C146-E096B

SHIMADZU
Excellence in Science

Thermal Desorption System

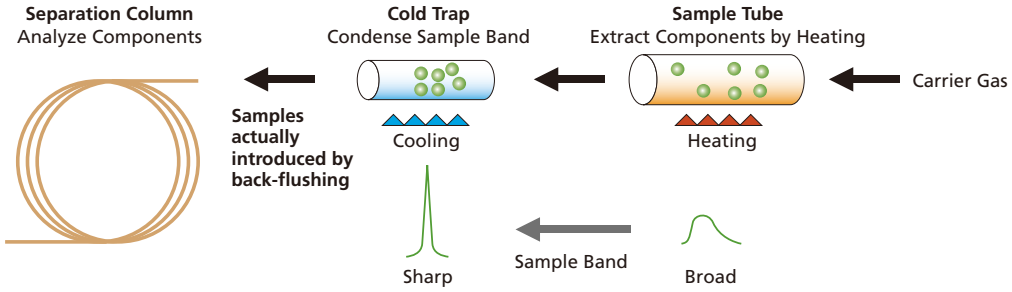
TD-20

Thermal Desorption

Thermal desorption systems trap target substances carried in mobile phase by adsorption in a sample tube packed with adsorbent. Then, by thermal desorption, the substances are delivered to a GC system. Since samples are condensed using simple operations, thermal desorption is often used when headspace methods do not provide adequate sensitivity or when gas must be collected for long periods. In addition, the sample tube is easily transported, so it is often used when samples must be collected on site.

Major Fields of Application

- Measurement of indoor air pollutants, air pollutants inside automobiles, clean room pollutants, and hazardous pollutants in the atmosphere
- Measurement of gases generated from parts or materials (outgassing)
- Measurement of fragrance components



High Performance System Optimized for GCMS-QP2010 Series

Simple Configuration

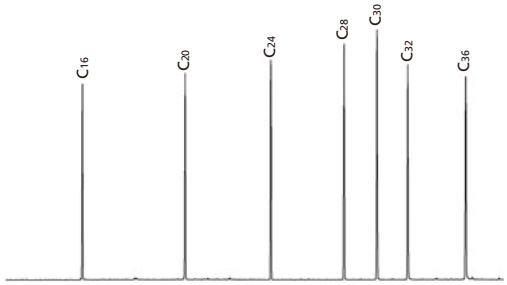
When a thermal desorption (TD) system is connected to a GC-MS system, the background and contamination levels must be reduced. In addition, air must be kept from leaking into the system. To satisfy these requirements, the TD-20 uses a simple flow path design and a Silcosteel secondary trap with excellent sealing characteristics.

High Recovery Rates

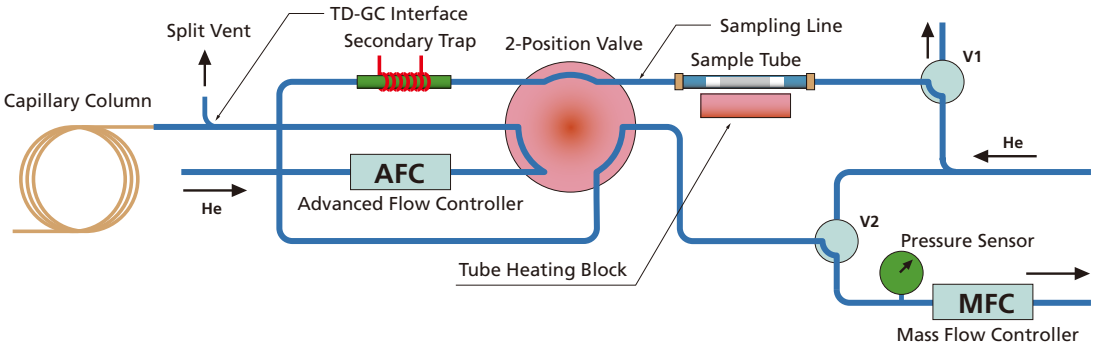
The TD-20 keeps the lines from the sample tube connection port to the capillary column connection joint heated efficiently to provide uniform heat distribution. Consequently, the recovery rate of high boiling point components is high and there are almost no memory or contamination problems, even after measuring highly concentrated samples.

