MARKES international

TD100-xr™

Specification sheet

The TD100-xr is a high-throughput, automated thermal desorption system for the rapid and unattended processing of up to 100 sample sorbent tubes in a single sequence.

TD100-xr Thermal Desorbers are compatible with most GC and GC–MS applications and accommodate tube-based workflows with the choice of manual or electronic control of gases: helium, nitrogen, and hydrogen (H_2 available with the Multi-Gas enabled range only).

1. System features

- **'Universal' TD platform** allowing analysis of compounds over a wide volatility range AND the ability to select low flow path temperatures for compatibility with labile compounds:
  - Quantitative recovery up to n-C_{44}.
  - Quantitative recovery of labile compounds.
  - Simultaneous analysis of volatiles and semi-volatiles.
- **100-tube capacity** offers unattended, unsupervised operation over an entire weekend.
- **Compatible with 3½" sorbent tubes:** Stainless steel, inert-coated stainless steel, and glass.
- **Quantitative re-collection** of both tube and trap desorption split flow to allow repeat analysis, with automation available with the 'Advanced' model.
- **Sample stacking:** Combine multiple tube samples onto the focusing trap before injection onto GC column.
- **Internal standard (optional):** Allows gas-phase standard to be loaded onto the focusing trap or a sample tube *via* a 1 mL loop.
- **Electrically-cooled focusing trap** cools rapidly and is easy to maintain.
- **Stringent, method-compliant leak test** (no-flow/ambient temperature) is carried out on every sample. Failed tubes are retained intact.
- **Splitless, single-split and double-split options** ensure compatibility with samples over a wide concentration range (ppt to percent).
- **Trap heating rates up to 100°C/s** and backflush desorption combine to facilitate splitless operation at flows ≥2 mL/min, therefore maximising sensitivity.
- **Prepurge of air to vent** and selective elimination of water and solvents minimise analytical interference.
- **Integrated TubeTAG read/write capability** for enhanced tracking of tube history.
- **Overlap mode** (desorption of a subsequent sample while a previous sample is still running) optimises productivity.
- **Sealing of tubes with DiffLok caps** prevents entry of contaminants and loss of volatiles before, during and after analysis.
- **Minimal linear robotic movements** required for operation increases reliability.
- **Tube cooling fan:** Rapidly cools sample tubes after desorption, for increased sample throughput.
- **Versatility and throughput:** Software allows multiple sets of tubes, requiring different TD methods, to be linked together in a single automatic tube sequence (see below).
- **Stand-alone injector** that can be connected to any make of GC(–MS) and does not interfere with other GC accessories.

Markes International Ltd
T: +44 (0)1443 230935 **F:** +44 (0)1443 231531 **E:** enquiries@markes.com

- **Interface to the GC** typically *via* a direct coupling to the analytical column. Part of a GC inlet may be required for back-pressure-regulated electronic pneumatic control. This can be used to provide electronic carrier gas control (ECC) through the entire TD–GC(–MS) analyser, and stabilise retention times independent of split flow and other analytical settings.
- **Extended standby mode** reduces instrument power consumption when not in use.
- **Small footprint** for operation in mobile labs or other confined environments.

2. System controls

2.1 Control software

- **Markes Instrument Control (MIC)** allows:
  - Automated, unattended sequencing of tube samples.
  - Addition, insertion or skipping of active sequences.
  - Rapid set-up of methods using pre-programmed parameters for: (a) standard methods including VDA 278, US EPA TO-17, US EPA 325 and PAH analysis; (b) conditioning methods for popular sorbent tubes and focusing traps.
  - Automated, intelligent system self-checking diagnostics, including leak isolation.
  - Preventative maintenance feedback with usage counter – indicates when parts could be replaced to avoid instrument downtime.
  - Integrated pressure ratio calculation for monitoring tube packing integrity.
  - Export of sequence history to .csv and .pdf file.
  - Set-up in English, Chinese, French and Japanese language.

2.2 Desorption modes

- **Two- (or three-) stage desorption mode:** Normal two-stage desorption of a sample, with the additional option of an elevated-temperature trap purge.
- **Single-stage desorption mode:** Sample tube desorbed directly to GC column/Analyser, by-passing focusing trap. (Advanced models only)
- **Tube conditioning:** Desorption of the sample tube for cleaning purposes, with all the effluent directed to vent, *i.e.* away from the focusing trap and other important components of the sample flow path.
- **Trap conditioning mode:** Desorption of focusing trap for cleaning purposes, or for obtaining a system blank.

2.3 Primary (tube) desorption oven

- **Temperature**
  - Range: 35°C to 425°C.
  - Settable in 1°C increments.
  - Temperature limits are user-settable within the stated range.

  N.B. The tube oven heats from ambient to the selected temperature at the start of tube desorption in order to minimise risk of flash vaporisation and split discrimination when analysing samples with unknown water/solvent content.
- **Desorption time**
  - Range: 0–600.0 min.
  - Settable in 0.1 min increments.

