

# Multinuclide Standards



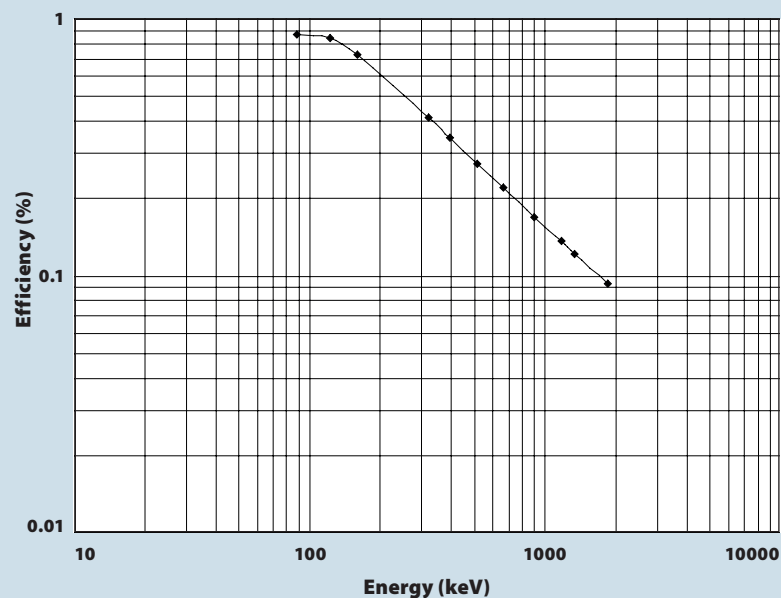
The nine-nuclide gamma standard, routinely used to establish efficiency curves for gamma spectrometers, covers an energy range from 88 keV to 1836 keV. As options, Am-241 and/or Pb-210 can be added to extend the calibration curve down to 60 keV and 46 keV respectively. IPL offers two nine-nuclide gamma standards. Series 7500 contains Te-123m and Cr-51 for those customers who require a non-mercury containing standard.

Series 7600 contains Hg-203 and Ce-139. Please note that Hg-203 may leach out from polyethylene containers and may contaminate the entire container. Proper handling techniques must be observed. The component nuclides of each series have been chosen to minimize peak interference, and the activity ratios have been selected to yield similar count rates in all major peaks on typical coaxial germanium detectors.

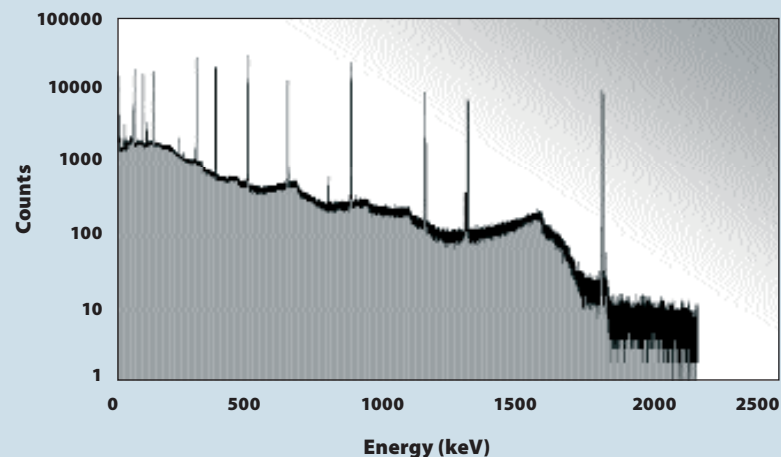
The multinuclide standards are NIST traceable with each component certified with an uncertainty less than  $\pm 5\%$  at the 99% confidence level except for Pb-210 when added. The multinuclide standards are prepared gravimetrically from calibrated solutions and then confirmed using a high purity germanium detector to ensure the highest possible quality.

Multinuclide standards are made to order and are available on a year-round basis in a variety of configurations described on pages 22–24. Standards can be supplied for special applications with nuclides, activities, containers and matrices manufactured to customer specifications.

