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環境中放射性同位元素分析用標準物質カタログ

(U, Th含有混合標準液・環境中放射性同位元素・放射性同位元素単体溶液)

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環境中放射性同位元素分析用標準物質

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米国 SPEX 社製ウラン・トリウム含有混合標準溶液 (弊社オリジナル)

ウラン含有水質分析用標準溶液

カタログ XSTC - 760C

毒・劇

元素数 : 15 元素

ラベル値 : Fe..... 30mg / L As, Ni, Pb, Se... 各 1mg / L
Al, B, Cu, Zn... 各 10mg / L Cd..... 0.3mg / L
Mo..... 7mg / L Sb, U..... 各 0.2mg / L
Cr, Mn..... 各 5mg / L

マトリックス : 2% HNO₃/tr 酒石酸

容量 : 100ml

カタログ XSTC - 469

毒・劇

元素数 : 15 元素

ラベル値 : Al, B, Fe, Mn, Zn... 各 50mg / L
As, Cd, Cr, Cu, Pb, Mo, Ni, Se..... 各 10mg / L
Sb, U..... 各 1mg / L

マトリックス : 2% HNO₃

容量 : 100ml

汎用混合標準溶液 (ICP - MS, ICP - AES)

カタログ XSTC - 13

毒・劇

元素数 : 31 元素

Th, Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ga, In, K,
Li, Mg, Mn, Na, Ni, Pb, Rb, Se, Sr, TL, V, Zn, U, Hg

ラベル値 : 10mg / L 均一

マトリックス : 5% HNO₃

容量 : 100ml

汎用混合標準溶液 (I C P - M S , I C P - A E S)

カタログ X S T C - 3 3 1 毒・劇

元 素 数 : 29 元素

Th, Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ga, K,
Li, Mg, Mn, Na, Ni, Pb, Rb, Se, Sr, TL, V, Zn, U

ラ ベ ル 値 : 10mg / L 均一

マトリックス : 2% HNO₃

容 量 : 100ml

カタログ X S T C - 6 2 2 毒・劇

元 素 数 : 35 元素

Al, As, Sb, Ba, B, Cd, Ca, Cs, Cr, Co, Cu, Ga, Ge, Fe, Pb, Li,
Mg, Mn, Mo, Ni, P, K, Rb, Se, Si, Ag, Na, Sr, Sn, Ti, W, U, V, Zn, Zr

ラ ベ ル 値 : 10mg / L 均一

マトリックス : 5% HNO₃ / tr 酒石酸 / tr HF

容 量 : 100ml

I C P - M S 校正用標準溶液

カタログ X S T C - 2 8 9 劇

元 素 数 : 5 元素

Be, Bi, Co, In, U

ラ ベ ル 値 : 1mg / L 均一

マトリックス : 5% HNO₃

容 量 : 100ml 入

H F を含む標準溶液は、ガラスパーツからの溶出が分析結果に影響を及ぼす恐れがありますので、取扱いにはご注意ください。

tr (trace) は、0.1%未満を表します。

保証期間は、弊社出荷日より1年となっております。

これらの規格以外に、御希望の濃度・元素で調整できるオーダーメイド品を100ml から作成可能です。

Certified Reference Materials

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Soil and Biological Solutions



A sampling of our most popular simulated solutions. Simulations of natural solids are based upon dissolution of 1 gram of a natural material in acid and diluted to 100 mL.

	Sea Water	River Sediment Solution B	Estuarian Sediment Solution	Soil Solution A	Orchard Leaves Solution
Catalog No.	CRM-SW	CRM-RS-B	CRM-ES	CRM-SOIL-A	CRM-OL
Matrix	2% HNO ₃ mg/kg	4% HNO ₃ µg/mL	4% HNO ₃ µg/mL	4% HNO ₃ µg/mL	4% HNO ₃ µg/mL
Elements					
Aluminum	0.5	600	700	500	3
Antimony	--	0.04	0.004	0.03	--
Arsenic	0.02	0.20	0.10	0.2	0.1
Barium	0.05	4	--	5	0.5
Beryllium	--	--	0.02	--	--
Boron	5	--	--	--	--
Bromide	65	--	--	--	0.1
Cadmium	(0.0001)	0.03	(0.0004)	0.003	0.001
Calcium	400	300	80	350	200
Carbon	30	--	--	--	--
Chloride	19,000	--	--	--	7
Chromium	(0.0003)	15	0.80	--	0.03
Cobalt	--	0.15	0.10	--	0.002
Copper	0.01	1	0.20	0.30	0.1
Iodide	0.05				
Iron	0.02	400	350	200	3.0
Lead	0.004	2.0	0.30	0.40	0.5
Lithium	0.1				--
Magnesium	1,250	120	100	70	60
Manganese	0.01	6	4.0	0.10	1
Nickel	(0.0001)	0.50	0.30	0.30	0.01
Phosphorus	0.1	10	5.0	10	20
Potassium	380	200	150	200	150
Rubidium	0.2	--	--	--	0.1
Selenium	0.004	0.01	0.05	0.01	0.0008
Silicon	4	3000.0	3000	3000	5
Sodium	10,500	50	200	70	1
Strontium	12	--	--	--	--
Sulfur	900	--	--	--	20
Thallium	--	0.01	--	--	--
Thorium	--	0.10	0.10	0.10	--
Uranium	(0.0015)	0.03	--	0.01	--
Vanadium	(0.0003)	1	1	0.10	0.005
Zinc	0.005	5	1.5	1	25

Note: Values in parentheses are for information purposes only.

