculated at 600 s measuring time	RP/02/KC/E.01 P2-02-E.007 P2-02-E035

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Electronic chronometers	n.a.	0,10 s / 24 h	direct measurement	P2-02-E.014
Mechanic chronometers	n.a.	5,0 s / 24 h	direct measurement	
Electronic & mechanic chronometers	Standard 0 h to 72 h	0,50 s / 24 h with a minimum van 0,30 s	By comparison with a standard chronometer via a digital-optical recorder	P1-02-E.003
Signal-triggered chronometers	Standard 0 h to 72 h	0,15 s / 24 h with a minimum van 0,060 s	By comparison with a standard chronometer via a digital-optical recorder	

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Time and Frequency Wellin
Calibration and Measurement Capabilities

Relative time

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Tachometers, stroboscopes (optical)	6 rpm to 100 000 rpm	$3{,}0 \times 10^{-7} \times n$		P2-02-E.041

n : number of rotations in rpm

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Frequencymeters, frequencygenerators, counters	10 MHz	$4{,}0 \times 10^{-10} \times f$	Value generated by a Rb Quarz (reference frequency)	
	1 MHz to 10 MHz	$5{,}0 \times 10^{-10} \times f$	Measurement by means of an electronic counter synchronized to the reference frequency	
	0,1 Hz to 10 MHz	$5{,}0 \times 10^{-10} \times f$ + 0,50 mHz		
	10 MHz to 1000 MHz	$5{,}0 \times 10^{-10} \times f$ + 0,50 mHz		
	1 GHz to 45 GHz	$5{,}0 \times 10^{-10} \times f$ + 1,5 Hz		

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Electronic chronometers	n.a.	0,10 s / 24 h	direct measurement	P2-02-E.014
Mechanic chronometers	n.a.	5,0 s / 24 h	direct measurement	

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Dimensional Quantities Berchem
Calibration and Measurement Capabilities

Length gauges

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Central length steel	0,5 mm to 100 mm 0,02 inch to 4 inch	0,060 µm + 0,90 × 10^{-6} × *l*	fixed sizes	P2-02-G.001
Central length tungsten carbide		0,060 µm + 0,70 × 10^{-6} × *l*		
Central length ceramic		0,060 µm + 0,80 × 10^{-6} × *l*		
		0,060 µm + 1,2 × 10^{-6} × *l*	reference steel	
Central length steel, tungsten carbide, ceramic	0,05 mm to 500 mm 0,005 inch to 20 inch	0,10 µm + 2,0 × 10^{-6} × *l*	all sizes	P2-02-G.003
Lengthvariation steel, tungsten carbide, ceramic	0,5 mm to 100 mm 0,02 inch to 4 inch	0,050 µm		P2-02-G.002
Step gauge	to 1200 mm	0,80 µm + 3,0 × 10^{-6} × *l*		P2-02-G.011

Clinometers
See 1.5.13

Line scales, distances

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Ruler (all models)	to 200 mm	1,5 µm + 3,0 × 10^{-6} × *l*	e.g. spring rule	P2-02-G.094 P2-02-G.100
	to 400 mm	2,0 µm + 3,0 × 10^{-6} × *l*		
	to 3000 mm	12 µm + 3,0 × 10^{-6} × *l*		
	to 100 m	6,0 µm + 5,0 × 10^{-6} × *l*		P2-02-G.143
Feeler gauges	to 5 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.011 P2-02-G.041 P2-02-G.068 P2-02-G.070 P2-02-G.127
Setting standard for external micrometers	to 300 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.011 P2-02-G.012 P2-02-G.041 P2-02-G.068 P2-02-G.070 P2-02-G.127
	300 to 500 mm	0,90 µm + 0,60 × 10^{-6} × *l*		
	500 to 3000 mm	3,0 µm + 3,0 × 10^{-6} × *l*		
Other distance of 2 parallel planes	to 300 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.011 P2-02-G.012 P2-02-G.041 P2-02-G.068 P2-02-G.070 P2-02-G.127
	300 to 500 mm	0,90 µm + 0,60 × 10^{-6} × *l*		
	500 to 3000 mm	3,0 µm + 3,0 × 10^{-6} × *l*		

Length measuring instruments

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Hand held tools for external measurements	0 mm to 200 mm	0,45 µm + 0,50 × R + 25 × 10^{-6} × *l*	(1) e.g. vernier, micrometer, …	P2-02-G.050
	200 mm to 3000 mm	4,0 µm + 0,50 × R + 5,0 × 10^{-6} × *l*		P2-02-G.050
Hand held tools for internal measurements			(1) e.g. internal micrometers	- - -
2-point	0 mm to 200 mm	0,70 µm + 0,50 × R + 25 × 10^{-6} × *l*		P2-02-G.051 P2-02-G.055
	200 mm to 400 mm	5,0 µm + 0,50 × R + 4,0 × 10^{-6} × *l*		
2- and 3-point	0 mm to 250 mm	1,5 µm + 0,50 × R + 25 × 10^{-6} × *l*		P2-02-G.055
Hand held tools for height and depth measurements	0 mm to 500 mm	0,70 µm + 0,50 × R + 25 × 10^{-6} × *l*	(1)	P2-02-G.052 P2-02-G.097
Linear displacement sensor	to 200 mm	0,050 µm + 2,5 × 10^{-6} × *l* + 0,80 × R	to 50 mm (1)	P2-02-G.042 P2-02-G.050
Height gauge	to 1500 mm	0,80 µm + 0,70 × R + 2,5 × 10^{-6} × *l*	(1)	P2-02-G.052 P2-02-G.098
Film thickness gauge	to 2 mm	1,0 µm + 2,0 × 10^{-3} × *l*	(1)	P2-02-G.099
Laser distance meter	to 25 m	0,50 mm + 40 × 10^{-6} × *l* + 0,60 × R		P2-02-G.045 P2-02-G.126

Diameter

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Setting rings and ring gauges	Ø 1 mm to Ø 250 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.039 P2-02-G.043 P2-02-G.121
Cylindrical setting pins	to 200 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127
Plain plug gauges	to 200 mm	0,50 µm + 1,5 × 10^{-6} × *l*		
Thread wires	to 20 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127
Radius gauge	to Ø 200 mm	3,0 µm + 5,0 × 10^{-6} × *l*		P2-02-G.121 P2-02-G.136
Other internal diameters	Ø 1 mm to Ø 250 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.039 P2-02-G.043 P2-02-G.121
Other external diameters	Ø 0,05 mm to Ø 300 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127
	Ø 300 mm to Ø 500 mm	0,90 µm + 0,60 × 10^{-6} × *l*		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127

