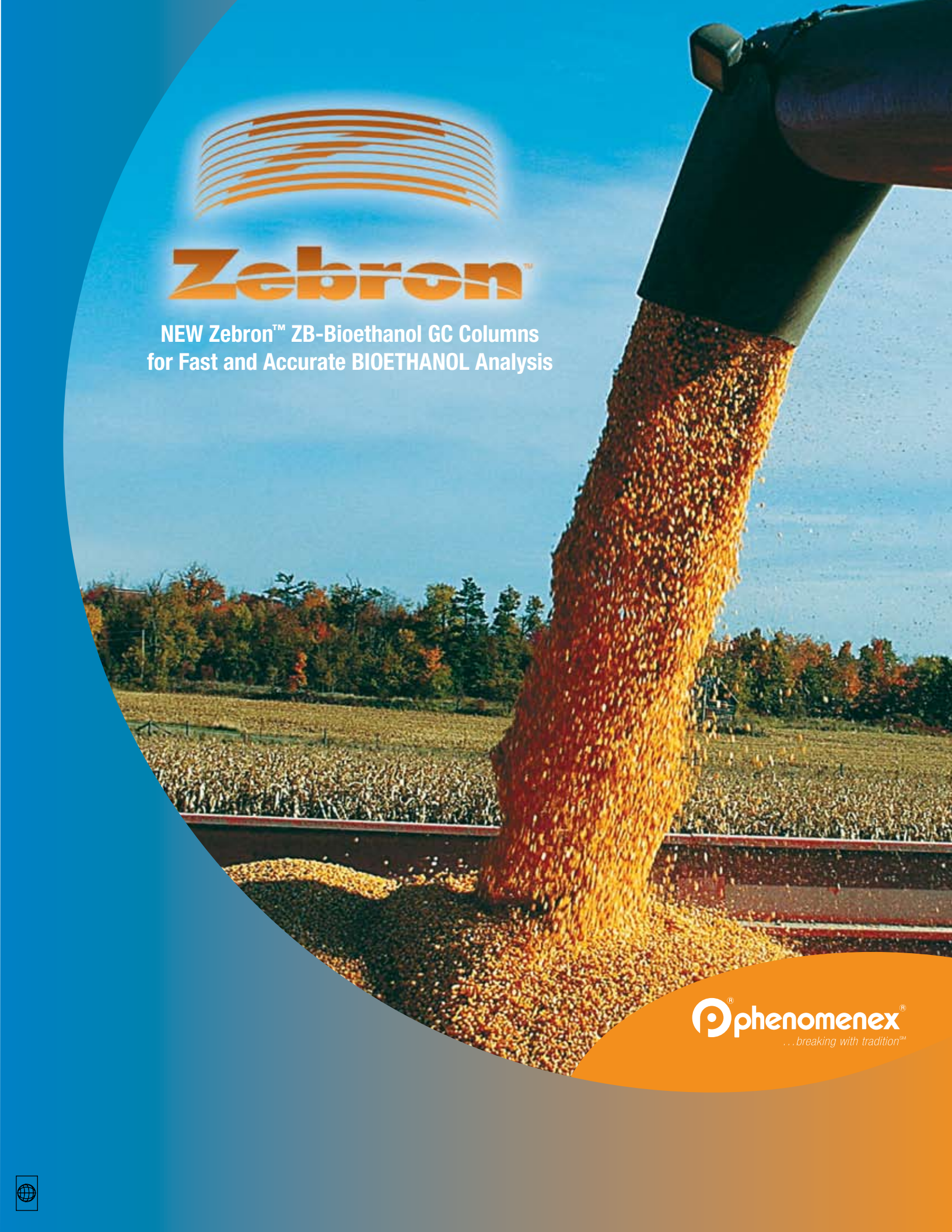

Zebron™
NEW Zebron™ ZB-Bioethanol GC Columns
for Fast and Accurate BIOETHANOL Analysis
phenomenex®
. . . breaking with tradition℠

Today's Growing Bioethanol Market

Political priorities as well as economic interests have fueled a dramatic growth in the biofuels industry, due much in part to research funding and tax incentives. Right now an estimated 46 % of gasoline contains at least some blend of ethanol and that amount is likely to increase. With more biofuel plants planned or under construction than are currently operating, the usage of fuel grade ethanol or gasoline-ethanol blends is likely to increase significantly.

