



## Series 2 TT24-7



**Continuous monitoring of trace chemical vapours**

# Series 2 TT24-7™



## TT24-7 Series 2 – Continuous monitoring of trace chemical vapours

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The TT24-7 Series 2 is an advanced thermal desorption (TD) system for continuous near-real-time (NRT) monitoring of volatile and semi-volatile organic vapours in air or gas.

With its high-performance analytical capability, reciprocating dual-trapping functionality and cryogen-free operation, the TT24-7 Series 2 is ideal for continuous unattended monitoring, either in static or mobile laboratories.

The TT24-7 Series 2 offers reliable, near-real-time monitoring of chemical warfare agents in military and government installations. It is also an ideal choice for a wide range of challenging civilian applications: advanced environmental research, monitoring pollution levels, controlling air/gas purity, and continuous odour or fragrance profiling.

The TT24-7 Series 2 is normally used in combination with GC or GC/MS technology, but can also be interfaced to direct read-out instrumentation such as process MS systems.

## TT24-7 Series 2 – High-performance on-line air/gas monitoring

### Responsive

- Highly time-resolved data – cycle times as low as 3–5 minutes if required
- Wide range of sampling flows (up to 800 mL/min) with quantitative trapping offers high sensitivity
- Dual-trap continuous monitoring – 100% data capture

### Versatile

- Inert, uniformly-heated flow path offers compatibility for C<sub>2</sub>–C<sub>40</sub> compounds and reactive species
- Compatible with any make of GC(MS), fast GC, and various real-time vapour detectors
- Enhanced splitting options to accommodate high-level samples
- Sampling options include on-line air/gas analysis and tube desorption

### Transportable and practical

- Small footprint – suitable for mobile laboratories
- Operates cryogen-free – ideal for unattended remote-site operation over extended periods
- Robust and low maintenance, including minimal gas consumption
- Easy to calibrate

### Analytical excellence

- Efficient desorption means no cross-contamination
- Ultra-rapid trap desorption also delivers narrow peaks, optimising sensitivity even under splitless analytical conditions; the excellent chromatographic resolution also helps eliminate false positives
- Great precision, repeatability and linearity
- Tube desorption option facilitates quantitative repeat analysis for easy validation of analyte recovery



