

Increase Throughput and Recoveries for EPA Method 508.1 with Automated Extraction using Strata[®] C18-E SPE Cartridges and Zebron[™] ZB-MultiResidue[™] GC Columns

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End-capped Strata C18-E SPE cartridges provide strong hydrophobic retention with negligible secondary polar interactions from active silanol groups. Pairing these cartridges with the fully-automated Horizon Technology SmartPrep[™] Cartridge Extraction system can increase productivity by preparing up to 12 samples without allocating valuable personnel time to this process.

Introduction

Chlorinated pesticides, herbicides, and organohalides were initially intended to protect human health and well-being. For example, DDT was created to control mosquito populations, which significantly limited the number of malaria and typhus cases in World War II. Atrazine increased corn and sugar cane production, helping to meet the world's needs for food. However, these benefits contrast the detrimental effects on flora and fauna that resulted from exposure to compounds within these chemicals. These toxic compounds have been banned or are strictly controlled throughout much of the world.

US EPA Method 508.1 outlines the analytical procedure for these toxins using Solid Phase Extraction (SPE) and Electron Capture Gas Chromatography (GC/ECD). Within these parameters, laboratories interested in increasing productivity may choose to automate the extraction process. This technical note will highlight the use of the Horizon Technology SmartPrep Automated Cartridge Extractor System using Strata C18-E SPE cartridges. Following the extraction procedure, the Horizon Technology DryVap[®] Concentrator System along with a DryDisk[®] Separation Membrane will provide automated drying and concentration. Extracted, dried, and concentrated samples are then injected onto a GC/ECD system equipped with a set of Zebron ZB-MultiResidue GC columns, which are specifically designed for the separation of pesticides.

Materials and Methods

Material

Sample extractions were performed using a SmartPrep Automated Cartridge Extractor System configured for 6 mL cartridges with a bottle rinse kit and 20 mL tray. The DryDisk Separation Membrane was used along with the DryVap Concentrator System to dry and concentrate up to six samples at a time (Horizon Technology, Inc., Salem, NH, USA).

Samples were injected onto an HP[®] 5890 Series II GC/ECD equipped with a 7373 controller (Agilent Technologies, Palo Alto, CA, USA). The GC columns used were a Zebron ZB-MultiResidue-1 column with the dimensions 30 m x 0.32 mm x 0.50 μm and a Zebron ZB-MultiResidue-2 with the dimensions of 30 m x 0.25 mm x 0.25 μm. The cartridges used in the extractor were Strata C18-E 1000 mg/6 mL SPE cartridges (Phenomenex Inc., Torrance, CA, USA).

Method

1. Prepare 1 liter of deionized water using 1 mL of concentrated HCl to lower the pH to approximately 2.
2. After mixing, add 25 μL of a 20 μg/mL surrogate solution and 25 μL of a 20 μg/mL spike solution (for blank samples, add only surrogate solution).
3. Insert Sip Tube number 1 and attach Bottle Rinse Kit 7 to the sample container.
4. Place a 20 mL VOA vial in position 1 of the tray.
5. Place a 6 mL C18-E cartridge in position 1 of the carousel.
6. Run the method given in **Table 3**.
7. Place a 1 mL endpoint Concentrator Tube on the DryVap.
8. Add a DryDisk membrane to the DryDisk reservoir and attach to the DryVap.
9. Transfer the contents of the VOA vial to the DryDisk Reservoir and start the DryVap using the conditions given in **Table 1**.
10. When the extract has processed through the DryDisk, add approximately 2 mL of Ethyl Acetate (EtOAc) to the VOA vial, cap, and shake vigorously.
11. Transfer the rinsate to the DryDisk Reservoir and allow it to process through into the Concentrator Tube.
12. Repeat steps 10 and 11 two additional times.
13. Rinse the DryDisk Reservoir using approximately 2 mL of EtOAc and allow for this rinsate to process through to the Concentrator Tube.
14. Repeat step 13 two additional times.
15. Allow the extract to concentrate to its final volume.
16. Upon completion, use approximately 0.1 mL of EtOAc to rinse the heater and the Concentrator Tube and bring the volume up to the 1 mL mark as indicated on the Tube and transfer to a vial.
17. Add internal standard and run on a GC/ECD using **Table 2**.

