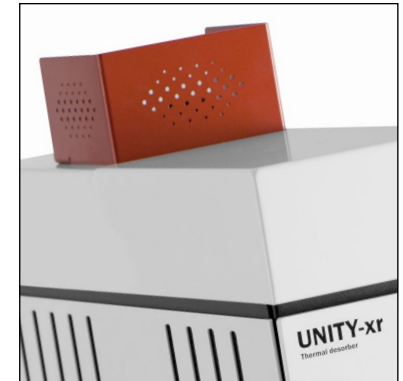


UNITY-xr

**Single-tube thermal desorption platform
with unmatched upgradability**



UNITY-xrTM

Introducing UNITY-xr – the world's leading thermal desorption platform. Delivering exceptional GC(–MS) performance for industry-standard sample tubes and offering unmatched upgrade flexibility for tube, canister and on-line automation.

Benefitting from Markes' long commitment to thermal desorption, UNITY-xr is a full-functionality, cost-effective TD 'starter' package that operates cryogen-free.

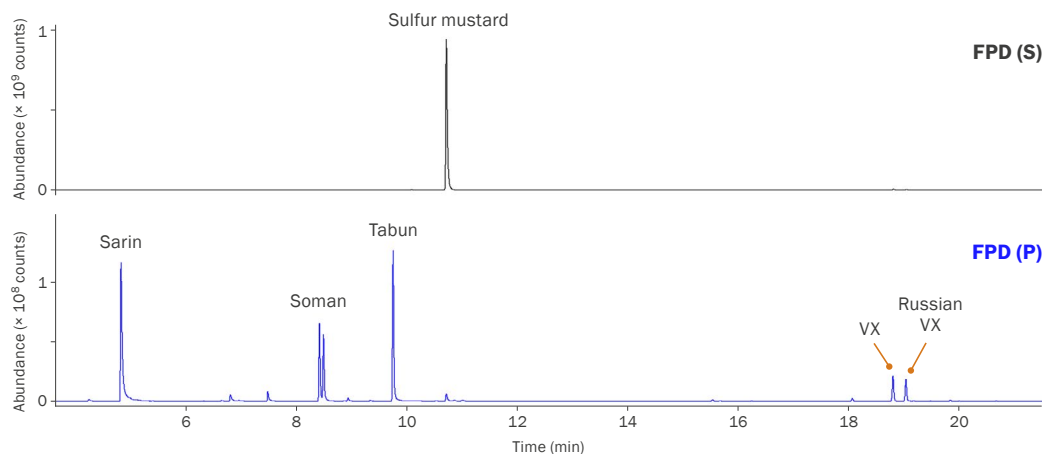
Key innovations and advantages:

- **Application versatility:** UNITY-xr is compatible with an unmatched range of compounds and applications from acetylene to n-C₄₄ plus reactive species, at levels from ppt to percent.
- **Trouble-free operation:**
 - Easy user access for tube loading/unloading.
 - Small footprint and platform-neutral – UNITY-xr can be installed onto any make of GC or GC–MS.
 - Efficient electrical cooling of an easy-change focusing trap optimises analytical performance without the cost and inconvenience of liquid cryogen.
- **Outstanding performance:** UNITY-xr is the only manual thermal desorber to:
 - Overcome the one-shot limitation of less advanced TD systems with quantitative sample re-collection, providing simple method validation and reliable repeat analysis.
 - Offer full compliance with all the recommendations of international TD standard methods.
 - Eliminate risk of discrimination, minimise artefacts and optimise data confidence, thanks to the combination of inert flow path and backflush trap desorption.
- **Future-proof:** Multi-gas enabled UNITY-xr systems are independently certified for use with helium, nitrogen and hydrogen carrier gases, offering enhanced throughput.
- **Easy upgrades:** Modular upgrade options provide high-capacity tube and/or canister automation, as well as round-the-clock on-line air/gas monitoring, as your needs grow.

