ProElut™ SPE

Introduction

The primary goal of solid phase extraction (SPE) with ProElut™ is the selective extraction of the components of interest from a complex sample or much larger sample volume prior to actual analysis (e.g. HPLC, GC). As SPE works on the principle of liquid chromatography, this is achieved by using strong but reversible interactions between the analyte and surface of the stationary phase. Typical interactions are hydrophobic (the Van der Waals force), polar (hydrogen bonding, dipole-dipole interaction) or ion exchange interactions. Interaction between the stationary phase and matrix should not occur. It is thus meaningful to carry out appropriate sample pre-treatment as this emphasizes the differences in chemical properties between the substance to be analyzed and matrix components so that these are then achieved by altering the pH or the ionic strength of the sample solution.

Under these conditions, the analyte is enriched as a narrow zone on the stationary phase. Subsequent to a washing step, which serves to remove possible adsorbed sample components, the actual selective elution of the analyte takes place.

ProElut™ SPE products are packed and assembled using custom designed equipment. Every part of ProElut™ manufacturing process is carefully monitored, we only accept products that meet our high quality standards.

SPE Principles and Techniques

SPE is a chromatographic technique first developed during the mid-1980s and is increasingly used for sample pre-treatment. The main objectives of SPE are removal of interfering matrix components and selective concentration and isolation of the analytes. This is done either by retaining the substance of interest and washing off everything else or by retaining the interfering substances and eluting the product of interest. Compared to traditional liquid / liquid extraction, SPE is more rapid, uses less solvent, eliminates emulsions, and can be automated. Additionally, a sample preparation task can often be solved more specifically by using SPE, since different interactions of the analyte with the adsorbent are possible, and methods can be optimized by adjusting chromatographic conditions. SPE offers a multitude of adsorbents for polar, hydrophobic and / or ionic interactions and has been widely used in medicine, food, environmental protection, commodity inspection, cosmetics and other fields.

The most popular SPE products are: Normal Phase, Reversed Phase, Ion Exchange Phase and Mix Mode. It is important to select the most suitable product for each application and sample.

Type	Reversed Phase	Normal Phase	Ion Exchange Phase	Mix Mode
Separation Mode	Reserved phase separation involves a polar (usually aqueous) or moderately polar sample matrix and a non-polar stationary phase. The analyte of interest is typically mid- to non-polar. C18 is the most common reversed phase packing	Normal phase SPE typically involves a mid- to non-polar sample matrix and a polar stationary phase. The analytes are polar compounds and the bonded phases are typically NH_2, PSA, polar adsorbent, silica, Florisil, and alumina, etc.	Ion exchange SPE can be used for compounds that are charged when in solution (usually aqueous, but sometimes organic). The primary retention mechanism of the compound is based on the electrostatic attraction of the charged functional group on the compound to the charged group that is bonded to the silica surface. In order for a compound to be retained by ion exchange from an aqueous solution, the pH of the sample matrix must be one at which both the compound of interest and the functional group on the bonded silica are charged The most common stationary phases are SAX and SCX	A mix of ion exchange and reserved phase retention mechanisms. This can be used for hydrophobic compounds (reversed phase) and compounds that are charged in solution (ion exchange). The most common stationary phases are PXC, PXA, etc.
Sample	Polar or hydrophobic compounds	Polar compounds	Compounds with charges	Compounds with charges, polar or hydrophobic compounds
Elution	Water or organic solvents	Non-polar solvents	Water or non-polar organic solvents	Water or organic solvents

Benefits of SPE

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

Use SPE for Samples That

- Contain particulate matter that may cause 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

Choosing a SPE Product

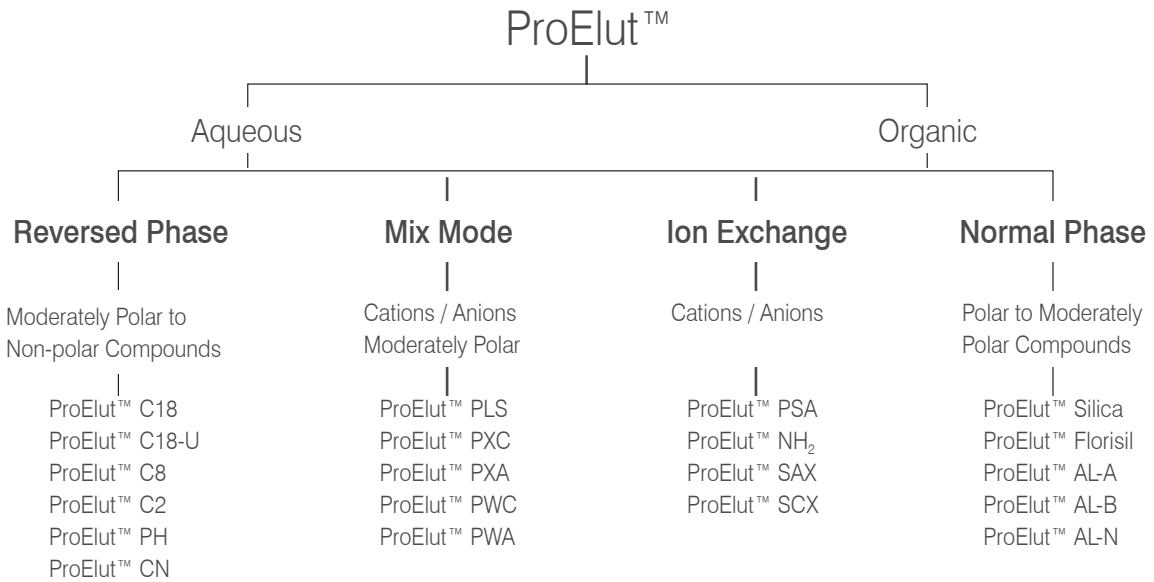
1. *Characterize the sample.* Factors such as the analyte's polarity relative to the matrix, the presence of charged functional groups, solubility, molecular weight, etc., determine how strongly the analyte is retained by the packed bed.

2. *Select a retention strategy.* Two approaches are possible: retain interfering compounds while the analyte passes through, or retain the analyte while interfering compounds pass through. This second approach allows concentration of the sample during analyte elution.