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Table 1.
DryVap Parameters

Parameter	Setting
Dry Volume	100 mL
Heat Power	5
Heat Timer	OFF
Auto Rinse Mode	OFF
Nitrogen Sparge	20 psi
Vacuum	-10 in. Hg

Table 2.
GC/ECD Acquisition Program

Parameter	Setting
Inlet Temperature	1 μ L at 250 °C
Carrier Gas	Helium at a constant flow rate
Oven Program	120 °C for 0.5 min to 210 °C at 30 °C/min to 230 °C at 6 °C/min hold for 3 min to 300 °C at 6 °C/min hold for 10 min
Detector	ECD at 320 °C

Results and Discussion

Following EPA Method 508.1, a calibration curve was prepared and analyzed using the spike concentrations of 0.1 μ g/mL, 0.2 μ g/mL, 0.5 μ g/mL, 1.0 μ g/mL, and 2.0 μ g/mL. This curve was then used to analyze all the data obtained for this technical note. A degradation check solution prepared using DDT and Endrin was used for every analytical batch to investigate the degradation products of the two analytes.

As a confirmational pair, the Zebron™ Multi Residue™ GC columns provide distinct benefits. While co-elutions were present on the Zebron ZB-MultiResidue-1 column between Simazine and Atrazine as well as between δ -BHC and Metribuzin, these compounds were fully separated on the Zebron ZB-MultiResidue-2 column. The ZB-MultiResidue-2 column initially showed co-elution of Heptachlor Epoxide B and the recommended surrogate, Dibromophenyl. In this case, a different surrogate, Decachlorobiphenyl, was selected. The average recovery for 12 LCS extracts are given in **Table 4** for each column used. With averages of 93 % and the highest RSD being 17 %, they show excellent results for all compounds that are able to be reported on each column. For a full list of all recoveries including blanks, refer to **Tables 5a** and **5b**.

Conclusion

Strata® C18-E SPE cartridges were used to extract EPA Method 508.1 compounds from water samples with the Horizon Technology SmartPrep™ Automated Cartridge Extractor System. When coupled with the DryVap® Concentrator System and DryDisk® Separation Membranes, this preparation process demonstrated both excellent precision and accuracy. Responses were measured using the Zebron ZB-MultiResidue-1 and ZB-MultiResidue-2 GC columns, whose chemistry was designed specifically for environmental analyses. The solutions presented will allow a laboratory to streamline their aqueous extraction procedures and minimize the costs associated with labor and solvent while maintaining the level of quality required.

References

We thank Horizon Technology, Inc. for sharing the method procedure, results, and discussion displayed in this technical note.

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Table 3.
EPA Method 508.1 Extraction Parameters

Step	Conditioning	Reagent	Volume (mL)	Rate (mL/min)	Soak (s)	N ₂ Purge (s)	Liquid Sense	
1		EtOAc	5	10	10	2	No	
2		DCM	5	10	10	2	No	
3		DCM	5	10	10	2	No	
4		MeOH	5	10	0	0	No	
5		MeOH	5	10	10	0	No	
6		DI H ₂ O	5	10	0	0	No	
7		DI H ₂ O	5	10	10	0	No	
8	Load Sample	Load Until Empty	Syringe Fill Pause (s)	Sample Sip Rate (mL/min)	Sample Deliver Rate (mL/min)	Minimum Volume (mL)	Expected Volume (mL)	
		Yes	1	20	10	800	1000	
9	N ₂ Purge Timer	Delay (min)						
		5						
10	Sample Bottle Rinse	Reagent	Volume (mL)	Vent Volume (mL)	Spray Time (s)	Liquid Sense		
		EtOAc	5	5	5	No		
11	Sample Bottle Elute	Volume (mL, to Mixer)	Destination (Tube)	Volume (mL, to elute)	Sip Rate (mL/min)	Delivery Rate (mL/min)	Soak (s)	N ₂ Purge (s)
		15*	1	5	10	10	20	1
12	Sample Bottle Rinse	Reagent	Volume (mL)	Vent Volume (mL)	Spray Time (s)	Liquid Sense		
		DCM	5	5	5	No		
13	Sample Bottle Elute	Volume (mL, to Mixer)	Destination (Tube)	Volume (mL, to elute)	Sip Rate (mL/min)	Delivery Rate (mL/min)	Soak (s)	N ₂ Purge (s)
		10*	1	5	10	10	20	1
14	Sample Bottle Rinse	Reagent	Volume (mL)	Vent Volume (mL)	Spray Time (s)	Liquid Sense		
		DCM	5	5	5	No		
15	Sample Bottle Elute	Volume (mL, to Mixer)	Destination (Tube)	Volume (mL, to elute)	Sip Rate (mL/min)	Delivery Rate (mL/min)	Soak (s)	N ₂ Purge (s)
		10*	1	5	10	10	20	1
16	Add to Mixing Chamber	Reagent	Volume (mL)	Rate (mL/min)				
		DCM	5	10				
17	Elute Cartridge	Reagent	Volume (mL)	Rate (mL/min)	Destination (Tube)	Soak (s)	Purge (s)	
		Mixing Chamber	10	10	1	5	15	

