Restek GC

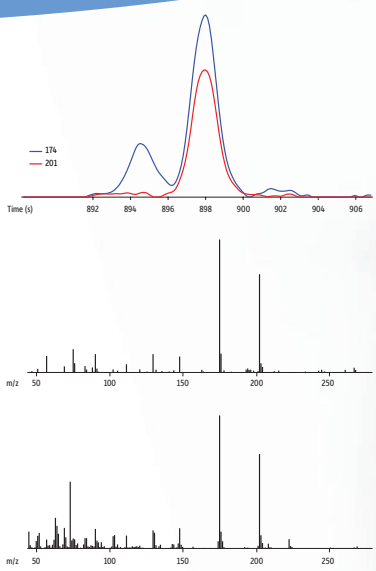
Rxi-5Sil MS Columns

Rugged, Low-Bleed Performance for Challenging GC-MS Work

Part of the Rxi GC Column Family

- Accurate MS data
- The right results fast
- Maximize instrument uptime

Rxi GCColumns



RESTEK Pure Chromatography www.restek.com

Rxi-5Sil MS Columns from Restek Give Rugged, Low-Bleed Performance for Challenging GC-MS Work

In every industry, testing methods are becoming more stringent, limits of detection are dropping, and deadlines are getting tighter. Newer GC-MS and GC-MS/MS instruments have been developed to increase overall detectability, but all too often instrument performance is compromised by use of an analytical column that produces high levels of bleed. Column bleed occurs when the stationary phase is lost during exposure to high temperatures or extreme conditions. Column bleed can negatively impact data quality and complicate software integration. In addition, it can contaminate sensitive MS sources, resulting in more downtime due to frequent cleaning. Restek's Rxi-5Sil MS columns are rugged enough to withstand high temperatures and harsh conditions and still provide the low bleed levels needed for accurate, reliable MS performance.

Why Choose an Rxi-5Sil MS Column?	Feature	Benefit
	Robust, stable column chemistry	Maximize instrument uptime. Save money and stay productive with less conditioning and less detector maintenance.
	Enhanced selectivity	Ensure accurate data with optimum resolution.
	Low bleed (high thermal stability)	Excellent MS data quality, low background noise, low detection limits, and fast analysis times.
	Restek controls the entire manufacturing process	Reliable column-to-column accuracy and reproducibility ensures consistent performance and increased confidence in your data.
	Available in Integra-Guard formats (integrated guard and analytical columns)	Get the protection of a guard column without the risk of problems caused by a poor connection.

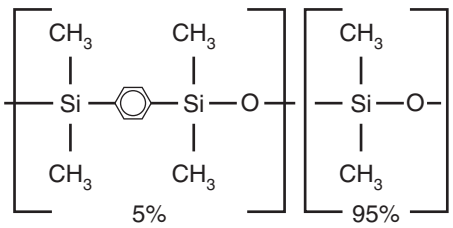
What Makes an Rxi-5Sil MS Column So Unique?

Rxi-5Sil MS columns contain a silarylene-modified stationary phase, which provides nearly identical selectivity to traditional 5-type phases, but with much greater thermal stability. This is accomplished by incorporating phenylene groups into the polysiloxane backbone, forming silarylene copolymers that increase phase rigidity and prevent phase bleed (Figure 1). The silarylene copolymer reduces column bleed and increases robustness, allowing for a higher maximum temperature.

In addition to employing a silarylene-stabilized stationary phase, Restek controls all facets of column manufacturing: we draw our own fused silica tubing, manufacture polymers, and individually check each column against industry standard specifications for column performance parameters, such as efficiency, selectivity, inertness, and bleed. By choosing a Restek Rxi-5Sil MS column, you are ensuring you will get the maximum value from your MS investment. Regardless of your industry, if your GC-MS method requires high temperatures or other challenging conditions, using a long-lasting Rxi-5Sil MS column can help you improve both data quality and instrument productivity.

Rugged Rxi-5Sil MS columns are ideal for trace-level GC-MS analyses of a broad range of compounds. Review the example applications shown here; then try an Rxi-5Sil MS column for yourself!

Figure 1: The silarylene-based Rxi-5Sil MS phase structure is exceptionally robust, making it ideal for GC-MS work at high temperatures.



