SGE's silica drawing towers where continuous lengths of fused silica are drawn and coated.

GC Capillary Columns

- Five decades of capillary column innovation.
- End to end capillary column manufacture.
- Providing separation solutions.

Five Decades of Capillary Column Innovation

SGE has a long history developing and producing GC capillary columns, with SGE's founder Ernest Dawes first being involved making glass capillary columns in 1959. That expertise has been built upon with the development of leading capabilities in glass technology, polymer synthesis, surface chemistry and production processes all combined with an intimate knowledge of chromatography.

SGE develops and synthesizes specialty polymers leading to SGE being the first, and often only, capillary chromatography company to offer many types of GC stationary phases. SGE was the first to introduce the now industry standard silarylene phases in 1987 with their improved thermal stability, as well as SolGel in 1999 and the carborane phases in 1987. A detailed explanation of how these polymers work can be found on pages 76-80.

End to End Capillary Column Manufacture

SGE has long been a manufacturer of GC capillary columns with the complete technology capability to produce the finest capillary columns from beginning to end, including the special requirements of producing the fused silica capillary tubing. This end to end manufacturing capability allows SGE to control the fabrication process precisely to produce the finest quality capillary columns available.

The individual technologies SGE employs in GC capillary column manufacture are:

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

SGE Analytical Science To view the video on SGE's GC Capillary Column manufacture and testing visit **www.sge.com/support/videos**

Fused Silica

The process of producing fused silica at SGE 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 ourselves, SGE has complete control of this important aspect of producing the highest quality GC capillary columns.

The fused silica used by SGE is very high purity devoid of impurities such as metal oxides found in conventional glasses. Depending on the application, SGE offers two types of FST coating - polyimide (max temp 400 °C) and aluminum (max. temperature 480 °C). SGE's capillary columns operate comfortably to 400 °C (dependent on the phase selected).

Stationary Phase Polymer

SGE has designed its phase synthesis so that most capillary 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. See page 196 for details and equipment available for washing capillary columns.

Rigorous 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, SGE's non-polar phase BPX5 is tested using active probes such as n-decylamine and 2,4-dinitrophenol chromatographed at low concentrations (1-2 nanogram 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 capillary column. SGE does not offer separate ranges of capillary columns of different performance levels – all SGE GC capillary columns meet these high standards.

Retention Time and Consistency

Because SGE controls the capillary column fabrication process from beginning to end we are also able to achieve remarkably consistent retention characteristics from column to column. When a method is established on an SGE column, the same separation can be expected column after column.

Thermal Stability

A long term issue in capillary GC is the breakdown of the stationary phase in the capillary column at elevated temperatures which leads to rising and noisy baseline signals thereby limiting sensitivity of the analysis. Stationary phase breakdown at elevated temperatures cannot be eliminated but it can be reduced dramatically through improving the technology. SGE developed, and was the first to introduce, silarylene - containing polymers such as silphenylene stationary phases in 1987. Silphenylene phases replace some of the oxygen atoms in the backbone of the siloxane polymer with aromatic groups. This led to a dramatically improved thermal stability for GC phases with silphenylene phases now available in a wide range of polarities and selectivities. SGE capillary columns are monitored for bleed performance with rigorous standards established. Bleed is measured and specified in terms of detector signal and calibrated to "nanograms of siloxane per second" eluted from the capillary columns. **The test is performed at the maximum operating temperature for the capillary column.**

The measure for bleed of nanograms of siloxane per second eluting from the capillary column is more meaningful than exclusively reporting picoamp FID signal. Picoamp signal is highly dependent on the detector and conditions used and is not an absolute measure. SGE carries out the bleed measurement on FID to assure the best performance possible.

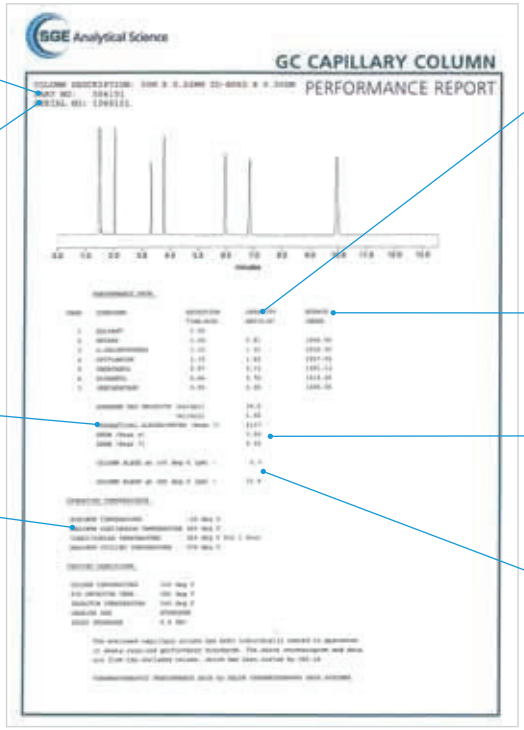
Below is an example of the SGE GC Capillary Column Performance Report.

Part Number:
Re-order information.

Serial Number Column Traceability:
Every SGE GC column is traceable back to its manufacture.

Measure of Theoretical Plates/ meter:
This is a measure of the efficiency of the column.

Maximum continuous temperature:
This is the maximum recommended temperature for the column. Higher temperatures can be used, but this will reduce column lifetime.



Capacity Ratio:
This is a measure of the film thickness.

Kovats Index:
Describes the retention behavior of a compound relative to that of straight chain hydrocarbons. Especially important for more polar columns.

Skew:
This is a measure of the degree of tailing (1.0 = Perfect).

Thermal Stability:
Each column is bleed tested to its maximum continuous operating temperature.

Providing Separation Solutions

GC Capillary Columns Polarity Scale

SGE strives to develop a better understanding of the interactions of the solute molecules with the GC stationary phase types in our product range and those we could design and synthesize. The objective is to be able to assist you the chromatographer to select a GC stationary phase for the separation of particular classes of compounds.

All chromatographers want the best separation and need to focus on the key parameters that influence the resolution equation. R can be viewed in three sections consisting of variables which influence capillary column efficiency, retention and selectivity.

$$R = \left(\frac{\sqrt{N}}{4}\right)\left(\frac{k}{k+1}\right)\left(\frac{\alpha-1}{\alpha}\right)$$

Column Efficiency Retention Selectivity

R = resolution, N = theoretical plates, k = capacity factor, α = selectivity

Another way of viewing the resolution equation from the GC capillary column perspective is that quality impacts the capillary column efficiency, the physical dimensions of the capillary column influence retention and the phase chemistry dictates selectivity. Inevitably, many GC operators focus on flow rates and temperatures because of their importance in getting good peak shapes and nice separations – rarely do we pay attention to how the phase can have such an effect on the relative retention time. The fine detail of the chromatography comes in the interaction with the phase.

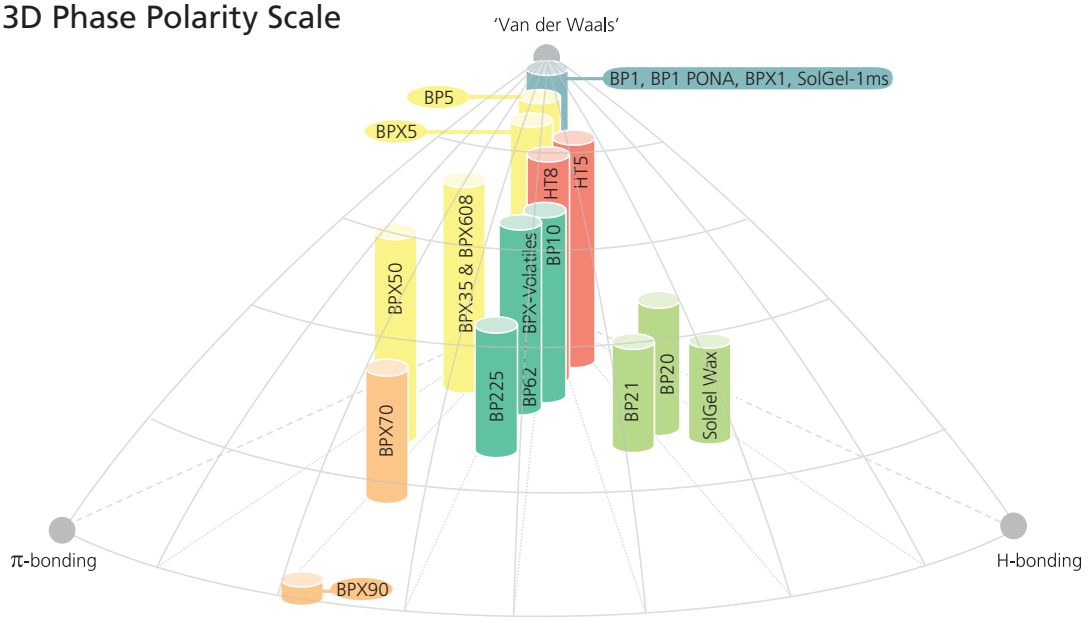
Stationary Phase Polarity

A discussion on phase chemistry inevitably involves a reference to polarity – polarity in general terms and where phases fit along a linear polarity scale – but there is more

to it than this. There are different types of interactions based on the different types of functionality of the GC stationary phase polymer. In trying to create a scaled representation of the mechanisms of separation SGE has placed the stationary phases against a qualitative scale, although this scale is analyte dependent. The scale reflects the relative ability of phases to interact with particular types of analytes.

