



Cannabis Testing Guide

- Potency
- Pesticides
- Residual Solvents
- Terpenes
- Mycotoxins



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Cannabis Analysis Product Overview

Sample Preparation

04

HPLC / UHPLC Columns

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GC Columns and Accessories

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Sample Filtration

Filter Vials



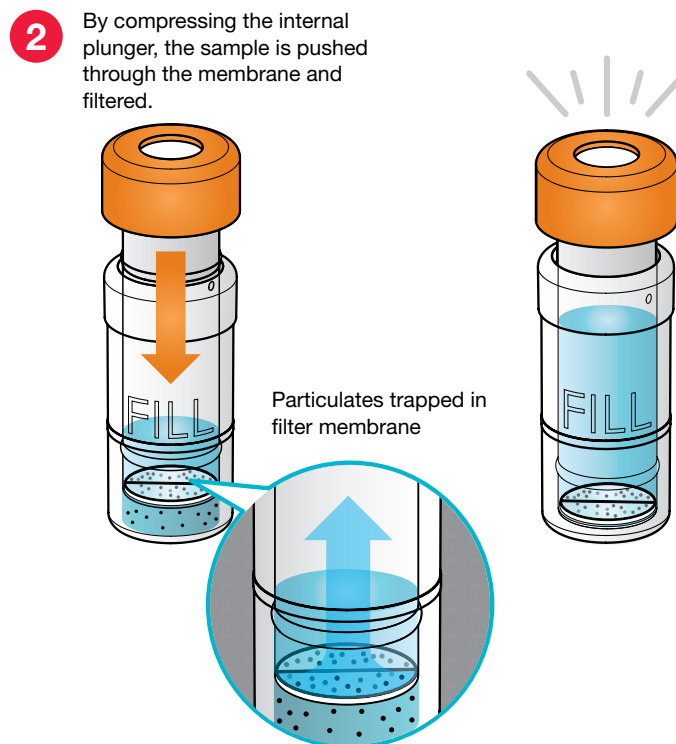
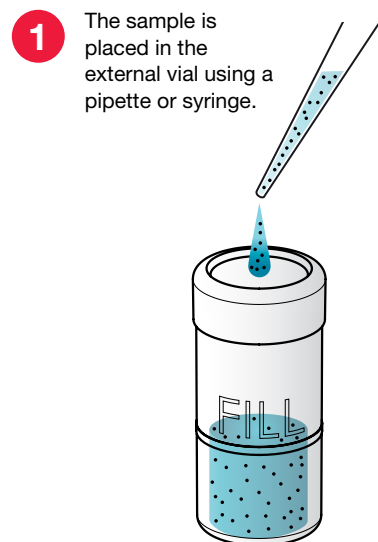
VEREX

Certified Filter Vials

Sample Preparation in Two Steps

Verex Filter Vials is an easy two-step sample preparation device that consists of two parts: an external vial to be filled with sample, and an internal plunger with a filtration membrane and cap with a pre-slit septa.

Filter Vials



Now the Verex Filter Vial is ready to be placed into the autosampler!

Simply dispense your sample and filter!

Verex Filter Vial Offers:

- **All-in-one sample prep solution**
Combines sample storage, transfer, and filtration
- **Identifiable colored caps**
Easily find the correct membrane and pore size
- **Low dead-volume**
Higher sample recovery and increased sensitivity

For a complete selection of Verex products and ordering part numbers visit www.phenomenex.com/Products/VialDetail/VerexF



Sample Filtration

Phenex Syringe Filters

Efficient and Rapid Filtration for a Particulate-Free Eluent



Wide variety of membranes for any application. Select your filter in three EASY steps:

1. What is your sample volume?

≤ 2 mL Sample Volume	2 to 10 mL Sample Volume	10 to 100 mL Sample Volume
4 mm Diameter	15 mm Diameter	25 - 28 mm Diameter

2. What is your LC column ID?

≥ 3 μm	< 3 μm	OR
0.45 μm	0.20 μm	Viscous samples such as serum, plasma, or other biological matrices. Solutions with high particulate load (e.g., some environmental or food and beverage applications).
		Glass Fiber Filter with 0.45 μm membrane

3. What type of sample are you working with?

Aqueous			Solvents	
	Solvents Mixtures	Tissue Culture Media, Buffers	Non-Aqueous	Aqueous Mixtures
		Protein Analysis/ Biological Samples	Hydrophobic/ Strong Acids	Hydrophilic
	RC (Regenerated Cellulose)	CA (Cellulose Acetate)	PTFE (Polytetrafluoroethylene)	RC (Regenerated Cellulose)

Other Applications:

Application / Sample*	Recommended Filter**	First Alternative
General GC and LC	RC	PTFE
Aggressive or Pure Organic Solvents	PTFE	RC
High Particulate Loads	GF/NY	GF + RC
Dissolution Testing	GF/NY	RC
Ion Chromatography	RC	PES
Trace Metals (ICP-MS, AAS)	RC	PES
Capillary Electrophoresis (CE)	RC	PES
Tissue Cultures, Media, Buffers	GF/CA	PES

* Removal of high particulate matter with a glass fiber prefilter is critical before any drug, tox, or dirty environmental sample is filtered to ensure the highest syringe filter membrane performance.

** For high load and particulate-laden samples you may consider placing a Glass Fiber (GF) prefilter, either integrated with the membrane as one unit (Phenex-GF/NY or -GF/CA) or in series with the membrane syringe filter of your choice.

Generally, 0.45 μm porosity filters are used to remove particulates from samples and mobile phase solutions. For sterile-filtration, a 0.20 μm porosity filter can be used.

Sample Preparation

Strata-X

Solid Phase Extraction (SPE)

Targeted Extraction and Clean Up

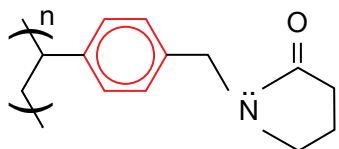
Strata-X

Strata-X polymeric sorbents are available in unique selectivities developed to cover a diverse spectrum of analytes and simplify the method development process for fast and efficient sample preparation.

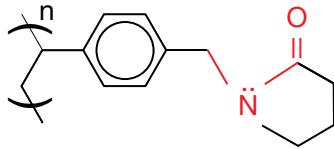
- **Tightly retain analytes**
- **Remove unwanted contaminants**
- **Easily cleanup large volume**

Mechanisms of Retention

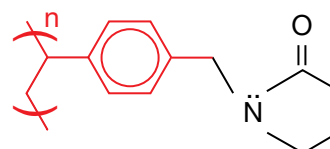
π - π Bonding



Hydrogen Bonding Dipole-Dipole Interactions



Hydrophobic Interaction



strata™ X
Polymeric SPE



View all Strata-X products and ordering information

www.phenomenex.com/StrataX

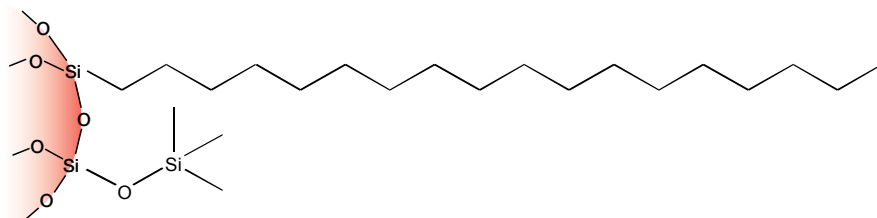


Strata C18

SPE for extraction of hydrophobic or polar organic analytes from aqueous matrices.

Mechanisms of Retention

End-capped C18 sorbent that offers strong hydrophobic retention with negligible secondary polar interactions from active silanol groups.



View all Strata-X products and ordering information

www.phenomenex.com/StrataC18



Sample Preparation

roQ QuEChERS Kits



Why Choose roQ QuEChERS?

Improved with you in mind, roQ picks up where other QuEChERS kits fail. The unique design of the roQ QuEChERS kits eliminates common problems seen with current QuEChERS kits on the market.

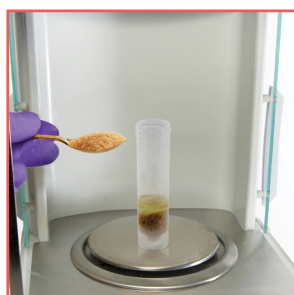
roQ
QuEChERS Kits

Ease of Use

Built-in Removable Rack*



Stand Alone Extraction Tubes



Easy Pour Salt Packets



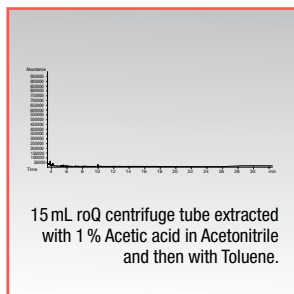
*Applies to roQ Extraction Kits (excludes dSPE Kits)

Quality

Leak-Free Tubes



Low Leachate Tubes



Quality Management System Certified

- Validates processes to be fully established, functional, and meet international standards
- MSDS and Certificate of Analysis (CoA) available for all kits
- roQ QuEChERS kits are guaranteed for quality

QUALITY
MANAGEMENT SYSTEM
CERTIFIED BY DNV GL
= 9001:2015 =

*Applies to roQ Extraction Kits (excludes dSPE Kits)

Salts and Sorbents used in roQ Kits

Extraction:

- Magnesium Sulfate ($MgSO_4$)
- Sodium Acetate ($NaOAc$)
- Sodium Chloride ($NaCl$)
- Sodium Citrate Tribasic Dihydrate (SCTD)
- Sodium Citrate Dibasic Sesquihydrate (SCDS)

Clean Up/dSPE:

- Magnesium Sulfate ($MgSO_4$)
- Primary/Secondary Amine (PSA)
- Endcapped C18 Sorbent (C18E)
- Graphitized Carbon Black (GCB)

For a complete selection of roQ QuEChERS and ordering part numbers visit
www.phenomenex.com/roQ



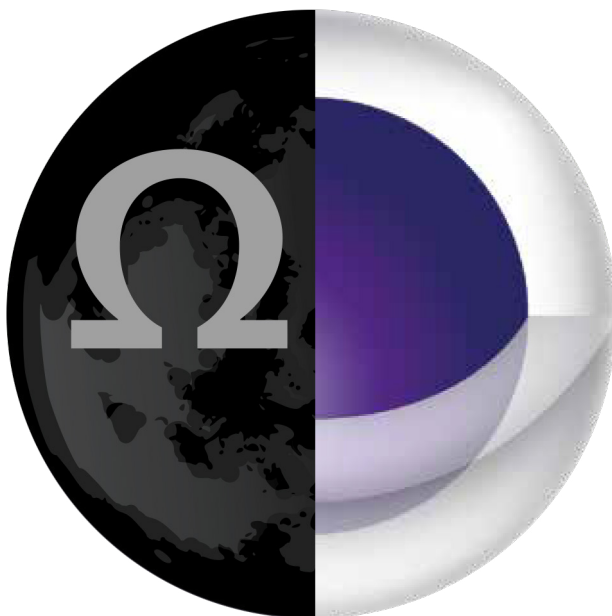
HPLC / UHPLC

Columns



Cutting Edge Fully Porous Silica Particle

Luna is one of the most recognized HPLC brands on the market, delivering high efficiency, ruggedness, reproducibility, and dependability for a wide range of analyses.