**Figure 19-A: Typical Efficiency vs. Energy Plot for 7500 ML**



**Figure 19-B: Multinuclide Spectrum of a 5  $\mu$ Ci Solution Containing Te-123m and Cr-51, Series 7500**



# Multinuclide Standards

Model 7500—7500 ML							
Isotope	Half-Life Years or Days	Gamma Ray (MeV)	Photons/ Decay	% Activity	( $\mu\text{Ci}$ )	Activity in 1 $\mu\text{Ci}$ , kBq	Photons/s per $\mu\text{Ci}$
Cd-109	462.6 d	0.088	0.0363	28.7	0.287	10.6	385
Co-57	271.79 d	0.122	0.856	1.1	0.011	0.407	348
		0.137	0.107				44
Te-123m	119.7 d	0.159	0.840	1.4	0.014	0.518	435
Cr-51	27.706 d	0.320	0.0986	35.7	0.357	13.2	1302
Sn-113	115.09 d	0.392	0.649	5.2	0.052	1.92	1249
Sr-85	64.849 d	0.514	0.984	6.6	0.066	2.44	2403
Cs-137	30.17 y	0.662	0.851	4.8	0.048	1.78	1511
Co-60	5.272 y	1.173	0.999	5.6	0.056	2.07	2070
		1.333	0.999				2070
Y-88	106.63 d	0.898	0.940	10.9	0.109	4.03	3791
		1.836	0.994				4009
<b>Total</b>				<b>100.0</b>	<b>1.00</b>	<b>37.00</b>	

Model 7501—7500 ML + Am-241							
Am-241	432.17 y	0.060	0.360	3.0	0.030	1.11	400
Cd-109	462.6 d	0.088	0.0363	28.7	0.287	10.6	385
		0.122	0.856				348
Co-57	271.79 d	0.137	0.107	1.1	0.011	0.407	44
		0.159	0.840				435
Te-123m	119.7 d	0.159	0.840	1.4	0.014	0.518	435
Cr-51	27.706 d	0.320	0.0986	35.7	0.357	13.2	1302
Sn-113	115.09 d	0.392	0.649	5.2	0.052	1.92	1249
Sr-85	64.849 d	0.514	0.984	6.6	0.066	2.44	2403
Cs-137	30.17 y	0.662	0.851	4.8	0.048	1.78	1511
Co-60	5.272 y	1.173	0.999	5.6	0.056	2.07	2070
		1.333	0.999				2070
Y-88	106.63 d	0.898	0.940	10.9	0.109	4.03	3791
		1.836	0.994				4009
<b>Total</b>				<b>103.0</b>	<b>1.03</b>	<b>38.1</b>	

Model 7503—7500 ML + Am-241 + Pb-210							
Pb-210	22.3 y	0.046	0.0418	30.0	0.300	11.10	464
Am-241	432.17 y	0.060	0.360	3.0	0.030	1.11	400
Cd-109	462.6 d	0.088	0.0363	28.7	0.287	10.6	385
		0.122	0.856				348
Co-57	271.79 d	0.137	0.107	1.1	0.011	0.407	44
		0.159	0.840				435
Te-123m	119.7 d	0.159	0.840	1.4	0.014	0.518	435
Cr-51	27.706 d	0.320	0.0986	35.7	0.357	13.2	1302
Sn-113	115.09 d	0.392	0.649	5.2	0.052	1.92	1249
Sr-85	64.849 d	0.514	0.984	6.6	0.066	2.44	2403
Cs-137	30.17 y	0.662	0.851	4.8	0.048	1.78	1511
Co-60	5.272 y	1.173	0.999	5.6	0.056	2.07	2070
		1.333	0.999				2070
Y-88	106.63 d	0.898	0.940	10.9	0.109	4.03	3791
		1.836	0.994				4009
<b>Total</b>				<b>133.0</b>	<b>1.33</b>	<b>49.2</b>	

<b>Model 7600—7600 ML</b>							
<b>Isotope</b>	<b>Half-Life Years or Days</b>	<b>Gamma Ray (MeV)</b>	<b>Photons/ Decay</b>	<b>% Activity</b>	<b>(<math>\mu</math>CI)</b>	<b>Activity in 1 <math>\mu</math>CI, kBq</b>	<b>Photons/s per <math>\mu</math>CI</b>
Cd-109	462.6 d	0.088	0.0363	42.0	0.420	15.5	564
Co-57	271.79 d	0.122	0.856	1.6	0.016	0.592	507
		0.137	0.107				63
Ce-139	137.64 d	0.166	0.799	2.0	0.020	0.740	591
Hg-203	46.595 d	0.279	0.815	6.0	0.060	2.22	1809
Sn-113	115.09 d	0.392	0.649	7.6	0.076	2.81	1825
Sr-85	64.849 d	0.514	0.984	9.6	0.096	3.55	3495
Cs-137	30.17 y	0.662	0.851	7.0	0.070	2.59	2204
Co-60	5.272 y	1.173	0.999	8.2	0.082	3.03	3031
		1.333	0.999				3031
Y-88	106.63 d	0.898	0.940	16.0	0.160	5.92	5565
		1.836	0.994				5884
<b>Total</b>				<b>100.0</b>	<b>1.00</b>	<b>37.00</b>	

