

Health Physics Society



An American National Standard

Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment

An American National Standard -

Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment

**Approved: July 31, 2001
American National Standards Institute, Inc.**

Forward

(This forward is not part of ANSI/HPS N43.2-2001, Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment.)

The problem of radiation hazards connected with the operation of x-ray diffraction and fluorescence analysis equipment has been a continuing one since the advent of such equipment. While many improvements have been made in safety since the last release of this standard, many pieces of older and custom-built equipment are still in use today. In addition, new uses have been found in areas like surface and thin film analysis that were not addressed in the original standard. This revision is meant to modernize the past recommendations (many of which are still valid, however) and to provide guidance for x-ray use in new technologies.

Historically, the American Standards Association (ASA), Sectional Committee Z54, in 1946 issued American War Standard Z54.1 "Safety Code for the Industrial Use of X-rays" which included a section on x-ray diffraction. In 1967, the ASA was superseded by the USA Standard Institute, and Sectional Committee Z54 was replaced by Committee N43 under the sponsorship of the National Bureau of Standards (NBS).

Responsibility for the development of the original standard was assigned to Subcommittee N43-1. American National Standard N43.2-1971 "Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment" was approved on October 6, 1971, published as NBS Handbook 111, and then reaffirmed with minor revisions in 1976. In 1985, the Health Physics Society replaced the National Bureau of Standards as the Secretariat for the N43 Committee.

In 1988 Subcommittee N43.2 reformed to begin updating process and had the standard reaffirmed in March 1989. Revision work was completed in December 1998 and the draft received N43 Committee approval April 23, 1999.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to HPS Standards Program Director, Health Physics Society, 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101, USA.

Below is the list of Members of Subcommittee N43.2 which had the responsibility for the development of ANSI/HPS 43.2-2001:

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This standard was consensus balloted and approved by the ANSI-Accredited HPS N43 Committee on April 23, 1999. At that time, the N43 Standards Committee had the following membership:

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Alliance of American Insurers

American Automobile Manufacturers Association

American Conference of Governmental Industrial Hygienists

American Crystallographic Association

American Insurance Services Group

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Health Physics Society

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Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment

1. Introduction

This standard reviews the types of injuries resulting from accidental exposure to ionizing radiation resulting from the operation of analytical x-ray diffraction and fluorescence equipment, establishes equipment design criteria, sets up requirements for approved operating procedures, and recommends the establishment of health surveillance, and personnel monitoring programs. The circumstances under which operation of equipment must be limited to specially designated areas equipped with radiation barriers and warning signs are provided. Dose limits recommended by the National Council on Radiation Protection and Measurements are provided for reference. A list of references to selected articles on various aspects of radiation safety is given, and notes on the detection and measurement of radiation from x-ray diffraction and fluorescence analysis equipment are included in an appendix.

2. Scope

This standard provides guidelines specific to the radiation safety aspects of the design and operation of x-ray diffraction and fluorescence analysis equipment. It does not include electrical safety guidelines or other safety considerations outside the realm of radiation safety.

3. Definitions

The definitions and terms contained in this standard, or in other American National Standards referred to in this document, are not intended to embrace all legitimate meanings of the terms. They are applicable only to the subject treated in this standard.

ALARA. As Low As Reasonably Achievable - making every reasonable effort to maintain exposures to radiation as far below the dose limits as practical, taking into account the state

of the technology, the economics of the improvements in relation to the benefits, and other societal or socioeconomic considerations.

Analytical X-ray Equipment. Laboratory equipment utilizing x-ray radiation to analyze or obtain information about material properties (e.g. surface characteristics, elemental composition, material structure, etc.) using diffraction or fluorescence techniques.

Controlled Area. A specified area to which access is managed in order to protect personnel from radiation.

Dose, Absorbed. The energy imparted to matter in a volume element by ionizing radiation divided by the mass of irradiated material in that volume element. The unit is the Gray (Gy) and the special unit of absorbed dose is the rad. One Gy = 1 J/kg and one rad equals 100 ergs per gram. (1 Gy = 100 rad.)

Dose Equivalent (H). The product of absorbed dose, radiation weighting factor, and other modifying factors necessary to express on a common scale, for all ionizing radiation, the dose incurred by exposed persons. The unit is the Sievert (Sv) and the special unit of dose equivalent is the rem. (1 Sv = 100 rem.)

Dose Rate, Absorbed. The absorbed dose per unit time.

Exposure. A measure of the ionization produced in air by x- or gamma-radiation. This unit is considered obsolete. It is the sum of the electrical charges on all of the ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in the air, divided by the mass of the air in the volume element. The special unit of exposure is the roentgen (R) which = 2.58×10^{-4} Coulomb/kg.

Exposure Rate. The exposure per unit time.

Fail-safe Design. A design in which all realistically anticipated failures of indicators or