

Shimadzu Gas Chromatograph Solutions for Hydrocarbon Processing Industry



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INTRODUCTION

Shimadzu provides proven System GC Solutions designed to meet the demands of your business and industry.

Our System GC Analyzers are built and tested to meet the specific analysis requirements of applicable industry standards.

Pre-installation

- Each System GC analyzer is factory pre-configured and pre-tested.
- Field installation and performance verification is completed by a Shimadzu factory-trained engineer or a certified partner engineer.

Post-installation

- Dedicated support by Shimadzu experts and partners will allow you to overcome your analytical challenges.



For six decades Shimadzu has been building gas chromatography products and remains committed to building the best GC products in the world.

Throughout our long history, the customers' needs have always been central to all our design, manufacturing and testing processes.

As part of this continuing commitment, we developed System GC solutions for the hydrocarbon processing industry (HPI) to provide our customers with the most reliable analytical solutions available anywhere.

From characterization of raw crude and natural gas to monitoring production and quality of refined chemicals and alternative fuels, Shimadzu is committed to providing the most complete GC analysis portfolio.

Shimadzu's HPI GC analyzers are built on a reputation of reliable, quality hardware and decades of technical expertise.

Our solutions range from a basic system modified with chemically deactivated material and customized columns to quantify trace contaminations in petrochemical systems to a complex multi-valve system for characterization of diverse components in a product.

The following pages provide an overview of Shimadzu's complete HPI GC analyzer solutions, which include:

- More than 100 factory-tested GC analyzers developed to comply with industry standards established by ASTM, GPA, ISO, UOP, etc.
- Customized GC analyzers configured and tested to your application's pre-determined specifications.
- Customized GC instruments and tools designed, delivered and supported by Shimadzu and its partners.

When you need pre-configured or customized analyzers, look to Shimadzu. We'll help you and your team reduce the time spent on application development and, as a result, improve your productivity.

PRODUCT OVERVIEW

Nexis GC-2030

The Next Industry Standard

Nexis GC-2030, Shimadzu's premier gas chromatograph, offers a modern approach to a classic chromatograph technique. Designed with the user in mind, new innovative features, exceptional performance and high throughput capabilities will elevate your lab to the next level.

Detailed Product Information:

<https://www.shimadzu.com/an/gc/2030/index.html>

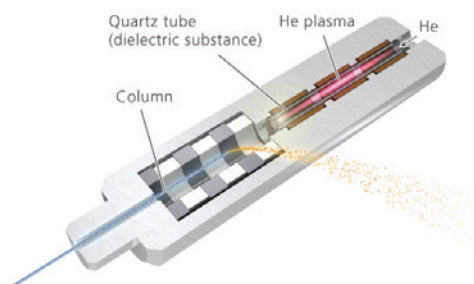
Product Brochure download:

<https://www.shimadzu.com/an/literature/gc/jpc118001.html>

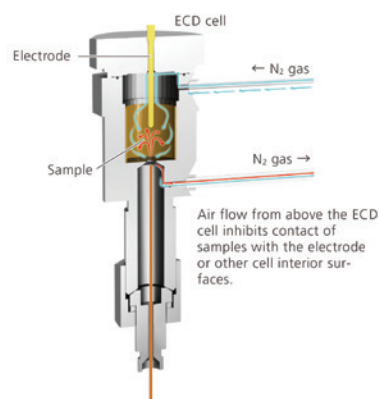


Features

High-Sensitivity Detectors Support a Wide Variety of Analyses



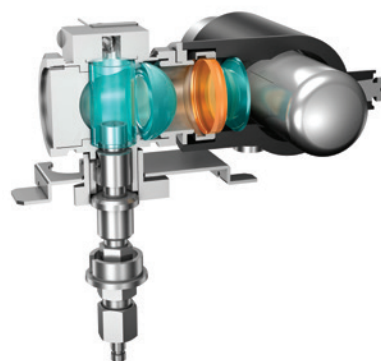
Barrier Discharge Ionization Detector (BID-2030)



Electron Capture Detector (ECD-2010 Exceed)



Flame Ionization Detector (FID-2030)



Flame Photometric Detector (FPD-2030)

Intelligent Flow Controller with Exceptional Reproducibility

A new advanced flow controller (AFC) has been developed to include a CPU. It supports carrier gas constant linear velocity control, constant flowrate control, constant pressure control and various other control modes and achieves exceptionally high reproducibility for ultra-high-speed and ultra-high-precision control modes. Multi-step programs can be created for each control mode as well. Time split line filter can be replaced with hands. Internal contamination can be confirmed visually to ensure filters are replaced at the proper timing.

	Peak Area Value RSD%	Retention time RSD%
Decane	0.29	0.005
1-Octanol	0.32	0.004
Undecane	0.28	0.004
2,6-dimethylaniline	0.29	0.003
n-Methyl Nonanoate	0.24	0.003
n-Methyl Decanoate	0.25	0.002
Dicyclohexylamine	0.23	0.003
n-Methyl Laurate	0.27	0.004



Flow Controller (AFC-2030)

GC Systems Customized for Specific Needs

Gasoline analysis system

This system is able to measure specific substances in gasoline, such as oxygenates.

Inorganic gas analysis system

This system is able to measure hydrogen and various other inorganic gases.

Refinery gas analysis system

This system is able to analyze components in gas from petroleum refineries.



Natural gas analysis system

This system is able to analyze components in natural gas, such as shale gas.

Hydrocarbon analysis system

This system is able to measure hydrocarbons that are generated, such as from catalyst reactions.

Public utility natural gas analysis system

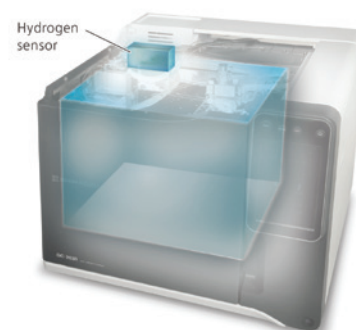
This system is able to calculate calorific values from measurements of natural gas.

Faster Analysis with Hydrogen Carrier Gas

Hydrogen can be a safe and highly effective carrier gas. As a highly efficient gas with a flat Van Deemter curve, it maintains its separation efficiency across a wide linear velocity range. This makes it both a good substitute for Helium and also a great choice for speeding up analysis times. We know safety is paramount, which is why the Nexis GC-2030 offers an optional built-in hydrogen sensor*. It not only maintains a safe standby mode for early detection of any potential leaks, but also shuts off hydrogen flow. The main unit also includes an automatic carrier gas leak check function, which is very helpful when using hydrogen as a carrier gas.