<b>Model 7601—7600 ML + Am-241</b>							
Am-241	432.17 y	0.060	0.360	3.0	0.030	1.11	400
Cd-109	462.6 d	0.088	0.0363	42.0	0.420	15.5	564
Co-57	271.79 d	0.122	0.856	1.6	0.016	0.592	507
		0.137	0.107				63
Ce-139	137.64 d	0.166	0.799	2.0	0.020	0.740	591
Hg-203	46.595 d	0.279	0.815	6.0	0.060	2.22	1809
Sn-113	115.09 d	0.392	0.649	7.6	0.076	2.81	1825
Sr-85	64.849 d	0.514	0.984	9.6	0.096	3.55	3495
Cs-137	30.17 y	0.662	0.851	7.0	0.070	2.59	2204
Co-60	5.272 y	1.173	0.999	8.2	0.082	3.03	3031
		1.333	0.999				3031
Y-88	106.63 d	0.898	0.940	16.0	0.160	5.92	5565
		1.836	0.994				5884
<b>Total</b>				<b>103.0</b>	<b>1.03</b>	<b>38.1</b>	

<b>Model 7603—7600 ML + Am-241 + Pb-210</b>							
Pb-210	22.3 y	0.046	0.0418	30.0	0.300	11.10	464
Am-241	432.17 y	0.060	0.360	3.0	0.030	1.11	400
Cd-109	462.6 d	0.088	0.0363	42.0	0.420	15.5	564
Co-57	271.79 d	0.122	0.856	1.6	0.016	0.592	507
		0.137	0.107				63
Ce-139	137.64 d	0.166	0.799	2.0	0.020	0.740	591
Hg-203	46.595 d	0.279	0.815	6.0	0.060	2.22	1809
Sn-113	115.09 d	0.392	0.649	7.6	0.076	2.81	1825
Sr-85	64.849 d	0.514	0.984	9.6	0.096	3.55	3495
Cs-137	30.17 y	0.662	0.851	7.0	0.070	2.59	2204
Co-60	5.272 y	1.173	0.999	8.2	0.082	3.03	3031
		1.333	0.999				3031
Y-88	106.63 d	0.898	0.940	16.0	0.160	5.92	5565
		1.836	0.994				5884
<b>Total</b>				<b>133.0</b>	<b>1.33</b>	<b>49.2</b>	

# Multinuclide Standards

Multinuclide Gamma Standard	Catalog Number	Uncertainty (99% Confidence Level)	Minimum Activity		Maximum Activity	
Mixed Gamma 7500 Nine Nuclide Mixed Gamma Solution in 2 M HCl with Cr-51 and Te-123m	7500	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
7501 with 3% Am-241	7501	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
7502 with 30% Pb-210 <sup>(1)</sup>	7502	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
7503 with 3% Am-241 and 30% Pb-210 <sup>(1)</sup>	7503	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
Mixed Gamma 7600 Nine Nuclide Mixed Gamma Solution in 2 M HCl with Hg-203 and Ce-139	7600	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
7601 with 3% Am-241	7601	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
7602 with 30% Pb-210 <sup>(1)</sup>	7602	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
7603 with 3% Am-241 and 30% Pb-210 <sup>(1)</sup>	7603	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq
Mixed Tri-Nuclide <sup>(2)</sup> In 4 M HCl	7700	Calibrated Solution uncertainty +/-3-5%	1 µCi	37 kBq	100 µCi	3.7 MBq

## Multinuclide Solutions— 7500 and 7600

Multinuclide solutions are available in 5 mL flame sealed glass ampoules. The nuclide mixture is supplied in 2 M HCl containing the appropriate amount of each carrier to prevent precipitation or adsorption on the glass walls. Additional ampoule sizes can be quoted on request.



