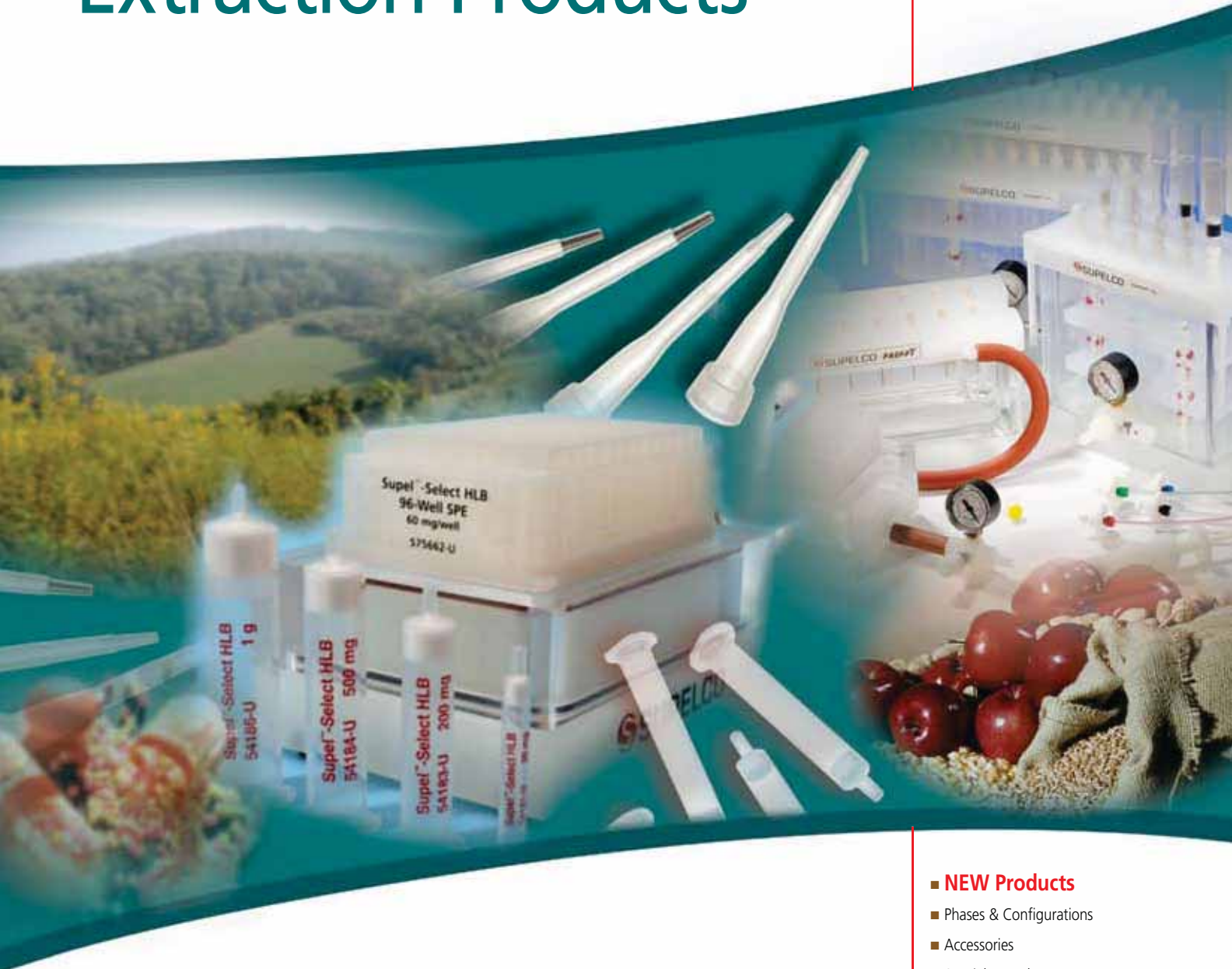


# Supelco Solid Phase Extraction Products



*Achieve Your Sample Prep Objectives*

- **NEW Products**
- Phases & Configurations
- Accessories
- Specialty Products
- Quick Look-up Guides
- Useful Tips

# A Brief History of Supelco Solid Phase Extraction (SPE)

Supelco, the Analytical & Chromatography Division of Sigma-Aldrich, first introduced SPE technology in 1985 under the Supelclean™ brand name. Shortly thereafter, we introduced our Visiprep™ Vacuum Manifold system.

In 1992, with the focus on environmental, food/ agrochemical, and industrial analyses, we improved and extended the line further to include Supelclean ENVI™- SPE products. In 1998, we introduced the Discovery® SPE line for pharmaceutical analysis.

Beginning 2007, the emphasis for Supelco Sample Prep R&D has been innovation. For example, MIP Technologies AB collaborated with Supelco to introduce SupelMIP™ SPE - Molecularly Imprinted Polymer Technology. HybridSPE™ -Precipitation was developed for phospholipid and protein removal.

In addition, Supelco was among the first to introduce a dispersive SPE (QuEChERS) product line for multi-residue pesticide analysis.



P001015

## 20+ Years Ago

## Present

### Supelclean & Supelclean ENVI

### Discovery SPE

### An Era of Innovative SPE

- Original pioneers of commercially available SPE Products
- Referenced in 100s of publications
- Developed, tested, and quality controlled for environmental applications
- Available in glass tubes, disk formats, and PTFE frits
- Unique chemistries such as ENVI-Carb™
- Documented applications in compliance to standardized EPA methods

- Developed, tested, and quality controlled for pharmaceutical and clinical applications
- Over 12 different phase chemistries ranging from mixed-mode SPE to polyamide adsorbents.
- Available in 96-well and Büchner funnel configurations
- Ultra-clean phases for highly sensitive analyses

- SupelMIP SPE – Molecularly Imprinted Polymers for extreme selectivity
- HybridSPE-Precipitation for quick and easy phospholipid and protein removal
- Supelclean Sulfoxide SPE for PCB analysis
- Dispersive SPE for multi-residue pesticide analysis
- Supel™-Select HLB SPE – our newest line of hydrophilic polymer SPE phases
- ... and more!

#### Supelclean Specifications:

<b>Base Silica:</b>	Irregular shape, acid washed for Supelclean ENVI
<b>Mean Particle Size:</b>	45 µm
<b>Mean Pore Diam.:</b>	60 Å
<b>Tot. Pore Vol.:</b>	0.8 cm <sup>3</sup> /g
<b>Specific Surf. Area:</b>	475 m <sup>2</sup> /g
<b>Endcapped:</b>	Yes (unless otherwise noted)
<b>Frit:</b>	Polyethylene (PE), 20 µm porosity (unless otherwise noted)

#### Discovery Specifications:

<b>Base Silica:</b>	Irregular shape, acid washed
<b>Mean Particle Size:</b>	50 µm
<b>Mean Pore Diam.:</b>	70 Å
<b>Tot. Pore Vol.:</b>	0.9 cm <sup>3</sup> /g
<b>Specific Surf. Area:</b>	480 m <sup>2</sup> /g
<b>Endcapped:</b>	Yes (unless otherwise noted)
<b>Frit:</b>	Polyethylene (PE), 20 µm porosity (unless otherwise noted)

# The Importance of SPE

Solid phase extraction is a form of digital (step-wise) chromatography designed to extract, partition, and/or adsorb one or more components from a liquid phase (sample) onto stationary phase (sorbent or resin). Over the last twenty years, SPE has become the most powerful technique available for rapid and selective sample preparation (prep) prior to analytical chromatography. SPE extends a chromatographic system's lifetime, improves qualitative and quantitative analysis, and by changing an analyte of interest's original matrix environment to a simpler matrix more suitable for subsequent analysis, the demand placed on an analytical instrument is considerably lessened.



## Use SPE for Samples that:

- Contain particulate matter causing system clogging and high back-pressure
- Contain components that cause high background, misleading peaks, and/or poor sensitivity
- Require cleanup, trace enrichment/concentration, or purification
- Require sample matrix or solvent exchange

## Benefits of SPE:

- Switch sample matrices to a form more compatible with chromatographic analyses
- Concentrate analytes for increased sensitivity
- Remove interferences to simplify chromatography and improve quantitation
- Protect the analytical column from contaminants

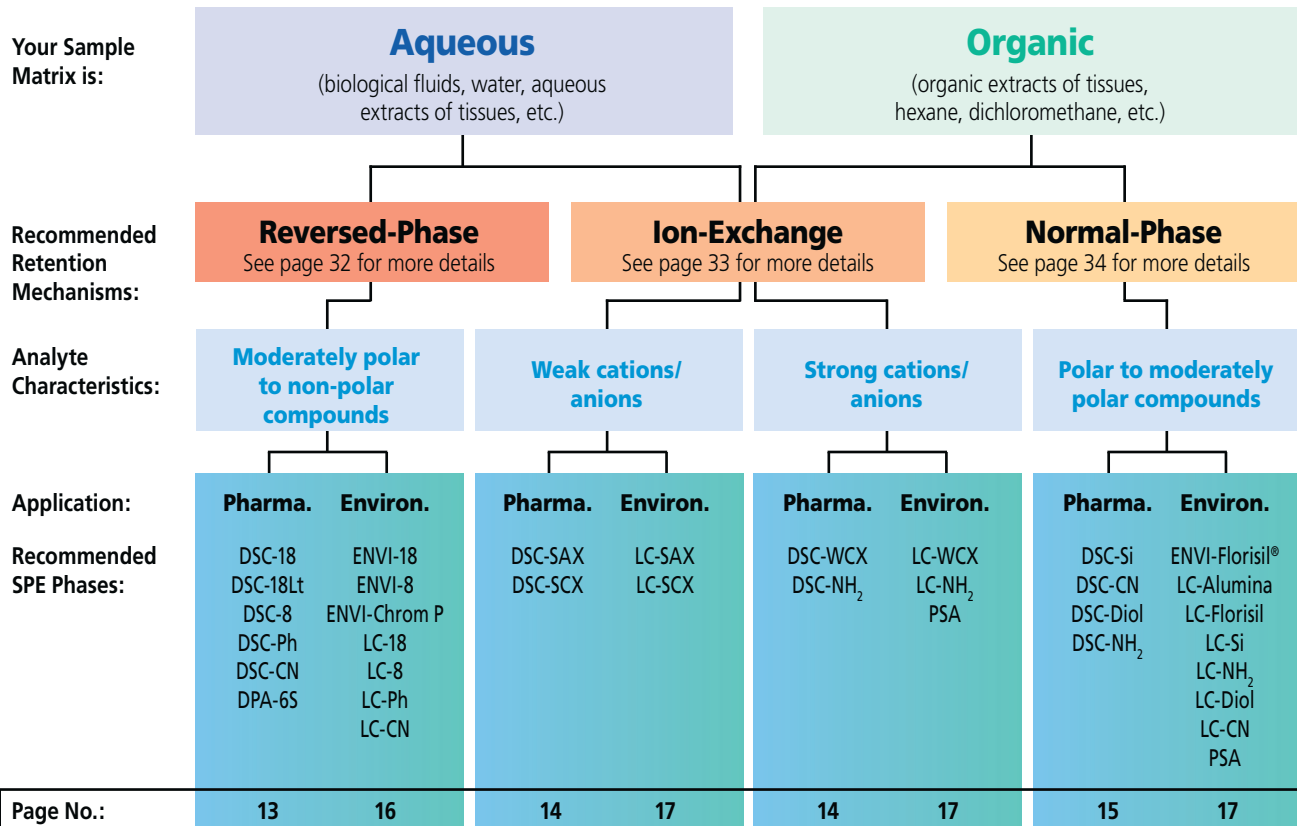
## Common SPE Applications:

- Pharmaceutical compounds and metabolites in biological fluids
- Drugs of abuse in biological fluids
- Environmental pollutants in drinking and wastewater
- Pesticides and antibiotics in food/agricultural matrices
- Desalting of proteins and peptides
- Fractionation of lipids
- Water and fat soluble vitamins
- For more applications and application details, please visit our web site, [sigma-aldrich.com/spe](http://sigma-aldrich.com/spe) or refer to the current Supelco catalog.

## Table of Contents:

Page	Description
<b>4</b>	Quick Look Up Guides <i>SPE Phase Selection</i> <i>SPE Bed Weight, SPE Tubes and Specialty Hardware</i> <i>SPE Accessories</i>
<b>8</b>	SPE Phase Chemistries by Retention Mechanism <b>NEW!</b> <i>HybridSPE®-PPT</i> <b>NEW!</b> <i>Supel™-Select HLB</i> <b>NEW!</b> <i>Empore® SPE</i> <b>NEW!</b> <i>SupelMIP® Discovery®</i> <i>Supelclean™/Supelclean ENVI</i>
<b>19</b>	Specialty Products <i>Method Development</i> <i>Pharmaceutical Analysis</i> <i>Purification</i> <i>Environmental</i> <i>Pesticide Analysis</i> <i>Miscellaneous</i> <i>(FAMEs, Glass SPE Tubes)</i>
<b>26</b>	SPE Accessories
<b>32</b>	SPE Methodology & Useful Tips

# SPE Phase Selection Quick Look-Up Guide



## Supelco SPE Specialty Phases:

Phase Description	Field/Applic.	Page	Description
HybridSPE-Precipitation	Ph	8	Combines the simplicity of protein precipitation with the selectivity of SPE for the targeted removal of proteins and phospholipids in biological samples
Supel-Select HLB	Ph, G, F	9	Hydrophilic modified styrene based polymer for the broad range extraction of diverse analytes from aqueous samples
Empore SPE	Ph, E, G	10	SPE particles enmeshed in a PTFE membrane. Allows for faster flow-rates, smaller solvent consumption, and reduced elution volumes.
SupelMIP SPE	Ph, F, E	12	Molecularly imprinted polymers for the highly selective extraction of trace analytes in difficult sample matrices
Discovery DSC-MCAX	Ph, G	14	Mixed-mode cation exchange for superior selectivity/sample cleanup when extracting basic compounds (most pharmaceuticals) from biological fluids (e.g., plasma, urine, etc.)
Discovery DPA-6S	G, E, Ph	13	Polyamide resin that adsorbs polar compounds containing multi -OH and -COOH groups. Useful for extracting polyphenolics and other natural compounds (e.g., flavanoids, chlorophyll, humic acid, etc.) from plant extracts.
Polymer SAX Rezorian™ Cartridge / Polymer SCX Reversible Tube	G	21	Strong cation and anion exchanger on a styrene base particle. Offers much higher ion-exchange capacity than silica based ion-exchangers.
Supelclean ENVI-18 and -8 DSK SPE Disks	E	16	Provides fast flow rates for processing large volumes of water samples (≥0.5 L). Used in EPA 500 series methods - Drinking Water.
Dual Layer Florisil/Na <sub>2</sub> SO <sub>4</sub>	E	17	For total petroleum hydrocarbon index according to European Method EN9377-2
Supelclean Coconut Charcoal	E	22	Configured for EPA Method 521 - Nitrosamines in Water
Supelclean ENVI-Carb Plus	E	22	Spherical carbon particles packed in a reversible tube for the extraction of highly polar compounds from water
Supelclean Sulfoxide	E	22	Developed for the highly selective extraction of PCBs from transformer and waste oil
EPA 8290 SPE Tubes	E	22	Multi-layer SPE tubes configured for EPA Method 8290 - PCDDs and PCDFs by HRGC/HRMS
Discovery Ag-Ion	F	24	Silver Ion SPE for the fractionation of cis-trans isomers and other FAMES
Supelclean ENVI-Carb	F	23	Extreme affinity for polar compound in aqueous samples and water miscible organic extracts. Commonly used in pesticide analysis of food samples.
Multi-layer Supelclean SPE Products	F	23	Developed to provide superior cleanup when conducting multi-residue pesticide analysis in food/agricultural (ENVI-Carb, SAX, PSA, NH <sub>2</sub> ) matrices
Supelclean LC-4 (wide pore)	B	16	Used for desalting proteins/peptides and other macromolecules

Key: Ph = Pharmaceutical/Drugs; F = Food / ; E = Environmental; B = Biological macromolecules; G = General

# SPE Bed Weight Quick Look-Up Guide

## Choosing the Right Bed Weight and Tube Size

General guidelines for choosing the appropriate SPE tube size and bed weight configuration are listed in this table. Optimal method parameters and hardware/ bed weight dimensions should be determined during method optimization and troubleshooting.

Bed Weight	Tube Volume	Minimum Elution Vol.	Bed Capacity*
50-100 mg	1 mL	100-200 µL	2.5-10 mg
500 mg	3 mL	1-3 mL	25-100 mg
0.5-1 g	6 mL	2-6 mL	25-100 mg
2 g	12 mL	10-20 mL	0.1-0.2 g
5 g	20 mL	20-40 mL	1.25-2.5 g
10 g	60 mL	40-100 mL	0.5-1 g

\* This value depends on the analyte and sample matrix. As a rule of thumb, the bed capacity can be estimated with ~5% of the bed weight.

- Smaller tube dimensions (1 mL) contain smaller bed weights. Smaller bed weights allow for reduced elution volumes which can be beneficial for sensitive analyses, and when further processing is required (e.g., evaporation).
- 3 mL SPE tubes are the most common size dimension.
- 6 mL SPE tubes should be used when one or more steps in the SPE process require volumes greater than 3 mL. 6 mL tubes also contain larger bed weights (up to 1g) which offers greater capacity, and can be beneficial when extracting difficult to retain compounds.
- 12, 20, and 60 mL tubes contain larger bed weights and head space volume which offer greater capacity. This allows researchers to use SPE as a purification or modified LPLC/Flash technique.
- The 10 mL LRC (large reservoir cartridges) are ideal for preparing larger sample volumes with smaller bed weights (25-100 mg). The packed section has the same diameter like a 1 mL tube.

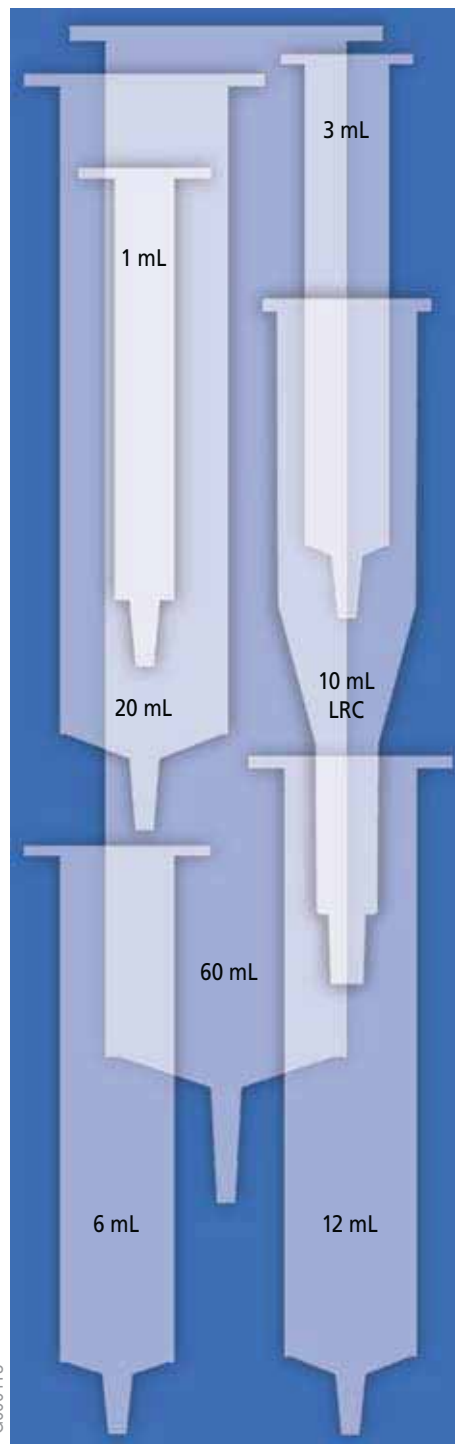
## FREE SPE MultiPaks for Method Development

SPE MultiPaks consist of an assortment of SPE phase chemistries and tube dimensions ideally suited for method development. The mix of phase chemistries available in these MultiPaks allows you to screen for optimal retention and selectivity required to achieve your sample prep objectives.

