

## Automate and track your sample preparation workflow

Easily program the Thermo Scientific™ TriPlus™ RSH SMART Autosampler for integrated sample preparation with operation traceability

# Overcome the challenges of sample preparation

When gas chromatography (GC) or gas chromatography mass spectrometry (GC-MS) analysis is performed, several manual procedures are required in the laboratory to prepare the sample prior to the injection, with the purpose of making it amenable to GC analysis, or to increase sensitivity through analytes enrichment, or simply to prepare standard solutions for instrument calibration.

Sample preparation normally involves multiple steps such as extraction, clean up, dilution, standard addition, derivatization, mixing and heating. More than 60% of the time spent in a chromatographic analysis can be dedicated to sample preparation.

Additionally, it is estimated that approximately 30% of possible sources of analytical error are due to manual sample handling (i.e., sample loss and/or sample contamination), with significant consequences on the analytical data accuracy and precision.

The Thermo Scientific™ TriPlus™ RSH SMART Autosampler is a robotic platform enabling SMART technology for consumables ID recognition and usage tracking. It is capable of combining highly versatile sample introduction with automated and fully traceable sample preparation procedures. The typical bottle-neck of manual GC and GC-MS analytical workflows can be eliminated by this autosampler through fully unattended operations and automated tracking of SMART consumable usage, for increased confidence in the analytical results. Basic and advanced sample preparation procedures can be performed by batching samples before the GC analysis or sequentially by optimizing the overall cycle time through overlapping capabilities.

## Advantages of sample handling automation:

- Higher sample throughput
- Improved data repeatability
- Increased laboratory efficiency by unattended routine operations
- Reduced cost per sample
- Enhanced confidence of the analytical results

- ▶ TriPlus RSH SMART Autosampler with Thermo Scientific™ ISQ™ 7610 Single Quadrupole MS System coupled to Thermo Scientific™ TRACE™ 1610 Gas Chromatograph

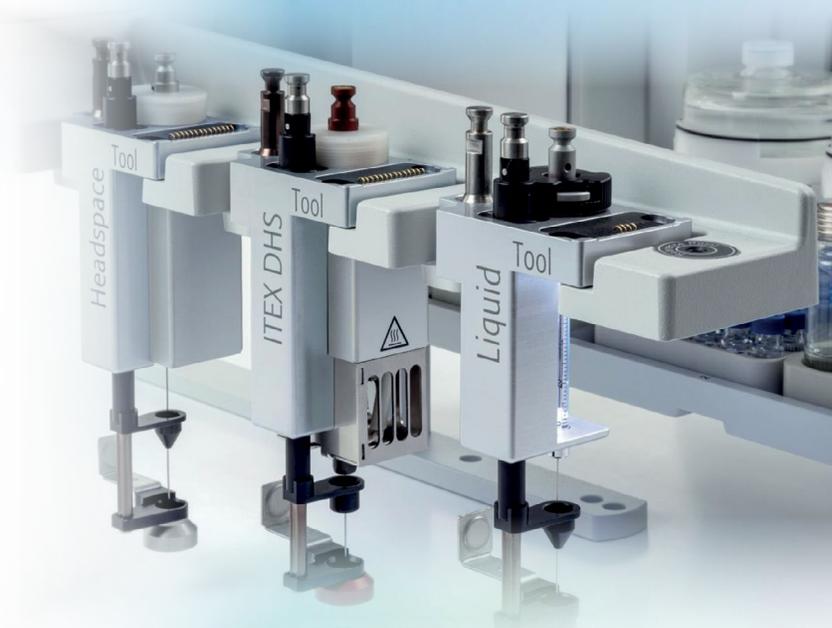


# Error-free sample handling

The Automatic Tool Change (ATC) provides the foundation for automated basic and advanced sample handling and sample preparation procedures. The automatic selection of the suitable tool permits different injection techniques like liquid, static and dynamic headspace, and solid phase microextraction (SPME) to be executed within the same sample sequence in a fully unattended way. Up to 6 different tools can be programmed for extended sample preparation capabilities. With that, different liquid syringes can be dedicated to specific operations like standard addition or dilution, minimizing possible cross contamination.

Several tools are available to reliably automate the most common sample preparation procedures, including on-line microSPE clean-up of QuEChERS extracts, and to achieve the highest level of sample handling flexibility. Combined with high sample capacity, the TriPlus RSH SMART autosampler overcomes stringent productivity requirements.

SMART syringes and SPME/SPME Arrow fibers are automatically recognized by the autosampler to further streamline the workflow through error-free operations. Additionally, the SMART technology allows to track consumables usage and conditions, locally and through the chromatography data system, supporting GLP accreditation.