The scales shown in the 3D Phase Polarity diagram below, are qualitative rather than quantitative and have been derived from experimental work studying the retention of different analytes in the different types of stationary phases. Essentially the focus has been to develop a three dimensional representation of where each phase fits as a point on a plot of three classic bonding mechanisms - 'Van der Waals', H-bonding and π-bonding.

3D Phase Polarity Scale



- Dimethyl Polysiloxane
- Phenyl Polysilphenylene Siloxane
- Polycarborane Siloxane
- Cyanopropylphenyl Siloxane
- Cyanopropyl Polysilphenylene Siloxane
- Polyethylene Glycol

Bonding Mechanisms

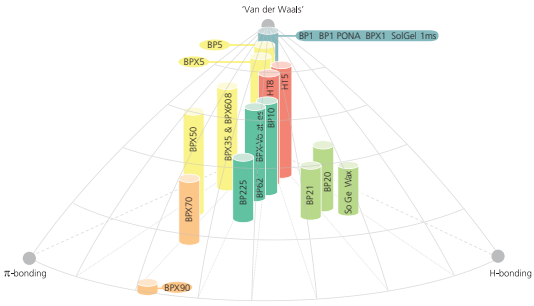
Van der Waals – essentially electrostatic attraction from temporary dipoles and are a very weak interaction. They are at their greatest relative contribution in the non-polar phases like the dimethylsiloxanes.

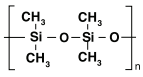
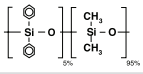
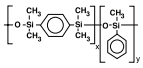
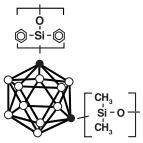
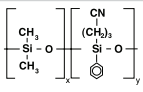
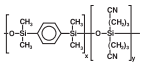
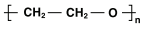
Hydrogen bonding results from the attraction of positive and negative charges of hydrogen and non-bonding pairs of electrons and is the force that holds water molecules together as liquid.

The π-bonding is associated with the aromatic class of compounds that include benzene rings. Molecules with these loose clouds of donut shaped electronic charges have their own attraction towards each other. The π-bond in benzene is perpendicular to the benzene ring bonds so they interact more easily if the shape of the molecules does not create steric hindrance.

Stationary phases consist of basic polymer units with functionalities that can be modified by the addition of various moieties during synthesis. These moieties can be added in various amounts to create different concentrations of a particular functionality.

SGE GC Capillary Column Phases

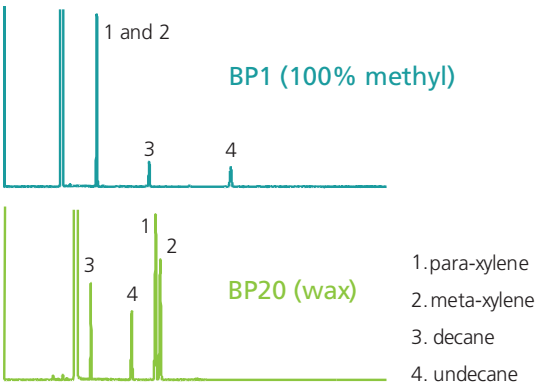


Color Code	Phase	Structure	SGE Phase	Characteristics
	Dimethyl Polysiloxane		BP1 BP1 PONA BPX1 SolGel-1ms	• Polydimethylsiloxane (PDMS) "non-polar" type phases which rely on Van der Waals interactions between molecules and separate primarily based on "boiling point" type separation. • Useful chromatographic space is usually considered in terms of modifications to non-polar retention. This is understandable because the GC is useful for volatile compounds and that usually means organics. • Organics that can be vaporized are generally high in non-polar (alkane or hydrocarbon) character. It is this part of their surface that allows them to be soluble in a non-polar phase. It is also this characteristic that makes the BP1 (dimethylsiloxane) a universal phase.
	Diphenyl Dimentyl Siloxane (Phenyl substituted Siloxanes)		BP5	• The classical 5% phenyl group of phases
	Phenyl Polysilphenylene Siloxane (Silphenylene substituted Polydimethylsiloxane)		BPX5 BPX35 BPX608 BPX50	• Silphenylene phases have become fairly common now with many manufacturers offering at least some phases of this type, SGE has a full range. • Phases with the "X" notation have a silphenylene backbone (exception is the BPX1). • Phenyl substituted polymers are relatively non-polar and rely for their different functionality on π - bonding with the aromatic phenyl groups. • SGE was the first GC capillary column manufacturer to introduce this type of phase commercially in the 1980s with the intention of improving the thermal stability to give higher maximum temperatures and reduced bleed.
	Polycarborane Siloxane		HT5 HT8	• The carborane phases were originally developed as very high thermal stability phases for high temperature work to 460 °C. • The functionality of the carboranes is difficult to explain – they end up with pentavalent bonds with shared sigma bonds rather than π - bonds. The bonds are transient like a benzene with a ball of shared electrons. • HT5 and HT8 are low π - bonding purely due to the low concentration of carborane in the polymer, otherwise it would be high.
	Cyanopropylphenyl Siloxane		BP225 BP10 BP624 BPX-Volatiles	• 'Polar' phases with <50% cyanopropyl substituted dimethylpolysiloxane.
	Cyanopropyl Polysilphenylene Siloxane		BPX70 BPX90	• High cyanopropyl substituted phases, are more difficult to make as efficient, thermally stable phases. • BPX70 is equivalent to and behaves like a 70% cyanopropyl siloxane but with siphenyl end substituted backbone for stability which was introduced in 1987 and remained the most polar thermally stable phase for a long time. • BPX90 which is equivalent to a 90% cyanopropyl siloxane and stable to 300 °C which is excellent for such a polar phase. The prominent interaction for BPX90 is π - π bonding with the cyano group; the cyano groups become almost entirely responsible for the partitioning.
	Polyethylene Glycol		BP21 BP20 SolGel-WAX™	• (PEG) 'wax' type phases where the main separation mechanisms are hydrogen bonding or dipole interactions. • The wax phases are often considered as ideal for mixtures of chemically different components such as those contained in essential oils.

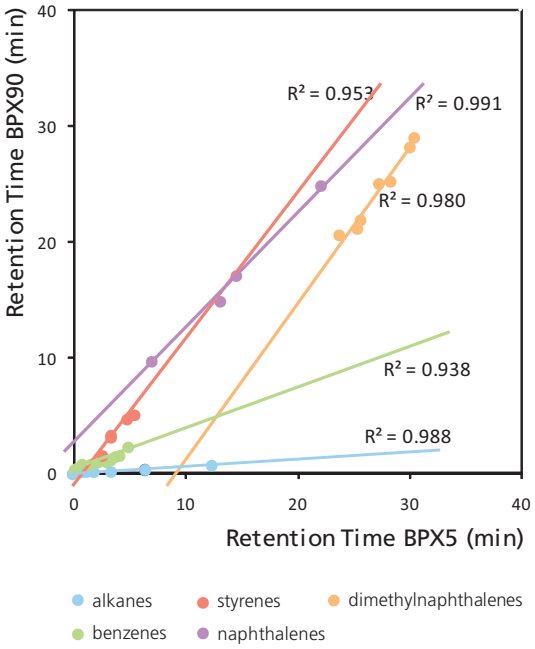
Choosing the Right Phase for Your Separation

So how can you use this elaborate explanation of phases and bonding types? The answer is simple! In separation science we seek solutions in resolving complex mixtures and a "one-phase fits all" is more a hope than a reality. Here SGE has explored different phases from a polarity scale to assist the chromatographer to choose the best combination of phases which provide an orthogonal solution rather than a simple variation of a theme.

Take for example the separation of aromatics on the polyethylene glycol capillary column BP20 (H-bonding) compared to BP1 where the primary interaction is Van der Waals. Whereas para- and meta-xylene are unresolved on BP1, they are clearly resolved on BP20 with a corresponding change in elution order to the alkanes. This is an interesting interaction because the aromatic xylenes have been attracted by the H-bond rich BP20. It is not a totally 'one or the other' situation when judging the contribution of H-bond and π-bond affinities, because they have some affinity for each other.



A higher component separation is demonstrated with a series of hydrocarbons run on a relatively non-polar phase (BPX5, on the x-axis in figure above right) and on a highly polar BPX90 with the retention times plotted on the y-axis. If the hydrocarbon family is split up on the basis of unsaturated groups, this extra dimension shown in color (chemical group) reveals that the plot shows strong correlations for retention characteristics and functional chemistry.



In this case, the hydrocarbon alkanes (light blue) are completely non-polar. They are retained on the phase only because the phase has sufficient non-polar character to interact with them. In the case of BPX90, it is so polar that it does not offer alkanes the opportunity for interaction. As a result, the alkanes tend to elute almost unretained. The alkanes show almost perfect orthogonality here. Retention on BPX5 versus no retention on BPX90 – they lie almost along the x-axis. We can now reason that if pure hydrocarbons (Van der Waals or non-polar interactions) give little or no BPX90 retention then retention of the remaining aromatics is due to purely π type interactions. When comparing GC phases, departures from the diagonal mark a significant change in the retention mechanism.

