Clarus 500 Gas Chromatograph/Mass Spectrometer

ultimate data integrity

PerkinElmer®
precisely.

innovative technology

Unmatched accuracy and precision

The Clarus® 500 Gas Chromatograph/ Mass Spectrometer (GC/MS) features a wealth of innovative technology to provide the most complete characterization of samples. PerkinElmer Selected Ion and Full Ion (SIFI™) scanning technology and high scan speed increase system throughput and accuracy. The mass spectrometer boasts the fastest, widest-mass-range quadrupole mass spectrometer available for GC/MS, providing capability to analyze a greater scope of applications. The Clarus 500 GC/MS also includes proven gold technology for enhanced performance.

State-of-the-art electronics process more scans across each peak, resulting in unmatched accuracy and precision and better overall spectral fidelity. Couple the high performance electronics with unique productivity tools and you have a system that provides the functionality necessary to achieve optimum performance, allowing you to complete work quickly, easily and efficiently.

The wide mass range and flexible data acquisition modes help tackle the most complex applications, while robust instrument design delivers maximum uptime, easy maintenance and lower operating cost.

Combine the Clarus 500 MS with the Clarus 500 GC, market-leading PerkinElmer sample handling accessories, flexible user-friendly software and world-class service and support for an integrated, complete analytical solution. Whatever your application – environmental, chemical, flavor and fragrance, food, beverage, forensic or pharmaceutical – PerkinElmer delivers the accuracy and precision you need.

Run fast GC using GC/MS

With faster scan speeds, the Clarus 500 GC/MS opens new and attractive opportunities in fast GC applications. Extremely narrow chromatographic peaks, previously unresolvable with full-scan quadrupole mass spectrometry, can be easily defined and quantified with the Clarus 500 GC/MS (Figure 1). Consider the productivity gains your lab can achieve by applying fast GC/MS techniques, such as in separation of solvent mixtures or semivolatile components.

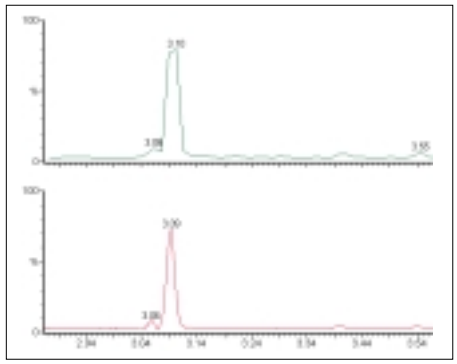

Figure 1. In fast GC/MS, the Clarus 500 GC/MS resolves peaks that were previously unresolvable with full scan quadrupole mass spectrometry. The top chromatogram shows resolution with slow scan speed, while the lower chromatogram demonstrates the benefit of increasing the number of scans.

the choice for high performance

Take the lead on GC/MS speed

The Clarus 500 GC/MS is the fastest quadrupole GC/MS available, acquiring more spectra (up to 60 scans/second) across a GC peak than any other GC/MS system. More spectra per peak means more accurate and precise results (Figure 2) and better spectral fidelity (Figure 3), resulting in the most complete information and the highest confidence in analytical data reporting.

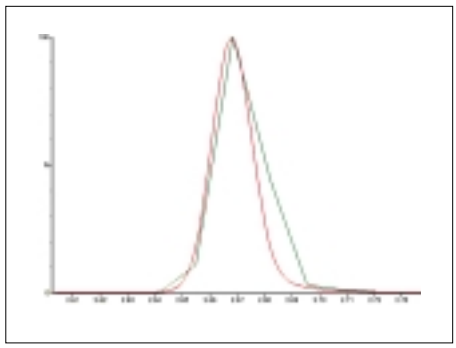

Figure 2. Chromatographic signal at fast scan speed (red) compared to slow scan speed (green).

How does fast scan speed improve your data?

Scan speed is the rate of data acquisition across a chromatographic peak, measured as scans per second.

Scan speed of a quadrupole mass spectrometer is critical in ensuring data integrity. Too few scans across a GC peak lead to poor recorded peak shape, limiting quantitative accuracy and precision (Figure 2). A slow scan rate on a fast peak causes spectral distortion, or "skewing", reducing spectral fidelity (Figure 3, top). Faster scanning minimizes the skewing and gives better overall spectral fidelity (Figure 3, bottom).

