

New Gs BP GC Columns

GS-Tek

What really makes GsBP GC columns different from other brand name columns?

GsBP columns are developed and made in USA with proprietary manufacturing processes developed by column tech gurus. GsBP columns not only replicate the performances of brand name columns, but they also have improved the long-time known limitations and problems of brand name columns. GsBP columns are offered at very competitive prices. GsBP columns are excellent in quality and value.

1. Replicating Performances

Column chromatographic performances are characterized by stationary phase, column selectivity, and retention time. GsBP GC columns are reengineered with very similar stationary phases to those that most column makers use. The process control practically replicates column selectivity and retention times in order to ensure seamless column switching from the name brand products in market. Tables I and II, and Figures 1 and 2 illustrate the performance comparisons of the most popular stationary phases: GsBP-5MS and GsBP-Inowax versus the brand name stationary phases.

Table I GsBP-5MS Comparisons at 135°C

Column Brand	GsBP-5MS	Brand H-5MS	Brand D-5MS
RI (Methyl Decanoate)	1324.0+/-1.0	1324.2	1323.7
RI (Acenaphthylene)	1461.0+/-1.0	1462.1	1460.1
RI (1-Dodecanol)	1473.5+/-1.0	1474.2	1473.7
K'(Pentadecane)	6.2+/-0.6	5.9	6.4
K'(Undecane)	0.72	0.69	0.76
Temperature Limits	-60 to 325/350°C	-60 to 325/350°C	-60 to 340/360°C

Table II GsBP-Inowax Comparisons at 130°C

Column Brand	GsBP-Inowax	Brand H-Innowax	GsBP-CarboWax (true PEG column)
RI (Methyl Undecanoate)	1715.8	1716.2	1699.6
RI (1-Decanol)	1779.8	1779.7	1752.1
K'(Tetradecane)	0.51	0.54	
K'(2,6-Dimethylphenol)	9.31	9.81	
Temperature Limits	40 to 260/280°C	50 to 260/280°C	50 to 220°C
Crosslinked and Bonded	Yes	Yes	No

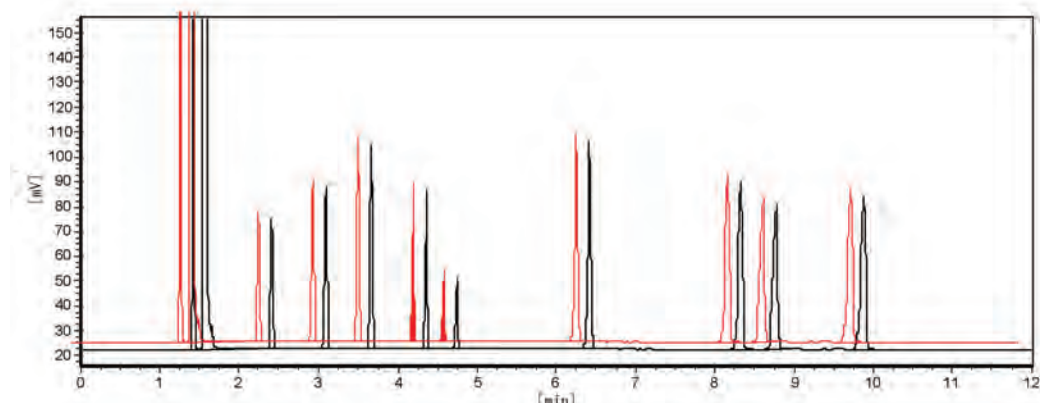


Figure 1 Chromatogram comparison of GsBP-5MS and Brand name H-5MS columns

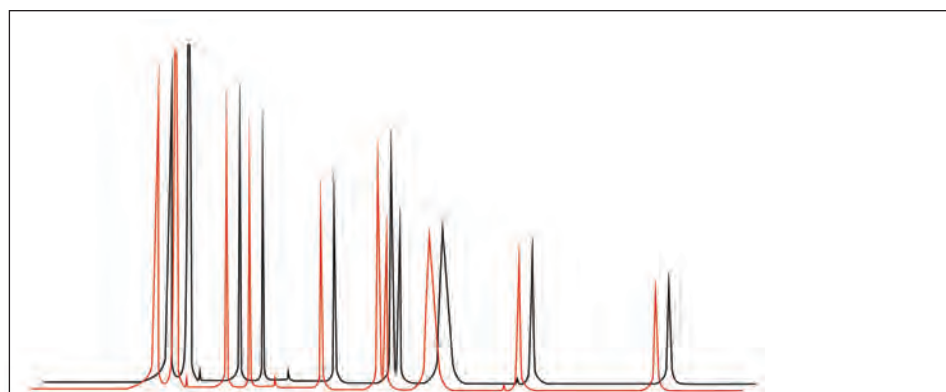


Figure 2 Chromatogram comparisons of GsBP-Inowax and Brand name H-INNOWax columns

Figures 1 and 2 display the great similarities of these two popular stationary phase columns. Figure 1 is the graphic comparison of the GsBP-5MS column to the brand name H-5MS column, while Figure 2 is a graphic comparison of the GsBP-Inowax column to the brand name H-Innowax column. Tables I and II show GS-Tek's published specifications for these two columns.

Based on these comparisons, it can be concluded that GsBP GC columns have nearly identical performances when compared to brand name columns.

2. Totally Inert Column

It is not an industrial secret that most brand name columns exhibit slightly acidic or basic surfaces. The surfaces of these brand name columns are deactivated with either basic or acidic silanes. This causes the surfaces to be bias towards acidic or basic compounds. Techniques like surface deactivation and other processes ones employed by brand name column makers lack controllability from batch to batch. Hence, the surfaces of brand name columns are neither completely deactivated nor very neutral. As a result of non-neutral surfaces, these brand name columns are limited in certain applications like the analyses of

amines, sulfurs, pesticides, and other environmental samples, amongst many others. A non-neutral column surface can also result in inaccurate quantification and can change the separation and column selectivity. For example, DB-5 columns are slightly different from HP-5 columns in elution orders and resolutions. The surface inertness of these two brand name columns is also slightly different.

GS-Tek has developed a controllable proprietary surface deactivation technique to produce totally inert column surfaces. In order to ensure that the surfaces are inert, GsBP columns are tested with samples containing strong acids, bases, and alcohol probes. Table III lists two of GS-Tek Industries' testing samples and their components.