Inert Lines

The TD-20 uses Silcosteel-treated material to provide inertness for all tubing in contact with gases to inhibit adsorption and decomposition. Furthermore, the TD-20 is designed specifically to couple with the GCMS-QP2010 Series, so transfer lines are as short as possible to minimize any decrease in recovery rates due to adsorption.



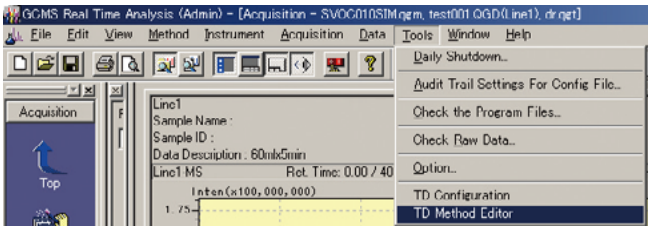
Results from Measuring N-Alkanes (C_{16} to C_{36})



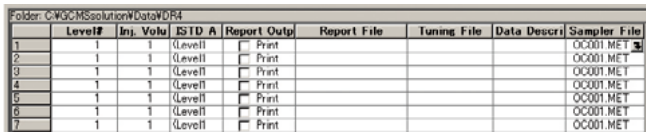
Fully Compatible with Automated Analysis

Interlinked with GC, GC-MS Control Software

TD-20 analytical conditions can be set via a computer. Furthermore, TD-20 functions are linked to GCsolution or GCMSsolution workstation software. Not only does this make it easy to set conditions for serial analyses using batch processes, but it also allows changing TD, GC, or GC-MS analytical conditions while serial analyses are still being performed.



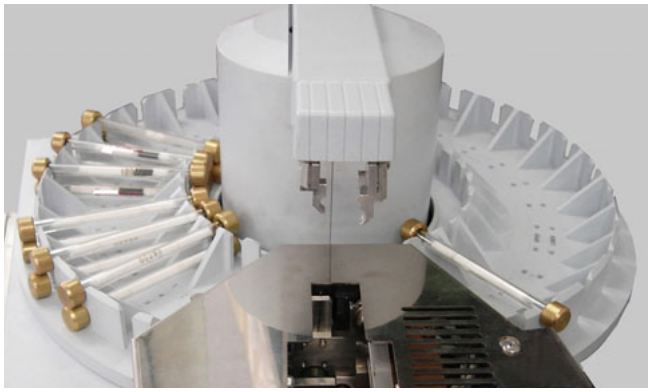
GCMSsolution Window for Specifying TD-20 Settings



For Batch Processes, Set TD-20 Parameters in the [Sampler File] Column

48-Sample Autosampler

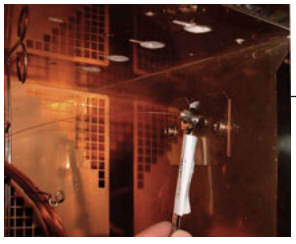
The TD-20 includes an autosampler capable of holding up to 48 sample tubes. Therefore, data can be collected at night or even on weekends by batch processing in automatic operation mode.

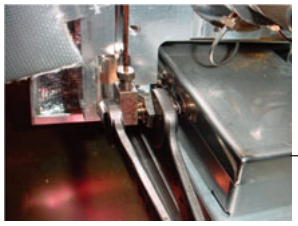

48-Sample Sample Tray

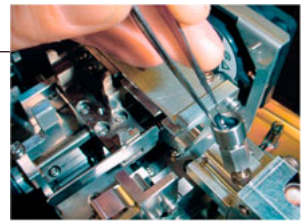
Exceptionally Easy to Maintain

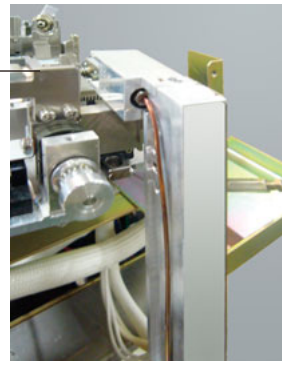
Parts are Easy to Replace

Maintenance tasks on the TD-20, such as replacing the O-ring seals for secondary trap or sample tubes, can be performed from the front, making maintenance a breeze. Even if transfer lines or other areas exposed to sample gases become contaminated from concentrated samples, tubing sections can be replaced individually. In addition, joints used for the capillary column are the same as those used for the GC injection unit, making exchange or replacement easy.


