RAAD VOOR ACCREDITATIE

Dutch Accreditation Council RvA
PO Box 2768 NL-3500 GT Utrecht

De Stichting Raad voor Accreditatie,
bij wet aangewezen als de nationale accreditatie-instantie voor Nederland,
verklaart hierbij accreditatie te hebben verleend aan:

VSL B.V.
Delft

De instelling heeft aangetoond in staat te zijn op technisch bekwame wijze valide resultaten te leveren en te werken volgens een managementsysteem.

Deze accreditatie is gebaseerd op een beoordeling tegen de vereisten zoals vastgelegd in EN ISO/IEC 17025:2017.

De accreditatie is van toepassing op de activiteiten zoals gespecificeerd in de gewaarmerkte bijlage die is voorzien van het registratienummer.

De accreditatie is van kracht, onder voorwaarde dat de instelling blijft voldoen aan de vereisten.

De accreditatie voor registratienummer:

K 999

is verleend op 20 mei 1994

Deze verklaring is geldig tot
1 november 2025

Het bestuur van de Raad voor Accreditatie,
namens deze,

mr. J.A.W.M. de Haas

De Stichting Raad voor Accreditatie is ondertekenaar van de European co-operation for Accreditation (EA) Multilateral Agreement voor accreditatie in dit werkgebied.

RAAD VOOR ACCREDITATIE

Dutch Accreditation Council RvA
PO Box 2768 NL-3500 GT Utrecht

The Dutch Accreditation Council RvA, by law appointed as
the national accreditation body for The Netherlands,
hereby declares that accreditation has been granted to:

VSL B.V.
Delft

The organisation has demonstrated to be able to generate technical valid results in a competent way and work according to a management system.

This accreditation is based on an assessment against the requirements as laid down in EN ISO/IEC 17025:2017.

The accreditation covers the activities as specified in the authorized annex bearing the registration number.

The accreditation is valid provided that the organisation continues to meet the requirements.

The accreditation with registration number:

K 999

is granted on 20 May 1994

This declaration is valid until
1 November 2025

The board of the Dutch Accreditation Council,
on its behalf,

mr. J.A.W.M. de Haas

The Dutch Accreditation Council (RvA) is a signatory of the European co-operation for Accreditation (EA) Multilateral Agreement for accreditation in this field.

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

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**

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.

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 U1 > U2
	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 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

LF 00	DC/LF Electricity			
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 µV – 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 µA – 2 µA 2 µA – 20 µA		 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 µA – 100 µA 0.1 µA – 100 mA 0.1 µA – 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

LF 00	DC/LF Electricity			
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 21	0.2 µA – 2 µA		$3\cdot10^{-5}\cdot I$ – $1.0\cdot10^{-5}\cdot I$	Generating at multifunction facility
	2 µA – 20 µA		$1.0\cdot10^{-5}\cdot I$	
	20 µA – 100 µA		$5\cdot10^{-6}\cdot I$ – $3\cdot10^{-6}\ I$	
	0.1 mA – 100 mA		$3\cdot10^{-6}\cdot I$	
	0.1 A – 1 A		$6\cdot10^{-5}\cdot I$	
	1 A – 10 A		$1.0\cdot10^{-4}\cdot I$	
	10 A – 100 A		$7\cdot10^{-6}\cdot I$	Generating at DC ratio facility Currents up to 900 A possible with devices that allow multiple turns
	10 A – 900 A		$7\cdot10^{-6}\cdot I$	Measuring at DC ratio facility
LF 22	Direct Current Ratio			
	$1\cdot10^{-4}$ – 1		$0.7\cdot10^{-6}$	Primary current 1 A – 1200 A
	$1\cdot10^{-4}$ – 1		$0.4\cdot10^{-6}$	Primary current 1 A – 1200 A, linearity
LF 24	Direct Charge			
	10 pC – 200 pC		$2.0\cdot10^{-3}\cdot Q$ – $4\cdot10^{-4}\cdot Q$	
	200 pC – 200 nC		$4\cdot10^{-4}\cdot Q$ – $3\cdot10^{-4}\cdot Q$	
LF 31	Alternating Voltage			at multifunction facility
	1 mV – 100 mV	40 Hz – 100 kHz	$2.5\cdot10^{-5}\cdot U$ – $3.0\cdot10^{-3}\cdot U$	
	100 mV – 200 mV	10 Hz – 1 MHz	$2.0\cdot10^{-5}\cdot U$ – $4\cdot10^{-4}\cdot U$	
	200 mV – 2 V	10 Hz – 1 MHz	$9\cdot10^{-6}\cdot U$ – $4\cdot10^{-4}\cdot U$	
	2 V – 20 V	10 Hz – 1 MHz	$9\cdot10^{-6}\cdot U$ – $4\cdot10^{-4}\cdot U$	
	20 V – 30 V	10 Hz – 500 kHz	$1.3\cdot10^{-5}\cdot U$ – $4\cdot10^{-4}\cdot U$	
	30 V – 60 V	10 Hz – 300 kHz	$1.5\cdot10^{-5}\cdot U$ – $1.5\cdot10^{-4}\cdot U$	
	60 V – 200 V	10 Hz – 100 kHz	$1.5\cdot10^{-5}\cdot U$ – $9\cdot10^{-5}\cdot U$	
	200 V – 1 000 V	10 Hz – 100 kHz	$1.8\cdot10^{-5}\cdot U$ – $1.0\cdot10^{-4}\cdot U$	
	1 mV – 130 mV	10 Hz – 100 kHz	$5\cdot10^{-7}\cdot U$ – $5\cdot10^{-4}\cdot U$	Josephson standard
LF 32	Alternating Voltage Ratio			
	$1\cdot10^{-7}$ V/V – 1 V/V	400 Hz – 1.6 kHz 400 Hz – 1.6 kHz	$1.0\cdot10^{-7}$ V/V (in-phase) $1.0\cdot10^{-6}$ V/V (quadrature)	
	$1\cdot10^{-6}$ V/V – 1 V/V	50 Hz – 5 kHz 50 Hz – 5 kHz	$2.0\cdot10^{-6}$ V/V (in-phase) $1.0\cdot10^{-5}$ V/V (quadrature)	
	$1\cdot10^{-3}$ V/V – 10 V/V	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 300 Hz	$2.5\cdot10^{-5}$ V/V $1.0\cdot10^{-5}$ V/V $3.0\cdot10^{-5}$ V/V	Input voltage up to 700 V

