



Restek Refined

# Biodiesel Solutions

Innovative Products for Simple,  
Reliable Biodiesel Analysis

- MXT-Biodiesel TG, Rtx-Biodiesel TG, and FAMEWAX columns—engineered specifically for high-performance biodiesel analysis.
- GC accessories to simplify your lab work and increase productivity.
- High-quality standards for reliable use.

Integrated  
retention gaps—

**The Ultimate  
Biodiesel  
Solution!**

See page 8 for details

**RESTEK**

Pure Chromatography

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# Introduction to Biodiesel

Biodiesel is one of the alternative fuels commonly available today. It may be used in engines, either pure or blended with diesel fuel, to reduce exhaust pollutants. It can be produced easily from sunflowers, soy, rapeseed, tallow, lard, yellow grease, marine sources, and other sources. Chemically, it is the product obtained when a vegetable or animal fat is reacted with an alcohol in the presence of an acidic or basic catalyst to produce fatty acid methyl esters (FAMEs).

Methods used to test the quality of biodiesel fuels can be categorized into four types based on the target compounds: ASTM D6584 and EN 14105 test for total glycerin; EN 14103 tests for FAMEs; EN15779 tests for presence of methyl esters of polyunsaturated fatty acids (PUFAs); and EN 14110 tests for residual methanol. As shown in this brochure, Restek's Rtx-Biodiesel TG, MXT-Biodiesel TG, FAMEWAX, and Rtx-1 columns offer outstanding performance for these methods. Specifically, for the analysis of total glycerin, our fused silica Rtx-Biodiesel TG and metal MXT-Biodiesel TG columns provide the high-temperature tolerance required for successful analysis.

## Rtx-Biodiesel TG Columns (fused silica)

- Linearity for all reference compounds exceeds method requirements.
- Columns with retention gaps feature SilTite  $\mu$ -Union connectors for a permanent, leak-tight connection.
- Low column bleed at high temperatures.
- For glycerin and glycerides analysis, according to ASTM D6584 and EN 14105 methods.
- Stable to 380 °C.

ID	df	Length	Temp. Limits	Modification	qty.	cat.#
0.32 mm	0.10 $\mu$ m	10 m	to 330/380 °C		ea.	10292
	0.10 $\mu$ m	10 m	to 330/380 °C	with 2 m x 0.53 mm ID Retention Gap (connected with SilTite $\mu$ -Union connector)	ea.	10291
	0.10 $\mu$ m	15 m	to 330/380 °C		ea.	10294
	0.10 $\mu$ m	15 m	to 330/380 °C	with 2 m x 0.53 mm ID Retention Gap (connected with SilTite $\mu$ -Union connector)	ea.	10293

## Biodiesel Calibration Standards

Description	CAS #	Conc. in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
(s)-(-)-1,2,4-Butanetriol	42890-76-6	1000 $\mu$ g/mL in pyridine, 1 mL/ampul	No	6 months	24 months	Ambient	10 °C or colder	ea.	33024
	42890-76-6	1000 $\mu$ g/mL in pyridine, 5 mL/ampul	No	6 months	24 months	Ambient	10 °C or colder	ea.	33032
Diiolein (1,3-di[ <i>cis</i> -octadecenoyl]glycerol)	2465-32-9	5000 $\mu$ g/mL in pyridine, 1 mL/ampul	No	6 months	24 months	Ambient	10 °C or colder	ea.	33022
Glycerin	56-81-5	500 $\mu$ g/mL in pyridine, 1 mL/ampul	Yes	6 months	24 months	Ambient	10 °C or colder	ea.	33020
Monolein (1-mono[ <i>cis</i> -9-octadecenoyl]-rac-glycerol)	111-03-5	5000 $\mu$ g/mL in pyridine, 1 mL/ampul	No	6 months	24 months	Ambient	10 °C or colder	ea.	33021
Monopalmitin	524-44-9	5000 $\mu$ g/mL in pyridine, 1 mL/ampul	Yes	6 months	24 months	Ambient	10 °C or colder	ea.	33026
Tricaprin (1,2,3-tricaprinoylglycerol)	621-71-6	8000 $\mu$ g/mL in pyridine, 1 mL/ampul	Yes	6 months	24 months	Ambient	10 °C or colder	ea.	33025
	621-71-6	8000 $\mu$ g/mL in pyridine, 5 mL/ampul	Yes	6 months	24 months	Ambient	10 °C or colder	ea.	33033
Triolein (1,2,3-tri[ <i>cis</i> -octadecenoyl]glycerol)	122-32-7	5000 $\mu$ g/mL in pyridine, 1 mL/ampul	Yes	6 months	24 months	Ambient	10 °C or colder	ea.	33023

## Diesel:Biodiesel (80:20) Blend Standard

The biodiesel component is methyl soyate.

Description	CAS #	Conc. in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
Diesel:biodiesel (80:20)	67784-80-9	5000 µg/mL in methylene chloride, 1 mL/ampul	Yes	6 months	48 months	Ambient	25 °C nominal	ea.	31880

## Silylation Derivatization Reagents

- Replace active hydrogen, reducing polarity and making the compounds more volatile.
- Increase stability of derivatives.

Silylation is the most widely used derivatization procedure for sample analysis by GC. In silylation, an active hydrogen is replaced by an alkylsilyl group such as trimethylsilyl (TMS) or *tert*-butyldimethylsilyl (*tert*-BDMS). Silyl derivatives are more volatile, less polar, and more thermally stable. As a result, GC separation is improved, and detection is enhanced.

Both TMS and *tert*-BDMS reagents are suitable for a wide variety of compounds and can be used for many GC applications. (Note that silylation reagents are generally moisture-sensitive and must be sealed to prevent deactivation.)

