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Designed to deliver more

Thermo Scientific TriPlus 500 Gas Chromatography Headspace Autosampler

ThermoFisher SCIENTIFIC

Superior repeatability. High data quality. Best reliability.

Powered by an innovative new design, the Thermo Scientific™ TriPlus™ 500 GC Headspace Autosampler delivers more of what you want, and less of what you don't. Helping you maximize valuable time with reliable unattended operations and optimize throughput with expanded vial capability, this modular platform gives today's routine laboratories the productivity they need to succeed—both today and in the future.



TriPlus 500 Headspace Autosampler coupled to the Thermo Scientific™ TRACE™ 1300 Gas Chromatograph

Drive reliability through innovation

For any testing laboratory conducting volatiles analysis, static headspace-gas chromatography, with its simplicity and broad applicability is one of the most reliable and robust techniques. When seeking highly accurate analytical results, the valve-and-loop sampling technique is a must-have. Packed with innovative features, the TriPlus 500 Headspace (HS) autosampler makes the most of daily workflows by addressing the biggest challenges facing today's laboratories doing routine volatiles determination.



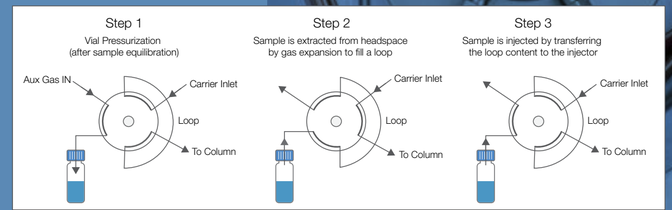
New pneumatic circuit design

A proprietary pneumatic circuit design and a highly precise heating control work together for an accurate sampling process, increasing the system reliability and robustness. The repeatability of the area counts is the highest in the market. This, coupled with the sample integrity maintained during the injection process, ensure the required data quality is easily achieved.

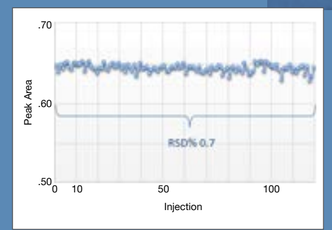
High precision – Innovative control of the pressure in the sampling loop during filling delivers excellent repeatability of the sample amount injected into the gas chromatograph.

High robustness – Efficient heating of the entire sample path greatly reduces the risk of high boiling solvents contamination, especially through the vent line, which guarantees an extended robustness of the system.

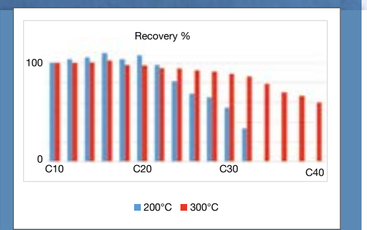
Low carryover – Effective purging over 5 levels of flow rates and short sample path assure minimal to no carryover. An empty blank vial analyzed after undiluted 2-butanol headspace injection shows a carryover <0.0003%.



Valve-and-loop headspace injection principle



Long Sequence Area Counts Repeatability. 120 consecutive headspace injections of a 50 ppm ethanol solution in water (5 ml in 10 ml crimp top vial). Overall RSD%=0.7.



Recovery of a standard hydrocarbon mixture C10-C40 at high temperature operation, showing >60% recovery at 300°C

Solve the toughest challenges with smart design

Optimize productivity, reliability and data quality with key features

Direct GC column interface
Instead of a long transfer line connecting the static headspace to the GC column, the TriPlus 500 HS autosampler features a direct connection from the valve manifold to the GC column, maintaining split flow control capability.

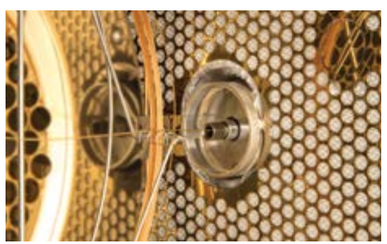
This creates a shorter sample path which eliminates possible cold or hot spots, assuring sample integrity during transfer into the column.

Quick Spin Shaking (QSS)
The new proprietary design for vial shaking during vial incubation provides a larger exchange surface area between liquid and gas phases, accelerating the sample equilibration with valuable time-saving benefits:

- Reduced overall cycle time: the spin shaking device offers three levels of agitation to speed sample equilibration and shorten the incubation time.
- High extraction efficiency: consistent equilibrium between liquid and gas phase enables highly repeatable extraction efficiency.