### Available SPE MultiPaks

- HybridSPE-PPT
- Supel-Select HLB
- Supel-Tips
- SupelMIP
- Dispersive SPE (dSPE)
- Discovery Reversed-Phase
- Discovery Normal-Phase
- Discovery Ion-Exchange
- Discovery DSC-MCAX (Mixed-Mode Cation Exchange)
- Discovery DPA-6S (Polyamide)
- Supelclean ENVI-Carb (Graphitized Carbon)
- Discovery Ag-Ion
- Supelclean Dual Layer (for multi-residual pesticide analysis)
- Supelclean PSA

Most common SPE hardware:  
Polypropylene SPE tubes with PE Frit



Actual size of SPE tubes

SPE Tube Dimensions

To learn more about SPE MultiPaks, or to request a **FREE SPE MultiPak sample**, please visit [sigma-aldrich.com/spe](http://sigma-aldrich.com/spe) or contact Technical Service at 800-359-3041/814-359-3041.

# SPE Tubes and Specialty Hardware Quick Look-Up Guide

## Additional Tubes & Cartridges

### Glass SPE Tubes with PTFE & SS Frits (pg. 25 and 26)



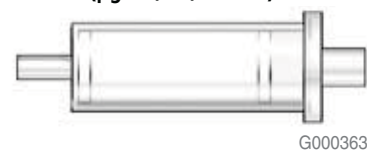
Common in environmental analysis to reduce leachables from PP hardware and PE frits

### VersaPure® PrePacked Büchner Funnels (21 and 26)



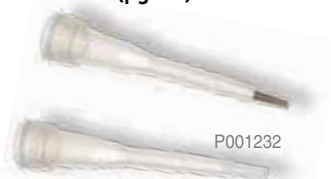
Used for large scale purification (medicinal chemistry purification)

### Reversible SPE Tubes (pg. 21, 22, and 26)



Reverse SPE tubes prior to elution to minimize elution volume for strongly retained compounds

### Supel-Tips SPE (pg. 20)



Ideal for the micro-extraction of small & biological macromolecules

### Rezorian Cartridges (pg. 21 and 26)



Luer-Lock® cartridges for positive pressure applications. Can also be used with vacuum manifold with proper luer connectors.

### Discovery SPE 96-Well Plates (pg. 19 and 20)



For high throughput sample preparation

### Dispersive SPE (pg. 24)



Custom pre-washed salt sorbent vials for dispersive SPE

## Custom Capabilities

Supelco offers custom manufacturing services so you can optimize your sample processing procedure to the parameters dictated by your sample prep objectives. If there is a certain permutation of phase chemistry, bed weight and hardware configuration you require that is not listed within our standard product line, please inquire.

To request a price quote or inquire on the feasibility of Supelco manufacturing a custom SPE product, please contact our Order Processing & Technical Service representatives:

### Flangeless SPE Tubes (custom - inquire)



Accommodate robotic liquid vials handling systems (e.g. Gilson SPE 215™ System)

<b>Order Processing:</b>	Phone: 800-247-6628/814-359-3441	Fax: 800-447-3044/814-359-5459	email: <a href="mailto:supelco@sial.com">supelco@sial.com</a>
<b>Technical Service:</b>	Phone: 800-359-3041/814-359-3041	Fax: 800-359-3044/814-359-5468	email: <a href="mailto:techservice@sial.com">techservice@sial.com</a>

For US only. All other countries, please contact your local Sigma-Aldrich office or distributor.

#### TRADEMARKS

AutoTrace - Caliper Technologies Corp., Celite - Celite Corp.; Discovery, ENVI, ENVI-Carb, ENVI-Disk, Hisep, HybridSPE, Preppy, Rezorian, Sigma-Aldrich, Supelclean, Supelco, SupelMIP, VersaFlash, VersaPure, Visi-1, Visidry, Visiprep - Sigma-Aldrich Biotechnology LP; DOWEX - Dow Chemical Co., Empore - 3M; Florisil - U.S. Silica Company; Gilson SPE 215 - Gilson; Laboport - KNF Neuberger GmbH; Luer-Lock - Becton-Dickinson & Co.; Multi-Probe - Hewlett-Packard Corp.; Quadra 96 - TomTec, Inc.

# SPE Accessories Quick Look-Up Guide

**Visiprep™ DL & Standard Vacuum Manifold (pg. 27)**



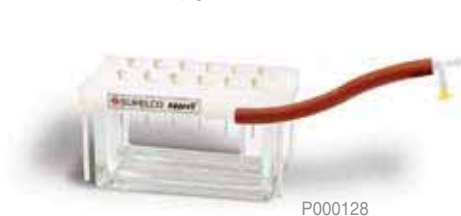
Uses disposable liners that prevent cross-contamination

**Visiprep 5-Port Flask Manifold (pg. 27)**



Collects the SPE eluate in round flasks for easy rotary evaporation

**Preppy™ Vacuum Manifold (pg. 28)**



Most economical

**PlatePrep Vacuum Manifold (pg. 30)**



For 96-well SPE  
Useful for stacking SPE tubes,

**ENVI-Disk™ Holder (pg. 31)**



Used with 47 mm SPE disks  
Simple racks for using SPE

**Visi-1™ Single SPE Tube Processor (pg. 25)**



For processing very few  
SPE samples

**Visiprep Large Volume Sampler (pg. 28)**



For processing larger  
sample volumes

**Visidry™ Drying Attachment & (pg. 28)**



For drying SPE tubes or  
evaporating SPE eluate

**Large Volume Reservoirs & Tube Adapters (pg. 25)**



Useful for stacking SPE tubes,  
increasing headspace volume, or  
processing SPE tubes via luer syringe

**SPE Elution Rack (pg. 28)**



Simple racks for using SPE  
under gravity flow

**KNF Laboport® Vacuum Pumps (inquire)**



Provides vacuum source for  
vacuum manifolds

**Trap Kit and Vacuum Gauge Bleed Valve (pg. 29)**



Additional vacuum accessories

# NEW! HybridSPE - Precipitation Technology

Winner of the *SelectScience.net* Scientists' Choice Award for Best New Separations Product in 2008

HybridSPE-Precipitation (HybridSPE-PPT) combines the simplicity of protein precipitation with the selectivity of solid phase extraction (SPE) for the targeted removal of phospholipids in biological plasma/serum (Figure 1). The technology utilizes a zirconia-coated particle, and exhibits selective affinity towards phospholipids while remaining non-selective towards a range of basic, acidic, and neutral compounds. The phospholipid retention mechanism is based on a highly selective Lewis acid-base interaction between the proprietary zirconia ions (functionally bonded to the HybridSPE stationary phase) and the phosphate moiety consistent with all phospholipids (Figure 2).

Hybrid SPE

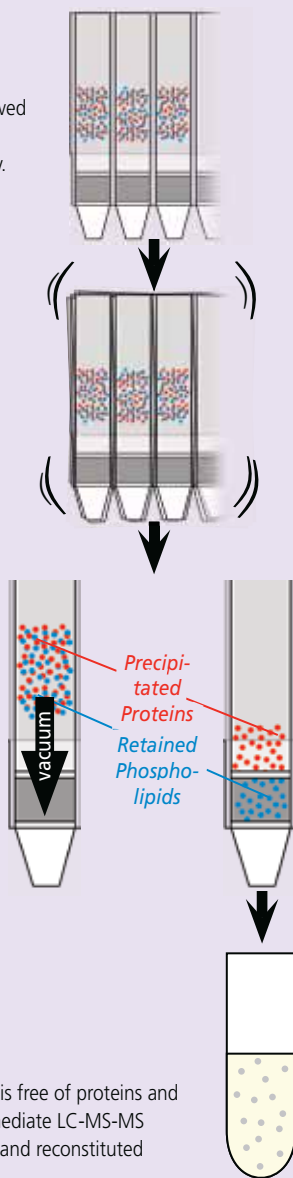
Figure 1. HybridSPE-PPT "In-well" Method

1) **Precipitate Proteins** by adding 100  $\mu$ L plasma or serum to the HybridSPE-PPT plate followed by 300  $\mu$ L 1% formic acid in acetonitrile. Add I.S. as necessary.

2) **Mix** by vortexing/shaking HybridSPE-PPT plate or by aspirating/dispensing with 0.5-1 mL pipette tip (e.g., TOMTEC Quadra liquid handler)

3) **Apply vacuum.** The packed-bed filter/frit assembly acts as a depth filter for the concurrent physical removal of precipitated proteins and chemical removal phospholipids. Small molecules (e.g., pharma compounds and metabolites) pass through unretained.

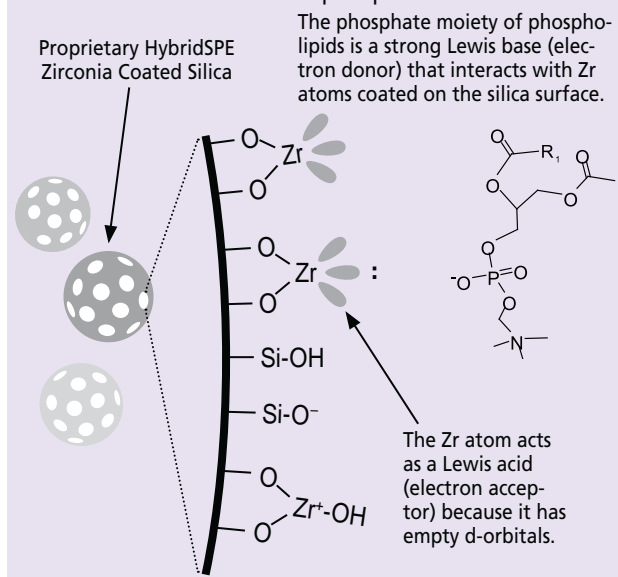
4) **Resulting filtrate/eluate** is free of proteins and phospholipids and ready for immediate LC-MS-MS analysis; or it can be evaporated and reconstituted as necessary prior to analysis



## Features & Benefits:

- Merges both protein precipitation & SPE
  - ◆ Offers the simplicity and generic nature of protein precipitation
  - ◆ Selectivity approaches SPE via the targeted removal of phospholipids
- 2-3 step generic procedure
- 100% removal of phospholipids and precipitated proteins
- Minimal to no method development required
- Available in 96-well and 1 mL cartridge dimensions

Figure 2. Lewis Acid-Base Interactions Between HybridSPE Zirconia Ions and Phospholipids



Description	Qty.	Cat. No.
<b>HybridSPE-PPT Products</b>		
96-well Plate, 50 mg/well	1	575656-U
1 mL Cartridge, 30 mg/well	100	55261-U
<b>Related Products</b>		
96-well Protein Precipitation Filter Plate	1	55263-U
Supelco PlatePrep Vacuum Manifold	1	57192-U
96 Square/Deep Well Collection Plate, 0.35 mL, PP	50	575651-U
96 Square/Deep Well Collection Plate, 0.5 mL, PP	50	575652-U
96 Square/Deep Well Collection Plate, 2 mL, PP	50	575653-U
96 Square Well Pierceable Cap Mats	25	575656-U

[sigma-aldrich.com/hybridspe-ppt](http://sigma-aldrich.com/hybridspe-ppt)

# NEW! Supel-Select HLB SPE

## Sample Prep Performance at the Price you Desire

Supelco Supel-Select HLB SPE is a hydrophilic modified styrene-based polymer developed for the solid phase extraction of a highly broad range of compounds from aqueous samples. The retention mechanism is predominately based on reversed-phase interaction. However, because the phase is hydrophilic modified, the phase is also selective for more polar compounds (HLB: Hydrophilic Lipohilic Balance). Examples of more polar compounds that are retained and recovered on Supel-Select HLB include (but not limited to): pyridoxine (logPo/w -0.56), riboflavin (logPo/w -2.02), biotin (logPo/w 0.11).

### Features & Benefits:

- Extract and recover a highly broad range of compounds from aqueous samples
- Reduce ion-suppression
- Amenable to generic methodology
- Resistant to overdrying for greater reproducibility
- Low UV and MS extractables
- Stringent production and QC guidelines
- Greater capacity for smaller elution volumes



P001336

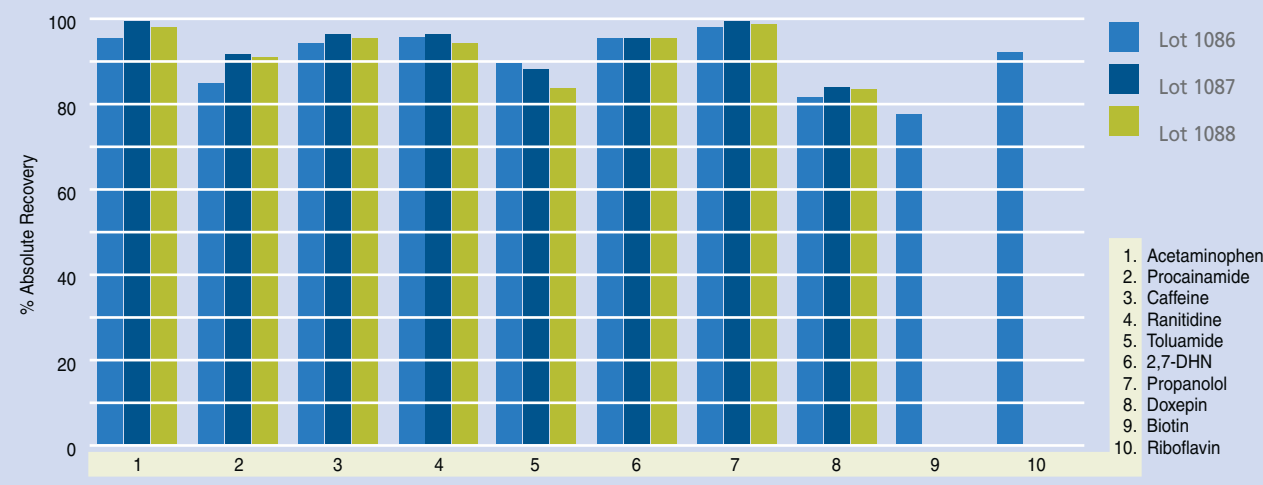
Phase Chemistry:	Hydrophilic modified styrene polymer
pH Compatibility:	0-14
Particle Size:	55-60 $\mu\text{m}$
MS Suitable:	Yes
Surface Area:	400-410 $\text{m}^2/\text{g}$
Pore Volume:	0.88 $\text{mL/g}$
Pore Size:	87 $\text{\AA}$

## High & Reproducible Recoveries

Supel-Select HLB SPE allows users to extract a broad range of compounds using a single sorbent and generic methodology.

Analyte recovery was high across all the compounds tested, and results were highly reproducible across three production lots.

### Supel-Select HLB Recoveries

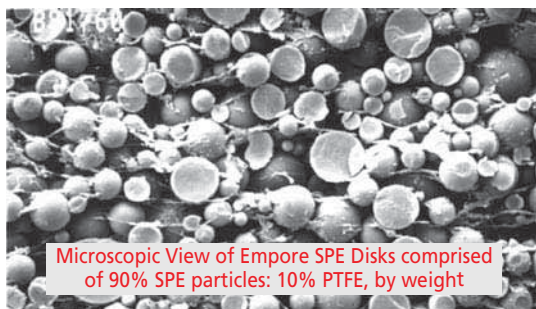


Description	Qty/Pk.	Cat. No.
<b>Supel-Select HLB SPE</b>		
30 mg/1 mL	100	54181-U
60 mg/3 mL	50	54182-U
200 mg/6 mL	30	54183-U
500 mg/12 mL	20	54184-U
1 g/20 mL	20	54186-U
<b>Supel-Select HLB 96-well SPE</b>		
10 mg/well	1	Inquire
30 mg/well	1	575661-U
60 mg/well	1	575662-U

[sigma-aldrich.com/supel-select](http://sigma-aldrich.com/supel-select)

# NEW! Empore Solid Phase Extraction (SPE) Products

Empore membrane SPE technology comprises of SPE particles tightly enmeshed within a network of inert PTFE fibrils. The SPE-membrane fabrication process results in a highly dense and uniform extraction medium that offers distinct advantages over traditional sorbent/packed-bed SPE products. Empore SPE technology provides a denser, more uniform extraction bed than traditional packed bed products allowing for smaller bed weights, shorter analyte to pore diffusion paths, and more efficient extractions.



Microscopic View of Empore SPE Disks comprised of 90% SPE particles: 10% PTFE, by weight

E001071

## Save Time & Money with Empore SPE

Reduced SPE bed mass = Reduced SPE solvent & elution volumes

- Minimizes SPE eluate evaporation time
- Potentially allows for direct injection of the SPE eluate

Dense & uniform extraction medium = NO SPE channeling/voiding

- Efficient mass-transfer kinetics allow for faster flow rates
- Eliminate SPE fines improving column and instrument life

Cartridge Dimension	Bed Vol.	Conditioning <sup>1</sup>	Elution <sup>2</sup>
Empore 7 mm (12 mg)/3 mL cartridge	50 µL	200-250 µL	100-150 µL
Traditional 500 mg/6 mL packed bed	60 µL	2400-3000 µL	1200-1800 µL
Traditional 100 mg/1 mL packed bed	120 µL	480-600 µL	240-360 µL

<sup>1</sup> Conditioning typically requires 4-5 x bed volumes.

<sup>2</sup> Elution typically requires 2-3 x bed volumes

## Available Formats:

**The Empore 96-well line** is ideal for high throughput SPE allowing users to process up to 96 samples in parallel. The unique Empore technology comprises of a series of polypropylene (PP) pre-filters that are layered on top of the SPE disk.



E001070

The PP pre-filter acts as a depth filter that provides faster flow rates and reduces the risk of clogging.

