

Essential Guide for BIOFUEL ANALYSIS

Tips, Web Tools & Advanced Technologies

- Get Higher Throughput at Lower Cost
- Product Selection Made Easy



phenomenex[®]
...breaking with traditionSM

www.phenomenex.com/Biofuels

OUR COMMITMENT TO THE BIOFUEL INDUSTRY

Phenomenex is dedicated to supporting the biofuel industry with cutting edge chromatographic tools and resources designed to enhance production, simplify alternative fuels analysis, and lower production costs.



Online Resources for Biofuel Analysis

- 1000's of Applications
- Column Selection Charts
- Technical Notes
- Knowledgeable Technical Consultants

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guarantee

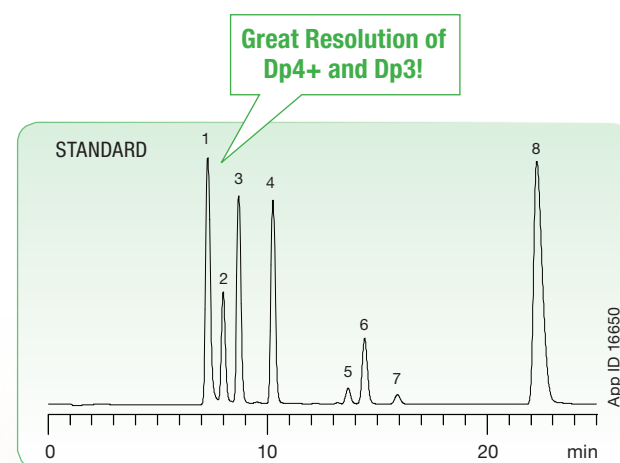
If Phenomenex products in this brochure do not provide at least an equivalent separation as compared to other products of the same phase and dimensions, return the product with comparative data within 45 days for a FULL REFUND.



Dependably Monitor Ethanol Fermentation Reaction Components

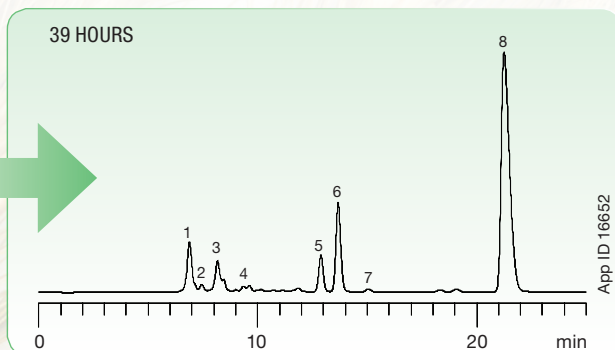
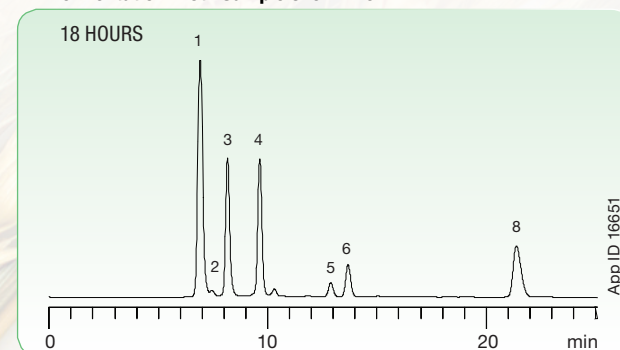
- Easily quantitate ethanol fermentation broth components
- Monitor starches, sugars, organic acids, and ethanol in one run
- Reliably monitor lactic and acetic acids

To maximize ethanol conversion, bioethanol labs monitor key reaction components throughout the fermentation process. With results easily obtained through an isocratic run, Rezex™ ROA-Organic Acid columns separate simple and complex sugars, organic acids, and ethanol found in a fermentation broth sample.



