Physikalisch-Technische Bundesanstalt
Nationales Metrologieinstitut

Kalibrierschein

Calibration Certificate

Gegenstand: *Object:*	Capacitance Diaphragm Gauge Full scale: 2.7×10^4 Pa
Hersteller: *Manufacturer:*	The Manufacturer
Typ: *Type:*	A999
Kennnummer: *Serial No.:*	99999-999
Auftraggeber: *Applicant:*	Physikalisch-Technische Bundesanstalt Abbestraße 2–12 10597 Berlin
Anzahl der Seiten: *Number of pages:*	4
Geschäftszeichen: *Reference No.:*	7.5-9.9-99-99-99
Kalibrierzeichen: *Calibration mark:*	75999PTB20
Ort der Kalibrierung: *Location of calibration:*	PTB Berlin
Datum der Kalibrierung: *Date of calibration:*	2020-08-07 to 2020-08-08

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Im Auftrag
On behalf of PTB

Berlin, 2020-08-27

Siegel
Seal

Im Auftrag
On behalf of PTB

Givenname1 Name1

Givenname2 Name2

1. Description relating to calibration device

The vacuum port of the CDG was not equipped with a valve and open to atmosphere. The head was installed in a vertical orientation (horizontal orientation of the membrane).

The device was read out via its analog voltage output by means of a calibrated digital voltmeter (Keithley 2700).

The previous calibration performed by PTB is described in the calibration certificate 75999 PTB 19.

2. Calibration procedure

The calibration was carried out at the laboratory for vacuum metrology at the Physikalisch-Technische Bundesanstalt (PTB). In the pressure range from 2.7×10^{1} Pa to 1.3×10^{2} Pa, the calibration pressure was established in the primary standard SE3 metrologically linked to the primary standard SE2 of PTB applying the static expansion method. In the range 2.7×10^{2} Pa to 2.7×10^{4} Pa the calibration was carried out by direct comparison to a secondary standard consisting of 15 diaphragm gauges. The gas temperature during calibration using the static expansion method with nitrogen was (296.719 ± 0.031) K at a room temperature of (296.32 ± 0.09) K. During the calibration by direct comparison with nitrogen the temperature of the gas was (296.3 ± 1.6) K. Here, the room temperature was (296 ± 2) K.

The device was operated with the following setup:

Heater: on
Unit: Volt

Before each calibration point the offset p_r was recorded (5 readings) at the base pressure and subtracted from the subsequent indication p_{ind} to give the corrected indicated value p_{corr}. The contribution of the offset scatter to the total uncertainty was (k = 1):

nitrogen, static expansion method:

7.6×10^{-2} Pa entire measurement range

nitrogen, direct comparison method:

1.6×10^{-1} Pa entire measurement range

3. Relative error of pressure indication and correction factor

The relative error e of the corrected indicated pressure p_{corr} (with $p_{corr} = p_{ind} - p_r$) at the time of calibration is defined as:

$$e = \frac{p_{ind} - p_r}{p_{cal}} - 1$$

where p_{cal} denotes the calibration pressure as generated in the primary standard. From this, the real pressure p can be calculated from the indicated and offset pressure by:

$$p = \frac{p_{ind} - p_r}{e + 1}$$

The correction factor CF is defined by:

$$CF = \frac{p_{cal}}{p_{ind} - p_r}$$

and can be used to calculate the real pressure p by:

$$p = CF(p_{ind} - p_r)$$

4. Result of the calibration

The results of the measurements are given in the following table. $U(e)$ is the uncertainty of the relative error and $U(CF)$ the uncertainty of the correction factor. Included is the repeatability of the measurement under otherwise identical conditions (p_{cal}, T).

