Chrompack PLOT Columns: the best choice for analyzing gases and volatiles

Analyzing gases and volatiles has long been one of the most difficult tasks in gas chromatography. The challenge to maintain resolution for very volatile compounds has meant that many methods are still based on traditional packed columns. This is very limiting, since packed columns offer low resolution and are often dedicated to one specific analysis. When Wall Coated Open Tubular (WCOT) capillary columns are used, it has been necessary to operate at very low temperatures requiring liquid nitrogen or CO2 coolants. Other problems arise when using columns with very thick films, which aren't very efficient and offer poor resolution.

The Original PLOT Column
The introduction of the first Porous Layer Open Tubular (PLOT) column by Chrompack in 1988 finally allowed users to experience the benefits of high-resolution capillary gas chromatography when analyzing a wide range of gases and volatiles. In comparison to packed WCOT columns, the PLOT columns were more versatile, offered higher resolution, and delivered faster analysis.

A Technological Revolution
Recent technical breakthroughs by our research laboratories in the Netherlands have allowed Varian to introduce a new line of bonded PLOT columns. Varian's PLOT columns deliver superior mechanical and temperature stability and allow for increasingly fast methods. These columns are ideal for use in the chemical, petrochemical, pharmaceutical, and environmental applications.

In comparison to their non-bonded predecessors, bonded PLOT columns contain significant improvements in column stability. New technology has led to the development of "in-situ" column manufacturing techniques, process that enable adsorbents to be grown in-situ within a column. The result is a layer that cross links to produce a column with significantly higher mechanical and temperature stability. This is drastically different than earlier techniques in which pre-formed particles were coated in the column.

Some of the advantages of bonded PLOT columns include:

- **High Tmax.** The new CP-PoraBOND Q has a Tmax of 320 °C and offers increased flexibility and versatility. PLOT columns can now be used for analyzing a wide range of volatile and semi-volatile applications; cycle times can be shortened by temperature ramping to higher temperatures. Plus, using different columns in the same oven (e.g. CP-PoraBOND and CP-Molsieve) increases system flexibility.

- **Lower bleed.** The bonding process means lower bleed, by a factor of >5. This results in improved sensitivity and reduced detector fouling.

- **No particle loss.** High mechanical stability means that columns can be interfaced to MS detectors and valve switching systems. Particle traps are no longer required, eliminating column blockage and increasing column lifetimes.

- **High inerntness.** Superior synthesis and column manufacturing techniques ensure columns are suitable for accurately analyzing a wide range of compounds, including solvents, sulfur compounds, and CFCs at trace levels.
The Chrompack PLOT Advantage

The Original PLOT Manufacturer
The Chrompack brand name is synonymous with PLOT columns. The innovations that began more than 15 years ago with the PLOT column still continues, with constant product development and continual improvements. By working closely with laboratories in a variety of industries, Varian is able to offer practical solutions to your analytical and productivity challenges. Our newest innovations are designed for the online process and field portable GCs, as well as applications requiring value switching and systems interfaced to MS detectors.

The widest range of columns to optimize your analysis

• Stationary phases
Varian's Chrompack line of PLOT columns now includes 6 different types of columns, making unique separations possible for a wide range of compounds.

• Tubing materials
Our columns are available in fused silica for general-purpose laboratory work and Ultimetal, for online processes and field portable instruments.

• Tubing diameters
Varian's columns are available in many different lengths, internal diameters, and coil diameters. This allows you the flexibility to select the right column to suit your sample, GC, and laboratory.

Application support
We're pleased to offer you more than 15 years of application knowledge. In addition to Help Desks in Europe and the United States, we have an applications database on CD-ROM as well as a wide range of posters and technical publications. Challenge us with your application today!

Highest Quality
Varian combines the highest quality materials with the latest manufacturing techniques to produce high-quality, high-performance PLOT columns.

Bonded
Bonded columns offer increased method reliability and are ideal for labs in which high throughput and low maintenance are essential. Instead of coating the column with particles, Varian builds a homogeneous layer within the column. This process eliminates particle traps and ensures that column and valve blockage are a thing of the past.

Inertness
In attempting to lower detection levels, the purity of materials and deactivation procedures become essential to achieving symmetrical peaks and accurate measurements. CP-PoraBOND Q is the only "PLOT Q" column available that is designed to provide accurate analysis of a wide range of polar solvents at trace levels.

Highest Price Performance Ratio
Varian is committed to providing high quality products at competitive prices. Contact your local office for more details.
### CP-PoraBOND Q

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>10</td>
<td>3</td>
<td>300/320</td>
<td>CP7347</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>25</td>
<td>3</td>
<td>300/320</td>
<td>CP7348</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>5</td>
<td>300/320</td>
<td>CP7350</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>5</td>
<td>300/320</td>
<td>CP7351</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>50</td>
<td>5</td>
<td>300/320</td>
<td>CP7352</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>10</td>
<td>10</td>
<td>300/320</td>
<td>CP7353</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>10</td>
<td>300/320</td>
<td>CP7354</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>50</td>
<td>10</td>
<td>300/320</td>
<td>CP7355</td>
</tr>
</tbody>
</table>

CP-PoraBOND Q replaces CP-PoraPLOT Q in >95% of applications offering higher column performance.

### CP-PoraPLOT Q

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused silica</td>
<td>0,25</td>
<td>10</td>
<td>8</td>
<td>250/250</td>
<td>CP7548</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,25</td>
<td>25</td>
<td>8</td>
<td>250/250</td>
<td>CP7549</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,32</td>
<td>10</td>
<td>10</td>
<td>250/250</td>
<td>CP7550</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,32</td>
<td>25</td>
<td>10</td>
<td>250/250</td>
<td>CP7551</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,32</td>
<td>50</td>
<td>10</td>
<td>250/250</td>
<td>CP7552</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,53</td>
<td>10</td>
<td>20</td>
<td>250/250</td>
<td>CP7553</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,53</td>
<td>25</td>
<td>20</td>
<td>250/250</td>
<td>CP7554</td>
</tr>
<tr>
<td>Fused silica</td>
<td>0,53</td>
<td>50</td>
<td>20</td>
<td>250/250</td>
<td>CP7555</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>10</td>
<td>20</td>
<td>250/250</td>
<td>CP6953</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>25</td>
<td>20</td>
<td>250/250</td>
<td>CP6954</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>50</td>
<td>20</td>
<td>250/250</td>
<td>CP6955</td>
</tr>
</tbody>
</table>