IAEA-330 , Spinach

Organic , Vegetation

- Unit Size: 100g
- Report: IAEA/AQ/8 
- Date of Release: 2009-05-01
- Reference Sheet: IAEA-330 

The material was obtained from the "Vladimirovka" collective farm, Polesskoe, Kiev, Ukraine, in summer 1990. The material was air dried and milled to less than 0.35 mm by the Brjansk Centre for Agricultural Radiology and Chemistry. 100 kg of the bulk material were recombined and homogenized at the IAEA Terrestrial Environment Laboratory by mixing the powder in a 300 liter drum for 72 hours. The material density was measured in 13 test portions and found to be 0.778 ± 0.001 g/cm³. Bottling of IAEA-330 was carried out under normal laboratory conditions, taking all precautions to avoid segregation. Portions of 100 g were dispensed into plastic bottles sealed with security polyethylene caps and labelled with the code IAEA-330. After bottling the material was sterilized by gamma ray irradiation with a total dose of 25 kGy using a Co-60 source according to EN ISO 13485:2003 to ensure long-term stability of the material by inhibiting microbial action.

Reference date for decay correction: 2007-10-15



Radionuclide	Certified Value Bq kg ⁻¹	Uncertainty* Bq kg ⁻¹
⁴⁰ K	1188	30
⁹⁰ Sr	20.1	2.1
¹³⁷ Cs	1235	35
²³⁴ U	1.02	0.07
²³⁸ U	0.95	0.05

(*) Uncertainty is expressed as a Mixture model median based standard deviation S(MM-median) at 95 % confidence level [1, 2].

The certified values listed above were established on the basis of results reported by the IAEA Terrestrial Environment Laboratory in Seibersdorf, Austria. Five expert laboratories from Finland, Hungary, Republic of Korea and Portugal analysed the IAEA-330 spinach material. Each laboratory received three bottles, and was asked to determine the measurands of interest in each bottle. The obtained results from the expert laboratories were used to confirm the IAEA reference values. In total 30 and 15 bottles were analysed in the Terrestrial Environment Laboratory and expert laboratories respectively during the characterization campaign of the spinach material. The IAEA derived reference values were in good agreement with the expert laboratories results.

IAEA-321 , Milk Powder

Organic , Animal Products

- Unit Size: 250g
- Report: IAEA/AL/026 
- Date of Release: 1990-01-02
- Reference Sheet: IAEA-321 

The milk and whey powders (IAEA-152 and IAEA-154) were donated to the IAEA by a milk processing facility in the former USSR whereas IAEA-321 (milk powder) was collected from an European dairy products processing plant. The materials were produced from cow's milk obtained from animals that had grazed on land contaminated with radioactive fallout resulting from the Chernobyl incident in 1986. These materials were γ -sterilized to ensure long-term stability of the material by inhibiting microbial action

Reference date for decay correction: 1989-01-01

Analyte	Value	Unit	95% C.I.	N	R/I/C
^{134}Cs	15.5	Bq/kg	14.8 – 16.2	53	R
^{137}Cs	72.6	Bq/kg	71.1 – 74.2	49	R
^{40}K	552	Bq/kg	536 – 569	55	R
^{90}Sr	3.3	Bq/kg	3.16 – 3.44	17	R



(Value) Concentration calculated as a mean of the accepted laboratory means

(N) Number of accepted laboratory means which are used to calculate the recommended or information values and their respective confidence intervals
(R/I/C) Classification assigned to the property value for analyte (Recommended/Information/Certified)

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in one or more international interlaboratory comparisons organized by the Chemistry Unit, IAEA Laboratories, Seibersdorf. The details concerning the criteria for qualification as a recommended or information value can be found in the respective report (attached).

IAEA-156 , Clover

Organic , Vegetation

- Unit Size: 250g
- Report: IAEA/AL/035 
- Date of Release: 1991-01-01
- Reference Sheet: IAEA-156 

The clover sample (IAEA-156) was harvested within a small geographical region in Austria in the summer of 1986. It was anticipated that the material would be contaminated with radioactive fallout resulting from the Chernobyl incident in April 1986. This material was γ -sterilized to ensure long-term stability of the material by inhibiting microbial action.

Reference date for decay correction: 1986-08-01

Analyte	Value	Unit	95% C.I.	N	R/I/C
^{134}Cs	132	Bq/kg	126 – 138	48	R
^{137}Cs	264	Bq/kg	254 – 274	48	R
^{40}K	657	Bq/kg	637 – 676	40	R
^{90}Sr	14.8	Bq/kg	13.4 – 16.3	20	R

(Value) Concentration calculated as a mean of the accepted laboratory means



(N) Number of accepted laboratory means which are used to calculate the recommended or information values and their respective confidence intervals

(R/I/C) Classification assigned to the property value for analyte (Recommended/Information/Certified)

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in one or more international interlaboratory comparisons organized by the Chemistry Unit, IAEA Laboratories, Seibersdorf. The details concerning the criteria for qualification as a recommended or information value can be found in the respective report (attached).

