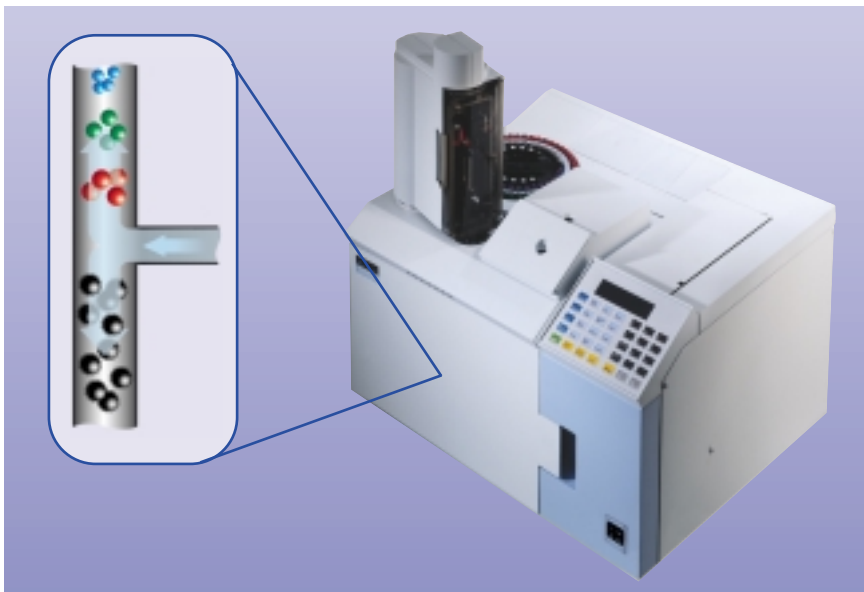


# Gas Chromatography

## PreVent: The next generation in capillary GC productivity



AutoSystem XL Gas Chromatograph with PreVent

PerkinElmer's PreVent™ is a unique, innovative productivity tool for gas chromatography only available on the PerkinElmer AutoSystem XL™ GC configured with PPC™ (Programmable Pneumatic Control). Almost every GC analysis, from routine operations to the most demanding research application, will benefit significantly from this revolutionary technique. PreVent offers four outstanding modes of operation for improving chromatographic performance, minimizing system downtime and greatly enhancing productivity.

- **Isolation mode** – Eliminates downtime during routine injector maintenance. Provides many additional analytical hours of productivity per system per year.
- **Enhanced Large-Volume Injection (ELVI) mode** – Facilitates manual injection volumes up to 150  $\mu\text{L}$  and automatic injection volumes up to 50  $\mu\text{L}$  without solvent reaching

the column or detector. Used for the analysis of semivolatile organics such as pesticides, PCBs, and PAHs. ELVI offers up to 150 times more sensitivity and/or eliminates lengthy sample preparation. ELVI with total solvent elimination is particularly beneficial for methods where a sample preconcentration step is required. For these determinations, PreVent can significantly increase revenue per system per year. ELVI mode requires a Programmable Split/Splitless (PSS) injector.

- **Time-Saver mode** – Prevents unwanted, low volatility material from reaching the detector, thus shortening analysis times, facilitating isothermal chromatography and protecting the detector from contamination.
- **ProTect mode** – Makes possible many "impossible" separations of volatile components in semivolatile samples. The ProTect™ mode prevents heavy components in the sample from reaching the expensive and very retentive chromatographic column.

### Key Features

- ▶ Perform routine maintenance while the chromatography is occurring.
- ▶ Perform large volume injection for greater sensitivity with no solvent reaching the detector.
- ▶ Backflush the column so that none of the unwanted material reaches the detector.
- ▶ Make "impossible" separations by using ProTect so that none of the heavy components goes through the column.

## Isolation Mode

Isolation mode allows the injector to be disassembled for routine maintenance such as changing the liner or septum. This can be achieved *even while chromatography is in progress* (Figure 1). The flow of carrier gas is not disturbed and air does not enter the system during this procedure. Isolation mode is particularly suited to applications using electron capture (ECD) or mass spectrometric (MS) detectors which would otherwise require extended cool-down periods and reequilibration times (Table I).

Isolation mode is complemented by the optimum design of the AutoSystem XL autosampler. The design positions the syringe away from the GC inlets except during injection (Figure 2). This allows access to the injectors without interrupting or interfering with the automation sequence in any way. The self-aligning autosampler can also be rotated to the front of the GC which makes the syringe readily accessible for maintenance and quick exchange.