*Sample volumes increased due to sample viscosities

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Table 4.
Average Recovery and RSD for EPA Method 508.1 Blanks and LCS Samples

Sample Name		Blanks		LCS			
		Average (µg/L) ZB-MR-1	Average (µg/L) ZB-MR-2	Average (%) ZB-MR-1	RSD (%) ZB-MR-1	Average (%) ZB-MR-2	RSD (%) ZB-MR-2
Etridiazole		0.01	0.00	115	12.64	84	8.99
Chloroneb		0.02	0.00	90	5.23	68	6.70
Propachlor		0.03	0.01	92	9.59	86	8.31
Trifuralin		0.01	0.01	83	6.11	92	10.06
α-BHC		0.00	0.00	87	5.67	94	6.89
Lindane (γ-BHC)		0.00	0.02	93	5.37	104	6.91
Simazine	1*	N/A	0.06	N/A	N/A	94	9.60
Atrazine	1*	N/A	0.09	N/A	N/A	95	7.05
β-BHC		0.01	0.00	94	3.99	103	5.74
δ-BHC	2*	N/A	0.00	N/A	N/A	114	7.75
Chlorothalonil		0.00	0.00	112	8.72	117	10.13
Metribuzin	2*	N/A	0.00	N/A	N/A	83	8.44
Heptachlor		0.03	0.01	91	13.83	86	13.64
Alachlor		0.05	0.00	89	11.32	92	10.18
Cyanazine		0.01	0.00	119	8.60	94	4.48
Metolachlor		0.00	N/A	100	5.37	N/A	N/A
Dacthal		0.00	0.00	92	3.75	101	6.13
Heptachlor epoxide B		0.00	0.00	89	4.22	99	6.66
trans-Chlordane		0.00	0.00	84	4.93	91	7.37
Butaclor		0.00	0.00	105	6.81	95	8.19
cis-Chlordane		0.00	0.00	85	4.62	90	6.66
Endosulfan I		0.00	0.00	89	4.01	98	6.76
4,4'-DDE		0.01	0.01	78	7.19	85	9.74
Dieldrin		0.00	0.00	94	4.54	97	6.26
Endrin		0.00	0.00	97	6.56	100	7.74
Chlorobenzilate		0.00	0.00	70	12.60	92	10.99
Endosulfan II		0.00	0.00	92	4.14	99	8.15
4,4'-DDD		0.01	0.00	91	5.00	92	8.40
Endrin Aldehyde		0.01	0.00	90	4.28	92	8.90
4,4-DDT		0.01	0.00	107	6.82	94	8.75
Endosulfan sulfate		0.00	0.00	96	4.67	96	8.68
Methoxychlor		0.01	0.00	118	10.22	94	10.99
Permethrin		0.05	0.00	107	16.09	106	16.99
Decachlorobiphenyl		0.40	0.46	83	6.23	96	10.66

* Co-eluting compounds on ZB-MultiResidue™-1 resolved on ZB-MultiResidue-2

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Table 5A.
All EPA Method 508.1 Data Generated

