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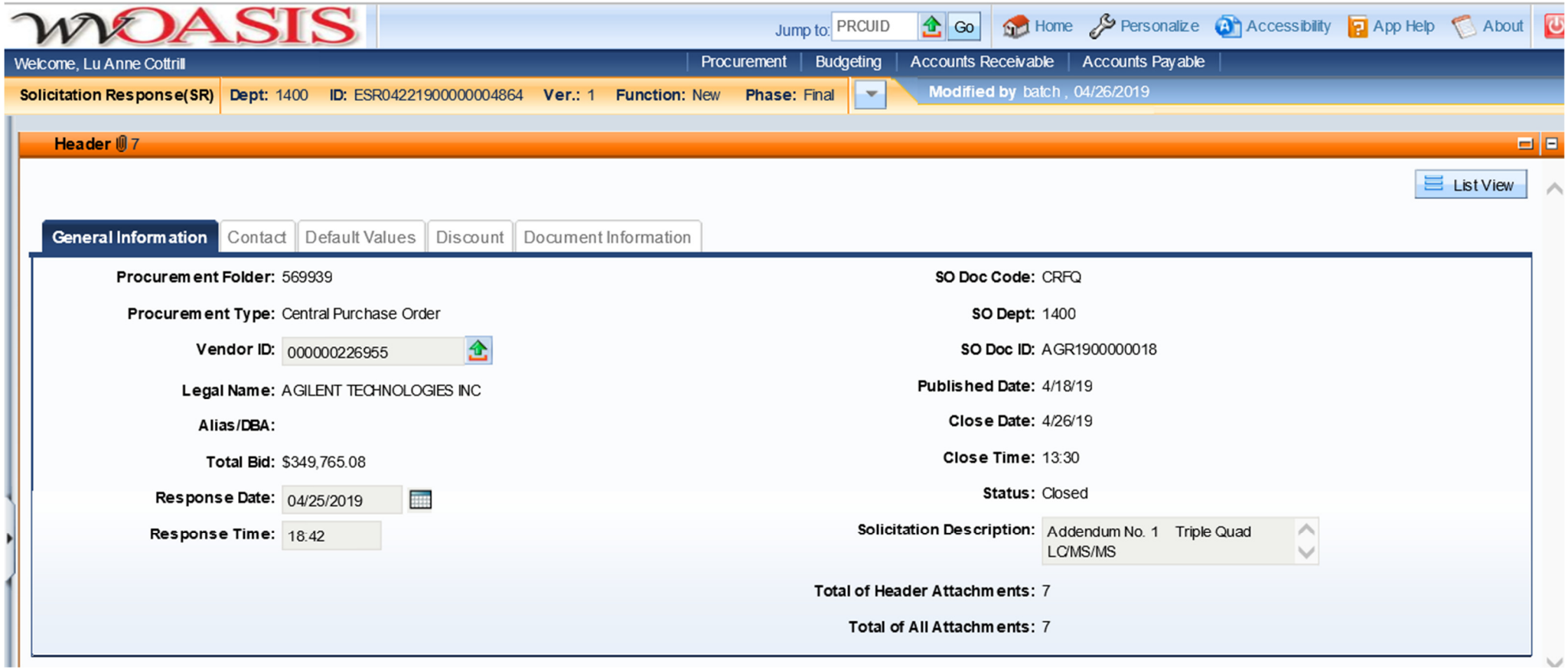
wvOASIS
Jump to: PRCUID Go
Home
Personalize
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App Help
About
Welcome, Lu Anne Cottrill
Procurement
Budgeting
Accounts Receivable
Accounts Payable
Solicitation Response(SR) Dept: 1400 ID: ESR04221900000004864 Ver.: 1 Function: New Phase: Final
Modified by batch , 04/26/2019
Header 7
List View
General Information
Contact
Default Values
Discount
Document Information
Procurement Folder: 569939
Procurement Type: Central Purchase Order
Vendor ID: 000000226955
Legal Name: AGILENT TECHNOLOGIES INC
Alias/DBA:
Total Bid: $349,765.08
Response Date: 04/25/2019
Response Time: 18:42
SO Doc Code: CRFQ
SO Dept: 1400
SO Doc ID: AGR1900000018
Published Date: 4/18/19
Close Date: 4/26/19
Close Time: 13:30
Status: Closed
Solicitation Description: Addendum No. 1 Triple Quad LC/MS/MS
Total of Header Attachments: 7
Total of All Attachments: 7

Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Solicitation Response

Proc Folder : 569939

Solicitation Description : Addendum No. 1 Triple Quad LC/MS/MS

Proc Type : Central Purchase Order

Date issued	Solicitation Closes	Solicitation Response	Version
	2019-04-26 13:30:00	SR 1400 ESR04221900000004864	1

VENDOR

000000226955

AGILENT TECHNOLOGIES INC

Solicitation Number: CRFQ 1400 AGR1900000018

Total Bid : $349,765.08 **Response Date:** 2019-04-25 **Response Time:** 18:42:55

Comments: Agilent Technologies, Inc. (Agilent) is bidding in accordance with quotation 2842798. Please refer to the attachments for details of Agilent's offer.

FOR INFORMATION CONTACT THE BUYER

Melissa Pettrey

(304) 558-0094
melissa.k.pettrey@wv.gov

Signature on File **FEIN #** **DATE**

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	LC/MS/MS, Workstation PC, Software, Printer, nitrogen	1.00000	EA	$334,860.080000	$334,860.08

Comm Code	Manufacturer	Specification	Model #
41100000			

Extended Description : generator, uninterrupted power supply, specific test methods per section 3.1

Comments: Agilent 6470 LC/MS Triple Quad with Peak Nitrogen Generator and Power VAR UPS. Per Agilent Quotation 2842798

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
2	shipping charges & inside delivery	1.00000	EA	$0.000000	$0.00

Comm Code	Manufacturer	Specification	Model #
78121603			

Extended Description : Shipping charges & inside delivery per section 3.1.6

Comments: Included

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
3	Installation/validation	1.00000	EA	$0.000000	$0.00

Comm Code	Manufacturer	Specification	Model #
73171605			

Extended Description : Installation/Validation per section 3.1.6

Comments: Included

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
4	Training/warranty	1.00000	EA	$3,997.000000	$3,997.00

Comm Code	Manufacturer	Specification	Model #
73171605			

Extended Description : Training/Warranty per section 3.1.6

Comments: The bid response includes a gratis for 5-days on-site method consulting. SYS-LC-1290II, R1893A. Per Agilent Quotation 2842798

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
5	Service	1.00000	EA	$10,908.000000	$10,908.00

Comm Code	Manufacturer	Specification	Model #
73171605			

Extended Description : Service per section 3.1.6

Comments: 2 Years total Preventative Maintenance. Does not include the UPS or Nitrogen Generator. SYS-LM-6470-E. Per Agilent Quotation 2842798

Agilent 6470 Triple Quadrupole LC/MS System with Agilent JetStream Technology

Data Sheet

The Agilent 6470 Triple Quadrupole LC/MS delivers superior sensitivity for trace level analysis with performance specifications in signal-to-noise (S/N) and instrument detection limit (IDL). IDL is a rigorous, statistically based metric that indicates practical sensitivity performance of your quantitative assays. The 6470 Triple Quadrupole LC/MS achieves sensitivity and resolution specifications with autotune.

Parameter	Measure	Specification
MRM sensitivity Signal-to-Noise ratio (S/N) ESI positive	1 pg of reserpine injected on column, quantifying on the transition *m/z* 609 to 195	S/N > 75,000:1 Noise 1 × RMS
MRM sensitivity Signal-to-Noise ratio (S/N) ESI Negative	1 pg of chloramphenicol injected on column, quantifying on the transition *m/z* 351 to 152	S/N > 30,000:1 Noise 1 × RMS
MRM sensitivity Instrument Detection Limit (IDL) ESI positive	10 fg of reserpine injected on column, quantifying on the transition *m/z* 609 to 195	IDL < 4.0 fg
MRM sensitivity Instrument Detection Limit (IDL) ESI Negative	10 fg of chloramphenicol injected on column, quantifying on the transition *m/z* 351 to 152	IDL < 4.0 fg
Mass range		*m/z* 5–3,000
Polarity switching		25 ms
Mass resolution (autotune) Mass resolution (manual tune)	Full width at half maximum Full width at half maximum	0.7 Da 0.5 Da
Mass accuracy		0.1 Da from *m/z* 5 – 1,000 0.01% from *m/z* 1,000 – 2,000 0.02% from *m/z* 2,000 – 3,000
Mass stability		≤ 0.1 Da in 24 hours
Dynamic range		> 6.0×10^6
Scan modes		MRM, SIM, MS scan, product ion scan, neutral loss/gain scan, and precursor ion scan
MRM transitions		450 per time segment Up to 13,500 MRM transitions per method
Dynamic MRM transitions		Up to 4,000 dynamic MRM transitions per method
Triggered MRM transitions		Up to 10 MRM transitions (primary and secondary) per analyte for library search and compound confirmation
Maximum scan rate		17,000 Da/s
Maximum MRM acquisition rate		500 MRMs/s
Minimum MRM dwell time		0.5 ms

Agilent Technologies

General system specifications

Parameter	Specification
Single point of control	Single-point data system method capability with full control of Agilent 1200 Series LC systems and 6470A Triple Quadrupole LC/MS/MS System
Time programming	• Polarity change in time segment • Scan and SIM or MRM (plus other modes of data collection) • Dynamic and triggered MRM aligns MRMs with compound retention time • Solvent divert through calibrant delivery system valve
Wide range of orthogonal ionization sources	• Electrospray (ESI) • Nanospray with HPLC-Chip Cube MS interface • APCI source (Atmospheric Pressure Chemical Ionization) • Multimode source (simultaneous ESI and APCI) • APPI Source (Atmospheric Pressure Photo Ionization)
Autotune	Automated optimization of ion optics and mass axis calibration in positive and negative ion modes using a proprietary tune solution
Solvent declustering	Countercurrent drying gas, sheath gas (AJS)
Detector	±20 kV high-energy conversion dynode (HED) and high-gain electron multiplier horn
Vacuum system	Two turbomolecular pumps with one mechanical pump

Ordering Information

G6470AA: 6470 Triple Quadrupole LC/MS System

Includes the Agilent 6470 Triple Quadrupole Mass Spectrometry, MassHunter Workstation Software with both compliance and method optimization software, a PC, a monitor, and service installation of the system.

The above are not standard installation specifications for the 6470 Triple Quad. Performance specifications in this document are reviewed for accuracy, but they do not represent the tests and procedures performed at installation, which are described in the Agilent 6400 Series Triple Quad LC/MS System Installation Manual, document G3335-90170 or subsequent version number. See Site Preparation Guide and Service Notes for additional product and specification information.

For More Information

These data represent typical results. For more information on our products and services, visit our Web site at www.agilent.com/chem.

www.agilent.com/chem

Printed in the USA
September 16, 2015
5991-6152EN

Agilent Technologies

Agilent Jet Stream Thermal Gradient Focusing Technology

Electrospray ionization mass spectrometry (ESI-MS) is a sensitive technique that is used extensively for the analysis and identification of small molecules and proteins. Proprietary Agilent Jet Stream thermal gradient focusing technology optimizes ESI conditions to produce dramatic gains in sensitivity, decreasing sample size requirements, increasing sample throughput, improving assay robustness and reducing the LODs and LOQs of screening and quantitation applications.

Alex Mordehai
John Fjeldsted

Agilent Technologies
Santa Clara, CA, USA

Agilent Jet Stream technology enhances ESI-MS sensitivity

Agilent Jet Stream thermal gradient focusing technology was developed to significantly enhance sensitivity in ESI-MS by improving the desolvation and spatial focusing of ions. Super-heated nitrogen sheath gas confines the nebulizer spray to more effectively dry ions and concentrate them in a thermal confinement zone **(Figures 1-3)**.

Desolvation reduces noise. Full confinement of the spray by the super-heated nitrogen gas eliminates sample recirculation and reduces peak tailing.

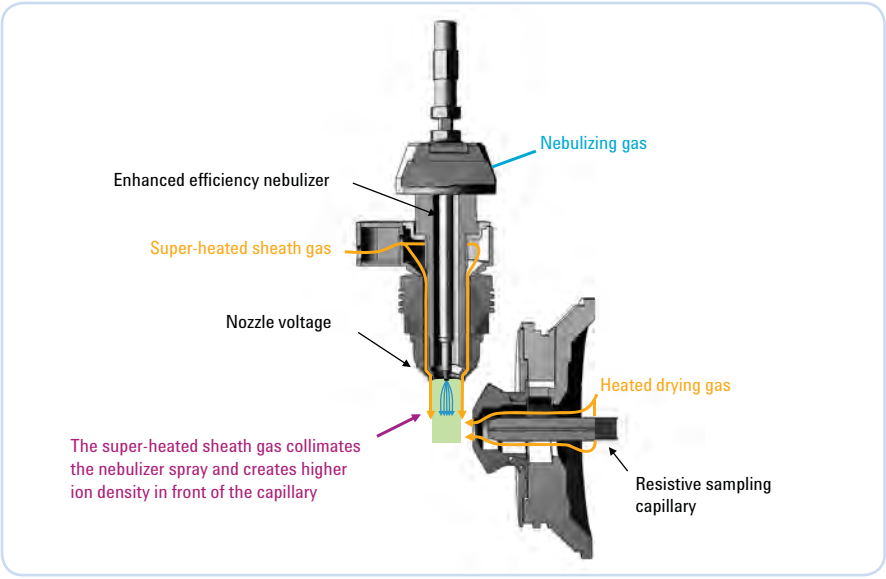


Figure 1. Agilent Jet Stream technology utilizes super-heated nitrogen to desolvate the spray and confine the electrospray plume making more ions accessible to sampling by the mass spectrometer.

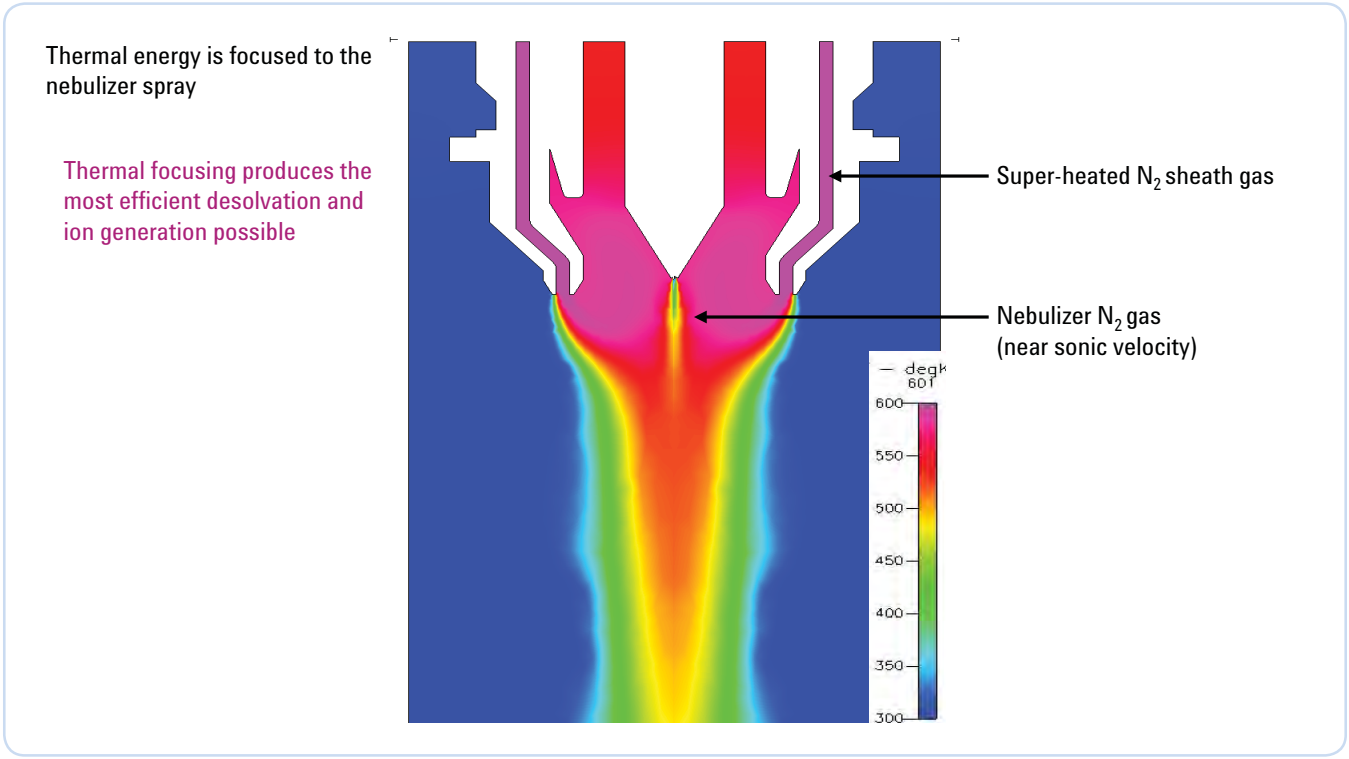


Figure 2. Simulation showing the thermal profile of the Agilent Jet Stream technology. Note the creation of a thermal confinement zone by introduction of a super-heated N_2 sheath gas.

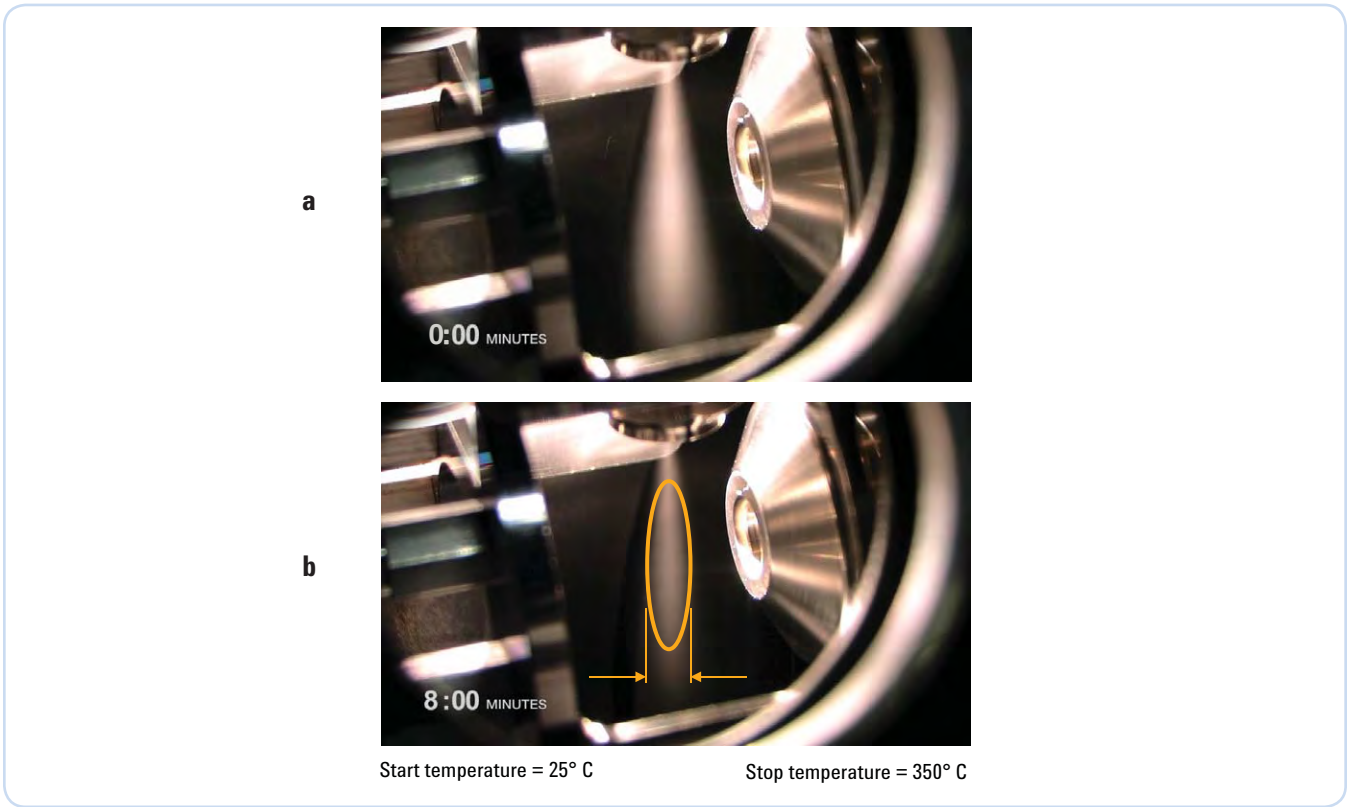


Figure 3. Time lapse images of an electrospray generated using Agilent Jet Stream technology at **(a)** 25° C and **(b)** 350° C. Less light scattering is observed in the spray at 350° C, indicating enhanced desolvation.

Improved ion production results in higher MS and MS/MS signal intensities and improved signal-to-noise ratios. On average, a 5 to 10-fold improvement in MS and MS/MS sensitivity is realized by using Agilent Jet Stream technology **(Figures 4a and 4b)**.

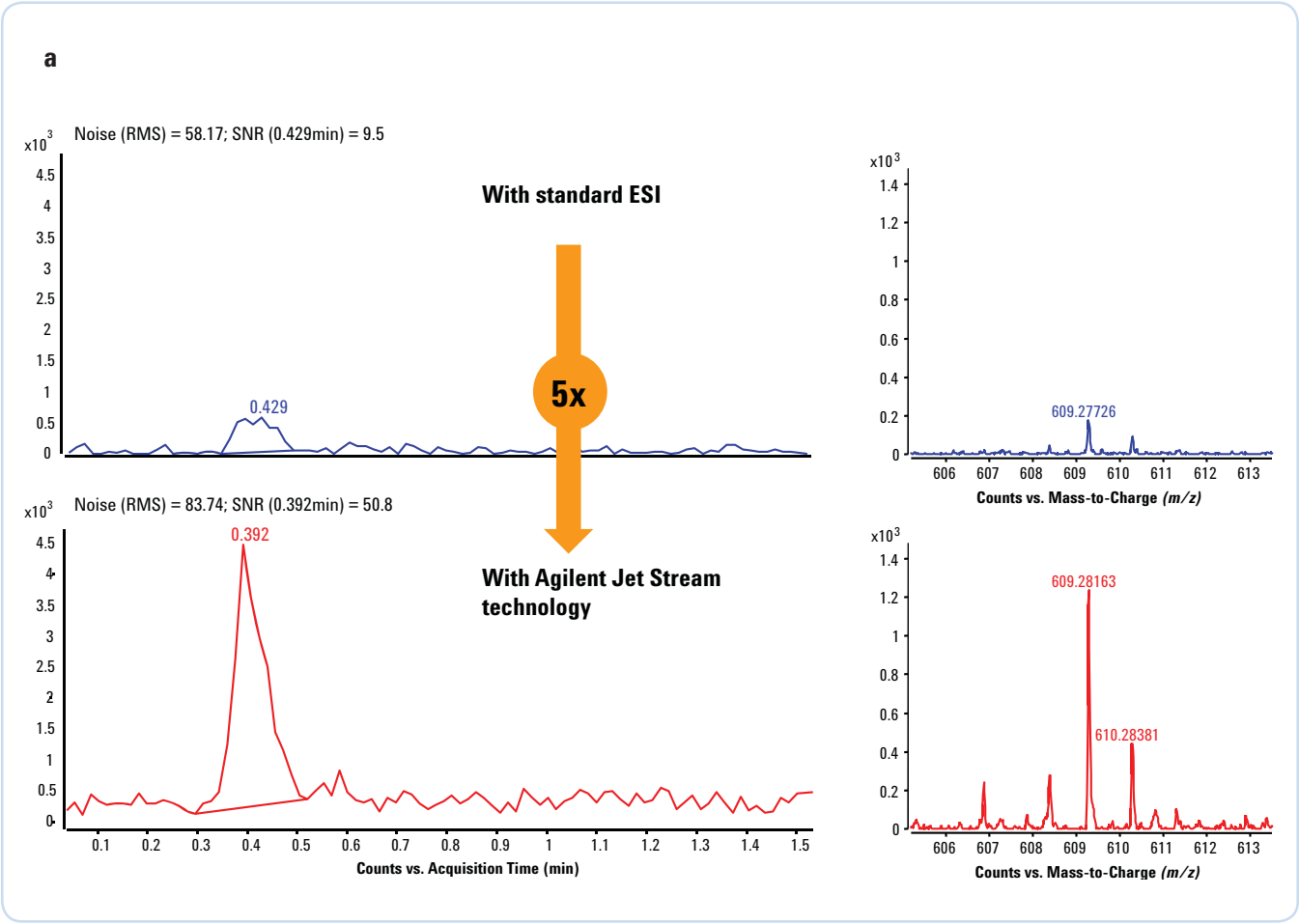


Figure 4a. Comparison of the MS spectra of a 1 pg sample of the drug reserpine obtained using conventional Agilent ESI source and Agilent Jet Stream technology on an Agilent 6530 Accurate-Mass Q-TOF LC/MS system. A 5-fold gain in signal intensity is observed with Agilent Jet Stream technology. LC conditions: Agilent 1200 LC system. Column: 2.1 x 30 mm Zorbax SB-C18, 3.5 µm; flow rate: 0.4 mL/min of 75:25 methanol/water containing 0.1% (v/v) formic acid and 5 mM ammonium formate. Agilent Jet Stream technology conditions: sheath gas temperature: 350° C; sheath gas flow: 12 L/min.

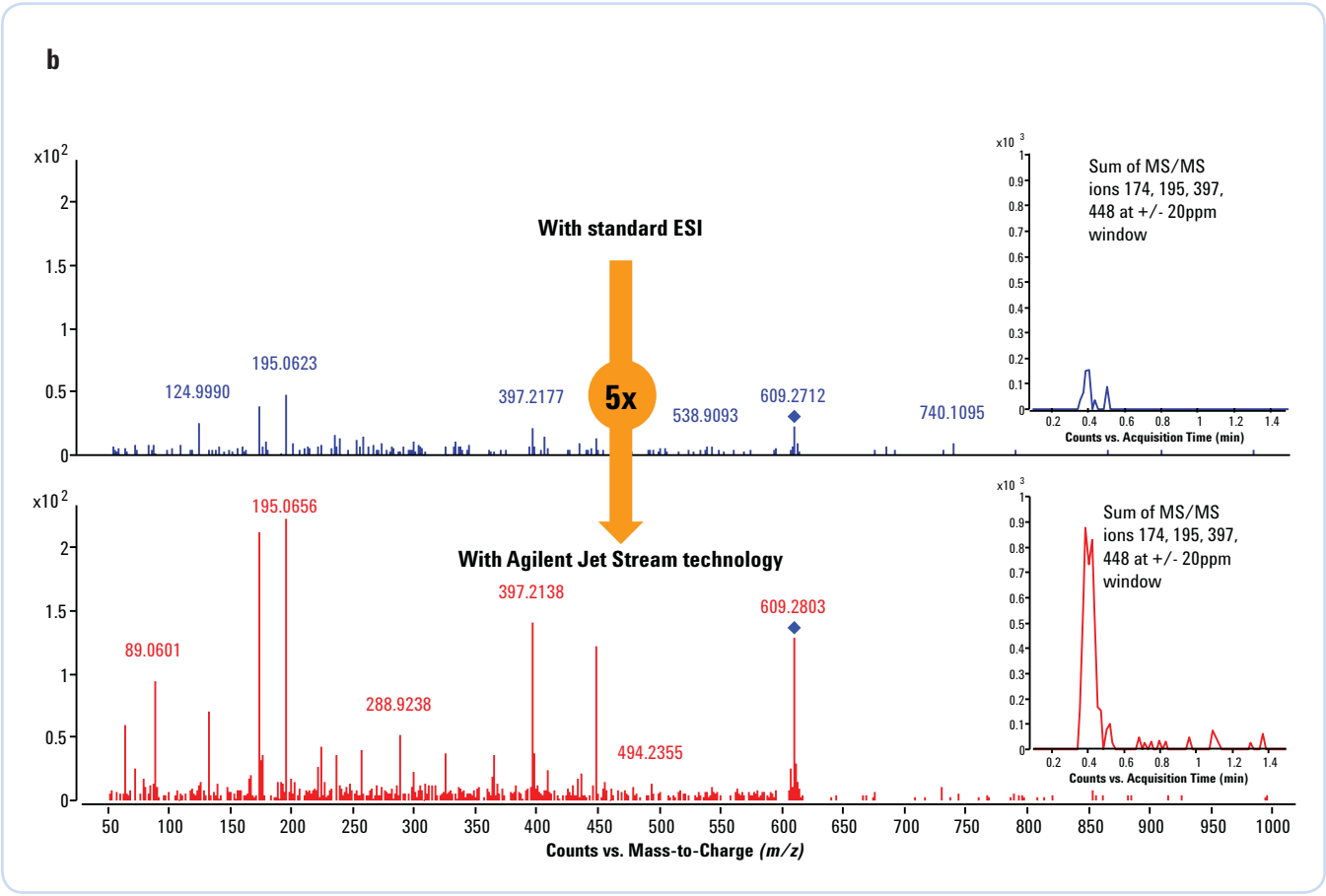


Figure 4b. Comparison of the MS/MS spectra of a 1 pg sample of the drug reserpine obtained using conventional Agilent ESI source and Agilent Jet Stream technology on an Agilent 6530 Q-TOF LC/MS system. A 5-fold gain in signal intensity is observed with Agilent Jet Stream technology. Conditions: same as for figure 4a.

The Agilent Jet Stream technology provides exceptional ESI-MS sensitivity over a wide range of flow rates. Sensitivity gains of 5-10x were seen over flow rates ranging from 50 µL/min to 2.5 mL/min, with the greatest gains typically seen at flow rates from 0.25-1.0 mL/min. Importantly, recommended operating parameters were consistent across a wide range of flow rates, reducing the need for optimization at different flow rates. The following conditions resulted in optimal results over flow rates ranging from 0.25 to 2.0 mL/min (typical flowrates for 2.1 mm ID HPLC columns):

Sheath Gas Flow:	11 mL/min
Sheath Gas Temperature:	350° C
Nozzle Voltage:	600 V
Nebulizer Pressure:	30 psi
Chamber Voltage:	4 kV

(The recommended default operating parameters for the Agilent Jet Stream technology are relatively invariant with HPLC flow rate but should be optimized for best analyte response).

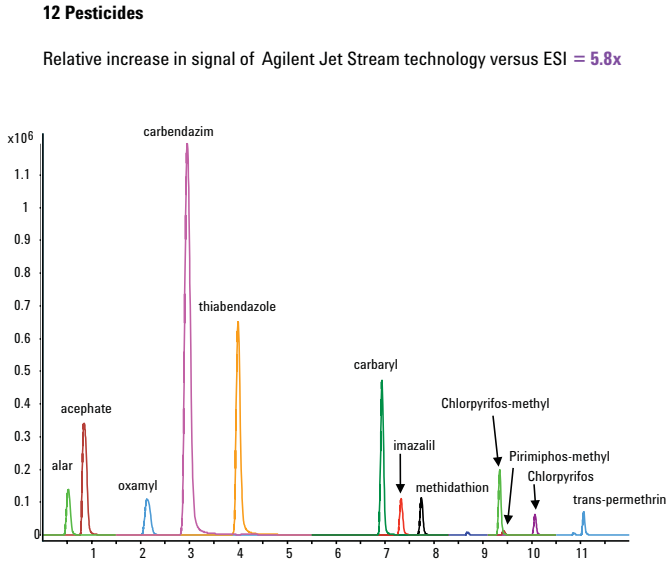
Applications

Trace Analysis of Pesticides

Sensitive and reliable analytical methods for the routine monitoring of pesticide residues are required in food safety and environmental applications. Agilent Jet Stream technology enables highly sensitive analysis of pesticides as shown in **Figure 5**. Compared to conventional ESI, an almost 6-fold improvement in sensitivity was realized.

Drug Analysis in Biological Matrices

LC-MS and LC-MS/MS detection are routinely used for the analysis of drugs in biological fluids. Agilent Jet Stream technology based LC/MS analyses of four therapeutic drugs in pure solvent and in blood plasma are presented in **Figure 6**. MS analysis in biological media is often adversely affected by ion suppression, but in this particular application no such matrix effects are observed with the Agilent Jet Stream technology.



Pesticide	Optimal Temp [°C]	Signal Gain
Alar	380	5.60
Acephate	380	6.30
Oxamyl	250	5.10
Carbendazim	380	7.20
Thiabendazole	380	7.20
Carbaryl	380	6.60
Imazalil	380	8.10
Methidathion	250	5.00
Chlorpyrifos-methyl	100	6.40
Pirimiphos-methyl	380	5.50
Chlorpyrifos	380	4.00
Trans-permethrin	250	2.50
Average		**5.8x**

Figure 5. LC/MS analysis of a mixture of pesticide standards in methanol/water using Agilent Jet Stream technology on an Agilent 6460 triple quadrupole LC/MS system. The table shows the relative gain in ion signal intensities using Agilent Jet Stream technology compared to conventional ESI.

LC Conditions: Agilent 1200 LC system. Column: 2.1 x 100 mm Eclipse Plus C18, 1.8 µm; flow rate: 0.4 mL/min; gradient: water: methanol containing 0.1% formic acid and 10 mM ammonium formate. Agilent Jet Stream technology conditions: sheath gas temperature: programmed for best analyte response between 100-380° C; sheath gas flow: 10 L/min.

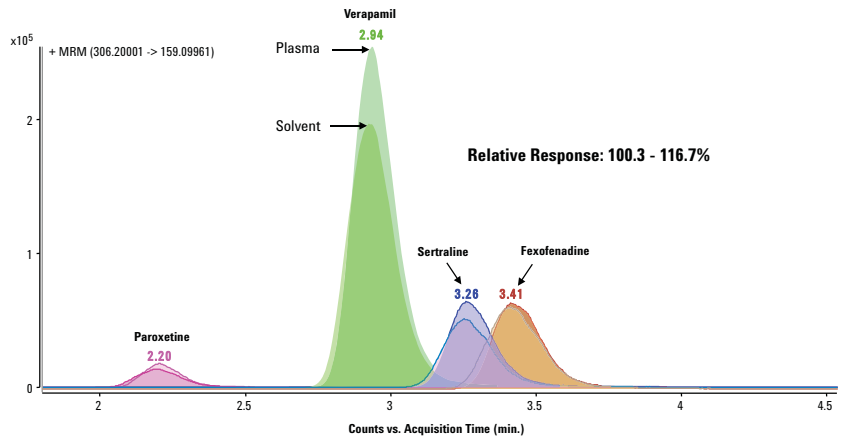


Figure 6. LC-MS analysis of four therapeutic drugs in pure solvent and in plasma on an Agilent 6460 triple quadrupole LC/MS system. LC Conditions: Agilent 1200 LC system. Column: 2.1 x 12 mm C8 guard column (5 µm) in-line with 2.1 x 100 mm C18 (3.5 µm) analytical column; gradient: acetonitrile: water (90:10 v/v).

Human Health Care Products in Drinking Water

Significant sensitivity enhancements were observed for the analysis of four pharmaceutical compounds in drinking water samples **(Figure 7)**.

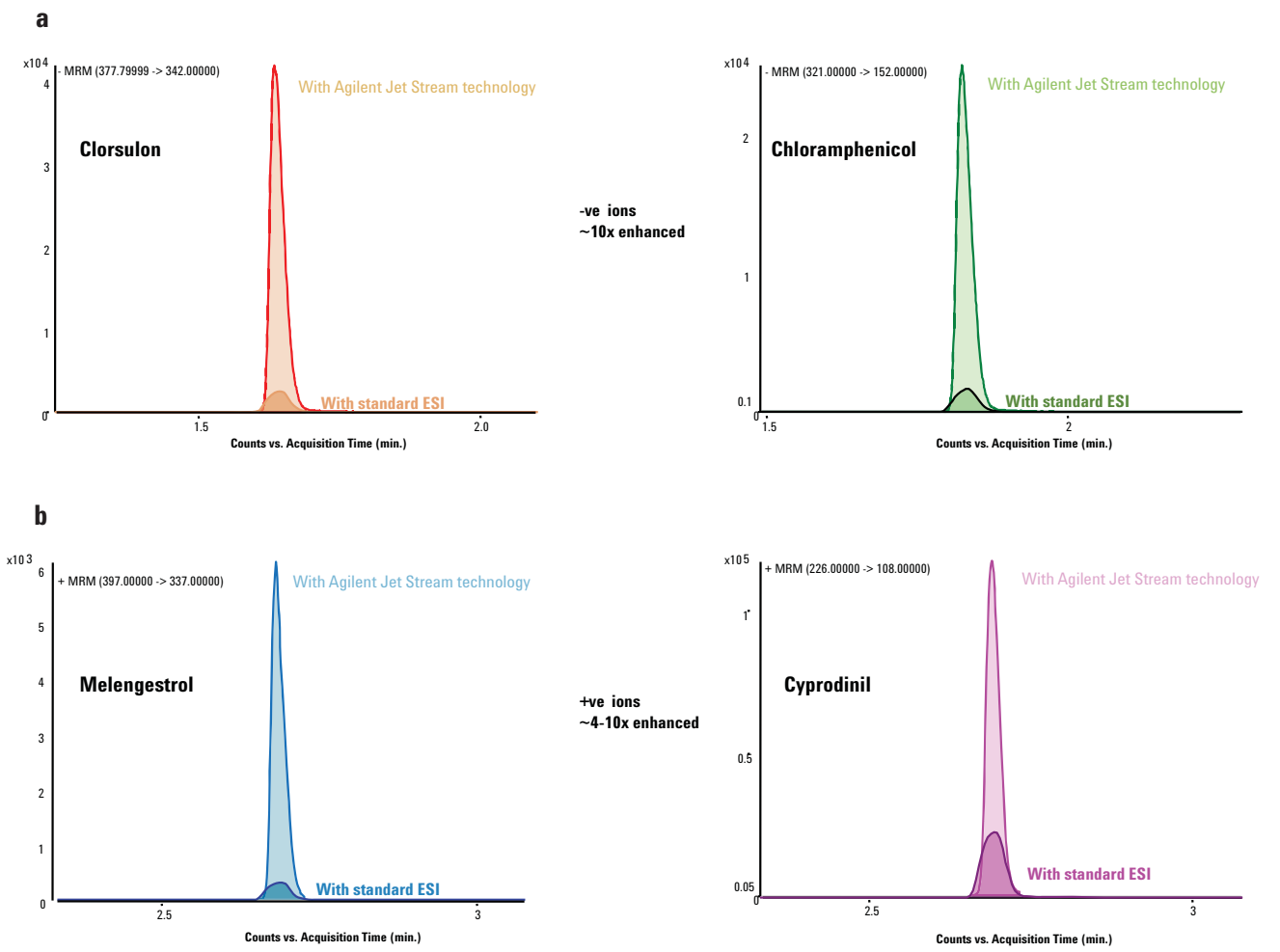


Figure 7. Pharmaceuticals spiked into potable water analyzed in **(a)** negative ion mode and **(b)** positive ion mode. Compared to conventional ESI (lower traces in each of the four graphs), Agilent Jet Stream technology enabled sensitivity improvements of approximately 10-fold in negative ion mode and between 4-to-10-fold in positive ion mode. Injected volume was 5 µL of a 50 ppb solution. LC Conditions: Agilent 1200 LC system. Column: 2.1 x 50 mm Zorbax Eclipse Plus C-18, flow rate: 0.5 mL/min, gradient: A=water, B= methanol, 5% B to 90% B. Agilent Jet Stream technology conditions: sheath gas temperature: 380° C, sheath flow: 11 L/min.

Illicit Drugs in Urine

Agilent Jet Stream technology was used for LC/MS detection and quantitation of the illicit drug MDMA in urine **(Figure 8)**. Significant sensitivity gains were seen with the use of Agilent Jet Stream technology versus standard ESI.

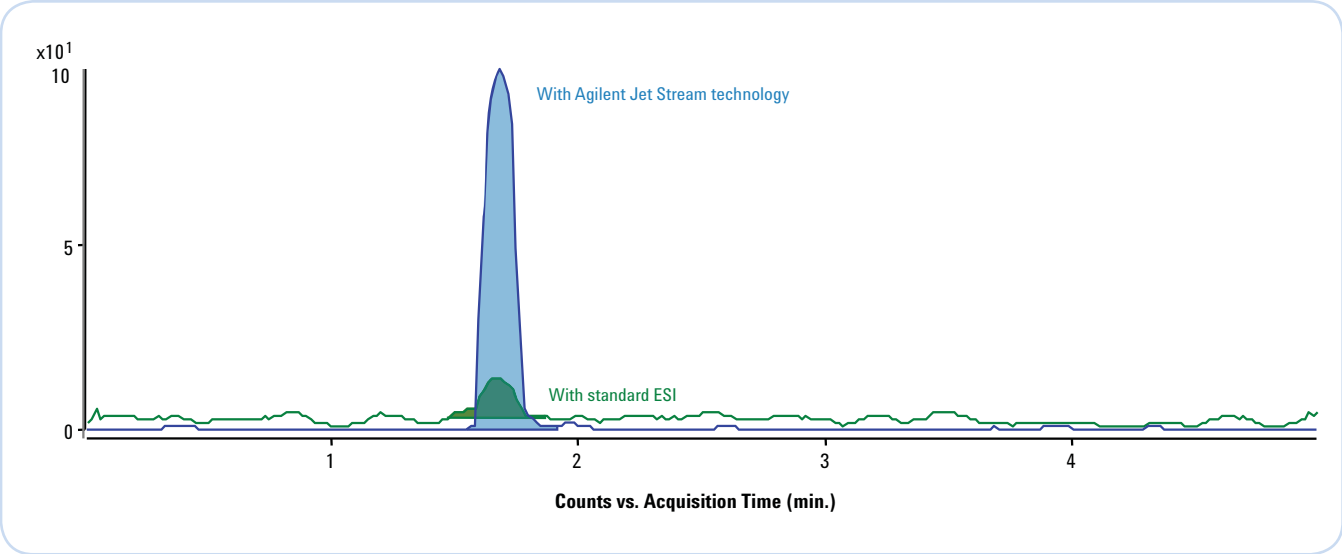


Figure 8. Analysis of MDMA spiked into urine (50 fg on-column) by standard ESI (green trace) and Agilent Jet Stream technology (blue trace) on an Agilent 6460 Triple Quad LC/MS system. LC Conditions: Agilent 1200 LC system. Column: Zorbax Eclipse Plus C-18 (2.1 x 50 mm, 1.8 µm), flow rate: 0.5 mL/min, gradient: A=water with 0.1% formic acid, B= acetonitrile with 0.1% formic acid, 5% B to 100% B.

Conclusions

Agilent Jet Stream thermal gradient focusing technology enables a 5-10 fold sensitivity improvement over ESI at conventional flow rates (50 µL/min-2.5 mL/min). Dramatically improved ion desolvation and confinement of the spray by a thermal gradient yield improved ion generation and sampling efficiencies for significantly increased signal and reduced noise. Agilent Jet Stream technology is suited for today's most demanding applications—it provides maximum sensitivity for the analysis of pharmaceutical compounds to support drug development applications and trace-level pesticide and chemical analysis to assure environmental quality and food safety.

About Agilent Technologies

Agilent Technologies is a leading supplier of life science research systems that enable scientists to understand complex biological processes, determine disease mechanisms, and speed drug discovery. Engineered for sensitivity, reproducibility, and workflow productivity, Agilent's life science solutions include instrumentation, microfluidics, software, microarrays, consumables, and services for genomics, proteomics, and metabolomics applications.

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Printed in the U.S.A. February 12, 2009
5990-3494EN

Agilent 1290 Infinity II High Speed Pump

Data Sheet

Product Description

The Agilent 1290 Infinity II High Speed Pump is designed to enhance your efficiency through highest speed and ultimate chromatographic performance. A low-delay-volume mixer allows you to run ultrafast gradients for narrow-bore applications for highest laboratory efficiency. The new 1290 Infinity II LC power range guarantees highest instrument efficiency, allowing you to run any HPLC and UHPLC method. The full ISET range enables you to seamlessly transfer existing methods from different instruments , including current Agilent systems as well as instruments from other manufacturers. Furthermore, proven technologies, such as active damping, automatic purge valve, new ultralow dispersion kits or lowest delay-volume capability, combine to achieve highest instrument and analytical efficiency.

Features

- Ultimate performance in terms of accuracy and precision for flow and composition.
- Infinite power range combining ultrahigh pressure up to1300 bar and high analytical flow rates up to 5 mL/min for maximum chromatographic performance.
- The unique Intelligent System Emulation Technology (ISET) enables the emulation of current Agilent 1100, 1200 and 1260 Infinity series instrument, as well as Waters Alliance, Waters H-Class, Waters Acquity and Shimadzu Prominence.
- Lowest delay volumes (to 10 µL) for running ultrafast gradients on narrow-bore columns make this pump the perfect front-end for LC/MS applications.
- Active damping with independently controllable high resolution pump drives and firmware-embedded tuning algorithms significantly reduce ripples and associated UV noise.
- The new Agilent Jet Weaver mixer, based on multi-layer microfluidic technology, facilitates highest efficiency mixing in combination with lowest delay volume for highest UV-detector sensitivity.
- Integrated high efficiency degasser with low internal volume is based on PTFE AF technology and offers fast change-over of solvents for purging and priming the pump.
- Built-in active seal-wash for increased uptime.

Specifications

Table 1 Physical Specifications

Type	Specification	Comments
Weight	21.0 kg (46.3 lbs)	
Dimensions (height × width × depth)	200 x 396 x 436 mm (7.9 x 15.6 x 17.2 inches)	
Line voltage	100 – 240 V~, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	210 VA / 180 W	
Ambient operating temperature	4 – 55 °C (39 – 131 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 95 % r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 3000 m (9842 ft)	
Non-operating altitude	Up to 4600 m (15092 ft)	For storing the module
Safety standards: IEC, EN, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

Table 2 Agilent 1290 Infinity II High Speed Pump (G7120A) Performance Specifications

Feature	Specification
Hydraulic system	Two dual pistons in series, pumps with proprietary servo-controlled variable stroke design and smooth motion control.
Pump resolution step size	300 pL step size
Settable flow range	0.001 – 5 mL/min, in 0.001 mL/min increments (executed in 300 pL/step increments).
Flow precision	≤0.07 % RSD or 0.005 min SD, whatever is greater
Flow accuracy	±1 % or 10 µL/min, whatever is greater
Pressure range	up to 130 MPa (1300 bar) at 0 – 2 mL/min ramping down to 80 MPa (800 bar) at 5 mL/min
Pressure pulsation	<1 % amplitude or <0.5 MPa (5 bar), whatever is greater
Compressibility compensation	Automatic
Recommended pH-range	1.0 – 12.5, solvents with pH <2.3 should not contain acid which attack stainless steel.

Table 2 Agilent 1290 Infinity II High Speed Pump (G7120A) Performance Specifications

Feature	Specification
Gradient formation	High pressure binary mixing
Delay volume	As low as 45 µL (10 µL without mixer)
Composition precision	<0.15 % RSD or 0.01 min SD, whatever is greater
Composition accuracy	±0.35 % absolute
Number of solvent	2 out of maximum 26 solvents
Solvent selection valve	Internal 4-solvent selection valve included. External 2x 12 solvent valve as option, fully integrated in the pump control interface.
Integrated degassing unit	Included Number of channels: 2 Internal volume per channel: 1.5 mL Materials in contact with solvent: TFE/PDD Copolymer, FEP, PEEK, PPS.
Automatic Purge Valve	Included
Active Seal wash	Included
Intelligent System Emulation Technology (ISET)	Included
Communications	Controller-area network (CAN), RS232C, APG remote: ready, start, stop and shutdown signals, LAN
Safety and maintenance	Extensive diagnostics, error detection and display through included Agilent LabAdvisor, leak detection, safe leak handling, leak output signal for shutdown of the pumping system. Low voltage in major maintenance areas.
GLP feature	Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of seal wear and volume of pumped mobile phase with pre-defined and user settable limits and feedback messages. Electronic records of maintenance and errors.
Housing	All materials are recyclable.

Ordering Details

Description	Product Number
Agilent 1290 Infinity II High Speed Pump	
Maximum pressure 1300 bar	G7120A
Agilent Lab Advisor Advanced Software	G7120A#004
Ultra-low Dispersion Kit	G7120A#006
Ultra-clean Tubing Kit	G7120A#033
Safety Caps	G7120A#034
V380 Jet Weaver Mixer Upgrade Kit	G7120A#070

www.agilent.com/chem/1200

Published December 1, 2014
5991-5336EN

Agilent Technologies

Agilent 1290 Infinity II Multisampler

Data Sheet

Product Description

The Agilent 1290 Infinity II Multisampler can handle both vials and microtiter plates with ease and efficiency up to 1300 bar system pressure, optimized on chromatographic performance. In fact, this compact module has the capacity to house up to 6144 samples, all inside the Agilent stack footprint – more than any single sampler from any other vendor – and the robotics to smoothly inject each into the chromatograph in turn. With our multi-wash capability, you can reduce carryover to less than 9 parts per million.

Features

- **Unmatched flexibility** – You choose how you want to introduce samples for injection, whether you prefer vials, microtiter plates, or any combination of formats. Sample drawers are available in three heights, and you can mix shallow drawers with deeper ones to accommodate different sample sizes.
- **High capacity** – Using shallow well-plate drawers, the 1290 Infinity II Multisampler takes a maximum load of 16 microtiter plates and up to 6144 samples—the most of any single system.
- **Seamless automation** – Internal robotics move microtiter plates and other sample containers from the sample hotel to the central workspace for sample processing steps and injections.
- **Dual-needle injection** – By running samples alternately through one or the other injection path, you can reduce cycle times to mere seconds, virtually eliminating conventional wait times—whether for large volume loadings or flushing procedures.
- **Scalable injection volumes** – The Agilent unique dual-needle setup also enhances flexibility by providing two differently optimized injectors in a single instrument. You can, for example, optimize one path for large volume injections and the other for low delay volumes.
- **Ultralow carryover** – The 1290 Infinity II Multisampler is designed for low carryover, but you can take clean to a whole new level with our multi-wash capability, cleaning all relevant injection parts between runs. This sophisticated, integrated feature flushes the injection needle outside with three solvents, and uses seat backflush procedures to reduce carryover to less than 9 ppm.
- **Integrated sample cooler or thermostat** – available as option or upgrade, providing cooling capacity down to 4 °C (with cooler), or cooling and heating (with thermostat) in the range from 4 °C - 40 °C.
- **Instant information** – Lights on each drawer tell you all you need to know about loading status, current activity, and accessibility.

