Calibration Report: Pyrheliometer
Kipp and Zonen CH1-010254
World Meteorological Organization number 39038
(For the Baseline Radiation Network)

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Calibration date: 2025 April 17.
Next calibration due: 2027 April 17.
Reference standard: AHF-31041, irradiance less than 700 watts/meter^2.

The calibration coefficients and their associated uncertainties (U95%) have been determined for one pyrheliometer. The unit of the calibration coefficient (S) is µV/(W/m^2). The reference standard was Eppley Laboratories Inc., absolute cavity radiometer AHF-31041, with its associated data acquisition system. The AHF-31041 calibration is traceable Through the Golden Colorado National Renewable Energy Laboratory's (NREL) September 2023 National Pyrheliometer Comparison (NPC) to the World Radiation Reference Maintained at the Physikalisch-Meteorologisches Observatorium Davos / World Radiation Center. The NREL cavity reference group attended the International Pyrheliometer Comparison held in Davos during September and October of 2021, and is therefore traceable to the World Radiation Reference.

The sensitivity factor and its associated uncertainty (95%) are as follows:

Manufacturer	Serial Number	logger S µV/(W/m^2)	U95
Kipp and Zonen WMO number 39038	CH1-010254	10.652	± 0.45%

Application

I = (mV output)/S ± sqrt(2)*U95%

Where: I = the irradiance measured by the pyrheliometer
(mV output) = microvolt output of the pyrheliometer
S = calibration coefficient of the pyrheliometer
U95% = the 95 % confidence level of a field measurement.

Supporting information, plots, a list of past calibration values, and a brief description of the calibration process is presented below.

CALIBRATION LOCATION

NASA Langley Hampton VA.

Latitude = 37.1038 deg., Longitude = -76.3872 deg., Elevation = 6 meters.

CALIBRATING PERSON(S)

Fred Denn, Bryan Fabbri

TRACEABILITY

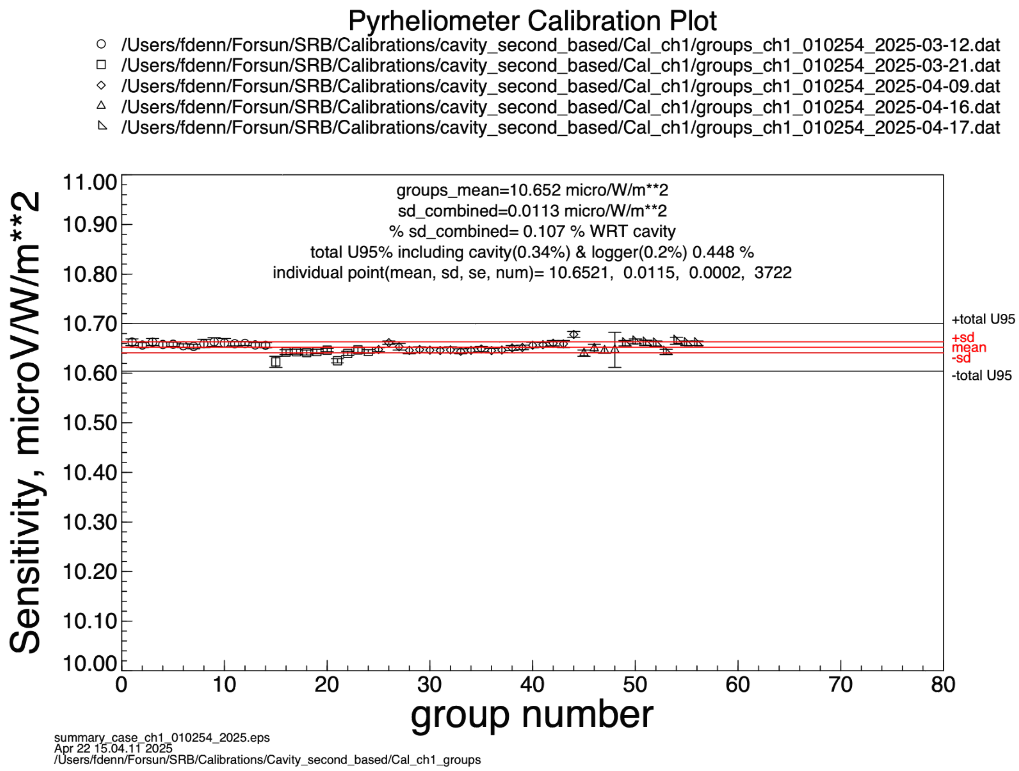
The reference standard was Eppley Laboratories Inc., absolute cavity radiometer AHF31041, with its associated, Campbell 1000x based, data acquisition system. The cavity calibration is traceable first to the cavity working group at the National Renewable Energy Laboratory (NREL) in Golden Colorado, And through the NREL group to the World Radiation Reference (WRR), located at the Physikalisch-Meteorologisches Observatorium, in Davos Switzerland. The NREL working group attended the 2021 International Pyrheliometer Intercomparison (IPC). Cavity AHF31041 participated National Pyrheliometer Comparisons (NPC)s at NREL in September and October 2022 and 2023.

