

Traceability

The sources are traceable to standards held by national laboratories such as the Physikalisch-Technische Bundesanstalt (Germany), the National Physical Laboratory (UK), the National Institute of Standards and Technology (USA), the Laboratoire Primaire des Rayonnements Ionisants (France), and many other laboratories world-wide. Further details are given in section 9.1.

Certification

Each source is supplied with a certificate of calibration which states:

- Activity of radionuclide
- Uncertainty
- Reference time and date
- Activity of any gamma-ray emitting impurities detected, expressed as a percentage of the activity of the main radionuclide at the reference time
- Serial number
- ISO classification
- Results and date of leakage test

Quality assurance

The sources are calibrated at Eckert & Ziegler Nuclitec's DKD accredited measurement laboratory at Eckert & Ziegler Nuclitec in Germany. The facility operates a quality management systems which have been independently audited and approved to ISO9001:1994.

ISO classification

The International Organization for Standardization has published a classification of sealed sources based on safety requirements of typical usage. The source types have been tested to ISO2919 which is equivalent to ANSI N542-1977 (see section 9.3). The ISO classification is given for each source type in the following pages.

Useful working life

The useful working life of the sources is usually limited by the half life of the radionuclide. In addition, regular improvements in source design and measurement mean that it is good working practice to renew the sources every 10 years.

Availability

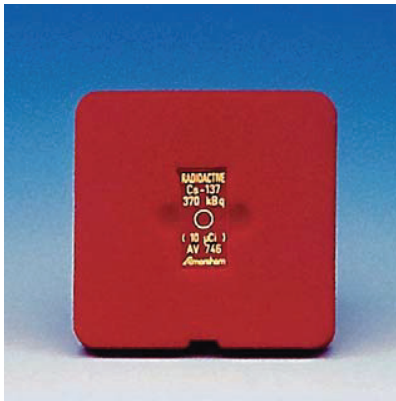
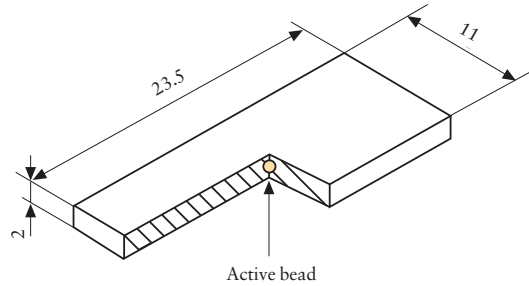
Sources are normally delivered within 6 weeks from receipt of order.

3. Point and tube sources (gamma and electron emitters)

3.2 Rectangular type sources

Construction

The radioactive isotope is absorbed in an ion-exchange bead approximately 1mm in diameter. The bead is fixed inside a solid plastic capsule. The active bead is visible, and located at the geometric centre of the source. The engraving is colour-coded.



Tolerance

The maximum deviation of the delivered activity from the nominal values is -10% to +30% for all radionuclides with the exception of Hg-203 which is -10% to +50%.

Absorption corrections

The effect of absorption and scattering in the source depends on the measurement geometry and the measurement equipment. The table below shows the transmission factor for the main gamma rays emitted. Transmission factors at other energies may be calculated by interpolation. The transmission factor is the fraction of gamma rays produced in the source that will emerge from its surface calculated for narrow beam emission normal to the plane of the source.

ISO classification

C.34343
Drawing: VZ-1240

Energy [keV]	Radionuclide	Transmission factor
60	Am-241	0.970
88	Cd-109	0.981
122	Co-57	0.982
279	Hg-203	0.986
344	Eu-152	0.987
662	Cs-137	0.990
834	Mn-54	0.991
1173	Co-60	0.993
1836	Y-88	0.994

3. Point and tube sources (gamma and electron emitters)

3.2 Rectangular type sources

Ordering information - Single radionuclides

Radionuclide	Nominal activity [kBq]	Overall uncertainty [%]	Product code (DKD certificate)
Am-241	37	3	AMR1122
	370	3	AMR1152
Ba-133	37	3	BDR1122
	370	3	BDR1152
Cd-109	37	4	CUR1122
	370	4	CUR1152
Cs-137	37	3	CDR1122
	370	3	CDR1152
Co-57	37	3	CTR1122
	370	3	CTR1152
Co-60	37	3	CKR1122
	370	3	CKR1152
Eu-152	37	3	EFR1122
	370	3	EFR1152
Hg-203	74	4	MBR1222
	740	4	MBR1252
Mn-54	37	3	MFR1122
	370	3	MFR1152
Na-22	37	3	SKR1122
	370	3	SKR1152
Y-88	37	3	YER1122
	370	3	YER1152



Radionuclide sets

Each set of sources is supplied in a presentation box which also contains a pair of forceps, two positron absorbers, and an adaptor plate. For easy reference, a copy of the calibration information is shown in the lid of the box.

