

Get in the driver's seat

Thermo Fisher Scientific/Marques International
Solutions for Vehicle Interior Air Quality (VIAQ) Analysis

Confidently get in the driver's seat with industry-leading VIAQ testing solutions

Plastic, leather, carpets, foams, and adhesives used in vehicle interiors have the potential to release harmful chemicals and unpleasant odors. As a result, many regions around the world have standardized screening of new vehicle interiors and their components for volatile and semi-volatile organic compound (VOC and SVOC) emissions. Suppliers at all stages of the manufacturing chain are often required to test their products and raw materials to identify components that contribute chemical emissions and to facilitate development of low-emitting alternatives.

Whether you are an automotive manufacturer, OEM supplier, or testing laboratory, Thermo Fisher Scientific together with Markes International provides comprehensive solutions and expert guidance for Vehicle Interior Air Quality (VIAQ) analysis.



Comprehensive solutions, trusted guidance

Adopt compliant VIAQ testing capability with ease

Comprehensive solutions, including assistance with deployment, compliance and high-productivity operation provided by the industry leaders, ensure you can easily adopt VIAQ testing to meet global regulatory requirements. We offer world-renowned instruments and accessories for robust sampling and quantitative analysis of VOCs and SVOCs. Adoption and use of our solutions are streamlined with integrated software that connects the entire VIAQ testing workflow, from sample collection to reporting.

Increase confidence in results

Our VIAQ analysis systems are designed to ensure confidence in the quality and integrity of data obtained. For example, Thermo Fisher Scientific/Markes International thermal desorption (TD)-gas chromatography-mass spectrometry (GC-MS) solutions provide high sensitivity and accurate quantitation over a wide concentration range, from sub-ppt to percent levels, for more certainty of the final result. Software features like Thermo Scientific™ Chromeleon™ eWorkflows™ and customizable methods and reports with out-of-specification flagging, ensure error-free data collection and processing for daily testing.

Adapt to tomorrow's regulatory requirements and increase return on investment with unmatched versatility

Unlike any other TD platform, our solutions can be used for simultaneous targeted and non-targeted analysis of VOCs and SVOCs over a wide concentration range—from formaldehyde to C44, including reactive and thermally labile compounds—and can accommodate every tube, canister, bag and online TD-sampling approach. You can meet future regulatory demands and increase efficiency by adding advanced capabilities.

Leverage our industry-leading expertise to address evolving VIAQ regulatory requirements

Ultimate responsibility for demonstrating conformance with the complex landscape of regulatory requirements rests with the car manufacturer and the need to meet these requirements is passed down to component manufacturers, raw material suppliers and associated testing laboratories.

We can help. As industry leaders, we participate in global VIAQ regulatory councils to help establish standards and align our solutions.



Korea

Automobile Management Act Article 33_3 Indoor Air Quality Management for Newly Produced Vehicles

Korea was among the first countries to establish whole vehicle VIAQ requirements with the 2007 publication of its *Newly Manufactured Vehicle Indoor Air Quality Management Standard*.



Japan

Voluntary set of Guidelines for Reducing Vehicle Cabin VOC Concentration Levels

In 2005, the Japan Automobile Manufacturers Association (JAMA) published a voluntary set of *Guidelines for Reducing Vehicle Cabin VOC Concentration Levels*, which include concentration limits for 13 separate VOCs. Notably, concentration limits for benzene were not included.



China

Voluntary National Standard GB/T 27630 Guidelines for Air Quality Assessment of Passenger Vehicles

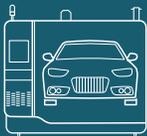
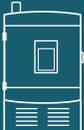
Currently under revision to become a mandatory national standard, GB/T 27630 requires assessment and reporting of eight specific VOCs and potentially the total VOCs (TVOCs) or top 25 most abundant VOCs.



Russian Federation

GOST 33554-2015 Motor Vehicles–Pollutant Content in the Interior of Driver’s Cab and Passenger Compartment. Technical Requirements and Test Methods

GOST 33554-2015 differs from other regulations in taking into account the ingress of outdoor pollutants into the cabin.