Table III Column test sample probes

GsBP-50+MS	GsBP-Ultra
Tridecane	Undecane
4-Chlorophenol	4-Chlorophenol
Tetradecane	1-Decylamine
Decylamine	Tridecane
Pentadecane	Methyl decanoate
2-Methylnaphthlene	Tetradecane
1-Dodecanol	Acenaphthylene
Hexadecane	1-Dodecanol
	Pentadecane

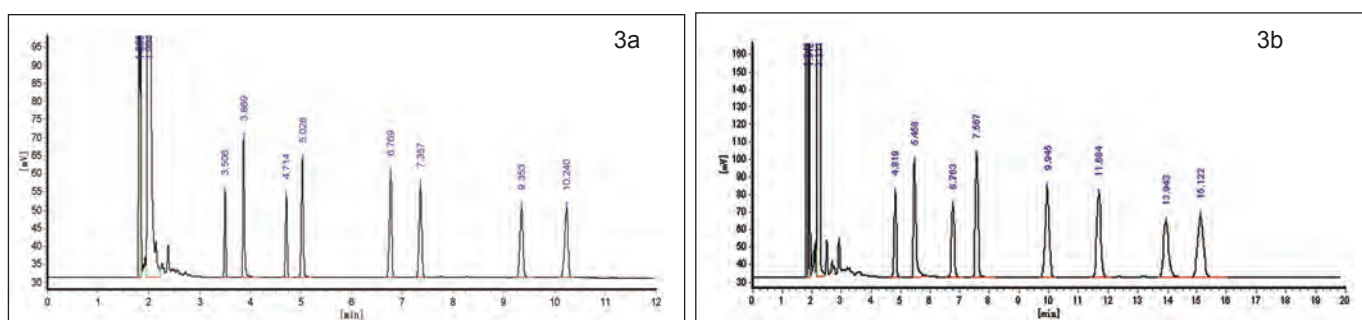


Figure 3 Column inertness comparison of GsBP-50+MS and brand name D-17 columns

Figure 3 shows the difference in column surfaces between the brand name D-17 column and GS-Tek Industries' GsBP-50+MS column tested by the same testing sample. In Figure 3a, the 4-chlorophenol peak (the second peak after the solvent peak) exhibits slight tailing, meaning that the column has a slightly basic surface. In Figure 3b, the 4-chlorophenol peak has almost no tailing, showing that GsBP-50+, 0.25mm x 30m has a nearly neutral surface. It can also be seen that the peak height ratio of 4-chlorophenol over C14 on an GsBP-50+ column is higher than on the D-17 column. With this information it is valid to conclude that the GsBP-50+MS column has an inert surface and can be used for many applications.

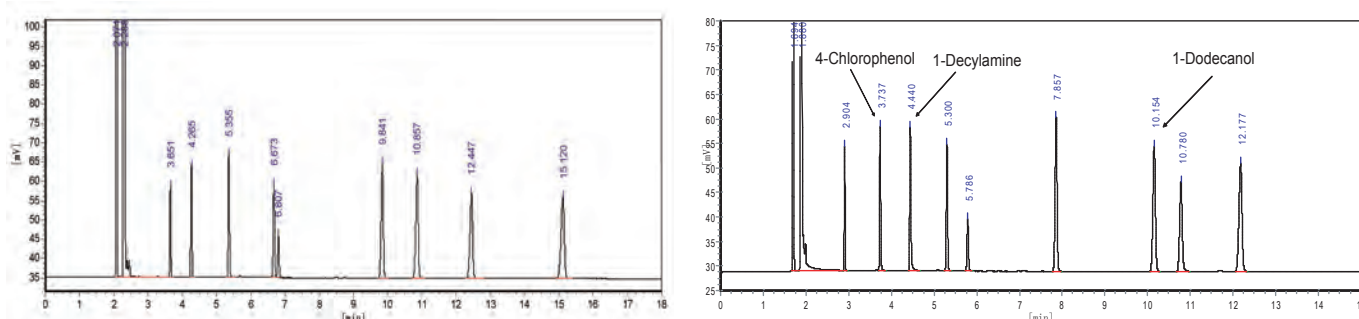


Figure 4 Column inertness testing

(a) GsBP-1MS, 0.25mm x 30m x 0.25µm; (b) GsBP-5MS, 0.25mm x 30m x 0.25µm + 10m x 0.25mm guard column

Figure 4a demonstrates that GsBP-1 columns have very inert surfaces. The acid (4-chlorophenol, RT 4.265min), base (decylamine, RT 5.355min) and alcohol (1-decanol, RT 12.447min) all exhibit symmetric peak shapes. Figure 4b shows the surface inertness of a 30m GsBP-5MS column with a 10m integrated guard column (total length 40m). Both GsBP-1 and GsBP-5 columns have the best neutrally inert surfaces among all brand name columns, making them the best fit for all applications.

3. Very Low Column Bleed

Low column bleed is an industrial trend pushing applications to new limits like temperature limit and detection limit. Low column bleed can lead to longer lifetimes for GC columns. Low column bleed means that there is crosslinking and bonding of the columns' stationary phases. All stationary phases of GsBP GC columns are carefully made in-house to ensure controllable column selectivity (specified by retention indices) and low column bleed. Most stationary phases are crosslinked and bonded after column preparations. Without any compromise, most GsBP GC columns are tested for column bleed. Table IV shows GsBP-5MS column specifications.

Table IV Column Bleed Comparison

Brand Name	GsBP-5MS	Brand H-5MS	Brand D-5MS
Column Bleed	<4pA @325°C	<4pA @320°C	<4pA @325°C
Temperature Limit (°C)	-60 -325/350	-60 -325/350	-60 -340/360

4. Stringent Quality Control

All GsBP GC columns are tested with comprehensive test samples to ensure the highest quality possible of the products. GsBP GC columns are not ECONOMIC columns that have low performance and quality. The specs in Tables I-IV show GS-Tek's confidence in maintaining quality without compromise. As a result, GsBP GC columns have consistently high performances. Figure 15 shows the production data distribution of GsBP-5MS column bleeds as a demonstration of our product quality control and consistency.

