HPLC

Column Protection Guide

Version 0113

Includes:

- Mobile Phase Limitations
- Column Storage Tips
- Column Protection Devices

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COLUMN PROTECTION GUIDE

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INTRODUCTION

Every Phenomenex HPLC column is a precision product which, though delicate, will provide excellent performance, reproducibility and column lifetime if cared for properly. The information and recommendations contained in this manual are designed to guide you in the care and use of your column, but should not be considered absolute. Please follow the instructions herein to maximize column performance and lifetime. Should you have any questions, please contact your Phenomenex Technical Representative or local distributor.

UPON RECEIPT OF THE COLUMN

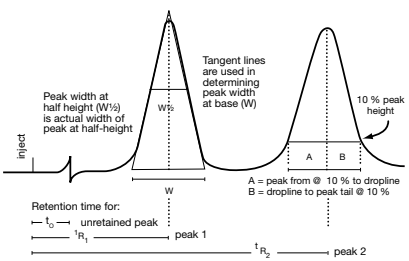
- **Verify the column you received is the column you ordered**
- **Check the column for physical damage which may have occurred during shipping**
- **Test the column immediately to verify performance and quality**
- **All columns are shipped in the testing solvent, unless otherwise specified**

Each Phenomenex manufactured HPLC column is individually packed and tested to ensure high column quality. Every column is supplied with its Test Chromatogram and a Specification Sheet which indicates column serial number and identity, testing conditions and operating parameters.

The warranty period begins upon receipt of the column. Testing is especially important if the column is to be placed in storage. Test the column using the same conditions in the test chromatogram. Use the formulae in Figure 1 to determine column efficiency and peak asymmetry.

Chromatographic performance depends on the entire system, not just the column. Columns are QC tested using optimum conditions to minimize bandspreading from "extra column effects." Most variations from the Phenomenex test data are due to extra-column effects created by the design of your system (i.e., injector, flow cell, connecting tubing, etc.). If you have any questions regarding your test results or the column quality, or if there are signs of damage, CONTACT PHENOMENEX OR YOUR LOCAL DISTRIBUTOR IMMEDIATELY.

FIGURE 1



Peak Asymmetry

$$A_s = \frac{B}{A}$$

Column Efficiency

$$N_{W½} = 5.54 \left(\frac{^tR_1}{W½}\right)^2$$

Formulae for calculating efficiency and peak asymmetry

SELECTING THE RIGHT TUBING AND FITTINGS

The tubing and fittings on an HPLC system contribute to system dead volume. If not minimized, dead volume can lead to band broadening and peak degradation. Please use the following guideline to keep system dead volume to a minimum and to help ensure optimum column performance.

TUBING

The choice of tubing material is based on its chemical resistivity, application and HPLC system considerations (i.e. flow rate, backpressure, etc). Please refer to Tables 1-3 for specifics.

TUBING DIAMETER

TABLE 1

High Pressure Tubing:

1/16 in. OD x 0.010 in. ID

Inlet/Outlet Low Pressure Tubing:

1/16 in. OD x 0.030 in. ID

1/8 in. OD x 0.062 in. ID

TUBING COMPATIBILITY

TABLE 2

Stainless Steel (Type 316)		AVOID high concentrations of acids or halogenated salts
PEEK (biocompatible)		AVOID 100 % THF, chlorinated solvents, high concentrations of acids
Titanium (biocompatible)		Compatible with nearly all chemicals

TUBING APPLICATIONS

TABLE 3

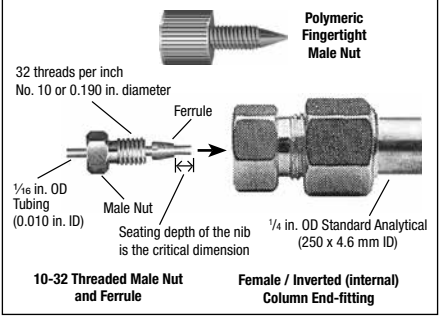
Tubing ID (Inch)	Column IDs (mm)	Typical Flow Rates (mL/min)
0.002	0.30 (Fused Silica)	0.001 - 0.02
0.005	1.0 (Stainless Steel)	0.02 - 0.1
0.007	2.0 - 4.6	0.2 - 2.0
0.010	3.2 - 7.8	0.5 - 5.0
0.020	10.0 - 21.2	2.0 - 50.0
0.040	21.2 - 100.0	10.0 - 200.0

FITTINGS

All Phenomenex column end-fittings are female inverted (internal type) with 10-32 type threading:

- The end-fitting can fit any 1/16 in. OD tubing (see page 2 for tubing considerations)
- A 10-32 threaded male nut and ferrule or a polymeric fingertight male nut* is used to swage or tighten the tubing onto the fitting (see Figure 2)

FIGURE 2

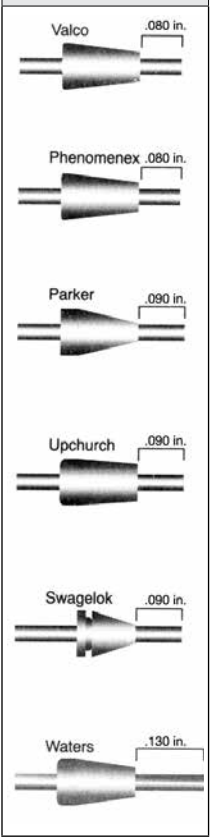


INSTALLATION CONSIDERATIONS:

- The shape of the swaged ferrule can differ between manufacturers. For Phenomenex columns, you may use Phenomenex or Valco type ferrules.
- VERY IMPORTANT: The seating depth of the nib (Figure 2) for Phenomenex columns is 0.080 in. Tubing MUST be seated all the way down into the column end-fitting. Failure to do so will result in having a small mixing chamber at the top or bottom of the column. This will lead to degraded chromatography.

  *Polymeric fingertight fittings are easy to use. They come in one piece, require NO tools for attachment and easily conform to the shape of the column end-fitting.

FIGURE 3



COLUMN INSTALLATION

IT IS HIGHLY RECOMMENDED THAT YOU READ THIS GUIDE FOR SPECIFIC COLUMN CONSIDERATIONS BEFORE PROCEEDING WITH THE INSTALLATION (PARTS I-XI)

- Flush HPLC pump and line thoroughly with filtered and degassed mobile phase (without any buffers). Make sure there are no air bubbles in the system.
- Connect the column to the injector corresponding to the direction of the flow label (located on the column). Leave the outlet of the column unattached.
- Set pump to flow at 0.1 mL/min (or lowest setting) and increase to normal flow rate over 5 minutes.
- Stop flow when there is a free flow of solvent from the column outlet, wipe the end and attach to the detector
- Equilibrate the column by passing approximately 10-30 column volumes of mobile phase at normal flow rate.
- **For those columns that can be used under reversed-phase or normal phase conditions (i.e., -CN or -NH_2), flush with 20-30 column volumes of IPA or THF as the intermediate solvent when switching from reversed-phase to normal phase modes, or vice versa.**

PART I - SILICA-BASED & TWIN™ TECHNOLOGY COLUMNS

RUNNING PARAMETERS

- Unless otherwise specified, all porous silica and TWIN technology columns should be limited to backpressure below 3500 psi (245 bar). For applications where such pressures may be exceeded, please consult Phenomenex technical support for method specific considerations. Guidelines presented within this section also apply to High Speed Technology (HST) silica-based columns. See the core-shell column guide for specific UHPLC operational tips.
- Avoid any sudden pressure changes
- If high backpressure is observed, reverse flush the column (do not try this on other manufacturers' columns)
- Use a backpressure regulator if you are experiencing out-gassing problems in the detector cell.
- Unless otherwise specified, maximum operating temperature for all silica columns is 60 °C. For core-shell and polymer specific columns, see specific guides or contact Phenomenex technical support for method specific considerations.

MOBILE PHASE CONSIDERATIONS

- Use only HPLC grade solvents and water
- Use only highest purity chemicals and reagents
- Filter and degas all mobile phases prior to use
- **Make sure solvents are miscible**

Trace impurities can dramatically degrade HPLC columns. When changing to a different mobile phase, make sure the solvents and/or buffers are miscible (see Table 11). Using solvents that are immiscible with the solvent in the column can permanently damage the column. **Salt and buffer precipitation from the mobile phase can permanently damage the column.** Always check sample solubility and if possible use the mobile phase as the diluent (sample solvent).

STATIONARY PHASE CONSIDERATIONS

- Maintain pH between 2.0 and 8.0*
- Use presaturator columns and guard columns
- Avoid aldehydes and ketones with amino columns

Silica-based columns are pH sensitive. Low pH ($\leq$ 2.0) will hydrolyze the bonded phase (strip off the functional groups) and high pH ($\geq$ 8.0) will dissolve the silica. If the mobile phase pH is near 2.0 or 8.0, use a presaturator column.

Consult Phenomenex for columns that have extended pH ranges.

BACKPRESSURE AND FLOW RATES

The following backpressures are typically observed during QC testing of the following particle sizes and dimensions.

TABLE 4

Particle Size µm	Internal Diameter(mm)	Typical Flow Rate(mL/min)	Typical Pressure(psi) 150 mm*	250 mm*
1.7	2.1	0.3	6700	NA
2.6	2.1	0.2	6400	NA
2.6	3.0	0.8	5500	NA
2.6	4.6	1.85	5000	NA
3	2.0	0.2	1500	2400
3	3.0	0.3	1500	2400
3	4.6	0.75	1500	2300
5	2.0	0.2	650	1000
5	3.0	0.5	900	1400
5	4.6	1.0	850	1200
10	10.0	5.0	900	1000
Axia Luna	21.2	20.0	350	500

** column length*

Columns can be operated at any flow rate that is consistent with the backpressure limitations described previously. Flow rates should be optimized to provide the best efficiency for your sample.

SCALING UP/SCALING DOWN

Adjusting flow rates for different column internal diameters is straightforward. To keep the retention times constant, the flow rates and loading capacity must be adjusted according to the column's internal diameter. Assuming column length does not change:

$$X = \text{Scale Factor} = \frac{(\text{radius column B})^2}{(\text{radius column A})^2}$$

From a 4.6 mm ID column some approximate scaling factors are:

TABLE 5

Internal Diameter	Scaling Factor
1.0 mm	0.05x
2.0 mm	0.2x
3.0 mm	0.5x
10.0 mm	5x
21.2 mm	21x

HPLC columns running water-free, flammable organic solvents (e.g., normal phase, chiral, GPC) can generate static electricity and should be properly grounded to avoid a potentially dangerous electrical discharge.

COLUMN STORAGE

- Column storage conditions affect column lifetime
- Never store columns containing buffers or ion-pairing reagents
- Flush with 5 column volumes of mobile phase without buffer to remove any buffers or salts

Storage Conditions for Silica-Based HPLC Columns:

TABLE 6

Column Type	Storage Solvent
Reversed Phase C18, C12, C8, C4, C2, C1, Phenyl, PFP	65 % Acetonitrile/ 35 % Water
Normal Phase Silica, CN, NH_2, PAC, Diol Alumina	Isopropanol or Hexane
Ion-Exchange SAX, SCX, WAX, WCX	Methanol*
Size-Exclusion Diol	0.05 % NaN_3 in water or 10 % methanol
HILIC Luna HILIC	80 % Acetonitrile/ 20 % Water

**Flush column with 50 mL HPLC grade water prior to storage solvent*

COLUMN CLEANING PROCEDURES

The following conditions apply to Phenomenex silica-based columns with the exception of chiral columns (see Parts V and VI):

- Before starting any kind of cleaning procedure, make sure your in-column solvent or mobile phase is miscible with the recommended cleaning solvent(s).
- Flow rates should be 1/5 – 1/2 of the typical flow rate.

To estimate the column volume, use the following equation: $V=\pi r^2 L$

V =	column volume in mL
r =	column radius in cm
L =	column length in cm

UNBONDED SILICA (Si)

Rinse with 10 Column Volumes each of:

- Hexane
- Methylene Chloride
- Isopropanol
- Methylene Chloride
- Mobile Phase

Water Removal Procedure:

Flush column with 30 mL 2.5 % 2,2-dimethoxy-propane and 2.5 % glacial acetic acid in Hexane

BONDED NORMAL PHASE (CN, NH_2, DIOL, PAC)

Rinse with 10 Column Volumes each of:

- Chloroform
- Isopropanol
- Methylene Chloride
- Mobile Phase

Exception: Luna Amino in reversed phase mode.

