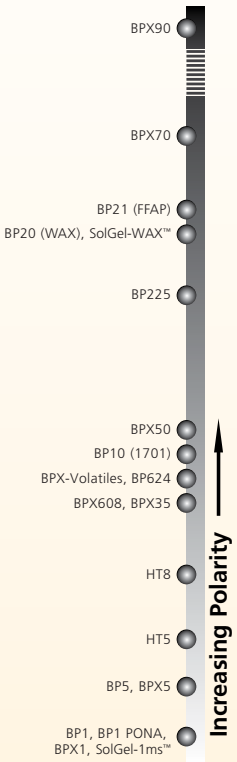
The primary advantages of considering phase selectivity include:

- 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.

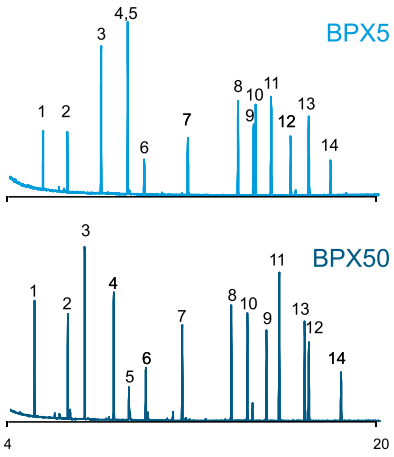
GC Capillary Column Selection



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.

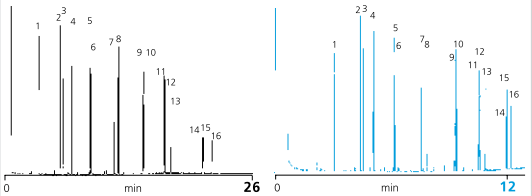
- To separate compounds that differ more in their hydrogen bonding capacities (for example aldehydes and alcohols), polyethylene glycol type phases are best suited - SolGel-WAX™, BP20 (WAX) and BP21(FFAP).

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.

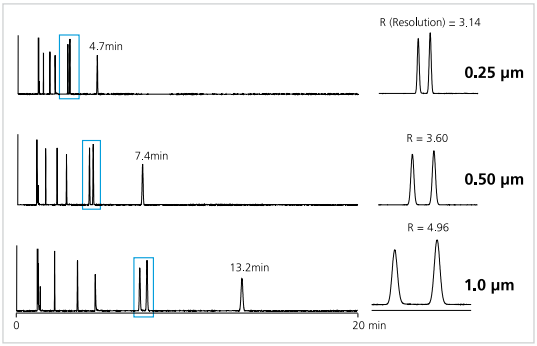
3. Film Thickness

- 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.



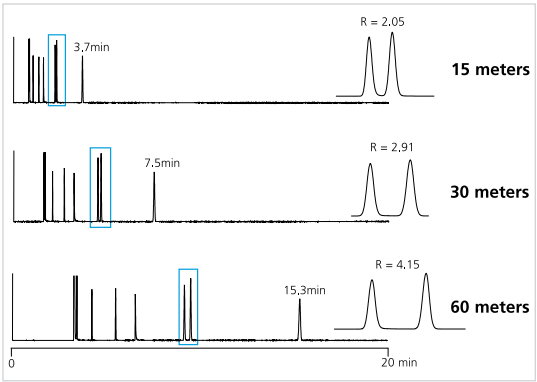
Effect of Film Thickness.

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.