TD 3.5+ system

The TD 3.5+ system is used for the thermal desorption of samples located in TD tubes. The system was developed to work in conjunction with a GERSTEL Cooled Injection System CIS.

The connection between the TD module and the CIS has been manufactured in such a way that the possibility of the sample coming into contact with active surfaces is kept to a minimum. This liner-in-liner principle means that the overall system is highly inert.

The system can be used for the desorption of liquid and gaseous samples enriched on an adsorbent and for the desorption of solid samples and GERSTEL Twisters. The injection of liquid standards and samples is also possible.

Within the TD module, desorption of the sample is performed using a temperature program. The analytes are then transferred by means of the carrier gas stream to the CIS, where they are cryofocused. The temperature programs and pneumatic programs of both modules can be coordinated to achieve optimum desorption results. Desorption of the sample can be performed in split mode or splitless mode.

The system is controlled using the GERSTEL MAESTRO software.

The operation of the system can be automated if used in conjunction with a GERSTEL MPS.

System configuration

- Compatible with all current GCs

- GERSTEL Cooled Injection System CIS with a special liner for analyte focusing and enrichment

System requirements

To use the TD 3.5+ system, you will need the following additional hardware:

- A Cooled Injection System CIS
- One of the cooling options UPC Plus or CCD 2

Control

- In combination with the GERSTEL MAESTRO software, either integrated in an Agilent® Technologies chromatography data system (CDS), or coupled to a CDS from AB Sciex™ and Thermo Scientific®, or on a stand-alone basis.
- In combination with the C506

Control of pressures and flows

- In the TD module using the LowSplit pneumatic control box
- In the system as a whole in conjunction with the optional ePneumatics control box or an integrated GC pneumatic control unit
- Pressure drop when loading and unloading

Automation

- The TD 3.5+ Automation option for MPS Liquid, MPS Robotic or MPS Robotic Pro

TD module

Cooling options

- Universal Peltier Cooling UPC Plus
- 2-channel cryostatic cooling device CCD 2

Minimum temperatures

- +30 °C with the UPC Plus (or lower temperatures possible, depending on the transfer temperature)
- +10 °C using the CCD 2

Cooling rate

- From 300 °C to 30 °C in < 60 s (using the UPC Plus, transfer heater at 350 °C)

Desorption temperature

- Ambient temperature … 350 °C

Transfer temperature

- Ambient temperature … 350 °C
- Static or following the temperature of the TD module (max. 120 °C/min)

Temperature program

- 2 temperature ramps
- Heating rate max. 400 °C/min
- Start temperature 10 … 350 °C
- First end temperature 10 … 350 °C
- Second end temperature 10 … 350 °C
- Hold time max. 650 min per end temperature

Desorption flow

- > 200 mL/min
- Depending on TD tube, carrier gas and GC

Transfer of the sample to the CIS

To transfer the samples to the CIS, various flow modes are available.

- Split
- Splitless
- Solvent venting
- Low split

Flow mode during desorption

- Retain Tube – Standby Cooling
  The tube remains in the TD module after desorption; the TD module is cooled to the standby temperature.

- Retain Tube – no Cooling
  The tube remains in the TD module after desorption; the TD module is not cooled any further once the GC run has started.

- Remove Tube – Standby Cooling
  The tube is removed from the TD module after desorption; the TD module is cooled to the standby temperature.

- Remove Tube – no Cooling
  The tube is removed from the TD module after desorption; the TD module is not cooled any further, once the GC run has started.

Electrical specifications

- Power consumption maximum 190 W

Operating conditions

- 15 … 35 °C
- Relative humidity 50 … 60%, non-condensing
- Max. 4615 m above normal height null (sea level)

Storage conditions

- -20 … 50 °C
- Relative humidity not exceeding 90%, non-condensing
- Max. 4615 m above normal height null (sea level)

Dimensions (W × H × D)

- 75 mm × 115 mm × 90 mm

Weight

- 0.45 kg

Types of tube

- TD 3.5+ tubes, empty, for GERSTEL Twister® or solid samples, dimensions 89 mm × 6.4 mm × 5 mm (L × ED × ID)
- TD 3.5+ tubes, filled with adsorbent, dimensions 89 mm × 6.4 mm × 5 mm (L × ED × ID)
- Heated area for the analysis of material emissions, approx. 40 mm
- Detailed information in the TD module accessories catalog

LowSplit pneumatic control box

Functions

- Controls the split behavior of the TD module
- Controls the pneumatic lock of the TD module

Specific features

- Low split mode for sample introduction with a fixed low split ratio
- 4 LEDs provide a quick status overview
- Interface for additional pneumatic control units

Carrier gas

- Any non-flammable, non-oxidizing, non-toxic gas
- Oil-free
- Initial pressure 5 … 8 bar
- Purity 5.0

Compressed air

- Any non-flammable, non-oxidizing, non-toxic gas
- Oil-free
- Initial pressure 5 … 8 bar

Dimensions (W × H × D)

- 200 mm × 100 mm × 175 mm

Weight

- 1.5 kg

Extensions and options

- TD 3.5+ Automation option
  Allows tubes to be changed automatically and liquid injection to be performed automatically with an MPS
- MPS-HIT
  Hot headspace/SPME injection and trapping to concentrate the analytes and improve the recovery of high-boiling compounds
- DHS 3.5+ option
  Allows the dynamic headspace technique to be performed automatically with an MPS
- DHS Large option
  For the DHS analysis of larger samples in sample vessels up to 1 liter in volume, in combination with the DHS 3.5+ option. Its applications include determining emissions from materials, climate chamber simulations or determining extractables and leachables from pharmaceutical packaging.
- DHS Large Sampler option
  For the automated DHS analysis of larger samples in sample vessels up to 1 liter in volume, in combination with the DHS option
- Tube Conditioner TC 2
  For the simultaneous thermal conditioning of up to 10 TD tubes or up to 60 Twisters® under a flow of inert gas

