Solar irradiance sensor (pyranometer) calibration services for every brand: PV system asset management

Today's system performance monitoring requires regular pyranometer calibration

Solar radiation measurement is a cornerstone of a PV power plant's Performance Ratio (PR) measurement. It is also the weakest link. That's why the latest versions of the IEC 61724-1 (2017 and 2021) require regular pyranometer calibration, which means sending instruments to a lab. Hukx's worldwide calibration and servicing organization is at your disposal.

Introduction

In utility-scale PV system performance monitoring, solar irradiance is typically measured with pyranometers. The PR calculation essentially takes the system's electrical output and divides it by the irradiance. The PR is a key performance indicator of the PV system performance. Accurate day-to-day and year-to-year PR records also increase the value of the PV system.

The IEC 61724-1 standard update

The first edition of IEC 61724-1: Photovoltaic system performance monitoring – Guidelines for measurement, data exchange and analysis dates back to 2008. The updated 2017 and 2021 editions are fundamentally different from the original version. The new scope not only defines the measuring system components and procedures (as in the 2008 version), but it also aims to keep measurement errors within specified limits. In the latest standard, regular recalibration of pyranometers is a requirement.

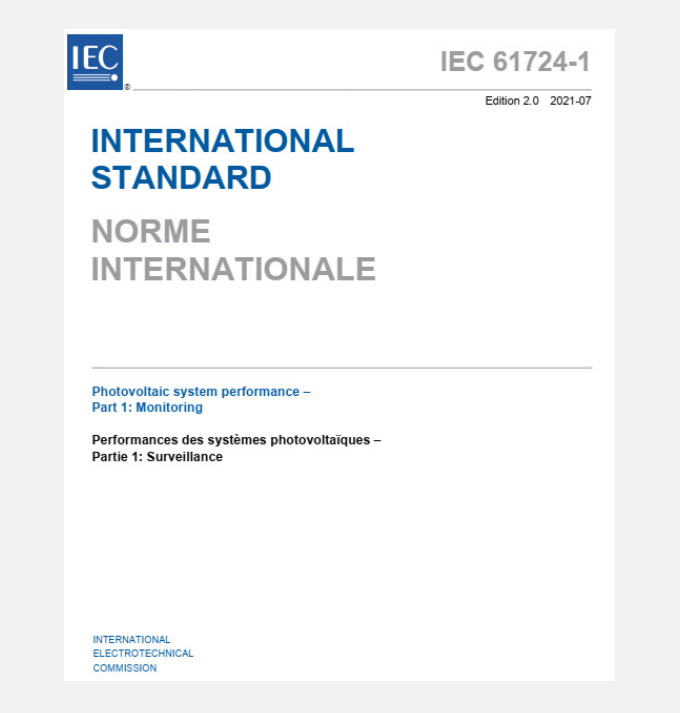


Figure 1 Cover of the new IEC 61724-1 standard, published in July 2021.

Why calibration?

Regular calibration is an essential part of quality management for all "mission critical" measuring instruments. Its purpose is to verify that the measurement instrument has been, stable and, if not, to correct for this. Pyranometers, due to prolonged exposure to the sun, are not expected to be perfectly stable. To attain the high accuracy necessary to monitor PV system performance and degradation, you must frequently recalibrate pyranometers. Before calibration, the laboratory performing the calibration will also assess the condition of the pyranometer dome and replace the desiccant, if needed.

How often?

Most instrument owners use a calibration interval of 1 year for all their instruments. With pyranometers, the manufacturer's recommendation is 2 years, as it's too costly to calibrate every year. IEC recommends either a 2-year interval or to follow the manufacturer's recommendation (see Figures 2 and 3). The general consensus is that a calibration interval of more than 2 years involves a significant risk. Most utility-scale PV power plants employ multiple pyranometers. They may send 50 % away for calibration in year one, and the other 50 % in year two.

4 Monitoring system classification

This document defines two classifications of monitoring system, Class A and Class B.

