



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS Z 4342 : 2013

(JEMIMA/JSA)

**Equipment for measuring specific
activity of gamma-emitting radionu-
clides in foodstuffs**

ICS 13.280;17.240

Reference number : JIS Z 4342 : 2013 (E)

PROTECTED BY COPYRIGHT

Z 4342 : 2013

Date of Establishment: 2013-03-21

Date of Public Notice in Official Gazette: 2013-03-21

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Testing and Measurement

Technology

JIS Z 4342 : 2013, First English edition published in 2013-09

Translated and published by: Japanese Standards Association

4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2013

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Classification	4
5 Performance	4
5.1 Activity concentration conversion factor	4
5.2 Effective range of measurement	5
5.3 Energy measurement range	5
5.4 Relative intrinsic error	5
5.5 Response to standard source for test	5
5.6 Minimum detectable activity	5
5.7 Effect of external gamma radiation	5
5.8 Effect of other radionuclides	5
5.9 Indicated value variation	5
5.10 Temperature characteristics	5
5.11 Humidity characteristics	6
5.12 Stability against power supply voltage variation	6
5.13 Shock resistance	6
5.14 Vibration resistance	6
5.15 Preheating time characteristics	6
5.16 Overload characteristics	6
5.17 Alarm trip stability	6
5.18 External electromagnetic field characteristics	7
5.19 Immunity characteristics against power supply frequency magnetic field	7
5.20 Electrostatic discharge characteristics	7
5.21 Immunity characteristics against conducted interference derived by radio frequency electromagnetic field	7
5.22 Immunity characteristics against electrical fast transient/burst	7
5.23 Surge immunity characteristics	7
5.24 Immunity characteristics against voltage dip, short-term power outage and voltage variation	8
6 Structure	8
6.1 General	8
6.2 Detection sub-assembly	8
6.3 Measurement sub-assembly	8

6.4	Power supply	9
6.5	Storage and transportation	10
7	Test	10
7.1	Test conditions	10
7.2	Test methods	11
8	Inspection	18
8.1	General	18
8.2	Type inspection	19
8.3	Acceptance inspection	20
9	Marking	20
10	Operation manual	20
Annex JA (informative)	Comparison table between JIS and corresponding International Standards	21

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by Japan Electric Measuring Instruments Manufacturers' Association (JEMIMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public and utility model rights.

Equipment for measuring specific activity of gamma-emitting radionuclides in foodstuffs

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **IEC 61563** published in 2001, with some modifications of the technical contents for responding to the usage condition in Japan and the progress in technology subsequent to the publication of the said International Standard.

The portions with dotted underlines in this Standard are the matters in which the contents of the corresponding International Standards have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the scintillation type radiation meters used for measuring the activity concentration of gamma-emitting radionuclides in food/foodstuffs (hereafter referred to as “radiation meters”) under field conditions where radioactive substances have spread due to the nuclear reactor accident, etc. It does not apply to the low background stationary radioactivity analysis equipment such as a germanium gamma-ray detector used in specialized agencies for analysis.

In addition, this Standard is applicable also to the measurement of environmental samples in general such as soil, sewage, plant and animal life.

NOTE 1 The pretreatment method of samples is not covered by this Standard.

NOTE 2 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 61563 : 2001 *Radiation protection instrumentation — Equipment for measuring specific activity of gamma-emitting radionuclides in foodstuffs* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards indicated below (including amendment) shall be applied.

