ULTRA-xr

Sorbent tube autosampler for unattended high-throughput thermal desorption analysis

THE QUEEN'S AWARDS
FOR ENTERPRISE:
INNOVATION
2019

ULTRA-xr™

The ULTRA-xr 100-tube autosampler enables high-productivity thermal desorption analysis of trace-level volatile and semi-volatile organic compounds (VOCs and SVOCs) with GC or GC–MS.

Used with the UNITY-xr™, ULTRA-xr incorporates all the latest technical advances from Markes, making the combined system perfect for a wide range of sample types and applications.

Outstanding productivity
Automated, cryogen-free, unattended operation for up to 100 industry standard 3 1/2" sample tubes.

Future-proof your ULTRA-xr
Add an ULTRA-xr Pro for 99 additional sample tubes or a CIA *Advantage*-xr autosampler for up to 27 canisters.

Enhanced reliability, mechanical simplicity and precision
All tubes are sealed with proprietary difflok caps before and after desorption. No uncapping/recappping required.
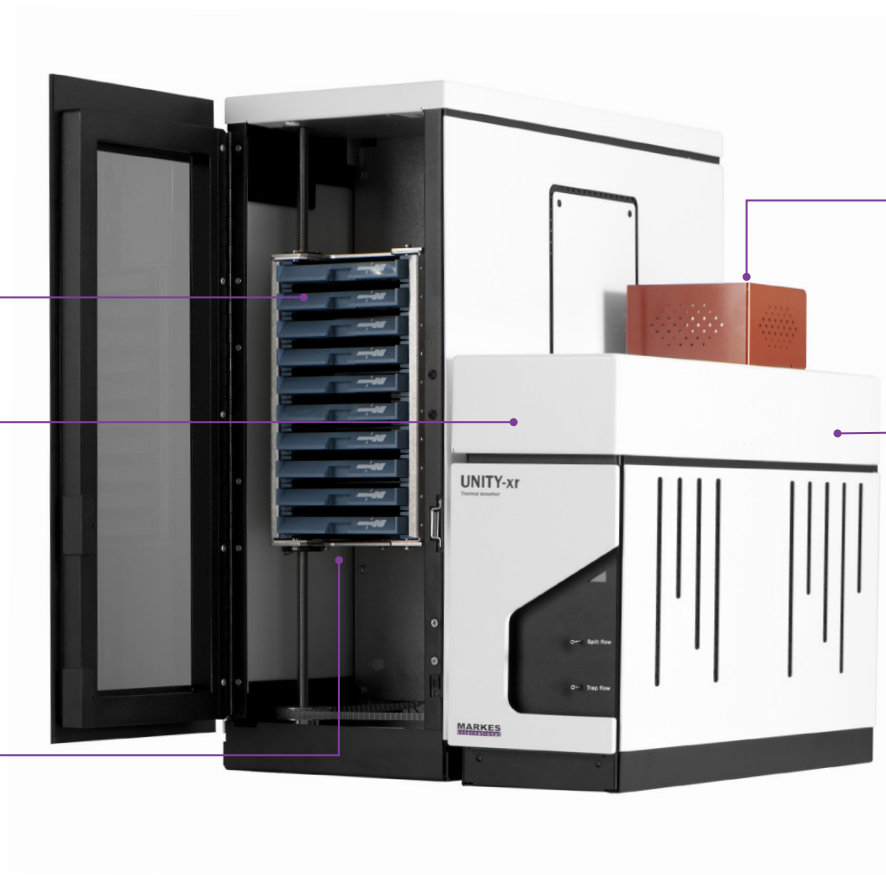
Unbeatable application versatility
Compatibility with a variety of analytes over a wide concentration range: very volatile, semi volatile and reactive compounds

Superior sample integrity and traceability
- Confidence in results through quantitative sample re-collection of split flows and repeat analysis.
- Method compliance aided by leak-testing, water management and addition of internal standard.
- Enhanced traceability of samples using barcodes and RFID TubeTAGs.