Many plants require that the ethanol in a denatured fuel sample be analyzed by gas chromatography (GC) prior to transporting the product. The results of this test are required to be with the truck as it leaves the plant. However, due to the long analysis time needed by the method, the results are not ready and must be faxed ahead to the trucks final destination.

The current analytical procedure for ethanol in a denatured fuel product is covered under ASTM Method D 5501 and Europe prEN 15376. The methodology uses a long (100 or 150 meter) GC column and an analysis time up to 30 minutes to resolve methanol and ethanol from the denaturant, which is typically gasoline. The long run time is necessary to resolve these components because of the complexity of gasoline, which contains thousands of components, many of which can co-elute with methanol and ethanol.




Phenomenex Commitment to Biofuels

Phenomenex is dedicated to providing analytical testing solutions for the biofuels industry. The Zebron™ ZB-1HT and 5HT Inferno™ GC columns have won the R&D 100 award for their ability to withstand the high temperatures used in the testing of biodiesel products. The use of the Rezex™ ROA LC columns have become the industry standard for fermentation monitoring during the bioethanol manufacturing process.

The new Zebron ZB-Bioethanol column is no exception. It provides plants with a much needed run time savings for ASTM Method D 5501 analysis. Using a new, innovative stationary phase, the analysis time for this method can be reduced to less than 8 minutes on a 30 meter GC column, while still providing complete resolution of methanol and ethanol from all denaturant components. This fast analysis time allows the trucks to be tested before leaving the plant!

guarantee

If you are not completely satisfied with any of the products featured in this brochure, return within 45 days for a FULL REFUND.

*This guarantee is not valid in India and China.

NEW Zebron™ ZB-Bioethanol GC Columns

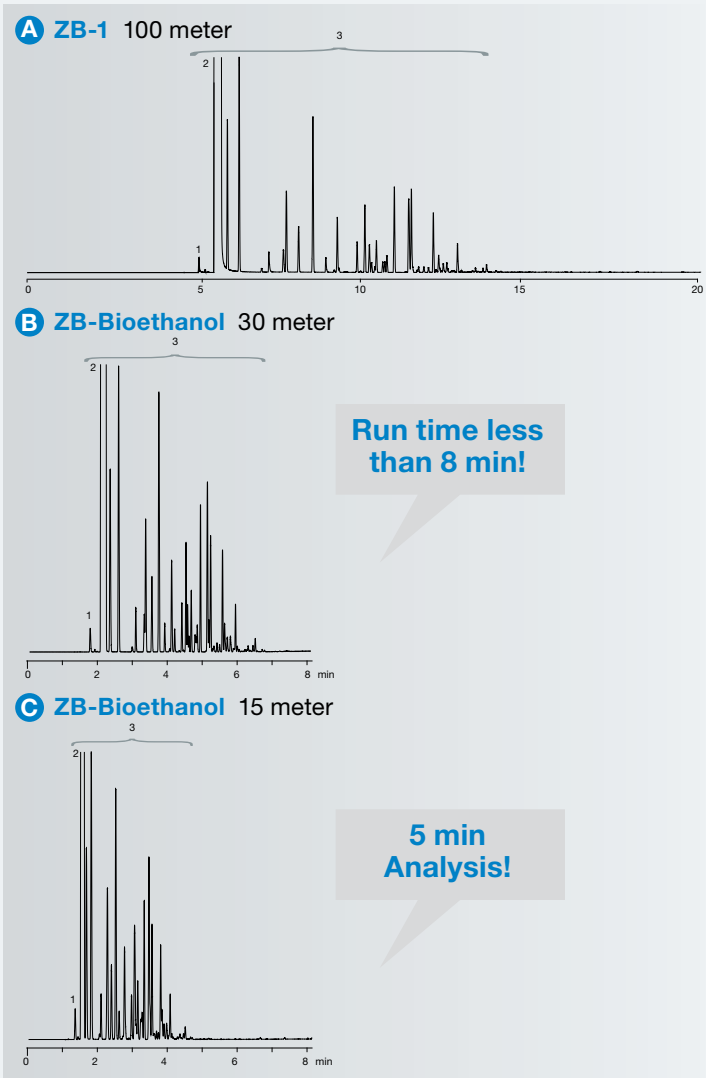
Fast and Accurate Bioethanol Analysis

- Resolve methanol and ethanol from all other denaturant peaks
- With analysis time down to 5 minutes, complete certificate of analysis (COA) before fuel truck leaves
- Major cost savings over the standard 100 meter GC columns

Zebron ZB-Bioethanol columns provide bioethanol analysis in less than half the time of standard GC columns. Using this new, specially designed phase, resolution of methanol and ethanol from a sample denatured with gasoline can be achieved in less than 8 minutes. In fact, the column provides such great resolution that the analysis can be reduced to less than 5 minutes by using a 15 meter column. This dramatic time savings gives you the ability to test the fuel trucks before they leave the facility reducing the chance for potential problems.