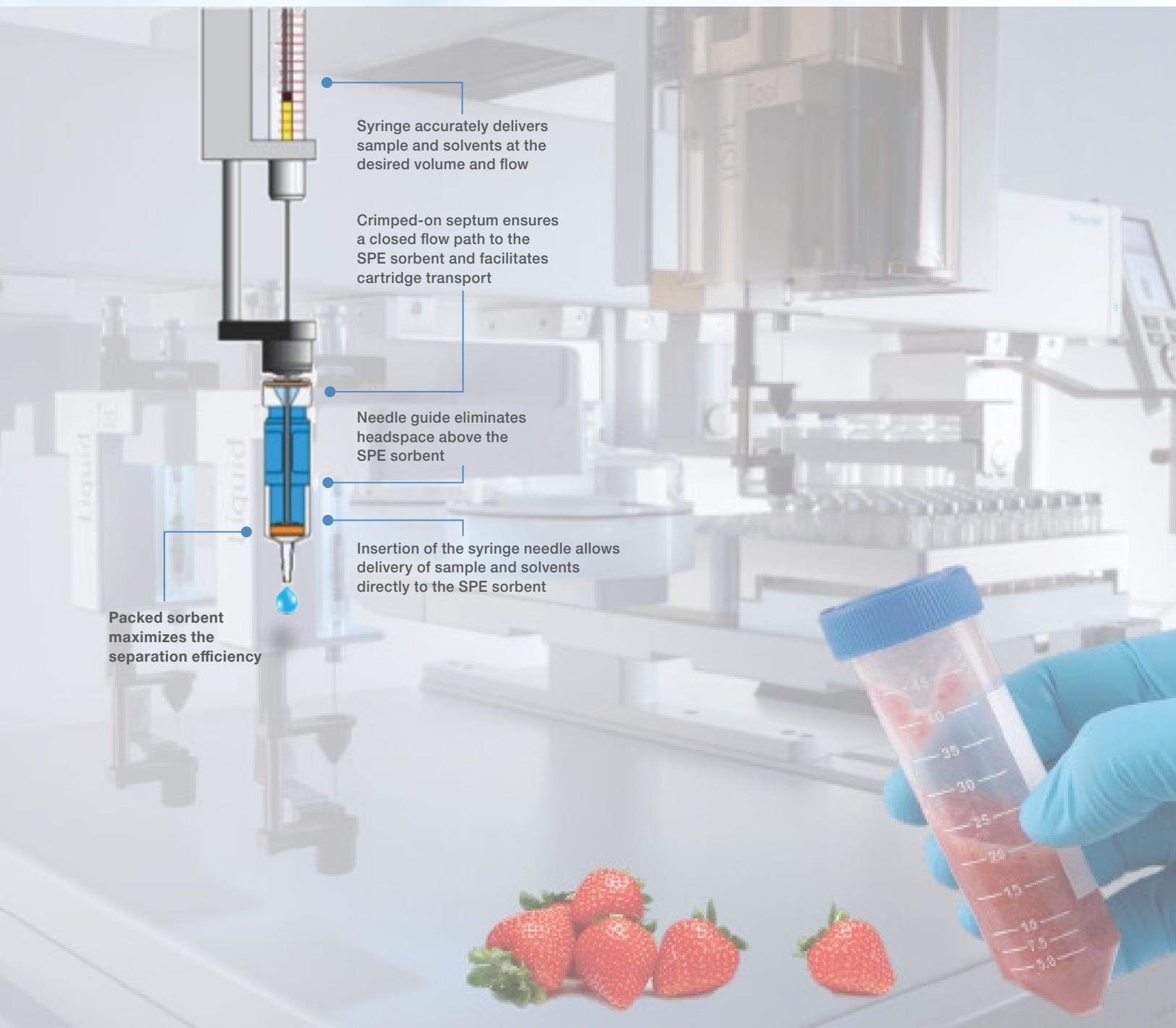
# Automated clean-up of QuEChERS extracts of foods

Evolve from manual clean-up operations to automated miniaturized cartridge-base  $\mu$ SPE

Automated  $\mu$ SPE clean-up available on the TriPlus RSH and TriPlus RSH SMART autosamplers allows modern laboratories to gain reliable high throughput operations for GC-MS analysis of pesticides in a wide variety of food matrices, even those with high lipid contents.

Replacing manual clean-up procedures with a fully automated on-line approach maintains the efficiency of the [QuEChERS extraction](#), while offering the benefits of eliminating human errors and scaling down sample volume and solvent consumption.

The miniaturization of the clean-up step to a microliter scale solid-phase extraction prevents the typical dilution during manual SPE operations, thus avoiding an additional evaporation step. The pesticides fraction is eluted only in a small volume of a few 100  $\mu$ L for direct injection into the GC-MS system.



