C184-E049

SHIMADZU
Excellence in Science

Capillary Gas Chromatograph

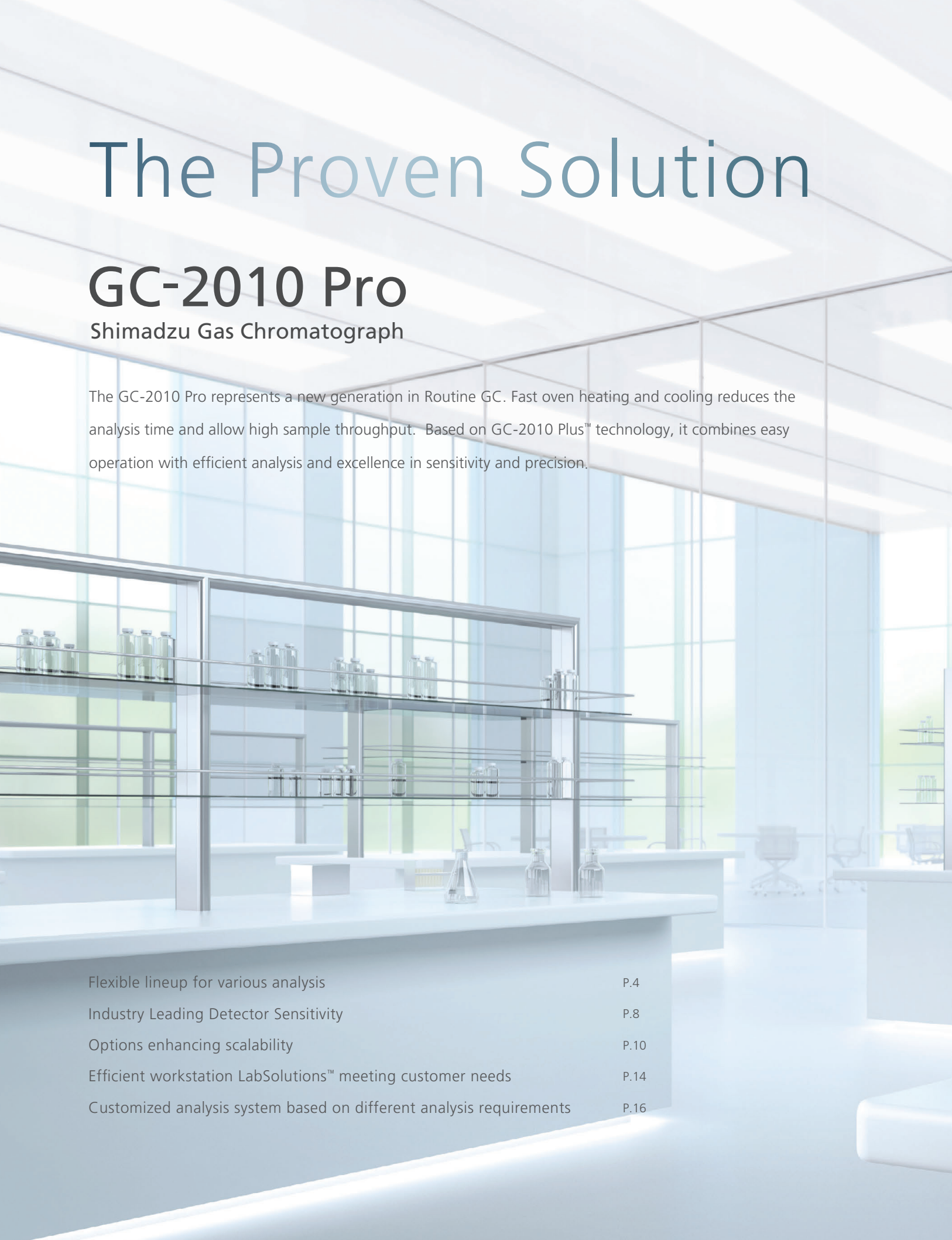
GC-2010 Pro

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.




SHIMADZU
GC-2010 Pro
GAS CHROMATOGRAPH
START
STOP
DIAG
SYSTEM
Monitor Main
READY
2017.05.30(Thu) 17:52:52
SPL
FID
Rt
0.00min
150°C
RemainTime
0.00min
Retention Time
Atten
Speed
Scroll
ChnGraph
MONIT
SET
COL
FUNC
FLOW
INJ
DET
OPTION
HELP
CE
ENTER
POWER

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

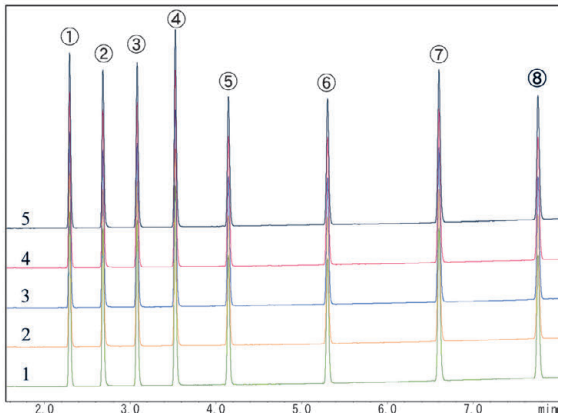
Faster heating accelerates chromatographic separation and fast cooling reduces GC run time.

