

# WIDE AREA REFERENCE SOURCES

This section contains details of sealed sources for calibrating surface contamination monitors. A wide range of

products with different dimensions and radionuclides is available. Also shown are sources designed for specific instruments and applications: calibration standards for Harwell Instrument monitors; photon emitting standards; tritium standards; standards for hand, foot, and whole body monitors.

To help you to select the right source for your application, information on source construction and measurement is included. Sources with dimensions and radionuclides other than those shown may also be available. Please use the form at the end of this section for your requests.



isotrak™

 Eckert & Ziegler  
Nuclitec

## 1. Wide area reference sources

### 1.1 General information



#### Applications

One of the fundamental principles of radiation protection is that the dose to workers must be as low as reasonably practicable. In many laboratories the main risk is from ingestion or inhalation of the radionuclides. It is normal practice to monitor the workplace for surface contamination regularly and, in some cases, to check for airborne radioactive particles.

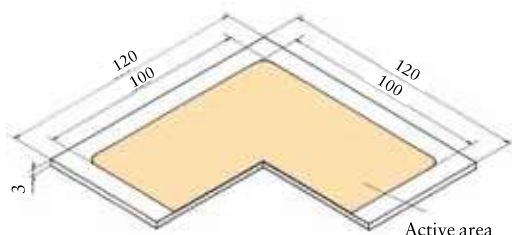
Eckert & Ziegler Nuclitec GmbH's range of wide area reference sources is designed for calibrating portable surface contamination monitors, fixed hand/foot monitors and planchet counters for filter papers.

The main applications are

- Calibrating instruments to meet statutory requirements
- Instrument type testing
- Pre-use testing of instruments to prove fitness for purpose

Sources are normally constructed from anodized aluminium foils. This type of construction results in:

- Robust, durable, sealed sources
- A thin deposit of activity to comply with international standards (ISO8769, ISO7503): the energy distribution of particles is not distorted by the source construction, which means that instrument response is easy to interpret



#### Construction

The sources are constructed to meet the requirements of ISO8769 (see section 9.4). The activity is incorporated in the top surface of an aluminium foil resulting in a source which has an active layer only 5µm (0.8mg/cm<sup>2</sup>) in depth. The source is also robust.

To produce anodized foil sources, micropores are etched into the surface of a 0.3mm thick aluminium foil. The micropores are less than 0.01µm in diameter, and are 4-10µm deep. The active material is then incorporated in the pores in an insoluble chemical form. The pores are chemically sealed to produce a thin layer which is mechanically robust and chemically resistant.

To construct a rigid source, the aluminium foil is mounted on a backing plate.

## Measurement of emission rate and uniformity

### Emission rate

The quantity of interest for wide area reference sources is the particle emission rate. This quantity is used to calibrate the instruments, and the calibration is related back to the quantity of radiological importance (the activity of the radionuclide) following the procedure in ISO7503 or national recommendations.

The particle emission rate is measured using a high efficiency windowless and/or windowed proportional counter, which is calibrated using a Class 1 source. All particles which are emitted from the surface with an energy greater than 590eV are detected. A particle emitted by a decaying nucleus can be scattered by the source material, or can lose energy in a series of inelastic collisions. The probability of high angle scattering of an alpha particle is very low, and the energy loss in inelastic collisions is low (until the alpha particle reaches the end of its range). For an alpha source, the emission rate is therefore approximately half the activity. Beta particles are deflected relatively easily, and low energy beta particles can quickly lose energy. Consequently, backscatter from the source backing plate and self-absorption of particles in the source material are more significant, and the emission rate can be greater or less than half of the activity, depending on the end-point energy of the beta particles. Typical ratios are shown below:

Radionuclide	Beta end-point energy [MeV]	Ratio of particle emission rate to activity (source efficiency)
C-14	0.156	0.38
Pm-147	0.225	0.48
Tc-99	0.294	0.49
Co-60	0.318	0.48
Cl-36	0.710	0.63
Cs-137	0.514	0.61
Sr-90 / Y-90	0.546 / 2.280	0.63
Ru-106/Rh-106	3.541	0.64

### Uniformity

The uniformity of each source is checked in accordance with ISO8769.

### Uncertainties

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k=2$ , providing a level of confidence of approximately 95% (see section 9.2). Sources are offered with a choice of DKD certificate (measurement uncertainty less than 5%) or Eckert & Ziegler Nuclitec GmbH certificate (measurement uncertainty less than 10%). Sources that are greater than 100cm<sup>2</sup> in area are in addition classified as class 2 or working sources in compliance with ISO8769 (see section 9.4).

For Class 2 sources, the uncertainty in the particle emission rate and activity is equal to or less than  $\pm 5\%$  ( $k=2$ ).

For natural uranium sources the uncertainty in the activity is  $\pm 10\%$ .

For comparison: ISO 8769 recommends that activity and surface emission rate shall be stated with an uncertainty not exceeding  $\pm 6\%$  ( $k=1$ ), which is equal to  $\pm 12\%$  for  $k=2$ .

For Working sources, the uncertainty in the particle emission rate and activity is equal to or less than  $\pm 10\%$ .

### Certification

Each source is supplied with a certificate of calibration which states

- Radionuclide
- Serial number
- Reference time and date
- Measured particle emission rate into  $2\pi$
- Measured activity\*
- Measurement uncertainties
- Date of leak test
- ISO classification

\* As the Tritium (H-3) activity cannot be calibrated, it is stated as a nominal value.

### Tolerances

The maximum deviation of the delivered activity from the nominal activity is  $\pm 30\%$ . Other tolerances are available on request.

### Traceability

The sources are calibrated in accordance with the requirements of ISO8769 and all measurements are traceable to national standards.

1.1 General information

Quality assurance

The sources are manufactured in a facility which operates a quality management system which has been independently audited and approved to ISO9001:1994.

ISO classification

The sources are tested to ISO2919 which is equivalent to ANSI N542 1977(see section 9.3). The assessed classification for the sources listed on page 11 to page 23 is C34645.

Advice on handling of sources and replacement

Sources should be recalibrated at regular intervals in accordance with national recommendations. Abrasion of the top surface of the aluminium foil will inevitably remove activity, although only from the sections of the source that have been physically damaged. Sources may be cleaned by wiping with a lint-free cloth moistened with alcohol. NB: Detergents or abrasive compounds such as metal polish should not be used.

To prevent loss of C-14 due to exchange of carbon with the atmosphere, C-14 sources should be kept in their storage box and kept out of strong sunlight and high humidity atmospheres when not in use.

Regular improvements in source design and measurement mean that it would be good working practice to renew the sources within 10 years.

Availability

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

Guide to selecting the source for the required application

1) Choose the nuclide to match (in terms of energy of particle emitted) the nuclide for which a calibration is needed.

Alpha emitting radionuclides

Radionuclide	Half life [years]	Main alpha particle energy [MeV]
U (nat)	4.5x10 <sup>9</sup>	4.199
Th-230	75,400	4.687
Pu-239	24,000	5.156
Am-241	433	5.486
Pu-238	88	5.499



## 1.1 General information

## Beta emitting radionuclides

Nuclide	Half life [years]	Beta end-point energy [MeV]
H-3	12.3	0.019
Ni-63	100	0.067
C-14	5700	0.156
Pm-147	2.6	0.225
Tc-99	214,000	0.294
Co-60	5.3	0.318
Cs-137	30	0.514
Cl-36	301,000	0.710
Sr-90/Y-90	28.8	0.546 / 2.280

## 2) Choose the active dimensions of the source

For portable contamination monitors the dimensions should be chosen so that the source is slightly larger than the detector window. This means that the source will simulate contamination spread over a large area, and all of the detector volume is irradiated.