# Higher selectivity and extended instrument up-time

Discover the benefits of the  $\mu$ SPE clean-up automated workflow

Unlike classical SPE using a vacuum manifold, the flow rate applied to the  $\mu$ SPE cartridge can be precisely controlled with a liquid syringe on a TriPlus RSH autosampler, ensuring optimum selectivity and recovery.

The  $\mu$ SPE cartridge is sealed by a septum allowing the autosampler syringe to push the raw QuEChERS extract through the sorbent bed. The syringe works as an LC pump. Low flow rates of approx. 2  $\mu$ L/s in the load and elution steps are used for sharp analyte/matrix separation.

- **Automated workflow**

Reduced manual errors and extended unattended operation

- **Optimized sorbent material**

Single type cartridge for hundreds of pesticides in many different food matrices

- **Higher selectivity**

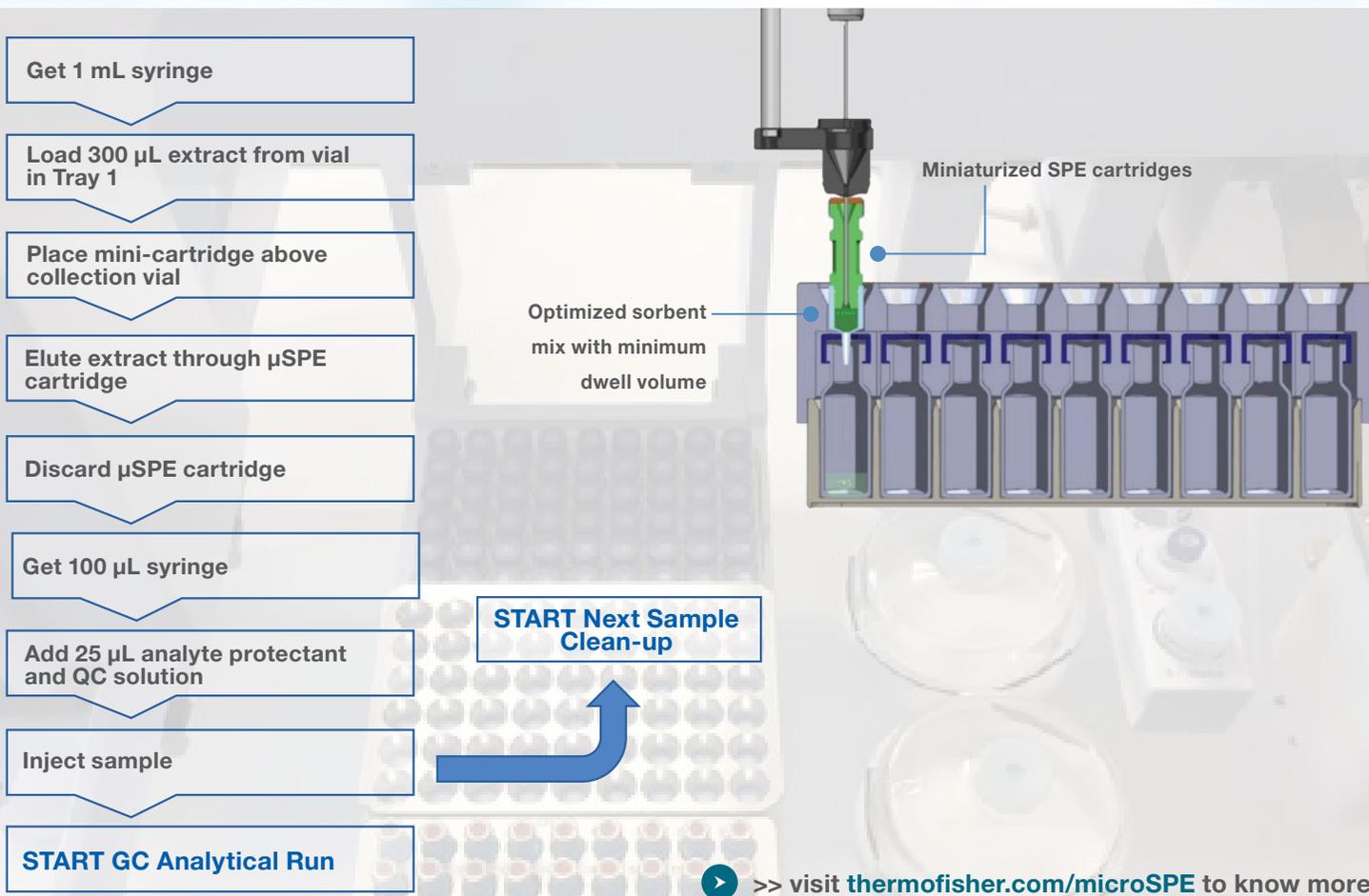
Cleaner extract for an extended instrument uptime

- **Miniaturization to microliter scale**

Less sample and solvent consumption with no concentration step required

- **Optimized cycle time through overlapping**

Fast clean up step <10 min run in parallel to the chromatographic separation of the previous sample



# Gain control of your TriPlus RSH SMART Autosampler

Let the robotic capabilities of the TriPlus RSH SMART autosampler perform daily sample preparation workflow – from samples and standards dilution up to more complex derivatization protocols – automatically and reliably.

