



Organisme belge d'Accréditation
Belgische Accreditatieinstelling
Belgische Akkreditierungsstelle
Belgian Accreditation Body

EA MLA Signatory

Certificat d'Accréditation n° 001-CAL

En application des dispositions de l'arrêté royal du 31 janvier 2006 créant BELAC, le Bureau d'Accréditation atteste avoir délivré une accréditation conformément aux exigences de la norme EN ISO/IEC 17025:2017 à:

TRESCAL nv
Vosstraat, 200
2600 Antwerpen

L'organisme a démontré posséder la compétence pour effectuer les activités réalisées dans les sites d'activités mentionnés dans la portée d'accréditation 001-CAL qui fait partie intégrante du présent certificat.

La version en vigueur de la portée d'accréditation est disponible via www.belac.be.

Ce certificat reste valable à condition que l'organisme continue de répondre aux conditions d'accréditation.

La Présidente du Bureau d'Accréditation BELAC,

Maureen LOGGHE

Version : 13

Période de validité : 2022-01-13 - 2026-06-01

La version originale de ce certificat est en néerlandais.



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Accreditatiecertificaat nr. 001-CAL

In uitvoering van de beschikkingen van het koninklijk besluit van 31 januari 2006 tot oprichting van BELAC, verklaart het Accreditatiebureau accreditatie conform de eisen van de norm EN ISO/IEC 17025:2017 te hebben verleend aan:

TRESCAL nv
Vosstraat, 200
2600 Antwerpen

De instelling heeft aangetoond bekwaamheid te bezitten voor de activiteiten uitgevoerd in de activiteitencentra zoals gespecificeerd in de accreditatiescope 001-CAL die integraal deel uitmaakt van dit certificaat.

De huidige versie van de accreditatiescope is beschikbaar op www.belac.be.

Dit certificaat blijft geldig onder voorwaarde dat de instelling blijft voldoen aan de accreditatievoorwaarden.

De Voorzitster van het Accreditatiebureau BELAC,

Maureen LOGGHE

Versie : 13

Geldigheidsduur : 2022-01-13 - 2026-06-01



Organisme belge d'Accréditation
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Accreditation Certificate No. 001-CAL

In compliance with the provisions of the Royal Decree of 31 January 2006 setting up BELAC, the Accreditation Board hereby declares to have granted accreditation conform the requirements of the standard EN ISO/IEC 17025:2017 to:

TRESCAL nv
Vosstraat, 200
2600 Antwerpen

The body demonstrated the competence to perform the activities in the activity sites, as described in the scope of accreditation 001-CAL which is an integral part of the present certificate.

The current version of the scope of accreditation is available at www.belac.be.

This certificate remains valid as long as the body continues to meet the accreditation conditions.

The Chair of the Accreditation Board BELAC,

Maureen LOGGHE

Version : 13

Validity period : 2022-01-13 - 2026-06-01

Original version of this certificate is in Dutch.



Organisme belge d'Accréditation
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Akkreditierungszertifikat Nr. 001-CAL

Aufgrund der Bestimmungen des königlichen Erlasses vom 31. Januar 2006 zur Gründung von BELAC, bestätigt das Akkreditierungsbüro, gemäß den Vorschriften der Norm EN ISO/IEC 17025:2017, die folgende Stelle akkreditiert zu haben:

TRESCAL nv
Vosstraat, 200
2600 Antwerpen

Die Stelle hat ihre Kompetenz für die in den Aktivitätszentren durchgeführten Aktivitäten gemäß dem Geltungsbereich der Akkreditierung 001-CAL, der ein integraler Bestandteil des vorliegenden Zertifikats ist, nachgewiesen.

Die aktuelle Version des Geltungsbereichs der Akkreditierung ist unter www.belac.be verfügbar.

Dieses Zertifikat bleibt unter der Bedingung gültig, dass die Stelle die Akkreditierungsanforderungen weiterhin erfüllt.

Die Vorsitzende des Akkreditierungsbüros BELAC,

Maureen LOGGHE

Fassung : 13

Gültigkeitsdauer : 2022-01-13 - 2026-06-01

Die Originalfassung dieses Zertifikats ist in niederländischer Sprache.



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

001-CAL

EN ISO/IEC 17025:2017

Versie / Version / Version / Fassung	23
Geldigheidsperiode / Validité / Validity / Gültigkeitsdauer	2024-12-02 - 2026-06-01

Vrijwillige gedeeltelijke opschorting voor de aangeduide activiteit met ingang van 2024-12-02

Suspension partielle volontaire de l'activité indiquée à partir du 2024-12-02

Voluntary partial suspension for the indicated activity as of 2024-12-02

Maureen Logghe

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 Antwerpen

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

Locatie 1 - WOMMELGEM	Nijverheidsstraat 70 2160 Wommelgem
Locatie 2 - WELLIN	Rue Jean Meunier 2 6922 Wellin
Locatie 3 - LOUVAIN-LA-NEUVE	Rue du Bosquet 7 1348 Ottignies-Louvain-la-Neuve

Accréditation
Service public fédéral Economie
P.M.E., Classes moyennes et Energie
Bd du Roi Albert II 16 - 1000 Bruxelles
Numéro d'entreprise : 0314.595.348

Accreditatie
Federale Overheidsdienst Economie
K.M.O., Middenstand en Energie
Koning Albert II-laan 16 - 1000 Brussel
Ondernemingsnummer : 0314.595.348

+32 2 277 54 34
belac@economie.fgov.be
www.belac.be

.be

BELAC

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DCLF Electricity Wommelgem (In House or Onsite)