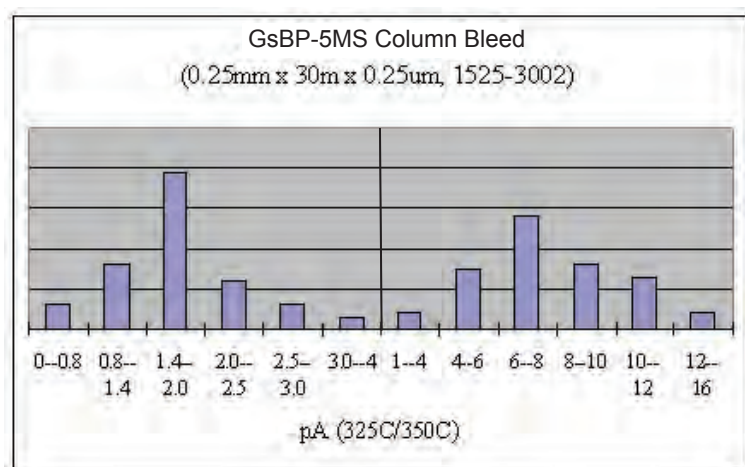


Figure 15 Production distribution of GsBP-5MS column bleed, 0.25mm x 30m x 0.25µm

In summary, GsBP GC columns are carefully made at the highest industrial quality standard. GsBP GC columns replicate the performances of brand name columns in selectivity and retention times, making column switching seamless. GsBP GC columns are extremely inert and have very low column bleeds. They can fit all known applications. The testing results from GsBP GC columns may actually overtake the quality of brand name columns.

With GsBP GC columns, end users will experience and benefit from the following:

(A) Smooth and Seamless Column Switching

The near identical performance of GsBP GC columns to brand name columns makes the column switching process virtually seamless. This has been proven with one of the most stringent applications. PONA or ASTM D 5134 for DHA identifies the peaks of gasoline based on the retention times of the industrial fleet column, the HP-PONA column. Figure 5 shows the comparison of the reformulated gasoline analyses using both GsBP-PONA and HP-PONA columns. Both columns are 0.20mm x 50m x 0.5µm. The PONA software has easily identified over 300 peaks and has correctly calculated the iso-octane number of the gasoline sample.

With the installation of an GsBP GC column, the existing instrumentation condition does not need to be changed at all. The analysis result will be extremely similar to the result from the previously used brand name column. It has been proven by our customers from all over the world that GsBP GC columns fit almost all existing applications that previously were employed by similar brand name columns.

(B) Similar and Improved Separations

Figure 6 is a GC-MS analysis of a solvent mix in a drug sample on an GsBP-Inowax column (0.25mm x 30m x 0.25µm, p/n 2025-3002). In addition to the baseline separations of all of the solvents, this PEG type of GsBP-Inowax column has a very low column bleed. This makes it a great column to be used with GC-MS instrumentation as it quickly identifies all solvent peaks.

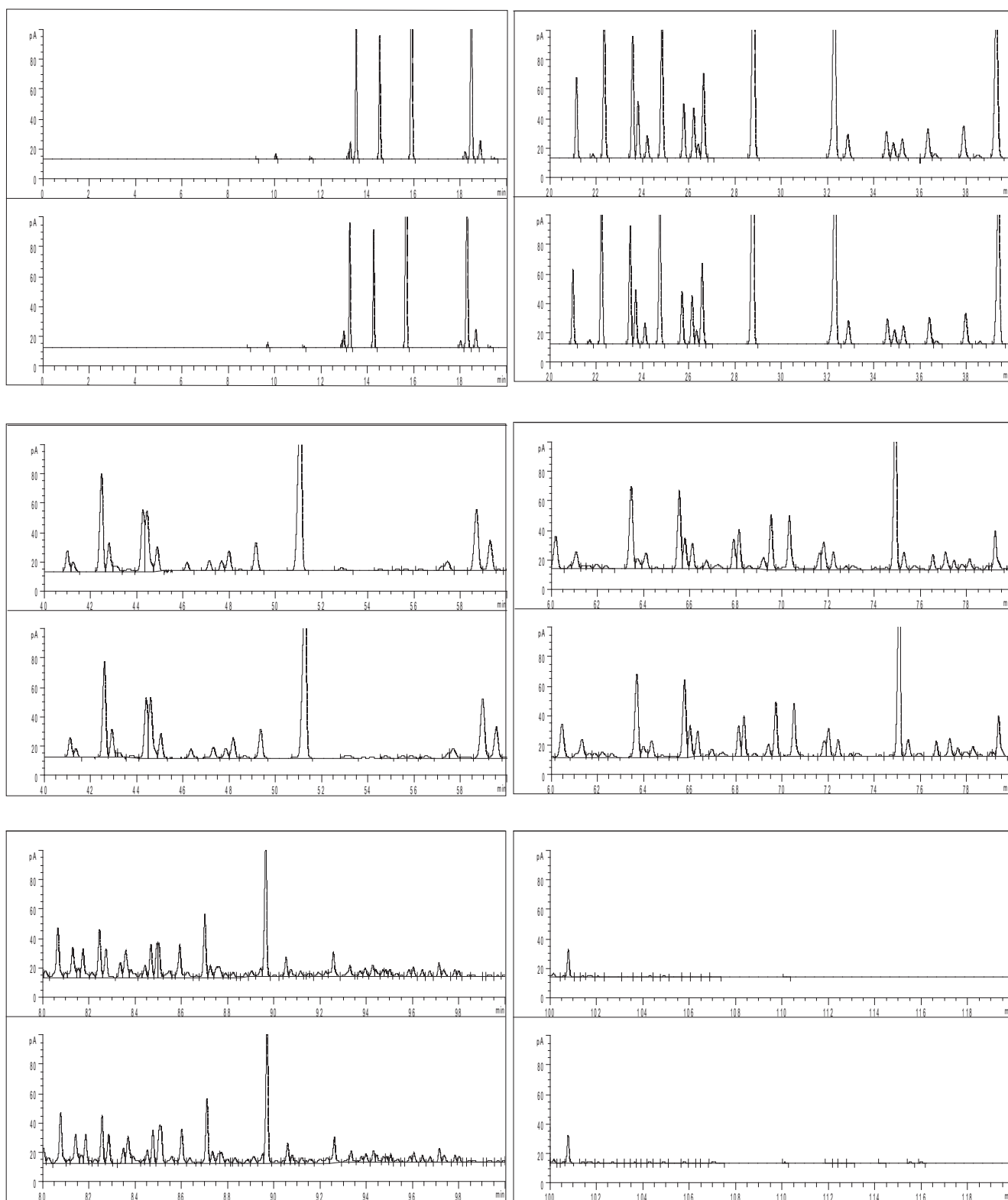
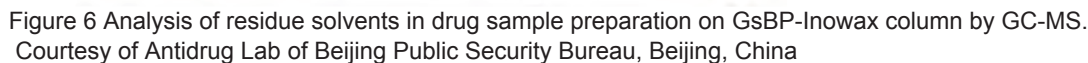


