

Annex to declaration of accreditation (scope of accreditation)
Normative document: EN ISO/IEC 17025:2017
Registration number: **K 999**

of **VSL B.V.**

This annex is valid from: **19-01-2023** to **01-11-2025**

Replaces annex dated: **20-01-2022**

Locations where activities are performed under accreditation

Location	Abbreviation/ location code
Thijsseweg 11 2629 JA Delft The Netherlands	Delft
Hugo de Grootplein 1 3314 EG Dordrecht The Netherlands	Dordrecht

This annex has been approved by the Board of the
Dutch Accreditation Council, on its behalf,

J.A.W.M. de Haas

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HCS code	Quantity, Instrument, Measure		Nominal ambient temperature	Location
LF	LF 00	DC/LF Electricity	23 °C	Delft, on-site
RF	RF 00	High Frequency Electricity	23 °C	Delft
TF	TF 00	Time and Frequency	23 °C	Delft, on site
DM	DM 00	Dimensional Quantities	20 °C	Delft, on site
MW	MW 10	Mass	20 °C	Delft
PV	PV 00	Pressure and Vacuum	20 °C	Delft, on-site
DV	DV 10	Density, Viscosity	20 °C	Delft, Dordrecht
VL	VL 10	Volume of liquids	20 °C	Dordrecht, on-site
FG	FG 10	Flow of Gas	20 °C	Delft, on-site
FL	FL 10	Flow of Liquids	20 °C	Dordrecht, on-site
OQ	OQ 10	Optical Quantities	23 °C	Delft, on-site
IR	IR 10	Ionising Radiation and Radioactivity	20 °C	Delft, on-site
TE	TE 10	Temperature	23 °C	Delft, on-site
RH	RH 00	Humidity	23 °C	Delft, on-site
CH	CH 00	Chemical Analysis	20 °C	Delft
RM	RM 00	Reference Materials	20 °C	Delft

Remarks

- 1) Calibration and Measurement Capability (CMC): Demonstrated measurement uncertainty, with coverage probability of 95%, in a given measurement point or measurement range. Measurement uncertainty, U , is calculated according to EA-4/02 "Expression of the Uncertainty of Measurement in Calibration" and/or GUM "Evaluation of measurement data - Guide to the Expression of Uncertainty in Measurement".
- 2) VSL is appointed by Royal Decree as the national organisation responsible for the realisation and maintenance of the Dutch national measurement standards. As a member of BIPM, VSL is obliged to fulfil the requirements of the Mutual Recognition Arrangement (MRA) which has been signed by the members of BIPM. In order to fulfil the requirements of the MRA with respect to the quality system applied for the calibration and measurement services, VSL has chosen for a third party assessment by the Dutch Council for Accreditation (RvA).

Calibration on-site: The uncertainties achievable on a customer's site (on-site) can be expected to be larger than the Calibration and Measurement Capability (CMC) that the accredited laboratory has been assigned as the CMC on the RvA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the CMC. The instruction, General Instruction On-Site Calibrations VSL (VSL-Kal-Alg/IDS/005), describes additional requirements specifically applicable for performing calibrations outside of the permanent laboratories in Delft and Dordrecht.

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LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 11	Direct Voltage 1 V and 1.018 V		$1.0 \cdot 10^{-7} \cdot U$	Josephson standard
	10 V		$5 \cdot 10^{-8} \cdot U$	Josephson standard
	Gain -1 mV – +1 mV -10 mV – +10 mV -100 mV – +100 mV -1 V – +1 V Non linearity -1 mV – +1 mV -10 mV – +10 mV -100 mV – +100 mV -1 V – +1 V Voltage ratio -1 mV – +1 mV -10 mV – +10 mV -100 mV – +100 mV -1 V – +1 V		$2.0 \cdot 10^{-6} \cdot U$ $4 \cdot 10^{-7} \cdot U$ $3 \cdot 10^{-7} \cdot U$ $2 \cdot 10^{-7} \cdot U$ 2 nV 3 nV 5 nV 10 nV $2.0 \cdot 10^{-6} \cdot U_1/U_2$ $3 \cdot 10^{-7} \cdot U_1/U_2$ $5 \cdot 10^{-8} \cdot U_1/U_2$ $1.0 \cdot 10^{-8} \cdot U_1/U_2$	Gain of range of multimeter Josephson standard In steps of about 145 microvolt. Non-linearity of range of multimeter Josephson standard In steps of about 145 microvolt. Voltage ratio within range of multimeter Josephson standard In steps of about 145 microvolt. Uncertainty scales with ratio for $U_1 > U_2$
	1 V and 1.018 V		$5 \cdot 10^{-7} \cdot U$	Zener reference
	10 V		$3 \cdot 10^{-7} \cdot U$	Zener reference
	1 mV 10 mV 100 mV 1 V 10 V 100 V 1 000 V		$1.1 \cdot 10^{-4} \cdot U$ $1.1 \cdot 10^{-5} \cdot U$ $1.4 \cdot 10^{-6} \cdot U$ $1.7 \cdot 10^{-6} \cdot U$ $1.1 \cdot 10^{-6} \cdot U$ $1.6 \cdot 10^{-6} \cdot U$ $1.7 \cdot 10^{-6} \cdot U$	Measuring at multifunction facility
	0 μV – 100 mV 100 mV – 10 V 10 V – 1 100 V		$2.0 \cdot 10^{-4} \cdot U - 3 \cdot 10^{-6} \cdot U + 20 \text{ nV}$ $3 \cdot 10^{-6} \cdot U - 2.0 \cdot 10^{-6} \cdot U$ $2.0 \cdot 10^{-6} \cdot U - 5 \cdot 10^{-6} \cdot U$	Measuring at multifunction facility

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HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 11	1 mV 10 mV 100 mV 1 V 10 V 100 V 1 000 V		$2.1 \cdot 10^{-4} \cdot U$ $2.1 \cdot 10^{-5} \cdot U$ $2.7 \cdot 10^{-6} \cdot U$ $1.3 \cdot 10^{-6} \cdot U$ $6 \cdot 10^{-7} \cdot U$ $8 \cdot 10^{-7} \cdot U$ $1.2 \cdot 10^{-6} \cdot U$	Generating at multifunction facility
	0 μ V – 1 mV 1 mV – 10 mV 10 mV – 100 mV 100 mV – 1 100 V		$3 \cdot 10^{-4} \cdot U + 20$ nV $3 \cdot 10^{-4} \cdot U - 3 \cdot 10^{-5} \cdot U$ $3 \cdot 10^{-5} \cdot U - 3 \cdot 10^{-6} \cdot U$ $2.0 \cdot 10^{-6} \cdot U$	Generating at multifunction facility
LF 12	Direct Voltage Ratio 10V/V – $1 \cdot 10^6$ V/V		 $1.0 \cdot 10^{-5}$ V/V – $5 \cdot 10^{-5}$ V/V	 Input 1 kV – 200 kV
LF 13	Direct High Voltage 1 kV – 200 kV		 $1.0 \cdot 10^{-5} \cdot U - 5 \cdot 10^{-5} \cdot U$	
LF 21	Direct Current 0.01 pA – 1 pA 1 pA – 20 pA 20 pA – 200 pA 0.2 nA – 2 nA 2 nA – 20 nA 20 nA – 200 nA 0.2 μ A – 2 μ A 2 μ A – 20 μ A		0.2 fA $5 \cdot 10^{-5} \cdot I - 2.0 \cdot 10^{-4} \cdot I$ $5 \cdot 10^{-5} \cdot I$ $3 \cdot 10^{-4} \cdot I - 1.0 \cdot 10^{-4} \cdot I$ $1.0 \cdot 10^{-4} \cdot I - 3 \cdot 10^{-5} \cdot I$ $3 \cdot 10^{-5} \cdot I$ $3 \cdot 10^{-5} \cdot I - 9 \cdot 10^{-6} \cdot I$ $7 \cdot 10^{-6} \cdot I$	Measuring
	20 μ A – 100 μ A 0.1 μ A – 100 mA 0.1 μ A – 1 A		$7 \cdot 10^{-6} \cdot I - 5 \cdot 10^{-6} \cdot I$ $5 \cdot 10^{-6} \cdot I$ $8 \cdot 10^{-5} \cdot I$	Measuring at multifunction facility
	0.01 pA – 1 pA 1 pA – 20 pA 20 pA – 200 pA 0.2 nA – 2 nA 2 nA – 20 nA 20 nA – 200 nA		0.2 fA $5 \cdot 10^{-5} \cdot I - 2.0 \cdot 10^{-4} \cdot I$ $5 \cdot 10^{-5} \cdot I$ $3 \cdot 10^{-4} \cdot I - 1.0 \cdot 10^{-4} \cdot I$ $1.0 \cdot 10^{-4} \cdot I - 3 \cdot 10^{-5} \cdot I$ $3 \cdot 10^{-5} \cdot I$	Generating

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LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 21	0.2 μ A – 2 μ A 2 μ A – 20 μ A 20 μ A – 100 μ A 0.1 mA – 100 mA 0.1 A – 1 A 1 A – 10 A		3 · 10 ⁻⁵ · I – 1.0 · 10 ⁻⁵ · I 1.0 · 10 ⁻⁵ · I 5 · 10 ⁻⁶ · I – 3 · 10 ⁻⁶ · I 3 · 10 ⁻⁶ · I 6 · 10 ⁻⁵ · I 1.0 · 10 ⁻⁴ · I	Generating at multifunction facility
	10 A – 100 A		7 · 10 ⁻⁶ · I	Generating at DC ratio facility Currents up to 900 A possible with devices that allow multiple turns
	10 A – 900 A		7 · 10 ⁻⁶ · I	Measuring at DC ratio facility
LF 22	Direct Current Ratio 1 · 10 ⁻⁴ – 1 1 · 10 ⁻⁴ – 1		0.7 · 10 ⁻⁶ 0.4 · 10 ⁻⁶	Primary current 1 A – 1200 A Primary current 1 A – 1200 A, linearity
LF 24	Direct Charge 10 pC – 200 pC 200 pC – 200 nC		2.0 · 10 ⁻³ · Q – 4 · 10 ⁻⁴ · Q 4 · 10 ⁻⁴ · Q – 3 · 10 ⁻⁴ · Q	
LF 31	Alternating Voltage 1 mV – 100 mV 100 mV – 200 mV 200 mV – 2 V 2 V – 20 V 20 V – 30 V 30 V – 60 V 60 V – 200 V 200 V – 1 000 V	40 Hz – 100 kHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 500 kHz 10 Hz – 300 kHz 10 Hz – 100 kHz 10 Hz – 100 kHz	2.5 · 10 ⁻⁵ · U – 3.0 · 10 ⁻³ · U 2.0 · 10 ⁻⁵ · U – 4 · 10 ⁻⁴ · U 9 · 10 ⁻⁶ · U – 4 · 10 ⁻⁴ · U 9 · 10 ⁻⁶ · U – 4 · 10 ⁻⁴ · U 1.3 · 10 ⁻⁵ · U – 4 · 10 ⁻⁴ · U 1.5 · 10 ⁻⁵ · U – 1.5 · 10 ⁻⁴ · U 1.5 · 10 ⁻⁵ · U – 9 · 10 ⁻⁵ · U 1.8 · 10 ⁻⁵ · U – 1.0 · 10 ⁻⁴ · U	at multifunction facility
	1 mV – 130 mV	10 Hz – 100 kHz	5 · 10 ⁻⁷ · U – 5 · 10 ⁻⁴ · U	Josephson standard
LF 32	Alternating Voltage Ratio 1 · 10 ⁻⁷ V/V – 1 V/V	400 Hz – 1.6 kHz 400 Hz – 1.6 kHz	1.0 · 10 ⁻⁷ V/V (in-phase) 1.0 · 10 ⁻⁶ V/V (quadrature)	
	1 · 10 ⁻⁶ V/V – 1 V/V	50 Hz – 5 kHz 50 Hz – 5 kHz	2.0 · 10 ⁻⁶ V/V (in-phase) 1.0 · 10 ⁻⁵ V/V (quadrature)	
	1 · 10 ⁻³ V/V – 10 V/V	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 300 Hz	2.5 · 10 ⁻⁵ V/V 1.0 · 10 ⁻⁵ V/V 3.0 · 10 ⁻⁵ V/V	Input voltage up to 700 V

LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 32	1·10 ⁻⁶ V/V – 10 V/V	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 300 Hz	3.0·10 ⁻⁵ V/V 2.0·10 ⁻⁵ V/V 2.0·10 ⁻⁴ V/V	Input voltage up to 100 kV On-site: Input voltage up to 500 kV; for voltages above 230 kV, a HV capacitor with known voltage dependence needs to be supplied by the customer Including conventional and non-conventional instrument transformers and transformers with digital output (Sampled values according to IEC 61869-9 and IEC 61850-9-2)
	Phase displacement <i>D</i> (-π – +π) rad	45 Hz – 65 Hz	0.9·10 ⁻³ rad	Input 1 kV – 100 kV
	-0.1 rad – +0.1 rad	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 300 Hz	2.5·10 ⁻⁵ rad + 5·10 ⁻³ · <i>D</i> 1.0·10 ⁻⁵ ·rad + 5·10 ⁻³ · <i>D</i> 3.0·10 ⁻⁵ rad + 5·10 ⁻³ · <i>D</i> (<i>D</i> in rad)	Input voltage up to 100 kV On-site: Input voltage up to 500 kV; for voltages above 230 kV, a HV capacitor with known voltage dependence needs to be supplied by the customer Including conventional and non-conventional instrument transformers and transformers with digital output (Sampled values according to IEC 61869-9 and IEC 61850-9-2)
LF 33	Alternating High Voltage 1 kV – 100 kV	45 Hz – 65 Hz	1·10 ⁻⁴ · <i>U</i>	
LF 34	AV/DV Transfer 10 mV – 20 mV 20 mV – 100 mV 0.1 mV – 0.2 V 0.2 mV – 0.5 V 0.5 V – 1 V 1 V – 10 V 10 V – 30 V 30 V* – 60 V* 60 V – 100 V 100 V – 1 000 V	10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 1 MHz 10 Hz – 500 kHz 10 Hz – 300 kHz 10 Hz – 100 kHz	4·10 ⁻⁴ · <i>U</i> – 8·10 ⁻⁵ · <i>U</i> 3·10 ⁻⁴ · <i>U</i> – 2.0·10 ⁻⁵ · <i>U</i> 2.0·10 ⁻⁴ · <i>U</i> – 1.5·10 ⁻⁵ · <i>U</i> 1.0·10 ⁻⁴ · <i>U</i> – 5·10 ⁻⁶ · <i>U</i> 4·10 ⁻⁵ · <i>U</i> – 2.0·10 ⁻⁶ · <i>U</i> 2.0·10 ⁻⁶ · <i>U</i> – 4·10 ⁻⁵ · <i>U</i> 5·10 ⁻⁶ · <i>U</i> – 6·10 ⁻⁵ · <i>U</i> 1.0·10 ⁻⁵ · <i>U</i> – 5·10 ⁻⁵ · <i>U</i> 1.0·10 ⁻⁵ · <i>U</i> – 4·10 ⁻⁵ · <i>U</i> 1.0·10 ⁻⁵ · <i>U</i> – 1.0·10 ⁻⁴ · <i>U</i>	*) Max. 2.2·10 ⁷ V·Hz

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LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 41	Alternating Current			at multifunction facility
	200 μ A	10 Hz – 10 kHz	$1.0 \cdot 10^{-3} / - 3 \cdot 10^{-5} /$	
	2 mA	10 Hz – 10 kHz	$2.3 \cdot 10^{-4} / - 5 \cdot 10^{-5} /$	
	20 mA	10 Hz – 10 kHz	$2.3 \cdot 10^{-4} / - 6 \cdot 10^{-5} /$	
	200 mA	10 Hz – 10 kHz	$2.3 \cdot 10^{-4} / - 8 \cdot 10^{-5} /$	
	2 A	10 Hz – 10 kHz	$1.5 \cdot 10^{-4} / - 2.3 \cdot 10^{-4} /$	
	10 A	10 Hz – 10 kHz	$2.1 \cdot 10^{-4} / - 5 \cdot 10^{-4} /$	
LF 42	5 A – 5 000 A	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 200 Hz 200 Hz – 400 Hz	$20 \cdot 10^{-6} /$ $20 \cdot 10^{-6} /$ $25 \cdot 10^{-6} /$ $35 \cdot 10^{-6} /$	at current ratio facility
	Alternating current ratio	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 200 Hz 200 Hz – 400 Hz	$7 \cdot 10^{-6}$ $5 \cdot 10^{-6}$ $1.0 \cdot 10^{-5}$ $1.5 \cdot 10^{-5}$	Primary current from 1 mA – 8 kA Including conventional and non-conventional instrument transformers and transformers with digital output (Sampled values according to IEC 61869-9 and IEC 61850-9-2) Increased uncertainty for current-to-voltage transducers
	Magnitude ratio error			
	0 – 1			
LF 44	Phase displacement	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 200 Hz 200 Hz – 400 Hz	$7 \cdot 10^{-6}$ rad $5 \cdot 10^{-6}$ rad $1.0 \cdot 10^{-5}$ rad $1.5 \cdot 10^{-5}$ rad	Primary current from 1 mA – 8 kA Including conventional and non-conventional instrument transformers and transformers with digital output (Sampled values according to IEC 61869-9 and IEC 61850-9-2)
	$-\pi$ rad – $+\pi$ rad			
	AC/DC Transfer			
	10 mA – 500 mA 0.5 A – 5 A 5 A – 20 A	10 Hz – 100 kHz 10 Hz – 100 kHz 10 Hz – 100 kHz	$3 \cdot 10^{-5} / - 1.3 \cdot 10^{-4} /$ $4 \cdot 10^{-5} / - 2.5 \cdot 10^{-4} /$ $7 \cdot 10^{-5} / - 7 \cdot 10^{-4} /$	
LF 50	Power quality			IEC 61000-4-30
	Voltage unbalance	50 Hz or 60 Hz	0.03 %	
	0 % – 100 %			
LF 50	Harmonics and interharmonics	40 Hz – 5000 Hz	0.01 V – 0.03 V 0.1 mA – 2 mA	resolution 5 Hz resolution 5 Hz
	0.1 V – 250 V 1 mA – 20 A			

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LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 50	Total harmonic distortion 0.01 % – 100 %	40 Hz – 5000 Hz	0.001 % – 0.02 %	Voltage or current
	Voltage fluctuations 0.01 % – 10 %	50 Hz – 60 Hz	0.001 % – 0.003 %	10 mHz – 40 Hz modulation; P_{st} from 0.2 – 10 (IEC 61000-4-15)
	Active power 0 kW – 48 kW	45 Hz – 65 Hz	$1.5 \cdot 10^{-5}$ W/VA	1 V – 600 V 1 mA – 80 A $0 \leq \cos(\varphi) \leq 1$ inductive or capacitive Minimum apparent power 1 mVA
	0 MW – 500 MW	45 Hz – 65 Hz	$5 \cdot 10^{-5}$ W/VA	Single phase 0.05 kV – 100 kV 0.1 A – 5 000 A $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 5 VA
	0 GW – 1.5 GW	45 Hz – 65 Hz	$5 \cdot 10^{-5}$ W/VA	Three-phase 0.05 kV – 100 kV 0.1 A – 5 000 A $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 15 VA
	0 MW – 460 MW	45 Hz – 65 Hz	$2.0 \cdot 10^{-5}$ W/VA	Single phase – Loss Power 0.1 kV – 230 kV 0.1 A – 2 000 A $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 10 VA
	0 MW – 1380 MW	45 Hz – 65 Hz	$2.0 \cdot 10^{-5}$ W/VA	Three-phase – Loss Power 0.1 kV – 230 kV 0.1 A – 2 000 A $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 10 VA
	Apparent power 1 mVA – 48 kVA	45 Hz – 65 Hz	$1.5 \cdot 10^{-5}$ VA/VA	1 V – 600 V 1 mA – 80 A
	5 VA – 500 MVA	45 Hz – 65 Hz	$5 \cdot 10^{-5}$ VA/VA	Single phase 0.05 kV – 100 kV 0.1 A – 5 000 A
	15 VA – 1.5 GVA	45 Hz – 65 Hz	$5 \cdot 10^{-5}$ VA/VA	Three-phase 0.05 kV – 100 kV 0.1 A – 5 000 A

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LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 50	Energy			
	0 MWh – 8 MWh	45 Hz – 65 Hz	$5 \cdot 10^{-5} \text{ Wh/VAh} - 3 \cdot 10^{-4} \text{ Wh/VAh}$	Single phase 30 V – 600 V 0.02 A – 80 A $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 0.6 VA Measurement time 1 min – 1 Week
	0 MWh – 24 MWh	45 Hz – 65 Hz	$5 \cdot 10^{-5} \text{ Wh/VAh} - 3 \cdot 10^{-4} \text{ Wh/VAh}$	Three-phase 30 V – 600 V Line to Ground 0.02 A – 80 A per phase $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 1.8 VA Measurement time 1 min – 1 Week
	0 GWh – 84 GWh	45 Hz – 65 Hz	$5 \cdot 10^{-5} \text{ Wh/VAh} - 3 \cdot 10^{-4} \text{ Wh/VAh}$	Single phase 0.05 kV – 100 kV 0.1 A – 5 000 A $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 5 VA Measurement time 1 min – 1 Week
	0 GWh – 252 GWh	45 Hz – 65 Hz	$5 \cdot 10^{-5} \text{ Wh/VAh} - 3 \cdot 10^{-4} \text{ Wh/VAh}$	Three-phase 0.05 kV – 100 kV Line to Ground 0.1 A – 5 000 A per phase $0 \leq \cos(\varphi) \leq 1$, inductive or capacitive Minimum apparent power 15 VA Measurement time 1 min – 1 Week
LF 51	Power factor/ $\cos(\varphi)$			
	0 – ± 1	45 Hz – 65 Hz	$1.0 \cdot 10^{-6} - 3.5 \cdot 10^{-6}$	
LF 62	DC Resistance			
	1 $\mu\Omega$ 10 $\mu\Omega$ 100 $\mu\Omega$ 1 m Ω 10 m Ω 100 m Ω		$4 \cdot 10^{-5} \cdot R$ $4 \cdot 10^{-6} \cdot R$ $1.5 \cdot 10^{-6} \cdot R$ $1.0 \cdot 10^{-6} \cdot R$ $4 \cdot 10^{-7} \cdot R$ $2.0 \cdot 10^{-7} \cdot R$	
	1 Ω 10 Ω 25 Ω 100 Ω 1 k Ω 10 k Ω		$5 \cdot 10^{-8} \cdot R$ $3 \cdot 10^{-8} \cdot R$ $3 \cdot 10^{-8} \cdot R$ $2.0 \cdot 10^{-8} \cdot R$ $2.0 \cdot 10^{-8} \cdot R$ $2.0 \cdot 10^{-8} \cdot R$	