HILIC

Rinse with 10 Column Volumes each of:

- 95 % Water/5 % Acetonitrile (for buffer removal)
- 95 % 100 mM Ammonium Acetate, pH 5.8/5 % Acetonitrile
- 95 % Water/5 % Acetonitrile
- Mobile Phase

REVERSED PHASE
(C18, C12, C8, C5, C4, C2, C1, PHENYL, PFP, CN, NH_2)

Rinse with 10 Column Volumes each of:

- 95 % Water/5 % Acetonitrile (for buffer removal)
- THF
- 95 % Acetonitrile/5 % Water
- Mobile Phase

REVERSED PHASE PROTEIN/PEPTIDE
(C18, C12, C8, C5, C4, Phenyl)

Rinse with 20 Column Volumes of mobile phase with buffer removed. Run gradient (2x):

A) 0.1 % TFA in water

B) 0.1 % TFA in Acetonitrile/Isopropanol (1:2)

25 % B to 100 % B for 30 minutes

Equilibrate with 10 column volumes of mobile phase

Do not store column in TFA

ION-EXCHANGE (SAX, SCX, WAX, WCX)

Rinse with 10 Column Volumes each of:

- 500 mM Phosphate Buffer pH 7
- 10 % Acetic Acid (Aq)
- 5 Column Volumes of Water
- 10 Column Volumes of Phosphate Buffer pH 7
- 5 Column Volumes of Water
- 10 Column Volumes of Methanol
- 10 Column Volumes of Water

For Protein Removal

Follow the above procedure with this exception:

Substitute 10 Column Volumes of Methanol with 10 Column Volumes of 5 M Urea **or** 5 M Guanidine Thiocyanate

NH_2 for HILIC or ION-EXCHANGE

Rinse with at least 20 Column Volumes each of:

- 50/50 Organic (Acetonitrile or Methanol) / 20 mM ammonium bicarbonate pH 10 (to clean ionically-bound components)
- Water
- Mobile Phase

This column cleaning procedure should only be done infrequently, as repeated exposure to high pH solutions will cause silica dissolution resulting in peak shape issues.

GFC/SEC (Yarra SEC, BioSep SEC*) *See Part VII for more details*

Rinse with 5 column volumes of 0.1 M Phosphate Buffer pH 3.0. For strongly retained proteins, run the following gradient: 100 % Water to 100 % Acetonitrile to 100 % Water over 60 minutes OR wash with 5 column volumes of 6 M Guanidine Thiocyanate or 10 % DMSO. **Do not backflush column**.

SAMPLE CONSIDERATIONS

Always prefilter samples with Phenex™ syringe filters to avoid particulate contaminants which may clog the column. Use of a guard column is highly recommended to prolong the life of your analytical to preparative column.

PART II - ONYX SILICA MONOLITH COLUMNS

RUNNING PARAMETERS

Pressure

- Keep backpressures below 3000 psi (200 bar)
- Avoid any sudden pressure changes
- Use a backpressure regulator if you are experiencing out-gassing problems in the detector cell
- If high backpressure is observed, reverse flush the column

Reverse the flow periodically to prevent particles and non-eluting sample components from accumulating on the column When reversing the flow, flush the column before connecting it to the detector

Temperature

- Maximum operating temperature is 45 °C

As with particulate columns, preheating the mobile phase to the same temperature as the column is recommended. This can be done by placing the connecting tubing inside the column oven. [R.G. Wolcotte et al. (2000), J. Chromatogr. A., 869, 211-230].

SPECIFICALLY for 150 x 0.1 mm dimension

Pressure

- < 300 bar

Flow Rate

- We recommend 1–3 µL per minute to maximize column performance

SPECIFICALLY for SemiPrep (10 mm ID) dimension

Pressure

- Maximum operating pressure is 150 bar (2175 psi)
- When switching valves are used – Maximum operating pressure is 100 bar (1450 psi) due to pressure fluctuations (or pressure spikes) that occur when using these

Flow Rate

- 5 – 35 mL/min
- Fast flow rates require fast system settings.

(Continued on next page)

If sampling valve or fraction collector valves switch slowly, the high flow rate of mobile phase will cause large pressure build-up momentarily. This may damage the column.

MOBILE PHASE CONSIDERATIONS

- Use only HPLC grade solvents and water
- Use only highest purity chemicals and reagents
- Degas and filter mobile phases prior to use
- Make sure solvents are miscible
- For best performance use acetonitrile/water mobile phases

Organic Solvents

Onyx columns can be used with all commonly used HPLC grade organic solvents with the following restrictions. The mobile phase should NOT contain more than 50 % tetrahydrofuran (THF), 5 % Dichloromethane (DCM), or 5 % Dimethylsulfoxide (DMSO).

Pure DMSO (up to 100 µL) can be used as a solvent for samples. For DMSO injection volumes larger than 100 µL, we recommend using a mixture of 50 % DMSO and 50 % diluting solvent (i.e. – Methanol).

Buffers, Organic Modifiers, & Ion-Pair Reagents

Buffers, organic modifiers, and ion-pair reagents present no problems as long as the appropriate pH range is not exceeded. Ion-pair reagents are often difficult to completely flush from the column. Therefore, columns used with these reagents should be dedicated to the particular analysis involved.

Acids & Bases

Do not use strong acids (i.e., hydrochloric, nitric, and sulfuric acids) in the column. Limit your use of strong bases (i.e., sodium, potassium, ammonium hydroxide) to amounts needed to adjust the pH of the mobile phase.

STATIONARY PHASE CONSIDERATIONS

- Maintain pH between 2.0 and 7.5*
- Use guard columns

*Silica-based columns are pH sensitive. Low pH (≤ 2.0) will hydrolyze the bonded phase (strip off functional groups) and high pH (≥ 8.0) will dissolve the silica. If the mobile phase pH is near 2.0 or 8.0, use a presaturator column.

HARDWARE CONSIDERATIONS

Onyx columns are clad with a PEEK polymer. The endfittings are also made of PEEK. DO NOT remove the endfittings from the column.

COLUMN INSTALLATION

SPECIFICALLY for 150 x 0.1 mm dimension

The tubing and fittings contribute to system dead volume. Therefore dead volume should be minimized. Onyx capillary column packages are equipped with PEEK $^{1}/_{16}$ inch fittings and green sleeves. The fittings and sleeves fit with any 360 µm OD fused silica tubing.

Connection to Injector

- Always use in the flow direction indicated by the arrow on the column label
- Connect a 360 µm OD fused silica tubing with the PEEK $^{1}/_{16}$ inch fittings and the green sleeves to tighten the tubing

- Make sure that the tubing is seated all the way down into the fittings
- Make sure that the tubing enters all the way to the bottom of the injector port
- Keep the tubing as short as possible to avoid dead volumes
- Be careful not to over bend the capillary

Connection to the Detector

Onyx capillary columns can be directly connected to any nano/capillary-HPLC UV detector (e.g. equipped with a nano/capillary flow cell) or MS. Connections are made with either a fingertight fitting or with PTFE tubing.

COLUMN EQUILIBRATION

Columns can dry out during shipping and stocking, therefore thoroughly activate the Onyx packing material by equilibrating your column.

Onyx columns are shipped in acetonitrile/water (60/40, v/v). Verify that your mobile phase is miscible with the shipping solvent before equilibrating your column for use.

- Flush column for 5 minutes with 100 % acetonitrile at a flow rate of:
  - 0.6 mL/min for analytical dimensions (i.e. – 2.0 mm ID)
  - 1 mL/min for analytical dimensions (i.e. – 3.0 mm ID)
  - 4 mL/min for analytical dimensions (i.e. – 4.6 mm ID).
  - 10 mL/min for semi-prep dimensions (i.e. – 10.0 mm ID)
- Continue conditioning the column with your mobile phase until you get a stable baseline

SPECIFICALLY for 150 x 0.1 mm dimension

Onyx reversed phase 150 x 0.1 mm columns are shipped in methanol/water (80:20).

- Verify that your mobile phase is miscible with the shipping solvent before equilibrating your column for use
- Install your column as described above. Make sure that no air bubbles are in the system
- Equilibrate by passing 10 column volumes of mobile phase at normal flow rate until you achieve a stable baseline

SPECIFICALLY for Silica (Si) phase

Onyx normal phase columns are shipped in n-heptane/dioxane (95/5, v/v). Verify that your mobile phase is miscible with the shipping solvent before equilibrating your column for use. As it can dry out during stocking and shipping thoroughly activate the packing by equilibrating.

- Flush column for 5 minutes with n-heptane/ dioxane (50/50, v/v) at a flow rate of 3 mL/min
- Continue conditioning your column with your mobile phase until you get a stable baseline

CLEANING & REGENERATION PROCEDURE

For cleaning and regeneration of Onyx materials, connect the column with the flow arrow on the label pointing toward the pump for backflushing.

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SPECIFICALLY for reversed phase materials (C18 & C8)

In most cases, a flushing with 100 % acetonitrile or methanol for 5 minutes (see Table 7) is sufficient. If buffers have been used, first pump 100 % water, then methanol.

TABLE 7

Column ID (mm)	Flow Rate (mL)
2.0	0.6
3.0	1.0
4.6	3.0
10.0	15.0

f the result is not satisfactory, flush the Onyx reversed phase column (see Table 7) with the following solvents, one after the other, for 5 minutes each in the following order:

1. Water
2. Acetonitrile
3. 2-Propanol
4. Heptane
5. 2-Propanol
6. Acetonitrile
7. Water

SPECIFICALLY for 150 x 0.1 mm dimension

A shift in retention or resolution or unspecific background may indicate contamination of the column.

- Use 95 % acetonitrile for cleaning
- Make sure that your in-column solvent or mobile phase is miscible with the cleaning solvent
- Flush the column with 2 – 4 column volumes of 95 % acetonitrile

SPECIFICALLY for Silica (Si) phase

Flush the Onyx Silica (Si) column (see Table 7) with the following solvents for 5 minutes each in the following order:

- n-heptane
- n-heptane/ dioxane (50/50)
- dioxane
- n-heptane/ dioxane (50/50)

DO NOT use more than 5 % DMSO, 5 % chlorinated hydrocarbons, or solvent mixtures containing more than 50 % THF.

COLUMN STORAGE

- Column storage conditions affect the column lifetime
- When storing the column for several days or longer, store the column in 100 % acetonitrile
- Never store column with buffers
- If the mobile phase contained a buffer, flush with 10 column volumes of HPLC grade water to remove any buffers or salts, then with acetonitrile
- Confirm that the column end plugs are firmly in place

SPECIFICALLY for 150 x 0.1 mm dimension

- For prolonged storage, flush the column with a mobile phase with 60 to 80 % acetonitrile or methanol in water
- In case the column has been used with buffer media, flush the column with several column volumes of 60 – 80 % acetonitrile or methanol
- Never store columns for a long time with buffer or acid containing solvents
- When not in use, store the column in the protective shipping box

SPECIFICALLY for Silica (Si) phase

- When storing a normal phase column for several days or longer, store the column in n-heptane/ dioxane (95/5, v/v).

PART III - SFC (SUPERCRITICAL) FLUID CHROMATOGRAPHY

Phenomenex analytical and Axia 'SFC Approved' columns have been leak tested under SFC conditions at pressure far exceeding what may be expected with normal SFC operation.

RUNNING PARAMETERS

- Backpressure Limitation: 3500 psi
- Flow Rate Limitations: Flow rate is to be controlled so that pressure limit of 3500 psi is not exceeded
- pH Limitations: Dictated by the media packed in the column

EQUILIBRATING COLUMN

SFC column stationary phases have a polar surface and may be shipped under reversed phase or normal phase conditions. Flush all columns with 10-30 column volumes of Methanol/CO_2 as intermediate solvent between CO_2 and column shipping conditions. Be aware of backpressure settings.

Equilibrate column to starting conditions with 10 column volumes of mobile phase.

