



## Multigamma ray standards : water-equivalent



### • Use

Multigamma ray standards, characterized in terms of activity, are designed for energy and efficiency calibration of spectrometers used in low-activity measurements.

The resin matrices are characterized in water-equivalent activity, and are designed mainly for calibrating gamma spectrometers (GeLi, Ge hyperpure, etc.) in the field of environmental measurements.

- Density of resin:  $1.15 \pm 0.01 \text{ g.cm}^{-3}$
- Density of water:  $0.9982 \text{ g.cm}^{-3}$  (4/20°C)

They are designed to replace water matrices with aqueous media there is a risk of fixation on walls, or precipitation of certain radionuclides. These phenomena induce changes in geometry which impair functional and constancy testing of the measuring chain.

The use of water-equivalent resin matrices eliminates the risk of leakage and contamination during transport and handling, and ensures **stability over time** due to the incorporation of the radionuclides into a resin mass.

LEA offers the following water-equivalent resin matrices:

- barium-133,
- europium-152,
- mixture of radionuclides ( $^{241}\text{Am}$ ,  $^{109}\text{Cd}$ ,  $^{57}\text{Co}$ ,  $^{139}\text{Ce}$ ,  $^{51}\text{Cr}$ ,  $^{113}\text{Sn}$ ,  $^{85}\text{Sr}$ ,  $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{88}\text{Y}$ ),
- any other radionuclide or mixture on request.

These standard reference sources are delivered with a calibration certificate labelled COFRAC, EUROPEAN COOPERATION FOR ACCREDITATION, EA (ISO 17025).

### • Barium-133 and Europium-152

These multigamma ray sources cover the following energy ranges:

- 30 - 400 keV (barium-133)
- 122 - 1408 keV (europium-152)

and have the advantage of exhibiting the following half-lives:

- 10.5 years (barium-133)
- 13.53 years (europium-152).

### • Mixture of radionuclides

$^{241}\text{Am}$ ,  $^{109}\text{Cd}$ ,  $^{57}\text{Co}$ ,  $^{139}\text{Ce}$ ,  $^{51}\text{Cr}$ ,  $^{113}\text{Sn}$ ,  $^{85}\text{Sr}$ ,  $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{88}\text{Y}$

This mixture of radionuclides is made up proportionally to ensure equivalent counts for each of the energies.

The mixture of radionuclides enables water calibration of the detector in a **single operation** in the energy range from 60 to 1836 keV for each type of container.

This mixture has the advantage of providing a **simpler spectrum** than europium-152 and barium-133 standards, with few  $\gamma$ - $\gamma$  coincidences, and enabling plotting of the calibration curve of the detector up to 1836 keV (1408 keV for europium-152).

Even after decreasing of the short half-lived radionuclides it still remains a number of long-lived radionuclides.

These radionuclides enable further checking of part of the efficiency curve for certain energies (59.5 KeV for  $^{241}\text{Am}$ , 88.0 KeV for  $^{109}\text{Cd}$ , 122.0 and 136.5 KeV for  $^{57}\text{Co}$ , 661.7 KeV for  $^{137}\text{Cs}$ , 1173 and 1332.5 KeV for  $^{60}\text{Co}$  – in other words seven energies out of the thirteen initially present).



## • LEA recommends

- use of these matrices for calibration and periodic calibration checks of detectors,
- use of a source with a long half-life (for example <sup>152</sup>Eu) for functional and constancy testing of the measuring chain.

## • Validity

For <sup>133</sup>Ba and <sup>152</sup>Eu the validity is 2 years

The validity of the mixture multigamma standard is generally considered to be twice the shortest half-life. In this case, the period would be two months (twice the half-life of <sup>51</sup>Cr). However, the standard can be used for a relatively long period given the presence of long-lived radionuclides.

## • Type SG15 vial

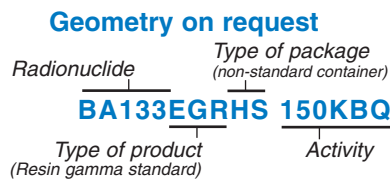
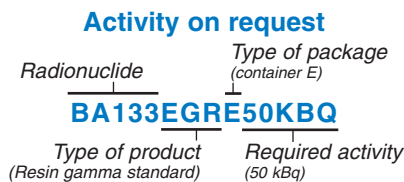
The use of this type of container is standardized in EDF\* or other nuclear power plant laboratories for routine gamma spectrometry activities with respect to the reactor coolant system.

\* Électricité De France

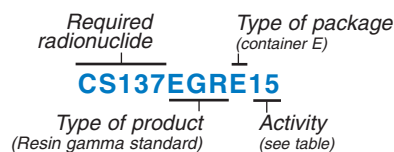
## • Type SG50N, SG500N,SG3000 vial and type *Marinelli beaker*.

