

JIS

JAPANESE INDUSTRIAL STANDARD

**Portable Photon Ambient Dose
Equivalent Ratemeters for
Radiation Protection**

JIS Z 4333—1990

**Amendment 1 to this Standard listed in the Official gazette
issued in March, 2001 is not included in this text.**

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Portable Photon Ambient Dose
Equivalent Ratemeters for
Radiation Protection

Z 4333-1990

1. Scope

This Japanese Industrial Standard specifies portable photon ambient 1 cm dose equivalent ratemeters for radiation protection (hereafter referred to as the "ratemeter").

Remark: The units and numerical values given in { } in this Standard are based on the traditional units and are currently the criteria in force.

Informative

Reference: This Standard is only to standardize persistently ratemeters and does not mean that it is required to use ratemeters for radiation control.

2. Definitions

For the purposes of this Standard, main definitions are in accordance with JIS Z 4001, JIS Z 4511 and JIS Z 8103 and to others the following apply:

- (1) 1 cm dose equivalent When irradiating ICRU ball by X-rays or γ -rays of broad beam in a single direction, the dose equivalent in depth of 1 cm on main axis from the surface of incidence along the incident direction.
- (2) ICRU ball A ball having the element composition shown in Report 39 of the International Commission on Radiation Units and Measurement (ICRU) (In mass percentage, oxygen 76.2 %, carbon 11.1 %, hydrogen 10.1 and nitrogen 2.6 %), of 1 g/cm³ in density and 30 cm in diameter.

Applicable Standards:

JIS Z 4001-Nuclear Energy Glossary

JIS Z 4511-Methods of Calibration for Radiation Exposure Meters and
Radiation Exposure Rate Meters

JIS Z 8103-Glossary of Terms Used in Instrumentation

Reference Standards:

JIS Z 4328-Radiation Survey Meters for X and γ RaysJIS Z 4332-General Requirements for Personal X-and γ -ray Dosimeters**Documents**

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- (3) indicating value The value of 1 cm dose equivalent indicated by ratemeter.
- (4) decade The unit indicating the scale range of logarithmic scale or equivalent scale thereto (hereafter referred to as the "logarithmic scale"). For example, when the common logarithm of ratio of two scale values is A, the scale range between two scales is taken as A decade.
- (5) response The value of indicating value divided by 1 cm dose equivalent to be reference (hereafter referred to as the "reference dose equivalent"). This is the inverse number of calibration constant.
- (6) coefficient of variance (C) The ratio of estimated value (S) of standard deviation of n pieces of measured value (x_i) to average value ($\bar{x}$) and it is in accordance with the following formula:

$$C = \frac{S}{\bar{x}} = \frac{1}{\bar{x}} \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$$

- (7) effective energy Relating to X-ray of not single energy, the energy of single energy photon having the equivalent half-value layer thereto. Herein, the half-value layer means the thickness of filter paper required for reducing the exposure rate to half by measuring under narrow beam conditions.

3. Classification

Ratemeters shall be classified according to detector used into ionization chamber type, GM counter tube type scintillation type and semiconductor type.

4. Performance

4.1 Indication Error When tested according to 6.2.2, the following specifications shall be satisfied.

- (1) In the case of linear scale, either one of the percentage to the reference dose equivalent or the percentage to the maximum scale value shall comply with the permissible range shown in Table 1.

Table 1. Permissible Range of Indication Error in the Case of Linear Scale

Unit: %

Classification	Permissible range of percentage to reference dose equivalent	Permissible range of percentage to the maximum scale value
Ionization chamber	± 10	± 5
GM counter tube type Scintillation type Semi-conductor type	± 20	± 6

- (2) In the case of logarithmic scale, it shall comply with the permissible range shown in Table 2.

Table 2. Permissible Range of Indication Error in the Case of Arithmetic Scale

Classification	Permissible range decade
Ionization chamber type	$\pm 0.04 \times N$
GM counter tube type	$\pm 0.06 \times N$
Scintillation type	
Semi-conductor type	

Remark: N indicates the number of decades of its indication range.

- (3) In the case of digital type, it shall comply with the permissible deviation shown in Table 3.

Table 3. Permissible Range of Indication Error in the Case of Digital System

Classification	Permissible range %
Ionization chamber type	± 10
GM counter tube type	± 20
Scintillation type	
Semi-conductor type	

4.2 Energy Characteristics When the energy characteristics are expressed by energy dependence of response and tested according to 6.2.3, the ratio of γ rays of ^{137}Cs to response shall comply with Table 4.

Table 4. Permissible Range of Energy Dependence

Classification	Energy range	Permissible range of ratio of response
Ionization chamber type	30 keV to 1.5 MeV (30 keV to 6.5 MeV)*	0.8 to 1.2 (0.7 to 1.2)*
GM counter tube type	60 keV to 1.5 MeV	0.5 to 2.5
Scintillation type	60 keV to 1.5 MeV	0.2 to 5.0
Semi-conductor type	80 keV to 1.5 MeV (80 keV to 6.5 MeV)*	0.7 to 1.3 (0.5 to 1.3)*

Note * Numerical values in parentheses are the preferable value as the permissible range when obtained the ratio of response relating to energy range up to 6.5 MeV by using γ rays of ^{16}N , but these are reference values and are not a part of Standard.

4.3 Directional Characteristics When the directional characteristics are expressed by irradiation direction dependence of radiation in indicating value to detect in part, and tested according to 6.2.4, the permissible range of direction dependence shall be $\pm 20\%$. However, the direction dependence to X-rays near 80 keV in effective energy or to γ rays of ^{241}Am shall be reference and does not specify the tolerance.

4.4 Variation of Indicating Value When tested according to 6.2.5, the coefficient of variance shall comply with Table 5.

Table 5. Permissible Values of Coefficients of Variance

Ionization chamber type	GM counter tube type	Scintillation type	Semi-conductor type
0.10 max.	0.15 max.	0.10 max.	0.15 max.

4.5 Response Time When tested according to 6.2.6 the response time shall be not more than 30 s.

4.6 Drift When tested according to 6.2.7, the variation of indicating value shall be $\pm 2\%$ in the case of analog system, and not more than three digits in the case of digital type.