SC 45B Radiation protection instrumentation

International standards for the performance of radiation detection instruments used in the global nuclear security framework

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IEC - International Electrotechnical Commission

- Founded in 1906
- Prepares and publishes international standards for all **electrical, electronic and related technologies**
- National Committees (NC)
  - 62 member countries
  - 23 associated member countries
- Technical Committees (TC) and Sub-committees (SC)
  - 207 TCs and SCs
  - more than 560 WGs

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IEC/SC 45B Radiation protection instrumentation

- **Prepare standards that address instrumentation used for:**
  - the measurement of ionizing radiation in the workplace, to the public and in the environment for radiation protection purposes
  - illicit trafficking detection and identification of radionuclides
  - radiation-based security screening
- **Country membership**
  - Participating countries (P-members): 20, Observer countries (O-members): 15
- **More than 100 experts**
  - Testing laboratories
  - Governmental agencies
  - Manufacturers
  - Users
- **Standards and technical documents**
  - Published: 57, In development: 10
- **Liaisons with ISO, IAEA, ICRP, ICRU…**
- **7 Working Groups (WGs)**
  - WG 15: Illicit Trafficking Control Instrumentation using spectrometry, personal electronic dosimeter and portable dose rate instrumentation

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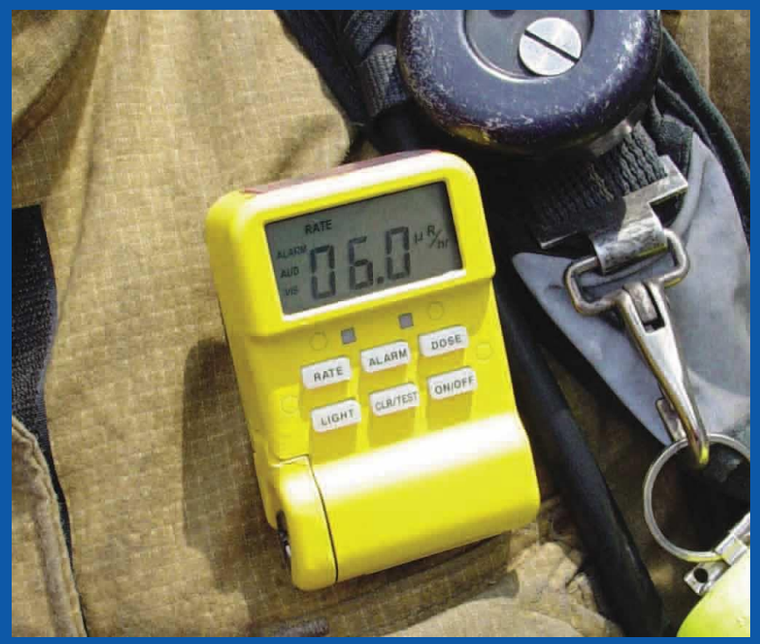
Standards on instrumentation used for detection of illicit trafficking of radioactive material

- 11 international standards published since 2003
- Revisions undertaken since 2014
  - Harmonization
  - Taking into account the feedback from different testing programs and international projects as ITRAP+10
- Types of instruments
  - Body-worn
  - Portable or hand-held
  - Portal
  - Vehicle-mounted
- Data output format standard
  - IEC 62755 (2012)

Body-worn



- IEC 62401 Ed. 2 (2017) Alarming Personal Radiation Devices (PRD)
- IEC 62618 Ed. 2 (in progress) Spectroscopy-Based Alarming Personal Radiation Devices (SPRD)
- IEC 62694 Ed.2 (in progress) Backpack Based Radiation Detector (BRD)

Portable or hand-held

- IEC 62327 Ed. 2 (2017) Hand-held Radionuclide Identification Devices (RID)
- IEC 62533 (2010) Hand-held highly sensitive Photon Devices (GSD)
- IEC 62534 (2010) Hand-held highly sensitive Neutron Devices (NSD)

