



**GERSTEL**

# Automated Dynamic Headspace

# DHS



Enhanced Detection Limits  
Carryover Eliminated  
Highest Productivity and Throughput  
Most Flexible Automated Solution Available

# Automated Dynamic Headspace DHS

*The Dynamic Headspace technique combines the sensitivity and low detection limits of Purge and Trap with the ease of handling, high productivity and ruggedness of Headspace analysis.*

The Dynamic Headspace (DHS) option for the GERSTEL MPS autosampler, an industry standard, offers complete automation of the dynamic headspace technique. The DHS station is used to extract and concentrate VOCs from liquid or solid samples placed in standard headspace vials.

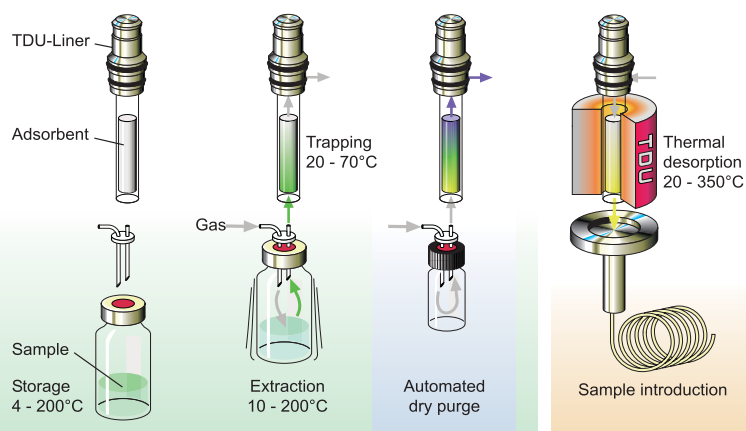
The headspace above the sample is purged and analytes are concentrated on a user selectable adsorbent-filled trap. Analytes are subsequently introduced into a gas chromatographic system by

thermal desorption of the trap in a GERSTEL Thermal Desorption Unit (TDU) resulting in maximum recovery, and lowest possible detection limits. DHS offers improved performance for a wide variety of sample types, such as food, beverages, polymers, personal care products and pharmaceuticals.

GERSTEL exclusive MAESTRO software enables fully integrated control of the complete process from extraction and analyte collection to GC/MS analysis. Just one method and one sequence table is required, minimizing the risk of errors and enabling fastest possible set-up. Intelligent software control ensures that the DHS process is performed during the GC run of the preceding sample, thereby optimizing productivity and system utilization, an exclusive GERSTEL feature.



## The DHS process from extraction to sample introduction



## Adsorbents

For most applications, Tenax TA adsorbent can be used in the trap. If your application requires another adsorbent, you can choose from a selection of pre-packed and conditioned tubes or you can pack the tubes yourself with the adsorbent(s) of your choice. Since the trap is back-flushed during desorption, multi-bed adsorbent tubes can be used in order to cover a wide range of analyte boiling points and polarities in one analysis for improved flexibility and productivity.



## DHS Background and System Overview

The DHS station provides sample thermostating and agitation combined with purging of the sample headspace with a controlled flow of inert gas. The result is fast, efficient and reproducible extraction of analytes from liquid or solid samples. Extracted compounds are trapped and concentrated on a replaceable adsorbent-filled trap, which is subsequently thermally desorbed in the integrated GERSTEL Thermal Desorption Unit (TDU) followed by determination of the analytes using GC/MS. While in the GERSTEL MPS autosampler, samples are stored in standard headspace vials at ambient temperature. Optionally, samples can be stored at controlled temperatures between 4 °C to 200 °C. Lower sample temperatures can help reduce decomposition of heat sensitive samples

such as food and biological materials. Higher temperatures can be used to simulate sample behavior under "stressed" conditions. During extraction, samples can be agitated to enhance and speed up the extraction process. The temperature of the adsorbent tube during the DHS process can be independently controlled from 20 °C to 70 °C for optimal trapping of the analytes of interest. The adsorbent tube can be dry purged for water removal to ensure the best possible chromatography and MS stability. A new adsorbent tube can be used for every sample, eliminating the risk of cross contamination or the same tube can be used for multiple samples as in standard Purge and Trap instruments.



