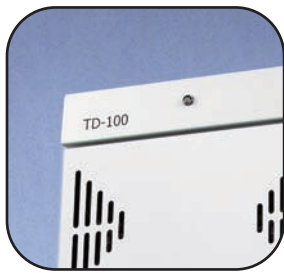




TD-100

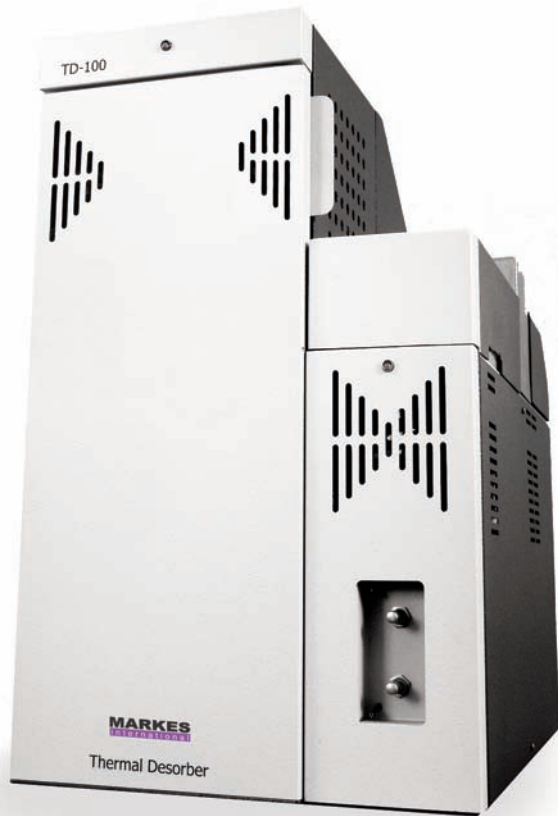
Automated thermal desorber



Universal TD system for up to 100 RFID-tagged or untagged tubes

TD-100™

Simply the best available dedicated system for automated tube desorption



Thermal desorption (TD) is a highly versatile, sensitive and labour-saving sample introduction technique for GC and GC/MS. It combines selective concentration enhancement with direct extraction into the carrier gas. Extracted analytes are then efficiently transferred/injected into the GC(MS) or alternative vapour analyser. All this takes place in one fully automated operation.

Key applications include measurement of volatile and semi-volatile organic chemicals (VOC and SVOC) in air and materials.



For over a decade Markes International has led the way in analytical thermal desorption. TD-100 builds on this pedigree, combining every technological innovation of the last 10 years with field-proven reliability to provide a robust yet high performance solution for any high throughput laboratory.



<p>Versatility</p>	<ul style="list-style-type: none"> • Single system for all tube-based TD applications • Trace levels (ppt) & high concentration samples (ppm/%) in a single sequence • Simultaneous analysis of VOC & SVOC • Platform neutral: Adds to all major makes of GC & GC/MS
<p>Confidence</p>	<ul style="list-style-type: none"> • Quantitative sample re-collection (SecureTD-Q™) for repeat analysis - overcomes the one-shot limitation of other analytical thermal desorption systems and simplifies method/data validation • TubeTAG™: Every TD-100 is compatible with RFID tagged or untagged tubes and includes tag read/write as standard for enhanced sample/tube traceability • Fully method compliant including stringent leak testing of every sample • Options for internal standard addition and tube dry purging functionality (ISDP) • Patented DiffLok™ caps provide a uniquely effective tube seal pre- and post-desorption – preserving the integrity of sampled and blank tubes • Automatic pressure ratio testing monitors the integrity of sorbent tubes
<p>High throughput</p>	<ul style="list-style-type: none"> • 100 tubes for unattended operation over extended periods • Time saving overlap mode allows desorption of a subsequent sample to begin while GC analysis of a previous sample continues • Intuitive control software offers simple sequence construction and rigorous system/sample logging
<p>Economical</p>	<ul style="list-style-type: none"> • Easy to maintain modular design • Much lower purge gas consumption than other TD brands • Cryogen-free operation reduces running costs
<p>Robust</p>	<ul style="list-style-type: none"> • DiffLok caps facilitate mechanically simple automation (no capping/uncapping required) • Electrically-cooled focusing trap eliminates ice plug formation and minimises downtime
<p>Upgradability</p>	<p>The TD-100 is available with the following options:</p> <ul style="list-style-type: none"> • Electronic control of split and desorption flows • Automated re-collection for repeat analysis (also includes dry purge functionality) • Internal standard/dry purge (ISDP) functionality <p>For your convenience TD-100 is usually supplied pre-configured with automated sample re-collection. Electronic mass flow control (MFC) is also available for all split and desorption flows</p>



One automated system ...