Calibration and Measurement Capabilities

Direct voltage

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	Location
± 100 mV	DC	$5,0 \times 10^{-6} \times U$	• Transfer standard in "30 day" loop • Fixed points • positive /negative • measuring	P2-02-E.006	AN, OS
± 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 $0,1 \mu V^1$	• measure • positive / negative	P2-02-E.019	AN , OS
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	OS

¹ Whichever is greater

Direct voltage					
Generate					
Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
100 mV	DC	$1,5 \times 10^{-6} \times U$	• generate / measure • Fixed points with Zener	P22-02-E.001	AN
1 V, 10 V, 100 V	DC	$1 \times 10^{-6} \times U$			
1000 V	DC	$1,2 \times 10^{-6} \times U$			
Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
0 mV to 200 mV	DC	$18 \times 10^{-6} \times U$ or $0,5 \mu V^1$	• generate • positive / negative	P2-02-E.005	AN, OS
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	OS

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	P2-02-E.006	AN, OS
±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	
1 A to 10 A	DC	$2 \times 10^{-5} \times I$	• measure / generate • positive / negative • with standard resistances	P2-02-E.022	AN
100 mA to 1 A	DC	$1 \times 10^{-5} \times I$			
100 nA to 100 mA	DC	$5 \times 10^{-6} \times I$			
100 nA to 10 nA	DC	$6 \times 10^{-5} \times I$			
10 nA to 1 nA	DC	$1 \times 10^{-4} \times I$			
1 nA to 100 pA	DC	$3 \times 10^{-4} \times I$			
100 pA to 10 pA	DC	$1 \times 10^{-3} \times I$			
10 pA to 1 pA	DC	$2 \times 10^{-3} \times I$			
Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
0 µA to 200 µA	DC	$12 \times 10^{-6} \times I$ or $0,5 \text{ nA}^1$	• measure • in the lowest possible range • positive / negative	P2-02-E.019	AN, OS
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	OS

¹ Whichever is greater

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
20 A to 3000 A	DC	$2,0 \times 10^{-4} \times I$	measure/generate	P2-02-E.030	AN, OS

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	AN, OS

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	AN, OS
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	OS

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	P2-02-E.006	AN, OS
	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	P2-02-E.006	AN, OS
	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	AN, OS
	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	AN, OS
	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	AN, OS
	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	AN, OS
	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	AN, OS
	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	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	$7 \times 10^{-5} \times U$	• measure	P2-02-E.019	AN, OS
	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	AN, OS

Generate

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

Alternating current
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
100 μ A	10 Hz to 30 Hz	$1,4 \times 10^{-4} \times I$	• Transfer standard in "30 day" loop • Fixed points • Measurement	P2-02-E.006	AN, OS
	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	
10 mA	10 Hz to 300 Hz	$61 \times 10^{-6} \times I$	• measure / generate • AC/DC difference	P2-02-E.022	AN
	300 Hz to 5 kHz	$35 \times 10^{-6} \times I$			
	5 kHz to 10 kHz	$41 \times 10^{-6} \times I$			
	10 kHz to 30 kHz	$45 \times 10^{-6} \times I$			
100 mA	10 Hz to 300 Hz	$66 \times 10^{-6} \times I$			
	300 Hz to 5 kHz	$37 \times 10^{-6} \times I$			
	5 kHz to 10 kHz	$41 \times 10^{-6} \times I$			
	10 kHz to 30 kHz	$45 \times 10^{-6} \times I$			
1 A	10 Hz to 300 Hz	$70 \times 10^{-6} \times I$			
	300 Hz to 5 kHz	$49 \times 10^{-6} \times I$			
	5 kHz to 10 kHz	$51 \times 10^{-6} \times I$			
	10 kHz to 30 kHz	$55 \times 10^{-6} \times I$			
10 A	10 Hz to 300 Hz	$101 \times 10^{-6} \times I$			
	300 Hz to 5 kHz	$88 \times 10^{-6} \times I$			
	5 kHz to 10 kHz	$90 \times 10^{-6} \times I$			
	10 kHz to 30 kHz	$95 \times 10^{-6} \times I$			
Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
5 μ A to 200 μ A	10 Hz to 5 kHz	$1,6 \times 10^{-4} \times I$	• measure	P2-02-E.019	AN, OS
	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	$10 \times 10^{-4} \times I$			

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
20 A to 6000 A	50 / 60 Hz	$5,0 \times 10^{-4} \times I$	measure	P2-02-E.030	AN, OS
20 A to 4000 A	50 / 60 Hz	$5,0 \times 10^{-4} \times I$	generate	P2-02-E.030	AN, OS