Form error

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Knife edge straight edge	to 300 mm	0,30 µm		P2-02-G.028 P2-02-G.101 P2-02-G.111 P2-02-G.113 P2-02-G.128 P2-02-G.133
Straight edge	to 6000 mm	0,50 µm + 0,50 × 10^{-6} × *l*	(1)	P2-02-G.037
Surface plate	to 6 000 mm x 10 000 mm	0,30 µm + 1,6 × 10^{-6} × *l*	(1) *l* = longest side of the surface plate	P2-02-G.038
Roundness tester	to 300 µm	0,050 µm + 0,50 × R	(1)	P2-02-G.056
Roundness standard	to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness	P2-02-G.027
Flick standard (roundness standard)	to 1 mm	0,25 µm		P2-02-G.074

Roughness

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Surface texture measuring instruments	Ra: 0,05 µm to 5 µm	0,040 × A + 0,50 × R (minimum 0,030 µm)	(1) A = Ra-value of reference	P2-02-G.059
	Rz: 0,1 µm to 10 µm	0,060 × A + 0,50 × R (minimum 0,050 µm)	(1) A = Rz-value of reference	
	Rmax: 0,1 µm to 10 µm	0,060 × A + 0,50 × R (minimum 0,050 µm)	(1) A = Rmax-value of reference	
Roughness standards	Ra: to 10 µm	0,025 µm + 0,060 × A	A = measured Ra-value	P2-02-G.025
	Rz: to 15 µm	0,030 µm + 0,090 × A	A = measured Rz-value	
	Rmax: to 15 µm	0,030 µm + 0,090 × A	A = measured Rmax-value	

Thread quantities

Thread external				
Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**
Pitch	to 10 mm	2 µm		P2-02-G.011 P2-02-G.045
Profile angle	to 180°	(0,50 + 12/*l*) bgmin	*l* = leg length in mm	P2-02-G.040
Simple pitch diameter	Ø 1 mm to Ø 300 mm	α = 30°: (6,0 µm to 9,7 µm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.102
		α = 60°: (3,2 µm to 5,9 µm)		
		α = 90°: (2,6 µm to 5,5 µm)		
Thread internal				
Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**
Pitch	to 10 mm	2 µm		P2-02-G.011 P2-02-G.045
Profile angle	to 180°	(0,50 + 12/*l*) bgmin	*l* = leg length in mm	P2-02-G.040
Simple pitch diameter	Ø 4 mm to Ø 300 mm	α = 30°: (9,0 µm to 14 µm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.106
		α = 60°: (3,6 µm to 7,0 µm)		
		α = 90°: (3,1 µm to 6,2 µm)		

Coordinate measuring machines

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Deviation of nominal displacement	to 20 m		e.g. 1D/2D/3D Measuring machine with:	- - -
		0,15 µm + 0,70 × R + 1,0 × 10^{-6} × *l*	Zerodur scales; (1)	P2-02-G.046
		0,15 µm + 0,70 × R + 1,3 × 10^{-6} × *l*	Glass scales; (1)	P2-02-G.046
		0,15 µm + 0,70 × R + 1,6 × 10^{-6} × *l*	Steel scales; (1)	P2-02-G.046
	to 400 mm	0,30 µm + 2,3 × 10^{-6} × *l*	using reference glass scale; (1)	P2-02-G.073
Deviations transverse to the translation directions	to 0,5 mm	0,30 µm + 3,0 × 10^{-6} × *l* + 5,0 × 10^{-3} × A	A = measured deviation Measuring length to 3000 mm; (1)	P2-02-G.047
Rotational deviations around the translation direction	to 400 as	0,50 as + 3,5 × 10^{-3} × A	A = measured angle; horizontal translation only; (1)	P2-02-G.048 P2-02-G.069 P2-02-G.124
Other rotational deviations	to 7200 as	0,50 as + 1,6 × 10^{-3} × A	A = measured angle; measured length to 4500 mm; (1)	P2-02-G.048 P2-02-G.124

as = arcsecond

Angle gauges

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Angle gauge block	to 180°	0,000 28° + 10 × 10^{-6} × A 1,0” + 10 × 10^{-6} × A	A = measured angle	P2-02-G.120 P2-02-G.125
Cylindrical square	to Ø 300 mm to height 300 mm	0,30 µm + 2,0 × 10^{-6} × *l*	Squareness	P2-02-G.032 P2-02-G.122
Square	to 300 mm leg length	0,30 µm + 2,0 × 10^{-6} × *l*	Squareness	P2-02-G.032 P2-02-G.122
Angle plate	90°	0,50 as		P2-02-G.034 P2-02-G.122
Polygon	to 360 °	0,50 as		P2-02-G.072
Pentagonprism	90 °	0,50 as		P2-02-G.075

as = arcsecond

Angle (measuring instruments)

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Spirit level	to 12,5 mm/m	0,50 µm/m + 1,0 × 10^{-3} × A + 0,7 × R	A = set angle	P2-02-G.091
	to 2600 as	0,10 as + 1,0 × 10^{-3} × A + 0,70 × R		
Autocollimator	to 12,5 mm/m	0,50 µm/m + 1,0 × 10^{-3} × A + 0,70 × R	A = set angle	P2-02-G.091
	to 2600 as	0,10 as + 1,0 × 10^{-3} × A + 0,70 × R		
Angle meters	0° - 360°	0,50 amin	e.g. protractor; (1)	P2-02-G.120 P2-02-G.040
Angle sensor	0° - 360°	2,0 as	e.g. protractor; (1)	P2-02-G.064
Clinometers	0° - 360°	2,0 as		P2-02-G.084
Theodolites	180°	3,0 as	Rotation around vertical axis	
	180°	1,5 as	Defining horizontal plane	
	180°	1,8 as	Deviation of crosshairs to rotations	