JIS C 8500 Primary batteries — General

JIS C 61000-4-2 Electromagnetic compatibility (EMC) — Part 4-2 : Testing and

- measurement techniques — Electrostatic discharge immunity test*
- JIS C 61000-4-3 *Electromagnetic compatibility (EMC) — Part 4-3 : Testing and measurement techniques — Radiated, radio-frequency, electro-magnetic field immunity test*
- JIS C 61000-4-4 *Electromagnetic compatibility (EMC) — Part 4-4 : Testing and measurement techniques — Electrical fast transient/burst immunity test*
- JIS C 61000-4-5 *Electromagnetic compatibility (EMC) — Part 4-5 : Testing and measurement techniques — Surge immunity test*
- JIS C 61000-4-6 *Electromagnetic compatibility (EMC) — Part 4-6 : Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields*
- JIS C 61000-4-8 *Electromagnetic compatibility (EMC) — Part 4 : Testing and measurement techniques — Section 8 : Power-frequency magnetic field immunity test*
- JIS C 61000-4-11 *Electromagnetic compatibility (EMC) — Part 4-11 : Testing and measuring techniques — Voltage dips, short interruptions and voltage variations immunity tests*
- JIS Q 17025 *General requirements for the competence of testing and calibration laboratories*
- JIS Z 4001 *Glossary of terms used in nuclear energy*
- NOTE : Corresponding International Standards : **ISO 921** : 1997 *Nuclear energy — Vocabulary*, **IEC 60050-393** : 1996 *International Electrotechnical Vocabulary — Chapter 393 : Nuclear instrumentation : Physical phenomena and basic concepts* and **IEC 60050-394** : 1995 *International Electrotechnical Vocabulary — Chapter 394 : Nuclear instrumentation : Instruments* (Overall evaluation : MOD)
- JIS Z 8103 *Glossary of terms used in measurement*
- JIS Z 8401 *Guide to the rounding of numbers*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions in **JIS Z 4001**, **JIS Z 8103** and the following apply.

3.1 effective range of measurement

range of values of the quantity to be measured over which the performance of a piece of equipment or assembly meets the requirements of its specifications

3.2 indication error

difference between indicated value M_i and conventionally true value M_t

3.3 relative error of indication, I

percentage of the ratio of indication error to conventionally true value (%)

The relative error of indication shall be obtained according to the following formula :

$$I = \frac{M_i - M_t}{M_t} \times 100$$

where, M_i : indicated value
 M_t : conventionally true value

3.4 relative intrinsic error

sum of relative error of indication when radioactive sources etc. are used and uncertainty of conventionally true value of radioactivity or activity concentration under the reference condition

The relative error of indication is expressed by $\pm (|I| + U)$ taking relative error of indication as $\pm I$, and relative expanded uncertainty of conventionally true value of radioactivity or activity concentration as U (coverage factor $k = 2$).

NOTE : The uncertainty of radioactivity or activity concentration is expressed by expanded uncertainty. The expanded uncertainty is obtained by multiplying the combined standard uncertainty by the coverage factor. The combined standard uncertainty is a square root of the sum of squares of the standard deviation (standard uncertainty) of the component of each uncertainty.

3.5 coefficient of variation, V

ratio (V) of estimated value of standard deviation (s) to the arithmetic mean ($\bar{x}$) of a set of n measurements (x_i), given by the following equation:

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

3.6 minimum detectable activity, $A_{\min}$

the lowest detectable radioactivity at which, under the condition of a certain background, the probability of the radioactivity that cannot be statistically estimated by using the variation of that background is 95 % or greater

When the background is expressed in units of activity concentration, the minimum detectable activity $A_{\min}$ is expressed by activity concentration (Bq/kg), and is obtained according to the following formula, where the background value is measured each time during the same period, and the number of measurements n is 10 or more :

$$A_{\min} = 2 \times 1.65 \times \sqrt{\frac{2 \sum_{i=1}^n (A_{bi} - \bar{A}_b)^2}{n(n-1)}}$$

where, A_{bi} : i -th background measured value (Bq/kg)
 n : number of background readings

$\overline{A}_b$: mean background value for n measurements (Bq/kg)

The background value is measured each time during the same period, and the number of measurements n is 10 or more.

When the background is expressed by counting rate, it is obtained according to the following formula :

$$A_{\min} = 2 \times 1.65 \times C \sqrt{\frac{2 \sum_{i=1}^n (N_{bi} - \overline{N}_b)^2}{n(n-1)}}$$

where, N_{bi} : i -th background counting rate

C : activity concentration conversion factor (Bq/kg) /s⁻¹

$\overline{N}_b$: mean background value for n measurements

3.7 detection sub-assembly

detector and device containing the functional unit attached to it, which are not provided with the display function.

