



## Optimize Critical Separations in the Simultaneous Analysis of PCBs and PAHs

Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) are two critical classes of environmental contaminants that pose significant risks to human health and the environment. Europe has established comprehensive regulatory frameworks and monitoring programs to address these pollutants. Continued vigilance and research are essential to mitigate their impacts and protect public health and the environment. Please see references at the end of the article for information on the specific regulations.

Excellent resolution and selectivity for closely eluting compounds is essential for environmental analysis where complex mixtures require high-resolution separations to identify and quantify individual contaminants accurately. The Rxi-XLB, Rtx-440 and the Rxi-SVOCms GC columns were evaluated for optimal separation of select PAHs and PCBs in one method. This evaluation was done using a 30 m x 0.25 mm ID x 0.25  $\mu$ m column format. Standards were prepared at a concentration of 5  $\mu$ g/mL.

For this evaluation, the three columns produced varying results. The Rxi-SVOCms and Rtx-440 GC columns produced good resolution for the PAHs, but they did not separate the PCBs as well as the Rxi-XLB GC column (See Table 1; poor or no separation of PCB 28/31 on the Rxi-SVOCms and Rtx-440 GC columns). The Rxi-XLB GC column produced the best overall resolution for critical pair separations. Notably, excellent separation was achieved for PCB 31 and PCB 28 (peaks 8 & 9) and phenanthrene and anthracene (peaks 6 & 7) as shown in Figure 1. Other critical separations of interest include benzo[b]fluoranthene and benzo[k]fluoranthene (peaks 23 & 24) and indeno[1,2,3-cd]pyrene, dibenzo[a,h]anthracene (peaks 27 & 28), which the Rxi-XLB GC column was able to resolve to the requirements for regulatory compliance. PCB 180 and benzo[a]anthracene also exhibited the best separation using the Rxi-XLB compared to the other columns that were tested (peaks 18 & 19). The total analysis time using the Rxi-XLB GC column was 20 minutes.

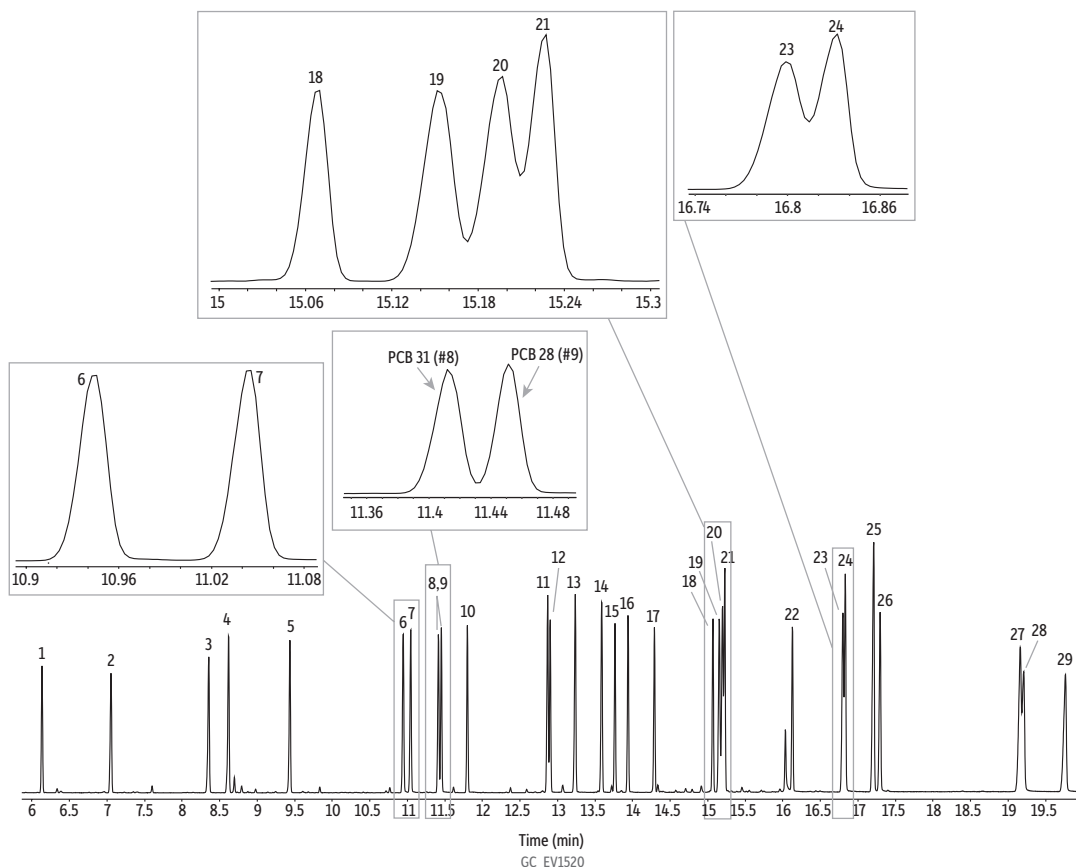
Whether analyzing air, water, soil, or sediment methods, the Rxi-XLB GC column provides the resolution necessary to ensure compliance with environmental regulations and to support the protection of public health and the environment.