Easy-change focusing trap with collar

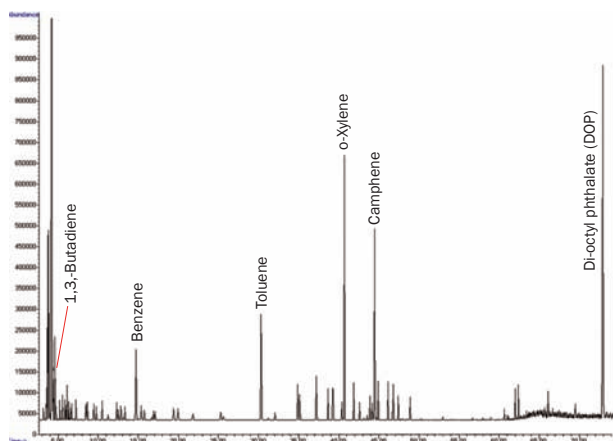
Universal TD system for all applications

The TD-100 is dedicated and optimised for automated tube desorption. It complements Markes' state-of-the-art modular TD units (series 2 UNITY™, ULTRA™, Air Server™) and incorporates many of the same innovative features.

The patented heated valve built into TD-100 is specifically designed for analytical thermal desorption. It can be operated at the low temperatures required for enhanced recovery of labile components and also at the high temperatures required for the quantitative recovery of semi-volatiles such as n-C₄₀.

Tube desorption and conditioning is possible at temperatures up to 425°C. Critical sections of the internal flow path have also been optimised, both for enhanced recovery of higher boiling "sticky" compounds and quantitative analysis of reactive components. Example analytes include: 5/6-ring PAHs, phthalates, PCBs, hydrocarbons to n-C₄₀, mercaptans, explosives and chemical warfare agents.

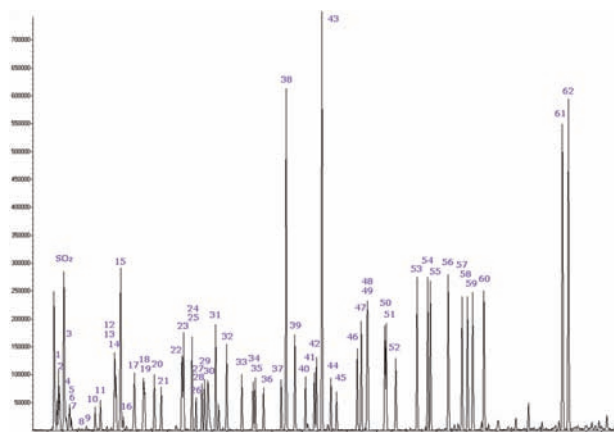
With extended electrical cooling of the entire 60 mm sorbent bed down to -30°C, the TD-100 focusing trap offers quantitative, cryogen-free retention of ultra-volatiles without risk of ice plug formation. Quantitative retention of volatiles can also be combined with efficient release of high boiling components for simultaneous analysis of VOC and SVOC.



Simultaneous analysis of VOC & SVOC optimises productivity

Peerless analytical performance

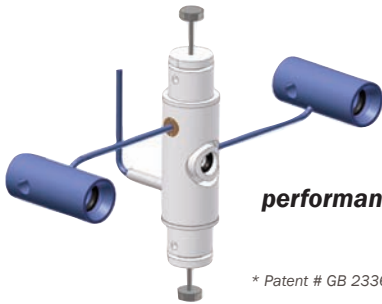
Unsurpassed trap heating rates (100°C/sec) and unique trap heater design offer optimum desorption efficiency even under low flow (<2 mL/min) splitless conditions. This ensures best possible detection limits for trace level compounds. Fast trap cooling rates minimise cycle times and optimise productivity.