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).



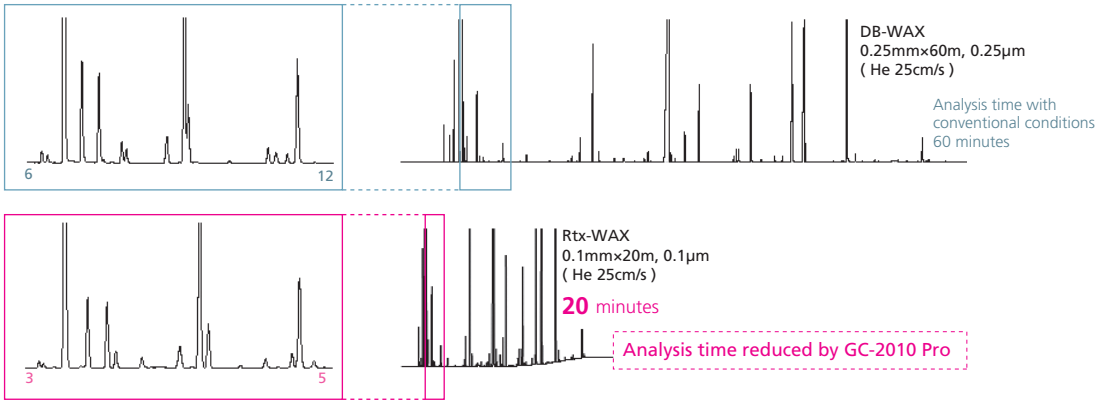
Analysis of Grob Test Mixture (Solvent: acetone, each 100 ppm)

	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

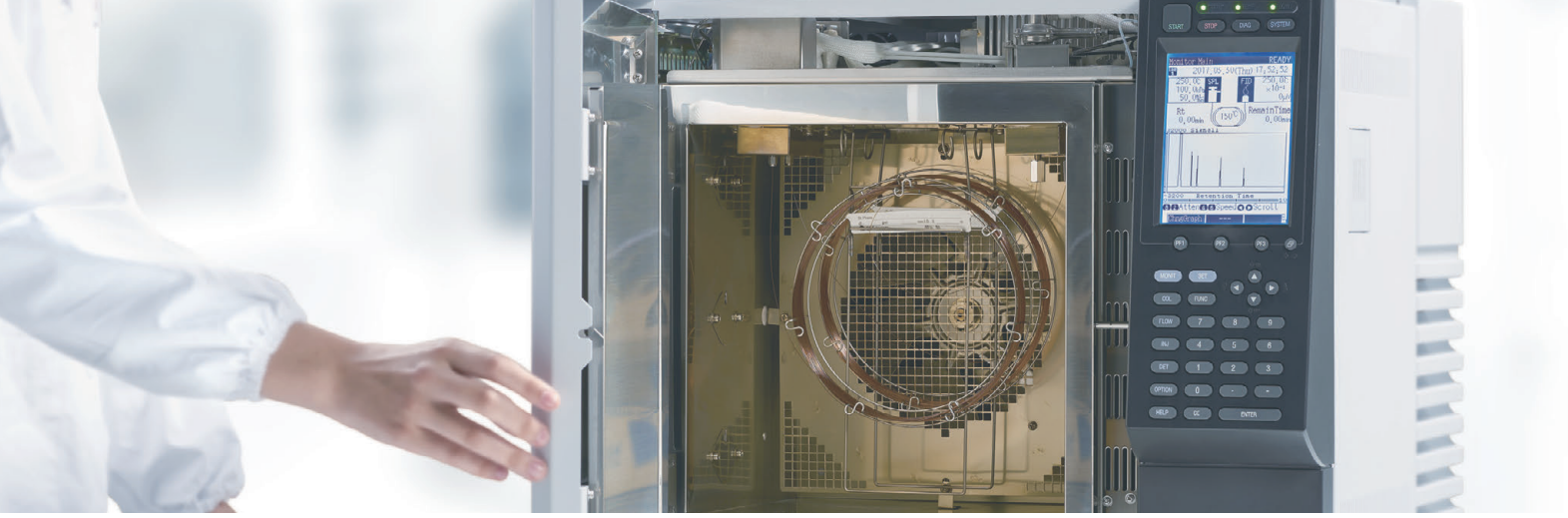
Peak area reproducibility

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.

