C184-E041

SHIMADZU
Excellence in Science

Gas Chromatograph

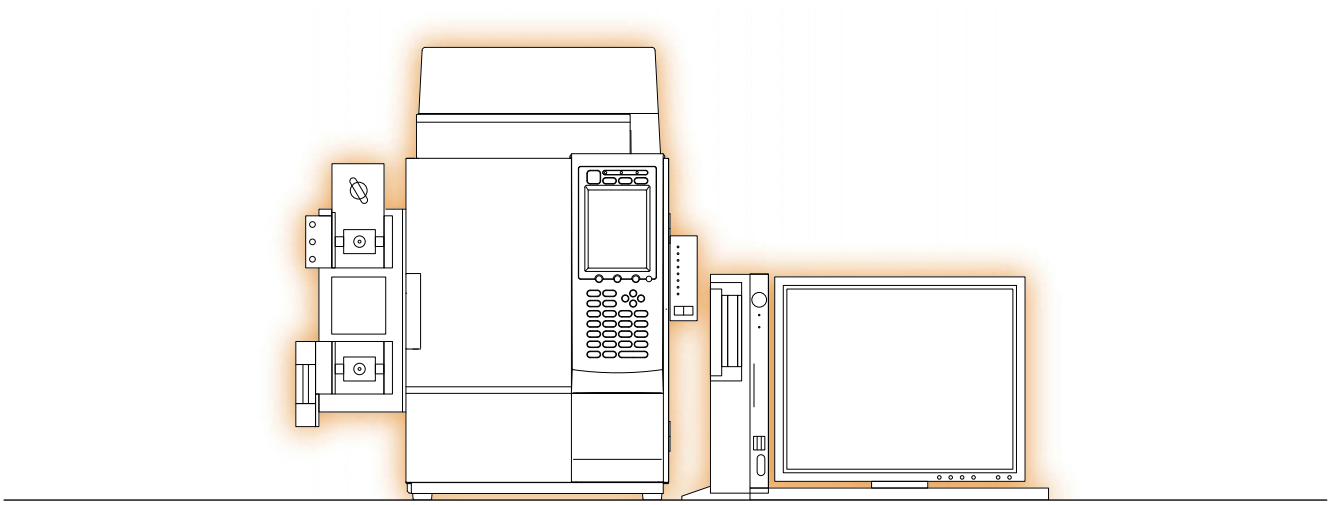
System GC

Basic Information

System GC Overview

For automating Gas Chromatography

System GC, also known as custom GC or automatic GC, refers to gas chromatograph systems configured with a sample injection unit, valves, and other components for specific operating environments and analyses. These include quality or process control applications in petrochemical or gas manufacturing plants, environmental gas analysis, or reaction gas research.
For more than 30 years Shimadzu has been delivering such systems. This program represents an integration of technology utilizing Shimadzu's extensive wealth of GC experience, and enables analysis not possible with conventional GC systems. These GC systems are designed to meet specific customer needs, such as automatic switching between sample lines, continuous measurement, and high-sensitivity measurement.



1 Robust and Stable

Major benefits of configuring such systems include the ability to analyze specific components using simple operations and the ability to perform long-term stable with high precision, high sensitivity, and high separation performance. Systems can also be automated, from sampling to data output, by adding specific valves, solenoid valves and other components and by sequencing programs in the data processing unit. Consequently, systems can be configured to analyze samples continuously with no human intervention, thereby maximizing the benefits of the exceptionally stable performance. Using a combination of valve systems protects columms and detectors from concentrated primary components that can interfere with their performance, enabling analysis of even trace substances with excellent reproducibility.

