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FREQUENTLY ASKED SOLUTIONS

IEC 62387:2012 – REQUIREMENTS FOR EXTREMITY DOSEMETERS

Radiation protection instrumentation - Passive integrating dosimetry systems for personal and environmental monitoring of photon and beta radiation

European Radiation Dosimetry Group

EURADOS

Table 9: Standards applicable to devices

Type of radia-tion	Area dosemeters		Personal dosemeters	
	active	passive	active	passive
Photon	PTB-A 23.3, 2013 IEC 61017, FDIS 2015-10 (environmental dosim.) IEC 60532 Ed.3, 2010 (fixed installed in nuclear facilities) IEC 60846-1 Ed.1, 2009 (hand held dosem.) IEC 60846-2 Ed.1, 2007 (emergency dosem.)	DIN 25483, 2000 (TLD, only env.) IEC 62387 Ed.1, 2012 (all passive dosemeters)	PTB-A 23.2, 2013 IEC 61526 Ed.3, 2010 (all active dosemeters)	IEC 62387 Ed.1, 2012 (all passive dosemeters) ISO 12794 Ed.1, 2000 *to be withdraw soon* (only TLD, only extremity dosem.)
Beta				
Neu-tron	IEC 61005 Ed.3, 2014 IEC 61322 Ed.1, 1994 (fixed installed)	---		ISO 21909-1 Ed.1, 2015 (all passive neutron detectors) DIN 6802-4, 1998 (Albedo)

Page 4 of 4 *Responsible: Dr. R. Behrens, PTB Braunschweig* *As of: 02.02.2016*

www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_6/6.3/information/norm_lst.pdf .

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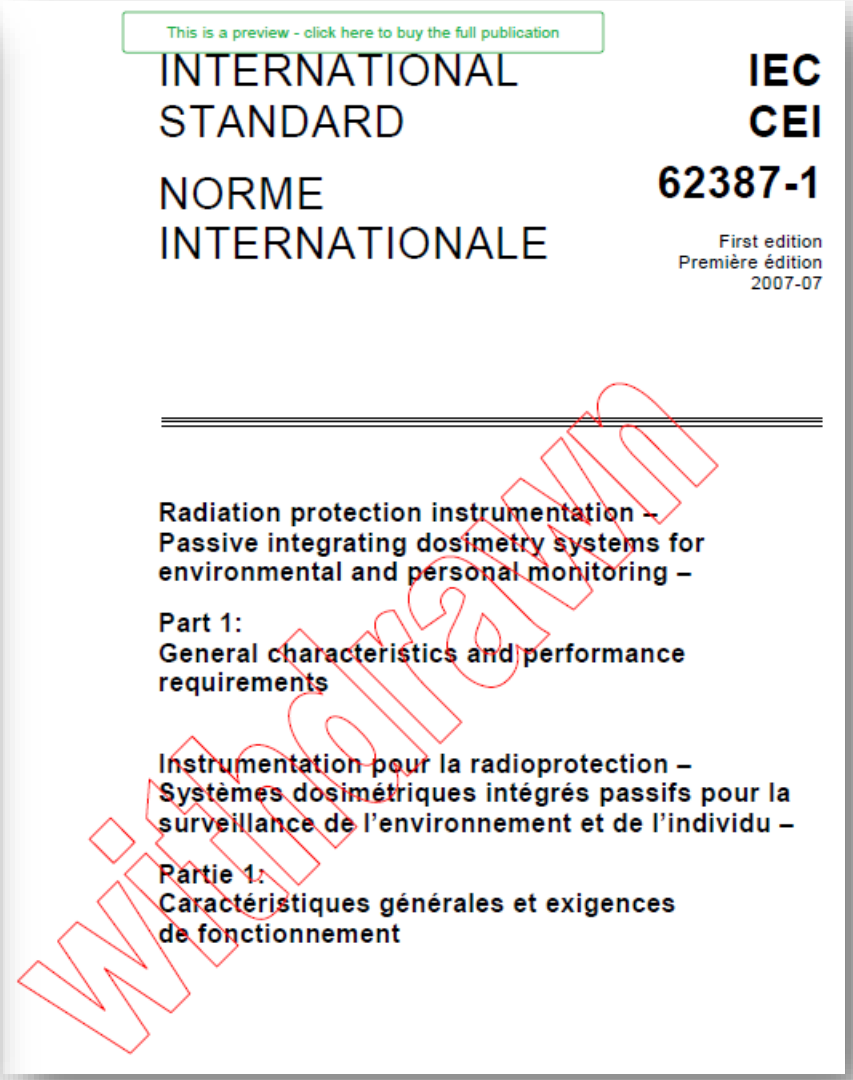
https://webstore.iec.ch/publication/6966