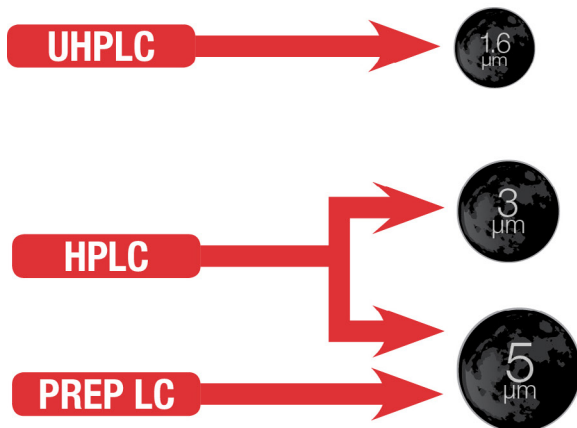


The Chosen Core-Shell Brand

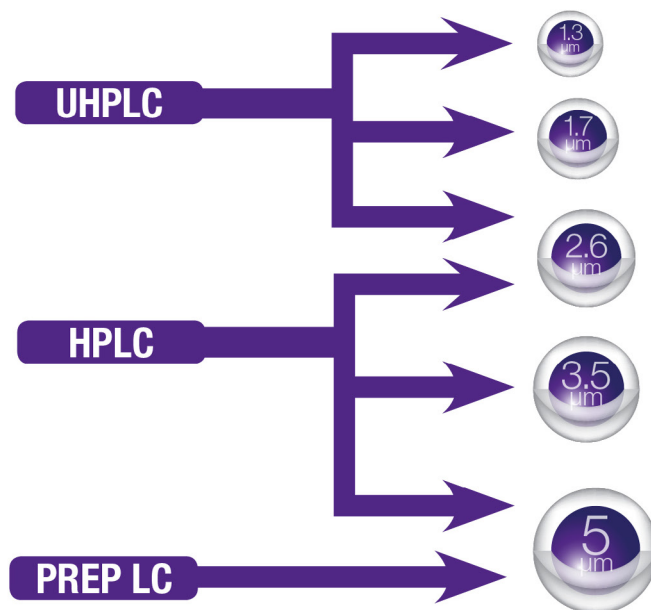
Kinetex Core-Shell Technology delivers dramatic improvements in efficiency over conventional fully porous media which can be leveraged to increase resolution, greatly improve productivity, reduce solvent consumption and decrease costs.

Complete Scalable Solution from UHPLC to HPLC to PREP LC

Luna Omega Particle Selection



Kinetex Core-Shell Particle Selection



For a complete selection of HPLC and UHPLC columns and ordering part numbers visit www.phenomenex.com/LCcolumns



Explore the Options and Choose the Best Selectivity for Your Analysis

Zebron GC Columns offer reliability, reproducibility, and robustness when performing cannabis testing for pesticides, terpenes, and residual solvents. Zebron GC columns are designed to provide very low bleed levels, resulting in a gas chromatography column that offers increased sensitivity and stability over traditional GC columns on the market. Every Zebron GC column is extensively tested to ensure: high efficiency, low bleed, optimal resolution, and best retention.

Benefits of the ZB 624PLUS™ for Cannabis

- Superior deactivation for best resolution and enhanced peaks
- Increased sensitivity for high boiling solvent
- Extremely low bleed for GC-MS
- Robust column performance for high temperature bake outs

Click to access the selection tool to select the column with the best selectivity for your analysis.

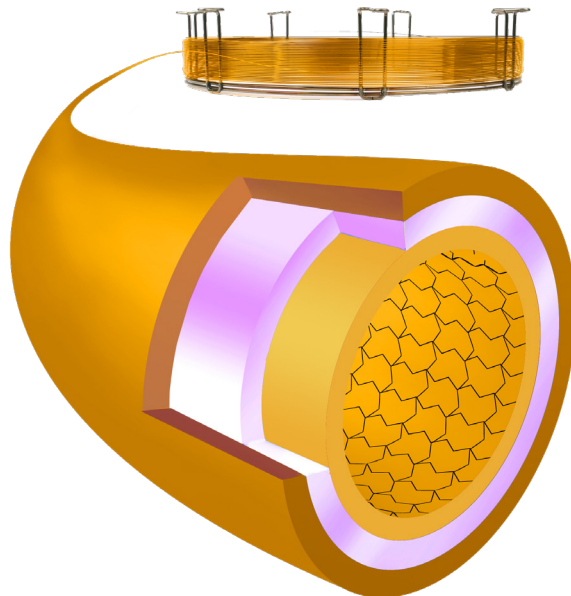
Column	Recommended for
ZB-624PLUS	Residual Solvents, Terpenes
ZB-WAXPLUS	Residual Solvents, Terpenes
ZB-5PLUS	Potency, Pesticides
ZB-MultiResidue-1 & -2	Pesticides

Don't Forget Your Gas Management Tools and Accessories

- Preserve the life and quality of your column and your analysis
- Avoid costly equipment failure and down-time



Zebron™
GC Columns



For a complete selection of GC columns and accessories, and ordering part numbers visit www.phenomenex.com/Zebtron



Cannabis Analysis Applications

Potency

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Terpenes

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18 Cannabinoids for Potency Testing by LC-UV

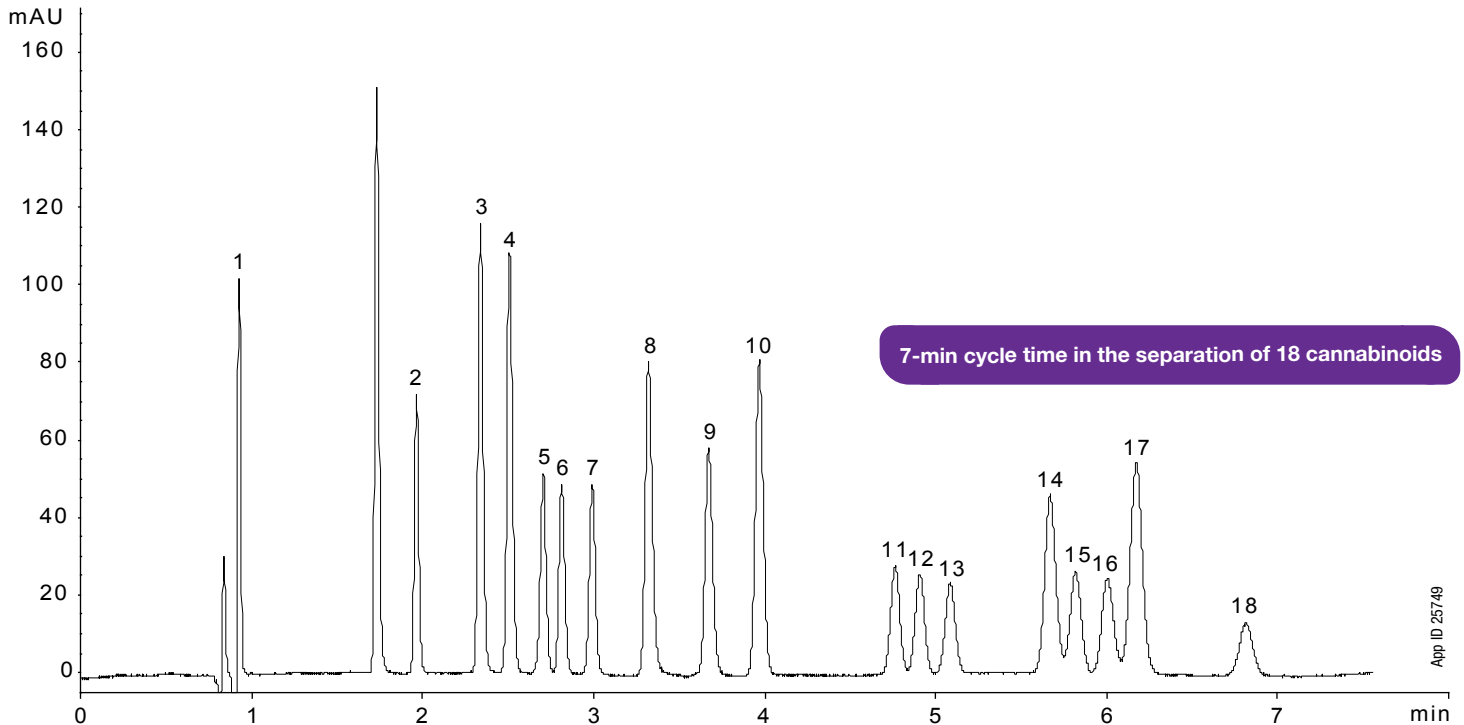


LC-UV Conditions

Column: Kinetex 2.6 μ m C18
Dimensions: 150 x 4.6 mm
Part No.: [00F-4462-EO](#)
Mobile Phase: A: 20 mM Ammonium Formate, pH 2.9 with Formic Acid
B: Acetonitrile
Isocratic: Isocratic 24:76 (A/B)
Flow Rate: 1.5 mL/min
Injection Volume: 2 μ L
Back Pressure: ~260 bar
Temperature: 40 $^{\circ}$ C
Flow Rate: 1.5 mL/min
Detection: UV @ 228 nm

Analytes:

1. CBDVA Cannabidivarinic acid	10. CBN Cannabinol
2. CBDV Cannabidivarin	11. EXO-THC Exo-tetrahydrocannabinol
3. CBDA Cannabidiolic acid	12. D9-THC Δ 9-Tetrahydrocannabinol
4. CBGA Cannabigerolic acid	13. D8-THC Δ 8-Tetrahydrocannabinol
5. CBG Cannabigerol	14. THCA-A Tetrahydrocannabinolic acid A
6. CBD Cannabidiol	15. CBCA Cannabichromenic acid
7. THCV Tetrahydrocannabivarin	16. CBL Cannabicycol
8. THCVA Tetrahydrocannabivarinic acid	17. CBC Cannabichromene
9. CBNA Cannabinolic acid	18. CBLA Cannabicyclolic acid



[Download Complete Application Note](#)

[Order Now](#)



Quantification of 10 Cannabinoids

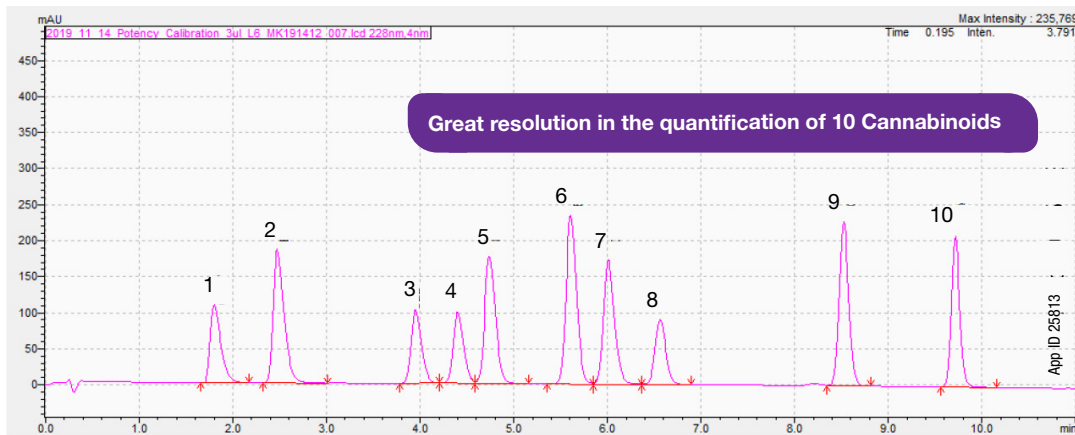


Column: Kinetex 2.6µm C18
Dimensions: 50 x 2.1 mm
Part No.: [00B-4462-AN](#)
Mobile Phase: A: 0.10 % Formic Acid in Water
 B: 0.05 % Formic Acid in Methanol
Injection Volume: 3 µL
Detection: UV @ 228 nm
Flow Rate: 0.8 mL/min
Gradient:

