SGE Analytical Science By TRAJAN

The Suite for Environmental GC Analysis

SGE Environmental GC Columns

- Performance
- Selectivity
- Delivery Promise

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SGE Environmental GC Columns

The Suite for Environmental GC Analysis

SGE GC Columns have a history of being effective columns for the separation of environmental analytes.

TRAJAN Since Trajan Scientific and Medical acquired the SGE business, significant focus has been invested in improving the manufacturing process and phase synthesis to ensure the performance, consistency and quality of the GC column meets the needs of the analysis in the laboratory.

The range of GC columns presented for environmental analysis now delivers improved performance, selectivity and a guarantee on delivery, making SGE GC columns by Trajan a key product for the Environmental laboratory.

End-to-End Capillary Column Manufacture

With the **complete technical ability to produce GC columns from beginning to end**, including the special requirements of producing fused silica capillary tubing, Trajan controls fabrication process precisely to produce the finest quality GC columns available.

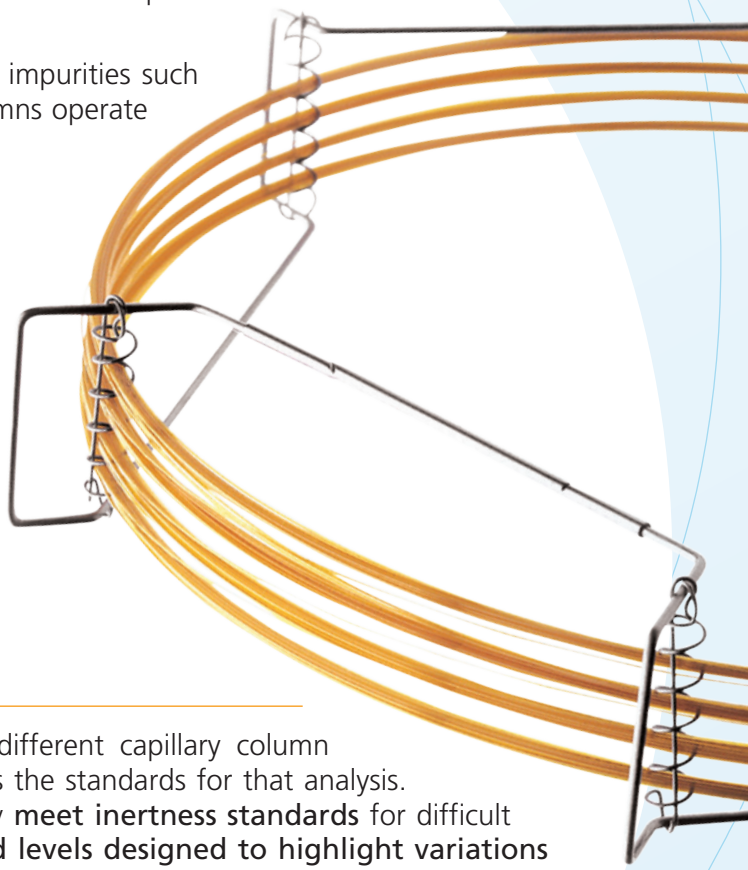
The individual technology processes Trajan employs in GC column manufacture are:

- Drawing of the precision fused silica capillary tubing.
- Developing and synthesizing specialty polymer stationary phases.
- Performing the specialized chemical treatment of the fused silica surface so it is inert and compatible for the cross-linked stationary phase.
- Coating and cross-linking the polymer stationary phase.
- Quality testing of every completed GC column to rigorous standards.

Fused Silica

The process of producing fused silica tubing is carried out on a series of sophisticated drawing towers with fine control of conditions and feedback loops to automatically make adjustments to the conditions. This ensures **superb dimensional control and strength** which is verified through stress proof testing of all material. By producing the fused silica in-house, Trajan has complete control of this important aspect of producing the highest quality GC columns.

