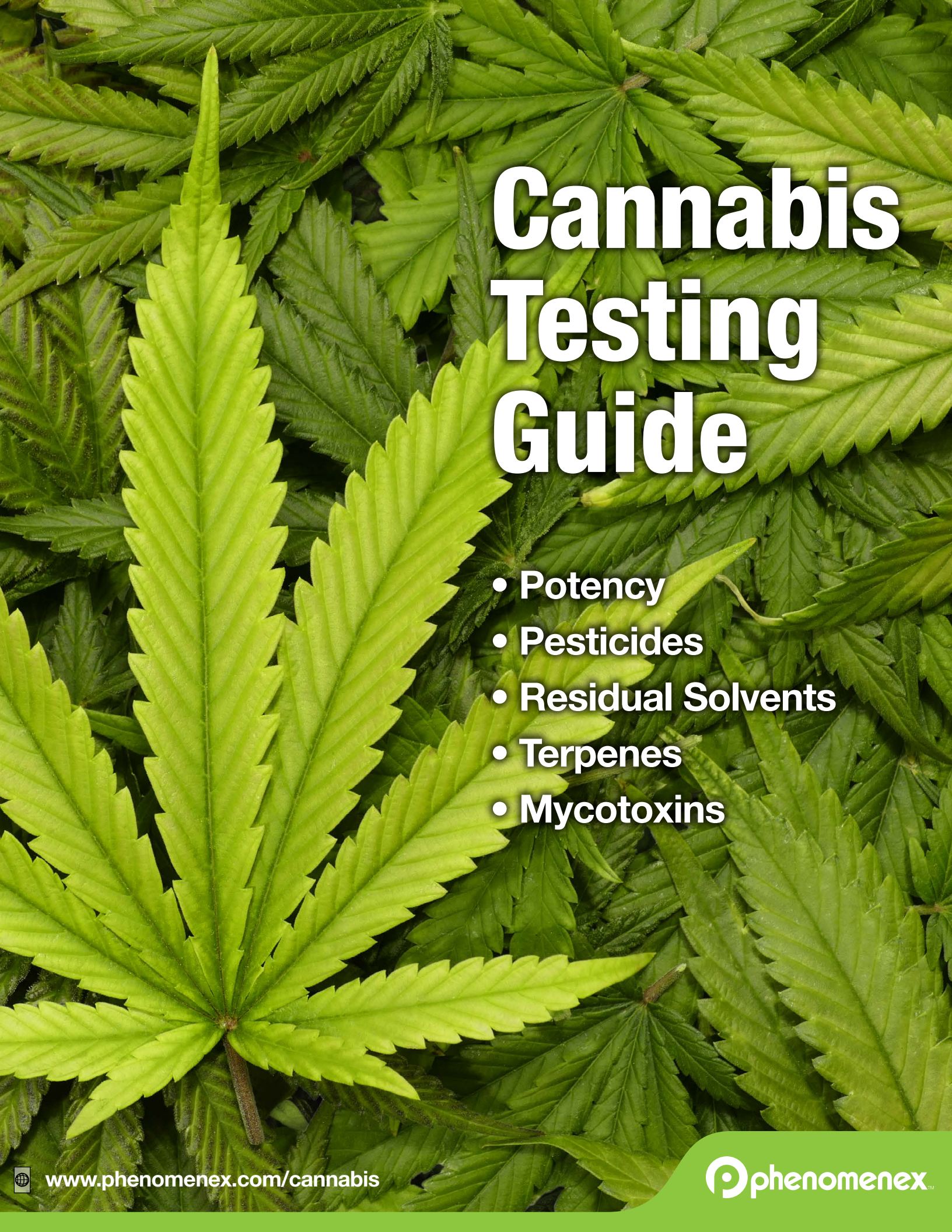

Cannabis Testing Guide
• Potency
• Pesticides
• Residual Solvents
• Terpenes
• Mycotoxins
www.phenomenex.com/cannabis
phenomenex

Table of Contents

Cannabis Analysis Product Overview

Sample Filtration

Filter Vials

Sample Preparation in Two Steps

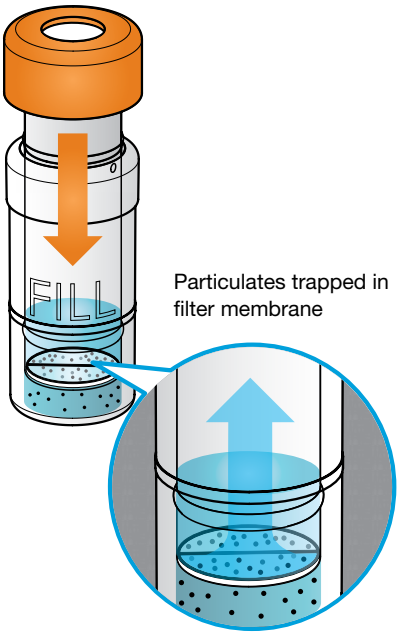
Verex Filter Vials is an easy two-step sample preparation device that consists of two parts: an external vial to be filled with sample, and an internal plunger with a filtration membrane and cap with a pre-slit septa.

Verex™ Certified Filter Vials

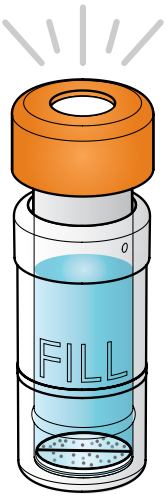
Filter Vials

1 The sample is placed in the external vial using a pipette or syringe.

2 By compressing the internal plunger, the sample is pushed through the membrane and filtered.



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	Protein Analysis/ Biological Samples	Non-Aqueous	Aqueous Mixtures
			Hydrophobic/ Strong Acids	Hydrophilic
RC (Regenerated Cellulose)	**CA** (Cellulose Acetate)	**PES** (Polyethersulfone)	**PTFE** (Polytetrafluoroethylene)	**RC** (Regenarated 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.

Solid Phase Extraction (SPE)

Targeted extraction and clean up

Strata™ X
Polymeric SPE

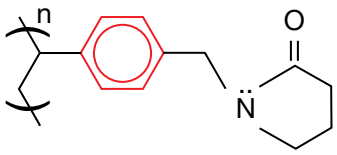
Strata-X

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.

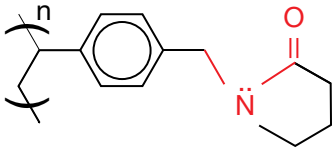
- **Tightly retain analytes**
- **Remove unwanted contaminants**
- **Easily cleanup large volume**

Mechanisms of Retention

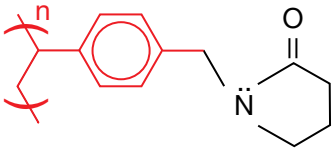
π-π Bonding



Hydrogen Bonding Dipole-Dipole Interactions



Hydrophobic Interaction

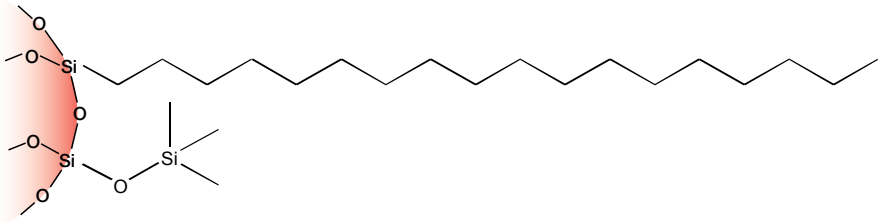


Strata C18

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/StrataX

Sample Preparation

roQ QuECHERS Kits

Why Choose roQ QuEChERS?

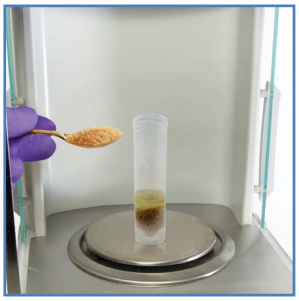
Improved with you in mind, roQ picks up where other QuEChERS kits fail. The unique design of the roQ QuEChERS kits eliminates common problems seen with current QuEChERS kits on the market.

roQ™ QuEChERS Kits

Ease of Use

Built-in Removable Rack*

Stand Alone Extraction Tubes



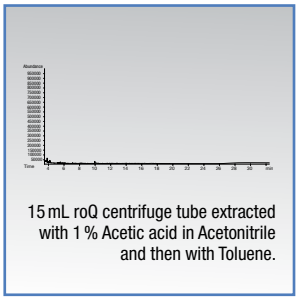
Easy Pour Salt Packets

*Applies to roQ Extraction Kits (excludes dSPE Kits)

Quality

Leak-Free Tubes

Low Leachate Tubes



15 mL roQ centrifuge tube extracted with 1 % Acetic acid in Acetonitrile and then with Toluene.

