Specialty Columns by Application

Specialty columns

- Designed for specific classes of compounds.
- Specially deactivated columns.

Many chromatography markets and applications represented

- Foods, Flavors, & Fragrances.
- Petrochemical.
- Clinical/Forensic.
- Pharmaceutical.
- Environmental.

Unique stationary phases and applications

- Designed to help solve chromatographic challenges.

Basic Compounds Analysis

Rtx®-5 Amine (low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

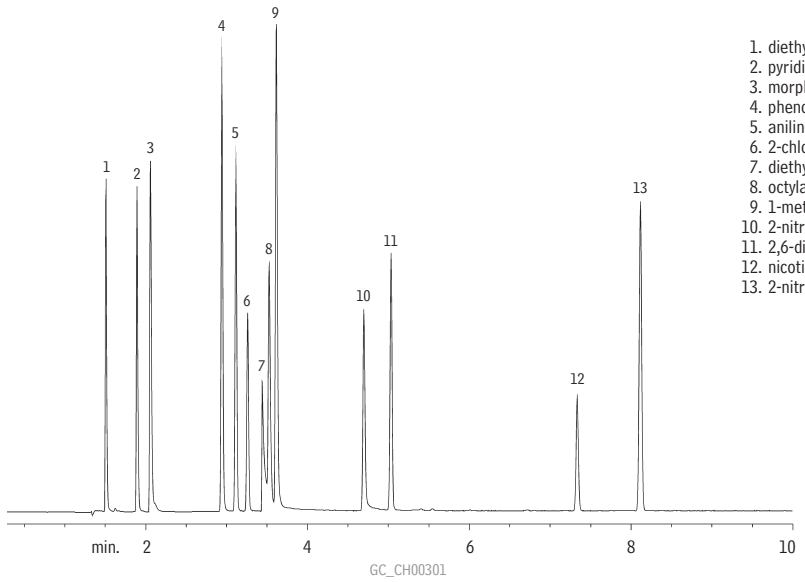
- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 315°C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-5 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-5 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding, or even weakly acidic compounds such as phenols. Every Rtx®-5 Amine column is tested to ensure that it exceeds the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

Rtx®-5 Amine Columns (fused silica)
(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	-60 to 300/315°C	12320	12323
	0.50	-60 to 300/315°C	12335	12338
	1.00	-60 to 300/315°C	12350	12353
0.32mm	1.00	-60 to 300/315°C	12351	12354
	1.50	-60 to 290/305°C	12366	12369
0.53mm	1.00	-60 to 290/305°C	12352	12355
	3.00	-60 to 280/295°C	12382	12385

Excellent peak shapes for amines & phenols on an Rtx®-5 Amine column.



1. diethylamine
2. pyridine
3. morpholine
4. phenol
5. aniline
6. 2-chlorophenol
7. diethylenetriamine
8. octylamine
9. 1-methyl-2-pyrrolidinone
10. 2-nitrophenol
11. 2,6-dimethylaniline
12. nicotine
13. 2-nitroaniline

Column:	Rtx®-5 Amine, 30m, 0.32mm ID, 1.0µm (cat.# 12354)
Inj.:	1.0µL split injection of amines and phenols in water
On-column conc.:	22ng
Oven temp.:	120°C to 220°C @ 10°C/min.
Inj./det. temp.:	305°C
Carrier gas:	hydrogen
Linear velocity:	38cm/sec. set @ 120°C
FID sensitivity:	6.4 x 10^{-11} AFS
Split ratio:	25:1

restek **innovation**!

similar **phase**

PTA-5

also **available**

See **page 58** for Rtx®-35 Amine columns.

please **note**

We recommend using base-deactivated fused silica guard columns **(page 29)** and base-deactivated liners (Instrument Supplies section of this catalog) with Rtx®-5 Amine columns.

Table of Contents for **Applications** see **pages 518-519**

restek
innovation!

Basic Compounds Analysis

Rtx®-35 Amine (midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

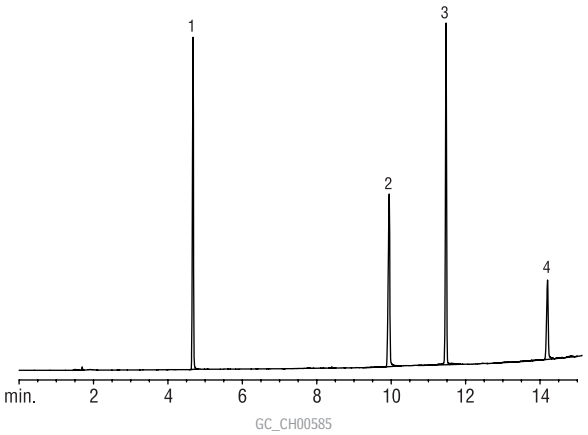
- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 220°C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-35 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-35 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding. Every Rtx®-35 Amine column is tested to ensure that it meets the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

Rtx®-35 Amine Columns (fused silica)
(Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.50	0 to 220°C	11335	11338
	1.00	0 to 220°C	11350	11353
0.32mm	1.00	0 to 220°C	11351	11354
	1.50	0 to 220°C	11366	11369
0.53mm	1.00	0 to 220°C	11352	11355
	3.00	0 to 220°C	11382	11385

Sharp ethanolamine peaks, low bleed: Rtx®-35 Amine column.



1. monoethanolamine
2. diethanolamine
3. triethyleneglycol monomethylether
4. triethanolamine

Column:	Rtx®-35 Amine, 30m, 0.32mm ID, 1.0µm (cat.# 11354)
Sample:	500µg/mL ethanolamine standard in water
Inj.:	1.0µL split (split ratio 10:1), cup splitter inlet liner (cat.# 20709)
Inj. temp.:	300°C
Carrier gas:	helium, constant pressure
Linear velocity:	40cm/sec. @ 50°C
Oven temp.:	50°C (hold 0.50 min.) to 280°C @15°C/min.
Det.:	FID @ 300°C

Table of Contents for
Applications
see pages 518-519

Basic Compounds Analysis

Stabilwax®-DB (polar phase; Crossbond® base-deactivated Carbowax® polyethylene glycol)

- Application-specific columns for underivatized amines and other basic compounds, including alkylamines, diamines, triamines, nitrogen-containing heterocyclics. No need for column priming.
- Temperature range: 40°C to 220°C.

Stabilwax®-DB columns reduce adsorption and improve responses for many basic compounds, without analyte derivatization or column priming. For different selectivity of basic compounds, or higher oven temperatures, use an Rtx®-5 Amine or Rtx®-35 Amine column.

Stabilwax®-DB is a bonded stationary phase, but avoid rinsing these columns with water or alcohols.

Stabilwax®-DB Columns (fused silica)

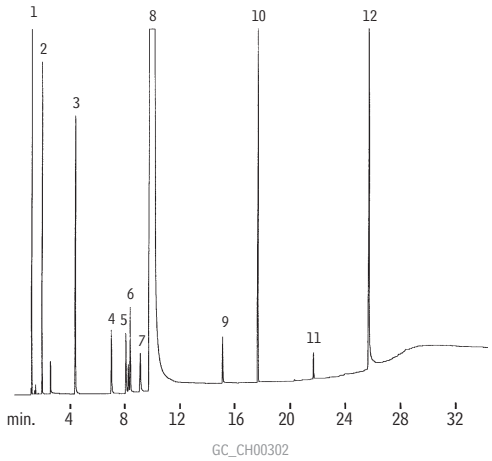
(Crossbond® Carbowax® polyethylene glycol for amines and basic compounds)

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	40 to 210/220°C	10820	10823	
	0.50	40 to 210/220°C		10838	
0.32mm	0.25	40 to 210/220°C	10821	10824	
	0.50	40 to 210/220°C		10839	
	1.00	40 to 210/220°C	10851	10854	10857
0.53mm	0.50	40 to 210/220°C		10840	
	1.00	40 to 210/220°C	10852	10855	10858
	1.50	40 to 210/220°C		10869	

similar phases

DB-CAM, Carbowax® Amine, CP Wax 51 for amines

Hexamethylenediamine on a Stabilwax®-DB column.



1. cyclohexane
2. hexamethyleneimine
3. 1,4-diaminobutane
4. pentamethylenediamine
5. 1,2-diaminocyclohexane
6. 1,5-diamino-2-methylpentane
7. aminomethylcyclopentylamine
8. hexamethylenediamine
9. 6-aminocapronitrile
10. *n*-valeramide
11. adiponitrile
12. bis-hexamethylenetriamine

Column:	Stabilwax®-DB, 30m, 0.32mm ID, 0.25µm (cat.# 10824)
Inj.:	0.4µL direct injection of a neat hexamethylenediamine sample
On-column conc.:	10 to 1000ng/component
Oven temp.:	95°C (hold 6 min.) to 235°C @ 7°C/min. (hold 4 min.)
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	2 x 10^{-11} AFS

Acidic Compounds Analysis

Steve Allison
R&D Group Leader
1+ year of service!

Stabilwax®-DA (polar phase; Crossbond® acid-deactivated Carbowax® polyethylene glycol)

- Application-specific columns for free (underivatized) acids, some inorganic acids.
- Resistant to oxidative damage.
- Temperature range: 40°C to 250°C.
- Equivalent to USP G25, G35 phases.

Stabilwax®-DA bonded polyethylene glycol has an acidic functionality incorporated into the polymer structure. This permits analysis of acidic compounds without derivatization, significantly reduces adsorption of acids, and increases sample capacity for volatile free acids. Stabilwax®-DA columns last longer and give better peak shapes for high molecular weight acids. Some inorganic acids also chromatograph well on a Stabilwax®-DA column; the limitation is the volatility of the acidic compound.

similar phases

DB-FFAP, HP-FFAP, NUKOL, OV-351, CP-Wax 58 CB, FFAP

Stabilwax®-DA Columns (fused silica)
(Crossbond® Carbowax® polyethylene glycol for acidic compounds)

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	40 to 250°C	11005	11008	11011
	0.25	40 to 250°C	11020	11023	11026
	0.50	40 to 250°C	11035	11038	11041
0.32mm	0.10	40 to 250°C	11006	11009	11012
	0.25	40 to 250°C	11021	11024	11027
	0.50	40 to 250°C	11036	11039	11042
	1.00	40 to 240/250°C	11051	11054	11057
0.53mm	0.10	40 to 250°C	11007	11010	11013
	0.25	40 to 250°C	11022	11025	11028
	0.50	40 to 250°C	11037	11040	11043
	1.00	40 to 240/250°C	11052	11055	11058
	1.50	40 to 230/240°C	11062	11065	11068

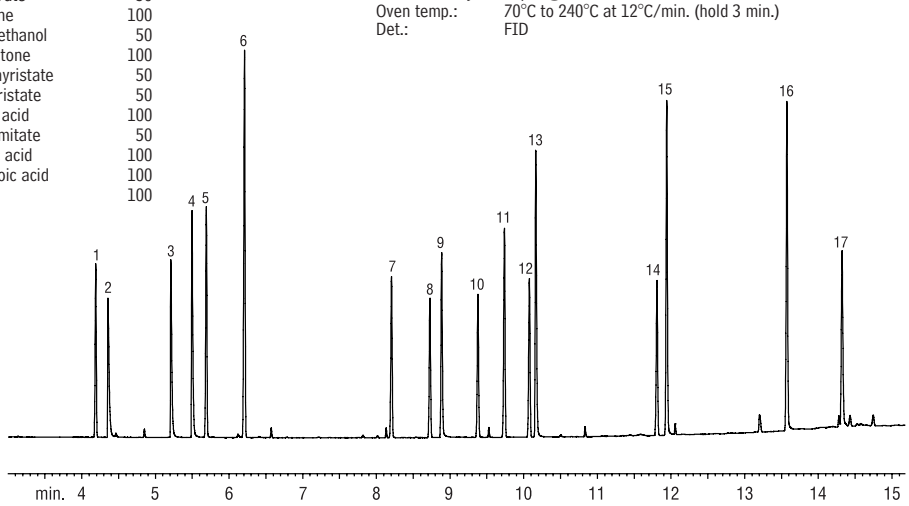
crossbond® technology

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

Underivatized alcoholic beverage acids and methyl esters on a Stabilwax®-DA column.

Peak List	Conc. (ppm)
1. ethyl octanoate	100
2. acetic acid	100
3. propionic acid	100
4. isobutyric acid	100
5. 3-decanol	50
6. ethyl decanoate	50
7. ethyl laurate	50
8. *cis*-lactone	100
9. 2-phenylethanol	50
10. *trans*-lactone	100
11. methyl myristate	50
12. ethyl myristate	50
13. octanoic acid	100
14. ethyl palmitate	50
15. decanoic acid	100
16. dodecanoic acid	100
17. vanillin	100

Column: Stabilwax®-DA, 30m, 0.18mm ID, 0.18µm (cat.# 550752)
Inj.: 1µL splitless (hold 0.5 min.) at conc. shown in peak list, in ethyl acetate, 4mm ID splitless liner w/wool (cat.# 20814-202.1)
Inj. temp.: 240°C
Carrier gas: hydrogen
Make-up gas: nitrogen
Linear velocity: 28psi @ 240°C
Oven temp.: 70°C to 240°C at 12°C/min. (hold 3 min.)
Det.: FID



GC_FF00500

Enantiomers Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

By adding β or γ cyclodextrin to our bonded Rtx®-1701 stationary phase, we greatly enhance overall utility and column lifetime for our chiral columns, compared to columns that have pure cyclodextrin stationary phases. Separations of more than one hundred chiral compounds have been achieved using our unique DEX columns, and our columns continue to demonstrate stability after hundreds of temperature program cycles. Refer to the applications section of this catalog for examples, or call our Technical Service chemists or your Restek representative for assistance in matching a column to your chiral analysis.

Rt™-βDEXm Columns (fused silica)

(permethylated beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13100
0.32mm	0.25	40 to 230°C	13101

Uses: General purpose chiral phase with many published applications.

Rt™-βDEXsm Columns (fused silica)

(2,3-di-O-methyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13105
0.32mm	0.25	40 to 230°C	13104

Uses: Excellent column for most chiral compounds in essential oils.

Rt™-βDEXse Columns (fused silica)

(2,3-di-O-ethyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13107
0.32mm	0.25	40 to 230°C	13106

Uses: Similar in performance to Rt™-βDEXsm but provides better resolution for limonene, linalool, linalyl acetate, ethyl-2-methylbutyrate, 2,3-butane diol, and styrene oxides.

Rt™-βDEXsp Columns (fused silica)

(2,3-di-O-propyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13111
0.32mm	0.25	40 to 230°C	13110

Uses: Often useful in dual-column configurations, with the Rt™-βDEXsm column, for complex enantiomeric separations.

Rt™-βDEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13109
0.32mm	0.25	40 to 230°C	13108

Uses: Unique selectivity for esters, lactones, and other fruit flavor components.

Rt™-βDEXcst Columns (fused silica)

(Proprietary cyclodextrin material doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13103
0.32mm	0.25	40 to 230°C	13102

Uses: Proprietary stationary phase, developed specifically for the fragrance industry. Also used for pharmaceutical applications.

Rt™-γDEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl gamma cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13113
0.32mm	0.25	40 to 230°C	13112

Uses: Larger organic molecules. Also useful for flavor compounds in fruit juices.

free literature

A Guide to the Analysis of Chiral Compounds by GC

Many example chromatograms in our 24-page chiral analysis guide will help you find the best chiral columns for your applications.

Download your free copy from www.restek.com

Technical Guide
lit. cat.# 59889

please note

Application-specific chiral column kits are available! See **page 62**.

free literature

Grape Flavor Analysis, Using an Rt™-γDEXsa GC Column

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Applications Note
lit. cat.# 59553

GC Analysis of Chiral Flavor Compounds in Apple Juices, Using Rt™-βDEXsm and Rt™-βDEXse Columns

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Applications Note
lit. cat.# 59546

Doug Smith
R&D Technician
10+ years of service!

Enantiomers Analysis

Convenient chiral column kits, based on sample type. Enantiomeric profile and confirmational identification of individual chiral compounds.