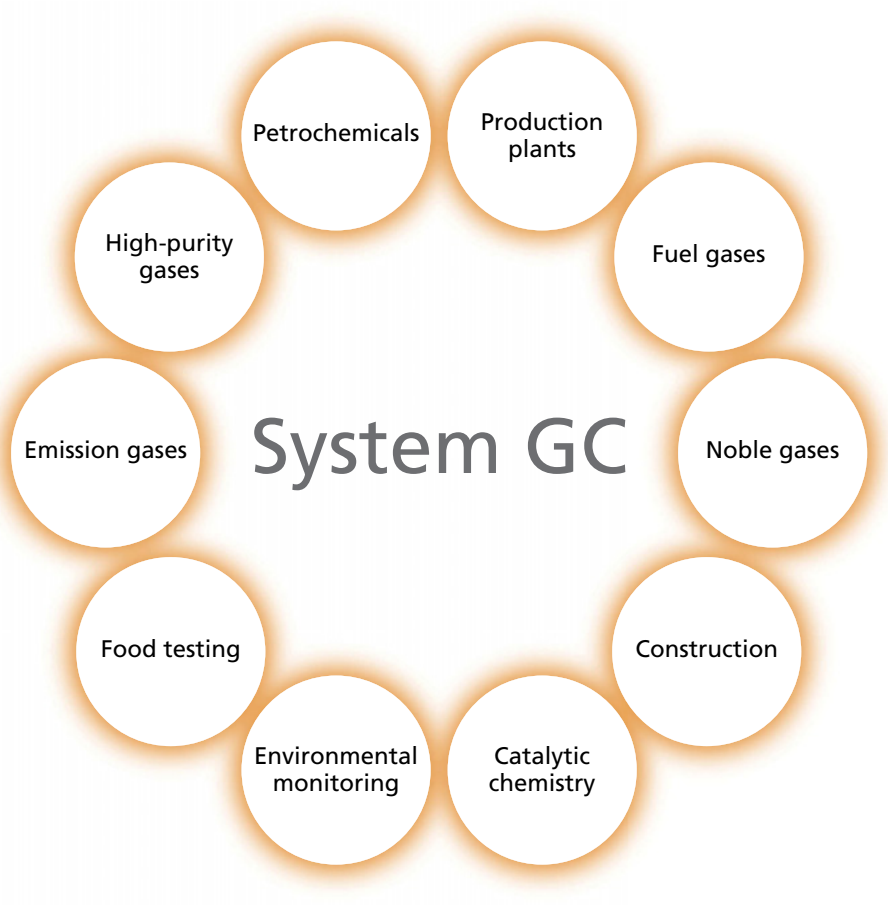
2 High Separation and Shorter Cycle Times

System GC systems only target specific components. By using a special valve system or optimized column configuration, they are able to analyze, with good separation, components that are normally very difficult to detect.
At the same time, they can achieve much shorter cycle times by using multiple columns or a special valve system to shorten the lengthy analytical or stabilization processes that are often required when using conventional methods.

3 High Sensitivity Analysis

Analyzing trace quantities requires increasing the sample quantities injected into the GC unit by using a larger measuring tube. With general-purpose GC systems, that results in poor separation and target peaks being hidden behind peaks for interfering substances. However, a customized system can detect such trace components.
Even ultra-trace components can be detected by using a detector with higher selectivity, such as an FPD, SCD, or ECD, or a highly sensitive detector, such as a PDD or BID.

Applicable Fields



Refinery/Petrochemicals

- Hydrocarbons analysis
- Source gas impurity analysis
- Simulated distillation gas chromatography (SIMDIS)
- PONA analysis

Fuel Gases

- LNG (liquid natural gas)
- LPG (liquid petroleum gas)
- SNG (synthetic natural gas) and coal gas

High-Purity Gases

- Impurity analysis(H_2,O_2,Ar,N_2,CH_4,CO_2,Ne,Xe,N_2O,NH_3)
- Semiconductor and noble gases
- Analysis of hydrocarbons in oxygen

Environmental Monitoring

- Greenhouse gases(CO_2,N_2O,CH_4)analysis
- Organic solvents
- Automobile emissions

Research and Development

- Catalyst evaluation
- Reactor evaluation
- New materials development

Other Fields

- EOG (ethylene oxide gas)
- Town gas heat capacity measurement

For More Efficient Analysis

Improved Separation

Samples that cannot be adequately separated with a single column can be separated and detected by pre-cutting or by switching between multiple columns. Pre-cutting or heart-cutting separates the target components from other components, enabling more accurate qualitative and quantitative analysis.