Agilent Technologies

Specifications

Table 1 Physical Specifications

Type	Specification	Comments
Weight	22 kg (48.5 lbs)	w/o sample cooler
Dimensions (height × width × depth)	320 x 396 x 468 mm (12.6 x 15.6 x 18.4 inches)	
Line voltage	100 – 240 V~, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	180 VA, 180 W	
Ambient operating temperature	4 – 40 °C (39 – 104 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 95 % r.h. at 40 °C (104 °F)[1]	Non-condensing
Operating altitude	Up to 3000 m (9842 ft)	
Non-operating altitude	Up to 4600 m (15092 ft)	For storing the module
Safety standards: IEC, EN, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.
ISM Classification	ISM Group 1 Class B	According to CISPR 11
Permitted solvents	Boiling point ≥56 °C Auto-ignition temperature ≥200 °C	

[1] If a sample cooler is included the upper value for humidity can be reduced. Please check your lab conditions to stay beyond dew point values for non–condensing operation.

Table 2 Performance Specifications Agilent 1290 Infinity II Multisampler (G7167B)

Type	Specification
Injection range for *Single-needle* instruments	Default: 0.1 – 20 µL in 0.1 µL increments; optional: 40 µL or 100 µL (using 100 µL analytical head)
	0.1 – 500 µL or 900 µL in 0.1 µL increments (using 900 µL analytical head)
	0.1 – 120 µL in 0.1 µL increments with 1290 Infinity large volume injection kit (hardware modification required) G4216-68711 0.1 – 500 µL or 1500 µL in 0.1 µL increments with 100 µL upgrade kit (hardware modification required) G7167-68711
Injection range for *Dual-needle* instruments	Default: 0.1 – 20 µL in 0.1 µL increments; optional: 40 µL or 100 µL
	Up to 500 µL in 0.1 µL increments depending on installed loop size
Precision for *Single-needle* instruments	<0.15 % RSD or SD <10 nL, whatever is greater
Precision for *Dual-needle* instruments	<0.2 % RSD or SD <10 nL, whatever is greater
Pressure range	Up to 1300 bar
Sample viscosity range	0.2 – 5 cp
Sample capacity	1H Drawer up to 8 drawers and 16 positions Shallow well plates (MTP)
	2H Drawer up to 4 drawers and 8 positions MTP, deep well plates, vials, Eppendorf
	3H Drawer up to 2 drawers and 4 positions MTP, deep well plates, vials up to 6 mL, Eppendorf
Injection cycle time	<10 s using following standard conditions: Default draw speed: 100 µL/min
	Default eject speed: 400 µL/min Injection volume: 1 µL
Carry Over	<0.003 % (30 ppm) Multisampler Standard and Dual Needle <0.0009 % (9 ppm) Multisampler Multiwash
Multiwash	Outer needle wash and seat backflush for carryover reduction with up to 3 different solvents
Instrument Control	Lab Advisor B.02.06 or above LC and CE Drivers A.02.10 or above
Local control	Agilent Instant Pilot (G4208A)
Communications	Controller-area network (CAN), Local Area Network (LAN) ERI: ready, start, stop and shut-down signals

Table 2 Performance Specifications Agilent 1290 Infinity II Multisampler (G7167B)

Type	Specification
Safety and maintenance	Extensive support for troubleshooting and maintenance is provided by the Instant Pilot, Agilent Lab Advisor, and the Chromatography Data System. Safety-related features are leak detection, safe leak handling, leak output signal for shutdown of pumping system, and low voltages in major maintenance areas.
GLP features	Early maintenance feedback (EMF) for continuous tracking of instrument usage with user-settable limits and feedback messages. Electronic records of maintenance and errors.
Housing	All materials recyclable.
Metering device	Metering device in high pressure flow path

Table 3 Physical Specifications of the Sample Thermostat

Type	Specification	Comment
Weight	<6 kg	
Dimensions (height x width x depth)	205 mm x 340 mm x 370 mm	
Refrigerant gas	R600a (0.030 kg)	Ozone depletion potential (ODP) =0 Global warming potential (GWP) =3
Supply voltage	24VDC (nominal)	
Current	10 A max.	
Ambient operating temperature	-4 – 40 °C (39.2 – 104 °F)	
Ambient non-operating temperature	-40 – 70 °C (-20 – 158 °F)	
Operating altitude	Up to 3000 m (9842 ft)	
Non-operating altitude	Up to 4600 m (15091 ft)	
Safety standards: IEC, EN, CSA, UL	Installation category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Table 4 Performance Specifications for the Sample Thermostat

Type	Specifications
Operating principle	High performance, low-energy consumption micro-compressor based cooler with natural R600a coolant (Butane 30 g), user-upgradable
Temperature range	from 4 – 40 °C
Temperature settable	from 4 – 40 °C in 1 °C increments
Temperature accuracy (<25 °C, <50 % r.H.)	2 – 6 °C at a setpoint of 4 °C

Ordering Details

Table 5 Agilent 1290 Infinity II Multisampler Instrument

Description	Product Number	Comments
1290 Infinity II Multisampler		
Designed for low carryover of up to 1300 bar, handles well plates and individual sample containers (e.g. vials, Eppendorf tubes). Includes: • One double-height drawer for 2 individual sample containers and 3x 2H drawer-substitutes to cover the remaining drawer-slots • Single needle setup with 20 µL loop and 40 µL analytical head • Standard needle flush port and peristaltic pump • Separate position for 5x 2 mLreference vials • One 54-vial container for 2 mL vials	G7167B	
Sample Cooler		
Cooling unit for 1290 Infinity II Multisampler (G7167A & B). Slide-in device, customer installable.	G7167B #100	Compressor based cooler with high performance cooling down to 4 °C. Not a thermostat, no heating!
InfinityLab Sample Thermostat Thermostat unit for 1290 Infinity II Multisampler (G7167A and B). Slide-in device, customer installable.	G7167B #101	Thermostat to control sample temperature from 4 °C up to 40 °C
1290 Infinity II Dual-needle option		
Offers a second flow path with needle, seat and loop for parallel operation. Default flow path is 2x 20 µL loops plus one 100 µL analytical head.	G7167B #111	For alternating quantitative injections, identical loop volumes are required! Variable volumes need to be purchased and added separately. Combinations of Dual-needle with Multi-wash require an additional external valve mounted via rail.
1290 Infinity II Multi-wash option		
Minimizes carryover adding a high performance pump for 3 different solvents plus a solvent selection valve. An extra high pressure flush head is included to allow for active needle seat back flush.	G7167B #112	Combinations of Multi-wash with Dual-needle require an additional external valve mounted via rail.

Table 6 Multisampler Drawers for the Agilent 1290 Infinity II Multisampler

Description	Product Number	Comments
Single-height drawer (1H)		
Comes in quantity of 2. Each drawer can hold 2 individual sample containers for: Shallow well plates (96 or 384 well plates)	G7167B #131	Maximum setup with 1H drawers is 8 per instrument.
Dual-height drawer (2H)		
Comes in quantity of 1. Each drawer can hold 2 individual sample containers for: • Shallow well plates (96 or 384 well plates) • Deep well plates (96 or 384 well plates) • 40 x 2 mL vial container • 54 x 2 mL vial container (6/pk) • 27 x 0.5 or 1.5 or 2 mL Eppendorf safe-lock tubes	G7167B #132	Maximum setup with 2H drawers is 4 per instrument.
Triple-height drawer (3H)		
Comes in quantity of 2. Each drawer can hold 2 individual sample containers for: • Shallow well plates (96 or 384 well plates) • Deep well plates (96 or 384 well plates) • 40 x 2 mL vial container • 54 x 2 mL vial container • 27 x 0.5 or 1.5 or 2 mL Eppendorf safe-lock tubes • Deep well plates for 96x 1 mL vials capped • 15 x 6 mL vial container	G7167B #133	Maximum setup with 3H drawers is 2 per Instrument

Table 7 Analytical Heads and Sample Loops for the Agilent 1290 Infinity II Multisampler

Description	Product Number	Comments
Analytical head 100 µL		
100 µL metering device for use at up to 1300 bar.	G7167B #161	
Analytical head 900 µL		
900 µL metering device for large single stroke injections at max. 400 bar.	G7167B #163	Only for single needle setup. Limits system pressure to 400 bar.
Sample Loop-flex 40 µL right		
(only for Single-needle) For max. 40 µL injection.	G7167B #150	Extension of a default 20 µL loop
Loop 40 µL right Dual-needle		
Calibrated Dual-needle loop right.	G7167B #144	Extension of a default 20 µL DN-loop
Loop 40 µL left Dual-needle		
Calibrated Dual-needle loop left.	G7167B #151	Extension of a default 20 µL DN-loop
Sample Loop-flex 100 µL right		
(only for Single-needle) For max. 100 µL injection.	G7167B #152	Extension of a default 20 µL loop. Requires a 100 µL analytical head.
Loop 100 µL right Dual-needle		
Calibrated Dual-needle loop 100 µL right.	G7167B #145	Extension of a default 20 µL DN-loop. Requires a 100 µL analytical head.
Loop 100 µL left Dual-needle		
Calibrated Dual-needle loop left.	G7167B #153	Extension of a default 20 µL loop. Requires a 100 µL analytical head.
Loop kit 500 µL right Dual-needle		
Calibrated Dual-needle flex-loop plus extension and slotted needle.	G7167B #146	Only within Dual-needle setup DN-loop. Requires a 100 µL analytical head.

Table 7 Analytical Heads and Sample Loops for the Agilent 1290 Infinity II Multisampler

Description	Product Number	Comments
Loop kit 500 µL left Dual-needle		
Calibrated Dual-needle flex-loop plus extension and slotted needle.	G7167B #155	Only within Dual-needle setup. Requires a 100 µL analytical head.
Sample Loop-flex 900 µL right		
(only for Single-needle) Sample Loop-flex 900 µL right for max. 900 µL injection. • Only in combination with *900 µL analytical head* • Max. pressure limitation to *400 bar*	G7167B #156	For Single-needle setup only. Requires G7167B #163. System pressure limited to max. 400 bar.
Multi-draw option adding 400 µL / 1400 µL		
Includes 2 seat capillary extensions to inject up to 500 µL or to 1500 µL volume. (G1313-68711).	G7167B #121	Only for single-needle instruments. Max. sample volume depends on installed loop capillary. Caution: Large volume injection at high pressures can shorten LC-column lifetime.
Multi-draw option adding 80 µL		
Includes seat capillary to inject up to 120 µL volume (G4216-68711).	G7167B #122	Only for single-needle instruments. Maximum sample volume depends on installed loop capillary.

www.agilent.com/chem/infinitylab-lc-series

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Agilent Technologies

Agilent 1290 Infinity II Multicolumn Thermostat

Data Sheet

Product Description

The Agilent 1290 Infinity II Multicolumn Thermostat (MCT) allows precise column thermostatting over a broad temperature range: from cooling down to 20 degrees below ambient temperature up to 110 °C, providing infinite flexibility for optimized speed and selectivity of LC separation. Ultrahigh pressure valves enable a wide range of applications such as column selection from 8 columns in a single MCT, sample preparation for analyte enrichment or matrix removal, alternating column regeneration – and many more. The MCT fits perfectly with all 1290 Infinity II modules and can also be combined with modules of the Agilent 1260 and 1290 Infinity Series.

Features

- Superior usability with flexible flap positions: open door to 90° (desk function), 180° or even remove door for accessibility.
- Efficient, fast and most convenient column exchange through new quick-connect fittings.
- Advanced column capacity for up to 8 columns in a single MCT.
- Next generation Quick-Connect Heat Exchanger for pre-column solvent thermostatting – easily mounted for each of up to 8 columns and optimized for lowest internal volume contribution.
- Maximum application flexibility through Peltier cooling and heating with two independent temperature zones from 20 degree below ambient up to 110 °C.
- Optional valve drive for use of 1200 Infinity Series Quick-Change high pressure valves.
- High temperature precision for reproducible retention times and peak areas.

Specifications

Table 1 Physical Specifications

Type	Specification	Comments
Weight	12.5 kg (27.6 lbs)	
Dimensions (height × width × depth)	160 x 435 (472) x 436 mm (6.3 x 17.1 (18.6) x 17.2 inches)	
Line voltage	100 – 240 V~, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	150 VA, 150 W	
Ambient operating temperature	4–55 °C (39–131 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 95 % r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 2000 m (6562 ft)	
Non-operating altitude	Up to 4600 m (15092 ft)	For storing the module
Safety standards: IEC, EN, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

Table 2 Agilent 1290 Infinity II Multicolumn Thermostat (G7116B) Performance Specifications

Feature	Specification
Operating principle	Dual, independent Peltier-element thermostatted column compartment. Solvent pre-heating and still-air operation for reduction of chromatographic band-broadening under UHPLC-conditions. Up to three devices can be clustered and controlled by a single user interface for additional flexibility*.
Temperature range	4 °C to 110 °C, (minimum 20 °C below ambient)
Temperature stability	±0.03 °C
Temperature accuracy	±0.5 °C (with calibration)
Temperature precision	0.05 °C
Independent Temperature zones	2 (in single device) up to 6 in clustered configuration[1]

Table 2 Agilent 1290 Infinity II Multicolumn Thermostat (G7116B) Performance Specifications

Feature	Specification
Column capacity	8 columns of 100 mm length plus Quick-Connect fittings or pre-columns 4 columns of 300 mm length plus Quick-Connect fittings or pre-columns Selection of columns by single optional integrated 8-column selection valve (1300 bar) Maximum of 24 columns of 100 mm length plus Quick-Connect fittings or pre-columns 12 columns of 300 mm length plus Quick-Connect fittings or pre-columns with clustering[1] of three devices.
Heat-up/cool-down time	5 min from ambient to 40 °C 10 min from 40 °C to 20 °C <30 min from 25 °C to 100 °C
Solvent heat exchangers	Individually quick-installable for every column. Available at 1 µL (ultra-low dispersion), 1.6 µL (standard) and 3 µL (high-flow) volume.
Valve options	1x integrated valve drive as option 2x external valve drives as option to host user-exchangeable Quick-Change valve heads of different formats, materials and pressure ratings (up to 1300 bar): 2-position/6-port, 2-position/10-port, 6-column selection (6-pos/14-port), 8-column selection (8-pos/18-port). Equipped with tags, valve heads are automatically identified by SW
Communications	Controller-area network (CAN).
Safety and maintenance	Extensive diagnostics, error detection and display (through Instant Pilot control module and Agilent LabAdvisor), leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in main maintenance areas. Door-open sensor.
GLP	Valve heads carrying tags with serial number, pressure rating, number of switches and valve type.

* Availability 2015

Ordering Details

Description	Part Number
1290 Infinity II Multicolumn Thermostat	G7116B
Add option for valve drive	G7116B #058
Add option for 1 standard flow quick-connect heat exchanger and 4 column clips	G7116B #062
Add option for 1 high flow quick-connect heat exchanger (2.5 mL/min and higher) and 4 column clips	G7116B #063
Add option for 1 ultralow-disperison quick-connect heat exchanger and 4 column clips	G7116B #064
8-column selector valve head, 1300 bar, for use in G7116B MCT	G4239C
Add option for low dispersion capillary (0.12 mm id) kit for valve G4239C	G4239 #005

www.agilent.com/chem/1200

Published December 1, 2014
5991-5337EN

Agilent Technologies

Genius NM32LA

Nitrogen Generator for LC-MS

Part Number : 10-6020 Service Kit : 08-4780

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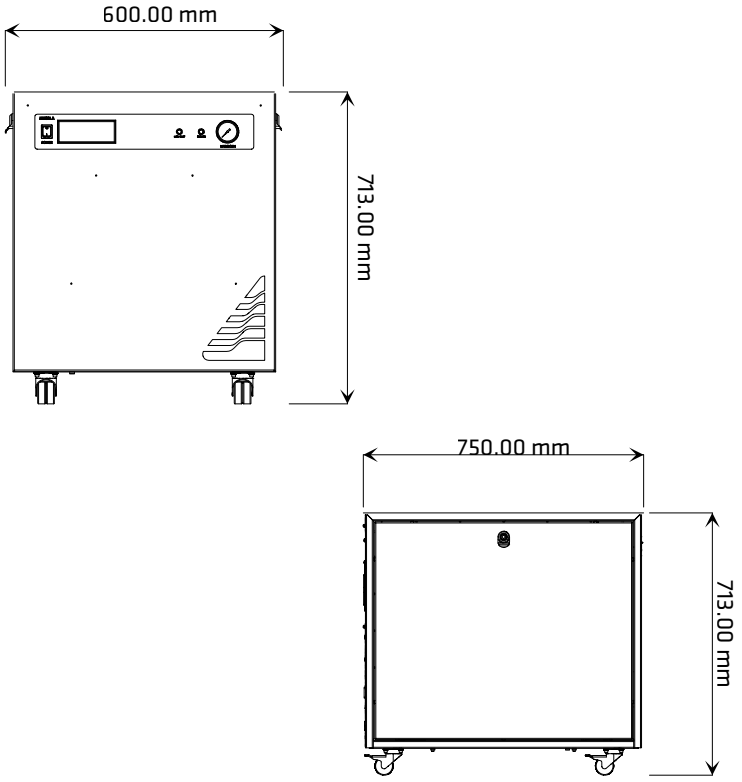
Description

The Genius NM32LA uses tried and tested membrane technology and internal compressors to generate laboratory grade nitrogen on-site and on demand. Built to last, with minimal maintenance requirements, this generator has been designed for ease of use, it will fit under a standard lab bench and is fitted with wheels for easy mobility.

The culmination of over a decade's work perfecting an on-site nitrogen gas generation for LC-MS, the Genius NM32LA is the pinnacle of our Genius series. The NM32LA has become a proven and reliable on-demand nitrogen solution in countless laboratories worldwide. This system's popularity is underpinned by its compatibility with most mass specs available in the market.

Applications

- Suitable for the majority of LC-MS instruments



Genius Nm32la Dimensions

Key Features

- Compressor based solution, generator can run on its own without the need for an external source of air
- Proven and reliable with 1000's in the field worldwide
- Duty and service indicators
- Latest generation, high specification compressor located in insulated chamber to minimize noise and vibration
- Once connected to the instrument and power is supplied, the system is fully operational
- The most cost effective method of gas supply
- Remove the hassle and safety concerns of ordering and changing out pressurized cylinders
- Gas is supplied on demand so generator works to your schedule
- Dual tap transformer available for labs with 110V electrical supply

Technical Specifications	Genius NM32LA
Max Flow Rate	32 L/min
Max Pressure	100 psi / 6.9 bar
Max Relative Humidity	80% Non-Condensing
Max Altitude	2000 Metres
Particles	< 0.01µm
Gas Outlets	1x 1/4" BSP Female
Phthalates	None
Suspended Liquids	None
Operating Temperature	5°C - 35°C / 41°F - 95°F
Electrical Requirements	230v 50/60Hz 7.0A
Power Consumption	1610 Watts
Noise Level	59 dB
Generator Dimensions (HxWxD)	713 x 600 x 750 mm/28.1 x 23.6 x 29.5 in
Generator Weight	102.5 Kg (226 lbs)

Ordering Information	
Part Number	10-6020
Annual Service	08-4780
Standard Maintenance Plan	09-3110
Complete Maintenance Plan	09-3010
Step-Up Transformer For Use With 208V Electrical Supply	06-3200

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Low Voltage	Load Power (kVA)	Input Voltage (VAC)	Output Voltage (VAC)	Input Plug	Output Receptacles	Frequency (Hz)	Case Size	Ship Weight lb (kg)
ABCDEF2000-11	2.0	100-120	100-120	Option Available	Option Available	50/60	A	310 (130)
ABCDEF3000-11	3.0	100-120	100-120	Option Available	Option Available	50/60	A	389 (175)

High Voltage	Load Power (kVA)	Input Voltage (VAC)	Output Voltage (VAC)	Input Plug	Output Receptacles	Frequency (Hz)	Case Size	Ship Weight lb (kg)
ABCDEF2000-22	2.0	200-240*	200-240*	Option Available	Option Available	50/60	A	316 (142)
ABCDEF3000-22	3.0	200-240*	200-240*	Option Available	Option Available	50/60	A	395 (178)
ABCDEF4000-22	4.0	200-240*	200-240*	Option Available	Option Available	50/60	A	412 (185)
ABCDEF5200-22	5.2	200-240*	200-240*	Option Available	Option Available	50/60	A	443 (200)
ABCDEF6000-22	6.0	200-240*	200-240*	Option Available	Option Available	50/60	A	443 (200)
ABCDEF8000-22	8.0	200-240*	200-240*	Option Available	Option Available	50/60	B	642 (291)
ABCDEF10.0-22	10.0	200-240*	200-240*	Option Available	Option Available	50/60	B	642 (291)
ABCDEF12.0-22	12.0	200-240*	200-240*	Option Available	Option Available	50/60	C	807 (366)
ABCDEF15.0-22	15.0	200-240*	200-240*	Option Available	Option Available	50/60	C	827 (375)

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Application Note

Cannabis Testing, Food

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Trusted Answers

A Sensitive and Robust Workflow to Measure Residual Pesticides and Mycotoxins from the Canadian Target List in Dry Cannabis Flower

Authors

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Abstract

As of October 2018, the recreational use of cannabis is legal at the federal level throughout Canada. Under Canadian law, licensed cannabis producers are obligated to meet strict quality requirements and mandatory testing to ensure consumer safety. The array of mandated testing includes potency determination, heavy metal detection, and microbial screening, amongst others. Of these, the analysis of pesticide residues is the most challenging, and Health Canada mandates a target list of 96 pesticides and five mycotoxins to be tested at limits of quantitation (LOQ) typically lower than any U.S. state. As a result, pesticide residue analysis in cannabis under Canadian regulations require state-of-the-art LC and GC triple quadrupole mass spectrometry (LC/MS/MS and GC/MS/MS, respectively).

Using a standardized sample preparation procedure and both LC/MS/MS and GC/MS/MS platforms, we demonstrate robust, specific, and sensitive quantification of the Canadian pesticide and mycotoxin target lists that meet the required reporting limits as published by Health Canada in dry cannabis. Eighty-eight target pesticides and five mycotoxins were analyzed with the Agilent 6470 LC/MS/MS system and alternatively, the Agilent Ultivo LC/MS/MS system, both coupled to an Agilent 1290 Infinity II UHPLC. Seventeen pesticides were analyzed on the Agilent 7890/7010 GC/MS/MS system.

As in the food and tobacco industries, pesticide testing requirements in cannabis are expected to become more rigorous over time, reinforcing the need for adopting a flexible and sensitive procedure such as the one described here. This multiplatform approach provides a rapid return on investment (ROI) and a stable foundation to meet current and future testing requirements.

Introduction

Many U.S. States have some form of cannabis or cannabinoid legalization. On the U.S. federal level however, cannabis (as defined by a Δ^9-tetrahydrocannabinol concentration >0.3 % wt/wt) is a Schedule 1 controlled substance, thus preventing the creation of clear nation-wide guidelines for cannabis testing. As a result, every state tests for different pesticides and define different limits of quantitation or action levels. The lack of harmonized guidelines results in many disparate methods that do not meet the pesticide testing requirements published by Health Canada in October 2018, where reporting limits are typically 10-fold lower than current requirements in California[1,2].

With respect to the number of target pesticides and action levels, Canada has the most comprehensive list in North America, with action levels for 96 pesticides as low as 20 parts-per-billion (ppb) for dried cannabis, and 10 ppb for fresh (wet) cannabis or cannabis oils. The California list includes 66 target pesticides and action levels down to 100 ppb for inhalable cannabis and other cannabis products. The Canadian list does not completely incorporate the California list, with captan, chlordane, and fenhexamid being unique to California.

Many U.S. state pesticide lists can be analyzed exclusively by LC/MS/MS. Notable exceptions include California, Florida, and Nevada, where GC/MS/MS is also required. This list of exceptions is expected to grow as the states add more compounds and lower the required limits of detection (LODs). Similarly to California, Florida, and Nevada, the extensive Canadian pesticide list presents at least six compounds for which reporting limits cannot be met by LC/MS/MS: endosulfan *alpha* and *beta*, etridiazole, fenthion, kinoprene, and quintozene (pentachloronitrobenzene). Those compounds and others, such as captan and chlordane, are commonly analyzed through GC/MS/MS using electron ionization.

A brief discussion of sample preparation

Cannabis is a complex plant containing many endogenous chemicals representing numerous chemical classes. Compared to other plants and vegetables, cannabis has higher amounts of potential interferences, and notably high concentrations of terpenes, cannabinoids, flavonoids, phenols, and fatty acids[4]. The complexity of the cannabis matrix makes detection and accurate quantification of trace levels of pesticides more challenging. Interfering compounds can negatively impact ionization in the mass spectrometer, affect signal-to-noise ratios (S/N), and build-up in the instrument source and consumables, thus decreasing productivity and increasing maintenance and operating costs. To overcome this challenge, a combination of optimized sample preparation and state-of-the-art instrumentation is required.

Initially, Quick, Easy, Cheap, Effective, Rugged, and Safe (QuEChERS) appeared to be a promising technique to extract pesticides and clean up samples. QuEChERS is a commonly used technique to prepare samples for residual pesticide testing in fruits and vegetables, and is a two-step procedure. The first step is to perform an extraction/partitioning between water and acetonitrile. The resulting acetonitrile layer undergoes a second cleaning step that uses dispersive solid-phase extraction (dSPE) sorbents to capture matrix interferences that would otherwise negatively impact detection by mass spectrometry.

Unfortunately, the QuEChERS approach is not viable for cannabis flower. Cannabis is a unique plant that calls for unique sample preparation. Why?

- QuEChERS requires wetting dry cannabis with water. This procedure increases the pH enough to degrade labile pesticides such as Captan, folpet, and spiroxamine.
- The addition of salts common to the procedure creates an exothermic reaction that also degrades sensitive pesticides.
- Mycotoxins and very polar pesticides such as daminozide are in the water layer in the extraction step.
- Finally, QuEChERS is not a good option to clean up cannabis because plant components such as cannabinoids and terpenes are in such high concentrations that dispersive kits do not have enough capacity to effectively remove matrix interferences.

Additionally, some dispersive compounds used in QuEChERS use a primary secondary amine (PSA) that can potentially capture acidic pesticides and reduce recoveries. Other dispersive reagents contain graphitized carbon black (GCB) that can inadvertently capture planar pesticides without additional solvents and drying steps. For these reasons, an alternative sample preparation approach was developed for simplicity, quick turnaround time, and to provide enough cleanup for improved sensitivity and system uptime.

Experimental

The LC/MS/MS analyses were performed using an Infinity II 1290 UHPLC system coupled to either a 6470 or an Ultivo triple quadrupole mass spectrometer. Both systems used an Agilent JetStream ESI source. The UHPLC system consisted of a binary pump (G7120A), low-carryover multisampler fitted with multiwash and 100-µL loop and metering device options (G7167B), thermostatted column compartment (G7116B), and Agilent MassHunter software.

The GC/MS/MS analyses were performed using an Agilent 7890B GC coupled to a 7010B triple quadrupole mass spectrometer. The GC configuration included a multimode inlet (MMI) and backflush capacity through a Purged Ultimate Union (PUU). The 7010B was equipped with a High Efficiency Source (HES) and the JetClean option, which allows for *in situ* cleaning of the HES source with hydrogen.

Instrumentation

Infinity II UHPLC method conditions	
Column (p/n 695975-312)	Infinity Lab Poroshell 120 Phenyl Hexyl, 3.0 × 100 mm, 2.7, µm
Guard column (p/n 823750-914)	Infinity Lab Poroshell 120 Phenyl Hexyl, 3.0 × 5 mm, 2.7, µm
Column temperature	55 °C
Injection volume	25 µL
Autosampler temperature	4 °C
Multiwash table	Step / Solvent / Time (s) / Seat backflush / Needle wash / Comments 1 / S1 / 10 / Yes / Yes / 0.1 % Formic acid in isopropanol 2 / S2 / 10 / Yes / Yes / 0.1 % Formic acid in acetonitrile 3 / S3 / 20 / Yes / Yes / 50:50 A:B
Mobile phase	A) 5 mM Ammonium formate + 0.1 % formic acid in water B) 0.1 % Formic acid in 90:10 methanol:acetonitrile
Gradient flow rate	0.5 mL/min
Analysis and re-equilibration time	10 minutes, 1.5 minutes
Total run time (sample to sample)	11.5 minutes
Gradient	Time (min) %B 0.00 50 1.00 50 8.00 95 9.00 100 10 100
LC/MS/MS Configuration and parameters	
Configuration	6470 QQQ or Ultivo QQQ Mass Spectrometer, both equipped with Jet Stream (AJS) ESI Source.
MS/MS Parameters	
Acquisition mode	dMRM
Polarity	Positive or Negative (compound-dependent)
Capillary voltage	4,000 V in positive mode, 3,000 V in negative mode
Drying gas flow	10 L/min
Drying gas temperature	200 °C
Nebulizer pressure	35 psi
Sheath gas temperature:	200 °C
Sheath gas flow	10 L/min
Nozzle voltage	300 V (either polarity)
Q1 and Q2 Resolution	Unit (0.7 amu), optimized by autotune
Delta EMV	0 V

Materials and reagents

Pesticide and mycotoxin standards

Pesticides and mycotoxins were obtained either individually or in mixes from various sources. All compounds were mixed to create a stock solution in acetonitrile, with each compound present at 1,000 ppb.

Other reagents

- **LC/MS grade methanol:** Sigma-Aldrich
- **LC/MS grade acetonitrile:** EMD Millipore
- **LC/MS grade water:** Burdick and Jackson
- **Pesticide-grade hexanes:** EMD Millipore
- **Pesticide-grade acetone:** Sigma-Aldrich
- **Formic acid (97+ %):** Sigma-Aldrich
- **Ammonium formate (99+ %):** Fisher Scientific

Sample and calibrator preparation

Several 1-g dried cannabis samples were simultaneously reduced to a fine powder by vertical shaking in clean tubes. Then, pesticides and mycotoxins were extracted from the cannabis powder with acetonitrile, and cleaned up on SampliQ C18 EC SPE cartridges. The resulting cannabis extracts were further diluted and tested by LC/MS/MS and GC/MS/MS (Figures 1 and 2).

Detailed sample preparation common to both LC/MS/MS and GC/MS/MS

1. Weigh 1.0 g of chopped cannabis into a 50-mL polypropylene (PP) centrifuge tube.
2. Add two ceramic homogenizers (p/n 5982-9313) or stainless steel beads to the tube, and cap. The homogenizers will help turn the chopped cannabis into a fine powder.
3. Shake mechanically for 2–5 minutes at high speed, ideally on a vertical shaking device (Geno/Grinder-type machine), to turn the dry cannabis into fine powder.
4. If precleanup spiked matrix samples are to be prepared, pipette the pesticide standard solution(s) and mycotoxin standards into the dry cannabis powder, then vortex for 30 seconds.
5. Add 15 mL of pesticide-grade acetonitrile to the tube from step 3.
6. Shake the tube mechanically for five minutes at high speed, ideally on a vertical shaking device (Geno/Grinder-type machine). This will extract the pesticides and mycotoxins into the acetonitrile.
7. While the tube is shaking, prepare the solid phase extraction (SPE) manifold by placing a SampliQ C18 EC 6 mL 500 mg SPE cartridge (p/n 5982-1365) onto the manifold. Place a collection tube that can hold 25 mL or more. Ideally, use a graduated 50-mL PP centrifuge tube underneath the cartridge in which the eluent will be collected.
8. Decant the supernatant from step 6 into the SampliQ C18 EC SPE cartridge. It will flow by gravity, but might require a small pressure pulse to initiate the flow.

7890B GC Method conditions	
Inlet	MMI
Inlet liner	Ultra Inert, Splitless, 4-mm single taper with deactivated fused silica wool (p/n 5190-2293)
Inlet temperature program	180 °C initial, hold 0 min, 400 °C/min to 280 °C
Injection volume	2 uL
Column 1	Agilent DB-35MS Ultra Inert, 15 m × 0.25 mm, 0.25 µm film thickness (p/n 122-3812), connected to MMI and Agilent Purged Ultimate Union
Column 2	Agilent HP-5MS Ultra Inert, 15 m × 0.25 mm, 0.25 µm film thickness (p/n 19091J-431), connected to Agilent Purged Ultimate Union and QQQ Transfer Line
Column 1 flow	1.0 mL/min, constant
Column 2 flow	1.4 mL/min, constant
Oven temperature program	Rate (°C/min) / Value (°C) / Hold time (min) / Run time (min) — / 70 / 1 / 1 60 / 240 / 0 / 3.8333 4 / 255 / 0 / 7.5833 30 / 300 / 6.9 / 15.983
Column backflush	Post run, 2.4 min at 2.49 mL/min
Run time	15-minute analysis time, 2.4-minute post run backflush, total sample-to-sample time of 22 minutes
GC/MS/MS Configuration and parameters	
Source	HES
Ionization mode	Electron Impact (EI)
Transfer line temperature	300 °C
Source temperature	280 °C
Quadrupole temperature	150 °C
Acquisition mode	dMRM
Detector gain factor	10
Solvent delay	3.5 minutes
Acquisition rate	7 cycles per second

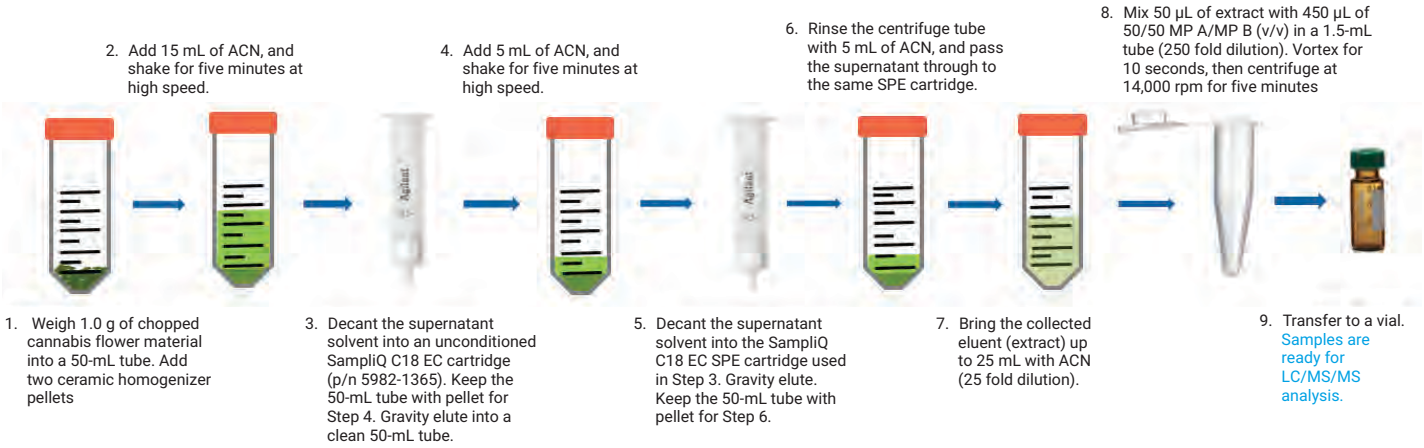

Figure 1. Schematic representation of sample preparation procedure for LC/MS/MS analysis.

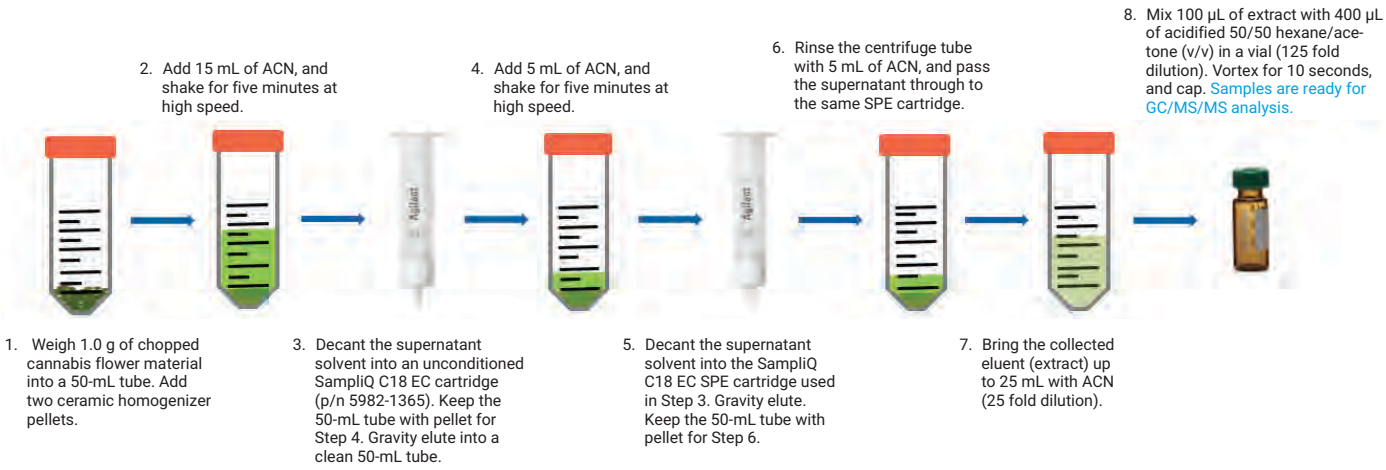

Figure 2. Schematic representation of sample preparation procedure for GC/MS/MS analysis.

9. After the entire solvent has gone through the C18 cartridge and is collected, add 5 mL of acetonitrile to the empty tube from step 6 and shake mechanically for five minutes at high speed. This will extract pesticides and mycotoxins that may still be in the cannabis material.
10. Decant the supernatant from step 9 into the same SampliQ C18 EC SPE cartridge.
11. Rinse the empty tube from step 9 with a final 5 mL of acetonitrile to wash any pesticides that might be retained on the tube wall, then pass this solvent through the same C18 cartridge. A volume of less than 25 mL (three portions of 15, 5, and 5 mL) of acetonitrile extract is collected.
12. Transfer all eluent into a volumetric flask, bring the final volume to 25 mL with acetonitrile or use the 25-mL mark on the graduated 50-mL PP centrifuge tube to adjust to 25 mL total. Vortex. Now the sample has been diluted 25 times.
13. Transfer the cleaned extract (step 12) into a clean tube, cap, and label.

Detailed sample preparation unique to LC/MS/MS

14. In a 1.5-mL centrifuge tube, mix solution 13 with a solution of 50:50 mobile phase A:mobile phase B in a 1-to-9 proportion. A typical scenario would be to mix 100 µL of solution 13 with 900 µL of 50:50 mobile phase A: mobile phase B. Vortex for 10 seconds. The solution might become cloudy. Now the sample has been diluted 250 times.
15. Centrifuge at 14,000 rpm for five minutes. Pellets might be observed at the bottom of the tube after centrifugation. Some cloudiness may be observed.
16. Transfer solution 15 to a 2-mL vial (p/n 5182-0716); avoid pipetting the pellets. Cap using p/n 5190-7021.
17. Inject the solution for LC/MS/MS or spike it with the desired amount of pesticide to obtain a post cleanup spiked matrix.

Matrix-matched calibrators: LC/MS/MS

Pesticide-free, extracted dry cannabis matrix in acetonitrile (1 g in 25 mL of acetonitrile = 25x dilution) further diluted 10x with 50:50 mobile phase A:mobile phase B (referred to as *Extract* in Table 1) was prepared in appropriate volume. Total dilution of matrix was 250x.

Dilutions were done in Eppendorf tubes, then the remaining solution in each tube was transferred into a deactivated glass insert (p/n 5181-8872) placed in a 2-mL vial, which was then capped and injected.

Detailed sample preparation unique to GC/MS/MS

18. Into a 2-mL vial, mix solution 13 with a solution of acidified hexane:acetone solution (0.1 % formic acid in 50:50 hexane:acetone) in a 1-to-4 proportion. A typical scenario would be to mix 200 µL of solution 13 with 800 µL of acidified hexane:acetone solution (0.1% formic acid in 50:50 hexane:acetone). Vortex for 10 seconds. Now the sample has been diluted 125 times.
19. Inject the solution for GC/MS/MS or spike it with the desired amount of pesticide to obtain a post cleanup spiked matrix.

Table 1. Preparation of calibrators for LC/MS/MS analysis.

STD Level (In vial, ppb)	Volume (µL)	Solution		Volume (µL)	Solution
25	12.5	1 ppm pesticide stock	added to	487.5	Extract
10	200	25 ppb	added to	300	Extract
5	250	10 ppb	added to	250	Extract
2.5	250	5 ppb	added to	250	Extract
1	200	2.5 ppb	added to	300	Extract
0.75	375	1 ppb	added to	125	Extract
0.5	333	0.75 ppb	added to	167	Extract
0.25	250	0.5 ppb	added to	250	Extract
0.1	200	0.25 ppb	added to	300	Extract
0.075	375	0.1 ppb	added to	125	Extract
0.05	333	0.075 ppb	added to	167	Extract
0.025	250	0.05 ppb	added to	250	Extract
0.01	200	0.025 ppb	added to	300	Extract
0.0075	375	0.01 ppb	added to	125	Extract
0.005	333	0.0075 ppb	added to	167	Extract

Matrix-matched calibrators: GC/MS/MS

Pesticide-free, extracted dry cannabis matrix in acetonitrile (1 g in 25 mL of acetonitrile = 25x dilution) further diluted 5x with acidified hexane:acetone solution (referred to as *Acidified Extract* in Table 2) was prepared in appropriate volume. Total dilution of matrix was 125x.

Dilutions were done in Eppendorf tubes, then the remaining solution in each tube was transferred into a deactivated glass insert (p/n 5181-8872) placed in a 2-mL vial, which was then capped and injected.

Table 2. Preparation of calibrators for GC/MS/MS analysis.

STD Level (In vial, ppb)	Volume (µL)	Solution		Volume (µL)	Solution
50	50	1 ppm pesticide stock	added to	450	Acidified extract
25	250	50 ppb	added to	250	Acidified extract
10	200	25 ppb	added to	300	Acidified extract
5	250	10 ppb	added to	250	Acidified extract
2.5	250	5 ppb	added to	250	Acidified extract
1	200	2.5 ppb	added to	300	Acidified extract
0.75	375	1 ppb	added to	125	Acidified extract
0.5	333	0.75 ppb	added to	167	Acidified extract
0.25	250	0.5 ppb	added to	250	Acidified extract
0.1	200	0.25 ppb	added to	300	Acidified extract
0.075	375	0.1 ppb	added to	125	Acidified extract
0.05	333	0.075 ppb	added to	167	Acidified extract

Results and discussion

Sample preparation

The use of ceramic homogenizers or stainless steel beads combined with the vertical shaking of multiple samples in individual 50-mL PP tubes eliminates the need for mechanical grinding. Mechanical grinding is typically low-throughput, and requires extra precaution to avoid cross-contamination from sample to sample. Vertical shaking increases lab productivity and reduces labor costs associated with sample handling. Sample size is important, as it must represent a statistically relevant proportion of the cannabis lot to be tested, with a constant pesticide exposure throughout. Therefore, approved sampling methods by Health Canada need to be followed.

Using a simple acetonitrile extraction and SPE cleanup, recoveries of pesticides and mycotoxins were calculated by spiking the acetonitrile extract (25x sample dilution) before the final dilution for either LC/MS/MS or GC/MS/MS analysis. Calculated recoveries (see Table 3) were comparable to those observed in a previous publication[5], although the approach described here was optimized for Canadian reporting limits.

The unique SampliQ C18 EC SPE cartridge used for cleanup displays superior inertness towards pesticides and mycotoxins. This SPE step shows its relevance as extracted samples have a significantly cleaner appearance after going through the cartridge. Cannabis is a unique plant that requires unique sample prep. High amounts of cannabinoids, terpenes, and other interferences can alter proper quantification by LC/MS/MS and GC/MS/MS. Therefore, the combination of SampliQ C18 EC cleanup followed by dilution in optimized solvents provides the best balance between sensitivity and robustness with reduced labor costs.

Table 3. Calculated recoveries from spiking matrix before final dilution.

Compound	Recovery (%)	%RSD (n = 3)
Pesticides		
Abamectin (Avermectin B1a)	102.7	3.3
Acephate	102.3	1.7
Acetamiprid	103.2	1.1
Acequinocyl	37.8	4.2
Aldicarb	101.9	1.5
Allethrin	108.7	2.5
Azadirachtin	92.7	5.5
Azoxystrobin	103.9	1.1
Benzovindiflupyr	106.4	0.9
Bifenazate	101.2	2.6
Bifenthrin	103.9	1.4
Boscalid	91.0	1.8
Buprofezin	103.0	1.3
Carbaryl	101.5	1.7
Carbofuran	102.2	1.1
Chlorantraniliprole	100.2	2.9
Chlorphenapyr	103.7	1.3
Chlorpyrifos	101.0	1.2
Clofentezine	113.0	3.9
Clothianidin	100.4	2.7
Coumaphos	98.9	2.8
Cyantranilipole	99.4	1.3
Cyfluthrin	99.8	2.1
Cypermethrin	92.5	4.8
Cyprodinil	79.8	3.5
Daminozide	102.4	3.2
Deltamethrin	91.9	5.5
Diazinon	103.4	1.6
Dichlorvos	98.9	2.1
Dimethoate	103.5	1.6
Dinotefuran	101.6	2.1
Dodemorph	94.2	2.1
Endosulfan alpha	96.2	3.4
Endosulfan beta	96.3	3.9
Endosulfan sulfate	101.4	3.0

Compound	Recovery (%)	RSD (%, n = 3)
Ethoprophos	102.6	2.3
Etofenprox	66.8	2.2
Etoxazole	86.6	2.0
Etridiazole	102.5	3.3
Fenoxycarb	110.0	1.1
Fenpyroximate	76.4	1.8
Fensulfothion	102.1	2.3
Fenthion	100.7	1.7
Fenvalerate	92.0	1.3
Fipronil	104.3	0.6
Flonicamid	1067.	2.4
Fludioxonil	101.5	1.2
Fluopyram	105.6	2.1
Hexythiazox	93.5	6.0
Imazalil	103.3	1.0
Imidacloprid	100.4	1.1
Kinoprene	96.9	4.0
Kresoxim-methyl	107.6	1.6
Malathion	103.1	1.8
Metalaxyl	101.1	0.5
Methiocarb	105.0	0.3
Methomyl	101.7	4.8
Methoprene	81.5	2.2
Methyl parathion	102.7	1.2
Mevinphos I	96.9	0.2
Mevinphos II	102.1	1.2
MGK-264	102.8	9.9
Myclobutanil	106.1	1.1
Naled	102.0	1.1
Novaluron	98.0	2.2
Oxamyl	103.2	1.9
Paclobutrazol	101.8	3.4
Permethrin	98.2	2.3
Phenothrin	69.7	1.5
Phosmet	104.9	2.7
Piperonyl butoxide	97.3	1.9

Compound	Recovery (%)	RSD (%, n = 3)
Pirimicarb	99.4	1.3
Prallethrin	108.9	0.5
Propiconazole	102.8	0.4
Propoxur	103.2	1.2
Pyraclostrobin	103.7	0.8
Pyrethrin I	88.5	4.1
Pyrethrin II	91.5	5.8
Pyridaben	70.5	0.9
Quintozene (PCNB)	100.2	3.5
Resmethrin	82.5	4.2
Spinetoram J	68.4	2.2
Spinetoram L	58.3	2.9
Spinosyn A	79.0	3.0
Spinosyn D	73.8	1.6
Spirodiclofen	92.1	2.9
Spiromesifen	98.3	1.0
Spirotetramat	100.4	5.5
Spiroxamine	96.3	1.2
Tebuconazole	100.1	5
Tebufenozide	105.0	1.0
Teflubenzuron	98.0	5.4
Tetrachlorvinphos	106.5	1.5
Tetramethrin	101.6	2.9
Thiacloprid	101.8	2.2
Thiamethoxam	103.4	0.4
Thiophanate-methyl	100.7	3.7
Trifloxystrobin	103.8	0.4
Mycotoxins		
Aflatoxin G1	102.8	0.2
Aflatoxin G2	102.7	0.3
Aflatoxin B1	104.8	0.4
Aflatoxin B2	102.3	1.4
Ochratoxin	100.5	2.2

6470 LC/MS/MS results and discussion

The 1290 Infinity II coupled with a 6470 triple quadrupole LC/MS/MS system offers both the level of sensitivity required by Canadian regulations to meet the reporting limits for pesticides in dry cannabis, and the level of robustness required to run this application daily. The combination of sample dilution and mobile phase composition allows one to maintain excellent peak shape for all compounds when injecting 25 µL, but will also allow for larger injection volumes, if necessary. The MRM transitions were optimized using the MassHunter Optimizer program (see Table 5 in Appendix), and the acquisition was performed in dMRM mode, in which the dwell time of each transition was optimized by the MassHunter software based on the retention time of each compound. Linear calibration curves were observed, with a regression fit equal to or greater than 0.99, and the LOQs listed in Table 2 were obtained in spiked matrix.