Figure 1. Faster bioethanol analysis using Zebron ZB-Bioethanol GC columns. Denatured bioethanol sample from corn feedstock was run on a Zebron ZB-1, 100 meter, ZB-Bioethanol, 30 meter, and ZB-Bioethanol, 15 meter GC columns. All columns provided complete resolution of methanol and ethanol from a sample denatured with gasoline. However, using the ZB-Bioethanol columns can shorten run time down to 5 minutes.

Same great results in less than ½ the time!



ASTM Method D 5501: Determination of Denatured Bioethanol

Column:	Zebron ZB-1
Dimensions:	A) 100 meter x 0.25 mm x 0.50 µm
Part No.:	7MG-G001-17
Injection:	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

ASTM Method D 5501: Determination of Denatured Bioethanol

Conditions same for both columns:

Column:	Zebron ZB-Bioethanol
Dimensions:	B) 30 meter x 0.25 mm x 1.00 µm C) 15 meter x 0.25 mm x 1.00 µm
Part No.:	B) 7HG-G020-22 C) 7EG-G020-22
Injection:	Split 50:1 @ 300 °C, 1 µL
Carrier Gas:	B) Hydrogen @ 35 cm/sec (Constant Flow) C) Hydrogen @ 25 cm/sec (Constant Flow)
Oven Program:	B) 45 °C for 2.5 min to 255 °C @ 30 °C/min (Hold 4.5 min) C) 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 a AOC-20i Automatic Liquid Handler
Sample:	1. Methanol 2. Ethanol 3. Denaturant

Accurate and Reproducible Results

Reliable Results Equivalent to Traditional GC Columns

While engineering the Zebron™ ZB-Bioethanol column, it was important to verify that the results obtained were equivalent to those obtained using the 100 meter column specified by the ASTM Method D 5501 and prEN 15376. To do this, we tested field samples supplied by bioethanol plants and compared the results on both columns. The results show very high correlations, proving that the Zebron ZB-Bioethanol could be trusted to provide the same high quality results, but in less than ½ the time!

Table 1. Consistent and reliable results between Zebron ZB-1 and ZB-Bioethanol GC columns. Each area percent (Area %) data point is an average of 3 replicate injections. Results show that both the 15 and 30 meter Zebron ZB-Bioethanol GC columns give virtually the same results as the Zebron ZB-1 GC column.

	Methanol Area %	Ethanol Area %
Zebron ZB-1 (100 meter)	0.057	92.52
Zebron ZB-Bioethanol (30 meter)	0.058	92.60
Zebron ZB-Bioethanol (15 meter)	0.057	93.11
Average	**0.057**	**92.74**
Relative Standard Deviation	**0.89 %**	**0.35 %**

Did You Know...?

Relative standard deviation is a measure of how precise the average is, that is, how well the individual numbers agree with each other. Anything less than 5 % indicates that the individual numbers are virtually the same. That means that you can use the ZB-1 or the ZB-Bioethanol column for your COA analysis and be confident you are getting accurate and precise results.

Extremely Reproducible Results with Minimal Day-to-Day Variation

Determining the accurate amount of methanol and ethanol is critical to ensure the quality of the bioethanol product. Day-to-day or run-to-run variability poses a problem for analysts in achieving this goal. Phenomenex is committed to providing the highest quality product to ensure the most accurate and reliable results. Every column is individually QC tested to give excellent batch-to-batch reproducibility and the highest performance possible.

