LABORATORY	National Institute of Standards and Technology
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	A new primary radioactivity standardization of ^{238}Pu
KEYWORDS	liquid scintillation, gamma-ray spectrometry, HPGe, Pu-238, SRM
RESULTS	A new primary radioactivity standardization of ^{238}Pu was performed. This standardization was performed to support new ^{238}Pu transfer standard that was developed and which will be disseminated by the National Institute of Standards and Technology (NIST) as Standard Reference Material SRM 4323c. Plutonium-238 is a very powerful alpha emitter and does not emit significant amounts of other, more penetrating radiation. This makes the plutonium-238 isotope suitable for usage in radioisotope thermoelectric generators (RTGs) and radioisotope heater units, its main application. RTG technology was first developed to provide radioisotope thermoelectric generator power for cardiac pacemakers. In addition, plutonium-238 is the material of choice to help produce electrical power for more than two-dozen U.S. space missions that have been enabled by radioisotope power systems. In many cases, the heat from this radioisotope has also been used to keep spacecraft electronics and other components warm enough to be able to operate effectively in the frigid environments often found in deep space and on planetary surfaces like Mars. The certified massic activity of SRM 4323c was obtained from the $4\pi\alpha\beta$ liquid scintillation based standardization. NIST confirmatory standardizations of the ^{238}Pu massic activity for SRM 4323c were performed by and by high-resolution HPGe gamma-ray spectrometry (γ-spec) with a comparison difference of -0.13 % and 3.8 %, respectively. The uncertainty in the (γ-spec measurement was 6.5 % (k = 1).
PUBLICATIONS	SRM 4323c Certificate, NIST 2016
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	SRM 4323c
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	Long-term Radiochemical Stability of Polonium Solutions and an Upper Limit on the ^{209}Po Half-Life.
KEYWORDS	Half-life, liquid scintillation spectrometry, polonium chemistry
RESULTS	A rigorous investigation of the stability of polonium solutions has been underway for several years. Polonium solutions at trace concentrations, under various alkaline, neutral, or weakly acidic conditions are known to be unstable: being readily hydrolyzed, chemically deposited, or volatilized; exhibiting "radiocolloidal" behavior; and undergoing "plate-out" or adsorption onto glass surfaces. Stored polonium solutions, such as those needed for SRMs, are generally considered by NIST to be stable in the acid range of 0.1 to 1.0 normality, but scant data existed on any possible long-term effects, particularly for very dilute, carrier- free, aged solutions. The work present was based on careful radionuclidic assays of solutions of ^{209}Po having massic concentrations of less than 10^{12} atoms of Po per gram of solution that have been stored in flame-sealed ampoules for ages ranging from less than 2 years to over 24 years. Measurements were made for the soluble and readily removable ^{209}Po activity as well as for any insoluble residual activity adhering to the glass surfaces. It was found that the solutions were stable for periods of nearly 25 years with deposition losses that were negligible within the low-level measurement uncertainties and less than few tenths of a percent in worst cases. The findings validate the previously determined ^{209}Po half-life, that is now based on 36 distinct data sets of decay measurements by NIST of stored ^{209}Po solution during seven periods in 1993, 1994, 2005, 2013, 2015, and 2016. The LS-based measurement methodology is "absolute" in the sense of not requiring use of identical LS cocktail compositions or the use of the same LS counter. The new assay results extend the ^{209}Po decay curve to a period of 24 years, or about 20 % of the ^{209}Po half-life.
PUBLICATIONS	R. Collé, et al. J. Res. NIST 100, 1 (1995); R. Collé, L. Laureano-Perez, I. Outola, Appl. Radiat.Isot. 65, 728 (2007); R. Collé, R. Fitzgerald, L. Laureano-Perez, J. Phys G 41:105103, doi 10.1088/0954-3899/41/10/105103 (2014) ; R. Collé, A.M. Collé, J. Radioanal. Chem. doi 10.1007/s109-015-4307-y (2015); R. Collé, R. Fitzgerald, L. Laureano-Perez, J. Res. NIST 120, 138 (2015).