Compact footprint with modular design
Directly coupled to the capillary column, the TriPlus 500 HS autosampler offers a compact footprint that optimizes your valuable bench space. Its industrial design complements the Thermo Scientific™ TRACE™ 1300 Series Gas Chromatograph systems with about 30% less bench space than competitive systems.* Its modular design enables easy system upgrades over time to accommodate increased sample throughput needs from 12 up to 240 vials capacity with no additional bench space required.

*when compared to a similar configuration.



GC oven view with direct column connection to the TriPlus 500 HS autosampler



Screen capture of vial in quick spin shaking mode



TriPlus 500 Headspace Autosampler coupled to the TRACE 1310 Gas Chromatograph

Labor-saving headspace injection capability

Automated tools for enhanced analytical performance

The advanced functionalities of the TriPlus 500 HS autosampler help you to save time when higher sensitivity is required or when complex sample matrix strongly impacts volatiles quantitation. Automatic Leak Check confirms sample integrity at each injection while multiple headspace extraction (MHE) and multiple headspace injection (MHI) techniques offer higher analytical flexibility in a manner that is fully-automated and unattended.

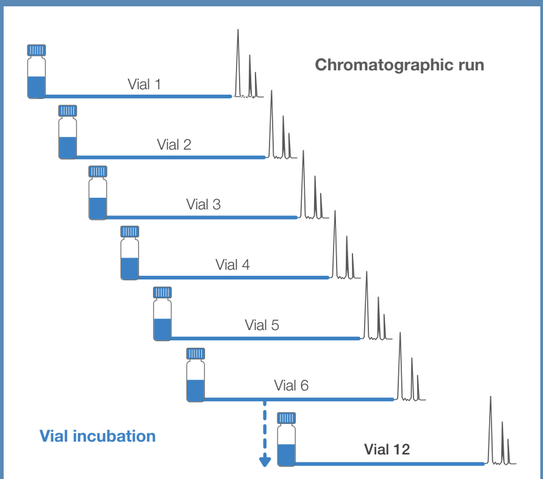
Automatic leak check
To guarantee the expected sample integrity at every analysis, each vial is automatically checked for possible leaks just prior to the loop filling stage. If a vial leak is detected, the error is tracked in the log file. Moreover, the user has different choices on how to handle the error during the sample sequence — either continue with the injection, abort the injection and proceed with the next sample, or abort the whole sequence.

Multiple headspace extraction
MHE is an absolute quantitative method for volatiles in solid samples, or any time the matrix cannot be easily reproduced as external standard. Each vial is automatically analyzed several times to track decreasing analyte area counts and extrapolate its concentration in the sample.

Multiple headspace injection
Ideal for testing low concentrated samples, this tool enables users to enrich the headspace by making multiple injections from the same vial before starting GC separation.

Save time with unattended sampling workflow
In busy pharmaceutical testing labs, efficiency is critical. The TriPlus 500 HS system offers the highest sample capacity for a valve-and-loop headspace autosampler, saving time and increasing productivity. With its 120-position tray (expandable to 240-position) and 12 positions for simultaneous incubation, the TriPlus 500 HS autosampler offers the highest overlapping capability for long unattended sequences with cycle time optimization.

Ideal for highly regulated workflows and routine environments, this flexible sample handling solution enables testing laboratories to maximize sample throughput and accelerate volatiles determinations while minimizing downtime.



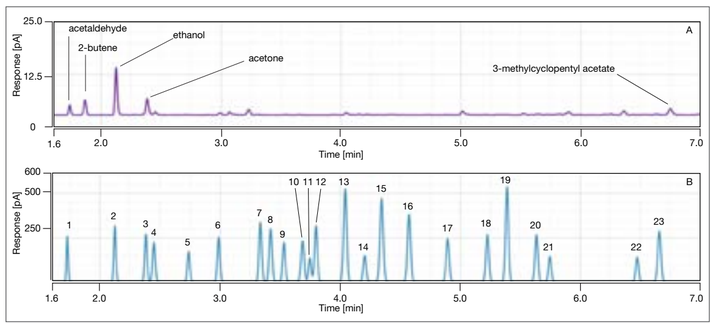
Residual solvents in food packaging material

Simplify compliance with food safety standards

Food packaging manufacturers, food retailers and food producers can rely on a fast and simple technique for the qualitative and quantitative assessment of volatiles organic compounds from food packaging samples without the need for time-consuming sample preparation.