Propose	Sampling method	Description of analytical process	Methods
Overall VIAQ	Environmental chamber 	<ul style="list-style-type: none"> • Air sampled from a chamber enclosing the whole car • Sampling onto a sorbent-packed TD tube • Tube desorbed and vapors collected on a focusing trap • Trap desorbed and vapors injected into GC 	ISO 12219-1 China: HJ/T 400 Japan: JASO Z125 South Korea: Article 33-3 UN method ECE/TRANS/WP.29/2017
	Emissions from assembly parts 	<ul style="list-style-type: none"> • Air sampled from a (typically) 1 m³ chamber • Sampling onto a sorbent-packed TD tube • Tube desorbed and vapors collected on focusing trap • Trap desorbed and vapors injected into GC 	ISO 16000-9 ISO 12219-4 ISO 12219-6 VDA 276 JIS A1901 BMW GS 97014-3 ("Sumer test") ASTM D5116-97
	Sampling bags 	<ul style="list-style-type: none"> • Air sampled from bags of various sizes from 10 L to 2000 L • Sampling directly into a focusing trap • Trap is desorbed and vapors are injected into GC 	Japan: JASO M902 MS300-55 (Hyundai-Kia) NES M0402 (Nissan) ATSM 0508G (Toyota) DWG 0094Z SNA 0000 (Honda) ISO 12219-2 (10 L bag) ISO 12219-9 (2000 L bag)
Emissions from components	Microchambers 	<ul style="list-style-type: none"> • Air/gas sampled from micro-scale chambers (44 or 114 cm³) • Sampling onto a sorbent-packed TD tube • Tubes are desorbed and vapors are collected on a focusing trap • Trap is desorbed and vapors are injected into GC 	TPJLR.52.104 (Jaguar Landrover) ISO 12219-3 ASTM D7706 GMW17082 (General Motors) RNES-B-20116 (Renault/Nissan)
	Direct desorption 	<ul style="list-style-type: none"> • Small sample (up to ~50 mg) heated in an empty TD tube • Vapors collected on a focusing trap • Trap is desorbed and vapors are injected into GC 	VDA 278

VIAQ sampling technologies per regulated method. The Thermo Scientific/Marques International TD-GC-MS solution accommodates every tube, canister, bag and online TD sampling approach.