IN PROGRESS	R. Collé, R. Fitzgerald, L. Laureano-Perez, "Long-term Radiochemical Stability of Polonium Solutions and an Upper Limit on the ^{209}Po Half-Life", to be published.
INFORMATION	
SOURCE IN PREPARATION	
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LABORATORY	National Institute of Standards and Technology
NAMES	Bergeron, D., Galea, R., Laureano-Perez, L., and Zimmerman, B.
ACTIVITY	Comparison of C-14 liquid scintillation counting at NIST and NRC Canada
KEYWORDS	C-14, liquid scintillation, TDCR
RESULTS	An informal bilateral comparison of ^{14}C liquid scintillation (LS) counting at the National Research Council of Canada (NRC) and the National Institute of Standards and Technology (NIST) has been completed. Two solutions, one containing ^{14}C-labeled sodium benzoate and one containing ^{14}C-labeled n-hexadecane, were measured at both laboratories. Despite observed LS cocktail instabilities, the two laboratories achieved accord in their standardizations of both solutions. With the ^{14}C-benzoate samples and without any corrections or added uncertainty for cocktail instabilities, activities determined by NRC using CNET and by NIST using TDCR differed by (1.1 ± 1.9) %, indicating accord. Even with the ^{14}C-hexadecane samples, some cocktail formulations, particularly those containing added water for matching with CNET ^{3}H tracer sources, exhibit long-term instability. Without any corrections or added uncertainty for cocktail instabilities, activities determined by NRC and NIST using CNET and TDCR were in accord. NRC recovered activities (-1.4 ± 1.6) % (CNET) and (-0.7 ± 2.2) % (TDCR) different from the certified activity for SRM 4222C. NIST recovered activities (-0.9 ± 1.3) % (CNET) and (0.1 ± 1.0) % (TDCR) different from the certified activity. The observation that TDCR-derived activities were consistently higher than CNET-derived activities prompted a reevaluation of the data using the beta spectrum shape factor limit reported by Alimonti et al. (1998) in the efficiency calculations. With the revised efficiencies, NRC recovered activities (-0.7 ± 1.6) % (CNET) and (-0.5 ± 1.5) % (TDCR) different from the certified activity and NIST recovered activities (-0.5 ± 1.2) % (CNET) and (0.3 ± 1.2) % (TDCR) different from the certified activity.
PUBLICATIONS	**Comparison of C-14 liquid scintillation counting at NIST and NRC Canada**, Bergeron, D., Galea, R., Laureano-Perez, L., and Zimmerman, B. Applied Radiation and Isotopes, Volume 109, March 2016, Pages 30-35. SRM 4222d Certificate, NIST 2016
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	SRM 4222d
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	Extend the SIR to β emitters
KEYWORDS	liquid scintillation, low-level, SIR, source preparation
RESULTS	Lizbeth was on detail at BIPM for approximately six months to test the feasibility and performance of both the UCE and AA in an exercise for the extension of the SIR as an external expert in measurement and sample preparation in the field of LS counting. She reinforced the current skills and task force available at the BIPM. She prepared LS samples for both UCE and AA methods from about 15 ampoules received from 8 laboratories with the test nuclides ^{63}Ni, ^{3}H, ^{14}C and ^{55}Fe, in three scintillators and two volumes. The sources will be used for establishing the LS cross-efficiency curves for those nuclides, using ^{3}H as tracers, using three commercial counters (Beckman, Quantulus, Packard) and the BIPM-designed Triple-to-Double Coincidence Ratio (TDCR). All the measurements of the sources have been completed and a report is being prepared to present at the ESWG (II) during their semiannual meeting in November in which the final decision on the exercise was taken. Preliminary results show an instability on some of the sources according to the preparation and a similar (high) uncertainty on both methods. This exercise was done in an effort to propose to the CCRI(II) the appropriate method to be chosen to extend the existing SIR to β emitters, which allowed NIST to play a major role in establishing which method will be used. This experience improved the knowledge base for the entire Radioactivity Group on LS and international radionuclide metrology with implications for health care, homeland security and environmental.
