
Environmental Sampling and Analysis

Solutions that enable a safe and
healthier world

Air Sampling

Sample Preparation for
Water and Soil

GC, HPLC and UHPLC
Columns and Accessories

Solvents and Reagents

Analytical Standards and CRMs

Custom Services



SIGMA | **ALDRICH** | **Fluka** | **SUPELCO**

SIGMA-ALDRICH[®]

ENVIRONMENTAL SAMPLING AND ANALYSIS

Sigma-Aldrich is dedicated to providing analytical solutions and technologies for air, water and soil protection

Our customers are located in all countries of the world. They are involved in manufacturing, quality control and research. And although they work in different areas, many of their analytical challenges are the same. We partner with our customers to offer solutions to those challenges. After all, their samples come from the air we breathe, the water we drink and the soil we build on.

This brochure provides a premier selection of proven tools and consumables that meet the needs of scientists who perform sample collection and analysis of contaminants in air, water, and soil matrices.

A preview of our offering includes:

- **ASSET™** EZ4-NCO dry sampler for isocyanates
- **radiello®** passive sampling devices
- Analytical standards and reagents
- Complete line of analytical columns for environmental applications
- An extensive line of products for VOCs and SVOCs

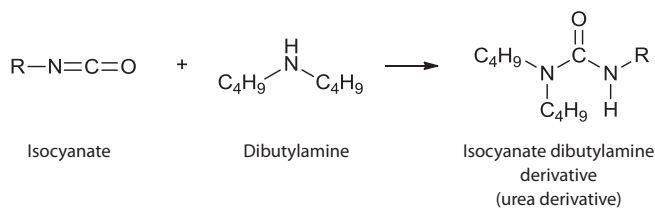


ASSET™ EZ4-NCO DRY SAMPLER FOR ISOCYANATES

Providing ultimate sensitivity for vapor phase and particulate isocyanates

Isocyanates are used in the production of polyurethane (PUR) materials, one of the most widely used plastics in the world. Workers who are exposed to these compounds are at risk for respiratory disorders, asthma and other health conditions. Particulates form incomplete reactions with the reagent as well as with the isocyanate monomers and oligomers being measured, which results in underestimation of exposure.

The ASSET EZ4-NCO sampling device is a unique dry sampler based on derivatization of isocyanate groups with di-n-butylamine (DBA). The sampler consists of a denuder and a filter, both impregnated with DBA. The extract is analyzed using LC-MS or LC-MS-MS offering the ultimate sensitivity and low detection limits not capable with other methods.



Isocyanates exposure is frequently underestimated with other air sampling devices because the particulates form incomplete reactions with both, the reagents and the isocyanate compounds.



Features

- Ability to achieve low detection limits for both vapor and particulate phase isocyanates
- Sampling from 5 minutes to > 8 hours
- Fast derivatization reactions into stable derivatives
- No field extraction/desorption
- High capacity
- No interferences
- No special storage requirements before and after sampling

Cat. No.	Description	Qty.
Sampling Device		
5027-U	ASSET EZ4-NCO Dry Sampler	10
5028-U		50
5047-U	Sample Kit Includes 2 samplers, 1 calibration fitting, and 2 tube adapters	1
Analytical Columns		
53822-U	LC-MS-MS Ascentis® Express C18, 5 cm x 2.1 mm, 2.7 µm particles	1
53829-U	LC-MS Ascentis Express C18, 15 cm x 4.6 mm, 2.7 µm particles	1
Analytical Standard		
40141-U	DBA Isocyanate Mix (acetone:nitrile:methanol, 99:1, varied conc)	6 x 1 mL
	Isocyanic acid-di-n-butylamine (ICA-DBA) 1 µg/mL	
	Ethyl isocyanate-di-n-butylamine (EIC-DBA) 1 µg/mL	
	Hexamethylene diisocyanate-2(di-n-butylamine) (HDI-2(DBA)) 1 µg/mL	
	Isophorone isocyanate-2(di-n-butylamine) isomer 1 (IPDI-2(DBA)) 1 µg/mL	
	Isophorone isocyanate-2(di-n-butylamine) isomer 2 (IPDI2-2(DBA)) 0.4 µg/mL	
	4,4'-Methylenediphenyl diisocyanate-2(di-n-butylamine) (4,4'-MDI-2(DBA)) 1 µg/mL	
	Methyl isocyanate-di-n-butylamine (MIC-DBA) 1 µg/mL	
	Phenyl isocyanate-di-n-butylamine (PhI-DBA) 1 µg/mL	
	Propyl isocyanate-di-n-butylamine (PIC-DBA) 1 µg/mL	
	2,4-Toluene diisocyanate-di-n-butylamine (2,4-TDI-2(DBA)) 1 µg/mL	
	2,6-Toluene diisocyanate-2(di-n-butylamine) (2,6-TDI-2(DBA)) 1 µg/mL	
40142-U	d ₉ -DBA Isocyanate Internal Standard Mix	6 x 1 mL
	Isocyanic acid-di-n-butylamine-d ₉ (ICA-DBA-d ₉) 1 µg/mL	
	Ethyl isocyanate-di-n-butylamine-d ₉ (EIC-DBA-d ₉) 1 µg/mL	
	Hexamethylene diisocyanate-2(di-n-butylamine-d ₉) (HDI-2(DBA-d ₉)) 1 µg/mL	
	Isophorone diisocyanate-2(di-n-butylamine-d ₉) isomer 1 (IPDI-2(DBA-d ₉)) 1 µg/mL	
	Isophorone diisocyanate-2(di-n-butylamine-d ₉) isomer 2 (IPDI2-2(DBA-d ₉)) 0.28 µg/mL	
	4,4'-Methylenediphenyl diisocyanate-2(di-n-butylamine-d ₉) (4,4'-MDI-2(DBA-d ₉)) 1 µg/mL	
	Methyl isocyanate-di-n-butylamine-d ₉ (MIC-DBA-d ₉) 1 µg/mL	
	Phenyl isocyanate-di-n-butylamine-d ₉ (PhI-DBA-d ₉) 1 µg/mL	
	Propyl isocyanate-di-n-butylamine-d ₉ (PIC-DBA-d ₉) 1 µg/mL	
	2,4-Toluene diisocyanate-2(di-n-butylamine-d ₉) (2,4-TDI-2(DBA-d ₉)) 1 µg/mL	
	2,6-Toluene diisocyanate-2(di-n-butylamine-d ₉) (2,6-TDI-2(DBA-d ₉)) 1 µg/mL	
40143-U	DBA Isocyanate Standard Kit Includes 1 mL of DBA Isocyanate Mix and 1 mL of d ₉ -DBA Internal Standard Mix	2 x 1 mL

For more information about our SSET EZ4-NCO dry sampler, visit sigma-aldrich.com/asset

CARBONYL SAMPLE COLLECTION DEVICES

Solvent desorption tubes, passive samplers, impingers and filters

Our carbonyl sampling devices are manufactured to the highest quality standards in a low background carbonyl-controlled manufacturing environment. We offer the widest range of carbonyl sampling devices in the air monitoring market, with 7 different packed cartridge configurations and 18 products. We also offer our innovative radial passive sampling devices, radiello® and DSD-DNPH; LpDNPH coated filters; impingers and solutions; and other adsorbents for sampling carbonyls.

- Low background
- High-purity adsorbent
- Meets OSHA, NIOSH, EPA, ASTM, CARB regulatory methods

ORBO™-555 Dual-bed LpDNPH Tube for NIOSH 2016 Appendix B for Formaldehyde



6 mm O.D. x 120 mm L packed with 300 mg/150 mg of LpDNPH. The 150 mg bed acts as a back-up for incidences of breakthrough sometimes associated with single-bed DNPH cartridges, or when you are not certain of the concentration

Cat. No	Description	Qty.
54020-U	ORBO-555 LpDNPH 300/150 mg Sorbent Tube	20

radiello, RAD165 Aldehyde Sampling Device

- Faster sampling rates than competitive passive sampling devices. (ex. formaldehyde sampling rate 99 mL/min)
- High capacity
- Available for a wide range of applications

For more information about radiello passive sampling products request the radiello brochure (IXV).

To learn more about radiello test methods, please request the radiello manual (IYP).



DSD-DNPH

Radial diffusive sampler comprised of a porous polyethylene tube which acts as the diffusive membrane to which is attached a small syringe barrel for elution of analytes from the adsorbent. DSD-DNPH is an all-in-one sample collection and elution device. Specified in OSHA 1007 Method for Determination of Aldehydes



S10 Cartridge

This design makes the S10 cartridge easy-to-use in the field and the laboratory. The built-in reservoir eliminates the need to attach to a syringe for sample extraction/elution. All S10 cartridges are 3 mL in size and are composed of our low extractable polypropylene syringe barrel packed with 350 mg of LpDNPH.



S10L Cartridge

Reversible design and is for analysts who prefer shorter dimensions and do not need an adapter for sampling. The cartridge is eluted by connecting to a syringe barrel which acts as a reservoir for gravity-fed elution solvent. Meets EPA TO-11A requirements.



S10x Cartridge

Shorter than the S10 cartridge and designed to fit automated systems.



Rezorian™ DNP Cartridges

Made of low extractable polypropylene with polyethylene frits. The end-fittings are luer lock syringe connections which can be used individually, or connected in a series (piggybacked), to monitor breakthrough or to increase capacity.



BPE-DNP Cartridge

This innovative product is packed into our Rezorian cartridge, and is dual-layered and designed to enable the end-user to use the front BPE-silica bed as an inline ozone scrubber and measure aldehydes in the same tube. This product is not affected by high humidity.



H Series Cartridges

The H series of LpDNP cartridges contain higher loadings of 2,4-DNP and larger bed weights compared to the S10 cartridges. This provides a much higher capacity for carbonyls making the H series cartridges the preferred choice for use in high concentration environments. The H series is available in H10 (350mg), H30 (1g) and H300 (10g) cartridges.



ORBO-DNP Tube

The ORBO-DNP tube contains 120 mg of 2,4-DNP packed into a glass tube with a "frangible" break seal at both ends; each tube measuring 6 mm O.D. x 90 mm long.



ORBO-24

OSHA 52 Method for Acrolein and/or Formaldehyde specifies the use of a glass tube packed with 2-HMP coated XAD-2.



Cat. No	Description	Qty.
20231	ORBO-24	25

ORBO-827 LpDNP Coated Glass Fiber Filters

Suitable for sampling crotonaldehydes, OSHA 81 method.



Cat. No	Description	Qty.
20069	ORBO-827, 37 mm	25

Solution Sampling for NIOSH 3500 – Formaldehyde

Our borosilicate glass impingers are ideal for NIOSH and OSHA methods that require collection of airborne contaminants by drawing them into solution; Available with ground glass joints or threaded PTFE micro-connectors.

We offer the reagents and solutions to perform the NIOSH 3500 method. Please visit our website.



Threaded Midget Impingers

Make your sampling process more convenient. The vial can be capped after sampling, thus reducing sample handling in the field with no transferring of samples from the reservoir to a separate vial. The reservoir may be easily replaced with a standard or graduated screw-top vial.



Adapters and Fittings

We offer a selection of reusable adapters and fittings for connecting our cartridges to a sampling pump and other devices.



For more information about carbonyl sampling devices, visit sigma-aldrich.com/air-monitoring

AIR SAMPLING FOR BTEX AND VOCS

Devices for active, passive and whole air sampling

There are many regulatory methods for collection of BTEX/VOCs in industrial hygiene, indoor air quality, and ambient environments. Thermal desorption tubes and gas sampling bags rank among the most widely used with radiello® passive sampling devices emerging as a reliable alternative or complement to these other collection devices.

radiello BTEX/VOC Sampling Devices

- Faster uptake rates than competitive passive sampling devices
- High capacity
- Available for both solvent and thermal desorption applications
- Sample kits available



For more information about radiello passive sampling products, request the radiello brochure (IXV), or for radiello test methods, request the radiello manual (IYP).

For more information about VOC sampling, visit sigma-aldrich.com/radiello

Cat. No.	Description	Qty.
BTEX VOC by Solvent Desorption		
RAD130	Adsorbing Cartridge	20
RAD120	Diffusive Body, White	20
BTEX VOC by Thermal Desorption		
RAD145	Adsorbing Cartridge	20
RAD1202	Diffusive Body, Yellow	20

Gas Sampling Bags and Bulbs

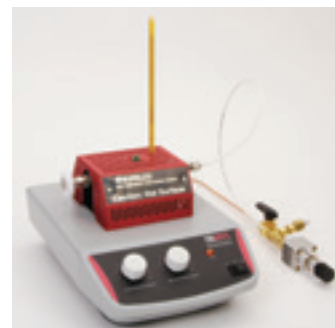
Tedlar®, Tedlar alternative films, and gas sampling bulbs are suitable for grab sampling whole air VOCs in situations where thermal desorption tubes or SUMMA canisters may not be required. We offer Tedlar, Supel™-Inert Film (Tedlar alternative film) and gas sampling bulbs in a variety of sizes. Our gas sampling bulbs are oven annealed to prevent damage during transportation and on-site use.



For more information about our gas sampling bags, visit sigma-aldrich.com/gassamplingbags

ATIS Adsorbent Tube Injector System

A unique sample preparation device for adsorbent tubes. It employs the technique of flash vaporization to vaporize the sample into a continuous flow of inert gas, which carries the sample to the adsorbent tube.



- Inject calibration standards directly onto the adsorbent tube to calibrate your analytical system
- Inject surrogates and system monitoring compounds before and after sampling
- Connect gas sampling bags to the ATIS outlet to vaporize calibration standards
- Available in 110V and 230V
- Purge and trap humidifier module also available

Cat. No.	Description
ATIS Adsorbent Tube Injector System	
28520-U	ATIS, 110 V
28521-U	ATIS, 230 V

Precleaned and Assembled Swagelok® End Fittings

For 1/4 inch O.D. thermal desorption tubes. Ideal for those who use unconditioned thermal desorption tubes and condition in-house before use. We save you the extra step by providing specially pre-cleaned and conditioned end fittings, ready for use.