**Table 1:** Comparison of Critical Pair Resolution\* Values in the Analysis of PAH and PCBs

Peak Pair	Peak Numbers	Rxi-XLB (30m x 0.25 mm ID x 0.25 $\mu$ m)	Rtx-440 (30m x 0.25 mm ID x 0.25 $\mu$ m)	Rxi-SVOCms (30m x 0.25 mm ID x 0.25 $\mu$ m)
Phenanthrene Anthracene	6 7	2.92	2.57	2.26
PCB 31 PCB 28	8 9	1.28	0.71	0.00
PCB 180 Benzo[a]anthracene	18 19	2.30	1.00	1.16
Triphenylene Chrysene	20 21	0.71	0.56	3.23
Benzo[b]fluoranthene Benzo[k]fluoranthene	23 24	0.76	1.20	1.39
Indeno[1,2,3-cd]pyrene Dibenzo[a,h]anthracene	27 28	0.67	0.89	1.38
<b>Run Time:</b>		<b>20.792 min</b>	<b>20.667 min</b>	<b>21.667 min</b>

\*Note - Baseline resolution = 1.50

**Figure 1:** Excellent separations were achieved for critical separations in the analysis of PAHs and PCBs on the Rxi-XLB GC column.



Peaks	$t_r$ (min)	Conc. (µg/mL)
1. Naphthalene	6.134	5
2. 2-Methylnaphthalene	7.051	5
3. Acenaphthylene	8.353	5
4. Acenaphthene	8.617	5
5. Fluorene	9.435	5
6. Phenanthrene	10.946	5
7. Anthracene	11.045	5
8. PCB 31	11.412	5
9. PCB 28	11.451	5
10. PCB 52	11.799	5
11. Fluoranthene	12.868	5
12. PCB 101	12.902	5
13. Pyrene	13.235	5
14. 2-Methylfluoranthene	13.586	5
15. PCB 118	13.765	5
16. PCB 153	13.937	5
17. PCB 138	14.289	5
18. PCB 180	15.07	5
19. Benzo[a]anthracene	15.152	5
20. Triphenylene	15.197	5
21. Chrysene	15.227	5
22. PCB 194	16.127	5
23. Benzo[b]fluoranthene	16.799	5
24. Benzo[k]fluoranthene	16.832	5
25. Benzo[e]pyrene	17.211	5
26. Benzo[a]pyrene	17.295	5
27. Indeno[1,2,3-cd]pyrene	19.161	5
28. Dibenzo[a,h]anthracene	19.209	5
29. Benzo[ghi]perylene	19.763	5

Column  
Standard/Sample

Diluent:

Conc.:

