EKO

ISO 9060:2018

Pyranometer Classifications

Quick Guide

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INTRODUCTION

When it comes to Pyranometers, A, B, C, isn’t quite as easy as 1, 2, 3. But don’t panic!

With ISO 9060:2018, introduced in 2018, the way solar sensors are ranked and categorized was re-defined, providing simpler, clearer, and more consistent standards across all kinds of sensor technologies.

Today, all EKO solar radiation sensors correspond to ISO 9060:2018.

ISO 9060:2018

About ISO

The International Organization for Standardization (ISO) is an independent, non-governmental organisation with a membership of 165 national standards bodies. The work of preparing international standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organisations, governmental and non-governmental, in liaison with ISO, also take part in the work.

‘Through its members, ISO brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges.’

ISO 9060:2018

Why ISO 9060:2018

'Solar radiation' is a general term for the energy, or electromagnetic radiation, emitted by the sun; including visible light. Every location on the planet's surface receives sunlight at least part of the year though the amount can vary a great deal depending on the geographic location, the time of day, the season, local landscape, and weather.

Accurate solar radiation data helps with scientific studies of the atmosphere, including weather processes and forecasting, otherwise known as meteorology, and in the development of solar power resources. From first selecting a site and position to set-up a solar panel, or solar park, based on the amount of light expected in that location, through to daily performance monitoring and management; accurate data is essential.

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Why ISO 9060:2018

With many types of solar sensor available, standards and specifications like ISO 9060:2018 provide a consistent and clear basis for comparison, helping users and organisations to choose between different manufacturers, models, and classes of sensor based on the requirements of their project or application.

ISO 9060:2018 establishes a classification and specification of instruments for the measurement of hemispherical solar and direct solar radiation based on results obtained from indoor or outdoor performance tests.

ISO 9060:2018

Class A, B, C

ISO 9060:2018 defines x3 classes of sensor, based on a series of parameters. Each of these parameters can impact on the accuracy, speed and quality of the data produced by the sensor. Class A is the highest rank, and to ensure the standard, Class A sensors must be individually tested to guarantee that the temperature and directional responses comply with the classification requirements. Sensors in the same class, even when made by the same manufacturer, won't necessarily have matching or equal ratings across each parameter so it is important to understand your specific needs, and to carefully research each model of pyranometer available.

EKO Instruments produces a range of sensors across each class. Our engineers and sales advisors work with customers to ensure that they get the best sensor for their specific application.

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Class A, B, C

ISO 9060:2018 Parameters	Class A	Class B	Class C
Response Time	< 10 s	< 20 s	< 30 s
Zero Offset a	±7 W/m^2	±15 W/m^2	±30 W/m^2
Zero Offset b	±2 W/m^2	±4 W/m^2	±8 W/m^2
Zero Offset c	±10 W/m^2	±21 W/m^2	41 W/m^2
Non-Stability	±0.8 %	±1.5 %	±3 %
Non-Linearity	±0.5 %	±1 %	±3 %
Directional Response	±10 W/m^2	±20 W/m^2	±30 W/m^2
Spectral Error	±0,5 %	±1 %	±5 %
Temperature Response	±1 %	±2 %	±4 %
Tilt Response	±0.5 %	±2 %	±5 %
Additional Signal Processing Errors	±2 W/m^2	±5 W/m^2	±10 W/m^2

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Class A

ISO 9060:2018 Parameters	Class A	MS-80S
Response Time	< 10 s	< 0.5 s
Zero Offset a	±7 W/m^2	±1 W/m^2
Zero Offset b	±2 W/m^2	±1 W/m^2
Zero Offset c	±10 W/m^2	±2 W/m^2
Non-Stability	±0.8 %	±0.5 % (5-Years)
Non-Linearity	±0.5 %	±0.2 %
Directional Response	±10 W/m^2	±10 W/m^2
Spectral Error	±0.5 %	±0.2 %
Temperature Response	±1 %	±0.5 %
Tilt Response	±0.5 %	±0.2 %
Additional Signal Processing Errors	±2 W/m^2	±1 W/m^2
ISO 9060:2018 Sub-Categories		
Fast Response (< 0.5 s)		☑
Spectrally Flat		☑