as = arcsecond
amin = arcminute

Product measurement

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Form				
Surface profile	to 10 mm × 100 mm	1,0 µm + 0,010 × A	A = measured profile height	P2-02-G.112
Roughness value	Ra: to 10 µm	0,025 µm + 0,060 × A	A = measured Ra-value	P2-02-G.025
	Rz: to 15 µm	0,030 µm + 0,090 × A	A = measured Rz-value	P2-02-G.025
	Rmax: to 15 µm	0,030 µm + 0,090 × A	A = measured Rmax-value	P2-02-G.025
Straightness	to 10 mm × 100 mm	1,0 µm + 0,010 × A	A = measured profile height	P2-02-G.112
	to 300 mm	0,30 µm		P2-02-G.028 P2-02-G.101 P2-02-G.111 P2-02-G.113 P2-02-G.128 P2-02-G.133
	to 6000 mm	0,50 µm + 0,50 × 10^{-6} × L	(1)	P2-02-G.037
Roundness				
Roundness external	to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness	P2-02-G.027
Roundness internal	Ø 0,7 mm to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness	P2-02-G.027
Cilindricity				
Cilindricity external	to Ø 300 mm to height 300 mm	0,40 µm + 0,040 × A	A = measured cilindricity	P2-02-G.030 P2-02-G.114
Cilindricity internal	Ø 0,7 mm to Ø 300 mm to height 300 mm	0,40 µm + 0,040 × A	A = measured cilindricity	P2-02-G.030 P2-02-G.114
Coaxiality and concentricity	Ø 0,7 mm to Ø300 mm to height 300 mm	0,10 µm + 0,040 × A	A = measured coaxiality / concentricity	P2-02-G.031 P2-02-G.115

Planes or sides				
Flatness	to Ø 55 mm	0,050 µm		P2-02-G.038 P2-02-G.060 P2-02-G.116
	to Ø 150 mm	0,060 µm		
	to Ø 290 mm	0,15 µm		
	to 6 000 mm × 10 000 mm	0,50 µm + 1,5 × 10^{-6} × *l*	*l* = longest side of surface plate; (1)	P2-02-G.060
Angle between sides or planes	to 180°	(0,50 + 12/*l*) amin	*l* = leg length in mm; leg length to 200 mm	P2-02-G.040 P2-02-G.049 P2-02-G.120
		3,0 as	optical surfaces	
Squareness	to 1200 x 550 mm	2,1 µm + 4,0 × 10^{-6} × *l*	*l* = leg length ratio leg length : reference length = 1 : 1	P2-02-G.082 P2-02-G.122 P2-02-G.129 P2-02-G.131
Parallelism	to 1200 mm	1,0 µm + 2,0 × 10^{-6} × *l*	*l* = leg length	P2-02-G.132 P2-02-G.134 P2-02-G.135
Diameter				
External	Ø 0,05 mm to Ø 300 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127 P2-02-G.136
	Ø 300 mm to Ø 500 mm	0,90 µm + 0,60 × 10^{-6} × *l*		
	Ø 500 mm to Ø 3000 mm	0,40 µm + 2,0 × 10^{-6} × *l*		
Internal	Ø 1 mm to Ø 250 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.039 P2-02-G.043
Distance of 2 parallel surfaces				
External	to 200 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P2-02-G.011 P2-02-G.012 P2-02-G.041 P2-02-G.045 P2-02-G.068 P2-02-G.070
	to 3000 mm	0,40 µm + 4,0 × 10^{-6} × *l*		
Internal	to 1200 mm	1,2 µm + 4,0 × 10^{-6} × *l*		P2-02-G.011 P2-02-G.012 P2-02-G.039
Thread external				
Pitch	to 10 mm	2,0 µm		P2-02-G.011 P2-02-G.045
Profile angle	to 180°	(0,50 + 12 / *l*) bgmin	*l* = leg length in mm	P2-02-G.040
Simple pitch diameter	Ø 1 mm to Ø 300 mm	α = 30°: (6,0 µm to 9,7 µm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.102
		α = 60°: (3,2 µm to 5,9 µm)		P2-02-G.102
		α = 90°: (2,6 µm to 5,5 µm)		P2-02-G.102
Thread internal				
Pitch	to 10 mm	2,0 µm		P2-02-G.011 P2-02-G.045
Profile angle	to 180°	(0,50 + 12 / *l*) bgmin	*l* = leg length in mm	P2-02-G.040
Simple pitch diameter	Ø 4 mm to Ø 300 mm	α = 30°: (9,0 µm to 14 µm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.106
		α = 60°: (3,6 µm to 7,0 µm)		P2-02-G.106
		α = 90°: (3,1 µm to 6,2 µm)		P2-02-G.106

(1): also on site, the CMC can be bigger on site

R: resolution of the instrument ; *l* : measured length

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Force and Torque Berchem

Calibration and Measurement Capabilities

Force

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Push pull force measuring devices in tension and compression	0,20 N to 5 000 N	$1{,}0 \times 10^{-4} \times F$	dead weights, f.i. ISO376 and ISO7500-1[3]	P1-02-M.009 P1-02-M.010 P1-02-M.019
	2 kN to 200 kN	$8{,}0 \times 10^{-4} \times F$	Generation and measurement by comparison with standard load cells, f.i. ISO376 and ISO7500-1[3]	
	200 kN to 500 kN	$10 \times 10^{-4} \times F$	Generation and measurement by comparison with standard load cells, f.i. ISO376 and ISO7500-1[3]	
	500 kN to 1,0 MN	$10 \times 10^{-4} \times F$	Measurement only by comparison with standard load cells, f.i. ISO376 and ISO7500-1[3]	
Gram force gauges	0,050 N to 500 N	$0{,}030 \times F$		

Torque

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Torque tools	0,1 Nm to 2700 Nm	$8{,}0 \times 10^{-3} \times M$	Accuracy acc. to ISO 6789[3]	P2-02-M.011
Torque measuring devices	0,1 Nm to 1 Nm	$1 \times 10^{-3} \times M$	With torque arms and weights	P1-02-M.004
	1 Nm to 200 Nm	$1{,}0 \times 10^{-3} \times M$		
	200 Nm to 4000 Nm	$0{,}5 \times 10^{-3} \times M$		

