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# REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

## REGULATORY GUIDE 8.4

### DIRECT-READING AND INDIRECT-READING POCKET DOSIMETERS

#### A. INTRODUCTION

The Atomic Energy Commission's "Standards for Protection Against Radiation," 10 CFR Part 20, contains several regulations regarding the measurement of X- or gamma radiation from sources external to the body. Such measurements are required by § 20.202(a) "Personnel Monitoring," to determine compliance with limits specified in § 20.101, "Exposure of Individuals to Radiation in Restricted Areas," and § 20.104, "Exposure of Minors," with results recorded as required by § 20.401, "Records of Surveys, Radiation Monitoring, and Disposal." Such measurements are also needed to determine incident reporting requirements as specified in § 20.403, "Notification of Incidents," whether the measurements are made during the actual incidents or during a post-incident investigation. The Commission's regulation "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations," 10 CFR Part 34, contains a provision which requires pocket dosimeters or pocket chambers as measurement devices for personnel monitoring control [§ 34.33]. These measurements are concerned with the dose to personnel.

Although compliance with these regulations necessitates measurements of X- and gamma radiation, the Commission has not prescribed performance standards for the instrumentation that may be used. This guide provides such standards for direct-reading and indirect-reading pocket dosimeters used for personnel dose or dose rate measurements pursuant to §§ 20.101, 20.104, 20.202(a), 20.401, 20.403, and 34.33.

Other regulations in 10 CFR Part 20 are concerned with area monitoring as necessary to demonstrate compliance with permissible levels of radiation in unrestricted areas [§ 20.105(b)(2)], survey requirements [§ 20.201], and area classification

requirements [§ 20.202(b)]. Specific performance standards for pocket dosimeters used for area monitoring are not included in this guide at this time. These latter standards are expected to be less stringent than personnel monitoring standards.

#### B. DISCUSSION

Subcommittee N13.5 on Performance of Portable Survey Meters and Personnel Dosimeters, of the American National Standards Committee N13 on Radiation Protection, has developed a standard which provides performance specifications for direct-reading and indirect-reading pocket dosimeters for X- or gamma radiation. The standard, ANSI N13.5-1972,<sup>1</sup> was approved by the American National Standards Institute on December 9, 1971.

As a performance standard, N13.5-1972 does not provide detailed guidance on the use of pocket dosimeters. However, certain details such as the maximum intervals for leak rate and calibration/response testing are directly related to performance standards in the context of satisfying Commission regulations. Therefore, guidance in this document is not limited to the standards appearing in N13.5-1972 but also includes recommended intervals for such testing.

Many Commission licensees employ film dosimetry to satisfy the personnel monitoring requirements of 10 CFR Part 20. However, film used in mixed fields of gamma and neutron radiation may provide an incomplete indication of the dose equivalent due to neutrons. This difficulty arises when a significant fraction of the dose equivalent is due to intermediate

<sup>1</sup>Copies may be obtained from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

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neutrons of insufficient energy to produce discernible recoil proton tracks in dosimetric film or when tracks are masked by blackening of the film due to gamma radiation. To overcome these problems, licensees often employ an indirect measurement technique which utilizes gamma pocket dosimeters to determine the neutron dose equivalent as well as the gamma exposure. This technique requires knowledge of the intermediate-neutron-to-gamma ratio in the area of interest. Under certain conditions this method is a useful personnel monitoring procedure. If the dose equivalent rate due to intermediate neutrons and the gamma exposure rate are determined separately and in a technically sound manner, and if the neutron-to-gamma ratio is essentially constant during the period(s) of exposure, the Commission will accept the method as complying with the regulations. Therefore, guidance on the method is included in this document.

### C. REGULATORY POSITION

American National Standard N13.5-1972, "Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X- and Gamma Radiation," provides an acceptable basis for the selection and continued use of direct-reading or indirect-reading pocket dosimeters, as defined in Section 2 of N13.5-1972; as instruments for measuring X- and gamma radiation<sup>2</sup> pursuant to the requirements of §§ 20.202(a) and 20.401 of 10 CFR Part 20, and § 34.33 of 10 CFR Part 34, as supplemented by the following:

#### 1. Testing

Direct- or indirect-reading pocket dosimeters used as personnel monitoring equipment should be tested for calibration/response and leak rate:

- a. Prior to initial use;
- b. After subjection to possible damage from dropping or other causes;<sup>3</sup>
- c. At maximum testing intervals of:

<sup>2</sup> Any pocket dosimeter meeting the performance standards specified in ANSI N13.5-1972 is acceptable to the AEC Regulatory staff for X- or gamma radiation measurements made pursuant to §§ 20.105(b)(2), 20.201, and 20.202(b) of 10 CFR Part 20.

<sup>3</sup> Dosimeters should be worn in pairs when used as the primary method of personnel monitoring required by the regulations.

(1) 3 months if the dosimeters are used as the primary method for compliance with §§ 20.202(a) and 20.401 of 10 CFR Part 20, or for compliance with § 34.33 of 10 CFR Part 34; or

(2) 6 months if the dosimeters are used to supplement the primary method for compliance with the above sections of the regulations.

#### 2. Rejection

A dosimeter should be rejected if it fails to comply with either of the following:

- a. ANSI N13.5-1972, Section 9;
- b. The calibration/response test result should not exceed  $\pm 10\%$  of an exposure from a source traceable to the National Bureau of Standards.

#### 3. Mixed Radiation Fields

Direct- or indirect-reading pocket dosimeters may be used in a mixed neutron/gamma radiation field to comply with the personnel monitoring and record keeping requirements of 10 CFR Part 20, §§ 20.202(a) and 20.401, provided that all of the following conditions are met:

- a. The neutron dose equivalent rate and the gamma exposure rate at the point of personnel exposure are known from separately made determinations;
- b. The neutron-to-gamma ratio is essentially constant during the period of personnel exposure;
- c. The degree of response of the dosimeter to the neutron flux density is known.

If the response to the neutron flux density is negligible, the gamma exposure indicated by the dosimeter may be accepted. To determine the neutron dose equivalent, multiply the indicated gamma exposure by the neutron-to-gamma ratio.

If the response to the neutron flux density is significant, the actual gamma exposure should be obtained by subtracting the neutron response from the indicated gamma exposure. To determine the neutron dose equivalent, multiply the actual gamma exposure by the neutron-to-gamma ratio.