Replacing the Capillary Column


Replacing the Secondary Trap Tube


Replacing O-Rings on Sealed Joints


Transfer Line Tubing

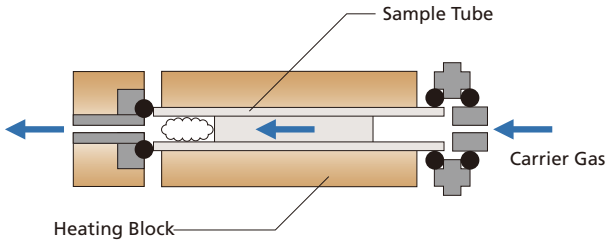
Exceptionally Easy To Operate

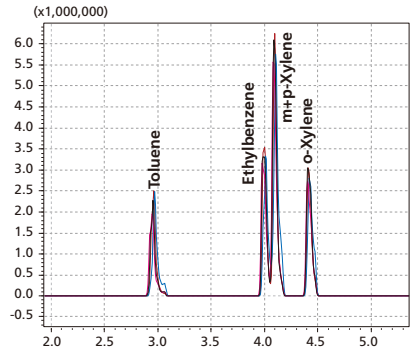
Packed Cold Trap System

Before components collected in the sample tube can be introduced into the GC column, they must be focused to a band width compatible with the capillary column. Focusing can be accomplished either by the capillary cryofocus method, which cools the capillary column with liquid nitrogen or another coolant, or the packed cold trap method, which cools a trap tube packed with adsorbent. Advantages of the packed cold trap method include 1) the trap only needs to be cooled slightly lower than room temperature, which allows using electronic cooling instead of coolant, and 2) because the trap tube has a larger internal diameter than the capillary column, samples with higher moisture content can be focused without freezing the lines shut. The TD-20 uses the packed cold trap method. Therefore, it is able to obtain a more than adequate breakthrough volume, even at a relatively warm -20°C. Consequently, electronic cooling can be used instead of time-and cost-consuming coolants, such as liquid nitrogen. Furthermore, the TD-20 is well-suited to analyzing samples with high moisture content, such as atmospheric or indoor air samples. (Tenax TA is specified as the standard adsorbent, but Carbonpak and Carbosieve adsorbents are also available for analyzing compounds with low boiling points.)

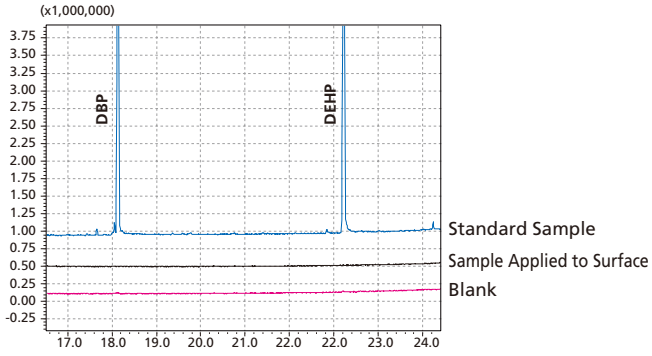
Easy-to-Use Sample Tube

The blank level should be low when analyzing trace substances. However, the exterior of sample tubes are, for various reasons, typically contaminated with substances other than the target substance.
The TD-20 sends carrier gas through the inside of the sample tube only while heating. Therefore, even if the exterior is contaminated, this minimizes the effect it can have on analysis. Also, by switching flow paths after heating is finished, the sample tube is disconnected from the carrier gas to prevent any influence from residual heat.





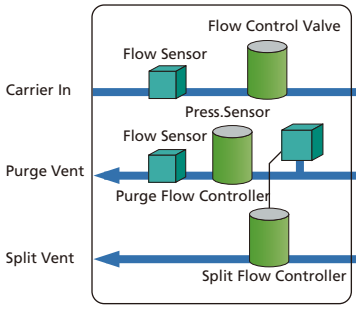
Change in Retention Times for Standard Sample Spike With 10 µL Water



Effect of Applying DBP and DEHP 1000 ng to Surface of Sample Tube

Electronic Flow Control

The TD-20 uses an electronic AFC (advanced flow controller) to control the carrier gas. Therefore, there is no need to make any adjustments to the flow rate, column inlet pressure or split ratio during thermal desorption. This also provides excellent repeatability of analytical conditions. It also allows using pressure programs or spit ratio programs.