LF 00	DC/LF Electricity			
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 32	$1 \cdot 10^{-6}$ V/V – 10 V/V	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 300 Hz	$3.0 \cdot 10^{-5}$ V/V $2.0 \cdot 10^{-5}$ V/V $2.0 \cdot 10^{-4}$ 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 *D* ($-\pi$ – $+\pi$) rad	45 Hz – 65 Hz	$0.9 \cdot 10^{-3}$ rad	Input 1 kV – 100 kV
	-0.1 rad – +0.1 rad	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 300 Hz	$2.5 \cdot 10^{-5}$ rad + $5 \cdot 10^{-3} \cdot D$ $1.0 \cdot 10^{-5} \cdot$rad + $5 \cdot 10^{-3} \cdot D$ $3.0 \cdot 10^{-5}$ rad + $5 \cdot 10^{-3} \cdot D$ (*D* 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	$1 \cdot 10^{-4} \cdot U$	
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	 $4 \cdot 10^{-4} \cdot U$ – $8 \cdot 10^{-5} \cdot U$ $3 \cdot 10^{-4} \cdot U$ – $2.0 \cdot 10^{-5} \cdot U$ $2.0 \cdot 10^{-4} \cdot U$ – $1.5 \cdot 10^{-5} \cdot U$ $1.0 \cdot 10^{-4} \cdot U$ – $5 \cdot 10^{-6} \cdot U$ $4 \cdot 10^{-5} \cdot U$ – $2.0 \cdot 10^{-6} \cdot U$ $2.0 \cdot 10^{-6} \cdot U$ – $4 \cdot 10^{-5} \cdot U$ $5 \cdot 10^{-6} \cdot U$ – $6 \cdot 10^{-5} \cdot U$ $1.0 \cdot 10^{-5} \cdot U$ – $5 \cdot 10^{-5} \cdot U$ $1.0 \cdot 10^{-5} \cdot U$ – $4 \cdot 10^{-5} \cdot U$ $1.0 \cdot 10^{-5} \cdot U$ – $1.0 \cdot 10^{-4} \cdot U$	*) Max. $2.2 \cdot 10^{7}$ V·Hz

LF 00	DC/LF Electricity			
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 41	Alternating Current			at multifunction facility
	200 µA	10 Hz – 10 kHz	$1.0\cdot10^{-3}\cdot I - 3\cdot10^{-5}\cdot I$	
	2 mA	10 Hz – 10 kHz	$2.3\cdot10^{-4}\cdot I - 5\cdot10^{-5}\cdot I$	
	20 mA	10 Hz – 10 kHz	$2.3\cdot10^{-4}\cdot I - 6\cdot10^{-5}\cdot I$	
	200 mA	10 Hz – 10 kHz	$2.3\cdot10^{-4}\cdot I - 8\cdot10^{-5}\cdot I$	
	2 A	10 Hz – 10 kHz	$1.5\cdot10^{-4}\cdot I - 2.3\cdot10^{-4}\cdot I$	
	10 A	10 Hz – 10 kHz	$2.1\cdot10^{-4}\cdot I - 5\cdot10^{-4}\cdot I$	
	5 A – 5 000 A	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 200 Hz 200 Hz – 400 Hz	$20\cdot10^{-6}\cdot I$ $20\cdot10^{-6}\cdot I$ $25\cdot10^{-6}\cdot I$ $35\cdot10^{-6}\cdot I$	at current ratio facility
LF 42	Alternating current ratio Magnitude ratio error 0 – 1	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 200 Hz 200 Hz – 400 Hz	$7\cdot10^{-6}$ $5\cdot10^{-6}$ $1.0\cdot10^{-5}$ $1.5\cdot10^{-5}$	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
	Phase displacement $-\pi$ rad – $+\pi$ rad	16 Hz – 45 Hz 45 Hz – 65 Hz 65 Hz – 200 Hz 200 Hz – 400 Hz	$7\cdot10^{-6}$ rad $5\cdot10^{-6}$ rad $1.0\cdot10^{-5}$ rad $1.5\cdot10^{-5}$ 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)
LF 44	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	$3\cdot10^{-5}\cdot I - 1.3\cdot10^{-4}\cdot I$ $4\cdot10^{-5}\cdot I - 2.5\cdot10^{-4}\cdot I$ $7\cdot10^{-5}\cdot I - 7\cdot10^{-4}\cdot I$	
LF 50	Power quality			IEC 61000-4-30
	Voltage unbalance 0 % – 100 %	50 Hz or 60 Hz	0.03 %	
	Harmonics and interharmonics 0.1 V – 250 V 1 mA – 20 A	40 Hz – 5000 Hz	0.01 V – 0.03 V 0.1 mA – 2 mA	resolution 5 Hz resolution 5 Hz

