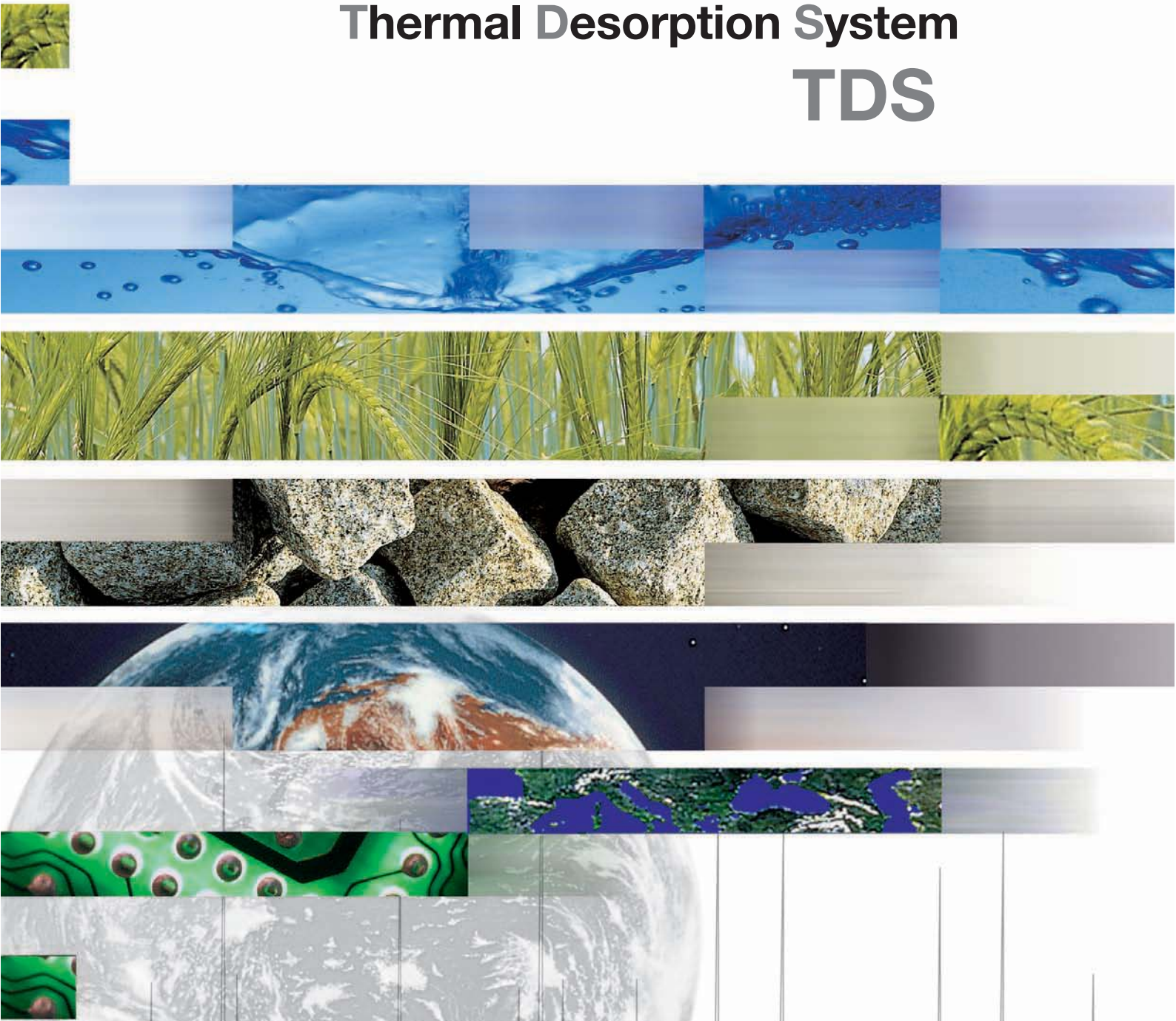
G L O B A L  A N A L Y T I C A L  S O L U T I O N S