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HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 62	6.45 kΩ 12.9 kΩ 100 kΩ 1 MΩ		$3 \cdot 10^{-8} \cdot R$ $3 \cdot 10^{-8} \cdot R$ $4 \cdot 10^{-7} \cdot R$ $5 \cdot 10^{-7} \cdot R$	
	10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ		$8 \cdot 10^{-7} \cdot R$ $1.6 \cdot 10^{-6} \cdot R$ $2.5 \cdot 10^{-6} \cdot R$ $4 \cdot 10^{-6} \cdot R$ $8 \cdot 10^{-6} \cdot R$	
	1 TΩ 10 TΩ 100 TΩ 1 PΩ 10 PΩ		$1.5 \cdot 10^{-5} \cdot R$ $7.5 \cdot 10^{-5} \cdot R$ $1.5 \cdot 10^{-4} \cdot R$ $1.0 \cdot 10^{-2} \cdot R$ $1.0 \cdot 10^{-1} \cdot R$	
	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ		$7 \cdot 10^{-5} \cdot R$ $2.0 \cdot 10^{-5} \cdot R$ $1.5 \cdot 10^{-5} \cdot R$ $1.0 \cdot 10^{-5} \cdot R$ $1.0 \cdot 10^{-5} \cdot R$ $1.0 \cdot 10^{-5} \cdot R$ $1.5 \cdot 10^{-5} \cdot R$ $6 \cdot 10^{-5} \cdot R$ $6 \cdot 10^{-4} \cdot R$	Measuring at multifunction facility
	0 Ω – 10 kΩ 10 kΩ – 100 MΩ		$4 \cdot 10^{-5} \cdot R - 2.0 \cdot 10^{-5} \cdot R + 10 \mu\Omega$ $2.0 \cdot 10^{-5} \cdot R - 7 \cdot 10^{-4} \cdot R$	Measuring at multifunction facility
	0 Ω 1 and 1.9 Ω 10 and 19 Ω 100 and 190 Ω 1 and 1.9 kΩ 10 and 19 kΩ 100 and 190 kΩ 1 and 1.9 MΩ 10 and 19 MΩ 100 MΩ		5 μΩ $1.8 \cdot 10^{-5} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $1.7 \cdot 10^{-6} \cdot R$ $2.4 \cdot 10^{-6} \cdot R$ $2.4 \cdot 10^{-6} \cdot R$ $4 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $2.2 \cdot 10^{-5} \cdot R$ $1.0 \cdot 10^{-4} \cdot R$	Generating at multifunction facility
	Temperature coefficient			
	0 μΩ/Ω/K – 5 μΩ/Ω/K		0.015 μΩ/Ω/K	1 Ω – 10 kΩ 15 °C – 30 °C
	5 μΩ/Ω/K – 200 μΩ/Ω/K		0.015 μΩ/Ω/K – 0.3 μΩ/Ω/K	1 Ω – 10 kΩ 15 °C – 30 °C

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HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 62	0 $\mu\Omega/\Omega/K$ – 5 $\mu\Omega/\Omega/K$		0.1 $\mu\Omega/\Omega/K$	10 k Ω – 10 M Ω 15 °C – 30 °C
	5 $\mu\Omega/\Omega/K$ – 200 $\mu\Omega/\Omega/K$		0.1 $\mu\Omega/\Omega/K$ – 0.3 $\mu\Omega/\Omega/K$	10 k Ω – 10 M Ω 15 °C – 30 °C
LF 63	AC Resistance Real component			
	0 Ω – 10 Ω	50 Hz – 2 kHz	2 m Ω – 5 m Ω	
	0 Ω – 10 Ω	2 kHz – 10 kHz	2 m Ω – 10 m Ω	
	10 Ω – 100 Ω	50 Hz – 2 kHz	$3 \cdot 10^{-5} \cdot R - 2.0 \cdot 10^{-4} \cdot R$	
	10 Ω – 100 Ω	2 kHz – 10 kHz	$6 \cdot 10^{-5} \cdot R - 1.0 \cdot 10^{-3} \cdot R$	
	100 Ω – 1 k Ω	50 Hz – 2 kHz	$2.0 \cdot 10^{-5} \cdot R - 1.4 \cdot 10^{-4} \cdot R$	
	100 Ω – 1 k Ω	2 kHz – 10 kHz	$4 \cdot 10^{-5} \cdot R - 7 \cdot 10^{-4} \cdot R$	
	1 k Ω – 10 k Ω	50 Hz – 2 kHz	$1.0 \cdot 10^{-5} \cdot R - 4 \cdot 10^{-5} \cdot R$	
	1 k Ω – 10 k Ω	2 kHz – 10 kHz	$1.4 \cdot 10^{-5} \cdot R - 5 \cdot 10^{-4} \cdot R$	
	10 k Ω – 100 k Ω	50 Hz – 2 kHz	$1.0 \cdot 10^{-5} \cdot R - 1.0 \cdot 10^{-4} \cdot R$	
	10 k Ω – 100 k Ω	2 kHz – 10 kHz	$1.4 \cdot 10^{-5} \cdot R - 1.6 \cdot 10^{-4} \cdot R$	
	100 k Ω – 1 M Ω	50 Hz – 2 kHz	$2.0 \cdot 10^{-5} \cdot R - 1.4 \cdot 10^{-4} \cdot R$	
	100 k Ω – 1 M Ω	2 kHz – 10 kHz	$4 \cdot 10^{-5} \cdot R - 7 \cdot 10^{-4} \cdot R$	
	AC Resistance Imaginary component			Values and uncertainties are given as relative values with respect to the nominal resistance value R_{nom}
	-1.0 m Ω/Ω – +1.0 m Ω/Ω for $R_{nom} = 10 \Omega - 100 \Omega$	50 Hz – 2 kHz 2 kHz – 10 kHz	$1.3 \cdot 10^{-4} \cdot R - 5 \cdot 10^{-4} \cdot R$ $3 \cdot 10^{-4} \cdot R - 1.4 \cdot 10^{-3} \cdot R$	
	-1.0 m Ω/Ω – +1.0 m Ω/Ω for $R_{nom} = 100 \Omega - 1 k\Omega$	50 Hz – 2 kHz 2 kHz – 10 kHz	$1.0 \cdot 10^{-4} \cdot R - 3 \cdot 10^{-4} \cdot R$ $2 \cdot 10^{-4} - 1.0 \cdot 10^{-3} \cdot R$	
	-1.0 m Ω/Ω – +1.0 m Ω/Ω for $R_{nom} = 1 k\Omega - 10 k\Omega$	50 Hz – 2 kHz 2 kHz – 10 kHz	$3 \cdot 10^{-5} \cdot R - 2.0 \cdot 10^{-4} \cdot R$ $6 \cdot 10^{-5} \cdot R - 7 \cdot 10^{-4} \cdot R$	
	-1.0 m Ω/Ω – +1.0 m Ω/Ω for $R_{nom} = 10 k\Omega - 100 k\Omega$	50 Hz – 2 kHz 2 kHz – 10 kHz	$3 \cdot 10^{-5} \cdot R - 2 \cdot 10^{-4} \cdot R$ $6 \cdot 10^{-5} \cdot R - 7 \cdot 10^{-4} \cdot R$	
	-1.0 m Ω/Ω – +1.0 m Ω/Ω for $R_{nom} = 100 k\Omega - 1 M\Omega$	50 Hz – 2 kHz 2 kHz – 10 kHz	$1.0 \cdot 10^{-4} \cdot R - 3 \cdot 10^{-4} \cdot R$ $1.4 \cdot 10^{-4} \cdot R - 1.0 \cdot 10^{-3} \cdot R$	

LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 64	Capacitance			For measurements made using a three terminal configuration. Measurements can also be made in a two terminal configuration over the same capacitance and frequency range but the uncertainties will be increased.
	10 pF 100 pF 1 pF – 1 000 pF 10 nF – 1 µF	1 kHz; 1.592 kHz 1 kHz; 1.592 kHz 1 kHz 1 kHz	$3 \cdot 10^{-7} \cdot C$ $3 \cdot 10^{-7} \cdot C$ $5 \cdot 10^{-6} \cdot C$ $1.0 \cdot 10^{-5} \cdot C - 5 \cdot 10^{-5} \cdot C$	
	0 pF 0 pF 1 pF 1 pF 10 pF 10 pF 100 pF 100 pF 1 nF 1 nF 10 nF 10 nF 100 nF 100 nF 1 µF 1 µF	50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz 50 Hz – 1 kHz 1 kHz – 10 kHz	0.1 fF – 5 aF 5 aF – 0.04 fF $1.0 \cdot 10^{-4} \cdot C - 5 \cdot 10^{-6} \cdot C$ $5 \cdot 10^{-6} \cdot C - 4 \cdot 10^{-5} \cdot C$ $8 \cdot 10^{-5} \cdot C - 3 \cdot 10^{-6} \cdot C$ $3 \cdot 10^{-6} \cdot C - 4 \cdot 10^{-5} \cdot C$ $8 \cdot 10^{-5} \cdot C - 3 \cdot 10^{-6} \cdot C$ $3 \cdot 10^{-6} \cdot C - 4 \cdot 10^{-5} \cdot C$ $8 \cdot 10^{-5} \cdot C - 5 \cdot 10^{-6} \cdot C$ $5 \cdot 10^{-6} \cdot C - 6 \cdot 10^{-5} \cdot C$ $1.5 \cdot 10^{-4} \cdot C - 1.0 \cdot 10^{-5} \cdot C$ $1.0 \cdot 10^{-5} \cdot C - 1.5 \cdot 10^{-4} \cdot C$ $3 \cdot 10^{-4} \cdot C - 2.0 \cdot 10^{-5} \cdot C$ $2.0 \cdot 10^{-5} \cdot C - 3.1 \cdot 10^{-4} \cdot C$ $6 \cdot 10^{-4} \cdot C - 5 \cdot 10^{-5} \cdot C$ $5 \cdot 10^{-5} \cdot C - 7 \cdot 10^{-4} \cdot C$	
LF 65	10 pF – 100 nF	45 Hz – 65 Hz	$2.0 \cdot 10^{-5} \cdot C$	Input voltage up to 100 kV On-site: Input voltage up to 500 kV; for voltages above 230 kV, a HV capacitor with known voltage dependence needs to be supplied by the customer Current 5 µA – 10 A
LF 67	Inductance			
	0 µH	1 kHz	0.1 µH	
	100 µH	1 kHz	$3 \cdot 10^{-4} \cdot L$	
	1 mH	1 kHz	$2.0 \cdot 10^{-4} \cdot L$	
	10 mH	1 kHz	$2.0 \cdot 10^{-4} \cdot L$	
	100 mH	400 Hz 1 kHz 1.592 kHz	$1.5 \cdot 10^{-4} \cdot L$ $1.5 \cdot 10^{-4} \cdot L$ $1.5 \cdot 10^{-4} \cdot L$	
	1 H	100 Hz 200 Hz 400 Hz 1 kHz 1.592 kHz	$3 \cdot 10^{-4} \cdot L$ $2.0 \cdot 10^{-4} \cdot L$ $1.5 \cdot 10^{-4} \cdot L$ $1.5 \cdot 10^{-4} \cdot L$ $1.5 \cdot 10^{-4} \cdot L$	

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LF 00		DC/LF Electricity		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 67	10 H	100 Hz 200 Hz 400 Hz 1 kHz	$3 \cdot 10^{-4} \cdot L$ $2.0 \cdot 10^{-4} \cdot L$ $1.5 \cdot 10^{-4} \cdot L$ $2.0 \cdot 10^{-4} \cdot L$	
LF 68	Dissipation factor DF -0.1 – 0.1	45 Hz – 65 Hz	$1.0 \cdot 10^{-5} + 5 \cdot 10^{-3} \cdot DF$	Input voltage up to 100 kV On-site: Input voltage up to 500 kV; for voltages above 230 kV, a HV capacitor with known voltage dependence needs to be supplied by the customer Current 5 μ A – 10 A

RF 00		High Frequency Electricity		
HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
RF 21	Impedance (reflection factor) $ \rho \leq 1$	9 kHz – 18 GHz	$0.002 + 0.001 \cdot \rho^2 - 0.003 + 0.001 \cdot \rho^2$	GPC7 (50 Ω)
		9 kHz – 18 GHz	$0.003 + 0.001 \cdot \rho^2 - 0.004 + 0.001 \cdot \rho^2$	Type-N (50 Ω)
		9 kHz – 33 GHz	$0.003 + 0.001 \cdot \rho^2 - 0.004 + 0.002 \cdot \rho^2$	3.5 mm (50 Ω)
		9 kHz – 40 GHz	$0.002 + 0.002 \cdot \rho^2 - 0.004 + 0.002 \cdot \rho^2$	Type-K 2.92 mm (50 Ω)
		9 kHz – 50 GHz	$0.003 + 0.003 \cdot \rho^2 - 0.005 + 0.004 \cdot \rho^2$	2.40 mm (50 Ω)
RF 22	Attenuation $L = 0 \text{ dB} - 50 \text{ dB}$ $L = 50 \text{ dB} - 60 \text{ dB}$ $L = 60 \text{ dB} - 70 \text{ dB}$ $L = 70 \text{ dB} - 80 \text{ dB}$	50 kHz – 18 GHz	$(0.010 + 0.001 \cdot L) \text{ dB}$ 0.080 dB – 0.090 dB 0.180 dB – 0.220 dB 0.550 dB – 0.680 dB	GPC7, Type-N (50 Ω)
		50 kHz – 33 GHz	$(0.010 + 0.001 \cdot L) \text{ dB}$ 0.080 dB – 0.120 dB	3.5 mm (50 Ω)
		50 kHz – 40 GHz	$(0.010 + 0.001 \cdot L) \text{ dB}$ 0.080 dB – 0.120 dB	Type-K 2.92 mm (50 Ω)
		50 kHz – 50 GHz	$(0.010 + 0.001 \cdot L) \text{ dB}$ 0.080 dB – 0.120 dB	2.40 mm (50 Ω)

