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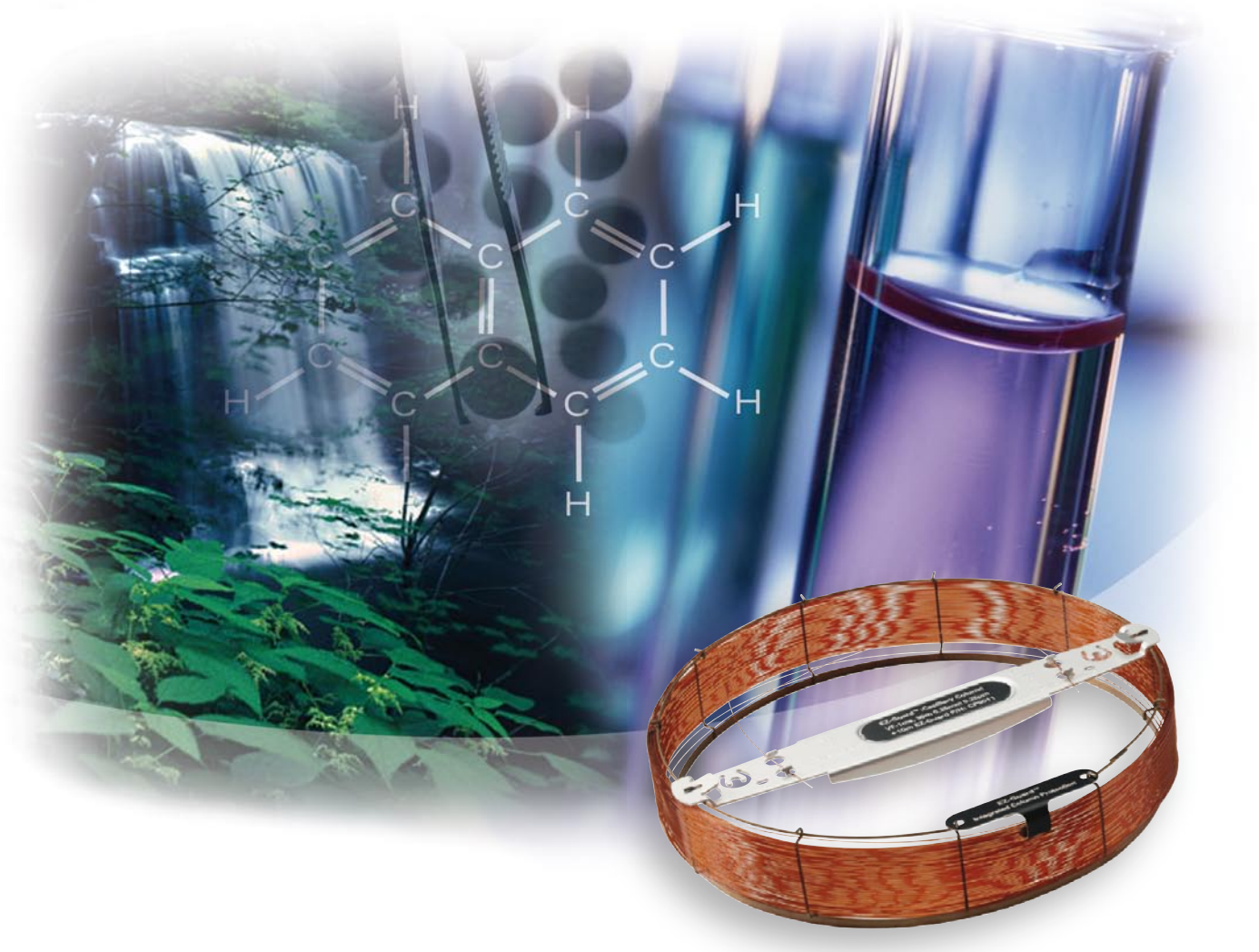
Agilent Technologies



# FactorFour™

## HIGH PERFORMANCE CAPILLARY GC COLUMNS



# High Performance Capillary Columns for GC

FactorFour™ (VF) is a comprehensive line of high performance capillary gas chromatography (GC) columns from Varian, Inc. FactorFour columns are manufactured from the highest quality materials with the most detailed specifications across the product range to ensure reproducibility, ultra low bleed and high inertness for quality chromatography. Such high performance columns can routinely be used with confidence in all areas of GC and GC/MS analysis.

- **Environmental**
- **Toxicology**
- **Clinical Research**
- **Industrial**
- **Chemical**
- **Pharmaceutical**
- **Foods, Beverages, Flavors**

In addition to standard column dimensions, FactorFour columns have an extended range of 0.15 mm ID columns designed to reduce run times by half and to increase throughput. An added advantage is that there is no requirement for new hardware or additional capital equipment purchases.

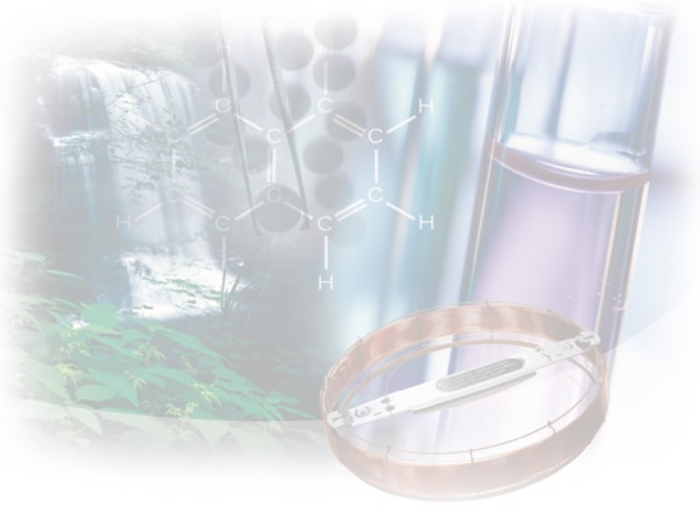
High quality consumables from Varian contribute to the superior quality and performance of FactorFour columns. These include EZ-Guard™ columns, Gas Clean Filters and EZ-GRIP™ for easy column handling. Turn to page 18 for more details.

With over 50 years' experience and expertise in analytical analysis, Varian is the perfect GC column partner, offering quality products, method development, training, applications and product support.

Utilizing advanced proprietary manufacturing techniques, the FactorFour range provides highly inert, ultra-low bleed GC columns which offer low background and high signal to noise ratios and minimal peak tailing. These combine to offer superior performance for routine or trace analysis for all GC detectors.

To meet every application and selectivity requirement, FactorFour columns are available in a variety of general and application specific phases. All the benefits of high performance, low bleed and quality inertness are built into each FactorFour column.

| Advantages | Benefits |
|---|---|
| • Higher signal to noise ratios<br>• Lower detection limits<br>• More accurate peak identification | Greater analytical accuracy – the right result first time |
| • Extended column lifetimes<br>• Faster column installation<br>• Less detector contamination | Reduced costs and instrument downtime |
| • Higher sample throughput<br>• Faster sample turnaround | Increased productivity – analyze more samples in less time |



## Varian's GC Pedigree... Timeline of GC Column Development

| 1969 | 1977 | 1980 | 1982 | 1983 |
|---|---|---|---|---|
| First packed GC column manufactured | First glass capillary column manufactured | First PLOT column manufactured | First Chemically Bonded (CB) column manufactured | Start drawing own fused silica<br>Commercial introduction of $Al_2O_3$/KCl PLOT column<br>First 100 µm capillary column manufactured |

VARIAN, INC.

# Columns Targeted to Your Application...

FactorFour columns have been designed specifically to provide the highest quality GC separations across the broadest range of compounds of interest, from environmental to clinical toxicology applications. Applications support is readily available across the spectrum of compounds to assist with your analyses.

A new Chromatography and Spectroscopy Applications Database - ScanView™, version 8.1 - is available on CD or from Varian's Web site.


| FactorFour | Applications | Page No. |
|---|---|---|
| NEW! VF-5 Pesticides | Pesticides. | 7 |
| NEW! VF-1701 Pesticides | | 7 |
| VF-1ms | Alcohols, aromatic hydrocarbons, esters, flavors and aromas, free fatty acids, halogenated hydrocarbons, hydrocarbons, ketones, organic acids, oxygenates, PAHs, pesticides, polymers, steroids, solvents and sulfur compounds. | 8 |
| VF-5ms | Alcohols, amines, aromatic hydrocarbons, bile acids, drugs, EPA methods, esters, flavors and aromas, glycerides, halogenated compounds, herbicides, hydrocarbons, organic acids, oxygenates, PAHs, PCBs, pesticides, phenols, polymers, prostaglandin solvents, steroids, sterols, sugars and sulfur compounds. | 9 |
| VF-5ht | High boiling mixtures, incl. long chain hydrocarbons, polymers, plastics, waxes, heavy PAHs, tars, triglycerides, motor oils, surfactants, crown ethers and other compounds requiring high temperature separation. | 10 |
| VF-Xms | Pesticides, herbicides, PCBs and PAHs. | 11 |
| VF-624ms | Purgeable organic volatiles & semi-volatiles, aromatics, hydrocarbons and solvents. | 12 |
| VF-1301ms | Pesticides, PCBs and other organic compounds requiring thin films. | 12 |
| VF-1701ms | Organic compounds in drinking water: EPA 524.2; base/neutrals and acids: EPA 625; PCBs, PCBs and chlorinated pesticides: EPA 508, 608, 808, 8082; organophosphorus pesticides and herbicides: EPA 507, 8081, 8140/8141, 8151. | 13 |
| VF-35ms | Aromatic compounds, pesticides and herbicides, sterols and other substituted aromatic compounds. | 14 |
| VF-17ms | Antidepressants, herbicides and pesticides, ideal confirmation column for EPA methods. | 15 |
| VF-200ms | Ketones, aldehydes, nitro- or chloro-containing compounds, PAHs, unsaturated compounds, silanes and CFCs. | 16 |
| VF-23ms | Fatty acid methyl esters (FAME), solvents and sugars. | 17 |
| NEW! VF-WAXms | Food, fragrances, flavors, beverages, FAMEs, acids, alcohols and aromatics. | 20-21 |

| 1985 | 1987 | 1991 | 1998 | 2002 – 2007 |
|---|---|---|---|---|
| Molsieve PLOT column introduced | CP-PoraPLOT™ Q column introduced<br>ScanView applications database introduced | UltiMetal™ columns launched | CP-PoraBOND Q™ columns introduced | FactorFour columns launched |

# Improving Column Quality Through Varian's Advanced Manufacturing

To successfully manufacture high quality capillary GC columns, all aspects of column manufacturing and quality testing must be carefully controlled. In addition to starting with the highest quality fused silica available, every manufacturing step is performed in Varian's state of the art GC manufacturing facility with Varian manufactured raw materials. This level of control ensures the highest reproducibility and quality.

With high performance FactorFour columns, Varian developed their expertise in successful GC column production still further, designing the lowest bleed, most inert, capillary GC columns available.

## Testing to Ensure Performance

Varian's stringent performance specifications are your guarantee of column to column and batch to batch reproducibility.

Ensuring column to column reproducibility is the key to a rugged analytical method.

**Performance tests**

| | |
|---|---|
| **Bleed** | pA at maximum operating temperature |
| **Inertness** | Peak asymmetry |
| **Efficiency** | Plates/meter - N/M |
| **Reproducibility** | |
| Retention Index | Column selectivity and elution order reproducibility |
| Phase Ratio | Retention time reproducibility |

Varian GC columns are produced to exacting ISO 9001:2000 certified procedures.

