GO FURTHER
WITH THE POWER OF
HYPHENATION

Modular and Integrated TG-IR-GC/MS PerkinElmer Hyphenation System

PerkinElmer
Science with Purpose

Go Further With the Power of Hyphenation

Complete characterization of complex mixtures, evolved gases, or competitors' product deformulations requires material engineering researchers to use multiple analytical techniques with disparate sample preparation processes, which can result in wasted lab time, reduced productivity, lost revenue – and suboptimal research.

Accelerate your research with the PerkinElmer Hyphenation System, a modular, multimodal TGA, IR, and GC/MS solution managed by an electronic control panel, enabling complete sample characterization with minimal sample prep. With its automation features and functionality, your research can benefit from greater efficiencies and lower maintenance costs. And it delivers sample information and insights that can provide a real competitive advantage that is simply not available with single-system analyses. And you can rely on a single partner, every step of the way – from installation to application support.

GCMS 2400™ System

Spectrum™ FTIR

TGA System

Intelligent Transfer Line

Electronic Control Panel
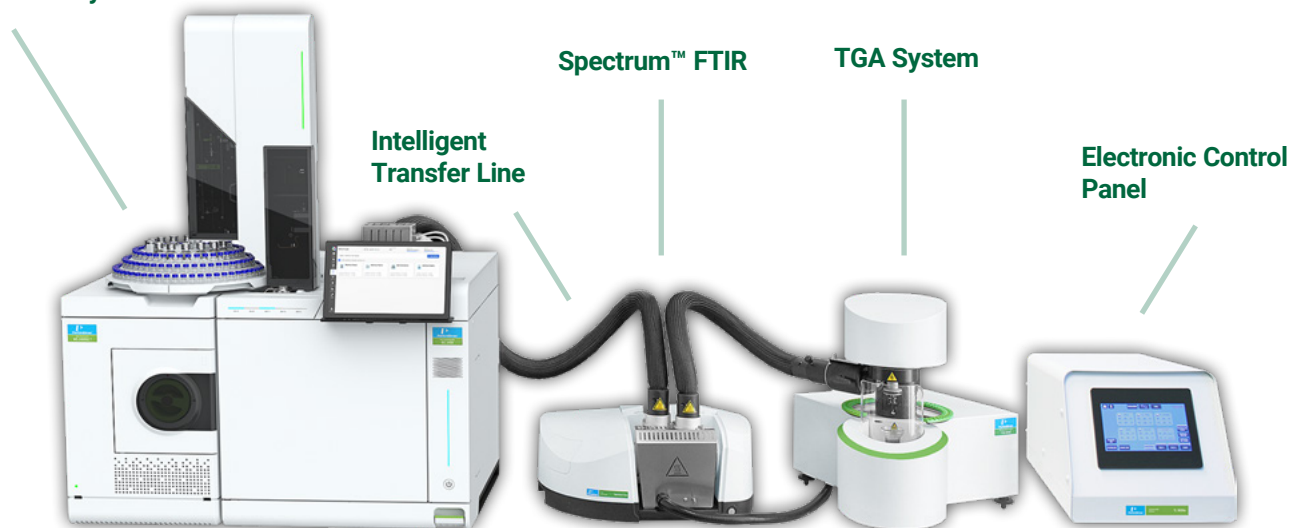
Integrated multimodal analysis with modular, scalable TG-IR, TG-GC/MS, or TG-IR-GC/MS

Simplified control by single-access electronic panel

Best chromatographic conditions and reduced sample loss with intelligent transfer line

Operational efficiency with reduced sample prep and use of solvents

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The Best Answers Happen When Great Technologies Connect

Scalable configuration to address the need for complete sample characterization

Hyphenated technology means connecting two or more instruments together to enhance material characterization. Here are some of the PerkinElmer Hyphenation System configurations that address your particular characterization challenges.

TG-IR Configuration

With this configuration, low sample volumes and a balanced flow system provide linear response between evolved gas and FTIR, for more accurate data. The heated transfer line reduces blockages, and the inert gas purging of the sample compartment reduces the amount and impact of ambient moisture and CO_2.

TG-IR-GC/MS Configuration

This configuration delivers a complete solution, with real-time FTIR analysis of evolved gases before GC/MS injection and the ability to carry out simultaneous TG-IR and TG-GC/MS analysis. Its balanced-flow system provides linear response in FTIR, giving you confidence in results with multiple data sets.

TG-GC/MS Configuration

This configuration delivers three modes of analysis: GC/MS, on-line direct-to-MS, and PyroTGA-GC/MS. Automated triggering of evolved-gases injection (based on TGA data) provides optimal analytical flexibility. And again, its heated transfer line and valves reduce blockages and carryover between samples.

