



Photon and Neutron Fluence-to-Dose Conversion Coefficients

An American National Standard

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**American National Standard
Photon and Neutron
Fluence-to-Dose
Conversion Coefficients**

Secretariat
American Nuclear Society

Prepared by the
**American Nuclear Society
Standards Committee
Working Group ANS-6.1.1**

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American National Standard

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American National Standard ANSI/ANS-6.1.1-2020

Foreword

(This foreword does not contain any requirements of American National Standard “Photon and Neutron Fluence-to-Dose Conversion Coefficients,” ANSI/ANS-6.1.1-2020, but is included for informational purposes.)

In 1977, the American Nuclear Society (ANS) published ANS-6.1.1-1977, “Neutron and Gamma-Ray Flux-to-Dose-Rate Factors,” which provided a standard method for computing dose equivalent values pertinent to the radiation protection of individuals exposed to externally incident neutron and gamma-ray flux. That standard, which was based on definitions and data from the National Council on Radiation Protection and Measurements, was in effect for 12 years. Later revisions led to the issuance of ANS-6.1.1-1991, which was based on new dosimetric quantities provided by the International Commission on Radiological Protection (ICRP) and the International Commission on Radiation Units and Measurements. ANS-6.1.1-1991 provided tables relating the fluence of gamma rays and neutrons to effective dose equivalents for radiation incident on mathematical anthropomorphic phantoms in five standard exposure geometries.

Despite its widespread use in shielding analysis and design, ANS-6.1.1-1991 was not maintained and was allowed to lapse by the Shielding Subcommittee. Recent new recommendations for dosimetric quantities in ICRP Publication 103 and the determination of these concepts using improved Monte Carlo transport codes and with realistic computational phantoms described in ICRP Publication 110 have culminated in ICRP Publication 116, “Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures.” That report also extends the areas of interest to other radiation types and to significantly higher energies. We have chosen to use the photon and neutron fluence to effective dose coefficients from ICRP Publication 116 as the basis of this standard, ANSI/ANS-6.1.1-2020. The coefficients for cranial and caudal irradiation geometries are taken from the coefficients reported by Veinot et al. coefficients using ICRP 116 methodology.

This standard does not incorporate the concepts of generating risk-informed insights, performance-based requirements, or a graded approach to quality assurance. The user is advised that one or more of these techniques could enhance the application of this standard.

This standard might reference documents and other standards that have been superseded or withdrawn at the time the standard is applied. A statement has been included in the references section that provides guidance on the use of references.

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Photon and Neutron Fluence-to-Dose Conversion Coefficients

1 Scope and purpose

1.1 Scope

This standard¹⁾ presents data recommended for computing the biologically relevant dosimetric quantity in photon and neutron radiation fields. Specifically, this standard is intended for use by radiation shielding designers for the calculation of effective dose. Fit coefficients are given for evaluating whole-body effective dose per unit fluence for photons with energy 10 keV to 10 GeV and for neutrons with energy 0.001 eV to 10 GeV. Eight different irradiation geometries are considered. Establishing exposure limits is outside the scope of this standard.

1.2 Purpose

The purpose of this standard is to assist those involved in the design or analysis of radiation facilities by providing a means for determining whether calculated fluence levels satisfy radiation exposure limits recommended by the International Commission on Radiological Protection (ICRP) or specified by regulatory agencies. This standard is relevant for those applications whose intent is to reduce the occurrence of stochastic, somatic effects resulting from the radiation exposure to an acceptable level. Use of this standard in assessing the likelihood of nonstochastic effects, such as applications in which the effective dose is far in excess of occupational exposure guidelines, is not recommended. This standard is also not intended for use in testing or calibrating instruments.

2 Acronyms and definitions

2.1 Acronyms

AP: antero posterior

CRA: cranial

CAU: caudal

ICRP: International Commission on Radiological Protection

ICRU: International Commission on Radiation Units and Measurements

ISO: isotropic

LLAT: left lateral

¹⁾ The current standard, ANSI/ANS-6.1.1-2020, is hereinafter referred to as "this standard."