- Reduced elution volume (< 100 µL) allows for direct injection or reduced eluate evaporation
- Faster flow rates without risk of recovery and reproducibility loss
- Proprietary pre-filter reduces risk of clogging
- Luer tip collar eliminates potential cross-contamination

## The Empore SPE disk line

comprises of the most complete line of SPE disks for extracting large volumes of aqueous samples. The product line ranges from time-tested C18 to unique phase chemistries such as carbon and the oil & grease disk. The disks are ideal for environmental analysis where 1 L sample volumes are not uncommon and provide an efficient alternative to liquid-liquid extraction (LLE).



E001068

- Amenable to dozens of EPA and related environmental methods
- Developed for the highly efficient extraction of pollutants in large volume water samples

## The Empore SPE cartridge line

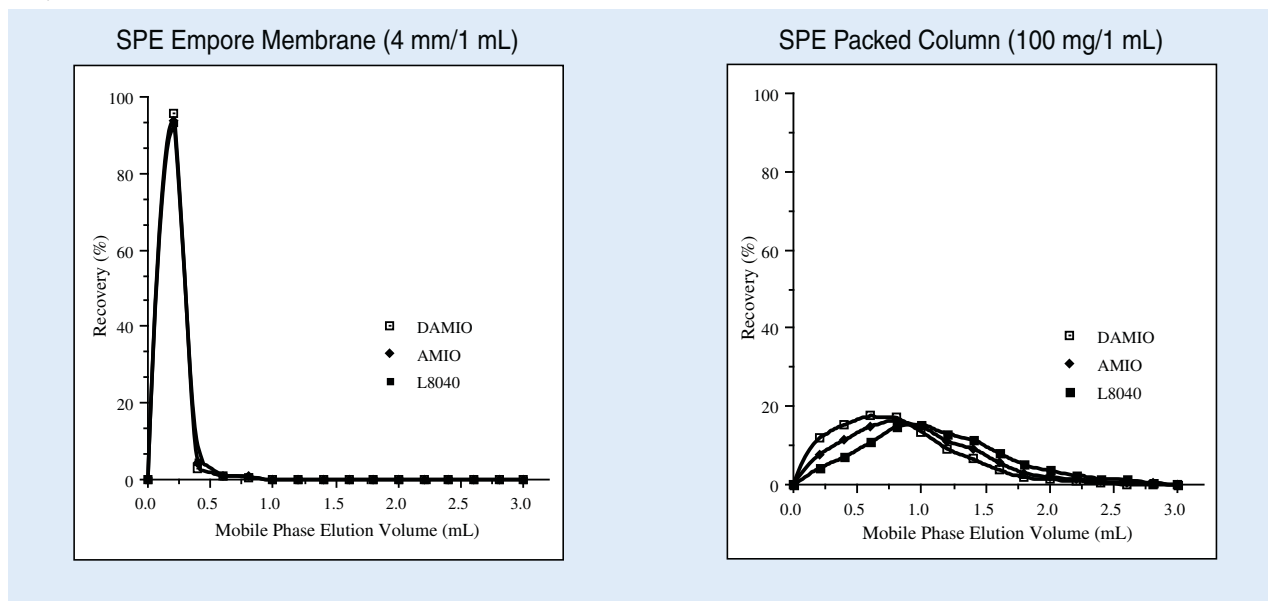
is packed with a PTFE membrane enmeshed with SPE particles. Layered above the SPE membrane is a polypropylene pre-filter to prevent particulates from reaching the underlying membrane. The dense particle packing and uniform distribution within the Empore membrane offers outstanding extraction efficiency and reproducibility.



E001069

## Recovery, Precision, & Elution Volume Profile of Empore SPE

Antiarrhythmic drug amiodarone (AMIO) and its metabolite, desethyl-amiodarone (DAMIO), were extracted from 250 µL serum using reversed-phase SPE. Elution volume profiles for both the Empore and traditional packed SPE approaches are compared below. Only 0.5 mL of mobile phase elution volume was required for complete analyte elution using Empore SPE. In contrast, the traditional SPE packed column required over 2 mL to recover the analytes of interest.



	Precision (between-run, n = 15)			Recovery (at 300 µg/mL)		Sensitivity (lowest limit of quantitation)	
	Mean µg/mL	SD µg/mL	CV %	Mean µg/mL	SD µg/mL	CV %	
AMIO	0.415	0.015	3.7	3.06	0.094	3.1	92-95%
DAMIO	0.412	0.013	3.3	3.06	0.096	3.2	90-93%

SD = standard deviation  
CV = coefficient of variation

### Empore Solid Phase Microextraction Products

Description	Dimension	Qty./Pk	Cat. No.
<b>Cartridges</b>			
Empore C18-SD (Standard Density)	4 mm/1 mL	100	66871-U
Empore C18-SD (Standard Density)	7 mm/3 mL	50	66872-U
Empore C18-SD (Standard Density)	10 mm/6 mL	30	66873-U
Empore UR-SD (Universal Resin)	7 mm/3 mL	50	66874-U
<b>96-well</b>			
Empore C18	5.5 mm/1.2 mL well	1	66875-U
Empore UR (Universal Resin)	5.5 mm/1.2 mL well	1	66877-U
Empore MPC (Mixed Phase Cation)	5.5 mm/1.2 mL well	1	66876-U
Empore Filter Plate	5.5 mm/1.2 mL well	1	66878-U
<b>Disks</b>			
Empore C18 Octadecyl	47 mm	20	66883-U
Empore C8 Octyl	47 mm	20	66882-U
Empore Oil and Grease	47 mm	20	66887-U
Empore Oil and Grease	90 mm	10	66898-U
Empore Styrene Divinyl Benzene (SDB-RPS)	47 mm	20	66886-U
Empore Styrene Divinyl Benzene (SDB-XC)	47 mm	20	66884-U
Empore Cation	47 mm	20	66889-U
Empore Anion-SR	47 mm	20	66888-U
Empore Chelating	47 mm	20	66894-U
Empore Carbon	47 mm	20	66896-U
<b>Accessories</b>			
Empore 96-well Vacuum Manifold		1	66879-U
Empore Filter Aid 400		1	66897-U
Empore Sealing Tape for 96-well		10 pads (25 sheets/pad)	66881-U

[sigma-aldrich.com/empore](http://sigma-aldrich.com/empore)

[sigma-aldrich.com/spe](http://sigma-aldrich.com/spe)

**SUPELCO**  
Analytical

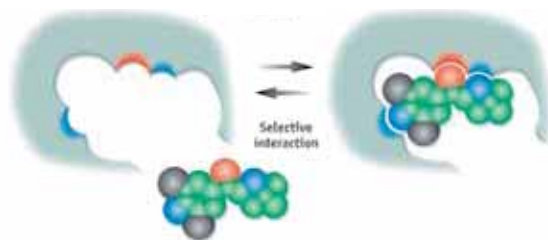
Empore SPE

# NEW! SupelMIP SPE – Molecularly Imprinted Polymers

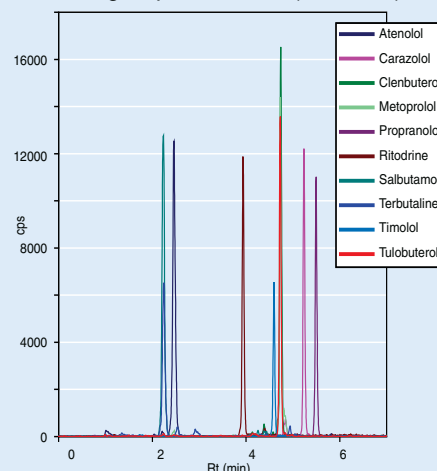
SupelMIP SPE phases were developed by MIP Technologies AB, which is one of the leading authorities and commercial pioneers of molecularly imprinted polymers for process scale separations, analytical chromatography, and sample preparation.

The SupelMIP SPE line consists of highly cross-linked polymers that are engineered to extract a single analyte of interest or a class of structurally related analytes with an extremely high degree of selectivity. This is possible because selectivity is introduced during MIP synthesis in which a template molecule, designed to mimic the analyte, guides the formation of specific cavities or imprints that are sterically and chemically complementary to the analyte(s) of interest.

By careful design of the imprinting site, either by molecular modeling, experimental design, or screening methods, the binding cavities can be engineered to offer multiple interaction points (ion-exchange, reversed-phase with polymer backbone, and hydrogen bonding) with the analyte(s) of interest. MIP binding site is both chemically and sterically complementary to the analyte(s) of interest. This leads to a stronger interaction between the solid phase and the analyte(s). As a consequence, harsher wash conditions can be tolerated during SPE methodology resulting in cleaner extracts. Because extraction selectivity is significantly improved, lower background is observed allowing analysts to achieve lower limits of detection.



## β-agonists and β-blockers (1 ng/mL spike) in Urine and Wastewater using SupelMIP SPE (53223-U)



Note: Clenbuterol and Tulobuterol were spiked at the levels of 0.1 ng/mL.

## Key Features & Benefits:

- Achieve lower detection limits through superior selectivity
- Reduce ion-suppression
- Save time and reduce cost via robust and rapid methodology
- Minimal to no method development required
- Stable at broad pH ranges and high temperatures
- Stringent quality control conditions

## SupelMIP Phases & Methods available for:

- **PAHs** (polyaromatic hydrocarbons) in edible oils
- **Nitroimidazoles** in milk, eggs, and other food matrices
- **Non-steroidal anti-inflammatory drugs** (NSAIDs) in wastewater and other sample matrices
- **Fluoroquinolones** in bovine kidney, honey, and milk
- **Amphetamine** and related compounds in urine
- **Chloramphenicol** in milk, plasma, honey, urine, and shrimp/prawns
- **NNAL** (4-(N-nitrosomethylamino)-1-(3-pyridyl)-1-butanol) in urine
- **TSNAs** (Tobacco Specific Nitrosamines) in urine and tobacco
- **β-agonists** and **β-blockers** in tissue, urine, and wastewater
- **Clenbuterol** in urine
- **Triazines** in water
- **Riboflavin** in milk

Analyte	Lower Limit of Quantitation (ng/mL, ppb, or µg/kg)	
	1 mL Horse Urine	10 mL Wastewater
Atenolol	0.1	0.01
Carazolol	0.1	0.01
Metoprolol	0.1	0.01
Propranolol	0.1	0.01
Timolol	0.1	0.01
Clenbuterol	0.02	0.002
Ritodrine	0.05	0.005
Salbutamol	0.1	0.01
Terbutaline	0.2	0.02
Tulobuterol	0.005	0.0005

SupelMIP SPE	25 mg/3 mL pk 50	25 mg/10 mL (LRC)* pk 50
PAHs	52773-U*	—
Nitroimidazoles	52734-U	—
NSAIDs	52769-U	—
Fluoroquinolones	53269-U	—
Amphetamines	53228-U	—
Clenbuterol	—	53201-U
Beta-agonists (class selective)	53225-U	53202-U
Beta-blockers (class selective)	53213-U	53218-U
Full Beta-receptors (beta-agonists and beta-blockers)	53223-U	53224-U
Chloramphenicol	53209-U	53210-U
NNAL (4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol)	53203-U	53206-U
TSNAs (4 tobacco specific nitrosamines: NNK, NNN, NAB, NAT)	53222-U*	53221-U*
Riboflavin (vitamin B2)	—	53207-U
Triazines (class selective)	—	53208-U

- ▲ LRC = large reservoir cartridge
- 50 mg/3 mL, pk 50
- 50 mg/10 mL (LRC), pk 50

[sigma-aldrich.com/supelmip](http://sigma-aldrich.com/supelmip)

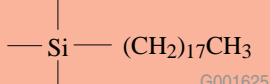
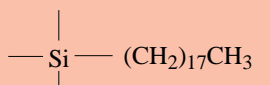
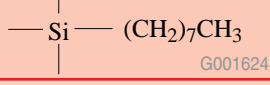
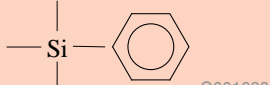
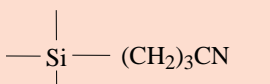
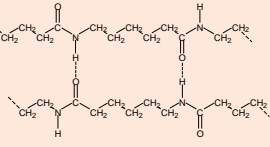
# Discovery SPE

## Reversed-Phase

Discovery reversed-phase SPE products are specifically developed, tested and quality controlled for pharmaceutical and clinical applications. Experience greater and more reproducible recoveries for the quick and effective extraction, isolation, and

concentration of pharmaceuticals from biological fluids and other aqueous sample matrices.

For Discovery silica specifications, see pg. 2. For general guidelines on reversed-phase SPE, see pg. 32.

<b>DSC-18</b>  G001625	<ul style="list-style-type: none"> <li>• Polymerically bonded, octadecyl (18% C), endcapped</li> <li>• Higher 18% C loading for increased binding capacities and higher recoveries</li> <li>• The least selective phase: retains most organic analytes from aqueous matrices</li> <li>• Beneficial for extracting numerous analytes diverse in structure from the same sample</li> </ul>
<b>DSC-18Lt</b>  G001633	<ul style="list-style-type: none"> <li>• Monomerically bonded, octadecyl (11% C), endcapped</li> <li>• Increased retention for moderately polar hydrophobic molecules</li> <li>• Used to elute very large hydrophobic molecules that are too strongly retained on DSC-18. Use this less retentive phase for the rapid release of hydrophobic compounds using weaker organic solvents at lower volumes</li> </ul>
<b>DSC-8</b>  G001624	<ul style="list-style-type: none"> <li>• Monomerically bonded, octyl (9% C), endcapped; lower carbon content than DSC-18Lt</li> <li>• Used to elute very large hydrophobic molecules too strongly retained on DSC-18 or DSC-18Lt</li> <li>• Use this less retentive phase for the rapid release of hydrophobic molecules using weaker organic solvents at lower volumes</li> </ul>
<b>DSC-Ph</b>  G001628	<ul style="list-style-type: none"> <li>• Monomerically bonded, phenyl (7% C), endcapped</li> <li>• Similar in polarity to DSC-8; however, electron dense aromatic ring offers some unique selectivity and retention</li> </ul>
<b>DSC-CN</b>  G001626	<ul style="list-style-type: none"> <li>• Monomerically bonded, cyanopropyl (7% C), endcapped</li> <li>• Can behave as either reversed-phase or normal-phase</li> <li>• Ideal for very hydrophobic analytes that may be irreversibly retained on more hydrophobic sorbents such as DSC-18</li> <li>• Less retentive than DSC-Si or DSC-Diol when used as normal phase (organic matrices such as hexane or oils)</li> <li>• Allows for the rapid release of very polar molecules irreversibly retained on very polar sorbents</li> </ul>
<b>DPA-6S</b>  G001195	<ul style="list-style-type: none"> <li>• Polyamide Resin: Particle Size: 50-160 μm, Surf pH: 4.5-7.5, Density: 0.2-0.3 cm<sup>3</sup>/g, Water Content: &lt; 5%</li> <li>• Used to adsorb polar compounds (-OH groups, esp. phenolic compounds) from aqueous or methanolic solutions under the reversed-phase mechanism through strong hydrogen bonding between compound hydroxyl groups and amide groups of the resin</li> <li>• Useful for extracting tannins, chlorophyll, humic acid, pharmacologically active terpenoids, flavanoids, gallic acid, catechol A protocatechuic acid, and phloroglucinol</li> <li>• Also useful for extracting aromatic carboxylic acids, nitroaromatic compounds, and irreversibly retains quinones</li> </ul>

### Discovery Reversed-Phase SPE Products

Description	Qty./Pk	DSC-18	DSC-18Lt	DSC-8	DSC-Ph	DSC-CN	DPA-6S
<b>Discovery SPE Tubes</b>							
50 mg/1 mL	108	52601-U	52610-U	52703-U	52723-U	52693-U	52624-U
100 mg/1 mL	108	52602-U	52611-U	52707-U	52725-U	52694-U	-
500 mg/3 mL	54	52603-U	52613-U	52713-U	52727-U	52695-U	<sup>4</sup> 52625-U
500 mg/6 mL	30	52604-U	52615-U	52714-U	52728-U	52696-U	<sup>5</sup> 52626-U
1 g/6 mL	30	52606-U	52616-U	52716-U	52731-U	52697-U	<sup>6</sup> 52627-U
2 g/12 mL	20	52607-U	52618-U	52717-U	Custom	52698-U	<sup>7</sup> 52629-U
5 g/20 mL	20	52608-U	52621-U	52718-U	Custom	52699-U	<sup>8</sup> 52631-U
10 g/60 mL	16	52609-U	52622-U	52722-U	Custom	52700-U	<sup>9</sup> 52632-U
<b>Discovery SPE 96-Well Plates</b>							
100 mg/well	1	575603-U	575606-U	575627-U	575630-U	575624-U	Custom
50 mg/well	1	575602-U	575605-U	575628-U	575631-U	575625-U	Custom
25 mg/well	1	575601-U	575604-U	575629-U	575632-U	575626-U	Custom
<b>Bulk packing</b>	100 g	52600-U	52623-U	57223-U	57227-U	57222-U	<sup>10</sup> 52633-U

<sup>4</sup> 250 mg/3 mL, <sup>5</sup> 250 mg/6 mL, <sup>6</sup> 500 mg/6 mL, <sup>7</sup> 1 g/12 mL, <sup>8</sup> 2 g/20 mL, <sup>9</sup> 5 g/60 mL, <sup>10</sup> 50 g

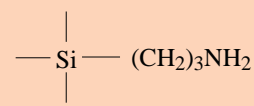
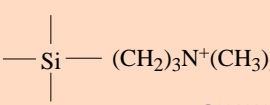
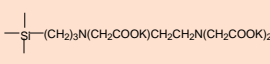
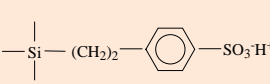
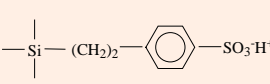
# Discovery SPE

## Ion-Exchange & Mixed-Mode

Discovery ion-exchange SPE products are specifically developed, tested and quality controlled for pharmaceutical and clinical applications. The Discovery ion-exchange product line offers excellent selectivity towards charged molecular species enabling the user to extract, isolate, purify, and concentrate charged ionizable pharmaceuticals (basic or acidic) from both polar and non-polar sample matrices.

Use mixed-mode SPE (e.g., Discovery DSC-MCAX) for superior cleanup and selectivity when extracting basic pharmaceutical compounds from biological matrices such as plasma and urine.

For Discovery silica specifications, see pg. 2. For general guidelines on ion-exchange & mixed-mode SPE, see pg. 33.