Comparison of Retention Index

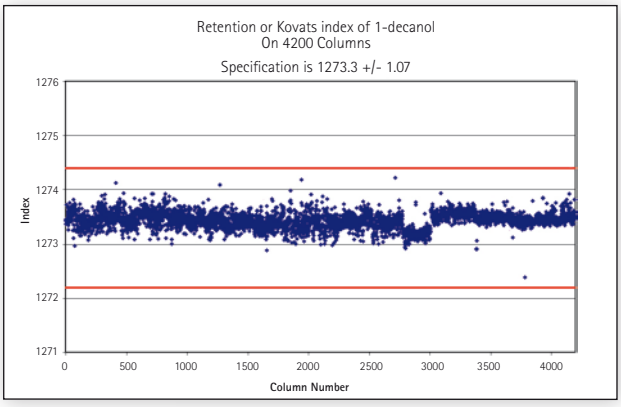



Figure 1 shows the extremely small variation of RI over 4200 columns

The Retention Index (RI) is the measure of column selectivity, and indicates the elution order of compounds. From column to column, the RI variation of Varian columns is very small, thus ensuring a reproducible elution order. By setting tight specifications on the RI, Varian ensures that the reproducibility is the highest possible, ensuring that your Varian column works the same for each analysis.

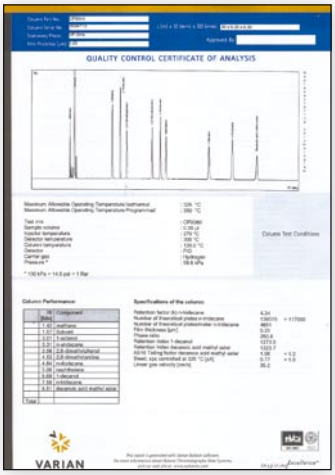



Figure 2 shows the quality control Certificate of Analysis

# The Benefits of Low Bleed and High Inertness

FactorFour columns offer many performance advantages, resulting in higher throughput, therefore increasing efficiency and reducing costs.

## Highest Sensitivity

The ultra-low bleed specification of FactorFour columns minimizes detector background noise and provides increased sensitivity and improved signal to noise ratios. Optimal performance of sensitive and selective detection systems is therefore achievable.

Comparison of Vendor A and FactorFour VF-5ms

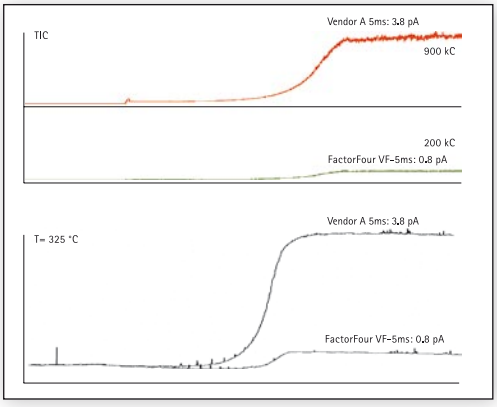



Figure 1 demonstrates how FactorFour bleed rates are up to 4x lower than a column from another vendor.

## Reduced Costs & Maintenance

FactorFour applications are not limited to MS detectors. Virtually every type of detector will operate with greater stability due to the low bleed of FactorFour columns. Minimizing detector contamination avoids time-consuming maintenance.

Reduced Detector Contamination with FactorFour Low Bleed Columns

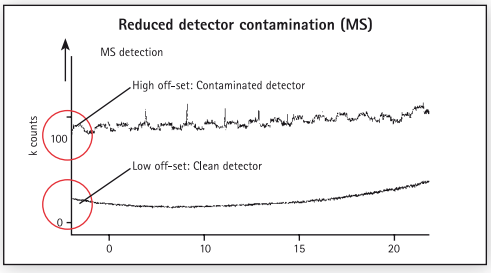



Figure 2 shows a detector contaminated by a well known MS grade capillary column compared to a detector which is uncontaminated by a low bleed FactorFour column.

Improved Trace Analysis with Varian's Low Bleed Columns

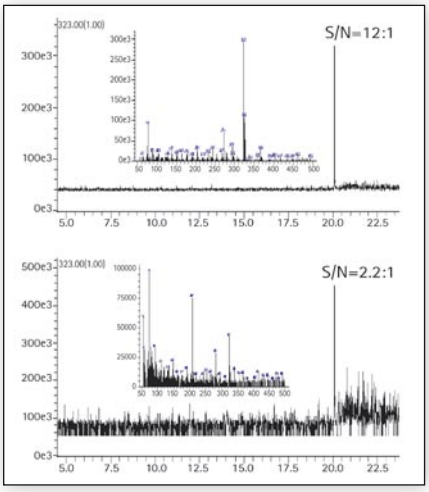



Figure 3. In this MS comparison, Varian's low bleed FactorFour VF-5ms column (top) shows a 5 fold increase in signal to noise vs. a similar column from another vendor (bottom) and quantification at trace levels is improved.

## Greater Accuracy & Reliability

In addition to low bleed, FactorFour columns utilize proprietary surface deactivation techniques for high column inertness. High inertness prevents compound peak tailing, affecting critical pair separation. Inert GC columns minimize the loss or degradation of compounds on the column surface.

FactorFour Columns Show Higher Inertness

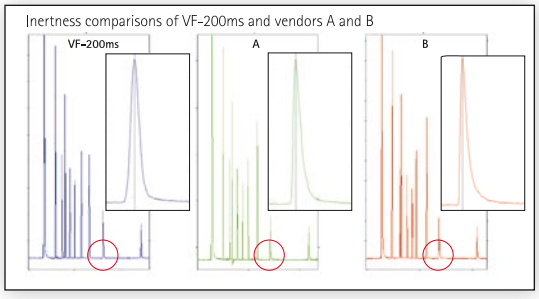



Figure 4 shows a comparison of inertness between the VF-200ms and comparable columns from vendors A and B. VF-200ms offers superior peak symmetry for the polar 1-decanol standard.

# VF 0.15 mm ID - Double Your Sample Throughput!

## Higher Throughput, Reduced Analysis Times, Increased Sensitivity

- Double your throughput
- Faster sample turnaround
- Increase sensitivity
- Simple and inexpensive

Compared to traditional 0.25 and 0.32 mm ID columns, 0.15 mm ID FactorFour columns enable you to halve your analysis times and increase sensitivity. FactorFour 0.15 mm ID columns are suitable for all users for whom high throughput, faster sample turnaround time and economy are essential. In particular, contract laboratories in environmental, clinical toxicology and petrochemical industries will benefit from increased productivity and reduced costs.

Dramatically Reduce Analysis Times!

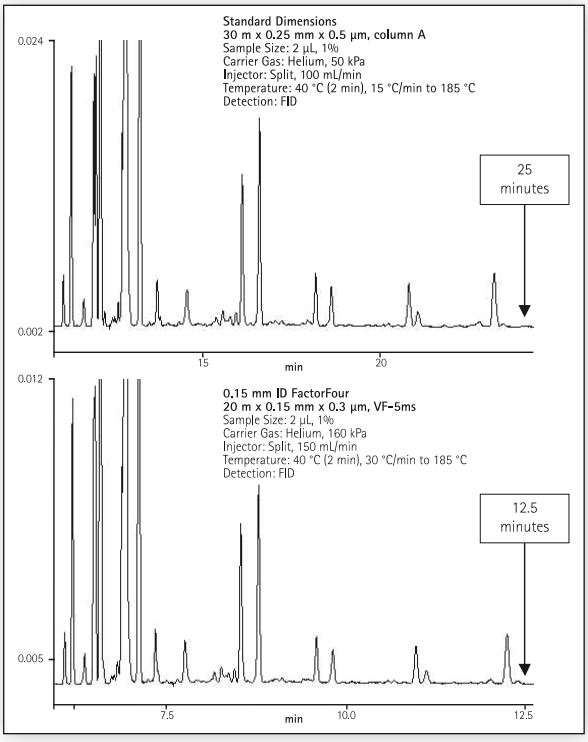



Figure 1 shows a 50% reduction in analysis time when a 0.25 mm ID column is replaced by an 0.15 mm ID column. The elution order remains the same.

## Increased Sensitivity

The combination of the reduced quantity of phase and FactorFour ultra-low bleed technology ensures up to 3-fold increase in sensitivity, ideal for laboratories performing trace analysis.

FactorFour 0.15 mm ID columns are available for the majority of phases, covering a wide range of applications. Select from:

| | | | |
|---|---|---|---|
| VF-1ms | VF-5ms | VF-Xms | VF-624ms |
| VF-1301ms | VF-1701ms | VF-35ms | VF-17ms |
| VF-200ms | VF-23ms | VF-WAXms | |

## Easy Method Transfer using Existing Instrumentation

There are just Three Easy Steps to faster analysis with superior sensitivity:

**1.** Increase temperature program rate by a factor of 1.6 - 2.0

**2.** Increase pressure by a factor of 2

**3.** Reduce sample amount loaded onto the column by a factor of 4, by either increasing the split flow or by injecting a smaller amount of sample

Elution orders remain the same, thereby eliminating time-consuming method redevelopment. The only difference is that the peaks appear in half the time.

Furthermore, FactorFour 0.15 mm ID columns are compatible with all known GC and GC/MS hardware, therefore you can halve your analysis time while using your existing instrumentation.

For ease of use, 0.15 mm ID columns from Varian use the same ferrules as conventional 0.25 mm ID columns.

Reduced Background Noise with FactorFour 0.15 mm ID Columns

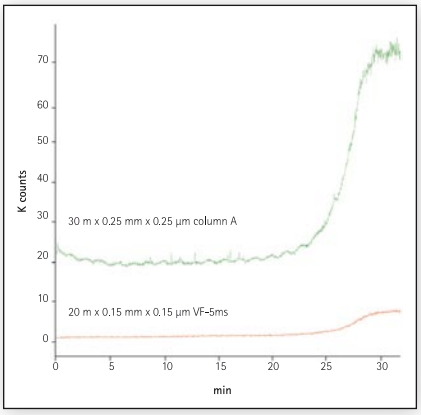
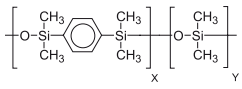



Figure 2 illustrates the ultra-low background noise of a VF-5ms 0.15 mm ID column compared to a conventional 0.25 mm ID column A. Ultra-low background noise enables optimal performance from all sensitive and selective detection systems, offering increased sensitivity. Data courtesy of Dr. Stéphane Bouchonnet of l'Ecole Polytechnique, France

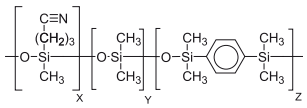
VARIAN, INC.

# NEW! VF-Pesticides FactorFour™ Columns For Pesticide Residue Analysis at Pico Gram Levels

VF-5 Pesticides



VF-1701 Pesticides



The new FactorFour VF-Pesticides columns have been specifically designed for analyzing trace levels of pesticide residues.

- Each column is individually tested with key pesticides, including endrin and aldrin, before shipment, ensuring optimal performance and consistency of results
- Columns are highly inert for trace pesticide determination, affording better detection limits
- Columns are ultra-low bleed
- Proven performance with ECD and MS detection

Analyses at extremely low, trace level concentrations are easy with the new VF-Pesticides columns, regardless of whether your method specifies ECD or MS detection.

VF-Pesticides columns benefit from ultra-low bleed FactorFour technology to improve sensitivity. The VF-1701 Pesticides column demonstrates up to 8x lower bleed than other columns used for pesticide analysis, as shown in Figure 1.