3. *Select proper packing type and bed volume.* Choosing the packing material with the proper selectivity results in the cleanest extract with the highest recovery. Poor sample recovery often occurs when the packed bed dimensions are not optimized. Too large of a bed volume results in an incomplete elution while too small of a bed volume results in an incomplete retention. Due to the unknown composition of many samples, experimentation may be required to determine the optimum bed dimensions for an application. Start with an intermediate bed volume, such as 200 mg or 500 mg. If you observe complete retention, you may be able to use a smaller bed volume and elution volume. If you observe incomplete retention, you will need to use a larger bed volume and elution volume.

4. *Select suitable conditioning, wash, and elution solvents.* Consider the solvent strength relative to the packing material. The final conditioning solvent should be weak, so as not to act as an eluting solvent. Buffers should be used to control ionization of potentially charged compounds. Wash solvents should remove weakly retained interferences without being strong enough to elute the analyte. Elution solvents should be strong enough to completely elute an analyte in a small volume.

SPE Phase Selection



ProElut™ SPE

Common SPE Applications

- Pharmaceutical compounds and metabolites in biological fluids
- Drugs of abuse in biological fluids
- Environmental pollutants in drinking and waste water
- Pesticides and antibiotics in food / agricultural matrices
- Desalting of proteins and peptides
- Fractionation of lipids
- Water and fat soluble vitamins

General SPE Procedures

Reversed Phase

(extraction of hydrophobic or polar organic analytes from aqueous matrix)

A. Conditioning

Rinse tube with 3 - 5 mL of methanol follow by 3 - 5 mL of deionized water / buffer (do not allow tube to dry before next step).

B. Sample Application

Apply sample to the top of the tube and draw through the packing bed.

C. Tube Wash

Wash with 5 mL of a polar solvent if analyte is to be retained (deionized water, buffer or aqueous / organic mixtures are most often used).

D. Elution

Elute analyte into a collection tube with 1 - 5 mL of a non-polar solvent.

Normal Phase

(extraction of polar analytes from non-polar organic solvents)

A. Conditioning

Rinse tube with 3 - 5 mL of non-polar solvent.

B. Sample Application

Apply sample to the top of the tube and draw through the packing bed.

C. Tube Wash

Wash with 5 mL of a non-polar solvent if analyte is to be retained.

D. Elution

Elute analyte into a collection tube with 1 - 5 mL of a polar solvent.

Ion Exchange

(extraction of charged analytes from aqueous or non-polar organic samples)

A. Conditioning

Rinse tube with 3 - 5 mL of deionized water or low ionic strength buffer (10 mM).

B. Sample Application

Apply sample to the top of the tube and draw through the packing bed (ion exchange kinetics is slower than reverse or normal phase, so keep the flow slow).

C. Tube Wash

Wash with 5 mL of deionized water or low ionic strength buffer.

D. Elution

Elute analyte into a collection tube with 1 - 5 mL of buffer at high ionic strength (0.1 - 1 M) or modified pH (pH such that the analyte is uncharged).

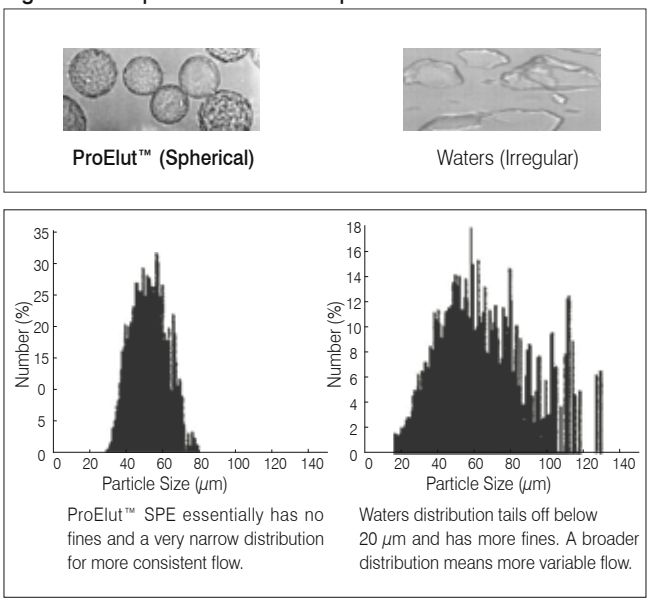
Features of ProElut™ SPE

- Rapid sample preparation within minutes
- Higher recoveries without the formation of emulsion
- High precision of analytical results by use of disposable cartridges
- Saving of solvent and hence reduction in both materials costs and cost of disposal
- Possibilities for automating the entire process
- Optimized, validated and certified manufacturing

ProElut™ SPE Features and Benefits

ProElut™ SPE uses spherical silica with high purity and narrow particle size distribution as support. The spherical silica with fewer fines gives a more regular, stable and reproducible chromatography bed that gives a faster, more even flow rate for better separation. Fines cause back pressure increases that can result in clogging and can pass through filters and contaminate the final product. A narrower particle size distribution will give a more homogenous packing that will help in collecting more concentrated fractions and reducing solvent consumption to achieve higher recovery and reproducible results.

Figure 1. Comparison of Silica Shape and Particle Size Distribution



High Purity Silica Improves Recovery and Reproducibility

- ProElut™ packings are considerably lower in trace metals than the other materials
- High purity silica to enhance retention capacity of basic compounds
- Irregular silica, depending on its method of manufacturing, normally contains trace quantities of a variety of different metals, which in turn can affect the separation

Table 1. Metal Analysis of Base Silica (ppm)

Metal	Dikma ProElut™ High-purity Silica	Brand A Silica	Brand B Silica
Na	< 12	917	17
Al	< 12	276	57
Ca	< 12	< 12	< 12
Fe	< 12	64	23
Ti	< 12	< 12	130
Zr	< 12	48	38

Figure 2. Level of Organic Extractables from SPE Packing Meterials as Measured by GC-FID*