IAEA-154 , Whey Powder

Organic , Animal Products

- Unit Size: 250g
- Report: IAEA/AL/007 
- Date of Release: 1988-01-11
- Reference Sheet: IAEA-154 

The milk and whey powders (IAEA-152 and IAEA-154) were donated to the IAEA by a milk processing facility in the former USSR whereas IAEA-321 (milk powder) was collected from an European dairy products processing plant. The materials were produced from cow's milk obtained from animals that had grazed on land contaminated with radioactive fallout resulting from the Chernobyl incident in 1986. These materials were γ -sterilized to ensure long-term stability of the material by inhibiting microbial action

Reference date for decay correction: 1987-08-31

Analyte	Value	Unit	95% C.I.	N	R/I/C
^{134}Cs	1355	Bq/kg	1295 – 1417	25	R
^{137}Cs	3749	Bq/kg	3613 – 3887	26	R
^{40}K	1575	Bq/kg	1511 – 1644	23	R
^{90}Sr	6.9	Bq/kg	6.0 – 8.0	12	R

(Value) Concentration calculated as a mean of the accepted laboratory means

(N) Number of accepted laboratory means which are used to calculate the recommended or information values and their respective confidence intervals

(R/I/C) Classification assigned to the property value for analyte (Recommended/Information/Certified)

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in one or more international interlaboratory comparisons organized by the Chemistry Unit, IAEA Laboratories, Seibersdorf. The details concerning the criteria for qualification as a recommended or information value can be found in the respective report (attached).

IAEA-152 , Milk Powder

Organic , Animal Products

- Unit Size: 250g
- Report: IAEA/AU/098
- Date of Release: 1987-01-01
- Reference Sheet: IAEA-152



The milk and whey powders (IAEA-152 and IAEA-154) were donated to the IAEA by a milk processing facility in the former USSR whereas IAEA-321 (milk powder) was collected from an European dairy products processing plant. The materials were produced from cow's milk obtained from animals that had grazed on land contaminated with radioactive fallout resulting from the Chernobyl incident in 1986. These materials were γ -sterilized to ensure long-term stability of the material by inhibiting microbial action.

Reference date for decay correction: 1987-08-31

Analyte	Value	Unit	95% C.I.	N	R/I/C
^{134}Cs	764	Bq/kg	722 – 802	34	R
^{137}Cs	2129	Bq/kg	2053 – 2209	35	R
^{40}K	539	Bq/kg	510 – 574	28	R
^{90}Sr	7.7	Bq/kg	7.0 – 8.3	16	R

(Value) Concentration calculated as a mean of the accepted laboratory means



(N) Number of accepted laboratory means which are used to calculate the recommended or information values and their respective confidence intervals

(R/I/C) Classification assigned to the property value for analyte (Recommended/Information/Certified)

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in one or more international interlaboratory comparisons organized by the Chemistry Unit, IAEA Laboratories, Seibersdorf. The details concerning the criteria for qualification as a recommended or information value can be found in the respective report (attached).

IAEA-414 , Fish

Organic , Animal Products

- Unit Size: 100g
- Report: IAEA/AL/145 
- Date of Release: 2006-01-10
- Reference Sheet: IAEA-414 

About 350 kg of mixed fish species were collected in the eastern Irish Sea by the Center for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft, U.K., in 1996. The skin was removed, the fish filleted, freeze-dried and subsequently sent to IAEA-MEL for processing. The sample, which was reduced by freeze-drying to about 69 kg, was then ground to powder, sieved through a 0.5 mm mesh and homogenized by mixing in a nitrogen atmosphere. The sample was freeze-dried once more, ground and sieved at 250 µm to obtain a final amount of 10 kg. The sample was then mixed with 100 kg of North Sea fish powder (fraction below 250 µm). To ensure homogenization of the final sample, both samples were mixed by jet pulverizing in a nitrogen atmosphere. The samples were then packed into bottles under nitrogen gas, sealed with polyethylene caps and labelled with the code IAEA-414. The bottles containing 100 g of fish powder each were sterilized according to ISO standards at 10 kGy in an irradiation facility.

Reference date for decay correction: 1997-01-01


Analyte	Value	Unit	95% C.I.	N	R/I/C
⁴⁰ K	481	Bq/kg	470 - 486	19	R
⁹⁰ Sr	0.28	Bq/kg	0.10 - 0.54	6	I
¹³⁷ Cs	5.18	Bq/kg	5.12 - 5.22	16	R
²¹⁰ Pb(²¹⁰ Po)	2.1	Bq/kg	1.8 - 2.5	11	I
²²⁶ Ra	1.4	Bq/kg	0.6 - 1.6	9	I
²³² Th	0.028	Bq/kg	0.025 - 0.031	6	R
²³⁴ U	1.22	Bq/kg	1.15 - 1.26	8	R
²³⁵ U	0.050	Bq/kg	0.045 - 0.055	9	R
²³⁸ Pu	0.0230	Bq/kg	0.0221 - 0.0250	11	R
²³⁸ U	1.11	Bq/kg	1.07 - 1.15	9	R
²³⁹ Pu	0.066	Bq/kg	0.055 - 0.073	10	I
²³⁹⁺²⁴⁰ Pu	0.120	Bq/kg	0.116 - 0.123	14	R
²⁴⁰ Pu	0.047	Bq/kg	0.046 - 0.051	10	I
²⁴¹ Am	0.197	Bq/kg	0.193 - 0.204	9	R
²⁴¹ Pu	2.0	Bq/kg	1.8 - 2.3	11	I

(N) Number of accepted laboratory means which are used to calculate the recommended or information values and their respective confidence intervals
(R/I/C) Classification assigned to the property value for analyte (Recommended/Information/Certified)

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in an international interlaboratory comparison organized by the IAEA Marine Environment Laboratories, Monaco. The details concerning the criteria for qualification as recommended or information value can be found in the report IAEA/AL/145 (attached).