The fused silica used by Trajan is very high purity devoid of impurities such as metal oxides found in conventional glasses. SGE GC columns operate comfortably to 400 °C (dependent on the phase selected).



Stationary Phase Polymer

Trajan has designed its phase synthesis so that most GC columns may be **washed with solvent to remove any contamination**. When a capillary column's performance has deteriorated from extended use or contamination, performance can often be restored though washing with a suitable solvent.

Targeted Performance Testing

Test criteria are selected based on the applications that different capillary column types are targeted for, to ensure the capillary column meets the standards for that analysis. General purpose capillary columns are tested to ensure they **meet inertness standards** for difficult to chromatograph compounds, **and run at conditions and levels designed to highlight variations** in capillary column performance. For example, Trajan's non-polar phase BPX5 is tested using active probes such as n-decylamine and 2,4-dinitrophenol chromatographed at low concentrations (1-2 ng on capillary column for 0.25 µm film thickness) and with sufficient retained time on the run to induce tailing on all but the most highly inert GC columns.

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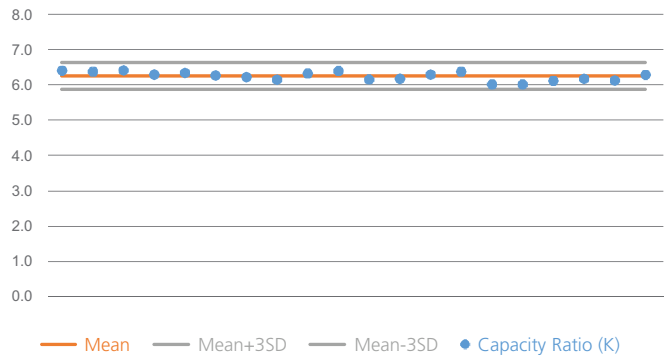
Retention Time and Consistency

Because Trajan controls the GC column fabrication process from beginning to end, remarkably consistent retention characteristics can be achieved from column to column. When a method is established on an SGE GC column, **the same separation can be expected column after column**.

Enhanced retention time consistency achieved through manufacturing improvements is demonstrated here for capacity ratio (K) measured on 20 BPX5 columns showing very high congruence.

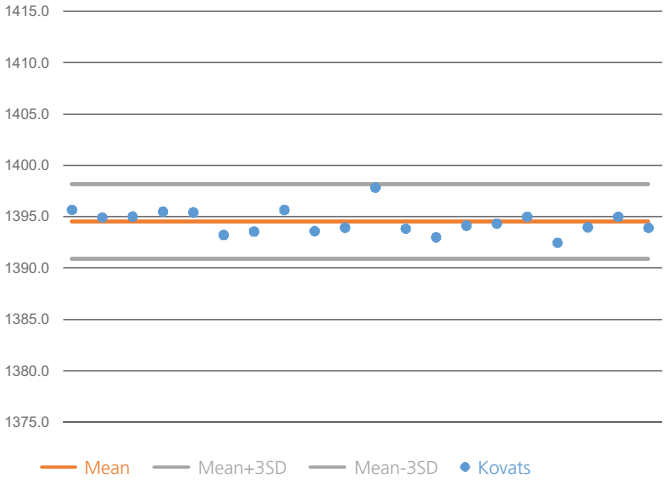


BPX5 Retention - Consistency.