- Broad range of columns and selectivities.
- Rugged, highly stable columns.
- Extended column lifetime.
- Convenience and cost savings.

For phase descriptions, or to order columns separately, see page 61.

Pharmaceutical Chiral Column Kits

(fused silica)

Dimensions & Columns	cat.#
30m, 0.25mm ID, 0.25µm Rt™-βDEXcst & Rt™-βDEXsm columns	13190
30m, 0.32mm ID, 0.25µm Rt™-βDEXcst & Rt™-βDEXsm columns	13191

Environmental Chiral Column Kits

(fused silica)

Dimensions & Columns	cat.#
30m, 0.25mm ID, 0.25µm Rt™-βDEXcst & Rt™-βDEXsm columns	13192
30m, 0.32mm ID, 0.25µm Rt™-βDEXcst & Rt™-βDEXsm columns	13193

Juices Chiral Column Kits

(fused silica)

Dimensions & Columns	cat.#
30m, 0.25mm ID, 0.25µm Rt™-βDEXse, Rt™-βDEXsm & Rt™-γDEXsa columns	13194
30m, 0.32mm ID, 0.25µm Rt™-βDEXse, Rt™-βDEXsm & Rt™-γDEXsa columns	13195

Essential Oils Chiral Column Kits

(fused silica)

Dimensions & Columns	cat.#
30m, 0.25mm ID, 0.25µm Rt™-βDEXsm, Rt™-βDEXse, Rt™-βDEXsa, & Rt™-βDEXsp columns	13196
30m, 0.32mm ID, 0.25µm Rt™-βDEXsm, Rt™-βDEXse, Rt™-βDEXsa, & Rt™-βDEXsp columns	13197

please note

Application-specific chiral column kits offer convenience and cost savings.

tech tip

Chiral selectivity improves significantly by realizing lower elution temperatures. This can be achieved by:

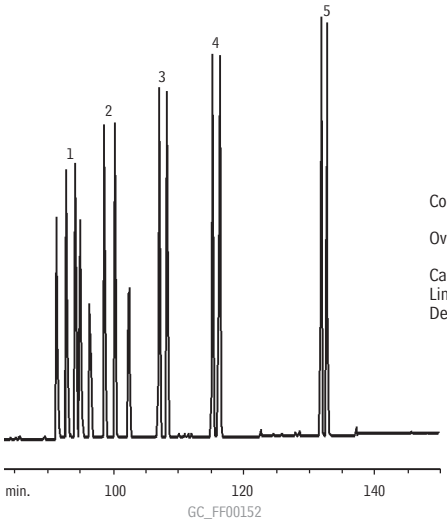
Faster linear velocities (80cm/sec.) with hydrogen carrier gas.

Slower temperature ramp rates (1–2°C/min.).

Appropriate minimum operating temperature (40 or 60°C).

On-column concentrations of 50ng or less.

Complex γ-lactones mix resolved on an Rt™-βDEXcst column.



1. (+/-)γ-heptalactone
2. (+/-)γ-octalactone
3. (+/-)γ-nonalactone
4. (+/-)γ-decalactone
5. (+/-)γ-dodecalactone

Column:	Rt™-βDEXcst, 30m, 0.32mm ID, 0.25µm (cat.# 13102)
Oven temp.:	60°C (hold 1 min.) to 200°C @ 1°C/min.
Carrier gas:	hydrogen
Linear velocity:	40cm/sec. set @ 60°C
Det.:	FID @ 220°C

Table of Contents for **Applications** see pages 518-519

Polyunsaturated FAME Analysis

FAMEWAX (polar phase; Crossbond® polyethylene glycol)
- Application-specific columns for FAMEs, specially tested with a FAME mixture.
- Temperature range: 20°C to 250°C.

The elution order of polyunsaturated FAMEs on FAMEWAX columns is comparable to that on other Carbowax® columns, but baseline resolution is achieved in significantly less time.

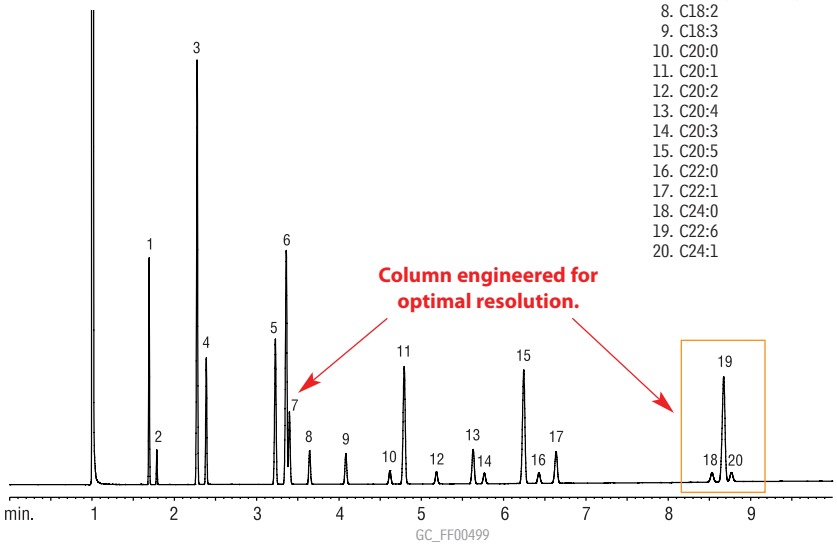
FAMEWAX Columns (fused silica)
(Crossbond® polyethylene glycol)

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	20 to 250°C	12497
0.32mm	0.25	20 to 250°C	12498
0.53mm	0.50	20 to 250°C	12499

FAMEs (marine oil standard) on a FAMEWAX column.

Column: FAMEWAX, 30m, 0.32mm ID, 0.25µm (cat. # 12498)
Inj.: 1µL
Conc.: 10,000µg/mL in isooctane (total FAMES; see breakdown in peak list)
Oven temp.: 195–240°C at 5°C/min., 1 min. hold
Inj./det. temp.: 250°C/275°C
Carrier gas: hydrogen
Flow rate: 3mL/min. (constant flow)
Split ratio: 100:1

Peak List	Conc. (µg/mL)
1. C14:0	600
2. C14:1	100
3. C16:0	1600
4. C16:1	500
5. C18:0	800
6. C18:1 (oleate)	1300
7. C18:1 (vaccenate)	400
8. C18:2	200
9. C18:3	200
10. C20:0	100
11. C20:1	900
12. C20:2	100
13. C20:4	300
14. C20:3	100
15. C20:5	1000
16. C22:0	100
17. C22:1	300
18. C24:0	100
19. C22:6	1200
20. C24:1	100



similar **phase**

Omegawax

free literature

Foods, Flavors, and Fragrances
Includes important analysis tips and chromatograms for analysis of fats and oils, carbohydrates, vitamins, amino acids, organic acids, preservatives, flavors and fragrances, essential oils, and chiral separations. Retention time indices and complete product listings for all relevant GC and HPLC products also are included.

Minicatalog
lit. cat.# 59260A

Monitoring Volatile Compounds in Food Contact Packaging, Using Purge and Trap GC/MS and an Rtx®-5MS Capillary Column

Download your free copy from www.restek.com

Applications Note
lit. cat.# 59348

Flavor and Fragrance Compounds Analysis

Rt™-CW20M F&F (polar phase; Carbowax® polyethylene glycol—not bonded)
- Application-specific columns for flavor and fragrance compounds, specially tested.
- True non-bonded Carbowax® 20M polarity.
- Temperature range: 20°C to 220°C.

Rt™-CW20M F&F Columns (fused silica)
(Carbowax® polyethylene glycol)

ID	df (µm)	temp. limits	30-Meter	50-Meter
0.25mm	0.25	60 to 220°C	12523	
0.32mm	0.33	60 to 220°C		12539

similar **phases**

HP-20M, Carbowax® 20M

Flavor & Fragrance Compounds Analysis

please **note**

Our Rt™-CW20M F&F column is the perfect confirmation column for flavor and fragrance analysis. See page 63.

Rtx®-1 F&F (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns for flavor and fragrance compounds.
- Stable to 350°C.

Retention index libraries in the flavor and fragrance industry have been compiled from years of data and thousands of compounds. Any slight variation in column selectivity could render the column useless. Rtx®-1 F&F columns are tailored to match the selectivity required in the industry, while offering excellent thermal stability. Our stringent quality testing ensures column-to-column reproducibility and extended column lifetimes over conventional 100% dimethyl polysiloxane columns.

similar **phase**

HP-1

Rtx®-1 F&F Columns (fused silica)
(Crossbond® 100% dimethyl polysiloxane)

ID	df (µm)	temp. limits	15-Meter	30-Meter	50-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C		18023		18026
	0.50	-60 to 330/350°C		18038		18041
	1.00	-60 to 320/340°C		18053		18056
0.32mm	0.25	-60 to 330/350°C		18024		18027
	0.50	-60 to 330/350°C		18039	18010	18042
	1.00	-60 to 320°C		18054		18057
0.53mm	0.50	-60 to 310/330°C	18037	18040		18043
	1.00	-60 to 310/330°C	18052	18055		18058
	1.50	-60 to 310/330°C	18067	18070		18073

Fused Silica Manufacturing Group
Jason Fisher, Sheldon McMurtrie, Michele Richner, Tom Barone, Ken Kline, Linda Holden, Tom Gurecki, Jack Haesler, Aaron Decker, Carolyn Williams, Dale Lucas, Kelsea Miller

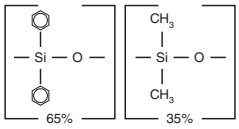
Raymond Ciampichini, Pete Rose, David Rhodes, Jackie Glasgow, Kim Shaffer, Marcia Fulton, Santina Newlen, David W. Rhodes, Henry Knepp, Russ Stewart, Jessica Andrus, Tim Wilson, Bob Langford

Triglycerides in Foods Analysis

Rtx®-65TG (high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)
- Application-specific columns, specially tested for triglycerides.
- Stable to 370°C.

The Rtx®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370°C thermal stability, an Rtx®-65TG column should not be used for analyses of polar compounds.

Rtx®-65TG Structure

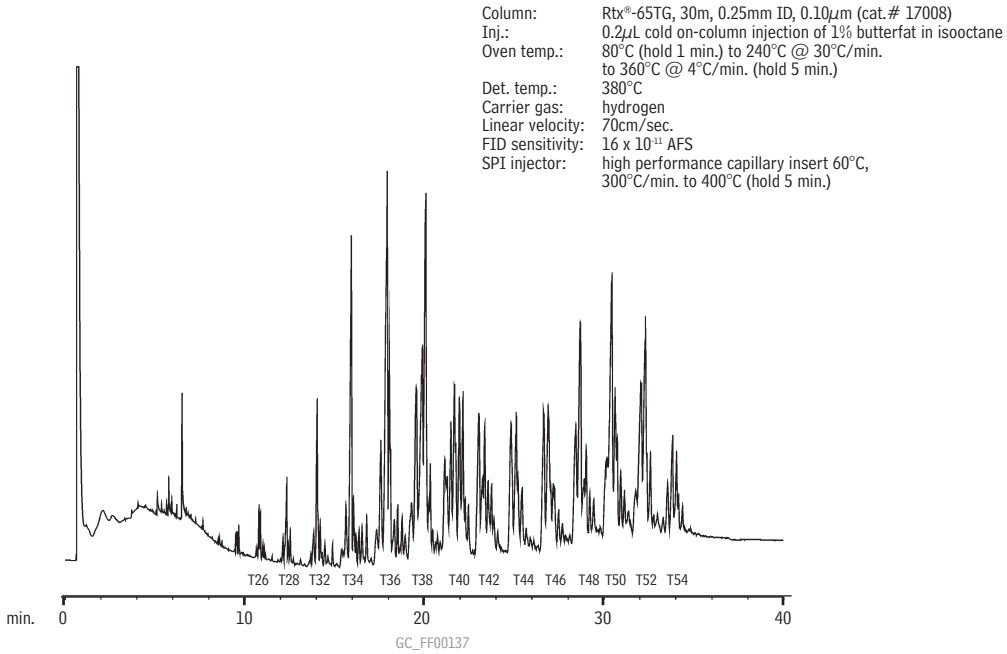


Rtx®-65TG Columns (fused silica)

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.10	40 to 370°C	17005	17008
0.32mm	0.10	40 to 370°C	17006	17009
0.53mm	0.10	40 to 370°C	17007	17010

Sharp resolution of butter triglycerides on an Rtx®-65TG column.



save money!

Get six columns for the price of five. **Call 800-356-1688, ext. 4**, or your Restek representative for details!

crossbond® technology

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

please note

Triglycerides are often injected via on-column injection. Use 0.53mm retention gaps and appropriate connectors.

- Vu2 Union® (page 222)
- MXT™-Union Connector Kits for Fused Silica (page 225)

Detailed Hydrocarbon Analysis (DHA)

please note

To achieve critical resolutions, a 5-meter tuning column is connected to the analytical column and adjusted to the needed length through a series of trial analyses.

similar phases

Petrocol DH, DB-Petro, HP-PONA

Rtx®-1PONA (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns meet ASTM and CGSB requirements for detailed hydrocarbon analysis.
- Stable to 340°C.

The Rtx®-1PONA polymer was designed to offer the exact polarity necessary to resolve hydrocarbons in the specific order requested by petrochemical companies. In order to meet the demanding resolution and retention criteria of the American Society for Testing and Materials (ASTM) and the Canadian General Standards Board (CGSB), Restek has developed unique quality control tests and specifications for the Rtx®-1PONA column. The measured values for retention (k), efficiency (n), and stationary phase selectivity (RI) are controlled so that each column exceeds the requirements of the ASTM and CGSB methods.

Rtx®-1PONA Column (fused silica)

(Crossbond® 100% dimethyl polysiloxane—optimized for hydrocarbon analysis)

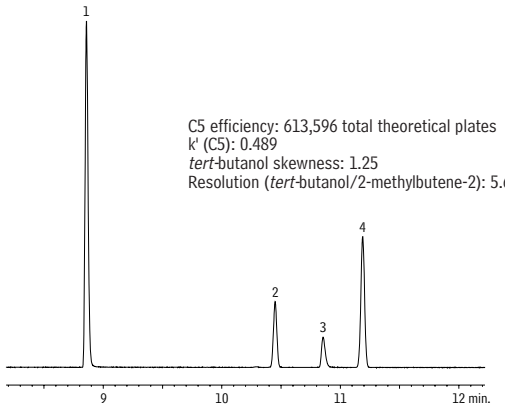
ID	df (µm)	temp. limits	100-Meter
0.25mm	0.50	-60 to 300/340°C	10195

Rtx®-5PONA Tuning Column (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (µm)	temp. limits	5-Meter
0.25mm	1.0	-60 to 325°C	10196

Sharp, symmetric peak for ethanol (gasoline oxygenate), using an Rtx®-1PONA column.**



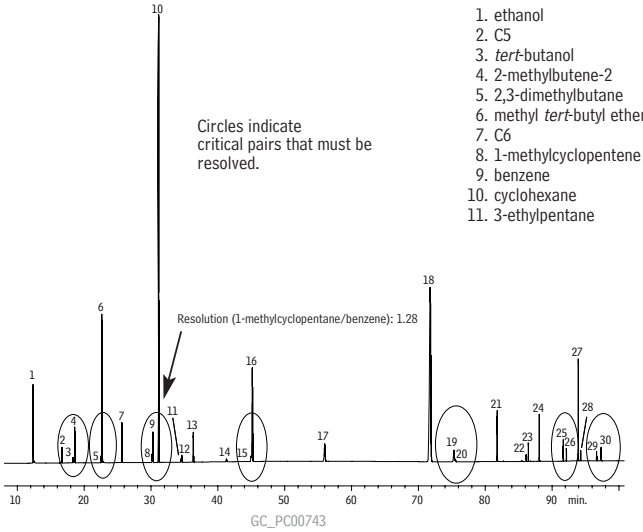
C5 efficiency: 613,596 total theoretical plates
k' (C5): 0.489
tert-butanol skewness: 1.25
Resolution (*tert*-butanol/2-methylbutene-2): 5.60

1. ethanol
2. C5
3. *tert*-butanol
4. 2-methylbutene-2

Rtx®-1PONA column produces near symmetrical alcohol peaks!