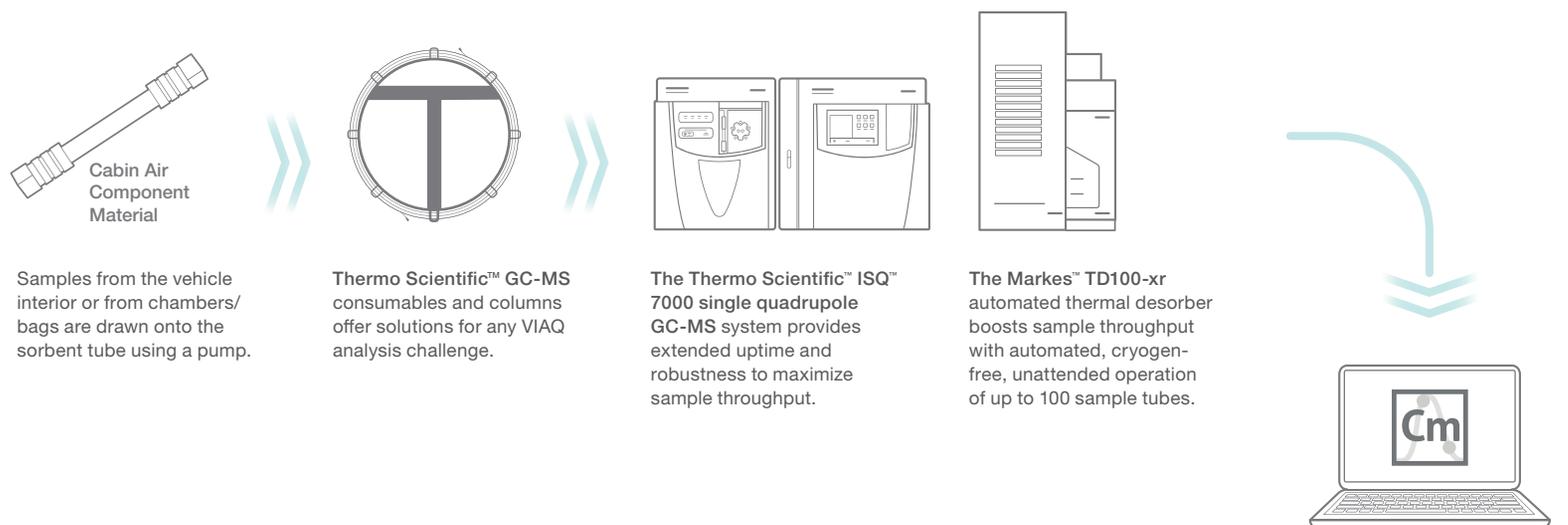


Access our portfolio of end-to-end solutions for compliant VIAQ analysis and reporting

Comprehensive solutions, including instrumentation, columns, consumables, software and expert assistance, ensure you can **quickly, easily and confidently implement compliant VIAQ testing**. With direct control of Markes TD products and Thermo Scientific™ GC-MS and high-pressure liquid-chromatography (HPLC) systems, Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software connects your entire workflow, from sample collection, desorption, separation and data analysis, to final reporting. Training and operation are simplified and laboratory data unified on a single customizable CDS platform.

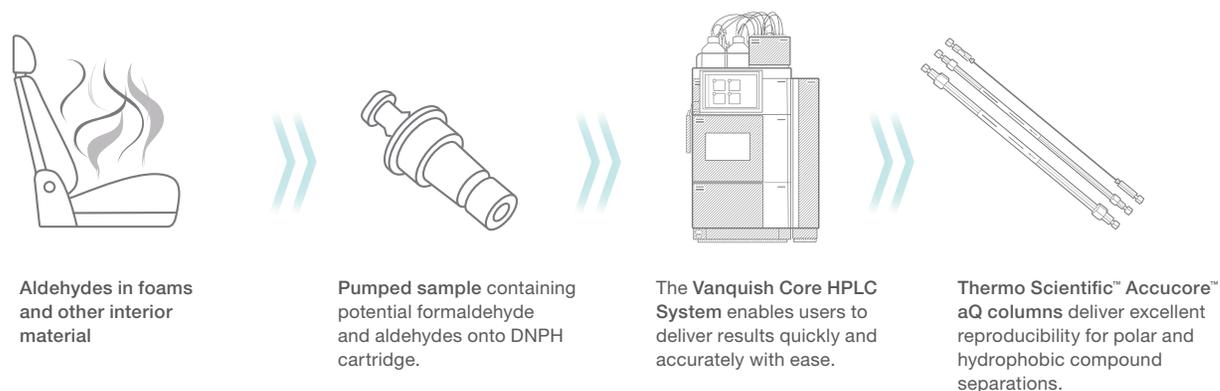
High-confidence VOC and Total VOC analysis with TD-GC-MS

The Thermo Fisher Scientific/Marques International TD-GC-MS combined solution accommodates every sampling approach for simultaneous analysis of VOCs and SVOCs for every tube-based TD application on a single platform—from C3 to n-C44, plus reactive compounds and total VOCs over a wide concentration range. Automated sample handling and robust system performance increase productivity.



Simplified formaldehyde and aldehydes analysis with HPLC

The Thermo Scientific™ Vanquish™ Core HPLC system simplifies analysis of SVOCs (aldehydes, acetaldehyde and acrolein), empowering laboratories to deliver high-quality, compliant results with ease. Designed specifically for ease of adoption for everyday analyses, Vanquish Core HPLC systems provide reliability, exceptional analytical precision, detector sensitivity, and operational simplicity.



Navigate the road to VIAQ compliance with our versatile TD-GC-MS solution

Sample collection method is navigated with ease using the Thermo Fisher Scientific/Marques International TD-GC-MS combined solution and offers unprecedented sampling flexibility to meet any stage in automotive development, assembly and production.

Complete TD-GC-MS workflow

A sample of air from the vehicle interior, chamber, bag or tube containing the material, is drawn into a sample tube filled with adsorbent material. To meet diverse VIAQ testing needs, the solution accommodates every TD sampling approach for unprecedented sampling versatility.

The tube is then analyzed using TD-GC-MS which enables identification and quantitation of the targeted and non-targeted compounds responsible for adverse air quality and odors.