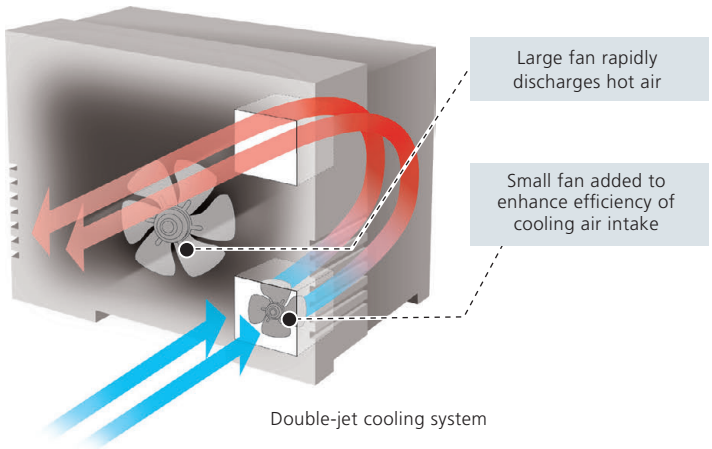


High-speed analysis of coffee flavoring

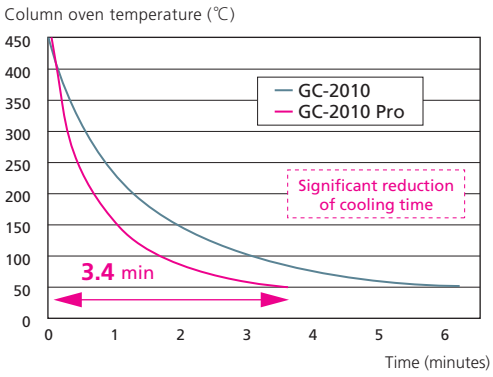


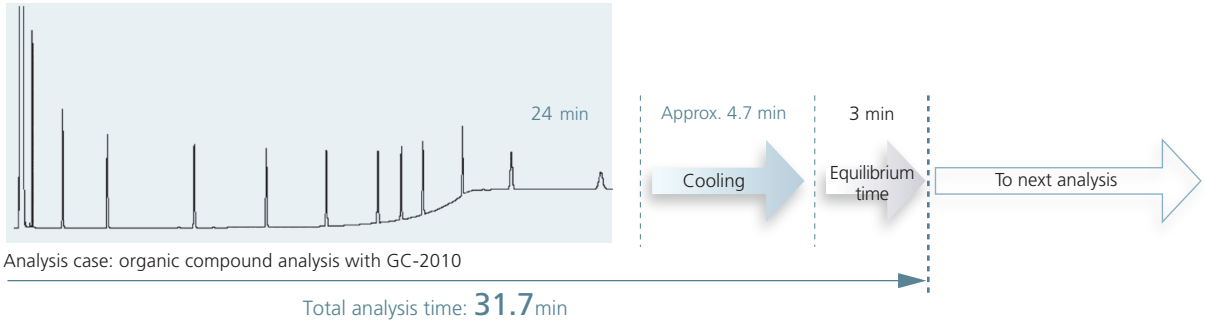
Rapid oven heating / cooling

GC-2010 Pro incorporates a double-jet cooling system, which enables the reduction of cooling time from 450℃ to 50℃ in 3.4min, realizing more efficient and rapid cooling. In addition, with the ability of rapid heating, GC-2010 Pro can significantly reduce the analysis time.



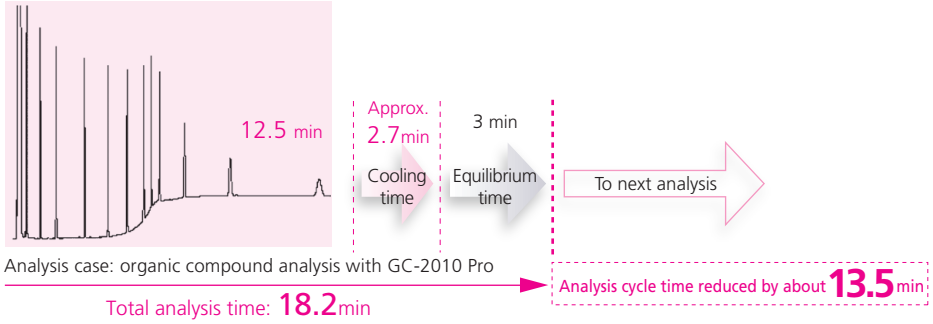
Double-jet cooling system





Analysis case: organic compound analysis with GC-2010

Total analysis time: **31.7**min



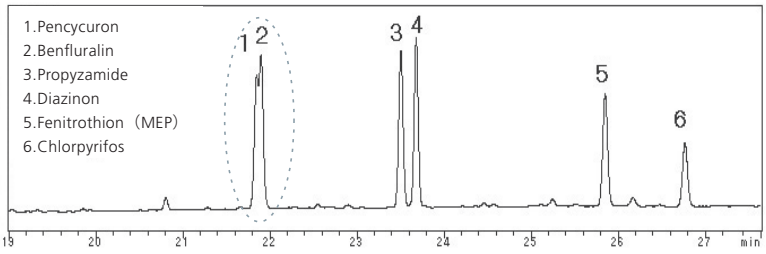
Analysis case: organic compound analysis with GC-2010 Pro

Total analysis time: **18.2**min

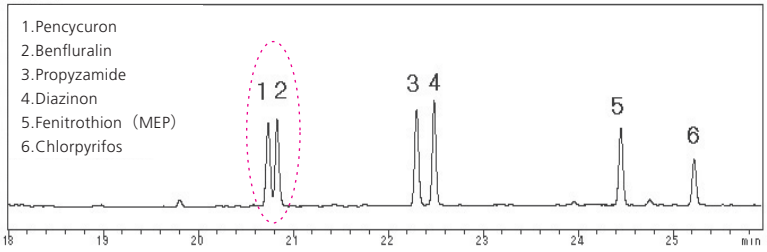
Constant linear velocity mode quickly determines separation conditions