**P=paraffins; O=olefins; N=naphthenes; A=aromatics.
In alternate terminology: paraffins & isoparaffins = alkanes; naphthenes = cyclic alkanes; olefins = alkenes.

Critical pairs of gasoline components resolved per ASTM specifications, using an Rtx®-1PONA column.



1. ethanol
2. C5
3. *tert*-butanol
4. 2-methylbutene-2
5. 2,3-dimethylbutane
6. methyl *tert*-butyl ether (MTBE)
7. C6
8. 1-methylcyclopentene
9. benzene
10. cyclohexane
11. 3-ethylpentane
12. 1-*tert*-2-dimethylcyclopentane
13. C7
14. 2,2,3-trimethylpentane
15. 2,3,3-trimethylpentane
16. toluene
17. C8
18. ethylbenzene
19. *p*-xylene
20. 2,3-dimethylheptane
21. C9
22. 5-methylnonane
23. 1,2-methylethylbenzene
24. C10
25. C11 (undecane)
26. 1,2,3,5-tetramethylbenzene
27. naphthalene
28. C12 (dodecane)
29. 1-methylnaphthalene
30. C13 (tridecane)

Column:	Rtx®-1PONA, 100m, 0.25mm ID, 0.5µm (cat.# 10195) plus Rtx®-5PONA tuning column, 2.62m, 0.25mm ID, 1.0µm, connected via Press-Tight® connector (cat.# 20446)
Sample:	custom detailed hydrocarbon analysis (DHA) mix, neat
Inj.:	0.01µL, split (split ratio 150:1), 4mm cup inlet liner (cat.# 20709)
Inj. temp.:	200°C
Carrier gas:	helium, constant flow
Linear velocity:	28cm/sec. (2.3mL/min.)
Oven temp.:	5°C (hold 15 min.) to 50°C @ 5°C/min. (hold 50 min.) to 200°C @ 8°C/min. (hold 10 min.)
Det.:	FID @ 250°C

Simulated Distillation (C5-C44) Analysis

Rtx®-2887 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)
- Application-specific columns for simulated distillation.
- Stable to 360°C.

Rtx®-2887 columns' stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements currently specified in ASTM method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times.

Jason Fisher
GC Column
Manufacturing Supervisor

similar phases

DB-2887, Petrocol EX2887

Rtx®-2887 Column (fused silica)

(Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

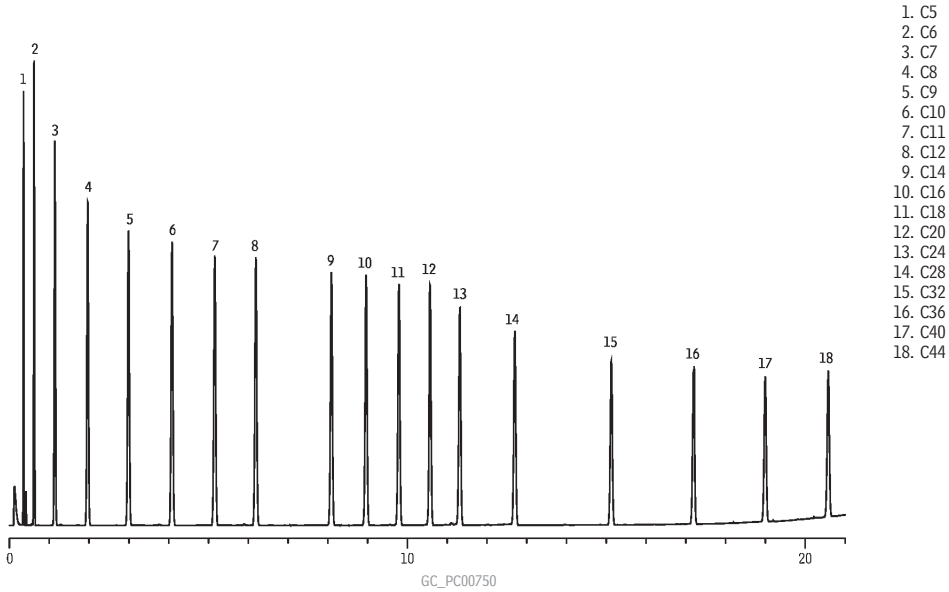
ID	df (µm)	temp. limits	10-Meter
0.53mm	2.65	-60 to 360°C	10199

MXT®-2887 Column (Siltek® treated stainless steel)

(Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

ID	df (µm)	temp. limits	10-Meter
0.53mm	2.65	-60 to 400°C	70199

Negligible baseline rise for C5 to C44 hydrocarbons on an Rtx®-2887 column.



Column:	Rtx®-2887, 10m, 0.53mm ID, 2.65µm (cat.# 10199)
Sample:	1µL direct injection of 0.01-0.1 wt. % C5 to C44 hydrocarbon standard in carbon disulfide
Inj. temp.:	360°C
Det. temp:	360°C
Carrier gas:	helium (constant flow)
Linear velocity:	15mL/min. (112cm/sec.)
Oven temp.:	35°C to 360°C @ 15°C/min. (hold 5 min.)

Simulated Distillation (C44-C100) Analysis

MXT®-1HT Sim Dist/MXT®-1 Sim Dist/MXT®-500 Sim Dist (nonpolar phases)

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation (e.g., ASTM Method D2887 Extended).
- MXT®-1HT Sim Dist and MXT®-1 Sim Dist phases offer true methyl silicone polarity; MXT®-500 Sim Dist phase is a carborane siloxane polymer.
- Stable to 430°C.

Manufactured from Siltek® treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available. As outlined in ASTM Method D6352, high temperature simulated distillation requires a column that can withstand temperatures to 430°C. MXT®-1HT Sim Dist and MXT®-500 Sim Dist columns exhibit excellent peak shape and low bleed, even at 430°C! The unique MXT®-1HT Sim Dist methyl silicone polymer gives the correct retention time/boiling point curve. The MXT®-500 Sim Dist carborane siloxane polymer offers a slight shift in the calculated boiling range distribution for petroleum samples containing aromatic hydrocarbons.

similar **phases**

DB-1HT, HT-Simdist CB

MXT®-1HT Sim Dist Column (Siltek® treated stainless steel)

ID	df (µm)	temp. limits	5-Meter
0.53mm	0.10	-60 to 430°C	70100

MXT®-1 Sim Dist Column (Siltek® treated stainless steel)

ID	df (µm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 430°C	70101

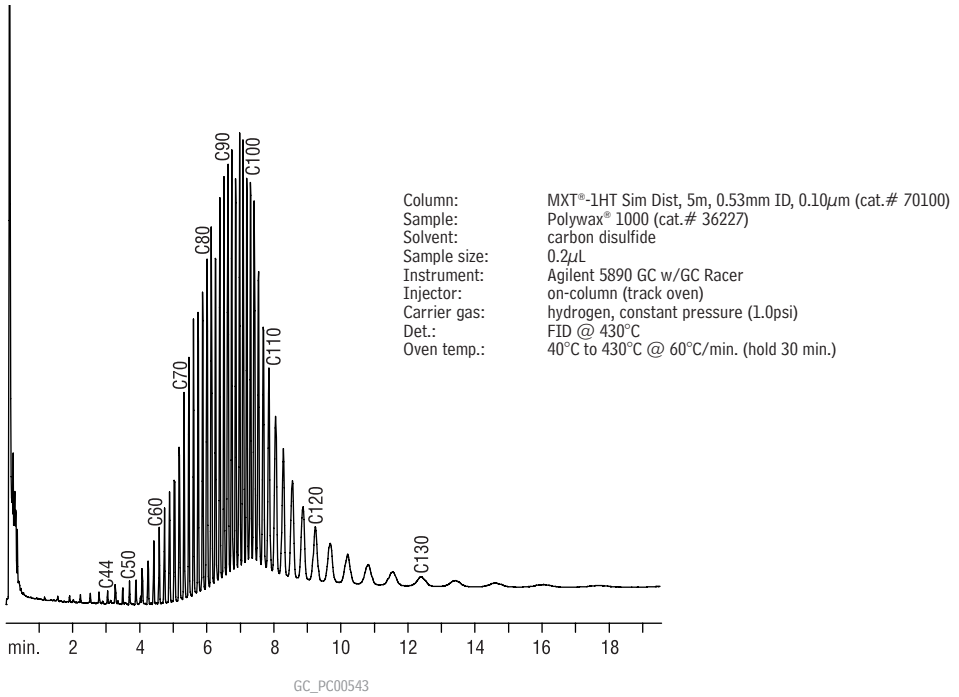
MXT®-500 Sim Dist Column (Siltek® treated stainless steel)

ID	df (µm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 430°C	70104

Polywax® Calibration Materials

Description	qty.	cat.#
Polywax® 655 calibration material	1g	36225
Polywax® 1000 calibration material	1g	36227

C44-C130 hydrocarbons on an MXT®-1HT Sim Dist column.



Aromatics & Oxygenates in Gasoline Analysis

Rt™-TCEP (highly polar phase; 1,2,3-tris[2-cyanoethoxy]propane—not bonded)

- General purpose columns, ideal for aromatics and oxygenates in gasoline.
- Temperature range: 0°C to 135°C.

Brian Salisbury
ASG Chemist
1+ year of service!

Most gasolines contain aliphatic hydrocarbons up to *n*-dodecane (C12). To improve identification of the aromatics and oxygenates, it is desirable to elute benzene after C11 and toluene after C12. The extremely polar Rt™-TCEP stationary phase provides a retention index for benzene greater than 1100 and permits the separation of alcohols and aromatics from the aliphatic constituents in gasoline.

Rt™-TCEP columns have the same high polarity as TCEP packed columns (precolumns in ASTM Method D4815 for the analysis of petroleum oxygenates), with the efficiency of a capillary column. The result is a column that can separate a wide variety of compounds with an elution pattern unattainable using other high polarity siloxanes.

The Rt™-TCEP column incorporates a nonbonded stationary phase coated on a surface specialized for enhanced polymer stability and extended column lifetime. Solvent rinsing should be avoided. Conditioning is necessary only if the column is to be used at temperatures near the maximum operating temperature.

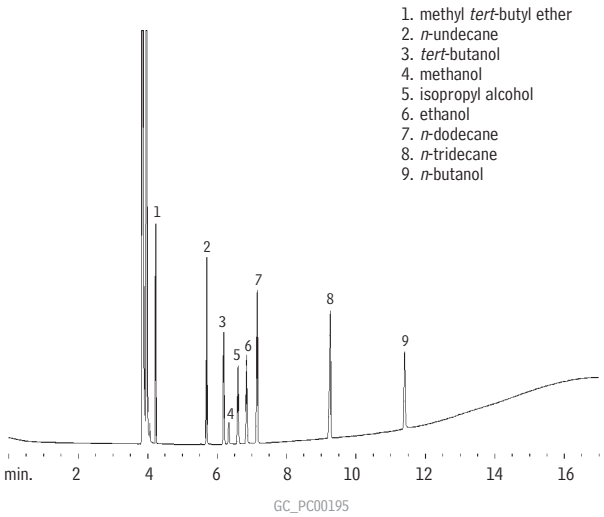
Rt™-TCEP Columns (fused silica)
(1,2,3-tris[2-cyanoethoxy]propane)

ID	df (µm)	temp. limits	30-Meter	60-Meter
0.25mm	0.40	0 to 135°C	10998	10999

similar **phases**

SPB-TCEP, CP-TCEP

Petroleum oxygenates on an Rt™-TCEP column.



Column:	Rt™-TCEP, 60m, 0.25mm ID, 0.4µm (cat.# 10999)
Inj.:	1.0µL split injection, components @ 500ppm.
Oven temp.:	60°C (hold 5 min.) to 100°C @ 5°C/min. (hold 10 min.)
Inj./det. temp.:	200°C
Carrier gas:	helium
Linear velocity:	30cm/sec. set @ 80°C
FID sensitivity:	6.4 x 10-11 AFS
Split flow:	46mL/min.

Biodiesel Fuels Analysis

new!

Rtx®-Biodiesel TG

- Linearity for all reference compounds exceeds method requirements.
- Alumaseal™ connector provides leak-free connection; guard column extends column life.
- Low column bleed at high temperatures.
- For glycerine and glyceride analysis, according to ASTM D6584 and EN 14105 methods.

Rtx®-Biodiesel TG Columns (fused silica)

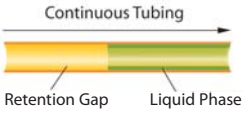
ID	df (µm)	temp. limits	10-Meter
0.32mm	0.10	to 330/380°C	10292

ID	df (µm)	temp. limits	10-Meter w/2m x 0.53mm IP Guard Column attached using Alumaseal™ Connector
0.32mm	0.10	to 330/380°C	10291

new!

Integra-Gap™ technology.

- Built-in retention gap
- Eliminates connector



MXT®-Biodiesel TG

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Stable at 430°C for reliable, consistent performance.
- Integra-Gap™ built-in retention gap on 0.53mm ID column eliminates column coupling completely.

MXT®-Biodiesel TG Columns (Siltek® treated stainless steel)

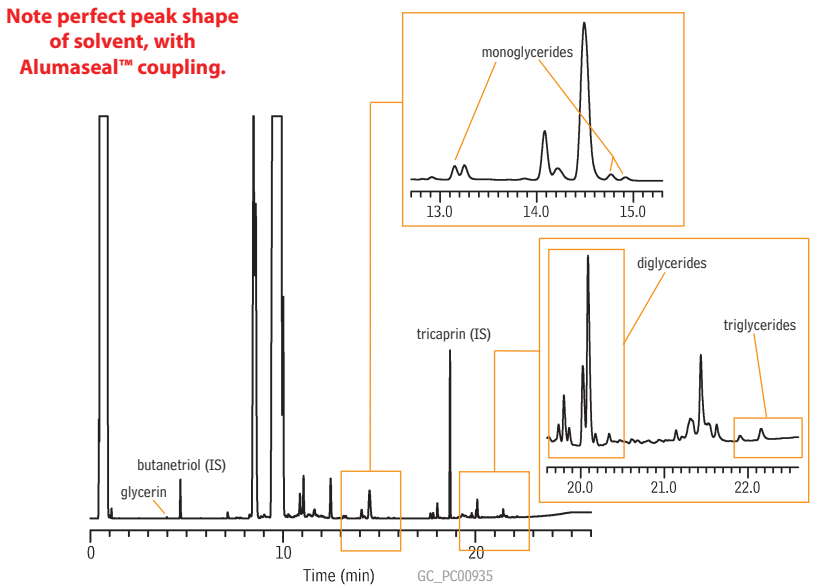
ID	df (µm)	temp. limits	14-Meter w/2m Integra-Gap™*
0.53mm	0.16	-60 to 380/430°C	70289

ID	df (µm)	temp. limits	10-Meter w/2m x 0.53mm retention gap**
0.32mm	0.10	-60 to 380/430°C	70290

*Total column length=16 meters.
**Connected with low-dead-volume Alumaseal™ connector.

Michelle Long
Innovations Chemist

Derivatized B100 and internal standards on an MXT®-Biodiesel TG column with 2m x 0.53mm ID retention gap, according to ASTM D6584.



Column:	MXT®-Biodiesel TG, 10m, 0.32mm ID, 0.1µm with 2m x 0.53mm retention gap (cat.# 70290)
Sample:	B100 + IS Butanetriol & Tricaprin derivatized with MSTFA as per ASTM D-6584
Inj.:	1.0µL cool on-column
Inj. temp.:	oven track
Carrier gas:	hydrogen, constant flow
Flow rate:	4mL/min.
Oven temp.:	50°C (hold 1 min.) to 180°C @ 15°C/min., to 230°C @ 7°C/min., to 430°C @ 30°C/min. (hold 5 min.)
Det.:	FID @ 430°C

also available

See pages 678 and 680 for more applications on our new Rtx®-Biodiesel TG and MXT®-Biodiesel TG columns.