Withdrawn standards



History

IEC 62387:2012 (2012-12-04)

- **Radiation protection instrumentation - Passive integrating dosimetry systems for personal and environmental monitoring of photon and beta radiation**

IEC 62387-1:2007 (2007-07-30)

- Radiation protection instrumentation - Passive integrating dosimetry systems for environmental and personal monitoring - **Part 1: General characteristics** and performance requirements

IEC 61066:2006 (2006-06-26)

- **Thermoluminescence** dosimetry systems for personal and environmental monitoring

Abstract IEC 62387:2012

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IEC 62387:2012 applies to all kinds of passive dosimetry systems that are used for measuring the personal dose equivalent (for whole body dosimetry), the personal dose equivalent (for eye lens dosimetry), the personal dose equivalent (for both whole body and extremity dosimetry), the ambient dose equivalent (for environmental dosimetry), or the directional dose equivalent (for environmental dosimetry). This standard applies to dosimetry systems that measure external photon and/or beta radiation in the dose range between 0,01 mSv and 10 Sv and in wide energy ranges. The dosimetry systems usually use electronic devices for the data evaluation and thus are often computer controlled

Mandatory and maximum energy ranges

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Table 1 – Mandatory and maximum energy ranges covered by this standard

Measuring quantity	Mandatory energy range for photon radiation	Maximum energy range for testing photon radiation	Mandatory energy range for beta-particle radiation[a]	Maximum energy range for testing beta-particle radiation[a]
$H_p(10)$, $H^*(10)$	80 keV to 1,25 MeV	12 keV to 10 MeV	–	–
$H_p(3)$	30 keV to 250 keV	8 keV to 10 MeV	0,8 MeV almost equivalent to an E_{max} of 2,27 MeV	0,7 MeV[b] to 1,2 MeV almost equivalent to E_{max} from 2,27 MeV to 3,54 MeV
$H_p(0,07)$, $H'(0,07)$	30 keV to 250 keV	8 keV to 10 MeV	0,8 MeV almost equivalent to an E_{max} of 2,27 MeV	0,06 MeV[c] to 1,2 MeV almost equivalent to E_{max} from 0,225 MeV to 3,54 MeV

a The following beta radiation source are suggested for the different mean energies: For 0,06 MeV: ^{147}Pm; for 0,8 MeV: ^{90}Sr/^{90}Y; for 1,2 Mev: ^{106}Ru/^{106}Rh.

b For beta-particle radiation, an energy of 0,7 MeV is required to reach the radiation sensitive layers of the eye lens in a depth of about 3 mm (approximately 3 mm of ICRU tissue).

c For beta-particle radiation, an energy of 0,07 MeV is required to penetrate the dead layer of skin of 0,07 mm (approximately 0,07 mm of ICRU tissue).

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Content/Requirements

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- Scope
- Terms and definitions
- Units and symbols
- General test procedures
- Performance requirements: summary
- Capability of a dosimetry system
- Requirements for the design of the dosimetry system
- Instruction manual
- Software, data and interfaces of the dosimetry system
- **Radiation performance requirements and tests (dosimetry system)**
- Response to mixed irradiations
- Environmental performance requirements and tests
- Electromagnetic performance requirements and tests (dosimetry system)
- Mechanical performance requirements and tests
- Documentation
- Annex

Radiation performance requirements and tests

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- **Radiation performance requirements and tests (dosimetry system)**
  - Coefficient of variation
  - Non-linearity
  - Overload characteristics, after-effects, and reusability
  - Radiation energy and angle of incidence for $H_p(0,07)$ or $H'(0,07)$ dosemeters
  - Over response to radiation incidence from the side of an $H_p(10)$, $H_p(3)$ or $H_p(0,07)$ dosemeter
  - Indication of the presence of beta dose for $H_p(0,07)$ whole body dosemeters

