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

001-CAL

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Voorzitster van het Accreditatiebureau
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 BERCHEM

Voor activiteiten uitgevoerd door/ Pour des activités exécutés par/
For activities performed by/ Die tätigkeiten werden durchgeführt von:

locatie 1	**BERCHEM**	**Vosstraat, 200** **2600 Berchem**
locatie 2	**WELLIN**	**Rue Jean Meunier, 2** **6920 Halma (Wellin)**
locatie 3	**LOUVAIN-LA-NEUVE**	**Rue du Bosquet, 7** **1348 LOUVAIN-LA-NEUVE**

DCLF Electricity Berchem (In House or In Situ)
Calibration and Measurement Capabilities

Direct voltage
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
± 100 mV	DC	$5{,}0 \times 10^{-6} \times U$	• 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	$3{,}0 \times 10^{-6} \times U$	
± 1000 V	DC	$3{,}0 \times 10^{-6} \times U$	

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
0 mV to 200 mV	DC	$7{,}0 \times 10^{-6} \times U$ or 0,1 µV[1]	• measure • positive / negative
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
0,2 V to 11 V	DC	$5{,}0 \times 10^{-6} \times U$	Loop calibration
[1] Whichever is greater			

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
0 mV to 200 mV	DC	$18 \times 10^{-6} \times U$ or 0,5 µV[1]	• generate • positive / negative
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 - 40 kV	DC	$3{,}0 \times 10^{-4} \times U$	Generate
0,2 V to 11 V	DC	$8{,}0 \times 10^{-6} \times U$	Loop calibration
[1] Whichever is greater			

Direct current

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
±100 µA	DC	$24 \times 10^{-6} \times I$	• Transfer standard in "30 day" loop • Fixed points • positive / negative • Measurement
±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
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
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	$16 \times 10^{-6} \times I$	Loop calibration

[1] Whichever is greater

Calibration of current clamps

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

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
0 µA to 20 µA	DC	1,5 nA	• generate • positive / negative
20 µA to 200 µA	DC	$1{,}7 \times 10^{-4} \times I$	
0,2 mA to 200 mA	DC	$0{,}7 \times 10^{-4} \times I$	
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	$0{,}7 \times 10^{-4} \times I$	Loop calibration

Alternating voltage

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
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
	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
	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
0,7 mV to 2,2 mV	10 Hz to 20 Hz	$17 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure
	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	$8{,}2 \times 10^{-4} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$12 \times 10^{-4} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$23 \times 10^{-4} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$26 \times 10^{-4} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$50 \times 10^{-4} \times U + 8\ \mu V$	
2 mV to 7 mV	10 Hz to 20 Hz	$8{,}5 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure
	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	$4{,}1 \times 10^{-4} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$6{,}1 \times 10^{-4} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$12 \times 10^{-4} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$14 \times 10^{-4} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$36 \times 10^{-4} \times U + 8\ \mu V$	
7 mV to 22 mV	10 Hz to 20 Hz	$2{,}9 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure
	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	$2{,}1 \times 10^{-4} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$3{,}1 \times 10^{-4} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$8{,}2 \times 10^{-4} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$10 \times 10^{-4} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$26 \times 10^{-4} \times U + 8\ \mu V$	
22 mV to 70 mV	10 Hz to 20 Hz	$2{,}4 \times 10^{-4} \times U + 1{,}5\ \mu V$	• measure
	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	$1{,}3 \times 10^{-4} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$2{,}6 \times 10^{-4} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$5{,}3 \times 10^{-4} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$6{,}8 \times 10^{-4} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$13 \times 10^{-4} \times U + 8\ \mu V$	

70 mV to 220 mV	10 Hz to 20 Hz	$21 \times 10^{-5} \times U + 1{,}5\ \mu V$	• measure
	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	$7{,}3 \times 10^{-5} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$16 \times 10^{-5} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$28 \times 10^{-5} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$40 \times 10^{-5} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U + 8\ \mu V$	
220 mV to 700 mV	10 Hz to 20 Hz	$21 \times 10^{-5} \times U + 1{,}5\ \mu V$	• measure
	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	$5{,}6 \times 10^{-5} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$8{,}4 \times 10^{-5} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$21 \times 10^{-5} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$34 \times 10^{-5} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U + 8\ \mu V$	
0,7 V to 2,2 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure
	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
	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
	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
	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
	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
	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
	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 Hz	$3{,}0 \times 10^{-3} \times U$	• measure

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
2 mV to 20 mV	1 kHz to10 kHz	$7{,}0 \times 10^{-4} \times U$	• generate
	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
	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
	300 Hz to 1 kHz	$1{,}1 \times 10^{-4} \times U$	
	1 kHz to30 kHz	$0{,}7 \times 10^{-4} \times U$	
	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
	300 Hz to 1 kHz	$1{,}0 \times 10^{-4} \times U$	
	1 kHz to10 kHz	$0{,}8 \times 10^{-4} \times U$	
	10 kHz to 30 kHz	$0{,}7 \times 10^{-4} \times U$	
	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
	300 Hz to 1 kHz	$1{,}2 \times 10^{-4} \times U$	
	1 kHz to10 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
	300 Hz to 1 kHz	$2{,}3 \times 10^{-4} \times U$	
	1 kHz to10 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
1 kV to 45 kV	50 Hz	$3{,}0 \times 10^{-3} \times U$	• generate