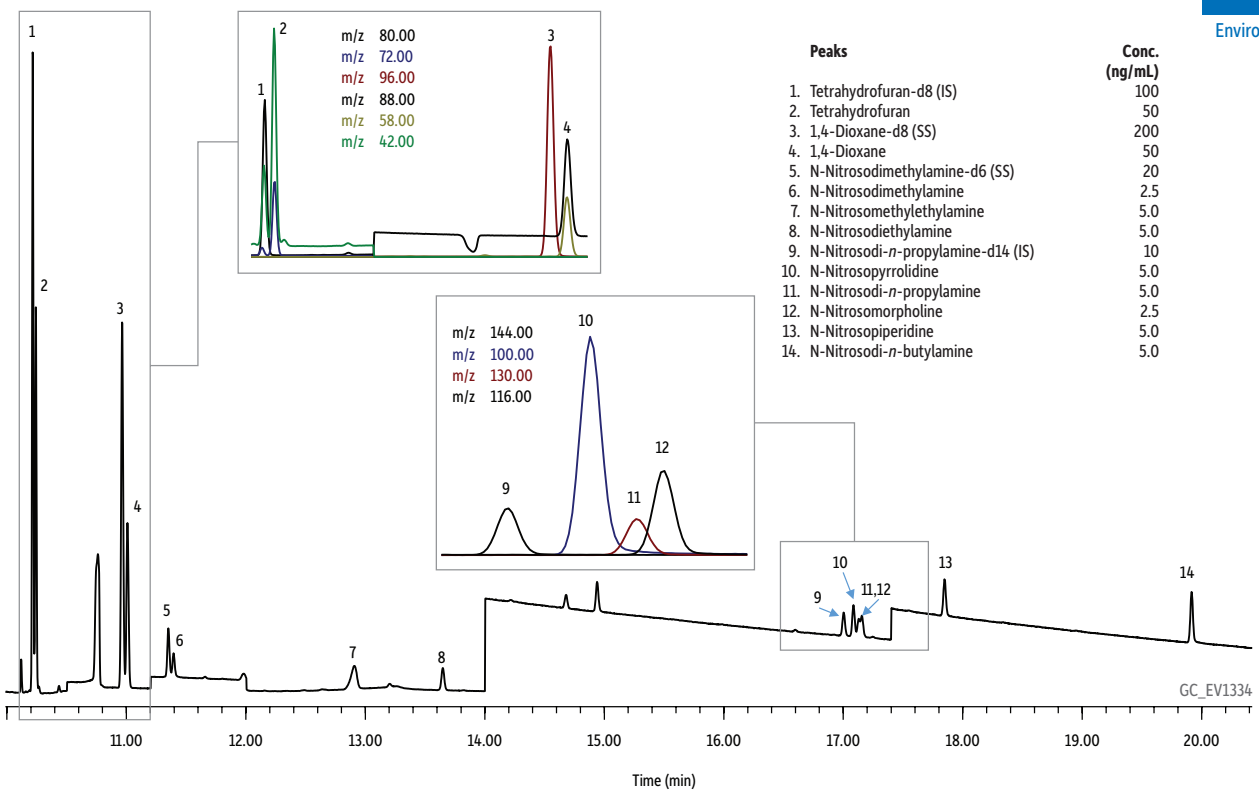
High Thermal Stability Rxi-5Sil MS Columns Provide Accurate MS Results for Nitrosamines and 1,4-Dioxane at Trace Levels in Drinking Water

1,4-Dioxane and various nitrosamines are carcinogenic drinking water contaminants. 1,4-Dioxane is a common additive used to stabilize chlorinated solvents; it is introduced into groundwater though the improper disposal of solvents. Nitrosamines are an emerging class of contaminants and are byproducts of drinking water disinfection. As shown in Figure 2, Restek has developed a simple combined method for trace-level determination of 1,4-dioxane and nitrosamines in drinking water that can be run on a relatively inexpensive GC-MS in EI mode, rather than by GC-MS/MS or by GC-MS in PCI mode. This method relies on the concurrent solvent recondensation–large volume splitless injection (CSR-LVSI) described by Magni and Porzano [1,2] to introduce sufficient analyte mass onto the column. Although drinking water samples are relatively clean, the large volume injection introduces coextracted matrix interferences onto the column. The temperature stability of the Rxi-5Sil MS column allows for a high-temperature hold after each analysis to ensure that carryover is not a source of interference in subsequent analyses.

Tech Tip: For complete full method conditions and an explanation of CSR-LVSI and its benefits, visit **www.restek.com** and enter **EVAN1922A-UNV** in the search.

Figure 2: Rxi-5Sil MS columns allow the combined analysis of low levels of 1,4-dioxane and various nitrosamine drinking water contaminants using CSR-LVSI and GC-MS.