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Class B

ISO 9060:2018 Parameters	Class B	MS-60S
Response Time	< 20 s	< 18 s
Zero Offset a	±15 W/m^2	±5 W/m^2
Zero Offset b	±4 W/m^2	±2 W/m^2
Zero Offset c	±21 W/m^2	±7 W/m^2
Non-Stability	±1.5 %	±1.5 % (1-Year)
Non-Linearity	±1 %	±1 %
Directional Response	±20 W/m^2	±18 W/m^2
Spectral Error	±1 %	±0.2 %
Temperature Response	±2 %	±2 %
Tilt Response	±2 %	±1 %
Additional Signal Processing Errors	±5 W/m^2	±1 W/m^2
ISO 9060:2018 Sub-Categories		
Spectrally Flat		☑

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Class C

ISO 9060:2018 Parameters	Class C	MS-40S
Response Time	< 30 s	< 18 s
Zero Offset a	±30 W/m^2	±12 W/m^2
Zero Offset b	±8 W/m^2	±5 W/m^2
Zero Offset c	41 W/m^2	±17 W/m^2
Non-Stability	±3 %	±1.5 % (1-Year)
Non-Linearity	±3 %	±1 %
Directional Response	±30 W/m^2	±20 W/m^2
Spectral Error	±5 %	±0.2 %
Temperature Response	±4 %	±3 %
Tilt Response	±5 %	±1 %
Additional Signal Processing Errors	±10 W/m^2	±1.5 W/m^2
ISO 9060:2018 Sub-Categories		
Spectrally Flat		☑

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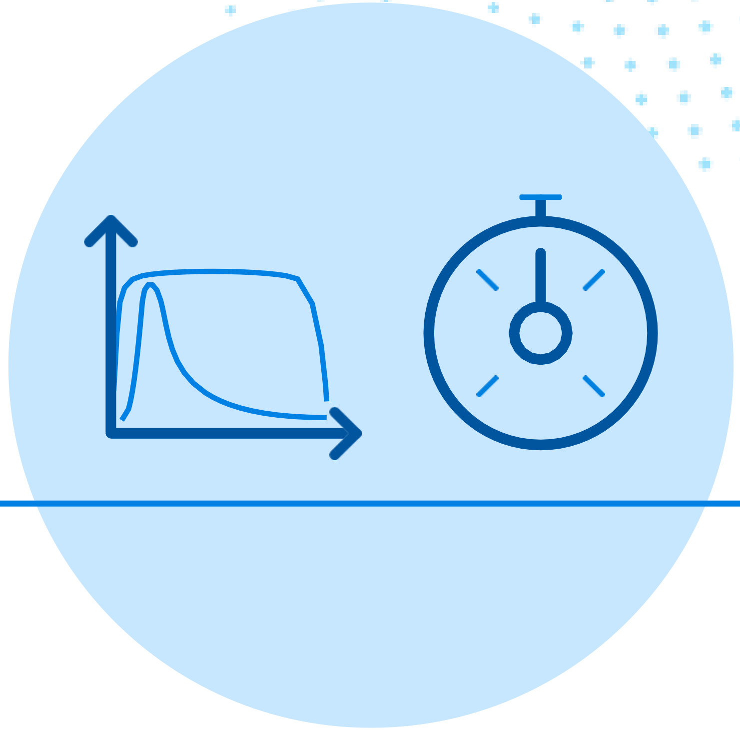
Fast response & Spectrally flat

‘Fast response’ and ‘spectrally flat’ are two sub-classifications, included in ISO 9060:2018. They help to further distinguish and categorise sensors. To gain the ‘fast response’ classification, the response time for 95% of readings must be less than 0.5 seconds; while ‘spectrally flat’ can apply to sensors with a spectral selectivity of less than 3% in the wavelength range from 0.35 to 1.5 microns. While most Class A pyranometers are ‘spectrally flat’, sensors in the ‘fast response’ sub-classification are much rarer. Most Class A pyranometers have a response time of 5 seconds or more, a whole 4.5 seconds slower than required by ISO 9060:2018.

Class A, and class-leading, our MS-80, and MS-80S pyranometers are both fast response and spectrally flat.



