

Capillary Gas Chromatograph

GC-2010 Pro



The Proven Solution

GC-2010 Pro

Shimadzu Gas Chromatograph

The GC-2010 Pro represents a new generation in Routine GC. Fast oven heating and cooling reduces the analysis time and allow high sample throughput. Based on GC-2010 Plus™ technology, it combines easy operation with efficient analysis and excellence in sensitivity and precision.

| | |
|---|------|
| Flexible lineup for various analysis | P.4 |
| Industry Leading Detector Sensitivity | P.8 |
| Options enhancing scalability | P.10 |
| Efficient workstation LabSolutions™ meeting customer needs | P.14 |
| Customized analysis system based on different analysis requirements | P.16 |



Flexible lineup for various analysis

Two analytical lines can be operated simultaneously for different applications

High performance injector / high sensitivity detector

Simultaneously install up to two analytical lines and up to three detectors.

(Consult separately for the quantity of units that can be carried simultaneously.)

High precision gas control

The injector and detector gas is controlled by the high-performance modular electronic flow controller.



Column oven

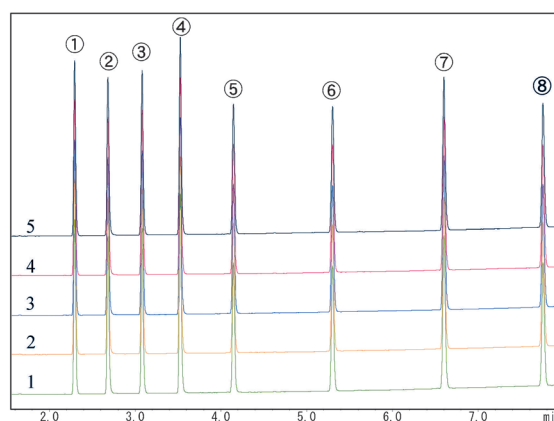
Faster heating accelerates chromatographic separation and fast cooling reduces GC run time.

Big display

Big display for easy operation and providing all information at a glance

Achieving excellent reproducibility

All units including the column oven, flow controller and sample injection unit are comprehensively optimized at the design stage to achieve world-class repeatability of peak area and peak height. The large vaporization capacity ensures excellent repeatability, even when using solvents that are highly volatile upon injection, such as acetone. Long-term stability of retention time is realized by the new room compensation technology built into the advanced flow controller (AFC).



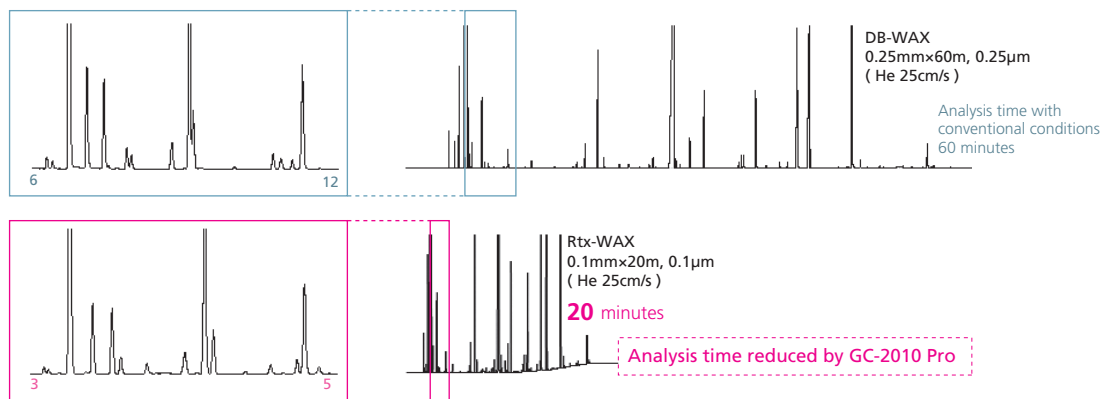
Analysis of Grob Test Mixture (Solvent: acetone, each 100 ppm)

| | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation | C.V. % |
|-----------------------|-------|-------|-------|-------|-------|---------|--------------------|--------|
| ① n-decane | 23479 | 23467 | 23371 | 23416 | 23415 | 23429.8 | 43.8058 | 0.1870 |
| ② n-octyl alcohol | 22324 | 22292 | 22201 | 22284 | 22164 | 22252.9 | 67.2148 | 0.3020 |
| ③ n-undecane | 24013 | 24046 | 23919 | 23967 | 24041 | 23997.2 | 53.6469 | 0.2236 |
| ④ 2,6-dimethylaniline | 29692 | 29653 | 29500 | 29593 | 29645 | 29616.6 | 74.0909 | 0.2502 |
| ⑤ Methyl n-nonanoate | 20614 | 20552 | 20512 | 20529 | 20609 | 20563.3 | 46.5207 | 0.2262 |
| ⑥ Methyl n-caprate | 21470 | 21487 | 21493 | 21506 | 21469 | 21484.8 | 15.9908 | 0.0744 |
| ⑦ Dicyclohexylamine | 28044 | 28124 | 28000 | 28049 | 28119 | 28067.3 | 53.1637 | 0.1894 |
| ⑧ Methyl laurate | 22750 | 22739 | 22726 | 22761 | 22822 | 22759.5 | 37.2898 | 0.1638 |

Peak area reproducibility

High-speed analysis

High-speed analysis with narrow bore capillary columns reduces analysis time and improves sample throughput. GC-2010 Pro has excellent flow and pressure control system, which can meet the requirements of rapid analysis with conventional configuration and effectively improve the analysis efficiency.

