

### Statement 3: Agreement on the uncertainties of the best units under calibration for consideration in CMC entries

The CCM WG PV wishing to make the CMC entries in the scope of the CCM WG PV more user friendly and adapted to the needs of the NMI customer

and

considering the relevant CIPM documents CIPM 07/11, CIPM-D-01, and CIPM MRA-P-11 to -P-13, CIPM MRA-G-11 to -G-13

has identified the units under calibration including their uncertainties to be used for CMC entries. For each pressure range given below the unit under calibration (UUC) with the lowest (“nominal”) uncertainty was identified. This uncertainty shall be considered when calculating the uncertainty for a CMC entry. It also gives the lower limit of uncertainty in an CMC entry. If an NMI/DI is not able to calibrate the identified UUC, it shall call the best UUC (lowest uncertainty) that it is able to calibrate. This uncertainty must not be smaller than the uncertainty given in the table below for the respective pressure range.

Since CMC entries shall be oriented towards the best UUCs, calibration ranges may overlap.

#### UUCs for Pressure and Vacuum CMCs

Decimal point is used. The order is gauge pressure liquid, gauge pressure gas, absolute pressure, differential pressure, within these categories from high pressure to low pressure. **Cells marked in red are still under discussion (2023-06-28).**

Quantity	UUC: Instrument or Artifact under study	Alternative name for instrument	Range minimum (Pa)	Range maximum (Pa)	Nominal uncertainty ( $k = 1$ )
gauge pressure, liquid medium	pressure transducer		$3 \cdot 10^8$	$10^9$	30 kPa
gauge pressure, liquid medium	pressure balance	piston gauge, pressure multiplier	$10^8$	$10^9$	$50 \text{ Pa} + 1.3 \cdot 10^{-6} \cdot p$
gauge pressure, liquid medium	pressure transducer	resonance- or resistance-based pressure gauge	$10^7$	$3 \cdot 10^8$	0.5 kPa

Quantity	UUC: Instrument or Artifact under study	Alternative name for instrument	Range minimum (Pa)	Range maximum (Pa)	Nominal uncertainty ( $k = 1$ )
gauge pressure, liquid medium	pressure balance	piston gauge	$10^7$	$10^8$	$7 \text{ Pa} + 1.2 \cdot 10^{-6} \cdot p$
gauge pressure, liquid medium	pressure balance	piston gauge	$10^5$	$10^7$	$5 \text{ Pa} + 10^{-6} \cdot p$
gauge pressure, gas medium	pressure balance	piston gauge	$-1 \cdot 10^5$	$7.5 \cdot 10^6$	$0.05 \text{ Pa} + 1 \cdot 10^{-6} \cdot  p $
gauge pressure, gas medium	pressure transducer	resonance- or resistance-based pressure gauge	$3.5 \cdot 10^5$	$7 \cdot 10^6$	$0.23 \text{ Pa} + 2.5 \cdot 10^{-6} \cdot p$
gauge pressure, gas medium	pressure transducer	resonance- or resistance-based pressure gauge	$-1 \cdot 10^5$	$3.5 \cdot 10^5$	$0.1 \text{ Pa} + 2.5 \cdot 10^{-6} \cdot  p $
gauge pressure, gas medium	non-rotating piston gauge	digital piston gauge	1	$1.5 \cdot 10^4$	$0.004 \text{ Pa} + 8 \cdot 10^{-6} \cdot p$
absolute pressure, gas medium	pressure balance	piston gauge	$7 \cdot 10^5$	$7.5 \cdot 10^6$	$0.15 \text{ Pa} + 5 \cdot 10^{-7} \cdot p$
absolute pressure, gas medium	pressure transducer	resonance- or resistance-based pressure gauge	$3.5 \cdot 10^5$	$7 \cdot 10^6$	$0.23 \text{ Pa} + 2.5 \cdot 10^{-6} \cdot p$
absolute pressure, gas medium	pressure balance	Piston gauge	$1.4 \cdot 10^3$	$7 \cdot 10^5$	$0.015 \text{ Pa} + 1.6 \cdot 10^{-7} \cdot p$
absolute pressure, gas medium	pressure transducer	resonance- or resistance-based pressure gauge	$5 \cdot 10^3$	$3.5 \cdot 10^5$	$0.1 \text{ Pa} + 2.5 \cdot 10^{-6} \cdot p$
absolute pressure, gas medium	capacitance diaphragm gauge	capacitance manometer, resonance-based pressure gauge	0.1	$1.3 \cdot 10^5$	$2.5 \cdot 10^{-6} \cdot (\text{full scale}) + 5 \cdot 10^{-6} \cdot p$ , but not less than $5 \cdot 10^{-5} \text{ Pa}$
absolute pressure, gas medium	non-rotating piston gauge	digital piston gauge	1	$1.5 \cdot 10^4$	$0.004 \text{ Pa} + 8 \cdot 10^{-6} \cdot p$
absolute pressure	spinning rotor gauge		$10^{-4}$	1	$7 \cdot 10^{-7} \text{ Pa} + 5 \cdot 10^{-4} \cdot p$
absolute pressure	metal-envelope ionization vacuum gauge	metal-envelope Bayard-Alpert gauge with electrometer	$10^{-7}$	$10^{-3}$	$10^{-9} \text{ Pa} + 10^{-3} \cdot p$
absolute pressure	ultra-high vacuum range ionization gauge	extractor gauge with electrometer, ion energy analyzing gauge	$10^{-9}$	$10^{-3}$	$10^{-11} \text{ Pa} + 10^{-3} \cdot p$

Quantity	UUC: Instrument or Artifact under study	Alternative name for instrument	Range minimum (Pa)	Range maximum (Pa)	Nominal uncertainty ( $k = 1$ )
differential pressure, gas medium	pressure transducer	resonance- or resistance-based pressure gauge	1	1000	0.01 Pa
differential pressure, gas medium	pressure transducer	resonance- or resistance-based pressure gauge	$10^3$	$10^4$	0.03 Pa
differential pressure, gas medium	capacitance diaphragm gauge <b>under discussion: perhaps other suitable UUCs will be included</b>	capacitance manometer, pressure divider	0	$1.3 \cdot 10^5$	$2.5 \cdot 10^{-6} \cdot (\text{full scale}) + 5 \cdot 10^{-6} \cdot p$ , but not less than $5 \cdot 10^{-5}$ Pa
differential pressure, gas medium	differential pressure transducer	differential pressure gauge	$10^3$	$10^8$	$0.1 \text{ Pa} + 3 \cdot 10^{-6} \cdot p + 3 \cdot 10^{-8} \cdot p_{\text{line}}$
molar flow rate	He leak standard	glass-permeation He leak artifact	$10^{-14}$ (mol/s)	$10^{-9}$ (mol/s)	$0.0018 \cdot q_{\text{mol}}$