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 ≤ cos(φ) ≤ 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 ≤ cos(φ) ≤ 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 ≤ cos(φ) ≤ 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 ≤ cos(φ) ≤ 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 ≤ cos(φ) ≤ 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

LF 00	DC/LF Electricity			
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 50	Energy			
	0 MWh – 8 MWh	45 Hz – 65 Hz	$5\cdot10^{-5}$ Wh/VAh – $3\cdot10^{-4}$ Wh/VAh	Single phase 30 V – 600 V 0.02 A – 80 A 0 ≤ cos(φ) ≤ 1, inductive or capacitive Minimum apparent power 0.6 VA Measurement time 1 min – 1 Week
	0 MWh – 24 MWh	45 Hz – 65 Hz	$5\cdot10^{-5}$ Wh/VAh – $3\cdot10^{-4}$ Wh/VAh	Three-phase 30 V – 600 V Line to Ground 0.02 A – 80 A per phase 0 ≤ cos(φ) ≤ 1, inductive or capacitive Minimum apparent power 1.8 VA Measurement time 1 min – 1 Week
	0 GWh – 84 GWh	45 Hz – 65 Hz	$5\cdot10^{-5}$ Wh/VAh – $3\cdot10^{-4}$ Wh/VAh	Single phase 0.05 kV – 100 kV 0.1 A – 5 000 A 0 ≤ cos(φ) ≤ 1, inductive or capacitive Minimum apparent power 5 VA Measurement time 1 min – 1 Week
	0 GWh – 252 GWh	45 Hz – 65 Hz	$5\cdot10^{-5}$ Wh/VAh – $3\cdot10^{-4}$ Wh/VAh	Three-phase 0.05 kV – 100 kV Line to Ground 0.1 A – 5 000 A per phase 0 ≤ cos(φ) ≤ 1, inductive or capacitive Minimum apparent power 15 VA Measurement time 1 min – 1 Week
LF 51	Power factor/cos(*φ*)			
	0 – ±1	45 Hz – 65 Hz	$1.0\cdot10^{-6}$ – $3.5\cdot10^{-6}$	
LF 62	DC Resistance 1 µΩ 10 µΩ 100 µΩ 1 mΩ 10 mΩ 100 mΩ		 $4\cdot10^{-5}\cdot R$ $4\cdot10^{-6}\cdot R$ $1.5\cdot10^{-6}\cdot R$ $1.0\cdot10^{-6}\cdot R$ $4\cdot10^{-7}\cdot R$ $2.0\cdot10^{-7}\cdot R$	
	1 Ω 10 Ω 25 Ω 100 Ω 1 kΩ 10 kΩ		$5\cdot10^{-8}\cdot R$ $3\cdot10^{-8}\cdot R$ $3\cdot10^{-8}\cdot R$ $2.0\cdot10^{-8}\cdot R$ $2.0\cdot10^{-8}\cdot R$ $2.0\cdot10^{-8}\cdot R$	

LF 00	DC/LF Electricity			
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 62	6.45 kΩ 12.9 kΩ 100 kΩ 1 MΩ		$3\cdot10^{-8}\cdot R$ $3\cdot10^{-8}\cdot R$ $4\cdot10^{-7}\cdot R$ $5\cdot10^{-7}\cdot R$	
	10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ		$8\cdot10^{-7}\cdot R$ $1.6\cdot10^{-6}\cdot R$ $2.5\cdot10^{-6}\cdot R$ $4\cdot10^{-6}\cdot R$ $8\cdot10^{-6}\cdot R$	
	1 TΩ 10 TΩ 100 TΩ 1 PΩ 10 PΩ		$1.5\cdot10^{-5}\cdot R$ $7.5\cdot10^{-5}\cdot R$ $1.5\cdot10^{-4}\cdot R$ $1.0\cdot10^{-2}\cdot R$ $1.0\cdot10^{-1}\cdot R$	
	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ		$7\cdot10^{-5}\cdot R$ $2.0\cdot10^{-5}\cdot R$ $1.5\cdot10^{-5}\cdot R$ $1.0\cdot10^{-5}\cdot R$ $1.0\cdot10^{-5}\cdot R$ $1.0\cdot10^{-5}\cdot R$ $1.5\cdot10^{-5}\cdot R$ $6\cdot10^{-5}\cdot R$ $6\cdot10^{-4}\cdot R$	Measuring at multifunction facility
	0 Ω – 10 kΩ 10 kΩ – 100 MΩ		$4\cdot10^{-5}\cdot R$ – $2.0\cdot10^{-5}\cdot R$ + 10 µΩ $2.0\cdot10^{-5}\cdot R$ – $7\cdot10^{-4}\cdot R$	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 $1.8\cdot10^{-5}\cdot R$ $5\cdot10^{-6}\cdot R$ $1.7\cdot10^{-6}\cdot R$ $2.4\cdot10^{-6}\cdot R$ $2.4\cdot10^{-6}\cdot R$ $4\cdot10^{-6}\cdot R$ $7\cdot10^{-6}\cdot R$ $2.2\cdot10^{-5}\cdot R$ $1.0\cdot10^{-4}\cdot R$	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

