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Solar energy — Calibration of a pyranometer using a pyrhelimeter

Énergie solaire — Étalonnage d'un pyranomètre utilisant un pyrhéliomètre

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member 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 organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 180, *Solar energy*, Sub-Committee SC 1, *Climate – Measurement and data*.

This second edition cancels and replaces the first edition (ISO 9846:1993) which has been technically revised.

The main changes are as follows:

- focus on current calibration practices
- addition of a collimation tube calibration method;
- adapted recommendations for mathematical treatment of data;
- revised terminology in line with ISO 9060, ISO 9488 ~~Reference [1]~~ and ISO Guide 99 ~~Reference [2]~~;
- added comments on uncertainty evaluation of the calibration with reference to ASTM G213 ~~Reference [3]~~ and ISO/IEC Guide 98-3.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document aims to promote the uniform application of reliable methods to calibrate pyranometers by comparison to a reference pyrhelimeter. Calibration methods for pyranometers using a pyranometer as a reference are described in ISO 9847.

Calibration of measuring instruments is essential for accurate and reliable measurements. Accurate measurements of the solar irradiance are required for:

- a) determination of the energy input to solar energy systems such as photovoltaic (PV), and solar thermal systems, as a basis for performance assessment;
- b) testing and assessment of solar technologies;
- c) geographic mapping of solar energy resources;
- d) understanding climate change and extreme weather through the surface radiation budget;
- e) applications such as agriculture, building efficiency, material degradation and reliability, health.

Current solar energy performance assessment demands high-accuracy measurements and low measurement uncertainties. To meet this demand, reliable and accurate solar irradiance measurements with synchronized time stamps ~~Reference [4]~~(see Reference [0]) and a correct uncertainty evaluation are required.

The World Meteorological Organization (WMO) World Radiometric Reference (WRR), which represents the SI units of solar irradiance, is determined by a group of selected pyrhelimeters. For hemispherical irradiance measurements, transfer of this scale to pyranometers has to be accomplished. In order to calibrate pyranometers, which have a field-of-view angle of 2π , with pyrhelimeters that have a limited field of view (typically only 5 degrees) requires additional equipment such as shading discs or collimation tubes.

The pyranometer calibration procedures described in this document are traceable to the International System of Units (SI) through the WRR according to the WMO guidelines Reference-~~[5]~~[0]. The classification and specification used are prescribed in ISO 9060 Reference-~~[6]~~[0].

Due to the relatively high accuracy of pyrhelimeters, the methods in this document may lead to lower uncertainties than those obtained by calibration of a pyranometer using a reference pyranometer as given in ISO 9847 ~~Reference [7]~~.

Unless otherwise specified, uncertainties mentioned in this document are expanded uncertainties with a coverage factor $k = 2$.