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:

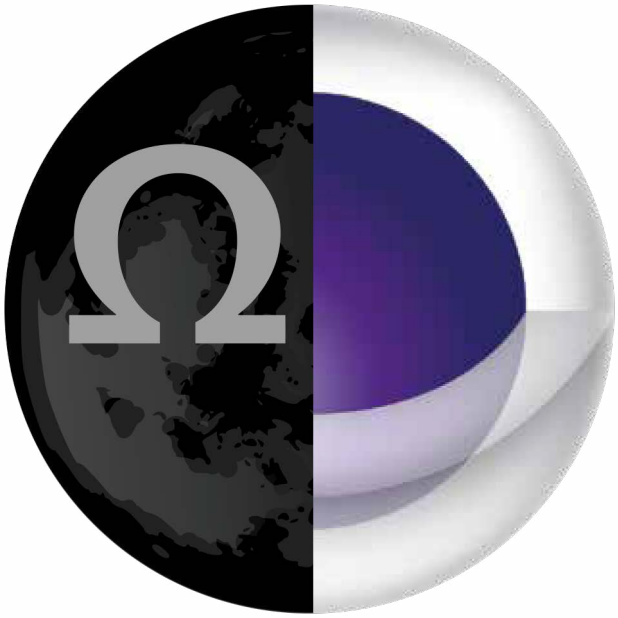
- Magnesium Sulfate ($MgSO_4$)
- Sodium Acetate (NaOAc)
- Sodium Chloride (NaCl)
- Sodium Citrate Tribasic Dihydrate (SCTD)
- Sodium Citrate Dibasic Sesquihydrate (SCDS)

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

Luna™ Omega



Kinetex™ Core-Shell Technology

Cutting Edge Fully Porous Silica Particle

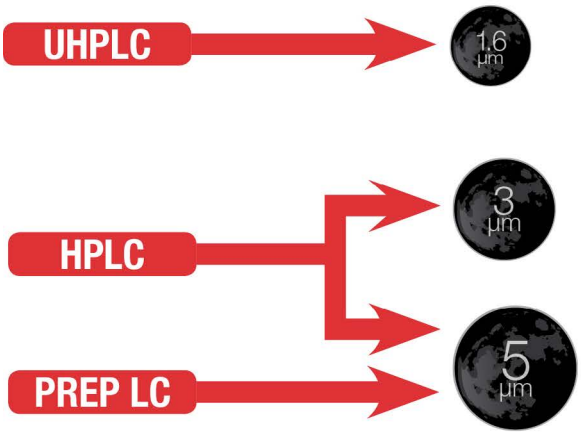
Luna is one of the most recognized HPLC brands on the market, delivering high efficiency, ruggedness, reproducibility, and dependability for a wide range of analyses.

The Chosen Core-Shell Brand

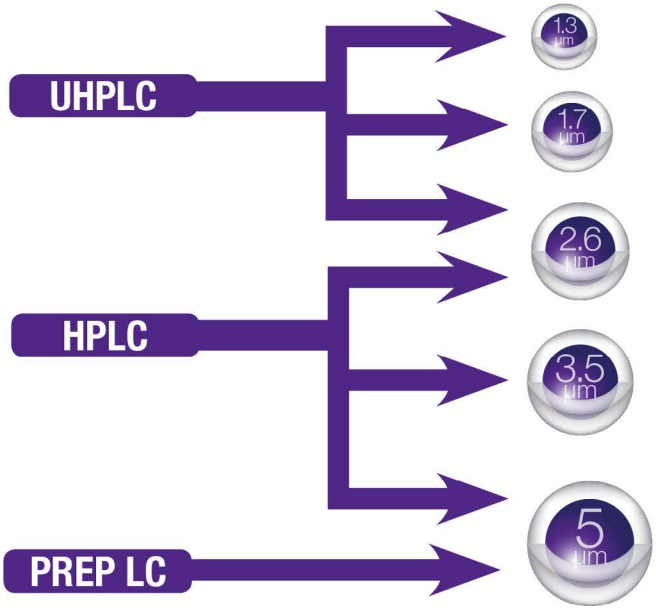
Kinetex Core-Shell Technology delivers dramatic improvements in efficiency over conventional fully porous media which can be leveraged to increase resolution, greatly improve productivity, reduce solvent consumption and decrease costs.

Complete Scalable Solution from UHPLC to HPLC to PREP LC

Luna Omega Particle Selection



Kinetex Core-Shell Particle Selection

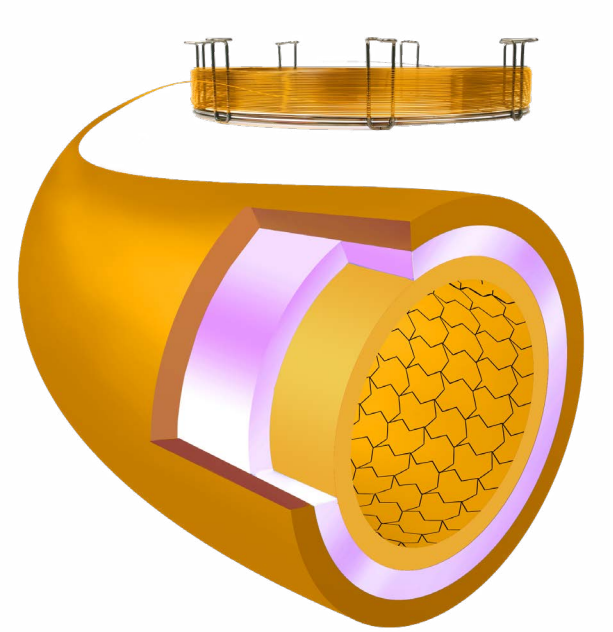


For a complete selection of HPLC and UHPLC columns and ordering part numbers visit
www.phenomenex.com/LCcolumns

Explore the Options and Choose the Best Selectivity for Your Analysis

Zebron GC Products

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 624*PLUS*™ 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.

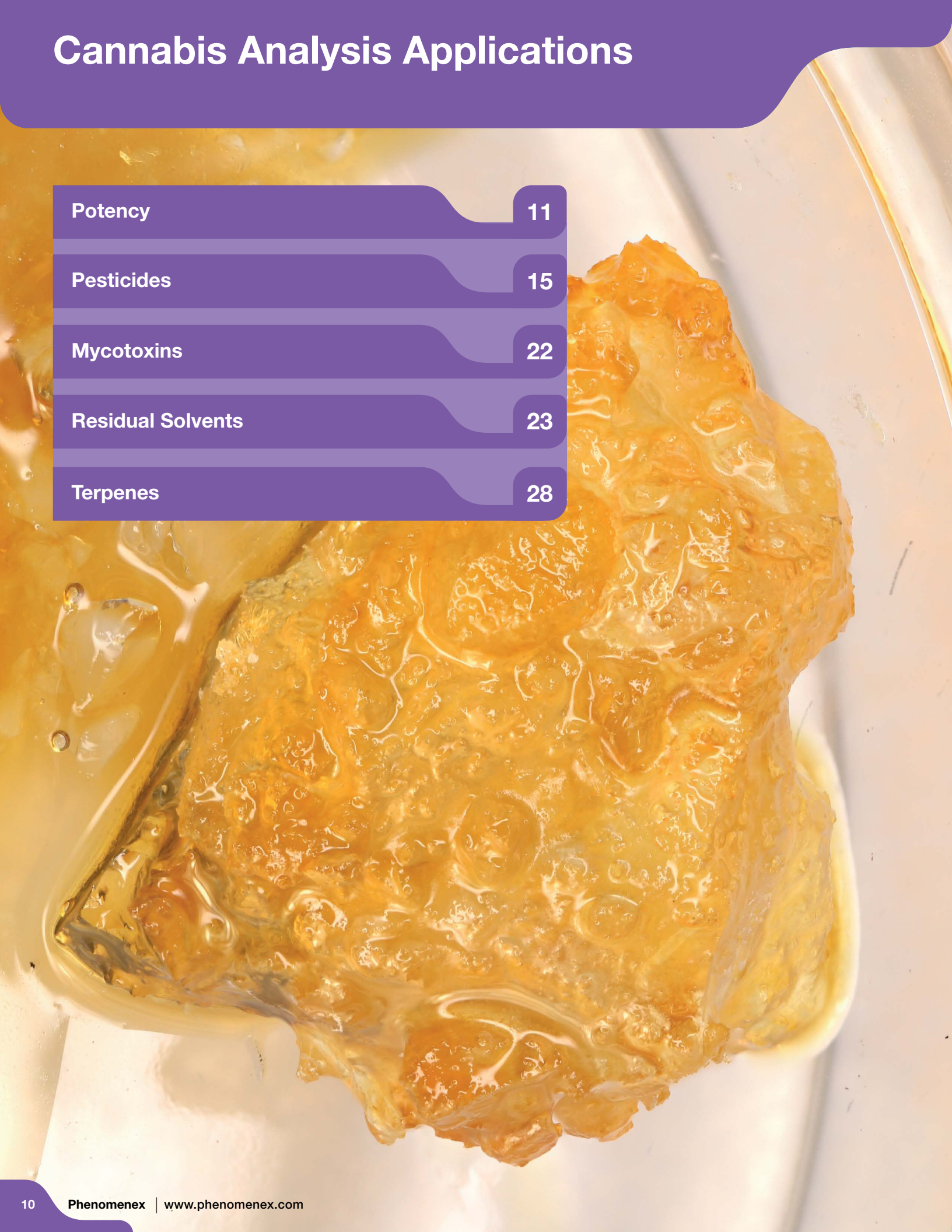
Column	Recommended for
ZB-624*PLUS*	Residual Solvents, Terpenes
ZB-WAX*PLUS*	Residual Solvents, Terpenes
ZB-5*PLUS*	Potency, Pesticides
ZB-MultiResidue-1 & -2	Pesticides