Shorter Analysis Time

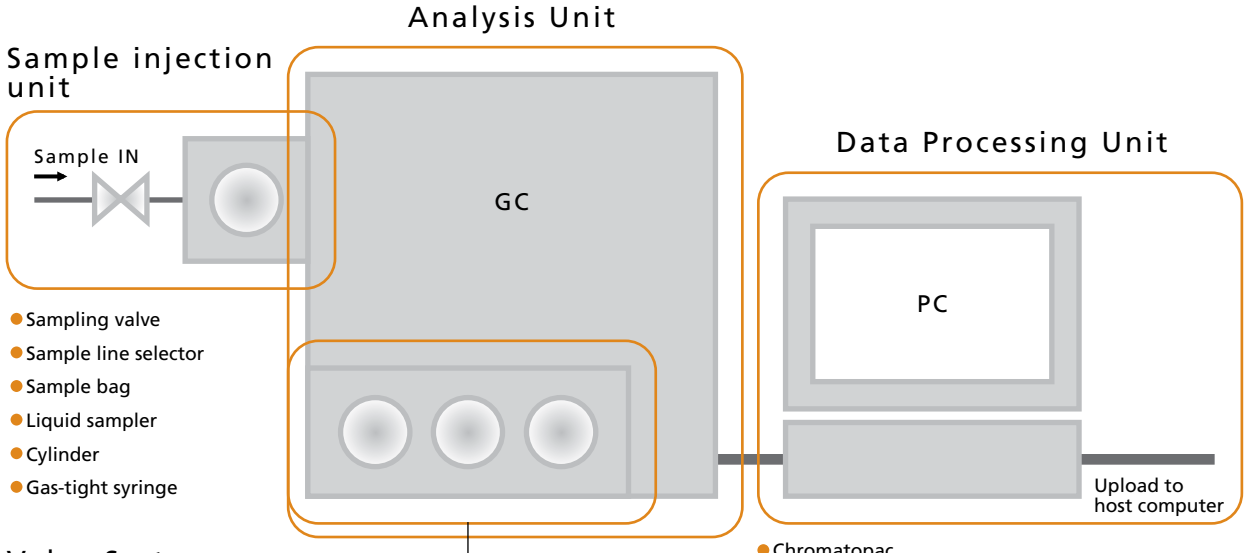
Typically, if a sample containing slowly eluted components, such as those with a high boiling point, is injected into a column, it is necessary to wait until the slow components finish eluting. However, using pre-cutting or backflushing allows the slow components to be discharged from the system or to be collectively eluted early without altering the separation of target components.

High Sensitivity Analysis

Trace components can be detected by using large-quantity sampling, heart-cutting, or a detector with higher selectivity for the given target components.

System GC Configurations

System GC systems are configured with a sample injection unit, analysis unit (valve system), and data processing unit.



Valve System

System GC can be optimized with 6-way, 8-way, or 10-way valves to automate and increase the efficiency of analysis.

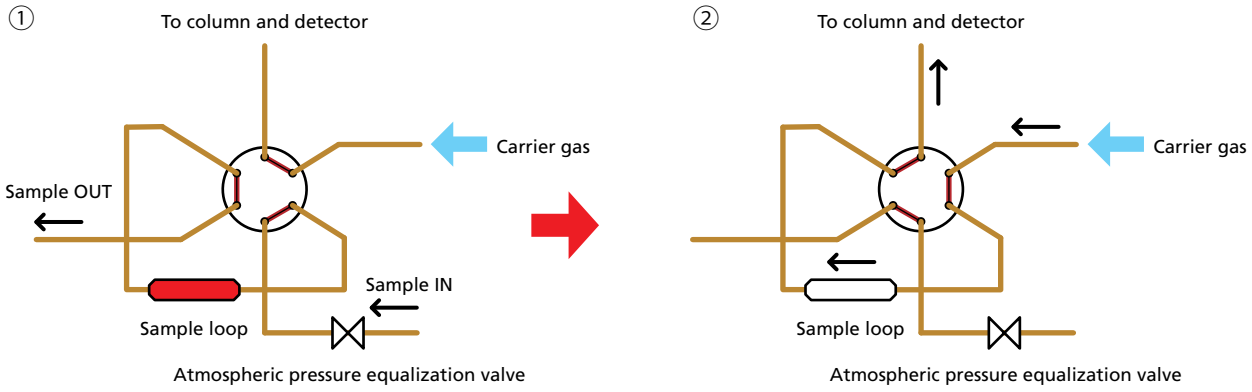
Sampling	Acquires a fixed quantity of the sample.
Pre-cutting	By analyzing only components that elute early, pre-cutting discharges late-eluting components from the analysis system.
Heart-cutting	Delivers only the trace components, contained among primary components, to the detector.
Column switching	Switches between different columns within the same analysis, depending on the components being analyzed.
Backflush	Elutes multiple late-eluting components at the same time and early.

