Hukseflux pyranometer selection guide

Highest accuracy in every class at the most attractive price level

Hukseflux offers a wide range of solutions for measurement of solar radiation. This brochure offers you general guidelines for selection of the right instrument. The application of pyranometers in PV system performance monitoring is highlighted as an example. Please contact us for further assistance.

Figure 1 *maintenance of SR20 secondary standard pyranometer with VU01 ventilation unit in PV system performance monitoring, measuring plane of array irradiance*

Figure 2 *example of a Hukseflux pyranometer: SR25-D1 digital secondary standard pyranometer with sapphire outer dome. This model offers better data availability and measurement accuracy than traditional ventilated pyranometers. Its digital interface, using the industry standard Modbus communication protocol, allows for easy implementation and service*

The right instrument for the application

Choosing the right instrument for your application is not an easy task. We can offer assistance. But first, you should ask yourself the following questions:

- are there standards for my application?
- what level of accuracy do I need?
- what will be the instrument maintenance level?
- what are the interfacing possibilities?

When discussing with Hukseflux we will not only select the most suitable pyranometer.
Our recommendation will include:

- recommended pyranometer class
- recommended maintenance level
- estimate of the measurement accuracy
- recommended calibration policy
- recommended interface

Accuracy improvement by a factor 2

Pyranometers are subject to classification according to ISO 9060. The 3 classes are:

- secondary standard
- first class
- second class

From second class to first class and from first class to secondary standard, the achievable accuracy improves by a factor 2. (see Figure 3)

Hukseflux pyranometers

Measurand	hemispherical solar radiation
ISO 9060 classification	secondary standard, first class, second class
Options	analogue, 4-20 mA and / or digital output; cable length; sapphire outer dome or use with VU01 ventilation unit; internal temperature sensors; heating and / or temperature sensors are standard on higher class models

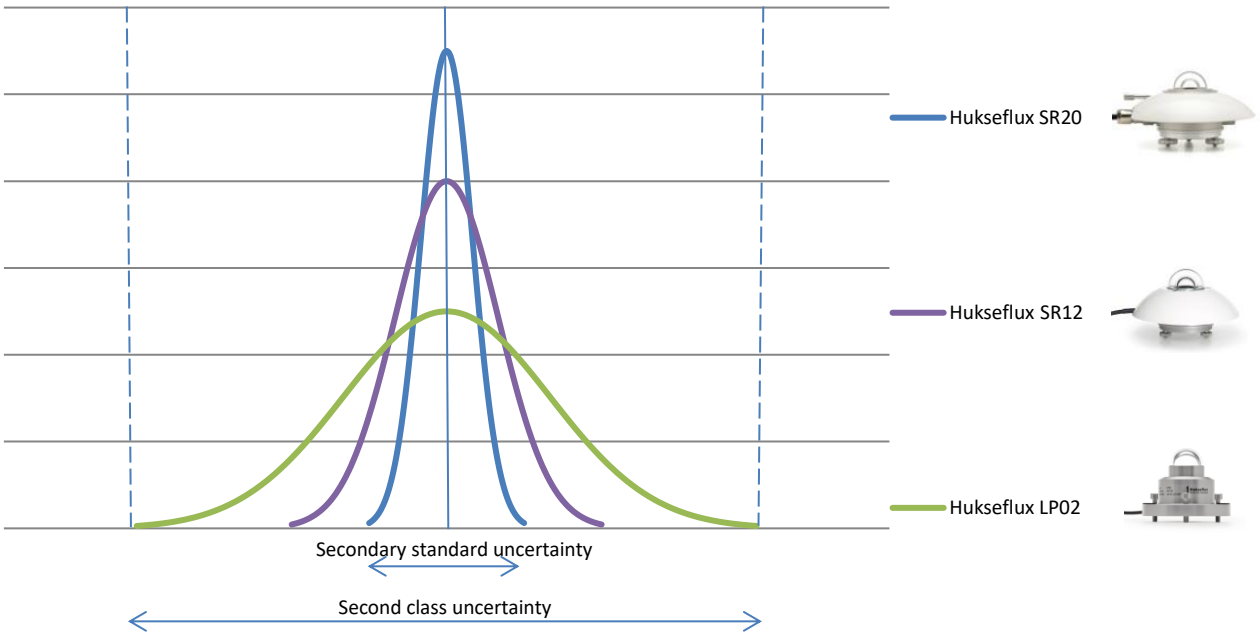

Figure 3 *a visual impression of measurement uncertainty for well maintained instruments of different ISO 9060 pyranometer classes. From second to first class and from first class to secondary standard, the achievable accuracy improves by a factor 2*

Hukseflux pyranometer benefits

Hukseflux is a leading manufacturer, both in technology and market share, of pyranometers. We offer you the best measurement accuracy in every class. In more detail, superior instrument design allows us to claim:

- the best calibration uncertainty
- lowest "zero offset a"
- reduction of measurement errors caused by early morning dew deposition via a heater

PV system performance monitoring

In PV system performance monitoring, the recommended starting point is a first class pyranometer. This is explicitly stated in ASTM E2848 "Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance" (issued end 2011). Hukseflux model SR12 pyranometer is a good choice, complying with ISO 9060 "first class for solar energy testing applications". Recommended recalibration interval is 2 years. ASTM E2848 suggests instruments to be "characterised to the extent practicable". You may prefer SR20 and SR20-D2 secondary standard pyranometers because of their higher level of characterisation, and the fact that they are more stable than the cells used in PV systems. Optionally, SR20 and SR20-D2 can be ventilated by ventilation unit VU01. Secondary standard pyranometers SR25 and SR25-D1, equipped with a sapphire outer dome and an internal heater, offer the highest data availability and measurement accuracy without the need to ventilate.