Techniques supported

- Conventional thermal desorption of analytes, enriched on GERSTEL Twisters® or sorbent tubes as used for purposes such as air-sampling
- Direct, thermal extraction of analytes from solid and liquid samples
- Hot headspace/SPME injection and trapping (HIT) to concentrate the analytes and improve the recovery of high-boiling compounds
- Analysis of headspace samples with the optional modules DHS, DHS Large or DHS Large Sampler

Conventional thermal desorption \Twister® desorption

Principle

Analytes that were previously enriched on a sorbent tube or a GERSTEL Twister® undergo thermal desorption in the TD module.

Specific features

- No transfer line or valves in the sample flow. Analytes are transferred directly into the CIS for concentration before GC/MS analysis
- Short cycle times and low power consumption thanks to the low thermal mass of the TD module
- Venting of low-boiling compounds or solvents is possible

Possible applications

- The thermal desorption of analytes that have been enriched on an adsorbent. Applications include determining flavor and fragrance compounds or monitoring the air from sample tubes or as a technique performed automatically using the DHS Option
- The thermal desorption of analytes that have been enriched on a GERSTEL Twister®, e.g. in order to determine flavor and off-flavor compounds in drinks and food products

Direct liquid addition

- A reagent or standard is added to the sample in the TD tube in the TD module.
- Using an internal standard or system test enhances quantification and quality assurance
- Derivation of analytes

Required accessories

- TD tubes with an adsorbent or empty TD tubes for GERSTEL Twisters®
- Transport adapters for liquid injection, for direct liquid addition

Commonly-used adsorbents

- Tenax® TA
- Tenax® GR
- Carbopack™ B + X
- Carbotrap® 300
- PDMS or EG silicone-coated magnetic stir bars, GERSTEL Twisters®

Types of Twister®

- Length 10 mm, coating 0.5 mm, PDMS volume 24 µL
- Length 10 mm, coating 1.0 mm, PDMS volume 63 µL
- Length 20 mm, coating 0.5 mm, PDMS volume 47 µL
- Length 20 mm, coating 1.0 mm, PDMS volume 127 µL
- Length 10 mm, EG/Silicone volume 32 µL

Automation

- The TD 3.5+ Automation option for MPS Liquid, MPS Robotic or MPS Robotic Pro
- Max. 240 samples per sequence
- Also for direct liquid addition

Direct thermal extraction

Principle

Samples in TD tubes stored in a closed tray are thermally extracted in the TD module. The samples are either placed in micro-vials or are kept in place by a glass frit inside the TD tube.

Specific features

- Samples are loaded into TD tubes offline
- No cross-contamination, as a new tube is used for each run
- Venting of low-boiling compounds or solvents is possible

Possible applications

- Direct thermal extraction of substances that cannot be injected directly into the GC/MS system by syringe, such as solids or highly viscous substances

Direct liquid addition

- A reagent or standard is added to the sample in the TD tube in the TD module.
- Using an internal standard or system test enhances quantification and quality assurance
- Derivation of analytes

Required accessories

- TD tubes with micro-vials or TD tubes with a frit
- Transport adapters for liquid injection, for direct liquid addition

Automation

- The TD 3.5+ Automation option for MPS Liquid, MPS Robotic or MPS Robotic Pro
- Max. 240 samples per sequence
- Also for direct liquid addition

Direct headspace and SPME injection

Principle

The sample is injected through the hot TD module into the cold CIS using the Hot Injection and Trapping (MPS-HIT) technique. The analytes are concentrated in the cold CIS.

Specific features

- Direct injection can take place without removing the TD module
- Headspace or SPME sampling combined with injection into the TD module
- No discrimination of high-boiling compounds, improved chromatography of low-boiling compounds
- Concentration of analytes from multiple headspace injections for improved limits of detection

Required accessories

- Transport adapters for liquid injection, for direct liquid addition
- TD tubes, empty

Automation

- MultiPurposeSampler MPS Robotic with Headspace or SPME option

Liquid injection into TD tubes

Principle

The sample is injected into a TD tube immediately before thermal extraction. The TD tube will already be located inside the TD module.

Specific features

- Injection into a closed TD module
- Direct liquid injection can take place without removing the TD module
- Analysis results are independent of sample introduction speed
- No outgassing of analytes in the TD tube before extraction
- No contamination of the TD tray
- Automated introduction of a standard can be performed using the MPS
- Automated introduction of a deriving agent can be performed using the MPS

Possible applications

- One-shot analysis of large-volume samples, including solvent venting
- Dynamic headspace analysis of liquid samples of up to 100 µL

Required accessories

- Transport adapters for liquid injection, for direct liquid addition
- TD tubes with a frit or TD tubes filled with glass wool

Automation

- The TD 3.5+ Automation option for MPS Liquid, MPS Robotic or MPS Robotic Pro
- Max. 240 samples per sequence

Site prep requirements

The TD module is provided without a cooling device. It is usually cooled with the UPC Plus. However, the TD module can alternatively be cooled with a CCD 2. The cooling device must be ordered separately. The relevant site prep requirements can be found on the separate site prep sheet for cooling options.

- GC with fitted CIS
- Compressed air connection, 1/8", max. pressure 8 bar
- Cooling option