Electronic Carrier Gas Control
AFC
(Advanced Flow Controller)

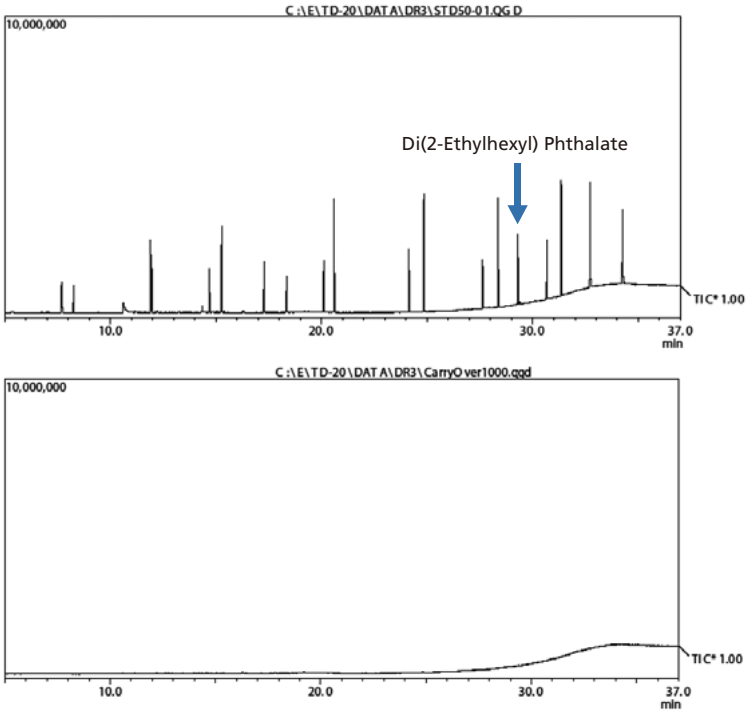
- **Does not require adjusting flow rate, column inlet pressure, or split ratio during thermal desorption**
- **Compatible with constant linear velocity mode**
- **Allows using pressure programs or split ratio programs**


AFC-2010 Electronic Flow Controller

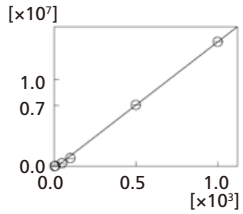
Wide Analytical Range

High Boiling Point Substances and Low Concentration Substances

The TD-20 leaves almost no residues, even for phthalic esters with high boiling points. Linearity of calibration curves is very high and repeatability for low-concentration samples is also good.

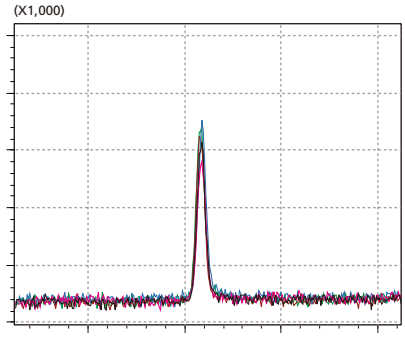


Residues of Cyclosiloxane and Phthalic Esters
Upper: 50 ng Standard Sample
Lower: Residue Immediately After Measurement (0.03% Di(2-Ethylhexyl) Phthalate)



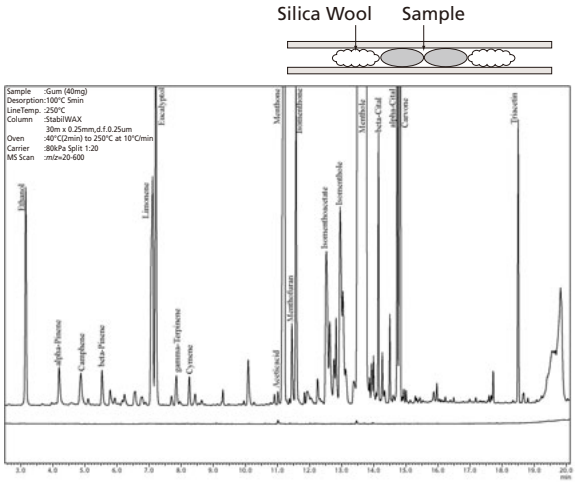
Calibration Curve for Di(2-Ethylhexyl) Phthalate
5 ng, 10 ng, 50 ng, 100 ng, 500 ng, and 1000 ng
Contribution (R^2) = 0.999