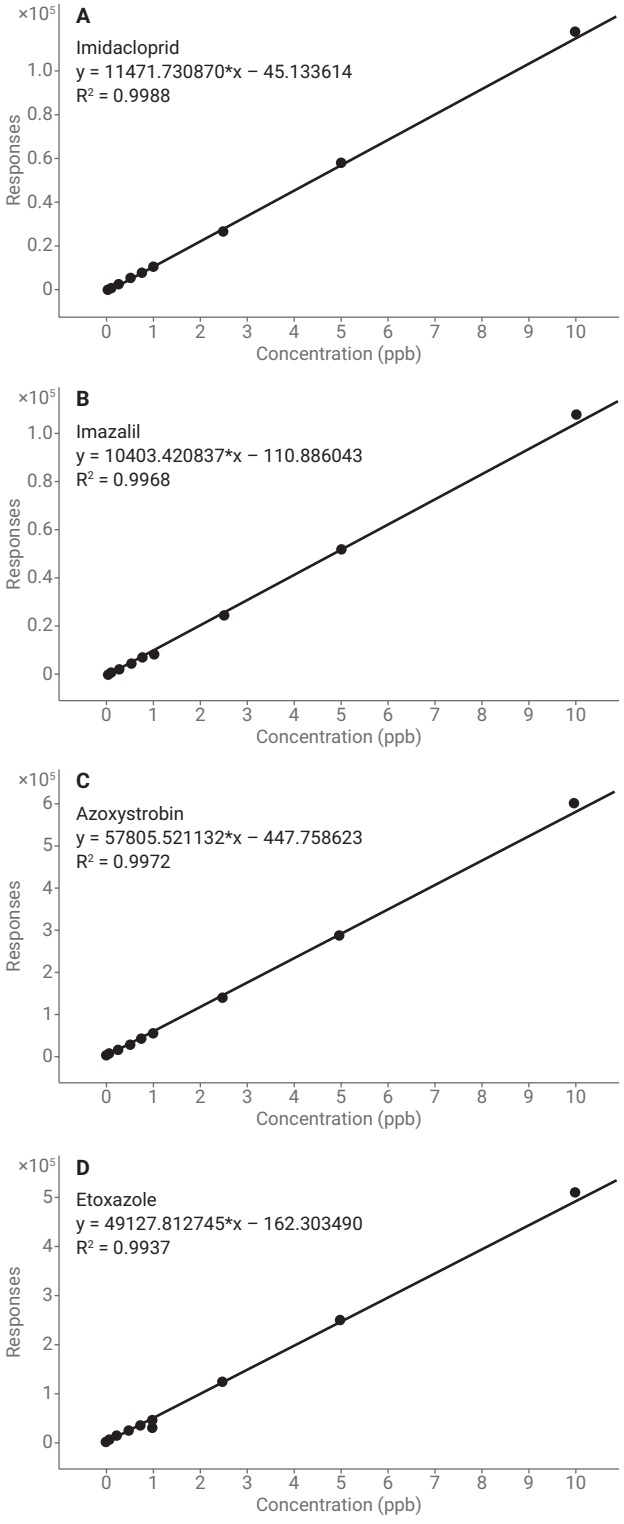

Figure 3. Select 6470 LC/MS/MS calibration curves. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

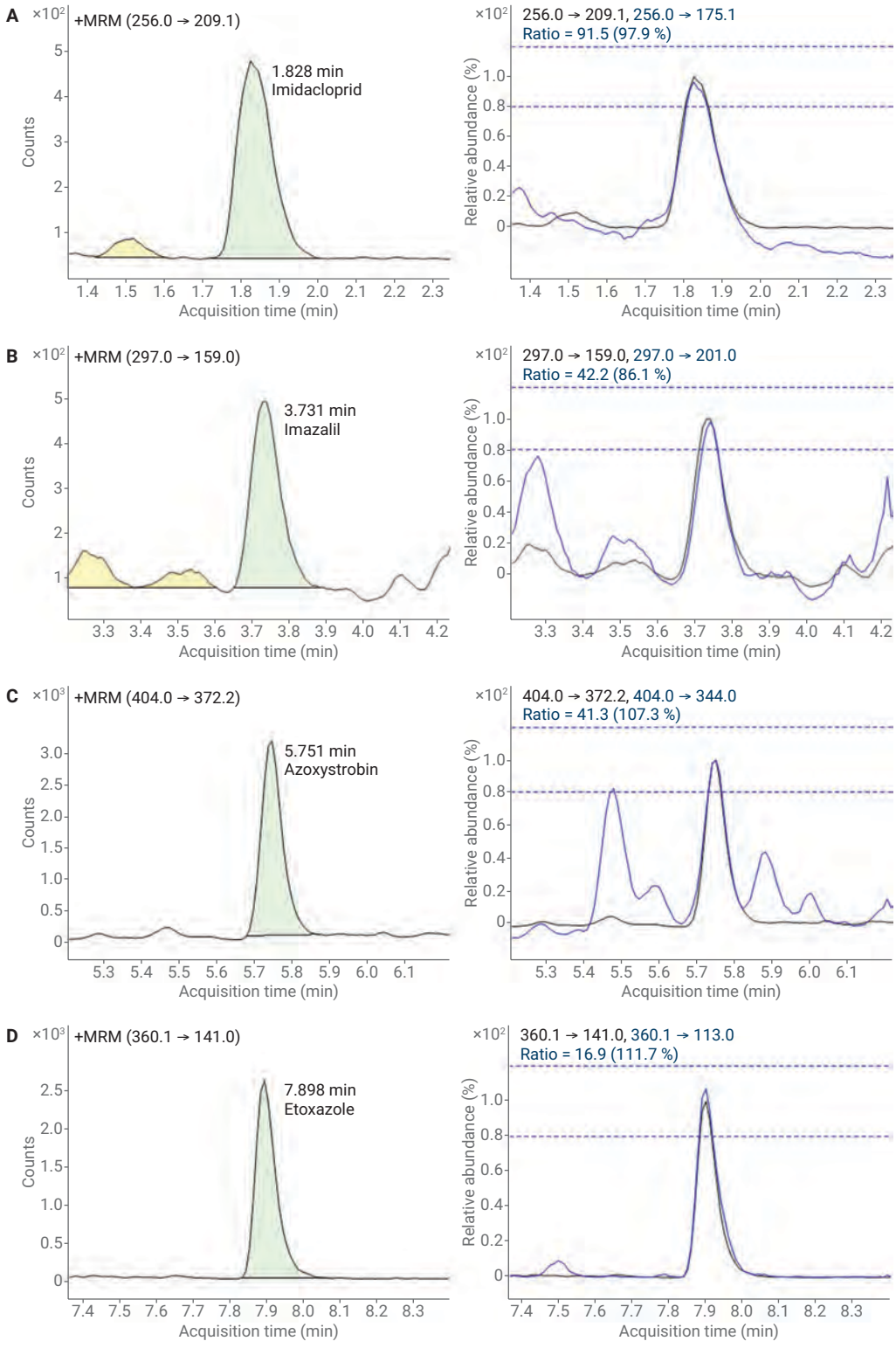

Figure 4. Select 6470 LC/MS/MS chromatograms. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

Ultivo LC/MS/MS results and discussion

The Ultivo LC/MS/MS was introduced in 2017 as a next-generation LC/MS/MS system, with new optical and electronic components. Its development was based on combining small size, ease of maintenance, and maximum instrument uptime. Given the challenging nature of pesticide residue testing in cannabis, it is of interest to evaluate if the Ultivo can match the 6470 in terms of sensitivity for this application.

The 1290 Infinity II UHPLC stack previously used with the 6470 was connected to the Ultivo, which allowed us to keep retention times identical between the two systems, and thus, identical dwell times for all compounds using the dMRM mode.

The Ultivo equaled the performance of the 6470 in terms of linearity range and LOQ, as illustrated by the equivalent calibration curves in Figure 5 compared to Figure 3.

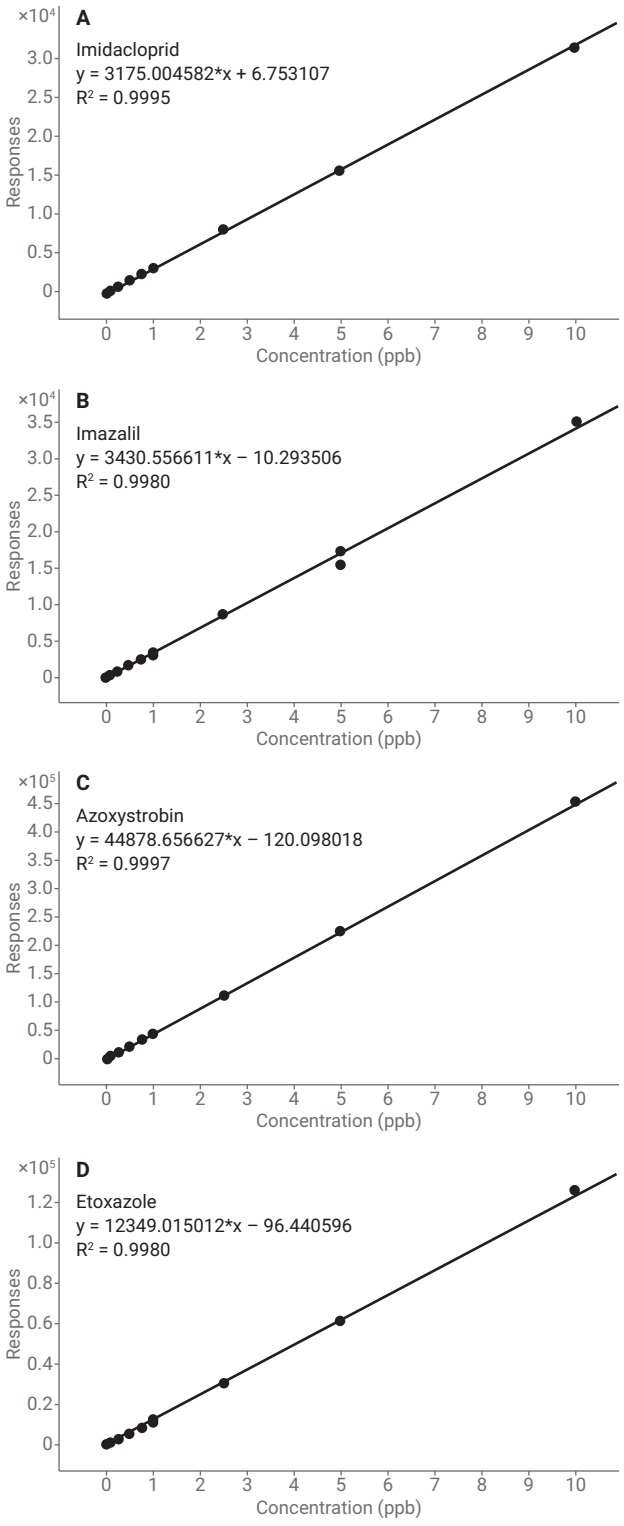

Figure 5. Select Ultivo LC/MS/MS calibration curves. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

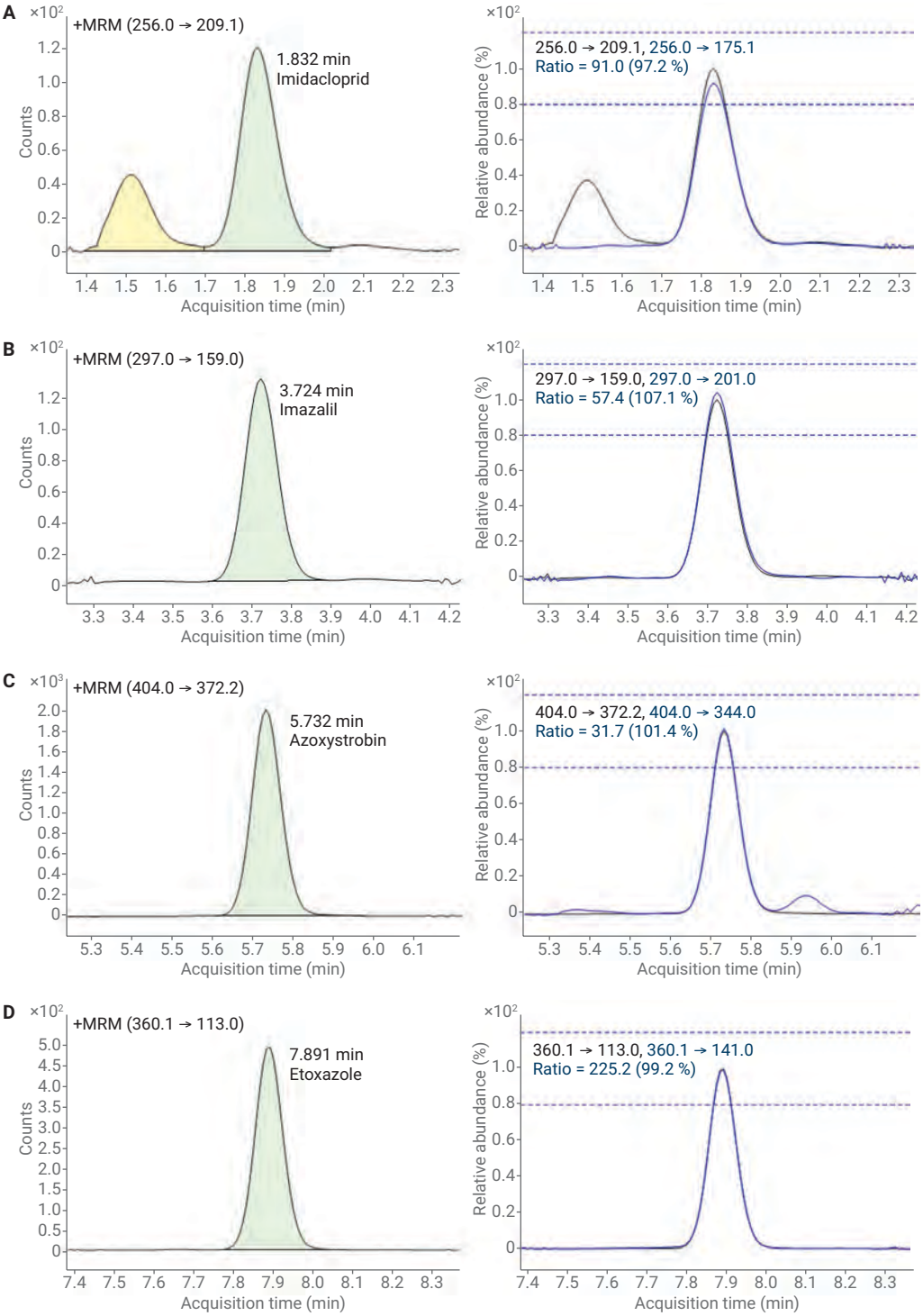

Figure 6. Select Ultivo LC/MS/MS chromatograms. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

7010 GC/MS/MS results and discussion

A vast majority of the pesticides included in the Health Canada list can be analyzed by LC/MS/MS. However, for some of these pesticides, it is impossible to consistently meet the required reporting limits (RLs) set by Health Canada without very extensive and long sample cleanup, or at the expense of sample throughput through time-consuming instrument optimization. The same is true for some regulated pesticides in California that are not part of the Canadian list, and that are also not amenable to LC/MS/MS. GC/MS/MS is the best choice to complete the coverage of the Canadian and California lists, as it can be used as the primary reporting platform or in a confirmatory approach when matrix could interfere with some compounds in LC/MS/MS.

The first cleanup step in sample preparation is common between LC/MS/MS and GC/MS/MS, but some optimization was required in the second step (dilution) as well as in hardware setup. A mix of acidified acetone:hexane was used for the second 1-in-5 dilution, for a final sample dilution of 125x. To compensate for this smaller dilution factor, and keeping instrument uptime as a primary objective, two hardware options were selected: post run, midcolumn backflush to avoid source contamination by late eluting compounds, and post sequence JetClean source cleaning to restore source conditions from sequence to sequence.

Table 6 in the Appendix lists the 7010 MRM transitions, and Table 4 shows the LOQs.

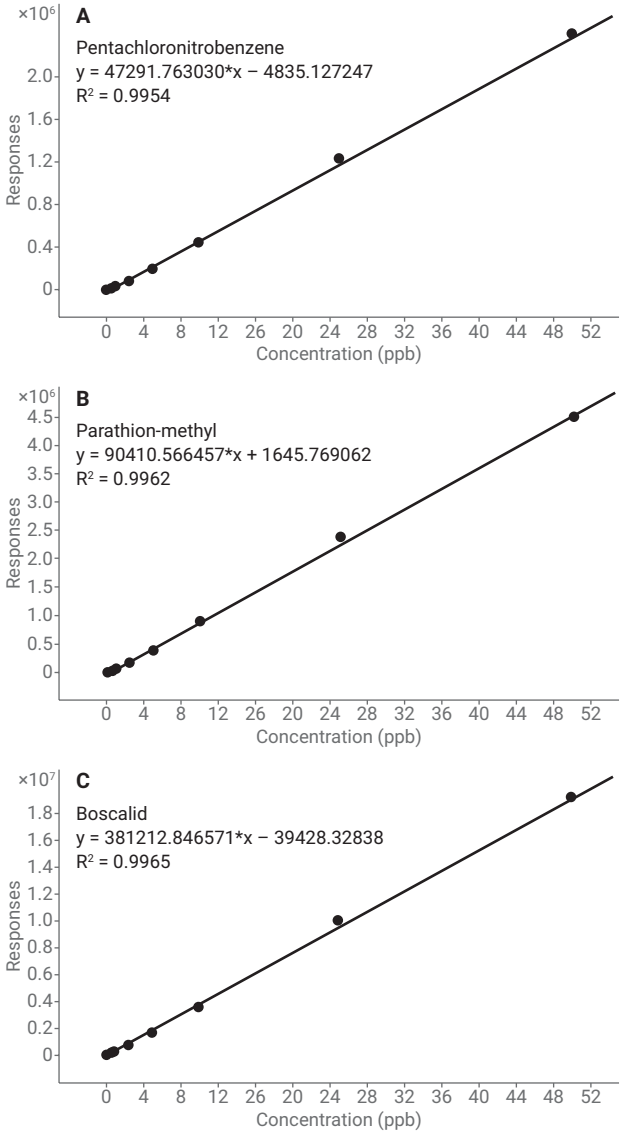

Figure 7. Select 7010 GC/MS/MS calibration curves.
A) Pentachloronitrobenzene (PCNB, Quintozene), B) Parathion-methyl, C) Boscalid.

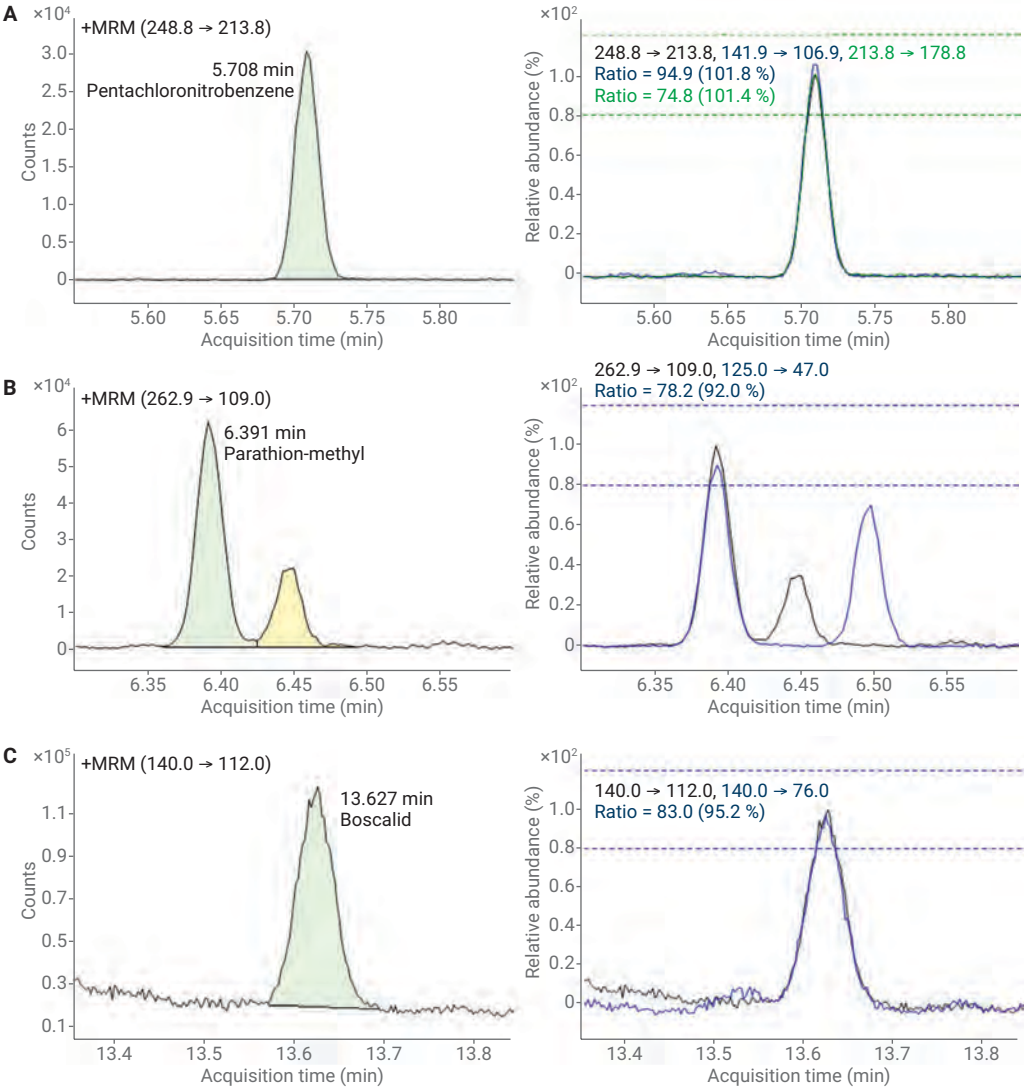

Figure 8. Select 7010 GC/MS/MS chromatograms. A) Pentachloronitrobenzene (PCNB, quintozene), B) Parathion-methyl, C) Boscalid.

Table 4. Calculated LOQs in matrix. A blank cell indicates that no data were collected for a given compound using that specific platform (continued next page).

Compound	Health Canada reporting limit (ppb)	LC/MS/MS LOQ in matrix (ppb)	GC/MS/MS LOQ in matrix (ppb)
Pesticides			
Abamectin (Avermectin B1a)	500	12.5	
Acephate	20	2.5	
Acetamiprid	100	2.5	
Acequinocyl	Under development*	18.75	
Aldicarb	1,000	2.5	
Allethrin	200	125	
Azadirachtin	1,000	12.5	
Azoxystrobin	20	2.5	
Benzovindiflupyr	20	2.5	
Bifenazate	20	2.5	
Bifenthrin	Under development*	62.5	31
Boscalid	20	6.25	12.5
Buprofezin	20	2.5	
Carbaryl	50	2.5	
Carbofuran	20	2.5	
Chlorantraniliprole	Under development*	2.5	
Chlorphenapyr	Under development*	25	
Chlorpyrifos	Under development*	25	6.25
Clofentezine	20	18	
Clothianidin	50	2.5	
Coumaphos	20	6.25	
Cyantranilipole	20	6.25	
Cyfluthrin	Under development*		125
Cypermethrin	Under development*	250	125
Cyprodinil	Under development*	12.5	
Daminozide	Under development*	2.5	
Deltamethrin	Under development*	62.5	62.5
Diazinon	Under development*	2.5	
Dichlorvos	100	6.25	
Dimethoate	20	2.5	
Dinotefuran	100	2.5	
Dodemorph	Under development*	2.5	
Endosulfan *alpha*	Under development*		31
Endosulfan *beta*	Under development*		12.5
Endosulfan sulfate	Under development*	12.5	
Ethoprophos	20	2.5	
Etofenprox	Under development*	6.25	
Etoxazole	20	2.5	
Etridiazole	Under development*		6.25

Compound	Health Canada reporting limit (ppb)	LC/MS/MS LOQ in matrix (ppb)	GC/MS/MS LOQ in matrix (ppb)
Fenoxycarb	20	2.5	
Fenpyroximate	20	2.5	
Fensulfothion	20	2.5	
Fenthion	Under development*		9.4
Fenvalerate	Under development*		31
Fipronil	60	2.5	
Flonicamid	50	12.5	
Fludioxonil	20	2.5	
Fluopyram	20	2.5	
Hexythiazox	Under development*	12.5	
Imazalil	20	2.5	
Imidacloprid	20	2.5	
Iprodione	1000	250	
Kinoprene	Under development*		312.5
Kresoxim-methyl	Under development*	2.5	
Malathion	20	2.5	
Metalaxyl	20	2.5	
Methiocarb	20	2.5	
Methomyl	50	1.25	
Methoprene	Under development*	187.5	
Methyl parathion	Under development*		9.375
Mevinphos I	50	6.25	
Mevinphos II	50	6.25	
MGK-264	Under development*	187.5	31.25
Myclobutanil	20	2.5	
Naled	Under development*	6.25	
Novaluron	50		31.25
Oxamyl	3000	1.25	
Paclobutrazol	20	2.5	
Permethrin	Under development*		125
Phenothrin	50	2.5	
Phosmet	Under development*	2.5	
Piperonyl butoxide	Under development*	2.5	
Pirimicarb	20	2.5	
Prallethrin	Under development*	62.5	
Propiconazole	Under development*	2.5	
Propoxur	20	2.5	
Pyraclostrobin	20	2.5	
Pyrethrin I	50	32.7	
Pyrethrin II	50	32.9	
Pyridaben	50	2.5	

* Under development: The reporting limit in dry cannabis matrix was not established by Health Canada at the time of this Application Note's publication.

A total workflow for pesticide quantitation and reporting

The Agilent workflow for residual pesticides in cannabis flower not only includes a single-stream sample preparation procedure amenable to both LC/MS/MS and GC/MS/MS data acquisition platforms, but also includes unified data analysis and reporting tools. Using the Quant-My-Way features of the MassHunter Quantitative Analysis software package, processing raw data is performed within a graphical environment designed specifically for residual pesticide testing in cannabis and related products. The interface is striated, and controls how a user interacts with the software and the features that are available for specific workflows. For example, the Scientist interface has read/write permissions and offers the abilities to create and edit quantitative procedures and define reporting information. The Analyst interface has read-only permission for use in the daily production environment. Thus, the laboratory can control how data are processed and reported, and capture change-exceptions when necessary.

Compound	Health Canada reporting limit (ppb)	LC/MS/MS LOQ in matrix (ppb)	GC/MS/MS LOQ in matrix (ppb)
Quintozene (PCNB)	Under development*		6.25
Resmethrin	100	6.25	
Spinetoram J	Under development*	6.25	
Spinetoram L	Under development*	12.5	
Spinosyn A	Under development*	6.25	
Spinosyn D	Under development*	6.25	
Spirodiclofen	20	18.75	
Spiromesifen	3000	2.5	
Spirotetramat	20	2.5	
Spiroxamine	Under development*	2.5	
Tebuconazole	Under development*	2.5	
Tebufenozide	20	2.5	
Teflubenzuron	50	18.75	
Tetrachlorvinphos	20	2.5	
Tetramethrin	100	12.5	
Thiacloprid	20	2.5	
Thiamethoxam	20	2.5	
Thiophanate-methyl	50	2.5	
Trifloxystrobin	20	2.5	
Mycotoxins			
Aflatoxin G1	2	1.25	
Aflatoxin G2	2	1.25	
Aflatoxin B1	2	1.25	
Aflatoxin B2	2	1.25	
Ochratoxin	20	2.5	

* Under development: The reporting limit in dry cannabis matrix was not established by Health Canada at the time of this Application Note's publication.

Conclusion

Mandatory reporting limits established by Health Canada for pesticide testing in cannabis are typically lower than those published in various U.S. states, and require both LC/MS and GC/MS for accurate and robust testing. Because dried cannabis leaves and flowers generate many co-extractives that can negatively impact testing results, a simple and cost-effective sample preparation had to be developed to meet the demanding testing requirements in Canada. A combination of acetonitrile extraction, unique SPE on SampliQ C18 EC, and further dilution in optimized solvent is the best approach for accurate pesticide and mycotoxin quantification at levels as low as 20 ppb.

Agilent instrumentation including the 1290 Infinity II LC coupled with a 6470 LC/MS/MS system and Ultivo LC/MS/MS, as well as the 7010 GC/MSMS, provides robust, accurate, and sensitive residual pesticide and mycotoxin testing in challenging matrices such as cannabis.

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Disclaimer

Agilent products and solutions are intended to be used for cannabis quality control and safety testing in laboratories where such use is permitted under state/country law.

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Appendix

Table 5. LC/MS/MS MRM transitions.

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Avermectin B1a	8.48	Positive	890.5	567.1	160	8
Avermectin B1a	8.48	Positive	890.5	567.1	160	8
Avermectin B1a	8.48	Positive	890.5	305.1	160	28
Avermectin B1a	8.48	Positive	890.5	145	160	45
Avermectin B1b	8.29	Positive	876.6	553.2	160	7
Avermectin B1b	8.29	Positive	876.6	291.1	160	15
Acephate	1.26	Positive	184	143	60	5
Acephate	1.26	Positive	184	95	60	20
Acequinocyl	9.58	Positive	402.3	343.2	90	10
Acequinocyl	9.58	Positive	402.3	189.1	90	41
Acetamiprid	2.1	Positive	223	126.1	100	20
Acetamiprid	2.1	Positive	223	90.1	100	35
AflatoxinB1	4.23	Positive	313.1	285.1	160	16
AflatoxinB1	4.23	Positive	313.1	241.1	160	35
AflatoxinB2	3.78	Positive	315.1	287.1	130	17
AflatoxinB2	3.78	Positive	315.1	259.1	130	17
AflatoxinG1	3.46	Positive	329.1	311.1	130	20
AflatoxinG1	3.46	Positive	329.1	243.1	130	17
AflatoxinG2	3.03	Positive	331.1	285.1	150	21
AflatoxinG2	3.03	Positive	331.1	245.1	150	26
Aldicarb	2.22	Positive	116	89.1	50	4
Aldicarb	2.22	Positive	116	70.1	50	4
Allethrin	7.5	Positive	303	169	85	4
Allethrin	7.5	Positive	303	135	85	10
Allethrin	7.5	Positive	303	123	85	16
Azadirachtin	4.36	Positive	703	685	165	8
Azadirachtin	4.36	Positive	703	585	165	12
Azadirachtin	4.36	Positive	703	567	165	12
Azoxystrobin	5.73	Positive	404	372.2	100	10
Azoxystrobin	5.73	Positive	404	344	100	25
Benzovindiflupyr	6.69	Positive	398	378	150	12
Benzovindiflupyr	6.69	Positive	398	342	150	20
Benzovindiflupyr	6.69	Positive	398	322	150	24
Bifenazate	5.83	Positive	301.1	198.2	80	5
Bifenazate	5.83	Positive	301.1	170.1	80	15
Bifenthrin	9.07	Positive	440.1	181.1	90	5
Bifenthrin	9.07	Positive	440.1	166	90	20
Boscalid	5.58	Positive	343	307	140	12
Boscalid	5.58	Positive	343	271	140	28
Buprofezin	7.38	Positive	306	201	105	8
Buprofezin	7.38	Positive	306	116	105	16
Carbaryl	3.33	Positive	202	145	70	0
Carbaryl	3.33	Positive	202	127	70	25
Carbofuran	3.16	Positive	222	165	90	5
Carbofuran	3.16	Positive	222	123	90	20
Chlorantraniliprole	5.04	Positive	483.9	452.9	100	15
Chlorantraniliprole	5.04	Positive	483.9	285.9	100	10
Chlorfenapyr	7.35	Positive	409.2	59	130	20
Chlorfenapyr	7.35	Positive	409.2	31	130	45
Chlorpyrifos	7.95	Positive	349.9	197.9	100	20
Chlorpyrifos	7.95	Positive	349.9	97	100	41
Clofentezine	7.04	Positive	303	138	90	10
Clofentezine	7.04	Positive	303	102.1	90	10
Clothianidin	1.69	Positive	250	169	95	12
Clothianidin	1.69	Positive	250	132	95	16
Coumaphos	7.4	Positive	363	307	125	15
Coumaphos	7.4	Positive	363	226.9	125	33
Cyantranilipole	4.29	Positive	475	444	115	20

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Cyantranilipole	4.29	Positive	475	286	115	12
Cyfluthrin	9.2	Positive	453.3	193	90	13
Cyfluthrin	9.2	Positive	451.3	191	90	13
Cypermethrin	8.72	Positive	435.3	193	90	16
Cypermethrin	8.72	Positive	433.3	191	90	16
Cyprodinil	5.5	Positive	226	133	160	28
Cyprodinil	5.5	Positive	226	93	160	40
Daminozide	1.18	Positive	161	143	80	10
Daminozide	1.18	Positive	161	61.1	80	10
Deltamethrin	9.15	Positive	523	506	100	8
Deltamethrin	9.15	Positive	523	281	100	12
Diazinon	6.43	Positive	305.1	169.1	100	20
Diazinon	6.43	Positive	305.1	153.1	100	20
Dichlorvos	2.72	Positive	221	109	110	12
Dichlorvos	2.72	Positive	221	79	110	24
Dimethoate	1.86	Positive	230	199	80	0
Dimethoate	1.86	Positive	230	125	80	20
Dimethomorph I	7.2	Positive	388.1	301	134	24
Dimethomorph I	7.2	Positive	388.1	165	134	36
Dimethomorph II	7.84	Positive	388.1	301	134	24
Dimethomorph II	7.84	Positive	388.1	165	134	36
Dinotefuran	1.24	Positive	203	157	90	4
Dinotefuran	1.24	Positive	203	129	90	8
Dinotefuran	1.24	Positive	203	87	90	16
Dinotefuran	1.24	Positive	203	73	90	20
Dodemorph	4.1	Positive	282	116	145	24
Dodemorph	4.1	Positive	282	98	145	32
Endosulfan sulfate	7.09	Negative	421	97	130	28
Endosulfan sulfate	7.09	Negative	421	80	130	56
Ethoprophos	5.51	Positive	243	131	90	15
Ethoprophos	5.51	Positive	243	97	90	30
Etofenprox	9	Positive	394.2	177.2	90	10
Etofenprox	9	Positive	394.2	107.1	90	45
Etoxazole	7.87	Positive	360.1	141	140	28
Etoxazole	7.87	Positive	360.1	113	140	50
Fenoxycarb	6.37	Positive	302.1	116.1	100	5
Fenoxycarb	6.37	Positive	302.1	88.1	100	15
Fenpyroximate	8.14	Positive	422.1	366.2	130	15
Fenpyroximate	8.14	Positive	422.1	135.1	130	30
Fensulfothion	4.52	Positive	309	281	125	12
Fensulfothion	4.52	Positive	309	253	125	16

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Fenvalerate	9	Positive	437	167	105	16
Fipronil	6.05	Negative	436.9	332	100	18
Fipronil	6.05	Negative	434.9	330	100	18
Fipronil	6.05	Negative	434.9	250.1	100	30
Flonicamid	1.4	Positive	230.1	203	125	18
Flonicamid	1.4	Positive	230.1	148	125	32
Flonicamid	1.4	Positive	230.1	98	125	48
Fludioxonil	5.01	Negative	247	169	120	36
Fludioxonil	5.01	Negative	247	126	120	40
Fluopyram	5.62	Positive	397	208	150	24
Fluopyram	5.62	Positive	397	173	150	36
Hexythiazox	8.2	Positive	353	228.1	90	10
Hexythiazox	8.2	Positive	353	168.1	90	25
Imazalil	3.73	Positive	297	201	120	15
Imazalil	3.73	Positive	297	159	120	20
Imidacloprid	1.85	Positive	256	209.1	90	16
Imidacloprid	1.85	Positive	256	175.1	90	20
Iprodione	6.77	Positive	332	247	80	16
Iprodione	6.77	Positive	332	56	80	44
Iprodione	6.77	Positive	330	245	80	16
Iprodione	6.77	Positive	330	56	80	50
Kresoxim methyl	6.6	Positive	314.1	267.1	80	0
Kresoxim methyl	6.6	Positive	314.1	222.2	80	10
Malathion	5.7	Positive	331.1	126.9	80	5
Malathion	5.7	Positive	331.1	99	80	10
Metalaxyl	4.06	Positive	280.1	220.2	100	10
Metalaxyl	4.06	Positive	280.1	160.1	100	20
Methiocarb	4.98	Positive	226.1	169.1	70	0
Methiocarb	4.98	Positive	226.1	121.1	70	15
Methomyl	1.38	Positive	162.9	106.1	60	5
Methomyl	1.38	Positive	162.9	88.1	60	0
Methoprene	8.09	Positive	311	151	100	0
Methoprene	8.09	Positive	311	123	100	2
Methoprene	8.09	Positive	311	109	100	4
Methyl-Parathion	5.61	Positive	264	232	140	18
Methyl-Parathion	5.61	Positive	264	125	140	24
Mevinphos I	1.62	Positive	225	193	75	4
Mevinphos I	1.62	Positive	225	127	75	16
Mevinphos II	1.99	Positive	225	193	75	4
Mevinphos II	1.99	Positive	225	127	75	16
MGK-264	6.8	Positive	276.2	210.1	100	12

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
MGK-264	6.8	Positive	276.2	98	100	28
Myclobutanil	5.66	Positive	289.1	125	110	35
Myclobutanil	5.66	Positive	289.1	70.1	110	15
Naled (Dibrom)	4.42	Positive	380.8	127	90	8
Naled (Dibrom)	4.42	Positive	378.8	127	90	5
Novaluron	7.19	Positive	493	158	145	20
Novaluron	7.19	Positive	493	141	145	56
Ochratoxin	6.33	Positive	404.1	238.9	120	14
Ochratoxin	6.33	Positive	404.1	220.9	120	32
Oxamyl	1.29	Positive	237	90.1	60	0
Oxamyl	1.29	Positive	237	72.1	60	15
Paclobutrazol	5.05	Positive	294.1	125	110	40
Paclobutrazol	5.05	Positive	294.1	70.1	110	20
Permethrin	7.7	Positive	391.1	355	120	5
Permethrin	7.7	Positive	391.1	183	120	5
Phenothrin	8.73	Positive	351	237	120	8
Phenothrin	8.73	Positive	351	183	120	20
Phenothrin	8.73	Positive	351	168	120	48
Phosmet	5.59	Positive	317.9	160	80	10
Phosmet	5.59	Positive	317.9	133	80	40
Piperonyl butoxide	7.51	Positive	356.2	177.1	90	5
Piperonyl butoxide	7.51	Positive	356.2	119.1	90	35
Pirimicarb	2.7	Positive	239	182	100	16
Pirimicarb	2.7	Positive	239	72	100	24
Prallethrin	7.03	Positive	301.1	169	90	5
Prallethrin	7.03	Positive	301.1	105	90	20
Propiconazole	6.75	Positive	342.1	159	130	32
Propiconazole	6.75	Positive	342.1	69.1	130	16
Propoxur	3	Positive	210	168	60	5
Propoxur	3	Positive	210	111	60	10
Pyraclostrobin	7.18	Positive	388	194	110	8
Pyraclostrobin	7.18	Positive	388	163	110	24
Pyrethrin I	8.3	Positive	329.2	161	90	5
Pyrethrin I	8.3	Positive	329.2	143	90	20
Pyrethrin I	8.3	Positive	329.2	133	90	20
Pyrethrin_II	7.5	Positive	373.2	161	102	2
Pyrethrin_II	7.5	Positive	373.2	133.1	102	24
Pyrethrin_II	7.5	Positive	373.2	77	102	98
Pyridaben	8.53	Positive	365.1	309.1	90	4
Pyridaben	8.53	Positive	365.1	147.2	90	20
Pyridaben	8.53	Positive	365.1	117.1	90	60

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Resmethrin	8.52	Positive	339	171	135	12
Resmethrin	8.52	Positive	339	143	135	28
Spinetoram J	7.81	Positive	748.5	142.1	165	26
Spinetoram J	7.81	Positive	748.5	98.1	165	50
Spinetoram L	7.5	Positive	760.5	142.1	165	26
Spinetoram L	7.5	Positive	760.5	98.1	165	50
Spinosyn A	7.48	Positive	732.5	142.1	160	28
Spinosyn A	7.48	Positive	732.5	98	160	60
Spinosyn D	7.11	Positive	746.5	142.1	160	35
Spinosyn D	7.11	Positive	746.5	98	160	55
Spirodiclofen	8.18	Positive	411	313	140	8
Spirodiclofen	8.18	Positive	411	71	140	16
Spiromesifen	7.85	Positive	388.2	273	80	6
Spiromesifen	7.85	Positive	388.2	255	80	26
Spirotetramat	5.9	Positive	374.2	330.2	110	12
Spirotetramat	5.9	Positive	374.2	302	110	12
Spirotetramat	5.9	Positive	374.2	216.1	110	36
Spiroxamine	4.8	Positive	298.2	144.1	120	16
Spiroxamine	4.8	Positive	298.2	100.1	120	32
Tebuconazole	6.27	Positive	308.1	124.9	120	47
Tebuconazole	6.27	Positive	308.1	70	120	40
Tebufenozide	6	Positive	353.2	297.1	100	4
Tebufenozide	6	Positive	353.2	133	100	20
Tebufenozide	6	Positive	353.2	102.9	100	20
Teflubenzuron	7.87	Negative	379	339	125	8
Teflubenzuron	7.87	Negative	379	196	125	24
Tetrachlorvinphos	6.56	Positive	365	204	125	48
Tetrachlorvinphos	6.56	Positive	365	127	125	12
Tetrachlorvinphos	6.56	Positive	365	109	125	48
Tetramethrin	7.9	Positive	332	314	100	8
Tetramethrin	7.9	Positive	332	286	100	8
Tetramethrin	7.9	Positive	332	164	100	28
Tetramethrin	7.9	Positive	332	135	100	16
Thiacloprid	2.44	Positive	253	126	100	16
Thiacloprid	2.44	Positive	253	90	100	40
Thiamethoxam	1.58	Positive	292	211.1	80	8
Thiamethoxam	1.58	Positive	292	181.1	80	20
Thiophanate-methyl	3.43	Positive	343	311	105	8
Thiophanate-methyl	3.43	Positive	343	151	105	20
Trifloxystrobin	7.35	Positive	409.1	186	100	12
Trifloxystrobin	7.35	Positive	409.1	145	100	52

Table 6. GC/MS/MS MRM transitions (continued next page).

Compound	RT (min)	Precursor (*m/z*)	Product (*m/z*)	CE
Novaluron	3.7	335	167.9	15
Novaluron	3.7	168	139.9	10
Novaluron	3.7	168	75.9	35
Clofentezine	3.88	139	102	16
Clofentezine	3.88	137	102	16
Clofentezine	3.88	102	75	11
Teflubenzuron	4.3	199	162	14
Teflubenzuron	4.3	197	162	14
Teflubenzuron	4.3	157	141	6
Teflubenzuron	4.3	141	113	15
Etridiazole	4.5	213.1	142	25
Etridiazole	4.5	211.1	140	25
Etridiazole	4.5	183	140	15
Pentachloronitroenzene	5.7	248.8	213.8	15
Pentachloronitroenzene	5.7	213.8	178.8	15
Pentachloronitroenzene	5.7	141.9	106.9	30
Kinoprene	5.95	149	93	4
Kinoprene	5.95	149	91	10
Kinoprene	5.95	149	77	14
Parathion-methyl	6.45	262.9	109	10
Parathion-methyl	6.45	125	79	5
Parathion-methyl	6.45	125	47	10
Chlorpyrifos	6.6	313.8	257.8	15
Chlorpyrifos	6.6	198.9	171	15
Chlorpyrifos	6.6	196.9	169	15
Allethrin	6.73	123	81	10
Allethrin	6.73	107	91	10
Allethrin	6.73	91	65	15
MGK-264 I	6.8	164.2	98	10
MGK-264 I	6.8	164.2	67.1	5
MGK-264 I	6.8	111	82	5
Fenthion	6.9	278	169	15
Fenthion	6.9	124.9	47	10
Prallethrin	6.98	123	81	10
Prallethrin	6.98	105	77	20
Prallethrin	6.98	90.9	65	15
MGK-264 II	7.05	164.2	98	10
MGK-264 II	7.05	164.2	67.1	5
MGK-264 II	7.05	111	82	5
Pyrethrin I	7.68	123.1	81	5
Pyrethrin I	7.68	123.1	41.1	30
Pyrethrin I	7.68	91	65	15
Chlordane-*cis*	7.7	372.8	300.9	10
Chlordane-*cis*	7.7	372.8	265.9	25
Chlordane-*cis*	7.7	271.8	236.9	15
Chlordane-*trans*	7.85	374.8	265.8	15
Chlordane-*trans*	7.85	372.8	265.8	15
Chlordane-*trans*	7.85	271.7	236.9	15
Endosulfan-*alpha*	7.95	194.9	160	5
Endosulfan-*alpha*	7.95	194.9	159	5
Endosulfan-*alpha*	7.95	194.9	125	20
Captan	8.1	263.9	79	25
Captan	8.1	148.1	70	15
Captan	8.1	116.9	81.9	20
Pyrethrin II	8.2	123.1	81	5
Pyrethrin II	8.2	123.1	41.1	30
Pyrethrin II	8.2	91	65	15
Endosulfan-*beta*	9.1	276.7	240.9	5
Endosulfan-*beta*	9.1	206.9	172	15
Endosulfan-*beta*	9.1	194.9	158.9	10
Bifenthrin	9.34	181.2	166.2	10
Bifenthrin	9.34	181.2	165.2	25
Bifenthrin	9.34	166.2	165.2	20
Spirodiclofen	11.2	312.1	259	10
Spirodiclofen	11.2	109.1	81.1	10
Spirodiclofen	11.2	109.1	79.1	15
Permethrin, (1R)-*cis*-	11.25	183.1	168.1	10
Permethrin, (1R)-*cis*-	11.25	183.1	153.1	15
Permethrin, (1R)-*cis*-	11.25	182.9	155.1	10
Permethrin, (1R)-*trans*-	11.4	163	127	5
Permethrin, (1R)-*trans*-	11.4	163	91	15
Permethrin, (1R)-*trans*-	11.4	162.9	91.1	15
Cyfluthrin I	11.7	198.9	170.1	25
Cyfluthrin I	11.7	162.9	127	5
Cyfluthrin I	11.7	162.9	90.9	15
Cyfluthrin II	11.8	198.9	170.1	25
Cyfluthrin II	11.8	162.9	127	5
Cyfluthrin II	11.8	162.9	90.9	15
Cyfluthrin III	11.9	198.9	170.1	25
Cyfluthrin III	11.9	162.9	127	5

Compound	RT (min)	Precursor (*m/z*)	Product (*m/z*)	CE
Cyfluthrin III	11.9	162.9	90.9	15
Coumaphos	12.07	362	109	16
Coumaphos	12.07	226	198	10
Coumaphos	12.07	226	163	20
Coumaphos	12.07	210	182	10
Coumaphos	12.07	210	154	18
Acequinocyl	12.09	341.9	187.9	15
Acequinocyl	12.09	189	115	25
Acequinocyl	12.09	187.9	160	5
Cypermethrin	12.5	181	152	25
Cypermethrin	12.5	165	127	5
Cypermethrin	12.5	165	91	15
Cypermethrin	12.5	163	127	5
Cypermethrin	12.5	163	91	15
Boscalid	13.6	140	112	10
Boscalid	13.6	140	76	25
Boscalid	13.6	111.9	76	15
Fenvalerate	13.75	208.9	141.1	15
Fenvalerate	13.75	181	152.1	20
Fenvalerate	13.75	167	125.1	5
Deltamethrin	15	252.9	93	15
Deltamethrin	15	252.9	77	30
Deltamethrin	15	250.7	172	5
Deltamethrin	15	181	152.1	25

Agilent products and solutions are intended to be used for cannabis quality control and safety testing in laboratories where such use is permitted under state/country law.

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Application Note

Cannabis Quality Testing, Food Safety

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Determination of Pesticides and Mycotoxins as Defined by California State Recreational Cannabis Regulations

A combined LC/MS/MS analysis method

Authors

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Agilent Technologies, Inc.

Introduction

This Application Note details an LC/MS/MS analytical workflow developed by Agilent for the accurate measurement of the California State combined pesticide and mycotoxin action lists[1]. The workflow illustrates sample preparation and analysis techniques uniquely applied to cannabis flower through to data review and reporting.

Since the sanctioning of recreational cannabis use in various U.S. States in recent years, respective lawmakers have introduced unique State legislation. This State legislation details minimum acceptable levels of specific pesticides and mycotoxin content allowed in potential retail material. Table 1[1] summarizes the specific requirements for pesticide and mycotoxin limits in cannabis flower in California.

Table 1. The California list of pesticides and mycotoxins, and the defined action (not to exceed) levels. No Category I pesticide can be present at a concentration greater than the empirically determined limit of detection (LOD). This value is defined as *>LOD* in the table.

Target list	Action level, ng/g (ppb)
Avamectin B1a	100
Avamectin B1b	100
Acephate	100
Acequinocyl	100
Acetamiprid	100
Aldicarb	>LOD
Azoxystrobin	100
Bifenazate	100
Bifenthrin	3,000
Boscalid	100
Captan	700
Carbaryl	500
Carbofuran	>LOD
Chlorantraniliprole	10,000
Chlordane	>LOD
Chlorfenapyr	>LOD
Chlorpyrifos	>LOD
Clofentezine	100
Coumaphos	>LOD
Cyfluthrin	2,000
Cypermethrin	1,000
Daminozide	>LOD
Diazinon	100
DDVP (Dichlorvos)	>LOD

Target list	Action level, ng/g (ppb)
Dimethoate	>LOD
Dimethomorph 1	2,000
Dimethomorph 2	2,000
Ethoprop(hos)	>LOD
Etofenprox	>LOD
Etoxazole	100
Fenhexamid	100
Fenoxycarb	>LOD
Fenpyroximate	100
Fipronil	>LOD
Flonicamid	100
Fludioxonil	100
Hexythiazox	100
Imazalil	>LOD
Imidacloprid	5,000
Kresoxim-methyl	100
Malathion	500
Metalaxyl	100
Methiocarb	>LOD
Methomyl	1,000
Methyl parathion	>LOD
Mevinphos	>LOD
MGK-264	NA
Myclobutanil	100

Target list	Action level, ng/g (ppb)
Dibrom Naled	100
Oxamyl	500
Paclobutrazol	>LOD
Pentachloronitrobenzene	100
Permethrin	500
Phosmet	100
Piperonyl butoxide	3,000
Prallethrin	100
Propiconazole	100
Propoxur	>LOD
Pyrethrin I	500
Pyrethrin II	500
Pyridaben	100
Spinetoram J	100
Spinetoram L	100
Spinosin A	100
Spinosin D	100
Spiromesifen	100
Spirotetramat	100
Spiroxamine	>LOD
Tebuconazole	100
Thiacloprid	>LOD
Thiamethoxam	5,000
Trifloxystrobin	100

Experimental

Materials and reagents

Pesticide and mycotoxin standards: Pesticide mixes representative of respective U. S. States were obtained from LGC USA at a concentration of 100 µg/mL, as were the mixed aflatoxin standards (B1, B2, G1, and G2). The ochratoxin A standard was obtained at a concentration of 2 µg/mL.