Environmental



Peaks	Conc. (ng/mL)
1. Tetrahydrofuran-d8 (IS)	100
2. Tetrahydrofuran	50
3. 1,4-Dioxane-d8 (SS)	200
4. 1,4-Dioxane	50
5. N-Nitrosodimethylamine-d6 (SS)	20
6. N-Nitrosodimethylamine	2.5
7. N-Nitrosomethylethylamine	5.0
8. N-Nitrosodiethylamine	5.0
9. N-Nitrosodi-*n*-propylamine-d14 (IS)	10
10. N-Nitrosopyrrolidine	5.0
11. N-Nitrosodi-*n*-propylamine	5.0
12. N-Nitrosomorpholine	2.5
13. N-Nitrosopiperidine	5.0
14. N-Nitrosodi-*n*-butylamine	5.0

Column: Rxi-5Sil MS, 30 m, 0.25 mm ID, 1.00 µm (cat.# 13653) using Rxi guard column 10 m, 0.53 mm ID (cat.# 10073) with SGE µ-union; **Sample:** N-Nitrosodimethylamine-d6 (cat.# 33910), 1,4-Dioxane-d8 (cat.# 30614), N-Nitrosodi-*n*-propylamine-d14 (cat.# 33911), Tetrahydrofuran-d8 (cat.# 30112), Nitrosamine calibration mix, Method 521 (cat.# 31898), Appendix IX mix #1, revised (cat.# 32459); Diluent: Dichloromethane; **For full list of conditions search for chromatogram# GC_EV1334 at www.restek.com**

1. P. Magni, T. Porzano, Concurrent solvent recondensation large sample volume splitless injection, J. Sep. Sci. 26 (2003).
2. Patent No: U.S. 6,955,709 B2.

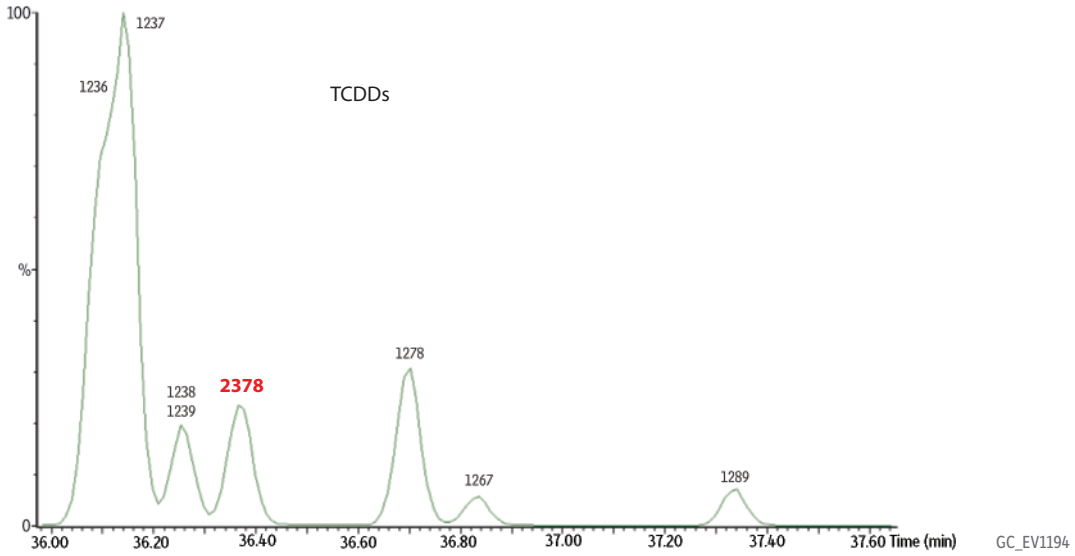
Rxi-5Sil MS Columns Accurately Determine Dioxins and Furans in Challenging Matrices

Chlorinated dioxins and furans comprise a large class of persistent organic pollutants (POPs) that are known to bioaccumulate and to biomagnify, which significantly impact human health and the environment. Dioxin analyses are challenging in that there is a total of 210 potential compounds and isomers in the classes of polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Only 17 of these compounds are toxic; however, the toxic species must be chromatographically resolved from other interfering dioxins or furans in order to obtain accurate measurements of the amount of toxic compounds in a sample. When the Rxi-5Sil MS column is used in conjunction with Restek's Rtx-Dioxin2 column, full, unequivocal quantification of all dioxins can be achieved. On its own, the Rxi-5Sil MS column fully resolves 15 of the 17 toxic congeners, including 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) (Figure 3), which is something that traditional 5-type phases cannot accomplish. In addition, the 350 °C maximum temperature of the Rxi-5Sil MS column allows elution of interfering matrix components between analyses.

Figure 3: The Rxi-5Sil MS column allows separation of toxic congeners from interfering dioxins and furans. In addition, its high temperature tolerance allows matrix interferences to be removed using high-temperature holds between analytical runs.