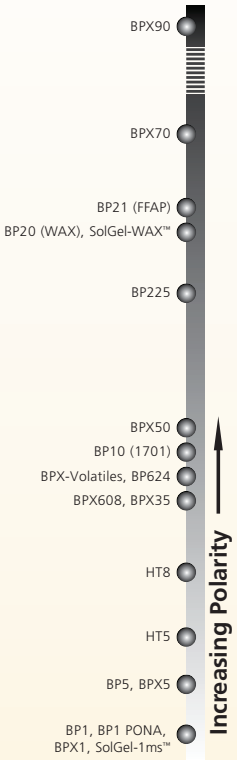
In conclusion, polar phases offer selectivity based on functionality rather than on Van der Waals interactions and are an ideal choice for the separation of analytes that were unresolved on non-polar or moderately polar phases.

The primary advantages of considering phase selectivity include:

- 2D GC – the choice of orthogonal chemistries for the 1st and 2nd dimensions.
- Fast GC – highly retained analytes on non-polar phases elute much earlier on polar phases.
- Ubiquitous FAMEs methods.
- Separation of unresolved analytes due to alternative functionality.

SGE hopes this information assists in your understanding of optimum GC capillary column phase selection for your application. Following is a summary of phase, plus other capillary column parameters such as internal diameter, capillary column length and film thickness, to assist with identification of the right SGE GC capillary column for your separation solution.

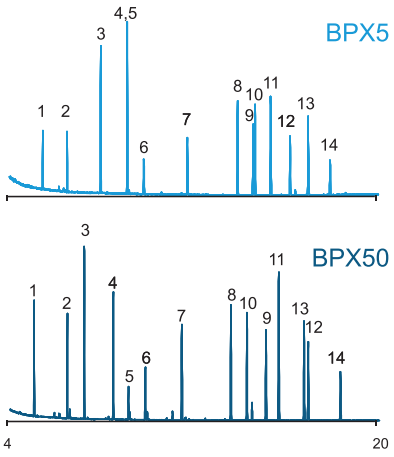
GC Capillary Column Selection



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, BP225 and BPX70).

OPs on Aromatic Phases



Organophosphorus Pesticides

1. 4-Chloro-3-nitrobenzotrifluoride
2. 1-Bromo-2-nitrobenzene
3. Tributylphosphate
4. Terbufos
5. Dioxathion
6. Phoshamidon
7. Chlorfenvinphos
8. Ethion
9. Famphur
10. Carbophenothion
11. Triphenylphosphate
12. Phosmet
13. Leptophos
14. Azinphos-ethyl

Columns	30 m x 0.25 mm x 0.25 µm
Initial Temp	45 °C (1 min)
1st Temp Ramp	30 °C/min to 200 °C (0.1 min)
2nd Temp Ramp	7 °C/min
Final Temp	315 °C (hold 10 min)
Injector Temp	280 °C
Splitless Time	1 min
Carrier	He, 1 ml.min
Instrument	HP 6890/5973

Effect of increasing Phenyl content in the stationary phase.

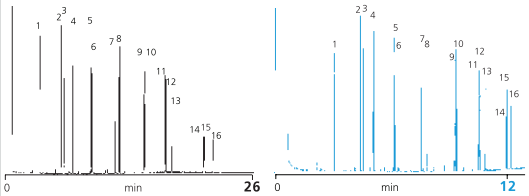
- To separate compounds that differ more in their hydrogen bonding capacities (for example aldehydes and alcohols), polyethylene glycol type phases are best suited - SolGel-WAX™, BP20 (WAX) and BP21(FFAP).

2. Internal Diameter

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

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

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



Components

1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
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.

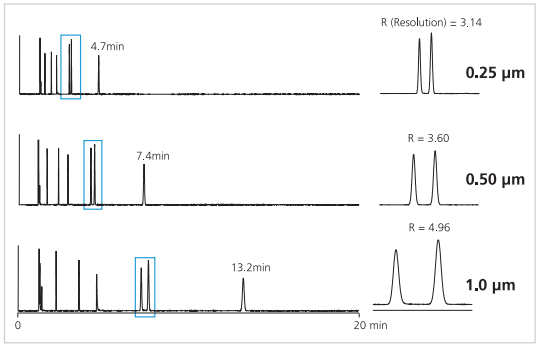
3. Film Thickness

- 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 °C under isothermal conditions. Using a temperature program, the increase in elution temperature is slightly less.
- From the phase ratio value β, a column can be categorized for the type of application it would best suit. The smaller the β value, the greater the ratio of phase to the column inner diameter, making it better suited for analyzing volatile compounds. Columns that have thin films are generally better suited for high molecular weight compounds and are characterized by large β values.
- Maintain phase ratio among different ID columns to yield similar chromatography.

$$\beta = \frac{id}{4d_f}$$

where
β = phase ratio
id = column internal diameter (µm)
d_f = film thickness (µm)

Formula to calculate Phase Ratio.



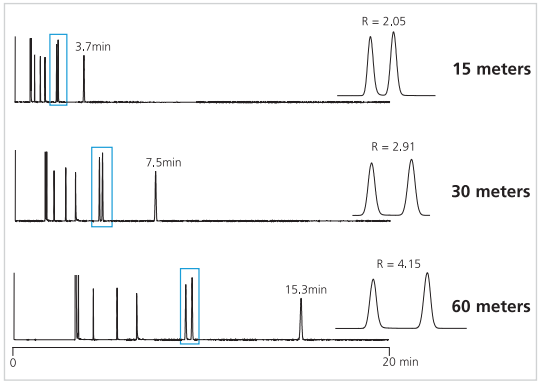
Effect of Film Thickness.

Film Thickness (µm)	Column ID (µm)					
	100	150	220	250	320	530
0.10	250	-	550	625	800	1325
0.15	-	250	-	-	-	883
0.25	-	150	220	250	320	530
0.50	-	75	110	125	160	265
1.00	-	-	55	63	80	132
3.00	-	-	-	-	27	44
5.00	-	-	-	-	16	26

Table 1. Above shows the phase ratio (β) 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.

4. Column Length

- Always try to select the shortest column length 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, doubling the column length will only increase the resolving power of the column by approximately 40%.



Effect of Length.

Application Range For Varying Phase Ratios

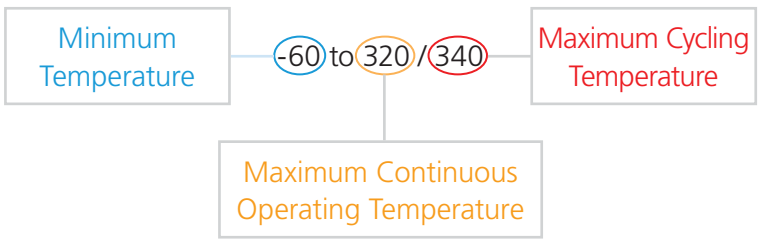
Phase Ratio (β)	Application
16-100	Gases, Low M.W. Hydrocarbons, Solvents, Volatile Halogens (M.W.16-250)
100-320	Semi-volatiles, General Applications (M.W. 100-700)
320-1325	High M.W. Hydrocarbons, Waxes, Petroleum Products (M.W. 300-1500)

SGE GC Capillary Column Phase Cross Reference Table

SGE Phase	Description	Capillary Column to Replace
BP1	100% Dimethyl Polysiloxane	DB-1, HP-1, Ultra-1, SPB-1, CP-Sil 5CB, RSL-150, RSL-160, Rtx®-1, ZB-1, CB-1, OV®-1, PE-1, 007-1(MS), SP-2100, SE-30, RH-1, CC-1, CP-Sil 5CB MS, VF-1ms, Petrocol DH
BP1-PONA	100% Dimethyl Polysiloxane	Petrocol DH, DB-Petro
BPX1	100% Dimethyl Polysiloxane	DB-HT Sim Dis, DB-2887, Rtx-2887, HP-1, Petrocol 2887, Petrocol EX2887
SolGel-1ms™	SolGel + 100% Dimethyl Polysiloxane	Unique highly inert phase
BP5	5% Phenyl Polysiloxane	DB-5, DB-5.625, Rtx-5, HP-5, Ultra-2, PTE-5, PB-5, MDN-5, CP-Sil 8CB, VB-5 & ZB-5
BPX5	5% Phenyl Polysilphenylene-siloxane	DB-5, DB-5ms, HP-5, Ultra-2, Rtx®-5, Rtx-5Sil MS, Rtx 5MS, AT-5, AT-5MS, 007-5MS, SPB-5,CP-Sil 8CB, VF-5ms, RSL-200, CB-5, OV®-5, PE-5, 007-2(MPS-5), SE-52, SE-54, XTI-5, PTE-5, CC-5, RH-5ms, ZB-5
BPX35	35% Phenyl Polysilphenylene-siloxane	DB-35, DB-35ms, Rtx-35, HP-35, HP-35MS, SPB-35, MDN-35, VB-50, ZB-35
BPX608	35% Phenyl Polysilphenylene-siloxane	DB-608, Rtx-35, SPB-608
BPX50	50% Phenyl Polysilphenylene-siloxane	OV-17, SP-2250, DB-17ms, DB-17ht, Rtx-50, SPB-50, HP-50+, HP-17, VB-50/608, ZB-50
HT5	5% Phenyl Polycarborane-siloxane	MXT-1 SimDist, HT-SimDist, DistCB, MXT-500
HT8	8% Phenyl Polycarborane-siloxane	No equivalent, unique high temperature capillary column with special selectivity (standard for PCB)
BP225	50% Cyanopropylphenyl Polysiloxane	HP-225, DB-225, Rtx-225
BP10 (1701)	14% Cyanopropylphenyl Polysiloxane	DB-1701, Rtx-1701, HP-1701, SPB-7, CP-Sil 19CB, VB-1701, ZB-1701
BP624, BPX-Volatiles	Cyanopropylphenyl Polysiloxane	DB-624, HP-VOC, Rtx Volatiles, Rtx 624, VOCOL, VB-624, ZB-624
BPX70	70% Cyanopropyl Polysilphenylene-siloxane	DB-23, CP-Sil 88, VF-23ms, SP-2330, SP-2380, Rtx®-2330, 007-23, AT-Silar, PE-23
BPX90	90% Cynopropyl Polysilphenylene-siloxane	Unique highly polar phase
BP21 (FFAP)	Polyethylene Glycol (TPA treated)	DB-FFAP, HP-FFAP, Stabilwax-DA, CP Wax 58CB, VB-FFAP, ZB-FFAP
BP20 (Wax)	Polyethylene Glycol	DB-Wax, Rtx-Wax, Stabilwax, HP20M, HP-Wax, HP-INNOWax, Supelcowax-10, AT-Wax, Nukol, CP Wax 2CB, VB-WAX, ZB-WAX
SolGel-WAX™	SolGel + Polyethylene Glycol	Unique highly inert phase
CYDEX-B	Permethylated Beta Cyclodextrin	Cyclodex-B, Rt-BDEXm