1	Propylene	32	n-Heptane
2	Dichlorodifluoromethane	33	Trichloroethylene
3	1,2-Dichlorotetrafluoroethane	34	1,2-Dichloropropane
4	Methyl chloride	35	1,4-Dioxane
5	Chloroethane	36	Bromodichloromethane
6	1,3-Butadiene	37	Cis-1,3-dichloropropene
7	Vinyl chloride	38	Methyl isobutyl ketone
8	Methyl bromide (bromomethane)	39	Toluene
9	1,2-Dichloroethane	40	Trans-1,3-Dichloropropene
10	Trichlorotrifluoroethane (Freon® 113)	41	1,1,2-Trichloroethane
11	Ethanol	42	Tetrachloroethylene
12	1,1-Dichloroethylene	43	Methyl n-butyl ketone
13	1,1,2-Trichlorotrifluoroethane	44	Dibromochloromethane
14	Acetone	45	1,2-Dibromoethane
15	Carbon disulfide	46	Chlorobenzene
16	Isopropyl alcohol	47	
17	Methylene chloride	48	o-, m-, p-Xylene + ethylbenzene
18	Tert-butyl methyl ether	49	
19	Cis-1,2-dichloroethylene	50	
20	n-Hexane	51	Styrene
21	1,1-Dichloroethane	52	Tribromomethane
22	Vinyl acetate	53	1,1,2,2-Tetrachloroethane
23	Trans-1,2-dichloroethylene	54	Trimethylbenzene
24	Methyl ethyl ketone	55	Trimethylbenzene
25	Ethyl acetate	56	1-Ethyl-4-methyl benzene
26	Tetrahydrofuran	57	Dichlorobenzene
27	Chloroform	58	Dichlorobenzene
28	1,1,1-Trichloroethane	59	Chloromethylbenzene (alpha)
29	Cyclohexane	60	Dichlorobenzene
30	Carbon tetrachloride	61	1,2,4-Trichlorobenzene
31	Benzene	62	Hexachloro-1,3-butadiene

Splitless TD-GC/MS (scan) analysis of complex "air toxics" standard (1 L, 2 ppb concentration) optimises sensitivity

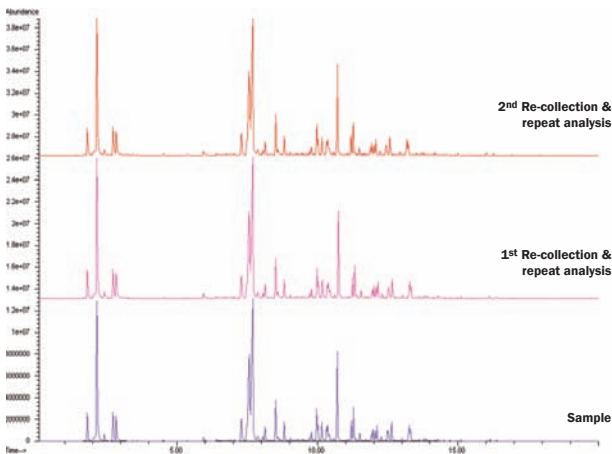
... for every tube-based TD application



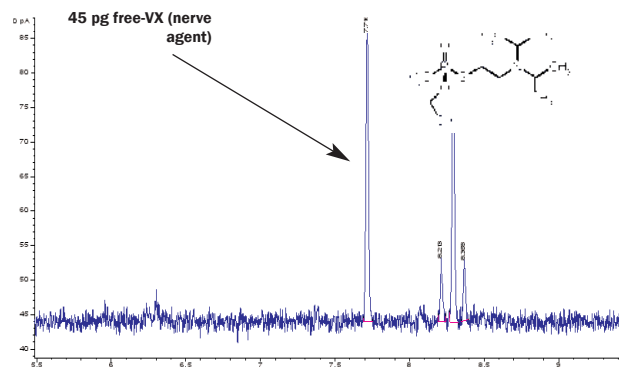
“60 mm sorbent trap length, -30°C cooling, uniquely fast trap heating and patented* TD valving combine to ensure the TD-100 offers optimum performance for the widest possible TD application range”

