# Application Note 73

# Wide Bore Capillary GC Columns: Useful Tools in Arson Investigations

***Many forensics specialists use chromatograms as reference profiles for the complex hydrocarbon mixtures often used as accelerants in arson. Capillary GC columns of 0.53mm ID or more offer sample resolution superior to that for packed columns, and equal to that of narrow bore capillary columns. Wide bore columns can be used in packed column systems, with detectors designed for use with packed columns, to greatly improve sample resolution without a large investment in new equipment. Despite the differences in resolution, chromatograms from wide bore capillary columns and packed columns are very similar, so there is no need to replace reference chromatograms.***

**Key Words:**
- arson • accelerants • gasoline • kerosene
- weathered hydrocarbons

Many forensics specialists use chromatograms from nonpolar gas chromatography columns as reference profiles, or *fingerprints,* for the complex hydrocarbon mixtures arsonists often use to accelerate fires. A packed column containing SP™-2100 or SE-30 phase provides high thermal stability, low bleed rates, short analysis times, and reproducible results. A 10-foot SP-2100 column, for example, can resolve 30 or more gasoline components in less than 20 minutes.

Unfortunately, an accelerant recovered from fire debris often produces a chromatogram markedly different from that produced by the fresh material. Partial burning or indirect heat from the fire can selectively reduce the more volatile components. Extracted accelerants can be mixed with, or can resemble, pyrolysis products of building materials. Alternatively, the arsonist may have used a mixture of accelerants. In any of these situations, it can be very difficult to match the material extracted from the fire debris to a pattern in a library of chromatograms.

To avoid incorrectly interpreting the chromatogram of a suspected accelerant, it may be necessary to improve sample resolution. In such situations, forensics specialists have used narrow bore capillary columns (0.25–0.32mm ID), rather than packed columns. A 30 meter SPB™-1 column (bonded equivalent to SE-30) provides short analysis times and excellent resolution of hydrocarbons. Many more peaks are resolved than on a packed column with an equivalent phase. In fact, if you prolong the analysis time, a 30 meter SPB-1 column will resolve more than 250 gasoline components. A longer column – and long analysis times – can further increase the number of components resolved.

There are, however, disadvantages to using narrow bore capillary columns. Capillary chromatography requires expensive equipment, and the operator must have special training. The columns require very small samples. Therefore, they cannot be used with low-sensitivity detectors, such as thermal conductivity detectors. The sample splitting systems needed to deliver small amounts of sample onto the column can discriminate among sample components. In arson detection, splitter discrimination can complicate an already difficult analysis.

To obtain excellent sample resolution without incurring the problems associated with narrow bore capillary columns, some analysts have turned to wide bore capillary columns (1). Wide bore columns – 0.53mm ID or greater – offer sample resolution equal to that of narrow bore capillary columns, but wide bore columns are compatible with the larger samples and greater gas flows required by detectors in packed column systems. This makes it possible to use wide bore columns in chromatographs designed for packed columns, with flame ionization detectors, thermal conductivity detectors, and other detectors designed for use with packed columns. Thus, a forensics specialist now using a packed column system can greatly improve sample resolution without making a large investment in new equipment. At high detector sensitivities, the signal-to-noise ratio is greater for wide bore capillary columns than for packed columns. This can be especially important for detecting trace components. Despite the advantages of wide bore columns, chromatograms from wide bore columns and packed columns are very similar, so there is no need to replace fingerprint files.

Figure A clearly shows that although fingerprints obtained from a wide bore capillary column and a packed column are basically the same, the wide bore column consistently provides far more detail. The severely evaporated (99.9+%) gasoline sample simulates a situation a fire would present. As the figure shows, the accelerant could be identified from the wide bore chromatogram, but not from the packed column chromatogram. Note that the analysis times shown in these chromatograms are not necessarily optimal for either the packed column or the wide bore capillary column, but have been chosen simplify peak for peak comparison.

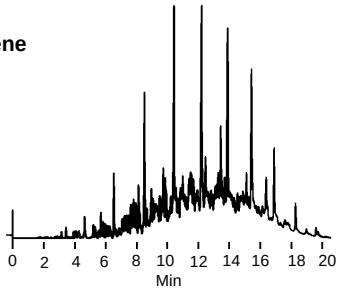
It takes only a few minutes to interchange a packed column system between use with a packed column and use with a wide bore capillary column. And no special training is required to use these columns. If you need greater resolution than a packed column can provide, but lack the experience or equipment necessary for narrow bore capillary chromatography, or if you simply do not want to replace your library of packed column chromatograms, a wide bore capillary column can be ideal.