Operating Temperature

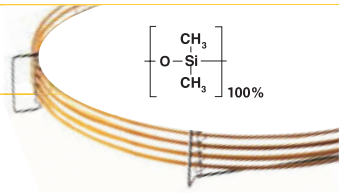
For each SGE GC column phases temperature limits are represented three ways:



Minimum Temperature	Maximum Continuous Operating Temperature	Maximum Cycling Temperature
The temperature below which the capillary column will not separate components due to loss of partitioning in the stationary phase.	The maximum temperature at which a capillary column can be held for 72 hours with no significant change. SGE capillary columns are designed to pass all criteria measured by their test analysis after 72 hours at their Maximum Continuous Operating Temperature.	The maximum cycling temperature to which a capillary column can be taken for short periods (up to 30 minutes) without causing serious bleed problems or degradation of the phase. This is usually higher than the Maximum Continuous Operating Temperature. The lifetime of a capillary column is affected by the amount of time it spends at high temperatures.

SGE Analytical Science If you'd prefer to select your column electronically, click on the GC column locator at www.sge.com/products

BP1



GC Columns and Applications

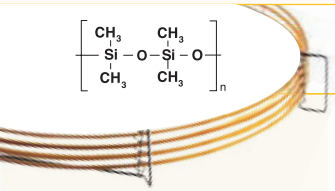
- Classic crosslinked dimethyl polysiloxane technology.
- Excellent general purpose GC column.
- Low bleed.
- Non-polar.
- Suitable for all routine analyses.
- 320 – 340 °C upper temperature limit – dependent on film thickness.

Especially Suitable for these Industries:	Fuels, Environment, Forensics
Application Areas:	Suitable for analysis of hydrocarbons, aromatics, pesticides, phenol, herbicides, amines. Applications AMI04, POL05, PHA04.
Suitable Replacement for:	DB-1, DB-Petro, HP-1, HP-1MS, Rtx-1, Ultra-1, SPB-1, SPB-1 Sulfur, Petrocol DH, CP-Sil 5CB, VB-1, ZB-1, VF-1ms.

Expert Tip :
Columns should be conditioned to the maximum continuous temperature unless specified.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.1	10	-60 to 320/340	054022
0.15	0.25	12	-60 to 320/340	054028
0.15	0.25	25	-60 to 320/340	054029
0.22	0.1	12	-60 to 320/340	054040
0.22	0.25	12	-60 to 320/340	054046
0.22	1	12	-60 to 320/340	054052
0.22	0.25	15	-60 to 320/340	054049
0.22	0.1	25	-60 to 320/340	054041
0.22	0.25	25	-60 to 320/340	054047
0.22	1	25	-60 to 320/340	054053
0.22	0.25	30	-60 to 320/340	054050
0.22	0.1	50	-60 to 320/340	054042
0.22	0.25	50	-60 to 320/340	054048
0.22	1	50	-60 to 320/340	054054
0.22	0.25	60	-60 to 320/340	054051
0.25	0.1	15	-60 to 320/340	054039
0.25	0.25	15	-60 to 320/340	054043
0.25	0.25	30	-60 to 320/340	054044
0.25	0.5	30	-60 to 320/340	054820
0.25	1	30	-60 to 320/340	054056
0.25	0.25	60	-60 to 320/340	054045
0.25	0.5	60	-60 to 320/340	054812
0.25	1	60	-60 to 320/340	054815
0.32	0.25	12	-60 to 320/340	054058
0.32	0.5	12	-60 to 320/340	054064
0.32	1	12	-60 to 320/340	054070
0.32	0.25	15	-60 to 320/340	054061
0.32	0.25	25	-60 to 320/340	054059
0.32	0.5	25	-60 to 320/340	054065
0.32	1	25	-60 to 320/340	054071
0.32	4	25	-60 to 280/300	054076
0.32	5	25	-60 to 280/300	054081
0.32	0.25	30	-60 to 320/340	054062
0.32	0.5	30	-60 to 320/340	054068
0.32	1	30	-60 to 320/340	054813
0.32	1.5	30	-60 to 300/320	054811
0.32	3	30	-60 to 300/320	054073
0.32	4	30	-60 to 280/300	054077
0.32	0.25	50	-60 to 320/340	054060
0.32	0.5	50	-60 to 320/340	054066
0.32	1	50	-60 to 320/340	054072
0.32	5	50	-60 to 280/300	054082
0.32	0.25	60	-60 to 320/340	054067

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.32	0.5	60	-60 to 320/340	054069
0.32	1	60	-60 to 320/340	054810
0.32	5	60	-60 to 280/300	054085
0.53	1	12	-60 to 320/340	054086
0.53	3	12	-60 to 300/320	054097
0.53	0.5	15	-60 to 320/340	054870
0.53	1	15	-60 to 320/340	054089
0.53	1	25	-60 to 320/340	054087
0.53	3	25	-60 to 300/320	054098
0.53	5	25	-60 to 280/300	054095
0.53	0.5	30	-60 to 320/340	054092
0.53	1	30	-60 to 320/340	054090
0.53	2.6	30	-60 to 300/320	054819
0.53	3	30	-60 to 300/320	054808
0.53	5	30	-60 to 280/300	054806
0.53	1	50	-60 to 320/340	054088
0.53	5	50	-60 to 280/300	054096
0.53	0.5	60	-60 to 320/340	054871
0.53	3	60	-60 to 300/320	054809
0.53	5	60	-60 to 280/300	054807

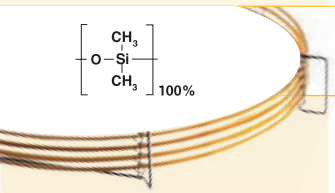


BP1 PONA

- Designed for the analysis of petroleum products.
- Non-polar phase for PONA analysis.
- Detailed hydrocarbon analysis according to ASTM (DHA-method).
- Crosslinked and washable.
- Very high resolving power columns for complex samples.
- 320 – 340 °C upper temperature limit.

Especially Suitable for this Industry:	Fuels
Application Areas:	Suitable for petroleum hydrocarbons, gasoline range hydrocarbons, MTBE, paraffins, olefins, naphthenes, aromatics. Aplication PET01.
Suitable Replacement for:	Petrocol DH, DB-Petro, HP-PONA, AT-Petro, Elite-PONA, ZB-1, 007-1-100-0.5F, Rtx-1PONA, CP Sil PONA.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.15	0.5	50	-60 to 320/340	054950
0.25	0.5	100	-60 to 320/340	054818



BPX1

- Non-polar column.
- Dimensionally stabilized phase.
- Low bleed.
- Specifically designed for high temperature hydrocarbon analysis.
- Ideal for simulated distillation methods (ASTM Method D2887).
- 430 °C upper temperature limit – Aluminum clad.
- 370- 400 °C upper temperature limit – Polyimide clad (dependent on film thickness).

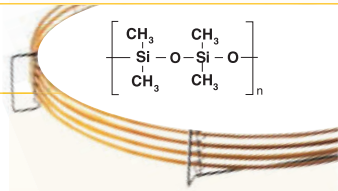
Especially Suitable for this Industry:	Fuels
Application Areas:	ASTM methods D2887 and D6532. Applications PET26, PET18, ENV54.
Suitable Replacement for:	DB-2887, DB-HT Sim Dis, HP-1, Petrocol 2887, Petrocol EX2887, Rtx-2887.

