



Restek® GC Columns

Analyze Seven EPA Methods on One GC Column Pair!

Pesticides, PCBs, Herbicides, and
More on Rtx®-CLPesticides &
Rtx®-CLPesticides2 Columns

- Reduce downtime by running multiple methods on a single column set.
- Speed up analysis time without sacrificing resolution.
- Restek's unique column selectivity assures optimal separations.

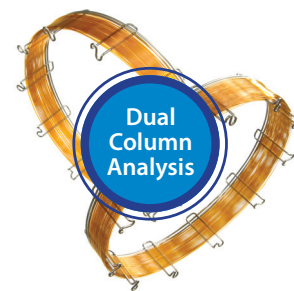


RESTEK

Pure Chromatography

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Save Time and Money—Use One Column Pair for Seven EPA Methods



Analyze Pesticides, PCBs, Herbicides, and More on Rtx®-CLPesticides & Rtx®-CLPesticides2 Columns

Get fast separations without sacrificing resolution by using Restek's proprietary Rtx®-CLPesticides and Rtx®-CLPesticides2 columns for multiple environmental methods. Instead of changing columns between GC-ECD methods, you can save time by analyzing chlorinated pesticides, PCBs, herbicides, and other halogenated compounds on a single column set using an Agilent® micro-ECD. As shown in the applications in this brochure, Rtx®-CLPesticides and Rtx®-CLPesticides2 columns have a unique selectivity and are ideal for multiple GC-ECD methods. Compare them to your current column set (Table I) and you'll see the Restek advantage!

Table I: Rtx®-CLPesticides columns offer the best overall performance for organochlorine pesticide analysis, as well as many other GC-ECD methods (0.32 mm ID columns).

Method Compound List	Column Pair	Analysis Time (min)	Coelutions	Restek Advantage
8081B (Organochlorine pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	0 / 0	• Increase sample throughput with 7 min analyses and baseline resolution.
	Competitor A set	7 / 8	0 / 1	
	Competitor B set	10 / 9	0 / 0	
8081B (extended) (Organochlorine pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	24 / 23	1 / 2	• Best balance of speed and selectivity. • All compounds are resolved on at least one column.
	Competitor A set	27 / 29	0 / 3	
	Competitor B set	NDP / 16	NDP / 3	
8082A (Polychlorinated biphenyls [PCBs], Aroclors)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	n/a	• Fast PCB analysis times.
	Competitor A set	6 / 7	n/a	
	Competitor B set	24 / 21	n/a	
8151A (Chlorinated herbicides)	Rtx-CLPesticides / Rtx-CLPesticides2	13 / 13	1 / 0	• More elution order changes improve confidence in confirmational results.
	Competitor A set	13 / 13	0 / 0	
	Competitor B set	16 / 15	1 / 1	
504.1 (EDB, DBCP, TCP)	Rtx-CLPesticides / Rtx-CLPesticides2	6 / 6	0 / 0	• Reliably separate analytes from trihalomethane interferences.
	Competitor A set	6 / 6	0 / 0	
	Competitor B set	NDP	NDP	
505 (Organohalide pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	18 / 18.5	1 / 1	• All compounds resolved on at least one column.
	Competitor A set	14 / 14	0 / 1	
	Competitor B set	35 / 36	1 / 2	
508.1 (Chlorinated pesticides, herbicides, organohalides)	Rtx-CLPesticides / Rtx-CLPesticides2	23.5 / 24	2 / 2	• Good balance of speed and resolution.
	Competitor A set	21 / 23	0 / 3	
	Competitor B set	18 / 17	2 / 4	
552.2 (Haloacetic acids, dalapon)	Rtx-CLPesticides / Rtx-CLPesticides2	12 / 12	0 / 0	• No coelutions—get accurate results for compounds that coelute on other columns.
	Competitor A set	8 / 9	1 / 1	
	Competitor B set	NDP / 10	NDP / 1	

Comparison based on published competitor data. All columns tested were 0.32 mm ID. NDP = no data published

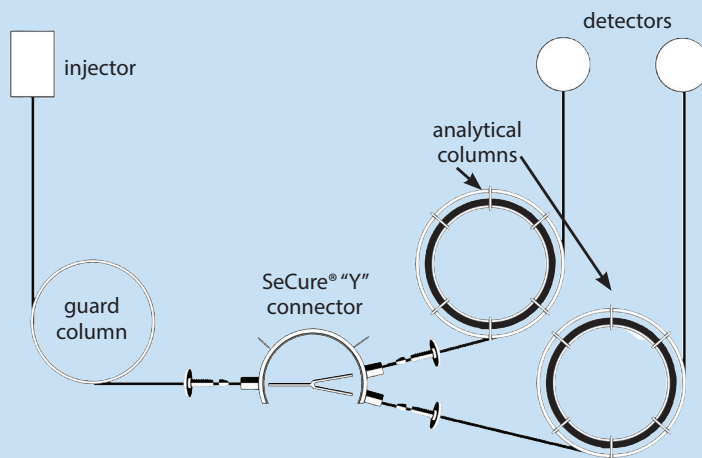
NOTE: Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

Achieve Optimal Results with Our Parallel Dual-Column Setup

Rtx®-CLPesticides and Rtx®-CLPesticides2 columns are designed for organochlorine pesticide analysis using a parallel dual-column setup that provides both fast analyses and reduced downtime. The stationary phase film thicknesses and optimized run conditions allow rapid analysis without sacrificing column capacity, meaning faster sample throughput for your laboratory. Parallel dual-column analysis saves time because data for primary and confirmation analyses are obtained from a single injection. In addition, injection port maintenance is reduced because only one injector is used. Once the sample passes through a single guard column, it is split on to two analytical columns, which are attached using a “Y” connector (Figure 1). Parallel dual-column analysis using Rtx®-CLPesticides and Rtx®-CLPesticides2 columns offers many advantages including:

- **Method-compliant results in half the time**
Parallel dual-column analysis provides simultaneous acquisition of primary and confirmation data using columns with different selectivities.
- **Reduced contamination**
Guard column traps nonvolatile residue, protecting the analytical columns.
- **Consistent performance**
Resolution and relative retention times are unaffected by maintenance because the guard column can be trimmed instead of the analytical columns.
- **Enhanced reproducibility**
Using a single inlet and “Y” connector results in consistent vaporization and on-column amounts.

Figure 1: Perform parallel dual-column analysis using a single injector and guard column with split flow onto two analytical columns.



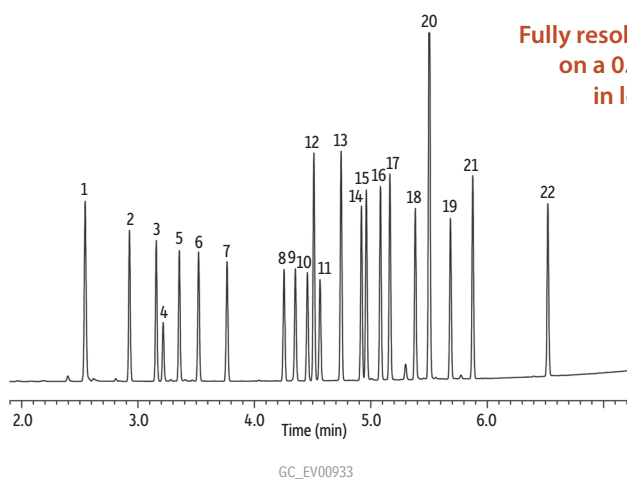
In addition to organochlorine pesticide analysis, parallel dual-column analysis using the Rtx®-CLPesticides and Rtx®-CLPesticides2 columns is an effective approach for several other environmental ECD methods. As detailed on the following pages, this column pair provides excellent results for analysis time and resolution of critical compounds for seven EPA methods: 8081B (organochlorine pesticides); 8082A (PCBs/Aroclors); 8151A (chlorinated herbicides); 504.1 (EDB, DBCP, and TCP); 505 (organohalide pesticides); 508.1 (chlorinated pesticides, herbicides, and organohalides); and 552.2 (haloacetic acids and dalapon).

EPA Method 8081B: Organochlorine Pesticide Analysis

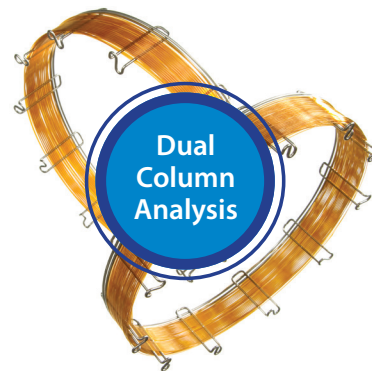
Organochlorine pesticides emerged in the 1940s, but are no longer used today due to their persistence in the environment. However, they still are monitored in water, soil, and other samples. EPA Method 8081B is widely used for organochlorine pesticide analysis in a variety of difficult sample matrices. The selectivity of the Rtx®-CLPesticides column set was originally tuned for Method 8081 and Method 8081B, which provide an excellent example of the performance of the column pair (Figure 2). All compounds are fully resolved in just seven minutes using standard 0.32 mm columns and an Agilent® micro-ECD for analysis. (Analysis times reflect simultaneous parallel dual-column analysis.) Fast analysis times translate into high sample throughput, which is an important consideration for environmental labs. In addition, several elution order changes are observed, filling the confirmational requirements of the method.

Figure 2: Cut analysis time in half for organochlorine pesticide analysis (Method 8081B) using Rtx®-CLPesticides columns and a micro-ECD.