## Multinuclide Point Standards (GF-ML)

The GF-ML is available in the Type D or Type M configurations. See pages 46 and 48 for technical drawings. Both have a 1" (25.4 mm) outside diameter with nuclide deposited in the center of each disk.

10 µCi maximum activity for GF-ML-D, and 2 µCi maximum activity for GF-ML-M. Please contact customer service if greater activities are required.



## Multinuclide Simulated Charcoal or Zeolite Cartridge (EG-CH-ML)

The activity is uniformly distributed between two polyimide films and placed under the screen of a 1" x 2.25" (25.4 mm x 57.2 mm) separable plastic charcoal cartridge (surface loaded). This configuration simulates a surface loaded charcoal cartridge. See page 33 for technical drawing.



1) Pb-210 uncertainty is +/- 7.1%

2) See page 29 for specifications of this mixture.

## Simulated Gas Standards (SGS-ML)

This configuration is available in the 7500 series only. EZIP's' Simulated Gas Standard is used for the calibration of gamma-ray detectors for the counting of radioactive noble gases. EZIP supplies a uniform, low density foam standard in many configurations. These standards are available on a continual basis.

The nuclide combination employed in the Simulated Gas Standard is a nine-nuclide multinuclide gamma standard. Americium-241 and/or Lead-210 can be added to allow efficiency determinations down to 60 keV or 46 keV respectively. See page 20 for more information on our 7500 series nine-nuclide gamma standard.

Standard activity is 1-5  $\mu\text{Ci}$  (37 kBq-185 kBq) with higher activities on request. Single nuclide standards are also available on request. The foam matrix density range is 0.04-0.4 g/cc. The Simulated Gas Standards are NIST traceable  $\pm 5\%$  at the 99% confidence level. Please refer to page 24 for a listing of available beaker sizes.



## Planar Multinuclide Calibration Standards

Three large area multinuclide configurations are available. In all cases the active elements are prepared by evaporative deposition.

### Ring and Disk (EAB-LB-ML)

EAB-LB disk standards are designed to check the performance and efficiency of low level counting systems such as proportional counters. The stainless steel disk containing the active element is surrounded by an aluminum ring which holds the window assembly in place. Please see page 57 for technical drawing.



### Planchet (EAB-PL-ML)

These sources simulate cupped planchet samples and can be used as calibration or performance check standards. Please see page 56 for technical drawing.



### Filter Paper (EAB-FP-ML)

Filter paper standards are designed to simulate surface smears and thus develop efficiencies for smear samples of similar construction. Please see page 58 and 59 for technical drawing.



# Multinuclide Standards

## Large Volume Multinuclide Standards (EG-LV-ML) and Multinuclide Marinelli Beaker Standards (EG-LVM-ML)

These configurations provide a convenient method to calibrate HPGe and NaI(Tl) detectors, Large Volume Multinuclide Standards (EG-LV-ML) and Multinuclide Marinelli Beaker Standards (EG-LVM-ML). In both series the radioactivity is uniformly dispersed in the matrix. Specify the series, matrix and container type and size. For the Marinelli beakers, specify the detector type. The following are examples of customer-supplied materials that may also be used:

- Soil
- Vegetation/Food Products
- Pulverized Concrete

The LV-ML wide mouth polyethylene sample bottles are available in 250 mL, 500 mL, and 1000 mL. Additional sizes are quoted upon request. Customer supplied containers will be filled upon request. See page 31 for technical drawings.

Series LVM-ML Marinelli beakers, for both HPGe and NaI(Tl) detectors, are available in 500 mL, 1000 mL, 2000 mL and 4000 mL sizes. This configuration is useful where maximum efficiency is needed such as environmental samples. See below for a complete listing of available sizes.



### GA-MA Catalog Numbers for Marinelli Beakers

Catalog Number	Detector Types	Detector "Endcap" Diameter Inches	cm
<b>200 ml Models</b>			
443016	Germanium or Ge-Li	3.00	7.6
463316	Germanium, 3 x 3 NaI	3.25	8.3
<b>500 ml Models</b>			
523N-E	2 x 2 NaI	2.25	5.7
527G-E	Germanium	2.75	7.0
530G-E	Germanium or Ge-Li	3.00	7.6
533N	Germanium, 3 x 3 NaI	3.25	8.3
538G	Germanium	3.75	9.5
541G	Germanium	4.00	10.2
580G	Germanium	3.15	8.0
590G	Germanium	3.54	9.0