*Optional

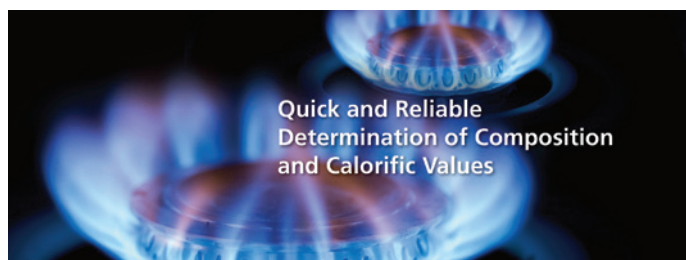
<https://www.shimadzu.com/an/system-gc/index.html>



Hydrogen Sensor Monitors Inside the GC oven

SYSTEM GC SOLUTIONS AND PRODUCTS LINEUP

NATURAL GAS



<https://www.shimadzu.com/an/system-gc/n9j25k00000fndej.html>

Natural gas is a fossil fuel widely used for town gas, electric generation and organic chemicals as feedstock. Natural gas contains mainly methane and other light hydrocarbons and also contains a small amounts of carbon dioxide, oxygen, nitrogen, hydrogen, sulfide, or helium as impurities. For the trading of natural gas, calorific value and purity are measured. Some of impurities such as hydrogen sulfide must be controlled before Using for producing chemicals in next streams in the plant. Shimadzu natural gas analyzers measure permanent gases and light hydrocarbons from C1 to C5 with C6+ backflush, as well as extended type has function for measuring middle hydrocarbons up to C15. Our factory assembles and tests our GC analyzers for chemical composition analysis of natural gas and liquid natural gas. System is equipped with software that outputs reports according to ISO, BTU requirements.

Extended Natural Gas Analyzer (Single Oven)

Nexis GC-2030ENGA1

Analyzer Description

System Configuration:

-4 Valves / 7 columns (Packed and Capillary) / 2 TCDs / FID

Sample Information:

- Natural gas or similar gaseous mixture

Compounds Analyzed:

- C1 to C14 hydrocarbons, He, H₂, O₂, N₂, H₂S, CO, CO₂

Typical Concentration Range:

- 0.01% mol for permanent gases and C2 hydrocarbon on TCD, 10ppm for C3 to C13 hydrocarbons on FID except for H₂S and CH₄, 0.10% mol for H₂S and 20% for methane

Reference Method:

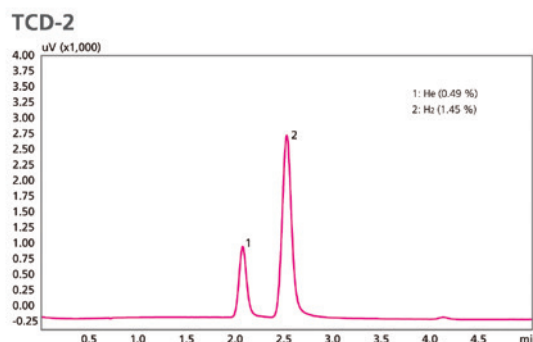
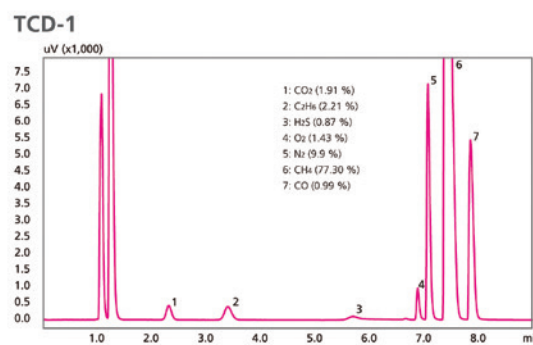
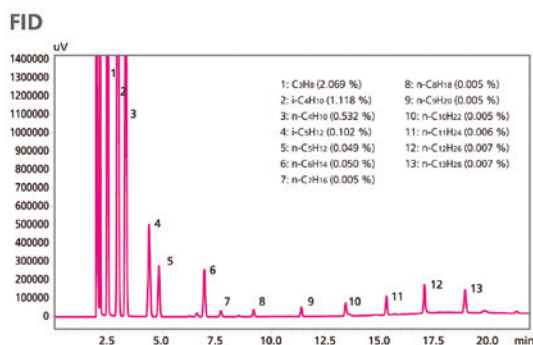
- ASTM D-1945, D-3588 and GPA2286

Application Brochure Download:

<https://solutions.shimadzu.co.jp/an/n/en/gc/jpc118002.pdf>

Features

- Dual TCD channels
- Dedicated channel for hydrocarbon and Helium analysis
- FID channel for C3 to C13 hydrocarbons
- Rugged packed and capillary columns
- 30min. analysis time
- BTU Calorific and Specific Gravity Calculation Software provided as per ASTM D-3588



PRODUCT LINEUP FOR NATURAL GAS ANALYSIS

Recently, natural gas has been recognized as a clean resource for energy, in addition to being a raw material for chemical products. Recently a cutting-edge drilling technology has increased the use of shale gas. As the production area diversifies, the need for gas composition analysis has increased. Shimadzu addresses analytical requests with a wide system GC lineup. For analysis of liquified gas, such as LPG, a dedicated injector with a vaporizer is available. Both manual injection and online injection are available. The operation software can automatically calculate needed values, such as indexes, calorific values, etc.

The ultrafast natural gas analyzer UFRGA is here.

<https://solutions.shimadzu.com/an/system-gc/n9j25k00000fne72.html>

Natural Gas Analysis System Lineup

Model Name	Nexis GC-2030 BIDUFNGA	Nexis GC-2030FNGA-II1	Nexis GC-2030FNGA-II2	Nexis GC-2030FNGA1	Nexis GC-2030FNGA2
Reference Method	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588, GPA-2261
Type of Detector	BID, FID	TCDx2, FID	TCD, FID	TCDx2, FID	TCD, FID
Target Compounds	Permanent gases, C1-C5, H2S, C6+(backflush)	H2, O2, N2, CO, CO2, H2S, C1-C5, C6+(backflush)	O2, N2, CO, CO2, H2S, C1-C5, C6+(backflush)	He, H2, O2, N2, CO, CO2, H2S, C1-C5, C6+(backflush)	O2, N2, CO, CO2, H2S, C1-C5, C6+(backflush)
Analysis Time	5 minutes	10 minutes	10 minutes	10 minutes	10 minutes
Others	Permanent gases>10 ppm, H2S>100 ppm, CH4>100 ppm, Other hydrocarbons>10 ppm, Calorific value software available	Permanent gases>100 ppm, H2S>1000 ppm, CH4>20%, Other hydrocarbons>10 ppm, Calorific value software available	Permanent gases>100 ppm, H2S>1000 ppm, CH4>20%, Other hydrocarbons>10 ppm, Calorific value software available	Permanent gases>50 ppm, H2S>500 ppm, Hydrocarbons>10 ppm, Calorific value software available	Permanent gases>50 ppm, H2S>500 ppm, Hydrocarbons>10 ppm, Calorific value software available