The Clarus 500 GC/MS incorporates fast micro-processor technology bringing new, high-speed, state-of-the-art electronics to GC/MS data processing that maximizes scan speed. Up to 60 scans/second can be achieved, the fastest scan speed available in quadrupole GC/MS. The result is the most accurate and precise data ever, easily beating the generally accepted criteria of at least 8-10 data points per chromatographic peak, for performance unmatched by other GC/MS systems.

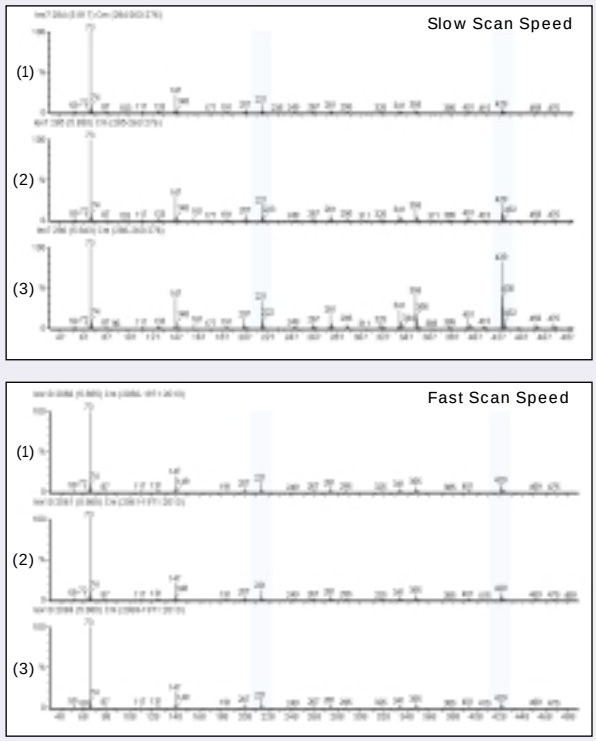

Figure 3. Better spectral fidelity with fast scan speeds, increasing confidence in results. Top and bottom figure with spectra acquired from (1) fronting, (2) apex and (3) tailing point along a chromatographic peak.

innovative tools bring productivity to new levels

The Clarus 500 GC/MS features innovative and unique productivity-enhancing tools that help laboratories operate effectively and efficiently.

Selected Ion and Full Ion (SIFI) scanning

The Clarus GC/MS can perform a powerful process called Selected Ion and Full Ion (SIFI) scanning in which a Selected Ion Monitoring (SIM) scan is obtained while simultaneously acquiring data in the Full Scan mode. Since SIFI provides the information from both operational modes in one chromatographic run, you receive more information in less time. With other GC/MS systems, two or more runs might be required to accomplish the same task.

With SIFI, labor-intensive pre-concentration and sample clean-up steps may be reduced or eliminated, saving time and money on costly solvents. In addition, compounds difficult to determine at low levels, such as pentachlorophenol, can be detected and quantified with greater accuracy and greater sensitivity. This also reduces the number of analyses by combining a wider range of analyte responses in a single chromatographic run, improving the throughput of your lab.

What is SIFI scanning?

The Clarus 500 GC/MS can perform a Selected Ion Monitoring (SIM) scan while simultaneously acquiring data in the Full Scan mode (Figure 4). Called SIFI scanning, this unique technique provides more complete sample information in less time.

The SIM mode increases sensitivity by selectively scanning for individual masses, while weeding out or ignoring unwanted or irrelevant masses. This powerful scan mode focuses all the attention on masses of interest, without wasting effort and efficiency. By using SIM, detection limits can be extended down to the femtogram range. In Full Scan mode, low picogram levels can be detected, allowing acquisition of library-searchable spectra over a wide concentration range.

SIFI scanning ensures accurate identification, while simultaneously providing enhanced quantifiable sensitivity from the selected ion signal.

SIFI is NOT an extracted chromatogram from a full scan acquisition. Extracted ion chromatograms offer no improvement in signal strength for the ions of interest – only noise rejection from the unwanted masses. SIFI provides at least an order of magnitude improvement in detection limits.

SIFI is also a powerful way to troubleshoot unknowns during routine quantification due to its ability to provide accurate and complete sample information.