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

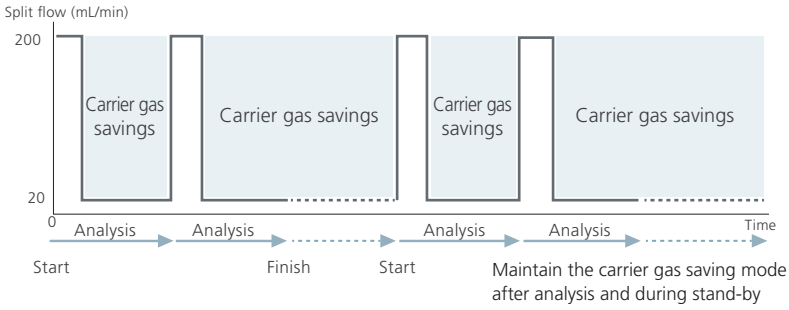


Comparison of chromatograms with constant linear velocity and constant column inlet pressure (Pesticides analysis)

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

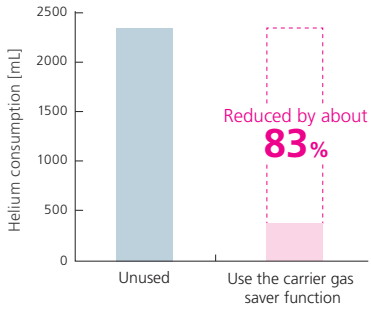
Gas saver function reduces helium consumption

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℃
Chromatographic column: inner diameter 0.25mm length 30m film thickness 0.25µm

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

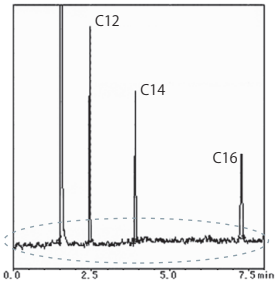
Industry Leading Detector Sensitivity

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.

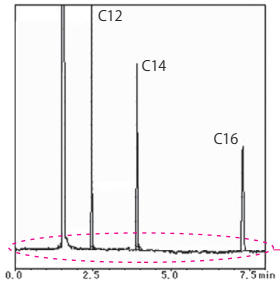
Flame ionization detector FID

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

· FID (without noise reduction technology)



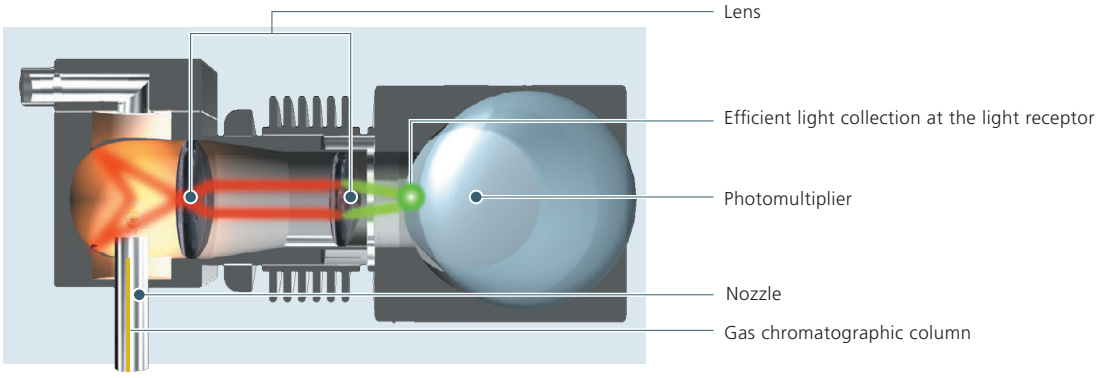
· FID (with noise reduction technology)



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

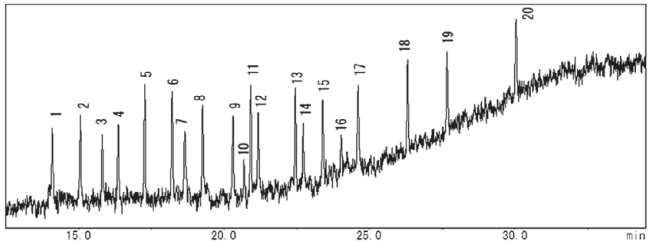
Flame photometric detector FPD

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.



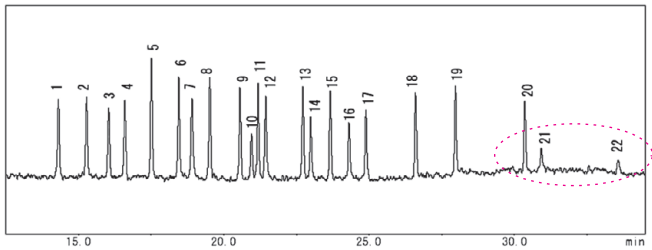
Dual-focus system

· FPD (without dual-focus system)



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

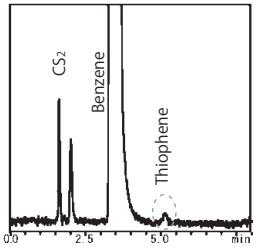
· FPD (with dual-focus system)