2.4 Focusing trap

- **Quartz focusing trap:** 2 mm i.d. where packed and 0.9 mm i.d. at the sample input/output end. Collar at non-sampling end makes trap easy to change.
- Trap can be packed with between one and four sorbents.
- **Backflush desorption** ensures quantitative retention and release of compunds across a wide volatility range.
- **Trap low temperature**
  - Range: –30°C to 50°C.
  - Settable in 1°C increments.
  - Temperature limits are user-settable within the stated range.
  - Uniform electrical cooling applied over full length of sorbent bed.
- **Trap desorption:**
  - Default setting is ballistic heating, which reaches rates of 100°C/s during the first critical stages of secondary (trap) desorption.

  - Alternatively, programmed trap heating rates from 1°C/s to 40°C/s can be selected.
- **Trap high temperature**
  - Range: 35°C to 425°C.
  - Settable in 1°C increments.
  - Temperature limits are user-settable within the stated range.
  - Uniform heating applied over full length of sorbent bed.
- **Hold time at trap high temperature**
  - Range: 0–60.0 min.
  - Settable in 0.1 min increments.

2.5 Sample flow path

- **Temperature range:**
  - Valve: 50°C to 210°C.
  - Transfer line: 50°C to 250°C.
  - Both settable in 1°C increments.
  - Temperature limits are user-settable within the stated ranges.
- **Constructed entirely of inert materials:** PTFE, quartz, inert-coated stainless steel and uncoated, deactivated fused silica.

2.6 Pneumatics

- Requires a pressure-controlled 0–60 psig (0–415 kPa) supply of helium, hydrogen, or nitrogen carrier gas under manual or electronic control.
- Electronic mass flow control (option) is settable between 2–500 mL/min (helium and hydrogen), and 2–250 mL/min (nitrogen).
- Requires a pressurised supply of dry air or nitrogen (dewpoint below –50°C) at 50–60 psig (340–415 kPa). The dry gas is used for both pneumatic actuation of the valve and for purging the focusing trap box.

  N.B. Helium or hydrogen cannot be used as the dry gas supply.
- Carrier gas and dry air or nitrogen pressure control must be regulated by the included pneumatic control accessory (U-GAS01 or U-GAS01-H).

2.7 Pre-desorption checks and controls

- **Leak test:** Each tube is pressurised and subjected to a stringent, ambient temperature leak test without carrier gas flow. Failed tubes are not desorbed, but preserved intact for operator attention. The number of consecutive fails before sequence stop is user-settable.
- **Pre-purge:** Each tube can be optionally purged with carrier gas (in the desorption direction) at ambient temperature, to remove oxygen before desorption. The air is purged to vent and none of it is allowed to reach the analyser *e.g.* GC–MS.
- **Pre-purge time:**
  - Range: 0–60.0 min.
  - Adjustable in 0.1 min increments.
- **Pre-purge flow rate** (when MFC is fitted):
  - Range: 2–500 mL/min
  - Adjustable in 1 mL/min increments
- An additional carrier gas pre-purge can be carried out at elevated temperature to remove water or other interfering solvent if required.
- The focusing trap can be selected to be in or out of line during either of the pre-purge stages.
- The split can be selected to be open or closed during either of the pre-purge stages.
- **Tube dry-purge:** This is an alternative to pre-purge. The sample tube is purged with dry carrier gas in the sampling direction to eliminate water and oxygen from the back of the tube. The purged air is directed away from the analytical column and is sent to vent.
- **Tube dry-purge time:**
  - Range: 0–60.0 min.
  - Adjustable in 0.1 min increments.
- **Tube dry-purge flow rate** (when MFC is fitted):
  - Range: 2–500 mL/min.
  - Adjustable in 1 mL/min increments.
- **Trap dry-purge:** The focusing trap can be optionally purged with dry carrier gas after primary (tube) desorption and before the trap is desorbed. The purge flow is then directed through the focusing trap, in the trapping (sampling) direction, to sweep any remaining interferences to vent.

- **Trap dry-purge time:**
  - Range: 0 to 60.0 min.
  - Adjustable in 0.1 min increments.
- **Trap dry-purge flow** (when MFC is fitted):
  - Range: 2–500 mL/min.
  - Adjustable in 1 mL/min increments.
- **Trap dry-purge temperature:**
  - Range: –30°C to 50°C.
  - Adjustable in 1°C increments.
  - Temperature limits are user-settable within the stated range.

2.8 Sample splitting and quantitative re-collection for repeat analysis

- The TD100-xr split can be operated in the following ways:
  - During primary (tube) desorption only (inlet split).
  - During secondary (trap) desorption only (outlet split).
  - During both desorption stages, *i.e.* double-split operation (inlet and outlet split).
  - During neither desorption stage, *i.e.* splitless operation.
- The split can be turned on or off during system standby.
- Split and desorb flows are controlled by needle and solenoid valves downstream of the sample flow path.
  - Optional mass flow controllers provide electronic control of split and desorb/trap flows.
- The split vent line contains a charcoal filter in front of the control valves (and MFC) to prevent contamination of the valves/MFC and laboratory atmosphere. The charcoal filter has the same external dimensions as a standard sorbent tube. The charcoal filter is connected to the main heated valve *via* a short, inert, heated flow path.
- When required, the charcoal filter can be replaced with a conditioned sorbent tube to quantitatively re-collect the split effluent from tube and trap desorption (inlet and outlet split). This capability allows repeat analysis, method/data validation and archiving of critical samples.
- Note: Maximum split ratios and flows may not be achievable in all configurations with all carrier gas types.

