

Spotlighting NIST Standard Reference Materials

PCB MIXTURES IN THE LABORATORY: NEW AROCLOR IN METHANOL AND TRANSFORMER OIL STANDARD REFERENCE MATERIALS® FOR THE DETERMINATION OF PCBs IN WATER AND ENVIRONMENTAL SAMPLES

Dianne L. Poster, Michele M. Schantz, Stephen A. Wise
National Institute of Standards and Technology, Gaithersburg, MD 20899-8392

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Two new series of Standard Reference Materials® (SRMs) prepared by NIST provide support for the determination of PCB mixtures in water or environmental and food matrices. The analysis of drinking and waste water or environmental and food matrices for PCB mixtures and other organic compounds is performed by a large system of laboratories that provide chemical measurement services. The assurance that these services provide accurate results is extremely important. SRMs assist with this process. SRMs for chemical measurements are materials that have been well-characterized for specific chemical properties such as the concentration of a chemical or a mixture of analytes. Recently, a wide range of SRMs were issued for the determination of individual or mixtures of volatile or semi-volatile organic compounds in water¹. Many of these new SRMs have analytes or mixtures of compounds that were not previously characterized in SRMs. These SRMs are intended primarily for the calibration of instrumentation or measurement processes and are designed to allow for appropriate dilution schemes to correlate detector response to individual analyte or mixture mass. The solvents chosen for these SRMs are all miscible with water, therefore, each SRM can be used to fortify aqueous samples with known amounts of the organic compound or a mixture of analytes. The SRMs may be used for method validation or performance verification and may be applied to laboratory investigations of chromatographic separations and retention times.

The new SRMs include six individual Aroclors² in a water-soluble solvent (methanol) and the same six individual Aroclors in transformer oil (Table 1). Historically, SRM 1581, Polychlorinated Biphenyls (PCBs) in Oil, was available for the determination of PCBs as Aroclor mixtures in oil. SRM 1581 consisted of ampoules of Aroclors 1242 and 1260 in both motor and transformer oil at concentrations near 100 $\mu\text{g g}^{-1}$. The material was issued in 1982. SRM 1581 is no longer available (its supply is depleted) and will be replaced by these new Aroclor in transformer oil SRMs. Other solution SRMs currently available from NIST with certified values for PCB congeners (though not in water miscible solvents) include the following SRMs: SRM 1493 (PCBs in 2,2,4-Trimethylpentane), SRM 2262 (Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane, Nominal Concentration 2 $\mu\text{g mL}^{-1}$), SRM 2274 (PCB Congener Solution-II in Isooctane), and SRM 2276 (Three Planar Polychlorinated Biphenyl Congeners in Isooctane).

Table 1. Certified Concentrations for Aroclors in Methanol and Transformer Oil SRMs

<u>SRM</u>	<u>Title</u>	<u>Mass Fraction</u> <u>mg kg⁻¹</u>	<u>Mass</u> <u>Concentration</u> <u>mg L⁻¹</u>	<u>Unit of Issue</u>
3081	Aroclor 1016 in Methanol	17.13 ± 0.54	13.70 ± 0.44	5 x 1.2 mL
3082	Aroclor 1232 in Methanol	5.25 ± 0.31	4.20 ± 0.25	5 x 1.2 mL
3083	Aroclor 1242 in Methanol	16.36 ± 0.35	13.08 ± 0.29	5 x 1.2 mL
3084	Aroclor 1248 in Methanol	6.89 ± 0.22	5.51 ± 0.18	5 x 1.2 mL
3085	Aroclor 1254 in Methanol	7.08 ± 0.16	5.66 ± 0.13	5 x 1.2 mL
3086	Aroclor 1260 in Methanol	6.18 ± 0.17	4.94 ± 0.14	5 x 1.2 mL
3075	Aroclor 1016 in Transformer Oil	17.1 ± 1.0	15.2 ± 0.9	5 x 1.2 mL
3076	Aroclor 1232 in Transformer Oil	4252 ± 114	3789 ± 106	5 x 1.2 mL
3077	Aroclor 1242 in Transformer Oil	4102 ± 87	3656 ± 82	5 x 1.2 mL
3078	Aroclor 1248 in Transformer Oil	3658 ± 161	3260 ± 146	5 x 1.2 mL
3079	Aroclor 1254 in Transformer Oil	3579 ± 154	3190 ± 139	5 x 1.2 mL
3080	Aroclor 1260 in Transformer Oil	1079 ± 98	962 ± 88	5 x 1.2 mL
3090	Aroclors in Transformer Oil (set)	SRMs 3081 – 3086 ^a		6 x 1.2 mL
3091	Aroclors in Methanol (set)	SRMs 3075 – 3080 ^a		6 x 1.2 mL