IAEA-372 , Grass

Organic , Vegetation

- Unit Size: 100g
- Date of Release: 2010-03-15
- Reference Sheet: IAEA-372 

The material was obtained from the "Vladimirovka" collective farm, Poleskoe, Kiev, Ukraine, in summer 1990. The material was air dried and milled to less than 0.3 mm by the Brjansk Centre for Agricultural Radiology and Chemistry. Then 75 kg of the bulk material were recombined and homogenized at an IAEA collaborating centre (the Hungarian National Institute for Food Inspection) by mixing the powder in a 300 L drum for 72 hours, and then dispensed into plastic bottles, sealed with polyethylene caps in 100 g units, and labelled with the code IAEA-372. Subsequently, the samples were irradiated to a dose of 25.5 kGy minimum using a Co-60 source according to EN ISO 13485:2003 to ensure long-term stability of the material by inhibiting microbial action.

Reference date for decay correction: 2006-06-01

Analyte	Value	Unit	Uncertainty	N
⁴⁰ K	1060	Bq/kg	56	7
¹³⁷ Cs	11320	Bq/kg	360	7

(N) Number of accepted laboratory means which are used to calculate the recommended or information values and their respective confidence intervals

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in one or more international interlaboratory comparisons organized by the Chemistry Unit, IAEA Laboratories, Seibersdorf. The details concerning the criteria for qualification as a recommended or information value can be found in the respective report.

References:

Shakhashiro, A., Sansone, U., Arnold, D., Dryak, P., La Rosa, J. J., Jerome, S. M., Makarewicz, M., Mentcheva, J., Sato, K., Tarjan, S. (2008): The new IAEA-372 grass-certified reference material for ⁴⁰K and ¹³⁷Cs, Applied radiation and isotopes, 66, 1718-1721.

IAEA-445 , Gamma emitting radionuclides in water new!

Inorganic , Mineral

- Unit Size: 200g
- Report: IAEA/OB
- Date of Release: 2003-01
- Reference Sheet: IAEA-445



Demineralised tap water from Seibersdorf (Austria) was used to prepare this sample. The water was screened for artificial nuclides and ^{210}Pb using high resolution gamma spectrometry, and it was found that all nuclides were below the detection limit and far below the spiked values. The water sample was gravimetrically prepared in one batch. A portion of 200 kg demineralised water was acidified with nitric acid to 3% (mass/mass) and spiked with a mixture of certified single radionuclide solutions traceable to the international standard of radioactivity units. A pump with multiple outlets was used to homogenize the bulk water sample in a tank of 600 L. The spiked water was dispensed in plastic bottles of 500 ml.

The final reference massic activity of each radionuclide, was established based on the certified activity value of the radionuclide standard solutions used for spiking the water, taking into account the successive dilution steps, the mass of spiking mixture and the amount of water being spiked as determined from weighing. The combined standard uncertainty includes two major components: uncertainty of the certified solution and weighing uncertainty.

Reference date for decay correction:

Analyte	Certified Value ^{1,2} [Bq kg ⁻¹]	Uncertainty* [Bq kg ⁻¹]
^{54}Mn	4.74	0.05
^{60}Co	7.52	0.07
^{65}Zn	13.06	0.15
^{109}Cd	34.96	0.35
^{134}Cs	7.65	0.10
^{137}Cs	8.12	0.08
^{234}Pb	29.34	0.5
^{241}Am	7.11	0.07

¹Established based on the certified activity value of the standard solutions used for spiking.

²The certified values of massic activities are traceable to the SI through the radioactivity standard solutions used for spiking.

The quantity values assigned to the IAEA-445 certified reference material are massic activities of ^{54}Mn , ^{60}Co , ^{65}Zn , ^{109}Cd , ^{134}Cs , ^{137}Cs , ^{210}Pb and ^{241}Am , expressed in the derived SI unit Bq kg⁻¹. Values were established based on the certified activity values of the standard solutions used for spiking, taking into account the successive dilution steps, the mass of spiking solutions and the amount of matrix being spiked. For all values used in the calculation of the assigned values and associated uncertainties, the evidence on metrological traceability to the SI Units was provided.

References

[1] International Atomic Energy Agency (2009): Worldwide Open Proficiency Test on the Determination of Radionuclides in Spinach, Soil and Water, IAEA-CU-2007-03, IAEA Analytical Quality in Nuclear Applications Series No. 8 (report attached).