GERSTEL

# Thermal Desorption System
# TDS



**Lowest Detection Limits**
**Dependable Operation**
**Reliable and Accurate Results**

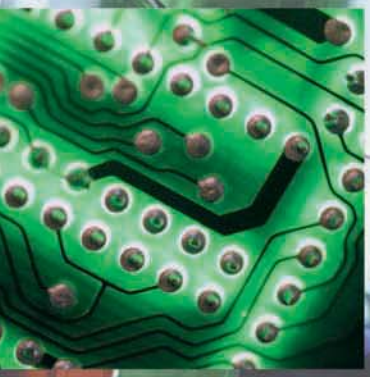
# GERSTEL Thermal Desorption System TDS 3

The GERSTEL TDS 3 is a flexible multi-functional thermal desorption system for highly sensitive and accurate determination of volatile and semi-volatile organic compounds (VOCs and SVOCs). Analytes can be desorbed and concentrated from adsorbent tubes, from GERSTEL Twisters® or directly from solid or viscous samples that have been placed in TDS tubes - without the need for sample preparation. The TDS 3 enables the analyst to accurately determine analytes, even at ultra-trace levels, in gaseous, liquid or solid samples. When a TDS A2 autosampler is added, the TDS 3 becomes a fully automated thermal desorption system capable of unattended analysis of up to 20 samples.

The GERSTEL TDS is the leading thermal desorption system world-wide in a range of industries, where accurate and sensitive analytical results are of the highest importance to ensure product quality and consumer safety. Among these industries are food and beverage, flavor and fragrance, tobacco, automotive and semiconductors

**Food & Beverages**

**Flavor and fragrance**



**Tobacco**

**Automotive**

**Toy safety**

**Semiconductor**

**Forensic**

**Polymer and Packaging**

**Environmental**

**Pharmaceutical**

*For a complete listing of GERSTEL application notes, please visit www.gerstel.com*

## GERSTEL - The leading provider of customer focused solutions for Thermal Desorption

**Flavors, off-odors and trace level contaminants**

**Complex flavors and fragrances, odors and off-odors in raw materials and final products. Complex analysis using multidimensional GC/MS and olfactory detection.**

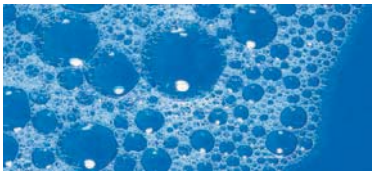
**Flavors, fumigants, nitrosamines, additives and trace level organic compounds**

**Emission from materials used in vehicle interiors, vehicle indoor air monitoring, and engine exhaust monitoring**

**VOC Emissions from toys (EN 71-11:2005 Safety of toys)**

**VOC and SVOC contaminants in materials and sub-assemblies. Clean room air monitoring**

**Fire accelerants, document forgery markers, paint chips, solvent fingerprinting of controlled substances**



**Solvent residues, monomers, additives and off-odors**

**Organic contaminants in water, soil and air; material emissions and indoor air**

**Residual solvents in tablets, migration from packaging**

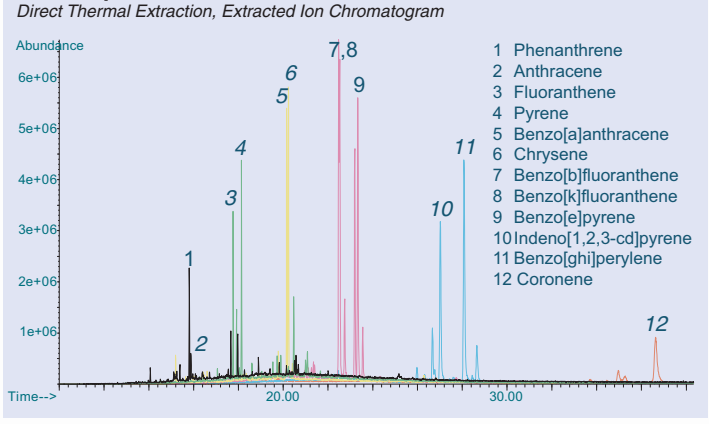
# Advantages and benefits of the GERSTEL TDS