Ordering information - Radionuclide sets

Radionuclide	Nominal activity [kBq]	Product code (DKD certificate)
Set 1, containing:		QCR3110
Am-241	37	(total activity = 370kBq)
Ba-133	37	
Cs-137	37	
Co-57	37	
Co-60	37	
Hg-203	74	
Mn-54	37	
Na-22	37	
Y-88	37	
Set 2, containing:		QCR310
Am-241	370	(total activity = 3.7MBq)
Ba-133	370	
Cs-137	370	
Co-57	370	
Co-60	370	
Hg-203	740	
Mn-54	370	
Na-22	370	
Y-88	370	

3. Point and tube sources (gamma and electron emitters)

3.3 Disc type sources



Construction

With the exception of Ra-226, Am-241 and Pb-210 sources, the radioactive isotope is absorbed in an ion-exchange bead approximately 1mm in diameter. The bead is fixed inside a solid plastic capsule 25mm in diameter and 3mm thick. The active bead is visible, and located at the geometric centre of the source.

For Am-241 and Pb-210, the active component is in the form of a ceramic bead.

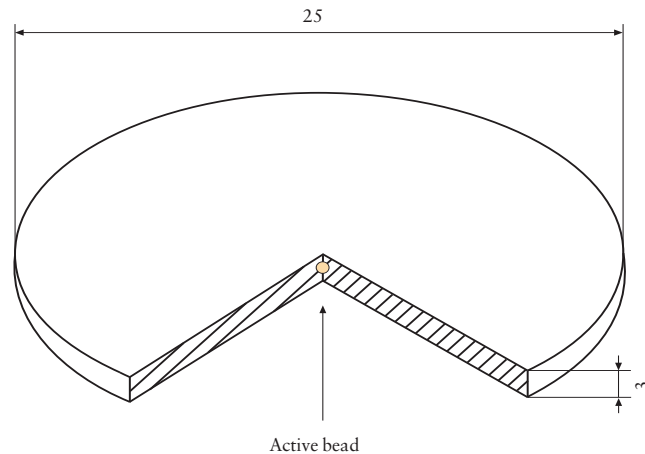
For Ra-226, the ion exchange bead is sealed inside a glass capillary tube before being fixed inside a 6 mm thick plastic disc. This construction (drawing VZ-590) reduces the possibility of release of radon gas from the decay of Ra-226.

Tolerances

The maximum deviation of the delivered activity from the nominal values is -10% to +30% for all radionuclides with the exception of Hg-203 (which is -10% to +50%) and Ra-226 (which is $\pm 30\%$).

ISO classification

C.34313
 Drawing: VZ-477
 Drawing: VZ-478
 (Pb-210, Am-241)



(Note: Ra-226 sources are 6mm thick.)

Absorption corrections

The effect of absorption and scattering in the source depends on the measurement geometry and the measurement equipment. The table shows the transmission factor for the main gamma rays emitted. Transmission factors at other energies may be calculated by interpolation. The transmission factor is the fraction of gamma-rays produced in the source that will emerge from its surface calculated for narrow beam emission normal to the plane of the source.

Energy [keV]	Radionuclide	Transmission factor
47	Pb-210	0.964
60	Am-241	0.958
88	Cd-109	0.970
122	Co-57	0.973
279	Hg-203	0.979
344	Eu-152	0.979
662	Cs-137	0.985
834	Mn-54	0.987
1173	Co-60	0.988
1836	Y-88	0.991

3. Point and tube sources (gamma and electron emitters)

3.3 Disc type sources

Ordering information - Single radionuclides

Radionuclide	Nominal activity [kBq]	Overall uncertainty [%]	Product code (DKD certificate)
Am-241	37	3	AMR8122
	370	3	AMR8152
Ba-133	37	3	BDR8122
	370	3	BDR8152
	3700	3	BDR8252
Cd-109	370	4	CUR8152
Cs-137	37	3	CDR8122
	370	3	CDR8152
	3700	3	CDR8252
Co-57	37	3	CTR8122
	370	3	CTR8152
	3700	3	CTR8252
Co-60	37	3	CKR8122
	370	3	CKR8152
	3700	3	CKR8252
Eu-152	37	3	EFR8122
	370	3	EFR8152
Hg-203	74	4	MBR8222
	740	4	MBR8252
Mn-54	37	3	MFR8122
	370	3	MFR8152
Na-22	37	3	SKR8122
	370	3	SKR8152
	3700	3	SKR8252
Pb-210	200	4	RBR8122
Ra-226	100	3	RARB9480
Y-88	37	3	YER8122
	370	3	YER8152



Radionuclide set

The set contains 8 sources of long-lived radionuclides for calibrating gamma-ray spectrometers from 46keV to 1836keV.

The set of sources is supplied in a presentation box and includes a positron absorber. For easy reference, a copy of the calibration information is shown in the lid of the box.

Ordering information - Radionuclide set

Radionuclide	Nominal activity [kBq]	Product code (DKD-Certificate)
Set comprising:		QCRB9481 (total activity = 452kBq)
Am-241	37	
Ba-133	37	
Cs-137	37	
Co-60	37	
Eu-152	37	
Na-22	37	
Pb-210	200	
Ra-226	30	