Table 10 – Performance requirements for $H_p(0,07)$ dosemeters

Line	Characteristic under test	Main characteristics of mandatory measuring range or mandatory range of influence quantity	Performance requirement for the listed range	Clause/ Sub-clause
1	Capability of the dosimetry system	Measuring range, influence quantities, f_{test}, model function	To be documented by the manufacturer for the type test	7
2	Requirements to the design of the dosimetry system	Close indication; information on reader, dosemeter and evaluation algorithm	To be documented by the manufacturer for the type test and checked during type test	8
3	Effects of radiation not intended to be measured	Response to thermal neutrons, ^{252}Cf and ^{241}Cf (D_2O moderated)	Response to be stated by the manufacturer	8.7
4	Instruction manual	Information for correct use, information about the performance of the system	To be documented by the manufacturer for the type test and checked during type test	9
5	Software, data and interfaces	Authenticity of the software, correctness and integrity of data	To be documented by the manufacturer for the type test and checked during type test	10
6	Coefficient of variation, v	H_p: 1 mSv 1 mSv ≤ H < 11 mSv H ≥ 11 mSv	15 % (10 – 661 mSv) % 5 %	11.2
7	Relative response due to non-linearity	1 mSv ≤ H ≤ 3 Sv	−9 % to +11 %	11.3
8	Overload, after effects, and reusability	10 times the upper limit of the measuring range $10 H_{max}$, however at maximum 10 Sv; Reused dosemeters shall fulfil the requirements	Perception to be obtainable on the high end side of the measuring range, after effects may not cause fault measurements and $r(N_{ref})$ shall be according to line 6	11.4
9	Relative response due to mean photon radiation energy and angle of incidence	30 keV to 250 keV and 0° to ± 60° from reference direction	For 8 keV ≤ E_{ph} < 20 keV: r_{app} = 0,67 to r_{max} = 2,00 and for 20 keV ≤ E_{ph} < 33 keV: r_{app} = 0,83 to r_{max} = 1,82 and for E_{ph} ≥ 33 keV: 0,71 to 1,67	11.7.1
10	Relative response due to mean beta radiation energy	0,8 MeV and 0° to ± 60° for extremity dosemeters and 0° to + 60° for whole body dosemeters	For 0,08 MeV ≤ $E_{max\beta}$ < 0,2 MeV: r_{app} = 0,67 to r_{max} = 2,00 and for 0,2 MeV ≤ $E_{max\beta}$ < 0,7 MeV: r_{app} = 0,83 to r_{max} = 1,82 and for $E_{max\beta}$ ≥ 0,7 MeV: 0,71 to 0,67 For whole body dosemeters: If indicated, line 12 applies	11.7.2
11	As in lines 9 and 10 but new reference direction opposite to that one used	See lines 9 and 10, if no statement by the manufacturer	See lines 9 and 10, if no statement by the manufacturer	8.4 f)
12	Radiation incidence from the side of the dosemeter	Radiation incidence from 60° to 120°	Indication less than 3 times of indication due to irradiation free in air from the front	11.8
13	For whole body dosemeters: Indication of the presence of beta dose	0,8 MeV at 0° angle of incidence	r_{app} = 0,71 to r_{max} = 1,67	11.9
14	Response to mixed irradiations	Irradiation with different radiation qualities	Response within ranges of radiation qualities under test	12
15	Total effect due to environmental performance requirements	Temperature, RH, time; for details, see Table 13	See Table 13	13
16	Deviation due to electromagnetic performance requirements	See Table 14	See Table 14	14
17	Deviation due to mechanical performance requirements	Drop; for details, see Table 15	± 0,2 H_{max} at a dose of H = 2 H_{min}	15

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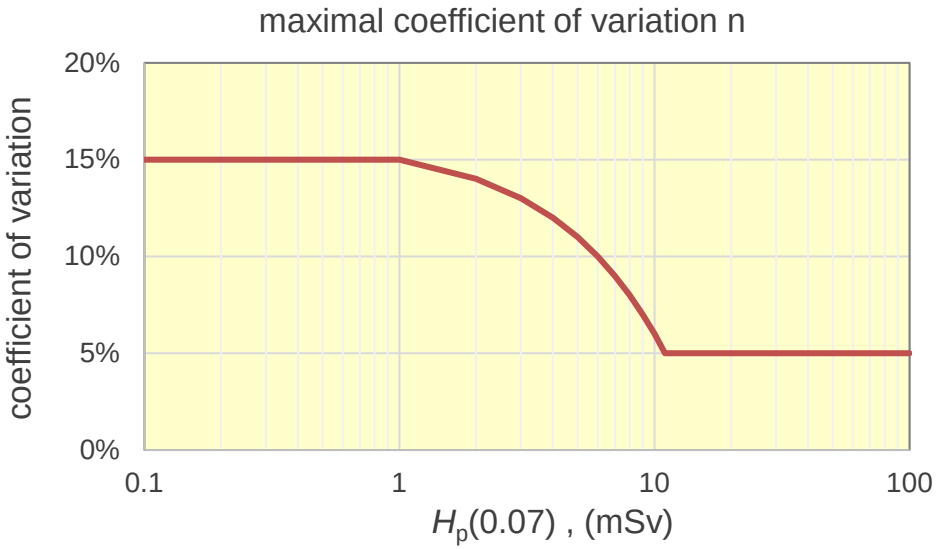
- **Table 10** summarises all requirements for $H_p(0.07)$ dosemeters
  - Coefficient of variation
  - Non-linearity
  - Radiation energy and angle of incidence for $H_p(0,07$dosemeters
  - Over response to radiation incidence from the side of an $H_p(10)$, $H_p(3)$ or $H_p(0,07)$ dosemeter