Cat. No.	Description	Pk.
23094-U	Precleaned and Assembled End Fitting	20

For more information about BTEX/VOC sampling, visit sigma-aldrich.com/air-monitoring

Thermal Desorption Tubes

PerkinElmer®, Markes, DANI™, OI Analytical®, and Shimadzu® Instruments
¼ in (6.35 mm) O.D. x 3.5 in. (89 mm) L



- Suitable for use in a wide variety of instruments
- Available in glass-fritted w/ barcode and stainless steel tubes
- Unique numbers on every tube for traceability
- Products offered in both preconditioned and unconditioned versions.
- Preconditioned tubes sealed in our exclusive TDS³™ Storage containers to preserve low background and protect the sample.
- Available in a wide range of adsorbent packaging configurations.
- Custom products available

Gerstel®
6 mm O.D. x 7 in., I.D, 4 mm



- Fits Gerstel Thermo Desorption System models TDS A and TDS 2
- Available in glass-fritted and stainless steel tubes
- Unique numbers on every tube for traceability
- All products are preconditioned and are sealed in our exclusive TDS³ Storage Containers.
- Available in a wide range of adsorbent packaging configurations.
- Custom products available

CDS / Dynatherm™
6 mm O.D. x 4.5 in. L, I.D. 4 mm



- Fits ACEM9300, ACEM900, ACEM 850/890 TDU, MTDU, and OI Analytical Air Desorber.
- Available in glass fritted and non-fritted tubes
- Unique numbers on every tube for traceability
- All products are preconditioned and sealed with Swagelok® end fittings.
- Available in a wide range of adsorbent packaging configurations.
- Custom products available
- We also offer Fast Flow (FF) and Focusing Tubes

Adsorbent Packing Configurations

Adsorbent tubes may contain any configuration of adsorbents inside the tube to collect your compounds of interest. We offer the widest range of adsorbent materials, including porous polymers – Chromosorb®, Porapak®, HaySep®, Tenax®; carbon molecular sieves – Carbosieve™ and Carboxen™; graphitized carbon blacks – Carbotrap™

and Carboxen™; and activated charcoals. Listed in the table below are the Supelco product names associated with Supelco thermal desorption tubes. Other manufacturers do not have the authorization to use these names without prior written consent. We do not guarantee our competitor's tubes.

Product Name	Adsorbents.	Compounds and Applications
Carbotrap 100	Carbotrap B	C5-C12 compounds in air; ASTM D6196
Carbotrap 150	Glass Beads, Carbotrap C	Large molecules in air or aqueous samples
Carbotrap 200	Glass Beads, Carbotrap B, Carbosieve-SIII	C2-C14 compounds in air
Carbotrap 201	Carbopack B, Carboxen-1000	Focusing semi-volatile to very volatile compounds
Carbotrap 202	Carbopack B, Carbopack C	C5-20 compounds in air
Carbotrap 217	Carbotrap B, Carboxen-1000	"Air Toxics"; EPA TO-17 compounds and other volatiles in air; EPA TO-14
Carbotrap 300	Carbotrap C, Carbotrap B, Carbosieve-SIII	C2 and larger compounds in air; EPA TO-17
Carbotrap 301	Carbopack C, Carbopack B, Carboxen-1000	Focusing volatile and semi-volatile compounds
Carbotrap 302	Carbopack C, Carbopack B, Carboxen-1001	Volatile compounds in aqueous solutions
Carbotrap 317	Carbotrap C, Carbotrap B, Carboxen-1000	EPA TO-17 compounds and other volatiles in air
Carbotrap 349	Carbopack Y, Carbopack B, Carboxen-1003	Volatile organic compounds in Air; NIOSH 2549, EPA IP-1B
Carbotrap 370	Carbopack F, Carbopack C, Carbopack B	C5-C30 compounds thermally extracted from solid samples; focusing semi-volatile compounds
Carbotrap 400	Carbotrap F, Carbotrap C, Carbotrap B, Carboxen-569	C2 and larger compounds in aqueous samples

For more information about our Thermal Desorption Tubes, visit sigma-aldrich.com/thermaldesorption

AIR SAMPLING PRODUCTS

Products for pesticides and hydrogen sulfide sample collection

DETECTION OF PESTICIDES, PAHS AND PCBS

Precleaned ORBO PUF Sampling Tubes



Several US EPA and ASTM methods require a polyurethane foam (PUF) adsorbent cartridge for monitoring pesticides in residential, commercial, and workplace environments. A low-pressure drop across the cartridge facilitates high volume sampling. We thoroughly clean and test our PUF plugs to ensure absence of contamination. We also offer pre-cleaned replacement PUFs.

Specifications for Small PUF Plug (Low Volume)

Sampling Rate: 1-5 L/min, PUF Density: 0.022g/cm³

ORBO-1000 Small PUF	
Dimensions:	22 mm OD x 7.6 cm Length
Applications:	ASTM D4861-05 Pesticides/PCBs ASTM D4947 Chlordane/Heptachlor EPA IP-8 Pesticides/PCBs EPA TO-10A Pesticides/PCBs EN1948-1 Stationary Source Emissions: Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs
ORBO-1500 PUF/XAD-2/PUF	
Dimensions:	22 mm OD x 30 mm Length/ 1.5 g XAD [®] -2/22 mm OD x 30 mm Length
Applications:	Pesticides/PCBs

Specifications for Large PUF Plug (High Volume)

Sampling Rate: 20-225 L/min, PUF Density: 0.022g/cm³

ORBO-1000 Small PUF	
Dimensions:	6 cm OD x 7.6 cm Length
Applications:	ASTM D6209 PAHs EPA IP-7 PAHs EPA TO-4A Pesticides/PCBs EPA TO-9A Dioxins EPA TO-13 PAHs EN1948-1 Stationary Source Emissions: Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs
ORBO-1500 PUF/XAD-2/PUF	
Dimensions:	6 cm OD x 30 mm Length/ 10 g XAD-2/6 cm OD x 30 mm Length
Applications:	Pesticides/PCBs PAHs Dioxins

For more information, visit

sigma-aldrich.com/air-monitoring

OSHA Versatile Sampler (OVS)

ORBO-49P tubes contain a glass fiber filter, a 270 mg sampling bed, a 140 mg backup bed of Supelpak™-20 (specially cleaned XAD®-2 resin), and high purity polyurethane foam plugs. These tubes are effective for sampling organophosphorous pesticides, such as, carbaryl (Sevin), chlordane, pyrethrum, and aldicarb, in both vapor and aerosol form, without the need for a filter cassette or an additional adsorbent tube in tandem. Suitable for OSHA methods 62, 63, 67, 70 and 74.



ORBO Solvent Desorption Tubes

Select methods require specially treated XAD-2 packed in sampling tubes to collect and measure pesticides, PAHs, and PCBs in ambient air. Amberlite® XAD-2 tubes are packed with specially cleaned Supelpak 2 (20/40).



Cat. No.	Compound	Method	ORBO Tube	Matrix	Tube Size
20262	General	US Air Force	ORBO-42	XAD-2, 66 mg/33 mg	6 mm I.D. x 75 mm L
20260-U	Endrin	NIOSH 5519	ORBO-44	XAD-2, 100 mg/50 mg	8 mm I.D. x 100 mm L
20351	PCBs	NIOSH 5503	ORBO-60	Florisil® 100 mg/50 mg	6 mm I.D. x 70 mm L

To learn more, request our Guide to the Analysis of Pesticides (BGQ) and Dioxin and PCB Analysis Brochure (JXB).

For more information, visit sigma-aldrich.com/air-monitoring

DETECTION OF HYDROGEN SULFIDE

Sample Detection Kit

The radiello RAD170 is the ideal sample for passively measuring hydrogen sulfide exposure. Historically H₂S sampling has been performed using active sampling devices which employ a pump to collect the sample. In 2009 the RAD170 sampler was employed in a 51 home study to measure hydrogen sulfide (and radiello samplers were also used for sampling aldehydes, ozone, sulfur dioxide and nitrogen dioxide and hydrofluoric acid) due to Chinese Drywall contamination issues; and in 2010 for the BP Horizon Gulf oil spill. Due to the lethality of hydrogen sulfide, it is best to measure it passively.

Handy sample size to get you started with radiello. Kit Includes:

- 1 white diffusive body
- Vertical adapter
- Triangular base plate
- 2 RAD170 adsorbing cartridges
- Instruction sheet



Cat. No.	Description
RAD170S	Hydrogen Sulfide Sample Kit

For more information about radiello passive sampling products, request the radiello brochure (IXV). To learn more about radiello test methods, please request the radiello manual (IYP).

AIR SAMPLING PUMPS

The right selection of pumps for your air sampling needs

Escort Elf Twin Port Sampler

This pump attachment is designed for low flow industrial hygiene sampling, such as gas and vapor monitoring, using sorbent tubes. Two needle valves provide independent flow control for simultaneous collection on two tubes, but can also be used for a single tube by closing the flow to one valve. The sampler is compatible with any personal sampling pump capable of 1.5 L/min flow rate and a load of 25 in. of water. Total flow cannot exceed 500 mL/min. Each sampler comes with two tube protectors, one for small tubes (<2 inches long) and one for large tubes (<4.5 inches long), and the tubing required to connect the sampler to the sampling pump.



Model 1067 Dual Channel Tube Sampler



For quick, clean sample collections of low ambient air and high vacuum VOC's vapor collection, the Model 1067, Dual Channel Ambient Air Sampler was developed specifically to meet the dual channel sampling requirements of US EPA Method TO-17. Precision needle valves provide stable flow rates for two independently controlled flow channels for sorbent tube sampling over a range of 5-500 mL/min. Quick connectors make sampling set-up fast and easy. These connectors accept 6 mm O.D. or 1/4 in. O. D. solvent or thermal desorption tubes. The rechargeable battery provides 12 hours of continuous sampling on each channel with remarkable accuracy and precision.

PAS-500 Micro Air Sampler

This low flow pump is lightweight (4 oz) and compact (7 in. high), fitting easily into your shirt pocket. The adsorbent tube connects directly to the inlet of the pump. This sampler is versatile, adapts to fit both 6 mm and 8 mm tubes, and has a flow range of 40-200 cc/min. The low flow adapter enables you to sample at 20 cc/min. This unit is powered by a convenient and easily replaceable 9-volt battery. The full flow regulation feature provides constant voltage to the pump, even as battery voltage drops. It is intrinsically safe; a built-in resistor limits the power current, preventing any short circuit.



Gas Sampling Bags

Our bag samplers do not require an additional external pump, it's built right in. They are designed so the sampled gas flows through exchangeable tubing directly to the bag's inlet without first passing through a pump, which can contaminate your sample. The built-in pump evacuates the air from the box, creating a negative pressure inside the box, causing the ambient air to enter the inlet and flow into the bag. The desired flow rate / sampling speed can be achieved by adjusting the flow control valve venting the chamber. Battery chargers not included, please order separately. Products not UL listed or EX rated.

Model 1060 - Single 1-2 Liter Gas Sampling Bags

- See-through window
- Carrying strap
- Rechargeable battery
- Flow Rate: 100-1900 mL/min; installed needle valve for coarse flow rate control



Model 1062 - Single 1-10 Liter Gas Sampling Bags

- For fast sampling of stack and vent gases with zero cross-contamination
- See-through window
- Automatic shut-off for 10 L bags
- Can fill a 10 L bag in 2 minutes
- Rechargeable battery
- Flow Rate: 1-5 L/min; installed rotameter valve for coarse flow rate control



Model 1063 - Six 1 Liter Gas Sampling Bags

- Controller can be programmed to draw samples sequentially; battery backed memory
- Optional 1 mL/min critical orifice is available to deliver low sampling rates
- Rechargeable battery
- Flow Rate: 1-5 L/min; installed needle valve for coarse flow rate control



mini-Buck™ Flow Calibrator

The mini-Buck Primary Flow Calibrator is the industry standard for day-to-day flow verification and calibration of your personal and environmental sampling pumps. It is also suitable for verifying rotameters, setting instrument panels, and calibrating laboratory instrumentation. No more lugging oversized calibration panels. No more rotameter inaccuracies. It is accurate at any altitude. Its rugged design provides fast, one-handed operation with an easy-to-read LED display visible even in sunlight. Flow cells are sun shielded, with a sealed bubble stem for pressure readings, easy to clean, and won't leak even if unit is inverted. It automatically displays averaged readings of volumetric flow and is NIST traceable with display accuracy of $\pm 0.5\%$. Now you have the advantage of accuracy and portability in one compact package which can be used in the lab or in the field. We offer both the Model M-5 with a flow rate of 1-6000 mL/min, and Model M-30 with a flow rate of 1-30 mL/min.



Humonics Flowmeter

A soap film type flowmeter with microprocessor controls that measures volumetric flow between 5 to 5,000 mL/min, with accuracy to within $\pm 3\%$ of the reading. A microprocessor indicates fault and low battery conditions, and automatically adjusts the meter to the air flow rate.



Bubble Flowmeter

The simplest and most economical soap film flowmeter. It is supplied with a glass buret, available in 500 mL and 1000 mL sizes, film solution, ring stand with clamp, and operating instructions. Stop watch sold separately.



For more information about our sampling pumps, visit sigma-aldrich.com/air-monitoring

ADSORBENT MATERIALS FOR AIR SAMPLING

The commitment to carbon adsorbent technology at Supelco has been ongoing for more than two decades. This effort has been critical to the advancement of chromatography products like GC columns and sample preparation products. Today, Supelco has over 87 different carbons, ranging in particle size from 1-1000 microns and surface areas from 1-1500 m²/g. Our efforts have been broad in scope, and have ranged from purification process development, to research focusing on the thermodynamic and kinetic properties of adsorbents. Understanding the performance characteristics of adsorbents has been our primary goal.

If you do not see a specialty carbon adsorbent that meets your needs, contact our Technical Service group at techserv@sial.com to inquire about custom materials.

In addition to our specialty carbon adsorbents, we also offer popular adsorbents; such as activated charcoal, polymer materials, and silica gel.

Carbon Adsorbent Sample Kits

Often choosing the right adsorbent or combination of adsorbents can be difficult. The goal in selecting the proper adsorbent is to choose one or more that can retain a specific analyte, or group of analytes, for a specific sample volume. However, equally important is that the adsorbent(s) must also be able to release the analyte(s) during the desorption process.



By using one of the Supelco Carbon Adsorbent Sampler Kits, the method developer obtains a cost-effective way to evaluate several carbon adsorbents when designing adsorbent-based applications and products. Once the appropriate material has been identified, Supelco is ready to work with you to produce larger quantities to your specifications.

To learn more about our carbon products and capabilities, visit sigma-aldrich.com/carbon

Graphitized Carbon Black (GCB)

Graphitized carbon black (GCB) materials generally are nonporous. Consequently, surface interactions depend solely on dispersion (London) forces. GCBs exhibit hydrophobic surface characteristics, meaning that small, polar molecules, such as water, are not adsorbed. Therefore, analyte displacement by water is significantly reduced, allowing them to be effectively used in trapping organic compounds despite high humidity.

We offer two groups of GCB adsorbents: Carbotrap and Carboxen Materials and Small Particle Size Materials.