Description	CAS #	CRM?	Min Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	Similar to Part #	cat.#
MSTFA (N-methyl-N-trimethylsilyltrifluoroacetamide)	24589-78-4	No	12 months	Ambient	Ambient	10-pk. (10x1 g)	UCT SMSTFA-0-1	35600
	24589-78-4	No	12 months	Ambient	Ambient	25 g vial	UCT SMSTFA-0-25	35601
MSTFA w/1% TMCS (N-methyl-N-trimethylsilyltrifluoroacetamide w/1% trimethylchlorosilane)	24589-78-4	No	12 months	Ambient	Ambient	10-pk. (10x1 g)	UCT SMSTFA-1-1	35602
	24589-78-4	No	12 months	Ambient	Ambient	25 g vial	UCT SMSTFA-1-25	35603
BSTFA (N,O-bis(trimethylsilyl)trifluoroacetamide)	25561-30-2	No	12 months	Ambient	Ambient	10-pk. (10x1 g)	UCT SBSTFA-0-1	35604
	25561-30-2	No	12 months	Ambient	Ambient	25 g vial	UCT SBSTFA-0-25	35605
BSTFA w/1% TMCS (N,O-bis(trimethylsilyl)trifluoroacetamide w/1% trimethylchlorosilane)	25561-30-2	No	12 months	Ambient	Ambient	10-pk. (10x1 g)	UCT SBSTFA-1-1	35606
	25561-30-2	No	12 months	Ambient	Ambient	25 g vial	UCT SBSTFA-1-25	35607
MTBSTFA w/1% TBDMCS (N-methyl-N[ <i>tert</i> -butyldimethylsilyl]trifluoroacetamide) w/1% <i>tert</i> -butyldimethylchlorosilane)	77377-52-7	No	12 months	Ambient	Ambient	10-pk. (10x1 g)	UCT SMTBSTFA-1-1	35608
	77377-52-7	No	12 months	Ambient	Ambient	25 g vial	UCT SMTBSTFA-1-25	35610
TMCS (trimethylchlorosilane)	75-77-4	No	12 months	Ambient	Ambient	10-pk. (10x1 g)	UCT STMCS-0-1	35611

# Analyzing Total Glycerin in Biodiesel

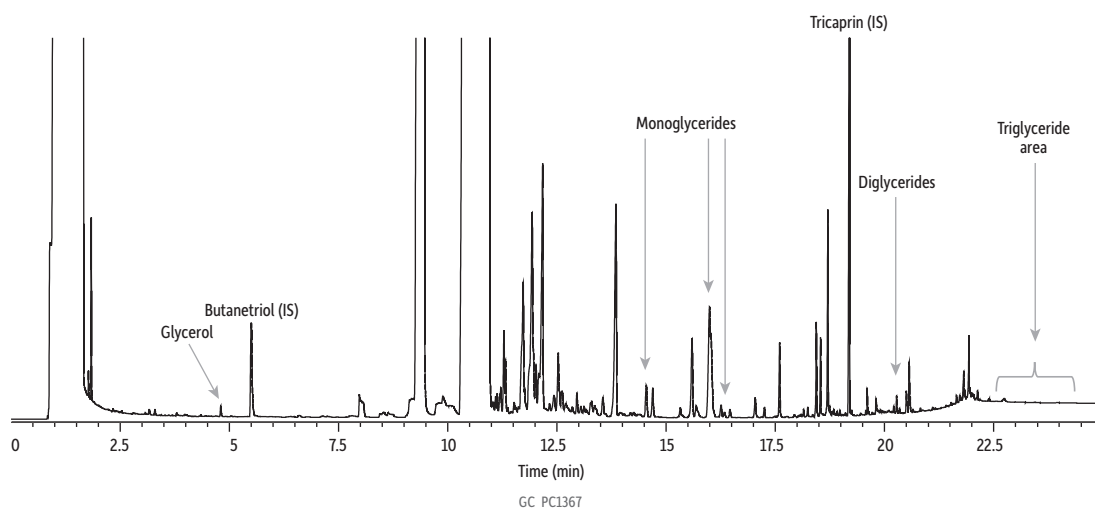
## Rtx-Biodiesel TG Fused Silica Columns

Glycerin in biodiesel falls out of solution, causing gumming in fuel systems and malfunctioning of engine parts, which eventually leads to inferior engine performance. Total glycerin presents itself in two forms: free glycerin and bound glycerin in the form of glycerides. Derivatization is required for analysis, and both ASTM D6584 and EN 14105 use N-methyl-N-trimethylsilyltrifluoroacetamide derivatization reagent.

A 10 m or 15 m x 0.32 mm ID Rtx-Biodiesel TG column with a 2 m x 0.53 mm ID retention gap performs well for the analysis of glycerin and glycerides. The retention gap is factory-coupled using a SilTite  $\mu$ -Union connector. The data in Figure 1 show the elution of glycerin, monoglycerides, diglycerides, and triglycerides in B100 biodiesel following ASTM Method D6584, utilizing cool on-column injection. The Rtx-Biodiesel TG column provides good resolution and signal-to-noise ratios for mono-, di-, and triglycerides.



**Figure 1:** The Rtx-Biodiesel TG column meets resolution criteria and shows excellent response for determining glycerin in biodiesel.



Peaks	tr (min)
1. Glycerol	4.80
2. 1,2,4-Butanetriol (IS)	5.50
3. Monoglycerides	as shown
4. Tricaprin (IS)	19.19
5. Diglycerides	20.16 - 20.9
6. Triglycerides	22.27 - 25.15

