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In situ gamma spectrometry Practical aspects

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Extract presented by Barbara Nadalut

Advantages and disadvantages

+
Short measurement time
No sample preparation needed
Representative results
Prompt result availability
Facilitates sampling plan

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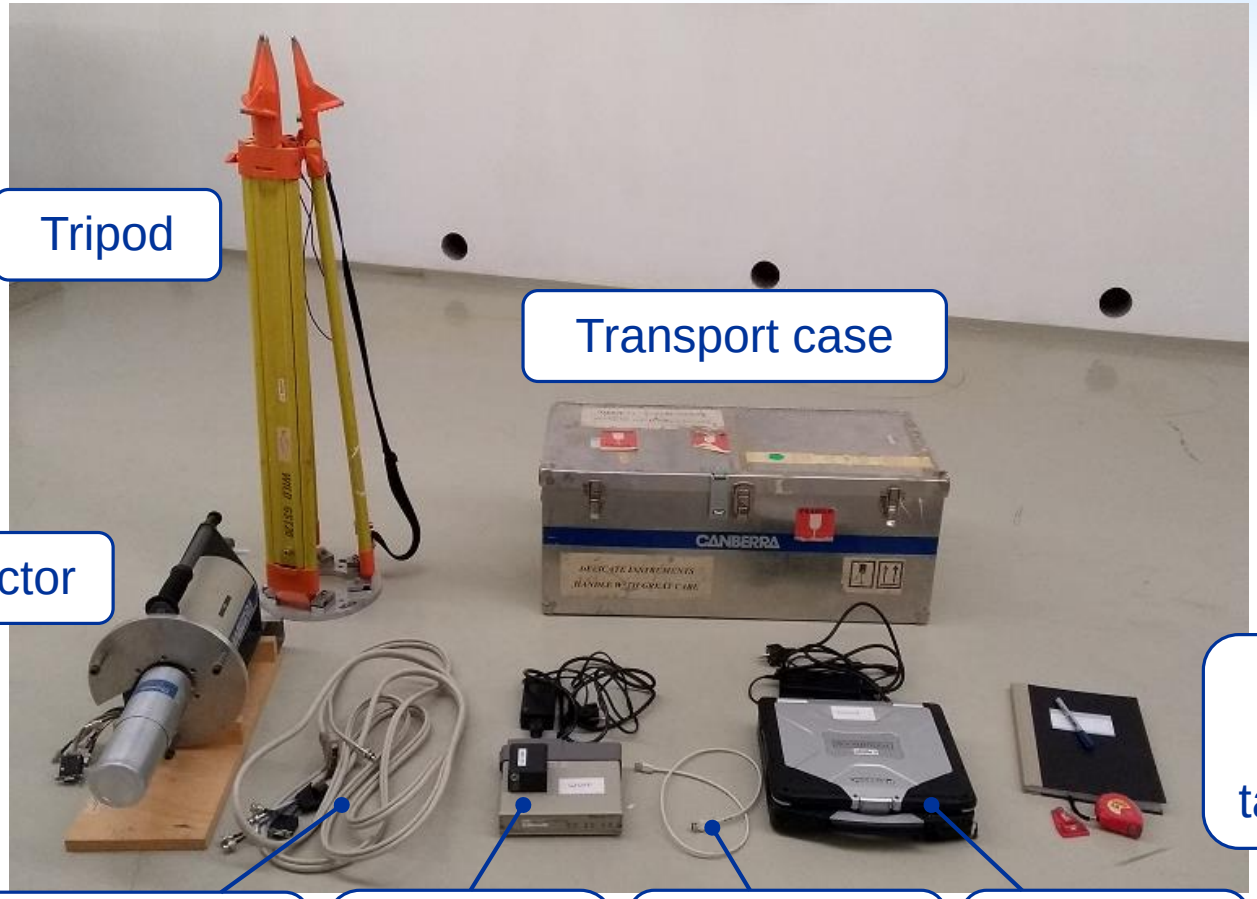
All you need is just….