### CP-PoraPLOT S

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>10</td>
<td>20</td>
<td>250/250</td>
<td>CP7573</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>25</td>
<td>20</td>
<td>250/250</td>
<td>CP7574</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>10</td>
<td>190/190</td>
<td>CP7578</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>10</td>
<td>190/190</td>
<td>CP7580</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>10</td>
<td>20</td>
<td>190/190</td>
<td>CP7583</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>20</td>
<td>190/190</td>
<td>CP7584</td>
</tr>
</tbody>
</table>

### CP-PoraPLOT U

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>10</td>
<td>4</td>
<td>200/200</td>
<td>CP7575</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>25</td>
<td>4</td>
<td>200/200</td>
<td>CP7576</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>50</td>
<td>4</td>
<td>200/200</td>
<td>CP7577</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>5</td>
<td>200/200</td>
<td>CP7511</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>5</td>
<td>200/200</td>
<td>CP7519</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>50</td>
<td>5</td>
<td>200/200</td>
<td>CP7515</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>10</td>
<td>10</td>
<td>200/200</td>
<td>CP7516</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>10</td>
<td>200/200</td>
<td>CP7517</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>50</td>
<td>10</td>
<td>200/200</td>
<td>CP7518</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>10</td>
<td>10</td>
<td>200/200</td>
<td>CP6918</td>
</tr>
</tbody>
</table>

CP-PoraBOND Q replaces CP-PoraPLOT Q in >95% of applications offering higher column performance.

### CP-PoraPLOT Amines

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>10</td>
<td>220/220</td>
<td>CP7591</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>20</td>
<td>220/220</td>
<td>CP7594</td>
</tr>
</tbody>
</table>

### CP-Al₂O₃/KCl

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>10</td>
<td>4</td>
<td>200/200</td>
<td>CP7575</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>25</td>
<td>4</td>
<td>200/200</td>
<td>CP7576</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>50</td>
<td>4</td>
<td>200/200</td>
<td>CP7577</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>5</td>
<td>200/200</td>
<td>CP7511</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>5</td>
<td>200/200</td>
<td>CP7519</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>50</td>
<td>5</td>
<td>200/200</td>
<td>CP7515</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>10</td>
<td>10</td>
<td>200/200</td>
<td>CP7516</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>10</td>
<td>200/200</td>
<td>CP7517</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>50</td>
<td>10</td>
<td>200/200</td>
<td>CP7518</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>10</td>
<td>10</td>
<td>200/200</td>
<td>CP6918</td>
</tr>
</tbody>
</table>
### CP-Al₂O₃/Na₂SO₄

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>10</td>
<td>4</td>
<td>200/200</td>
<td>CP7585</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>25</td>
<td>4</td>
<td>200/200</td>
<td>CP7586</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>50</td>
<td>4</td>
<td>200/200</td>
<td>CP7587</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>5</td>
<td>200/200</td>
<td>CP7561</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>50</td>
<td>5</td>
<td>200/200</td>
<td>CP7567</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>50</td>
<td>10</td>
<td>200/200</td>
<td>CP7568</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>50</td>
<td>10</td>
<td>200/200</td>
<td>CP6968</td>
</tr>
</tbody>
</table>

### CP-SilicaPLOT

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>15</td>
<td>3</td>
<td>225/225</td>
<td>CP8563</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>30</td>
<td>3</td>
<td>225/225</td>
<td>CP8564</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,25</td>
<td>60</td>
<td>3</td>
<td>225/225</td>
<td>CP8565</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>15</td>
<td>4</td>
<td>225/225</td>
<td>CP8566</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>30</td>
<td>4</td>
<td>225/225</td>
<td>CP8567</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>60</td>
<td>4</td>
<td>225/225</td>
<td>CP8568</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>15</td>
<td>6</td>
<td>225/225</td>
<td>CP8569</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>30</td>
<td>6</td>
<td>225/225</td>
<td>CP8570</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>60</td>
<td>6</td>
<td>225/225</td>
<td>CP8571</td>
</tr>
</tbody>
</table>

### CP-Lowox

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>10</td>
<td>10</td>
<td>350/350</td>
<td>CP8587</td>
</tr>
</tbody>
</table>

### CP-CarboBOND

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>5</td>
<td>200/300</td>
<td>CP7371</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>25</td>
<td>10</td>
<td>200/300</td>
<td>CP7374</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>50</td>
<td>5</td>
<td>200/300</td>
<td>CP7372</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>50</td>
<td>10</td>
<td>200/300</td>
<td>CP7375</td>
</tr>
</tbody>
</table>

### CP-CarboPLOT P7

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>25</td>
<td>115/115</td>
<td>CP7513</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>30</td>
<td>115/115</td>
<td>CP7514</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>10</td>
<td>350/350</td>
<td>CP7535</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>30</td>
<td>350/350</td>
<td>CP7536</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>30</td>
<td>10</td>
<td>350/350</td>
<td>CP7537</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>30</td>
<td>30</td>
<td>350/350</td>
<td>CP7540</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>50</td>
<td>5</td>
<td>350/350</td>
<td>CP7543</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>15</td>
<td>15</td>
<td>350/350</td>
<td>CP7538</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,53</td>
<td>10</td>
<td>50</td>
<td>350/350</td>
<td>CP7544</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>50</td>
<td>50</td>
<td>350/350</td>
<td>CP7539</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>25</td>
<td>50</td>
<td>350/350</td>
<td>CP6937</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>25</td>
<td>30</td>
<td>350/350</td>
<td>CP6938</td>
</tr>
</tbody>
</table>

### CP-Molsieve 5Å

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>ID (mm)</th>
<th>Length (m)</th>
<th>Df (µm)</th>
<th>Tmax °C</th>
<th>Cat. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>10</td>
<td>30</td>
<td>350/350</td>
<td>CP7587</td>
</tr>
<tr>
<td>Fused Silica</td>
<td>0,32</td>
<td>25</td>
<td>30</td>
<td>350/350</td>
<td>CP7588</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>10</td>
<td>50</td>
<td>350/350</td>
<td>CP7589</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>15</td>
<td>15</td>
<td>350/350</td>
<td>CP7590</td>
</tr>
<tr>
<td>Ultimetal</td>
<td>0,53</td>
<td>25</td>
<td>50</td>
<td>350/350</td>
<td>CP7591</td>
</tr>
</tbody>
</table>