Alternating currect
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
100 µA	10 Hz to 30 Hz	$1{,}4 \times 10^{-4} \times I$	• Transfer standard in "30 day" loop • Fixed points • Measurement
	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
5 µA to 200 µA	10 Hz to 5 kHz	$1{,}6 \times 10^{-4} \times I$	• measure
	5 kHz to 10 kHz	$5{,}0 \times 10^{-4} \times I$	
0,2 mA to 2 mA	10 Hz to 5 kHz	$0{,}6 \times 10^{-4} \times I$	
	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
20 A to 1000 A	45 Hz to 440 Hz	$5{,}0 \times 10^{-3} \times I$	• with current coils

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
20 µA to 200 µA	10 Hz to 1 kHz	$4{,}0 \times 10^{-4} \times I$	• generate • in the lowest range possible
	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
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
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	$1{,}0 \times 10^{-4} \times P$	0,66 W to 500 kW / kVA(r) generate
33 mV to 1000 V / 20 A to 500 A	45 Hz to 100 Hz	$1{,}1 \times 10^{-3} \times P$	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
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
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
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
-67 dBm to -19 dBm	20 kHz to 100 MHz	0,056 dB	• measure
	100 MHZ to 4 GHz	0,047 dB	
	4 GHz to 6 GHz	0,048 dB	
-19 dBm to 1 dBm	20 kHz to 100 MHz	0,066 dB	• measure
	100 MHZ to 4 GHz	0,058 dB	
	4 GHz to 6 GHz	0,063 dB	
1 dBm to 23 dBm	20 kHz to 100 MHz	0,083 dB	• measure
	100 MHZ to 4 GHz	0,072 dB	
	4 GHz to 6 GHz	0,082 dB	
24 dBm to 20 dBm	10 Hz to 20 kHz	0,050 dB	• generate
	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
	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
	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
	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
	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
	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
	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
	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
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
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
0 Ω to 2 Ω	DC	$18 \times 10^{-6} \times R$ or 20 μΩ[1]	• measure • 4-wire resistance measurement • negligible dissipated power
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	$60 \times 10^{-6} \times R$	
200 MΩ to 2 GΩ	DC	$1{,}2 \times 10^{-3} \times R$	

[1] Whichever is greater

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
0 Ω	DC	100 µΩ	• generate • fixed points • 4-wire resistance • Negligible dissipated power in the lowest range possible
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 • maximum dissipated power 10 mW
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 • maximum dissipated power 10 mW
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.			

Calibration of resistor / insulation meters

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
50 V to 250 V	10 kΩ to 40 MΩ	$1{,}0 \times 10^{-4} \times R$	
	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
10 pF to 100 pF	1 kHz	$15 \times 10^{-4} \times C$	Measure / generate
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
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
100 µH to 1 H	1 kHz	$10 \times 10^{-4} \times L$	Measure / generate
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
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
± 1 mV to 200 V	DC	$2{,}5 \times 10^{-4} \times U + 25\ \mu V$	50 Ω to 5,56 V
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

Bridge calibration

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
-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
0 mV to 200 mV	DC	$8{,}0 \times 10^{-6} \times U$ or 0,12 µV[1]	• measure • positive / negative
0,2 V to 2 V	DC	$10 \times 10^{-6} \times U$	
2 V to 20 V	DC	$7{,}0 \times 10^{-6} \times U$	
20 V to 200 V	DC	$5{,}0 \times 10^{-6} \times U$	
200 V to 1000 V	DC	$5{,}0 \times 10^{-6} \times U$	
[1] Whichever is greater			

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
0 V	DC	0,5 µV	• generate • positive / negative
0 mV to 220 mV	DC	$13 \times 10^{-6} \times U$ or 1,0 µV[1]	
220 V to 2,2 V	DC	$4{,}0 \times 10^{-6} \times U$	
2,2 V to 22 V	DC	$4{,}0 \times 10^{-6} \times U$	
22 V to 220 V	DC	$7{,}0 \times 10^{-6} \times U$	
220 V to 1100 V	DC	$7{,}0 \times 10^{-6} \times U$	
[1] Whichever is greater			

Direct current
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
0 µA to 200 µA	DC	$20 \times 10^{-6} \times I$ or 0,5 nA[1]	• measure • in the lowest possible range • positive / negative
0,2 mA to 2,0 mA	DC	$10 \times 10^{-6} \times I$	
2,0 mA to 20 mA	DC	$10 \times 10^{-6} \times I$	
20 mA to 200 mA	DC	$10 \times 10^{-6} \times I$	
0,2 A to 2 A	DC	$60 \times 10^{-6} \times I$	
2 A to 20 A	DC	$200 \times 10^{-6} \times I$	
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
20 A to 500 A	DC	$10 \times 10^{-3} \times I$	• with current coils

