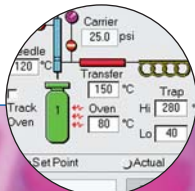


TurboMatrix

headspace and headspace trap samplers for GC



the **clear choice** for any GC
or GC/MS volatile-analysis system

unparalleled **precision** and



Figure 1. TurboMatrix Headspace 40 (right) with Clarus Gas Chromatograph (left).

There are many reasons why PerkinElmer's TurboMatrix™ Headspace (HS) and high-sensitivity Headspace Trap samplers are the clear choice for any GC or GC/MS system for the analysis of volatile compounds. Advanced technology and thoughtful design ensure that our systems can meet the diverse requirements of your application needs. *You* define your performance and throughput requirements. Our proven TurboMatrix Headspace technology delivers on your expectations, providing unparalleled precision and ease-of-use for any volatile application need.

Building on more than 40 years of experience in GC sample-handling and introduction, TurboMatrix Headspace samplers incorporate proven pressure-balanced sampling for better performance.

Modern user interface increases productivity

The intuitive, multilingual touch-screen graphical user interface provides easy control of the sampler in multiple languages (Figure 2). The interface provides

instant access to system functionality. Set parameters, recall stored methods and start analyses, all with a few quick presses of the touch pad, making it easy for both new and experienced users.

The system guides parameter selection and experiment setup by providing a graphical representation of the headspace sampler operation—from vial to column—with an accompanying display of either the set points or the current temperature and pressure conditions. The display automatically adapts to the current hardware configuration, showing only active functions as they are added or removed.

For routine analyses, the headspace sampler features one-touch operation. After loading the samples, you just need to enter a range of vial numbers and press START (Figure 3). Headspace sampling is easy to automate, so 24-hour unattended operation is possible. The unit also features priority vial sampling, enabling you to interrupt a run in order to insert an urgent sample for analysis.

ease-of-use for any application

Improve sample throughput

Volatile compounds in almost any sample matrix can be determined simply and quickly by headspace gas chromatography. Headspace sampling provides a solvent-free extraction of volatile compounds from liquid and solid samples, while eliminating the time-consuming and error-producing steps required in other GC sample-preparation techniques, such as purge-and-trap or solvent extraction. Samples can be sealed in headspace vials at the point of collection, reducing analyte losses that can occur with other techniques during sample handling and storage.

The TurboMatrix Headspace sampling system maximizes sample throughput. Equilibration of headspace vapor is attained under thermostatted temperature conditions. The system thermostats simultaneously up to 12 samples at a time, ensuring that the next sample is ready for analysis upon completion of the previous run. This produces significant time savings, since there is no need to wait for the next sample to heat and equilibrate. Furthermore, repeatability is ensured through precise thermostating, an inert sample flow path that minimizes carryover and the elimination of multiport valves that can cause peak distortion through adsorption and dead volumes.

Other productivity benefits built into the TurboMatrix Headspace sampling systems include the ability to prioritize sample vials containing rush samples during an active sequence and a time-saving, pre-programmed shut-down and wake-up mode that allows for complete unattended operation.

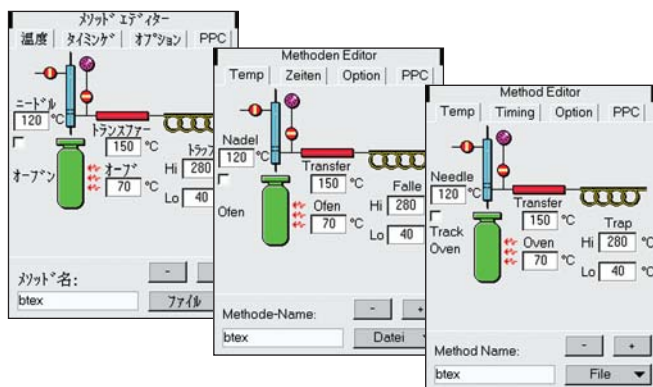


Figure 2. Easy-to-use method editor shown in Japanese, German and English (Chinese, French, Italian, Spanish and Russian also available).

The right tool for your needs

Every laboratory is unique in its sample-handling requirements. Whether you run a high number of samples on a routine basis, require headspace to occasionally troubleshoot quality-control problems or use more sophisticated techniques such as cryofocusing or analyte trapping to handle difficult samples, our TurboMatrix family of Headspace samplers can provide a system to meet your needs.