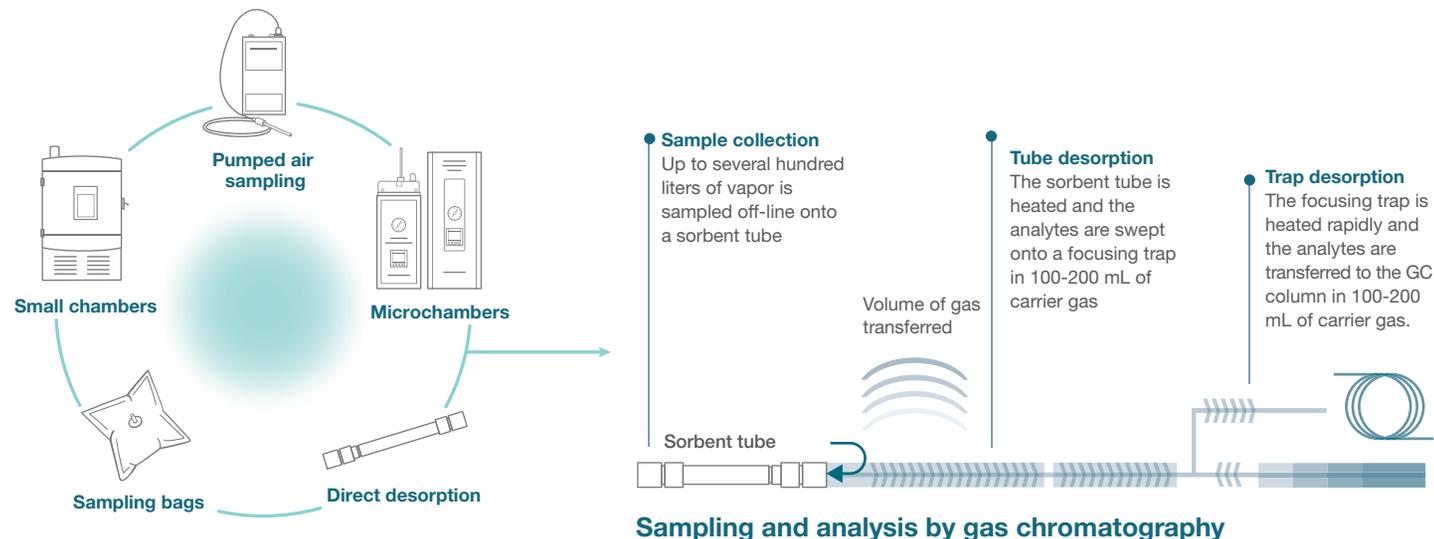
In-vehicle air sampling



Screening of emissions from assembly parts



Screening of emissions from components

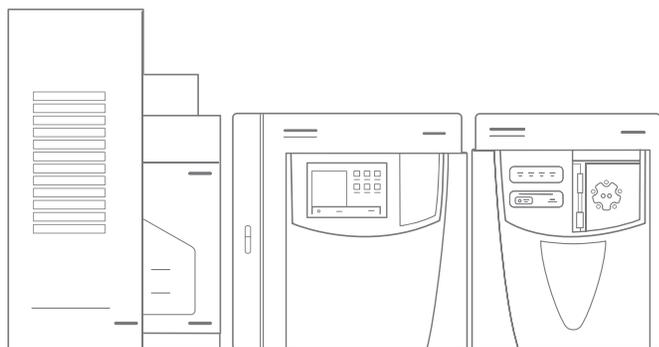


Unprecedented peace of mind, productivity and flexibility

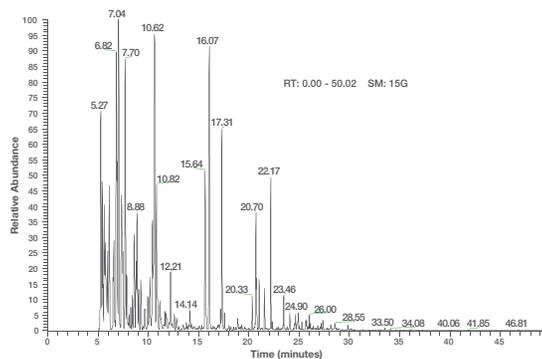
Unrivalled confidence: With features such as leak testing, tube sealing, automated sample re-collection and online internal standard addition, the solution facilitates compliance with standard methods. Sensitivity and accurate quantitation over a wide concentration range from sub-ppt to percent levels, ensure highest data quality and integrity.