Carbon Molecular Sieve (CMS)

A carbon molecular sieve (CMS) particle is the carbon skeletal framework remaining after the pyrolysis of a polymeric precursor. These materials are primarily used for collecting very small molecular-sized compounds (C₂-C₅). The size and shape of the analyte molecule, and the size and shape of the pores in the CMS particle, determine how well the analyte is adsorbed and desorbed. Because our CMSs are prepared from high-purity polymers, the resulting material is a high-purity carbon, effective in the release/desorption of adsorbed analytes for quantification. Our Carbosieve S-III and Carboxen carbon molecular sieves have upper temperature limits of at least 400 °C.

General Guidelines for Choosing Carbon Adsorbents

For multi-bed tubes, use the weaker adsorbent in front of the stronger adsorbent. For example, use Carboxen C in front of Carboxen B.

Relative Analyte Size*	Recommended Materials (listed weakest to strongest)
>C ₂₀	Carbotrap F, Carboxen F
C ₁₂ -C ₂₀	Carbotrap C, Carboxen C, Carbotrap Y, Carboxen Y
C ₅ -C ₁₂	Carbotrap B, Carboxen B
C ₃ -C ₉	Carboxen 1016, Carbotrap X, Carboxen X, Carboxen Z
C ₂ -C ₅	Carboxen 569, Carbosieve G, Carboxen 1000, Carbosieve S-III, Carboxen 1021, Carboxen 1018
Carboxen	1003, Carboxen 1012

* Analyte size relative to n-Alkanes. Consider all atoms, not just Carbon. For example, even though 1,2-Dichloroethane is a C₂, the two Chlorine atoms give it a relative size between C₄ and C₅.

Carbon Adsorbent Sample Kits

This chart lists the approximate surface area, pore volume, pore diameter, and free fall density for each of our specialty carbons.

Carbon	Approx. Surface Area (m ² /g)	Approx. Pore Volume (cc/g)			Approx Pore Diam. (Å)	Approx. Free Fall Density (g/mL) [particle sizes expressed in mesh and µm units]											
		Micro	Meso	Macro		20/40 400-841	20/45 354-841	40/60 250-400	45/60 250-354	60/80 177-250	80/100 149-177	80/120 125-177	100/140 105-149	120/400 37-125	— 40-50	— 2	— <0.2
Carbotrap F / Carbopack F [▲]	5	–	–	–	–	0.70		0.68		0.67							
Carbotrap C / Carbopack C [▲]	10	–	–	–	–	0.70		0.65		0.64	0.64						
Carbotrap Y / Carbopack Y [▲]	24	–	–	–	–	0.44		0.42		0.38				0.38			
Carboxen 1017	61	–	0.33	–	–		0.56										
Graphitized carbon black	70	0.01	0.23	–	137												0.07
Carboxen 1016	75	–	0.34	–	–					0.41							
Carbotrap B / Carbopack B [▲]	100	–	–	–	–	0.38		0.38		0.36		0.35	0.34	0.30			
Mesoporous carbon	203	–	0.49	–	96.3											0.35	
Purified carbon black	214	0.06	0.28	–	63.9												0.06
Carbopack Z [▲]	220	–	1.73	–	255					0.16							
Carbotrap X / Carbopack X [▲]	240	–	0.62	–	100	0.44		0.44		0.44				0.39			
Carboxen 564	400	0.24	0.13	0.14	6-9		0.61										
Carboxen 569	485	0.20	0.14	0.10	5-8		0.61	0.57									
Carboxen 1001	500	0.22	0.13	0.11	5-8					0.55							
Carboxen 563	510	0.24	0.15	0.24	7-10		0.52										
Carboxen 1021	600	0.30	–	–	5-8					0.78							
Carboxen 1010	675	0.35	–	–	6-8												0.43
Carboxen 1018	675	0.35	–	–	6-8					0.74							
Carboxen 1006	715	0.29	0.26	0.23	7-10												0.26
Carbosieve S-III	975	0.35	0.04	–	4-11					0.66							
Carboxen 1003	1000	0.38	0.26	0.28	5-8		0.51	0.49									
Carbosieve S-II	1059	0.45	0.01	–	6-15					0.61	0.61						
Carboxen 572	1100	0.41	0.19	0.24	10-12		0.48										
Supelcarb	1150	0.47	0.26	0.28	5-8		0.51										
Carbosieve G	1160	0.49	0.02	–	6-15				0.27	0.27	0.27						
Carboxen 1000	1200	0.44	0.16	0.25	10-12			0.50		0.47	0.47						
Carboxen 1012	1500	–	0.66	–	19-21							0.52					

■ This specialty carbon is available with this particle size in at least 1 package size as a stock catalog number. Alternative package sizes may be available as custom items.

■ This specialty carbon is available with this particle size only as a custom item.

▲ Carbotrap signifies graphitized carbon black (GCB) with particles 40 mesh or larger (e.g. 20/40). Carbopack signifies GCB with particles 40 mesh or smaller (e.g. 40/60, 60/80, 80/100, etc.).

SAMPLE PREPARATION AND ANALYSIS OF CARBONYLS

HPLC AND GC COLUMNS

After sample collection of carbonyls by the wide range of sample collection devices, the analytes are typically analyzed by HPLC with a UV detector; an exception to this is the OSHA 52 method whose modified method employs capillary GC analysis. In addition to carbonyl sample collection devices, we provide the complete solution of analytical standards, neats, reagents, solutions, and analytical HPLC and GC columns.

Analytical Columns for HPLC Analysis

Cat. No.	Description
Ascentis Express C18 HPLC Column	
53829-U	15 cm x 4.6 mm I.D., 2.7 µm
Ascentis Express RP-Amide HPLC Column	
53931-U	15 cm x 4.6 mm I.D., 2.7 µm

Analytical Columns for GC Analysis (OSHA 52 Method)

Cat. No.	Description
SUPELCO WAX® 10 Capillary Column	
25325	30 m x 0.53 mm I.D., 0.5 µm

RADIELLO ALDEHYDE CALIBRATION STANDARD

The aldehyde calibration standard consists of nine 2,4-dinitrophenylhydrazones (2,4-DNPH) diluted in acetonitrile. Actual concentrations for each component are certified for each lot. The standard stock solution is shipped in a pierceable-septum, crimped cap. Cartridges are stable for at least four months when stored at 4 °C.

Cat. No.	Description	Qty.
	Aldehyde Calibration Standard	10 mL
RAD302	50 µg/mL of each component in acetonitrile, except where noted	
	<i>Formaldehyde-2,4-DNPH</i>	<i>Acetaldehyde-2,4-DNPH</i>
	<i>Acrolein-2,4-DNPH, 10 µg/mL</i>	<i>Propanal-2,4-DNPH</i>
	<i>Butanal-2,4-DNPH</i>	<i>Isopentanal-2,4-DNPH</i>
	<i>Pentanal-2,4-DNPH</i>	<i>Hexanal-2,4-DNPH</i>
	<i>Benzaldehyde-2,4-DNPH</i>	

CARBONYL-DNPH CALIBRATION STANDARDS

European Auto Exhaust

Cat. No.	Description
Carbonyl DNPH Mix 1, in acetonitrile	
47672-U	20 µg/mL (14 compounds)
47671-U	2 µg/mL (14 compounds)

California Air Resources Board (CARB)

Cat. No.	Description
Method 1004 - Carbonyl-DNPH Mix, in acetonitrile	
47649-U	CARB Carbonyl DNPH Mix, varied conc., (7 compounds)
47650-U	CARB Method 1004 DNPH Mix 1, 3 µg/mL (14 compounds)
47651-U	CARB Method 1004 DNPH Mix 2, 30 µg/mL (14 compounds)

Neats

Cat. No.	Description	Qty.
Select carbonyl-DNPH compounds		
442597	Formaldehyde-2,4-DNPH	100 mg
442434	Acetaldehyde-2,4-DNPH	100 mg
442441	Acrolein-2,4-DNPH	25 mg
442436	Acetone-2,4-DNPH	50 mg
442504	Butyraldehyde-2,4-DNPH	100 mg
442768	Propionaldehyde-2,4-DNPH	100 mg

Single Component Solutions

Cat. No.	Description
Select Carbonyl-DNPH solutions, in acetonitrile	
47177	Formaldehyde-2,4-DNPH, 100 µg/mL
47564-U	Glutaraldehyde-2,4-DNPH, 100 µg/mL
47342	Acrolein-2,4-DNPH, 1000 µg/mL
47340-U	Acetaldehyde-2,4-DNPH, 1000 µg/mL
47181	Propionaldehyde-2,4-DNPH, 1000 µg/mL

US Environmental Protection Agency

Cat. No.	Description
TO11/IP-6A Aldehyde/Ketone-DNPH Mix, in acetonitrile	
47285-U	15 Component Mix, 15 µg/mL each component

For more information about our carbonyl standards, visit sigma-aldrich.com/standards

SAMPLE PREPARATION AND ANALYSIS OF BTEX/VOCS

GC COLUMNS

A selection of special purpose columns designed for industry specific applications. These columns are manufactured to deliver high resolution, great analyte response, low bleed, and long column life; allowing analysts to achieve the analytical performance they require. Use the table below to locate your BTEX/VOC application and identify the recommended phase.

Analytical Column Selection Guide by Application

Method	Compound	Column
EPA TO-1/TO-2	Toxic Organics	Equity®-1
EPA TO-14A	Aromatics	Equity-1
EPA TO-14A	VOCs	Equity-1
BTEX		SUPELCO WAX 10
EPA IP-1A/IP-1B	VOCs	Equity-1
NIOSH 1501	Aromatic Hydrocarbons	Equity-1
OSHA 7	Organic Solvents	Equity-1 SLB®-5ms

For more information about our GC columns for environmental applications, visit sigma-aldrich.com/gc-enviro

CHEMICAL STANDARDS

We offer a variety of chemical reference standards for the qualitative calibration of air monitoring and industrial hygiene equipment. These standards are available in both liquid solutions and gaseous blends, to accommodate calibration of today's variety of air monitoring and analysis devices and applications. Each standard includes a Certificate of Analysis summarizing the testing data. Each standard solution is provided in a flame-sealed amber ampul. Each gaseous standard is provided in a transportable cylinder for ease of use in either the laboratory or the field.



Cat. No.	Description	Qty.
EPA TO-1 Toxic Organics Mix 1A		
48896	2 mg/mL each compound in methanol (4 component mix)	1 mL
EPA TO-1 Toxic Organics Mix 1B		
48897	2 mg/mL each compound in methanol (13 component mix)	1 mL
EPA TO-2 Toxic Organics Mix 2A		
48898	2 mg/mL each compound in methanol (3 component mix)	1 mL
TO-14 Calibration Mix 1		
41900-U	100 ppb each component in nitrogen (39 component mix)	110 L
TO-14 Aromatics Subset Mix		
41901	100 ppb each component in nitrogen (14 component mix)	110 L
TO-14 Chlorinated Hydrocarbons Subset Mix		
41902	100 ppb each component in nitrogen (19 component mix)	110 L
TO-14 CFC/HCFC Subset Mix		
41903	110 ppb each component in nitrogen (4 component mix)	110 L
TO-14 Reactive Subset Mix		
41911	110 ppb each component in nitrogen (3 component mix)	110 L
TO-14 GC/MS Tuning Standard		
41913	2 ppm bromofluorobenzene in nitrogen	110 L
EPA TO-15/17 Calibration Mix		
41973-U	1 ppm each component in nitrogen (62 component mix)	110 L
41974-U	100 ppb each component in nitrogen (62 component mix)	110 L
41978-U	1 ppm each component in nitrogen (25 component mix)	110 L
41979-U	100 ppb each component in nitrogen (25 component mix)	110 L
501883	10 ppm each component in nitrogen 300 psi	48 L
25884-U	Scotty IV gas cylinder	74 L
BTEX Mix, High Concentration		
47993	2000 µg/mL in methanol (6 components)	1 mL

For more information, visit sigma-aldrich.com/standards

RADIELLO® CALIBRATION KITS

radiello BTEX Calibration Kits

The BTEX Calibration Kit is available for CS₂ desorption and thermal desorption; both kits are designed for analysis of BTEX in urban environments. The kit may be used for both routine calibration and quality control. The calibration kit includes 12 cartridge



adsorbents; of which, three are blanks, and the remaining nine are divided into three concentration groups preloaded with BTEX to simulate 7-day exposures (100,800 minutes). Concentrations are described in the table below. The values shown are indicative. Actual concentrations are certified for each lot. Cartridges are stable for at least four months when stored at 4 °C.

radiello BTEX Calibration Kit (CS₂ Desorption)

Includes: 12 RAD130 Cartridge Adsorbents

Simulated Concentrations in µg/m³

Exposure Limit: 7 days equivalent

	Group 1	Group 2	Group 3
Benzene	1	10	50
Toluene	2	20	100
Ethylbenzene	1	10	50
m-xylene	1	10	50
p-xylene	1	10	50
o-xylene	1	10	50

Cat. No.	Description
RAD405	radiello BTEX Calibration Kit (CS ₂ Desorption)

radiello BTEX Calibration Kit (Thermal Desorption)

Includes: 12 RAD145 Cartridge Adsorbents

Simulated Concentrations in µg/m³

Exposure Limit: 7 days equivalent

	Group 1	Group 2	Group 3
Benzene	1	5	25
Toluene	2	10	50
Ethylbenzene	1	5	25
m-xylene	1	5	25
p-xylene	1	5	25
o-xylene	1	5	25

Cat. No.	Description
RAD407	radiello BTEX Calibration Kit (Thermal Desorption)

radiello VOC Calibration Kit (Workplace Environment)

The VOC Calibration Kit is ideal for conducting scheduled quality control runs when analyzing workplace environments. The calibration kit includes 12 cartridge adsorbents; of which, three are blanks, and the remaining nine are divided into three concentration groups preloaded with VOC's to simulate 8-hour (480 minutes) exposure. Concentrations are described in the listed table below. The values shown are indicative. Actual concentrations are certified for each lot. The composition of VOC's represents a broad range of polarity. The spiked concentrations represent 0.5, 1.0, and 2.0 times the threshold limit values (TLV) for each compound. VOC's are spiked onto the cartridges by injecting vaporized VOC standards in CS₂ under nitrogen flow. Cartridges are stable for at least four months when stored at 4 °C.

radiello VOC Calibration Kit

Includes: 12 RAD130 Cartridge Adsorbents

Simulated Concentrations in µg/m³

Exposure Limit: 8 hours equivalent

	Group 1	Group 2	Group 3
Benzene	0.1	0.2	0.4
Toluene	19	38	76
Ethylbenzene	12	24	48
m-xylene	12	24	48
p-xylene	12	24	48
o-xylene	12	24	48
Butanol	15	30	60
2-ethoxyethyl acetate	2.5	5	10

Cat. No.	Description
RAD406	radiello VOC Calibration Kit

For more information, visit sigma-aldrich.com/radiello

SAMPLE PREPARATION AND ANALYSIS OF PESTICIDES, PCBs AND PAHS

HPLC AND GC COLUMNS

Listed below is a selection of special purpose columns manufactured to deliver high resolution, great analyte response, low bleed, and long column life; allowing analysts to achieve the analytical performance they require.