Other reagents

- LC/MS grade methanol, Alfa Aesar (Ward Hill, Massachusetts, USA)
- Millipore deionized water >18.2 mOhm, MilliporeSigma (Burlington, Massachusetts, USA)
- Formic acid (97+ %), Sigma-Aldrich (St. Louis, MO, USA)
- Ammonium formate (99+ %), Sigma-Aldrich (St. Louis, MO, USA)

Instrumentation

UHPLC: Although any Agilent UHPLC configuration can be used for this analysis, the following instruments were used:

- Agilent 1290 Infinity binary pump (G4220A)
- Agilent 1260 Infinity II multisampler, thermostatted, with 100-µL loop and multiwash options (G7167A)
- Agilent 1260 Infintiy II multicolumn thermostat (G7116A with 6-port/2-position valve option #058)

To offset any extra time required for the injection program, it is recommended for high-throughput environments to perform overlapped injections. These injections should be initiated specifically at 10.5 minutes, and started from the MassHunter worklist run parameters settings by checking the overlapped injection radio button. For this process to operate optimally, it is important to set the autosampler configuration for a 100-µL loop and 100-µL metering device.

California MRM parameters are detailed in Appendix A for Agilent 6470 (G6470AA) and Agilent Ultivo (G6465BA) units. All fragmentor voltage (Frag) settings, respective collision energies (CE), and most abundant/appropriate MS/MS product ions per analyte were determined and obtained using the Agilent MassHunter Optimizer software.

Sample preparation protocol for LC/MS triple quadrupole analysis

1. One gram of chopped organic cannabis flower was transferred to a 50-mL polypropylene centrifuge tube.
2. Two ceramic homogenizers (p/n 5982-9313) or stainless-steel beads were also placed in the tube, which was then capped.
3. The tube was shaken mechanically for 2–5 minutes at high speed (vertical shaking on a Geno/Grinder-type machine) turning the plant content into fine powder.
4. (For prespiked samples only and recovery studies, the pesticide standard solutions were added to the 15 mL used in step 5 at the appropriate concentrations).
5. Fifteen milliliters of LC/MS-grade acetonitrile was added to the tube from step 3.

UHPLC method conditions

Parameter	Value
Column	Agilent InfinityLab Poroshell 120 Phenyl-Hexyl, 3.0 × 100 mm, 2.7 µm bead size (p/n 695975-312)
Guard column	Agilent InfinityLab Poroshell 120 Phenyl-Hexyl, 2.1 × 5 mm, 2.7 µm bead size (p/n 821725-914)
Column temperature	55 °C
Injection volume	10 µL (with injector program/pretreatment, see Table 2)
Autosampler temperature	4 °C
Needle wash	Flush port (100 % methanol), five seconds
Mobile phase	A) 5 mM ammonium formate/0.1% formic acid in water B) 0.1% formic acid in methanol
Gradient flow rate	0.5 mL/min
Gradient	Time (min) %B 0.00 30 1.00 30 2.00 75 8.00 96 9.00 100 9.50 100 9.51 30
Analysis and re-equilibration time	11 minutes
Total run time (sample to sample)	11 minutes

Table 2. Injector program/pretreatment.

Step	Action	Description
1	Draw	Draw 10 µL from location 1 with default speed using default offset (100 % deionized water)
2	Draw	Draw default volume from the sample with default speed using default offset
3	Wash	Wash needle in flush port for five seconds (100 % methanol)
4	Draw	Draw 10 µL from location 1 with default speed using default offset (100 % deionized water)
5	Mix	Mix 30 µL volume from air with maximum speed five times
6	Inject	Inject

Mass spectrometer configuration and conditions

Parameter	Value
Configuration	6470 or Ultivo triple quadrupole mass spectrometer equipped with Agilent Jet Stream (AJS) ESI source
Ion source conditions	
Ion mode	AJS ESI, positive and negative polarities
Capillary voltage	5,000 V
Drying gas (nitrogen)	13 L/min
Drying gas temperature	200 °C
Nebulizer gas (nitrogen)	55 psi
Sheath gas temperature	200 °C
Sheath gas flow	10 L/min
Nozzle voltage	500 V
Q1 and Q2 resolution	0.7 amu [autotune]
Delta EMV	0 V

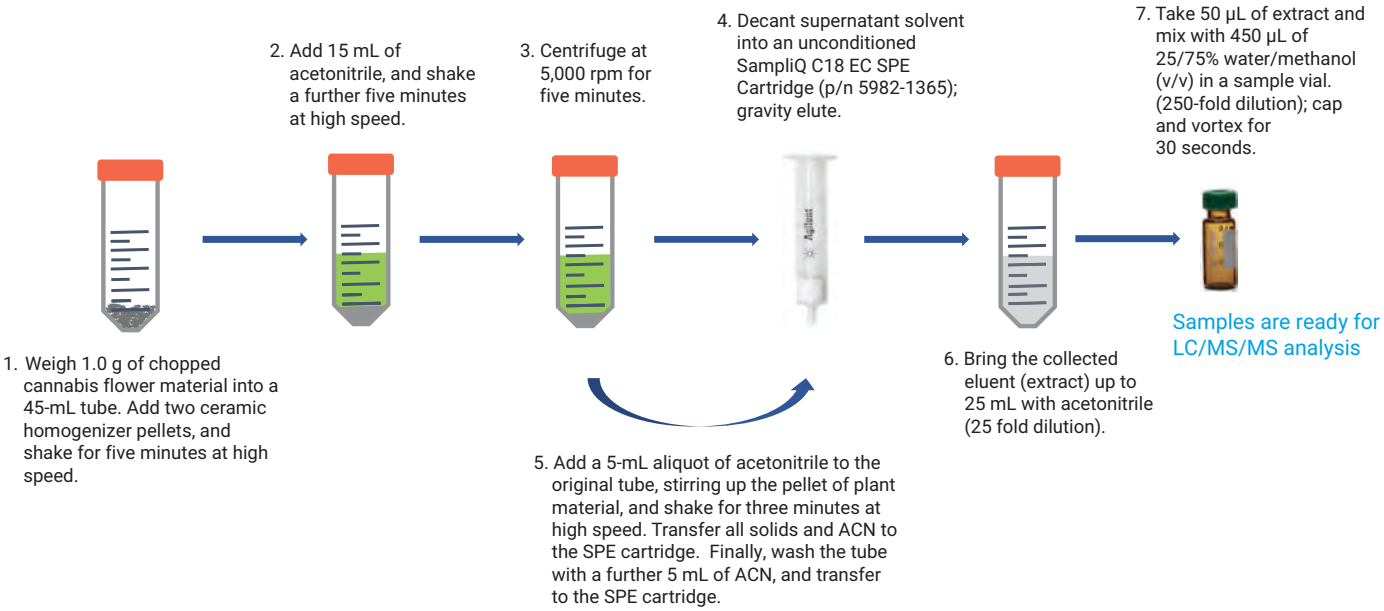
6. The tube and its contents were once more shaken mechanically for five minutes at high speed (vertical shaking on a Geno/Grinder). This shaking was for the extraction of pesticides and aflatoxins into the acetonitrile.
7. The tube was then centrifuged at 5,000 rpm for 10 minutes, and the supernatant transferred to a fresh vessel.
8. While the tube was centrifuged, the extraction manifold was prepared by placing a SampliQ C18 EC 6 mL, 500 mg solid phase extraction (SPE) cartridge (p/n 5982-1365) on the SPE manifold. To collect the cleaned-up eluent, a collection tube of 25 mL or more capacity was placed underneath the cartridge.
9. The supernatant from step 7 was decanted into the SampliQ C18 SPE cartridge. Flow through the cartridge was by gravity. When all solvent had completely passed through the C18 cartridge, the tube and plant pellet from step 7 was mixed with 5 mL of acetonitrile. The pellet was then agitated to bring it into a suspension once again, and was shaken for three minutes. The contents of the tube were then poured into the same C18 SPE cartridge, and the cleaned eluent collected. A further 5 mL of acetonitrile was added to the empty tube, vortexed for 30 seconds, and added to the SPE cartridge. This resulted in just under 25 mL volume of cleaned acetonitrile extract, which was made up to 25 mL using the graduations on the outside of the tube.
10. Fifty microliters of eluent from step 9 were added to 450 µL of water/methanol (25 %/75 % v/v) containing 0.1 % formic acid in a 2-mL sample vial, and capped.
11. This 10× dilution was vortexed for 20 seconds, and was then ready for LC/MS injection.
12. For samples, this solution was injected directly into the LC/TQ. For matrix calibrations or post extraction recovery studies, the desired amounts of pesticide and mycotoxins were spiked into the solution at this point.

The sample preparation steps outlined constitute a resultant 1/250 total dilution, and are outlined schematically in Figure 1.

Results and discussion

Matrix extract calibration standards were prepared down to low part per trillion (ppt) actual levels. This was so the lower limits of quantitation (LLOQ) could be determined and related back to the legislative requirements for California. This was necessary since the outlined sample preparation routine effectively dilutes the original plant material by effectively 250×. Given that California limits are effectively 100 ppb and higher, depending on the analyte concerned, the instrumental detection lower limits would need to be lower than 200 ppt for the most challenging analytes.

Figure 2 illustrates the California pesticide mix spiked into matrix, and each analyte overlaid together with aflatoxins B1, B2, G1, G2, and ochratoxin A at an actual concentration of 500 ppt, relating to an original pre-extraction concentration of 125 ppb.



These sample preparation steps constitute a resultant 1/250 total dilution.

Figure 1. LC/MS sample preparation—cannabis flower SPE cleanup and dilution (California).

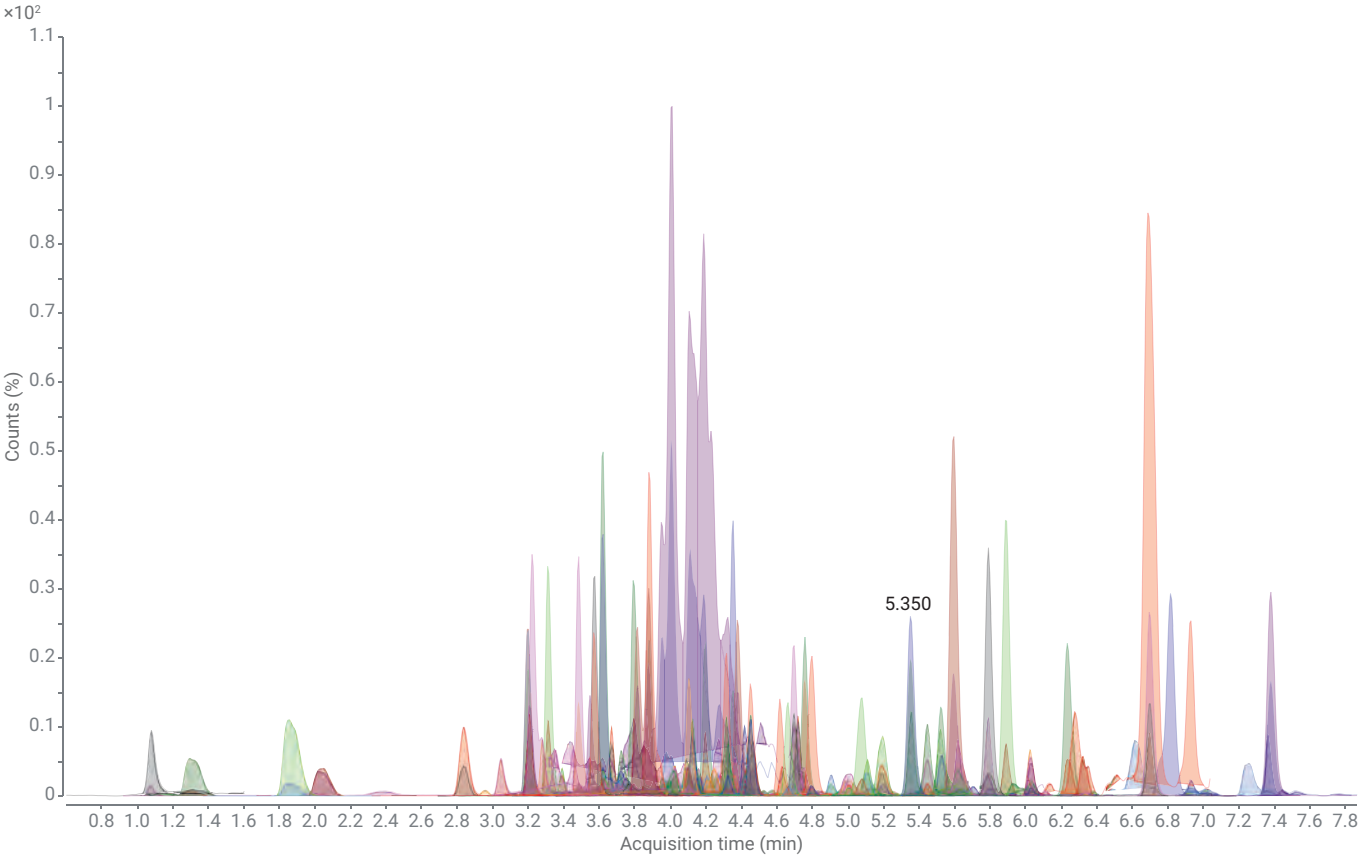


Figure 2. Overlaid chromatograms of California pesticides list and mycotoxins in extracted flower matrix, actual concentration 500 ppt (pre-extraction concentration = 125 ppb.)

Typical matrix calibration curves and LLOQ chromatography observed and obtained through this sample preparation routine are illustrated in Figures 3 and 4 (A, B, and C), respectively. Linear correlation values (R^2) for the spiked pesticides and mycotoxins were 0.990 or higher.

Table 3 outlines typical LLOQ results for pesticides obtained from multiple batches of cannabis flower prepared as outlined in the sample preparation section of this Application Note. The table for the California action list contains four analytes, which need to be analyzed using GC/MS/MS techniques due to a lack of functional groups required to invoke a true molecular ion adduct through LC/MS/MS. These are labeled in the LLOQ column as *GC/MS*, and Reference 2 outlines the techniques and methods required to analyze them. Table 4 summarizes the typical LLOQ values obtained for mycotoxins listed with Californian action levels.

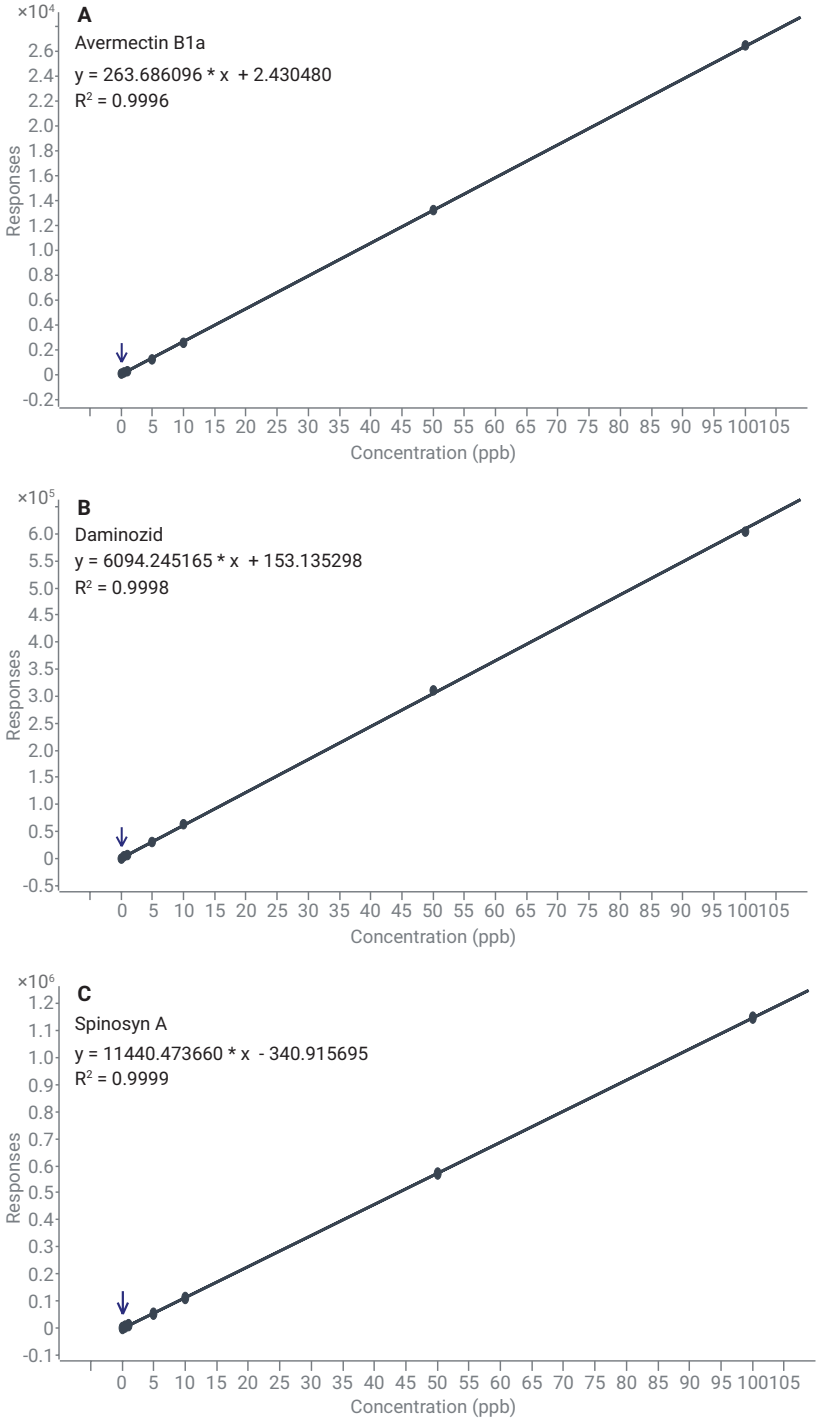


Figure 3. Example calibration curves, California list.

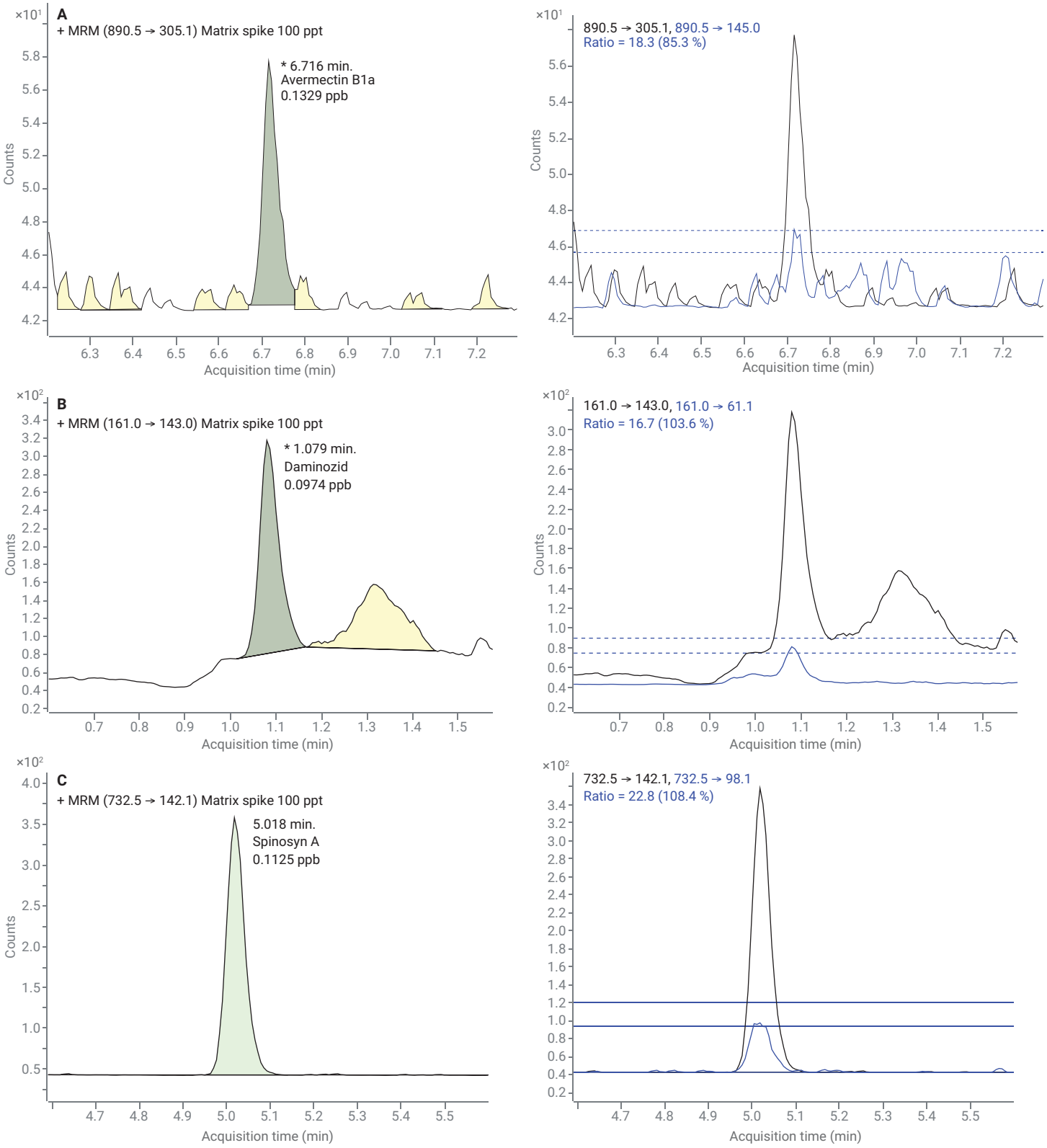


Figure 4. Examples of chromatography near LLOQ. A) Avermectin B1a, 0.1 ppb (ng/mL). B) Daminozide, 0.1 ppb (ng/mL). C) Spinosyn A, 0.1 ppb (ng/mL).

Table 3. Typical pesticide LLOQ results obtained as a mean from multiple (n = 5) batches of cannabis flower and prespiked into the sample extract before the SPE extraction and dilution routine described previously. Analytes typically responding more reliably through GC/MS are denoted in the LLOQ column as *GC/MS*.

California action list	CA action level (ppb)	LLOQ with 10 µL injection (ppb) original plant concentration
Avamectin B1a	100	50
Avamectin B1b	100	50
Acephate	100	25
Acequinocyl	100	2.5
Acetamiprid	100	2.5
Aldicarb	>LOD	5
Azoxystrobin	100	5
Bifenazate	100	50
Bifenthrin	3,000	5
Boscalid	100	50
Captan	700	GC/MS
Carbaryl	500	25
Carbofuran	>LOD	25
Chlorantraniliprole	10,000	25
Chlordane	>LOD	GC/MS
Chlorfenapyr	>LOD	100
Chlorpyrifos	>LOD	25
Clofentezine	100	2.5
Coumaphos	>LOD	5
Cyfluthrin	2,000	50
Cypermethrin	1,000	50
Daminozide	>LOD	25
Diazinon	100	2.5
Dichlorvos	>LOD	50
Dimethoate	>LOD	25
Dimethomorph 1	2,000	25
Dimethomorph 2	2,000	25
Ethoprop	>LOD	25
Etofenprox	>LOD	5
Etoxazole	100	25
Fenhexamid	100	50
Fenoxycarb	>LOD	5
Fenpyroximate	100	25
Fipronil	>LOD	5
Flonicamid	100	25
Fludioxonil	100	25

California action list	CA action level (ppb)	LLOQ with 10 µL injection (ppb) original plant concentration
Hexythiazox	100	5
Imazalil	>LOD	50
Imidacloprid	5,000	2.5
Kresoxim-methyl	100	5
Malathion	500	100
Metalaxyl	100	25
Methiocarb	>LOD	50
Methomyl	1,000	25
Methyl parathion	>LOD	GC/MS
Mevinphos	>LOD	50
MGK-264	NA	25
Myclobutanil	100	50
Dibrom Naled	100	50
Oxamyl	500	0.5
Paclobutrazol	>LOD	25
Pentachloronitrobenzene	100	GC/MS
Permethrin	500	50
Phosmet	100	5
Piperonyl butoxide	3,000	5
Prallethrin	100	25
Propiconazole	100	25
Propoxur	>LOD	25
Pyrethrin I	500	50
Pyrethrin II	500	50
Pyridaben	100	5
Spinetoram J	100	25
Spinetoram L	100	25
Spinosin A	100	5
Spinosin D	100	50
Spiromesifen	100	25
Spirotetramat	100	25
Spiroxamine	>LOD	25
Tebuconazole	100	25
Thiacloprid	>LOD	25
Thiamethoxam	5,000	25
Trifloxystrobin	100	2.5

Table 4. Typical mycotoxin LLOQ results obtained as a mean from multiple batches (n = 5) of cannabis flower and prespiked into the sample extract before the described SPE extraction and dilution routine.

CA action list (mycotoxins)	CA action level (ppb)	LLOQ with 10 µL injection original plant concentration (ppb)
Aflatoxin G1	Total amount of Aflatoxins not to exceed 20 ppb	3
Aflatoxin G2		3.5
Aflatoxin B1		3
Aflatoxin B2		3
Ochratoxin A	20	7

Sample preparation and autosampler pretreatment discussion

Recovery data were gathered for the sample preparation routine outlined in this Application Note, and displayed in Table 5. Prespiked negative cannabis flower and nonspiked negative flower were ground, solvent-extracted, and cleaned up using SPE as outlined in the sample preparation experimental section. The nonspiked extracts from this routine were then spiked at set levels, and the percentage recovery of the pre- and post spiked matrix-matched samples was calculated for every analyte with the following equation using single point calibrations:

$$\% \text{ Recovery} = \frac{\text{Pre} - \text{SPE spiked sample}}{\text{Post} - \text{SPE spiked sample}} \times 100$$

An important aspect of the sample preparation routine to note is the nature and composition of the diluent used in the final dilution step outlined in the experimental section stage 7 of Figure 1.

Many of the analytes in the California action list are highly nonpolar, and can precipitate out of solution when the aqueous content of the diluent is sufficiently high, yielding extremely poor recoveries for these analytes. For this reason, the composition of the final diluent was investigated from a recovery point of view. This investigation determined that the aqueous content

Table 5. Sample preparation percent recoveries observed for each California action pesticide from five separate batches (n = 5).

California pesticide list	Percent recovery at 60 ppb
Abamectin B1a	92.5
Abamectin B1b	113.4
Acephate	91.9
Acequinocyl	94.2
Acetamiprid	94.9
Aldicarb	93.7
Azoxystrobin	95.2
Bifenazate	98.8
Bifenthrin	98.0
Boscalid	104.2
Carbaryl	95.7
Carbofuran	94.9
Chlorantraniliprole	98.2
Chlorfenapyr	102.4
Chlorpyrifos	96.4
Clofentezine	100.8
Coumaphos	106.8
Cyfluthrin	97.7
Cypermethrin	96.3
Daminozide	88.4
DDVP (Dichlorvos)	97.3
Diazinon	97.1
Dimethomorph I	107.6
Dimethomorph II	108.2
Dimethoate	97.9
Ethoprop	103.0
Etofenprox	101.1
Etoxazole	98.6
Fenhexamid	129.5
Fenoxycarb	102.4
Fenpyroximate	103.2
Fipronil	90.6
Flonicamid	97.9
Fludioxonil	107.5
Hexythiazox	106.3
Imazalil	99.1
Imidacloprid	97.8
Kresoxim-methyl	103.7
Malathion	100.5
Metalaxyl	98.2
Methiocarb	102.7
Methomyl	96.5
Methyl parathion	110.4
Mevinphos	103.9
MGK-264	109.4
Myclobutanil	104.9
Oxamyl	97.0
Paclobutrazol	106.9
Permethrins*	96.8
Phosmet	101.9
Piperonyl butoxide	100.5
Prallethrin	98.1
Propiconazole	104.7
Propoxur	99.2
Pyrethrins†	70.8
Pyridaben	101.0
Spinetoram L	108.6
Spinetoram J	102.4
Spinosin A	101.2
Spinosin D	96.5
Spiromesifen	99.0
Spirotetramat	99.3
Spiroxamine	97.4
Tebuconazole	105.5
Thiacloprid	100.4
Thiamethoxam	97.2
Trifloxystrobin	100.8

Table 6. Average percent recoveries for each California mycotoxin (n = 5).

CA mycotoxin list	% Recovery at 4 ppb
Aflatoxin G1	102.8
Aflatoxin G2	102.7
Aflatoxin B1	104.8
Aflatoxin B2	102.3
Ochratoxin A	100.5

of that diluent could be no higher than 25 % v/v for the final dilution.

Injector pretreatment

For reversed-phase chromatography, such a high composition of organic solvent in the sample to be injected (in this case methanol at 75 % v/v) can and will result in splitting or smearing the early-eluting analyte peaks upon normal injection. To counter this effect and to keep peak shape and symmetry acceptable for all analytes in this method, an injector pretreatment routine is required, and is outlined in Table 2.

This pretreatment routine effectively dilutes the 75 % methanol in the sample when injected by sandwiching it between two equal 10 µL volumes of 0.1 % FA in water, mixing this together and effectively diluting it *in situ* to approximately 75/25 % aqueous/methanol. The chromatography gradient composition starts at 30 % methanol composition, and peak smearing/splitting is avoided, thus, acceptable peak shapes and symmetry is maintained across the complete chromatographic analysis.

Overlapped injections

To avoid the extra time needed for sample pretreatment in this manner, it is possible to preload samples at the re-equilibration period at the end of the chromatographic gradient by selecting the overlapped injection option. This option is available on all Agilent LC/MS/MS systems and configurations. For this methodology, it is recommended to invoke this function at or after 10.5 minutes to ensure that no retention time shift occurs in subsequent samples injected.

Review and reporting

Agilent LC/MS/MS and GC/MS/MS instruments employ the same MassHunter Quantitation software for data review and reporting. This optimizes lab productivity and operator's ease-of-use. To allow for review by exception, MassHunter Quantitation software enables quick and efficient batch processing using outlier settings per analyte. This approach automatically flags any sample or individual analyte, and draws the reviewer's attention to anything that may not be within designated limits. Figure 5 illustrates these outlier flags. The red color designates a value above accepted outlier limits, while blue denotes results below the required outlier limits.

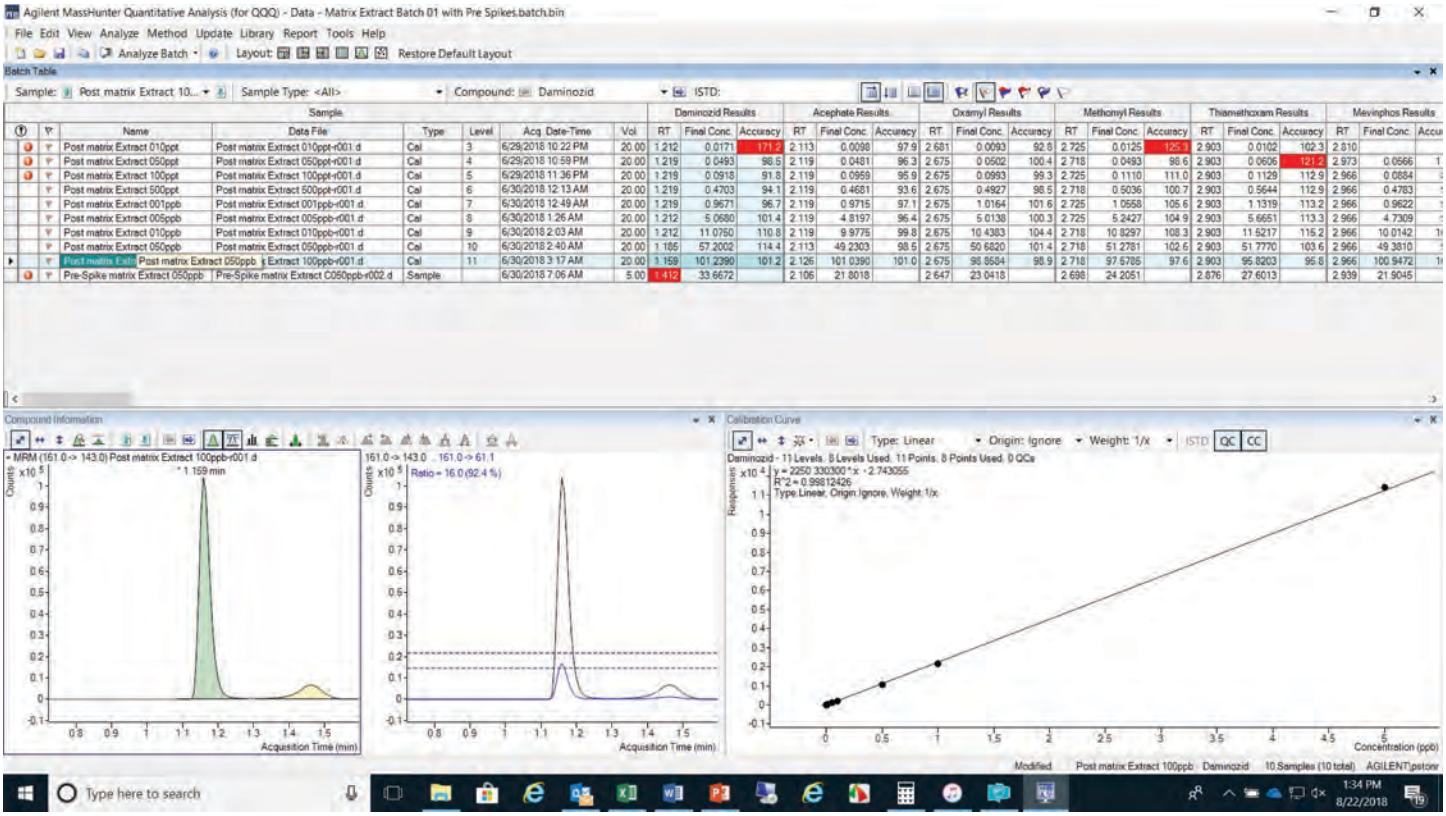
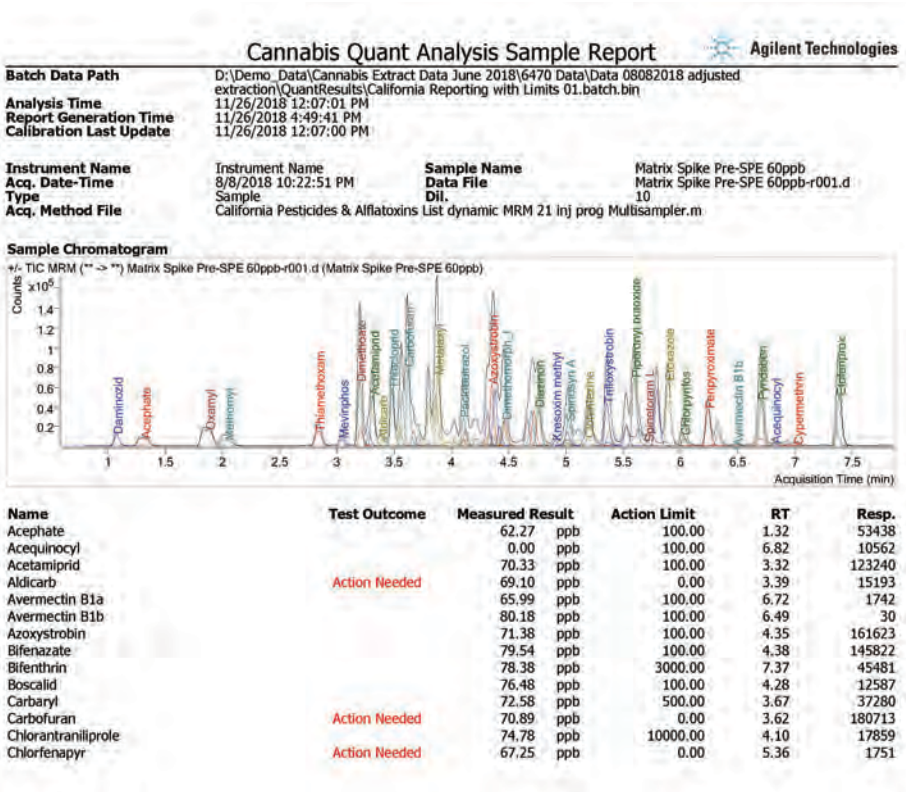


Figure 5. MassHunter Quantitative Analysis, review by exception batch review.

MassHunter offers the ability to tailor the analysis interface to the application with the Quant-My-Way functionality. Two preset configurations, or flavors, have been developed to meet the needs of cannabis method development, data processing and review, as well as reporting for LC/MS or GC/MS.

- First, the Scientist level has complete method setup, batch review, and reporting capabilities for each instrument technique (gas phase or liquid phase.)
- Second, the Analyst level has a simplified and uncluttered GUI, for use in the daily production environment. In this level, batch review and report generation are only allowed from predefined data review criteria, methods, and templates, which are set by the Scientist-designated personnel. Using these different GUI choices, a laboratory can more easily control how data are processed and reported in a more controlled environment.

Custom report templates that have been specifically designed for the cannabis analysis requirements of each geographic region are also available as an integral element of the MassHunter Quantitation software. Figure 6 shows an example of this.



Cannabis Quant Analysis Sample Report — Agilent Technologies

Batch Data Path	D:\Demo_Data\Cannabis Extract Data June 2018\6470 Data\Data 08082018 adjusted extraction\QuantResults\California Reporting with Limits 01.batch.bin
Analysis Time	11/26/2018 12:07:01 PM
Report Generation Time	11/26/2018 4:49:41 PM
Calibration Last Update	11/26/2018 12:07:00 PM

Instrument Name	Instrument Name	**Sample Name**	Matrix Spike Pre-SPE 60ppb
Acq. Date-Time	8/8/2018 10:22:51 PM	**Data File**	Matrix Spike Pre-SPE 60ppb-r001.d
Type	Sample	**Dil.**	10
Acq. Method File	California Pesticides & Alflatoxins List dynamic MRM 21 inj prog Multisampler.m		

Sample Chromatogram

Name	Test Outcome	Measured Result		Action Limit	RT	Resp.
Acephate		62.27	ppb	100.00	1.32	53438
Acequinocyl		0.00	ppb	100.00	6.82	10562
Acetamiprid		70.33	ppb	100.00	3.32	123240
Aldicarb	Action Needed	69.10	ppb	0.00	3.39	15193
Avermectin B1a		65.99	ppb	100.00	6.72	1742
Avermectin B1b		80.18	ppb	100.00	6.49	30
Azoxystrobin		71.38	ppb	100.00	4.35	161623
Bifenazate		79.54	ppb	100.00	4.38	145822
Bifenthrin		78.38	ppb	3000.00	7.37	45481
Boscalid		76.48	ppb	100.00	4.28	12587
Carbaryl		72.58	ppb	500.00	3.67	37280
Carbofuran	Action Needed	70.89	ppb	0.00	3.62	180713
Chlorantraniliprole		74.78	ppb	10000.00	4.10	17859
Chlorfenapyr	Action Needed	67.25	ppb	0.00	5.36	1751

Figure 6. Example of cannabis reporting templates.

Conclusions

This Application Note describes a robust LC/MS/MS method and sample preparation workflow that reliably meets at least 50 % the current California legislative safety action limits for pesticide and mycotoxin content for cannabis dried flower samples. It uses Agilent 6470 (G6470AA) and Agilent Ultivo (G6465BA) units, which yield similar results. This methodology complements other techniques, which are necessary for a handful of the action list items (captan, chlordane, PCNB, and methyl parathion). These analytes are more reliably analyzed using GC/MS/MS techniques such as that outlined in Agilent Application Note 5994-0568EN[3].

Sample preparation used a simple SPE filtration approach, recoveries from which were all between 70–130 %, as required by California legislation[1]. In addition, most recoveries were close to 100 % using the unique SampliQ C18 EC SPE cartridges and routines outlined in the experimental section. The unique ability to use an injector pretreatment routine for injection handling and manipulation of samples adds to the high percent recoveries while allowing for excellent chromatographic peak shapes across the entire analysis gradient.

A two-level graphical user interface approach has been created (if required), consisting of the Scientist and Analyst levels, for seamless data review and method creation using MassHunter Quantitation and batch processing software. This specifically allows a quality testing laboratory to assign access roles, and simplify workflows for data review and reporting within its workforce based on access level to methodology and ability levels.

Custom reporting templates are available as standard with MassHunter software, and are focused on regions or states, depending on local requirements.

References

1. Bureau of Marijuana Control Proposed Text of Regulations California Code of Regulations Title 16 Division 42. Bureau of Marijuana Control Chapter 5. Testing Laboratories.
2. Mordehai, A.; Fjeldsted, J. Agilent Jet Stream Thermal Gradient Focusing Technology. *Agilent Technologies Technical Overview*, publication number 5990 3494EN, **2009**.
3. Andrianova, A. A.; *et al.* Sensitive and Robust Detection of Pesticides in Dried Cannabis Plant Material Regulated in California, *Agilent Technologies Application Note*, publication number 5994-0568EN, **2019**.

Appendix A: Agilent 6470 (G6470AA) and Agilent Ultivo (G6465BA) transitions for pesticides and mycotoxins

Cell acceleration voltage (CAV) is irrelevant for Ultivo LC/MS instruments

Compound	Precursor Ion	Product Ion	Fragmentor (V)	CE (V)	Cell Acc (V)	Polarity
Acephate	184	143	60	5	4	Positive
Acephate	184	95	60	20	4	Positive
Acequinocyl	402.3	343.2	90	10	4	Positive
Acequinocyl	402.3	189.1	90	41	4	Positive
Acetamiprid	223	126.1	100	20	3	Positive
Acetamiprid	223	90.1	100	35	3	Positive
AflatoxinB1	313.1	285.1	130	20	3	Positive
AflatoxinB1	313.1	241.1	130	35	3	Positive
AflatoxinB2	315.1	287.1	130	25	3	Positive
AflatoxinB2	315.1	259.1	130	25	3	Positive
AflatoxinG1	329.1	311.1	130	20	3	Positive
AflatoxinG1	329.1	243.1	130	25	3	Positive
AflatoxinG2	331.1	285.1	130	25	3	Positive
AflatoxinG2	331.1	245.1	130	30	3	Positive
Aldicarb	116	89.1	50	4	3	Positive
Aldicarb	116	70.1	50	4	3	Positive
Avermectin B1a	890.5	567.1	160	8	4	Positive
Avermectin B1a	890.5	305.1	160	28	4	Positive
Avermectin B1a	890.5	145	160	45	4	Positive
Avermectin B1b	876.6	553.2	160	7	4	Positive
Avermectin B1b	876.6	291.1	160	15	4	Positive
Azoxystrobin	404	372.2	100	10	3	Positive
Azoxystrobin	404	344	100	25	3	Positive
Bifenazate	301.1	198.2	80	5	3	Positive
Bifenazate	301.1	170.1	80	15	3	Positive
Bifenthrin	440.1	181.1012	90	5	5	Positive
Bifenthrin	440.1	166	90	20	5	Positive
Boscalid	343	307.0633	140	12	5	Positive
Boscalid	343	271	140	28	5	Positive
Carbaryl	202	145	70	0	3	Positive
Carbaryl	202	127.1	70	25	3	Positive
Carbofuran	222.1	165.1	90	5	3	Positive
Carbofuran	222.1	123.1	90	20	3	Positive
Chlorantraniliprole	483.9	452.9	100	15	3	Positive
Chlorantraniliprole	483.9	285.9	100	10	3	Positive
Chlorfenapyr	409.2	59	130	20	3	Positive
Chlorfenapyr	409.2	31	130	45	3	Positive
Chlorpyrifos	349.9	197.9275	100	20	5	Positive

Compound	Precursor Ion	Product Ion	Fragmentor (V)	CE (V)	Cell Acc (V)	Polarity
Chlorpyrifos	349.9	96.9508	100	41	5	Positive
Clofentezine	303	138	90	10	3	Positive
Clofentezine	303	102.1	90	40	3	Positive
Coumaphos	363	307	125	15	4	Positive
Coumaphos	363	226.9	125	33	4	Positive
Cyfluthrin	453.3	193	90	13	2	Positive
Cyfluthrin	451.3	191	90	13	2	Positive
Cypermethrin	435.3	193	90	16	2	Positive
Cypermethrin	433.3	416.3	90	7	2	Positive
Cypermethrin	433.3	191	90	16	2	Positive
Daminozide	161	143	80	10	2	Positive
Daminozide	161	61.1	80	10	2	Positive
Diazinon	305.1	169.0794	100	20	5	Positive
Diazinon	305.1	153.1022	100	20	5	Positive
Dichlorvos	221	109	110	12	3	Positive
Dichlorvos	221	79	110	24	3	Positive
Dimethoate	230	199	80	0	3	Positive
Dimethoate	230	125	80	20	3	Positive
Dimethomorph_I	388.1	301.1	145	20	3	Positive
Dimethomorph_I	388.1	165	145	32	3	Positive
Dimethomorph_II	388.1	301.1	145	20	3	Positive
Dimethomorph_II	388.1	165	145	32	3	Positive
Ethoprophos	243	131	90	15	3	Positive
Ethoprophos	243	97	90	30	3	Positive
Etofenprox	394.2	177.2	90	10	3	Positive
Etofenprox	394.2	107.1	90	45	3	Positive
Etoxazole	360.1	141.0146	140	28	5	Positive
Etoxazole	360.1	113.0197	140	50	5	Positive
Fenhexamid	302.1	97.2	145	25	4	Positive
Fenhexamid	302.1	55.1	145	45	4	Positive
Fenoxycarb	302.1	116.1	100	5	3	Positive
Fenoxycarb	302.1	88.1	100	15	3	Positive
Fenpyroximate	422.1	366.2	130	15	3	Positive
Fenpyroximate	422.1	135.1	130	30	3	Positive
Fipronil	436.9	332	100	18	2	Negative
Fipronil	434.9	330	100	18	2	Negative
Fipronil	434.9	250.1	100	30	2	Negative
Flonicamid	230.1	199	80	4	2	Positive
Flonicamid	230.1	125	80	16	3	Positive
Fludioxonil	229	185	120	15	2	Positive
Fludioxonil	229	158	120	20	2	Positive
Hexythiazox	353	228.1	90	10	3	Positive

Compound	Precursor Ion	Product Ion	Fragmentor (V)	CE (V)	Cell Acc (V)	Polarity
Hexythiazox	353	168.1	90	25	3	Positive
Imazalil	297	201	120	15	3	Positive
Imazalil	297	159	120	20	7	Positive
Imidacloprid	256	209.1	90	16	2	Positive
Imidacloprid	256	175.1	90	20	2	Positive
Kresoxim methyl	314.1	267.1	80	0	3	Positive
Kresoxim methyl	314.1	222.2	80	10	3	Positive
Malathion	331.1	126.9	80	5	5	Positive
Malathion	331.1	99	80	10	5	Positive
Metalaxyl	280.1	220.2	100	10	3	Positive
Metalaxyl	280.1	160.1	100	20	3	Positive
Methiocarb	226.1	169.1	70	0	7	Positive
Methiocarb	226.1	121.1	70	15	3	Positive
Methomyl	162.9	106.1	60	5	3	Positive
Methomyl	162.9	88.1	60	0	3	Positive
Methyl-Parathion	264	232	140	18	2	Positive
Methyl-Parathion	264	125	140	24	2	Positive
Mevinphos	225	192.9	60	5	4	Positive
Mevinphos	225	126.9	60	17	4	Positive
MGK-264	276.2	210.1	100	12	4	Positive
MGK-264	276.2	98	100	28	4	Positive
Myclobutanil	289.1	125	110	35	3	Positive
Myclobutanil	289.1	70.1	110	15	7	Positive
Ochratoxin	404.1	238.9	130	26	3	Positive
Ochratoxin	404.1	220.9	130	32	3	Positive
Oxamyl	237	90.1	60	0	3	Positive
Oxamyl	237	72.1	60	15	3	Positive
Paclobutrazol	294.1	125	110	40	3	Positive
Paclobutrazol	294.1	70.1	110	20	7	Positive
Permethrin	391.1	355	120	5	3	Positive
Permethrin	391.1	183	120	5	3	Positive
Phosmet	317.9	160	80	10	3	Positive
Phosmet	317.9	133	80	40	3	Positive
Piperonyl butoxide	356.2	177.1	90	5	3	Positive
Piperonyl butoxide	356.2	119.1	90	35	3	Positive
Prallethrin	301.1	169	90	5	3	Positive
Prallethrin	301.1	105	90	20	3	Positive
Propiconazole	342.1	159	130	32	2	Positive
Propiconazole	342.1	69.1	130	16	2	Positive
Propoxur	210	168	60	5	5	Positive
Propoxur	210	111	60	10	5	Positive
Pyrethrin I	329.2	161	90	5	3	Positive
Pyrethrin I	329.2	143	90	20	3	Positive

Compound	Precursor Ion	Product Ion	Fragmentor (V)	CE (V)	Cell Acc (V)	Polarity
Pyrethrin I	329.2	133	90	20	3	Positive
Pyrethrin_II	373.2	161	102	2	3	Positive
Pyrethrin_II	373.2	133.1	102	24	3	Positive
Pyrethrin_II	373.2	77	102	98	3	Positive
Pyridaben	365.1	309.1	90	4	2	Positive
Pyridaben	365.1	147.2	90	20	2	Positive
Pyridaben	365.1	117.1	90	60	2	Positive
Spinetoram J	748.5	142.1	165	26	3	Positive
Spinetoram J	748.5	98.1	165	50	3	Positive
Spinetoram L	760.5	142.1	165	26	3	Positive
Spinetoram L	760.5	98.1	165	50	3	Positive
Spinosyn A	732.5	142.1	160	28	2	Positive
Spinosyn A	732.5	98.1	160	60	2	Positive
Spinosyn D	746.5	142.1	160	35	2	Positive
Spinosyn D	746.5	98	160	55	2	Positive
Spiromesifen	388.2	273	80	6	2	Positive
Spiromesifen	388.2	255	80	26	2	Positive
Spirotetramat	374.2	330.2	110	12	5	Positive
Spirotetramat	374.2	302.2	110	12	5	Positive
Spirotetramat	374.2	216.1	110	36	5	Positive
Spiroxamine	298.2	144.1	120	16	4	Positive
Spiroxamine	298.2	100.1	120	32	4	Positive
Tebuconazole	308.1	124.9	120	47	2	Positive
Tebuconazole	308.1	70	120	40	2	Positive
Thiacloprid	253	126	100	16	2	Positive
Thiacloprid	253	90	100	40	2	Positive
Thiamethoxam	292	211.1	80	8	2	Positive
Thiamethoxam	292	181.1	80	20	2	Positive
Trifloxystrobin	409.1	186	100	12	2	Positive
Trifloxystrobin	409.1	145	100	52	2	Positive

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A Sensitive and Robust Workflow to Measure Residual Pesticides and Mycotoxins from the Canadian Target List in Dry Cannabis Flower

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Abstract

As of October 2018, the recreational use of cannabis is legal at the federal level throughout Canada. Under Canadian law, licensed cannabis producers are obligated to meet strict quality requirements and mandatory testing to ensure consumer safety. The array of mandated testing includes potency determination, heavy metal detection, and microbial screening, amongst others. Of these, the analysis of pesticide residues is the most challenging, and Health Canada mandates a target list of 96 pesticides and five mycotoxins to be tested at limits of quantitation (LOQ) typically lower than any U.S. state. As a result, pesticide residue analysis in cannabis under Canadian regulations require state-of-the-art LC and GC triple quadrupole mass spectrometry (LC/MS/MS and GC/MS/MS, respectively).