*The TDS 3 transfer line between the sample and the trap is only 15 cm long and it can be heated to 400 °C for best possible analyte transfer. No transfer line is needed between the trap and GC column since these are directly connected. There are no cold spots in the system; optimum transfer of VOC and SVOC compounds to the GC column is ensured (see chromatogram "Air Sample on Glass Fiber Filter" on this page).*

1. **Cooled Injection System CIS trap for best performance and versatility**
2. **No valves in TDS flow path**
3. **No transfer line between and trap and GC column, unique design**
4. **Multi-level temperature programmed desorption**
5. **Cooled pre-drying and purging of desorption chamber.**
6. **Reduce sample matrix contribution and improve extraction efficiency**
7. **Horizontal design enables direct thermal extraction of solids**
8. **High flow desorption with splitless transfer**
9. **Mounts on top of GC**

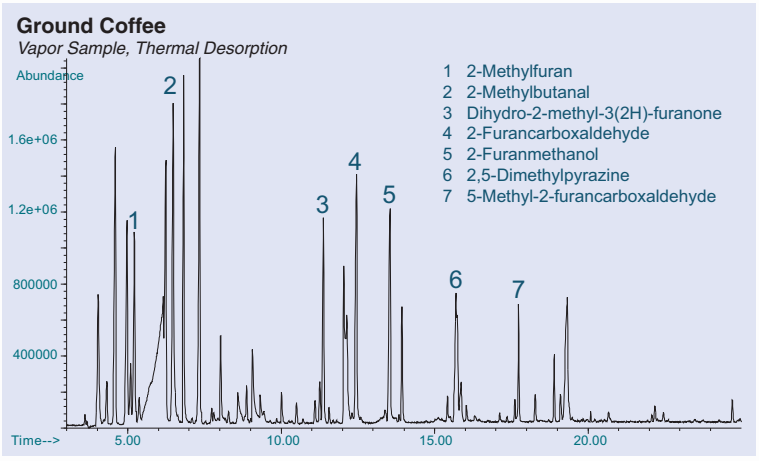
**Air Sample on Glass Fibre Filter**

*Direct Thermal Extraction, Extracted Ion Chromatogram*



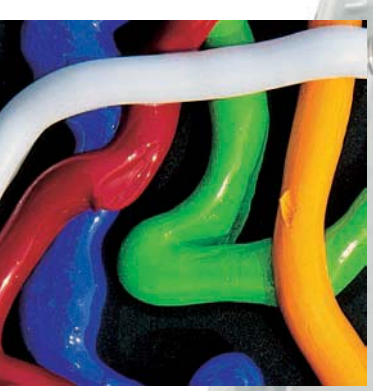
GERSTEL

- The CIS functions as focusing trap; trapping on glass, quartz or adsorbent for best flexibility and selectivity; inert system with high-flow transfer of analytes for best recovery and accuracy; split or true splitless analyte transfer to the GC column enables covering a wide concentration range and providing ultra-low detection limits
- No downtime due to valve failure, contamination or leaks. Simple, robust system, easy to keep clean, no carry over, reliable results
- The best transfer line is no transfer line. Optimum analyte transfer for best recovery and highest sensitivity
- Transfer only the compounds of interest to the trap, reduce analysis time and system contamination.
- Eliminate water, solvents or oxygen for best possible results, while still retaining analytes on adsorbent or in sample
- Dynamic headspace mode enables selective analyte transfer to the trap at desorption temperatures as low as -40 °C
- More flexibility in sample introduction, no sample preparation required
- Detection limits up to 100 times lower than other systems
- Small foot print, minimal bench space required, fully integrated with GC/MS system



# The GERSTEL TDS 3 Thermal Desorption System

# provides you with maximum flexibility



- **Conventional Thermal Desorption**

Volatile and semi-volatile compounds can be determined by sampling a gas using one or more of a wide range of adsorbents. Desorption of the sample can be performed in four different modes using a flexible, software controlled pneumatic system.