Sampling ～Automated and Stable Continuous Analysis～

Sampling methods are configured according to customer preferences.
For sample introduction, either an automatic or manual gas sampler, sample line selector, sample bags, or a gas-tight syringe, can be selected based on the analytical techniques involved.
More stable analysis can be achieved by configuring the system with an appropriate sampling method.

Gas Sampler Flow Diagram

The gas sampler collects a fixed quantity of sample in the sample loop and then delivers it to the column.

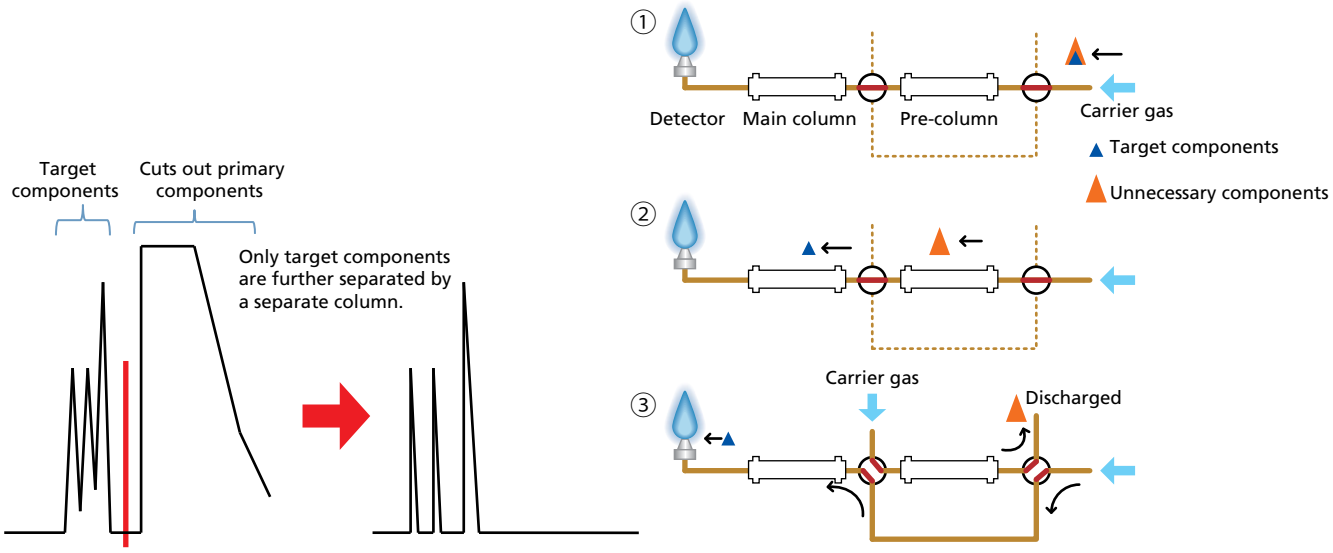


Sample gas flows into the sample loop for a fixed period of time. Then the atmospheric pressure equalization valve is closed to equalize the pressure. Equalizing the atmospheric pressure ensures that a fixed quantity of sample is measured.

The sample in the sample loop is delivered to the column by switching the sampling valve.