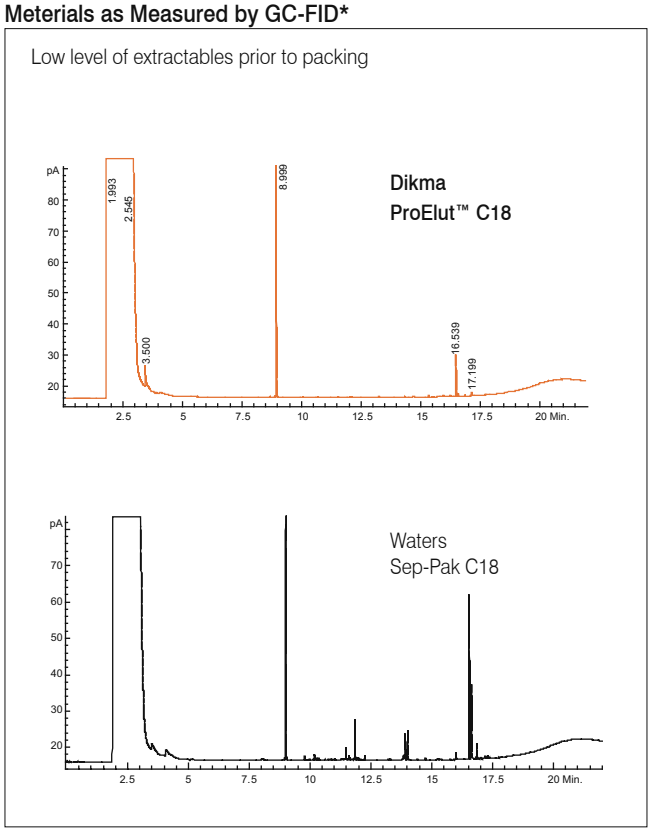
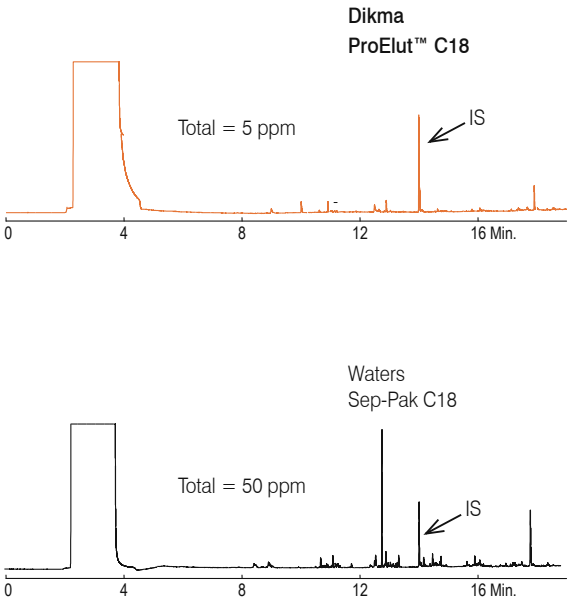


Figure 3. Level of Organic Extractables of Cartridge Tubes and Frits as Measured by GC-FID*

- Clean cartridge tubes and frits
- The sample can easily pass through the cartridge to yield quantitative recovery and reproducible results



*Sep-Pak is a registered trademark of Waters Corporation. Dikma Technologies Inc. is not affiliated with the above company.

ProElut™ SPE

Sorbent Specifications

Sorbent Phase	Category	Base Material	Particle Size (μm)	Pore Size (Å)	Surface Area (m^2/g)	Bonded Functional Group	Carbon Loading	Endcapping
PLS	Reversed phase	PS-DVB	50	80	800	Hydrophilic / lipophilic	-	-
PWC	Reversed phase / weak cation exchange	PS-DVB	50	80	800	Hydrophilic / lipophilic, carboxylic acid	-	-
PWA	Reversed phase / weak anion exchange	PS-DVB	50	80	800	Hydrophilic / lipophilic, ethylene diamine	-	-
PXC	Reversed phase / strong cation exchange	PS-DVB	50	80	800	Hydrophilic / lipophilic, sulfonic acid	-	-
PXA	Reversed phase / strong anion exchange	PS-DVB	50	80	800	Hydrophilic / lipophilic, quaternary amine	-	-
C18	Reversed phase	Silica	50	60	500	Octadecyl	19%	Yes
C18-U	Reversed phase	Silica	50	60	500	Octadecyl, silanol	17%	No
C8	Reversed phase	Silica	50	60	500	Octyl	11%	Yes
C2	Reversed phase	Silica	50	60	500	Ethyl	5.6%	Yes
PH	Reversed phase	Silica	50	60	500	Phenyl	10%	Yes
CN	Normal / reversed phase	Silica	50	60	500	Cyanopropyl	8%	Yes
SCX	Strong cation exchange	Silica	50	60	500	Benzenesulfonic acid	10.9%	No
SAX	Strong anion exchange	Silica	50	60	500	Trimethylaminopropyl	8%	No
Silica	Normal phase	Silica	50	60	500	Silanol	-	No
NH_2	Normal phase / weak anion exchange	Silica	50	60	500	Aminopropyl	5.5%	No
PSA	Normal phase / weak anion exchange	Silica	50	60	500	Ethylenediamino-*N*-propyl	8.5%	No
AL-A	Normal phase	Acidic alumina	125	-	200	Acidic alumina	-	-
AL-B	Normal phase	Basic alumina	125	-	200	Basic alumina	-	-
AL-N	Normal phase	Neutral alumina	125	-	200	Neutral alumina	-	-
Florisil	Normal phase	Magnesium	150 - 200	-	-	-	-	-
CARB	Nonbonded carbon phase	Carbon	120 - 400	-	100	-	-	-

Silica-based Sorbent	Reversed phase	Normal Phase	Weak Ion Exchange	Strong Ion Exchange
	C18 C18-U C8 C2 PH	Silica CN (can also be used as reversed phase)	NH_2 PSA	SCX SAX
Polymer-based Sorbent	**Universal Phase**	**Mix Mode***	**Mix Mode****	
	PLS	PXC PXA	PWC PWA	
Other	**Inorganic Material**		**Double Layer Sorbent**	
	Al_2O_3 (Acidic) Al_2O_3 (Neutral) Al_2O_3 (Basic) Florisil (Magnesium silicate) CARB (Graphitized carbon black) Na_2SO_4		CARB / NH_2 CARB / PSA SAX / PSA	