Blood Alcohol Analysis

Rtx®-BAC1/Rtx®-BAC2 (proprietary Crossbond® phase)

- Application-specific columns for blood alcohol analysis—achieve baseline resolution in less than 3 minutes. Also excellent for abused inhalant anesthetics, γ-hydroxybutyrate (GHB)/γ-butyrolactone (GBL), glycols, and common industrial solvents.
- Rtx®-BAC2 confirmation column provides four elution order changes under the same conditions.
- Stable to 260°C.

These columns separate to baseline all blood alcohol compounds in blood, breath, or urine, in less than 3 minutes, under isothermal conditions. Isothermal analysis increases productivity by eliminating the need for oven cycling. Confirmation is easily achieved with this tandem set because there are four elution order changes between the two columns.

restek innovation!

Baseline resolution in less than 3 minutes.

similar phases

DB-ALC1, DB-ALC2

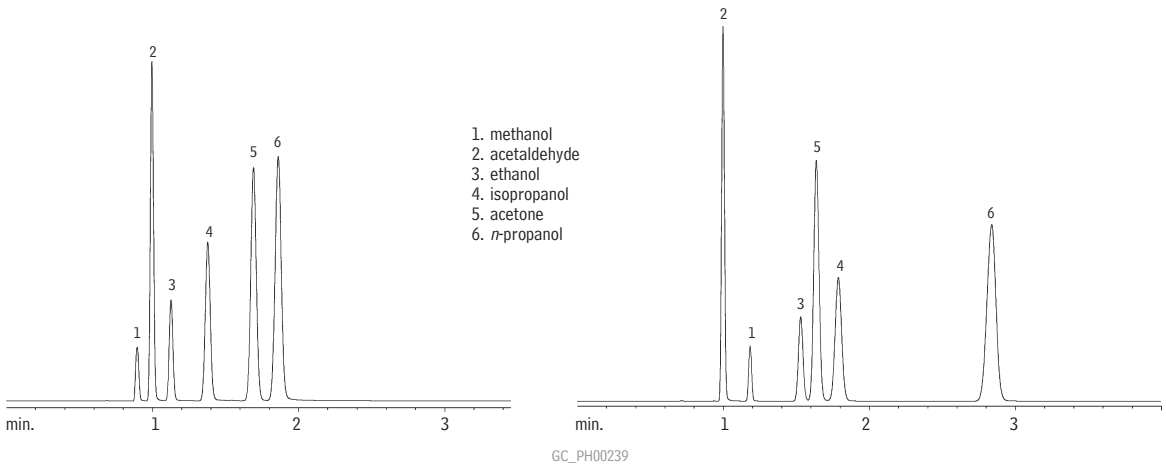
Rtx®-BAC1 Columns (fused silica)

ID	df (µm)	temp. limits	30-Meter
0.32mm	1.80	-20 to 240/260°C	18003
0.53mm	3.00	-20 to 240/260°C	18001

Rtx®-BAC2 Columns (fused silica)

ID	df (µm)	temp. limits	30-Meter
0.32mm	1.20	-20 to 240/260°C	18002
0.53mm	2.00	-20 to 240/260°C	18000

Rapid, reliable blood alcohol testing, using Rtx®-BAC column.



Rtx®-BAC1, 30m, 0.53mm ID, 3.0µm (cat.# 18001)

Rtx®-BAC2, 30m, 0.53mm ID, 2.0µm (cat.# 18000)

Inj.:	1.0mL headspace sample of a blood alcohol mix
Sample conc.:	0.1% per compound
Oven temp.:	40°C
Inj./det. temp.:	200°C
Carrier gas:	helium
Linear velocity:	80cm/sec. set @ 40°C
FID sensitivity:	1.28×10^{-10} AFS

ordering note

Rtx®-BAC1 and Rtx®-BAC2 columns are available with Integra-Guard™ built-in guard columns.
Get the protection without the connection! See **page 30** for descriptions and ordering information.

Organic Volatile Impurities (OVI) Analysis

Rick Morehead
Marketing Specialist
17+ years of service!

Rtx®-G27 (Crossbond® 5% diphenyl/95% dimethyl polysiloxane)
with Integra-Guard™ Guard Column
Rtx®-G43 (Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)
with Integra-Guard™ Guard Column

- Application-specific columns for residual solvents in pharmaceutical products. Meet all requirements of USP <467>.
- Analytical column with Integra-Guard™ guard column eliminates connecting problems and leaks.
- Rtx®-G27 stable to 290°C; Rtx®-G43 stable to 240°C.

Some USP <467> methods require the use of a guard column. Our Integra-Guard™ integrated guard column system makes it easy to comply.

please note

Analytical Reference Materials for USP <467> are available on page 510.

free literature

A Technical Guide for Static Headspace Analysis Using GC

Download your free copy from www.restek.com.

Technical Guide
lit. cat.# 59895A

Rtx®-G27 Column (fused silica with 5-meter Integra-Guard™ guard column)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard™ Guard Column
0.53mm	5.00	-60 to 270/290°C	10279-126

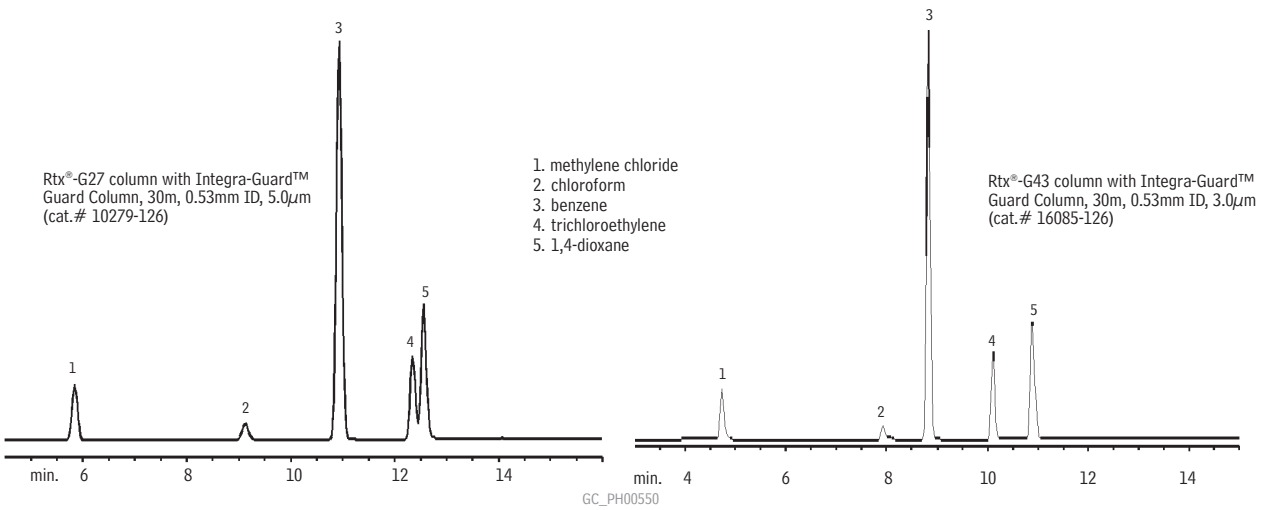
Rtx®-G43 Column (fused silica with 5-meter Integra-Guard™ guard column)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard™ Guard Column
0.53mm	3.00	-20 to 240°C	16085-126

Searching for a chromatogram?
www.restek.com

Specially-designed Rtx®-G27 and Rtx®-G43 columns resolve residual solvents in USP <467>.



Inj.:	1.0µL direct injection of USP <467> Mix #1 (cat.# 36004)
Oven temp.:	35°C (hold 5 min.) to 175°C @ 8°C/min. to 260°C @ 35°C/min.
Inj./det. temp.:	200°C/240°C
Carrier gas:	helium
Linear velocity:	34cm/sec. set @ 35°C
FID sensitivity:	1 x 10^{-11} AFS
Recommended liner:	Uniliner® inlet liner

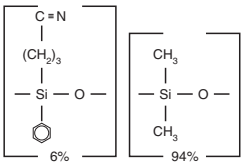
Organic Volatile Impurities (OVI) Analysis

Rtx®-1301/Rtx®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/ 94% dimethyl polysiloxane)

- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20°C to 240°C.
- Equivalent to USP G43 phase.

Many analysts feel the Rtx®-1301/Rtx®-624 column has the best cyanosilicone bonded stationary phase available, with no other column manufacturer providing lower bleed, longer lifetime, or better inertness. Our polymer is fully characterized to ensure long-term reproducibility, column-to-column consistency, and low bleed—even with sensitive detectors such as ECDs and MSDs.

Rtx®-1301/Rtx®-624 Structure



Rtx®-1301 (G43) Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (µm)	temp. limits*	15-Meter	30-Meter	60-Meter	75-Meter	105-Meter
0.53mm	3.00	-20 to 240°C	16082	16085	16088	16076	16091

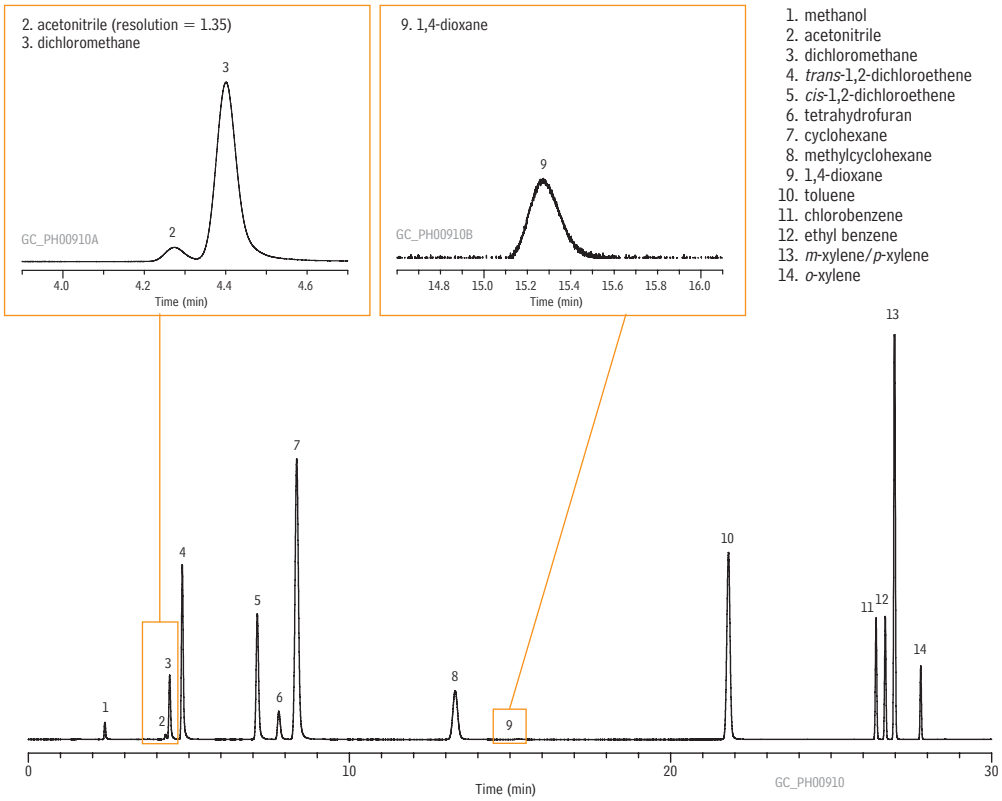
Rtx®-624 Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter	60-Meter
0.32mm	1.80	-20 to 240°C	10970	10972

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

USP Residual Solvent Class 2 Mixture A standard solution on an Rtx®-624 column.



Column:	Rtx®-624, 30m, 0.32 ID, 1.8µm (cat. # 10970)	**Headspace Conditions**	
Sample:	USP <467> Class 2 Mixture A Standard Solution (cat.# 36271) in 20mL headspace vial	Instrument:	Tekmar HT3
Inj.:	Headspace injection (split ratio 1:5), 1mm Split liner Siltek® deactivated (cat.# 20972-214.1)	Transfer Line Temp.:	105°C
Inj. temp.:	140°C	Valve Oven Temp.:	105°C
Carrier gas:	helium, constant flow	Sample Temp.:	80°C
Flow rate:	2.16mL/min., 35.3cm/sec.	Sample Equil. Time:	45 min.
Oven temp.:	40°C for 20 min. to 240°C @ 10°C/min. (hold for 20 min.)	Vial Pressure:	10psi
Det.:	FID @ 240°C	Pressurize Time:	0.5 min.
		Loop Fill Pressure:	5psi
		Loop Fill Time:	2.00 min.
		Inject Time:	1.00 min.

similar phases

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

please note

Rtx®-1301 and Rtx®-624 columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See page 30 for descriptions and ordering information.

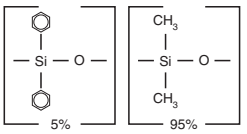
also available

MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See pages 105 and 107 for our MXT®-1301 and MXT®-624 columns.

See our OVI Retention Index on page 721.

Organic Volatile Impurities (OVI) Analysis

Rtx®-5 Structure



Rtx®-5 (low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners or (e.g.) Aroclor mixes, essential oils, semivolatiles.
- Temperature range: -60°C to 350°C.
- Equivalent to USP G27 and G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

similar phases

DB-5, HP-5, HP-5MS, Ultra-2, SPB-5, Equity-5, MDN-5

Rtx®-5 Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (µm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.53mm	5.00	-60 to 270/290°C	10277	10279	10283

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

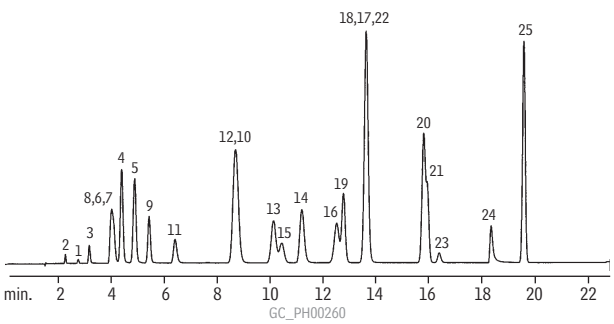
also available

MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See page 102 for our MXT®-5 columns.

it's a fact

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-5ms columns! See pages 33-35, 37.

Organic volatile impurities on an Rtx®-5 (Rtx®-G27) column.



Rtx®-5 (Rtx®-G27) with 5m phenylmethyl Integra-Guard™ guard column, 30m, 0.53mm ID, 5.0µm (cat.# 10279-126)

1. ethylene oxide
2. methanol
3. ethanol
4. diethyl ether
5. 1,1-dichloroethene
6. acetone
7. isopropanol
8. acetonitrile
9. methylene chloride
10. *n*-hexane
11. *n*-propanol
12. methyl ethyl ketone
13. ethyl acetate
14. tetrahydrofuran
15. chloroform
16. 1,1,1-trichloroethane
17. carbon tetrachloride
18. benzene
19. 1,2-dichloroethane
20. heptane
21. trichloroethylene
22. *n*-butanol
23. 1,4-dioxane
24. pyridine
25. toluene

Inj.:	Headspace injection of common solvents for pharmaceutical processing. Prepared to equal about 500ppm in the bulk pharmaceutical. Samples shaken and heated at 90°C for 15 minutes, 1mL headspace injection.
Oven temp.:	35°C (hold 10 min.) to 100°C @ 5°C/min., to 240°C @ 25°C/min. (hold 5 min.)
Inj./det. temp.:	220°C/240°C
FID sensitivity:	1.05 x 10^{-11} AFS
Carrier gas:	helium, 35cm/sec. set @ 35°C
Split ratio:	2:1

See our OVI Retention Index on page 721.

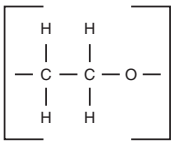
Organic Volatile Impurities (OVI) Analysis

Stabilwax® (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMEs, flavor compounds, essential oils, amines, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 250°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

Our polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. The bonding mechanisms produce a column that can be rejuvenated by solvent washing. Compared to silicone stationary phases, PEG phases are more resistant to damage from strongly acidic or basic volatile compounds, including inorganic acids and volatile inorganic bases.