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
0 µA to 220 mA	DC	$40 \times 10^{-6} \times I$ or 1,0 nA[1]	• generate • positive / negative
220 mA to 2,2 A	DC	$1{,}0 \times 10^{-4} \times I$	
2,2 A to 11 A	DC	$2{,}0 \times 10^{-4} \times I$	
11 A to 100 A	DC	$10 \times 10^{-4} \times I$	
[1] Whichever is greater			

Alternating voltage
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
0,7 mV to 2,2 mV	10 Hz to 20 Hz	$17 \times 10^{-4} \times U$ + 1,3 µV	• measure
	20 Hz to 40 Hz	$7{,}4 \times 10^{-4} \times U$ + 1,3 µV	
	40 Hz to 20 kHz	$4{,}2 \times 10^{-4} \times U$ + 1,3 µV	
	20 kHz to 50 kHz	$8{,}2 \times 10^{-4} \times U$ + 2 µV	
	50 kHz to 100 kHz	$12 \times 10^{-4} \times U$ + 2,5 µV	
	100 kHz to 300 kHz	$23 \times 10^{-4} \times U$ + 4 µV	
	300 kHz to 500 kHz	$26 \times 10^{-4} \times U$ + 8 µV	
	500 kHz to 1 MHz	$50 \times 10^{-4} \times U$ + 8 µV	
2 mV to 7 mV	10 Hz to 20 Hz	$8{,}5 \times 10^{-4} \times U$ + 1,3 µV	• measure
	20 Hz to 40 Hz	$3{,}7 \times 10^{-4} \times U$ + 1,3 µV	
	40 Hz to 20 kHz	$2{,}1 \times 10^{-4} \times U$ + 1,3 µV	
	20 kHz to 50 kHz	$4{,}1 \times 10^{-4} \times U$ + 2 µV	
	50 kHz to 100 kHz	$6{,}1 \times 10^{-4} \times U$ + 2,5 µV	
	100 kHz to 300 kHz	$12 \times 10^{-4} \times U$ + 4 µV	
	300 kHz to 500 kHz	$14 \times 10^{-4} \times U$ + 8 µV	
	500 kHz to 1 MHz	$36 \times 10^{-4} \times U$ + 8 µV	

7 mV to 22 mV	10 Hz to 20 Hz	$2{,}9 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure
	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	$2{,}1 \times 10^{-4} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$3{,}1 \times 10^{-4} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$8{,}2 \times 10^{-4} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$10 \times 10^{-4} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$26 \times 10^{-4} \times U + 8\ \mu V$	
22 mV to 70 mV	10 Hz to 20 Hz	$2{,}4 \times 10^{-4} \times U + 1{,}5\ \mu V$	• measure
	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	$1{,}3 \times 10^{-4} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$2{,}6 \times 10^{-4} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$5{,}3 \times 10^{-4} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$6{,}8 \times 10^{-4} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$13 \times 10^{-4} \times U + 8\ \mu V$	
70 mV to 220 mV	10 Hz to 20 Hz	$21 \times 10^{-5} \times U + 1{,}5\ \mu V$	• measure
	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	$7{,}3 \times 10^{-5} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$16 \times 10^{-5} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$28 \times 10^{-5} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$40 \times 10^{-5} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U + 8\ \mu V$	
220 mV to 700 mV	10 Hz to 20 Hz	$21 \times 10^{-5} \times U + 1{,}5\ \mu V$	• measure
	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	$5{,}6 \times 10^{-5} \times U + 2\ \mu V$	
	50 kHz to 100 kHz	$8{,}4 \times 10^{-5} \times U + 2{,}5\ \mu V$	
	100 kHz to 300 kHz	$21 \times 10^{-5} \times U + 4\ \mu V$	
	300 kHz to 500 kHz	$34 \times 10^{-5} \times U + 8\ \mu V$	
	500 kHz to 1 MHz	$120 \times 10^{-5} \times U + 8\ \mu V$	

0,7 V to 2,2 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure
	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
	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
	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
	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
	20 Hz to 40 Hz	$7{,}2 \times 10^{-5} \times U$	
	40 Hz to 20 kHz	3,8 × 10-5 × 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 to 700 V	10 Hz to 20 Hz	$20 \times 10^{-5} \times U$	• measure
	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
	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	$85 \times 10^{-5} \times U$	

