MARKES international

UNITY-xr™

Specification sheet

The UNITY-xr is an analytical thermal desorption instrument for the simultaneous analysis of VOCs, SVOCs and thermally labile compounds collected onto sorbent tubes.

UNITY-xr Thermal Desorbers are compatible with most GC and GC–MS applications and accommodate any 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:
  - Highly effective retention of ultra-volatiles.
  - Quantitative recovery up to n-C_{44}.
  - Quantitative recovery of labile compounds.
  - Simultaneous analysis of volatiles and semi-volatiles.
- **Quantitative re-collection** of both tube and trap desorption split flow to allow repeat analysis.
- **Compatible with 3½″ sorbent tubes**: Stainless steel, inert-coated stainless steel, and glass. Also 4½″ sorbent tubes (optional).
- **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 column flows ≥2 mL/min, therefore maximising sensitivity.
- **Pre-purge of air to vent and selective elimination of water and solvents** minimise analytical interference.
- **Overlap mode** (desorption of a subsequent sample while a previous sample is still running) optimises productivity.
- **Stand-alone injector** that can be connected to any make of GC(–MS) and does not interfere with other GC accessories.
- **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.
- **Flexible upgrade routes include:**
  - One or two integrated mass flow controllers (MFCs) for electronic control of split and/or desorb flows.
  - ULTRA-xr for 100-tube automation, or ULTRA-xr + ULTRA-xr Pro for 199-tube automation, allowing unattended operation all weekend.
  - Options for automated, multi-channel canister/bag analysis or round-the-clock on-line air monitoring (with Kori-xr water-management accessory).

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2. System controls

2.1 Control software

- **Markes Instrument Control (MIC)** allows:
  - Automated, unattended sequencing of tube, on-line or canister/bag samples.
  - Addition, insertion or skipping of samples in 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.
  - Export of sequence history to .csv and .pdf file.
  - Set-up in English, Chinese, French, or Japanese language.

2.2 Desorption modes

- **Two- (or three-) stage desorption** – Normal two-stage desorption of a sample, with the additional option of an elevated-temperature purge.
- **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:** Desorption of focusing trap for cleaning purposes, or for obtaining a system blank.
- Other modes including on-line monitoring, direct sampling, sample stacking and automation are available when the system is configured with the appropriate module.

2.3 Primary (tube) desorption oven

- **Temperature:**
  - Range: 35°C to 425°C.
  - Adjustable 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 to 600.0 min.
  - Adjustable 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 wide boiling range samples.
- **Trap low temperature:**
  - Range: –30°C to 50°C.
  - Adjustable in 1°C increments.
  - Temperature limits are user-settable within the stated range.
  - Uniform electrical cooling applied over full 60 mm 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.
  - Adjustable 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 min.
  - Adjustable 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 adjustable in 1°C increments.
  - Temperature limits are user-settable within the stated range.
  - Uniform heating.
- **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 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 are preserved intact for operator attention.
- **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 UNITY-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/trap 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.
  - Configurations including Air Server-xr or CIA *Advantage*-xr modules have mass flow controllers configured as standard for controlling both split and 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.

3. System specification

3.1 Dimensions and weight

- Height: 46 cm (18.1″).
- Width: 16 cm (6.3″).
- Depth: 54 cm (21.3″).
- Weight: 16 kg (35 lb).

3.2 Tubes accommodated

- 3½″ (89 mm) long × ¼″ (6.4 mm) o.d. tubes.
- 4½″ (114 mm) long × 6 mm o.d. tubes (optional).

  N.B. Kits are available to allow users to interchange between the 3½″ and 4½″ versions.
- 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: 5–95% RH (non-condensing).

3.4 Power requirements

- 100–240 V, 50/60 Hz, 650 W (UNITY-xr self-adjusts to local voltage input).

3.5 Gas consumption

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

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 UNITY-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.61010-1:2012.
  - 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

- UNITY-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 UNITY-xr focusing trap desorbs, and allows UNITY-xr to check the 'ready' status of the analyser and associated data handling.
- The UNITY-xr focusing trap will not desorb unless and until it receives a 'ready' signal from the GC(–MS) system.

4. System options

- Standard models configured for use with helium and nitrogen carrier gas
- 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.
- ULTRA-xr 100-tube autosampler and automated outlet split re-collection.
- ULTRA-xr plus ULTRA-xr Pro 199-tube automation and automated inlet and outlet split re-collection.
- Air Server-xr options (3- or 8-channel) for continuous on-line air/gas monitoring or analysis of multiple canisters/bags.
- CIA *Advantage*-xr options (T or HL models) for method-compliant analysis from whole-air/gas samples, collected using multiple canisters/bags or on-line monitoring.

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