MOBILE PHASE CONSIDERATIONS

- Use only HPLC grade solvent modifiers
- Use only highest purity chemicals and reagents
- Filter and degas all mobile phases prior to use

CLEANING PROCEDURE

- Under extreme conditions the column can be flushed with 50/50 Acetonitrile/Isopropyl Alcohol followed by 100 % Isopropyl Alcohol. Maintain backpressure below limits.
- Re-Equilibrate column to starting conditions with 10 column volumes of mobile phase

COLUMN STORAGE

- Completely remove all buffers, acids, bases or other mobile phase additives to prevent damage to media
- Flush with at least 10 column volumes of Methanol after the last sample is purified
- Store column with end plugs firmly seated in endfittings to ensure storage solvent does not evaporate

PART IV - AXIA PACKED PREPARATIVE COLUMN

RUNNING PARAMETERS

- Backpressure Limitation: 3500 psi
- Flow Rate Limitations: Determined by the viscosity of mobile phase; flow rates to be controlled so that backpressure limit of 3500 psi is not exceeded
- pH Limitations: Dictated by the media packed in the column

MOBILE PHASE CONSIDERATIONS

- Use only HPLC grade solvents and water
- Use only highest purity chemicals and reagents
- Filter and degas all mobile phases prior to use

CLEANING PROCEDURE (for Axia reversed phase columns)

- For achiral applications, see silica-based and twin technology column cleaning procedures.

(Continued on next page)

- Under extreme conditions, the column can be flushed with 10 column volumes of 100 % THF (or IPA) followed by 100 % methylene chloride
- After cleaning, wash with 100 % THF (or IPA) and 50:50 Acetonitrile/Water, prior to equilibrating with the starting mobile phase n.

COLUMN STORAGE

- Completely remove all buffers, acids, bases, or other mobile phase additives to prevent physical damage to the media
- Flush with at least 10 column volumes of 50:50 Acetonitrile/Water after the last sample is purified
- Store with column end plugs placed back in the end-fittings to ensure that the packing media does not dry out

For additional information, consult the Care and Use of Axia Packed Preparative HPLC Columns, included with each Axia column purchased.

PART V - LUX CHIRAL COLUMNS

RUNNING PARAMETERS

OPERATING BACKPRESSURE

The mobile phase flow rate should be set such that the column backpressure stays below 300 bar (4300 psi). This maximum backpressure should not be exceeded for long periods of time.

OPERATING TEMPERATURES

With standard mobile phases (such as alkane/alcohol) the column can be used in the temperature range 0-50 °C.

MOBILE PHASE CONSIDERATIONS

MOBILE PHASE COMPATIBILITY

Lux columns can be used with normal phase (alkane/alcohol), reversed phase (aqueous methanol, aqueous acetonitrile or appropriate buffer/methanol or buffer/acetonitrile mixtures), as well as with pure polar organic solvents (low molecular weight alcohols, acetonitrile or their mixtures).

SOLVENT SWITCHING

An appropriate column washing procedure must be applied when changing from one mobile phase to another. The miscibility of the different mobile phase components must be carefuly considered for this wash.

To safely transfer a column from normal phase to polar organic or reversed phase conditions, flush the column with methanol/ethanol 9:1 (V/V) as transition solvent at a flow rate of 0.5 mL/min. Flush the column with at least ten column volumes (i.e. 25 mL for a 250 x 4.6 mm ID column or 15 mL for a 150 x 4.6 mm ID column) to completely remove the initial mobile phase. When the column has been flushed, equilibrate the column with at least ten column volumes of the polar organic or reversed phase solvent mixture to condition the column. In addition, when the buffer salt additive of the reversed phase mobile phase is insoluble in methanol/ethanol, flush the column briefly with water before switching to the buffered mobile phase. When the column has been flushed equilibrate the column with at least ten column volumes of the reversed phase solvent mixture.

To safely transfer a column from polar organic to normal phase conditions flush the column with at least ten column volumes of methanol/ethanol 9:1 (V/V) as transition solvent at a flow rate of 0.5 mL/min. When the column has been flushed with methanol/ethanol equilibrate the column with at least ten column volume of the normal phase solvent mixture to condition the column. We do not recommend switching from reversed phase mode back to normal phase mode.

USE OF MOBILE PHASE MODIFIERS

For basic samples or acidic chiral compounds, it may be necessary to use an appropriate mobile phase modifier in order to achieve chiral resolution and to insure proper peak shapes. Diethylamine, ethanolamine and butyl amine in the concentration range 0.1-0.5 % can be used with basic analytes, while trifluoroacetic or acetic acid (0.1-0.5 %; typically 0.1-0.2 %) with acidic analytes. Mixtures of basic and acidic mobile phase additives are acceptable (e.g. diethylamine acetate or trifluoroacetate). Lux columns will deliver consistent results when operated with mobile phases containing additives at the concentration levels specified above. However, limited decrease in column efficiency may occur when a column is used in combination with these additives. Therefore, we advise to dedicate columns to mobile phases containing basic additives.

MOBILE PHASE RESTRICTIONS

Lux chiral stationary phases are prepared by coating silica with various polysaccharide derivatives. Therefore, any solvent dissolving the polysaccharide derivative (such as tetrahydrofurane, acetone, chlorinated hydrocarbons, ethylacetate, dimethylsulfoxide, dimethylformamide, N-methylformamide, toluene, methylethyl ketone and methyl tert-butyl ether, etc. must be avoided even in trace amounts (e.g. even as sample solvent).

EXTENDING LIFETIME AND RECONDITIONING

Phenomenex recommends the use of SecurityGuard™ guard cartridges to extend the lifetime of your column, especially with samples extracted from complex matrixes. Ideally, samples must be completely dissolved in the mobile phase or filtered through a syringe filter of approximately 0.45 µm porosity.

To regenerate or remove potential contaminant after extended use of your Lux column, we recommend flushing the column with methanol for polar organic and reversed phase mode or with ethanol for normal phase mode for 2-3 hours at the appropriate flow rate.

COLUMN STORAGE

- Column storage for a longer period of time is recommended in n-hexane/2-propanol (9:1, v/v).
- Columns used in reversed phase conditions should be first flushed with water (whenever a buffer salt was used as RP mobile phase additive) and then with methanol (or with methanol only when no salt was used). The column can be stored in methanol

PART VI - CHIREX CHIRAL COLUMNS

RUNNING PARAMETERS

- Temperature must not exceed 50 °C
- Column pressure must not exceed 3000 psi
- Maintain flow rate between 0.5-2.0 mL/min for 4.6 mm ID columns

MOBILE PHASE CONSIDERATIONS

- Dedicate column to reversed or normal phase solvents
- pH range: 2.5 to 7.5
- Use only HPLC grade solvents
- Use only highest purity chemicals and reagents

(Continued on next page)

- Filter and degas all mobile phases prior to use
- Make sure solvents are miscible (see pp. 22-23)

Most CHIREX Chiral columns use a Type I or brush type Chiral stationary phase (CSP I). Normal phase systems usually provide better selectivity than reversed phase systems. SEE COLUMN INSERT FOR FURTHER INFORMATION ABOUT SPECIFIC CHIREX COLUMNS (included with each column)

SAMPLE CONSIDERATIONS

Always prefilter samples with Phenex™ syringe filters to avoid particulate contaminants which may clog the column. Use of a guard column is highly recommended to prolong the life of your analytical to preparative column.

PART VII - BIOSEP & YARRA SEC COLUMNS

RUNNING PARAMETERS

- Maximum flow rate: 1.5 mL/min
- Column pressure must not exceed 1500 psi for BioSep and 3000 psi for Yarra SEC-2000 or -3000
- Column pressure for Yarra SEC-4000 must not exceed 1750 psi
- Maximum temperature: 50 °C

MOBILE PHASE CONSIDERATIONS

- pH range: 2.5 - 7.5
- Maximum organic modifier: Up to 100 % CH_3CN, 10 % DMSO or 500 mM β-mercaptoethanol
- Maximum salt concentration: 1 M
- Filter and degas all mobile phases prior to use

SAMPLE CONSIDERATIONS

Always prefilter samples with Phenex™ syringe filters and add SecurityGuard™ guard cartridge system to maximize column lifetime.

CLEANING PROCEDURE

- General protein removal: wash with 30 mL of 0.1 M NaH_2PO_4, pH 3.0
- Hydrophobic protein removal: use Acetonitrile gradient
- Strongly adsorbed proteins: wash with 30 mL of 6 M guanidine thiocyanate or 10 % DMSO

COLUMN STORAGE

- Overnight storage: run mobile phase at 0.2 mL/min
- Prolonged storage: use 0.05 % sodium azide in water or 20 % methanol in water
- Yarra SEC-4000 columns should only be stored in 20 % methanol. Be careful not to exceed 1750 psi when exchanging between buffer and storage conditions.

PART VIII - REZEX POLYMER-BASED COLUMN

RUNNING PARAMETERS

- Columns should be run at elevated temperatures
- (60-85 °C) except Rezex ROA and RHM for most applications (Rezex ROA and RHM ~ 40 °C)
- Column pressure for 8 % cross-linked material must not exceed 1,000 psi; must not exceed 300 psi for 4 % cross-linked material

- Clean and reverse flush column regularly with HPLC grade water
- To increase column lifetime, use a Rezex guard column or SecurityGuard™ cartridge system (See p.16-19 and p.33)

Important: Never exceed maximum pressure limitations. This will cause irreversible damage to the column.

MOBILE PHASE CONSIDERATIONS

- Filter and degas all mobile phases prior to use
- Replace mobile phase frequently to avoid microbial contamination
- Do not exceed 5 % Methanol, IPA, EtOH
- Do not exceed 30 % Acetontrile or other organic
- Store columns in HPLC grade water

Rezex utilizes a sulfonated polystyrene resin which is very rugged and resistant to chemical attack. However, the material **is pressure sensitive and must be cared for properly**.

START UP (IMPORTANT!)

Turn on column heating unit to 60 - 85 °C and start the mobile phase at 0.1 mL/min. ake sure the pressure remains below 400 psi for 8 % cross-linked material; below 200 psi for 4 % cross-linked material. As the temperature reaches working condition, increase flow rate to the specified level. (See Rezex Operating Parameters)

Column may exhibit brown/gray liquid upon startup after storage. This is perfectly normal and will dissipate after a few minutes. It will not adversely affect your LC system.

SHUT DOWN

- Reduce flow rate slowly

Overnight: Lower flow rate to 0.1 mL/min. Leave system on and continue heating.

Long Term: Store columns in 100 % water. Turn off pump and allow the system to cool. Replace the end plugs and tightly cap the column.

SAMPLE CONSIDERATIONS

Always prefilter samples with Phenex™ syringe filters to avoid particulate contaminants which may clog the column. Use of a guard column is highly recommended to prolong the life of your analytical column.

CLEANING PROCEDURE

Before utilizing any cleaning procedure outlined in the Tables on pages 17 and 19, first try to clean your Rezex column as follows:

Remove the guard column and reverse the direction of flow on the analytical column. Run 100 % HPLC grade water through the column as follows:

TABLE 8

Rezex Column	Flow (mL/min)	Temp. (°C)
RPM, RCM, RHM	0.4	85
RCU	0.2	85
RSO and RNO	0.1	75
RNM and RAM	0.4	75
ROA	0.4	85

Run the column under these conditions for a minimum of 12 hours. After completing the cleaning procedure, return the column to the original direction of flow and equilibrate for analysis.

If this procedure is not effective in cleaning the column, proceed to the specified procedures outlined in Tables 9 and 10.

See pp. 14-15 for general care and usage of Rezex columns.