Bleed comparison of the new VF-1701 Pesticides column and an alternative pesticides column.

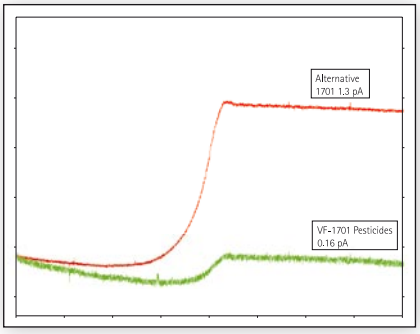


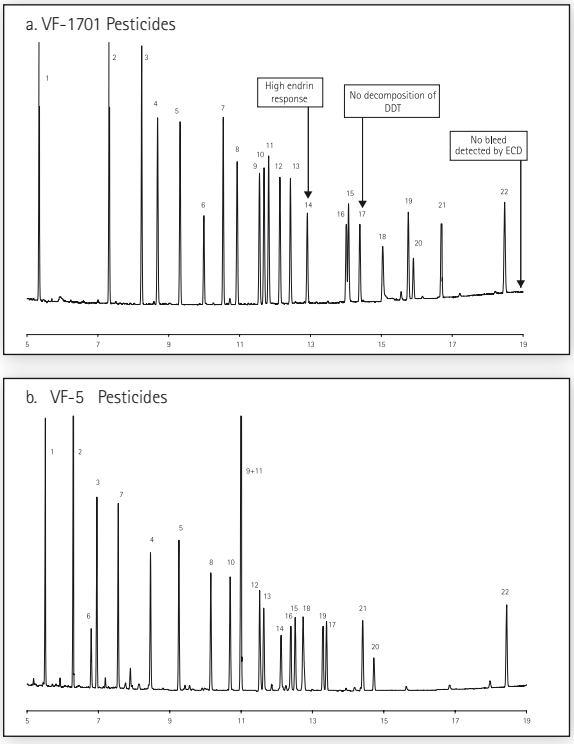

Figure 1. The VF-1701 Pesticides column shows an 8x lower bleed than an alternative 1701 column.

Column: VF-1701 Pesticides 0.25 mm x 30 m x 0.25 µm
Temperature: 100 °C + 10 °C / min -> 280 °C
Detector: FID

## Typical Application Areas

Pesticide residues in food and environmental samples, including EPA methods 8081 and 625.

Analysis of Pesticides using EPA 8081 with ECD.




Peak Identification

1. 2,4,5,6-tetrachloro-m-xylene
2. α-BHC
3. γ-BHC
4. Heptachlor
5. Aldrin
6. β-BHC
7. δ-BHC
8. Heptachlor epoxide
9. Endosulfan I
10. γ-chlordane
11. α-chlordane
12. 4,4'-DDE
13. Dieldrin
14. Endrin
15. 4,4'-DDD
16. Endosulfan II
17. 4,4'-DDT
18. Endrin aldehyde
19. Endosulfan sulfate
20. Methoxychlor
21. Endrin ketone
22. Decachlorobiphenyl

Figure 2 illustrates a dual column configuration using VF-Pesticides columns which combine excellent inertness with ultra low bleed to enable fast and accurate determination of endrin and DDT at 3 pg levels.

Column: a. VF-1701 Pesticides 30 m x 0.32 mm x 0.25 µm (pn: CP9071)
b. VF-5 Pesticides 30 m x 0.32 mm x 0.25 µm (pn: CP9075)
Sample Size: 0.5 µL, 6 ng/mL
Carrier Gas: Helium, 150 kPa
Injector: Split/Splitless, in splitless mode, T=250 °C
Temperature: 60 °C (hold 30 sec) -> 150 °C @ 50 °C / min -> 275 °C @ 8 °C / min
Detector: ECD, T=325 °C

## Ordering Information

**VF-5 Pesticides** TMax-Iso/Prog 325/350 °C, TMin -60 °C

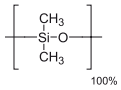
| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry p,p'-DDT | N/M |
|---|---|---|---|---|---|---|
| CP9074 | 0.25 | 30 | 0.25 | 1.00 | 1.25 | 3500 |
| CP9075 | 0.32 | 30 | 0.25 | 1.00 | 1.25 | 2667 |

**VF-1701 Pesticides** TMax-Iso/Prog 280/300 °C, TMin -20 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry p,p'-DDT | N/M |
|---|---|---|---|---|---|---|
| CP9070 | 0.25 | 30 | 0.25 | 1.00 | 1.25 | 3500 |
| CP9071 | 0.32 | 30 | 0.25 | 1.00 | 1.25 | 2667 |

# VF-1ms - The Non-Polar FactorFour™ Column

VF-1ms




VF-1ms is a highly inert, non-polar, low bleed FactorFour GC column for increased sensitivity for a wide range of applications.

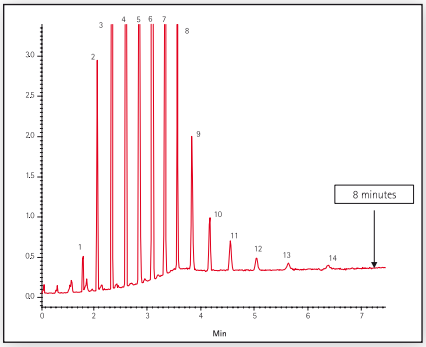
- 100% dimethylpolysiloxane guaranteed low bleed phase
- Non-polar
- Lowest guaranteed bleed specification of 1 pA @ 325 °C (0.25 mm x 30 m x 0.25 µm)
- Suitable for a wide range of applications.

FactorFour columns from Varian provide all the benefits of the lowest bleed specifications.

## Typical Application Areas

Alcohols, aromatic hydrocarbons, esters, flavors and aromas, free fatty acids, halogenated hydrocarbons, hydrocarbons, ketones, organic acids, oxygenates, PAHs, pesticides, polymers, steroids, solvents and sulfur compounds.

Triglycerides C28-C54




Peak Identification
1. Tri-C28
2. Tri-C30
3. Tri-C32
4. Tri-C34
5. Tri-C36
6. Tri-C38
7. Tri-C40
8. Tri-C42
9. Tri-C44
10. Tri-C46
11. Tri-C48
12. Tri-C50
13. Tri-C52
14. Tri-C54

Figure 1 shows superior low bleed performance for the VF-1ms, even when used above the recommended operating temperature. At an operating temperature of 375 °C, FactorFour still provides excellent stability and signal to noise ratios.

Column: VF-1ms 0.25 mm x 15 m x 0.25 µm (pn: CP8907)
Carrier Gas: Helium, 2 mL/min
Injector: Split 1:10, T=340 °C
Temperature: 250 °C to 375 °C, 35 °C
Detection: MS-1200L Triple Quad operated in single quad mode

## Ordering Information

**VF-1ms** TMax-Iso/Prog 325/350 °C, TMin -60 °C

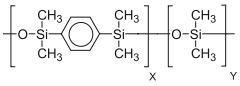
| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP5881 | 0.15 | 15 | 0.15 | 0.50 | 1.24 | 5670 |
| CP8900 | 0.10 | 10 | 0.10 | 0.50 | 1.3 | 8500 |
| CP8901 | 0.10 | 10 | 0.40 | 0.50 | 1.1 | 6750 |
| CP8902 | 0.10 | 20 | 0.10 | 0.50 | 1.3 | 7500 |
| CP8903 | 0.10 | 20 | 0.40 | 0.50 | 1.2 | 6000 |
| CP9030 | 0.15 | 10 | 0.15 | 0.50 | 1.2 | 6050 |
| CP9031 | 0.15 | 20 | 0.15 | 0.50 | 1.3 | 6050 |
| CP9032 | 0.15 | 20 | 0.60 | 1.50 | 1.1 | 5100 |
| CP9033 | 0.15 | 40 | 0.60 | 3.00 | 1.1 | 5750 |
| CP8904 | 0.20 | 12 | 0.33 | 1.00 | 1.2 | 4750 |
| CP8905 | 0.20 | 25 | 0.33 | 1.25 | 1.2 | 4800 |
| CP8906 | 0.25 | 15 | 0.10 | 0.50 | 1.3 | 4100 |
| CP8907 | 0.25 | 15 | 0.25 | 0.50 | 1.3 | 4000 |
| CP8908 | 0.25 | 15 | 1.00 | 2.00 | 1.1 | 3400 |
| CP8909 | 0.25 | 25 | 0.25 | 1.00 | 1.3 | 4000 |
| CP8910 | 0.25 | 25 | 0.40 | 1.40 | 1.2 | 3900 |
| CP8911 | 0.25 | 30 | 0.10 | 0.75 | 1.4 | 4100 |
| CP8912 | 0.25 | 30 | 0.25 | 1.00 | 1.3 | 4000 |
| CP8913 | 0.25 | 30 | 1.00 | 4.00 | 1.1 | 3400 |
| CP8914 | 0.25 | 50 | 0.25 | 2.00 | 1.3 | 4000 |
| CP8915 | 0.25 | 50 | 0.40 | 2.70 | 1.2 | 3900 |
| CP8916 | 0.25 | 60 | 0.25 | 2.13 | 1.3 | 4000 |
| CP8917 | 0.25 | 60 | 1.00 | 8.00 | 1.1 | 3400 |
| CP8918 | 0.32 | 15 | 0.10 | 0.50 | 1.3 | 3200 |
| CP8919 | 0.32 | 15 | 0.25 | 0.50 | 1.3 | 3100 |
| CP8920 | 0.32 | 15 | 1.00 | 2.60 | 1.1 | 2650 |
| CP8921 | 0.32 | 25 | 0.25 | 1.00 | 1.3 | 3100 |
| CP8922 | 0.32 | 25 | 0.40 | 2.13 | 1.2 | 3050 |
| CP8923 | 0.32 | 30 | 0.10 | 0.75 | 1.4 | 3200 |
| CP8924 | 0.32 | 30 | 0.25 | 1.00 | 1.3 | 3100 |
| CP8925 | 0.32 | 30 | 0.50 | 2.60 | 1.2 | 3000 |
| CP8926 | 0.32 | 30 | 1.00 | 5.00 | 1.1 | 2650 |
| CP8927 | 0.32 | 50 | 0.25 | 2.25 | 1.3 | 3100 |
| CP8928 | 0.32 | 50 | 0.40 | 4.79 | 1.2 | 3050 |
| CP8929 | 0.32 | 60 | 0.25 | 2.25 | 1.3 | 3100 |
| CP8930 | 0.32 | 60 | 1.00 | 10.00 | 1.1 | 2650 |
| CP8965 | 0.53 | 15 | 0.50 | 3.50 | 1.3 | 1420 |
| CP8966 | 0.53 | 15 | 1.00 | 5.00 | 1.2 | 1420 |
| CP8967 | 0.53 | 15 | 1.50 | 10.00 | 1.1 | 1420 |
| CP8968 | 0.53 | 30 | 0.50 | 7.00 | 1.3 | 1700 |
| CP8969 | 0.53 | 30 | 1.00 | 10.00 | 1.2 | 1700 |
| CP8970* | 0.53 | 30 | 1.50 | 10.00 | 1.1 | 1700 |

*CP8970: TMax-Iso/Prog 310/335 °C, TMin -60 °C

VARIAN, INC.

# VF-5ms - General Purpose FactorFour™ Column

VF-5ms



VF-5ms is a highly inert, low bleed FactorFour GC column for increased sensitivity and accuracy for a wide range of applications.