The use of such containers is standardized in many laboratories for gamma spectrometry applications (environmental monitoring, and monitoring of aqueous effluent disposal).

## • Codification System for special request

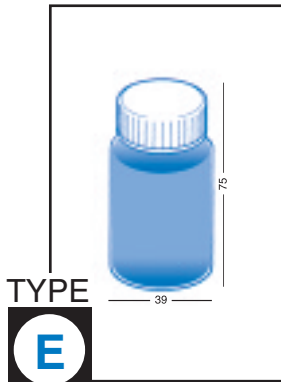


### Other radionuclide on request



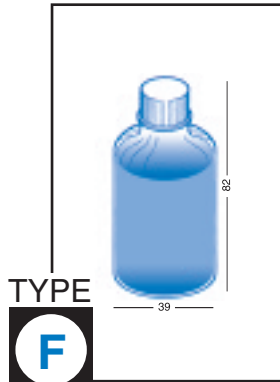


• Available packaging



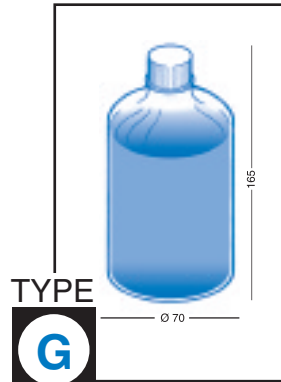
TYPE  
**E**

**Material:** *hostalene*  
**Matrix:** *epoxy resin*  
**Density:**  $1.15 \text{ g.cm}^{-3}$   
**Useful volume:**  $50 \text{ cm}^3$   
**Resin mass:**  $57.5 \text{ g}$   
**Vial:** *type SG50N*



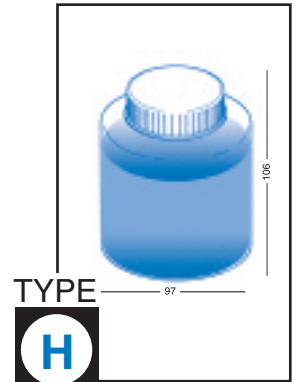
TYPE  
**F**

**Material:** *hostalene*  
**Matrix:** *epoxy resin*  
**Density:**  $1.15 \text{ g.cm}^{-3}$   
**Useful volume:**  $50 \text{ cm}^3$   
**Resin mass:**  $57.5 \text{ g}$



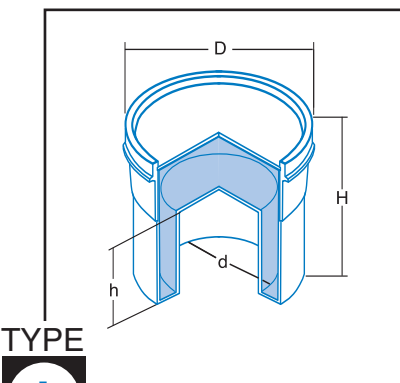
TYPE  
**G**

**Material:** *hostalene*  
**Matrix:** *epoxy resin*  
**Density:**  $1.15 \text{ g.cm}^{-3}$   
**Useful volume:**  $500 \text{ cm}^3$   
**Resin mass:**  $575 \text{ g}$



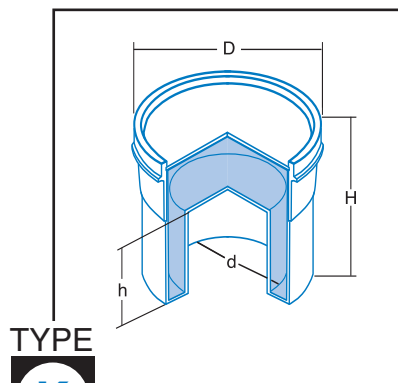
TYPE  
**H**

**Material:** *hostalene*  
**Matrix:** *epoxy resin*  
**Density:**  $1.15 \text{ g.cm}^{-3}$   
**Useful volume:**  $500 \text{ cm}^3$   
**Resin mass:**  $575 \text{ g}$   
**Vial:** *type SG500N*



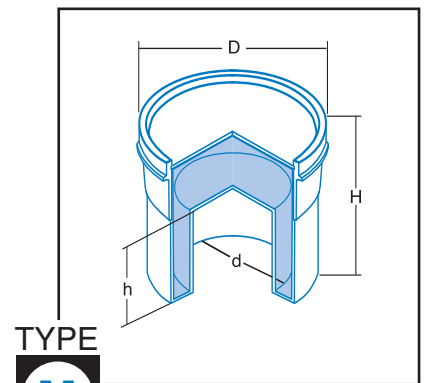
TYPE  
**I**

**Material:** *polypropylene*  
**Matrix:** *epoxy resin*  
**D:**  $114 \text{ mm}$  / **d:**  $77 \text{ mm}$   
**H:**  $101 \text{ mm}$  / **h:**  $68 \text{ mm}$   
**Useful volume:**  $450 \text{ cm}^3$   
**Resin mass:**  $518 \text{ g}$   
**Vial:** *Marinelli beaker type*



