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**Space environment (natural and  
artificial) — Process for determining solar  
irradiances**

*Environnement spatial (naturel et artificiel) — Procédé de détermination  
des irradiances solaires*

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21348 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

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## Introduction

This International Standard provides guidelines for specifying the process of determining solar irradiances. Solar irradiances are reported through products such as measurement sets, reference spectra, empirical models, theoretical models and solar irradiance proxies or indices. These products are used in scientific and engineering applications to characterize within the natural space environment solar irradiances that are relevant to space systems and materials.

Examples of applications using input solar irradiance energy include the determination of atmospheric densities for spacecraft orbit determination, attitude control and re-entry calculations, as well as for debris mitigation and collision avoidance activity. Direct and indirect pressure from solar irradiance upon spacecraft surfaces also affects attitude control separately from atmospheric density effects.

Solar irradiances are used to provide inputs for

- a) calculations of ionospheric parameters,
- b) photon-induced radiation effects, and
- c) radiative transfer modelling of planetary atmospheres.

Input solar irradiance energy is used to characterize material properties related to spacecraft thermal control, including surface temperatures, reflectivity, absorption and degradation. Solar energy applications requiring a standard process for determining solar irradiance energy include

- solar cell power simulation,
- material degradation, and
- the development of lamps and filters for terrestrial solar simulators.

A solar irradiance product certifies compliance with this process-based standard by following compliance criteria that are described in this International Standard. The compliance criteria in Clause 7 are based upon solar irradiance product types that are described in Clause 5 and solar irradiance spectral categories described in Clause 6. The method for certifying compliance of a solar irradiance product with this International Standard is provided in Clause 8.

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# Space environment (natural and artificial) — Process for determining solar irradiances

## 1 Scope

This International Standard specifies the process for determining solar irradiances and is applicable to measurement sets, reference spectra, empirical models, theoretical models, and solar irradiance proxies or indices that provide solar irradiance products representing parts or all of the solar electromagnetic spectrum. Its purpose is to create a standard method for specifying all solar irradiances for use by space systems and materials users.

## 2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 2.1 astronomical unit ua AU

unit of length approximately equal to the mean distance between the Sun and the Earth with a currently accepted value of  $(149\,597\,870\,691 \pm 3)$  m

See References [1] and [2].

**NOTE** Distances between objects within the solar system are frequently expressed in terms of ua. The ua or AU is a non-SI unit accepted for use with the International System and whose value in SI units is obtained experimentally. Its value is such that, when used to describe the motion of bodies in the solar system, the heliocentric gravitation constant is  $(0,017\,202\,098\,95)^2 \text{ ua}^3 \text{ d}^{-2}$ , where one day (d) is 86 400 s (see Reference [3]).

1 AU is slightly less than the average distance between the Earth and the Sun, since an AU is based on the radius of a Keplerian circular orbit of a point-mass having an orbital period, in days, of  $2\pi/k$ , where k is the Gaussian gravitational constant and is  $(0,017\,202\,098\,95 \text{ AU}^3 \text{ d}^{-2})^{1/2}$ . The most current published authoritative source for the value of 1 ua is from Reference [2].

### 2.2 solar irradiance

radiation of the Sun integrated over the full disk and expressed in SI units of power through a unit of area,  $\text{W m}^{-2}$

**NOTE** The commonly used term “full disk” includes all of the Sun’s irradiance coming from the solar photosphere and temperature regimes at higher altitudes, including the chromosphere, transition region and corona. Some users refer to these composite irradiances as “whole Sun”. Solar irradiance is more precisely synonymous with “total solar irradiance”, while spectral solar irradiance is the derivative of irradiance with respect to wavelength and can be expressed in SI units of  $\text{W m}^{-3}$ ; an acceptable SI submultiple unit description is  $\text{W m}^{-2} \text{ nm}^{-1}$ . Mixed spectral solar irradiance units (e.g. quanta  $\text{cm}^{-2} \text{ s}^{-1} \text{ nm}^{-1}$ , photons  $\text{cm}^{-2} \text{ s}^{-1} \text{ \AA}^{-1}$  and ergs  $\text{cm}^{-2} \text{ s}^{-1} \text{ nm}^{-1}$ ) can be useful as an addition to, but not as a replacement for, SI unit reporting.

Solar radiances, or the emergent energy from a spatial area that is less than the full disk of the Sun, are not explicitly covered by this International Standard at the present time unless the radiances are integrated across the full disk to represent an irradiance.