LF 00	DC/LF Electricity			
HCS code	Measured quantity, Range	Frequency	CMC	Remarks
LF 62	0 µΩ/Ω/K – 5 µΩ/Ω/K		0.1 µΩ/Ω/K	10 kΩ – 10 MΩ 15 °C – 30 °C
	5 µΩ/Ω/K – 200 µΩ/Ω/K		0.1 µΩ/Ω/K – 0.3 µΩ/Ω/K	10 kΩ – 10 MΩ 15 °C – 30 °C
LF 63	AC Resistance Real component 0 Ω – 10 Ω 0 Ω – 10 Ω 10 Ω – 100 Ω 10 Ω – 100 Ω 100 Ω – 1 kΩ 100 Ω – 1 kΩ 1 kΩ – 10 kΩ 1 kΩ – 10 kΩ 10 kΩ – 100 kΩ 10 kΩ – 100 kΩ 100 kΩ – 1 MΩ 100 kΩ – 1 MΩ	 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz	 2 mΩ – 5 mΩ 2 mΩ – 10 mΩ $3\cdot10^{-5}\cdot R - 2.0\cdot10^{-4}\cdot R$ $6\cdot10^{-5}\cdot R - 1.0\cdot10^{-3}\cdot R$ $2.0\cdot10^{-5}\cdot R - 1.4\cdot10^{-4}\cdot R$ $4\cdot10^{-5}\cdot R - 7\cdot10^{-4}\cdot R$ $1.0\cdot10^{-5}\cdot R - 4\cdot10^{-5}\cdot R$ $1.4\cdot10^{-5}\cdot R - 5\cdot10^{-4}\cdot R$ $1.0\cdot10^{-5}\cdot R - 1.0\cdot10^{-4}\cdot R$ $1.4\cdot10^{-5}\cdot R - 1.6\cdot10^{-4}\cdot R$ $2.0\cdot10^{-5}\cdot R - 1.4\cdot10^{-4}\cdot R$ $4\cdot10^{-5}\cdot R - 7\cdot10^{-4}\cdot R$	
	AC Resistance Imaginary component -1.0 mΩ/Ω – +1.0 mΩ/Ω for R_{nom} = 10 Ω – 100 Ω -1.0 mΩ/Ω – +1.0 mΩ/Ω for R_{nom} = 100 Ω – 1 kΩ -1.0 mΩ/Ω – +1.0 mΩ/Ω for R_{nom} = 1 kΩ – 10 kΩ -1.0 mΩ/Ω – +1.0 mΩ/Ω for R_{nom} = 10 kΩ – 100 kΩ -1.0 mΩ/Ω – +1.0 mΩ/Ω for R_{nom} = 100 kΩ – 1 MΩ	 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz 50 Hz – 2 kHz 2 kHz – 10 kHz	 $1.3\cdot10^{-4}\cdot R - 5\cdot10^{-4}\cdot R$ $3\cdot10^{-4}\cdot R - 1.4\cdot10^{-3}\cdot R$ $1.0\cdot10^{-4}\cdot R - 3\cdot10^{-4}\cdot R$ $2\cdot10^{-4} - 1.0\cdot10^{-3}\cdot R$ $3\cdot10^{-5}\cdot R - 2.0\cdot10^{-4}\cdot R$ $6\cdot10^{-5}\cdot R - 7\cdot10^{-4}\cdot R$ $3\cdot10^{-5}\cdot R - 2\cdot10^{-4}\cdot R$ $6\cdot10^{-5}\cdot R - 7\cdot10^{-4}\cdot R$ $1.0\cdot10^{-4}\cdot R - 3\cdot10^{-4}\cdot R$ $1.4\cdot10^{-4}\cdot R - 1.0\cdot10^{-3}\cdot R$	Values and uncertainties are given as relative values with respect to the nominal resistance value R_{nom}

