Zebron™

GC COLUMN CARE GUIDE

phenomenex®

. . . breaking with tradition™

GC Column Installation

A. Capillary GC Installation with a Traditional GC Nut

Note: GC columns do not have a specific directional flow when received from the manufacturer. Upon initial use of your new Zebron™ column, Phenomenex recommends the practice of dedicating one specific end of the column for injector installation only. This is particularly important when dealing with active/caustic or contaminating compounds. If these compounds are routinely injected onto the column, degradation of the phase will occur - leading to higher bleed. A typical first step to remedying (removing) this bleed would be to trim 10 cm from the front (injector) end of the column and keep trimming this inlet end of the column as necessary. Trying to remedy any bleed issues by trimming the column may not work if both ends have been interchangeably installed into the inlet.

Injector Installation

1. Place a capillary nut and ferrule on the injector end of the GC column, allowing a section of column to protrude. Trim one to two centimeters (cm) from the protruding end to remove ferrule contamination that may have entered the column (Figure 1). Inspect the cut with a magnifier to ensure that a smooth, clean, square-cut edge has been made – cut again if necessary (Figure 2).
2. Carefully hang the column in the GC oven, being cautious not to scratch or damage the polyimide coating on the capillary tubing. Rotate the column to avoid sharp bends of the capillary column and any contact of the column with oven surfaces.
3. Insert the column into the injector exactly the correct distance specified in the instrument manual. Tighten the ferrule nut finger-tight then ½ turn with a wrench. If the column can still be moved, tighten another ¼ turn until the column is secure.
4. Adjust the carrier gas.

Detector Installation

Note: For users with sensitive detectors such as MS and ECD, column conditioning steps should be performed before installing the column to prevent contamination and frequent maintenance of the detector.

1. Place the column nut and ferrule past the end of the column and cut a centimeter or two off the end of the column (Figure 1). Be sure that the ferrule is the right size and pointing in the correct direction. Inspect the cut with a magnifier and ensure that the cut is square and smooth (Figure 2). Cut again if needed.
2. Insert the outlet end of the column into the detector exactly the distance prescribed in the instrument manual. Distances will vary between detectors. Tighten the ferrule nut finger-tight then ½ turn with a wrench. If the column can still be moved, tighten another ¼ turn until the column is secure.
3. Inspect the column connections for leaks using an electronic leak detector. Leaks at the inlet end may introduce oxygen to the column that will result in increased column bleed and damage to the column phase.

Figure 1: Cutting Fused Silica Tubing

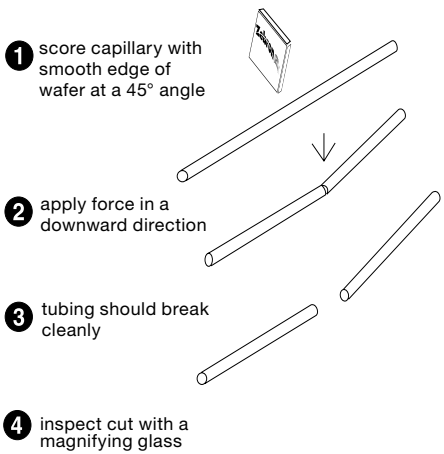
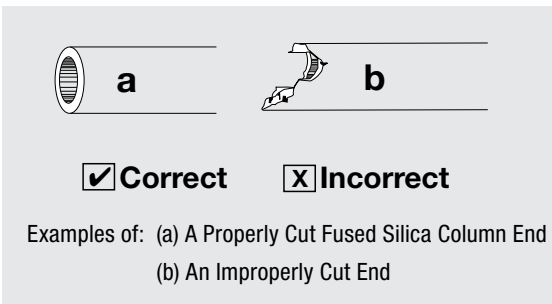