Since all sizes of capillary columns can be interfaced easily, analysis of a wide variety of samples is possible. By providing your choice of entry-level, mid-range or high-capacity units, the headspace instruments can satisfy the requirements of virtually any laboratory. The PerkinElmer® suite of headspace samplers offers you the ability to extend the system's capabilities by upgrading from one model to the next or adding accessories that provide more capabilities.

The system is fully self-contained and can be interfaced to almost any gas chromatograph, giving you access to PerkinElmer's proven headspace technology, regardless of the brand or model GC you have in your laboratory. However, if you are in need of a complete system, PerkinElmer is the only supplier that manufactures a complete solution—from sample handling to data handling.

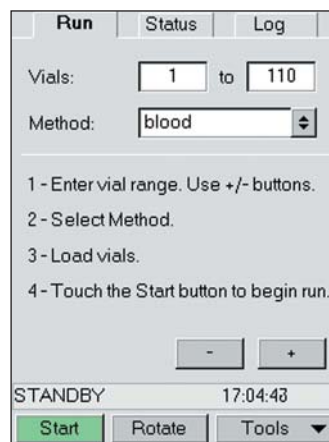


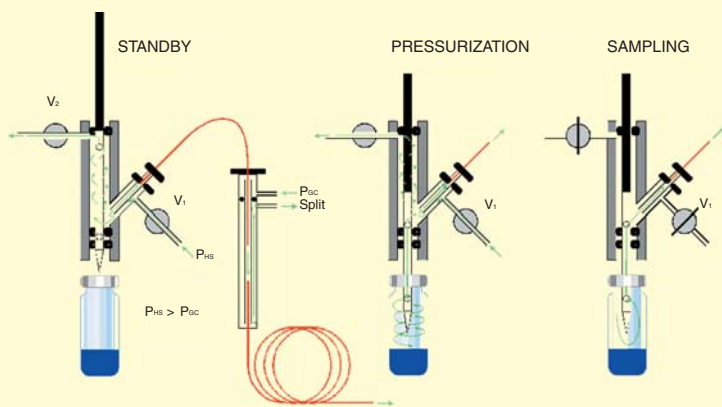
Figure 3. Simple one-touch start.

sophisticated tools

boost GC performance

Pressure-balanced technology increases sensitivity

Using the pressure-balanced technique, the headspace sample is introduced onto the column without using a gas syringe, avoiding fractionation due to pressure changes in the syringe; and, since the system is closed, there is no loss of headspace during transfer. The technique does not require multiport valves, minimizing the number of components in contact with delicate samples. Before injection, the system is on standby with carrier gas flowing through the column. When the sample reaches equilibrium, the vial is pressurized to the column head pressure. During sampling, a solenoid valve interrupts the carrier gas supply and the vial acts as a reservoir of carrier gas, delivering the sample onto the column for the preset injection time. At the end of the sampling period, the valve is reopened and the normal carrier gas flow resumes.



Our TurboMatrix Headspace samplers utilize a pneumatic pressure-balanced system, a proven technology that has been used in all PerkinElmer headspace samplers for more than 40 years. This proven technique provides higher sensitivity and better performance than alternative systems, which may use valve-and-loop or syringe-based technology.

The pressure-balanced sampling technique

- Produces sharper peaks by rapidly transferring a narrow sample band to the GC column.
- Offers adjustable injection volume, requiring no hardware changes.
- Avoids fractionation due to pressure changes in the syringe.
- Eliminates multiport valves that are prone to adsorption and may introduce dead volumes.
- Provides exceptional reproducibility equal to that obtainable with liquid injection.
- Increases sensitivity since there is no carrier-gas dilution of sample.

Built-in checks improve confidence in your analysis

The TurboMatrix HS and HS Trap samplers provide automated leak checking of the complete system, offering maximum sampler integrity.

For TurboMatrix HS Trap samplers, a dynamic leak check improves confidence in your results. As each vial is sampled, the pressure inside the vial decreases at a predictable rate. The pressure decay is checked against a reference profile for each sample vial as it is analyzed and any leaks in the system or vial seal are flagged in the system run log. This unique technique* also identifies whether an incorrect sample volume has been added to the vial.