For planchet counters, the source should be chosen to match the sample size. Please consult the instrument manual or manufacturer. (Please note that if the source size needed is not listed, Eckert & Ziegler Nuclitec GmbH can manufacture a source to meet your requirements - see page 31.)

## 3) Calculate the emission rate needed

For portable contamination monitors, the particle emission rate should be chosen to give an observed count rate well above the background.

1. Calculate the activity per unit area (Bq/cm<sup>2</sup>) needed to generate the required count rate. This can be calculated from the response factors (cps/Bq/cm<sup>2</sup>) given in the instrument manual, type test data, or from the instrument manufacturer.
2. Calculate the equivalent particle emission rate in particles emitted per second per square cm. By convention, this is normally taken to be half the activity, irrespective of nuclide, backscatter factors, etc.
3. Calculate the total emission rate of the source; the source area is given at the top of each table.
4. Choose the source with the emission rate that matches this value.

For planchet counters etc., consult the instrument manufacturer.

## 4) Choose the type of source required

Eckert & Ziegler Nuclitec GmbH recommends Class 2 sources for statutory calibration work, and Working sources for field use.

## 5) Select the product code from the tables on page 11 to page 23.

# 1. Wide area reference sources

## 1.1 General information

### Example

To calibrate a Mini Instruments EP15 detector for a beta-emitting radionuclide with an energy of approximately 2MeV. From the instrument handbook we know:

- 1) Diameter of window: 4.4cm
- 2) Quoted response to Sr-90: 4.0 counts per second / Bq/cm<sup>2</sup>



This picture shows the isotrak contamination monitor.

#### 1) Choose the nuclide

In this case, Sr-90 with a beta end-point energy of 2.284MeV is a good match

#### 2) Choose the active dimensions of the source

A source 5cm or more in diameter would be suitable.

#### 3) Calculate the emission rate needed

For a count rate of about 500 counts per second above background.

1. The source activity needed is:  
 $500 / 4.0 = 125 \text{ Bq/cm}^2$ , from the manufacturer's data
2. The emission rate needed is therefore, by convention,  
 $125 / 2.0 = 63 \text{ betas per second per cm}^2$   
(Note: with this method of calculating an 'effective activity', we can ignore the decay scheme of Sr-90; we only need consider the emission from the source)
3. The total emission rate from the source (radius 2.5cm) is given by:  
 $63 \times 20 \text{ cm}^2 = 1260 \text{ betas per second}$
4. The most suitable source is therefore  
SIR05021 or SIR05022 (see page 15)

#### 4) Select the type of source

For the annual or statutory calibration, the source with the DKD certificate is recommended.

#### 5) Select the product code

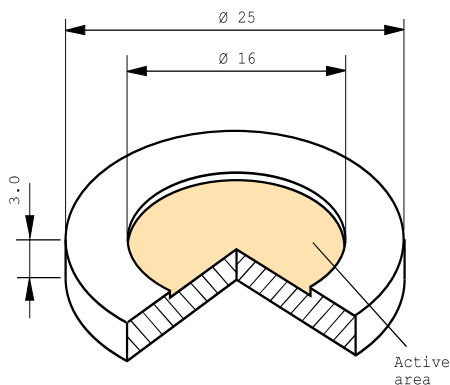
The best source for this application is therefore  
SIR05022

The measured count rate will not be exactly 500cps, due to the manufacturing tolerance of the source ( $\pm 30\%$ ) and variations in the detector construction.

## 1.2 Planchet sources



Planchet source: Drawing VZ-1366  
 Active diameter: 16mm ~ 2cm<sup>2</sup>  
 Overall dimensions: 25mm diameter x 3mm thick <sup>1)</sup>  
 Backing plate: Aluminium



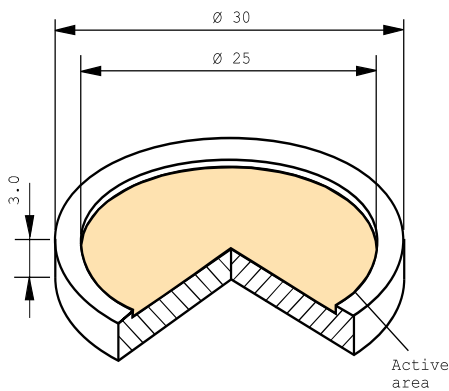
Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMR01011	AMR01012
	1 kBq	~ 480	AMR01021	AMR01022
	3 kBq	~ 1450	AMR01031	AMR01032
Pu-238	185 Bq	~ 90	PPR01011	PPR01012
	1 kBq	~ 480	PPR01021	PPR01022
Pu-239	20 Bq	~ 10	PIR01011	–
Th-230	185 Bq	~ 85	TZR01011	TZR01012
<b>Beta sources</b>				
H-3	5 kBq	~ 50-150	TRR01051	–
Ni-63	1 kBq	~ 100	NBR01021	–
C-14	1 kBq	~ 380	CFR01021	CFR01022
Pm-147	185 Bq	~ 75	PHR01011	PHR01012
	1 kBq	~ 410	PHR01021	PHR01022
Tc-99	185 Bq	~ 90	TCR01011	TCR01012
Co-60	185 Bq	~ 90	CKR01011	CKR01012
	1 kBq	~ 480	CKR01021	CKR01022
Cs-137	185 Bq	~ 115	CDR01011	CDR01012
	1 kBq	~ 610	CDR01021	CDR01022
	3 kBq	~ 1830	CDR01031	CDR01032
Cl-36	185 Bq	~ 117	CIR01011	CIR01012
	0.5 kBq	~ 315	CIR01021	CIR01022
Sr-90/Y-90 <sup>2)</sup>	185 Bq	~ 235	SIR01011	SIR01012
	1 kBq	~ 1270	SIR01021	SIR01022
	3 kBq	~ 3800	SIR01031	SIR01032