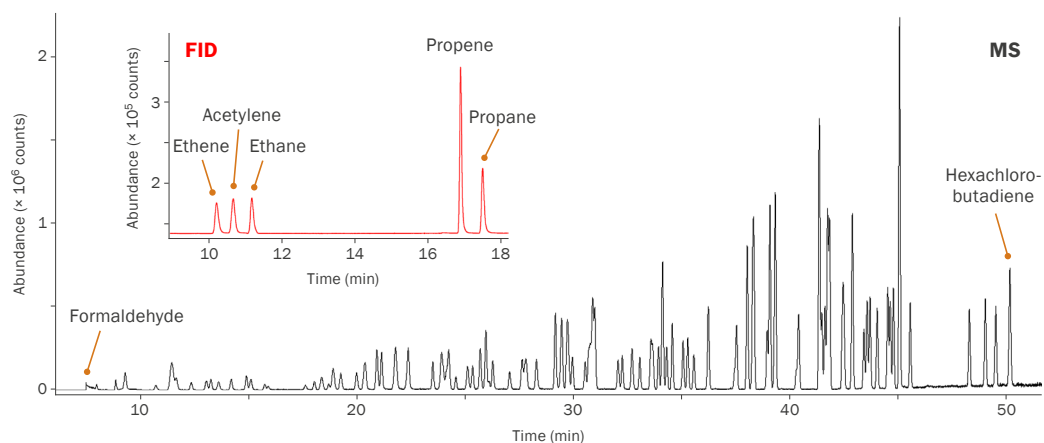


Every thermal desorption application on one versatile platform

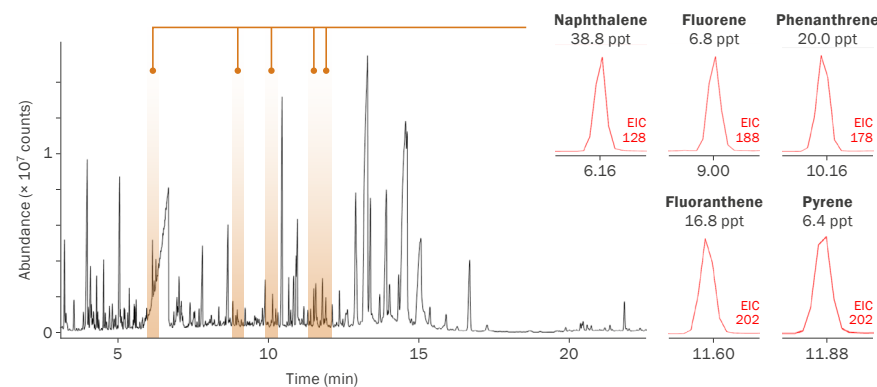
With its compact, platform-neutral design and intuitive user interface, UNITY-xr is the perfect TD starting point for any GC(-MS) laboratory. Common TD applications include air monitoring, emissions testing, odour/aroma profiling, and testing the release of chemicals from everyday products and materials.



Optimum performance for the most challenging applications on UNITY-xr is demonstrated by TD-GC-FPD analysis of these highly reactive chemical warfare agents.

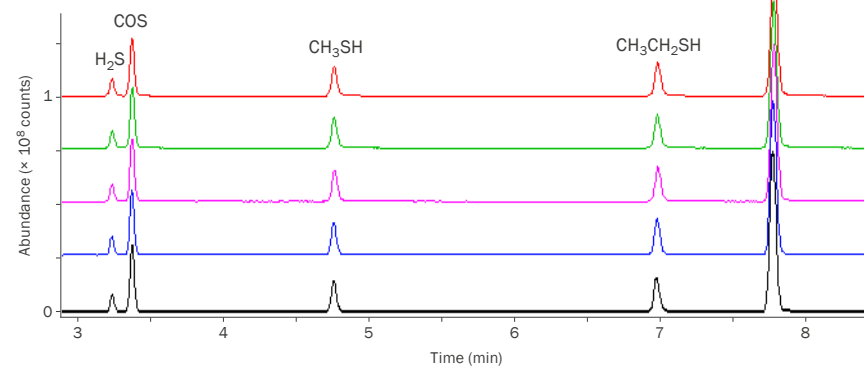


The exceptional cryogen-free analytical performance of UNITY-xr, coupled with canister automation using the CIA Advantage-xr™, delivers a fast return on investment for method-compliant analysis of priority pollutants. In this instance, a 117-compound standard (including C2 hydrocarbons and formaldehyde) was analysed in compliance with the Chinese Environmental Air VOC Monitoring Program.



Excellent recovery of trace-level semi-volatiles can be achieved from complex matrices using UNITY-xr, as shown for this complex urban air sample containing several PAHs.