## Enhanced Large-Volume Injection (ELVI) Mode

PerkinElmer was the first analytical instrument company to offer gas chromatographers true, routine large-volume injection (LVI) with standard instrumentation. The AutoSystem XL with the Programmable Split/Splitless (PSS) injector offers compatibility with liquid sample volumes up to 150  $\mu\text{L}$  by manual injection or 50  $\mu\text{L}$  by autosampler for solutions of semivolatiles. This facility enhances detection limits by factors of 10 to 150 and/or significantly reduces sample preparation times by eliminating or minimizing the requirement for sample preconcentration.

On an AutoSystem XL configured with a PSS injector, the sample is introduced while the injector is cool and the split vent is open. The vast majority of solvent (typically 98 to 99%) is thus purged from the system through the split vent. The vent is then closed, the injector heated and the analytes transferred splitless onto the analytical column. Using this

approach, a standard 50- $\mu\text{L}$  injection results in only 0.5 to 1  $\mu\text{L}$  of solvent reaching the column and detector.

This powerful, innovative feature of the PSS is further enhanced with PreVent. ELVI eliminates virtually all solvent from the analytical system. This allows otherwise hostile solvents to be used directly, which can drastically reduce sample preparation times. For example, ELVI allows use of halogenated solvents such as methylene chloride with ECD (Figure 3). Applications which can benefit from this capability include PCBs, pesticides and PAHs in soil and water (e.g., US EPA Method 8081), the analysis of pesticide residues in foods (e.g., AOAC Multiresidue Method 970.52), and many clinical/toxicological determinations.

In many of these applications, sample concentration steps can be simplified and the requirement for solvent exchange is entirely eliminated. Manual preparation times are halved from 1.5 to 2 hours per sample on a conventional GC to approximately 45 minutes per sample with the AutoSystem XL and PreVent. As sample preparation is the rate-determining step for these and other similar applications, twice as many samples can be run through an AutoSystem XL configured with PreVent as through a conventional GC. Consumable costs, solvent usage, and sample turn-around times are significantly reduced.

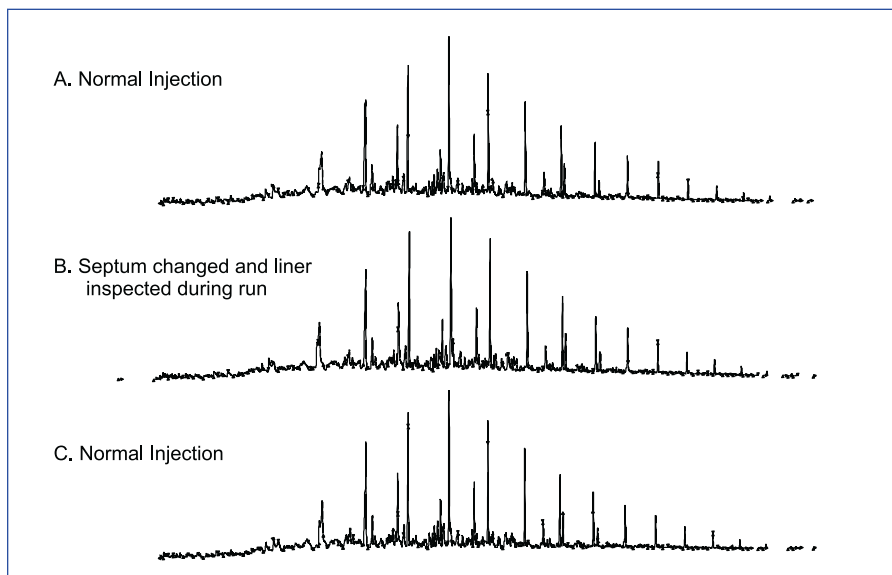


Figure 1. Three successive injections of diesel oil run in Isolation mode. Septum changed and injector liner inspected during run B.

Table I. System downtime for liner change (minutes)

	GC-MS without PreVent	AutoSystem XL / TurboMass Gold with PreVent
Remove autosampler	1.0	n/a
Cool oven, injector, transfer line and detector	60.0	n/a
Replace liner	2.0	0.0*
Replace autosampler	1.0	n/a
Pump down, heat and equilibrate	60.0	n/a
TOTAL	124.0 min	0.0 min

\* Liner changed while chromatography is in progress

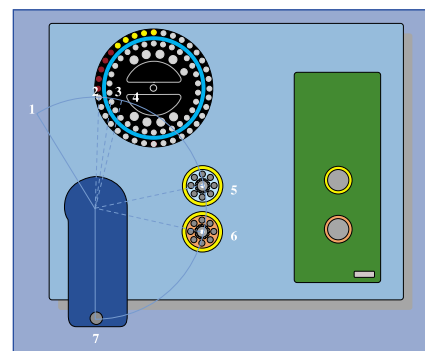


Figure 2. The autosampler rotates to various positions: 1)Rest 2)Outer sample vials 3)Inner sample vials 4)Waste/wash vials 5)Injector A 6)Injector B 7)Park. When in rest or park position, the injectors are fully accessible for inspection and maintenance.