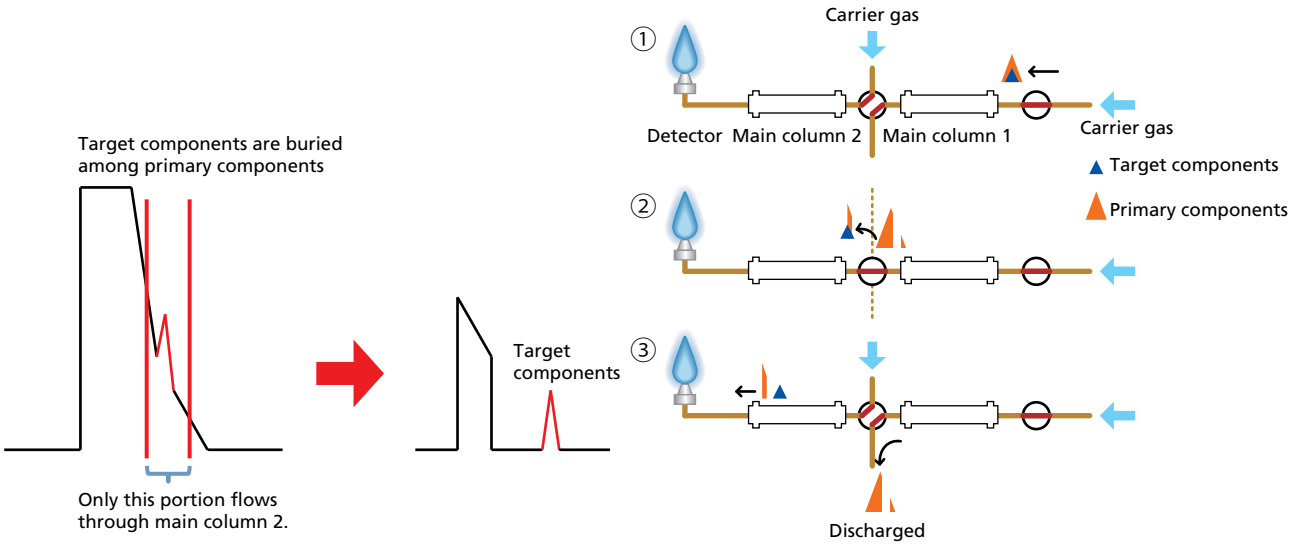
Pre-Cut System ～Reduces Analysis Time and Protects Columns～

The pre-cutting system shortens the analysis time by switching a valve to divert unwanted components. A pre-column separates target components from other components, so that only the target components are delivered to the main column for separation. This helps protect the main column from degradation. Consequently, it extends the service life of the main column and decreases the maintenance frequency.



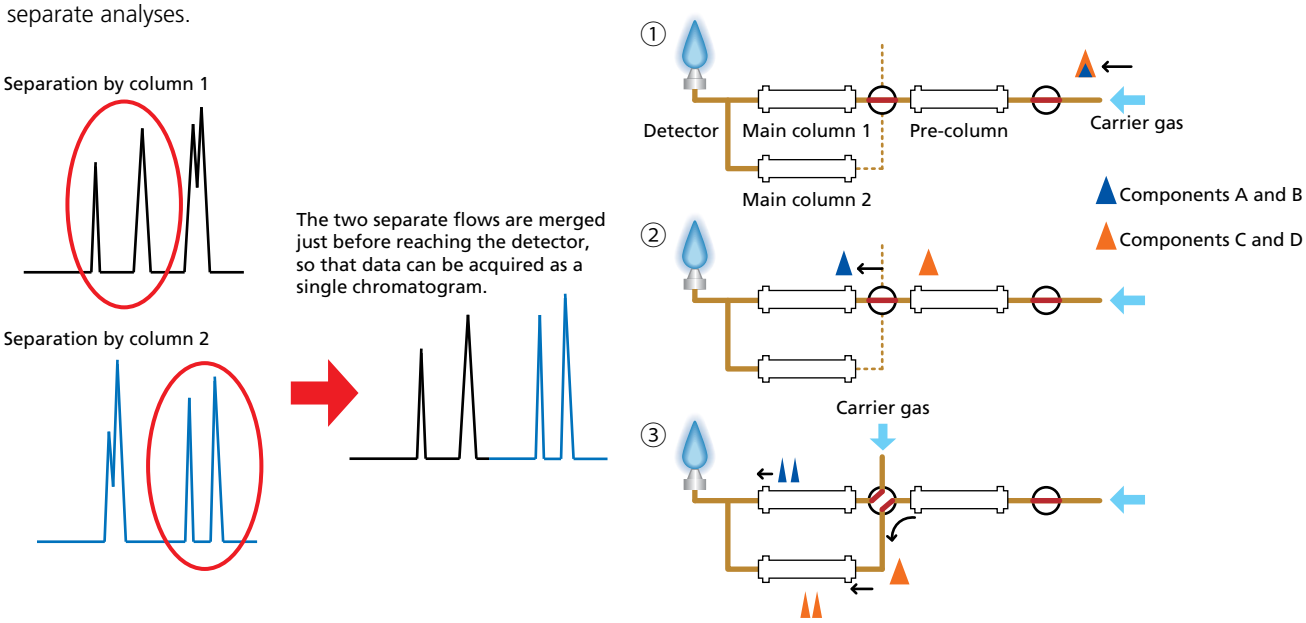
Heart-Cut System ～Improves Separation of Trace Components～