Stabilwax® Structure



similar phases

DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10

ordering note

Stabilwax® columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See page 30 for descriptions and ordering information.

also available

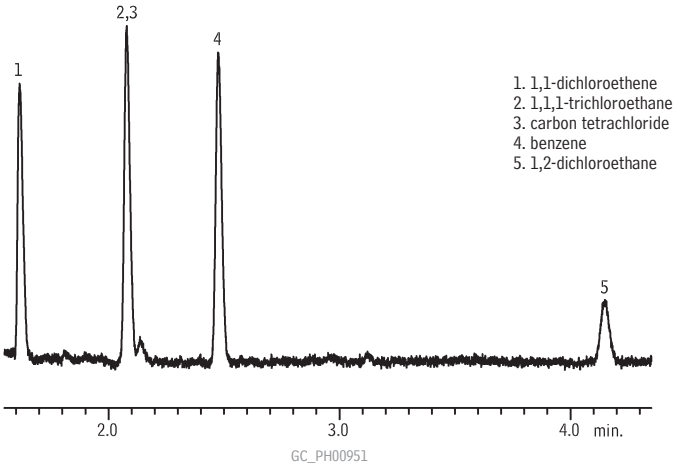
MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See page 106 for our MXT®-WAX columns.

Stabilwax® Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.32mm	0.25	40 to 250°C	10621	10624	10627
0.53mm	0.25	40 to 250°C	10622	10625	10628

Residual solvents class 1 on a Stabilwax® (G16) column.



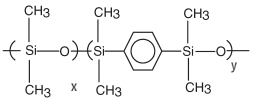
Column:	Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)
Sample:	USP Stock Mixture USP<467> Residual Solvents Class 1 Mix (cat.# 36279) in 20mL headspace vial (cat.# 24685), water diluent
Inj.:	headspace injection (split ratio 1:5), 2mm splitless liner IP deactivated (cat.# 20712)
Inj. temp.:	140°C
Carrier gas:	helium, constant flow
Flow rate:	2.15mL/min., 35.2cm/sec.
Oven temp.:	50°C for 20 min., to 165°C @ 6°C/min. (hold for 20 min.)
Det.:	FID @ 250°C

Headspace Conditions	
Instrument:	Overbrook Scientific HT200H
Syringe temp.:	100°C
Sample temp.:	80°C
Sample equil. time.:	45 min.
Injection vol.:	1.0mL
Injection speed:	setting 8
Injection dwell:	5 sec.

Semivolatiles Analysis

new!

Rxi®-5Sil MS Structure



Rxi®-5Sil MS (low polarity Crossbond® silarylene phase; similar to 5% diphenyl/95% dimethyl polysiloxane)

- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, hydrocarbons.
- Temperature range: -60°C to 350°C.

The Rxi®-5Sil MS stationary phase incorporates phenyl rings in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

Rxi®-5Sil MS column is recommended for US EPA Method 8270.

Rxi®-5Sil MS Columns (fused silica)

(Crossbond®, selectivity similar to 5% diphenyl/95% dimethyl polysiloxane)

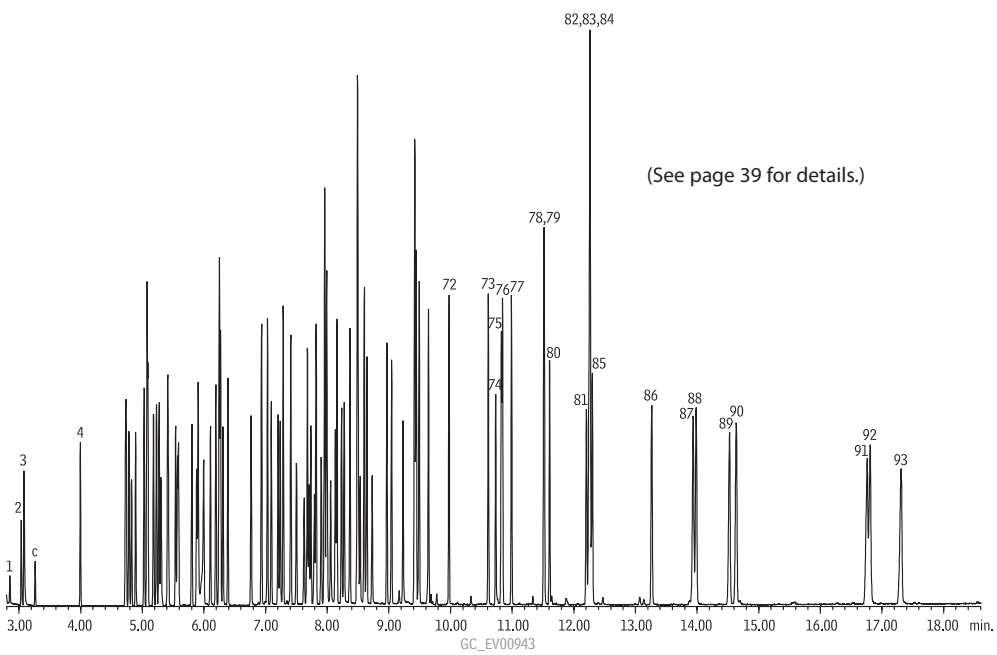
ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	13605	13608	
	0.25	-60 to 330/350°C	13620	13623	13626
	0.50	-60 to 330/350°C	13635	13638	
	1.00	-60 to 325/350°C	13650	13653	13697
0.32mm	0.25	-60 to 330/350°C	13621	13624	
	0.50	-60 to 330/350°C		13639	
	1.00	-60 to 325/350°C		13654	
0.53mm	1.50	-60 to 310/330°C		13670	

ID	df (µm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	43601	
0.18mm	0.18	-60 to 330/350°C		43602
	0.36	-60 to 330/350°C		43604

similar phases

DB-5MS, VF-5ms, CP-Sil 8 Low-Bleed/MS

Semivolatile organics by US EPA Method 8270 on an Rxi®-5Sil MS column.



(See page 39 for details.)

Cindy Ross
Southeast Sales Representative
21+ years of service!

Organophosphorus Pesticides Analysis

Rtx®-OPPesticides/Rtx®-OPPesticides2 (proprietary Crossbond® phases)

- Application-specific columns for organophosphorus pesticides; best column combination for US EPA Method 8141A.
- Low bleed—ideal for GC/FPD, GC/NPD, or GC/MS analyses.
- Stable to 330°C.

Using sophisticated computer modeling software, we created two stationary phases for separating the 55 organophosphorus pesticides (OPP) listed in EPA Method 8141A. Separation is improved, and analysis time is significantly reduced, compared to other columns. The extended upper temperature limit of these phases (330°C) allows analysts to bake out high molecular weight contamination typically associated with pesticide samples. The low bleed columns are a perfect match for sensitive detection systems.

restek **innovation**!

- Better separations
- Faster analysis

Rtx®-OPPesticides Columns (fused silica)

ID	df (µm)	temp. limits	30-Meter
0.32mm	0.50	-20 to 310/330°C	11239
0.53mm	0.83	-20 to 310/330°C	11240

Rtx®-OPPesticides2 Columns (fused silica)

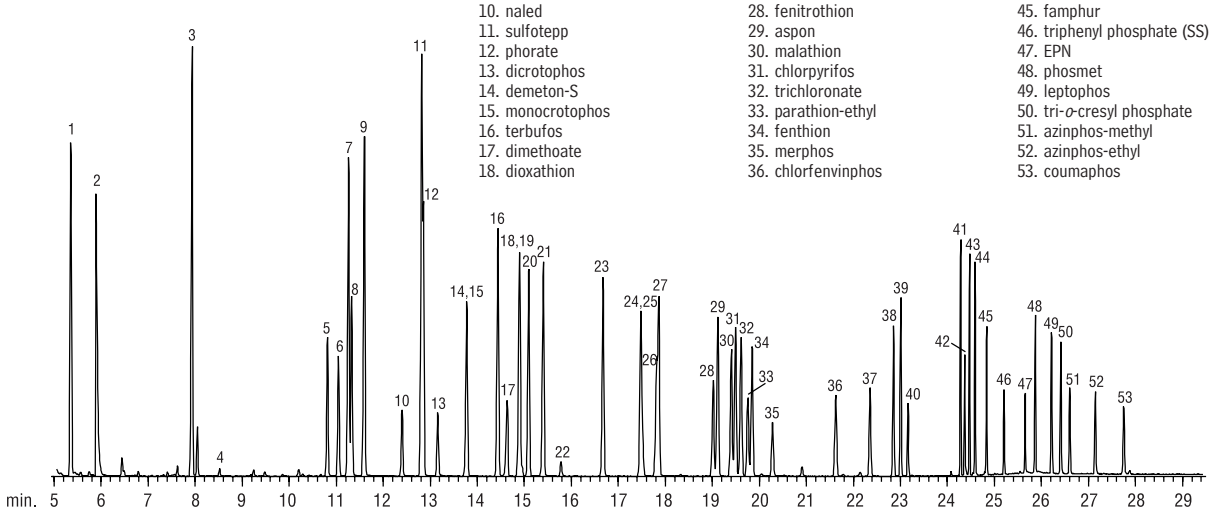
ID	df (µm)	temp. limits	20-Meter	30-Meter
0.18mm	0.20	-20 to 310/330°C	11244	
0.25mm	0.25	-20 to 310/330°C		11243
0.32mm	0.32	-20 to 310/330°C		11241
0.53mm	0.50	-20 to 310/330°C		11242

did you **know**?

These application-specific Restek columns give fast, efficient analysis of the OPPs listed in EPA Method 8141A

Organophosphorus pesticides by US EPA Method 8141A on an Rtx®-OPPesticides2 column.

1. dichlorvos
2. hexamethylphosphoramide
3. mevinphos
4. trichlorfon
5. TEPP
6. demeton-O
7. thionazin
8. tributyl phosphate (IS)
9. ethoprop
10. naled
11. sulfotepp
12. phorate
13. dicrotophos
14. demeton-S
15. monocrotophos
16. terbufos
17. dimethoate
18. dioxathion
19. fonophos
20. diazinon
21. disulfoton
22. phosphamidon isomer
23. dichlorofenthion
24. chlorpyrifos methyl
25. phosphamidon
26. parathion-methyl
27. ronnel
28. fenitrothion
29. aspon
30. malathion
31. chlorpyrifos
32. trichloronate
33. parathion-ethyl
34. fenthion
35. merphos
36. chlorfenvinphos
37. crotoxyphos
38. stirofos
39. tokuthion
40. merphos oxone (breakdown product)
41. ethion
42. fensulfothion
43 bolstar
44. carbophenothion
45. famphur
46. triphenyl phosphate (SS)
47. EPN
48. phosmet
49. leptophos
50. tri-*o*-cresyl phosphate
51. azinphos-methyl
52. azinphos-ethyl
53. coumaphos



Column:	Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25µm (cat.# 11243)	Inj. temp.:	250°C
Sample:	US EPA Method 8141A Custom Standard Mix 1µL 100ppm (100ng on column) Triphenylphosphate Standard (cat.# 32281) Tributylphosphate Standard (cat.# 32280) 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277) 8141 OP Pesticides Calibration Mix B (cat.# 32278) *Custom Mixes: Call Restek for Information*	Carrier gas:	helium, constant flow
		Flow rate:	1.0mL/min.
		Oven temp.:	80°C (hold 0.5 min.) to 140°C @ 20°C/min. to 210°C @ 4°C/min. (hold 1 min.) to 280°C @ 30°C (hold 5 min.)
		Det:	MS
Inj.:	1.0µL splitless (hold 0.4 min.), 4mm double gooseneck inlet liner (cat.# 20785)	Transfer line temp.:	280°C
		Scan range:	35-400amu
		Ionization:	EI

Chlorinated Pesticides Analysis

restek innovation!

- Very low bleed
- Faster analysis

Rtx®-CLPesticides/Rtx®-CLPesticides2 (proprietary Crossbond® phases)

- Application-specific columns for organochlorine pesticides and herbicides.
- Low bleed—ideal for GC/ECD or GC/MS analyses.
- Baseline separations in less than 10 minutes.
- Stable to 340°C.

Improved resolution and faster analyses, compared to 1701 or phenyl phases, make these the pesticide columns of choice. Rtx®-CLPesticides columns are specially designed to overcome the coelutions and analyte breakdown typically encountered in chlorinated pesticide analyses for EPA Methods 8081, 608, and CLP. By achieving baseline resolution of the 20 target analytes, more accurate qualitative data can be obtained, providing reliable identification without GC/MS.

Column bleed, measured by ECD, is extremely low at temperatures up to 330°C, which is critical for baking-out the column to remove high-boiling compounds commonly found in pesticide/PCB extracts. An analysis time of less than 10 minutes improves throughput compared to other stationary phases.

free literature

Fast GC Analysis of Chlorinated Pesticides

Download your free copy from www.restek.com

Flyer
lit. cat.# 59547A

Rtx®-CLPesticides Columns (fused silica)

ID	df (µm)	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.10mm	0.10	-60 to 310/330°C	43101				
0.18mm	0.18	-60 to 310/330°C	42101		42102		
0.25mm	0.25	-60 to 320/340°C		11120		11123	11126
0.32mm	0.32	-60 to 320/340°C			new!	11141	
	0.50	-60 to 320/340°C		11136		11139	
0.53mm	0.50	-60 to 300/320°C		11137		11140	

Rtx®-CLPesticides2 Columns (fused silica)

ID	df (µm)	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.10mm	0.10	-60 to 310/330°C	43301		43302		
0.18mm	0.14	-60 to 310/330°C	42301		42302		
0.25mm	0.20	-60 to 320/340°C		11320		11323	11326
0.32mm	0.25	-60 to 320/340°C		11321		11324	
	0.50	-60 to 320/340°C				11325	
0.53mm	0.42	-60 to 300/320°C		11337		11340	

ordering note

Add "-530" or "-535" to the catalog number for the kit, to save on the cost of the reference mix.

Rtx®-CLPesticides Column Kits

(Note: Columns are not preconnected in these kits.)

0.25mm ID Rtx®-CLPesticides Kit **cat.# 11199 (kit),** **kit**

Includes:	cat.#
30m, 0.25mm ID, 0.25µm Rtx®-CLPesticides Column	11123
30m, 0.25mm ID, 0.20µm Rtx®-CLPesticides2 Column	11323
Universal Angled "Y" Press-Tight® Connector	20403
5m, 0.25mm ID Siltek® Guard Column	10026

new!

New column dimensions now available.

0.32mm ID Rtx®-CLPesticides Kit **cat.# 11196 (kit),** **kit**

Includes:	cat.#
30m, 0.32mm ID, 0.32µm Rtx®-CLPesticides Column	11141
30m, 0.32mm ID, 0.25µm Rtx®-CLPesticides2 Column	11324
Universal Angled "Y" Press-Tight® Connector	20403
5m, 0.32mm ID Siltek® Guard Column	10027

0.53mm ID Rtx®-CLPesticides Kit **cat.# 11197 (kit),** **kit**

Includes:	cat.#
30m, 0.53mm ID, 0.50µm Rtx®-CLPesticides Column	11140
30m, 0.53mm ID, 0.42µm Rtx®-CLPesticides2 Column	11340
Universal Angled "Y" Press-Tight® Connector	20403
5m, 0.53mm ID IP Deactivated Guard Column	10045

also available

For column connectors, see pages 220-227.

Add a reference mix to your kit order and save!