PUBLICATIONS	
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	Natural Uranium Solution Standard
KEYWORDS	isotope dilution α spectrometry, gamma-ray spectrometry, HPGe liquid scintillation, NaI well-type counter, Natural Uranium
RESULTS	A new natural uranium solution standard has been produced and will be disseminated by the National Institute of Standards and Technology (NIST) as Standard Reference Material 4321d. The standard is certified for the massic activities of ^{234}U, ^{235}U, and ^{238}U in solution, and it is based on isotopic mass data for the metallic Certified Reference Material (CRM) 112-A (originally issued as SRM 960) that was obtained from the U.S. Department of Energy, New Brunswick Laboratory. The metallic CRM was chemically cleaned, dissolved, and gravimetrically diluted to prepare a master solution, which was quantitatively dispensed into 5 mL aliquots that were contained within flame-sealed glass ampoules for each SRM unit. Homogeneity among SRM units, verifying solution homogeneity, was substantiated by photonic-emission integral counting with a NaI(Tl) well counter. Confirmatory measurements were performed by liquid scintillation counting for the total massic activity, and by isotope dilution α spectrometry for the ^{234}U and ^{238}U massic activities. The standards will be disseminated with the following specifications: Radionuclides: Natural uranium (mixture of ^{234}U, ^{235}U, and ^{238}U) Reference time: 1200 h EST, 15 March 2017 Massic activities of the solution: ^{234}U: 220.16 Bq g^{-1}; ^{235}U: 10.540 Bq g^{-1}; ^{238}U: 228.93 Bq g^{-1} Relative expanded uncertainties (k = 2): ^{234}U: 0.52 %; ^{235}U: 0.31 %; ^{238}U: 0.25 %
PUBLICATIONS	Collé R, Laureano-Pérez L, Nour S, La Rosa JJ, Zimmerman BE, Pibida L, Bergeron DE (2017) Natural Uranium Radioactivity Solution Standard: SRM 4321d. *J Res Natl Inst Stan* 122:44. https://doi.org/10.6028/jres.122.044; SRM 4321d Certificate, NIST 2017
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	SRM 4321d
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technologu
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	SRM 4334j: Pu-242 Radioactive Standard
KEYWORDS	Alpha spectrometry, gamma-ray spectrometry, HPGe, liquid scintillation, Pu-242, SRM
RESULTS	Plutonium-242 is a very powerful alpha emitter and does not emit significant amounts of other, more penetrating radiation. It is the number one tracer for the monitoring of chemical processes involving plutonium and it is mainly used in the calibration of instruments. However, lately it has been suggested as a choice in explosive tests. The plutonium-242 isotope in explosives tests would allow a full-scale nuclear weapon mockup to be detonated without resulting in any nuclear yield, an experiment that would allow detailed hydrodynamical study of the early stages of the implosion of a nuclear weapon. A new primary radioactivity standardization of ^{242}Pu was performed. This standardization was used to support SRM 4334i which is currently out of stock. ^{242}Pu is our best seller SRM with an average sale of 46 units/year. Approximately 400 SRM ampoules were prepared for dissemination. Measurements by liquid scintillation counting indicates an agreement with previous SRM batches (i.e. 4334i) to ± 0.12 %. A complete standardization based on $4\pi\alpha\beta$ LS counting was completed and certification is underway.
PUBLICATIONS	
IN PROGRESS	Certification
INFORMATION	
SOURCE IN PREPARATION	SRM 4334j
OTHER RELATED PUBLICATIONS	
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