Analytical Column Selection Guide by Application

Method	Compound	Column
EPA TO-4A/TO-10A EPA IP-8	Pesticides	Equity-1701, SLB-5ms, SPB®-608
EPA TO-13	PAHs	SLB-5ms
NIOSH 5506	PAHs by HPLC	Ascentis® Express C18
NIOSH 5515	PAHs by GC	SLB-5ms
ASTM D4861	PCBs	Equity-1701, SLB-5ms, SPB-608
CARB 428	PCDDs/PCDFs and PCBs	SLB-5ms, SPB-2331, SPB-Octyl
EN1948-1	PCDDs/PCDFs and dioxin-like PCBs	SLB-5ms, SPB-2331, SPB-Octyl

For more information about our GC columns for environmental applications, visit sigma-aldrich.com/environmental

CHEMICAL STANDARDS

Each standard solution is provided in a flame-sealed amber ampul and includes a Certificate of Analysis.

Standards for Pesticides, PCBs and PAHs

Cat. No.	Description	Qty.
ASTM D4861		
48861	Analysis of PCBs in Air Aroclor Mix 1 200 µg/mL each component in methanol	1 mL
48862	Aroclor Mix 2 200 µg/mL each component in methanol	1 mL
ASTM D4947		
	Analysis of chlordane and heptachlor, 200 µg/mL in isooctane	
48984	Chlordane (mixture of isomers)	10 mL
48964	Heptachlor solution	10 mL

Standards for Pesticides, PCBs and PAHs continued

Cat. No.	Description	Qty.
NIOSH 5506, 5515		
	Analysis of PAHs in Indoor Air	
48743	EPA 610 Polynuclear Aromatic Hydrocarbons Mix At indicated conc. in methanol:methylene chloride (50:50) (16 compounds, varied concentrations)	1 mL
EPA TO-4A/TO-10/EPA IP-8		
	Analysis of organochlorine pesticides in indoor air by capillary GC/ECD	
48858-U	EPA Pesticide Mix In methanol:methylene chloride (98:2) (16 compounds, varied concentrations)	1 mL
EPA TO-13		
	Polynuclear aromatic hydrocarbons by GC/FID and HPLC/UV	
49156	EPA TCL PAH Mix in acetonitrile:methanol (9:1)(16 compounds, varied concentrations)	1 mL

For more information, visit sigma-aldrich.com/pesticides

Standards for Hydrogen Sulfide

The hydrogen sulfide calibration standard contains a methylene blue concentrate that, once diluted 1:50 (v/v) with water, provides the same absorbance value of hydrogen sulfide at 665 nm, at a concentration of 1.145 µg/mL sulfide ions. This concentration value is the highest absorbance value within linear range of the spectrophotometer, and can be used as a stock solution to prepare standards for the calibration curve. The concentrate is suitable for preparing up to 50 calibration curves and is stable for at least 1 year.

Cat. No.	Description
radiello Methylene Blue Calibration Standard	
RAD171	radiello VOC Calibration Kit

SAMPLE COLLECTION FOR WATER AND SOIL

SAMPLE CONTAINERS

We offer containers suitable for the collection of samples for volatile analysis and other types of testing. Our sampling containers are cleaned according to US EPA protocol B and are available in amber and clear glass.

- Containers suitable for water and solid samples
- Pre-cleaned per EPA protocol B
- Variety of sizes available in both amber and clear glass

40 mL Pre-cleaned Vials

Used for the collection of water samples for VOC analysis per a variety of methods. A Certificate of Analysis (COA) and a package of labels for each vial are provided. The vials are shrink wrapped after cleaning to maintain their integrity.



- Pre-cleaned per US EPA Protocol B
- Available in clear and amber glass

Cat. No.	Description	Qty.
23188	40 mL clear glass	100
23189	40 mL amber glass	100

Pre-cleaned Sampling Containers, Larger Volume

These are larger volume containers, available in narrow and wide mouth. Narrow mouth containers are usually used for collecting water samples, while wide mouth are usually used for solid samples. All containers come with PTFE lined polypropylene caps.



- Pre-cleaned per US EPA Protocol B
- Variety of sizes for water and solid samples

Cat. No.	Description	Qty.
24551-U	4 oz, clear glass, wide mouth	24
24555	4 oz, amber glass, wide mouth	24
24552	8 oz, clear glass, wide mouth	24
24556	8 oz, amber glass, wide mouth	12

For additional sampling containers, visit [sigmaaldrich.com/analytical](https://www.sigmaaldrich.com/analytical)

SAMPLE PREPARATION FOR WATER AND SOIL

SOLVENTS AND MIXES

Solid and water samples can be prepared for the analysis of environmental contaminants using a variety of techniques as described in various EPA methods. Sigma-Aldrich offers a full line of glassware, solvents, and spiking solutions suitable for these techniques. If extracts require cleanup prior to analysis, the Supelclean™-ENVI™ line of solid phase extraction (SPE) tubes and materials are designed for use with environmental samples.

Relevant Methods: US EPA 3540, 3541, 3550, 3510, 3520, 3535, 508, 608, 525, 625, and many additional methods.

High Purity Solvents

We offer several brands of high-purity solvents suitable for environmental testing. These include our CHROMASOLV® Plus and pesticide residue grade (PRA) product lines.

- Suitable for environmental testing
- Tested for purity
- Many types of solvents available



Cat. No.	Description
650552	CHROMASOLV Plus Hexane
650463	CHROMASOLV Plus Dichloromethane
34488	Dichloromethane, PRA Grade (Fluka®)
34480	Acetone, PRA Grade (Fluka)
34484	Hexane, PRA Grade (TraceSelect®)

For more information, visit sigma-aldrich.com/solvents

EPA 8270 LCS Spike Mix

This mix contains 78 semivolatile components and can be used for the spiking of laboratory control standards (LCS). The large composition of this mix will save the time and frustration involved with using multiple mixes.

- Contains 78 semivolatile compounds analyzed by method 8270
- Formulated for analyte stability
- Water soluble matrix



Cat. No.	Description
40032-U	EPA 8270 LCS Mix, High Concentration, 200 µg/mL, 25 mL
46853-U	EPA 8270 LCS Mix, 100 µg/mL, 25 mL

For more information on spiking mixes, visit sigma-aldrich.com/standards

ANALYSIS OF SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCS)

Total product line for the analysis of SVOCs

The analysis of semi-volatile organic compounds by GC-MS requires the use of inert, low bleed capillary columns, complex calibration standards, and GC accessories to keep instruments running at peak performance. We can provide you with everything you need; from mass spec grade capillary columns, to calibration mixes, to perform analysis of semi-volatile organic compounds by a variety of EPA methodologies.

Relevant Methods: US EPA 525, 625, 8270

Semivolatile Calibration Standard Mixes

Our standards are specially formulated for stability, and come with certificates of analysis. Our semivolatile calibration mixes contain a large number of the compounds on the target lists of many laboratories performing semi-volatile analysis. Minimizing the number of mixes required to make calibration standards will save time and reduce the potential for error.



- Stable formulations
- Formulated to be method specific
- Provided with certificates of analysis
- Full data packets available, free of charge upon request
- Separate source standards available for many mixes

Cat. No.	Description
506508	EPA CLP Semivolatile Calibration Mix
506559	EPA 625 Semivolatile Calibration Mix
48905-U	EPA TLC Polynuclear Aromatic Hydrocarbons
47260-U	EPA 8270 Surrogate Standard
46955-U	EPA 8270 Semivolatiles Internal Standard Mix

For information on additional mixes, visit sigma-aldrich.com/standards

SLB[®]-5ms

The low phenyl content provides a boiling point elution order with a slight increase in selectivity, especially for aromatic compounds.

- Low bleed, highly inert
- High maximum temperature
- Available in fast GC dimensions



Cat. No.	Description
SLB-5ms Capillary Columns	
28471-U	30 m x 0.25 mm I.D., 0.25 µm
28473-U	30 m x 0.25 mm I.D., 0.50 µm
28564-U	20 m x 0.18 mm I.D., 0.18 µm
28576-U	20 m x 0.18 mm I.D., 0.36 µm

For more information, including additional column dimensions, visit sigma-aldrich.com/slb

Low Adsorption Vials and Mass Spectral Quality Caps

To minimize the potential for adsorption of active compounds from semi-volatile extracts, we now offer Low Adsorption (LA) vials.

We recommend using LA vials in combination with our mass spectral quality (MSQ) caps. This polypropylene/PTFE silicone cap/septa combination provides a clean seal, with little to no background contamination.

- Suitable for use in the analysis of extracts for trace levels of semi-volatile compounds
- LA Vials made to provide a highly inert glass surface
- MSQ caps designed for MS use
- LA vials also available in a low-volume insert configuration



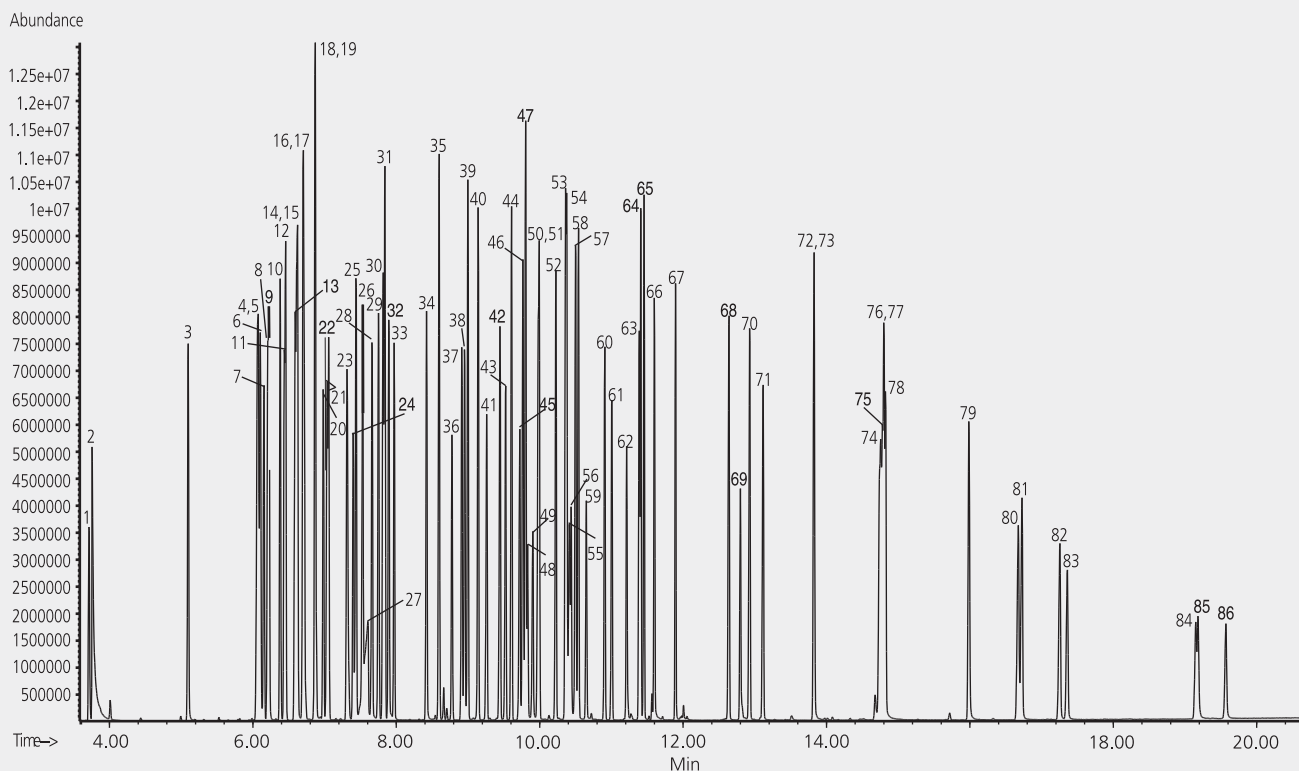
Cat. No.	Description	Qty.
29653-U	LA Vial, 2 mL amber glass w/markings spot	100
29651-U	LA Vial, 2 mL clear glass w/markings spot	100
29665-U	MSQ caps, 9 mm, natural PTFE/silicone septa	100

For additional vials and caps, visit sigma-aldrich.com/vials

Analysis of US EPA Method 8270D Semivolatiles Using SLB-5ms

column: SLB-5ms, 30 m x 0.25 mm I.D., 0.25 μ m (28471-U)
 oven: 40 °C (2 min.), 22 °C/min. to 240 °C, 10 °C/min. to 330 °C, (1 min.)
 inj.: 250 °C
 MSD interface: 330 °C
 scan range: 40-450 m/z
 carrier gas: helium, 1.0 mL/min. (11 min.), 10 mL/min² to 1.5 mL/min. (hold remainder of run)
 injection: 0.5 μ L, splitless (0.50 min.)
 liner: 2 mm I.D., straight
 sample: 50 ng on-column of a 72-component semivolatile standard and 8 surrogate compounds, plus 6 internal standards (at 40 ng on-column)