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

<sup>2)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

1. Wide area reference sources

1.2 Planchet sources

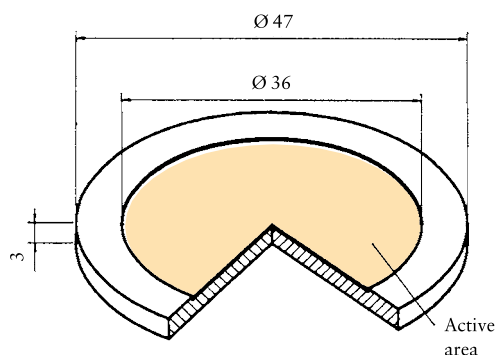


Planchet source: Drawing VZ-1367  
Active diameter: 25mm ~ 5cm<sup>2</sup>  
Overall dimensions: 30mm diameter x 3mm thick <sup>1)</sup>  
Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
Alpha sources				
Am-241	185 Bq	~ 90	AMR02011	AMR02012
	1 kBq	~ 480	AMR02021	AMR02022
	3 kBq	~ 1450	AMR02031	AMR02032
Pu-238	185 Bq	~ 90	PPR02011	PPR02012
	3 kBq	~ 1450	PPR02031	PPR02032
Pu-239	50 Bq	~ 25	PIR02011	PIR02012
Th-230	185 Bq	~ 85	TZR02011	TZR02012
	500 Bq	~ 230	TZR02021	TZR02022
Natural U <sup>2)</sup> (U-238)	5 Bq	~ 4.6	UAR02011	–
Beta sources				
H-3	5 kBq	~ 50-150	TRR16021	–
Ni-63	1 kBq	~ 100	NBR02021	–
C-14	1 kBq	~ 380	CFR02021	CFR02022
Pm-147	1 kBq	~ 410	PHR02021	PHR02022
Tc-99	185 Bq	~ 90	TCR02011	TCR02012
	1 kBq	~ 490	TCR02021	TCR02022
Co-60	185 Bq	~ 90	CKR02011	CKR02012
	1 kBq	~ 480	CKR02021	CKR02022
Cs-137	185 Bq	~ 115	CDR02011	CDR02012
	1 kBq	~ 610	CDR02021	CDR02022
Cl-36	185 Bq	~ 117	CIR02011	CIR02012
	1 kBq	~ 315	CIR02021	CIR02022
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR02011	SIR02012
	1 kBq	~ 1270	SIR02021	SIR02022

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.  
<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.  
<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

## 1.2 Planchet sources



Planchet source: Drawing VZ-1368  
 Active diameter: 36mm ~ 10cm<sup>2</sup>  
 Overall dimensions: 47mm diameter x 3mm thick <sup>1)</sup>  
 Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMR03011	AMR03012
	1 kBq	~ 480	AMR03021	AMR03022
	3 kBq	~ 1450	AMR03031	AMR03032
Pu-238	185 Bq	~ 90	PPR03011	PPR03012
Pu-239	100 Bq	~ 50	PIR03031	PIR03032
Th-230	185 Bq	~ 85	TZR03011	TZR03012
	1 kBq	~ 460	TZR03021	TZR03022
Natural U <sup>2)</sup> (U-238)	5 Bq	~ 4.6	UAR03011	–
	10 Bq	~ 9.2	UAR03021	–
<b>Beta sources</b>				
H-3	10 kBq	100-300	TRR03011	–
Ni-63	1 kBq	~ 100	NBR03021	–
C-14	1 kBq	~ 380	CFR03021	CFR03022
Pm-147	1 kBq	~ 410	PHR03021	PHR03022
Tc-99	1 kBq	~ 490	TCR03021	TCR03022
Co-60	185 Bq	~ 90	CKR03011	CKR03012
	1 kBq	~ 480	CKR03021	CKR03022
Cs-137	185 Bq	~ 115	CDR03011	CDR03012
	1 kBq	~ 610	CDR03021	CDR03022
	3 kBq	~ 1830	CDR03031	CDR03032
Cl-36	185 Bq	~ 117	CIR03011	CIR03012
	1 kBq	~ 630	CIR03021	CIR03022
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR03011	SIR03012
	1 kBq	~ 1270	SIR03021	SIR03022
	3 kBq	~ 3800	SIR03031	SIR03032

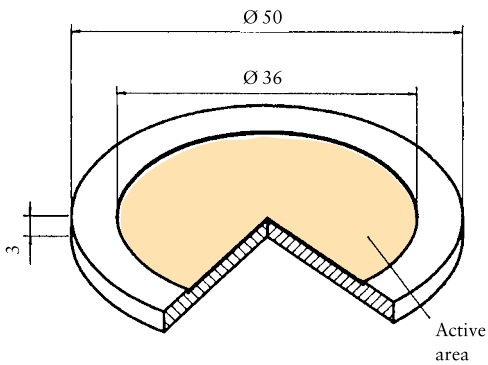
<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.

<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

1. Wide area reference sources

1.2 Planchet sources

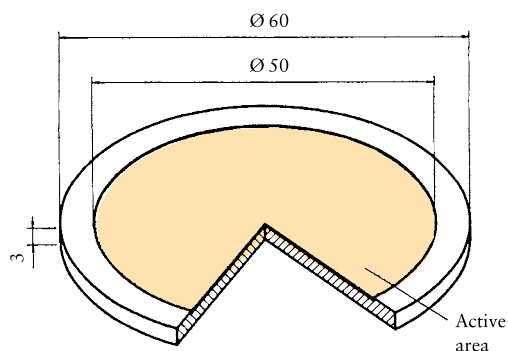


Planchet source: Drawing VZ-1369  
Active diameter: 36mm ~ 10cm<sup>2</sup>  
Overall dimensions: 50mm diameter x 3mm thick <sup>1)</sup>  
Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
Alpha sources				
Am-241	185 Bq	~ 90	AMR04011	AMR04012
	1 kBq	~ 480	AMR04021	AMR04022
Pu-238	185 Bq	~ 90	PPR04011	PPR04012
Pu-239	100 Bq	~ 50	PIR04011	PIR04012
Th-230	185 Bq	~ 85	TZR04011	TZR04012
	1 kBq	~ 460	TZR04021	TZR04022
Natural U <sup>2)</sup> (U-238)	5 Bq	~ 4.6	UAR04011	–
	10 Bq	~ 9.2	UAR04021	–
Beta sources				
H-3	10 kBq	100-300	TRR04011	–
Ni-63	1 kBq	~ 100	NBR04021	–
C-14	1 kBq	~ 380	CFR04021	CFR04022
	3 kBq	~ 1150	CFR04031	CFR04032
Pm-147	185 Bq	~ 75	PHR04011	PHR04012
Tc-99	185 Bq	~ 90	TCR04011	TCR04012
Co-60	185 Bq	~ 90	CKR04011	CKR04012
	1 kBq	~ 480	CKR04021	CKR04022
Cs-137	1 kBq	~ 610	CDR04021	CDR04022
Cl-36	1 kBq	~ 630	CIR04021	CIR04022
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR04011	SIR04012
	1 kBq	~ 1270	SIR04021	SIR04022
	3 kBq	~ 3800	SIR04031	SIR04032

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.  
<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.  
<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

## 1.2 Planchet sources



Planchet source: Drawing VZ-1370  
 Active diameter: 50mm ~ 20cm<sup>2</sup>  
 Overall dimensions: 60mm diameter x 3mm thick <sup>1)</sup>  
 Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMR05011	AMR05012
	1 kBq	~ 480	AMR05021	AMR05022
	3 kBq	~ 1450	AMR05031	AMR05032
Pu-238	185 Bq	~ 90	PPR05011	PPR05012
Pu-239	50 Bq	~ 25	PIR05011	PIR05012
Th-230	185 Bq	~ 85	TZR05011	TZR05012
	1 kBq	~ 460	TZR05021	TZR05022
Natural U <sup>2)</sup> (U-238)	5 Bq	~ 4.6	UAR05011	–
	10 Bq	~ 9.2	UAR05021	–
<b>Beta sources</b>				
H-3	10 kBq	100-300	TRR05011	–
Ni-63	1 kBq	~ 100	NBR05021	–
C-14	1 kBq	~ 380	CFR05021	CFR05022
Pm-147	185 Bq	~ 75	PHR05011	PHR05012
Tc-99	1 kBq	~ 490	TCR05021	TCR05022
Co-60	185 Bq	~ 90	CKR05011	CKR05012
	1 kBq	~ 480	CKR05021	CKR05022
	3 kBq	~ 1450	CKR05031	CKR05032
Cs-137	1 kBq	~ 610	CDR05021	CDR05022
Cl-36	1 kBq	~ 630	CIR05021	CIR05022
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR05011	SIR05012
	1 kBq	~ 1270	SIR05021	SIR05022
	3 kBq	~ 3800	SIR05031	SIR05032

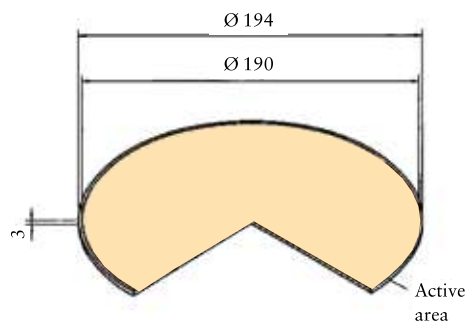
<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.