Rtx®-CLPesticides



Fully resolve target compounds
on a 0.32 mm ID column
in less than 7 min.

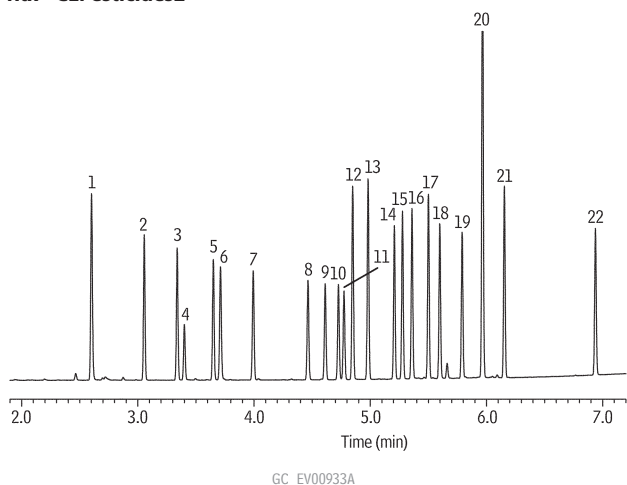


Peaks

1. 2,4,5,6-Tetrachloro-*m*-xylene (SS)
2. α -BHC
3. γ -BHC
4. β -BHC
5. δ -BHC
6. Heptachlor
7. Aldrin
8. Heptachlor epoxide (isomer B)
9. *trans*-Chlordane*
10. *cis*-Chlordane*
11. Endosulfan I
12. 4,4'-DDE
13. Dieldrin
14. Endrin
15. 4,4'-DDD
16. Endosulfan II
17. 4,4'-DDT
18. Endrin aldehyde
19. Endosulfan sulfate
20. Methoxychlor
21. Endrin ketone
22. Decachlorobiphenyl (SS)

* For information regarding the nomenclature used for *cis*-chlordane and *trans*-chlordane, visit www.restek.com/chlordane-notice

Rtx®-CLPesticides2



Columns: Rtx®-CLPesticides 30 m, 0.32 mm ID, 0.32 μ m (cat.# 11141) and Rtx®-CLPesticides2 30 m, 0.32 mm ID, 0.25 μ m (cat.# 11324) using Rxi® guard column 5 m, 0.32 mm ID (cat.# 10039) with deactivated universal "Y" Press-Tight® connector (cat.# 20405-261); **Sample:** Organochlorine pesticide mix AB #2 (cat.# 32292) Pesticide surrogate mix, EPA 8080, 8081 (cat.# 32000); **Injection:** Inj. Vol.: 1 μ L splitless (hold 0.3 min), Liner: Splitless taper (4 mm) (cat.# 20799), Inj. Temp.: 250 °C, **Oven:** Oven Temp.: 120 °C to 200 °C at 45 °C/min to 230 °C at 15 °C/min to 330 °C at 30 °C/min (hold 2 min); **Carrier Gas:** He, **Detector:** Micro-ECD @ 330 °C;

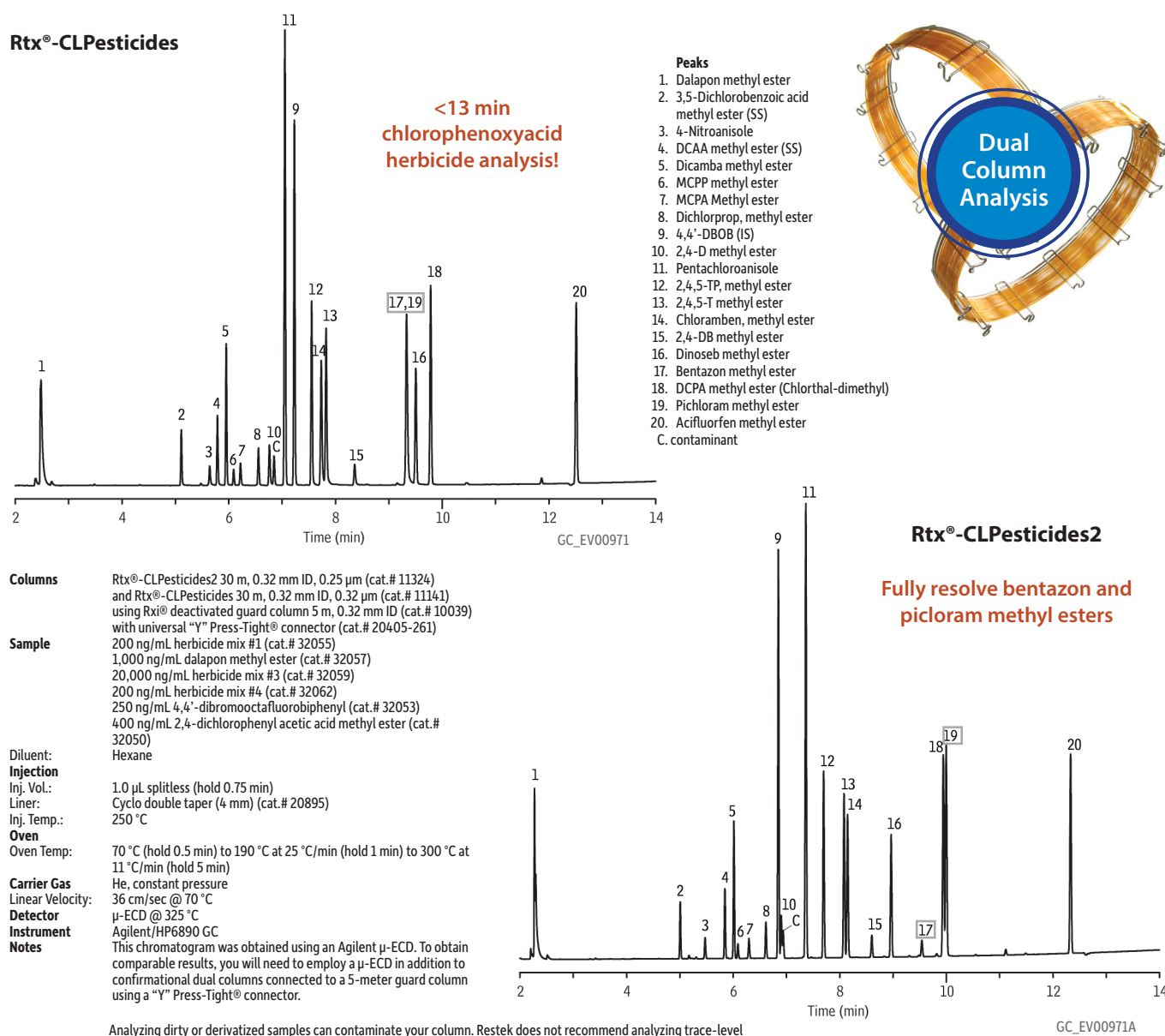
Notes: Instrument was operated in constant flow mode. Linear velocity: 60 cm/sec @ 120 °C. This chromatogram was obtained using an Agilent® micro-ECD. To obtain comparable results, you will need to employ a micro-ECD in addition to dual columns connected to a 5-meter guard column using a "Y" Press-Tight® connector.

EPA Method 8151A: Chlorinated Herbicide Analysis

Today, many modern herbicides are designed to selectively kill specific types of vegetation. Even though these herbicides are not environmentally persistent and degrade in less than one year, EPA Method 8151A was developed for chlorinated herbicide analysis in wastewater and soil matrices. The most commonly used compounds targeted in this method are the chlorophenoxy herbicides. Of these herbicides, (2,4-dichlorophenoxy)acetic acid, also known as 2,4-D, is the most widely used and widely monitored herbicide worldwide.

According to Method 8151A, samples containing the target herbicides are analyzed using a parallel dual-column confirmation setup and an ECD, the recommended method of detection. Because of this, many laboratories acquire chlorinated herbicides on the same instrument setup used for chlorinated pesticide and PCB analyses. The Rtx®-CLPesticides and Rtx®-CLPesticides2 column pair also perform exceptionally well for chlorinated herbicide analysis; in fact, all 17 target compounds in EPA Method 8151A can be determined in just 13 minutes using these columns. One pair of compounds (bentazon and picloram methyl esters) coelutes on the Rtx®-CLPesticides column, but these compounds are fully resolved on the Rtx®-CLPesticides2 column. And, due to the difference in selectivity of the columns, several elution order changes occur filling the confirmational requirement of the method (Figure 3).

Figure 3: Excellent resolution of chlorinated herbicides on the Rtx®-CLPesticides/Rtx®-CLPesticides2 column pair.



Columns Rtx®-CLPesticides2 30 m, 0.32 mm ID, 0.25 µm (cat.# 11324) and Rtx®-CLPesticides 30 m, 0.32 mm ID, 0.32 µm (cat.# 11141) using Rxi® deactivated guard column 5 m, 0.32 mm ID (cat.# 10039) with universal "Y" Press-Tight® connector (cat.# 20405-261)

Sample 200 ng/mL herbicide mix #1 (cat.# 32055)
1,000 ng/mL dalapon methyl ester (cat.# 32057)
20,000 ng/mL herbicide mix #3 (cat.# 32059)
200 ng/mL herbicide mix #4 (cat.# 32062)
250 ng/mL 4,4'-dibromooctafluorobiphenyl (cat.# 32053)
400 ng/mL 2,4-dichlorophenyl acetic acid methyl ester (cat.# 32050)

Diluent: Hexane

Injection
Inj. Vol.: 1.0 µL splitless (hold 0.75 min)
Liner: Cyclo double taper (4 mm) (cat.# 20895)
Inj. Temp.: 250 °C

Oven
Oven Temp: 70 °C (hold 0.5 min) to 190 °C at 25 °C/min (hold 1 min) to 300 °C at 11 °C/min (hold 5 min)

Carrier Gas He, constant pressure
Linear Velocity: 36 cm/sec @ 70 °C

Detector µ-ECD @ 325 °C

Instrument Notes Agilent/HP6890 GC
This chromatogram was obtained using an Agilent µ-ECD. To obtain comparable results, you will need to employ a µ-ECD in addition to confirmational dual columns connected to a 5-meter guard column using a "Y" Press-Tight® connector.

Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

EPA Method 8082A: PCB Analysis

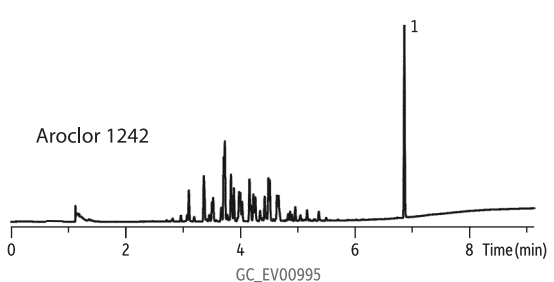
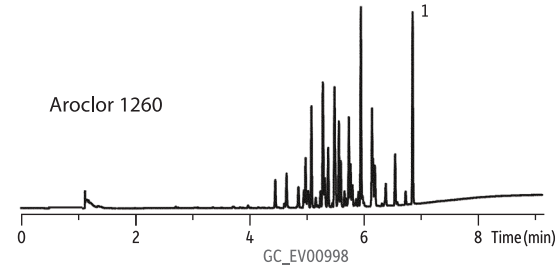
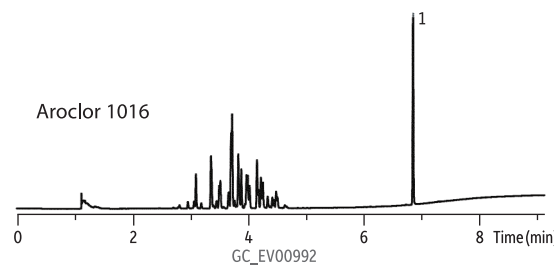
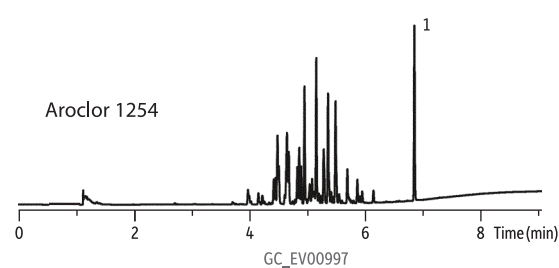
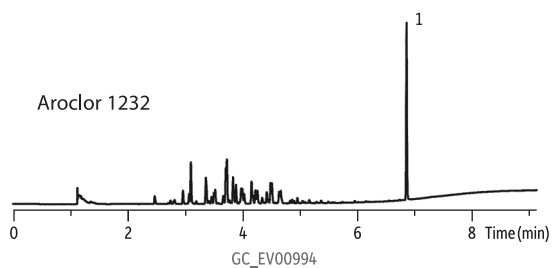
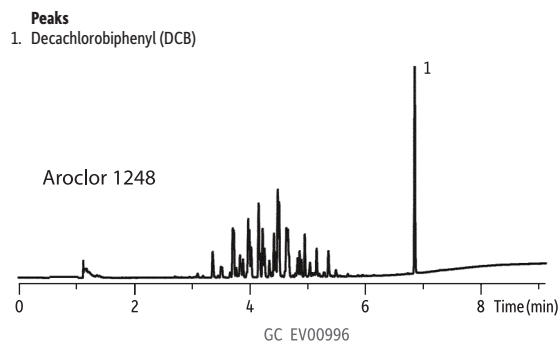
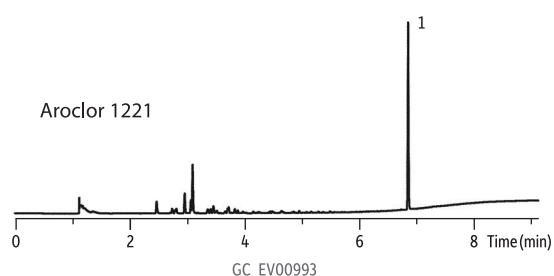
Polychlorinated biphenyls (PCBs) are a group of industrial organochlorine chemicals that were used extensively as coolant fluids in transformers and capacitors. Later they were used as plasticizers, de-inking solvents, heat transfer fluids in machinery, and also as waterproofing agents, among other uses. PCBs are chemically inert liquids that are difficult to burn. Because they are very persistent in the environment, bioaccumulate in living systems, and some are toxic (i.e., coplanar PCBs), they are a major environmental concern.

EPA Method 8082A details how Aroclor mixtures and PCB congeners are to be analyzed in a parallel dual-column confirmation setup. When choosing columns, it is important to select stationary phases that have low bleed and high thermal stability. This allows the columns to be held at high temperature at the end of each analysis to prevent carryover from one injection to the next. Because many instruments used for PCB analysis also may be used for pesticide and herbicide analyses, the column pair of choice is the Rtx®-CLPesticides and Rtx®-CLPesticides2 columns. This column set provides low bleed, high thermal stability, and is designed for primary column analysis and secondary column confirmation.

Figure 4: Aroclor analysis on the Rtx®CLPesticides column.

Rtx®-CLPesticides

30 m, 0.32 mm ID, 0.32 µm (cat.# 11141)



Peaks
1. Decachlorobiphenyl (DCB)

Column Rtx®-CLPesticides, 30 m, 0.32 mm ID, 0.32 µm (cat.# 11141)
Sample PCB kit #1 diluted to 1,000 ppb in hexane (cat.# 32089)
 Decachlorobiphenyl (BZ #209) diluted to 100 ppb in acetone (cat.# 32029)
Injection
 Inj. Vol.: 1.0 µL pulsed splitless (hold 0.3 min)
 Liner: Cyclo double taper (4 mm) (cat.# 20895)
 Inj. Temp.: 250 °C
 Pulse Pressure: 30 psi (206.8 kPa)
Oven
 Oven Temp: 120 °C to 200 °C at 45 °C/min to 230 °C at 15 °C/min to 330 °C at 30 °C/min (hold 2 min)
Carrier Gas
 He, constant flow
 Linear Velocity: 60 cm/sec
Detector
 Micro-ECD @ 330 °C
Notes
 This chromatogram was obtained using an Agilent® micro-ECD. To obtain comparable results, you will need to employ a micro-ECD in addition to confirmational dual columns connected to a 5-meter guard column using a "Y" Press-Tight® connector.

For Aroclor mixture analysis under EPA 8082A, individual Aroclor mixes are required to be analyzed as standards, then the sample extract chromatograms are compared to the standards to qualitatively identify the Aroclor mixtures. Once identification has been made, quantification can be performed by selecting five of the largest peaks, treating them as individual compounds, and then reporting the average concentration. Figures 4 and 5 show the individual Aroclor mixes and the differences among them.

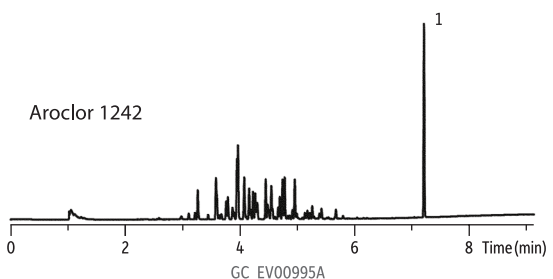
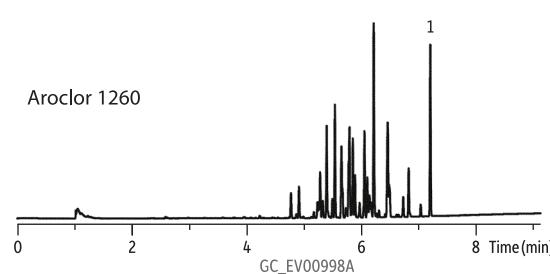
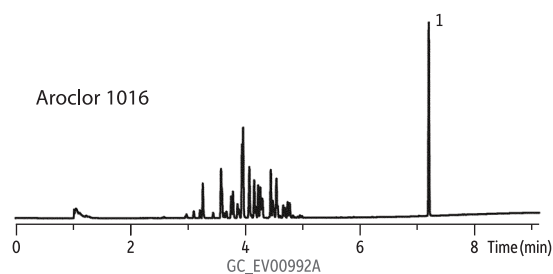
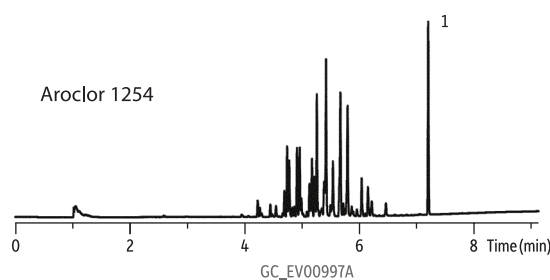
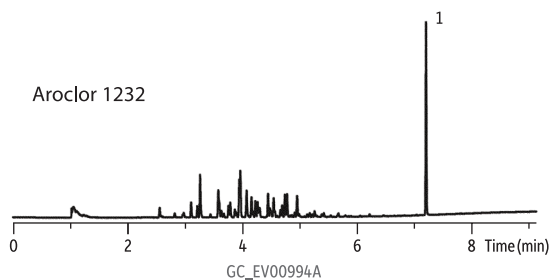
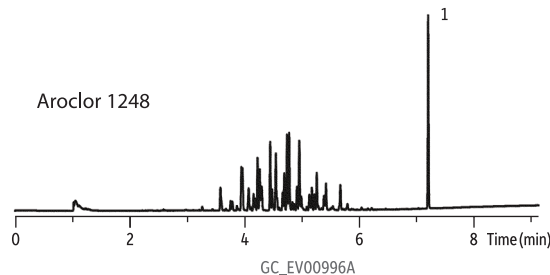
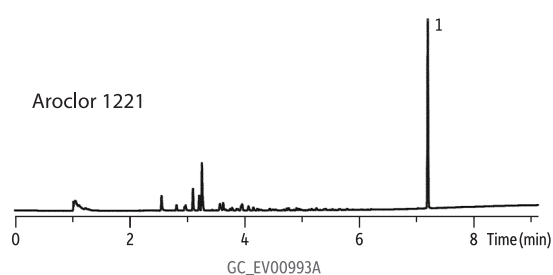
When analyzing for PCB congeners using Method 8082A, each peak is to be treated as an individual component and a standard curve is made for each of the congeners of interest. Note that while many laboratories are interested in the analysis of PCBs by congener, most do not need, or desire, to analyze all 209.