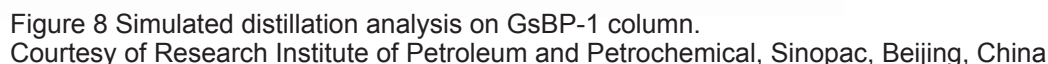
Figure 5 PONA analyses of reformulated gasoline on GsBP-PONA and HP-PONA, both 0.20mm x 50m x 0.5µm



1	Air	10	Propane
2	CH ₄	11	Methanol
3	CO ₂	12	i-Butane
4	Ethylene	13	n-Butane
5	Ethane	14	Butene
6	H ₂ S	15	Butene
7	COS	16	i-pentane
8	Water	17	n-pentane
9	Propylene		

Figure 7 Refinery gas separations on GsBP-PLOT Q column

Figure 7 shows the separation of a refinery gas sample on an GsBP-PLOT Q column. Figure 8 is another example of the same separation for a simulated distillation on an GsBP-1 column.



Complex analysis that analyzes difficult samples is often done on the highest quality columns. EPA 8270 is an example of a complex analysis. The highest quality column must have the right column selectivity, an extended temperature limit, a low column bleed, a high column plate number, and an inert surface. GsBP-5MS is an example of one of the highest quality columns that is able to perform such an analysis. As shown in Figure 9a, the GsBP-5MS column produces both

symmetric and sharp peak of 1ppm Benzidine, because of its completely inert surface. This meets the requirement of EPA method 8270. Figure 9b shows another example that requires an inert surface, where, the totally inert GsBP-5MS column produces symmetric peaks for all of the strong bases and acids, as specified in EPA method 625.

Another example of a complex analysis is the analysis of melamine. When analyzing melamine in dairy products it is extremely important that the columns used are high in quality (good column inertness and low column bleeds). Figure 9c shows a GC-MS analysis of a 10ppm melamine spiking in a baby formula on an GsBP-5MS column. The derivative 10ppm melamine was easily detected. Figure 9d shows another example of a complex analysis, where a low level of ephedrine used by athletes can accurately be measured on an GsBP-5MS. For the same analysis, one of the brand name products gave a result with poor reproducibility of ephedrine quantitation over various testing runs.

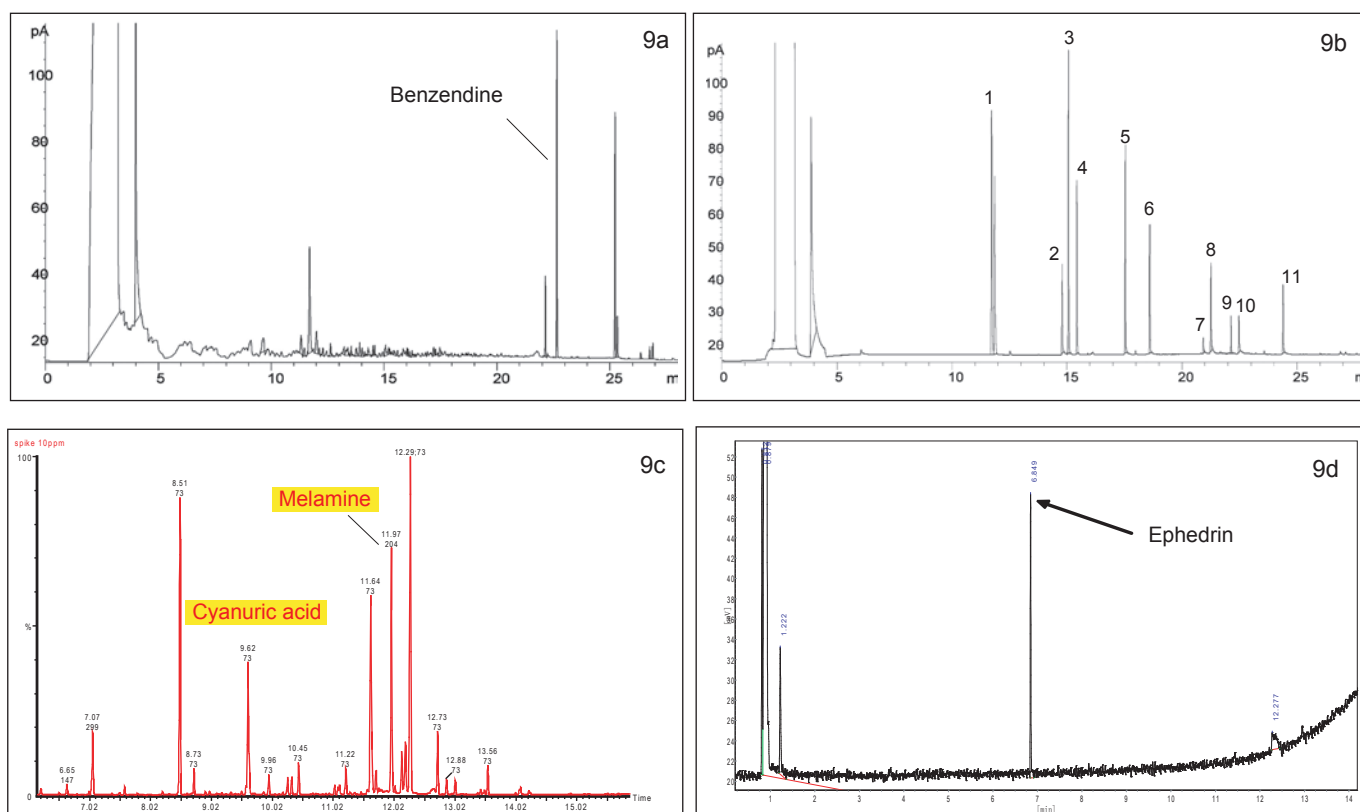


Figure 9 Complex analyses on GsBP-5MS column.