UNITY-xr
Thermal desorption

MARKES

Advanced automation technologies

Extending the capability of standard thermal desorption systems

Adding an ULTRA-xr to any UNITY-xr-based Markes TD instrument offers these key advantages:

Extended analyte range

Add ULTRA-xr to whole-air analysis instruments and maximise return on investment with the most versatile thermal desorption platforms – adapt to variations in sample demand with high productivity for a wide range of sample types.

UNITY–CIA *Advantage*–ULTRA-xr   **UNITY–Air Server–ULTRA-xr**

- Automation of up to 27 canisters, bags or on-line samples.
- 100-tube automation.
- Automated re-collection of the outlet split flows of all tube, canister and on-line samples.
- Fully automated sequencing for tubes, canisters/bags and on-line samples.

Maximum sample throughput

Add ULTRA-xr and ULTRA-xr Pro to UNITY-xr for:

- Robust, highly efficient automation of up to 199 tubes in a single sequence.
- Ultimate sample security with the most comprehensive automated re-collection functions.


UNITY–ULTRA-xr Pro

- Automation of up to 199 sorbent tubes.
- Automated re-collection of all split flows (inlet, outlet or both).
- Automated re-analysis of re-collected samples.

Unmatched versatility and sample security

For wide-ranging samples and concentrations

The unique design of the flow path and focusing trap at the heart of all Markes' TD systems provides a uniquely versatile analytical platform:

- The uniformly inert flow path, in conjunction with tube and trap backflushing, allows quantitative recovery and re-collection up to n-C_{44}, including reactive and thermally labile species.

- Flexible splitting options during both tube and trap desorption provide compatibility with a wide range of sample concentrations – from sub-ppt to percent.

- ULTRA-xr provides automated re-collection and re-analysis of outlet split flows, while adding the ULTRA-xr Pro brings automated re-collection and re-analysis of inlet and outlet splits (double split).
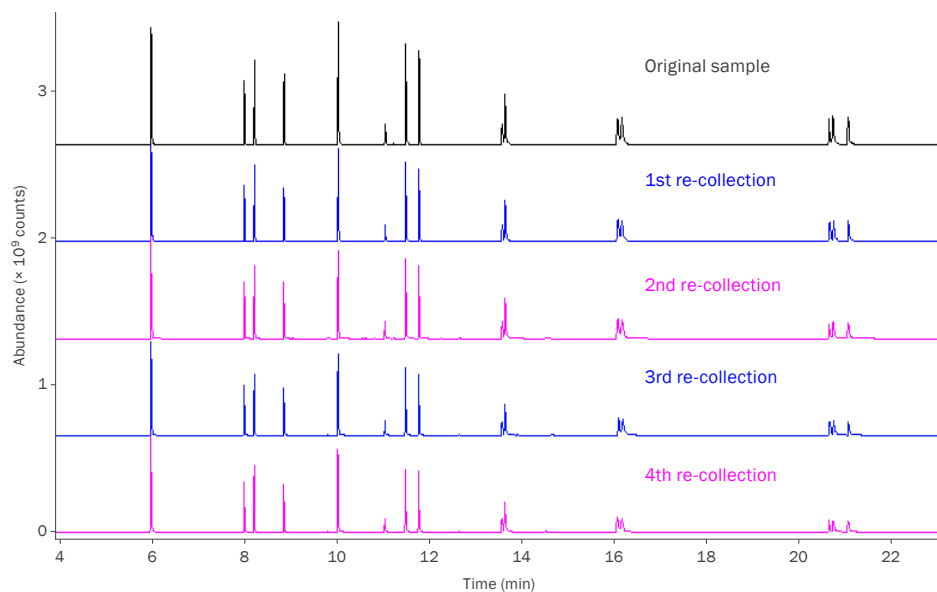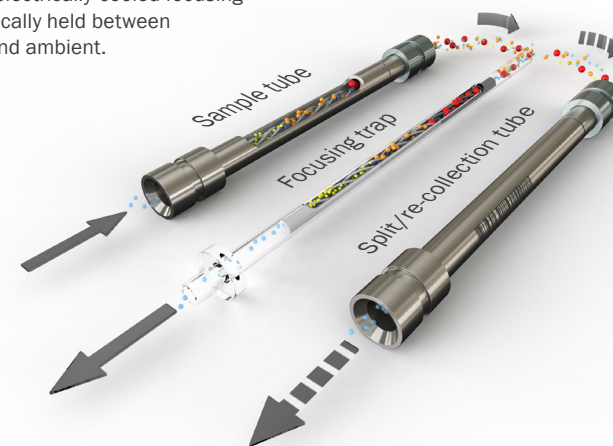
Automated double-split re-collection and re-analysis of high-boiling polycyclic aromatic hydrocarbons (PAHs) shows quantitative recovery through the full flow path.