- | | | | |
|--|---------------------------------------|---|---------------------------------------|
| 1. N-nitrosodimethylamine | 23. Isophorone | 45. 3-Nitroaniline | 67. Di-n-butyl phthalate |
| 2. Pyridine | 24. 2-Nitrophenol | 46. Acenaphthene-d ₁₀ (I.S.) | 68. Fluoranthene |
| 3. 2-Fluorophenol (surr.) | 25. 2,4-Dimethylphenol | 47. Acenaphthene | 69. Benzidine |
| 4. Phenol-d ₆ (surr.) | 26. Bis(2-chloroethoxy)methane | 48. 2,4-Dinitrophenol | 70. Pyrene |
| 5. Phenol | 27. Benzoic acid | 49. 4-Nitrophenol | 71. Terphenyl-d ₁₄ (surr.) |
| 6. Aniline | 28. 2,4-Dichlorophenol | 50. Dibenzofuran | 72. 3,3'-Dimethylbenzidine |
| 7. Bis(2-chloroethyl)ether | 29. 1,2,4-Trichlorobenzene | 51. 2,4-Dinitrotoluene | 73. Butylbenzyl phthalate |
| 8. 2-Chlorophenol-d ₄ (surr.) | 30. Naphthalene-d ₈ (I.S.) | 52. Diethyl phthalate | 74. 3,3'-Dichlorobenzidine |
| 9. 2-Chlorophenol | 31. Naphthalene | 53. 4-Chlorophenyl phenyl ether | 75. Benzo(a)anthracene |
| 10. 1,3-Dichlorobenzene | 32. 4-Chloroaniline | 54. Fluorene | 76. Bis(2-ethylhexyl)phthalate |
| 11. 1,4-Dichlorobenzene-d ₄ (I.S.) | 33. Hexachlorobutadiene | 55. 4-Nitroaniline | 77. Chrysene-d ₁₂ (I.S.) |
| 12. 1,4-Dichlorobenzene | 34. 4-Chloro-3-methylphenol | 56. 2-Methyl-4,6-dinitrophenol | 78. Chrysene |
| 13. Benzyl alcohol | 35. 2-Methylnaphthalene | 57. N-Nitrosodiphenylamine | 79. Di-n-octyl phthalate |
| 14. 1,2-Dichlorobenzene-d ₄ (surr.) | 36. Hexachlorocyclopentadiene | 58. Azobenzene | 80. Benzo(b)fluoranthene |
| 15. 1,2-Dichlorobenzene | 37. 2,4,6-Trichlorophenol | 59. 2,4,6-Tribromophenol (surr.) | 81. Benzo(k)fluoranthene |
| 16. 2-Methylphenol | 38. 2,4,5-Trichlorophenol | 60. 4-Bromophenyl phenyl ether | 82. Benzo(a)pyrene |
| 17. Bis(2-chloroisopropyl)ether | 39. 2-Fluorobiphenyl (surr.) | 61. Hexachlorobenzene | 83. Perylene-d ₁₂ (I.S.) |
| 18. N-nitroso-di-n-propylamine | 40. 2-Chloronaphthalene | 62. Pentachlorophenol | 84. Indeno(1,2,3-cd)pyrene |
| 19. 4-Methylphenol | 41. 2-Nitroaniline | 63. Phenanthrene-d ₁₀ (I.S.) | 85. Dibenzo(a,h)anthracene |
| 20. Hexachloroethane | 42. Dimethyl phthalate | 64. Phenanthrene | 86. Benzo(g,h,i)perylene |
| 21. Nitrobenzene-d ₅ (surr.) | 43. 2,6-Dinitrotoluene | 65. Anthracene | |
| 22. Nitrobenzene | 44. Acenaphthylene | 66. Carbazole | |



ANALYSIS OF VOLATILE ORGANIC COMPOUNDS (VOCs)

Total product line for VOCs

This application requires the use of many consumable items; such as, adsorbent purge traps for the trapping and thermal desorption of VOCs into the GC, and various standards for calibration and spiking. We can provide you with everything you need; including capillary columns suitable for VOC analysis, purge traps tailored for specific applications, and ultra-clean purge-and-trap grade methanol.

Relevant Methods: US EPA 502, 503, 524, 601, 602, 624, 8260

- Purge-and-trap grade methanol
- Purge traps designed to fit a variety of instrumentation
- SPB-624 and VOCOL® GC capillary columns for the analysis of VOCs
- Calibration and spiking standards
- Gastight® syringes and Mininert® valves for sample preparation and storage

Purge and Trap Grade Methanol

Methanol may contain impurities, that when concentrated through purge and trap, can interfere with the GC analysis of VOCs. This grade of methanol is specially tested to ensure low organic background and suitability for use in the GC-MS analysis of VOCs.

It can be used in the preparation of calibration standards, spiking solutions, and medium level extraction of solid samples.

Cat. No.	Description
414816-1L	Methanol for GC-MS analysis of VOCs, 1 L

For more information, visit sigma-aldrich.com/solvents

Purge Traps

The trap selected for an application should have the ability to trap and efficiently desorb the compounds of interest. Other factors should also come into consideration such as the ability of the trap to release water if a dry purge cycle is used. Our VOCARB® and other carbon-based traps are designed and packed with multiple beds of adsorbent materials to efficiently trap and desorb a broad range of compounds.

- Available in configurations for most purge and trap instruments
- VOCARB purge traps contain hydrophobic adsorbents, which significantly reduce the dry purge time needed to remove moisture
- VOCARB purge traps use higher desorption temperatures than other types of traps, for more rapid transfer of analytes to the GC column and improved chromatography.

Cat. No.	Description
21066-U	VOCARB 3000 ("K"Trap), for Tekmar LSC 2000, 4000, and Velocity XPT
24938	VOCARB 4000 ("I"Trap) for OI Eclipse 4660 and 4560
20321	Carbopack B/Carbosieve SIII ("H"Trap), for Tekmar LSC 2000, 4000, and Velocity XPT

For more information on purge traps, visit sigma-aldrich.com/sampleprep

Calibration and Spiking Standards

We offer a variety of multi-component standards, for use in many VOC methods.

- Provided with certificates of analysis
- Full data packets available free of charge upon request
- Some available as separate source standards



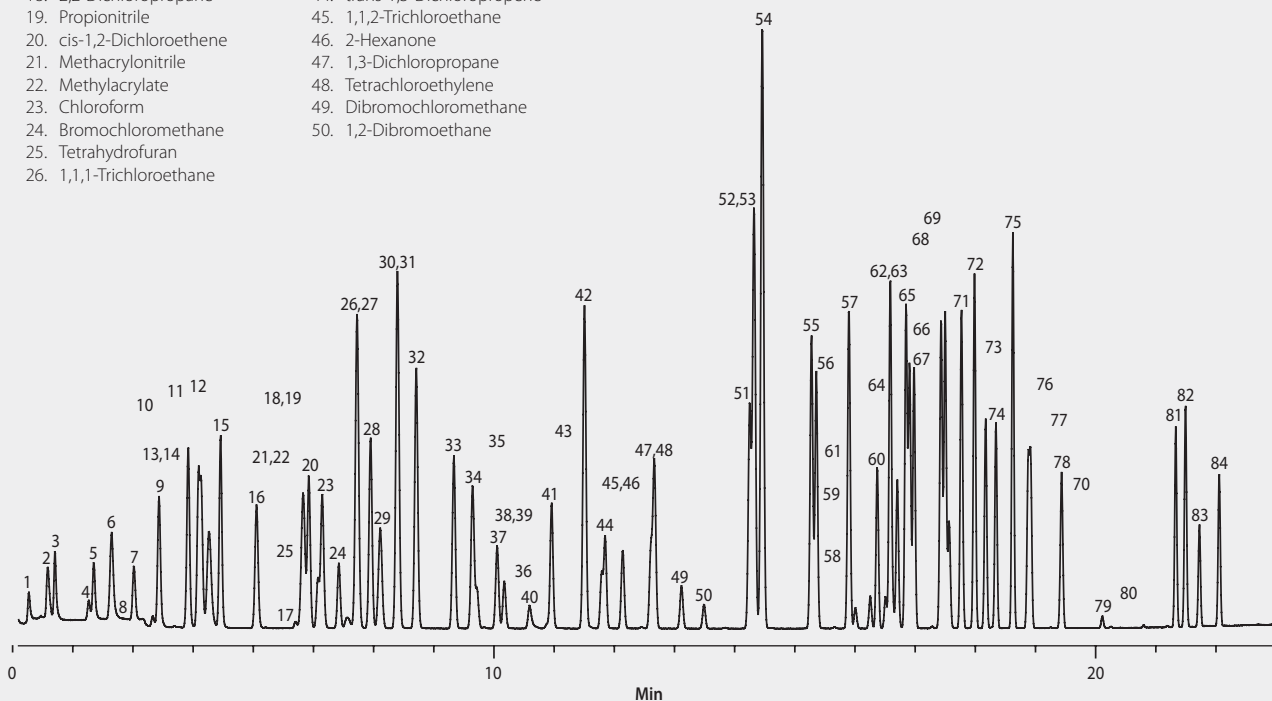
Cat. No.	Description
48799-U	VOC Mix 6 (gases)
502111	EPA 502/524 Volatiles Organic Calibration Mix A (w/o gases)
47358-U	EPA 524 Fortification Solution
48958	EPA 8260 Internal Standards Mix
47778	EPA 8260 Surrogate Standards Mix

For additional standards, visit sigma-aldrich.com/standards

US EPA Method 524: GCMS Analysis of Volatiles on the VOCOL after Purge and Trap Using a "K" Trap

trap: VOCARB® 3000 (24940-U)
 purge time: 11 min.
 purge temp.: 25 °C
 dry purge time: 2 min.
 desorb. preheat: 205 °C
 desorb. temp.: 210 °C (2 min.)
 desorb flow: 24 mL/min.
 bake temp.: 260 °C (10 min.)
 transfer line temp.: 110 °C
 valve temp.: 110 °C
 column: VOCOL®, 30 m x 0.25 mm I.D., 1.5 µm (24205-U)
 inj.: 150 °C
 oven: 40 °C (2 min.), 7 °C/min. to 125 °C, 12°C/min. to 220 °C (5 min.)
 MSD interface: 200 °C
 scan range: m/z = 35-350
 carrier gas: helium, 0.7 mL/min.
 injection: split, 30:1
 liner: 0.75 mm I.D. SPME
 sample: each analyte at 10 ppb in 25 mL of water

- | | | | |
|------------------------------|-------------------------------|----------------------------------|--|
| 1. Dichlorofluoromethane | 27. 1-Chlorobutane | 51. Chlorobenzene | 68. tert-Butylbenzene |
| 2. Chloromethane | 28. 1,1-Dichloropropene | 52. Ethylbenzene | 69. 1,2,4-Trimethylbenzene |
| 3. Vinyl chloride | 29. Carbon tetrachloride | 53. 1,1,1,2-Tetrachloroethane | 70. Pentachloroethane |
| 4. Bromomethane | 30. Benzene | 54. m&p-Xylenes | 71. sec-Butylbenzene |
| 5. Chloroethane | 31. 1,2-Dichloroethane | 55. o-Xylene | 72. p-Isopropyltoluene |
| 6. Trichlorofluoromethane | 32. Fluorobenzene (I.S.) | 56. Styrene | 73. 1,3-Dichlorobenzene |
| 7. Diethyl ether | 33. Trichloroethene | 57. Isopropylbenzene | 74. 1,4-Dichlorobenzene |
| 8. Acetone | 34. 1,2-Dichloropropane | 58. Bromoform | 75. n-Butylbenzene |
| 9. 1,1-Dichloroethene | 35. Methyl methacrylate | 59. 1,1,2,2-Tetrachloroethane | 76. 1,2-Dichlorobenzene-d ₄ (surr.) |
| 10. Allyl chloride | 36. Chloroacetonitrile | 60. 4-Bromofluorobenzene (surr.) | 77. 1,2-Dichlorobenzene |
| 11. Methylene chloride | 37. Bromodichloromethane | 61. 1,2,3-Trichloropropane | 78. Hexachloroethane |
| 12. Carbon disulfide | 38. Dibromomethane | 62. n-Propylbenzene | 79. 1,2-Dibromo-3-chloropropane |
| 13. Acrylonitrile | 39. 2-Nitropropane | 63. trans-1,2-Dichloro-2-butene | 80. Nitrobenzene |
| 14. Methyl-tert-butyl ether | 40. 4-Methyl-2-pentanone | 64. Bromobenzene | 81. 1,2,4-Trichlorobenzene |
| 15. trans-1,2-Dichloroethene | 41. cis-1,3-Dichloropropene | 65. 1,3,5-Trimethylbenzene | 82. Hexachlorobutadiene |
| 16. 1,1-Dichloroethane | 42. Toluene | 66. o-Chlorotoluene | 83. Naphthalene |
| 17. 2-Butanone | 43. Ethyl methacrylate | 67. p-Chlorotoluene | 84. 1,2,3-Trichlorobenzene |
| 18. 2,2-Dichloropropane | 44. trans-1,3-Dichloropropene | | |
| 19. Propionitrile | 45. 1,1,2-Trichloroethane | | |
| 20. cis-1,2-Dichloroethene | 46. 2-Hexanone | | |
| 21. Methacrylonitrile | 47. 1,3-Dichloropropane | | |
| 22. Methylacrylate | 48. Tetrachloroethylene | | |
| 23. Chloroform | 49. Dibromochloromethane | | |
| 24. Bromochloromethane | 50. 1,2-Dibromoethane | | |
| 25. Tetrahydrofuran | | | |
| 26. 1,1,1-Trichloroethane | | | |



COMPONENTS IN FUELS AND OILS FROM ENVIRONMENTAL SAMPLES

Total product line for the analysis of fuels and oils

The analysis of fuels and oils in environmental samples is often referred to by general terms such as "TPH", "VPH", or "DRO/GRO". The specific methods come from several different sources, including the US EPA and state regulatory agencies. Depending on the method used and analytes of interest, the sample may have to be analyzed by solvent extraction/liquid injection, and/or purge and trap. Whatever your specific needs are, we carry many of the supplies you will need; including, capillary columns suitable for VOC analysis, purge traps tailored for specific applications, and ultra-clean purge-and-trap grade methanol.

Relevant Methods: US EPA 8015, 8021 and other State-Specific Methods.

- Purge-and-trap grade methanol
- Purge traps designed to fit a variety of instrumentation
- GC capillary columns for the analysis of BTEX and other VOCs
- Calibration and spiking standards
- Gastight syringes and Mininert valves for sample preparation and storage

Purge and Trap Grade Methanol

Methanol may contain impurities, that when concentrated through purge and trap, can interfere with the GC analysis of VOCs. This grade of methanol is specially tested to ensure low organic background and suitability for use in the analysis of VOCs.

It can be used in the preparation of calibration standards, spiking solutions, and medium level extraction of solid samples.

Cat. No.	Description
414816	Methanol for GC-MS analysis of VOCs, 1 L

For more information, visit sigma-aldrich.com/solvents

Purge Traps

Our purge traps are packed with multiple beds of adsorbent materials for efficient trapping and desorption of a broad range of compounds. Carbon-based traps such as the VOCARB® and BTEX traps contain hydrophobic adsorbents which will allow for shorter and more effective removal of water during a dry purge cycle. In addition, the BTEX line of traps was designed for minimal retention of methanol, making them suitable for the purge and trap analysis of samples containing large amounts of methanol.

- Available in configurations for most purge and trap instruments
- VOCARB purge traps for the efficient management of water, and use with higher desorption temperatures than non-carbon based traps
- BTEX traps specifically designed for management of high levels of methanol
- Modified BTEX traps now available for BTEX applications requiring analysis of MTBE and other lighter VOCs

Cat. No.	Description
21066-U	VOCARB 3000 ("K" Trap), for Tekmar LSC 2000, 4000, and Velocity XPT
21064	BTEXTRAP ("J" Trap), for OI 4460, 4560, and Eclipse
24939	Modified BTEX ("M" Trap), for Tekmar LSC 2000, 4000, and Velocity XPT

For additional purge traps, visit sigma-aldrich.com/sampleprep

Calibration and Spiking Standards

We offer a variety of multi-component standards suitable for analyses related to Underground Storage Tank (UST) remediation, including BTEX, DRO, GRO and TPH.