Essential equipment



Tripod

Transport case

Detector

Notebook, pen, level, tape measure

Cable Detector → MCA

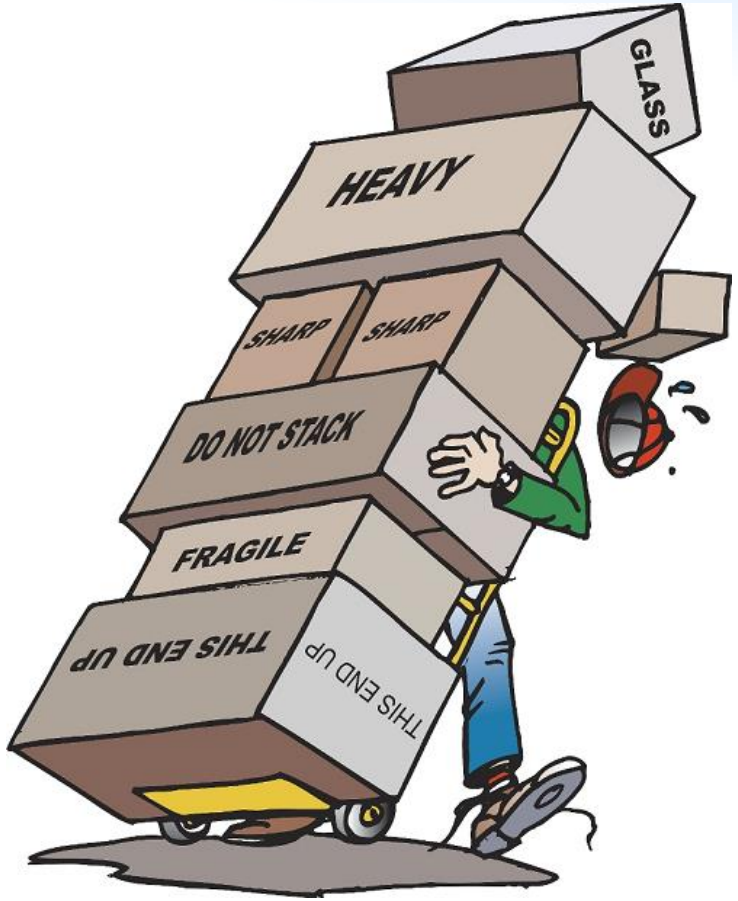
MCA, Charger, Battery

Cable MCA → PC

Laptop, Charger

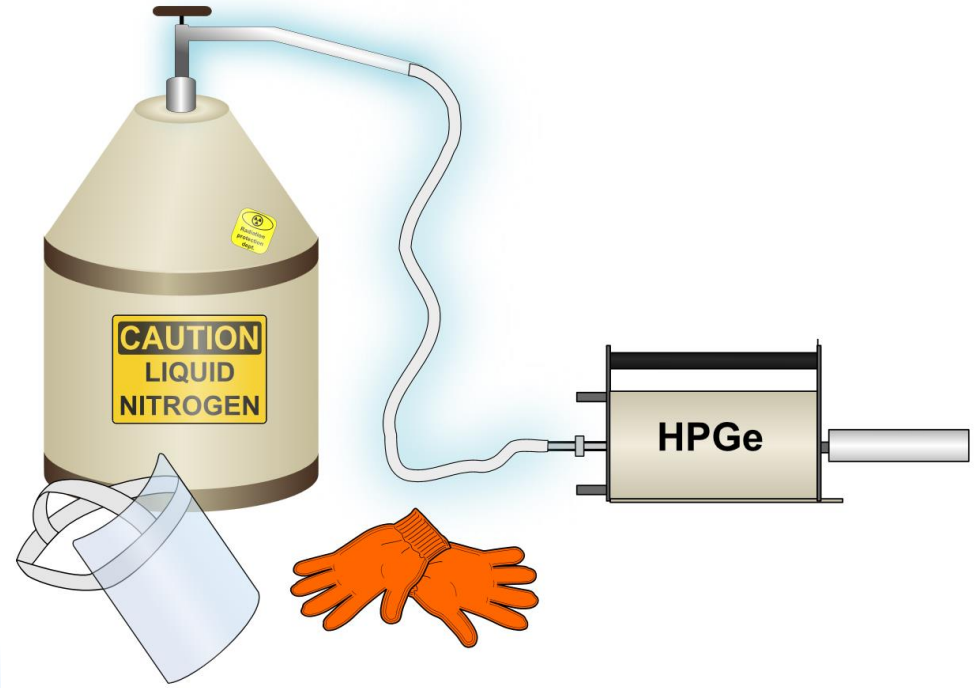
Useful accessories

- Collimator
- Contamination protection (personal and equipment)
- Dose rate meter
- Electronic dosimeters
- Laser distance meter
- Basic toolkit
- Spare batteries
- Check source(s)
- Duct tape
- Sampling tools
- …