<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

# 1. Wide area reference sources

## 1.2 Planchet sources



Designed for EG & G Berthold  
Alpha-Beta Aerosolmonitor LB 150 D.

Planchet source: Drawing VZ-615  
Active diameter: 190 mm ~283cm<sup>2</sup>  
Overall dimensions: 194 mm diameter x 3mm height <sup>1)</sup>  
Backing plate: Aluminium

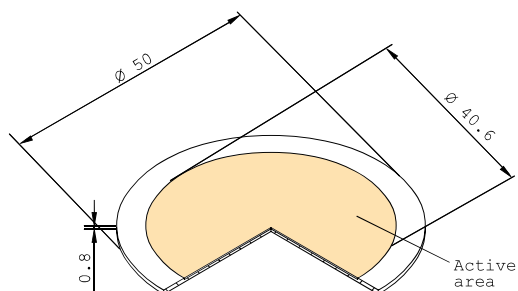
Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2
Alpha sources				
Am-241	1 kBq	~ 480	AMR11021	AMR11022
Pu-238	1 kBq	~ 480	PPR11021	PPR11022
Th-230	1 kBq	~ 460	TZR11021	TZR11022
Natural U <sup>2)</sup> (U-238)	150 Bq	~ 140	UAR11011	UAR11012
Beta sources				
C-14	1 kBq	~ 380	CFR11021	CFR11022
Pm-147	1 kBq	~ 410	PHR11021	PHR11022
Tc-99	1 kBq	~ 490	TCR11021	TCR11022
Co-60	1 kBq	~ 480	CKR11021	CKR11022
Cs-137	1 kBq	~ 610	CDR11021	CDR11022
Cl-36	1 kBq	~ 630	CIR11021	CIR11022
Sr-90/Y-90 <sup>3)</sup>	1 kBq	~ 1270	SIR01021	SIR11022

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.  
<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.  
<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.



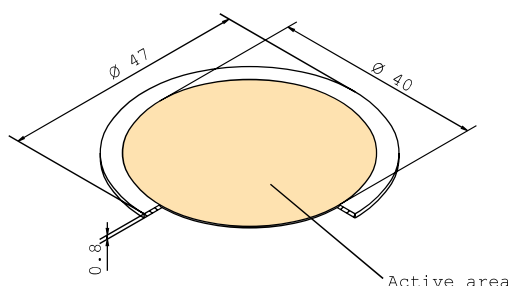
## 1.2 Planchet sources

### Thin sources for continuous-air-monitoring applications



Planchet source: Drawing VZ-1688  
 Active diameter: 40.6mm ~13cm<sup>2</sup>  
 Overall dimensions: 50mm diameter x 0.8mm thick <sup>1)</sup>  
 Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMRB5861	AMRB5862
	1 kBq	~ 610	AMRB5863	AMRB5864
<b>Beta sources</b>				
Cs-137	185 Bq	~ 115	CDRB5865	CDRB5866
	1 kBq	~ 610	CDRB5867	CDRB5868
Sr-90/Y-90 <sup>2)</sup>	185 Bq	~ 235	SIRB5869	SIRB5870
	1 kBq	~ 1270	SIRB5871	SIRB5872
Tc-99	185 Bq	~ 90	TCRB5873	TCRB5874
	1 kBq	~ 490	TCRB5875	TCRB5876
H-3	10 kBq	~ 100 - 300	TRRB3512	—



Planchet source: Drawing VZ-1964  
 Active diameter: 40mm ~12.5cm<sup>2</sup>  
 Overall dimensions: 47mm diameter x 0.8mm thick <sup>1)</sup>  
 Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMRB5877	AMRB5878
	1 kBq	~ 610	AMRB5879	AMRB5880
<b>Beta sources</b>				
Cs-137	185 Bq	~ 115	CDRB5881	CDRB5882
	1 kBq	~ 610	CDRB5883	CDRB5884
Sr-90/Y-90 <sup>2)</sup>	185 Bq	~ 235	SIRB5885	SIRB5886
	1 kBq	~ 1270	SIRB5887	SIRB5888
Tc-99	185 Bq	~ 90	TCRB5889	TCRB5890
	1 kBq	~ 490	TCRB5891	TCRB5892
H-3	10 kBq	~ 100-300	TRRB5893	—

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

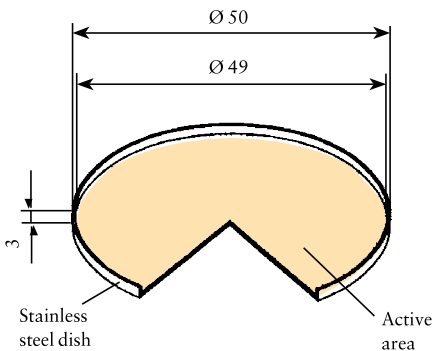
<sup>2)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

1. Wide area reference sources

1.3 Dish sources



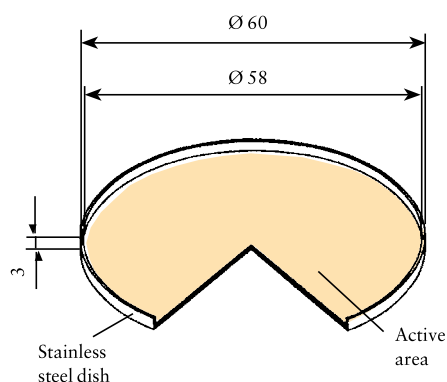
Dish source: Drawing VZ-1430  
Active diameter: 49 mm ~19cm²  
Overall dimensions: 50mm diameter x 3mm height <sup>1)</sup>  
Backing plate: Stainless steel



Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
Alpha sources				
Am-241	185 Bq 1 kBq	~ 90 ~ 480	AMR0811 AMR0821	AMR0812 AMR0822
Pu-238	185 Bq	~ 90	PPR0811	PPR0812
Pu-239	185 Bq	~ 90	PIR0811	PIR0812
Th-230	185 Bq	~ 85	TZR0811	TZR0812
Natural U <sup>2)</sup> (U-238)	5 Bq	~ 4.6	UAR0811	—
Beta sources				
H-3	10 kBq	100-300	TRR16081	—
Ni-63	185 Bq	~ 85	NBR0811	—
C-14	185 Bq	~ 70	CFR0811	CFR0812
Pm-147	1 kBq	~ 410	PHR0821	PHR0822
Tc-99	185 Bq	~ 90	TCR0811	TCR0812
Co-60	185 Bq 1 kBq	~ 90 ~ 480	CKR0811 CKR0821	CKR0812 CKR0822
Cs-137	185 Bq 1 kBq	~ 115 ~ 610	CDR0811 CDR0821	CDR0812 CDR0822
Cl-36	1 kBq	~ 630	CIR0821	CIR0822
Sr-90/Y-90 <sup>3)</sup>	185 Bq 1 kBq	~ 235 ~ 1270	SIR0811 SIR0821	SIR0812 SIR0822