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
2,2 mV to 22 mV	20 Hz to 20 kHz	$4{,}0 \times 10^{-4} \times U$	• generate
	20 kHz to 100 kHz	$11 \times 10^{-4} \times U$	
22 mV to 220 mV	20 Hz to 20 kHz	$0{,}5 \times 10^{-4} \times U$	• generate
	20 kHz to 100 kHz	$23 \times 10^{-4} \times U$	
0,22 V to 2,2 V	20 Hz to 20 kHz	$0{,}5 \times 10^{-4} \times U$	• generate
	20 kHz to 100 kHz	$20 \times 10^{-4} \times U$	
2,2 V to 22 V	40 Hz to 20 kHz	$0{,}5 \times 10^{-4} \times U$	• generate
	20 kHz to 100 kHz	$1{,}0 \times 10^{-4} \times U$	
22 V to 220 V	40 Hz to 20 kHz	$0{,}6 \times 10^{-4} \times U$	• generate
	20 kHz to 100 kHz	$6{,}0 \times 10^{-4} \times U$	
220 V to 1000 V	50 Hz to 20 kHz	$0{,}6 \times 10^{-4} \times U$	• generate

Alternating currect

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
10 µA to 200 µA	55 Hz to 5 kHz	$2{,}0 \times 10^{-4} \times I$	• measure
0,2 mA to 2 mA	55 Hz to 5 kHz	$1{,}0 \times 10^{-4} \times I$	
2 mA to 20 mA	55 Hz to 5 kHz	$2{,}0 \times 10^{-4} \times I$	
20 mA to 200 mA	55 Hz to 5 kHz	$1{,}0 \times 10^{-4} \times I$	
0,2 A to 2 A	55 Hz to 1 kHz	$3{,}0 \times 10^{-4} \times I$	
	1 kHz to 5 kHz	$8{,}0 \times 10^{-4} \times I$	
2 A to 20 A	55 Hz to 1 kHz	$40 \times 10^{-4} \times I$	

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
20 A to 500 A	45 Hz to 100 Hz	$10 \times 10^{-3} \times I$	• with current coils
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
10 µA to 2,2 A	40 Hz to 1 kHz	$2{,}0 \times 10^{-4} \times I$	• generate
2,2 A to 10 A	20 Hz to 1 kHz	$6{,}0 \times 10^{-4} \times I$	

Power and Energy

Impedance (DC/LF)

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
0 Ω to 2 Ω	DC	$30 \times 10^{-6} \times R$ or 70 µΩ[1]	• measure • 4-wire resistance measurement • negligible dissipated power
2 Ω to 20 Ω	DC	$10 \times 10^{-6} \times R$	
20 Ω to 200 Ω	DC	$11 \times 10^{-6} \times R$	
0,2 kΩ to 200 kΩ	DC	$10 \times 10^{-6} \times R$	
0,2 MΩ to 2 MΩ	DC	$40 \times 10^{-6} \times R$	
2 MΩ to 20 MΩ	DC	$80 \times 10^{-6} \times R$	
20 MΩ to 200 MΩ	DC	$40 \times 10^{-6} \times R$	
200 MΩ to 2 GΩ	DC	$1{,}0 \times 10^{-3} \times R$	

[1] Whichever is greater

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark
0 Ω	DC	1 mΩ	• generate • fixed points • 2-wire resistance
1 Ω	DC	$100 \times 10^{-6} \times R$ + 8 mΩ	
1,9 Ω	DC	$100 \times 10^{-6} \times R$ + 8 mΩ	
10 Ω	DC	$30 \times 10^{-6} \times R$ + 8 mΩ	
19 Ω	DC	$30 \times 10^{-6} \times R$ + 8 mΩ	
100 Ω	DC	$20 \times 10^{-6} \times R$ + 8 mΩ	
190 Ω	DC	$20 \times 10^{-6} \times R$ + 8 mΩ	
1,0 kΩ	DC	$15 \times 10^{-6} \times R$ + 20 mΩ	
1,9 kΩ	DC	$15 \times 10^{-6} \times R$ + 20 mΩ	
10 kΩ	DC	$15 \times 10^{-6} \times R$ + 100 mΩ	
19 kΩ	DC	$15 \times 10^{-6} \times R$ + 100 mΩ	
100 kΩ	DC	$20 \times 10^{-6} \times R$ + 100 mΩ	
190 kΩ	DC	$20 \times 10^{-6} \times R$ + 100 mΩ	
1 MΩ	DC	$25 \times 10^{-6} \times R$	
1,9 MΩ	DC	$30 \times 10^{-6} \times R$	
10 MΩ	DC	$50 \times 10^{-6} \times R$	
19 MΩ	DC	$60 \times 10^{-6} \times R$	
100 MΩ	DC	$140 \times 10^{-6} \times R$	
0 Ω	DC	100 µΩ	• generate • fixed points • 4- wire resistance
1 Ω, 1,9 Ω, 10 Ω, 19 Ω, 100 Ω, 190 Ω	DC	$30 \times 10^{-6} \times R$	
1 kΩ, 1,9 kΩ, 10 kΩ, 19 kΩ, 100 kΩ, 190 kΩ	DC	$10 \times 10^{-6} \times R$	
1 MΩ, 1,9 MΩ	DC	$18 \times 10^{-6} \times R$	
1,9 MΩ	DC	$40 \times 10^{-6} \times R$	
10 MΩ	DC	$60 \times 10^{-6} \times R$	
19 MΩ	DC	$250 \times 10^{-6} \times R$	