Di(2-Ethylhexyl) Phthalate
Repeatability at 0.1 ng (n = 5)
m/z = 149 SIM mode



Direct Thermal Desorption

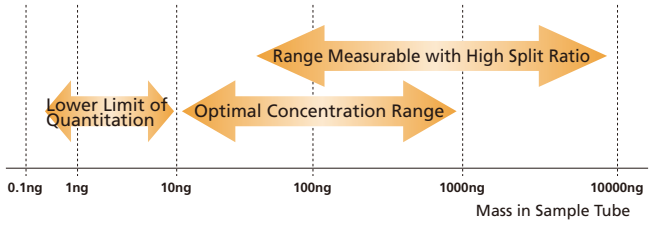
Because residue levels on the TD-20 are extremely low after measuring highly concentrated substances, it can be used also for direct thermal desorption, where samples are thermally desorbed after being introduced directly into the tube.



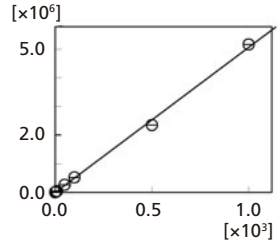
Residue After Analyzing Gum
Upper: 40 mg Gum
Lower: Residue Immediately After Measurement (0.03% Menthol)

Broad Range of Concentrations

The TD-20 is capable of split ratios up to 1:200 at the secondary tube outlet. Therefore, it can analyze a wide range of sample concentrations.



Ethylbenzene *m/z* 106
f(x) = 5075.219995 * x + 0.000000
(R^2) = 0.998104



#	(ng)	Area
1	1.000	4941.00
2	5.000	23576.00
3	10.000	46715.00
4	50.000	259269.00
5	100.000	529518.00
6	500.000	2350433.00
7	1000.000	5166383.00

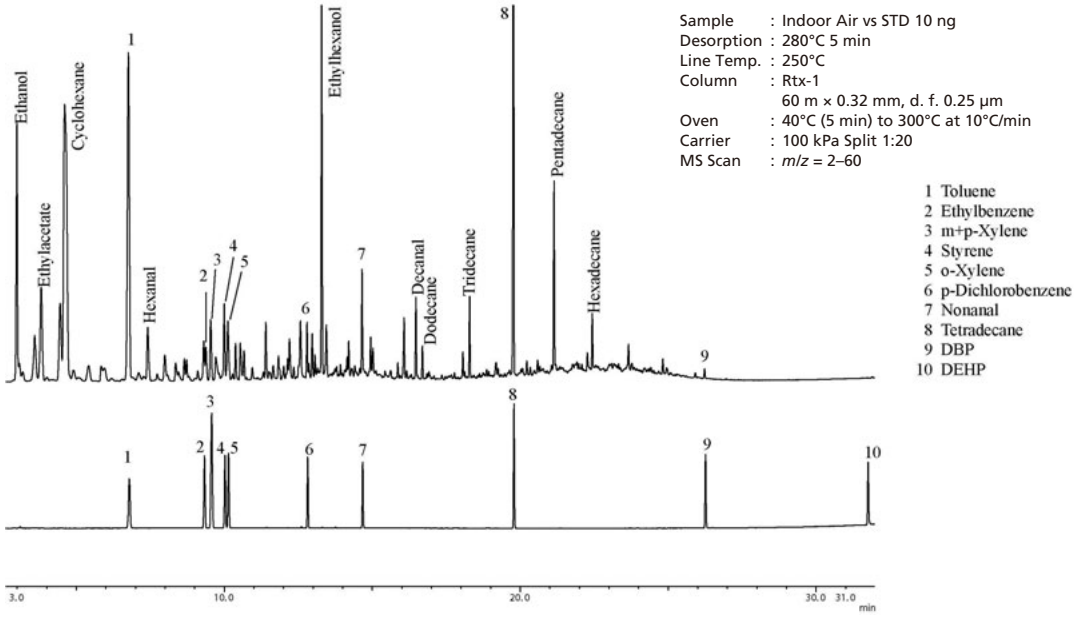
Linearity of Ethylbenzene (1 ng to 1000 ng)

TD-20 Thermal Desorption System - Analysis Examples

Gas Samples

Simultaneous Analysis of VOCs and SVOCs in Indoor Air

To measure indoor air pollutants, a constant-flow pump is connected downstream of the Tenax TA packed sample tube. After drawing in air for 30 minutes to 24 hours, the sample is heated for thermal desorption. Components ranging from toluene to DEHP can be analyzed simultaneously.