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**

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

Cannabis Analysis Applications



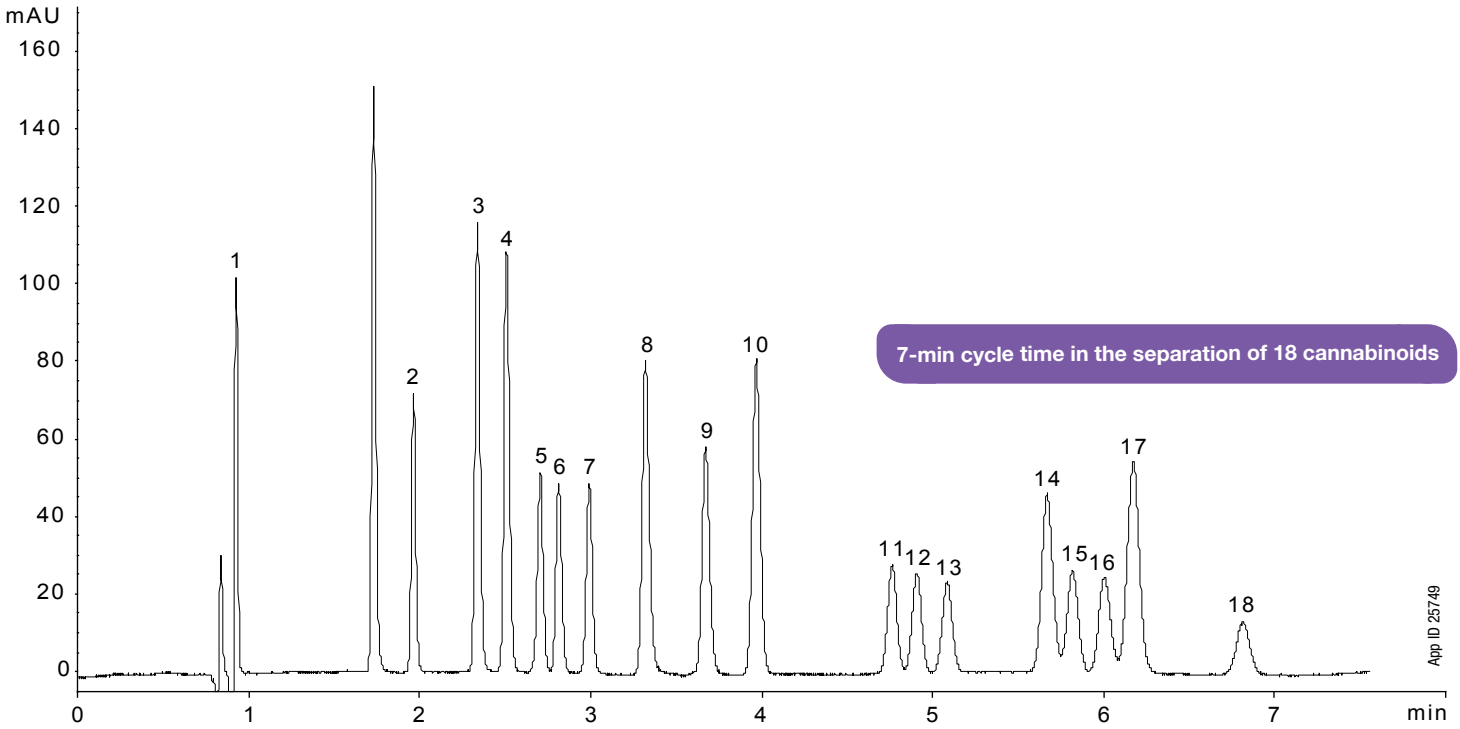
18 Cannabinoids for Potency Testing by LC-UV

Kinetex™ Core-Shell Technology

LC-UV Conditions

Column: Kinetex 2.6 µm C18
Dimensions: 150 x 4.6 mm
Part No.: 00F-4462-E0
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 µL
Back Pressure: ~260 bar
Temperature: 40 °C
Flow Rate: 1.5 mL/min
Detection: UV @ 228 nm

Analytes:
1. **CBDVA** Cannabidivarinic acid
2. **CBDV** Cannabidivarin
3. **CBDA** Cannabidiolic acid
4. **CBGA** Cannabigerolic acid
5. **CBG** Cannabigerol
6. **CBD** Cannabidiol
7. **THCV** Tetrahydrocannabivarin
8. **THCVA** Tetrahydrocannabivarinic acid
9. **CBNA** Cannabinolic acid
10. **CBN** Cannabinol
11. **EXO-THC** Exo-tetrahydrocannabinol
12. **D9-THC** Δ9-Tetrahydrocannabinol
13. **D8-THC** Δ8-Tetrahydrocannabinol
14. **THCA-A** Tetrahydrocannabinolic acid A
15. **CBCA** Cannabichromenic acid
16. **CBL** Cannabicycol
17. **CBC** Cannabichromene
18. **CBLA** Cannabicyclolic acid



7-min cycle time in the separation of 18 cannabinoids

Download Complete Application Note

Order Now

Potency

HPLC / UHPLC

Quantification of 10 Cannabinoids

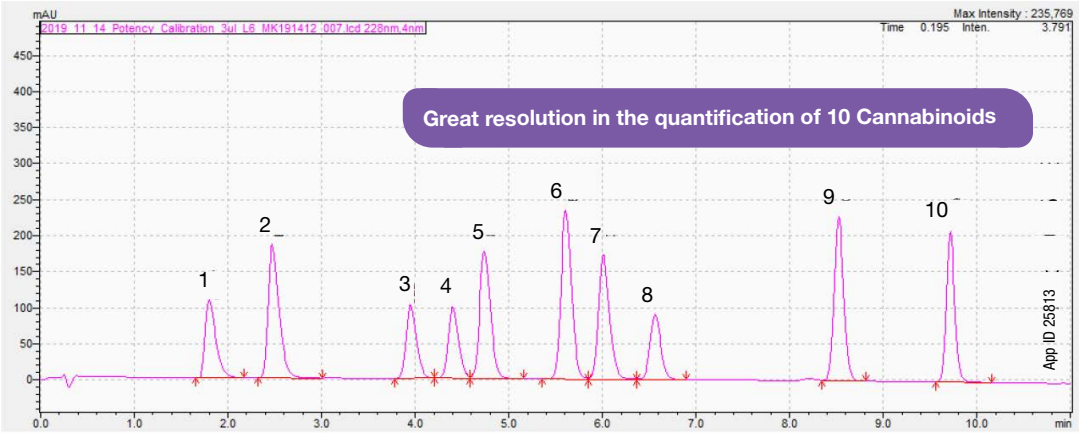
Kinetex™ Core-Shell Technology

Column: Kinetex 2.6 µm 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:

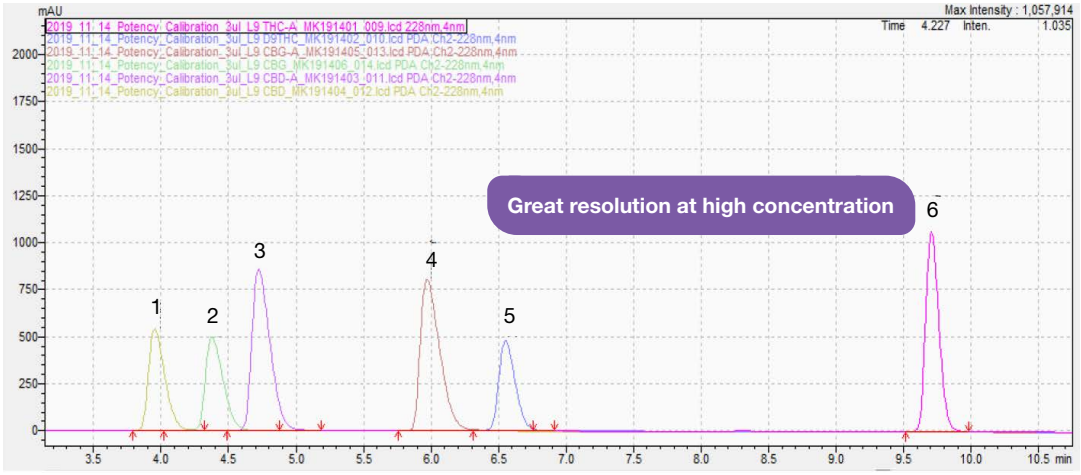
Time (min)	%A	%B
0	40	60
7	30	70
10.9	17	83
11	0	100
11.9	0	100
12	40	60
13	40	6D

Analytes:
1. **CBD-V** Cannabidivarin
2. **CBD-VA** Cannabidivarinic 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 ug/mL



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

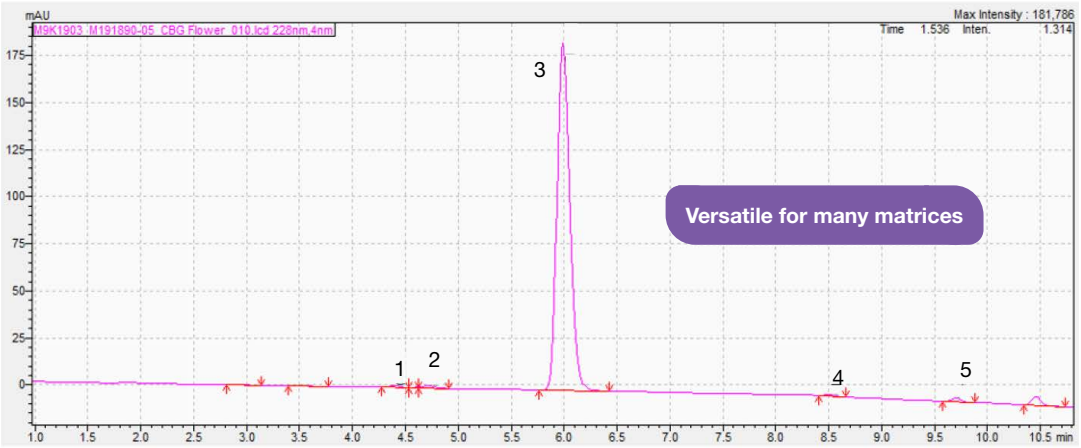


Analytes:
1. **CBD** Cannabidiol
2. **CBG** Cannabigerol
3. **CBD** Cannabidiolic acid
4. **CBG-A** Cannabigerolic acid
5. **d9 THC** Δ9-Tetrahydrocannabinol
6. **THC-A** Tetrahydrocannabinol

Potency

HPLC / UHPLC

CBG-A Dominant Hemp Cultivar



Kinetex™
Core-Shell Technology

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

Order Now

HPLC / UHPLC Columns and Accessories

Part No.	Description
00F-4462-E0	Kinetex 2.6µm C18 150 x 4.6 mm
AJ0-8768	SecurityGuard Ultra (for 4.6 mm)
00B-4462-AN	Kinetex 2.6µm 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
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Complete Cannabis Proficiency Testing Solutions

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

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- Flower, Oil and Alternative Matrix PT Standards
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- State Specific Analytes - Action Level Based
- Enroll in an Active PT Study Today!