### Trademarks:
Chrompack; PoraPLOT; Porabond; CarboPLOT and CarboBOND are trademarks of Varian, Inc.
Varian Analytical Instruments, serving worldwide markets in:
Agriculture
Basic Chemical
Biotechnology
Clinical
Electronics
Environmental
Photonics
Toxicology
Pharmaceutical
Food and Beverage
Metals and Mining
Petroleum and Petrochemical

Varian is committed to a process of continuous improvement which demands that we understand and then meet or exceed the needs and expectations of our customers — both inside and outside the company — in everything we do.
Chrompack PLOT Columns

The Original

Manufacturer
# Selecting the Right Chrompack PLOT Column for your Analysis

## Table of Contents

<table>
<thead>
<tr>
<th>Applications</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CP-PoraBOND/CP-PoraPLOT</strong></td>
<td></td>
</tr>
<tr>
<td>• CP-PoraPLOT Q/HT CP-PoraBOND Q</td>
<td>Solvents and hydrocarbons</td>
</tr>
<tr>
<td>• CP-PoraPLOT U</td>
<td>Polar solvents, hydrocarbons and CFCs</td>
</tr>
<tr>
<td>• CP-PoraPLOT S</td>
<td>Alcohols; aldehydes; ppm water; nitriles and nitro compounds</td>
</tr>
<tr>
<td>• CP-PoraPLOT amines</td>
<td>Ketones; esters and hydrocarbons</td>
</tr>
<tr>
<td>• CP-PoraBOND</td>
<td>Ammonia, C1-C6 amines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CP-Al₂O₃</strong></td>
<td>Light hydrocarbons (C1-C10) isomers</td>
</tr>
<tr>
<td>• CP-Al₂O₃/KCL</td>
<td>ppm C1-C4 impurities in C1-C4</td>
</tr>
<tr>
<td>• CP-Al₂O₃/Na₂SO₄</td>
<td>Highest selectivity for C4 isomers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CP-SilicaPLOT</strong></td>
<td>Light hydrocarbons in the presence of water</td>
</tr>
<tr>
<td>• CP-SilicaPLOT</td>
<td>Hydrocarbons; sulfur gases and CFCs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CP-Lowox</strong></td>
<td>Oxygenates</td>
</tr>
<tr>
<td>• CP-Lowox</td>
<td>ppb/ppm level oxygenates in hydrocarbons</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CP-CarboBOND/CP-CarboPLOT P7</strong></td>
<td>Permanent gases in C1/C2 streams</td>
</tr>
<tr>
<td>• CP-CarboBOND</td>
<td>Impurities in ethylene, CO; CO₂; C1-C2; coke oven gas</td>
</tr>
<tr>
<td>• CP-CarboPLOT P7</td>
<td>He; N₂; O₂; CO; CO₂; C1-C2; coke oven gas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CP-Molsieve 5Å</strong></td>
<td>Permanent gases</td>
</tr>
<tr>
<td>• CP-Molsieve 5Å</td>
<td>He, Ne, Ar, O₂, N₂, CH₄, CO; C2H₆, hydrogen isotopes</td>
</tr>
</tbody>
</table>

**Further application help**

- CP-Scanview CD-ROM application database
- Help Desk Teams
- Additional Reading, Technical Posters
Styrene-divinylbenzene-based porous polymer columns are ideal for the analysis of solvents and volatile compounds in the chemical, petrochemical, environmental, and pharmaceutical industries. A porous polymer exhibits unique retention characteristics, including the perfect elution of polar and apolar volatile compounds, as well as hydrocarbons, alcohols, esters, and ketones.

Polar compounds such as methanol, acetaldehyde and ethylene oxide have very short retention times in gas-liquid chromatography but do not elute from alumina or molecular sieve adsorbents. The CP-PoraBOND and PoraPLOT range of columns elute these polar compounds as perfectly symmetrical peaks, allowing them to be analyzed together with light hydrocarbons or permanent gases.

Since the retention is not influenced by water in the sample, retention times are repeatable.

**PoraBOND/PoraPLOT Application fields**
- **Q** alcohols and water, polar solvents, hydrocarbons, gases
- **S** ketones, esters, halogenated compounds, hydrocarbons
- **U** all polar volatiles, nitriles/nitro-compounds, alcohols/aldyes, ethane/ethylene, sulfur gases, oxygen in air, ppm water in gases

**Amines** ammonia, very volatile amines

### Fast separation of commonly used residual solvents

**Application 1457 - GC**

**Residual solvents**

In addition to a CP-Select 624 CB column (see Application notes 1282 - 1286), which phase is prescribed in the USP for the analysis of residual solvents in pharmaceutical products, a second column often is used for confirmation or special solvents analysis. In many cases this column is a PLOT column. The CP-PoraBOND Q column, with a bonded layer of the very hydrophobic styrene-divinylbenzene copolymer phase, is an improved version of this type of column. The CP-PoraBOND Q column provides a good selectivity, peak shape, signal/noise ratio and stable baseline, even at high flow rates due to the bonded character of the stationary phase.

- **Technique:** GC - capillary
- **Column:** CP-PoraBOND Q fused silica PLOT 10 m x 0.32 mm, df = 5 µm
- **Cat. no.** 7350
- **Temperature:** 150 °C → 220 °C, 10 °C/min; 220 °C (5 min)
- **Carrier gas:** N₂, 1 ml/min
- **Injector:** Splitter, 20 ml/min, T = 150 °C
- **Detector:** FID, T = 280 °C
- **Sample size:** 1.0 µl
- **Concentration range:** 0.05 mg/ml
- **Solvent sample:** pyridine
- **Courtesy:** Mr. J. Vloet, Organon, Oss, The Netherlands

**Peak identification:**
1. methanol
2. ethanol
3. acetone
4. dichloromethane
5. ethyl acetate
6. 1,2-dichloroethane (Internal Standard)
7. hydrocarbons C₆
8. pyridine (sample solvent)

### Headspace analysis of cyanides in blood.

**Application 1529 - GC**

**Gases**

Blood samples of 500 µl are spiked with acetonitrile (Internal Standard) and with 100 µl phosphoric acid. After homogenization they are heated in a closed vial at 60 °C for 30 minutes. A 250 µl headspace sample is injected and analyzed. The PoraBOND Q column gives an excellent separation, peak shape and quantitative results.