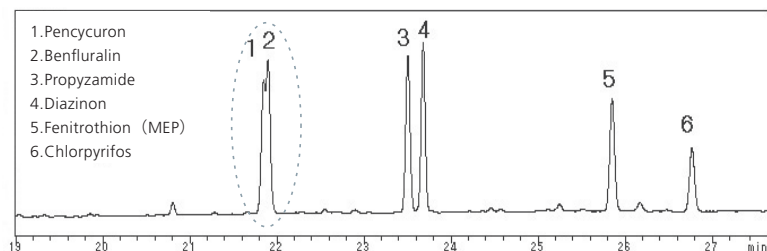


High-speed analysis of coffee flavoring

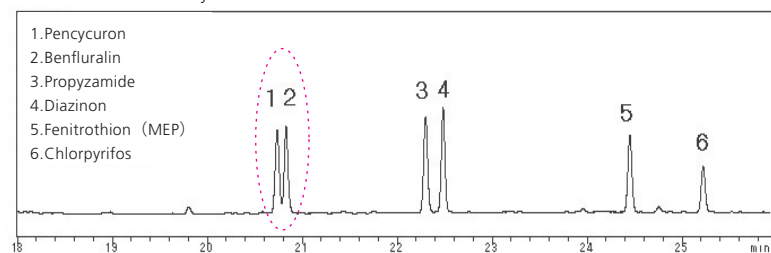
Constant linear velocity mode quickly determines separation conditions

The constant linear velocity mode related to the separation performance is recommended for the carrier gas control and can obtain the optimum separation conditions in the shortest time compared with the previous control method by setting the column inlet pressure and flow.

Constant column inlet pressure



Constant linear velocity



Comparison of chromatograms with constant linear velocity and constant column inlet pressure (Pesticides analysis)

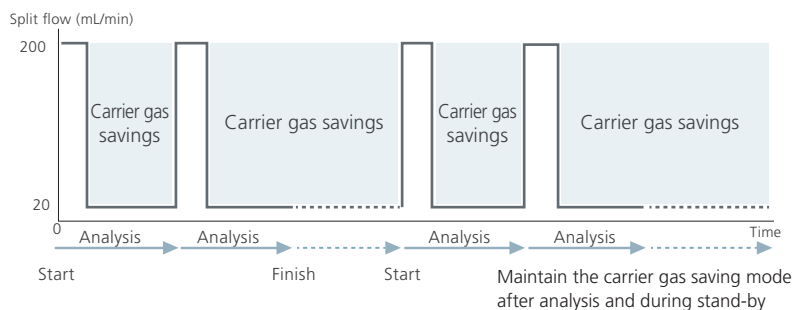
[Conditions of Analysis]

Column: SH-Rtx column 30m X 0.32mm i.d. df=0.25 μ m
Column temperature: 60°C (1 min)-7°C/min-230°C
Injection port temperature: 240°C
Detector temperature: 270°C (FID)
Carrier gas: He
Carrier gas linear velocity: 40cm/sec, column inlet pressure 44.0kPa
Injection volume: 1 μ L (splitless analysis)



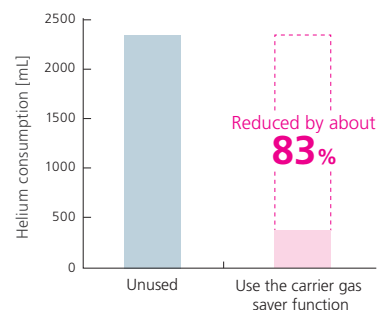
Gas saver function reduces helium consumption

Reducing running cost by gas saving is an important issue in GC operation. GC-2010 Pro reduces gas consumption by decreasing of split ratio after injection as well as automatic shutdown functions after finishing all analysis.



Carrier gas saver function example

In this example, the split flow is set to 200mL/min only upon injection and in the remaining time, the split ratio is reduced to 20mL/min to save carrier gas consumption. The carrier gas saving mode is maintained after the end of batch processing analysis until the beginning of the next batch processing analysis.



Analysis time: 30min split ratio: 100
Carrier gas saver function: split ratio 10 one minute later
Column temperature: 170°C
Chromatographic column: inner diameter 0.25mm
length 30m film thickness 0.25 μ m

Comparison of helium consumption for one analysis using and not using carrier gas saver function

Industry Leading Detector Sensitivity

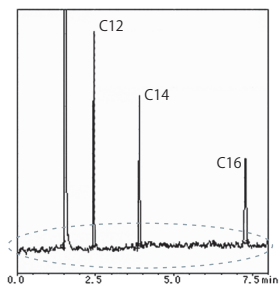
Responding to the ever increasing demands for trace level analysis, all detectors of GC-2010 Pro realize high sensitivity in miniaturization design. The new flame photometric detector (FPD) and flame ionization detector (FID) show significantly increased sensitivity.



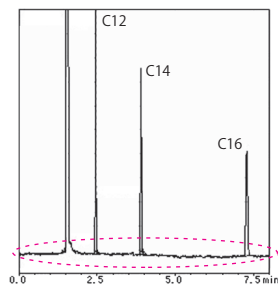
Flame ionization detector FID

High-sensitivity has been achieved by thorough cleaning of detector gas lines and the latest noise-reduction technology.

· FID (without noise reduction technology)



· FID (with noise reduction technology)

