

# National Bureau of Standards

## Certificate

### Standard Reference Material 4352

#### Environmental Radioactivity

Source description	Human liver
Source identification	4352
Reference time	June 1, 1982

#### General Comments(1)\*

This Standard Reference Material (SRM), which has been developed in cooperation with member laboratories of the International Committee for Radionuclide Metrology, consists of approximately 45 grams of dried, cryogenically ground human liver(2), vacuum packed in a 125 ml glass bottle.

This SRM is intended for use in the measurement of radionuclides under study by members of the Transuranium Registry and other laboratories studying the movement and effects of heavy alpha-particle-emitting radionuclides within and upon the human body. It should prove useful to those scientists who may wish to evaluate analytical methods, or to use as a generally available "real" sample matrix in interlaboratory intercomparisons.

The contents of the whole bottle represents a typical working sample for many monitoring laboratories. The bottle should be opened carefully, releasing the vacuum in the bottle first. The sample should be weighed as soon as possible after the bottle is opened.

When additional data become available, it is expected that other radionuclides will be certified and purchasers will be notified. To aid in these certifications, users are requested to send their measurement results for uncertified radioactivities, together with the methods used, to NBS(1).

\*See notes

CERTIFIED VALUES

Radionuclide	Activity(3) Concentration (Bq g <sup>-1</sup> )	Total(4) Uncertainty (Percent)	Method Code(5)
<sup>238</sup> Pu	5.5 x 10 <sup>-5</sup>	44	1A, 2B, 2
<sup>239</sup> Pu + <sup>240</sup> Pu	2.06 x 10 <sup>-3</sup>	19	1A, 1+2, 2B, 2
<sup>241</sup> Am	1.5 x 10 <sup>-4</sup>	37	1A, 1+2, 2B, 2

This Standard Reference Material was prepared in the Center for Radiation Research, Nuclear Radiation Division, Radioactivity Group, D.D. Hoppes, Group Leader.

Washington, D.C. 20234

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Office of Standard Reference Materials

### Notes

- (1) For further information contact K.G.W. Inn (301) 921-2383 or J.M.R. Hutchinson (301) 921-2396, National Bureau of Standards, Room C114, Building 245, Washington, D.C., 20234.
- (2) Liver specimens were radiation sterilized and freeze dried. The ratio of the wet-liver-tissue weight to the freeze-dried liver-tissue weight is 4:1. Radioactivity-contaminated livers from two chronically exposed individuals were mixed with diluent material from healthy individuals. The sample was cryogenically milled and blended in a 3 ft<sup>3</sup> "V" cone blender. It was then vacuum packed in a glass bottle. Approximately 89 percent of the activity contained in the SRM is provided by the highly contaminated livers and approximately 11 percent originates in the background contamination of the diluent material.
- (3) Certified values are those measured by two or more laboratories and/or two or more methods.
- (4) Because of variations in radioactivity concentrations from bottle to bottle, the uncertainties indicated for <sup>239</sup>Pu + <sup>240</sup>Pu, <sup>241</sup>Am, and <sup>238</sup>Pu are the 95 percent tolerance limits for coverage of at least 95 percent of the measured values for this lot of bottled human liver samples. In other words, if measurements were made on all the samples (with precision and accuracy no worse than that of the measurements used to certify this SRM), then at least 95 percent of these measured values would fall within the indicated tolerance limits with confidence 95 percent.

These tolerance limits are based on the following: for <sup>239</sup>Pu + <sup>240</sup>Pu, a sample standard deviation of 6.8 percent calculated from 18 measurements; for <sup>241</sup>Am, a sample standard deviation of 11.5 percent based on 11 measurements; and for <sup>238</sup>Pu, a sample standard deviation of 13.5 percent based on 11 measurements. These measurements are judged to have negligible systematic error.

- (5) Analytical Methods (References in parentheses); all with alpha-particle spectrometry with surface-barrier detector

- A. KF-pyrosulfate fusion (SHA79)
- B. NaNO<sub>3</sub>-LiNO<sub>3</sub> fusion (MCI80)
  1. Dryash
  2. HNO<sub>3</sub> or HNO<sub>3</sub>-HF-HClO<sub>4</sub> acid dissolution (HAR81, LMB75)

### PARTICIPATING IN THE ASSAYS

Environmental Measurements Laboratory  
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Los Alamos National Laboratory  
 University of California  
 Los Alamos, New Mexico  
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National Bureau of Standards  
 U.S. Department of Commerce  
 Washington, D.C.  
 (Dr. J.M.R. Hutchinson, Dr. K.G.W. Inn and Dr. W.S. Liggett)

Woods Hole Oceanographic Institution  
 Woods Hole, Massachusetts  
 (Dr. V.T. Bowen and Dr. H.D. Livingston)

#### UNCERTIFIED VALUES

The following activities are not certified. These sample standard deviations were computed from the available measurements. These measurements do not allow adequate checking of the assumptions needed for statements of uncertainty.