HARDWARE CONFIGURATION

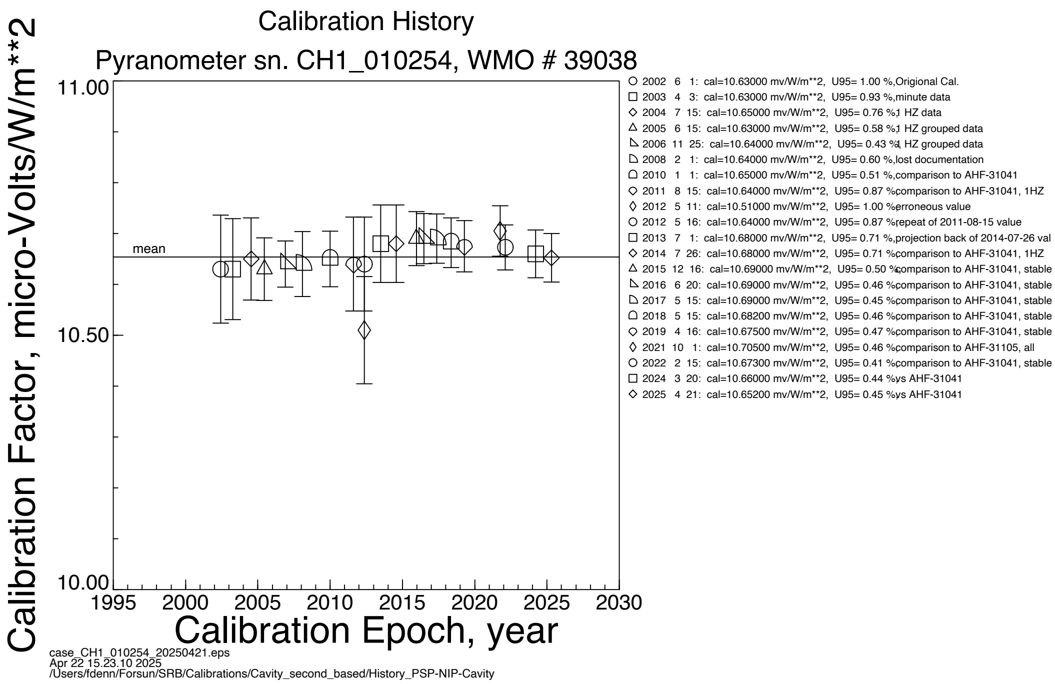
The pyrheliometer was mounted on a sun tracker and aligned with the sun.

DATA COLLECTION

Data were collected on the days shown in the plot below. Test pyrheliometer data are calibrated against cavity pyrheliometer data taken each second during runs of approximately twenty minutes generally starting on the hour and half hour.



Calibration coefficients for several days. Each symbol represents a cavity run which is approximately 25 minutes. These data are combined to get a final calibration coefficient for the entire, multi-day, calibration session.



Calibration history for pyrheliometer CH1-010254. The solid horizontal line represents the mean value. The symbols and their error bars represent the mean and U95 of each calibration event. The column on the right presents numerical values for each calibration event and a brief description of the calibration method used.

CALIBRATION HISTORIES

Pyrheliometer: Kipp and Zonen CH1-010254.

date	S (μV/(W/m^2))	U95 (%)	Note
2025 Apr 17	10.65	0.46	1Hz, ref. AHF-31041
2024 Mar 20	10.66	0.44	1Hz, ref. AHF-31041
2022 Mar 01	10.67	0.41	1Hz, ref. AHF-31041
2018 Oct 01	10.71	0.46	(intermediate value)
2019 May 16	10.68	0.47	1Hz, ref. AHF-31041
2018 May 15	10.68	0.46	1Hz, ref. AHF-31041
2017 May 15	10.69	0.45	1Hz, ref. AHF-31041
2016 June 20	10.69	0.46	1Hz, ref. AHF-31041
2015 Dec. 16	10.69	0.50	1Hz, ref. AHF-31041
2014 July 26	10.68	0.714	1Hz, ref. AHF-31041
~~2012 May 11~~	~~10.51~~	~~1.43~~	Bad do not use. 2018-09-11
2011 Sep 01	10.64	0.87	1HZ, ref. AHF-31041
2010 Jan 01	10.65	0.51	comparison to AHF-31041
2008 Feb 01	10.64	0.60	lost document
2006 Nov 25	10.64	0.58	(1 HZ grouped data)
2006 May 10			Setup error, no useable data.
2006 Jan 27			Setup error, no useable data.
2005 Jun 15	10.63	0.58	(1 HZ grouped data)
2004 Jul 15	10.65	0.76	(1 HZ data)
2003 Apr 03	10.63	0.93	(minute data)
2002 Jun 01	10.6		

A Very Brief Description of the Calibration Process.

1) Pyranometers are to be mounted horizontally, while pyrheliometers are to be mounted on the tracker pointing at the sun.
2) Deploy the Cavity Radiometer, select the 4 second data collection parameter file. Start the cavity calibration process.
3) Modify the field radiometer program, so that a file of second data is produced in addition to the minute resolution data file.
4) Prepare the tracker hardware to operate in manual shade/unshade mode. Either in manual mode or with the automatic pneumatic cylinder.
5) Start the cavity system, first calibrating the cavity, then collecting data for about 20 minutes before doing a recalibration. Repeat the calibration/measure process for the entire calibration period.
6) Collect test pyrheliometer data, while cavity irradiance is greater than 700W/m**2.
7) Continue this process as long as sky conditions permit while cavity irradiance is greater than 700 Watts/meter**2.
8) Transfer the cavity and pyranometer data to the data processing computer.
9) Remove cavity data that is flagged as "unstable" in the cavity data file.
10) Run a splitter program on the field radiometer file to generate a separate file for the shaded and unshaded periods for each instrument.
11) Run a plotting program on each data file so the data can be reviewed for: cloud events; bad shading; errors in the splitting routine; etc. Remove bad data records.
12) Run calibration programs to determine the calibration coefficient for each instrument.
13) Combine several days of calibration data to get a final calibration coefficient.
14) Produce a calibration document, such as this one, for each instrument. To be considered valid, a calibration must be both traceable to recognized standards, in this case the World Radiation Reference (WRR) in Davos Switzerland, and documented.