Model Name	Nexis GC-2030ENGA1	Nexis GC-2030ENGA2	Nexis GC-2030NGA1	Nexis GC-2030NGA2	Nexis GC-2030HNR1	Nexis GC-2030HNR2
Reference Method	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588, GPA-2261	ASTM-D1945, ASTM-D3588	-	-
Type of Detector	TCDx2, FID	TCDx2, FID	TCD	TCD	FID	FID
Target Compounds	He, H2, O2, N2, CO, CO2, H2S, C1-C14	H2, O2, N2, CO, CO2, H2S, C1-C18	He, H2, O2, N2, CO, CO2, H2S, C1-C5 (Better He and H2 separation)	O2, N2, CO, CO2, H2S, C1-C5, C6+(backflush)	C1-C5 C6+(backflush)	C1-C5 C6+(backflush)
Analysis Time	30 minutes	28 minutes	23 minutes	23 minutes	27 minutes	10 minutes
Others	Permanent gases>50 ppm, H2S>500 ppm, Hydrocarbons>10 ppm, Liquified samples can be directly injected.	Permanent gases>50 ppm, H2S>500 ppm, Hydrocarbons>10 ppm, Liquified samples can be directly injected.	-	-	C1 is 0.01%, C2-C6 is 0.001% Packed column as main column	Hydrocarbons > 0.001% Good separation

Application Datasheet Download - Natural Gas Analysis System:

<https://www.shimadzu.com/an/system-gc/n9j25k00000fndej.html>

ISO6974-3: <https://www.shimadzu.com/an/system-gc/nga/ads-0060.pdf>

ISO6974-4: <https://www.shimadzu.com/an/system-gc/nga/ads-0061.pdf>

Compliant systems are also available

LPG Analysis System Lineup

<https://www.shimadzu.com/an/system-gc/n9j25k00000fndej.html>



REFINERY GAS



Provide Advance and Complete Work Solution without Workflow Disruption

<https://www.shimadzu.com/an/system-gc/n9j25k0000fndbr.html>

Refineries distillates crude oil into different fractions and finally produces converts fuels and feedstock for downstream chemical processes such as gasoline, naphtha, fuels heavy oils and lubricants. Refinery gases contain permanent gases such as oxygen, nitrogen, carbon dioxide and saturated & unsaturated hydrocarbons from C1 to C5. Refinery gas composition analysis is very complex and high-speed analysis is enquired for quick feedback to processing control. Shimadzu refinery gas analyzers measure permanent gases and light hydrocarbons from C1 to C5 with C6+ backflush, as well as high speed type analyzers can give results within only 6 minutes. Our factory assembled and tested our GC analyzer for the chemical composition analysis of refinery gas.

Complete Extended Refinery Gas Analyzer

Nexis GC-2030CERGA1

Analyzer Description

System Configuration:

- 5 Valves / 6 columns (Packed and Capillary) / 2 TCDs / 2FIDs
- Dual GC ovens

Sample Information:

- Refinery gas or similar gaseous mixture

Compounds Analyzed:

- C3 to C14 hydrocarbons, He, H₂, O₂, N₂, H₂S, CO, CO₂, C₂C₆, C₂C₄, C₂H₂

Typical Concentration Range:

- 0.01% mol for permanent gases and C₂ hydrocarbon on TCD, except for H₂S 0.1% for H₂S
- 0.001% for C₃ to C₁₄ hydrocarbons

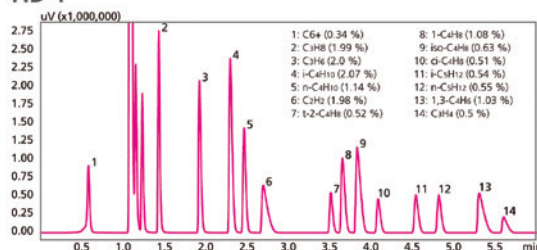
Reference Method:

- ASTM D-1946, D-1945, D-3588 and GPA2286

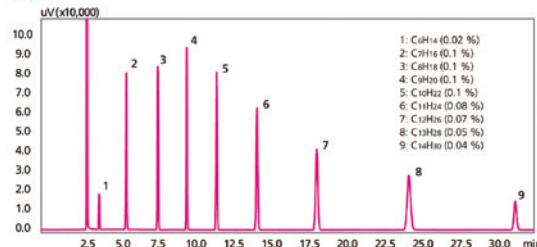
Features

- Multi sample-type injectors
Vaporizer/ Liquid sampling valve/ Gas sample injection
- Dual TCD channels
- Dedicated channel for Hydrogen and Helium
- FID for C₃ to C₆+ hydrocarbons
- 2nd FID for C₆ to C₁₄ hydrocarbons in 2nd GC oven
- Rugged packed and capillary columns
- Dedicated software for switching analytical flow and sample injection for easy-to-use

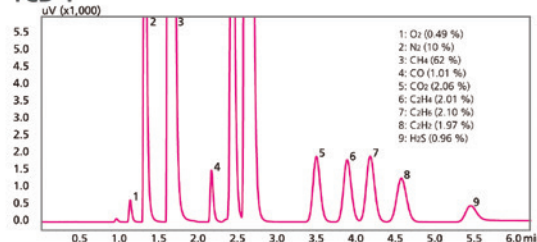
FID-1



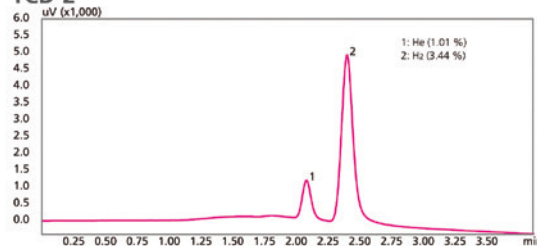
FID-2



TCD-1



TCD-2



PRODUCT LINEUP FOR REFINERY GAS ANALYSIS

Gas compositions produced in refinery plants consist of hydrocarbons, permanent gases, H₂S, etc. Analyzing these gases is essential to control the quality of chemical products and plant operation. Shimadzu's RGA systems, available in numerous configurations, are designed to analyze various compositions in a variety of processes. In research and development for petrochemical and its catalysis field, target compounds often contain high-boiling point compounds and isomers. The Shimadzu CERGA makes it possible to precisely analyze those samples. In addition, calorific value calculation software is compliant with various calculation methods such as BTU and ISO-6976.