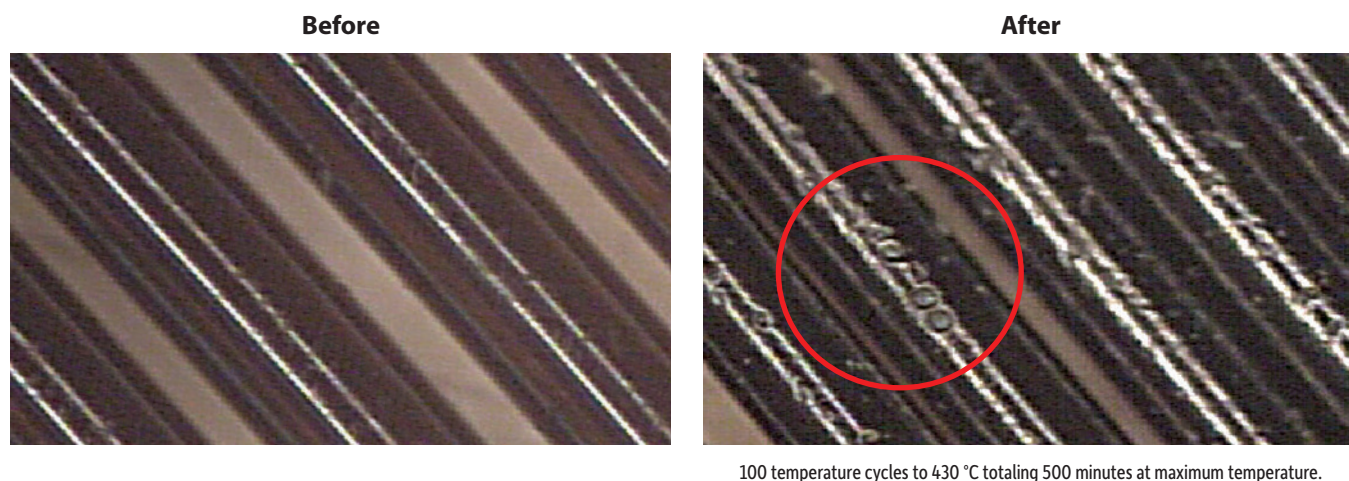
<b>Column</b>	Rtx-Biodiesel TG with 2 m x 0.53 mm ID retention gap, 15 m, 0.32 mm ID, 0.1 $\mu$ m (cat.# 10293)
<b>Standard/Sample</b>	Soy B100 biodiesel Tricaprin (1,2,3-tricaprinoylglycerol) (cat.# 33025) (s)-(-)-1,2,4-Butanetriol (cat.# 33024) Heptane
<b>Diluent:</b>	
<b>Injection</b>	
Inj. Vol.:	1 $\mu$ L cool on-column
Temp. Program:	Track oven
<b>Oven</b>	
Oven Temp.:	50 °C (hold 1 min) to 180 °C at 15 °C/min to 230 °C at 7 °C/min to 380 °C at 30 °C/min (hold 2 min)
<b>Carrier Gas</b>	H <sub>2</sub> , constant flow
Flow Rate:	2.7 mL/min
<b>Detector</b>	FID @ 380 °C
<b>Instrument</b>	Agilent 7890B GC
<b>Sample Preparation</b>	Sample preparation followed ASTM D6584-17: Soy biodiesel B100 was fortified with internal standards (butanetriol and tricaprin) and derivatized using MSTFA.

### Comparing Fused Silica to Metal

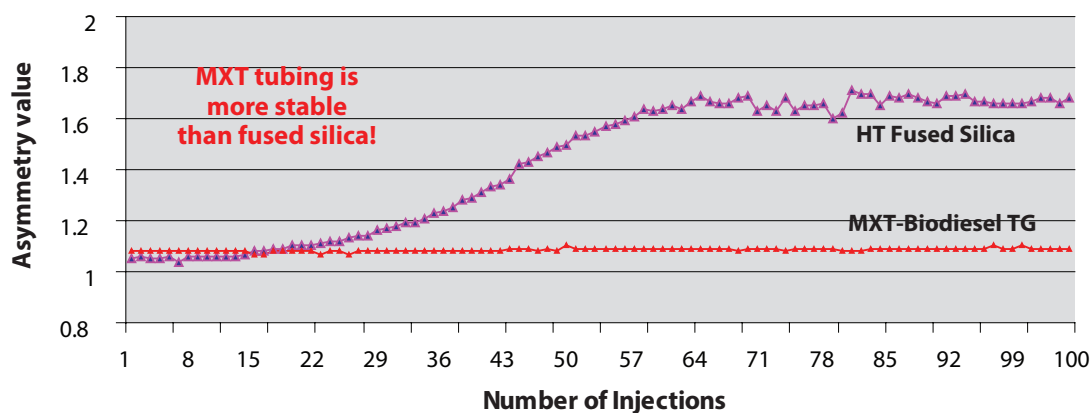
High-temperature applications shorten the lifetime of fused silica columns due to deterioration of the polyimide resin used to make the columns. When fused silica columns are exposed to oven temperatures over 400 °C, the polyimide coating becomes brittle and the deactivation of the column is compromised. Figure 2 shows the effect of cycling a commercially available fused silica column to 430 °C for 5 minutes, 100 times. Although the column was labeled as stable up to 430 °C, the polyimide coating shows damage. The inertness of the column also deteriorates as shown by the loss of peak symmetry for the internal standard butanetriol over multiple injections (Figure 3).

Metal MXT-Biodiesel TG columns are a better alternative to fused silica columns. As shown in Figure 3, they clearly outperform high-temperature fused silica columns under the cycling conditions required for biodiesel analysis. Metal MXT-Biodiesel TG columns offer greater stability and longer column lifetimes compared to fused silica columns.

**Figure 2:** Fused silica columns, labeled as stable up to 430 °C, show significant pitting and breakdown.



**Figure 3:** Stable peak shape for internal standard butanetriol on MXT-Biodiesel TG columns gives more accurate quantification.





## Metal Column Solutions: Two Options for Increased Stability and Performance

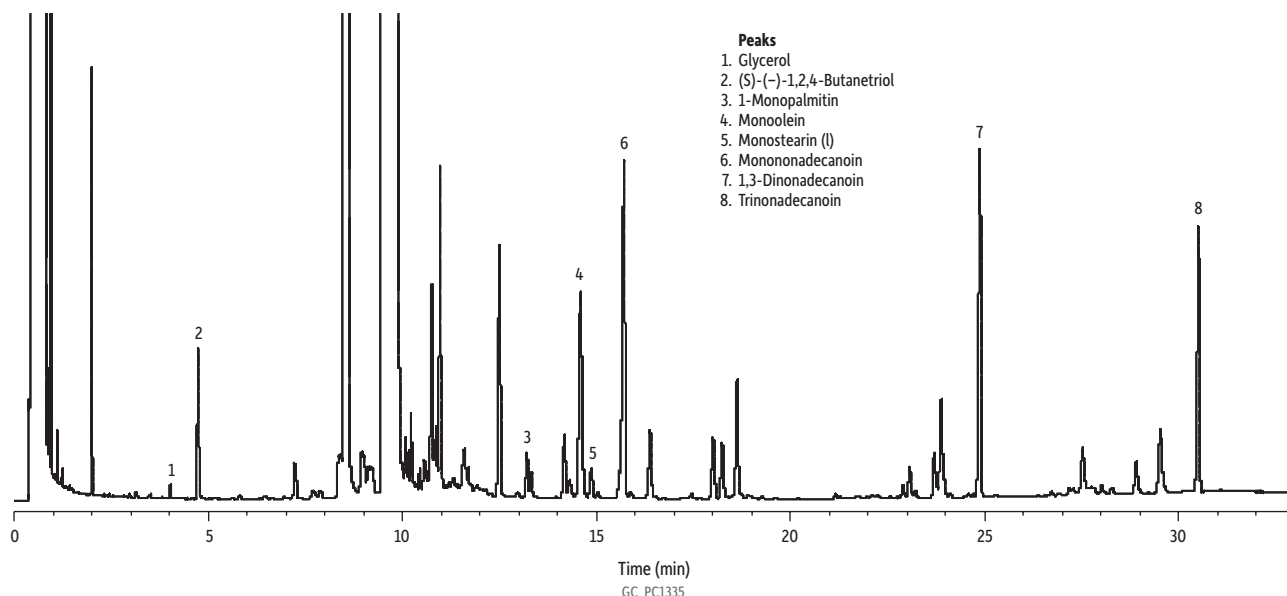
- 0.32 mm MXT-Biodiesel TG column with a 0.53 mm retention gap, factory-coupled with an MXT low-dead-volume connector.
- 0.53 mm MXT-Biodiesel TG column with a built-in 0.53mm Integra-Gap integrated retention gap.