* Patent # GB 2336649

Compatible with analyte levels from sub-ppt to percent

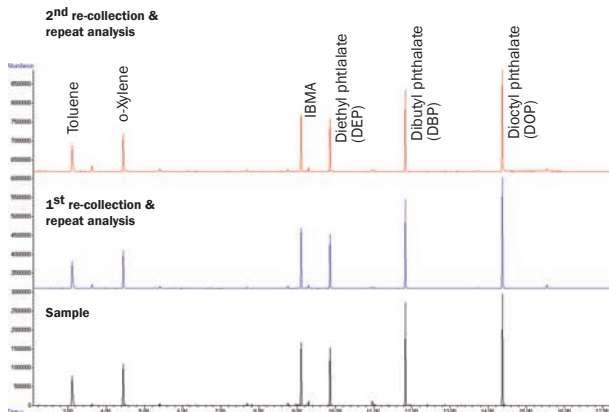


Sequence of repeat analyses of high concentration VOCs from a stack gas sample. Overall split ratio 3,000:1

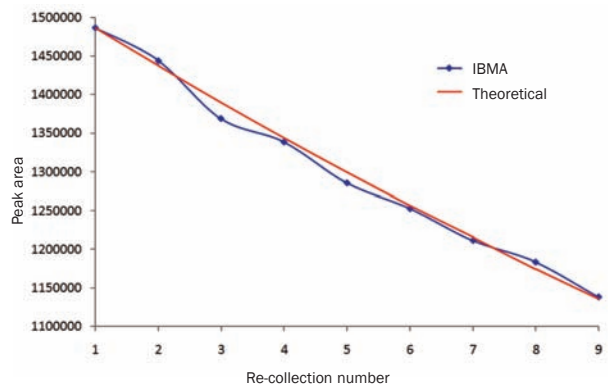


Chromatogram showing 45 pg of free-VX (nerve agent). Splitless injection

Quantitative recovery of high boiling, reactive & “sticky” compounds



Sequence of repeat analyses of a mixture containing both VOCs and SVOCs including IBMA & phthalates



Quantitative re-collection of iso-bornyl methacrylate (IBMA) through a sequence of repeat analyses confirms analyte recovery



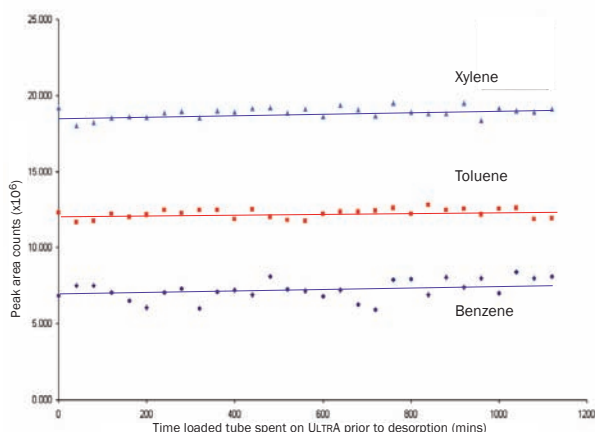
DiffLok™ caps seal tubes effectively & simplify TD automation

TD tube automation made simple

100-tube capacity

With capacity for up to 100 standard (3.5-inch) tubes, TD-100 maximises the throughput and revenue generation potential of the analytical system.

- Time saving overlap mode: When one sample is being analysed via GC another can be leak tested and desorbed to minimise analytical cycle times. With typical GC/MS cycle times of 40 minutes, the TD-100 offers unattended processing of 100 tubes over a standard 60-hour weekend; this represents significant revenue potential with minimal labour costs.
- TD-100 trap cooling speed is optimised to reduce cycle times.
- The TD-100 is mechanically simple ensuring maximum uptime.



No analyte losses from Tenax tubes capped with DiffLok caps and analysed over a 24 hr period

Patented tube sealing mechanism

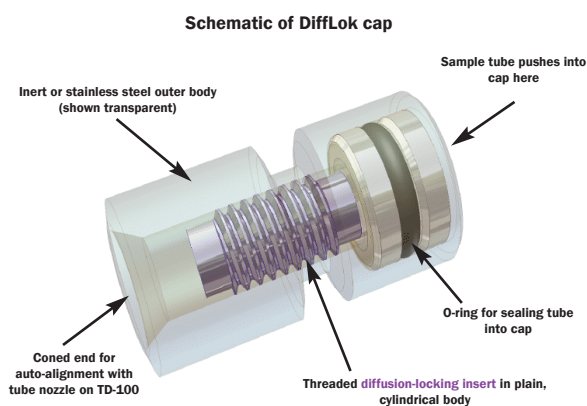
Tubes in the TD-100 are sealed with Markes unique patented* DiffLok caps. DiffLok caps simply push on to both ends of every tube and preserve sample integrity by preventing both analyte loss and artefact ingress. Even volatile analytes are confidently preserved on sorbent tubes giving identical recovery for standards at the beginning and end of a 100-tube sequence.