Detection of chemical warfare agents



Environmental monitoring



Monitoring of cleanroom environments



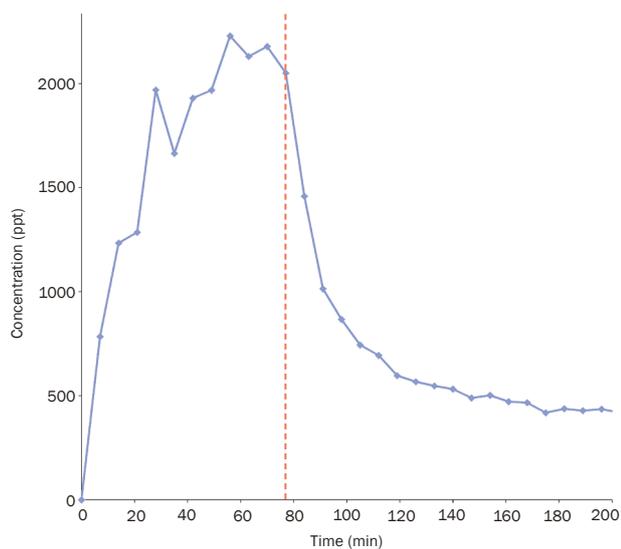
Emissions from consumer products

# Unattended monitoring – 24 hours a day, 7 days a week

## Near-real-time monitoring

### Defence and homeland security

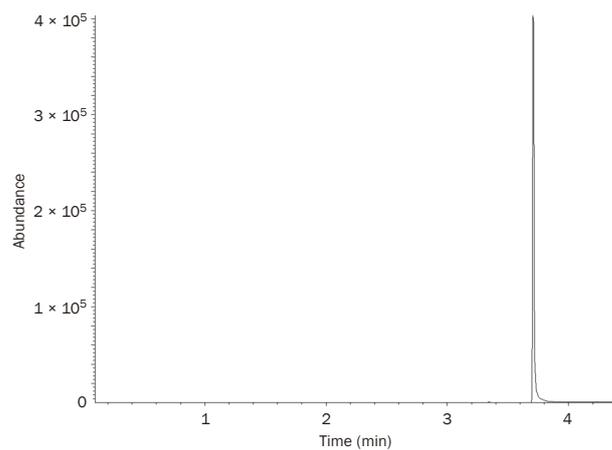
The acute toxicity of many chemical warfare agents means that near-real-time (NRT) data is often required to minimise risk to human health. The TT24-7 Series 2 is ideal for continuous unattended monitoring, and a network of systems can all be controlled from a central point.



Time profile showing the rapid rise and gradual decay of the mustard simulant methyl salicylate in laboratory air. The source was a 2 cm<sup>2</sup> tissue spiked with 100 µL of methyl salicylate, placed 5 ft from the sample inlet of the TT24-7 Series 2. The red dotted line marks the time at which the source was removed from the laboratory.

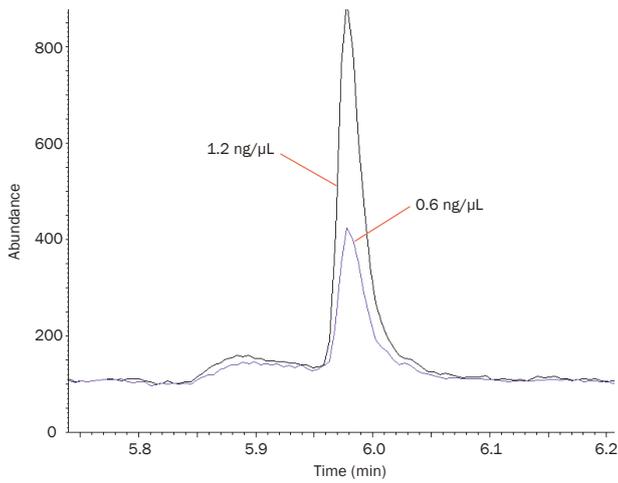
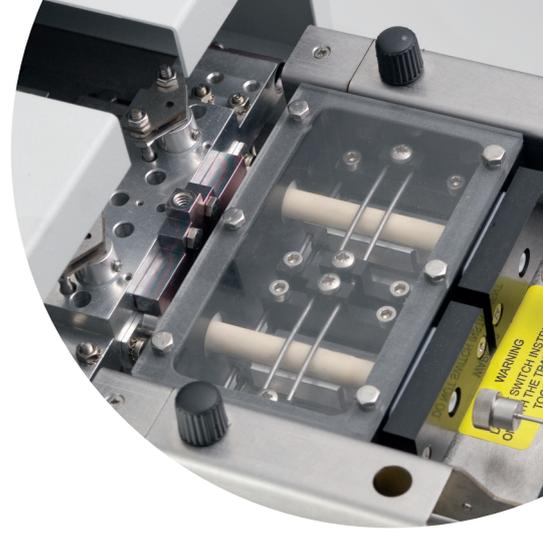
Relevant application examples include:

- Monitoring agent stockpiles and destruction facilities
- On-site monitoring at suspected chemical incidents
- Counter-terrorism – e.g. routine monitoring of key government buildings and other strategic facilities.

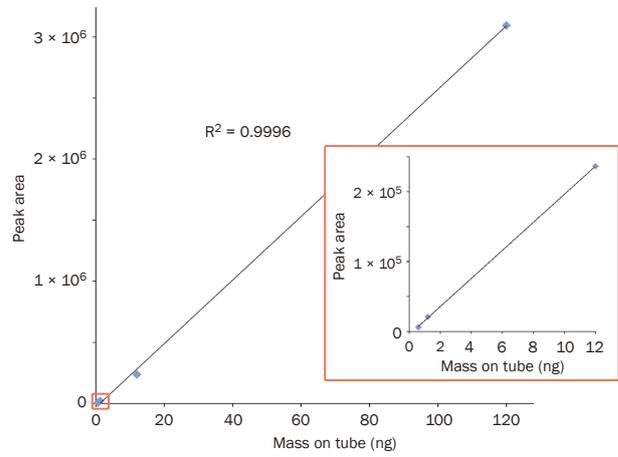


Analysis of methyl salicylate in laboratory air, with a 4.4-minute run time and selected ion monitoring (SIM) at m/z 120.

