



Analytical Methods Approved for Drinking Water Compliance Monitoring of Radionuclides

Analysis for the following contaminants shall be conducted in accordance with the methods in the following table, or their equivalent as determined by EPA. The methods for these contaminants are specified in 40 CFR 141.25. Additional methods are listed in Appendix A to Subpart C of Part 141. Monitoring requirements for these contaminants are specified in 40 CFR 141.26.

The CFR is the legal reference for approved methods and takes precedence over this table. The table should accurately reflect the analytical methods information published in 40 CFR 141.

Naturally Occurring Radionuclides:

Gross Alpha

Natural uranium and thorium-230 are approved as gross alpha calibration standards for gross alpha with co-precipitation and evaporation methods; americium-241 is approved with co-precipitation methods.

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
EPA 00-02	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Gross Alpha Particle Activity in Drinking Water by Co-precipitation</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 18 th Edition	1992		Standard Methods
7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods
7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 20 th Edition	1998		Standard Methods
7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st Edition	2005		Standard Methods
7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 22 nd Edition	2012		Standard Methods

7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7110 C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7110 C-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods

Gross Alpha and Beta

Natural uranium and thorium-230 are approved as gross alpha calibration standards for gross alpha with co-precipitation and evaporation methods; americium-241 is approved with co-precipitation methods.

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
D7283-17	ASTM International	<i>Alpha and Beta Activity in Water by Liquid Scintillation Counting</i>	2017		ASTM International
EPA 00-01	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Gross Alpha and Gross Beta Particle Activity in Water</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
EPA 900.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Gross Alpha and Gross Beta Radioactivity</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 900.0, Rev. 1.0	EPA	<i>Gross Alpha and Gross Beta Radioactivity in Drinking Water</i>	February 2017	EPA 815-B-18-002	EPA 815-B-18-002
Page 1 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Determination of Gross Alpha and Beta in Water</i>	March 1979	EMSLLV053917	EMSL LV 053917
Page 1 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Gross Alpha and Beta Radioactivity in Drinking Water</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008

302	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 13th Edition</i>	1971		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7110 B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7110 D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7110 B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
7110 D-17	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to	2017		Standard Methods

		Subpart C of Part 141 are approved.			
R-1120-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Radium-226

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
D2460-97	ASTM International	<i>Standard Test Method for Alpha-Particle-Emitting Isotopes of Radium in Water</i>	1997		ASTM International
D2460-07	ASTM International	<i>Standard Test Method for Alpha-Particle-Emitting Isotopes of Radium in Water</i>	2007		ASTM International
D3454-97	ASTM International	<i>Standard Test Method for Radium-226 in Water</i>	1997		ASTM International
D3454-05	ASTM International	<i>Standard Test Method for Radium-226 in Water</i>	2005		ASTM International
D3454-18	ASTM International	<i>Standard Test Method for Radium-226 in Water</i>	2018		ASTM International
D3454-21	ASTM International	<i>Standard Test Method for Radium-226 in Water</i>	2021		ASTM International
Ra-04	Dept. of Homeland Security	In EML Procedures Manual, 28 th Edition, Vol. I, Department of Energy Report, HASL-300	1997		HASL-300
Ra-05 (Ra-04 see Note)	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I Note: See footnote 8 in the table at 40 CFR 141.25(a)(25); in the 27th Edition 'Ra-04' is listed as 'Ra-05'	1990		HASL-300-Ed. 27
EPA 903.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in	August 1980	EPA 600/4/80-032	EPA 600/4/80-032

		Drinking Water: <i>Alpha-Emitting Radium Isotopes</i>			
EPA 903.0, Rev. 1.0	EPA	<i>Alpha-Emitting Radium Isotopes in Drinking Water</i>	January 2021	EPA 815-B-21-002	EPA 815-B-21-002
EPA 903.1	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radium-226 – Radon Emanation Technique</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 903.1, Rev. 1.0	EPA	<i>Radium-226 in Drinking Water – Radon Emanation Technique</i>	January 2021	EPA 815-B-21-003	EPA-815-B-21-003
EPA Ra-03	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Radium-226 in Water Samples</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
EPA Ra-04	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Radium-226, De-emanation Procedure</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
Page 13 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radium-226 in Drinking Water – Alpha-Emitting Radium Isotopes – Precipitation Method</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008
Page 16 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radium-226 in Drinking Water – Radon Emanation Technique</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008
Page 19 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Determination of Radium-226 and Radium-228 in Water, Soil, Air and Biological Tissue</i>	March 1979	EMSLLV053917	EMSL LV 053917
GA	Georgia Institute of Technology	<i>The Determination of Radium-226 and Radium-228 in Drinking Water by Gamma-ray Spectrometry using HPGE or Ge(Li) Detectors, Revision 1.2</i>	December 2004		GA
NY	NY Dept. of Health	<i>Determination of Ra-226 and Ra-228 (Ra-02)</i>	January 1980, Revised June 1982		Radiological Sciences Institute for Laboratories and Research, NY State Department of Health, Albany, NY