Figure 5: Aroclor analysis on the Rtx[®]CLPesticides2 column.

Rtx[®]-CLPesticides2

30 m, 0.32 mm ID, 0.25 μm (cat.# 11324)

Peaks
1. Decachlorobiphenyl (DCB)



Column Rtx[®]-CLPesticides2, 30 m, 0.32 mm ID, 0.25 μm (cat.# 11324)
Sample PCB kit #1 diluted to 1,000 ppb in hexane (cat.# 32089)
 Decachlorobiphenyl (BZ #209) diluted to 100 ppb in acetone (cat.# 32029)
Injection
 Inj. Vol.: 1.0 μL pulsed splitless (hold 0.3 min)
 Liner: Cyclo double taper (4 mm) (cat.# 20895)
 Inj. Temp.: 250 °C
 Pulse Pressure: 30 psi (206.8 kPa)
Oven
 Oven Temp: 120 °C to 200 °C at 45 °C/min to 230 °C at 15 °C/min to 330 °C at 30 °C/min (hold 2 min)
Carrier Gas He, constant flow
 Linear Velocity: 60 cm/sec
Detector Micro-ECD @ 330 °C
Notes This chromatogram was obtained using an Agilent[®] micro-ECD. To obtain comparable results, you will need to employ a micro-ECD in addition to confirmational dual columns connected to a 5-meter guard column using a "Y" Press-Tight[®] connector.

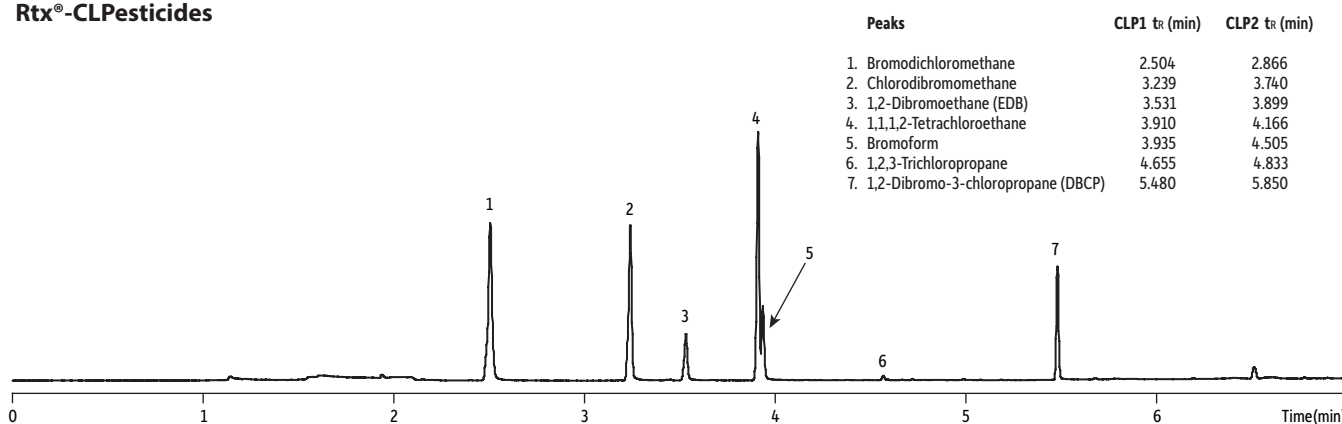
EPA Method 504.1: EDB, DBCP, TCP Analysis

EPA Method 504.1 is a common test performed by environmental laboratories for the analysis of 1,2-dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP), and 1,2,3-trichloropropane (TCP) in drinking water. This method uses parallel dual-column gas chromatography with electron capture detection (GC-ECD), the same instrument setup that is used for the analysis of chlorinated pesticides and herbicides. Thus, when selecting a set of capillary columns for EDB, DBCP, TCP analysis, it is advantageous that they work well for a number of different methods.

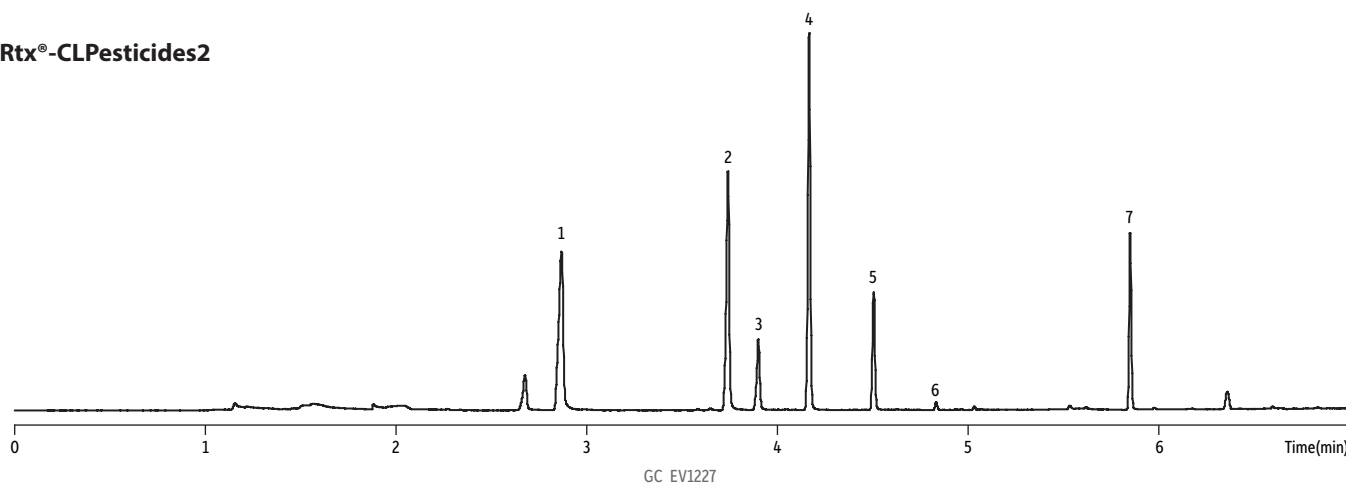
The Rtx[®]-CLPesticides and the Rtx[®]-CLPesticides2 columns provide excellent separation for the compounds listed in Method 504.1, as well as for analytes in several other drinking water methods. Figure 6 shows the analysis of the Method 504.1 target compounds on these columns connected in parallel using a glass "Y" Press-Tight[®] connector. This configuration is important to ensure that both the primary and confirmation column analyses are performed simultaneously under the same conditions and using the same injection port. Method 504.1 requires that EDB, DBCP, and TCP be fully resolved from the common interference compounds (e.g., chloroform, bromodichloromethane, chlorodibromomethane, 1,1,1,2-tetrachloroethane, and bromoform). The Rtx[®]-CLPesticides2 columns fully resolved these compounds. Note that the coelution of 1,1,1,2-tetrachloroethane and bromoform is between two interference compounds; it does not affect the identification or quantification of EDB, DBCP, or TCP.

Figure 6: EDB, DBCP, and TCP analysis on Rtx[®]-CLPesticides and Rtx[®]-CLPesticides2 columns according to EPA Method 504.1

Rtx[®]-CLPesticides



Rtx[®]-CLPesticides2



Columns: Rtx[®]-CLPesticides2 30 m, 0.32 mm ID, 0.25 μm (cat.# 11324) and Rtx[®]-CLPesticides 30 m, 0.32 mm ID, 0.32 μm (cat.# 11141) using Rxi[®] guard column 5 m, 0.32 mm ID (cat.# 10039 with universal "Y" Press-Tight[®] connector (cat.# 20405); **Sample:** Dibromochloromethane (chlorodibromochloromethane) (cat.# 30271) Bromodichloromethane (cat.# 30251); 504.1 calibration mix (cat.#30239); 1,1,1,2-tetrachloroethane (cat.# 30411); Bromoform (cat.# 30252); Diluent: n-Hexane; Conc.: 10 ng/mL; **Injection:** Inj. Vol.: 2 μL splitless (hold 0.50 min.); **Liner:** Restek Premium 4 mm single taper inlet liner w/wool (cat.# 23303.1); Inj. Temp.: 200 °C; Purge Flow: 50 mL/min; **Oven:** Oven Temp: 30 °C (hold 2.0 min) to 220 °C at 30 °C/min; **Carrier Gas:** He, constant flow; Linear Velocity: 60 cm/sec; **Detector:** Micro-ECD @ 220 °C; Make-up Gas Flow Rate: 50 mL/min; Make-up Gas Type: He; Data Rate: 50 Hz; **Instrument:** Agilent/HP6890 GC; **Notes:** This chromatogram was obtained using an Agilent[®] micro-ECD. To obtain comparable results, you will need to employ a micro-ECD in addition to confirmational dual-columns connected to a 5-meter guard column using a "Y" Press-Tight[®] connector.