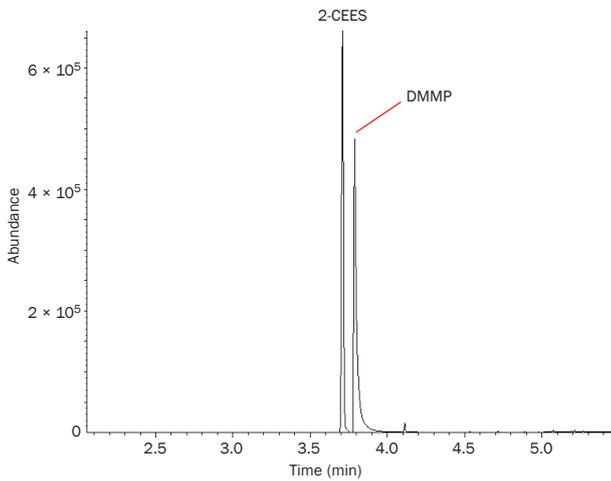




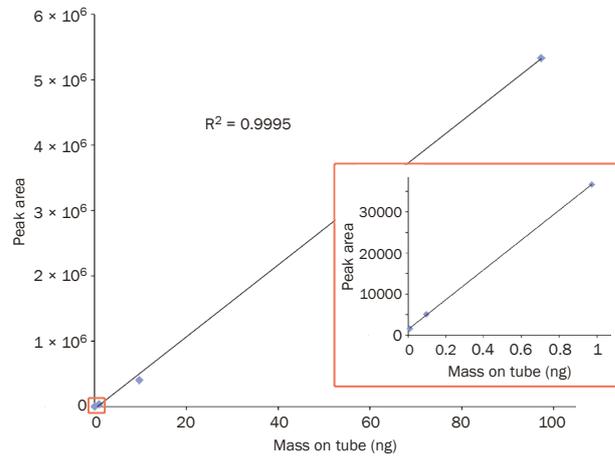
**Analysis of the VX simulant malathion at 0.6 and 1.2 ng on-tube.**



**Plot of peak area against sample mass for malathion, demonstrating outstanding linearity.**



**Analysis of the mustard simulant 2-CEES (2-chloroethyl ethyl sulfide) and the sarin simulant DMMP (dimethyl methylphosphonate) at 100 ng on-tube.**



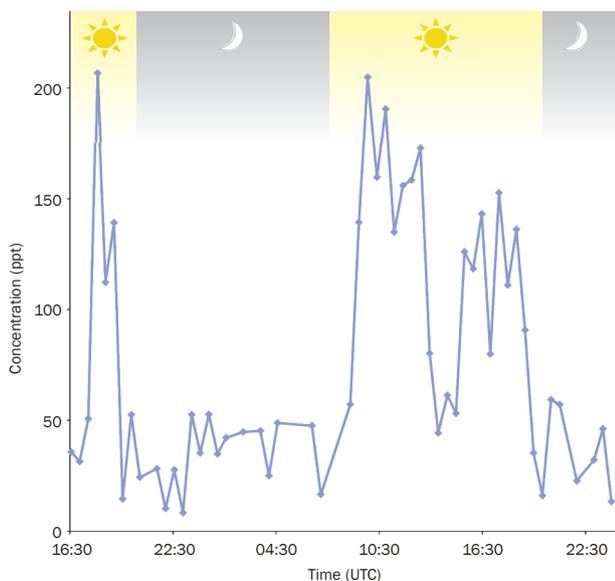
**Plot of peak area against sample mass for 2-CEES, demonstrating outstanding linearity.**

# Continuous monitoring of hazardous or odorous emissions

## Environmental and workplace air monitoring

The TT24-7 Series 2 excels in situations where the continuous monitoring of VOCs and SVOCs is required over extended periods, including:

- Priority pollutants in urban air
- Kinetic studies in atmospheric chemistry
- Chemical releases from industrial sites or in workplaces
- Environmental emergency response, including mobile laboratory installations
- Hazardous chemical processes.