Actions such as sequential dilution, calibration dilution, standard addition, batch and sequential sample derivatization, heating/mixing and vortexing are now at your fingertips to easily create your automated workflow.

Ready-to-use PrepCycles are pre-compiled set of basic operations to go beyond standard injection functions and are available within the TriPlus RSH SMART autosampler as a default. Additionally, you can gain extra control of your autosampler by programming customized workflows to easily fulfill your routine sample handling needs.

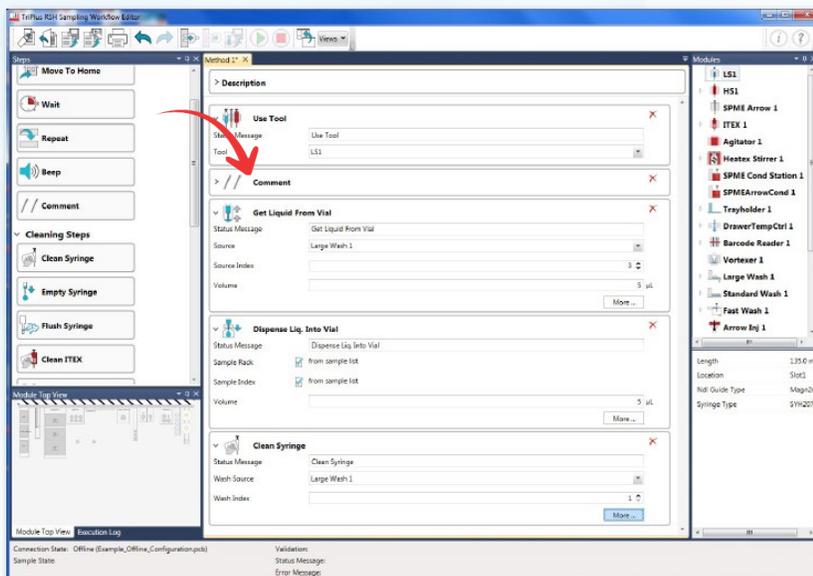


Easily instruct the TriPlus RSH SMART autosampler to perform daily sample handling operations for you, in a fully automated way, with the Thermo Scientific™ Sampling Workflow Editor software.

Simply connect the Sampling Workflow Editor software to the TriPlus RSH SMART autosampler and all the configured tools will be automatically recognized. Then, you can play with all the actions compatible with your tools, through an easy drag-and-drop approach, to program your own sample preparation workflow.



Visit [www.thermofisher.com/SamplingWorkflowEditor](http://www.thermofisher.com/SamplingWorkflowEditor) to view the video demonstration.



## Sequential dilution

A high concentration standard is automatically diluted to easily meet your requirements.



Sequential dilution

## Calibration dilution

Reliability and precision for your quantitative calibration. Prepare calibration levels with or without internal standards.



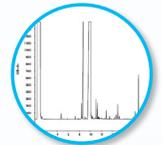
Calibration dilution with internal standard

## Standard addition

Add increasing amounts of standard to any sample. Calibrating by standard additions is commonly used in headspace and SPME analyses. The accurate addition of standards is now a reliable, automated step in the measurement cycle.

## Sample derivatization

Derivatization steps for repeated batches of up to six samples or sequentially for immediate injection to prevent sample degradation.



Automated batch or sequential derivatization

## Heating/mixing

Vials undergo automatic agitation after the addition of standard volumes. You can also speed-up headspace and SPME applications by reaching the equilibrium faster.



Incubator for mixing and derivatization

## Vortexing at ambient temperature

Physical vortexing for thorough mixing can be used for liquid homogenization and extraction steps with solvents.



Vortex mixer utilizing different vial sizes

## Centrifugation

Essential tool for phase separation, supporting automated liquid-liquid extraction with micro volumes.