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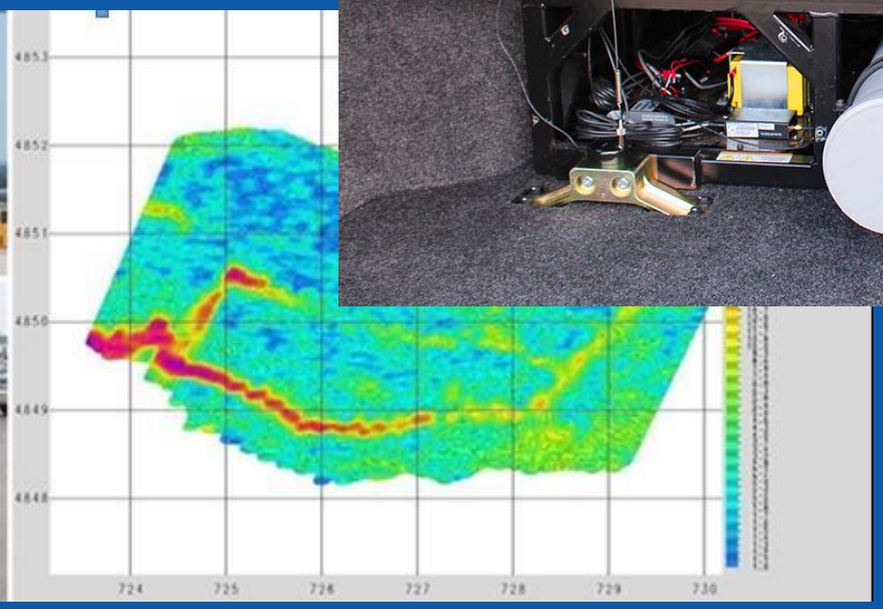
Portal

- IEC 62244 Ed. 2 (2019) Portal Monitors (RPM)
- IEC 62484 Ed. 2 (in progress) Spectroscopy-Based Portal Monitors (SPRM)

Vehicle-mounted



- IEC 63121 (in progress) Vehicle-mounted mobile systems (VMS)

Basic radiation detection requirements

	Max rate of false alarm	Gamma or neutron alarm	Gamma dose rate indication error	Gamma dose rate over-range	Additional tests
PRD	1 alarm in 1 h	≤ 2 s at increase of 0.5 μSv·h^{-1} above background	≤ ±50 %	At 2 times max range	
SPRD	3 alarms in 8 h	≤ 3 s at increase of 0,5 μSv·h^{-1} above background	≤ ±50 %	At 2-10 times max range or 1 mSv·h^{-1}	
BRD	1 alarm in 1 h	≤ 2 s with gamma fluence rate of 4 s^{-1}·cm	≤ ±30 %	At 1.5 times max range	Angular dependence
RID	-	≤ 1 s at increase of 0.5 μSv·h^{-1} above background	≤ ±30 %	At 1.5 times max range	Gamma source localization
GSD	1 alarm in 1 h	≤ 3 s at increase of 0,05 μSv·h^{-1} above background	≤ ±30 %	At 10 times max range or 1 mSv·h^{-1}	
NSD	1 alarm in 1 h	≤ 2 s at exposure from ^{252}Cf to 0.1 n·s^{-1}.cm^{-2}	-	At 10 times max range	
RPM	2 alarms in 10 h	At radiation level greater than a threshold	-	At 1.5 times max range	Warning when backgr. change
SRPM	1 alarm in 10 h	Alarm at radionuclide identification	-	At 1.5 times max range	Warning when backgr. Change
VMS	1 alarm in 2 h	At radiation level greater than a threshold	-	At 1.5 times max range	Background effects

Other radiation tests

- Detection of gradually increasing radiation
- Neutron detection alarm (if applicable)
- Personal protection alarm
- Radionuclide identification (RID)
  - Single: ^{241}Am, ^{133}Ba, ^{60}Co, ^{137}Cs, ^{67}Ga, ^{131}I, ^{99m}Tc, ^{40}K (KCl or KOH), ^{201}Tl, ^{226}Ra, ^{232}Th, ^{238}U (DU), ^{235}U (HEU) and ^{239}Pu (WGPu)
  - Mixed: ^{131}I + WGPu, NORM+HEU, NORM+WGPu

Climatic, mechanical and EMC requirements and tests

- **Climatic**: ambient temperature, temperature shock, low/high temperature start-up, relative humidity, moisture and dust protection
- **Mechanical**: drop, vibrations, microphonics/impact and mechanical shock
- **Electromagnetic**: electrostatic discharge, radio frequency (RF) immunity, radiated emissions, magnetic fields and AC line powered equipment requirements
- **Electrical**: battery lifetime and power requirements
- **Documentation**

Conclusion

- Criteria and compliance test methods in the standards
  - Optimization
  - Compromise
  - Consensus
- Objects of the standards
  - Describe the performance requirements and functional criteria
  - Develop testing methods for evaluating the performance of the applicable instrumentation
  - Specify general characteristics, general test procedures, radiation characteristics, climatic, mechanical, electromagnetic and electric characteristics
- Compliance with standard requirements provides
  - Manufacturers with internationally acceptable specifications
  - Device users with assurance of the rigorous quality and accuracy of the measurements
- International use
  - CENELEC transposition as EN standards
  - Harmonization with US ANSI standards by the Accredited Standards Committee “Radiation Detection”

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Thank you for your attention. Any questions?

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