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	AN, OS

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
20 μ A to 200 μ A	10 Hz to 1 kHz	$4,0 \times 10^{-4} \times I$	• generate • in the lowest range possible	P2-02-E.005	AN, OS
	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 μ W to 330 W generate	P2-02-E.013	AN, OS
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 μ W 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 μ W 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	AN, OS
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	AN
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	AN, OS
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	AN, OS
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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	AN
	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	P2-02-E.006	AN, OS
10 Ω	DC	$9,5 \times 10^{-6} \times R$			
100 Ω	DC	$6,5 \times 10^{-6} \times R$			
1 k Ω	DC	$4,5 \times 10^{-6} \times R$			
10 k Ω	DC	$4,5 \times 10^{-6} \times R$			
100 k Ω	DC	$7,5 \times 10^{-6} \times R$			
1 M Ω	DC	$1,4 \times 10^{-5} \times R$			
10 M Ω	DC	$2,5 \times 10^{-5} \times R$			
100 M Ω	DC	$2,0 \times 10^{-4} \times R$			
Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
0 Ω to 2 Ω	DC	$18 \times 10^{-6} \times R$ or $20 \mu\Omega^1$	• measure • 4-wire resistance measurement • negligible dissipated power	P2-02-E.019	AN, OS
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 k Ω to 2 k Ω	DC	$2,6 \times 10^{-6} \times R$			
2 k Ω to 20 k Ω	DC	$5,0 \times 10^{-6} \times R$			
20 k Ω to 200 k Ω	DC	$6,3 \times 10^{-6} \times R$			
0,2 M Ω to 2 M Ω	DC	$6,0 \times 10^{-6} \times R$			
2 M Ω to 20 M Ω	DC	$11 \times 10^{-6} \times R$			
20 M Ω to 200 M Ω	DC	$60 \times 10^{-6} \times R$			
0,2 G Ω to 2 G Ω	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 $\mu\Omega$			
1 m Ω	DC	$12 \times 10^{-6} \times R$	• generate • standard resistors • also combinations of these resistors¹ • 4-wire resistance • maximum dissipated power 10 mW^{1,2}	P2-02-E.020	AN
10 m Ω	DC	$12 \times 10^{-7} \times R$			
100 m Ω	DC	$3 \times 10^{-6} \times R$			
1 Ω	DC	$12 \times 10^{-7} \times R$			
10 Ω , 25 Ω , 100 Ω , 1 k Ω , 10 k Ω , 100 k Ω	DC	$5 \times 10^{-7} \times R$			
1 M Ω	DC	$15 \times 10^{-7} \times R$			
10 M Ω	DC	$8 \times 10^{-6} \times R$			
100 M Ω	DC	$2 \times 10^{-5} \times R$			
1 G Ω	DC	$7 \times 10^{-5} \times R$			
10 G Ω	DC	$3 \times 10^{-4} \times R$			
100 G Ω	DC	$1 \times 10^{-3} \times R$			
1 T Ω	DC	$2 \times 10^{-3} \times R$			
10 T Ω	DC	$6 \times 10^{-3} \times R$			
100 T Ω	DC	$2 \times 10^{-2} \times R$			
378 Ω	DC	$4 \times 10^{-6} \times R$			
10 Ω	75 Hz	$3,0 \times 10^{-6} \times R$	• generate • standard resistors • also combinations of these resistors¹ • 4- wire resistance	P2-02-E.020	AN
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.

² these resistors can be used to generate/measure currents from 10pA up to 10A with decreased uncertainties.

Calibration of resistor / insulation
meters

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

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	AN
100 pF to 1000 nF	1 kHz	$10 \times 10^{-4} \times C$	Measure / generate		
1000 nF to 10 μF	100 Hz & 1 kHz	$6 \times 10^{-4} \times C$	Measure / generate		
10 μF tot 100 μF	100 Hz & 1 kHz	$7 \times 10^{-4} \times C$	Measure / generate		
10 pF, 100 pF, 1 nF, 10 nF	1 kHz	$1,0 \times 10^{-4} \times C$	Generate	P2-02-E.040	AN
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	AN
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	AN
10 H	100 Hz, 1 kHz	$7,0 \times 10^{-4} \times L$			

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

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	
± 1 mV to 200 V	DC	$2,5 \times 10^{-4} \times U + 25 \mu\text{V}$	50 Ω to 5,56 V	P2-02-E.007	AN, OS
1 mVpp to 21 mVpp	10 Hz to 10 kHz	$25 \times 10^{-4} \times U + 10 \mu\text{V}$	Square wave		
21 mVpp to 556 mVpp	10 Hz to 10 kHz	$10 \times 10^{-4} \times U + 10 \mu\text{V}$	Square wave		
556 mVpp to 210 Vpp	10 Hz to 10 kHz	$5,0 \times 10^{-4} \times U + 10 \mu\text{V}$	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	AN, OS

Bridge calibration

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

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

DCLF Electricity Wellin

Calibration and Measurement Capabilities

Vrijwillige gedeeltelijke opschorting voor de volgende activiteit met ingang van 2024-12-02:
Voluntary partial suspension for the indicated activity as of 2024-12-02:

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.C
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	$10,0 \times 10^{-6} \times U + 550 \mu V$		

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
0 mV to 220 mV	DC	$8,0 \times 10^{-6} \times U + 2,0 \mu V$	•generate •positive / negative	P2-02-E.039.C
220 mV 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.C
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	$41 \times 10^{-5} \times I + 450 \mu A$		
10 A to 100 A	DC	$2 \times 10^{-5} \times I + 2 mA$		P2-02-E.058

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 2,2 mA	DC	$55 \times 10^{-6} \times I + 8,0 nA$	•generate •positive / negative	P2-02-E.039.C
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	$38 \times 10^{-5} \times I + 490 \mu A$		
2 A to 20 A	DC	$1 \times 10^{-5} \times I + 0,3 mA$		
20 A to 100 A	DC	$2 \times 10^{-5} \times I + 2 mA$		P2-02-E.058

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.C
	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.C
	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.C
	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.C
	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	$30 \times 10^{-5} \times U + 50 mV$	•measure	P2-02-E.019.C
	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.039.C
	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 current
Measure

Measuring-range or point	Frequency	expanded-uncertainty (*)	Remark	Calibration-procedure
10 μA to 200 μA	55 Hz to 5 kHz	$31 \times 10^{-5} \times I + 40 nA$	•measure	P2-02-E.019.C
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 1000 A	45 Hz to 440 Hz	$5,0 \times 10^{-3} \times I$	* with current coils	P2-02-E.021