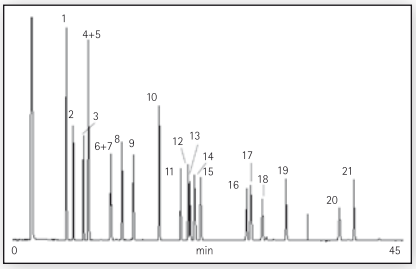
- Equivalent to 5% phenyl, 95% dimethylpolysiloxane low bleed phase
- Lowest guaranteed bleed specification of 1 pA @ 325 °C (0.25 mm x 30 m x 0.25 µm)

The VF-5ms has a slightly higher polarity than the VF-1ms, resulting in improved selectivity for aromatic compounds. This selectivity, combined with superior inertness, also makes these columns applicable for a wide range of semi-polar and even polar components, such as phenols.

## Typical Application Areas

Alcohols, amines, aromatic hydrocarbons, bile acids, drugs, EPA methods, esters, flavors and aromas, glycerides, halogenated compounds, herbicides, hydrocarbons, organic acids, oxygenates, PAHs, PCBs, pesticides, phenols, polymers, prostaglandin solvents, steroids, sterols, sugars and sulfur compounds.

High Resolution Phenol Analysis by GC/MS




Peak Identification
1. Phenol
2. 2-chlorophenol
3. o-cresol
4. m-cresol
5. p-cresol
6. 2-nitrophenol
7. 2, 4-dimethylphenol
8. 2, 4-dichlorophenol
9. 2, 6-dichlorophenol
10. 4-chloro-3-methylphenol
11. 2, 3, 5-trichlorophenol
12. 2, 4, 6-trichlorophenol
13. 2, 4, 5-trichlorophenol
14. 2, 3, 4-trichlorophenol
15. 2, 3, 6-trichlorophenol
16. 4-nitrophenol
17. 2, 4-dinitrophenol
18. 2, 3, 5, 6-tetrachlorophenol
19. 2-methyl-4, 6-dinitrophenol
20. Pentachlorophenol
21. 2-sec-butyl-4, 6-dinitrophenol

Figure 1 shows excellent baseline resolution of 21 phenols.

Column: VF-5ms 0.25 mm x 30 m x 0.25 µm (pn: CP8944)
Carrier Gas: Helium, 70 kPa
Injector: Split, 1:200, T=275 °C
Concentration Range: Approx. 5-10 ng per component on column
Detection: Varian Ion Trap MS

## Ordering Information

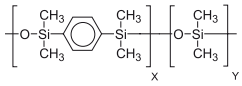
**VF-5ms** TMax-Iso/Prog 325/350 °C, TMin -60 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP8934 | 0.10 | 10 | 0.40 | 0.50 | 1.1 | 6750 |
| CP9034 | 0.15 | 10 | 0.15 | 0.50 | 1.2 | 6050 |
| CP9035 | 0.15 | 15 | 0.15 | 0.50 | 1.2 | 6050 |
| CP9036 | 0.15 | 20 | 0.15 | 0.50 | 1.2 | 6050 |
| CP9037 | 0.15 | 20 | 0.30 | 0.75 | 1.1 | 5700 |
| CP9038 | 0.15 | 20 | 0.60 | 1.50 | 1.1 | 5500 |
| CP9039 | 0.15 | 40 | 0.15 | 0.75 | 1.2 | 5625 |
| CP9040 | 0.15 | 40 | 0.60 | 3.00 | 1.1 | 5500 |
| CP8935 | 0.20 | 12 | 0.33 | 0.75 | 1.1 | 4750 |
| CP8936 | 0.20 | 25 | 0.33 | 1.00 | 1.1 | 4800 |
| CP8937 | 0.20 | 50 | 0.33 | 1.25 | 1.3 | 4500 |
| CP8938 | 0.25 | 15 | 0.10 | 0.50 | 1.3 | 4100 |
| CP8939 | 0.25 | 15 | 0.25 | 0.63 | 1.2 | 3900 |
| CP8940 | 0.25 | 15 | 1.00 | 2.00 | 1.1 | 3500 |
| CP8941 | 0.25 | 25 | 0.25 | 1.00 | 1.2 | 3900 |
| CP8942 | 0.25 | 25 | 0.40 | 1.40 | 1.1 | 3850 |
| CP8943 | 0.25 | 30 | 0.10 | 0.63 | 1.4 | 4100 |
| CP8944 | 0.25 | 30 | 0.25 | 1.00 | 1.2 | 3900 |
| CP8945 | 0.25 | 30 | 0.50 | 2.00 | 1.1 | 3800 |
| CP8946 | 0.25 | 30 | 1.00 | 4.00 | 1.1 | 3500 |
| CP8947 | 0.25 | 50 | 0.25 | 1.75 | 1.2 | 3900 |
| CP8948 | 0.25 | 60 | 0.10 | 1.25 | 1.5 | 4100 |
| CP8949 | 0.25 | 60 | 1.00 | 8.00 | 1.1 | 3500 |
| CP8950 | 0.32 | 15 | 0.10 | 0.50 | 1.3 | 3200 |
| CP8951 | 0.32 | 15 | 0.25 | 0.63 | 1.2 | 3050 |
| CP8952 | 0.32 | 15 | 1.00 | 2.60 | 1.1 | 2700 |
| CP8953 | 0.32 | 25 | 0.52 | 2.20 | 1.1 | 2950 |
| CP8954 | 0.32 | 30 | 0.10 | 0.63 | 1.4 | 3200 |
| CP8955 | 0.32 | 30 | 0.25 | 1.00 | 1.2 | 3050 |
| CP8956 | 0.32 | 30 | 0.50 | 2.60 | 1.1 | 2950 |
| CP8957 | 0.32 | 30 | 1.00 | 5.00 | 1.1 | 2700 |
| CP8958 | 0.32 | 50 | 0.25 | 2.00 | 1.2 | 3050 |
| CP8959 | 0.32 | 50 | 0.40 | 4.79 | 1.1 | 3000 |
| CP8960 | 0.25 | 60 | 0.25 | 2.00 | 1.2 | 3900 |
| CP8961 | 0.32 | 60 | 0.25 | 2.00 | 1.2 | 3050 |
| CP8962 | 0.32 | 60 | 1.00 | 10.00 | 1.1 | 2700 |
| CP8971 | 0.53 | 15 | 0.50 | 2.50 | 1.2 | 1800 |
| CP8972 | 0.53 | 15 | 1.00 | 4.00 | 1.1 | 1800 |
| CP8973 | 0.53 | 15 | 1.50 | 8.00 | 1.1 | 1700 |
| CP8974 | 0.53 | 30 | 0.50 | 5.00 | 1.2 | 1800 |
| CP8975 | 0.53 | 30 | 1.00 | 8.00 | 1.1 | 1800 |
| CP8976* | 0.53 | 30 | 1.50 | 8.00 | 1.1 | 1700 |

*CP8976: TMax-Iso/Prog 310/335 °C, TMin -60 °C

# VF-5ht - FactorFour™ Columns for High Temperature Analysis

VF-5ht



FactorFour VF-5ht columns have been designed specifically for high performance, high temperature analyses.

- Extended high temperature analysis
- High molecular weight selectivity
- Enhanced stability
- Enhanced detector performance

## Analysis up to 400 °C

The VF-5ht FactorFour column improves the analysis of high-boiling compounds by exhibiting low bleed, even at high temperatures. Based on ultra-low bleed FactorFour technology, the VF-5ht has a maximum operating temperature of 400 °C, providing unmatched selectivity, sensitivity and accuracy for the analysis of high molecular weight compounds.

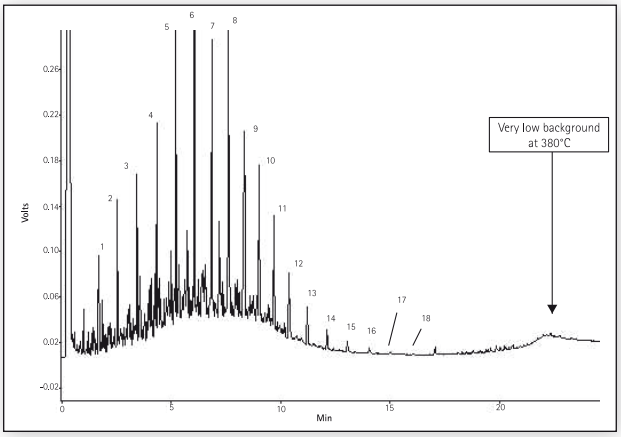
The VF-5ht is a stabilized equivalent of 5% phenyl methyl dimethylpolysiloxane, offering the same polarity as a VF-5ms. The difference is that while it can be operated at higher temperatures than the traditional 325/350 °C, the VF-5ht still offers the benefits of low bleed (bleed spec of a 0.25 mm x 30 m column is <5 pA at 400 °C). This enables better separation of high-boiling mixtures.

## Typical Application Areas

High-boiling mixtures, including long chain hydrocarbons, polymers, plastics, waxes, heavy PAHs, tars, triglycerides, motor oils, surfactants, crown ethers plus other compounds requiring high temperature separation.

The VF-5ht is ideal for non-polar to mid polarity compounds.

Diesel Analysis




Peak Identification

| | | |
|---|---|---|
| 1. C10 | 7. C16 | 13. C22 |
| 2. C11 | 8. C17 | 14. C23 |
| 3. C12 | 9. C18 | 15. C24 |
| 4. C13 | 10. C19 | 16. C25 |
| 5. C14 | 11. C20 | 17. C26 |
| 6. C15 | 12. C21 | 18. C27 |

Figure 1 shows the excellent resolution of a complex diesel sample obtained at 380 °C, with very low background noise.

Column: VF-5ht 0.32 mm x 15 m x 0.10 µm (pn: CP9047)
Carrier Gas: $H_2$, 60 kPa, 0.6 bar, 8.6 psi
Temperature: 50°C (1 min), 15 °C to 180 °C, 7 °C to 230 °C, 30 °C to 380 °C
Detection: FID

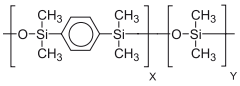
## Ordering Information

| **VF-5ht** | | | | TMax-Iso/Prog 400/400 °C, TMin -60 °C | |
|---|---|---|---|---|---|
| **Part No.** | **ID (mm)** | **Length (m)** | **Df (µm)** | **Bleed (pA)** | **N/M** |
| CP9045 | 0.25 | 15 | 0.10 | 5.00 | 4100 |
| CP9046 | 0.25 | 30 | 0.10 | 5.00 | 4100 |
| CP9044 | 0.32 | 10 | 0.10 | 5.00 | 3200 |
| CP9047 | 0.32 | 15 | 0.10 | 5.00 | 3200 |
| CP9048 | 0.32 | 30 | 0.10 | 5.00 | 3200 |

VARIAN, INC.

# VF-Xms - The Lowest Bleed FactorFour™ Column

VF-Xms



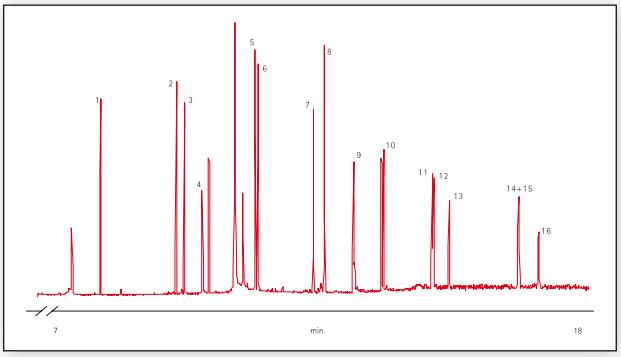
The VF-Xms column from Varian exhibits the lowest bleed of all FactorFour columns. These columns are ideal for customers who want the ultimate in sensitivity and signal to noise.