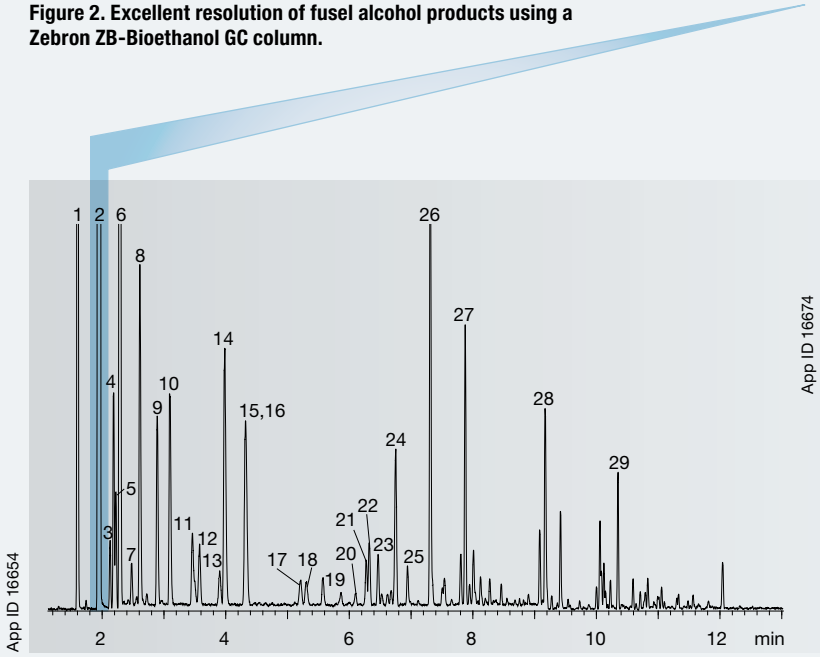
Table 2. Great reproducibility of bioethanol field samples using Zebron GC columns. The average and standard deviation of three denatured bioethanol injections were calculated to show that Zebron GC columns give amazing results with virtually no difference from sample to sample.

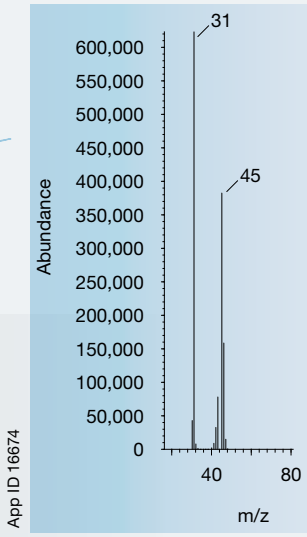
	Zebron ZB-1 (100 meter)		Zebron ZB-Bioethanol (30 meter)		Zebron ZB-Bioethanol (15 meter)	
	Methanol Area %	Ethanol Area %	Methanol Area %	Ethanol Area %	Methanol Area %	Ethanol Area %
Injection #1	0.057	92.50	0.058	92.57	0.058	93.09
Injection #2	0.057	92.54	0.056	92.69	0.057	93.10
Injection #3	0.057	92.51	0.060	92.54	0.057	93.14
Average	**0.057**	**92.52**	**0.058**	**92.60**	**0.057**	**93.11**
Relative Standard Deviation	**0.00 %**	**0.02 %**	**3.45 %**	**0.08 %**	**1.01 %**	**0.03 %**

Great Resolution of Fusel Alcohols Products

Since gasoline is a very complex mixture and contains many low boiling components that could potentially co-elute with methanol and ethanol, the resolution provided by the Zebron™ ZB-Bioethanol column was confirmed using GC/MS. As you can see in Figure 2, the methanol and ethanol peaks are well resolved from all potential interferences.

Figure 2. Excellent resolution of fusel alcohol products using a Zebron ZB-Bioethanol GC column.





Ethanol Purity Confirmed by GC/MS

Are You Looking at Fusel Peaks?

The ZB-Bioethanol is able to resolve many fusel peaks, such as t-Butaol and Allyl Alcohol. This will allow you to quantify your fusel peaks and better understand your fermentation process.