- **Direct Thermal Extraction**

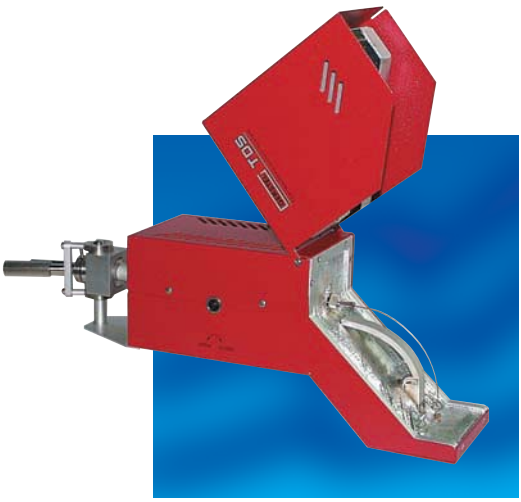
Dynamic headspace of volatile and semi-volatile compounds in solids or gels can be performed directly without sample preparation.

- **Simultaneous Liquid Injection**

The TDS allows liquid injection to be performed simultaneously in the back inlet of most GCs or it can be removed and the GC can be configured for liquid injection in a matter of minutes.


## • GERSTEL TDS 3

Manual thermal desorption system for conventional thermal desorption or direct thermal extraction/dynamic headspace. The system has the option of using $LN_2$ or $LCO_2$ cooling.

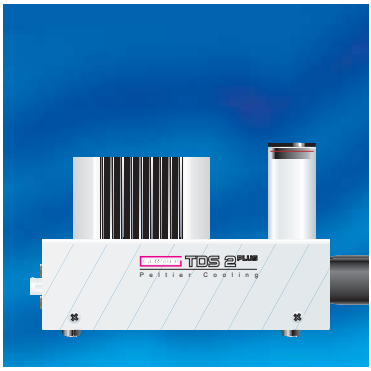



## • GERSTEL TDS A2

*The addition of a TDS A2 to a TDS 3 or TDS 3PLUS provides complete automated processing of up to 20 samples using multiple analysis methods.*