EKO Pyranometers

Summary

Sensor/Product Name	Spectrally Flat	Fast Response	Class A	Class B	Class C
MS-80S	✓	✓	●		
MS-80	✓	✓	●		
MS-80M	✓		●		
MS-80A	✓		●		
MS-60/60A/60M	✓			●	
MS-40/40A/40M	✓				●

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- Call our EU office +31 (0)703050117
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Terms & Definitions 1/2

Parameter	Standard	Explanation
Response Time	Time for 95% response	Faster sensors allow a higher sample rate, and are especially important when measuring solar irradiance for photovoltaic panels. For example, a fast response sensor can provide data that is close to or on par with the response or output from a solar panel, minimizing discrepancies when estimating performance ratio.
Zero Offset a	Response to −200 W/m^2 net thermal radiation	Thermal exchange, or heat flow between the body of the sensor and the environment can occur, and can impact on measurements. This is particularly important for sensors exposed to extreme weather conditions, or rapid temperature changes. Zero offset A covers temperature differences between the sensor and the sky, while B covers ambient temperatures. Zero offset C covers both. Sensors with very low thermal offsets are less affected by the surrounding conditions and may not need additional ventilation or heating.
Zero Offset b	Response to 5 K/h change in ambient temperature	
Zero Offset c	Total zero off-set including zero offset a, zero offset b, and other sources	
Non-Stability	% change in responsivity per year	This parameter defines how stable, meaning how accurate, a sensor is over time. As sensors may degrade over time, they need periodic re-calibration to maintain the accuracy and traceability of their results. The MS-80 and MS-80S from EKO both have a recommended recalibration interval of 5-years, but most other pyranometers need to be recalibrated every 1 to 2 years.
Non-Linearity	% deviation from responsivity at 500 W/m^2 due to change in irradiance within 100 to 1000 W/m^2	An irradiance sensors output should be directly proportional to irradiance, that is the amount of solar power per unit area. Sensors with higher non-linearity will have a higher measurement uncertainty, making it harder to have reproducible measurements.

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Terms & Definitions 2/2

Parameter	Standard	Explanation
Directional Response	Range of errors caused by assuming that the normal incidence responsivity is valid for all directions when measuring from any direction (with an incidence angle of up to 90° or even from below the sensor) a beam radiation whose normal incidence irradiance is 1000 W/m^2	Solar radiation sensors don't have an ideal cosine response, and the directional response, or cosine error, provides the deviation of the actual sensor response to the ideal, as a function of the angle of incidence. Put another way, this parameter gives an estimate of the measurement error that can occur due to the fact that the sun moves apparently through the sky during the day and that, from sun rise to sun set, the angle between the sun and the sensor changes.
Spectral Error	Maximum spectral error observed for a set of global horizontal irradiance clear sky spectra defined in the *ISO 9060:2018(E)* document	Solar radiation is complex, its unevenly distributed along the spectral range, and is affected by clouds, aerosols, water vapour, and other gases in the atmosphere. Pyranometers and pyrheliometers output a single value, ideally with a spectrally flat response. Large or small deviations from the flat response can mean that a sensor is more or less accurate. For example thermopile detectors have a flat response, while silicon based detectors are spectrally selective devices.
Temperature Response	% deviation due to change in ambient temperature within the interval from −10 °C to 40 °C relative to the signal at 20 °C	For measurements to remain accurate under various weather conditions the sensor output should not vary under different temperatures while experiencing the same irradiance conditions. A small temperature response ensures that the measurements will remain consistent under a wider range of environment conditions.
Tilt Response	% deviation from the responsivity at 0° tilt (horizontal) due to change in tilt from 0° to 180° at 1000 W/m^2 irradiance	While a directional response estimates the measurement error for different angles of incidence, the tilt response gives an estimate of measurements deviations that may occur when the sensor is installed in a tilted position. The differences may occur due to the calibration method followed, directional response and different thermal disposition.

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Links

- Find out more about ISO @ www.iso.org
- Buy & download a copy of ISO 9060:2018 @ www.iso.org/standard/67464.html
- Check out ISO's Online Browsing Platform for a sample of ISO 9060:2018, including the foreword @ www.iso.org/obp/ui/#iso:std:iso:9060:ed-2:v1:en

Thank you