Using a standardized sample preparation procedure and both LC/MS/MS and GC/MS/MS platforms, we demonstrate robust, specific, and sensitive quantification of the Canadian pesticide and mycotoxin target lists that meet the required reporting limits as published by Health Canada in dry cannabis. Eighty-eight target pesticides and five mycotoxins were analyzed with the Agilent 6470 LC/MS/MS system and alternatively, the Agilent Ultivo LC/MS/MS system, both coupled to an Agilent 1290 Infinity II UHPLC. Seventeen pesticides were analyzed on the Agilent 7890/7010 GC/MS/MS system.

As in the food and tobacco industries, pesticide testing requirements in cannabis are expected to become more rigorous over time, reinforcing the need for adopting a flexible and sensitive procedure such as the one described here. This multiplatform approach provides a rapid return on investment (ROI) and a stable foundation to meet current and future testing requirements.

Introduction

Many U.S. States have some form of cannabis or cannabinoid legalization. On the U.S. federal level however, cannabis (as defined by a Δ^9-tetrahydrocannabinol concentration >0.3 % wt/wt) is a Schedule 1 controlled substance, thus preventing the creation of clear nation-wide guidelines for cannabis testing. As a result, every state tests for different pesticides and define different limits of quantitation or action levels. The lack of harmonized guidelines results in many disparate methods that do not meet the pesticide testing requirements published by Health Canada in October 2018, where reporting limits are typically 10-fold lower than current requirements in California[1,2].

With respect to the number of target pesticides and action levels, Canada has the most comprehensive list in North America, with action levels for 96 pesticides as low as 20 parts-per-billion (ppb) for dried cannabis, and 10 ppb for fresh (wet) cannabis or cannabis oils. The California list includes 66 target pesticides and action levels down to 100 ppb for inhalable cannabis and other cannabis products. The Canadian list does not completely incorporate the California list, with captan, chlordane, and fenhexamid being unique to California.

Many U.S. state pesticide lists can be analyzed exclusively by LC/MS/MS. Notable exceptions include California, Florida, and Nevada, where GC/MS/MS is also required. This list of exceptions is expected to grow as the states add more compounds and lower the required limits of detection (LODs). Similarly to California, Florida, and Nevada, the extensive Canadian pesticide list presents at least six compounds for which reporting limits cannot be met by LC/MS/MS: endosulfan *alpha* and *beta*, etridiazole, fenthion, kinoprene, and quintozene (pentachloronitrobenzene). Those compounds and others, such as captan and chlordane, are commonly analyzed through GC/MS/MS using electron ionization.

A brief discussion of sample preparation

Cannabis is a complex plant containing many endogenous chemicals representing numerous chemical classes. Compared to other plants and vegetables, cannabis has higher amounts of potential interferences, and notably high concentrations of terpenes, cannabinoids, flavonoids, phenols, and fatty acids[4]. The complexity of the cannabis matrix makes detection and accurate quantification of trace levels of pesticides more challenging. Interfering compounds can negatively impact ionization in the mass spectrometer, affect signal-to-noise ratios (S/N), and build-up in the instrument source and consumables, thus decreasing productivity and increasing maintenance and operating costs. To overcome this challenge, a combination of optimized sample preparation and state-of-the-art instrumentation is required.

Initially, Quick, Easy, Cheap, Effective, Rugged, and Safe (QuEChERS) appeared to be a promising technique to extract pesticides and clean up samples. QuEChERS is a commonly used technique to prepare samples for residual pesticide testing in fruits and vegetables, and is a two-step procedure. The first step is to perform an extraction/partitioning between water and acetonitrile. The resulting acetonitrile layer undergoes a second cleaning step that uses dispersive solid-phase extraction (dSPE) sorbents to capture matrix interferences that would otherwise negatively impact detection by mass spectrometry.

Unfortunately, the QuEChERS approach is not viable for cannabis flower. Cannabis is a unique plant that calls for unique sample preparation. Why?

- QuEChERS requires wetting dry cannabis with water. This procedure increases the pH enough to degrade labile pesticides such as Captan, folpet, and spiroxamine.
- The addition of salts common to the procedure creates an exothermic reaction that also degrades sensitive pesticides.
- Mycotoxins and very polar pesticides such as daminozide are in the water layer in the extraction step.
- Finally, QuEChERS is not a good option to clean up cannabis because plant components such as cannabinoids and terpenes are in such high concentrations that dispersive kits do not have enough capacity to effectively remove matrix interferences.

Additionally, some dispersive compounds used in QuEChERS use a primary secondary amine (PSA) that can potentially capture acidic pesticides and reduce recoveries. Other dispersive reagents contain graphitized carbon black (GCB) that can inadvertently capture planar pesticides without additional solvents and drying steps. For these reasons, an alternative sample preparation approach was developed for simplicity, quick turnaround time, and to provide enough cleanup for improved sensitivity and system uptime.

Experimental

The LC/MS/MS analyses were performed using an Infinity II 1290 UHPLC system coupled to either a 6470 or an Ultivo triple quadrupole mass spectrometer. Both systems used an Agilent JetStream ESI source. The UHPLC system consisted of a binary pump (G7120A), low-carryover multisampler fitted with multiwash and 100-µL loop and metering device options (G7167B), thermostatted column compartment (G7116B), and Agilent MassHunter software.

The GC/MS/MS analyses were performed using an Agilent 7890B GC coupled to a 7010B triple quadrupole mass spectrometer. The GC configuration included a multimode inlet (MMI) and backflush capacity through a Purged Ultimate Union (PUU). The 7010B was equipped with a High Efficiency Source (HES) and the JetClean option, which allows for *in situ* cleaning of the HES source with hydrogen.

Instrumentation

Infinity II UHPLC method conditions	
Column (p/n 695975-312)	Infinity Lab Poroshell 120 Phenyl Hexyl, 3.0 × 100 mm, 2.7, µm
Guard column (p/n 823750-914)	Infinity Lab Poroshell 120 Phenyl Hexyl, 3.0 × 5 mm, 2.7, µm
Column temperature	55 °C
Injection volume	25 µL
Autosampler temperature	4 °C
Multiwash table	Step / Solvent / Time (s) / Seat backflush / Needle wash / Comments 1 / S1 / 10 / Yes / Yes / 0.1 % Formic acid in isopropanol 2 / S2 / 10 / Yes / Yes / 0.1 % Formic acid in acetonitrile 3 / S3 / 20 / Yes / Yes / 50:50 A:B
Mobile phase	A) 5 mM Ammonium formate + 0.1 % formic acid in water B) 0.1 % Formic acid in 90:10 methanol:acetonitrile
Gradient flow rate	0.5 mL/min
Analysis and re-equilibration time	10 minutes, 1.5 minutes
Total run time (sample to sample)	11.5 minutes
Gradient	Time (min) %B 0.00 50 1.00 50 8.00 95 9.00 100 10 100
LC/MS/MS Configuration and parameters	
Configuration	6470 QQQ or Ultivo QQQ Mass Spectrometer, both equipped with Jet Stream (AJS) ESI Source.
MS/MS Parameters	
Acquisition mode	dMRM
Polarity	Positive or Negative (compound-dependent)
Capillary voltage	4,000 V in positive mode, 3,000 V in negative mode
Drying gas flow	10 L/min
Drying gas temperature	200 °C
Nebulizer pressure	35 psi
Sheath gas temperature:	200 °C
Sheath gas flow	10 L/min
Nozzle voltage	300 V (either polarity)
Q1 and Q2 Resolution	Unit (0.7 amu), optimized by autotune
Delta EMV	0 V

Materials and reagents

Pesticide and mycotoxin standards

Pesticides and mycotoxins were obtained either individually or in mixes from various sources. All compounds were mixed to create a stock solution in acetonitrile, with each compound present at 1,000 ppb.

Other reagents

- **LC/MS grade methanol:** Sigma-Aldrich
- **LC/MS grade acetonitrile:** EMD Millipore
- **LC/MS grade water:** Burdick and Jackson
- **Pesticide-grade hexanes:** EMD Millipore
- **Pesticide-grade acetone:** Sigma-Aldrich
- **Formic acid (97+ %):** Sigma-Aldrich
- **Ammonium formate (99+ %):** Fisher Scientific

Sample and calibrator preparation

Several 1-g dried cannabis samples were simultaneously reduced to a fine powder by vertical shaking in clean tubes. Then, pesticides and mycotoxins were extracted from the cannabis powder with acetonitrile, and cleaned up on SampliQ C18 EC SPE cartridges. The resulting cannabis extracts were further diluted and tested by LC/MS/MS and GC/MS/MS (Figures 1 and 2).

Detailed sample preparation common to both LC/MS/MS and GC/MS/MS

1. Weigh 1.0 g of chopped cannabis into a 50-mL polypropylene (PP) centrifuge tube.
2. Add two ceramic homogenizers (p/n 5982-9313) or stainless steel beads to the tube, and cap. The homogenizers will help turn the chopped cannabis into a fine powder.
3. Shake mechanically for 2–5 minutes at high speed, ideally on a vertical shaking device (Geno/Grinder-type machine), to turn the dry cannabis into fine powder.
4. If precleanup spiked matrix samples are to be prepared, pipette the pesticide standard solution(s) and mycotoxin standards into the dry cannabis powder, then vortex for 30 seconds.
5. Add 15 mL of pesticide-grade acetonitrile to the tube from step 3.
6. Shake the tube mechanically for five minutes at high speed, ideally on a vertical shaking device (Geno/Grinder-type machine). This will extract the pesticides and mycotoxins into the acetonitrile.
7. While the tube is shaking, prepare the solid phase extraction (SPE) manifold by placing a SampliQ C18 EC 6 mL 500 mg SPE cartridge (p/n 5982-1365) onto the manifold. Place a collection tube that can hold 25 mL or more. Ideally, use a graduated 50-mL PP centrifuge tube underneath the cartridge in which the eluent will be collected.
8. Decant the supernatant from step 6 into the SampliQ C18 EC SPE cartridge. It will flow by gravity, but might require a small pressure pulse to initiate the flow.

7890B GC Method conditions	
Inlet	MMI
Inlet liner	Ultra Inert, Splitless, 4-mm single taper with deactivated fused silica wool (p/n 5190-2293)
Inlet temperature program	180 °C initial, hold 0 min, 400 °C/min to 280 °C
Injection volume	2 uL
Column 1	Agilent DB-35MS Ultra Inert, 15 m × 0.25 mm, 0.25 µm film thickness (p/n 122-3812), connected to MMI and Agilent Purged Ultimate Union
Column 2	Agilent HP-5MS Ultra Inert, 15 m × 0.25 mm, 0.25 µm film thickness (p/n 19091J-431), connected to Agilent Purged Ultimate Union and QQQ Transfer Line
Column 1 flow	1.0 mL/min, constant
Column 2 flow	1.4 mL/min, constant
Oven temperature program	Rate (°C/min) / Value (°C) / Hold time (min) / Run time (min) — / 70 / 1 / 1 60 / 240 / 0 / 3.8333 4 / 255 / 0 / 7.5833 30 / 300 / 6.9 / 15.983
Column backflush	Post run, 2.4 min at 2.49 mL/min
Run time	15-minute analysis time, 2.4-minute post run backflush, total sample-to-sample time of 22 minutes
GC/MS/MS Configuration and parameters	
Source	HES
Ionization mode	Electron Impact (EI)
Transfer line temperature	300 °C
Source temperature	280 °C
Quadrupole temperature	150 °C
Acquisition mode	dMRM
Detector gain factor	10
Solvent delay	3.5 minutes
Acquisition rate	7 cycles per second

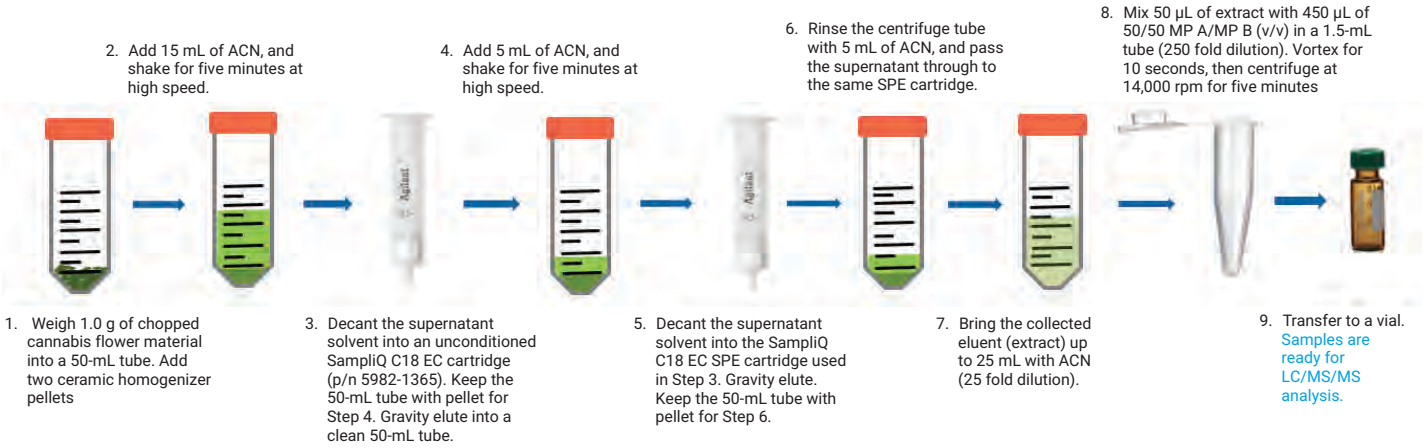

Figure 1. Schematic representation of sample preparation procedure for LC/MS/MS analysis.

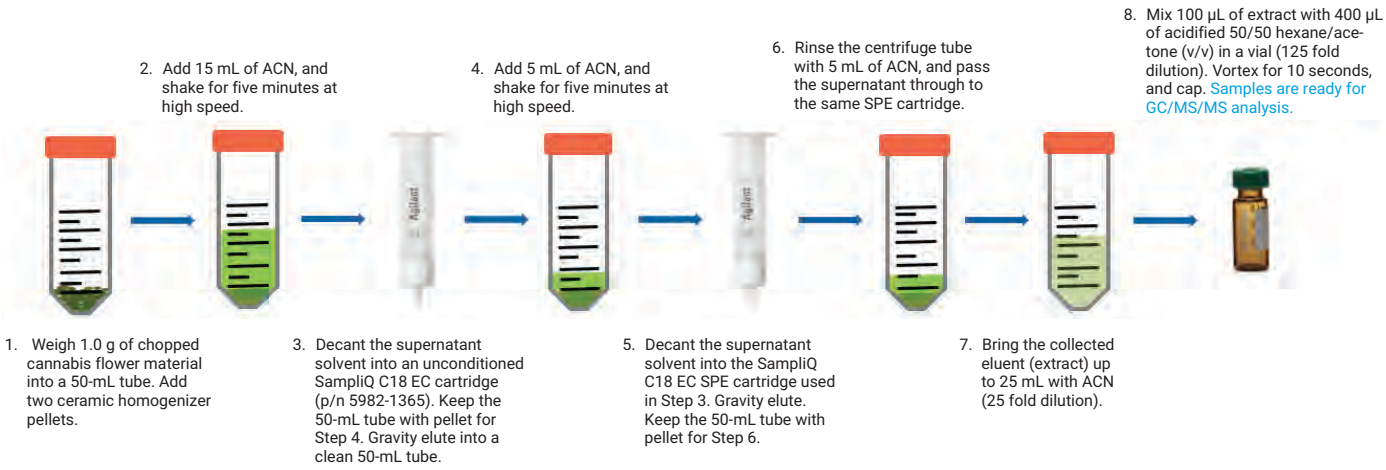

Figure 2. Schematic representation of sample preparation procedure for GC/MS/MS analysis.

9. After the entire solvent has gone through the C18 cartridge and is collected, add 5 mL of acetonitrile to the empty tube from step 6 and shake mechanically for five minutes at high speed. This will extract pesticides and mycotoxins that may still be in the cannabis material.
10. Decant the supernatant from step 9 into the same SampliQ C18 EC SPE cartridge.
11. Rinse the empty tube from step 9 with a final 5 mL of acetonitrile to wash any pesticides that might be retained on the tube wall, then pass this solvent through the same C18 cartridge. A volume of less than 25 mL (three portions of 15, 5, and 5 mL) of acetonitrile extract is collected.
12. Transfer all eluent into a volumetric flask, bring the final volume to 25 mL with acetonitrile or use the 25-mL mark on the graduated 50-mL PP centrifuge tube to adjust to 25 mL total. Vortex. Now the sample has been diluted 25 times.
13. Transfer the cleaned extract (step 12) into a clean tube, cap, and label.

Detailed sample preparation unique to LC/MS/MS

14. In a 1.5-mL centrifuge tube, mix solution 13 with a solution of 50:50 mobile phase A:mobile phase B in a 1-to-9 proportion. A typical scenario would be to mix 100 µL of solution 13 with 900 µL of 50:50 mobile phase A: mobile phase B. Vortex for 10 seconds. The solution might become cloudy. Now the sample has been diluted 250 times.
15. Centrifuge at 14,000 rpm for five minutes. Pellets might be observed at the bottom of the tube after centrifugation. Some cloudiness may be observed.
16. Transfer solution 15 to a 2-mL vial (p/n 5182-0716); avoid pipetting the pellets. Cap using p/n 5190-7021.
17. Inject the solution for LC/MS/MS or spike it with the desired amount of pesticide to obtain a post cleanup spiked matrix.

Matrix-matched calibrators: LC/MS/MS

Pesticide-free, extracted dry cannabis matrix in acetonitrile (1 g in 25 mL of acetonitrile = 25x dilution) further diluted 10x with 50:50 mobile phase A:mobile phase B (referred to as *Extract* in Table 1) was prepared in appropriate volume. Total dilution of matrix was 250x.

Dilutions were done in Eppendorf tubes, then the remaining solution in each tube was transferred into a deactivated glass insert (p/n 5181-8872) placed in a 2-mL vial, which was then capped and injected.

Detailed sample preparation unique to GC/MS/MS

18. Into a 2-mL vial, mix solution 13 with a solution of acidified hexane:acetone solution (0.1 % formic acid in 50:50 hexane:acetone) in a 1-to-4 proportion. A typical scenario would be to mix 200 µL of solution 13 with 800 µL of acidified hexane:acetone solution (0.1% formic acid in 50:50 hexane:acetone). Vortex for 10 seconds. Now the sample has been diluted 125 times.
19. Inject the solution for GC/MS/MS or spike it with the desired amount of pesticide to obtain a post cleanup spiked matrix.

Table 1. Preparation of calibrators for LC/MS/MS analysis.

STD Level (In vial, ppb)	Volume (µL)	Solution		Volume (µL)	Solution
25	12.5	1 ppm pesticide stock	added to	487.5	Extract
10	200	25 ppb	added to	300	Extract
5	250	10 ppb	added to	250	Extract
2.5	250	5 ppb	added to	250	Extract
1	200	2.5 ppb	added to	300	Extract
0.75	375	1 ppb	added to	125	Extract
0.5	333	0.75 ppb	added to	167	Extract
0.25	250	0.5 ppb	added to	250	Extract
0.1	200	0.25 ppb	added to	300	Extract
0.075	375	0.1 ppb	added to	125	Extract
0.05	333	0.075 ppb	added to	167	Extract
0.025	250	0.05 ppb	added to	250	Extract
0.01	200	0.025 ppb	added to	300	Extract
0.0075	375	0.01 ppb	added to	125	Extract
0.005	333	0.0075 ppb	added to	167	Extract

Matrix-matched calibrators: GC/MS/MS

Pesticide-free, extracted dry cannabis matrix in acetonitrile (1 g in 25 mL of acetonitrile = 25x dilution) further diluted 5x with acidified hexane:acetone solution (referred to as *Acidified Extract* in Table 2) was prepared in appropriate volume. Total dilution of matrix was 125x.

Dilutions were done in Eppendorf tubes, then the remaining solution in each tube was transferred into a deactivated glass insert (p/n 5181-8872) placed in a 2-mL vial, which was then capped and injected.

Table 2. Preparation of calibrators for GC/MS/MS analysis.

STD Level (In vial, ppb)	Volume (µL)	Solution		Volume (µL)	Solution
50	50	1 ppm pesticide stock	added to	450	Acidified extract
25	250	50 ppb	added to	250	Acidified extract
10	200	25 ppb	added to	300	Acidified extract
5	250	10 ppb	added to	250	Acidified extract
2.5	250	5 ppb	added to	250	Acidified extract
1	200	2.5 ppb	added to	300	Acidified extract
0.75	375	1 ppb	added to	125	Acidified extract
0.5	333	0.75 ppb	added to	167	Acidified extract
0.25	250	0.5 ppb	added to	250	Acidified extract
0.1	200	0.25 ppb	added to	300	Acidified extract
0.075	375	0.1 ppb	added to	125	Acidified extract
0.05	333	0.075 ppb	added to	167	Acidified extract

Results and discussion

Sample preparation

The use of ceramic homogenizers or stainless steel beads combined with the vertical shaking of multiple samples in individual 50-mL PP tubes eliminates the need for mechanical grinding. Mechanical grinding is typically low-throughput, and requires extra precaution to avoid cross-contamination from sample to sample. Vertical shaking increases lab productivity and reduces labor costs associated with sample handling. Sample size is important, as it must represent a statistically relevant proportion of the cannabis lot to be tested, with a constant pesticide exposure throughout. Therefore, approved sampling methods by Health Canada need to be followed.

Using a simple acetonitrile extraction and SPE cleanup, recoveries of pesticides and mycotoxins were calculated by spiking the acetonitrile extract (25x sample dilution) before the final dilution for either LC/MS/MS or GC/MS/MS analysis. Calculated recoveries (see Table 3) were comparable to those observed in a previous publication[5], although the approach described here was optimized for Canadian reporting limits.

The unique SampliQ C18 EC SPE cartridge used for cleanup displays superior inertness towards pesticides and mycotoxins. This SPE step shows its relevance as extracted samples have a significantly cleaner appearance after going through the cartridge. Cannabis is a unique plant that requires unique sample prep. High amounts of cannabinoids, terpenes, and other interferences can alter proper quantification by LC/MS/MS and GC/MS/MS. Therefore, the combination of SampliQ C18 EC cleanup followed by dilution in optimized solvents provides the best balance between sensitivity and robustness with reduced labor costs.

Table 3. Calculated recoveries from spiking matrix before final dilution.

Compound	Recovery (%)	%RSD (n = 3)
Pesticides		
Abamectin (Avermectin B1a)	102.7	3.3
Acephate	102.3	1.7
Acetamiprid	103.2	1.1
Acequinocyl	37.8	4.2
Aldicarb	101.9	1.5
Allethrin	108.7	2.5
Azadirachtin	92.7	5.5
Azoxystrobin	103.9	1.1
Benzovindiflupyr	106.4	0.9
Bifenazate	101.2	2.6
Bifenthrin	103.9	1.4
Boscalid	91.0	1.8
Buprofezin	103.0	1.3
Carbaryl	101.5	1.7
Carbofuran	102.2	1.1
Chlorantraniliprole	100.2	2.9
Chlorphenapyr	103.7	1.3
Chlorpyrifos	101.0	1.2
Clofentezine	113.0	3.9
Clothianidin	100.4	2.7
Coumaphos	98.9	2.8
Cyantranilipole	99.4	1.3
Cyfluthrin	99.8	2.1
Cypermethrin	92.5	4.8
Cyprodinil	79.8	3.5
Daminozide	102.4	3.2
Deltamethrin	91.9	5.5
Diazinon	103.4	1.6
Dichlorvos	98.9	2.1
Dimethoate	103.5	1.6
Dinotefuran	101.6	2.1
Dodemorph	94.2	2.1
Endosulfan alpha	96.2	3.4
Endosulfan beta	96.3	3.9
Endosulfan sulfate	101.4	3.0

Compound	Recovery (%)	RSD (%, n = 3)
Ethoprophos	102.6	2.3
Etofenprox	66.8	2.2
Etoxazole	86.6	2.0
Etridiazole	102.5	3.3
Fenoxycarb	110.0	1.1
Fenpyroximate	76.4	1.8
Fensulfothion	102.1	2.3
Fenthion	100.7	1.7
Fenvalerate	92.0	1.3
Fipronil	104.3	0.6
Flonicamid	1067.	2.4
Fludioxonil	101.5	1.2
Fluopyram	105.6	2.1
Hexythiazox	93.5	6.0
Imazalil	103.3	1.0
Imidacloprid	100.4	1.1
Kinoprene	96.9	4.0
Kresoxim-methyl	107.6	1.6
Malathion	103.1	1.8
Metalaxyl	101.1	0.5
Methiocarb	105.0	0.3
Methomyl	101.7	4.8
Methoprene	81.5	2.2
Methyl parathion	102.7	1.2
Mevinphos I	96.9	0.2
Mevinphos II	102.1	1.2
MGK-264	102.8	9.9
Myclobutanil	106.1	1.1
Naled	102.0	1.1
Novaluron	98.0	2.2
Oxamyl	103.2	1.9
Paclobutrazol	101.8	3.4
Permethrin	98.2	2.3
Phenothrin	69.7	1.5
Phosmet	104.9	2.7
Piperonyl butoxide	97.3	1.9

Compound	Recovery (%)	RSD (%, n = 3)
Pirimicarb	99.4	1.3
Prallethrin	108.9	0.5
Propiconazole	102.8	0.4
Propoxur	103.2	1.2
Pyraclostrobin	103.7	0.8
Pyrethrin I	88.5	4.1
Pyrethrin II	91.5	5.8
Pyridaben	70.5	0.9
Quintozene (PCNB)	100.2	3.5
Resmethrin	82.5	4.2
Spinetoram J	68.4	2.2
Spinetoram L	58.3	2.9
Spinosyn A	79.0	3.0
Spinosyn D	73.8	1.6
Spirodiclofen	92.1	2.9
Spiromesifen	98.3	1.0
Spirotetramat	100.4	5.5
Spiroxamine	96.3	1.2
Tebuconazole	100.1	5
Tebufenozide	105.0	1.0
Teflubenzuron	98.0	5.4
Tetrachlorvinphos	106.5	1.5
Tetramethrin	101.6	2.9
Thiacloprid	101.8	2.2
Thiamethoxam	103.4	0.4
Thiophanate-methyl	100.7	3.7
Trifloxystrobin	103.8	0.4
Mycotoxins		
Aflatoxin G1	102.8	0.2
Aflatoxin G2	102.7	0.3
Aflatoxin B1	104.8	0.4
Aflatoxin B2	102.3	1.4
Ochratoxin	100.5	2.2

6470 LC/MS/MS results and discussion

The 1290 Infinity II coupled with a 6470 triple quadrupole LC/MS/MS system offers both the level of sensitivity required by Canadian regulations to meet the reporting limits for pesticides in dry cannabis, and the level of robustness required to run this application daily. The combination of sample dilution and mobile phase composition allows one to maintain excellent peak shape for all compounds when injecting 25 µL, but will also allow for larger injection volumes, if necessary. The MRM transitions were optimized using the MassHunter Optimizer program (see Table 5 in Appendix), and the acquisition was performed in dMRM mode, in which the dwell time of each transition was optimized by the MassHunter software based on the retention time of each compound. Linear calibration curves were observed, with a regression fit equal to or greater than 0.99, and the LOQs listed in Table 2 were obtained in spiked matrix.

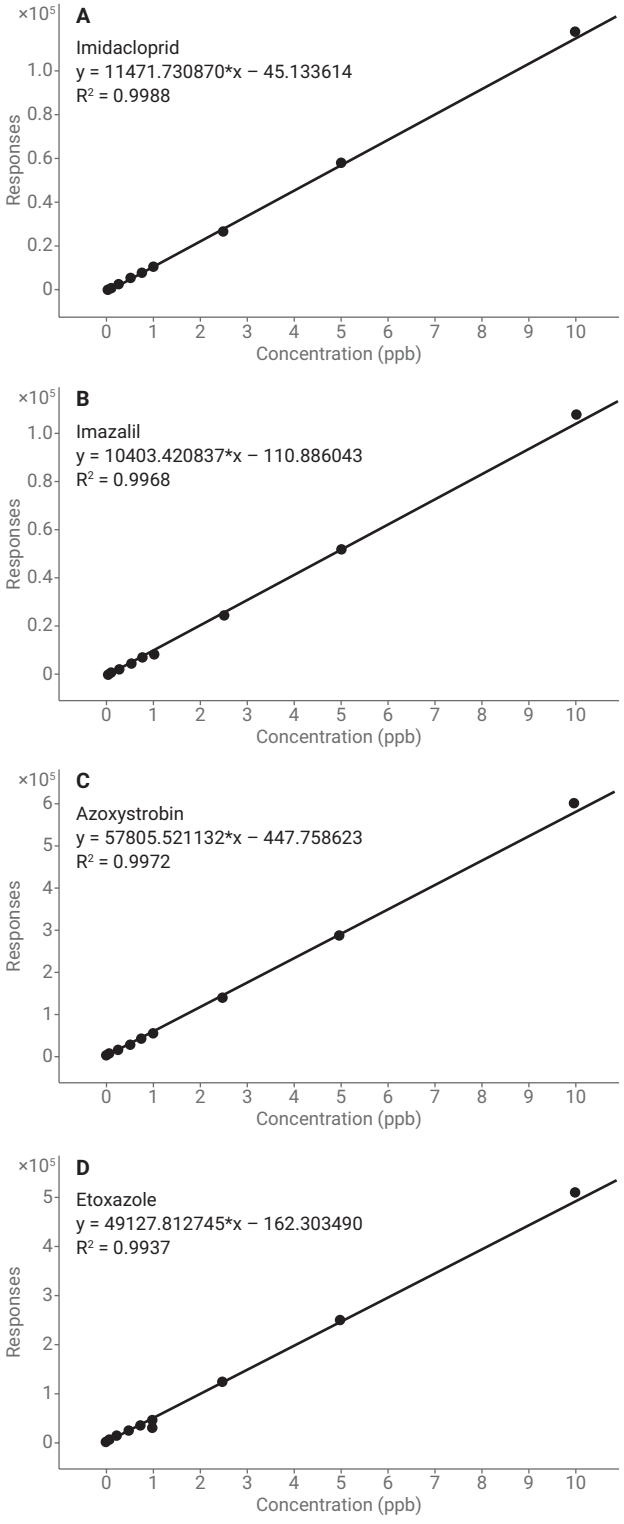

Figure 3. Select 6470 LC/MS/MS calibration curves. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

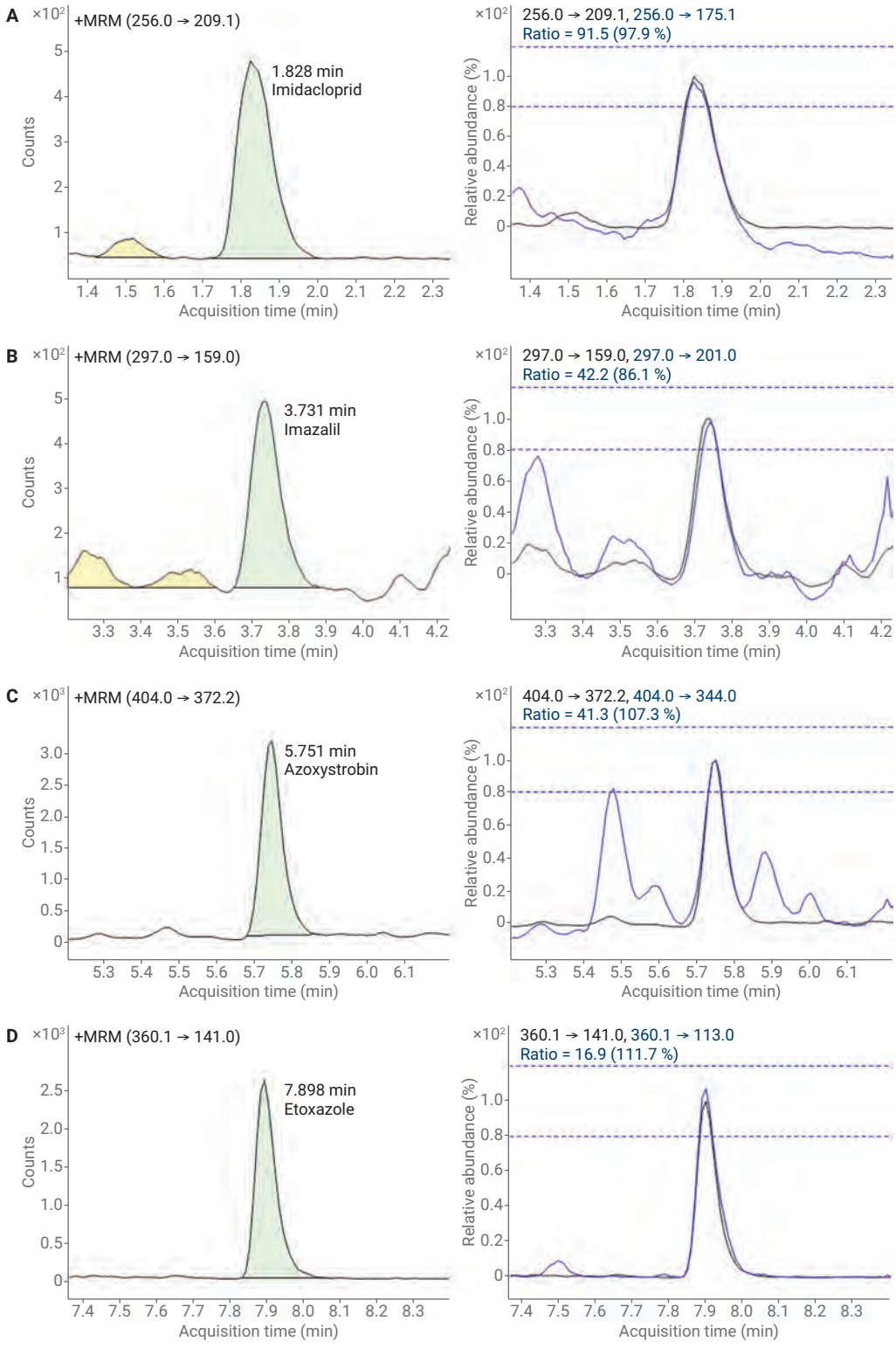

Figure 4. Select 6470 LC/MS/MS chromatograms. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

Ultivo LC/MS/MS results and discussion

The Ultivo LC/MS/MS was introduced in 2017 as a next-generation LC/MS/MS system, with new optical and electronic components. Its development was based on combining small size, ease of maintenance, and maximum instrument uptime. Given the challenging nature of pesticide residue testing in cannabis, it is of interest to evaluate if the Ultivo can match the 6470 in terms of sensitivity for this application.

The 1290 Infinity II UHPLC stack previously used with the 6470 was connected to the Ultivo, which allowed us to keep retention times identical between the two systems, and thus, identical dwell times for all compounds using the dMRM mode.

The Ultivo equaled the performance of the 6470 in terms of linearity range and LOQ, as illustrated by the equivalent calibration curves in Figure 5 compared to Figure 3.

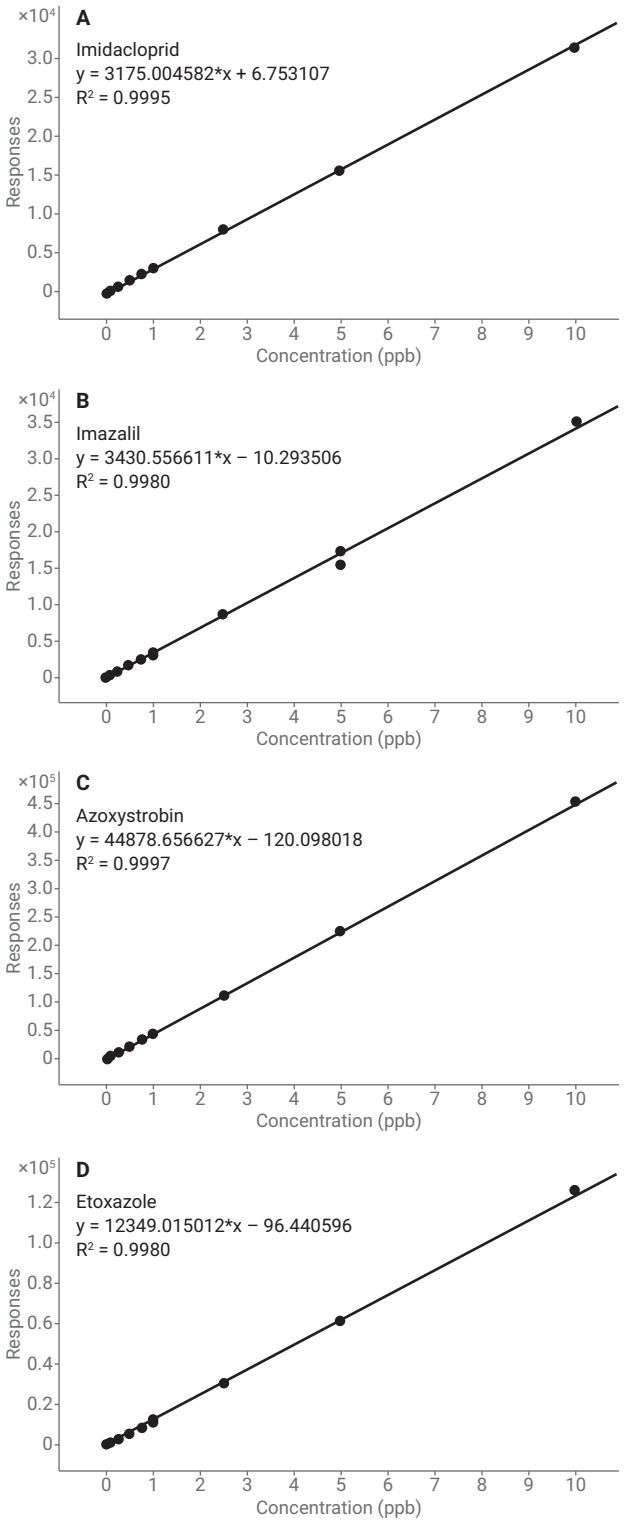

Figure 5. Select Ultivo LC/MS/MS calibration curves. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

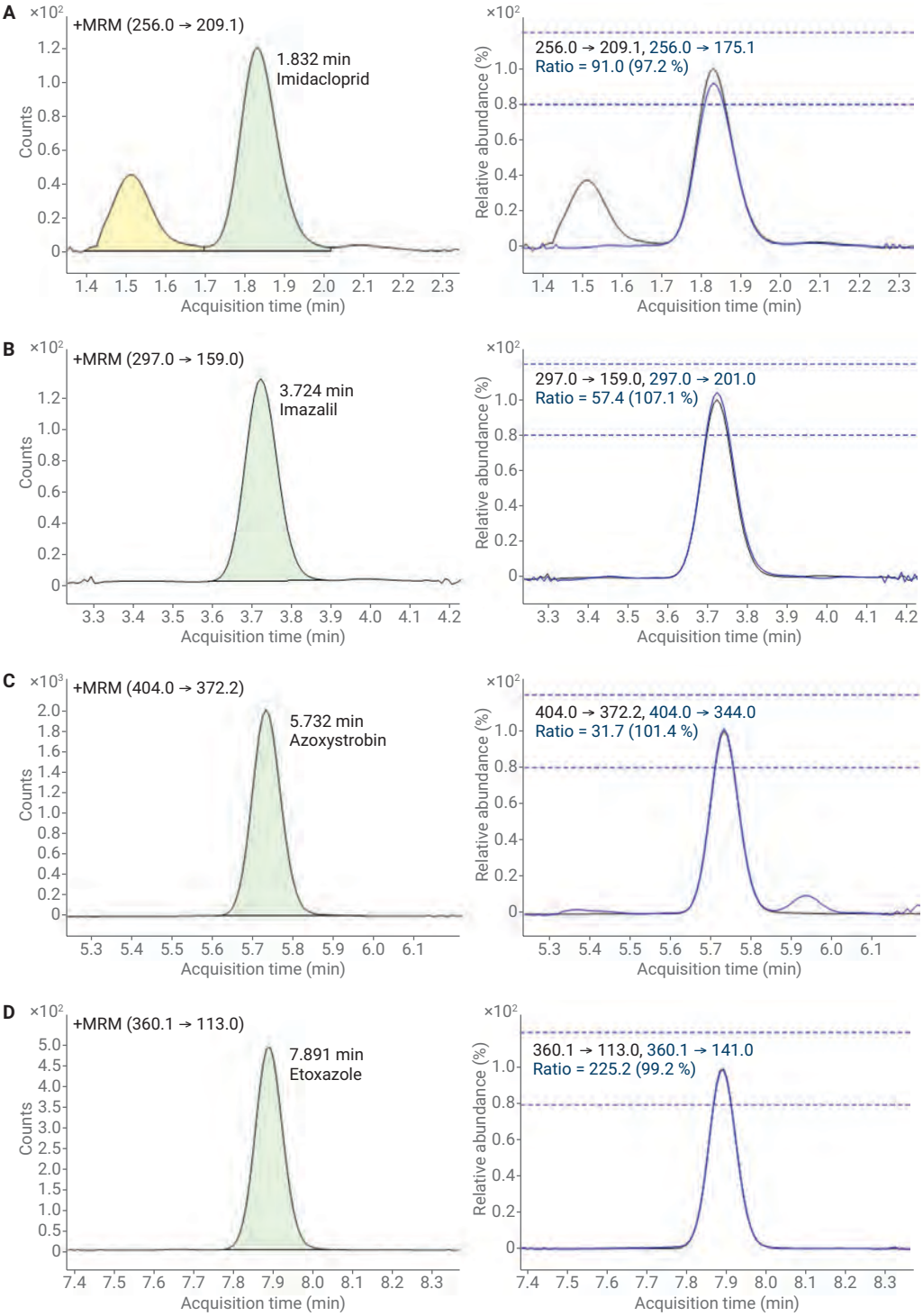

Figure 6. Select Ultivo LC/MS/MS chromatograms. A) Imidacloprid, B) Imazalil, C) Azoxystrobin, D) Etoxazole.

7010 GC/MS/MS results and discussion

A vast majority of the pesticides included in the Health Canada list can be analyzed by LC/MS/MS. However, for some of these pesticides, it is impossible to consistently meet the required reporting limits (RLs) set by Health Canada without very extensive and long sample cleanup, or at the expense of sample throughput through time-consuming instrument optimization. The same is true for some regulated pesticides in California that are not part of the Canadian list, and that are also not amenable to LC/MS/MS. GC/MS/MS is the best choice to complete the coverage of the Canadian and California lists, as it can be used as the primary reporting platform or in a confirmatory approach when matrix could interfere with some compounds in LC/MS/MS.

The first cleanup step in sample preparation is common between LC/MS/MS and GC/MS/MS, but some optimization was required in the second step (dilution) as well as in hardware setup. A mix of acidified acetone:hexane was used for the second 1-in-5 dilution, for a final sample dilution of 125x. To compensate for this smaller dilution factor, and keeping instrument uptime as a primary objective, two hardware options were selected: post run, midcolumn backflush to avoid source contamination by late eluting compounds, and post sequence JetClean source cleaning to restore source conditions from sequence to sequence.

Table 6 in the Appendix lists the 7010 MRM transitions, and Table 4 shows the LOQs.

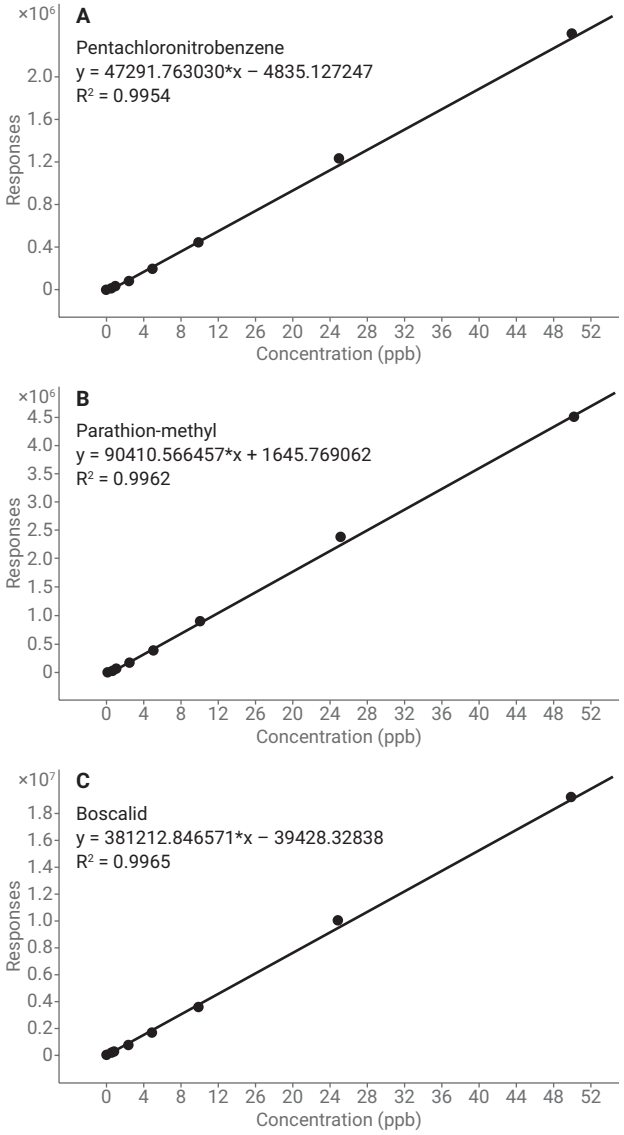

Figure 7. Select 7010 GC/MS/MS calibration curves.
A) Pentachloronitrobenzene (PCNB, Quintozene), B) Parathion-methyl, C) Boscalid.

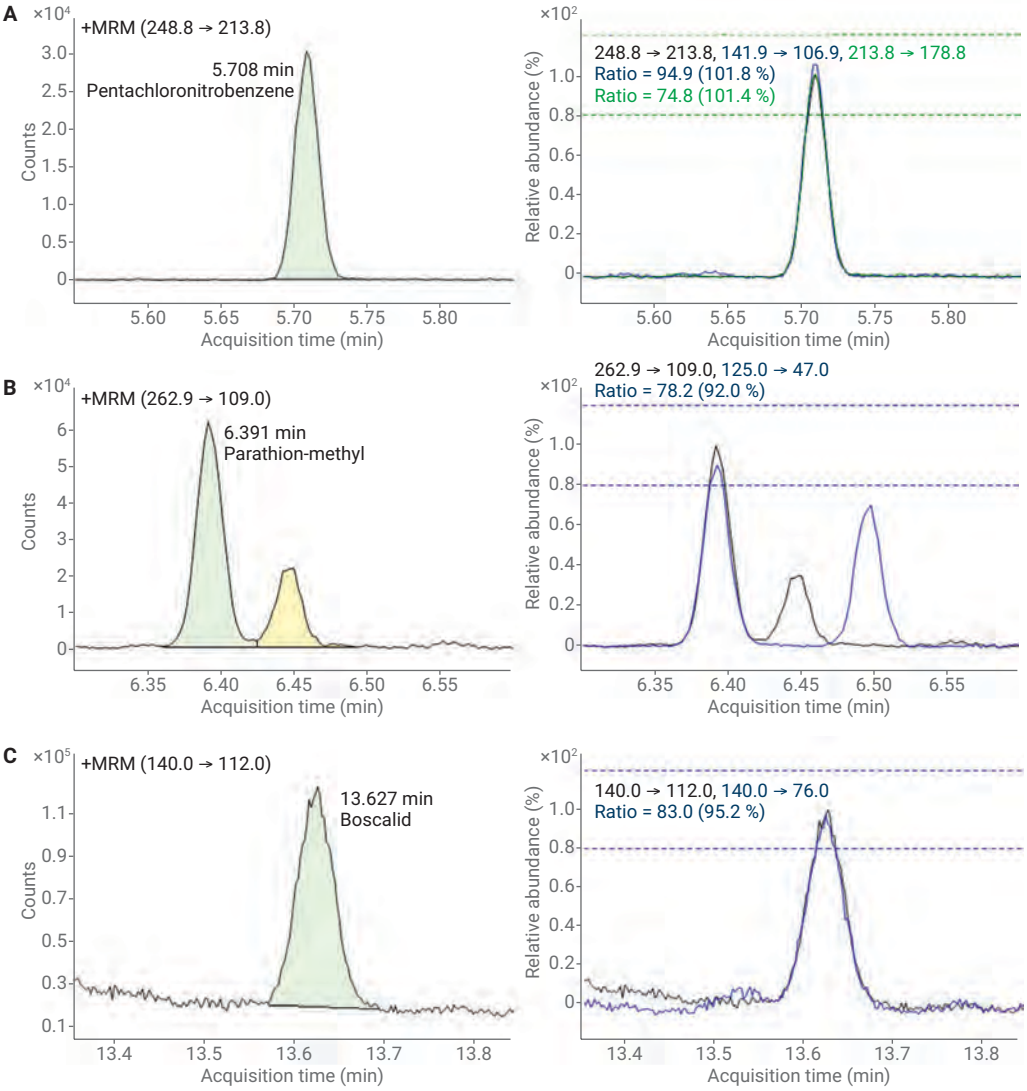

Figure 8. Select 7010 GC/MS/MS chromatograms. A) Pentachloronitrobenzene (PCNB, quintozene), B) Parathion-methyl, C) Boscalid.

