

Standard Reference Material[®] 1947a

Great Lakes Fish Tissue

CERTIFICATE OF ANALYSIS

Purpose: The certified values delivered by this Standard Reference Material (SRM) are intended for evaluating analytical methods for the determination of total mercury, polychlorinated biphenyl (PCB) congeners, chlorinated pesticides, polybrominated diphenyl ether (PBDE) congeners, and polyfluoroalkyl substances (PFAS) in fish tissue and similar matrices. All of the constituents for which certified and non-certified mass fraction values are provided are naturally present in the fish tissue homogenate.

Description: A unit of SRM 1947a consists of four jars, each containing approximately 10 g (wet basis) of cryogenically homogenized frozen tissue material. The jars are packaged together in a sealed aluminized pouch.

Certified Values: The certified values for total mercury, PCB congeners, chlorinated pesticides, and PBDE congeners in SRM 1947a are listed in Tables 1 to 4. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or accounted for by NIST [1]. The certified value is metrologically traceable to the International System of Units (SI) derived unit for mass fraction, expressed as either milligrams per kilogram or micrograms per kilogram on a wet-mass basis [1,2].

Non-Certified Values: Non-certified values are provided in Appendix A.

Additional Information: Values of potential interest are provided in Appendix B. Full details on the production, analysis, and statistical evaluation of SRM 1947a are provided in NIST Special Publication 260-260 [2].

Period of Validity: The certified values delivered by **SRM 1947a** are valid within the measurement uncertainty specified until **31 July 2040**. The certified values are nullified if the material is stored or used improperly, damaged, contaminated, or otherwise modified.

Maintenance of Certified Values: NIST will monitor this SRM over the period of its validity. If substantive technical changes occur that affect the certification, NIST will issue an amended certificate through the NIST SRM website (<https://www.nist.gov/srm>). Before making use of any of the values delivered by this material, users should verify they have the most recent version of this documentation, available through the NIST SRM website (<https://www.nist.gov/srm>).

Table 1. Certified Mass Fraction Values (Wet-Mass Basis) for Total Mercury in SRM 1947a

	Mass Fraction ^(a) (mg/kg)
Total Mercury (Hg)	174.9 ± 3.1

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the certified value, $U_{95\%}(x)$ is the expanded uncertainty of the certified value, and coverage factor is $k = 2$ [3,4,5].

Table 2. Certified Mass Fraction Values (Wet-Mass Basis) for Select PCB Congeners in SRM 1947a

PCB Congener	Mass Fraction ^(a) (µg/kg)
PCB 52 2,2',5,5'-Tetrachlorobiphenyl	14.0 ± 0.7
PCB 87 2,2',3,4,5'-Pentachlorobiphenyl	11.2 ± 1.3
PCB 95 2,2',3,5',6'-Pentachlorobiphenyl	15.5 ± 2.3
PCB 99 2,2',4,4',5'-Pentachlorobiphenyl	25.6 ± 0.7
PCB 101 2,2',4,5,5'-Pentachlorobiphenyl	53.2 ± 12.8
PCB 105 2,3,3',4,4'-Pentachlorobiphenyl	23.0 ± 7.2
PCB 110 2,3,3',4',6'-Pentachlorobiphenyl	33.7 ± 3.5
PCB 146 2,2',3,4',5,5'-Hexachlorobiphenyl	21.4 ± 2.1
PCB 149 2,2',3,4',5',6'-Hexachlorobiphenyl	34.4 ± 4.7
PCB 151 2,2',3,5,5',6'-Hexachlorobiphenyl	13.2 ± 3.1
PCB 156 2,3,3',4,4',5'-Hexachlorobiphenyl	5.08 ± 1.10
PCB 174 2,2',3,3',4,5,6'-Heptachlorobiphenyl	9.28 ± 1.10
PCB 180 2,2',3,4,4',5,5'-Heptachlorobiphenyl	36.4 ± 0.6
PCB 194 2,2',3,3',4,4',5,5'-Octachlorobiphenyl	5.64 ± 0.16
PCB 195 2,2',3,3',4,4',5,6'-Octachlorobiphenyl	1.80 ± 0.47
PCB 209 Decachlorobiphenyl	3.31 ± 0.27

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the certified value, $U_{95\%}(x)$ is the expanded uncertainty of the certified value, and coverage factor is $k = 2$ [3,4,5].

