Cambridge Isotope Laboratories, Inc.

Analytical Standards for Human Exposure Analysis

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Exposomics is the study of the exposome and is a field that has been gaining attention as researchers focus not only on identifying contaminants present in the environment, but their effects on humans. The exposome encompasses an individual's lifetime exposure to internal and external stresses, including environmental, dietary, and metabolic factors, to name a few.

Cambridge Isotope Laboratories, Inc. (CIL) has and continues to produce standards that are used in many leading biomonitoring research projects, such as the US Centers for Disease Control and Prevention (CDC) "National Health and Nutrition Examination Survey (NHANES)" and the Japan National Institute for Environmental Studies (NIES) "Japan Environment and Children's Study (JECS)."

The CDC's NHANES program is focused on assessing the health and nutritional status of both children and adults in the United States. There are several studies involved in this program, which is notable in that both interviews and physical examinations are factored in when compiling data. The first NHANES study was conducted from 1971-1975 and subsequent studies are continuing to this day. Additional information about the NHANES program can be found at **www.cdc.gov/nchs/nhanes/index.htm**.

NIES' JECS is a nationwide program in Japan that studies the effects of environmental exposure on children's health and development from pregnancy through childhood. The program began in 2011 with the goal of compiling data to provide a foundation for proposing pertinent regulations to safeguard the environment for future generations. Additional information about the JECS program can be found at **www.nies.go.jp/projects/Projects-b.html**.

Another widescale biomonitoring study that is ongoing is HBM4EU, which involves 28 countries in Europe. This study began in 2017 and will run through 2021. The study group includes all citizens, but there is a focus on particularly vulnerable groups, including children, pregnant women, and workers. A complete overview of the HBM4EU study can be found at **www.hbm4eu.eu**.

Emergence of new research institutions and programs, such as the Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai and the National Institute of Environmental Health Sciences (NIEHS)-funded Human Health Exposure Analysis Resource (HHEAR) program, is a further testament to the importance of studying the impact the environment can have on human health.

In this Catalog...

Any exogenous compound can be considered to contribute to the exposome, but a few chemical classes have received particular attention and have been the focus of both CIL's efforts to support this line of study. Following is a list of some of the targets of exposomics researchers, with specific product groups identified in each category.

- Biomarkers
- Per- and polyfluoralkyl substances (PFAS)
- Tobacco-related compounds
- Phthalates and phthalate-replacement products
- Polycyclic aromatic compounds (PACs)
- Phenolic compounds
- Bisphenols
- Parabens
- Pesticides and pesticide metabolites
- Dioxins and furans
- Polyclorinated biphenyls (PCBs)
- Flame retardants and metabolites

Biomarkers

Biomarkers, which are referred to as biological (or environmental) indicators of disease (or exposure), have received considerable attention over the past couple of decades in an effort to improve personalized and preventative medicine. Guided studies to assess the effectiveness of candidate biomarkers, the implementation of clinically validated targets, and the effects of environmental pollutants on an organism's health have been pursued across several research fields (e.g., metabolomics, proteomics). In these applications, researchers have employed stable isotope-labeled and/or unlabeled standards in their sample preparations, commonly analyzed with tandem mass spectrometry. In capitalizing on the merits of MS-based approaches, compound mixes have been increasingly incorporated in the routine screening of biomarkers of exposure and their degradants. While sources of exposure are expansive (e.g., air, food, water, drugs), examples of biomarker classes of environmental contaminants and a few select compounds of high interest are highlighted below:

- Per- and polyfluoroalkyl substances (PFAS)
- Tobacco-related compounds
- Polycyclic aromatic compounds (PACs)
- Herbicides, insecticides, and pesticides
- Dioxins and furans
- Polychlorinated biphenyls (PCBs)
- Flame retardants and metabolites
- Steroids and hormones

Featured Products

Catalog No.	Description	Amount
CDNLM-11114	*N*-Acetyl-*S*-(2,2-dichlorovinyl)-L-cysteine (cysteine-$^{13}C_3$, 99%; ^{15}N, 99%: acetyl-D_3, 98%)	Inquire
CNLM-11116	*N*-Acetyl-*S*-(3-hydroxypropyl-1-methyl)-L-cysteine (cysteine-$^{13}C_3$, 99%; acetyl-1-^{13}C, 99%; ^{15}N, 99%)	Inquire
CNLM-11112	4-Methylhippuric acid (glycine-1,2-^{13}C, 99%; ^{15}N, 99%)	Inquire
ULM-11122	3-Hydroxy-2-methylpropyl mercapturic acid (unlabeled)	Inquire
NLM-6715-1.2	8-Hydroxy-2′-deoxyguanosine ($^{15}N_5$, 98%) (CP 95%) 25 µg/mL in water	1.2 mL
ULM-9700-1.2	8-Hydroxy-2′-deoxyguanosine (unlabeled) 25 µg/mL in water	1.2 mL
ES-5536	JECS Native Mixture Solution (contains cotinine and 8-hydroxy-2′-deoxyguanosine for oxidative stress analysis)	1.2 mL in water
CLM-4860-T-1.2	6-Hydroxychrysene ($^{13}C_6$, 98%) (mix of ring labeling) 50 µg/mL in toluene	1.2 mL
ULM-7552-1.2	6-Hydroxychrysene (unlabeled) 50 µg/mL in toluene	1.2 mL
ES-5570	PFOS/PFOA Calibration Series (CS1-CS5)	5 × 0.25 mL in methanol