[3] onsite calibration also

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Mass Berchem

Calibration and Measurement Capabilities

Mass standards

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Weights and masses	1 mg	0,001 0 mg	For example mass pieces up to grade E1 according to OIML R111-1	KI/02/KC/W.02 KI/02/KC/W.03 KI/02/KC/W.04 KI/02/KC/W.05
	2 mg	0,001 0 mg		
	5 mg	0,001 0 mg		
	10 mg	0,001 0 mg		
	20 mg	0,001 0 mg		
	50 mg	0,001 2 mg		
	100 mg	0,001 6 mg		
	200 mg	0,002 0 mg		
	500 mg	0,002 5 mg		
	1 g	0,003 0 mg		
	2 g	0,004 0 mg		
	5 g	0,005 0 mg		
	10 g	0,007 0 mg		
	20 g	0,008 0 mg		
	50 g	0,010 mg		
	100 g	0,017 mg		
	200 g	0,033 mg		
	500 g	0,080 mg		
	1 kg	0,16 mg		
	2 kg	0,33 mg		
	5 kg	0,80 mg		
	10 kg	1,7 mg		
	20 kg	10 mg	For example mass pieces up to grade E2 according to OIML R111-1	KI/02/KC/W.02 KI/02/KC/W.03 KI/02/KC/W.04 KI/02/KC/W.05
	50 kg	600 mg	For example mass pieces up to grade M1 according to OIML R111-1	KI/02/KC/W.05
	100 kg	1 000 mg		
	150 kg	1 600 mg		

Weighing instruments

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Non automatic weiging machines	1 mg to 645 kg 0,5 t to 10 t 20 t by substitution	$20 \times 10^{-6} \times m$	Available weights: grade E2: 1 mg to 5 kg grade F1: 1 g to 20 kg grade M1: 1 g to 500 kg	KI/02/KC/W.50

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Pressure and Vacuum Berchem
Calibration and Measurement Capabilities

Gas pressure

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Gauges, digital indicators, plotters, calibrators, liquid column, transmitters, transducers and pressure balances for relative and absolute[1] pressures	0 Pa to 4800 Pa	$1 \times 10^{-4} \times p$ minimum 0,03 Pa	By comparison with a low pressure standard	P2-02-P.002
	-100 kPa to -1,5 kPa	$80 \times 10^{-6} \times p$	By comparison with a gas pressure balance	P2-02-P.001 P2-02-P.007
	1,5 kPa to 5,0 kPa	$80 \times 10^{-6} \times p$		
	5,0 kPa to 350 kPa	$20 \times 10^{-6} \times p$		
	5,0 kPa to 1,9 MPa	$26 \times 10^{-6} \times p$		
	1,9 MPa to 7,6 MPa	$30 \times 10^{-6} \times p$		
	7,6 MPa to 12 MPa	$70 \times 10^{-6} \times p$		
Barometers	5,0 kPa to 350 kPa abs	$20 \times 10^{-6} \times p$	By comparison with a gas pressure balance	
Piston/cilinder combination (effective area)[2]	5,0 kPa to 350 kPa	$20 \times 10^{-6} \times p$	By comparison with a gas pressure balance	
	350 kPa to 1,9 MPa	$25 \times 10^{-6} \times p$		
	1,9 MPa to 7,6 MPa	$30 \times 10^{-6} \times p$		
	7,6 MPa to 12 MPa	$70 \times 10^{-6} \times p$		

1 For absolute pressures the uncertainty of the atmospheric pressure is added to the uncertainty (except when working with an absolute pressure balance)
2 The masses can be calibrated in our mass laboratory

Liquid pressure

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Gauges, digital indicators, plotters, calibrators, liquid column, transmitters, transducers and pressure balances for relative and absolute[1] pressures	0,30 MPa to 2,5 MPa	$65 \times 10^{-6} \times p$	By comparison with a liquid pressure balance	P2-02-P.001 P2-02-P.007
	2,5 MPa to 100 MPa	$30 \times 10^{-6} \times p$		
	100 MPa to 120 MPa	$70 \times 10^{-6} \times p$		
	120 MPa to 400 MPa	$250 \times 10^{-6} \times p$		
Piston/cilinder combination (effective area)[2]	0,30 MPa to 2,5 MPa	$65 \times 10^{-6} \times p$	By comparison with a liquid pressure balance	
	2,5 MPa to 100 MPa	$30 \times 10^{-6} \times p$		
	100 MPa to 120 MPa	$70 \times 10^{-6} \times p$		

1 For absolute pressures the uncertainty of the atmospheric pressure is added to the uncertainty (except when working with an absolute pressure balance)
2 The masses can be calibrated in our mass laboratory

Vacuum quantities

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Absolute pressure	1 Pa to 5 kPa	$2 \times 10^{-2} \times p$	By comparison with capacitive pressure indicators	RP/02/KC/P.05 RP/02/KC/P.06
	1 mPa to 1 Pa	$2{,}5 \times 10^{-2} \times p + 5$ mPa		

Onsite

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Relative pressures	20 kPa to 60 MPa	$1 \times 10^{-3} \times p$	By comparison with digital pressure indicators	RP/02/KC/S.01
Absolute pressures	20 kPa to 60 MPa abs.	$1 \times 10^{-3} \times p$		

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Flow of Gas Berchem

Calibration and Measurement Capabilities

Velocity of gases

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Windspeed	0,1 m/s to 35 m/s	0,60 % + 0,020 m/s	By comparison with an LDV in a windtunnel	P2-02-P.010

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Temperature Berchem

Calibration and Measurement Capabilities

Resistance thermometers				
Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**
Resistance thermometers			Fixed points	
	-38,8344 °C	0,004 °C	triple point of mercury	P1-02-T.020
	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 aluminum	
	-196 °C	0,025 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	P1-02-T.004
	-100 °C to -40 °C	0,05 °C	By comparison with reference standards	
	-40 °C to 0 °C	0,025 °C		
	0 °C to 280 °C	0,015 °C		
	280 °C to 350 °C	0,04 °C		
	350 °C to 660 °C	0,04 °C		

Standard Pt resistance thermometers

Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**
Platinum resistance thermometers which meet the specifications of the ITS-90 or close to these specifications			Fixed points	
	-38,8344 °C	0,004 °C	triple point of mercury	P1-02-T.020
	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 aluminum	