3.8 measurement sub-assembly

device that does not contain a detection sub-assembly and contains functional units designed to display the measured values of radioactivity, activity concentration, etc.

3.9 activity concentration conversion factor, C

value obtained by dividing the conventionally true value of activity concentration of a radioactive standard solution, radioactive standard volume source or standard source for test by the net counting rate at the time of measurement of these standard sources, where the net counting rate is a quantity obtained by subtracting the background counting rate from the actually measured counting rate

4 Classification

The classification of radiation meters shall be as follows.

- a) **Portable type** Those which can be hand-carried.
- b) **Mobile type** Those which can be moved with casters etc. attached.
- c) **Stationary type** Those which are fixed at a location required.

5 Performance

5.1 Activity concentration conversion factor

The activity concentration conversion factor of at least the following radionuclides shall be obtained as specified in 7.2.2, and indicated in the operation manual. The tolerance ranges shall not be specified.

⁴⁰K, ⁶⁰Co, ¹³¹I, ¹³³Ba, ¹³⁴Cs, ¹³⁷Cs

5.2 Effective range of measurement

The effective range of measurement of the activity concentration of radionuclides specified in 5.1, when the external gamma dose rate does not exceed 2.5 µGy/h, should contain the range of at least 100 Bq/kg to 1 MBq/kg, except ⁴⁰K of natural radionuclides that exist in foodstuffs.

5.3 Energy measurement range

The energy measurement range shall contain at least 150 keV to 1 500 keV.

5.4 Relative intrinsic error

The tolerance on relative intrinsic error, when the test is performed as specified in 7.2.3, shall be $\pm (20 + U) \%$.

5.5 Response to standard source for test

The response to the standard source for test shall be tested as specified in 7.2.4, and the response value shall be stated in the operation manual. The tolerance shall not be specified. However, when the radiation source in 7.1.2 c) is not used in all the tests in 7.2, this test need not be performed.

5.6 Minimum detectable activity

The minimum detectable activity, when the test is performed as specified in 7.2.5, shall not exceed the minimum detectable activity (Bq/kg) stated by the manufacturer in the operation manual. The time required for the measurement for attaining the minimum detectable activity shall be stated in the operation manual. The time for the sample pretreatment and the background analysis shall not be included in this time.

5.7 Effect of external gamma radiation

The response of the radiation meter to the external gamma radiation, when the test is performed as specified in 7.2.6, shall not exceed the nominal value of the manufacturer.

5.8 Effect of other radionuclides

The manufacturer shall perform the test as specified in 7.2.7 and present the relative intrinsic error to ¹³⁷Cs. However, for radiation meters not having the analytical function of radionuclides, this test need not be performed.

5.9 Indicated value variation

The coefficient of variation, when the test is performed as specified in 7.2.8, shall not exceed 0.1.

5.10 Temperature characteristics

The tolerance on the variation of the indicated values, when the test is performed as specified in 7.2.9, shall be $\pm 10 \%$ for the temperature range of 10 °C to 35 °C. However, when the test is performed at -10 °C to 40 °C according to the agreement between the parties concerned with delivery, the tolerance shall be $\pm 10 \%$ for the range of 10 °C to 35 °C, and $\pm 20 \%$ for the ranges of -10 °C to 10 °C and 35 °C to 40 °C.

In addition, when the test is performed at $-20\text{ }^{\circ}\text{C}$ to $50\text{ }^{\circ}\text{C}$ according to the agreement between the parties concerned with delivery, the tolerance shall be $\pm 10\%$ for the range of $10\text{ }^{\circ}\text{C}$ to $35\text{ }^{\circ}\text{C}$, $\pm 20\%$ for the ranges of $-10\text{ }^{\circ}\text{C}$ to $10\text{ }^{\circ}\text{C}$ and $35\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$, and as agreed between the parties concerned with delivery for the ranges of $-20\text{ }^{\circ}\text{C}$ to $-10\text{ }^{\circ}\text{C}$ and $40\text{ }^{\circ}\text{C}$ to $50\text{ }^{\circ}\text{C}$.