Table 3. Certified Mass Fraction Values (Wet-Mass Basis) for Select Chlorinated Pesticides in SRM 1947a

Pesticide	Mass Fraction ^(a) (µg/kg)
Hexachlorobenzene	6.88 ± 0.10
Oxychlorane	3.06 ± 0.62
Mirex	35.6 ± 1.3
4,4'-DDE	221 ± 5
4,4'-DDT	21.8 ± 1.0

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the certified value, $U_{95\%}(x)$ is the expanded uncertainty of the certified value, and coverage factor is $k = 2$ [3,4,5].

Table 4. Certified Mass Fraction Values (Wet-Mass Basis) for Select PBDE Congeners in SRM 1947a

PBDE Congener	Mass Fraction ^(a) (µg/kg)
PBDE 47 2,2',4,4'-Tetrabromodiphenylether	27.0 ± 1.7
PBDE 100 2,2',4,4',6'-Pentabromodiphenylether	9.38 ± 0.92
PBDE 153 2,2',4,4',5,5'-Hexabromodiphenylether	2.91 ± 0.16
PBDE 154 2,2',4,4',5,6'-Hexabromodiphenylether	5.27 ± 0.35

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the certified value, $U_{95\%}(x)$ is the expanded uncertainty of the certified value, and coverage factor is $k = 2$ [3,4,5].

Safety: SRM 1947a is intended for research use; not for human consumption. This SRM was developed after an appropriate vertebrate research determination by NIST.

Storage: SRM 1947a is packaged as a cryogenically homogenized frozen material in glass jars. The tissue homogenate should not be allowed to thaw prior to subsampling for analysis. This material has been stored at NIST at $-80\text{ }^{\circ}\text{C}$ (or lower) since it was prepared and should be stored by the user at this temperature for the certified values to be valid within the stated uncertainties. An open jar can be reused until the material reaches its expiration date, provided that the open jar is resealed and stored frozen at $-80\text{ }^{\circ}\text{C}$ (or lower).

Use: This material is a fresh frozen tissue homogenate. After extended storage at temperatures of $-25\text{ }^{\circ}\text{C}$ or higher, the tissue homogenate will lose its powder-like form. For the handling of this material during sample preparation, the following procedures and precautions are recommended. If weighing relatively large quantities, weigh the jar, remove a portion from the jar then reweigh the jar to determine the mass of the subsample. Avoid heavy frost buildup by handling the jars quickly and wiping them prior to weighing. For weighing, transfer subsamples to a pre-cooled, thick-walled glass container rather than a thin-walled plastic container to minimize heat transfer to the sample. If possible, use a cold workspace (e.g., insulated container with either dry ice or liquid nitrogen on the bottom and pre-cooled implements, such as spatulas, for transferring the frozen powder). Subsamples of this SRM for analysis should be withdrawn from the jar immediately after opening and used without delay for the certified values to be valid within the stated uncertainties. To relate analytical determinations to the certified values in this certificate, test portions of the material equal to or greater than 0.25 g for total mercury; and equal to or greater than 2.5 g for PCBs, chlorinated pesticides, and PBDEs should be used. The mass fractions of constituents in SRM 1947a are reported on a wet-mass basis.