(a) EPA 8270; (b) EPA 625; (c) Melamine in Dairy Product by GC-MS, Courtesy of Mr. Foo, ChromStation Sdn. Bhd. Malaysia; (d) Ephedrine, Courtesy of Chinese Antitopping Center

Peak Identify (b):	1	Phenol
	2	2-Chlorophenol
	3	2-nitrophenol
	4	2,4-dimethylphenol
	5	2,4-dichlorophenol
	6	4-chloro,3-methylphenol
	7	2,4,6-trichlorophenol
	8	2,4-dinitrophenol
	9	4-nitrophenol
	10	2-methyl, 6-nitrophenol
	11	Pentachlorophenol

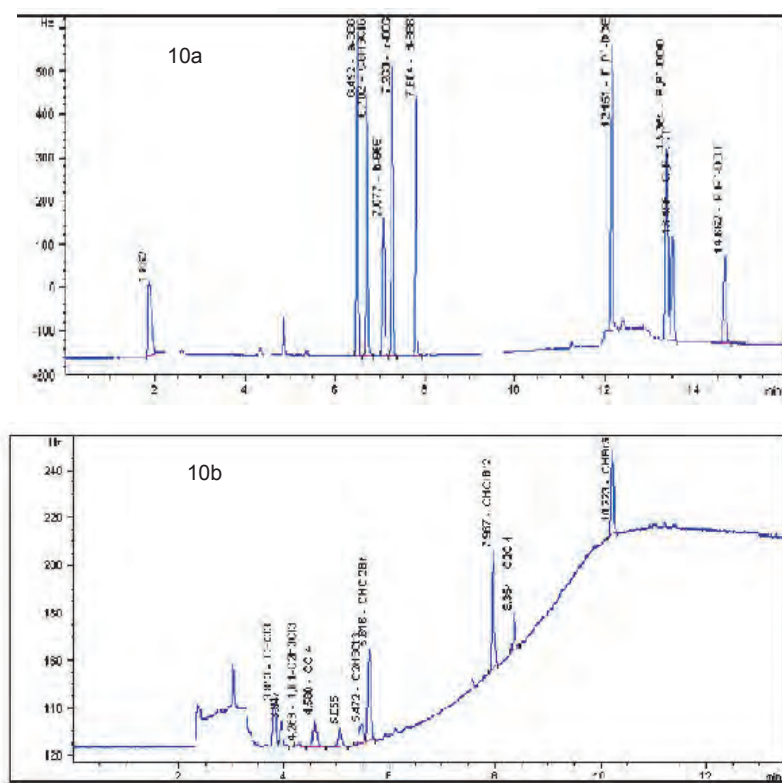


Figure 10 Pesticide separations on GsBP-5MS column, Courtesy of Chinese Academy of Agriculture Science, Beijing, China

Figure 10 demonstrates the benefits of an inert 1701 column with a low column bleed for pesticide analysis. In this GC-ECD analysis of pesticides, all needed compounds were nicely separated and low levels of pesticides were detected at elevated temperatures.

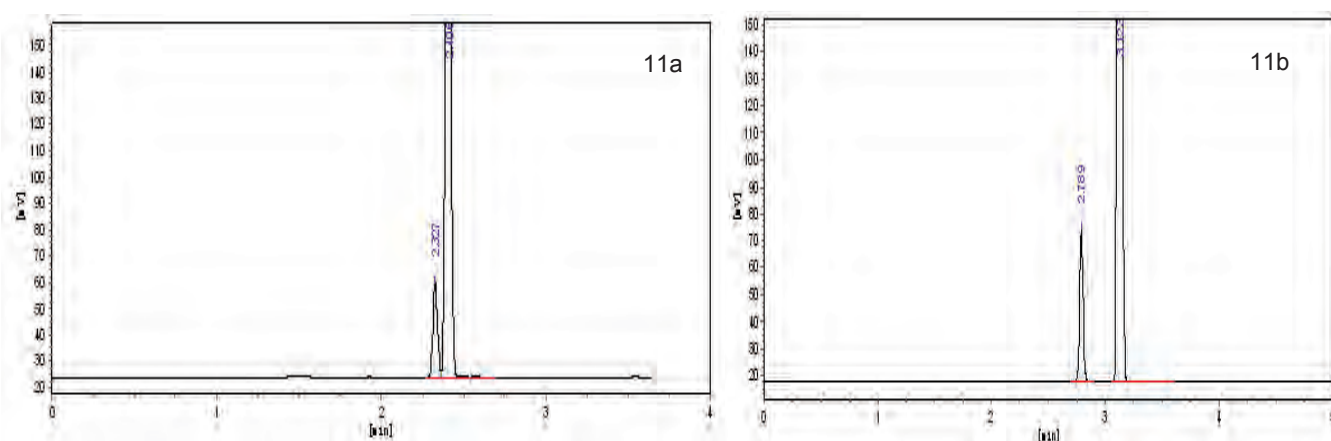


Figure 11 Dichloromethane and Isopropyl Alcohol separation.

Courtesy of Mr. Fernandes, Chromtopak, Mumbai, India. (a) on GsBP-Inowax Column; (b) on GsBP-624 column

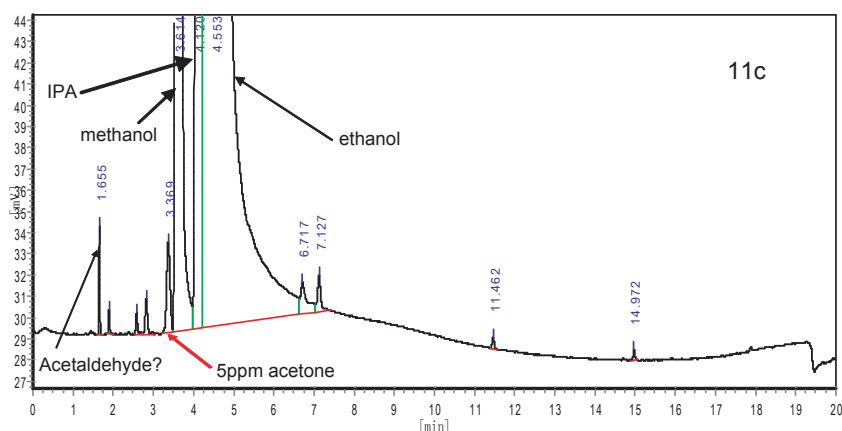


Fig 11C Analysis of low level acetone in ethyl alcohol by GsBP-Inowax column

Figure 11a shows the separation of residue solvents, isopropyl alcohol and dichloromethane in a pharmaceutical quality control done on a head-space GC instrument. In this application, the isopropyl alcohol peak eluted before the dichloromethane peak with a resolution of 1.68 on an GsBP-Inowax column, as the existing quality control requirement. This separation can be greatly improved on an GsBP-624 column which has better selectivity. The column easily produces a baseline separation, as shown in Figure 11b. Figure 11c demonstrates an analysis of 5ppm acetone spiking in a reagent alcohol done on an GsBP-Inowax column. A lower level of acetone presence in sugar cane alcohol means that there will be a higher price for perfume alcohol grade usage. The unique selectivity of the GsBP-Inowax phase makes this analysis possible because the low level acetone elutes before the matrix ethanol.