The ultrafast analysis system UFRGA series is now available. <https://www.shimadzu.com/an/system-gc/n9j25k00000fne72.html>

Model Name	Nexis GC-2030TH2	Nexis GC-2030TNO	Nexis GC-2030TCC	Nexis GC-2030HC2	Nexis GC-2030RGA1	Nexis GC-2030RGA2
Reference Method	ASTM-D2504	ASTM-D2504	ASTM-D2504	ASTM-D1945	ASTM-D2163, UOP 539 ASTM D7833	ASTM-D2163, UOP 539 ASTM D7833
Type of Detector	TCD	TCD	FID with Methanizer	TCDx2	TCDx3	TCDx3
Target Compounds	H ₂	O ₂ , N ₂	CO, CO ₂ , CH ₄	H ₂ , O ₂ , N ₂ , Ar, CO, CO ₂ , C ₂ H ₄ , C ₂ H ₆ , C ₂ H ₂	H ₂ , O ₂ , N ₂ , Ar, CO, CO ₂ , C ₁ -C ₅ , C ₆ +	H ₂ , O ₂ , N ₂ , Ar, CO, CO ₂ , C ₁ -C ₅ , C ₆ +
Analysis Time	5 minutes	5 minutes	20 minutes	10 minutes	30 minutes	40 minutes
Others	Good separation for H ₂ and O ₂	Good separation for N ₂ and O ₂	Good separation for CO, CO ₂ and CH ₄	Good separation for each composition	Good separation for each compositionThree TCD channels	Good separate for each compositionThree TCD channels

Model Name	Nexis GC-2030 FRGA1 GC-2014 FRGA1	Nexis GC-2030 FRGA2 GC-2014 FRGA2	Nexis GC-2030 FRGAI1 GC-2014 FRGAI1	Nexis GC-2030 FRGAI2 GC-2014 FRGAI2	Nexis GC-2030 HSRGA1 GC-2014 HSRGA1	Nexis GC-2030 HSRGA2 GC-2014 HSRGA2
Reference Method	ASTM-D1945, D1946, D3588, GPA-2261, UOP 539, ASTM D7833	ASTM-D1945, D1946, D3588, GPA-2261, UOP 539, ASTM D7833	ASTM-D1945, D1946, D3588, GPA-2261, UOP 539, ASTM D7833	ASTM-D1945, D1946, D3588, GPA-2261, UOP 539, ASTM D7833	ASTM-D1945, D1946, D3588, GPA-2261, UOP 539, ASTM D7833	ASTM-D1945, D1946, D3588, GPA-2261, UOP 539, ASTM D7833
Type of Detector	TCDx2, FID	TCD, FID	TCDx2, FID	TCD, FID	TCDx2, FID	TCD, FID
Target Compounds	He, H ₂ , O ₂ , N ₂ , H ₂ S, CO, CO ₂ , C ₁ -C ₅ , C ₆ +	O ₂ , N ₂ , H ₂ S, CO, CO ₂ , C ₁ -C ₅ , C ₆ +	He, H ₂ , O ₂ , N ₂ , H ₂ S, CO, CO ₂ , C ₁ -C ₅ , C ₆ +	O ₂ , N ₂ , H ₂ S, CO, CO ₂ , C ₁ -C ₅ , C ₆ +	He, H ₂ , O ₂ , N ₂ , H ₂ S, CO, CO ₂ , C ₁ -C ₅ , C ₆ +	O ₂ , N ₂ , H ₂ S, CO, CO ₂ , C ₁ -C ₅ , C ₆ +
Analysis Time	10 minutes	10 minutes	10 minutes	10 minutes	6 minutes	6 minutes
Others	Full range capability for H ₂	Hydrogen and helium are removed from target compounds compared with FRGA1.	Full range capability for H ₂	Hydrogen and helium are removed from target compounds compared with FRGAI-2.	Full range capability for H ₂ High-speed analysis model	Hydrogen and helium are removed from target compounds compared with HSRGA1.

Model Name	Nexis GC-2030 ERGA1	Nexis GC-2030 ERGA2
Reference Method	ASTM-D1945, D1946, D3588, GPA-2261	ASTM-D1945, D1946, D3588, GPA-2261
Type of Detector	TCDx2, FIDx2	TCD, FIDx2
Target Compounds	H ₂ , He, O ₂ , N ₂ , CO, CO ₂ , H ₂ S, C ₁ to C ₁₈	O ₂ , N ₂ , CO, CO ₂ , H ₂ S, C ₁ to C ₁₈
Analysis Time	25 minutes	25 minutes
Others	By using second GC-2014 oven, extended hydrocarbons up to C ₁₃ can be analyzed. Simple software enables us to operate dual oven system simply.	By using second GC-2014 oven, extended hydrocarbons up to C ₁₃ can be analyzed. Simple software enables us to operate dual oven system simply.

Application Datasheet Download: <https://www.shimadzu.com/an/system-gc/n9j25k00000fndbr.html>

Complete Extended RGA: <https://www.shimadzu.com/an/system-gc/n9j25k00000fne9x.html>

Calorific value calculation software: <https://www.shimadzu.com/an/system-gc/n9j25k00000fnevcv.html>

GC-2014 system is also available for some applications

REFORMULATED FUEL



Reformulated Gasoline is oxygenates deliberately added gasoline for increasing atmosphere cleanness. Environmental regulators have set limitation on volatile organic compounds and other toxic chemicals from exhaust gasses. Fuel producer have to design fuels for keeping good engine efficiency and performance, and also watch the quality of feedstock such as naphtha and additive oxygenates. Shimadzu reformulated fuel analyzers measure oxygenates in the gasolines. Our factory assembled and tested our GC analyzers according to ASTM refined methods.

Reformulated Fuel Analyzer - BT / ARO / OXY

Nexis GC-2030_3606-4815-5580_1

Analyzer Description

System Configuration:

- 2 Valves / 4 columns (Packed and Capillary) / Split / Splitless and Packed Injector / FID / TCD

Sample Information:

- Aviation and motor gasoline fuel

Compounds Analyzed:

- Benzene and Toluene
- MTBE, Ethers and Alcohols
- Benzene, toluene, 2-hexanone, ethylbenzene, xylene, C9 and heavier aromatics, total aromatics

Typical Concentration Range:

- 0.1% for Benzene and 2% for Toluene
- 0.1% for Ethers and Alcohols
- 0.1% for Benzene, 1% for Toluene and 0.5% for Ethylbenzene and Xylene, 5% for C9 aromatics and 10% for total aromatics

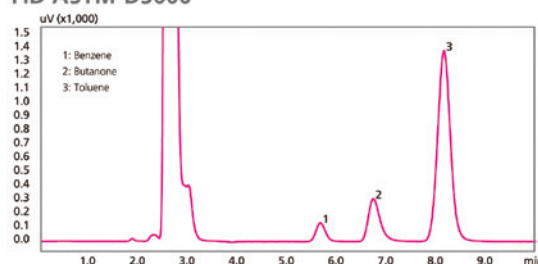
Reference Method:

- ASTM D-4815, D-5580, D-3606

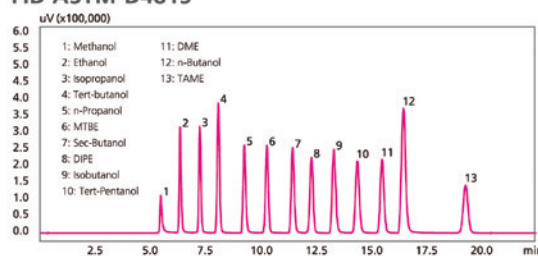
Features

- Single channel configured with dual columns to determine benzene, toluene, ethylbenzene and xylene in finished gasoline fuel
- Configured with newly improved TCEP column to improve method stability
- 40 min. analysis time

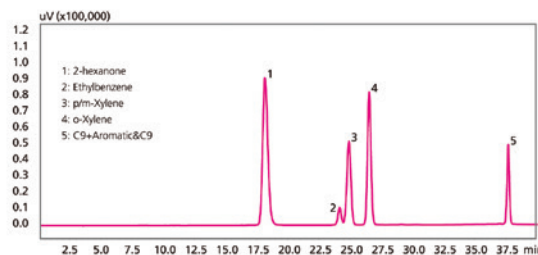
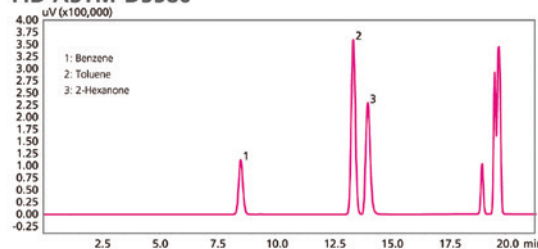
FID ASTM-D3606



FID ASTM-D4815



FID ASTM-D5580



PRODUCT LINEUP FOR GASOLINE/FUEL ANALYSIS

A gas chromatograph is used for composition analysis of gasoline and its additives in order to improve fuels' performance. In addition to excellent performance, Shimadzu's GC systems improve productivity. For example, the Nexis GC-2030 system combines three standards into one to save analytical instrument and labor costs.

Benzene, toluene, and aromatics analysis system (Compliant with ASTM-D3606, D4815, D5580)

Model Name	Nexis GC-2030 3606-4815-5580-1 GC-2014 3606-4815-5580-1
Reference Method	ASTM-D3606, ASTM-D4815, ASTM-D5580
Type of Detector	TCD, FID
Target Compounds	Dual channel and valve system realizes simultaneous analysis compliant with ASTM D3606, D4815, D5580

Benzene and toluene analysis system

Model Name	Nexis GC-2030 BTA1	Nexis GC-2030 BTA2	Nexis GC-2030FBTA1
Reference Method	ASTM-D3606	ASTM-D3606	ASTM-D3606
Type of Detector	TCD	FID	FID
Target Compounds	0.1% to 5% for Benzene, 2% to 20% for Toluene	10ppm to 5% for Benzene, 200ppm to 20% for Toluene	1 ppm to 1000 ppm for Benzene, 1 ppm to 1000 ppm for Toluene
Analysis Time	9 minutes	9 minutes	4 minutes

Aromatic components analysis

Model Name	Nexis GC-2030ACA1
Reference Method	ASTM-D5580
Type of Detector	FID
Target Compounds	0.1 to 5% for Benzene, 1 to 15% for Toluene, 0.5 to 10% for C8 aromatics, 5 to 30% for total C9 and heavier aromatics
Analysis Time	38 minutes

Oxygenate Analysis

MDGC-2010 system provides higher separation. Learn MDGC-2010: <https://www.shimadzu.com/an/gc/multidimgc/multidimmdgc.html>

Oxygenate Analysis

Model Name	Nexis GC-2030OXY2	Nexis GC-2030OAS3	Nexis GC-2030OAS1
Reference Method	ASTM-D7423	UOP-960	ASTM-D4815
Type of Detector	FID	Two FID	FID
Target Compounds	DME, Diethyl ether, Acetaldehyde, ETBE, MTBE, DIPE, Methanol, Acetone, MEK	ETBE, MTBE, DIPE, Propionaldehyde, TAME, C1 to C5 alcohols in liquid hydrocarbon stream	MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 alcohols in gasoline

Application Datasheet Download - Gasoline/Fuel Analysis System:

<https://www.shimadzu.com/an/system-gc/n9j25k00000fndk6.html>

Detailed hydrocarbon analysis (DHA):

<https://www.shimadzu.com/an/system-gc/n9j25k00000fndn1.html>

GC-2014 system is also available for some applications.



DETAILED HYDROCARBONS ANALYSIS



<https://www.shimadzu.com/an/system-gc/n9j25k00000fndn1.html>

The purpose of detailed hydrocarbon analysis (DHA) is to determine the bulk hydrocarbon group type composition (PONA: Paraffins, Olefins, Naphthenes and Aromatics) of gasoline and other spark ignition engine fuels that contain oxygenate blends (Methanol, ethanol, MTBE, ETBE, and TAME) GC-2030's intelligent Advance Flow Controller realizes precise linear velocity control to provide accurate and stable analytical result. Using third party software, bothering identification work of several hundreds of peaks will become easier. Misidentification will also be prevented.

Detailed Hydrocarbon Analyzer

Nexis GC-2030 PONA Series

Analyzer Description

System Configuration:

- 1 column (Capillary) / Split or Splitless Injector / FID

Sample Information:

- Spark ignition engine fuels, naphtha

Compound Analyzed:

- Paraffins, Oxygenates, Naphthene, Aromatics

Typical Concentration Range:

- 0.1%

Reference Method:

- ASTM D-5134, D-6729, D-6730

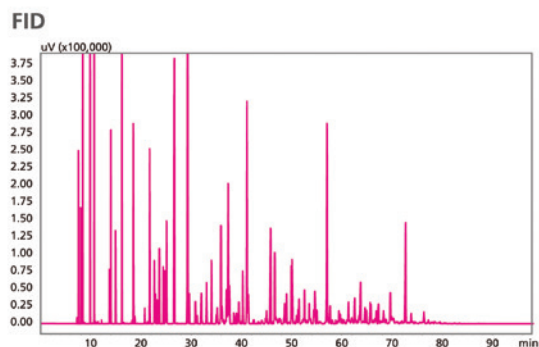
Application Datasheet; GC-2030PONA2 for ASTM D5134

"Detailed Hydrocarbon Analysis of Naphtha":

<https://www.shimadzu.com/an/system-gc/dha/ads-0173.pdf>

Features

- Complies to method ASTM D-5134, D-6729, D-6730
- Includes third party software
 - Fast peaks identification and report processing
 - Automatic re-calculation when changes are made
 - Hydrocarbon group type filtering
 - Full preview and printing of report
 - Data files are saved as CDF (AIA) format and can be assessed by 3rd party applications that support AIA formatfile
 - Full reports are stored with results for easy retrieval without reprocessing
- Built in Chemical and Physical Property Calculations:
 - Vapor Pressure
 - Oxygenate Content
 - Relative Density
 - Average Molecular Weight
 - Calculated Research Octane Number
 - % Carbon, % Hydrogen
 - Calculated Bromine Number
 - Mass % and Vol % Multi substituted Ring Aromatics



SIMULATED DISTILLATION



https://www.shimadzu.com/an/gc/dst/dst_index.html

Simulated distillation GC analysis applies a gas chromatograph with a nonpolar Column to the boiling-point distribution analysis of petroleum fractions, such as kerosene, diesel oil, lubricating oil and heavy oil.