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure
10 µA to 220 µA	40 Hz to 1 kHz	$14 \times 10^{-5} \times I + 35 \text{ nA}$	* generate	P2-02-E.039.C
220 µA to 2,2 mA	40 Hz to 1 kHz	$20 \times 10^{-5} \times I + 35 \text{ nA}$		
2,2 mA to 22 mA	40 Hz to 1 kHz	$20 \times 10^{-5} \times I + 350 \text{ nA}$		
22 mA to 220 mA	40 Hz to 1 kHz	$20 \times 10^{-5} \times I + 3,5 \text{ µA}$		
220 mA to 2,2 A	40 Hz to 1 kHz	$70 \times 10^{-5} \times I + 35 \text{ µA}$		
2,2 A to 11 A	40 Hz to 1 kHz	$65 \times 10^{-5} \times I + 200 \text{ µA}$		

Impedance (DC/LF)

Measure

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

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.039.C
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	$1,0 \times 10^{-4} \times R$		P2-02-E.017
	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	$3,0 \times 10^{-4} \times R$		

Capacity

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration- procedure
1 μF	From 20 Hz to 1 kHz	0,50%	Capacitance generation- on all DUTs with a "capacitance meas- urement" function with a sinusoidal measurement signal	P2-02-E.053
10 μF				

(*) 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 Wommelgem
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	$0,050 \text{ rpm} + 10 \times 10^{-5} \times n$		P2-02-E.046

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	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	$6,0 \times 10^{-11} \times f$	• measure	P2-02-E008
	0,002 Hz to 4 GHz	$5,0 \times 10^{-9} \times f$	• generate	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

Vrijwillige gedeeltelijke opschorting voor de volgende activiteit met ingang van 2024-12-02:
 Voluntary partial suspension for the indicated activity as of 2024-12-02:

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
Frequency meter, Reference oscillator	1 Hz	$5 \times 10^{-11} \times f$	Frequency generated by a Rubidium controlled by GPS. Calibration made by generation or comparison.	P2-02-E.031D
	1 MHz			P2-02-E.031D
	5 MHz			P2-02-E.031D
	10 MHz			P2-02-E.031D
	0,1 Hz to 10 MHz	$1 \times 10^{-10} \times f + 0,1 \mu\text{Hz}$	Frequency generation	P2-02-E.054
	10 MHz to 45 GHz	2 Hz		P2-02-E.056
Frequency generator	0,1 Hz to 10 MHz	$6 \times 10^{-11} \times f + 0,1 \mu\text{Hz}$	Frequency measurement (Square wave)	P2-02-E.055
	10 Hz to 3 GHz	$6 \times 10^{-11} \times f + 0,1 \text{ mHz}$	Frequency measurement (Sine wave)	P2-02-E.055
	3 GHz to 45 GHz	$6 \times 10^{-11} \times f + 2 \text{ Hz}$	Frequency measurement	P2-02-E.057

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 Wommelgem
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	$0,060\text{ }\mu\text{m} + 0,90 \times 10^{-6} \times l$	fixed sizes	P2-02-G.001
Central length tungsten carbide		$0,060\text{ }\mu\text{m} + 0,70 \times 10^{-6} \times l$		
Central length ceramic		$0,060\text{ }\mu\text{m} + 0,80 \times 10^{-6} \times l$		
		$0,060\text{ }\mu\text{m} + 1,2 \times 10^{-6} \times l$	reference steel	
Central length steel, tungsten carbide, ceramic	0,05 mm to 500 mm 0,005 inch to 20 inch	$0,10\text{ }\mu\text{m} + 2,0 \times 10^{-6} \times l$	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	$0,80\text{ }\mu\text{m} + 3,0 \times 10^{-6} \times l$		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	$1,5 \mu\text{m} + 3,0 \times 10^{-6} \times l$	e.g. spring rule	P2-02-G.094 P2-02-G.100
	to 400 mm	$2,0 \mu\text{m} + 3,0 \times 10^{-6} \times l$		
	to 3000 mm	$12 \mu\text{m} + 3,0 \times 10^{-6} \times l$		P2-02-G.143
	to 100 m	$6,0 \mu\text{m} + 5,0 \times 10^{-6} \times l$		
Feeler gauges	to 5 mm	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		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	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.011 P2-02-G.012
	300 to 500 mm	$0,90 \mu\text{m} + 0,60 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.068
	500 to 3000 mm	$3,0 \mu\text{m} + 3,0 \times 10^{-6} \times l$		P2-02-G.070 P2-02-G.127
Other distance of 2 parallel planes	to 300 mm	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.011 P2-02-G.012
	300 to 500 mm	$0,90 \mu\text{m} + 0,60 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.068
	500 to 3000 mm	$3,0 \mu\text{m} + 3,0 \times 10^{-6} \times l$		P2-02-G.070 P2-02-G.127