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	$3·10^{-7}·C$ $3·10^{-7}·C$ $5·10^{-6}·C$ $1.0·10^{-5}·C$ – $5·10^{-5}·C$	
	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 $1.0·10^{-4}·C$ – $5·10^{-6}·C$ $5·10^{-6}·C$ – $4·10^{-5}·C$ $8·10^{-5}·C$ – $3·10^{-6}·C$ $3·10^{-6}·C$ – $4·10^{-5}·C$ $8·10^{-5}·C$ – $3·10^{-6}·C$ $3·10^{-6}·C$ – $4·10^{-5}·C$ $8·10^{-5}·C$ – $5·10^{-6}·C$ $5·10^{-6}·C$ – $6·10^{-5}·C$ $1.5·10^{-4}·C$ – $1.0·10^{-5}·C$ $1.0·10^{-5}·C$ – $1.5·10^{-4}·C$ $3·10^{-4}·C$ – $2.0·10^{-5}·C$ $2.0·10^{-5}·C$ – $3.1·10^{-4}·C$ $6·10^{-4}·C$ – $5·10^{-5}·C$ $5·10^{-5}·C$ – $7·10^{-4}·C$	
LF 65	10 pF – 100 nF	45 Hz – 65 Hz	$2.0·10^{-5}·C$	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	$3·10^{-4}·L$	
	1 mH	1 kHz	$2.0·10^{-4}·L$	
	10 mH	1 kHz	$2.0·10^{-4}·L$	
	100 mH	400 Hz 1 kHz 1.592 kHz	$1.5·10^{-4}·L$ $1.5·10^{-4}·L$ $1.5·10^{-4}·L$	
	1 H	100 Hz 200 Hz 400 Hz 1 kHz 1.592 kHz	$3·10^{-4}·L$ $2.0·10^{-4}·L$ $1.5·10^{-4}·L$ $1.5·10^{-4}·L$ $1.5·10^{-4}·L$	

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 µA – 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 dB – 50 dB *L* = 50 dB – 60 dB *L* = 60 dB – 70 dB *L* = 70 dB – 80 dB	50 kHz – 18 GHz	$(0.010 + 0.001 \cdot L)$ dB 0.080 dB – 0.090 dB 0.180 dB – 0.220 dB 0.550 dB – 0.680 dB	GPC7, Type-N (50 Ω)
	L = 0 dB – 50 dB *L* = 50 dB – 60 dB	50 kHz – 33 GHz	$(0.010 + 0.001 \cdot L)$ dB 0.080 dB – 0.120 dB	3.5 mm (50 Ω)
	L = 0 dB – 50 dB *L* = 50 dB – 60 dB	50 kHz – 40 GHz	$(0.010 + 0.001 \cdot L)$ dB 0.080 dB – 0.120 dB	Type-K 2.92 mm (50 Ω)
	L = 0 dB – 50 dB *L* = 50 dB – 60 dB	50 kHz – 50 GHz	$(0.010 + 0.001 \cdot L)$ 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	$0.005 \cdot K - 0.015 \cdot K$ $0.005 \cdot K - 0.020 \cdot K$ $0.005 \cdot K - 0.030 \cdot K$	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 9 kHz – 33 GHz 9 kHz – 50 GHz	$0.005 \cdot P - 0.015 \cdot P$ $0.005 \cdot P - 0.020 \cdot P$ $0.005 \cdot P - 0.030 \cdot P$	GPC7, Type-N (50 Ω) 3.5 mm (50 Ω) 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 / $(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	$2.0 \cdot 10^{-13} \cdot f$	$U_{eff} \geq 1$ V $t_{avg} \geq 10$ ks
		1 kHz – 4.3 GHz	$1.0 \cdot 10^{-11} \cdot f / \sqrt{(t_{avg} \text{ in s})}$	level: -140 dBm – +13 dBm t_{avg} = 0.1s – 10 ks
		4 GHz – 26 GHz	1 Hz	level: -60 dBm – +13 dBm
TF 22	Time interval Single shot 0 ns – 1 000 s		1.0 ns + trigger error	2 U_m = 0.1 V – 10 V
	Period 0 ns – 1 000 s		100 ps	2 U_m = 0.1 V – 10 V periodic signals
	Stopwatches, time base 0.01 s/d – 300 s/d		0.010 s/d	
	Oscilloscopes, time base		$1.0 \cdot 10^{-7}$ s/s	
TF 22	Time interval Time delay of optical components 0 ps – 1 µs		50 ps	Optical component used in CWDM / DWDM optical fibre networks.
	Time delay between a 1pps output of locked pair of White Rabbit master and slave -2 ns to 2 ns		0.1 ns	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		2.5 ps – 0.035 ns 0.035 ns – 0.035 µs	U_m = 0.01 V – 0.25 V t_{rep} < 200 kHz U_{gen} terminated in 50 Ω
	0.1 ns – 10 ns 10 ns – 1 µs		0.035 ns – 0.22 ns 0.22 ns – 21 ns	U_m = 0.25 V – 5 V U_{gen} terminated in 50 Ω

DM 00	Dimensional Quantities			
HCS code	Quantity, Instrument, Measure	Measuring range	CMC[1]	Remarks *
	* $Q[X ; Y] = \sqrt{X^2 + Y^2}$			
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 tungsten carbide	 0.1 mm – 125 mm 0.1 mm – 125 mm	 $Q[20 \text{ nm}; 2.2 \cdot 10^{-7} \cdot L]$ $Q[20 \text{ nm}; 1.5 \cdot 10^{-7} \cdot L]$	Interferometry, exact fractions MRA NMI Service Identifier 13
	Gauge blocks central length steel tungsten carbide	 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