Centrifuge for phase separation compatible with flammable solvents

## Ambient temperature headspace

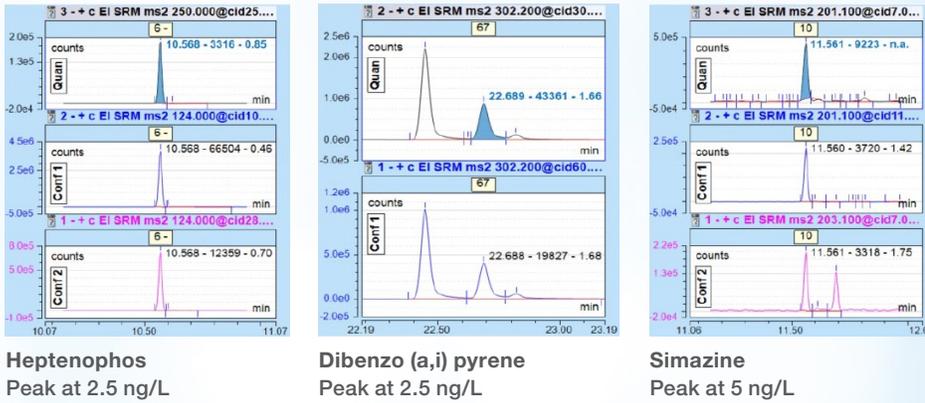
Perform static headspace injection skipping the incubation step, for temperature sensitive samples or for sampling from special vessels, i.e. Exetainer®, Vacutainer®.

Sampling Workflow Editor user interface. Intuitive visual programming of your autosampler through drag-and-drop motion.

# Boost sample preparation for environmental analysis

## Automated liquid-liquid extraction (LLE) of Semi-Volatile Organic Compounds (SVOC) in water samples

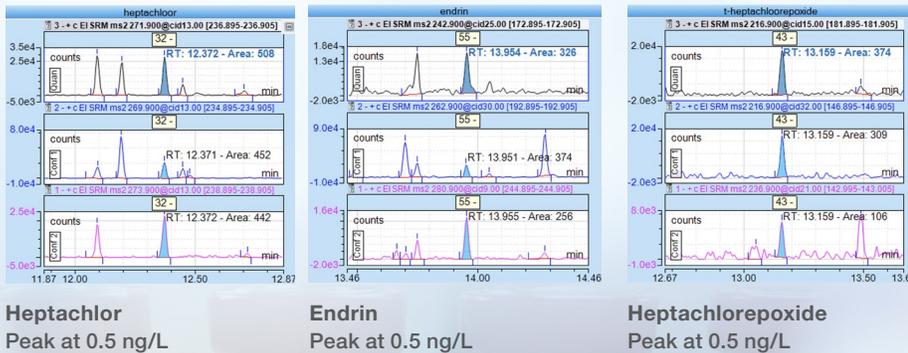
Semi-volatile organic contaminants in water belong to a wide variety of chemical structures, such as hydrocarbons, pesticides, phenols, PCBs, PAHs and nitrosamines, representing a serious risk for the environment and human health. Liquid-liquid extraction remains one of the go-to options for organic contaminant extraction from water samples, but manual operations are time consuming, prone to human error, and involve high solvent consumption. Automated sample preparation workflow coupled to the highly sensitive Thermo Scientific™ TSQ™ 9610 GC-MS/MS is a valuable opportunity to save on solvent costs, minimize labor time, and achieve extremely high data quality by removing the variability of manual operations.



▲ Quantified concentration in water samples

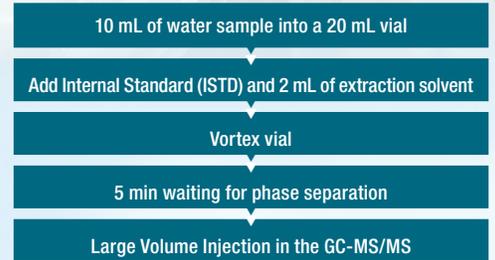
## Dispersive liquid-liquid micro extraction (DLLME) for sub-ppt sensitivity

The DLLME uses a micro volume of extraction solvent (ca 300 µL) added in a dispersive way to water samples offering an elevated surface exchange, and dramatically increasing the final concentration of the analytes in the organic phase.