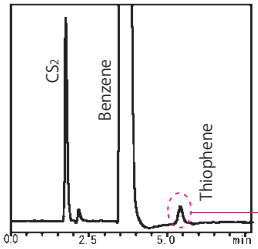
Detect the low-concentration organophosphorus pesticide samples that were not detected previously (Peak No.21.22)

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

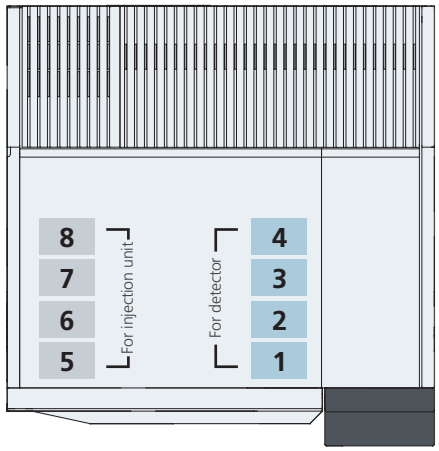
Options enhancing scalability

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 was 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.

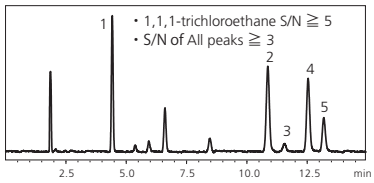
Each detector is equipped with an advanced pressure controller (APC) that digitally sets the gas parameters of each detector. To ensure secure use of hydrogen the connector joints have reverse threads to prevent incorrect pipe connections (FID, FPD, FTD).

Flame ionization detector

FID

For analysis of all organic compounds

- 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.



1: 1,1-Dichloroethene
2: 1,1,1-Trichloroethane
3: Carbontetrachloride
4: Benzene
5: 1,2-Dichloroethane

Analysis of aqueous solution of medicine residual solvent
USP467 Class1 ProcedureA

Thermal conductivity detector

TCD

For analysis of inorganic gases and concentrated organic compounds

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

Flame photometric detector

FPD

For analysis of organic phosphorus and sulfur compounds

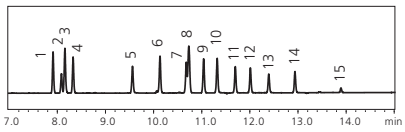
- For analysis of pesticide residues, odor components, phosphorous compounds, sulfur compounds and organo-tin compounds.
- The dual-focus system achieves high sensitivity.
- No tools required for replacement of interference filters with high daily maintenance frequency.

Electron capture detector

ECD

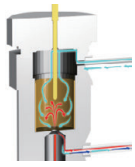
For analysis of electrophilic compounds

- 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.



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

Analysis of 10ppb of organochlorine pesticides



Contact-free Technology

Flame thermionic detector

FTD

For analysis of organo nitrogen and phosphorus compounds

- 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.

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

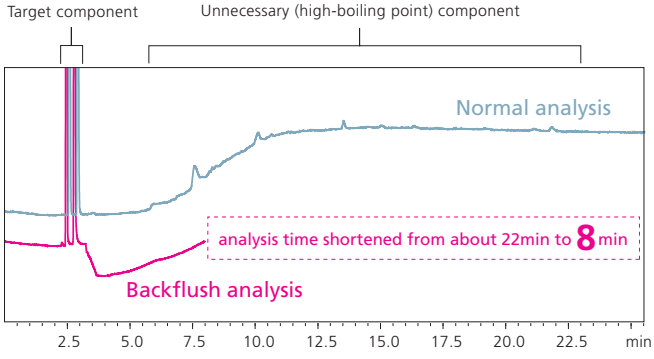
Advanced flow technology is a capillary analysis system implementing chromatographic techniques like backflush, heart cut, and detector switching.

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.

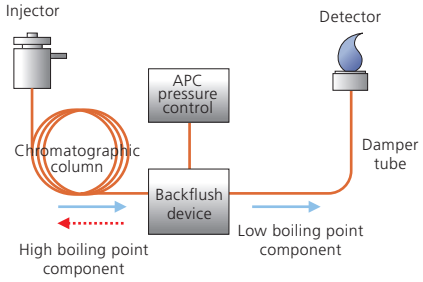
Special software for each system can be downloaded free of charge from the homepage of Shimadzu official website.

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.



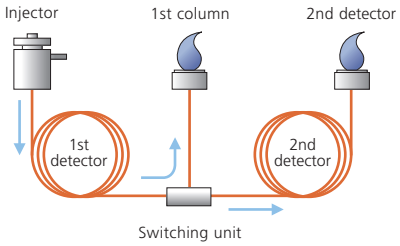
Analysis of ethanol in solution
(comparison between conventional analysis and backflush analysis)



Schematic diagram of backflush system

Advanced flow technology - heart cutting system

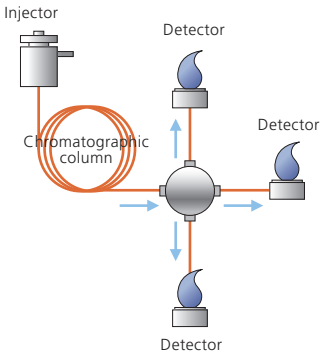
The heart cutting system uses two chromatographic columns with different separation characteristics to separate specific compounds from complex original samples for quantitation. It can achieve high separation analysis which cannot be achieved by single chromatographic column.