The primary advantage of using metal MXT columns is that they are more stable at high temperatures than fused silica columns. This means they will exhibit lower bleed, improving analytical performance, and have longer lifetimes, making them a cost-effective option. They also can be brought to high temperatures (430 °C) allowing nonvolatile material to be thermally driven off of the column, removing carryover contamination and improving cycle times.

Metal MXT-Biodiesel TG columns are offered in the same column dimensions as their fused silica counterparts. Two different column configurations are available for cool on-column injection: (1) a 10 m (or 15 m) x 0.32 mm ID MXT-Biodiesel TG column factory-coupled to a 2 m x 0.53 mm retention gap using an MXT connector; and (2) a 14 m x 0.53 mm ID MXT-Biodiesel TG column with a built-in 2 m x 0.53 mm ID Integra-Gap integrated retention gap.

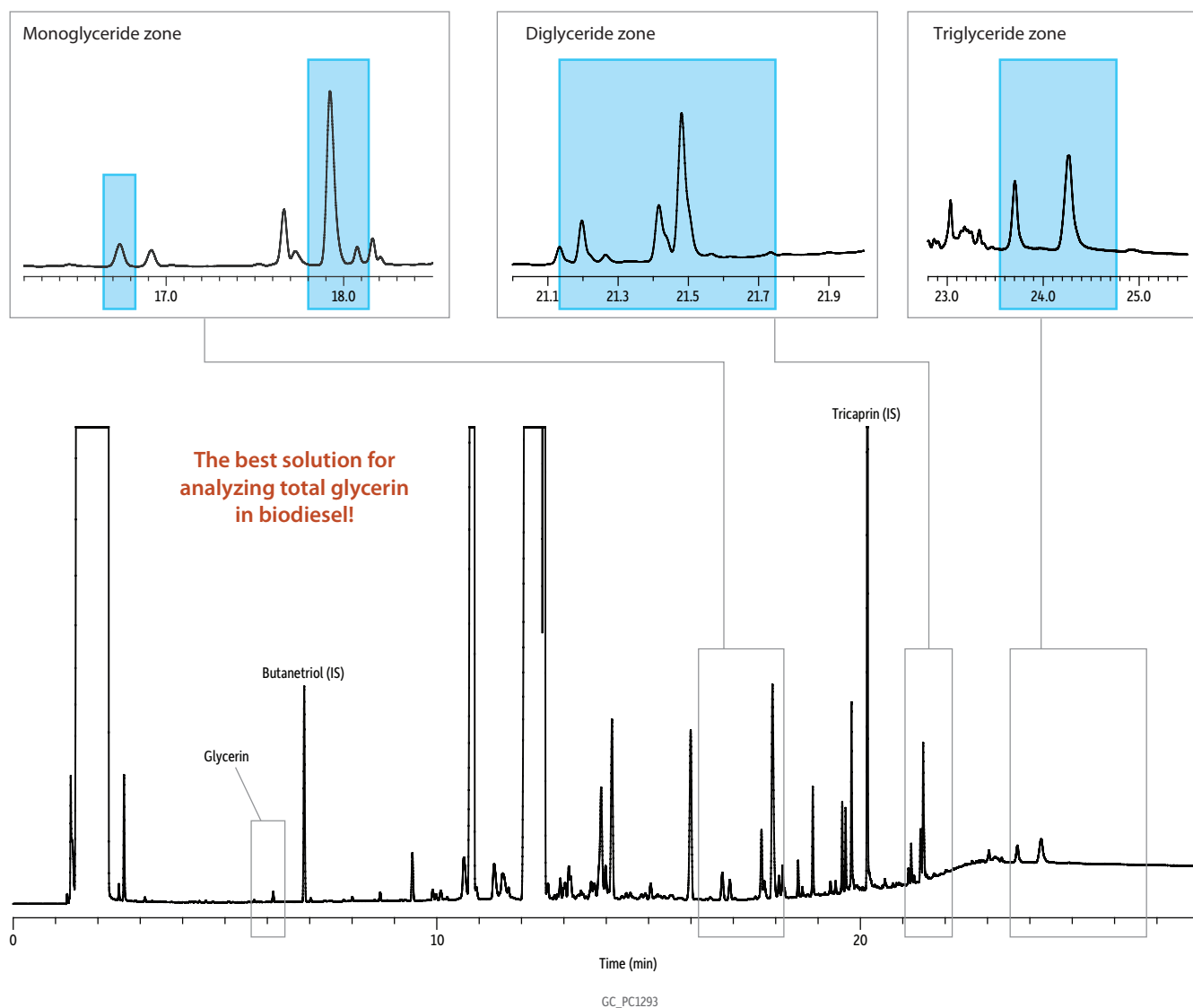
Target analytes resolve well, and the solvent and triglyceride peaks show excellent symmetry on both columns (Figures 4 and 5), but the 0.53 mm MXT-Biodiesel TG column with the Integra-Gap integrated retention gap eliminates the need for a connector, making connector-related leaks a thing of the past. Peak shape for butanetriol is very good, demonstrating inertness, and the resolution and responses for the mono-, di-, and triglycerides are excellent. The leak-proof 0.53 mm MXT-Biodiesel TG column with the Integra-Gap integrated retention gap is the ultimate biodiesel solution (Figure 6).