- Lower bleed, more polar alternative to the VF-5ms
- High arylene modified phase
- High temperature stability enabling isothermal applications up to 360 °C
- Ideal for confirmational analysis

## Typical Application Areas

Pesticides, herbicides, PCBs, PAHs.

Analysis of Polycyclic Aromatic Hydrocarbons




Peak Identification

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

Column: VF-Xms 0.25 mm x 30 m x 0.10 µm (pn: CP8805)
Sample: 1 µL ca. 3 ng per component on column
Carrier Gas: Helium, 60 kPa
Injector: Split, T=275 °C
Detection: Varian Ion Trap MS

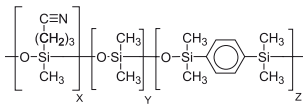
## Ordering Information

| VF-Xms | | | | | TMax-Iso/Prog 340/360 °C, TMin 30 °C | |
|---|---|---|---|---|---|---|
| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
| CP9041 | 0.15 | 20 | 0.15 | 0.75 | 1.2 | 6050 |
| CP8800 | 0.20 | 12 | 0.33 | 0.80 | 1.1 | 4750 |
| CP8801 | 0.20 | 25 | 0.33 | 1.50 | 1.1 | 4800 |
| CP8802 | 0.25 | 15 | 0.10 | 0.60 | 1.3 | 4333 |
| CP8803 | 0.25 | 15 | 0.25 | 1.00 | 1.2 | 4200 |
| CP8804 | 0.25 | 15 | 1.00 | 4.50 | 1.1 | 3533 |
| CP8805 | 0.25 | 30 | 0.10 | 1.00 | 1.4 | 4333 |
| CP8806 | 0.25 | 30 | 0.25 | 2.00 | 1.2 | 4167 |
| CP8807 | 0.25 | 30 | 0.50 | 4.50 | 1.1 | 3800 |
| CP8808 | 0.25 | 30 | 1.00 | 9.00 | 1.1 | 3500 |
| CP8809 | 0.25 | 60 | 0.25 | 4.00 | 1.3 | 4167 |
| CP8810 | 0.32 | 15 | 0.25 | 1.50 | 1.2 | 3333 |
| CP8811 | 0.32 | 15 | 1.00 | 6.00 | 1.1 | 2667 |
| CP8812 | 0.32 | 30 | 0.10 | 2.00 | 1.4 | 3333 |
| CP8813 | 0.32 | 30 | 0.25 | 3.00 | 1.2 | 3333 |
| CP8814 | 0.32 | 30 | 0.50 | 6.00 | 1.1 | 3000 |
| CP8815 | 0.32 | 30 | 1.00 | 12.00 | 1.1 | 2667 |
| CP8816 | 0.32 | 60 | 0.25 | 6.00 | 1.3 | 3333 |
| CP8817* | 0.53 | 15 | 1.50 | 10.00 | 1.1 | 1667 |
| CP8818* | 0.53 | 30 | 1.50 | 20.00 | 1.2 | 1667 |

*CP8817 - CP8818: TMax-Iso/Prog 325/340 °C, TMin 30°C

# VF-624ms & VF-1301ms
# Cyano-based FactorFour™ Columns for Volatiles

VF-624ms & VF-1301ms



The VF-624ms and VF-1301ms are the world's first ultra-low bleed 6% cyanopropyl/phenyl, 94% PDMS GC columns with the benefit of:

- Improved signal to noise - especially for late eluters such as naphthalene
- Enhanced selectivity - VF-624ms separates typical co-eluters such as benzene and 1,2-dichloroethane
- Ghost peaks and unstable baselines are eliminated

VF-624ms columns set a new standard for the analysis of volatile organic compounds. Improved phase technology reduces bleed, thereby increasing signal to noise. These columns are especially suited for analyzing solvents according to EPA Methods 524, 624 and 8260, as well as USP 467.

The ultra-low bleed, thin-filmed, VF-1301ms column has a similar selectivity and is suitable for semi-volatile organic solvents, as well as PCBs and pesticides.

## Typical Application Areas

Purgeable organic volatiles and semi-volatiles, aromatics, hydrocarbons and solvents.

FactorFour Columns Eliminate Ghost Peaks

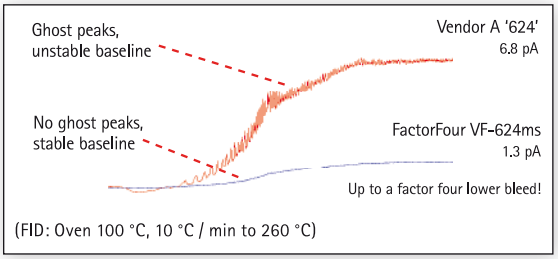
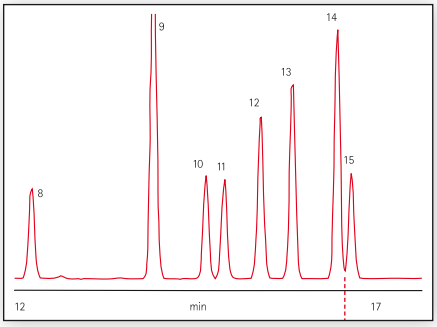



Figure 1 illustrates the low bleed profile of the VF-624ms column compared to vendor A.

FactorFour Cyano Columns Eliminate Unstable Baselines




Peak Identification
8. 1,1-dichloroethane
9. 1,2-dichloroethylene (cis)
10. Bromochloromethane
11. Chloroform
12. 1,1,1-trichloroethane
13. 1,1-dichloro-1-propylene
14. Benzene
15. 1,2-dichloroethane

Figure 2 shows the near baseline separation of benzene and 1,2- dichloroethane.

Column: VF-624ms 0.32 x 60 m x 1.8 µm (pn: CP9105)
Carrier Gas: Helium 1 mL/min
Injector: Split 1:100, Injection temp 250 °C
Temperature: Trap 150 °C, Manifold 40 °C, Transfer line 185 °C
Detection: Varian Ion Trap MS

## Ordering Information

**VF-624ms** TMax-Iso/Prog 280/300 °C, TMin -40 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP9101 | 0.15 | 15 | 0.84 | 1.00 | 1.1 | 4500 |
| CP9100 | 0.15 | 20 | 0.84 | 1.30 | 1.1 | 4500 |
| CP9109 | 0.15 | 30 | 0.84 | 1.50 | 1.1 | 4166 |
| CP9110 | 0.15 | 40 | 0.84 | 2.00 | 1.1 | 4000 |
| CP9102 | 0.25 | 30 | 1.40 | 2.50 | 1.1 | 2833 |
| CP9103 | 0.25 | 60 | 1.40 | 5.00 | 1.1 | 2833 |
| CP9104 | 0.32 | 30 | 1.80 | 3.00 | 1.1 | 2167 |
| CP9105 | 0.32 | 60 | 1.80 | 6.00 | 1.1 | 2167 |
| CP9106 | 0.53 | 30 | 3.00 | 8.00 | 1.1 | 1333 |
| CP9107* | 0.53 | 60 | 3.00 | 8.00 | 1.1 | 1333 |
| CP9108* | 0.53 | 75 | 3.00 | 10.00 | 1.1 | 1333 |

*CP9107 - CP9108: TMax-Iso/Prog 265/280 °C, TMin -40 °C

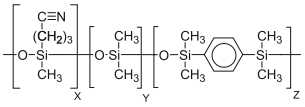
**VF-1301ms** TMax-Iso/Prog 280/300 °C, TMin -40 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP9050 | 0.15 | 15 | 0.15 | 0.50 | 1.2 | 6000 |
| CP9051 | 0.15 | 20 | 0.15 | 0.50 | 1.2 | 6000 |
| CP9052 | 0.25 | 15 | 1.00 | 1.00 | 1.1 | 3000 |
| CP9053 | 0.25 | 30 | 0.25 | 0.50 | 1.2 | 4000 |
| CP9054 | 0.25 | 30 | 1.00 | 2.00 | 1.1 | 3000 |
| CP9056 | 0.25 | 60 | 1.00 | 4.00 | 1.1 | 3000 |
| CP9062 | 0.53 | 15 | 1.00 | 2.00 | 1.1 | 1667 |
| CP9063 | 0.53 | 30 | 1.00 | 4.00 | 1.1 | 1667 |

VARIAN, INC.

# VF-1701ms - Cyano-based FactorFour™ Columns for Pesticides, PCBs & other Semi-volatile Organic Compounds

VF-1701ms



The VF-1701ms is the world's first ultra-low bleed equivalent of a 14% cyanopropyl/phenyl, 86% PDMS GC column for pesticides, PCBs and semi-volatile organic compounds.

- Elute difficult analytes such as p,p'-DDT
- Perfect peak shape for endrin aldehyde
- Eliminate ghost peaks and unstable baselines
- Bleed specification of 2 pA @ 280 °C for a 0.25 mm x 60 m x 0.25 µm ID column

The VF-1701ms is ideal for the analysis of semi-volatile organic compounds such as pesticides and PCBs. Improved phase technology delivers increased inertness and reduced bleed, resulting in more accurate trace analysis.

Note - the VF-1701ms is also available as a dedicated column for the analysis of pesticides (see page 7).

## Typical Application Areas

Organic compounds in drinking water (EPA 524.2), bases/neutrals and acids (EPA 625), PCBs and chlorinated pesticides (EPA 508, 608, 808, 8082), organophosphorus pesticides and herbicides (EPA 507, 8081, 8140/8141, 8151).

EPA 625 Halogenated Pesticides on "1701" Type Phases

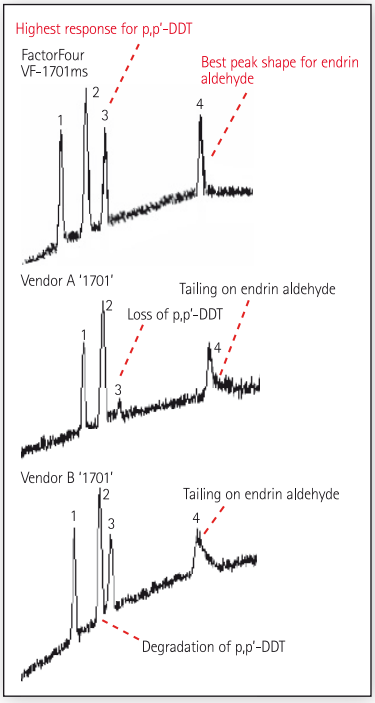



Figure 1 shows a comparison of the FactorFour VF-1701ms and two columns from other vendors. The VF-1701ms column shows a fully resolved elution of problematic pesticides and endrin aldehyde with a near perfect peak shape.