2.9 Automatic sequencing

- A tube sequence of multiple methods can be entered into the sequence table *via* the PC user interface.
- An entire sequence can be repeated any number of times.
- Individual tubes can be identified as ‘calibrant’, ‘blank’, ‘sample’, or as a user-defined name.
- A sequence history/log file is produced as a sequence progresses, and is automatically maintained and saved.
- Sequence deviations, *e.g.* leak test failure or missing tube, are recorded in the log file. If any occur, the GC run is initiated to keep the analytical system synchronised with the desorber.

3. System specification

3.1 Dimensions and weight

- Height: 62 cm (24.4″).
- Width: 38 cm (15.0″).
- Depth: 55 cm (21.7″).
- Weight: 32 kg (71 lb) unloaded, 37 kg (82 lb) fully loaded.

3.2 Tubes accommodated

- 3½″ (89 mm) long × ¼″ (6.4 mm) o.d. tubes.
- Constructed of stainless steel, inert-coated stainless steel or glass.
- With or without sorbent packing.
- With or without TubeTAG RFID tags.

3.3 Ambient operating conditions

- Temperature: 15°C to 30°C.
- Relative humidity: 5 to 95% RH (non-condensing).

3.4 Gas consumption

- Dry air or nitrogen: ~100 mL/min.
- Carrier gas consumption is method-dependent (typically 5–200 mL/min).

3.5 Power requirements

- 100–240 V, 50/60 Hz, 900 W (TD100-xr self-adjusts to local voltage input).

3.6 Minimum PC specification

For TD control:

- CPU: 1 GHz 64-bit dual-core or better.
- RAM: 4 GB.
- Hard disk space: 2 GB.
- Graphics card: DirectX 9 or later.
- Display: 1024 × 768 display.
- Operating system: Windows 10 or 11, 64-bit, English.
- Other requirements: Windows-compatible keyboard and mouse; one free USB connection for TD100-xr communication with PC.

3.7 Safety and regulatory certifications

- The instrument is designed and manufactured under a quality system registered to ISO 9001.
- The instrument complies with the essential requirements of the following applicable European and North American Directives, and carries the CE/UKCA marks
  - Low Voltage Directive 2014/35/EU.
  - EMC Directive 2014/30/EU.
  - ROHS Directive 2015/863/EU.
- The instrument conforms to the following product safety standards:
  - IEC 61010-1:2010/AMD1:2016.
  - IEC 61010-2-010/EN 61010-2-010:2014.
  - IEC 61010-2-081/EN 61010-2-081:2015.
  - Canada: CSA C22.2 No.61010-1-12:2012.
  - USA: ANSI/UL 61010-1:2012.
- The instrument conforms to the following regulation on electromagnetic compatibility (EMC):
  - IEC 61326-1/EN 61326-1:2013.

3.8 GC remote cable connections

- TD100-xr includes a GC interface cable that connects to the ‘ready’ output and ‘start’ input of the GC(–MS) and data-handling systems.
- The cable supports automatic start of the entire analytical system when the TD100-xr focusing trap desorbs, and allows the TD100-xr to check the ‘ready’ status of the analyser and associated data handling.
- The TD100-xr focusing trap will not desorb unless and until it receives a ‘ready’ signal from the GC(–MS) system.

4. System options

- Standard models with 100 tube automation and manual re-collection.
- Advanced models with 100 tube automation and automated re-collection.
- Multi-Gas enabled models configured for use with helium, hydrogen and nitrogen carrier gas.

Accessory and upgrade options include:

- Integrated electronic mass flow control of split and/or desorb flow. MFCs available with flow range between 2–500 mL/min (helium and hydrogen), and 2–250 mL/min (nitrogen). Allows split ratios from zero to 125,000:1 to be used with standard (60 m × 0.25 mm i.d.) capillary columns.
- Automated re-collection for repeat analysis (also includes dry-purge functionality).
- Internal Standard/Dry-Purge accessory: Contains a 1 mL loop for introducing a gas-phase internal standard onto the focusing trap or inlet end of a blank or sampled tube. Also facilitates automated dry-purging of tubes with standard models (without automated re-collection). Multi-Gas enabled models are only compatible with U-ISDPAC-H-XR.
- TD100-xr is also available pre-configured with automated sample re-collection, and electronic mass flow control (MFC) of all split and desorption flows.

For more information about our products and services, please visit www.markes.com.

Trademarks

UNITY-xr™, DiffLok™ and TubeTAG™ are trademarks of Markes International.

DirectX® and Windows® are trademarks of Microsoft Corporation.

Markes International shall not be liable for errors contained in this specification or for incidental or consequential damages in connection with the supply, performance or use of this equipment.

Markes International reserves the right to change information, descriptions and specifications within this document without notice.