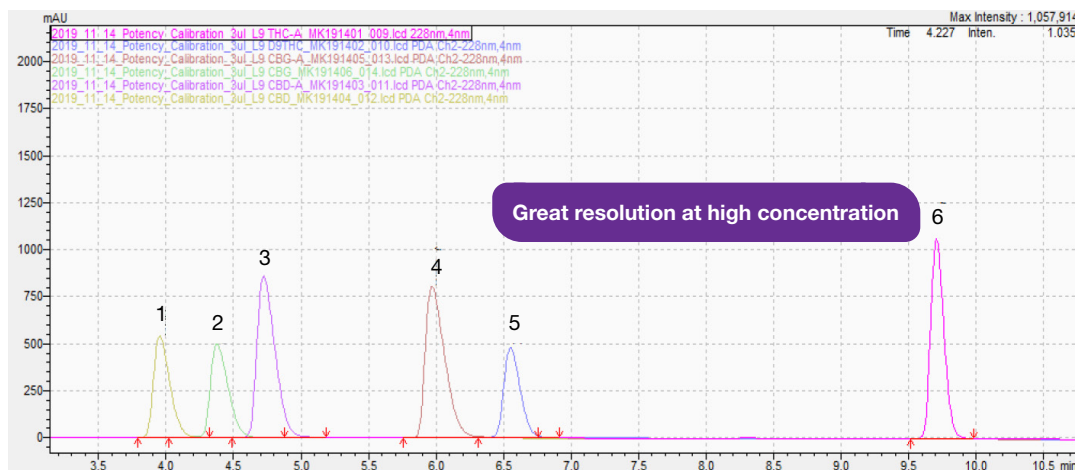
Time (min)	%A	%B
0	40	60
7	30	70
10.9	17	83
11	0	100
11.9	0	100
12	40	60
13	40	60

- Analytes:**
1. CBD-V Cannabidiarin
 2. CBD-VA Cannabidiarinic acid
 3. CBD Cannabidiol
 4. CBG Cannabigerol
 5. CBD-A Cannabidiolic acid
 6. CBN Cannabinol
 7. CBG-A Cannabigerolic acid
 8. D9-THC Δ9-Tetrahydrocannabinol
 9. CBC Cannabichromene
 10. THC-A Cannabichromene

10 analytes displayed at 100 µg/mL



6 Analytes (CBD, CBG, CBD-A, CBG-A, D9-THC, and THC-A) at 600 µg/mL With Full Resolution



- Analytes:**
1. CBD Cannabidiol
 2. CBG Cannabigerol
 3. CBD Cannabidiolic acid
 4. CBG-A Cannabigerolic acid
 5. d9 THC Δ9-Tetrahydrocannabinol
 6. THC-A Tetrahydrocannabinol

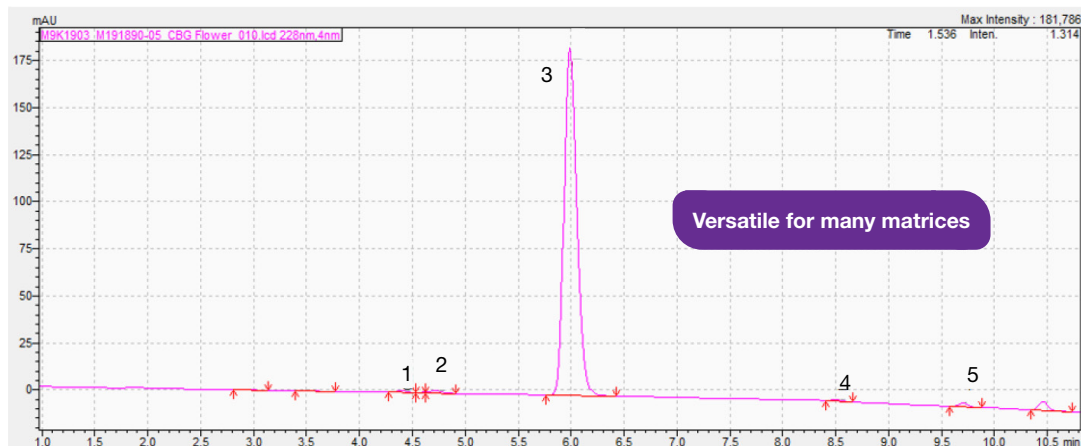
[Download Complete Application Note](#)

Potency

HPLC / UHPLC



CBG-A Dominant Hemp Cultivar



- Analytes:**
1. CBG Cannabigerol
 2. CBD-A Cannabidiolic acid
 3. CBG-A Cannabigerolic acid
 4. CBG Cannabigerolic
 5. THC-A Tetrahydrocannabinol

[Download Complete Application Note](#)

[Order Now](#)

HPLC / UHPLC Columns and Accessories

Part No.	Description
00F-4462-E0	Kinetex 2.6 μ m C18 150 x 4.6 mm
AJ0-8768	SecurityGuard Ultra (for 4.6 mm)
00B-4462-AN	Kinetex 2.6 μ m C18 50 x 2.1 mm
AJ0-8782	SecurityGuard™ Ultra for (2.1 mm)
AJ0-9000	SecurityGuard Holder

For a complete selection of Kinetex products and ordering part numbers visit www.phenomenex.com/Kinetex

Phenova

Certified Reference Materials

Complete Cannabis Proficiency Testing Solutions

- Potency
- Pesticide Residues
- Residual Solvents
- Moisture/Water Activity

Contact Phenova for Cannabis Proficiency Testing. Information in Your State!

- Flower, Oil and Alternative Matrix PT Standards
- ISO 17043/17025 Accredited PT Provider
- State Specific Analytes - Action Level Based
- Enroll in an Active PT Study Today!



Call: 1-303-940-0033
www.phenova.com/cannabis

Pesticides

HPLC / UHPLC



65 California Pesticides Analysis from Cannabis by LC-MS/MS using Luna Omega Polar C18 LC Column



Sample Preparation

1. 1 gram of homogenized flower or 0.02 grams of concentrate is vortexed in 10 mL of Acetonitrile
2. Sonicate for 15 minutes
3. Winterization at -20 °C or lower for at least 2 hours
4. Centrifuge at 4000 rpm
5. Injection volume of 2 μ L for LC-MS/MS analysis

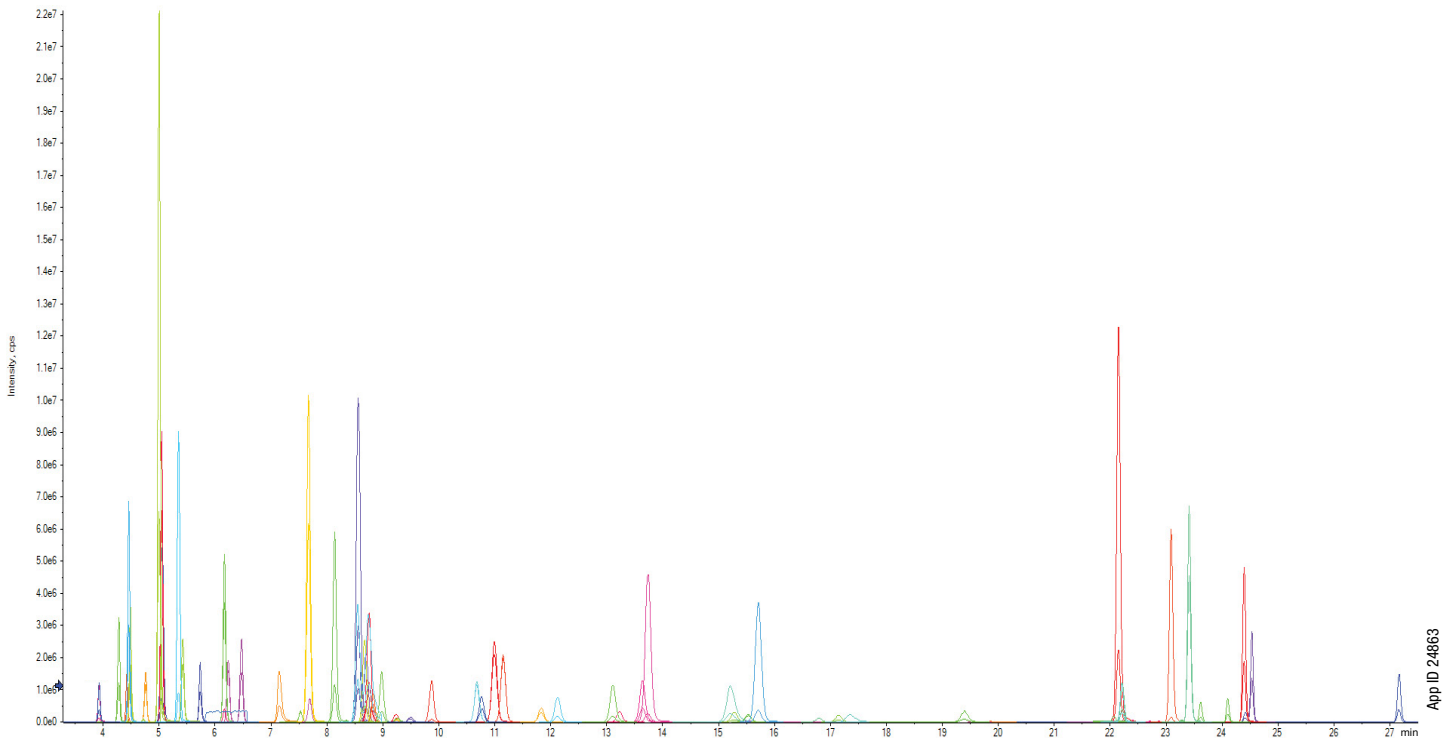
LC-MS/MS Method

Column: Luna Omega 3 μ m Polar C18
Dimension: 150 x 4.6 mm
Part No.: [00E-4760-E0](#)
Mobile Phase: A: 5 mM Ammonium Acetate + 0.1% Formic Acid
B: Methanol/Water (98:2) + 5 mM Ammonium Acetate

Gradient	Time (min)	% B
	0	10
	2	60
	3	65
	4	70
	18	80
	20	88
	22	95
	27	100
	28	100
	28.1	10
	30	10

Flow Rate: 0.8 mL/min
Injection: 2 μ L
Temperature: 30 °C
Detection: MS/MS
Instrument: SCIEX™ QTRAP® 6500+ with DuoSpray APCI/ESI
Analytes: For full list search APP ID 24863

Standards Chromatogram



App ID 24863

[Download Complete Application Note](#)



[Order Now](#)





Defining Robustness of Pesticide and Mycotoxin Analysis in Cannabis Matrices

Using the SCIEX® Triple Quad 6500+ system



Keep it clean to analyze more green

Sample clean-up is an important step for high-throughput LCMS/MS analyses. The more contaminants that are removed during the clean-up step, the longer the LC-MS/MS will be able to maintain the required sensitivity. Unfortunately, cannabis matrices contain high concentrations of cannabinoids, waxes, terpenes, and other secondary metabolites which present a significant analytical challenge. These compounds have the potential to interfere with the analysis of pesticides, making it difficult to meet the ng/g sensitivity levels required by most recreational United States regulations¹⁻⁷ and Canadian regulations⁸. In this study, the robustness of the SCIEX Triple Quad 6500+ system was evaluated by injecting a cannabis flower extract 830 times with no system maintenance. The cannabis flower was spiked with a mixture of commonly monitored cannabis pesticides and the peak area of these pesticides was monitored over time, with and without internal standard correction.



Methods

Sample preparation: A 1:10 dilution was performed using 5 g of homogenized cannabis flower extracted in 50 mL of 0.1% formic acid in acetonitrile. Extracts were winterized at -20 °C for 2 hours before filtration with 0.2 µm PTFE syringe filters. The extract was fortified with an analytical pesticide mixture and vortexed before being dispensed into equal 1 mL aliquots to be stored at 4 °C prior to LC-MS/MS analysis.

LC-MS/MS: A 5-minute gradient was used to inject cannabis flower matrix repeatedly for analysis. An analytical 20-minute gradient representing a typical analysis strategy was injected every 10th sample for comparative analysis. The analytical column used was a Phenomenex 3 µm Luna Omega Polar C18 (3x150 mm) and chromatographic separation was achieved using 5 mM ammonium formate with 0.1% formic acid in water and methanol.

Key features of the SCIEX Triple Quad 6500+ system for cannabis analysis

- Save 30 or more minutes per 96-well plate!
- At least 8x more sensitive than traditional 10mg SPE
- Elution volumes as low as 25 µL!

Robustness data

Cannabis flower extracts are a particularly challenging matrix. Very few LC-MS/MS robustness studies have been conducted with this matrix, without MS system maintenance over a prolonged duration. When determining instrument stability using this type of robustness test, normalizing the analyte peak area to an internal standard (IS) area can be misleading, as the response from the internal standard and the native pesticide(s) are likely to change proportionately. Therefore, the IS ratio will stay consistent across many injections, as shown for carbofuran (Figure 1, left), inaccurately suggesting ideal system performance despite the harsh conditions employed in this study.

