

MEASUREMENT REPORT

PYRANOMETER

Routine measurement of directional error during final inspection

Mean cosine error of each new pyranometer type CMP 22 is measured by a simple routine.

Routine:

The pyranometerbase is placed against the vertical turntable of a goniometer in the parallel (0,5°) beam of a sunsimulator.

Voltage output $U(z)$ is measured for beam incidence (zenith) angles of 0°, 40°, 60°, 70° and 80° coming in over azimuth south (cable pointing to North).

Next the pyranometer output $U(-z)$ is measured for incidence angles of -80°, -70°, -60°, -40° and 0° consequently for azimuth south. The dark signal is measured at the beginning of the routine in the middle and at the end. For each beam incident angle the dark signal is interpolated.

During the CMP 22 measurement cycle, a check is done on the azimuth error at 40° and 70° by measuring voltages for azimuth-directions S, E, N and W. Also at -70° and -40° this azimuth error is measured and the mean of both azimuth measurements cancels out the eventual error in the 0° position.

With the extended procedure at both 40° and -40° and 70° and -70° the specific cosine error for 8 azimuth directions (40° S, W, N and E and 70° E, N, W, S) can be calculated according to formula 1 and verified whether it is within $\pm 10 \text{ W/m}^2$.

The applied formula for the relative cosine error is:

$U(0^\circ)$ Pyranometer output voltage for normal incidence

$U(z)$ Pyranometer output voltage for angles (z)

Zero(z) Dark signal for angles

$$\frac{\left(\frac{U(z) + U(-z)}{2} - \text{zero}(z) \right)}{\left(\frac{U(0^\circ) + U(0^\circ)}{2} - \text{zero}(z) \right)} \cdot \cos(z) \cdot 100\% \quad \text{Formula 1.}$$

Relative cosine error at zenith angle in %

Zenith angle	South	East	North	West
40	0.35	0.64	0.61	0.51
60	0.75			
70	1.05	0.99	0.93	0.34
80	1.30			

Absolute cosine error for 1000 W/m^2 beam radiation in W/m^2

Zenith angle	South	East	North	West
40	2.65	4.89	4.69	3.87
60	3.76			
70	3.60	3.40	3.19	1.16
80	2.25			

PYRANOMETER MODEL: CMP 22

SERIAL NUMBER: 110292

Kipp & Zonen B.V.
Delftechpark 36, 2628 XH Delft
P.O. Box 507, 2600 AM Delft
The Netherlands

T: +31 (0) 15 2755 210
F: +31 (0) 15 2620 351
info@kippzonen.com
www.kippzonen.com

VAT no.: NL0055.74.857.B.01
Trade Register no.: 27239004
Member of HMEI