
**Reference radiation fields — Simulated
workplace neutron fields —**

**Part 2:
Calibration fundamentals related
to the basic quantities**

*Champs de rayonnement de référence — Champs de neutrons
simulant ceux de postes de travail —*

*Partie 2: Concepts d'étalonnage en relation avec les grandeurs
fondamentales*



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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 12789-2 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

ISO 12789 consists of the following parts, under the general title *Reference radiation fields — Simulated workplace neutron fields*:

- *Part 1: Characteristics and methods of production*
- *Part 2: Calibration fundamentals related to the basic quantities*

Introduction

Neutron fields commonly encountered in radiation workplaces are, in most cases, quite different from routinely used calibration fields produced using standard radionuclide sources in low-scatter calibration facilities. The dose equivalent response of personal neutron dosimeters and neutron area survey meters depends upon the energy distributions of the neutron fields in which they are used, and, in the case of personal dosimeters in particular, the angle of incidence of the neutrons. Calibrations of such devices in reference neutron fields as described in ISO 8529 (all parts) do not thus provide appropriate calibration factors in most cases. For this reason, several laboratories have developed simulated workplace neutron fields that are intended to simulate the characteristics of particular types of fields in which it is necessary to make personal dosimeter and area survey instrument measurements. These provide facilities in which the performance of these devices in workplace fields can be investigated, and that, in some circumstances, can act as calibration facilities. Because workplace neutron fields depend upon the physical structure of each workplace, this part of ISO 12789 has been written to specify the methods of producing and characterizing simulated workplace neutron fields rather than standardizing reference fields as is the philosophy in the companion standard, ISO 8529 (all parts).

This part of ISO 12789 is closely related to ISO 12789-1, which describes the facilities and methods currently used to produce simulated workplace neutron radiation fields. These fields have been constructed specifically to moderate source neutrons and include neutrons scattered from the surrounding structure and equipment for the simulation of workplace environments. This part of ISO 12789 describes the methods used to determine conventional values of the operational quantities characterizing the realistic workplace neutron fields.

The operational quantities used in this part of ISO 12789 are ambient dose equivalent, $H^*(10)$, and personal dose equivalent, $H_p(10)$. For reference radiation fields, it is recommended to determine their conventional values from the neutron fluence or fluence rate as a function of neutron energy and, for the case of $H_p(10)$, the direction using the conversion coefficients listed in Annex A. In some cases, the use of conversion coefficients is not feasible for determining $H_p(10)$, necessitating its direct calculation.

At present, no simple methods exist to provide traceability of the operational quantities from a national standards institute to the simulated workplace neutron fields. The process of determining operational quantities from fluence described in this part of ISO 12789 introduces additional uncertainty.

This part of ISO 12789 incorporates accepted methods for determining the uncertainty associated with the values of the operational quantities and gives new information regarding the uncertainty associated with the inference of energy distributions of neutron fluence using accepted unfolding techniques. The uncertainties in determining $H_p(10)$ using information from the direction distribution of the neutron fluence can be large but, at present, the quantification of the uncertainty from this source is not addressed.

Reference radiation fields — Simulated workplace neutron fields —

Part 2: Calibration fundamentals related to the basic quantities

1 Scope

This part of ISO 12789 describes the characterization of simulated workplace neutron fields produced by methods described in ISO 12789-1. It specifies the procedures used for establishing the calibration conditions of radiation protection devices in neutron fields produced by these facilities, with particular emphasis on the scattered neutrons. The diversity of workplace neutron fields is such that several special facilities have been built in order to simulate them in the laboratory. In this part of ISO 12789, the neutron radiation field specifications are classified by operational quantities. General methods for characterizing simulated workplace neutron fields are recommended.

2 Terms and definitions

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

2.1

indication reading

M

quantity value provided by a measuring instrument or a measuring system

NOTE 1 An indication may be presented in visual or acoustic form or may be transferred to another device. An indication is often given by the position of a pointer on the display for analog outputs, a displayed or printed number for digital outputs, a code pattern for code outputs, or an assigned quantity value for material measures.

NOTE 2 An indication and a corresponding value of the quantity being measured are not necessarily values of quantities of the same kind.

[ISO/IEC Guide 99:2007, 4.1]

2.2

conventional quantity value conventional value of a quantity

quantity value attributed by agreement to a quantity for a given purpose

EXAMPLE 1 Standard acceleration of free fall (formerly called “standard acceleration due to gravity”) $g_n = 9,806\,65 \text{ m}\cdot\text{s}^{-2}$.

EXAMPLE 2 Conventional quantity value of the Josephson constant, $K_{J-90} = 483\,597,9 \text{ GHz V}^{-1}$.

EXAMPLE 3 Conventional quantity value of given mass standard, $m = 100,003\,47 \text{ g}$.

NOTE 1 The term “conventional true quantity value” is sometimes used for this concept, but its use is discouraged.