Per- and Polyfluoroalkyl Substances (PFAS)

For several years, PFAS have been one of the most discussed classes of chemical pollutants. Many have been scrutinized and even withdrawn from production over the past two decades with increased detection in environmental compartments, especially water contamination near manufacturing sites. Exposure concerns are still not well defined; however, several PFAS compounds are included in the Stockholm Convention list of POPs, and exposure studies are ongoing.

- Perfluorocarboxylic acids (PFCA)
- Perfluoroalkyl sulfonates (PFAS)
- Fluorotelomer sulfonates (FTS)
- Fluorotelomer alcohols (FTOH)
- Perfluorooctanesulfonamidoacetic acids (FOSAA)
- Perfluorooctanesulfonamides (FOSA)
- Perfluorooctanesulfonamido ethanols (FOSE)
- Fluoropolymers
- EPA Method 537.1 and Method 537 mixtures
- PFCA and PFAS multicomponent mixtures

Featured Products

Catalog No.	Description	Amount
ES-5631	Method 537.1 Analyte Primary Dilution Standard (PDS)	1.2 mL in methanol (with 4 molar equivalent NaOH)
ES-5610-A	Method 537.1 Internal Standard Primary Dilution Standard (ISPDS)	1.2 mL in methanol (with 4 molar equivalent NaOH)
ES-5632	Method 537.1 Surrogate Primary Dilution Standard (SUR PDS)	1.2 mL in methanol (with 4 molar equivalent NaOH)
ES-5587	Perfluoroalkylcarboxylic acid (PFCA) C_4-C_{14} Native Mixture	1.2 mL in methanol
ES-5576	Perfluoroalkylsunfonate (PFAS) C_4-C_{10} Native Mixture	1.2 mL in methanol
ES-5636	PFAS EF-28 Native Mixture	1.2 mL in methanol
ES-5640	PFAS SIL Superfund Mixture 1	1.2 mL in methanol (with 4 molar equivalent NaOH)
ES-5641	PFAS SIL Superfund Mixture 2	1.2 mL in methanol (with 4 molar equivalent NaOH)
ES-5639	PFAS Superfund Mixture 1	1.2 mL in methanol (with 4 molar equivalent NaOH)
ES-5570	PFOS/PFOA Calibration Series (CS1-CS5)	5 × 0.25 mL in methanol
ES-5571	PFOS/PFOA Extraction Standard Mixture	3 mL in methanol
ES-5572	PFOS/PFOA Injection Standard Mixture	3 mL in methanol
ES-5573	PFOS/PFOA Native Standard Mixture	1.2 mL in methanol

Tobacco-Related Compounds

Tobacco-specific nitrosamines (TSNAs) are one of the major groups of carcinogenic compounds found in tobacco and cigarette smoke, as well as smokeless tobacco and related products. With new technologies in place for reducing the use of tobacco products – such as e-cigarettes – researchers will be monitoring levels of TSNAs and other emerging biomarkers in the body to evaluate exposure levels of these harmful chemicals over time.

- Tobacco-specific nitrosamines
- Nicotine
- Tobacco additives
  – *Menthol and menthol derivatives*
- Tobacco biomarkers
  – *Cotinine and cotinine derivatives*
- Emerging biomarkers in e-cigarette use
  – *Nicotelline*
  – *Anatalline*

Featured Products

Catalog No.	Description	Concentration	Amount
CLM-9692-1.2	DL-Cotinine (2′,3′,4′-$^{13}C_3$, 99%) CP 97%	100 µg/mL in water	1.2 mL
DLM-1819-1.2	DL-Cotinine (methyl-D_3, 98%)	100 µg/mL in acetonitrile	1.2 mL
ULM-9614-W-1.2	Cotinine (unlabeled)	100 µg/mL in water	1.2 mL
ULM-9614-1.2	Cotinine (unlabeled)	100 µg/mL in acetonitrile	1.2 mL
DLM-4412	(-)-Menthol (1,2,6,6-D_4, 98%)		25 mg
ULM-11045-1.2	Menthol (unlabeled)	1 mg/mL in methanol	1.2 mL
CLM-6705-1.2	NAB (*N*′-Nitrosoanabasine) ($^{13}C_6$, 99%)	100 µg/mL in acetonitrile	1.2 mL
ULM-7168-1.2	NAB (*N*′-Nitrosoanabasine) (unlabeled)	500 µg/mL in acetonitrile	1.2 mL
ULM-7168-4X-1.2	NAB (*N*′-Nitrosoanabasine) (unlabeled)	2 mg/mL in acetonitrile	1.2 mL
CDLM-11054-1.2	Vitamin E acetate (dimethyl-$^{13}C_2$, acetyl-$^{13}C_2$, 99%; dimethyl-D_6, 98%)	100 µg/mL in methanol	1.2 mL
ULM-11055-1.2	Vitamin E acetate (unlabeled)	100 µg/mL in methanol	1.2 mL
DLM-11063-1.2	Nicotelline (2,2′,4,4′,5,5′,6,6′-D_8, 97%)	100 µg/mL in acetonitrile	1.2 mL
ULM-11060-1.2	Nicotelline (unlabeled)	100 µg/mL in acetonitrile	1.2 mL
DLM-11074-1.2	*cis/trans*-Anatalline·3HCl (D_3, 98%)	100 µg/mL in methanol-OD	1.2 mL
ULM-11075-1.2	*cis/trans*-Anatalline·3HCl (unlabeled)	100 µg/mL in methanol	1.2 mL

