



Certificate of Analysis

Standard Reference Material[®] 2274 PCB Congener Solution-II in Isooctane

This Standard Reference Material (SRM) is a solution of 11 polychlorinated biphenyl (PCB) congeners in 2,2,4-trimethylpentane (isooctane) intended primarily for use in the calibration of chromatographic instrumentation. A unit of SRM 2274 consists of five 2 mL ampoules, each containing approximately 1.2 mL of solution.

Certified Concentrations of Constituent PCB Congeners: The certified concentration values, expressed as mass fractions, for 11 PCB congeners are given in Table 1. These values are based on results obtained from the gravimetric preparation of the solution and from the analytical results determined by using gas chromatography. 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.

Supplemental Information: A summary of the gravimetric and gas chromatographic measurements for SRM 2274 is provided in Table 2. This information is **NOT** to be used as a substitute for NIST certified values. Chemical Abstracts Service (CAS) Nomenclature and Registry Numbers of the certified components are listed in Table 3. A representative chromatogram from the gas chromatographic analysis is shown in Figure 1 on page 5 of this certificate.

Expiration of Certification: The certification **SRM 2274** is valid, within the measurement uncertainty specified, until **31 January 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Use"). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

Coordination of the technical measurements leading to the certification on this SRM was under the direction of M.M. Schantz and S.A. Wise of the NIST Analytical Chemistry Division.

Consultation on the statistical design of the experimental work and evaluation of the data were provided by S.B. Schiller and S.D. Leigh of the NIST Statistical Engineering Division.

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Preparation and analytical measurements of the SRM were performed by M.P. Cronise of the NIST Standard Reference Materials Program and R.M. Parris and D.L. Poster of the NIST Analytical Chemistry Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

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See Certificate Revision History on Last Page

INSTRUCTIONS FOR USE

Handling: This material contains polychlorinated biphenyls, many of which have been reported to have toxic, mutagenic, and/or carcinogenic properties, and should be handled with care. Use proper disposal methods.

Storage: Sealed ampoules, as received, should be stored in the dark at temperatures lower than 30 °C.

Opening of Ampoule: Open ampoules carefully to prevent contamination and injury. The ampoules are pre-scored and should **NOT** be opened using a file. Sample aliquots for analysis should be withdrawn at 20 °C to 25 °C **immediately** after opening the ampoules and should be processed without delay for the certified values in Table 1 to be valid within the stated uncertainties. Because of the volatility of 2,2,4-trimethylpentane, certified values are not applicable to material stored in ampoules that have been opened for more than 5 minutes, even if they are resealed.

PREPARATION AND ANALYSIS

SRM Preparation: The PCB congeners used in the preparation of this SRM were obtained from AccuStandard, New Haven, CT. The solution was prepared at NIST by weighing and mixing the individual PCB congeners and 2,2,4-trimethylpentane. The weighed components were added to the 2,2,4-trimethylpentane and mixed until completely dissolved and homogenized. The total mass of this solution was measured and the concentrations calculated for the components (see Table 2). These gravimetric concentrations were adjusted for the consensus purity estimation of each component that was determined using capillary gas chromatography with flame ionization detection, differential scanning calorimetry, and the purity assay information from the component suppliers. This bulk solution was then chilled to approximately -5 °C and 1.2 mL aliquots were dispensed into 2 mL amber glass ampoules that were then flame sealed.

SRM Analysis: Aliquots from nine randomly selected ampoules selected by random-stratified sampling were analyzed in duplicate by using capillary gas chromatography with electron capture detection employing an immobilized non-polar stationary phase column. An internal standard solution containing PCB 103 and PCB 198 was added to each sample for quantification purposes. Calibration solutions consisting of weighed amounts of the PCB congeners (adjusted for the consensus purity estimation) and internal standard compounds in 2,2,4-trimethylpentane were chromatographically analyzed to determine analyte response factors. The analytical values determined for the compounds also are given in Table 2.

Table 1. Certified Concentrations of the Polychlorinated Biphenyl (PCB) Congeners in SRM 2274

PCB Number ^(a)	Compound	Concentrations	
		mg/kg ^(b)	µg/mL ^(c)
PCB 31	2,4',5'-Trichlorobiphenyl	2.929 ± 0.074	2.021 ± 0.051
PCB 49	2,2',4,5'-Tetrachlorobiphenyl	2.916 ± 0.072	2.012 ± 0.050
PCB 95	2,2',3,4',6-Pentachlorobiphenyl	2.925 ± 0.063	2.018 ± 0.043
PCB 99	2,2',4,4',5-Pentachlorobiphenyl	2.933 ± 0.062	2.023 ± 0.043
PCB 110	2,3,3',4',6-Pentachlorobiphenyl	2.911 ± 0.059	2.008 ± 0.041
PCB 149	2,2',3,4',5',6-Hexachlorobiphenyl	2.911 ± 0.068	2.008 ± 0.047
PCB 151	2,2',3,5,5',6-Hexachlorobiphenyl	2.904 ± 0.064	2.003 ± 0.044
PCB 156	2,3,3',4,4',5-Hexachlorobiphenyl	2.917 ± 0.059	2.012 ± 0.041
PCB 169	3,3',4,4',5,5'-Hexachlorobiphenyl	2.902 ± 0.059	2.002 ± 0.041
PCB 183	2,2',3,4,4',5',6-Heptachlorobiphenyl	2.879 ± 0.059	1.986 ± 0.041
PCB 194	2,2',3,3',4,4',5,5'-Octachlorobiphenyl	2.889 ± 0.063	1.993 ± 0.043