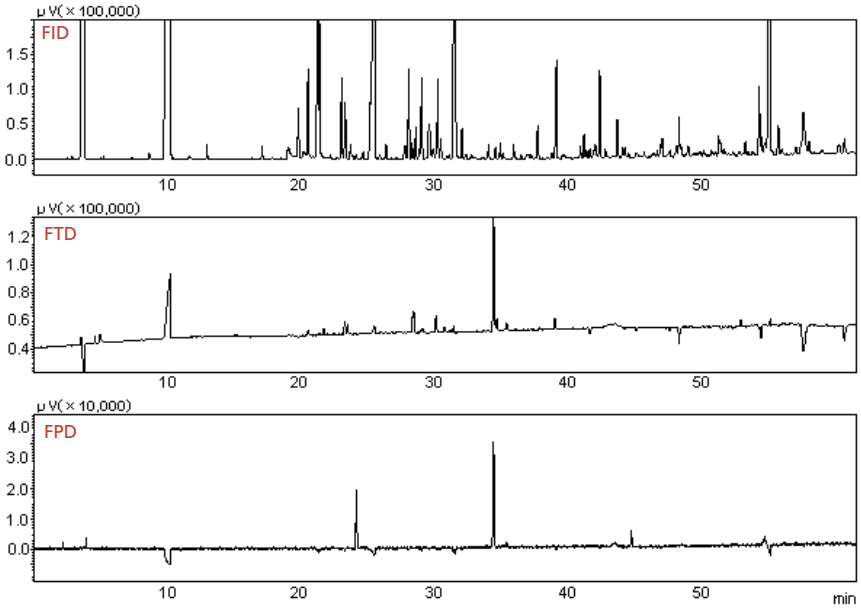
Schematic diagram of heart cutting system

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.



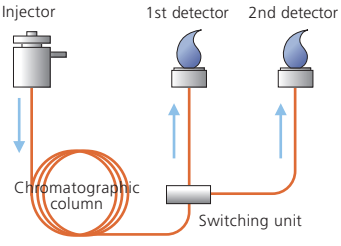
Schematic diagram of detector splitting system



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.

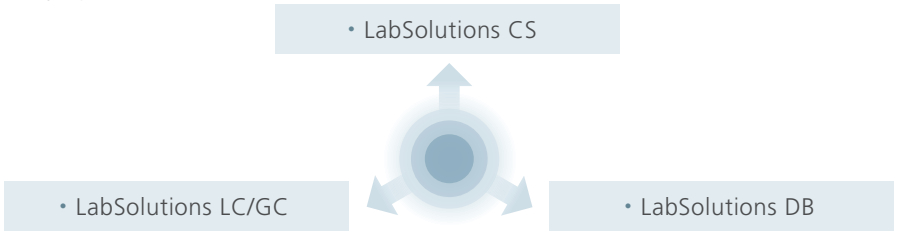


Schematic diagram of detector switching system

Efficient workstation LabSolutions meeting customer needs

LabSolutions workstation fully integrates the functions of LC and GC

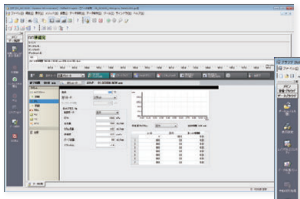
The LabSolutions series is the next-generation workstation software that integrates GC control, LC control, and other improvements in functionality, while maintaining compatibility with GC solution products. LabSolutions offers sophisticated functionality and easy operation.



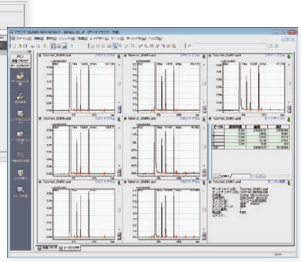
User-friendly interface

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.