Column: Zebron ZB-Bioethanol
Dimensions: 30 meter x 0.25 mm x 1.00 µm
Part No.: 7HG-G020-22
Oven Program: 40 °C for 5 min to 300 °C @ 25 °C/min
Carrier Gas: Helium @ 1.2 mL/min (Constant Flow)
Injection: Split 100:1 @ 240 °C, 0.1 µL
Detector: MSD @ 230 °C; 30 - 450 amu
Samples:

1. Methanol
2. Ethanol
3. Acrolein
4. Acetone
5. 2-Methylbutane
6. Isopropyl alcohol
7. Pentane
8. t-Butanol
9. Allyl alcohol
10. n-Propanol
11. 2,3-Dimethylbutane
12. 2-Methylpentane
13. 3-Methylpentane
14. 2-Butanol
15. Ethyl acetate
16. Hexane
17. Methylcyclopentane
18. 2,4-Dimethylpentane
19. Benzene
20. Cyclohexane
21. 2-Methylhexane
22. 2,3-Dimethylpentane
23. 3-Methylhexane
24. 2,2,4-Trimethylpentane
25. Heptane
26. Acetal
27. Toluene
28. Xylene
29. Trimethylbenzene

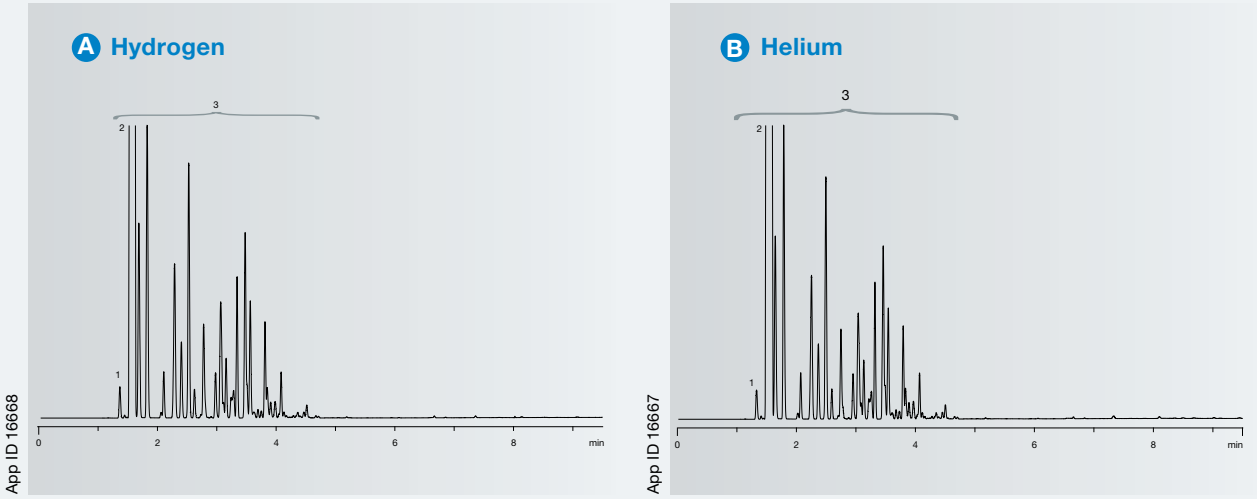
Compatible with Various Carrier Gases

As competition in the biofuels market increases, the need to reduce costs while maintaining quality is of major concern. The shortages of helium and its increasing costs have forced many labs to consider using alternative gases such as hydrogen.

The Zebron™ ZB-Bioethanol column is compatible with all carrier gases and will provide great separation no matter which gas you choose. To verify this, we ran several denatured fuel ethanol samples using various carrier gases. The results were virtually the same regardless of the carrier gas, proving the selectivity provided by the Zebron™ ZB-Bioethanol was not affected.

Figure 3. Zebron ZB-Bioethanol GC column is compatible with various carrier gases. This ensures that there are no resolution changes when switching from one carrier gas to another.

No resolution changes using different carrier gases



ASTM Method D 5501: Determination of Denatured Bioethanol

Conditions same for both runs:

Column:	Zebron ZB-Bioethanol
Dimensions:	15 meter x 0.25 mm x 1.00 µm
Part No.:	7EG-G020-22
Injection:	Split 50:1 @ 300 °C, 1 µL
Carrier Gas:	A) Hydrogen @ 25 cm/sec (Constant Flow) B) Helium @ 25 cm/sec (Constant Flow)
Oven Program:	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 a AOC-20i Automatic Liquid Handler
Sample:	1. Methanol 2. Ethanol 3. Denaturant