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## DHS Benefits

### 1 Low detection limits

- Exhaustive purge of sample headspace
- Efficient trapping on selectable adsorbent tube
- Direct and quantitative, split or splitless transfer from trap to GC/MS system
- Lower detection limits than static headspace, SPME, and other widely used techniques

### 2 Reliable and reproducible

- Inert, unique valve free sample path: No analyte discrimination, no cross contamination
- A new trap can be selected for every sample to eliminate any risk of cross-contamination
- Headspace purge technique, limits the risk of system contamination from sample foaming
- Automated standard addition provides improved Quality Control
- Integrated GERSTEL MAESTRO control of complete system minimizes risk of errors

### 3 High productivity through high throughput design

- Complete automation from sample extraction to sample introduction
- Fast, simple analysis setup, just one integrated method and one sequence table
- Agitation and gas purge provides fast extraction and short analysis cycles
- Optimized system utilization with exclusive GERSTEL PrepAhead functionality
- High throughput, up to 98 samples in one sequence (custom systems with higher sample capacity available)

### 4 Highly Flexible

- User defined extraction time, flow and temperature
- Samples can be heated, cooled and agitated
- Large capacity adsorbent trap can cover a wide analyte concentration range
- Any adsorbent can be used for analyte trapping
- A new trap can be used for every sample
- Adsorbent trap can be heated or cooled for better efficiency
- Multi-method sequences for method development and flexible analysis

### 5 Solvent free extraction

- Saves on costly solvents and expensive disposal fees
- Improves the laboratory environment and occupational safety
- Improves detection limits by eliminating solvent dilution factor

### 6 Multiple water management options

- Subambient extraction temperature can be selected to limit evaporation of water
- Trap temperature and adsorbent type can be varied to reduce trapping of water
- Automated dry purge

### 7 Convenient, user friendly operation

- GERSTEL "Sample Prep by Mouse-Click"
- Control of complete system including GC/MS through one method and one sequence table
- Simple sample handling using standard headspace vials
- No solvents required
- Modular system, easy upgrade of existing MPS

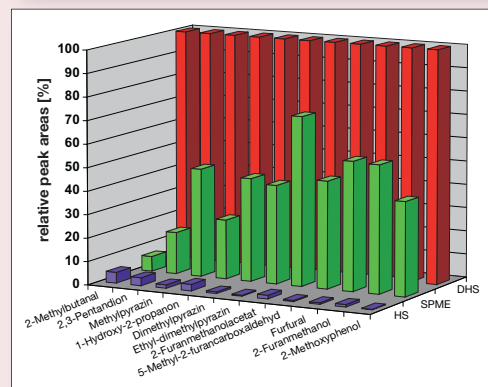
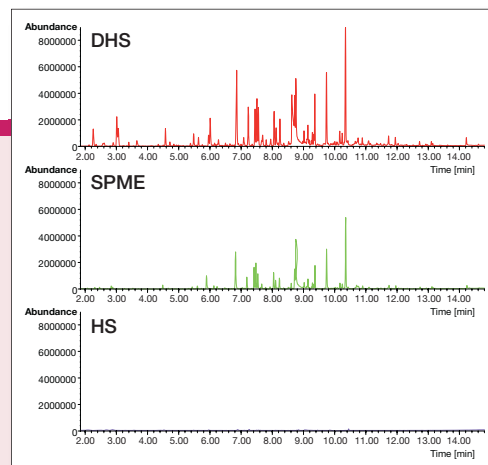
## Analysis of coffee powder using DHS, HS-SPME and Static Headspace