REFERENCES

- [1] Beauchamp, C.R.; Camara, J.E.; Carney, J.; Choquette, S.J.; Cole, K.D.; DeRose, P.C.; Duewer, D.L.; Epstein, M.S.; Kline, M.C.; Lippa, K.A.; Lucon, E.; Molloy, J.; Nelson, M.A.; Phinney, K.W.; Polakoski, M.; Possolo, A.; Sander, L.C.; Schiel, J.E.; Sharpless, K.E.; Toman, B.; Winchester, M.R.; Windover, D.; *Metrological Tools for the Reference Materials and Reference Instruments of the NIST Material Measurement Laboratory*; NIST Special Publication (NIST SP) 260-136, 2021 edition; National Institute of Standards and Technology, Gaithersburg, MD (2021); available at <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.260-136-2021.pdf> (accessed Dec 2025).
- [2] Burdette, C.Q.; Blevins, K.; Boggs, A.S.P.; Bryan Sallee, C.E.; Cuthbertson, A.; Ellisor, D.; Heckert, N.A.; Hoguet, J.C.; Huncik, K.; Moors, A.; Ness, J.; Reiner, J.L.; *Certification of Standard Reference Material® 1947a: Great Lakes Fish Tissue*; NIST Special Publication (NIST SP) 260-260; National Institute of Standards and Technology, Gaithersburg, MD (2025) available at <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.260-260.pdf> (accessed Dec 2025).
- [3] JCGM 100:2008; *Evaluation of Measurement Data — Guide to the Expression of Uncertainty in Measurement* (GUM 1995 with Minor Corrections); Joint Committee for Guides in Metrology (2008); available at <https://www.bipm.org/en/committees/jc/jcgm/publications> (accessed Dec 2025); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at <https://www.nist.gov/pml/nist-technical-note-1297> (accessed Dec 2025).
- [4] JCGM 101:2008; *Evaluation of Measurement Data—Supplement 1 to the “Guide to the Expression of Uncertainty in Measurement”—Propagation of Distributions using a Monte Carlo Method*; Joint Committee for Guides in Metrology (2008); available at <https://www.bipm.org/en/committees/jc/jcgm/publications> (accessed Dec 2025)
- [5] Efron, B.; Tibshirani, R.J.; *An Introduction to the Bootstrap*; Chapman & Hall, UK (1993).

If you use this SRM in published work, please reference:

Burdette CQ, Blevins K, Boggs ASP, Bryan Sallee CE, Cuthbertson A, Ellisor D, Heckert NA, Hoguet JC, Huncik K, Moors A, Ness J, Reiner JL (2025) Certification of Standard Reference Material® 1947a: Great Lakes Fish Tissue. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (NIST SP) 260-260. <https://doi.org/10.6028/NIST.SP.260-260>.

Certain commercial equipment, instruments, or materials may be identified in this Certificate of Analysis to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the Office of Reference Materials 100 Bureau Drive, Stop 2300, Gaithersburg, MD 20899-2300; telephone (301) 975-2200; e-mail srminfo@nist.gov; or the Internet at <https://www.nist.gov/srm>.

***** End of Certificate of Analysis *****

APPENDIX A

Non-Certified Values: Non-certified values are suitable for use in method development, method harmonization, and process control but do not provide metrological traceability to the SI or other higher-order references systems [1]. Non-certified mass fraction values are provided in the tables below.

Table A1. Non-Certified Mass Fraction Values (Wet-Mass Basis) for Select PCB Congeners in SRM 1947a