Headspace sampling technique coupled to gas chromatography represents the recommended method for the quantitative determination of residual solvents in flexible packaging, as reported in the European Standard absolute method EN 13628-1:2002.

Reliable quantitation through automated Multiple Headspace Extraction (MHE) calibration is easily achieved with the TriPlus 500 HS autosampler and Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software. The coupling of the headspace autosampler to a versatile GC-MS/FID dual detector configuration allows for reliable quantitation and ID confirmation of unknown volatile organics through mass spectra library matching.



FID chromatograms of residual solvents in the sample of salad wrap (upper) and the reference standard solution (lower). Ethanol and acetone were detected in the sample based on retention time comparison, while the remaining peaks ID were confirmed through mass spectra matching against NIST17 library.

Peak No.	Component Name	RT (min)
1	Methanol	1.76
2	Ethanol	2.15
3	Acetone	2.41
4	2-Propanol	2.45
5	Methyl acetate	2.77
6	1-Propanol	3.02
7	2-Butanone	3.36
8	2-Butanol	3.45
9	Ethyl acetate	3.52
10	2-Methyl-1-propanol	3.68
11	2-Methoxyethanol	3.75
12	Tetrahydrofuran	3.83
13	Isopropyl acetate	4.04
14	1-Methozy-2-propanol	4.24
15	Cyclohexane	4.34
16	Propylacetate	4.60
17	4-Methyl-2-pentanone	4.93
18	Isobutyl acetate	5.26
19	Toluene	5.42
20	Butyl acetate	5.74
21	2-Methoxyethyl acetate	5.75
22	2-Etoxyethyl acetate	6.47
23	Cyclohexanone	6.69



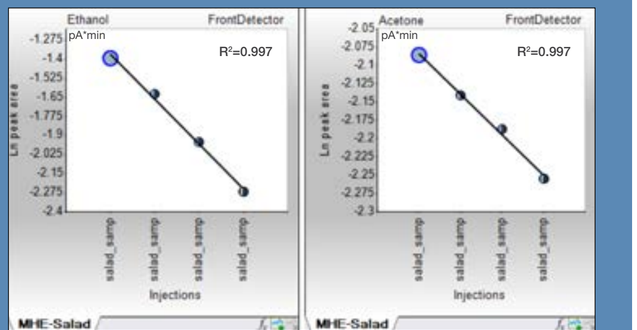
TriPlus 500 Headspace Autosampler coupled to TRACE 1310 GC and Thermo Scientific™ ISQ 7000™ single quadrupole mass spectrometer. A 3-port microfluidic device assures leak free, zero dead volume connections for a safe and robust dual-detector configuration.

A dedicated dual detector GC-FID/MS configuration is easily set up through a 3-port microfluidic device, allowing for simultaneous identification and confirmation of known and unknown impurities, increasing the confidence in compound identification and solving possible analytes co-elution.

MHE is particularly suitable for absolute quantitative analysis of volatiles in solid samples, when matrix-matched calibration reference materials are not available. The TriPlus 500 HS autosampler offers a fully automated MHE workflow, overcoming the matrix effect and eliminating the need of sample preparation. Excellent MHE linearity assures high precision and accuracy in the quantitative determination of residual solvents while significantly reducing the operator workload.

High-throughput requirements are smartly satisfied by the TriPlus 500 HS autosampler. Thanks to the overlapping capability between MHE cycles of the same sample and, as well, between different samples in the sequence, the overall workflow cycle time is automatically optimized.

Chromeleon CDS software offers integrated charts and advanced reporting capability for an easy and integrated MHE data processing, thus eliminating the need for external calculation tools.



MHE linearity for ethanol and acetone in salad wrap sample. For both the analytes, the resulting correlation coefficients (R^2) are extremely good, assuring accurate quantitative results.