Outstanding productivity and cost savings: Reliable unattended automation with 100-tube sample capacity and cryogen-free focusing, allows you to run large numbers of samples while reducing consumables costs. The robust performance of the vent-free ion source maximizes uptime and simplifies system operation.

Unbeatable versatility: Unlike other TD instruments, our TD-based solutions can be configured to perform a wide range of SVOC and VOC, from formaldehyde to C44, including reactive and thermally labile compounds, while accommodating every tube, canister, bag and online TD sampling approach.



Markes TD100-xr | TRACE 1310 | ISQ 7000



Data analysis and results reporting

Compound	Leather [$\mu\text{g/g}$]	Foam [$\mu\text{g/g}$]
Benzene	5.23	1.52
Toluene	16.24	7.99
Ethylbenzene	5.50	0.83
p/m-Xylene	9.22	2.33
Styrene	0.65	0.06
o-Xylene	5.17	0.79
TVOC	185.70	76.45

Meet future demands, increase efficiency with advanced capabilities

Current VIAQ analysis methods use two analytical techniques, with two different sampling procedures, to analyze target VOCs and SVOCs: TD-GC-MS and HPLC. When analyzing complex samples, HPLC methods can suffer from interferences and poor or unknown collection efficiencies. A huge step forward, our TD-GC-MS platform enables analysis of both VOCs and SVOCs in a single analytical run.

The **CIA Advantage-xr autosampler** automates direct online air sampling from tubes or bags, canisters and chambers using either a sample lock loop or a mass flow controller (MFC) to analyze concentrations at trace level as well as avoiding time-consuming, error-prone dilution of high concentration samples.

To achieve optimal results, the amount of water reaching the GC-MS must be very low. The **Kori-xr water condenser** efficiently removes water from the ambient air stream without cryogen use, while preserving the analytes of interest with no loss of polar compounds.

The **UNITY-xr thermal desorber** quantitatively traps analytes and purges the trap without loss or breakthrough of analytes retained, and can split the sample, either to vent or onto a clean sorbent tube, for storage and re-analysis later.

The **ULTRA-xr tube sampler autosampler** has a capacity of up to 100 tubes, and automates sampling splitting and re-collection.