Cooling the detector (HPGe)

- Initiated 4-24 hours prior to measurement



Checking the equipment

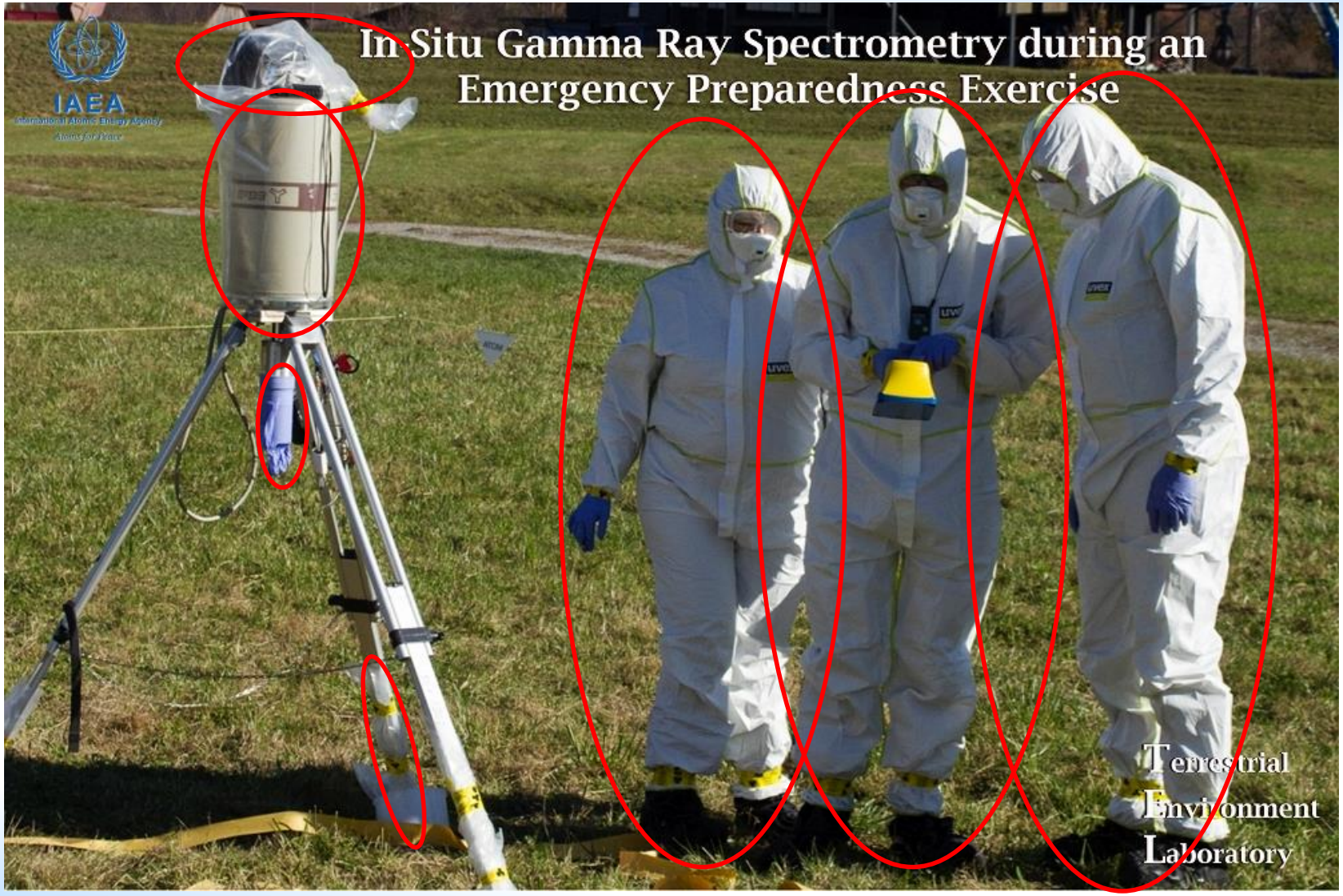
- **Before/during** measurement campaign
  - Check source measurement. E.g. Am-241 (60 keV), Cs-137 (662 keV) and Co-60 (1173 and 1332 keV)