RF 00		High Frequency Electricity		
HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
RF 30	RF Power			
	Calibration Factor 0 – 1	9 kHz – 18 GHz 9 kHz – 33 GHz 9 kHz – 50 GHz	0.005·K – 0.015·K 0.005·K – 0.020·K 0.005·K – 0.030·K	GPC7, Type-N (50 Ω) 3.5 mm (50 Ω) 2.40 mm (50 Ω) cf = Calibration factor P = 1 μW – 10 mW
	Absolute Power 1 μW – 10 mW	9 kHz – 18 GHz	0.005·P – 0.015·P	GPC7, Type-N (50 Ω)
		9 kHz – 33 GHz	0.005·P – 0.020·P	3.5 mm (50 Ω)
		9 kHz – 50 GHz	0.005·P – 0.030·P	2.40 mm (50 Ω)

TF 00		Time and Frequency		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
TF 11	UTC-time			
	Local clock versus UTC (VSL) 0 ns – 1 s		1.0 ns	$2 U_m = 0.1 V - 10 V$ $t_{avg} \geq 10 ks$
	Local clock versus UTC 0 ns – 1 s		10 ns	$2 U_m = 0.1 V - 10 V$ $t_{avg} \geq 10 ks$
	Local clock versus UTC NTP time server -1 s to +1 s		0.5 ms	Via Network Time Protocol (NTP) On location
	Local clock versus UTC PTP time server -1 s to +1 s		1 μs	Via Precision Time Protocol On location
TF 21	Frequency			
	Frequency measurement	5; 10 MHz	$2.0 \cdot 10^{-13} \cdot f$	$2 U_m = 0.1 V - 1 V$ $t_{avg} \geq 10 ks$
		1 mHz – 1.3 GHz	$2.0 \cdot 10^{-10} \cdot f / (\text{gate time s})$	$2 U_m = 0.1 V - 1 V$ gate time = 1 μs – 10 ks
		1.3 GHz – 26 GHz	1.0 Hz	level: -10 dBm – +7 dBm
Frequency difference	(0.1; 1; 2.5; 5; 10) MHz	$1.0 \cdot 10^{-11} \cdot f / \sqrt{(t_{avg} \text{ in s})}$	$2 U_m = 0.1 V - 1 V$ $t_{avg} = 0.1 s - 10 ks$	

TF 00		Time and Frequency		
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
	Frequency generation	1, 5, 10 MHz 1 kHz – 4.3 GHz 4 GHz – 26 GHz	$2.0 \cdot 10^{-13} \cdot f$ $1.0 \cdot 10^{-11} \cdot f / \sqrt{t_{\text{avg}} \text{ in s}}$ 1 Hz	$U_{\text{eff}} \geq 1 \text{ V}$ $t_{\text{avg}} \geq 10 \text{ ks}$ level: -140 dBm – +13 dBm $t_{\text{avg}} = 0.1 \text{ s} - 10 \text{ ks}$ level: -60 dBm – +13 dBm
TF 22	Time interval Single shot 0 ns – 1 000 s Period 0 ns – 1 000 s Stopwatches, time base 0.01 s/d – 300 s/d Oscilloscopes, time base		1.0 ns + trigger error 100 ps 0.010 s/d $1.0 \cdot 10^{-7} \text{ s/s}$	$2 U_m = 0.1 \text{ V} - 10 \text{ V}$ $2 U_m = 0.1 \text{ V} - 10 \text{ V}$ periodic signals
TF 22	Time interval Time delay of optical components 0 ps – 1 μs Time delay between a 1pps output of locked pair of White Rabbit master and slave -2 ns to 2 ns		50 ps 0.1 ns	Optical component used in CWDM / DWDM optical fibre networks. The length of the optical fibre link between the White Rabbit master and slave is less than 10 m
	Optical fibre delay asymmetry from chromatic dispersion -50 ns to 50 ns		0.1 ns	Wavelengths between 1310 nm and 1610 nm. The product of fibre length in km and wavelength difference in nm > 10.
TF 24	Rise time 10 ps – 1 ns 1 ns – 1 μs 0.1 ns – 10 ns 10 ns – 1 μs		2.5 ps – 0.035 ns 0.035 ns – 0.035 μs 0.035 ns – 0.22 ns 0.22 ns – 21 ns	$U_m = 0.01 \text{ V} - 0.25 \text{ V}$ $t_{\text{rep}} < 200 \text{ kHz}$ U_{gen} terminated in 50 Ω $U_m = 0.25 \text{ V} - 5 \text{ V}$ U_{gen} terminated in 50 Ω

DM 00		Dimensional Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC ¹	Remarks *
* $Q[X; \gamma] = \sqrt{X^2 + Y^2}$				
DM 01	Laser wavelength vacuum wavelength absolute frequency	633 nm 474 THz	0.04 fm 24 kHz	Stabilised laser of the "mise en pratique". Optical beat frequency
	vacuum wavelength, λ_0	633 nm	$1 \cdot 10^{-9} \cdot \lambda_0$	Stabilised laser. Optical beat frequency
	Laser interferometer counting system	0 m – 50 m	$Q[0.01; 2 \cdot 10^{-8} \cdot L]$ μm , L in m	Comparison with reference interferometer Environmental sensors and optics of laser interferometer not taken into account MRA NMI Service Identifier 3
	Laser frequency	474 THz	4 kHz	Stabilized laser of Mise en Pratique with optical femtosecond comb generator; sample time 10 s
	Laser vacuum wavelength	633 nm	5.4 am	Stabilized laser of Mise en Pratique with optical femtosecond comb generator; sample time 10 s
	Laser frequency	563 THz	4.4 kHz	Stabilized laser of Mise en Pratique with optical femtosecond comb generator; sample time 10 s
	Laser vacuum wavelength	532 nm	4.2 am	Stabilized laser of Mise en Pratique with optical femtosecond comb generator; sample time 10 s
	laser frequency, ν_0	330 THz – 577 THz	$1 \cdot 10^{-9} \cdot \nu_0$	Stabilized laser with optical femtosecond comb generator; sample time 10 s
	laser vacuum wavelength, λ_0	530 nm – 1 000 nm	$1 \cdot 10^{-9} \cdot \lambda_0$	Stabilized laser with optical femtosecond comb generator; sample time 10 s
	DM 10	Gauge blocks central length steel	0.1 mm – 125 mm 0.1 mm – 125 mm	$Q[20 \text{ nm}; 2.2 \cdot 10^{-7} \cdot L]$ $Q[20 \text{ nm}; 1.5 \cdot 10^{-7} \cdot L]$
tungsten carbide				
Gauge blocks central length steel		100 mm – 1 000 mm 100 mm – 1 000 mm	$Q[20 \text{ nm}; 2.0 \cdot 10^{-7} \cdot L]$ $Q[20 \text{ nm}; 1.3 \cdot 10^{-7} \cdot L]$	Interferometry, exact fractions
tungsten carbide				

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DM 00		Dimensional Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC ¹	Remarks *
DM 10	Gauge blocks central length steel tungsten carbide	0.1 mm – 100 mm 0.1 mm – 100 mm	Q[0.044 μm; 0.91·10 ⁻⁶ ·L] Q[0.044 μm; 0.91·10 ⁻⁶ ·L]	Mechanical comparison with reference gauges of the same nominal length and the same material
	Gauge blocks length difference	1 mm – 100 mm	Q[0.015 μm; 0.2 10 ⁻⁶ ·L]	Interferometry, exact fractions
	Gauge blocks coefficient of thermal expansion	-5·10 ⁻⁶ ≤ α ≤ +30·10 ⁻⁶ K ⁻¹	≥ 5.5·10 ⁻⁸ K ⁻¹	Interferometry, exact fractions Length artefact: 25 mm – 1 000 mm Temperature range: 18 °C – 22 °C MRA NMI Service Identifier 15
	Length bar (circular cross section): central length	100 mm – 1 000 mm	Q[0.22 μm; 1.18·10 ⁻⁶ ·L]	CMM and laser Interferometer
	Gauge blocks central length	100 mm – 1 000 mm	Q[0.22 μm ; 1.18·10 ⁻⁶ ·L]	CMM and laser Interferometer
	Gauge blocks central length	100 mm – 500 mm	Q[0.056 μm; 0.82·10 ⁻⁶ ·L]	Mechanical comparison
	Step gauges Front faces Rear faces Parallelism	0 mm – 1 100 mm	Q[0.12 μm; 0.65·10 ⁻⁶ ·L] Q[0.12 μm; 0.65·10 ⁻⁶ ·L] Q[0.15 μm]	CMM and laserinterferometer
	Depth (groove) standard (ISO 5436-1 (1985) type A): step height (depth) H	0 nm – 3 000 nm	Q[1.4 nm; 14·10 ⁻³ ·H]	Interference microscope Minimum groove width: 100 μm
	Thermal expansion artefact (step gauges and others): coefficient of thermal expansion	-5·10 ⁻⁶ ≤ α ≤ +30·10 ⁻⁶ K ⁻¹	1.5·10 ⁻⁷ K ⁻¹	CMM, laser interferometer with plane mirror Cross section: (5 × 5) mm to (50 × 100) mm Length artefact: 25 mm – 1000 mm Temp range: 16 °C – 26 °C
Thermal expansion artefact: coefficient of thermal expansion	-5·10 ⁻⁶ ≤ α ≤ +30·10 ⁻⁶ K ⁻¹	5.5·10 ⁻⁸ K ⁻¹	Interferometry, exact fractions Cross section: (5 × 5) to (20 × 35) mm ² Length artefact: 150 mm – 1 000 mm Temp range: 18 °C – 22 °C	

DM 00		Dimensional Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC ¹	Remarks *
DM 20	Precision line scales: line spacing	Up to 1020 mm expansion coefficient $\alpha = 8 \cdot 10^{-6} \text{ K}^{-1}$ $\alpha = 3 \cdot 10^{-8} \text{ K}^{-1}$	Q[0.03 μm ; $5 \cdot 10^{-7} \cdot L$] Q[0.03 μm ; $1.7 \cdot 10^{-7} \cdot L$]	1-D measuring machine, CCD microscope, laser interferometer
	Precision line scales: line spacing	0 mm – 4000 mm	Q[0.5 μm ; $2.0 \cdot 10^{-6} \cdot L$]	1-D measuring machine, CCD microscope, laser interferometer
	Levelling rod: line spacing	0 m – 3 m	Q[20 μm ; $5 \cdot 10^{-6} \cdot L$]	1-D measuring machine, optical sensor, line scale
	Levelling rod: spacing between reference line and support	0 mm – 100 mm	20 μm	1-D measuring machine, optical microscope, line scale
DM 30	Length measuring instrument displacement L	0 m – 20 m	Q[0.2 μm ; $1.0 \cdot 10^{-6} \cdot L$]	Laser interferometer
	Displacement transducers (inductive, incremental e.g.): displacement L	0 μm – 12 μm	8 nm	Digital piezo transducer
	Displacement transducers (inductive, incremental e.g.): displacement L	0 mm – 100 mm	Q[0.06 μm ; $1.0 \cdot 10^{-6} \cdot L$]	1D measuring machine with laser interferometer. resolution: 0.01 μm displacement: 100 mm
	1D displacement actuator (dial gauge tester): displacement	0 mm – 25 mm	Q[0.09 μm ; $1.4 \cdot 10^{-6} \cdot L$]	Laser interferometer
	Measuring projector: error of indicated length error of indicated angle squareness of measurement axis	10 mm – 250 mm 0° – 360° 0" – 3 600"	Q[0.4 μm ; $2.2 \cdot 10^{-6} \cdot L$] 2' 19"	Grid plate Max. area: (250 × 250) mm MRA NMI Service Identifier 65
	Gauge block mechanical comparator: error of indicated difference D	-6 μm – +6 μm	17 nm	Gauge block set Max gauge block length 100 mm
	Laser distance meter (EDM) error of indicated distance L	500 mm – 50 000 mm	Q[0.7 mm; $1.5 \cdot 10^{-2} \cdot L$]	50 m measuring bench with laserinterferometer. L in mm