Calibration of resistor / insulation meters

Measuring range or point	Frequency	expanded uncertainty (*)	Remark
50 V to 250 V	10 kΩ to 40 MΩ	$1{,}0 \times 10^{-4} \times R$	
	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
Tachometers, stroboscopes (optical)	1,2 rpm to 100 000 rpm	$3{,}0 \times 10^{-7} \times n$	
Mechanical tachometers	10 rpm to 17 000 rpm	$0{,}050 \text{ rpm} + 10 \times 10^{-5} \times n$	
n: number of rotations in rpm			

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Frequencymeters, frequencygenerators, counters	1 Hz	$5{,}0 \times 10^{-11} \times f$	• generate • fixed points • CMC calculated at 600 s measuring time
	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
	0,002 Hz to 4 GHz	$5{,}0 \times 10^{-9} \times f$	• generate • CMC calculated at 600 s measuring time

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Electronic chronometers	n.a.	0,10 s / 24 h	direct measurement
Mechanic chronometers	n.a.	5,0 s / 24 h	direct measurement
Elektronic & 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
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
Tachometers, stroboscopes (optical)	6 rpm to 100 000 rpm	$3{,}0 \times 10^{-7} \times n$	
n : number of rotations in rpm			

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

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Electronic chronometers	n.a.	0,10 s / 24 h	direct measurement
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
Central length steel	0,5 mm to 100 mm 0,02 inch to 4 inch	$0{,}060\ \mu m + 0{,}90 \times 10^{-6} \times l$	fixed sizes
Central length tungsten carbide		$0{,}060\ \mu m + 0{,}70 \times 10^{-6} \times l$	
Central length ceramic		$0{,}060\ \mu m + 0{,}80 \times 10^{-6} \times l$	
		$0{,}060\ \mu m + 1{,}2 \times 10^{-6} \times l$	reference steel
Central length steel, tungsten carbide, ceramic	0,05 mm to 500 mm 0,005 inch to 20 inch	$0{,}10\ \mu m + 2{,}0 \times 10^{-6} \times l$	all sizes
Lengthvariation steel, tungsten carbide, ceramic	0,5 mm to 100 mm 0,02 inch to 4 inch	0,050 µm	
Step gauge	to 1200 mm	$0{,}80\ \mu m + 3{,}0 \times 10^{-6} \times l$	

Clinometers
See 1.5.13

Line scales, distances

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Ruler (all models)	to 200 mm	$1{,}5\ \mu m + 3{,}0 \times 10^{-6} \times l$	e.g. spring rule
	to 400 mm	$2{,}0\ \mu m + 3{,}0 \times 10^{-6} \times l$	
	to 3000 mm	$12\ \mu m + 3{,}0 \times 10^{-6} \times l$	
	to 100 m	$6{,}0\ \mu m + 5{,}0 \times 10^{-6} \times l$	
Feeler gauges	to 5 mm	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$	
Setting standard for external micrometers	to 300 mm	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$	
	300 to 500 mm	$0{,}90\ \mu m + 0{,}60 \times 10^{-6} \times l$	
	500 to 3000 mm	$3{,}0\ \mu m + 3{,}0 \times 10^{-6} \times l$	
Other distance of 2 parallel planes	to 300 mm	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$	
	300 to 500 mm	$0{,}90\ \mu m + 0{,}60 \times 10^{-6} \times l$	
	500 to 3000 mm	$3{,}0\ \mu m + 3{,}0 \times 10^{-6} \times l$	

Length measuring instruments

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Hand held tools for external measurements	0 mm to 200 mm	$0{,}45\ \mu m + 0{,}50 \times R + 25 \times 10^{-6} \times l$	(1) e.g. vernier, micrometer, …
	200 mm to 3000 mm	$4{,}0\ \mu m + 0{,}50 \times R + 5{,}0 \times 10^{-6} \times l$	
Hand held tools for internal measurements			(1) e.g. internal micrometers
2-point	0 mm to 200 mm	$0{,}70\ \mu m + 0{,}50 \times R + 25 \times 10^{-6} \times l$	
	200 mm to 400 mm	$5{,}0\ \mu m + 0{,}50 \times R + 4{,}0 \times 10^{-6} \times l$	
2- and 3-point	0 mm to 250 mm	$1{,}5\ \mu m + 0{,}50 \times R + 25 \times 10^{-6} \times l$	
Hand held tools for height and depth measurements	0 mm to 500 mm	$0{,}70\ \mu m + 0{,}50 \times R + 25 \times 10^{-6} \times l$	(1)
Linear displacement sensor	to 200 mm	$0{,}050\ \mu m + 2{,}5 \times 10^{-6} \times l + 0{,}80 \times R$	to 50 mm (1)
Height gauge	to 1500 mm	$0{,}80\ \mu m + 0{,}70 \times R + 2{,}5 \times 10^{-6} \times l$	(1)
Film thickness gauge	to 2 mm	$1{,}0\ \mu m + 2{,}0 \times 10^{-3} \times l$	(1)
Laser distance meter	to 25 m	$0{,}50\ mm + 40 \times 10^{-6} \times l + 0{,}60 \times R$	