Figure 2: Proper and Improper Cut Capillary End



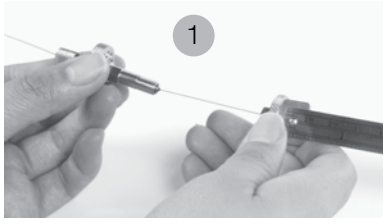
Examples of: (a) A Properly Cut Fused Silica Column End
(b) An Improperly Cut End

B. Capillary GC Installation with the Cool-Lock™ Nut

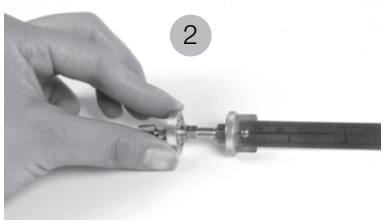
- Avoid burning your fingers again – cools with the oven
- No Wite-Out® or Tipp-Ex® needed
- Achieve the proper installation depth each and every time
- No need for wrench with hand-tightened connections

~exclusive~

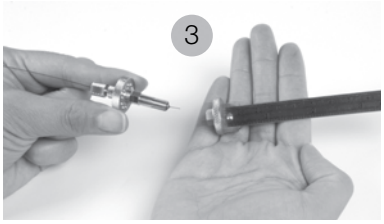
patent pending



1. Insert column through column nut and ferrule. Cleanly cut ≥ 1 cm of the column that is protruding from the nut and ferrule. Insert the end of the column and column nut into the bottom of the Cool-Lock Nut Installation Gauge.



2. Hand-tighten the column nut into the gauge until the ferrule starts to compress. Adjust the length of the column to the desired length. Further tighten the nut into the gauge until the column cannot slide. If using the Cool-Lock Nut, tighten its bottom ferrule. Make sure lower body/ferrule is in the full extension position. Otherwise, mark the column at the base of the column nut to ensure the correct installation depth after installation.



3. Unscrew the installation gauge and install the nut and column into the instrument.

4. Make sure Cool-Lock Nut is in the full extension position to achieve the correct premeasured position, and allow for proper leak checking.

Agilent® GC Systems

Cool-Lock GC Capillary Nut*

Part No.	Description	Unit
AG0-8319	Cool-Lock GC Capillary Nut For Use with Short-Style Ferrules	ea
AG0-8320	Cool-Lock GC Capillary Nut For Use with Long-Style Ferrules	ea
AG0-8349	Cool-Lock Nut Installation Gauge	ea
Replacement Ferrules		
AG0-4701	GC Capillary Ferrules Graphite 1/16 in. to 0.5 mm ID	10/pk
AG0-4704	GC Capillary Ferrules Graphite 1/16 in. to 0.8 mm ID	10/pk

*Guaranteed fit for Agilent 5850, 5890, 6890, 6850 GC systems

Shimadzu® GC Systems

Cool-Lock GC Capillary Nut**

Part No.	Description	Unit
AG0-8419	Cool-Lock GC Capillary Nut For Use with Short-Style Ferrules	ea
AG0-8420	Cool-Lock Nut Installation Gauge	ea

**Guaranteed fit for Shimadzu 2010 and 2014 GC systems

A. Column Conditioning

1. Allow sufficient time for the carrier gas to flow through the column to purge any oxygen that may be in the system.
2. Raise the temperature of the column to the maximum isothermal operating temperature that is listed on the individual Zebron™ GC Column Test Report. Maintain this temperature until a constant baseline is achieved. Conditioning times will depend on the phase identity and thickness, with thicker films taking longer to stabilize. If necessary in order to minimize the downtime of the instrument, columns can be conditioned overnight at the maximum isothermal temperature.

B. Installation Testing

Inject a detectable unretained sample, such as methane for an FID, to determine dead volume time and linear gas velocity at the desired column temperature. Adjust gas pressure for optimal flow depending on carrier gas selection.

1. The non-retained peak must have ideal peak shape or installation is faulty and needs to be redone.

C. Checking for Leaks

Use a thermoconductivity detector to check for leaks. It is highly sensitive to H_2, He, and N_2 and will not contaminate the instrument or column. Liquid leak indicators are not recommended for capillary columns. There is the risk of drawing the liquid into the column or fittings and contaminating the system.

