SLOVENSKI STANDARD
SIST EN 61098:2007

01-november-2007

Oprema za varstvo pred sevanjem - Vgrajeni sestavi za nadzor kontaminacije delovnih površin (IEC 61098:2003)

Radiation protection instrumentation - Installed personnel surface contamination monitoring assemblies

Strahlenschutz-Messgerte - Festinstallierte Personenkontaminationsmonitore

Instrumentation pour la radioprotection - Ensembles fixes pour la surveillance de la contamination de surface du personnel

Ta slovenski standard je istoveten z: EN 61098:2007

ICS:

13.280	Varstvo pred sevanjem	Radiation protection
17.240	Merjenje sevanja	Radiation measurements

SIST EN 61098:2007 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 61098

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ICS 13.280

English version

Radiation protection instrumentation - Installed personnel surface contamination monitoring assemblies (IEC 61098:2003, modified)

Instrumentation pour la radioprotection - Ensembles fixes pour la surveillance de la contamination de surface du personnel (CEI 61098:2003, modifiée)

Strahlenschutz-Messgeräte - Festinstallierte Personenkontaminationsmonitore (IEC 61098:2003, modifiziert)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

The text of the International Standard IEC 61098:2003, prepared by SC 45B, Radiation protection instrumentation, of IEC TC 45, Nuclear instrumentation, together with the common modifications prepared by the CENELEC BTTF 111-3, Nuclear instrumentation and radiation protection instrumentation, was submitted to the formal vote and was approved by CENELEC as EN 61098 on 2007-04-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2008-04-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2010-04-01

Clauses, subclauses, notes, tables and figures which are additional to those in IEC 61098:2003 are prefixed “Z”.

Annexes ZA, ZB and ZC have been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61098:2003 was approved by CENELEC as a European Standard with agreed common modifications as given below.

COMMON MODIFICATIONS

1 Scope and object

First paragraph, first line: **delete** “, meters”.

Second paragraph: **replace** “face” with “head”.

2 Normative references

Replace “IEC 60050(151):2001” with “IEC 60050-151:2001”.

Replace “IEC 60050(393):1996” with “IEC 60050-393:2003, *International Electrotechnical Vocabulary (IEV) – Part 393: Nuclear instrumentation – Physical phenomena and basic concepts*”.

Replace “IEC 60050(394):1995” with “IEC 60050-394:1995 + A1:1996 + A2:2000“.

Replace “IEC 61000-4-2:1995“ with “IEC 61000-4-2:1995 + A1:1998 + A2:2000“.

Replace “IEC 61000-4-3:2002“ with “IEC 61000-4-3:2002 + A1:2002“.

Replace “IEC 61000-4-5:1995“ with “IEC 61000-4-5:1995 + Corr. 1995 + A1:2000“.

Replace “IEC 61000-4-6:2003“ with “IEC 61000-4-6:2003 + A1:2004“.

Replace “IEC 61000-4-8:1993“ with “IEC 61000-4-8:1993 + A1:2000“.

Replace “IEC 61000-4-12:1995” with “IEC 61000-4-12:1995 + A1:2000“.

Add the following references:

IEC 60038:1983 + A1:1994 + A2:1997, *IEC standard voltages*

IEC 60068 series, *Environmental testing*

IEC 60359:2001, *Electrical and electronic measurement equipment – Expression of performance*

ISO 7503-1:1988, *Evaluation of surface contamination – Part 1: Beta-emitters (maximum beta energy greater than 0,15 MeV) and alpha-emitters*

ISO 8769-2:1996, *Reference sources for the calibration of surface contamination monitors – Part 2: Electrons of energy less than 0,15 MeV and photons of energy less than 1,5 MeV*

ISO 11929 series, *Determination of the detection limit and decision threshold for ionizing radiation measurements*

3 Terms and definitions

3.2
surface emission rate of a source

Add below the definition: “(according to ISO 8769 definition)”.

3.5
high efficiency source

Replace “0,5 keV” with “0,59 keV”.

3.6
small source

Add “surface” between “active” and “dimension”.

3.14
decision threshold

The whole definition to be **replaced** with a note, reading

NOTE Not used in EN 61098, see 3.Z1.