Gasoline Range Organics in water

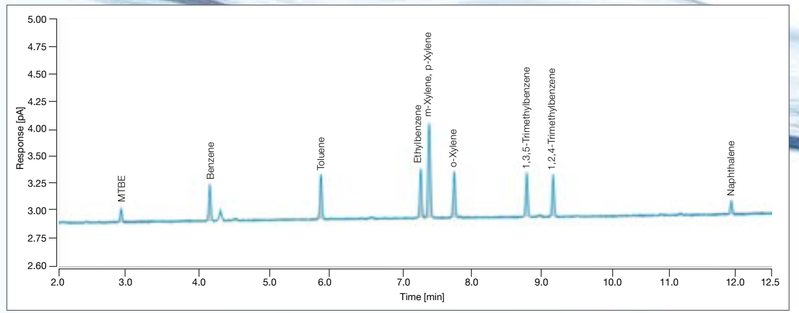
Automated routine-grade solution compliant with EPA 8015C method

Environmental testing laboratories involved in volatile organics determination in water and soil samples will benefit of the innovative design of the TriPlus 500 HS offering scalable producitvity, extended recovery and data quality, at the best cost/value.

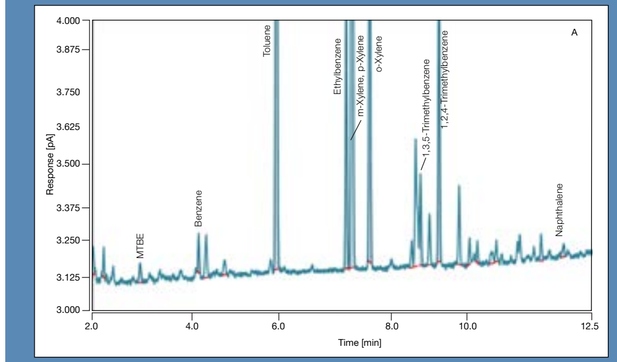
Gasoline Range Organics (GRO) are highly volatile compounds that can be easily extracted from the matrix without the need for time-consuming sample preparation. These chemicals are often present in the environment, especially in ground water and soil, mainly due to contamination incidents during handling, storing or transporting oil and related products.

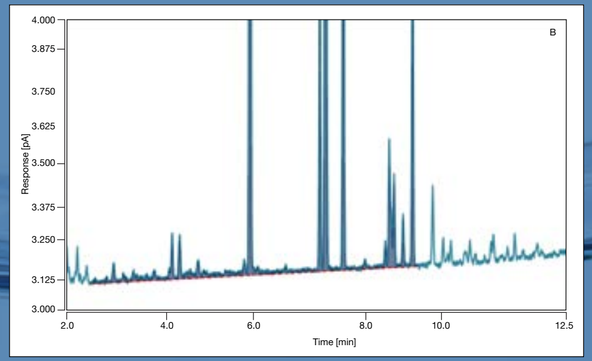
The TriPlus 500 HS autosampler offers a very efficient extraction of the volatiles, maximizing the sensitivity in shorter cycle times. The coupling with the GC-FID configuration provides a rugged solution for quantitiative determination of volatile hydrocarbons at ppb levels, representing a robust analytical tool for routine environmental laboratories.

Gasoline Range Organics	Spiked concentration (µg/L)	Average measured concentration (µg/L, n=7)	Calculated MDL (µg/L)	Calculated LOQ (µg/L)	Average Recovery (%, n=7)
Methyl tert-butyl ether (MTBE)	12.5	11.5	1.4	4.4	92
Benzene	12.5	12.8	1.2	3.9	103
Toluene	12.5	13.7	1.7	5.5	110
Ethylbenzene	12.5	12.8	1.3	4.0	102
m-Xylene, p-Xylene	12.5	12.8	0.8	2.7	103
o-Xylene	12.5	12.4	0.8	2.6	100
1,3,5-Trimethylbenzene	12.5	14.4	1.7	5.5	115
1,2,4-Trimethylbenzene	12.5	13.3	1.7	5.3	107
Naphthalene	12.5	14.6	2.2	7.1	117
Average		**13.1**	**1.4**	**4.6**	**105**



Calculated MDL, LOQ and % Recovery from 7 repeated headspace injections of tap water sample spiked at 12.5 ug/L (ppb)



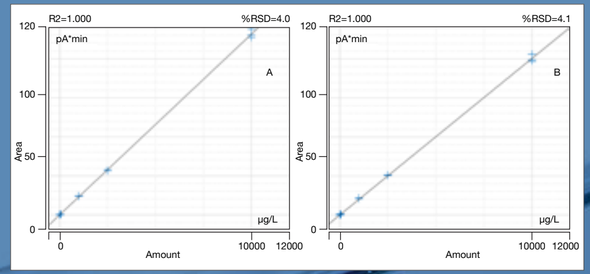


Example of tap water sample (5 mL) spiked with raw gasoline solution (5%) chromatogram, applying single component integration (A) and total area integration (EPA 8015C integration window) (B).