Digital Controller and Intelligent Transfer Line

These unique technologies deliver a controllable flow rate (up to 200 mL/min); individual temperature control for each part of the transfer line (ambient – 350 °C); selectable analysis modes in TGA-GC/MS (GC/MS and on-line direct-to-MS); and multiple injections for samples with multiple weight-losses.

Evolved Gas Analysis with TG-IR (EGA 4000)

The EGA 4000 is the world's first fully integrated TG-IR system for evolved gas analysis. The unique design eliminates issues posed by current-generation EGA systems to offer a simplified TG-IR analysis, accessible to experienced and novice users alike.

PerkinElmer®

For the Better

A History of Bringing Great Technologies Together

EVOLUTION OF OUR HYPHENATED SOLUTIONS

1980	1990	2000	2010	2020

THERMAL ▶ ▶ ▶

TGA 7
Introduced the first hyphenation-ready thermal system – built-in multitasking computer

PYRIS 1 TGA
The first TGA with anticonvention tubing and long-lasting glassware

TGA 4000/STA 6000
TGA 4000: Temperature control for accurate results, fast sample purge and cooldown

STA 6000: Simultaneous thermal performance, reliability, and productivity

TGA 8000
Designed for hyphenation with autosampler

TL Series
New controller and transfer lines for hyphenation

EGA 4000
First single-supplier, fully integrated TG-IR – winner of the R&D World 100 Award

INFRARED ▶ ▶ ▶

1700
First microprocessor-controlled FTIR, with rotating mirror-pair design

Spectrum GX
With first-ever validated FTIR software, Spectrum for Windows®

Spectrum™ One
With patented DynaScan interferometer, the first FTIR with smart accessory recognition and validated FTIR software (Spectrum for Windows®)

Spectrum 100
Incorporated smart accessories for efficient analysis of a wide range of samples

Spectrum 400
First with automated phase switching

Spectrum Two
First portable, low-maintenance FTIR for everyday use – with application packs and powerful software

Frontier
High-performance FTIR/FT-NIR for high-demand environments

Spectrum 3
Tri-range system with top fast-scan performance

GAS CHROMATOGRAPHY ▶ ▶ ▶

AutoSystem™ XL GC/MS with TurboMass™ Software
GC with precise induction interfaced with quadrupole benchtop MS

Clarus GC/MS
Perfect combination of high-performance GC and mass spec software

GC/MS 2400™ Platform
Innovative platform combined with detachable touchscreen and smart sampling capabilities

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TG-IR Configuration

The PerkinElmer Hyphenation System's TG-IR configuration is designed for analyzing materials that decompose upon heating. It is effective in identifying residual solvents in pharmaceuticals, characterizing components in plastics and rubbers, and analyzing combustion products. In this system, as the sample heats in the TGA, it emits gases that are directed to the IR module. These gases interact with IR radiation to produce an absorption spectrum, identifying their molecular composition.

The TG-IR configuration delivers:

- Efficient heat transfer that minimizes energy loss

- Durable, replaceable SilcoSteel® liner and cost-effective insulated transfer line

- Automatic accessory identification, efficient sample area purging, and low-volume capabilities

- An all-inclusive unit featuring mass flow controllers, particle filters, flow-smoothing system, independent temperature controls (transfer line and gas cell), and a vacuum pump with exhaust

- Streamlined operations with automatic IR data collection directly from Pyris™ software

- A constant gas flow that optimizes separation between time-resolved peaks

- Reduced mixing of IR signals for easy identification and quantification of components

- Automatic import of TGA data into the Timebase™ software for easy data comparison

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TG-GC/MS Configuration

The TGA series combined with the GCMS 2400™ system provides a comprehensive solution for analyzing evolved gases. In the TG-GC/MS setup, a sample is heated in the TGA to release or combust materials, producing gases that are then conveyed to the GC/MS. These gases can be collected via trapping media, a gas sampling loop, or deposited on a chromatography column head. Subsequent gas chromatography separates the components, which are then identified through mass spectrometry.

The TG-GC/MS configuration delivers:

- Extended versatility to match your precision and temperature requirements by connecting any TGA model

- Software-driven switch from GC separation (TG-GC/MS mode) and single-ion monitoring (TG-MS mode)

- Precise gas-flow management with the TG-GC/MS transfer line, operating at a consistent 350 °C, that integrates pumps and mass flow controllers

- Enhanced sample collection options with two sample collection loops

- Unparalleled detection sensitivity (GCMS 2400 system) for identification down to ppb levels

TG-IR-GC/MS Configuration

The TG-IR-GC/MS configuration combines TGA, Spectrum IR series, and GCMS 2400 systems, enabling the detailed analysis of evolved gases to identify primary substances, additives, and contaminants. This technique is valuable for product analysis and regulatory compliance. In this process, samples thermally decompose in the TGA, and the gases produced are analyzed by FTIR, resulting in a sequence of spectra acquired at regular intervals.