IAEA-444 , Gamma emitting radionuclides in soil **new!**

Inorganic , Mineral

- Unit Size: 200g
- Report: IAEA/OC/8
- Date of Release: 2003-01
- Reference Sheet: IAEA-444



A soil from China was used to prepare the IAEA-444 soil certified reference material spiked with gamma emitting radionuclides. Before using the soil for spiking, it was milled and sieved to collect the appropriate fraction at mesh size less than 0.3 mm, and then homogenized. The matrix of Chinese soil was characterized and a number of samples were pre-screened for the radionuclides of interest prior to spiking. The results have shown that the material is free from artificial radionuclides, except for Cs-137, which was present at 2.6 ± 0.2 Bq kg⁻¹ based on dry mass. (Ref. date: 2006-01-01). The moisture content was found to be 2.3 ± 0.2 %.

The preparation of the spiked soil CRM was performed according to a validated procedure [1]. In total, 400 bottles of 200 grams each were prepared. After bottling the material was sterilized by gamma ray irradiation with a total dose of 25 kGy using a Co-60 source according to EN ISO 13485:2003 to ensure long-term stability of the material by inhibiting microbial action.

Reference date for decay correction: 2007-10-15

Analyte	Certified Value ^{1,2} [Bq kg ⁻¹]	Uncertainty* [Bq kg ⁻¹]
⁵⁴ Mn	61.0	1.3
⁶⁰ Co	82.6	2.0
⁶⁵ Zn	29.9	1.0
¹⁰⁹ Cd	248.7	5.2
¹³⁴ Cs	59.4	1.7
¹³⁷ Cs	68.5	1.4
²³⁴ Pb ³	48.0	1.6
²⁴¹ Am	55.6	1.6

¹Established based on the certified activity value of the standard solutions used for spiking.

²The certified values of massic activities are traceable to the SI through the radioactivity standard solutions used for spiking.

³Information value

The reference values of the massic activities of each nuclide and their associated standard uncertainties were established based on the certified activity value of the standard solutions used for spiking the soil, taking into account the successive dilution steps, the mass of spiking solutions and the dry mass of the soil being spiked.

The information property value of ²¹⁰Pb was established based on a consensus value derived from measurement results of 10 test portions measured using a broad energy type Ge detector. The obtained consensus value from measurement results was comparable to the median (48.9 ± 1.7) calculated from 172 measurement results reported in the IAEA-CU-03-2007 world wide proficiency test [2]. This information value of ²¹⁰Pb massic activity should not be used for calibration purposes and it could only be used for quality control purposes.

References

[1] Shkhashiro, A., Gondin da Fonseca Azeredo, A. M., Sansone, U., Fajgelj, A. (2007): Matrix materials for proficiency testing: optimization of a procedure for spiking soil with gamma-emitting radionuclides, Analytical and bioanalytical chemistry, 387 (7), 2509-2515.

[2] International Atomic Energy Agency (2009): Worldwide Open Proficiency Test on the Determination of Radionuclides in Spinach, Soil and Water, IAEA-CU-2007-03, IAEA Analytical Quality in Nuclear Applications Series No. 8 (report attached).

These SRMs are intended for the calibration of radioactivity measuring instruments and for the monitoring of chemical and geochemical processes. They are calibrated in terms of activity per gram of solution. Each SRM is contained in a flame-sealed glass ampoule or bottle and, except as noted, consists of the radionuclide dissolved in an aqueous solution (usually acidic). Click here for more information.

PLEASE NOTE: The tables are presented to facilitate comparisons among a family of materials to help customers select the best SRM for their needs. For specific values and uncertainties, the certificate is the only official source.

SRM	Description	Unit of Issue	Decay Modes	Massic Activity (Bq/g)	Time of Calibration (month/year)	Volume of Solution (mL)
4222c	Carbon-14 Hexadecane	5 mL	β^-	50 000	09/90	5
4226d	Nickel-63 Radioactivity Solution	5 mL	β^-	85 940	11/09	
4233E*	Cesium-137 Solution	5 mL	β^- , γ	300 000	09/05	5
4239	Strontium-90 Radioactivity Standard	5 mL	β^-	32000	12/06	5
4251C*	Barium-133 Solution	5 mL	EC	487600	09/93	5
4274	Holmium-166m Gamma-ray Emission Rate Standard	5 mL	γ	19 300	02/06	5
4288b	Technetium-99 Radioactivity Solution	5 mL				
4320a*	Curium-244 Solution	5 mL	α	35	02/96	5
4321c	Natural Uranium Solution	5 mL	α	500	01/92	5
4322C*	Americium-241 Radioactivity Standard	5 mL	α	106.4	05/07	5
4323b*	Plutonium-238 Solution	5 mL	α	40	11/99	5
4324b	Uranium-232 Solution	5 mL	α	30	7/2002	5
4326	Polonium-209 Solution	5 mL	α , EC	85.42	03/94	5
4328C	Thorium-229 Solution	5 mL	α	35	12/07	5
4329	Curium-243 Solution	5.1 g	α	70	06/84	5
4330c	Plutonium-239 Radioactivity Solution	3 g	α	38.41	05/09	5
4332e	Americium-243 Radioactivity Solution	5 mL	α	38.49	10/08	5
4334I	Plutonium-242 Solution	5 mL	α	26.77	01/10	5
4337	Lead-210 Radioactivity Solution	5 mL	β^-	9037	06/06	5
4338a*	Plutonium-240 Solution	5 mL	α	40.88	05/96	5