Columns: "1701" type 0.25 mm x 30 m x 0.25 µm
Injector: Split, T=275 °C ECD: T=275 °C, 2 pg
Temperature: 150 °C, 5 °C / min to 275 °C

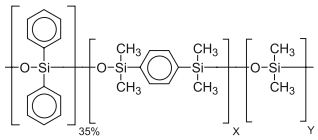
## Ordering Information

**VF-1701ms** TMax-Iso/Prog 280/300 °C, TMin -20 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP9148 | 0.25 | 15 | 0.25 | 0.50 | 1.1 | 4000 |
| CP9149 | 0.25 | 15 | 1.00 | 1.00 | 1.1 | 3000 |
| CP9151 | 0.25 | 30 | 0.25 | 1.00 | 1.2 | 4000 |
| CP9152 | 0.25 | 30 | 1.00 | 2.00 | 1.2 | 3000 |
| CP9154 | 0.25 | 60 | 0.25 | 2.00 | 1.3 | 4000 |
| CP9155 | 0.25 | 60 | 0.50 | 4.00 | 1.3 | 3333 |
| CP9158 | 0.32 | 15 | 0.25 | 0.50 | 1.1 | 3100 |
| CP9159 | 0.32 | 15 | 1.00 | 1.00 | 1.1 | 2500 |
| CP9162 | 0.32 | 30 | 0.25 | 1.00 | 1.2 | 3100 |
| CP9163 | 0.32 | 30 | 1.00 | 2.00 | 1.2 | 2500 |
| CP9165 | 0.32 | 60 | 0.25 | 2.00 | 1.3 | 2833 |
| CP9166 | 0.32 | 60 | 1.00 | 4.00 | 1.3 | 2333 |

# VF-35ms - The Ideal FactorFour™ Column for Trace Environmental & Chemical Analyses

VF-35ms



The VF-35ms is a mid polarity column which is the ideal choice for trace environmental and chemical analyses, and as a confirmation column.

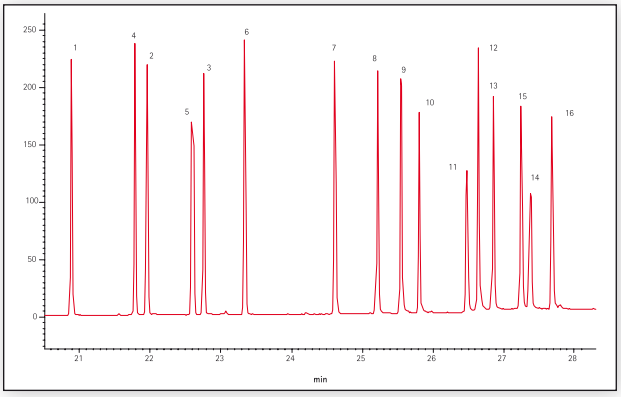
- Stabilized arylene-modified equivalent of a 35% phenylmethyl phase
- Ideal for dual column confirmational analysis

The VF-35ms uses FactorFour technology to produce a low bleed, highly stable column with a programmable maximum temperature of 360 °C.

## Typical Application Areas

Aromatic compounds, pesticides and herbicides, sterols and other substituted aromatic compounds.

Organochlorine Pesticides to EPA 625 via GC/MS




Peak Identification
1. α-BHC
2. β-BHC
3. δ-BHC
4. γ-BHC (lindane)
5. Heptachlor
6. Aldrin
7. Heptachlorepoxide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. Endrin aldehyde
15. 4,4'-DDT
16. Endosulfan sulfate

Figure 1 shows excellent baseline resolution of 16 organochlorine pesticides.

Column: VF-35ms 0.25 mm x 30 m x 0.25 µm (pn: CP8877)
Carrier Gas: Helium, approx. 1.0 mL/min, 60 kPa
Injector: Split/Splitless, in Split mode, 1:100
Temperature: 45 °C + 10 °C / min to 325 °C
Detection: Varian Ion Trap MS

## Ordering Information

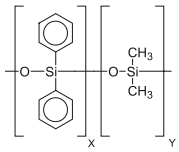
| VF-35ms | | | | | TMax-Iso/Prog 340/360 °C, TMin 40 °C | |
|---|---|---|---|---|---|---|
| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
| CP8872 | 0.20 | 15 | 0.33 | 2.00 | 1.2 | 4667 |
| CP8873 | 0.20 | 25 | 0.33 | 3.00 | 1.2 | 4667 |
| CP8874 | 0.25 | 15 | 0.25 | 1.50 | 1.4 | 3900 |
| CP8875 | 0.25 | 30 | 0.10 | 2.00 | 1.3 | 3900 |
| CP8876 | 0.25 | 30 | 0.15 | 2.00 | 1.2 | 3900 |
| CP8877 | 0.25 | 30 | 0.25 | 3.00 | 1.2 | 3900 |
| CP8878 | 0.25 | 30 | 0.50 | 6.00 | 1.2 | 3667 |
| CP8879 | 0.25 | 30 | 1.00 | 12.00 | 1.2 | 3000 |
| CP8880 | 0.25 | 60 | 0.25 | 6.00 | 1.2 | 4000 |
| CP8881 | 0.32 | 15 | 0.25 | 2.00 | 1.2 | 3050 |
| CP8882 | 0.32 | 30 | 0.25 | 3.00 | 1.2 | 3050 |
| CP8883 | 0.32 | 30 | 0.50 | 6.00 | 1.2 | 2950 |
| CP8884 | 0.32 | 30 | 1.00 | 12.00 | 1.2 | 2500 |
| CP8885 | 0.32 | 60 | 0.25 | 7.00 | 1.2 | 3050 |
| CP8886* | 0.53 | 15 | 1.00 | 6.00 | 1.2 | 1667 |
| CP8887* | 0.53 | 30 | 0.50 | 8.00 | 1.2 | 1667 |
| CP8888* | 0.53 | 30 | 1.00 | 12.00 | 1.2 | 1500 |

*CP8886 - CP8888: TMax-Iso/Prog 325/350 °C, TMin 40 °C

VARIAN, INC.

# VF-17ms - FactorFour™ Column for Medium Polarity Applications

VF-17ms




VF-17ms is a medium polarity, low bleed column for increased sensitivity, accuracy and instrument uptime.

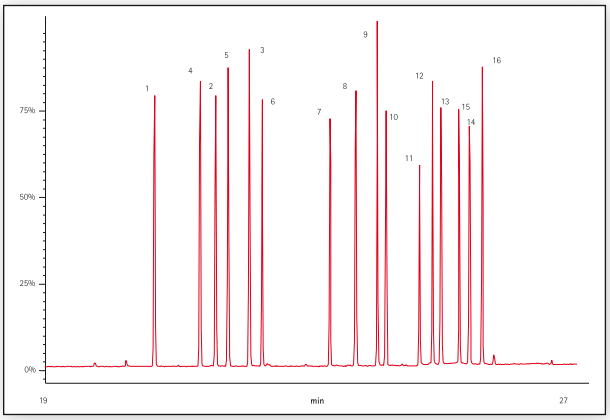
- 50% phenyl, 50% dimethylpolysiloxane low bleed column
- Ideal confirmation column for EPA methods
- Bonded and crosslinked to allow solvent rinsing
- Lowest bleed specification of 2 pA @ 325 °C (0.25 mm x 30 m x 0.25 µm)

The VF-17ms is a column often referenced in environmental and clinical methods. The use of new deactivation technology improves column stability, resulting in improved repeatability and column lifetimes.

## Typical Application Areas

Antidepressants, herbicides and pesticides.

Organochlorine Pesticides




Peak Identification
1. α-BHC
2. β-BHC
3. δ-BHC
4. γ-BHC (lindane)
5. Heptachlor
6. Aldrin
7. Heptachlorepoxide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. Endrin aldehyde
15. 4,4'-DDT
16. Endosulfan sulfate

Figure 1 shows excellent peak shapes for heptachlor, endrin, endrin aldehyde and 4,4'-DDT, illustrating the high inertness of the GC column.

Sample Size: 1 µL
Column: VF-17ms 0.25 mm x 30 m x 0.25 µm (pn: CP8982)
Carrier Gas: Helium, 70 kPa
Injector: Splitter, 1:100
Concentration: 200 µg/mL
Detection: MS, Saturn 2000 Ion Trap, TIC

## Ordering Information

**VF-17ms** TMax-Iso/Prog 330/360 °C, TMin 40 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP8977 | 0.10 | 10 | 0.20 | 0.50 | 1.3 | 7800 |
| CP8978 | 0.25 | 15 | 0.15 | 0.60 | 1.3 | 3667 |
| CP8979 | 0.25 | 15 | 0.25 | 1.00 | 1.2 | 3333 |
| CP8980 | 0.25 | 15 | 0.50 | 2.00 | 1.2 | 3000 |
| CP8981 | 0.25 | 30 | 0.15 | 1.20 | 1.5 | 3667 |
| CP8982 | 0.25 | 30 | 0.25 | 2.00 | 1.4 | 3333 |
| CP8983 | 0.25 | 30 | 0.50 | 4.00 | 1.3 | 3000 |
| CP8984 | 0.25 | 60 | 0.25 | 4.00 | 1.6 | 3167 |
| CP8985 | 0.25 | 60 | 0.50 | 8.00 | 1.4 | 2833 |
| CP8986 | 0.32 | 15 | 0.15 | 0.70 | 1.4 | 3333 |
| CP8987 | 0.32 | 15 | 0.25 | 1.30 | 1.3 | 2667 |
| CP8988 | 0.32 | 15 | 0.50 | 2.50 | 1.2 | 2667 |
| CP8989 | 0.32 | 30 | 0.15 | 1.40 | 1.5 | 3000 |
| CP8990 | 0.32 | 30 | 0.25 | 2.50 | 1.4 | 2667 |
| CP8991 | 0.32 | 30 | 0.50 | 5.00 | 1.3 | 2500 |

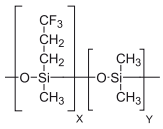
| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP8992 | 0.32 | 60 | 0.25 | 5.00 | 1.6 | 2833 |
| CP8993 | 0.32 | 60 | 0.50 | 10.00 | 1.4 | 2500 |
| CP8994 | 0.53 | 15 | 0.25 | 2.60 | 1.4 | 1833 |
| CP8995 | 0.53 | 15 | 0.50 | 5.00 | 1.3 | 1667 |
| CP8996 | 0.53 | 15 | 1.00 | 10.00 | 1.2 | 1400 |
| CP8998* | 0.53 | 15 | 1.50 | 5.00 | 1.2 | 1200 |
| CP8999 | 0.53 | 30 | 0.25 | 5.00 | 1.5 | 1833 |
| CP9000 | 0.53 | 30 | 0.50 | 10.00 | 1.4 | 1667 |
| CP9001* | 0.53 | 30 | 1.00 | 7.00 | 1.3 | 1400 |
| CP9002* | 0.53 | 30 | 1.50 | 10.00 | 1.2 | 1167 |
| CP9003** | 0.53 | 60 | 1.00 | 5.00 | 1.3 | 1333 |
| CP9005** | 0.53 | 60 | 1.50 | 7.00 | 1.3 | 1167 |

*CP8998, CP9001 - CP9002: TMax-Iso/Prog 310/340 °C, TMin 40 °C

**CP9003 - CP9005: TMax-Iso/Prog 290/320 °C, TMin 40 °C

# VF-200ms - Highly Inert FactorFour™ Column with a Unique Selectivity for Polar Compounds

VF-200ms



The VF-200ms is one of the newest stationary phases in the FactorFour range, designed with a unique selectivity for compounds rich in dipole-dipole interactions.