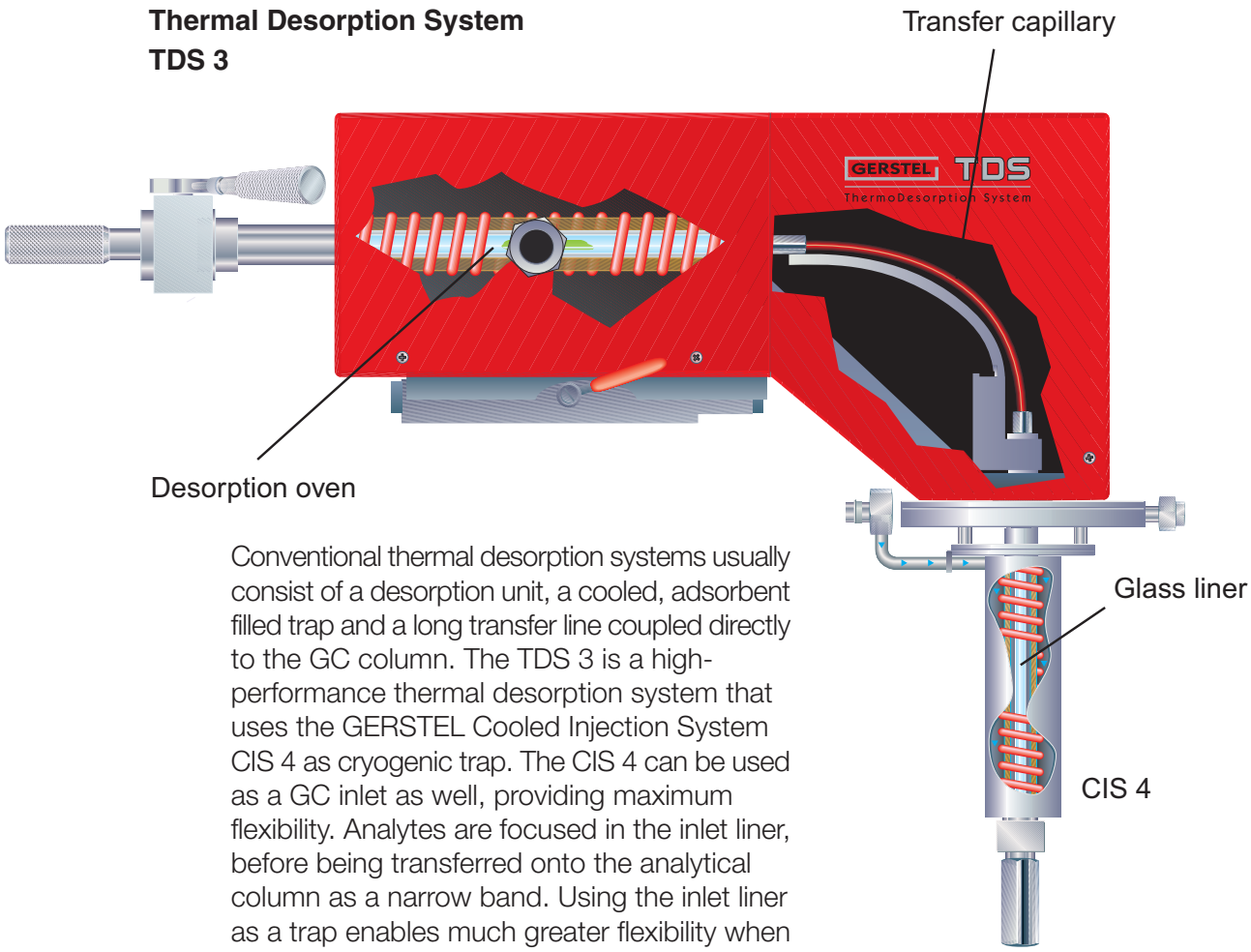
## • GERSTEL TDS 3 PLUS

The GERSTEL TDS 3PLUS has an integrated Peltier cooling system that eliminates the need for cryogenic cooling.



# Technical Summary
# GERSTEL Thermal Desorption Systems

**Thermal Desorption System**
**TDS 3**




Conventional thermal desorption systems usually consist of a desorption unit, a cooled, adsorbent filled trap and a long transfer line coupled directly to the GC column. The TDS 3 is a high-performance thermal desorption system that uses the GERSTEL Cooled Injection System CIS 4 as cryogenic trap. The CIS 4 can be used as a GC inlet as well, providing maximum flexibility. Analytes are focused in the inlet liner, before being transferred onto the analytical column as a narrow band. Using the inlet liner as a trap enables much greater flexibility when trapping analytes while protecting the column from water and contamination.

Prior to desorption in the TDS 3, tubes can be cooled and purged with carrier gas to remove oxygen, water or unwanted solvents. Two temperature ramps enable programmed heating and stepwise desorption of analytes up to 400 °C. Analytes are transferred at high flow through a very short transfer line (15 cm long) from the TDS 3 to the CIS trap for best possible recovery.