Column: Rezex ROA-Organic Acid
Dimensions: 300 x 7.8 mm
Part No.: 00H-0138-K0
Mobile Phase: 0.005 N Sulfuric Acid
Flow Rate: 0.6 mL/min
Detection: RI @ 40 °C
Temperature: 60 °C
System: Shimadzu® Prominence® LC-20A
Sample: 1. Dp4+ 5. Lactic Acid
 2. Dp3 6. Glycerol
 3. Maltose 7. Acetic Acid
 4. Glucose 8. Ethanol

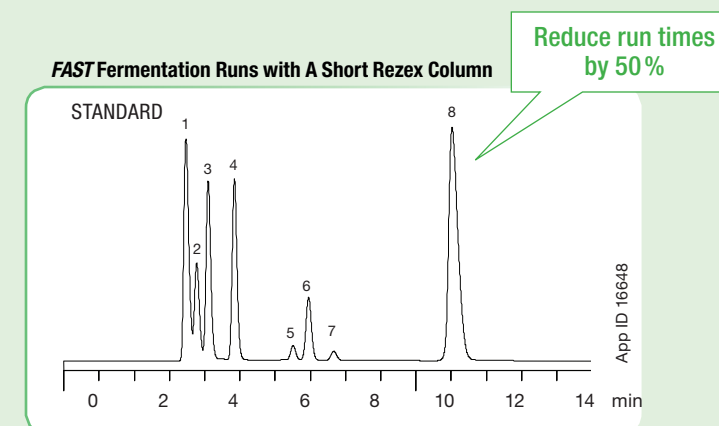
Fermentation Broth Sample Over Time



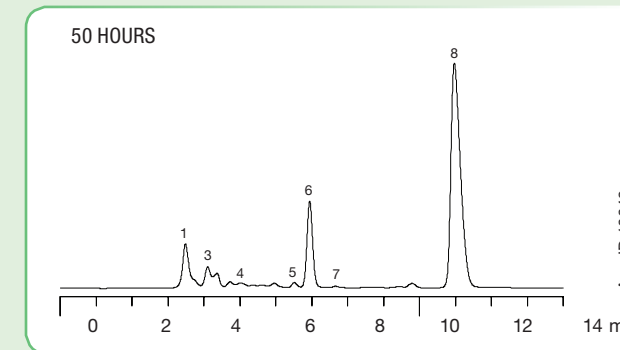
Reduce Fermentation Run Times by 50 %

- Increase throughput by reducing run times by 50 %
- Obtain faster results – respond in real-time
- Reduce solvent usage and cost

Rezex ROA achieves excellent baseline separation of typically troublesome Dp3 and Dp4+. This means you can select a shorter column and reduce run times up to 50 %, while maintaining resolution!



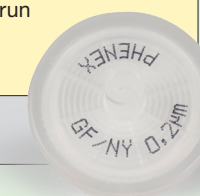
Column: Rezex ROA-Organic Acid
Dimensions: 150 x 7.8 mm
Part No.: 00F-0138-K0
Mobile Phase: 0.005 N Sulfuric Acid
Flow Rate: 0.6 mL/min
Detection: RI @ 40 °C
Temperature: 60 °C
System: Shimadzu® Prominence® LC-20A
Sample: 1. Dp4+ 5. Lactic Acid
 2. Dp3 6. Glycerol
 3. Maltose 7. Acetic Acid
 4. Glucose 8. Ethanol



Incorporate Quick and Easy Cleanup!

Filtration of fermentation samples with a 0.20 µm Phenex™ syringe filter can reduce chromatographic interferences due to particulates or cationic impurities. This helps increase run-to-run reproducibility and extend column lifetime!

Learn more on p. 10



Recommended Biofuel Products

	Part No.	Description	Dimensions	Unit	Price
HPLC Analysis	00H-0138-K0	Rezex ROA-Organic Acid H+ (8%) HPLC Column	300 x 7.8 mm	ea	
	03B-0138-K0	Rezex ROA-Organic Acid H+ (8%) HPLC Guard Column	50 x 7.8 mm	ea	
Column Protection	KJO-4282	SecurityGuard™ Cartridge Holder Kit	–	ea	
	AJO-4490	SecurityGuard Carbo-H Cartridges	4 x 3.0 mm ID	10/pk	