BPX1

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
Polyimide Clad				
0.1	0.1	10	-30 to 400/400	054777
0.53	2.65	6	-30 to 370/370	0548025
0.53	0.1	10	-30 to 400/400	054803
0.53	0.9	10	-30 to 400/400	054801
0.53	2.65	10	-30 to 370/370	054802
Aluminum Clad				
0.53	0.1	5	-30 to 430/430	054800
0.53	0.17	5	-30 to 430/430	054782
0.53	0.1	10	-30 to 430/430	054779

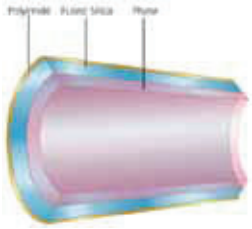
GC Capillary Columns | 100% Dimethyl Polysiloxane in a Sol-Gel Matrix

SolGel-1ms™

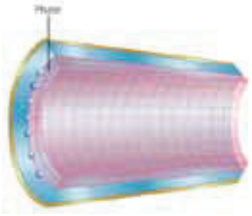


What is Sol-Gel?

Sol-Gel is essentially a synthetic glass with ceramic-like properties. These modified Sol-Gels offer the best of both worlds – ceramic-like properties with the film-forming properties of the associated polymer. The Sol-Gel process involves hydrolysis and condensation of alkoxides that lead to the formation of a glassy material at ambient temperatures. This method has been used to produce high quality ceramics and mono- and multi-component glasses of high homogeneity and purity. The further modification of this ceramic material with polymeric material (with appropriate functionality) leads to the formation of organic-inorganic nanomaterials.



Conventional Phase
The phase is coated onto the surface of the fused silica resulting in weak intermolecular bonding but no covalent bonding, ie no anchoring.



Sol-Gel Phase
Anchored to the surface of the fused silica through covalent bonding.

Where can Sol-Gel materials be used?

The further organic-modified Sol-Gels have been incorporated in a variety of high-end technology products including membrane chemical and pH sensors, films for protection of optical lenses, cosmetic and electronic products.

SGE and Sol-Gel materials?

At SGE, Sol-Gel processes are used to manufacture stationary phases for gas chromatography capillary columns. SGE is the first company to offer Sol-Gel technology capillary columns. The organic component in our case is a GC stationary phase. The final Sol-Gel product has all the properties of the GC phase as well as the additional properties of the Sol-Gel part. The Sol-Gel material is able to covalently bond to the surface of the fused silica. The 'heavy-duty' bonding imparts better thermal stability of the phase leading to ultra-low bleed capillary columns. To date, two Sol-Gel phases have been developed by SGE, namely SolGel-1ms™ and SolGel-WAX™. The SolGel-1ms™ stationary phase is a non-polar phase derived from 100% dimethyl polysiloxane. SolGel-WAX™ is a polar phase which incorporates polyethylene glycol in the matrix.

Expert Tip :
Always use SilTite™ or SilTite™ Finger-Tite ferrules when connecting a column to a GC/MS interface.

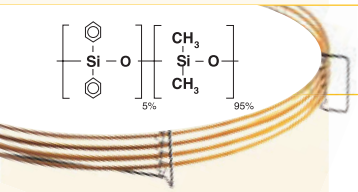
SolGel-1ms™ has a robust, inert, high temperature, non-polar phase for use with mass spectrometers.

- Highly inert.
- Less bleed means:
  - Better MS library identification.
  - Less ion source maintenance.
  - Better sensitivity.
- Can also be used for all non-MS detectors.
- Same selectivity as BP1.
- 340 /360 °C upper temperature limit.

Especially Suitable for these Industries:	Fuels, Environment, Forensics
Application Areas:	Recommended for highly active compounds. Applications ARO14, ENV51.
Operating Temperature:	0.25 µm film thickness 0 °C to 340/360 °C.
Suitable Replacement for:	DB-1, DB-Petro, HP-1, HP-1MS, Rtx-1, Ultra-1, SPB-1, SPB-1 Sulfur, Petrocol DH, CP-Sil 5CB, VB-1, ZB-1, VF-1ms.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.25	0.25	30	0 to 340/360	054795
0.25	0.25	60	0 to 340/360	054793
0.32	0.25	30	0 to 340/360	054798
0.32	0.25	60	0 to 340/360	054794

GC Capillary Columns | 5% Phenyl / 95% Dimethyl Polysiloxane



BP5

- Excellent general purpose GC column.
- Low bleed.
- Non-polar.
- High temperature.
- 320/340 °C upper temperature limit - dependent on film thickness.

Especially Suitable for these Industries:	All Industries
Application Areas:	General purpose, aromatics, pesticides, herbicides, drugs of abuse, hydrocarbons, solvent impurities, PCB congeners or Aroclor mixes, essential oils, semivolatiles. Applications FOO02, AMI03, PHA08, PHA 10.
Suitable Replacement for:	DB-5, Rtx-5, HP-5, Ultra-2, PTE-5, SPB-5, MDN-5, CP-Sil 8CB, VB-5, ZB-5.

For your instrument specific septa see the Instrument Quick Pick Guide on pages 167-180.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.22	0.25	12	-60 to 320/340	054167
0.22	0.25	25	-60 to 320/340	054168
0.22	0.25	30	-60 to 320/340	054171
0.22	0.25	50	-60 to 320/340	054169
0.22	1	50	-60 to 320/340	054175
0.25	0.25	15	-60 to 320/340	054182
0.25	0.25	30	-60 to 320/340	054183
0.25	0.5	30	-60 to 320/340	054202
0.25	1	30	-60 to 320/340	054203

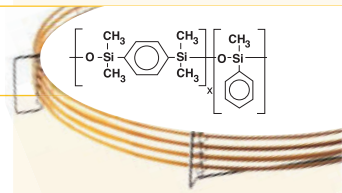
BP5

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.25	0.25	60	-60 to 320/340	054184
0.25	1	60	-60 to 320/340	054215
0.32	0.25	12	-60 to 320/340	054179
0.32	0.25	15	-60 to 320/340	054176
0.32	0.25	25	-60 to 320/340	054180
0.32	0.5	25	-60 to 320/340	054186
0.32	1	25	-60 to 320/340	054192
0.32	0.25	30	-60 to 320/340	054177
0.32	0.5	30	-60 to 320/340	054216
0.32	1	30	-60 to 320/340	054189
0.32	0.5	50	-60 to 320/340	054187
0.32	1	50	-60 to 320/340	054193
0.32	0.25	60	-60 to 320/340	054178
0.32	1	60	-60 to 320/340	054188
0.53	1	12	-60 to 320/340	054197
0.53	1	15	-60 to 320/340	054194
0.53	1.5	15	-60 to 320/340	054199
0.53	1	25	-60 to 320/340	054198
0.53	0.5	30	-60 to 320/340	0541935
0.53	1	30	-60 to 320/340	054195
0.53	5	30	-60 to 280/300	054196
0.53	1.5	60	-60 to 280/300	054204

Expert Tip :
If the injection port temperature is not specified in the method, 250 °C is usually the recommended temperature.

GC Capillary Columns | 5% Phenyl Polysilphenylene-siloxane

BPX5

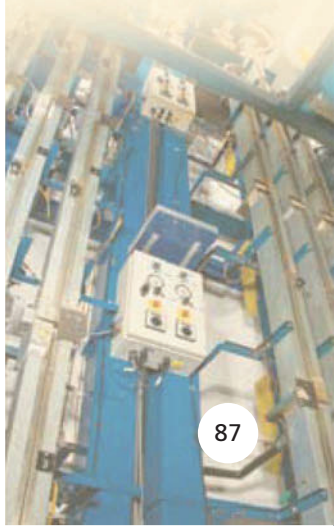


- High temperature.
- General purpose GC column – suitable for over 80% of all routine analyses performed by gas chromatography.
- Very low bleed – ideal for trace analysis.
- Non-polar.
- Extremely inert.
- Ideal for GC-MS.
- 360 – 370 °C upper temperature limit – dependent on film thickness.

Recommended column for General Purpose use.

Especially Suitable for these Industries:	All Industries
Areas:	Ultra trace analyses, pesticides/herbicides, hydrocarbons, solvents, phenols, amines, GC/MS and other specific detector applications. Applications ENV62, ARO09, ENV20, ENV03, ENV48, ENV59, ENV84, FOO21, FLA14, FLA16, FLA15, FLA12 FLA13, ENV54, PET22, SOL33 PHA06, PHA08, PHA15.
Suitable Replacement for:	DB-5, DB-5ms, DB-5.625, XTI-5, Rtx-5ms, Ultra-2, HP-5, HP-5MS, HP5-TA, SPB-5, MDN-5S, CP-Sil8CB, Rxt-Sil 5MS, AT-5ms, VB-5, ZB-5, VF-5ms.

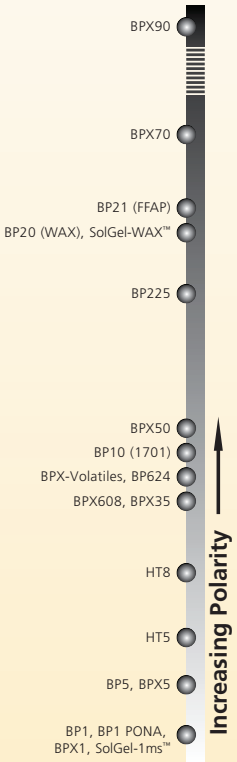
ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.1	10	-40 to 360/370	054099
0.15	1.2	10	-40 to 360/370	054106
0.15	0.25	12	-40 to 360/370	054103
0.15	0.4	12	-40 to 360/370	054107
0.15	0.25	25	-40 to 360/370	054104
0.15	0.4	25	-40 to 360/370	054108



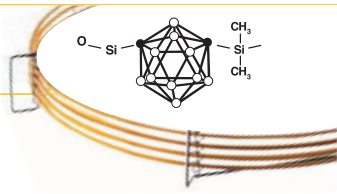
Expert Tip :
If you're having problems with solvent focusing, or early eluting peaks seem broad or lopsided in splitless injection, then try using a column with a thicker film.