*Reversed phase and strong ion exchange **Reversed phase and weak ion exchange

Brand Cross Reference

Dikma	Waters	Agilent	Supelco
ProElut™ PLS	Oasis HLB	Plexa	-
ProElut™ PXC	Oasis MCX	Plexa PCX	-
ProElut™ PXA	Oasis MAX	-	-
ProElut™ PWC	Oasis WCX	-	-
ProElut™ PWA	Oasis WAX	-	-
ProElut™ C18	Sep-pak C18	BondElut C18	ENVI-18, LC-18
ProElut™ C18-U	-	BondElut C18-OH	-
ProElut™ C8	Sep-pak C8	BondElut C8	-
ProElut™ C2	-	BondElut C2	-
ProElut™ PH	-	BondElut PH	LC-PH
ProElut™ CN	Sep-pak CN	BondElut CN	LC-CN
ProElut™ NH_2	Sep-pak NH_2	BondElut NH_2	LC-NH_2
ProElut™ PSA	-	BondElut PSA	
ProElut™ Silica	Sep-pak Silica	BondElut Silica	LC-Silica
ProElut™ SCX	-	BondElut SCX	LC-SCX
ProElut™ SAX	-	BondElut SAX	LC-SAX

Technical Reference

A. Typical elution sequence of PLS, PXC, PXA, PWA and PWC

ProElut™ PLS (60 mg / 3 mL)

Suggested Method	Purpose
Condition / equilibrate 3 mL MeOH / 3 mL H_2O	Ready for use
Load sample solution 3 mL	The compounds of interest will be adsorbed by the sorbent
Wash 3 mL H_2O (5% MeOH)	To remove aqueous soluble materials and disruptors
Elution 3 mL MeOH	To get compounds of interest that previously adsorbed on the sorbent by non-polar interaction
Evaporate and reconstitute	For HPLC or GC analysis

ProElut™ PXC (60 mg / 3 mL)

Suggested Method	Purpose
Condition / equilibrate 3 mL MeOH / 3 mL H_2O	Ready for use
Load acidified sample solution 3 mL	Protonated basic compounds (under low pH) will approach sulfonic group by Coulomb force The neutral and acidic compounds will be absorbed on the sorbent by non-polar interaction
Wash 1 3 mL 0.1 M HCl	To remove aqueous soluble materials and disruptors
Wash 2 3 mL MeOH	To remove compounds that adsorbed on the sorbent by non-polar interaction
Elution 3 mL MeOH (5% NH_4OH)	Neutralize the basic compounds that adsorbed on the sorbent by Coulomb force and carry them out
Evaporate and reconstitute	For HPLC or GC analysis

ProElut™ PXA (60 mg / 3 mL)

Suggested Method	Purpose
Condition / equilibrate 3 mL MeOH / 3 mL H_2O	Ready for use
Load sample solution 3 mL	Negative charged acidic compounds will approach quaternary amino group by Coulomb force The neutral and acidic compounds will be absorbed on the sorbent by non-polar interaction
Wash 1 3 mL 5% NH_4OH	To remove aqueous soluble materials and disruptors, including salts and proteins The interaction between acid compounds and the quaternary amino group is reinforced
Wash 2 3 mL MeOH	To remove compounds that adsorbed on the sorbent by non-polar interaction
Elution 3 mL MeOH (2% HCOOH)	Neutralize the acidic compounds that adsorbed on the sorbent by Coulomb force and carry them out
Evaporate and reconstitute	For HPLC or GC analysis

ProElut™ PWC (60 mg / 3 mL)

Suggested Method	Purpose
Condition / equilibrate 3 mL MeOH / 3 mL 5% NH_4OH	Ready for use Add ammonia to make the carboxyl functional group negatively charged
Load sample solution 3 mL	Protonated strong basic compounds will approach carboxyl group by Coulomb force The neutral and weak- / mid- basic compounds will be absorbed on the sorbent by non-polar interaction
Wash 1 3 mL 5% NH_4OH	To remove aqueous soluble materials and disruptors, including salts and proteins The interaction between strong basic compounds and the carboxyl group is reinforced
Wash 2 3 mL MeOH	To remove compounds that adsorbed on the sorbent by non-polar interaction
Elution 3 mL MeOH (2% HCOOH)	To neutralize the carboxyl (negatively charged) so that the Coulomb force between analyte and functional group is cut off and therefore the strong basic compounds will be carried away by methanol
Evaporate and reconstitute	For HPLC or GC analysis

ProElut™ PWA (60 mg / 3 mL)

Suggested Method	Purpose
Condition / equilibrate 3 mL MeOH / 3 mL 2% HCOOH	Ready for use Add formic acid to make the piperazine functional group protonated
Load sample solution 3 mL	Negatively charged strong acidic compounds will approach sorbent functional group by Coulomb force The neutral and weak- / mid- basic compounds will be absorbed on the sorbent by non-polar interaction
Wash 1 3 mL 2% HCOOH	To remove aqueous soluble materials and disruptors, including salts and proteins The interaction between strong acidic compounds and the piperazine group is reinforced
Wash 2 3 mL MeOH	To remove compounds that adsorbed on the sorbent by non-polar interaction
Elution 3 mL MeOH (5% NH_4OH)	To neutralize the protonated functional group so that the Coulomb force between analyte and functional group is cut off and therefore the strong acidic compounds will be carried away by methanol
Evaporate and reconstitute	For HPLC or GC analysis

B. ProElut™ SPE Sorbents Weight Based on Sample Size

Bed Weight (mg)	Bed Capacity (mg)*	Minimum Elution Volume (μL)
50	2.5	125
100	5	250
150	7.5	375
200	10	500
500	25	1250
1000	50	2500

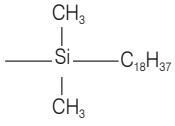
*This value depends on the analyte and sample matrix. As a rule of thumb, the bed capacity can be estimated with ~5% of the bed weight.

ProElut™ SPE Sorbents

Silica-based Sorbents

ProElut™ C18

ProElut™ C18 is the most broadly used SPE cartridge. It can be used to adsorb non-polar, slightly polar and mid-polar compounds. Polar materials such as salt cannot be retained on the sorbent, which makes ProElut™ C18 an excellent choice for desalting samples. In addition, non-polar and slightly polar disruptors in matrix such as fats, PAHs and phthalates can be retained by the sorbent, leaving ionic analytes eluted in the collector for reconstitution.