Chemical Testing Laboratory
Certificate No. 2427.03

Reference Material Producer
Certificate No. 2427.02

Call: 1-303-940-0033

www.phenova.com/cannabis

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 ºC or lower for at least 2 hours
4. Centrifuge at 4000 rpm
5. Injection volume of 2 µL for LC-MS/MS analysis

LC-MS/MS Method

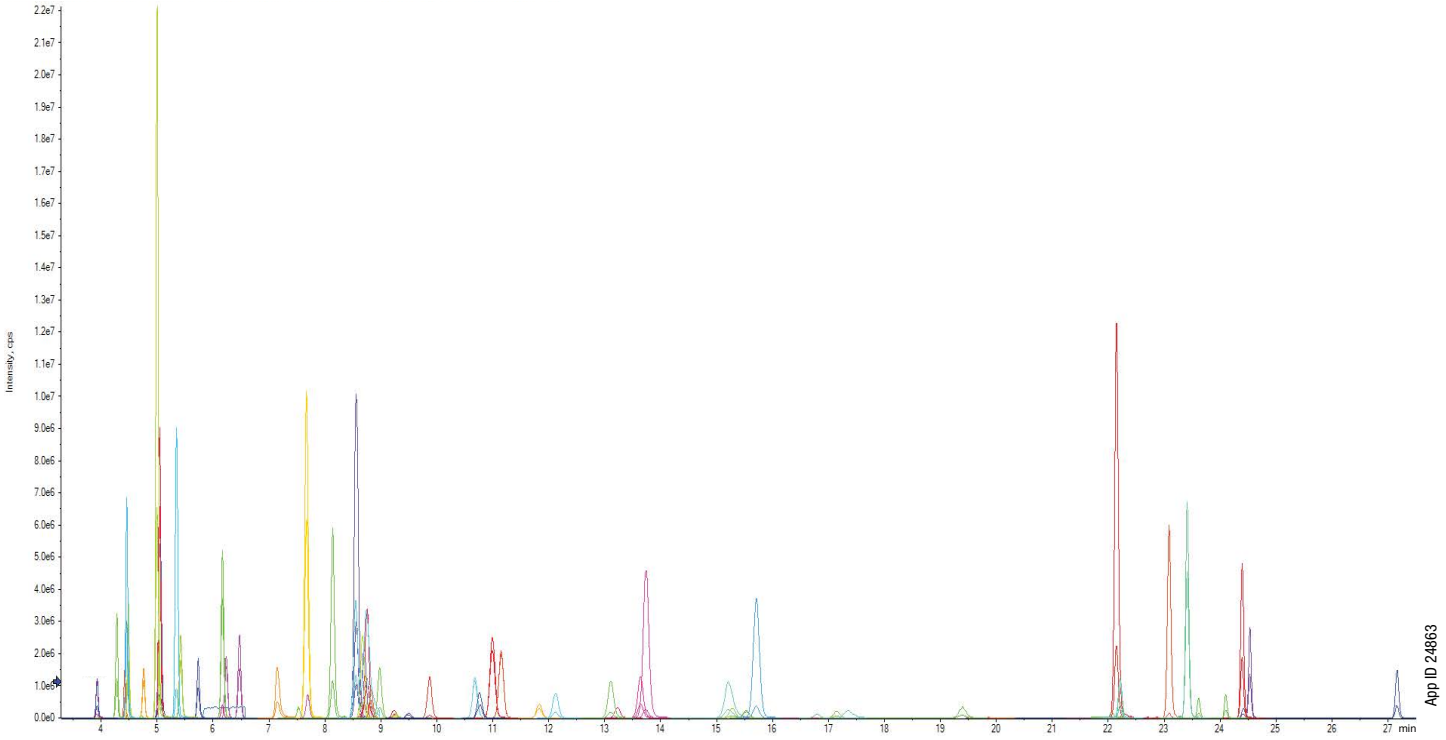
Column: Luna Omega 3 µm Polar C18
Dimension: 150 x 4.6 mm
Part No.: 00F-4760-E0
Mobile Phase: A: 5 mM Ammonium Acetate + 0.1% Formic Acid
B: Methanol/Water (98:2) + 5 mM Ammonium Acetate

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 µL
Temperature: 30 °C
Detection: MS/MS
Instrument: SCIEX™ QTRAP® 6500+ with DuoSpray APCI/ESI
Analytes: For full list search APP ID 24863

Standards Chromatagram



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Defining Robustness of Pesticide and Mycotoxin Analysis in Cannabis Matrices

Using the SCIEX® Triple Quad 6500+ system

SCIEX
The Power of Precision

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 regulations [1–7]and Canadian regulations[8]. 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 10 mg 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

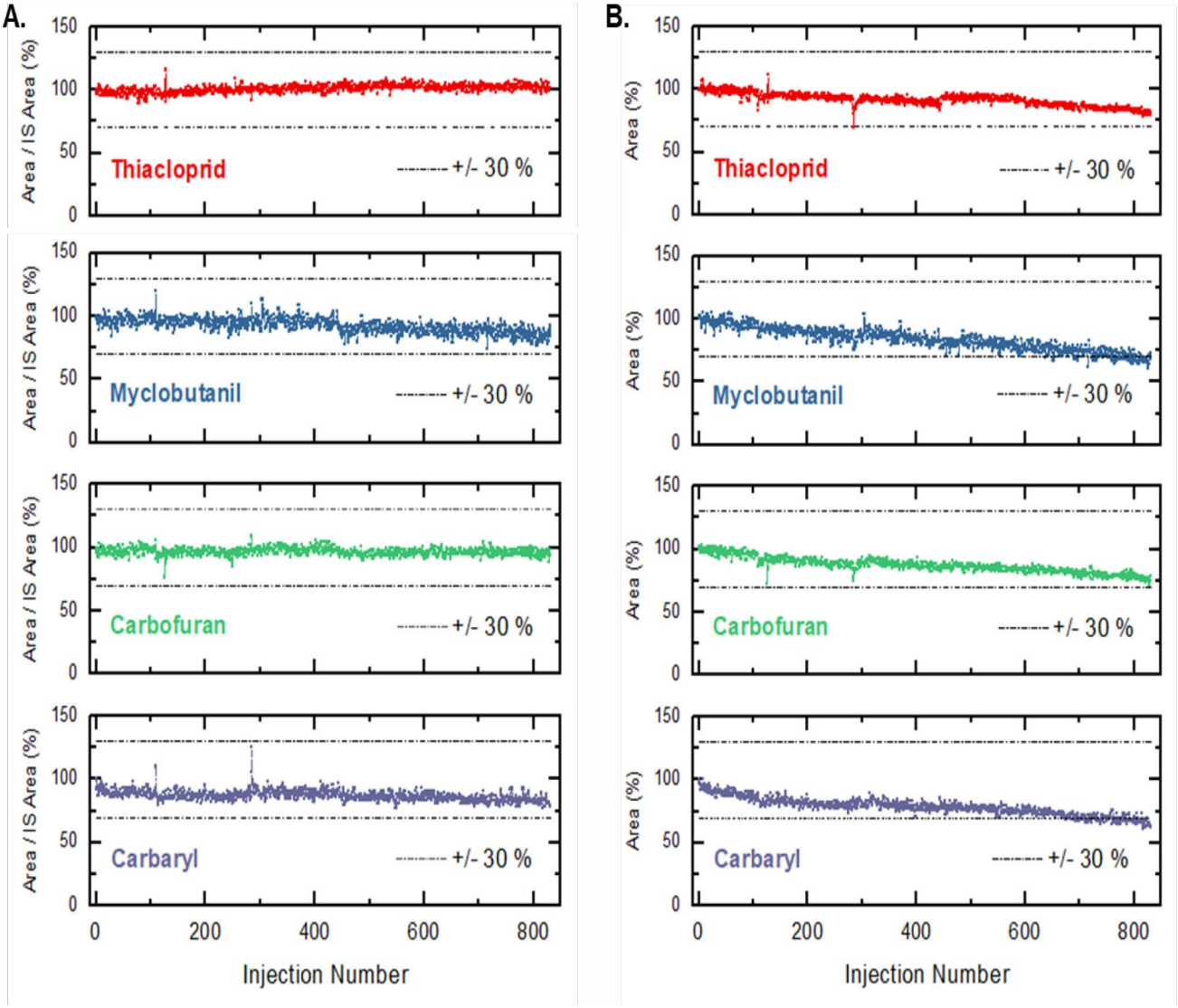


Figure 1. 830 replicate injections of cannabis flower matrix. IS-corrected (A) and raw peak area (B) responses for several pesticides in cannabis flower extracts over 830 injections without instrument maintenance. Raw areas illustrate the true measure of system robustness. Pesticides were fortified to 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 limits[1] (**Figure 2, top**). Additionally, avermectin B1a, which is known for its thermal lability, was detected at a concentration 10x lower than Oregon regulatory limits[5] 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.