DM 00		Dimensional Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC ¹	Remarks *
DM 40	Diameter			
	External cylinders (plug gauge, piston): diameter <i>D</i>	2.5 mm – 400 mm	Q[0.20 μm; 0.88 · 10 ⁻⁶ · <i>D</i>]	CMM and laser interferometer
	External cylinders (wires, pin): diameter <i>D</i>	0.1 mm – 100 mm	Q[0.20 μm; 1.07 · 10 ⁻⁶ · <i>D</i>]	1-D measuring machine with laser interferometer. Repeatability ≤ 0.05 μm Influence roundness deviation ≤ 0.03 μm
	Internal cylinders (ring): diameter <i>D</i>	1.5 mm – 4 mm	Q[0.20 μm; 0.88 · 10 ⁻⁶ · <i>D</i>]	CMM, laser interferometer with plane mirror
	Internal cylinders (ring): diameter <i>D</i>	4 mm – 400 mm	Q[0.10 μm; 1.1 · 10 ⁻⁶ · <i>D</i>]	CMM, laser interferometer with plane mirror
	Spheres (ball): diameter <i>D</i>	12 mm – 60 mm	Q[0.10 μm; 0.8 · 10 ⁻⁶ · <i>D</i>]	CMM, laser interferometer with plane mirror
	Diameter standards (ball): diameter <i>D</i>	0.5 mm – 12 mm	0.030 μm	Interferometry exact fractions, indentation correction Uncertainty in nm D: Diameter in mm
	Spheres (ball): diameter <i>D</i>	0.5 mm – 1.5 mm 1.5 mm – 15 mm	0.30 μm 0.28 μm	1D measuring machine with laser interferometer, reference ball
DM 50	Form error			
	90° steel/granite square: squareness straightness	90 ° 0 μm – 500 μm	1 μm 0.2 μm	Reversal technique on a CMM Orientation: horizontal Max. size: 1 200 mm × 400 mm
	90° cylinder square: Squareness	90 °	0.5 μm (1.5 ")	Reversal technique on a CMM Orientation: horizontal Max. length: 1 200 mm Diameter: 50 mm – 300 mm
	90° cylinder square: Straightness	0 μm – 500 μm	0.2 μm	Reversal technique on a CMM Orientation: horizontal Max. length: 1 200 mm Diameter: 50 mm – 300 mm
	Optical flat: Flatness	0 μm – 0.3 μm	22 nm	Fizeau interferometer Diameter: 10 mm – 100 mm
DM 50	Optical flat: Flatness	0 μm – 25 μm	Q[0.032 μm; 1.8 · 10 ⁻¹⁰ · <i>D</i>]	CMM with electronic levels Diam.: 100 mm – 400 mm D = diameter

DM 00		Dimensional Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC ¹	Remarks *
	Optical flats: combined parallelism/flatness	0 µm – 12 µm	0.044 µm	Gauge block comparator Diameter: 10 mm – 60 mm
	Surface plate: Flatness	0 µm – 250 µm	$Q[0.2 \mu\text{m}; 5 \cdot 10^{-7} \cdot L]$	Electronic levels Minimum size L × L: 0.1 m × 0.1 m L = length of the longest side of the surface plate MRA NMI Service Identifier 49
	Cylindrical artefacts + spheres (ball): roundness deviation R	0 µm – 2 µm	$60 \text{ nm} + 0.03 \cdot R$	Roundness measuring machine, spindle correction. Diameter external cylinders (plugs): 2.5 mm – 160 mm Diameter internal cylinders (rings): 4 mm – 160 mm
	Sphere (hemispheres): roundness deviation R	0 µm – 1 µm	$10 \text{ nm} + 0.030 \cdot R$	Roundness measuring machine, error separation Diameter: 2.5 mm – 160 mm
	Straightness artefacts: straightness deviation	0 µm – 500 µm	0.2 µm	Electronic levels; Cylindrical artefacts: Length: 100 mm – 1 100 mm Diameter: 20 mm – 300 mm Cubic artefacts, length: 100 mm – 3 000 mm Width: ≥ 25 mm
	Levelling rod: form deviation of support	0 µm – 1 mm	20 µm	CMM
DM 90	Angle			
	Autocollimator: error of indicated angle	0' – 14'	0.1"	Sine bar, dial gauge tester MRA NMI Service Identifier 34
	Electronic level: error of indicated inclination angle	0 µm/m – 4 000 µm/m	0.5 µm/m	Sine bar, dial gauge tester MRA NMI Service Identifier 35
	Clinometers: error of indicated inclination angle	0 ° – 360 °	0.012 °	Index table
	Theodolite			
	Horizontal Angle	0 GON – 400 GON 0 ° – 360 °	2 mGON 6"	Autocollimator and Index Table Theodolite turned around
	Vertical Angle	-33.3 GON – +33.3 GON - 0 ° – +30 °	2 mGON 6"	

DM 00		Dimensional Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC ¹	Remarks *
	Deviation from level position	See Telescopic level		50 m measuring bench
	Telescopic level	1'	0,4"	
DM100	Angle gauges: included angle	0 ° – 180 °	0.5"	Autocollimator and rotary table
	Optical polygons: face angle	5 ° – 120 °	0.2"	2 autocollimators, full closure No. of faces: 3 – 72
	Optical square (pentaprism): deviation angle	90 °	0.2"	2 autocollimators, full closure

MW 10		Mass		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
MW 11	Mass	1 mg – 100 mg 0.1 g – 1 g 1 g – 10 g 10 g – 100 g 0.1 kg – 1 kg 1 kg – 10 kg 10 kg – 20 kg	0.6 µg – 1.5 µg 1.5 µg – 3 µg 3 µg – 6 µg 6 µg – 15 µg 15 µg – 100 µg 0.1 mg – 1.5 mg 1.5 mg – 10 mg	stainless steel mass standards

PV 00		Pressure and Vacuum		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
PV 11	Absolute pressure	5 kPa – 350 kPa	0.019 Pa + 15·10 ⁻⁶ ·p	Gas
		350 kPa – 7 000 kPa	0.08 Pa + 15·10 ⁻⁶ ·p	Gas
		7 MPa* – 20 MPa*	0.1 Pa + 38·10 ⁻⁶ ·p	Gas
PV 12	Gauge pressure	0 kPa – 500 kPa	0.019 Pa + 15·10 ⁻⁶ ·p _e	Gas
		0.5 MPa – 20 MPa	0.06 Pa + 15·10 ⁻⁶ ·p _e	Gas
	Differential pressure	0 MPa – 10 MPa	4 Pa + 4·10 ⁻⁵ ·p _d + 1,2·10 ⁻⁶ ·p _l	Gas, max. Line pressure 10 MPa p _d = differential pressure p _l = Line pressure
	Negative Gauge pressure	-0.5 kPa – -100 kPa	5·10 ⁻⁵ ·p _e	Gas
PV 21	Absolute pressure	1 MPa* – 80 MPa*	6 Pa + 4·10 ⁻⁵ ·p	Oil
		80 MPa* – 500 MPa*	25 Pa + 65·10 ⁻⁶ ·p	Oil

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PV 00		Pressure and Vacuum		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
PV 22	Gauge pressure	1 MPa – 80 MPa 80 MPa – 500 MPa	0.18 Pa + 15·10 ⁻⁶ ·p _e 27 Pa + 54·10 ⁻⁶ ·p _e	Oil Oil p _e = p – p _{amb} ; p _e = gauge pressure, p _{amb} = ambient pressure * Pressure balance + barometer

DV 10		Density, Viscosity		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
DV 10	Density and viscosity			
DV 11	Density of liquids	998 kg/m ³	0.001 %	Demineralised doubly distilled water Measurement by oscillation-type density meter. Temperatures: 15 °C – 40 °C
DV 11	Density of liquids	600 kg/m ³ – 1000 kg/m ³	0.02 %	Liquids Measurement by oscillation-type density meter. Temperatures: 15 °C – 40 °C
DV 12	Viscosity of liquids Kinematic and dynamic Viscosity	0.6 mm ² /s – 47 000 mm ² /s 0.4 mPa·s – 42 000 mPa·s	0.1 % – 0.5 %	Newtonian liquids, Temperatures: 15 °C – 40 °C

VL 10		Volume of liquids		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
VL 11	Volume capacity measures			Dordrecht, on location
	Proving tanks, standard test measures, flasks, cylinders (water + other liquids)	0.001 L – 3 000 L 10 L – 20 000 L 0.5 L – 200 L	0.02 % – 0.01 % 0.02 % 0.02 %	Weighing method Master meter Volumetric method
	Overflow pipettes	1 mL – 25 L	0.005 % – 0.02 %	Weighing method
	Burettes / pipettes	1 mL – 1 L	0.005 % – 0.02 %	Weighing method

VL 10		Volume of liquids		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
VL 11	Provers (water + mineral products)	1 L – 650 L	0.01 % – 0.02 %	Weighing method Reference volume Master meter
		10 L – 650 L	0.02 % – 0.04 %	
		100 L – 30 000 L	0.02 % – 0.04 %	
	Gamma Spheres (water)	10 cm ³ – 200 cm ³	0.01 % – 0.02 %	Weighing method
	Pyknometers (water)	10 mL – 200 mL	0.01 % – 0.02 %	Weighing method

FG 10 Flow of Gas

The scope of VSL is formulated for the measurands volume flow and flow speed in m³/h and m/s. The final calibration results can be different from this, e.g. kg/s for mass flow rate or discharge coefficient (differential pressure meter).

HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
FG 11	Gas Flow rate Low Pressure Gas (max. 10 kPa gauge pressure)	2·10 ⁻⁵ m ³ /h – 3.5 m ³ /h	0.4 – 0.20 %	Delft, on site Displacement prover system Displacement prover system Displacement prover system Master meter method
		1 m ³ /h – 400 m ³ /h	0.09 %	
		16·10 ⁻³ m ³ /h – 15 000 m ³ /h	0.4 % – 0.15 %	
		High Pressure Gas (max. 6.0 MPa gauge pressure)	5 m ³ /h – 230 m ³ /h	
	High Pressure Natural Gas (max. 6.0 MPa gauge pressure)	5 m ³ /h – 20 m ³ /h 20 m ³ /h – 2 000 m ³ /h	0.30 % – 0.1 % 0.1 %	VSL Traceability System (2 mobile transfer units)
FG 13	Velocity of gases			Delft, on site
	Air velocity	0.1 m/s – 1.0 m/s	3.2/v – 1.2 %	
		1 m/s – 2 m/s	2 %	
		2 m/s – 35 m/s	1 %	

FL 10		Flow of Liquids		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
FL 11	Mass flow rate			Dordrecht
	Flow meters (mass quantity) (water)	0.001 t/h – 400 t/h	0.02 % – 0.025 %	Weighing method
		0.8 t/h – 400 t/h	0.02 % – 0.025 %	Pipe prover method
		0.1 t/h – 400 t/h	0.04 % – 0.045 %	Master meter method
FL12	Volume flow rate			Dordrecht
	Flow meters (volume quantity) (water)	0.001 m ³ /h – 400 m ³ /h	0.02 % – 0.025 %	Weighing method
		0.8 m ³ /h – 400 m ³ /h	0.02 % – 0.025 %	Pipe prover method
		0.1 m ³ /h – 400 m ³ /h	0.04 % – 0.045 %	Master meter method