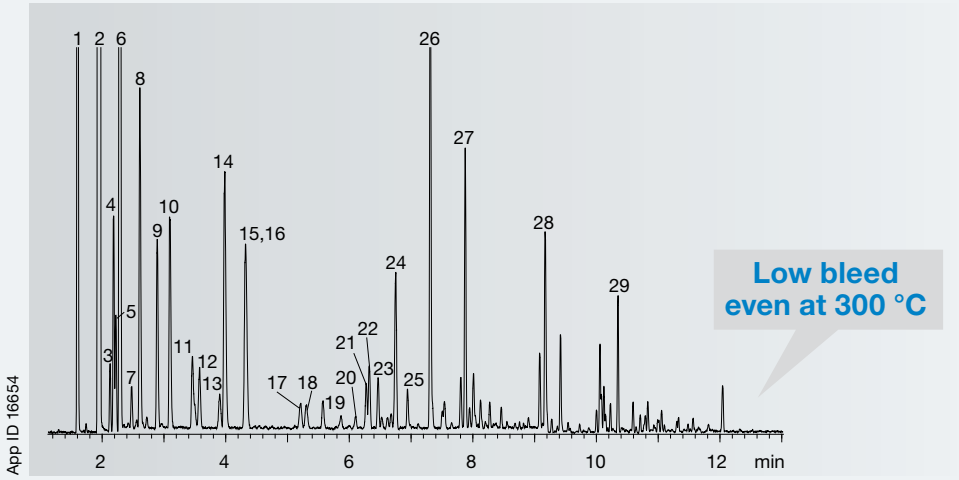
Leading Industry Technology

- NEW proprietary stationary phase
- High temperature limits allow fuel additives to be baked off the column preventing column damage
- Low bleed for most accurate results
- Long lifetime from higher column stability

Phenomenex Zebron™ chemists have spent more than 20 years designing new GC stationary phases to solve challenging separations. Our recent development of specialty phases for the analysis of pesticides has given rise to several new GC phases that provide enhanced selectivity for polar compounds within very complex matrices. This has allowed us to develop a phase that resolves ethanol, methanol, and all other fusel alcohols from a fuel sample denatured with gasoline. This separation is particularly challenging due to the complexity of gasoline.

By applying our Engineered Self Crosslinking™ (ESC) technology to the bonding process, the columns also feature very high temperature limits (340/360 °C). Bleed levels at temperatures up to 360 °C are low enough to qualify for MS Certification. This extended temperature range allows plants to bake off the high boiling fuel additives that are present in gasoline. If not removed, these contaminants can cause changes to the GC column selectivity and cause premature column death.

Figure 4. Zebron ZB-Bioethanol GC column's high column stability gives extremely low bleed levels, even at 300 °C. Column bleed, an indicator of the stability and lifetime a GC column will offer, is the loss of lower molecular weight stationary phase pieces (MS Ions 355, 281, 207, 73). Bleed is either the result of impurities in the starting polymer or the decomposition of the phase at elevated temperatures. Zebron's Engineered Self Cross-linking (ESC)™ bonding technology provides very low bleed levels, providing a sensitive, stable, and long-lasting GC column.



CERTIFIED MS ESC EQUIPPED

Column:	Zebron ZB-Bioethanol
Dimensions:	30 meter x 0.25 mm x 1.00 µm
Part No.:	7HG-G020-22
Oven Program:	40 °C for 5 min to 300 °C @ 25 °C/min
Carrier Gas:	Helium @ 1.2 mL/min (Constant Flow)
Injection:	Split 100:1 @ 240 °C, 0.1 µL
Detector:	MSD @ 230 °C; 30 - 450 amu

Samples:

1. Methanol
2. Ethanol
3. Acrolein
4. Acetone
5. 2-Methylbutane
6. Isopropyl alcohol
7. Pentane
8. t-Butanol
9. Allyl alcohol
10. n-Propanol
11. 2,3-Dimethylbutane
12. 2-Methylpentane
13. 3-Methylpentane
14. 2-Butanol
15. Ethyl acetate
16. Hexane
17. Methylcyclopentane
18. 2,4-Dimethylpentane
19. Benzene
20. Cyclohexane
21. 2-Methylhexane
22. 2,3-Dimethylpentane
23. 3-Methylhexane
24. 2,2,4-Trimethylpentane
25. Heptane
26. Acetal
27. Toluene
28. Xylene
29. Trimethylbenzene

Great Technical Support with Zebron™ GC Specialists

- Don’t get put on hold - get answers when you need them
- Experienced, specialized GC technical support
- Application development support
- Free on-site training

Have you ever called another column manufacturer, only to be put on hold for long periods of time and forced to leave a message, in hope that someone will call you back? At Phenomenex, we believe that our customers are the lifeblood of our business and that they deserve the highest level of service.