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.  
<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.  
<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

## 1.3 Dish sources



Dish source: Drawing VZ-1431  
 Active diameter: 58mm ~26cm<sup>2</sup>  
 Overall dimensions: 60mm diameter x 3mm height <sup>1)</sup>  
 Backing plate: Stainless steel

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMR0911	AMR0912
	1 kBq	~ 480	AMR0921	AMR0922
Pu-238	185 Bq	~ 90	PPR0911	PPR0912
Pu-239	185 Bq	~ 90	PIR0911	PIR0912
Th-230	185 Bq	~ 85	TZR0911	TZR0912
	1 kBq	~ 460	TZR0921	TZR0922
	3 kBq	~ 1380	TZR0931	TZR0932
Natural U <sup>2)</sup> (U-238)	7.5 Bq	~ 7	UAR0911	UAR0912
<b>Beta sources</b>				
H-3	10 kBq	100-300	TRR16091	–
Ni-63	3 kBq	~ 300	NBR0931	–
C-14	1 kBq	~ 380	CFR0921	CFR0922
Pm-147	1 kBq	~ 410	PHR0921	PHR0922
Tc-99	1 kBq	~ 490	TCR0921	TCR0922
Co-60	185 Bq	~ 90	CKR0911	CKR0912
	1 kBq	~ 480	CKR0921	CKR0922
Cs-137	1 kBq	~ 610	CDR0921	CDR0922
Cl-36	1 kBq	~ 630	CIR0921	CIR0922
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR0911	SIR0912
	1 kBq	~ 1270	SIR0921	SIR0922

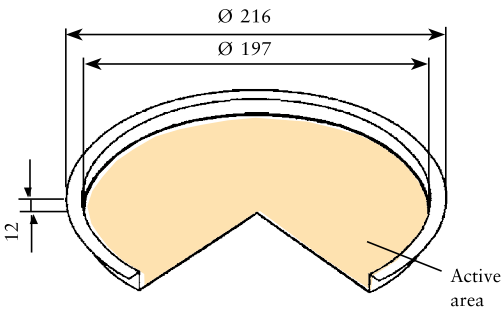
<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.

<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

1. Wide area reference sources

1.3 Dish sources

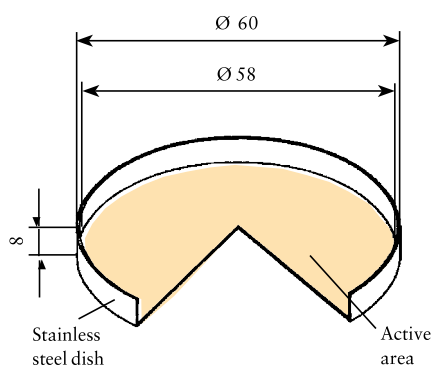


Dish source: Drawing VZ-339  
Active diameter: 197mm ~305cm<sup>2</sup>  
Overall dimensions: 216mm diameter x 12mm height <sup>1)</sup>  
Backing plate: Steel

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2
Alpha sources				
Am-241	185 Bq	~ 90	AMR1011	AMR1012
	1 kBq	~ 480	AMR1021	AMR1022
Pu-238	1 kBq	~ 480	PPR1021	PPR1022
Th-230	1 kBq	~ 460	TZR1021	TZR1022
Natural U <sup>2)</sup> (U-238)	150 Bq	~ 140	UAR1011	UAR1012
Beta sources				
C-14	1 kBq	~ 380	CFR1021	CFR1022
Pm-147	1 kBq	~ 410	PHR1021	PHR1022
Tc-99	1 kBq	~ 490	TCR1021	TCR1022
Co-60	1 kBq	~ 480	CKR1021	CKR1022
Cs-137	185 Bq	~ 115	CDR1011	CDR1012
	1 kBq	~ 610	CDR1021	CDR1022
Cl-36	1 kBq	~ 630	CIR1021	CIR1022
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR1011	SIR1012
	1 kBq	~ 1270	SIR1021	SIR1022

1) For other nuclides, activities and dimensions please enquire using the fax back form on page 32.  
2) The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.  
3) For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

## 1.3 Dish sources



Dish source: Drawing VZ-1392  
 Active diameter: 58mm ~26cm<sup>2</sup>  
 Overall dimensions: 60mm diameter x 8mm height <sup>1)</sup>  
 Backing plate: Stainless steel

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>				
Am-241	185 Bq	~ 90	AMR1411	AMR1412
10-sources-set	10 kBq/set	~ 480/source	QCR1421	QCR1422
4-sources-set	4 kBq/set	~ 480/source	QCR1441	QCR1442
Pu-238	185 Bq	~ 90	PPR1411	PPR1412
Natural U <sup>2)</sup> (U-238)	7.5 Bq	~ 7	UAR1411	UAR1412
<b>Beta sources</b>				
C-14	185 Bq	~ 70	CFR1411	CFR1412
Pm-147	185 Bq	~ 75	PHR1411	PHR1412
Tc-99	185 Bq	~ 90	TCR1411	TCR1412
Co-60	185 Bq	~ 90	CKR1411	CKR1412
Cs-137	185 Bq	~ 115	CDR1411	CDR1412
Cl-36	185 Bq	~ 117	CIR1411	CIR1412
Sr-90/Y-90 <sup>3)</sup>	185 Bq	~ 235	SIR1411	SIR1412
10-sources-set	10 kBq/set	~ 480/source	QCR1431	QCR1432
4-sources-set	4 kBq/set	~ 480/source	QCR1451	QCR1452

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

<sup>2)</sup> The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.

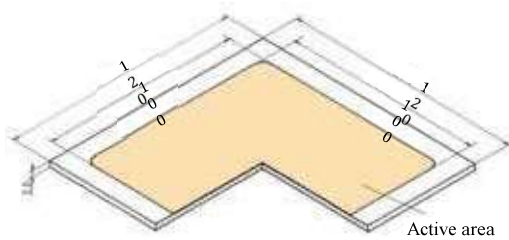
<sup>3)</sup> For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides, so the activity is approximately equal to the emission.