Class A is intended for large PV systems such as utility-scale or large commercial installations.

Class B is intended for smaller systems such as rooftop or small to medium-size commercial installations.

Users of the document may specify whichever classification is most appropriate to their application, regardless of PV system size.

The monitoring system classification shall be stated in any conformity declarations to this document.

Figure 2 Text from IEC 61724-1:2021. For IEC 61724 conformity declarations, you need documented proof of calibration of instruments.

8.2.4 Recalibration

Recalibration of sensors shall be conducted in a manner that minimizes downtime and sensor outages in order to prevent interruption of monitoring. Effective methods may include:

- Exchanging installed sensors with new or recalibrated units
- Performing on-site recalibration of sensors where possible
- Providing redundant sensors and alternating laboratory recalibration schedules.

For Class A systems, sensors shall be recalibrated once every 2 years, or more frequently per manufacturer recommendations.

For Class B systems, recalibrate sensors according to manufacturer recommendations.

Figure 3 Text from IEC 61724-1: 2021. There is consensus that an interval of larger than 2 years involves too much risk.

Table 4 – Irradiance sensor requirements

Sensor type	Class A system	Class B system
Pyranometer	Front side (POA and GHI): Class A per ISO 9060:2018, Spectrally flat Calibration uncertainty ≤ 2 % at 1 000 $W \cdot m^{-2}$ Range up to 1 500 $W \cdot m^{-2}$ Resolution ≤ 1 $W \cdot m^{-2}$	Class C or better per ISO 9060:2018 Calibration uncertainty ≤ 3 % at 1 000 $W \cdot m^{-2}$ Range up to 1 500 $W \cdot m^{-2}$ Resolution ≤ 1 $W \cdot m^{-2}$

Figure 4 Text from IEC 61724-1; 2021. Calibration uncertainty of 2 % is required.

What level of accuracy?

IEC 61724-1 requires uncertainties of calibration, expressed as expanded measurement uncertainties with a coverage factor k of 2.

– Class A: 2%
– Class B: 3%

Why not on-site?

Pyranometer calibration equipment is costly, bulky, and vulnerable—making it difficult to transport. Also, on-site availability of the natural sun is not sufficiently reliable to use for calibration. Even if the sun shines, it may not be sufficiently stable, or at angles that are too close to the horizon.

In practice, outdoor pyranometer calibration will not attain the 2 % uncertainty level required for Class A PV system performance measurement. In some cases, the 3 % requirement of Class B systems will be attained, but this is generally considered insufficient for utility-scale PV power plants. High-accuracy solar calibrations are nowadays done at specialized laboratories. More details on why you must send instruments to a laboratory.

Hukx

Hukx is the leading manufacturer of solar radiation sensors, both in technology and market share. We calibrate pyranometers of all commonly used brands and can work more efficiently if you supply us with your sensors in batches of 3 or more. You may then benefit from our quantity discounts.

Most popular pyranometer calibration services

Table 1 Hukx's most popular calibration services.

Most common calibration services

Brand and model	Calibration method
Hukx and Hukseflux SR series	ISO 9847:2023 *Solar energy—Calibration of pyranometers by comparison to a reference pyranometer*
Kipp & Zonen CMP, SMP series	Indoor calibration type A1.

Figure 5 A typical calibration system at Hukx's specialized laboratory. We have 8 calibration and servicing facilities around the globe.