### Time-Saver Mode

Time-Saver mode reduces analysis times for volatile target analytes in samples which also contain high-boiling components (Figure 4). Productivity can be enhanced three to six times in many cases. For some applications, elimination of high-boiling non-target components also allows isothermal chromatography to be used, thus removing the necessity for GC oven cool-down periods between samples.

Applications include volatile organics in crude oil, foods, polymers, biological/toxicological samples, soil, and waste.

By preventing high-boiling components from reaching the detector, significant additional cost savings and productivity enhancements can also be realized in terms of less frequent maintenance and reduced downtime. This factor is especially critical for GC/MS systems and sensitive selective detectors such as the ECD, NPD (Nitrogen Phosphorus Detector), and ELCD (Electrolytic Conductivity Detector). In these cases, Time-Saver mode can reduce the frequency of routine maintenance due to system contamination to as little as one tenth of that expected on conventional systems.

### ProTect Mode

While the Time-Saver mode is an effective way to remove unwanted sample residue from the GC column once the analytes have eluted, the whole sample still enters the separation column. While this is not normally a problem, there are some instances where heavy or reactive sample components must be kept out of a sensitive, retentive (and expensive) separation column. The PerkinElmer ProTect system does just this, *protecting* the separation column from such materials.

ProTect inserts a miniature precolumn between the injector and the separation column. The whole sample is loaded onto this precolumn. The volatile components elute first from the precolumn and enter the separation column. The heavier sample residue is retained in the precolumn until backflushing is initiated within the precolumn – thus all of the heavy residue is excluded from the separation column.

Figure 5 illustrates a typical application of the ProTect system: the deter-

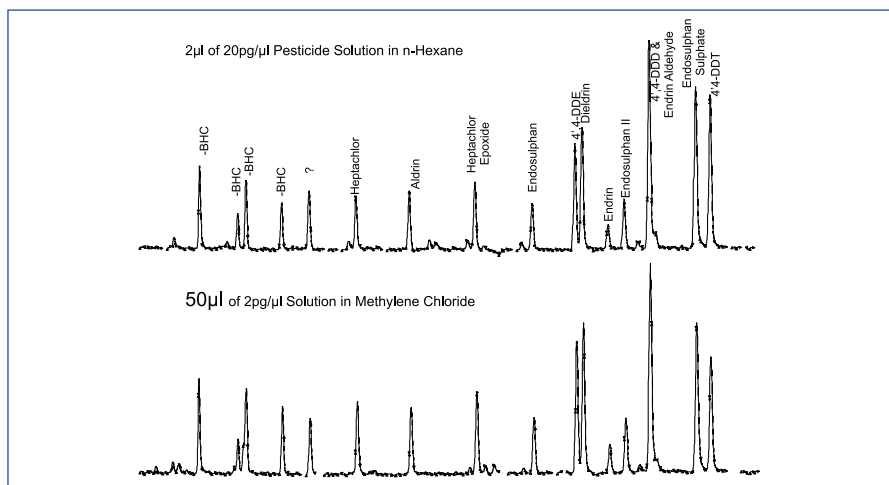


Figure 3. ELVI allows the use of chlorinated solvents with an electron capture detector (ECD).

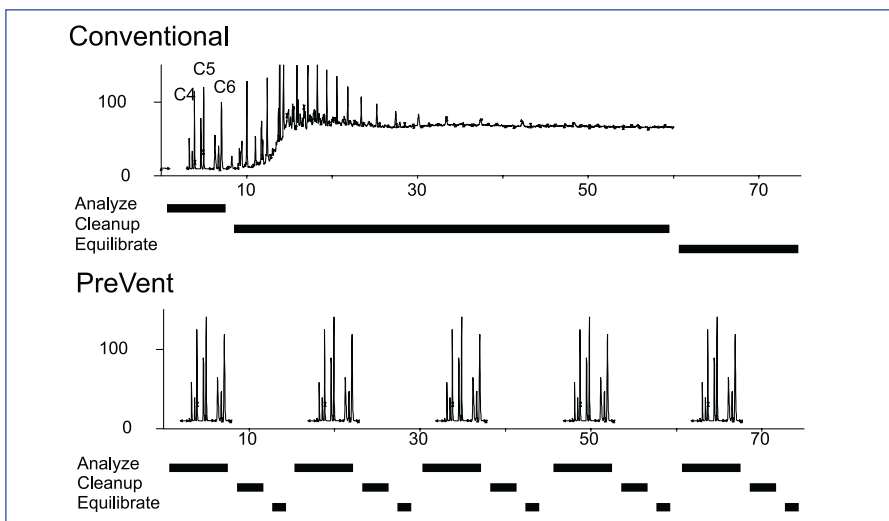


Figure 4. Time-Saver reduces analysis time.