Environmental

A: Tetrachlorinated Dibenzodioxins (TCDDs)



B: Pentachlorinated Dibenzodioxins (PeCDDs)

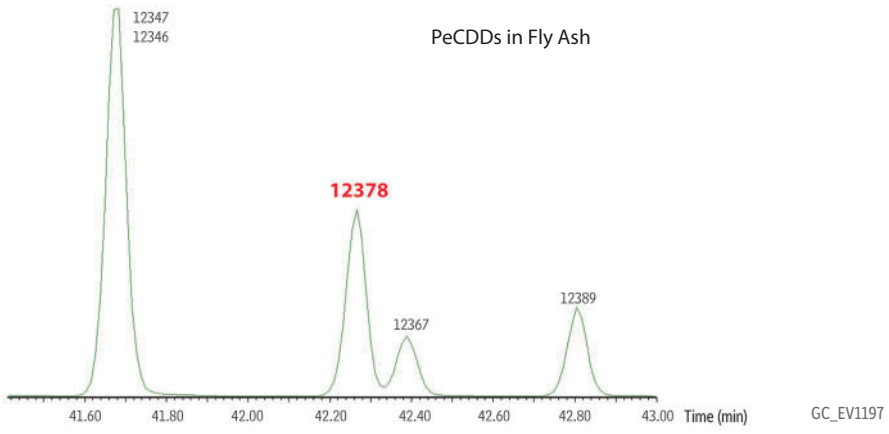
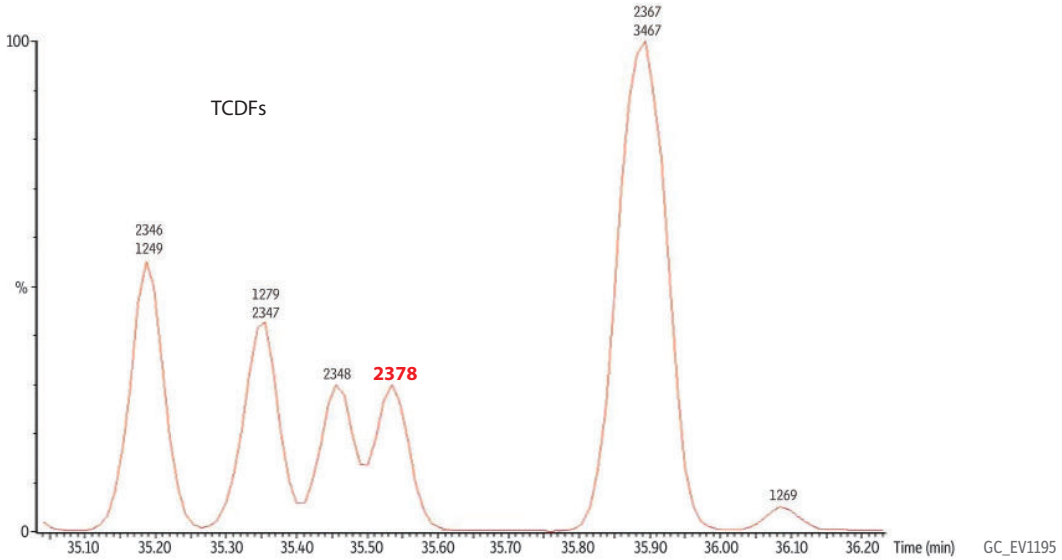


Figure 3 continued on page 5.

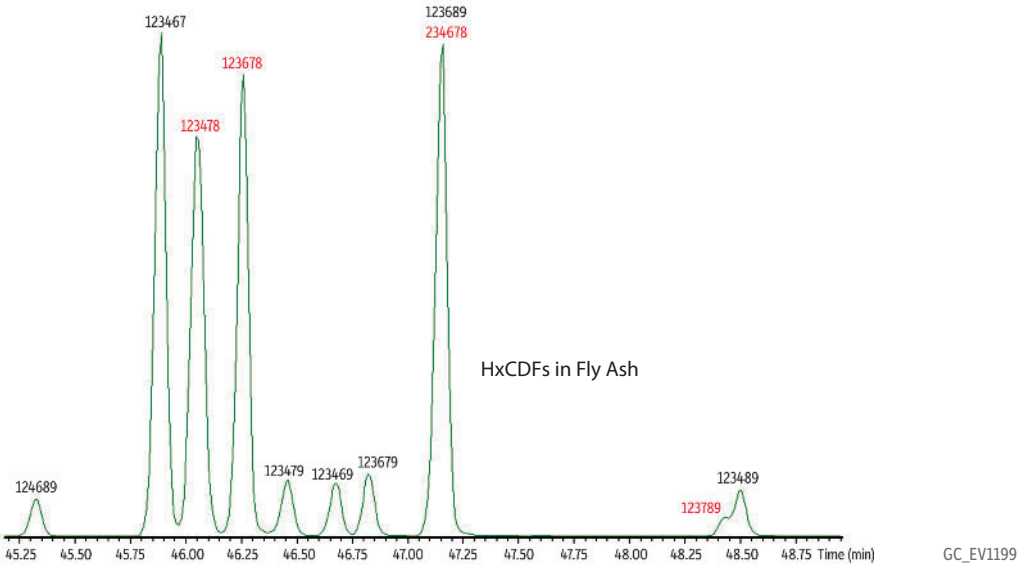
Column: Rxi-5Sil MS, 60 m, 0.18 mm ID, 0.10 µm (cat.# 43607); **Sample:** Fly ash extract; Diluent: Nonane; **Injection:** Inj. Vol.: 1 µL splitless; Liner: 2 mm splitless liner (cat.# 20712); **Oven:** 120 °C (hold 1 min) to 160 °C at 10 °C/min to 300 °C at 2.5 °C/min; **Carrier Gas:** He, constant flow; Flow Rate: 1 mL/min; **Detector:** Waters AutoSpec Ultima mass spectrometer; Source Temp.: 280 °C; Ionization Mode: EI, electron ionization at 40 eV; **Notes:** Red indicates toxicity; **Acknowledgement:** Chromatogram courtesy of Karen MacPherson, Li Shen, Terry Kolic, and Eric Reiner at the Ontario Ministry of the Environment.