The heart-cut system is normally used for separating and analyzing samples that are difficult to measure due to large differences in component concentrations (for example, when trace components are obscured by primary components). After an approximate separation via main column 1, a valve is switched while trace components are being eluted, so that only trace components flow into main column 2. This results in most of the primary components being discharged from the system. Consequently, it eliminates the large differences in concentration between primary and trace components flowing through main column 2.



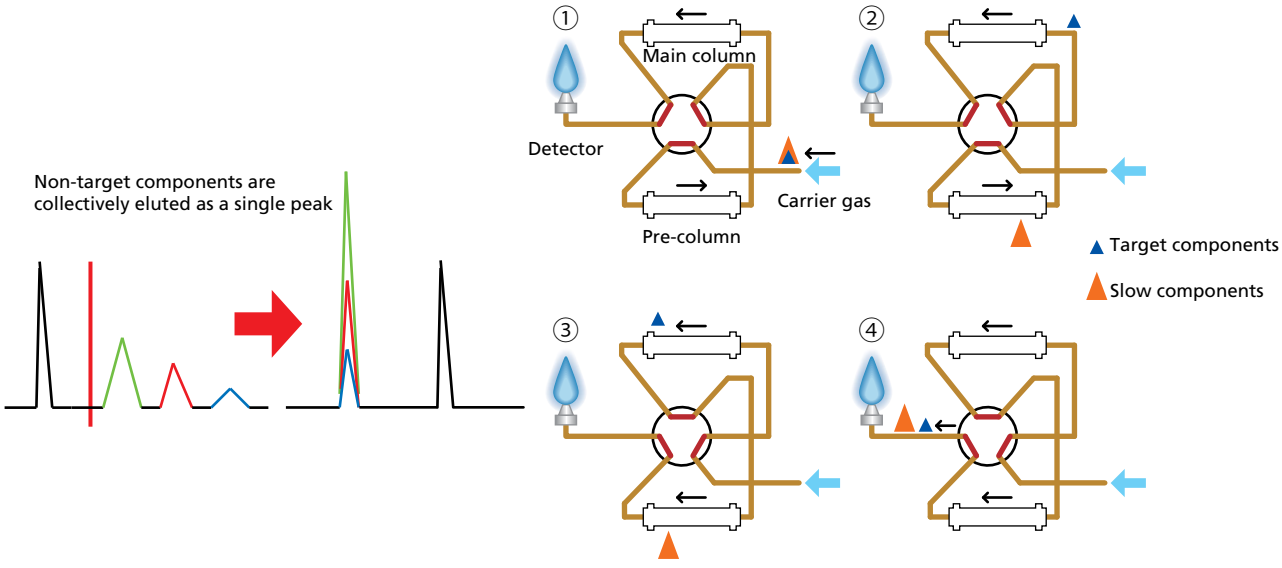
Column-Switching ～Improves Separation and Reduces Burden on Analysts～

Column-switching systems are used in cases where all components cannot be adequately separated with a single column. It achieves adequate separation by switching between different columns depending on respective component characteristics. This also helps reduce the burden on analysts, because all components can be analyzed at the same instead of requiring two separate analyses.



Backflush System ～Reduces Analysis Time and Protects Columns～

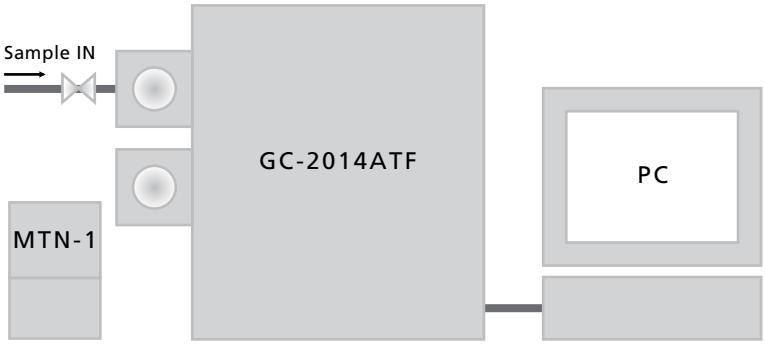
Backflushing systems elute non-target components early, all at the same time. Samples are approximately separated via a pre-column and target components are sent through a main column. Then a valve is switched to backflush the pre-column and send all the remaining components (components that elute late) to the detector. This can shorten the time required for flushing out slow components and helps prevent contamination of the main column.