SRM>	Description	Unit of Issue	Decay Modes	Massic Activity (Bq/g)	Time of Calibration (month/year)	Volume of Solution (mL)
4339a	Radium-228 Solution	5 mL	α , EC	200	In Prep	
4340B*	Plutonium-241 Solution	5 mL	β^-	258	06/07	5
4341*	Neptunium-237 Solution	5 mL	α	100	03/94	5
4342A	Thorium-230 Radioactivity Standard	5 mL	α	50	06/93	5
4361C	Hydrogen-3 Water	500 mL	β^-	2	09/98	500
4370c*	Europium-152 Solution	5 mL	β^- , EC, γ	90 000	02/87	5
4915F*	Cobalt-60 Solution	5 mL	β^- , γ	60 000	11/05	5

*[License certification](#) is required of purchaser by NIST before shipment.

205.4 - Radioactive Solutions

These SRMs are intended for the calibration of radioactivity measuring instruments and for the monitoring of chemical and geochemical processes. They are calibrated in terms of activity per gram of solution. Each SRM is contained in a flame-sealed glass ampoule or bottle and, except as noted, consists of the radionuclide dissolved in an aqueous solution (usually acidic). Click here for more information.

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4919I*	Strontium-90 Solution	5 mL	β^-	4200	12/06	5
4926E	Hydrogen-3 Water	20 mL	β^-	5 000	09/98	20
4927f	Hydrogen-3 Water	5 mL	β^-	635 000	09/98	5
4929-d	Iron-55 Solution	5 mL				
4929F	Iron-55 Solution	5 mL	EC, β^-	59000	11/05	5
4943	Chlorine-36 Solution	3 mL	β^-	10 000	12/84	3
4947c	Hydrogen-3 Toluene	4 mL	β^-	300 000	03/87	4
4949C*	Iodine-129 Solution	5 mL	β^-	3 451	03/93	5
4965	Radium-226 Solution	5 mL	α, γ	30	09/91	5
4966A	Radium-226 Solution	5 mL	α, γ	290	01/07	5
4967A	Radium-226 Solution	5 mL	α, γ	2 500	09/03	5
4969	Radium-226 Solution	5 mL	α, γ	3	09/98	5

* License certification is required of purchaser by NIST before shipment.

*[License certification](#) is required of purchaser by NIST before shipment.

205.5 - Radiopharmaceuticals (solution and gaseous forms)

These SRMs are intended for the calibration of radioactivity-measuring instruments. They are calibrated in terms of activity per gram of solution (except SRM 4415, which is calibrated in terms of activity). Each SRM is contained in a 5 mL flame-sealed glass ampoule and, except for SRM 4415, consists of the radionuclide dissolved in an aqueous solution (usually acidic). These SRMs are produced in collaboration with the Nuclear Energy Institute and, because of the short half lives, are available only at specific times.

PLEASE NOTE: The tables are presented to facilitate comparisons among a family of materials to help customers select the best SRM for their needs. For specific values and uncertainties, the certificate is the only official source.

SRM	Description	Unit of Issue	Activity per gram (MBq · g ⁻¹)	Half Life (days)
4401L	Iodine-131 Solution	5 mL	25	8.0
4401H	Iodine-131 Solution	5 mL	1 GBq/g	8.0
4401hz	Iodine-131 Solution	5 mL		
4401lz	Iodine-131 Solution	5 mL		
4404l	Thallium-201 Solution	5 mL	7.509	3.0
4404h	Thallium-201 Solution	5 mL	80.35	3.0
4404hv	Thallium-201 Solution	5 mL		
4404hw	Thallium-201 Solution	5 mL		
4404lv	Thallium-201 Solution	5 mL		
4404lw	Thallium-201 Solution	5 mL		
4406ho	Phosphorus-32 Solution	5 mL		
4406lo	Phosphorus-32 Solution	5 mL		
4407L	Iodine-125 Solution	5 mL	3.078	59.4
4407H	Iodine-125 Solution	5 mL	152.9	59.4
4407hx	Iodine-125 Solution	5 mL		
4407lx	Iodine-125 Solution	5 mL		
4408hf	Cobalt-57 Solution	5 mL		
4408lf	Cobalt-57 Solution	5 mL		
4410h	Technetium-99m Solution	5 mL	1.428 GBq/g	0.3
4410hy	Technetium-99 Solution	5 mL		

SRM>	Description	Unit of Issue	Activity per gram (MBq · g ⁻¹)	Half Life (days)
4410hz	Technetium-99 Solution	5 mL		
4412L	Molybdenum-99 Solution	5 mL	26.03	2.74
4412H	Molybdenum-99 Solution	5 mL	889.6	2.74
4412hy	Molybdenum-99 Solution	5 mL		
4412ly	Molybdenum-99 Solution	5 mL		
4415L	Xenon-133 Gas	Ampoule		
4415H	Xenon-133 Gas	Ampoule	11.90 GBq/g	5.243
4415hx	Xenon-133 Solution	5 mL		
4415lx	Xenon-133 Solution	5 mL		
4416l	Gallium-67 Solution	5 mL	7.863	3.3
4416h	Gallium-67 Solution	5 mL	89.16	3.3
4416hu	Gallium-67 Solution	5 mL		

*NIST requires [license certification](#) of purchaser before SRM can be shipped.

