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

Nijverheidsstraat 70

2160 Wommelgem

Numéro d'entreprise: 0414.459.224

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 : **15**

Période de validité : **2026-06-02 - 2026-12-01**

La version originale de ce certificat est en néerlandais.

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

EA MLA Signatory

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

Nijverheidsstraat 70

2160 Wommelgem

Ondernemingsnummer: 0414.459.224

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 : **15**

Geldigheidsduur : **2026-06-02 - 2026-12-01**

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BELAC 6-319 R2-2025

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

EA MLA Signatory

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

Nijverheidsstraat 70

2160 Wommelgem

Enterprise number: 0414.459.224

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 : **15**

Validity period : **2026-06-02 - 2026-12-01**

Original version of this certificate is in Dutch.

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

EA MLA Signatory

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

Nijverheidsstraat 70

2160 Wommelgem

Unternehmensnummer: 0414.459.224

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 : **15**

Gültigkeitsdauer : **2026-06-02 - 2026-12-01**

Die Originalfassung dieses Zertifikats ist in niederländischer Sprache.

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

EA MLA Signatory

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

001-CAL

EN ISO/IEC 17025:2017

Versie / Version / Version / Fassung	25
Geldigheidsperiode / Validité / Validity / Gültigkeitsdauer	2026-06-02 - 2026-12-01

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
Nijverheidsstraat 70
2160 Wommelgem

Ondernemingsnummer / Numéro d'entreprise / Enterprise number / Unternehmensnummer:
0414.459.224

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

Locatie 1 - WOMMELGEM	Nijverheidsstraat 70 2160 Wommelgem
Locatie 3 - LOUVAIN-LA-NEUVE	Rue du Bosquet 7 1348 Ottignies-Louvain-la-Neuve

DCLF Electricity Wommelgem: In House or Onsite (IH/OS)

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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	location
0 mV to 200 mV	DC	$7{,}0 \times 10^{-6} \times U$ or 0,1 µV[1]	• measure • positive / negative	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH , 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	P1-02-E.013	
0,2 V to 11 V	DC	$1{,}0 \times 10^{-4} \times U$	Loop calibration	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	OS

[1] Whichever is greater

Direct voltage Generate					
Generating range or point	**Frequency**	**expanded uncertainty (*)**	**Remark**	**Calibration procedure**	**location**
100 mV	DC	$1{,}5 \times 10^{-6} \times U$	• generate / measure • Fixed points with Zener	P1-02-E.001 P1-02-E.006 P1-02-E.025	IH
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**	**location**
0 mV to 200 mV	DC	$18 \times 10^{-6} \times U$ or 0,5 µV[1]	• generate • positive / negative	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.013	
0,2 V to 11 V	DC	$1{,}0 \times 10^{-4} \times U$	Loop calibration	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	OS

[1] Whichever is greater

Direct current
Measure

Measuring range or point	**Frequency**	**expanded uncertainty (*)**	**Remark**	**Calibration procedure**	**location**
±100 µA	DC	$24 \times 10^{-6} \times I$	• Transfer standard in "30 day" loop • Fixed points • positive / negative • Measurement	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	location
1 pA to 10 pA	DC	$2 \times 10^{-3} \times I$	• measure / generate • positive / negative • with standard resistances	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH
10 pA to 100 pA	DC	$1 \times 10^{-3} \times I$			
100 pA to 1 nA	DC	$3 \times 10^{-4} \times I$			
1 nA to 10 nA	DC	$1 \times 10^{-4} \times I$			
10 nA to 100 nA	DC	$6 \times 10^{-5} \times I$			
100 nA to 100 mA	DC	$5 \times 10^{-6} \times I$			
100 mA to 1 A	DC	$1 \times 10^{-5} \times I$			
1 A to 10 A	DC	$2 \times 10^{-5} \times I$			
Measuring range or point	**Frequency**	**expanded uncertainty (*)**	**Remark**	**Calibration procedure**	**location**
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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	OS

[1] Whichever is greater

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
20 A to 3000 A	DC	$2{,}0 \times 10^{-4} \times I$	measure/generate	P1-02-E.002, P1-02-E.011	IH, OS

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
20 A to 1000 A	DC	$5{,}0 \times 10^{-3} \times I$	• with current coils	P1-02-E.026	IH, OS

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
0 µA to 20 µA	DC	1,5 nA	• generate • positive / negative	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS

Alternating voltage

Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
1 mV	20 Hz to 20 kHz	$3{,}0 \times 10^{-4} \times U + 2$ µV	• Transfer standard in "30 day" loop • Fixed points • measuring	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS
	30 kHz & 50 kHz	$4{,}0 \times 10^{-4} \times U + 2$ µV			
	100 kHz	$6{,}5 \times 10^{-4} \times U + 2$ µV			
10 mV	20 Hz to 20 kHz	$1{,}7 \times 10^{-4} \times U + 2$ µV			
	30 kHz & 50 kHz	$2{,}5 \times 10^{-4} \times U + 2$ µV			
	100 kHz	$4{,}5 \times 10^{-4} \times U + 2$ µV			
100 mV	20 Hz to 20 kHz	$1{,}2 \times 10^{-4} \times U + 2$ µV			
	30 kHz & 50 kHz	$2{,}0 \times 10^{-4} \times U + 2$ µV			
	100 kHz	$4{,}0 \times 10^{-4} \times U + 2$ µV			
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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	location
0,7 mV to 2,2 mV	10 Hz to 20 Hz	$17 \times 10^{-4} \times U + 1{,}3\ \mu V$	• measure	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.013	IH, OS