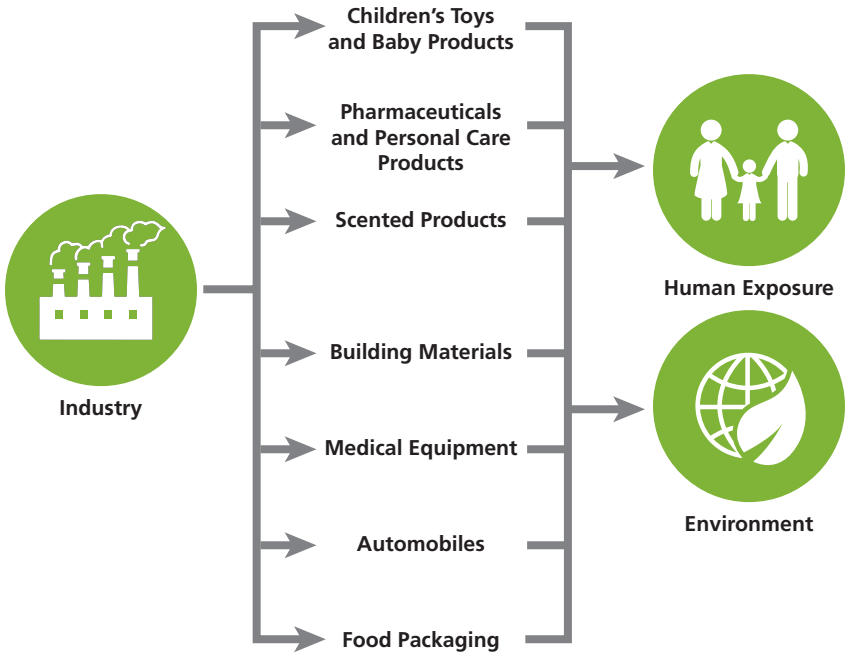
Phthalates and Phthalate-Replacement Products

Phthalates are a class of industrial chemicals used to increase the flexibility, durability, transparency, and longevity of plastics. Since phthalates are not chemically bound to their substrates, they are easily released into the environment, resulting in widespread human exposure. Certain phthalates have been regulated for use in children's products, and because of these restrictions, manufacturers have turned to using related alternative plasticizers. Studies conducted by the CDC have shown that most people have metabolites of phthalates present in their urine, resulting in a focus on metabolite-detection studies to determine the human exposure element.

- Phthalate standards
  - *Diester phthalates (traditional and replacement plasticizers)*
  - *Monoester phthalates; primary and secondary metabolites*
- Phthalate-related compounds
  - *Terephthalate esters and metabolites*
  - *Cyclohexane-1,2-dicarboxylic acid esters (DINCH) and metabolites*
  - *1,2,4-Benzenetricarboxylic acid (trimellitic acid) esters and metabolites*
- Phthalate and phthalate-replacement metabolites mixture

Featured Products

Catalog No.	Description	Concentration	Amount
ES-5633	JECS Phthalate/Phthalate Replacement Metabolites Native Mix		1.2 mL
DLM-1368-1.2	Bis(2-ethylhexyl) phthalate (ring-D_4, 98%)	100 µg/mL in nonane	1.2 mL
ULM-6241-1.2	Bis(2-ethylhexyl) phthalate (unlabeled)	1000 µg/mL in nonane	1.2 mL
CLM-4584-MT-1.2	Mono-2-ethylhexyl phthalate (ring-1,2-$^{13}C_2$, dicarboxyl-$^{13}C_2$, 99%)	100 µg/mL in MTBE	1.2 mL
ULM-4583-MT-1.2	Mono-2-ethylhexyl phthalate (unlabeled)	100 µg/mL in MTBE	1.2 mL
CLM-10192-1.2	Mono-(4-methyl-7-carboxyheptyl) phthalate (ring-1,2-$^{13}C_2$, dicarboxyl-$^{13}C_2$, 99%)	100 µg/mL in MTBE	1.2 mL
ULM-10193-1.2	Mono-(4-methyl-7-carboxyheptyl) phthalate (unlabeled)	100 µg/mL in MTBE	1.2 mL
CLM-10592-1.2	Cyclohexane-1,2-dicarboxylic acid, di-(4-methyloctyl) ester (DINCH) ($^{13}C_4$, 99%)	100 µg/mL in MTBE	1.2 mL
ULM-10591-1.2	Cyclohexane-1,2-dicarboxylic acid, di-(4-methyloctyl) ester (DINCH) (unlabeled)	100 µg/mL in MTBE	1.2 mL
CLM-10299-1.2	Cyclohexane-1,2-dicarboxylic acid, mono-(4-methyloctyl) ester (MINCH) ($^{13}C_4$, 99%)	100 µg/mL in MTBE	1.2 mL
ULM-10300-1.2	Cyclohexane-1,2-dicarboxylic acid, mono-(4-methyloctyl) ester (MINCH) (unlabeled)	100 µg/mL in MTBE	1.2 mL