## 1.4 Rectangular sources



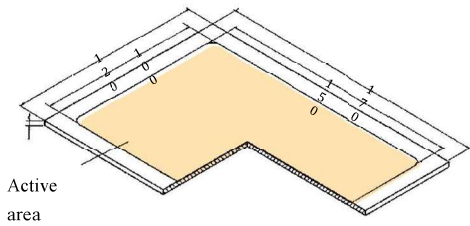
Planar source: Drawing VZ-626-001  
 Active dimensions: 100mm x 100mm ~100cm<sup>2</sup>  
 Overall dimensions: 120mm x 120mm x 3mm thick  
 Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate <sup>3)</sup>	Product code DAkKS certificate <sup>4)</sup>	Product code Class 2 ISO8769 <sup>5)</sup>
<b>Alpha Sources</b>					
Am-241	185 Bq	~ 90	AMR06011	AMR06013	AMR06012
	1 kBq	~ 480	AMR06021	AMR06023	AMR06022
	3 kBq	~ 1450	AMR06031	AMR06033	AMR06032
Pu-238	1 kBq	~ 480	PPR06021	PPR06023	PPR06022
Pu-239	50 Bq	~ 25	PIR06011	PIR06013	PIR06012
	1 kBq	~ 500	PIR06021	PIR06023	PIR06022
Th-230	185 Bq	~ 85	TZR06011	TZR06013	TZR06012
	1 kBq	~ 460	TZR06021	TZR06023	TZR06022
Natural U (U-238) <sup>1)</sup>	25 Bq	~ 23	UAR06011	UAR06013	-
	50 Bq	~ 46	UAR06021	UAR06023	-
	100 Bq	~ 92	UAR06031	UAR06033	-
<b>Beta Sources</b>					
C-14	1 kBq	~ 380	CFR06021	CFR06023	CFR06022
	3 kBq	~ 1150	CFR06031	CFR06033	CFR06032
Pm-147	1 kBq	~ 410	PHR06021	-	-
Tc-99	185 Bq	~ 185	TCR06011	TCR06013	TCR06012
	1 kBq	~ 490	TCR06021	TCR06023	TCR06022
	3 kBq	~ 1470	TCR06031	TCR06033	TCR06032
Co-60	1 kBq	~ 480	CKR06021	CKR06023	CKR06022
	3 kBq	~ 1450	CKR06031	CKR06033	CKR06032
Cs-137	185 Bq	~ 113	CDR06011	CDR06013	CDR06012
	1 kBq	~ 610	CDR06021	CDR06023	CDR06022
	3 kBq	~ 1830	CDR06031	CDR06033	CDR06032
Cl-36	1 kBq	~ 630	CIR06021	CIR06023	CIR06022
	3 kBq	~ 1900	CIR06031	CIR06033	CIR06032
Sr-90/ Y-90 <sup>2)</sup>	185 Bq	~ 235	SIR06011	SIR06013	SIR06012
	1 kBq	~ 1270	SIR06021	SIR06023	SIR06022
	3 kBq	~ 3800	SIR06031	SIR06033	SIR06032



- 1) The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.
- 2) For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides.
- 3) Sources supplied with EZN certificates comply with 'Working Class Sources' as defined in ISO8769:2016
- 4) DAkKS certificate are issued by Eckert & Ziegler Nuclitec's ISO17025 accredited laboratory
- 5) 'Class 2 Sources' according to ISO8769:2016 are supplied with DAkKS certificates, issued by Eckert & Ziegler Nuclitec's ISO17025 accredited laboratory.

## 1.4 Rectangular sources



Planar source: Drawing VZ-628-001  
 Active dimensions: 100mm x 150mm ~150cm<sup>2</sup>  
 Overall dimensions: 120mm x 170mm x 3mm thick  
 Backing plate: Aluminium

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate <sup>4)</sup>	Product code DAkKS certificate <sup>5)</sup>	Product code Class 2 ISO8769 <sup>6)</sup>
<b>Alpha sources</b>					
Am-241	1 kBq	~ 480	AMR07021	AMR07023	AMR07022
	3 kBq	~ 1450	AMR07031	AMR07033	AMR07032
Pu-238	185 Bq	~ 90	PPR07011	PPR07013	PPR07012
	1 kBq	~ 480	PPR07021	PPR07023	PPR07022
	3 kBq	~ 1440	PPR07031	PPR07033	PPR07032
Pu-239	50 Bq	~ 25	PIR07011	PIR07013	PIR07012
	1 kBq	~ 500	PIR07021	PIR07023	PIR07022
Th-230	1 kBq	~ 460	TZR07021	TZR07023	TZR07022
Natural U (U-238) <sup>1)</sup>	50 Bq	~ 46	UAR07011	UAR07013	-
	100 Bq	~ 92	UAR07021	UAR07023	-
	150 Bq	~ 138	UAR07031	UAR07033	-
<b>Beta sources</b>					
Ni-63	1 kBq	~ 100	NBR07021 <sup>2)</sup>	-	-
	3 kBq	~ 300	NBR07031 <sup>2)</sup>	-	-
C-14	1 kBq	~ 380	CFR07021	CFR07023	CFR07022
	3 kBq	~ 1150	CFR07031	CFR07033	CFR07032
Pm-147	1 kBq	~ 410	PHR07021	-	-
Tc-99	1 kBq	~ 490	TCR07021	TCR07023	TCR07022
	3 kBq	~ 1470	TCR07031	TCR07033	TCR07032
Co-60	1 kBq	~ 480	CKR07021	CKR07023	CKR07022
	3 kBq	~ 1450	CKR07031	CKR07033	CKR07032
Cs-137	1 kBq	~ 610	CDR07021	CDR07023	CDR07022
	3 kBq	~ 1830	CDR07031	CDR07033	CDR07032
Cl-36	185 Bq	~ 117	CIR07011	CIR07013	CIR07012
	1 kBq	~ 630	CIR07021	CIR07023	CIR07022
	3 kBq	~ 1900	CIR07031	CIR07033	CIR07032
Sr-90/ Y-90 <sup>3)</sup>	1 kBq	~ 1270	SIR07021	SIR07023	SIR07022
	3 kBq	~ 3800	SIR07031	SIR07033	SIR07032

1) The natural uranium source contains the uranium isotopes U-234, U-235 and U-238 (daughter nuclides below U-234 have been removed by a radiochemical separation procedure). U-238 is in equilibrium with U-234; the certificate states only the activity of the U-238 parent. The alpha surface emission rate consists of the emission rates of all uranium isotopes.

2) Calibrated for emission rate only, nominal activity reported

3) For Sr-90/Y-90 sources, the activity quoted on the certificate is that of the Sr-90 parent only. The emission rate quoted is from both nuclides.

4) Sources supplied with EZN certificates comply with 'Working Class Sources' as defined in ISO8769:2016

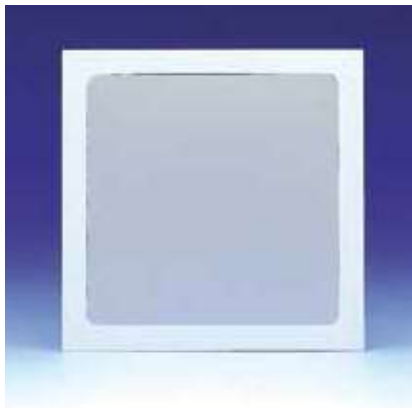
5) DAkKS certificate are issued by Eckert & Ziegler Nuclitec's ISO17025 accredited laboratory

6) 'Class 2 Sources' according to ISO8769:2016 are supplied with DAkKS certificates, issued by Eckert & Ziegler Nuclitec's ISO17025 accredited laboratory.

## 1. Wide area reference sources

### 1.5 Photon sources

#### Photon reference sources



The sources described below are designed to meet the requirements of ISO8769 part 2. The sources are used to characterise and calibrate surface contamination monitors for photon emitting radionuclides such as Ga-67, In-111 and Tl-201.  
Active dimensions: 100mm x 100mm  
Overall dimensions: 150mm x 150mm x 3mm height

Further details of these standards are given in section 9.4.  
The photon emission is calibrated at AWE Aldermaston.