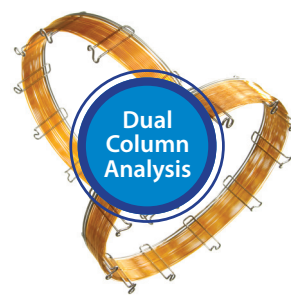
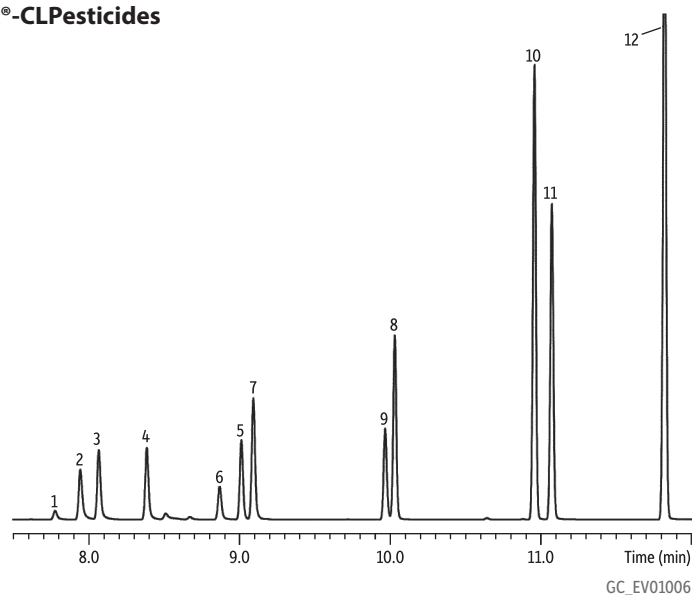
EPA Method 504.1: EDB, DBCP, TCP Analysis

Haloacetic acids are a byproduct of chlorinated disinfection of drinking water. Historically, there has been some concern that these analytes may represent a chronic risk to human health, and toxicological evidence suggests that some of them are possible human carcinogens. Elevated levels of haloacetic acids in drinking water could pose acute human risk because of their corrosive nature. Using Method 552.2 and an appropriate GC column set, such as the Rtx®-CLPesticides and the Rtx®-CLPesticides2 columns, environmental chemists can achieve accurate analysis of haloacetic acids and dalapon.

Haloacetic acid analysis can be performed on a variety of GC column phases. However, an important criterion for column selection is the degree of resolution between the methylated haloacetic acid compounds and known interference compounds like bromoform. Bromoform may be present due to the partial decarboxylation of tribromoacetic acid that can occur during a methylation step that uses acidic methanol. As shown in Figure 7, the Rtx®-CLPesticides and Rtx®-CLPesticides2 columns provide the necessary resolution for this GC-ECD analysis in less than 12 minutes, using the same instrument setup as several other EPA methods.

Figure 7: Dalapon and haloacetic acid analysis by Method 552.2 on an Rtx®-CLPesticides column set.

Rtx®-CLPesticides



Peaks	Conc. (µg/mL)
1. Methyl monochloroacetate	1.2
2. Methyl monobromoacetate	0.8
3. Methyl dichloroacetate	1.2
4. Dalapon methyl ester	2
5. Methyl trichloroacetate	0.4
6. 1,2,3-Trichloropropane (IS)	4
7. Methyl bromo(chloro)acetate	0.8
8. Methyl bromodichloroacetate	0.8
9. Methyl dibromoacetate	0.4
10. Methyl chlorodibromoacetate	2
11. Methyl 2,3-dibromopropionate (SS)	2
12. Methyl tribromoacetate	4

Rtx®-CLPesticides2

Columns Rtx®-CLPesticides2 30 m, 0.32 mm ID, 0.25 µm (cat.# 11324) and Rtx®-CLPesticides 30 m, 0.32 mm ID, 0.32 µm (cat.# 11141) using Rxi® guard column 5 m, 0.32 mm ID (cat.# 10039) with deactivated universal "Y" Press-Tight® connector (cat.# 20405-261)

Sample Haloacetic acid methyl ester mix #2 (cat.# 31647)
Dalapon methyl ester (cat.# 32057)
Methyl-2,3-dibromopropionate (cat.# 31656)
1,2,3-Trichloropropane (cat.# 31648)
Methyl *tert*-butyl ether (MTBE)

Diluent:

Injection

Inj. Vol.: 1.0 µL splitless (hold 0.75 min)

Liner: Cyclo double taper (4 mm) (cat.# 20896)

Inj. Temp.: 250 °C

Oven

Oven Temp.: 35 °C (hold 4 min) to 250 °C at 15 °C/min (hold 5 min)

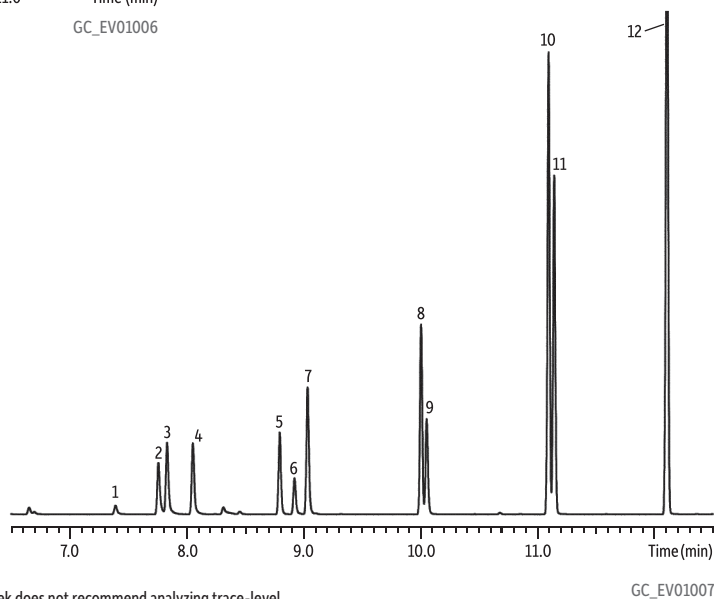
Carrier Gas He, constant flow

Linear Velocity: 25 cm/sec

Detector Micro-ECD @ 300 °C

Notes

This chromatogram was obtained using an Agilent® micro-ECD. To obtain comparable results, you will need to employ a micro-ECD in addition to confirmational dual columns connected to a 5-meter guard column using a "Y" Press-Tight® connector.



Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

EPA Method 505: Organohalide Pesticide Analysis and EPA Method 508.1: Chlorinated Pesticide, Chlorinated Herbicide, and Organohalide Analysis

With the advent of modern agriculture and its vast selection of chemical pest control measures, the farming community has made significant increases in productivity and efficiency. Crop yield per acre is extremely high, due in part to the role of pesticides and herbicides in mitigating the devastating effects of many plant and insect pests. However, the use of these chemicals can have drawbacks, including surface and ground water contamination. EPA Methods 505 and 508.1 are used for chlorinated pesticide, chlorinated herbicide, and organohalide analysis in drinking and ground water. The Rtx®-CLPesticides and Rtx®-CLPesticides2 column set also works well for the analysis of compounds in these methods because the columns are highly selective for analytes that contain electronegative substituents. The optimized parallel dual-column method shown here satisfies method requirements in very fast analysis times, which improves sample throughput (Table II, Figures 8 and 9).

Table II: Rtx®-CLPesticides and Rtx®-CLPesticides2 columns easily pass Method 508.1 performance criteria.

Test/Requirement	Analyte	Concentration (ppb)	Rtx®-CLPesticides2	Rtx®-CLPesticides
Inertness (breakdown <20%)	endrin	50	0.9%	1.4%
Inertness (breakdown <20%)	4,4'-DDT	100	1.0%	1.1%
Sensitivity (S/N>3)	chlorpyrifos	2	12.0	6.2
Chromatographic performance (0.8<PGF<1.15)	DCPA	50	1.03	1.06
Column performance (resolution>0.50)	delta-BHC/ chlorothalonil	40/50	9.9	26.8

Figure 8: Organohalide pesticide analysis (Method 505) on Rtx®-CLPesticides and Rtx®-CLPesticides2 columns.