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	$0,45 \mu\text{m} + 0,50 \times R + 25 \times 10^{-6} \times l$	(1) e.g. vernier, micrometer, ...	P2-02-G.050
	200 mm to 3000 mm	$4,0 \mu\text{m} + 0,50 \times R + 5,0 \times 10^{-6} \times l$		P2-02-G.050
Hand held tools for internal measurements			(1) e.g. internal micrometers	
2-point	0 mm to 200 mm	$0,70 \mu\text{m} + 0,50 \times R + 25 \times 10^{-6} \times l$		P2-02-G.051
	200 mm to 400 mm	$5,0 \mu\text{m} + 0,50 \times R + 4,0 \times 10^{-6} \times l$		P2-02-G.055
2- and 3-point	0 mm to 250 mm	$1,5 \mu\text{m} + 0,50 \times R + 25 \times 10^{-6} \times l$		P2-02-G.055
Hand held tools for height and depth measurements	0 mm to 500 mm	$0,70 \mu\text{m} + 0,50 \times R + 25 \times 10^{-6} \times l$	(1)	P2-02-G.052 P2-02-G.097
Linear displacement sensor	to 200 mm	$0,050 \mu\text{m} + 2,5 \times 10^{-6} \times l + 0,80 \times R$	to 50 mm (1)	P2-02-G.042 P2-02-G.050
Height gauge	to 1500 mm	$0,80 \mu\text{m} + 0,70 \times R + 2,5 \times 10^{-6} \times l$	(1)	P2-02-G.052 P2-02-G.098
Film thickness gauge	to 2 mm	$1,0 \mu\text{m} + 2,0 \times 10^{-3} \times l$	(1)	P2-02-G.099
Laser distance meter	to 25 m	$0,50 \text{ mm} + 40 \times 10^{-6} \times l + 0,60 \times R$		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	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.039 P2-02-G.043 P2-02-G.121
Cylindrical setting pins	to 200 mm	$0,50 \mu\text{m} + 1,5 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127
Plain plug gauges	to 200 mm	$0,50 \mu\text{m} + 1,5 \times 10^{-6} \times l$		
Thread wires	to 20 mm	$0,50 \mu\text{m} + 1,5 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127
Radius gauge	to Ø 200 mm	$3,0 \mu\text{m} + 5,0 \times 10^{-6} \times l$		P2-02-G.121 P2-02-G.136
Other internal diameters	Ø 1 mm to Ø 250 mm	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.039 P2-02-G.043 P2-02-G.121
Other external diameters	Ø 0,05 mm to Ø 300 mm	$0,50 \mu\text{m} + 1,5 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.071 P2-02-G.121 P2-02-G.127
	Ø 300 mm to Ø 500 mm	$0,90 \mu\text{m} + 0,60 \times 10^{-6} \times l$		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 $\times 10^{-6} \times l$	(1)	P2-02-G.028 P2-02-G.101 P2-02-G.113 P2-02-G.128 P2-02-G.133
Surface plate	to 6 000 mm x 10 000 mm	0,30 μm + 1,6 $\times 10^{-6} \times l$	(1) l = longest side of the surface plate	P2-02-G.038
Roundness tester	to 300 μm	0,050 μm + 0,50 $\times R$	(1)	P2-02-G.056
Roundness standard	to $\varnothing$ 300 mm	0,050 μm + 0,020 $\times A$	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 $\times A$ + 0,50 $\times R$ (minimum 0,030 μm)	(1) A = Ra-value of reference	P2-02-G.059
	Rz: 0,1 μm to 10 μm	0,060 $\times A$ + 0,50 $\times R$ (minimum 0,050 μm)	(1) A = Rz-value of reference	
	Rmax: 0,1 μm to 10 μm	0,060 $\times A$ + 0,50 $\times R$ (minimum 0,050 μm)	(1) A = Rmax-value of reference	
Roughness standards	Ra: to 10 μm	0,025 μm + 0,060 $\times A$	A = measured Ra-value	P2-02-G.025
	Rz: to 15 μm	0,030 μm + 0,090 $\times A$	A = measured Rz-value	
	Rmax: to 15 μm	0,030 μm + 0,090 $\times A$	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//) bgmin	l = leg length in mm	P2-02-G.040
Simple pitch diameter	$\varnothing$ 1 mm to $\varnothing$ 300 mm	$\alpha = 30^\circ$: (6,0 μm to 9,7 μm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.102
		$\alpha = 60^\circ$: (3,2 μm to 5,9 μm)		
		$\alpha = 90^\circ$: (2,6 μm to 5,5 μm)		
Pitch diameter	$\varnothing$ 3 mm to $\varnothing$ 90 mm	2,5 μm + 5 $\times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha \geq 27^\circ$	PM2-02-G.002
		4,5 μm + 10 $\times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha < 27^\circ$	PM2-02-G.002
Outside, core diameter	$\varnothing$ 3 mm to $\varnothing$ 90 mm	1,5 μm + 10 $\times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b	PM2-02-G.002

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//) bgmin	l = leg length in mm	P2-02-G.040
Simple pitch diameter	$\varnothing$ 4 mm to $\varnothing$ 300 mm	$\alpha = 30^\circ$: (9,0 μm to 14 μm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.106
		$\alpha = 60^\circ$: (3,6 μm to 7,0 μm)		
		$\alpha = 90^\circ$: (3,1 μm to 6,2 μm)		
Pitch diameter	$\varnothing$ 3 mm to $\varnothing$ 90 mm	2,5 μm + $10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha \geq 27^\circ$	PM2-02-G.002
		4,5 μm + $10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha < 27^\circ$	PM2-02-G.002
Outside, core diameter	$\varnothing$ 3 mm to $\varnothing$ 90 mm	1,5 μm + $10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b	PM2-02-G.002