	H ₂ S	COS	CH ₃ SH	CH ₃ CH ₂ SH	CS ₂
t _R RSD	0.06%	0.05%	0.04%	0.03%	0.04%
Response RSD	4.1%	2.1%	4.4%	4.5%	2.3%



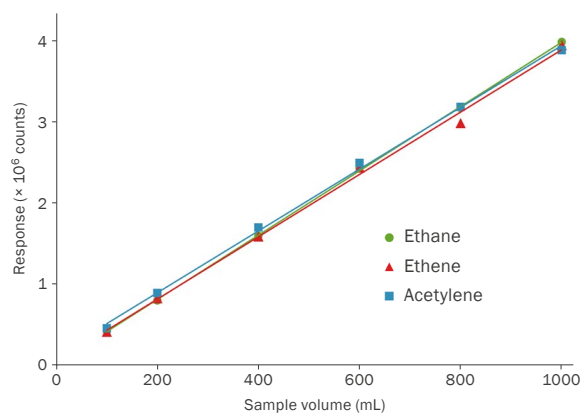
Highly stable retention times and responses across a sequence of runs – as shown here for a set of sulfur compounds sampled on-line with UNITY-Air Server-xr™ – minimises time spent on data review and reduces QC requirements.

Exceptional trapping functionality

Combining performance and practicality

Harnessing over 20 years' experience at the forefront of TD innovation, UNITY-xr has been optimised for outstanding capillary GC performance and ease-of-use. Key features include:

- **The 4th-generation focusing trap module** in every UNITY-xr offers super-fast desorption in a reverse ('backflush') flow of carrier gas. This optimises transfer/injection of the widest range of analytes, enabling simultaneous analysis of VOCs and SVOCs with the best available sensitivity. Each focusing trap typically provides 12 months' use and is easy to change (see inset), with no tools or special training required.
- **The short flowpath, valve and capillary column interface** are all ultra-inert and uniformly heated, meaning that the most challenging organic chemicals pass through the system without degradation or deposition.
- **Electrical trap cooling** means that the cost and inconvenience of cryogen – and the associated risk of ice blockages – is completely avoided, while fast trap cooldown means short cycle times and optimum productivity.

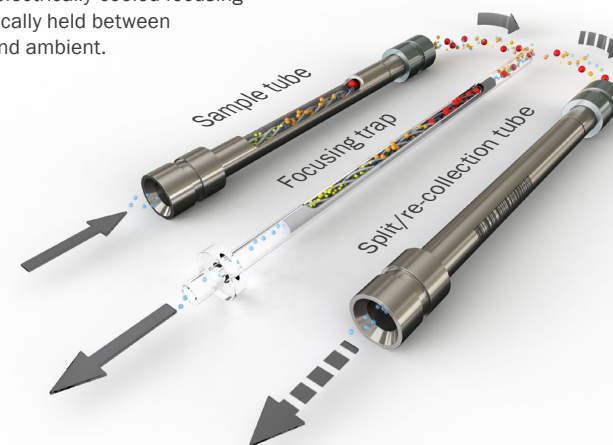


The excellent performance of the focusing trap at the heart of all Markes' TD instruments is demonstrated by the linearity obtained for high volumes of ultra-volatile C₂ hydrocarbons, sampled using the Air Server-xr on-line sampling module for UNITY-xr.

How two-stage thermal desorption works

1 Tube desorption and inlet split

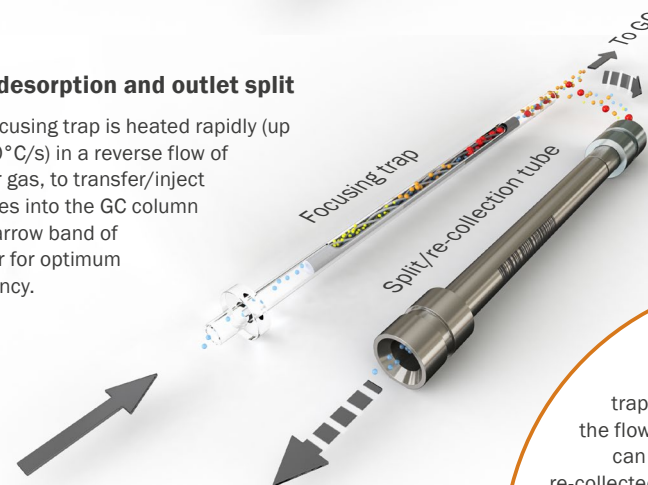
The sample tube is heated in a flow of carrier gas and the analytes are swept onto an electrically-cooled focusing trap, typically held between -30°C and ambient.