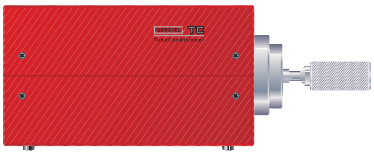
The combination of the CIS and the TDS permit a high desorption flow by trapping analytes in the glass inlet liner of the CIS while excess gas flows out the split vent. The system is capable of a wide range of sampling modes (from true splitless to very high split ratios) providing a dynamic range that allows ultra-trace constituents to be determined as easily as major sample components.

When adding the TDS A2, the TDS 3 is upgraded to a fully automated system capable of analyzing up to twenty samples in one batch; for method optimization, each tube can be desorbed using a different method.

### *Simple and efficient set-up*

The TDS 3 and TDS A2 are easily set up and operated using the GERSTEL MAESTRO software. In combination with an Agilent® Technologies GC/MS system and ChemStation Software, just one method and one sequence table are required to control the complete system from Thermal Desorption to GC/MS analysis.
(Please see back cover of this brochure).

# High performance accessories for even greater versatility



## GERSTEL Tube Conditioner TC 2

Conditioning of up to ten GERSTEL thermal desorption tubes or up to 50 GERSTEL Twisters. Tubes are held at a user-defined elevated temperature and purged with inert gas.

*Benefits of off-line tube conditioning:*

- The TDS/GC/MS system is kept clean
- Conditioned TDS tubes available at all times
- Extends useful life of tubes
- Reduced cost per analysis
- Reduced background and better results
- Improved detection limits

## GERSTEL Pyrolysis Module PM 1

Manually operated pyrolysis module for the TDS 3. Enables pyrolysis of samples at temperatures up to 1000 °C without any modification to the TDS 3.

*Benefits of the PM 1*

- Adds pyrolysis to the TDS 3
- Increases the temperature range of the TDS 3 expanding its analytical capability
- Thermal desorption/Extraction and pyrolysis in a single system
- Thermal desorption and pyrolysis can be performed on a single sample
- Reduces cost - no extra pyrolysis system required
- Cleaner pyrolysis chromatograms are obtained when volatiles are desorbed from samples prior to pyrolysis

## GERSTEL Thermal Extractor TE 2

Sample preparation system for thermal extraction and concentration of analytes from bulk materials or large samples.

### *Applications*

*Packaging industry*

- Analysis of packaging for off-flavors

*Flavors and fragrance industry*

- Determination of flavors in natural products

*Accelerated emission tests for materials, replacing or complementing environmental chambers:*

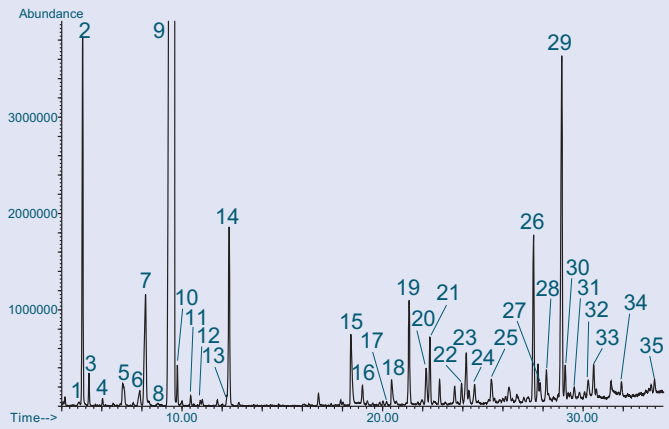
- Building materials
- Automotive materials
- Toys
- Carpets and flooring

*Benefits of the GERSTEL TE 2:*

- Greater sample capacity
- Lower detection limits
- Eliminates matrix and moisture using a single system
- Keeps TDS/GC/MS system clean