* patent pending

trap technology provides up to 100 times lower detection limits

Models with built-in analyte-trapping capability, available as the TurboMatrix HS-40 Trap and HS-110 Trap configurations, maximize the extraction and transfer of headspace vapor into the GC column, thereby lowering the detection limits by up to 100 times. Figure 5 shows a total ion chromatogram (TIC) for the detection of a 2 part-per-billion (ppb) mixture of compounds in a U.S. EPA Method 8260 standard. This standard contains volatile compounds commonly determined in environmental samples, including analytes such as dichlorodifluoromethane, vinyl chloride, 1,4-dioxane, naphthalene and 1,2,3-trichlorobenzene to name a few. The built-in headspace trap uses advanced trapping technology developed for and proven in the TurboMatrix Thermal Desorption systems to improve detection limits by maximizing the extraction of volatile compounds from the headspace.

Built-in trap technology also maximizes performance. An exclusive-design dry purge removes water efficiently. Compared to conventional purge-and-trap technology which requires long bake-out times periodically throughout a sample run, sample throughput with the built-in headspace trap is maximized, allowing a reduction of up to 25% in sample-handling time.

With the sensitivity advantages provided by headspace-trapping technology, the application of TurboMatrix Headspace systems can be expanded to a variety of determinations not previously possible, including:

- **Environmental**—Volatile organic compound determination in water, soils and solid sample matrices.
- **Food packaging**—Determination of printed ink solvents in food packaging films that can impart off-flavors or off-odors.
- **Pharmaceuticals, foods, forensics**—Analysis of organic volatile impurities at lowest possible detection levels.
- **Materials testing**—Monomers, polymers and additives analysis of compounds outgassing from coatings.



Figure 4. TurboMatrix HS-40 Trap.

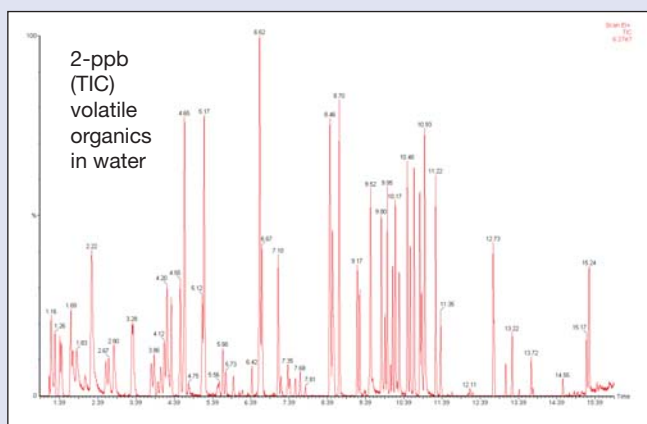


Figure 5. 2-ppb volatile organics in water (U.S. EPA Method 8260B standard).

how the **headspace-trap** technology works

Originally developed for TurboMatrix Thermal Desorption systems, automated analyte trapping has now been expanded for use in headspace sampling (Figure 6). The principles of this unique technology* (Figures 7a and 7b) are quite simple:

- Sample is heated inside a sealed vial until equilibrium is achieved.
- Carrier gas is used to pressurize the vial contents and the increased pressure is allowed to decay through the cooled adsorbent trap. This pressurization/decay cycling may be repeated several times to extract further vapor from the sample in the vial (Figure 7a).
- Once the vapor extraction is complete, a flow of dry carrier gas is passed through the trap to remove moisture from the sample.
- The trap is then rapidly heated and the desorbed analytes are carried, via an optional split, by the carrier gas into the GC column for separation and quantification (Figure 7b).

Column isolation ensures GC/MS stability

A column-isolation feature allows the carrier-gas flow into the GC to be maintained during servicing of the headspace and trapping system even when the headspace instrument is turned off. This feature is particularly useful when mass spectrometric (MS) detection is being used with the GC.

Internal standard addition for enhanced analytical performance

The analytical performance of the TurboMatrix Headspace Trap systems is enhanced with the internal standard addition accessory. This feature uses a gas-sampling valve to introduce a fixed volume of a standard gas (i.e. solvent-less) mixture into the sample vial during initial pressurization. The standard gas mixture can then be used to standardize the instrument responses, providing better long-term accuracy and precision.