### 1 Liter Models

125G	Germanium, 2 x 2 NaI	2.50	6.4
127G	Germanium	2.75	7.0
130G	Germanium or Ge-Li	3.00	7.6
LA130G	Germanium or Ge-Li	3.00	7.6
132G	Germanium	3.25	8.3
133N	3 x 3 NaI	3.25	8.3
138G	Germanium	3.75	9.5
141G	Germanium	4.00	10.2
190G	Germanium	3.54	9.0

### GA-MA Catalog Numbers for Marinelli Beakers

Catalog Number	Detector Types	Detector "Endcap" Diameter Inches	cm
<b>2 Liter Models</b>			
227G	Germanium	2.75	7.0
230G	Germanium or Ge-Li	3.00	7.6
233N	3 x 3 NaI	3.25	8.3
<b>4 Liter Models</b>			
430G	Germanium or Ge-Li	3.00	7.6
433N	3 x 3 NaI	3.25	8.3
438G	Germanium	3.75	9.5
441G	Germanium	4.00	10.2
445N	Germanium, 4 x 4 NaI	4.25	10.8
448G	Germanium	4.75	12.1

### Standard Matrices

Matrix	Density	Description	Density Tolerance
Epoxy	1.0 g/cc	Standard IPL Epoxy Mixture	+/- 10%
Sand	1.7 g/cc	50-70 Mesh Sand	
Epoxy	1.1 to 2.0 g/cc	Standard IPL Proprietary Filler	+/- 10%
Epoxy	2.1 to 3.5 g/cc <sup>(1)</sup>	Upon Request	+/- 10%
Epoxy	0.4 to 0.9 g/cc	Standard Epoxy Using Proprietary LD Filler	+/- 10%
Foam	0.04-0.4 g/cc <sup>(2)</sup>	Low Density Styrofoam	0.04 - 0.4 g/cc

1) Not available with Am-241 or Pb-210 due to attenuation of the gamma emissions from the epoxy and interference of coincidental x-ray emissions from the epoxy matrix with the gamma rays from Am-241.

2) Volumes of 100 mL and above only. Below 100 mL, density cannot be guaranteed.



## Planar Multinuclide Calibration Standards (EAB)

EAB-7500 Series Multinuclide					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7500-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7500-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7500-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq

EAB-7501 Series Multinuclide with 3% Am-241					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7501-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7501-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7501-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq

EAB-7502 Series Multinuclide with 30% Pb-210					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7502-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7502-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7502-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq

EAB-7503 Series Multinuclide with 3% Am-241 and 30% Pb-210					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7503-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7503-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7503-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq



# Multinuclide Standards

## Planar Multinuclide Calibration Standards (EAB)

EAB-7600 Series Multinuclide					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7600-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7600-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7600-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7601 Series Multinuclide with 3% Am-241					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7601-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7601-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7601-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7602 Series Multinuclide with 30% Pb-210					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7602-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7602-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7602-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7603 Series Multinuclide with 3% Am-241 and 30% Pb-210					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7603-PL	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7603-47LB	<b>LB Disk</b>				
	1.85" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq
EAB-7603-50LB	<b>Planchet</b>				
	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Polymeric Membrane	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 µCi-25 µCi 37 kBq-925 kBq

## Filter Paper (EAB-FP-ML)

Filter paper standards are designed to simulate surface smears and thus develop efficiencies for smear samples of similar construction. The standard mounts for the filter paper source are detailed below.

<b>EAB-FP-7500 Series Multinuclide</b>					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7500-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7500-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
<b>EAB-FP-7501 Series Multinuclide with 3% Am-241</b>					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7501-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7501-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
<b>EAB-FP-7502 Series Multinuclide with 30% Pb-210</b>					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7502-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7502-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
<b>EAB-FP-7503 Series Multinuclide with 3% Am-241 and 30% Pb-210</b>					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7503-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7503-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq

# Multinuclide Standards

## Filter Paper (EAB-FP-ML)

Filter paper standards are designed to simulate surface smears and thus develop efficiencies for smear samples of similar construction. The standard mounts for the filter paper source are detailed below.