Polycyclic Aromatic Compounds (PACs)

PACs are organic compounds that can be found in natural or processed petroleum products. They are ubiquitous pollutants that demonstrate persistent, bioaccumulative, and toxic properties. PACs are commonly formed during incomplete combustion of organic materials such as coal, oil, and gas, as well as burning of tobacco and high-temperature cooking of meats. Human exposure to PACs occurs through ingestion, inhalation, and dermal contact. In the body, polyaromatic hydrocarbons (PAHs) are predominantly metabolized as epoxides, and the CDC began to measure 22 hydroxylated PAH urinary metabolites as part of their third NHANES study.

- Polyaromatic hydrocarbon (PAH) standards and multicomponent mixtures
- Polychlorinated naphthalene (PCN) standards and multicomponent mixtures
- Alkyl PAHs
- Halogenated PAHs
- Hydroxy PAHs
- Nitro PAHs
- Amino PAHs

Featured Products

Catalog No.	Description	Amount
ES-4087	US EPA 16 PAH Cocktail	1.2 mL in nonane
ES-5164	PAH Surrogates Standard Mixture	10 mL in toluene/isooctane
ES-2528	PAH Cocktail for CARB Method 429	1 mL in benzene-d_6
ES-5540	EFSA-4 ^{13}C PAH Standard Mixture	1.2 mL in nonane
ES-5542	EFSA-4 Native PAH Standard Mixture	1.2 mL in isooctane
ES-5472	CDC OH-PAH Calibration Standards (CS1-CS10)	10 × 0.5 mL in toluene
ES-5473-T	CDC OH-PAH Spiking Standard	0.6 mL in toluene
ES-5484	CDC OH-PAH Native PAR Standard	1.2 mL in toluene
ECN-5578	Mono-Octa PCN Cleanup Standard Spiking Solution	1.2 mL in isooctane
EC-4979-A	Mono-Octa PCN Syringe Standard Spiking Solution	1.2 mL in nonane
ECN-5603	Mono-Octa PCN Sampling Spike Solution	1.2 mL in isooctane
ECN-5580	Mono-Octa PCN Native PAR Solution	1.2 mL in nonane

Phenolic Compounds

Many industrial and consumer products are composed of chemicals that contain halogenated or substituted benzene or phenol functional groups. Resistant to decomposition and metabolism, these chemicals may persist even after the parent molecule has undergone partial decomposition, or they may exist as a product or an industrial byproduct.

- Halogenated benzene, phenol, and anisole standards
- Alkylated phenols
- Nitrophenols
- Mixtures combined with parabens

Featured Products

Catalog No.	Description	Amount
ES-5629	JECS Phenol/Paraben Cleanup Standard	1.2 mL in methanol
ES-5600	JECS Phenol/Paraben Cleanup Standard	1.2 mL in methanol
ES-5630	JECS Phenol/Paraben Syringe Standard	1.2 mL in methanol-OD
ES-5599	JECS Phenol/Paraben Native Standard	1.2 mL in methanol
ES-5628	JECS Phenol/Paraben Native Standard	1.2 mL in methanol

Bisphenols

Bisphenol A (BPA) is a synthetic compound that has long been used in the production of polycarbonate plastics and epoxy resins, largely as a component in food and beverage containers. BPA can mimic estrogen, potentially interfering with functionality of the endocrine system. BPA has been banned for use in certain products related to food and beverage consumption, and manufacturers have turned to other bisphenol compounds as alternatives.