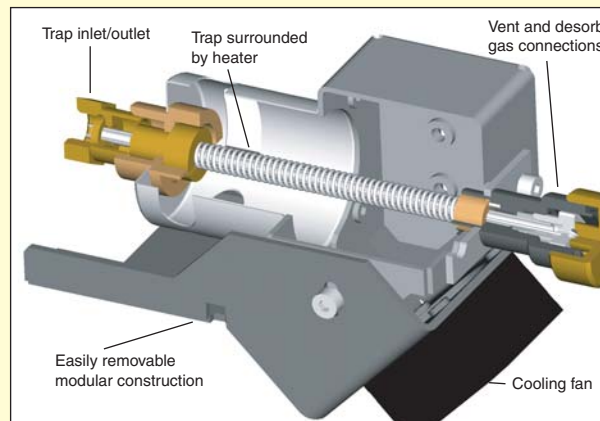


Figure 6. Built-in headspace trap.

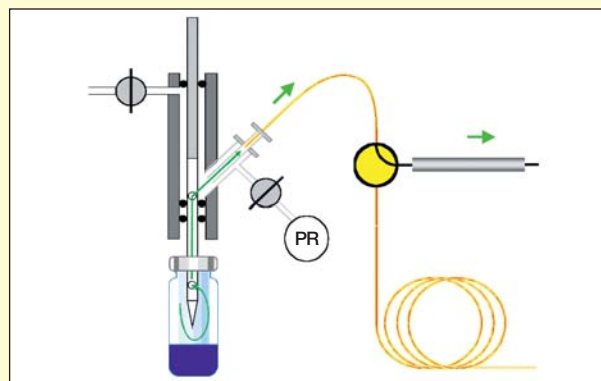


Figure 7a. Vapor extraction from the sample vial onto the trap. PR=pressure regulator.

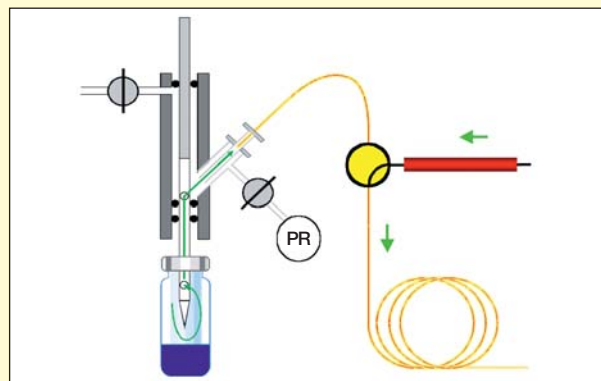


Figure 7b. Desorption of analytes from the trap into the GC column.

* patent pending

solve difficult problems

with no sample preparation

TurboMatrix Headspace samplers solve problems and provide answers for difficult applications in many industries. By eliminating sample preparation, the technique saves time and increases performance.

Rapid blood-alcohol analysis

TurboMatrix Headspace systems are the industry standard around the world for the determination of alcohol in blood. These simultaneous chromatograms (Figure 8) illustrate the ability of the headspace samplers to deliver confirmatory results within 1.5 minutes for ethanol and other required analytes for blood analysis. With the TurboMatrix HS-110, a full magazine of 110 vials can be processed in three hours.

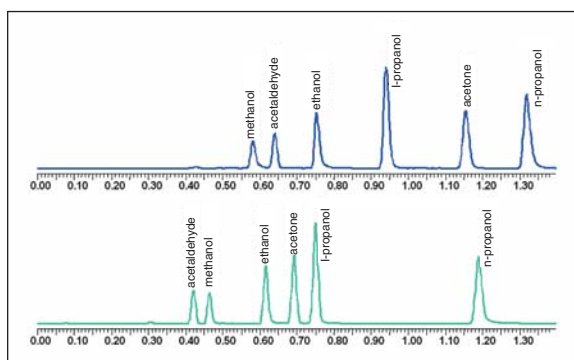


Figure 8. Blood-alcohol analysis.

Organic volatile impurities in drugs

Static headspace is the ideal sample-preparation instrument for the determination of residual solvents in drugs as prescribed by U.S. Pharmacopoeia Chapter <467>, Method IV.

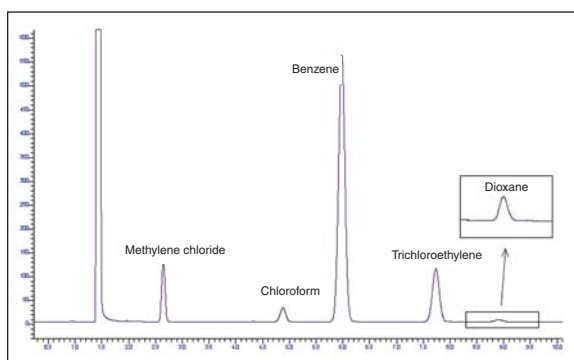


Figure 9. Determination of residual solvents in drugs.