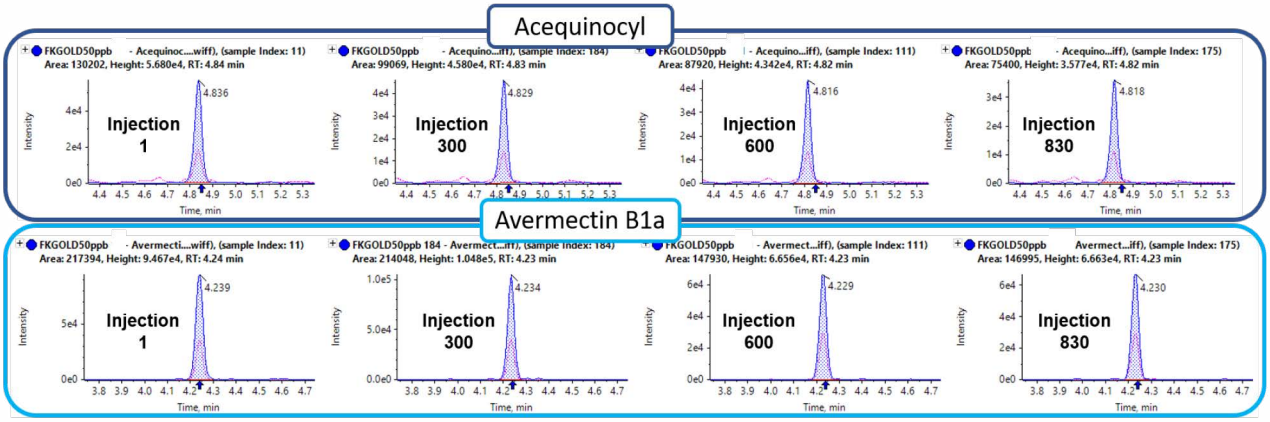
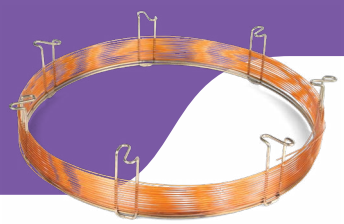


Figure 2: Stable pesticide peak areas across 830 injections. Acequinocyl is the last-eluting compound and normally is susceptible to cannabinoid suppression in matrix (top). Avermectin B1a is the primary component of Abamectin (bottom). Example chromatograms of each are shown throughout the instrument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

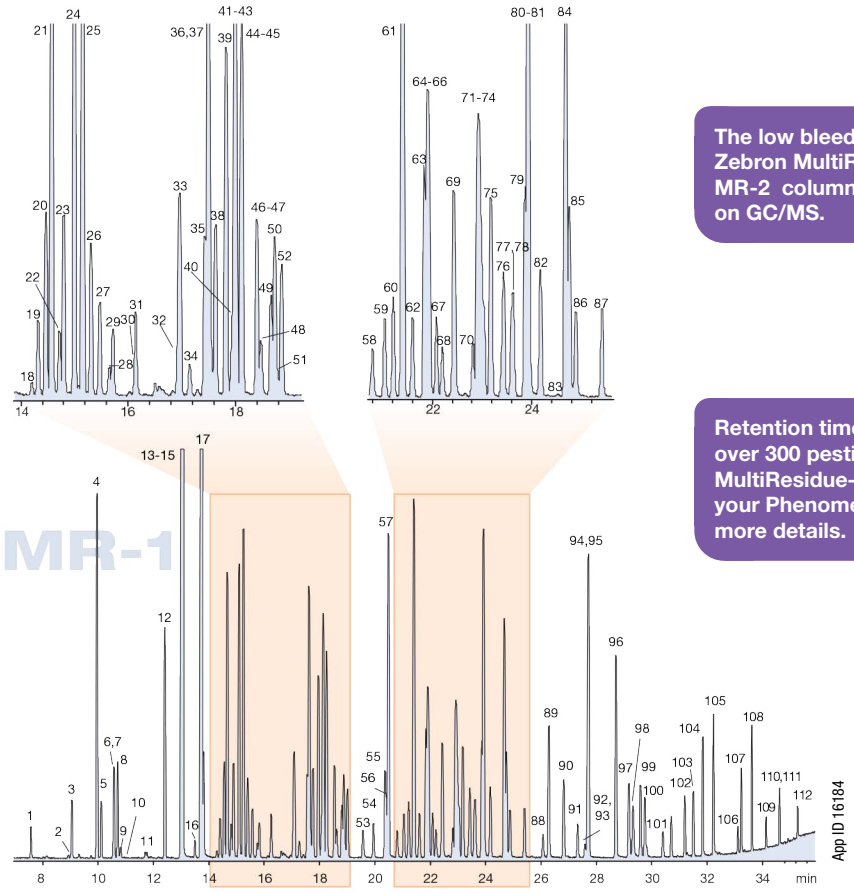
References

1) Bureau of Cannabis Control. Bureau of Cannabis Control Text of Regulations California Code of Regulations Title 16 Division 42. Bureau of Cannabis Control. Order of Adoption. **2018**.
2) Register of Arizona, A. Arizona Rules Division.A.Medical Cannabis; Code, A. A. 9 A.A.C. 17 Supp. 20-4. **2021**, 1–57.
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**.
5) D.G., Farrer. (**2016**) Oregon Health Authority's Process to Determine Which Types of Contaminants to Test for in Cannabis Products, and Levels of Action. *Oregon Heal. Auth*. 1–14.
6) Massaschusetts Department of Health. MassCommonwealth.Comment, W. Protocol for the Sampling and Analysis of Finished Marijuana Products and Marijuana Products for Marijuana Establishments, Medical Marijuana Treatment Centers and Colocated Marijuana Operations. **2020**.
7) Florida Depatment of Health. 64ER20-9. CMTL Regulations. **2019**.
8) Government of Canada. Mandatory Cannabis Testing for Pesticide. Health Canada **2019**.



112 Multi-Residue Pesticide Screening Method using GC/MS

Zebron™ GC Products



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

Pesticides

List of recommended part numbers

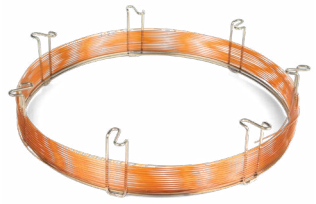
HPLC / UHPLC Columns & Accessories

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	Zebron ZB-MultiResidue™-1 30 m x 0.25 mm x 0.25 µm
7HG-G017-10	Zebron 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-5MS*PLUS*™, 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
Zebron ZB-5MS columns **ZB-5MS*PLUS* columns**

Sample Preparation – rOQ Quechers

Extraction	
KS0-8910	roQ QuEChERS, Original, 4.0 g MgSO4, 1.0 g NaC
KS0-8912	roQ QuEChERS, Original, 6.0 g MgSO4, 1.5 g NaCl
KS0-8909	roQ QuEChERS, EN Method, 4.0 g MgSO4, 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 MgSO4, 150 mg PSA, 45 mg GCB
KS0-9506	roQ QuEChERS dSPE Kit - 2 mL CT, 150 mg MgSO4, 25 mg PSA, 7.5 mg GCB

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

5 Ways SCIEX Addresses Pesticide Challenges in Cannabis Testing

Making your laboratory operations easier and more productive

SCIEX
The Power of Precision

1 Maximizing uptime

SCIEX instruments are robust and can help improve laboratory productivity by minimizing the downtime needed for cleaning and maintenance.

2 Meeting strict regulatory requirements

The SCIEX 7500 system is sensitive and can help labs meet the requirements set by cannabis regulators in Canada and the United States for measuring trace level pesticides and mycotoxins in cannabis products.

3 Establishing lab operations

Set up your lab with a vMethod™ application which outlines a step-by-step procedure requiring minimal training to get your lab staff performing analyses.

4 Finding technical and applications support

Get access to experts who are skilled in cannabis analysis to help address your most challenging problem analysis issues.

5 Learning LC-MS/MS for cannabis analysis

Take our course for hands-on experience with sample preparation, method development strategies, sample analysis and data reporting.