- Bisphenol standards
- Bisphenol-related compounds
  - *Glucuronide conjugated standards*
  - *Bissulfate conjugated standards*
  - *Bisphenol diglycidyl ethers*

Featured Products

Catalog No.	Description	Concentration	Amount
CLM-4325-1.2	Bisphenol A (ring-$^{13}C_{12}$, 99%)	100 µg/mL in acetonitrile	1.2 mL
DLM-2774-1.2	Bisphenol A (ring-3,3′,5,5′-D_4, 97%)	100 µg/mL in methanol-OD	1.2 mL
ULM-7106-1.2	Bisphenol A (unlabeled)	100 µg/mL in acetonitrile	1.2 mL
CLM-9319-1.2	Bisphenol S (ring-$^{13}C_{12}$, 99%)	100 µg/mL in methanol	1.2 mL
DLM-10923-1.2	Bisphenol S (2,2′,3,3′,5,5′,6,6′-D_8, 98%)	100 µg/mL in methanol-OD	1.2 mL
ULM-9320-1.2	Bisphenol S (unlabeled)	100 µg/mL in methanol	1.2 mL
CLM-9866-1.2	Bisphenol F (ring-$^{13}C_{12}$, 99%)	100 µg/mL in acetonitrile	1.2 mL
DLM-10924-1.2	Bisphenol F (D_{10}, 98%)	100 µg/mL in methanol-OD	1.2 mL
ULM-9827-1.2	Bisphenol F (unlabeled)	100 µg/mL in acetonitrile	1.2 mL
DLM-9193-1.2	Bisphenol A diglycidyl ether (BADGE) (diglycidyl-D_{10}, 98%)	100 µg/mL in acetonitrile	1.2 mL
ULM-9857-1.2	Bisphenol A diglycidyl ether (BADGE) (unlabeled)	100 µg/mL in acetonitrile	1.2 mL

Parabens

Parabens are a class of 4-hydroxybenzoate alkyl esters commonly used as preservatives in the cosmetic, pharmaceutical, and food industries as antimicrobial agents. There is growing concern over the estrogen-like behavior of parabens and their metabolites, causing many consumers and manufacturers to seek paraben-free alternatives.

- Paraben and paraben metabolite standards
- Mixtures combined with phenolic compounds

Featured Products

Catalog No.	Description	Concentration	Amount
CLM-8249-1.2	Methyl paraben (methyl 4-hydroxybenzoate) (ring-$^{13}C_6$, 99%)	1 mg/mL in methanol	1.2 mL
DLM-10921-1.2	Methyl paraben (methyl 4-hydroxybenzoate) (2,3,5,6-D_4, 98%)	1 mg/mL in methanol-OD	1.2 mL
ULM-8250-1.2	Methyl paraben (methyl 4-hydroxybenzoate) (unlabeled)	1 mg/mL in methanol	1.2 mL
CLM-9763-1.2	*n*-Propyl paraben (*n*-propyl 4-hydroxybenzoate) (ring-$^{13}C_6$, 99%)	1 mg/mL in methanol	1.2 mL
DLM-10922-1.2	*n*-Propyl paraben (*n*-propyl 4-hydroxybenzoate) (2,3,5,6-D_4, 98%)	1 mg/mL in methanol-OD	1.2 mL
ULM-9762-1.2	*n*-Propyl paraben (*n*-propyl 4-hydroxybenzoate) (unlabeled)	1 mg/mL in methanol	1.2 mL
CLM-8285-1.2	*n*-Butyl paraben (*n*-butyl 4-hydroxybenzoate) (ring-$^{13}C_6$, 99%)	1 mg/mL in methanol	1.2 mL
ULM-8287-1.2	*n*-Butyl paraben (*n*-butyl 4-hydroxybenzoate) (unlabeled)	1 mg/mL in methanol	1.2 mL
CLM-4745-1.2	4-Hydroxybenzoic acid (ring-$^{13}C_6$, 99%)	1 mg/mL in methanol	1.2 mL
ULM-8251-1.2	4-Hydroxybenzoic acid (unlabeled)	1 mg/mL in methanol	1.2 mL
ES-5629	JECS Phenol/Paraben Cleanup Standard	1.2 mL in methanol	
ES-5630	JECS Phenol/Paraben Syringe Standard	1.2 mL in methanol-OD	
ES-5628	JECS Phenol/Paraben Native Standard	1.2 mL in methanol	

Pesticide and Pesticide Metabolites

Essential to agricultural productivity and general pest control, many pesticides have been found to be toxic to humans and animals and as such have been banned from use in numerous countries. CIL continues to add to its already extensive inventory of pesticide standards and is focusing on producing metabolite standards, as studies focus on exposure effects and metabolic pathways of parent compounds.

- Stockholm Convention compounds
  - *Organochlorine (OC) pesticides*
  - *Toxaphene standards and mixtures*
- Organophosphate (OP) and carbamate insecticides
- Crop-protection standards
  - *Glyphosate, glufosinate, and AMPA*
  - *Dicamba and other herbicides*
  - *Polyethoxylated tallow amines (POEA)*
- Neonicotinoid pesticides
- Pyrethroid insecticides
- Triazine herbicides and metabolites
- Fungicides
- Pesticide standard mixtures
- Pesticide and herbicide metabolites
- Cannabis pesticide standards