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	 $Q[0.044\ \mu m; 0.91 \cdot 10^{-6} \cdot L]$ $Q[0.044\ \mu m; 0.91 \cdot 10^{-6} \cdot L]$	Mechanical comparison with reference gauges of the same nominal length and the same material
	Gauge blocks length difference	1 mm – 100 mm	$Q[0.015\ \mu m; 0.2\ 10^{-6} \cdot L]$	Interferometry, exact fractions
	Gauge blocks coefficient of thermal expansion	$-5 \cdot 10^{-6} \leq \alpha \leq +30 \cdot 10^{-6}\ K^{-1}$	$\geq 5.5 \cdot 10^{-8}\ K^{-1}$	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	$Q[0.22\ \mu m; 1.18 \cdot 10^{-6} \cdot L]$	CMM and laser Interferometer
	Gauge blocks central length	100 mm – 1 000 mm	$Q[0.22\ \mu m; 1.18 \cdot 10^{-6} \cdot L]$	CMM and laser Interferometer
	Gauge blocks central length	100 mm – 500 mm	$Q[0.056\ \mu m; 0.82 \cdot 10^{-6} \cdot L]$	Mechanical comparison
	Step gauges Front faces Rear faces Parallelism	0 mm – 1 100 mm	 $Q[0.12\ \mu m; 0.65 \cdot 10^{-6} \cdot L]$ $Q[0.12\ \mu m; 0.65 \cdot 10^{-6} \cdot L]$ $Q[0.15\ \mu m]$	CMM and laserinterferometer
	Depth (groove) standard (ISO 5436-1 (1985) type A): step height (depth) H	0 nm – 3 000 nm	$Q[1.4\ nm; 14 \cdot 10^{-3} \cdot H]$	Interference microscope Minimum groove width: 100 µm
	Thermal expansion artefact (step gauges and others): coefficient of thermal expansion	$-5 \cdot 10^{-6} \leq \alpha \leq +30 \cdot 10^{-6}\ K^{-1}$	$1.5 \cdot 10^{-7}\ K^{-1}$	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	$-5 \cdot 10^{-6} \leq \alpha \leq +30 \cdot 10^{-6}\ K^{-1}$	$5.5 \cdot 10^{-8}\ K^{-1}$	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 $\alpha = 8 \cdot 10^{-6}$ K^{-1} $\alpha = 3 \cdot 10^{-8}$ 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 *D*	2.5 mm – 400 mm	$Q[0.20\ \mu m; 0.88 \cdot 10^{-6} \cdot D]$	CMM and laser interferometer
	External cylinders (wires, pin): diameter *D*	0.1 mm – 100 mm	$Q[0.20\ \mu m; 1.07 \cdot 10^{-6} \cdot D]$ 0] [illegible]	1-D measuring machine with laser interferometer. Repeatability ≤ 0.05 µm Influence roundness deviation ≤ 0.03 µm
	Internal cylinders (ring): diameter *D*	1.5 mm – 4 mm	$Q[0.20\ \mu m; 0.88 \cdot 10^{-6} \cdot D]$	CMM, laser interferometer with plane mirror
	Internal cylinders (ring): diameter *D*	4 mm – 400 mm	$Q[0.10\ \mu m; 1.1 \cdot 10^{-6} \cdot D]$	CMM, laser interferometer with plane mirror
	Spheres (ball): diameter *D*	12 mm – 60 mm	$Q[0.10\ \mu m; 0.8 \cdot 10^{-6} \cdot D]$	CMM, laser interferometer with plane mirror
	Diameter standards (ball): diameter *D*	0.5 mm – 12 mm	0.030 µm	Interferometry exact fractions, indentation correction Uncertainty in nm D: Diameter in mm
	Spheres (ball): diameter *D*	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	$Q[0.032\ \mu m; 1.8 \cdot 10^{-10} \cdot D]$	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	$Q[0.2\ \mu m; 5 \cdot 10^{-7} \cdot L]$	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 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 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 350 kPa – 7 000 kPa 7 MPa* – 20 MPa*	0.019 Pa + $15 \cdot 10^{-6} \cdot p$ 0.08 Pa + $15 \cdot 10^{-6} \cdot p$ 0.1 Pa + $38 \cdot 10^{-6} \cdot p$	Gas Gas Gas
PV 12	Gauge pressure	0 kPa – 500 kPa 0.5 MPa – 20 MPa	0.019 Pa + $15 \cdot 10^{-6} \cdot p_e$ 0.06 Pa + $15 \cdot 10^{-6} \cdot p_e$	Gas Gas
	Differential pressure	0 MPa – 10 MPa	4 Pa + $4 \cdot 10^{-5} \cdot p_d$ + $1{,}2 \cdot 10^{-6} \cdot p_l$	Gas, max. Line pressure 10 MPa p_d= differential pressure p_l = Line pressure
	Negative Gauge pressure	-0.5 kPa – -100 kPa	$5 \cdot 10^{-5} \cdot p_e$	Gas
PV 21	Absolute pressure	1 MPa* – 80 MPa* 80 MPa* – 500 MPa*	6 Pa + $4 \cdot 10^{-5} \cdot p$ 25 Pa + $65 \cdot 10^{-6} \cdot p$	Oil Oil