BPX5

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.15	0.15	30	-40 to 360/370	054110
0.15	0.25	50	-40 to 360/370	054105
0.18	0.18	40	-40 to 360/370	054229
0.22	0.25	12	-40 to 360/370	054112
0.22	0.25	25	-40 to 360/370	054113
0.22	1	25	-40 to 360/370	054116
0.22	0.25	30	-40 to 360/370	054142
0.22	0.25	50	-40 to 360/370	054114
0.22	1	50	-40 to 360/370	054117
0.25	0.25	7	-40 to 360/370	054149
0.25	0.1	15	-40 to 360/370	0542170
0.25	0.25	15	-40 to 360/370	054100
0.25	1	15	-40 to 360/370	054121
0.25	0.1	30	-40 to 360/370	0541011
0.25	0.25	30	-40 to 360/370	054101
0.25	0.5	30	-40 to 360/370	0541025
0.25	1	30	-40 to 360/370	054122
0.25	0.25	60	-40 to 360/370	054102
0.25	1	60	-40 to 360/370	054123
0.32	1	6	-40 to 360/370	0541261
0.32	0.25	12	-40 to 360/370	054118
0.32	0.5	12	-40 to 360/370	054124
0.32	1	12	-40 to 360/370	054127
0.32	0.25	15	-40 to 360/370	054144
0.32	1	15	-40 to 360/370	054152
0.32	0.25	25	-40 to 360/370	054119
0.32	0.5	25	-40 to 360/370	054125
0.32	1	25	-40 to 360/370	054128
0.32	3	25	-40 to 350/360	054136
0.32	0.25	30	-40 to 360/370	054145
0.32	0.5	30	-40 to 360/370	0541205
0.32	1	30	-40 to 360/370	054153
0.32	0.25	50	-40 to 360/370	054120
0.32	0.5	50	-40 to 360/370	054126
0.32	1	50	-40 to 360/370	054129
0.32	0.25	60	-40 to 360/370	054146
0.32	1	60	-40 to 360/370	054154
0.53	0.25	12	-40 to 360/370	054133
0.53	1	12	-40 to 360/370	054130
0.53	3	12	-40 to 350/360	054138
0.53	0.5	15	-40 to 360/370	0541344
0.53	1	15	-40 to 360/370	054147
0.53	1.5	15	-40 to 350/360	0541347
0.53	3	15	-40 to 350/360	054159
0.53	0.25	25	-40 to 360/370	054134
0.53	1	25	-40 to 360/370	054131
0.53	3	25	-40 to 350/360	054139
0.53	0.5	30	-40 to 360/370	0541345
0.53	1	30	-40 to 360/370	054148
0.53	1.5	30	-40 to 350/360	0541348
0.53	3	30	-40 to 350/360	054160
0.53	1	50	-40 to 360/370	054132
0.53	1	60	-40 to 360/370	054158



HT5



- Ultra high temperature columns.
- Unique phase – no equivalent phases.
- Ideal for simulated distillation applications (petroleum industry).
- 460/480 °C upper temperature limit – Aluminum clad.
- 380/400 °C upper temperature limit – Polyimide clad.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	Fuels, Environment, Food
Application Areas:	Simulated distillation, general hydrocarbon profiles, pesticides/herbicides, GC/MS applications. Applications FOO16, PET11, PET27, PET06.
Suitable Replacement for:	MXT-1 Sim Dist, HT-Sim, DistCB, MXT-500.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
Polyimide Clad				
0.22	0.1	12	10 to 380/400	054631
0.22	0.1	25	10 to 380/400	054632
0.25	0.1	15	10 to 380/400	054633
0.25	0.1	30	10 to 380/400	054634
0.32	0.1	12	10 to 380/400	054641
0.32	0.5	15	10 to 380/400	054667
0.32	0.1	25	10 to 380/400	054642
0.32	0.5	30	10 to 380/400	054668
0.53	0.1	6	10 to 380/400	054655
0.53	0.5	10	10 to 380/400	054670
0.53	0.15	12	10 to 380/400	054657
0.53	0.5	15	10 to 380/400	054671
0.53	0.15	25	10 to 380/400	054658
0.53	0.5	30	10 to 380/400	054672
Aluminum Clad				
0.22	0.1	12	10 to 460/480	054635
0.22	0.1	25	10 to 460/480	054636
0.32	0.1	12	10 to 460/480	054651
0.32	0.1	25	10 to 460/480	054652
0.32	0.1	50	10 to 460/480	054653
0.53	0.075	5	10 to 460/480	054673
0.53	0.1	6	10 to 460/480	054661
0.53	0.15	12	10 to 460/480	054662
0.53	0.15	25	10 to 460/480	054665

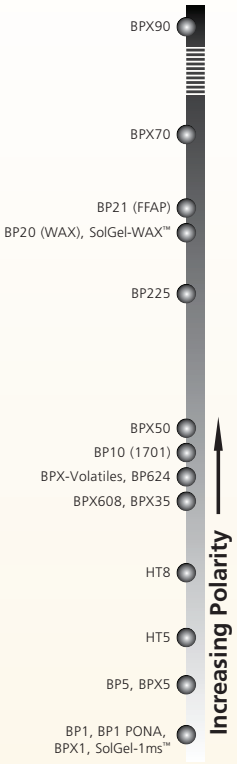
Expert Tip :
To prevent increasing retention times in your chromatography, replace the septum regularly.

For your gas purifiers see pages 165-166.

HT8

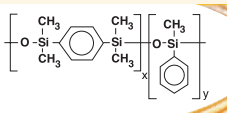
- High temperature.
- Low bleed.
- Preferred column for polychlorinated biphenyl (PCB) compounds.
- Separates PCB's on ortho ring substitution as well as boiling point.
- Ideal for environmental analysis.
- 360/370 °C upper temperature limit.
- Unique high temperature phase suited for the analysis of persistent organic pollutants (POPs).

GC Columns and Applications



Especially Suitable for this Industry:	Environment
Application Areas:	PCB congener analyses, nitro-substituted aromatics, polynuclear aromatic hydrocarbons, pesticides/herbicides. Application ARO08.
Suitable Replacement for:	No equivalents, unique ultra high temperature column.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.1	10	-20 to 360/370	054690
0.22	0.25	12	-20 to 360/370	054674
0.22	0.25	25	-20 to 360/370	054675
0.22	0.25	50	-20 to 360/370	054676
0.25	0.25	30	-20 to 360/370	054677
0.25	0.25	60	-20 to 360/370	054683
0.32	0.25	12	-20 to 360/370	054679
0.32	0.25	25	-20 to 360/370	054680
0.32	0.25	50	-20 to 360/370	054681
0.32	0.25	60	-20 to 360/370	054682
0.53	0.5	12	-20 to 360/370	054684
0.53	0.5	25	-20 to 360/370	054685



BPX35

- Mid polarity column.
- Ideal for confirmational analysis.
- Inert.
- Equivalent to USP phase G42.
- High temperature.
- Very low bleed.
- Pharmaceutical specialist.
- 330/360 °C upper temperature limit.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	Pharmaceuticals, Environment, Food, Forensics
Application Areas:	Environmental analyses, pesticides/herbicides, drugs of abuse, pharmaceuticals, polynuclear aromatic hydrocarbons, GC/MS applications. Applications ENV57, ENV04 AMI09, ALC09, SOL25, PHA14, PHA09
Suitable Replacement for:	DB-35, DB-35ms, Rtx-35, HP-35, HP-35MS, SPB-35, MDN-35.

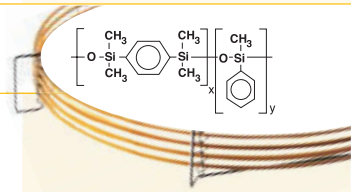
BPX35

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.1	10	10 to 330/360	054699
0.22	0.25	15	10 to 330/360	054713
0.22	0.25	25	10 to 330/360	054711
0.22	0.25	30	10 to 330/360	054714
0.22	0.25	50	10 to 330/360	054712
0.25	0.25	15	10 to 330/360	054700
0.25	1	15	10 to 330/360	054703
0.25	0.25	30	10 to 330/360	054701
0.25	0.5	30	10 to 330/360	0547025
0.25	1	30	10 to 330/360	054704
0.25	0.25	60	10 to 330/360	054702
0.25	1	60	10 to 330/360	054705
0.32	0.25	15	10 to 330/360	054723
0.32	0.5	15	10 to 330/360	054718
0.32	1	15	10 to 330/360	054716
0.32	0.25	25	10 to 330/360	054721
0.32	0.25	30	10 to 330/360	054724
0.32	0.5	30	10 to 330/360	0547158
0.32	1	30	10 to 330/360	054717
0.32	0.25	50	10 to 330/360	054722
0.53	0.5	15	10 to 330/360	054734
0.53	1	15	10 to 330/360	054736
0.53	0.5	30	10 to 330/360	054735
0.53	1	30	10 to 330/360	054737

Expert Tip :
When peak shape deteriorates, replace the liner immediately and cut 30cm from the front end of the column.