Injection

Inj. Vol.:

Liner:

Inj. Temp.:

Oven

Oven Temp.:

Carrier Gas

Flow Rate:

Detector

Mode:

Scan Program:

Transfer Line Temp.:

Source Temp.:

Quad Temp.:

Instrument

Sample Preparation

Rxi-XLB, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13723)

2-Methylnaphthalene (cat.# 31285)

SV calibration mix #5/610 PAH (cat.# 31011)

PCB congener mix #2 (cat.# 32294)

Methylene chloride

5 µg/mL

1 µL splitless

Topaz Precision inlet liner, 4.0 mm x 6.3 x 78.5 (cat.# 23305)

240 °C

Oven Temp.: 40 °C (hold 1 min) to 120 °C at 30 °C/min to 330 °C at 16 °C/min (hold 4 min)

He, constant flow

1 mL/min

MS

Scan

Group	Start Time (min)	Scan Range (amu)	Scan Rate (scans/sec)
1	4	50-550	10

250 °C

300 °C

180 °C

Agilent 7890A GC & 5975C MSD

The sample was in a 2 mL short-cap, screw-thread vial (cat.# 21143) and capped

with a short-cap, screw-vial closure (cat.# 24495).

For an optimized analysis of PAHs on the Rxi-SVOCms, see our application at

<https://www.restek.com/articles/optimized-polycyclic-aromatic-hydrocarbon-pah-analysis-by-gc-ms>.

#### References:

1. iTeH, Inc., EN 17322:2020, Environmental Solid Matrices-Determination of polychlorinated biphenyls (PCB) by gas chromatography-mass selective detection (GC-MS) or electron-capture detection (GC-ECD), 28 July 2020. <https://standards.iteh.ai/catalog/standards/cen/bd16cd16-70b0-4f08-8ad6-e3d3e125c05b/en-17322-2020>
2. International Organization for Standardization, ISO 18475:2023, Environmental solid matrices- Determination of polychlorinated biphenyls (PCB) by gas chromatography-mass selective detection (GC-MS) or electron-capture detection (GC-ECD), October 2023. <https://www.iso.org/standard/84177.html>

## Rxi-XLB GC Capillary Column

Improvements in polymer synthesis and tubing deactivation enable us to make inert, stable Rxi-XLB columns especially well-suited for analyzing active, high molecular weight compounds with sensitive GC-MS systems, including ion trap detectors. Excellent efficiency, coupled with inertness, low bleed, and high thermal stability, make Rxi-XLB columns ideal for analyzing semivolatile compounds in drinking water.

Rxi-XLB columns are a great choice for semivolatile organics analysis by EPA Method 525.2. An Rxi-XLB column plus some simple adjustments to the injection conditions can greatly improve sensitivity for active and high molecular weight Method 525.2 target compounds.

- General-purpose columns with unique selectivity. Ideal for many GC-MS applications, including pesticides, PCB congeners (e.g., Aroclor mixes), PAHs.
- High thermal stability; exhibits extremely low bleed.
- Temperature range: 30 °C to 360 °C.



Catalog No.	Product Name	Units
13723	Rxi-XLB GC Capillary Column, 30 m, 0.25 mm ID, 0.25 µm	ea.

## Topaz Precision Inlet Liner

Topaz GC inlet liners feature revolutionary technology and inertness to deliver you the next level of True Blue Performance:

- **Deactivation**—unbelievably low breakdown for accurate and precise low-level GC analyses.
- **Reproducibility**—unbeatable manufacturing controls and QC testing for superior reliability across compound classes.
- **Productivity**—unparalleled cleanliness for maximized GC uptime and lab throughput.
- **100% Satisfaction**—if a liner doesn't perform to your expectations, we will replace it or credit your account.



Patented

Catalog No.	Product Name	Units
23305	Topaz, Precision Inlet Liner, 4.0 mm x 6.3 x 78.5, for Agilent GCs, w/Quartz Wool, Premium Deactivation	5-pk.