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 10 L – 650 L 100 L – 30 000 L	0.01 % – 0.02 % 0.02 % – 0.04 % 0.02 % – 0.04 %	Weighing method Reference volume Master meter
	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 m^3/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			Delft, on site
	Low Pressure Gas (max. 10 kPa gauge pressure)			
		$2 \cdot 10^{-5}$ m^3/h – 3.5 m^3/h	0.4 – 0.20 %	Displacement prover system Displacement prover system
		1 m^3/h – 400 m^3/h	0.09 %	Displacement prover system
		$16 \cdot 10^{-3}$ m^3/h – 15 000 m^3/h	0.4 % – 0.15 %	Master meter method
	High Pressure Gas (max. 6.0 MPa gauge pressure)	5 m^3/h – 230 m^3/h	0.29 % – 0.06 %	Gas Oil Piston Prover
	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 1 mW – 10 mW	0.5 % 0.8 %	488, 532, 543, 633 nm Reference Detector
	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 300 nm – 380 nm 380 nm – 450 nm 450 nm – 900 nm 900 nm – 950 nm 950 nm – 1000 nm 1000 nm – 1250 nm 1250 nm – 1500 nm 1500 nm – 1600 nm	 0.38 % – 0.29 % 0.29 % – 0.07 % 0.07 % 0.07 % – 0.11 % 0.11 % – 0.43 % 0.9 % – 0.4 % 0.4 % 0.4 % – 1.5 %	Reference detector

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	$8.0 \cdot 10^{-5}$	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			By comparison in climatic chamber at atmospheric pressure with air
		12 %rh – 95 %rh	0.29 %rh – 0.87 %rh	-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_3H_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_2H_5OH in N_2	$100 \cdot 10^{-6} – 1 \cdot 10^{-3}$		
	H_2S 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_2O 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 µg m^{-3} – 2.1 µg 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 µg m^{-3} – 100 µg 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

[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	$0.5 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$	2 % – 0.09 %	MRA CMC's:312177
	CO in N_2 and synthetic air	10.10^{-6} – $50 \cdot 10^{-2}$	0.09 % – 0.09 %	MRA CMC's: 312178
	CO_2 in N_2 and synthetic air	$0.5 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$	2 % – 0.09 %	MRA CMC's: 312179
	CO_2 in N_2 and synthetic air	$10 \cdot 10^{-6}$ – $50 \cdot 10^{-2}$	0.09 % – 0.09 %	MRA CMC's: 312180
	CH_4 in N_2 and synthetic air	$0.5 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$	0.4% – 0.3%	MRA CMC's: 312186R
	CH_4 in N_2 and synthetic air	$10 \cdot 10^{-6}$ – $2.2 \cdot 10^{-2}$	0.3% – 0.12%	MRA CMC's: 312187R
	CH_4 in N_2	$2.2 \cdot 10^{-2}$ – $50 \cdot 10^{-2}$	0.12 % – 0.12 %	MRA CMC's: 312188R
	C_3H_8 in N_2 and synthetic air	$1 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$	0.2 % – 0.14 %	MRA CMC's: 312189R
	C_3H_8 in N_2 and synthetic air	$10 \cdot 10^{-6}$ – $1 \cdot 10^{-2}$	0.14 % – 0.12 %	MRA CMC's: 312190R
	C_3H_8 in N_2	$1 \cdot 10^{-2}$ – $50 \cdot 10^{-2}$	0.12 % – 0.12 %	MRA CMC's: 312191R
	O_2 in N_2	$0.5 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$	2 % – 0.08 %	MRA CMC's: 312181
	O_2 in N_2	$10 \cdot 10^{-6}$ – $50 \cdot 10^{-2}$	0.08 % – 0.08 %	MRA CMC's: 312182
	NO in N_2	$0.1 \cdot 10^{-6}$ – $1 \cdot 10^{-6}$	1.6% – 0.90 %	MRA CMC's: 312016R-3

RM 00	Reference Materials

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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_2O 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_2S in N_2	$1·10^{-6}$ – $10·10^{-6}$	4 % – 2 %	
	H_2S in N_2	$10·10^{-6}$ – $1000·10^{-6}$	2 % – 1 %	
	H_2S in CH_4	$10·10^{-6}$ – $1000·10^{-6}$	3 % – 2 %	
	C_2H_5OH in synth. air or N_2	$75·10^{-6}$ – $800·10^{-6}$	1 % – 0.5 %	
	1-C_4H_9OH in N_2	$56·10^{-6}$ – $64·10^{-6}$	1.0 %	
	NH_3 in N_2	$30·10^{-6}$ – $300·10^{-6}$	5 %	
	H_2O in N_2 and CH_4	$10·10^{-6}$ – $100·10^{-6}$	5 %	H_2O 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