^a one ampoule of each

The Aroclor in methanol and oil SRMs were prepared and analyzed for the determination of the concentrations using Aroclors from the former U.S. EPA repository and commercially available materials. A detailed description of the Aroclor in methanol and transformer SRMs is available [1]. The certified values of the individual Aroclors in methanol range from (5.25 ± 0.31) mg kg⁻¹ to (17.13 ± 0.54) mg kg⁻¹ (Table 1). The certified values of the individual Aroclors in transformer oil range from (17.1 ± 1.0) mg kg⁻¹ to (4252 ± 114) mg kg⁻¹ (Table 1). The listed uncertainties represent expanded uncertainties at the 95 % level of confidence and include an allowance for differences

between the concentration determined by gas chromatographic measurements with various sources of Aroclors used as calibrants and the gravimetric preparation. The levels of Aroclors in each SRM are designed to allow for appropriate dilution schemes for calibration and quantification of PCBs in water, oil, or similar matrices. A diluent transformer oil that does not contain a significant amount of PCBs will be available as a separate Reference Material, RM 8504 (Transformer Oil). A unit of RM 8504 consists of one bottle containing approximately 100 mL of the same transformer oil used to prepare the Aroclor in transformer oil SRMs. RM 8504 is intended to be used as a diluent oil with the Aroclor in transformer oil SRMs.

In summary, the new Aroclor in methanol and oil SRMs will be beneficial to laboratories to underpin their accurate determination of the concentrations of individual Aroclors, Aroclor combinations, or PCB mixtures in water, including drinking and waste water, or environmental and food matrices. These SRMs were developed initially to support the NIST NVLAP³ Chemical Calibration Providers of the Proficiency Testing Program with support by the U.S. Environmental Protection Agency (EPA).

Footnotes

¹ see www.nist.gov/srm for a complete description of available SRMs and https://srmors.nist.gov/tables/view_table.cfm?table=109-3.htm for a listing of SRMs for organic compounds or mixtures related to water analysis

² From 1927 to 1977, commercial mixtures of industrial fluids containing PCBs were solely manufactured in the U.S. by the Monsanto Chemical Company, and which also accounted for an estimated 50 % of the worldwide production of PCBs. Monsanto registered its PCB mixtures under the trade name Aroclor® [2-4].

³ learn about the National Voluntary Laboratory Accreditation Program (NVLAP) at <http://ts.nist.gov/nvlap>

References

- [1] D. L. Poster, M. M. Schantz, S. D. Leigh, and S. A. Wise, Standard Reference Materials (SRMs) for the Calibration and Validation of Analytical Methods for PCBs (as Aroclor Mixtures), *J. Res. Natl. Inst. Stand. Technol.* **109** (2), 245-266 (2004).
- [2] O. Hutzinger, *Chemistry of PCBs*, Westport, Englewood Cliffs (1974).
- [3] *PCBs and the Environment*, 4th Edition, J. S. Waid, ed., CRC Press, Boca Raton (1987).
- [4] M. D. Erickson, *Analytical Chemistry of PCBs*, 2nd, CRC/Lewis, Boca Raton (1997).