Thermocouples

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Thermocouples B, R & S	0 °C to 280 °C	0,40 °C	By comparison with reference standards	P1-02-T.014
	280 °C to 660 °C	0,70 °C		
	660 °C to 1100 °C	1,7 °C		
	1100 °C to 1300 °C	2,3 °C		
Thermocouples	-196 °C	0,20 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	P1-02-T.014
	-100 °C to 280 °C	0,20 °C	By comparison with reference standards	
	280 °C to 660 °C	0,50 °C		
	660 °C to 1100 °C	1,7 °C		
	1100 °C to 1300 °C	2,3 °C		

Self indicating thermometers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Temperature indicators with resistance probe			Fixed points	P1-02-T.020
	-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 aluminum	
	-196 °C	0,025 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	P1-02-T.001
	-100 °C to -40 °C	0,025 °C	By comparison with reference standards	
	-40 °C to 0 °C	0,020 °C		
	0 °C to 280 °C	0,015 °C		
	280 °C to 350 °C	0,025 °C		
	350 °C to 660 °C	0,040 °C		
Temperature indicators with thermocouple probes B, R & S	0 °C to 280 °C	0,40 °C	By comparison with reference standards	P1-02-T.001
	280 °C to 660 °C	0,70 °C		
	660 °C to 1100 °C	1,7 °C		
	1100 °C to 1300 °C	2,3 °C		
Temperature indicators with thermocouple probes	-196 °C	0,20 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	P1-02-T.001
	-100 °C to 280 °C	0,20 °C	By comparison with reference standards	
	280 °C to 660 °C	0,50 °C		
	660 °C to 1100 °C	1,7 °C		
	1100 °C to 1300 °C	2,3 °C		

Analogue thermometers	-100 °C to 0 °C	0,60 °C	By comparison with reference standards	P1-02-T.007
	0 °C to 280 °C	0,20 °C		
Liquid in glass thermometers with a resolution of	-100 °C to 0 °C		By comparison with reference standards (totally or partially submerged) Partially submerged thermometers have a bigger CMC than mentioned	P1-02-T.005
5 °C		2,0 °C		
2 °C		0,80 °C		
1 °C		0,40 °C		
0,5 °C		0,20 °C		
0,2 °C		0,090 °C		
0,1 °C		0,060 °C		
0,05 °C		0,060 °C		
Liquid in glass thermometers with a resolution of	0 °C to 275 °C		By comparison with reference standards (totally or partially submerged) Partially submerged thermometers have a bigger CMC than mentioned	P1-02-T.005
5 °C		2,0 °C		
2 °C		0,80 °C		
1 °C		0,40 °C		
0,5 °C		0,20 °C		
0,2 °C		0,070 °C		
0,1 °C		0,050 °C		
0,05 °C		0,025 °C		
Surface temperature probes	ambient to 300 °C	0,50 % × t + 0,50 °C	By comparison with reference standards	P1-02-T.012

Radiation thermometry

Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**
Infrared thermometry	-17 °C to 100 °C	0,50 °C	By comparison with reference standards	P1-02-T.010
	100 °C to 200 °C	0,60 °C		
	200 °C to 400 °C	1,7 °C		
	400 °C to 600 °C	0,60%		
	600 °C to 800 °C	0,70%		

Temperature controlled chambers

Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**
Charcterisation of ovens and climatic chambers	-100 °C to -38,5 °C	1,6 °C	Using thermocouple type K	P2-02-S.040
	-38,5 °C to 230 °C	0,080 °C	Using Pt100 probes	
	230 °C to 600 °C	1,5 °C	Using thermocouple type R & S	

Other temperature enclosures

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Block calibrators	-100 °C to 650 °C	0,040 °C + 0,000 05 × |*t*|	Full evaluation following DOC EM/CG/13 "Guidelines on the Calibration of Temperature Block Calibrators" Or calibration with known evaluation information	P1-02-T.003 P1-02-T.002

Cold junction compensation

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Cold junction compensation B, R & S	0 °C	0,25 °C		P2-02-T.015
Cold junction compensation	0 °C	0,060 °C		

Onsite calibration

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Temperature probe with or without readout	-100 °C to -20 °C	0,11 °C	By comparison in Block calibrators with external reference standards	P2-02-S.002
	-20 °C to 50 °C	0,09 °C		
	50 °C to 250 °C	0,16 °C		
	250 °C to 650 °C	0,22 °C		

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Temperature Louvain-La-Neuve

Calibration and Measurement Capabilities

Thermomètres en laboratoire				
Grandeur/Instrument	**Etendue de mesure**	**Incertitude élargie (*)**	**Remarques**	**Procedure d'étalonnage**
Thermomètre à résistance de platine répondant aux spécifications définies par l'EIT-90 ou de caractéristiques très voisines	-196 °C	0,01 °C	PG-LABO_ETAL	Par comparaison à des étalons de référence dans l'azote liquide à pression atmosphérique
	-38,834 °C 0,010 °C 29,765 °C 231,928 °C 419,527 °C 156,594 °C	0,004 °C 0,001 °C 0,004 °C 0,004 °C 0,006 °C 0,004 °C	PG-LABO_ETAL	**Points fixes de définition** Point triple du mercure Point triple de l'eau Point de fusion du gallium Point de congélation de l'etain Point de congélation du zinc Point triple de l'indium
Tout type de capteur thermométrique associé ou non à un indicateur ou tout autre moyen de conversion en température (à l'exclusion des pyromètres).	Voir tableau I			
	-100 °C à <-80 °C -80 °C à <-20 °C -20 °C à <300 °C 300 °C à <450 °C 450 °C à <660 °C 660 °C à <1064 °C 1064 °C à 1550 °C	0,022 °C 0,010 °C 0,008 °C 0,010 °C 0,012 °C 0,80 °C 1,60 °C	PG-ETC	Par comparaison à des étalons de référence dans des bains thermostatés et des fours
	-40 °C à <120 °C 120 °C à 180 °C	0,07 °C 0,18 °C	PG-ETC	Par comparaison à des étalons de référence dans une enceinte climatique
Thermomètre à dilatation de liquide en verre	-80 °C à <-58 °C -58 °C à <160 °C 160 °C à <300 °C 300 °C à 350 °C	0,11 °C 0,01 °C 0,03 °C 0,10 °C	PG-ETC	Par comparaison à des étalons de référence dans des bains thermostatés et des fours

Remarques concernant les tableaux I et II:

- Suivant 'Echelle Internationale de Température 1990 (EIT-90)
- 'L'incertitude mentionnée tient compte des sondes et moyens de comparaison du laboratoire. L'incertitude totale affectée à l'étalonnage d'un thermomètre ne saurait être inférieure à celle mentionnée et dépendra, entre autres, du matériel disponible sur site, des conditions d'environment, ...