205.5 - Radiopharmaceuticals (solution and gaseous forms)

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4416lu	Gallium-67 Solution	5 mL		
4417l	Indium-111 Solution	5 mL	3.763	2.8
4417h	Indium-111 Solution	5 mL	61.15	2.8
4417hr	Indium-111 Solution	5 mL		
4417hs	Indium-111 Solution	5 mL		
4417ht	Indium-111 Solution	5 mL		
4417ls	Indium-111 Solution	5 mL		
4417lt	Indium-111 Solution	5 mL		

SRM>	Description	Unit of Issue	Activity per gram(MBq · g ⁻¹)	Half Life (days)
4425l	Samarium-153 Solution	5 mL	4	1.9
4425h	Samarium-153 Solution	5 mL		
4425he	Samarium-153 Solution	5 mL		
4425hf	Samarium-153 Solution	5 mL		
4425le	Samarium-153 Solution	5 mL		
4425lf	Samarium-153 Solution	5 mL		
4426ha	Strontium-89 Solution	5 mL		
4426la	Strontium-89 Solution	5 mL		
4427L	Yttrium-90 Solution Radioactivity	5 mL	5.115	64.0 hrs
4427H	Yttrium-90 Solution	5 mL	54.40	64.0 hrs
4427hc	Yttrium-90 Solution	5 mL		
4427lc	Yttrium-90 Solution	5 mL		
4428ha	Gadolinium-153 Solution	5 mL		

*NIST requires [license certification](#) of purchaser before SRM can be shipped.

205.11 - Radioactive Natural Matrix Materials (powder form)

PLEASE NOTE: The tables are presented to facilitate comparisons among a family of materials to help customers select the best SRM for their needs. For specific values and uncertainties, the certificate is the only

Massic Activity (mBq/g)

SRM INFORMATION:		4350B River Sediment (Radioactivity) 85 g		
Name	Symbol	Value	Uncertainty	Type
Americium-241 (²⁴¹ Am)			0.15	Certified
Cesium-137 (¹³⁷ Cs)			29	Certified
Cobalt-60 (⁶⁰ Co)			4.64	Certified
Europium-152 (¹⁵² Eu)			30.5	Certified
Europium-154 (¹⁵⁴ Eu)			3.78	Certified
Plutonium-238 (²³⁸ Pu)			0.013	Certified
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			0.508	Certified
Radium-226 (²²⁶ Ra)			35.8	Certified
Ref. Date			9-Sep-81	Certified

SRM INFORMATION:		4351 Human Lung Powder 45 g		
Name	Symbol	Value	Uncertainty	Type
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			1.1	Certified
Ref. Date		1200 EST	1-Oct-82	Certified
Thorium-232 (²³² Th)			0.21	Certified
Uranium-234 (²³⁴ U)			0.1	Certified
Uranium-238 (²³⁸ U)			0.101	Certified

SRM INFORMATION:		4352 Human Liver Powder 45 g		
Name	Symbol	Value	Uncertainty	Type
Americium-241 (²⁴¹ Am)			0.15	Certified
Plutonium-238 (²³⁸ Pu)			0.055	Certified
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			2.06	Certified
Ref. Date			1-Jun-82	Certified

SRM INFORMATION:		4353A Rocky Flats Soil Number 2 90 g		
Name	Symbol	Value	Uncertainty	Type
Cesium-137 (¹³⁷ Cs)			21.6	Certified
Lead-210 (²¹⁰ Pb)			58	Certified
Plutonium-238 (²³⁸ Pu)			0.278	Certified
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			16.8	Certified
Radium-226 (²²⁶ Ra)			74.9	Certified
Ref. Date			1-Apr-98	Certified
Strontium-90 (⁹⁰ Sr)			10.5	Certified
Uranium-234 (²³⁴ U)			40.4	Certified
Uranium-235 (²³⁵ U)			1.88	Certified
Uranium-238 (²³⁸ U)			39.6	Certified

SRM INFORMATION:		4354 Lake Sediment Powder 25 g		
Name	Symbol	Value	Uncertainty	Type
Americium-241 (²⁴¹ Am)			1.1	Certified
Antimony-125 (¹²⁵ Sb)		<0.14		Certified
Cesium-137 (¹³⁷ Cs)			59.2	Certified
Cobalt-60 (⁶⁰ Co)			320	Certified
Plutonium-238 (²³⁸ Pu)			0.26	Certified
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			4	Certified
Ref. Date			14-Feb-86	Certified
Strontium-90 (⁹⁰ Sr)			1090	Certified
Thorium-228 (²²⁸ Th)			28.6	Certified
Thorium-232 (²³² Th)			26.8	Certified
Uranium-235 (²³⁵ U)			0.75	Certified
Uranium-238 (²³⁸ U)			17.4	Certified