3.15
decay probability

The whole definition to be **replaced** with a note, reading

NOTE Not used in this document.

Add the following definitions:

3.Z1
minimum detectable surface emission rate
specific performance criteria taking account both the statistical fluctuation in the background count rates and nominal factors of the background to take account of short term spatial and temporal changes in background as well as changes due to the operator mass

NOTE This definition is specific for this standard only.

3.Z2
lowest level of detection
minimum count rate above background that will not trigger a false alarm due to statistical fluctuations

3.Z3
lowest limit of detection
limit of detection associated to the lowest level of detection

4 Classification of assemblies

4.1 According to type of radiation to be measured

Replace “contamination warning assemblies and monitors” with “contamination monitors and warning assemblies” all over the clause.

Fourth dash: **add** at the end: “(where the alpha and beta contaminations are indicated separately)”.

Fifth dash: **replace** the text in brackets with “(where the beta and gamma contaminations are indicated separately)”.

Sixth dash: **replace** the text in brackets with “(where the alpha, beta and gamma contaminations are indicated separately)”.

4.2 According to type of surface

First dash: **replace** “face” with “head”.

Second dash: **delete** “hand warning”.

Third dash: **delete** “foot warning”.

Fourth dash: **delete** “hand and foot warning”.

Add the following clause after 4.3:

4.Z1 Compressed overall classification

The equipment may also be supported with a compressed overall classification based on the intended field of use, as shown in Table Z1 below.

Table Z1 – Classification according to the intended field of use

Common			Options		
Category	**Abbreviation**	**Energy range**	**Energy extension**	**Ambient background compensation**	**Control type**
Alpha	A	3 MeV to 6 MeV	–	**O: Without any compensation** **CP: Post compensation** **CPA:** Alpha natural compensation **CPB:** Beta high energy compensation **CS: Simultaneous compensation** **CSA:** Alpha natural dynamic compensation **CSB:** Beta high energy dynamic compensation	Hands, Feet, Whole body
Beta	B	E_{max} of 150 keV to 3 MeV	–	**O: Without any compensation** **CP: Post compensation** **CPA**: Alpha natural compensation **CPB**: Beta ambient compensation **CPGX**: Gamma and X-ray ambient compensation **CS: Simultaneous compensation** **CSA**: Alpha natural dynamic compensation **CSB**: Beta ambient dynamic compensation **CSGX**: Gamma and X-ray ambient dynamic compensation	Hands, Feet, Whole body
Gamma	G	500 keV to 1,5 MeV	**L1**: Low limit 1 at 50 keV **L2**: Low limit 2 at 150 keV	**O: Without any compensation** **CP: Post compensation** **CPB**: Beta ambient compensation **CPGX**: Gamma and X-ray ambient compensation **CS: Simultaneous compensation** **CSB**: Beta ambient dynamic compensation **CSGX**: Gamma and X-ray ambient dynamic compensation	Hands, Feet, Whole body
X-rays	X	5 keV to 20 keV	**H**: High limit at 50 keV	**O: Without any compensation** **CP: Post compensation** **CPB**: Beta ambient compensation **CPGX**: Gamma and X-ray ambient compensation **CS: Simultaneous compensation** **CSB**: Beta ambient dynamic compensation **CSGX**: Gamma and X-ray ambient dynamic compensation	Hands, Feet, Whole body

5 Design characteristics

5.3 Hand monitoring facilities

Add at the end of the third paragraph: “if not otherwise agreed between manufacturer and user for existing equipment.”

5.4 Foot monitoring facilities

In the second paragraph, **replace** “30 cm” with “35 cm”.

6 Performance requirements and test procedures

6.1 General test procedure

6.1.1 Nature of tests

Add a note below the first paragraph, reading:

NOTE Other test methods may be agreed between manufacturer and purchaser to be regarded as additional acceptance tests. Examples may be published as informative annexes to this standard in future.

6.3 Reference sources

Start the second and third paragraphs as follows: “For assemblies for the monitoring of …”

7 Radiation characteristics

7.1 Variation of response with source position

7.1.1 For clothing or the body

7.1.1.1 Requirement

Add an additional paragraph below the current text, reading:

In order to improve the performance and meet the requirements of this standard, the manufacturer may in the case of beta and/or gamma monitoring additionally sum the response of any number of adjacent detectors.