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:	
		$0,15 \mu\text{m} + 0,70 \times R + 1,0 \times 10^{-6} \times l$	Zerodur scales; (1)	P2-02-G.046
		$0,15 \mu\text{m} + 0,70 \times R + 1,3 \times 10^{-6} \times l$	Glass scales; (1)	P2-02-G.046
		$0,15 \mu\text{m} + 0,70 \times R + 1,6 \times 10^{-6} \times l$	Steel scales; (1)	P2-02-G.046
	to 400 mm	$0,30 \mu\text{m} + 2,3 \times 10^{-6} \times l$	using reference glass scale; (1)	P2-02-G.073
Deviations transverse to the translation directions	to 0,5 mm	$0,30 \mu\text{m} + 3,0 \times 10^{-6} \times l + 5,0 \times 10^{-3} \times A$	A = measured deviation Measuring length to 3000 mm; (1)	P2-02-G.047
Rotational deviations around the translation direction	to 400 as	$0,50 \text{ as} + 3,5 \times 10^{-3} \times A$	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	$0,50 \text{ as} + 1,6 \times 10^{-3} \times A$	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		Remarks	Calibration procedure
Angle gauge block	to 180°	$0,000 28^\circ + 10 \times 10^{-6} \times A$	A = measured angle	P2-02-G.120
		$1,0'' + 10 \times 10^{-6} \times A$		P2-02-G.125
Cylindrical square	to Ø 300 mm to height 300 mm	$0,30 \mu\text{m} + 2,0 \times 10^{-6} \times l$	Squareness	P2-02-G.032 P2-02-G.122
Square	to 300 mm leg length	$0,30 \mu\text{m} + 2,0 \times 10^{-6} \times l$	Squareness	P2-02-G.032 P2-02-G.122
Angle plate	90°	0,50 as		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	$0,50 \mu\text{m/m} + 1,0 \times 10^{-3} \times A + 0,7 \times R$	A = set angle	P2-02-G.091
	to 2600 as	$0,10 \text{ as} + 1,0 \times 10^{-3} \times A + 0,70 \times R$		
Autocollimator	to 12,5 mm/m	$0,50 \mu\text{m/m} + 1,0 \times 10^{-3} \times A + 0,70 \times R$	A = set angle	P2-02-G.091
	to 2600 as	$0,10 \text{ as} + 1,0 \times 10^{-3} \times A + 0,70 \times R$		
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	P2-02-G.089
	180°	1,5 as	Defining horizontal plane	P2-02-G.138
	180°	1,8 as	Deviation of crosshairs to rotations	P2-02-G.090

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	$1,0 \mu\text{m} + 0,010 \times A$	A = measured profile height	P2-02-G.112
Roughness value	Ra: to 10 μm	$0,025 \mu\text{m} + 0,060 \times A$	A = measured Ra-value	P2-02-G.025
	Rz: to 15 μm	$0,030 \mu\text{m} + 0,090 \times A$	A = measured Rz-value	P2-02-G.025
	Rmax: to 15 μm	$0,030 \mu\text{m} + 0,090 \times A$	A = measured Rmax-value	P2-02-G.025
Straightness	to 10 mm × 100 mm	$1,0 \mu\text{m} + 0,010 \times A$	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	$0,50 \mu\text{m} + 0,50 \times 10^{-6} \times L$	(1)	P2-02-G.037
Roundness				
Roundness external	to Ø 300 mm	$0,050 \mu\text{m} + 0,020 \times A$	A = measured roundness	P2-02-G.027
Roundness internal	Ø 0,7 mm to Ø 300 mm	$0,050 \mu\text{m} + 0,020 \times A$	A = measured roundness	P2-02-G.027
Cilindricity				
Cilindricity external	to Ø 300 mm to height 300 mm	$0,40 \mu\text{m} + 0,040 \times A$	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	$0,40 \mu\text{m} + 0,040 \times A$	A = measured cilindricity	P2-02-G.030 P2-02-G.114
Coaxiality and concentricity	Ø 0,7 mm to Ø 300 mm to height 300 mm	$0,10 \mu\text{m} + 0,040 \times A$	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
	to Ø 150 mm	0,060 µm		P2-02-G.060
	to Ø 290 mm	0,15 µm		P2-02-G.116
	to 6 000 mm × 10 000 mm	$0,50 \mu\text{m} + 1,5 \times 10^{-6} \times l$	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	$2,1 \mu\text{m} + 4,0 \times 10^{-6} \times l$	l = leg length ratio leg length : reference length = 1 : 1	P2-02-G.082 P2-02-G.122 P2-02-G.131
Parallelism	to 1200 mm	$1,0 \mu\text{m} + 2,0 \times 10^{-6} \times l$	l = leg length	P2-02-G.132 P2-02-G.135
Diameter				
External	Ø 0,05 mm to Ø 300 mm	$0,50 \mu\text{m} + 1,5 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.071
	Ø 300 mm to Ø 500 mm	$0,90 \mu\text{m} + 0,60 \times 10^{-6} \times l$		P2-02-G.121 P2-02-G.127
	Ø 500 mm to Ø 3000 mm	$0,40 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.136
Internal	Ø 1 mm to Ø 250 mm	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.039 P2-02-G.043
Distance of 2 parallel surfaces				
External	to 200 mm	$0,50 \mu\text{m} + 2,0 \times 10^{-6} \times l$		P2-02-G.011 P2-02-G.012
	to 3000 mm	$0,40 \mu\text{m} + 4,0 \times 10^{-6} \times l$		P2-02-G.041 P2-02-G.045 P2-02-G.068 P2-02-G.070 P2-02-G.127
Internal	to 1200 mm	$1,2 \mu\text{m} + 4,0 \times 10^{-6} \times l$		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	$\alpha = 30^\circ$: (6,0 µm to 9,7 µm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.102
		$\alpha = 60^\circ$: (3,2 µm to 5,9 µm)		P2-02-G.102
		$\alpha = 90^\circ$: (2,6 µm to 5,5 µm)		P2-02-G.102
Pitch diameter	Ø 3 mm to Ø 90 mm	$2,5 \mu\text{m} + 5 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha \geq 27^\circ$	PM2-02-G.002
		$4,5 \mu\text{m} + 10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha < 27^\circ$	PM2-02-G.002
Outside, core diameter	Ø 3 mm to Ø 90 mm	$1,5 \mu\text{m} + 10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b	PM2-02-G.002

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	$\alpha = 30^\circ$: (9,0 µm to 14 µm)	Acc. to Euramet/CG-10, method 1a or 1b	P2-02-G.106
		$\alpha = 60^\circ$: (3,6 µm to 7,0 µm)		P2-02-G.106
		$\alpha = 90^\circ$: (3,1 µm to 6,2 µm)		P2-02-G.106
Pitch diameter	Ø 3 mm to Ø 90 mm	$2,5 \mu\text{m} + 10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha \geq 27^\circ$	PM2-02-G.002
		$4,5 \mu\text{m} + 10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b, $\alpha < 27^\circ$	PM2-02-G.002
Outside, core diameter	Ø 3 mm to Ø 90 mm	$1,5 \mu\text{m} + 10 \times 10^{-6} \times l$	Acc. to Euramet/CG-10, method 2b	PM2-02-G.002

(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 Wommelgem
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%.