EAB-FP-7600 Series Multinuclide					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7600-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7600-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-FP-7601 Series Multinuclide with 3% Am-241					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7601-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7601-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-FP-7602 Series Multinuclide with 30% Pb-210					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7602-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7602-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-FP-7603 Series Multinuclide with 3% Am-241 and 30% Pb-210					
Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Available Activities
EAB-7603-PL-FP	<b>Planchet</b> 2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
	<b>LB Disk</b> 1.85" x 0.125" 47 mm x 3.18 mm	1.61" 41 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq
EAB-7603-50LB-FP	2.0" x 0.125" 50.8 mm x 3.18 mm	1.77" 45 mm	Deposited onto Filter Paper	0.9 mg/cm <sup>2</sup> Aluminized Mylar	1 μCi-25 μCi 37 kBq-925 kBq

### Tri-Nuclide Calibration Standards—TN Series

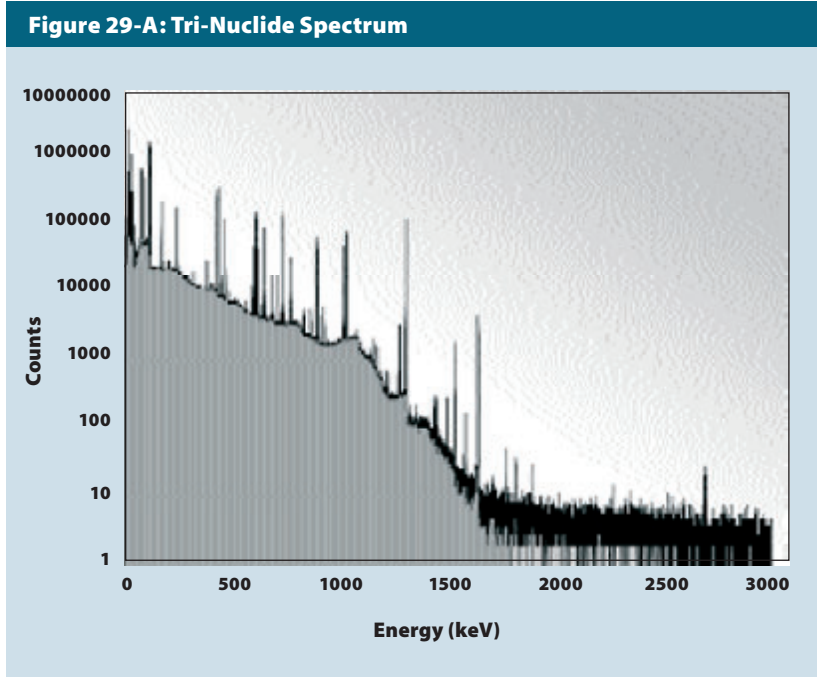
This standard is a multiple energy gamma emitting standard consisting of Sb-125 (T1/2=2.76y), Eu-154 (T1/2=8.59y), and Eu-155 (T1/2=4.85y). It is a relatively long lived gamma standard with many useful calibration points between 56 keV and 1597 keV.

While this standard does have the advantage of a longer useful life span when compared to the nine-nuclide mixed gamma standard, there are some disadvantages including cascade summing and spectral conflicts in photopeak emission rates.

The Tri-Nuclide Source is available as a nominal activity check source for various gamma energies, or as a NIST traceable gamma efficiency calibration standard in which the activity of each nuclide is certified to within  $\pm 5\%$  at the 99% confidence level. The Tri-Nuclide is available in the same configurations as the nine nuclide multiline standard described on page 20.

Tri-Nuclide Calibration						
Nuclide	Half-Life Days	Gamma Energy (MeV)	Photons/Decay (MeV)	Percent of Total	Total Activity in 2 $\mu\text{Ci}$ (74 kBq) Activity	Approx. Photons/s Standard
Sb-125	1007.7	0.4279	0.297	40	0.800 (29.6)	2300
		0.6006	0.1773			1580
Eu-154 <sup>(1)</sup>	3136.8	0.1231	0.412	40	0.800 (29.6)	6090
		0.7233	0.202			2990
		1.0047	0.182			2694
		1.274	0.350			5180
		1.5965	0.0181			268
Eu-155	1770	0.087	0.311	20	0.400 (14.8)	2300
		0.105	0.214			1580

1) Eu-154 will have Eu-152 impurities. Call customer service at time of order for specific information.