Table 4. Calculated LOQs in matrix. A blank cell indicates that no data were collected for a given compound using that specific platform (continued next page).

Compound	Health Canada reporting limit (ppb)	LC/MS/MS LOQ in matrix (ppb)	GC/MS/MS LOQ in matrix (ppb)
Pesticides			
Abamectin (Avermectin B1a)	500	12.5	
Acephate	20	2.5	
Acetamiprid	100	2.5	
Acequinocyl	Under development*	18.75	
Aldicarb	1,000	2.5	
Allethrin	200	125	
Azadirachtin	1,000	12.5	
Azoxystrobin	20	2.5	
Benzovindiflupyr	20	2.5	
Bifenazate	20	2.5	
Bifenthrin	Under development*	62.5	31
Boscalid	20	6.25	12.5
Buprofezin	20	2.5	
Carbaryl	50	2.5	
Carbofuran	20	2.5	
Chlorantraniliprole	Under development*	2.5	
Chlorphenapyr	Under development*	25	
Chlorpyrifos	Under development*	25	6.25
Clofentezine	20	18	
Clothianidin	50	2.5	
Coumaphos	20	6.25	
Cyantranilipole	20	6.25	
Cyfluthrin	Under development*		125
Cypermethrin	Under development*	250	125
Cyprodinil	Under development*	12.5	
Daminozide	Under development*	2.5	
Deltamethrin	Under development*	62.5	62.5
Diazinon	Under development*	2.5	
Dichlorvos	100	6.25	
Dimethoate	20	2.5	
Dinotefuran	100	2.5	
Dodemorph	Under development*	2.5	
Endosulfan *alpha*	Under development*		31
Endosulfan *beta*	Under development*		12.5
Endosulfan sulfate	Under development*	12.5	
Ethoprophos	20	2.5	
Etofenprox	Under development*	6.25	
Etoxazole	20	2.5	
Etridiazole	Under development*		6.25

Compound	Health Canada reporting limit (ppb)	LC/MS/MS LOQ in matrix (ppb)	GC/MS/MS LOQ in matrix (ppb)
Fenoxycarb	20	2.5	
Fenpyroximate	20	2.5	
Fensulfothion	20	2.5	
Fenthion	Under development*		9.4
Fenvalerate	Under development*		31
Fipronil	60	2.5	
Flonicamid	50	12.5	
Fludioxonil	20	2.5	
Fluopyram	20	2.5	
Hexythiazox	Under development*	12.5	
Imazalil	20	2.5	
Imidacloprid	20	2.5	
Iprodione	1000	250	
Kinoprene	Under development*		312.5
Kresoxim-methyl	Under development*	2.5	
Malathion	20	2.5	
Metalaxyl	20	2.5	
Methiocarb	20	2.5	
Methomyl	50	1.25	
Methoprene	Under development*	187.5	
Methyl parathion	Under development*		9.375
Mevinphos I	50	6.25	
Mevinphos II	50	6.25	
MGK-264	Under development*	187.5	31.25
Myclobutanil	20	2.5	
Naled	Under development*	6.25	
Novaluron	50		31.25
Oxamyl	3000	1.25	
Paclobutrazol	20	2.5	
Permethrin	Under development*		125
Phenothrin	50	2.5	
Phosmet	Under development*	2.5	
Piperonyl butoxide	Under development*	2.5	
Pirimicarb	20	2.5	
Prallethrin	Under development*	62.5	
Propiconazole	Under development*	2.5	
Propoxur	20	2.5	
Pyraclostrobin	20	2.5	
Pyrethrin I	50	32.7	
Pyrethrin II	50	32.9	
Pyridaben	50	2.5	

* Under development: The reporting limit in dry cannabis matrix was not established by Health Canada at the time of this Application Note's publication.

A total workflow for pesticide quantitation and reporting

The Agilent workflow for residual pesticides in cannabis flower not only includes a single-stream sample preparation procedure amenable to both LC/MS/MS and GC/MS/MS data acquisition platforms, but also includes unified data analysis and reporting tools. Using the Quant-My-Way features of the MassHunter Quantitative Analysis software package, processing raw data is performed within a graphical environment designed specifically for residual pesticide testing in cannabis and related products. The interface is striated, and controls how a user interacts with the software and the features that are available for specific workflows. For example, the Scientist interface has read/write permissions and offers the abilities to create and edit quantitative procedures and define reporting information. The Analyst interface has read-only permission for use in the daily production environment. Thus, the laboratory can control how data are processed and reported, and capture change-exceptions when necessary.

Compound	Health Canada reporting limit (ppb)	LC/MS/MS LOQ in matrix (ppb)	GC/MS/MS LOQ in matrix (ppb)
Quintozene (PCNB)	Under development*		6.25
Resmethrin	100	6.25	
Spinetoram J	Under development*	6.25	
Spinetoram L	Under development*	12.5	
Spinosyn A	Under development*	6.25	
Spinosyn D	Under development*	6.25	
Spirodiclofen	20	18.75	
Spiromesifen	3000	2.5	
Spirotetramat	20	2.5	
Spiroxamine	Under development*	2.5	
Tebuconazole	Under development*	2.5	
Tebufenozide	20	2.5	
Teflubenzuron	50	18.75	
Tetrachlorvinphos	20	2.5	
Tetramethrin	100	12.5	
Thiacloprid	20	2.5	
Thiamethoxam	20	2.5	
Thiophanate-methyl	50	2.5	
Trifloxystrobin	20	2.5	
Mycotoxins			
Aflatoxin G1	2	1.25	
Aflatoxin G2	2	1.25	
Aflatoxin B1	2	1.25	
Aflatoxin B2	2	1.25	
Ochratoxin	20	2.5	

* Under development: The reporting limit in dry cannabis matrix was not established by Health Canada at the time of this Application Note's publication.

Conclusion

Mandatory reporting limits established by Health Canada for pesticide testing in cannabis are typically lower than those published in various U.S. states, and require both LC/MS and GC/MS for accurate and robust testing. Because dried cannabis leaves and flowers generate many co-extractives that can negatively impact testing results, a simple and cost-effective sample preparation had to be developed to meet the demanding testing requirements in Canada. A combination of acetonitrile extraction, unique SPE on SampliQ C18 EC, and further dilution in optimized solvent is the best approach for accurate pesticide and mycotoxin quantification at levels as low as 20 ppb.

Agilent instrumentation including the 1290 Infinity II LC coupled with a 6470 LC/MS/MS system and Ultivo LC/MS/MS, as well as the 7010 GC/MSMS, provides robust, accurate, and sensitive residual pesticide and mycotoxin testing in challenging matrices such as cannabis.

Acknowledgments

Agilent would like to thank Canopy Growth for providing cannabis extracts. We also need to recognize the many contributions of Rick Jordan from Pacific Agricultural Laboratory in Sherwood, OR USA.

Disclaimer

Agilent products and solutions are intended to be used for cannabis quality control and safety testing in laboratories where such use is permitted under state/country law.

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4. Tuner, C. E.; Elsohly, M. A.; Boeren. For example, *J. Nat. Prod.* **1980**, *43*, 169–234. doi:10.1021/np50008a001.
5. A novel comprehensive strategy for residual pesticide analysis in cannabis flower, *Agilent Technologies Application Note*, publication number 5991-9030EN.

Appendix

Table 5. LC/MS/MS MRM transitions.

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Avermectin B1a	8.48	Positive	890.5	567.1	160	8
Avermectin B1a	8.48	Positive	890.5	567.1	160	8
Avermectin B1a	8.48	Positive	890.5	305.1	160	28
Avermectin B1a	8.48	Positive	890.5	145	160	45
Avermectin B1b	8.29	Positive	876.6	553.2	160	7
Avermectin B1b	8.29	Positive	876.6	291.1	160	15
Acephate	1.26	Positive	184	143	60	5
Acephate	1.26	Positive	184	95	60	20
Acequinocyl	9.58	Positive	402.3	343.2	90	10
Acequinocyl	9.58	Positive	402.3	189.1	90	41
Acetamiprid	2.1	Positive	223	126.1	100	20
Acetamiprid	2.1	Positive	223	90.1	100	35
AflatoxinB1	4.23	Positive	313.1	285.1	160	16
AflatoxinB1	4.23	Positive	313.1	241.1	160	35
AflatoxinB2	3.78	Positive	315.1	287.1	130	17
AflatoxinB2	3.78	Positive	315.1	259.1	130	17
AflatoxinG1	3.46	Positive	329.1	311.1	130	20
AflatoxinG1	3.46	Positive	329.1	243.1	130	17
AflatoxinG2	3.03	Positive	331.1	285.1	150	21
AflatoxinG2	3.03	Positive	331.1	245.1	150	26
Aldicarb	2.22	Positive	116	89.1	50	4
Aldicarb	2.22	Positive	116	70.1	50	4
Allethrin	7.5	Positive	303	169	85	4
Allethrin	7.5	Positive	303	135	85	10
Allethrin	7.5	Positive	303	123	85	16
Azadirachtin	4.36	Positive	703	685	165	8
Azadirachtin	4.36	Positive	703	585	165	12
Azadirachtin	4.36	Positive	703	567	165	12
Azoxystrobin	5.73	Positive	404	372.2	100	10
Azoxystrobin	5.73	Positive	404	344	100	25
Benzovindiflupyr	6.69	Positive	398	378	150	12
Benzovindiflupyr	6.69	Positive	398	342	150	20
Benzovindiflupyr	6.69	Positive	398	322	150	24
Bifenazate	5.83	Positive	301.1	198.2	80	5
Bifenazate	5.83	Positive	301.1	170.1	80	15
Bifenthrin	9.07	Positive	440.1	181.1	90	5
Bifenthrin	9.07	Positive	440.1	166	90	20
Boscalid	5.58	Positive	343	307	140	12
Boscalid	5.58	Positive	343	271	140	28
Buprofezin	7.38	Positive	306	201	105	8
Buprofezin	7.38	Positive	306	116	105	16
Carbaryl	3.33	Positive	202	145	70	0
Carbaryl	3.33	Positive	202	127	70	25
Carbofuran	3.16	Positive	222	165	90	5
Carbofuran	3.16	Positive	222	123	90	20
Chlorantraniliprole	5.04	Positive	483.9	452.9	100	15
Chlorantraniliprole	5.04	Positive	483.9	285.9	100	10
Chlorfenapyr	7.35	Positive	409.2	59	130	20
Chlorfenapyr	7.35	Positive	409.2	31	130	45
Chlorpyrifos	7.95	Positive	349.9	197.9	100	20
Chlorpyrifos	7.95	Positive	349.9	97	100	41
Clofentezine	7.04	Positive	303	138	90	10
Clofentezine	7.04	Positive	303	102.1	90	10
Clothianidin	1.69	Positive	250	169	95	12
Clothianidin	1.69	Positive	250	132	95	16
Coumaphos	7.4	Positive	363	307	125	15
Coumaphos	7.4	Positive	363	226.9	125	33
Cyantranilipole	4.29	Positive	475	444	115	20

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Cyantranilipole	4.29	Positive	475	286	115	12
Cyfluthrin	9.2	Positive	453.3	193	90	13
Cyfluthrin	9.2	Positive	451.3	191	90	13
Cypermethrin	8.72	Positive	435.3	193	90	16
Cypermethrin	8.72	Positive	433.3	191	90	16
Cyprodinil	5.5	Positive	226	133	160	28
Cyprodinil	5.5	Positive	226	93	160	40
Daminozide	1.18	Positive	161	143	80	10
Daminozide	1.18	Positive	161	61.1	80	10
Deltamethrin	9.15	Positive	523	506	100	8
Deltamethrin	9.15	Positive	523	281	100	12
Diazinon	6.43	Positive	305.1	169.1	100	20
Diazinon	6.43	Positive	305.1	153.1	100	20
Dichlorvos	2.72	Positive	221	109	110	12
Dichlorvos	2.72	Positive	221	79	110	24
Dimethoate	1.86	Positive	230	199	80	0
Dimethoate	1.86	Positive	230	125	80	20
Dimethomorph I	7.2	Positive	388.1	301	134	24
Dimethomorph I	7.2	Positive	388.1	165	134	36
Dimethomorph II	7.84	Positive	388.1	301	134	24
Dimethomorph II	7.84	Positive	388.1	165	134	36
Dinotefuran	1.24	Positive	203	157	90	4
Dinotefuran	1.24	Positive	203	129	90	8
Dinotefuran	1.24	Positive	203	87	90	16
Dinotefuran	1.24	Positive	203	73	90	20
Dodemorph	4.1	Positive	282	116	145	24
Dodemorph	4.1	Positive	282	98	145	32
Endosulfan sulfate	7.09	Negative	421	97	130	28
Endosulfan sulfate	7.09	Negative	421	80	130	56
Ethoprophos	5.51	Positive	243	131	90	15
Ethoprophos	5.51	Positive	243	97	90	30
Etofenprox	9	Positive	394.2	177.2	90	10
Etofenprox	9	Positive	394.2	107.1	90	45
Etoxazole	7.87	Positive	360.1	141	140	28
Etoxazole	7.87	Positive	360.1	113	140	50
Fenoxycarb	6.37	Positive	302.1	116.1	100	5
Fenoxycarb	6.37	Positive	302.1	88.1	100	15
Fenpyroximate	8.14	Positive	422.1	366.2	130	15
Fenpyroximate	8.14	Positive	422.1	135.1	130	30
Fensulfothion	4.52	Positive	309	281	125	12
Fensulfothion	4.52	Positive	309	253	125	16

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Fenvalerate	9	Positive	437	167	105	16
Fipronil	6.05	Negative	436.9	332	100	18
Fipronil	6.05	Negative	434.9	330	100	18
Fipronil	6.05	Negative	434.9	250.1	100	30
Flonicamid	1.4	Positive	230.1	203	125	18
Flonicamid	1.4	Positive	230.1	148	125	32
Flonicamid	1.4	Positive	230.1	98	125	48
Fludioxonil	5.01	Negative	247	169	120	36
Fludioxonil	5.01	Negative	247	126	120	40
Fluopyram	5.62	Positive	397	208	150	24
Fluopyram	5.62	Positive	397	173	150	36
Hexythiazox	8.2	Positive	353	228.1	90	10
Hexythiazox	8.2	Positive	353	168.1	90	25
Imazalil	3.73	Positive	297	201	120	15
Imazalil	3.73	Positive	297	159	120	20
Imidacloprid	1.85	Positive	256	209.1	90	16
Imidacloprid	1.85	Positive	256	175.1	90	20
Iprodione	6.77	Positive	332	247	80	16
Iprodione	6.77	Positive	332	56	80	44
Iprodione	6.77	Positive	330	245	80	16
Iprodione	6.77	Positive	330	56	80	50
Kresoxim methyl	6.6	Positive	314.1	267.1	80	0
Kresoxim methyl	6.6	Positive	314.1	222.2	80	10
Malathion	5.7	Positive	331.1	126.9	80	5
Malathion	5.7	Positive	331.1	99	80	10
Metalaxyl	4.06	Positive	280.1	220.2	100	10
Metalaxyl	4.06	Positive	280.1	160.1	100	20
Methiocarb	4.98	Positive	226.1	169.1	70	0
Methiocarb	4.98	Positive	226.1	121.1	70	15
Methomyl	1.38	Positive	162.9	106.1	60	5
Methomyl	1.38	Positive	162.9	88.1	60	0
Methoprene	8.09	Positive	311	151	100	0
Methoprene	8.09	Positive	311	123	100	2
Methoprene	8.09	Positive	311	109	100	4
Methyl-Parathion	5.61	Positive	264	232	140	18
Methyl-Parathion	5.61	Positive	264	125	140	24
Mevinphos I	1.62	Positive	225	193	75	4
Mevinphos I	1.62	Positive	225	127	75	16
Mevinphos II	1.99	Positive	225	193	75	4
Mevinphos II	1.99	Positive	225	127	75	16
MGK-264	6.8	Positive	276.2	210.1	100	12

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
MGK-264	6.8	Positive	276.2	98	100	28
Myclobutanil	5.66	Positive	289.1	125	110	35
Myclobutanil	5.66	Positive	289.1	70.1	110	15
Naled (Dibrom)	4.42	Positive	380.8	127	90	8
Naled (Dibrom)	4.42	Positive	378.8	127	90	5
Novaluron	7.19	Positive	493	158	145	20
Novaluron	7.19	Positive	493	141	145	56
Ochratoxin	6.33	Positive	404.1	238.9	120	14
Ochratoxin	6.33	Positive	404.1	220.9	120	32
Oxamyl	1.29	Positive	237	90.1	60	0
Oxamyl	1.29	Positive	237	72.1	60	15
Paclobutrazol	5.05	Positive	294.1	125	110	40
Paclobutrazol	5.05	Positive	294.1	70.1	110	20
Permethrin	7.7	Positive	391.1	355	120	5
Permethrin	7.7	Positive	391.1	183	120	5
Phenothrin	8.73	Positive	351	237	120	8
Phenothrin	8.73	Positive	351	183	120	20
Phenothrin	8.73	Positive	351	168	120	48
Phosmet	5.59	Positive	317.9	160	80	10
Phosmet	5.59	Positive	317.9	133	80	40
Piperonyl butoxide	7.51	Positive	356.2	177.1	90	5
Piperonyl butoxide	7.51	Positive	356.2	119.1	90	35
Pirimicarb	2.7	Positive	239	182	100	16
Pirimicarb	2.7	Positive	239	72	100	24
Prallethrin	7.03	Positive	301.1	169	90	5
Prallethrin	7.03	Positive	301.1	105	90	20
Propiconazole	6.75	Positive	342.1	159	130	32
Propiconazole	6.75	Positive	342.1	69.1	130	16
Propoxur	3	Positive	210	168	60	5
Propoxur	3	Positive	210	111	60	10
Pyraclostrobin	7.18	Positive	388	194	110	8
Pyraclostrobin	7.18	Positive	388	163	110	24
Pyrethrin I	8.3	Positive	329.2	161	90	5
Pyrethrin I	8.3	Positive	329.2	143	90	20
Pyrethrin I	8.3	Positive	329.2	133	90	20
Pyrethrin_II	7.5	Positive	373.2	161	102	2
Pyrethrin_II	7.5	Positive	373.2	133.1	102	24
Pyrethrin_II	7.5	Positive	373.2	77	102	98
Pyridaben	8.53	Positive	365.1	309.1	90	4
Pyridaben	8.53	Positive	365.1	147.2	90	20
Pyridaben	8.53	Positive	365.1	117.1	90	60

Compound	RT (min)	Polarity	LC/MS/MS			
			Precursor (*m/z*)	Product (*m/z*)	Frag	CE
Resmethrin	8.52	Positive	339	171	135	12
Resmethrin	8.52	Positive	339	143	135	28
Spinetoram J	7.81	Positive	748.5	142.1	165	26
Spinetoram J	7.81	Positive	748.5	98.1	165	50
Spinetoram L	7.5	Positive	760.5	142.1	165	26
Spinetoram L	7.5	Positive	760.5	98.1	165	50
Spinosyn A	7.48	Positive	732.5	142.1	160	28
Spinosyn A	7.48	Positive	732.5	98	160	60
Spinosyn D	7.11	Positive	746.5	142.1	160	35
Spinosyn D	7.11	Positive	746.5	98	160	55
Spirodiclofen	8.18	Positive	411	313	140	8
Spirodiclofen	8.18	Positive	411	71	140	16
Spiromesifen	7.85	Positive	388.2	273	80	6
Spiromesifen	7.85	Positive	388.2	255	80	26
Spirotetramat	5.9	Positive	374.2	330.2	110	12
Spirotetramat	5.9	Positive	374.2	302	110	12
Spirotetramat	5.9	Positive	374.2	216.1	110	36
Spiroxamine	4.8	Positive	298.2	144.1	120	16
Spiroxamine	4.8	Positive	298.2	100.1	120	32
Tebuconazole	6.27	Positive	308.1	124.9	120	47
Tebuconazole	6.27	Positive	308.1	70	120	40
Tebufenozide	6	Positive	353.2	297.1	100	4
Tebufenozide	6	Positive	353.2	133	100	20
Tebufenozide	6	Positive	353.2	102.9	100	20
Teflubenzuron	7.87	Negative	379	339	125	8
Teflubenzuron	7.87	Negative	379	196	125	24
Tetrachlorvinphos	6.56	Positive	365	204	125	48
Tetrachlorvinphos	6.56	Positive	365	127	125	12
Tetrachlorvinphos	6.56	Positive	365	109	125	48
Tetramethrin	7.9	Positive	332	314	100	8
Tetramethrin	7.9	Positive	332	286	100	8
Tetramethrin	7.9	Positive	332	164	100	28
Tetramethrin	7.9	Positive	332	135	100	16
Thiacloprid	2.44	Positive	253	126	100	16
Thiacloprid	2.44	Positive	253	90	100	40
Thiamethoxam	1.58	Positive	292	211.1	80	8
Thiamethoxam	1.58	Positive	292	181.1	80	20
Thiophanate-methyl	3.43	Positive	343	311	105	8
Thiophanate-methyl	3.43	Positive	343	151	105	20
Trifloxystrobin	7.35	Positive	409.1	186	100	12
Trifloxystrobin	7.35	Positive	409.1	145	100	52

Table 6. GC/MS/MS MRM transitions (continued next page).

Compound	RT (min)	Precursor (*m/z*)	Product (*m/z*)	CE
Novaluron	3.7	335	167.9	15
Novaluron	3.7	168	139.9	10
Novaluron	3.7	168	75.9	35
Clofentezine	3.88	139	102	16
Clofentezine	3.88	137	102	16
Clofentezine	3.88	102	75	11
Teflubenzuron	4.3	199	162	14
Teflubenzuron	4.3	197	162	14
Teflubenzuron	4.3	157	141	6
Teflubenzuron	4.3	141	113	15
Etridiazole	4.5	213.1	142	25
Etridiazole	4.5	211.1	140	25
Etridiazole	4.5	183	140	15
Pentachloronitroenzene	5.7	248.8	213.8	15
Pentachloronitroenzene	5.7	213.8	178.8	15
Pentachloronitroenzene	5.7	141.9	106.9	30
Kinoprene	5.95	149	93	4
Kinoprene	5.95	149	91	10
Kinoprene	5.95	149	77	14
Parathion-methyl	6.45	262.9	109	10
Parathion-methyl	6.45	125	79	5
Parathion-methyl	6.45	125	47	10
Chlorpyrifos	6.6	313.8	257.8	15
Chlorpyrifos	6.6	198.9	171	15
Chlorpyrifos	6.6	196.9	169	15
Allethrin	6.73	123	81	10
Allethrin	6.73	107	91	10
Allethrin	6.73	91	65	15
MGK-264 I	6.8	164.2	98	10
MGK-264 I	6.8	164.2	67.1	5
MGK-264 I	6.8	111	82	5
Fenthion	6.9	278	169	15
Fenthion	6.9	124.9	47	10
Prallethrin	6.98	123	81	10
Prallethrin	6.98	105	77	20
Prallethrin	6.98	90.9	65	15
MGK-264 II	7.05	164.2	98	10
MGK-264 II	7.05	164.2	67.1	5
MGK-264 II	7.05	111	82	5
Pyrethrin I	7.68	123.1	81	5
Pyrethrin I	7.68	123.1	41.1	30
Pyrethrin I	7.68	91	65	15
Chlordane-*cis*	7.7	372.8	300.9	10
Chlordane-*cis*	7.7	372.8	265.9	25
Chlordane-*cis*	7.7	271.8	236.9	15
Chlordane-*trans*	7.85	374.8	265.8	15
Chlordane-*trans*	7.85	372.8	265.8	15
Chlordane-*trans*	7.85	271.7	236.9	15
Endosulfan-*alpha*	7.95	194.9	160	5
Endosulfan-*alpha*	7.95	194.9	159	5
Endosulfan-*alpha*	7.95	194.9	125	20
Captan	8.1	263.9	79	25
Captan	8.1	148.1	70	15
Captan	8.1	116.9	81.9	20
Pyrethrin II	8.2	123.1	81	5
Pyrethrin II	8.2	123.1	41.1	30
Pyrethrin II	8.2	91	65	15
Endosulfan-*beta*	9.1	276.7	240.9	5
Endosulfan-*beta*	9.1	206.9	172	15
Endosulfan-*beta*	9.1	194.9	158.9	10
Bifenthrin	9.34	181.2	166.2	10
Bifenthrin	9.34	181.2	165.2	25
Bifenthrin	9.34	166.2	165.2	20
Spirodiclofen	11.2	312.1	259	10
Spirodiclofen	11.2	109.1	81.1	10
Spirodiclofen	11.2	109.1	79.1	15
Permethrin, (1R)-*cis*-	11.25	183.1	168.1	10
Permethrin, (1R)-*cis*-	11.25	183.1	153.1	15
Permethrin, (1R)-*cis*-	11.25	182.9	155.1	10
Permethrin, (1R)-*trans*-	11.4	163	127	5
Permethrin, (1R)-*trans*-	11.4	163	91	15
Permethrin, (1R)-*trans*-	11.4	162.9	91.1	15
Cyfluthrin I	11.7	198.9	170.1	25
Cyfluthrin I	11.7	162.9	127	5
Cyfluthrin I	11.7	162.9	90.9	15
Cyfluthrin II	11.8	198.9	170.1	25
Cyfluthrin II	11.8	162.9	127	5
Cyfluthrin II	11.8	162.9	90.9	15
Cyfluthrin III	11.9	198.9	170.1	25
Cyfluthrin III	11.9	162.9	127	5

Compound	RT (min)	Precursor (*m/z*)	Product (*m/z*)	CE
Cyfluthrin III	11.9	162.9	90.9	15
Coumaphos	12.07	362	109	16
Coumaphos	12.07	226	198	10
Coumaphos	12.07	226	163	20
Coumaphos	12.07	210	182	10
Coumaphos	12.07	210	154	18
Acequinocyl	12.09	341.9	187.9	15
Acequinocyl	12.09	189	115	25
Acequinocyl	12.09	187.9	160	5
Cypermethrin	12.5	181	152	25
Cypermethrin	12.5	165	127	5
Cypermethrin	12.5	165	91	15
Cypermethrin	12.5	163	127	5
Cypermethrin	12.5	163	91	15
Boscalid	13.6	140	112	10
Boscalid	13.6	140	76	25
Boscalid	13.6	111.9	76	15
Fenvalerate	13.75	208.9	141.1	15
Fenvalerate	13.75	181	152.1	20
Fenvalerate	13.75	167	125.1	5
Deltamethrin	15	252.9	93	15
Deltamethrin	15	252.9	77	30
Deltamethrin	15	250.7	172	5
Deltamethrin	15	181	152.1	25

Agilent Technologies

Agilent 6400 Series Triple Quad LC/MS Site Preparation Checklist

Thank you for purchasing an Agilent **instrument**. To get you started and to assure a successful and timely installation, please refer to this specification or set of requirements.

Correct site preparation is the key first step in ensuring that your instruments and software systems operate reliably over an extended lifetime. This document is an **information guide AND checklist** prepared for you that outlines the supplies, consumables, space and utility requirements for your equipment.

Customer Responsibilities

Make sure your site meets the following specifications before the installation date. For details, see specific sections within this checklist, including:

- ❑ The necessary laboratory or bench space is available
- ❑ The proper pressure, capacity, and purity of nitrogen gases for instruments and peripherals are planned.
- ❑ The adequate exhaust ventilation for instruments and peripherals are planned.
- ❑ The environmental conditions for the lab as well as laboratory gases and plumbing
- ❑ The power requirements related to the product (e.g., number & location of electrical outlets)
- ❑ The computing environment and the necessary space is made available.
- ❑ That your site meets the software, hardware and networking specifications below locate your sales order information, software authorization codes and/or software licenses/certificates
- ❑ The necessary software media, disks etc are available including upgrade/update disks that a suitable backup solution is identified for your software.
- ❑ Availability of a system/network administrator as needed to connect to your intranet please consult Other/Special Requirements section below for other product-specific information.
- ❑ The required operating supplies necessary for the product and installation
- ❑ Please consult Other Requirements section below for other product-specific information.
- ❑ For more details, please consult the product-specific Site Preparation manual.

If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, they will miss important operational, maintenance and safety information.

Important Customer Information

1. If you have questions or problems in providing anything described as a Customer Responsibility above, please contact your local Agilent or partner support/service organization for assistance prior to delivery. In addition, Agilent and/or it's partners reserve the right to reschedule the installation dependent upon the readiness of your laboratory.
2. Should your site not be ready for whatever reasons, please contact Agilent as soon as possible to re-arrange any services that have been purchased.
3. Other optional services such as additional training, operational qualification (OQ) and consultation for user-specific applications may also be provided at the time of installation when ordered with the system, but should be contracted separately.

Dimensions and Weight

Identify the laboratory bench space before your system arrives based on the table below.

Pay special attention to the **total height and total weight requirements for all system components you have ordered and avoid bench space with overhanging shelves**.

Special Notes

1. The 6400 Series Triple Quad LC/MS dimensions represent the maximum cabinet dimensions with a Spray Chamber installed.
2. At least 30 cm (1 ft.) to the left (source end) and right of the instrument must be added to the dimensions to provide adequate instrument access and ventilation.
3. The supporting surface must be relatively vibration free and capable of supporting the combined weight of the Triple Quad system.

Instrument/Spray Chamber/Foreline Pump Model	Weight		Height		Depth		Width	
	Kg	lbs	cm	in	cm	in	cm	in
G6410B QQQ LC/MS	107.5	236.5	47	18.5	66	26	111	43.5
G6420A QQQ LC/MS	107.5	236.5	47	18.5	66	26	111	43.5
G6430A QQQ LC/MS	115	255	47	18.5	66	26	111	43.5
G6460A QQQ LC/MS	115	255	48	18.8	66	26	111	43.5
G6460C QQQ LC/MS	115	255	48	18.8	66	26	111	43.5
G6470A QQQ LC/MS	115	255	47	18.5	76	30	84	33
G6490A QQQ LC/MS	115	255	47	18.5	76	30	84	33
G6495A QQQ LC/MS	115	255	47	18.5	76	30	84	33
G6495B QQQ LC/MS	115	255	47	18.5	76	30	84	33
G1948B Electrospray Source	1.7	3.8	17	6.8	9.5	3.7	18	7.1
G1947B APCI Source	1.7	3.8	23	9.2	13.0	5.1	18	7.1
G1971B APPI Source	1.7	3.8	23	9.2	13.0	5.1	18	7.1
G1978B Multimode Source	2.29	5.05	23	9.2	13.0	5.1	18	7.1
Agilent Jet Stream	1.7	3.8	23	9.2	11.5	4.5	18	7.1
MS40+ Foreline Pump	33.0	72.7	22.8	9.0	41.8	16.5	29.7	11.7

Identify the laboratory bench space before your system arrives based on the table below. Pay special attention to the total height and total weight requirements for all system components you have ordered and avoid bench space with overhanging shelves.

Environmental Conditions

Operating your instrument within the recommended temperature ranges insures optimum instrument performance and lifetime.

Special Notes

1. Performance can be affected by sources of heat & cold e.g. direct sunlight, heating/cooling from air conditioning outlets, drafts and/or vibrations.
2. The site's ambient temperature conditions must be stable for optimum performance.
3. The Agilent 6400 Series Triple Quad LC/MS is specified for operation under the following conditions:
    a. Indoor use.
    b. Constant temperature (< +/-3°C from calibration temperature).
    c. Non-condensing, non-corrosive atmosphere.
4. Altitude: Not to exceed 3,300 m up to 35°C, not to exceed 3,700 m up to 30°C.

Instrument Model	Operating temp range °C (F)	Operating humidity range (%)	Heat Dissipation (BTU)
6400 Series QQQ LC/MS (all models)	15 - 35 °C (59 - 95 °F)	< 85% RH @ 35 °C	< 4500 BTU/hr

Power Consumption

Special Notes

1. If a computer system is supplied with your instrument, be sure to account for those electrical outlets.
2. The LC/MS electrical outlet(s) must have an isolated, noise-free electrical ground that is connected to the main earth ground for the facility.
3. Mains supply voltage tolerances must be between +10% and -5% of nominal line voltage.
4. Models utilizing the E2M28 foreline pump (6410A, 6410B, 6430A, 6460A) must ordered specifying installation site voltage.
5. Electrical power for the 6400 Series Triple Quad LC/MS may be delivered in either single-phase or 208- Wye configuration:

Configuration	Measurement	Nominal Voltage
Singe Phase	Line to neutral	200, 220, 230 or 240 VAC
	Line to ground	200, 220, 230 or 240 VAC
	Ground to neutral	< 0.5 V rms
208-Wye	Line to line (phase A to phase B)	208, 220 VAC
	Line to ground (phase A to ground)	120, 127 VAC
	Line to ground (phase B to ground)	120, 127 VAC

Instrument Model	Line Voltage & Frequency (V, Hz)	Supply Circuit Rating (A)	Number of Outlets	Maximum Power Consumption (VA)
G6410B G6430A G6460A	200 - 240 VAC @ 50/60 Hz	15 A	1	2700
G6420A	200 - 240 VAC @ 50/60 Hz	15 A	2	2700
G6460C	200 - 240 VAC @ 50/60 Hz	15 A	2	2850
G6470A	200 - 240 VAC @ 50/60 Hz	15 A	2	2850
G6490A G6495A G6495B	200 - 240 VAC @ 50/60 Hz	15 A	2	2850

Main Nitrogen Gas Supply Requirements

Special Notes

1. For information on Agilent consumables, accessories and laboratory operating supplies, please visit: http://www.agilent.com/en-us/products/lab-supplies/chromatography-spectroscopy
2. Impurities from LN2 Dewar being oxygen only.
3. "Hydrocarbon free" means < 0.1 PPM hydrocarbons with the remaining gas being oxygen and trace argon.
4. Nitrogen Pressure as measured at the LC/MS inlet (not the supply side).
5. Minimum Nitrogen Flow required at all times to prevent air from entering the instrument.
6. Main Nitrogen Supply fittings are 1/4" Swagelok.

Model	Nitrogen Source	Nitrogen Purity	Pressure	Flow
G6410B G6420A G6430A G6460A#100 G6460C#100	LN2 Dewar	≥ 99.5% and hydrocarbon free	5.5 - 6.8 bar (80 - 100 PSI)	≤ 18 L/min Maximum (≤ 1080 L/hour) > 3 L/min Minimum
	Nitrogen Generator	≥ 95.0% and hydrocarbon free		
G6460A G6460C	LN2 Dewar	≥ 99.5% and hydrocarbon free	5.5 - 6.8 bar (80 - 100 PSI)	≤ 30 L/min Maximum (≤ 1800 L/hour) > 3 L/min Minimum
	Nitrogen Generator	≥ 95.0% and hydrocarbon free		
G6490A G6495A G6495B	LN2 Dewar	≥ 99.5% and hydrocarbon free	5.5 - 6.8 bar (80 - 100 PSI)	≤ 50 L/min Maximum (≤ 3000 L/hour) > 9 L/min Minimum
	Nitrogen Generator	≥ 95.0% and hydrocarbon free		
G6470A Maximum	LN2 Dewar	≥ 95% hydrocarbon Free	5.5 - 6.8 bar (80 - 100 PSI)	≤ 30 L/min Maximum (≤ 1800 L/hour) > 3 L/min Minimum
	Nitrogen Generator	≥ 95% and Hydrocarbon free		

Collision Cell Nitrogen Gas Supply Requirements

Special Notes

1. For information on Agilent consumables, accessories and laboratory operating supplies, please visit http://www.agilent.com/en-us/products/lab-supplies/chromatography-spectroscopy .
2. Nitrogen is the only supported Collision Cell gas.
3. Splitting the Main Nitrogen Gas supply for use with the collision cell is not supported due to nitrogen purity requirements.
4. Collision Cell gas supply fittings are 1/8" Swagelok.

Instrument Model	Nitrogen Source	Nitrogen Purity	Pressure	Flow
6400 Series QQQ LC/MS (all models)	High Pressure Cylinder	≥ 99.999% and hydrocarbon free (< 0.1 PPM hydrocarbons)	1 - 2 bar (15 - 30 PSI)	≤ 0.001 L/min (≤ 0.006 L/hour)

Exhaust Venting

For information on Agilent consumables, accessories and laboratory operating supplies, please
The LC/MS generates exhaust fumes from the foreline pump(s) and drain bottle (from the spray chamber) that must be properly vented for supported instrument operation and compliance with laboratory safety requirements.

Special Notes

1. Exhaust must be vented according to local Environmental Health and Safety regulations.
2. Exhaust gases contain traces of solvent, sample and hydrocarbon pump fluid.
3. Venting Rate is commensurate with Nitrogen consumption rate.
4. Two independent, negative pressure vents must be available with one for each of the exhaust sources: foreline pump(s) and Spray Chamber. If only 1 vent is available, the exhaust line(s) from the foreline pump(s) required must extend beyond the exhaust line from the spray chamber.
5. If a negative pressure vent is not available, the length of the tubing from the foreline pump(s) and the drain bottle to the vent should each not exceed 460 cm (15 ft).
6. Exhaust tubing is 1/2" interior diameter (I.D.).

Instrument Model	Combined Exhaust Venting Rate (Continuous)
G6410B G6420A G6430A G6460A#100 G6460C#100	≤ 20 L/min Maximum (≤ 1080 L/hour) > 3 L/min Minimum
G6460A G6460C G6470A	≤ 30 L/min Maximum (≤ 1800 L/hour) > 3 L/min Minimum
G6490A G6495A G6495B	≤ 50 L/min Maximum (≤ 3000 L/hour) > 9 L/min Minimum

Note:
Failure to vent the foreline pump and spray chamber separately will void the warranty for the 6400 Series Triple Quad LC/MS. Agilent service representatives will not install an Agilent 6400 Series Triple Quad LC/MS until an adequate exhaust system is present and functioning.

Recommended Configurations

Agilent recommends 2 standard stacking configurations for your new system depending on the number and type of included modules. Please use these notes and figures as reference for HPLC and LC/MS configurations.

Special Notes

Stacking the entire HPLC modules on top of the 6400 Series QQQ LC/MS is not supported.

Figure 4
Single HPLC stack configuration

Figure 5
Double HPLC stack configuration

Important Customer Web Links

- For additional information about our solutions, please visit our web site at http://www.agilent.com/home
- Need to get information on your product?
  Literature Library - http://www.agilent.com/en-us/library/
- Need to know more?
  Customer Education – http://www.agilent.com/crosslab/university/
- Need technical support, FAQs? – http://www.agilent.com/home
- Need supplies? – http://www.agilent.com/en-us/products/lab-supplies/chromatography-spectroscopy

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Thank you for purchasing an Agilent instrument. To get you started and to assure a successful and timely installation, please refer to this specification or set of requirements.

Correct site preparation is the key first step in ensuring that your instruments and software systems operate reliably over an extended lifetime. This document is an **information guide AND checklist** prepared for you that outlines the supplies, consumables, space and utility requirements for your equipment.

Customer Responsibilities

Make sure your site meets the following prior to the installation date using the checklist below. For details, see specific sections within this document, including:

- ❑ The necessary laboratory or bench space is available.
- ❑ The environmental conditions for the lab as well as laboratory gases, tubing.
- ❑ The power requirements related to the product (e.g. number & location of electrical outlets).
- ❑ The required operating supplies necessary for the product and installation.
- ❑ Please consult Other/Special Requirements section below for other product-specific information.
- ❑ If Agilent is delivering installation and familiarization services, users of the instrument should be present throughout these services; otherwise, they will miss important operational, maintenance and safety information.

Important Customer Information

1. If you have questions or problems in providing anything described as **Customer Responsibilities** above, please contact your local Agilent or partner support/service organization for assistance prior to delivery. In addition, Agilent and/or its partners reserve the right to reschedule the installation dependent upon the readiness of your laboratory.
2. Should your site not be ready for whatever reasons, please contact Agilent as soon as possible to re-arrange any services that have been purchased.
3. Other optional services such as additional training, operational qualification (OQ) and consultation for user-specific applications may also be provided at the time of installation when ordered with the system, but should be contracted separately.

Module List

Module	Instrument Description
G7102A	1290 Infinity II Evaporative Light Scattering Detector
G7104A	1290 Infinity II Flexible Pump
G7104C	1260 Infinity II Flexible Pump
G7110B	1260 Infinity II Isocratic Pump
G7111A	1260 Infinity II Quaternary Pump VL
G7111B	1260 Infinity II Quaternary Pump
G7112B	1260 Infinity II Binary Pump
G7114A	1260 Infinity II Variable Wavelength Detector
G7114B	1290 Infinity II Variable Wavelength Detector
G7115A	1260 Infinity II Diode Array Detector WR
G7116A	1260 Infinity II Multicolumn Thermostat
G7116B	1290 Infinity II Multicolumn Thermostat
G7117A	1290 Infinity II DAD FS
G7117B	1290 Infinity II DAD
G7117C	1260 Infinity II Diode Array Detector HS
G7120A	1290 Infinity II High Speed Pump
G7121A	1260 Infinity II Fluorescence Detector
G7121B	1260 Infinity II Infinity Fluorescence Detector Spectra
G7122A	1260 Infinity II Degasser
G7129A	1260 Infinity II Vialsampler VL
G7129B	1290 Infinity II Vialsampler
G7129C	1260 Infinity II Vialsampler
G7130A	1200 Infinity Integrated Column Compartment
G7162A	1260 Infinity II Refractive Index Detector
G7162B	1290 Infinity II Refractive Index Detector
G7165A	1260 Infinity II Multiple Wavelength Detector
G7167A	1260 Infinity II Multisampler
G7167B	1290 Infinity II Multisampler
G5654A	1260 Infinity II Bio-Inert Quaternary Pump
G5664B	1260 Infinity II Bio-inert Fraction Collector
G5668A	1260 Infinity II Bio-Inert Multisampler
G1328B	1260 Infinity II Manual Injector
G1364F	1260 Infinity II Analytical Fraction Collector
G4208A	1200 Infinity Series Instant Pilot

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Dimensions and Weight

The module dimensions and weight allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 8 cm (3.1 inches) in the rear for air circulation and electric connections. The ELSD needs an additional approximately 15 cm (5.9 inches) of space in the rear for air circulation and electric connections. If the bench shall carry a complete HPLC system, make sure that the bench is designed to bear the weight of all modules. The autosampler module especially with a sample cooler/thermostat installed should be operated in a proper horizontal position. Use a bubble level to check the leveling of the sampler.

Instrument Description	Weight		Height		Depth		Width	
	kg	lbs	mm	in	mm	in	mm	in
G7102A	11 (non-cooled), 13 (cooled)	24.3	415	16.3	450	17.7	200	7.9
G7104A, G7104C	16.1	35.5	180	7.1	436	17.2	396	15.6
G7110B	12.6	28	180	7.1	436	17.2	396	15.6
G7111A, G7111B, G5654A	14.5	32	180	7.1	436	17.2	396	15.6
G7112B	17.6	38.8	180	7.1	436	17.2	396	15.6
G7114A, G7114B	11	24.3	140	5.5	436	17.2	396	15.6
G7115A	12	26.5	140	5.5	436	17.2	396	15.6
G7116A, G7116B	12.5	27.6	160	6.3	436	17.2	435 (460 [1])	17.1 (18.1 [1])
G7117A, G7117B, G7117C	11.5	25.4	140	5.5	436	17.2	396	15.6
G7120A	21	46.3	200	7.9	436	17.2	396	15.6
G7121A, G7121B	11.9	26.2	140	5.5	436	17.2	396	15.6
G7122A	7	16	80	3.1	436	17.2	396	15.6
G7129A, G7129B, G7129C	19 (without sample cooler/thermostat)	41.9 (without sample cooler/thermostat)	320	12.8	468	18.4	396	15.6
G7130A	1.8		86.5		106.5		396	
G7162A, G7162B	15	33	180	7.1	436	17.2	396	15.6
G7165A	12	26.5	140	5.5	436	17.2	396	15.6
G7167A, G7167B, G5668A	22 (without sample cooler/thermostat)	48.5 (without sample cooler/thermostat)	320	12.6	468	18.4	396	15.6
G1364F, G5664B	13.5	29.8	200	8	440	17.0	345	13.5

[1] width with column ID readers

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Environmental Conditions

Special Notes

1 Performance can be affected by sources of heat and cold, e.g. direct sunlight, heating/cooling from air conditioning outlets, drafts and/or vibrations. Heat, cold, or vibration generated from other InfinityLab LC Series modules, which are installed according to instructions provided by Agilent Technologies, do not affect the performance of the LC system.

2 The site's ambient temperature conditions must be stable for optimum performance.

3 The following table summarizes some key physical specifications. For the complete set of physical specifications, please refer to the corresponding module manual.

Instrument Description	Operating temp range °C (°F)	Operating humidity range (%)
G7102A	10 – 35 °C (50 – 95 °F), constant temperature	< 95 % r.h. at 40 °C (104 °F), non-condensing
G7104A, G7104C, G7110B, G7111A, G7111B, G5654A, G7112B, G7114A, G7114B, G7115A, G7116A, G7116B, G7120A, G7121A, G7121B, G7162A, G7162B, G7165A	4 – 55 °C (39 – 131 °F), constant temperature	< 95 % r.h. at 40 °C (104 °F), non-condensing
G7130A	4 – 55 °C (39 – 131 °F), constant temperature	< 95 % r.h. at 40 °C (104 °F), non-condensing[1]
G7117A, G7117B, G7117C, G7167A, G7167B, G5668A	4 – 40 °C (39 – 104 °F), constant temperature	< 95 % r.h. at 40 °C (104 °F), non-condensing
G7129A, G7129B, G7129C	4 – 40 °C (39 – 104 °F), without chiller up to 55 °C (131 °F)	< 95 % r.h. at 40 °C (104 °F), non-condensing[1]
G7122A	0 – 55 °C (32 – 131 °F), constant temperature	< 95 % r.h. at 40 °C (104 °F), non-condensing
G1364F, G5664B	4 – 40 °C (39 – 104 °F)	< 95 % r.h. at 25 – 40 °C (77 – 104 °F), non-condensing[2]

[1] If a sample cooler/thermostat is included the upper value for humidity can be reduced. Please check your lab conditions to stay beyond dew point values for non-condensing operation.

[2] If a thermostat is used the upper value for humidity can be reduced. Please check your lab conditions to stay beyond dew point values for non-condensing operation.

Power Consumption

Special Notes:

1 If a computer system is supplied with your instrument, be sure to account for those electrical outlets.

2 The heat dissipation can be calculated from the active power, using the following equation: 1 W = 3.413 BTU/h

Instrument Description	Line Voltage & Frequency (V, Hz)	Maximum Power Consumption (VA)	Maximum Power Consumption (W)
G7102A	100 – 240 V (AC), 50 or 60 Hz	480 VA	150 W (max)
G7104A, G7104C	100 – 240 V (AC), 50 or 60 Hz	120 VA	110 W
G7110B, G7111A, G7111B, G5654A	100 – 240 V (AC), 50 or 60 Hz	80 VA	65 W
G7112B	100 – 240 V (AC), 50 or 60 Hz	90 VA	74 W
G7114A, G7114B, G7162A, G7162B	100 – 240 V (AC), 50 or 60 Hz	80 VA	70 W
G7116A, G7116B	100 – 240 V (AC), 50 or 60 Hz	150 VA	150 W
G7115A, G7117A, G7117B, G7117C, G7165A	100 – 240 V (AC), 50 or 60 Hz	110 VA	100 W
G7120A	100 – 240 V (AC), 50 or 60 Hz	210 VA	180 W
G7121A, G7121B	100 – 240 V (AC), 50 or 60 Hz	70 VA	60 W
G7122A	100 – 240 V (AC), 50 or 60 Hz	30 VA	30 W
G7129A, G7129B, G7129C	100 – 240 V (AC), 50 or 60 Hz	350 VA	350 W
G7130A			110 W
G7162A, G7162B	100 – 240 V (AC), 50 or 60 Hz	80 VA	70 W
G7167A, G7167B, G5668A	100 – 240 V (AC), 50 or 60 Hz	180 VA	180 W
G1364F, G5664B	100 – 240 V (AC) (±10 %) 50 or 60 Hz (±5 %)	200 VA	180 W

Required Operating Supplies by Customer

Special Notes:

- For information on Agilent consumables, accessories and laboratory operating supplies, please visit http://www.chem.agilent.com/en-US/Products/consumables/Pages/default.aspx

Other/Special Requirements

G7102A

Gas requirements

A supply of inert gas (typically nitrogen) is required to operate the detector. The gas supply needs to be free of oil, humidity and particles, as such contaminations will create background noise in the chromatograms and may damage the built-in pressure sensor. In case of such noise for example for newly installed gas lines, flush the gas lines for sufficient time (might take days) and use additional filters of 0.5 µm or less. The typical gas pressure is 4 bar (60 psi) and must be set by an external pressure regulator. Pure gas is not required as the gas is only used as a carrier for the solid sample particles. The gas inlets of the detector have an outer diameter of 4 mm (0.157 inches). The lab installation must therefore allow the installation of a tubing with 4 mm (0.157 inches) outer diameter. Gas consumption is typically 0.9 SLM to 3.25 SLM, depending on the detector settings.

Item description, (including dimensions etc)	Vendor/Part Number (if applicable)	Recommended quantity
G7102A ELSD Gas Nitrogen (typical)	N/A	N/A

Solvent requirements

Customer should have available HPLC grade Acetonitrile and water with a dry residue below 1 ppm or MS grade solvents.

Precautions: Solvent Vapours

Vapour sensors are used inside and outside the enclosure of the Agilent 1290 Infinity II ELSD to alert the operator to solvent leaks. Liberal use of organic solvents in close proximity to the instrument may activate the vapour sensor, causing the instrument to shutdown.

NOTE Please exercise with care when using solvents close to the instrument: Vapor Sensors are present in the Agilent 1290 Infinity II ELSD.

Exhaust venting and drain requirements

The exhaust from the detector must be directed into a fume hood or exhaust vent. If a vacuum is used, it should be moderate so as to avoid turbulence in the optical chamber leading to a much reduced sensitivity of the detector. The potentially hazardous exhaust of evaporated solvent and sample must not be allowed to enter the laboratory atmosphere and any appropriate accessory like solvent filters should be disposed according to local environmental requirements.

If the extraction tube provided with the instrument is to be extended it is recommended that the diameter of the extension is increased to at least 50 mm (2 in) diameter tubing so the extraction quality is not inhibited.