Food & beverage applications

TurboMatrix Headspace systems are used by food and beverage manufacturers to analyze aroma and flavors, residual solvents and volatile preservatives in foods. The systems also assess fermentation characteristics of products such as beer and dairy products. Volatile-free fatty acids are produced by bacteria, particularly anaerobic bacteria. These acids provide information needed to identify the particular bacteria. This chromatogram of volatile-free fatty acids was obtained using a TurboMatrix Headspace system.

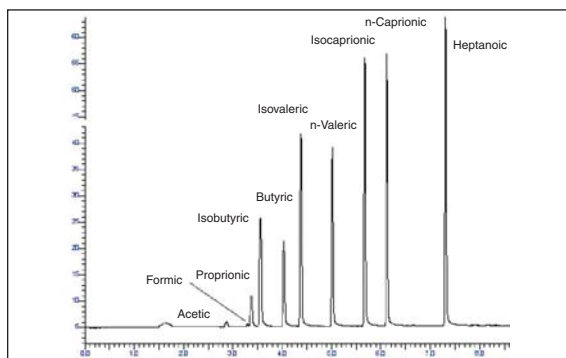


Figure 10. Volatile-free fatty acids.

BTEX in environmental samples

The technique of headspace sampling provides a quick and easy method of screening complex environmental samples for petroleum contaminants such as benzene, toluene, ethyl benzene, xylenes (BTEX) and methyl tert-butyl ether.

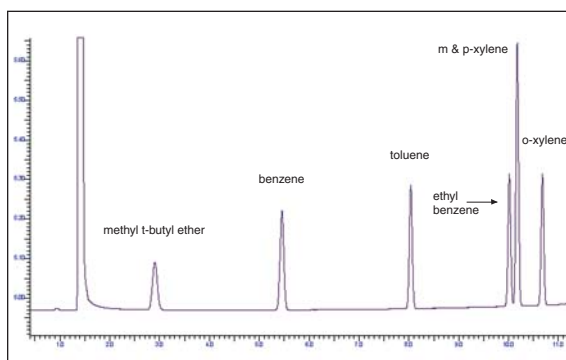


Figure 11. BTEX in environmental samples.

optional accessories extend the application of your system

You can enhance the capabilities of your TurboMatrix Headspace sampler by adding specialized accessories. Our wide range of accessories allows analysis of special samples, improving system performance and increasing speed.

Intelligent frequency vial shaker

For certain applications such as ethanol analysis in blood, the vial shaker will shorten the time needed to achieve equilibrium and increase sample throughput. The intelligent frequency shaker guarantees efficient agitation for every sample, regardless of liquid volume and resonant frequency.

GC zero dilution liner

The powerful GC zero dilution liner allows you to achieve lower detection limits, sharpen peak shape and increase throughput for many routine analyses. Installed in a standard GC capillary injector, this special hourglass insert connects the fused-silica transfer line from the headspace sampler to the capillary column, permitting undiluted and efficient sample transfer. The insert is optimized for your convenience, making it easy to connect and disconnect the transfer line, as well as for performance using splitless transfer with low dispersion.

Instrument control and data handling

TotalChrom® software simplifies the routine use of PerkinElmer TurboMatrix Headspace samplers (HS-40, HS-110, HS-40 Trap and HS-110 Trap models). Enhanced integration between TotalChrom and TurboMatrix HS methods provides streamlined operation, including faster setup times and reduced entry errors.

TotalChrom software provides direct sequence and method creation for both headspace and liquid autosampling, using the Remote Control Software (RCS) module. The TurboMatrix HS RCS module ensures reliable assignment of TurboMatrix HS vial numbers to TotalChrom data files and reduces the risk of data-entry errors.

Remote control software

While the graphical user interface allows easy control of the headspace sampler, a Remote Control Software package for a PC is also available. Running under Microsoft® Windows® XP, the software provides complete control of the sampler and displays the status of all parameters. Methods and sequences can be easily edited, stored and downloaded to the instrument.

