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BSI Standards Publication

Space systems — Space environment (natural and artificial) — The Earth's ionosphere model: international reference ionosphere (IRI) model and extensions to the plasmasphere

National foreword

This British Standard is the UK implementation of ISO 16457:2014. It supersedes DD ISO/TS 16457:2009 which is withdrawn.

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A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This first edition of ISO 16457 cancels and replaces ISO/TS 16457:2009, which has been technically revised.

This corrected version of ISO 16457:2014 incorporates the following correction.

In the Foreword, the following sentence has been added regarding the revision:

This first edition of ISO 16457 cancels and replaces ISO/TS 16457:2009, which has been technically revised.

Introduction

Guided by the knowledge gained from empirical data analysis, this International Standard provides guidelines for specifying the global distribution of electron density, electron temperature, ion temperature, ion composition, and total electron content through the Earth's ionosphere and plasmasphere. The model recommended for the representation of these parameters in the ionosphere is the international reference ionosphere (IRI).

IRI is an international project[1)] sponsored by the Committee on Space Research (COSPAR) and the International Union of Radio Science (URSI). These organizations formed a working group in the late 1960s to produce an empirical standard model of the ionosphere based on all available data sources. The IRI Working Group consists of more than 50 international experts representing different countries and different measurement techniques and modelling communities. The group meets annually to discuss improvements and additions to the model. As a result of these activities, several steadily improved editions of the model have been released (see References [1], [2], [3], [5], [6], [18], [19], [20], and [53]).

For a given location over the globe, time, and date, IRI describes the monthly averages of electron density, electron temperature, ion temperature, and the percentage of O^+, H^+, He^+, N^+, NO^+, O_2^+, and Cluster ions in the altitude range from 50 km to 1 500 km. In addition, IRI provides the electron content by numerically integrating over the electron density height profile within user-provided integral boundaries. IRI is a climatological model describing monthly average conditions. The major data sources for building the IRI model are the worldwide network of ionosondes, the powerful incoherent scatter radars, the topside sounders, and *in situ* instruments flown on several satellites and rockets. This International Standard also presents several empirical and semi-empirical models that can be used to extend the IRI model to plasmasphere altitudes.

One advantage of the empirical approach is that it solely depends on measurements and not on the evolving theoretical understanding of the processes that determine the electron and ion densities and temperatures in the Earth's ionosphere. A physical model can help to find the best mathematical functions to represent variations of these parameters with altitude, latitude, longitude, time of day, day of year, and solar and magnetic activity.

IRI is recommended for international use by COSPAR and URSI. The IRI model is updated and improved as new data and new sub-models become available. This International Standard provides a common framework of the International Standard of the Earth's ionosphere and plasmasphere for the potential users.

1) The homepage of the IRI project is at http://irimodel.org/. The IRI homepage provides access to the IRI FORTRAN computer code and an interactive system for computing and plotting IRI parameters online A special PC Windows version of IRI-2001 with multiple plotting options is available from the University of Massachusetts Lowell at http://umlcar.uml.edu/IRI-2001/[16]. The IRI-Plas code including IRI extension to the plasmasphere is available at http://ftp.izmiran.ru/pub/izmiran/SPIM/.

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1 Scope

This International Standard provides guidance to potential users for the specification of the global distribution of ionosphere densities and temperatures, as well as the total content of electrons in the height interval from 50 km to 1 500 km. It includes and explains several options for a plasmaspheric extension of the model, embracing the geographical area between latitudes of 80°S and 80°N and longitudes of 0°E to 360°E, for any time of day, any day of year, and various solar and magnetic activity conditions.

2 Terms and definitions

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

2.1
ionosphere
region of the Earth's atmosphere in the height interval from 50 km to 1 500 km containing weakly ionized cold plasma

2.2
plasmasphere
torus of cold, relatively dense (>10 cm^{-3}) plasma of mostly H^+ in the inner magnetosphere, which is trapped on the Earth's magnetic field lines and co-rotates with the Earth

Note 1 to entry: Cold plasma is considered to have an energy of between a few electronvolts and a few dozen electronvolts.

2.3
plasmapause
outward boundary of the plasmasphere located at between two and six earth radii from the centre of the Earth and formed by geomagnetic field lines where the plasma density drops by a factor of 10 or more across a range of *L*-shells of as little as 0,1

Note 1 to entry: The *L*-shell is a parameter describing a particular set of planetary magnetic field lines, often describing the set of magnetic field lines which cross the Earth's magnetic equator at a number of Earth-radii equal to the *L*-value, e.g. "$L = 2$" describes the set of the Earth's magnetic field lines which cross the Earth's magnetic equator two earth radii from the centre of the Earth.

2.4
solar activity
series of processes occurring in the sun's atmosphere which affect the interplanetary space and the Earth

Note 1 to entry: The level of solar activity is characterized by indices.