Sample : Indoor Air vs STD 10 ng
Desorption : 280°C 5 min
Line Temp. : 250°C
Column : Rtx-1
60 m × 0.32 mm, d. f. 0.25 µm
Oven : 40°C (5 min) to 300°C at 10°C/min
Carrier : 100 kPa Split 1:20
MS Scan : *m/z* = 2–60

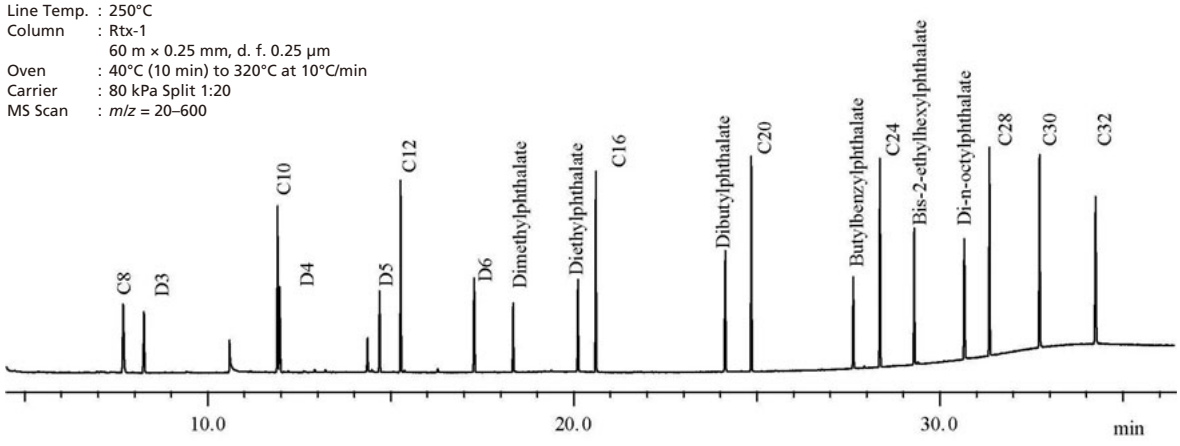
1 Toluene
2 Ethylbenzene
3 m+p-Xylene
4 Styrene
5 o-Xylene
6 p-Dichlorobenzene
7 Nonanal
8 Tetradecane
9 DBP
10 DEHP

Upper: Indoor air from occupied studio apartment, collected for 24 hours
Lower: 100 ng standard mixture sample

Simultaneous Analysis of Cyclosiloxanes, Alkanes and Phthalic Esters

Cyclosiloxanes are raw materials for silicone, and trace residues are present in oil, liquid rubber and other such products. Because cyclosiloxanes are volatile, they can cause contact points in electronic parts to malfunction. Therefore, it is extremely important to control their concentration. The TD-20 is able to simultaneously measure the concentration of VOCs ranging from cyclosiloxanes to phthalic esters.