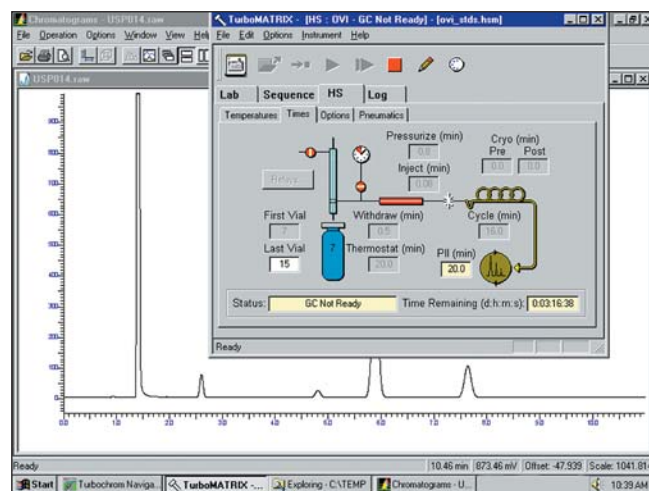


Figure 12. Remote Control Software permits complete control of the TurboMatrix Headspace samplers from a PC, allowing you to create methods, modify sampling conditions and monitor the status of the sample vials.

one company, one solution

Since the TurboMatrix Headspace samplers are fully self-contained, they can be interfaced to almost any GC system, giving you access to PerkinElmer's proven headspace technology regardless of the brand or model GC you have in your laboratory. However, if you are in need of a complete system, PerkinElmer is the only supplier that manufactures and sells a complete single-vendor solution—from sample handling to data handling.

Our family of Clarus® GCs not only features a sleek design—it uses an intuitive touch screen to make GC analysis easier than ever. Plus, our Clarus benchtop mass spectrometers (MS) have all the tools to perform routine GC/MS tests, as well as the sophisticated features to run complex analyses.

This means you will not struggle to find answers to applications and service questions—one company provides the complete solution.

Flexible systems expand as your needs change

Every laboratory has unique GC sample-handling requirements. Whether you run a high number of samples on a routine basis, require headspace to occasionally troubleshoot quality-control problems or use more sophisticated techniques such as trapping to handle research samples, TurboMatrix Headspace samplers will meet your needs.

Instruments are available in your choice of entry-level, mid-range or high-capacity units. And, since upgradeability is built in, you can adapt your system to changing requirements by upgrading from one model to the next.



Figure 13. Clarus GC/MS with TurboMatrix HS Trap.

You can choose from five TurboMatrix Headspace sampler configurations.

TurboMatrix HS-16

This entry-level headspace sampler holds up to 16 sample vials. The unit heats and equilibrates the next sample so it can be injected when the gas chromatograph is ready for the next run.



TurboMatrix HS-40

The magazine on the mid-range model holds up to 40 sample vials. The system thermostats up to 12 vials simultaneously for higher throughput. A sophisticated nesting algorithm optimizes timing of vial heating so the sampler is always ready for the next sample, maximizing throughput.



TurboMatrix HS-110

The high-capacity headspace sampler with 110 vial positions is ideal for labs requiring maximum throughput. The instrument uses the same sample-thermostating technology as the HS-40.



TurboMatrix HS-40 Trap

This model includes all features of the HS-40 plus the built-in trap for lower detection limits.

TurboMatrix HS-110 Trap

This model includes all features of the HS-110 plus the built-in trap for lower detection limits.



PerkinElmer, Inc.

PerkinElmer, Inc. is a global technology leader driving growth and innovation in Health Sciences and Photonics markets to improve the quality of life. Combining operational excellence and technology expertise with an intimate understanding of your needs, PerkinElmer provides products and services for a range of applications that require innovation, precision and reliability.

PerkinElmer is the only company that designs and manufactures a complete suite of chromatography tools – from GC, GC/MS and HPLC systems to productivity-enhancing accessories like autosamplers, headspace samplers and thermal desorption systems. And chromatography data management software provides all the capabilities you need to effectively analyze, manage, report and store data. In addition to our Gas Chromatography product line, we offer a broad range of solutions in Luminescence, AA, UV/Vis, FT-IR and FT-NIR, HPLC, ICP, ICP-MS, Thermal Analysis, Elemental Analysis and LIMS.

Comprehensive service and support for today's results-driven lab

As a world leader in analytical instrumentation, PerkinElmer is the right partner for your application needs. In concert with global distribution of instruments, turnkey systems and consumables, we provide factory-trained global service and support.

PerkinElmer 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 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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