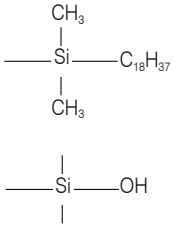
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	Yes
Carbon loading	19%
Retention mechanism	Reversed phase
Application	For reversed phase extraction of non-polar to moderately polar compounds, such as antibiotics, barbiturates, benzodiazepines, caffeine, drugs, dyes, essential oils, fat-soluble vitamins, fungicides, herbicides, pesticides, hydrocarbons, parabens, phenols, phthalate esters, steroids, surfactants, theophylline and water-soluble vitamins

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ C18 SPE Tubes				
50 mg	1 mL	100	63101	$125
100 mg	1 mL	100	63102	125
200 mg	3 mL	50	63103	95
500 mg	3 mL	50	63104	115
500 mg	6 mL	30	63105	80
1 g	6 mL	30	63106	105
2 g	12 mL	20	63107	120
5 g	20 mL	20	63108	190
10 g	60 mL	10	63109	260
ProElut™ C18 Bulk Sorbents				
10 g		1	63181	Inquire
100 g		1	63182	Inquire
1 kg		1	63183	Inquire

ProElut™ C18-U

ProElut™ C18-U has a non-endcapped octadecyl bonded phase that enables the silanols on the silica surface to be more active. However, the well-controlled silanol activity exhibits excellent selectivity towards polar compounds, especially amines such as tetracyclines.

Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å, Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	No
Carbon loading	17%
Retention mechanism	Reversed phase
Application	Similar to ProElut™ C18, but with enhanced retention for polar compounds

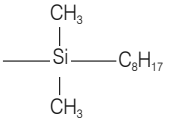
Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ C18-U SPE Tubes				
50 mg	1 mL	100	63501	$125
100 mg	1 mL	100	63502	125
200 mg	3 mL	50	63503	95
500 mg	3 mL	50	63504	115
500 mg	6 mL	30	63505	80
1 g	6 mL	30	63506	105
2 g	12 mL	20	63507	120
5 g	20 mL	20	63508	190
10 g	60 mL	10	63509	260
ProElut™ C18-U Bulk Sorbents				
10 g		1	63581	Inquire
100 g		1	63582	Inquire
1 kg		1	63583	Inquire

ProElut™ SPE

ProElut™ C8

ProElut™ C8 is very similar to the C18 phase, but has a shorter chain. This makes the phase less non-polar than C18, leaving non-polar compounds less retained by the sorbents. In this case, those compounds retained too strongly on the C18 can be effectively eluted if you choose the C8 phase. In addition, the C8 phase for polar interaction is somewhat higher than C18 because there is less coverage of the silica surface. However, this polar interaction is not the main characteristic of C8 phase.

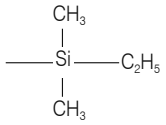
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	Yes
Carbon loading	11%
Retention mechanism	Reversed phase
Application	For reversed phase extraction of non-polar to moderately polar compounds, such as antibiotics, barbiturates, benzodiazepines, caffeine, drugs, dyes, essential oils, fat-soluble vitamins, fungicides, herbicides, pesticides, hydrocarbons, parabens, phenols, phthalate esters, steroids, surfactants, theophylline, and water-soluble vitamins

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ C8 SPE Tubes				
100 mg	1 mL	100	63702	$125
200 mg	3 mL	50	63703	95
500 mg	3 mL	50	63704	115
500 mg	6 mL	30	63705	80
1 g	6 mL	30	63706	105
2 g	12 mL	20	63707	120
5 g	20 mL	20	63708	190
10 g	60 mL	10	63709	260
ProElut™ C8 Bulk Sorbents				
10 g		1	63781	Inquire
100 g		1	63782	Inquire
1 kg		1	63783	Inquire

ProElut™ C2

ProElut™ C2 has the shortest carbon chain among non-polar silica-based phases. It provides the least retentive ability for non-polar compounds and somewhat higher polar interaction than C8 and C18 phases. The polarity of C2 is slightly lower than a cyano phase for polar interactions.

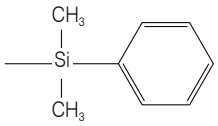
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	Yes
Carbon loading	5.6%
Retention mechanism	Reversed phase
Application	Plasma, urine, aqueous samples

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ C2 SPE Tubes				
100 mg	1 mL	100	65602	$125
500 mg	3 mL	50	65604	115
1 g	6 mL	30	65606	105
2 g	12 mL	20	65607	120
5 g	20 mL	20	65608	190
10 g	60 mL	10	65609	260
ProElut™ C2 Bulk Sorbents				
10 g		1	65681	Inquire
100 g		1	65682	Inquire
1 kg		1	65683	Inquire

ProElut™ PH

ProElut™ PH has a similar polarity as that of C8 phase. However, it shows different selectivity to other non-polar phases due to the presence of conjugated double bonds. In addition, the planar shape of benzene and its electron distribution make it much more retentive to aromatic compounds.

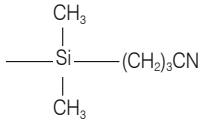
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	Yes
Carbon loading	10%
Retention mechanism	Reversed phase
Application	Volatiles in water: PAHs, PAEs, PCBs, pesticides, herbicides, phenols Biological fluids: blood, urine

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PH SPE Tubes				
100 mg	1 mL	100	63902	$125
500 mg	3 mL	50	63904	115
1 g	6 mL	30	63906	105
2 g	12 mL	20	63907	120
5 g	20 mL	20	63908	190
10 g	60 mL	10	63909	260
ProElut™ PH Bulk Sorbents				
10 g		1	63981	Inquire
100 g		1	63982	Inquire
1 kg		1	63983	Inquire

ProElut™ CN

ProElut™ CN is a mid-polar phase SPE column. We recommend using it to extract samples for which analytes are irreversibly retained on C8 and C18 phases.

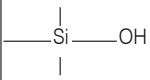
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	Yes
Carbon loading	8%
Retention mechanism	Reversed phase or normal phase
Application	Pesticides in water, metabolites

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ CN SPE Tubes				
100 mg	1 mL	100	63802	$125
500 mg	3 mL	50	63804	115
1 g	6 mL	30	63806	105
2 g	12 mL	20	63807	120
5 g	20 mL	20	63808	190
10 g	60 mL	10	63809	260
ProElut™ CN Bulk Sorbents				
10 g		1	63881	Inquire
100 g		1	63882	Inquire
1 kg		1	63883	Inquire

ProElut™ Silica

ProElut™ Silica is the most polar SPE sorbent. It is very effective for separating compounds with similar structures and extracting polar compounds in non-polar solvents. In addition, the silica surface silanols have slight anion exchange properties that can be used to remove organic acids and phenols in extracts.

Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	No
Carbon loading	-
Retention mechanism	Normal phase or weak anion exchange
Application	Extract polar compounds from non-polar matrix Remove polar hydrocarbons, organic acids, and phenols in extracts. Separate compounds with very similar structures (isomers)

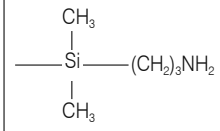
Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ Silica SPE Tubes				
100 mg	1 mL	100	63002	$125
500 mg	3 mL	50	63004	115
1 g	6 mL	30	63006	105
ProElut™ Silica Bulk Sorbents				
10 g		1	63081	Inquire
100 g		1	63082	Inquire
1 kg		1	63083	Inquire

ProElut™ SPE

ProElut™ NH_2

ProElut™ NH_2 has both polar and weak anion exchange interactions. It can effectively absorb compounds with a polar functional group (-OH, -NH_2, -SH, etc.) by hydrogen bonding from non-polar solvents such as hexane. In addition, it has weaker anion exchange property than SAX (a quaternary amine sorbent that is always charged) and is therefore an excellent choice for retention of very strong anions that are always irreversibly adsorbed on a SAX sorbent, such as sulfonic acid.

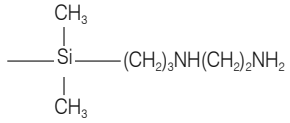
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	No
Carbon loading	5.5%
Retention mechanism	Normal phase or anion exchange
Application	Extract polar compounds from non-polar matrix Remove polar hydrocarbons, organic acids, and phenols in extracts Separate compounds with very similar structures (isomers)

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ NH_2 SPE Tubes				
100 mg	1 mL	100	63302	$125
200 mg	3 mL	50	63303	95
500 mg	3 mL	50	63304	115
500 mg	6 mL	30	63305	80
1 g	6 mL	30	63306	105
2 g	12 mL	20	63307	120
5 g	20 mL	20	63308	190
10 g	60 mL	10	63361	260
ProElut™ NH_2 Bulk Sorbents				
10 g		1	63381	Inquire
100 g		1	63382	Inquire
1 kg		1	63383	Inquire

ProElut™ PSA

ProElut™ PSA sorbent contains two different amino groups, one primary and one secondary. It gives comparatively higher pK_a and ionic capacity relative to ProElut™ NH_2. The PSA sorbent is an excellent choice for extracting polar compounds from non-polar solvents. The compounds that are retained too strongly on a NH_2 sorbent can be effectively eluted on a PSA sorbent. In addition, the PSA functional group is a very effective bidentate ligand in chelation applications.

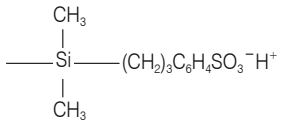
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	No
Carbon loading	8.5%
Retention mechanism	Normal phase or weak anion exchange
Application	Extract polar compounds from non-polar matrix Remove polar hydrocarbons, organic acids, and phenols in extracts Separate compounds with very similar structures (isomers)

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PSA SPE Tubes				
100 mg	1 mL	100	63202	$150
200 mg	3 mL	50	63203	115
500 mg	3 mL	50	63204	140
500 mg	6 mL	30	63205	115
1 g	6 mL	30	63206	160
2 g	12 mL	20	63207	188
5 g	20 mL	20	63208	223
10 g	60 mL	10	63209	307
ProElut™ PSA Bulk Sorbents				
10 g		1	63281	Inquire
100 g		1	63282	Inquire
1 kg		1	63283	Inquire

ProElut™ SCX

ProElut™ SCX sorbent has benzenesulfonic acid as a bonded functional group with a very low pK_a. The presence of the benzene ring in the functional group increases its potential for non-polar interaction. The two properties are quite useful in the absorption of cationic organic compounds from aqueous systems where non-polar compounds are seen.

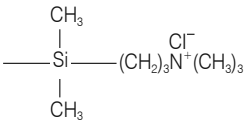
Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	No
Carbon loading	10.9%
Retention mechanism	Strong cation exchange
Application	Basic compounds in aqueous solution

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ SCX SPE Tubes				
100 mg	1 mL	100	63602	$150
500 mg	3 mL	50	63604	140
500 mg	6 mL	30	63606	115
2 g	12 mL	20	63607	147
5 g	20 mL	20	63608	211
10 g	60 mL	10	63609	271
ProElut™ SCX Bulk Sorbents				
10 g		1	63681	Inquire
100 g		1	63682	Inquire
1 kg		1	63683	Inquire

ProElut™ SAX

ProElut™ SAX sorbent has trimethylaminopropyl as a bonded functional group with a very high pK_a. The presence of the benzene ring in the functional group increases its potential for non-polar interaction. The two properties are quite useful in the absorption of anionic organic compounds from aqueous systems where non-polar compounds are seen.

Base material	Spherical silica, Particle Size: 50 μm, Pore Size: 60 Å Specific Surface Area: 500 m^2/g
Functional group	
Endcapping	No
Carbon loading	8%
Retention mechanism	Strong anion exchange
Application	Carboxylic acids in aqueous solution

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ SAX SPE Tubes				
100 mg	1 mL	100	63402	$150
500 mg	3 mL	50	63404	140
500 mg	6 mL	30	63406	115
2 g	12 mL	20	63407	147
5 g	20 mL	20	63408	211
10 g	60 mL	10	63409	271
ProElut™ SAX Bulk Sorbents				
10 g		1	63481	Inquire
100 g		1	63482	Inquire
1 kg		1	63483	Inquire

Polymer-based Sorbents

ProElut™ PLS-Hydrophilic-Lipophilic-Balance Copolymer, Reversed Phase Sorbent

ProElut™ PLS is a hydrophilic polystyrene / divinylbenzene copolymer sorbent, designed to expand the SPE application fields and improve extraction efficiency. This sorbent contains the lipophilic divinylbenzene and the hydrophilic pyrrolidone. The hydrophilic-lipophilic balance is a reversed phase sorbent maintaining retention for non-polar and polar analytes. Compared to traditional silica-based reversed phase sorbent (C18), ProElut™ PLS features are as follows:

(1) Real Versatility

- High retention of hydrophilic compounds and lipophilic compounds
- Applications covering the non-polar, weakly polar, and polar compounds to overcome the C18 sorbent poor retention of polar compounds

(2) Higher Stability

- PLS is water-wettable
- Maintaining high retention and capacity after activation even if the SPE cartridge runs dry

(3) Wider pH Range

PLS is a polymer sorbent that can be used in the range of pH 0 - 14 while the silica-based sorbents can only be used in the range of pH 2 - 7.5.