- BTEX, GRO and DRO mixes
- State specific TPH mixes available as stock items
- Custom mixes available

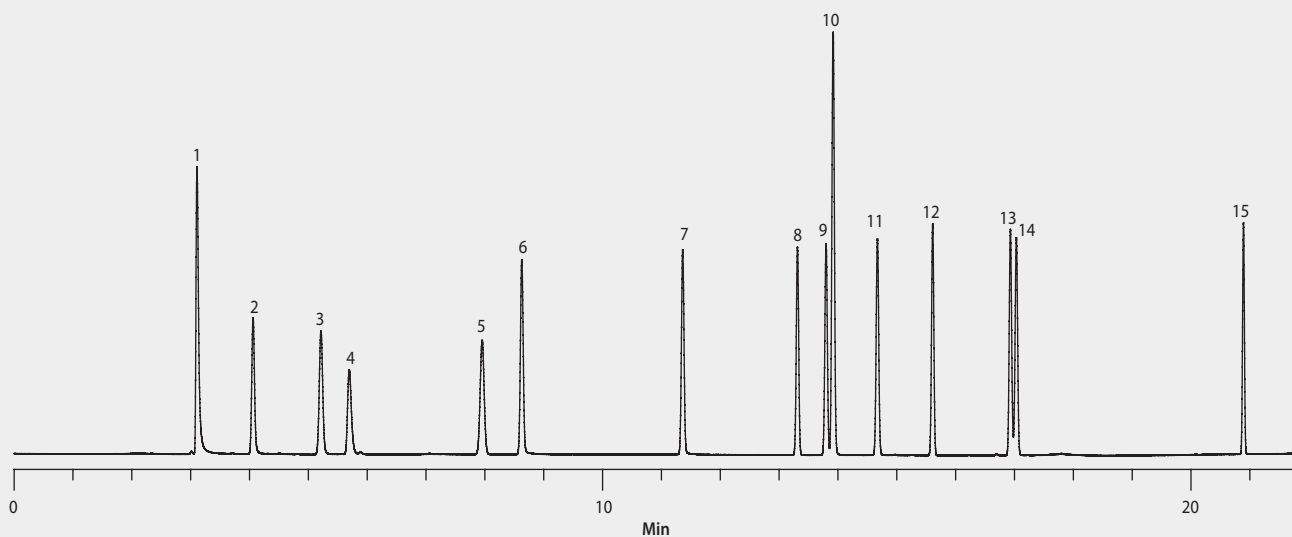
Cat. No.	Description
47993	BTEX Mix, High Conc., 2000 µg/mL in methanol
47505-U	BTEX/MTBE Mix, High Conc., 2000 µg/mL in methanol
48166	Underground Storage Tank (UST) Modified DRO

For additional standards, visit sigma-aldrich.com/standards

Analysis of BTEX and Additional Hydrocarbons by Purge and Trap using the "M" BTEX Trap

trap: Modified BTEX, M trap (20079-U)
purge time: 11 min.
purge temp.: 25 °C
dry purge time: 4 min.
desorb. preheat: 220 °C
desorb. temp.: 225 °C (2 min.)
desorb flow: 40 mL/min.
bake temp.: 260 °C (10 min.)
transfer line temp.: 110 °C
valve temp.: 110 °C
column: VOCOL, 30 m x 0.25 mm I.D., 1.5 µm (24205-U)
oven: 40 °C (2 min.), 7 °C/min. to 125 °C, 12 °C/min. to 220 °C (5 min.)
inj.: 150 °C
det.: FID, 250 °C
carrier gas: helium, 1.0 mL/min.
injection: split, 30:1
liner: 0.75 mm I.D. SPME
sample: each analyte at 50 ppb in 5 mL of water, plus 100 µL methanol

1. Methanol (100 µL spiked in addition to standard)
2. Pentane
3. 2-Methylpentane
4. Methyl-tert butyl ether (MTBE)
5. Isooctane
6. Benzene
7. Toluene
8. Nonane
9. Ethylbenzene
10. m&p-Xylenes
11. o-Xylene
12. Decane
13. 1,2,4-Trimethylbenzene
14. Butylcyclohexane
15. Naphthalene



ORGANOCHLORINE PESTICIDES AND PCBS

Full line of standards, columns, and GC consumables

The analysis of organochlorine pesticides and PCBs by GC-ECD requires the use of inert, low bleed capillary columns, and GC accessories to keep instruments running at peak performance. We can provide you with everything you need; from capillary GC columns to calibration mixes, to perform analysis of pesticides and PCBs by a variety of EPA methodologies.

Relevant Methods: US EPA 508, 608, 8081, 8082

- Specially tested SPB-608 for pesticide analysis
- Calibration standards
- Deactivated liners and other GC accessories
- Autosampler vials and syringes

Solvents for Pesticide Residue Analysis

Highly sensitive detectors such as ECDs require the use of ultra-clean solvents in the preparation of samples and standards. We offer a variety of high-purity solvents, as well as, grades of hexane that are suitable for pesticide residue analysis by GC/ECD.

- Variety of high purity solvents for GC applications
- PESTANAL® solvents tested for suitability with GC/ECD



Cat. No.	Description
34493	Hexane, solvent for residue analysis, PESTANAL
34484	Hexane for pesticide residue analysis, TraceSelect
34499	Isooctane, for pesticide residue analysis, Fluka
20257-U	tert-Butyl methyl ether for residue analysis, Fluka
20256-U	tert-Butyl methyl ether – puriss for GC, Sigma-Aldrich

For more information, visit sigma-aldrich.com/solvents

SPB-608 and Equity®-5

The SPB-608 is specially tested by GC/ECD with low concentrations of chlorinated pesticides. It can be paired with a 5% diphenyl column, such as the Equity-5, for the dual-column analysis of organochlorine pesticides, PCBs, and herbicides

- SPB-608 is specially tested using a mixture of chlorinated pesticides
- Equity-5 is an inert, low bleed, general purpose column
- Both columns suitable for the analysis of pesticides, PCBs and herbicides

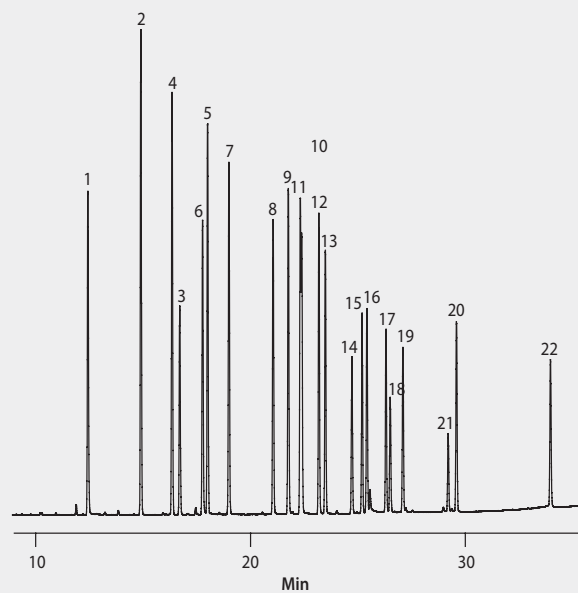
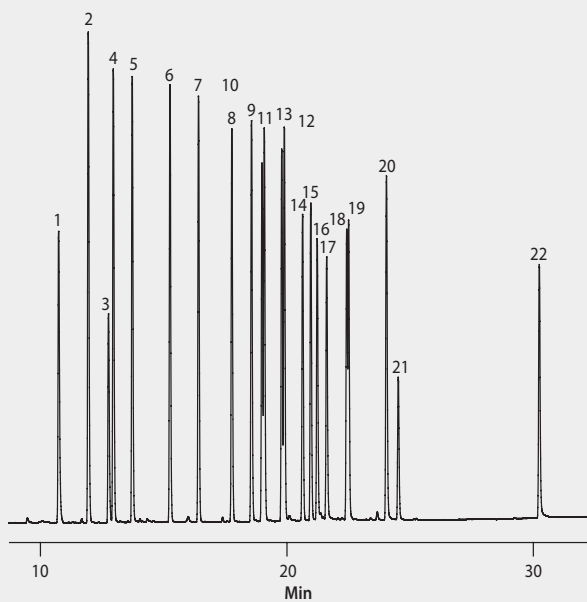
Cat. No.	Description
SPB-608 Capillary Columns	
24103-U	30 m x 0.25 mm I.D., 0.25 µm
25312	30 m x 0.53 mm I.D., 0.50 µm
Equity-5 Capillary Columns	
28089-U	30 m x 0.25 mm I.D., 0.25 µm
28259-U	30 m x 0.53 mm I.D., 0.50 µm

For additional column dimensions, visit sigma-aldrich.com/gc-enviro

Dual-Column Analysis of Organochlorine Pesticides on the SPB-608 and Equity-5

column: Equity-5, 30 m x 0.25 mm ID, 0.25 μ m (28089-U)
column: SPB-608, 30 m x 0.25 mm ID, 0.25 μ m (24103-U)
oven: 100 $^{\circ}$ C (2 min), 15 $^{\circ}$ C/min to 160 $^{\circ}$ C, 5 $^{\circ}$ C/min to 300 $^{\circ}$ C (10 min)
inj.: 225 $^{\circ}$ C
det.: ECD, 310 $^{\circ}$ C
carrier gas: helium, 30 cm/sec @ 100 $^{\circ}$ C
injection: 2.0 μ L, splitless (0.5 min)
liner: 4 mm ID double taper
sample: 50 ppb of a 22-component chlorinated pesticide standard (46845-U)

- | | |
|---|--------------------------------|
| 1. 2,4,5,6-Tetrachloro-m-xylene (surr.) | 12. 4,4'-DDE |
| 2. α -BHC | 13. Dieldrin |
| 3. β -BHC | 14. Endrin |
| 4. γ -BHC | 15. Endosulfan II |
| 5. δ -BHC | 16. 4,4'-DDD |
| 6. Heptachlor | 17. Endrin aldehyde |
| 7. Aldrin | 18. Endosulfan sulfate |
| 8. Heptachlor epoxide | 19. 4,4'-DDT |
| 9. γ -Chlordane | 20. Endrin ketone |
| 10. Endosulfan I | 21. Methoxychlor |
| 11. α -Chlordane | 22. Decachlorobiphenyl (surr.) |



PHARMACEUTICAL AND PERSONAL CARE PRODUCTS (PPCPS) IN WATER

Select products for sample cleanup and analysis

The presence of PPCPs in waste, ground, and drinking water has been an area of much interest in the past few years. The US EPA published Method 1694 "Pharmaceutical and Personal Care Products in Water, Soil, Sediment, and Biosolids by HPLC/MS/MS" in December 2007. For labs doing this method, Sigma-Aldrich Analytical can offer support in the form of HPLC columns, solid phase extraction tubes, solvents, and reagents. Individual pharmaceutical compound standards, some isotopically labeled, are available from Cerilliant, which is now a Sigma-Aldrich company.

Relevant Methods: US EPA 1694

- Supel Select HLB SPE tubes
- Ascentis® Express C18 and HILIC HPLC Columns
- Pharmaceutical Compound Standards available through Cerilliant – a Sigma-Aldrich company

Supel-Select HLB SPE Cartridges

Supel-Select HLB is a hydrophilic modified styrene-based polymer developed for the solid phase extraction of a broad range of compounds from aqueous samples. The phase is also selective for more polar compounds, such as many pharmaceuticals.



- Available in different size SPE cartridges and bedweights and in 96-well plates
- Quality controlled for LC-UV and LC-MS-MS extractables
- Suitable for the extraction of pharmaceutical compounds from water

Cat. No.	Description	Qty.
Supel-Select HLB SPE Cartridge		
54186-U	1 g/20 mL	20
54184-U	500 mg/12 mL	20
54183-U	200 mg/6 mL	30

For more on Supel-Select HLB, visit sigma-aldrich.com/spe

Ascentis Express HPLC Columns

Ascentis Express is a high-speed, high-performance liquid chromatography column based on Fused-Core® particle technology. This allows for faster, more efficient separations, such as those achieved with sub-2 µm columns, but with a large 2.7 µm particle size. This larger particle size allows the Ascentis Express columns to be used in conventional HPLC systems.

Cat. No.	Description
53823-U	Ascentis Express C18, 10 cm x 2.1 mm I.D., 2.7 µm
53939-U	Ascentis Express HILIC, 10 cm x 2.1 mm I.D., 2.7 µm

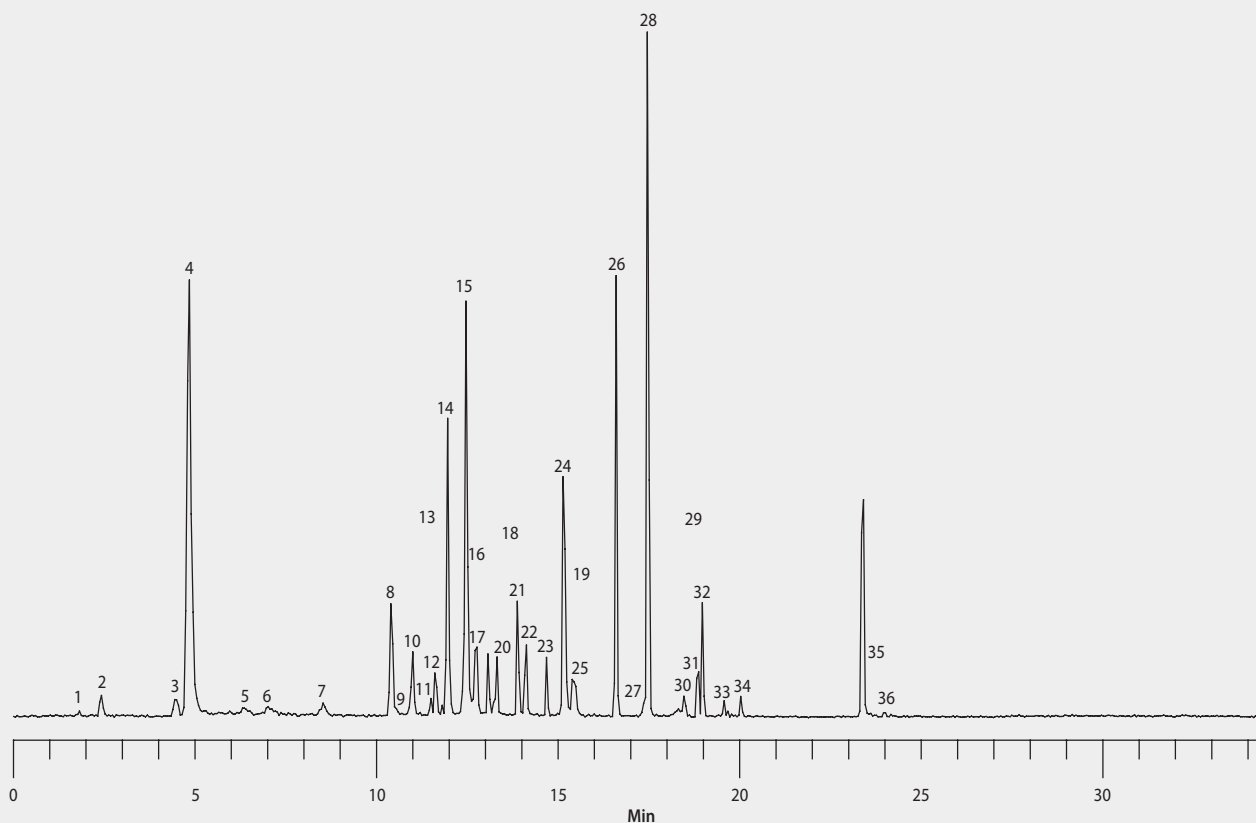
For more information on Ascentis Express HPLC columns, visit sigma-aldrich.com/express