▲ Quantified concentration in water samples

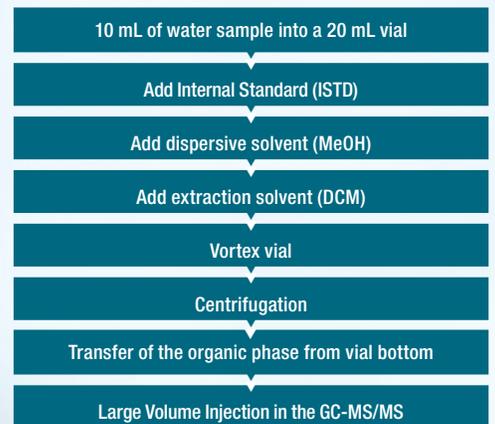
### Automated LLE workflow\* steps



\*www.SampleQ.com

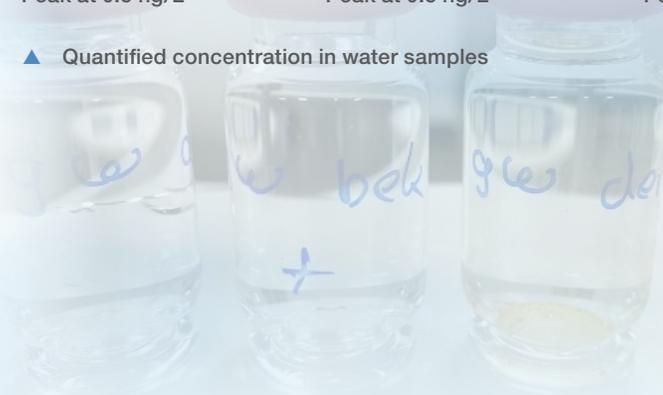
- ✓ In-vial extraction for limited sample volume and solvent consumption
- ✓ On-line injection in the GC-MS/MS system
- ✓ Suitable for drinking, ground, surface, sea water and wastewater
- ✓ Sensitivity at ppt levels
- ✓ H24 operations

### Automated DLLME workflow\* steps



\*www.SampleQ.com

- ✓ Enhanced enrichment
- ✓ Sensitivity at sub-ppt levels
- ✓ On-line injection in the GC-MS/MS system
- ✓ Suitable for drinking, ground, surface, sea water and wastewater
- ✓ H24 operations



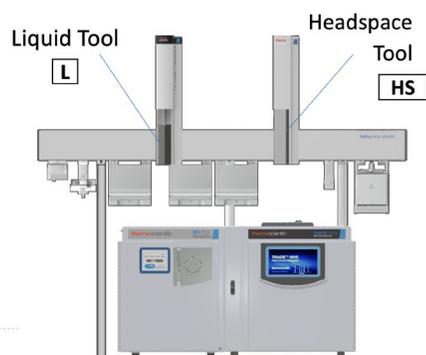
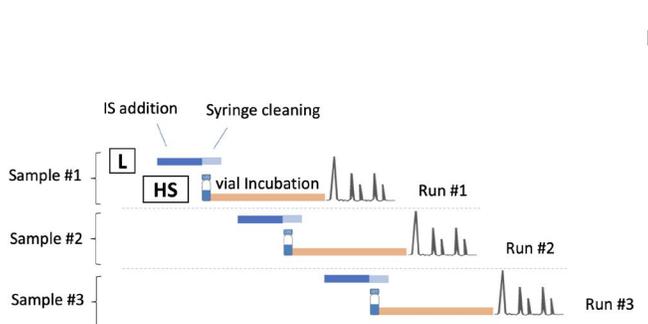
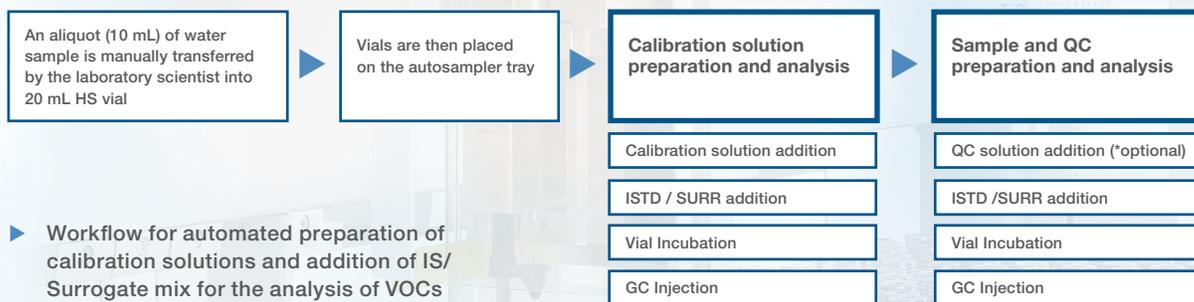


## TriPlus RSH SMART VOC Sample Prep Station

### Streamline Volatile Organic Compounds (VOC) analysis for water and soil samples

The Thermo Scientific™ TriPlus™ RSH SMART VOC Sample Prep Station, in the dedicated dual-head configuration, streamlines the headspace analysis of Volatile Organic Compounds (VOCs) in water and soil samples by automating sample preparation steps and seamlessly integrating on-line HS-GC-MS analysis. This automated workflow preserves sample integrity by adding internal standards and surrogates to samples just before headspace sampling and analysis, while maintaining overlap of all the steps for an optimized cycle time. It also automates the preparation and analysis of calibration standards using the same procedure.