- **Analysis technique:** GC - wide-bore
- **Column:** CP-PoraBOND Q, 25 m x 0.53 mm, df = 10 µm
- **Cat. no.** CP7354
- **Temperature:** 120 °C
- **Carrier gas:** He, 40 kPa
- **Injector:** headspace/split, 200 °C
- **Detector:** NPD, 230 °C
- **Sample size:** 250 µl headspace
- **Sample solvent:** body fluid / water
- **Courtesy:** P. Visinoni, Lab. de Police Scientifique, Toulouse, France

**Peak identification:**
1. nitrogen (air)
2. hydrocyanic acid (HCN) 0.47 mg/l
3. acetonitrile (IS) 1.0 mg/l
4. methanol
5. ethanol
6. acetone
7. dichloromethane
8. ethyl acetate
9. hydrocarbons C₆
10. pyridine (sample solvent)
CP-PoraBOND Q

- New bonded column which replaces CP-PoraPLOT Q and CP-PoraPLOT Q-HT
- Applicable on a wide range of non-polar volatiles/semivolatiles
- No effect of water on retention times
- High column stability with Tmax of 320 °C
- Suitable for valve switching, high flow rates, and EPC pressure/flow programming
- No need for particle traps

Styrene-divinylbenzene polymer

Replaces: Porapak Q, HayeSep Q, Chromosorb 102, 105, 106, GS-Q, HP-PLOT Q; CP-PoraPLOT Q; CP-PoraPLOT Q-HT

Analysis of trace of polar solvents in water via splitless injection

The CP-PoraBOND Q column allows direct water injections via direct or splitless sample introduction without extra peak broadening for quick-eluting compounds, and avoiding difficult techniques like purge and trap analysis. Especially the splitless injection of water results in good chromatography, even for volatile polar compounds like ethanol, acetonitrile and acetone. The water peak elutes very early and will coelute with the methanol. This peak is also somewhat broadened due to the water matrix effect. All other components elute with good symmetry at levels of 10 ppm. Even at 1 ppm level all components can be quantified. The inertness of the CP-PoraBOND Q porous polymer in combination with the stability of the bonded phase, form a base for a long lifetime. See also application 1423.

Technique: GC - capillary
Column: CP-PoraBOND Q fused silica PLOT
25 m x 0.32 mm, df = 5 μm, Cat. no. 7351
Temperature: 90 °C (2 min) → 200 °C, 10 °C/min
Carrier gas: He, 160 kPa (1.6 bar, 22 psi)
Sample size: 1 µl
Concentration range: 10 ppm and 1 ppm
Solvent sample: water

Peak identification:
1. methanol
2. ethanol
3. acetonitrile
4. acetone
5. 2-propanol (isopropanol)
6. 2-propanol (isopropanol)
7. 1-propanol
8. diethyl ether
9. 2-methyl-2-propanol
10. water

Courtesy: E. Houben, Pro Analyse, Environmental Laboratory, Barneveld, the Netherlands

Chromatogram 1: Concentration range 10 ppm

Chromatogram 2: Concentration range 1 ppm

Trace analysis of sulfur compounds in water

The inertness of the CP-PoraBOND Q column allows the separation of volatile sulfur compounds at low levels with an excellent peak shape. Together with the high sensitivity of the Pulsed Discharge Detector, linear quantification down to the sub-ppm level is possible under these conditions. Also water can be detected.

Technique: GC - capillary
Column: CP-PoraBOND Q fused silica PLOT
25 m x 0.32 mm, df = 5 μm, Cat. no. 7351 (as 25 m column)
Temperature: 35 °C (3 min) → 250 °C, 20 °C/min
Carrier gas: He, 50 kPa (0.5 bar, 7.2 psi)
Injector: Valve/Split
Detector: VICI Pulsed Discharge Detector,
T = 300 °C
Sample size: 100 µl
Concentration range: 100 ppm

Peak identification:
1. water
2. hydrogen sulfide
3. carbonyl sulfide
4. methanethiol (methyl mercaptan)
5. ethanethiol (ethyl mercaptan)

Department: Dow Environmental Laboratory

Separation of CFCs

Porous polymers are generally preferred for CFC separations as the high retention allows the volatile CFCs to be measured at low levels. However, if the porous polymer has no homogeneous pore size distribution, several molecules will show extra peak broadening resulting in poor detection limits. A CFC that shows this behavior is the CFC 113 or its isomer 113a.

The CP-PoraBOND Q, with its well defined pore size distribution, elutes CFC 113 as a sharp peak. Due to the inertness of the CP-PoraBOND Q porous polymer a wide range of CFCs will elute at low concentrations. Conditioning the column at 300 °C removes any heavy material which might be in the sample as an impurity. Valve injections that include pressure pulses can be done as the CP-PoraBOND Q has a chemically bonded integrated adsorption layer, that does not contain particles.

Technique: GC - wide-bore
Column: CP-PoraBOND Q fused silica PLOT
25 m x 0.53 mm, df = 10 μm
Cat. no. 7354
Temperature: 100 °C (2 min) → 250 °C, 10 °C/min
Carrier gas: He, 40 kPa (0.4 bar, 6 psi)
Injector: Split
Detector: FID,
T = 250 °C
Sample size: 50 µl
Concentration range: 0.1% in N2

Peak identification:
1. methane
2. ethane
3. CFC 113a
4. CFC 112a
5. propane
6. CFC 12
7. isobutane
8. butane
9. CFC 11
10. pentane
11. CFC 113 + CFC 113a
12. hexane
13. CFC 112 + CFC 112a
**CP-PoraPLOT U**
- Most polar Porous polymer PLOT
- Symmetrical peaks for polar and non-polar volatiles
- No effect of water on retention times
- Separates CO₂ from bulk air

Divinylbenzene-ethylene glycol-dimethacrylate polymer

Replaces: Porapak N, T; HayeSep N, T, C; Chromosorb 104, HP-PLOT U

---

**CP-PoraPLOT S**
- Analysis of medium-polarity volatiles
Divinylbenzene-vinylpyridine polymer
Replaces: Porapak S, R, HayeSep S, R, Chromosorb 107

**CP-PoraPLOT Amines**
- High retention for very volatile amines

---

**Impurities in polymer**

Vinyl chloride, vinyl acetate and volatiles in polymeric dispersion

Headspace sampling makes the analysis possible of volatile compounds at low levels in a complex, "dirty" matrix.
The unique selectivity of the CP-PoraPLOT U column separates vinyl chloride, vinyl acetate and many other hydrocarbons and oxygenates.