Figure 3 *(continued)*

C: Tetrachlorinated Dibenzofurans (TCDFs)

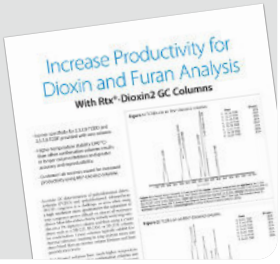


D: Hexachlorinated Dibenzofurans (HxCDFs)



Tech Tip: The Rtx-Dioxin2 column is recommended for use with the Rxi-5Sil MS column for comprehensive, accurate quantification of dioxin congeners. In contrast with the traditional cyano-type phase used for this analysis, the Rtx-Dioxin2 column has a maximum temperature of 340 °C, allowing it to be used in the same oven as the Rxi-5Sil MS column in order to increase productivity.

To learn more about dioxin analysis and how one lab improved their productivity, visit **www.restek.com** and enter **GNTS1511-UNV** in the search.



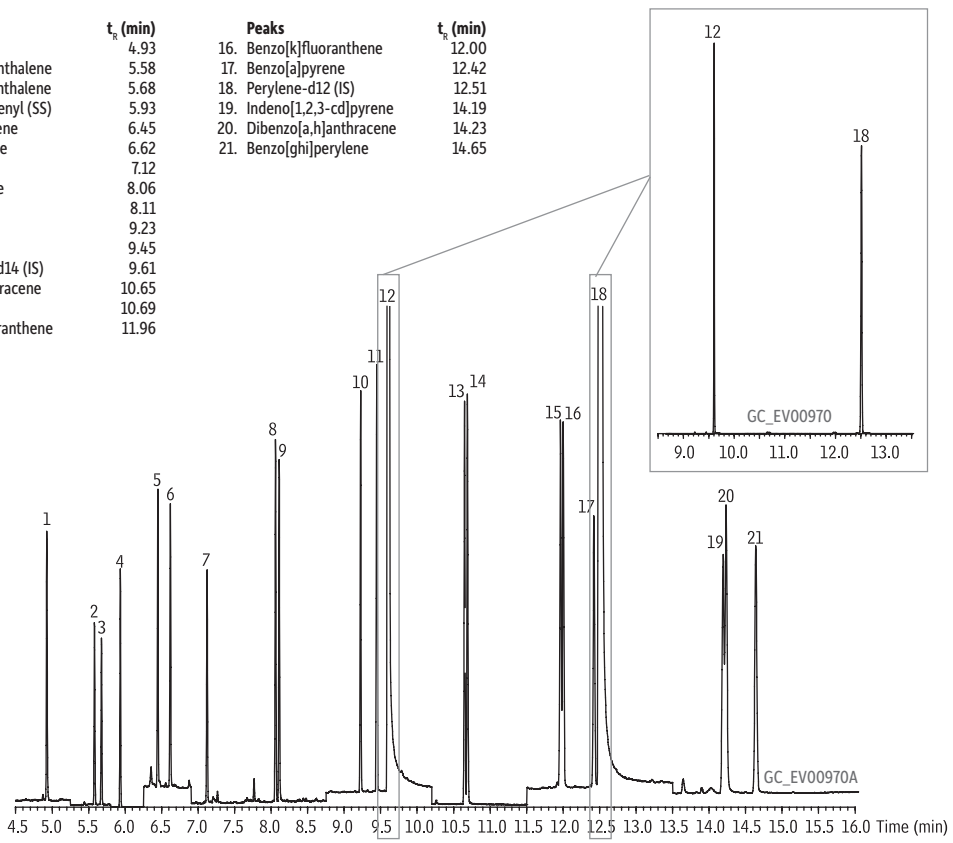
Get the Right Results Fast—Accurately Detect Key Polycyclic Aromatic Hydrocarbons Using Thermally Stable Rxi-5Sil MS Columns