Requirements for Coefficient of Variation & Linearity

Coefficient of variation. ν	
H < 1 mSv	15%
1 mSv ≥ H < 11 mSv	(16 – H/1 mSv) %
H ≥ 11 mSv	5%



Relative response due to **non-linearity:**	
1 mSv ≤ H ≤ 3 Sv	–9 % to +11 %

Requirements: Energy/Direction

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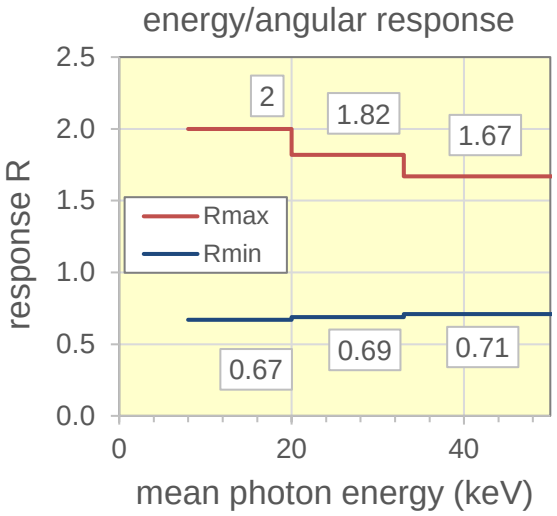
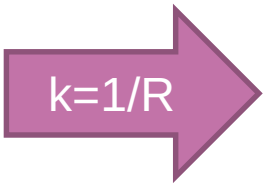
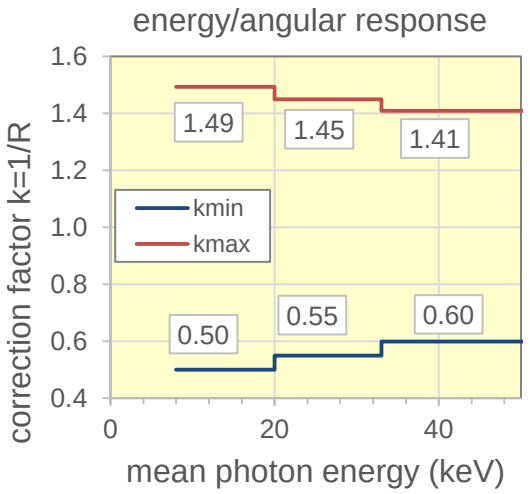
Relative response due to **mean photon radiation energy and angle of incidence**:	
30 keV to 250 keV and 0° to ±60° from reference direction	8 keV ≤ E_{ph} < 20 keV: 0.67 to 2.00 20 keV ≤ E_{ph} < 33 keV: 0.69 to 1.82 for E_{ph} ≥ 33 keV: 0.71 to 1.67