The true measure of instrument robustness must be an evaluation of the uncorrected peak area as a function of time. Without MS system maintenance and given the conditions of this study, a decrease in peak area may be expected, as observed when the raw carbofuran area is plotted (Figure 1, right).

For a complete selection of Luna Omega products and ordering part numbers visit www.phenomenex.com/LunaOmega



Pesticides

HPLC / UHPLC

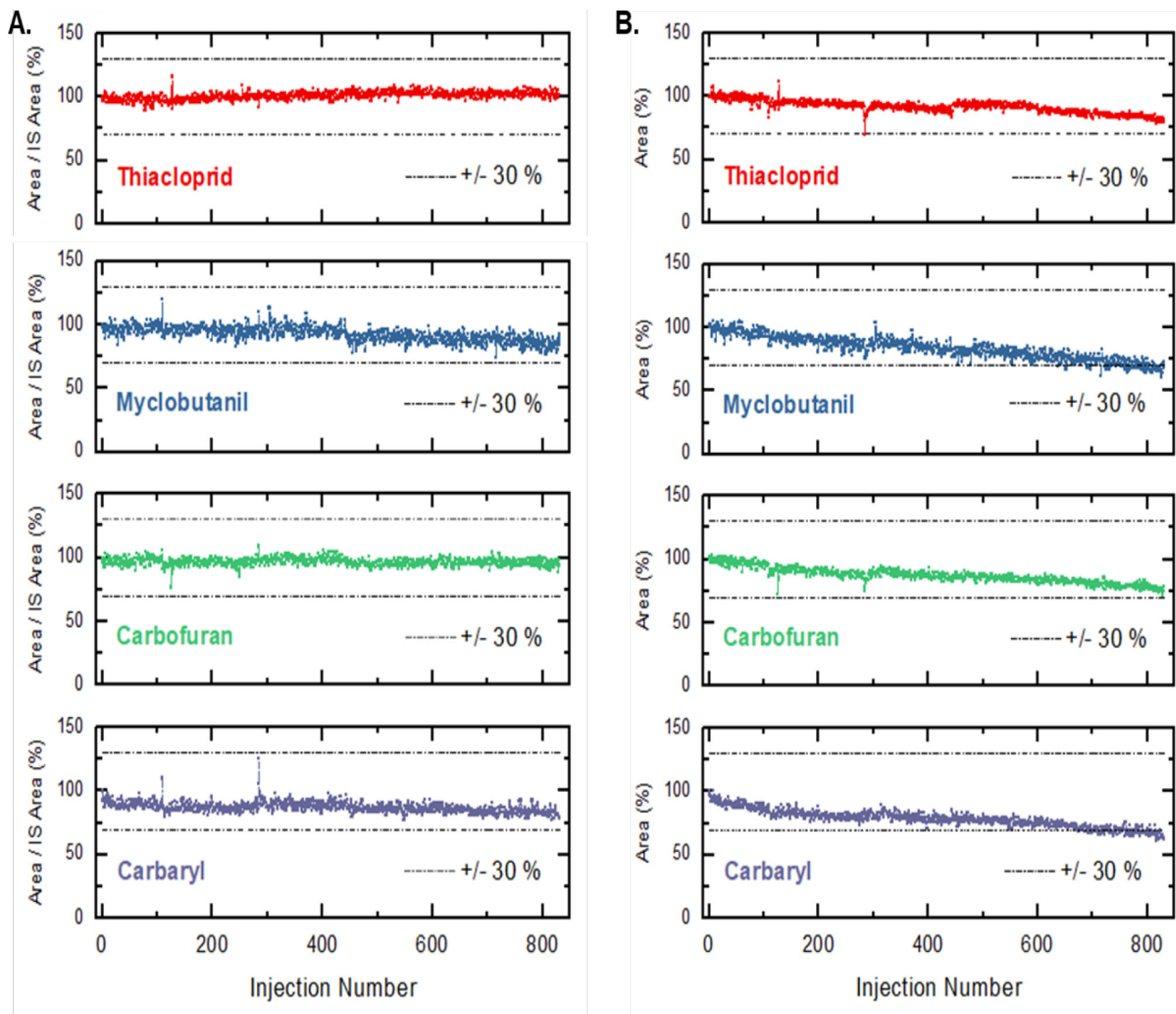


Figure 1. 830 replicate injections of cannabis flower matrix. IS-corrected (A) and raw peak area (B) responses for several pesticides in cannabis flower extracts over 830 injections without instrument maintenance. Raw areas illustrate the true measure of system robustness. Pesticides were fortified to 0.05 ppm in cannabis flower. The 30% lines are relative to the analyte response for injection 1.

However, these data show that the SCIEX® Triple Quad 6500+ system achieves sensitivity that meets regulatory limits and reliably detects pesticides of interest in a complex matrix. These features persist over the analysis of 830 cannabis samples without cleaning the MS system.

An example of this robust sensitivity can be seen with acequinocyl, which is hydrolytically unstable, has poor ionization efficiency and coelutes with numerous cannabinoids late in the gradient. For all 830 injections, acequinocyl was detected at a concentration 40x lower than Oregon regulatory limits¹ (Figure 2, top). Additionally, avermectin B1a, which is known for its thermal lability, was detected at a concentration 10x lower than Oregon regulatory limits⁵ after the 830 matrix injections (Figure 2, bottom).

Conclusion

The reality of analyzing a highly contaminating matrix is an inevitable decrease in sensitivity. In this application note, it is shown that the way instrument robustness data is organized and presented can fail to capture changes in sensitivity over time. It is therefore important to assess both the ion ratio reproducibility (Figure 2) and the raw peak area reproducibility (Figure 1), as this will inform practical considerations in a testing lab such as how often an MS system must be cleaned to maintain sensitivity requirements.

Pesticides

HPLC / UHPLC

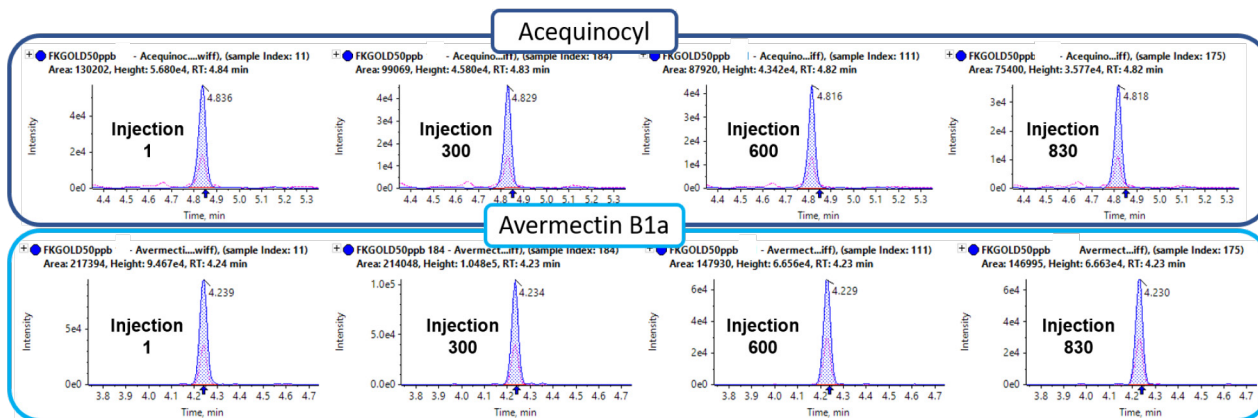


Figure 2: Stable pesticide peak areas across 830 injections. Acequinocyl is the last-eluting compound and normally is susceptible to cannabinoid suppression in matrix (top). Avermectin B1a is the primary component of Abamectin (bottom). Example chromatograms of each are shown throughout the instrument robustness test. Both quantifier and qualifier are clearly visible with no impact on ion ratio (blue and pink overlaid chromatograms) and excellent sensitivity is maintained, even under the extreme conditions employed for this robustness test.

References

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- 3) Pennsylvania Department of Public Health. Program, M. M.; Marijuana, M. OFFICE OF MEDICAL MARIJUANA GUIDANCE FOR QUALITY TESTING AND SAMPLING Definitions. **2018**, 1–9.
- 4) Safety, L.; Facilities, C.; Regulation, M. M. Safety Compliance Facility. **2018**.
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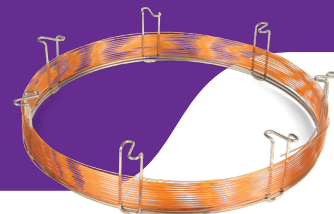
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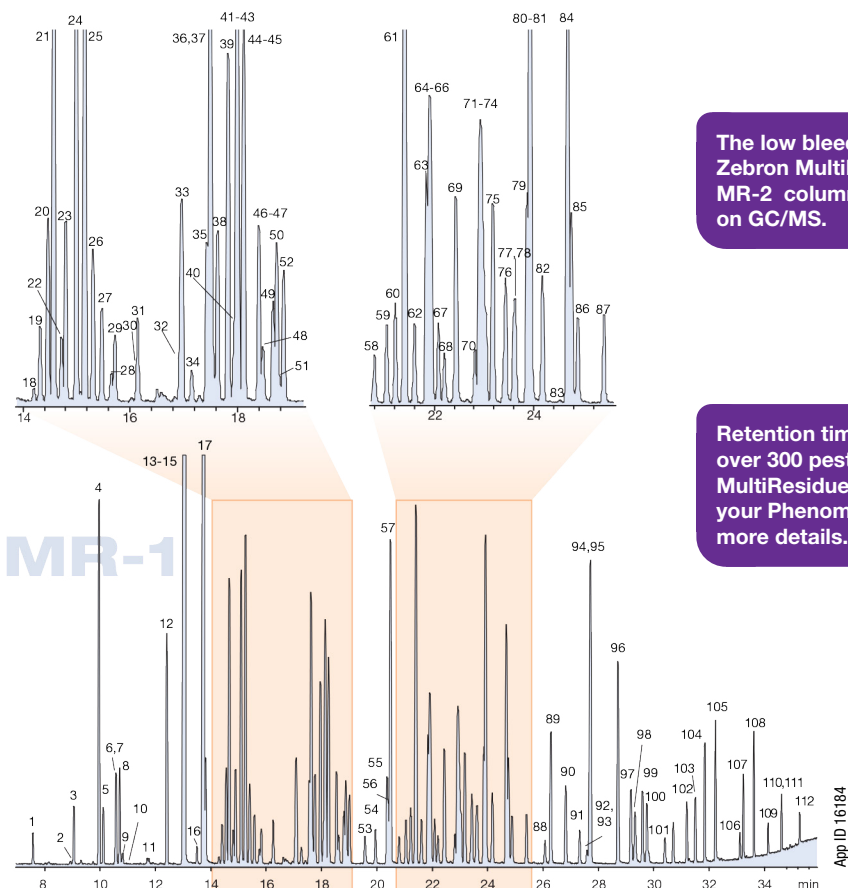
Have Questions? Chat With Our Team





112 Multi-Residue Pesticide Screening Method using GC/MS

Zebron™
GC Columns



The low bleed performance of both Zebron MultiResidue™ MR-1 and MR-2 columns allow them to be used on GC/MS.

Retention time data is available for over 300 pesticides on a Zebron MultiResidue-1 column. Please contact your Phenomenex representative for more details.