**Technique:** GC - wide-bore

**Column:** CP-PoraPLOT U fused silica PLOT 10 m x 0.53 mm, df = 20 µm, Cat. no. 7583

**Temperature:** 65 °C (0.1 min) → 150 °C, 10 °C/min

**Carrier gas:** He, 50 kPa (0.5 bar, 7.2 psi), 6 ml/min

**Sampler:** CP-9020 headspace sampler; incubation temperature and time: 40 °C for 30 min

**Detector:** FID, T = 200 °C

**Sample size:** 250 µl headspace

**conc. range:** 2 ppm (vinyl chloride) and other hydrocarbons and oxygenates.

**Concentration range:** polymeric dispersion

**Sample size:** 250 µl headspace

**Carrier gas:** He, 50 kPa (0.5 bar, 7.2 psi), 6 ml/min

**Sampler:** CP-9020 headspace sampler

**Temperature:** 65 °C (0.1 min) → 150 °C, 10 °C/min

**Carrier gas:** He, 50 kPa (0.5 bar, 7.2 psi), 6 ml/min

**Sampler:** CP-9020 headspace sampler

**Temperature:** 40 °C for 30 min

**Detector:** FID, T = 200 °C

**Sample size:** 250 µl headspace

**Carrier gas:** He, 50 kPa (0.5 bar, 7.2 psi), 6 ml/min

**Sampler:** CP-9020 headspace sampler

**Temperature:** 40 °C for 30 min

**Detector:** FID, T = 200 °C

**Sample size:** 250 µl headspace

**Technique:** GC - wide-bore

**Column:** CP-PoraPLOT U fused silica PLOT 10 m x 0.53 mm, df = 20 µm, Cat. no. 7583

**Temperature:** 65 °C (0.1 min) → 150 °C, 10 °C/min

**Carrier gas:** He, 50 kPa (0.5 bar, 7.2 psi), 6 ml/min

**Sampler:** CP-9020 headspace sampler; incubation temperature and time: 40 °C for 30 min

**Detector:** FID, T = 200 °C

**Sample size:** 250 µl headspace

**Concentration range:** 2 ppm (vinyl chloride) and other hydrocarbons and oxygenates.

**Peak identification:**
1. Methane
2. Ethylene
3. Propylene
4. Propane
5. Vinyl chloride
6. Isobutane
7. Methanol
8. n-Butane
9. Ethanol
10. 2-Methyl-2-propanol (t-Butanol)
11. Acetone
12. n-Pentane
13. 2-Propanol
14. Vinyl acetate
15. Ethyl acetate
16. 1-Propanol
17. 2-Methyl-2-propanol (t-Butanol)

**Analysis of trace amines**

Amines C1 - C2

Amines are difficult to analyze due to their strong basic nature. Capillary columns must be base-modified to elute amines with acceptable recovery. For highly volatile amines including ammonia, the siloxane-based phases do not provide enough retention.

The CP-PoraPLOT Amines porous polymer provides a high retention combined with a high inertness for amines. Volatile amines elute at low levels as shown in this application. Also ammonia elutes as a sharp peak at nanogram levels.

If besides these amines also alcohols and/or water must be measured, a 5 µm film CP-Sil 5 CB is recommended, operated at temperatures around 30 °C.

**Technique:** GC - capillary

**Column:** CP-PoraPLOT amines fused silica PLOT 25 m x 0.32 mm, df = 10 µm, Cat. no. 7591

**Temperature:** 140 °C (2 min) → 250 °C, 10 °C/min

**Carrier gas:** H₂, 95 kPa (0.95 bar, 13 psi)

**Injector:** on-column

**Detector:** ELD

**Sample size:** 0.1 µl

**Peak identification:**
1. Ammonia 1.8 ng
2. Methylamine 3.4 ng
3. Dimethylamine 2.9 ng
4. Trimethylamine 2.9 ng
5. Ethylamine 3.4 ng
6. n-Butane 2.9 ng
7. Ethanol 2.9 ng
8. 2-Methyl-2-propanol (t-Butanol) 2.9 ng
9. Acetone 3.4 ng
10. n-Pentane 2.9 ng
11. 2-Propanol 2.9 ng
12. Vinyl acetate 2.9 ng
13. Ethyl acetate 2.9 ng
14. 1-Propanol 2.9 ng
15. Methanol 2.9 ng
16. Isobutane 2.9 ng
17. Methane 2.9 ng
Aluminum oxide PLOT columns offer high selectivity for analyzing ppm levels of C1-C5 hydrocarbons in a main stream of C1-C5 hydrocarbons. These columns are able to analyze more compounds in a single run than packed columns, while still delivering higher resolution and faster analysis times. When compared to liquid stationary phases, the Al2O3 PLOT column offers increased selectivity and allows all C1-C5 hydrocarbon isomers to be separated.

In the presence of moisture, the retention times on Al2O3 PLOT columns may vary from analysis to analysis. This can be prevented by temperature programming up to 200 °C, which elutes the water.