Polycyclic aromatic hydrocarbons (PAHs) are byproducts of combustion and are created when products like coal, oil, gas, or garbage are not completely burned. PAHs persist in the environment and bioaccumulate. While some PAHs have no toxic potential, other PAHs (e.g., benz[a]anthracene) have considerable toxicological impacts, including carcinogenicity. PAHs are relatively inert and respond very well for GC-MS analyses; however, PAH analyses are complicated in that the compounds of interest encompass a relatively wide volatility range with the heaviest PAHs eluting at high oven temperatures. As shown in Figure 4, the high maximum temperature of the Rxi-5Sil MS column allows for fast elution of even the heavier PAHs, reducing run times and eliminating carryover of matrix components into subsequent runs. Additionally, the low bleed of the Rxi-5Sil MS column allows for very low-level SIM analyses for PAHs without interference from bleed ions.

Figure 4: Accurately quantify low levels of a wide range of PAHs without interference from column bleed using robust Rxi-5Sil MS columns.

Environmental

Peaks	t_R (min)
1. Naphthalene	4.93
2. 2-Methylnaphthalene	5.58
3. 1-Methylnaphthalene	5.68
4. 2-Fluorobiphenyl (SS)	5.93
5. Acenaphthylene	6.45
6. Acenaphthene	6.62
7. Fluorene	7.12
8. Phenanthrene	8.06
9. Anthracene	8.11
10. Fluoranthene	9.23
11. Pyrene	9.45
12. *p*-Terphenyl-d14 (IS)	9.61
13. Benzo[a]anthracene	10.65
14. Chrysene	10.69
15. Benzo[b]fluoranthene	11.96
16. Benzo[k]fluoranthene	12.00
17. Benzo[a]pyrene	12.42
18. Perylene-d12 (IS)	12.51
19. Indeno[1,2,3-cd]pyrene	14.19
20. Dibenzo[a,h]anthracene	14.23
21. Benzo[ghi]perylene	14.65



Column	Rxi-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	PAH mix, 1 µL of 0.005 µg/mL (IS 2 µg/mL) SV calibration mix #5 / 610 PAH mix (cat.# 31011) 1-Methylnaphthalene (cat.# 31283) 2-Methylnaphthalene (cat.# 31285) 2-Fluorobiphenyl (cat.# 31091)
Conc.:	5 pg on-column
Injection	
Inj. Vol.:	1.0 µL pulsed splitless (hold 0.15 min)
Liner:	Drilled Uniliner (hole near top) w/wool (cat.# 21055-200.5)
Inj. Temp.:	300 °C
Pulse Pressure:	20 psi (137.9 kPa)
Pulse Time:	0.2 min
Purge Flow:	60 mL/min
Oven	
Oven Temp.:	50 °C (hold 0.5 min) to 290 °C at 25 °C/min to 320 °C at 5 °C/min
Carrier Gas	He, constant flow
Flow Rate:	1.4 mL/min

Detector	MS
Mode:	SIM
SIM Program:	

Group	Start Time (min)	Ion(s) (m/z)	Dwell (ms)
1	4.00	128	100
2	5.25	142	100
3	5.80	172	100
4	6.25	152	100
5	6.90	166	100
6	7.60	178	100
7	8.75	202, 244	100
8	10.2	228	100
9	11.5	252, 264	100
10	13.5	276, 278	100

Transfer Line Temp.:	290 °C
Ionization Mode:	EI

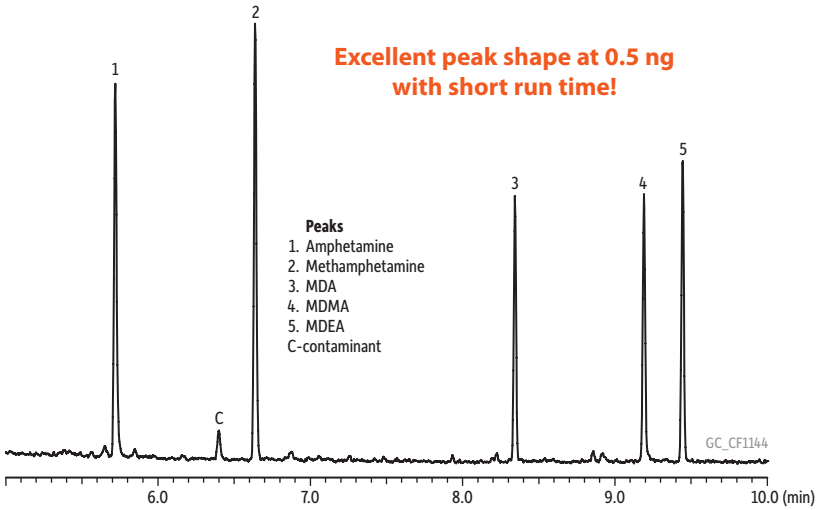
Maximize Instrument Uptime: Rxi-5Sil MS Columns Even Withstand Exposure to Derivatization Reagents