Featured Products

Catalog No.	Description	Amount
ES-5464-A	Expanded POPs Pesticides Calibration Solutions with Endosulfan Sulfate (CS1-CS6)	6 × 0.2 mL in nonane/isooctane
ES-5465-A	Expanded POPs Pesticides Cleanup Spike with Endosulfan Sulfate (100 ng/mL)	1.2 mL in nonane
ES-5466	Expanded POPs Pesticides Sampling Spike	1.2 mL in nonane
ES-5467-A	Expanded POPs Pesticides PAR Solution with Endosulfan Sulfate	1.2 mL in nonane/isooctane
EC-5350-L	POPs Pesticides LRMS (PCB) Syringe Spike	1.2 mL in nonane
ES-5634	JECS Labeled Neonicotinoid Mixture	1.2 mL in methanol
ES-5627	JECS Native Neonicotinoid Mixture	1.2 mL in methanol
ES-5516	EPA Method 1699 Labeled Pesticide Stock Solution	0.5 mL in nonane
ES-5543	US EPA Method 8276 Toxaphene Composite Stock Standard	1.2 mL in nonane
ES-5544	US EPA Method 8276 Toxaphene Surrogate Standard	1.2 mL in nonane
ES-5545	US EPA Method 8276 Toxaphene Injection Internal Standard	1.2 mL in nonane

Dioxins and Furans

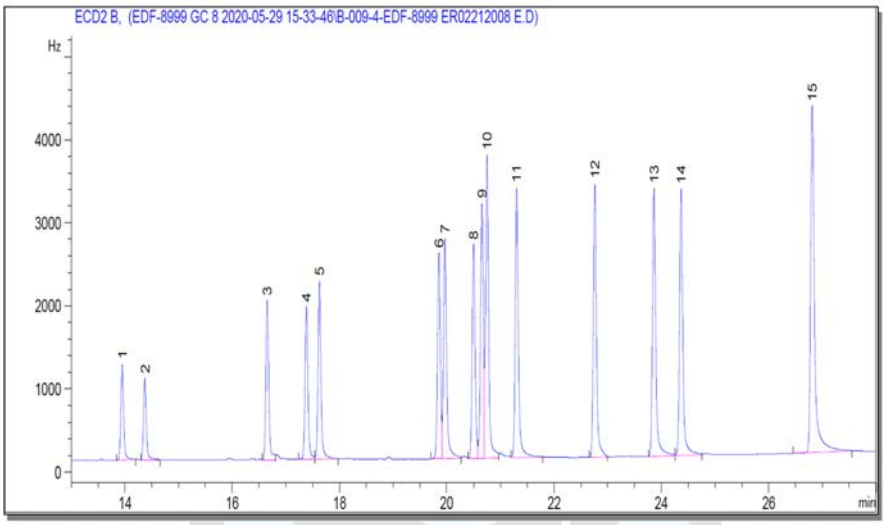
Dioxins and furans are organic pollutants that can be found as byproducts in commercial organochlorine pesticide formulations, chlorine-bleached pulp and paper products, and incineration of organic material in the presence of chlorine. Dioxins are persistent in the environment, bioaccumulate in humans and animals, and some are suspected to be teratogenic, mutagenic, and carcinogenic. Humans are primarily exposed to dioxins and furans via contaminated foods, with numerous high-profile contaminations occurring over the last 40 years.

- Polychlorinated dioxins and furans
- Method standards
  - *US EPA Methods 1613, 23, 8290, and 8280*
  - *European Air Method EN-1948*
  - *JIS Methods K0311 and K0312*
- Dioxin, furan, and PCB standard mixtures
- Dioxin and furan food/feed/QQQ standard mixtures
- Bromodioxin/furan standards and multicomponent mixtures
- Native qualitative solutions for elution profiling (JR)

Featured Products

Catalog No.	Description	Amount
EDF-9999	Method 1613 Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EDF-4052	Method 23 Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EDF-5006	Method 8290 Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EDF-4095	Modified Method 8280 Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EDF-4947	EN-1948 Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EDF-5187	JIS Dioxin/Furan Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EDF-5443-A	Two Column Dioxin, Furan, and PCB Revision-A Calibration Solutions [CS1H-CS6H]	6 × 0.2 mL in nonane
EDF-5581	PCDD/F and NO PCB Labeled Mixture	1.2 mL in nonane
EDF-5579	PCDD/F and NO PCB Native Mixture	1.2 mL in isooctane/nonane
EDF-5554	Dioxin and Furan Food/Feed/QQQ Calibration Series (CS1-CS8)	8 × 0.25 mL in nonane
EDF-5407	Bromodioxin/Furan Calibration Standard Solutions (CS1-CS5)	5 × 0.2 mL in nonane/toluene

Product Analysis



1. 2,3,7,8-Tetrachlorodibenzofuran- $^{13}C_{12}$
2. 2,3,7,8-Tetrachlorodibenzo-p-dioxin- $^{13}C_{12}$
3. 1,2,3,7,8-Pentachlorodibenzofuran- $^{13}C_{12}$
4. 2,3,4,7,8-Pentachlorodibenzofuran- $^{13}C_{12}$
5. 1,2,3,7,8-Pentachlorodibenzo-p-dioxin- $^{13}C_{12}$
6. 1,2,3,4,7,8-Hexachlorodibenzofuran- $^{13}C_{12}$
7. 1,2,3,6,7,8-Hexachlorodibenzofuran- $^{13}C_{12}$
8. 2,3,4,6,7,8-Hexachlorodibenzofuran- $^{13}C_{12}$
9. 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin- $^{13}C_{12}$
10. 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin- $^{13}C_{12}$
11. 1,2,3,7,8,9-Hexachlorodibenzofuran- $^{13}C_{12}$
12. 1,2,3,4,6,7,8-Heptachlorodibenzofuran- $^{13}C_{12}$
13. 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin- $^{13}C_{12}$
14. 1,2,3,4,7,8,9-Heptachlorodibenzofuran- $^{13}C_{12}$
15. Octachlorodibenzo-p-dioxin- $^{13}C_{12}$