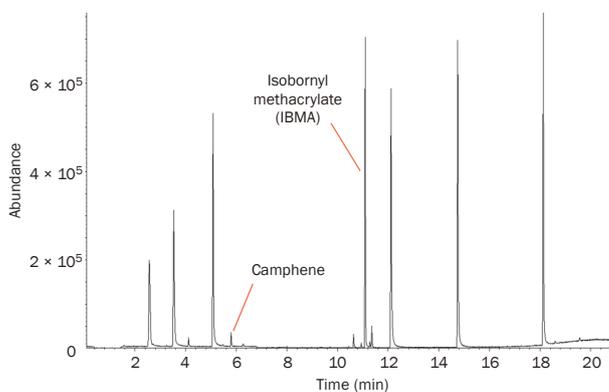


**The daily variation in levels of benzene in semi-rural air monitored using the TT24-7 Series 2, showing a clear association between raised levels of benzene and daylight hours, when levels of traffic on a nearby road were higher.**

## Cleanroom air monitoring

Trace-level airborne contaminants in cleanroom environments can adversely affect the production of silicon wafers and semiconductors, and so are a key application of NRT systems. Tests of these systems often employ isobornyl methacrylate (IBMA), partly because of its use in hard disk drives but also because it breaks down to camphene on chemically active surfaces. Consistency in the amount of camphene arising from multiple analyses of a standard is therefore useful proof of flow path inertness, as confirmed below for the TT24-7 Series 2.

Re-collection	Camphene : IBMA
1	5.28 : 100
2	5.37 : 100
3	5.33 : 100
4	5.23 : 100
5	5.55 : 100
6	5.38 : 100

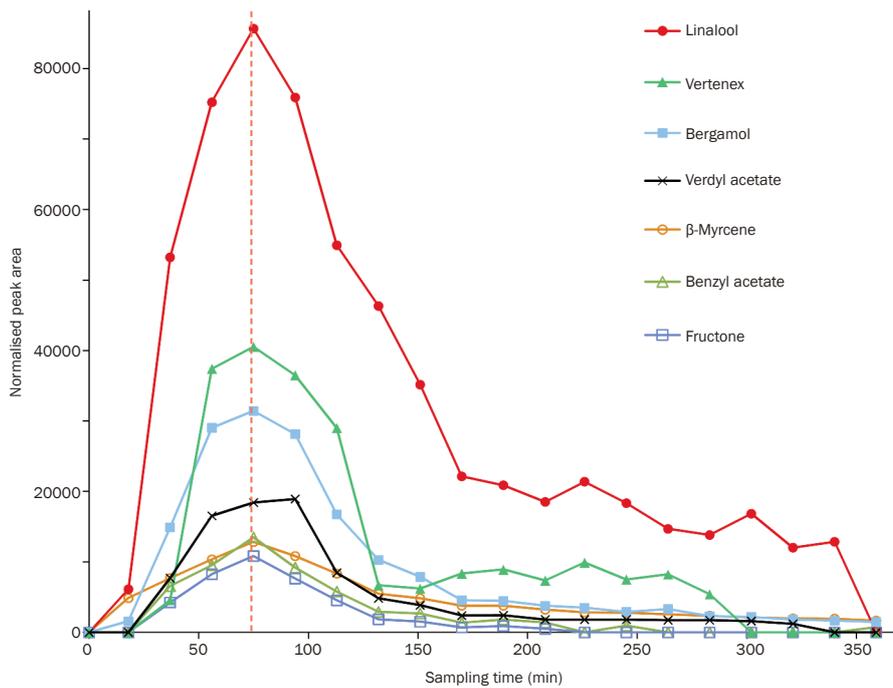


**The consistency of the camphene : IBMA ratio over a series of re-collections of a standard sample demonstrates the flow path inertness of the TT24-7 Series 2, and its suitability for analysis of cleanroom air.**



## Continuous monitoring of odour and fragrance profiles

The TT24-7 Series 2 can also be used for advanced research into emissions from consumer products – for example, to understand the decay profiles of fragrances and other compounds in air fresheners. Conversely, it can also be used to monitor fugitive odorous emissions, to ensure rapid response to industrial incidents.