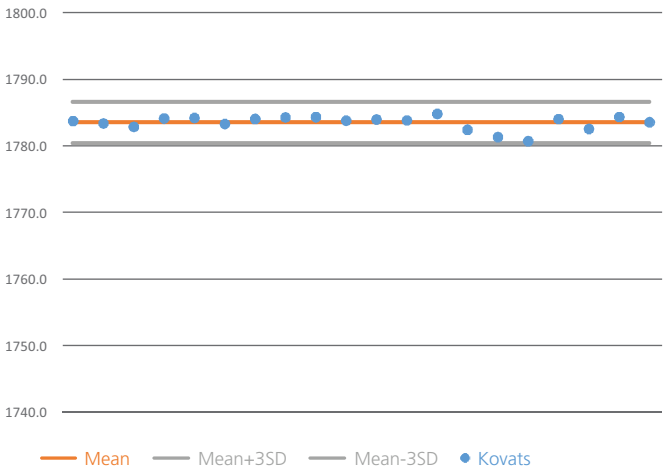
Selectivity

SGE GC columns **deliver accurate retention indices with high precision** to ensuring confidence in peak identification for non-polar and polar stationary phase columns.

Retention index repeatability is shown here for 20 BP5 columns and for 20 BP20 columns.



BP5 Kovats' Biphenyl - Accuracy and precision.

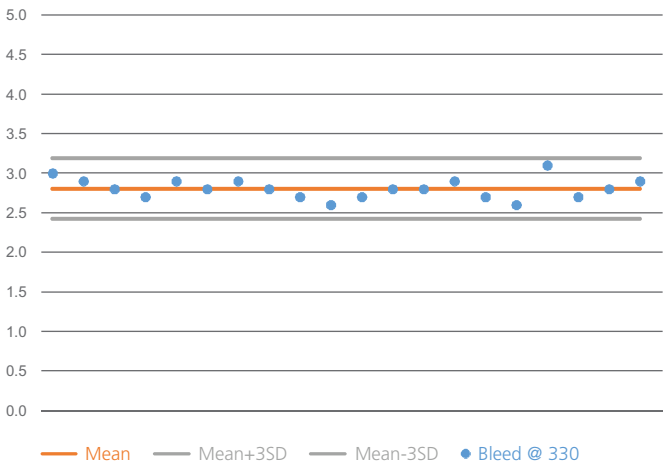


BP20 Kovats' Retention Index

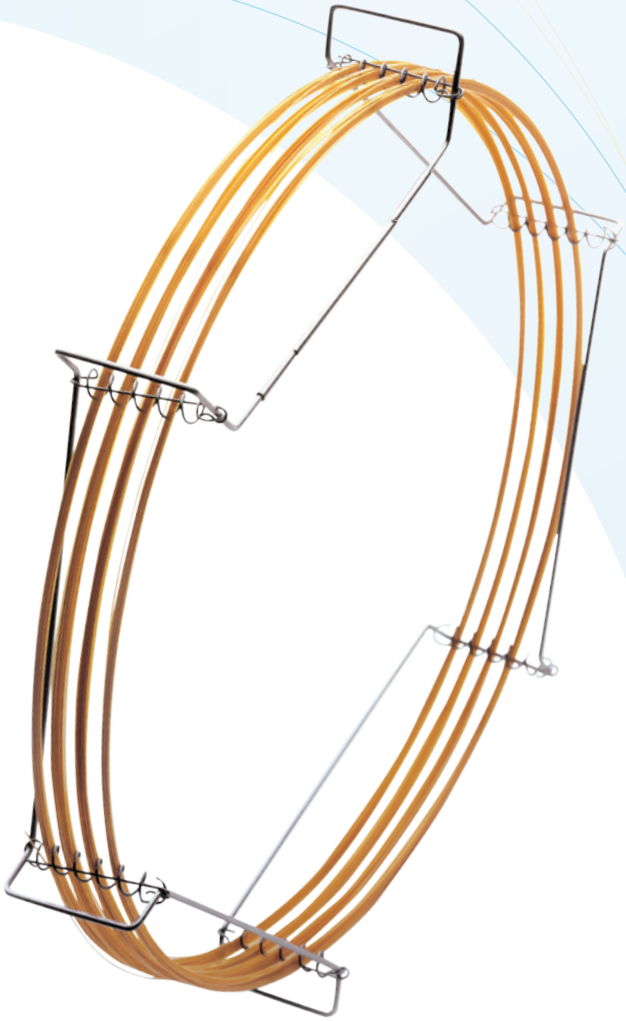
Thermal Stability

SGE GC columns are **monitored for bleed performance with rigorous standards**. Bleed is measured and specified in terms of detector signal and calibrated to "nanograms of siloxane per second" eluted from the GC columns. The test is performed at the maximum operating temperature for the GC column. Picoamp signal is highly dependent on the detector and conditions used and is not an absolute measure. Bleed measurements are carried out using FID to ensure the best performance possible.