5.11 Humidity characteristics

The tolerance on the humidity characteristics, when the test is performed as specified in 7.2.10, shall be $\pm 10\%$.

5.12 Stability against power supply voltage variation

The tolerance on the stability against power supply voltage variation shall be as follows.

- a) **AC power supply system** The permissible deviation of the indicated values from the reference value, when the test is performed as specified in 7.2.11 a), shall be $\pm 5\%$.
- b) **Battery-powered system** The permissible deviation of the indicated values from the reference value, when the test is performed as specified in 7.2.11 b), shall be $\pm 10\%$.

5.13 Shock resistance

The tolerance on shock resistance, when the test is performed as specified in 7.2.12, shall be $\pm 10\%$. However, for the mobile type radiation meter and stationary type radiation meter, this test need not be performed.

5.14 Vibration resistance

The tolerance on vibration resistance, when the test is performed as specified in 7.2.13, shall be $\pm 10\%$. However, for the mobile type radiation meter and stationary type radiation meter, this test need not be performed.

5.15 Preheating time characteristics

The tolerance on preheating time characteristics, when the test is performed as specified in 7.2.14, shall be $\pm 10\%$.

5.16 Overload characteristics

When the test is performed as specified in 7.2.15, the maximum value or overscale shall be displayed during the exposure with the radiation source that generates overload. After the radiation source that generates overload is removed, the indicated value shall return from the overscale state within the time agreed between the parties concerned with delivery not exceeding 30 min. The tolerance on the difference of the indicated values from the reference value after returning to the measurement range shall be $\pm 10\%$.

5.17 Alarm trip stability

When the test is performed as specified in 7.2.16, the alarm shall not be generated

by the signal input corresponding to not more than 89 % of the preset alarm level and the alarm trip shall function when the signal input corresponding to not less than 111 % is applied. However, for radiation meters without an alarm function, this test need not be performed.

5.18 External electromagnetic field characteristics

The tolerance on external electromagnetic field characteristics, when the test is performed as specified in 7.2.17, shall be ± 10 %.

5.19 Immunity characteristics against power supply frequency magnetic field

The tolerance on immunity characteristics against power supply frequency magnetic field, when the test is performed as specified in 7.2.18, shall be ± 10 %.

5.20 Electrostatic discharge characteristics

The tolerance on electrostatic discharge characteristics, when the test is performed as specified in 7.2.19, shall be ± 10 %.

5.21 Immunity characteristics against conducted interference derived by radio frequency electromagnetic field

The tolerance on immunity characteristics against conducted interference derived by radio frequency electromagnetic field, when the test is performed as specified in 7.2.20, shall be ± 10 %. However, in the case of the signal connection cable and power cable of 3 m or less in length, this test need not be performed.

5.22 Immunity characteristics against electrical fast transient/burst

5.22.1 Signal cable

The tolerance on immunity characteristics against electrical fast transient/burst, when the test is performed as specified in 7.2.21 a), shall be ± 10 %. However, in the case of the signal cable of 3 m or less in length, this test need not be performed.

5.22.2 Power cable

The tolerance on immunity characteristics against electrical fast transient/burst, when the test is performed as specified in 7.2.21 b), shall be ± 10 %. However, in the case of the power cable of 3 m or less in length, this test need not be performed.

5.23 Surge immunity characteristics

5.23.1 AC power supply cable

The tolerance on surge immunity characteristics, when the test is performed as specified in 7.2.22 a), shall be ± 10 %. However, in the case of the power cable of 3 m or less in length, this test need not be performed.

5.23.2 DC power supply cable

The tolerance on surge immunity characteristics, when the test is performed as specified in 7.2.22 b), shall be ± 10 %. However, in the case of the power cable of 3 m or less in length, this test need not be performed.