How two-stage thermal desorption works

Sample tubes and traps can contain multiple sorbent beds for analysing samples with a wide boiling range.

1 Tube desorption and inlet split

The sample tube is heated in a flow of carrier gas and the analytes are swept onto an electrically-cooled focusing trap, typically held between −30°C and ambient.

2 Trap desorption and outlet split

The focusing trap is heated rapidly (up to 100°C/s) in a reverse flow of carrier gas, to transfer/inject analytes into the GC column in a narrow band of vapour for optimum efficiency.
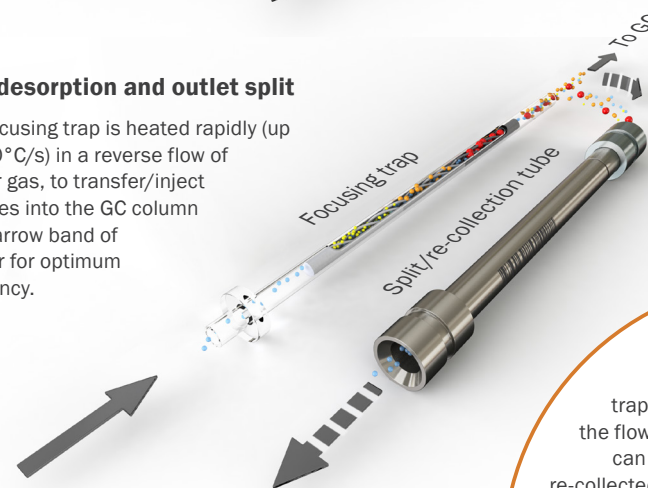
During tube and/or trap desorption, the flow of analytes can be split and re-collected on a clean sorbent tube.

Quantitative sample re-collection for automated repeat analysis

Simple method validation, superior sample security and extended dynamic range

The powerful, quantitative re-collection and repeat analysis capabilities of the ULTRA-xr allows TD users to:

- Reliably repeat sample analysis under identical conditions - for data confirmation - or using a different analyser configuration as required.

- Archive critical samples for future analysis.

- Easily validate analytical methods for analyte recovery using a series of re-collection experiments in compliance with many standard methods.