Sample Name		Blank 1		Blank 2		LCS 1		LCS 2		LCS 3		LCS 4		LCS 5	
		(µg/L)		(µg/L)		(%)		(%)		(%)		(%)		(%)	
Column		ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2
Pentachloronitrobenzene	IS	0.50	0.50	0.50	0.50	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Etridiazole		0.01	0.00	0.01	0.00	86.00	76.00	106.00	82.00	106.00	80.00	106.00	80.00	106.00	78.00
Chloroneb		0.02	0.00	0.01	0.00	86.00	74.00	94.00	72.00	88.00	68.00	88.00	68.00	86.00	60.00
Propachlor		0.02	0.01	0.03	0.00	80.00	86.00	86.00	82.00	84.00	80.00	88.00	84.00	84.00	72.00
Trifluralin		0.00	0.02	0.01	0.00	80.00	82.00	84.00	80.00	80.00	84.00	84.00	86.00	72.00	104.00
α-BHC		0.00	0.00	0.00	0.00	80.00	84.00	86.00	92.00	84.00	88.00	84.00	90.00	80.00	86.00
Lindane (γ-BHC)		0.00	0.01	0.00	0.02	86.00	92.00	92.00	98.00	90.00	98.00	90.00	100.00	88.00	98.00
Simazine	1*	N/A	0.06	N/A	0.05	N/A	102.00	N/A	90.00	N/A	84.00	N/A	90.00	N/A	84.00
Atrazine	1*	N/A	0.07	N/A	0.10	N/A	86.00	N/A	90.00	N/A	96.00	N/A	90.00	N/A	96.00
β-BHC		0.00	0.00	0.01	0.00	88.00	96.00	92.00	96.00	92.00	100.00	94.00	102.00	90.00	98.00
δ-BHC	2*	N/A	0.00	N/A	0.00	N/A	98.00	N/A	104.00	N/A	106.00	N/A	112.00	N/A	108.00
Chlorothalonil		0.00	0.00	0.00	0.00	98.00	98.00	102.00	104.00	102.00	106.00	108.00	110.00	108.00	114.00
Metribuzin	2*	N/A	0.00	N/A	0.00	N/A	94.00	N/A	80.00	N/A	72.00	N/A	90.00	N/A	78.00
Heptachlor		0.02	0.00	0.04	0.02	84.00	82.00	88.00	80.00	76.00	70.00	84.00	80.00	74.00	68.00
Alachlor		0.00	0.00	0.09	0.00	80.00	86.00	82.00	82.00	86.00	96.00	84.00	88.00	84.00	74.00
Cyanazine		0.00	0.00	0.01	0.00	106.00	94.00	110.00	90.00	112.00	94.00	114.00	96.00	112.00	90.00
Metolachlor		0.00	N/A	0.00	N/A	88.00	N/A	96.00	N/A	98.00	N/A	98.00	N/A	98.00	N/A
Dacthal		0.00	0.00	0.00	0.00	86.00	92.00	90.00	96.00	92.00	96.00	92.00	100.00	90.00	94.00
Heptachlor epoxide B		0.00	0.00	0.00	0.00	84.00	N/A	88.00	94.00	88.00	92.00	88.00	96.00	86.00	90.00
trans-Chlordane		0.00	0.00	0.00	0.00	82.00	82.00	86.00	90.00	82.00	86.00	84.00	90.00	80.00	84.00
Butaclor		0.00	0.00	0.00	0.00	88.00	104.00	106.00	86.00	98.00	88.00	102.00	94.00	108.00	86.00
cis-Chlordane		0.00	0.00	0.00	0.00	82.00	82.00	88.00	92.00	84.00	88.00	86.00	92.00	82.00	84.00
Endosulfan I		0.00	0.00	0.00	0.00	84.00	86.00	88.00	96.00	88.00	96.00	88.00	98.00	86.00	92.00
4,4'-DDE		0.01	0.01	0.01	0.01	78.00	80.00	80.00	86.00	74.00	78.00	78.00	86.00	70.00	72.00
Dieldrin		0.00	0.00	0.00	0.00	86.00	88.00	92.00	94.00	92.00	92.00	94.00	98.00	92.00	92.00
Endrin		0.00	0.00	0.00	0.00	86.00	90.00	94.00	92.00	90.00	94.00	94.00	98.00	104.00	92.00
Chlorobenzilate		0.00	0.00	0.00	0.00	84.00	84.00	78.00	86.00	76.00	90.00	66.00	90.00	52.00	76.00
Endosulfan II		0.00	0.00	0.00	0.00	84.00	84.00	90.00	94.00	92.00	96.00	92.00	100.00	90.00	92.00
4,4'-DDD		0.01	0.00	0.01	0.00	84.00	82.00	92.00	90.00	90.00	92.00	90.00	96.00	88.00	84.00
Endrin Aldehyde		0.01	0.00	0.01	0.00	84.00	82.00	90.00	88.00	92.00	94.00	92.00	96.00	92.00	88.00
4,4-DDT		0.01	0.00	0.01	0.00	94.00	82.00	106.00	94.00	106.00	94.00	110.00	100.00	110.00	86.00
Endosulfan Sulfate		0.00	0.00	0.00	0.00	86.00	80.00	94.00	94.00	96.00	96.00	96.00	98.00	96.00	86.00
Methoxychlor		0.00	0.00	0.01	0.00	102.00	86.00	116.00	90.00	116.00	94.00	120.00	100.00	92.00	66.00
Permethrin		0.06	0.00	0.03	0.00	108.00	94.00	94.00	112.00	96.00	104.00	104.00	130.00	94.00	98.00
Decachlorobiphenyl	S	0.41	0.46	0.39	0.45	N/A	N/A	86.00	90.00	84.00	100.00	86.00	104.00	80.00	84.00