Thanks to the intelligent programming, the two heads can move simultaneously and synchronized, safely sharing a common working space and optimizing the total cycle time for maximum sample throughput.



Liquid and headspace tools move simultaneously to allow the ISTD/SURR addition just before vial incubation and analysis, maintaining headspace cycle time optimization.

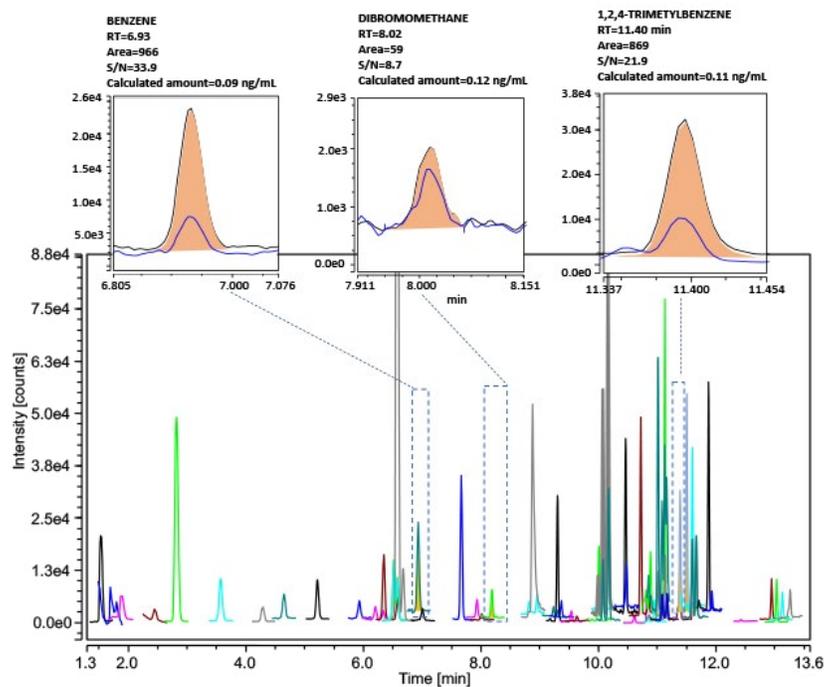
By eliminating the uncertainties of manual operations, this automated workflow enhances data precision and provides greater confidence in quantitative results, all while adhering to regulatory requirements.

Suitable for the EPA 8260 compounds list, the TriPlus RSH SMART VOC Sample Prep Station is paired with the Thermo Scientific ISQ 7610 Single Quadrupole GC-MS to achieve sensitivity at ppt level for VOCs in water samples, ensuring high robustness and extended instrument uptime.

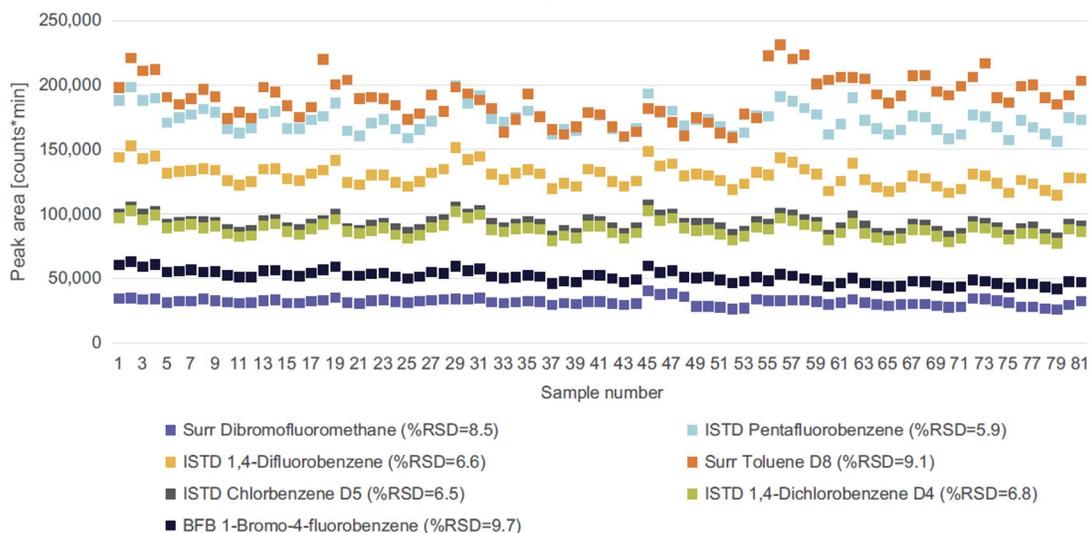
Visit [thermofisher.com/triplusrshsmartvoc](https://thermofisher.com/triplusrshsmartvoc) to know more