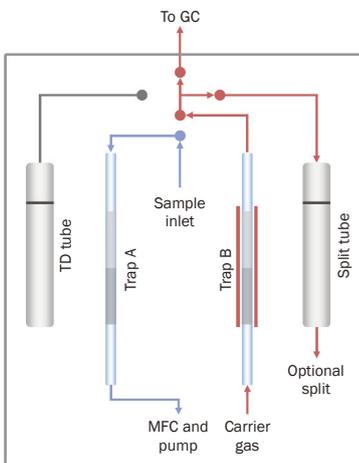
Time profile of seven fragrance compounds emitted by a domestic 'plug-in' air freshener, monitored using the TT24-7 Series 2. The red dotted line indicates when the air freshener was turned off.

# Emissions from materials and products

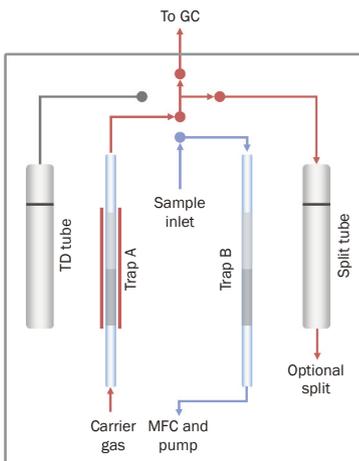
# 100% data capture

## Operation

The TT24-7 Series 2 incorporates two electrically-cooled traps operating in tandem to ensure 100% sample coverage, with no blind spots.



**Stage 1**  
Sampling onto Trap A  
Desorb/analysis of Trap B

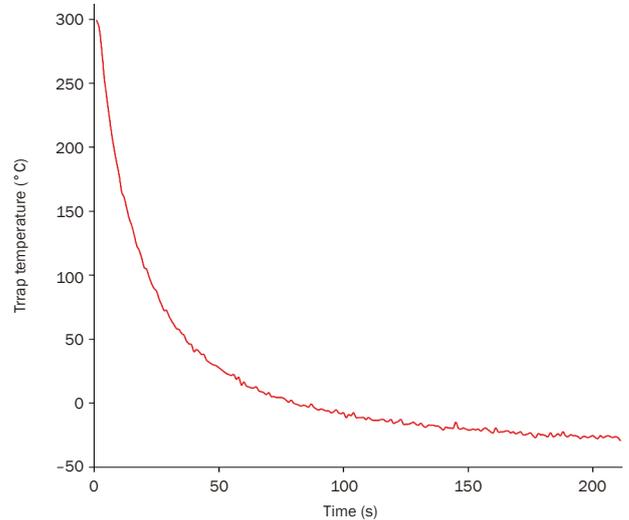


**Stage 2**  
Sampling onto Trap B  
Desorb/analysis of Trap A

Air is first sampled onto Trap A at flow rates between 50 and 800 mL/min. At the end of the specified time the sampling flow is switched to Trap B, and Trap A is desorbed. Once desorption of Trap A is complete, the process is repeated.



Rapid trap heating rates combined with a reverse flow of carrier gas ensure efficient desorption – giving narrow peaks and optimum sensitivity. In addition, efficient trap cooling after desorption of the sample enables the next stage of sampling to begin with the minimum of delay, making possible cycle times of as little as 3 minutes.



**The rapid cooldown of traps in the TT24-7 Series 2 greatly facilitates short cycle times.**

## Exceptional performance

### Wide analyte range

The TT24-7 Series 2 can be operated at trapping temperatures down to  $-30^{\circ}\text{C}$  and sampling flow rates from 50 to 800 mL/min, making it suitable for a wide range of GC applications.

This flexibility allows quantitative trapping of ultra-volatiles such as  $\text{C}_2$  hydrocarbons, as well as providing exceptional desorption and recovery characteristics for semi-volatiles.