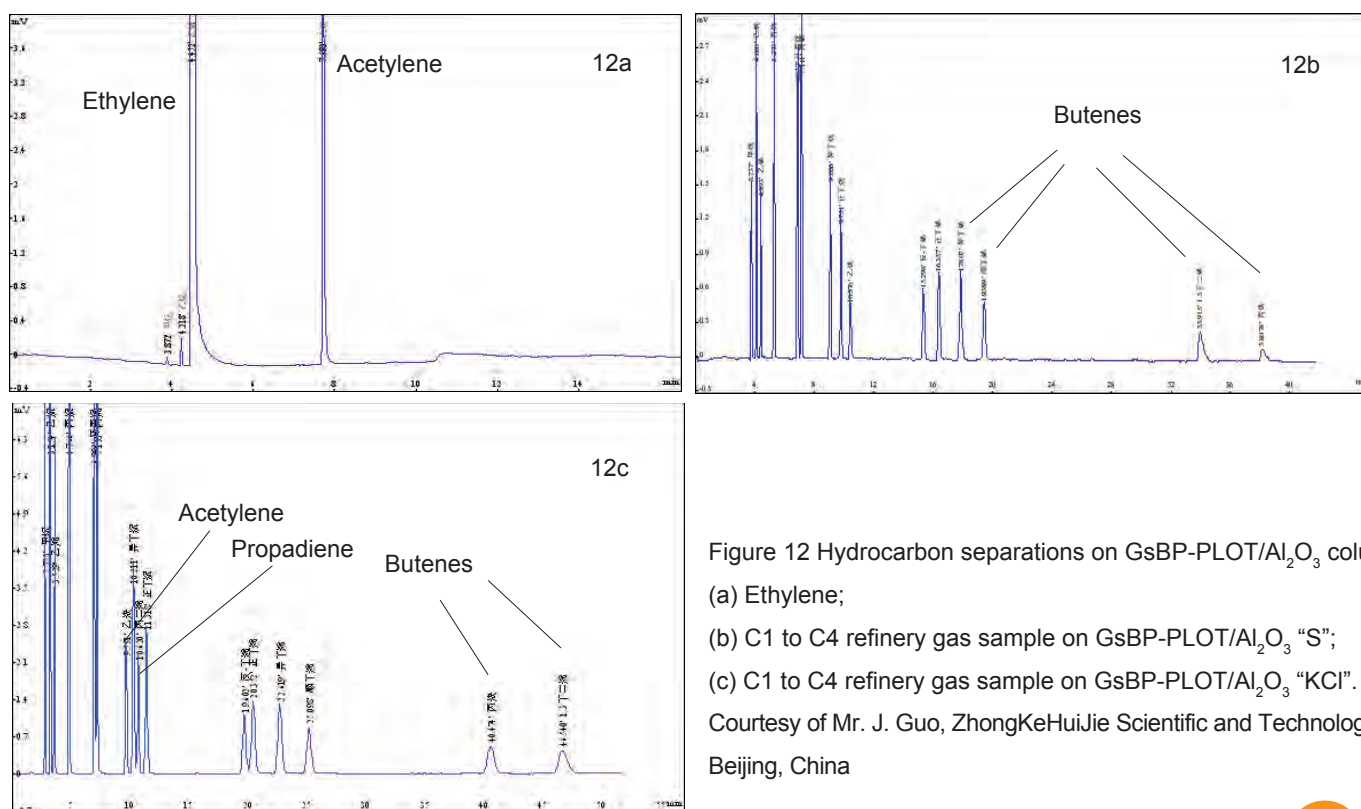


Figure 12 Hydrocarbon separations on GsBP-PLOT/ Al_2O_3 column.
(a) Ethylene;
(b) C1 to C4 refinery gas sample on GsBP-PLOT/ Al_2O_3 "S";
(c) C1 to C4 refinery gas sample on GsBP-PLOT/ Al_2O_3 "KCl".
Courtesy of Mr. J. Guo, ZhongKeHuiJie Scientific and Technologies,
Beijing, China

Figure 12a is an analysis of the impurities in ethylene by an GsBP-PLOT Al_2O_3 column at 100°C. The sample is 99% ethylene and 1% acetylene. Low levels of impurities of methane and ethane (around 1ppm) were detected at a temperature of 100°C. Excellent separations of the compounds were achieved. Figures 12b and 12c illustrate the separation of light hydrocarbons C1 to C4 on two types of GsBP-PLOT Al_2O_3 columns ("S" and KCl). The columns have slightly different column selectivities for C2 to C4 olefines. All C4 isomers were well resolved on both the "S" type column and the KCl type column.

(D) High Performances of Columns that are Challenging to Manufacture

GS-Tek has developed its own innovative and proprietary column manufacturing technology that enables GS-Tek to easily make many superior columns that are often difficult to make. Figure 13 demonstrates the exceptionally good particle immobilization of GsBP-PLOT Q columns. In this programmable run, the GsBP-PLOT Q column was quickly heated to 300°C at 15°C/min. Its baseline exhibited no spiking, which is often caused by particles dislodging from column coatings. Baseline spiking often interferes with analyte peaks.