Table 9	RCM Monosaccharide	RSO Oligosaccharide	RNO Oligosaccharide	RNM Carbohydrate	RAM Carbohydrate
Part Number	00H-0130-K0	00P-0133-N0	00P-0137-N0	00H-0136-K0	00H-0131-K0
Ionic Form	Calcium	Silver	Sodium	Sodium	Silver
Standard Dimensions	300 x 7.8 mm	200 x 10 mm	200 x 10 mm	300 x 7.8 mm	300 x 7.8 mm
Matrix	Sulfonated Styrene Divinyl Benzene				
Cross Linking	8 %	4 %	4 %	8 %	8 %
Particle Size (µm)	8	12	12	8	8
Min. Efficiency (p/m) based on last peak	35,000	N/A	N/A	30,000	35,000
Typical Pressure (psi @ Testing Flow Rate)	260	115	130	170	285
Max. Pressure (psi @ Max Flow Rate)	1,000	300	300	1,000	1,000
Max. Flow Rate (mL/min)*	1.0	0.3	0.3	1.0	1.0
Max. Temperature (°C)	85	85	85	85	85
Typical Mobile Phase	Water	Water	Water	Water	Water
pH Range	Neutral	Neutral	Neutral	Neutral	Neutral
Guard Column Part No.	03B-0130-K0	03R-0133-N0	03R-0137-N0	03B-0136-K0	03B-0131-K0

** Make sure the maximum pressure is not exceeded*

Table 9 (continued)	RCM Monosaccharide	RSO Oligosaccharide	RNO Oligosaccharide	RNM Carbohydrate	RAM Carbohydrate
Cleaning, Regeneration and Storage					
Organic Modifiers (Max)			5 % Methanol, IPA, EtOH		
Inorganic Modifiers (Max)	5 % $CaSO_4$, $Ca(NO_3)_2$, $CaCl_2$	5 % Silver Nitrate	5 % Sodium Salts	5 % Sodium Salts	2 % Silver Nitrate
Avoid	Acids, Bases, Non-Calcium Salts or Metal Ions, >30 % Acetonitrile	Acids, Bases, Non-Silver Salts/Metal Ions, >30 % Acetonitrile	Acids, Bases, Non-Sodium Salts/Metal Ions, >30 % Acetonitrile	Acids, Bases, Non-Sodium Salts/Metal Ions, >30 % Acetonitrile	Acids, Bases, Non-Silver Salts/Metal Ions, >30 % Acetonitrile
Cleaning Solvent	100 % Water	100 % Water	100 % Water	100 % Water	100 % Water
Flow Rate(mL/min)	0.4	0.1	0.1	0.4	0.4
Temperature (°C)	85	85	85	85	85
Duration (hrs)	12	12	12	12	12
Regeneration Solvent	0.1 M $Ca(NO_3)_2$	0.1 M $AgNO_3$	0.1 M $NaNO_3$	0.1 M $NaNO_3$	0.1 M $AgNO_3$
Flow Rate (mL/min)	0.2	0.1	0.1	0.2	0.2
Temperature (°C)	85	85	85	85	85
Duration (hrs)	4-16	4-16	4-16	4-16	4-16
Ship/Storage Solvent	Water	Water	Water	Water	Water

See pp. 14-15 for general care and usage of Rezex columns.

Table 10	RPM Monosaccharide	RHM Monosaccharide	ROA Organic Acid	RFQ Fast Acid	RCU Sugar Alcohols
Part Number	00H-0135-K0	00H-0132-K0	00H-0138-K0	00D-0223-K0	00G-0130-D0
Ionic Form	Lead	Hydrogen	Hydrogen	Hydrogen	Calcium
Standard Dimensions	300 x 7.8 mm	300 x 7.8 mm	300 x 7.8 mm	100 x 7.8 mm	250 x 4.0 mm
Matrix	Sulfonated Styrene Divinyl Benzene				
Cross Linking	8 %	8 %	8 %	8 %	8 %
Particle Size (µm)	8	8	8	8	8
Min. Efficiency (p/m) (based on last peak)	35,000	35,000	50,000 (Acetic Acid)	30,000	12,000
Typical Pressure (psi @ Testing Flow Rate)	190	275	580	365	90
Max. Pressure (psi @ Max Flow Rate)	1,000	1,000	1,000	1,000	1,000
Max. Flow Rate (mL/min)*	1.0	1.0	1.0	1.0	0.5
Max. Temperature (°C)	85	85	85	85	85
Typical Mobile Phase	Water	Water	0.005N H_2SO_4	0.005N H_2SO_4	Water
pH Range	Neutral	1–8	1–8	1–8	Neutral
Guard Column Part No.	03B-0135-K0	03B-0132-K0	03B-0138-K0	03B-0223-K0	03A-0130-D0

** Make sure the maximum pressure is not exceeded*

See pp. 14-15 for general care and usage of Rezex columns.

Table 10 (continued)	RPM Monosaccharide	RHM Monosaccharide	ROA Organic Acid	RFQ Fast Acid	RCU Sugar Alcohols
Cleaning, Regeneration and Storage					
Organic Modifiers (Max)			5 % Methanol, IPA, EtOH		
Inorganic Modifiers (Max)	5 % Lead Nitrate	5 % HNO_3, H_3PO_4	5 % HNO_3, H_3PO_4	5 % HNO_3, H_3PO_4	5 % $CaSO_4$, $Ca(NO_3)_2$, $CaCl_2$
Avoid	Acids, Bases, Non-Lead Salts/Metal Ions, >30 % Acetonitrile	Acids, Bases, Salts, Metal Ions, >30 % Acetonitrile	Acids, Bases, Salts, Metal Ions, pH > 3, >30 % Acetonitrile	Acids, Bases, Salts, Metal Ions, pH > 3, >30 % Acetonitrile	Acids, Bases, Non-Calcium Salts or Metal Ions, >30 % Acetonitrile
Cleaning Solvent	100 % Water	100 % Water	100 % Water	100 % Water	100 % Water
Flow Rate(mL/min)	0.4	0.4	0.4	0.4	0.1
Temperature (°C)	85	85	85	85	85
Duration (hrs)	12	12	12	12	12
Regeneration Solvent	0.1 M $Pb(NO_3)_2$	0.025 M H_2SO_4	0.025 M H_2SO_4	0.025 M H_2SO_4	0.1 M Ca $(NO_3)_2$
Flow Rate (mL/min)	0.2	0.2	0.2	0.2	0.1
Temperature (°C)	85	85	85	85	85
Duration (hrs)	4-16	4-16	4-16	4-16	4-16
Ship/Storage Solvent	Water	Water	0.005 N H_2SO_4	0.005 N H_2SO_4	Water

See pp. 14-15 for general care and usage of Rezex columns.

PART IX - POLYSEP-GFC-P COLUMNS

RUNNING PARAMETERS

- Column pressure must not exceed 1000 psi
- Do not exceed 60 °C

MOBILE PHASE CONSIDERATIONS

- pH range: 3 - 12
- Maximum salt concentration: 0.5 M
- Organic Modifier capacity:

	POLYSEP PHASE						
	1000	**2000**	**3000**	**4000**	**5000**	**6000**	**Linear**
Methanol	20 %	95 %	70 %	70 %	70 %	70 %	70 %
Acetonitrile	20 %	70 %	70 %	70 %	70 %	70 %	70 %

CLEANING PROCEDURE

0.5 % SDS or 6 M guanidine thiocyanate. All PolySep columns except for PolySep 1000 may also be cleaned with 50 % acetonitrile. Make sure not to exceed a maximum pressure of 650 psi when cleaning.

COLUMN STORAGE

- Overnight storage: run water at low flow rate (0.2 mL/min or less)
- Prolonged storage: store in 0.05 % sodium azide in water or 10 % methanol in water

SAMPLE CONSIDERATIONS

Always prefilter samples with Phenex™ syringe filters to avoid particulate contaminants which may clog the column. Use of a guard column is highly recommended to prolong the life of your analytical to preparative column.

PART X - PHENOGEL GPC COLUMNS

SPECIFICATIONS

Matrix:	Styrene-Divinyl Benzene Copolymer
Particle Size:	5, 10 µm
Porosities:	50 Å to 10^6 Å, and mixed beds
Maximum Pressure*:**	1500 psi
Maximum Temperature:	140 °C
Minimum Efficiency*:	**5 µm:** 45,000 P/m** **10 µm:** 35,000 P/m**
Typical Flow Rates:	**4.6 mm ID:** 0.35 mL/min **7.8 mm ID:** 1.0 mL/min **21.2 mm ID:** 7.0 mL/min
End Fittings:	Valco Compatible

**Tested in THF ** For 300 x 7.8 mm ID columns*

**** At testing flow rates in THF, other solvents will vary*

SAMPLE CONSIDERATIONS

Always prefilter samples with Phenex™ syringe filters to avoid particulate contaminants which may clog the GPC column. Use of a GUARD COLUMN is highly recommended to prolong the life of your analytical or preparative column. For optimal results, use the chart below to determine sample concentrations and injection volumes.

TABLE 11

Molecular Weight	Concentration (w/v)	Max Injection Volume
<50 K	0.5 %	100 µL
50-600 K	0.25 %	100 µL
600-3000 K	0.05 %	100 µL
>3000 K	0.01 %	20 µL

Continued on p. 24

SOLVENT MISCIBILITY TABLE

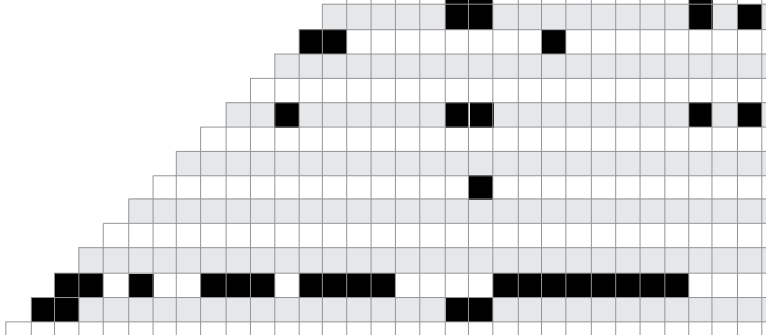
TABLE 12

Solvent Polarity Chart

Relative Polarity	Compound Formula	Group	Representative Solvent Compounds
NONPOLAR	R - H	Alkanes	Petroleum ethers, ligroin, hexanes
	Ar - H	Aromatics	Toluene, benzene
	R - O - R	Ethers	Diethyl ether
	R - X	Alkyl halides	Tetrachloromethane, chloroform
	R - COOR	Esters	Ethyl acetate
	R - CO - R	Aldehydes and ketones	Acetone, methyl ethyl ketone (MEK)
	R - NH_2	Amines	Pyridine, triethylamine
	R - OH	Alcohols	Methanol, ethanol, isopropanol, butanol
	R - $COHN_2$	Amides	Dimethylformamide
	R - COOH	Carboxylic acids	Ethanoic acid
POLAR	H - OH	Water	Water

Increasing Polarity

Solvent	Polarity Index	Refractive Index @ 20 °C	UV (nm) Cutoff @ 1 AU	Boiling Point (°C)	Viscosity (cPoise)	Solubility in Water (% w/w)
Acetic Acid	6.2	1.372	230	118	1.26	100
Acetone	5.1	1.359	330	56	0.32	100
Acetonitrile	5.8	1.344	190	82	0.37	100
Benzene	2.7	1.501	280	80	0.65	0.18
Butyl Acetate	4.0	1.394	254	125	0.73	0.43
n-Butanol	3.9	1.399	215	118	2.98	7.81
Carbon tetrachloride	1.6	1.466	263	77	0.97	0.08
Chloroform	4.1	1.446	245	61	0.57	0.815
Cyclohexane	0.2	1.426	200	81	1.00	0.01
1,2-Dichloroethane[1]	3.5	1.444	225	84	0.79	0.81
Dichloromethane[2]	3.1	1.424	235	41	0.44	1.6
Dimethylformamide	6.4	1.431	268	155	0.92	100
Dimethyl sulfoxide[3]	7.2	1.478	268	189	2,00	100
Dioxane	4.8	1.422	215	101	1.54	100
Ethyl Acetate	4.4	1.372	260	77	0.45	8.7
Ethanol	5.2	1.360	210	78	1.20	100
di-Ethyl Ether	2.8	1.353	220	35	0.32	6.89
Heptane	0.0	1.387	200	98	0.39	0.0003



Hexane	0.0	1.375	200	69	0.33	0.001
Methanol	5.1	1.329	205	65	0.60	100
Methyl-t-Butyl Ether[4]	2.5	1.369	210	55	0.27	4.8
Methyl Ethyl Ketone[5]	4.7	1.379	329	80	0.45	24
Pentane	0.0	1.358	200	36	0.23	0.004
n-Propanol	4.0	1.384	210	97	2.27	100
iso-Propanol[6]	3.9	1.377	210	82	2.30	100
di-iso-Propyl Ether	2.2	1.368	220	68	0.37	
Tetrahydrofuran	4.0	1.407	215	65	0.55	100
Toluene	2.4	1.496	285	111	0.59	0.051
Trichloroethylene	1.0	1.477	273	87	0.57	0.11
Water	9.0	1.333	200	100	1.00	100
Xylene	2.5	1.500	290	139	0.61	0.018

& Miscible

Immiscible*

**Immiscible means that in some proportions two phases will be produced.*

SYNONYM TABLE

[1] *Ethylene Chloride*	[4] *tert-Butyl Methyl Ether*
[2] *Methylene Chloride*	[5] *2-Butanone*
[3] *Methyl Sulfoxide*	[6] *2-Propanol*

COLUMN STORAGE

Solvents such as THF (stabilized THF only), Chloroform, Methylene Chloride, and Toluene are commonly used for column storage. Be sure to follow solvent switching instructions (see below) if using solvents other than THF. Storage solvents that remain liquefied at ambient temperatures and are not oxidizing can be used for storage.