- Extend the dynamic range using 'High/Low' analysis: Samples are first analysed under high-split conditions to quantify major components without overloading the detector. The split flow is then automatically re-collected and re-analysed under low-split conditions to gain sensitivity for minor components of the same sample.
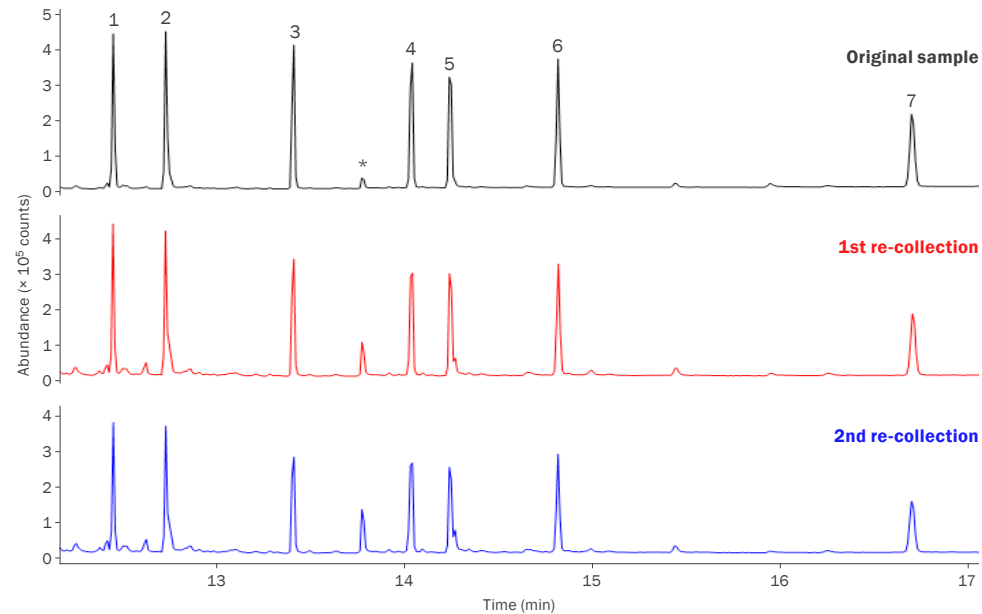
1	PCB-28
2	PCB-52
3	PCB-101
4	PCB-138
5	PCB-153
6	PCB-180
7	PCB-209

* The increasing area of this peak during the series of re-collections confirms it as an artefact (generated from the sorbents in the sampling tube).

Quantitative recovery of these challenging semi-volatile compounds is confirmed by the perfect agreement in relative response factors in each repeat analysis.
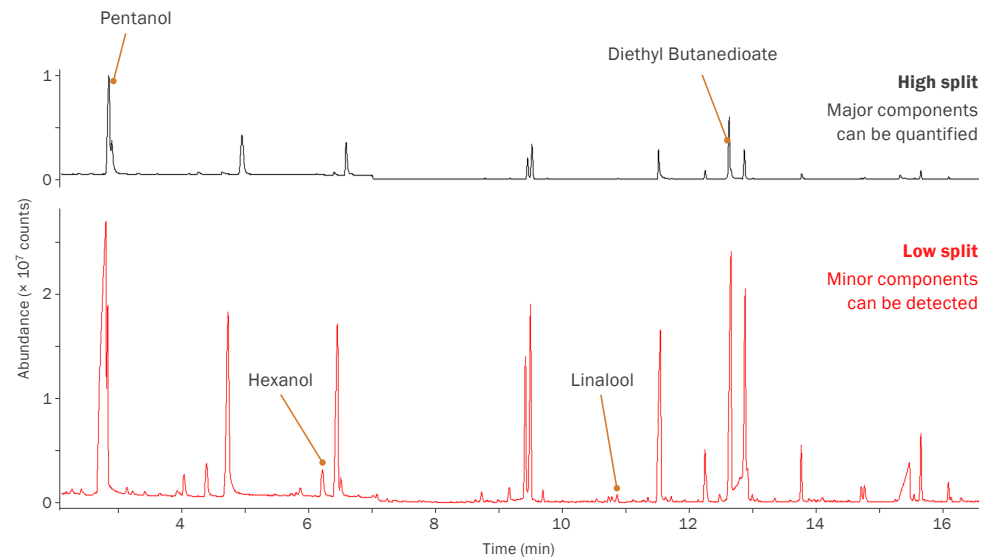
Major and minor components from the same sample can be automatically quantified using re-collection to extend the dynamic range, as shown for this wine aroma sample.