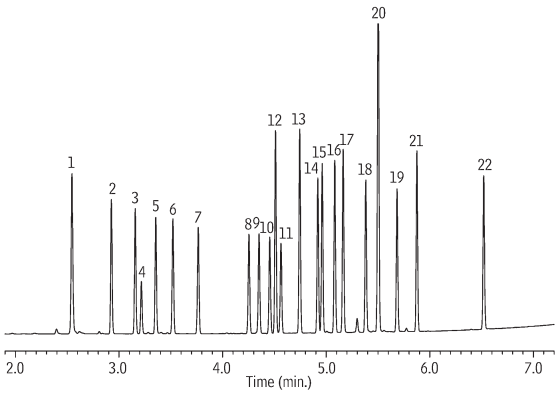
Description	suffix #
Organochlorine Pesticide Mix AB #1 (cat.# 32291)	-530
Organochlorine Pesticide Mix AB #2 (cat.# 32292)	-535

Chlorinated Pesticides Analysis

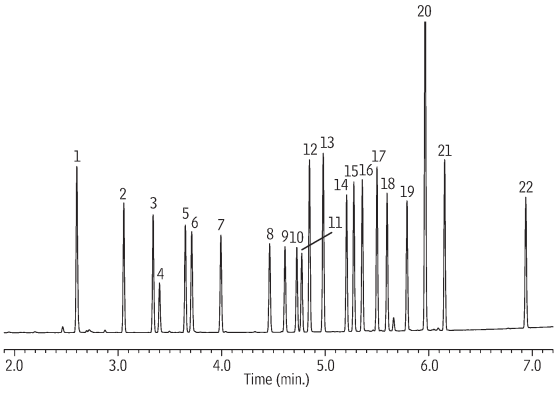
Fast GC analyses of chlorinated pesticides on Rtx®-CLPesticides and Rtx®-CLPesticides2 columns.

Rtx®-CLPesticides & Rtx®-CLPesticides2 columns (0.32mm ID)

Rtx®-CLPesticides



Rtx®-CLPesticides2

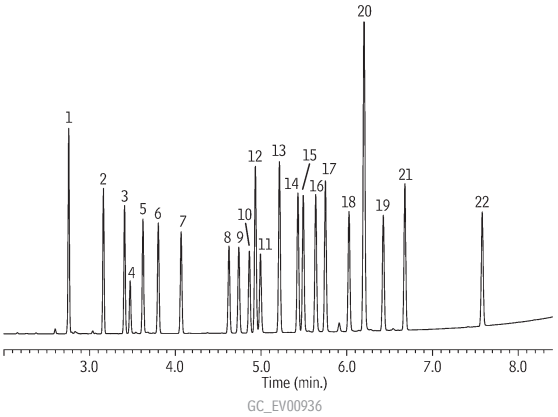


Columns:	Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® connector (cat.# 20405-261)
Sample:	Organochlorine Pesticide Mix AB #2, 8-80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.:	1.0µL splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	60cm/sec. @ 120°C
Oven temp.:	120°C to 200°C @ 45°C/min. to 230°C @ 15°C/min. to 330°C (hold 2 min.) @ 30°C/min.
Det.:	ECD @ 330°C

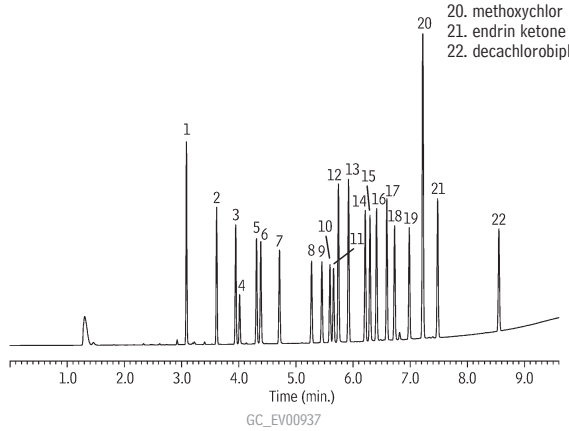
1. 2,4,5,6-tetrachloro-*m*-xylene (SS)
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide (isomer B)
9. γ-chlordane
10. α-chlordane
11. endosulfan I
12. 4,4'-DDE
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. endosulfan sulfate
20. methoxychlor
21. endrin ketone
22. decachlorobiphenyl (SS)

Rtx®-CLPesticides & Rtx®-CLPesticides2 columns (0.53mm ID)

Rtx®-CLPesticides



Rtx®-CLPesticides2



Columns:	Rtx®-CLPesticides, 30m, 0.53mm ID, 0.50µm (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42µm (cat.# 11340) with 5m x 0.53mm ID Rxi® deactivated guard tubing (cat.# 10054), connected using Universal Siltek® "Y" Press-Tight® connector (cat.# 20486)
Sample:	Organochlorine Pesticide Mix AB #2, 8-80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.:	1.0µL splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	45cm/sec. @ 120°C
Oven temp.:	120°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 325°C (hold 2 min.) @ 30°C/min.
Det.:	ECD @ 330°C

Chlorinated Pesticides Analysis

restek **innovation**!

Stx™-CLPesticides/Stx™-CLPesticides2 (proprietary Crossbond® phases)

- Application-specific columns for organochlorine pesticides and herbicides.
- Baseline separations in less than 10 minutes.
- Siltek® surface deactivation enhances responses for endrin, DDT, methoxychlor.
- Stable to 330°C.

Many laboratories analyzing organochlorine pesticides struggle with breakdown and adsorption of endrin, DDT, and methoxychlor caused by active sites throughout the analytical system. Siltek® passivation technology enables these columns to offer unsurpassed inertness and the highest responses for active pesticides.

it's a **fact**

These columns are treated with Siltek® deactivation, which provides better responses for endrin, DDT, and methoxychlor.

Stx™-CLPesticides Columns (fused silica with Siltek® deactivation)

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	-60 to 310/330°C	11540	11543
0.32mm	0.32	-60 to 310/330°C		new! 11546
	0.50	-60 to 310/330°C	11541	11544

Stx™-CLPesticides2 Columns (fused silica with Siltek® deactivation)

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.20	-60 to 310/330°C	11440	11443
0.32mm	0.25	-60 to 310/330°C	11441	11444

ordering **note**

Kits include Siltek® deactivated guard column.

Stx™-CLPesticides Kits
(Note: Columns are not preconnected in these kits.)

kit

0.25mm ID Stx™-CLPesticides Kit cat.# 11190 (kit)

Includes:	cat.#
30m, 0.25mm ID, 0.25µm Stx™-CLPesticides Column	11543
30m, 0.25mm ID, 0.20µm Stx™-CLPesticides2 Column	11443
Universal Angled "Y" Press-Tight® Connector	20403
5m, 0.25mm ID Siltek® Guard Column	10026

kit

0.32mm ID Stx™-CLPesticides Kit cat.# 11193 (kit)

Includes:	cat.#
30m, 0.32mm ID, 0.32µm Stx™-CLPesticides Column	11546
30m, 0.32mm ID, 0.25µm Stx™-CLPesticides2 Column	11444
Universal Angled "Y" Press-Tight® Connector	20403
5m, 0.32mm ID Siltek® Guard Column	10027

new! →

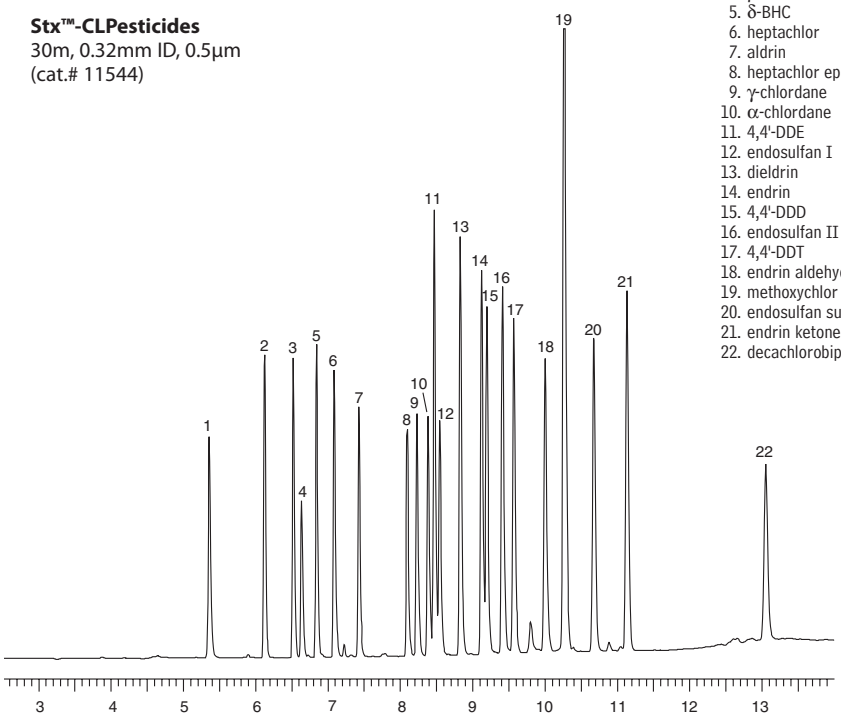
New column dimensions now available.

Chlorinated Pesticides Analysis

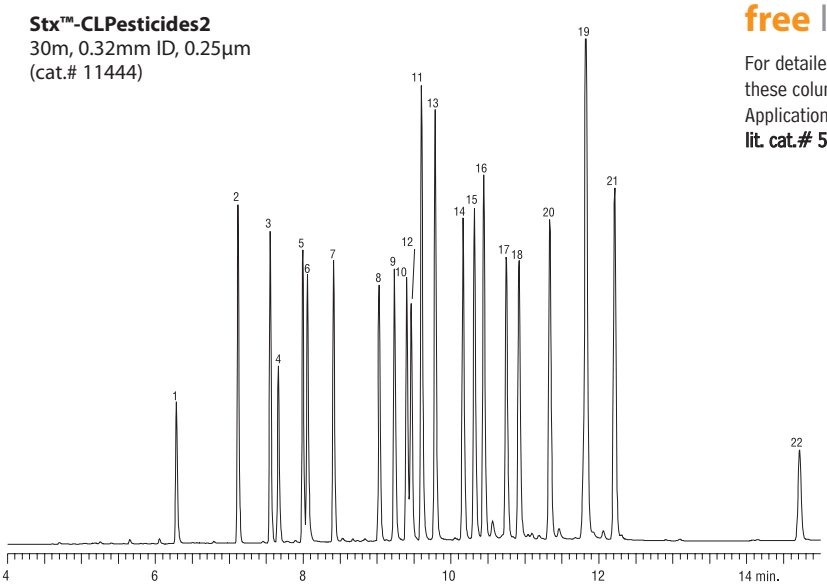
Excellent responses for all US EPA Method 8081 chlorinated pesticides: Stx™-CLPesticides columns.

1. 2,4,5,6 tetrachloro-*m*-xylene (SS)
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide
9. γ-chlordane
10. α-chlordane
11. 4,4'-DDE
12. endosulfan I
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. methoxychlor
20. endosulfan sulfate
21. endrin ketone
22. decachlorobiphenyl (SS)

Stx™-CLPesticides
30m, 0.32mm ID, 0.5µm
(cat.# 11544)



Stx™-CLPesticides2
30m, 0.32mm ID, 0.25µm
(cat.# 11444)



GC_EV00512

Inj.:	1µL direct injection of 20/40/200ng/mL std. concentration in hexane
Oven temp.:	110°C (hold 1 min.) to 245°C @ 20°C/min. to 300°C @ 6°C/min.
Inj./det. temp.:	210°C/310°C
Carrier gas:	helium
Dead time:	0.8min. @ 120°C
Inlet liner:	Siltek® deactivated Drilled Uniliner® inlet liner (cat.# 21055-214.1)
Make-up gas:	nitrogen

free literature

For detailed information about these columns, request Applications Note
lit. cat.# 59351B

Table of Contents for
Applications
see pages 518-519

Jason Thomas
Innovations Chemist
6+ years of service!

it's a fact

The Stx™-CLPesticides and Stx™-CLPesticides2 column pair will provide <10 minute analysis times if you use the same conditions used for the Rtx®-CLPesticides and Rtx®-CLPesticides2 column pair listed on page 79!

PCB Congeners Analysis

restek
innovation!

Rtx®-PCB (proprietary Crossbond® phase)

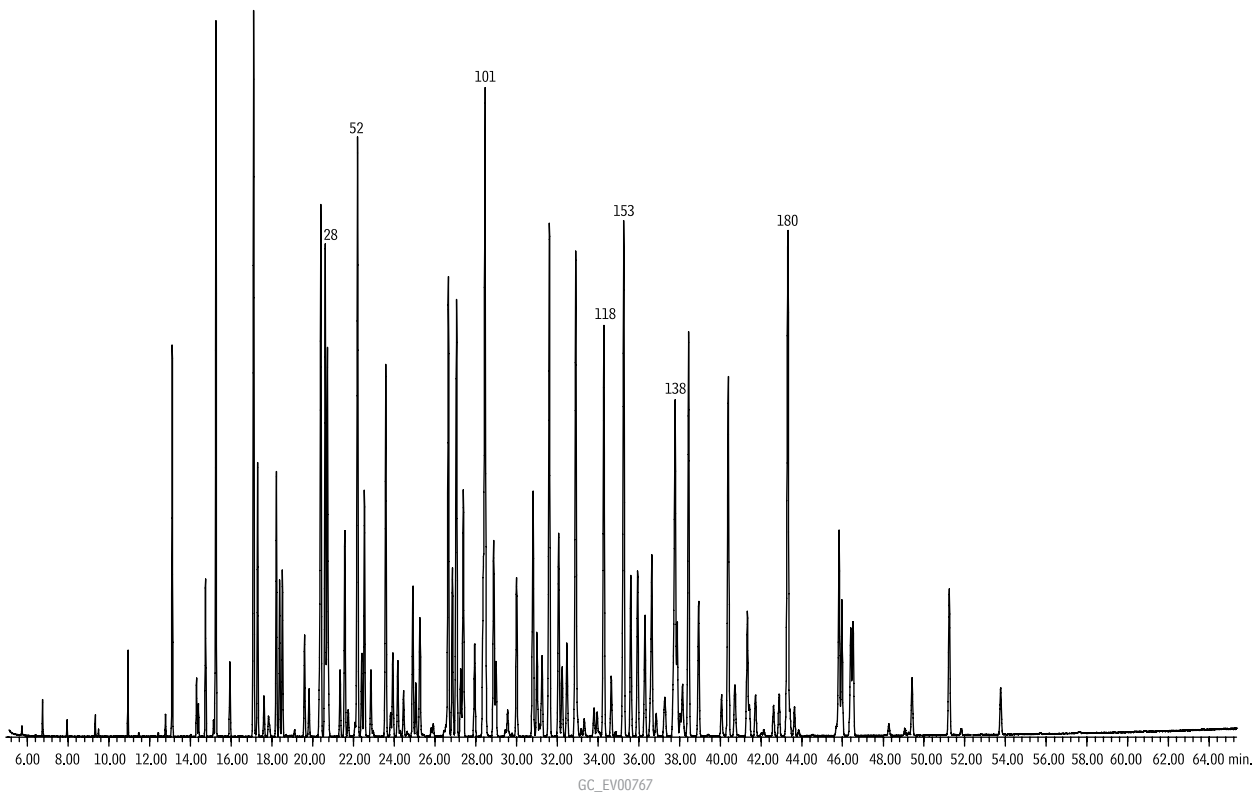
- Unique polymer for PCBs analysis by GC/ECD or GC/MS.
- Good results for other semivolatiles.
- Low polarity; inert to active compounds.
- Stable to 340°C.

Rtx®-PCB Columns (fused silica)

ID	df (µm)	temp. limits*	20-Meter	30-Meter	40-Meter	60-Meter
0.18mm	0.18	30°C to 320/340°C	41302		41303	41304
0.25mm	0.25	30°C to 320/340°C		13223		13226
0.32mm	0.50	30°C to 320/340°C		13239		

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Aroclor 1242/1254/1262 PCBs on Rtx®-PCB: best available resolution of individual congeners.



Column:	Rtx®-PCB, 60m, 0.25mm ID, 0.25µm (cat.# 13226)
Sample:	Aroclor 1242 (cat.# 32009), 1254 (cat.# 32011), 1262 (cat.# 32409), 333ppm each
Inj.:	1.0µL splitless (hold 0.75 min.), 4mm single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.:	280°C
Carrier gas:	helium, constant flow
Flow rate:	1.1mL/min.
Oven temp.:	100°C (hold 1 min.) to 200°C @ 30°C/min., to 320°C @ 2°C/min. (hold 1 min.)
Det.:	MS
Transfer line temp.:	280°C
Scan range:	50 to 550amu
Ionization:	EI
Mode:	scan

PCB Congeners Analysis

Stx™-500 (Crossbond® carborane/dimethyl polysiloxane)

- Application-specific columns for brominated flame retardants, coplanar PCB congeners, and other analytes with high boiling temperatures.
- Low bleed—ideal for GC/FPD, GC/NPD, or GC/MS analyses.
- Stable to 380°C.
- Stx™ is used for columns that have been deactivated using Restek's Siltek® deactivation.