- Trifluoropropyl methyl stationary phase
- Ultra-low background noise
- Ideal for sensitive and selective detector systems

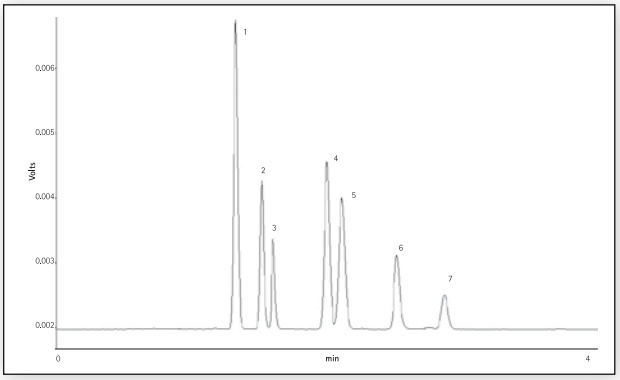
The VF-200ms provides a unique selectivity due to the electrophilic nature of the trifluoropropyl stationary phase. It is especially suited for electron rich, high dipole moment compounds like ketones, aldehydes, nitro- or chloro- containing compounds, PAHs, unsaturated compounds, silanes and CFCs. VF-200ms, as with all FactorFour columns, offers superior surface deactivation and thereby symmetrical peak shapes. The high inertness of the VF-200ms leads to more accurate peak identification and reliable analysis.

The VF-200ms trifluoropropyl phase has very high temperature stability and can be used routinely up to 350 °C.

## Typical Application Areas

Ketones, aldehydes, nitro- or chloro-containing compounds, PAHs, unsaturated compounds, silanes and CFCs.

Fast Separation of Silanes




Peak Identification
1. Vinyl-trimethyl silane
2. Dichloromethyl silane
3. Dichloromethane
4. Trimethylchloro silane
5. Pentamethyl disiloxane
6. Trichloromethyl silane
7. Dichlorodimethyl silane

Figure 1 shows a high resolution separation of silanes in <4 minutes.

Column: VF-200ms 0.25 mm x 30 m x 1.00 µm (pn: CP8860)
Carrier Gas: Hydrogen, ca 1.0 mL/min, 60 kPa
Injector: Split/Splitless, in split mode, 1:100
Temperature: 50 °C
Detection: FID

## Ordering Information

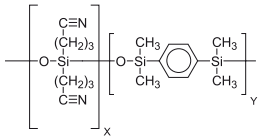
| **VF-200ms** | | | | | TMax-Iso/Prog 325/350 °C, TMin 0 °C | |
|---|---|---|---|---|---|---|
| **Part No.** | **ID (mm)** | **Length (m)** | **Df (µm)** | **Bleed (pA)** | **Asymmetry** | **N/M** |
| CP8855 | 0.25 | 15 | 0.25 | 1.00 | 1.2 | 3900 |
| CP8856 | 0.25 | 15 | 0.50 | 2.00 | 1.2 | 3500 |
| CP8857 | 0.25 | 30 | 0.10 | 1.00 | 1.5 | 4100 |
| CP8858 | 0.25 | 30 | 0.25 | 2.00 | 1.2 | 3900 |
| CP8859 | 0.25 | 30 | 0.50 | 4.00 | 1.2 | 3800 |
| CP8860 | 0.25 | 30 | 1.00 | 8.00 | 1.2 | 3500 |
| CP8861 | 0.25 | 60 | 0.25 | 4.00 | 1.2 | 4000 |
| CP8862 | 0.32 | 15 | 0.25 | 1.00 | 1.2 | 3050 |
| CP8863 | 0.32 | 30 | 0.25 | 2.00 | 1.2 | 3050 |
| CP8864 | 0.32 | 30 | 0.50 | 4.00 | 1.2 | 2950 |
| CP8865 | 0.32 | 30 | 1.00 | 8.00 | 1.2 | 2700 |
| CP8866* | 0.53 | 15 | 1.00 | 3.00 | 1.2 | 1667 |
| CP8867* | 0.53 | 30 | 0.50 | 3.00 | 1.2 | 1667 |
| CP8868* | 0.53 | 30 | 1.00 | 6.00 | 1.2 | 1667 |

*CP8866 - CP8868: TMax-Iso/Prog 300/325 °C, TMin 0 °C

VARIAN, INC.

# VF-23ms – The Highest Polarity FactorFour™ Column for Very Polar Applications

VF-23ms



The VF-23ms column features a unique combination of high polarity and low bleed to enable more accurate analysis of very polar analytes.

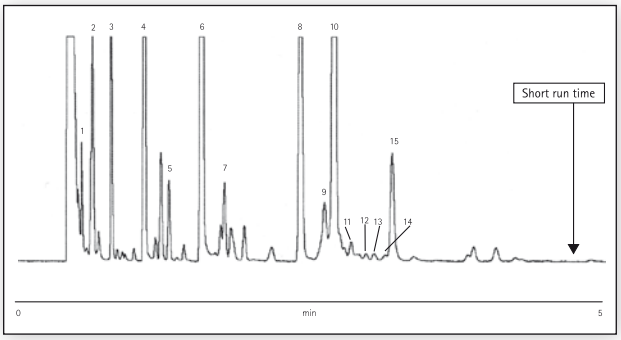
- High substituted cyanopropyl, low bleed phase
- 100% bonded phase ensures splitless injection as well as column rinsing
- Operating temperature up to 260 °C

The VF-23ms is a unique high polarity low bleed phase. The enhanced stabilization of the VF-23ms permits splitless injection, column rinsing and temperatures up to 260 °C to be used. Compared to other 23ms type phases, this expands the range of possible applications by enabling the analysis of higher molecular weight compounds.

## Typical Application Areas

Fatty acid methyl esters (FAME), solvents, sugars.

Fast Screening of FAME isomers in butter




Peak Identification

1. C8:0
2. C10:0
3. C12:0
4. C14:0
5. C14:1
6. C16:0
7. C16:1 9-cis
8. C18:0
9. C18:1 trans
10. C18:1 9-cis
11. C18:1 13-cis
12. C18:2 9-trans, 12-trans
13. C18:2 9-cis, 12-trans
14. C18:2 9-trans,12-cis
15. C18:2 9-cis, 12-cis

Figure 1 illustrates the high temperature stability of a fast screening analysis of FAME isomers in butter.

Column: VF-23ms 0.25 mm x 30 m x 0.25 µm (pn: CP8822)
Sample: 0.5 µL ca. 5 ng per component on column
Carrier Gas: Hydrogen, 70 kPa
Injector: Split, 1:100 T=275 °C
Temperature: 185 °C
Detection: FID

## Ordering Information

| **VF-23ms** | | | | | TMax-Iso/Prog 260/260 °C, TMin 40 °C | |
|---|---|---|---|---|---|---|
| **Part No.** | **ID (mm)** | **Length (m)** | **Df (µm)** | **Bleed (pA)** | **Asymmetry** | **N/M** |
| CP8819 | 0.10 | 10 | 0.10 | 1.00 | 1.5 | 5500 |
| CP9042 | 0.15 | 20 | 0.15 | 1.00 | 1.5 | 3750 |
| CP8820 | 0.25 | 15 | 0.25 | 2.00 | 1.4 | 2333 |
| CP8821 | 0.25 | 30 | 0.15 | 2.00 | 2.0 | 2833 |
| CP8822 | 0.25 | 30 | 0.25 | 3.00 | 1.5 | 2333 |
| CP8823 | 0.25 | 60 | 0.15 | 4.00 | 2.5 | 2667 |
| CP8824 | 0.25 | 60 | 0.25 | 6.00 | 1.7 | 2167 |
| CP8825 | 0.32 | 15 | 0.25 | 2.50 | 1.4 | 1867 |
| CP8826 | 0.32 | 30 | 0.15 | 2.50 | 2.0 | 2500 |
| CP8827 | 0.32 | 30 | 0.25 | 4.00 | 1.5 | 1833 |
| CP8828 | 0.32 | 60 | 0.15 | 5.00 | 2.5 | 2333 |
| CP8829 | 0.32 | 60 | 0.25 | 8.00 | 1.7 | 1750 |
| CP8830* | 0.53 | 15 | 0.50 | 4.00 | 1.3 | 800 |
| CP8831* | 0.53 | 30 | 0.50 | 8.00 | 1.5 | 733 |

*CP8830 - CP8831: TMax-Iso/Prog 245/245 °C, TMin 40 °C

# Varian GC Columns & Consumables Ensure Optimal Performance

Varian, Inc. manufactures the full range of products for all your gas chromatography and gas chromatography/mass spectrometry needs. With over 35 years' experience in GC, Varian will provide you with the best quality consumables, systems and technical support, to suit your application and requirements.

## Widest Choice of GC Columns

Varian offers a complete selection of the highest quality capillary GC columns with the most demanding quality assurance specifications in the industry. In addition to the FactorFour column range, keynote GC columns from Varian, Inc. include:

- CP-Sil - Chemically bonded and non-chemically bonded phases on a polysiloxane backbone
- CP-Wax - Chemically bonded, relatively polar columns on a polyethylene glycol backbone
- PLOT - Porous Layer Open Tubular (PLOT) columns for analyzing gases and volatiles
- Varian Select™ - Application-specific columns for environmental, food & fragrance, chemical and chiral analyses

## Protect Your Performance

The Gas Clean Filter System prevents contaminants entering your GC. Contaminants in carrier gas could result in damage to the column, loss of sensitivity and unnecessary instrument downtime.

Filters available:

- Oxygen
- Moisture
- Charcoal
- GC/MS

## Optimize Your Performance

Varian offers advanced GC septa for optimized GC and GC/MS performance, including:

- BTO Septa for MS
- Marathon Septa for autosampler use
- Advanced Green 3 Septa for high temperature use

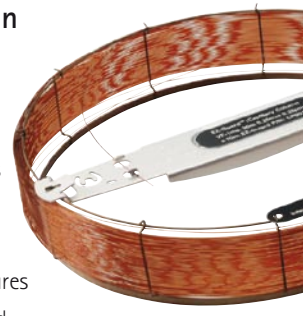
## Simplified Column Installation

Varian's patented EZ-GRIP™ capillary column cage makes single and dual capillary column installation and coupling fast and easy. Correct installation of columns to the injector and detector using EZ-GRIP maximizes system performance.

Advantages of the EZ-GRIP system include:

- The ability to add a second column on the same grip
- Eliminating the risk of column contact with the oven wall
- Easy coupling/maintenance performed outside the oven using the EZ-GRIP holder

## Integrated Guard Column



EZ-Guard™ from Varian is a combination of a FactorFour column with an integrated 5 or 10 m guard column, which eliminates coupling and the possibility of leaks. Available with most FactorFour phases, EZ-Guard features a unique uncoated and deactivated outlet section as an integrated transfer line. Advantages are faster stabilization in MS and other detector systems.

## Comprehensive Liner Design

Varian manufactures dedicated liners for the three major injection types:

- Direct injection
- Split injection
- Split/Splitless injection

For more information on the comprehensive range of capillary GC columns and consumables from Varian, Inc., visit our Web site at www.varianinc.com.

# GC and GC/MS Systems from Varian, Inc.
# Reliable, Robust, Precise

Varian delivers Information Rich Detection (IRD) solutions that provide the multi-dimensional data the scientific community needs. Instead of merely detecting the presence of compounds, IRD provides highly detailed structural and compositional molecular information.

## Leading in Gas Chromatography

Varian manufactures an extensive range of systems to suit all applications.

Whichever Varian gas chromatograph you choose, it will be easy to use, efficient and reliable. Varian GCs feature rapid heating/cooling for fast sample turnaround times. Outstanding electronic flow control, injectors, detectors, autosamplers and control software ensure you of the best performance and trouble-free GC.

The introduction of solid phase micro-extraction (SPME) and the pulsed flame photometric detector (PFPD) have helped put Varian at the forefront of innovation in GC.