Requirements: Energy/Direction

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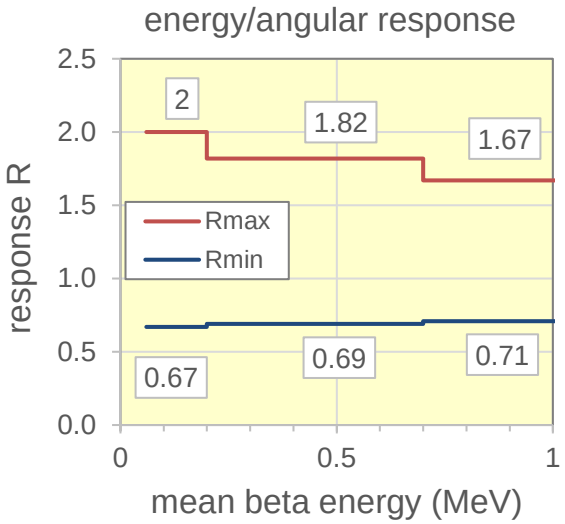
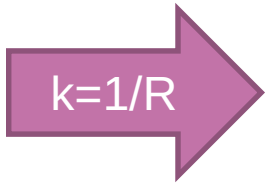
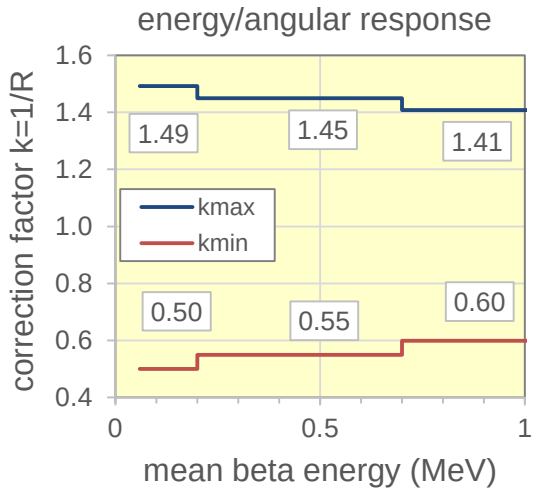
Relative response due to mean **beta radiation energy:**	
0.8 MeV and 0° to ±60° (for extremity dosemeters)	0.06 MeV ≤ E_{beta} ≤ 0.2 MeV: 0.67 to 2.00 0.2 MeV ≤ E_{beta} ≤ 0.7 MeV: 0.69 to 1.82 E_{beta} ≥ 0.7 MeV: 0.71 to 1.67







Photon irradiations: Trumpet curve Criteria

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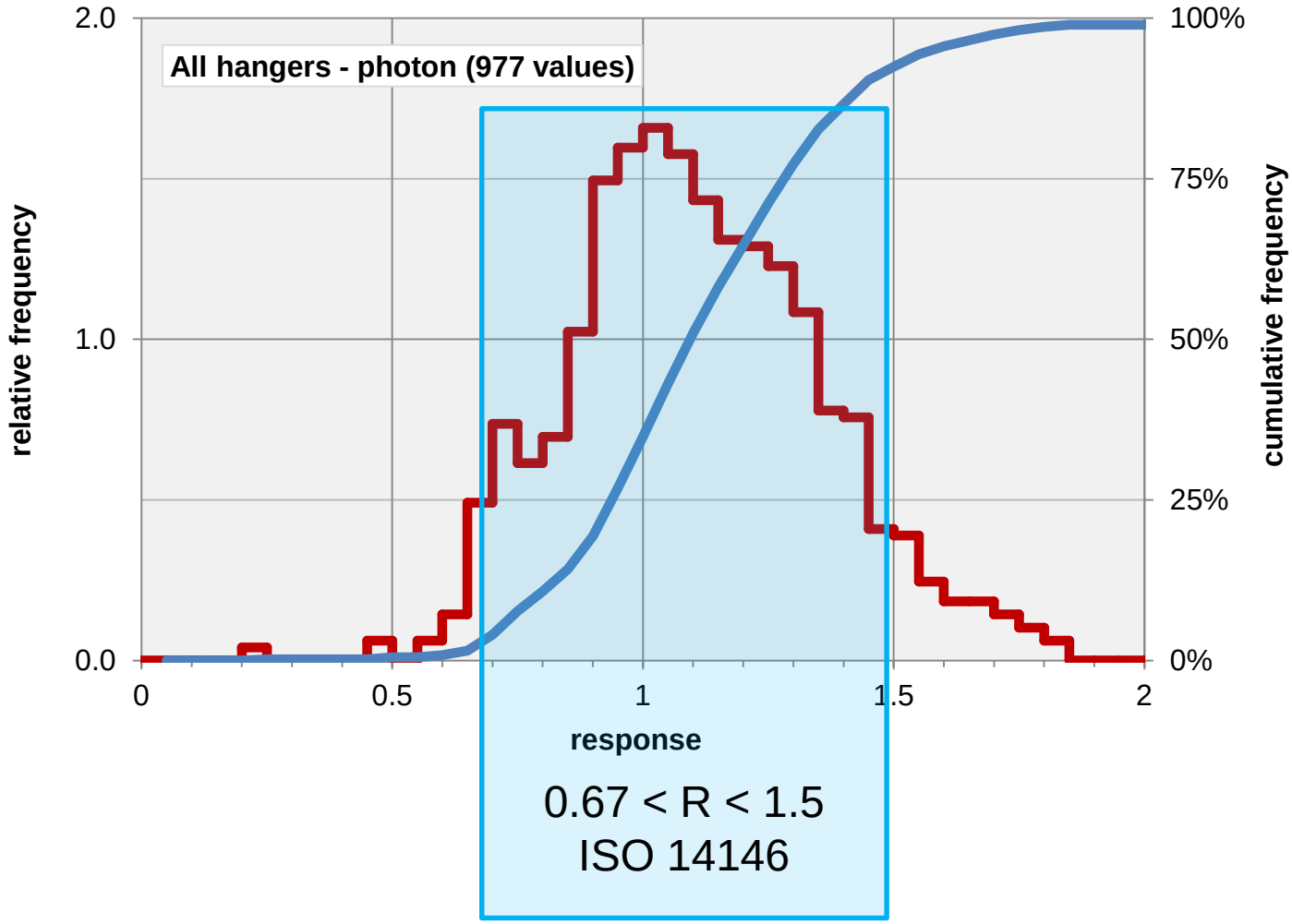