BE SURE THAT ANY COLUMN THAT IS NOT USED IS CAPPED TIGHTLY WITH END-PLUGS TO AVOID EVAPORATION OF SOLVENTS FROM COLUMN. COLUMN DESICCATION IS THE MOST COMMON SOURCE OF COLUMN FAILURE.

SOLVENT SWITCHING CONSIDERATIONS FOR NON-AQUEOUS GPC COLUMNS

Phenogel columns are rugged and exhibit wide solvent compatibility. Different solvents, however, produce different swell characteristics (Table 13). Improper solvent switches can result in a void. For this reason, we recommend that you dedicate columns to specific solvents.

If you need to switch solvents, it is VERY IMPORTANT to take the following into consideration:

1. Reduce flow rate to 0.2 mL/min.
2. Backpressure must NEVER exceed 650 psi.
3. Always check solvent miscibility in a beaker or follow the solvent miscibility table on page 22-23 before proceeding with ANY solvent switch.
4. Compare the swell characteristics of solvent 1 (old solvent) to solvent 2 (new solvent) and use the following guidelines:

- If solvent 1 and solvent 2 belong to the same swell category (Table 13), check the solvent miscibility and proceed with the switch.
- If solvent 1 and solvent 2 belong to successive swell categories as indicated by the arrows on Table 13, check the miscibility and proceed with the switch.
- If solvent 1 and solvent 2 DO NOT belong to the same OR successive swell categories, switch to an intermediate solvent FIRST, as indicated by the arrows on Table 13.

Table 13

A – 70-80 % SWELL

Toluene	TCB
THF	p-Xylene
Chloroform	Cyclopentane
Benzene	Pyridine
o-Dichlorobenzene	

B – 60 % SWELL

Ethyl Ether	Cycloheptane
Methylene Chloride	Ethyl Acetate
Methyl Ethyl Ketone	

C – 50 % SWELL

Acetone	Dimethyl Acetamide
m-Cresol	N-Methyl Pyrrolidone
o-Chlorophenol	DMSO
Dimethyl Formamide	Dioxane

D – 30 % SWELL

Acetonitrile	Freon 113	n-Butyl Alcohol
Cyclohexane	HFIP	Methanol
n-Hexane	Iso-Propanol	

SOLVENT COMPATIBILITY CHART FOR PHENOGEL GPC COLUMNS

Mobile Phase Solvent	PHENOGEL PORE SIZE								Suggested Operating Temperature
	50 Å	100 Å	500 Å	10^3 Å	10^4 Å	10^5 Å	10^6 Å	Linear & Mixed	
Acetone	Y	Y	Y	Y	Y	Y	Y	Y	
Benzene	Y	Y	Y	Y	Y	Y	Y	Y	
Carbon Tetrachloride	Y	Y	Y	Y	Y	Y	Y	Y	
Chloroform	Y	Y	Y	Y	Y	Y	Y	Y	
30 % HFIP/chloroform	Y	Y	Y	Y	Y	Y	Y	Y	
Diethyl Ether	Y	Y	Y	Y	Y	Y	Y	Y	
Dimethylacetamide (DMAC)	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Dimethylformamide (DMF)	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Dioxane	Y	Y	Y	Y	Y	Y	Y	Y	
DMSO	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Ethyl Acetate	Y	Y	Y	Y	Y	Y	Y	Y	
Hexafluoroisopropanol (HFIP)	Y	Y	Y	Y	Y	Y	Y	Y	

*Not recommended on 5 µm 50 Å columns. N = Not Compatible Y = Compatible

Mobile Phase Solvent	PHENOGEL PORE SIZE								Suggested Operating Temperature
	50 Å	100 Å	500 Å	10^3 Å	10^4 Å	10^5 Å	10^6 Å	Linear & Mixed	
Hexane	Y	Y	Y	Y	Y	Y	Y	Y	
m-Cresol	Y*	Y	Y	Y	Y	Y	Y	Y	100 °C
Methyl Ethyl Ketone	Y	Y	Y	Y	Y	Y	Y	Y	
Methylene Chloride	Y	Y	Y	Y	Y	Y	Y	Y	
o-Chlorophenol	Y*	Y	Y	Y	Y	Y	Y	Y	100 °C
o-Dichlorobenzene	Y*	Y	Y	Y	Y	Y	Y	Y	135 °C
Quinolin	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Tetrahydrofuran	Y	Y	Y	Y	Y	Y	Y	Y	
Toluene	Y	Y	Y	Y	Y	Y	Y	Y	
Trichlorobenzene	Y*	Y	Y	Y	Y	Y	Y	Y	135 °C
Water	N	N	N	N	N	N	N	N	
Xylene	Y	Y	Y	Y	Y	Y	Y	Y	

Table 14

PART XI - POLYMERX RP COLUMNS

SPECIFICATIONS

- Matrix: Polystyrene Divinylbenzene (PSDVB)
- Particle Size: 3, 5, 7, 10 µm
- Pore Size: 100 Å

RUNNING PARAMETERS

- Maximum temperature: 60 °C
- Maximum pressure: 2500 psi

MOBILE PHASE CONSIDERATIONS

- pH range: 0 - 14
- Avoid buffer strength > 0.5 N

CLEANING PROCEDURE

- 100 % Water to 100 % Acetonitrile. Repeat 3 times.

COLUMN STORAGE

- 75:25 Acetonitrile / Water

PART XII - HPLC COLUMN PROTECTION & PERFORMANCE TESTING

- Maximize the life of your valuable HPLC Column
- Reduce system wear and tear
- Save time and money

PHENEX™ SYRINGE FILTERS

- Increase column lifetime (save money!)
- Ensure more accurate, consistent results
- Eliminate damaging microparticlates

Particulates can damage expensive equipment, valves, columns and pumps. They can also lead to erratic analytical results. Pre-filtering samples prior to analysis is critical in preventing column and frit blockage, undue wear on valve seals, and abnormally high operating pressures.

TABLE 15

Sample or Mobile Phase Volume (mL)	Filter Membrane (diameter, mm)	Format
≤ 2	4	Syringe filter
2 to 10	15	Syringe filter
10 to 100	25-28	Syringe filter
> 100	47	Membrane disk
> 1000	90	Membrane disk

MEMBRANE FILTERS ORDER LIST GUIDE

REGENERATED CELLULOSE (RC)

As a universal hydrophilic membrane, RC is widely used in chromatography for the clarification of aqueous samples and solvents. Due to its ultra-low binding capabilities, RC membranes are an excellent choice for proteins, peptides and other biomolecules.

POLYTETRAFLUOROETHYLENE (PTFE, TEFLON®)

PTFE is an inherently hydrophobic membrane, excellent for filtration of organic-based, highly acidic or basic samples and solvents. Widely used in chromatography, it is especially well suited for the clarification of non-aqueous samples. Although this membrane is hydrophobic, it can be made hydrophilic by

wetting the membrane with alcohol and then flushing with deionized water.

POLYETHERSULFONE (PES)

Polyethersulfone, a hydrophilic membrane with fast flow, high-throughput characteristics, with ultra-low protein binding. It is ideally suited for use in life sciences applications. The PES membrane offers better chemical resistance than cellulose acetate. Recommended for filtering critical biological samples, tissue culture media, additives, and buffers.

NYLON (NY)

Nylon has inherent hydrophilic characteristics and works well for filtration of many aqueous and mixed-organic samples. Nylon exhibits a high non-specific affinity for proteins. Phenomenex recommends Phenex-RC (Regenerated Cellulose) filters for applications requiring low non-specific adsorption of proteins.

CELLULOSE ACETATE (CA)

Cellulose Acetate membranes exhibit ultra-low protein binding and are broadly used in the filtration of biological samples. In combination with a glass pre-filter (Phenex-GF/CA), this membrane is excellent for filtration of tissue culture media, general biological sample filtration and clarification.

GLASS FIBER (GF)

Glass Fiber filters are made of inert borosilicate glass and have a nominal 1.2 µm pore size. They are commonly used with highly viscous samples or samples containing high concentrations of particulate matter (e.g., food analysis, biological samples, soil samples, fermentation broth samples, removal of yeasts, molds, etc.). Glass Fiber filters can be used alone or in conjunction with other Phenex filter membranes such as the 0.45 µm pore Phenex-RC filter to reduce clogging of the membrane and optimize flow.

ORDERING INFORMATION

Part No.	Pore Size (µm)	Phenex Membrane	Housing
4 mm Diameter (500/pk)			
AF0-3103-52	0.45	RC	PP
AF0-3102-52	0.45	PTFE[6]	PP
AF3-3107-52	0.45	NY	PP
AF0-3203-52	0.20	RC	PP
AF0-3202-52	0.20	PTFE[6]	PP
AF3-3207-52	0.20	NY	PP
15 mm Diameter (500/pk)			
AF0-2103-52	0.45	RC	PP
AF0-2102-52	0.45	PTFE[6]	PP
AF0-2107-52	0.45	NY	PP
AF0-2203-52	0.20	RC	PP
AF0-2202-52	0.20	PTFE[6]	PP
AF0-2207-52	0.20	NY	PP
25–28 mm Diameter (500/pk)			
AF0-8103-52[5]	0.45	RC	PP
AF0-8108-52[7]	0.45	PES[3]	PP
AF0-1102-52	0.45	PTFE[6]	PP
AF0-1107-52	0.45	NY	PP
AF0-8B09-52[7]	0.45	GF/CA[2,3,4]	MBS
AF0-8203-52[5]	0.20	RC	PP
AF0-8208-52[7]	0.20	PES[3]	PP
AF0-1202-52	0.20	PTFE[6]	PP
AF0-1207-52	0.20	NY	PP
AF0-8A09-52[7]	0.20	GF/CA[2,3,4,7]	MBS
AF0-8515-52[7]	1.20	GF[2,3]	MBS

Housing is made of medical-grade polypropylene (PP), unless otherwise indicated. Above syringe filters are non-sterile.

1. *Additional membrane types available.*
2. *Glass fiber filters are 28 mm diameter and made of borosilicate. They will remove 90 % of all particles >1.2 µm.*
3. *Housing material is methacrylate butadiene styrene (MBS) polymerisate. Also known as Cryolite®.*
4. *Cellulose acetate is surfactant-free.*
5. *26 mm diameter.*
6. *Hydrophobic membrane. Can be made hydrophilic by pre-wetting with IPA.*
7. *28 mm diameter.*

PHENEX™ DISPOSABLE CENTRIFUGAL FILTER UNITS

- Convenient filtration of multiple HPLC and GC samples
- High recovery for small samples
- Nylon, Cellulose Acetate, and PTFE (Teflon®) membrane materials

Centrifugal force drives the sample through the filter quickly without effort on the part of the chemist. No cleaning of syringes is required between samples. The receiver tube serves as a container for the filtered sample and can be retained as long as desired.

ORDERING INFORMATION

Part No.	Pore Size (µm)	Volumes (mL) Sample/Receiver	Membrane Non-Sterile	Unit
AF0-0438	0.2	2.0 / 5.0	Nylon	25/pk
AF0-0439	0.45	2.0 / 5.0	Nylon	25/pk
AF0-0440	0.2	2.0 / 5.0	PTFE	25/pk
AF0-0441	0.45	2.0 / 5.0	PTFE	25/pk
AF0-8353	0.2	2.0 / 5.0	CA	25/pk
AF0-8354	0.45	2.0 / 5.0	CA	25/pk

Above centrifugal filters are non-sterile.

GUARD CARTRIDGE SYSTEM

SecurityGuard™

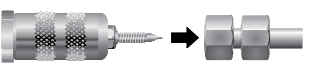
SecurityGuard provides a great balance of convenience, column protection capability and value. If you've ever used another guard cartridge system or conventional guard column, you will be pleasantly surprised when you see how practical and effective SecurityGuard really is. This highly advanced, patented design offers several unique features up to now not available.

CONVENIENCE

Knowing when to replace your guard is no longer a mystery! SecurityGuard's direct-view feature lets you inspect the packing material for visual contaminants and indicates when it's time to replace the cartridge. No other guard cartridge has this convenient feature.

EXTRA PROTECTION

SecurityGuard offers the option of stacking two cartridges in the same holder, using the simple stacking ring provided. Extra length provides extra protection. When the first cartridge becomes exhausted, contaminants are retained by the second cartridge.



VERSATILITY

One direct-connect holder conveniently finger-tightens into virtually any brand of HPLC column worldwide. How can one holder be direct-connect and universal at the same time when end-fittings have different depths? Answer- the length of the stainless steel nib at the end of the holder automatically adjusts to the precise depth of a column's endfitting. SecurityGuard's fingertight connection will withstand pressures up to 3500 psi (241 bar) and it features a completely inert and biocompatible flowpath.