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
2 mV to 20 mV	1 kHz to10 kHz	$7{,}0 \times 10^{-4} \times U$	• generate	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017,	IH, OS
	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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	$6{,}0 \times 10^{-4} \times U$			
	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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS
	300 Hz to 1 kHz	$1{,}2 \times 10^{-4} \times U$			
	1 kHz to 10 kHz	$1{,}0 \times 10^{-4} \times U$			
	10 kHz to 30 kHz	$1{,}1 \times 10^{-4} \times U$			
	30 kHz to 100 kHz	$2{,}1 \times 10^{-4} \times U$			

200 V to 1000 V	40 Hz to 300 Hz	$2{,}3 \times 10^{-4} \times U$	• generate	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS
	300 Hz to 1 kHz	$2{,}3 \times 10^{-4} \times U$			
	1 kHz to 10 kHz	$1{,}7 \times 10^{-4} \times U$			
	10 kHz to 30 kHz	$2{,}2 \times 10^{-4} \times U$			
200 V to 750 V	30 kHz to 100 kHz	$15 \times 10^{-4} \times U$	• generate	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS
1 kV to 45 kV	50 / 60 Hz	$3{,}0 \times 10^{-3} \times U$	• generate	P1-02-E.013	IH, OS

Alternating current
Measure

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
100 µA	10 Hz to 30 Hz	$1{,}4 \times 10^{-4} \times I$	• Transfer standard in "30 day" loop • Fixed points • Measurement	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	location
10 mA	10 Hz to 300 Hz	$61 \times 10^{-6} \times I$	• measure / generate • AC/DC difference	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH
	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	$45 \times 10^{-6} \times I$			
1A	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	$55 \times 10^{-6} \times I$			
10A	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	location
5 µA to 200 µA	10 Hz to 5 kHz	$1{,}6 \times 10^{-4} \times I$	• measure	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	location
20 A to 6000 A	50 / 60 Hz	$5{,}0 \times 10^{-4} \times I$	measure	P1-02-E.002, P1-02-E.011 P1-02-E.026	IH, OS
20 A to 4000 A	50 / 60 Hz	$5{,}0 \times 10^{-4} \times I$	generate	P1-02-E.002, P1-02-E.011 P1-02-E.026	IH, OS

Calibration of current clamps

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
20 A to 1000 A	45 Hz to 440 Hz	$5{,}0 \times 10^{-3} \times I$	• with current coils	P1-02-E.026	IH, OS

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
20 µA to 200 µA	10 Hz to 1 kHz	$4{,}0 \times 10^{-4} \times I$	• generate • in the lowest range possible	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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	location
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	P1-02-E.015	IH, 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 µW to 20,5 kW / kVA(r) generate cosphi/sinphi > 0,5		
33 mV to 1000 V / 0,1 mA to 20,5A	45 Hz to 1 kHz	$40 \times 10^{-4} \times P$	3,3 µW to 20,5 kW / kVA(r) generate cosphi/sinphi > 0,25		
Mono phase , direct with measuring clamps					
33 mV to 1000 V / 20 A to 500 A	DC	$10 \times 10^{-3} \times P$	0,66 W to 500 kW / kVA(r) generate	P1-02-E.015	IH, 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	P1-02-E.015	IH, OS
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	P1-02-E.015	IH
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	P1-02-E.015	IH, 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	P1-02-E.015	IH, 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**	**location**
-67 dBm to -19 dBm	20 kHz to 100 MHz	0,056 dB	• measure	P1-02-E.006, P1-02-E.037	IH
	100 MHz to 4 GHz	0,047 dB			
-19 dBm to 1 dBm	20 kHz to 100 MHz	0,066 dB	• measure	P1-02-E.006, P1-02-E.037	IH
	100 MHz to 4 GHz	0,058 dB			
1 dBm to 23 dBm	20 kHz to 100 MHz	0,083 dB	• measure	P1-02-E.006, P1-02-E.037	IH
	100 MHz to 4 GHz	0,072 dB			
24 dBm to 20 dBm	10 Hz to 20 kHz	0,050 dB	• generate	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	P1-02-E.006, P1-02-E.037	IH
	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	location
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	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS
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	$1{,}4 \times 10^{-5} \times R$			
10 MΩ	DC	$2{,}5 \times 10^{-5} \times R$			
100 MΩ	DC	$2{,}0 \times 10^{-4} \times R$			
Measuring range or point	**Frequency**	**expanded uncertainty (*)**	**Remark**	**Calibration procedure**	**location**
0 Ω to 2 Ω	DC	$18 \times 10^{-6} \times R$ or 20 μΩ[1]	• measure • 4-wire resistance measurement • negligible dissipated power	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, 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 kΩ to 2 kΩ	DC	$2{,}6 \times 10^{-6} \times R$			
2 kΩ to 20 kΩ	DC	$5{,}0 \times 10^{-6} \times R$			
20 kΩ to 200 kΩ	DC	$6{,}3 \times 10^{-6} \times R$			
0,2 MΩ to 2 MΩ	DC	$6{,}0 \times 10^{-6} \times R$			
2 MΩ to 20 MΩ	DC	$11 \times 10^{-6} \times R$			
20 MΩ to 200 MΩ	DC	$60 \times 10^{-6} \times R$			
0,2 GΩ to 2 GΩ	DC	$1{,}2 \times 10^{-3} \times R$			