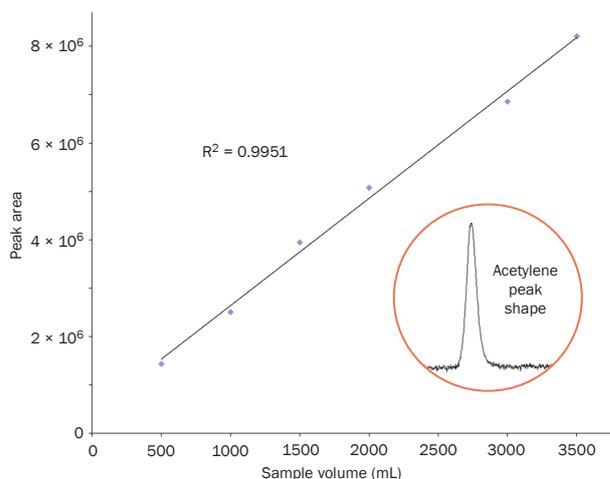
### Designed for remote operation

The TT24-7 Series 2 has been designed with remote operation in mind. Most importantly, no liquid cryogen is required, eliminating the need for topping-up, and facilitating unattended operation for periods of weeks or months.

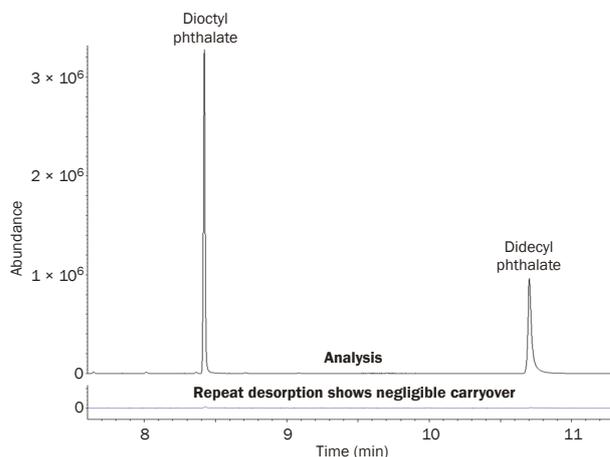
In addition, the valves and Peltier coolers of the TT24-7 Series 2 use just 100 mL/min of dry air or nitrogen, meaning that a standard 5 ft cylinder lasts at least 2 months. Similarly, carrier gas usage can be minimised – a typical low-split method will use 5–10 mL/min, although this will vary according to analytical conditions.

### Compatible with fast GC

When coupled with fast GC, the TT24-7 Series 2 allows short cycle times and rapid near-real-time data generation.



**Effective electrical cooling of the twin sorbent traps in TT24-7 Series 2 allows retention of ultra-volatiles. In this example, quantitative retention of acetylene (b.p  $-84^{\circ}\text{C}$ ) is demonstrated from over 3 L of air.**



**Analysis of the semi-volatile plasticisers diocetyl phthalate and didecyl phthalate from a 100 ng standard, demonstrating near-complete desorption from the focusing trap of the TT24-7 Series 2 (carryover  $<0.5\%$ ).**

