

Thermo Scientific Dionex SoEx SPE Cartridges

The Thermo Scientific™ Dionex™ SoEx™ Solid-Phase Extraction (SPE) Cartridge line of sample pretreatment products includes silica-based and polymeric-based stationary phase chemistries in barrel, disposable cartridge format.



The barrel-format cartridges are designed for compatibility with the Thermo Scientific™ Dionex™ AutoTrace™ 280 SPE instrument for large sample volume applications as well as small-volume applications with vacuum SPE manifolds. Solid-phase extraction (SPE) is a widely used sample preparation method for the concentration of pesticides, herbicides, hydrocarbons, and other organic contaminants from aqueous samples. The Dionex AutoTrace 280 SPE instrument is a high-throughput workstation dedicated specifically for automating SPE with demonstrated use for U.S. EPA methods 505, 506, 507, 521, 525.2, 525.3, 535, 547, 608,625, 1613, 1664, and 1694. The Dionex AutoTrace 280 SPE instrument automates cartridge or disk conditioning, sample loading, rinsing, and eluting steps for large volume aqueous solution extractions (20 mL to 4 L). The unit can process up to six samples in parallel, automatically conditioning, washing, and eluting SPE cartridges or disks with a choice of up to five reagents. The unit also segregates aqueous and solvent waste using separate waste lines for efficient, cost effective waste handling.

The Dionex SoEx SPE line of barrel-format sample pretreatment cartridges are designed for compatibility with the Dionex AutoTrace 280 SPE instrument for large sample volume applications. Large sample volumes are necessary when the required detection limits of the targets are below that achieved by direct injection or the pre-concentration of less than about 20 mLs of sample. The barrel cartridges have luer-slip outlets that are compatible with the 1 mL, 3 mL and 6 mL volumes plunger assembly of the Dionex AutoTrace 280 SPE instrument and include silica-based and polymeric-based stationary phase chemistries.

Table 1. Summary of the Dionex SolEx SPE cartridge product line with associated chemistries and recommended applications.

Cartridge Type	Format	Functional Group	Example Applications
HRPHS	3, 6 mL barrels	Divinylbenzene (DVB)/ polyvinylpyrrolidone (PVP, high molecular weight)	General reversed phase, polyphenolics, azo compounds
SAX	3, 6 mL barrels	DVB-quaternary ammonium	Ionizable (weak) anions, carboxylic acids
SCX	3, 6 mL barrels	DVB-sulfonate	Ionizable (weak) cations, amines
WAX	3, 6 mL barrels	DVB-amine	Permanent anions, inorganic and organic, sulfonates, sulfates
WCX	3, 6 mL barrels	DVB-carboxylate	Permanent cations, inorganic and organic, quaternary ammonium
HRP	Online cartridge and RSLC column	DVB-PVP (low)	General neutral organics
C8, C18	1, 3, 6 mL barrels	Bonded silica	Pesticides, herbicides, hydrocarbons
Phthalate-free C8, C18	6 mL barrel	Bonded silica	Trace analysis
Silica	6 mL barrel	Acid-washed unbonded silica	Polar compounds
Activated Carbon	6 mL barrel	Charcoal	Nitrosamines, 1,4-dioxane
Graphitized Carbon	6 mL barrel	Graphitized carbon particles	Herbicides

The decision to choose polymeric or silica-based stationary phase products for SPE is generally guided by pH requirements and relative retention of targets and matrix on the phase. Bonded silica products have a safe operating range generally pH 3–8. The bonded silica phases are generally non-aromatic which means that highly aromatic targets can be more easily eluted with organic solvents. Highly polar targets are generally not well-retained and selectivity among species containing aromatic rings can be limited. These silica phases are generally not mixed-mode.

Polymeric stationary phases have a useful pH range of 0–14. The substrate particles in the polymeric Dionex SolEx SPE cartridge products are based on divinylbenzene and therefore afford retention via adsorption and pi-pi interactions in addition to the surface graft functionality, as reflected in the product name. Dionex SolEx SPE cartridges are offered in three forms: silica-based, which includes various C8 and C18 chemistries and unbonded silica; carbon-based, which includes activated carbon (charcoal) and graphitized carbon; and polymeric stationary phases.