[1] Whichever is greater

Generate

Generating range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
0 Ω	DC	100 μΩ			
1 mΩ	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]	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH
10 mΩ	DC	$12 \times 10^{-7} \times R$			
100 mΩ	DC	$3 \times 10^{-6} \times R$			
1 Ω	DC	$12 \times 10^{-7} \times R$			
10 Ω, 25 Ω, 50 Ω, 75 Ω, 100 Ω, 378 Ω, 1 kΩ, 10 kΩ, 100 kΩ	DC	$5 \times 10^{-7} \times R$			
1 MΩ	DC	$15 \times 10^{-7} \times R$			
10 MΩ	DC	$8 \times 10^{-6} \times R$			
100 MΩ	DC	$2 \times 10^{-5} \times R$			
1 GΩ	DC	$7 \times 10^{-5} \times R$			
10 GΩ	DC	$3 \times 10^{-4} \times R$			
100 GΩ	DC	$1 \times 10^{-3} \times R$			
1 TΩ	DC	$2 \times 10^{-3} \times R$			
10 TΩ	DC	$6 \times 10^{-3} \times R$			
100 TΩ	DC	$2 \times 10^{-2} \times R$			

[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	location
10 kΩ to 40 MΩ	50 V to 250 V	$1{,}0 \times 10^{-4} \times R$		P1-02-E.020	IH, 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	location
10 pF to 100 pF	1 kHz	$15 \times 10^{-4} \times C$	Measure / generate	P1-02-E.023	IH
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	P1-02-E.023	IH
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	location
100 µH to 1 H	1 kHz	$10 \times 10^{-4} \times L$	Measure / generate	P1-02-E.023	IH
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	P1-02-E.023	IH
10 H	100 Hz, 1 kHz	$7{,}0 \times 10^{-4} \times L$			

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

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
± 1 mV to 200 V	DC	$2{,}5 \times 10^{-4} \times U + 25\ \mu V$	50 Ω to 5,56 V	P1-02-E.004, P1-02-E.026	IH, OS
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	P1-02-E.004, P1-02-E.026	IH, OS

Bridge calibration

Measuring range or point	Frequency	expanded uncertainty (*)	Remark	Calibration procedure	location
-2,5 mV / V to 2,5 mV / V	225 Hz	50×10^{-6} mV / V	5 V supply / 350 Ω bridges	P1-02-E.001	IH, 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%.

Time and Frequency Wommelgem: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Relative time

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Tachometers, stroboscopes (optical)	1,2 rpm to 100 000 rpm	$3{,}0 \times 10^{-7} \times n$		P1-02-E.008	IH, OS
Mechanical tachometers	10 rpm to 17 000 rpm	$0{,}050 \text{ rpm} + 10 \times 10^{-5} \times n$		P1-02-E.008	IH, OS

n: number of rotations in rpm

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Frequencymeters, frequencygenerators, counters	1 Hz	$5{,}0 \times 10^{-11} \times f$	• generate • fixed points	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS
	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 Tavg >600s	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	
Frequencymeters, frequencygenerators, counters	0,002 Hz to 4 GHz	$5{,}0 \times 10^{-9} \times f$	• generate	P1-02-E.001, P1-02-E.002, P1-02-E.006, P1-02-E.007, P1-02-E.011, P1-02-E.017, P1-02-E.018, P1-02-E.021, P1-02-E.025, P1-02-E.026, P1-02-E.037	IH, OS

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Electronic chronometers	n.a.	0,10 s / 24 h	direct measurement	P1-02-E.003, P1-02-E.005	IH, OS
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 of 0,30 s	By comparison with a standard chronometer via a digital-optical recorder	P1-02-E.003, P1-02-E.005	IH, OS
Signal-triggered chronometers	Standard 0 h to 72 h	0,15 s / 24 h with a minimum of 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%.