## 2-Methylnaphthalene Standard

2-Methylnaphthalene (91-57-6)

Catalog No.	Product Name	Units
31285	2-Methylnaphthalene Standard, 1000 µg/mL, Methylene Chloride, 1 mL/ampul	ea.



## SV Calibration Mix #5/610 PAH

Acenaphthene (83-32-9)	Chrysene (218-01-9)
Acenaphthylene (208-96-8)	Dibenz[a,h]anthracene (53-70-3)
Anthracene (120-12-7)	Fluoranthene (206-44-0)
Benz[a]anthracene (56-55-3)	Fluorene (86-73-7)
Benzo[a]pyrene (50-32-8)	Indeno[1,2,3-cd]pyrene (193-39-5)
Benzo[b]fluoranthene (205-99-2)	Naphthalene (91-20-3)
Benzo[k]fluoranthene (207-08-9)	Phenanthrene (85-01-8)
Benzo[g,h,i]perylene (191-24-2)	Pyrene (129-00-0)

Catalog No.	Product Name	Units
31011	SV Calibration Mix #5/610 PAH, 2000 µg/mL, Methylene Chloride, 1 mL/ampul	ea.

## PCB Congener Mix #2

2,4,4'-Trichlorobiphenyl (BZ #28) (7012-37-5)	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ #138) (35065-28-2)
2,2',5,5'-Tetrachlorobiphenyl (BZ #52) (35693-99-3)	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ #153) (35065-27-1)
2,2',4,5,5'-Pentachlorobiphenyl (BZ #101) (37680-73-2)	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ #180) (35065-29-3)
2,3',4,4',5-Pentachlorobiphenyl (BZ #118) (31508-00-6)	

Catalog No.	Product Name	Units
32294	PCB Congener Mix #2, 10 µg/mL, Isooctane, 1 mL/ampul	ea.

## Vials and Caps

Catalog No.	Product Name	Units
21143	Short-Cap Vial with Grad Marking Spot, 9-425 Screw-Thread, 2.0 mL, 9 mm, 12 x 32 (vial only), Amber	1000-pk.
24495	Short Screw Caps, Polypropylene, Screw-Thread, PTFE/Silicone/PTFE Septa, Black, Preassembled, 2.0 mL, 9 mm	100-pk.



## EZ No-Vent GC Column-Mass Spectrometer Connectors

Topaz GC inlet liners feature revolutionary technology and inertness to deliver you the next level of True Blue Performance:

- Change GC-MS columns in minutes without venting—100 µm transfer line maintains vacuum and eliminates the need to vent.
- Easy to install and maintain—no special tools or plumbing required.
- Gold-plated body for inertness.
- High-temperature polyimide ferrules eliminate leaks at the problematic transfer line fitting.
- Lower cost than other “no-vent” fittings.



Catalog No.	Product Name	Units
21323	EZ No-Vent GC Column-Mass Spectrometer Connector, for Agilent GCs with 5971/5972, 5973, 5975, or 5977 GC-MS	kit
22431	EZ No-Vent GC Column-Mass Spectrometer Connector, for Shimadzu QP2010, QP2010 Plus, and QP2020, kit	kit

**Questions? Contact us or your local Restek representative ([www.restek.com/contact-us](http://www.restek.com/contact-us)).**

Restek patents and trademarks are the property of Restek Corporation. (See [www.restek.com/Patents-Trademarks](http://www.restek.com/Patents-Trademarks) for full list.) Other trademarks in Restek literature or on its website are the property of their respective owners. Restek registered trademarks are registered in the U.S. and may also be registered in other countries. To unsubscribe from future Restek communications or to update your preferences, visit [www.restek.com/subscribe](http://www.restek.com/subscribe) To update your status with an authorized Restek distributor or instrument channel partner, please contact them directly.

© 2024 Restek Corporation. All rights reserved. Printed in the U.S.A.