DiffLok caps have been field proven to seal sampled and blank tubes much more effectively than older push on cap designs.

DiffLok caps revolutionise TD automation by overcoming the need to uncap and re-cap tubes during operation; DiffLok caps remain in place throughout the entire automated desorption sequence.

Low running costs

TD-100 is cost-effective to buy and maintain; no liquid cryogen is required; purge (dry) gas consumption is also 5x lower than other brands of electrically-cooled TD system.



* Patent # GB 2337513 US 6,564656 B1

Field proven TD automation

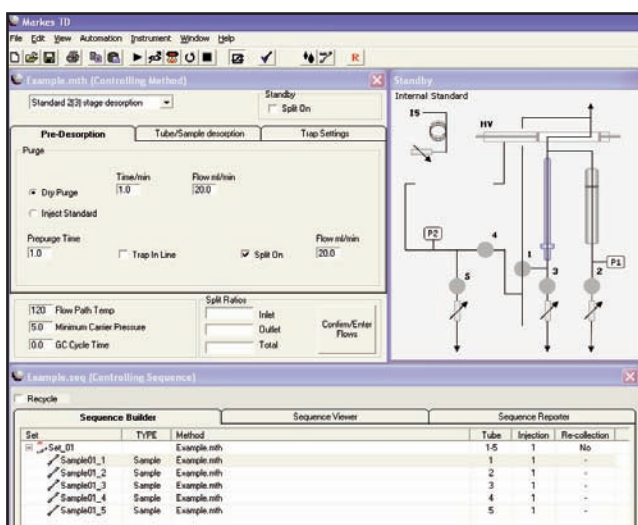


Intuitive automation control software

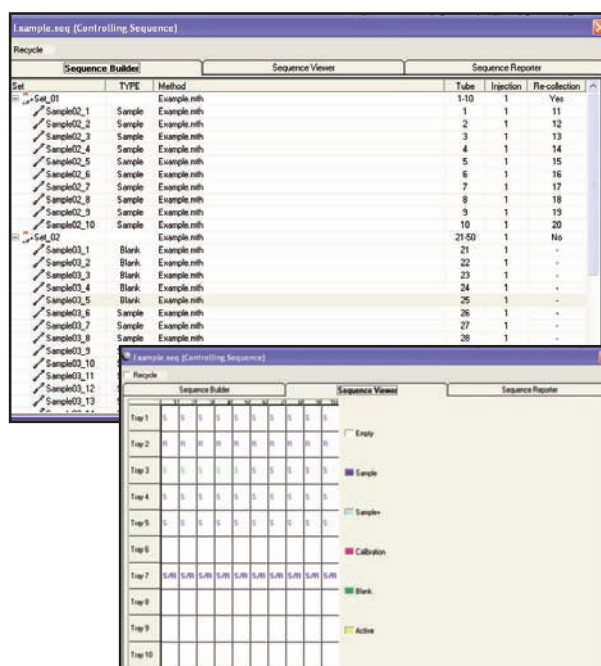
TD-100 software incorporates all TD method parameters and automation control in one easy-to-use package.

- Sequence builder:** Automated sequences are easily constructed via the sequence builder. Samples may be assigned individual desorption methods and can be analysed either sequentially or with random access. All sequences may be stored and recalled for future reference or repeat use.

- Graphical sequence viewer:** The sequence viewer presents a clear graphical display of the position, classification and operating status of each tube. It can also serve as a template for the operator when loading tubes.
- Sequence reporting:** Events associated with every analysis are all recorded in the sequence reporter. Any leak test or other tube sequence failure triggers the GC/MS system to start a blank run to keep the analyser in step with the desorber at all times.