Dimensional Quantities Wommelgem: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Length gauges

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
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	P1-02-G.002	IH
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		IH
Lengthvariation steel, tungsten carbide, ceramic	0,5 mm to 100 mm 0,02 inch to 4 inch	0,050 µm			IH
Step gauge	to 1200 mm	$0{,}80\ \mu m + 3{,}0 \times 10^{-6} \times l$		P1-02-G.048	IH

Angle gauges

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Conicity on conical plug and ring gauges	to 1:1	0,00001 + 0,0020 mm / *l*	*l* in mm	P2-02-G.186	IH

Clinometers
See Angle (measuring instruments)

Line scales, distances

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Ruler (all models)	to 200 mm	$1{,}5\ \mu m + 3{,}0 \times 10^{-6} \times l$	e.g. spring rule	P1-02-G.011 P1-02-G.052 P1-02-G.073	IH
	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	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$		P1-02-G.018	IH
Setting standard for external micrometers	to 300 mm	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$		P1-02-G.012	IH
	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	$0{,}50\ \mu m + 2{,}0 \times 10^{-6} \times l$			IH
	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	Calibration procedure	Location
Hand held tools for external measurements	0 mm to 200 mm	$0{,}45\ \mu m + 0{,}50 \times R + 25 \times 10^{-6} \times l$	e.g. vernier, micrometer, ...	P1-02-G.003 P1-02-G.004	IH, OS
	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			e.g. internal micrometers	P1-02-G.015 P1-02-G.024	IH, OS
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	$0{,}70\ \mu m + 0{,}50 \times R + 25 \times 10^{-6} \times l$		P1-02-G,003	IH, OS
Linear displacement sensor	to 200 mm	$0{,}050\ \mu m + 2{,}5 \times 10^{-6} \times l + 0{,}80 \times R$	to 50 mm	P1-02-G.005	IH, OS
Height gauge	to 1500 mm	$0{,}80\ \mu m + 0{,}70 \times R + 2{,}5 \times 10^{-6} \times l$		P1-02-G.008	IH, OS
Film thickness gauge	to 2 mm	$1{,}0\ \mu m + 2{,}0 \times 10^{-3} \times l$		P1-02-G.047	IH, OS
Laser distance meter	to 25 m	$0{,}50\ mm + 40 \times 10^{-6} \times l + 0{,}60 \times R$		P1-02-G.082	IH, OS

Diameter

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Setting rings and ring gauges	Ø 1 mm to Ø 250 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P1-02-G.013 P1-02-G.014	IH
Cylindrical setting pins	to 200 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P1-02-G.020	IH
Plain plug gauges	to 200 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P1-02-G.009	
Thread wires	to 20 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P1-02-G.020	IH
Radius gauge	to Ø 200 mm	3,0 µm + 5,0 × 10^{-6} × *l*		P1-02-G.025	IH
Other internal diameters	Ø 1 mm to Ø 250 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P1-02-G.068	IH
Other external diameters	Ø 0,05 mm to Ø 300 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P1-02-G.064 P1-02-G.068	IH
	Ø 300 mm to Ø 500 mm	0,90 µm + 0,60 × 10^{-6} × *l*		P1-02-G.064 P1-02-G.068	IH
Conical plug gauge	Ø 0,5 mm to Ø 300 mm	1,2 µm + 2,5 × 10^{-6} × *d*		P2-02-G.185	IH
Conical ring gauge	Ø 1,0 mm to Ø 300 mm	1,2 µm + 2,5 × 10^{-6} × *d*		P2-02-G.185	IH

Form error

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Knife edge straight edge	to 300 mm	0,30 µm		P1-02-G.069	IH
Straight edge	to 6000 mm	0,50 µm + 0,50 × 10^{-6} × *l*		P1-02-G.074	IH, OS
Surface plate	to 6 000 mm x 10 000 mm	0,30 µm + 1,6 × 10^{-6} × *l*	*l* = longest side of the surface plate	P1-02-G.006	IH, OS
Roundness tester	to 300 µm	0,050 µm + 0,50 × R		P1-02-G.030	IH, OS
Roundness standard	to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness	P1-02-G.028	IH
Flick standard (roundness standard)	to 1 mm	0,25 µm		P1-02-G.043	IH

Roughness

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Surface texture measuring instruments	Ra: 0,05 µm to 5 µm	0,040 × A + 0,50 × R (minimum 0,030 µm)	A = Ra-value of reference	P1-02-G.029	IH, OS
	Rz: 0,1 µm to 10 µm	0,060 × A + 0,50 × R (minimum 0,050 µm)	A = Rz-value of reference		
	Rt (Rmax): 0,1 µm to 10 µm	0,060 × A + 0,50 × R (minimum 0,050 µm)	A = Rt(Rmax)-value of reference		
Roughness standards	Ra: to 10 µm	0,025 µm + 0,060 × A	A = measured Ra-value	P1-02-G.028	IH
	Rz: to 15 µm	0,030 µm + 0,090 × A	A = measured Rz-value		
	Rt(Rmax): to 15 µm	0,030 µm + 0,090 × A	A = measured Rt(Rmax)-value		

Thread quantities

Thread external					
Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**Location**
Pitch	to 10 mm	2 µm		P1-02-G.059	IH
Profile angle	to 180°	(0,50 + 12/*l*) bgmin	*l* = leg length in mm		IH
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		IH
		α = 60°: (3,2 µm to 5,9 µm)			
		α = 90°: (2,6 µm to 5,5 µm)			
Pitch diameter	Ø 3 mm to Ø 90 mm	2,5 µm + 5 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α ≥ 27°	P1-02-G.059 P1-02-G.060	IH
		4,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α < 27°		
Outside, core diameter	Ø 3 mm to Ø 90 mm	1,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b		IH