Torque Wellin

Calibration and Measurement Capabilities

Vrijwillige gedeeltelijke opschorting voor de volgende activiteit met ingang van 2024-12-02:
Voluntary partial suspension for the indicated activity as of 2024-12-02:

Torque

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure
Torque tools	0,5 Nm to 1350 Nm	$8,0 \times 10^{-3} \times M$	Accuracy acc. to ISO 6789	P2-02-M.011

(*) 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 Wommelgem
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 weighing machines			Available weights: grade E1: 1 mg to 1 kg grade E2: 1 mg to 10 kg grade F1: 1 g to 20 kg grade M1: 1 g to 500 kg	P2-02-W.001
	1 mg to 1 kg	$5,0 \times 10^{-6} \times m$ <i>minimal 0,002 mg</i>		
	> 1 kg to 10 kg	$2,0 \times 10^{-6} \times m$		
	> 10 kg to 240 kg	$3,0 \times 10^{-6} \times m$		
	> 240 kg to 10 000 kg	$1,1 \times 10^{-4} \times m$		

(*) 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 Wellin

Calibration and Measurement Capabilities

Mass standards

Measured quantity, instrument	Range	expanded measurement uncertainty (*)	Remarks	Calibration procedure
Weights and masses	1 g	0,3 mg	OIML R111 defined Class M1, M2 and M3 weights or equivalent, using traceable calibrated F1 reference standards while applying the direct comparison method such as defined and elaborated in OIML R111-1 Annex C.	P1-02-W.010
	2 g	0,4 mg		
	5 g	0,5 mg		
	10 g	0,6 mg		
	20 g	0,8 mg		
	50 g	1,0 mg		
	100 g	1,6 mg		
	200 g	3,0 mg		
	500 g	8 mg		
	1 kg	16 mg		
	2 kg	30 mg		
	5 kg	80 mg		
	10 kg	0,16 g		P1-02-W.008
	20 kg	0,3 g		
	50 kg	0,8 g		

(*) 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 Wommelgem

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 -5 kPa	$25 \times 10^{-6} \times p$	By comparison with a gas pressure balance	P2-02-P.001 P2-02-P.007
	-5 kPa to -1,5 kPa	$80 \times 10^{-6} \times p$		
	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	0,5 MPa to 100 MPa	$3,0 \times 10^{-5} \times p$	By comparison with a liquid pressure balance	P2-02-P.001 P2-02-P.007
	100 MPa to 120 MPa	$7,0 \times 10^{-5} \times p$		
	120 MPa to 400 MPa	$2,5 \times 10^{-4} \times p$		
Piston/cilinder combination (effective area) ²	0,5 MPa to 100 MPa	$3,0 \times 10^{-5} \times p$	By comparison with a liquid pressure balance	
	100 MPa to 120 MPa	$7,0 \times 10^{-5} \times p$		
	120 MPa to 400 MPa	$2,5 \times 10^{-4} \times p$		

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 30 Pa	$2 \times 10^{-2} \times p$	By comparison with capacitive pressure indicators	RP/02/KC/P.05 RP/02/KC/P.06
	30 Pa to 5 kPa	$5,0 \times 10^{-3} \times p$		
	1 mPa to 1 Pa	$2,5 \times 10^{-2} \times p + 5 \text{ mPa}$		

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 Wommelgem

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 Wommelgem
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	0,04 °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	$0,50 \% \times t + 0,50 \text{ °C}$	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
Characterisation 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\text{ °C} + 0,000\ 05 \times 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

Inhouse calibrations				
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	-196 °C	0,01 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	PL-02-A.032
			Fixed points	PL-02-A.032
	-38,834 °C	0,004 °C	Triple point of mercury	
	0,010 °C	0,001 °C	Triple point of water	
	29,765 °C	0,004 °C	Melting point of gallium	
	156,594 °C	0,004 °C	Triple point of indium	
	231,928 °C	0,004 °C	Melting point of tin	
	419,527 °C	0,006 °C	Freeze point of zinc	
Temperature probes with indicators (eg: resistance probes and thermocouples)	-196 °C	0,01 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	PL-02-A.032
	-100 °C to <-80 °C	0,022 °C	By comparison with reference standards in thermal baths or ovens	
	-80 °C to <-20 °C	0,010 °C		
	-20 °C to <300 °C	0,008 °C		
	300 °C to <450 °C	0,010 °C		
	450 °C to <660 °C	0,012 °C		
	660 °C to <1064 °C	0,80 °C		
	1064 °C to 1550 °C	1,60 °C		
	-40 °C to <120 °C	0,07 °C	By comparison with reference standards in a climatic chamber	PL-02-A.032
	120 °C to 180 °C	0,18 °C		
Liquid in glass thermometers	-80 °C to <-58 °C	0,11 °C	By comparison with reference standards in thermal baths or ovens	PL-02-A.032
	-58 °C to <160 °C	0,01 °C		
	160 °C to <300 °C	0,03 °C		
	300 °C to 350 °C	0,10 °C		

Remarks:

- According to ITS-90 (International Temperature Scale of 1990)
- Expanded uncertainties are only associated to the probes and calibration means of the laboratory. Final uncertainty associated to the calibration of thermometer shall not be inferior to expanded uncertainty.