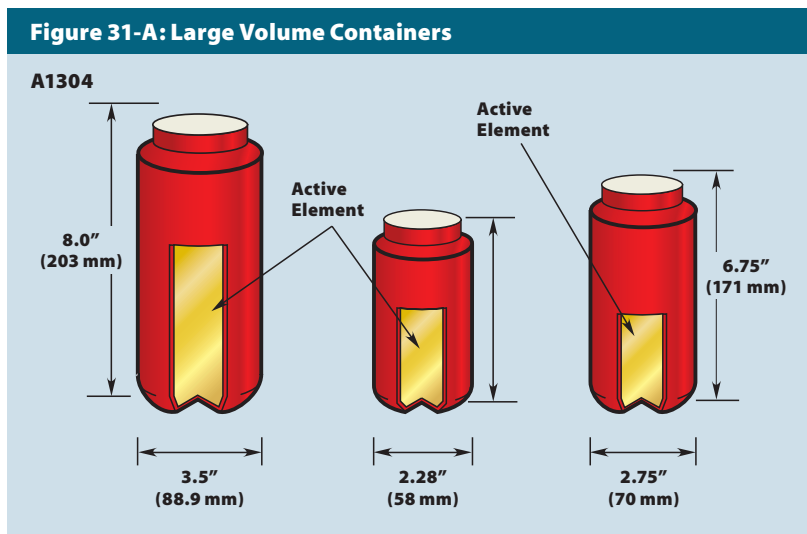
# Large Volume Calibration Standards



The model EG Series standards offer a convenient method to calibrate HPGe and NaI(Tl) detectors for the analysis of soil and water samples, reactor coolants, air samples, and other environmental materials. Standard activity is 0.1  $\mu\text{Ci}$  (3.7 kBq) - 5  $\mu\text{Ci}$  (185 kBq). Customer supplied containers will be filled upon request.

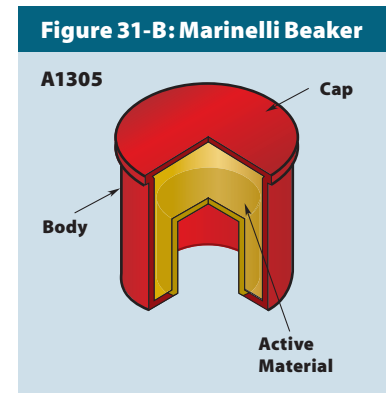
### Large Volume Bottle Gamma Standards—EG-LVB

Series LVB wide mouth polyethylene sample bottles are available in 250 mL, 500 mL, and 1000 mL. Additional sizes are available upon request.



### Marinelli Gamma Standards—EG-LVM

Series LVM Marinelli beakers, for both HPGe and NaI(Tl) detectors, are available in 500 mL, 1000 mL, 2000 mL and 4000 mL sizes. This configuration is useful where maximum efficiency is needed such as environmental samples. See table on page 32 for complete details on beakers.



See table on page 32 for model numbers and dimensions.

Standard Matrices for Large Volume Bottle Containers and Marinelli Beakers				
Matrix	Density	Materials	Density Tolerance <sup>(1)</sup>	Details
Epoxy	1.0 g/cc	Standard EZIP Epoxy Mixture	+/- 10%	Customer supplied materials may be used upon request. In both series the radioactivity is uniformly dispersed in the matrix. Specify the series, matrix and container type and size. For the Marinelli beakers, specify the model number as listed on page 32.
Sand	1.7 g/cc	50-70 Mesh Sand		
Epoxy	1.1 to 2.0 g/cc	Standard EZIP Proprietary Filler	+/- 10%	
Epoxy	2.1 to 3.5 g/cc	Upon Request	+/- 10%	
Epoxy	0.4 to 0.9 g/cc	Standard Epoxy Using Proprietary LD Filler	+/- 10%	
Foam	0.04 to 0.4g/cc <sup>(2)</sup>	Low Density Styrofoam	0.04 - 0.4 g/cc	

1) Epoxy matrices will cure over time. Shrinkage may occur and cause density to increase slightly. There may also be separation of epoxy away from the wall of its container which will not affect the function of the source.

2) Volumes of 100 mL and above only. Below 100 mL density can not be guaranteed.