<p><b>DSC-NH<sub>2</sub></b></p>  <p>G001631</p>	<ul style="list-style-type: none"> <li>• Polymerically bonded, aminopropyl phase that is very polar in nature (hydrogen bonding) allowing for both normal-phase and ion-exchange applications</li> <li>• A weak anion exchanger with a pKa of 9.8. At pH 7.8 or below, the functional groups are positively charged</li> <li>• Allows the rapid release of very strong anions such as sulfonic acids that may be retained irreversibly on SAX (a quarternary amine sorbent that is always positively charged)</li> <li>• Can be used in some reversed-phase applications (due to ethyl spacer); however, it is predominately used as an ion-exchanger or normal-phase sorbent due to its polar nature</li> </ul>
<p><b>DSC-SAX</b></p>  <p>G001629</p>	<ul style="list-style-type: none"> <li>• A polymerically bonded quarternary amine that remains charged at all pH levels</li> <li>• Commonly used when extracting weaker cations (e.g., carboxylic acids) that may not bind strongly enough to weaker anion-exchangers</li> <li>• Selectivity can be modified by changing the counter ion with the appropriate buffer during conditionin</li> <li>• Counter ion Cl<sup>-</sup></li> </ul>
<p><b>DSC-WCX</b></p>  <p>G001632</p>	<ul style="list-style-type: none"> <li>• A polymerically bonded carboxy propyl phase with a K<sup>+</sup> counter ion and a pKa of 4.8</li> <li>• Its weak cation exchange properties carries a negative charge at pH 6.8 or above</li> <li>• A pH of 2.8 or below neutralizes this phase for easier elution of strong cationic analytes that are neutralized only at extreme basic conditions</li> <li>• Typically used when dealing with very strong cationic (high pKa) compounds that may be irreversibly retained on strong cation exchangers</li> </ul>
<p><b>DSC-SCX</b></p>  <p>G001630</p>	<ul style="list-style-type: none"> <li>• A polymerically bonded, benzene sulfonic acid functional group with a H<sup>+</sup> counter ion that is a strong cation exchanger due to its very low pKa (&lt;1.0)</li> <li>• Silica support allows for use with very organic solvents (no shrinking/swelling)</li> <li>• Excellent capacity (0.8 meq/g) for cleaning up solution phase combinatorial chemistry reactions (removing target molecules from reaction by-products and excess reagents)</li> <li>• The presence of the benzene ring offers some mixed-mode capabilities (hydrophobic interactions) that should be considered when extracting cations from aqueous matrices</li> </ul>
<p><b>DSC-MCAX</b></p>  <p>G001630, G001624</p>	<ul style="list-style-type: none"> <li>• Packed bed contains both octyl (C8) and benzene sulfonic acid (SCX) bondings. (H<sup>+</sup> as counterion)</li> <li>• Developed for superior selectivity/sample cleanup when isolating basic compounds from biological fluids</li> <li>• Dual retention mechanisms broadens retention for a range of neutral, basic, acidic and zwitterionic compounds</li> <li>• Greater ion-exchange capacity for isolating polar basic and zwitterionic compounds</li> <li>• Can be used to fractionate basic/zwitterionic compounds from acidic and neutral compounds</li> </ul>

### Discovery Ion-Exchange SPE Products

Description	Qty./Pk	DSC-NH <sub>2</sub>	DSC-SAX	DSC-WCX	DSC-SCX	DSC-MCAX
<b>Discovery SPE Tubes</b>						
50 mg/1 mL	108	52635-U	52661-U	52737-U	52684-U	52781-U
100 mg/1 mL	108	52636-U	52662-U	52739-U	52685-U	52782-U
500 mg/3 mL	54	52637-U	52664-U	52741-U	52686-U	52783-U
500 mg/6 mL	30	52638-U	52665-U	52742-U	52688-U	52784-U
1 g/6 mL	30	52640-U	52666-U	52743-U	52689-U	52786-U
2 g/12 mL	20	52641-U	52667-U	52744-U	52690-U	52788-U
5 g/20 mL	20	52642-U	52668-U	52745-U	52691-U	-
10 g/60 mL	16	52644-U	52669-U	52746-U	52692-U	-
<b>Discovery SPE 96-Well Plates</b>						
100 mg/well	1	575615-U	575618-U	575633-U	575621-U	575641-U
50 mg/well	1	575616-U	575619-U	575634-U	575622-U	575640-U
25 mg/well	1	575617-U	575620-U	575635-U	575623-U	575639-U
<b>Bulk packing</b>	100 g	57212-U	57214-U	57228-U	57221-U	-

# Discovery SPE

## Normal-Phase

Discovery normal-phase SPE products are specifically developed, tested and quality controlled for normal phase pharmaceutical applications and other modified flash techniques. The Discovery normal phase product line enables you to quickly and effectively extract, isolate, purify, and concentrate polar compounds from non-

polar solutions. Its highly selective properties allow the user to separate or remove structurally similar molecules through successive wash/elutions with increasingly polar solutions.

For Discovery silica specifications, see pg. 2. For general guidelines on normal-phase SPE, see pg. 34.

<p><b>DSC-Si</b></p> $\begin{array}{c}   \\ \text{---Si---OH} \\   \end{array}$	<ul style="list-style-type: none"> <li>Unbonded acid washed silica sorbent ideal for normal-phase SPE and other modified flash techniques</li> <li>Considered the most polar normal-phase sorbent available</li> <li>Excellent capacity for purifying solution phase CombiChem reactions when removing target molecules from reaction by-products and excess reagents</li> <li>Available in Büchner Funnel configurations for easy scalability</li> </ul>
<p><b>DSC-Diol</b></p> $\begin{array}{c}   \\ \text{---Si---(CH}_2\text{)}_3\text{CH}_2\text{CH---CH}_2 \\   \quad \quad \quad   \quad \quad \quad   \\ \quad \quad \quad \text{OH} \quad \quad \quad \text{OH} \end{array}$ <p>G001627</p>	<ul style="list-style-type: none"> <li>Polymerically bonded, 2,3-Dihydroxypropoxypropyl (7% C)</li> <li>Polar sorbent most commonly used for normal-phase applications (polar extractions from non-polar matrices)</li> <li>The sorbent's dihydroxy groups facilitate strong hydrogen bonding</li> <li>Excellent selectivity when extracting structurally similar molecules</li> </ul>
<p><b>DSC-CN</b></p> $\begin{array}{c}   \\ \text{---Si---(CH}_2\text{)}_3\text{CN} \\   \end{array}$ <p>G001626</p>	<ul style="list-style-type: none"> <li>Monomerically bonded, cyanopropyl (7% C), endcapped</li> <li>Can behave as either reversed-phase or normal-phase</li> <li>Ideal for very hydrophobic analytes that may be irreversibly retained on more hydrophobic sorbents such as DSC-18</li> <li>Less retentive than DSC-Si or DSC-Diol when used as normal-phase (organic matrices such as hexane or oils)</li> <li>Allows for the rapid release of very polar molecules irreversibly retained on very polar sorbents</li> </ul>
<p><b>DSC-NH<sub>2</sub></b></p> $\begin{array}{c}   \\ \text{---Si---(CH}_2\text{)}_3\text{NH}_2 \\   \end{array}$ <p>G001631</p>	<ul style="list-style-type: none"> <li>Polymerically bonded, aminopropyl phase that is very polar in nature (hydrogen bonding) allowing for both normal-phase and ion-exchange applications</li> <li>A weak anion exchanger with a pKa of 9.8. At pH 7.8 or below, the functional groups are positively charged</li> <li>Allows the rapid release of very strong anions such as sulfonic acids that may be retained irreversibly on SAX (a quarternary amine sorbent that is always positively charged)</li> <li>Can be used in some reversed-phase applications (due to ethyl spacer); however, it is predominately used as an ion-exchanger or normal-phase sorbent due to its polar nature</li> </ul>

### Discovery Normal-Phase SPE Products

Description	Qty./Pk	DSC-CN	DSC-Si	DSC-Diol	DSC-NH <sub>2</sub>
<b>Discovery SPE Tubes</b>					
50 mg/1 mL	108	52652-U	52652-U	52747-U	52635-U
100 mg/1 mL	108	52653-U	52653-U	52748-U	52636-U
500 mg/3 mL	54	52654-U	52654-U	52751-U	52637-U
500 mg/6 mL	30	52655-U	52655-U	52752-U	52638-U
1 g/6 mL	30	52656-U	52656-U	52753-U	52640-U
2 g/12 mL	20	52657-U	52657-U	Custom	52641-U
5 g/20 mL	20	52658-U	52658-U	Custom	52642-U
10 g/60 mL	16	52659-U	52659-U	Custom	52644-U
<b>Discovery SPE 96-Well Plates</b>					
100 mg/well	1	575609-U	575609-U	575636-U	575615-U
50 mg/well	1	575608-U	575608-U	575637-U	575616-U
25 mg/well	1	575607-U	575607-U	575638-U	575617-U
<b>Discovery Büchner Funnels</b>					
12.5 g, 55 mm ID x 30 mm H	6	Custom	52591-U	Custom	Custom
25 g, 70 mm ID x 40 mm H	6	Custom	52592-U	Custom	Custom
50 g, 90 mm ID x 48 mm H	6	Custom	52593-U	Custom	Custom
100 g, 110 mm ID x 66 mm H	6	Custom	52594-U	Custom	Custom
<b>Bulk packing</b>	100 g	52651-U	52651-U	57229-U	57212-U

For a complete list of available Büchner funnels, see page 21.

Discovery SPE  
Normal-Phase

# Supelclean & Supelclean ENVI

## Reversed-Phase

The Supelclean SPE line represents one of our original brands and is referenced in hundreds of journal publications, and validated in methods such as EPA 500 series (drinking water) and SW-846 methods (solid waste).

For Supelclean silica specifications, see pg. 2. For general guidelines on reversed-phase SPE, see pg. 32.

<b>ENVI-18</b>	<ul style="list-style-type: none"> <li>• Polymerically bonded, octadecyl (17% C), endcapped</li> <li>• Excellent for cleaning, extracting &amp; concentrating pollutants from aqueous environmental samples</li> <li>• Higher 17% C loading for increased binding capacities and higher recoveries</li> <li>• Higher carbon loading also offers greater resistance to extreme pH conditions</li> <li>• Typical applications include herbicides, fungicides, pesticides and other aqueous hazardous waste materials</li> <li>• Ideal for EPA 500 series including 525.1 and 508.1</li> </ul>
<b>ENVI-18 &amp; ENVI-8 DSK SPE Disks</b>	<ul style="list-style-type: none"> <li>• The SPE membrane equivalents of ENVI-18 and ENVI-8 packed bed SPE sorbents</li> <li>• Porous glass fiber membranes embedded with C18 or C8 silica particles</li> <li>• Provides faster flow rates and exhibits less clogging than PTFE discs for the extraction of organic contaminants from drinking water</li> <li>• Typical applications include PAHs, PCBs, phthalates, semivolatile organics, paraquat and diquat, pesticides and herbicides</li> <li>• Ideal for EPA 500 series including 525.1 and 508.1</li> </ul>
<b>LC-18</b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, octadecyl (10% C), endcapped</li> <li>• For reversed-phase extraction of nonpolar to moderately polar compounds.</li> </ul>
<b>ENVI-8</b>	<ul style="list-style-type: none"> <li>• Available in glass tubes with PTFE frits</li> <li>• High 14% C loading for increased binding capacities and higher recoveries</li> <li>• Higher carbon loading also offers greater resistance to extreme pH conditions</li> <li>• Excellent for cleaning, extracting &amp; concentrating pollutants from aqueous environmental samples</li> </ul>
<b>LC-8</b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, octyl (7% C), endcapped</li> </ul>
<b>ENVI-Chrom P</b> <i>(polystyrene divinylbenzene)</i>	<ul style="list-style-type: none"> <li>• Styrene/divinylbenzene co-polymer resin: Particle Size: 80-160 µm; Spherical Shape; Pore Size: 110-175 Å; Surface Area: 900 m<sup>2</sup>/g</li> <li>• Highly crosslinked, neutral, specially cleaned styrene-divinylbenzene resin used to retain hydrophobic compounds with some hydrophilic functionality under the reversed-phase mechanism</li> <li>• Highly resistant to extreme pH conditions</li> <li>• Typical applications include aromatic and phenolic compounds from aqueous sample matrices</li> <li>• Used for priority pollutant phenols from aqueous samples</li> </ul>
<b>ENVI-Carb &amp; ENVI-Carb II</b> <i>(graphitized carbon black)</i>	<ul style="list-style-type: none"> <li>• Surface Area: 100 m<sup>2</sup>/g, Particle Size: 100/400 mesh (ENVI-Carb-II: 100/140 mesh)</li> <li>• Extreme affinity for organic polar and non-polar compounds from both non-polar and polar matrices when used under reversed-phase conditions</li> <li>• Carbon surface comprised of hexagonal ring structures, interconnected and layered into graphitic sheets</li> <li>• Non-porous nature of the carbon phase allows for rapid processing, adsorption does not require analyte dispersion into solid phase pores</li> <li>• Independent investigators have found ENVI-Carb extremely useful for the rapid sample preparation of over 200 pesticides from various matrices including ground water, fruits, and vegetables (publication T196900)</li> </ul>
<b>LC-4 (Wide Pore)</b>	<ul style="list-style-type: none"> <li>• Butyldimethyl, wide pore (500 Å), endcapped</li> <li>• Larger pore size to accommodate larger macromolecules (e.g., proteins and peptides)</li> <li>• Commonly used for desalting proteins and peptides in aqueous samples</li> </ul>
<b>Hisep™</b>	<ul style="list-style-type: none"> <li>• Hydrophobic sites shielded by a hydrophilic surface for protein exclusion during sample load</li> <li>• Hydrophobicity similar to C8</li> </ul>
<b>LC-Ph</b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, phenyl (5.5% C), endcapped</li> </ul>
<b>LC-CN</b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, cyanopropyl (7.5% C), endcapped</li> </ul>

For available configurations & part numbers, please see page 18.

# Supelclean & Supelclean ENVI

## Ion-Exchange & Normal-Phase

The Supelclean SPE line represents one of the original brands to be introduced into the market place. It is referenced in hundreds of journal publications, and validated in a variety of methods spanning environmental applications to the food & beverage industry. The Supelclean ENVI reversed-phase line was developed and optimized for numerous

environmental methods including EPA 500 series (drinking water methods), and a number of SW-846 methods (solid waste).

For Supelclean silica specifications, please see pg. 2. For general guidelines on ion-exchange & normal-phase SPE, see pgs. 33 & 34.

<b>LC-SAX</b>	<ul style="list-style-type: none"> <li>• A strong anion exchanger with pKa of 10.1 and 10.9</li> <li>• Quarternary amine, Cl<sup>-</sup> counter-ion</li> </ul>
<b>LC-SCX</b>	<ul style="list-style-type: none"> <li>• Aliphatic sulfonic acid, Na<sup>+</sup> counter-ion, endcapped</li> </ul>
<b>LC-WCX</b>	<ul style="list-style-type: none"> <li>• Carboxylic acid, Na<sup>+</sup> counter-ion</li> </ul>
<b>LC-NH<sub>2</sub></b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, aminopropyl (5% C)</li> </ul>
<b>PSA</b>	<ul style="list-style-type: none"> <li>• Polymerically bonded, ethylenediamine-N-propyl phase that contains both primary and secondary amines</li> </ul>
<b>ENVI-Florisil</b>	<ul style="list-style-type: none"> <li>• Magnesium silicate, mesh: 100/200, available with PTFE or stainless steel frits</li> <li>• Tested for US Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) statement of work for pesticides</li> <li>• Highly polar material that strongly adsorbs polar compounds from non-polar matrices under normal-phase conditions</li> <li>• Typical applications include alcohols, aldehydes, amines, herbicides, pesticides, PCBs, ketones, nitro compounds, organic acids, and phenols</li> </ul>
<b>Dual Layer Florisil/Na<sub>2</sub>SO<sub>4</sub></b>	<ul style="list-style-type: none"> <li>• Dual layer glass SPE tube that contains Na<sub>2</sub>SO<sub>4</sub> (upper layer) and Florisil (magnesium silicate; lower layer) separated and packed with PTFE frits</li> <li>• Florisil, activated, size- 60/100 mesh (150-200 mm), Na<sub>2</sub>SO<sub>4</sub> Purity- 99.99 %, Density- 2.68 g/mL</li> <li>• Excellent for removing/isolating polar compounds from organic matrices</li> <li>• Na<sub>2</sub>SO<sub>4</sub> layer aids in removing aqueous sample residues that may hinder Florisil performance and/or subsequent GC analysis</li> <li>• Suitable for the determination of the hydrocarbon oil index in water (surface, waste, and sewage treatment plants) by GC-FID analysis according to European Standard EN ISO 9377-2:2000 (enclosed in the Extraction Kit for EN ISO 9377-2 Cat.No. 68172)</li> <li>• Glass SPE hardware allows user to reactivate Florisil through heating at 140 °C, 16 hours</li> <li>• Use in conjunction with Visiprep Large Volume Sampler (Cat.No.57275, only suitable for PP SPE tubes) and Visiprep SPE Vacuum Manifolds for processing larger volume samples</li> </ul>
<b>LC-Florisil</b>	<ul style="list-style-type: none"> <li>• Magnesium silicate, mesh: 100/120</li> </ul>
<b>LC-Alumina A, N, &amp; B</b>	<ul style="list-style-type: none"> <li>• Alumina-A for acidic pH (~5)</li> <li>• Alumina-N for neutral pH (~6.5)</li> <li>• Alumina-B for basic pH (~8.5)</li> <li>• Brockman Activation I for all Alumina SPE products, mesh: 60/325</li> </ul>
<b>LC-CN</b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, cyanopropyl (7% C), endcapped</li> </ul>
<b>LC-Si</b>	<ul style="list-style-type: none"> <li>• Silica gel</li> </ul>
<b>LC-Diol</b>	<ul style="list-style-type: none"> <li>• Monomerically bonded, Diol (7% C), endcapped</li> </ul>

For available configurations & part numbers, please see page 18.

# Supelclean & Supelclean ENVI SPE

All SPE tubes listed consist of polypropylene hardware and PE frits unless noted otherwise. Color coded footnotes denote differences in hardware, package size, or bed weight from the standard configuration.