SRM INFORMATION:		4355 Peruvian Soil Powder 75 g		
Name	Symbol	Value	Uncertainty	Type
Americium-241 (²⁴¹ Am)			0.004	Certified
Cesium-137 (¹³⁷ Cs)			0.33	Certified
Cobalt-60 (⁶⁰ Co)		<0.016		Certified
Europium-152 (¹⁵² Eu)		<0.23		Certified
Europium-154 (¹⁵⁴ Eu)		<0.2		Certified
Europium-155 (¹⁵⁵ Eu)		<0.2		Certified
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			0.0075	Certified
Ref. Date			1-Jun-82	Certified
Thorium-228 (²²⁸ Th)			42.2	Certified
Thorium-230 (²³⁰ Th)			39.7	Certified
Thorium-232 (²³² Th)			43	Certified

SRM INFORMATION:		4356 Ashed Bone (Radioactivity) 15 g		
Name	Symbol	Value	Uncertainty	Type
Americium-241 (²⁴¹ Am)			0.0432	Certified
Curium-243,244 (²⁴³ Cm + ²⁴⁴ Cm)			0.12	Certified
Plutonium-238 (²³⁸ Pu)			0.86	Certified
Plutonium-239,240 (²³⁹ Pu + ²⁴⁰ Pu)			1.26	Certified
Radium-226 (²²⁶ Ra)			14.5	Certified
Ref. Date		1200 EST	31-Dec-	Certified
Strontium-90 (⁹⁰ Sr)			42.6	Certified
Thorium-230 (²³⁰ Th)			0.52	Certified
Thorium-232 (²³² Th)			0.98	Certified
Uranium-234 (²³⁴ U)		0.64*		Certified
Uranium-238 (²³⁸ U)			0.63	Certified

SRM INFORMATION:		4357 Ocean Sediment Powder 85 g		
Name	Symbol	Value	Uncertainty	Type
Cesium-137 (^{137}Cs)			12.7	Certified
Plutonium-238 (^{238}Pu)			2.29	Certified
Plutonium-239,240 ($^{239}\text{Pu} + ^{240}\text{Pu}$)			10.4	Certified
Potassium-40 (^{40}K)			225	Certified
Radium-226 (^{226}Ra)			12.7	Certified
Radium-228 (^{228}Ra)			13.3	Certified
Ref. Date			16-Feb-94	Certified
Strontium-90 (^{90}Sr)			4.4	Certified
Thorium-228 (^{228}Th)			12.1	Certified
Thorium-230 (^{230}Th)			12	Certified
Thorium-232 (^{232}Th)			13	Certified

SRM INFORMATION:		4359 Seaweed Radionuclide Standard 300 g		
Name	Symbol	Value	Uncertainty	Type
Cesium-137 (^{137}Cs)			0.933	Certified
Lead-210 (^{210}Pb)			21	Certified
Plutonium-238 (^{238}Pu)			0.00606	Certified
Plutonium-239 (^{239}Pu)			0.084	Certified
Plutonium-239,240 ($^{239}\text{Pu} + ^{240}\text{Pu}$)			0.1296	Certified
Polonium-210 (^{210}Po)			20.6	Certified
Potassium-40 (^{40}K)			734	Certified
Radium-228 (^{228}Ra)			4.32	Certified
Ref. Date			1-Jan-02	Certified
Thorium-232 (^{232}Th)			2.4	Certified
Uranium-234 (^{234}U)			9.5	Certified
Uranium-235 (^{235}U)			0.4	Certified
Uranium-238 (^{238}U)			8.67	Certified

205.1 - Radiation Dosimetry (wire form)

[This SRM is a cobalt-in-aluminum alloy wire 0.5 mm in diameter and 1 m in length for use as a neutron density monitor standard. Click here for more information.](#)

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SRM INFORMATION:		953 Neutron Density Monitor Wire 1 m		
Name	Symbol	Value	Uncertainty	Type
Cobalt Composition (mass fraction, in %)			0.116	Certified

205.2 - Fission Track Glass (wafer form)

This SRM, which contains uranium, will aid laboratories performing fission track analyses in interlaboratory comparisons of data and in monitoring neutron fluences. The material was irradiated in the 20MW reactor at the NIST Center for Neutron Research, at two different neutron energies. Each unit consists of four unirradiated glass wafers and two irradiated wafers.

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Neutron Fluence

SRM INFORMATION:		963a Fission Track Glass U-1 mg/g set (6)		
Name	Symbol	Value	Uncertainty	Type
Neutron Fluence			39.5	Certified
Copper Foil			41.2	Certified
Neutron Fluence			43	Certified
Gold Foil			45.8	Certified
Reactor Position		RT-4: ($10^{14}n/cm^2$)		Certified
		RT-3: ($10^{14}n/cm^2$)		Certified
Uranium Composition (in mg/kg)			0.823	Certified
Uranium-235 (in Atom %)			0.2792	Certified

205.8 - Accelerator Mass Spectrometry (solution form)

[This SRM is intended for the calibration of accelerator mass spectrometers used to measure beryllium isotopic ratios. It is calibrated in terms of the isotopic ratio. The SRM is contained in a Teflon™ bottle and consists of the nuclides dissolved in an aqueous solution \(acidic\). Click here for more information.](#)

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SRM INFORMATION:		4325 Beryllium-10/9 Solution 2 x 25 mL		
Name	Symbol	Value	Uncertainty	Type
Isotopic Ratio		3×10^{-11}		Certified
Time of Calibration (month/year)		08/86		Certified
Total Nuclide Concentration (mg . g-1)			5	Certified
Volume of Solution (mL)		2 x 25 mL		Certified