Etalonnage et caractérisation de fours d'etalonnage				
Grandeur/Instrument	**Etendue de mesure**	**Incertitude élargie (*)**	**Remarques**	**Procedure d'étalonnage**
Etalonnage de four d'étalonnage	De -100 °C à 650 °C	de 0,02 °C à 0,10 °C	PG-ETC	Par comparaison à un étalon de référence dans un puits du four.
Etalonnage + Caractérisation de four d'étalonnage	De -100 °C à 650 °C	L'incertitude déterminée lors de la caractérisation est variable en fonction du nombre de puits caractérisés (nombre différent selon la demande client et le bloc d'égalisation utilisé)	PG-ETC	En plus de l'étalonnage du four, détermination de l'homogénéité radiale entre différents puits et des fuites thermiques selon le document Euramet cg-13 version 4 de 09/2017.
Thermomètres sur site				
Grandeur/Instrument	**Etendue de mesure**	**Incertitude élargie (*)**	**Remarks**	**Procedure d'étalonnage**
Tout type de capteur thermométrique associé ou non à un indicateur ou tout autre moyen de conversion en température (à l'exclusion des pyromètres).	0,010 °C 29,765 °C	0,001 °C 0,004 °C	PG-ETC	Points fixes
	-196 °C à <232 °C 232 °C à <420 °C 420 °C à <660 °C 660 °C à <1064 °C 1064 °C à 1550 °C	0,05 °C 0,06 °C 0,08 °C 1,00 °C 1,90 °C	PG-ETC	Par comparaison à un étalon de référence dans des bains thermostatés et des fours

Remarques concernant les tableaux I et II:

- Suivant 'Echelle Internationale de Température 1990 (EIT-90)
- 'L'incertitude mentionnée est celle des sondes du laboratoire seules. L'incertitude totale affectée à l'étalonnage d'un thermomètre ne saurait être inférieure à celle mentionnée et dépendra, entre autres, du matériel disponible sur site, des conditions d'environment, ...

(*) le plus petite incertitude de mesure que le laboratoire puisse fournir à ses clients, exprimée en tant qu'incertitude élargie avec un niveau de confiance d'environ 95 %.

Thermometers in laboratorium				
Grootheid/meettoestel	**Meetbereik**	**Uitgebreide meetonzekerheid (*)**	**Opmerkingen**	**Kalibratieprocedure**
Platina-weerrstands-thermometer die voldoet aan de specificaties van de ITS-90 of die de specificaties zeer dicht benadert	-196 °C	0,01 °C	PG-LABO_ETAL	Door vergelijking met de referentiestandaarden in vloeibare stikstof bij atmosferische druk
	-38,834 °C 0,010 °C 29,765 °C 231,928 °C 419,527 °C 156,594 °C	0,004 °C 0,001 °C 0,004 °C 0,004 °C 0,006 °C 0,004 °C	PG-LABO_ETAL	**Vaste definitiepunten** Tripelpunt van kwik Tripelpunt van water Smeltpunt van gallium Stolpunt van tin Stolpunt van zink Tripelpunt van indium
Elk type van temperatuuropnemer al dan niet verbonden met een indicator of elke andere mogelijkheid tot omzetting naar temperatuur (met uitzondering van pyrometers)	Zie tabel I			
	-100 °C tot <-80 °C -80 °C tot <-20 °C -20 °C tot <300 °C 300 °C tot <450 °C 450 °C tot <660 °C 660 °C tot <1064 °C 1064 °C tot 1550 °C	0,022 °C 0,010 °C 0,008 °C 0,010 °C 0,012 °C 0,80 °C 1,60 °C	PG-ETC	Door vergelijking met referentiestandaarden in thermostaatregelingsbaden en ovens
	-40 °C tot <120 °C 120 °C tot 180 °C	0,07 °C 0,18 °C	PG-ETC	Door vergelijking met referentiestandaarden in een klimaatkast
Glazen vloeistofthermometers	-80 °C tot <-58 °C -58 °C tot <160 °C 160 °C tot <300 °C 300 °C tot 350 °C	0,11 °C 0,01 °C 0,03 °C 0,10 °C	PG-ETC	Door vergelijking met referentiestandaarden in thermostaatregelingsbaden en ovens

Opmerkingen betreffende de tabellen I en II:

- Volgens de Internationale temperatuurschaal 1990 (ITS-90)

- De vermelde onzekerheid houdt rekening met de sondes en vergelijkingsmiddelen van het laboratorium. De totale meetonzekerheid van een kalibratie van een thermometer zal niet kleiner kunnen zijn dan de bovenvermelde.

Kalibratie en karakterisering van kalibratieoven				
Grootheid/meettoestel	**Meetbereik**	**Uitgebreide meetonzekerheid (*)**	**Opmerkingen**	**Kalibratieprocedure**
Kalibratie van kalibratieoven	Van -100 °C tot 650 °C	van 0,02 °C tot 0,10 °C	PG-ETC	Door vergelijking met referentiestandaarden in een boring van de oven.
Kalibratie + karakterisering van kalibratieoven	Van -100 °C tot 650 °C	De onzekerheid bepaald tijdens de karakterisering is afhankelijk van het aantal gekarakteriseerde boringen (aantal verschillend volgens aanvraag klant)	PG-ETC	Naast de kalibratie van de oven, bepaling van de radiale uniformiteit tussen verschillende boringen, de warmte van de flux parasiet volgens Euramet cg-13 versie 4 van 09/2017.