Description	0.1 g/1 mL pk 108	0.5 g/3 mL pk 54	0.5 g/6 mL pk 30	1 g/6 mL pk 30	2 g/12 mL pk 20	5 g/20 mL pk 20	10 g/60 mL pk 16	100 g bulk
ENVI-18	57062	57063	57064 54331-U <sup>1</sup>	505706	57114	57137	57138	57219
ENVI-18 DSK SPE Disks			57171 <sup>12</sup>	57170-U <sup>13</sup>				
ENVI-8 DSK SPE Disks			57172 <sup>12</sup>					
LC-18	504270	57012	57054	505471	57117	57135-U	57136	57202
ENVI-8	57230-U	57231 57106 <sup>6</sup>	57232 57107 <sup>6</sup>	57233 57108 <sup>6</sup>		57139	57140-U	
LC-8	504157	505145	57052					57201
ENVI-Chrom P	57143	57224 <sup>5</sup>	57226 57225-U <sup>7</sup>					57217 <sup>11</sup>
ENVI-Carb	57109-U	57088 <sup>5</sup>	57094 57092 <sup>7</sup>		57128 57127-U <sup>10</sup>	57129	57130	57210-U <sup>11</sup>
ENVI-Carb C, mesh 80/100					57149 <sup>10</sup>			
LC-4 (Wide Pore)		57089						
Hisep		57076-U						
LC-Ph	504599	505269						
LC-CN	504386	57013	57056			57141	57142	
LC-Diol	504718	57016						
ENVI-Florisil		57058 <sup>2</sup>	57046 <sup>3</sup>	57053 <sup>3</sup> 54095 <sup>1</sup>				
Dual Layer Florisil/ Na <sub>2</sub> SO <sub>4</sub>				52582-U <sup>1,9</sup> 54116-U <sup>2,9</sup>				
LC-Florisil			54333-U <sup>1</sup>	57057 54334-U <sup>1</sup>	57115	57131	57132	57209
LC-Alumina A		57082-U <sup>6</sup>		57083-U <sup>8</sup>				57026
LC-Alumina B		57084 <sup>6</sup>		57085 <sup>8</sup>				57207
LC-Alumina N		57086 <sup>6</sup>		57087 <sup>8</sup>				57028
LC-Si	504041	505048	505374	57051 54335-U <sup>1</sup>	57116	57133	57134	57200
LC-NH <sub>2</sub>	504483	57014	54059-U					57205
PSA		52578-U <sup>4</sup>	52579-U					52738-U
LC-SAX	504815	57017						57203
LC-SCX	504920	57018						57204
LC-WCX	505595	57061						

#### Footnotes/Color Codes

<sup>1</sup> glass SPE tubes, PTFE frits

<sup>2</sup> PP SPE tubes, PTFE frits

<sup>3</sup> PP SPE tubes, stainless steel frits

<sup>4</sup> 0.2 g/3 mL, pk 54

<sup>5</sup> 0.25 g/3 mL, pk 54

<sup>6</sup> 1 g/3 mL, pk 54

<sup>7</sup> 0.25 g/6 mL

<sup>8</sup> 2 g/6 mL, pk 30

<sup>9</sup> 2 g/2 g/6 mL, pk 48

<sup>10</sup> 1 g/12 mL, pk 20

<sup>11</sup> 50 g bulk

<sup>12</sup> 47 mm diam. disks, pk 24

<sup>13</sup> 90 mm diam. disks, pk 12

For a list of method development kits containing various phases, see next page.

## Multi-Layer SPE

Developed to provide superior cleanup when conducting multi-residue pesticide analysis in food/agricultural matrices.

Description	Cat. No.	Description	Cat. No.
<b>ENVI-Carb-II/PSA</b>		<b>ENVI-Carb/LC-NH<sub>2</sub></b>	
0.3 g/0.5 g/6 mL, pk 30	54058-U	0.5 g/0.5 g/3 mL, pk 20	54332-U
0.5 g/0.5 g/6 mL, pk 30	54067-U	0.5 g/0.5 g/20 mL, pk 20	54216-U
0.5 g/0.3 g/6 mL, pk 30	55119-U	0.5 g/0.5 g/20 mL, pk 300	54024-U
0.5 g/0.5 g/20 mL, pk 20	54217-U	0.5 g/0.5 g/6 mL, pk 30	54035-U
<b>ENVI-Carb-II/SAX/PSA</b>		<b>ENVI-Carb/NH<sub>2</sub>/Silica</b>	
0.5 g/0.5 g/0.5 g/12 mL, pk 20	52574-U	0.5 g/0.4 g/0.6 g/12 mL, pk 20	54034-U
<b>SAX/PSA</b>		0.5 g/0.4 g/0.6 g/20 mL, pk 20	54036-U
0.25 g/0.25 g/6 mL, pk 30	52576-U	<b>Dual Layer Florisil/Na<sub>2</sub>SO<sub>4</sub></b>	
0.5 g/0.5 g/6 mL, pk 30	52577-U	Glass tubes, PTFE frits, 2 g/2 g/6 mL, pk 48	52582-U
		2 g/2 g/6 mL, PP, pk 48	54116-U

# SPE Method Development Kits

## Supelclean SPE Method Development Kits

Supelclean SPE Method Development Kits consist of an assortment of SPE phase chemistries and cartridge configurations ideal for SPE method development. The range of phase chemistries available for each kit allows the user to profile for compound retention, elution and sample matrix selectivity.



### Supelclean SPE Method Development Kits

SPE Method Development Kit	Kit A	Kit B	Kit C	Kit NP-3	Kit IX-3
<b>Supelclean Packing</b>			<b>Sorbent Qty./Tube Size</b>		
LC-Si	500 mg/3 mL	100 mg/1 mL	500 mg/6 mL 1 g/6 mL	500 mg/3 mL -	- -
LC-8	500 mg/3 mL	100 mg/1 mL	500 mg/6 mL	-	-
LC-18	500 mg/3 mL	100 mg/1 mL	500 mg/6 mL	-	-
LC-CN	500 mg/3 mL	100 mg/1 mL	500 mg/6 mL	-	500 mg/3 mL
LC-Diol	500 mg/3 mL	100 mg/1 mL	-	500 mg/3 mL	-
LC-NH <sub>2</sub>	500 mg/3 mL	100 mg/1 mL	-	500 mg/3 mL	500 mg/3 mL
LC-Ph	500 mg/3 mL	100 mg/1 mL	-	-	-
LC-SAX	500 mg/3 mL	100 mg/1 mL	-	-	500 mg/3 mL
LC-SCX	500 mg/3 mL	100 mg/1 mL	-	-	500 mg/3 mL
LC-WCX	500 mg/3 mL	100 mg/1 mL	-	-	500 mg/3 mL
LC-Alumina-A	-	-	2 g/6 mL	1 g/3 mL	-
LC-Alumina-B	-	-	2 g/6 mL	1 g/3 mL	-
LC-Alumina-N	-	-	2 g/6 mL	1 g/3 mL	-
LC-Florisil	-	-	1 g/6 mL	-	-
Qty. Ea. Tube	6	12	3	6	12
Cat. No.	57019	57009-U	57075-U	57074-U	57073

For more information about **FREE SPE SAMPLES**, see pg. 5.

## 96-Well SPE Method Development Plate

Supelco 96-Well SPE method development plates contain an assortment of SPE phase chemistries ideally suited for method development. The mix of phase chemistries contained within this 96-well SPE plate allows researchers to screen for analyte retention, recovery, and selectivity when achieving one's sample prep objectives.



Description	Qty.	Cat. No.
<b>96-well SPE Method Development Plate</b>		
BAN, 25 mg/well (configured for extracting basic, acidic and neutral compounds)	1	577522-U

	1	2	3	4	5	6	7	8	9	10	11	12
A	Discovery DSC-PS/DVB (polystyrene divinyl benzene) <sup>1</sup>											
B	Discovery DSC-18 (tC18) <sup>1</sup>											
C	Discovery DSC-8 (C8) <sup>1</sup>											
D	Discovery DSC-CN (cyanopropyl) <sup>1</sup>											
E	Discovery DSC-MCAX (mixed-mode cation exchange) <sup>1,2</sup>											
F	Discovery DSC-WCX (weak cation exchange) <sup>2</sup>											
G	Discovery DSC-SAX (strong anion exchange) <sup>3</sup>											
H	Discovery DSC-NH <sub>2</sub> (aminopropyl weak anion exchange) <sup>3</sup>											

<sup>1</sup> Reversed-phase; <sup>2</sup> Cation-exchange; <sup>3</sup> Anion-exchange

# Specialty Products for Pharmaceutical Analysis

## Supelco SPE 96-well Plates



P001248

Supelco SPE 96-well plates answer the challenge of high throughput sample prep for pharmaceutical bioanalysis. These plates are packed with our high quality Discovery SPE line, Supel-Select HLB phase (see pg. 9), and our new and innovative HybridSPE-Precipitation technology (see pg. 8). The uniform flow dynamics inherent with well plate technology offers a high level of

reproducibility and throughput while maintaining excellent recoveries for increased sensitivity.

### 96-Well Plate Specifications:

- One-piece polypropylene square well design
- 2 mL sample volume
- Polyethylene frit, 20 µm porosity (Discovery and Supel-Select HLB only)
- Compatible with TomTec Quadra 96®, Microlab STAR®, Packard Multi-Probe®, and most other 96-well automated SPE systems.

### Supelco SPE 96-well Plates

Phase	25 mg/well	50 mg/well	100 mg/well
HybridSPE-PPT	–	575656-U	–
Supel-Select HLB	–	575661-U*	575662-U*
Discovery DSC-18	575601-U	575602-U	575603-U
Discovery DSC-18Lt	575604-U	575605-U	575606-U
Discovery DSC-MCAX	575639-U	575640-U	575641-U
Discovery DSC-8	–	575628-U	575627-U
Discovery DSC-Ph	575632-U	575631-U	575630-U
Discovery DSC-CN	575626-U	575625-U	575624-U
Discovery DSC-PS/DVB	575610-U	575611-U	–
Discovery DSC-Si	575607-U	575608-U	575642-U* 575609-U
Discovery DSC-Diol	575638-U	575637-U	575636-U
Discovery DSC-NH <sub>2</sub>	575617-U	575616-U	575615-U
Discovery DSC-SAX	575620-U	575619-U	575618-U
Discovery DSC-WCX	575635-U	575634-U	575633-U
Discovery DSC-SCX	575623-U	575622-U	575621-U

\*PE bottom frit (5 µm porosity)

\*Actual bed weight = 30 mg/well

▼Actual bed weight = 60 mg/well

## Supel-Tips SPE – Microscale Extraction

The Supel-Tips SPE product line is designed for the microscale extraction, concentration, and recovery of small molecules and biological macromolecules. These 10 µL pipette tips containing a sorbent bed bonded at the working end of the tip using an inert high-purity adhesive. The bed acts as a solid phase extraction medium to adsorb molecules of interest from the sample matrix. Subsequently, the concentrated and desalted analytes are eluted for downstream analysis.



P001231

### Supel-Tips Offer:

- Superior recovery
- Exceptional binding capacity and enhanced affinity
- Excellent sorbent bed stability for cleaner samples
- Fast and effective analyte retention/elution

[sigma-aldrich.com/pipette-tips](http://sigma-aldrich.com/pipette-tips)

### Supel-Tips

Description	Supel-Tip C18	Supel-Tip Carbon	Supel-Tip Zr	Supel-Tip Ti
Pipette Tip	10 µL, PP	10 µL, PP	10 µL, PP	10 µL, PP
Application	peptides and proteins	Oligosaccharides and other sugar containing macromolecules	Phosphopeptides and other phosphate containing molecules	Phosphopeptides and other phosphate containing molecules
Adsorbent	C18	Carbon	Zirconia-silica composite	Titania-silica composite
Particle Size	50-60 µm	50-60 µm	50-60 µm	50-60 µm
Pore Size	200 Å	175 Å	300 Å	300 Å
Capacity (per tip)	Insulin, Chain B, Oxidized – 17 µg; β-amyloid – 17 µg; Bradykinin, Fragment 1-7 – 7.6 µg	Maltohexose – 10.2 µg; Glycopeptide (mol. wt. 1300-3500) - > 10 µg	MPP1- 1 µg	MPP1- 1 µg
Cat. No. (pk. 96)	TPSC18	54227-U	54266-U	54263-U

# Specialty Products for Purification

## VersaPure Prepacked, Disposable Büchner Funnels

VersaPure Büchner funnels offer the convenience and capacity necessary to purify and/or filter larger scale samples and reaction mixtures. Researchers have used VersaPure Büchner Funnels for a variety of applications including: the purification of organic synthesis reactions, isolation of actives from natural products, filtration, removal of residual moisture from solvents, and more. The funnel consists of a solvent resistant two-piece semi-translucent polypropylene body. The packed bed is sandwiched between two PE frits (20 µm porosity) that are compressed in place by a heat riveted retaining ring to eliminate loose frits and minimize channeling. A 0.7 µm glass fiber membrane is placed below the bottom frit to capture any residual fines.



P001246

### VersaPure Büchner Funnel

Description	I.D. x H:	12.5 g (45 mL) - pk 6 55 mm x 30 mm	25 g (90 mL) - pk 6 70 mm x 40 mm	50 g (174 mL) - pk 3 90 mm x 48 mm	100 g (410 mL) - pk 3 110 mm x 66 mm
Discovery DSC-Si		52591-U	52592-U	52593-U	52594-U
Merck-Si		2026-U	2027-U	2028-U	2029-U
Charcoal		2031-U	2032-U	2033-U	2034-U
Magnesium Sulfate		2037-U	2041-U	2043-U	2044-U
Celite®		2047-U	2048-U	2049-U	2064-U
Florisil		2074-U	2076-U	2077-U	2078-U
Alumina-A		2084-U	2087-U	2088-U	2089-U
Alumina-N		2091-U	2092-U	2093-U	2094-U
Alumina-B		2096-U	2097-U	2098-U	2099-U
Discovery DPA-6S		2079-U	2081-U	2082-U	2083-U (pk. 1) 52634-U
Empty Büchner Funnel		2141-U	2142-U	2143-U	2144-U

## Polymer SAX Rezorian Cartridge



P000619

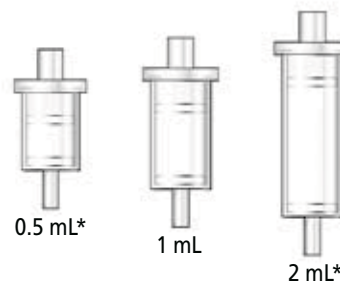
Retention Mechanism: Anion exchange

Sample Matrix Compatibility: Organic or aqueous samples

- A quarternary amine functional group bonded to styrene gel, 200/400 mesh (Dowex 1x8)
- Offers high capacity (3.5 meq/g) for extracting acidic compounds
- OH<sup>-</sup> counter ion; 8% cross linking; ~42% moisture; max temp. 99 °C
- Excellent resistance to extreme pH conditions

Description	Qty.	Cat. No.
<b>Polymer SAX Rezorian Cartridge</b>		
Bed wt. 6 g, vol. 5 mL	10	2832-U
Bed wt. 14.4 g, vol. 13 mL	10	2833-U

## Polymer SCX Reversible SPE Tube



G000363

Retention Mechanism: Cation exchange

Sample Matrix Compatibility: Organic or aqueous solutions

- A sulfonic acid functional group bonded to styrene gel, 200/400 mesh (DOWEX® 50Wx8)
- Offers high capacity (4.8 meq/g) for extracting basic compounds
- H<sup>+</sup> counter ion; 8% cross linking; ~54% moisture; max temp. 150 °C
- Excellent resistance to extreme pH conditions (1-14)

Description	Qty.	Cat. No.
<b>Polymer SCX Reversible SPE Tube</b>		
Bed wt. 700 mg, vol. 1 mL	10	54037-U

\*Available as custom only.

## Specialty Products for Environmental Analysis

### Supelclean Coconut Charcoal SPE Tube



9940374

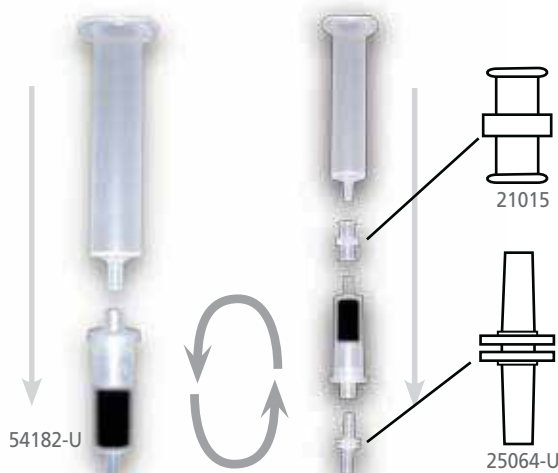
- Developed specifically for EPA Method 521 – Nitrosamines in Drinking Water
- Activated coconut charcoal stationary phase – particle size: 80/120 mesh
- Quality controlled for low fines and nitrosamine recovery

Description	Qty.	Cat. No.
Supelclean Coconut Charcoal SPE Tube, 2 g/6 mL	30	57144-U
Female Luer Coupler	20	2105
Male Luer Coupler	20	25064-U

### Supelclean ENVI-Carb Plus Reversible SPE

- Spherical carbon particles (carbon mol sieve) developed for the SPE of highly polar compounds from aqueous samples as drinking or ground water
- Offers extreme affinity to organic polar and non-polar compounds from both non-polar and polar matrices when used under reversed-phase conditions.
- Strong high surface spherical particles which are less friable (fines) than traditional graphitized carbon blacks
- Examples of highly polar compounds recovered:
  - ◆ Acephate (LogPo/w: -0.85)
  - ◆ Phenol (LogPo/w: 1.51)
  - ◆ 1,4-dioxane (LogPo/w: -0.27)
  - ◆ Oxamyl (LogPo/w: -1.2)
- When used in conjunction with an SPE vacuum manifold, a male luer coupler (25064-U), female luer coupler (21015) and empty SPE tube(s) are required but not included.

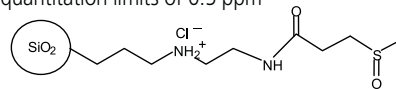
Description	Qty.	Cat. No.
Supelclean ENVI-Carb Plus Reversible SPE Tube, 0.4 g/1 mL	30	54182-U
Female Luer Coupler	20	21015
Male Luer Coupler	20	25064-U



G004179

### Supelclean Sulfoxide SPE

- Developed for the extraction of polychlorinated biphenyls (PCBs) from transformer, waste and mineral oil
- Proprietary silica-bonded sulfoxide (-SO) phase
- PCB retention facilitated by interaction between the SPE phase's electrophilic sulfur atom and the pi-electron cloud formed from aromatic rings inherent with PCBs
- Simple and efficient sample prep method for identifying PCBs at quantitation limits of 0.5 ppm



G004219



P001240

Description	Qty.	Cat. No.
Supelclean Sulfoxide Glass SPE Tube, 6 g/20 mL	5	55252-U
Supelclean Sulfoxide SPE, 3 g/6 mL	30	55253-U
Supelclean Sulfoxide, Bulk	100 g	55254-U
Empty Glass SPE Tube (17 mm I.D. x 137 mm L) with PE frit, 20 mL, with PE frit, luer cap, and screw-top cap	5	55255-U
Frit Insertion Tool for 20 mL Glass SPE tube	1	55257-U
Disposable PTFE liners	100	57059
Large volume reservoir (25 mL) for 6 mL SPE tubes, PP	30	54258-U
Large volume reservoir (25 mL) for 6 mL SPE tubes, PTFE	3	54259-U

### Multi-Layer SPE Tubes for EPA Method 8290

Configured for EPA Method 8290 – PCDDs and PCDFs by HRGC/HRMS

Cat. No. 52732-U	Cat. No. 52733-U
Upper PTFE Frit	Upper PTFE Frit
100 mg Merck Silica Gel 9385	400 mg Celite 545
200 mg Basic Silica Gel (2% KOH coated silica)	200 mg Celite/Carbon
400 mg Acidic Silica Gel (22% H <sub>2</sub> SO <sub>4</sub> coated silica)	400 mg Celite 545
200 mg Merck Silica Gel 9385	Lower PTFE Frit
Lower PTFE Frit	

The sample cleanup employed in EPA Method 8290 requires a series of hand-packed glass chromatography steps involving:

1. A multi-layer silica gel glass column
2. A sodium sulfate/alumina glass column
3. A multi-layer celite 545-activated carbon glass column

Cat. No. 52732-U can be used in place of the required multi-layer silica gel glass column, and Cat. No. 52733-U can be used in place of the required multi-layer celite 545-activated carbon glass column.