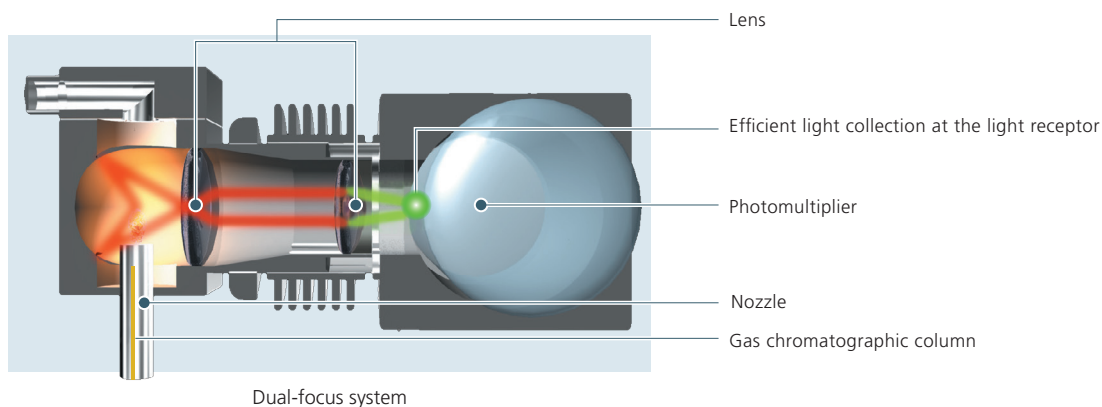


Sharp noise reduction

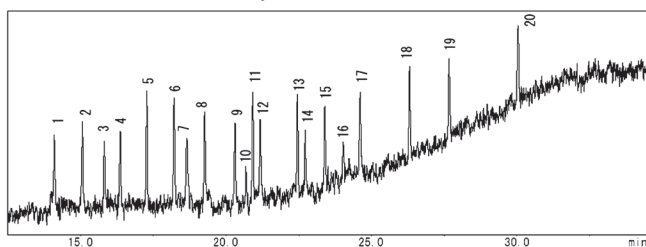
Analysis of n-C12, 14, 16 / n-heptane solution

Flame photometric detector FPD

It achieves compact design and improves the flame stability by improving the nozzle form. In addition, the "dual-focus system" achieves excellent ultra high sensitivity. The dual-focus system adds a lens to the interference filter for efficient light collection at the photomultiplier light receptor.

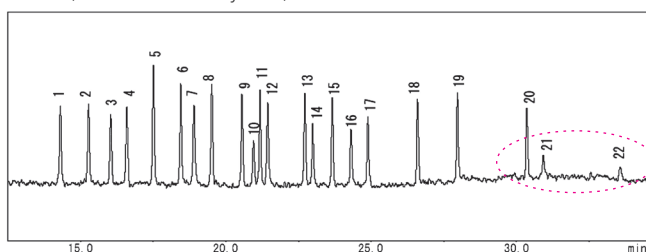


· FPD (without dual-focus system)



- | | |
|---------------------|-----------------------|
| ① Ethoprophos | ⑫ Fenitrothion (MEP) |
| ② Phorate | ⑬ Isofenphos |
| ③ Thiometon | ⑭ Phenthoate (PAP) |
| ④ Terbufos | ⑮ Prothiofos |
| ⑤ Etrimfos | ⑯ Methidathion (DMTP) |
| ⑥ Dichlofenthion | ⑰ Butamifos |
| ⑦ Dimethoate | ⑱ Sulprofos |
| ⑧ Tolclophos-methyl | ⑲ Fensulfothion |
| ⑨ Chlorpyrifos | ⑳ EPN |
| ⑩ Formothion | ㉑ Phosmet |
| ⑪ Fenthion (MPP) | ㉒ Pyraclofos |

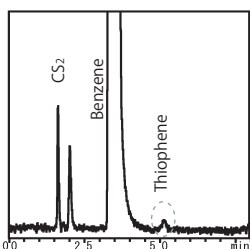
· FPD (with dual-focus system)



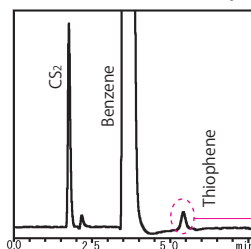
Detect the low-concentration organophosphorus pesticide samples that were not detected previously (Peak No.21.22)

5ppb of 22 components of organophosphorus pesticide

· FPD (without dual-focus system)



· FPD (with dual-focus system)



The detection sensitivity for sulfur compounds is improved.

20ppb of thiophene in benzene

Options enhancing scalability

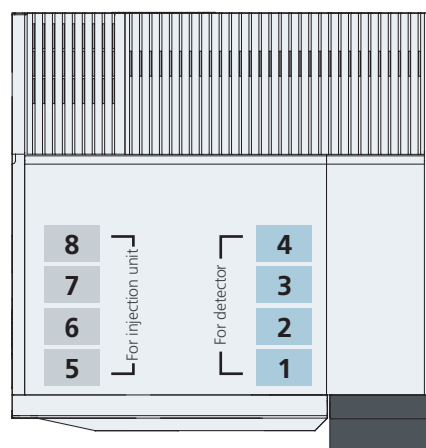


Simultaneously install up to **three** injection units and up to **three** detectors *

Select from three injection units and five detector types to suit the needs of your analysis. When using LabSolutions, three kinds of plotter can be used for simultaneous detection. Options such as injection units, detectors and autoinjectors can easily be retrofitted.

*The number of parts installed simultaneously depends on the type of injection unit and detector.

*Only two analytical lines could be running simultaneously.



Top of GC-2010 Pro

High-performance injection unit series

In order to obtain good data, it is necessary to select an appropriate injection method according to the analysis purpose and sample. GC-2010 Pro can select the most suitable injection method from three injection units.

Split/splitless injector

SPL

- Injection unit used for split/splitless injection of capillary column.
- Standard configuration, namely, AFC with high performance, supports high-speed GC with narrow bore capillary columns.
- Gas saver function reduces split gas consumption.
- Permits high-pressure injection mode.
- The purge flow can be set and changed to achieve more efficient sample purge and prevent cross contamination.