Results from BP5MS column testing (20 columns) highlight the low bleed expected of SGE GC columns.



BP5MS Bleed @ 330 - Consistency.



SGE GC Columns

Meeting the needs of the environmental analysis in the laboratory.

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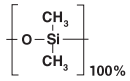
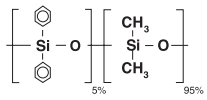
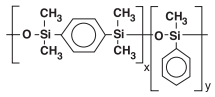
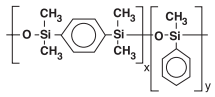
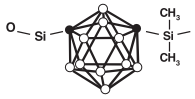
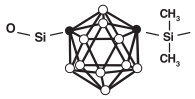
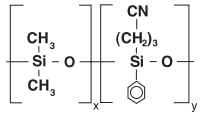
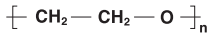
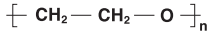
SGE GC Columns for Environmental Analysis

Phase	Overview	Stationary Phase	Phase Structure	Application Suited
BP1	• Classic crosslinked dimethyl polysiloxane technology. • Low bleed. • 320 – 340 °C upper temperature limit – dependent on film thickness.	100% Dimethyl Polysiloxane		Suitable for all routine analysis.
BP5	• Low bleed. • High temperature. • 320/340 °C upper temperature limit - dependent on film thickness.	5% Phenyl / 95% Dimethyl Polysiloxane		Suitable for all routine analysis.
BPX5	• High temperature. • Popular column range used for a wide variety of applications. • 360/370 °C upper temperature limit. • Very low bleed - ideal for trace analysis. • Extremely inert.	5% Phenyl Polysilphenylene-siloxane		Excellent for all routine high-temperature applications.
BP5MS	• High temperature. • General purpose GC column - suitable for over 80% of all routine GC analyses. • 330/350 °C upper temperature limit. • Very low bleed - ideal for GC-MS analysis. • Extremely inert.	5% Phenyl Polysilphenylene-siloxane		Suitable for all routine GC-MS analysis.
HT5	• Ultra high temperature columns. • Unique phase – no equivalent phases. • 380/400 °C upper temperature limit. • Bonded and cross-linked. • Able to be solvent rinsed.	5% Phenyl Polycarborane-siloxane		• Suited to petrochemicals and petroleum derived environmental contaminants. • Excellent for high-temperature applications.
HT8	• High temperature. • Low bleed. • Separates PCB's on ortho ring substitution as well as boiling point. • 360/370 °C upper temperature limit.	8% Phenyl Polycarborane-siloxane		• Ideal for environmental analysis. • Preferred column for polychlorinated biphenyl (PCB) compounds. • Unique high temperature phase suited for the analysis of persistent organic pollutants (POPs).
BP624	• US EPA 624 optimized column. • 230/240 °C upper temperature limit. • Able to be solvent rinsed. • Bonded and cross-linked.	Cyanopropylphenyl Polysiloxane		• Designed for volatiles analysis. • Ideal for EPA624, SW-846 methods 8240/8260. • Ideal for USP G43 method.
BP20	• Polar phase. • 240 – 280 °C upper temperature limit – dependent on film thickness. • Bonded and cross-linked. • Able to be solvent rinsed.	Polyethylene Glycol		Industry standard wax column for polar compounds analysis.
SolGel-WAX™	• The world's highest temperature wax phase. • Bonded polyethylene glycol. • Less susceptible to damage by oxygen than conventional wax phases. • Low bleed and inert. • 280 °C upper temperature limit. • Bonded and cross-linked. • Able to be solvent rinsed.	Polyethylene Glycol (PEG) in a Sol-Gel matrix		Very robust high-temperature column for polar compounds analysis.