NOTE: If Vespel® ferrules are being used, leakage can occur after the initial heating phase due to ferrule deformation. Be sure that the fitting is re-tightened after this initial heating phase, and then carefully check all corrections for leaks.

D. Test Column with Zebron's Text Mix

Good chromatographic practices include the use of Performance Check Standards to establish the baseline performance characteristics of your column and to monitor any changes over time. Test solutions should evaluate column inertness, efficiency and resolution in an easy-to-use format. Most Phenomenex test mixes are supplied ready to use at a concentration of 250 µg/mL in glass ampules.

Match your column phase to the correct standard to set up initial running conditions. Should you have any questions on the proper use of these Check Standards, contact your local Phenomenex GC Specialists.

Zebron's Text Mix

- Suitable for Phenomenex Zebron™ and equivalent brands
- Convenient way to check column performance
- Affordable and easy-to-use

Zebron Phase	Test Mix Part Number
ZB-1	AG0-5155
ZB-1ms	AG0-7805
ZB-1HT	AG0-5155
ZB-5	AG0-5155
ZB-5ms	AG0-7578
ZB-5MSi	AG0-8362
ZB-5HT	AG0-5155
ZB-35	AG0-5156
ZB-35HT	AG0-5156
ZB-1701	AG0-5156
ZB-1710P	AG0-5156
ZB-50	AG0-5157
ZB-624	AG0-5159
ZB-WAX	AG0-5158
ZB-WAX*PLUS*™	AG0-7869
ZB-FFAP	AG0-5158
ZB-XLB	AG0-7578
ZB-XLB-HT	AG0-7578
ZB-Drug-1	AG0-8431
Grob Test	AG0-5154

A. Four Key Steps to Protecting the GC Column and Extending Lifetime

It is important to protect the column and instrument components from exposure to dirty samples. Non-volatile or high molecular weight components can contaminate the stationary phase, causing peak resolution, lower accuracy, and poor column lifetime. Cutting off the damaged portion will usually restore the column performance, but over time performance will degrade to a point where the column can no longer be used. If you are experiencing rapid degradation of column performance, there are several simple ways to help protect your column and increase lifetime:

1. Ensure Proper Sample Preparation

a. Filter your samples prior to injection with Phenex™ syringe filters (see Appendix A for details).

b. Use Strata® or Strata™-X SPE Cartridges to eliminate contaminants (see Appendix D for details).

2. Use a Guardian™ or Z-Guard

a. **Guard Columns – Standard Guards.** Z-Guard columns are 5 or 10 meter pieces of deactivated tubing that are connected to an analytical column using a glass press-fit connector. The tubing acts like a trap for non-volatile residues that would otherwise damage the stationary phase of your analytical column.

b. **Guardian Integrated Guard Columns**. Unlike traditional guard columns, there is no mechanical connection between the guard and the analytical column. The result: all the benefits of a guard column without the possibility of leaks or activity resulting from a faulty connection. Please contact a Phenomenex GC Specialist for information on the Guardian.

3. Use a Wool Liner

The liner is the first line of defense for the column and the style chosen can make a big difference in how much contamination gets onto the column. The easiest thing to do is to add a small amount of silanized glass wool to a liner, which traps the non-volatile compounds and prevents them from entering the column (Figure 3). See Appendix B for other recommended GC accessories.

Caution: glass wool can also add activity for acids, bases, and pesticides. Crushing the glass wool can lead to increased activity, so it is recommended to purchase pre-packed liners, rather than try to pack your own.