Direct injection unit

WBI

- Used for full injection of wide bore capillary columns above 0.45mm.
- Septum purge flow channel prevents solvent tailing.
- Uses the same glass inserts as splitless analysis to simplify use. (Patented)

On-column/programmed temperature vaporization injector

OCI/PTV

- Temperature programmable Injector
The sample is injected at a low temperature and gasified by programmed heating of the injection port. This way recovery of thermolabile components can be improved. OCI is suitable for samples with a wide boiling point range.
- Configured for either cool, on-column injector (OCI) or programmed temperature vaporization (PTV) injection mode.
- Uses inert quartz PTV inserts.
- An optional OCI insert allows connecting a narrow-bore capillary column directly to the injector without a 0.53mm pre-column. (No need to compress the connecting device)

Small and high-sensitivity detector series

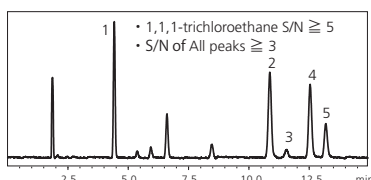
The full range of high-sensitivity detectors supports a wide variety of application analyses.

Each detector is equipped with an advanced pressure controller (APC) that digitally sets the gas parameters of each detector. To ensure secure use of hydrogen the connector joints have reverse threads to prevent incorrect pipe connections (FID, FPD, FTD).

Flame ionization detector

FID

- High-sensitivity has been achieved by thorough cleaning of detector gas lines and the latest noise-reduction technology.
- Automatic ignition, re-ignition and flame extinguishing functions
- Feedback function reduces gas supply pressure to zero when the hydrogen flame is extinguished.
- Hydrogen connector joints have reverse threads to prevent incorrect pipe connections.



Analysis of aqueous solution of medicine residual solvent
USP467 Class1 ProcedureA

Thermal conductivity detector

TCD

- Microvolume cell for sharper peaks
- Analysis is not easily affected by the temperature changes within column oven

Flame photometric detector

FPD

- For analysis of pesticide residues, odor components, phosphorus compounds, sulfur compounds and organo-tin compounds.
- The dual-focus system achieves high sensitivity.
- No tools required for replacement of interference filters with high daily maintenance frequency.

For analysis of
all organic
compounds

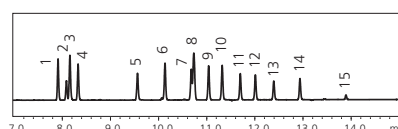
For analysis of
inorganic gases and
concentrated organic
compounds

For analysis of
organic phosphorus
and sulfur
compounds

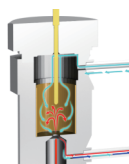
Electron capture detector

ECD

- For analysis of electrophilic compounds and also for high sensitivity detection of organohalogen compounds, metallo-organic compounds and compounds with C=O double bond.
- By thoroughly simulating the gas flow path inside the ECD detection cell, a gas flow path and the detection structure (Contact Free technology) are developed to minimize the contact between the samples flowing from the chromatographic column and the collector and the nickel wire source, thus significantly improving the durability of ECD detection cell.



Analysis of 10ppb of organochlorine pesticides



Contact-free Technology

- 1: α -BHC
- 2: β -AAA
- 3: Hexachlorobenzene
- 4: γ -BHC
- 5: Heptachlor
- 6: Dichloropropionic acid
- 7: Heptachlor-*exo*-epoxide
- 8: Heptachlor epoxide A+ oxychlordane isomer
- 9: Chlordane-*cis*
- 10: Chlordane-*trans*
- 11: Dieldrin
- 12: Endrin
- 13: o, p'-DDT
- 14: p, p'-DDT
- 15: Dicofol

Flame thermionic detector

FTD

- For analysis of organo nitrogen and phosphorus compounds, such as residual pesticides.
- No tools needed for collector replacement.
- Alkali source regeneration kit (option) reduces operational costs.
- Hydrogen connector fittings have reverse threads to prevent pipe connections.

For analysis of
organo nitrogen
and phosphorus
compounds

Automatic injection system

Automatic liquid injection system for GC

AOC™-20 series

- Easy to install and remove.
- AOC-20s can support analysis of up to 150 samples (1.5mL sample bottles).
- A dual injection system can be configured with a combination of two AOC-20i injectors. Two-line simultaneous injection doubles the sample throughput to improve productivity.





Advanced flow technology

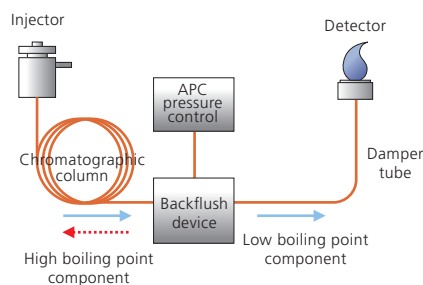
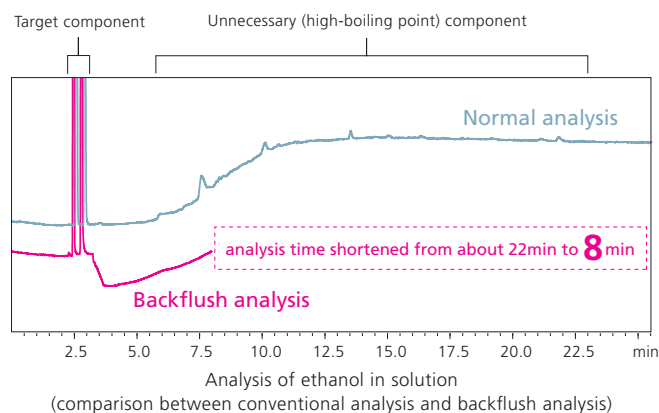
Advanced flow technology is a capillary analysis system implementing chromatographic techniques like backflush, heart cut, and detector switching.

It can achieve high efficiency and high separation by improving the efficiency of analysis and accurately separating the target component from the complex original samples.

Special software for each system can be downloaded free of charge from the homepage of Shimadzu official website.

Advanced flow technology - backflush system

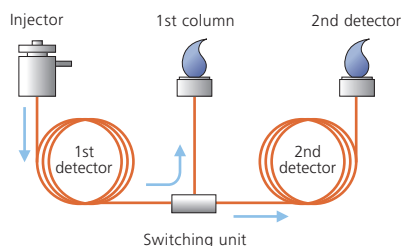
The backflush system reverses the carrier gas flow after the target compounds have eluted, to discharge residual late eluting compounds in the column through the injection port split vent, thus shortening the analysis time and improving productivity. In addition, high-boiling point components are discharged efficiently to reduce the bakeout time and thus prevent column deterioration, contamination and retention time shifts.