Length (m)	ID (mm)	Film Thickness (µm)	Part No.
BP1			
12	0.22	0.25	054046
25	0.22	0.25	054047
30	0.22	0.25	054050
50	0.22	0.25	054048
60	0.22	0.25	054051
50	0.22	1.00	054054
30	0.25	0.25	054044
60	0.25	0.25	054045
30	0.25	0.50	054820
30	0.25	1.00	054056
30	0.32	0.25	054062
25	0.32	0.50	054065
25	0.32	1.00	054071
30	0.32	1.00	054813
60	0.32	1.00	054810
30	0.32	3.00	054073
30	0.53	1.00	054090
30	0.53	3.00	054808
30	0.53	5.00	054806
BP5			
30	0.25	0.25	054183
60	0.25	0.25	054184
30	0.32	0.25	054177
30	0.53	1.00	054195

Length (m)	ID (mm)	Film Thickness (µm)	Part No.
BPX5			
10	0.10	0.10	054099
12	0.22	0.25	054112
25	0.22	0.25	054113
15	0.25	0.25	054100
30	0.25	0.25	054101
60	0.25	0.25	054102
30	0.25	0.50	0541025
BP5MS			
15	0.25	0.25	054308
30	0.25	0.25	054310
HT5			
12	0.22	0.10	054631
25	0.22	0.10	054632
12	0.32	0.10	054641
25	0.32	0.10	054642
12	0.53	0.15	054657
25	0.53	0.15	054658
HT8			
10	0.10	0.10	054690
25	0.22	0.25	054675
50	0.22	0.25	054676
60	0.25	0.15	054236
30	0.25	0.25	054677
60	0.25	0.25	054683

Length (m)	ID (mm)	Film Thickness (µm)	Part No.
30	0.25	1.00	054122
15	0.32	0.25	054144
30	0.32	0.25	054145
60	0.32	0.25	054146
25	0.32	0.50	054125
12	0.32	1.00	054127
30	0.32	1.00	054153
60	0.32	1.00	054154
30	0.53	0.50	0541345
25	0.53	1.00	054131
30	0.53	3.00	054160
BP624			
30	0.32	1.80	054832
30	0.53	3.00	054836
BP20			
50	0.22	0.25	054422
30	0.25	0.25	054427
60	0.25	0.25	054428
30	0.25	0.50	054415
30	0.32	0.25	054433
30	0.32	0.50	054438
SolGel-WAX™			
30	0.53	0.50	054786
30	0.25	0.25	054796
30	0.32	0.50	054797
60	0.25	0.25	054791