Parameter	Check of…
Peak centroid position	System gain / energy calibration
Peak FWHM / FWTM	System resolution
Peak cps (decay corrected)	System efficiency

- **After** measurement campaign

Parameter	Check of…
System total background cps	Possible detector contamination

Protection from contamination



Choosing a measurement site

- The ideal measurement site should be…
  - As flat as possible
  - Relatively large (>400m^2)
  - Without any large obstructions or irregularities
  - Untreated by agriculture, industry, etc.

- Any deviation from the above will add to the overall uncertainty of the measurement

Positioning the detector

- Detector is placed facing down approx. 100 cm height above the ground
- Make sure tripod (or equivalent) is placed securely with no risk of tipping over
- Guidance in ISO18589-7:2013
  - Uncollimated detector: Several cm variation in the height is acceptable
  - Collimated detector: Height above ground should be determined within ± 5%
- Take care to ensure detector face is perpendicular to ground surface

Performing the measurement

- Set appropriate counting time
  - Typically between 3 and 60 minutes

- Avoid high dead times (> 30 %) if possible

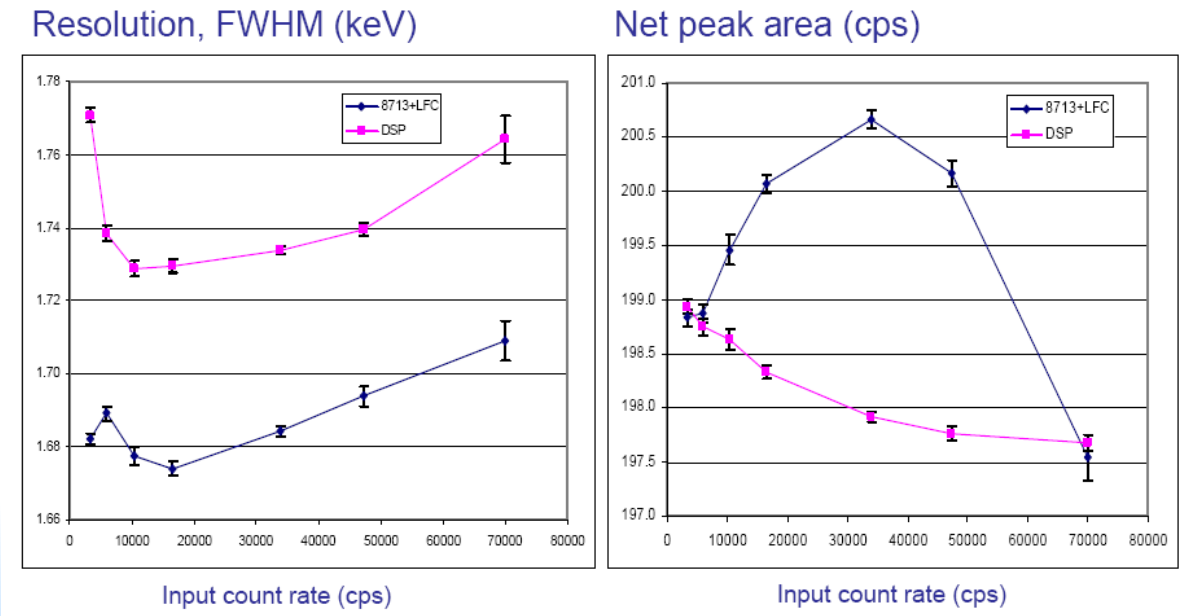


Figure:
Gyula Kis-Benedek

During the measurement

- Stand at least 3-4 meters away from the detector

- While waiting for the acquisition to finish…
  - Document all relevant parameters
  - Start planning the next operation

Activity calculation

- Source geometry must be approximated!

- Assumed depth distribution and soil density both have a strong influence on the calculated result

ISO 18589-7:2013 method:

1. Estimate minimum and maximum model parameters, and calculate geometry factor and relative flux densities using both “extremes”
2. Assume that the minimum and maximum calculations represent the endpoints of a rectangular distribution

Documenting the measurement

- Some parameters of interest:
  - Date and time
  - Environmental conditions
  - Site ID
  - GPS coordinates
  - Ambient dose rate
  - Spectrum file name

Documenting the measurement

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Measurement log for *in situ* gamma spectrometry

This form is to be filled out as applicable and signed by a responsible person. One form is filled out per measurement site and gamma detector.