The Shimadzu simulated distillation system, employs dedicated on cool column injector (OCI-2030) and LabSolutions simulated distillation GC analysis software, meets all applicable ASTM, ISO, EN, and JIS standards. Permitting accurate and highly reproducible analysis of high-boiling components in crude oil samples, it is the optimal system for product quality control and process management in oil refinery plant

	Carbon No.	Sample
ASTM D 3710 D 7096	n-C3 n-C15	Gasoline, naphtha
JIS K 2254	-	Kerosene, diesel oil
ASTM D 2887 (ISO3924, IP406)	n-C5 n-C44	Jet fuel, diesel oil
ASTM D 6417	n-C8 n-C60	Lubricating oil, base stock oil
ASTM D 7213 (Extended D2887)	n-C7 n-C60	Lubricating oil, base stock oil
ASTM D 6352	n-C10 n-C90	Lubricating oil, base stock oil
ASTM D 7500	n-C7 n-C100	Lubricating oil, base stock oil
EN 15199-1 (IP480, DIN 51435)	n-C7 n-C120	Lubricating oil, base stock oil
ASTM D 5307	n-C44 Max	Crude oil (internal standard method)
ASTM D 7169, EN 15199-2 (IP 507)	n-C7 n-C100	Crude oil (external standard method, n-C120 max. for EN)

Simulated Distillation Analyzer

Nexis GC-2030 SDA

Analyzer Description

System Configuration:

- 1 column (Capillary) / OCI-PTV / injector / FID

Sample Information:

- Base stock, lube oil, crude oil, petroleum distillate fractions (naphtha, gasoline, diesel, jet fuel, kerosene)

Compound Analyzed:

- Hydrocarbons from n-C3 to n-C120

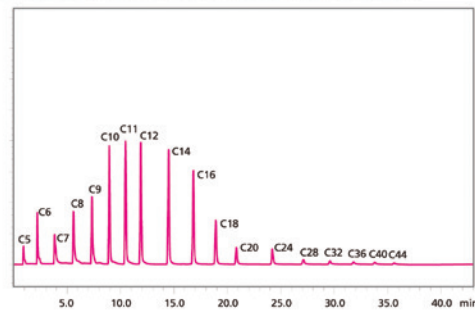
Typical Concentration Range: ~0.1%

Features

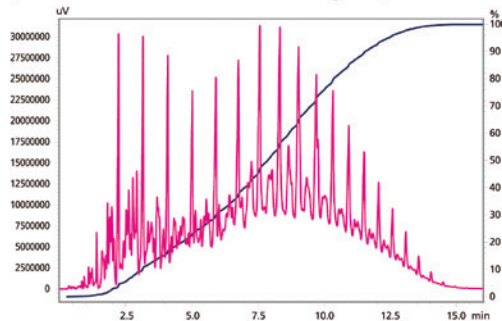
- Complies to method ASTM D-3710, JIS K 2254, D-2887, D-5307, D-6417, D-7213 (Extended D2887), D-6352, D-7169, D-7500, EN 15199-1 7-steps temperature programmable vaporization injector
- High performance column designed and suited for SIMDIST
- SIMDIST software integrated with LabSolutions
- Easy operation with multi-reporting option.

<https://www.shimadzu.com/an/literature/gc/jpc113003.html>

Chromatogram of Calibration Mix Standard



Sample Analysis of ASTM-D2887 Light Oil (Distillation Curve and Chromatogram)



CUTTING-EDGE TECHNOLOGY INTRODUCTION

Moisture Analysis via Gas Chromatography/BID in Petroleum and Petroleum Products



<https://www.shimadzu.com/an/gc/moisture.html>

Analyzing moisture, and how much of it, is critical to the performance of petroleum products, as well as infrastructure and product integrity. For example, moisture in petrochemical feedstock can cause pipelines and valves to freeze, as well as poison some catalysts. One popular method used to analyze for moisture is Karl Fischer Titration (KFT). KFT has a wide dynamic range but has difficulty in measuring relatively low amounts of moisture. In addition, there are the well-known problems of side reactions and known interferences.

An alternative method combines Shimadzu's proprietary Barrier Discharge Ionization Detector (BID) with MilliporeSigma's* moisture analysis column "Watercol". This combination separates and measures the moisture in a formulation of feedstock and provides sensitive and accurate results with measurements made down to a ppm level of moisture detection without any interference.

New Approach Using Gas Chromatography with the Novel BID

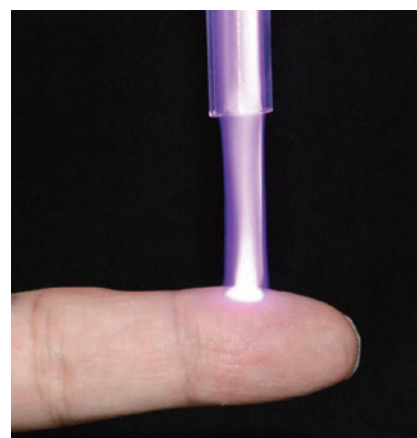
Unlike traditional wet chemistry methods, this new method uses Gas Chromatography (GC) with a newer detector - the Barrier Discharge Ionization Detector (BID). The BID is a highly sensitive device that creates ionization from a Helium-based, dielectric barrier discharge plasma. A 17.7eV plasma is generated by applying a high voltage to a quartz dielectric chamber, in the presence of helium at a relatively low temperature. Compounds that elute from the GC column are ionized by this He plasma energy and then detected by the collection electrode and processed as peaks.

The BID is more sensitive than both a Thermal Conductivity Detector (TCD) and a Flame Ionization Detector (FID) with the ability to analyze down to sub-ppm levels of water. Additionally, the method uses MilliporeSigma's new, highly polar ionic liquid column, Watercol™, which provides excellent water retention, separation and peak shapes.

Because wet chemistry techniques are prone to interfering compounds, such as mercaptans and sulfides, this method uses a column separation technique to separate these and other compounds in the sample. Anyone with GC experience can quickly set up and run this method. Those without GC experience are easily trained by the Shimadzu Scientific Instruments service and tech support team.