Silica-Based SPE Cartridges

Regular C8 and C18 SPE Cartridges

The 1 mL cartridges contain 0.1 g of packing; the 3 mL cartridges contain 0.5 g of packing; and the 6 mL cartridges contain 1 g of packing. The C18 material is available as endcapped or uncapped silica to provide the selectivity required by various applications. The C8 and C18 chemistries are two of the most commonly used sorbent types for off-line SPE and are used for concentration of pesticides, herbicides, hydrocarbons, and other organic contaminants from water as approved by the U.S. EPA.

Phthalate-Free C8 and C18 SPE Cartridges

Phthalate-free SPE cartridges can be used for extraction of pesticides from water, and are excellent for trace analysis. They are available in C18 and C8 functionalities in a 6 mL cartridge. The C18 cartridges have 1 g of packing and the C8 cartridges have 0.5 g of packing. These have the same specifications as the standard C8 and C18 cartridges, except they feature Teflon® frits and are packed in mylar bags to minimize phthalate contamination.

C18 SPE Cartridges for EPA Method 525.2

These SPE cartridges are designed specifically for extraction of semivolatiles from drinking water (US EPA Method 525.2). These C18 cartridges are available in a 6 mL cartridge and have 1.5 g of packing.

Unbonded Silica (Acid Washed) SPE Cartridges

The unbonded silica SPE cartridges can be used to remove polar impurities and purify polar compounds. They are available in 6 mL cartridges with 0.5 g of packing.

Carbon-Based SPE Cartridges

Activated Carbon (Charcoal) SPE Cartridges for EPA Methods 521 and 522

The activated carbon or charcoal SPE cartridges can be used for the extraction of nitrosamines in drinking water (U.S. EPA Method 521) and for extraction of 1,4-dioxane in drinking water (US EPA Method 522). They are available in 6 mL cartridges with 2 g of packing.

Graphitized Carbon SPE Cartridges for EPA Method 535

The graphitized carbon SPE cartridges can be used for the extraction of herbicides from drinking water (EPA Method 535). They are available in 6 mL cartridges with 0.5 g of packing.

Polymer-Based SPE Cartridges

The polymeric stationary phases are built on a new, high-capacity base particle, with a narrow size distribution yielding high efficiency with low backpressure.

SAX SPE Cartridges

The SAX stationary phase is comprised of a 22 μm high surface area divinylbenzene resin particle grafted with an aromatic quaternary ammonium functionality. The ion-exchange capacity is 900 $\mu\text{Eq/g}$ and the sites bear a permanent charge. This phase is recommended for the SPE of weak acid anions such as carboxylates. The phase is conditioned to a pH at which the target analytes are charged (about 2 pH units above the pKa). The sample is loaded, the phase washed, and the targets are eluted with solvent and at the pH about 2 pH units below the pKa. The target analytes are eluted as neutral species by reversed phase.

WAX SPE Cartridges

The WAX stationary phase is comprised of a 22 μm medium surface area divinylbenzene resin particle grafted with an amine functionality. The ion-exchange capacity is about 1200 $\mu\text{Eq/g}$. This phase is mixed mode reversed phase and anion exchange. Strong acids are retained at low pH where the amine sites on the resin are charged and therefore capable of ion-exchange, and eluted raising the pH and therefore neutralizing the stationary phase. This is the common methodology when the target species are permanently (strongly) charged anions such as sulfonates.