* Co-eluting compounds on ZB-MultiResidue™-1 resolved on ZB-MultiResidue-2

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Table 5B.
All EPA Method 508.1 Data Generated

Sample Name		LCS 6		LCS 7		LCS 8		LCS 9		LCS 10		LCS 11		LCS 12	
		(µg/L)		(µg/L)		(%)		(%)		(%)		(%)		(%)	
Column		ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2	ZB-MR-1	ZB-MR-2
Pentachloronitrobenzene	IS	100.00	100.00	100.00	100.00	100.00	100.00	110.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Etridiazole		110.00	80.00	120.00	78.00	122.00	84.00	118.00	80.00	136.00	92.00	136.00	100.00	128.00	94.00
Chloroneb		82.00	62.00	96.00	72.00	94.00	70.00	88.00	64.00	94.00	74.00	94.00	70.00	84.00	66.00
Propachlor		86.00	80.00	98.00	92.00	98.00	96.00	98.00	86.00	110.00	94.00	100.00	94.00	92.00	90.00
Trifluralin		80.00	82.00	86.00	92.00	90.00	94.00	82.00	92.00	90.00	94.00	88.00	106.00	82.00	104.00
α-BHC		82.00	90.00	92.00	100.00	94.00	104.00	90.00	100.00	92.00	98.00	90.00	100.00	84.00	94.00
Lindane (γ-BHC)		88.00	100.00	98.00	106.00	100.00	114.00	98.00	112.00	100.00	110.00	96.00	112.00	92.00	108.00
Simazine	1*	N/A	80.00	N/A	90.00	N/A	98.00	N/A	98.00	N/A	102.00	N/A	104.00	N/A	108.00
Atrazine	1*	N/A	98.00	N/A	82.00	N/A	94.00	N/A	102.00	N/A	100.00	N/A	100.00	N/A	104.00
β-BHC		90.00	100.00	96.00	106.00	100.00	112.00	96.00	114.00	98.00	108.00	96.00	106.00	90.00	102.00
δ-BHC	2*	N/A	114.00	N/A	112.00	N/A	126.00	N/A	126.00	N/A	120.00	N/A	122.00	N/A	116.00
Chlorothalonil		100.00	118.00	124.00	112.00	124.00	128.00	114.00	128.00	122.00	124.00	120.00	136.00	116.00	130.00
Metribuzin	2*	N/A	80.00	N/A	78.00	N/A	84.00	N/A	82.00	N/A	76.00	N/A	92.00	N/A	90.00
Heptachlor		80.00	76.00	104.00	92.00	106.00	100.00	86.00	84.00	108.00	98.00	106.00	102.00	100.00	96.00
Alachlor		88.00	90.00	116.00	86.00	94.00	98.00	80.00	98.00	98.00	96.00	90.00	96.00	86.00	110.00
Cyanazine		110.00	88.00	130.00	88.00	138.00	100.00	124.00	90.00	132.00	98.00	124.00	98.00	118.00	96.00
Metolachlor		98.00	N/A	104.00	N/A	108.00	N/A	102.00	N/A	106.00	N/A	104.00	N/A	98.00	N/A
Dacthal		90.00	98.00	94.00	98.00	98.00	110.00	92.00	106.00	98.00	106.00	94.00	110.00	90.00	104.00
Heptachlor epoxide B		86.00	94.00	90.00	98.00	96.00	110.00	90.00	104.00	94.00	106.00	94.00	106.00	86.00	100.00