Schematic diagram of backflush system

Advanced flow technology - heart cutting system

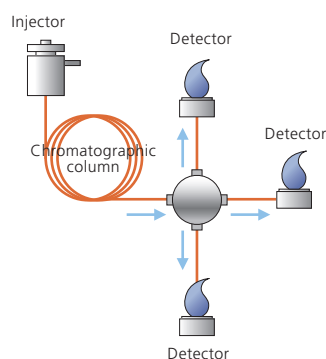
The heart cutting system uses two chromatographic columns with different separation characteristics to separate specific compounds from complex original samples for quantitation. It can achieve high separation analysis which cannot be achieved by single chromatographic column.



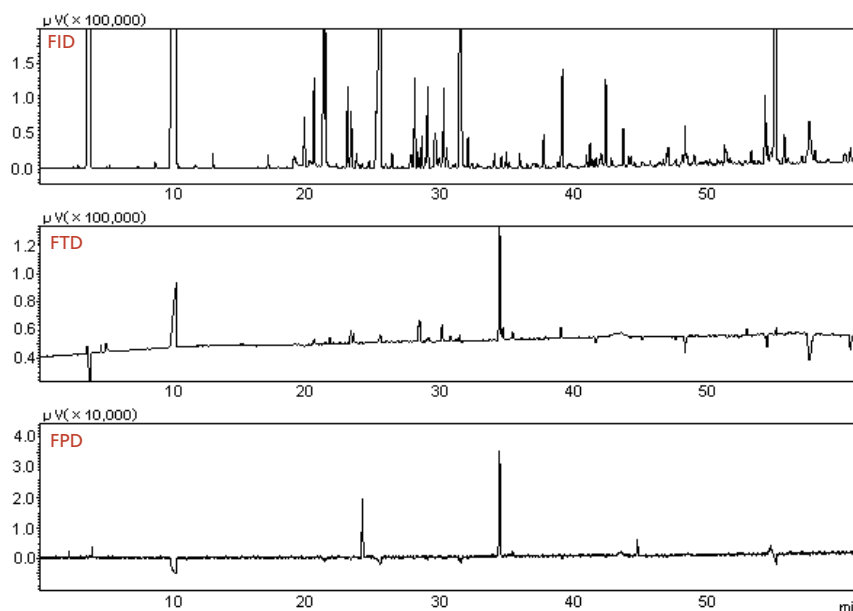
Schematic diagram of heart cutting system

Advanced flow technology - detector splitting system

Compounds eluting from an analytical column may be split to multiple detectors to obtain multiple chromatograms. Offering abundant information in a single analysis, this system saves time and money and improves productivity. The combination of common detector and selective detector can improve the analysis accuracy and support the analysis of complex samples with more impurities.



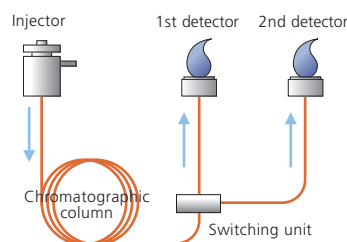
Schematic diagram of detector splitting system



Simultaneous analysis of grape seed oil with detector splitting system (FID, FTD, FPD)

Advanced flow technology - detector switching system

The detector switching system controls sample introduction through the switching device at the column outlet. Unlike the detector splitting system, the detector switching system can distribute the chromatographic column fractions to different detectors.

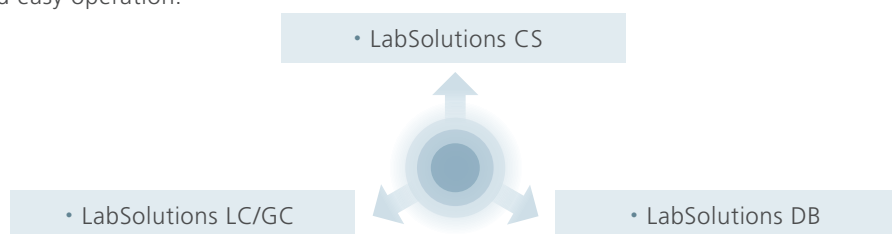


Schematic diagram of detector switching system

Efficient workstation LabSolutions meeting customer needs

LabSolutions workstation fully integrates the functions of LC and GC

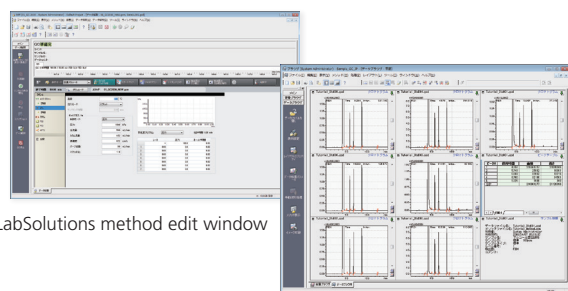
The LabSolutions series is the next-generation workstation software that integrates GC control, LC control, and other improvements in functionality, while maintaining compatibility with GC solution products. LabSolutions offers sophisticated functionality and easy operation.



User-friendly interface

The assistant bar, data explorer and other user-friendly interface of LabSolutions can make the beginners master the instrument in the shortest time. Windows for operating the instrument and assistant bar panels can be customized according to the working environment of the system.