According to Wisconsin and EPA method 8015C, GRO quantitation is based on a direct comparison of the total area within a defined retention time window to the total peak areas of the gasoline component standards.

Excellent repeatability (RSD% 0.80-1.2) and linearity (R^2 = 1) for standards and matrix spiked samples, assure accurate quantitative results by applying both single component integration and total area integration.

Quantification of spiked samples is simplified with Chromeleon CDS. Advanced reprocessing features allow easy single component and total hydrocarbon content quantification.



Gasoline Range Organics	Spiked concentration (µg/L)	Average measured concentration (µg/L, n=7)	Calculated MDL (µg/L)	Calculated LOQ (µg/L)	Average Recovery (%, n=7)
Total Area Integration (Wisconsin method)					
Total	12.5	11.4	1.9	6.1	91
Total Area Integration (RT range 2.62-9.25 min) (EPA 8015C method)					
Total	12.5	13.0	2.2	7.0	105

Calibration curves for total area integration within the gasoline range for Wisconsin (A) and EPA 8015C (B) showing in both cases a correlation coefficient R^2=1. MDL and LOQ are in the low ppb levels, with a recovery > 90%.

Blood Alcohol Content forensic determination

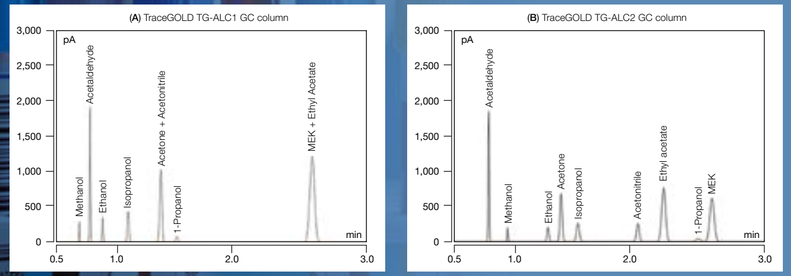
Defendability and high data quality combined with 24/7 productivity

The TriPlus 500 HS autosampler connected to the TRACE 1300 Series GC offers to forensic and toxicology laboratories the required sample throughput combined with highly precise, accurate and reliable results.

The static headspace sampling technique followed by GC-FID analysis can be easily approached with almost no manual manipulation of the samples. This worldwide adopted methodology is however challenged to be fast and capable to produce reliable and defendable results in the shortest time as possible.

With a total GC cycle time of less than 5 minutes and the highest vial capacity offered by the TriPlus 500 HS autosampler, the Thermo Scientific solution guarantees long unattended sequences for 24/7 operations.

The full control in Chromeleon CDS software and its automated reporting capabilities make the entire workflow very easy, even for less experienced operators, while assuring fully compliant data integrity and offering the most advanced tools for data tracking and management.



Example of chromatographic separation of target components in a control standard at 0.1 g/dL (1-propanol as internal standard) on (A) Thermo Scientific™ TraceGOLD™ TG-ALC1 GC Column, (B) Thermo Scientific™ TraceGOLD™ TG-ALC2 GC Column

- GC run time < 3 min (last peak at 2.6 min)
- Calibration range 0.01-0.2 g/dL
- R^2 > 0.999 on the widest concentration range
- Ethanol Area Counts repeatability < 1% (15 replicates, 0.1 g/dL std)
- No carryover after high concentrated samples