RM 00	Reference Materials

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

RM 00	Reference Materials

[1] PRM's are primary realizations of calibration gases produced and certified by VSL. (P002 scope)
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HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	**Refinery gas B**			Analysed Gas Mixtures
	Methane	10 % – 13 %	0.15 %	
	Ethane	1.5 % – 2.5 %	0.3 %	
	Propane	0.4 % – 0.6 %	0.3 %	
	Hydrogen	7 % – 8 %	0.15 %	
	n–Butane	0.8 % – 4.2 %	0.3 %	
	i-Pentane	0.5 % – 1 %	0.5 %	
	n-Pentane	0.5 % – 1 %	0.5 %	
	n-Hexane	0.01 % – 0.1 %	0.5 %	
	Carbon monoxide	1 % – 4 %	0.4 %	
	Carbon dioxide	0.4 % – 0.8 %	0.4 %	
	Hydrogen sulphide	1 % – 4 %	0.5 %	
	Nitrogen	60 % – 80 %	0.3 %	
	Automotive gas			Analysed Gas Mixtures
	O_2	0.1 % – 22 %	0.6 % – 0.3 %	MRA CMC's: 312124R
	CO	0.1 % – 9 %	0.3 %	
	CO_2	1 % – 18 %	0.3 %	
	C_3H_8	0.005 % – 0.5 %	0.5 % – 0.3 %	
	Sulphur in Methane			Analysed Gas Mixtures
	Hydrogen sulphide Methyl mercaptane Ethyl mercaptane Carbonyl sulphide Dimethyl sulphide	$10 \cdot 10^{-6} – 50 \cdot 10^{-6}$	3 %	
	Stack gas			Analysed Gas Mixtures
	Carbon monoxide	$10 \cdot 10^{-6} – 1\,000 \cdot 10^{-6}$	1 % – 0.15 %	
	Carbon dioxide	$1 \cdot 10^{-2} – 20 \cdot 10^{-2}$		
	Nitrogen monoxide	$10 \cdot 10^{-6} – 1\,000 \cdot 10^{-6}$		
	Sulphur dioxide	$10 \cdot 10^{-6} – 1\,000 \cdot 10^{-6}$		
	Propane	$3 \cdot 10^{-6} – 1\,000 \cdot 10^{-6}$		

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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*-Xyelene, *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 % 0.5 % – 0.2 % 2%–1% 0.5 % – 0.2 %	

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HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM 20	**OVOC in nitrogen** Methanol Ethanol Acetone	 $1 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$ mol/mol $1 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$ mol/mol $1 \cdot 10^{-6}$ – $10 \cdot 10^{-6}$ 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, *m*-xylene, *o*-xylene, *p*-xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, *n*-hexane, *n*-heptane, *n*-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-t-butyl ether	$1 \cdot 10^{-9}$ – $1 \cdot 10^{-6}$	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, *cis*-1,2-dichloroethene in air	$1 \cdot 10^{-9}$ – $1 \cdot 10^{-6}$	4 %	Analysed Gas Mixtures Preparation by diffusion / permeation (ISO 6145, parts 8 and 10)

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HCS code	Quantity, Instrument, Measure	Measuring range	CMC*	Remarks
RM20	**VOC (ISO 6145-4)** Benzene, toluene, *m*-xylene, ethylbenzene, styrene, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, halothane, acetone, methanol, ethanol, *n*-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-tert-butyl-4-hydroxytoluene *n*-decane *n*-dodecane Styrene Dodecamethyl-cyclohexasiloxane Dimethyl phthalate *n*-tetradecane Naphthalene *n*-Hexadecane Benzyl alcohol *n*-octadecane *n*-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

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**

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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_2O	 $5\cdot10^{-9}$ – $500\cdot10^{-9}$ $1\cdot10^{-9}$ – $500\cdot10^{-9}$ $0.1\cdot10^{-6}$ – $10\cdot10^{-6}$ $100\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $10\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $1\cdot10^{-6}$ – $100\cdot10^{-6}$	 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_2O	 $5\cdot10^{-9}$ – $500\cdot10^{-9}$ $1\cdot10^{-9}$ – $500\cdot10^{-9}$ $100\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $100\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $10\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $1\cdot10^{-6}$ – $100\cdot10^{-6}$	 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_2O	 $5\cdot10^{-9}$ – $500\cdot10^{-9}$ $1\cdot10^{-9}$ – $500\cdot10^{-9}$ $0.1\cdot10^{-6}$ – $10\cdot10^{-6}$ $100\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $10\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $1\cdot10^{-6}$ – $100\cdot10^{-6}$	 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_2O	 $5\cdot10^{-9}$ – $500\cdot10^{-9}$ $1\cdot10^{-9}$ – $500\cdot10^{-9}$ $50\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $50\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $10\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $1\cdot10^{-6}$ – $100\cdot10^{-6}$	 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_2O C_2H_6 Higher hydrocarbons	 $1\cdot10^{-9}$ – $500\cdot10^{-9}$ $0.1\cdot10^{-6}$ – $10\cdot10^{-6}$ $100\cdot10^{-9}$ – $1\,000\cdot10^{-9}$ $1\cdot10^{-6}$ – $100\cdot10^{-6}$ $1\cdot10^{-6}$ – $100\cdot10^{-6}$ $10\cdot10^{-9}$ – $1\,000\cdot10^{-9}$	 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 % 30 % – 5 %	Purity analyses of high purity gases

RM 20	Single and Multi-Component Gas Mixtures containing: permanent gases, hydrocarbons up to n-C_6H_{14}, automotive gas mixtures, stack gas mixtures, sulphur components BTEX mixtures, noble gases, greenhouse gases, NH_3, HNO_3, H_2O, SF_6, HCl in Nitrogen, Synthetic Air, Methane, Helium, Hydrogen, Argon	$0.1 \cdot 10^{-6}$ – $50 \cdot 10^{-2}$ 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	$0.1 \cdot 10^{-9}$ – $1000 \cdot 10^{-6}$ 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.