## Benefits of TriPlus RSH SMART VOC Sample Prep workflow:

- Improve data quality with precision in compliance with regulatory requirements
- Relieve manual operation and enhance laboratory efficiency through unattended operations
- H24 operations with highly consistent results
- Facilitate good laboratory practice with SMART consumables traceability and instrument health notifications from Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS)



▲ SIM trace showing the target compounds in a tap water sample spiked with a VOC mix at the lowest calibration point (0.1 ng/mL). Calculated MDL is  $\leq 0.17$  ng/mL for all the compounds (MDL for BTEX is 0.01 ng/mL).



◀ ISTD/surrogate peak area %RSD across the samples in the evaluation period of six working days

## Streamlined control with Chromeleon CDS

The TriPlus RSH SMART VOC Sample Prep Station instrument control is fully integrated in Chromeleon 7.2.10 and 7.3 CDS, ensuring a smooth and efficient control of the automated workflow covering sequence setup, sample preparation and online injection, data acquisition, and reporting.

The Chromeleon Environmental Analysis Extension Pack for EPA-based environmental applications provides a comprehensive set of GC-MS e-workflows for quick sequence set-up and reporting templates to make data review and reporting easier. Moreover, with the ever-evolving compliance requirements for data integrity and data security, Chromeleon CDS offers a secure platform for analytical laboratories to comply with modern regulatory guidelines including FDA 21 CFR Part 11 and European Commission (EU) Annex 11.

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 RSH SMART autosampler by pairing it with advanced, high-performance Thermo Scientific products.



▶ **Learn more about SureSTART**

Have you ever thought about the quality of your glass vial? Especially when you need to detect small concentrations or certain structures of analytes, it's important to preserve your sample integrity right from the start with vials. With our SureSTART brand you will find the vial best suited for your needs. Find our offering in 3 different performance levels:

Performance Level 1: Everyday applications; choose these for the cost-effective choice

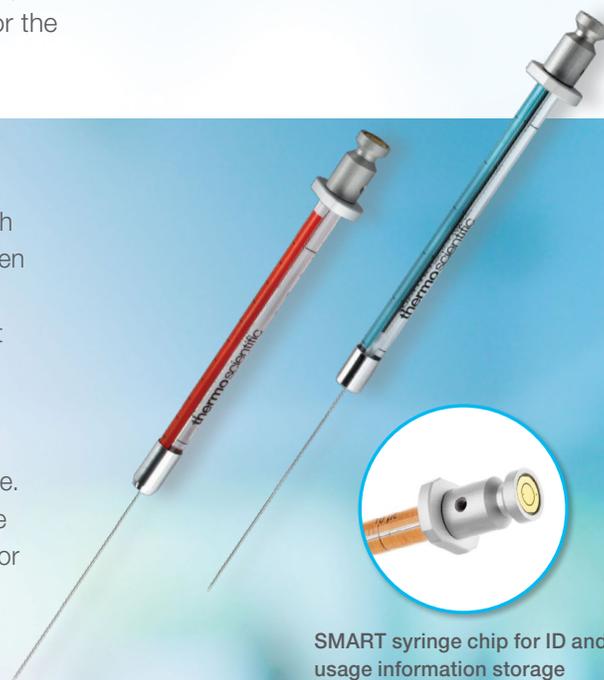
Performance Level 2: High throughput applications; choose these when robustness and reproducibility are key

Performance Level 3: High performance; choose these when sensitivity is a must

All SureSTART products are Specification Certified. In addition, kits are either LC/GC Certified or MS Certified.

Achieve error-free sample handling and electronic tracking capability using Thermo Scientific™ SMART GC Syringes and SPME/SPME Arrow fibers with the TriPlus RSH SMART Autosampler. Read/write ID chip on each field-proven syringe and SPME fiber allows an automatic connection to the TriPlus RSH SMART autosampler for information exchange. Key information such as part number, lot number, usage parameters, operational ranges and history for that specific consumable are stored in the chip. This information is directly accessed and reported via Chromeleon CDS, integrating consumables identification and usage tracking into an audit trail log file for GLP compliance. The combination of smart syringe technology and Chromeleon CDS with the TriPlus RSH SMART autosampler provides an entirely automated workflow for full traceability in compliance with regulatory protocols.

▶ **Learn more about GC SMART Syringes**



SMART syringe chip for ID and usage information storage

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 at [thermofisher.com/triplusrsh](https://www.thermofisher.com/triplusrsh)