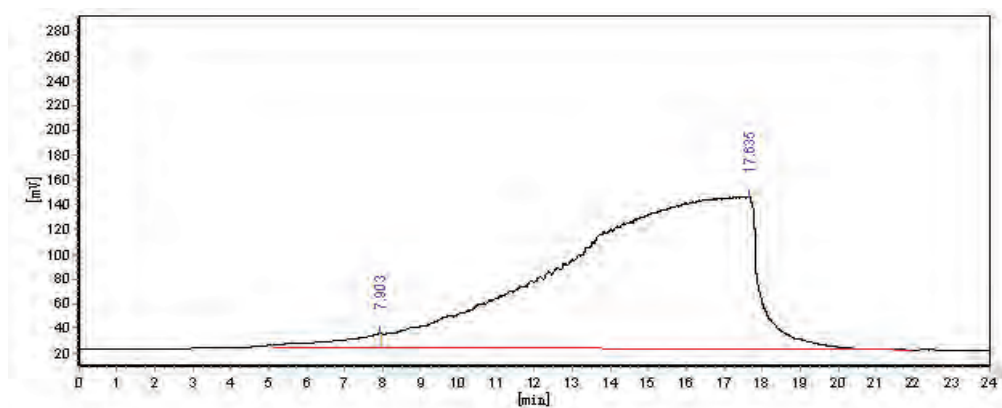


Figure 13 Baseline of GsBP-PLOT Q column from a temperature run

Column: 0.32mm x 30m x 15 μ m (p/n 8632-3015) Oven: 60°C (1min) 15°C/min to 300°C (5min)

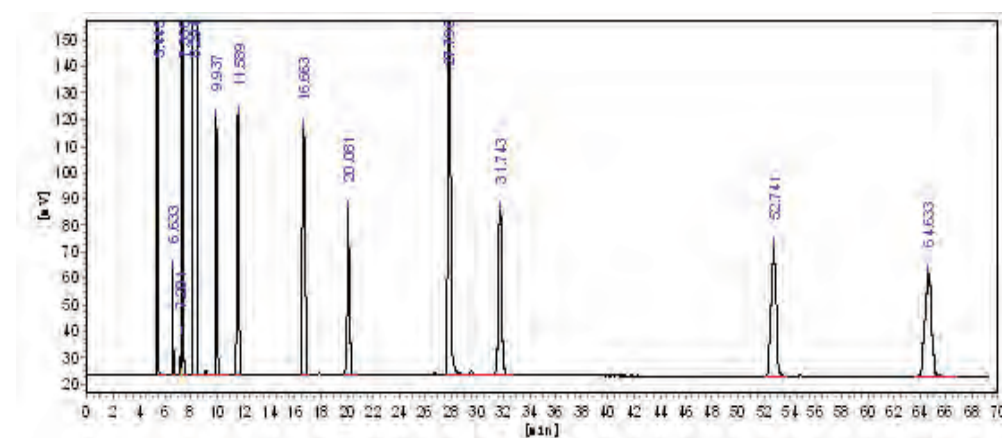
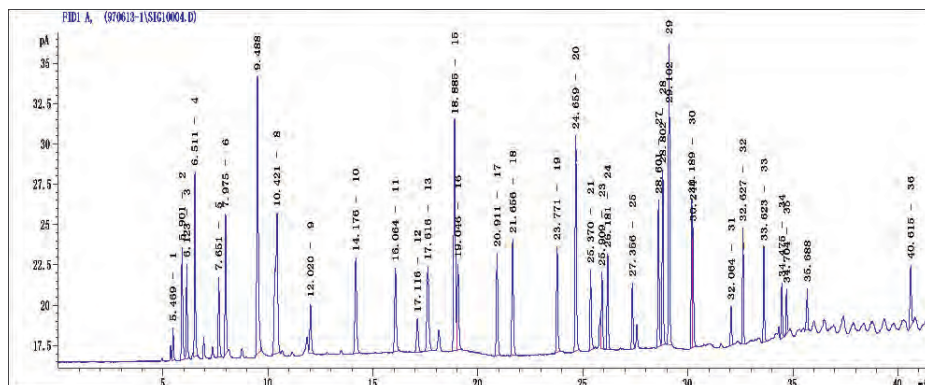


Fig 14a, Test chromatogram of GsBP-624, 105m x 0.53mm x 3 μ m.



This run is with Entech 7100 + GC/FID

Inlet : 150 °C

Carrier gas: He 1.5mL/min

Detector : FID 200°C

Temperature program : 35°C stay 5 min then increasing with 3°C/min to 200°C then keeping 5 min.

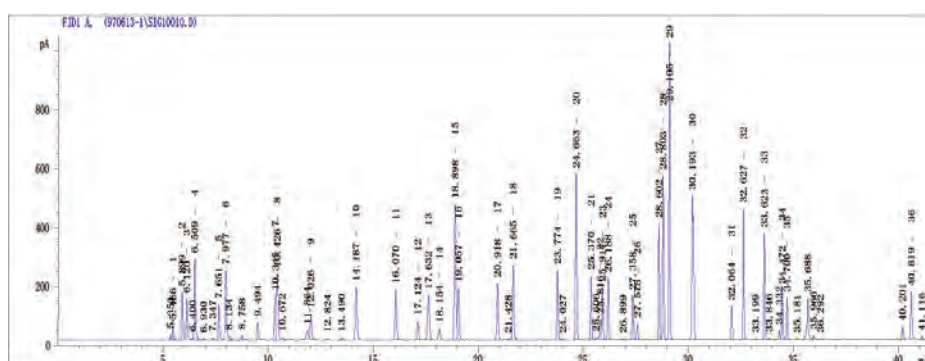


Figure 14 VOC separations on GsBP-624 columns.

(a) Test chromatogram of GsBP-502.2, 0.53mm x 105m x 3µm; (b) Purge/trap-GC, 10mL purging volume; (c) Purge/trap-GC, 400mL purging volume. (b) and (c) : Courtesy of Mr. Wei Peng Cheng, Systematic Instrumentation Company, Taipei, Taiwan, ROC

Figure 14a illustrates another example of a column that is challenging to manufacture, GsBP502.2 (0.53mm x 105m x 3µm). This column is widely used in VOC analysis. Because of better column coating uniformity and column inertness, isopropyl alcohol, pyridine and chlorobenzene peaks exhibit excellent symmetry and sharp peak shapes. GsBP-624 columns also have very low column bleeds. This makes the columns suitable for programmable temperature runs for a wide range of VOCs, as shown in Figure 14b (10ml purging volume) and Figure 14c (400mL purging volume). This analysis was done on an Entech purge/trap instrument.

(E) Competitive Price and Complete Offer

GS-Tek manufactures a large variety of GC columns, from non-polar and mid-polar stationary phases, to PEG and PLOT stationary phases. The columns' dimensions range from 0.20mm to 0.53mm, 1m to 150m, and 0.05µm to 50µm. Table V shows the complete array of GsBP GC columns available and the columns' approximate or exact replacements of their respectful brand name columns. GS-Tek also manufactures non-standard custom-made columns which have very competitive prices and especially short production times.