Date/time: _____ **Site:** _____

Terrain/vegetation: _____

Environmental conditions: _____

Gamma detector model: _____ **Serial no:** _____

Dose rate instrument model: _____ **Serial no:** _____

Time (HH:MM)	Measurement point ID	Spectrum file name	GPS Latitude	GPS Longitude	Dose rate (µGy/h)

Comments:

Prepared by (date/sign.): _____

Results reporting form for *in situ* gamma spectrometry

This form is to be filled out as applicable and signed by a responsible person. One form is filled out per measurement point and gamma detector (i.e. several forms per site if applicable).

Date/time: _____ **Site:** _____

Measurement point ID: _____ **GPS Lat.:** _____ **GPS Long:** _____

Environmental conditions: _____

Ambient dose rate at measurement point: _____ **[uSv/h]**

Gamma detector model: _____ **Serial no:** _____

Dose rate instrument model: _____ **Serial no:** _____

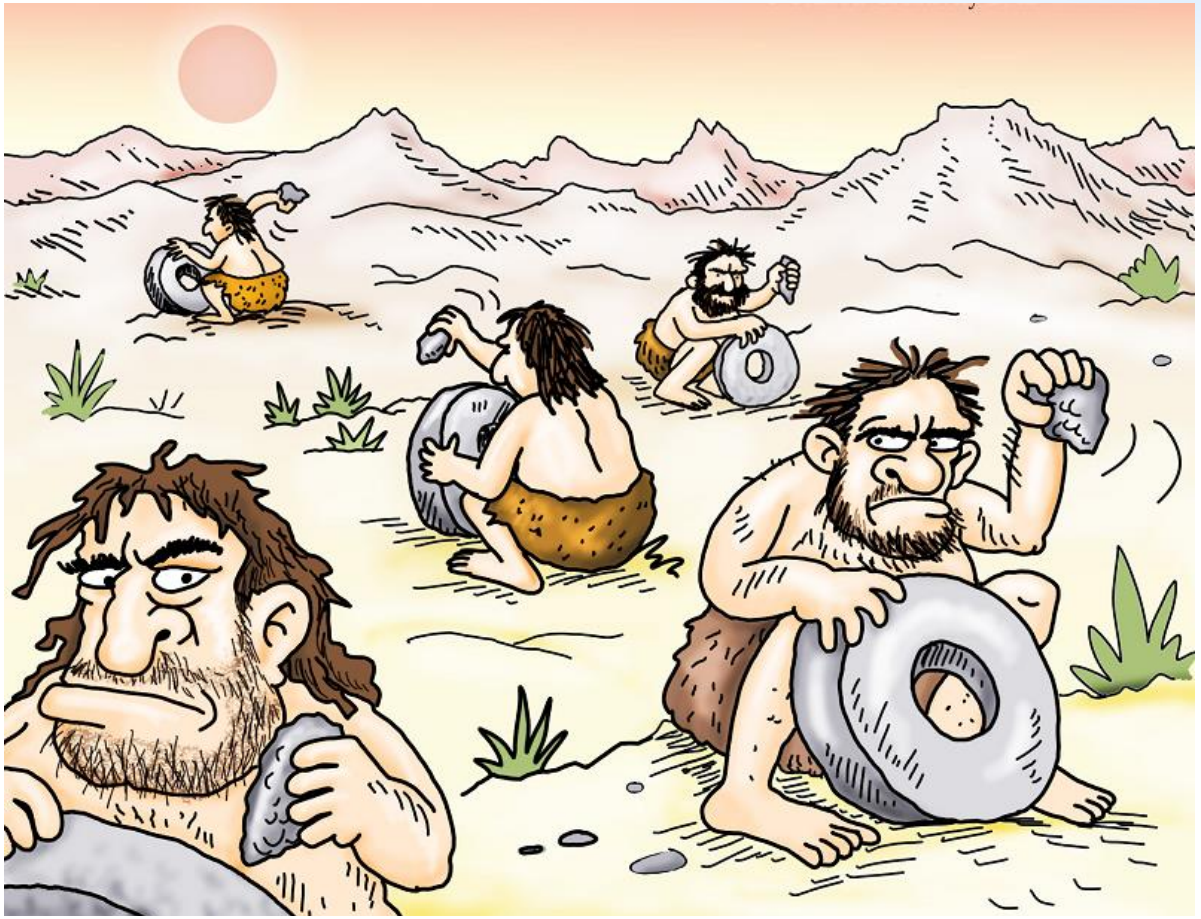
Nuclide	Source model assumed	Activity concentration	Dose rate