**Note:** The bed weights packed into these SPE tubes are smaller than what is described in EPA Method 8290. Therefore, to use these SPE tubes, sample volumes need to be scaled down accordingly.


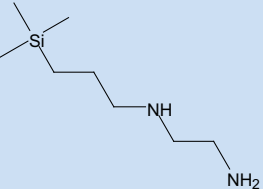
Description	Qty.	Cat. No.
Multi-layer Silica Gel SPE Tube, glass, 6 mL	30	52732-U
Multi-layer Celite/Activated Carbon SPE Tube, glass, 6 mL	30	52733-U

# Specialty Products for Pesticide Analysis

The Supelclean ENVI-Carb-II/PSA SPE product line consists of multi-layer SPE cartridges that were developed for superior cleanup when conducting multi-residue pesticide analysis in agricultural products (fruits, vegetables, meat, shellfish, grains, and dairy

products). The technology acts as a chemical filter in which each layer plays a specific role for removing key interferences.

**Note that dual layer ENVI-Carb/NH<sub>2</sub> SPE products are also available. Please see pg. 18 for a listing.**

<p><b>ENVI-Carb-II/PSA</b></p>  <p>G002462</p>	<ul style="list-style-type: none"> <li>• Dual layer SPE tube that contains both Supelclean ENVI-Carb-II (upper layer) and PSA (lower layer) SPE sorbents (separated by PE frit)</li> <li>• Developed to offer superior cleanup when conducting multi-residue pesticide analysis in food (e.g., fruits, vegetables, etc.)</li> <li>• ENVI-Carb-II is a graphitized non-porous carbon (100/140 mesh, surface area 100 m<sup>2</sup>/g) that has a strong affinity towards planar molecules, and has been quality controlled specifically for the isolation/removal of pigments (e.g., chlorophyll and carotinoids) and sterols commonly present in fruits, vegetables, and other natural products</li> <li>• Supelclean PSA is a polymerically bonded, ethylenediamine-N-propyl phase that contains both primary and secondary amines</li> <li>• Supelclean PSA has a strong affinity and high capacity for fatty acids, organic acids, and some polar pigments and sugars</li> <li>• Tested for superior cleanliness using GC-FID and GC-MS</li> </ul>
<p><b>ENVI-Carb-III/SAX/PSA</b></p>	<ul style="list-style-type: none"> <li>• Tri-layer SPE tube that contains Supelclean ENVI-Carb-II (upper layer), SAX (middle layer) and PSA (lower layer) SPE sorbents (separated by PE frit)</li> <li>• Developed to offer superior cleanup when conducting multi-residue pesticide analysis in food (e.g., fruits, vegetables, etc.)</li> <li>• ENVI-Carb-II is a graphitized non-porous carbon (100/140 mesh, surface area 100 m<sup>2</sup>/g) that has a strong affinity towards planar molecules, and has been quality controlled specifically for the isolation/removal of pigments (e.g., chlorophyll and carotinoids) and sterols commonly present in fruits, vegetables and other natural products</li> <li>• Supelclean PSA has a strong affinity and high capacity for fatty acids, organic acids, and some polar pigments and sugars</li> <li>• Supelclean SAX offers additional ion-exchange capacity for removing matrix components that may induce ion-suppression or enhancement during GC analysis</li> </ul>
<p><b>SAX/PSA</b></p>	<ul style="list-style-type: none"> <li>• Dual layer SPE tube that contains both Supelclean SAX (upper layer) and PSA (lower layer) SPE sorbents (separated by PE frit)</li> <li>• Supelclean SAX is a quarternary amine, Cl<sup>-</sup> counter-ion</li> <li>• Supelclean PSA is a polymerically bonded, ethylenediamine-N-propyl phase that contains both primary and secondary amines</li> <li>• Ideal for removing matrix components (fatty acids, organic acids, polar pigments, and some sugars) when conducting multi-residue pesticide analysis in foods</li> <li>• In compliance with Luke and Luke II methods that use SPE to reduce matrix induced ion-suppression and enhancement when conducting GC analysis of pesticides in food</li> </ul>
<p><b>ENVI-Carb</b></p>	<ul style="list-style-type: none"> <li>• Surface Area: 100 m<sup>2</sup>/g, Particle Size:100/400 mesh</li> <li>• Extreme affinity for organic polar and non-polar compounds from both non-polar and polar matrices when used under reversed-phase conditions</li> <li>• Carbon surface comprised of hexagonal ring structures, interconnected and layered into graphitic sheets</li> <li>• Non-porous nature of the carbon phase allows for rapid processing, adsorption does not require analyte dispersion into solid phase pores</li> <li>• Independent investigators have found ENVI-Carb extremely useful for the rapid sample preparation of over 200 pesticides from various matrices including ground water, fruits, and vegetables</li> </ul>
<p><b>PSA</b></p>  <p>G002460</p>	<ul style="list-style-type: none"> <li>• Polymerically bonded, ethylenediamine-N-propyl phase that contains both primary and secondary amines</li> <li>• A weak anion exchanger with a pKa of 10.1 and 10.9</li> <li>• Similar to aminopropyl SPE phases (NH<sub>2</sub>) in terms of selectivity, but has a much higher capacity due to presence of secondary amine (0.98-1.05 meq/g)</li> <li>• Strong affinity and high capacity for removing fatty acids, organic acids, and some polar pigments and sugars when conducting multi-residue pesticide analysis in foods</li> <li>• Has been shown to significantly reduce matrix-enhancement effects encountered during the GC analysis of food products</li> <li>• Bidentate nature of ligands allow for chelation</li> </ul>

For available configurations & part numbers, please see page 18.

## Specialty Products for Pesticide & FAME Analysis

### Dispersive SPE (dSPE)

Dispersive SPE (dSPE), often referred to as the “QueChERS” method (Quick, Easy, Cheap, Effective, Rugged, and Safe), is an emerging sample prep technique that is becoming increasingly popular in the area of multi-residue pesticide analysis in food and agricultural products.

In dSPE, food/agricultural samples are first extracted with an aqueous miscible solvent (e.g., acetonitrile) in the presence of high amounts of salts (e.g., sodium chloride and magnesium sulfate) and/or buffering agents (e.g. citrate) to induce liquid phase separation and stabilize acid and base labile pesticides, respectively. Upon shaking and centrifugation, an aliquot of the organic phase is subjected to further cleanup using SPE. Unlike traditional methods using SPE tubes, in dispersive SPE, cleanup is facilitated by mixing bulk amounts of SPE (e.g., Supelclean PSA, ENVI-Carb, and/or Discovery DSC-18) with the extract. After sample cleanup, the mixture is centrifuged and the resulting supernatant can either be analyzed directly or can be subjected to minor further treatment before analysis.



Supelco now offers a Comprehensive Dispersive SPE Customization Service. To learn more visit [sigma-aldrich.com/quechers](http://sigma-aldrich.com/quechers)

#### Dispersive SPE Products now Available for:

- 50 mL centrifuge tubes
- 2 mL microcentrifuge tubes
- Glass vials
- A wide range for Sigma-Aldrich/Supelco salts, buffering agents, and SPE phases

### Discovery Ag-Ion SPE Tubes for cis/trans FAME Analysis

Retention Mechanism: Normal-phase

Sample Matrix Compatibility: Organic solvents, oils, and lipids

- Developed for the fractionation of FAMES based on degree of unsaturation, and for the resolution of cis/trans isomers.
- Silver counter-ions are anchored onto a SCX support using a proprietary procedure to offer optimal resolution, performance, and capacity.
- Each lot is tested and quality controlled for cis/trans FAME resolution

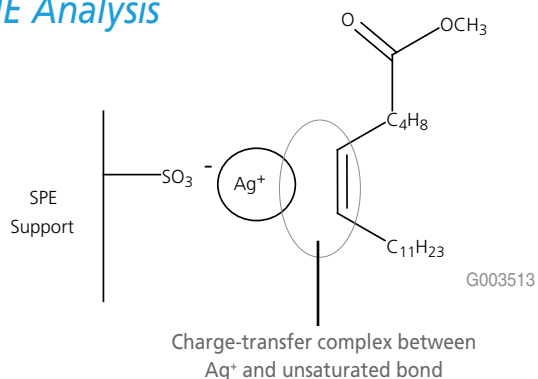
Description	Qty.	Cat. No.
750 mg/6 mL	30	54225-U
750 mg/1 mL reversible cartridge	10	54226-U

Supelco now carries a line of vials and centrifuge tubes containing pre-determined amounts of salts and SPE sorbents to support the most common method configurations used today.

#### Dispersive SPE (dSPE) Products

Description	Qty.	Cat. No.
<b>Packed in 12 mL Greiner Centrifuge Tube (Greiner Cat. No. 163270)</b>		
<i>Citrate Extraction Tube</i>	50	55227-U
4 g magnesium sulfate (Cat. No. 63135)		
1 g sodium chloride (Cat. No. 71379)		
0.5 g sodium citrate dibasic sesquihydrate (Cat. No. 71635)		
1 g sodium citrate tribasic dihydrate (Cat. No. 32320)		
<i>Mg<sub>2</sub>SO<sub>4</sub> Extraction Tube</i>	50	55234-U
6 g magnesium sulfate (Cat. No. 63135)		
1.5 g sodium acetate (Cat. No. 24,124-5)		
<i>PSA SPE Cleanup Tube 1</i>	50	55228-U
900 mg magnesium sulfate (Cat. No. 63135)		
150 mg Supelclean PSA (Cat. No. 52738-U)		
<i>PSA/C18 SPE Cleanup Tube 1</i>	50	55229-U
900 mg magnesium sulfate (Cat. No. 63135)		
150 mg Supelclean PSA (Cat. No. 52738-U)		
150 mg Discovery DSC-18 (Cat. No. 52600-U)		
<i>PSA/ENVI-Carb SPE Cleanup Tube 1</i>	50	55230-U
900 mg magnesium sulfate (Cat. No. 63135)		
150 mg Supelclean PSA (Cat. No. 52738-U)		
15 mg Supelclean ENVI-Carb (Cat. No. 57210-U)		
<i>PSA/ENVI-Carb SPE Cleanup Tube 2</i>	50	55233-U
900 mg magnesium sulfate (Cat. No. 63135)		
150 mg Supelclean PSA (Cat. No. 52738-U)		
45 mg Supelclean ENVI-Carb (Cat. No. 57210-U)		

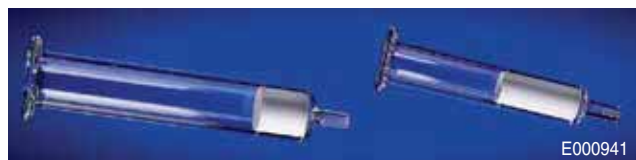
[sigma-aldrich.com/quechers](http://sigma-aldrich.com/quechers)



# Miscellaneous Specialty Products & SPE Accessories

## Glass SPE Tubes with PTFE Frits

A select line of our Supelclean SPE phase chemistries is also available in inert glass and PTFE hardware configurations.



### Features & Benefits:

- Resistant to harsh chemicals and aggressive solvents
- Absence of leachables such as phthalates and plasticizers
- Hygroscopic adsorbents (e.g. Florisil) can be easily heat treated/activated (e.g., 105-120 °C oven, overnight) prior to use.

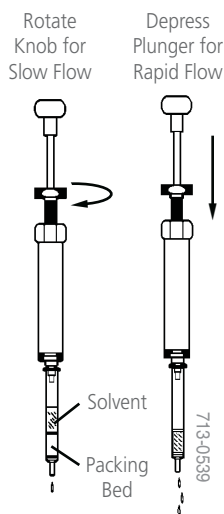
Description	Qty.	Cat. No.
<b>Supelclean ENVI-18 SPE Tube</b>		
glass hardware, PTFE frit, bed wt. 500 mg, vol. 6 mL	30	54331-U
<b>Supelclean ENVI-8 SPE Tube</b>		
glass hardware, PTFE frit, bed wt. 500 mg, vol. 3 mL	27	57106
glass hardware, PTFE frit, bed wt. 500 mg, vol. 6 mL	20	57107
<b>Supelclean LC-Florisil SPE Tube</b>		
glass hardware, PTFE frit, bed wt. 500 mg, vol. 6 mL	30	54333-U
glass hardware, PTFE frit, bed wt. 1 g, vol. 6 mL	30	54334-U
<b>Supelclean LC-Si SPE Tube</b>		
glass hardware, PTFE frit, bed wt. 1 g, vol. 6 mL	30	54335-U
<b>Dual Layer Florisil/Na<sub>2</sub>SO<sub>4</sub> SPE Tube</b>		
bed A 2 g (Na <sub>2</sub> SO <sub>4</sub> ), bed B 2 g (Florisil), vol. 6 mL	48	52582-U

## Single SPE Tube Processor

### Visi-1 processor - two rates of flow control

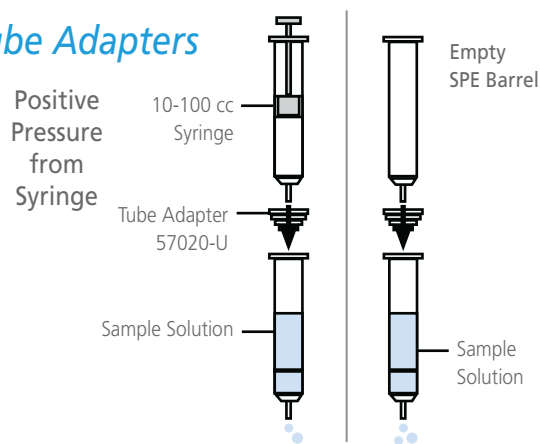
Our Visi-1 Single SPE Tube Processor provides precise flow control through a single 1 mL, 3 mL, or 6 mL SPE tube. There is no faster, more convenient, or more reliable method for processing one or a few samples.

Simply fill the SPE tube with the appropriate solution, and attach it to the Visi-1 processor. Remove the tube from the processor, introduce the next solution, and repeat the process.



Description	Cat. No.
Visi-1 Single SPE Tube Processor	57080-U

## Tube Adapters



Tube adapters serve many purposes. They can be used to stack one SPE tube on top of another to provide different selectivities. A larger empty syringe barrel can be stacked on top of a smaller SPE tube to act as a larger load reservoir. Or, they can serve as an adapter for positive pressure methods (e.g. from a syringe or air/N<sub>2</sub> line).

Description	Qty.	Cat. No.
<b>SPE Tube Adapters for Polypropylene Tubes</b>		
For 1, 3, 6 mL Tubes	12	57020-U
For 12, 20, 60 mL Tubes	6	57267
<b>AutoTrace SPE Tube Adapters*</b>		
For 3 mL Tubes	6	57123
For 6 mL Tubes	6	57126
* Allows SPE tubes to be used with AutoTrace® Automated Systems		
<b>SPE Tube Adapter for Glass Tubes</b>		
PTFE, for use with 6 mL glass SPE Tube	24	504335

## Large Volume SPE Reservoirs

Large volume SPE reservoirs are designed to increase the headspace volume of standard polypropylene SPE tubes. Because these reservoirs are designed to connect directly to the mouth of the SPE tube, they are ideal for gravity applications where increased headspace volume is required.

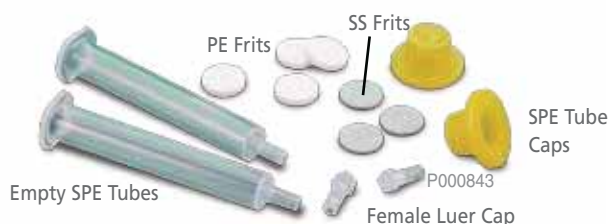
The reservoirs are designed for use with 6 mL polypropylene SPE tubes, and add an additional headspace volume of 25 mL.



Description	Qty.	Cat. No.
<b>Large Volume SPE Reservoir</b>		
Polypropylene	30	54258-U
PTFE	3	54259-U

# SPE Accessories

## Empty SPE Hardware & Components



SPE Accessories

### SPE Tube Components

Description		1 mL	3 mL	6 mL	12 mL	20 mL	60 mL
<b>Empty SPE Tubes with and without Frits</b>	<b>Qty.:</b>	<b>108</b>	<b>54</b>	<b>30</b>	<b>20</b>	<b>20</b>	<b>16</b>
Empty PP SPE Tube with PE Frits, 20 µm porosity	57023	57024	57026	57176	57177	57178	
Empty PP SPE Tube with PE Frits, 20 µm porosity – pre-fritted with bottom frit	54220-U (pk 100)	54221-U (pk 100)	54222-U (pk 100)	54223-U (pk 100)	57118-U	57119-U	
Empty PP SPE Tube (no frits)	57240-U	57241	57242	57179	57021 (Qty. 12)	57022 (Qty. 12)	
Empty Glass SPE Tubes with PTFE Frits, 20 µm porosity	–	–	504394*	–	–	–	
<b>SPE Tube Caps (encloses top of SPE tubes)</b>	<b>Qty.:</b>	<b>108</b>	<b>54</b>	<b>30</b>	<b>20</b>	<b>20</b>	<b>20</b>
PP cap for PP SPE tubes	52171-U	52172-U	52173-U	52174-U	52175-U	52176-U	
PTFE cap for glass SPE tube	–	–	504343*	–	–	–	
<b>Frits for use with SPE tubes</b>	<b>Qty.:</b>	<b>216</b>	<b>108</b>	<b>60</b>	<b>40</b>	<b>40</b>	<b>32</b>
PE Frits for PP SPE tubes, 20 µm porosity	57244	57180-U	57181	57182-U	57183	57184	
PTFE Frits for PP SPE tubes, 20 µm porosity	57185	57186	57187	57188	57189	57190-U	
PTFE Frits for glass SPE tubes, 20 µm porosity	–	–	504327	–	–	–	
SS Frit for PP SPE tubes, 20 µm porosity	–	–	57246-U	–	–	–	
<b>SPE Frit Insertion Tool</b>							
SPE Frit Insertion Tool, pk 1	55217-U	55218-U	55219-U	55221-U	55224-U	55224-U	
SPE Frit Insertion Tool Kit (includes all 5 tools for 1, 3, 6, 12 & 20/60 mL tubes)	–	–	–	–	55226-U	–	

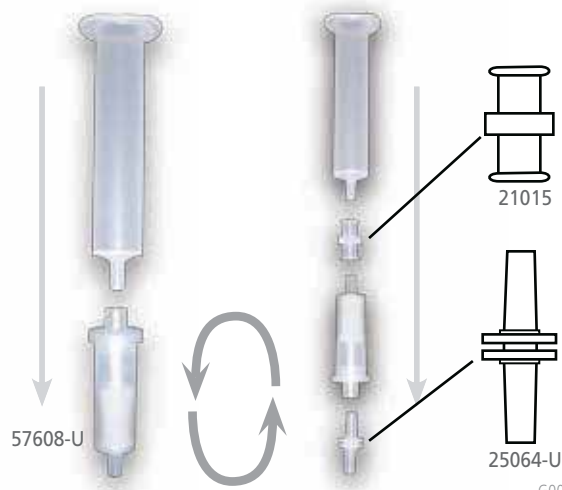
PP = Polypropylene; PTFE = Polytetrafluoroethylene; SS = Stainless steel; PE = Polyethylene

\* Qty. of 24

## Miscellaneous SPE Hardware & Accessories

Description	Qty.	Cat. No.
<b>Empty Reversible SPE Tube, non-fluorous PP, w/PE frits</b>		
0.5 mL	50	57602-U
1.0 mL	50	57607-U
2.0 mL	50	57608-U
<b>Empty Flangeless PP SPE Tubes w/PE Frits, 20 µm porosity</b>		
1 mL	108	Inquire
3 mL	54	Inquire
6 mL	30	Inquire
<b>Empty PP Rezorian Tube Kit w/PE Frits, luer plugs and caps</b>		
1.0 mL	50	57609-U
5.0 mL	50	57613-U
<b>Empty 96-well SPE Plates</b>		
2 mL deep square well, w/PE frits	1	Inquire
1.25 mL round well, w/PE frits	1	Inquire
<b>Empty PP Disposable Büchner Funnels w/PE Frits</b>		
55 mm I.D. x 30 mm H, 75 mL	6	2141-U
70 mm I.D. x 40 mm H, 165 mL	6	2142-U
90 mm I.D. x 48 mm H, 315 mL	6	2143-U
110 mm I.D. x 66 mm H, 875 mL	3	2144-U

Description	Qty.	Cat. No.
<b>Luer Caps, Plugs, and Couplers</b>		
Female Luer Cap, PP (caps SPE luer tips)	12	57098
Male Luer Plug, PP (plugs female luer fitting)	12	504351
Female Luer Coupler	20	21015
Male Luer Coupler	20	25064-U



G004179

# SPE Accessories - Vacuum Manifolds

## Visiprep & Visiprep DL SPE Vacuum Manifolds

Visiprep SPE Vacuum Manifolds allow you to process up to 12 or up to 24 SPE tubes simultaneously. Both DL (disposable liner) and standard models are available.