Figure 3. Some liners that are available pre-packed with glass wool or provide additional column protection:

Description GC Model No.	Dimensions ID x L x OD (mm)	Material* (deactivated)	Quartz Wool (Y / N)	Mfr. No.	Part No.	Unit
Split/Splitless						
5880/5890/6890	4 x 78.5 x 6.3	B (y)	Y	210-4004	AG0-7515	5/pk
					AG0-7582	25/pk
Split/Splitless, Recessed Gooseneck Liner						
5880/5890/6890	4 x 78.5 x 6.45	B (y)	Y	5183-4691	AG0-4661	5/pk
				5183-4692	AG0-4662	25/pk
Cup Splitter/Split Liner						
5880/5890/6890	4 x 78.5 x 6.3	B (n)	N	5183-4699	AG0-4647	5/pk
				5183-4700	AG0-4648	25/pk
Cup Splitter/Split Liner						
AutoSystem™	3.5 x 100 x 5	B (n)	N	0330-5181	AG0-4663	5/pk
Splitless Single Taper/Liner						
5880/5890/6890	4 x 78.5 x 6.45	B (y)	Y	5183-4693	AG0-4657	5/pk
				5183-4694	AG0-4658	25/pk

** B = Borosilicate; Deactivated = Yes (y) or No (n)*

4. "Baking Out" the Column

The easiest way to reduce column contamination is to add a short, high temperature bake out at the end of the standard GC method. This bake out helps remove high boiling contaminants that would otherwise remain in the column and cause damage. To bake out, the final oven temperature needs to be set high enough to ensure elution of these compounds, but not so high as to cause thermal damage. This can be done either isothermally, or more commonly, via a gradient or ballistic increase until the last components elute from the column.

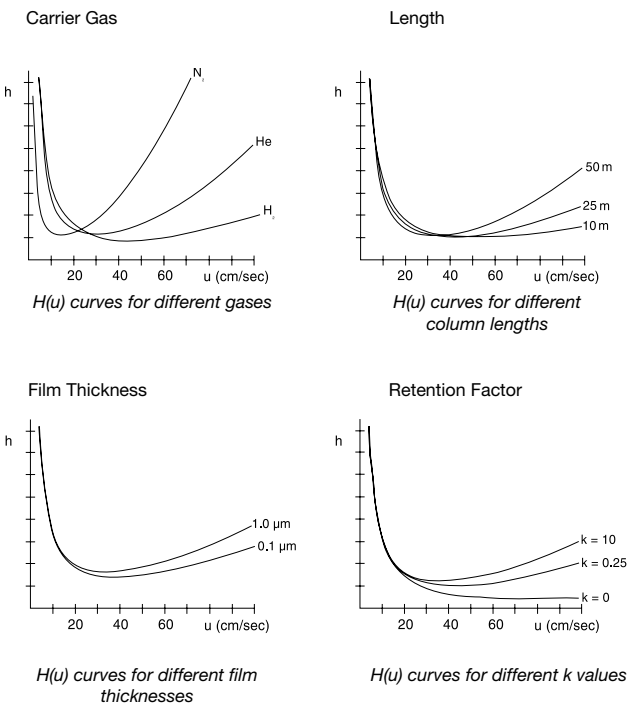
Caution: NEVER exceed the upper temperature limits of the column. DO NOT exceed more than 15 minutes at the upper isothermal temperature limit specified for the column.

B. Carrier Gas Selection and Flow Optimization

It is advisable to use the highest purity gas possible. Ultra high purity (99.99 %), ultra pure carrier (99.995 %), or even research grade (99.9999 %) is preferred to minimize critical impurities, instrument downtime and troubleshooting. Three types of gas are commonly used as a carrier gas:

1. Hydrogen (H_2): Hydrogen will yield maximal number of theoretical plates for thin film columns and the high efficiency is largely retained at velocities higher than u_{opt}. Hydrogen is not generally recommended due to its hazardous nature.
2. Helium (He): When hydrogen is not used, helium is the best alternative for speed and sensitivity.
3. Nitrogen (N_2): Nitrogen is the last choice for thin film columns. For thick film columns, nitrogen yields the highest number of theoretical plates. However, the optimal velocity is fairly low (long analysis times), and the loss in efficiency at higher velocities is high. If resolution is sufficient, hydrogen or helium are good alternatives.