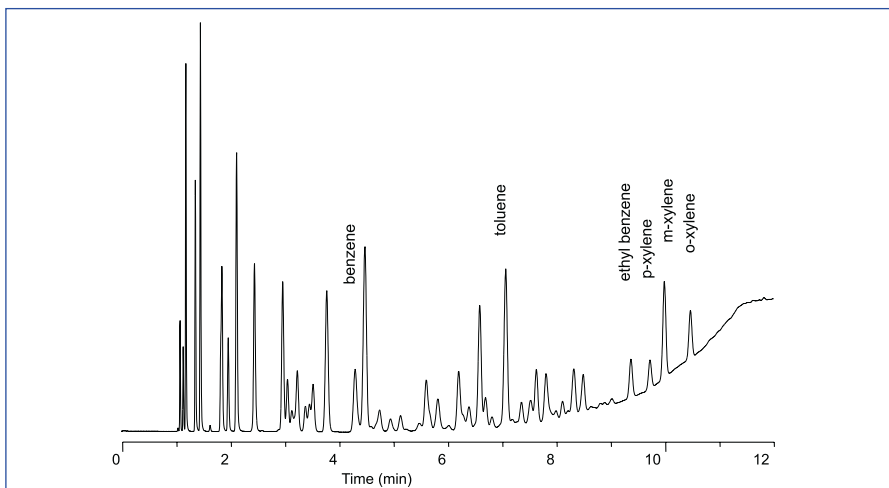


Figure 5. ProTect system used for analysis of BTEX in Alaska Crude Oil (undiluted). Analysis cycle time is 20 minutes.

mination of benzene, toluene, ethyl benzene and xylenes (BTEX) in a heavy oil matrix. The separation column used in this instance (Bentone 34/DnDP SCOT) is very good at resolving the BTEX components including all the xylene isomers but has a maximum temperature limit of

130°C. Direct injections of the heavy crude oil into this column would degrade the column in a short time. The ProTect system excludes all the heavy material from this delicate column and produces a very robust, fast, and reliable analysis requiring no sample preparation.

### Additional features of the PerkinElmer PreVent option

- PreVent is user installed within five minutes and is simple to set up and operate. It is inert (Figure 6) and compatible with fast chromatography.
- All PreVent flows are electronically controlled by PPC (Programmable Pneumatic Control) with all parameters stored as part of the GC method.
- The system may be controlled via the GC keyboard or via the TotalChrom™ Chromatography Workstation.

PreVent enhances these features and more – providing an innovative solution to the key productivity issues of sample preparation, maintenance, and contamination – issues faced by chromatographers on a daily basis.

Productivity, cost savings, and quality of results are critical factors in almost every analytical laboratory. The next generation of GC instruments must offer a significant positive impact on these key laboratory requirements. The AutoSystem™ XL GC with PreVent, based on the AutoSystem™ GC, renowned for its

exceptional reproducibility, reliability, and ease of operation, meets these needs more effectively than any other commercially-available GC system.

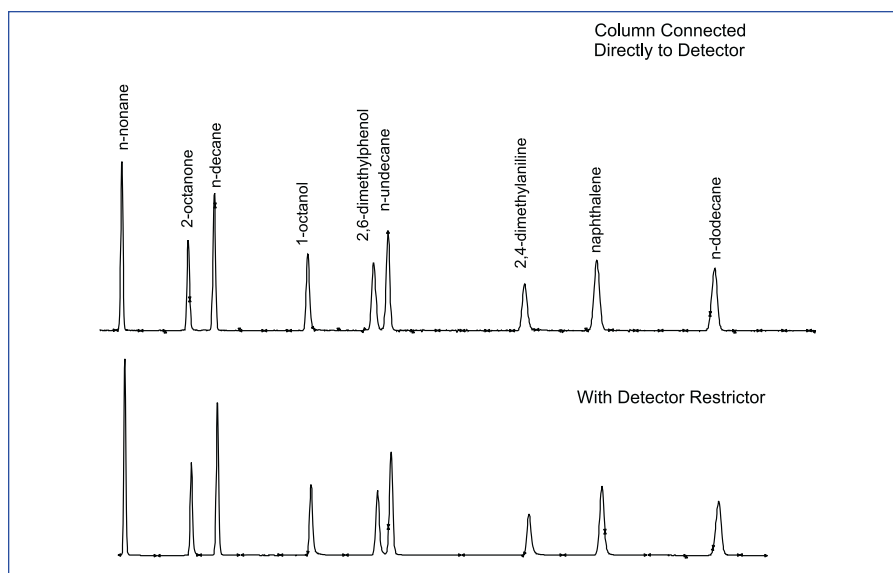


Figure 6. PreVent is totally inert and does not affect peak shape.

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