Column: Zebron MultiResidue-1
Dimensions: 30 meter x 0.25 mm x 0.25 µm
Part No.: 7HG-G016-11
Injection: Splitless @ 260 °C, 1 µL
Carrier Gas: Helium @ 0.90 mL/min (constant flow)
Oven Program: 80 °C for 0.5 min to 150 °C @ 10 °C/min to 240 °C @ 4 °C/min to 320 °C @ 15 °C/min for 3 min
Detector: MSD @ 320 °C; 45-400 amu

- | | | | |
|--|--------------------------------------|------------------------------|----------------------|
| 1. Dichlorvos | 33. Pentachlorophenol (methyl ester) | 63. Prometryn | 95. Oxadiazon |
| 2. DEET | 34. Demeton | 64. Methyl parathion | 96. Oxyfluorfen |
| 3. EPTC | 35. Atraton | 65. Ametryn | 97. Carboxin |
| 4. 3,5-Dichlorobenzoic acid (methyl ester) | 36. Profluralin | 66. Simetryn | 98. Tricyclazole |
| 5. Butylate | 37. Prometon | 67. Aspon | 99. Acifluorfen |
| 6. 4-Nitrophenol (methyl ester) Vernolate | 38. Silvex (methyl ester) | 68. Metribuzin | 100. Ethion |
| 7. Mevinphos | 39. Terbufos | 69. Terbutryn | 101. Fensulfotihon |
| 8. Mevinphos isomer | 40. Dimethoate | 70. Malathion | 102. Carbofenthiol |
| 9. Pebulate | 41. Simazine | 71. Fenitrothion | 103. Famfur |
| 10. Trichlorfon | 42. Propazine | 72. Pichloram (methyl ester) | 104. Norflurazon |
| 11. Dicamba (methyl ester) | 43. Atrazine | 73. Metolachlor | 105. Hexazinone |
| 12. Molinate | 44. Diazinon | 74. Chlorpyrifos | 106. EPN |
| 13. Tebuthiuron | 45. Dioxathion | 75. DCPA | 107. Phosmet |
| 14. MCPP (methyl ester) | 46. Terbutylazine | 76. Bromacil | 108. Leptophos |
| 15. 1Tetraethyl pyrophosphate (methyl ester) | 47. Fonofos | 77. Fenthion | 109. Azinphos-methyl |
| 16. MCPA (methyl ester) | 48. Pronamide | 78. Trichloronate | 110. Fenarimol |
| 17. Demeton isomer | 49. Chloramben (methyl ester) | 79. Triadimeton | 111. Azinphos-ethyl |
| 18. Thionazin | 50. 2,4,5-T Methyl ester | 80. Isopropalin | 112. Coumaphos |
| 19. Dichloroprop (methyl ester) | 51. Phosphamidon isomer | 81. Parathion | |
| 20. 2Propachlor | 52. Disulfoton | 82. MGK-624 | |
| 21. Cycloate | 53. Secbumeton | 83. Merphos | |
| 22. Ethoprop | 54. Terbacil | 84. Pendimethalin | |
| 23. Trifluralin | 55. Dinoseb (methyl ester) | 85. Diphenamid | |
| 24. Benefin | 56. Dichlofenthion | 86. MGK-264 isomer | |
| 25. 2,4-D (methyl ester) | 57. 2,4-DB (methyl ester) | 87. Clofenvinfos | |
| 26. Sulfotep | 58. Phosphamidon | 88. Crotoxyphos | |
| 27. 13C-1,2,3,4,6,7,8-HpCDD | 59. Chlorpyrifos methyl | 89. Butachlor | |
| 28. Naled | 60. Alachlor | 90. Stirofos | |
| 29. Chlorpropham | 61. Bentazon (methyl ester) | 91. Tokuthion | |
| 30. Dicrotophos | 62. Ronnel | 92. Napropamide | |
| 31. Phorate | 63. Prometryn | 93. Fenamiphos | |
| 32. Monocrotophos | 64. Methyl parathion | 94. Merphos Oxide | |

Have Questions? Chat With Our Team



Pesticides

List of recommended part numbers

HPLC / UHPLC Columns & Accessories

Part No.	Product Description
00B-4760-E0	Luna Omega 3 µm Polar C18 150 x 4.6 mm
00D-4760-AN	Luna Omega 3 µm Polar C18 100 x 2.1 mm
AJ0-7601	SecurityGuard Cartridge (for 4.6 mm)
AJ0-9000	SecurityGuard Holder

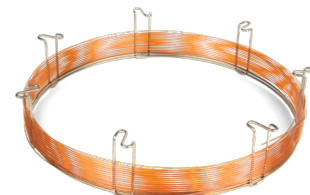


For a complete selection of columns, accessories, and ordering part numbers visit www.Phenomenex.com



GC Columns & Accessories

Part No.	Product Description
7HG-G016-11	Zebtron ZB-MultiResidue™-1 30 m x 0.25 mm x 0.25 µm
7HG-G017-10	Zebtron ZB-MultiResidue-2 30 m x 0.25 mm x 0.20 µm



Check the next generation of inertness for specialty applications, ZB-5MS™ and ZB-5MSPLUS™, featuring low bleed and suited for high sensitivity GC-MS and GC-MS/MS work.

Click below for to access complete product and ordering information
[Zebtron ZB-5MS columns](#) [ZB-5MSPLUS columns](#)



Sample Preparation – roQ Quechers

Extraction	
KS0-8910	roQ QuEChERS, Original, 4.0 g MgSO ₄ , 1.0 g NaC
KS0-8912	roQ QuEChERS, Original, 6.0 g MgSO ₄ , 1.5 g NaCl
KS0-8909	roQ QuEChERS, EN Method, 4.0 g MgSO ₄ , 1.0 g NaCl, 1.0 g SCTD, 0.5 g SCDS
Clean up/dSPE	
KS0-9510	roQ QuEChERS dSPE Kit - 15mL CT, 900 mg MgSO ₄ , 150 mg PSA, 45 mg GCB
KS0-9506	roQ QuEChERS dSPE Kit - 2 mL CT, 150 mg MgSO ₄ , 25 mg PSA, 7.5 mg GCB



For a complete selection of roQ Quechers and ordering part numbers visit www.phenomenex.com/roQ



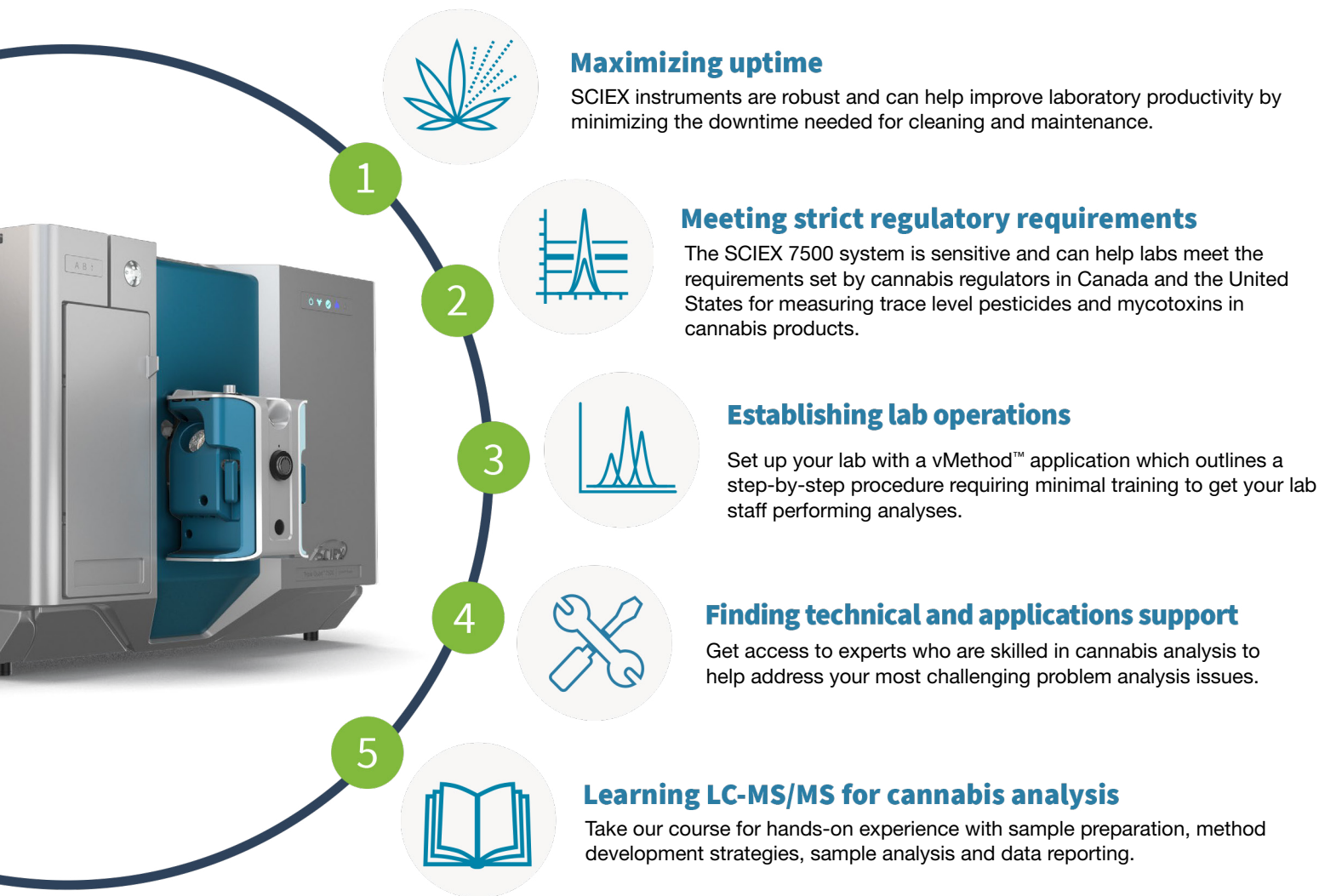
Pesticides

SCIEX



5 Ways SCIEX Addresses Pesticide Challenges in Cannabis Testing

Making your laboratory operations easier and more productive



For more information visit: sciex.li/cannabis



SCAN
ME

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Mycotoxins

HPLC / UHPLC



Expanded Mycotoxins Analysis in Cannabis Matrices by LC-MS/MS



LC Method Parameters

Column: Luna Omega 3 μ m Polar C18
Dimension: 150 x 2.1 mm
Part No.: [00D-4760-AN](#)
Flow Rate: 0.4 mL/min
Injection Volume: 3 μ L
Mass Spec Detector: Sciex® Triple Quad™ 5500
Samples were ionized using electrospray with positive/negative ion-mode polarity switching

Mobile Phase: A: 1 mM Ammonium formate + 0.1% Formic Acid in Water
B: Methanol

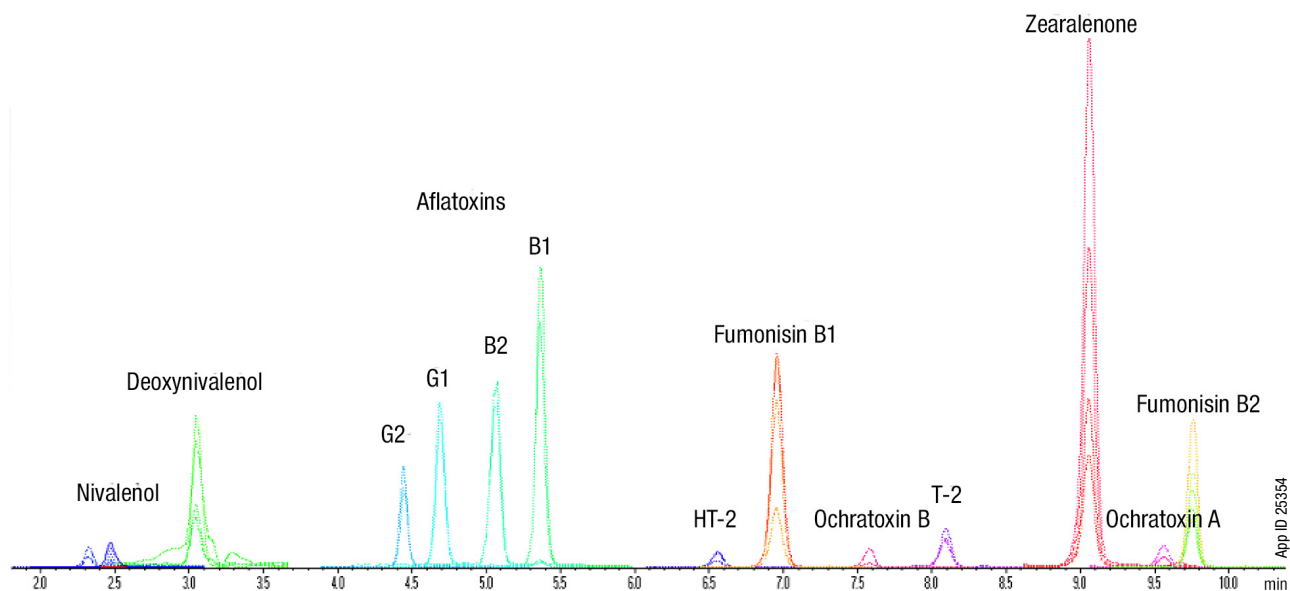
Gradient:	Time (min)	% B
	0	5
	3	35
	10	90
	12	90