## Figure A. A Wide Bore Capillary Column Provides More Information about Complex Hydrocarbon Mixtures

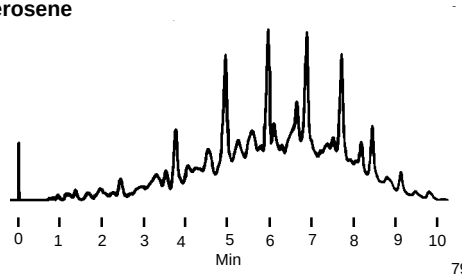
Capillary Column: **SPB-1, 60m x 0.75mm ID, 1.0µm film**
Oven: 50°C (2 min), then to 230°C at 8°C/min
Carrier: helium, 15mL/min
(make-up gas = 15mL/min helium)
Det.: FID, 290°C
Inj.: 220°C

Packing: 3% OV®-101 on Chromosorb® W HP
Column: **2m x 1/8" stainless steel**
Oven: 70°C (2 min) to 230°C at 16°C/min
Carrier: helium, 30mL/min
(make-up gas = 30cc/min helium)
Det.: FID, 290°C
Inj.: 220°C

**0.1µL Kerosene**

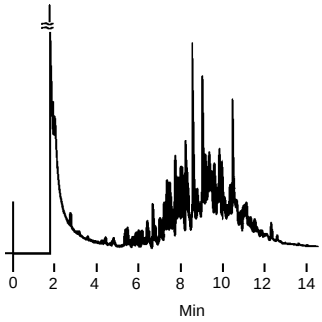



**1µL Kerosene**

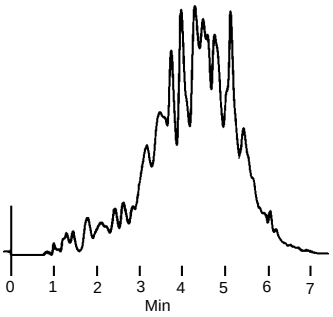



795-0304, 0303

**1ng Varsol®-1 in 1µL $CS_2$**

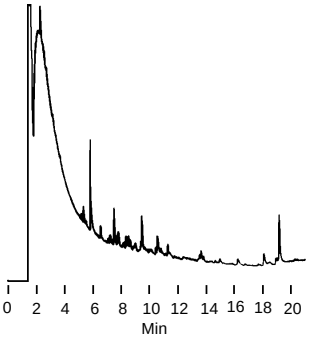



**1µL Varsol-1**

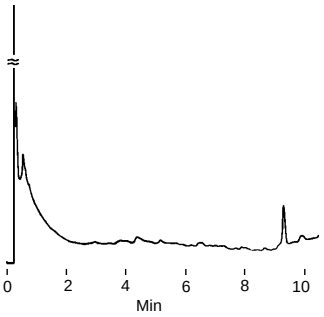



795-0308, 0307

**99.9+% Evaporated Gasoline (Trace Gasoline Residue in 5µL $CS_2$)**




**Trace Gasoline Residue in 5µL $CS_2$**




795-0306, 0305

## Ordering Information:

### SPB-1 Capillary Columns*

| | |
|---|---|
| 60m x 0.53mm ID, 1.0µm film | **25418** |
| 60m x 0.53mm ID, 1.5µm film | **25388** |

For many other wide bore capillary columns, or for packed columns, please refer to our catalog or call our Order Processing personnel.

**Reference**

1. Kubler, D.G., Arson Analysis Newsletter (1985).

Reference not available from Supelco.

* 0.75mm ID columns are no longer available. We recommend 0.53mm ID fused silica columns for this application.

**Trademarks**

SP, SPB, SUPELCOPORT– Sigma-Aldrich Co.
Chromosorb – Celite Corp.
OV – Ohio Valley Specialty Chemical Co.
Varsol – Humble Oil & Refining Co.

**Acknowledgment**

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Contact our Technical Service Department (phone 800-359-3041 or 814-359-3041, FAX 800-359-3044 or 814-359-5468) for expert answers to your questions.

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