ACCURACY

The cartridges can be used with virtually any matching phase of virtually any brand of column without affecting efficiency, retention time or backpressure. There are 37 different phases to choose from, including cartridges for general purpose, pharmaceutical, protein and polypeptide, aqueous size exclusion, chiral, carbohydrate and organic acid applications. SecurityGuard phases can be used with columns containing 3, 3.5, 4, 5, 10, 15 µm or larger diameter particle sizes.

SECURITYGUARD ORDERING INFORMATION

Analytical Holder Assembly Kit

Part No.	Description	Unit
KJ0-4282	Guard Cartridge Kit	ea

Kit includes: *1 Cartridge Holder, 3 PEEK Ferrules, 2 Stacking Rings, 2 PEEK Fingertight Male Nuts, 2 Wrenches*

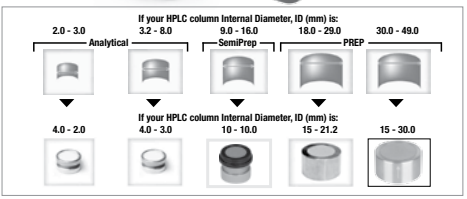
(Continued on next page)

Semi-Preparative and Preparative Holder for 10.0, 21.2 and 30.0 mm ID cartridges

Part No.	Description	Unit
AJ0-7220	Holder for 10.0 mm ID cartridges	ea
AJ0-8223	Holder for 21.2 mm ID cartridges	ea
AJ0-8277	Holder for 30.0mm ID cartridges	ea

Semi-Preparative

Preparative



Cartridges - General Purpose / Pharmaceutical

Part No.	Material Description	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-4286	C18 (ODS, Octadecyl)	1.5-10	4 x 2.0	10/pk
AJ0-4287	C18 (ODS, Octadecyl)	1.5-10	4 x 3.0	10/pk
AJ0-7221	C18 (ODS, Octadecyl)	1.5-10	10 x 10	3/pk
AJ0-7839	C18 (ODS, Octadecyl)	1.5-10	15 x 21.2	ea
AJ0-8301	C18 (ODS, Octadecyl)	1.5-10	15 x 30	ea
AJ0-6073	C12 (Dodecyl)	1.5-10	4 x 2.0	10/pk
AJ0-6074	C12 (Dodecyl)	1.5-10	4 x 3.0	10/pk
AJ0-7275	C12 (Dodecyl)	1.5-10	10 x 10	3/pk
AJ0-7842	C12 (Dodecyl)	1.5-10	15 x 21.2	ea
AJ0-8304	C12 (Dodecyl)	1.5-10	15 x 30	ea
AJ0-4289	C8 (Octyl, MOS)	1.5-10	4 x 2.0	10/pk
AJ0-4290	C8 (Octyl, MOS)	1.5-10	4 x 3.0	10/pk
AJ0-7222	C8 (Octyl, MOS)	1.5-10	10 x 10	3/pk
AJ0-7840	C8 (Octyl, MOS)	1.5-10	15 x 21.2	ea
AJ0-8302	C8 (Octyl, MOS)	1.5-10	15 x 30	ea
AJ0-4292	C5 (Pentyl)	1.5-10	4 x 2.0	10/pk
AJ0-4293	C5 (Pentyl)	1.5-10	4 x 3.0	10/pk
AJ0-7372	C5 (Pentyl)	1.5-10	10 x 10	3/pk
AJ0-4298	C1 (TMS)	2-9	4 x 2.0	10/pk
AJ0-4299	C1 (TMS)	2-9	4 x 3.0	10/pk
AJ0-7373	C1 (TMS)	2-9	10 x 10	3/pk
AJ0-4347	Silica	—	4 x 2.0	10/pk
AJ0-4348	Silica	—	4 x 3.0	10/pk
AJ0-7223	Silica	—	10 x 10	3/pk
AJ0-7229	Silica	—	15 x 21.2	ea
AJ0-8312	Silica	—	15 x 30	ea
AJ0-8328	HILIC	1.5-8	4 x 2.0	10/pk
AJ0-8329	HILIC	1.5-8	4 x 3.0	10/pk
AJ0-8902	HILIC	1.5-8	10 x 10	3/pk
AJ0-4301	NH_2 (Amino, Aminopropyl)		4 x 2.0	10/pk
AJ0-4302	NH_2 (Amino, Aminopropyl)		4 x 3.0	10/pk
AJ0-7364	NH_2 (Amino, Aminopropyl)		10 x 10	3/pk
AJ0-8162	NH_2 (Amino, Aminopropyl)		15 x 21.2	ea
AJ0-8309	NH_2 (Amino, Aminopropyl)		15 x 30	ea
AJ0-4304	CN (Cyano, Cyanopropyl)		4 x 2.0	10/pk
AJ0-4305	CN (Cyano, Cyanopropyl)		4 x 3.0	10/pk
AJ0-7313	CN (Cyano, Cyanopropyl)		10 x 10	3/pk
AJ0-8220	CN (Cyano, Cyanopropyl)		15 x 21.2	ea
AJ0-8311	CN (Cyano, Cyanopropyl)		15 x 30	ea
AJ0-4350	Phenyl (Phenylhexyl)	1.5-10	4 x 2.0	10/pk
AJ0-4351	Phenyl (Phenylhexyl)	1.5-10	4 x 3.0	10/pk

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Cartridges - General Purpose / Pharmaceutical

(Continued)

Part No.	Material Description	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-7314	Phenyl (Phenylhexyl)	1.5-10	10 x 10	3/pk
AJ0-7841	Phenyl (Phenylhexyl)	1.5-10	15 x 21.2	ea
AJ0-8303	Phenyl (Phenylhexyl)	1.5-10	15 x 30	ea
AJ0-8326	PFP(2) (Pentafluorophenylpropyl)		4 x 2.0	10/pk
AJ0-8327	PFP(2) (Pentafluorophenylpropyl)		4 x 3.0	10/pk
AJ0-8376	PFP(2) (Pentafluorophenylpropyl)		10 x 10	3/pk
AJ0-8377	PFP(2) (Pentafluorophenylpropyl)		15 x 21.2	ea
AJ0-8378	PFP(2) (Pentafluorophenylpropyl)		15 x 30	ea
AJ0-4307	SCX (SA, Strong Cation Exchanger)		4 x 2.0	10/pk
AJ0-4308	SCX (SA, Strong Cation Exchanger)		4 x 3.0	10/pk
AJ0-7369	SCX (SA, Strong Cation Exchanger)		10 x 10	3/pk
AJ0-8595	SCX (SA, Strong Cation Exchanger)		15 x 21.2	ea
AJ0-8596	SCX (SA, Strong Cation Exchanger)		15 x 30	ea
AJ0-4310	SAX (SA, Strong Cation Exchanger)		4 x 2.0	10/pk
AJ0-4311	SAX (SA, Strong Cation Exchanger)		4 x 3.0	10/pk
AJ0-7370	SAX (SA, Strong Cation Exchanger)		10 x 10	3/pk
AJ0-5808	RP-1(Reversed Phase Polymer)		4 x 2.0	10/pk
AJ0-5809	RP-1(Reversed Phase Polymer)		4 x 3.0	10/pk
AJ0-7368	RP-1(Reversed Phase Polymer)		10 x 10	3/pk
AJ0-8358	RP-1(Reversed Phase Polymer)		15 x 21.2	ea
AJ0-6075	Polar-RP (Ether-linked Phenyl)		4 x 2.0	10/pk
AJ0-6076	Polar-RP (Ether-linked Phenyl)		4 x 3.0	10/pk
AJ0-7276	Polar-RP (Ether-linked Phenyl)		10 x 10	3/pk
AJ0-7845	Polar-RP (Ether-linked Phenyl)		15 x 21.2	ea
AJ0-8307	Polar-RP (Ether-linked Phenyl)		15 x 30	ea
AJ0-7556	Fusion-RP (C18 Polar Embedded)		4 x 2.0	10/pk
AJ0-7557	Fusion-RP (C18 Polar Embedded)		4 x 3.0	10/pk
AJ0-7558	Fusion-RP (C18 Polar Embedded)		10 x 10	3/pk
AJ0-7844	Fusion-RP (C18 Polar Embedded)		15 x 21.2	ea
AJ0-8306	Fusion-RP (C18 Polar Embedded)		15 x 30	ea
AJ0-7510	AQ C18 (Polar Endcapped C18)		4 x 2.0	10/pk
AJ0-7511	AQ C18 (Polar Endcapped C18)		4 x 3.0	10/pk
AJ0-7512	AQ C18 (Polar Endcapped C18)		10 x 10	3/pk
AJ0-7843	AQ C18 (Polar Endcapped C18)		15 x 21.2	ea
AJ0-8305	AQ C18 (Polar Endcapped C18)		15 x 30	ea
AJ0-7596	Gemini C18 (TWIN Technology)		4 x 2.0	10/pk
AJ0-7597	Gemini C18 (TWIN Technology)		4 x 3.0	10/pk
AJ0-7598	Gemini C18 (TWIN Technology)		10 x 10	3/pk
AJ0-7846	Gemini C18 (TWIN Technology)		15 x 21.2	ea
AJ0-8308	Gemini C18 (TWIN Technology)		15 x 30	ea
AJ0-8367	Gemini-NX (C18 TWIN-NX Technology)		4 x 2.0	10/pk
AJ0-8368	Gemini-NX (C18 TWIN-NX Technology)		4 x 3.0	10/pk
AJ0-8369	Gemini-NX (C18 TWIN-NX Technology)		10 x 10	3/pk
AJ0-8370	Gemini-NX (C18 TWIN-NX Technology)		15 x 21.2	ea
AJ0-8371	Gemini-NX (C18 TWIN-NX Technology)		15 x 30	ea
AJ0-7914	Gemini C6-Phenyl (TWIN Tech.)		4 x 2.0	10/pk
AJ0-7915	Gemini C6-Phenyl (TWIN Tech.)		4 x 3.0	10/pk
AJ0-8134	Oligo-RP (C18 TWIN Technology)		4 x 2.0	10/pk
AJ0-8135	Oligo-RP (C18 TWIN Technology)		4 x 3.0	10/pk
AJ0-8136	Oligo-RP (C18 TWIN Technology)		10 x 10	3/pk
AJ0-8210	Oligo-RP (C18 TWIN Technology)		15 x 21.2	ea
AJ0-8310	Oligo-RP (C18 TWIN Technology)		15 x 30	ea
AJ0-8324	Oligo-WAX (WA, Weak Anion Exchanger)		4 x 3.0	10/pk
AJ0-8325	Oligo-WAX (WA, Weak Anion Exchanger)		10 x 10	3/pk
AJ0-8339	Oligo-WAX (WA, Weak Anion Exchanger)		15 x 21.2	ea
AJ0-8420	Oligo-WAX (WA, Weak Anion Exchanger)		15 x 30	ea

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Cartridges for Protein/Polypeptide Reversed Phase

For use with all silica columns for separation of proteins and peptides, such as Jupiter (Phenomenex); Vydac® 218TP, 214TP (Alltech Associates, Inc.); SynChropak® 300 C18, C4 (Eprogen, Inc.); Nucleosil® 300 Å C18, C4 (Macherey-Nagel); Hypersil® 300 Å (Thermo Hypersil-Keystone) and all other widepore or 300 Å brands.