Pharmaceutical Compounds on Ascentis Express C18

column: Ascentis Express C18, 10 cm x 2.1 mm, I.D., 2.7 µm (53823-U)
mobile phase A: 0.1% formic acid and 0.1 % ammonium formate
mobile phase B: 50:50 methanol:acetonitrile
temp: 40 °C
det: ESI (+), MS/MS
injection: 5 µL
sample: CS-5 concentrations from EPA method 1694

gradient:	min	mL/min	% A	% B
	0	0.15	95	5
	4	0.25	95	5
	22.5	0.30	12	88
	23	0.30	0	100
	26	0.30	0	100
	26.5	0.15	95	5

- | | | |
|-----------------------------------|--|---|
| 1. Sulfanilamide | 13. Cefotaxime, Sulfamethiazine | 25. Azithromycin, Sulfadimethoxine |
| 2. Cotinine | 14. Thiabendazole | 26. Acetaminophen, Diphenhydramine |
| 3. Sulfadiazine | 15. Ofloxacin, Ormetoprim, Carbadox | 27. Flumequine |
| 4. 1,7-Dimethylxanthine | 16. Norfloxacin | 28. Carbamazepine, Diltiazem, Oxacillin |
| 5. Sulfathiazole | 17. Ciprofloxacin, Sulfachloropyridazine | 29. Erythromycin, Cloxacillin |
| 6. Codeine | 18. Lomefloxacin | 30. Tylosin, Digoxin |
| 7. Sulfamerazine | 19. Sulfamethoxazole | 31. Dehydronifedipine |
| 8. Caffeine | 20. Enrofloxacin | 32. Erythromycin anhydrate, Fluoxetine |
| 9. Ampicillin | 21. Sarafloxacin, PenicillinV | 33. Virginiamycin |
| 10. Lincomycin | 22. Clinafloxacin | 34. Roxithromycin |
| 11. Sulfamethiazole, Penicillin G | 23. Digoxigenin | 35. Miconazole |
| 12. Trimethoprim | 24. Oxolinic acid | 36. Norgestimate |



OTHER ORGANIC COMPOUNDS IN ENVIRONMENTAL SAMPLES

Featuring products for chlorinated herbicides and polar organics

Sigma-Aldrich has product offerings to help with the sample preparation and analysis of water and solid samples for contaminants not analyzed in the very common methods, such as 8260 and 8270. We have highlighted a few of these methods here, including chlorinated acid herbicides, haloacetic acids, and highly polar organics not suitable for purge and trap.

Chlorinated Herbicides

We offer products for all aspects of the workflow required to analyze samples for chlorinated herbicides, from sample collection containers to GC capillary columns.

Relevant Methods: US EPA 8151, 515.1, 615

- High purity solvents
- Derivatization reagents
- Low bleed, highly inert SLB-5ms for GC/ECD analysis
- Methylated herbicide standards for instrument calibration

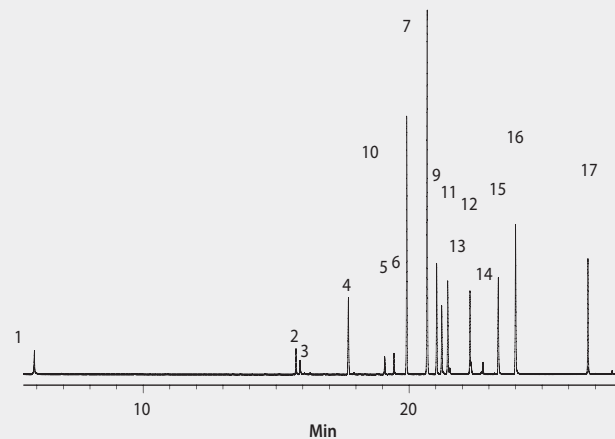
Cat. No.	Description
Z100250	Diazald kit with clear seal joints
D28000	Diazald, 99%
32203	Diethyl Ether, Puriss, ACS Reagent (with BHT inhibitor)
28471-U	SLB-5ms, 30 m x 0.25 mm I.D., 0.25 μ m
48997-U	EPA 8151 Methylated herbicide mix

For additional SLB-5ms column dimensions, standards, and reagents, visit sigma-aldrich.com/analytical

GC Analysis of Method 515.3 Herbicides on SLB-5ms

column: SLB-5ms, 30 m x 0.25 mm I.D., 0.25 μ m (28471-U)
oven: 50 °C (2 min.), 8 °C/min. to 260 °C
inj.: 250 °C
det: μ -ECD, 300 °C
carrier gas: helium, 1 mL/min., constant
injection: 1 μ L, splitless (0.75 min.)
liner: 4 mm I.D., single taper
sample: 100 ppb each in hexane

1. Dalapon
2. 3,5-Dichlorobenzoic acid
3. 4-Nitrophenol
4. Dicamba
5. Dichlorprop
6. 2,4-D
7. 4,4'-Dibromooctafluorobiphenyl (I.S.)
8. Pentachlorophenol
9. 2,4,5-TP
10. Chloramben
11. 2,4,5-T
12. Dinoseb
13. 2,4-DB
14. Bentazon
15. Picloram
16. DCPA
17. Acifluorfen



Haloacetic Acids

We offer high-purity solvents, reagents, standards, and GC columns; everything you need for the analysis of haloacetic acids.

Relevant Methods: US EPA 552

- PRA grade solvents
- Derivatization reagents
- Calibration and spiking mixes.

Cat. No.	Description
34498	tert-Butyl methyl ether, PRA grade
506516	Methanolic H ₂ SO ₄ , 10% v/v
47630-U	EPA 552.2 Methyl Ester Calibration Mix w/Surrogate
47629-U	EPA 552.2 Acids Calibration Mix w/Surrogate

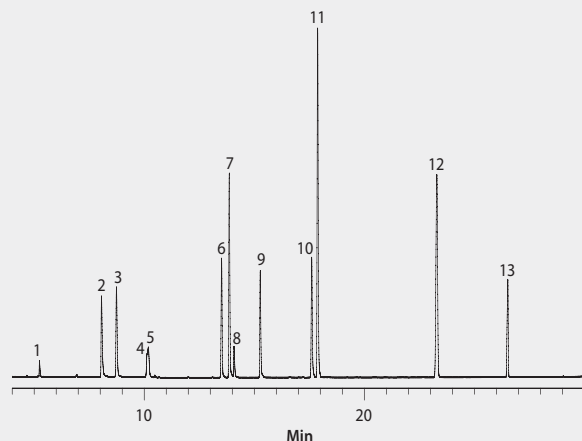
For additional haloacetic acid standards, visit sigma-aldrich.com/standards

GC Analysis of Method 552.3 Haloacetic Acids on SLB-5ms

column: SLB-5ms, 30 m x 0.25 mm I.D., 0.25 µm (28471-U)
oven: 40 °C (10 min.), 5 °C/min. to 75 °C (5 min.), 10 °C/min. to 150 °C (10 min.)
inj.: 200 °C
det.: µ-ECD, 250 °C
carrier gas: helium, 1.3 mL/min., constant
injection: 2 µL, splitless (0.75 min.)
liner: 4 mm I.D., dual taper
sample: 100-1000 ppb in MTBE

(all analyzed as methyl esters except 1,2,3-trichloropropane)

1. Monochloroacetic acid (MCAA), 300 ppb
2. Monobromoacetic acid (MBAA), 200 ppb
3. Dichloroacetic acid (DCAA), 300 ppb
4. 2-Methyl-2-bromopropanoic acid (Surr.- no longer used), 200 ppb
5. Dalapon, 200 ppb
6. Trichloroacetic acid (TCAA), 100 ppb
7. Bromochloroacetic acid (BCAA), 200 ppb
8. 1,2,3-Trichloropropane (I.S.), 1000 ppb
9. 2-Bromobutanoic acid (Surr.- current), 100 ppb
10. Dibromoacetic acid (DBAA), 100 ppb
11. Bromodichloroacetic acid (BDCAA), 200 ppb
12. Chlorodibromoacetic acid (CDBAA), 200 ppb
13. Tribromoacetic acid (TBAA), 100 ppb



Other Polar Organics in Water

We offer a unique carbon based sorbent, ENVI-Carb™ Plus, capable of retaining small, highly polar organics from water. ENVI-Carb can be used for the extraction of 1,4-dioxane and glycols from waters.

We also offer other products useful in the analysis of these compounds, including GC columns and high purity solvents.

Relevant Methods: US EPA 522, 8015, 1671

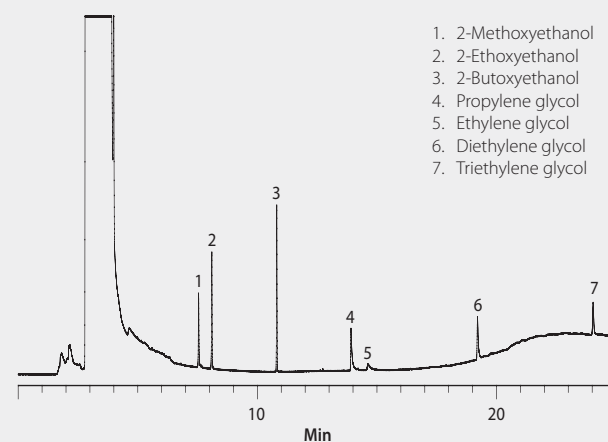
- Supelclean™ ENVI-Carb Plus cartridges for extraction of small, highly polar molecules from water
- SPB-1000 capillary column developed for the analysis of glycols
- Purge and trap grade methanol for the analysis of 1,4-dioxane by US EPA Method 522

Cat. No.	Description
54812-U	ENVI-Carb Plus, 400 mg/1mL reversible cartridge
24313	SPB-1000 capillary column, 30 m x 0.25 mm I.D., 0.25 µm
414816-1L	Methanol for GC-MS analysis of VOCs, 1 L

For more on ENVI-Carb Plus, visit sigma-aldrich.com/spe

Extraction and GC Analysis of Glycols in Water

sample/matrix: tap water spiked at 2 µg/mL with glycols
SPE tube: ENVI-Carb Plus reversible cartridge, 400 mg/1 mL (54812-U)
conditioning: 1 mL methylene chloride, 2 x 2 mL methanol, 3 mL dei. water (do not allow cartridge to dry during conditioning)
sample addition: 5 mL spiked tap water
drying: 10 min, 10 mm Hg
elution: 2 mL 80:20 methanol:methylene chloride
column: SPB-1000, 30 m x 0.25 mm I.D. x 0.25 µm (24313)
oven: 50 °C (1 min.), 8 °C/min. to 200 °C (7 min.)
inj.: 220 °C
det.: FID, 220 °C
carrier gas: helium, 1.5 mL/min constant flow
injection: 1 µL, splitless (splitter open at 0.75 min.)
liner: 4 mm I.D. FocusLiner™ with taper



1. 2-Methoxyethanol
2. 2-Ethoxyethanol
3. 2-Butoxyethanol
4. Propylene glycol
5. Ethylene glycol
6. Diethylene glycol
7. Triethylene glycol

INORGANIC TRACE ANALYSIS

Metals, including mercury and hexavalent chromium

Fluka offers an extensive line of high-quality products for inorganic trace analysis. All products are designed to meet the demanding requirements of AAS, ICP-OES/MS, and IC.

- TraceSELECT® Ultra High-Purity Reagents: For sample digestion by various methodologies
- TraceCERT® inorganic CRMs: For metals analysis by EPA methodologies and Standard Methods

Relevant US Methods: EPA SW-846 (solid waste and ground water); EPA 7000 series (AAS); EPA 6000 series (ICP); EPA 200 series (mostly AAS, 200.7 for ICP); Standard methods: 3000 series (AAS) and 3120 (ICP)

To view our complete offering for inorganic and organic trace analysis, visit sigma-aldrich.com/traceanalysis

TraceSELECT Ultra High-Purity Reagents

For sample preparation for ultra low blank values

- Low blank values for ultra-trace analysis at ppb and ppt levels
- Clear and transparent specifications and certificates of analysis (60-70+ traces specified)
- Guaranteed long term stability due to improved filling and packaging processes (PFA or HDPE bottles)



Cat. No.	Description
02650	Nitric acid ≥65%, TraceSELECT Ultra
96208	Hydrochloric acid ≥30%, TraceSELECT Ultra
16911	Hydrogen peroxide ≥30%, TraceSELECT Ultra

For more information, visit sigma-aldrich.com/traceselect

TraceCERT Certified Reference Materials

For instrument calibration and process validation in spectroscopy and ion chromatography.

- Highest-purity starting materials available
- Superior (Swiss metrological) level of accuracy, very low uncertainties, and lot-specific values
- Traceability to at least two independent references (i.e. NIST, BAM, or SI unit kg)
- Production according to ISO/IEC 17025 and ISO Guide 34
- Comprehensive documentation (certification according to ISO Guide 31), certificates of ICP standards list up to 70 trace impurities
- ICP standards packaged in light- and gas-tight aluminum foil bags (for extended stability)



For TraceCERT inorganic custom standards, visit sigma-aldrich.com/csp

For more information on TraceCERT, visit sigma-aldrich.com/tracecert

PRODUCTS FOR ENVIRONMENTAL ANALYSIS

Innovative accessories and separation devices for many methods

In addition to many method or analyte-specific standards and separation consumables, Sigma-Aldrich® offers products for general environmental sampling and analysis.

Solid Phase Microextraction (SPME)

SPME is an innovative, solvent-free sample prep technology that is fast, economical, and versatile. The SPME fiber is inserted directly into the chromatograph or mass spec for desorption and analysis. SPME is used for sampling in liquids (direct immersion) or headspace.