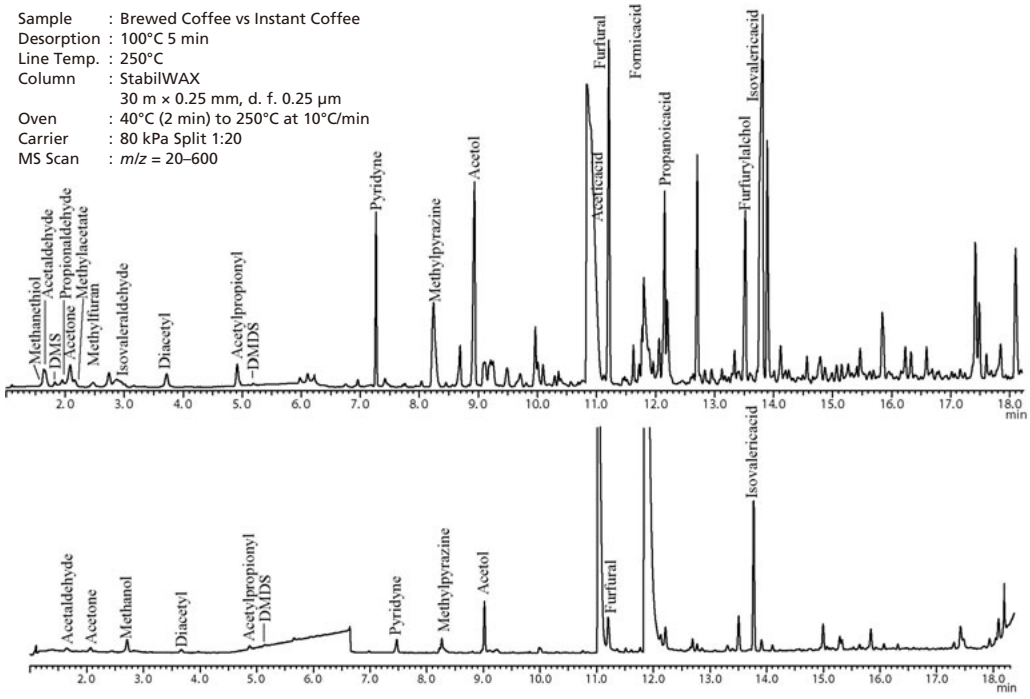
Sample : Standard Mix 100 ng
Desorption : 280°C 5 min
Line Temp. : 250°C
Column : Rtx-1
60 m × 0.25 mm, d. f. 0.25 µm
Oven : 40°C (10 min) to 320°C at 10°C/min
Carrier : 80 kPa Split 1:20
MS Scan : *m/z* = 20–600



Direct Thermal Desorption

Comparison of Brewed Coffee and Instant Coffee

To analyze by direct thermal desorption, an empty tube is packed with a few milligrams to a few dozen milligrams of sample and placed in the TD-20 unit. The results below show the detection of pyrazines and sulfur compounds, which can affect the aroma of coffee.

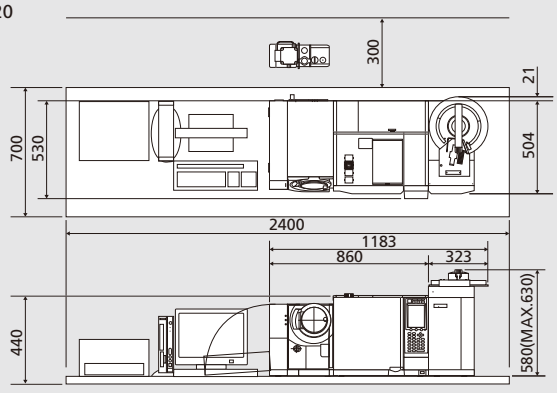


Upper: Brewed Coffee
Lower: Instant Coffee

TD-20 Thermal Desorption System Specifications

Trap Tube Cooling Method	Cooled by Peltier element
Max. Number of Samples	48 tubes
Sample Tube	1/4 OD × 90 mm Tenax TA
Sample Tube Heat/Purge Flow Rate	21 mL/min to 150 mL/min (1 mL increments) at 80°C to 400°C (1°C increments)
Sampling Line Temperature	80°C to 350°C (1°C increments)
Valve Heating Temperature	80°C to 300°C (1°C increments)
Cold Trap	2 mm ID × 100 mm Tenax TA with minimum cooling temperature of 50°C below room temperature (1°C increments) If valve is heated to 260°C to 300°C, minimum cooling temperature is 45°C below room temperature and heating temperature is 80°C to 350°C (1°C increments).
Interface Temperature	80°C to 350°C (1°C increments)
Carrier Gas Control	Electronically controlled by AFC, with split ratios up to 1:200
Valve Actuation	Motor actuated
Capping/Uncapping	Controlled by stepping motor
Carrier and Purge Gases	High purity helium at 5 kPa to 900 kPa as carrier gas or dry air at 2 kPa to 300 kPa
Control Line	COM port at 9600 bps
Software	Linked TDU control software and GCMSsolution (Ver. 2.4 or later) or GCsolution (Ver. 2.3 SU6 or later)
Software Operating System	Windows XP, Windows Vista, Windows 7
Environment for Guaranteed Performance	Constant temperature between 18°C and 28°C (40% to 70% RH)
Power Supply	AC100 V/115 V/230 V
Size	W323 × D525 × H580 mm, not including computer
Weight	43 kg

GCMS-QP2010 Ultra + TD-20
External Dimensions



Unit: mm

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