Thread internal					
Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**Location**
Pitch	to 10 mm	2 µm		P1-02-G.059	IH
Profile angle	to 180°	(0,50 + 12/*l*) bgmin	*l* = leg length in mm		IH
Simple pitch diameter	Ø 4 mm to Ø 300 mm	α = 30°: (9,0 µm to 14 µm)	Acc. to Euramet/CG-10, method 1a or 1b		IH
		α = 60°: (3,6 µm to 7,0 µm)			
		α = 90°: (3,1 µm to 6,2 µm)			
Pitch diameter	Ø 3 mm to Ø 90 mm	2,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α ≥ 27°	P1-02-G.059 P1-02-G.060	IH
		4,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α < 27°		
Outside, core diameter	Ø 3 mm to Ø 90 mm	1,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b		IH

Coordinate measuring machines

Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**Location**
Deviation of nominal displacement	to 20 m		e.g. 1D/2D/3D Measuring machine with:	P1-02-G.007 P1-02-G.055 P1-02-G086	IH, OS
		0,15 µm + 0,70 × R + 1,0 × 10^{-6} × *l*	Zerodur scales		
		0,15 µm + 0,70 × R + 1,3 × 10^{-6} × *l*	Glass scales		
		0,15 µm + 0,70 × R + 1,6 × 10^{-6} × *l*	Steel scales		
	to 400 mm	0,30 µm + 2,3 × 10^{-6} × *l*	using reference glass scale	P1-02-G.044	
Deviations transverse to the translation directions	to 0,5 mm	0,30 µm + 3,0 × 10^{-6} × *l* + 5,0 × 10^{-3} × A	A = measured deviation Measuring length to 3000 mm	P1-02-G.007	IH, OS
Rotational deviations around the translation direction	to 400 as	0,50 as + 3,5 × 10^{-3} × A	A = measured angle; horizontal translation only	P1-02-G.007	IH, OS
Other rotational deviations	to 7200 as	0,50 as + 1,6 × 10^{-3} × A	A = measured angle; measured length to 4500 mm	P1-02-G.007	IH, OS

as = arcsecond

Angle gauges

Measured quantity, instrument or gauge	Range		Remarks	Calibration procedure	Location
Angle gauge block	to 180°	0,000 28° + 10 × 10^{-6} × A	A = measured angle	P1-02-G.063	IH
		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	P1-02G.080	IH
Square	to 300 mm leg length	0,30 µm + 2,0 × 10^{-6} × *l*	Squareness	P1-02-G.032	IH
Angle plate	90°	0,50 as		P1-02-G.062	IH
Polygon	to 360 °	0,50 as		P1-02-G.050	IH
Pentagonprism	90 °	0,50 as		P1-02-G.087	IH

as = arcsecond

Angle (measuring instruments)

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Spirit level	to 12,5 mm/m	0,50 µm/m + 1,0 × 10^{-3} × A + 0,7 × R	A = set angle	P1-02-G.017	IH
	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	P1-02-G.037	IH
	to 2600 as	0,10 as + 1,0 × 10^{-3} × A + 0,70 × R			
Angle meters	0° - 360°	0,50 amin	e.g. protractor	P1-02-G.022	IH, OS
Angle sensor	0° - 360°	2,0 as	e.g. protractor	P1-02-G.061	IH, OS
Clinometers	0° - 360°	2,0 as		P1-02-G.017	IH
Theodolites	180°	3,0 as	Rotation around vertical axis	P1-02-G.066	IH
	180°	1,5 as	Defining horizontal plane		IH
	180°	1,8 as	Deviation of crosshairs to rotations		IH

as = arcsecond
amin = arcminute

Product measurement

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Form					
Surface profile	to 10 mm × 100 mm	1,0 µm + 0,010 × A	A = measured profile height	P1-02-G.068	IH
Roughness value	Ra: to 10 µm	0,025 µm + 0,060 × A	A = measured Ra-value	P1-02-G.028	IH
	Rz: to 15 µm	0,030 µm + 0,090 × A	A = measured Rz-value		
	Rt(Rmax): to 15 µm	0,030 µm + 0,090 × A	A = measured Rt(Rmax)-value		
Straightness	to 10 mm × 100 mm	1,0 µm + 0,010 × A	A = measured profile height	P1-02-G.068	IH
	to 300 mm	0,30 µm		P1-02-G.077	
	to 6000 mm	0,50 µm + 0,50 × 10^{-6} × L		P1-02-G.068	IH, OS
Roundness					
Roundness external	to Ø 300 mm	0,050 µm + 0,020 × A	A = measured roundness	P1-02-G.046	IH
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	P1-02-G.079	IH
Cilindricity internal	Ø 0,7 mm to Ø 300 mm to height 300 mm	0,40 µm + 0,040 × A	A = measured cilindricity		IH
Coaxiality and concentricity	Ø 0,7 mm to Ø300 mm to height 300 mm	0,10 µm + 0,040 × A	A = measured coaxiality / concentricity	P1-02-G.068	IH