- Solvent-free sample prep
- Used as a screening tool (e.g. TWA for VOC)
- For analysis by GC, HPLC, or direct DESI-MS

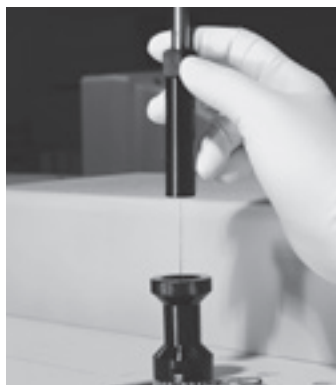
For more information, visit sigma-aldrich.com/spme

Vials for Mass Spectrometry

Use our inert and contaminant-free vials to eliminate interferences and sample loss in sensitive MS analyses. Many different designs for all autosamplers are available.

- Low Adsorption (LA) Vials improve quantitation, minimize pH shifts
- Certified Vials eliminate fit and septa contamination issues
- Center Draining (CD™) Vials unique conical interior bottom that allows the contents to completely drain to the center of the vial
- Certified QSert Vial™s at 300 µL are the ultimate microsampling device

For more information, visit sigma-aldrich.com/ms-vials



GASTIGHT Syringes



GASTIGHT syringes are particularly well-suited for VOC analysis. We offer both Hamilton and SGE syringes from 1 µL to 100 mL with many differentiating features.

- Maximum inertness for liquid or gas samples
- High accuracy of dispensed volume
- Wide variety of terminations and valves

For more information, visit sigma-aldrich.com/syringes

GC Inlet Liners: FocusLiners



Inlet liners serve an important role: They help ensure accurate and efficient delivery of the sample to the GC column with minimal loss from adsorption. FocusLiners™ incorporate a unique design that prevents shifting of the wool plug during repeated injections or sudden inlet pressure changes.

- Stabilized wool plug
- Provides maximum sensitivity and improved detection levels
- Part of our complete line of GC accessories

Cat. No.	Product Description
2879901-U	Split/Splitless FocusLiner with taper, for Agilent® GC, 4 mm ID
2877001-U	Split/Splitless FocusLiner (no taper), for Thermoquest 8000 and TRACE™ GC, 5 mm ID
2879501-U	Split/Splitless FAST FocusLiner with taper, for Agilent GC, 2 mm ID

For more information, visit sigma-aldrich.com/gc

CUSTOM SERVICES



A wide range of custom product and service options is available to meet the unique needs often encountered in the environmental field.

If you want to discuss a specific custom request and obtain a quote on price and delivery, contact a Technical Service Specialist at techserv@sial.com.

GLASSWARE SERVICES

Glassware fabrication, repair, and silanization services that can save you time and money

Custom Fabrication

We specialize in one-of-a-kind pieces and unusual glassware requests to meet customer-specific needs. All we require is a dimensional drawing or sketch, and details of any special design requirements. From that we can prepare a custom quote to get you exactly what you need.

Glassware Repairs

Why purchase new glassware when our staff of experienced glassblowers can often repair that expensive piece of broken glassware. You can save as much as 75% compared to the cost of a new purchase. There is no charge to have us examine your broken glassware items to see if they can be repaired; just pay return postage if you decide not to proceed.

Glassware Silanization

We offer deactivation treatment for all of your glassware, vials, and other glass storage containers. High concentrations of silanol groups (Si-O-H) on untreated glass surfaces can catalyze decomposition of unstable compounds or adsorb polar compounds through hydrogen bonding. This can reduce recoveries and result in the formation of unwanted decomposition by-products. Our silanization process creates a more inert glass surface that eliminates many of these issues. If you wish, we can even provide a certificate of treatment.

CUSTOM CHEMICAL STANDARDS

We can formulate analytical chemical standards specifically tailored to meet your unique applications. With over 25 years of experience manufacturing environmental standards, and an inventory of over 2300 raw materials, chances are we can formulate a mixture in the solvent, concentration and/or package size needed to meet your project needs. Our custom standards group provides:

- Material Safety Data Sheet (MSDS) for every product shipped
- A variety of packaging options
- Quality Control options designed to meet your needs and budget:
 - Gravimetric assurance (routine, at no charge)
 - Qualitative testing (optional)
 - Quantitative testing (optional)

CUSTOM PREPARED HPLC COLUMNS

If the column of your choice is not listed as a stock product in our catalog or website, Supelco may be able to prepare it for you on a custom basis. All columns are tested for efficiency and symmetry. Special test criteria options may also be available.

CUSTOM PREPARED SPE TUBES

Our custom manufacturing services allow you to optimize to the parameters dictated by your sample prep objectives. If there is a certain permutation of phase chemistry, bed weight or hardware configuration you require that is not listed within our standard product line, please inquire. An array of sorbents, resins and hardware configurations including polypropylene tubes, glass tubes, 96-well plates, Büchner funnels, and various positive pressure cartridges are available.



CUSTOM PREPARED GC CAPILLARY COLUMNS

Supelco has been manufacturing fused silica capillary GC columns since 1982. We have the ability to manufacture to various lengths, phase thicknesses, and coil options to meet your specific needs.

CUSTOM PREPARED GC PACKED COLUMNS

Supelco has manufactured packed GC columns and components since 1966. Our unsurpassed knowledge of packed GC, and our unrivaled product offering, is why Supelco Analytical is the world's leading supplier of packed GC columns and components. We have the ability to prepare custom metal and glass columns using our vast selection of packings, stationary phases, and supports, configured to fit many commonly used instruments.

CUSTOM AIR SAMPLING DEVICES FOR SOLVENT AND THERMAL DESORPTION

If your cartridge or tube is not featured as a standard product, we may be able to make it for you on a custom basis. You select your tube dimensions - glass or stainless steel, retaining plugs, and adsorbents. If you're not sure what is the best adsorbent configuration for your application, please contact our technical service department for assistance.

PROFICIENCY TESTING (PT)

Sigma-Aldrich RTC provides proficiency testing for water supply, water pollution, Resource Conservation and Recovery Act, and Discharge Monitoring Report-Quality Assurance. RTC has been producing environmental LPTP for more than 20 years and regularly sends out more than 20,000 PT samples a year to over 2,500 participants throughout the world. These PT studies are ACLASS accredited, producing accredited NELAC Proficiency Tests to the relevant sections of ISO 17025 and ISO 17043. RTC also has a registered ISO9001:2008 quality system.

Proficiency Testing Subcategories:

- DMRQA
- Microbiological
- Pharmaceutical
- Solids/Soils Hazardous Waste PTs
- Underground Storage Tank (UST)
- Water Pollution/Waste Water
- Water Supply/Drinking Water

Sigma-Aldrich® Worldwide Offices

Argentina

Free Tel: 0810 888 7446
Tel: (+54) 11 4556 1472
Fax: (+54) 11 4552 1698

Australia

Free Tel: 1800 800 097
Free Fax: 1800 800 096
Tel: (+61) 2 9841 0555
Fax: (+61) 2 9841 0500

Austria

Tel: (+43) 1 605 81 10
Fax: (+43) 1 605 81 20

Belgium

Tel: (+32) 3 899 13 01
Fax: (+32) 3 899 13 11

Brazil

Free Tel: 0800 701 7425
Tel: (+55) 11 3732 3100
Fax: (+55) 11 5522 9895

Canada

Free Tel: 1800 565 1400
Free Fax: 1800 265 3858
Tel: (+1) 905 829 9500
Fax: (+1) 905 829 9292

Chile

Tel: (+56) 2 495 7395
Fax: (+56) 2 495 7396

People's Republic of China

Free Tel: 800 819 3336
Tel: (+86) 21 6141 5566
Fax: (+86) 21 6141 5567

Czech Republic

Tel: (+420) 246 003 200
Fax: (+420) 246 003 291

Denmark

Tel: (+45) 43 56 59 00
Fax: (+45) 43 56 59 05

Finland

Tel: (+358) 9 350 9250
Fax: (+358) 9 350 9255

France

Free Tel: 0800 211 408
Free Fax: 0800 031 052
Tel: (+33) 474 82 28 88
Fax: (+33) 474 95 68 08

Germany

Free Tel: 0800 51 55 000
Free Fax: 0800 64 90 000
Tel: (+49) 89 6513 0
Fax: (+49) 89 6513 1169

Hungary

Tel: (+36) 1 235 9055
Fax: (+36) 1 235 9068

India

Telephone

Bangalore: (+91) 80 6621 9400
New Delhi: (+91) 11 4358 8000
Mumbai: (+91) 22 4087 2364
Pune: (+91) 20 4146 4700
Hyderabad: (+91) 40 3067 7450
Kolkata: (+91) 33 4013 8000

Fax

Bangalore: (+91) 80 6621 9550
New Delhi: (+91) 11 4358 8001
Mumbai: (+91) 22 2579 7589
Pune: (+91) 20 4146 4777
Hyderabad: (+91) 40 3067 7451
Kolkata: (+91) 33 4013 8016

Ireland

Free Tel: 1800 200 888
Free Fax: 1800 600 222
Tel: +353 (0) 402 20370
Fax: +353 (0) 402 20375

Israel

Free Tel: 1 800 70 2222
Tel: (+972) 8 948 4222
Fax: (+972) 8 948 4200

Italy

Free Tel: 800 827 018
Tel: (+39) 02 3341 7310
Fax: (+39) 02 3801 0737

Japan

Tel: (+81) 3 5796 7300
Fax: (+81) 3 5796 7315

Korea

Free Tel: (+82) 80 023 7111
Free Fax: (+82) 80 023 8111
Tel: (+82) 31 329 9000
Fax: (+82) 31 329 9090

Luxembourg

Tel: (+32) 3 899 1301
Fax: (+32) 3 899 1311

Malaysia

Tel: (+60) 3 5635 3321
Fax: (+60) 3 5635 4116

Mexico

Free Tel: 01 800 007 5300
Free Fax: 01 800 712 9920
Tel: (+52) 722 276 1600
Fax: (+52) 722 276 1601

The Netherlands

Tel: (+31) 78 620 5411
Fax: (+31) 78 620 5421

New Zealand

Free Tel: 0800 936 666
Free Fax: 0800 937 777
Tel: (+61) 2 9841 0555
Fax: (+61) 2 9841 0500

Norway

Tel: (+47) 23 17 60 00
Fax: (+47) 23 17 60 10

Poland

Tel: (+48) 61 829 01 00
Fax: (+48) 61 829 01 20

Portugal

Free Tel: 800 202 180
Free Fax: 800 202 178
Tel: (+351) 21 924 2555
Fax: (+351) 21 924 2610

Russia

Tel: (+7) 495 621 5828
Fax: (+7) 495 621 6037

Singapore

Tel: (+65) 6779 1200
Fax: (+65) 6779 1822

Slovakia

Tel: (+421) 255 571 562
Fax: (+421) 255 571 564

South Africa

Free Tel: 0800 1100 75
Free Fax: 0800 1100 79
Tel: (+27) 11 979 1188
Fax: (+27) 11 979 1119

Spain

Free Tel: 900 101 376
Free Fax: 900 102 028
Tel: (+34) 91 661 99 77
Fax: (+34) 91 661 96 42

Sweden

Tel: (+46) 8 742 4200
Fax: (+46) 8 742 4243

Switzerland

Free Tel: 0800 80 00 80
Free Fax: 0800 80 00 81
Tel: (+41) 81 755 2511
Fax: (+41) 81 756 5449

Thailand

Tel: (+66) 2 126 8141
Fax: (+66) 2 126 8080

United Kingdom

Free Tel: 0800 717 181
Free Fax: 0800 378 785
Tel: (+44) 01747 833 000
Fax: (+44) 01747 833 574

United States

Toll-Free: 800 325 3010
Toll-Free Fax: 800 325 5052
Tel: (+1) 314 771 5765
Fax: (+1) 314 771 5757

Vietnam

Tel: (+84) 8 3516 2810
Fax: (+84) 8 6258 4238

Internet

sigma-aldrich.com

*Enabling Science to
Improve the Quality of Life*

Order/Customer Service: sigma-aldrich.com/order
Technical Service: sigma-aldrich.com/techservice
Development/Custom Manufacturing Inquiries **SAFC®** safcglobal@sial.com
Safety-related Information: sigma-aldrich.com/safetycenter

World Headquarters
3050 Spruce St.
St. Louis, MO 63103
(314) 771-5765
sigma-aldrich.com

©2014 Sigma-Aldrich Co. LLC. All rights reserved. SIGMA, SAFC, SIGMA-ALDRICH and SUPELCO are trademarks of Sigma-Aldrich Co. LLC, registered in the US and other countries. Solutions within is a trademark of Sigma-Aldrich Co. LLC. radiello is a registered trademark of Fondazione Salvatore Maugeri. Swagelok is a registered trademark of Swagelok Co. PerkinElmer is a registered trademark of PerkinElmer, Inc. Tedlar is a registered trademark of E.I. duPont de Nemours & Company. GERSTEL is a registered trademark of Gerstel GmbH & Co. Shimadzu is a registered trademark of Shimadzu Corp. Chromosorb is a registered trademark of Celite Corp. Porapak is a registered trademark of Waters & Associates, Inc. HayeSep is a registered trademark of Hayes Separation, Inc. Tenax is a registered trademark of Buchem B.V. Amberlite and XAD are registered trademarks of The Dow Chemical Company. Florisil is a registered trademark of U.S. Silica Company. Miniret is a registered trademark of Valco Instruments Co., Inc. Gastight is a registered trademark of Hamilton Co. Fused-Core is a registered trademark of Advanced Materials Technology, Inc. Agilent is a registered trademark of Agilent Technologies. CarboSieve, Carbotrap, Carboxen, SUPELCOWAX, Equity, SLB, Ascendis, SPB, CHROMASOLV, Fluka, TraceCERT, VOCOL, VOCARB, PESTANAL and TraceSELECT are registered trademarks of Sigma-Aldrich Co. LLC. Dynatherm is a trademark of CDS Analytical. Porapak is a trademark of Waters & Associates, Inc. CD is a trademark of QIS, Inc. FocusLiner is a trademark of SGE Analytical Science Pty. Ltd. Qsirt Vial is a trademark of AR Corp. Mini-Buck is a trademark of A.P. Buck Co. TRACE is a trademark of Thermo Fisher Scientific. ASSET, ORBO, Rezorian, Supel, TDS®, CarboPack, Supelpak, Supelclean, ENVI and ENVI-Carb are trademarks of Sigma-Aldrich Co. LLC. Supelco brand products are sold through Sigma-Aldrich, Inc. Purchaser must determine the suitability of the product(s) for their particular use. Additional terms and conditions may apply. Please see product information on the Sigma-Aldrich website at www.sigmaaldrich.com and/or on the reverse side of the invoice or packing slip.

OJI
82110
1054