7.1.1.2 Method of test

7.1.1.2.1 Alpha monitoring systems

Add a note below the current text, reading:

NOTE For a possible further test (for further characterization of the sensitive volume) see ZA.2.

7.1.1.2.2 Beta monitoring systems

Change the existing note to become NOTE 1.

Add a second note reading:

NOTE 2 For a possible further test (for further characterization of the sensitive volume) see ZA.2.

7.1.1.2.3 Gamma monitoring systems

Add a note below the current text, reading:

NOTE For a possible further test (for further characterization of the sensitive volume) see ZA.1.

7.3 Minimum detectable surface emission rate

Delete "Decision threshold" in the headline.

Replace "decision threshold" with "minimum detectable surface emission rate" wherever it appears (also in any subclause).

Add new paragraph between the first and the second paragraphs, reading:

Since the minimum detectable surface emission rate depends on the response of the equipment and this is going to depend on where on the body the activity is to be measured, the minimum detectable surface emission rate is dependent on where the activity is. In order to provide some indication of performance an average minimum detectable activity shall be determined from the average efficiency. Since also the signal from the background can be large by comparison to the signal from the activity being measured, and this background will be far from constant both in terms of time and position, allowance in determining the minimum detectable surface emission rate shall take account of this. The user also has a significant effect on the background. In this document the minimum detectable surface emission rate has a special meaning and includes arbitrary factors not used in the more precise decision threshold defined in ISO 11929.

7.3.1 For clothing or body

Replace the first paragraph with:

For the purposes of this document, the minimum detectable surface emission rate shall relate to the 4 π body average efficiency to clothing (body). This shall be determined as below, or the manufacturer shall undertake similar methods of determining an average efficiency. In the latter case the manufacturer shall provide the purchaser with a full description of the phantom used, all measurements taken, the assumptions made in calculating the average efficiency and the calculations made to determine this "average". The 4 π efficiency shall be determined from both the vertical response characteristic shown in Figure 1 and the polar response given in Figure 2.

Delete the third sentence of the third paragraph.

In the last paragraph, **replace** the second sentence with "Where monitoring is undertaken by two or more steps, the sum of the times taken for each monitoring step shall not exceed the time specified above or a time agreed between the manufacturer and purchaser."

7.4 Variation of response with energy

7.4.1 Beta

7.4.1.1 Requirements

Replace "^{90}Sr" with "^{90}Sr/^{90}Y".

7.4.1.2 Method of test

Add in the second line of item b) "or by default 10 cm x 10 cm (performing two measurements without overlap in order to cover the whole detector area and using the mean response for further reference)" behind "15 cm x 10 cm".

Add in the second line of item c) "or by default 10 cm x 10 cm (performing three measurements without overlap in order to cover the whole detector area and using the mean response for further reference)" behind "30 cm x 10 cm".

7.4.3 Gamma

7.4.3.3 Method of test

Item a), first paragraph, second sentence: **add** "of the nuclide" between "A small source" and "of interest".

Item b), first paragraph, last word: **replace** "counter" with "detector".

Add in the second line of item b) "or by default 10 cm x 10 cm (performing two measurements without overlap in order to cover the whole detector area and using the mean response for further reference)" behind "15 cm x 10 cm".

Add in the second line of item c) "or by default 10 cm x 10 cm (performing three measurements without overlap in order to cover the whole detector area and using the mean response for further reference)" behind "30 cm x 10 cm".

7.5 Response to other ionizing radiations

7.5.1 Gamma radiation

7.5.1.1 Requirements for alpha contamination monitors or warning assemblies

Add "from a Caesium-137 source" behind "10 µGy/h".

7.5.3 Beta or gamma radiation (for alpha contamination monitoring assemblies)

7.5.3.2 Method of test

Replace the text of 7.5.3.2 with:

Add the foot or hand beta radiation reference source in the assembly and using a scaler or similar equipment determine the ratio of the response in terms of count rate per unit surface emission rate of the beta source to the similar response to the alpha reference source.

10 Environmental conditions

10.1 Temperature

10.1.1 Requirements

At the end of the second paragraph, **add** "(see also IEC 60068 series)".