**Figure 4:** Derivatized B100 samples resolve well on the 15 m x 0.32 mm MXT-Biodiesel TG column, which is factory coupled to a 0.53 mm retention gap using an MXT low-dead-volume connector.



<b>Column</b>	MXT-Biodiesel TG with 2 m x 0.53 mm ID retention gap, 15 m, 0.32 mm ID, 0.10 µm (cat.# 70291)
<b>Sample</b>	Soy biodiesel B100 EN 14105 custom standard 1 (cat.# 572879) (s)-(-)-1,2,4-Butanetriol (cat.# 33032) MSTFA (N-methyl-N-trimethylsilyltrifluoroacetamide) (cat.# 35600)
<b>Diluent:</b>	Heptane
<b>Injection</b>	
Inj. Vol.:	1 µL cool on-column
Temp. Program:	Oven track
<b>Oven</b>	
Oven Temp.:	50 °C (hold 1 min) to 180 °C at 15 °C/min to 230 °C at 7 °C/min to 370 °C at 10 °C/min (hold 5 min)
<b>Carrier Gas</b>	H <sub>2</sub> , constant flow
Flow Rate:	7 mL/min
<b>Detector</b>	FID @ 380 °C
<b>Instrument</b>	Agilent 7890A GC
<b>Notes</b>	The sample was derivatized with MSTFA according to the method EN 14105 (2011) procedure.

**Figure 5:** Excellent chromatographic quality and resolution on the 0.53 mm MXT-Biodiesel TG column with the Integra-Gap integrated retention gap.



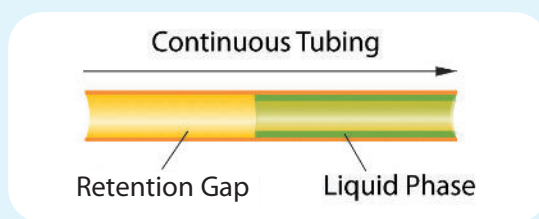
<b>Column</b>	MXT-Biodiesel TG with 2 m Integra-Gap (integrated retention gap), 16 m total length, 0.53 mm ID, 0.16 $\mu$ m (cat.# 70289)
<b>Sample</b>	Biodiesel (B100), derivatized
<b>Diluent:</b>	Heptane
<b>Injection</b>	
Inj. Vol.:	1 $\mu$ L cold on-column
Temp. Program:	Oven track
<b>Oven</b>	
Oven Temp.:	50 °C (hold 1 min) to 180 °C at 15 °C/min to 230 °C at 7 °C/min to 380 °C at 30 °C/min (hold 5 min)
Carrier Gas	He, constant flow
Flow Rate:	3 mL/min
Detector	FID @ 380 °C
<b>Instrument</b>	Agilent 7890A GC

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

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Temperature range: -60 to 430 °C

ID	df	Length	Temp. Limits	Modification	Column Config	qty.	cat.#
0.53 mm	0.16 µm	14 m	-60 to 380/430 °C	with 2 m Integra-Gap (Total column length = 16 meters.)	7" 11-pin cage	ea.	70289
	0.16 µm	14 m	-60 to 380/430 °C	with 2 m Integra-Gap (Total column length = 16 meters.)	3.5" Coil	ea.	70289-273
	0.10 µm	10 m	-60 to 380/430 °C		7" 11-pin cage	ea.	70292
0.32 mm	0.10 µm	10 m	-60 to 380/430 °C	with 2 m x 0.53 mm ID Retention Gap (Connected with low-dead-volume MXT connector.)	7" 11-pin cage	ea.	70290
	0.10 µm	15 m	-60 to 380/430 °C		7" 11-pin cage	ea.	70293
	0.10 µm	15 m	-60 to 380/430 °C	with 2 m x 0.53 mm ID Retention Gap (Connected with low-dead-volume MXT connector.)	7" 11-pin cage	ea.	70291
0.53 mm		2 m	-60 to 380/430 °C	Retention Gap	7" 11-pin cage	ea.	70294

**Figure 6:** The Ultimate Biodiesel Solution: MXT-Biodiesel TG column with Integra-Gap integrated retention gap.



The 0.53 mm MXT-Biodiesel TG columns are an innovative alternative to using a 0.32 mm column coupled to a 0.53 mm retention gap. Restek applied the Integra-Gap integrated retention gap technology to the 0.53 mm MXT-Biodiesel TG columns, eliminating the column coupling. These 100% leak-proof columns feature a built-in retention gap, reducing the risk of peak broadening and tailing, and guaranteeing the user many analyses without downtime.



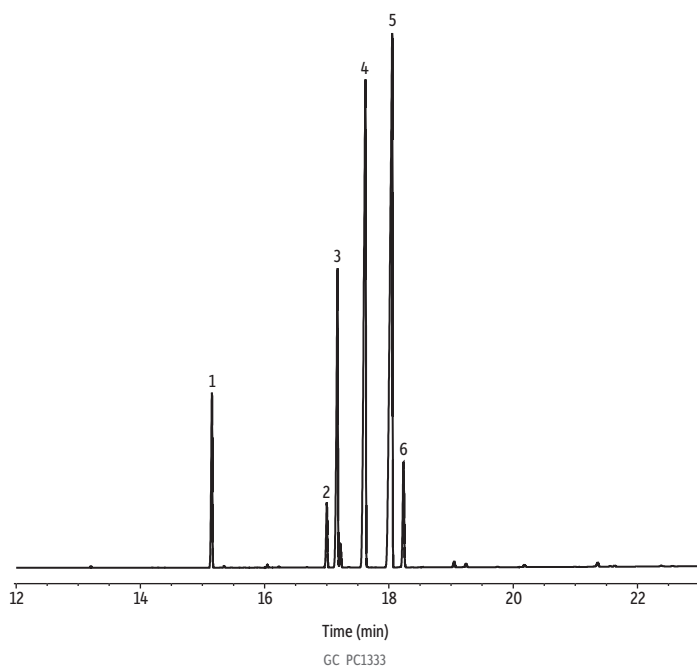
## Analyzing FAMES in Biodiesel

FAMES are the desired end product of biodiesel production, and they are analyzed to determine the quality and cetane number of the final product. A FAMEWAX fused silica GC column affords excellent peak symmetry, resolution, and reproducibility for determining the FAMES and linolenic acid methyl ester content in B100 biodiesel fuel, following European standard method EN 14103.