Diameter

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Setting rings and ring gauges	Ø 1 mm to Ø 250 mm	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$	
Cylindrical setting pins	to 200 mm	$0{,}50\ \mu m + 1{,}5 \times 10^{-6} \times l$	
Plain plug gauges	to 200 mm	$0{,}50\ \mu m + 1{,}5 \times 10^{-6} \times l$	
Thread wires	to 20 mm	$0{,}50\ \mu m + 1{,}5 \times 10^{-6} \times l$	
Radius gauge	to Ø 200 mm	$3{,}0\ \mu m + 5{,}0 \times 10^{-6} \times l$	
Other internal diameters	Ø 1 mm to Ø 250 mm	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$	
Other external diameters	Ø 0,05 mm to Ø 300 mm	$0{,}50\ \mu m + 1{,}5 \times 10^{-6} \times l$	
	Ø 300 mm to Ø 500 mm	$0{,}90\ \mu m + 0{,}60 \times 10^{-6} \times l$	

Form error

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Knife edge straight edge	to 300 mm	0,30 µm	
Straight edge	to 6000 mm	$0{,}50\ \mu m + 0{,}50 \times 10^{-6} \times l$	(1)
Surface plate	to 6 000 mm x 10 000 mm	$0{,}30\ \mu m + 1{,}6 \times 10^{-6} \times l$	(1) l = longest side of the surface plate
Roundness tester	to 300 µm	0,050 µm + 0,50 × R	(1)
Roundness standard	to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness
Flick standard (roundness standard)	to 1 mm	0,25 µm	

Roughness

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
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
	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
	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**
Pitch	to 10 mm	2 µm	
Profile angle	to 180°	(0,50 + 12/*l*) bgmin	*l* = leg length in mm
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
		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**
Pitch	to 10 mm	2 µm	
Profile angle	to 180°	(0,50 + 12/*l*) bgmin	*l* = leg length in mm
Simple pitch diameter	Ø 4 mm to Ø 300 mm	α = 30°: (9,0 µm to 14,0 µm)	Acc. to Euramet/CG-10, method 1a or 1b
		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**
Deviation of nominal displacement	to 20 m		e.g. 1D/2D/3D Measuring machine with:
		$0{,}15\ \mu m + 0{,}70 \times R + 1{,}0 \times 10^{-6} \times l$	Zerodur scales; (1)
		$0{,}15\ \mu m + 0{,}70 \times R + 1{,}3 \times 10^{-6} \times l$	Glass scales; (1)
		$0{,}15\ \mu m + 0{,}70 \times R + 1{,}6 \times 10^{-6} \times l$	Steel scales; (1)
	to 400 mm	$0{,}30\ \mu m + 2{,}3 \times 10^{-6} \times l$	using reference glass scale; (1)
Deviations transverse to the translation directions	to 0,5 mm	$0{,}30\ \mu m + 3{,}0 \times 10^{-6} \times l + 5{,}0 \times 10^{-3} \times A$	A = measured deviation Measuring length to 3000 mm; (1)
Rotational deviations around the translation direction	to 400 as	$0{,}50\ as + 3{,}5 \times 10^{-3} \times A$	A = measured angle; horizontal translation only; (1)
Other rotational deviations	to 7200 as	$0{,}50\ as + 1{,}6 \times 10^{-3} \times A$	A = measured angle; measured length to 4500 mm; (1)
as = arcsecond			

Angle gauges

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

Angle (measuring instruments)

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Spirit level	to 12,5 mm/m	0,50 µm/m + 1,0 × 10^{-3} × A + 0,7 × R	A = set angle
	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
	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)
Angle sensor	0° - 360°	2,0 as	e.g. protractor; (1)
Clinometers	0° - 360°	2,0 as	
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
Form			
Surface profile	to 10 mm × 100 mm	1,0 µm + 0,010 × A	A = measured profile height
Roughness value	Ra: to 10 µm	0,025 µm + 0,060 × A	A = measured Ra-value
	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
Straightness	to 10 mm × 100 mm	1,0 µm + 0,010 × A	A = measured profile height
	to 300 mm	0,30 µm	
	to 6000 mm	0,50 µm + 0,50 × 10^{-6} × L	(1)
Roundness			
Roundness external	to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness
Roundness internal	Ø 0,7 mm to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness
Cilindricity			
Cilindricity external	to Ø 300 mm to height 300 mm	0,40 µm + 0,040 × A	A = measured cilindricity
Cilindricity internal	Ø 0,7 mm to Ø 300 mm to height 300 mm	0,40 µm + 0,040 × A	A = measured cilindricity
Coaxiality and concentricity	Ø 0,7 mm to Ø300 mm to height 300 mm	0,10 µm + 0,040 × A	A = measured coaxiality / concentricity
Planes or sides			
Flatness	to Ø 55 mm	0,050 µm	
	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)
Angle between sides or planes	to 180°	(0,50 + 12/*l*) amin	*l* = leg length in mm; leg length to 200 mm
		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
Parallelism	to 1200 mm	1,0 µm + 2,0 × 10^{-6} × *l*	*l* = leg length