Example of Analysis

CO_2 Impurity Analysis System

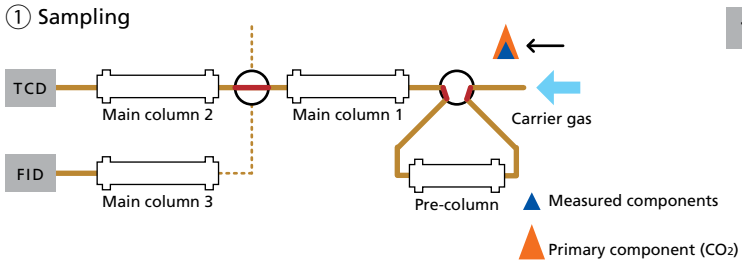
This system is intended for analyzing impurities (H_2, O_2, N_2, CH_4, and CO) in carbon dioxide.
A GC-2014ATF system is used to detect H_2, O_2, and N_2 with a TCD detector and CH_4 and CO with an FID detector. A pre-cut system diverts carbon dioxide, the primary component contained in the samples, from the system to shorten the analysis time and minimize column degradation due to CO_2.



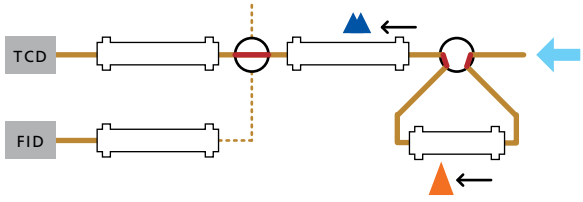
<System Configuration>
・GC-2014ATF (special-order model)
・PC with GCsolution
・MTN-1 (methanizer)
<Valve System>
・10-6 system
(Sampling, pre-cut, and column-switching)

Measured Components	Concentration Range
H_2	10ppm to 2%
O_2	50 to 500ppm
N_2	50 to 500ppm
CH_4	1 to 10ppm
CO	1 to 10ppm

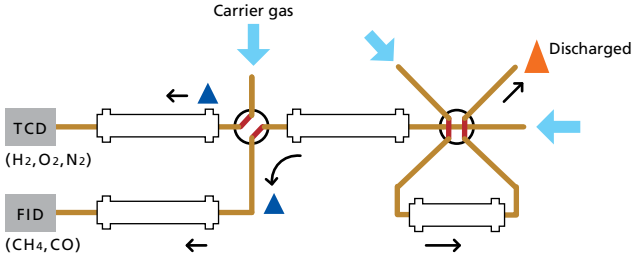
① Sampling



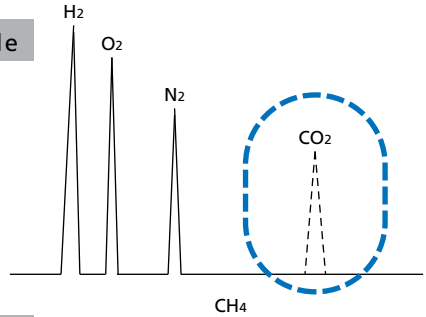
② Primary and measured components separated via a pre-column



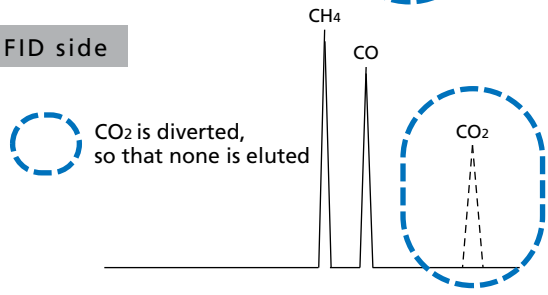
③ Detector switching and discharge of primary components



TCD side



FID side



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