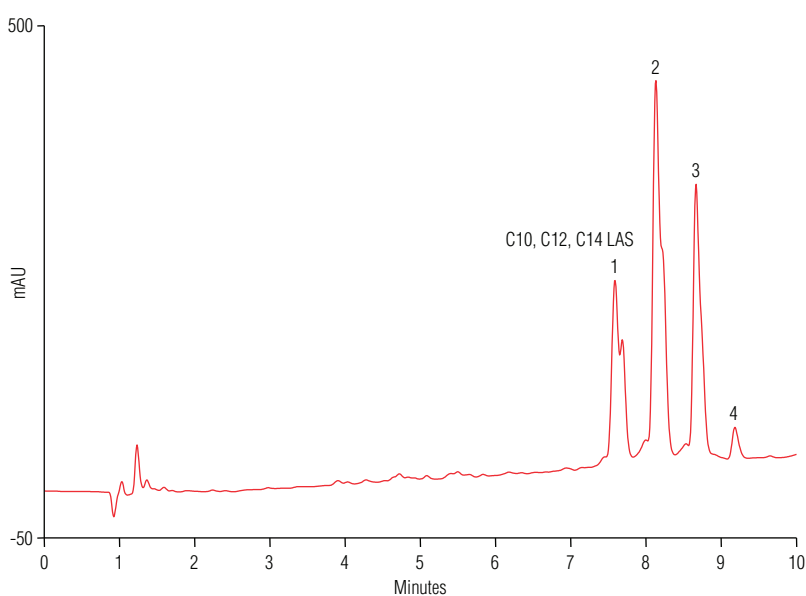


Figure 1. Determination of LAS by chain length after pre-concentration from wastewater using Dionex SolEx WAX SPE cartridge with the Dionex AutoTrace 280 SPE instrument.

SCX SPE Cartridges

The SCX stationary phase is comprised of a 22 μm high surface area divinylbenzene resin particle grafted with aromatic sulfonic acid groups. The ion-exchange capacity is 700 $\mu\text{Eq/g}$ and the phase is mixed mode with both reversed phase and cation exchange functionality. This phase is recommended for the SPE of weak cations such as weak base amines. The strong cation exchange (SCX) phase bears sulfonate (SO_3^-) sites which means it can exchange cations down to a pH <1.

WCX SPE Cartridges

The WCX stationary phase is comprised of a 22 μm medium surface area divinylbenzene resin particle grafted with carboxylate functional groups. The ion-exchange capacity is 1000 $\mu\text{Eq/g}$ and the pK_a of the weak acid sites is about 4. This phase is recommended for the solid phase extraction of strong (permanently charged) cations such as quaternary ammonium compounds. The phase is conditioned at pH 8 or higher. The phase is washed and the targets are eluted by protonating the stationary phase to carboxylic acid (neutral) thus eliminating the ion-exchange retention mechanism. For some applications recoveries can be improved by adding a Soak-to-Elute step before the Elute step in the method. The resin is shipped in the ammonium acetate form. In contrast to the SCX, the weak cation exchange (WCX) phase bears carboxylate sites which have $\text{pK}_a \sim 4$. This means that the WCX phase is neutral and will not hold cations at $\text{pH} < 3$. Of course, a weak ion-exchange site is 95% charged about 2 pH units from the pK_a , so there is some capacity in the proximity of the pK_a .

The ion-exchange phases are characterized by their ion-exchange capacities, which allow the calculation of how much sample can be held on the phase. For example, if a phase contains 1000 $\mu\text{Eq/g}$ of capacity and the cartridge contains 100 mg of resin, then the cartridge contains 100 μEq of capacity. If a sample contains 500 $\mu\text{g/mL}$ of sodium, for example, the question might be, how many milliliters of sample can be loaded on the cartridge before the resin bed is consumed. 50 $\mu\text{g/mL}$ sodium is 2.2 $\mu\text{Eq/mL}$, so the 100 μEq cartridge capacity / 2.2 $\mu\text{Eq/mL}$ sample matrix concentration = 45 mL sample can be processed.

Hydrophilic Reversed Phase Resin (HRPHS) SPE Cartridges

The HRPHS stationary phase is a neutral resin comprised of a 22 μm , high-surface area divinylbenzene base particle grafted with polyvinylpyrrolidone polymer. This material has properties of a hydrophilic reversed phase material and also has specific high-capacity for polyphenolics including humic acids, and azo-containing substances such as azo-dyes. The hydrophilic reversed phase properties allow high recovery of hydrophobic targets.