^(a) The PCB congener numbering scheme used here is as published by Ballschmiter and Zell [1] with revised numbering sequence as noted by Schulte and Malisch [2] in which the PCBs are numbered in accordance with IUPAC rules. For the specific congeners in this SRM, the Ballschmiter-Zell numbers correspond to those of Schulte and Malisch.

^(b) Each result is expressed as the certified value ± the expanded uncertainty. The certified value is the unweighted average of the concentrations determined by gravimetric and chromatographic measurements. The expanded uncertainty, at the 95 % level of confidence, is calculated as, $U = ku_c$, where u_c is a combined standard uncertainty calculated according to the ISO and NIST Guides [3] and $k = 2$ is the coverage factor. The value of u_c includes both a correction for estimated purity and an allowance for differences between the concentration determined by gravimetric preparation and chromatographic measurements.

^(c) The certified concentrations in µg/mL units, were obtained by multiplying the certified value by the measured density of the SRM solution at 22 °C (0.6899 g/mL). These concentrations are for use over the temperature range of 20 °C to 25 °C, and an allowance for the change in density over this temperature range is included in the uncertainties.

Table 2. Supplemental Information for PCB Congeners in SRM 2274^(a)

PCB Number	Concentrations	
	Gravimetric ^(b) mg/kg	GC-ECD ^(c) mg/kg
PCB 31	2.936	2.923 (± 0.005)
PCB 49	2.929	2.904 (± 0.008)
PCB 95	2.929	2.921 (± 0.005)
PCB 99	2.929	2.936 (± 0.006)
PCB 110	2.911	2.911 (± 0.010)
PCB 149	2.901	2.922 (± 0.011)
PCB 151	2.911	2.898 (± 0.009)
PCB 156	2.915	2.918 (± 0.013)
PCB 169	2.901	2.903 (± 0.011)
PCB 183	2.881	2.878 (± 0.011)
PCB 194	2.895	2.885 (± 0.007)

^(a) Results presented for use **only** as background information.

^(b) Calculated concentration based on the mass of the PCB congener added to the total mass of the solution corrected for the chemical purity.

^(c) Concentrations determined by using gas chromatography with electron capture detection (GC-ECD) corrected for the purity of the compounds. The listed uncertainties in parentheses represent one standard deviation of a single measurement for these results and recognize only the within-method variability.

Table 3. Chemical Abstracts Service Nomenclature and Registry Numbers

PCB Number ^(a)	CAS Nomenclature ^(b)	CAS Registry Number ^(b)
PCB 31	2,4',5'-Trichlorobiphenyl	16606-02-3
PCB 49	2,2',4,5'-Tetrachlorobiphenyl	41464-40-8
PCB 95	2,2',3,4',6-Pentachlorobiphenyl	38379-99-6
PCB 99	2,2',4,4',5-Pentachlorobiphenyl	38380-01-7
PCB 110	2,3,3',4',6-Pentachlorobiphenyl	38380-03-9
PCB 149	2,2',3,4',5',6-Hexachlorobiphenyl	38380-04-0
PCB 151	2,2',3,5,5',6-Hexachlorobiphenyl	52663-63-5
PCB 156	2,3,3',4,4',5-Hexachlorobiphenyl	38380-08-4
PCB 169	3,3',4,4',5,5'-Hexachlorobiphenyl	32774-16-6
PCB 183	2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1
PCB 194	2,2',3,3',4,4',5,5'-Octachlorobiphenyl	35694-08-7

^(a) The PCB congener numbering scheme used here is as published by Ballschmiter and Zell [1] with revised numbering sequence as noted by Schulte and Malisch [2] in which the PCBs are numbered in accordance with IUPAC rules. For the specific congeners in this SRM, the Ballschmiter-Zell numbers correspond to those of Schulte and Malisch.

^(b) Chemical Abstracts, Thirteenth Collective Index, Index Guide, American Chemical Society, Columbus, Ohio, 1996.