NOTE Do not connect the exhaust vent directly to the detector. This might cause either positive pressure or negative back pressure, both of which will impact the quality of your measurement results.

The drain tube must be directed to a waste container supplied with the instrument. The user is responsible for decontamination or recycling of any residue, regarding to local environmental requirements.

Further requirements

The 1290 Infinity II ELSD (G7102A) can be controlled either via RS232 or via LAN. If the RS232 interface is used for control, the ELSD must be installed close to the control PC unless special data transmission systems are used. The length of the straight female/female RS 232 cable supplied with both detectors is 2.9 m.

G7167-60101 Sample Thermostat

The Autosampler Sample Thermostat contains small amount of isobutane refrigerant (R600a), a natural gas with high environmental compatibility but combustible. Escaping vapor may ignite. Please adhere to the following to prevent ignition and explosion:

- Keep open fire or sources of ignition away from the device.
- Ensure a room size of 1 m^3 for every 8 g of r600a refrigerant inside of the sample thermostat.
- Ensure adequate ventilation: typical air exchange of 25 m^3/h per m^2 of laboratory floor area.
- Do not use mechanical devices or other means to accelerate the defrosting process.

Stack Configurations

Agilent 1290 Infinity II Stack Configurations

NOTE Generally install a G7122A Degasser underneath the pump.

NOTE Fraction Collectors are stacked in their own separate stack.

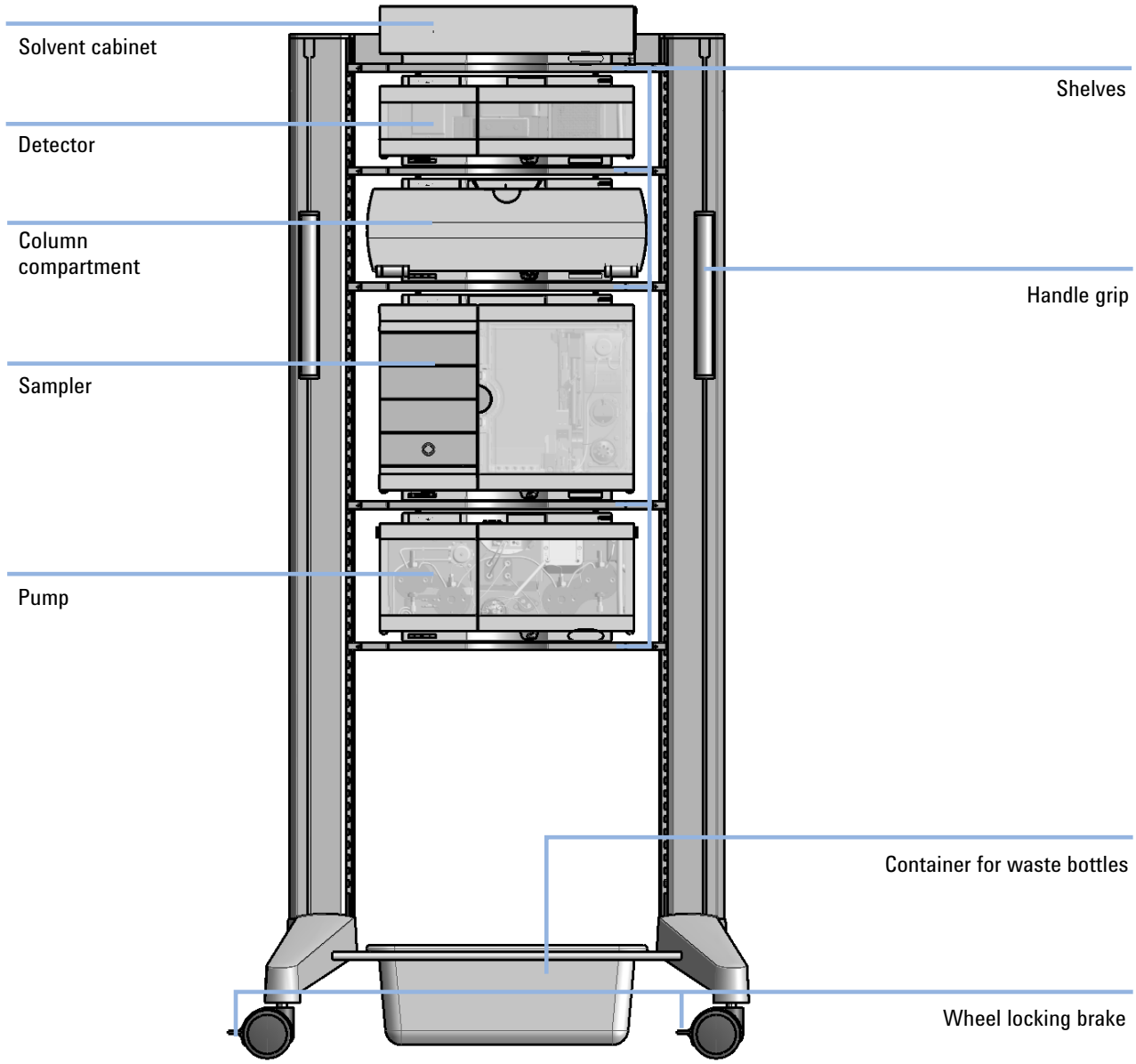

Figure 1 Agilent InfinityLab Flex Bench

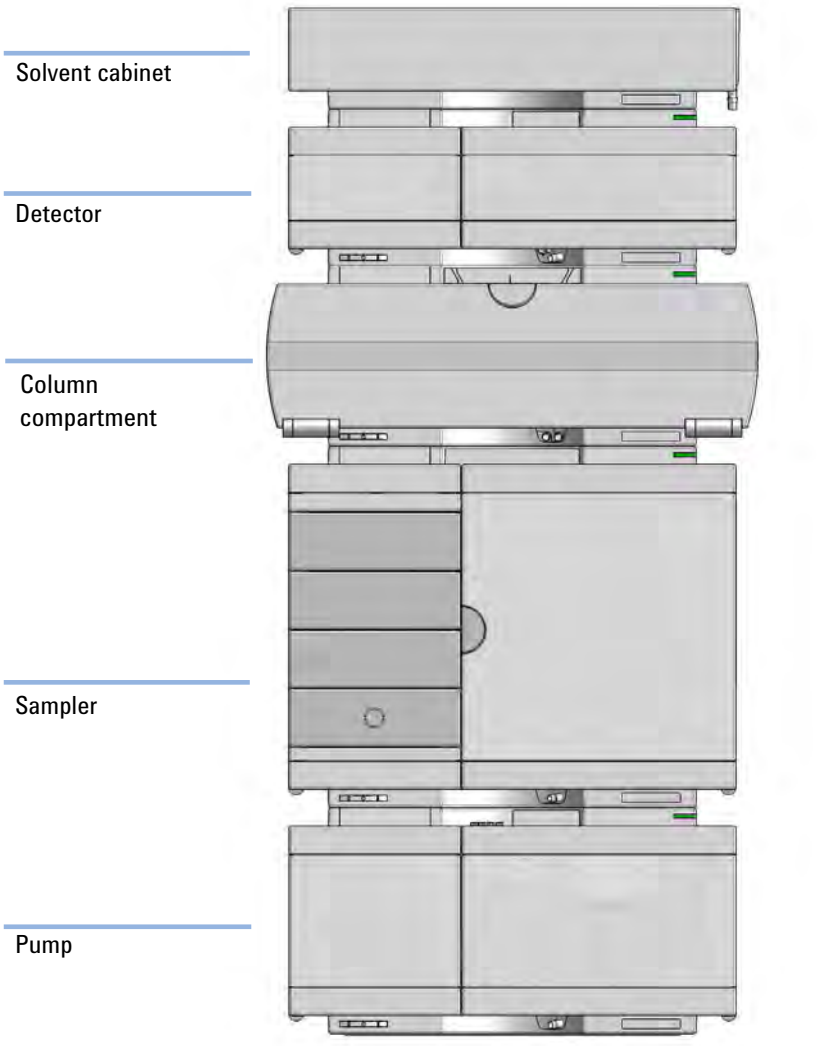

Figure 2 Single stack configuration (bench installation, example shows a multisampler)

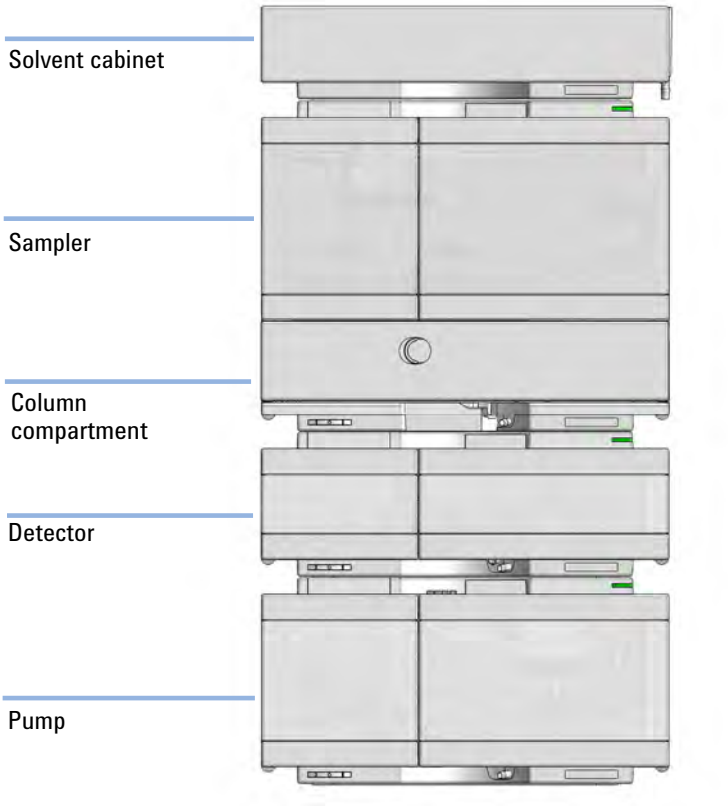

Figure 3 Single stack configuration (bench installation, example shows a vialsampler with optional ICC installed)

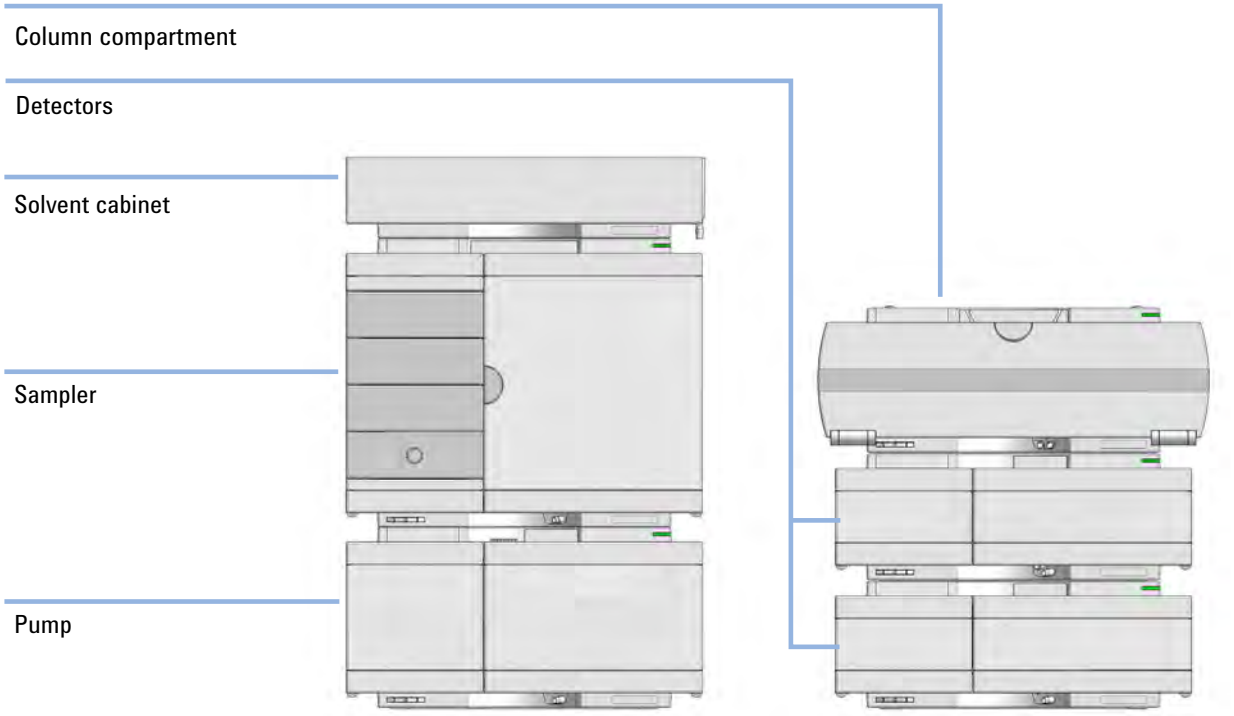

Figure 4 Two stack configuration (bench installation, example shows a multisampler)

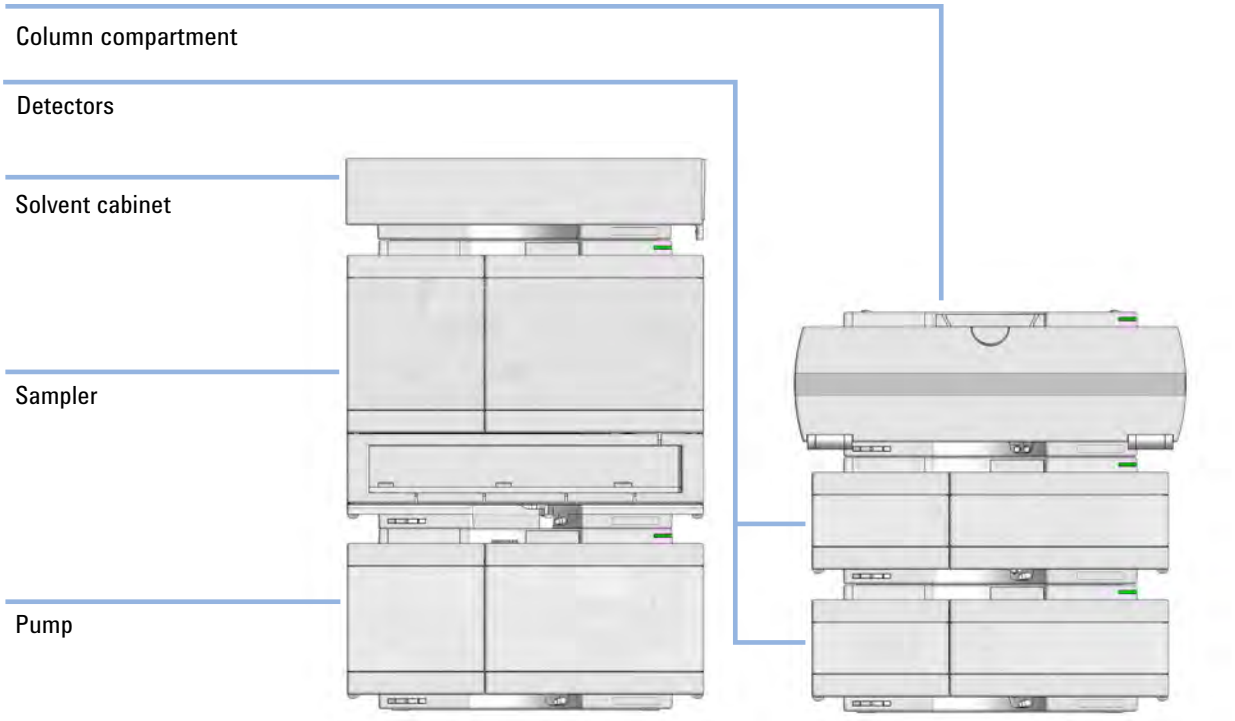

Figure 5 Two stack configuration (bench installation, example shows a vialsampler)

Mixed Stack Configurations

NOTE

The optimal stack configuration may vary. For details, refer to the documentation of the system in use. General recommendations for the Multisampler:

- Stack the Multisampler at the same position as recommended for other autosamplers.
- Arrange the Multisampler coaxial to the other modules.
- Install the adapter for safe leak and waste handling.

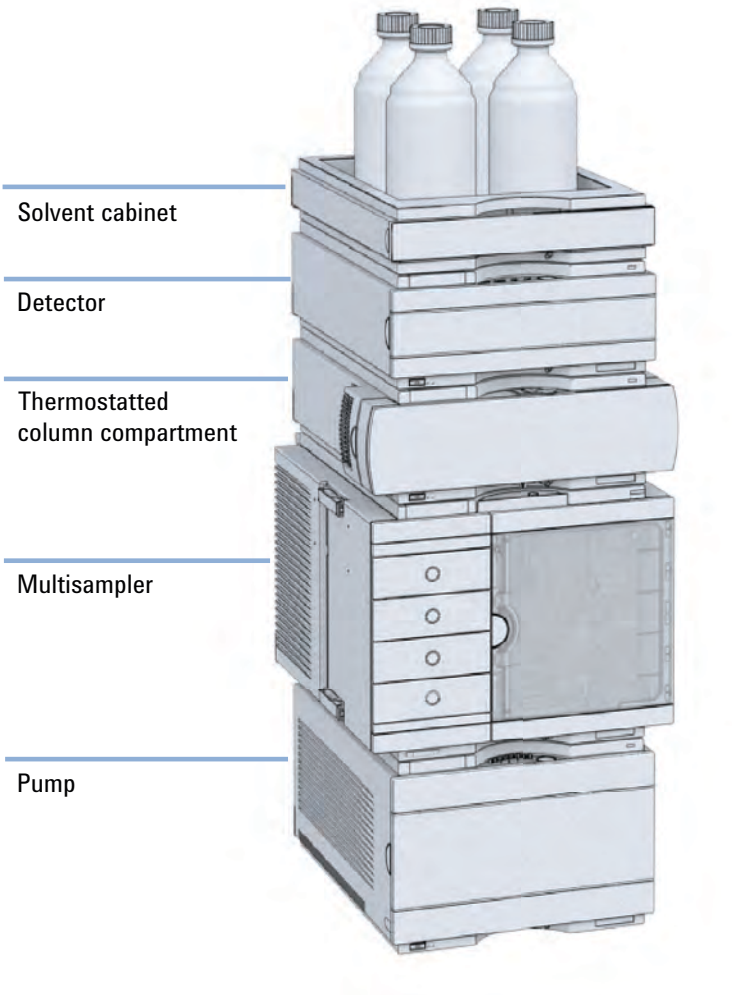

Figure 6 Example for a recommended stack configuration in a 1290 Infinity system

Agilent Value Promise

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OUR COMMITMENT LASTS FOREVER

The Measure of Confidence

Agilent Technologies

MAXIMIZE YOUR INSTRUMENT INVESTMENT

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Through the years, you've trusted Agilent Technologies to provide the instrumentation, supplies, and support needed to keep your lab running at peak performance. As each of your instruments reach the end of its useful life and as technology applications evolve, you can continue looking to Agilent to maximize the longevity of your initial investment. Let Agilent help ensure that your lab is always running at its highest level of efficiency and productivity. Plan to optimize your assets with our timely and cost-effective transition solutions.

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AGILENT VALUE PROMISE

The Agilent Value Promise reflects utmost confidence in our unrivaled industry standards for quality system design and manufacturing. From the date you purchase select instruments from our leading Agilent chromatography, spectrometry, and spectroscopy product lines, our Value Promise guarantees at least 10 years' use or residual-value credit towards a replacement model upgrade. Because we stand behind our systems, our Value Promise maximizes your return on investment by assuring your purchase is safe.

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Long before your instrument's end-of-production date, Agilent is helping you smoothly transition by taking full advantage of our fixed-cost, multi-year support agreements for continuous support, service, and supplies, and by planning to move to the latest technology. With our wide variety of cost-effective program options, we work to meet your specific support and system requirements throughout each lifecycle. During current production, you can rely on Agilent's highly-rated support to maximize your assets. When your system reaches its end-of-production date you can expect uninterrupted support and parts, as well as a clear and strategic path to the most cost-effective transition options for optimal performance. All the while, our 10-year Value Promise stays in force to ensure your lab gets the most for its budget.

> Agilent's first concern is helping you maintain optimal instrument uptime so your lab can be competitively efficient and profitable. Let our range of service options and technology transition solutions protect your investment.
>
> *Mike McMullen*
> *Agilent President and Chief Executive Officer*

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At Agilent, we look for ways to optimize your lab's performance by enhancing our 50 years of measurement solutions expertise with constant customer communication. That is why you can rely on us to provide the tools you need. Proudly, the Agilent name has become the assurance of unequalled dependability, reliability, ease of use, and enhanced productivity because we rigorously design, test and manufacture our comprehensive array of instruments, supplies, and services to the highest standards. We become your experienced partner delivering unrivaled systems, solutions, technical support, and education to help your lab increase efficiency and profit.

Plan for uninterrupted lab operation

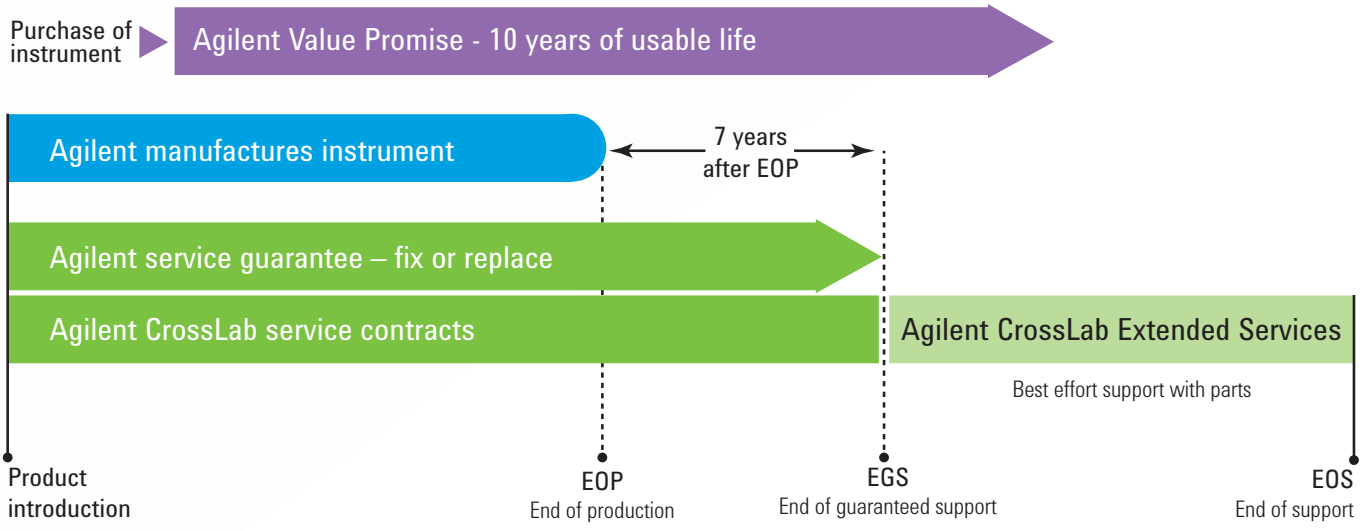
As your instrument is phased out of production, trust the Agilent support process–from our Service Guarantee to our Value Promise. By informing you along the way, we keep you ahead of the curve in managing the lifetime of your instrument. .

AGILENT VALUE PROMISE - 10 YEARS

The Agilent Value Promise guarantees you at least 10 years of use of your new instrument, from the date of purchase, or we will credit you with the residual value of that system when you upgrade to a replacement model[1].

AGILENT SERVICE GUARANTEE

If your instrument is under an Agilent CrossLab service agreement and a hardware problem cannot be solved immediately, a formal escalation process ensures that key technical and management resources quickly attend to your issue. If this process does not resolve the hardware issue, we will replace your Agilent analytical instrument for free. This escalation process exemplifies how Agilent is committed to keeping your lab up and running, no matter what.



[1] Applies to current generation Agilent instruments not being used in highly corrosive and bio-hazardous environments

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Find an Agilent Customer Center
in your country:
agilent.com/chem/contactus

An Agilent CrossLab service agreement guarantees repair of your Agilent instrument or we replace it for free.

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Doc Description: Triple Quad LC/MS/MS
Proc Type: Central Purchase Order

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Agilent Technologies, Inc.
2850 Centerville Road
Wilmington, DE 19808
800-227-9770

FOR INFORMATION CONTACT THE BUYER

Melissa Pettrey
(304) 558-0094
melissa.k.pettrey@wv.gov

Signature X [signature] **FEIN #** 77-0518772 **DATE** 04/23/2019

All offers subject to all terms and conditions contained in this solicitation

ADDITIONAL INFORMATION:

Central Request for Quotation

The West Virginia Purchasing Division is soliciting bids on behalf of the Agency, the West Virginia Department of Agriculture to establish a contract for the one time purchase of a Liquid Chromatography Triple Quadrupole Mass Spectrometer (LC/MS/MS), workstation PC, software, printer, nitrogen generator, uninterrupted power supply (UPS), specific test methods, shipping, installation, validation, warranty, training and service per the bid requirements, specifications, terms and conditions attached to this solicitation.

INVOICE TO	SHIP TO
PROCUREMENT OFFICER 304-558-2221 AGRICULTURE DEPARTMENT OF ADMINISTRATIVE SERVICES 1900 KANAWHA BLVD E CHARLESTON WV25305-0173 US	AUTHORIZED RECEIVER 304-558-2227 AGRICULTURE DEPARTMENT OF REGULATORY PROTECTION DIVISION 313 GUS R DOUGLAS LN, BLDG 11 CHARLESTON WV 25312 US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	LC/MS/MS, Workstation PC, Software, Printer, nitrogen	1.00000	EA	$334,860.08	$334,860.08

Comm Code	Manufacturer	Specification	Model #
41100000	Agilent Technologies, Inc.	6470 Triple Quadrupole LC/MS System	G6470AA, et al per quotation 2842798

Extended Description :

generator, uninterrupted power supply, specific test methods per section 3.1

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Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
2	shipping charges & inside delivery	1.00000	EA	Included	Included

Comm Code	Manufacturer	Specification	Model #
78121603			

Extended Description :

Shipping charges & inside delivery per section 3.1.6

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Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
3	Installation/validation	1.00000	EA	Included	Included

Comm Code	Manufacturer	Specification	Model #
73171605			

Extended Description :
Installation/Validation per section 3.1.6

INVOICE TO	SHIP TO
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Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
4	Training/warranty	1.00000	EA	$3,997.00	$3,997.00

Comm Code	Manufacturer	Specification	Model #
73171605			

Extended Description :
Training/Warranty per section 3.1.6

INVOICE TO	SHIP TO
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Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
5	Service	1.00000	EA	$10,908.00	$10,908.00

Comm Code	Manufacturer	Specification	Model #
73171605			

Extended Description :

Service per section 3.1.6

INSTRUCTIONS TO VENDORS SUBMITTING BIDS

1. REVIEW DOCUMENTS THOROUGHLY: The attached documents contain a solicitation for bids. Please read these instructions and all documents attached in their entirety. These instructions provide critical information about requirements that if overlooked could lead to disqualification of a Vendor's bid. All bids must be submitted in accordance with the provisions contained in these instructions and the Solicitation. Failure to do so may result in disqualification of Vendor's bid.

2. MANDATORY TERMS: The Solicitation may contain mandatory provisions identified by the use of the words "must," "will," and "shall." Failure to comply with a mandatory term in the Solicitation will result in bid disqualification.

3. PREBID MEETING: The item identified below shall apply to this Solicitation.

☑ A pre-bid meeting will not be held prior to bid opening

☐ A **NON-MANDATORY PRE-BID** meeting will be held at the following place and time:

☐ A **MANDATORY PRE-BID** meeting will be held at the following place and time:

All Vendors submitting a bid must attend the mandatory pre-bid meeting. Failure to attend the mandatory pre-bid meeting shall result in disqualification of the Vendor's bid. No one person attending the pre-bid meeting may represent more than one Vendor.

An attendance sheet provided at the pre-bid meeting shall serve as the official document verifying attendance. The State will not accept any other form of proof or documentation to verify attendance. Any person attending the pre-bid meeting on behalf of a Vendor must list on the attendance sheet his or her name and the name of the Vendor he or she is representing.

Additionally, the person attending the pre-bid meeting should include the Vendor's E-Mail address, phone number, and Fax number on the attendance sheet. It is the Vendor's responsibility to locate the attendance sheet and provide the required information. Failure to complete the attendance sheet as required may result in disqualification of Vendor's bid.

All Vendors should arrive prior to the starting time for the pre-bid. Vendors who arrive after the starting time but prior to the end of the pre-bid will be permitted to sign in, but are charged with knowing all matters discussed at the pre-bid.

Questions submitted at least five business days prior to a scheduled pre-bid will be discussed at the pre-bid meeting if possible. Any discussions or answers to questions at the pre-bid meeting are preliminary in nature and are non-binding. Official and binding answers to questions will be published in a written addendum to the Solicitation prior to bid opening.

4. VENDOR QUESTION DEADLINE: Vendors may submit questions relating to this Solicitation to the Purchasing Division. Questions must be submitted in writing. All questions must be submitted on or before the date listed below and to the address listed below in order to be considered. A written response will be published in a Solicitation addendum if a response is possible and appropriate. Non-written discussions, conversations, or questions and answers regarding this Solicitation are preliminary in nature and are nonbinding.

Submitted e-mails should have solicitation number in the subject line.

Question Submission Deadline: 04/17/2019 @ 3:00 P.M. EDT

Submit Questions to: Melissa Pettrey, Senior Buyer
2019 Washington Street, East
Charleston, WV 25305
Fax: (304) 558-4115 (Vendors should not use this fax number for bid submission)
Email: melissa.k.pettrey@wv.gov

5. VERBAL COMMUNICATION: Any verbal communication between the Vendor and any State personnel is not binding, including verbal communication at the mandatory pre-bid conference. Only information issued in writing and added to the Solicitation by an official written addendum by the Purchasing Division is binding.

6. BID SUBMISSION: All bids must be submitted electronically through wvOASIS or signed and delivered by the Vendor to the Purchasing Division at the address listed below on or before the date and time of the bid opening. Any bid received by the Purchasing Division staff is considered to be in the possession of the Purchasing Division and will not be returned for any reason. The Purchasing Division will not accept bids, modification of bids, or addendum acknowledgment forms via e-mail. Acceptable delivery methods include electronic submission via wvOASIS, hand delivery, delivery by courier, or facsimile.

The bid delivery address is:
Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

A bid that is not submitted electronically through wvOASIS should contain the information listed below on the face of the envelope or the bid may be rejected by the Purchasing Division.:

SEALED BID: CRFQ AGR1900000018
BUYER: Melissa Pettre, Senior Buyer
SOLICITATION NO.:
BID OPENING DATE: 04/26/2019
BID OPENING TIME: 1:30 P.M. EDT
FAX NUMBER: 304-558-3970

The Purchasing Division may prohibit the submission of bids electronically through wvOASIS at its sole discretion. Such a prohibition will be contained and communicated in the wvOASIS system resulting in the Vendor's inability to submit bids through wvOASIS. Submission of a response to an Expression or Interest or Request for Proposal is not permitted in wvOASIS.

For Request For Proposal ("RFP") Responses Only: In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal plus _____convenience copies of each to the Purchasing Division at the address shown above. Additionally, the Vendor should identify the bid type as either a technical or cost proposal on the face of each bid envelope submitted in response to a request for proposal as follows:

BID TYPE: (This only applies to CRFP)
☐ Technical
☐ Cost

7. BID OPENING: Bids submitted in response to this Solicitation will be opened at the location identified below on the date and time listed below. Delivery of a bid after the bid opening date and time will result in bid disqualification. For purposes of this Solicitation, a bid is considered delivered when confirmation of delivery is provided by wvOASIS (in the case of electronic submission) or when the bid is time stamped by the official Purchasing Division time clock (in the case of hand delivery).

Bid Opening Date and Time: 04/26/2019 @ 1:30 P.M. EDT

Bid Opening Location: Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

8. ADDENDUM ACKNOWLEDGEMENT: Changes or revisions to this Solicitation will be made by an official written addendum issued by the Purchasing Division. Vendor should acknowledge receipt of all addenda issued with this Solicitation by completing an Addendum Acknowledgment Form, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

9. BID FORMATTING: Vendor should type or electronically enter the information onto its bid to prevent errors in the evaluation. Failure to type or electronically enter the information may result in bid disqualification.

10. ALTERNATE MODEL OR BRAND: Unless the box below is checked, any model, brand, or specification listed in this Solicitation establishes the acceptable level of quality only and is not intended to reflect a preference for, or in any way favor, a particular brand or vendor. Vendors may bid alternates to a listed model or brand provided that the alternate is at least equal to the model or brand and complies with the required specifications. The equality of any alternate being bid shall be determined by the State at its sole discretion. Any Vendor bidding an alternate model or brand should clearly identify the alternate items in its bid and should include manufacturer's specifications, industry literature, and/or any other relevant documentation demonstrating the equality of the alternate items. Failure to provide information for alternate items may be grounds for rejection of a Vendor's bid.

☐ This Solicitation is based upon a standardized commodity established under W. Va. Code § 5A-3-61. Vendors are expected to bid the standardized commodity identified. Failure to bid the standardized commodity will result in your firm's bid being rejected.

11. EXCEPTIONS AND CLARIFICATIONS: The Solicitation contains the specifications that shall form the basis of a contractual agreement. Vendor shall clearly mark any exceptions, clarifications, or other proposed modifications in its bid. Exceptions to, clarifications of, or modifications of a requirement or term and condition of the Solicitation may result in bid disqualification.

12. COMMUNICATION LIMITATIONS: In accordance with West Virginia Code of State Rules §148-1-6.6, communication with the State of West Virginia or any of its employees regarding this Solicitation during the solicitation, bid, evaluation or award periods, except through the Purchasing Division, is strictly prohibited without prior Purchasing Division approval. Purchasing Division approval for such communication is implied for all agency delegated and exempt purchases.

13. REGISTRATION: Prior to Contract award, the apparent successful Vendor must be properly registered with the West Virginia Purchasing Division and must have paid the $125 fee, if applicable.

14. UNIT PRICE: Unit prices shall prevail in cases of a discrepancy in the Vendor's bid.

15. PREFERENCE: Vendor Preference may be requested in purchases of motor vehicles or construction and maintenance equipment and machinery used in highway and other infrastructure projects. Any request for preference must be submitted in writing with the bid, must specifically identify the preference requested with reference to the applicable subsection of West Virginia Code § 5A-3-37, and should include with the bid any information necessary to evaluate and confirm the applicability of the requested preference. A request form to help facilitate the request can be found at:
http://www.state.wv.us/admin/purchase/vrc/Venpref.pdf.

15A. RECIPROCAL PREFERENCE: The State of West Virginia applies a reciprocal preference to all solicitations for commodities and printing in accordance with W. Va. Code § 5A-3-37(b). In effect, non-resident vendors receiving a preference in their home states, will see that same preference granted to West Virginia resident vendors bidding against them in West Virginia. A request form to help facilitate the request can be found at:
http://www.state.wv.us/admin/purchase/vrc/Venpref.pdf.

16. SMALL, WOMEN-OWNED, OR MINORITY-OWNED BUSINESSES: For any solicitations publicly advertised for bid, in accordance with West Virginia Code §5A-3-37(a)(7) and W. Va. CSR § 148-22-9, any non-resident vendor certified as a small, women-owned, or minority-owned business under W. Va. CSR § 148-22-9 shall be provided the same preference made available to any resident vendor. Any non-resident small, women-owned, or minority-owned business must identify itself as such in writing, must submit that writing to the Purchasing Division with its bid, and must be properly certified under W. Va. CSR § 148-22-9 prior to contract award to receive the preferences made available to resident vendors. Preference for a non-resident small, women-owned, or minority owned business shall be applied in accordance with W. Va. CSR § 148-22-9.

17. WAIVER OF MINOR IRREGULARITIES: The Director reserves the right to waive minor irregularities in bids or specifications in accordance with West Virginia Code of State Rules § 148-1-4.6.

18. ELECTRONIC FILE ACCESS RESTRICTIONS: Vendor must ensure that its submission in wvOASIS can be accessed and viewed by the Purchasing Division staff immediately upon bid opening. The Purchasing Division will consider any file that cannot be immediately accessed and viewed at the time of the bid opening (such as, encrypted files, password protected files, or incompatible files) to be blank or incomplete as context requires, and are therefore unacceptable. A vendor will not be permitted to unencrypt files, remove password protections, or resubmit documents after bid opening to make a file viewable if those documents are required with the bid. A Vendor may be required to provide document passwords or remove access restrictions to allow the Purchasing Division to print or electronically save documents provided that those documents are viewable by the Purchasing Division prior to obtaining the password or removing the access restriction.

19. NON-RESPONSIBLE: The Purchasing Division Director reserves the right to reject the bid of any vendor as Non-Responsible in accordance with W. Va. Code of State Rules § 148-1-5.3, when the Director determines that the vendor submitting the bid does not have the capability to fully perform, or lacks the integrity and reliability to assure good-faith performance."

20. ACCEPTANCE/REJECTION: The State may accept or reject any bid in whole, or in part in accordance with W. Va. Code of State Rules § 148-1-4.5. and § 148-1-6.4.b."

21. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

22. INTERESTED PARTY DISCLOSURE: West Virginia Code § 6D-1-2 requires that the vendor submit to the Purchasing Division a disclosure of interested parties to the contract for all contracts with an actual or estimated value of at least $1 Million. That disclosure must occur on the form prescribed and approved by the WV Ethics Commission prior to contract award. A copy of that form is included with this solicitation or can be obtained from the WV Ethics Commission. This requirement does not apply to publicly traded companies listed on a national or international stock exchange. A more detailed definition of interested parties can be obtained from the form referenced above.

23. WITH THE BID REQUIREMENTS: In instances where these specifications require documentation or other information with the bid, and a vendor fails to provide it with the bid, the Director of the Purchasing Division reserves the right to request those items after bid opening and prior to contract award pursuant to the authority to waive minor irregularities in bids or specifications under W. Va. CSR § 148-1-4.6. This authority does not apply to instances where state law mandates receipt with the bid.

GENERAL TERMS AND CONDITIONS:

1. CONTRACTUAL AGREEMENT: Issuance of a Award Document signed by the Purchasing Division Director, or his designee, and approved as to form by the Attorney General's office constitutes acceptance of this Contract made by and between the State of West Virginia and the Vendor. Vendor's signature on its bid signifies Vendor's agreement to be bound by and accept the terms and conditions contained in this Contract.

2. DEFINITIONS: As used in this Solicitation/Contract, the following terms shall have the meanings attributed to them below. Additional definitions may be found in the specifications included with this Solicitation/Contract.

2.1. "Agency" or **"Agencies"** means the agency, board, commission, or other entity of the State of West Virginia that is identified on the first page of the Solicitation or any other public entity seeking to procure goods or services under this Contract.

2.2. "Bid" or **"Proposal"** means the vendors submitted response to this solicitation.

2.3. "Contract" means the binding agreement that is entered into between the State and the Vendor to provide the goods or services requested in the Solicitation.

2.4. "Director" means the Director of the West Virginia Department of Administration, Purchasing Division.

2.5. "Purchasing Division" means the West Virginia Department of Administration, Purchasing Division.

2.6. "Award Document" means the document signed by the Agency and the Purchasing Division, and approved as to form by the Attorney General, that identifies the Vendor as the contract holder.

2.7. "Solicitation" means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

2.8. "State" means the State of West Virginia and/or any of its agencies, commissions, boards, etc. as context requires.

2.9. "Vendor" or **"Vendors"** means any entity submitting a bid in response to the Solicitation, the entity that has been selected as the lowest responsible bidder, or the entity that has been awarded the Contract as context requires.

3. CONTRACT TERM; RENEWAL; EXTENSION: The term of this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below:

☐ **Term Contract**

Initial Contract Term: Initial Contract Term: This Contract becomes effective on _____ and extends for a period of _____year(s).

Renewal Term: This Contract may be renewed upon the mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any request for renewal should be delivered to the Agency and then submitted to the Purchasing Division thirty (30) days prior to the expiration date of the initial contract term or appropriate renewal term. A Contract renewal shall be in accordance with the terms and conditions of the original contract. Unless otherwise specified below, renewal of this Contract is limited to _____ successive one (1) year periods or multiple renewal periods of less than one year, provided that the multiple renewal periods do not exceed the total number of months available in all renewal years combined. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's office (Attorney General approval is as to form only)

☐ **Alternate Renewal Term** – This contract may be renewed for _____ successive _____ year periods or shorter periods provided that they do not exceed the total number of months contained in all available renewals. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's office (Attorney General approval is as to form only)

Delivery Order Limitations: In the event that this contract permits delivery orders, a delivery order may only be issued during the time this Contract is in effect. Any delivery order issued within one year of the expiration of this Contract shall be effective for one year from the date the delivery order is issued. No delivery order may be extended beyond one year after this Contract has expired.

☐ **Fixed Period Contract:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and must be completed within _____days.

☐ **Fixed Period Contract with Renewals:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and part of the Contract more fully described in the attached specifications must be completed within _____ days. Upon completion of the work covered by the preceding sentence, the vendor agrees that maintenance, monitoring, or warranty services will be provided for _____ year(s) thereafter.

☑ **One Time Purchase:** The term of this Contract shall run from the issuance of the Award Document until all of the goods contracted for have been delivered, but in no event will this Contract extend for more than one fiscal year.

☐ **Other:** See attached.

4. NOTICE TO PROCEED: Vendor shall begin performance of this Contract immediately upon receiving notice to proceed unless otherwise instructed by the Agency. Unless otherwise specified, the fully executed Award Document will be considered notice to proceed.

5. QUANTITIES: The quantities required under this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below.

☐ **Open End Contract:** Quantities listed in this Solicitation are approximations only, based on estimates supplied by the Agency. It is understood and agreed that the Contract shall cover the quantities actually ordered for delivery during the term of the Contract, whether more or less than the quantities shown.

☐ **Service:** The scope of the service to be provided will be more clearly defined in the specifications included herewith.

☑ **Combined Service and Goods:** The scope of the service and deliverable goods to be provided will be more clearly defined in the specifications included herewith.

☐ **One Time Purchase:** This Contract is for the purchase of a set quantity of goods that are identified in the specifications included herewith. Once those items have been delivered, no additional goods may be procured under this Contract without an appropriate change order approved by the Vendor, Agency, Purchasing Division, and Attorney General's office.

6. EMERGENCY PURCHASES: The Purchasing Division Director may authorize the Agency to purchase goods or services in the open market that Vendor would otherwise provide under this Contract if those goods or services are for immediate or expedited delivery in an emergency. Emergencies shall include, but are not limited to, delays in transportation or an unanticipated increase in the volume of work. An emergency purchase in the open market, approved by the Purchasing Division Director, shall not constitute of breach of this Contract and shall not entitle the Vendor to any form of compensation or damages. This provision does not excuse the State from fulfilling its obligations under a One Time Purchase contract.

7. REQUIRED DOCUMENTS: All of the items checked below must be provided to the Purchasing Division by the Vendor as specified below.

☐ **BID BOND (Construction Only):** Pursuant to the requirements contained in W. Va. Code § 5-22-1(c), All Vendors submitting a bid on a construction project shall furnish a valid bid bond in the amount of five percent (5%) of the total amount of the bid protecting the State of West Virginia. The bid bond must be submitted with the bid.

☐ **PERFORMANCE BOND:** The apparent successful Vendor shall provide a performance bond in the amount of 100% of the contract. The performance bond must be received by the Purchasing Division prior to Contract award.

☐ **LABOR/MATERIAL PAYMENT BOND:** The apparent successful Vendor shall provide a labor/material payment bond in the amount of 100% of the Contract value. The labor/material payment bond must be delivered to the Purchasing Division prior to Contract award.

In lieu of the Bid Bond, Performance Bond, and Labor/Material Payment Bond, the Vendor may provide certified checks, cashier's checks, or irrevocable letters of credit. Any certified check, cashier's check, or irrevocable letter of credit provided in lieu of a bond must be of the same amount and delivered on the same schedule as the bond it replaces. A letter of credit submitted in lieu of a performance and labor/material payment bond will only be allowed for projects under $100,000. Personal or business checks are not acceptable. Notwithstanding the foregoing, West Virginia Code § 5-22-1 (d) mandates that a vendor provide a performance and labor/material payment bond for construction projects. Accordingly, substitutions for the performance and labor/material payment bonds for construction projects is not permitted.

☐ **MAINTENANCE BOND:** The apparent successful Vendor shall provide a two (2) year maintenance bond covering the roofing system. The maintenance bond must be issued and delivered to the Purchasing Division prior to Contract award.

☐ **LICENSE(S) / CERTIFICATIONS / PERMITS:** In addition to anything required under the Section of the General Terms and Conditions entitled Licensing, the apparent successful Vendor shall furnish proof of the following licenses, certifications, and/or permits prior to Contract award, in a form acceptable to the Purchasing Division.

☐

☐

☐

☐

The apparent successful Vendor shall also furnish proof of any additional licenses or certifications contained in the specifications prior to Contract award regardless of whether or not that requirement is listed above.

8. INSURANCE: The apparent successful Vendor shall furnish proof of the insurance identified by a checkmark below and must include the State as an additional insured on each policy prior to Contract award. The insurance coverages identified below must be maintained throughout the life of this contract. Thirty (30) days prior to the expiration of the insurance policies, Vendor shall provide the Agency with proof that the insurance mandated herein has been continued. Vendor must also provide Agency with immediate notice of any changes in its insurance policies, including but not limited to, policy cancelation, policy reduction, or change in insurers. The apparent successful Vendor shall also furnish proof of any additional insurance requirements contained in the specifications prior to Contract award regardless of whether or not that insurance requirement is listed in this section.

Vendor must maintain:

☑ **Commercial General Liability Insurance** in at least an amount of: $1,000,000.00 per occurrence.

☑ **Automobile Liability Insurance** in at least an amount of: $100,000.00 per occurrence.

☐ **Professional/Malpractice/Errors and Omission Insurance** in at least an amount of: _____ per occurrence.

☐ **Commercial Crime and Third Party Fidelity Insurance** in an amount of: _____ per occurrence.

☐ **Cyber Liability Insurance** in an amount of: _____ per occurrence.

☐ **Builders Risk Insurance** in an amount equal to 100% of the amount of the Contract.

☐ **Pollution Insurance** in an amount of: _____ per occurrence.

☐ **Aircraft Liability** in an amount of: _____ per occurrence.

☐

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☐

Notwithstanding anything contained in this section to the contrary, the Director of the Purchasing Division reserves the right to waive the requirement that the State be named as an additional insured on one or more of the Vendor's insurance policies if the Director finds that doing so is in the State's best interest.

9. WORKERS' COMPENSATION INSURANCE: The apparent successful Vendor shall comply with laws relating to workers compensation, shall maintain workers' compensation insurance when required, and shall furnish proof of workers' compensation insurance upon request.

10. [Reserved]

11. LIQUIDATED DAMAGES: This clause shall in no way be considered exclusive and shall not limit the State or Agency's right to pursue any other available remedy. Vendor shall pay liquidated damages in the amount specified below or as described in the specifications:

☐ _____ for _____

☐ Liquidated Damages Contained in the Specifications

12. ACCEPTANCE: Vendor's signature on its bid, or on the certification and signature page, constitutes an offer to the State that cannot be unilaterally withdrawn, signifies that the product or service proposed by vendor meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise indicated, and signifies acceptance of the terms and conditions contained in the Solicitation unless otherwise indicated.

13. PRICING: The pricing set forth herein is firm for the life of the Contract, unless specified elsewhere within this Solicitation/Contract by the State. A Vendor's inclusion of price adjustment provisions in its bid, without an express authorization from the State in the Solicitation to do so, may result in bid disqualification. Notwithstanding the foregoing, Vendor must extend any publicly advertised sale price to the State and invoice at the lower of the contract price or the publicly advertised sale price.

14. PAYMENT IN ARREARS: Payment in advance is prohibited under this Contract. Payment may only be made after the delivery and acceptance of goods or services. The Vendor shall submit invoices, in arrears.

15. PAYMENT METHODS: Vendor must accept payment by electronic funds transfer and P-Card. (The State of West Virginia's Purchasing Card program, administered under contract by a banking institution, processes payment for goods and services through state designated credit cards.)

16. TAXES: The Vendor shall pay any applicable sales, use, personal property or any other taxes arising out of this Contract and the transactions contemplated thereby. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

17. ADDITIONAL FEES: Vendor is not permitted to charge additional fees or assess additional charges that were not either expressly provided for in the solicitation published by the State of West Virginia or included in the unit price or lump sum bid amount that Vendor is required by the solicitation to provide. Including such fees or charges as notes to the solicitation may result in rejection of vendor's bid. Requesting such fees or charges be paid after the contract has been awarded may result in cancellation of the contract.

18. FUNDING: This Contract shall continue for the term stated herein, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise made available, this Contract becomes void and of no effect beginning on July 1 of the fiscal year for which funding has not been appropriated or otherwise made available.

19. CANCELLATION: The Purchasing Division Director reserves the right to cancel this Contract immediately upon written notice to the vendor if the materials or workmanship supplied do not conform to the specifications contained in the Contract. The Purchasing Division Director may also cancel any purchase or Contract upon 30 days written notice to the Vendor in accordance with West Virginia Code of State Rules § 148-1-5.2.b.

20. TIME: Time is of the essence with regard to all matters of time and performance in this Contract.

21. APPLICABLE LAW: This Contract is governed by and interpreted under West Virginia law without giving effect to its choice of law principles. Any information provided in specification manuals, or any other source, verbal or written, which contradicts or violates the West Virginia Constitution, West Virginia Code or West Virginia Code of State Rules is void and of no effect.

22. COMPLIANCE WITH LAWS: Vendor shall comply with all applicable federal, state, and local laws, regulations and ordinances. By submitting a bid, Vendor acknowledges that it has reviewed, understands, and will comply with all applicable laws, regulations, and ordinances.

> **SUBCONTRACTOR COMPLIANCE:** Vendor shall notify all subcontractors providing commodities or services related to this Contract that as subcontractors, they too are required to comply with all applicable laws, regulations, and ordinances. Notification under this provision must occur prior to the performance of any work under the contract by the subcontractor.

23. ARBITRATION: Any references made to arbitration contained in this Contract, Vendor's bid, or in any American Institute of Architects documents pertaining to this Contract are hereby deleted, void, and of no effect.