GC Capillary Columns | 35% Phenyl Polysilphenylene-siloxane

BPX608

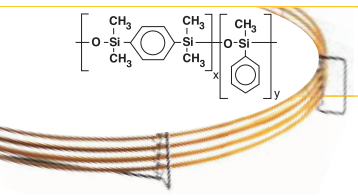


- Optimized for ECD.
- Ideal for organochlorine, pesticides and herbicides analysis.
- Maximum temperature 370 °C.

Especially Suitable for these Industries:	Environment
Application Areas:	Environmental analyses, EPA 608, pesticides/herbicides.
Operating Temperature	10 °C to 360/370 °C.
Suitable Replacement for:	DB-608, Rtx-35, SPB-608, HP-35, ZB-35.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.32	0.4	25	10 to 360/370	054823

For your instrument specific septa see the Instrument Quick Pick Pages pages 167-180.



BPX50

GC Columns and Applications

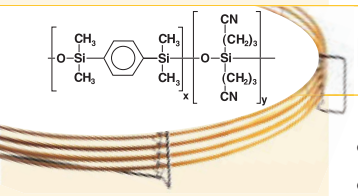
- Mid polarity.
- Inert.
- Low bleed.
- High temperature.
- Ideal for a range of EPA methods and pharmaceutical applications.
- 330/350 °C upper temperature limit.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	Pharmaceuticals, General Chemistry, Environment, Forensics
Application Areas:	EPA methods 604, 608, 8060, 8081, triazines/herbicides, drug screening, steroids and a variety of pharmaceutical applications GC2D. Applications ENV62, ENV45, ENV65, PHA19.
Suitable Replacement for:	OV-17, SP-2250, DB-17, DB-17ms, DB-17ht, Rtx-50, SPB-50, HP-50+, HP-17.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.05	10	80 to 330/350	054739
0.1	0.07	10	80 to 330/350	054738
0.1	0.1	10	80 to 330/350	054740
0.15	0.15	30	80 to 330/350	054741
0.25	0.25	15	80 to 330/350	054750
0.25	0.25	30	80 to 330/350	054751
0.25	0.25	60	80 to 330/350	054752
0.32	0.25	15	80 to 330/350	054760
0.32	0.25	30	80 to 330/350	054761
0.32	0.25	60	80 to 330/350	054762
0.53	0.5	15	80 to 330/350	054770
0.53	0.5	30	80 to 330/350	054771
0.53	1.0	30	80 to 330/350	054772

Expert Tip :
When installing your column into an FID jet, never pass the column through the flame. This will burn the inner (phase) and outer (polyimide) coatings and will cause higher background signals.

GC Capillary Columns | 70% Cyanopropyl Polysilphenylene-siloxane



BPX70

- High temperature.
- Custom designed for separation of Fatty Acid Methyl Esters (FAMEs).
- Industry standard column for FAME analysis.
- Polar phase.
- Long operating life.
- 250/260 °C upper temperature limit.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	Pharmaceuticals, Food
Application Areas:	Fatty acid methyl esters (FAMEs), carbohydrates, pharmaceuticals, GC/MS applications. Applications FOO02, FOO04.
Suitable Replacement for:	DB-23, Rtx-2330, SP-2330, CP-Sil 88, SP2380, HP-23.

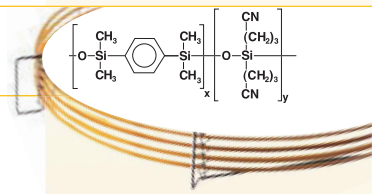
BPX70

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.2	10	50 to 250/260	054600
0.22	0.25	12	50 to 250/260	054601
0.22	0.25	25	50 to 250/260	054602
0.22	0.25	30	50 to 250/260	054612
0.22	0.25	50	50 to 250/260	054603
0.22	0.25	60	50 to 250/260	054613
0.25	0.25	15	50 to 250/260	054621
0.25	0.25	30	50 to 250/260	054622
0.25	0.25	60	50 to 250/260	054623
0.25	0.25	120	50 to 250/260	054624
0.32	0.25	12	50 to 250/260	054605
0.32	0.25	25	50 to 250/260	054606
0.32	0.25	30	50 to 250/260	054616
0.32	0.25	50	50 to 250/260	054607
0.32	0.25	60	50 to 250/260	054617
0.53	0.5	15	50 to 250/260	054619
0.53	0.5	25	50 to 250/260	054610
0.53	0.5	30	50 to 250/260	054620

Expert Tip :
Set the FID temperature 20 °C above the maximum method temperature.

GC Capillary Columns | 90% Cyanopropyl Polysilphenylene-siloxane

BPX90

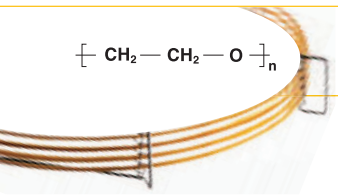


- Unique bonded phase.
- Highly polar.
- Thermally stable.
- Excellent resolution for cis and trans isomers.
- 260/280 °C upper temperature limit.
- Able to be solvent rinsed.

For your gas purifiers see page 165-166.

Especially Suitable for these Industries:	General Chemistry, Fuels, Environment, Food
Application Areas:	Ideal for fast separation of fragrances, aromatics, petrochemical, pesticides, PCBs and isomers of Fatty Acid Methyl Esters (FAMEs). Application AN0022C.
Suitable Replacement for:	Unique to SGE.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.25	0.25	15	80 to 260/280	054570
0.25	0.25	30	80 to 260/280	054580
0.25	0.25	60	80 to 260/280	054590
0.25	0.25	100	80 to 260/280	054596
0.32	0.5	15	80 to 260/280	054573
0.32	0.5	30	80 to 260/280	054583
0.32	0.5	60	80 to 260/280	054593

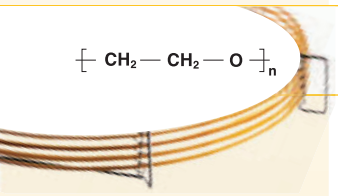


SolGel-WAX™

- The world's highest temperature wax phase.
- Bonded polyethylene glycol.
- Very robust high-temperature column.
- Less susceptible to damage by oxygen than conventional wax phases.
- Polar phase.
- Low bleed and inert.
- 280 °C upper temperature limit.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	General Chemistry, Food
Application Areas:	Recommended for highly active compounds. Applications ARO13, FLA19, FLA22, FLA21, FLA18, POL06, ENV52.
Suitable Replacement for:	DB-Wax, Rtx-Wax, Stabilwax, HP20M, HP-Wax, HP-INNOWax, Supelcowax-10, AT-Wax, Nukol, CP Wax 52CB, VB-WAX, ZB-WAX.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.1	10	30 to 260/280	0547100
0.25	0.25	30	30 to 260/280	054796
0.25	1	30	30 to 260/280	054787
0.25	0.25	60	30 to 260/280	054791
0.32	0.25	30	30 to 260/280	054788
0.32	0.5	30	30 to 260/280	054797
0.32	0.25	60	30 to 260/280	054789
0.32	0.5	60	30 to 260/280	054792
0.53	0.5	30	30 to 260/280	054786
0.53	1	30	30 to 260/280	054785



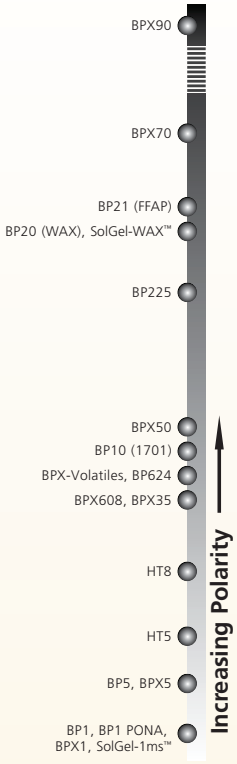
BP20 (WAX)

- Industry standard wax column.
- Polar phase.
- 240 – 280 °C upper temperature limit – dependent on film thickness.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	General Chemistry, Environment, Food
Application Areas:	Alcohol, free acids, fatty acid methyl esters (FAMEs), aromatics, solvents, essential oils. Applications FOO03, FOO24 FLA03, ALC03, ACI03, POL01, PHA13.
Suitable Replacement for:	DB-Wax, HP-20M, Supelcowax 10, CB-Wax, Stabilwax, Carbowax, HP-Innowax, Rtx-WAX, PE-WAX, RH-WAX, ZB-WAX, TRWAX.