KCl or Na2SO4 deactivation

The aluminum oxide PLOT columns are deactivated using very small salt crystals, providing a reproducible and stable deactivation up to 200 °C. Depending on the type of deactivation salt, the CP-Al2O3 column will show a certain selectivity. KCl salt results in a relatively apolar Al2O3 surface, while Na2SO4 deactivation results in a polar surface. Unsaturated compounds like ethylene and acetylene (ethyne) are retained longer.
CP-Al₂O₃/KCL
Replaces: Alumina

CP-Al₂O₃/Na₂SO₄
Replaces: GS-Alumina, HP-PLOT m/s

<table>
<thead>
<tr>
<th>Tmax iso/prog (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃/KCl 200/200°C</td>
</tr>
<tr>
<td>Al₂O₃/Na₂SO₄ 200/200°C</td>
</tr>
</tbody>
</table>

Impurities in 1,2-butadiene
Hydrocarbons C1 - C4

Technique: GC-capillary
Column: Al₂O₃/Na₂SO₄ (df = 5 µm) (Cat.no. 7565)
Temperature: 110 °C
Carrier gas: N₂, 110 kPa (1.1 bar, 16 psi)
Injector: Splitter, 20 ml/min
Detector: FID, 4 x 10⁻¹² Afs.
Sample size: 100 µl
Concentration range: 5 - 1000 ppm

Peak identification:
1. methane
2. ethane
3. ethene (ethylene)
4. propane
5. cyclopropane
6. propene (propylene)
7. isobutane
8. n-butane
9. cyclobutane
10. trans-2-butene
11. 1-butene
12. isobutene
13. cis-2-butene
14. 1,2-butadiene
15. 1,3-butadiene
16. propyne

Separation of C1 - C5 hydrocarbons on Al₂O₃/Na₂SO₄ PLOT
Hydrocarbons C1 - C4

Technique: GC-capillary
Column: Al₂O₃/Na₂SO₄ fused silica PLOT
50 m x 0.53 mm; df = 10 µm, Cat.no. 7568
Temperature: 120 °C
Carrier gas: He, 50 kPa (0.5 bar, 7 psi), 23 cm/s
Injector: Splitter, T = 225 °C
Detector: FID, T = 250 °C

Peak identification:
1. methane
2. ethane
3. ethylene
4. propane
5. cyclopropane
6. propene
7. isobutane
8. n-butane
9. trans-2-butene
10. 1-butene
11. isobutene
12. cis-2-butene
13. 1,2-butadiene
14. 1,3-butadiene
15. isopentane
16. n-pentane
17. 1,3-butadiene
18. propyne
19. cyclopropane
20. trans-2-pentene
21. 2-methyl-2-butene
22. 1-pentene
23. 2-methyl-1-butene
24. cis-2-pentene
CP-SilicaPLOT

- High selectivity for C1-C4 isomers in the presence of water
- Water does not influence retention times
- Elution of CO2 and sulfur gases at ppm levels
- Separates cyclopropane from propylene
- No decomposition of pentadienes
- High selectivity for CFCs without decomposition
- Bonded column ensures no particle loss

The CP-SilicaPLOT is a bonded silica-based column that offers unique selectivity for a wide range of compounds including light hydrocarbons, sulfur compounds, and CFCs. Its stable retention time even in the presence of water and other polar compounds makes the column ideal for high-throughput lab and online process applications.

Separation of halogenated hydrocarbons and C2 hydrocarbons

Halogenated hydrocarbons

The CP-SilicaPLOT separates all C2 isomers with high resolution. Besides this, the column is highly selective and inert for halogenated compounds. Volatile compounds like chloromethane, vinyl chloride and chloroethane elute as sharp peaks, well separated from the C2 isomers. Typical separations can be done at temperatures above ambient. Traces of water will not change retention time.

Technique: GC - capillary
Column: CP-SilicaPLOT fused silica PLOT
30 m x 0.32 mm, df = 4 µm
Cat. no. 8567
Temperature: 40 °C (2 min) Æ 200 °C, 20 °C/min
Carrier gas: N2, 50 kPa (0.5 bar, 7 psi)
Injector: Split 50 ml/min, T = 200 °C
Detector: FID, T = 200 °C
Sample size: 1 ml
Concentration range: % level
Sample matrix: nitrogen

Courtesy: H. Erlemeier, Zentrale Analytik, Hoechst AG, Germany

Peak identification: as v/v ppm
1. methane 1000 ppm
2. ethane 980 ppm
3. ethylene 980 ppm
4. acetylene 960 ppm
5. chloromethane 1020 ppm
6. vinyl chloride 880 ppm
7. chloroethane 960 ppm

Sulfur and hydrocarbons by GC-AED

Sulfur gases and hydrocarbons C1 - C3

Elution of sulfur gases in relation with hydrocarbons

COS and H2S elute without interference from light hydrocarbons making quantification possible with universal detection devices and avoids quenching effects with selective detectors.

Technique: GC - capillary
Column: CP-SilicaPLOT fused silica PLOT
30 m x 0.32 mm, df = 4 µm
Cat. no. 8567
Temperature: 40 °C (2 min) Æ 250 °C, 20 °C/min
Carrier gas: He, 210 kPa (2.1 bar, 30 psi)
Injector: Split, T = 200 °C
Detector: AED, Carbon channel, C 193;
Sulfur channel, S 181
T = 250 °C
Sample size: 1.0 ml
Concentration range: sulfur compounds: 50 ppm
hydrocarbons: 500 ppm

Courtesy: Jim Luong, The Dow Chemical Company, Canada

Peak identification:
1. methane + carbon monoxide
2. ethane
3. carbon dioxide
4. ethylene
5. carbonyl sulfide (COS)
6. acetylene
7. propane
8. propylene
9. methanethiol (methyl mercaptan)
10. ethanethiol (ethyl mercaptan)
11. hydrogen sulfide (H2S)

A. Sulfur channel

B. Carbon channel
CP-Lowox

- Designed for measuring ppm/ppb level oxygenates in C1-C10
- Separates a wide range of oxygenates from methanol to butyl alcohols
- Suitable for laboratory and on-line process applications
- High column stability Tmax 350 °C
- No particle loss

The new CP-Lowox offers a unique solution for the chemical and petrochemical industries, making it finally possible to analyze trace level oxygenate impurities in gas and liquid hydrocarbon streams. A unique *multi-layer* column coating process results in a highly polar column that exhibits unique characteristics for the analysis of trace level oxygenate impurities in hydrocarbon matrices.

Our multi-layer PLOT technology also delivers very high column stability, making Varian’s CP-Lowox ideal for valve switching and online process applications.

Tmax: 350°C/350°C (iso/prog)

**Analysis of trace methanol in 1,3-butadiene** Application 1361 - GC

**Oxygenates**

The CP-Lowox adsorbent provides very high retention for oxygenated compounds. The methanol elutes after n-C14, allowing this component to be measured at low levels in a range of hydrocarbon streams. A typical application of trace methanol in 1,3-butadiene is shown here. Methanol has to be measured usually at specs as low as 5 ppm. The high maximum temperature of 350 °C with virtually no bleed makes the CP-Lowox column widely applicable. Other C1 - C5 oxygenated compounds can also be separated as the selectivity of the CP-Lowox is also very high, see Application note 1362.