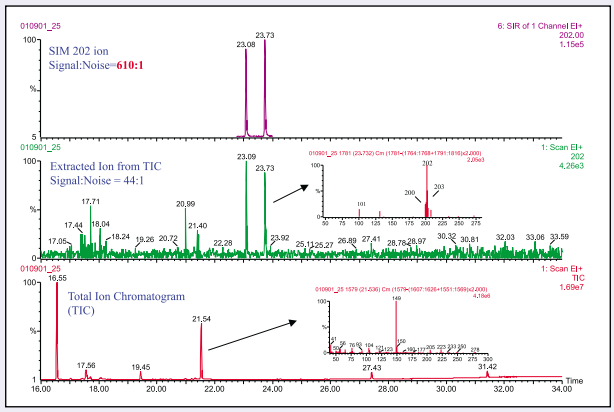

Figure 4. SIFI scanning ensures accurate identification, while simultaneously providing enhanced quantifiable sensitivity from the selected ion signal.

Intuitive software makes analysis easy

The Clarus 500 GC/MS runs on PerkinElmer's proven TurboMass™ software platform (Figure 5), which offers the versatility needed to run both routine and complex applications. TurboMass software for the Clarus 500 GC/MS makes report creation both intuitive and quick. The software includes report templates (Figure 6) designed to meet the specific needs of users conducting forensic, clinical or toxicological diagnostics, as well as general chemical analysis.

Figure 6. TurboMass software provides standard and customized report templates.

Easy to learn

The sample-centric graphical user interface, AutoTune, and other data-processing features are powerful yet easy to master, even for less skilled users. With a short learning curve, staff is easily trained and productive right away. The software includes flexible reports that can be generated quickly and easily. Data is easily accessible using our powerful Visual Basic™-based macro language and can be exported to spreadsheet and database programs.

The software uses Microsoft® Windows® 2000, providing a high level of security, network connectivity and operating stability. In addition, different levels of user access can be defined to ensure data integrity by securing files from unauthorized modification. Mass spectral data can be imported from or exported to industry standard AIA format. A variety of mass spectral libraries for compound identification, including NIST, Wiley and Pfleger/Maurer/Weber, are available.

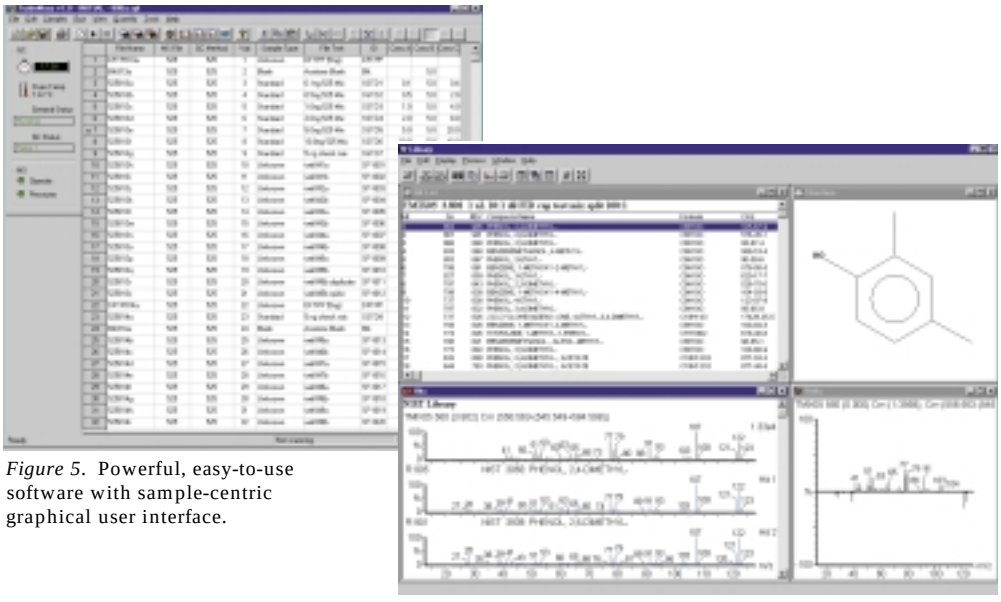

Figure 5. Powerful, easy-to-use software with sample-centric graphical user interface.

PreVent modes maximize productivity

PreVent accessory

The PerkinElmer exclusive PreVent productivity tool kit offers five modes of powerful operation for improving chromatographic performance, minimizing system down-time and enhancing productivity. Only the PerkinElmer PreVent accessory offers all five modes of operation.