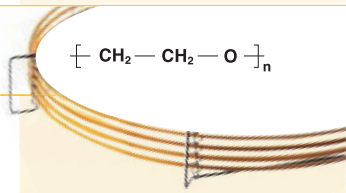
BP20 (WAX)

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.1	0.1	10	20 to 260/280	054405
0.22	0.25	12	20 to 260/280	054420
0.22	0.25	25	20 to 260/280	054421
0.22	0.25	30	20 to 260/280	054424
0.22	0.25	50	20 to 260/280	054422
0.22	0.25	60	20 to 260/280	054425
0.25	0.25	15	20 to 260/280	054426
0.25	0.25	30	20 to 260/280	054427
0.25	0.5	30	20 to 260/280	054415
0.25	1	30	30 to 240/260	054439
0.25	0.25	60	20 to 260/280	054428
0.25	0.5	60	20 to 260/280	054458
0.32	0.25	15	20 to 260/280	054432
0.32	0.25	25	20 to 260/280	054430
0.32	0.5	25	20 to 260/280	054436
0.32	1	25	20 to 240/260	054442
0.32	0.25	30	20 to 260/280	054433
0.32	0.5	30	20 to 260/280	054438
0.32	1	30	30 to 240/260	054444
0.32	0.25	50	20 to 260/280	054431
0.32	0.5	50	20 to 260/280	054437
0.32	1	50	20 to 240/260	054443
0.32	0.25	60	20 to 260/280	054434
0.32	0.5	60	20 to 260/280	054457
0.32	1	60	20 to 240/260	054445
0.53	1	12	20 to 240/260	054447
0.53	2	12	20 to 240/260	054455
0.53	0.5	15	20 to 260/280	054961
0.53	1	15	20 to 240/260	054450
0.53	1	25	20 to 240/260	054448
0.53	2	25	30 to 240/260	054456
0.53	0.5	30	20 to 260/280	054440
0.53	1	30	20 to 240/260	054451
0.53	0.5	60	20 to 260/280	054963
0.53	1	60	20 to 240/260	0544515



GC Capillary Columns | Polyethylene Glycol (PEG) – TPA Treated

BP21 (FFAP)



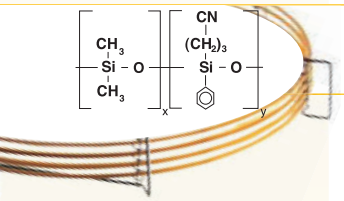
- Nitroterephthalic acid modified PEG.
- Polar phase.
- Ideal for low molecular weight acids.
- 240/250 °C upper temperature limit.
- Able to be solvent rinsed (water or methanol is NOT recommended for rinsing).
- Bonded and cross-linked.

Especially Suitable for these Industries:	General Chemistry, Environment, Food
Application Areas:	Volatile free acids, fatty acid methyl esters, alcohols, aldehydes, acrylates, ketones. Applications ACI02, SOL04.
Suitable Replacement for:	DB-FFAP, HP-FFAP, Stabilwax-DA, CPWax-58CB.

BP21 (FFAP)

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.22	0.25	25	35 to 240/250	054462
0.22	0.25	50	35 to 240/250	054463
0.25	0.25	15	35 to 240/250	054464
0.25	0.25	30	35 to 240/250	054465
0.25	0.25	60	35 to 240/250	054466
0.32	0.25	12	35 to 240/250	054467
0.32	0.25	15	35 to 240/250	054470
0.32	0.25	25	35 to 240/250	054468
0.32	0.25	30	35 to 240/250	054471
0.32	0.25	50	35 to 240/250	054469
0.32	0.25	60	35 to 240/250	054472
0.32	0.5	50	35 to 240/250	054480
0.53	0.5	12	35 to 240/250	054473
0.53	0.5	15	35 to 240/250	054476
0.53	0.5	25	35 to 240/250	054474
0.53	0.5	30	35 to 240/250	054477
0.53	1	30	35 to 240/250	054478

GC Columns | 14% Cyanopropylphenyl Polysiloxane



BP10 (1701)

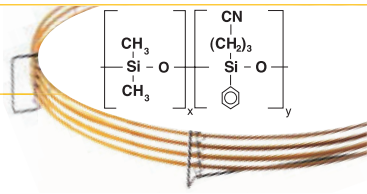
- Used for organochlorine pesticides analysis.
- Highly inert.
- Low bleed.
- 260/300 °C upper temperature limit - dependent on film thickness.
- Bonded and cross-linked.
- Able to be solvent rinsed.

Especially Suitable for these Industries:	Pharmaceuticals, Environment, Forensics
Application Areas:	Environmental analyses (EPA methods 608 and 8081), pesticides/herbicides, drugs of abuse, pharmaceuticals.
Suitable Replacement for:	DB-1701, Rtx-1701, SPB-7, HP-1701, CP-Sil 19CB, 007-1701, PE-1701, SP-1701.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.22	0.25	12	-20 to 280/300	054252
0.22	0.25	25	-20 to 280/300	054253
0.22	0.25	50	-20 to 280/300	054254
0.25	0.25	15	-20 to 280/300	054255
0.25	0.25	30	-20 to 280/300	054256
0.25	1	30	-20 to 260/280	054271
0.25	0.25	60	-20 to 280/300	054257
0.32	0.25	15	-20 to 280/300	054258
0.32	0.5	15	-20 to 280/300	054264
0.32	0.25	25	-20 to 280/300	054262
0.32	0.5	25	-20 to 280/300	054268
0.32	0.25	30	-20 to 280/300	054259
0.32	0.5	30	-20 to 280/300	054265
0.32	1	30	-20 to 260/280	054270
0.32	0.5	50	-20 to 280/300	054269
0.32	0.25	60	-20 to 280/300	054260
0.32	0.5	60	-20 to 280/300	054266
0.53	1	15	-20 to 260/280	054282
0.53	1	25	-20 to 260/280	054280
0.53	1	30	-20 to 260/280	054283

Expert Tip :
Do not use plastic tubing in GC systems. Plastic tubing, when used for general plumbing, can absorb up to 20% moisture allowing external laboratory gases to permeate through the tubing. SGE recommends clean stainless steel tubing to be used throughout the GC system.

BP225



- Mid to high polarity.
- Low bleed.
- Bonded and cross-linked.
- 230/260 °C upper temperature limit.
- Able to be solvent rinsed.

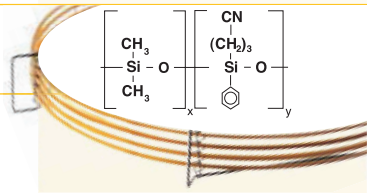
GC Columns and Applications

Especially Suitable for these Industries:	Food, Life Sciences
Application Areas:	Fatty Acid Methyl Esters (FAMEs), carbohydrates, neutral sterols.
Suitable Replacement for:	DB-225, HP-225 and RTX-225.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.22	0.25	25	40 to 230/260	054352
0.22	0.25	50	40 to 230/260	054353
0.32	0.25	25	40 to 230/260	054358
0.53	0.5	25	40 to 230/260	054364

For your instrument specific septa see the Instrument Quick Pick Guide pages 167-180.

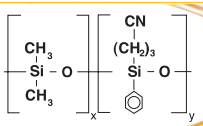
BPX-VOLATILES



- Polar phase.
- EPA volatile organics analysis (EPA 624, 502.2, SW-846 8240/8260).
- 290/300 °C upper temperature limit.
- Able to be solvent rinsed.
- Bonded and cross-linked.

Especially Suitable for these Industries:	Pharmaceuticals, Environment, Food
Application Areas:	Environmental analyses, volatile organics, alcohol analysis, USP G43. Application TP-0102-C.
Suitable Replacement for:	DB-VRX, HP-624, OPTIMA 624, ELITE-624, 007-624, RTX-VOLATILES, SPB-624, TRV1, CPSIL 13 CB, VOCOL, VB-624, CP-624.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.18	1	20	0 to 290/300	054978
0.18	1	40	0 to 290/300	054979
0.25	1.4	30	0 to 290/300	054980
0.25	1.4	60	0 to 290/300	054981
0.32	1.8	30	0 to 290/300	054982
0.32	1.8	60	0 to 290/300	054983
0.53	3	30	0 to 290/300	054984
0.53	3	60	0 to 290/300	054985



BP624

- US EPA 624 optimized column.
- Designed for volatiles analysis.
- Ideal for EPA624, SW-846 methods 8240/8260.
- Ideal for USP G43 method.
- 230/240 °C upper temperature limit.
- Able to be solvent rinsed.
- Bonded and cross-linked.

GC Columns and Applications

Especially Suitable for these Industries:	Environment
Application Areas:	EPA method 624, drinking water volatiles, chlorinated hydrocarbons, solvents, Excellent for U.S. EPA Methods: 501.3, 502.2, 503.1, 524.2, 601, 602, 8010, 8015, 8020, 8240, 8260. Applications ENV17, ENV13.
Suitable Replacement for:	DB-624, OV-624, AT-624, HP-VOC, CP-Select624CB, 007-624, Rtx-Volatiles, Rtx 624, VOCOL, ZB-624.

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.22	1.2	25	0 to 230/240	054826
0.22	1.2	30	0 to 230/240	054827
0.25	1.4	15	0 to 230/240	054839
0.25	1.4	30	0 to 230/240	054840
0.25	1.4	60	0 to 230/240	054842
0.32	1.8	25	0 to 230/240	054830
0.32	1.8	30	0 to 230/240	054832
0.32	1.8	50	0 to 230/240	054831
0.32	1.8	60	0 to 230/240	054841
0.53	3	25	0 to 230/240	054834
0.53	3	30	0 to 230/240	054836
0.53	3	50	0 to 230/240	054835
0.53	3	60	0 to 230/240	054838

CYDEX-B™

- Separation of chiral compounds

Especially Suitable for these Industries:	Pharmaceuticals, Food
Application Areas:	Separation of enantiomeric compounds found in natural products. Application FLA05.
Operating Temperature:	30 °C to 220/240 °C
Suitable Replacement for:	Cyclodex-B, Rt-BDEXm, LIPODEX C

ID (mm)	Film Thickness (µm)	Length (m)	Temperature Limits (°C)	Part No.
0.22	0.25	25	30 to 220/240	054900
0.22	0.25	50	30 to 220/240	054901
0.32	0.25	25	30 to 220/240	054902