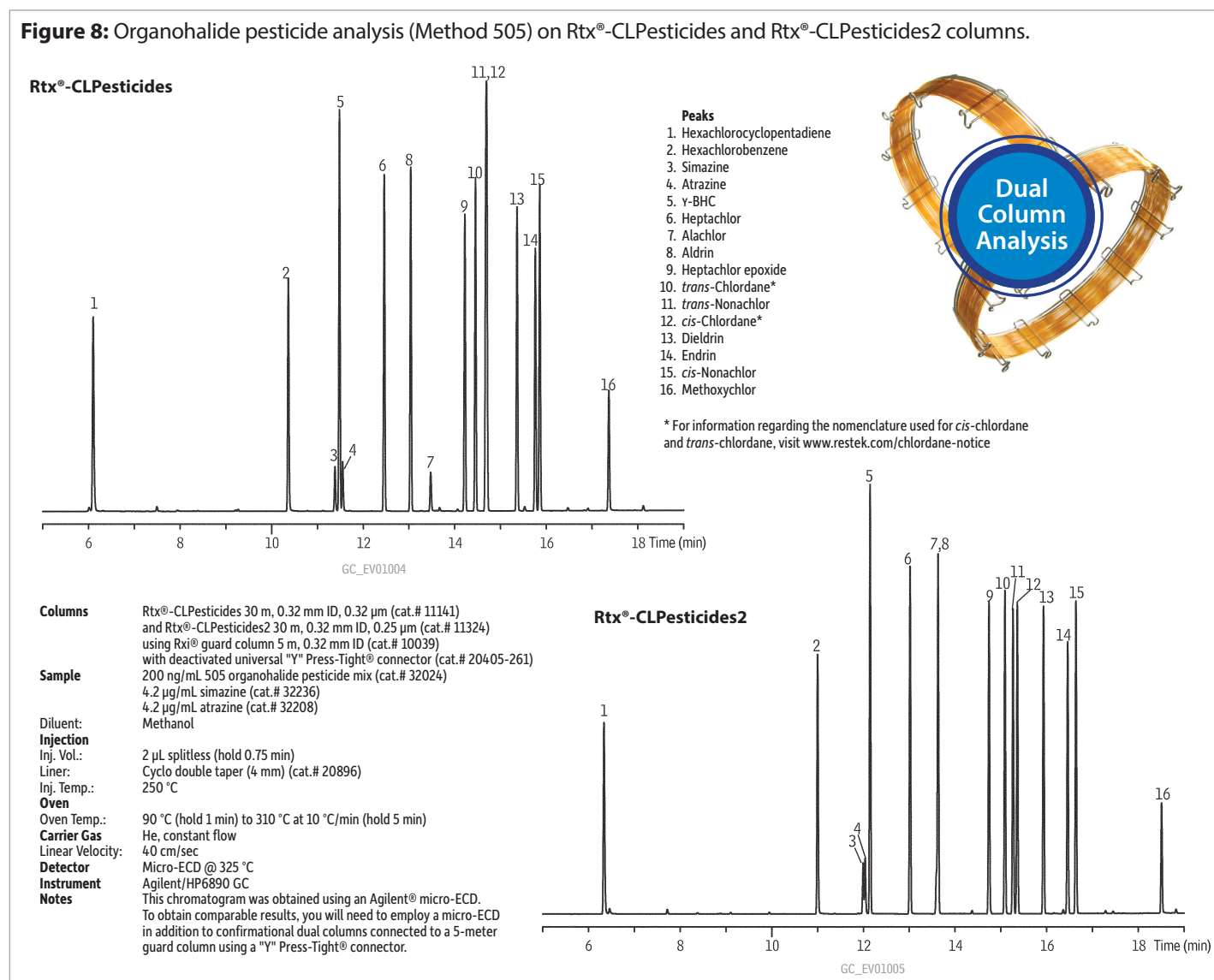
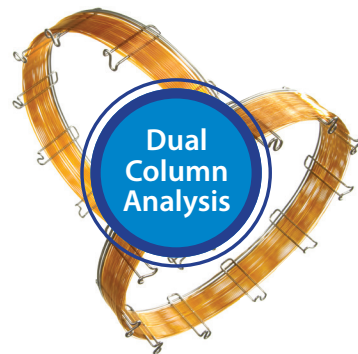
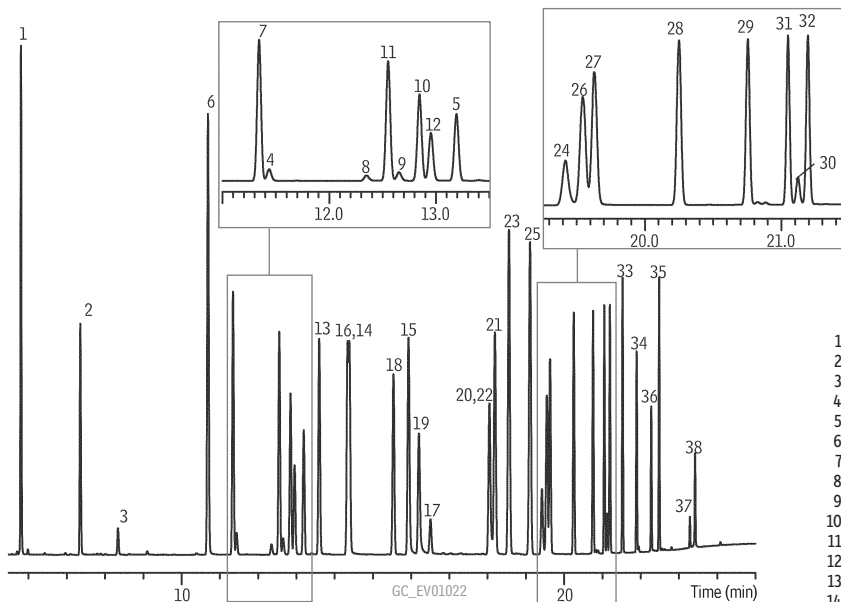


Figure 9: 24-minute analysis of Method 508.1 chlorinated pesticides, herbicides, and organohalides using Rtx®-CLPesticides columns and a micro-ECD.

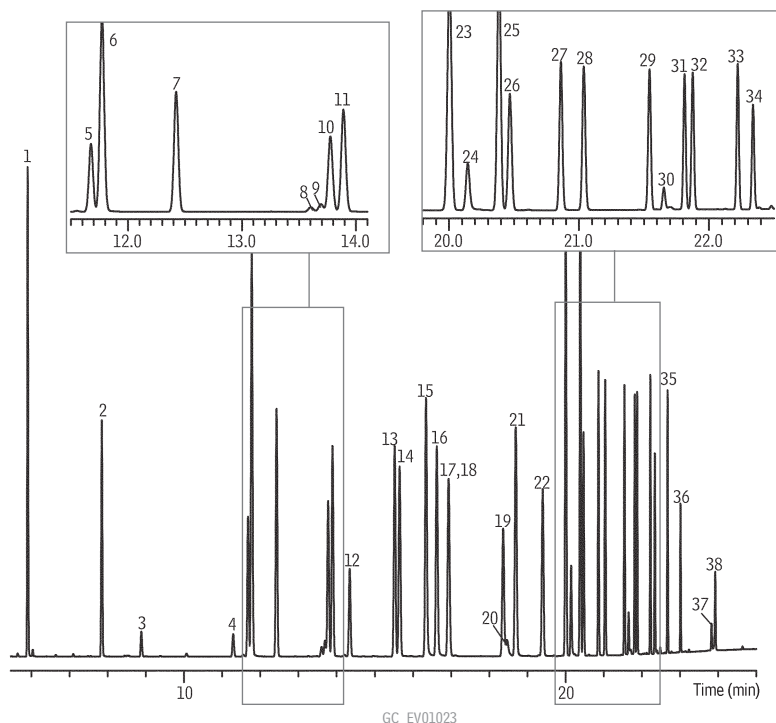
Rtx®-CLPesticides



- Peaks**
- | | |
|----------------------------------|------------------------------|
| 1. Hexachlorocyclopentadiene | 20. Metachlor |
| 2. Etridiazole | 21. DCPA |
| 3. Chlorneb | 22. Heptachlor epoxide |
| 4. Propachlor | 23. <i>trans</i> -Chlordane* |
| 5. Trifluralin | 24. Cyanazine |
| 6. Hexachlorobenzene | 25. <i>cis</i> -Chlordane* |
| 7. α -BHC | 26. Endosulfan I |
| 8. Simazine | 27. 4,4'-DDE |
| 9. Atrazine | 28. Dieldrin |
| 10. Pentachloronitrobenzene (IS) | 29. Endrin |
| 11. γ -BHC | 30. Chlorobenzilate |
| 12. β -BHC | 31. 4,4'-DDD |
| 13. δ -BHC | 32. Endosulfan II |
| 14. Heptachlor | 33. 4,4'-DDT |
| 15. Chlorothalonil | 34. Endrin aldehyde |
| 16. Metribuzin | 35. Endosulfan sulfate |
| 17. Alachlor | 36. Methoxychlor |
| 18. Aldrin | 37. <i>cis</i> -Permethrin |
| 19. 4,4'-Dibromobiphenyl (SS) | 38. <i>trans</i> -Permethrin |

* For information regarding the nomenclature used for *cis*-chlordane and *trans*-chlordane, visit www.restek.com/chlordane-notice

Rtx®-CLPesticides2



Columns Rtx®-CLPesticides2 30 m, 0.32 mm ID, 0.25 μ m (cat.# 11324) and Rtx®-CLPesticides 30 m, 0.32 mm ID, 0.32 μ m (cat.# 11141) using Rxi® guard column 5 m, 0.32 mm ID (cat.# 10039) with deactivated universal "Y" Press-Tight® connector (cat.# 20405-261)

Sample 50 ng/mL 508.1 calibration mix #1 (cat.# 32094)
100 ng/mL 508.1 calibration mix #2 (cat.# 32095)
100 ng/mL 508.1 calibration mix #3 (cat.# 32096)
50 ng/mL pentachloronitrobenzene (cat.# 32091)
250 ng/mL 4,4'-dibromobiphenyl (cat.# 32092)
500 ng/mL atrazine (cat.# 32208)
500 ng/mL simazine (cat.# 32236)
Ethyl acetate

Diluent:
Injection
Inj. Vol.: 2 μ L splitless (hold 0.75 min)
Liner: Cyclo double taper (4 mm) (cat.# 20896)
Inj. Temp.: 250 °C

Oven
Oven Temp.: 80 °C (hold 0.5 min) to 155 °C at 19 °C/min (hold 1 min) to 210 °C at 4 °C/min to 310 °C at 25 °C/min (hold 0.5 min)

Carrier Gas
Linear Velocity: 26 cm/sec
Detector
Micro-ECD @ 325 °C

Notes This chromatogram was obtained using an Agilent® micro-ECD. To obtain comparable results, you will need to employ a micro-ECD in addition to confirmational dual columns connected to a 5-meter guard column using a "Y" Press-Tight® connector.