To obtain a small injection band a 50 cm x 0.1 mm deactivated fused silica was placed before the CP-Lowox column.

- **Technique:** GC - wide-bore
- **Column:** CP-Lowox 0.53 mm fused silica PLOT, Cat. no. 8587
- **Temperature:** 175 °C (2 min) → 275 °C, 10 °C/min
- **Carrier gas:** He, 420 kPa (4.2 bar, 60 psi)
- **Injector:** Split via Valco valve
- **Sample size:** ca 0.1 µl liquid commercial 1,3-butadiene
- **Concentration range:** ca. 20 ppm
- **Solvent sample:** cyclohexane

**Peak identification:**

1. 1,3-butadiene
2. 2-methyl-1-propene
3. methanol

**Analysis of trace methanol in propylene** Application 1360 - GC

**Oxygenates**

The CP-Lowox adsorbent provides very high retention for oxygenated compounds. The methanol elutes after n-C14, allowing this component to be measured at low levels in a range of hydrocarbon streams, see Application note 1363. A typical application of trace methanol in propylene is shown here. Methanol has to be measured usually at specs as low as 5 ppm. The CP-Lowox column the methanol can be quantified down to sub-ppm levels. The reproducibility of this method is within 5%.

Besides propylene, also the measurement of methanol in ethylene and butadiene is possible. The high maximum temperature of 350 °C with virtually no bleed makes the CP-Lowox column widely applicable. Other C1 - C5 oxygenated compounds can also be separated as the selectivity of the CP-Lowox column is also very high, see Application 1362.

- **Technique:** GC - wide-bore
- **Column:** CP-Lowox 0.53 mm fused silica PLOT, Cat. no. 8587
- **Temperature:** 150 °C (2 min) → 250 °C, 10 °C/min
- **Carrier gas:** He, 10 kPa (0.1 bar, 1.4 psi)
- **Injector:** Direct
- **Detector:** FID
- **Sample size:** 1 µl
- **Concentration range:** 0.01 %

**Peak identification:**

1. acetaldehyde
2. diethyl ether
3. ethyl tert-butyl ether
4. methyl tert-butyl ether
5. diisopropyl ether
6. propionaldehyde (propanal)
7. tert-amyl methyl ether
8. dipropyl ether
9. isobutylaldehyde
10. butyraldehyde
11. methanol
12. acetone
13. isovaleraldehyde
14. valeraldehyde
15. 2-butanone
16. ethanol
17. 1-propanol
18. 2-methyl-1-propanol (isobutanol)
19. 2-methyl-2-propanol (isobutanol)
20. 1-butanol

**Analysis of trace methanol in propylene** Application 1360 - GC

**Oxygenates**

The CP-Lowox adsorbent provides very high retention for oxygenated compounds. The methanol elutes after n-C14, allowing this component to be measured at low levels in a range of hydrocarbon streams, see Application note 1363. A typical application of trace methanol in propylene is shown here. Methanol has to be measured usually at specs as low as 5 ppm. The CP-Lowox column the methanol can be quantified down to sub-ppm levels. The reproducibility of this method is within 5%.

Besides propylene, also the measurement of methanol in ethylene and butadiene is possible. The high maximum temperature of 350 °C with virtually no bleed makes the CP-Lowox column widely applicable. Other C1 - C5 oxygenated compounds can also be separated as the selectivity of the CP-Lowox column is also very high, see Application 1362.

- **Technique:** GC - wide-bore
- **Column:** CP-Lowox 0.53 mm fused silica PLOT, Cat. no. 8587
- **Temperature:** 250 °C (iso/prog)
- **Carrier gas:** He, 420 kPa (4.2 bar, 60 psi)
- **Detector:** FID
- **Sample size:** 1 µl
- **Concentration range:** 0.01 %

**Peak identification:**

1. methyl tert-butyl ether
2. 2-propanol (propanol)
3. 1-propanol
4. methanol
5. diisopropyl ether
6. isobutylaldehyde
7. 2-butanone
8. ethylene
9. diethyl ether
10. methanol
11. acetone
CP-CarboBOND and CP-CarboPLOT P7

CP-CarboBOND

- New Bonded Carbon PLOT column for analyzing CO and CO2 in C2/C3 streams
- ppm acetylene in ethylene streams using a single column
- High Tmax 300 °C for elution of high boiling components and fast cycle times
- Single column replacement for ASTM D2505
- No need for particle traps
- Repeatable retention times
- (no influence of moisture on retention)

CP-CarboPLOT P7

- Separates O2 and N2 together with CO and CO2 in C2/C3 streams
- Repeatable retention times
- No need for particle traps
- Single column replacement for ASTM D2505
- High Tmax 300 °C for elution of high boiling components
- ppm acetylene in ethylene streams using a single column

Fast analysis of acetylene in ethylene

Application 1433 - GC

Gases, hydrocarbons C1 - C3

CP-CarboBOND elutes acetylene in front of the ethylene allowing accurate quantification of ppm levels of acetylene in high-purity ethylene. This analysis is usually done by a multi-value packed system, see ASTM D2505. The acetylene peak, however, is broad and detection limits are depending strongly on the quality of the system, but are typically around 1 ppm. With the CP-CarboBOND, the analysis can be done on one column while improving the detection limit significantly.

The interest is mainly in traces acetylene and the separation of CO from air is not important. A 25 m column can be chosen with a 10 µm coating. This column allows acetylene measurements below 100 ppm within 7-8 minutes analysis times.

The large injection volume will make trace analysis of acetylene possible, but will also cause a coelution between air and CO. If CO and acetylene have to be measured at lowest level, a 50 m x 0.53 mm CP-CarboBOND with a 10 µm layer is recommended (Cat. no. 7372). At the CP-CarboBOND columns can be conditioned at 300 °C for quick bake-out. Due to the bonded layer, the CP-CarboBOND can be used with switching systems.