Recommended Biofuel Products

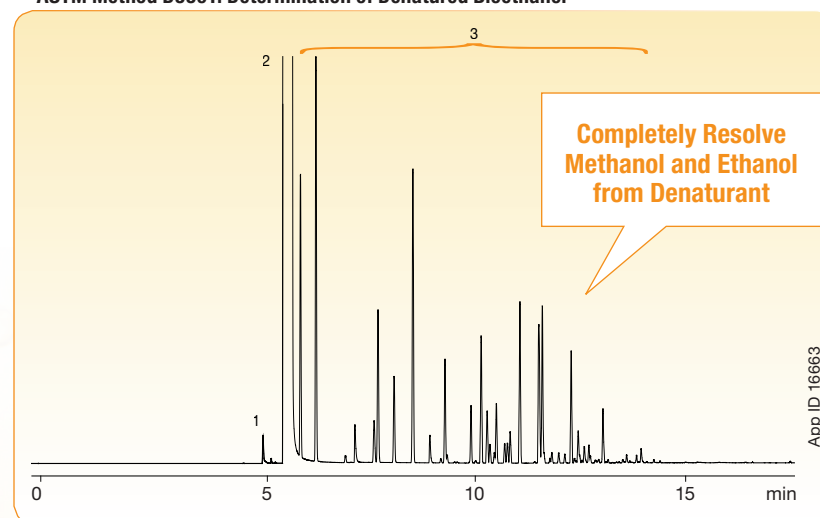
	Part No.	Description	Dimensions	Unit	Price
HPLC Analysis	00F-0138-K0	Rezex ROA-Organic Acid H+ (8%) HPLC Column	150 x 7.8 mm	ea	
	03B-0138-K0	Rezex ROA-Organic Acid H+ (8%) HPLC Guard Column	50 x 7.8 mm	ea	
Column Protection	KJO-4282	SecurityGuard™ Cartridge Holder Kit	–	ea	
	AJO-4490	SecurityGuard Carbo-H Cartridges	4 x 3.0 mm ID	10/pk	

Accurately Measure Ethanol Content in Finished Products

- Completely resolve ethanol and methanol from all denaturant components
- Guaranteed, reliable results

Determination of ethanol and methanol content in final fuel products requires a GC column capable of separating these compounds from all other components (such as fusel alcohols and denaturants). Zebron™ ZB-1 columns provide extremely low bleed levels for highly reproducible, reliable results.

ASTM Method D5501: Determination of Denatured Bioethanol



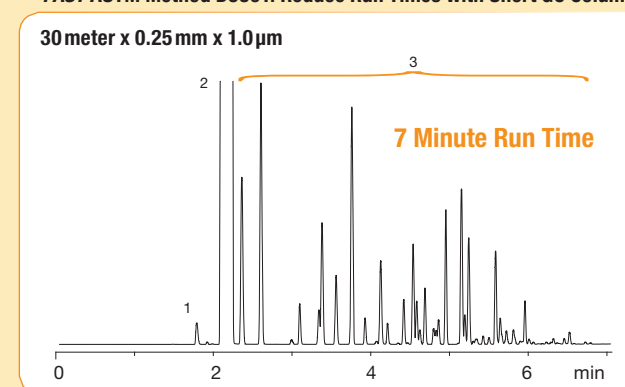
Column: Zebron ZB-1
Dimensions: 100 meter x 0.25 mm x 0.50 µm
Part No.: 7MG-G001-17
Injector: Split 50:1 @ 300 °C, 1 µL
Carrier Gas: Helium @ 35 cm/sec (Constant Flow)
Oven Program: 45 °C for 7 min to 255 °C @ 30 °C/min (Hold 6 min)
Detector: FID @ 300 °C
Instrument: Shimadzu® GC-2010 with Flame Ionization Detection and AOC-20i Automatic Liquid
Sample: 1. Methanol
 2. Ethanol
 3. Denaturant