Moisture Analysis by GC/BID offers the following advantages:

1. Easily analyzes both liquid and gas samples
2. Uses a variety of Watercol™ GC columns depending on your matrices
3. Uses a simple, high sensitivity, and very stable low cost GC detector



NEW ASTM WORK ITEM - PRECURSOR TO AN ASTM STANDARD METHOD

A new test method work item (WK59649): A New Standard Test Method for the Determination of Water in Liquefied Petroleum Gas (LPG) using Gas Chromatography and Barrier Discharge Ionization Detection (BID) has been submitted by the ASTM D02 H00 committee. This method uses the new GC/BID/Liquid/gas sampling valve with the Watercol™ (MilliporeSigma*) GC column. Be on the lookout for the official method once it is approved by ASTM.

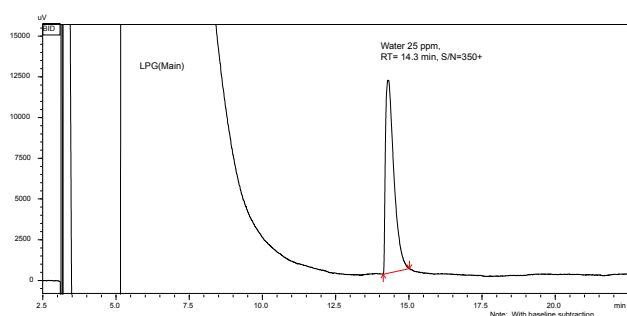


Fig 1. Chromatogram for water determination (25 ppm) in LPG. Quantification of Limit(S/N=10) and Detection of Limit(S/N=3.3) can be down to 0.66 ppm and 0.22 ppm respectively.

Moisture Analysis in Many Types of Petroleum Samples

- a: Standard addition with Aerosol-OT dissolved in moisture
- b: Standard addition is not feasible due to the samples high viscosity, complexity of samples and immiscibility with the added moisture standard
- c: Moisture measured in a 0.5g sample utilizing headspace gas chromatography

Many different types of samples can benefit from analyzing moisture content via the GC/BID Watercol™. Excellent precision and accuracy are achieved using manual or automated systems. Depending on the types of samples, a liquid/gas sampling valve can be used to introduce the samples to the GC or the Shimadzu HS-20 Headspace Autosampler.

(Lillian A. Frink; Daniel W. Armstrong, 8194-8201; Anal. Chem. 2016, 88)

Product	HSGC			Standard Addition
	mg water measured c	ppm water	RSD	ppm water
Motor Oil	0.386	770±2.9	0.4	770 a
Transmission Fluid	0.497	996±9.2	0.9	642
Engine Oil	0.131	261±5.8	2.2	269 a
Gear Oil	0.104	207±6.9	3.3	b
Power Steering Fluid	0.123	245±5.6	2.3	160
3 in One Oil	0.223	445±21.0	4.7	b
M-Pro 7 LPX Gun Oil	0.831	1630±15.9	1.0	1540
CLP Gun Oil	1.634	3260±87.4	2.7	b
Synthetic Gun Oil	0.117	234±3.4	1.5	b
Remington Moistureguard Rem Oil	0.165	330±8.1	2.5	302 a
Remington Rem Oil	0.048	116±4.5	3.9	102 a
WD-40	0.365	728±5.0	0.7	b
Transformer Oil (RM 8506a)	0.0061	12.1±0.8	6.6	b
Light Sour Crude Oil (SRM 2721)	0.071	146±7.6	5.2	b
Heavy Sweet Crude Oil (SRM 2722)	0.051	102±1.7	1.7	b

* MilliporeSigma, the life science business of Merck KGaA
Watercol is a trademark of MilliporeSigma.

CUSTOMERS TESTIMONIALS



Customer: Mr. Foo Sin Charm,
Superintendent

Quality Control & Assurance
Department, Petrochemical
Corporation of Singapore (Private)
Ltd., SINGAPORE

Since 1984, Petrochemical Corporation of Singapore (PCS) has been using SHIMADZU GCs to monitor trace impurities and determine purity of our petrochemical plant process stream samples. In PCS's laboratory, we have more than 30 units of SHIMADZU GCs equipped with different types of detectors.

SHIMADZU GC SYSTEMS CAN BE DESIGNED TO SUIT OUR APPLICATIONS.

It has the flexibility of incorporating any type of column (packed or capillary columns including, glass columns) with integrated multiple valves system and detectors to meet our GC operation requirements. SHIMADZU's Advanced Flow Technology for multi-dimensional system, back-flush and detector splitting systems are of acceptable performance. The software is user-friendly and allows for easy data analysis and management. Furthermore, sales and technical support teams are prompt in response.

We have been using SHIMADZU System GC which is preconfigured for Monitoring of Green House Gases especially Methane and Nitrous Oxide under climate change project.

We are using this system extensively for more than 5 years and results are reliable and reproducible.

THE DESIGN OF SYSTEM IS VERY ROBUST WITH EASE OF OPERATION.

Moreover, customer support and Service have been satisfactory.



Customer: Dr. S. V. Viyol,
Assistance Research
Scientist (Env. Sci.)

ASPEE College of
Horticulture and Forestry,
Navsari Agricultural
University, INDIA

Customer: Mr. Liu Lei, Director, Quality Management Department
China Shenhua Coal to Liquid and Chemical Co., LTD., Ningxia, CHINA

After we started to implement Shimadzu systems, we have purchased 24 GC systems for the first project 2009, 42 GC systems for the second project and 76 GC systems for the fourth project; in total 142 systems are currently working.

Among those systems, high-end system GC are used for various applications, for example, refinery gases with UOP539, trace level Ash3 and PH3, and in combination with many kinds of selective detectors, SCD, FPD, MS and Dean's switch. Also Shimadzu CDS (Chromatographic Data System) network is contributing to efficient and stable chromatographic data management.

DURING THE IMPLEMENTATION OF THOSE PROJECTS, SHIMADZU HAS PROVIDED THE COMPLETE AND WELL-PREPARED APPLICATION INFORMATION AND SUPPORT THROUGHOUT THE WHOLE PROCESS.

There are specific needs in coal-chemical industry, which they have addressed by continuous support in the laboratory for innovative application development and analytical solution creation.

We are closely working together with Shimadzu on revision of the analytical methods, formulation of the analytical standards, and we are expecting to establish a joint laboratory to further increase the synergy.



CONSUMABLES SOLUTIONS

GC Consumables are designed to complement your Shimadzu GC-2010, GC-2014, Nexis GC-2030 System. Shimadzu understands your chromatography analysis does not end with the selection of the GC column - the combination of components selected for your instrument make an important contribution to successful chromatography. Shimadzu GC Consumables are designed to provide you with the best separation possible.