## Galaxie™ Software GC Control from Varian

All Varian GCs are controlled by Galaxie Chromatography Workstation Software from Varian. If you want to expand, we'll expand with you, providing you with a scalable solution that will enable you to control all your GC and LC instruments, including other manufacturers' equipment, and process your data from any PC in your network. Galaxie Chromatography Software has been designed to suit real laboratories, enabling you to achieve the correct results, faster and easier.

## Innovation in Gas Chromatography/Mass Spectrometry

Varian is one of the leading suppliers of gas chromatography/mass spectrometry systems, providing ion trap mass spectrometry and quadrupole mass spectrometers coupled to Varian gas chromatographs.

The GC/MS series from Varian extends MS capabilities for every application. Compound identification and quantitation is maximized, with a wide choice of MS and MS/MS modes. This provides the benefit of more accurate and reliable results for confidence in your analyses, in easy to operate systems. Routine high performance analyses are standard, with both internal and external ionization configurations.

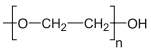
## Custom Gas Chromatography Solutions

Varian is the only analytical instrument vendor who provides comprehensive single vendor solutions for simple to complex gas chromatography applications, including separation, detection, data processing and results generation. If we don't have a solution for your application already, we'll build it for you. Please contact us in full confidence to discuss your specific requirements.

For more information about GC and GC/MS systems from Varian, Inc., contact us or visit our Web site at www.varianinc.com.

# NEW Low Bleed VF-WAXms FactorFour™ Column for Polar Compounds

VF-WAXms



Varian, Inc. has introduced a new wax column for the analysis of polar compounds, the VF-WAXms. This is the first high performance wax column available, and as part of the FactorFour product line, the VF-WAXms column benefits from the low bleed and high inertness of the FactorFour range.

- Polyethylene glycol (PEG) phase
- Operating temperature range of 20 to 250 °C for maximum flexibility
- Ideal for trace analyses as the low bleed provides better signal to noise values

The VF-WAXms is a high performance column for applications in the food, flavors and fragrances markets, and especially where trace analyses are required. These applications often require higher temperatures to analyze polar compounds, and therefore need an ultra stable wax as a stationary phase. The very low bleed provides increased sensitivity, extended column lifetime and greater accuracy, even at higher temperatures. In addition, due to its ultra low bleed, VF-WAXms columns are suitable for use with MS detectors, whereas the bleed of other wax columns available is too high to permit MS detection.

Baseline Comparison

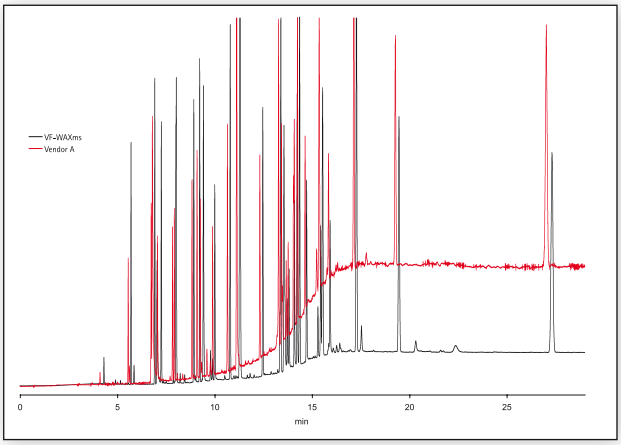
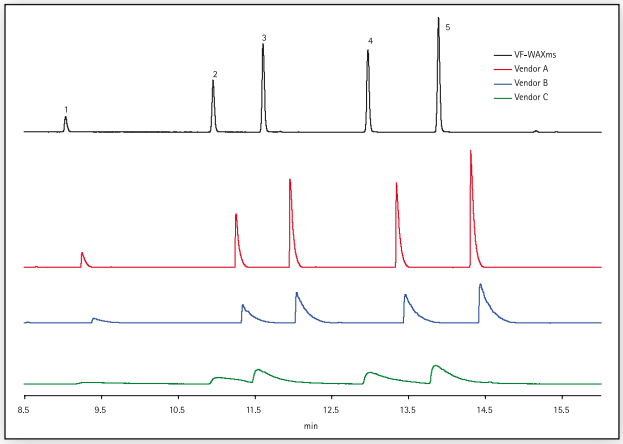



Figure 1. In a comparison of the baselines of the VF-WAXms and a conventional wax column at temperatures up to 250 °C, the VF-WAXms was shown to maintain a consistent, flat baseline.

Columns: 0.25 mm x 30 m x 0.25 µm
Carrier Gas: Helium, 100 kPa
Temperature: 100 °C to 250 °C, 10 °C/min

Advanced coating technology from Varian means that the VF-WAXms columns are highly inert. Such inertness gives better chromatograms, enhancing critical pair separation. A sample containing acids was analyzed with the VF-WAXms and conventional wax columns, and chromatograms compared.

Acids




Peak Identification
1. Acetic acid
2. Proprionic acid
3. Iso-butyric acid
4. Butyric acid
5. Iso-valeric acid

Figure 2 illustrates the superior inertness of the VF-WAXms compared to conventional wax columns.

Columns: 0.25 mm x 30 m x 0.25 µm
Sample: Acid sample, 0.1% (Cyclohexane)
Sample size: 0.1 µL
Carrier Gas: Hydrogen, 75 kPa
Injector: 250 °C, split 100 mL/min
Temperature: 60 °C to 200 °C, 5 °C/min
Detection: FID, 275 °C

# NEW Low Bleed VF-WAXms Column for Polar Compounds

## Typical Application Areas

Food, fragrances, flavors, beverages, FAMEs, acids, alcohols, aromatics.

With the introduction of the VF-WAXms column, wax applications such as food, fragrances and flavors can now benefit from the use of GC/MS detectors. Impurities can easily be identified using an MS detector when a wax column is required for separation.

Minimized MS Detector Contamination

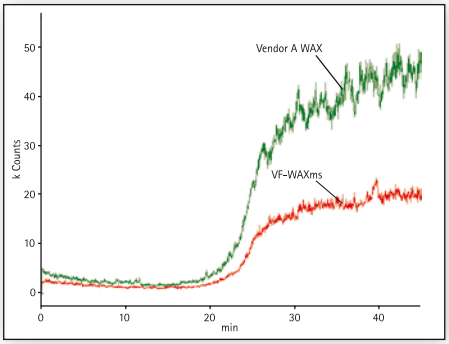



Figure 3. Bleed comparison of the VF-WAXms and a conventional wax column on a Varian Ion Trap MS detector –the VF-WAXms shows dramatically reduced bleed.

Columns: 0.25 mm x 30 m x 0.25 µm
Carrier Gas: Helium, 10 kPa
Flow Rate: 1 mL/min
Injector: 250 °C
Temperature: 50 to 250 °C, 10 °C/min
Detection: Varian Ion Trap MS, one tuning

Significantly improved performance is achieved with the VF-WAXms columns, yet the typical selectivity of PEG is unchanged. The chromatogram below of an essential oil run with the VF-WAXms is very similar to the chromatogram from the most widely available conventional wax columns. Switching to the new VF-WAXms column will be seamless.

Essential Oils

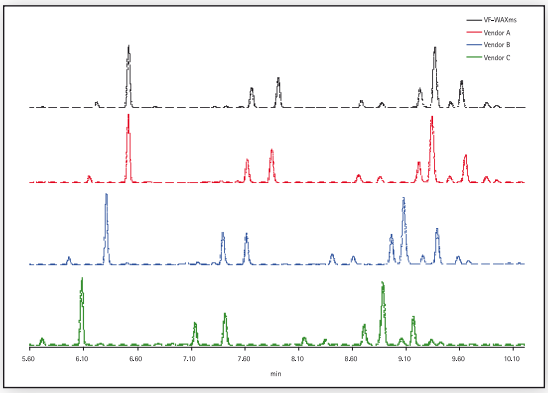



Figure 4 illustrates the comparable selectivity between the new VF-WAXms and conventional wax columns.

Column: 0.25 mm x 30 m x 0.25 µm
Sample: Ylang 2% (acetone)
Carrier Gas: Helium, 100 kPa
Temperature: 100 °C to 260 °C, 7 °C/min
Injector: 250 °C, split 75 mL/min
Detection: FID, 275 °C

## Ordering Information

**VF-WAXms** TMax-Iso 250 °C, TMax-Prog 260 °C, TMin 20 °C

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP9219 | 0.10 | 10 | 0.10 | 0.6 | 1.24 | 7500 |
| CP9218 | 0.10 | 10 | 0.20 | 0.6 | 1.34 | 7500 |
| CP9200 | 0.15 | 10 | 0.15 | 1 | 1.34 | 5800 |
| CP9201 | 0.15 | 15 | 0.15 | 1 | 1.34 | 5800 |
| CP9220 | 0.15 | 20 | 0.15 | 1 | 1.34 | 5800 |
| CP9202 | 0.15 | 30 | 0.15 | 1 | 1.24 | 5800 |
| CP9203 | 0.25 | 15 | 0.25 | 1.5 | 1.24 | 3800 |
| CP9221 | 0.25 | 15 | 0.50 | 3 | 1.14 | 3500 |
| CP9204 | 0.25 | 25 | 0.20 | 2 | 1.34 | 3800 |
| CP9205 | 0.25 | 30 | 0.25 | 3 | 1.34 | 3800 |
| CP9222 | 0.25 | 30 | 0.50 | 6 | 1.24 | 3500 |
| CP9206* | 0.25 | 30 | 1.00 | 7 | 1.24 | 2500 |
| CP9207 | 0.25 | 60 | 0.25 | 6 | 1.44 | 3800 |
| CP9223* | 0.25 | 60 | 0.50 | 9 | 1.34 | 3500 |
| CP9209 | 0.32 | 15 | 0.25 | 3 | 1.24 | 2950 |
| CP9224 | 0.32 | 15 | 0.50 | 4 | 1.14 | 2750 |

| Part No. | ID (mm) | Length (m) | Df (µm) | Bleed (pA) | Asymmetry | N/M |
|---|---|---|---|---|---|---|
| CP9208 | 0.32 | 15 | 1.00 | 12 | 1.14 | 2350 |
| CP9212 | 0.32 | 30 | 0.25 | 6 | 1.34 | 2950 |
| CP9210 | 0.32 | 30 | 0.50 | 8 | 1.24 | 2750 |
| CP9211* | 0.32 | 30 | 1.00 | 9 | 1.24 | 2350 |
| CP9214 | 0.32 | 60 | 0.25 | 10 | 1.44 | 2950 |
| CP9225* | 0.32 | 60 | 0.50 | 10 | 1.34 | 2750 |
| CP9213** | 0.32 | 60 | 1.00 | 15 | 1.34 | 2350 |
| CP9226 | 0.53 | 15 | 1.00 | 20 | 1.14 | 1600 |
| CP9227* | 0.53 | 15 | 2.00 | 22 | 1.14 | 1267 |
| CP9215* | 0.53 | 30 | 1.00 | 21 | 1.24 | 1600 |
| CP9216** | 0.53 | 30 | 2.00 | 14 | 1.14 | 1267 |
| CP9228** | 0.53 | 60 | 1.00 | 14 | 1.24 | 1600 |
| CP9217*** | 0.53 | 60 | 2.00 | 24 | 1.14 | 1267 |

*CP9206, CP9223, CP9211, CP9225, CP9227, CP9215: TMax-Iso 240 °C
**CP9213, CP9216, CP9228: TMax-Iso 230 °C
***CP9217: TMax-Iso 220 °C

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SI-0707/A/6.07 Printed in the UK