As shown in Figure 7, C16:0-C18:3 FAMES can be determined using a 30 m x 0.25 mm ID x 0.25  $\mu$ m FAMEWAX column. Particularly notable are the stability of the baseline, excellent peak symmetry, and baseline resolution of all compounds of interest. The FAMEWAX column shows excellent peak shape for all FAMES, even at low concentrations, which is critical for accurate quantification.

Marine-sourced or algal biodiesel could contain a significant amount of polyunsaturated fatty acid (PUFA) methyl esters ( $\geq 4$  double bonds). Biodiesel with a high concentration of PUFA methyl esters will show poor oxidation stability and can self-polymerize, which is an undesirable quality in fuels. Method EN 15779 describes the procedure for the analysis and quantification of the four most prevalent PUFA methyl esters present in marine biodiesel. A FAMEWAX column will separate PUFA methyl esters and FAME C23:0 (which is used as an internal standard) from other components in biodiesel. Visit [www.restek.com/ezgc](http://www.restek.com/ezgc) to model various chromatographic analyses using our FAMEWAX library.

**Figure 7:** Stable baselines, excellent peak symmetry, and rapid, baseline resolution of all compounds characterize FAMES analyses on a FAMEWAX column.



Peaks	ts (min)	Structural Nomenclature
1. Methyl palmitate	15.149	C16:0
2. Methyl stearate	16.997	C18:0
3. Methyl oleate	17.171	C18:1 ( <i>cis</i> -9)
4. Methyl linoleate	17.621	C18:2 ( <i>cis</i> -9,12)
5. Methyl nonadecanoate	18.052	C19:0
6. Methyl linolenate	18.235	C18:3 ( <i>cis</i> -9,12,15)

<b>Column</b>	FAMEWAX, 30 m, 0.25 mm ID, 0.25 $\mu$ m (cat.# 12497)
<b>Sample</b>	Soy B100 biodiesel
	Methyl nonadecanoate (cat.# 35055)
<b>Diluent:</b>	Toluene
<b>Conc.:</b>	10 mg/mL, EN 14103 (2011) method preparation
<b>Injection</b>	
Inj. Vol.:	1 $\mu$ L split (split ratio 100:1)
Liner:	Topaz 4.0 mm ID Precision inlet liner w/ wool (cat.# 23305)
Inj. Temp.:	240 °C
<b>Oven</b>	
Oven Temp.:	60 °C (hold 2 min) to 200 °C at 10 °C/min to 240 °C at 5 °C/min (hold 7 min)
<b>Carrier Gas</b>	H <sub>2</sub> , constant flow
<b>Flow Rate:</b>	1.7 mL/min
<b>Detector</b>	FID @ 250 °C
<b>Instrument</b>	Agilent 7890B GC

## FAMEWAX Columns (USP G16) (fused silica)

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.

ID	df	Length	Temp. Limits	qty.	cat. #
0.25 mm	0.25 µm	30 m	20 to 240/250 °C	ea.	12497
0.32 mm	0.25 µm	30 m	20 to 240/250 °C	ea.	12498
0.53 mm	0.50 µm	30 m	20 to 250 °C	ea.	12499

## Analyzing Methanol in Biodiesel

Methanol is commonly used to produce biodiesel by transesterification of triglycerides to methyl esters. The amount of residual methanol must be determined because engine performance can be negatively affected if the methanol concentration in the final product is too high. Methanol in biodiesel is quantified using a headspace method (e.g., EN 14110). We recommend an Rtx-1 column (30 m, 0.32 mm ID, 3 µm) for this analysis. The selectivity of the Rtx-1 column is ideal for resolving methanol from interfering peaks in biodiesel fuels.

## Conclusion

Whether testing for glycerin, FAMES, or methanol, Restek can supply the high-quality chromatography products required for biodiesel testing. We offer an array of metal and fused silica GC columns designed for high-performance biodiesel analysis, including our innovative MXT-Biodiesel TG column with an Integra-Gap integrated retention gap (Table II). Our columns, accessories, and reference materials are designed to improve analytical quality, simplify lab work, and increase productivity. Rely on Restek for innovative solutions to your biodiesel testing needs.

**Table II** GC column selection guide for biodiesel fuel methods.

Fused Silica GC Columns	Description	Injection Type	ASTM D6584	EN 14103, EN15779	EN 14105	EN 14110
			Free and Total Glycerin	FAMES and Linolenic Acid Methyl Ester	Free and Total Glycerin and Mono, Di, and Triglycerides	Methanol
Rtx-Biodiesel TG (max temp. 380°C)	15 m, 0.32 mm ID, 0.1 µm with 2 m x 0.53 mm ID retention gap	cool on-column	10293	—	10293	—
Rtx-Biodiesel TG (max temp. 380°C)	15 m, 0.32 mm ID, 0.1 µm	PTV**	10294	—	10294	—
Rtx-Biodiesel TG (max temp. 380°C)	10 m, 0.32 mm ID, 0.1 µm with 2 m x 0.53 mm ID retention gap	cool on-column	10291	—	10291	—
Rtx-Biodiesel TG (max temp. 380°C)	10 m, 0.32 mm ID, 0.1 µm	PTV**	10292	—	10292	—
FAMEWAX	30 m, 0.25 mm ID, 0.25 µm	split/splitless	—	12497	—	—
Rtx-1	30 m, 0.32 mm ID, 3.0 µm	headspace	—	—	—	10184
<b>Metal (MXT) GC Columns</b>						
*MXT-Biodiesel TG (max temp. 430°C)	14 m, 0.53 mm ID, 0.16 µm with 2 m Integra Gap	cool on-column	70289	—	70289	—
MXT-Biodiesel TG (max temp. 430°C)	15 m, 0.32 mm ID, 0.1 µm with 2 m x 0.53 mm ID retention gap	cool on-column	70291	—	70291	—
MXT-Biodiesel TG (max temp. 430°C)	15 m, 0.32 mm ID, 0.1 µm	PTV**	70293	—	70293	—
MXT-Biodiesel TG (max temp. 430°C)	10 m, 0.32 mm ID, 0.1 µm with 2 m x 0.53 mm ID retention gap	cool on-column	70290	—	70290	—
MXT-Biodiesel TG (max temp. 430°C)	10 m, 0.32 mm ID, 0.1 µm	PTV**	70292	—	70292	—

\*Recommended for total glycerin analysis. \*\*PTV=programmed temperature vaporizer.