Shorten QA Runs of Bioethanol to 5 Minutes

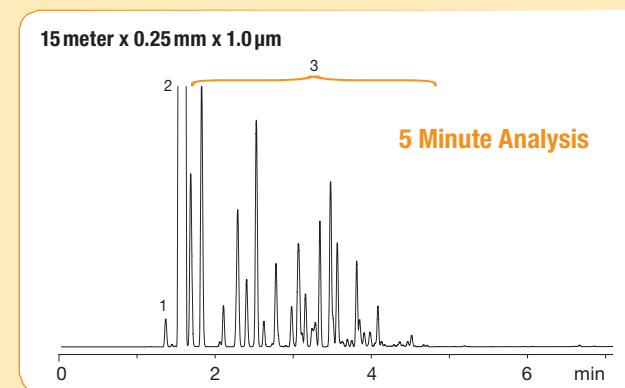
- Quickly determine ethanol content with shorter run times
- Complete your Certificate of Analysis (COA) in a fraction of the time
- Recommended for methods ASTM D4806, ASTM D5501, and prEN 153767

Standard GC runs of bioethanol with typical columns can take up to 40 minutes per sample to ensure proper separation of methanol and ethanol from denaturant peaks. Zebron ZB-Bioethanol GC columns are designed to streamline this quality assurance (QA) process, with 87% faster run times under 5 min.

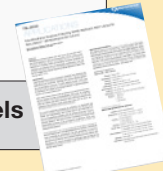
FAST ASTM Method D5501: Reduce Run Times with Short GC Columns



Column: Zebron ZB-Bioethanol
Dimensions: A) 30 meter x 0.25 mm x 1.00 µm
 B) 15 meter x 0.25 mm x 1.00 µm
Injector: Split 50:1 @ 300 °C, 1 µL
Carrier Gas: A) Hydrogen @ 35 cm/sec (Constant Flow)
 B) Hydrogen @ 25 cm/sec (Constant Flow)
Oven Program: A) 45 °C for 2.5 min to 255 °C @ 30 °C/min (Hold 4.5 min)
 B) 55 °C for 1.7 min to 260 °C @ 40 °C/min (Hold 2.67 min)
Detector: FID @ 300 °C
Instrument: Shimadzu® GC-2010 with Flame Ionization Detection and AOC-20i Automatic Liquid
Sample: 1. Methanol
 2. Ethanol
 3. Denaturant



FREE Biofuels Technical Notes
 Get the full details on bioethanol testing online.
www.phenomenex.com/Biofuels



Recommended Biofuel Products

	Part No.	Description	Dimensions	Unit	Price
GC Analysis	7MG-G001-17	Zebron ZB-1 GC Column	100 m x 0.25 mm x 0.50 µm	ea	

Recommended Biofuel Products

	Part No.	Description	Dimensions	Unit	Price
GC Analysis	7EG-G020-22	Zebron ZB-Bioethanol GC Column	15 m x 0.25 mm x 1.0 µm	ea	
	7HG-G020-22	Zebron ZB-Bioethanol GC Column	30 m x 0.25 mm x 1.0 µm	ea	

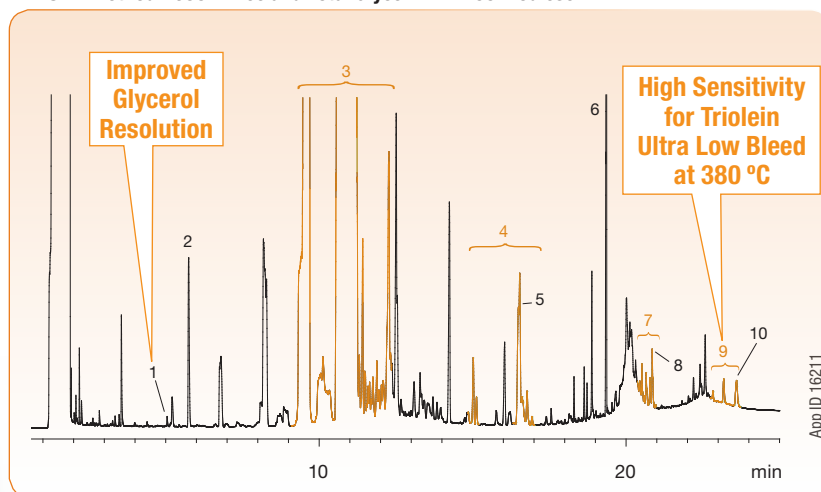


Reliably Determine Free and Total Glycerin in Biodiesel

- Long column lifetimes with temperature stability to 430 °C
- Remove contaminants and eliminate carryovers with aggressive temperature programs

To ensure the quality of the biodiesel product, many methods specify high temperature analysis of free and total glycerin. At temperatures above 380 °C however, most fused silica columns become brittle and spontaneously break due to polyimide degradation. Zebtron™ ZB-5HT Inferno™ columns are specially designed for thermal stability up to 430 °C, ideal for the elevated temperatures needed to resolve and remove high boiling triglycerides in biodiesel.