In addition to its utility in other industries, the rugged, low-bleed performance of the Rxi-5Sil MS column makes it well suited to the needs of clinical and forensic laboratories. The outstanding robustness imparted by the Rxi-5Sil MS column stationary phase allows labs to analyze more biological samples per column than when using standard 5-type phases, which reduces both downtime and expenditures for consumables. Analysis of amphetamines in urine or whole blood is a common, yet challenging, test procedure for these labs as amphetamines are basic compounds that should be derivatized prior to GC analysis. Derivatization reagents can produce harsh byproducts that cause phase degradation in GC columns. As shown in Figure 5, the Rxi-5Sil MS column stands up to derivatization reagents extremely well, ensuring a long life for your analytical column.

Another very common test procedure is the analysis of cannabinoids in urine. This test requires GC-MS analysis of low levels of delta-9-tetrahydrocannabinol (THC) metabolites in a difficult and dirty biological matrix. Additionally, derivatized cannabinoids have high molecular weights and elute at high oven temperatures. Column bleed at these higher temperatures can cause interference with low-level cannabinoids, reducing response and complicating integration. The rugged stationary phase of the Rxi-5Sil MS column ensures the low bleed required for this high-temperature, trace-level analysis with the robustness to stand up to dirty biological matrix components (Figure 6).

Figure 5: Robust Rxi-5Sil MS columns do not break down under harsh conditions, such as exposure to the derivatization reagents used in amphetamines analysis. (Compounds shown are HFAA derivatives.)

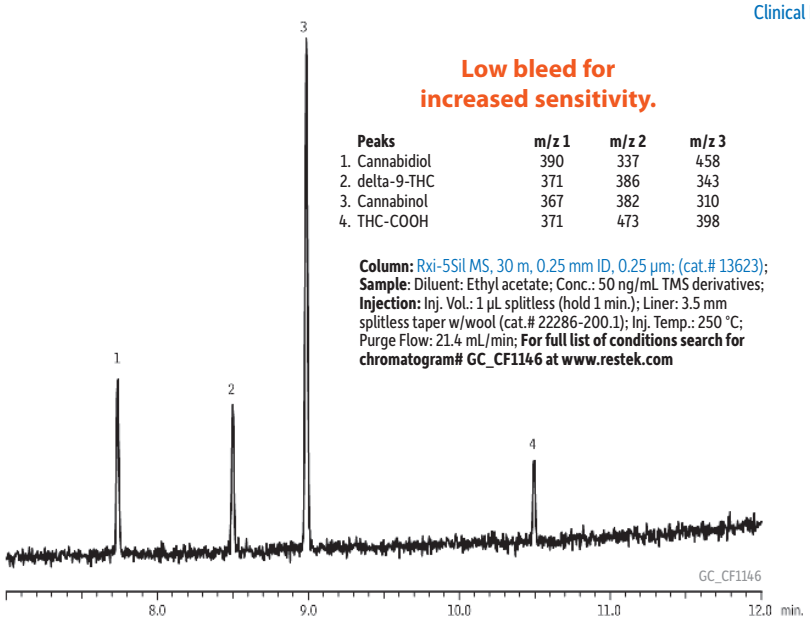
Clinical Forensic



Column: Rxi-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623); **Sample:** 500 ng/mL HFAA derivatives in butyl chloride; **Injection:** Inj. Vol.: 1 µL splitless (hold 1 min); Liner: 3.5 mm splitless taper w/wool (cat.# 22286-200.1); Inj. Temp.: 250 °C; Purge Flow: 28 mL/min; **For full list of conditions search for chromatogram# GC_CF1144 at www.restek.com**

Figure 6: High signal response is obtained for derivatized cannabinoids at just 0.05 ng on-column, due to the low-bleed characteristics of the Rxi-5Sil MS column. (Compounds shown are TMS derivatives.)

Clinical Forensic



Tech Tip: For other clinical and forensic applications on the Rxi-5Sil MS column, visit **www.restek.com**

Restek's Rxi-5Sil MS column offers the rugged, low-bleed performance needed for difficult GC-MS analyses across many industries. Make your next column purchase an Rxi-5Sil MS column and save time and money with fewer column replacements.