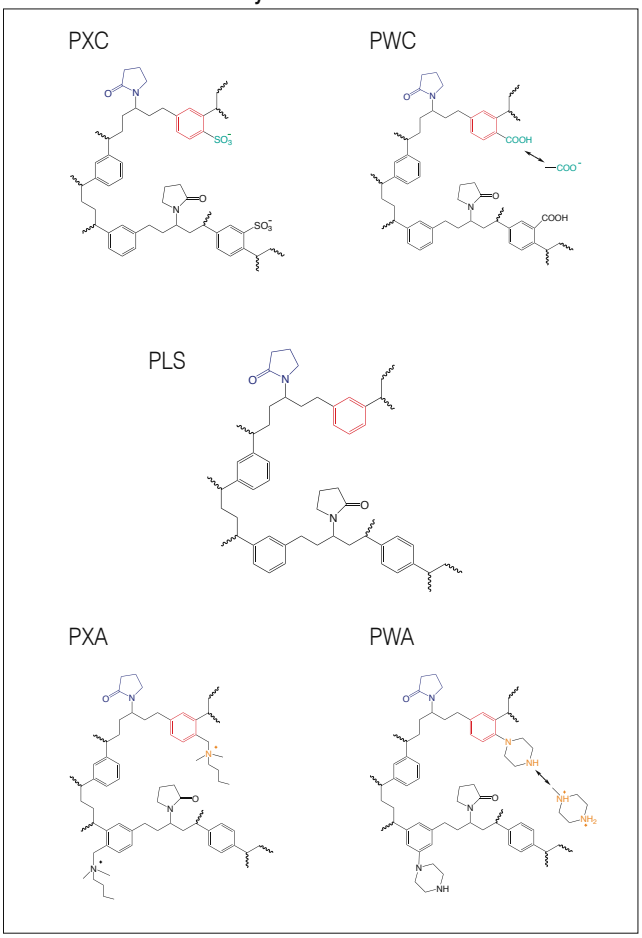
(4) Higher Capacity

The PLS sorbent has greater capacity for more compounds. It reduces breakthrough potential and improves reproducibility.

(5) No Secondary Interaction

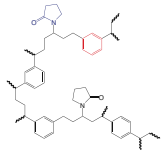
The residue silanols of silica-based sorbents can adsorb basic analytes resulting in low recovery. PLS is a polymer sorbent and there is no silanol activity leading to high recovery.

Structure of ProElut™ Polymer-based Sorbents



ProElut™ PLS

ProElut™ PLS is a highly cross-linked polystyrene-divinylbenzene (PS-DVB) copolymer with high surface area (800 m^2/g) and high capacity. It is an excellent choice for extraction of polar analytes in aqueous solvents where traditional C18 and C8 sorbents are not advisable because they are not "wettable". It is ideal in screening applications where a broad range of analytes can be extracted.

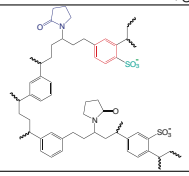
Base material	Porous, highly cross-linked, spherical PS-DVB, Particle Size: 50 μm, Pore Size: 80 Å, Specific Surface Area: 800 m^2/g
Functional group (Pyrrolidinone)	
Retention mechanism	Non-polar and polar interactions
Application	Pharmaceutical residues in animal tissue, such as tetracyclines, chloromycetin, sulfonamides, abamectin, macrolide antibiotics, nitrofurans, and pesticides in vegetables Environmental samples, such as PAHs, PAEs, phenols, and endocrine disruptors Biological samples, pharmaceuticals, and metabolites in plasma, serum, or urine

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PLS SPE Tubes				
30 mg	1 mL	100	68002	$159
60 mg	1 mL	100	68011	184
60 mg	3 mL	50	68003	221
150 mg	6 mL	30	68004	136
200 mg	6 mL	30	68012	155
500 mg	6 mL	30	68005	195
500 mg	12 mL	20	68007	156
1 g	20 mL	20	68008	242
6 g	60 mL	10	68009	491

ProElut™ PXC

ProElut™ PXC is a highly cross-linked PS-DVB copolymer with sulfonic acid as the functional group. It has both non-polar and cation exchange interactions and is therefore an excellent choice for extraction of basic organic compounds.

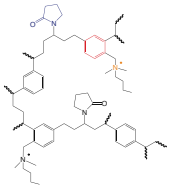
Base material	Porous, highly cross-linked, spherical PS-DVB, Particle Size: 50 μm, Pore Size: 80 Å, Specific Surface Area: 800 m^2/g
Functional group (Sulfonic acid)	
Retention mechanism	Non-polar interaction and cation exchange
Application	Basic compounds, such as sulfonamides and clenbuterol Biological samples, pharmaceuticals, and metabolites in plasma, serum, or urine

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PXC SPE Tubes				
30 mg	1 mL	100	68202	$143
60 mg	3 mL	50	68203	198
150 mg	6 mL	30	68204	122
200 mg	6 mL	30	68212	139
500 mg	12 mL	20	68207	140
1 g	20 mL	20	68208	218
6 g	60 mL	10	68209	442

ProElut™ PXA

ProElut™ PXA is a highly cross-linked PS-DVB copolymer with a quaternary amino as the functional group. It has both non-polar and anion exchange interactions and is therefore an excellent choice for extraction of acidic organic compounds, especially those containing carboxyl and phenolic hydroxyl.

Base material	Porous, highly cross-linked, spherical PS-DVB, Particle Size: 50 μm, Pore Size: 80 Å, Specific Surface Area: 800 m^2/g
Functional group (Quaternary amino)	
Retention mechanism	Non-polar interaction and anion exchange
Application	Compounds with groups as carboxyl and phenolic hydroxyl

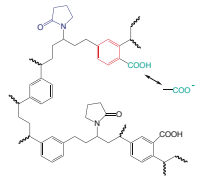
Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PXA SPE Tubes				
30 mg	1 mL	100	68302	$159
60 mg	3 mL	50	68303	221
150 mg	6 mL	30	68304	136
500 mg	12 mL	20	68307	156
1 g	20 mL	20	68308	242
6 g	60 mL	10	68309	491

ProElut™ SPE

ProElut™ PWC

ProElut™ PWC is a highly cross-linked PS-DVB copolymer with carboxyl as the functional group. It has both non-polar and weak cation exchange interactions and is therefore an excellent choice for extraction of strong basic compounds.