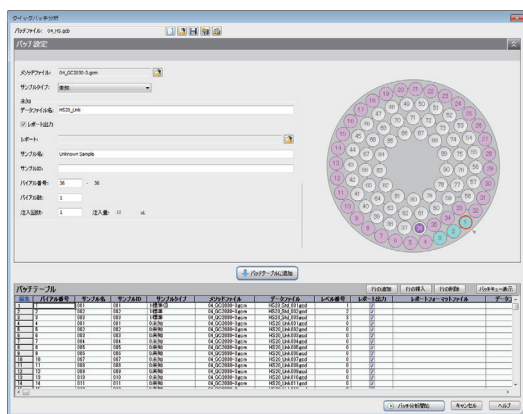
Therefore, LabSolutions offers both ease of operation and extensive functionality. The new data browser is convenient for comparing multiple sets of data by enabling access to chromatograms, peak information and quantitation results from multiple data files at the same time.



LabSolutions method edit window

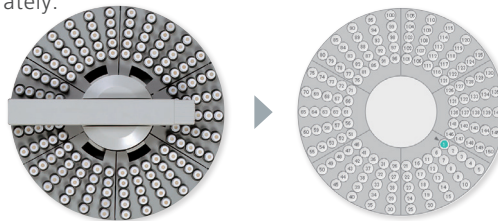
LabSolutions data browser window

Fast batch function simplifies the tedious process of creating sample injection sequence (batch file)

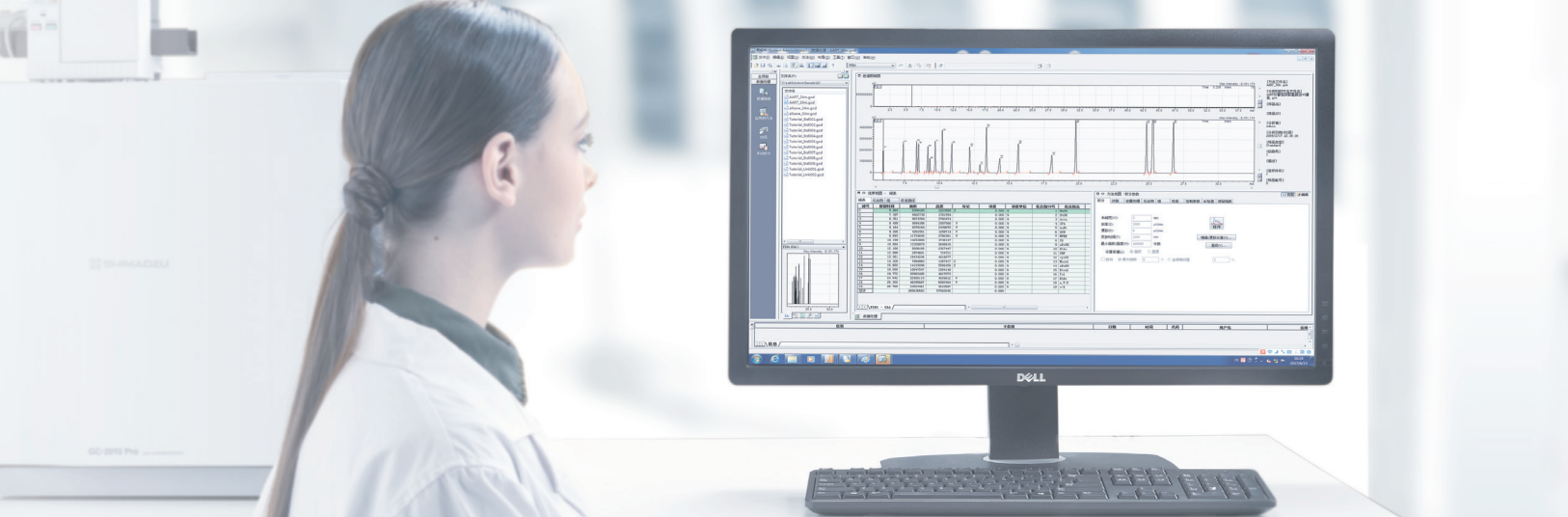


Fast batch window of LabSolutions

The fast batch function in LabSolutions makes it easy to create batch files. The fast batch window displays the sample bottle racks graphically in the system. The operator can directly confirm the location of the sample bottle through the window, so as to create the batch file faster and more accurately.