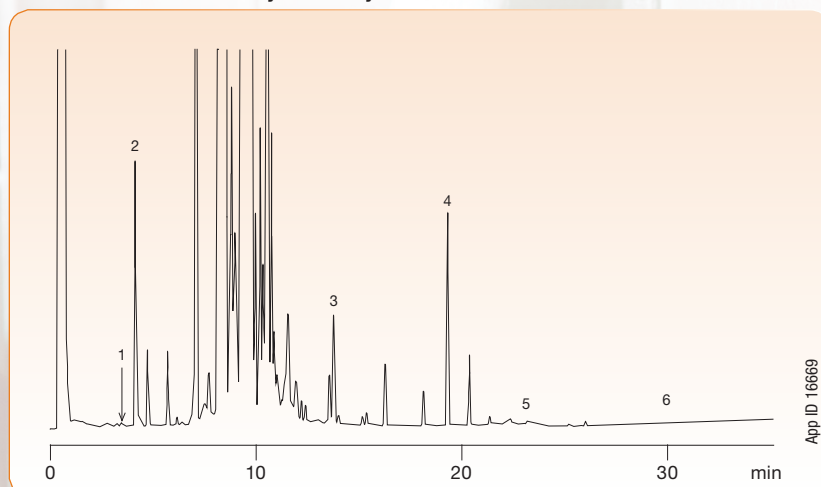
ASTM Method D6584: Free and Total Glycerin in B100 Biodiesel



Column: Zebtron ZB-5HT Inferno
Dimensions: 15 meter x 0.32 mm x 0.10 µm
Part No.: 7EM-G015-02
Injection: On-Column @ 53 °C, 1 µL
Carrier Gas: Helium @ 3 mL/min (constant flow)
Oven Program: 50 °C for 1 min to 180 °C @ 15 °C/min to 230 °C @ 7 °C/min to 380 °C @ 30 °C/min for 10 min
Detector: FID @ 380 °C
Sample: A 2.0 m x 0.53 mm guard column was connected to the analytical column per ASTM method requirements

1. Glycerol	6. Tricarpin (IS 2)
2. Butanetriol (IS 1)	7. Diglycerides
3. Ester	8. 1,3-Diolein
4. Monoolein	9. Triglycerides
5. 1-Monooleoyl-rac-glycerol	10. Triolein

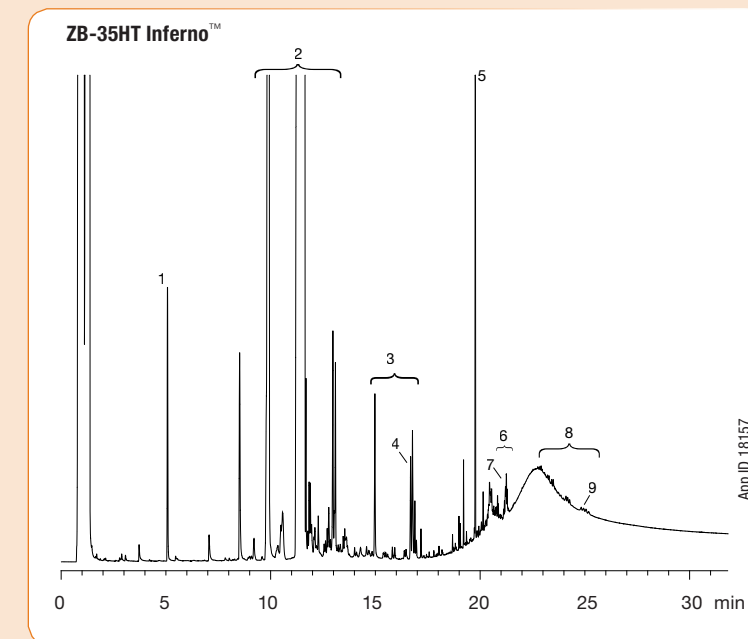
EN 14105: Free and Total Glycerin Analysis in Biodiesel