Planes or sides					
Flatness	to Ø 55 mm	0,050 µm		P1-02-G.058	IH
	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	P1-02-G.006	IH, OS
Angle between sides or planes	to 180°	(0,50 + 12/*l*) amin	*l* = leg length in mm; leg length to 200 mm	P1-02-G.032	IH
		3,0 as	optical surfaces	P1-02-G.068	
Squareness	to 1200 x 550 mm	2,1 µm + 4,0 × 10^{-6} × *l*	*l* = leg length ratio leg length : reference length = 1 : 1	P1-02-G.068	IH
Parallelism	to 1200 mm	1,0 µm + 2,0 × 10^{-6} × *l*	*l* = leg length	P1-02-G.068	IH
Diameter					
External	Ø 0,05 mm to Ø 300 mm	0,50 µm + 1,5 × 10^{-6} × *l*		P1-02-G.068	IH
	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*			IH
Distance of 2 parallel surfaces					
External	to 200 mm	0,50 µm + 2,0 × 10^{-6} × *l*		P1-02-G.068	IH
	to 3000 mm	0,40 µm + 4,0 × 10^{-6} × *l*			
Internal	to 1200 mm	1,2 µm + 4,0 × 10^{-6} × *l*		P1-02-G.057 P1-02-G.068	IH

Thread external					
Pitch	to 10 mm	2,0 µm		P1-02-G.059	IH
Profile angle	to 180°	(0,50 + 12 / *l*) bgmin	*l* = leg length in mm		IH
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		IH
		α = 60°: (3,2 µm to 5,9 µm)			
		α = 90°: (2,6 µm to 5,5 µm)			
Pitch diameter	Ø 3 mm to Ø 90 mm	2,5 µm + 5 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α ≥ 27°	P1-02-G.059 P1-02-G.060	IH
		4,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α < 27°		
Outside, core diameter	Ø 3 mm to Ø 90 mm	1,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b		IH
Thread internal					
Pitch	to 10 mm	2,0 µm		P1-02-G.059	IH
Profile angle	to 180°	(0,50 + 12 / *l*) bgmin	*l* = leg length in mm		IH
Simple pitch diameter	Ø 4 mm to Ø 300 mm	α = 30°: (9,0 µm to 14 µm)	Acc. to Euramet/CG-10, method 1a or 1b		IH
		α = 60°: (3,6 µm to 7,0 µm)			
		α = 90°: (3,1 µm to 6,2 µm)			
Pitch diameter	Ø 3 mm to Ø 90 mm	2,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α ≥ 27°	P1-02-G.059 P1-02-G.060	IH
		4,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b, α < 27°		
Outside, core diameter	Ø 3 mm to Ø 90 mm	1,5 µm + 10 × 10^{-6} × *l*	Acc. to Euramet/CG-10, method 2b		IH

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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Force

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
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, according to ISO376	P1-02-M.009 P1-02-M.010 P1-02-M.019 P1-02-S.015	IH, OS
			dead weights, in-house method (performed according to ISO7500-1)		
	2 kN to 200 kN	$8{,}0 \times 10^{-4} \times F$	Generation and measurement by comparison with standard load cells, according to ISO376		
			Generation and measurement by comparison with standard load cells, in-house method (performed according to ISO7500-1)		
	200 kN to 500 kN	$10 \times 10^{-4} \times F$	Generation and measurement by comparison with standard load cells, according to ISO376		
			Generation and measurement by comparison with standard load cells, in-house method (performed according to ISO7500-1)		
	500 kN to 1,0 MN	$10 \times 10^{-4} \times F$	Measurement only by comparison with standard load cells, according to ISO376		
			Measurement only by comparison with standard load cells, in-house method (performed according to ISO7500-1)		
Gram force gauges	0,050 N to 500 N	$0{,}030 \times F$		P1-02-M.014	IH

Torque

Measured quantity, instrument or gauge	Range	Expanded uncertainty (*)	Remarks	Calibration procedure	Location
Torque tools	0,1 Nm to 2700 Nm	$8{,}0 \times 10^{-3} \times M$	Accuracy acc. to ISO 6789	P1-02-M.011 P1-02-M.020	IH, OS
Torque measuring devices	0,1 Nm to 1 Nm	$1{,}0 \times 10^{-3} \times M$	With torque arms and weights	P1-02-M.015 P1-02-M.016	IH
	1 Nm to 200 Nm	$1{,}0 \times 10^{-3} \times M$			
	200 Nm to 4000 Nm	$0{,}5 \times 10^{-3} \times M$			

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

Torque Louvain-La-Neuve: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Torque

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	Location
Torque tools	0,5 Nm to 1350 Nm	$8{,}0 \times 10^{-3} \times M$	Accuracy acc. to ISO 6789	P1-02-M.011 P1-02-M.020	IH , 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%.

Mass Wommelgem: In House or Onsite (IH/OS)

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	P1-02-W.002 P1-02-W.003 P1-02-W.004 P1-02-W.005 P1-02-W.008
	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	P1-02-W.002 P1-02-W.003 P1-02-W.004 P1-02-W.005 P1-02-W.008
	50 kg	600 mg	For example mass pieces up to grade M1 according to OIML R111-1	P1-02-W.004 P1-02-W.005 P1-02-W.008
	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	P1-02-W.001
	1 mg to 1 kg	$5{,}0 \times 10^{-6} \times m$ minimal 0,002 mg		
	> 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%.