SGE Environmental GC Columns

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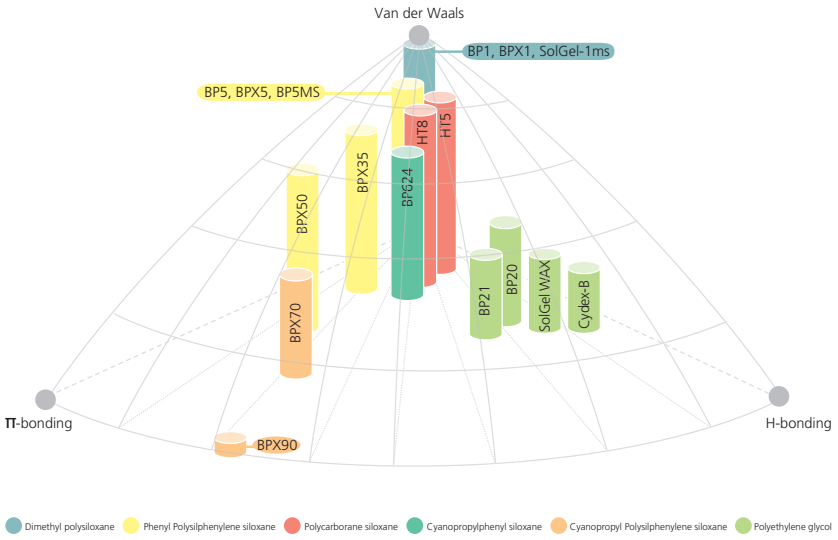
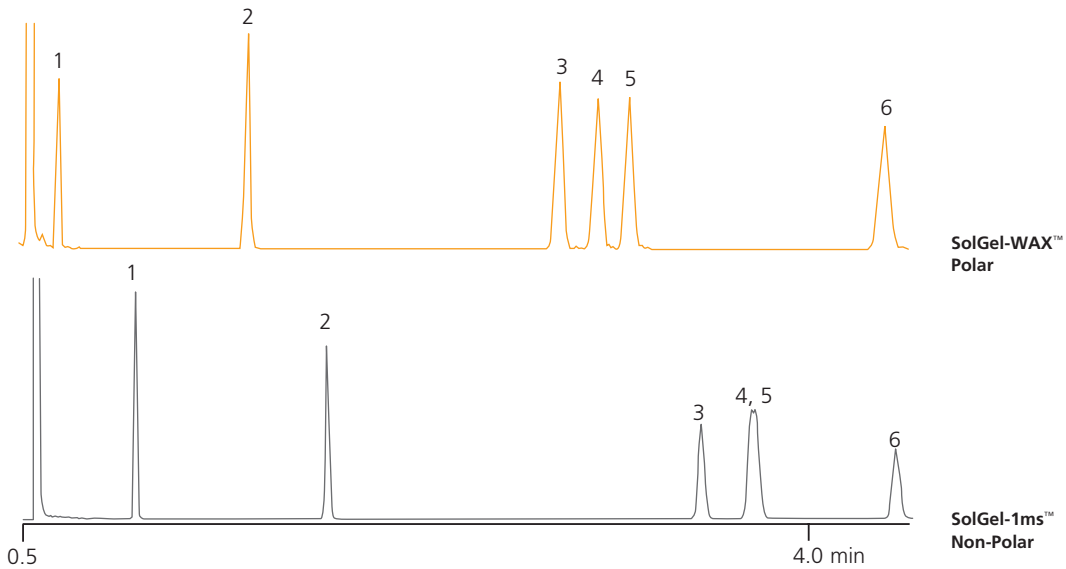
Guidelines for Choosing GC Columns

1. Stationary Phase

- Select the least polar phase that will perform the separation you require.
- Non-polar stationary phases separate analytes predominantly by order of boiling point.
- Increase the amount of phenyl and/or cyanopropyl content in the phase, and the separation is then influenced more by differences in dipole moments or charge distributions (BP10 (1701), BPX35, BPX50, and BPX70).
- To separate compounds that differ more in their hydrogen bonding capacities (for example aldehydes and alcohols), polythylene glycol type phases are best suited - SolGel-WAX™, BP20 (WAX).





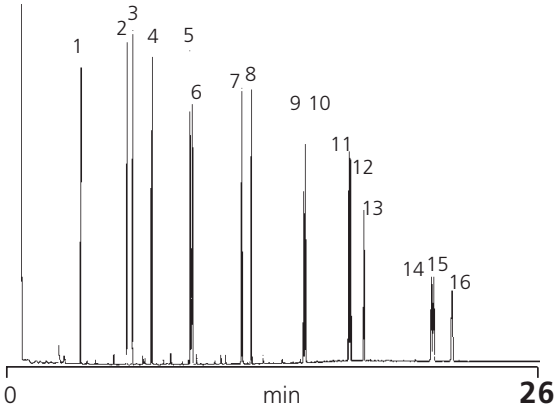
Components
1. Benzene
2. Toluene
3. Ethylbenzene
4. p-Xylene
5. m-Xylene
6. o-Xylene

Effect of stationary phase. BTEX analysis on a polar (SolGel-WAX™) column and a 100% dimethyl polysiloxane (SolGel-1ms™), both 30 m x 0.25 mm ID X 0.25 µm film.

