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Solar energy — Specification and classification of instruments for measuring hemispherical solar and direct solar radiation

Énergie solaire — Spécification et classification des instruments de mesurage du rayonnement solaire hémisphérique et direct

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Contents

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9060 was prepared by Technical Committee ISO/TC 180, *Solar energy*.

Annexes A, B and C of this International Standard are for information only.

Introduction

This International Standard is one of a series of standards that specify methods and instruments for the measurement of solar radiation in support of solar energy utilization.

Accurate solar radiation data are used in meteorology and are needed for developing solar energy appliances, in particular for performance testing, solar radiation simulation and resource assessment.

The measurement of radiation is needed for determination of the conversion efficiencies of solar appliances. The specification and classification of these instruments are needed in order to enable the comparison of solar radiation data on a worldwide basis.

The specification and classification of solar radiometers prescribed in this International Standard are based on a terminology and methodology that is similar to that used by the World Meteorological Organization (WMO). However, both the specification and the classification deviate from the WMO documents in order to meet the requirements specific to solar energy utilization and appliances.

In particular, this International Standard establishes the regulations necessary for the implementation of the classification.

Solar energy — Specification and classification of instruments for measuring hemispherical solar and direct solar radiation

1 Scope

This International Standard establishes a classification and specification of instruments for the measurement of hemispherical solar and direct solar radiation integrated over the spectral range from 0,3 μm to 3 μm.

Instruments for the measurement of hemispherical solar radiation and direct solar radiation are classified according to the results obtained from indoor or outdoor performance tests. Primary standards, which are direct solar radiation instruments, are classified on the basis of their design and specification of measuring reproducibility under outdoor test conditions verified by periodic pyrheliometric intercomparisons.

2 Normative reference

The following document contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid.

World Meteorological Organization, *Guide to Meteorological Instruments and Methods of Observation*, No. 8, 5th edition, WMO, Geneva, 1983.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 hemispherical solar radiation: Solar radiation received by a plane surface from a solid angle of 2π sr.

NOTE 1 More than 99 % of the hemispherical solar radiation incident at the earth's surface is contained within the wavelength range from 0,3 μm to 3 μm. Generally, hemispherical solar radiation is composed of direct solar radiation and diffuse solar radiation (solar radiation scattered in the atmosphere) as well as solar radiation reflected by the ground.

3.2 global (solar) radiation: Hemispherical solar radiation received by a horizontal plane surface.

3.3 direct solar radiation: Radiation received from a small solid angle centred on the sun's disc, on a given plane.

NOTE 2 In general, direct solar radiation is measured by instruments with field-of-view angles of up to 15°. Therefore a part of the scattered radiation around the sun's disc (circumsolar radiation) is also included (see 5.1).

More than 99 % of the direct solar radiation received at the ground is contained within the wavelength range from 0,3 μm to 3 μm.

3.4 pyranometers: Radiometers designed for measuring the irradiance on a plane receiver surface which results from the radiant fluxes incident from the hemisphere above within the wavelength range 0,3 μm to 3 μm.

NOTE 3 The spectral range given is only nominal. Depending on the materials used for the domes which protect the receiving surface of a pyranometer (see 4.1), the spectral limits of its responsitivity approximate to the limits mentioned above.

Radiometers which are of design similar to pyranometers, but which are equipped with photoelectrical sensors having spectral responsivity which is not as uniform over the spectral range as required in table 1 (reference No. 3d), are often designated by the name of the sensor, for instance "Silicon-pyranometer" (or, for short, Si-pyranometer).

3.5 pyrheliometers: Radiometers designed for measuring the irradiance which results from the solar radiant flux from a well-defined solid angle the axis of which is perpendicular to the plane receiver surface.

NOTE 4 It follows from this definition that pyrheliometers are used to measure direct solar radiation at normal incidence. Typical field-of-view angles of pyrheliometers range from 5° to 10°. Unlike the