### Rtx-1 Columns (fused silica)

nonpolar phase; Crossbond dimethyl polysiloxane

- General-purpose columns for solvent impurities, PCB congeners (e.g., Aroclor mixes), simulated distillation, arson accelerants, gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, oxygenates.
- Long lifetime and very low bleed at high operating temperatures.
- Equivalent to USP G1, G2, G38 phases.

ID	df	Length	Temp. Limits	qty.	Similar to Part #	cat.#
0.32 mm	3.00 µm	15 m	-60 to 280/300 °C	ea.	Agilent 123-1014; Scion/Bruker/ Varian CP8550	10181
	3.00 µm	30 m	-60 to 280/300 °C	ea.	Agilent 123-1034, 19091Z-513; Scion/ Bruker/Varian CP8687	10184
	3.00 µm	60 m	-60 to 280/300 °C	ea.	Agilent 123-1064; Phenomenex 7KM-G001-36; Scion/Bruker/Varian CP8689	10187
	3.00 µm	105 m	-60 to 260/280 °C	ea.		10190



## GC Accessories



27088

### 10 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	cat.#
Premium Non-stick BTO Septa	10 mm	50-pk.	27088
	10 mm	100-pk.	27089



27090

### 11 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	Similar to Part #	cat.#
Premium Non-stick BTO Septa	11 mm (7/16"), with Center-Guide, predrilled	50-pk.	Agilent 5181-3383-50, 5183-4757, 5183-4761; Grace 15132, 8603938; Thermo Fisher Scientific 31303233	27090
	11 mm (7/16"), with Center-Guide, predrilled	100-pk.	Agilent 5183-4757-100, 5183-4759-100	27091



27092

### 11.5 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	cat.#
Premium Non-stick BTO Septa	11.5 mm, with CenterGuide	50-pk.	27092
	11.5 mm, with CenterGuide	100-pk.	27093



### 12.7 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	cat.#
Premium Non-stick BTO Septa	12.7 mm (1/2"), with CenterGuide	48-pk.	27094



### 17 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	Similar to Part #	cat.#
Premium Non-stick BTO Septa	17 mm, with CenterGuide	48-pk.	Grace 15133, 8603939	27096

Note: Due to differences in inlet design, the actual septum temperature for a given inlet set point can vary by manufacturer. Restek recommends using only BTO septa in older Thermo TRACE and Focus GCs. For Thermo TRACE 1300/1310, 1600/1610 GCs, this recommendation does not apply; septa can be used to their maximum recommended temperature.

\*For all injectors, minimum recommended operating temperature for BTO septa is 250 °C.

## 5 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	Similar to Part #	cat.#
Premium Non-stick BTO Septa	5 mm, with CenterGuide, predrilled	50-pk.	Agilent 5181-1260, 5183-4758	27082
	5 mm, with CenterGuide, predrilled	100-pk.		27083



## 9 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	Similar to Part #	cat.#
Premium Non-stick BTO Septa	9 mm, with CenterGuide	50-pk.	Grace 15129, 8603937	27084
	9 mm, with CenterGuide	100-pk.		27085



## 9.5 mm Premium Non-Stick BTO Septa

Description	Diameter	qty.	Similar to Part #	cat.#
Premium Non-stick BTO Septa	9.5 mm (3/8")	50-pk.	Grace 15131, 2106410	27086
	9.5 mm (3/8")	100-pk.		27087



27086

Note: Due to differences in inlet design, the actual septum temperature for a given inlet set point can vary by manufacturer. Restek recommends using only BTO septa in older Thermo TRACE and Focus GCs. For Thermo TRACE 1300/1310, 1600/1610 GCs, this recommendation does not apply; septa can be used to their maximum recommended temperature.

\*For all injectors, minimum recommended operating temperature for BTO septa is 250 °C.

## Shimadzu Plug Premium Non-Stick BTO Septa

Description	Diameter	qty.	Similar to Part #	cat.#
Premium Non-stick BTO Septa	Shimadzu Plug	50-pk.	Grace 15134, 2106411	27098
	Shimadzu Plug	100-pk.		27099

Note: Due to differences in inlet design, the actual septum temperature for a given inlet set point can vary by manufacturer.

\*For all injectors, minimum recommended operating temperature for BTO septa is 250 °C.



27098

Learn more about our premium non-stick BTO and Thermolite Plus septa at [www.restek.com/septa](http://www.restek.com/septa)



21060

## Graphite Capillary Ferrules for 1/16-Inch Compression-Type Fittings

Description	Ferrule ID	Fits Column ID	Fitting Size	Material	Used with	qty.	Similar to Part #	cat.#
Ferrules	0.5 mm	0.32 mm	1/16"	Graphite		10-pk.		20201
	0.8 mm	0.45/0.53 mm	1/16"	Graphite		10-pk.	Grace 8620138	20202



20211

## Vespel/Graphite Capillary Ferrules for 1/16-Inch Compression-Type Fittings

Description	Ferrule ID	Fits Column ID	Fitting Size	Material	Used with	qty.	Similar to Part #	cat.#
Ferrules	0.5 mm	0.32 mm	1/16"	VG2, 60% Vespel/40% Graphite		10-pk.	Grace 5124714, 100/0.5-VG2	20212
	0.8 mm	0.45/0.53 mm	1/16"	VG2, 60% Vespel/40% Graphite		10-pk.	Grace 5124716, 100/0.8-VG2	20213



## FID Replacement Jets

Available in standard or Siltek-treated, high-performance versions.

### Capillary Adaptable FID Replacement Jet

for Agilent 5890/6850/6890 GCs

Engineered with a fluted tip to guide the capillary column into the jet.

