EPLAB

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STANDARD PRECISION PYRANOMETER, MODEL SPP
Instruction Sheet

Introduction

Measurement of Atmospheric Radiation is generally divided in to two distinct spectral regions: the solar (shortwave) region and the terrestrial (longwave) region.

Solar radiation is a term used to describe visible and near-visible (ultraviolet and near-infrared) radiation emitted from the sun. The different regions are described by their wavelength range within the broad band range of 0.20 to 4.0 μm (microns). Terrestrial radiation is a term used to describe infrared radiation emitted from the atmosphere. The following is a list of the components of solar and terrestrial radiation and their approximate wavelength ranges:

Ultraviolet:	0.20 - 0.39 μm
Visible:	0.39 - 0.78 μm
Near-IR:	0.78 - 4.00 μm
Infrared:	4.00 - 100.00 μm

Approximately 99% of the solar radiation at the earth's surface is contained in the region from 0.3 to 3.0 μm while most of infrared radiation is contained in the region from 4.0 to 50 μm. Shortwave radiation is measured using pyranometers and pyrheliometers while longwave radiation is measured using a pyrgeometer.

Standard Precision Pyranometer

The Standard Precision Pyranometer, Model SPP is a Secondary Standard Pyranometer used for the precise measurement of Global Shortwave Radiation. National Meteorological Authorities, Universities and Research Institutes use this instrument in worldwide networks such as the Atmospheric Radiation Measurement (ARM) Program, the Baseline Surface Radiation Network (BSRN) and the Global Atmospheric Watch (GAW). It is equally suitable for the measurement of Reflected Shortwave Radiation (Albedo), Diffuse Shortwave Radiation (shaded) or as a Transfer Standard for calibration of other pyranometers.

	SPP vs. ISO 9060 Specs		Additional Specs	
Response Time	<10 sec	1 sec (1/e)	Sensitivity	approx. 8 μV / Wm^{-2}
Zero Offset a)	± 5 Wm^{-2}		Impedance	approx. 700 Ω
Zero Offset b)	± 2 Wm^{-2}		Uncertainty*	
Non-Stability	± 0.5%		Calibration	less than 1%
Linearity	± 0.5%	0-2800 W m^{-2}	Measurement (Instant)	less than 10 Wm^{-2}
Directional Response	± 10 Wm^{-2}		Measurement (Hourly)	approx. 2%
Spectral Selectivity	± 2%		Measurement (Daily)	approx. 1%
Temperature Response	± 1%	-30 to +50ºC	Application: Working Standard or Network Measurements	
Tilt Response	± 0.5%		Housing: weatherproof designed for use at any latitude	
Traceability:	World Radiation Reference (WRR)			
Classification:	SECONDARY STANDARD / HIGH QUALITY			

Installation and Maintenance

The SPP should be free from obstructions (artificial and natural) above the plane of the sensing element. If this is not possible, the site selected should be as free as possible, especially to the south (in the Northern Hemisphere). The SPP should be located so that (a) no shadows (e.g. radio masts, buildings, trees, etc.) will be cast on it; (b) it is not too close to light-colored walls or other objects likely to reflect sunlight onto it; and (c) it is not exposed to artificial radiation sources. An accessible flat roof usually provides a good location for mounting the instrument.

In the case of a downward-looking SPP for the measurement of reflected radiation (albedo), the field of view should also be as free from obstructions as possible. A long boom with the SPP extending south of the stand will often be used to minimize the obstruction/shading (in the Northern Hemisphere).

The pyranometer should be securely attached to whatever mounting stand is decided upon, using the holes provided in the instrument's baseplate (4 ¾" diameter bolt circle) and, at the same time, leveling it with the adjustable leveling screws provided. By convention, the connector should face north in the Northern Hemisphere and south in the Southern Hemisphere. The stand should be sufficiently rigid to prevent the instrument from moving, especially in high winds.

Eppley recommends connecting the SPP to a Data Acquisition System or voltmeter using weather proof cabling (No 22 or 24 gauge, twisted shielded pair) such as Belden 8761 (two lead) or 9534 (four leads). A Bendix/Amphenol 4-pin mating connector is supplied with the instrument. For easy disassembly of the mating connector, unscrew the outer most section while it is connected to the PSP.

The pin designations are as follows:

PIN	A	Thermopile Output (-)
	B	Thermopile Output (+)
	C	Case Thermistor (YSI 44031)
	D	Case Thermistor (YSI 44031)

Grounding of the instrument can be achieved by pulling the shield from the cable connector out to the bulkhead connector using a spade lug.

The SPP produces a millivolt analog signal measured across pins A&B that is directly proportional to the irradiance being measured. Each instrument is provided with a Calibration Constant (Sensitivity) which, when divided into the signal, results in the Irradiance in watt per square meter (Wm^{-2}).

Also included is a case thermistor for measuring the instrument temperature, should you desire. The case temperature, Tc, is determined by measuring the resistance across pins C&D and using the relationship:

$$T = 1 / \{C_1 + C_2*Ln(R) + C_3*(Ln(R))^3\}$$

where T is the absolute temperature, R is the measure resistance of the YSI thermistor in ohms, Ln indicates the natural logarithm and the values of the constants are:

$C_1 = 0.0010295$
$C_2 = 0.0002391$
$C_3 = 0.0000001568$

To obtain temperatures in °C, subtract 273.15 from the calculated temperature.

Please refer to the Datalogger's Instructions or connecting the cable to the datalogger.

Pyranometers in continuous operation should be inspected often (daily if possible). At these inspections, the hemisphere should be cleaned with a lint-free soft cloth, being careful not to scratch the surface. Particular care should be used in environments that may leave traces of salt, soot, sand, etc. Such abrasions can scratch the hemisphere and alter the original transmission properties of the glass. If frozen snow, glazed ice, hoarfrost or rime is present, an attempt should be made to remove the deposit carefully with warmed cloths. The desiccator should be inspected and if the silica gel is pink or white in color, it should be replaced or rejuvenated by drying in an oven at about 135°C for a few hours. The spirit level should be inspected regularly to ensure the instrument is level.

Some meteorological networks have had success in keeping the hemispheres free from frost, snow, dew, and moisture build-up by using Eppley ventilators, Model VEN, to continuously blow air over both the instrument case and hemisphere.

Calibration

These pyranometers are calibrated according to procedures detailed in ISO 9847 Section 5.3.1. The comparison reference is a working standard pyranometer of similar design calibrated against Eppley AHF Cavity Pyrheliometers that participate in the International Pyrheliometric Comparisons (IPC) every five years. Newport calibrations of the Standard Precision Pyranometer reproduce the WRR to within ±1%. Eppley recommends a minimum calibration cycle of 5 years (in conjunction with the WRR) but encourages annual calibration for the highest measurement accuracy.

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