Part No.	Material Description	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-4320	Widepore C18 (ODS)	1.5-10	4 x 2.0	10/pk
AJ0-4321	Widepore C18 (ODS)	1.5-10	4 x 3.0	10/pk
AJ0-7224	Widepore C18 (ODS)	1.5-10	10 x 10	3/pk
AJ0-7230	Widepore C18 (ODS)	1.5-10	15 x 21.2	ea
AJ0-8313	Widepore C18 (ODS)	1.5-10	15 x 30	ea
AJ0-4326	Widepore C5 (Pentyl)	1.5-10	4 x 2.0	10/pk
AJ0-4327	Widepore C5 (Pentyl)	1.5-10	4 x 3.0	10/pk
AJ0-7371	Widepore C5 (Pentyl)	1.5-10	10 x 10	ea
AJ0-4329	Widepore C4 (Butyl)	1.5-10	4 x 2.0	10/pk
AJ0-4330	Widepore C4 (Butyl)	1.5-10	4 x 3.0	10/pk
AJ0-7225	Widepore C4 (Butyl)	1.5-10	10 x 10	3/pk
AJ0-7231	Widepore C4 (Butyl)	1.5-10	15 x 21.2	ea
AJ0-8314	Widepore C4 (Butyl)	1.5-10	15 x 30	ea

Cartridges for Silica GFC (Aqueous SEC)

For use with all silica GFC columns, such as Yarra and BioSep (Phenomenex); ZORBAX® GF-series (Agilent Technologies); Bio-Sil®(Bio-Rad)

Part No.	Material Description	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-4487	GFC-2000	2-7.5	4 x 3.0	10/pk
AJ0-7365	GFC-2000	2-7.5	10 x 10	3/pk
AJ0-8588	GFC-2000	2-7.5	15 x 21.2	ea
AJ0-4488	GFC-3000	2-7.5	4 x 3.0	10/pk
AJ0-7366	GFC-3000	2-7.5	10 x 10	3/pk
AJ0-8589	GFC-3000	2-7.5	15 x 21.2	ea
AJ0-4489	GFC-4000	2-7.5	4 x 3.0	10/pk
AJ0-7367	GFC-4000	2-7.5	10 x 10	3/pk
AJ0-8590	GFC-4000	2-7.5	15 x 21.2	ea

Cartridges for Chiral

For use with chiral columns, such as Lux Cellulose-1, -2, -3, -4, & Amylose-2 (Phenomenex); CHIRALCEL® OD-H®, CHIRALCEL® OJ-H®, & CHIRALPAK® AD®-H (DAICEL Chemical Industries Ltd.)

Part No.	Material Description*	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-8402	Lux Cellulose-1	2-9	4 x 2.0	10/pk
AJ0-8403	Lux Cellulose-1	2-9	4 x 3.0	10/pk
AJ0-8404	Lux Cellulose-1	2-9	10 x 10	3/pk
AJ0-8405	Lux Cellulose-1	2-9	15 x 21.2	ea
AJ0-8406	Lux Cellulose-1	2-9	15 x 30	ea
AJ0-8398	Lux Cellulose-2	2-9	4 x 2.0	10/pk
AJ0-8366	Lux Cellulose-2	2-9	4 x 3.0	10/pk
AJ0-8399	Lux Cellulose-2	2-9	10 x 10	3/pk
AJ0-8400	Lux Cellulose-2	2-9	15 x 21.2	ea
AJ0-8401	Lux Cellulose-2	2-9	15 x 30	ea

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Cartridges for Chiral (cont'd)

Part No.	Material Description*	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-8621	Lux Cellulose-3	2-9	4 x 2.0	10/pk
AJ0-8622	Lux Cellulose-3	2-9	4 x 3.0	10/pk
AJ0-8623	Lux Cellulose-3	2-9	10 x 10.0	3/pk
AJ0-8624	Lux Cellulose-3	2-9	15 x 21.2	ea
AJ0-8625	Lux Cellulose-3	2-9	15 x 30.0	ea
AJ0-8626	Lux Cellulose-4	2-9	4 x 2.0	10/pk
AJ0-8627	Lux Cellulose-4	2-9	4 x 3.0	10/pk
AJ0-8628	Lux Cellulose-4	2-9	10 x 10.0	3/pk
AJ0-8629	Lux Cellulose-4	2-9	15 x 21.2	ea
AJ0-8630	Lux Cellulose-4	2-9	15 x 30.0	ea
AJ0-8471	Lux Amylose-2	2-9	4 x 2.0	10/pk
AJ0-8470	Lux Amylose-2	2-9	4 x 3.0	10/pk
AJ0-8472	Lux Amylose-2	2-9	10 x 10	3/pk
AJ0-8473	Lux Amylose-2	2-9	15 x 21.2	ea
AJ0-8474	Lux Amylose-2	2-9	15 x 30	ea

* Lux Cellulose-1 is cellulose tris(3,5-dimethylphenylcarbamate)
Lux Cellulose-2 is cellulose tris(3-chloro-4-methylphenylcarbamate)
Lux Cellulose-3 is cellulose tris(4-methylbenzoate)
Lux Cellulose-4 is cellulose tris(4-chloro-3-methylphenylcarbamate)
Lux Amylose-2 is amylose tris(5-chloro-2-methylphenylcarbamate)

Cartridges for Carbohydrate / Organic Acid

For Organic acid and carbohydrate analysis, such as Rezex™ (Phenomenex); Aminex® (Bio-Rad); Sugar-Pak™ (Waters).

Part No.	Material Description	pH Stability	Dimensions L x ID(mm)	Unit
AJ0-4490	Carbo-H^+	1 - 8	4 x 3.0	10/pk
AJ0-8888	Carbo H^+	1 - 8	15 x 21.2	ea
AJ0-4491	Carbo-Ag^+*	Neutral	4 x 3.0	10/pk
AJ0-8891	Carbo Ag^+*	Neutral	15 x 21.2	ea
AJ0-4492	Carbo-Pb^{+2}	Neutral	4 x 3.0	10/pk
AJ0-8890	Carbo Pb^{+2}	Neutral	15 x 21.2	ea
AJ0-4493	Carbo-Ca^{+2}	Neutral	4 x 3.0	10/pk
AJ0-8889	Carbo Ca^{+2}	Neutral	15 x 21.2	ea

**For use with saccharide and oligosaccharide columns in Ag^+ form.*

Replacement Parts

Part No.	Description	Unit
AJ0-4283	PEEK Ferrules	3/pk
AJ0-4285	Stacking Rings	2/pk
AQ0-1389	PEEK Fingertight Male Nuts	10/pk
AJ0-4284	Security Guard Wrenches	2/pk
AQ0-8374	PREP Coupler, SS w/ PEEK Ferrule Inserts 10-32 Threads, 1/16 in. OD x 0.020 in. ID	ea
AQ0-8375	Replacement Ferrule Inserts, for PREP Coupler, PEEK, 0.020 in. ID	10/pk
AQ0-8222	PREP Replacement O-Rings, Kalrez® For 15 x 21.2 mm SG Holder, Size 2-021	2/pk
AQ0-8318	PREP Replacement O-Rings, Kalrez® For 15 x 30 mm SG Holder, Size 2-025	2/pk

High Pressure Applications

For applications where pressures exceed 3500 psi (241bar), or for use with core-shell, non-porous, or < 3 µm fully porous media, please choose SecurityGuard ULTRA. Contact Phenomenex or your local Phenomenex representative for more information.

HPLC SYSTEM TEST KIT

- Diagnose hardware problems rapidly and easily
- Avoid unnecessary and costly system repairs
- Convenient benchmark testing of HPLC systems using a C18 column standard
- Test system setup and hardware connections
- Quickly isolate method development problems
- Reduce instrument downtime

Each kit contains the following:
1. Phenomenex 5 µm C18, 50 x 4.6 mm HPLC column
2. Five vials of Isocratic Test Mix
3. Five vials of Gradient Test Mix

ORDERING INFORMATION

Part No.	Description	Unit
CH0-1684	HPLC System Test Kit, Reversed Phase, includes: C18 column, isocratic and gradient test mixes	ea
CH0-1685	Isocratic Test Mix	5/pk
CH0-1686	Gradient Test Mix	5/pk

COLUMN PERFORMANCE CHECK STANDARDS

- Convenient way to check column performance
- Affordable and easy to use

Phenomenex offers a comprehensive line of column performance check standards to help you evaluate column performance. We recommend using the check standards to verify performance of all columns upon receiving them and periodically over the lifetime of the column. Test conditions are located in the column jacket.

NORMAL PHASE Part No. **AL0-3033**

(For Si, NH_2, NO_2, Alumina, PAC, and Luna CN)

Unit quantity: 2 mL
Contains: Meta-xylene, Nitrobenzene

REVERSED PHASE 1 Part No. **AL0-3034**

(For C1, C18, CN and Phenyl)

Unit quantity: 2 mL
Contains: Uracil, Benzamide, Benzophenone, Biphenyl

REVERSED PHASE 2 Part No. **AL0-3045**

(For Prodigy C8, ODS(2), ODS(3); Luna C5, C8, C18, Phenyl-Hexyl, PFP(2); Jupiter C4, C5, C18, Proteo; Columbus C8, C18; Aqua; Synergi; PhenoSphere-*NEXT* C8, C18; Gemini C18, C6-Phenyl; Gemini NX-C18; Clarity Oligo-RP, Oligo-MS; Kinetex C8, XB-C18, Phenyl-Hexyl, C18, PFP; Aeris PEPTIDE XB-C18; 4.6 mm ID Aeris WIDEBORE XB-C18, XB-C8, C4)

Unit quantity: 2 mL
Contains: Uracil, Acetophenone, Toluene, Naphthalene
(Please refer to the QC Test Data for specific test conditions for Jupiter, Aeris, Kinetex, and Luna)

COLUMN PERFORMANCE CHECK STANDARDS (CONTINUED)

AERIS NARROW ID — Part No. ALO-8931

(For 2.1 mm ID Aeris WIDEPORE XB-C18, XB-C8, C4)

Unit quantity: 2 mL
Contains: Uracil; Acetophenone; Toluene; Naphthalene; Acenaphthalene (2.5 mg/mL)

HILIC PHASE — Part No. ALO-8317

(For Luna HILIC; Kinetex HILIC)

Unit quantity: 2 mL
Contains: Toluene, Uracil, Cytosine

CARBOHYDRATE MIX 1 — Part No. ALO-3035

(For Rezex RNM, RAM and other carbohydrate analysis columns)

Unit quantity: 2 mL
Contains: Maltotriose Hydrate, Maltose, Ribitol

CARBOHYDRATE MIX 2 — Part No. ALO-3036

(For Rezex RPM and other carbohydrate analysis columns)

Unit quantity: 2 mL
Contains: Melezitose, Glucose, Fructose, Ribitol

CARBOHYDRATE MIX 3 — Part No. ALO-3037

(For Rezex RCM, RCU, and other carbohydrate analysis columns)

Unit quantity: 2 mL
Contains: Melezitose, Maltose, Glucose, Mannose, Fructose, Ribitol

OLIGOSACCHARIDE STANDARD — Part No. ALO-3038

(For Rezex RSO, RNO, and other oligosaccharide analysis columns)

Unit quantity: 2 mL
Contains: Light corn syrup

ORGANIC ACID STANDARD — Part No. ALO-3039

(For Rezex ROA and other organic acid analysis columns)

Unit quantity: 2 mL
Contains: Oxalic acid, Succinic acid, Citric acid, Formic acid, Tartaric acid, Acetic acid

CATION-EXCHANGE — Part No. ALO-3040

(For SCX, SA, CM)

Unit quantity: 2 mL
Contains: Uracil, Cytosine

ANION-EXCHANGE — Part No. ALO-3041

(For SAX, SB, DEAE, PEI)

Unit quantity: 2 mL
Contains: Uridine, UMP

COLUMN PERFORMANCE CHECK STANDARDS (CONTINUED)

AQUEOUS SEC 1 — Part No. ALO-3042

(For Yarra SEC, BioSep-SEC-S, and other protein SEC columns)

Unit quantity: Dry; Reconstituted to 2 mL
Contains: Bovine thyroglobulin
Human gamma globulin (contains IgA and IgG)
Ovalbumin
Myoglobin
Uridine

(reconstitute with 1 mL of 100 mM Sodium Phosphate pH 6.8)

AQUEOUS SEC 2 — Part No. ALO-3043

(For PolySep GFC-P and other aqueous-soluble analysis columns)

Unit quantity: 2 mL
Contains: Ethylene Glycol

STAR-ION A300 — Part No. ALO-3420

Unit quantity: 2 mL
Contains:

Conc. (mg/mL)			
Fluoride	5	Nitrite	20
Nitrate	20	Sulfate	20
Chloride	10	Bromide	20
Phosphate	30		

POLYMERX RP-1 — Part No. ALO-7260

Unit quantity: 2 mL
Contains:

Conc. (mg/mL)	
Cytosine	13
Uracil	13
Uridine	33

ONYX MONOLITHIC REVERSED PHASE — Part No. ALO-7836

Unit quantity: 2 mL
Contains:

Conc. (µg/mL)	
Thiourea	10
Progesterone	100
Anthracene	10

ONYX MONOLITHIC NORMAL PHASE — Part No. ALO-7835

Unit quantity: 2 mL
Contains:

Conc. (µg/mL)	
Toluene	21.75
Nitrobenzene	150.00
2-Nitroanisol	0.18

COLUMN PERFORMANCE CHECK STANDARDS (CONTINUED)