Military installations and armament manufacturers have experienced closures for the last several years due to the non-proliferation treaties and disarmament agreements. These closures have resulted in munitions being disposed off through combustion, thus causing major environmental problems in the soil and groundwater quality. Surrounding land and groundwater have been found to be laden with explosive residues such as 2, 4, 6-trinitrotoluene (TNT) and associated nitroamine impurities. Figure 3 shows the separation of 14 explosives that are currently a health concern.

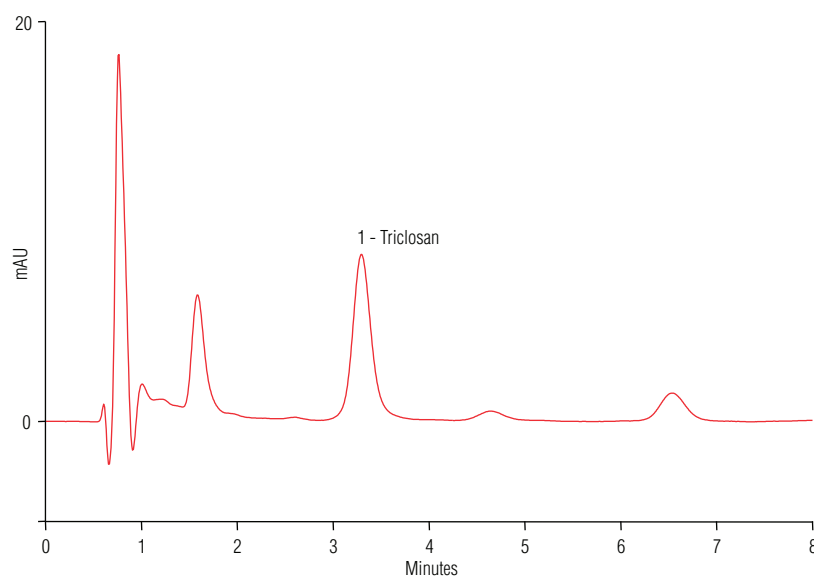


Figure 2. Determination of triclosan in Sunnyvale, CA tap water after pre-concentration using Dionex SolEx HRPHS SPE cartridges with the Dionex AutoTrace 280 SPE instrument.

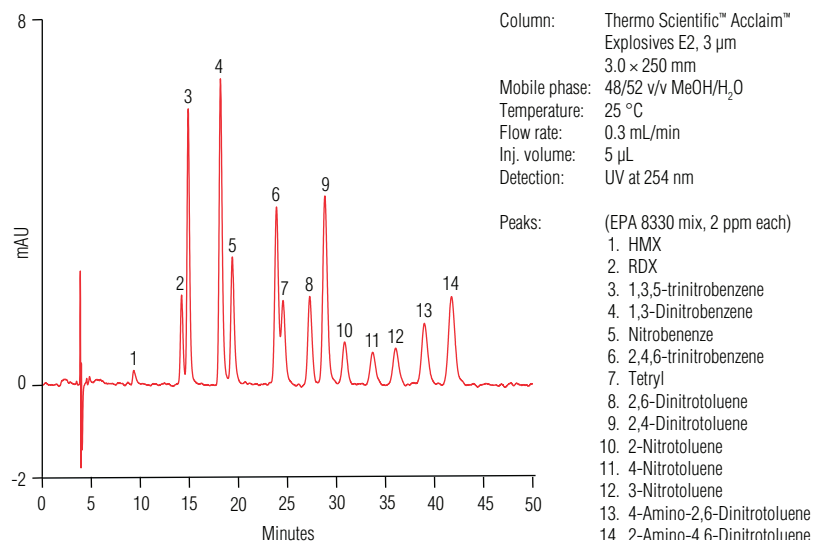


Figure 3. Separation of 14 explosives in EPA 8330 on Acclaim Explosives E2 Column and Dionex SolEx HRPHS and the Dionex AutoTrace 280 SPE instrument for automated sample preparation.