Column: Zebtron ZB-5HT Inferno
Dimensions: 15 meter x 0.32 mm x 0.10 µm
Part No.: 7EM-G015-02
Injection: On-Column @ 50 °C, 1 µL
Carrier Gas: Helium @ 5.79 cm/sec (constant flow)
Oven Program: 50 °C for 1 min to 180 °C @ 15 °C/min to 230 °C @ 7 °C/min to 370 °C @ 10 °C/min (hold 5 min)
Detector: FID @ 380 °C
Sample: A 5 m x 0.53 mm guard column was connected to the analytical column

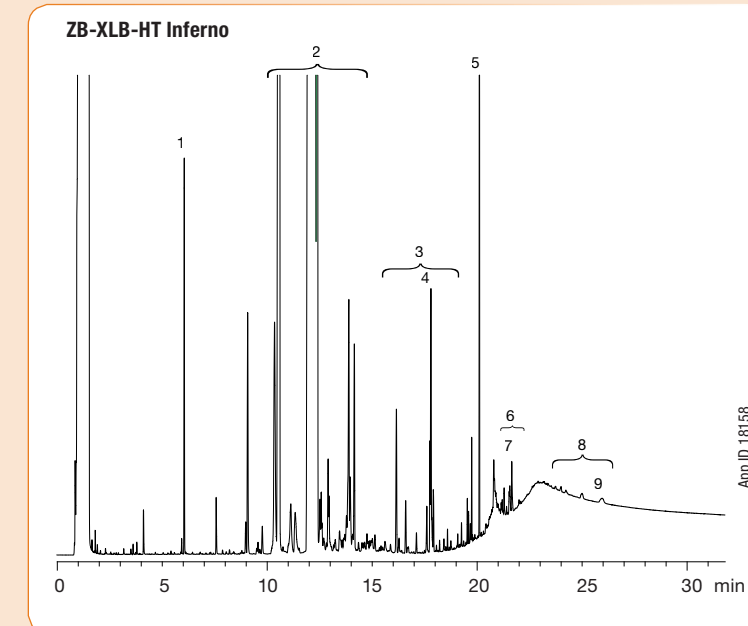
1. Glycerol	4. Tricarpin (IS 2)
2. Butanetriol (IS 1)	5. Diolein
3. Monoolein	6. Triolein

Accurately Test B100 Biodiesel



Column: Zebtron ZB-35HT Inferno™
Dimensions: 15 meter x 0.25 mm x 0.10 µm
Part No.: 7EG-G025-02
Injection: On-Column @ 53 °C, 0.1 µL
Carrier Gas: Helium @ 1.3 mL/min (constant flow)
Oven Program: 50 °C for 1 min to 180 °C @ 15 °C/min to 230 °C @ 7 °C/min to 380 °C @ 30 °C/min for 10 min
Detector: FID @ 380 °C
Sample: A 30 cm x 0.5 mm ID guard column was connected to the analytical column per ASTM method requirements

1. Butanetriol (ISTD 1)
2. Ester
3. Monoolein
4. 1-Monooleoyl-rac-glycerol
5. Tricarpin (ISTD 2)
6. Diglycerides
7. 1,3-Diolein
8. Triglycerides
9. Triolein



Column: Zebtron ZB-XLB-HT Inferno
Dimensions: 15 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G024-11
Injection: On-Column @ 53 °C, 0.10 µL
Carrier Gas: Helium @ 1.3 mL/min (constant flow)
Oven Program: 50 °C for 1 min to 180 °C @ 15 °C/min to 230 °C @ 7 °C/min to 380 °C @ 30 °C/min for 10 min
Detector: FID @ 380 °C
Sample: A 30 cm x 0.5 mm ID guard column was connected to the analytical column per ASTM method requirements