Calibration and characterisation of block calibrators				
Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure
Calibration of block calibrators	-100 °C to 650 °C	from 0,02 °C up to 0,10 °C	By comparison with a reference standard in a boring of the block calibrator	PL-02-A.032
Calibration and characterisation of block calibrators	-100 °C to 650 °C	Uncertainty determined during characterisation may vary depending on how many borings are characterised	In addition to the calibration of the block calibrator, determination of axial homogeneity alongs the borings and determination of temperature differences between the borings according to DOC EM/CG/13 "Guidelines on the Calibration of Temperature Block Calibrators"	PL-02-A.037

Onsite calibrations				
Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure
Temperature probe with or without readout (pyrometers excepted)	-196 °C to <232 °C	0,05 °C	By comparison with reference standards in thermal baths or ovens	PL-02-A.035
	232 °C to <420 °C	0,06 °C		
	420 °C to <660 °C	0,08 °C		
	660 °C to <1064 °C	1,00 °C		
	1064 °C to 1550 °C	1,90 °C		

Remarks:

- According to ITS-90 (International Temperature Scale of 1990)
- Expanded uncertainties are only associated to the probes of the laboratory. Final uncertainty of a thermometer calibration shall not be inferior to expanded uncertainty and shall also depend on, among others, the availability of equipment onsite, environmental conditions...

(*) 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 Wommelgem
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, ...	5 % RH to 6 % RH @ ambient temperature	0,30 % RH	by comparison with two pressure humidity generator	P2-02-H.008
	> 6 % RH to 10 % RH @ ambient temperature	0,50 % RH		
	10 % RH to 95 % RH @ ambient temperature	0,50 % RH		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	P2-02-H.003
	0 °C to 10 °C	0,12 °C		

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 dewpoint meter	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

Inhouse calibrations				
Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure
Dew point meters, impedance hygrometers and psychrometers	-60 °Cdp to -40 °Cdp	0,10 °Cdp	Temperature frost- or dew point	P2-02-H.010
	-40 °Cdp to 60 °Cdp	0,11 °Cdp		
	60 °Cdp to 80 °Cdp	0,13 °Cdp		
	Relative humidity from 5% rh up to 95% rh	From 0,3% rh up to 1,5% rh (see table hereunder)	Temperature from -20 °C up to +80 °C, by comparison with reference standards in a humidity generator	P2-02-H.009

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

Details											
Absolute uncertainty for relative humidity depending on the temperature and the relative humidity (95%)											
	Relative humidity (% rh)										
T (°C)	5	10	20	30	40	50	60	70	80	90	95
-20	0,3	0,3	0,4	0,5	0,7	0,9	1,0	1,1	1,3	1,4	1,5
0	0,3	0,3	0,4	0,5	0,6	0,8	0,9	1,1	1,2	1,3	1,4
10	0,3	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1
20	0,3	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,9	0,9
30	0,3	0,3	0,3	0,3	0,4	0,5	0,6	0,6	0,7	0,8	0,8
40	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,7	0,8
50	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0,7
60	0,3	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,6	0,6	0,7
> 60	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,5	0,6	0,6
70	0,3	0,3	0,3	0,3	0,4	0,5	0,6	0,7	0,7	0,8	0,9
80	0,3	0,3	0,3	0,3	0,4	0,5	0,6	0,6	0,7	0,8	0,8

Onsite calibrations				
Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure
Dew point meters, impedance hygrometers and psychrometers	-20 °Cdp to +60 °Cdp	0,21 °Cdp	Temperature frost- or dew point	PL-02-A.035
	Relative humidity from 5% rh up to 95% rh	From 0,3% RH up to 2,1% rh (see table hereunder)	Temperature from -20 °C up to +60 °C, by comparison with reference standards in a humidity generator	PL-02-A.035

Details											
Absolute uncertainty for relative humidity depending on the temperature and the relative humidity (95%)											
	Relative humidity [% rh]										
T (°C)	5	10	20	30	40	50	60	70	80	90	95
-20	/	/	/	0,8	1,0	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	2,0
10	0,3	0,4	0,5	0,7	0,9	1,0	1,2	1,4	1,6	1,7	1,8
20	0,3	0,3	0,5	0,6	0,8	0,9	1,0	1,1	1,2	1,4	1,4
30	0,3	0,3	0,5	0,6	0,7	0,8	1,0	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	1,0	1,1	1,2
50	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,1	1,1
60	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,9	1,0	1,0

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

Chemical Analysis Louvain-La-Neuve
Calibration and Measurement Capabilities

Inhouse calibrations				
Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure
Gas analyzers	0 % (mol/mol) CO2 up to 10 % (mol/mol) CO2	0,06 % (mol/mol) CO ₂	By comparison with ISO/IEC 17025 accredited gas cylinders	P1-02-C.005
	10 % (mol/mol) CO2 up to 20 % (mol/mol) CO2	0,11 % (mol/mol) CO ₂		
Onsite calibrations				
Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure
Gas analyzers, CO ₂ incubators	from 0 % (mol/mol) CO2 up to 20 % (mol/mol) CO2	0,24 % (mol/mol) CO ₂	By comparison with reference standards in the chamber of the customer	P1-02-C.005

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

Reference materials Wommelgem
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		P1-02-M.018
	0 Shore D to 100 Shore D	0,50 Shore D		P1-02-M.018
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 Wommelgem
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%.