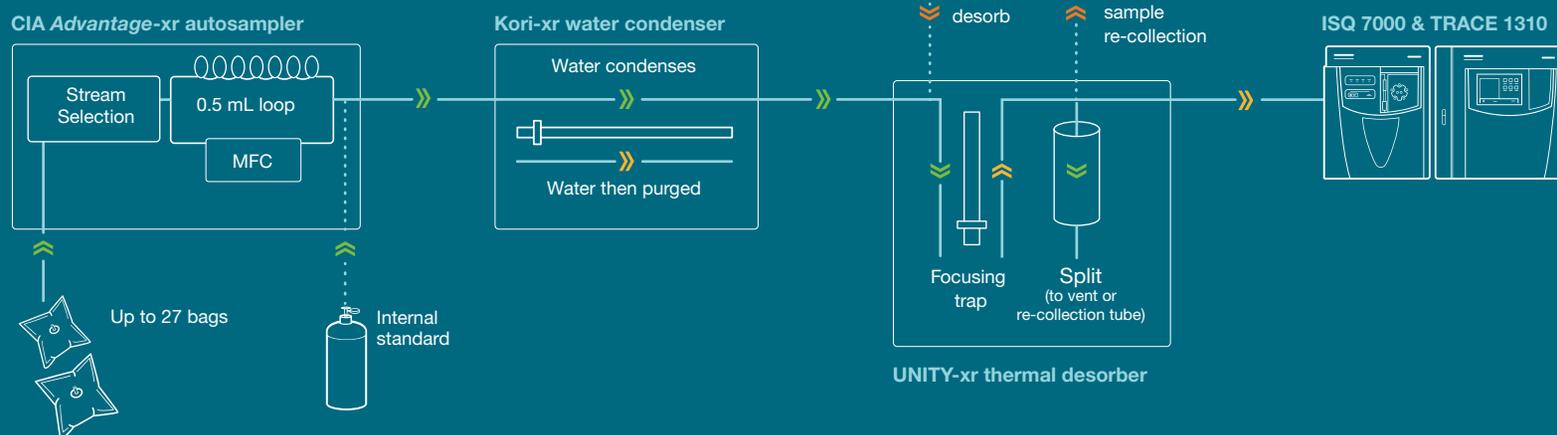


Thermo Scientific ISQ 7000 single quadrupole GC-MS system with Markes ULTRA-xr tube autosampler, Markes UNITY-xr thermal desorber, Markes Kori-xr water condenser, and Markes CIA Advantage-xr autosampler

Key

- Main flowpath
- ... Optional flowpath
- » Sampling flow
- » Desorption flow
- » Automated tube options

No user intervention required to switch between "on-line" analysis from bags/chambers to tubes (but note that columns may differ for specific methods)



Analyze VOCs and SVOCs on one platform, in one run

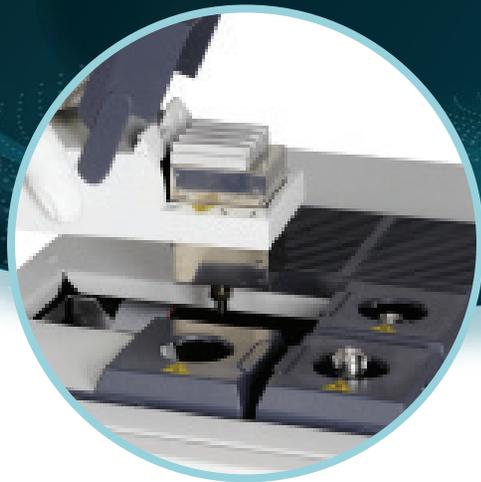
Automated analysis of high and low-concentration samples in a single automated sequence avoids the need to dilute samples. Internal standard addition via a 1 mL loop allows use of a small volume of high-concentration internal standard gas, reducing the need for dilution and excessive consumption of expensive gases.

Efficient water management removes the limitation of traditional cryogen-cooled technology, while preserving analytes. Sample passes into the thermal desorber held at -30 °C and the analytes are quantitatively trapped. The trap is then purged with carrier

gas in the sampling direction to eliminate oxygen and further reduce water without any loss or breakthrough of retained analytes. Finally, the gas flow is reversed and the trap is heated rapidly (up to 100 °C/sec) to inject the analytes onto the GC-MS system. At this point, the sample can be split either to vent or to a clean sorbent tube for storage and re-analysis at a later time.

Easily adopt TD-GC-MS and achieve robust uninterrupted operation

Effortlessly and consistently meet your VIAQ testing requirements with technologies that allow continuous operation of your TD-GC-MS solution. Proprietary Instant Connect modularity and patented Thermo Scientific™ NeverVent™ technology boost instrument productivity to unprecedented levels. Familiarization for new users is simplified with built-in guides on an easily navigated touch screen.



Transfer line from Markes thermal desorber entering GC oven

Carrier gas to Markes thermal desorber

Proprietary user-exchangeable Instant Connect GC injector and detector modules make it easy to integrate Markes sampling technology. Swapping modules takes less than five minutes without a service visit or specialized tools. Instant Connect modularity provides ease of use for operation by novice and experienced users.



The touch-screen software interface with built-in maintenance guides and videos coach users through routine procedures. Even new users can access tools to configure and run the system immediately.



The **V-Lock source plug** allows vent-free GC column exchange and requires no complicated fluidics or extra connections.



The **Thermo Scientific™ ExtractaBrite™** ion source with vent-free source exchange maximizes mass spectrometer utilization. When used with the vacuum probe interlock and V-Lock source plug, routine maintenance such as source cleaning and column changing can be performed without the need to vent the mass spectrometer. With a spare source, cleaning can be performed offline removing interruptions to instrument operation.