Figure 4: Carrier Gas Selection and Velocity Optimization Plots



H(u) curves for different gases

H(u) curves for different column lengths

H(u) curves for different film thicknesses

H(u) curves for different k values

Optimal velocities for low d_f values:	u_{opt} (cm/sec)
H_2	40
He	25
N_2	10

Optimal velocities for high d_f values:	u_{opt} (cm/sec)
H_2	25
He	15
N_2	7

C. Column Storage

Important! The column may be left in the instrument for short-term storage. Ensure a flow of carrier gas through the column at 100-200 °C. For long-term storage, disconnect from the GC and cap or seal the capillary ends. Oxygen and moisture can degrade or irreversibly damage the column, especially cyanopropyl-based phases. Wax (polyethylene glycol) and cyanopropyl-based phases are also susceptible to UV-induced degradation and should be shielded from light (fluorescent or sunlight). Store the column in the original box. Upon reinstallation, cut column ends to ensure that septum fragments or other debris have not been left in the column.

D. Chemical Compatibility / Solvent Rinsing of Zebron™ Capillary Columns

Important! Water and organic solvents such as those listed in Table 1 will not damage Zebron column stationary phases. However, inorganic acids and bases should be completely avoided or rapid degradation and permanent damage to the stationary phase will result. In the event chemical damage is incurred, the removal of 0.5-2 meter of capillary off the front end will often restore column performance. Select the rinse solvent from the Table below.

Table 1. Phase Compatibility with Rinsing Solvents

Phase	Water	Methanol	CH_2Cl_2	$CHCl_3$	Acetone	Hexane
ZB-1, 1ms, 1HT	OK					
ZB-5, 5ms, 5MSi, 5HT						
ZB-XLB, ZB-XLB-HT						
ZB-624						
ZB-35, ZB-35HT						
ZB-1701, ZB-1701P						
ZB-50						
ZB-WAX*PLUS*™						
ZB-WAX	AVOID					
ZB-FFAP	AVOID					
MR-1, MR-2						
ZB-Drug-1						
ZB-BAC1, ZB-BAC2						
ZB-Bioethanol						

Table 2. Rinsing Conditions

Column ID (mm)	Rinse Solvent Volume (mL)	Pressure (psig)
0.25	5	40
0.32	5	40
0.53	10	20

Important: Rinse from the back to the front of the column to avoid pushing inlet contaminants further into the column.

Phenex™ Syringe Filters

For Sample Filtration Prior to GC Analysis

- Increased column lifetime
- More consistent, reproducible results
- Less system downtime

Syringe Filter Applications and Recommended Membranes

Application / Sample	Recommended Fitler	First Alternative	Second Alternative
HPLC and GC Sample Prep	**RC**	PTFE	PES
Aggressive or Pure Organic Solvents	**PTFE**	RC	NY
High Particulate Loads	**RC**	NY	PTFE
Environmental Methods	**RC**	PTFE	NY
Food and Beverage	**RC**	PTFE	NY
Clinical / Toxicology	**RC**	PES	NY

Try a Sample Pack!
visit: www.phenomenex.com/sample

Choose a pore size based on the nature of your sample and chromatographic method

Sample Description	Recommended Filter Pore Size
General clarification of GC samples.	0.45 µm
Removal of fine particulate matter prior to GC analysis.	0.20 µm