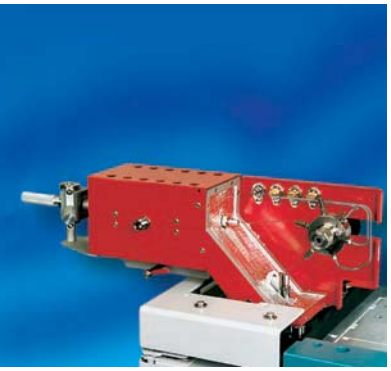
**Freshly squeezed orange juice**

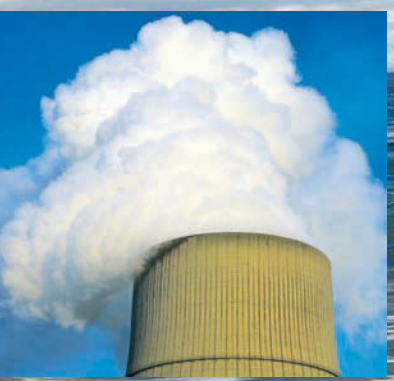
*Sample preparation using GERSTEL Thermo Extractor TE followed by thermal desorption*




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | a-Pinene | 12 | g-Terpinene | 23 | 1,2-Propanediol | 29 | Valencene |
| 2 | Ethyl Butyrate | 13 | a-Terpinolene | 24 | Terpinene-4-ol | 30 | a-Selinene |
| 3 | Ethyl-2-Methyl Butyrate | 14 | Acetoine | 25 | Butyric Acid | 31 | Carvone |
| 4 | Hexanal | 15 | Acetic Acid | 26 | Ethyl-3-Hydroxy Hexanoate | 32 | d-Cardinene |
| 5 | Sabinene | 16 | Furfural | 27 | b-Selinene | 33 | 7-epi-a-Selinene |
| 6 | d-3-Carene | 17 | a-Copaene | 28 | a-Terpineol | 34 | Nerol |
| 7 | Myrcene | 18 | Formic Acid | | | 35 | Geraniol |
| 8 | a-Terpinene | 19 | Ethyl-3-Hydroxy Butyrate | | | | |
| 9 | Limonene | 20 | 2,3-Butanediol | | | | |
| 10 | b-Phellandrene | 21 | Linalool | | | | |
| 11 | Ethyl Caproate | 22 | Hexadecane | | | | |

# Online analysis with the TDS

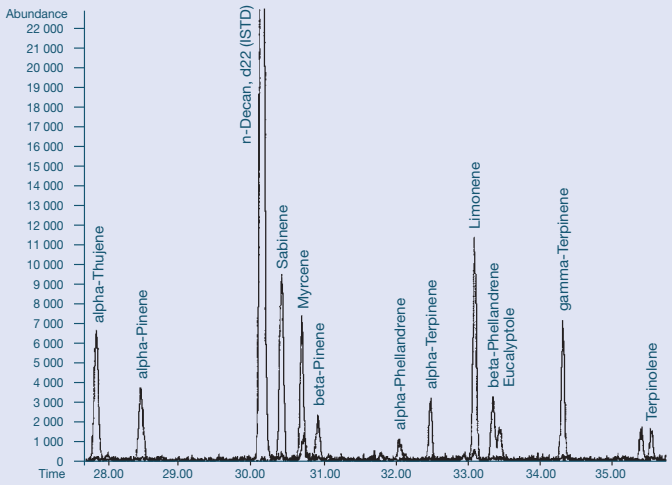




• The **GERSTEL Online TDS G** is designed for continuous monitoring of compounds in air, gas streams or large volume headspace. The TDS G features automatic sample volume control and reversed sample desorption flow.