Column Replacement (including conditioning)



Ion Source Maintenance



Unify instrument operation, data analysis and reporting with operational simplicity: One CDS does it all

Chromeleon CDS software delivers operational simplicity that minimizes the training, number of steps and time required for any VIAQ analysis task. Intuitive software tools offer the best possible workflow experience, shortening the time needed to become familiar with the software, all while reducing errors and increasing efficiency. For seamless operation, Chromeleon CDS software controls Markes TD products and Thermo Scientific GC-MS and HPLC systems, unifying your chromatography data and everyday operations.

Simplify administration

The software allows centralized administration of licenses, users, network resources and data. Customizable user interfaces streamline system management to accommodate different skill levels.

Increase productivity

Chromeleon CDS software features easy-to-use eWorkflow procedures for error-free sequence and method setup. Method parameters can be stored and easily reused. Smart Startup, Intelligent Run Control and other smart tools streamline data processing and reporting.

Achieve regulatory compliance

Automated VIAQ tailored reporting using custom reports facilitates compliance reporting and streamlines repetitive workflows.

Control all of your instruments

One software controls Thermo Scientific Ion Chromatography (IC), GC, LC and MS instruments as well as over 300 third-party instruments such as Markes TD systems. Customizable ePanels provide a consistent look and feel for all instruments controlled. As a result, deployment of new analytical techniques is simplified.

Connect your laboratory

Distribute resources across the network, between laboratories and sites. Easily interface with other laboratory software (e.g., LIMS, SRM) and control instruments and view data from mobile devices. Access Thermo Scientific™ AppsLab for a library of analytical applications.

Method: TD100xr standard

Status

Ready state: NotReady
 Driver state: Idle
 Elapsed time:
 Message: TD100 PELTIER SHUTDOWN

Temperatures

Tube oven: 28.30 [°C]
 Transfer line: 149.90 [°C]
 Heated valve: 149.60 [°C]
 Cold trap: 37.30 [°C]
 Cap heater: 28.60 [°C]

Moss flow control

Split MFC flow: 10.00 [µL/min]
 Trap MFC flow: 0.00 [µL/min]

Sample Info

Volume: 1.0 [µL]
 Position: 0
 Method mode: 23StepsDesorb

Pressures

Purge gas: On
 Split gauge pressure: 10.90 [psi]
 Tube oven pressure: 0.00 [psi]

#	Date	Time	Retention Time	Device	Message
1	2/12/2020	2:46:27 PM -06:00			User Chemist has disconnected Chromeleon Instrument Configuration Manager from this
2	2/12/2020	1:58:58 PM -06:00			User Chemist (from ISQ71801009) has connected Chromeleon Instrument Configuration
3	2/12/2020	1:45:42 PM -06:00		Trace1310	New detailed run state: Waiting for prep-run key
4	2/12/2020	1:45:41 PM -06:00		Trace1310	Log RunState: Standby
5	2/12/2020	1:45:30 PM -06:00		Trace1310	New detailed run state: Waiting for equilibration time
6	2/12/2020	1:45:18 PM -06:00		Trace1310	Log DoorStatus: Closed
7	2/12/2020	1:45:07 PM -06:00		Trace1310	Log RunState: NotReady
8	2/12/2020	1:45:07 PM -06:00		Trace1310	New detailed run state: Waiting for ready
9	2/12/2020	1:45:07 PM -06:00		Trace1310	Log DoorStatus: Open
10	2/12/2020	1:17:57 PM -06:00		Trace1310	New detailed run state: Waiting for prep-run key
11	2/12/2020	12:17:06 PM -06:00		Trace1310	Log RunState: Standby
12	2/12/2020	12:16:55 PM -06:00		Trace1310	New detailed run state: Waiting for equilibration time
13	2/12/2020	12:16:43 PM -06:00		Trace1310	Log DoorStatus: Closed
14	2/12/2020	12:16:39 PM -06:00		Trace1310	New detailed run state: Waiting for ready
15	2/12/2020	12:16:38 PM -06:00		Trace1310	Log RunState: NotReady
16	2/12/2020	12:16:38 PM -06:00		Trace1310	Log DoorStatus: Open
17	2/12/2020	11:38:06 AM -06:00			User Chemist has disconnected Chromeleon Instrument Configuration Manager from this
18	2/12/2020	11:37:40 AM -06:00			User Chemist (from ISQ71801009) has connected Chromeleon Instrument Configuration