PCB Congener	Mass Fraction ^(a) ($\mu\text{g}/\text{kg}$)	
PCB 18	2,2',5'-Trichlorobiphenyl	1.25 \pm 0.04
PCB 31	2,4',5'-Trichlorobiphenyl	2.30 \pm 1.23
PCB 44	2,2',3,5'-Tetrachlorobiphenyl	5.11 \pm 1.25
PCB 45	2,2',3,6'-Tetrachlorobiphenyl	0.27 \pm 0.01
PCB 49	2,2',4,5'-Tetrachlorobiphenyl	9.47 \pm 0.29
PCB 56	2,3,3',4'-Tetrachlorobiphenyl	4.33 \pm 0.65
PCB 63	2,3,4',5'-Tetrachlorobiphenyl	0.53 \pm 0.3
PCB 66	2,3',4,4'-Tetrachlorobiphenyl	19.8 \pm 3.9
PCB 70	2,3',4',5'-Tetrachlorobiphenyl	12.5 \pm 6
PCB 74	2,4,4',5'-Tetrachlorobiphenyl	6.23 \pm 2.36
PCB 79	3,3',4,5'-Tetrachlorobiphenyl	0.71 \pm 0.22
PCB 82	2,2',3,3',4'-Pentachlorobiphenyl	0.91 \pm 0.04
PCB 92	2,2',3,5,5'-Pentachlorobiphenyl	15.0 \pm 0.6
PCB 106	2,3,3',4,5'-Pentachlorobiphenyl	0.88 \pm 0.11
PCB 112	2,3,3',5,6'-Pentachlorobiphenyl	2.08 \pm 0.06
PCB 114	2,3,4,4',5'-Pentachlorobiphenyl	0.95 \pm 0.21
PCB 118	2,3',4,4',5'-Pentachlorobiphenyl	35.3 \pm 1.7
PCB 119	2,3',4,4',6'-Pentachlorobiphenyl	2.32 \pm 0.08
PCB 128	2,2',3,3',4,4'-Hexachlorobiphenyl	10.6 \pm 0.4
PCB 130	2,2',3,3',4,5'-Hexachlorobiphenyl	5.41 \pm 0.20
PCB 137	2,2',3,4,4',5'-Hexachlorobiphenyl	2.73 \pm 1.08
PCB 154	2,2',4,4',5,6'-Hexachlorobiphenyl	0.82 \pm 0.05
PCB 157	2,3,3',4,4',5'-Hexachlorobiphenyl	1.19 \pm 0.21
PCB 158	2,3,3',4,4',6'-Hexachlorobiphenyl	3.86 \pm 0.26
PCB 165	2,3,3',5,5',6'-Hexachlorobiphenyl	16.9 \pm 0.1
PCB 166	2,3,4,4',5,6'-Hexachlorobiphenyl	0.53 \pm 0.20
PCB 167	2,3',4,4',5,5'-Hexachlorobiphenyl	3.27 \pm 0.76
PCB 170	2,2',3,3',4,4',5'-Heptachlorobiphenyl	11.1 \pm 0.1
PCB 172	2,2',3,3',4,5,5'-Heptachlorobiphenyl	4.57 \pm 1.22
PCB 175	2,2',3,3',4,5',6'-Heptachlorobiphenyl	0.99 \pm 0.22
PCB 176	2,2',3,3',4,6,6'-Heptachlorobiphenyl	0.66 \pm 0.19
PCB 177	2,2',3,3',4,5',6'-Heptachlorobiphenyl	12.1 \pm 2.9
PCB 178	2,2',3,3',5,5',6'-Heptachlorobiphenyl	6.63 \pm 1.69
PCB 183	2,2',3,4,4',5',6'-Heptachlorobiphenyl	10.6 \pm 0.4
PCB 185	2,2',3,4,5,5',6'-Heptachlorobiphenyl	1.49 \pm 0.25
PCB 187	2,2',3,4',5,5',6'-Heptachlorobiphenyl	29.7 \pm 1.0
PCB 189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	0.47 \pm 0.13
PCB 191	2,3,3',4,4',5',6'-Heptachlorobiphenyl	0.49 \pm 0.13
PCB 196	2,2',3,3',4,4',5,6'-Octachlorobiphenyl	9.15 \pm 1.12
PCB 197	2,2',3,3',4,4',6,6'-Octachlorobiphenyl	0.52 \pm 0.1
PCB 199	2,2',3,3',4,5,5',6'-Octachlorobiphenyl	10.4 \pm 1.5
PCB 201	2,2',3,3',4,5',6,6'-Octachlorobiphenyl	1.40 \pm 0.04
PCB 202	2,2',3,3',5,5',6,6'-Octachlorobiphenyl	3.14 \pm 0.93
PCB 205	2,3,3',4,4',5,5',6'-Octachlorobiphenyl	0.225 \pm 0.004
PCB 206	2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl	3.45 \pm 0.36
PCB 207	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	0.62 \pm 0.09
PCB 208	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	1.79 \pm 0.40

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the non-certified value and $U_{95\%}(x)$ is the expanded uncertainty of the non-certified value with a coverage factor of $k = 2$.