The figure corresponds to the position of the actual sample disk

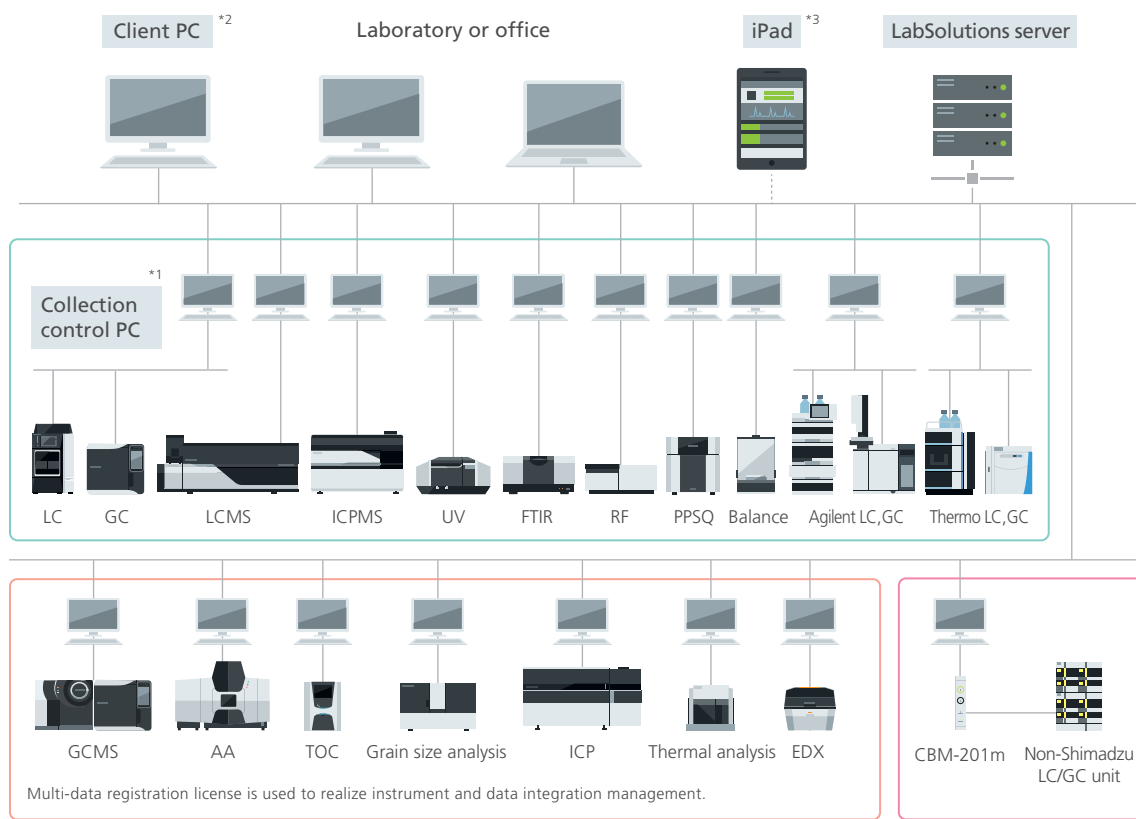


LabSolutions CS: free access to the analysis network

LabSolutions CS manages all analytical data on the network server, perfectly integrates lab and office, and can be controlled by other client PC in the network through analytical instructions, device monitoring and remote mode. LabSolutions CS can also directly control non-Shimadzu LC or GC hosts.

Regulatory compliance

- Compliance with FDA 21 CFR Part 11 (US FDA)
- Compliance with the requirements for the use of electronic records and electronic signatures in drug approval or licensing (Ministry of Health, Labour and Welfare, Japan)
- Compliance with the computerized system management policy of pharmaceutical and health product manufacturers (Ministry of Health, Labour and Welfare, Japan)



*1 The collection control PC is used to control the analysis device. Like the client PC, it can also execute analytical instructions and data reanalysis.

*2 LabSolutions software is not required on the client PC when using terminal services.

*3 If an iPad is used, then XenApp from Citrix must be installed.

Customized analysis systems based on different analysis requirements

All kinds of accessories are available for GC analysis

Headspace analysis system (HS-20)



The sample is sealed in a bottle, heated for a certain time, and the headspace is analyzed. Used to analyze the volatile components in solid or liquid.

System configuration

GC-2010 Pro + HS-20

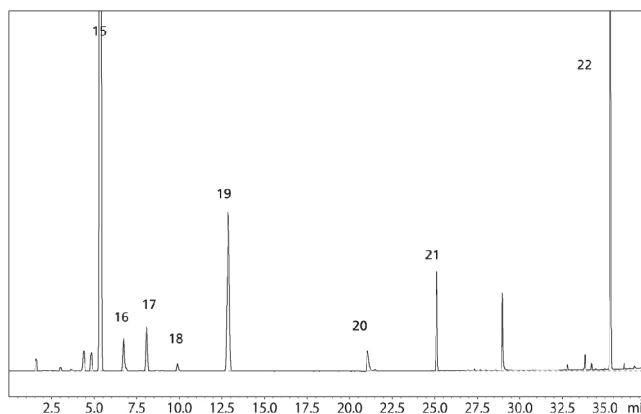
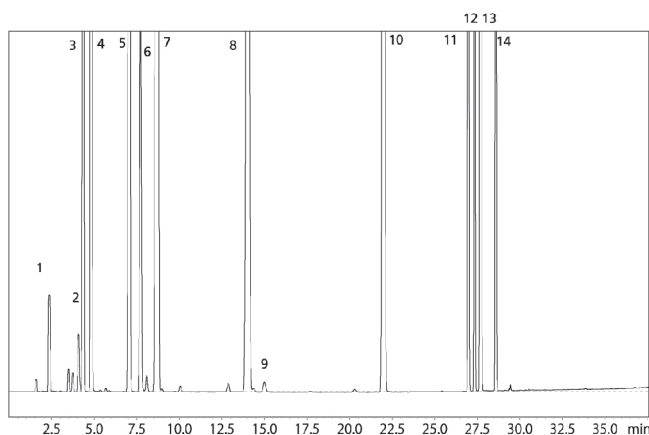
Analysis applications

Measurement of residual solvents in pharmaceuticals

Measurement of flavor components in foods

Reproducibility of USP<467> Class 2A/2B Procedure A (Aqueous Solution)

| | | RSD% (n=20) |
|----|--------------------------|-------------|
| 2 | Acetonitrile | 1.1 |
| 3 | Dichloromethane | 1.7 |
| 4 | trans-1,2-Dichloroethene | 2.3 |
| 5 | cis-1,2-Dichloroethene | 1.9 |
| 6 | THF | 0.6 |
| 10 | Toluene | 2.5 |
| 11 | Chlorobenzene | 2.5 |
| 18 | 1,2-Dimethoxyethane | 3.1 |
| 20 | Pyridine | 2.6 |



Headspace analysis system (HS-10)



The HS-10 is highly cost effective sampler. It has many of the same features of higher end models but is offered at a lower price.

System configuration

GC-2010 Pro + HS-10

Analysis applications

Analysis of residual solvents

Blood alcohol

Liquid injection/headspace/SPME analysis system



Liquid, large volume, headspace and SPME injection in one single instrument. Used to analyze the volatile components in solid or liquid samples.

System configuration

GC-2010 Pro + AOC-6000

Analysis applications

Measurement of residual solvents in pharmaceuticals
Measurement of flavor components in foods

* Appended software package

Dual tower injection system



The AOC-20 series includes a dual tower auto injector option which doubles the productivity of a single dual injector, dual detector gas chromatograph.