The TG-IR data is presented in absorption format rather than wave-number format, revealing the unique spectral profile of the evolved gases. Spectrum Timebase software offers a comprehensive 3D graphical representation, capturing the entire TG-IR separation with stacked IR spectra.

TG-IR-GC/MS configuration enables you to:

- Seamlessly combines the strengths of two EGA techniques to unlock a comprehensive approach that enriches your analytical insights

- Use FTIR analysis to gain a deeper understanding of gas evolution and its underlying chemistry

- Perform sequential measurement of off-gas components by GC/MS to detect trace evels too subtle to observe through FTIR alone

- Ensure that minute concentrations are identified accurately, enhancing the precision and reliability of your results

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Digital Controller and Intelligent Transfer Line

The digital controller and pump are integral components in the balanced flow mode system, designed to regulate temperature, flow, and pressure meticulously. They facilitate the seamless transfer of substances through a 1/8" silicosteel tubing, known as the Transfer Line (TL), which connects the individual instruments in the hyphenation setup together. The transfer line is bolstered by a control unit equipped with advanced temperature control devices, a mass flow controller (MFC), a flow smoothing system, along with filters and a pump complete with an exhaust line.

The Digital Controller and Intelligent Transfer Line deliver:

- Easy interaction with a 7 inch touchscreen connected to web-server
- More control over instruments and analyses from one centralized location (start/stop, temperature, flow, etc)
- Troubleshoot issues with real-time alerts displayed on the controller
- Trigger table for samples with multiple weight loss events allowing for the implementation of fast-GC in hyphenated analysis
- Programmable temperature ramping
- Balanced flow system providing a constant flow through the whole system regardless of changes in furnace pressure

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Better Characterization of Evolved Gases

Active Hyphenation with the lowest Dead Volume
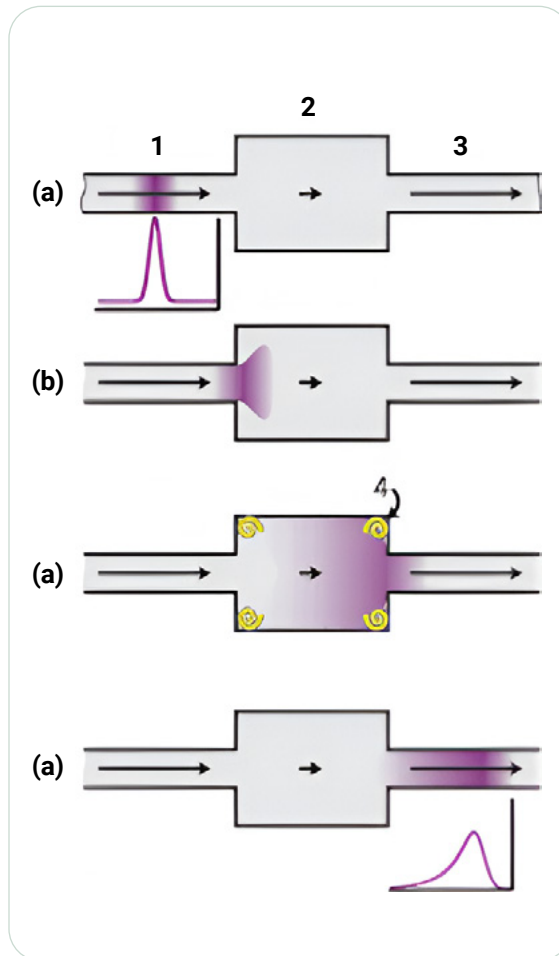
Dead Volume affects TGA furnace. It is the unmoving, stagnant, or un-swept volume of gas trapped in the furnace space. Over time, the stagnant gas deposits over surfaces and can seriously affect the TGA balance mechanism creating problems to the TGA normal functionalities. An active hyphenation system sucks gas partially from the TGA furnace and leave a little amount to the exhaust outlet. Dead Volume in these terms is negligible.

PerkinElmer TGA active hyphenation systems have the lowest a negligible Dead Volume compared to the other TGA systems in the market.