11 Power supply

11.1 Voltage and frequency

In the first paragraph, **add** "(in accordance with IEC 60038)" behind "categories".

13 Documentation

13.1 Certificate

Replace the last entry with "declaration whether the EN 61098:2007 standard test and, if necessary, the tests of Annex ZA are met".

Figure 1 – Vertical position of the source of radiation

Replace the title of the figure with "Response to the reference point source depending on its vertical position".

Figure 2 – Position of the source of radiation around the body

Replace the title of the figure with "Example of the polar response to the reference point source".

Figure 3 – Detector for hand monitoring

Add "Dimensions in cm".

Figure 4 – Foot monitor

Add "Dimensions in cm".

Replace the title of the figure with “Detector for foot monitoring”.

Annex A Explanation of the derivation of minimum detectable surface emission rate formula

A.1 Assemblies with no automatic compensation of background radiation

First paragraph: **replace** the whole text following the first sentence with:

The manufacturer shall state the maximum operational background, which can also be related to a count rate. The count rate from the activity must therefore be greater than the difference between the real operational background and this maximum background to be significant. It should be noted that the background signal will be reduced by the presence of the user. This reduction will depend on the size and the shape of the user. The manufacturer shall use a background count rate less than the reduced background due to the largest user specified by the manufacturer as the minimum background, and a background count rate greater than the reduced background due to the smallest user specified by the manufacturer as the maximum background. The manufacturer shall specify the height and mass of the smallest and largest user specified above.

Add a new paragraph between the first and the second paragraph, reading

There however will also be a random deviation on the count, which, when no contamination is present will be the square root of the count in the measurement time for a one standard deviation.

Replace the sentence in front of equation (A.1) with “So the minimum count to be sure that there is activity measured is given by”.

In the explanation of P, **replace** “of each channel” with “(at the maximum background; 3,1 for one in a thousand for each detector)”

In the explanation of B_1, **add** at the end “(Zero if not specified)”

Delete the two paragraphs before the paragraph starting “The count rate from the detector will be …”

There, **replace** “The count rate from the detector will be the minimum” with “This count rate from the detector will determine the minimum” and **delete** “(Chlorine 36)” at the end of the paragraph.

Add a note at the end of the clause, reading

NOTE The sizes of the users used for the above should not be taken as a physical limit on the size of users of the assemblies. The background count rate shall be determined from the count rates taken in naturally occurring omni-directional background conditions.

A.2 Assemblies with simultaneous subtraction of background radiation

Add a new paragraph between the first and the second paragraphs, reading

In determining this, the manufacturer shall take into account that both background count rates will be effected by the presence of the user. The manufacturer shall specify the mass and height of the largest and smallest users for which the minimum detectable surface emission rate is specified.

Add a note at the end of the clause, reading

NOTE The sizes of the users used for the above should not be taken as a physical limit on the size of users of the assemblies. The background count rate shall be determined from the count rates taken in naturally occurring omni-directional background conditions.

A.3 Assemblies with sequential background subtraction

Replace equation (A.11) with $u(Bt) = \frac{(Bt)^{0,5}}{t}$

Replace equation (A.12) with $u(BT) = T\,\frac{(B)^{0,5}}{t}$

Add a new paragraph and note a the end of the clause, reading

The major variation between background count rate during the monitoring cycle and background cycle is due to the absorption of the radiation by the user. The manufacturer shall determine the reduction in background due to the largest user as specified by the manufacturer. If the change is greater than 5 %, this percentage change shall be used in place of 5 % unless compensation is included for the presence of the user. Half the difference between this value and that due to the largest person may be used in place of 5 % unless this value is less than 5 %.

NOTE The sizes of the users used for the above should not be taken as a physical limit on the size of users of the assemblies. The background count rate shall be determined from the count rates taken in naturally occurring omni-directional background conditions.

Add the following annexes:

Annex ZA
(informative)

Examples of possible additional tests for further characterization of the sensitive volume

To take account of different interaction distances for gamma rays and alpha or beta particles, two possible additional test procedures with specific source locations are described below. The examples are given for an assembly of x = 60 cm wide, z = 200 cm high and y = 60 cm depth.