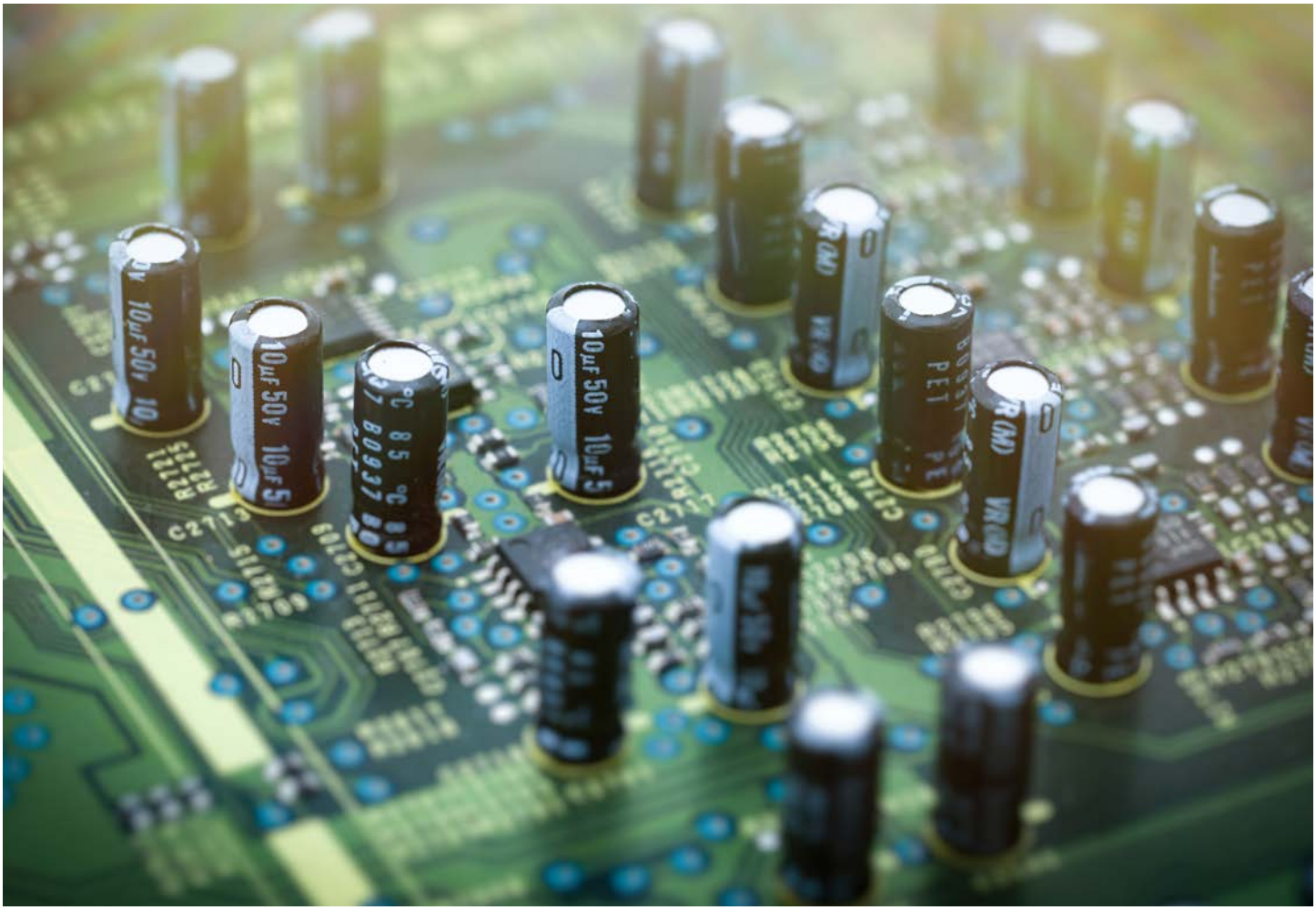
Polychlorinated Biphenyls (PCBs)

PCBs are a class of synthetic chemicals that were widely used in electrical equipment like transformers and capacitors. PCBs were banned from production in most countries in the 1970s, though owing to their persistence and occasional irresponsible disposal, large-scale contamination of the environment remains a problem today.