Greater sensitivity and accuracy of data (ZG-Cell)
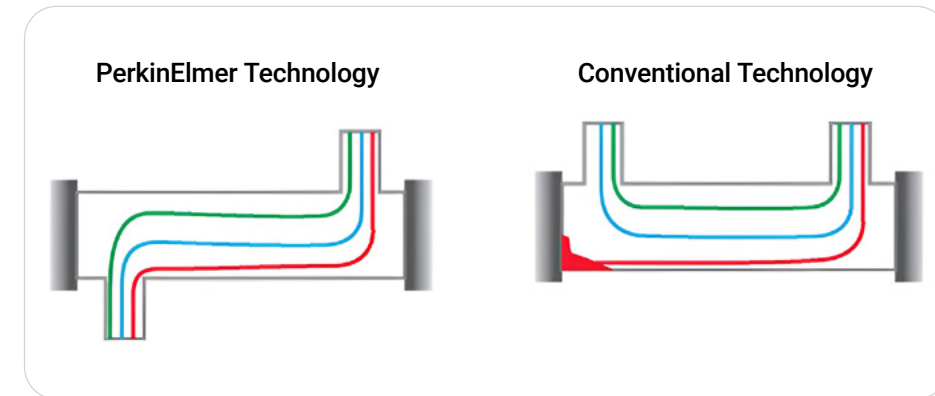
Gas input at the top and exhaust at the bottom provides a constant gas flow and decreases potential accumulation of heavy compounds on the windows. This design also reduces maintenance, while making it easy to use and extending its lifespan. The cell comes with a baseplate and instrument software that automatically recognizes the accessory installed in the sample compartment.

Complete Characterization of Evolved Gases

TGA by itself measures sample decomposition of materials (weight loss event), which provides limited quantitative information but does not tell us what the decomposition products are concurrent to the weight loss. The power of hyphenation is in its ability to carry out in-depth characterization of evolved gases.

Increase Your Characterization of 'evolved' Gases

TG-IR TG-MS TG-GC/MS TG-GC/MS
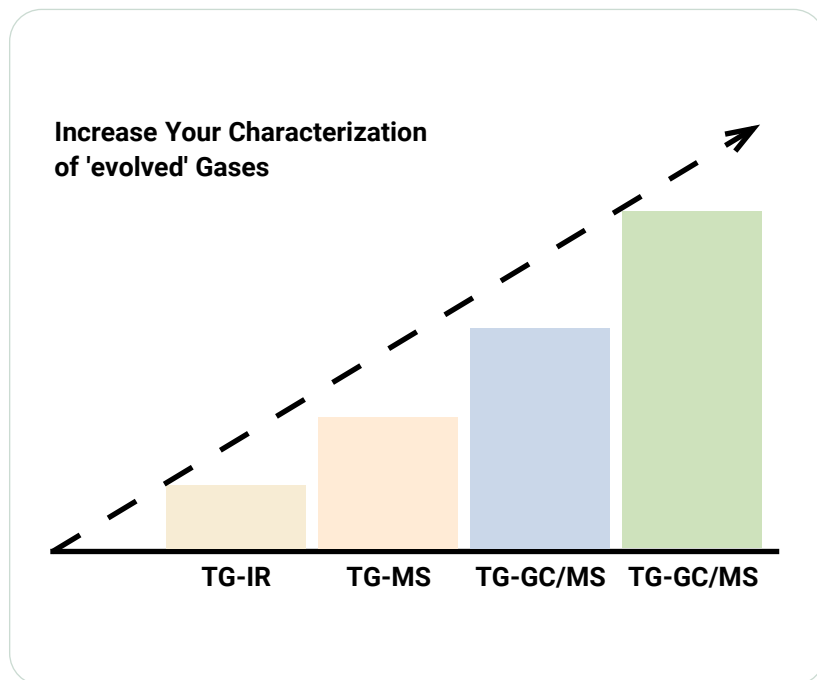
Materials Analysis

Hyphenation enables you to achieve complete characterization of complex samples with minimal sample preparation.

- Chemical identification
- Competitive analysis
- Nanomaterials
- Packaging materials
- Polymer additives
- Process optimization

Battery and Energy Storage

For the most complex samples in energy storage applications, hyphenation provides a solution that meets multiple requirements.

- Full complex sample characterization of complex and difficult-to-handle samples
- Competitive analysis and reverse engineering
- Providing an understanding of thermal degradation processes
- Safety analysis

Environmental

TG-GC/MS provides an ideal solution for the analysis of complex environmental matrices with minimal sample preparation.

- Microplastics
- Formulation analysis
- Moisture analysis

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For more information visit www.perkinelmer.com/Hyphenation

For a complete listing of our global offices, visit www.perkinelmer.com/ContactUs