ZA.1 Complete window pattern (CWP) method for gamma rays

A set of vertical (x,z) planes grid, with a pitch of 30 cm x 50 cm is located inside the assembly, distance of each other of 30 cm in the y direction, starting from the inlet gate up to the outlet gate.

In these conditions, for x = 60 cm, z = 200 cm, y = 60 cm, we obtain a 3 x 5 x 3 = 45 points location matrix.

The CWP method consists in testing the response of the whole assembly with respect of each 45 small gamma source locations.

To take account of different shape of assembly, it is allowed to replace the orthogonal pattern by a cylindrical coordinate one composed of two vertical planes shifted from a $\pi/2$ angle.

This disposition allows five test source locations, including the center point, for each of the nine horizontal levels spaced by 25 cm from bottom to top. This provides 45 measurement test locations.

For gamma radiation the assembly meets the requirements for this test if, for a 4,5 (± 5 %) kBq of ^{60}Co gamma equivalent source, and an alarm threshold set at 3 kBq:

The test is performed three times. The acceptance criteria are that the following requirements are both met:

– in one of the three tests at least 44 of the test source points trigger an alarm in less than 5 seconds and

– none of the source locations which don’t trigger alarm in the three tests appears twice.

ZA.2 Thin Frame Window pattern (TFW) method for alpha and beta particles

Use the location matrix as in ZA.1 but replace the internal parallelepipedic volume by one delimited by a 10 cm band thickness starting from the vertical active walls of the assembly, and move the source in the middle vertical plane at 1 cm for alpha, 2,5 cm for beta particles, starting from the vertical active walls.

In these conditions, for x = 60 cm, z = 200 cm, y = 60 cm, we obtain a 2 x 5 x 2 = 20 points location matrix for two active walls.

The TFW method consists in testing the response of the whole assembly with respect of each 20 small alpha or beta source locations.

It may be completed by a test of the top and a test of the bottom central locations.

For alpha and beta radiation the information received from this test is of an informative character only.

Annex ZB
(informative)

Summation of information from adjacent detectors

The body is such a large area that to reduce the effect of background it is necessary to have a number of individual detector channels. It is inevitable that there will be gaps between these detectors and the detection capability of the contamination on the body adjacent to these gaps will be much lower than for activity adjacent to the centre of the detectors.

The effects of these gaps on performance can be reduced by summing the signals from adjacent detectors. However under these circumstances there is an increased background signal and this must be taken into account when determining any improvement in the minimum detectable activity. In the simplest case where the detectors are identical the effective limit of detection is increased by approximately $\sqrt{2}$. In the case where the detectors are not identical the resulting limit will be approximately the root of the sum of the squares of the effective limit of detection of each of the two detectors involved.

Figure ZB.1 illustrates the effect of summation on the response in the case of six vertical detectors. The response values which should be taken in determining the body average efficiency have been shown very slightly greater than the true value to clearly show how they have been determined.

Figure ZB.2 similarly illustrates the effect on the polar response where effectively four detector arrays forming a square (two actual detectors with the user making a second monitoring procedure having turned through 180°) are used.

The detector configurations used in these illustrations are not to taken as the best configurations to be used but provide one of the better configurations to illustrate the principle.

The line of effective response in shown in these figures can be used in place of responses illustrated in Figures 1 and 2 of the main text and used in the determination of the 4π average overall efficiency as used in 7.3.1.

In the diagrams the line .... is the efficiency of a single detector to a point source.

-.-.-.-.-.- is the sum of the efficiencies of two adjacent detectors to a point source:

$$E_{m} + E_{n}$$

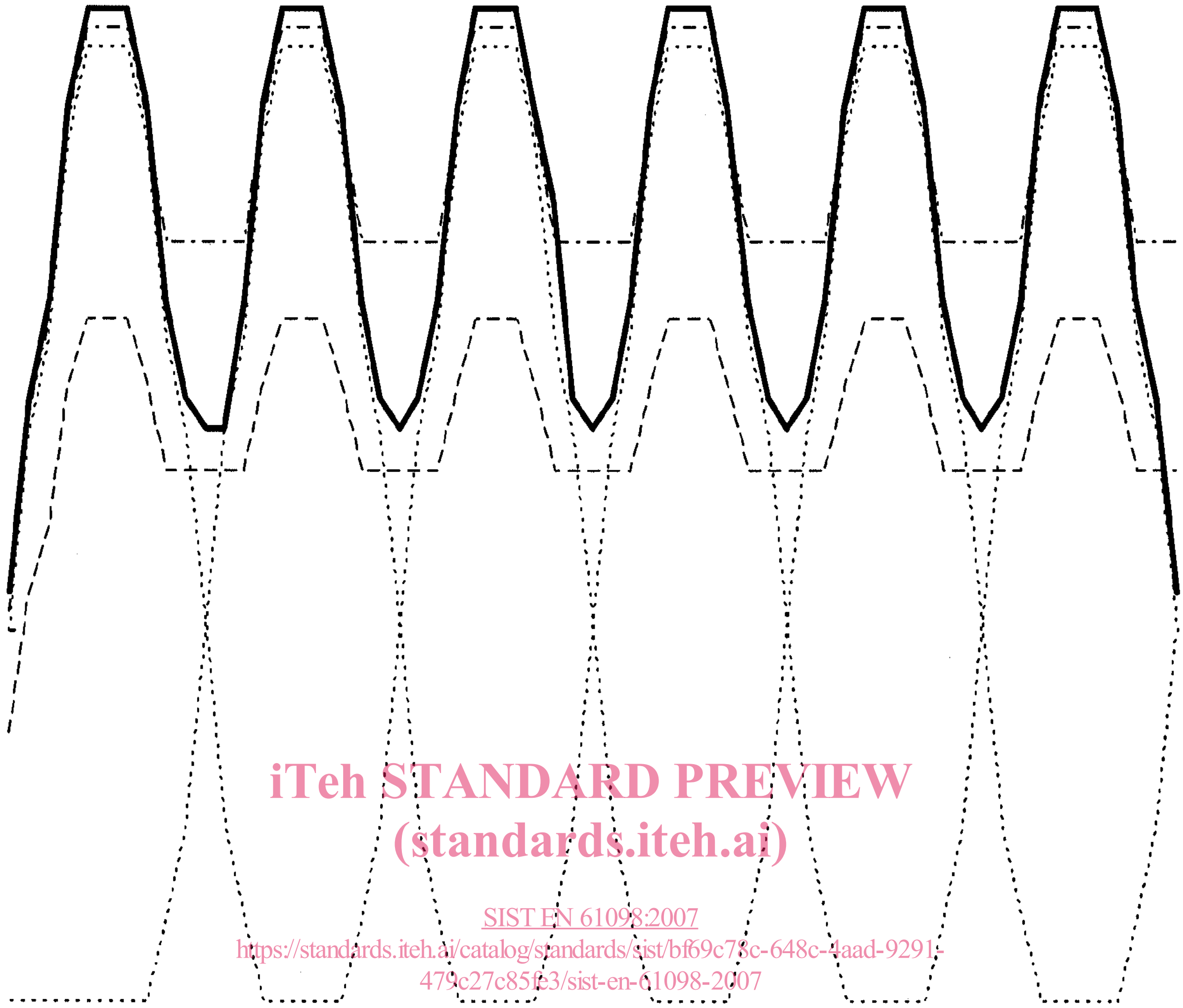
\- - - - - - is the weighted efficiency of two adjacent detectors, for the purpose of this standard:

$$\frac{(E_{m} + E_{n}) \cdot (B_{m}^{2} + B_{n}^{2})^{0,5}}{B_{m} + B_{n}}$$

B_{m} and B_{n} the background count in the monitoring period from detectors m and n respectively. Where detectors are the same ($B_{m} = B_{n}$) and the weighted efficiency is:

$$\frac{E_{m} + E_{n}}{\sqrt{2}}$$

———— is the efficiency from a single detector or the weighted efficiency from two adjacent detectors from a point source, whichever is the greater and is the efficiency to be taken in determining the 4π average efficiency and hence the minimum detection surface emission rates (in the illustrations the values are shown very slightly greater than actual value for clarity of interpretation).



Key

....	Single detector
-.-.-.-.-.-.-.-.-.-.	Summation of adjacent detectors
– – – – – – – –	Weighted summation
————	Efficiency for MDA

Figure ZB.1 – Example of effect of summation on efficiencies in vertical plane