We guarantee that you will always speak to an experienced GC representative when you call Phenomenex. We are also available for troubleshooting and method development questions. Our full staff of technical support specialists and laboratory personnel will give you the answer you need when you need it. Experience the difference with Phenomenex, where you, the customer, are our number one priority.

“At Phenomenex we believe that customers are the lifeblood of our business. Big or small, your business is important to us. We want to grow with you and become a valued part of your business success. Let us show you how the Zebron experience puts you first.”




ORDERING INFORMATION

Zebron™ ZB-Bioethanol GC Columns

- Temperature Limits: -60 to 340/360 °C (Isothermal/TPGC)
- Specially designed for fast and accurate Bioethanol analysis
- Provides accurate and reproducible results for Certificate of Analysis (COA)
- Great resolution of fusel alcohols products
- Compatible with various carrier gases

Part No.	Description	Unit	Price
7HG-G020-22	Zebron ZB-Bioethanol, 30 meter x 0.25 mm x 1.00 µm	ea	
7EG-G020-22	Zebron ZB-Bioethanol, 15 meter x 0.25 mm x 1.00 µm	ea	

Zebron™ ZB-1 GC Columns

- Temperature Limits: -60 to 360/370 °C (Isothermal/TPGC)
- Provides reliable and stable quality check results
- Equivalent to USP Phase G2

Part No.	Description	Unit	Price
7MG-G001-17	Zebron ZB-1, 100 meter x 0.25 mm x 0.50 µm	ea	
AG0-5155	Zebron ZB-1 Test Mix	ea	

(LIT_5784_I)

For a FREE copy of the
"Essential Guide for Biofuel Analysis",
please email: info@phenomenex.com

GC Accessories

Cool-Lock™ Nut*

GC nut for accurate and precise column installation

Part No.	Description	Unit	Price
AG0-8319	Cool-Lock GC Capillary Nut For Use with Short-Style Ferrules	ea	
AG0-8320	Cool-Lock GC Capillary Nut For Use with Long-Style Ferrules	ea	
AG0-8349	Cool-Lock Nut Installation Gauge	ea	
Replacement			
AG0-4701	GC Capillary Ferrules Graphite 1/16 in. to 0.5 mm ID	10/pk	
AG0-4704	GC Capillary Ferrules Graphite 1/16 in. to 0.8 mm ID	10/pk	

** For Agilent GC Systems. Patent pending.*

Inlet Base Seals*

Seals liner with injection port for better peak shape and quantitation

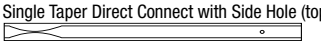
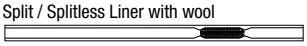
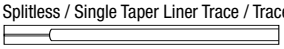
Part No.	Description	Similar to Manufacturer Number **	Unit	Price
Standard, single groove for splitless applications, 0.8 mm dia. inlet hole				
AG0-7518	Gold Inlet Base Seal, splitless (single groove), 0.8 mm	18740-20885	2/pk	
AG0-7519	Gold Inlet Base Seal, splitless (single groove), 0.8 mm	18740-20885	10/pk	
High Split Flow, cross groove for split applications, 0.8 mm dia. inlet hole				
AG0-7520	Gold Inlet Base Seal, split (double groove/cross), 0.8 mm	5182-9652	2/pk	
AG0-7521	Gold Inlet Base Seal, split (double groove/cross), 0.8 mm	5182-9652	10/pk	
Replacement Inlet Seal Washers				
AG0-7522	Inlet Seal Washers, for Agilent GC injection port	5061-5869	12/pk	