TD-100 user interface



TD-100 sequence builder (top) & viewer (bottom)



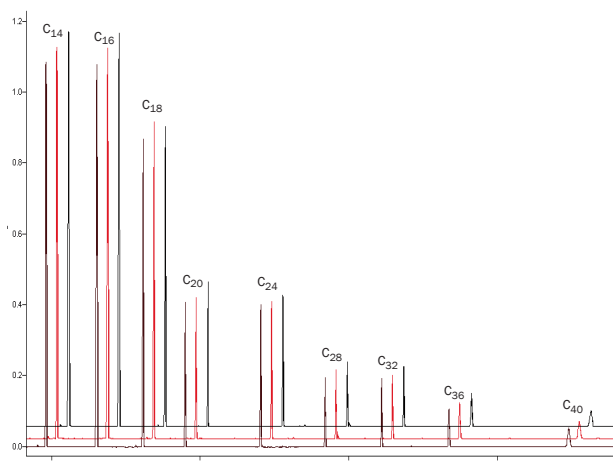
Quantitative sample re-collection (SecureTD-Q™)

SecureTD-Q, the quantitative re-collection of TD split flow for repeat analysis and method validation, is a unique feature of all Markes thermal desorbers, including the TD-100. Every TD-100 offers manual re-collection of the total split flow (i.e. the split during both sample tube and cold trap desorption) as standard. This allows repeat analysis of critical samples and also simplifies validation of single and double split TD methods as described in standards such as ASTM D6196.

Automated sample re-collection

SecureTD-Q can be readily automated on the TD-100 by adding 50:50 functionality*. This is factory-fitted on most TD-100 configurations and is also available for simple field upgrade.

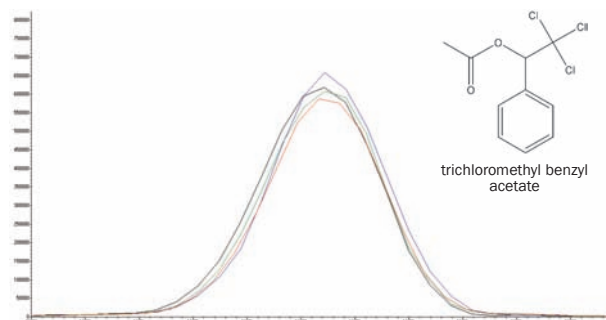
Patent # GB 2395785 (Automated re-collection using a single TD autosampler), US 7,373,847 B2



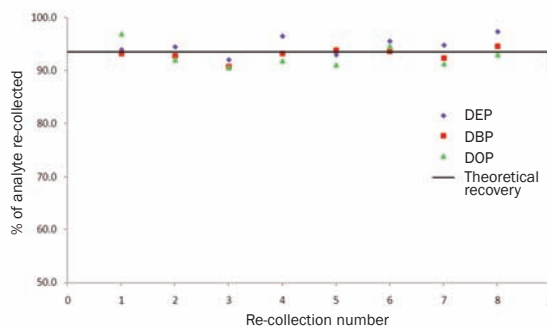
99% recovery of C₄₀ validated using SecureTD-Q

50:50 allows the trap desorption split flow from up to 50 samples to be re-collected onto 50 fresh (conditioned) sorbent tubes. Alternatively, the trap desorption split flow from up to 100 samples can be re-collected back onto the original sorbent tubes.

Automated sample re-collection on the TD-100 overcomes the one shot limitation of other TD systems preventing sample loss and giving additional operator peace of mind.



Re-collection of trichloromethyl benzyl acetate with a 99:1 split ratio, validated using SecureTD-Q



Analysis of phthalates with recovery validated using SecureTD-Q

Sample re-collection for repeat analysis

Error-free tube & sample tracking ...