## Comparison of gas phase extraction techniques

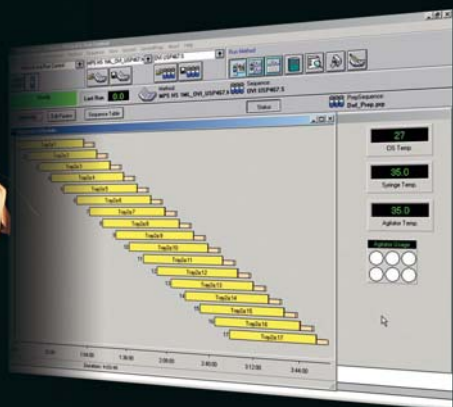
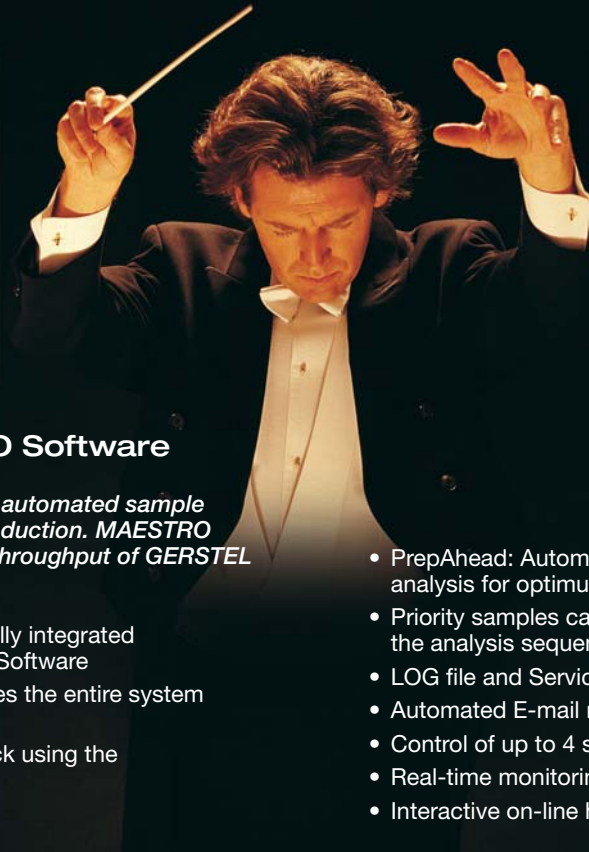
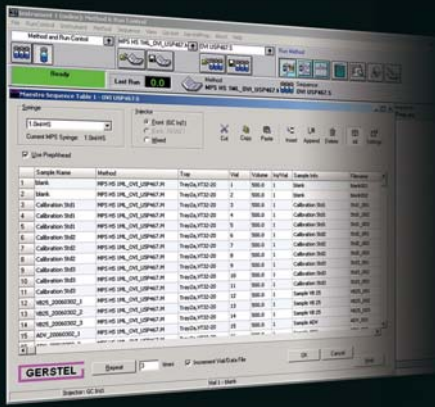
In order to compare different gas phase extraction techniques, 100 mg samples of a ground coffee were analyzed using static headspace, headspace-SPME and DHS. Comparable extraction conditions were chosen: Extraction temperature: 40 °C; Extraction time: 30 min (HS, SPME), 5 min (DHS); DHS gas flow: 20 mL/min; Adsorbent:

DVB/Carboxen/PDMS (SPME), Tenax (DHS)

It can be seen from the sample chromatograms and the bar graph showing relative peak areas (DHS response normalized to 100%), that DHS provided the highest response for the analytes that were determined. For most analytes, DHS provided relative standard deviations well below 5%, which is equal to or better than the other techniques







## GERSTEL MAESTRO Software

Next generation software for automated sample preparation and sample introduction. MAESTRO optimizes performance and throughput of GERSTEL modules and systems.

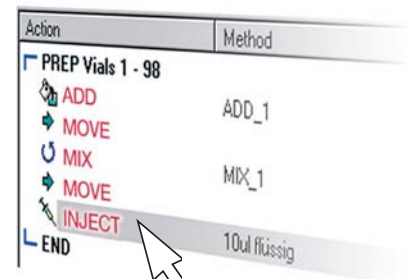
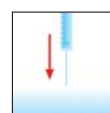
- Stand-Alone operation or fully integrated in the Agilent ChemStation Software
- One sequence table operates the entire system including LC/MS or GC/MS
- Sample Prep by Mouse-Click using the PrepBuilder functions
- Scheduler for easy planning

- PrepAhead: Automated overlapping of sample prep and analysis for optimum productivity and throughput
- Priority samples can be added to the system at any point in the analysis sequence
- LOG file and Service LOG file functions ensure traceability
- Automated E-mail notification if the sequence is stopped
- Control of up to 4 systems from one PC
- Real-time monitoring of all modules and parameters
- Interactive on-line help function

## Sample Prep by Mouse-Click

The MPS is an autosampler and sample preparation robot for GC and LC. Sample preparation steps are performed during the analysis of the preceding sample for best possible system utilization and highest sample throughput. Sample preparation steps are performed in a controlled and highly accurate and reproducible manner for best possible results. Every step is selected by mouse-click from a pull-down menu in the MAESTRO software and added to the overall GC/MS or LC/MS method. Available sample prep techniques are:

- Solid Phase Extraction (SPE)
- Standard addition
- Weighing
- Derivatization
- Extraction and dilution
- Heating, conditioning and mixing
- Twister Back Extraction (TBE)
- Automated Liner EXchange (ALEX)
- Automated Twister desorption and analysis (SBSE)
- Solid Phase Micro Extraction (SPME)
- Thermal Desorption (TDS)
- Dynamic Headspace (DHS)
- Multi Column Switching (MCS)



MAESTRO Software enables Sample Prep by Mouse-Click. All sample preparation steps are conveniently and easily selected from a drop down menu and added to the method. Example:



### ADD

Add solvent, internal standard or reagent



### MOVE

Move the vial or cartridge



### MIX

Agitate or stir and incubate the sample at a set temperature



### INJECT

Introduce an aliquot of the sample to the GC or LC system

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