Technique: GC - wide-bore
Column: CP-CarboBOND fused silica PLOT 25 m x 0.53 mm, df = 10 µm Cat. no. 7374
Temperature: 35 °C (4 min) → 180 °C, 30 °C/min
Carrier gas: He, 40 kPa (0.4 bar, 6.6 psi)
Injector: Valve into split, split 1:5, T = 30 °C
Detector: FID, T = 250 °C
Sample size: 1000 µl
Concentration range: 3 ppm acetylene in ethylene synthetic standard
Courtesy: Jim Luong and Lyndon Sieben, Dow Chemical Canada, Western Canada Operations

Peak identification:
1. methane
2. acetylene
3. ethylene bulk
4. ethane
5. propane

Analysis of carbon monoxide and carbon dioxide in hydrocarbon streams

Application 1431 - GC

Gases, hydrocarbons C1 - C2

The CP-CarboBOND column has a high retention for CO and CO2. The CO is separated from the air peak, but only if the air peak is not too big. Separation between CO and oxygen (air) is sufficient (Chromatogram 1). If there were coelution, response would be non-linear. Therefore, this can only be done if the oxygen concentration is of the same order as CO. Here we were able to inject up to 100 µl of ethylene, keeping the response on carbon monoxide reproducible. When using shorter columns, the sample size has to be much smaller to get the separation. A 50 m x 0.53 mm CP-CarboBOND with a 10 µm film will improve capacity, but will also require more time for higher boiling material to elute. To elute any high boiling material, the CP-CarboBOND column can be conditioned at 300 °C for quick bake-out. Due to the bonded layer, the CP-CarboBOND can be used with switching systems.

Technique: GC - wide-bore
Column: CP-CarboBOND fused silica PLOT 50 m x 0.53 mm, df = 10 µm Cat. no. 7372
Temperature: 35 °C (7 min) → 180 °C, 30 °C/min
Carrier gas: H2, 60 kPa (0.6 bar, 7.2 psi)
Injector: Valve via split, 1:5, T = 30 °C
Detector: FID 1: Chromatogram 1
Chromatogram 2

Peak identification: chromatogram 1
1. carbon monoxide
2. methane
3. carbon dioxide
4. acetylene
5. ethylene
6. ethane

Peak identification: chromatogram 2
Concentration range: equal concentrations
1. helium
2. air
3. carbon monoxide
CP-Molsieve 5Å

- High-resolution analysis of permanent gases
- New, thin-layer dimensions for fast elution of CO
- Symmetrical peaks (even for CO)
- Available in both fused silica and Ultimetal

The molecular-sieve coated capillary column is especially valuable when separating permanent gases. These columns deliver analysis times that are one quarter of those achieved with packed columns. The CP-Molsieve 5Å delivers baseline separation of Ar/O2 at ambient temperatures. Columns are available in fused silica and in Ultimetal. A special thin-film CP-Molsieve 5Å is available for the fast elution of CO.

Gases separated by Molsieve 5 PLOT
- He   H2   O2   CO
- Ne   HD   N2   N2O
- Ar   D2   CH4
- Kr   HT   C2H6
- Xe   DT   CD4
- Rn   T2   C2D6

Replaces: Molsieve 5
GS-Molsieve; HP-PLOT Molsieve

Tmax: 350/350 (°C) iso/prog

High resolution chromatography of permanent gases

Technique: GC - wide-bore
Column: Molsieve 5Å fused silica PLOT 50 m x 0.53 mm; df = 50 µm Cat. no. 7539
Temperature: 30 °C
Carrier gas: H2' 55 kPa (0.55 bar, 8 psi); 25.6 cm/s
Injector: Splitter, 200 ml/min T = 30 °C
Detector: TCD T = 180 °C
Concentration range: 5 - 10%

Peak identification:
1. helium
2. neon
3. argon
4. oxygen
5. nitrogen
6. methane

Permanent gases on a thin film Molsieve column

Technique: GC - wide-bore
Column: CP-Molsieve 5Å fused silica PLOT 30 m x 0.53 mm; df = 15 mm Cat. no. 7544
Temperature: 100°C
Carrier gas: H2
Injector: Split, 100 ml/min Detector: TCD
Sample size: 10 ml Concentration range: % range

Peak identification:
1. helium + neon
2. argon + oxygen
3. nitrogen
4. methane
5. carbon monoxide

Remarks:
1. For same application on a thick film column see Application Note 1247
2. For same application at 30°C oven temperature see Application Note 1248
3. For same application at 50°C oven temperature see Application Note 1245
Further application help

CP-Scanview CD-ROM

Expand your application possibilities with CP-Scanview, our FREE applications database. CP-Scanview is an easily searchable CD-ROM that contains over 1540 GC and HPLC applications, as well as 1200 sample preparation methods. This CD-ROM is an invaluable tool for all chromatographers; contact your Varian office today for your free copy.

Help Desk

For responsive customer support, you can always rely on our Technical Help Desks in the USA and Europe. Help Desks associates are a dedicated group of chemists, all with Ph.D or Master of Science in Chemistry degrees. Many have over ten years of experience with SPE, LC and, GC method development. Varian's Help Desk team is always available to answer customers' toughest application questions.

Call the US Help Desk toll-free at 800.421.2825, send a fax at 310.539.1449, or e-mail us at helpdesk.us@varianinc.com.

Call your local Varian office for the European Help Desk nearest you, we'll connect you at no cost. Or, e-mail us at helpdesk.eu@varianinc.com.

Additional Reading

For further information, please ask for our additional documentation, mentioned below.

P-126 Application of in-situ prepared PLOT columns for gas chromatograph (CP-PoraBOND; CP-CarboBOND; CP-SilicaPLOT)

P-121 CP-PoraBOND, a 100% bonded porous polymer coated capillary column (CP-PoraBOND Q)

P-120 Separation of impurities in light hydrocarbons using a highly stable carbon-coated capillary column (CP-CarboBOND)

P-119 Analysis of ppm-ppb levels of oxygenates in C1-C5 hydrocarbons by using a highly selective PLOT column (CP-Lowox)

P-115 Separation of chlorofluorocarbons (CFC) on PLOT columns coated with an inert adsorbent based on silica (CP-SilicaPLOT, CP-PoraPLOT Q,S&U)

P-112 New silica-based adsorbent for analyzing volatile compounds (CP-SilicaPLOT)

P-134 Moving from packed to wide bore: a simple step for significantly improve your packed GC method. (0.53 mm ID capillary columns)

P-97 CP-Al2O3 and CP-Molsieve 5Å, separation of light hydrocarbons and permanent gases using PLOT columns (CP-Al2O3 and CP-Molsieve 5Å)