trans-Chlordane		80.00	86.00	82.00	86.00	94.00	106.00	82.00	94.00	88.00	96.00	86.00	96.00	80.00	90.00
Butaclor		102.00	88.00	106.00	88.00	114.00	102.00	106.00	96.00	114.00	100.00	110.00	106.00	108.00	104.00
cis-Chlordane		82.00	86.00	82.00	86.00	94.00	104.00	84.00	92.00	90.00	94.00	88.00	96.00	82.00	88.00
Endosulfan I		86.00	94.00	90.00	96.00	96.00	110.00	88.00	104.00	94.00	104.00	92.00	106.00	86.00	98.00
4,4'-DDE		76.00	80.00	76.00	80.00	92.00	104.00	76.00	88.00	84.00	92.00	80.00	88.00	74.00	80.00
Dieldrin		92.00	94.00	94.00	90.00	102.00	106.00	94.00	100.00	100.00	100.00	98.00	106.00	92.00	102.00
Endrin		94.00	96.00	100.00	96.00	106.00	114.00	90.00	104.00	104.00	108.00	100.00	108.00	98.00	104.00
Chlorobenzilate		60.00	76.00	62.00	90.00	72.00	106.00	72.00	96.00	76.00	104.00	72.00	102.00	68.00	98.00
Endosulfan II		90.00	94.00	92.00	94.00	98.00	112.00	90.00	106.00	98.00	106.00	94.00	108.00	90.00	102.00
4,4'-DDD		92.00	92.00	84.00	78.00	100.00	104.00	90.00	94.00	94.00	96.00	96.00	102.00	92.00	96.00
Endrin Aldehyde		84.00	82.00	88.00	80.00	96.00	104.00	88.00	94.00	94.00	100.00	94.00	102.00	88.00	98.00
4,4'-DDT		110.00	94.00	94.00	78.00	120.00	108.00	106.00	96.00	112.00	96.00	112.00	100.00	106.00	94.00
Endosulfan Sulfate		94.00	90.00	96.00	90.00	104.00	108.00	96.00	100.00	102.00	106.00	100.00	104.00	96.00	96.00
Methoxychlor		120.00	92.00	112.00	102.00	134.00	104.00	120.00	92.00	132.00	98.00	130.00	102.00	122.00	98.00
Permethrin		104.00	92.00	98.00	80.00	156.00	132.00	94.00	92.00	114.00	96.00	116.00	106.00	106.00	136.00
Decachlorobiphenyl	S	84.00	96.00	74.00	78.00	90.00	110.00	82.00	96.00	74.00	88.00	88.00	108.00	84.00	104.00

* Co-eluting compounds on ZB-MultiResidue™-1 resolved on ZB-MultiResidue-2

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APPLICATIONS

Ordering Information

Products Featured in this Technical Note

Part No.	Description	Dimensions	Unit
8B-S001-JCH	Strata® C18-E (55 µm, 70 Å)	1000 mg/6 mL	30/box
7HM-G016-17	Zebtron™ ZB-MultiResidue™-1 GC Column	30 m x 0.32 mm x 0.50 µm	ea
7HG-G017-11	Zebtron ZB-MultiResidue-2 GC Column	30 m x 0.25 mm x 0.25 µm	ea

Sample Preparation Cartridges

Strata C18-E (55 µm, 70 Å)