All GsBP GC columns are offered at very competitive prices. Competitive price offers and high quality replicating performances make GsBP GC columns the best value columns in the world, and gainful replacements of brand name columns from seamless column switching.

GC columns, GS-Tek is Best!

GS-Tek Column Offer

GsBP Phase	Composition	Polarity	Approximate Temperature Limits °C	Similar Phases to Replace
GsBP-1, GsBP-1MS	100% Dimethylpolysiloxane	non-polar	from -60 to 325/350	DB-1, HP-1, DB-1MS, HP-1MS, Ultra-1, Rtx-1, ZB-1, BP-1, SPB-1, CP-Sil 5CB
GsBP-5, GsBP-5MS	5% Diphenyl 95% Dimethylpolysiloxane	non-polar	from -60 to 325/350	DB-5, HP-5, DB-5MS, HP-5MS, Ultra-2, Rtx-5, ZB-5, BP-5, SPB-5, CP-Sil 8CB
GsBP-1301	6% Cyanopropyl-phenyl 94% Dimethylpolysiloxane	mid-polar	from -20 to 280/300	HP-1301, DB-1301, ZB-1301, BP-10, Rtx-1301
GsBP-35MS	35% Phenyl backbone 65% Dimethylpolysiloxane	mid-polar	from 40 to 320/340	HP-35MS, DB-35MS, ZB-35, BPX-35, AT-35, Rtx-35, SPB-35
GsBP-1701	14% Cyanopropyl-phenyl 86% Dimethylpolysiloxane	mid-polar	from -20 to 280/300	DB-1701, ZB-1701, BP-10, Rtx-1701, CP-Sil 19CB
GsBP-50+	50% Diphenyl 50% Dimethylpolysiloxane	mid-polar	from 40 to 320/340	HP-50+, DB-17, DB-17MS, ZB-17, BPX-50, AT-50, Rtx-50, SPB-50
GsBP-502.2	Proprietary phase	mid-polar	from 0 to 260	DB-VRX, HP-VOC, Rtx-VRX, HP-624
GsBP-624	6% Cyanopropyl-phenyl 94% Dimethylpolysiloxane	mid-polar	from -20 to 280/300	DB-624, ZB-624, AT-624, Rtx-624, CP-624
GsBP-InoWax	Polyethylene Glycol	polar	from 40 to 260/280	HP-INNOWax, DB-WAX, DB-WAXetr, Supelco WAX 10, CB-WAX, AT-Wax, HP-20M
GsBP-Carbowax 20M	Polyethylene Glycol	polar	from 60 to 220	HP-20M, DB-CAM
GsBP-FFAP	Polyethylene Glycol, acid modified	polar	from 40 to 260	HP-FFAP, DB-FFAP, CB-WAX 58(FFAP)CB, BP-21, AT-100
GsBP-PLOT Molesieves	Molecular sieves, zeolite, 5A	n/a	from -80 to 300	HP-PLOT Molesieve, CP-Plot MolSieve
GsBP-PLOT Al ₂ O ₃ KCl	KCl modified Alumina	less selective	from -80 to 200	HP-PLOT Al ₂ O ₃ /KCl, GS-Alumina/KCl, CP-Al ₂ O ₃ /KCl PLOT
GsBP-PLOT Al ₂ O ₃ Na ₂ SO ₄	Na ₂ SO ₄ modified Alumina	selective	from -80 to 200	HP-PLOT Al ₂ O ₃ /"S", GS-Alumina, CP-Al ₂ O ₃ /Na ₂ SO ₄ PLOT, RT-Alumina
GsBP-PLOT Al ₂ O ₃ M	Na ₂ MoO ₄ modified Alumina	more selective	from -80 to 200	HP-PLOT Al ₂ O ₃ /"M", GS-Alumina
GsBP-PLOT Q	Divinylbenzene polymer	non-polar	from -80 to 280/300	HP-PLOT Q, GS-Q, CP-PoraPLOT Q HT, Rt-Q
GsBP-PLOT U	Divinylbenzene ethylene glycol	polar	from -80 to 190/200	HP-PLOT U, CP-PoraPLOT U
GsBP-PLOT GasPro	Dimethacrylate copolymer Proprietary Porous Silica	n/a	from -80 to 260/300	GS-GasPro, CP-Silica PLOT

Column Cat No of Nor xxid-llµm

	Column Phase / xx	Column ID / id	Length / ll	FilmThickness / µm	Cat No.
Code	15	25	30	25	1525-3002
Description	GsBP-5MS	0.25mm	30m	0.25µm	

Details of Nomenclature

Stationary Phase	xx	Column Length (meter)	ll	Film Thickness (µm)	µm
GsBP-1	01	1	01	0.1	01
GsBP-1MS	11	2	02	0.11	01
GsBP-5	05	5	05	0.17	01
GsBP-5MS	15	7.5	07	0.2	02
GsBP-35MS	35	10	10	0.25	02
GsBP-50+MS	50	12.5	12	0.3	03
GsBP-1301	60	15	15	0.33	03
GsBP-1701	61	20	20	0.4	04
GsBP-624	62	25	25	0.5	05
GsBP-INOWAX	20	30	30	0.52	05
GsBP-FFAP	21	35	35	0.88	08
GsBP-CarboWax 20M	22	40	40	1	10
GsBP-PLOT Al ₂ O ₃ "KCL"	81	50	50	1.05	10
GsBP-PLOT Al ₂ O ₃ "S"	82	60	60	1.12	11
GsBP-PLOT Al ₂ O ₃ "M"	83	75	75	1.33	13
GsBP-PLOT MoleSieve	84	90	90	1.4	14
GsBP-PLOT GasPro	85	100	A0	1.5	15
GsBP-PLOT Q	86	105	A5	1.8	18
GsBP-PLOT U	87	120	2A	2	20
Bare Tubings	90	customized length	actual length	2.65	26
Deactivated tubing	91			3	30
GsBP-PONA, 50m version	9002-PONA			4	40
GsBP-PONA, 100m version	9006-PONA			5	50
Customized phases	9xx			customized	actual

Special film thickness(µm) code for PLOTs	µm
5	05
10	10
15	15
20	20
25	25
30	30
40	40
50	50
customized thickness	actual µm

Column ID (mm)	id
0.2	20
0.25	25
0.32	32
0.53	53