**Sample taken from rape plants**

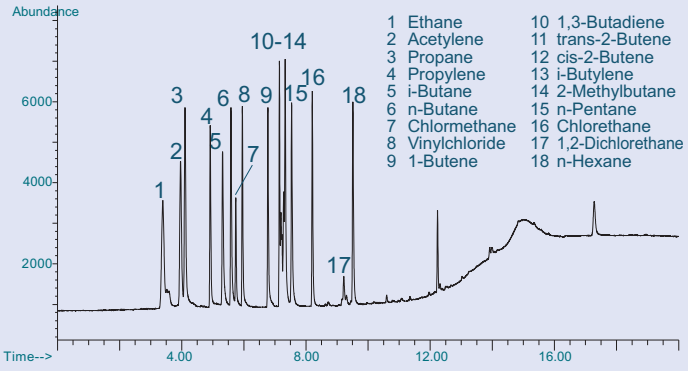
*Extracted ion chromtogram. The figure shows the mass traces m/z = 50 (ISTD) and m/z = 93 (monoterpene).*



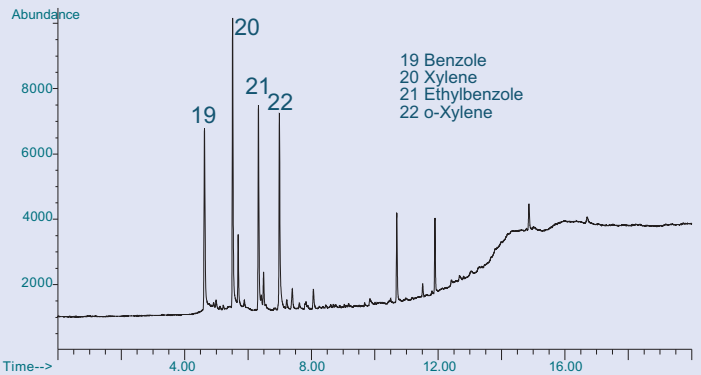

**Outdoor Air Sample**

*spiked with a 22 Compound Standard*

***Transfer of Fraction #1 (pre-Benzene) onto the Polar Column***




**Transfer of Fraction #2 (past Benzene) onto the Polar Column**



# Reliable results with GERSTEL approved consumables


***All GERSTEL consumables are subjected to rigorous testing before being approved for use with GERSTEL systems. Using approved GERSTEL consumables ensures optimum performance.***

## Desorption tubes

Desorption tubes are available for a wide range of applications. Tubes can be supplied empty, or packed with the adsorbent of your choice. All tubes have a unique identification number, and are available unconditioned or conditioned in storage containers.

*Standard adsorbents:*

Tenax™ TA 60/80
Tenax™ GR
Chromosorb™ 106
Carbosieve™
Carbotrap™ 300

Custom adsorbents available on request

***More information***

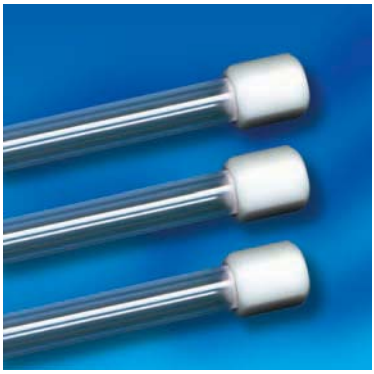
*Please request or download our consumables catalogue for more information on available accessories and consumables.*

## Sample magazine for the TDS A2

Stores up to 20 TDS tubes. The automatic sealing system on this interchangeable magazine ensures that tubes are stored safely with an airtight seal. The magazine can be inserted directly into the TDS A2. The tubes are then introduced automatically into the TDS 3 for analysis and returned to the magazine when analysis is complete.

## Storage Containers

Containers with airtight seal. These have been carefully designed to hold individual TDS tubes during storage or transport without the risk of sample loss or contamination.



# GERSTEL MAESTRO Software

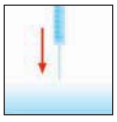
**Next generation software for automated sample preparation and sample introduction. MAESTRO optimizes performance and throughput of GERSTEL modules and systems.**

- 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
- Remote support tool included

## 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 preparation techniques are:

- Automated Disposable Pipette Extraction (DPX)
- 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

GERSTEL

GLOBAL ANALYTICAL SOLUTIONS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