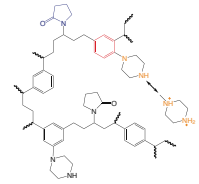
Base material	Porous, highly cross-linked, spherical PS-DVB, Particle Size: 50 μm, Pore Size: 80 Å, Specific Surface Area: 800 m^2/g
Functional group (Carboxyl)	
Retention mechanism	Non-polar interaction and weak cation exchange
Application	Strong basic compounds, quaternary ammonium salts

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PWC SPE Tubes				
30 mg	1 mL	100	65711	$159
60 mg	3 mL	50	65712	221
150 mg	6 mL	30	65713	136

ProElut™ PWA

ProElut™ PWA is a highly cross-linked PS-DVB copolymer with piperazine as the functional group. It has both non-polar and weak anion exchange interactions and is therefore an excellent choice for extraction of strong acidic compounds.

Base material	Porous, highly cross-linked, spherical PS-DVB, Particle Size: 50 μm, Pore Size: 80 Å, Specific Surface Area: 800 m^2/g
Functional group (Piperazine)	
Retention mechanism	Non-polar interaction and weak anion exchange
Application	For purification of strong acidic compounds

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PWA SPE Tubes				
30 mg	1 mL	100	65811	$159
60 mg	3 mL	50	65812	221
150 mg	6 mL	30	65813	136

Specific Sorbents

ProElut™ Florisil

Florisil is a highly selective adsorbent that has extensive utility in sample preparation, preparative and analytical chromatography. This sorbent is unique because it is comprised of extremely white, hard-powdered synthetic magnesium-silica gel.

Base material	Magnesium silicate, Particle Size: 150 - 200 μm
Functional group	$MgSiO_3$
Retention mechanism	Polar interaction
Application	For extraction of drugs, dyes, herbicides, pesticides, nitrogen compounds, organic acids, phenols, steroids, PCBs, and PAHs

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ Florisil SPE Tubes				
100 mg	1 mL	100	65002	$125
500 mg	3 mL	50	65004	115
500 mg	6 mL	30	65005	80
1 g	6 mL	30	65006	105
2 g	12 mL	20	65007	120
5 g	20 mL	20	65008	190
10 g	60 mL	10	65009	260
ProElut™ Florisil Bulk Sorbents				
10 g		1	65081	Inquire
100 g		1	65082	Inquire
1 kg		1	65083	Inquire

ProElut™ AL-A

Base material	Al_2O_3 (Acidic), Particle Size: 125 μm
pH	4.5
Retention mechanism	Lewis acid, polar, and ion exchange interactions
Application	Polar and anionic compounds

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ AL-A SPE Tubes				
100 mg	1 mL	100	65102	$125
500 mg	3 mL	50	65104	115
1 g	6 mL	30	65106	105
2 g	12 mL	20	65107	120
5 g	20 mL	20	65108	190
10 g	60 mL	10	65109	260
ProElut™ AL-A Bulk Sorbents				
10 g		1	65181	Inquire
100 g		1	65182	Inquire
1 kg		1	65183	Inquire

ProElut™ CARB

Base material	Graphitized carbon black, Particle Size: 120 - 400 μm
Application	In agriculture residues analysis, used to remove pigments in fruits and vegetables For purification of samples such as groundwater, fruits, and vegetables

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ CARB SPE Tubes				
250 mg	3 mL	50	65403	$200
500 mg	6 mL	30	65405	210

ProElut™ AL-N

Base material	Al_2O_3 (Neutral), Particle Size: 125 μm
pH	7.5
Retention mechanism	Lewis acid, polar, and ion exchange interactions
Application	Extract polar compounds from non-polar matrix Remove polar hydrocarbons, organic acids, and phenols in extracts. Separate compounds with very similar structures (isomers)

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ AL-N SPE Tubes				
100 mg	1 mL	100	65302	$125
500 mg	3 mL	50	65304	115
1 g	6 mL	30	65306	105
2 g	12 mL	20	65307	120
5 g	20 mL	20	65308	190
10 g	60 mL	10	65309	260
ProElut™ AL-N Bulk Sorbents				
10 g		1	65381	Inquire
100 g		1	65382	Inquire
1 kg		1	65383	Inquire

ProElut™ AL-B

Base material	Al_2O_3 (Basic), Particle Size: 125 μm
pH	10.0
Retention mechanism	Lewis acid, polar, and ion exchange interactions
Application	Polar and anionic compounds, amines

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ AL-B SPE Tubes				
100 mg	1 mL	100	65202	$125
500 mg	3 mL	50	65204	115
1 g	6 mL	30	65206	105
2 g	12 mL	20	65207	120
5 g	20 mL	20	65208	190
10 g	60 mL	10	65209	260
ProElut™ AL-B Bulk Sorbents				
10 g		1	65281	Inquire
100 g		1	65282	Inquire
1 kg		1	65283	Inquire

ProElut™ CARB / NH_2

Base material	Packing of equivalent volume of CARB and amine (NH_2)
Application	Widely used in analysis of pesticide residues (many different varieties) in foods To remove pigments, fatty acids, and phenols from analytes

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ CARB / NH_2 SPE Tubes				
500 mg / 500 mg	6 mL	30	64105	$240

ProElut™ SPE

ProElut™ GLASS SPE Tube

ProElut™ glass cartridges are designed for high-purity extraction as the inert glass body completely eliminates the pollution from plasticizers, such as phthalates. ProElut™ glass SPE tubes are standard size, with high quality sorbent and special purification frits, to assure stability and reproducibility.

Ordering Information

Mass	Volume	Qty	Cat. No.	Price
ProElut™ PLS GLASS SPE Tubes				
200 mg	6 mL	30	68012G	$189
500 mg	6 mL	30	68005G	397
ProElut™ C18 GLASS SPE Tubes				
500 mg	6 mL	30	63105G	228
1 g	6 mL	30	63106G	302
ProElut™ Florisil GLASS SPE Tubes				
500 mg	6 mL	30	65005G	271
1 g	6 mL	30	65006G	302
ProElut™ PSA GLASS SPE Tubes				
500 mg	6 mL	30	63205G	200
1 g	6 mL	30	63206G	270
ProElut™ Silica GLASS SPE Tubes				
500 mg	6 mL	30	63005G	198
1 g	6 mL	30	63006G	254