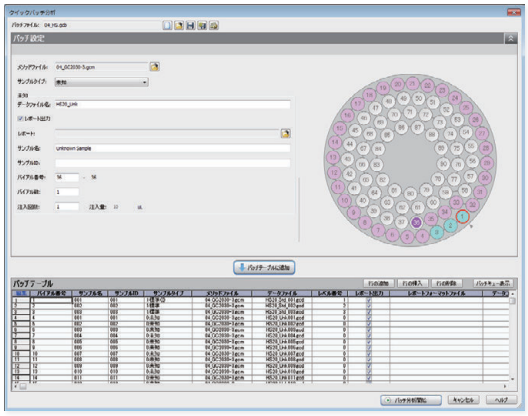


LabSolutions method edit window



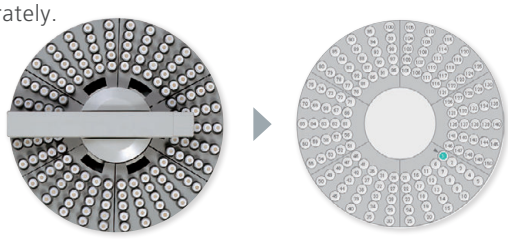
LabSolutions data browser window

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

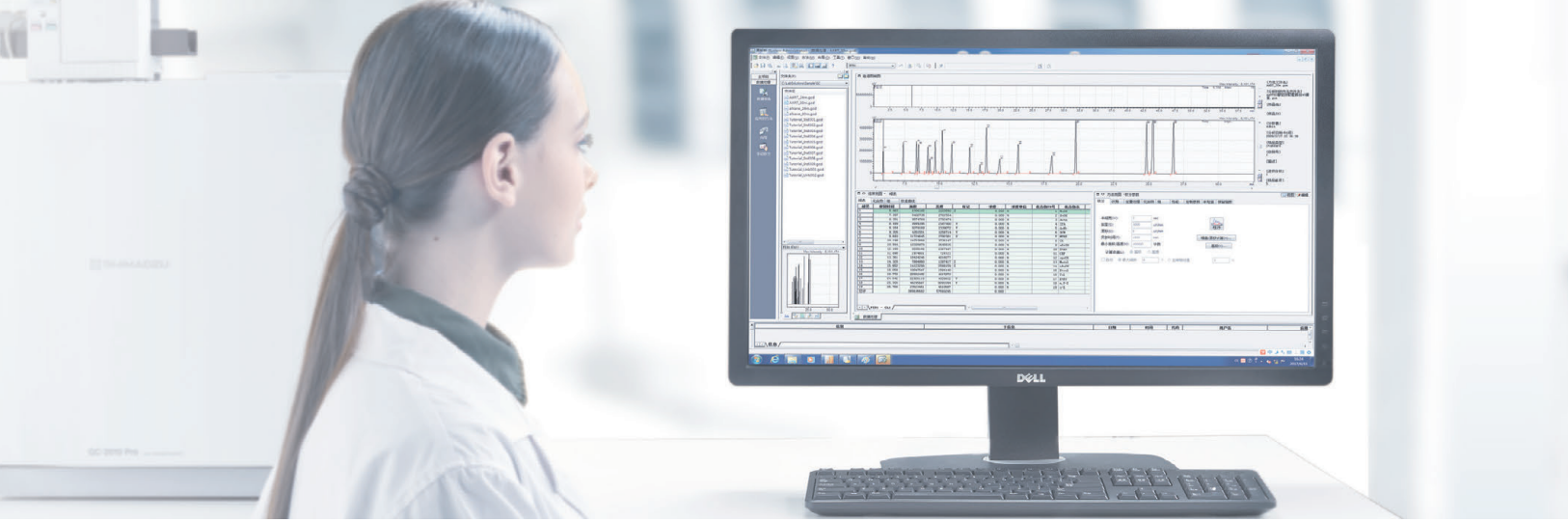


Fast batch window of LabSolutions

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

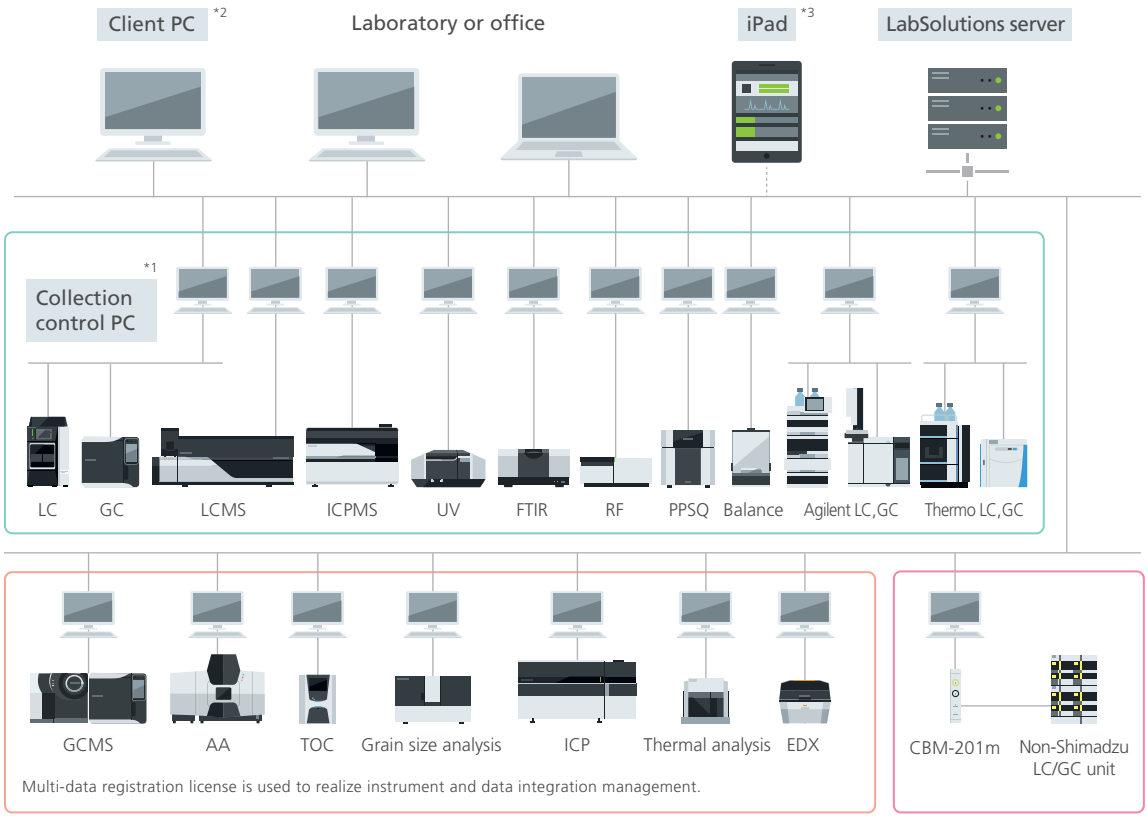


LabSolutions CS: free access to the analysis network

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

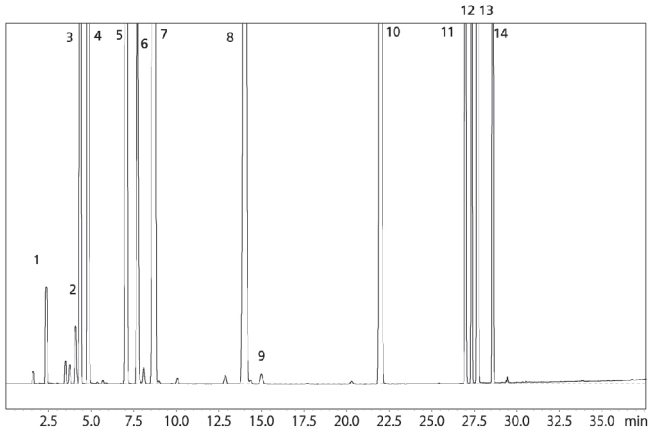
Analysis applications

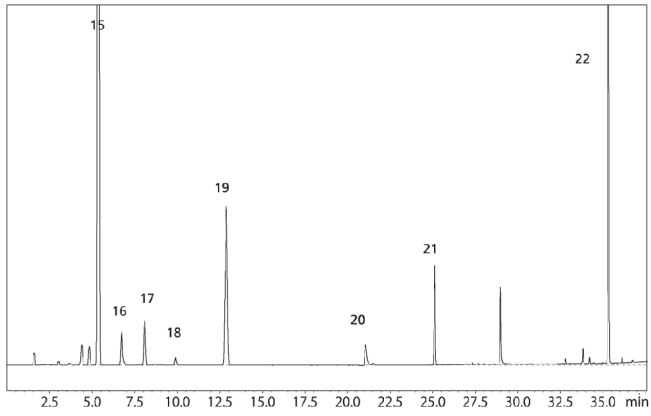
Measurement of residual solvents in pharmaceuticals