Superior analytical performance

Key features of ULTRA-xr for enhancing data quality and confidence in results
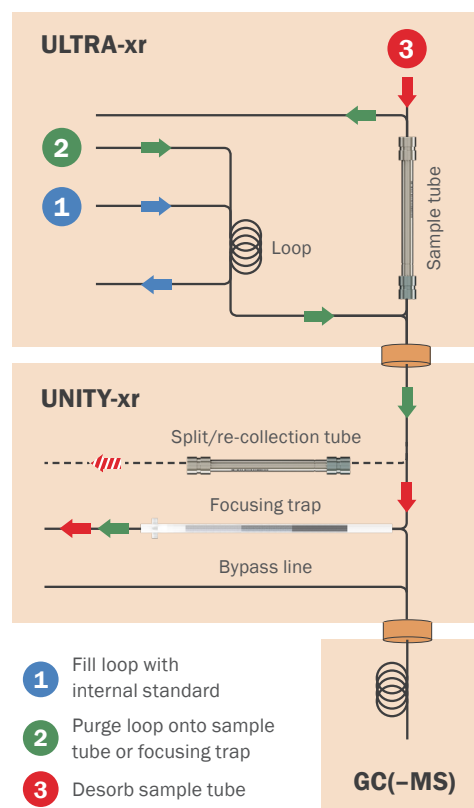
Internal standard capability

The optional internal standard capability of ULTRA-xr offers the following advantages:

- **Adding an internal standard to a sorbent tube** is widely used for quality-checking, and involves transferring a precise aliquot of the gaseous standard from a gas valve loop to the sampling end of the tube. This can be done immediately before tube desorption, and/or before the tube is sampled – allowing every aspect of the monitoring process to be checked, from tube storage and transport to sampling and analysis.

- **Adding internal standard to the focusing trap** can also be automated, and can be useful for direct desorption.

Dry-purging of sorbent tubes

Dry-purging on the UNITY–ULTRA-xr is carried out with gas flowing in the sampling direction as part of the automated sequence. This minimises water interference and is recommended by standard methods.


ULTRA-xr

Loop — Sample tube

UNITY-xr

Split/re-collection tube

Focusing trap

Bypass line

GC(–MS)

1 Fill loop with internal standard
2 Purge loop onto sample tube or focusing trap
3 Desorb sample tube

For versatile method validation, internal standards can be added to tubes or focusing traps on all ULTRA-xr systems.

DiffLok™ caps for stringent sample sealing

Markes' patented DiffLok caps preserve sample integrity, using a long, narrow, helical channel to prevent diffusive loss of sample or ingress of contaminants from the environment.

The caps are simply pushed on to both ends of every tube, and remain in place throughout automated TD sequences, overcoming the need to uncap and recap tubes.

Peak area (× 10⁶ counts) vs Storage time (hours)

- Xylene
- Ethylbenzene
- Benzene
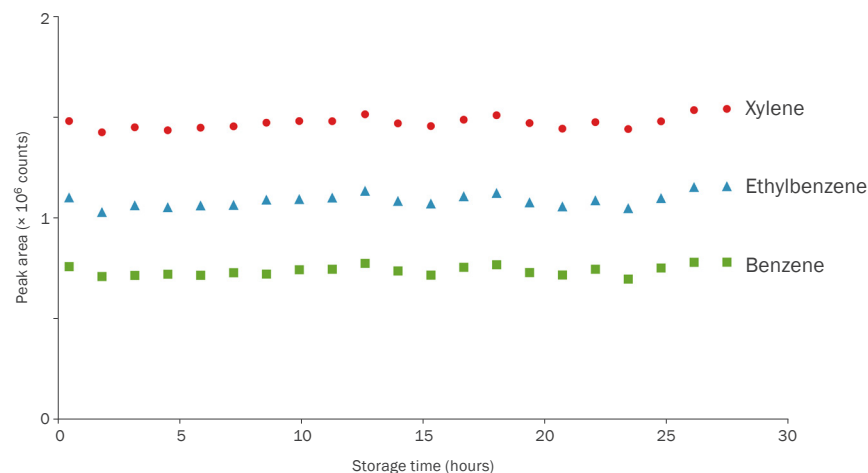
Sample integrity is maintained throughout extended sequences using DiffLok caps, as shown by the stability of response from three volatile compounds over a period of over 24 hours. The RSDs of <3.5% in each case are impressive for manually-spiked tubes.