** For Agilent GC Systems. ** Similar to but not always an exact equivalent to the original manufacturer's product.*

GC Accessories *(cont'd)*

Injection Port Inlet Liners

Focuses and concentrates sample to improve reproducibility and results

Description	GC Model No.	Dimensions ID x L x OD (mm)	Material* (deactivated)	Quartz Wool (Y/N)	Similar to Manufacturer Number **	Part No.	Unit	Price
Agilent Technologies (HP)								
Single Taper Direct Connect with Side Hole (top) 	5880/5980/6890	4 x 78.5 x 6.3	B (y)	N	21055	AG0-7850	5/pk	
Single Taper Direct Connect with Side Hole (bottom) 	5880/5980/6890	4 x 78.5 x 6.3	B (y)	N	G1544-80730 20771	AG0-7851	5/pk	
Split / Splitless Liner with wool 	5880/5890/6890	4 x 78.5 x 6.3	B (y)	Y	—	AG0-8174	5/pk	
Shimadzu™								
Split / Splitless Liner 	9A/16A	3.4 x 139 x 5.0	B (y)	N	20749	AG0-4669	5/pk	
Thermo Scientific (Finnigan)								
Splitless / Single Taper Liner Trace / Trace 	8000	5 x 105 x 8.0	B (y)	N	45350033	AG0-7852	5/pk	

** B= Borosilicate; Deactivated = Yes (y) or No (n).*
*** Similar to but not always an exact equivalent to the original manufacturer's product.*

Long Ferrules

Seals injection inlet to syringe to reduce coring and increase septum lifetime

Part No.	Description		Unit	Price
0.4 mm Ferrule ID				
AG0-4698	Graphite Ferrule	1/16 in. to 0.4 mm	10/pk	
AG0-4699	Graphite Ferrule	1/16 in. to 0.4 mm	50/pk	
0.5 mm Ferrule ID				
AG0-4701	Graphite Ferrule	1/16 in. to 0.5 mm	10/pk	
AG0-4702	Graphite Ferrule	1/16 in. to 0.5 mm	50/pk	
0.8 mm Ferrule ID				
AG0-4704	Graphite Ferrule	1/16 in. to 0.8 mm	10/pk	
AG0-4705	Graphite Ferrule	1/16 in. to 0.8 mm	50/pk	

Septa

Enhanced durability and re-sealing capabilities

Part No.	Description	Unit	Price
PhenoRed ⅜ in. (9.5 mm) Diameter 400 °C			
AG0-4690	PhenoRed-400 Injector Septa	50/pk	
AG0-4691	PhenoRed-400 Injector Septa	100/pk	
PhenoRed 7/16 in. (11 mm) Diameter 400 °C			
AG0-4696	PhenoRed-400 Injector Septa	50/pk	
AG0-4697	PhenoRed-400 Injector Septa	100/pk	

guarantee

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*This guarantee is not valid in India and China.

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	Australia	Austria	Canada	Denmark	France	Germany
mail:	PO Box 4084 Lane Cove, NSW 2066 Australia	Zeppelinstr. 5 63741 Aschaffenburg Germany	411 Madrid Ave. Torrance, CA 90501-1430 USA	Gydevang 39-41 3450 Allerød Denmark	Parc des Grillons, Bat.3 60 route de Sartrouville 78232 Le Pecq Cedex France	Zeppelinstr. 5 63741 Aschaffenburg Germany
tel.:	02-9428-6444	01-319-1301	(800) 543-3681	4824 8048	01 30 09 21 10	06021-58830-0
fax:	02-9428-6445	01-319-1300	(310) 328-7768	4810 6265	01 30 09 21 11	06021-58830-11
email:	auinfo@ phenomenex.com	anfrage@ phenomenex.com	info@ phenomenex.com	dkinfo@ phenomenex.com	franceinfo@ phenomenex.com	anfrage@ phenomenex.com

	Ireland	Italy	New Zealand	Puerto Rico	United Kingdom	USA
mail:	Queens Avenue, Hurdsfield Ind. Est., Macclesfield, Cheshire SK10 2BN, UK	Via Serenari, 15/D 40013 Castel Maggiore (BO) Italy	P O Box 31-601 Milford 0741 North Shore City New Zealand	273 Sierra Morena, Suite #104 San Juan, Puerto Rico 00926	Queens Avenue, Hurdsfield Ind. Est., Macclesfield, Cheshire SK10 2BN, UK	411 Madrid Ave. Torrance, CA 90501-1430 USA
tel.:	01 247 5405	051 6327511	09-4780951	(800) 541-HPLC	01625-501367	(310) 212-0555
fax:	+44 1625-501796	051 6327555	09-4780952	(310) 328-7768	01625-501796	(310) 328-7768
email:	eireinfo@ phenomenex.com	italiainfo@ phenomenex.com	nzinfo@ phenomenex.com	info@ phenomenex.com	ukinfo@ phenomenex.com	info@ phenomenex.com

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