Activity concentration results should be reported on the form C ± σ. Remember to state the unit of measurement for activity concentration and dose rate.

Comments:

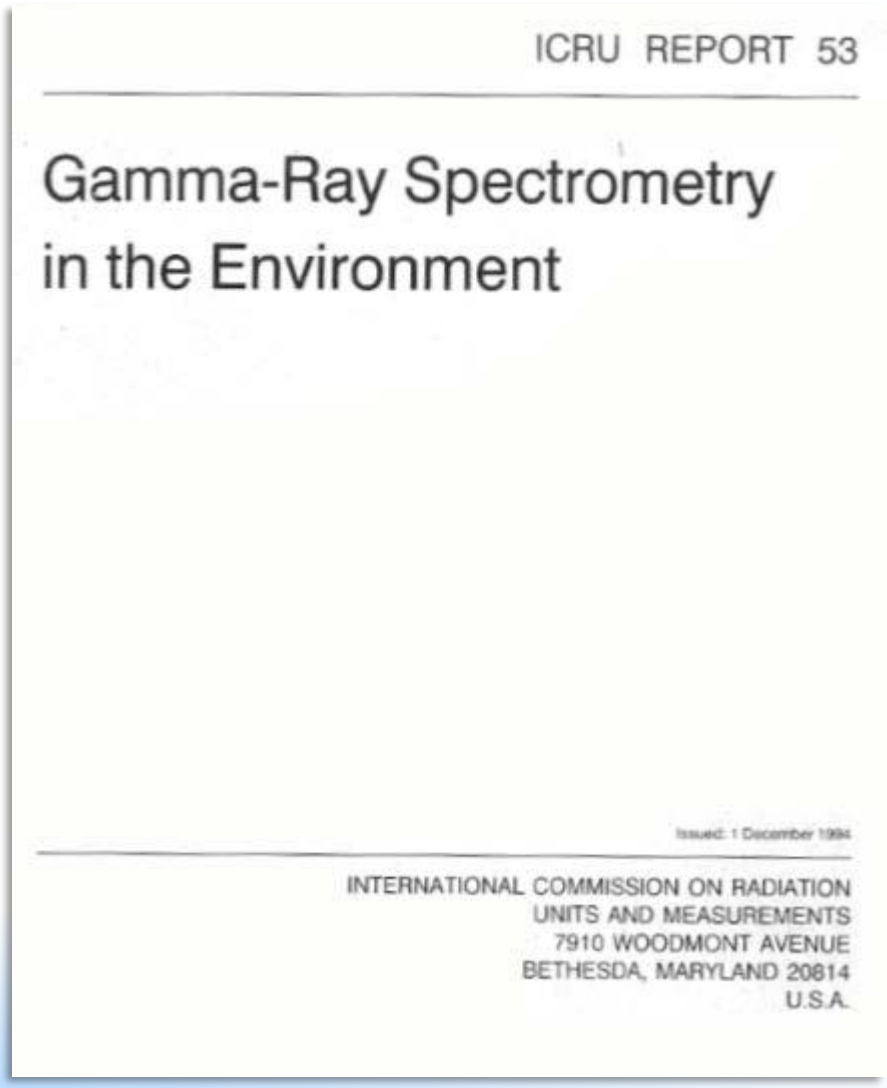
Prepared by (date/sign.): _____

Guidance documents



No need to reinvent the wheel!