Table A2. Non-Certified Mass Fraction Values (Wet-Mass Basis) for Select Chlorinated Pesticides, PBDE Congeners, and PFAS in SRM 1947a

Pesticide		Mass Fraction ^(a) ($\mu\text{g}/\text{kg}$)	
Heptachlor epoxide		1.20	\pm 0.04
<i>cis</i> -Chlordane		12.9	\pm 0.4
<i>trans</i> -Nonachlor		21.3	\pm 0.7
Dieldrin		12.1	\pm 0.5
2,4'-DDE		1.48	\pm 0.48
2,4'-DDD		3.78	\pm 0.65
4,4'-DDD		46.13	\pm 0.03
2,4'-DDT		6.04	\pm 0.70
PBDE Congener			
PBDE 17	2,2',4-Tribromodiphenylether	9.90	\pm 0.25
PBDE 25	2,3',4-Tribromodiphenylether	2.88	\pm 0.14
PBDE 28	2,4,4'-Tribromodiphenylether	0.90	\pm 0.23
PBDE 30	2,4,6-Tribromodiphenylether	2.57	\pm 1.27
PBDE 66	2,3',4,4'-Tetrabromodiphenylether	0.86	\pm 0.50
PBDE 75	2,4,4',6-Tetrabromodiphenylether	4.06	\pm 0.17
PBDE 101	2,2',4,5,5'-Pentabromodiphenylether	0.94	\pm 0.52
PBDE 138	2,2',3,4,4',5'-Hexabromodiphenylether	0.95	\pm 0.44
PFAS			
PFDA	Perfluorodecanoic acid	0.364	\pm 0.062
PFUnA	Perfluoroundecanoic acid	0.3025	\pm 0.0004
PFOS	Perfluorooctane sulfonate	12.9	\pm 2.0
PFOSA	Perfluorooctane sulfonamide	0.183	\pm 0.008
PFHxS	Perfluorohexane sulfonate	0.112	\pm 0.006

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the non-certified value and $U_{95\%}(x)$ is the expanded uncertainty of the non-certified value with a coverage factor of $k = 2$.

Period of Validity: The non-certified values are valid within the measurement uncertainty specified until **31 July 2040**. The value assignments are nullified if the material is stored or used improperly, damaged, contaminated, or otherwise modified.

Maintenance of Non-Certified Values: NIST will monitor this material to the end of its period of validity. If substantive technical changes occur that affect the non-certified values during this period, NIST will update this Certificate of Analysis. Before making use of any of the values delivered by this material, users should verify they have the most recent version of this documentation, available through the NIST SRM website (<https://www.nist.gov/srm>).

* * * * * End of Appendix A * * * * *

APPENDIX B

Values of Potential Interest: Each mass fraction value, reported on a wet-mass basis, is the mean result from analyses provided by NIST. No uncertainty is provided because there is insufficient information available for its assessment. Values of potential interest cannot be used to establish metrological traceability.

Mass Fraction Values (Wet-Mass Basis) of Potential Interest for Select PCB Congeners, PBDE Congeners, and PFAS in SRM 1947a

PCB Congener			Mass Fraction ($\mu\text{g}/\text{kg}$)
PCB 127		3,3',4,5,5'-Pentachlorobiphenyl	0.22
PCB 159		2,3,3',4,5,5'-Hexachlorobiphenyl	0.50
PBDE Congener			
PBDE 119		2,3',4,4',6-Pentabromodiphenylether	1.24
PBDE 155		2,2',4,4',6,6'-Hexabromodiphenylether	2.00
PFAS			
PFNA		Perfluorononanoic acid	0.22

***** End of Appendix B *****