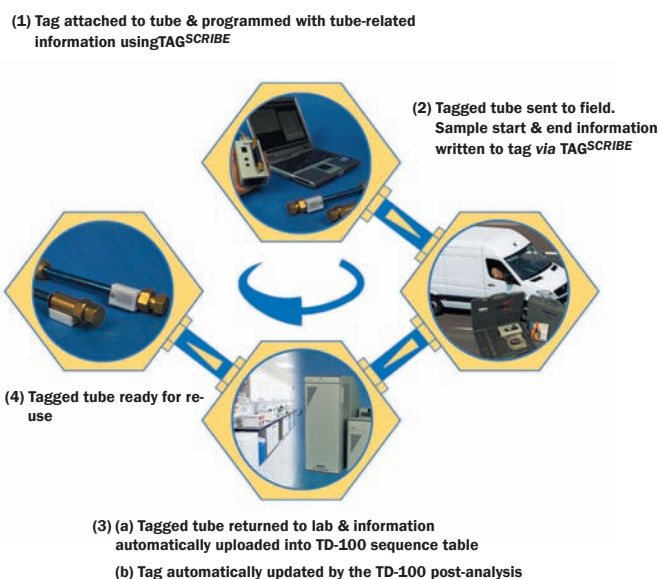
Error-free tube & sample tracking

Every TD-100 is compatible with electronically labelled (RFID tagged) tubes and incorporates pioneering tag read/write technology for confident sample tracking and enhanced tube tracability. TubeTAG™ technology* allows individual TD samples/tubes to be tracked from field to laboratory or within the laboratory. The tags can be programmed with comprehensive sample- and tube-specific data, such as tube ID, sorbent type & date of packing, number of thermal cycles, latest back-pressure reading, tube status, etc., providing the analyst with complete record of tube history.

Tube tagging and automated tag read/write also provides a practical and unique complement to automated SecureTD-Q on TD-100. Relevant information on the tag of each sample tube is automatically transferred to the tag of the respective re-collection tube, creating a failsafe sample audit trail.

For optimal productivity and convenience, TD-100 systems can accommodate both tagged and untagged sorbent tubes.

For further information on TubeTAG please see separate brochure



TubeTAG operational workflow

Sequence Builder		Sequence Viewer		Sequence Reporter		
Tube Letter/Number	Packing	Thermal Cycles	Tube Status	Tag Deviation	Re-collected from	Re-collected onto
N 150781	Tenax TA	28	Desorbed	Read/Write OK	-	N 150785
N 150782	Tenax TA	12	Desorbed	Read/Write OK	-	N 150786
N 150783	Tenax/Carbograph 1TD	45	Desorbed	Read/Write OK	-	N 150787
N 150784	Tenax/Carbograph 1TD	3	Desorbed	Read/Write OK	-	N 150788
N 150785	Tenax TA	1	Desorbed	Read/Write OK	N 150781	-

EXAMPLE SAMPLE INFORMATION TRANSFERRED TO RE-COLLECTION TUBE	
Sample reference	PAH_01
Sampling mode	Pumped
Sample start time	12:05
Sample start flow rate	50 mL/min
Sample end time	12:15
Sample end flow rate	50 mL/min

Schematic of tag report data for TD-100

* Patent # US 6,446,515 B2

... provides a sample audit trail

Full compliance with key international standard methods

State-of-the-art analytical thermal desorption

Compatible with analyte levels from sub-ppt to percent

The TD-100 is compatible with analyte levels from sub-ppt to percent because of its unsurpassed split flow versatility. Users can select from splitless operation, single split (either tube or trap desorption) or double split (both tube and trap desorption).

Double splitting is critical for the successful analysis of high level samples such as stack gases or direct desorption of materials. Working in fully splitless mode optimises sensitivity for trace level samples.

Use with any GC or GC/MS

TD-100 is compatible with all laboratory and transportable GC or GC/MS systems and a wide range of alternative vapour analysers such as process MS and sensor arrays. The selective concentration offered by TD-100 allows target analytes to be quantitatively retained while unwanted interferents (e.g. water, solvents) are purged to vent.

Negligible carryover

With significantly less than 0.1% carryover, TD-100 is ideally suited for automated, multi-method analysis. Samples with a high analyte concentration, such as stack gases or residual solvents, can be included in the same automated sequence as sub-ppb environmental air monitoring samples if required.