- **MSVent™ mode** allows changing of columns without cooling and venting the Clarus 500 MS, reducing instrument downtime, offering a significant time savings. In addition, MSVent facilitates connection of the vent to a second detector for dual-signal capability, providing greater flexibility and enhancing productivity.
- **Isolation mode** eliminates downtime during routine injector maintenance and can provide an extra 100 analytical hours of productivity per system per year. When running in Isolation mode, there is no need to interrupt the carrier-gas flow when disassembling the Clarus 500 GC injectors for routine maintenance (Figure 7), such as changing the glass liner. Time-consuming oven cool-down and vacuum shutdown periods are eliminated.
- **Enhanced Large Volume Injection (ELVI) mode** facilitates manual injection volumes of up to 150 µL and automatic injection volumes up to 50 µL without solvent reaching the column or the detector, minimizing contamination. By eliminating solvents, large volume injection makes time-consuming and expensive pre-concentration steps unnecessary, significantly decreasing the cost of analysis.

PreVent Accessory Benefits

Feature	Benefit
MSVent mode	Eliminates downtime during removal and change of columns.
	Allows connection of the vent to a second detector for enhanced flexibility and productivity.
Isolation mode	Eliminates downtime during routine injector maintenance.
	Provides approximately 100 extra analytical hours of productivity per system per year.
ELVI mode	Facilitates manual injection volumes up to 150 µL and automatic injection volumes up to 50 µL without solvent reaching the column or detector.
	Offers unparalleled sensitivity and eliminates lengthy sample preparation.
Time-Saver mode	Prevents unwanted, high molecular weight material from reaching the detector.
	Shortens analysis time, facilitates isothermal chromatography and protects the detector from contamination.
	Allows changing of the analytical column without venting the mass spectrometer.
ProTect mode	Eliminates contamination by preventing heavy components in the sample from reaching the expensive and retentive chromatographic column.
	Allows backflushing during a chromatographic run.

- **Time-Saver mode** prevents unwanted, high-boiling material from reaching the detector, thus shortening analysis times and increasing throughput. It facilitates isothermal chromatography and protects the detector from costly and time-consuming contamination.

  PreVent in Time-Saver mode allows changing of the analytical column without venting the mass spectrometer, a huge productivity gain for any lab.

- **ProTect™ mode** makes many difficult separations of volatile components in semivolatile samples possible. In addition, this mode prevents heavy components in the sample from reaching the expensive and very retentive chromatographic column, saving hours of cleaning and disassembling procedures. ProTect also allows backflushing even during chromatographic runs.

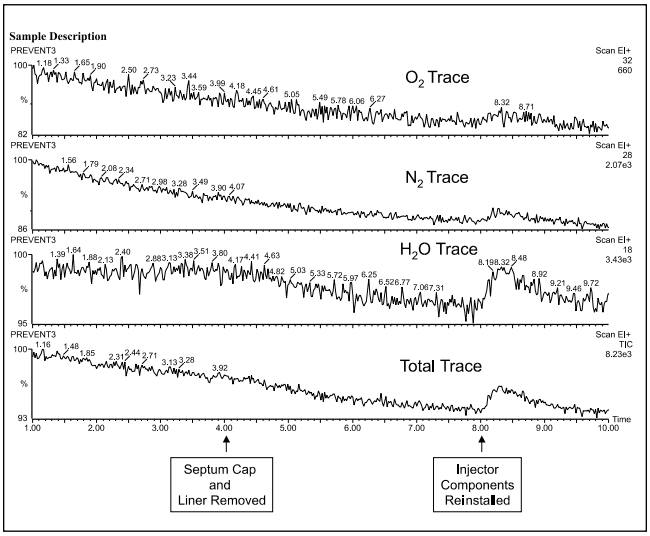

Figure 7. Background signal on the Clarus 500 GC/MS while the injector is being serviced. PreVent is operating in Isolation mode.

Wide mass range meets complex analytical needs

Because of superior design quality, the Clarus 500 GC/MS has the widest mass range (1.0-1200 Da) available in its class. This gives the capability to analyze higher molecular weight compounds (Figure 8), such as highly halogenated compounds and drug derivatives. Even for routine GC/MS analyses (< 800 Da), the Clarus 500 MS runs far from the quadrupole's limit, ensuring uncompromised performance over a wide mass range.

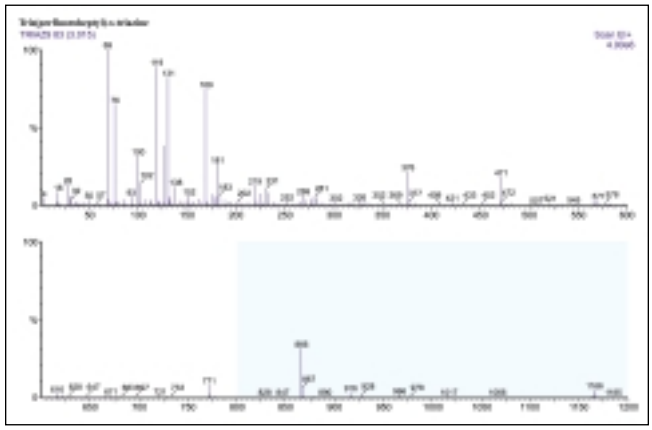

Figure 8. The Clarus 500 GC/MS 1200 Da mass range captures more complete sample information. Shaded area illustrates data missed by lower-mass-range analyzers.

