

# APPLICATIONS

## A Fast Isothermal GC Analysis of Spark Ignition Fuel Oxygenate Additives Using an Alternative Phase

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### Introduction

Oxygenates are chemical additives used to enhance the quality of spark ignition fuels and to boost the performance of engines. They are effective modifiers to improve acceleration of the engine which can also lower the vehicle's fuel mileage and help keep engines clean for longer while performing more efficiently. Oxygenates help gasoline burn efficiently during combustion to provide optimum torque to the vehicle. Another benefit to an efficient combustion burn is that it lowers harmful carbon monoxide levels and other harmful emissions from vehicles.

Below is a list of some of the common oxygenates found in spark ignition fuels:

### Alcohols

- Methanol (MeOH)
- Ethanol (EtOH)
- Isopropyl alcohol (IPA)
- n-Butanol (BuOH)
- Gasoline grade tert-butanol (GTBA)

### Ethers

- Methyl tert-butyl ether (MTBE)
- Tert-Amyl methyl ether (TAME)
- Tert-Hexyl methyl ether (THEME)
- Ethyl tert-butyl ether (ETBE)
- Tert-Amyl ethyl ether (TAEE)
- Diisopropyl ether (DIPE)

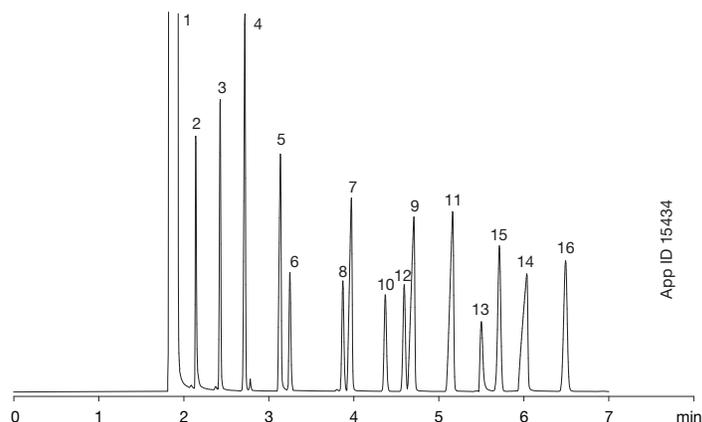
Historically MTBE had been used as the primary oxygenate additive in gasoline (petrol), from approximately 1974 as a replacement for lead up to the year 2000 when itself became an environmental concern. In place of MTBE, ethanol and ETBE are now commonly used as oxygenate additives in spark ignition fuels, though some regions of the world still use MTBE. Methanol is also being used in some proposed new low emission formulations.

A 100% dimethylpolysiloxane phase GC column is typically used for the analysis of oxygenates however this technical work describes an alternative selectivity, specifically a Zebron ZB-5ms 5% phenyl-arylene phase.

### GC Method Parameters

**Column:** Zebron™ ZB-5ms  
**Phase:** 5 % Phenyl-Arylene 95 % Dimethylpolysiloxane  
**Dimensions:** 30 meter x 0.25 mm x 0.50 μm  
**Part No.:** 7HG-G010-17  
**Injection:** Split 100:1 @ 200 °C, 0.2 μL  
**Carrier Gas:** Helium @ 1.4 mL/min (Constant Flow)  
**Oven Program:** 30 °C Isothermal  
**Detector:** Flame Ionization (FID) @ 250 °C  
**Sample:** 1. Methanol  
 2. Ethanol  
 3. 2-Propanol  
 4. tert-Butanol  
 5. n-Propanol  
 6. Methyl tert-butyl ether (MTBE)  
 7. Isopropyl ether  
 8. sec-Butanol  
 9. tert-Butyl ethyl ether (ETBE)  
 10. Methylcyclopentane  
 11. Isobutanol  
 12. tert-Pentanol  
 13. 1,2-Dimethoxyethane  
 14. Benzene  
 15. n-Butanol  
 16. tert-Amyl methyl ether

**Figure 1.**  
Separation of 16 Common Spark Ignition Fuel Oxygenates



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## Results and Discussion

The Zebron™ ZB-5ms has a special Engineered Self Cross-linking™ (ESC) stationary phase that provides low bleed when used to separate oxygenates. The column's low polar 5 % phenyl-arylene phase provided great separation for all the test components, with a fast sub-7 minute analysis time @ 30 °C isothermal run.

Alcohols in general are more polar than ethers, so the slightly polar Zebron™ ZB-5ms helped separate the more polar elements from the nonpolar ones, for example there was good separation of tert-pentanol from the methylcyclopentane, which can coelute when run on a 100% dimethylpolysiloxane phase.

## Conclusion

The Zebron ZB-5ms provided optimal separation of critical pairs with symmetric peaks and a fast run time of under 7 minutes at an isothermal temperature program. The Zebron ZB-5ms with the 5% phenyl-arylene phase is a great alternative selectivity to provide increased separation of polar and aromatic elements from the less polar components.

## Ordering Information

Zebron ZB-5ms GC Columns			
ID(mm)	df(μm)	Temp. Limits °C	Part No.
<b>10-Meter</b>			
0.10	0.10	-60 to 325/350	7CB-G010-02
0.18	0.18	-60 to 325/350	7CD-G010-08
<b>12-Meter</b>			
0.20	0.33	-60 to 325/350	7DE-G010-14
<b>15-Meter</b>			
0.25	0.25	-60 to 325/350	7EG-G010-11
<b>20-Meter</b>			
0.18	0.18	-60 to 325/350	7FD-G010-08
0.18	0.32	-60 to 325/350	7FD-G010-51
0.18	0.36	-60 to 325/350	7FD-G010-53
<b>25-Meter</b>			
0.20	0.33	-60 to 325/350	7GE-G010-14
<b>30-Meter</b>			
0.25	0.25	-60 to 325/350	7HG-G010-11
0.25	0.50	-60 to 325/350	7HG-G010-17
0.25	1.00	-60 to 325/350	7HG-G010-22
0.32	0.25	-60 to 325/350	7HM-G010-11
0.32	0.50	-60 to 325/350	7HM-G010-17
0.32	1.00	-60 to 325/350	7HM-G010-22
<b>60-Meter</b>			
0.25	0.10	-60 to 325/350	7KG-G010-02
0.25	0.25	-60 to 325/350	7KG-G010-11
0.32	0.25	-60 to 325/350	7KM-G010-11

Note: If you need a 5 in. cage, simply add a (-B) after the part number, e.g., 7HG-G010-11-B. Some exceptions may apply. Agilent 6850 and some SRI and process GC systems use only 5 in. cages.

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