Not only the right instrument should be chosen, but also the system configuration should be optimised. For PV system performance monitoring, irradiance needs to be measured in the plane of array of the PV panel. In addition, horizontally placed instruments are used for the measurement of global radiation. Global irradiance data enable the user to compare the local climate and system efficiency between different sites. These data can also be compared to measurements by local meteorological stations.

Need for recalibration

In case you require a first class pyranometer, but wish to avoid a 2-yearly recalibration, use a higher class instrument: secondary standard. Our SR20 and SR20-D2 secondary standard pyranometers offer better stability and therefore can work within first class limits at a lower recalibration interval.
The latest best practice to further improve efficiency is to perform field calibrations, using digital pyranometers remotely accessing their calibration and calibration history registers.

Influence of instrument cleaning

The performance of high class instruments strongly depends on cleaning. At a low maintenance level, the achievable accuracy will not be reliably attained. You may then consider to employ multiple instruments. The use of redundant instruments allows remote checks of one instrument using the other as a reference, which leads to a higher measurement reliability. For lower class instruments, the relative loss of accuracy at a low maintenance level is less significant. At low maintenance intervals, although this is not formally complying with the IEC, ASTM and ISO standards, use of multiple low class instruments is a good alternative to using a single high class instrument.

Asset management of large scale PV

Asset managers of large scale PV power plants prefer digital secondary standard pyranometers.

The reasons why:

- better stability than cells used in PV systems
- possibility to perform field calibration
- easy implementation and servicing

Asset managers essentially monitor for various reasons. Apart from monitoring as a tool to assess day-to-day performance, they are interested to have documented proof of performance in case of warranty claims, when negotiating (re-) financing and when selling the asset. For monitoring the plant performance, the irradiance sensor must be more stable than the cells used in the PV system. This is only the case with secondary standard instruments, offering a stability of < 0.5 %/yr compared to a typical > 1% /yr PV cell degradation.
In addition, the digital D1 and D2 sensors are suitable for field calibration by comparison to a reference instrument. Ask Hukseflux for more information on this latest best practice.

Table 1 *The most common considerations when choosing a pyranometer for PV system performance monitoring application*

					
	SR25-D1	SR20-D2	SR20	SR12	LP02
ISO 9060 classification	Secondary standard	Secondary standard	Secondary standard	First class	Second class
PV industry standards ASTM E2848, IEC 61427	+++++	+++++	++++	+++	-
ISO 9060 suitable for solar energy test applications	+++++	+++++	+++++	+++++	-
Stability better than cells used in PV systems	+++++	+++++	+++++	-	-
Ease of implementation and servicing	+++++	+++++	++	++	++
Field calibration possible	+++++	+++++	-	-	-
Heating to improve data availability	+++++	-	+	+	-
Low relative loss of accuracy at a low cleaning interval	+	+	+	++	+++++

Interfacing

We can assist you in optimising the interfacing of the pyranometer to the data collection platform at the measurement site. Solutions vary from using a datalogger as a local collection point for several different sensors to the use of transmitters incorporated in the pyranometer. Ideal for networks and the solar PV industry is SR20-D2 and SR25-D1. Their output is digital and these sensors communicate using the industry standard Modbus RTU protocol over 2-wire RS-485. SR20-D2 offers 4-20 mA output (current loop) as well.

Uncertainty evaluation

The uncertainty of a measurement under outdoor conditions depends on many factors. Guidelines for uncertainty evaluation according to the "Guide to Expression of Uncertainty in Measurement" (GUM) can be found in our user manuals. We provide spreadsheets to assist in the process of uncertainty evaluation of your measurement.

See also

View our complete range of sensors on our website.

About Hukseflux

Hukseflux Thermal Sensors offers measurement solutions for the most challenging applications. We design and supply sensors as well as test & measuring systems, and offer related services such as engineering and consultancy. With our laboratory facilities, we provide testing services including material characterisation and calibration. Our main area of expertise is measurement of heat transfer and thermal quantities such as solar radiation, heat flux and thermal conductivity. Hukseflux is ISO 9001:2008 certified. Hukseflux sensors, systems and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

Need for support in your selection process?
E-mail us at: info@hukseflux usa.com

SR25 PYRANOMETER
Secondary standard pyranometer with sapphire outer dome

SR20-D2 PYRANOMETER
Digital secondary standard pyranometer with Modbus RTU and 4-20 mA output

SR20 PYRANOMETER
Secondary standard pyranometer

SR12 PYRANOMETER
First class pyranometer for solar energy test applications

LP02 PYRANOMETER
Second class pyranometer

LP02-TR PYRANOMETER
Second class pyranometer with 4-20 mA transmitter

LP02 / LI19 PYRANOMETER
Second class pyranometer with LI19 handheld read-out unit

VU01 VENTILATION UNIT
Ventilation unit for SR25, SR20, SR20-D2