Diameter			
External	Ø 0,05 mm to Ø 300 mm	0,50 µm + 1,5 × 10^{-6} × *l*	
	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*	
Distance of 2 parallel surfaces			
External	to 200 mm	0,50 µm + 2,0 × 10^{-6} × *l*	
	to 3000 mm	0,40 µm + 4,0 × 10^{-6} × *l*	
Internal	to 1200 mm	1,2 µm + 4,0 × 10^{-6} × *l*	
Thread external			
Pitch	to 10 mm	2,0 µm	
Profile angle	to 180°	(0,50 + 12 / *l*) bgmin	*l* = leg length in mm
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
		α = 60°: (3,2 µm to 5,9 µm)	
		α = 90°: (2,6 µm to 5,5 µm)	
Thread internal			
Pitch	to 10 mm	2,0 µm	
Profile angle	to 180°	(0,50 + 12 / *l*) bgmin	*l* = leg length in mm
Simple pitch diameter	Ø 4 mm to Ø 300 mm	α = 30°: (9,0 µm to 14,0 µm)	Acc. to Euramet/CG-10, method 1a or 1b
		α = 60°: (3,6 µm to 7,0 µm)	
		α = 90°: (3,1 µm to 6,2 µm)	
(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
Push pull force measuring devices in tension and compression	0,80 N to 5 000 N	$1{,}0 \times 10^{-4} \times F$	dead weights, f.i. ISO376 and ISO7500-1[3]
	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	$0{,}010 \times F$	

Torque

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Torque tools	0,1 Nm to 2700 Nm	$8{,}0 \times 10^{-3} \times M$	Accuracy acc. to ISO 6789[3]
Torque measuring devices	0,1 Nm to 1 Nm	$1 \times 10^{-3} \times M$	With torque arms and weights
	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] in situ 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
Weights and masses	1 mg	0,001 0 mg	For example mass pieces up to grade E1 according to OIML R111-1
	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
	50 kg	600 mg	For example mass pieces up to grade M1 according to OIML R111-1
	100 kg	1 000 mg	
	150 kg	1 600 mg	

Weighing instruments

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
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

Volume

Measure quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Volume measuring devices, pipettes	10 µl to 50 µl	0,40 µl	Gravimetric method
	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
	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%.

Pressure and Vacuum Berchem
Calibration and Measurement Capabilities

Gas pressure

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
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
	-100 kPa to -1,5 kPa	$80 \times 10^{-6} \times p$	By comparison with a gas pressure balance
	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
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
	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
Absolute pressure	1 Pa to 5 kPa	$2 \times 10^{-2} \times p$	By comparison with capacitive pressure indicators
	1 mPa to 1 Pa	$2{,}5 \times 10^{-2} \times p$ + 5 mPa	

In Situ

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Relative pressures	20 kPa to 60 MPa	$1 \times 10^{-3} \times p$	By comparison with digital pressure indicators
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
Windspeed	0,1 m/s to 35 m/s	0,60 % + 0,020 m/s	By comparison with an LDV in a windtunnel

(*) 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

Standard Pt resistance thermometers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Resistance thermometers	-196 °C	0,025 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure
	-100 °C to -40 °C	0,050 °C	By comparison with reference standards
	-40 °C to 0 °C	0,025 °C	
	0 °C to 280 °C	0,015 °C	
	250 °C to 660 °C	0,040 °C	

Thermocouples

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Thermocouples B, R & S	0 °C to 280 °C	0,40 °C	By comparison with reference standards
	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
	-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
Temperature indicators with resistance probe	-196 °C	0,025 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure
	-100 °C to -40 °C	0,050 °C	By comparison with reference standards
	-40 °C to 0 °C	0,025 °C	
	0 °C to 280 °C	0,015 °C	
	250 °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
	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
	-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
	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
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
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

Radiation thermometry

Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**
Infrared thermometry	-17 °C to 100 °C	0,50 °C	By comparison with reference standards
	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%	

Contact thermometry fixed points for realizing ITS-90

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
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
	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
Temperature indicators with resistance probe			Fixed points
	-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

Temperature controlled chambers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Charcterisation of ovens and climatic chambers	-100 °C to -38,5 °C	1,6 °C	Using thermocouple type K
	-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
Blok 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

Cold junction compensation

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Cold junction compensation B, R & S	0 °C	0,06 °C	
Cold junction compensation	0 °C	0,025 °C	