Photon irradiations

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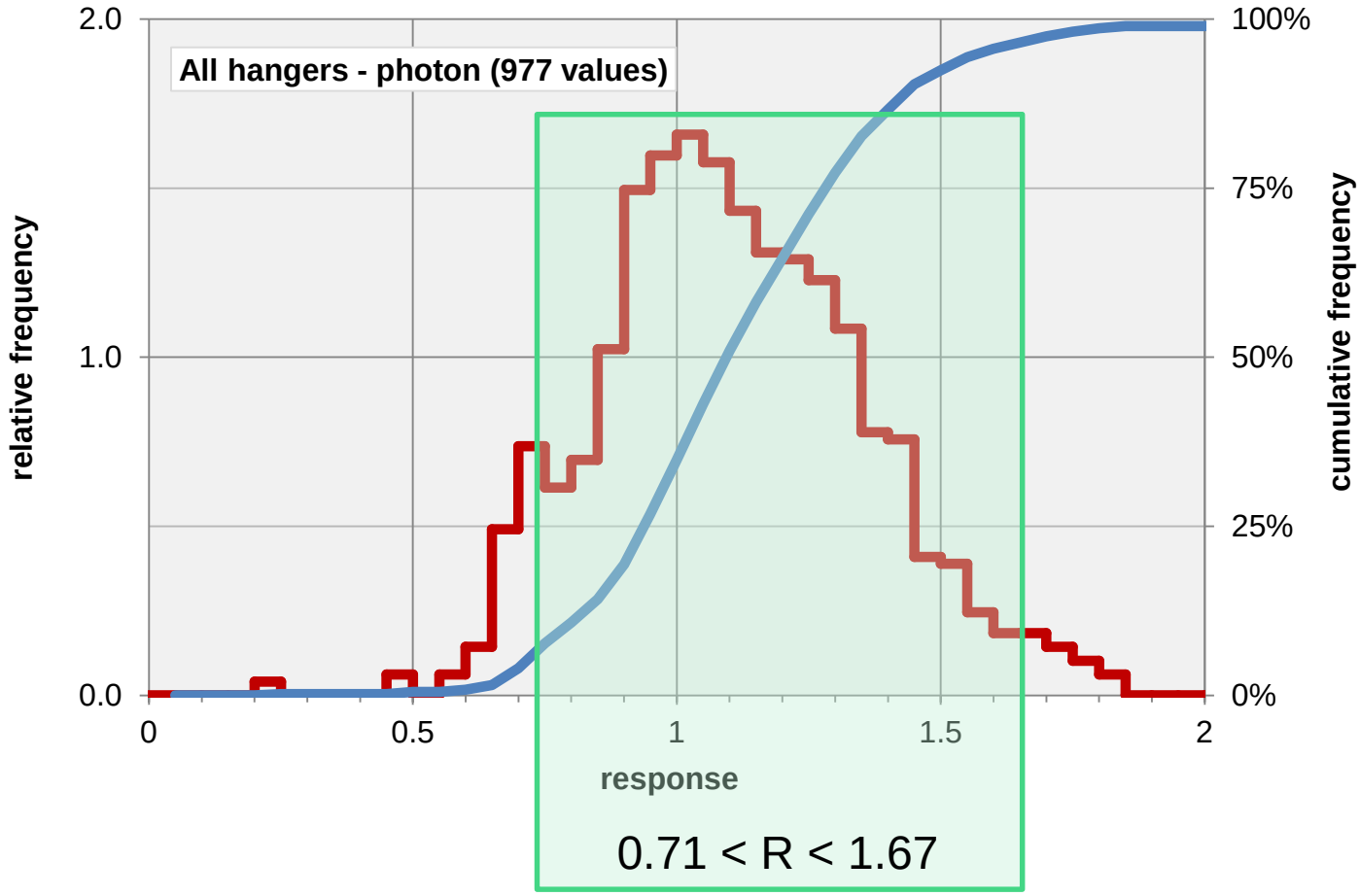
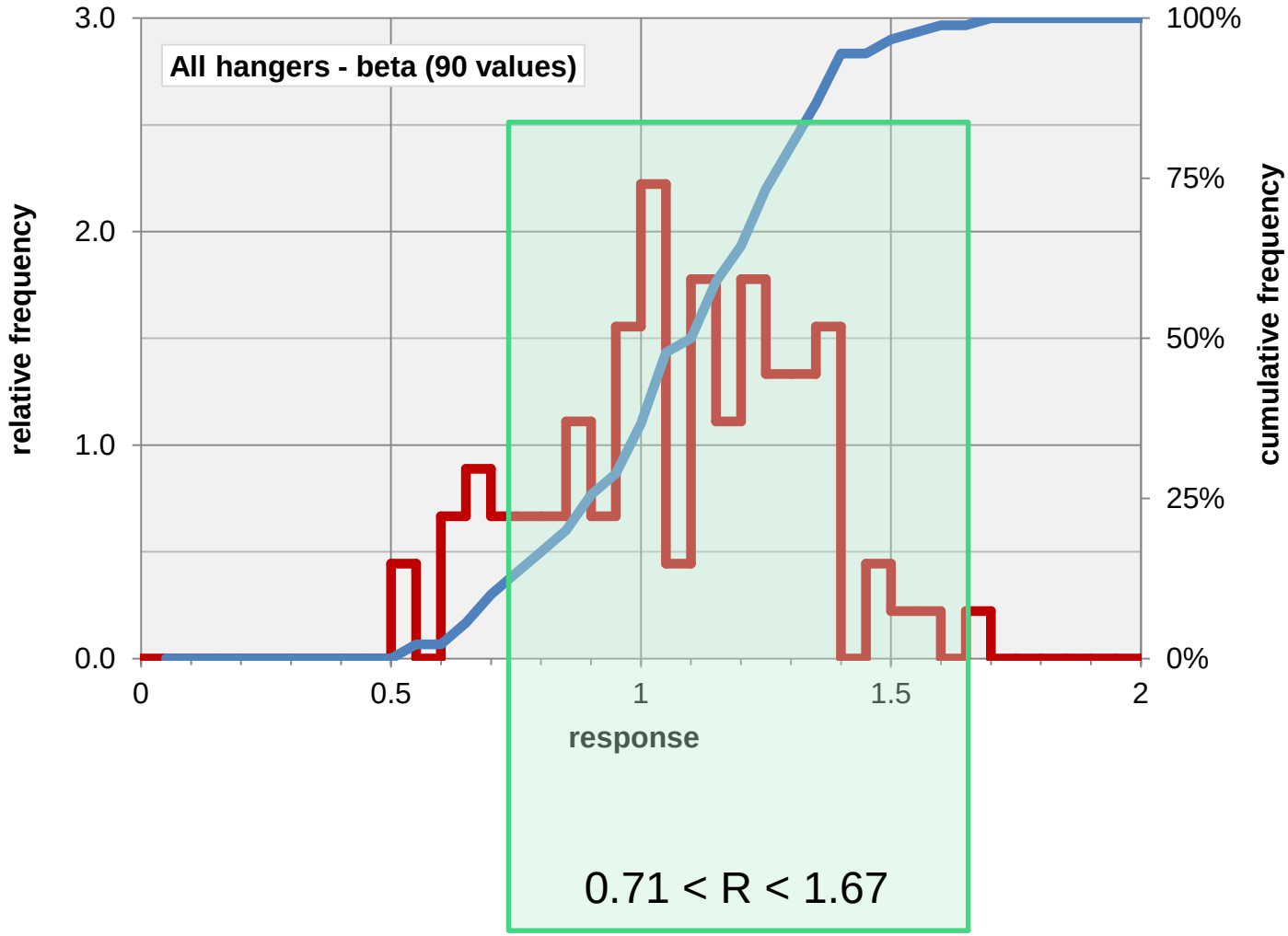