1. Butanetriol (ISTD 1)
2. Ester
3. Monoolein
4. 1-Monooleoyl-rac-glycerol
5. Tricarpin (ISTD 2)
6. Diglycerides
7. 1,3-Diolein
8. Triglycerides
9. Triolein

Recommended Biofuel Products

	Part No.	Description	Dimensions	Unit	Price
GC Analysis	7EM-G015-02	Zebtron ZB-5HT Inferno GC Column	15 m x 0.32 mm x 0.10 µm	ea	
Column Protection	7AK-G000-00-GHO	Zebtron Z-Guard™ High Temperature Guard Column	5 m x 0.53 mm	ea	

Recommended Biofuel Products

	Part No.	Description	Dimensions	Unit	Price
GC Analysis	7EG-G025-02	Zebtron ZB-35HT Inferno GC Column	15 m x 0.25 mm x 0.10 µm	ea	
	7EG-G024-02	Zebtron ZB-XLB-HT Inferno GC Column	15 m x 0.25 mm x 0.10 µm	ea	
Column Protection	7AK-G000-00-GHO	Zebtron Z-Guard™ High Temperature Guard Column	5 m x 0.53 mm	ea	



Phenex™ Syringe Filters

- Quickly and easily filter samples
- Ensure consistent, reproducible results
- Improve column lifetime
- Recommended filters (25 mm, 0.20 µm):
 - Phenex-NY
 - Phenex-GF/NY
 - Phenex-RC
 - Phenex-GF



GC Inlet Liners

- Available for Agilent®, Shimadzu®, Thermo Scientific, PerkinElmer®, and Varian® systems
- Split, splitless, and on-column styles
- Clean, non-reactive surfaces



Easy Seals™ Inlet Base Seals

- Easy, washerless, and leak-tight
- No washers or adapters needed!
- Guaranteed fit for Agilent 5000, 6000, and 7000 series instruments

Learn more about recommended biofuel accessories at www.phenomenex.com/Biofuels

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Bioethanol

		Fuel Production Source		
		"Sugary" Plants	"Amylaceous" Plants	Cellulosic Material
		Beets, Sugarcane	Corn, Wheat, Sweet Potato, Sorghum	Grass, Wood
				
Technique	Type of Analysis	Official Methods	Recommended Column	Benefits
HPLC	Fermentation Reaction Monitoring	–	Rezex™ ROA-Organic Acid HPLC Columns	<ul style="list-style-type: none"> • Monitor starches, sugars, organic acids, and ethanol all in one run • Ability to reduce run times by 50% with shorter column
	Ethanol Recovery Testing	–	Rezex ROA-Organic Acid HPLC Columns	<ul style="list-style-type: none"> • Quick and reproducible analysis
GC	Ethanol / Methanol Quality Assurance	ASTM D4806 ASTM D5501 prEN 15376	Zebtron™ ZB-Bioethanol GC Columns	<ul style="list-style-type: none"> • Increase throughput – reduce run times 87% • Resolve ethanol and methanol from denaturant components • Long column lifetimes

Biodiesel

		Fuel Production Source		
		Vegetable Oil	Animal Fats	Recycled Feeds
		Soybean Oil, Canola Oil, Corn Oil	White Grease, Poultry, Tallow	Yellow Grease
				
Technique	Type of Analysis	Official Methods	Recommended Column	Benefits
GC	Free and Total Glycerin Determination	ASTM D6584 EN 14105 EN 14106 ABNT NBR 15341 ABNT NBR 15344	Zebtron™ ZB-5HT Inferno™	<ul style="list-style-type: none"> • Temperature stability to 430 °C • Easily remove contaminants and carryovers with aggressive oven ramps • Long column lifetimes



If Phenomenex products in this brochure do not provide at least an equivalent separation as compared to other products of the same phase and dimensions, return the product with comparative data within 45 days for a FULL REFUND.

Essential Guide for BIOFUEL ANALYSIS

- Quickly and dependably monitor fermentation
- Accurately measure ethanol content
- Reliably determine glycerin in biodiesel

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