Smart design

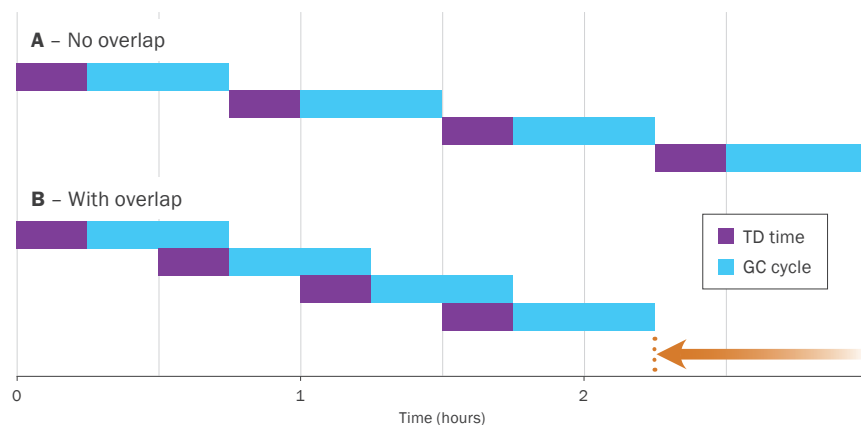## Delivering outstanding productivity and reliability

From intuitive software to mechanical robustness, ULTRA-xr combines ease of use with maximum output.

- **Mechanical simplicity:** DiffLok caps eliminate unreliable tube uncapping/ recapping operations, for maximum uptime and high productivity.

- **Efficient technologies for tube and trap cooling:** Combined with robust sample overlap, these minimise analytical cycle times and optimise sample throughput.

- **Enhanced productivity:** UNITY–ULTRA-xr integrates seamlessly with the pneumatics of many modern GCs, for easy method development and optimum retention-time stability.

- **Smart electronics:** Automated, intelligent troubleshooting and pre-maintenance warnings maximise instrument uptime.

- **Data security:** UNITY–ULTRA-xr allows read/write of TubeTAG™ electronic tube labels* (pictured right) during the analytical sequence, eliminating the risk of transcription errors.

  * Patent number GB 2362464.

A – No overlap

B – With overlap

Legend: TD time / GC cycle

Time (hours)

Fast returns on investment are achieved by the use of overlap mode to maximise sample throughput.

	Comment	Tube	Re-collection type	Re-collection tube	Trap Fire Time	Re-collected from Tube	Tube Number	Tube Status
1	Sample	1	Tube	2	2019/03/05 08:24:09	0	379294	Re-collected
2	Re-collected sample1	2	Tube	3	2019/03/05 08:34:23	379294	257661	Re-collected
3	Re-collected sample2	3	Tube	4	2019/03/05 08:44:35	257661	343753	Re-collected
4	Re-collected sample3	4	Tube	5	2019/03/05 08:54:49	343753	379291	Re-collected

Samples are easily tracked through a sequence of analyses, re-collections and repeats, using TubeTAG RFID tags to automatically collect sample and tube data.

Field sample deployment

Sample tube cleaning

Enhanced traceability throughout process with TubeTAG

Passive sampling

Sample & data analysis

Markes International – The TD experts

World-leading instruments, technical expertise and unmatched applications experience

Markes International has been at the forefront of thermal desorption design and innovation for over 20 years. Our 'xr' series of TD instruments sets the benchmark for product quality and delivers the best-available analytical performance across all TD–GC and TD–GC–MS application areas:

Environmental monitoring

Consumer environmental health

Food and drink

Automotive studies

Fragrance and odour profiling

Biological profiling

Defence and forensic

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