Electronic control of carrier gas

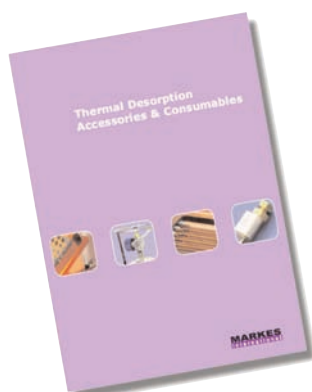
TD-100 allows integration with the electronic carrier gas control (ECC) of all leading brands of GC and GC/MS. ECC offers total flow read-out, enhanced leak diagnostics and a direct link between carrier gas and GC oven programming, whatever the make of GC. The clear advantage of integrating electronic control of carrier gas through the entire analytical system is that interaction is maintained between carrier gas flows and the GC programme; this is essential for programming pressure or flow as a function of GC oven temperature. It also means that carrier gas flow, pressure and velocity can be saved and recalled as part of the GC method.

The TD-100 also offers **monitoring of carrier gas pressure** to identify tubes with anomalously high back pressures. Such information can be recorded on the RFID tag and stored as part of tube history if required.

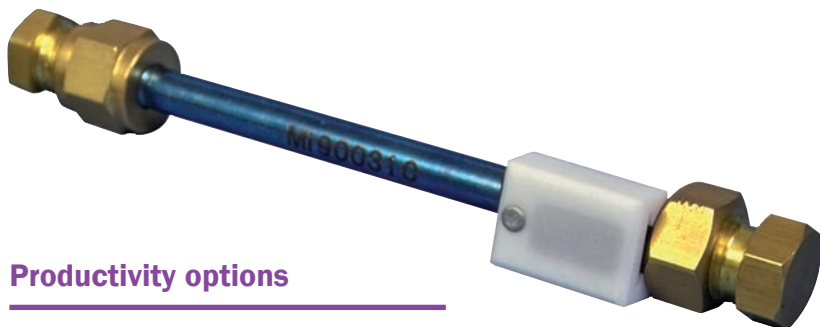
Method compliance and system validation

The TD-100 is fully compliant with the recommendations of all key standard TD methods, including:

- **Leak testing** to ensure data integrity.
- **Backflush desorption** of the focusing trap to extend the analyte volatility range.
- Tube and trap **purge to vent** to prevent sorbent/analyte oxidation and minimise analytical interference
- **Dry purge** and **IS** addition options
- **Sample re-collection** for method/data validation.



Full range of sampling accessories



Productivity options

Electronic flow control

Standard TD-100 systems feature manual control of split and desorb flows. The TD-100 mass flow control (MFC) accessories are available factory fitted or for easy field installation. They offer precise electronic (automated) control of split and desorb flows at each stage of TD operation and allow automated flow rate and split ratio recall during automated sequences with multiple TD methods.

Internal Standard/Dry Purge (ISDP) option

Addition of internal standard (IS) aids analytical quality assurance and is recommended in standard TD methods. When using an ISDP option with the TD-100 a precise aliquot of gaseous internal standard is transferred from a gas valve loop to the sampling end of a sorbent tube immediately after the leak test and before tube desorption. Typical compounds used as internal standards include toluene-d8 and bromofluorobenzene (BFB).

Gas-phase IS can be added either to sampled or blank tubes. When standard is added to the sampling end of blank tubes, they are not desorbed but replaced in the TD-100 tube tray ready for field monitoring. In this case the internal standard provides a quality check on every aspect of the monitoring process; tube storage, transport, sampling and analysis.

The TD-100 ISDP accessory also allows sample tubes to be dry purged in the sampling direction prior to analysis.

Automated sample re-collection & dry purge

The TD-100 50-50 option offers automated re-collection for repeat analysis. It also allows humid samples to be dry purged in the sampling direction prior to analysis. The 50:50 is 'must have' functionality for high-throughput laboratories with a focus on data quality. It is available as a field-installable option but is supplied factory fitted on most TD-100 configurations.

Note that Markes also offers a range of stand alone offline accessories for dry purging sorbent tubes and introducing gas or liquid phase standards.

Trademarks

TD-100™, DiffLok™, UNITY, ULTRA, SafeLok, SecureTD-Q™, TubeTAG™, TAGSCRIBE are all trademarks of Markes International Ltd.

Silcosteel® is a registered trademark of Restek, Inc., USA.

The UNITY family

TD-100 is complemented by Markes' separate additional range of modular TD systems, featuring options for manual tube desorption plus canister and online analysis



Series 2 ULTRA-UNITY-Air Server TD system



Series 2 UNITY-CIA 8



UNITY 2

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