304	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 13th Edition</i>	1971		Standard Methods
305	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 13th Edition</i>	1971		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Ra B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods

7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Ra C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-Ra E	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Ra E	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Ra E	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-Ra B-01	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2001		Standard Methods
7500-Ra C-01	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2001		Standard Methods
7500-Ra E-07	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to	2007		Standard Methods

		Subpart C of Part 141 are approved.			
R-1140-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS
R-1141-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Radium-228

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
EPA 904.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radium-228</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 904.0, Rev. 1.0	EPA	<i>Radium-228 in Drinking Water</i>	March 2022	EPA 815-B-22-003	EPA 815-B-22-003
EPA Ra-05	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Radium-228 in Water Samples</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
Page 19 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Determination of Radium-226 and Radium-228 in Water, Soil, Air and Biological Tissue</i>	March 1979	EMSLLV053917	EMSL LV 053917
Page 24 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radium-228 in Drinking Water – Sequential Method Radium-228/Radium-226</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008

GA	Georgia Institute of Technology	<i>The Determination of Radium-226 and Radium-228 in Drinking Water by Gamma-ray Spectrometry using HPGE or Ge(Li) Detectors, Revision 1.2</i>	December 2004		GA
NJ	NJ Dept. of Environmental Protection	<i>Determination of Ra-228 in Drinking Water</i>	August 1980		State of New Jersey, Department of Environmental Protection, Trenton, NJ
NY	NY Dept. of Health	<i>Determination of Ra-226 and Ra-228 (Ra-02)</i>	January 1980, Revised June 1982		Radiological Sciences Institute for Laboratories and Research, NY State Department of Health, Albany, NY
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Ra D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-Ra E	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Ra E	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods

7500-Ra E	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-Ra D-01	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2001		Standard Methods
7500-Ra E-07	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2007		Standard Methods
R-1142-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Uranium

If uranium (U) is determined by mass, a 0.67 pCi/μg conversion factor must be used. This conversion factor is based on 1:1 activity ratio of U-234 and U-238, characteristic of naturally occurring uranium.

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
D2907-97	ASTM International	<i>Standard Test Methods for Microquantities of Uranium in Water by Fluorometry</i>	1997		ASTM International
D3972-97	ASTM International	<i>Standard Test Method for Isotopic Uranium in Water by Radiochemistry</i>	1997		ASTM International
D3972-02	ASTM International	<i>Standard Test Method for Isotopic Uranium in Water by Radiochemistry</i>	2002		ASTM International
D3972-09	ASTM International	<i>Standard Test Method for Isotopic Uranium in Water by Radiochemistry</i>	2009		ASTM International

D5174-97	ASTM International	<i>Standard Test Method for Trace Uranium by Pulsed Laser Phosphorimetry</i>	1997		ASTM International
D5174-02	ASTM International	<i>Standard Test Method for Trace Uranium by Pulsed Laser Phosphorimetry</i>	2002		ASTM International
D5174-07	ASTM International	<i>Standard Test Method for Trace Uranium by Pulsed Laser Phosphorimetry</i>	2007		ASTM International
D5673-03	ASTM International	<i>Standard Test Method for Elements in Water by Inductively Coupled Plasma-Mass Spectrometry</i>	2003		ASTM International
D5673-05	ASTM International	<i>Standard Test Method for Elements in Water by Inductively Coupled Plasma-Mass Spectrometry</i>	2005		ASTM International
D5673-10	ASTM International	<i>Standard Test Method for Elements in Water by Inductively Coupled Plasma-Mass Spectrometry</i>	2010		ASTM International
D5673-16	ASTM International	<i>Standard Test Method for Elements in Water by Inductively Coupled Plasma-Mass Spectrometry</i>	2016		ASTM International
D6239-09	ASTM International	<i>Standard Test Method for Uranium in Drinking Water by High-Resolution Alpha-Liquid Scintillation Spectrometry</i>	2009		ASTM International
U-02	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I	1990		HASL-300-Ed. 27
U-02	Dept. of Homeland Security	In EML Procedures Manual, 28 th Edition, Vol. I, Department of Energy Report, HASL-300	1997		HASL-300
U-04	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I	1990		HASL-300-Ed. 27