- PCB standards and standard mixtures
- Method standards
  - *US EPA Method 1668C*
  - *CEN Method EN-1948-4*
- WHO "dioxin-like" and "non-dioxin-like" standard mixtures
- Mixed bromo/chloro standards and standard mixtures
- Combined dioxin, furan, and PCB mixtures

Featured Products

Catalog No.	Description	Amount
EC-4976	Method 1668A/B/C Calibration Solutions [CS1-CS5]*	5 × 0.2 mL in nonane
EC-5385	EN-1948-4 Marker PCB Calibration Series [CS1-CS6]*	6 × 0.2 mL in isooctane/nonane
EC-5618	DL-12 and Marker-6 PCB Standard Mixture (^{13}C, 99%)	1.2 mL in nonane
EC-5619	DL-12 and Marker-6 PCB Standard Mixture (unlabeled)	1.2 mL in nonane
EC-5583	MO and NDL PCB Mixture ($^{13}C_{12}$, 99%)	1.2 mL in nonane
EC-5582	MO and NDL PCB Mixture (unlabeled)	1.2 mL in nonane
EDF-5581	PCDD/F and NO PCB Labeled Mixture	1.2 mL in nonane
EDF-5579	PCDD/F and NO PCB Native Mixture	1.2 mL in isooctane/nonane
EDF-5443-A	Two Column Dioxin, Furan, and PCB Revision-A Calibration Solutions [CS1H-CS6H]	6 × 0.2 mL in nonane



Flame Retardants and Metabolites

As the use of flame retardants (FRs) escalates, the presence of these compounds in the environment also increases. New classes of FRs are emerging in commercial applications as the use of polybrominated diphenyl ethers (PBDEs) declines. These, along with traditional brominated diphenyl ethers (BDEs), phosphorus flame retardants (PFRs), and other compounds of historical use, are being found in various matrices.

- BDE standards and standard mixtures
- BDE metabolite standards
- US EPA Method 1614 standard mixtures
- RoHS BDE standard mixtures
- Alternative halogenated flame retardants
  - *Hexabromocyclododecane (HBCD) standards*
  - *Tetrabromobisphenol A (TBBPA) and tetrachlorobisphenol A*
  - *Dechloranes*
  - *Firemaster® 550 standards*
- Phosphate flame retardant (PFR) standards
- Polybrominated biphenyl (PBB) standards

Featured Products

Catalog No.	Description	Concentration	Amount
EO-5279	Method 1614 Calibration Solutions [CS1-CS5]*		5 × 0.2 mL in nonane
EO-5402	RoHS PBDE Calibration Solutions [CS1-CS5]*		5 × 0.2 mL in nonane
EO-5319-A	CDC BFR Calibration Standards (CS1-CS10)		10 × 0.5 mL in nonane
EO-5320-A	CDC BFR Spiking Standard		10 mL in methanol
EO-5617	CDC BFR PAR Solution		1.2 mL in nonane
OHBDE-5190-1.2	6-Hydroxy-2,2′,4,4′-tetrabromodiphenyl ether (ring-$^{13}C_{12}$, 99%) CP 92%	50 µg/mL in toluene	1.2 mL
OHBDE-5206-1.2	6-Hydroxy-2,2′,4,4′-tetrabromodiphenyl ether (unlabeled)	50 µg/mL in nonane	1.2 mL
ES-5529	Phosphorus Flame-Retardant Standard Mixture (D, 98%)		1.2 mL in acetonitrile
ES-5530	Phosphorus Flame-Retardant Standard Mixture (unlabeled)		1.2 mL in acetonitrile
EO-5003	DecaBDE ($^{13}C_{12}$, 99%) (BDE-209)	50 µg/mL in nonane	1.2 mL
BDE-209-CS	DecaBDE (unlabeled) (BDE-209)	50 µg/mL in non-ane	1.2 mL
CLM-7922-0.5	α-Hexabromocyclododecane ($^{13}C_{12}$, 99%)	50 µg/mL in toluene	0.5 mL
ULM-4834-1.2	α-Hexabromocyclododecane (unlabeled)	50 µg/mL in toluene	1.2 mL
CLM-7923-1.2	β-Hexabromocyclododecane ($^{13}C_{12}$, 99%)	50 µg/mL in toluene	1.2 mL
ULM-4835-1.2	β-Hexabromocyclododecane (unlabeled)	50 µg/mL in toluene	1.2 mL
CLM-7924-1.2	γ-Hexabromocyclododecane ($^{13}C_{12}$, 99%)	50 µg/mL in toluene	1.2 mL
ULM-4836-1.2	γ-Hexabromocyclododecane (unlabeled)	50 µg/mL in toluene	1.2 mL
CLM-8569-1.2	Dechlorane Plus *syn* (bis-cyclopentene-$^{13}C_{10}$, 99%)	100 µg/mL in nonane	1.2 mL
ULM-7886-1.2	Dechlorane Plus *syn* (unlabeled)	100 µg/mL in nonane	1.2 mL
CLM-8588-1.2	Dechlorane Plus *anti* (bis-cyclopentene-$^{13}C_{10}$, 99%)	100 µg/mL in nonane	1.2 mL
ULM-7887-1.2	Dechlorane Plus *anti* (unlabeled)	100 µg/mL in nonane	1.2 mL

Per informazioni:

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