The Visiprep DL Vacuum Manifold eliminates the possibility of cross contamination when processing a new sample on the same port. The liner consists of a PP luer hub that attaches to the SPE tube, and thin walled PTFE tubing that is threaded through the SPE port. This ensures that all SPE port/valve surfaces coming in contact with the sample can be replaced following each extraction.



12-Port Visiprep DL  
Vacuum Manifold (57044)

### Features & Benefits for both DL and standard models:

- Screw-type valves for SPE port for precise flow control
- Glass basin will not dissolve, fog, or discolor when exposed to solvents
- Legs on stand-alone cover allows user to easily rest cover on work surface when removed from vacuum manifold
- Screw type solvent resistant vacuum bleed gauge and valve offer better sealing and vacuum control. Valve takes ¼" vacuum tubing.
- PP collection vessel rack accommodates autosampler vials, small scintillation vials, 10 and 16 mm test tubes, and 1, 2, 5, and 10 mL volumetric flasks. An optional plate for 20 mL scintillation vials is available for 24-port models.

Description	Cat. No.
<b>Visiprep DL Solid Phase Extraction Manifold</b>	
12-Port Model	57044
24-Port Model	57265
Disposable valve liners, PTFE, (pk. of 100)	57059
<b>Visiprep Solid Phase Extraction Manifold</b>	
12-Port Model	57030-U
24-Port Model	57250-U



24-Port Visiprep  
Vacuum Manifold  
(57250-U)

P000129

## Visiprep 5-Port Flask Manifold

The Visiprep 5-Port Flask Vacuum Manifold enables analysts using Supelco solid phase extraction tubes to simultaneously prepare up to 5 samples.

Unlike conventional vacuum manifolds, the Visiprep 5-Port Flask Manifold allows users to collect their SPE eluate directly into 50 mL round or flat bottom flasks for direct Rotovap evaporation. The manifold consists of a chemical resistant 5-port cover (DL or standard available), gasket, base, a glass basin, vacuum gauge and bleed valve, 5 flow control valves, 5 replaceable solvent guide needles, and a base plate that supports up to five 50 mL round or flat bottom flasks. Each port on both the standard and DL Visiprep models are equipped with flow control valves.

Recommended Flasks: Aldrich single-neck flask, 50 mL, joint: ST/NS 24/40

- Round Bottom (Cat. No. Z414484)
- Flat Bottom (Cat. No. Z418773)

Description	Cat. No.
<b>Visiprep 5-Port Flask Vacuum Manifold</b>	
DL (Disposable Liner)	57101-U
Standard	57103-U
<b>Visiprep 5-Port Vacuum Manifold Conversion Kit</b>	
For converting 24-port model into DL 5- port flask model, includes DL 5-port lid and flask base plate	57104-U
For converting 24-port model into standard 5-port flask model, includes standard 5-port lid and flask base plate	57105-U



P001063



P001072

## SPE Processing Accessories

### Supelco Preppy Vacuum Manifold

Simultaneously prepare up to 12 samples with our simplest and most economical manifold. The Preppy consists of a chemical-resistant cover and gasket, glass basin, vacuum release vent, 12 individual control valves with knurled tops, and stainless steel solvent guide needles.

Two optional collection racks are available; one for 2 and 4 mL autosampler vials, and the other for 15 (w/21 mm O.D.) or 40 (w/28 mm O.D.) mL vials. An optional vacuum gauge/bleed valve assembly can be installed to allow precise control of the vacuum.

Description	Cat. No.
<b>Preppy Vacuum Manifold</b>	
12-Port Model	57160-U
<b>Preppy Replacement Parts</b>	
Cover with flow control valves and solvent needle guides	57158-U
<b>Collection Vessel Racks</b>	
For 2 or 4 mL vials	57159-U
For 15 or 40 mL vials	57162-U
<b>Accessories</b>	
Vacuum Gauge/Bleed Valve Assembly	57161-U



### Visidry Drying Attachment

Designed for our Visiprep Vacuum Manifold, the Visidry Drying Attachment (57100-U) also fits our economical Preppy manifold. The Visidry unit installs in minutes, dries up to 12 or up to 24 SPE

tubes at one time, and can be used with any inert gas supply. It is also useful for evaporating and concentrating recovered samples. Gas flow to each port can be independently adjusted.

57100-U

57030-U  
12-Port Model  
Order Separately

E000772

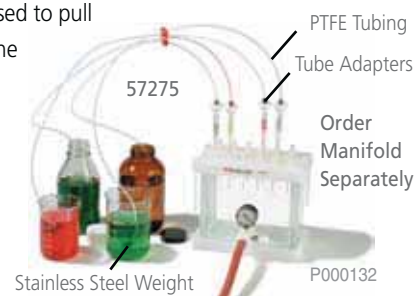
NOTE: The Visidry drying attachment cannot be used to dry 12 mL, 20 mL, or 60 mL SPE tubes.

Description	Qty.	Cat. No.
<b>Visidry Drying Attachment</b>		
12-Port Model	1	57100-U
24-Port Model	1	57124
<b>Replacement Parts for Visidry Drying Attachment</b>		
Control Knobs	2	57095
Retaining "C" Clips	2	57096
Female Luer Plugs	12	57098
Replacement SPE Tube Adapters (57020-U) listed on p. 20.		

### VisiPrep Large Volume Samplers

Allows for easy "hands-off" transfer of large volumes of low viscosity liquid samples directly from any sample container to conventional SPE tubes (not suitable for glass tubes).

The samplers consist of 1/8" PTFE tubing with a stainless steel weight at one end and a screw-fitted SPE tube adapter on the other end. To use the sampler, the weighted end is placed in the sample container, and the tube adapter is inserted into a pre-conditioned SPE tube. Vacuum pressure delivered from the vacuum manifold is used to pull the sample through the PTFE tubing into the SPE tube where analytes of interest are concentrated on the SPE tubes prior to elution.



Description	Qty.	Cat. No.
<b>VisiPrep Large Volume Sampler</b>		
for 12 mL, 20 mL, or 60 mL SPE Tubes (3 adapters) <sup>1</sup>	1	57272
for 3 mL or 6 mL SPE Tubes (4 adapters)	1	57275
<b>Replacement Parts</b>		
1/8" PTFE Tubes, color-coded	4	57276
Nuts and Ferrules, color-coded	4	57277
Stainless Steel Weights	4	57278
<b>Tube Adapters, 1/4-28 threads</b>		
For 3 mL or 6 mL Tubes	4	57273-U
For 12 mL, 20 mL, or 60 mL Tubes	3	57274-U

<sup>1</sup>Also, you must equip alternate manifold valves with long stem flow control knobs to accommodate 12 mL, 20 mL, or 60 mL SPE tubes.

### SPE Elution Rack for Gravity Feed Elution

This versatile stand-alone elution rack can be used with a variety of SPE tubes and receiving vessels, for simultaneous gravity feed extraction of up to 12 tubes. By assembling the plates in appropriate combinations, you can configure the rack to accept the following:

- 1 mL, 3 mL, or 6 mL syringe barrel-type tubes
- Closed cartridge (reversible) tubes
- 5 mL or 10 mL volumetric flasks
- 2 mL or 4 mL vials
- Test tubes up to 15 mm I.D. x 10 cm

Description	Cat. No.
SPE Elution Rack	21043-U



# SPE Accessories

## Vacuum Manifold Replacement Parts & Accessories

### Replacement Parts and Optional Components for Visiprep Manifolds

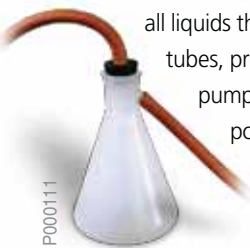
Description	Cat. No.
<b>For 12-Port Manifold</b>	
Cover, 12 flow control valves, gasket <sup>1</sup>	57031-U
Cover, 12 DL flow control valves, gasket <sup>2</sup>	57029
Gaskets (pk. of 2)	57033
Glass basin	57049
Glass basin, vacuum gauge and bleed valve <sup>3</sup>	57034
Collection rack (base, 3 support rods, center plate, 10 mm test tube plate, 12 retaining clips) <sup>3</sup>	57037
Plate for 16 mm test tubes <sup>3</sup>	57039
Plate for 2 mL autosampler vials <sup>3</sup>	57040-U
Plate for 20 mL scintillation vials	57043
Splash guard	57045-U
<b>For 24-Port Manifold</b>	
Cover, 24 flow control valves, gasket <sup>4</sup>	57251
Cover, 24 DL flow control valves, gasket <sup>5</sup>	57266
Gaskets (pk. of 2)	57254
Glass basin	57253
Glass basin, vacuum gauge and bleed valve <sup>6</sup>	57252
Collection rack (base, 2 support rods, center plate, 10 mm test tube plate, 8 retaining clips) <sup>6</sup>	57255
Plate for 16 mm test tubes <sup>6</sup>	57257
Plate for 2 mL autosampler vials <sup>6</sup>	57258
<b>For 12-Port or 24-Port Manifold</b>	
Valve Stem for Visiprep DL Vacuum Manifold (pk. of 24)	57146-U
Valve Stem for Visiprep/Preppy Vacuum Manifold (pk. of 24)	57147-U
Flow control valves (pk. of 2) <sup>7</sup>	57032
Solvent guide needles, PTFE (pk. of 12) <sup>1,8</sup>	57047
Solvent guide needles, stainless steel (pk. of 12) <sup>7</sup>	57036
Disposable liner flow control valves (pk. of 2) <sup>9</sup>	57028
Liner guide needles, stainless steel (pk. of 12) <sup>2,10</sup>	57027
Disposable valve liners, PTFE (pk. of 100) <sup>2,5</sup>	57059
Vacuum gauge and bleed valve	57035-U
Retaining clips for collection racks (pk. of 12)	57041
Test tubes, 10 x 75 mm (pk. of 12) <sup>2,8,10</sup>	57042

- <sup>1</sup> Compatible with 57030-U
- <sup>2</sup> Compatible with 57044
- <sup>3</sup> Compatible with 57030-U and 57044
- <sup>4</sup> Compatible with 57250-U
- <sup>5</sup> Compatible with 57265
- <sup>6</sup> Compatible with 57250-U and 57265
- <sup>7</sup> Compatible with 57030-U and 57250-U
- <sup>8</sup> 2 packages included with 57250-U
- <sup>9</sup> Compatible with 57044 and 57265
- <sup>10</sup> 2 packages included with 57265



### Trap Kit for SPE Vacuum Manifolds

When installed between a Visiprep SPE vacuum manifold and the vacuum source, a Supelco SPE Vacuum Pump Trap collects all liquids that are aspirated through the SPE tubes, preventing contamination of the vacuum pump. The easily assembled kit contains a polypropylene filtering flask, a one-hole rubber stopper, 4" (10 cm) of polypropylene tubing and 5' (1.5 m) of red rubber vacuum hose.



Description	Cat. No.
SPE Vacuum Pump Trap Kit	57120-U

### Vacuum Gauge / Bleed Valve Assembly

Install in-line for control of vacuum.

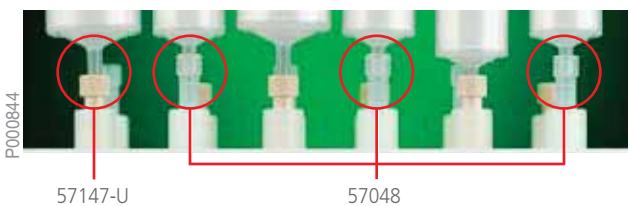


Description	Cat. No.
Vacuum Gauge / Bleed Valve Assembly	57161-U

### Long Stem Flow Control Valves for Visiprep Manifolds

Equip alternate valves in your 12-port or 24-port Visiprep vacuum manifold with these long stem flow control valves if you intend to use all ports of the manifold with 12 mL, 20 mL, or 60 mL tubes.

Not for use with DL manifolds.



Description	Qty.	Cat. No.
Long Stem Flow Control Valves	6	57048

### Long Stem Flow Control Knobs

If you have equipped your Visiprep Vacuum Manifold with long stem flow control valves, these control knobs will enable you to attach the Visidry Drying Attachment without removing the long stem valves.

NOTE: Not to be used w/24-port manifold to process 12 mL, 20 mL, or 60 mL tubes.

Description	Qty.	Cat. No.
Long Stem Flow Control Knobs	6	57093

## SPE Accessories

### 96-Well Vacuum Manifolds

#### PlatePrep Vacuum Manifold

The PlatePrep vacuum manifold consists of a clear acrylic top allowing for easier inspection of flow rates during SPE 96-well plate processing. The polypropylene base offers excellent chemical resistance while a single remote vacuum gauge/bleed valve controls flow through all the wells.

Use this compact vacuum manifold in conjunction with a Discovery SPE 96-well plate to process up to 96 samples concurrently. The single valve control, parallel processing capabilities, and uniform flow dynamics allow for easier method development, reduces clutter, and allow for greater reproducibility. Unused wells can be covered and used at a later date.

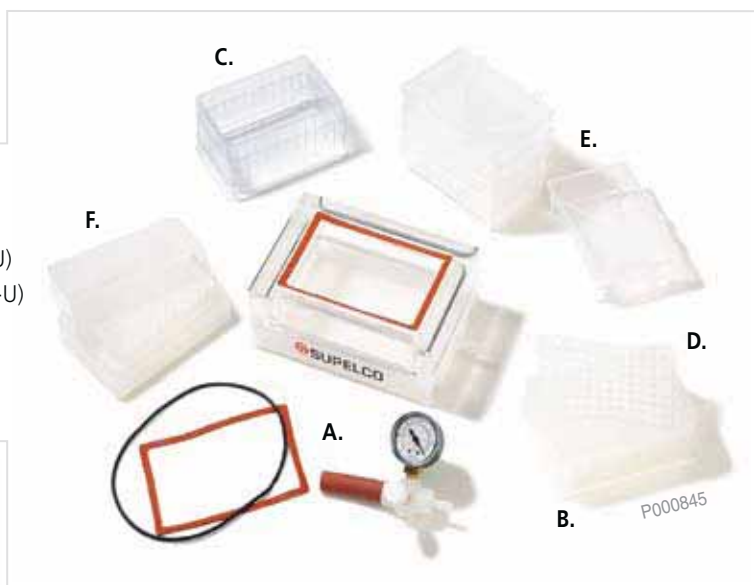


P001252

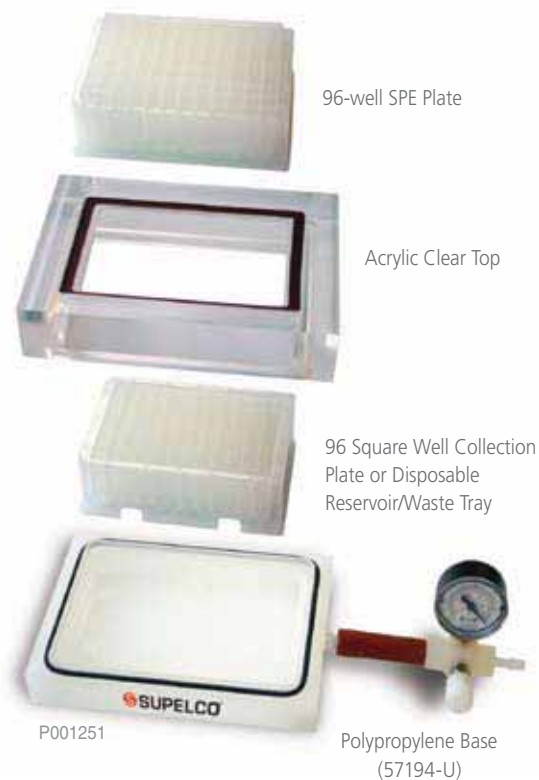
**Note:** The PlatePrep Vacuum Manifold is not compatible with the Empore 96-well plate

#### Starter Kit Includes:

- A. 1 PlatePrep Vacuum Manifold (57192-U)
- B. 1 96 Sq. Well Collection Plate, 2 mL, PP (575653-U)
- C. 2 Disposable Reservoir/Waste Trays, PVC (575654-U)
- D. 1 96 Sq. Well Piercable Cap Mat (575655-U)
- E. 5 Reagent Reservoirs (R9259-100EA)
- F. 1 Cluster Tube Rack (CLS4410-960EA)



P000845



96-well SPE Plate

Acrylic Clear Top

96 Square Well Collection  
Plate or Disposable  
Reservoir/Waste Tray

P001251

Polypropylene Base  
(57194-U)

Description	Qty.	Cat. No.
Supelco PlatePrep Vacuum Manifold	1	57192-U
96-Well Plate Starter Kit with PlatePrep Manifold	1	575650-U
<b>PlatePrep Vacuum Manifold Replacement Parts</b>		
Acrylic Clear Top	1	57193-U
Polypropylene Base	1	57194-U
Gasket/Connector Replacement Kit	1	57195-U
Remote Vacuum Gauge/Bleed Valve Assembly	1	57161-U
<b>96-Well SPE Accessory Items</b>		
96 Sq. Well Collection Plates, 0.35 mL, PP	50	575651-U
96 Sq. Well Collection Plates, 1 mL, PP	50	575652-U
96 Sq. Well Collection Plates, 2 mL, PP	50	575653-U
Disposable Reservoir/Waste Tray, PVC	25	575654-U
96 Sq. Well Piercable Cap Mats	50	575655-U
Reagent Reservoirs	100	R9259-100EA
Cluster Tube Rack	1	CLS4410-960EA

# SPE Accessories

## ENVI-Disk Accessories

### ENVI-Disk Holder

Use the ENVI-Disk Holder with 47 mm ENVI-DSK SPE disks. The unique design of the holder allows each disk to be installed and held

firmly in place without wrinkling or tearing. A screw clamp provides uniform pressure on the disk and the sealing surfaces to prevent troublesome leaks – spring-loaded clamps cannot offer the sealing integrity of the ENVI-Disk Holder.