In Situ calibration

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Temperature probe with or without readout	-100 °C to -20 °C	0,11 °C	By comparison in Block calibrators with external reference standards
	-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/méthode 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
				Points fixes de définition
	-38,834 °C	0,004 °C	PG-LABO_ETAL	Point triple du mercure
	0,010 °C	0,001 °C	PG-LABO_ETAL	Point triple de l'eau
	29,765 °C	0,004 °C	PG-LABO_ETAL	Point de fusion du gallium
	231,928 °C	0,004 °C	PG-LABO_ETAL	Point de congélation de l'etain
	419,527 °C	0,006 °C	PG-LABO_ETAL	Point de congélation du zinc
	156,594 °C	0,004 °C	PG-LABO_ETAL	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	0,022 °C	PG-ETC	Par comparaison à des étalons de référence dans des bains thermostatés et des fours
	-80 °C à <-20 °C	0,010 °C		
	-20 °C à <300 °C	0,008 °C		
	300 °C à <450 °C	0,010 °C		
	450 °C à <660 °C	0,012 °C		
	660 °C à <1064 °C	0,80 °C		
	1064 °C à 1550 °C	1,60 °C		
	-40 °C à <120 °C	0,07 °C	PG-ETC	Par comparaison à des étalons de référence dans une enceinte climatique
	120 °C à 180 °C	0,18 °C		
Thermomètre à dilatation de liquide en verre	-80 °C à <-58 °C	0,11 °C	PG-ETC	Par comparaison à des étalons de référence dans des bains thermostatés et des fours
	-58 °C à <160 °C	0,01 °C		
	160 °C à <300 °C	0,03 °C		
	300 °C à 350 °C	0,10 °C		

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/méthode 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	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/méthode 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

Thermometers in laboratorium				
Grootheid/meettoestel	**Meetbereik**	**Uitgebreide meetonzekerheid (*)**	**Opmerkingen**	**Kalibratieprocedure/methode**
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
				Vaste definitiepunten
	-38,834 °C	0,004 °C	PG-LABO_ETAL	Tripelpunt van kwik
	0,010 °C	0,001 °C	PG-LABO_ETAL	Tripelpunt van water
	29,765 °C	0,004 °C	PG-LABO_ETAL	Smeltpunt van gallium
	231,928 °C	0,004 °C	PG-LABO_ETAL	Stolpunt van tin
	419,527 °C	0,006 °C	PG-LABO_ETAL	Stolpunt van zink
	156,594 °C	0,004 °C	PG-LABO_ETAL	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	0,022 °C	PG-ETC	Door vergelijking met referentiestandaarden in thermostaatregelingsbaden en ovens
	-80 °C tot <-20 °C	0,010 °C		
	-20 °C tot <300 °C	0,008 °C		
	300 °C tot <450 °C	0,010 °C		
	450 °C tot <660 °C	0,012 °C		
	660 °C tot <1064 °C	0,80 °C		
	1064 °C tot 1550 °C	1,60 °C		
	-40 °C tot <120 °C	0,07 °C	PG-ETC	Door vergelijking met referentiestandaarden in een klimaatkast
	120 °C tot 180 °C	0,18 °C		
Glazen vloeistofthermometers	-80 °C tot <-58 °C	0,11 °C	PG-ETC	Door vergelijking met referentiestandaarden in thermostaatregelingsbaden en ovens
	-58 °C tot <160 °C	0,01 °C		
	160 °C tot <300 °C	0,03 °C		
	300 °C tot 350 °C	0,10 °C		

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/methode**
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	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 op Site				
Instrumenten	**Meetbereik**	**Uitgebreide meetonzekerheid (*)**	**Opmerkingen**	**Kalibratieprocedure/methode**
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
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
	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

Other instruments for humidity

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Dew point meters	-70 °C to 0 °C	0,10 °C	Temperature frost- or dewpoint
	0 °C to 10 °C	0,12 °C	

Generators for Humidity

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Humidity generator	10 % RH to 90 % RH	0,10 % RH to 0,90 % RH	by comparison with dew pointmeter

Humidity of temperature controlled chambers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks
Charcterisation 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

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 de -50 °Cdp à <0 °Cdp de 0 °Cdp à <50 °Cdp de 50 °Cdp à <60 °Cdp de 60 °Cdp à 80 °Cdp		0,43 °Cdp 0,17 °Cdp 0,10 °Cdp 0,12 °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) de -30 °Cdp à +60 °Cdp			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

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 vochtigheid (95 %)

	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 op Site												
Algemeenheden												
Grootheid/meettoestel			**Meetbereik**			**Uitgebreide meetonzekerheid (*)**			**Opmerkingen**			**Kalibratieprocedure/methode**
Spiegeldauwpuntsmeters, impedantie hygrometers en psychrometers			Dauwpunttemperatuur (vorstpunt) van -30 °Cdp tot +60 °Cdp			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 referentiestandaaarden in een vochtigheidsgenerator
Details												
Berekende absolute onzekerheid van de relatieve vochtigheid als functie van de temperatuur en relatieve vochtigheid (95 %)												
	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/méthode 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/methode**
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 op site	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
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	
	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