24. MODIFICATIONS: This writing is the parties' final expression of intent. Notwithstanding anything contained in this Contract to the contrary no modification of this Contract shall be binding without mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any change to existing contracts that adds work or changes contract cost, and were not included in the original contract, must be approved by the Purchasing Division and the Attorney General's Office (as to form) prior to the implementation of the change or commencement of work affected by the change.

25. WAIVER: The failure of either party to insist upon a strict performance of any of the terms or provision of this Contract, or to exercise any option, right, or remedy herein contained, shall not be construed as a waiver or a relinquishment for the future of such term, provision, option, right, or remedy, but the same shall continue in full force and effect. Any waiver must be expressly stated in writing and signed by the waiving party.

26. SUBSEQUENT FORMS: The terms and conditions contained in this Contract shall supersede any and all subsequent terms and conditions which may appear on any form documents submitted by Vendor to the Agency or Purchasing Division such as price lists, order forms, invoices, sales agreements, or maintenance agreements, and includes internet websites or other electronic documents. Acceptance or use of Vendor's forms does not constitute acceptance of the terms and conditions contained thereon.

27. ASSIGNMENT: Neither this Contract nor any monies due, or to become due hereunder, may be assigned by the Vendor without the express written consent of the Agency, the Purchasing Division, the Attorney General's office (as to form only), and any other government agency or office that may be required to approve such assignments.

28. WARRANTY: The Vendor expressly warrants that the goods and/or services covered by this Contract will: (a) conform to the specifications, drawings, samples, or other description furnished or specified by the Agency; (b) be merchantable and fit for the purpose intended; and (c) be free from defect in material and workmanship.

29. STATE EMPLOYEES: State employees are not permitted to utilize this Contract for personal use and the Vendor is prohibited from permitting or facilitating the same.

30. PRIVACY, SECURITY, AND CONFIDENTIALITY: The Vendor agrees that it will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the Agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the Agency's policies, procedures, and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in http://www.state.wv.us/admin/purchase/privacy/default.html.

31. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

32. LICENSING: In accordance with West Virginia Code of State Rules § 148-1-6.1.e, Vendor must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agency or political subdivision. Obligations related to political subdivisions may include, but are not limited to, business licensing, business and occupation taxes, inspection compliance, permitting, etc. Upon request, the Vendor must provide all necessary releases to obtain information to enable the Purchasing Division Director or the Agency to verify that the Vendor is licensed and in good standing with the above entities.

SUBCONTRACTOR COMPLIANCE: Vendor shall notify all subcontractors providing commodities or services related to this Contract that as subcontractors, they too are required to be licensed, in good standing, and up-to-date on all state and local obligations as described in this section. Obligations related to political subdivisions may include, but are not limited to, business licensing, business and occupation taxes, inspection compliance, permitting, etc. Notification under this provision must occur prior to the performance of any work under the contract by the subcontractor.

33. ANTITRUST: In submitting a bid to, signing a contract with, or accepting a Award Document from any agency of the State of West Virginia, the Vendor agrees to convey, sell, assign, or transfer to the State of West Virginia all rights, title, and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the State of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the State of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to Vendor.

34. VENDOR CERTIFICATIONS: By signing its bid or entering into this Contract, Vendor certifies (1) that its bid or offer was made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership, person or entity submitting a bid or offer for the same material, supplies, equipment or services; (2) that its bid or offer is in all respects fair and without collusion or fraud; (3) that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; and (4) that it has reviewed this Solicitation in its entirety; understands the requirements, terms and conditions, and other information contained herein.

Vendor's signature on its bid or offer also affirms that neither it nor its representatives have any interest, nor shall acquire any interest, direct or indirect, which would compromise the performance of its services hereunder. Any such interests shall be promptly presented in detail to the Agency. The individual signing this bid or offer on behalf of Vendor certifies that he or she is authorized by the Vendor to execute this bid or offer or any documents related thereto on Vendor's behalf; that he or she is authorized to bind the Vendor in a contractual relationship; and that, to the best of his or her knowledge, the Vendor has properly registered with any State agency that may require registration.

35. VENDOR RELATIONSHIP: The relationship of the Vendor to the State shall be that of an independent contractor and no principal-agent relationship or employer-employee relationship is contemplated or created by this Contract. The Vendor as an independent contractor is solely liable for the acts and omissions of its employees and agents. Vendor shall be responsible for selecting, supervising, and compensating any and all individuals employed pursuant to the terms of this Solicitation and resulting contract. Neither the Vendor, nor any employees or subcontractors of the Vendor, shall be deemed to be employees of the State for any purpose whatsoever. Vendor shall be exclusively responsible for payment of employees and contractors for all wages and salaries, taxes, withholding payments, penalties, fees, fringe benefits, professional liability insurance premiums, contributions to insurance and pension, or other deferred compensation plans, including but not limited to, Workers' Compensation and Social Security obligations, licensing fees, etc. and the filing of all necessary documents, forms, and returns pertinent to all of the foregoing.

Vendor shall hold harmless the State, and shall provide the State and Agency with a defense against any and all claims including, but not limited to, the foregoing payments, withholdings, contributions, taxes, Social Security taxes, and employer income tax returns.

36. INDEMNIFICATION: The Vendor agrees to indemnify, defend, and hold harmless the State and the Agency, their officers, and employees from and against: (1) Any claims or losses for services rendered by any subcontractor, person, or firm performing or supplying services, materials, or supplies in connection with the performance of the Contract; (2) Any claims or losses resulting to any person or entity injured or damaged by the Vendor, its officers, employees, or subcontractors by the publication, translation, reproduction, delivery, performance, use, or disposition of any data used under the Contract in a manner not authorized by the Contract, or by Federal or State statutes or regulations; and (3) Any failure of the Vendor, its officers, employees, or subcontractors to observe State and Federal laws including, but not limited to, labor and wage and hour laws.

37. PURCHASING AFFIDAVIT: In accordance with West Virginia Code §§ 5A-3-10a and 5-22-1(i), the State is prohibited from awarding a contract to any bidder that owes a debt to the State or a political subdivision of the State, Vendors are required to sign, notarize, and submit the Purchasing Affidavit to the Purchasing Division affirming under oath that it is not in default on any monetary obligation owed to the state or a political subdivision of the state.

38. ADDITIONAL AGENCY AND LOCAL GOVERNMENT USE: This Contract may be utilized by other agencies, spending units, and political subdivisions of the State of West Virginia; county, municipal, and other local government bodies; and school districts ("Other Government Entities"), provided that both the Other Government Entity and the Vendor agree. Any extension of this Contract to the aforementioned Other Government Entities must be on the same prices, terms, and conditions as those offered and agreed to in this Contract, provided that such extension is in compliance with the applicable laws, rules, and ordinances of the Other Government Entity. A refusal to extend this Contract to the Other Government Entities shall not impact or influence the award of this Contract in any manner.

39. CONFLICT OF INTEREST: Vendor, its officers or members or employees, shall not presently have or acquire an interest, direct or indirect, which would conflict with or compromise the performance of its obligations hereunder. Vendor shall periodically inquire of its officers, members and employees to ensure that a conflict of interest does not arise. Any conflict of interest discovered shall be promptly presented in detail to the Agency.

40. REPORTS: Vendor shall provide the Agency and/or the Purchasing Division with the following reports identified by a checked box below:

☑ Such reports as the Agency and/or the Purchasing Division may request. Requested reports may include, but are not limited to, quantities purchased, agencies utilizing the contract, total contract expenditures by agency, etc.

☐ Quarterly reports detailing the total quantity of purchases in units and dollars, along with a listing of purchases by agency. Quarterly reports should be delivered to the Purchasing Division via email at purchasing.requisitions@wv.gov.

41. BACKGROUND CHECK: In accordance with W. Va. Code § 15-2D-3, the Director of the Division of Protective Services shall require any service provider whose employees are regularly employed on the grounds or in the buildings of the Capitol complex or who have access to sensitive or critical information to submit to a fingerprint-based state and federal background inquiry through the state repository. The service provider is responsible for any costs associated with the fingerprint-based state and federal background inquiry.

After the contract for such services has been approved, but before any such employees are permitted to be on the grounds or in the buildings of the Capitol complex or have access to sensitive or critical information, the service provider shall submit a list of all persons who will be physically present and working at the Capitol complex to the Director of the Division of Protective Services for purposes of verifying compliance with this provision. The State reserves the right to prohibit a service provider's employees from accessing sensitive or critical information or to be present at the Capitol complex based upon results addressed from a criminal background check.

Service providers should contact the West Virginia Division of Protective Services by phone at (304) 558-9911 for more information.

42. PREFERENCE FOR USE OF DOMESTIC STEEL PRODUCTS: Except when authorized by the Director of the Purchasing Division pursuant to W. Va. Code § 5A-3-56, no contractor may use or supply steel products for a State Contract Project other than those steel products made in the United States. A contractor who uses steel products in violation of this section may be subject to civil penalties pursuant to W. Va. Code § 5A-3-56. As used in this section:

a. "State Contract Project" means any erection or construction of, or any addition to, alteration of or other improvement to any building or structure, including, but not limited to, roads or highways, or the installation of any heating or cooling or ventilating plants or other equipment, or the supply of and materials for such projects, pursuant to a contract with the State of West Virginia for which bids were solicited on or after June 6, 2001.

b. "Steel Products" means products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed, or processed by a combination of two or more or such operations, from steel made by the open heath, basic oxygen, electric furnace, Bessemer or other steel making process. The Purchasing Division Director may, in writing, authorize the use of foreign steel products if:

c. The cost for each contract item used does not exceed one tenth of one percent (.1%) of the total contract cost or two thousand five hundred dollars ($2,500.00), whichever is greater. For the purposes of this section, the cost is the value of the steel product as delivered to the project; or

d. The Director of the Purchasing Division determines that specified steel materials are not produced in the United States in sufficient quantity or otherwise are not reasonably available to meet contract requirements.

43. PREFERENCE FOR USE OF DOMESTIC ALUMINUM, GLASS, AND STEEL: In Accordance with W. Va. Code § 5-19-1 et seq., and W. Va. CSR § 148-10-1 et seq., for every contract or subcontract, subject to the limitations contained herein, for the construction, reconstruction, alteration, repair, improvement or maintenance of public works or for the purchase of any item of machinery or equipment to be used at sites of public works, only domestic aluminum, glass or steel products shall be supplied unless the spending officer determines, in writing, after the receipt of offers or bids, (1) that the cost of domestic aluminum, glass or steel products is unreasonable or inconsistent with the public interest of the State of West Virginia, (2) that domestic aluminum, glass or steel products are not produced in sufficient quantities to meet the contract requirements, or (3) the available domestic aluminum, glass, or steel do not meet the contract specifications. This provision only applies to public works contracts awarded in an amount more than fifty thousand dollars ($50,000) or public works contracts that require more than ten thousand pounds of steel products.

The cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than twenty percent (20%) of the bid or offered price for foreign made aluminum, glass, or steel products. If the domestic aluminum, glass or steel products to be supplied or produced in a

"substantial labor surplus area", as defined by the United States Department of Labor, the cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than thirty percent (30%) of the bid or offered price for foreign made aluminum, glass, or steel products. This preference shall be applied to an item of machinery or equipment, as indicated above, when the item is a single unit of equipment or machinery manufactured primarily of aluminum, glass or steel, is part of a public works contract and has the sole purpose or of being a permanent part of a single public works project. This provision does not apply to equipment or machinery purchased by a spending unit for use by that spending unit and not as part of a single public works project.

All bids and offers including domestic aluminum, glass or steel products that exceed bid or offer prices including foreign aluminum, glass or steel products after application of the preferences provided in this provision may be reduced to a price equal to or lower than the lowest bid or offer price for foreign aluminum, glass or steel products plus the applicable preference. If the reduced bid or offer prices are made in writing and supersede the prior bid or offer prices, all bids or offers, including the reduced bid or offer prices, will be reevaluated in accordance with this rule.

44. INTERESTED PARTY SUPPLEMENTAL DISCLOSURE: W. Va. Code § 6D-1-2 requires that for contracts with an actual or estimated value of at least $1 million, the vendor must submit to the Agency a supplemental disclosure of interested parties reflecting any new or differing interested parties to the contract, which were not included in the original pre-award interested party disclosure, within 30 days following the completion or termination of the contract. A copy of that form is included with this solicitation or can be obtained from the WV Ethics Commission. This requirement does not apply to publicly traded companies listed on a national or international stock exchange. A more detailed definition of interested parties can be obtained from the form referenced above.

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

Georgeann Foster/Bids Response Specialist

(Name, Title)

Georgeann Foster/Bids Response Specialist

(Printed Name and Title)

2850 Centerville Road, Wilmington, DE 19808

(Address)

800-227-9770/302-993-5941

(Phone Number) / (Fax Number)

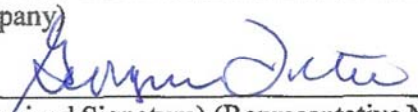
Lscabids@agilent.com

(email address)

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that I have reviewed this Solicitation in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

Agilent Technologies, Inc.

(Company)



Georgeann Foster/Bids Response Specialist

(Authorized Signature) (Representative Name, Title)

Georgeann Foster/Bids Response Specialist

(Printed Name and Title of Authorized Representative)

04/23/2019

(Date)

800-227-9770/302-993-5941

(Phone Number) (Fax Number)

SPECIFICATIONS

1. **PURPOSE AND SCOPE:** The West Virginia Purchasing Division is soliciting bids on behalf of West Virginia Department of Agriculture to establish a contract for the one time purchase of a **Liquid Chromatography Triple Quadrupole Mass Spectrometer (LC/MS/MS), workstation PC, software, printer, nitrogen generator, uninterrupted power supply (UPS), specific test methods, shipping, installation, validation, warranty, training and service.**

2. **DEFINITIONS:** The terms listed below shall have the meanings assigned to them below. Additional definitions can be found in section 2 of the General Terms and Conditions.

   2.1 "Contract Services" means the LC/MS/MS with inside delivery, installation, validation, warranty, and training.

   2.2 "Pricing Page" means the pages, contained in wvOASIS or attached as Exhibit A, upon which Vendor should list its proposed price for the Contract Items.

   2.3 "Solicitation" means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

   2.4 "Validation" means is the process used to confirm that the analytical procedure employed for a specific test or matrices is suitable for its intended use.

   2.5 "Installation" means unpacking and setting instrumentation in place with all connections secured for the instrument(s) to be in working order including software installation on the computer connected to the instrument.

   2.6 "Warranty" means the written warranty of the manufacturer of a new instrument of its condition and fitness for use, including any terms or conditions precedent to the enforcement of obligations under that warranty.

   2.7 "Training" means teaching staff how to use and maintain the instrument and software.

   2.8 "Service" means performing routine maintenance work or repair to the instrument or software.

   2.9 "APCI" means atmospheric pressure chemical ionization.

   2.10 "ESI" means electrospray.

2.11 "FG" means femtogram.

2.12 "LC/MS/MS" means Liquid Chromatography Triple Quadrupole Mass Spectrometer.

2.13 "MRM" means multiple reactions monitoring.

2.14 "MSMS" means tandem mass spectrometry.

2.15 "SIM" means selected ion monitoring.

2.16 "S/N" means signal to noise.

2.17 "M/Z" means mass to charge ratio.

2.18 "AMU" means Atomic mass unit.

2.19 "DA/S" means Daltons per second.

2.20 "UHPLC" means Ultra High-performance liquid chromatography.

2.21 "SLPM" means standard liters per minute.

2.22 "PSIG" means pounds per square inch gauge.

2.23 "UPS" means uninterrupted power supply.

3. GENERAL REQUIREMENTS:

3.1 Mandatory Contract Item Requirements: Contract Item must meet or exceed the mandatory requirements listed below for the **Liquid Chromatography Triple Quadrupole Mass Spectrometer (LC/MS/MS), workstation PC, software, printer, nitrogen generator, uninterrupted power supply (UPS), specific test methods, shipping, installation, validation, warranty, training, and service.**

3.1.1 Liquid Chromatography Triple Quadrupole Mass Spectrometer (LC/MS/MS)

3.1.1.1 Must be capable of detecting a variety of analytes including pesticides, herbicides, toxins, drugs in matrices such as foods, soil, vegetation (including hemp), animal feed, and water.

3.1.1.2 The system provided must be capable of analyzing the list of pesticides from the Cannabis and hemp pesticide lists from Oregon and California. See 3.1.4.2

3.1.1.3 MSMS must have dual ion sources that operate independently which can be set to electrospray ionization (ESI) or atmospheric pressure chemical ionization (APCI). The instrument must enable combinations such as ESI/APCI, ESI/ESI, APCI/APCI with the same or opposite polarities without having to remove the sources to switch modes.

3.1.1.4 Minimum sensitivity requirement for positive ion mode: signal/noise (S/N) 2000:1 25 femtograms (fg) of reserpine on column. Minimum sensitivity requirement for negative ion mode: signal/noise (S/N)>2000:1, 25 femtograms (fg) of chloramphenicol on column.

3.1.1.5 The source probes must be easy to remove without the use of tools.

3.1.1.6 Ion source must have flat response across flow rate up to 3 milliliters per minute without loss of sensitivity.

3.1.1.7 Capable of switching between rapidly between positive and negative ion detection without high voltage switching.

3.1.1.8 Acquisition modes: Q1 scan, Q2 scan, multiple reactions monitoring (MRM), selected ion monitoring (SIM), Neutral Loss scans, Product Ion, Precursor Ion, Time managed MRM

3.1.1.9 Minimum mass range requirement: 5-1500 mass to charge ratio (m/z)

3.1.1.10 Mass stability required: 0.05 atomic mass unit (amu) in 24 hours

3.1.1.11 Mass accuracy needed: minimum 0.1 unit across mass range

3.1.1.12 Scan speed: $\leq$30,000 daltons per second (da/s)

3.1.1.13 Quad resolution: unit, low and high, minimal sensitivity loss at 0.1 Daltons resolutions

3.1.1.14 Polarity switching time: $\leq$15 milliseconds

3.1.1.15 Dynamic range: 6 orders

3.1.1.16 Minimum multiple reactions monitoring (MRM) Dwell Time: 1 millisecond

3.1.1.17 MRM transitions: 450 per time segment > 40,000 ion transactions per method

3.1.1.18 Must have high selectivity mass filter at 0.3 Daltons. Signal loss must not be more than 10%.

3.1.1.19 For minimal tuning during method development and minimal maintenance of the ion path, the LC/MS/MS will require hot source induced desolvation interface to the mass analyzer by patented Laminar Flow Ion Guide using gas flow. Submit evidence of instrument use with cannabis for at least 6 months without matrix induced cleaning and maintenance

3.1.1.20 High performance liquid chromatograph capable of solvent and column switching without user intervention

3.1.1.21 High performance liquid chromatograph capable of regulating column temperature of at least 2 different columns

3.1.1.22 The UHPLC pump must have 18,000 psi capability and a flow rate to 5mL/minute.

3.1.1.23 High performance liquid chromatograph with an autosampler

3.1.1.24 The LC/MS/MS instrument must be fully automated for analysis with a system controller that is loaded with the necessary software that can perform instrument diagnostics, monitor all operating and electrical parameters, and allow remote tuning capability in real time.

3.1.1.25 The LC/MS/MS must include a maintenance kit.

3.1.1.26 Vendor must provide documentation for recommended environmental conditions, electrical requirements, gas requirements, or any other factor that would affect instrument performance.

3.1.2 Nitrogen generator

3.1.2.1 The nitrogen generator must be capable of producing up to 18 standard liters per minute (slpm) of liquid chromatography mass spectrometer grade gases at 80 pounds per square inch (psig) or have the capacity for the needs stated in the gas requirements of the LCMSMS.

3.1.2.2 The vendor must include if there is another gas requirement or need for the specific instrument being quoted other than listed in 3.1.2.1.

3.1.3 Uninterrupted Power Supply (UPS)

3.1.3.1 The uninterrupted power supply (UPS) must provide protection and complete power conditioning where the output remains continuously regulated. Must be rated to a capacity at least 5200

VA or have the capacity for the needs stated in the electrical requirements of the LCMSMS.

3.1.3.2 The vendor must include if there is another UPS electrical requirement or need to maintain the integrity of the instrument for proper operation being quoted other than listed in 3.1.3.1.

3.1.4 Specific Test methods: Cannabis and hemp methods

3.1.4.1 The vendor must provide a standard operating procedure for Cannabis and hemp analysis that includes sample preparation and analysis of the complete Cannabis list from states such as Oregon or California which include the analytes in 3.1.4.2.

3.1.4.2 See Exhibit B.

3.1.5 Workstation and software

3.1.5.1 Data station with windows based operating system capable of multitasking allowing data processing and data acquisition simultaneously.

3.1.5.2 Operating system must be fully integrated to control LS/MS/MS.

3.1.6 Shipping, Installation, Validation, Warranty, Training (including Specific Test Methods Application), and Service

3.1.6.1 Vendor must be on-site for delivery and perform the installation (labor and supplies included) of the LCMSMS.

3.1.6.2 The vendor must provide a written validation of the instrument's performance after installation.

3.1.6.3 Vendor will provide a full one-year parts and labor warranty on all items, including 2 preventative maintenances.

3.1.6.4 Vendor must be able to perform resolutions to service requests within 72 hours which includes on-site resolutions.

3.1.6.5 Vendor will provide on-site training (labor and non-consumable supplies included) for all instruments and software.

3.1.6.6 Vendor will provide on-site applications assistance for implementation of standard operating procedures for Cannabis and hemp analysis related to 3.1.4 by an applications scientist familiar with the analysis.

3.1.6.7 Vendor will provide copies of all system manuals (operations, training, technical, service, maintenance).

4. CONTRACT AWARD:

4.1 Contract Award: The Contract is intended to provide Agencies with a purchase price for the Contract Items. The Contract shall be awarded to the Vendor that provides the Contract Items meeting the required specifications for the lowest overall total cost as shown on the Pricing Pages.

4.2 Pricing Page: Vendor should complete the Pricing Page Exhibit A by placing all inclusive information in each column for item number, model/brand name, unit price and extended amount. There should be a price for the LCMSMS, workstation, software, printer, shipping/inside delivery, installation, validation, warranty, training, specific methods, and service. If there is no charge for any deliverable, indicate in the cell with "no charge". The bidder/vendor information must be completed and include an authorize signature. Vendor should complete the Pricing Page in full as failure to complete the Pricing Page in its entirety may result in Vendor's bid being disqualified.

Vendor should type or electronically enter the information into the Pricing Page to prevent errors in the evaluation.

5. PAYMENT:

5.1 Payment: Vendor shall accept payment in accordance with the payment procedures of the State of West Virginia.

6. DELIVERY AND RETURN:

6.1 Shipment and Delivery: Vendor should ship the Contract Items immediately after being awarded this Contract and receiving a purchase order. Contract Items must be delivered to Agency at 313 Gus R. Douglass Lane, Charleston, WV 25312.

6.2 Late Delivery: The Agency placing the order under this Contract must be notified in writing if the shipment of the Contract Items will be delayed for any reason. Any delay in delivery that could cause harm to an Agency will be grounds for cancellation of the Contract, and/or obtaining the Contract Items from a third party.

Any Agency seeking to obtain the Contract Items from a third party under this provision must first obtain approval of the Purchasing Division.

6.3 Delivery Payment/Risk of Loss: Vendor shall deliver the Contract Items F.O.B. destination to the Agency's location.

6.4 Return of Unacceptable Items: If the Agency deems the Contract Items to be unacceptable, the Contract Items shall be returned to Vendor at Vendor's expense and with no restocking charge. Vendor shall either make arrangements for the return within five (5) days of being notified that items are unacceptable, or permit the Agency to arrange for the return and reimburse Agency for delivery expenses. If the original packaging cannot be utilized for the return, Vendor will supply the Agency with appropriate return packaging upon request. All returns of unacceptable items shall be F.O.B. the Agency's location. The returned product shall either be replaced, or the Agency shall receive a full credit or refund for the purchase price, at the Agency's discretion.

6.5 Return Due to Agency Error: Items ordered in error by the Agency will be returned for credit within 30 days of receipt, F.O.B. Vendor's location. Vendor shall not charge a restocking fee if returned products are in a resalable condition. Items shall be deemed to be in a resalable condition if they are unused and in the original packaging. Any restocking fee for items not in a resalable condition shall be the lower of the Vendor's customary restocking fee or 5% of the total invoiced value of the returned items.

7 VENDOR DEFAULT:

7.1 The following shall be considered a vendor default under this Contract.

7.1.1 Failure to provide Contract Items in accordance with the requirements contained herein.

7.1.2 Failure to comply with other specifications and requirements contained herein.

7.1.3 Failure to comply with any laws, rules, and ordinances applicable to the Contract Services provided under this Contract.

7.1.4 Failure to remedy deficient performance upon request.

7.2 The following remedies shall be available to Agency upon default.

7.2.1 Immediate cancellation of the Contract.

7.2.2 Immediate cancellation of one or more release orders issued under this Contract.

7.2.3 Any other remedies available in law or equity.

8 FACILITIES ACCESS: Performance of Services will require access to the facility.

8.1 Vendor must identify principal service personnel who will be asked for identification upon entrance to the facility.

8.2 Anyone performing under this Contract will be subject to Agency's security protocol and procedures.

8.3 Vendor shall inform all staff of Agency's security protocol and procedures.

	Exhibit A CRFQ AGR1900000018				
		PRICING PAGE	Per Agilent Quotation 2842798		
Item No.	Description	Model No/Brand Name	Quanity	Unit Price	Extended Amount
	LCMSMS, workstation PC, software, printer, nitrogen generator, UPS, specific test methods		1	$334,860.08	$334,860.08
	installation/validation		1	Included	Included
	training/warranty		1	$3,997.00	$3,997.00
	service		1	$10,908.00	$10,908.00
	Failure to use this form may result in disqualification			GRAND TOTAL	349,765.08
	Bidder / Vendor Information				
Name:	Agilent Technologies, Inc.				
Address:	2850 Centerville Road				
	Wilmington, DE 19808				
Phone:	800-227-9770				
Email Address:	Lscabids@agilent.com				
Authorized Signature:					

Vendor should not alter pricing page and should fill out pricing page as it. The addition of alterations to the pricing page and/or addition of commodities other than those listed on the pricing page online or as an attachment will result in disqualification of bid submittal.

Exhibit B

Analytes of interest for the LCMSMS for West Virginia Department of Agriculture

Tox2	T022
Colchicine	Aminopterin
Aflatoxin G1	Codeine
Aflatoxin B1	Oxycodone
T2 Toxin	Scopolamine
*Digoxin	Ouabain
*Strychnine	Hydrocodone
*Ricinine	Eserine
*Aconitine	Emetine
*alpha-amanitin	Apomorphine
*Brodifacoum	Brucine
Anti-Coagulants (ran in negative ion mode)	Atropine
Warfarin	Hyoscyamine
Coumachlor	Levorphenol
Diphacinone	Heroin
Dicoumarol	Hydrastine
Chlorophacinone	Yohimbine
Bromadiolone	Digoxigenin
Difethialone	Picrotin
*Brodifacoum	Solanine
	Pentazocine
Other Compounds	Lobeline
Fluoroacetic Acid	Digitoxigenin
Melamine	Digitoxin
	*Ricinine
	*alpha-amanitin
	*strychnine
	*digoxin
	*aconitine

Compounds with * are in multiple lists

T022 method additional compounds	
Aldicarb	Coumaphos
Aldicarb sulfone	Ethiofencarb
Aldicarb sulfoxide	Fenamiphos
Atropine	Fenamiphos sulfide
Berberine	Methamidiphos
*Brodifacoum	Methomyl
Carbanyl	Oxamyl
Carbofuran	Picrotin
*Colchicine	Propoxur

Pesticides	
2,4-D	Imazethapyr
2,4,5-T	Isoxaflutole
2,4-DB	Mesotrione
2,4-DP	MCPA (2-methyl-4-chlorophenoxyacetic acid)

Exhibit B

Aldicarb (+ degradates)	Metsulfuron-methyl
Aminocyclopyrachlor	Metribuzin (+ DA, DADK, DK)
Aminopyralid	Napropamide
Bentazon	Picloram
Clopyralid	Propiconazole
Dacthal (+ degradates)	Rimsulfuron
Dicamba	Sulfometuron-methyl
Dinotefuran	Tebuthiuron
Diuron	Thiamethoxam
Glyphosate (+AMPA)	Thifensulfuron-methy
Imazapyr	Tralkoxydim
Hexazinone (+ Metabolite B)	Triclopyr

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

CONSTRUCTION CONTRACTS: Under W. Va. Code § 5-22-1(i), the contracting public entity shall not award a construction contract to any bidder that is known to be in default on any monetary obligation owed to the state or a political subdivision of the state, including, but not limited to, obligations related to payroll taxes, property taxes, sales and use taxes, fire service fees, or other fines or fees.

ALL CONTRACTS: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

"Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (*W. Va. Code* §61-5-3) that: (1) for construction contracts, the vendor is not in default on any monetary obligation owed to the state or a political subdivision of the state, and (2) for all other contracts, that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: Agilent Technologies, Inc.

Authorized Signature: _____ Date: 04/23/2019

State of Pennsylvania

County of Montgomery, to-wit:

Taken, subscribed, and sworn to before me this 23rd day of April, 2019.

My Commission expires 05 MAY, 2022

AFFIX SEAL HERE

Commonwealth of Pennsylvania - Notary Seal
Kimberly Zera, Notary Public
Montgomery County
My commission expires May 5, 2022
Commission number 1185103
Member, Pennsylvania Association of Notaries

NOTARY PUBLIC _____

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.:

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

- [x] Addendum No. 1
- [ ] Addendum No. 2
- [ ] Addendum No. 3
- [ ] Addendum No. 4
- [ ] Addendum No. 5
- [ ] Addendum No. 6
- [ ] Addendum No. 7
- [ ] Addendum No. 8
- [ ] Addendum No. 9
- [ ] Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Agilent Technologies, Inc.

Company

Authorized Signature

04/23/2019

Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

Agilent Technologies

Quotation

Melissa Pettrey
State of West Virginia
Dept of Agriculture
313 Gus R Douglass Ln
CHARLESTON WV 25312-6968

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	1 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

To place an order: Call 1-800-227-9770 Option 1
For Instruments Fax : 302-633-8953
Email : LSCAinstrumentsales@agilent.com
For Consumables Fax : 302-633-8901
Email : CAG_sales-NA@agilent.com
For Genomics Fax: 512-321-3128
Email : orders@agilent.com
For additional instructions, see last page

Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
G6470AA	1.000 EA	**460,489.00 USD**	**230,244.50-**	**230,244.50**
6470 Triple Quadrupole LC/MS System Includes: 6470 QQQ, workstation PC + monitor, MassHunter SW with 2 data analysis licenses, installation and familiarization training, 1Y warranty + 1Y PC image recovery, and 1Y SW upgrade/phone assist				
With the following configuration: Ship-to Country : USA Add Laser Printer Installation (44K) Familiarization at Installation (44L) 1 Year SW Update/Phone Assist (44W) Training (44P) 1YR PC Repair Recovery Service (0TP)	1 EA	1,754.00 USD	877.00-	877.00
		Item Total		**231,121.50**
Special discount of 50.00 % is applied.				
G1978B	1.000 EA	**30,606.00 USD**	**13,772.70-**	**16,833.30**
Multimode ESI/APCI Source				
With the following configuration: Configuration for usage with : Triple Quad Ship-to Country : USA Installation (44K)				

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	2 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

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CHARLESTON WV 25312-6968

Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
Familiarization at Installation (44L)				
		Item Total		**16,833.30**
Special discount of 45.00 % is applied.				
G7120A	1.000 EA	**48,836.00 USD**	**21,976.20-**	**26,859.80**
1290 Infinity II High Speed Pump. Power range 1300 bar and 5ml/min flow, binary high pressure mixing, lowest delay, highest precision and accuracy. Includes Active Seal Wash, Tool Kit, Solvent Cabinet, bottles and ISET.				
With the following configuration: High speed UCT (033) : selected Select bundled column : Poroshell 120 EC-C18, 2.1x 0mm Manual DVD for 1220/1260/1290 : DVD included Ship-to Country : USA				
Ultra Low Dispersion Kit	1 EA	2,647.00 USD	1,191.15-	1,455.85
Ultra Clean Tubing Kit	1 EA	220.00 USD	99.00-	121.00
Poroshell 120 EC-C18, 2.1x50mm, 1.9um	1 EA	1.00 USD	0.45-	0.55
Installation (44K)				
		Item Total		**28,437.20**
Special discount of 45.00 % is applied.				
G7167B	1.000 EA	**30,110.00 USD**	**13,549.50-**	**16,560.50**

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	3 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

To place an order: Call 1-800-227-9770 Option 1
For Instruments Fax : 302-633-8953
Email : LSCAinstrumentsales@agilent.com
For Consumables Fax : 302-633-8901
Email : CAG_sales-NA@agilent.com
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CHARLESTON WV 25312-6968

Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
1290 Infinity Multisampler up to 1300 bar for well plates and individual sample containers. Includes 1 sample drawer, 2x 54-vial containers, a needle flush port, 40 uL metering device, 20 uL loop. (for Dual-needle instruments metering is 100 ul and loop size is 100 ul).				
With the following configuration:				
Type of SW license : MassHunter System Driver				
Add thermostat (101) : InfLab sample thermostat incl.				
Multi-wash option (112) : selected				
Sample Loop-Flex 100 uL : Sample Loop-Flex 100 uL right				
Analytical head 100 uL (161) : Analytical head 100 uL				
Ship-to Country : USA				
Agilent InfinityLab Sample Thermostat	1 EA	5,440.00 USD	2,448.00-	2,992.00
1290 Infinity Multi-wash option	1 EA	5,079.00 USD	2,285.55-	2,793.45
Sample Loop-Flex 100 uL right	1 EA	418.00 USD	188.10-	229.90
Analytical head 100 uL	1 EA	1,354.00 USD	609.30-	744.70
Installation (44K)				
		Item Total		**23,320.55**
Special discount of 45.00 % is applied.				
G7116B	1.000 EA	**7,777.00 USD**	**3,499.65-**	**4,277.35**
1290 Infinity II Multicolumn Thermostat. Capacity up to 8 columns, temperature range 4 deg C. to 110 deg C. Includes 1.6uL Quick-Connect Heat Exchanger, Quick-Connect fitting and two Quick-Turn fittings. Valve drive optional.				

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	4 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

To place an order: Call 1-800-227-9770 Option 1
For Instruments Fax : 302-633-8953
Email : LSCAinstrumentsales@agilent.com
For Consumables Fax : 302-633-8901
Email : CAG_sales-NA@agilent.com
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Melissa Pettrey
State of West Virginia
Dept of Agriculture
313 Gus R Douglass Ln
CHARLESTON WV 25312-6968

Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
With the following configuration: Ship-to Country : USA				
Valve drive for 1290 MCT	1 EA	1,339.00 USD	602.55-	736.45
Quick-Connect HE Standard Flow	1 EA	322.00 USD	144.90-	177.10
Installation (44K)				
		Item Total		**5,190.90**
Special discount of 45.00 % is applied.				
G4231A	1.000 EA	**2,237.00 USD**	**1,006.65-**	**1,230.35**
2pos/6port Quick Change valve head, 800 bar. For use in G7116A/B MCT and G1316C TCC.				
With the following configuration: Ship-to Country : USA				
Installation (44K)				
		Item Total		**1,230.35**
Special discount of 45.00 % is applied.				
G1953A	1.000 EA	**616.00 USD**	**277.20-**	**338.80**
PEAK Nitrogen Generator System, including install. For model specific information, consult ELSA N2 generator ordering guide. For extended warranty and support service, contact PEAK directly. www.peakscientific.com				

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	5 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

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State of West Virginia
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Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
With the following configuration: Ship-to Country : USA N2 Generator-PEAK Model NM32LA Installation (44K)	1 EA	30,507.00 USD	13,728.15-	16,778.85
		Item Total		**17,117.65**
Special discount of 45.00 % is applied.				
NON AGILENT PROD	1.000 EA	**11,608.13 USD**		**11,608.13**
Power VAR UPS Security Plus 8.0kVA/7.2kW On-Line Isolated UPS model ABCDEF48000-22				
		Item Total		**11,608.13**
Please note that above product Power VAR UPS is not manufactured by Agilent Technologies which hereby disclaims any liability for the performance, quality, reliability or delivery of the items. The standard warranty,INCLUDING INDEMNIFICATION FOR INTELLECTUAL PROPERTY INFRINGEMENT, is to be supplied by manufacturer unless otherwise specified on the Agilent Technologies quotation.				
R1893A	1.000 EA	**4,576.00 USD**	**1,144.00-**	**3,432.00**
QQQ Operation Training				

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	6 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

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Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
		Item Total		**3,432.00**
Special discount of 25.00 % is applied.				
SYS-LM-6470-E	1.000 EA			**0.00**
LCMS 6470 QQQ Sys w/ Enh. Features				
With the following configuration: Ship-to Country : USA				
CrossLab Prev Maintenance - 2yrs total	1 EA	14,544.00 USD	3,636.00-	10,908.00
		Item Total		**10,908.00**
Promotion discount 5.00 %. Special discount of 20.00 % is applied.				
SYS-LC-1290II	1.000 EA			**0.00**
Infinity II 1290 LC Base System				
With the following configuration: Ship-to Country : USA				
Familiarization for New User	1 EA	754.00 USD	188.50-	565.50

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	7 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

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Melissa Pettrey
State of West Virginia
Dept of Agriculture
313 Gus R Douglass Ln
CHARLESTON WV 25312-6968

Product/Description	Qty/Unit	Unit List Price	Discount Amount	Extended Net Price
		Item Total		**565.50**

Special discount of 25.00 % is applied.

Gross Amount	: $	661,234.13
Total Discount	: $	311,469.05
Net Amount	: $	349,765.08
Total	**: $**	**349,765.08**

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	8 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

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TO PLACE AN ORDER, Agilent offers several options:

1) Visit **http://www.agilent.com/chem/supplies** to place online orders using a purchase order or credit card.
2) Call 1-800-227-9770 (option 1) any weekday between 8am and 8 pm Eastern time in the U.S., Canada & Puerto Rico.
3) To place an order for Consumables, please fax the order to 302-633-8901.
   To place an instrument and/or software order, please fax the order to 302-633-8953.
   To place an order for Genomics, please fax the order to 512-321-3128, or email to orders@agilent.com
4) Or you can mail your order to:
   Agilent Technologies
   North American Customer Contact Center
   2850 Centerville Road BU3-2
   Wilmington, DE 19808-1610

To place an order, the following information is required:

- Purchase order number or credit card, delivery date, ship to, invoice to, end user, and quote number.
- GSA customers please provide GSA contract #.

EXCLUSIVE OFFERS FOR NEW INSTRUMENT CUSTOMERS, go to **www.agilent.com/chem/exclusiveoffers**

TO CHECK THE STATUS OF AN ORDER:

1) Visit **http://www.agilent.com/chem/supplies** to check the status of your order.
2) Call 1-800-227-9770 (option 1) any weekday between 8 am and 8 pm Eastern time, in the U.S., Canada & Puerto Rico. You will need to know the purchase order or credit card number the order was placed on.

FINANCING AND LEASING - A wide range of options are available, for more information or to discuss how monthly payments could suit your operational or budgetary requirements,contact your Agilent Account Manager.

TERMS AND CONDITIONS:

- Pricing: Web prices are provided only for the U.S. in U.S.dollars. All phone prices are in local currency and for end use. Applicable local taxes are applied.
- All Sales Tax is subject to change at the time of order.
- Shipping and Handling Charges: Orders with a value less than $4000 or those requiring special services such as overnight delivery may be subject to additional shipping & handling fees. Some of these charges may be avoided by ordering via the Web
- Payment Terms: Net 30 days from invoice date, subject to credit approval.

* Quotation Validity: This quotation is valid for 60 days unless otherwise indicated.
* Warranty period for instrumentation is 1 year. The Warranty period for columns and consumables is 90 days.

It is Agilent Technologies intent to ship product at the earliest available date unless specified otherwise.

Agilent Technologies

Quotation

Quote No.	Create Date	Delivery Time	Page
2842798	04/23/2019	5 Weeks	9 of 9

Contact	Phone no.	Valid to
Mike Michalski	3042906353	06/22/2019

Melissa Pettrey
State of West Virginia
Dept of Agriculture
313 Gus R Douglass Ln
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Email : orders@agilent.com
For additional instructions, see last page

STATE OF WEST VIRGINIA
AGR1900000018
26APR2019
Agilent Attachment A

Agilent Technologies, Inc. (Agilent) is bidding in accordance with attached quotation 2842798. The quotation is included for pricing and configuration purposes only. Agilent is in agreement with customer's terms and conditions.

Please refer to the attached Document with General Requirements Clarifications for more details as to how Agilent meets customer's requirements.

Agilent is offering a functionally equivalent system that meets or exceeds all specifications with the exception of the following:

3.1.1.12 Scan speed: 30,000 daltons per second (da/s) The Agilent 6470 has a maximum scan rate of 17,000 da/s. However, it is capable of handling the above-mentioned application without any issue

3.1.1.14 Polarity switching time: <15 milliseconds - The Agilent 6470 has polarity switching speed of 25 ms. However, it is capable of handling the above-mentioned application without any issue.

The Peak Generator is covered for repairs during warranty but not after warranty; if coverage is needed after 365 days, the customer will need to contact Peak for coverage.
The non-Agilent Power Var UPS is not covered under SYS-LM-6470-E.

The bid response includes a gratis for 5-days on-site method consulting.

2.11 "FG" means femtogram.

2.12 "LC/MS/MS" means Liquid Chromatography Triple Quadrupole Mass Spectrometer.

2.13 "MRM" means multiple reactions monitoring.

2.14 "MSMS" means tandem mass spectrometry.

2.15 "SIM" means selected ion monitoring.

2.16 "S/N" means signal to noise.

2.17 "M/Z" means mass to charge ratio.

2.18 "AMU" means Atomic mass unit.

2.19 "DA/S" means Daltons per second.

2.20 "UHPLC" means Ultra High-performance liquid chromatography.

2.21 "SLPM" means standard liters per minute.

2.22 "PSIG" means pounds per square inch gauge.

2.23 "UPS" means uninterrupted power supply.

3. GENERAL REQUIREMENTS:

3.1 Mandatory Contract Item Requirements: Contract Item must meet or exceed the mandatory requirements listed below for the **Liquid Chromatography Triple Quadrupole Mass Spectrometer (LC/MS/MS), workstation PC, software, printer, nitrogen generator, uninterrupted power supply (UPS), specific test methods, shipping, installation, validation, warranty, training, and service.**

3.1.1 Liquid Chromatography Triple Quadrupole Mass Spectrometer (LC/MS/NIS)

3.1.1.1 Must be capable of detecting a variety of analytes including pesticides, herbicides, toxins, drugs in matrices such as foods, soil, vegetation (including hemp), animal feed, and water.

3.1.1.2 The system provided must be capable of analyzing the list of pesticides from the Cannabis and hemp pesticide lists from Oregon and California. See 3.1.4.2. The Agilent 6470 can accomplish this, see Agilent application notes 5994-0429 and 5994-0648 (attached) for an illustration.

3.1.1.3 MSMS must have dual ion sources that operate independently which can be set to electrospray ionization (ESI) or atmospheric pressure chemical ionization (APCI). The instrument must enable combinations such as ESI/APCI, ESI/ESI, APC1/APCI with the same or opposite polarities without having to remove the sources to switch modes. The Agilent 6470 with the Multimode source meets this specification

3.1.1.4 Minimum sensitivity requirement for positive ion mode: signal/noise (S/N) 2000:1 25 femtograms (fg) of reserpine on column. Minimum sensitivity requirement for negative ion mode: signal/noise (S/N)>2000:1, 25 femtograms (fg) of chloramphenicol on column. The Agilent 6470 uses an Instrument Detection Specification (IDL). This is a much more scientifically and statistically valid and reproducible approach than using a S/N. The Agilent 6470 has an IDL of <4fg of either reserpine or chloramphenicol following the injection of 10 fg of reserpine.

3.1.1.5 The source probes must be easy to remove without the use of tools. The Agilent 6470 meets this specification.

3.1.1.6 Ion source must have flat response across flow rate up to 3 milliliters per minute without loss of sensitivity. The Agilent 6470 meets this specification.

3.1.1.7 Capable of switching between rapidly between positive and negative ion detection without high voltage switching. The Agilent 6470 meets this specification.

3.1.1.8 Acquisition modes: Q1 scan, Q2 scan, multiple reactions monitoring (MRM), selected ion monitoring (SIM), Neutral Loss scans, Product Ion, Precursor Ion, Time managed MRM The Agilent 6470 meets this specification.

3.1.1.9 Minimum mass range requirement: 5-1500 mass to charge ratio (m/z) The Agilent 6470 exceeds this specification if a mass range of 5-3,000 m/z

3.1.1.10 Mass stability required: 0.05 atomic mass unit (amu) in 24 hours
The Agilent 6470 has a mass stability of <= 0.1 amu in 24 hours..
However, it is capable of handling the above mentioned application without any issue.

3.1.1.11 Mass accuracy needed: minimum 0.1 unit across mass range The Agilent 6470 meets this specification.

3.1.1.12 Scan speed: <30,000 daltons per second (da/s) The Agilent 6470 has a maximum scan rate of 17,000 da/s. However, it is capable of handling the above mentioned application without any issue.

3.1.1.13 Quad resolution: unit, low and high, minimal sensitivity loss at 0.1 Daltons resolutions The Agilent 6470 has a quad resolution of 0.5 Da. However, it is capable of handling the above mentioned application without any issue.

3.1.1.14 Polarity switching time: <15 milliseconds The Agilent 6470 has polarity switching speed of 25 ms. However, it is capable of handling the above mentioned application without any issue.

3.1.1.15 Dynamic range: 6 orders The Agilent 6470 meets this specification.

3.1.1.16 Minimum multiple reactions monitoring (MRM) Dwell Time: 1 Millisecond The Agilent 6470 meets this specification.

3.1.1.17 MRM transitions: 450 per time segment > 40,000 ion transactions per method The Agilent 6470 can handle 450 MRM transitions per time segment and a total of 13,500/method which is more than sufficient for the above mentioned application.

3.1.1.18 Must have high selectivity mass filter at 0.3 Daltons. Signal loss must not be more than 10%.The Agilent 6470 does not have a specification for this.

3.1.1.19 For minimal tuning during method development and minimal maintenance of the ion path, the LC/MS/MS will require hot source induced desolvation interface to the mass analyzer by patented Laminar Flow Ion Guide using gas flow. Submit evidence of instrument use with cannabis for at least 6 months without matrix induced cleaning and maintenance

3.1.1.20 High performance liquid chromatograph capable of solvent and column switching without user intervention The Agilent 6470 with the 1290 UHPLC meets this specification.

3.1.1.21 High performance liquid chromatograph capable of regulating column temperature of at least 2 different columns The Agilent 6470 with the 1290 UHPLC meets this specification.

3.1.1.22 The UHPLC pump must have 18,000 psi capability and a flow rate to 5mL/minute.

3.1.1.23 High performance liquid chromatograph with an autosampler

3.1.1.24 The LC/MS/MS instrument must be fully automated for analysis with a system controller that is loaded with the necessary software that can perform instrument diagnostics, monitor all operating and electrical parameters, and allow remote tuning capability in real time. The Agilent 6470 with 1290 UHPLC meets this specification

3.1.1.25 The LC/MS/MS must include a maintenance kit.

3.1.1.26 Vendor must provide documentation for recommended environmental conditions, electrical requirements, gas requirements, or any other factor that would affect instrument performance. The site preparation guides have this information

3.1.2 **Nitrogen generator**

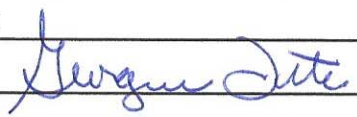
3.1.2.1 The nitrogen generator must be capable of producing up to 18 standard liters per minute (slpm) of liquid chromatography mass spectrometer grade gases at 80 pounds per square inch (psig) or have the capacity for the needs stated in the gas requirements of the LCMSMS. The quote includes the N2 generator adequate for the performance of the proposed system.

3.1.2.2 The vendor must include if there is another gas requirement or need for the specific instrument being quoted other than listed in 3.1.2.1. The site preparation documents contain this information

3.1.3 Uninterrupted Power Supply (UPS)

3.1.3.1 The uninterrupted power supply (UPS) must provide protection and complete power conditioning where the output remains continuously regulated. Must be rated to a capacity at least 5200

Revised 10/27/2014

	Exhibit A CRFQ AGR1900000018				
	PRICING PAGE				
Item No.	Description	Model No/Brand Name	Quanity	Unit Price	Extended Amount
	LCMSMS, workstation PC, software, printer, nitrogen generator, UPS, specific test methods	Agilent 6470 LC/MS T	1	$334,860.08	$334,860.08
	shipping charges and inside delivery	Included	1		$0.00
	installation/validation	Included	1		$0.00
	training/warranty	The bid response incl	1	$3,997.00	$3,997.00
	service	2 Years total Prevent	1	$10,908.00	$10,908.00
	Failure to use this form may result in disqualification			GRAND TOTAL	$349,765.08
	Bidder / Vendor Information				
Name:	Agilent Technologies, Inc.				
Address:	2850 Centerville Road				
	Wilmington, DE 19808				
Phone:	800-227-9770				
Email Address:	Lscabids@agilent.com				
Authorized Signature:	Georgeann Foster 				

Vendor should not alter pricing page and should fill out pricing page as it is.. The addition of alterations to the pricing page and/or addition of commodities other than those listed on the pricing page online or as an attachment will result in disqualification of bid submittal.

	Exhibit A CRFQ AGR1900000018				
	PRICING PAGE				
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	training/warranty	The bid response incl	1	$3,997.00	$3,997.00
	service	2 Years total Prevent	1	$10,908.00	$10,908.00
	Failure to use this form may result in disqualification			GRAND TOTAL	$349,765.08
	Bidder / Vendor Information				
Name:	Agilent Technologies, Inc.				
Address:	2850 Centerville Road				
	Wilmington, DE 19808				
Phone:	800-227-9770				
Email Address:	Lscabids@agilent.com				
Authorized Signature:	Georgeann Foster				

Vendor should not alter pricing page and should fill out pricing page as it is.. The addition of alterations to the pricing page and/or addition of commodities other than those listed on the pricing page online or as an attachment will result in disqualification of bid submittal.