The Stx™-500 column gives excellent results for neutral or slightly acidic compounds. It is not recommended for analyses of basic compounds.

similar **phase**

HT-8

Stx™-500 Columns (fused silica)
(Crossbond® carborane/dimethyl polysiloxane)

ID	df (µm)	temp. limits*	30-Meter	60-Meter
0.25mm	0.15	-60°C to 380°C	10750	10751
0.53mm	0.15	-60°C to 380°C	10752	

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Dioxin & Furan Congeners Analysis

Rtx®-Dioxin (proprietary Crossbond® phase)

- Replacement column for 5% diphenyl phases.
- Improved separations of dioxin or furan congeners.
- Greater thermal stability than 5% diphenyl phases or high-cyano confirmation columns.

restek **innovation**!

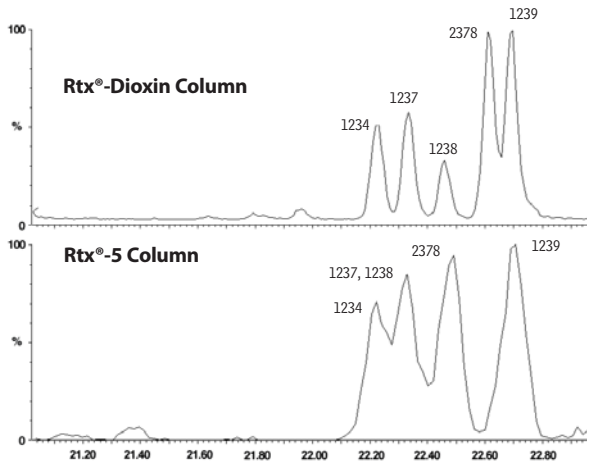
Rtx®-Dioxin Columns (fused silica)

ID	df (µm)	temp. limits	60-Meter
0.25mm	0.15	-60°C to 380°C	10755

also **available**

Rtx®-Dioxin2 columns.
See page 84.

Rtx®-Dioxin column separates all five components in the TCDD resolution check mixture.



Temperature program:

	Time (min.)	Rate (°C/min.)	Temp. (°C)
	0	52	200
	10.2	2.9	235
	10	6.9	300
	24		

Injector temp.: 270°C
Flow: 1.2mL/min. (constant pressure)

Column: Rtx®-Dioxin, 40m, 0.18mm ID, 0.11µm
Initial temp.: 130°C
Instrument: Micromass Altima high resolution GC/MS

Chromatography courtesy of Karen MacPherson and Eric Reiner, Ontario Ministry of the Environment, Etobicoke, ON, Canada.

Dioxin & Furan Congeners Analysis

restek
innovation!

Excellent for dioxins or furans.

Rtx®-Dioxin2 (proprietary Crossbond® phase)

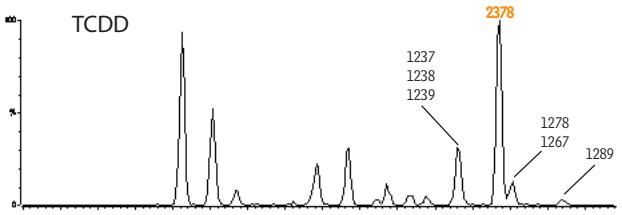
- Isomer specificity for 2,3,7,8-TCDD and 2,3,7,8-TCDF achieved with one GC column.
- Thermally stable to 340°C for longer lifetime.
- Unique selectivity for toxic dioxin and furan congeners allow use as a primary or confirmation GC column.

Rtx®-Dioxin2 Columns (fused silica)

ID	df (µm)	temp. limits	40-Meter	60-Meter
0.18mm	0.18	20°C to 340°C	10759	—
0.25mm	0.25	20°C to 340°C	—	10758

Jack Cochran
Director of New Business & Technology

2,3,7,8-Tetrachlorodibenzodioxin resolved from other TCDD congeners, using an Rtx®-Dioxin2 column.



Other peak identifications available upon request.

GC_EV00948

Column: Rtx®-Dioxin2, 60m, 0.25mm ID, 0.25µm (cat.# 10758)
Sample: WMS-01 Reference Material, Wellington Laboratories
Inj.: Splitless
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1.5mL/min.
Oven temp.: 130°C (hold 1.0 min.) to 200°C @ 40°C/min. to 235°C @ 3.0°C/min. to 300°C @ 5°C/min. (hold 10 min.)
Det.: Micromass Ultima high-resolution mass spectrometer
Ionization: EI
Mode: SIR

free literature

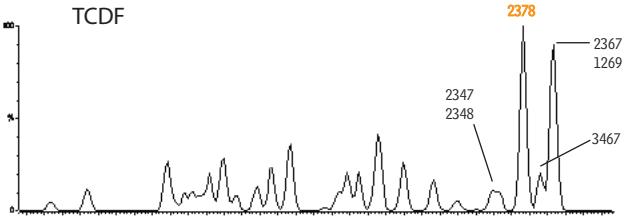
Rtx®-Dioxin2 Column: 2,3,7,8-TCDD and 2,3,7,8-TCDF Specificity in One GC Column

New data available—all 128 dioxin and furan tetra thru octa congeners aquired on the Rtx®-Dioxin2 column.

Download your free copy from www.restek.com

Flyer
lit. cat.# 580119A

Tetrachlorodibenzofuran congeners on an Rtx®-Dioxin2 column.



Other peak identifications available upon request.

GC_EV00949

Column: Rtx®-Dioxin2, 60m, 0.25mm ID, 0.25µm (cat.# 10758)
Sample: WMS-01 Reference Material, Wellington Laboratories
Inj.: Splitless
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1.5mL/min.
Oven temp.: 130°C (hold 1.0 min.) to 200°C @ 40°C/min. to 235°C @ 3.0°C/min. to 300°C @ 5°C/min. (hold 10 min.)
Det.: Micromass Ultima high-resolution mass spectrometer
Ionization: EI
Mode: SIR

Chromatograms courtesy of Terry Kolic, Karen MacPherson, Eric Reiner, Ontario Ministry of the Environment, Toronto, Ontario, Canada

Polycyclic Aromatic Hydrocarbon (PAH) Analysis

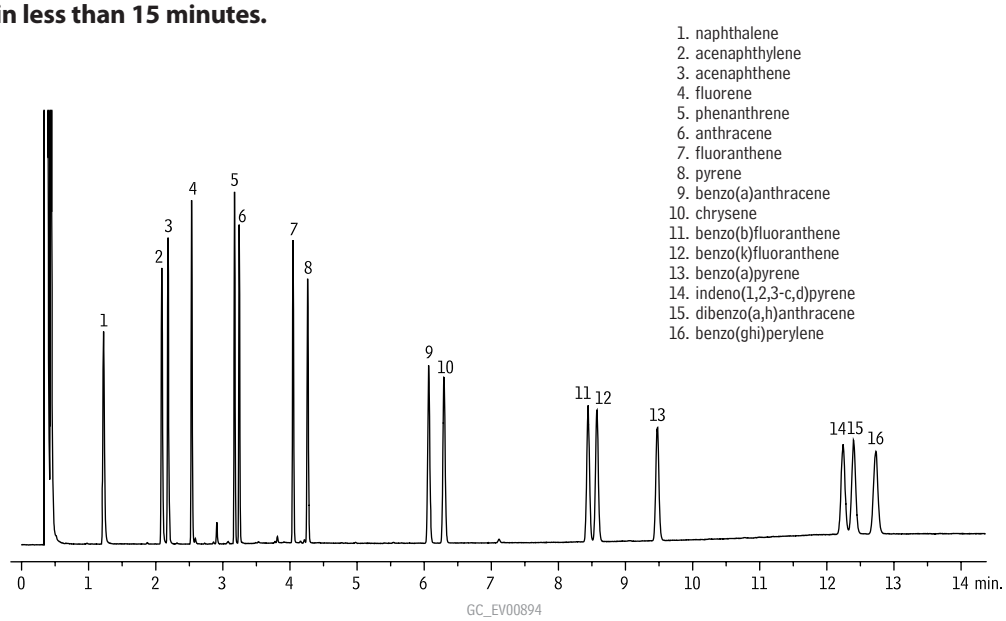
Rt™-PAH (polar, proprietary liquid crystalline phase)

- Specially designed for the analysis of polycyclic aromatic hydrocarbons (PAHs) listed in US EPA methods 610 and 8100.
- Low bleed at 285°C.
- Temperature range: 80°C to 285°C.

Rt™-PAH Columns (fused silica)

ID	df (µm)	temp. limits	12-Meter
0.25mm	0.15	80°C to 285°C	19733

Separation of 16 regulated polycyclic aromatic hydrocarbons (PAHs) in less than 15 minutes.



Column:	Rt™-PAH, 12m, 0.25mm ID, 0.15µm (cat.# 19733)
Sample:	16 component EPA Method 610 PAH standard (20ng/µl of each component in dichloromethane)
Inj.:	1.0µL split (split ratio 10:1)
Inj. temp.:	225°C
Carrier gas:	helium, 110kPa column head pressure
Oven temp.:	80°C to 220°C @ 40°C/min., 220°C to 285°C @ 8°C/min. (hold 5 min.)
Detector:	FID @ 290°C

Chromatogram courtesy of J&K Scientific.

Rt™-LC50 (polar, dimethyl (50% liquid crystal) polysiloxane)

- General purpose column with selectivity for dioxin or furan congeners, or PCB congeners.
- Low bleed at 270°C.
- Temperature range: 100°C to 270°C.

The unique liquid crystalline Rt™-LC50 stationary phase resolves compounds of similar structure and boiling point. It has proven effective for resolving many polycyclic aromatic hydrocarbons; other potential applications include dioxin, furan, or PCB congeners.

Rt™-LC50 Columns (fused silica)

ID	df (µm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	100°C to 270°C	19736	—
0.18mm	0.10	100°C to 270°C	19735	—
0.25mm	0.10	100°C to 270°C	—	19734

Explosives Analysis

restek **innovation**!

Rtx®-TNT/Rtx®-TNT2 (proprietary Crossbond® phase)

- Application-specific columns for explosives in US EPA Method 8095.
- Low bleed—ideal for ECD analysis.
- Complete analysis in less than 20 minutes.
- Rtx®-TNT2 confirmation column provides 8 elution order changes under same conditions.
- Economical 3-packs.
- Stable to 310°C.

please **note**

Polymer specially designed for explosives analysis.

We designed Rtx®-TNT and Rtx®-TNT2 columns specifically for analyses of nitroaromatic compounds by GC/ECD, such as the 16 analytes listed in US EPA Method 8095. They provide better resolution and higher thermal stability than any other currently recommended columns. Operate the Rtx®-TNT primary column and Rtx®-TNT2 confirmation column under identical GC oven temperature programs.

Rtx®-TNT Columns (fused silica)

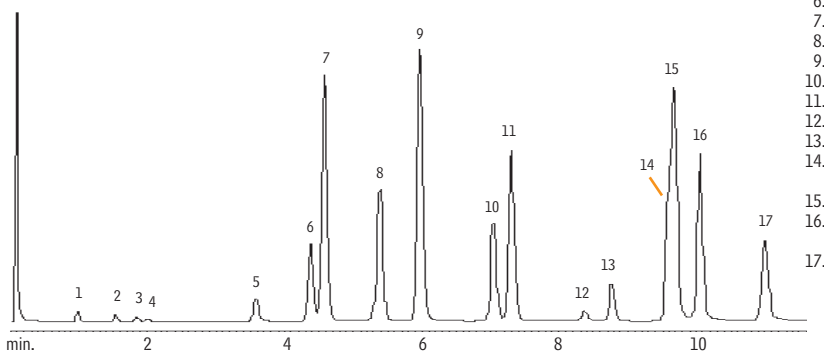
ID	df (µm)	temp. limits	6-Meter/3-pk.
0.53mm	1.50	-20 to 300/310°C	12998

Rtx®-TNT2 Columns (fused silica)

ID	df (µm)	temp. limits	6-Meter/3-pk.
0.53mm	1.50	-20 to 300/310°C	12999

US EPA Method 8095 explosives on Rtx®-TNT and Rtx®-TNT columns.

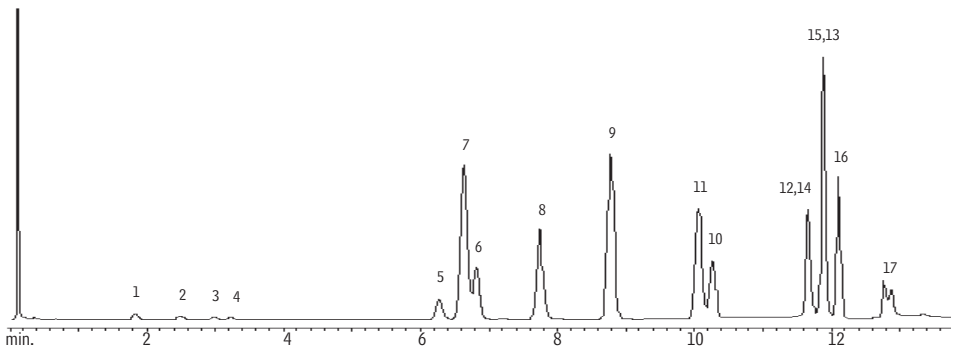
Rtx®-TNT
6m, 0.53mm ID, 1.50µm (cat.# 12998)



GC_EV00406

1. nitrobenzene
2. 2-nitrotoluene
3. 3-nitrotoluene
4. 4-nitrotoluene
5. nitroglycerine
6. 1,3-dinitrobenzene
7. 2,6-dinitrotoluene
8. 2,4-dinitrotoluene
9. 3,4-dinitrotoluene (IS)
10. 1,3,5-trinitrobenzene
11. trinitrotoluene
12. PETN
13. RDX
14. 4-amino-2,6-dinitrotoluene
15. 3,5-dinitroaniline
16. 2-amino-4,6-dinitrotoluene
17. tetryl

Rtx®-TNT2
6m, 0.53mm ID, 1.50µm (cat.# 12999)



GC_EV00407

Inj.:	Direct injection using a 1mm Siltek® Uniliner® (cat.# 21052-214.1)
On-column conc.:	est. 200-1000pg/compound. 8095 Calibration Mix A (cat.# 31607), 8095 Calibration Mix B (cat.# 31608), and 3,4-dinitrotoluene (cat.# 31452)
Oven temp.:	80°C (hold 1 min.) to 180°C @ 10°C/min. to 300°C @ 30°C/min. (hold 3 min.)
Inj. temp.:	250°C
Det.:	ECD @ 330°C with anode purge
Dead time:	4.4 sec.
Head pressure:	helium @ 3psi (20.7 KPa)
Flow rate:	helium @ 17mL/min. @ 80°C

Jarl Snider
R&D Chemist
12+ years of service!

Volatile Organics Analysis

Rtx®-VMS (proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants by GC/MS.
- Complete separation of US EPA Method 8260 compounds in less than 18 minutes.
- Stable to 260°C.
- No known equivalent phases.

Rtx®-VMS columns offer lower bleed, better selectivity, and overall faster analysis for separating volatile organic compounds, such as those listed in US EPA Method 8260. The Rtx®-VMS stationary phase is a highly stable polymer that provides outstanding analysis of volatile compounds, in combination with sensitive ion traps and Agilent 5973 mass spectrometers. 0.18 and 0.25mm ID columns allow sample splitting at the injection port, eliminating the added expense and maintenance of a jet separator. A 0.45mm or 0.53mm ID column can be directly connected to the purge & trap transfer line in a system equipped with a jet separator.

restek **innovation**!

- First choice for use with dual purge & traps[1]
- EPA recommended surrogate used.

[1]A.L. Hilling and G. Smith, Environmental Testing & Analysis, 10(3), 15-19, 2001.