SPECIFICATIONS

Silica-Based SPE Cartridges

Regular C8 and C18 SPE Cartridges

Particle Size:	40–63 µm
Pore Volume:	0.70–0.85 cm ³ /g
Surface Area:	470–530 m ² /g
Shelf Life:	24 months

Unbonded Silica (Acid Washed) SPE Cartridges

Particle Size:	40–63 µm
Pore Size:	60 Å
Surface Area:	500 m ² /g
Shelf Life:	24 months

Carbon-Based SPE Cartridges

Activated Carbon

Sorbent Material:	Activated carbon (charcoal) particles
Surface Area:	972 m ² /g
Shelf Life:	5 years

Graphitized Carbon

Sorbent Material:	Nonporous graphitized carbon particles
Surface Area:	90 m ² /g
Shelf Life:	5 years

Polymer-Based SPE Cartridges

SAX SPE Cartridges

Sorbent Material:	Styrene-Divinylbenzene/quaternary ammonium, chloride-form
Ion-Exchange Capacity:	0.9 mEq/g
Particle Size:	22 µm
Surface Area:	800 m ² /g
Shelf Life:	5 years

WAX SPE Cartridges

Sorbent Material:	Styrene-Divinylbenzene/amine, ammonium acetate-form
Ion-Exchange Capacity:	1.2 mEq/g
Particle Size:	22 µm
Surface Area:	800 m ² /g
Shelf Life:	5 years

SCX SPE Cartridges

Sorbent Material:	Styrene-Divinylbenzene/sulfonate, sodium-form
Ion-Exchange Capacity:	0.7 mEq/g
Particle Size:	22 µm
Surface Area:	800 m ² /g
Shelf Life:	5 years

WCX SPE Cartridges

Sorbent Material:	Styrene-Divinylbenzene/carboxylate, ammonium-form
Ion-Exchange Capacity:	1.2 mEq/g
Particle Size:	22 µm
Surface Area:	450 m ² /g
Shelf Life:	5 years

HRPHS SPE Cartridges

Sorbent Material:	Styrene-Divinylbenzene/Polyvinylpyrrolidone
Particle Size:	22 µm
Surface Area:	800 m ² /g
Shelf Life:	5 years

Ordering Information

In the U.S., call (800) 346-6390 or contact the Thermo Fisher Scientific Regional Office nearest you. Outside the U.S., order through your local Thermo Fisher Scientific office or distributor. Refer to the following part numbers.