Pressure and Vacuum Wommelgem: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Gas pressure

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
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	P1-02-P.001 P1-02-P.002 P1-02-P.003 P1-02-P.006	IH
	-100 kPa to -5 kPa	$25 \times 10^{-6} \times p$	By comparison with a gas pressure balance		IH
	-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	P1-02-P.005 P1-02-P.009	
	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	location
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	P1-02-P.001 P1-02-P.002 P1-02-P.003 P1-02-P.006	IH
	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	P1-02-P.005 P1-02-P.009	
	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	P1-02-P.010	IH
	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 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	P1-02-P.001 P1-02-P.002 P1-02-P.003 P1-02-P.006 P1-02-S.004	OS
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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Velocity of gases

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Windspeed	0,1 m/s to 35 m/s	0,60 % + 0,020 m/s	By comparison with an LDV in a windtunnel	P1-02-P.008	IH

(*) 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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Resistance thermometers					
Measured quantity, instrument or gauge	**Range**	**expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**location**
Resistance thermometers			Fixed points		
	-38,8344 °C	0,003 °C	triple point of mercury	P1-02-T.020 P1-02-T.024	IH
	0,01 °C	0,002 °C	triple point of water		
	29,7646 °C	0,002 °C	melting point of gallium		
	156,5985 °C	0,002 °C	freeze point of indium		
	231,928 °C	0,003 °C	freeze point of tin		
	419,527 °C	0,004 °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.020 P1-02-T.019	IH
	-100 °C to -70 °C	0,05 °C	By comparison with reference standards		
	-70 °C to 0 °C	0,015 °C			
	0 °C to 150 °C	0,011 °C			
	150 °C to 275 °C	0,012 °C			
	275 °C to 660 °C	0,04 °C			

Standard Pt resistance thermometers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Platinum resistance thermometers which meet the specifications of the ITS-90 or close to these specifications			Fixed points	P1-02-T.020 P1-02-T.024	IH
	-38,8344 °C	0,003 °C	triple point of mercury		IH
	0,01 °C	0,002 °C	triple point of water		
	29,7646 °C	0,002 °C	melting point of gallium		
	156,5985 °C	0,002 °C	freeze point of indium		
	231,928 °C	0,003 °C	freeze point of tin		
	419,527 °C	0,004 °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	location
Thermocouples B, R & S	0 °C to 280 °C	0,40 °C	By comparison with reference standards	P1-02-T.014 P1-02-T.019	IH
	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 P1-02-T.019	IH
	-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	location
Temperature indicators with resistance probe			Fixed points	P1-02-T.020 P1-02-T.023	IH
	-38,8344 °C	0,003 °C	triple point of mercury		
	0,01 °C	0,002 °C	triple point of water		
	29,7646 °C	0,002 °C	melting point of gallium		
	156,5985 °C	0,002 °C	freeze point of indium		
	231,928 °C	0,003 °C	freeze point of tin		
	419,527 °C	0,004 °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 P1-02-T.019 P1-02-T.008	IH
	-100 °C to -70 °C	0,05 °C	By comparison with reference standards		
	-70 °C to 0 °C	0,015 °C			
	0 °C to 150 °C	0,011 °C			
	150 °C to 275 °C	0,012 °C			
	275 °C to 660 °C	0,04 °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 P1-02-T.019	IH
	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 P1-02-T.019 P1-02-T.008	IH
	-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	IH
	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	IH
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	IH
5 °C		2,0 °C			
2 °C		0,80 °C			
1 °C		0,40 °C			
0,5 °C		0,20 °C			
0,2 °C		0,070 °C			
0,1 °C		0,050 °C			
0,05 °C		0,025 °C			
Surface temperature probes	ambient to 300 °C	0,50 % × t + 0,50 °C	By comparison with reference standards	P1-02-T.012	IH

Radiation thermometry

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Infrared thermometry	-17 °C to 100 °C	0,50 °C	By comparison with reference standards	P1-02-T.010	IH
	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	location
Charcterisation of ovens and climatic chambers	-100 °C to -38,5 °C	1,6 °C	Using thermocouple type K	P1-02-S.040	OS
	-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	location
Block calibrators	-100 °C to 650 °C	0,040 °C + 0,000 05 × $\|t\|$	Full evaluation following DOC EM/CG/13 "Guidelines on the Calibration of Temperature Block Calibrators" Or calibration with known evaluation information	P1-02-T.002 P1-02-T.003	IH