nitrogen, static expansion method					
p_{cal} in Pa	$p_{ind} - p_r$ in Pa	e	CF	$U(e)$	$U(CF)$
2.6650×10^1	2.6900×10^1	0.0094	0.9907	0.0060	0.0059
$1.326\,16 \times 10^2$	1.3306×10^2	0.0033	0.9967	0.0019	0.0019

nitrogen, direct comparison method					
p_{cal} in Pa	$p_{ind} - p_r$ in Pa	e	CF	$U(e)$	$U(CF)$
$2.699\,23 \times 10^2$	2.7075×10^2	0.0031	0.9969	0.0012	0.0011
$1.333\,35 \times 10^3$	$1.338\,12 \times 10^3$	0.0036	0.9964	0.0011	0.0011
$2.673\,54 \times 10^3$	$2.682\,62 \times 10^3$	0.003 40	0.996 62	0.000 53	0.000 53
$5.335\,19 \times 10^3$	$5.352\,40 \times 10^3$	0.003 23	0.996 78	0.000 36	0.000 36
8.0061×10^3	8.0302×10^3	0.003 01	0.997 00	0.000 33	0.000 33
$1.070\,66 \times 10^4$	$1.073\,66 \times 10^4$	0.002 80	0.997 21	0.000 30	0.000 30
$1.330\,49 \times 10^4$	$1.334\,13 \times 10^4$	0.002 74	0.997 27	0.000 31	0.000 31
$1.601\,14 \times 10^4$	$1.604\,56 \times 10^4$	0.002 14	0.997 87	0.000 70	0.000 70
$1.869\,91 \times 10^4$	$1.874\,29 \times 10^4$	0.002 35	0.997 66	0.000 61	0.000 61
$2.130\,47 \times 10^4$	$2.135\,63 \times 10^4$	0.002 42	0.997 59	0.000 55	0.000 55
$2.401\,56 \times 10^4$	$2.406\,59 \times 10^4$	0.002 09	0.997 91	0.000 50	0.000 50
$2.670\,64 \times 10^4$	$2.677\,01 \times 10^4$	0.002 38	0.997 62	0.000 47	0.000 47

5. Uncertainty

The uncertainty stated is the expanded measurement uncertainty obtained by multiplying the standard measurement uncertainty by the coverage factor $k = 2$. It has been determined in accordance with the “Guide to the Expression of Uncertainty in Measurement (GUM)”. The value of the measurand then normally lies, with a probability of approximately 95 %, within the attributed coverage interval.

Die Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig und Berlin ist das nationale Metrologieinstitut und die technische Oberbehörde der Bundesrepublik Deutschland für das Messwesen. Die PTB gehört zum Geschäftsbereich des Bundesministeriums für Wirtschaft und Energie. Sie erfüllt die Anforderungen an Kalibrier- und Prüflaboratorien auf der Grundlage der DIN EN ISO/IEC 17025.

Zentrale Aufgabe der PTB ist es, die gesetzlichen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI) darzustellen, zu bewahren und weiterzugeben. Die PTB steht damit an oberster Stelle der metrologischen Hierarchie in Deutschland. Die Kalibrierscheine der PTB dokumentieren eine auf nationale Normale rückgeführte Kalibrierung.

Dieser Ergebnisbericht ist in Übereinstimmung mit den Kalibrier- und Messmöglichkeiten (CMCs), wie sie im Anhang C des gegenseitigen Abkommens (MRA) des Internationalen Komitees für Maße und Gewichte enthalten sind. Im Rahmen des MRA wird die Gültigkeit der Ergebnisberichte von allen teilnehmenden Instituten für die im Anhang C spezifizierten Messgrößen, Messbereiche und Messunsicherheiten gegenseitig anerkannt (nähere Informationen unter http://www.bipm.org).

Diese Aussage und das CIPM-MRA-Logo beziehen sich nur auf die Messergebnisse in diesem Kalibrierschein.

CIPM MRA

The Physikalisch-Technische Bundesanstalt *(PTB) in Braunschweig and Berlin is the National Metrology Institute and the supreme technical authority of the Federal Republic of Germany for metrology. The PTB comes under the auspices of the Federal Ministry of Economics and Energy. It meets the requirements for calibration and testing laboratories as defined in DIN EN ISO/IEC 17025.*

The central task of PTB is to realize, to maintain and to disseminate the legal units in compliance with the International System of Units (SI). PTB thus is at the top of the metrological hierarchy in Germany. The calibration certificates issued by PTB document a calibration traceable to national measurement standards.

This certificate is consistent with the Calibration and Measurement Capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (CIPM). Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details, see http://www.bipm.org).

The CIPM MRA Logo and this statement attest only to the measurement component of the certificate.

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