Get Set for Parallel Dual-Column Analysis!

Analytical Columns

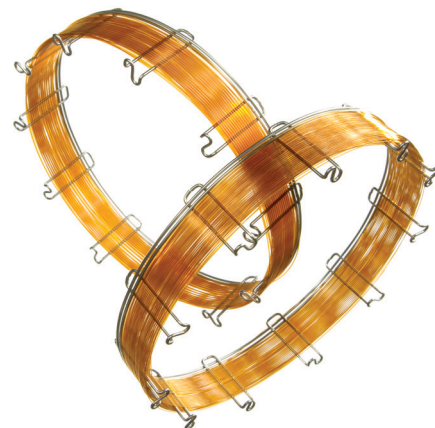
Improved resolution and faster analysis times, compared to 1701 or phenyl phases, make the Rtx®-CLPesticides/Rtx®-CLPesticides2 column pair ideal for analyzing chlorinated pesticides, PCBs as Aroclors, and chlorinated herbicides. These columns offer alternate selectivity, meeting method requirements for elution order changes and relative retention time shifts. Column bleed is low, allowing high boiling point contaminants to be heated off of the column, which extends column lifetime.

Rtx®-CLPesticides Columns (fused silica) (proprietary Crossbond® phases)

ID	df	temp. limits	15-Meter	20-Meter	30-Meter	60-Meter
0.18 mm	0.18 µm	-60 to 320/340 °C	—	42102	—	—
0.25 mm	0.25 µm	-60 to 320/340 °C	11120	—	11123	11126
0.32 mm	0.32 µm	-60 to 320/340 °C	—	—	11141	—
	0.50 µm	-60 to 320/340 °C	11136	—	11139	—
0.53 mm	0.50 µm	-60 to 300/320 °C	—	—	11140	—

Rtx®-CLPesticides2 Columns (fused silica) (proprietary Crossbond® phases)

ID	df	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.18 mm	0.14 µm	-60 to 320/330 °C	42301	—	42302	—	—
0.25 mm	0.20 µm	-60 to 320/340 °C	—	—	—	11323	11326
0.32 mm	0.25 µm	-60 to 320/340 °C	—	11321	—	11324	—
	0.50 µm	-60 to 320/340 °C	—	—	—	11325	—
0.53 mm	0.42 µm	-60 to 300/320 °C	—	11337	—	11340	—



Rtx®-CLPesticides Column Kit (0.32 mm ID)

(Note: Columns are not preconnected in this kit.)

Rtx-CLPesticides Kit (0.32 mm ID) cat.# 11196 (kit)



Includes (each product also available separately)	cat.#
30m, 0.32mm ID, 0.32µm Rtx-CLPesticides Column Column	11141
30m, 0.32mm ID, 0.25µm Rtx-CLPesticides2 Column Column	11324
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261
5m, 0.32 mm ID Siltek Guard Column	10027

Rtx®-CLPesticides Column Kit (0.53 mm ID)

(Note: Columns are not preconnected in this kit.)

Rtx-CLPesticides Kit (0.53 mm ID) cat.# 11197 (kit)



Includes (each product also available separately)	cat.#
30m, 0.53mm ID, 0.50µm Rtx-CLPesticides Column Column	11140
30m, 0.53mm ID, 0.42µm Rtx-CLPesticides2 Column Column	11340
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261
5m, 0.53mm ID IP Deactivated Guard Column	10045

Save Money, Buy a Kit!

Purchase one of these recommended combinations of guard and analytical columns and save money.

0.25 mm ID columns are also available at www.restek.com

Connectors

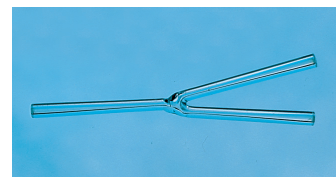
The best chromatography for parallel dual-column analysis is obtained using the universal “Y” Press-Tight® connector. The internal design of the taper allows the column to seal to the glass surface and minimizes dead volume. To strengthen this connection, Restek developed the SeCure® “Y” connector, which uses a C-clamp to hold the columns in place, assuring a reliable connection.

The MXT®-Union connectors are an alternative connector system that uses special ferrules designed to eliminate dead volume. The MXT®-Union is made of stainless steel and is deactivated with Siltek® treatment, making an inert sample pathway. The special ferrules used to make the connection are designed to eliminate the dead volume when installing the columns.

Universal “Y” Press-Tight® Connectors

An alternative method of performing dual-column confirmational analyses!

Description	ea.	3-pk.
Universal “Y” Press-Tight Connector, Deactivated	20405-261	20406-261



SeCure® “Y” Connector Kits

Kits include: SeCure® “Y” connector body, three knurled nuts, universal “Y” Press-Tight® union, and three ferrules.

Description	Ferrules Fit Column ID	qty.	cat.#
SeCure “Y” Connector Kit	0.18/0.25/0.28 mm	kit	20276
SeCure “Y” Connector Kit	0.32 mm	kit	20277
SeCure “Y” Connector Kit	0.45/0.53 mm	kit	20278
Knurled Nut		3-pk.	20279



The SeCure® “Y” connector’s open design allows visual confirmation of the seal.

Graphite Ferrules for SeCure® “Y” Connectors

Buy extra to keep spares on hand.

Ferrule ID	Fits Column ID	Graphite 10-pk.	Graphite 50-pk.
0.4 mm	0.10/0.15/0.18/0.25/0.28 mm	20200	20227
0.5 mm	0.32 mm	20201	20228
0.8 mm	0.45/0.53 mm	20202	20224



MXT® “Y”-Union Connector Kits for Connecting Metal and/or Fused Silica GC Columns

Each kit contains the MXT® union; three 1/32-inch nuts; and three, one-piece, fused silica adaptors.

Description	qty.	cat.#
For 0.25 mm ID Columns	kit	21389
For 0.32 mm ID Columns	kit	21388
For 0.53 mm ID Columns	kit	21387



Inlet Liners

The Rtx®-CLPesticides and Rtx®-CLPesticides2 column pair will work with both split or splitless injection techniques and any liner geometry. Various inlet liners are used for pesticide analysis; the four most common are the single taper, double taper, cyclo double taper, and the drilled Uniliner® inlet liner.

The drilled Uniliner® inlet liner provides the most inert sample pathway and eliminates injection port discrimination because the sample is funneled directly onto the column without contacting the metal injection port. Using a drilled Uniliner® inlet liner eliminates the need to replace the inlet seal at the bottom of the injection port, substantially reducing maintenance time and expense.

The tapered liners are also commonly used for pesticide analysis and work best with pressure pulsing conditions. The best tapered liner to use with pressure pulsing is the cyclo double taper. This liner has a screw-type sample pathway which collects nonvolatile material at the beginning of the screws and offers more surface area to vaporize the sample prior to reaching the entrance of the column.

Liners for Splitless Injection with Agilent GCs:

Restek Premium 4.0 mm ID Single Taper Inlet Liner



ID x OD x Length	qty.	cat.#
Single Taper, Restek Premium Technology, Borosilicate Glass		
4.0 mm x 6.5 mm x 78.5 mm	ea.	23302.1
4.0 mm x 6.5 mm x 78.5 mm	5-pk.	23302.5
4.0 mm x 6.5 mm x 78.5 mm	25-pk.	23302.25

Restek Premium 4.0 mm ID Single Taper Inlet Liner w/ Wool



ID x OD x Length	qty.	cat.#
Single Taper, Restek Premium Technology, Borosilicate Glass with Quartz Wool		
4.0 mm x 6.5 mm x 78.5 mm	ea.	23303.1
4.0 mm x 6.5 mm x 78.5 mm	5-pk.	23303.5
4.0 mm x 6.5 mm x 78.5 mm	25-pk.	23303.25

Restek Premium 4.0 mm ID Double Taper Inlet Liner



ID x OD x Length	qty.	cat.#
Double Taper, Restek Premium Technology, Borosilicate Glass		
4.0 mm x 6.5 mm x 78.5 mm	ea.	23308.1
4.0 mm x 6.5 mm x 78.5 mm	5-pk.	23308.5
4.0 mm x 6.5 mm x 78.5 mm	25-pk.	23308.25

Restek Premium 4.0 mm ID Cyclo Double Taper Inlet Liner



ID x OD x Length	qty.	cat.#
Cyclo Double Taper, Restek Premium Technology, Borosilicate Glass		
4.0 mm x 6.5 mm x 78.5 mm	ea.	23310.1
4.0 mm x 6.5 mm x 78.5 mm	5-pk.	23310.5
4.0 mm x 6.5 mm x 78.5 mm	25-pk.	23310.25