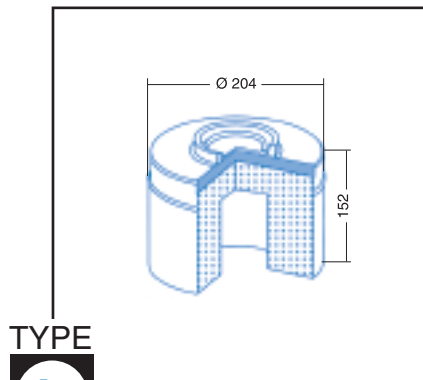
TYPE  
**K**

**Material:** *polypropylene*  
**Matrix:** *epoxy resin*  
**D:**  $130 \text{ mm}$  / **d:**  $85 \text{ mm}$   
**H:**  $152 \text{ mm}$  / **h:**  $77 \text{ mm}$   
**Useful volume:**  $1000 \text{ cm}^3$   
**Resin mass:**  $1150 \text{ g}$   
**Vial:** *Marinelli beaker type*



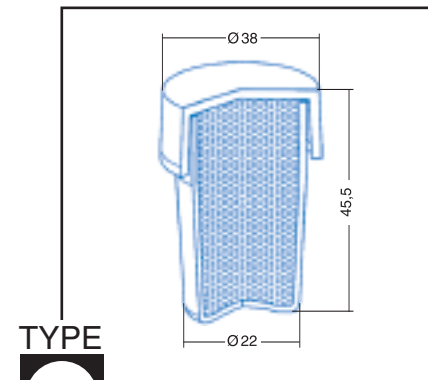
TYPE  
**M**

**Material:** *polypropylene*  
**Matrix:** *epoxy resin*  
**D:**  $117.8 \text{ mm}$  / **d:**  $84.9 \text{ mm}$   
**H:**  $66.3 \text{ mm}$  / **h:**  $38.1 \text{ mm}$   
**Useful volume:**  $250 \text{ cm}^3$   
**Resin mass:**  $287 \text{ g}$   
**Vial:** *Marinelli beaker type*



TYPE  
**L**

**Material:** *polyethylene* / **Matrix:** *epoxy resin*  
**Density:**  $1.15 \text{ g.cm}^{-3}$   
**Useful volume:**  $3000 \text{ cm}^3$   
**Resin mass:**  $3450 \text{ g}$   
**Vial:** *type SG3000*



TYPE  
**R**

**Material:** *polyethylene* / **Matrix:** *epoxy resin*  
**Density:**  $1.15 \text{ g.cm}^{-3}$   
**Useful volume:**  $14 \text{ cm}^3$   
**Resin mass:**  $16 \text{ g}$   
**Vial:** *type SG15*