Temperature: 40 °C
Injection Volume: 3 μ L
Detection: MS/MS – Sciex Triple Quad 5500

Sample Preparation

1. Sample Preparation: Cannabis flower samples were ground in a Retsch GM 200 knife mill, and 0.5 g sample E soaked in 0.5 mL of 2 % Ascorbic Acid in water in a 50 mL falcon tube
2. 10 mL Acetonitrile were added, followed by a modified EN 15662 QuEChERS salt extraction (4 g MgSO₄, 1 g NaCl, 1.5 g Sodium Citrate), shaken for 5 minutes, then centrifuged at 2500 RPM
3. The supernatant was diluted 5 x with aqueous Ammonium Formate buffer and filtered through a 0.45 μ m syringe filter prior to injection to HPLC

Chromatography of expanded Mycotoxins overlaid MRMs

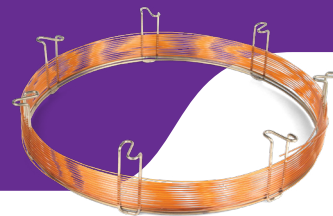


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Residual Solvents

Gas Chromatography



Analysis of 21 Residual Solvents from Cannabis Matrix by FET Headspace on a ZB-624PLUS™ GC Column



GC-MS Conditions

Column: Zebtron ZB-624PLUS
Dimensions: 30 meter x 0.25 mm x 1.40 μm
Part No.: 7HG-G040-27
Injection: Split 38:1 @ 250 °C
Split Flow: 75 mL/min
Purge Flow: 5 mL/min
Recommended Liner: Zebtron PLUS Liner (Compatible with Agilent® & Thermofisher™ GC instrument), 4 mm ID Single Taper, Wool on Bottom
Liner Part No.: AG2-0A11-05
Carrier Gas: Helium @ 1.3 mL/min (constant flow)
Oven Program:

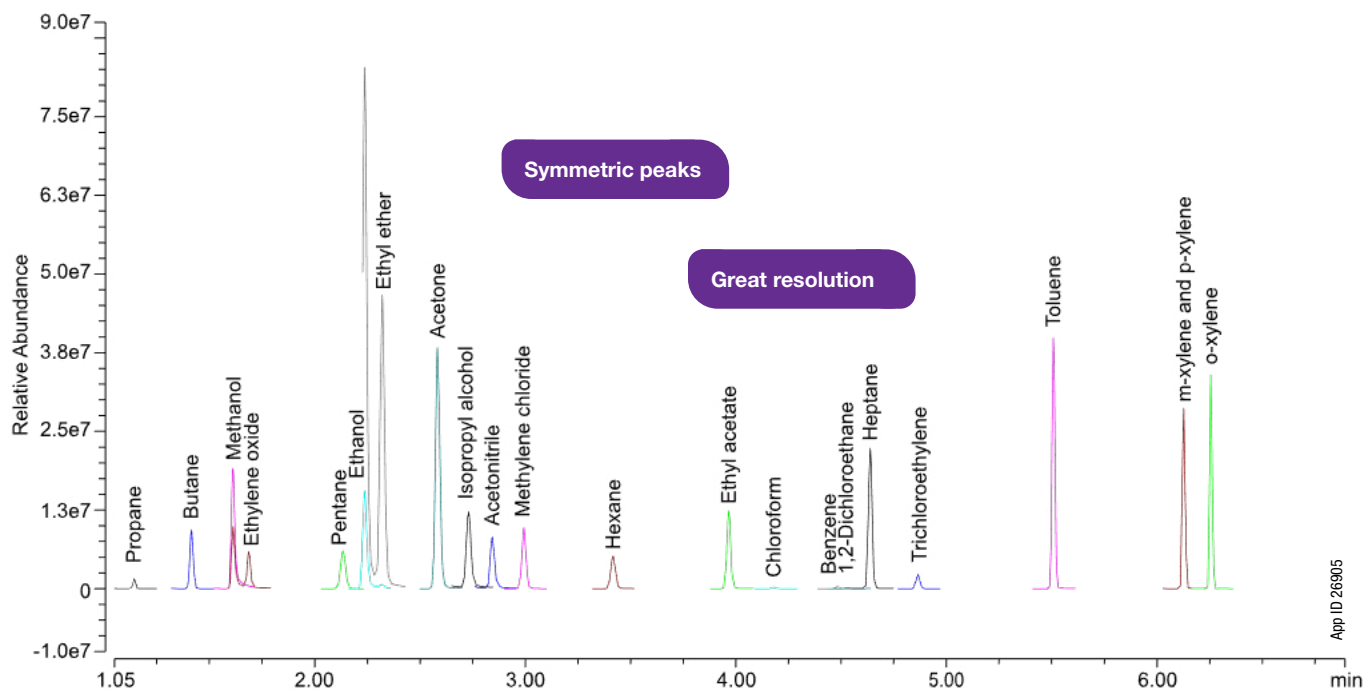
Ramp (°C/min)	Temp (°C)	Time (min)
-	35	2.0
7.3	58	0.0
11.3	115	0.0
25.2	300	8.9

Detector: Thermo ISQ GC-MS
Detector Temperature: 300 °C

Headspace Autosampler Conditions

Vial: Zebtron ZB-624PLUS
Description: 23 x 75 mm, 20 mL
Part No.: ARO-3260-13
Vial Seal: 20 mm, PTFE/Silicone, Magnetic
Vial Part No.: ARO-3260-13
Instrument: Thermo Scientific™ TriPlus™ 500
Vial Incubation Temperature: 170 °C
Vial Incubation Time: 8 min
Loop Temperature: 180 °C
Loop Pressure: 7.5 psi
Injection Mode: Standard
Injection Time: 0.10 min

Figure 1: Separation of 21 Residual Solvents with excellent resolution and peak symmetry on a ZB-624PLUS GC column



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Residual Solvents

Gas Chromatography

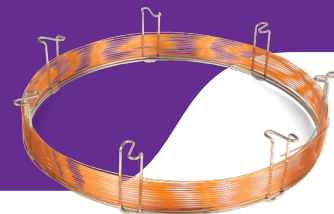
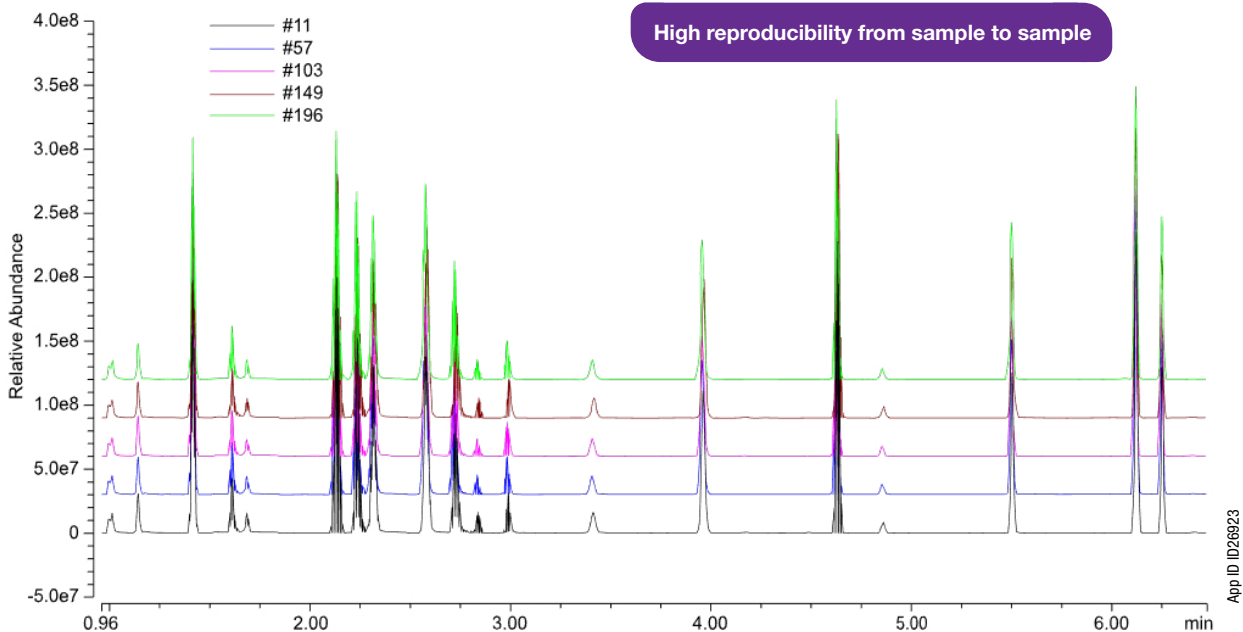


Figure 2: Reproducible peak shape and retention of residual solvents between 11 and 196 injections of residual solvents on a ZB-624PLUS GC column



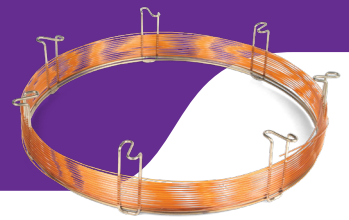
Analyte	Retention Time (min)	EI Mass Fragments (m/z)	%RSD- Peak Area (n-6)
Propane	1.15	29.2, 38.1, 39.1, 41.1, 42.1	5.79
Butane	1.42	29.2, 39.1, 41.1, 42.1, 43.1, 58.1	3.04
Methanol	1.62	29.2, 31.1, 32.1	5.86
Ethylene oxide	1.69	29.2, 42.1, 43.1, 44.1	2.88
Pentane	2.13	41.1, 42.1, 43.1, 57.1, 72.1	0.81
Ethanol	2.26	31.1, 45.1, 46.1	1.43
Ethyl ether	2.33	29.2, 31.1, 45.1, 59.1, 74.1	1.36
Acetone	2.6	42.1, 43.1, 58	2.81
Isopropyl alcohol	2.75	29.2, 43.1, 45.1, 59.1	0.93
Acetonitrile	2.86	38.1, 39.1, 40.1, 41.1, 42.1	4.18
Methylene chloride	3	49, 51, 83.9, 86, 88	3.69
n-Hexane	3.42	41.1, 43.1, 56.1, 57.1, 86.1	3.81
Ethyl acetate	3.98	43.1, 43.1, 45.1, 61.1, 70.1, 88	1.32
Chloroform	4.19	47, 83, 84.9, 86.9, 116.9, 117.9, 118.9	1.21
Benzene	4.49	74, 76, 77.1, 78.1, 79.1	2.01
1,2-Dichloroethane	4.54	62, 64, 98, 100	0.78
Heptane	4.65	41.1, 43.1, 56.1, 57.1, 70.1, 71.14.87	4.19
Trichloroethylene	4.87	95, 97, 129.9, 131.9, 133.9	2.51
Toluene	5.52	39.1, 65.1, 91, 92.1	0.86
m-xylene and p-xylene	6.14	78.1, 91.1, 103.1, 105.1, 106.1, 107.1	4.06
o-xylene	6.27	78.1, 91.1, 103.1, 105.1, 106.1, 107.1	4.02