Polymer-Based SPE Cartridges	Part Number
HRPHS SPE Cartridges	
Dionex SolEx HRPHS 3 mL Cartridge with 60 mg Resin, Package of 48	088124
Dionex SolEx HRPHS 3 mL Cartridge with 150 mg Resin, Package of 48	088125
Dionex SolEx HRPHS 6 mL Cartridge with 100 mg Resin, Package of 48	088126
Dionex SolEx HRPHS 6 mL Cartridge with 200 mg Resin, Package of 48	088127
Dionex SolEx HRPHS 6 mL Cartridge with 500 mg Resin, Package of 36	088128
SCX SPE Cartridges	
Dionex SolEx SCX 3 mL Cartridge with 60 mg Resin, Package of 48	088097
Dionex SolEx SCX 3 mL Cartridge with 150 mg Resin, Package of 48	088099
Dionex SolEx SCX 6 mL Cartridge with 100 mg Resin, Package of 48	088101
Dionex SolEx SCX 6 mL Cartridge with 200 mg Resin, Package of 48	088102
Dionex SolEx SCX 6 mL Cartridge with 500 mg Resin, Package of 36	088103
SAX SPE Cartridges	
Dionex SolEx SAX 3 mL Cartridge with 60 mg Resin, Package of 48	088105
Dionex SolEx SAX 3 mL Cartridge with 150 mg Resin, Package of 48	088106
Dionex SolEx SAX 6 mL Cartridge with 100 mg Resin, Package of 48	088107
Dionex SolEx SAX 6 mL Cartridge with 200 mg Resin, Package of 48	088108
Dionex SolEx SAX 6 mL Cartridge with 500 mg Resin, Package of 36	088109
WAX SPE Cartridges	
Dionex SolEx WAX 3 mL Cartridge with 60 mg Resin, Package of 48	088111
Dionex SolEx WAX 3 mL Cartridge with 150 mg Resin, Package of 48	088112
Dionex SolEx WAX 6 mL Cartridge with 100 mg Resin, Package of 48	088113
Dionex SolEx WAX 6 mL Cartridge with 200 mg Resin, Package of 48	088114
Dionex SolEx WAX 6 mL Cartridge with 500 mg Resin, Package of 36	088115
WCX SPE Cartridges	
Dionex SolEx WCX 3 mL Cartridge with 60 mg Resin, Package of 48	088117
Dionex SolEx WCX 3 mL Cartridge with 150 mg Resin, Package of 48	088118
Dionex SolEx WCX 6 mL Cartridge with 100 mg Resin, Package of 48	088119
Dionex SolEx WCX 6 mL Cartridge with 200 mg Resin, Package of 48	088121
Dionex SolEx WCX 6 mL Cartridge with 500 mg Resin, Package of 36	088122
Silica-Based SPE Cartridges	
Regular C18 SPE Cartridges	
Dionex SolEx C18 6 mL Cartridge with 1 g of Resin, Package of 30	074410
Dionex SolEx C18 6 mL Cartridge with 0.5 g of Resin, Package of 50	074417
Dionex SolEx C18 3 mL Cartridge with 0.5 g of Resin, Package of 50	074412
Dionex SolEx C18 1 mL Cartridge with 0.1 g of Resin, Package of 100	074623
Dionex SolEx C18 Cartridge (un-encapped material)	074416
Regular C8 SPE Cartridges	
Dionex SolEx C8 6 mL Cartridge with 1.0 g of Resin, Package of 30	074416
Dionex SolEx C8 6 mL Cartridge with 1 g of Resin, Package of 30	074411
Dionex SolEx C8 3 mL Cartridge with 0.5 g of Resin, Package of 50	074413
Dionex SolEx C8 1 mL Cartridge with 0.1 g of Resin, Package of 100	074415

Phthalate-Free C8 and C18 SPE Cartridges

Dionex SolEx C18 Clean 6 mL Cartridge with 1 g of Resin, Package of 30	075895
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Dionex SolEx C8 Clean 6 mL Cartridge with 0.5 g of Resin, Package of 50	075897
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C18 SPE Cartridges for EPA Method 525.2

Dionex SolEx C18 525 6 mL Cartridge with 1.5 g of Resin, Package of 30	075896
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Unbonded Silica (Acid Washed) SPE Cartridges

Dionex SolEx Silica 6 mL Cartridge with 0.5 g of Resin, Package of 50	074589
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Carbon-Based SPE Cartridges**Activated Carbon (Charcoal) SPE Cartridges for EPA Methods 521 and 522**

Dionex SolEx Carbon 6 mL Cartridge with 2 g of Resin, Package of 20	074590
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Graphitized Carbon SPE Cartridges for EPA Method 535

Dionex SolEx GCB 6 mL Cartridge with 0.5 g of Resin, Package of 30	075898
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Sunnyvale, CA USA is
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Africa +43 1 333 50 34 0

Australia +61 3 9757 4300

Austria +43 810 282 206

Belgium +32 53 73 42 41

Brazil +55 11 3731 5140

Canada +1 800 530 8447

China 800 810 5118 (free call domestic)
400 650 5118

Denmark +45 70 23 62 60

Europe-Other +43 1 333 50 34 0

Finland +358 10 3292 200

France +33 1 60 92 48 00

Germany +49 6103 408 1014

India +91 22 6742 9494

Italy +39 02 950 591

Japan +81 6 6885 1213

Korea +82 2 3420 8600

Latin America +1 561 688 8700

Middle East +43 1 333 50 34 0

Netherlands +31 76 579 55 55

New Zealand +64 9 980 6700

Norway +46 8 556 468 00

Russia/CIS +43 1 333 50 34 0

Singapore +65 6289 1190

Sweden +46 8 556 468 00

Switzerland +41 61 716 77 00

Taiwan +886 2 8751 6655

UK/Ireland +44 1442 233555

USA +1 800 532 4752

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