## Water-equivalent resin matrices

Radionuclide Half-life	Product code	Activity kBq	Matrix	Water volume cm <sup>3</sup>	Useful volume cm <sup>3</sup>	Type	Measurement uncertainty %
<b><sup>133</sup>Ba</b> 10,5 years	BA133EGRE15	37	resin	55	50	E	3 to 5
	BA133EGRF15	37	resin	55	50	F	3 to 5
	BA133EGRG15	37	resin	550	500	G	3 to 5
	BA133EGRH15	37	resin	550	500	H	3 to 5
	BA133EGRI15	37	resin	500	450	I	3 to 5
	BA133EGRK15	37	resin	1 000	1 000	K	3 to 5
	BA133EGRL15	37	resin	3 000	3 000	L	3 to 5
	BA133EGRM15	37	resin	250	250	M	3 to 5
	BA133EGRR15	37	resin	15	14	R	3 to 3
<b><sup>152</sup>Eu</b> 13,53 years	EU152EGRE15	37	resin	55	50	E	3 to 5
	EU152EGRF15	37	resin	55	50	F	3 to 5
	EU152EGRG15	37	resin	550	500	G	3 to 5
	EU152EGRH15	37	resin	550	500	H	3 to 5
	EU152EGRI15	37	resin	500	450	I	3 to 5
	EU152EGRK15	37	resin	1 000	1 000	K	3 to 5
	EU152EGRL15	37	resin	3 000	3 000	L	3 to 5
	EU152EGRM15	37	resin	250	250	M	3 to 5
	EU152EGRR15	37	resin	15	14	R	3 to 5
<b>Mixture</b> <sup>241</sup> Am, <sup>109</sup> Cd, <sup>57</sup> Co, <sup>139</sup> Ce, <sup>51</sup> Cr, <sup>113</sup> Sn, <sup>85</sup> Sr, <sup>137</sup> Cs, <sup>60</sup> Co, <sup>88</sup> Y	9ML01EGRE05 <sup>(1)</sup>	5	resin	55	50	E	3 to 6
	9ML01EGRE10 <sup>(1)</sup>	18	resin	55	50	E	3 to 6
	9ML01EGRE15 <sup>(1)</sup>	37	resin	55	50	E	3 to 6
	9ML01EGRE20 <sup>(1)</sup>	55	resin	55	50	E	3 to 6
	9ML01EGRE30 <sup>(1)</sup>	74	resin	55	50	E	3 to 6
	9ML01EGRF05 <sup>(1)</sup>	5	resin	55	50	F	3 to 6
	9ML01EGRF10 <sup>(1)</sup>	18	resin	55	50	F	3 to 6
	9ML01EGRF15 <sup>(1)</sup>	37	resin	55	50	F	3 to 6
	9ML01EGRF20 <sup>(1)</sup>	55	resin	55	50	F	3 to 6
	9ML01EGRF30 <sup>(1)</sup>	74	resin	55	50	F	3 to 6
	9ML01EGRG05 <sup>(1)</sup>	5	resin	550	500	G	3 to 6
	9ML01EGRG10 <sup>(1)</sup>	18	resin	550	500	G	3 to 6
	9ML01EGRG15 <sup>(1)</sup>	37	resin	550	500	G	3 to 6
	9ML01EGRG20 <sup>(1)</sup>	55	resin	550	500	G	3 to 6
	9ML01EGRG30 <sup>(1)</sup>	74	resin	550	500	G	3 to 6
	9ML01EGRH05 <sup>(1)</sup>	5	resin	550	500	H	3 to 6
	9ML01EGRH10 <sup>(1)</sup>	18	resin	550	500	H	3 to 6
	9ML01EGRH15 <sup>(1)</sup>	37	resin	550	500	H	3 to 6
	9ML01EGRH20 <sup>(1)</sup>	55	resin	550	500	H	3 to 6
	9ML01EGRH30 <sup>(1)</sup>	74	resin	550	500	H	3 to 6
	9ML01EGRI05 <sup>(1)</sup>	5	resin	500	450	I	3 to 6
	9ML01EGRI10 <sup>(1)</sup>	18	resin	500	450	I	3 to 6
	9ML01EGRI15 <sup>(1)</sup>	37	resin	500	450	I	3 to 6
	9ML01EGRK05 <sup>(1)</sup>	5	resin	1 000	1 000	K	3 to 6
	9ML01EGRK10 <sup>(1)</sup>	18	resin	1 000	1 000	K	3 to 6
	9ML01EGRK15 <sup>(1)</sup>	37	resin	1 000	1 000	K	3 to 6
	9ML01EGRM05 <sup>(1)</sup>	5	resin	3 000	3 000	L	3 to 6
	9ML01EGRM10 <sup>(1)</sup>	18	resin	3 000	3 000	L	3 to 6
	9ML01EGRM15 <sup>(1)</sup>	37	resin	3 000	3 000	L	3 to 6
	9ML01EGRM20 <sup>(1)</sup>	55	resin	250	250	M	3 to 6
9ML01EGRM30 <sup>(1)</sup>	74	resin	15	14	R	3 to 6	
9ML01EGRR05 <sup>(1)</sup>	5	resin	15	14	R	3 to 6	
9ML01EGRR10 <sup>(1)</sup>	18	resin	15	14	R	3 to 6	
9ML01EGRR15 <sup>(1)</sup>	37	resin	15	14	R	3 to 6	
9ML01EGRR20 <sup>(1)</sup>	55	resin	15	14	R	3 to 6	
9ML01EGRR30 <sup>(1)</sup>	74	resin	15	14	R	3 to 6	

Legend: (1) Lead time: see production schedule at the end of this catalogue

## • Accessories

Product	Volume (cm <sup>3</sup> )	Type	Product code
Marinelli beaker-type plastic vial	250	M	9ACETL11
Marinelli beaker-type plastic vial	500	I	9ACETL9
Matinelli beaker-type plastic vial	1 000	K	9ACETL1
Type SG50N black plastic vial	55	E	9ACETL5
Brown plastic vial	55	F	9ACETL7
Type SG500N black plastic vial	550	H	9ACETL6
Brown plastic vial	550	G	9ACETL8
Type SG3000 vial	3 000	L	9ACETL2
Type SG15 vial	15	R	9ACETL3

To order: see Commercial Information on pages I.1 – I.5 of the INFORMATION section