Format	Sorbent Mass	Part Number	Unit
Tube			
	50 mg	8B-S001-DAK	1 mL (100/box)
	100 mg	8B-S001-EAK	1 mL (100/box)
	100 mg	8B-S001-EBJ	3 mL (50/box)
	200 mg	8B-S001-FBJ	3 mL (50/box)
	200 mg	8B-S001-FCH	6 mL (30/box)
	500 mg	8B-S001-HBJ	3 mL (50/box)
	500 mg	8B-S001-HCH	6 mL (30/box)
	1 g	8B-S001-JCH	6 mL (30/box)

Giga™ Tube

500 mg	8B-S001-HDG	12 mL (20/box)
1 g	8B-S001-JEG	20 mL (20/box)
2 g	8B-S001-KDG	12 mL (20/box)
5 g	8B-S001-LEG	20 mL (20/box)
10 g	8B-S001-MFF	60 mL (16/box)
20 g	8B-S001-VFF	60 mL (16/box)
50 g	8B-S001-YSN	150 mL (8/box)
70 g	8B-S001-ZSN	150 mL (8/box)

GC Columns

Zebtron ZB-MultiResidue-1 GC Columns

ID(mm)	df(µm)	Temp. Limits °C	Part No.
20-Meter			
0.18	0.18	-60 to 320/340	7FD-G016-08
30-Meter			
0.25	0.25	-60 to 320/340	7HG-G016-11
0.32	0.25	-60 to 320/340	7HM-G016-11
0.32	0.50	-60 to 320/340	7HM-G016-17
0.53	0.50	-60 to 320/340	7HK-G016-17

Zebtron ZB-MultiResidue-2 GC Columns

ID(mm)	df(µm)	Temp. Limits °C	Part No.
30-Meter			
0.25	0.20	-60 to 320/340	7HG-G017-10
0.32	0.25	-60 to 320/340	7HM-G017-11
0.53	0.50	-60 to 320/340	7HK-G017-17

Zebtron ZB-MultiResidue Column Kits

0.25 mm ID

(kit consists of products below)

Part No.: KGO-8237

Description	Dimension	Part No.
MultiResidue MR-1 Column	30 meter x 0.25 mm x 0.25 µm df	7HG-G016-11
MultiResidue MR-2 Column	30 meter x 0.25 mm x 0.20 µm df	7HG-G017-10
Z-Guard Column	5 meter x 0.25 mm	7AG-G000-00-GZ0
Universal Capillary Column Y-connector, Borosilicate		AGO-4717

0.32 mm ID

(kit consists of products below)

Part No.: KGO-8238

Description	Dimension	Part No.
MultiResidue MR-1 Column	30 meter x 0.32 mm x 0.50 µm df	7HM-G016-17
MultiResidue MR-2 Column	30 meter x 0.32 mm x 0.25 µm df	7HM-G017-11
Z-Guard Column	5 meter x 0.32 mm	7AM-G000-00-GZ0
Universal Capillary Column Y-connector, Borosilicate		AGO-4717

0.53 mm ID

(kit consists of products below)

Part No.: KGO-8239

Description	Dimension	Part No.
MultiResidue MR-1 Column	30 meter x 0.53 mm x 0.50 µm df	7HK-G016-17
MultiResidue MR-2 Column	30 meter x 0.53 mm x 0.50 µm df	7HK-G017-17
Z-Guard Column	5 meter x 0.53 mm	7AK-G000-00-GZ0
Universal Capillary Column Y-connector, Borosilicate		AGO-4717

Recommended GC Accessories

Part No.	Description		Unit
AGO-7516	Split/Splitless Single Taper Inlet Liner	4 mm ID x 78.5 mm L x 6.45 mm OD	5/pk
AGO-8620	Easy Seals™ Inlet Base Seal, Gold-Plated	Single-Groove 0.8 mm	10/pk
AGO-4696	PhenoRed™-400 Injector Septa	7/16 in. (11 mm) Diameter	50/pk

Note: Additional GC Accessories available at www.phenomenex.com/GC



If Phenomenex products in this technical note do not provide at least an equivalent separation as compared to other products of the same phase and dimensions, return the product with comparative data within 45 days for a FULL REFUND.

Terms and Conditions

Subject to Phenomenex Standard Terms and Conditions which may be viewed at <http://www.phenomenex.com/TermsAndConditions>.

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TN-0050 APPLICATIONS

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