For more information visit: **sciex.li/cannabis**

SCAN ME

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

LC Method Parameters

Column: Luna Omega 3 µm Polar C18
Dimension: 150 x 2.1 mm
Part No.: 00D-4760-AN
Flow Rate: 0.4 mL/min
Injection Volume: 3 µL
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:

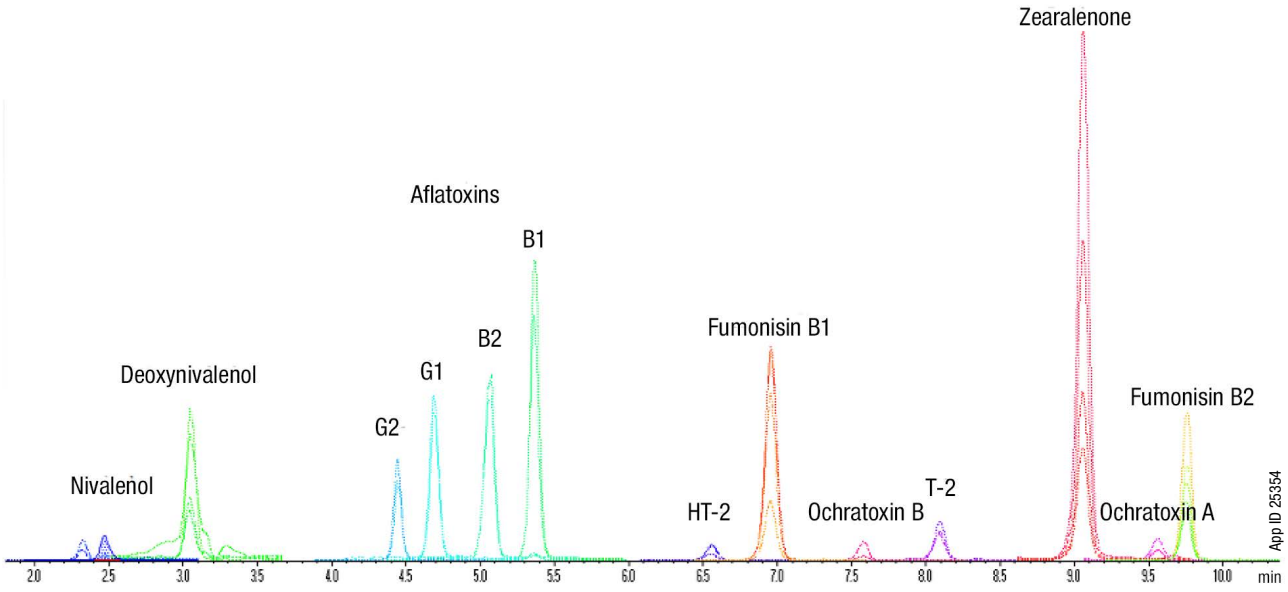
Time (min)	% B
0	5
3	35
10	90
12	90

Temperature: 40 °C
Injection Volume: 3 µL
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 O 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 $MgSO_4$, 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 µm syringe filter prior to injection to HPLC

Chromatography of expanded Mycotoxins overlayed MRMs



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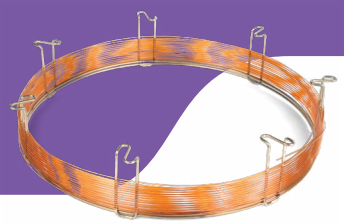


Analysis of 21 Residual Solvents from Cannabis Matrix by FET Headspace on a ZB-624*PLUS*™ GC Column

Zebron™ GC Products

GC-MS Conditions

Column: Zebron ZB-624*PLUS*
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: Zebron 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:

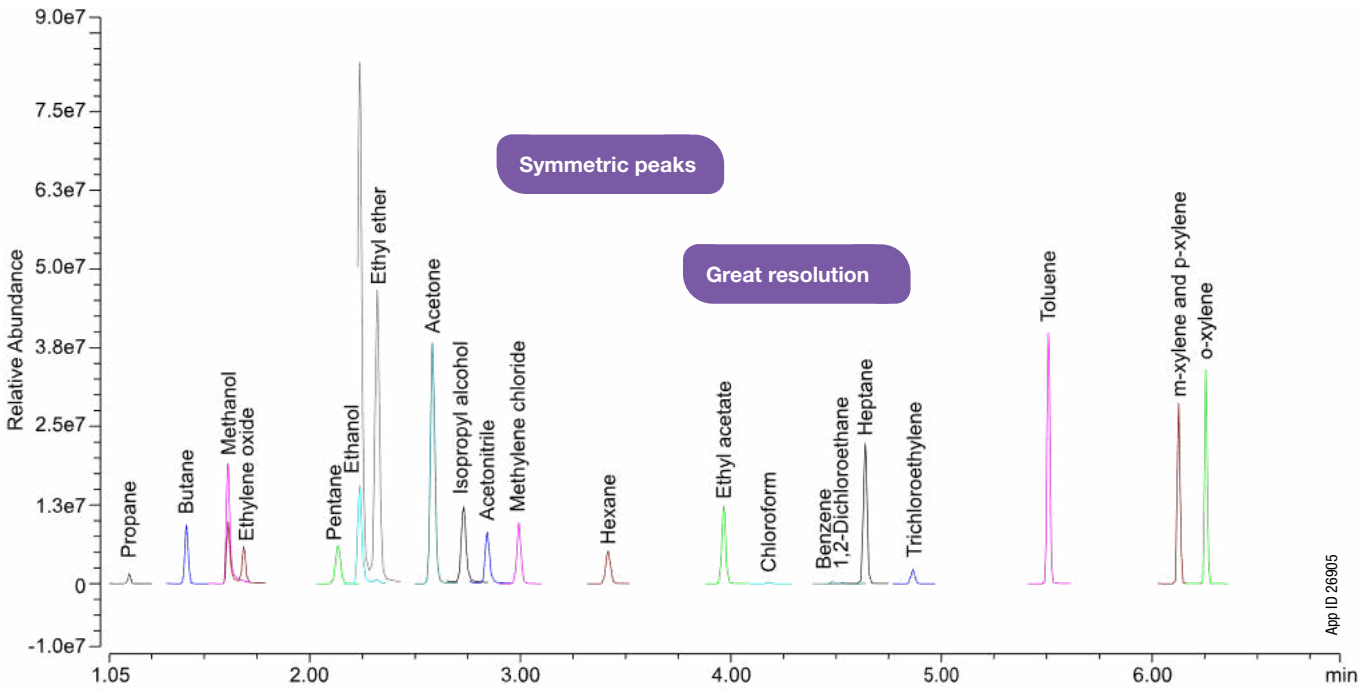
Ramp (°C/min)	Temp (°C)	Time(min)
-	35	2.0
7.3	58	0.0
11.3	115	0.0
25.2	300	8.9

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

Headspace Autosampler Conditions

Vial: Zebron ZB-624*PLUS*
Description: 23 x 75 mm, 20 mL
Part No.: AR0-3260-13
Vial Seal: 20 mm, PTFE/Silicone, Magnetic
Vial Part No.: AR0-3260-13
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-624*PLUS* GC column



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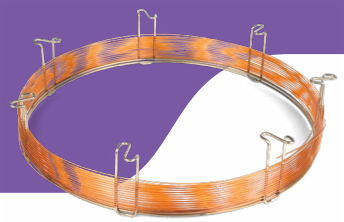
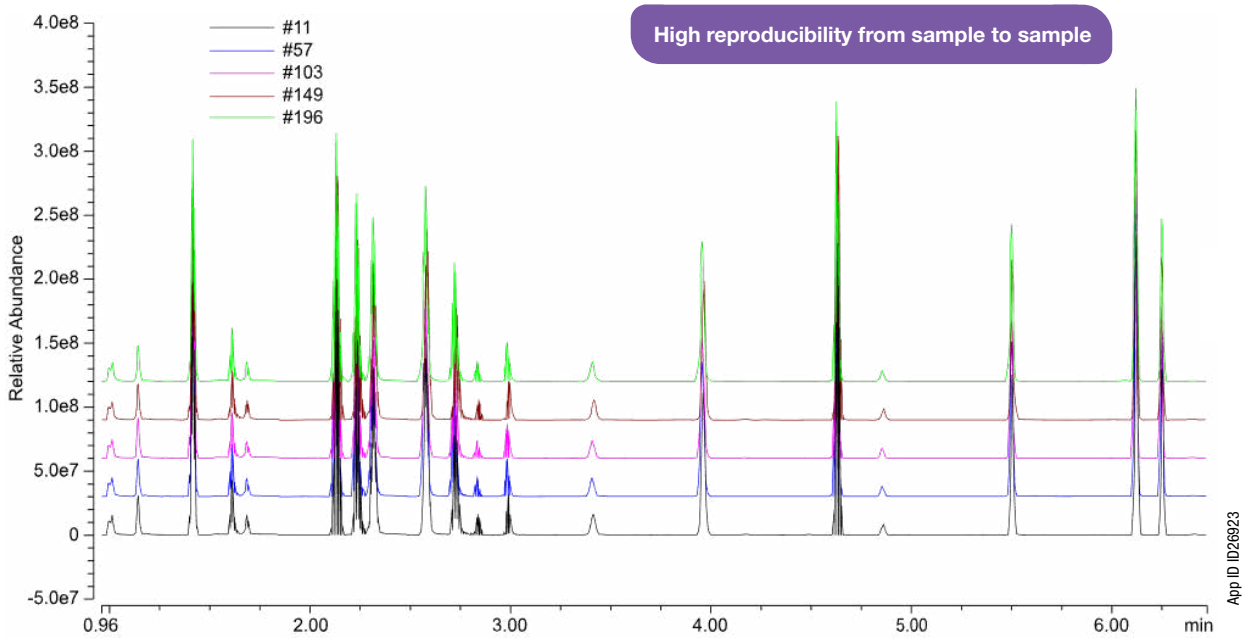


Figure 2: Reproducible peak shape and retention of residual solvents between 11 and 196 injections of residual solvents on a ZB-624*PLUS* GC column