OQ 10		Optical Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
OQ 11	Radiometric quantities			
	Responsivity, laser power	< 1 mW	0.5 %	488, 532, 543, 633 nm Reference Detector
		1 mW – 10 mW	0.8 %	
	Responsivity, spectral, irradiance	100 μW/cm ² – 10 mW/cm ²	10 %	365 nm Reference Detector
	Responsivity, spectral, irradiance	AW ⁻¹ m ² , VW ⁻¹ m ²	0.3 %	400 nm – 950 nm, Reference detector, Scanning spot method
	Responsivity, spectral, irradiance	counts W ⁻¹ m ² 250 nm to 700 nm	0.3 % to 4 %	Spectroradiometer
Responsivity, spectral	< 1 mW		Reference detector	
	300 nm – 380 nm	0.38 % – 0.29 %		
	380 nm – 450 nm	0.29 % – 0.07 %		
	450 nm – 900 nm	0.07 %		
	900 nm – 950 nm	0.07 % – 0.11 %		
	950 nm – 1000 nm	0.11 % – 0.43 %		
	1000 nm – 1250 nm	0.9 % – 0.4 %		
	1250 nm – 1500 nm	0.4 %		
	1500 nm – 1600 nm	0.4 % – 1.5 %		

OQ 10		Optical Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
OQ 11	Radiant flux, spectral	380 nm – 780 nm	1.4 % – 5.3 %	Integrating sphere, Tungsten Source, LED Source
	Irradiance, spectral	250 nm – 400 nm	3.2 % – 1.6 % varies with wavelength	(0.000 1 – 0.25) Wm ⁻² nm ⁻¹ Tungsten Source, Spectroradiometer
		400 nm – 700 nm	1.6 % – 0.8 % varies with wavelength	
		700 nm – 1000 nm	0.8 % – 1 % varies with wavelength	
		1000 nm – 2000 nm	1 % – 4.2 %	
Linearity	Power: 0 W to 6 W Wavelength: 532 nm	0.2 %	Other wavelengths on request	
OQ 12	Photometric quantities			
	Illuminance	0.03 lx – 20 lx	2.0 % – 1 %	Tungsten Source, Reference photometer
	Illuminance	20 lx – 7000 lx	1 %	Reference photometer
	Luminance	20 cd m ⁻² – 1000 cd m ⁻²	1.4 %	Reference photometer
	Luminous intensity	20 cd – 5000 cd	1 %	Reference photometer and reference ruler.
	Correlated colour temperature	2856 K – 7504 K	8 K	Spectroradiometer
	Luminous efficacy	30 lm – 30000 lm 0 W – 3000 W	6,5 %	Photogoniometer white-light LED source CCT 2700 – 6500 K
	Luminous flux	30 lm – 30000 lm	6,5 %	Photogoniometer white-light LED source CCT 2700 – 6500 K
	Luminous efficacy	0 W – 3000 W 30 lm – 30000 lm	1.6 %	Integrating sphere, Tungsten source, LED source, Including power factor
	Luminous flux	30 lm – 30000 lm	1.5 %	
	Illuminance responsivity	A lx ⁻¹ , V lx ⁻¹	0.3 %	Against illuminant A for x, y, and z photopic response

OQ 10		Optical Quantities		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
OQ 12	Luminous efficacy	0 W – 3000 W 30 lm – 30000 lm	1.6 %	Integrating sphere, Tungsten Source, LED Source, Including power factor
	Luminous flux	30 lm – 30000 lm	1.5 %	
	Illuminance responsivity	A lx ⁻¹ , V lx ⁻¹	0.3 %	Against illuminant A for x, y, and z photopic response
	Colour, emitted, x, y	0 – 0.9	0.0004	Based on spectral irradiance
	Colour, emitted, u, v	0 – 0.9	0.0001 – 0.0004 varies with measurand	Based on spectral irradiance
	Colour, emitted, u', v'	0 – 0.9	0.0002 – 0.0003 varies with measurand	Based on spectral irradiance
	Colour rendering, Ra	0 – 100	0.24	Based on spectral irradiance
	Percent flicker	0 % – 100 %	0.023 % (abs)	Sinusoidal waveform
	Flicker _{perc}	0 % – 70.7 %	0.017 % (abs)	Sinusoidal waveform
Flicker index	0 – 0.31	8.0·10 ⁻⁵	Sinusoidal waveform	
OQ 13	Optical system properties			Properties of materials
	Absorption filters	1 – 0.00001	0.3 % – 1.7 % 0.07 % – 1.7 %	200 nm – 380 nm 380 nm – 1000 nm Relative measurement
	Spectral filters	1 – 0.00001	0.3 % – 1.7 % 0.07 % – 1.7 %	200 nm – 400 nm 380 nm – 1000 nm Relative measurement

IR 10		Ionising Radiation and Radioactivity			
HCS code	Quantity, Instrument, Measure	Measuring range**	CMC*	Remarks	
IR 12	Dosimetric Quantities Air kerma rate	0.05 nGy/s – 0.3 nGy/s	6 %	¹³⁷ Cs	
		0.3 nGy/s – 3 µGy/s	3 %	¹³⁷ Cs	
		0.3 nGy/s – 3 µGy/s	3 %	⁶⁰ Co	
		0.3 mGy/s – 25 mGy/s	0.46 %	⁶⁰ Co	
		3 µGy/s – 1.5 mGy/s	0.85 %	¹³⁷ Cs	
		30 nGy/s – 3 mGys	1.2 %	x-rays W -anode 20 kV – 50 kV	
		30 nGy/s – 3 mGy/s	0.92 %	x-rays W-anode 50 kV – 320 kV	
		60 µGy/s – 3 mGy/s	1.2 %	¹⁹² Ir based on calibration coefficients for x-ray W-anode 250 kV / 2.94 mm Cu and ¹³⁷ Cs (Med. Phys.. 31, 2004 (2826))	
		Reference Air Kerma Rate	10 nGy/s – 20 µGy/s	1.2 %	¹⁹² Ir
		Absorbed dose rate to water	0.3 mGy/s – 25 mGy/s	0.84 %	⁶⁰ Co
0.3 mGy/s – 400 mGy/s	0.84 %		1 MV – 25 MV photon beams based on direct measurement with a water calorimeter		
	1.6 %		1 MV – 25 MV photon beams, beams based on ⁶⁰ Co $N_{D,w}$ with NCS-18, IAEA TRS-398 or equivalent		
0.3 mGy/s – 400 mGy/s	3.6 %	4 MeV– 25 MeV electron beams based on ⁶⁰ Co $N_{D,w}$ with NCS-18, IAEA TRS-398 or equivalent.			
IR 13	Radioprotection Quantities Ambient dose equivalent / rate (ISO 4037)	0.2 µSv/h – 1 µSv/h	7 %	¹³⁷ Cs	
		1 µSv/h – 600 mSv/h	5 %	¹³⁷ Cs	
		1 µSv/h – 10 mSv/h	5 %	⁶⁰ Co	
		0.1 mSv/h – 600 mSv/h	5 %	x-rays W-anode 50 kV –320 kV	

IR 10		Ionising Radiation and Radioactivity		
HCS code	Quantity, Instrument, Measure	Measuring range**	CMC*	Remarks
IR 13	Personal dose equivalent / rate (ISO 4037)	0.2 µSv/h – 1 µSv/h	7 %	¹³⁷ Cs
		1 µSv/h – 600 mSv/h	5 %	¹³⁷ Cs
		1 µSv/h – 10 mSv/h	5 %	⁶⁰ Co
		0.1 mSv/h – 600 mSv/h	5 %	x-rays W-anode 50 kV – 320 kV
	Directional dose equivalent / rate (ISO 4037)	0.2 µSv/h – 1 µSv/h	7 %	¹³⁷ Cs
		1 µSv/h – 600 mSv/h	5 %	¹³⁷ Cs
		1 µSv/h – 10 mSv/h	5 %	⁶⁰ Co
		0.1 mSv/h – 600 mSv/h	5 %	x-rays W-anode 50 kV – 320 kV

** Depends on actual dose rate of radioactive sources.

TE 10		Temperature		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
TE 10	Resistance thermometer			
	SPRT's and HT-SPRT's	-189.344 2 °C (Ar) -38.8344 °C (Hg) 0.01 °C (TPW) 29.7646 °C (Ga) 156.5985 °C (In) 231.928 °C (Sn) 419.527 °C (Zn) 660.323 °C (Al) 961.78 °C (Ag)	1 mK 0.25 mK 0.12 mK 0.31 mK 0.7 mK 0.6 mK 1 mK 3.4 mK 6 mK	On fixed points
	Resistance thermometer	-195 °C – -80 °C -80 °C – 0 °C 0 °C – 30 °C 30 °C – 70 °C 70 °C – 100 °C 100 °C – 280 °C 300 °C – 650 °C 650 °C – 850 °C	6 mK 4 mK 0.7 mK 0.9 mK 4 mK 6 mK 14 mK 0.2 °C	By comparison (including resistance thermometers with transmitter)

TE 10		Temperature		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
TE 30	Thermocouples			
	Thermocouples type S and R	419.527 °C (Zn) 660.323 °C (Al) 961.78 °C (Ag) 1084.62 °C (Cu)	0.2 °C 0.15 °C 0.15 °C 0.21 °C	On fixed points and secondary fixed points
	Thermocouples type B	419.527 °C (Zn) 660.323 °C (Al) 961.78 °C (Ag) 1084.62 °C (Cu)	0.25 °C 0.25 °C 0.25 °C 0.25 °C	On fixed points and secondary fixed points
	Thermocouples	-195 °C – -80 °C -80 °C – 280 °C 300 °C – 650 °C 650 °C – 1 050 °C 1 050 °C – 1 550 °C	70 mK 60 mK 60 mK 0.3 °C 1.3 °C – 3.5 °C	By comparison (including thermocouples with transmitter)
TE 41	Self-indicating thermometers			
	Indicating thermometers	-195 °C – -80 °C -80 °C – 0 °C 0 °C – 30 °C 30 °C – 70 °C 70 °C – 100 °C 120 °C – 280 °C 300 °C – 650 °C 650 °C – 1050 °C 1050 °C – 1550 °C	6 mK 4 mK 0.7 mK 0.9 mK 4 mK 6 mK 14 mK 0.3 °C 1.3 °C – 3.5 °C	By comparison (including liquid-in-glass thermometers)
	Dry block calibrator	-50 °C – 50 °C 50 °C – 250 °C 250 °C – 419 °C 450 °C – 800 °C 800 °C – 1100 °C	0.05 °C 0.03 °C 0.05 °C 0.5 °C 1 °C	
	Ice point references	0 °C / room temperature	10 mK	
TE 91	Resistance thermometer	-200 °C – 850 °C	0.05 °C	Electrical calibration
TE 92	Thermocouples	over total range Base metals: J, L, K, T, U, N, E Noble metals: R, S, B	4 µV	Electrical calibration CMC in degrees Celsius depends on Seebeck coefficient of thermocouple type

TE 10		Temperature		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
TE 100	Contact thermometry			
TE 101	Primary references Fixed point cells	-189.344 2 °C (Ar) -38.8344 °C (Hg) 0.01 °C (TPW) 29.7646 °C (Ga) 156.5985 °C (In) 231.928 °C (Sn) 419.527 °C (Zn) 660.323 °C (Al) 961.78 °C (Ag)	1 mK 0.25 mK 0.1 mK 0.26 mK 0.7 mK 0.6 mK 1 mK 3 mK 5 mK	Direct comparison

RH 00		Humidity		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RH 10	Dew point meters	-70 °C – +70 °C	0.04 °C – 0.05 °C	Against primary generator in single pressure mode with air and nitrogen
RH 13	Relative Humidity sensors	12 %rh – 95 %rh	0.29 %rh – 0.87 %rh	By comparison in climatic chamber at atmospheric pressure with air -9 °C < T < 0 °C
		12 %rh – 95 %rh	0.23 %rh – 0.60 %rh	0 °C < T < +70 °C
RH 14	Trace humidity meters	3 µmol/mol – 10 000 µmol/mol 0.1 Mpa	0.3 % – 2.0 %	Against primary generator in single pressure mode with air and nitrogen
RH 20	Other instruments for humidity Air temperature	-9 °C – 18 °C 18 °C – 25 °C 25 °C – 70 °C	0.048 °C – 0.025 °C 0.025 °C 0.025 °C – 0.081 °C	By comparison in climatic chamber at atmospheric pressure with air
RH 30	Generators for humidity	-10 °C – 70 °C	0.3 – 0.8 %rh	By comparison with dew point meter and air temperature sensor at atmospheric pressure
RH 36	Trace humidity in air and nitrogen	3 µmol/mol – 1000 µmol/mol	4.7 % - 1.4 %	By comparison with dewpoint meter