Rugged, Low-Bleed Performance for Challenging GC-MS Work

If your GC-MS method requires high temperatures or harsh derivatization reagents, you will benefit from using a robust, low-bleed Rxi-5Sil MS column from Restek.

Rxi-5Sil MS Columns (fused silica)

low-polarity phase; Crossbond 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane

- General-purpose columns for GC-MS analysis of most semivolatiles, polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- Temperature range: -60 °C to 350 °C.
- Some dimensions also available as Integra-Guard columns — a guard and analytical column in one to eliminate connection problems!

ID	df	Length	Temp. Limits	qty.	cat.#
0.10 mm	0.10 µm	10 m	-60 to 320/350 °C	ea.	43601
0.15 mm	0.15 µm	10 m	-60 to 320/350 °C	ea.	43815
	0.15 µm	20 m	-60 to 320/350 °C	ea.	43816
	2.0 µm	20 m	-60 to 320/350 °C	ea.	43817
0.18 mm	0.10 µm	60 m	-60 to 320/350 °C	ea.	43607
	0.18 µm	20 m	-60 to 320/350 °C	ea.	43602
	0.18 µm	40 m	-60 to 320/350 °C	ea.	43605
	0.36 µm	20 m	-60 to 320/350 °C	ea.	43604
0.25 mm	0.10 µm	15 m	-60 to 320/350 °C	ea.	13605
	0.10 µm	30 m	-60 to 320/350 °C	ea.	13608
	0.25 µm	15 m	-60 to 320/350 °C	ea.	13620
	0.25 µm	30 m	-60 to 320/350 °C	ea.	13623
	0.25 µm	30 m	-60 to 320/350 °C	6-pk.	13623-600
	0.25 µm	60 m	-60 to 320/350 °C	ea.	13626
	0.50 µm	15 m	-60 to 320/350 °C	ea.	13635
	0.50 µm	30 m	-60 to 320/350 °C	ea.	13638
	1.00 µm	15 m	-60 to 320/350 °C	ea.	13650
	1.00 µm	30 m	-60 to 320/350 °C	ea.	13653
	1.00 µm	60 m	-60 to 320/350 °C	ea.	13697
0.32 mm	0.25 µm	15 m	-60 to 320/350 °C	ea.	13621
	0.25 µm	30 m	-60 to 320/350 °C	ea.	13624
	0.50 µm	30 m	-60 to 320/350 °C	ea.	13639
	1.00 µm	30 m	-60 to 320/350 °C	ea.	13654
0.53 mm	1.50 µm	30 m	-60 to 320/330 °C	ea.	13670

Topaz 4.0 mm ID Single Taper Inlet Liner w/ Wool

for Agilent GCs equipped with split/splitless inlets

Length	ID	OD	Deactivation	Material	Packing	qty	cat.#
78.5 mm	4.0 mm	6.5 mm	Premium	Borosilicate Glass	Quartz Wool	5-pk.	23303

Topaz 4.0 mm ID Single Taper Inlet Liner

for Agilent GCs equipped with split/splitless inlets

Length	ID	OD	Deactivation	Material	Packing	qty	cat.#
78.5 mm	4.0 mm	6.5 mm	Premium	Borosilicate Glass		5-pk.	23302

Topaz 4.0 mm ID Straight Inlet Liner

for Agilent GCs equipped with split/splitless inlets

Length	ID	OD	Deactivation	Material	qty	cat.#
78.5 mm	4.0 mm	6.3 mm	Premium	Borosilicate Glass	5-pk.	23301

Topaz 4.0 mm ID Precision Inlet Liner w/ Wool

for Agilent GCs equipped with split/splitless inlets

Length	ID	OD	Deactivation	Material	Packing	qty	cat.#
78.5 mm	4.0 mm	6.3 mm	Premium	Borosilicate Glass	Quartz Wool	5-pk.	23305

Topaz 2.0 mm ID Single Taper Inlet Liner w/ Wool

for Agilent GCs equipped with split/splitless inlets

Length	ID	OD	Deactivation	Material	Packing	qty	cat.#
78.5 mm	2.0 mm	6.5 mm	Premium	Borosilicate Glass	Quartz Wool	5-pk.	23316

Topaz 4.0 mm ID Cyclo Double Taper Inlet Liner

for Agilent GCs equipped with split/splitless inlets

Length	ID	OD	Deactivation	Material	qty	cat.#
78.5 mm	4.0 mm	6.5 mm	Premium	Borosilicate Glass	5-pk.	23310

RESTEK
Pure Chromatography

Questions? Contact us or your local Restek representative (www.restek.com/contact-us).

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Lit. Cat.# GNSS2201A-UNV