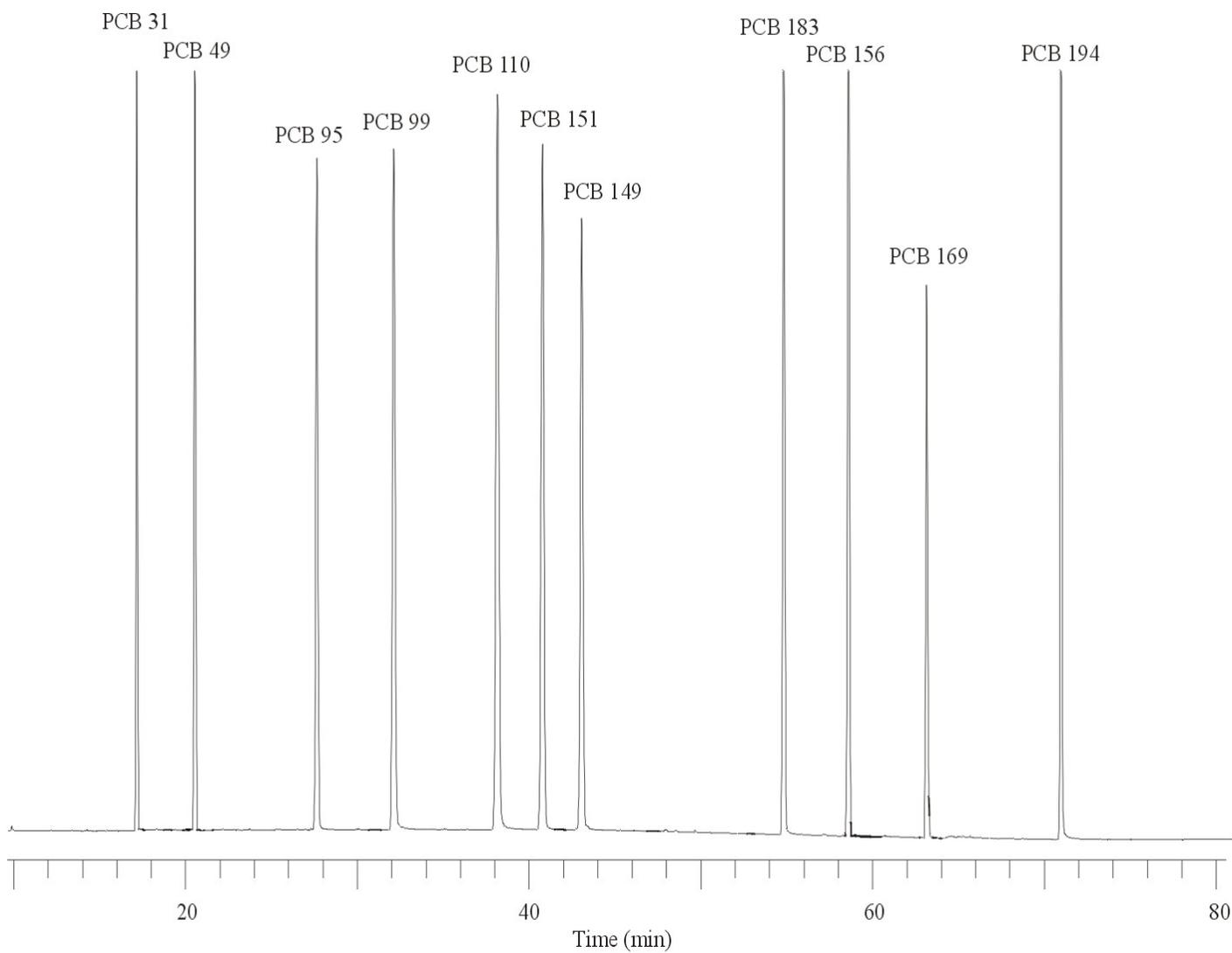


Figure 1. Example of the gas chromatographic elution order of analytes in SRM 2274 on a 5 % phenyl-substituted methylpolysiloxane capillary column (60 m x 0.25 mm i.d., 0.25 μ m film thickness) with electron capture detection.

REFERENCES

- [1] Ballschmiter, K.; Zell, M.; *Analysis of Polychlorinated Biphenyls (PCBs) by Glass Capillary Gas Chromatography – Composition of Technical Aroclor– and Clophen–PCB Mixtures*; Fresenius' J. Anal. Chem., Vol. 302, pp. 20–31, (1980).
- [2] Schulte, E.; Malisch, R.; *Calculation of the Real PCB Content in Environmental Samples. I. Investigation of the Composition of Two Technical PCB Mixtures*; Fresenius' J. Anal. Chem., Vol. 314, pp. 545–551, (1983).
- [3] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st ed., International Organization for Standardization: Geneva, Switzerland (1993); 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 <http://physics.nist.gov/Pubs/>.

Certificate Revision History: 06 November 2009 (This revision reflects at extension of the certification period and editorial changes); 01 August 2001 (Original certificate date).

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-2200; fax (301) 926-4751; e-mail srminfo@nist.gov; or via the Internet <http://www.nist.gov/srm>.