The unit consists of a 1-liter sample funnel, a threaded screw clamp, a PTFE disk support, and a PTFE filter base/adapter with a vacuum attachment fitting. The filter base fits onto any standard 1-liter flask that has a 40/35 tapered ground glass neck.

Use 25 x 250 mm test tubes to collect disk eluates. The flask and collection tubes are not included with the holder, but can be purchased separately.

Description	Cat. No.
ENVI-Disk Holder	57173
Flask, 1-liter, 40/35 fitting <sup>1</sup>	Z290610-1EA
Collection Tube, 25 x 250 mm <sup>1</sup>	57175

<sup>1</sup> Order separately – not included with holder.



P000116

### ENVI-Disk Holder Manifold

The ENVI-Disk Holder Manifold holds one to six ENVI-Disk Holders with flasks, allowing you to simultaneously extract up to six 1-liter samples. Each of the six stations is controlled through an independent flow control valve. These valves are designed to vent the flask to the atmosphere when moved from the open to the closed position. The flow rate is controlled by the needle valve on the manifold.

The unit includes a sturdy polymer base with six stations, six flow control valves, a needle valve, a vacuum gauge, and vacuum tubing. A 1-liter glass bottle in the manifold acts as a trap, to protect the vacuum source in the event of an overflow from one of the sample flasks.



P000115

Description	Cat. No.
ENVI-Disk Holder Manifold	57174

### ENVI-Disk Clamp

- Eliminates leaks
- Attaches to any 34/45 tapered flask

When used with a standard 47 mm glass filtration apparatus, the ENVI-Disk Clamp creates a better seal, eliminating leaks with SPE extraction disks or when filtering HPLC mobile phase solvents.

Use only with a filtration glassware funnel base that has a removable filtration stage, such as Supelco Mobile Phase Filtration Apparatus 1 (58061) or 2 (58062-U), or with a funnel base (58064 or 58068). It cannot be used with a permanent fritted glass filtration stage or stainless steel holder screen.



P000101

Description	Cat. No.
ENVI-Disk Clamp, 47 mm assembly	57260-U
Replacement PTFE stage	57261

# SPE Methodology & Useful Tips

## Reversed-Phase SPE

**Retention Mechanism:** **Non-polar or hydrophobic interactions**

- Van der Waals or dispersion forces

**Sample Matrix:** **Aqueous samples**

- Biological fluids (serum, plasma, urine)
- Aqueous extracts of tissues
- Environmental water samples
- Wine, beer and other aqueous samples

**Analyte Characteristics:** **Analytes exhibiting non-polar functionalities**

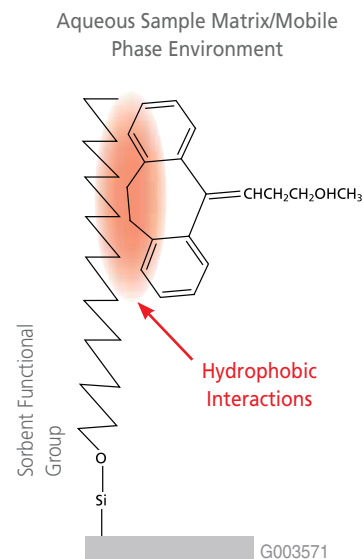
- Most organic analytes
- Alkyl, aromatic, alicyclic functional groups

**Elution Scheme:** **Disrupt reversed-phase interaction with solvent or solvent mixtures of adequate non-polar character**

- Methanol, acetonitrile, dichloromethane
- Buffer/solvent mixtures

**Common Applications:**

- Drugs and metabolites in biological fluids
- Environmental pollutants in water
- Aqueous extracts of tissues and solids



Reversed-phase SPE is considered the least selective retention mechanism when compared to normal-phase or ion-exchange SPE. In other words, it may be difficult for a reversed-phase method or bonded-chemistry to differentiate between molecules that are structurally similar. However, because reversed-phase will retain most molecules with any hydrophobic character, it is very useful for extracting analytes that are very diverse in structure within the same sample.

## Basic Steps

**1. Sample Pre-treatment** For interference laden samples (e.g., biological fluids), dilute samples 1:1 with buffer. pH manipulation may be important when dealing with ionizable compounds. A compound's ionization state can drastically change its retention and elution characteristics on a given SPE sorbent.

When an analyte is in its neutral form, it becomes more hydrophobic and retention strengthens under reversed-phase conditions. Adjusting the sample pH to 2 pH units above or below the compound's pKa (depending on the functional group) will effectively neutralize the compound. When dealing with tissues and other solids, conduct a solid-liquid extraction or homogenization using a buffer. Solvents of non-polar character (including methanol and isopropanol) disrupt interaction between the compound and sorbent functional groups.

To avoid clogging, it may be necessary to centrifuge, dilute, and/or pre-filter the sample prior to introducing it to the SPE phase.

**2. Condition/Equilibration** Conditioning wets or activates the bonded phases to ensure consistent interaction between the analyte and the sorbent functional groups. Reversed-phase sorbents are often conditioned with 1-2 tube volumes of a water miscible solvent such as methanol or acetonitrile.

Equilibration introduces a solution similar to the sample load in terms of solvent strength and pH in order to maximize retention. 1-2 tube volumes of buffer (used in sample pre-treatment) or water are good choices for reversed-phase equilibration.

**3. Sample Load** Apply sample (from step 1) at a consistent and reduced flow rate of ~1-2 drops/second to ensure optimal retention.

**4. Wash** Sample interferences are often co-retained with compounds of interest during sample load. A wash step is necessary to elute interferences without prematurely eluting compounds of interest. 5-20% methanol in water or sample pre-treatment buffer is typical for wash solvents.

**5. Elution** Disrupt hydrophobic interactions between the analyte and sorbent functional groups with an organic solvent or solvent combination of sufficient non-polar character. Example elution solvents are 1-2 volumes of methanol or acetonitrile.

pH manipulation during elution can often improve recovery when dealing with ionizable compounds. In their ionic form, basic and acidic compounds become more polar, weakening reversed-phase interaction, possibly allowing for weaker elution solvents and/or reduced elution volumes.

**6. Eluate Post-treatment** It is often necessary to evaporate and reconstitute the SPE eluate in mobile phase prior to LC analysis. GC analysis often requires further SPE eluate concentration and/or possible matrix exchange with a more volatile solvent.

## SPE Tips:

**1.** Drug-protein binding should be disrupted during sample pre-treatment.

### Strategies include:

- 40  $\mu$ L 2% disodium EDTA per 100  $\mu$ L mouse plasma
- 40  $\mu$ L 2% formic acid per 100  $\mu$ L mouse plasma
- Other possible reagents (per 100  $\mu$ L matrix): 40  $\mu$ L 2% TCA, 40  $\mu$ L 2% acetic acid, 40  $\mu$ L 2% TFA, 40  $\mu$ L 2% phosphoric acid, or 200  $\mu$ L MeCN (protein ppt.).

**2.** If the SPE eluate needs to be evaporated prior to analysis, pass vacuum air through the SPE tube for ~10 minutes prior to elution. This will remove residual moisture that may prolong evaporation.

**3.** Consistent and slow flow rate (1-2 drops per second) during sample load and elution will improve recovery and reproducibility.

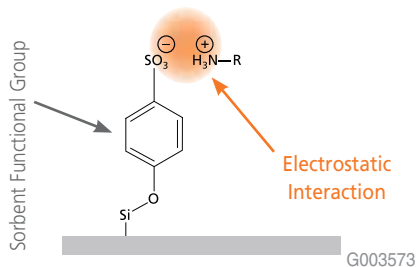
**4.** Reduce bed weight to minimize elution volume.

**5.** Increase bed weight to retain more polar compounds

**6.** Concern for sorbent over drying is only critical during methanol conditioning.

**7.** A pre-conditioning solvent such as dichloromethane (or solvent used for elution) can be used before conditioning to remove any impurities on the SPE tube that can interfere with subsequent analysis.

# SPE Methodology & Useful Tips



In order for electrostatic retention to occur, both analyte and sorbent functional groups must be in their ionized form. This is done through strict pH control of the sample matrix. For basic analytes, the pH should be adjusted to at least 2 pH units below the molecule's pKa. For acidic analytes, the pH should be adjusted to at least 2 pH units above the molecule's pKa.

To elute, the opposite is true. By adjusting the pH of the eluant to at least two pH units above or below the analytes' and/or sorbent's pKa, one can effectively neutralize one or both functional groups disrupting the electrostatic interaction allowing for elution to occur.

Note: Because the kinetic exchange processes between sample and sorbent functional groups are considerably slower for ion-exchange than for normal- and reversed-phase, flow rates should be drop wise (~1 drop/second). One may also need to increase elution and wash volumes allowing for sufficient residence time for the mobile phase and stationary phase to interact.

## Counter Ion Selectivity & Ion Exchange:

Counter ion selectivity is defined as the degree to which a counter ion is capable of competing with other counter ions for the functional group of an ion exchanger sorbent. Retention is facilitated by having a sorbent and/or sample matrix pre-equilibrated with a counter-ion that is less selective than the analyte functional group (minimum competition). Analyte elution is facilitated by using buffers with counter-ions more selective than analyte functional group.

### For Cation Exchangers:

- $\text{Ca}^{2+} > \text{Mg}^{2+} > \text{K}^+ > \text{Mn}^{2+} > \text{RNH}_3^+ > \text{NH}_4^+ > \text{Na}^+ > \text{H}^+ > \text{Li}^+$

### For Anion Exchangers:

- Benzene Sulphonate > Citrate >  $\text{HSO}_4^- > \text{NO}_3^- > \text{HSO}_3^- > \text{NO}_2^- > \text{Cl}^- > \text{HCO}_3^- > \text{HPO}_4^- > \text{Formate} > \text{Acetate} > \text{Propionate} > \text{F}^- > \text{OH}^-$

To change to a higher selective ion, pass 2-5 bed volumes of 1N solution of the new counter ion through sorbent.  
To change to a lower selective ion, pass 5-65 bed volumes of 1N solution of the new counter ion through sorbent.

Note: Number of bed volumes dependent of how much less selective the new counter ion is than the present one on the sorbent.

## Ion-Exchange & Mixed-Mode SPE

- Retention Mechanism:** Electrostatic attraction of charged functional groups of the analyte(s) to oppositely charged functional groups on the sorbent. Combination of reversed-phase and ion-exchange for mixed-mode
- Sample Matrix:** Aqueous or organic samples of low salt concentration (< 0.1M)
- Biological fluids
  - Solution phase synthesis reactions
- Analyte Characteristics:**
- Use cation-exchange for isolating basic compounds: primary, secondary, tertiary, and quaternary amines
  - Use anion-exchange for isolating acidic compounds: carboxylic acids, sulphonic acids, and phosphates
- Elution Scheme:** Electrostatic interactions disrupted via:
- pH modification to neutralize compound and/or sorbent functional groups
  - Increase salt concentration (> 1M); or use a more selective counter-ion to compete for ion-exchange binding sites
- Common Applications:**
- Drugs of abuse and pharmaceutical compounds in biological fluids
  - Fatty acids removal in food/agricultural samples
  - Cleanup of synthetic reactions
  - Organic acids from urine
  - Herbicides in soil

## Basic Steps

- 1. Sample Pre-treatment** Salt concentration should be less than 0.1M. Dilute sample 1:1 with buffer of appropriate pH to ensure analyte functional groups are ionized.

### Examples:

- Basic compounds: dilute with 10-25 mM buffer (e.g., potassium phosphate or ammonium acetate), pH 3-6
- Acidic compounds: dilute with 10-50 mM buffer (e.g., acetate buffer), pH 7-9

For interference laden samples (e.g., biological fluids) containing varying levels of salt concentration, use mixed-mode SPE technology.

- 2. Condition/Equilibration** If samples are in a non-polar solvent, the same solvent should be used to condition the SPE device. For aqueous samples, condition with 1-2 tube volumes of methanol or acetonitrile. Equilibrate with buffer similar/identical in pH and salt concentration to buffer used sample pre-treatment.

- 3. Sample Load** Apply sample (from step 1) at a consistent and reduced flow rate of ~1-2 drops/second to ensure optimal retention. Mass transfer kinetics of ion-exchange SPE are slower than reversed-phase and normal-phase. Reduced flow rate is critical for consistent recovery.

- 4. Wash** Adequate control of pH and ionic strength should be maintained to prevent premature elution of the analytes of interest. Use buffer of appropriate pH (e.g. buffer used in sample pre-treatment) to remove polar interferences. More hydrophobic interferences can be removed using up to 100% methanol diluted in sample pre-treatment buffer.

- 5. Elution** Elute at a consistent and reduced flow rate of ~1-2 drops/second to ensure optimal compound desorption. The most common elution strategy is by pH manipulation. Also, most ion-exchangers exhibit some mixed-mode behavior. Addition of organic modifier is necessary to disrupt secondary reversed-phase interactions.

### Examples:

- Basic compounds: elute with 2-5% ammonium hydroxide in 50-100% methanol
- Acidic compounds: elute with 2-5% acetic acid in 50-100% methanol.

### Other elution strategies:

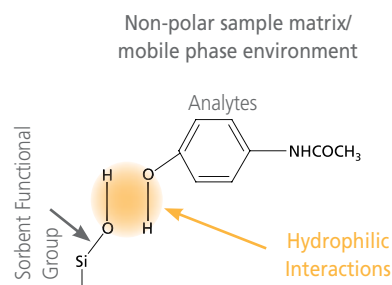
- Use an SPE eluate of higher salt concentration (> 1M)
- Use a more selective counter-ion to compete for ion-exchange binding sites

- 6. Eluate Post-treatment** A number of elution strategies are available. Various elution strategies should be tested and optimized to minimize eluate post-treatment.

# SPE Methodology & Useful Tips

## Normal-Phase SPE

- Retention Mechanism:** **Polar Interactions**
- Hydrogen bonding, pi-pi, dipole-dipole, and induced dipole-dipole
- Sample Matrix:** **Non-polar samples**
- Organic extracts of solids
  - Very non-polar solvents
  - Fatty oils, hydrocarbons
- Analyte Characteristics:** **Analytes exhibiting polar functionalities**
- Hydroxyl groups, carbonyls, amines, double bonds
  - Hetero atoms (O, N, S, P)
  - Functional groups with resonance properties
- Elution Scheme:** **Polar interactions disrupted with a more polar solvent or solution**
- Acetonitrile, methanol, isopropanol
  - Combinations of buffer/solvent or solvent/solvent mixtures
- Common Applications:**
- Cleanup of organic extracts of soils and sludge
  - Fractionation of petroleum hydrocarbons
  - PCBs in transformer oil
  - Isolation of compounds in cosmetics



G003572

In order for polar retention to occur between the sorbent and the sample, the analyte must be introduced to the SPE device in a non-polar sample or mobile phase environment. Therefore, typical sample matrices that can be employed in normal-phase SPE include hydrocarbon or fatty oils diluted in an organic solvent, hexane, isooctane, chlorinated solvents, THF, diethyl ether, and ethyl acetate.

Most organic analytes exhibit some polar functionalities that can be exploited for normal-phase separation. Because many molecules exhibit polar functionality, each interaction can provide different levels of selectivity offering highly selective separations of compounds very similar in structure.

## Basic Steps

- Sample Pre-treatment** Liquid samples should be initially extracted or diluted with a non-polar solvent such as hexane or a chlorinated solvent. Soil, sediment, and other solid samples are initially extracted (soxhlet or sonication) with a non-polar solvent, and concentrated prior to SPE cleanup. Aqueous residues in the sample can reduce normal-phase retention. It may be necessary to further dry the organic extract with sodium sulfate or magnesium sulfate prior to SPE.
- Condition/Equilibration** Condition and equilibrate with 2-3 tube volumes of a non-polar solvent similar or identical to sample matrix resulting from sample pre-treatment.
- Sample Load** Apply sample (from step 1) at a consistent and reduced flow rate of ~1-2 drops/second to ensure optimal retention. The compounds should be a non-polar solvent (e.g., hexane) for optimal retention. Note that methanol and acetonitrile are often used as elution solvents in normal-phase SPE, and will often not promote compound retention during sample load.
- Wash** Sample interferences are often co-retained with compounds of interest during sample load. A wash step is necessary to elute interferences without prematurely eluting compounds of interest. In normal-phase SPE, 1-2 tube volumes of solvent used in sample pre-treatment and conditioning can be used during wash.
- Elution** Disrupt polar interactions with a solvent or solvent/buffer mixture more polar than both the sample and wash solutions. Typical elution solvents include water miscible organic solvents such as acetone, acetonitrile, methanol, and isopropanol. Eluting with increasingly polar solvents or solvent mixtures in succession can also fractionate multiple compound classes. See "Common Normal-Phase Solvents" table for assistance.
- Eluate Post-treatment** Normal-phase SPE is often followed by GC analysis, and therefore requires a volatile sample matrix prior to injection. Use sodium sulfate or magnesium sample to remove residual moisture. Further SPE eluate concentration may also be necessary prior to analysis.

## Common Normal-Phase Solvents

Solvent	Elutropic (e°) or elution strength on silica	
Hexane	0.00	Promotes Normal-Phase Retention
Isooctane	0.00	
Carbon tetrachloride	0.14	
Toluene	0.22	
Benzene	0.27	
Tert-butyl methyl ether	0.29	
Chloroform	0.31	
Methylene chloride (dichloromethane)	0.32	
Diethyl ether	0.29	
Ethyl acetate	0.43	
Tetrahydrofuran	0.35	Promotes Normal-Phase Elution
Acetone	0.45	
Acetonitrile	0.50	
40% methanol in acetonitrile	0.67	
20% methanol in diethyl ether	0.65	
20% methanol in methylene chloride	0.63	
Isopropanol	0.63	
Methanol	0.73	
Water	>0.73	
Acetic acid	>0.73	

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Fax: (+351) 21 924 2610

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Fax: (+7) 495 621 6037

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Fax: (+65) 6779 1822

### Slovakia

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Free Fax: 0800 1100 79  
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### Spain

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Free Fax: 900 102 028  
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Fax: (+34) 91 661 96 42

### Sweden

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Free Tel: 0800 80 00 80  
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Fax: (+41) 81 755 2815

### United Kingdom

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