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

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.

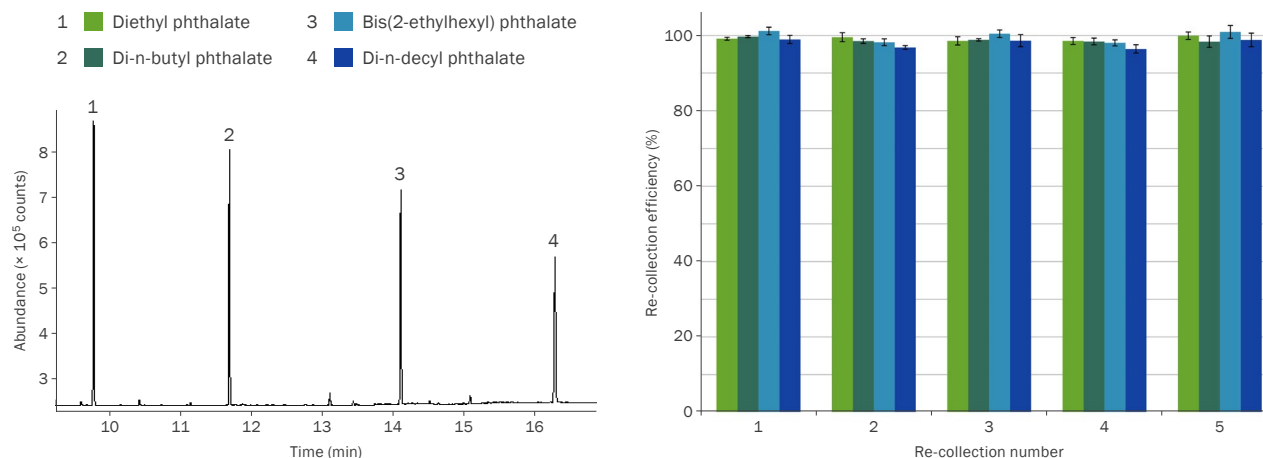
Quantitative sample re-collection for automated repeat analysis

Simple method validation AND extended dynamic range

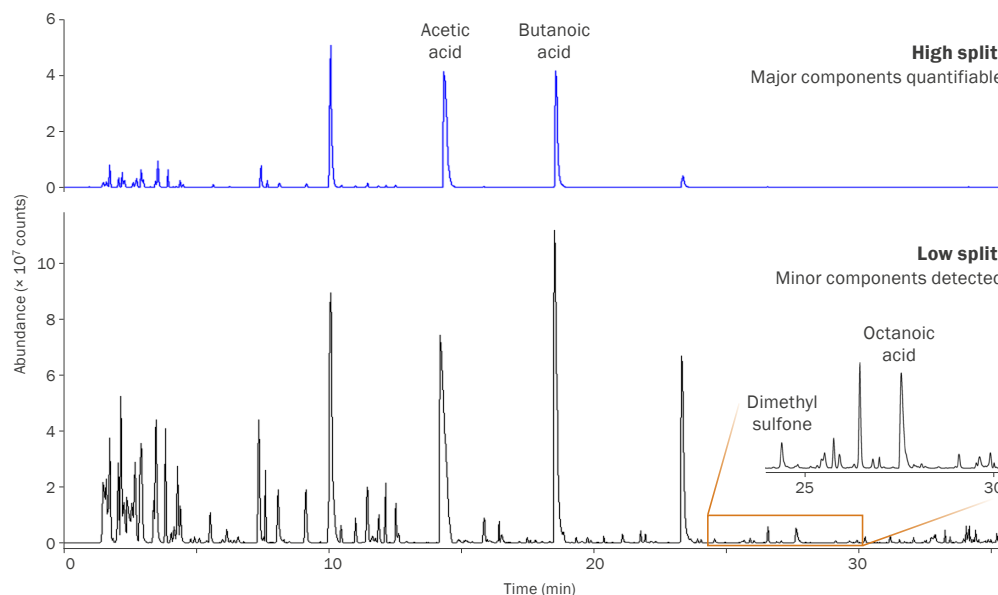
Introduced on the first-generation UNITY in 1998, split-flow re-collection has revolutionised analytical thermal desorption, by allowing one or both split flows to be quantitatively re-collected onto clean tubes. The re-collection capabilities offered by UNITY-xr are unmatched by any other TD system.