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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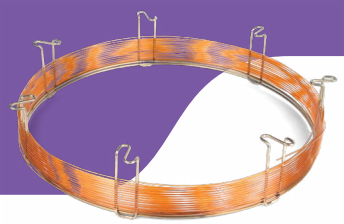
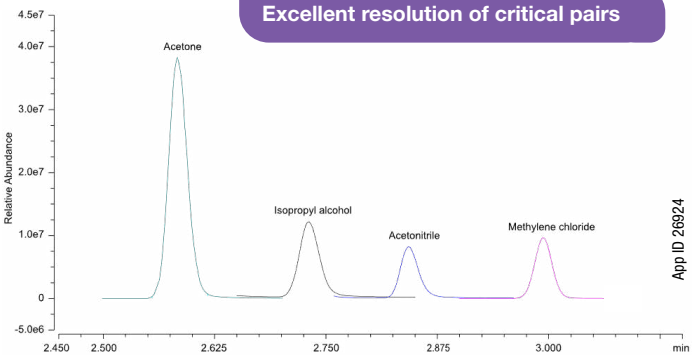
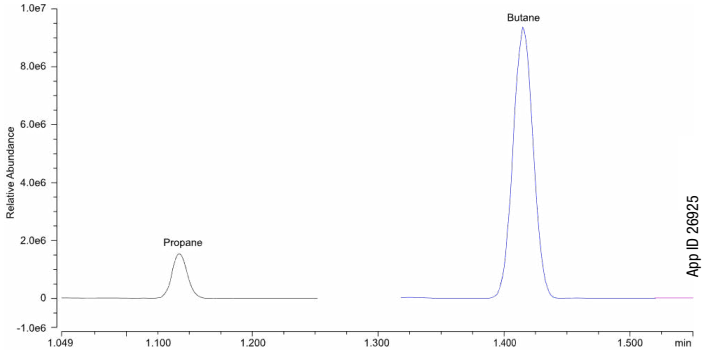


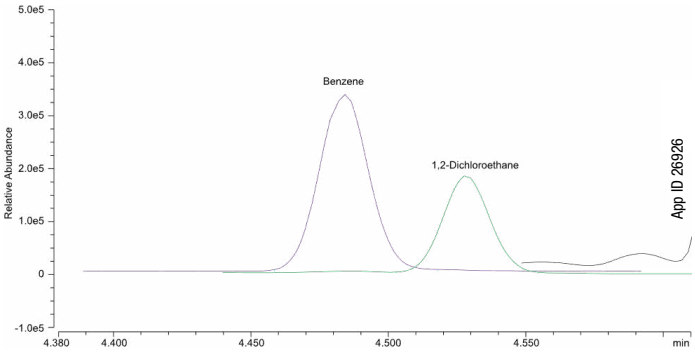
Chromatograms showing resolution of critical pairs using a ZB-624*PLUS* GC Column

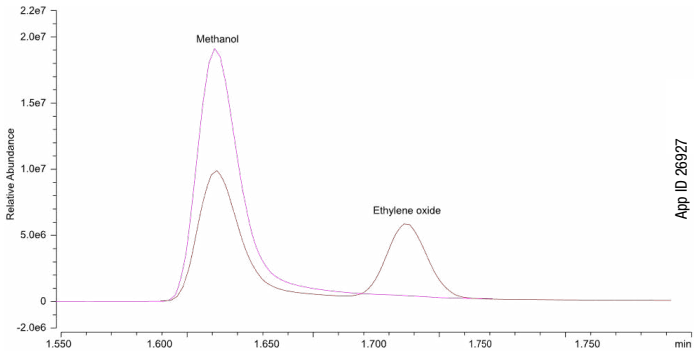
Zebron™ GC Products

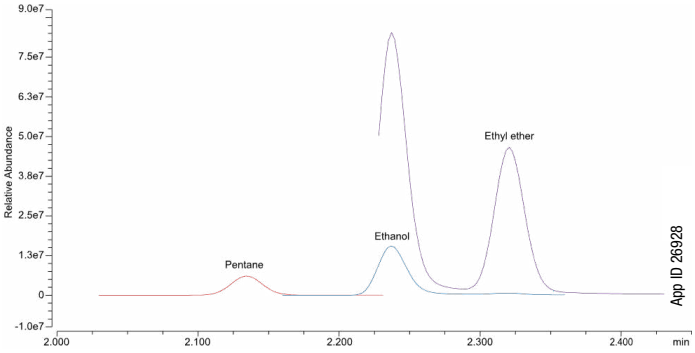
Excellent resolution of critical pairs











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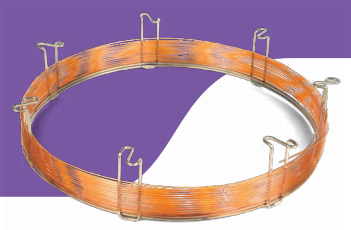
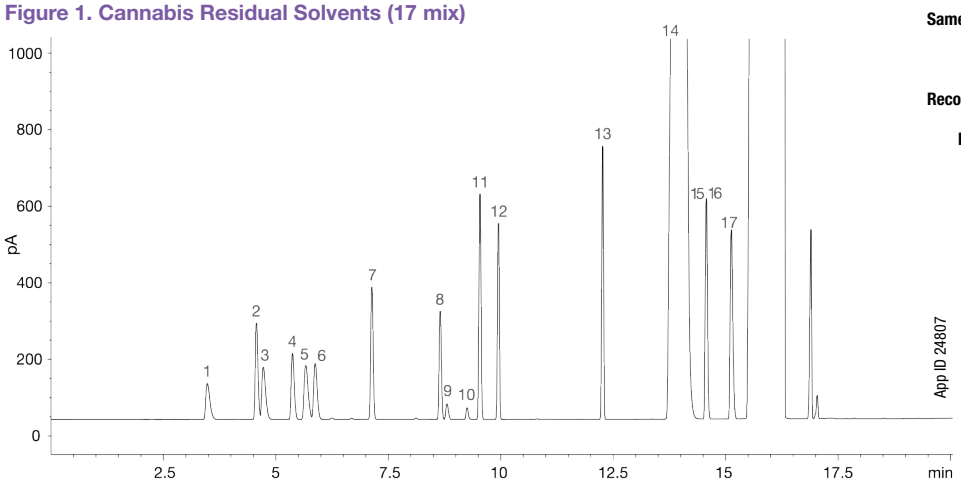


Determination of Residual Solvents and Terpenes in Cannabis by GC-FID using Zebron ZB-624*PLUS* GC Column

Zebron™ GC Products

Figure 1. Cannabis Residual Solvents (17 mix)



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GC-FID Conditions

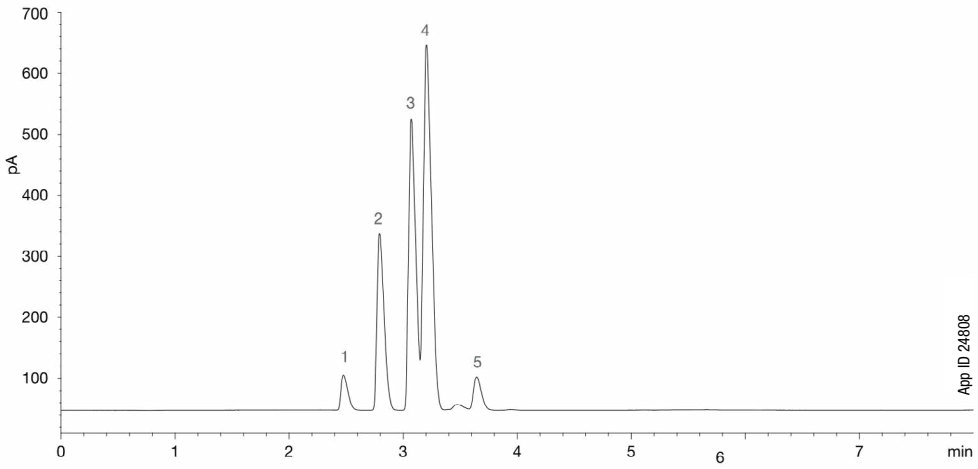
Same conditions for both separations

Column: Zebron ZB-624*PLUS*
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

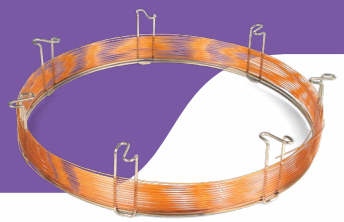
1. Methanol
2. n-Pentane
3. Ethanol
4. 2-Propanol
5. Acetone
6. Acetonitrile
7. n-Hexane
8. THF
9. Chloroform
10. Carbon Tetrachloride
11. n-Heptane
12. Benzene
13. Toluene
14. Dimethylformamide
15. m-Xylene
16. p-Xylene
17. o-Xylene

Figure 2. Low Boiling Cannabis Residual Solvents



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

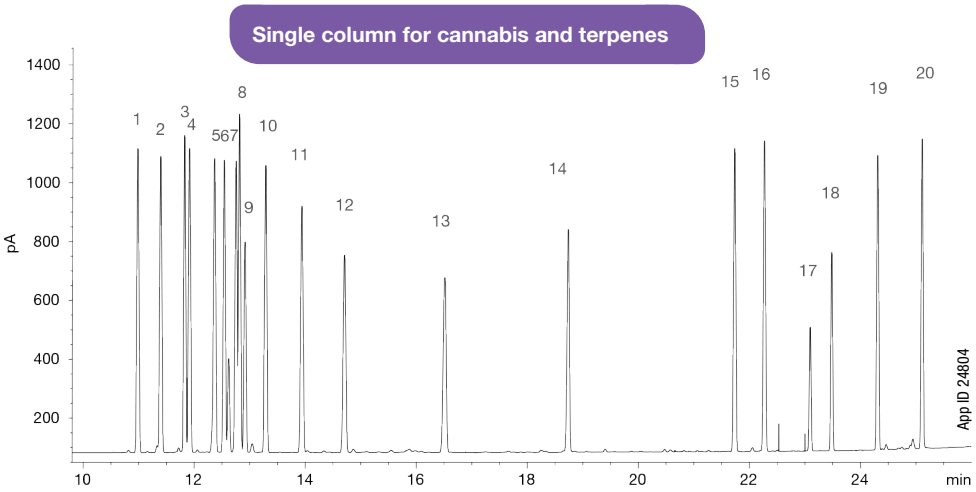
1. Propane
2. 2-Methylpropane
3. n-Butane
4. Neopentane
5. Ethylene Oxide