Nuclide	Energy [keV]	Filter	Nominal activity [kBq]	Drawing	Product code
Fe-55	6	None	40	VZ-1658	IERB4536
Pu-238	17	32.5 mg/cm <sup>2</sup> zirconium	200	VZ-1775	PPRB4472
I-129	32	81 mg/cm <sup>2</sup> aluminium	30	VZ-1898	ISRB4474
Am-241	60	200 mg/cm <sup>2</sup> stainless steel	40	VZ-1776	AMRB4473
Co-57	124	200 mg/cm <sup>2</sup> stainless steel	35	VZ-1776	CTRB 3504
Cs-137	662	800 mg/cm <sup>2</sup> stainless steel	10	VZ-2162	CDRB4475
Co-60	1200	81 mg/cm <sup>2</sup> aluminium	5	VZ-1898	CKRB4476

#### Other photon emitting standards

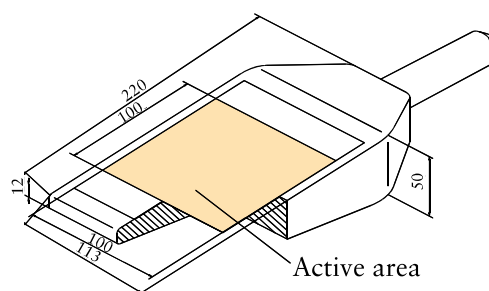
The sources listed in the table are a range of photon emitting radionuclides. The certificate of calibration states the activity of the source and not the emission.

Nuclide	Nominal activity [kBq]	Drawing	Active dimensions [mm]	Overall dimensions [mm]	Product code DKD certificate
<b>Planchet type</b>					
Fe-55	3	VZ-1366	diameter: 16	diameter: 25	IER01032
Co-57	3			height: 3	CTR01032
I-129	1	VZ-2130	diameter: 32	diameter: 50	ISRB5894
				height: 3	
<b>Planar type</b>					
Fe-55	3	VZ-626	100 x 100	120 x 120	IER06032
	10			height: 3	IER06102
Co-57	3				CTR06032
I-129	3	VZ-1957	100 x 100	120 x 120	ISRB5895
	10			height: 5	ISRB4180
Fe-55	3	VZ-628	100 x 150	120 x 170	IER07032
	10			height: 3	IER07102
Co-57	3				CTR07032
I-129	3	VZ-1958	100 x 150	120 x 170	ISRB5896
	10			height: 5	ISRB5897
<b>Dish type</b>					
Fe-55	3	VZ-1430	diameter: 49	diameter: 50	IER08032
Co-57	3			height: 3	CTR08032
Fe-55	3	VZ-1431	diameter: 58	diameter: 60	IER09032
Co-57	3			height: 3	CTR09032



## 1.6 Reference sources - hand and ladder type

## Alpha/beta hands



Alpha/beta hand sources are used for calibrating and checking hand monitors. The activated foil is mounted on one side of the aluminium hand<sup>1)</sup>.

Drawing: VZ-1614-001  
 Active dimensions: 100mm x 100mm  
 Overall dimensions: 113mm x 310mm x 50mm

Nuclide	Nominal activity	Particle emission rate [1/s]	Product code
<b>Alpha source</b>			
Am-241	1 kBq	~ 480	AMRB5929
<b>Beta sources</b>			
C-14	1 kBq	~ 380	CFRB5930
Cl-36	1 kBq	~ 630	CIRB5931
Co-60	1 kBq	~ 480	CKRB5932
Cs-137	1 kBq	~ 610	CDRB5933
Sr-90	1 kBq	~ 1270	SIRB5934
Tc-99	1 kBq	~ 490	TCRB5935

## Ladder sources



These sources are designed for calibrating NE Technology whole body monitors<sup>2)</sup>.

Drawing: VZ-1634  
 Active dimensions: each source 100mm x 100mm (6 sources)  
 Overall dimensions: 2020mm x 267mm

Nuclide	Nominal activity per source		Total activity	Product code <sup>3)</sup>
Cs-137	each	920 Bq	5.52 kBq	CDRX1878
Co-60	each	1.33 kBq	8 kBq	CKRX1916

<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the faxback form on page 34. The activated foils can also be mounted on both sides of the wooden hand.

<sup>2)</sup> For other types (dimensions, nuclides and activities) of ladder sources please enquire using the faxback form on page 32.

<sup>3)</sup> These sources have been designed particularly for the type IPM8A/IPM8D.

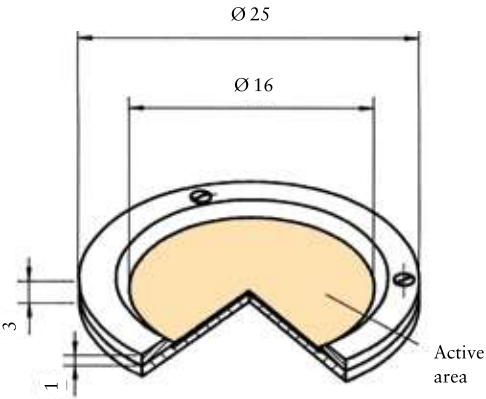
1. Wide area reference sources

1.7 Beta reference sources (high activity type)



Planchet source: Drawing VZ-599  
Active diameter: 16mm ~2cm<sup>2</sup>  
Overall dimensions: 25mm diameter x 3mm thick <sup>1)</sup>  
Backing plate: Aluminium

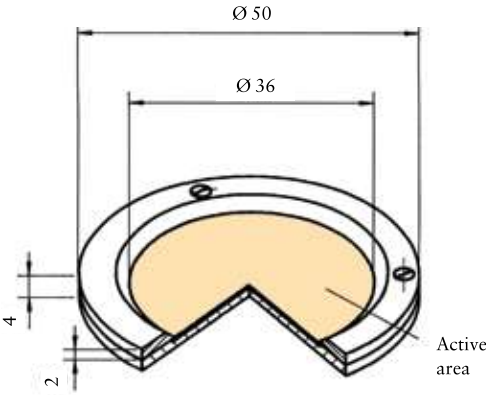
Nuclide	Nominal activity	Product code
Tc-99	37 kBq	TCR1211
Co-60	37 kBq 370 kBq	CKR1211 CKR1221
Cs-137	37 kBq 370 kBq	CDR1211 CDR1221
Cl-36	37 kBq	CIR1211
Tl-204	37 kBq 370 kBq	TER1211 TER1221
Sr-90/Y-90	37 kBq 370 kBq	SIR1211 SIR1221



Note:  
These sources are calibrated for activity. The emission rate is not calibrated.

Planchet source: Drawing VZ-605  
Active diameter: 36mm ~10cm<sup>2</sup>  
Overall dimensions: 50mm diameter x 4mm thick <sup>1)</sup>  
Backing plate: Aluminium

Nuclide	Nominal activity	Product code
Tc-99	37 kBq	TCR1311
Co-60	37 kBq 370 kBq	CKR1311 CKR1321
Cs-137	37 kBq 370 kBq	CDR1311 CDR1321
Cl-36	37 kBq	CIR1311
Tl-204	37 kBq 370 kBq	TER1311 TER1321
Sr-90/Y-90	37 kBq 370 kBq	SIR1311 SIR1321



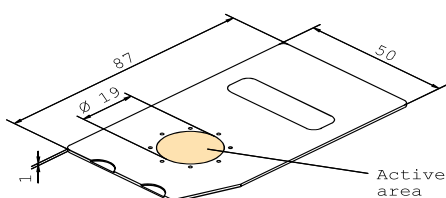
<sup>1)</sup> For other nuclides, activities and dimensions please enquire using the fax back form on page 32.