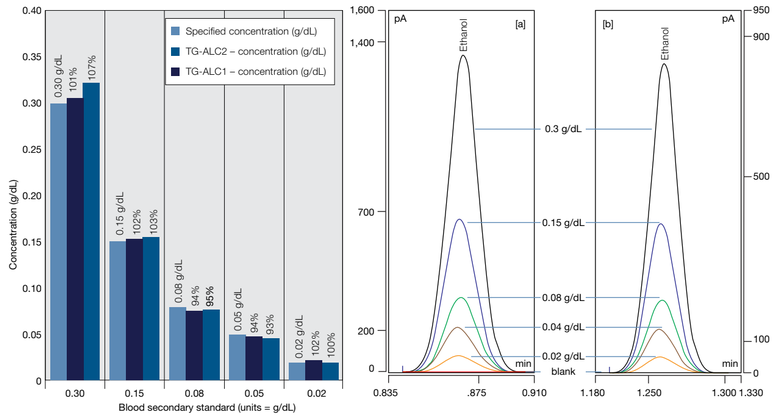
To assure safe and easy sample traceability, the TriPlus 500 HS autosampler offers 1D/2D barcode reading capability. Leveraging the sample management tools available in Chromeleon CDS, all relevant sample information are stored in the data system just before the analysis, for a secured asset tracking and inventory management.

In this way – without impacting the system productivity – forensic laboratories and high throughput environments maximize data quality, eliminating the possibility of dangerous vial misplacements.

A dual column/dual FID configuration is commonly used in isothermal conditions to achieve maximum throughput and for confirmation purposes. The highly efficient and reliable microfluidic 3-port connector delivers improved GC connectivity offering uncompromised peaks resolution and reproducible splitting between the two columns.

Dedicated TraceGOLD TG-ALC1 and TG-ALC2 GC columns provide the required separation efficiency to avoid possible false positives.

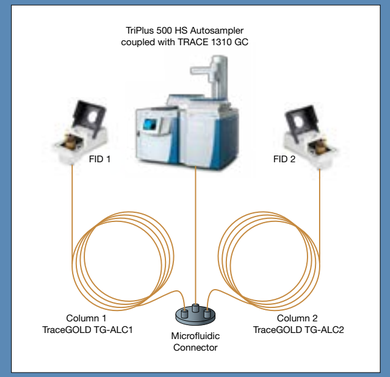
Possible false positives are also significantly reduced eliminating any carryover effect after high concentrated samples, thanks to the direct column connection of the TriPlus 500 HS autosampler and the efficient continuous purging of the sample path.



Left figure: Calculated ethanol concentration versus the specified values (in light blue), and associated recovery values, using TraceGOLD TG-ALC1 and TG-ALC2 GC columns.
Right figure: Overlaid chromatograms for each blood secondary standard concentration using columns [a] TraceGOLD TG-ALC1 GC column, and [b] TraceGOLD TG-ALC2 GC column.



TriPlus 500 HS autosampler (240-vial configuration) connected to the TRACE 1310 GC. The highest sample throughput in the most compact design.



Dual-FID configuration implemented through a microfluidic connector

Extend productivity with optional devices

Improve sample traceability, management and quality

For laboratories in need of complete and continued sample traceability, the TriPlus 500 HS autosampler barcode capability offers a flawless solution, eliminating the need for laborious manual sample tracking. The vials are automatically scanned and the barcode is read before the sample is placed into the headspace oven for analysis, transferring all the relevant information to the data system.

Benefits of a multi-format barcode reader

- **Time-savings:** no need to manually log sample information
- **Increased efficiency:** eliminate errors when recording information or tracking samples
- **Safer, smoother internal operations:** improves sample traceability and management with state-of-the-art technology



Vials are compatible with 1D and 2D barcode formats for more flexibility



TriPlus 500 Headspace autosampler coupled to the TRACE 1310 Gas Chromatograph, highlighting the barcode reader



HS-GC integrated solution
The TriPlus 500 HS autosampler is fully integrated with the TRACE 1310 GC and controlled through its wide, color touchscreen user interface. Having direct access to the instrument through the local GC interface is ideal for rapid instrument control, method development and troubleshooting.

Reliability for today. Scalability for tomorrow.
Whether you need an entry-level solution with 12-vial capacity or a high-throughput system with up to 240-vial capacity, the modular and fully scalable TriPlus 500 HS platform delivers the throughput you need. The system's basic configuration is easily upgradable to accommodate sample growth over time, yet never compromises on analytical performance.