Thermometers Onsite				
Instrumenten	**Meetbereik**	**Uitgebreide meetonzekerheid (*)**	**Opmerkingen**	**Kalibratieprocedure**
Elk type van temperatuuropnemer al dan niet verbonden met een indicator of elke andere mogelijkheid tot omzetting naar temperatuur (met uitzondering van pyrometers)	0,010 °C 29,765 °C	0,001 °C 0,004 °C	PG-ETC	Vaste punten
	-196 °C tot <232 °C 232 °C tot <420 °C 420 °C tot <660 °C 660 °C tot <1064 °C 1064 °C tot 1550 °C	0,05 °C 0,06 °C 0,08 °C 1,00 °C 1,90 °C	PG-ETC	Door vergelijking met referentiestandaarden in thermostaatregelingsbaden en ovens

Bemerking betreffende de tabel III:

- Volgens de Internationale temperatuurschaal 1990 (ITS-90)

- De vermelde onzekerheid is enkel geldig voor de sondes van het laboratorium. De totale meetonzekerheid verbonden aan de kalibratie van een thermometer kan niet kleiner kunnen zijn dan de hierboven vermelde cijfers en hangt af van materiaal beschikbaar op de site, de omgevingsomstandigheden, ...

(*) de kleinste meetonzekerheid die het laboratorium aan zijn klanten kan bieden, uitgedrukt als de uitgebreide onzekerheid met een dekkingswaarschijnlijkheid van ongeveer 95%.

Humidity Berchem
Calibration and Measurement Capabilities

Hygrometers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
RH meters with sensor type: resistive, capacitive, electrolytic, impedance, …	10 % RH to 95 % RH @ ambient temperature	0,50 % RH	by comparison with two pressure humitiy generator	P2-02-H.005
	10 % RH to 95 % RH @ 10 to 35 °C	1,0 % RH to 0,50 % RH		
	10 % RH to 95 % RH @ -10 to 10 °C	2,5 % RH to 0,50 % RH		
	10 % RH to 95 % RH @ 35 to 70 °C	1,5 % RH to 0,50 % RH		
Ambient thermometer / humidity meters with sensor type: resistive, capacitive, electrolytic, impedance, …	30 % RH to 85 % RH -20 °C to 140 °C	4,0 % RH 0,10 °C	by comparison with standard sensor in a climate chamber	P2-02-H.004

Other instruments for humidity

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Dew point meters	-70 °C to 0 °C	0,10 °C	Temperature frost- or dewpoint	
	0 °C to 10 °C	0,12 °C		P2-02-H.003

Generators for Humidity

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Humidity generator	10 % RH to 90 % RH	0,10 % RH to 0,90 % RH	by comparison with dew pointmeter	P2-02-H.007

Humidity of temperature controlled chambers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Characterisation of climatic chambers	10 % RH to 90 % RH	1,5 % RH	Only between -20 °C to 100 °C	

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Humidity Louvain-La-Neuve
Calibration and Measurement Capabilities

Hygromètres en laboratoire				
Portée générale				
Grandeur/Instrument	**Etendue de mesure**	**Incertitude élargie (*)**	**Remarques**	**Procedure/méthode d'étalonnage**
Hygromètres à point de rosée, à variation d'impédance et psychromètres	Température de rosée (gelée) de -60 °Cdp à +80 °Cdp	de -60 °Cdp à <-50 °Cdp 0,43 °Cdp de -50 °Cdp à <0 °Cdp 0,17 °Cdp de 0 °Cdp à <50 °Cdp 0,10 °Cdp de 50 °Cdp à <60 °Cdp 0,12 °Cdp de 60 °Cdp à 80 °Cdp 0,30 °Cdp	PG-HYGROMETRES	
	Humidité relative de 5 % HR à 95 % HR	De 0,3 % HR à 1,7 % HR (voir portée détaillée ci-dessous)	PG-HYGROMETRES	Température de -20 °C à +80 °C, par comparaison avec un étalon de référence dans un générateur d'humidité

Portée detaillée

Incertitude absolue calculée de l'humidité relative en fonction de la température et de l'humidité relative (95 %)

	Humidité relative [%HR]										
T (°C)	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**95**
-20	0,3	0,3	0,5	0,6	0,7	0,9	1	1,1	1,2	1,4	1,4
0	0,3	0,3	0,4	0,5	0,6	0,8	0,9	1	1,1	1,3	1,3
10	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,7	0,8	0,9	0,9
20	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,6	0,7	0,7	0,7
30	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0,7
40	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,6	0,6
50	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,5	0,6	0,6	0,6
60	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,5
> 60	0,3	0,3	0,4	0,5	0,6	0,6	0,7	0,8	0,9	0,9	1
70	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,8	0,9	0,9
80	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0.8	0,8	0,9

Hygromètres sur site

Portée générale

Grandeur/Instrument	Etendue de mesure	Incertitude élargie (*)	Remarques	Procedure/méthode d'étalonnage
Hygromètres à point de rosée, à variation d'impédance et psychromètres	Température de rosée (gelée)	0,21 °Cdp	PG-HYGROMETRES	
	Humidité relative de 5 % HR à 95 % HR	De 0,3 % HR à 2,1 % HR (voir portée détaillée ci-dessous)	PG-HYGROMETRES	Température de -20 °C à +60 °C, par comparaison avec un étalon de référence dans un générateur d'humidité

Portée detaillée

Incertitude absolue calculée de l'humidité relative en fonction de la température et de l'humidité relative (95 %)

	Humidité relative [%HR]										
T (°C)	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**95**
-20	/	/	/	0,8	1	1,2	1,4	1,6	1,8	2	2,1
0	/	0,4	0,5	0,7	0,9	1,1	1,3	1,5	1,7	1,9	2
10	0,3	0,4	0,5	0,7	0,9	1	1,2	1,4	1,6	1,7	1,8
20	0,3	0,3	0,5	0,6	0,8	0,9	1	1,1	1,2	1,4	1,4
30	0,3	0,3	0,5	0,6	0,7	0,8	1	1,1	1,2	1,3	1,4
40	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,2
50	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,1
60	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,9	1	1

(*) le plus petite incertitude de mesure que le laboratoire puisse fournir à ses clients, exprimée en tant qu'incertitude élargie avec un niveau de confiance d'environ 95 %.