Re-collection allows TD users to:

- Reliably repeat sample analyses, and so overcome the 'one-shot' limitation of less advanced systems.
- Easily confirm and validate data and analytical procedures, and so comply with standard methods.
- Ensure that no critical samples are lost.
- Expand the analytical dynamic range using 'High/Low' analysis: Samples are first analysed under high-split conditions to quantify major components without system overload. Re-collected samples are then re-run with a much lower split, as required for detailed analysis of trace compounds.



Full recovery of high-boiling phthalates through UNITY-xr is demonstrated by the high efficiency across five re-collections. Such re-collection experiments are also a straightforward way of validating methods for analyte recovery.



Major and minor components from the same sample can be quantified using re-collection to extend the dynamic range ('High/Low' analysis), as shown for this analysis of cheese aroma.

Modularity and upgradability: Future-proof your UNITY-xr

Investing in a modular TD system from Markes allows you to extend the capability of your UNITY-xr at any time.

Method-compliant CIA Advantage-xr™ modules

add automation for up to 27 canisters (or bags). Innovative water management technology and cryogen-free operation deliver cost-effective and robust systems for standard and extended air monitoring applications – including C₂ hydrocarbons and a wide range of air toxics (polars and non-polars).



UNITY-CIA Advantage-Kori-xr™

One or two ULTRA-xr™ autosamplers add to UNITY-xr for automation of desorption and split re-collection. With capacity for up to 100 (with one ULTRA-xr) or 199 (with two ULTRA-xr) sealed standard tubes, these systems allow unattended operation over extended sequences.



UNITY-ULTRA-xr Pro

Compact Air Server-xr™ modules

add cryogen-free on-line monitoring capability for unattended, round-the-clock monitoring of three or eight air/gas channels with automatic sequencing between samples, zero air and standard gas.



UNITY-Air Server-xr

CIA Advantage-xr and ULTRA-xr modules can both be interfaced to UNITY-xr, enabling combined, unattended tube/canister automation sequences thus maximising laboratory throughput.



UNITY-CIA Advantage-ULTRA-xr



UNITY-xr

Upgrade UNITY-xr to automate analysis of tubes with the ULTRA-xr, and canisters with CIA Advantage-xr, and maximise return on investment with high productivity for a wide range of sample types.

- **Tube automation** is fully compliant with standard methods including US EPA methods such as TO-17 and 325, as well as ISO 16000-6, EN14662-1, ASTM D6196 and other key standards.
- **Canister/on-line automation** is fully compliant with standard methods including US EPA Method TO-15, US EPA guidance for ozone precursor ('PAMS') monitoring, and Chinese Environment Agency methods such as HJ 759.
- **Run complementary tube and canister analyses on a single system** (and even in a single sequence) with no user intervention and without compromising analytical performance or sample-to-sample cycle time.
- **Re-collect canister, bag or on-line samples** onto sorbent tubes for extended storage stability.
- **Adapt your system** to seasonal applications or wide-ranging sample types.



	Status	Method	Tube	Channel	Recollection Tube
1	Complete	Tube Sample (issue 4)	1		
2	Complete	Tube Sample (issue 4)	2		
3	Complete	Canister Sample (issue 3)		13	99
4	Active	Canister Sample (issue 3)		14	100

Comprehensive portfolio of sampling accessories

Markes International offers a comprehensive range of high-quality sampling accessories for thermal desorption, including options for pumped, passive (diffusive) and canister air sampling, material emissions testing, soil gas and breath/biological monitoring. Just part of our extensive portfolio is shown below.



Micro-Chamber/Thermal Extractor™
for off-line dynamic headspace sampling



MTS-32™
multiple-tube sampler



Easy-VOC™
grab-sampler



ACTI-VOC™
low-flow pump



VOC-Mole™
soil-gas sampler



HiSorb™ high-capacity
sorptive extraction probes



**Sorbent tubes,
caps and TubeTAG™**

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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