Sr-90/0° irradiations



Sr-90/60° irradiations

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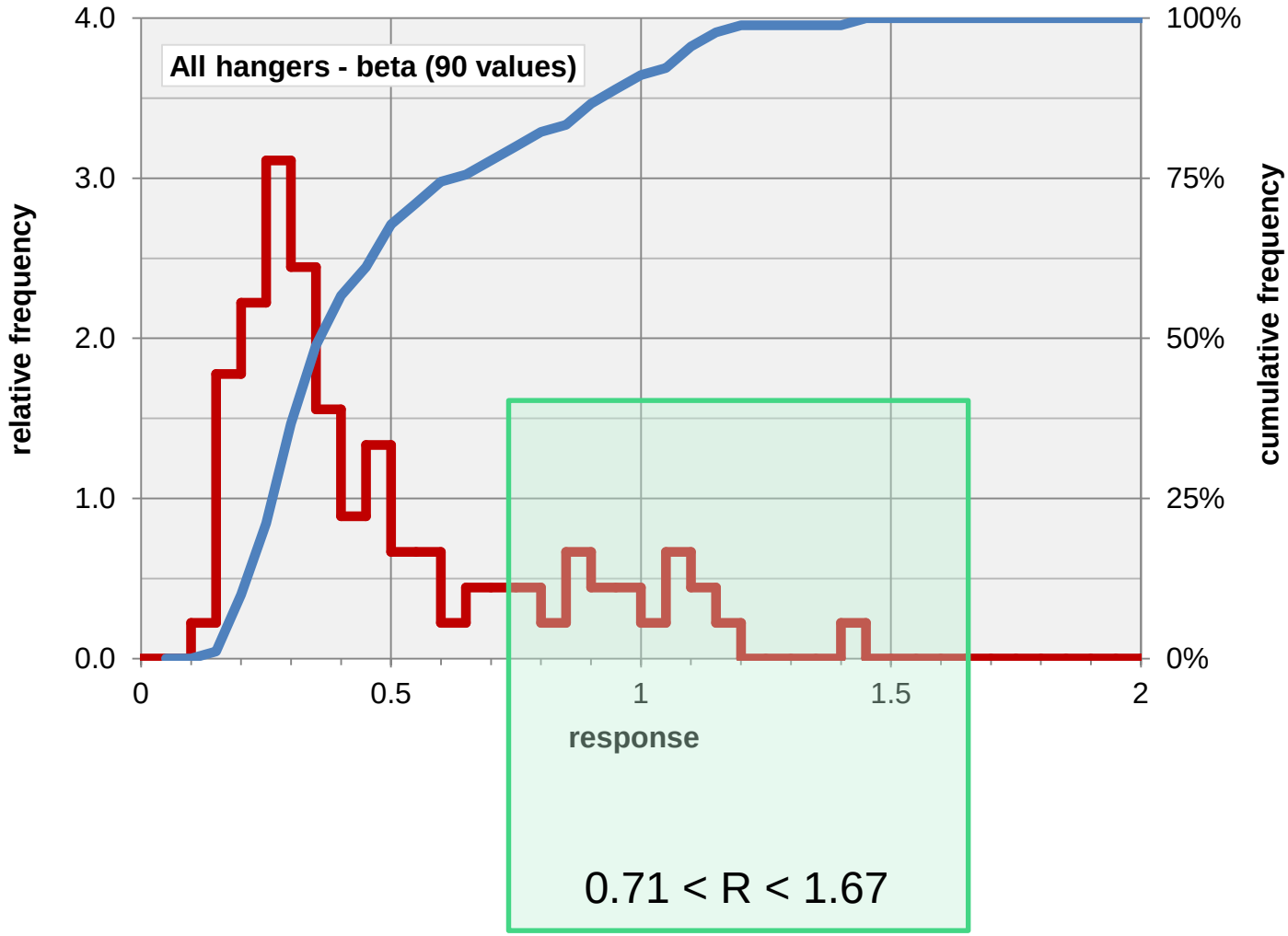

Outlook

For the evaluation of the intercomparison results $IC2015_{ext}$ only the trumpet curve criteria according ISO-14146 (2000) are applied. The new ISO-14146 (201?) however will use criteria in accordance with the current IEC-62387. After publication these new criteria will be applied for the evaluation of the next intercomparisons.