CHIRAL TEST MIX 1 — Part No. **AL0-3046**

Applicable to the following Chirex columns:
3001, 3005

Unit quantity: 2 mL
Contains:
1. S-(+)-2,2,2-trifluoro-1-(9-anthryl) ethanol CAS [60646-30-2]
2. R-(-)-2,2,2-trifluoro-1-(9-anthryl) ethanol CAS [53531-34-3]

CHIRAL TEST MIX 2 — Part No. **AL0-3047**

Applicable to the following Chirex columns:
3010, 3011, 3012

Unit quantity: 2 mL
Contains: N-dansyl-DL-valine (cyclohexylammonium salt) CAS[84540-67-0]

CHIRAL TEST MIX 3 — Part No. **AL0-3048**

Applicable to the following Chirex columns:
3014, 3017, 3018, 3019, 3020, 3022

Unit quantity: 2 mL
Contains:
1. (R)-(-)-N-(3,5-Dinitrobenzoyl)-α-methylbenzylamine CAS [69632-32-2]
2. (S)-(-)-N-(3,5-Dinitrobenzoyl)-α methylbenzylamine CAS[69632-31-1]

CHIRAL TEST MIX 4 — Part No. **AL0-3049**

Applicable to the following Chirex column:
3126

Unit quantity: 2 mL
Contains: DL-Aspartic Acid CAS [617-45-8]

CHIRAL TEST MIX 5 — Part No. **AL0-8412**

Applicable to the following Lux columns:
Lux Cellulose-1,-2,-3,-4, Lux Amylose-2

Unit quantity: 2 mL
Contains: trans-Stilbene oxide CAS [1439-07-2]

VEREX VIAL PRODUCTS CERTIFIED VIALS, CAPS, SEPTA, AND INSERTS

CERTIFIED FOR DEMANDING METHODOLOGIES:

- Regulated Methods
- High Sensitivity LC and GC
- Mass Spectrometry

ORDERING INFORMATION

12 x 32 mm, 11 mm Crimp-Top Vials and Closures

CRIMP-TOP VIALS, 2.0 mL

- Cleaner vials eliminate ghost peaks and contaminants
- Used with most autosamplers, including Agilent®, Thermo Scientific®, Waters®
- Larger-opening "wide-mouth" style prevents broken needles and system downtime
- Precision neck improves crimping

Description	1000/pk
Standard Opening	
Vial, Crimp, 2 mL Clear, No Patch	AR0-3700-13
Vial, Crimp, 2 mL Clear, w/ Patch	AR0-3710-13
Vial, Crimp, 2 mL Amber, w/ Patch	AR0-3711-13
Wide Mouth Opening	
Vial, Crimp, 2 mL Wide Mouth, Clear, No Patch	AR0-37K0-13
Vial, Crimp, 2 mL Wide Mouth, Clear, w/ Patch	AR0-37L0-13
Vial, Crimp, 2 mL Wide Mouth, Amber, No Patch	AR0-37K1-13
Vial, Crimp, 2 mL Wide Mouth, Amber, w/ Patch	AR0-37L1-13

SEALS / CLOSURES FOR CRIMP-TOP VIALS

- Excellent for volatile samples
- Extra clean to eliminate contamination
- Colored aluminum

Description	1000/pk
Seal, 11mm Diameter, Crimp, PTFE/ Silicone, silver	AR0-5780-13
Seal, 11mm Diameter, Crimp, PTFE/ Silicone/PTFE, silver	AR0-5760-13
Seal, 11mm Diameter, Crimp, PTFE/ Rubber, silver	AR0-5740-13
Seal, 11mm Diameter, Crimp, PTFE/ Rubber, blue	AR0-5742-13
Seal, 11mm Diameter, Crimp, PTFE/ Rubber, red	AR0-5741-13
Seal, 11mm Diameter, Crimp, PTFE/ Rubber, green	AR0-5743-13
Seal, 11mm Diameter, Crimp, PTFE/ Rubber, gold	AR0-574G-13
Seal, 11mm Diameter, Crimp, PTFE, silver	AR0-5710-13

Need help matching your current vials and caps to Verex? Visit www.phenomenex.com/VialMatch

12 x 32 mm, 9-425 (9 mm) Screw-Top Vials and Caps

9-425 SCREW-TOP VIALS, 2.0 mL

- Used with most autosamplers, including Agilent®, Thermo Scientific®, Waters® and many others
- Performs as well as crimp or snap vials
- Offers improved cap convenience and accessibility (easy on, easy off)

Description	1000/pk
Vial, 9 mm Screw, 2 mL Clear, No Patch	AR0-3900-13
Vial, 9 mm Screw, 2 mL Amber, No Patch	AR0-3901-13
Vial, 9 mm Screw, 2 mL Clear, w/ Patch	AR0-3910-13
Vial, 9 mm Screw, 2 mL Amber, w/ Patch	AR0-3911-13
Vial, 9 mm Screw, 2 mL Clear, w/ Patch, Silanized	AR0-3960-13

BONDED-IN CAPS FOR 9-425 SCREW-TOP VIALS

- Bonded septa caps eliminate costly liner/septa fallout
- Prevents rework and wasted productivity with perfect-fit septa
- Saves instrument downtime

Description	1000/pk
Cap (pre-assembled), 9 mm, w/ Bonded-in PTFE/Silicone septa, black	AR0-8957-13-B
Cap (pre-assembled), 9 mm, w/ Bonded-in PTFE/Silicone septa, blue	AR0-8952-13-B
Cap (pre-assembled), 9 mm, w/ Bonded-in PTFE/Silicone septa, natural	AR0-8956-13-B
Cap (pre-assembled), 9 mm, w/ Bonded-in PTFE/Silicone septa, red	AR0-8951-13-B
Cap (pre-assembled), 9 mm, w/ Bonded-in PTFE/Silicone preSlit septa, black	AR0-8977-13-B
Cap (pre-assembled), 9 mm, w/ Bonded-in PTFE/Silicone preSlit septa, blue	AR0-8972-13-B

ADDITIONAL CERTIFIED VIALS AND CAPS ALSO AVAILABLE:

- 12 x 32 mm, 2 mL Vials
  - 11 mm limited volume crimp-top vials
  - 11 mm limited volume screw-top vials
  - 11 mm snap-top vials
  - 11 mm limited volume snap-top vials
  - 8 mm screw-top vials
  - 10 mm screw-top vials
  - 10 mm limited volume screw-top vials
  - 13 mm screw-top vials
  - 13 mm limited volume screw-top vials
- VOA / ASE assembled vial kits and storage vial
- Headspace vials
- Plastic vials
- Shell vials
- Vial inserts

Learn More. *Visit Phenomenex.com/Verex for additional product selection and detailed information.*

PART XIV - SOLID PHASE EXTRACTION (SPE)

Increase column and instrument life by injecting samples cleaned-up with Strata®.

STRATA™-X Polymeric Sorbents

Tubes and 96-Well Plates

- Deconditioning Resistant
- Low Elution Volumes
- High Analyte Capacity

Strata™-X and **-XL** for simplified cleanup of polar and non-polar compounds

Strata™-X-C and **-XL-C** for selective extraction of basic compounds

Strata™-X-CW and **-XL-CW** for bases (including quaternary amines)

Strata™-X-A and **-XL-A** for cleanup of weak acids

Strata™-X-AW -XL-AW for acids

Strata™-X-Drug B for basic drugs of abuse

Strata™-X-Drug N for neutral drugs of abuse

STRATA® Traditional Sorbents

Tubes and 96-Well Plates

- Optimal Flow
- Lot-to-Lot Reproducibility
- Wide Range of Selectivity
- Available chemistries include: C18-E, C18-U, C18-T, C8, Phenyl, SDB-L, CN, Si-1, WCX, FI-PR, NH_2, SAX, SCX, Melamine

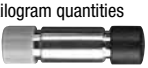
STRATA® Flash Sorbents

- Polar & Non-polar Phases
- Narrow Particle Range Distribution
- Can be used for Direct Scale-up

Strata® Giga™ Tubes available in 12, 20, 60 & 150 mL formats

Sepra™ Bulk available in gram to multi-kilogram quantities

STRATA® On-line Cartridges



- Rapid Extraction and Concentration
- Direct Inject Analysis
- Easily Automated

Strata™-X for polar and non-polar compounds

Strata™-X-C for weak bases

Strata™-X-CW for strong bases

Strata® C18 for non-polar compounds

Strata® C8 for compounds of intermediate polarity

PART XV - HPLC ACCESSORIES

ACCESSORIES

- Backpressure Regulators
- Biocompatible / Metal-free products
- Connectors and Splitters
- Filtration Products
- Injectors and Injector Loops
- Membrane Filters
- Mobile Phase Handling Devices
- Polymer Calibration Standards / Kits
- Rotor Seals, Stators, etc.
- Solvent Reservoir and Reagent Bottles
- SPE Consumables, Tube & Plate Manifolds
- Switching Valves
- Syringes
- Syringe Filters
- Tools
- Tubing, Fittings, Frits and Unions
- Valves (Injection, Switching)
- Vials, Caps and Septa

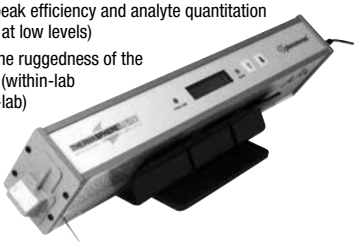
EQUIPMENT

- Column Chiller-Heater
- Column Heater
- Degasser

For ordering and additional information, please contact your Phenomenex Technical Consultant.

SINGLE COLUMN HEATER THERMASPHERE™ TS-130

- Compact, low-cost heater precisely controls temperature from 25-90 °C
- Improves reproducibility and chromatographic results
- Reduces analyte identification errors
- Improves baseline and overall detector performance
- Improves peak efficiency and analyte quantitation (especially at low levels)
- Improves the ruggedness of the separation (within-lab and lab-to-lab)



ORDERING INFORMATION

ThermaSphere™ TS-130

Part No.	Description
EH0-7057	ThermaSphere TS-130 HPLC Column Heater 25-90 °C, 95 to 265 VAC, 50/60 Hz
EH0-7058	Stand for ThermaSphere TS-130 HPLC Column Heater

More Accessories available. See Phenomenex Catalog for details.

PHENOMENEX WARRANTY

Phenomenex products are warranted to meet the stated performance and quality and to be free of defects in material and workmanship. They are not warranted, nor does Phenomenex assume liability, if misused. **NO OTHER WARRANTY OR REPRESENTATION IS IMPLIED OR EXPRESSED BY PHENOMENEX FOR ITS PRODUCTS WITH RESPECT TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER MATTER. PHENOMENEX SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, OR COMPENSATORY DAMAGE ARISING FROM THE USE OF, OR IN CONJUNCTION WITH, ITS PRODUCTS.** The maximum liability which can be assumed by Phenomenex for breach of warranty shall be the invoice price of the product.

SPECIFIC WARRANTIES ON HPLC COLUMNS

Phenomenex warrants its quality columns in accordance with the following terms and conditions. Phenomenex will repack, replace, or refund charges on any column (at our discretion), at no cost if a column fails to perform satisfactorily. Columns being returned must have prior return authorization granted by Phenomenex. Defective products must be accompanied by a written explanation of failure. Approval is subject to the following exclusions:

- All columns must be tested upon receipt and all deficiencies must be reported to Phenomenex no later than 15 days after the date of receipt of the column.
- Maximum warranty period is limited to 90 days on HPLC columns unless previously agreed upon. However, COLUMNS MAY NOT BE RETURNED FOR REFUND OR CREDIT AFTER 45 DAYS AND WITHOUT PRIOR AUTHORIZATION.
- Removal of column end-fittings automatically voids column warranty.
- Column performance warranty is limited to the conditions of the original test chromatograms.
- Physical damage to the column due to misuse, abuse, or mishap, including mechanical shock.
- Chemical damage to the packing material due to operation at incorrect chemical conditions, temperatures, or pressures.
- Failure due to high backpressures caused by improper solvent or sample filtration practices causing particulate build-up or precipitation in the column or end-fitting.
- Incorrect selection of packing material made by customer for their particular use or incompatibility of equipment, etc.
- For products supplied by but not manufactured by Phenomenex, the warranty is limited by the terms of the original manufacturer's warranty.

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contact Phenomenex USA, International Department by telephone, fax or email: international@phenomenex.com.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO 9001:2008

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...breaking with tradition℠