CH 00		Chemical Analysis		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
CH 01	Analytical instruments/monitors			Calibration of gas monitors and gas diluters
	Gas monitors-for the following components	Mole fractions	0.5 % – 5 % relative	Gas monitor calibration normally consists of zero and span adjustments and linearity check, using certified gas mixtures.
	CO in N ₂	$1 \cdot 10^{-6} - 10 \cdot 10^{-2}$		
	CO ₂ in N ₂	$10 \cdot 10^{-6} - 20 \cdot 10^{-2}$		
	NO in N ₂	$1 \cdot 10^{-6} - 1 \cdot 10^{-2}$		
	NO ₂ in N ₂	$1 \cdot 10^{-6} - 1 \cdot 10^{-3}$		
	SO ₂ in N ₂	$10 \cdot 10^{-6} - 1 \cdot 10^{-2}$		
	C ₃ H ₈ in N ₂	$10 \cdot 10^{-6} - 5 \cdot 10^{-2}$		
	O ₂ in N ₂	$100 \cdot 10^{-6} - 22 \cdot 10^{-2}$		
	C ₂ H ₅ OH in N ₂	$100 \cdot 10^{-6} - 1 \cdot 10^{-3}$		
	H ₂ S in N ₂	$10 \cdot 10^{-6} - 10 \cdot 10^{-3}$		
	CH ₄ in N ₂	$1 \cdot 10^{-6} - 100 \cdot 10^{-6}$		
	N ₂ O in N ₂	$0.3 \cdot 10^{-6} - 30 \cdot 10^{-6}$		
	NH ₃ in N ₂	$30 \cdot 10^{-6} - 300 \cdot 10^{-6}$		
O ₃ in purified air	$20 \cdot 10^{-9} - 500 \cdot 10^{-9}$	2 % – 1.6 %	Calibration of monitors and ozone generators	
Mercury in air	$0.1 \mu\text{g m}^{-3} - 2.1 \mu\text{g m}^{-3}$	5 %	Calibration of mercury monitors and generators using gas mixtures prepared by diffusion (ISO 6142-8). Calibrations are performed at normal conditions of temperature (293.15 K) and pressure (101.325 kPa).	
Mercury in air	$5 \mu\text{g m}^{-3} - 100 \mu\text{g m}^{-3}$	4 %	Calibration of mercury monitors and generators using gas mixtures prepared by diffusion (ISO 6142-8). Calibrations are performed at normal conditions of temperature (293.15 K) and pressure (101.325 kPa).	

CH 00		Chemical Analysis		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
CH 01	Mercury in sorption tubes	2 – 100 ng	10 %	Calibration of mercury monitors and generators using sorbent tubes prepared by sampling (ISO 16017-1) of gas mixtures prepared by diffusion (ISO 6142-8).
CH 02	Natural gas analysers			Performance evaluation according to ISO 10723:2012. Reference materials are the PSM's of VSL or CGM's traceable to VSL

RM 00		Reference Materials		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks

¹ PRM's are primary realizations of calibration gases produced and certified by VSL. (P002 scope)

² CGM's are produced by industry and certified by VSL. (K999 scope)

HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	Gas mixtures			CGM's Analysed Gas Mixtures Conform ISO 6143
	CO in N ₂ and synthetic air	0.5·10 ⁻⁶ – 10·10 ⁻⁶	2 % – 0.09 %	MRA CMC's:312177
	CO in N ₂ and synthetic air	10·10 ⁻⁶ – 50·10 ⁻²	0.09 % – 0.09 %	MRA CMC's: 312178
	CO ₂ in N ₂ and synthetic air	0.5·10 ⁻⁶ – 10·10 ⁻⁶	2 % – 0.09 %	MRA CMC's: 312179
	CO ₂ in N ₂ and synthetic air	10·10 ⁻⁶ – 50·10 ⁻²	0.09 % – 0.09 %	MRA CMC's: 312180
	CH ₄ in N ₂ and synthetic air	0.5·10 ⁻⁶ – 10·10 ⁻⁶	0.4% – 0.3%	MRA CMC's: 312186R
	CH ₄ in N ₂ and synthetic air	10·10 ⁻⁶ – 2.2·10 ⁻²	0.3% – 0.12%	MRA CMC's: 312187R
	CH ₄ in N ₂	2.2·10 ⁻² – 50·10 ⁻²	0.12 % – 0.12 %	MRA CMC's: 312188R
	C ₃ H ₈ in N ₂ and synthetic air	1·10 ⁻⁶ – 10·10 ⁻⁶	0.2 % – 0.14 %	MRA CMC's: 312189R
	C ₃ H ₈ in N ₂ and synthetic air	10·10 ⁻⁶ – 1·10 ⁻²	0.14 % – 0.12 %	MRA CMC's: 312190R
	C ₃ H ₈ in N ₂	1·10 ⁻² – 50·10 ⁻²	0.12 % – 0.12 %	MRA CMC's: 312191R
	O ₂ in N ₂	0.5·10 ⁻⁶ – 10·10 ⁻⁶	2 % – 0.08 %	MRA CMC's: 312181
	O ₂ in N ₂	10·10 ⁻⁶ – 50·10 ⁻²	0.08 % – 0.08 %	MRA CMC's: 312182
	NO in N ₂	0.1·10 ⁻⁶ – 1·10 ⁻⁶	1.6% – 0.90 %	MRA CMC's: 312016R-3

Annex to ISO/IEC 17025:2017 declaration of accreditation for registration number: **K 999**

of **VSL B.V.**

This annex is valid from: **19-01-2023 to 01-11-2025**

Replaces annex dated: **20-01-2022**

RM 00		Reference Materials		
¹ PRM's are primary realizations of calibration gases produced and certified by VSL. (P002 scope) ² CGM's are produced by industry and certified by VSL. (K999 scope)				
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	NO in N ₂	1·10 ⁻⁶ – 10·10 ⁻⁶	0.9 % – 0.50 %	MRA CMC's: 312017R-3
	NO in N ₂	10·10 ⁻⁶ – 1·10 ⁻²	0.5 % – 0.10 %	MRA CMC's: 312192R
	NO ₂ in synth. air	0.1·10 ⁻⁶ – 1000·10 ⁻⁶	3 % – 2%	
	NO ₂ in N ₂	10·10 ⁻⁶ – 1000·10 ⁻⁶	2 % – 1 %	
	N ₂ O in synth. air or N ₂	0.3·10 ⁻⁶ – 1000·10 ⁻⁶	3 % – 0.5 %	
	SO ₂ in N ₂ and synthetic air	0.1·10 ⁻⁶ – 1·10 ⁻⁶	3% – 0.9%	MRA CMC's: 312183
	SO ₂ in N ₂ and synthetic air	1·10 ⁻⁶ – 10·10 ⁻⁶	0.9 % – 0.09 %	MRA CMC's: 312184
	SO ₂ in N ₂ and synthetic air	10·10 ⁻⁶ – 5·10 ⁻²	0.09 % – 0.09 %	MRA CMC's: 312185
	H ₂ S in N ₂	1·10 ⁻⁶ – 10·10 ⁻⁶	4 % – 2 %	
	H ₂ S in N ₂	10·10 ⁻⁶ – 1000·10 ⁻⁶	2 % – 1 %	
	H ₂ S in CH ₄	10·10 ⁻⁶ – 1000·10 ⁻⁶	3 % – 2 %	
	C ₂ H ₅ OH in synth. air or N ₂	75·10 ⁻⁶ – 800·10 ⁻⁶	1 % – 0.5 %	
	1-C ₄ H ₉ OH in N ₂	56·10 ⁻⁶ – 64·10 ⁻⁶	1.0 %	
	NH ₃ in N ₂	30·10 ⁻⁶ – 300·10 ⁻⁶	5 %	
	H ₂ O in N ₂ and CH ₄	10·10 ⁻⁶ – 100·10 ⁻⁶	5 %	H ₂ O in CH ₄ has been measured for a long time and VSL has CMCs for this matrix gas. The actual measurement is performed in the same manner as the measurement in N ₂
	HCl in N ₂ or in synthetic air	10·10 ⁻⁶ – 300·10 ⁻⁶	5 % – 2.4 %	Analysed Gas Mixtures

of **VSL B.V.**

This annex is valid from: **19-01-2023 to 01-11-2025**

Replaces annex dated: **20-01-2022**

RM 00 Reference Materials

¹ PRM's are primary realizations of calibration gases produced and certified by VSL. (P002 scope)

² CGM's are produced by industry and certified by VSL. (K999 scope)

HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	Natural gas Methane Ethane Propane <i>n</i> -Butane <i>i</i> -Butane <i>n</i> -Pentane <i>i</i> -Pentane neo-Pentane <i>n</i> -Hexane Nitrogen Carbon dioxide Helium Hydrogen	60 % – 99.9 % 0.1 % – 14 % 0.05 % – 10 % 0.01 % – 3 % 0.01 % – 3 % 0.01 % – 0.8 % 0.01 % – 0.8 % 0.01 % – 0.8 % 0.01 % – 0.4 % 0.1 % – 20 % 0.05 % – 20 % 0.05 % – 0.4 % 3.5 % – 15 %	0.2 % 0.5 % – 0.2 % 0.5 % – 0.3 % 0.6 % – 0.2 % 0.6 % – 0.2 % 1 % – 0.4 % 1 % – 0.4 % 2 % – 1 % 1 % – 0.4 % 1.5 % – 0.2 % 1 % – 0.2 % 1 % – 0.4 % 0.4 % – 0.2 %	Analysed Gas Mixtures
	Main refrigerant (MR) Ethane Propane Nitrogen Methane	20 % mol/mol – 35 % mol/mol 5 % mol/mol – 15 % mol/mol 8 % mol/mol – 16 % mol/mol 45 % mol/mol – 90 % mol/mol	0.5 % 0.5 % 0.5 % 0.5 %	Analysed Gas Mixtures
	Coke oven gas Hydrogen Methane Carbon monoxide Carbon dioxide Nitrogen	0.2 % – 70 % 4 % – 35 % 3 % – 70 % 1 % – 25 % 3 % – 45 %	1 % – 0.5 % 1 % – 0.5 % 1 % – 0.5 % 1 % – 0.5 % 1 % – 0.5 %	Analysed Gas Mixtures
	Refinery gas A Methane Ethane Ethene Propane Propene 1,3-Butadiene 1-Butene <i>i</i> -Butene Hydrogen Nitrogen Helium	10 % – 13 % 1 % – 3 % 12 % – 16 % 0.4 % – 0.7 % 3 % – 5 % 0.75 % – 1.5 % 0.4 % – 0.65 % 0.4 % – 0.65 % 7 % – 9 % 3.5 % – 4.5 % 50 % – 60 %	0.4 % – 0.2 % 0.6 % – 0.3 % 0.6 % – 0.3 % 0.6 % – 0.3 % 0.6 % – 0.3 % 2 % – 1 % 2 % – 1 % 2 % – 1 % 1 % – 0.5 % 1 % – 0.5 % 1 % – 0.5 %	Analysed Gas Mixtures

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² CGM's are produced by industry and certified by VSL. (K999 scope)

HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	Refinery gas B Methane Ethane Propane Hydrogen <i>n</i> -Butane <i>i</i> -Pentane <i>n</i> -Pentane <i>n</i> -Hexane Carbon monoxide Carbon dioxide Hydrogen sulphide Nitrogen	10 % – 13 % 1.5 % – 2.5 % 0.4 % – 0.6 % 7 % – 8 % 0.8 % – 4.2 % 0.5 % – 1 % 0.5 % – 1 % 0.01 % – 0.1 % 1 % – 4 % 0.4 % – 0.8 % 1 % – 4 % 60 % – 80 %	0.15 % 0.3 % 0.3 % 0.15 % 0.3 % 0.5 % 0.5 % 0.5 % 0.4 % 0.4 % 0.5 % 0.3 %	Analysed Gas Mixtures
	Automotive gas O ₂ CO CO ₂ C ₃ H ₈	0.1 % – 22 % 0.1 % – 9 % 1 % – 18 % 0.005 % – 0.5 %	0.6 % – 0.3 % 0.3 % 0.3 % 0.5 % – 0.3 %	Analysed Gas Mixtures MRA CMC's: 312124R
	Sulphur in Methane Hydrogen sulphide Methyl mercaptane Ethyl mercaptane Carbonyl sulphide Dimethyl sulphide	10·10 ⁻⁶ – 50·10 ⁻⁶	3 %	Analysed Gas Mixtures
	Stack gas Carbon monoxide Carbon dioxide Nitrogen monoxide Sulphur dioxide Propane	10·10 ⁻⁶ – 1 000·10 ⁻⁶ 1·10 ⁻² – 20·10 ⁻² 10·10 ⁻⁶ – 1 000·10 ⁻⁶ 10·10 ⁻⁶ – 1 000·10 ⁻⁶ 3·10 ⁻⁶ – 1 000·10 ⁻⁶	1 % – 0.15 %	Analysed Gas Mixtures

RM 00		Reference Materials		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	VOC (in cylinders) ethane, ethene, Ethyne, propene, propane, 1-Butene, i-Butene, 1,3-Butadiene, n-Butane, i-Butane, cis-2-Butene, trans-2-Butene, 2-methyl-1,3-Butadiene, n-Pentane, i-Pentane, 1-Pentene, trans-2-Pentene, cis-2-Pentene, n-Hexane, n-Heptane, n-Octane, iso-Octane, 3-methyl-Pentane, 2-methyl-pentane, Benzene, Toluene, Ethylbenzene, o-Xylylene, m-Xylene, p-Xylene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene in nitrogen	$2 \cdot 10^{-9} - 1\ 000 \cdot 10^{-9}$	5 % – 2 %	Analysed Gas Mixtures including cis-2-Pentene and/or 3-methyl-Pentane only as CGM
	BTEX benzene, toluene, ethylbenzene, o-xylene, m-xylene, p-xylene in nitrogen	$2 \cdot 10^{-9} - 1\ 000 \cdot 10^{-9}$	5 % – 2 %	Analysed Gas Mixtures
	Energy gases Helium Hydrogen Methane Nitrogen Carbon monoxide Carbon dioxide Oxygen Ethene Ethane Propene Propane n-Butane i-Butane 1,3-Butadiene 1-Butene i-Butene n-Pentane i-Pentane Neo-Pentane n-Hexane	0.025 % – 1 % 0.2 % – 85% 1 % – 99.9 % 0.1 % – 70 % 1 % – 70 % 0.05 % – 45 % 0.2 % - 1.5 % 1.0 % – 16 % 0.002 % – 14 % 0.05 % – 5 % 0.002 % – 10 % 0.01 % – 3 % 0.01 % – 3 % 0.5 % – 1.5 % 0.2 % – 0.8 % 0.2 % – 0.8 % 0.01 % – 1 % 0.01 % – 1 % 0.01 % – 0.8 % 0.01 % – 0.4 %	1 % – 0.5 % 0.5% – 0.2 % 0.3 % – 0.15 % 0.7 % – 0.2 % 1 % – 0.5 % 0.5 % – 0.2 % 1.5 % – 1.3 % 0.5 % – 0.2 % 1% – 0.2 % 0.5 % – 0.2 % 2% – 0.2 % 0.5 % – 0.2 % 0.5 % – 0.2 % 0.5 % – 0.2 % 0.5 % – 0.2 % 0.5 % – 0.2 % 0.5 % – 0.2 % 2%–1% 0.5 % – 0.2 %	

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RM 00 Reference Materials

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HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	OVOC in nitrogen Methanol Ethanol Acetone	1 · 10 ⁻⁶ – 10 · 10 ⁻⁶ mol/mol 1 · 10 ⁻⁶ – 10 · 10 ⁻⁶ mol/mol 1 · 10 ⁻⁶ – 10 · 10 ⁻⁶ mol/mol	5 % 3 % 2 %	Analysed Gas Mixtures Preparation by a single reference procedure (gravimetry) Verification method: GC-FID
RM 20	Gas mixtures: Dynamic generation of standard atmospheres for calibration purposes (air measurements)			Analysed Gas Mixtures Gaseous components with Vapour pressure < 20 Pa
	VOC (ISO 6145-8/-10) Benzene, toluene, ethylbenzene, <i>m</i> -xylene, <i>o</i> -xylene, <i>p</i> -xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, <i>n</i> -hexane, <i>n</i> -heptane, <i>n</i> -octane, dichloromethane, trichloromethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane, trichloroethene, tetrachloroethene, ethyl acetate, 2-butanone, 1-butanol, methyl- <i>t</i> -butyl ether	1 · 10 ⁻⁹ – 1 · 10 ⁻⁶	2 %	Analysed Gas Mixtures Preparation by diffusion / permeation (ISO 6145, parts 8 and 10)
	Hexachloro-1,3-butadiene, formaldehyde, acetaldehyde, acrolein, hexanal, decanal, furfural, cyclohexanone 1,1-dichloroethene, <i>cis</i> -1,2-dichloroethene in air	1 · 10 ⁻⁹ – 1 · 10 ⁻⁶	4 %	Analysed Gas Mixtures Preparation by diffusion / permeation (ISO 6145, parts 8 and 10)

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RM 00		Reference Materials		
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HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM20	VOC (ISO 6145-4) Benzene, toluene, <i>m</i> -xylene, ethylbenzene, styrene, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, halothane, acetone, methanol, ethanol, <i>n</i> -propanol in air	$1 \cdot 10^{-6} - 1 \cdot 10^{-3}$	3 %	Analysed Gas Mixtures Preparation by continuous injection (ISO 6145, part 4)
	VOC (ISO 6145-4/-7) 1,3-Butadiene Vinyl chloride in air	$40 \cdot 10^{-9} - 100 \cdot 10^{-9}$ $0.1 \cdot 10^{-6} - 10 \cdot 10^{-6}$	3 % 5 % – 3 %	Analysed Gas Mixtures Preparation by diffusion / permeation (ISO 6145, parts 4 and 7)
	S-VOCs (ISO 6145-4) 2,5-di- <i>tert</i> -butyl-4-hydroxytoluene <i>n</i> -decane <i>n</i> -dodecane Styrene Dodecamethyl-cyclohexasiloxane Dimethyl phthalate <i>n</i> -tetradecane Naphthalene <i>n</i> -Hexadecane Benzyl alcohol <i>n</i> -octadecane <i>n</i> -Eicosane Diethyl phthalate Dibutyl phthalate	10 ng – 1000 ng	5 % 5 % 5 % 5 % 6 % 6 % 7 % 8 % 9 % 10 % 11 % 11 % 12 % 12 %	Prepared by continuous syringe injection (ISO 6145-4) Verification method: ATD-GC-FID
	Siloxanes in methane (in cylinder) Hexamethyldisiloxane (L2) Octamethyltrisiloxane (L3) Hexamethyl-cyclotrisiloxane (D3) Octamethyl-cyclotetrasiloxane (D4) Decamethyl-cyclopentasiloxane (D5)	$0.5 \cdot 10^{-6} - 50 \cdot 10^{-6}$ mol/mol $0.3 \cdot 10^{-6} - 35 \cdot 10^{-6}$ mol/mol $0.3 \cdot 10^{-6} - 20 \cdot 10^{-6}$ mol/mol $0.2 \cdot 10^{-6} - 9 \cdot 10^{-6}$ mol/mol $0.1 \cdot 10^{-6} - 3 \cdot 10^{-6}$ mol/mol	2 % 2 % 3 % 3 % 4 %	Verification method: GC-FID

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RM 00		Reference Materials		
HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
				CGM's
RM 20	High purity Hydrogen CO CO ₂ N ₂ O ₂ hydrocarbons H ₂ O	5·10 ⁻⁹ – 500·10 ⁻⁹ 1·10 ⁻⁹ – 500·10 ⁻⁹ 0.1·10 ⁻⁶ – 10·10 ⁻⁶ 100·10 ⁻⁹ – 1 000·10 ⁻⁹ 10·10 ⁻⁹ – 1 000·10 ⁻⁹ 1·10 ⁻⁶ – 100·10 ⁻⁶	30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 %	Purity analyses of high purity gases
	High purity Nitrogen CO CO ₂ Ar O ₂ hydrocarbons H ₂ O	5·10 ⁻⁹ – 500·10 ⁻⁹ 1·10 ⁻⁹ – 500·10 ⁻⁹ 100·10 ⁻⁹ – 1 000·10 ⁻⁹ 100·10 ⁻⁹ – 1 000·10 ⁻⁹ 10·10 ⁻⁹ – 1 000·10 ⁻⁹ 1·10 ⁻⁶ – 100·10 ⁻⁶	30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 %	Purity analyses of high purity gases
	High purity Helium CO CO ₂ N ₂ O ₂ hydrocarbons H ₂ O	5·10 ⁻⁹ – 500·10 ⁻⁹ 1·10 ⁻⁹ – 500·10 ⁻⁹ 0.1·10 ⁻⁶ – 10·10 ⁻⁶ 100·10 ⁻⁹ – 1 000·10 ⁻⁹ 10·10 ⁻⁹ – 1 000·10 ⁻⁹ 1·10 ⁻⁶ – 100·10 ⁻⁶	30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 %	Purity analyses of high purity gases
	High purity Synthetic air CO CO ₂ NO _x SO ₂ hydrocarbons H ₂ O	5·10 ⁻⁹ – 500·10 ⁻⁹ 1·10 ⁻⁹ – 500·10 ⁻⁹ 50·10 ⁻⁹ – 1 000·10 ⁻⁹ 50·10 ⁻⁹ – 1 000·10 ⁻⁹ 10·10 ⁻⁹ – 1 000·10 ⁻⁹ 1·10 ⁻⁶ – 100·10 ⁻⁶	30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 %	Purity analyses of high purity gases
	High purity Methane CO ₂ N ₂ O ₂ H ₂ O C ₂ H ₆ Higher hydrocarbons	1·10 ⁻⁹ – 500·10 ⁻⁹ 0.1·10 ⁻⁶ – 10·10 ⁻⁶ 100·10 ⁻⁹ – 1 000·10 ⁻⁹ 1·10 ⁻⁶ – 100·10 ⁻⁶ 1·10 ⁻⁶ – 100·10 ⁻⁶ 10·10 ⁻⁹ – 1 000·10 ⁻⁹	30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 %	Purity analyses of high purity gases

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RM 20	Single and Multi-Component Gas Mixtures containing: permanent gases, hydrocarbons up to n-C ₆ H ₁₄ , automotive gas mixtures, stack gas mixtures, sulphur components BTEX mixtures, noble gases, greenhouse gases, NH ₃ , HNO ₃ , H ₂ O, SF ₆ , HCl in Nitrogen, Synthetic Air, Methane, Helium, Hydrogen, Argon	0.1 · 10 ⁻⁶ – 50 · 10 ⁻² mol/mol	10% - 0.1%	Analysed Gas Mixtures Preparation by a single reference procedure (gravimetry) Verification method selected from: ND-IR, ND-UV, photo acoustic-IR, cavity ring down spectroscopy, chemiluminescence, pulsed fluorescence-UV, electrochemical and/or paramagnetic techniques, GC-TCD, GC-FID, GC-PDECD, GC-SCD and/or GC-PDHID.
	Single and Multi-Component Gas Mixtures containing: VOCs, s-VOCs, OVOCs, BTEX, alcohols in Nitrogen, Synthetic Air, Methane, Helium, Hydrogen, Argon	0.1 · 10 ⁻⁹ – 1000 · 10 ⁻⁶ mol/mol	30% – 0.5%	Analysed Gas Mixtures Preparation by a single reference procedure (gravimetry) Verification method selected from: ND-IR, ND-UV, photo acoustic-IR, cavity ring down spectroscopy, chemiluminescence, pulsed fluorescence-UV, electrochemical and/or paramagnetic techniques, GC-TCD, GC-FID, GC-PDECD, GC-SCD and/or GC-PDHID.