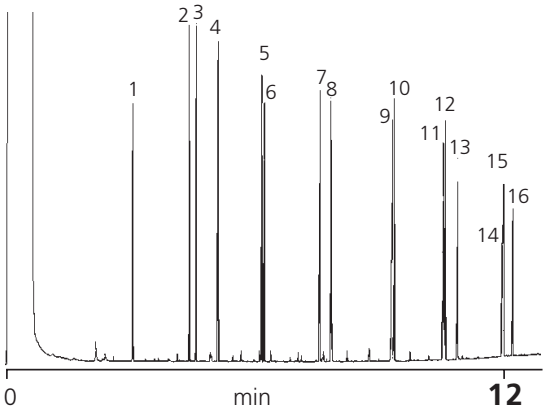
2. Internal Diameter (ID)

- The smaller the diameter the greater the efficiency, hence better resolution. Narrow columns (0.1 mm ID) are used for faster analysis because the same resolution can be achieved in a shorter time.
- The larger the diameter the greater the sample capacity.

NORMAL - 0.25 mm ID
Chromatogram using a conventional BPX5 column (30 m x 0.25 mm ID) with a 0.25 µm film.



FAST - 0.10 mm ID
Chromatogram using a FAST BPX5 column (10 m x 0.1 mm ID) with a 0.1 µm film.



Components

1. Naphthalene
2. Acenaphthylene
3. Ethylbenzene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Benzo(a)anthracene
10. Chrysene
11. Benzo(b)fluoranthene
12. Benzo(k)fluoranthene
13. Benzo(a)pyrene
14. Indeno(1,2,3,-c,d)pyrene
15. Dibenzo(a,h)anthracene
16. Benzo(g,h,i)perylene

Effect of internal diameter. Polynuclear Aromatic Hydrocarbon (PAH) analysis.

SGE Environmental GC Columns

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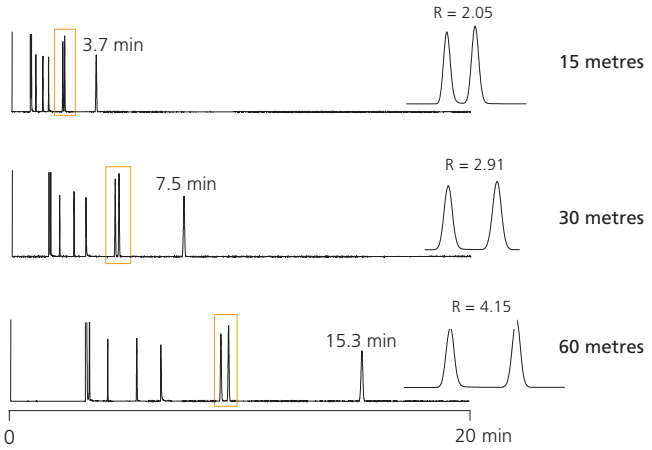
3. Column Length

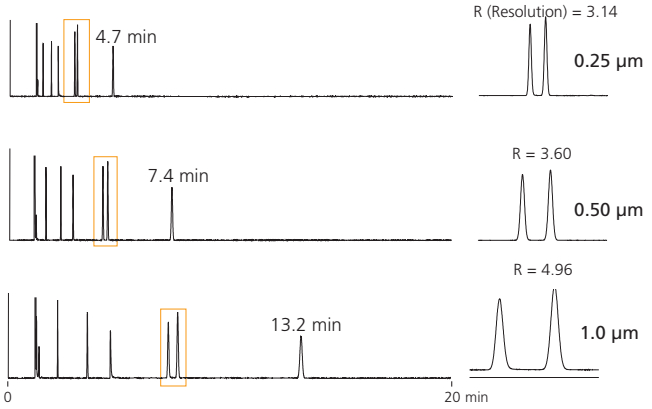
- Always try to select the shortest column that will provide the required resolution for the application. If the maximum column length available is being used, and resolution of the sample mixture is still inadequate then try changing the stationary phase or internal diameter.
- Resolution is proportional to the square root of the column efficiency. Therefore, halving the column length will only decrease the resolving power of the column by approximately 40 %.