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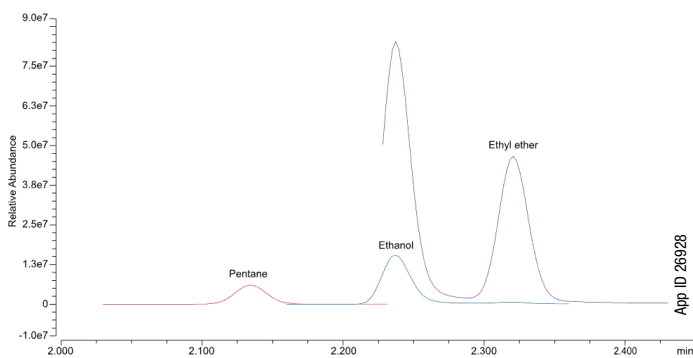
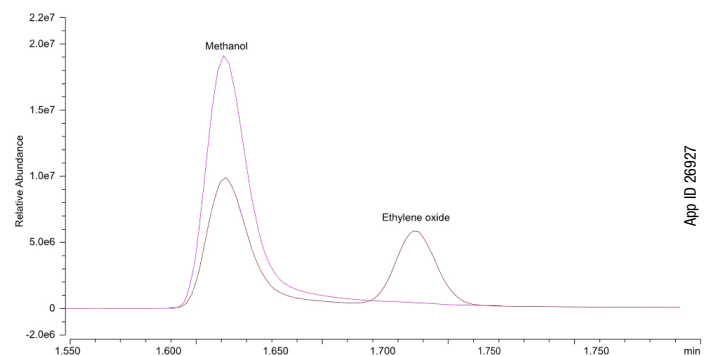
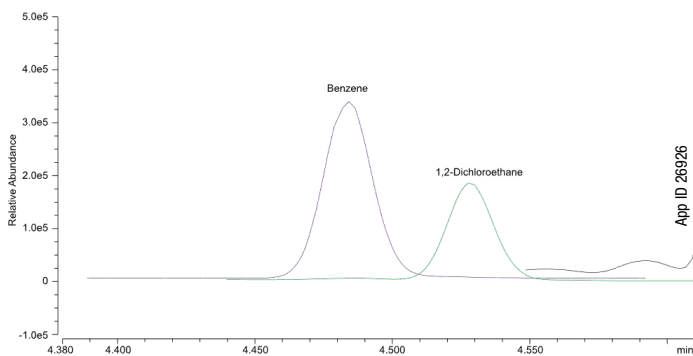
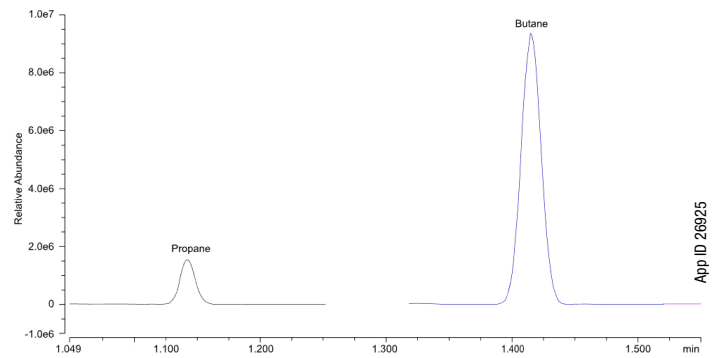
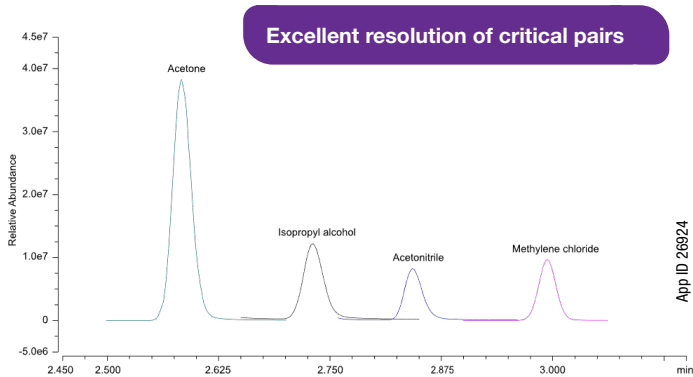


Residual Solvents

Gas Chromatography



Chromatograms showing resolution of critical pairs using a ZB-624PLUS GC Column

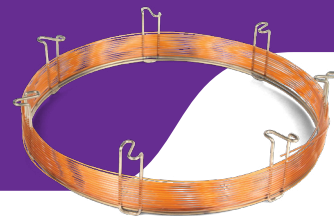


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Residual Solvents

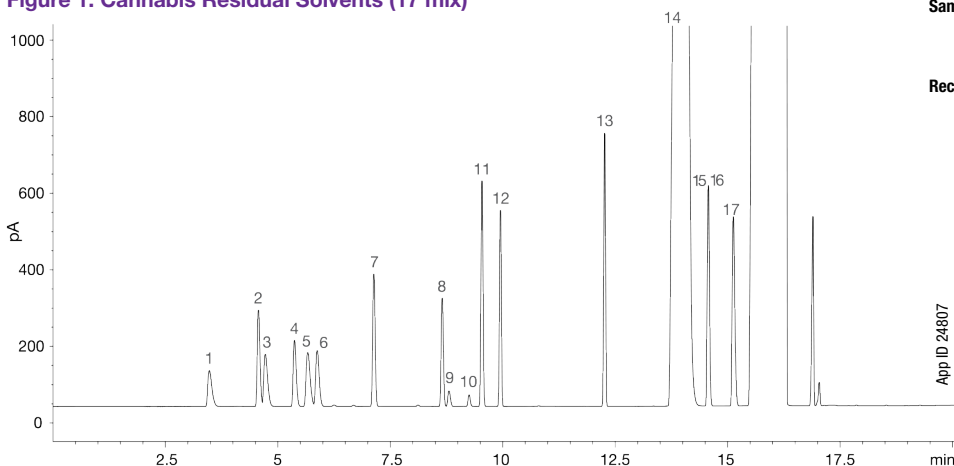
Gas Chromatography



Determination of Residual Solvents and Terpenes in Cannabis by GC-FID using Zebron ZB-624PLUS GC Column

Zebron™
GC Columns

Figure 1. Cannabis Residual Solvents (17 mix)



GC-FID Conditions

Same conditions for both separations

Column: Zebron ZB-624PLUS

Dimensions: 30 meter x 0.25 mm x 1.40 µm

Part No.: 7HG-G040-27

Recommended Z-Guard™: 7CG-G000-00-GHK

Injection: Split 10:1 @ 200 °C, 1 µL

Recommended Liner: Zebron PLUS Liner Z-Liner

Liner Part No.: AG2-0A03-05 (for Agilent® and Thermo Scientific™ systems)

Carrier Gas: Helium @ 1.0 mL/min (constant flow)

Oven Program: 35 °C for 4 min, 50 °C @ 20 °C/min for 1 min, 160 °C @ 10 °C/min for 4 min, 300 °C at 15 °C/min for 5 min

Detector: FID @ 240 °C

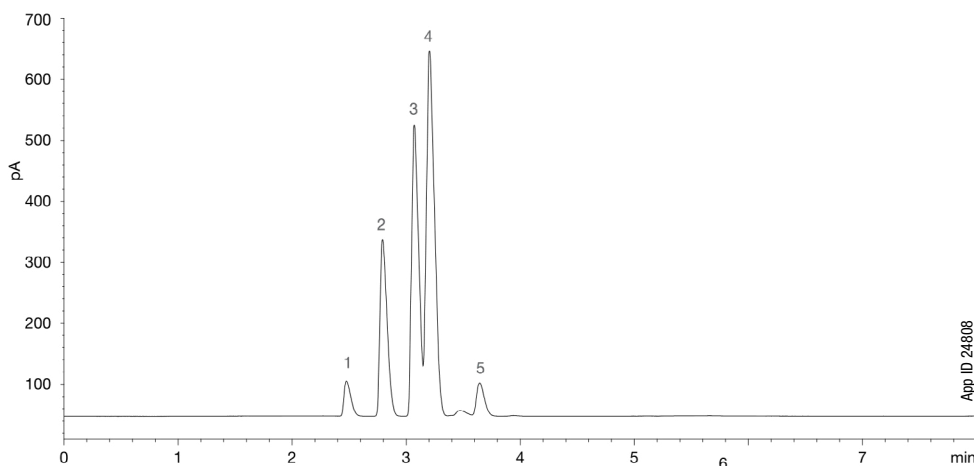
Emerald Scientific Residual Solvent standards STRS01024 at 1000 µg/mL

- | | |
|-----------------|--------------------------|
| 1. Methanol | 10. Carbon Tetrachloride |
| 2. n-Pentane | 11. n-Heptane |
| 3. Ethanol | 12. Benzene |
| 4. 2-Propanol | 13. Toluene |
| 5. Acetone | 14. Dimethylformamide |
| 6. Acetonitrile | 15. m-Xylene |
| 7. n-Hexane | 16. p-Xylene |
| 8. THF | 17. o-Xylene |
| 9. Chloroform | |

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Figure 2. Low Boiling Cannabis Residual Solvents

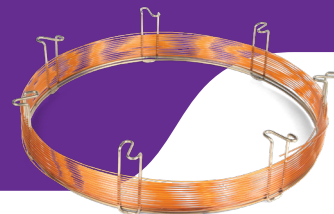


Emerald Scientific Residual Solvent Standards STRS01075 at 500-5000 µg/mL

1. Propane
2. 2-Methylpropane
3. n-Butane
4. Neopentane
5. Ethylene Oxide

Residual Solvents

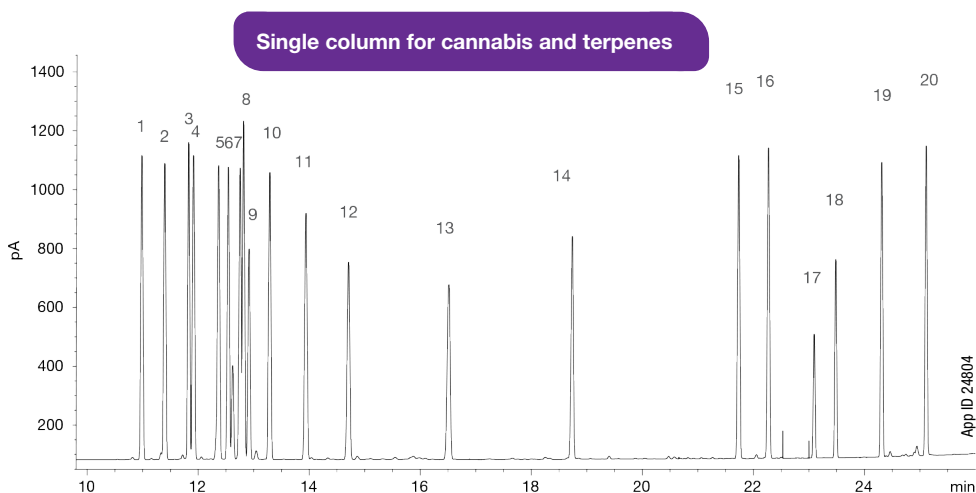
Gas Chromatography



Determination of Residual Solvents and Terpenes in Cannabis by GC-FID using Zebron ZB-624PLUS™ GC Column (cont'd)



Figure 3. 20 Terpene Standards Chromatogram at 2500 µg/mL



GC-FID Conditions

Same conditions for both separations

Column: Zebron ZB-624PLUS

Dimensions: 30 meter x 0.25 mm x 1.40 µm

Part No.: 7HG-G040-27

Recommended Z-Guard™: 7CG-G000-00-GHK

Injection: Split 20:1 @ 250 °C, 1 µL

Recommended Liner: Zebron PLUS Liner Z-Liner™

Liner Part No.: AG2-0A03-05 (for Agilent® and Thermo Scientific™ systems)

Carrier Gas: Helium @ 1.0 mL/min (constant flow)

Oven Program: 50 °C for 1 min, 160 °C @ 10 °C/min, hold for 4 min, to 280 °C @ 12 °C/min

Detector: FID @ 300 °C

Sample:

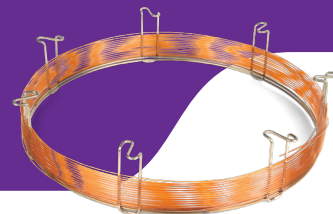
- | | |
|-----------------|---------------------|
| 1. α-Pinene | 11. Terpinolene |
| 2. Camphene | 12. Linalool |
| 3. β-Myrcene | 13. Isopulegol |
| 4. (-)-β-Pinene | 14. Geraniol |
| 5. Δ-3-Carene | 15. β-Caryophyllene |
| 6. α-Terpinene | 16. α-Humulene |
| 7. d-Limonene | 17. Nerolidol 1 |
| 8. Δ-Cymene | 18. Nerolidol 1 |
| 9. Ocimene | 19. Guaiol |
| 10. γ-Terpinene | 20. α-Bisabolol |

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Terpenes

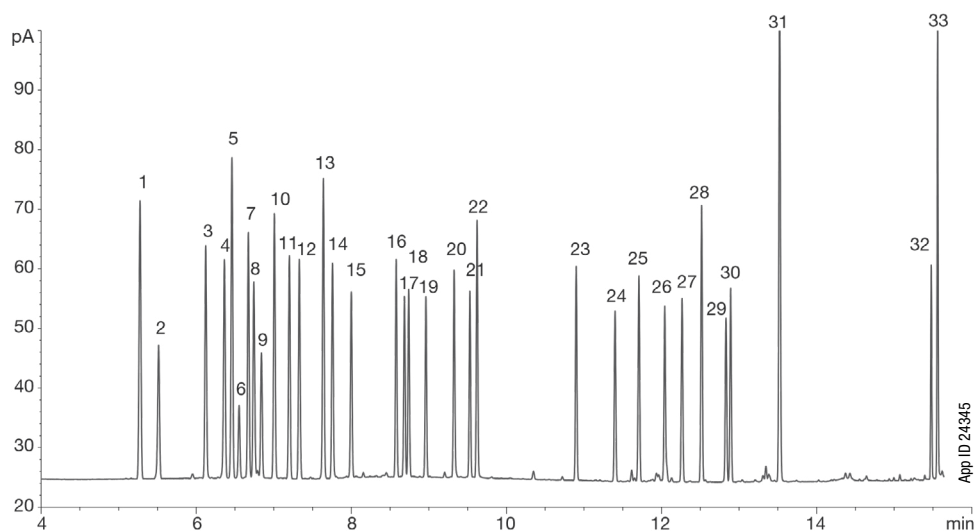
Gas Chromatography



Analysis of 33 Primary and Secondary Terpenes Found in Cannabis by GC-FID

Zebtron™
GC Columns

Excellent resolution of 33 terpenes



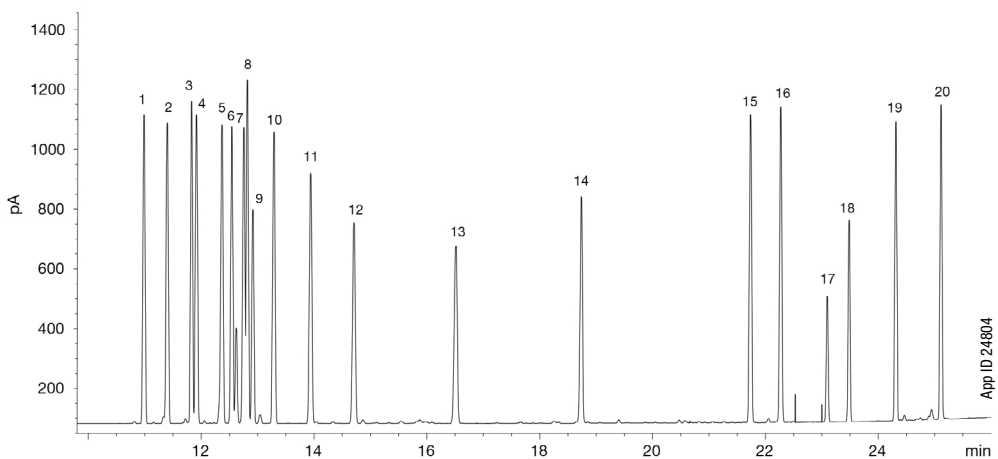
GC-FID Conditions

Column: Zebtron ZB-5PLUS
Dimensions: 20 m x 0.18 mm x 0.36 µm
Part No.: 7FD-G032-53
Recommended Z-Guard™: 5 m Z-Guard™ (7AD-G000-00-G70)
Injection: Split 20:1 @ 250 °C, 1 µL
Recommended Liner: Zebtron Plus Single Taper Z-Liner™
Liner Part No.: AG2-0A13-01
Carrier Gas: Helium @ 1.9 mL/min
Oven Program: 35 °C to 105 °C @ 10 °C/min to 205 °C @ 15 °C/min to 360 °C @ 35 °C/min for 1.9 min
Detector: FID @ 340 °C
Sample: Terpenes are 50-100 ppm in Acetonitrile

1. α-Pinene	18. Menthol
2. Camphene	19. α-Terpineol
3. β-Myrcene	20. Citronellol
4. α-Phellandrene	21. Pulegone
5. 3-Carene	22. Geraniol
6. α-Terpinene	23. Geranyl acetate
7. p-Cymene	24. Trans-Caryophyllene
8. Limonene	25. α-Humulene
9. Ocimene-1	26. Valencene
10. Ocimene-2	27. Nerolidol-1
11. γ-Terpinene	28. Nerolidol-2
12. Sabinine hydrate	29. Caryophyllene oxide
13. Terpineolene	30. Guaiol
14. Linalool	31. α-Bisabolol
15. Fenchol	32. Phytol-1
16. Isoborneol	33. htyol-2
17. Borneol	

[Download this Application Note](#)

20 Terpenes Using Zebtron ZB-624PLUS



GC-FID Conditions

Column: Zebtron ZB-5PLUS
Dimensions: 30 meter x 0.25 mm x 1.40 µm
Part No.: 7HG-G040-27
Recommended Z-Guard™: 7CG-G000-00-GHK
Injection: Split 20:1 @ 250 °C, 1 µL
Recommended Liner: Zebtron PLUS Straight Z-Liner™
Liner Part No.: AG2-0A03-05 (for Agilent® and Thermo Scientific™ systems)
Carrier Gas: Helium @ 1.0 mL/min (constant flow)
Oven Program: 50 °C for 1 min, 160 °C @ 10 °C/min, hold for 4 min, to 280 °C @ 12 °C/min
Detector: FID @ 300 °C
Sample: Terpenes 20 mix

1. α-Pinene	11. Terpinolene
2. Camphene	12. Linalool
3. β-Myrcene	13. Isopulegol
4. (-)-β-Pinene	14. Geraniol
5. d-3-Carene	15. β-Caryophyllene
6. α-Terpinene	16. α-Humulene
7. d-Limonene	17. Nerolidol 1
8. p-Cymene	18. Nerolidol 1
9. Ocimene	19. Guaiol
10. γ-Terpinene	20. α-Bisabolol

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Residual Solvents and Terpenes

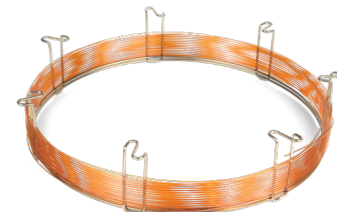
List of recommended part numbers

GC Columns and Accessories

Part No.	Product Description
7HG-G040-27	Zebron ZB-624PLUS, GC Cap. Column 30m x 0.25mm x 1.4 µm
7FD-G032-53	Zebron ZB-5PLUS Capillary GC, Column 20m x 0.18mm x 0.36 µm
7HG-G025-11	Zebron ZB-35HT, GC Cap. Column 30 m x 0.25 mm x 0.25 µm
AG2-0A11-05	Zebron PLUS Liner for Agilent & Thermo 4mm ID Single Taper Wool on Bottom
AG2-0A03-05	Zebron PLUS Liner for Agilent & Thermo, 4mm ID Straight Z-Liner™
AG2-0A13-01	Zebron PLUS Liner for Agilent & Thermo, 4mm ID Single Taper Z-Liner
7CG-G000-00-GHK	Zebron Z-Guard™ Hi-Temp Guard Column Kit, GC Cap. Column 10 m x 0.25 mm
7AD-G000-00-GZ0	Zebron Z-Guard Guard Column, GC Cap. Column 5 m x 0.18 mm

For a complete selection of GC columns and accessories, and ordering part numbers visit www.phenomenex.com/Zebbron

Zebbron™
GC Columns



Verex Headspace Vials

Screw- and Crimp-Top Headspace Vials

- 10 and 20 mL screw- or crimp-top, with round or flat bottom
- Uniform glass thickness ensures even heating
- Lot traceable



VEREX
Certified Filter Vials

Ordering Information

Description	1000/pk
Crimp-Top	
Headspace Vial, 23 x 75 mm, 20 mL Beveled Edge, Flat Bottom, Clear, No Patch	ARO-3260-13
Headspace Vial, 23 x 75 mm, 20 mL Beveled Edge, Flat Bottom., Clear, No Patch, Silanized	ARO-3263-13
Headspace Vial, 23 x 75 mm, 20 mL Square Rim, Flat Bottom, Clear, No Patch	ARO-3290-13
Headspace Vial, 23 x 75 mm, 20 mL Beveled Edge, Round Bottom, Clear, No Patch	ARO-3270-13
Screw-Top	
Headspace Vial, 23 x 75 mm, 20 mL 18 mm Screw, Round Bottom, Clear, No Patch	ARO-3280-13
Headspace Vial, 23 x 75 mm, 20 mL 18 mm Screw, Round Bottom, Amber, No Patch	ARO-3281-13



Autosampler Compatibility

Flat Bottom: HP / Agilent, Carlo Erba, Shimadzu

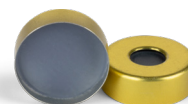
Round Bottom: PerkinElmer, Tekmar, LEAP Technologies, Varian

Headspace Screw- and Crimp-Top Seals / Closures

- Variety of styles for any application
- Magnetic and pressure-release caps available

Ordering Information

Description	1000/pk
Crimp-Top	
Seal, 20 mm Diameter, PTFE/Gray Butyl Rubber, magnetic cap	ARO-52C5-13
Seal, 20 mm Diameter, PTFE/Butyl Rubber Pharmafix Molded Septum, silver	ARO-52D0-13
Seal, 20 mm Diameter, PTFE/Butyl Rubber Pressure Release, Pharmafix Molded Septum, silver	ARO-52B0-13
Seal, 20 mm Diameter, PTFE/Silicone, magnetic cap	ARO-5255-13
Seal, 20 mm Diameter, PTFE/Silicone, silver	ARO-5250-13
Seal, 20 mm Diameter, PTFE/Silicone Pressure Release, silver	ARO-5220-13
Screw-Top	
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Butyl Rubber septa (red/grey)	ARO-814M-13
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Silicone septa (red/white)	ARO-815M-13
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Silicone septa (blue/white)	ARO-81AM-13
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Silicone septa (white/translucent blue)	ARO-81BM-13



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Accessories

HPLC / UHPLC / GC

HPLC / UHPLC Accessories

SecurityGuard™
Column Protection



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[SecurityGuard ULTRA UHPLC Column Protection](#)



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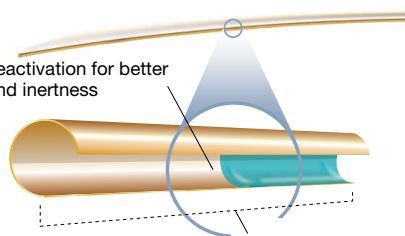


[SecurityGuard Standard HPLC Column Protection](#)

GC Accessories

Zebron™
GC Products

Continuous deactivation for better peak shape and inertness



Seamless guard transition, no connection hassles and no potential for leaks

[Guardian Integrated Guard Columns](#)

[Access complete line of columns and accessories](#)



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Cannabis Testing Guide

- Potency
- Pesticides
- Residual Solvents
- Terpenes
- Mycotoxins

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