Run Finished

#	TIC	Name	Type	Level	Position	Volume [µL]	Instrument Method	Comment	Processing
16	None	Instrument Blank	Blank		100	1.00	Markes Sample		TD Markes
17	None	Sample Tube 1 Conditioning	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
18	None	Sample Tube 2 Conditioning	Unknown		2	1.00	Markes Tube Conditioning		TD Markes
19	None	Sample Tube 3 Conditioning	Unknown		3	1.00	Markes Tube Conditioning		TD Markes
20	None	Sample Tube 4 Conditioning	Unknown		4	1.00	Markes Tube Conditioning		TD Markes
21	None	Sample Tube 5 Conditioning	Unknown		5	1.00	Markes Sample		TD Markes
22	None	Instrument Blank	Blank		100	1.00	Markes Sample		TD Markes
23		Instrument Blank	Unknown		101	1.00	Trap Condition		TD Markes
24		Instrument Blank	Unknown		102	1.00	Trap Condition		TD Markes
25		Instrument Blank	Unknown		103	1.00	Trap Condition		TD Markes
26		Instrument Blank	Unknown		104	1.00	Trap Condition		TD Markes
27		Instrument Blank	Unknown		105	1.00	Trap Condition_10 min		TD Markes
28		Instrument Blank	Unknown		106	1.00	Trap Condition_10 min		TD Markes
29		Instrument Blank	Unknown		107	1.00	Trap Condition_10 min		TD Markes
30		Instrument Blank	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
31		Instrument Blank	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
32		Instrument Blank	Unknown		11	1.00	Markes Tube Conditioning		TD Markes
33		Instrument Blank	Unknown		11	1.00	Markes Tube Conditioning		TD Markes
34		MeOH	Unknown		84	1.00	RSH Liquids		TD Markes
35		Tube 1 Rep 1	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
36		Tube 1 Rep 2	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
37		Tube 1 Rep 3	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
38		Tube 1 Rep 4	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
39		Tube 1 Rep 5	Unknown		1	1.00	Markes Tube Conditioning		TD Markes
40		Tube 2 Rep 1	Unknown		2	1.00	Markes Tube Conditioning		TD Markes
41		Tube 2 Rep 2	Unknown		2	1.00	Markes Tube Conditioning		TD Markes
42		Tube 2 Rep 3	Unknown		2	1.00	Markes Tube Conditioning		TD Markes
43		Tube 2 Rep 4	Unknown		2	1.00	Markes Tube Conditioning		TD Markes
44		Tube 2 Rep 5	Unknown		2	1.00	Markes Tube Conditioning		TD Markes
45		Tube 3 Rep 1	Unknown		3	1.00	Markes Tube Conditioning		TD Markes
46		Tube 3 Rep 2	Unknown		3	1.00	Markes Tube Conditioning		TD Markes
47		Tube 3 Rep 3	Unknown		3	1.00	Markes Tube Conditioning		TD Markes
48		Tube 3 Rep 4	Unknown		3	1.00	Markes Tube Conditioning		TD Markes

Name	Type	Date Modified	Comment
Markes Sample	Instrument Method	1/21/2020 3:01:49 PM -06:00	
Markes Trial	Instrument Method	1/21/2020 1:55:57 PM -06:00	
Markes Tube Conditioning	Instrument Method	1/22/2020 4:12:06 PM -06:00	
Mark's FID View	View Settings	1/22/2020 5:09:34 PM -06:00	
RSH Liquids	Instrument Method	1/22/2020 2:41:01 PM -06:00	

TD-GC-MS sequence results as shown in Chromeleon CDS software

Resources

Thermo Fisher Scientific Application Note 10363:

Determination of VOC in automotive interior materials by Thermal Desorption GC-MS

Thermo Fisher Scientific Application Note 73565:

A technical guide to the analysis of VOC and FOG emissions from automotive interior materials by direct desorption TD-GC-MS in accordance with VDA 278

Markes International Application Note 131:

The development of standard methods relating to vehicle interior air quality (VIAQ) and how to comply with them

Thermo Fisher Scientific Application Note 73527:

Analysis of VOCs in automotive trim components using TD-GC-MS

Find out more at thermofisher.com/gc-ms