Instrument	Length	Type	qty.	Similar to Part #	cat.#
for Agilent 5890/6850/6890 GCs	61.5 mm	Standard, 0.011" ID Tip	ea.	Agilent 19244-80560	20670
for Agilent 5890/6850/6890 GCs	61.5 mm	Standard, 0.011" ID Tip	3-pk.	Agilent 19244-80560	20671
for Agilent 5890/6850/6890 GCs	61.5 mm	High-Performance Siltek Treated, 0.011" ID Tip	ea.	Agilent 19244-80560	20672
for Agilent 5890/6850/6890 GCs	61.5 mm	High-Performance Siltek Treated, 0.011" ID Tip	3-pk.	Agilent 19244-80560	20673



### Capillary Dedicated FID Replacement Jet

for Agilent 5890/6850/6890/7890 GCs

Instrument	Length	Type	qty.	Similar to Part #	cat.#
for Agilent 5890/6850/6890/7890 GCs	43 mm	Standard, 0.011" ID Tip	ea.	Agilent G1531-80560	21621
for Agilent 5890/6850/6890/7890 GCs	43 mm	Standard, 0.011" ID Tip	3-pk.	Agilent G1531-80560	21682
for Agilent 5890/6850/6890/7890 GCs	43 mm	High-Temperature, 0.018" ID Tip	ea.	Agilent G1531-80620	23078
for Agilent 5890/6850/6890/7890 GCs	43 mm	High-Temperature, 0.018" ID Tip	3-pk.	Agilent G1531-80620	23079
for Agilent 5890/6850/6890/7890 GCs	43 mm	High-Performance Siltek Treated, 0.011" ID Tip	ea.	Agilent G1531-80560	21620
for Agilent 5890/6850/6890/7890 GCs	43 mm	High-Performance Siltek Treated, 0.011" ID Tip	3-pk.	Agilent G1531-80560	21683



## Restek Electronic Leak Detector

New and improved! Prevent small leaks from causing big problems with a Restek leak detector.

- Detects a broad range of gases and indicates leak severity with both an LED display and audible tone.
- No more waiting for a full charge—can be operated during charging or used up to 12 hours between charges.
- Charging kit includes both universal AC power adaptor and USB charging cable so you can charge anywhere, anytime.
- Pinpoint very small gas leaks quickly and accurately before they cause damage and downtime.
- Compact, handheld unit is easy to operate and convenient to use anywhere you need to check for leaks.

Backed by a one-year warranty, the Restek leak detector is the industry standard for performance and affordability in handheld leak detectors.

Description	Includes	qty.	cat.#
Restek Electronic Leak Detector	carrying case, universal AC power adaptor [U.S., UK, Europe, Australia, Japan], 6-ft USB charging cable	ea.	28500

Avoid using liquid leak detectors on a GC! Liquids can be drawn into the system and/or into the leak detector.

\*Caution: The Restek electronic leak detector should only be used to detect trace amounts of hydrogen in a noncombustible environment. It is NOT designed for determining leaks in a combustible environment. A combustible gas detector should be used for determining combustible gas leaks under any condition. When using it to detect hydrogen, the Restek electronic leak detector may only be used for determining trace amounts in a GC environment.



28500

**Leak Detector Specifications**  
Detectable Gases: Helium, nitrogen, argon, carbon dioxide, hydrogen\*  
Battery: Rechargeable nickel-metal hydride (NiMH) internal battery pack (12 hours normal operation)  
Ambient Temperature: 50–98.6 °F (10–37 °C)  
Humidity Range: 0–97%  
Warranty: One year  
Certification/Compliance: CE (EU, Korea, Japan, Australia); CSA/UL tested, not listed; WEEE; CEC; China RoHS 2; UKCA Indoor Use Only

## Small Probe Adaptor for Restek Electronic Leak Detector

Compatible with both current (cat.# 28500) and legacy (cat.# 22655) leak detector models.

Description	qty.	cat.#
Small Probe Adaptor for Leak Detector	ea.	22658



22658

## Soft-Sided Storage Case for Restek Leak Detector or ProFLOW 6000 Electronic Flowmeter

Optional soft-sided storage case is ideal for storing your leak detector or flowmeter in smaller spaces, such as your toolbox.

Compatible with both current (cat.# 28500) and legacy (cat.# 22655) leak detector models.

Description	qty.	cat.#
Soft-Sided Storage Case for Restek Leak Detector or ProFLOW 6000 Flowmeter	ea.	22657



22657

## Parker PEM Hydrogen Generators

- Proton exchange membrane (PEM) cell eliminates the need for liquid electrolytes.
- Reliably generate 99.9995% pure hydrogen—for better chromatography.
- Eliminates high-pressure cylinders—greater convenience and improved lab safety.
- Compact unit, requiring only one square foot of bench space.
- Quick and easy to service and maintain; unique display lighting changes color for easy status checks and water level indication.
- Comes with a set of universal power adapters for U.S., European, and Asian plug types.
- Automatic safety feature shuts the generator down if a hydrogen leak is detected.
- Warranty: one year from date of purchase on system and two years from date of purchase on cell life.



Safer alternative to  
high-pressure gas cylinders!

### Specifications

Purity: 99.9995% pure hydrogen  
Delivery Pressure: 5-100 psig  $\pm$  0.5 psig  
(69-689 kPa  $\pm$  7 kPa)  
Outlet Port: 1/8" compression  
Electrical Requirements: 100-230  
VAC/50-60 Hz  
Physical Dimensions: 17.12" h x 13.46" w  
x 17.95" d (43.48 x 34.19 x 45.6 cm)  
Shipping Weight: 59 lb (27 kg) dry

Description	Model #	Capacity	Certification/Compliance	qty.	cat.#
Hydrogen Generator	H2PEM-100	100 cc/min	CE, CSA, UL, cUL	ea.	23065
	H2PEM-165	165 cc/min	CE, CSA, UL, cUL	ea.	23066
	H2PEM-260	260 cc/min	CE, CSA, UL, cUL	ea.	23067
	H2PEM-510	510 cc/min	CE, CSA, UL, cUL	ea.	23068

## Parker Replacement and Maintenance Components for Hydrogen Generators

Description	Includes	Vendor cat.#	qty.	Similar to Part #	cat.#
Replacement Desiccant Cartridge for H2PEM Generators		MKH-2PEM-D	ea.	Parker Domnick Hunter 604970412	23069
6-Month Maintenance Kit for H2PEM Generators	deionizer cartridge (1); water filter (1); environmental filters (3)	MKH-2PEM-6M	kit	Parker Domnick Hunter 604970600	23070
24-Month Maintenance Kit for H2PEM Generators	deionizer cartridge (1); water filter (1); environmental filters (3); water level sensor (1); water pump (1); and desiccant cartridge (1)	MKH-2PEM-24M	kit	Parker Domnick Hunter 604970532	23071



Learn more at [www.restek.com](http://www.restek.com)

**RESTEK**  
Pure Chromatography

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