

ISO/IEC 17025 CALIBRATION CERTIFICATE

CERTIFICATE NUMBER 022720140049

PYRHELIOMETER MODEL CHP 1
SERIAL NUMBER 140049
CALIBRATION DATE 18 January 2021
INSTRUMENT CLASS ISO 9060, Class A*
CALIBRATION PROCEDURE Validated indoor procedure as described on page 2

REFERENCE PYRHELIOMETER Kipp & Zonen CHP 1 sn REF1 active from 01 January 2021
REFERENCE PYRHELIOMETER CALIBRATION PROCEDURE ISO 9059

CALIBRATION LOCATION Delft
The Netherlands

CUSTOMER Blichfeld Power and Measurements A/S
Birkemosevej 11D
6000
Kolding
Denmark

REMARKS
Instrument condition:
The calibration item was received fully functional and did not show any erratic behavior or irregularities during calibration.

Instrument changes after last calibration:
no

Delft, The Netherlands, 18 January 2021


J. Mes
(Calibration Manager)
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(Calibration Technician)

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CERTIFICATE NUMBER**022720140049**

Calibration procedure

The indoor transfer calibration is performed in analogy to the ISO 9847 pyranometer calibration; the reference and test instrument are of the same type. In the first step the reference pyrheliometer is placed in the collimated beam of a Xenon lamp. After a stabilization period the irradiance is measured and a dark measurement is performed. Then the reference instrument is replaced by the test instrument, after stabilization its output signal is measured. As a last step the reference instrument is again placed in the beam to validate the beam irradiance has not drifted. The sensitivity is calculated from the irradiance as measured by the reference pyrheliometer and the voltage output of the test instrument. The minimum beam intensity is 650 W/m², room temperature is 22 °C ± 2 °C

Hierarchy of traceability

The measurements have been executed using standards for which the traceability to international standards has been demonstrated towards the RvA.

This reference pyrheliometer was compared against the absolute cavity pyrheliometer PMO6 SN 103 using the sun as source according to ISO 9059 "Calibration of field pyrheliometers by comparison to a reference pyrheliometer". The comparison was performed in Delft, The Netherlands (latitude: 51.9969°, longitude: 4.3863°, altitude: 10 m above sea level). During the comparisons the reference pyrheliometer received direct solar radiation with intensities ranging from 992 W/m² to 1006 W/m², with a mean of 1000 W/m². The ambient air temperature ranged from +19.0°C to +29.9°C with a mean of +23.9°C. The sensitivity calculation is based on 101 individual measurements. The sensitivity and its expanded uncertainty (95% level of confidence) with respect to the WRR are valid for similar environmental conditions and amount to:

7.95 µV/(W/m²) ± 0.02 µV/(W/m²). Date of measurements: 22-24 June 2020

The absolute cavity pyrheliometer PMO6 SN 103 is calibrated against the World Standard Group (WSG), at the WRC Davos, Switzerland (latitude: 46.8143°, longitude: -9.8458°, altitude: 1558 m above sea level). This is done every 5 years at the International Pyrheliometer Comparison (IPC). The readings of the WSG are referred to as the World Radiometric Reference (WRR) as stated in the WMO Technical Regulations.

WRR- factor of PMO6 SN 103: 0.99789 (from the last international Pyrheliometer Comparison, IPC-2015). The estimated uncertainty of the WRR relative to SI is ±0.3%. During the yearly NPC hosted by NREL in Golden, Colorado (latitude: 39.742°, longitude: 105.18°, altitude: 1829 m above sea level) the WRR factor of the reference PMO6 SN 103 is verified.

SENSITIVITY 7.87 µV/(W/m²) at normal incidence**UNCERTAINTY** 0.08 µV/(W/m²) = 1.07 %**IMPEDANCE** 26 Ω ± 2 Ω

Justification of total instrument calibration uncertainty

The combined uncertainty of the result of the calibration is the positive "root sum square" of the following components:

1. The expanded uncertainty due to random effects and instrumental errors during the calibration of the reference CHP 1: 0.02 µV/(W/m²) / 7.95 µV/(W/m²) = ±0.25% with respect to the WRR (See traceability text).
2. The estimated uncertainty of the WRR relative to SI: ±0.3% (k=2).
3. The expanded uncertainty of the transfer procedure (calibration by non-simultaneous comparison) is estimated to be ±1% (k=2).

The expanded uncertainty is: $\sqrt{(0.25\%)^2 + 0.3\%^2 + 1\%^2} = \pm 1.07\%$ (k=2).

The reported expanded uncertainty is based on the standard uncertainty of the measurement multiplied by a coverage factor k, such that the coverage probability corresponds to approximately 95%. The standard uncertainty has been determined in accordance with EA 04/2.

Notice

The calibration certificate supplied with the instrument is valid at the date of first use. Even though the calibration certificate is dated relative to manufacture, or recalibration, the instrument does not undergo any sensitivity changes when kept in the original packing.

* from October 2018 the classification conforms to ISO 9060:2018. Instruments issued before that date conform to ISO 9060:1990.

RvA is member of the European Co-operation for Accreditation (EA) and is one of the signatories to the EA Multilateral Agreement (MLA) and to the ILAC Mutual Recognition Arrangement (MRA) for the mutual recognition of calibration certificates.

Reproduction of the complete certificate is allowed. Parts of the certificate may only be produced with written approval of the calibration laboratory.

This certificate is issued provided that the Raad voor Accreditatie does not assume any liability.