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

Zebron™ GC Products

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



GC-FID Conditions

Same conditions for both separations

Column: Zebron ZB-624*PLUS*
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, 1µL
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
2. Camphene
3. β-Myrcene
4. (-)-β-Pinene
5. Δ-3-Carene
6. α-Terpinene
7. d-Limonene
8. Δ-Cymene
9. Ocimene
10. γ-Terpinene
11. Terpinolene
12. Linalool
13. Isopulegol
14. Geraniol
15. β-Caryophllene
16. α-Humulene
17. Nerolidol 1
18. Nerolidol 1
19. Guaiol
20. α-Bisabolol

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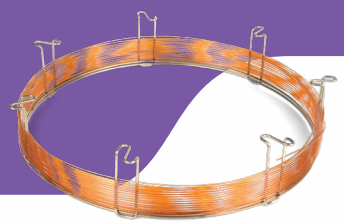
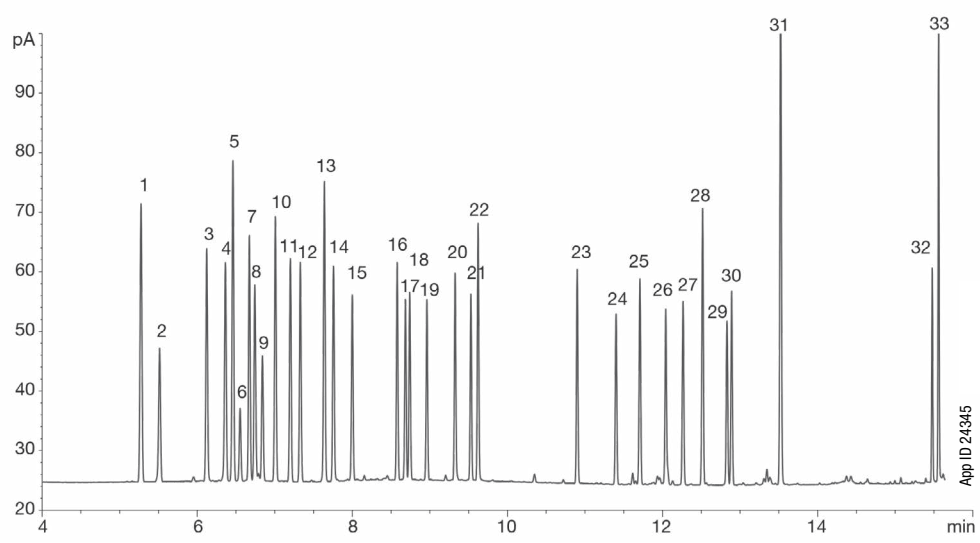


Analysis of 33 Primary and Secondary Terpenes Found in Cannabis by GC-FID

Zebron™ GC Products

Excellent resolution of 33 terpenes



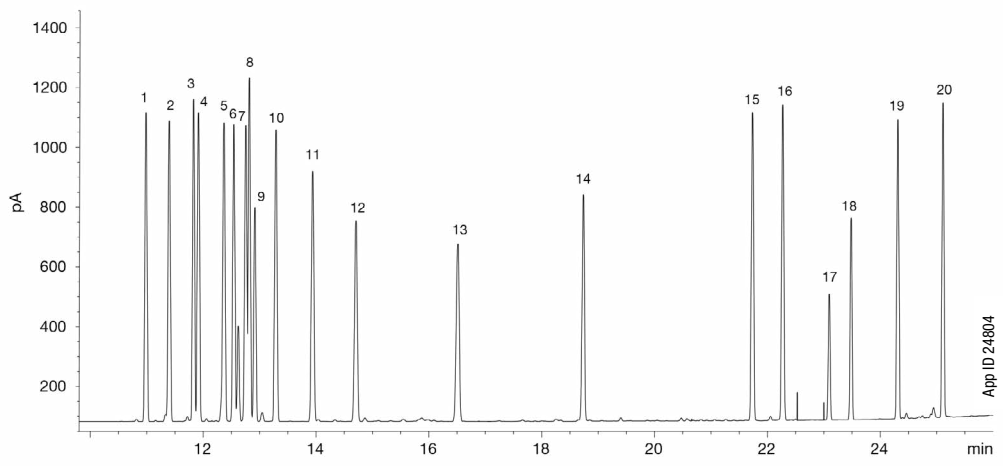
GC-FID Conditions

Column: Zebron ZB-5*PLUS*
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-GZ0)
Injection: Split 20:1 @ 250 °C, 1 µL
Recommended Liner: Zebron 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
2. Camphene
3. β-Myrcene
4. α-Phellandrene
5. 3-Carene
6. α-Terpinene
7. p-Cymene
8. Limonene
9. Ocimene-1
10. Ocimene-2
11. γ-Terpinene
12. Sabinine hydrate
13. Terpineolene
14. Linalool
15. Fenchol
16. Isoborneol
17. Borneol
18. Menthol
19. α-Terpineol
20. Citronellol
21. Pulegone
22. Geraniol
23. Geranyl acetate
24. Trans-Caryophyllene
25. α-Humulene
26. Valencene
27. Nerolidol-1
28. Nerolidol-2
29. Caryophyllene oxide
30. Guaiol
31. α-Bisabolol
32. Phytol-1
33. hytol-2

Download this Application Note

20 Terpenes Using Zebron ZB-624*PLUS*



GC-FID Conditions

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

Download this Application Note

Residual Solvents and Terpenes

List of recommended part numbers

GC Columns and Accessories

Part No.	Product Description
7HG-G040-27	Zebron ZB-624*PLUS*, GC Cap. Column 30m x 0.25mm x 1.4 µm
7FD-G032-53	Zebron ZB-5*PLUS* 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

Zebron™ GC Products

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

Verex Headspace Vials

Verex™ Certified Filter 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**

Ordering Information

Description	1000/pk
Crimp-Top	
Headspace Vial, 23 x 75 mm, 20 mL Beveled Edge, Flat Bottom, Clear, No Patch	AR0-3260-13
Headspace Vial, 23 x 75 mm, 20 mL Beveled Edge, Flat Bottom., Clear, No Patch, Silanized	AR0-3263-13
Headspace Vial, 23 x 75 mm, 20 mL Square Rim, Flat Bottom, Clear, No Patch	AR0-3290-13
Headspace Vial, 23 x 75 mm, 20 mL Beveled Edge, Round Bottom, Clear, No Patch	AR0-3270-13
Screw-Top	
Headspace Vial, 23 x 75 mm, 20 mL 18 mm Screw, Round Bottom, Clear, No Patch	AR0-3280-13
Headspace Vial, 23 x 75 mm, 20 mL 18 mm Screw, Round Bottom, Amber, No Patch	AR0-3281-13

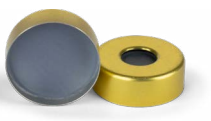
Autosampler Compatibility
Flat Bottom: HP / Agilent, Carlo Erba, Shimadzu
Round Bottom: PerkinElmer, Tekmar, LEAP Technologies, Varian

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	AR0-52C5-13
Seal, 20 mm Diameter, PTFE/Butyl Rubber Pharmafix Molded Septum, silver	AR0-52D0-13
Seal, 20 mm Diameter, PTFE/Butyl Rubber Pressure Release, Pharmafix Molded Septum, silver	AR0-52B0-13
Seal, 20 mm Diameter, PTFE/Silicone, magnetic cap	AR0-5255-13
Seal, 20 mm Diameter, PTFE/Silicone, silver	AR0-5250-13
Seal, 20 mm Diameter, PTFE/Silicone Pressure Release, silver	AR0-5220-13
Screw-Top	
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Butyl Rubber septa (red/grey)	AR0-814M-13
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Silicone septa (red/white)	AR0-815M-13
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Silicone septa (blue/white)	AR0-81AM-13
Screw Cap, 18 mm, Magnetic, Silver, PTFE/Silicone septa (white/translucent blue)	AR0-81BM-13



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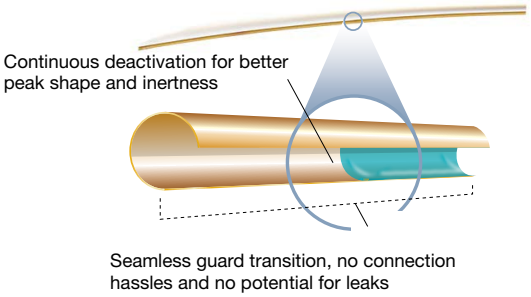
SecurityGuard Standard HPLC Column Protection

GC Accessories



Guardian Integrated Guard Columns

Access complete line of columns and accessories

Zebron PLUS Liners

Access Product Selection Guide

Gas Filters and Traps

Access Product Selection Guide

Ordering Information

Sample Preparation / SPE

GC Columns & Accessories

HPLC / UHPLC Columns & Accessories

Cannabis Testing Guide

- Potency
- Pesticides
- Residual Solvents
- Terpenes
- Mycotoxins

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