	4 mm Diameter for ≤ 2 mL sample volumes		15 mm Diameter for 2 - 10 mL sample volumes		25-28 mm Diameter for 10 - 100 mL sample volumes	
Membrane Type/Size	**Part No.**	**Unit**	**Part No.**	**Unit**	**Part No.**	**Unit**
0.45 µm						
Phenex-RC (Regenerated Cellulose)	AF0-3103-12 AF0-3103-52	100/Pk 500/Pk	AF0-2103-12 AF0-2103-52	100/Pk 500/Pk	AF0-8103-12[1] AF0-8103-52[1]	100/Pk 500/Pk
Phenex-PTFE [2] (Polytetrafluoroethylene)	AF0-3102-12 AF0-3102-52	100/Pk 500/Pk	AF0-2102-12 AF0-2102-52	100/Pk 500/Pk	AF0-1102-12 AF0-1102-52	100/Pk 500/Pk
0.20 µm						
Phenex-RC (Regenerated Cellulose)	AF0-3203-12 AF0-3203-52	100/Pk 500/Pk	AF0-2203-12 AF0-2203-52	100/Pk 500/Pk	AF0-8203-12[1] AF0-8203-52[1]	100/Pk 500/Pk
Phenex-PTFE [2] (Polytetrafluoroethylene)	AF0-3202-12 AF0-3202-52	100/Pk 500/Pk	AF0-2202-12 AF0-2202-52	100/Pk 500/Pk	AF0-1202-12 AF0-1202-52	100/Pk 500/Pk

Please inquire with Phenomenex about other Phenex Syringe filters offerings.

Above syringe filters are non-sterile. Housing is made of medical-grade polypropylene (PP) and offer luer lock inlet/slip outlet connections, unless otherwise indicated.

1. 26 mm diameter.

2. Hydrophobic membrane. Can be made hydrophilic by pre-wetting with IPA.

Other Recommended GC Accessories

Gold Inlet Base Seals

- Prevents analyte adsorption
- Improves detection sensitivity
- Improves method reproducibility
- Fits all Agilent 5890/6890 split/splitless injection ports

Part No.	Description	Similar to Mfr. No.*	Unit
Standard, single groove for splitless applications, 0.8 mm dia. inlet hole			
AG0-7518	Gold Inlet Base Seal, splitless (single groove), 0.8 mm	18740-20885	2/pk
AG0-7519	Gold Inlet Base Seal, splitless (single groove), 0.8 mm	18740-20885	10/pk
High Split Flow, cross groove for split applications, 0.8 mm dia. inlet hole			
AG0-7520	Gold Inlet Base Seal, split (double groove/cross), 0.8 mm	5182-9652	2/pk
AG0-7521	Gold Inlet Base Seal, split (double groove/cross), 0.8 mm	5182-9652	10/pk
Replacement Inlet Seal Washers			
AG0-8397	Inlet Seal Washers, Gold Plated, for Agilent GC injection port	—	12/pk

GuideRight™ Injection Hole Septa

The GuideRight™ through-hole guides the needle during injection. Septum performance and lifetime increase while downtime due to bent needles or dirty injection ports decreases. Choose from either high temperature PhenoGreen™ or PhenoRed™, both rated to 400 °C.

Part No.	Description	Unit
PhenoGreen ⅜ in. (9.5 mm) Diameter		
AG0-7874	PhenoGreen 400 Injector Septa	50/pk
PhenoGreen 7⁄16 in. (11 mm) Diameter		
AG0-7875	PhenoGreen 400 Injector Septa	50/pk
PhenoRed ⅜ in. (9.5 mm) Diameter		
AG0-7916	PhenoRed 400 Injector Septa	50/pk
PhenoRed 7⁄16 in. (11 mm) Diameter		
AG0-7917	PhenoRed 400 Injector Septa	50/pk

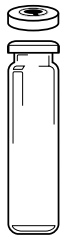
Long Graphite Ferrules

- High-purity graphite significantly reduces ferrule bleed
- Special construction minimizes “flaking”
- Stable to 450 °C - excellent for high temperature use

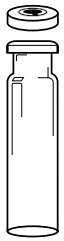
Part No.	Description		Unit
0.4 mm Ferrule ID			
AG0-4698	Graphite Ferrule	1⁄16 in. to 0.4 mm	10/pk
AG0-4699	Graphite Ferrule	1⁄16 in. to 0.4 mm	50/pk
0.5 mm Ferrule ID			
AG0-4701	Graphite Ferrule	1⁄16 in. to 0.5 mm	10/pk
AG0-4702	Graphite Ferrule	1⁄16 in. to 0.5 mm	50/pk
0.8 mm Ferrule ID			
AG0-4704	Graphite Ferrule	1⁄16 in. to 0.8 mm	10/pk
AG0-4705	Graphite Ferrule	1⁄16 in. to 0.8 mm	50/pk

Note: Not for use with GC/MS transfer lines.