Cold junction compensation

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

Onsite calibration

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
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	OS
	-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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Inhouse calibrations					
Measured quantity, instrument or gauge	**Range**	**Expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**location**
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	P1-02-T.020 P1-02-T.027	IH
			Fixed points	P1-02-T.020 P1-02-T.024 P1-02-T.027	IH
	-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 or without indicators (eg: resistance probes and thermocouples)	-196 °C	0,01 °C	By comparison with reference standards in liquid nitrogen at atmospheric pressure	P1-02-T.014 P1-02-T.020 P1-02-T.024 P1-02-T.027	IH
	-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 <80 °C	0,11 °C	By comparison with reference standards in a climatic chamber	P1-02-T.025	IH
	80 °C to <120 °C	0,15 °C			
	120 °C to 180 °C	0,18 °C			
	-40 °C to 0 °C	0,058 °C	Datalogger immerged in a bag, by comparison with reference standards in thermal bath	P1-02-T.026	IH
	0 °C to 70 °C	0,083 °C			

Liquid in glass thermometers	-80 °C to <-58 °C	0,11 °C	By comparison with reference standards in thermal baths or ovens	P1-02-T.005 P1-02-T.027	IH
	-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	P1-02-T.027	IH
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"	P1-02-S.053	IH, OS

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	P1-02-S.052	OS
	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 availbility 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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Hygrometers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
RH meters with sensor type: resistive, capacitive, electrolytic, impedance, ...	5 % RH to 6 % RH @ ambient temperature	0,30 % RH	by comparison with two pressure humitiy generator	P1-02-H.001 P1-02-H.002 P1-02-H.012 P1-02-H.013 P1-02-H.014	IH
	> 6 % RH to 10 % RH @ ambient temperature	0,50 % RH			
	10 % RH to 95 % RH @ ambient temperature	0,50 % RH			IH
	10 % RH to 95 % RH @ 10 to 35 °C	0,50 %rh to 1,0 %rh			
	10 % RH to 95 % RH @ -10 to 10 °C	0,50 %rh to 2,5 %rh			
	10 % RH to 95 % RH @ 35 to 70 °C	0,50 %rh to 1,5 %rh			
	5% RH to 95 % RH @ 0 to 70 °C	0,26 %rh to 0,73 %rh	by comparison with two pressure / two temperatures humitiy generator		IH
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	P1-02-H.001 P1-02-H.002 P1-02-H.010 P1-02-H.011 P1-02-H.012 P1-02-H.013 P1-02-H.014	IH

Other instruments for humidity

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

Generators for Humidity

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Humidity generator	5 % RH to 90 % RH	0,10 % RH to 0,90 % RH	by comparison with dewpoint meter	P2-02-H.007	IH

Humidity of temperature controlled chambers

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Characterisation of climatic chambers	10 % RH to 90 % RH	1,5 % RH	Only between -20 °C to 100 °C	P1-02-S.040	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%.

Humidity Louvain-La-Neuve: In House or Onsite (IH/OS)
Calibration and Measurement Capabilities

Inhouse calibrations					
Measured quantity, instrument or gauge	**Range**	**Expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**location**
Dew point meters, impedance hygrometers and psychrometers	-60 °Cdp to -30 °Cdp	0,10 °Cdp	Temperature frost- or dew point	P1-02-H.016	IH
	-30 °Cdp to 60 °Cdp	0,08 °Cdp			
	60 °Cdp to 80 °Cdp	0,10 °Cdp			
	Relative humidity from 5% rh up to 95% rh	From 0,3% rh up to 1,3% rh (see table hereunder)	Temperature from -20 °C up to +80 °C, by comparison with reference standards in a humidity generator	P1-02-H.016	IH

(*) 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	0,6	0,8	0,9	1,0	1,1	1,2	1,3
-10	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,1	1,2
0	0,3	0,3	0,4	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,1
10	0,3	0,3	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,9	0,9
20	0,3	0,3	0,3	0,3	0,4	0,5	0,6	0,6	0,7	0,8	0,8
30	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,8	0,8
40	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0,7
50	0,3	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,7
60	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7	0,7
70	0,3	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,6	0,7	0,7
80	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,5	0,6	0,6	0,7

Onsite calibrations					
Measured quantity, instrument or gauge	**Range**	**Expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**location**
Dew point meters, impedance hygrometers and psychrometers	-20 °Cdp to +60 °Cdp	0,21 °Cdp	Temperature frost- or dew point	P1-02-S.052	OS
	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	P1-02-S.052	OS

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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Inhouse calibrations					
Measured quantity, instrument or gauge	**Range**	**Expanded uncertainty (*)**	**Remarks**	**Calibration procedure**	**location**
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	IH
	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**	**location**
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	IH

(*) 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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Hardness

Measured quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Hardness tester	0 Shore A to 100 Shore A	0,50 Shore A		P1-02-M.018	IH
	0 Shore D to 100 Shore D	0,50 Shore D		P1-02-M.018	IH
Reference for hardness tester	Shore A	2,0 mN		P2-02-M.018	IH
	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: In House or Onsite (IH/OS)

Calibration and Measurement Capabilities

Volume

Measure quantity, instrument or gauge	Range	expanded uncertainty (*)	Remarks	Calibration procedure	location
Volume measuring devices, pipettes	5 µl to 50 ml	0,05 + (0,002 x V) in µl	Gravimetric method	P1-02-V.002	IH, OS
Volume measuring devices, glass cups, recipients, …	50 ml to 100 ml	1,0 ml	Gravimetric method	P1-02-V.001	IH, OS
	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%.