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 may 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 hignest productivity is then assured for applications such as simple hign sample throughput on identical GC analysis channels or for dual column confirmation. In either case, the AOC-20 dual tower configration 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

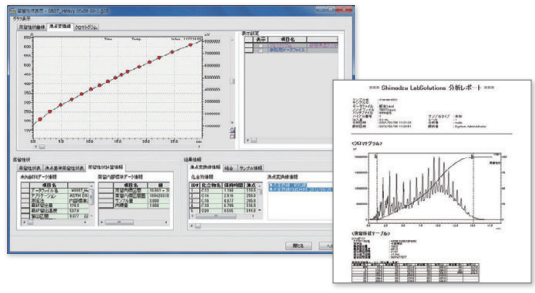
autosampler and cryotrap accessories available

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

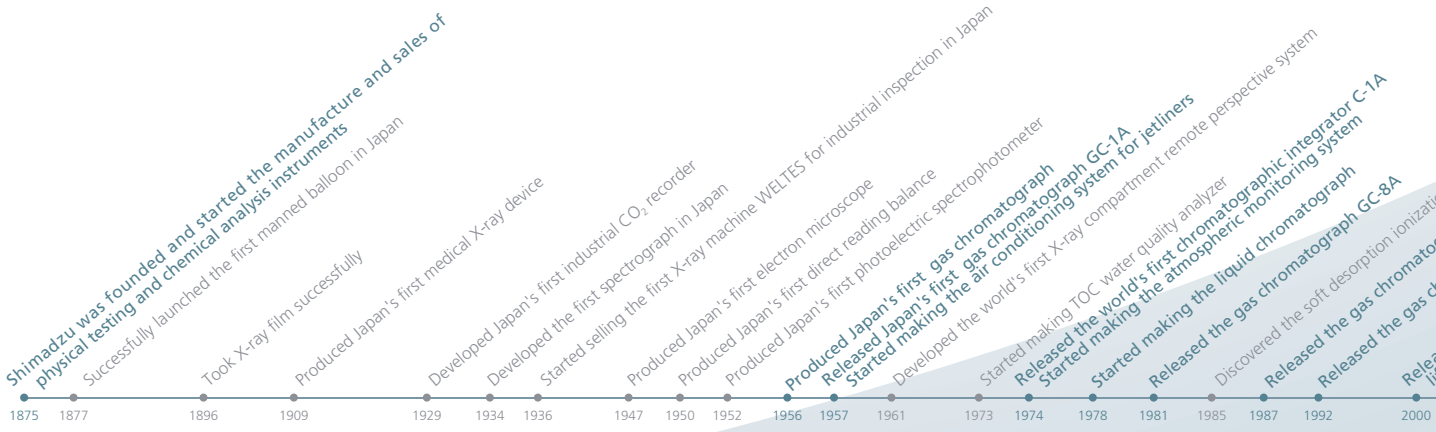
Petroleum fractions

* 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
romatograph GC-17A
sed the gas chromatograph GC-2010 and turned the attention to
fe sciences, semiconductor /FPD 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 2017 2019

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