# Large Volume Calibration Standards

## GA-MA Catalog Numbers for Marinelli Beakers

Catalog Number	Detector Types	Detector "Endcap" Diameter Inches	Diameter cm
<b>200 ml Models</b>			
443016	Germanium or Ge-Li	3.00	7.6
463316	Germanium, 3 x 3 Nal	3.25	8.3
<b>500 ml Models</b>			
523N-E	2 x 2 Nal	2.25	5.7
527G-E	Germanium	2.75	7.0
530G-E	Germanium or Ge-Li	3.00	7.6
533N	Germanium, 3 x 3 Nal	3.25	8.3
538G	Germanium	3.75	9.5
541G	Germanium	4.00	10.2
580G	Germanium	3.15	8.0
590G	Germanium	3.54	9.0
<b>1 Liter Models</b>			
125G	Germanium, 2 x 2 Nal	2.50	6.4
127G	Germanium	2.75	7.0
130G	Germanium or Ge-Li	3.00	7.6
LA130G	Germanium or Ge-Li	3.00	7.6
132G	Germanium	3.25	8.3
133N	3 x 3 Nal	3.25	8.3
138G	Germanium	3.75	9.5
141G	Germanium	4.00	10.2
190G	Germanium	3.54	9.0

## GA-MA Catalog Numbers for Marinelli Beakers

Catalog Number	Detector Types	Detector "Endcap" Diameter Inches	Diameter cm
<b>2 Liter Models</b>			
227G	Germanium	2.75	7.0
230G	Germanium or Ge-Li	3.00	7.6
233N	3 x 3 Nal	3.25	8.3
<b>4 Liter Models</b>			
430G	Germanium or Ge-Li	3.00	7.6
433N	3 x 3 Nal	3.25	8.3
438G	Germanium	3.75	9.5
441G	Germanium	4.00	10.2
445N	Germanium, 4 x 4 Nal	4.25	10.8
448G	Germanium	4.75	12.1





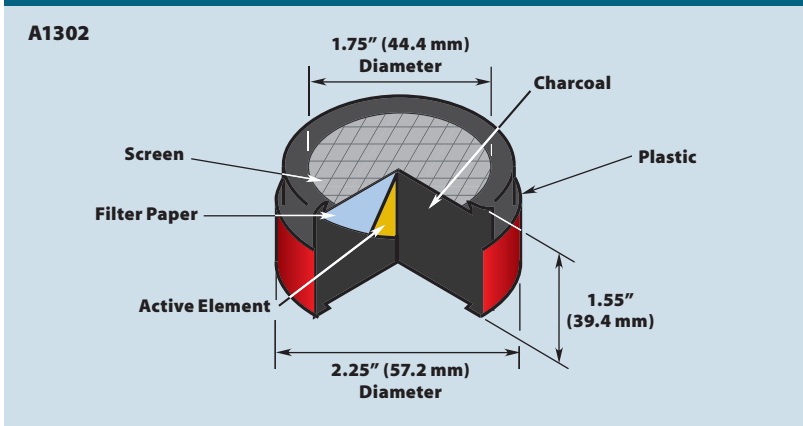
## Simulated Charcoal or Zeolite Gamma Cartridge Standards—EG-CH

Face Loaded: The activity is uniformly distributed between two polyimide films and placed under the screen of a 1" x 2.25" (25.4 mm x 57.2 mm) plastic charcoal cartridge (surface loaded).

Uniform Distribution: The activity is uniformly distributed within the charcoal or zeolite filling of the cartridge.

An aluminum metal cartridge is also available upon request. The standard activity for all configurations is 0.1  $\mu\text{Ci}$  (3.7 kBq). Sources are NIST traceable for contained activity.

**Figure 33-A : Charcoal Cartridge**



NOTE: I-125 and I-129 are available as surface loaded sources only. See "Simulated I-125" standards on page 45.

## Radon-226 Canister Standard—EG-226C

These standards are used to calibrate radioassay systems for measuring nanocurie levels of environmental radon in standard EPA charcoal canisters. The gamma spectrum above the Ra-226 gamma at 186 keV (4%) is identical with that of Rn-222 and its daughters.

The standard is prepared by uniform dispersion of a calibrated Ra-226 solution into the charcoal fill of a standard 1.25" x 4" (31.8 mm x 102 mm) canister, which is then sealed over the charcoal to define the charcoal volume and to prevent the escape of Rn-222 and its daughter products.

The EG-226C is supplied with 20 nCi (740 Bq) Ra-226 and is NIST traceable. Calibration accuracy is within  $\pm 5\%$  of the stated value at the 99% confidence level. Other activities and canister sizes are available on request.

**Figure 33-B : Radon Canister**