Restek Premium 4.0 mm ID Drilled Uniliner® Inlet Liner with Hole near Top



ID x OD x Length	qty.	cat.#
Drilled Uniliner (hole near top), Restek Premium Technology, Borosilicate Glass		
4.0 mm x 6.3 mm x 78.5 mm	ea.	23311.1
4.0 mm x 6.3 mm x 78.5 mm	5-pk.	23311.5
4.0 mm x 6.3 mm x 78.5 mm	25-pk.	23311.25

Liners for Split Injection with Agilent GCs

Restek Premium 4.0 mm ID Precision® Inlet Liner w/ Wool



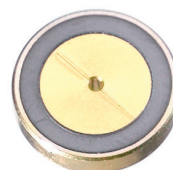
ID x OD x Length	qty.	cat.#
Precision, Restek Premium Technology, Borosilicate Glass with Quartz Wool		
4.0 mm x 6.3 mm x 78.5 mm	ea.	23305.1
4.0 mm x 6.3 mm x 78.5 mm	5-pk.	23305.5
4.0 mm x 6.3 mm x 78.5 mm	25-pk.	23305.25

Dual Vespel® Ring Inlet Seals

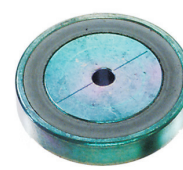
Washerless, Leak-Tight Seals for Agilent GCs

0.8 mm ID Dual Vespel Ring Inlet Seal	2-pk.	10-pk.	50-pk.
Gold-Plated	21240	21241	23418
Siltek-Treated	21242	21243	23419
1.2 mm ID Dual Vespel Ring Inlet Seal	2-pk.	10-pk.	—
Gold-Plated	21246	21247	—
Siltek-Treated	21248	21249	—

Patented.



21240



21248

Restek Recommended!

Sample Preparation

Resprep® SPE Cartridges (Normal Phase)

Hydrophilic (polar) adsorbents used to extract hydrophilic analytes from nonpolar matrices, such as organic solvents (e.g., polar contaminants from sample extracts).

	3 mL/500 mg (50-pk.)	6 mL/500 mg (30-pk.)	6 mL/1,000 mg (30-pk.)	15 mL/2 g (15-pk.)
Florisil (EPA SW 846 methods and CLP protocols)	24031 24032*	26086**	24034 26085**	26228
Silica (EPA SW 846 methods)	24035 24036*	—	24038	—

*PTFE frits **Glass tubes with PTFE frits

Resprep® CarboPrep® SPE Cartridges

SPE Cartridge	Tube Volume, Bed Weight	qty.	cat.#
CarboPrep 90	3 mL, 250 mg	50-pk.	26091
CarboPrep 90	6 mL, 500 mg	30-pk.	26092



All cartridges are manufactured using high-density polypropylene and have polyethylene frits unless otherwise noted.



Excellent for Pesticide Residue Cleanup!

Reference Standards

Organochlorine Pesticide Mix AB #1

(20 components)

aldrin	dieldrin
α-BHC	endosulfan I
β-BHC	endosulfan II
δ-BHC	endosulfan sulfate
γ-BHC (lindane)	endrin
cis-chlordane	endrin aldehyde
trans-chlordane	endrin ketone
4,4'-DDD	heptachlor
4,4'-DDE	heptachlor epoxide (isomer B)
4,4'-DDT	methoxychlor

200 µg/mL each in hexane:toluene (1:1), 1 mL/ampul
cat.# 32291 (ea.)

Organochlorine Pesticide Mix AB #2

(20 components)

aldrin	8 µg/mL	dieldrin	16
α-BHC	8	endosulfan I	8
β-BHC	8	endosulfan II	16
δ-BHC	8	endosulfan sulfate	16
γ-BHC (lindane)	8	endrin	16
cis-chlordane	8	endrin aldehyde	16
trans-chlordane	8	endrin ketone	16
4,4'-DDD	16	heptachlor	8
4,4'-DDE	16	heptachlor epoxide (isomer B)	8
4,4'-DDT	16	methoxychlor	80

In hexane:toluene (1:1), 1 mL/ampul
cat.# 32292 (ea.)

Organochlorine Pesticide System

Evaluation Mix (2 components)

4,4'-DDT (50-29-3), 200 µg/mL
endrin (72-20-8), 100 µg/mL

In methyl *tert*-butyl ether, 1 mL/ampul
cat.# 32417 (ea.)

Pesticide Surrogate Mix (2 components)

Decachlorobiphenyl (2051-24-3)
2,4,5,6-Tetrachloro-*m*-xylene (877-09-8)

200 µg/mL each in acetone, 1 mL/ampul
cat.# 32000 (ea.)

200 µg/mL each in acetone, 5 mL/ampul
cat.# 32457 (ea.)

Organochlorine Pesticide Resolution Check Mix (with surrogates) (22 components)

aldrin	0 µg/mL	endosulfan I	10
α-BHC	10	endosulfan II	20
β-BHC	10	endosulfan sulfate	20
δ-BHC	10	endrin	20
γ-BHC (lindane)	10	endrin aldehyde	20
cis-chlordane	10	endrin ketone	20
trans-chlordane	10	heptachlor	10
decachlorobiphenyl	20	heptachlor epoxide (isomer B)	10
dieldrin	20	methoxychlor	100
4,4'-DDD	20	2,4,5,6-Tetrachloro- <i>m</i> -xylene (SS)	10
4,4'-DDE	20		
4,4'-DDT	20		

In hexane:toluene (90:10), 1 mL/ampul
cat.# 32454 (ea.)

Aroclor Solutions

Volume is 1 mL/ampul. Concentration is µg/mL unless otherwise noted.

Compound	CAS #	Solvent	Conc.	cat.#
Aroclor 1016	12674-11-2	H	1,000	32006
Aroclor 1221	11104-28-2	H	1,000	32007
Aroclor 1232	11141-16-5	H	1,000	32008
Aroclor 1242	53469-21-9	H	1,000	32009
Aroclor 1248	12672-29-6	H	1,000	32010
Aroclor 1254	11097-69-1	H	1,000	32011
Aroclor 1260	11096-82-5	H	1,000	32012
Aroclor 1262	37324-23-5	H	1,000	32409
Aroclor 1268	11100-14-4	H	1,000	32410

H = hexane



Restek Offers a Full Line of Certified Reference Materials

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Dynamic Duo (Restek® Leak Detector and ProFLOW 6000 Flowmeter)

Protect your instrument and improve data quality with this powerful pair from Restek. Checking for leaks and verifying flows before you start helps you avoid costly problems later.

Description	qty.	cat.#
Dynamic Duo Combo Pack (Restek Leak Detector and ProFLOW 6000 Flowmeter)	kit	22654
Related Products and Accessories		
Leak Detector With Hard-Sided Carrying Case and Universal Charger Set (U.S., UK, European, Australian)	ea.	22655
Small Probe Adaptor for Leak Detector	ea.	22658
Restek ProFLOW 6000 Electronic Flowmeter With Hard-Sided Carrying Case	ea.	22656
Soft-Sided Storage Case for Leak Detector or ProFLOW 6000 Flowmeter	ea.	22657

Restek's New Leak Detector

Redesigned and better than ever, our new leak detector is an essential tool for troubleshooting and routine maintenance of your gas chromatograph. Don't risk damaging your system or losing sensitivity; check for leaks often and protect your GC column and instrument with a Restek® leak detector!



Leak Detector Specifications

Detectable Gases: Helium, nitrogen, argon, carbon dioxide, hydrogen
 Battery: Rechargeable lithium ion internal battery pack (12 hours normal operation)
 Operating Temperature Range: 32–120 °F (0–48 °C)
 Humidity Range: -97%
 Warranty: One year
 Certifications: CE, Ex, Japan
 Compliance: WEEE, RoHS

Limits of Detection

These gases can be detected with the Restek® electronic leak detector at the following leak rates:
 Minimum Detectable Gas Limits and Indicating LED Color:
 Helium, 1.0×10^{-5} , red LED
 Hydrogen*, 1.0×10^{-5} , red LED
 Nitrogen, 1.4×10^{-3} , yellow LED
 Argon, 1.0×10^{-4} , yellow LED
 Carbon dioxide, 1.0×10^{-4} , yellow LED
 Gas detection limits measured in atm cc/sec.

*Caution: The Restek® electronic leak detector is designed to detect trace amounts of hydrogen in a noncombustible environment. It is NOT designed for determining leaks in a combustible environment. A combustible gas detector should be used for determining combustible gas leaks under any condition. When using it to detect hydrogen, the Restek® electronic leak detector may only be used for determining trace amounts in a GC environment.

ProFLOW 6000 Flowmeter

With its wide range of capabilities, the ProFLOW 6000 flowmeter simplifies gas flow measurement in the lab. Real-time measurements can be made for various types of flow paths, including continually changing gas types.



Flowmeter Specifications:

Type of Flowmeter: Volumetric
 Battery: 2-AA
 Operating Temp. Range: 32–120 °F (0–48 °C)
 Warranty: One year
 Certifications: CE, Ex
 Compliance: WEEE, RoHS
 Patented

Optional Accessories



22657

Soft-Side Carry/Storage Case

Ideal for storing your leak detector or flowmeter in smaller spaces such as a tool box.



22658

Small Probe Adaptor for Leak Detector

Verify hard-to-reach leaks using the small probe adaptor.

Order today at www.restek.com

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RESTEK
 Pure Chromatography

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