Guidance documents

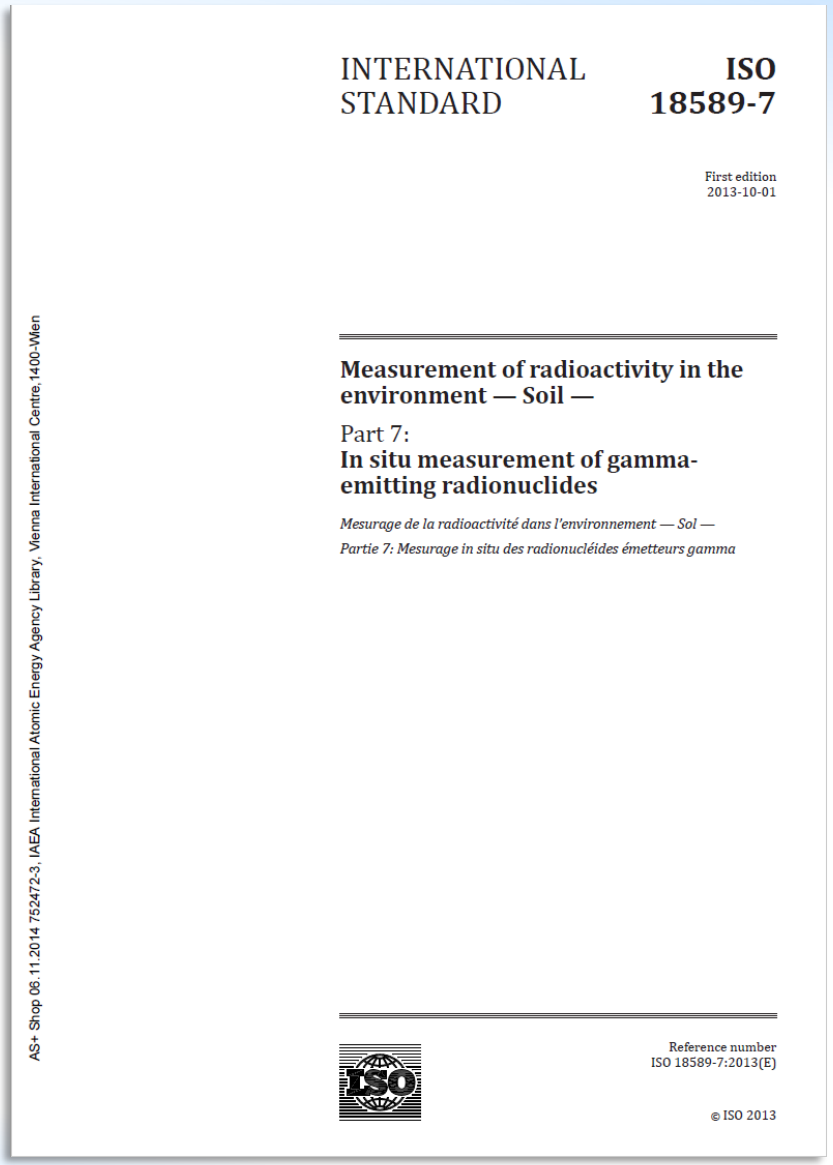


ICRU REPORT 53

Gamma-Ray Spectrometry in the Environment

Issued: 1 December 1994

INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS
7910 WOODMONT AVENUE
BETHESDA, MARYLAND 20814
U.S.A.



INTERNATIONAL STANDARD

ISO 18589-7

First edition
2013-10-01

Measurement of radioactivity in the environment — Soil —

Part 7:
In situ measurement of gamma-emitting radionuclides

Mesurage de la radioactivité dans l'environnement — Sol —
Partie 7: Mesurage in situ des radionucléides émetteurs gamma

Reference number
ISO 18589-7:2013(E)

Guidance documents

- Beck, H.L., DeCampo, J., Gogolak, C., 1972. *In situ* Ge(Li) and NaI(Tl) gamma-ray spectrometry, HASL-258, Health and Safety Laboratory, U.S. Atomic Energy Commission, New York, New York.
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- Helfer, I.K., Miller, K.M., 1988. Calibration factors for Ge detectors used for field spectrometry, Health Physics 55(1), 15-29.
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- Miller, M.M., Shebell, P., 1993. *In situ* gamma-ray spectrometry – A tutorial for environmental radioscientists, EML-557, Environmental Measurements Laboratory, U.S. Department of Energy, New York, New York.
- Tyler, A.N., 2008. *In situ* and airborne gamma-ray spectrometry, Radioactivity in the Environment 11, 407-448.

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Thank you for your attention!