Hygrometers in laboratorium

Algemeenheden

Grootheid/meettoestel	Meetbereik	Uitgebreide meetonzekerheid (*)	Opmerkingen	Kalibratieprocedure/methode
Spiegeldauwpuntsmeters, impedantie hygrometers en psychrometers	Dauwpunttemperatuur (vorstpunt) van -60 °Cdp tot +80 °Cdp	van -60 °Cdp tot <-50 °Cdp: 0,43 °Cdp van -50 °Cdp tot <0 °Cdp: 0,17 °Cdp van 0 °Cdp tot <50 °Cdp: 0,10 °Cdp van 50 °Cdp tot <60 °Cdp: 0,12 °Cdp van 60 °Cdp tot 80 °Cdp: 0,30 °Cdp	PG-HYGROMETRES	
	Relatieve vochtigheid van de 5 % RV tot 95 % RV	Van 0,3 % RV tot 1,7 % RV (zie uitvoerige tabel hieronder)	PG-HYGROMETRES	Temperatuur van -20 °C tot +80 °C, door vergelijking met referentiestandaaarden in een vochtigheidsgenerator

Details

Berekende absolute onzekerheid van de relatieve vochtigheid als functie van de temperatuur en relatieve

	Relatieve vochtigheid [%RV]										
T (°C)	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**95**
-20	0,3	0,3	0,5	0,6	0,7	0,9	1	1,1	1,2	1,4	1,4
0	0,3	0,3	0,4	0,5	0,6	0,8	0,9	1	1,1	1,3	1,3
10	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,7	0,8	0,9	0,9
20	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,6	0,7	0,7	0,7
30	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0,7
40	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,6	0,6
50	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,5	0,6	0,6	0,6
60	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,5
> 60	0,3	0,3	0,4	0,5	0,6	0,6	0,7	0,8	0,9	0,9	1
70	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,8	0,9	0,9
80	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0.8	0,8	0,9

Hygrometers Onsite

Algemeenheden

Grootheid/meettoestel	Meetbereik	Uitgebreide meetonzekerheid (*)	Opmerkingen	Kalibratieprocedure
Spiegeldauwpuntsmeters, impedantie hygrometers en psychrometers	Dauwpunttemperatuur (vorstpunt)	0,21 °Cdp	PG-HYGROMETRES	
	Relatieve vochtigheid van de 5 % RV tot 95 % RV	Van 0,3 % HR tot 2,1 % RV (zie uitvoerige tabel hier onder)	PG-HYGROMETRES	Temperatuur van -20 °C tot +60 °C, door vergelijking met referentiestandaarden in een vochtigheidsgenerator

Details

Berekende absolute onzekerheid van de relatieve vochtigheid als functie van de temperatuur en relatieve

	Relatieve vochtigheid [%RV]										
T (°C)	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**95**
-20	/	/	/	0,8	1	1,2	1,4	1,6	1,8	2	2,1
0	/	0,4	0,5	0,7	0,9	1,1	1,3	1,5	1,7	1,9	2
10	0,3	0,4	0,5	0,7	0,9	1	1,2	1,4	1,6	1,7	1,8
20	0,3	0,3	0,5	0,6	0,8	0,9	1	1,1	1,2	1,4	1,4
30	0,3	0,3	0,5	0,6	0,7	0,8	1	1,1	1,2	1,3	1,4
40	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,2
50	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,1
60	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,9	1	1

(*) de kleinste meetonzekerheid die het laboratorium aan zijn klanten kan bieden, uitgedrukt als de uitgebreide onzekerheid met een dekkingswaarschijnlijkheid van ongeveer 95%.

Chemical Analysis Louvain-La-Neuve
Calibration and Measurement Capabilities

Etalonnage CO_2				
Grandeur/Instrument	**Etendue de mesure**	**Incertitude élargie (*)**	**Remarques**	**Procedure d'étalonnage**
Etalonnage % CO_2 en laboratoire	De 0 % CO_2 à 20 % CO_2	0,07 % CO_2	PG-ETAL_CO2	Par comparaison avec des bouteilles de gaz accrédités ISO 17025
Etalonnage % CO_2 sur site	De 0 % CO_2 à 20 % CO_2	0,25 % CO_2	PG-ETAL_CO2	Par comparaison avec un étalon accrédité dans l'enceinte du client

(*) le plus petite incertitude de mesure que le laboratoire puisse fournir à ses clients, exprimée en tant qu'incertitude élargie avec un niveau de confiance d'environ 95%.

Kalibratie van CO_2				
Grootheid/meettoestel	**Meetbereik**	**Uitgebreide meetonzekerheid (*)**	**Opmerkingen**	**Kalibratieprocedure**
Kalibratie % CO_2 in laboratorium	Van 0 % CO_2 tot 20 % CO_2	0,07 % CO_2	PG-ETAL_CO2	Door vergelijking met ISO17025 geaccrediteerde gassen
Kalibratie % CO_2 Onsite	Van 0 % CO_2 tot 20 % CO_2	0,25 % CO_2	PG-ETAL_CO2	Door vergelijking met referentiestandaarden in de kast van de klant

(*) de kleinste meetonzekerheid die het laboratorium aan zijn klanten kan bieden, uitgedrukt als de uitgebreide onzekerheid met een dekkingswaarschijnlijkheid van ongeveer 95%.

Reference materials Berchem
Calibration and Measurement Capabilities

Hardness

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Hardness tester	0 Shore A to 100 Shore A	0,50 Shore A		
	0 Shore D to 100 Shore D	0,50 Shore D		
Reference for hardness tester	Shore A	2,0 mN		P2-02-M.018
	Shore D	6,0 mN		

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.

Volume Berchem

Calibration and Measurement Capabilities

Volume

Measure quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Volume measuring devices, pipettes	10 µl to 50 µl	0,40 µl	Gravimetric method	KI/02/KC/V.01
	50 µl to 100 µl	0,50 µl		
	100 µl to 500 µl	0,60 µl		
	500 µl to 1 ml	1,0 µl		
	1 ml to 10 ml	10 µl		
	10 ml to 25 ml	20 µl		
	25 ml to 50 ml	50 µl		
Volume measuring devices, glass cups, recipients, …	50 ml to 100 ml	1,0 ml	Gravimetric method	KI/02/KC/V.51
	100 ml to 200 ml	1,5 ml		
	200 ml to 300 ml	2,0 ml		
	300 ml to 500 ml	2,5 ml		
	500 ml to 1000 ml	3,0 ml		
	1 l to 5 l	3,5 ml		

(*) the smallest uncertainty of measurement the laboratory can provide to its customers, expressed as the expanded uncertainty having a coverage probability of approximately 95%.