AutoBuild method builder

The unique AutoBuild method builder automatically searches spectral libraries for chromatogram peaks and imports them into a quantification method. Names, retention times, spectra and quantification ions of the respective peaks are also imported. AutoBuild saves time building complex, multi-component methods.

rugged design for maximum uptime

The Clarus 500 GC/MS is rugged so it delivers reliability, reduced cost and easy maintenance for maximum uptime. The highly specialized gold component technology enhances overall instrument stability and reduces maintenance requirements by minimizing contamination.

The inner ion source is easily accessed from the front of the instrument without removing the cover or ion optics from the vacuum manifold. This allows a quick source changeover in less than 15 minutes and reduces the risk of contaminating the quadrupole analyzer. Because the Electron Ionization (EI) or Chemical Ionization (CI) sources have no wires, routine cleaning is simple. The filament system is rugged, performing consistently analysis after analysis, with a self-aligning design that makes filament replacement quick and easy.

To maximize spectral quality, the instrument ion source and transfer-line temperatures are controlled independently, reducing contamination and protecting thermally labile compounds from uncontrolled fragmentation. The 350 °C upper temperature limit for the GC transfer line and both EI and CI ion sources allow high-temperature operation for maximum cleanliness and performance with high-boiling compounds. To simplify maintenance, cleanable RF-only prefilters are located in front of the quadrupole analyzer.

The Clarus 500 GC/MS improves uptime and throughput of the laboratory with an air-cooled 250 L/sec turbomolecular pump that allows up to 5 mL/min helium carrier gas flow (EI mode). The pump-down time is minimal (under 3 minutes), qualitative stability is reached in under 15 minutes and quantitative stability is reached in less than 90 minutes. A water-cooled pump is optional.

The sealed, long-life photomultiplier detector lowers operating costs by eliminating expensive and contamination-prone electron multipliers that need periodic replacement. In the event carrier gas pressure drops, the unique PerkinElmer Programmable Pneumatic Control (PPC) pneumatics safeguard the system from column damage and ion-source contamination by automatically turning off the GC oven and transfer line heating.

Also, you will never need to worry about power outages because the Clarus 500 MS vent can be attached to a nitrogen purge gas stream. This prohibits oxygen from entering the system during venting, minimizing contamination.

Clarus 500 GC/MS Benefits

Feature	Benefit
Fastest scan rates	Provide unprecedented speed with better chromatographic peak definition, ensuring better quality results.
	Open the use of quadrupole technology to fast GC applications.
Widest mass range	Offers uncompromised performance over a wide mass range.
SIFI scanning mode	Includes Selected Ion Monitoring (SIM) and full scan in the same run, resulting in the most complete characterization of the sample.
	Eliminates the need to run the sample twice.
Gold component technology	Improves stability and reduces maintenance.
Easy-access ion source	Allows changeover in less than 15 minutes.
Sealed, long-life photomultiplier	Eliminates expensive replacement costs of electron multipliers.
	Improves reliability.

flexibility for customized analysis

Depending on your application, the Clarus 500 MS can use either EI or CI sources in either positive or negative mode (Figure 9). EI produces high-quality classical spectra that are the basis for compound identification by library searching. The optional CI mode can be used for any of the following:

- if molecular weight information is needed
- for additional selectivity with complex samples
- when detailed characterization is required

You can run EI mode for rapid screening without changing the CI source, a productivity benefit for your lab.

Further flexibility and creativity with analysis can be achieved through the extensive choice of acquisition-mode options. Full Scan mode is available with Centroid mode and Continuum mode running independently or simultaneously, while Selected Ion Monitoring mode can run independently or concurrently with the various Full Scan modes. Overall, there are 32 combinations of acquisition modes available, giving the greatest amount of information from one sample.