Why work with us

Hukx offers:

– well established and traceable calibration methods
– fast turnaround times
– quantity discounts
– calibration references for the most common brands and models
– calibration facilities in the main global economies: USA, EU, China, India, Japan, Singapore, Australia and Brazil
– added service at added cost: temporary replacement instruments available

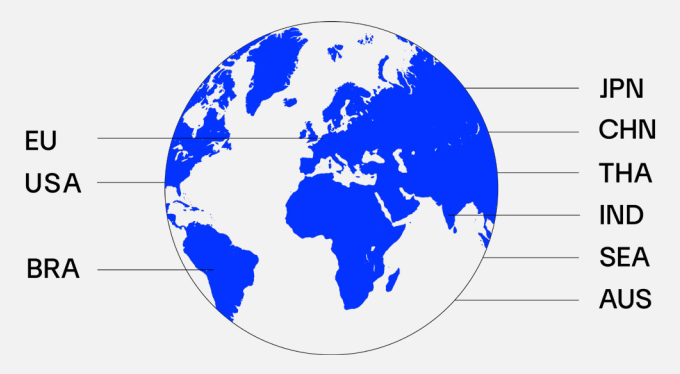
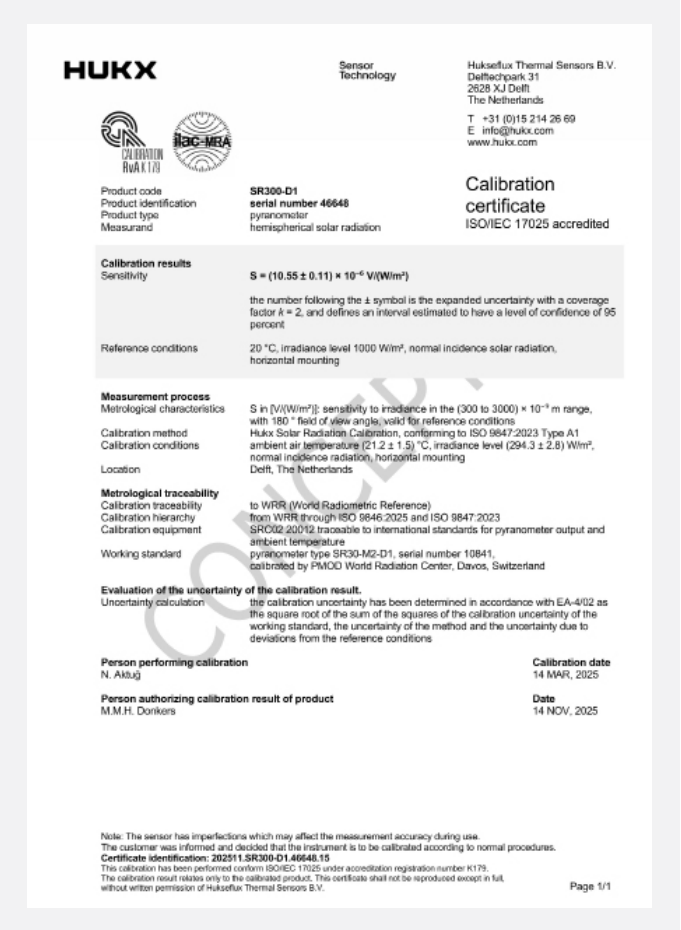


Figure 6 Pyranometer and pyrheliometer users are supported by the worldwide Hukx calibration and servicing organization.



HUKX

Sensor Technology

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Product code SR300-D1
Product identification serial number 46648
Product type pyranometer
Measurand hemispherical solar radiation

Calibration certificate
ISO/IEC 17025 accredited

Calibration results
Sensitivity S = (10.55 ± 0.11) × 10⁻⁶ V/(W/m²)

the number following the ± symbol is the expanded uncertainty with a coverage factor k = 2, and defines an interval estimated to have a level of confidence of 95 percent

Reference conditions 20 °C, irradiance level 1000 W/m², normal incidence solar radiation, horizontal mounting

Measurement process
Metrological characteristics S in [V/(W/m²)]: sensitivity to irradiance in the (300 to 3000) × 10⁻⁹ m range, with 180 ° field of view angle, valid for reference conditions
Calibration method Hukx Solar Radiation Calibration, conforming to ISO 9847:2023 Type A1
Calibration conditions ambient air temperature (21.2 ± 1.5) °C, irradiance level (294.3 ± 2.8) W/m², normal incidence radiation, horizontal mounting
Location Delft, The Netherlands