Radionuclide	Activity Concentration (Bq g <sup>-1</sup> )	Sample Standard Deviation (Percent)	Range of Measurements (Bq g <sup>-1</sup> ) x 10 <sup>4</sup>	Number of Assays
228Th	5.1 x 10 <sup>-4</sup>	38	3.3 to 7.0	4
230Th	2.0 x 10 <sup>-4</sup>	12	1.6 to 2.3	4
232Th	5.8 x 10 <sup>-5</sup>	24	0.4 to 0.8	8
234U	1.0 x 10 <sup>-4</sup>	11	0.8 to 1.2	8
235U	9 x 10 <sup>-6</sup>	113	-0.1 to 0.2	8
238U	8.8 x 10 <sup>-5</sup>	12	0.7 to 1.0	8

#### PARTICLE SIZE DISTRIBUTION OF THE FREEZE-DRIED LIVER MATRIX:

Percent by Weight	diameter ( μm)	(By Alpine Air Jet Sieve)
81	75	
8	75-90	
7	90-150	
4	150	

#### OTHER DATA

Iron concentration (millimoles Fe g <sup>-1</sup> )	Sample Standard Deviations (Percent)	Method	Laboratory
0.02171	1.3	Zinc titration	LANL

#### REFERENCES

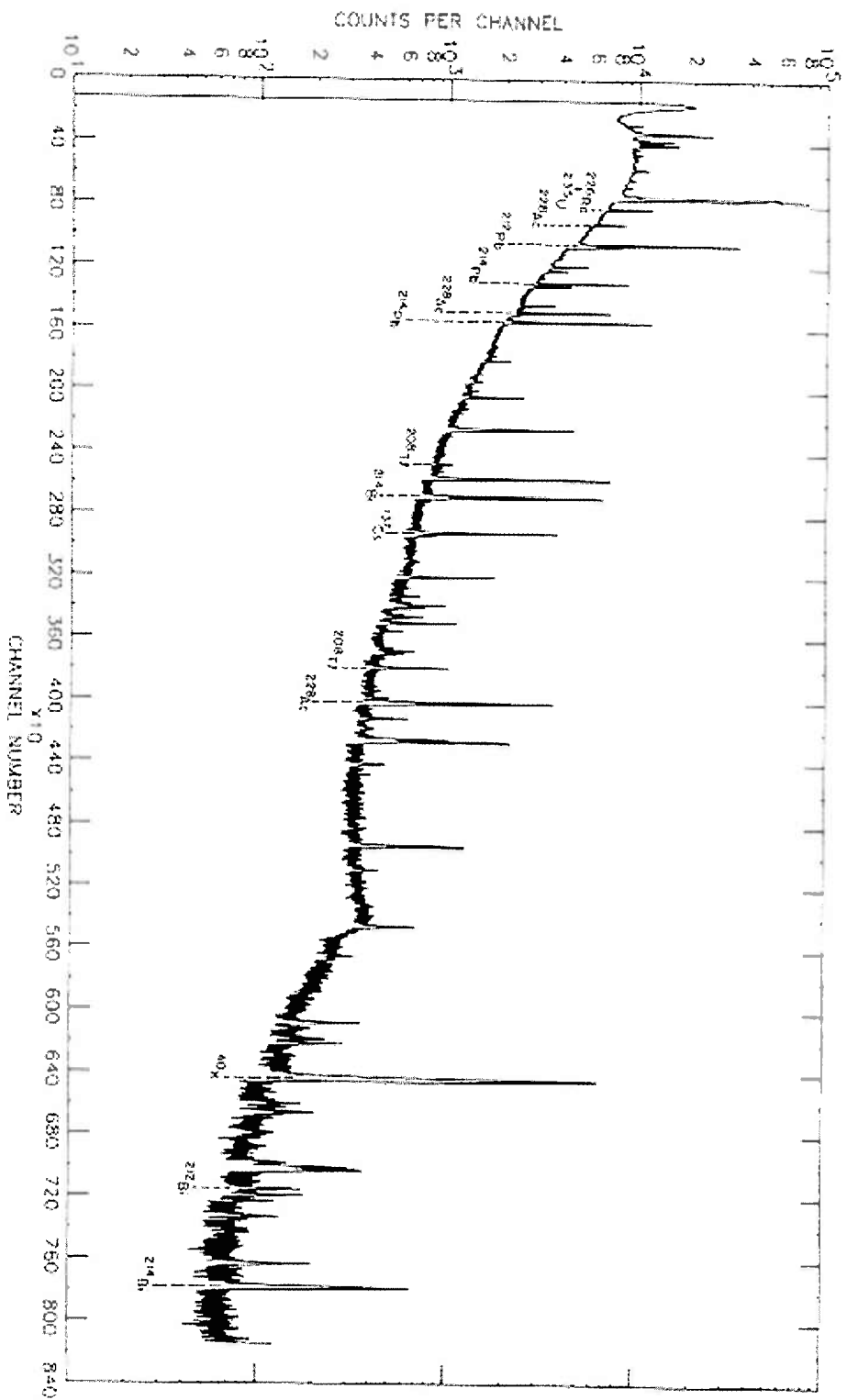
HAR 81 Environmental Measurements Laboratory Procedures Manual, HASL 300 with 8 supplements, J.H. Harley, ed., New York, New York (1980).

LMB 75 H.D. Livingston, D.R. Mann and V.T. Bowen, Analytical procedures for transuranic element in seawater and marine sediments, Analytical Methods in Oceanography, Advances in Chemistry Series No. 147, T.R.P. Gibb, Jr., ed., American Chemical Society, New York, 124 (1975).

MCI 80 Los Alamos National Laboratory, Industrial Hygiene Group, Plutonium in tissue analytical procedure, J.F. McInroy, ed., Los Alamos, New Mexico (1980).

SHA 79 C.W. Sill, F.D. Hindman, and J.I. Anderson, Simultaneous determination of alpha-emitting nuclides of radium through californium in large environmental and biological samples, Analytical Chemistry, 51 (8), 1307 (1979).

WNB 70 K.M. Wong, V.E. Noshkin and V.T. Bowen, Radiochemical procedures for the analysis of strontium, antimony, rare earths, caesium, and plutonium in seawater samples, Reference Methods for Marine Radiochemistry Studies, International Atomic Energy Agency Technical Report Series No. 118, International Atomic Energy, Vienna, 119 (1970).



Gamma-ray spectrum of SRM 4353, with 60 cm<sup>3</sup> Ge(Li) detector. Background has not been subtracted and contributes typically 20 percent to the peaks for many natural radioelements.