- **Entry-level solution:** 12-vial capacity
- **High-throughput solution:** 120-vial capacity – this can be further expanded to accommodate up to 240 vials by adding one vial tray



TriPlus 500 Headspace Autosampler with 240-vial capability coupled to the TRACE 1310 Gas Chromatograph



Centralized, single point of control

Seamless integration with Chromeleon CDS

Simplify chromatography processes
By seamlessly integrating the Chromeleon CDS software with the TriPlus 500 HS autosampler, you gain the simplicity and convenience of having a single point of control for the entire analytical workflow and beyond.

With its rich and intelligent functionality, Chromeleon CDS does everything you need, and thanks to its Operational Simplicity, everything is fast and easy to use. It reduces data review and processing time with unique automation tools such as the Cobra detection algorithm, SmartPeaks™ Integration Assistant, and SmartLink data review.

Chromeleon software uses eWorkflow™ procedures to accelerate chromatography analysis by reducing manual data entries and processing errors. They provide a solution to easily create complete, correct sequences with predefined associated files and a well-defined structure. They minimize the amount of training, effort and time required to get from sampling to reliable results. This increase in productivity is reinforced by 24/7 laboratory uptime and prevention of data loss through industry-leading network failure protection.

Ensure regulatory compliance
Chromeleon software is a critical partner in delivering technical controls that help ensure compliance. These will inevitably sit alongside both procedural and administrative controls, such as Standard Operating Procedures (SOPs), training and administration that must be put in place by the user.

Chromeleon CDS enables you to meet the full requirements of the Food and Drug Administration Title 21 Code of Federal Regulations Part 11 (FDA 21 CFR Part 11) Electronic Records and Electronic Signatures. The software provides features that allow users to implement controls in accordance with their interpretation, including comprehensive audit trails and security tools to ensure compliance and data integrity.

Chromatography consumables

The perfect partner for optimal analytical performance

Thermo Scientific™ chromatography consumables are designed to complement our innovative range of GC and GC-MS systems together with our autosamplers. Get the most out of the TriPlus 500 HS autosampler by pairing it with advanced, high-performance Thermo Scientific products.

The TriPlus 500 HS autosampler can use 10 mL, 20 mL and 22 mL vials with crimp or screw caps, and flat or rounded bottom, without using a vial adapter. Completing the consumables solution for headspace analysis are high temperature septa and closures. This flexibility ensures full compatibility with existing methods to meet any analytical requirement.

Learn more about Thermo Scientific vials.

Thermo Scientific chromatography consumables offer a leap forward in capillary column performance delivering ultra-low bleed, superior inertness for excellent peak shape and sensitivity, and the highest levels of run-to-run and column-to-column reproducibility.

The wide range of vials, septa, capillary columns and accessories offers application-focused solutions that are ideal for pharmaceutical, forensics/ toxicology, environmental, food analysis, petrochemical and general analytical industries.

Learn more about Thermo Scientific chromatography consumables.





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Comprehensive GC and GC-MS solutions

Gas chromatographs

Tailor the Thermo Scientific™ TRACE™ 1300 Series Gas Chromatograph to your needs and eliminate maintenance downtime with the proprietary user-exchangeable Thermo Scientific™ Instant Connect injector and detector modules. Swapping modules for continuous operation is easily done in a few minutes by the user without special tools.



TriPlus 500 HS Autosampler coupled to the TRACE 1310 GC and ISQ 7000 single quadrupole mass spectrometer

Single quadrupole GC-MS and triple quadrupole GC-MS/MS systems

With unprecedented sensitivity, ease-of-use and uptime, the Thermo Scientific™ ISQ™ 7000 single quadrupole GC-MS and TSQ™ 9000 triple quadrupole GC-MS/MS systems are truly scalable platforms that empower you to overcome increasingly challenging regulatory requirements and productivity pressure.

Orbitrap GC-MS systems

An unparalleled level of quantitative and qualitative GC-MS performance can be realized easily and routinely with Orbitrap GC-MS. Thermo Scientific™ Exactive™ GC Orbitrap™ GC-MS and Q Exactive GC Orbitrap™ GC-MS/MS systems cover all the GC-MS requirements in your research or routine laboratory — from targeted quantitation, and broad scope screening through to compound discovery workflows.

Find out more at **thermofisher.com/TriPlus500**

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