Metrological traceability
Calibration traceability to WRR (World Radiometric Reference)
Calibration hierarchy from WRR through ISO 9846:2025 and ISO 9847:2023
Calibration equipment SRC02 20012 traceable to international standards for pyranometer output and ambient temperature
Working standard pyranometer type SR30-M2-D1, serial number 10841, calibrated by PMOD World Radiation Center, Davos, Switzerland

Evaluation of the uncertainty of the calibration result.
Uncertainty calculation the calibration uncertainty has been determined in accordance with EA-4/02 as the square root of the sum of the squares of the calibration uncertainty of the working standard, the uncertainty of the method and the uncertainty due to deviations from the reference conditions

Person performing calibration N. Aktug
Calibration date 14 MAR, 2025

Person authorizing calibration result of product M.M.H. Donkers
Date 14 NOV, 2025

Note: The sensor has imperfections which may affect the measurement accuracy during use.
The customer was informed and decided that the instrument is to be calibrated according to normal procedures.
Certificate identification: 202511.SR300-D1.46648.15
This calibration has been performed conform ISO/IEC 17025 under accreditation registration number K179.
The calibration result relates only to the calibrated product. This certificate shall not be reproduced except in full without written permission of Hukseflux Thermal Sensors B.V.

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Figure 7 Example of a calibration certificate with each sensor, documenting traceability and uncertainty evaluation.

More about compliance of pyranometers with the new IEC classification

Hukx is specialized in solar radiation measurement. A separate memo offers comments on the consequences of the new standard concerning the selection of pyranometers.

Where can I order the IEC standard?

The standard can be purchased from the IEC web.

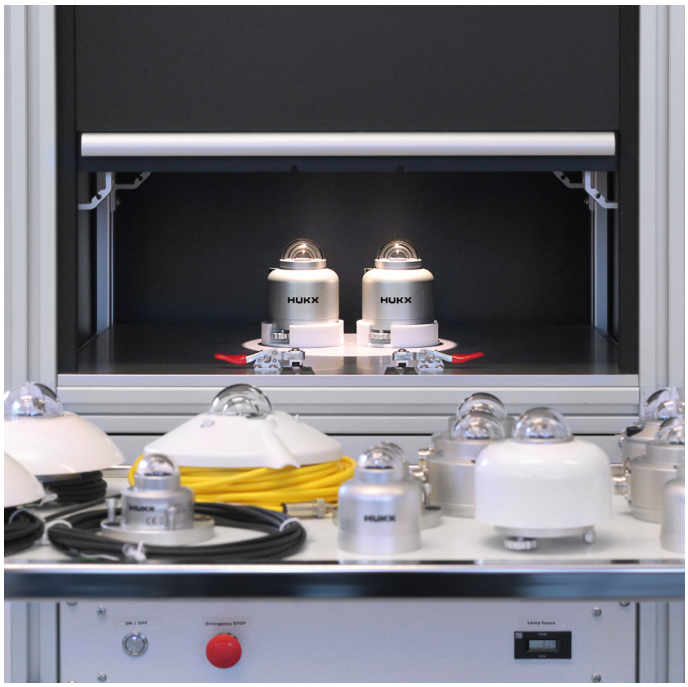

Figure 8 Example of a calibration certificate with each sensor, documenting traceability and uncertainty evaluation.

About Hukx

Hukx is the leading innovator in solar radiation and heat flux sensor technology. We are proud to set the standard in high-accuracy measurement, and to be working at the heart of the energy transition.

Customers worldwide rely on our bestselling pyranometers and heat flux sensors. From sensor design and selection to supply and recalibration, we support you across the entire lifecycle.

Hukx is headquartered in the Netherlands, with locally owned representative sales offices in the USA, Brazil, India, China, Southeast Asia, and Japan.

Let us help you select the best sensor for your application.
Get in touch with our experts today via: info@hukx.com

Version 2505

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