Rtx®-VMS Columns (fused silica)

ID	df (µm)	temp. limits	30-Meter	60-Meter	75-Meter
0.25mm	1.40	-40 to 240/260°C	19915	19916	
0.32mm	1.80	-40 to 240/260°C	19919	19920	
0.45mm	2.55	-40 to 240/260°C	19908	19909	
0.53mm	3.00	-40 to 240/260°C	19985	19988	19974

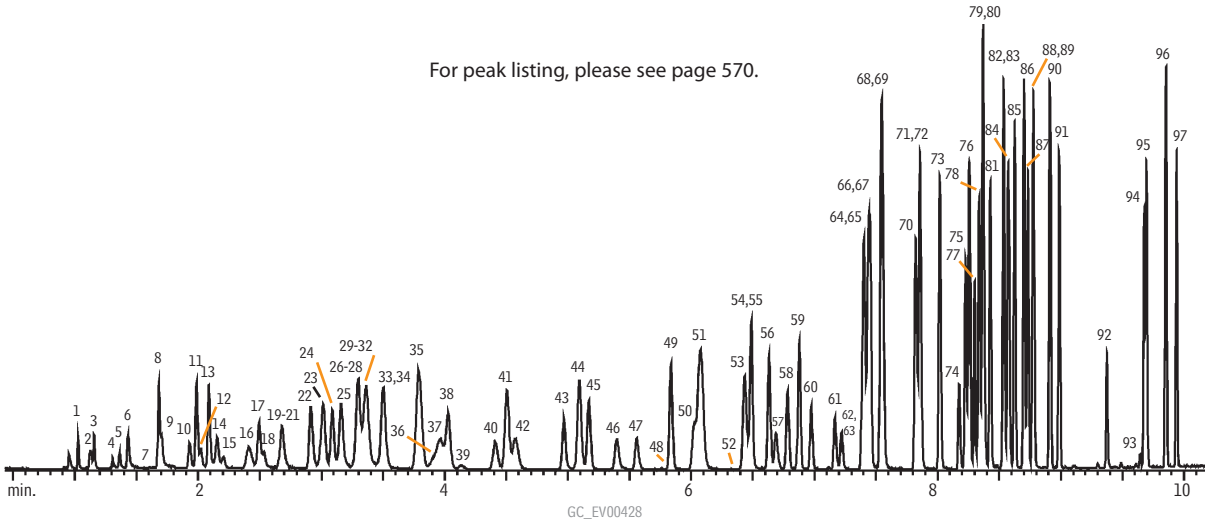
ID	df (µm)	temp. limits	20-Meter	40-Meter
0.18mm	1.00	-40 to 240/260°C	49914	49915

Need a column for a volatiles analysis?

see page 563

Rapid analysis of volatile organics in US EPA Method 8260B, on an Rtx®-VMS column.

For peak listing, please see page 570.



Column:	Rtx®-VMS, 20m, 0.18mm ID, 1.00µm (cat.# 49914)
Conc.:	10ppb in 5mL of RO water unless otherwise noted; ketones at 2.5X
Concentrator:	Tekmar LSC-3100 Purge and Trap
Trap:	Vocarb 3000 (type K)
Purge:	11 min. @ 40mL/min. (ambient temperature)
Dry purge:	1 min. @ 40mL/min.
Desorb preheat:	245°C
Desorb:	250°C for 2 min., flow 40mL/min.
Bake:	260°C for 8 min.
Interface:	0.53mm ID Silcosteel® tubing transfer line 1:40 split at injection port. 1mm ID liner.
Oven temp.:	50°C (hold 4 min.) to 100°C @ 18°C/min. (hold 0 min.) to 230°C @ 40°C/min. (hold 3 min.)
Carrier gas:	helium @ ~1.0mL/min. constant flow Adjust dichlorodifluoromethane to a retention time of 1.03 min. @ 50°C.
Detector:	Agilent 5973 MSD
Scan range:	35-300amu

Volatile Organics Analysis

restek
innovation!

Polymer specially designed for volatiles analysis by PID/ELCD.

Rtx®-VGC (proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants by GC/PID/ELCD. Excellent separation of trihalomethanes.
- Complete US EPA Method 8021A analysis in less than 28 minutes.
- Stable to 260°C.
- No known equivalent phases.

Using computer modeling techniques, we optimized the Rtx®-VGC column for analysis of volatile organic compounds on GC systems equipped with photoionization (PID) and electrolytic conductivity detectors (ELCD). It performs the most difficult separations of volatile organic compounds, such as those listed in US EPA Methods 502.2 and 8021, providing unsurpassed separation in the fastest analysis time, thereby increasing sample throughput. The Rtx®-VGC column provides ≥85% resolution of trihalomethanes (THMs) from other volatile compounds. This unique column also achieves excellent separation of gases and early eluting compounds.

Need a column for a volatiles analysis?
see page 563

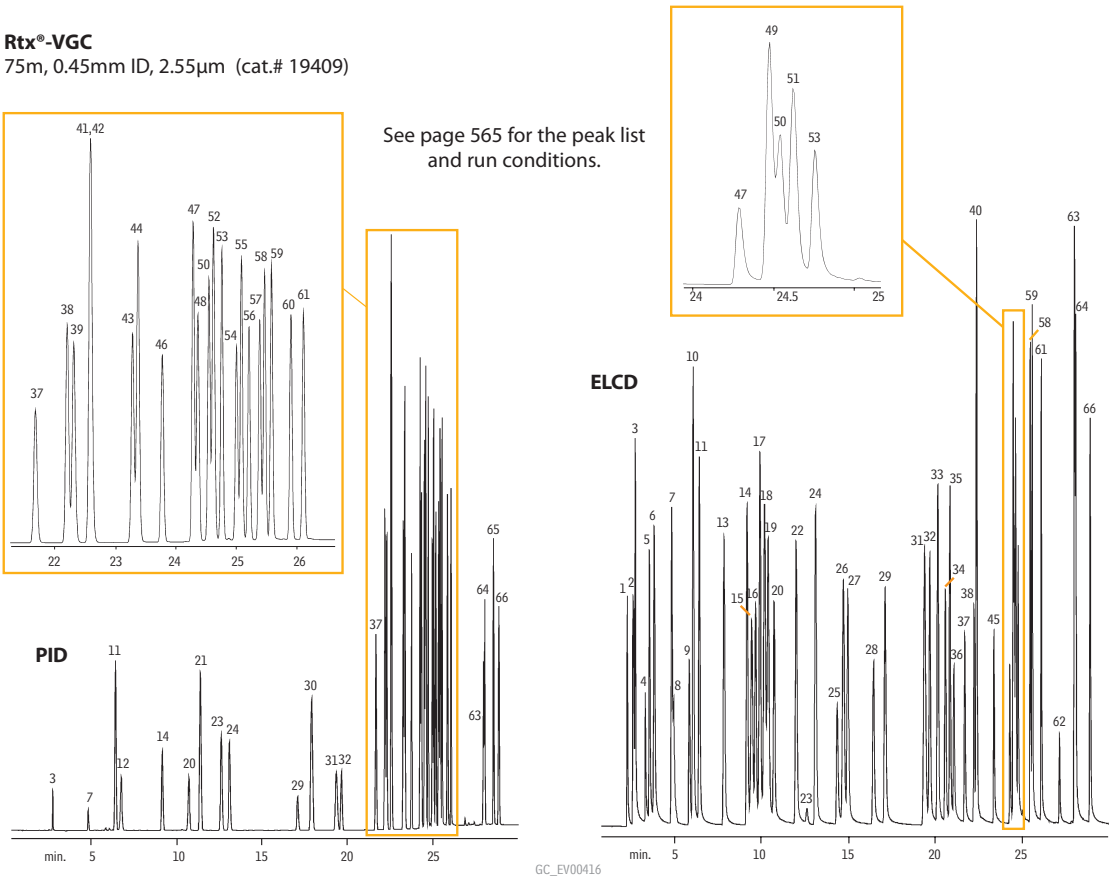
Rtx®-VGC Columns (fused silica)

ID	df (µm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-40 to 240/260°C	19415	19416		
0.32mm	1.80	-40 to 240/260°C	19419	19420		
0.45mm	2.55	-40 to 240/260°C	19408		19409	
0.53mm	3.00	-40 to 240/260°C	19485	19488	19474	19489

ID	df (µm)	temp. limits	20-Meter	40-Meter
0.18mm	1.00	-40 to 240/260°C	49414	49415

Fast separation of US EPA Method 8021 volatile organics: Rtx®-VGC column.
Primary column, dual-column analysis. Confirmation analysis shown on page 566.

Rtx®-VGC
75m, 0.45mm ID, 2.55µm (cat.# 19409)



Acknowledgement: Finnigan 9001 GC, µGold Tandem Photoionization/HALL® 2000 Electrolytic Conductivity Detector provided courtesy of Thermo Scientific GC & GC/MS Division, 2215 Grand Avenue Pkwy, Austin, Texas 78728

Volatile Organics Analysis

Rtx®-VRX (proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants.
- Excellent for US EPA Method 8021 compounds.
- Stable to 260°C.

The Rtx®-VRX stationary phase and optimized column dimensions provide low bleed, excellent resolution, and fast analysis times for volatile compounds.

similar **phase**

DB-VRX

Rtx®-VRX Columns (fused silica)

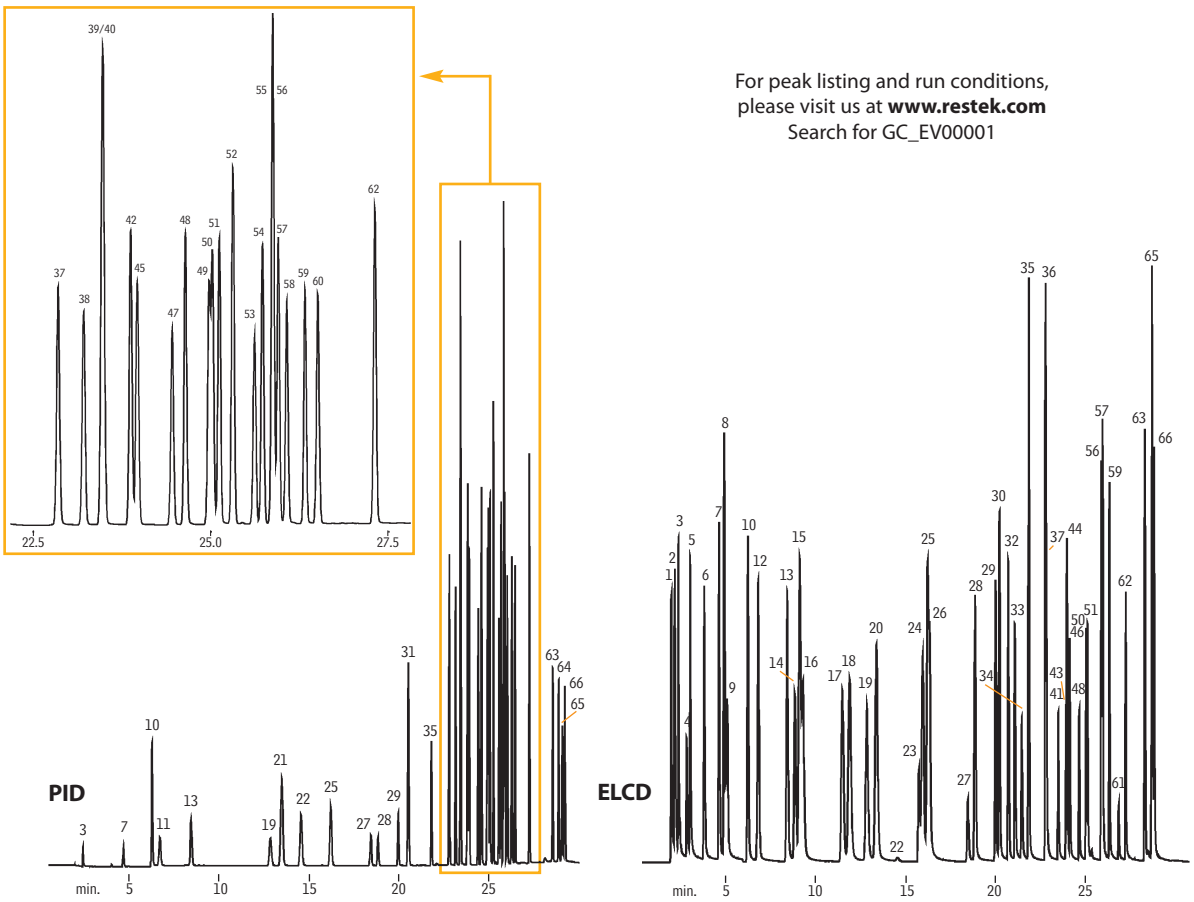
ID	df (µm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-40 to 240/260°C	19315	19316		
0.32mm	1.80	-40 to 240/260°C	19319	19320		
0.45mm	2.55	-40 to 240/260°C	19308		19309	
0.53mm	3.00	-40 to 240/260°C	19385	19388	19374	19389

ID	df (µm)	temp. limits	20-Meter	40-Meter
0.18mm	1.00	-40 to 240/260°C	49314	49315

Need a column for a volatiles analysis?

see page 563

Excellent resolution of EPA Method 8021 volatile organics on an Rtx®-VRX column.



Volatile Organics Analysis

Rtx®-502.2 (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants. The Rtx®-502.2 column is cited in US EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks.
- Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Stable to 270°C.

similar phase

DB-502.2

An Rtx®-502.2 column will enable you to quantify all compounds listed in US EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-502.2 stationary phase provides low bleed and thermal stability to 270°C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling. Narrow bore columns can interface directly in GC/MS systems.

Rtx®-502.2 Columns (fused silica)
(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

ID	df (µm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-20 to 250/270°C	10915	10916		
0.32mm	1.80	-20 to 250/270°C	10919	10920		10921
0.45mm	2.55	-20 to 250/270°C			10986	
0.53mm	3.00	-20 to 250/270°C	10908	10909		10910

ID	df (µm)	temp. limits	20-Meter	40-Meter
0.18mm	1.00	-20 to 250/270°C	40914	40915

also available

MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **pages 106 and 107** for our MXT®-502.2 and MXT®- Volatiles columns.

Rtx®-Volatiles (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Stable to 280°C.

similar phase

VOCOL®

Rtx®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in US EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-Volatiles stationary phase provides low bleed and thermal stability to 280°C. Narrow bore columns can interface directly in GC/MS systems.

ordering note

Rtx®-Volatiles columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See **page 30** for descriptions and ordering information.

Rtx®-Volatiles Columns (fused silica)
(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

ID	df (µm)	temp. limits*	30-Meter	60-Meter	105-Meter
0.25mm	1.00	-20 to 270/280°C	10900	10903	
0.32mm	1.50	-20 to 270/280°C	10901	10904	
0.53mm	2.00	-20 to 270/280°C	10902	10905	10906

it's a fact

Quantify all compounds in US EPA method 601, 602, or 624, using an Rtx®-Volatiles column.

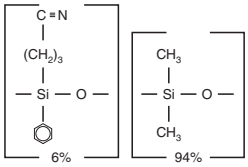
Volatile Organics Analysis

Rtx®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20°C to 240°C.
- Equivalent to USP G43 phase.

The unique polarity of the Rtx®-624 column makes it ideal for analyzing volatile organic pollutants. Although the Rtx®-502.2 column is recommended in many methods, the Rtx®-624 column offers better resolution of early eluting compounds. The Rtx®-624 phase produces greater than 90% resolution of the first six gases in EPA Methods 8260 and 524.2. This stationary phase is especially well-suited for EPA Method 524.2 revision IV since it resolves 2-nitropropane from 1,1-dichloropropanone, which share quantification ion m/z 43 and must be separated chromatographically.

Rtx®-624 Structure



Rtx®-624 Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (µm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-20 to 240°C	10968	10969		
0.32mm	1.80	-20 to 240°C	10970	10972		
0.45mm	2.55	-20 to 240°C			10982	
0.53mm	3.00	-20 to 240°C	10971	10973	10974	10975

ID	df (µm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	1.00	-20 to 240°C		40924	40925

similar **phases**

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

also **available**

MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 107** for our MXT®-624 columns.

Kristi Sellers
Innovations Chemist
20+ years of service!