U-04	Dept. of Homeland Security	In EML Procedures Manual, 28 th Edition, Vol. I, Department of Energy Report, HASL-300	1997		HASL-300
200.8, Rev. 5.4	EPA	In Methods for the Determination of Metals in Environmental Samples, Supplement I	May 1994	EPA/600/R-94/111	National Environmental Methods Index
EPA 00-07	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Thorium and Uranium in Water</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
EPA 908.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Uranium – Radiochemical Method</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 908.1	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Uranium – Fluorometric Method</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
Page 33 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Isotopic Determination of Plutonium, Uranium, and Thorium in Water, Soil, Air and Biological Tissue</i>	March 1979	EMSLLV053917	EMSL LV 053917
3125	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 20 th Edition	1998		Standard Methods
3125	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st Edition	2005		Standard Methods
7500-U B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 17 th Edition	1989		Standard Methods
7500-U B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 18 th Edition	1992		Standard Methods
7500-U B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods

7500-U B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-U B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
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7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
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7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-U C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-U B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits.	2000		Standard Methods

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7500-U C-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
R-1180-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS
R-1181-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS
R-1182-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Man-made Radionuclides:

Gamma Emitters

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
D3649-91	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	1991		ASTM International

D3649-98a	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	1998		ASTM International
D3649-06	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	2006		ASTM International
D4785-93	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	1993		ASTM International
D4785-00a	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	2000		ASTM International
D4785-08	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	2008		ASTM International
D4785-20	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	2020		ASTM International
Ga-01-R	Dept. of Homeland Security	In EML Procedures Manual, 28 th Edition, Vol. I, Department of Energy Report, HASL-300	1997		HASL-300
EPA 901.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radioactive Cesium</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 901.1	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Gamma Emitting Radionuclides</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 902.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radioactive Iodine</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
Page 92 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Isotopic Analysis by Gamma Ray Spectra using Lithium-Drifted Germanium Detectors</i>	March 1979	EMSLLV053917	EMSL LV 053917
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods

7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
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7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods

7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7120-97	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	1997		Standard Methods
7500-Cs B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
7500-I B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to	2000		Standard Methods

		Subpart C of Part 141 are approved.			
R-1110-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Radioactive Cesium

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
D2459-72	ASTM International	<i>Standard Test Method for Gamma Spectrometry of Water</i>	1972		ASTM International
D3649-91	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	1991		ASTM International
D3649-98a	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	1998		ASTM International
D3649-06	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	2006		ASTM International
4.5.2.3	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I	1990		HASL-300-Ed. 27
EPA 901.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radioactive Cesium</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 901.1	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Gamma Emitting Radionuclides</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
Page 4 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radioactive Cesium in Drinking Water</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008

Page 92 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Isotopic Analysis by Gamma Ray Spectra using Lithium-Drifted Germanium Detectors</i>	March 1979	EMSLLV053917	EMSL LV 053917
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 20 th Edition	1998		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st Edition	2005		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 22 nd Edition	2012		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 23 rd Edition	2017		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 24 th Edition	2023		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 17 th Edition	1989		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 18 th Edition	1992		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 20 th Edition	1998		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st Edition	2005		Standard Methods

7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Cs B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7120-97	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	1997		Standard Methods
7500-Cs B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
R-1110-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS
R-1111-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Radioactive Iodine

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
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D3649-91	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	1991		ASTM International
D3649-98a	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	1998		ASTM International
D3649-06	ASTM International	<i>Standard Practice for High Resolution Gamma-Ray Spectrometry of Water</i>	2006		ASTM International
D4785-93	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	1993		ASTM International
D4785-00a	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	2000		ASTM International
D4785-08	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	2008		ASTM International
D4785-20	ASTM International	<i>Standard Test Method for Low-Level Analysis of Iodine Radioisotopes in Water</i>	2020		ASTM International
4.5.2.3	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I	1990		HASL-300-Ed. 27
EPA 901.1	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Gamma Emitting Radionuclides</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA 902.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radioactive Iodine</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
Page 6 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radioactive Iodine in Drinking Water – Precipitation Method</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008
Page 9 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radioactive Iodine in Drinking Water – Distillation Method</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008