## 1.8 Sources for Harwell Instruments monitors

The sources listed below have been specially designed for calibrating and validating monitors manufactured by Harwell Instruments. The instruments are used for monitoring airborne contamination and surface contamination. Instructions on using the sources are given in the relevant instrument handbook.

Sources are available for use with the following instruments:

Instrument	Models
Alpha and beta in air monitors	3280, A85,3230, B96, A96 & AB96
Stack monitors	A31, B31
Drawer units	SC100, AB12
Filter paper scanners	AB14
Portable monitors	SC100 wound probe, B84 low energy beta probe
Tritium smear monitor	T13



### Alpha/Beta air monitors

Source:	Drawing VZ-2020 (except for SIRB3516 - drawing VZ-2029)
Active diameter:	19mm ~ 2.8cm <sup>2</sup>
Overall dimensions:	87mm x 50mm x 1mm height
Backing plate:	Stainless steel

Instrument type	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
<b>Alpha sources</b>					
A96 AB96	Am-241	320 Bq		AMRB3135	AMRB3518
A85(3280)	Pu-239	2 Bq 20 Bq		PIRK7430 PIRB3125	— PIRB3517
<b>Beta sources</b>					
B86(3230)	Sr-90	988 Bq 2000 Bq	~ 1250 ~ 2500	SIRB3090 SIRB3091	SIRB3021 SIRB3022
B96		14200 Bq	~ 15000	SIRB3516	—
AB96	Cl-36	198 Bq 396 Bq	~ 125 ~ 250	CIRB3088 CIRB3089	CIRB3028 CIRB3029

1.8 Sources for Harwell Instruments monitors

Stack monitors

Harwell Instruments source:  
Drawing VZ-2020

Active diameter:  
19mm ~ 2.8cm<sup>2</sup>

Overall dimensions:  
87mm x 5mm x 1mm height

Backing plate:  
Stainless steel

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class	Product code DKD certificate class 2 equivalent
Alpha sources					
A31	Am-241	320 Bq		AMRB3135	AMRB3518
Beta sources					
B31	Sr-90	988 Bq	~ 1250	SIRB3090	SIRB3021

Drawer units

Planchet source:  
Drawing VZ-1370

Active diameter:  
50mm ~ 20cm<sup>2</sup>

Overall dimensions:  
60mm diameter x 3mm height

Backing plate:  
Aluminium

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code DKD certificate class 2 equivalent
Alpha sources				
SC100	Am-241	1 kBq	~ 480	AMR05022
Beta sources				
SC100	Cl-36	1 kBq	~ 630	CIR05022
Alpha and Beta sources				
AB12	Am-241	1 kBq	~ 480	AMR05022
	Cl-36	1 kBq	~ 630	CIR05022

Filter paper scanners

Planchet source:  
Drawing VZ-1366

Active diameter:  
16mm ~ 2cm<sup>2</sup>

Overall dimensions:  
25mm diameter x 3mm height

Backing plate:  
Aluminium

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code DKD certificate class 2 equivalent
Alpha and Beta sources				
AB14 (25mm SAS)	Am-241	1 kBq	~ 480	AMR01022
	Cl-36	0.5 kBq	~ 315	CIR01022
AB14 (25mm PAS)	Am-241	1 kBq	~ 480	AMR01022
	Cl-36	0.5 kBq	~ 315	CIR01022

## 1.8 Sources for Harwell Instruments monitors

**Filter paper scanners**

Planchet source:  
Drawing VZ-1370

Active diameter:  
50mm ~ 20cm<sup>2</sup>

Overall dimensions:  
60mm diameter x 3mm height

Backing plate:  
Aluminium

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code DKD certificate class 2 equivalent
<b>Alpha and Beta sources</b>				
AB14 (50mm SAS)	Am-241	1 kBq	~ 480	AMR05022
	Cl-36	1 kBq	~ 630	CIR05022

**Hand held instruments**

Planchet source:  
Drawing VZ-1370

Active diameter:  
50mm ~ 20cm<sup>2</sup>

Overall dimensions:  
60mm diameter x 3mm height

Backing plate:  
Aluminium

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class
<b>Alpha and Beta sources</b>				
SC100	Am-241	1 kBq	~ 480	AMR05021
	Cl-36	1 kBq	~ 630	CIR05021

Planchet source:  
Drawing VZ-1366

Active diameter:  
16mm ~ 2cm<sup>2</sup>

Overall dimensions:  
25mm diameter x 3mm height

Backing plate:  
Aluminium

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class
<b>Beta source</b>				
B84	Cl-36	0.5 kBq	~ 315	CIR01021

**Tritium smear monitor**

Planchet source:  
Drawing VZ-497

Active diameter:  
49mm ~ 19cm<sup>2</sup>

Overall dimensions:  
50mm diameter x 1.5mm height

Backing plate:  
Aluminium

Instrument	Nuclide	Nominal activity	Particle emission rate [1/s]	Product code EZN certificate working class
<b>Beta source</b>				
T13	H-3	10 kBq	100-300	TRRK6400

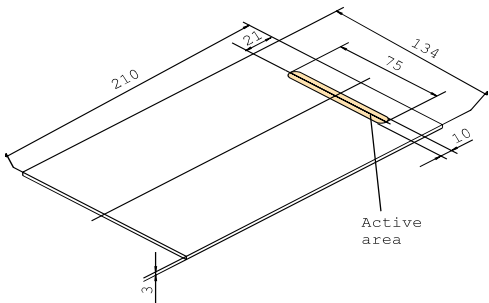
1. Wide area reference sources

1.9 Tritium reference sources



These wide area tritium sources are designed for the calibration and routine checking of tritium surface contamination monitoring equipment. Due to the extremely short range of Tritium (H-3) beta particles in air (approximately 4mm), the direct measurement of H-3 must be undertaken with great care. Therefore it is important to check the correct function of the detector using a suitable H-3 source immediately prior to measurement. These tritium sources are electrically conducting and do not suffer from the build up of electrostatic charge that can cause measurement problems. The thickness of the activated layer is approximately 3 microns. Tritium wide area reference sources are calibrated for  $\beta$ -emission only, not for activity.

Planar source for Eberline/ FAG tritium contamination monitor  
FHT 111M

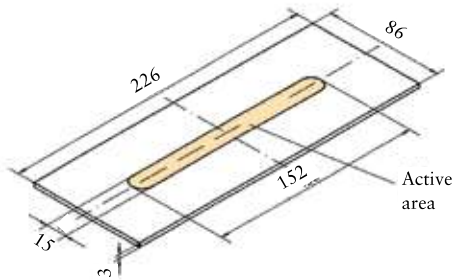


Drawing: VZ-1610<sup>1)</sup>  
Active dimensions: 10mm x 75mm  
Overall dimensions: 134mm x 210mm  
Backing plate: Aluminium

Radionuclide	Nominal activity	$\beta$ -emission rate [1/s]	Product code
H-3	10 kBq	100 - 300	TRRB1951



Planar source for Berthold tritium contamination monitor  
LB 6255



Drawing: VZ-1516<sup>1)</sup>  
Active dimensions: 15mm x 152mm  
Overall dimensions: 86mm x 226mm  
Backing plate: Aluminium

Radionuclide	Nominal activity	$\beta$ -emission rate [1/s]	Product code
H-3	10 kBq	100 - 300	<del>TRR16161</del> replaced by TRRB23652

<sup>1)</sup> For other activities and dimensions please see also pages 11 to 23.