Effect of length.

4. Film Thickness

- For samples with a variation in solute concentration, a thicker film column is recommended. This will reduce the possibility of broad overloaded peaks co-eluting with other compounds of interest. If the separation of two solutes is sufficient and co-elution is still unlikely, even with large differences in concentration, then a thinner film can be used. The greater the film thickness the greater the retention of solutes, therefore the higher the elution temperature. As a rule, doubling the film thickness results in an increase in elution temperature of approximately 15-20 ° under isothermal conditions. Using a temperature program, the increase in elution temperature is slightly less.
- From the phase ratio value ß, a column can be categorized for the type of application it would best suit. The smaller the ß value, the greater the ratio of phase to the column inner diameter, making it better suited for analyzing volatile compounds. Columns which have thin films are generally better suited for high molecular weight compounds and are characterized by large ß values. Maintaining phase ratio among different ID columns to yield similar chromatography.



Effect of film thickness.

Phase Ratio

Film Thickness (µm)	Column ID (mm)				
	0.1	0.22	0.25	0.32	0.53
0.10	250	550	625	800	1325
0.15	-	-	-	-	883
0.25	-	220	250	320	530
0.50	-	110	125	160	265
1.00	-	55	63	80	132
3.00	-	-	-	27	44
5.00	-	-	-	16	26

Above shows the phase ratio (ß) available for the SGE range of capillary columns. Keeping a similar phase ratio when changing column internal diameters will ensure that your chromatographic parameters will not need substantial changes.

$$ß = \frac{id}{4d_f}$$

where
ß = ratio
id = column internal diameter (µm)
$\mathbf{d_f}$ = film thickness (µm)

Formula to calculate Phase Ratio

Recommended Column by Application

APPLICATION	PHASE					
	BP1	BP5, BPX5, BP5MS	HT5	HT8	BP624	BP20, SolGel-WAX™
Alcohols		●			●	●
Amines Aliphatic		●			●	●
Amines Aromatic		●			●	●
Aromatic -PAH	●	●		●		
Aroclors				●		
Chlorinated Aromatics	●	●				
Cigarette Lighter Fuel		●			●	
Dioxins		●				
Herbicides	●	●				
Industrial Solvents					●	●
Ketones					●	●
Monomers		●				●
Nitroaromatics	●	●		●		
Organochlorine Pesticides	●	●		●		
Organophosphorous Pesticides	●	●				
Paraffins	●	●	●			
PCB's		●		●		
Petroleum	●	●	●			
Phenols		●				●
Phthalates	●	●				
Polymers	●		●			
Pyrethroids	●	●				
Semivolatiles	●	●				
Solvents					●	●
TRPH	●	●	●			
Volatiles		●			●	●
Xylenes	●	●	●			●

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SGE Analytical Science (SGE) is a world renowned brand for components and consumables used in scientific analysis.

Primarily in the field of scientific glass engineering for liquid handling and separation science, since its beginnings in 1960, SGE has become the global market leader in niche areas such as autosampler syringes and GC inlet liners.

Completing the transition into Trajan after acquisition in 2013, SGE products make up a solid foundation of Trajan's portfolio and will continue to be created and supported by Trajan customer service and distribution networks worldwide.

For more information visit www.sge.com or contact techsupport@sge.com.

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Approved Distribution Partner