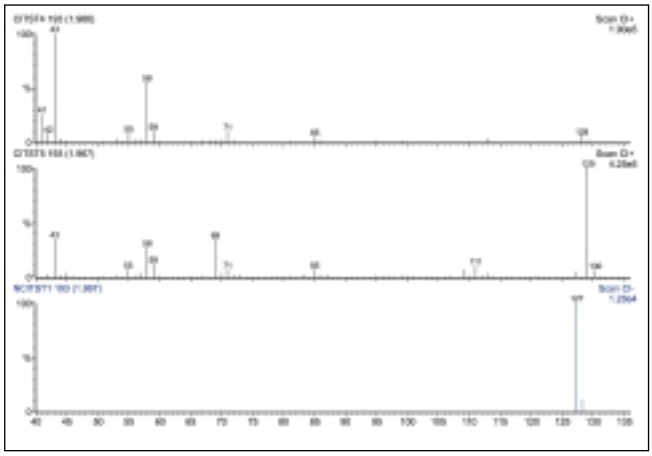

Figure 9. The three ionization modes of EI, CI^+ and CI^- can determine complete molecular information about your sample.

More column choices

Because the Clarus 500 GC/MS allows a carrier-gas flow of up to 5 mL per minute in EI, you have more column choices than with other GC/MS systems. Narrow-, medium- and wide-bore columns can be used, with almost unlimited choice of stationary phase, column diameter and analytical method with the Clarus 500 GC/MS.

Column	Internal Diameter	Typical Flows	Clarus 500 GC/MS	Others
Narrow bore	0.10 to 0.18 mm ID	0.1 to 0.8 mL/min	✓	✓
Medium bore	0.25 mm ID	1 to 1.5 mL/min	✓	✓
Wide bore	0.32 to 0.53 mm ID	3 to 5 mL/min	✓	

integrated system solutions

The PerkinElmer Headspace Sampler or Thermal Desorber, the industry-leading GC/MS sample handling accessories, provide powerful analytical capabilities for your specific sample matrices.

TurboMatrix Headspace Sampler models with built-in trapping capability maximize the extraction and transfer of headspace vapor into the Clarus 500 GC/MS, lowering detection limits up to 100 times.

Headspace Sampler with the Clarus 500 GC/MS

Toxic compounds in blood

Volatile chemicals, used as solvents, are present in petrochemical derivatives, paint and a variety of other industrial products. These airborne compounds can cause severe and chronic cases of toxic exposure of workers in occupational areas. Headspace GC/MS analysis is the ideal technique for specific and sensitive determination of these toxic compounds in blood or urine. The use of a PerkinElmer TurboMatrix™ Headspace Sampler along with the fully automated Clarus 500 GC/MS allows analysis of large numbers of such samples.

Headspace Sampling with the Clarus 500 GC/MS

- Volatile organics in soils
- Volatile priority pollutants in water
- Petrochemical pollution in seafood
- Airborne toxic volatile compounds in human tissue and body fluids
- Off-odors and off-flavors due to printed ink solvents in food packaging films
- Residual solvents in pharmaceuticals

Thermal Desorption System with the Clarus 500 GC/MS

Air toxics analysis

PerkinElmer has worked closely with the U.S. Environmental Protection Agency (EPA) and similar agencies around the world to develop instrumentation and methodologies to measure Hazardous Air Pollutants (HAPs). The fully integrated Air Toxics Analyzer identifies and quantifies volatile organic compounds in ambient air per U.S. EPA Method TO-17.

The Air Toxics Analyzer combines automated thermal desorption sampling, gas-chromatographic separation and detection via mass spectrometry into a single system. The PerkinElmer TurboMatrix Thermal Desorber system can process up to 50 sorbent tubes in a fully automated fashion.

Thermal Desorption Sampling with the Clarus 500 GC/MS

- Air Toxics (U.S. EPA Method TO-17)
- Off-odors due to food packaging films
- VOCs in food/pharmaceutical packaging
- Forensics (arson accelerants)
- PCBs in soil

PerkinElmer, Inc.

PerkinElmer, Inc. is a global technology leader focused in the following businesses – Life and Analytical Sciences, Optoelectronics and Fluid Sciences. Combining operational excellence and technology expertise with an intimate understanding of its customers' needs, PerkinElmer creates innovative solutions that accelerate drug discovery, enhance research productivity, help meet regulatory requirements, improve time-to-market and increase manufacturing efficiencies.

PerkinElmer's OneSource[SM] Laboratory Services provides you with a comprehensive worldwide service offering that allows you to take care of business and set your sights on what matters most – results. With over 1000 factory-trained professionals serving more than 125 countries worldwide, PerkinElmer is your single source for instrument care and repair, validation services, software and hardware upgrades, education and more.

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