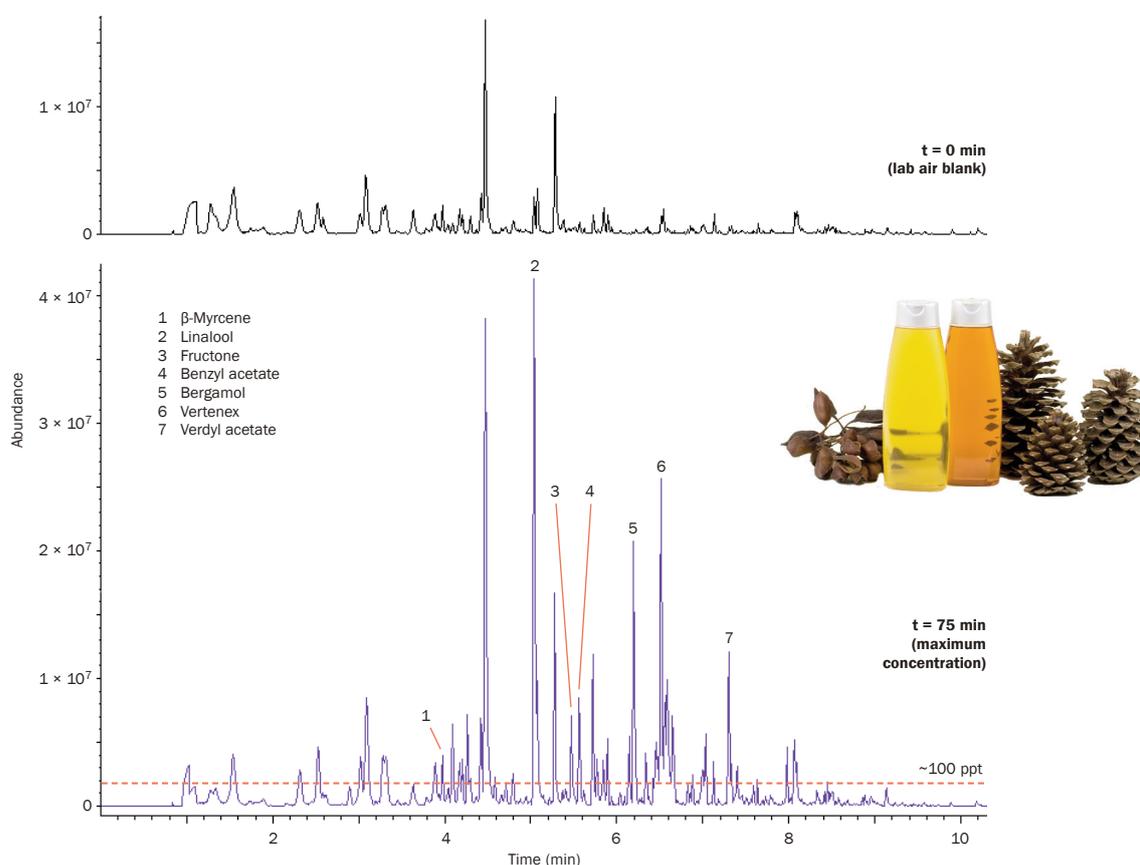
# Ultra-volatiles to semi-volatiles

# Detection of trace-level compounds

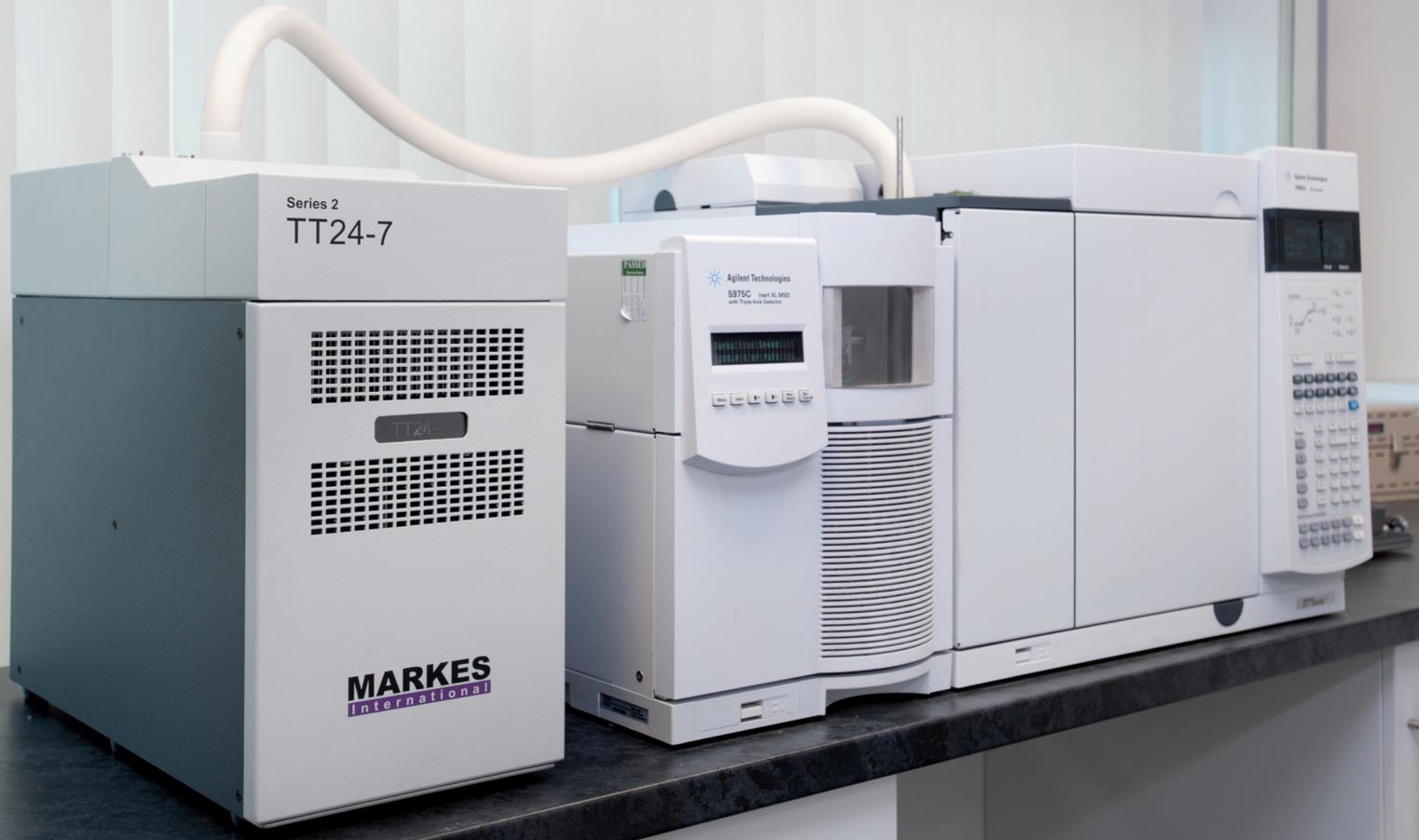
## High sensitivity

The TT24-7 Series 2 is compatible with a range of GC/MS systems. However, GC time-of-flight (TOF) mass spectrometers are the ideal partner for monitoring unknowns at optimum sensitivity. The latest TOF systems, such as ALMSCO International's BenchTOF-dx™, offer full spectral information at typical quadrupole SIM detection

levels, and allow the TT24-7 Series 2 to achieve ultra-low detection limits. This enables detection of trace odour compounds and certain chemical warfare agents at 'general population limit' (GPL) values.



**Comparison of VOC profiles showing the detection in laboratory air of seven trace-level fragrance compounds emitted by a domestic 'plug-in' air freshener, using the TT24-7 Series 2 and the BenchTOF-dx™ time-of-flight mass spectrometer from ALMSCO International. The chromatograms correspond to the laboratory air blank (top) and the profile taken at the point of maximum concentration, when the air freshener was switched off (bottom). The dotted line indicates a peak height corresponding to an approximate abundance in air of 100 ppt (toluene equivalents).**



## Advanced technology from Markes International

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Markes International pioneered high-performance cryogen-free NRT monitoring with the TT24-7 Series 1 nearly 10 years ago. With its track record of robust, low-maintenance field operation, the TT24-7 Series 1 brought research-grade analysis to the front line of agent monitoring in challenging, out-of-lab environments.

Now the TT24-7 Series 2 builds on the success of its predecessor, offering an advanced feature set that extends the application range. Key enhancements are:

- Optimised trap cooling for enhanced retention of more volatile compounds
- Improved serviceability makes trap changes easier
- Faster cooldown rates allow faster cycle times
- Inert and uniformly heated inlet line
- Smaller footprint for mobile laboratories
- Quantitative tube desorption and re-collection for repeat analysis/validation.

**For more information on this innovative new monitoring system, visit the Markes International website at [www.markes.com](http://www.markes.com), or contact your local dealer.**

### Trademarks

TT24-7™ is a trademark of Markes International, UK.

BenchTOF-dx™ is a trademark of ALMSCO International (a division of Markes International, UK).

# Innovation from the TD experts



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