Vials



Round Bottom
20 mL



Flat Bottom
20 mL

Headspace Vials

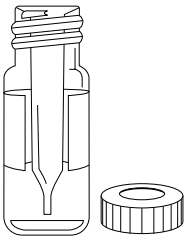
Compatible With The Following Autosamplers

Brand	Model	Round Bottom	Flat Bottom
Agilent	HS 7694		•
Carlo-Erba	HS 850		•
Dani	HS 39.50 / 86.50		•
Fisons	HS 850		•
PerkinElmer	HS 100 / 101 / 40	•	
Tekmar-Dohrmann	7000HT	•	
ThermoQuest	HS 850, Trace GC 2000 + HS 2000		•
Varian	Genesis	•	•

Headspace Autosampler Vials

Part No.	Description	100/pk
AH0-7546	Headspace Vial 20 mL clear, round bottom, 23 x 75 mm	
AH0-7547	Headspace Vial 20 mL clear, flat bottom, 23 x 75 mm	
AH0-7548	Aluminum Seal, with PTFE/Silicone septum, 0.130” thickness	
AH0-7550	Aluminum Seal, with Pharma-Fix molded pressure-release septum	
AG0-8350	Aluminum Seal, Magnetic Crimp Cap, 20 mm TEF/SIL, blue	

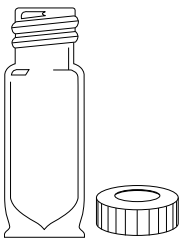
Limited Volume Vials



QsertVial™

QsertVial kits, Clear wide-mouth vial, 12 x 32 mm, 300 µL volume, with write-on patch.

Part No.	Description	100/pk
AH0-7508	QsertVial Kit, Silicone/PTFE septa	
AH0-7505	QsertVial Kit, Silicone/PTFE septa with pre-slit	



CD™ Vial

CD Vial kits, Clear wide-mouth vial, 12 x 32 mm, 1.5 mL volume

Part No.	Description	100/pk
AH0-7509	CD Vial Kit, Silicone/PTFE septa	
AH0-7506	CD Vial Kit, Silicone/PTFE septa with pre-slit	

Kit packs include caps.

Strata® and Strata™-X SPE Products

SPE products can help to eliminate contaminants and matrix effects, resulting in increased signal-to-noise ratios and longer column lifetimes. Phenomenex manufactures two types of SPE sorbents:

Product Offerings:

1. Strata - Silica Solid Phase Extraction (SPE) Products
   - Quickly and easily cleans samples, concentrates analytes, and facilitates solvent switching
   - Removes contaminants and eliminates matrix effects for improved separation and column lifetime
2. Strata-X-Polymeric Solid Phase Extraction (SPE) Sorbents. (Same functions as Strata but with the additional benefits):
   - De-conditioning resistant surface resists dry out and de-activation and provides worry-free manual and automated processing
   - pH stability from 1-14 for flexible method development
   - Ability to load up to 66 % more sample per gram in comparison to silica-based sorbents per gram

Formats: Strata and Strata-X SPE products are available in multiple formats:

Standard Tubes for Traditional SPE

Teflon®-Coated Tubes for Extra Inert Analysis

Large Volume/Flash Analysis Cleanup

Tab-less Tubes

96-Well Plates for High-Throughput

On-line Extraction Cartridges

20 x 2.0 mm

Large Volume

Need help selecting an SPE Sorbent? Please call your Phenomenex Sample Preparation Specialist for help or visit www.phenomenex.com/info/spehelp

Australia
t: 02-9428-6444
f: 02-9428-6445
auinfo@phenomenex.com

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