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SAFETY IN LABORATORIES—
Part 4—IONIZING RADIATIONS

STANDARDS ASSOCIATION OF AUSTRALIA
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SAFETY IN LABORATORIES—
Part 4
IONIZING RADIATIONS

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PREFACE

This edition of this standard was prepared by the Association's Committee on Safety in Laboratories under the direction of the Chemical Standards Board.

Grateful acknowledgement is made of the time and effort devoted to the drafting of this standard, by the following organizations:

Australian Atomic Energy Commission
Department of Health, NSW
Office of the Supervising Scientist for the Alligator Rivers Region
University of New South Wales

Acknowledgement is also made to authoritative information sources, such as the publications of the International Commission of Radiological Protection, the National Radiological Protection Board (UK), Her Majesty's Stationery Office (UK) and the International Atomic Energy Agency.

This standard is intended for use in conjunction with other standards of the AS 2243 series. Part 1—General, is applicable to all laboratory situations.

Other parts are as follows:

Part 1 General
Part 2 Chemical
Part 3 Microbiology
Part 5 Non-ionizing Radiations
Part 6 Mechanical Aspects
Part 7 Electrical Aspects
Part 8 Fume Cupboards*

* In course of preparation.

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FOREWORD

Radiation is the emission of energy, in the form of rays, wave motion or particles, from a source. The various kinds of radiation can be broadly subdivided as follows:

(a) *Ionizing radiations*—radiations that by reason of their nature and energy, interact with matter to remove electrons from (i.e. ionize) the atoms of substances, including those in the human organism, through which the radiations pass. Sufficiently energetic radiations may also cause permanent changes in the nuclei of the atoms in the substance. Ionizing radiation is propagated in the forms of X-rays, gamma rays, alpha particles, beta particles (i.e. high energy electrons), neutrons, protons and other nuclear particles. Ultraviolet radiation, under some circumstances, can also cause ionization.

(b) *Non-ionizing radiations*—radiations that do not cause ionization or nuclear changes, but can harm the human organism in other ways. Potentially harmful non-ionizing radiations are propagated in the forms of electromagnetic waves (in particular, when the wavelength is between about 1 m and 300 nm), and acoustic noise (i.e. unwanted sound). Refer to AS 2243, Part 5.

NOTES:

1. Although referred to in (a) above, ultraviolet radiation is generally classified as non-ionizing radiation and is therefore treated in AS 2243, Part 5.
2. Radiation protection is concerned with the protection of individuals, their progeny, and mankind as a whole, while still allowing necessary activities from which radiation exposure might result.
3. Various forms of high voltage apparatus may produce ionizing radiations and that various chemicals and minerals may be radioactive by virtue of the fact that they contain naturally radioactive elements.

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
SAFETY IN LABORATORIES

PART 4—IONIZING RADIATIONS

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard sets out the precautions needed to prevent unnecessary exposure of both workers using sources of ionizing radiation in laboratories and persons outside the laboratory from being harmed by accidental or planned releases of radioactive materials or external beams of radiation. It also describes the important characteristics of ionizing radiation-producing materials and apparatus, the nature of the hazards, laboratory design requirements, and other essential radiation protection information.

The requirements of this standard should be implemented in all laboratories in which—

(a) radioactive materials are used or stored;

(b) irradiating apparatus is operated.

As a guide to good practice, laboratories operating with sub-licensable quantities of radioactive material are invited to follow the principles contained in this standard.

1.2 REFERENCED DOCUMENTS. The following standards and other documents are referred to in this standard:

AS 1319 Rules for the Design and Use of Safety Signs for the Occupational Environment.

AS 2243 Safety in Laboratories
Part 5—Non-ionizing Radiations
Part 8—Fume Cupboards*

AS XXXX Laboratory Construction*

BS 381C Colours for Specific Purposes.

Code of Practice for the Control and Safe Handling of Sealed Radioactive Sources Used in Radiation Therapy (other than Teletherapy), NH&MRC† Special Report Series No. 1, 1962.

Code of Practice for Protection Against Ionizing Radiation Emitted from X-ray Analysis Equipment, NH&MRC†, 1984.

ICRP Publications 21, 26 and 30, published by the International Commission on Radiological Protection.

1.3 DEFINITIONS. For the purpose of this standard, the following definitions apply:

1.3.1 Absorbed dose—the energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The SI unit of absorbed dose is the gray (Gy).

1.3.2 Activity—the number of nuclear transformations of a radionuclide occurring in unit time. The SI unit of activity is the becquerel (Bq), which is equal to one nuclear transformation per second.

1.3.3 Adequate protection—protection against ionizing radiations so that the radiation doses received by any person from external or internal sources, or both, are as low as reasonably achievable and, in any event, do not exceed the maxima referred to in Section 4.

1.3.4 Annual limit of intake (ALI)—the activity of a radionuclide which, if taken alone, would irradiate a person, represented by Reference Man (ICRP 23), to the occupational annual dose equivalent limit specified in Section 4.

NOTE: For members of the public it is suggested that values of ALI should be taken as one fifth of those in ICRP Publication 30. (See also Appendix A, Paragraph A5).

1.3.5 becquerel (Bq)—the SI name for the unit of activity,

$1 \text{ Bq} = 1 \text{ s}^{-1}$

1.3.6 Committed dose equivalent (to a given organ or tissue from a specified intake of radioactive material into the body)—the dose equivalent that will be accumulated over 50 years from the time of intake.

1.3.7 Derived air concentration (DAC) (or occupational exposure DAC)—the ALI (of a radionuclide) divided by the volume of air inhaled by Reference Man in a working year (i.e. 2.4×10^3 m^3). The unit of DAC is the becquerel per cubic metre (Bq/m^3).

NOTE: For exposure of members of the public the DAC should be taken as one-two hundredth of that for occupational exposure. (See Appendix A, Paragraph A5.)

1.3.8 Derived air concentration for submersion (DAC (submersion))—is one-two-thousandth of the time integral of the concentration of radionuclide in air which alone over a working year would irradiate a person to the annual dose equivalent limit for occupational exposure specified in Section 4. The unit of DAC submersion is the becquerel per cubic metre (Bq/m^3).

NOTE: For exposure of members of the general public, the DAC submersion should be taken as one-two hundredth of that for occupational exposure. (See Appendix A, Paragraph A5.)

1.3.9 Designated radiation area (DRA)—an area where the occupational exposure of personnel to radiation or radioactive material is under the supervision of a Radiation Protection Adviser (RPA). (See Clause 3.2(a).)

1.3.10 Dose equivalent—product of absorbed dose at the point of interest in tissue and quality factor (QF). The SI unit for dose equivalent is the sievert (Sv). For radiation protection purposes, dose equivalent enables

* In course of preparation.

† National Health & Medical Research Council.