The highest productivity is then assured for applications such as simple high sample throughput on identical GC analysis channels or for dual column confirmation. In either case, the AOC-20 dual tower configuration is a powerful tool for laboratory productivity.

System configuration

GC-2010 Pro + Dual tower AOC-20i

Pyrolysis system



Decomposes samples at high temperatures and analyzes the pyrolytic decomposition products.

System configuration

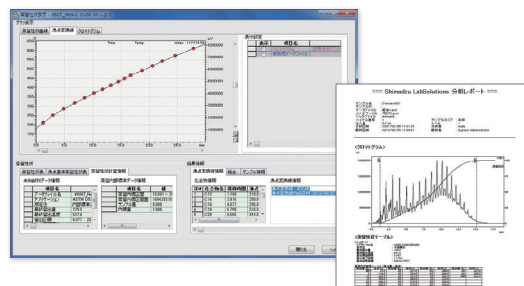
GC-2010 Pro + EGA/PY-3030D

autosampler and cryotrap accessories available

Analysis applications

Characterization of high molecular weight compounds
Measurement of outgassing from inorganic samples, such as ceramics

Simulated distillation GC system



Measure the boiling point distribution of petroleum fractions using the relationship between retention time and boiling point. Print formatted reports after analysis of distillation characteristics.

System configuration

GC-2010 Pro + WBI or OCI + LabSolutions + simulated distillation software

Analysis applications

Petroleum fractions

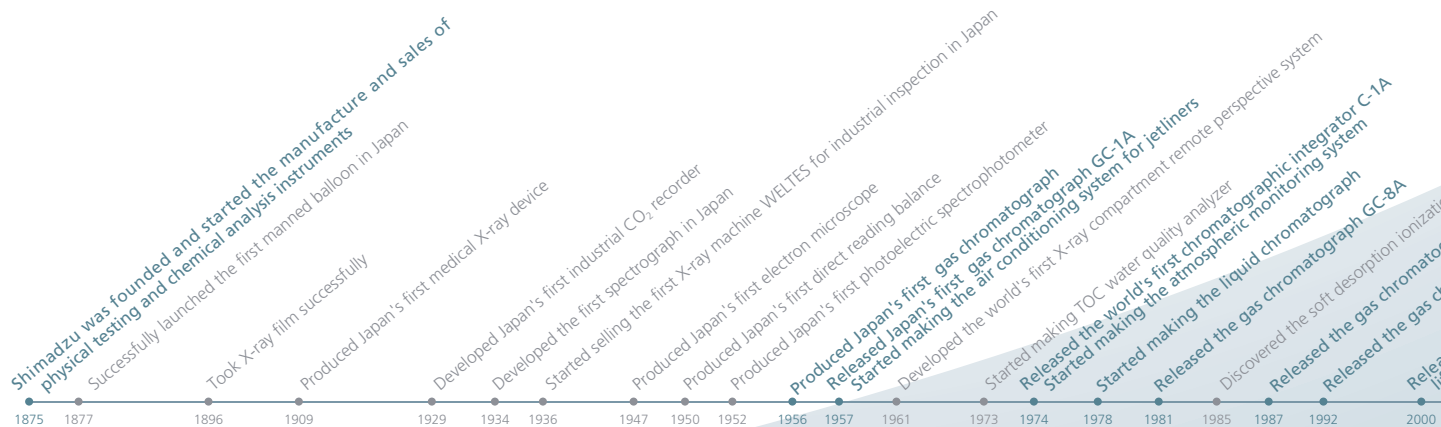
* Some ASTM standards are not supported when using LabSolutions LE



Shimadzu Corporation, the professional manufacturer of gas chromatograph for more than **60** years

Shimadzu has been developing and manufacturing gas chromatograph products for more than half a century in its development over 140 years. Excellent tradition and outstanding quality has been continued to today, so that Shimadzu has continuously launched a variety of GC application systems to meet the needs of customers.

It is because Shimadzu has always been adhering to the "spirit of craftsmanship", and the combination of solid technical capabilities that "Japanese ingenuity" is more well known.





2004

GC-2014



2009

GC-2010 Plus



2010

GC-2025



2013

Tracera



2017

Nexis GC-2030



2019

GC-2010 Pro

on method
 graph GC-14A
 chromatograph GC-17A
 used the gas chromatograph GC-2010 and turned the attention to
 te sciences, semiconductor I/PD and environmental solutions business
 Released MALDI mass spectrometer AXIMA series
 Koichi Tanaka won the Nobel Prize in chemistry
 Released the gas chromatograph GC-2014
 Started making the world's first X-ray diagnostic system equipped
 with a direct conversion flat panel detector (FPD)
 50th anniversary of Shimadzu Gas Chromatograph
 Released the gas chromatograph GC-2010Plus
 Released the gas chromatograph GC-2025
 Released the gas chromatograph Tracera
 60th anniversary of Shimadzu Gas Chromatograph
 Released the gas chromatograph GC-2030
 Released the gas chromatograph GC-2010 Pro

2001 2002 2004 2006 2009 2010 2013 2017 2019

GC-2010 Plus, LabSolutions, and AOC are trademarks of Shimadzu Corporation.



Shimadzu Corporation
www.shimadzu.com/an/

For Research Use Only. Not for use in diagnostic procedures.

This publication may contain references to products that are not available in your country. Please contact us to check the availability of these products in your country.

Company names, products/service names and logos used in this publication are trademarks and trade names of Shimadzu Corporation, its subsidiaries or its affiliates, whether or not they are used with trademark symbol "TM" or "®".

Third-party trademarks and trade names may be used in this publication to refer to either the entities or their products/services, whether or not they are used with trademark symbol "TM" or "®".

Shimadzu disclaims any proprietary interest in trademarks and trade names other than its own.

The contents of this publication are provided to you "as is" without warranty of any kind, and are subject to change without notice. Shimadzu does not assume any responsibility or liability for any damage, whether direct or indirect, relating to the use of this publication.