Page 92 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Isotopic Analysis by Gamma Ray Spectra using Lithium-Drifted Germanium Detectors</i>	March 1979	EMSLLV053917	EMSL LV 053917
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 20 th Edition	1998		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st Edition	2005		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 22 nd Edition	2012		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 23 rd Edition	2017		Standard Methods
7120	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 24 th Edition	2023		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 17 th Edition	1989		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 18 th Edition	1992		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 19 th Edition	1995		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 20 th Edition	1998		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st Edition	2005		Standard Methods

7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-I B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-I C	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods

7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-I D	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7120-97	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	1997		Standard Methods
7500-I B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
7500-I C-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
7500-I D-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to	2000		Standard Methods

		Subpart C of Part 141 are approved.			
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Radioactive Strontium 89 and 90

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
Sr-01	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I	1990		HASL-300-Ed. 27
Sr-01	Dept. of Homeland Security	In EML Procedures Manual, 28 th Edition, Vol. I, Department of Energy Report, HASL-300	1997		HASL-300
Sr-02	Dept. of Homeland Security	In EML Procedures Manual, 27 th Edition, Vol. I, Department of Energy Report, HASL-300-ED.27-Vol. I	1990		HASL-300-Ed. 27
Sr-02	Dept. of Homeland Security	In EML Procedures Manual, 28 th Edition, Vol. I, Department of Energy Report, HASL-300	1997		HASL-300
EPA 905.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Radioactive Strontium</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA Sr-04	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Radiostrontium in Water, Sea Water, and other Aqueous Media</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
Page 29 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Radioactive Strontium in Drinking Water</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008
Page 65 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Determination of Strontium-89 and Strontium-90 in Water, Vegetation, Soil, and Biological Tissue</i>	March 1979	EMSLLV053917	EMSL LV 053917

303	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 13th Edition</i>	1971		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-Sr B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-Sr B-01	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2001		Standard Methods
R-1160-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS

Tritium

Method	Organization	Reference Title	Date	EPA Publication Number	Source of Method
D4107-91	ASTM International	<i>Standard Test Method for Tritium in Drinking Water</i>	1991		ASTM International
D4107-98	ASTM International	<i>Standard Test Method for Tritium in Drinking Water</i>	1998		ASTM International
D4107-08	ASTM International	<i>Standard Test Method for Tritium in Drinking Water</i>	2008		ASTM International
D4107-20	ASTM International	<i>Standard Test Method for Tritium in Drinking Water</i>	2020		ASTM International
EPA 906.0	EPA	In Prescribed Procedures for Measurement of Radioactivity in Drinking Water: <i>Tritium</i>	August 1980	EPA 600/4/80-032	EPA 600/4/80-032
EPA H-02	EPA	In Radiochemistry Procedures Manual: <i>Radiochemical Determination of Tritium in Water: Dioxane Method</i>	June 1984	EPA 520/5-84-006	EPA 520/5-84-006
Page 34 in EPA 600/4-75-008	EPA	In Interim Radiochemical Methodology for Drinking Water: <i>Tritium in Drinking Water</i>	Revised March 1976	EPA 600/4-75-008	600/4-75-008
Page 87 in EMSL LV 053917	EPA	In Radiochemical Analytical Procedures for Analysis of Environmental Samples: <i>Determination of Tritium in Water and Biological Tissue (Direct Method)</i>	March 1979	EMSLLV053917	EMSL LV 053917
306	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 13th Edition</i>	1971		Standard Methods
7500- ³ H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 17th Edition</i>	1989		Standard Methods
7500- ³ H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 18th Edition</i>	1992		Standard Methods
7500- ³ H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 19th Edition</i>	1995		Standard Methods

7500-³H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 20th Edition</i>	1998		Standard Methods
7500-³H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 21st Edition</i>	2005		Standard Methods
7500-³H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 22nd Edition</i>	2012		Standard Methods
7500-³H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 23rd Edition</i>	2017		Standard Methods
7500-³H B	Standard Methods	<i>Standard Methods for the Examination of Water and Wastewater, 24th Edition</i>	2023		Standard Methods
7500-³H B-00	Standard Methods Online	Online version. Approval year is designated by the last 2 digits. Only online versions cited in the regulations or in Appendix A to Subpart C of Part 141 are approved.	2000		Standard Methods
R-1171-76	U.S. Geological Survey	In <i>Methods for the Determination of Radioactive Substances in Water and Fluvial Sediments</i> , USGS Series: Techniques of Water-Resource Investigation. Report Number: 05-A5; by Thatcher, L.L., Janzer, V.J., and Edwards, K.W.	1977		USGS