SAMPLE INTRODUCTION – Syringes

Shimadzu's syringes for both manual and autosampler use incorporate Diamond Syringe Technology offering significantly improved levels of durability, clarity and accuracy. Features of the Diamond Syringe Technology include:

- Longest working life in the industry
- Improved solvent resistance
- Greater operational temperature range
- Reduced dead volume and carryover

SAMPLE INTRODUCTION – GC Inlet Liners

The GC inlet liner is where the sample is introduced and vaporized into the gaseous phase. The geometry of each of Shimadzu's inlet liners is important and the correct choice of inlet liner can significantly improve the performance of the chromatography. Inlet liner deactivation, quartz wool quantity and position are essential to ensure reproducible and accurate sample introduction for each sample type.

SEPARATION – GC Connections (Ferrules and Unions)

Shimadzu provides an array of connection types for use in the GC, each selected to ensure the best connection solution is achieved. The correct selection of the connection type will eliminate dead volumes, leaks during temperature cycling and problems with mismatched tubing sizes.

SEPARATION – GC Columns (Fused silica capillary, PLOT, Packed & Micropacked, Metal)

Shimadzu offers a range of stationary phases including non-polar and polar functionalities for GC and GC/MS application in analysis of gases, solvents, hydrocarbons, drugs, pesticides, solvent impurities, polar and non-polar analytes, and for high-temperature analysis.

Shimadzu also offer custom packed columns according to your preferred column material (glass or metal), length, id, phase, solid support and mesh. Contact your local Shimadzu office or Authorized Shimadzu Distributor to receive a quote for your custom column needs.

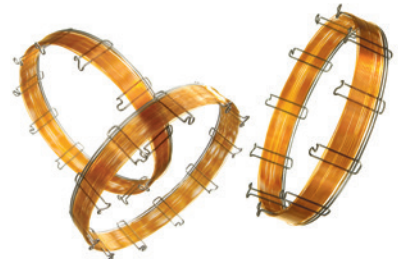
Super Clean Gas Filter

Shimadzu Super-Clean Gas Filter can remove the impurities (hydrocarbons, moisture and oxygen) and outlet 99.9999% pure gas. The use of high-purity and contaminant-free gases reduces column degradation, prevents ghost peaks and baseline fluctuations, eliminates excessive detector noise, and keeps your instrument in good working performance.



SAMPLE INTRODUCTION – Septa

Many chromatography problems are caused as a result of the wrong septa material or inappropriate handling of the septa. Shimadzu septa are selected to contribute low bleed and optimum sealing for many injections.



APPLICATION NEWS - NO. G288

High-Sensitivity Simultaneous Analysis of Inorganic Gases and Light Hydrocarbons using Nexis GC-2030 Dual BID System

Analyses for inorganic gases and light hydrocarbons are implemented in a variety of fields including petrochemistry, catalysts, batteries and other resource and energy fields, and environmental fields.

The barrier discharge ionization detector (BID) installed in Nexis GC-2030 gas chromatograph is capable of detecting a wide variety of components with high sensitivity*. Thanks to Shimadzu's proprietary barrier discharge technology, this detector features high sensitivity while maintaining the same level of stability as the previous general-purpose detectors.

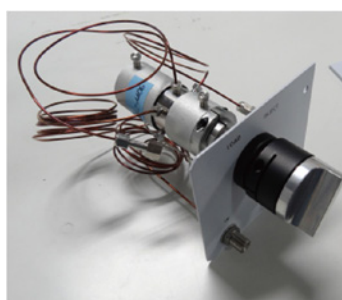
In this Application News, we introduce a high-sensitivity simultaneous analysis of inorganic gases and light hydrocarbons using Nexis GC-2030 gas chromatograph, which is equipped with two columns and two BID detectors.

*Unable to detect helium and neon

T. Yokoya, T. Murata

Instruments and Analytical Conditions

In this analysis, the MGS-2030 gas sampler was used for the introduction of gas into the instrument; the column was connected using the SPLITTER-INJ. The MGS-2030 is a manual gas sampler. A purge mechanism is included to reduce the leakage of peripheral air into the system. The SPLITTER-INJ refers to a special injection unit that permits split injection of the sample without requiring that it pass through the standard split/splitless injection unit. Using the MGS-2030 for sample gas injection together with the SPLITTER-INJ unit, it is possible to quantitatively analyze trace level air components, including Oxygen (O₂), Nitrogen (N₂), etc., with high accuracy.



Valve Unit



Manual Flow Controller for Purge

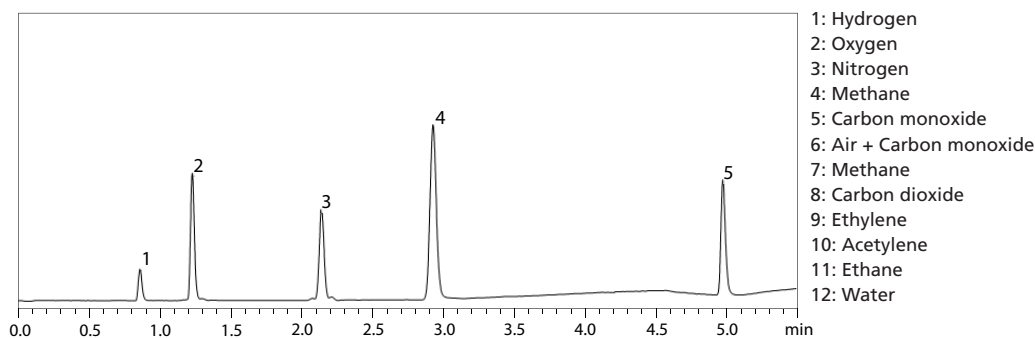
Table 1. Analytical Conditions

Model	Nexis GC-2030
Detector	BID-2030
Gas Sampler	MGS-2030
Column	Line1: Rt-Msieve 5A (0.32 mm I.D. × 15 m, d.f. = 30 μm) Line2: Rt-Q-BOND (0.32 mm I.D. × 30 m, d.f. = 10 μm)
Column Temperature	40 °C (3 min) - 40 °C /min - 200 °C (2 min) Total 9 min
Injection Mode	Split 1 : 10
Purge Gas	3 mL/min (He)
Carrier Gas Controller	Pressure (He)
Pressure Program	114 kPa (5 min) - 100 kPa/min - 200 kPa (3.14 min) Total 9 min
Detector Temperature	280 °C
Discharge Gas	50 mL/min (He)
Injection Volume	1 mL

Analysis Results

Only specific types of separation columns can be used for separation of inorganic gases and light hydrocarbons, and it is sometimes impossible to use a single column to separate all of the target components. Utilizing a dual capillary column system, constructed using two detectors and two columns, enables faster, higher separation analysis of inorganic gases and light hydrocarbons than methods using only one column.

Line 1 Rt-Msieve5A Column



Line 2 Rt-Q-BOND Column

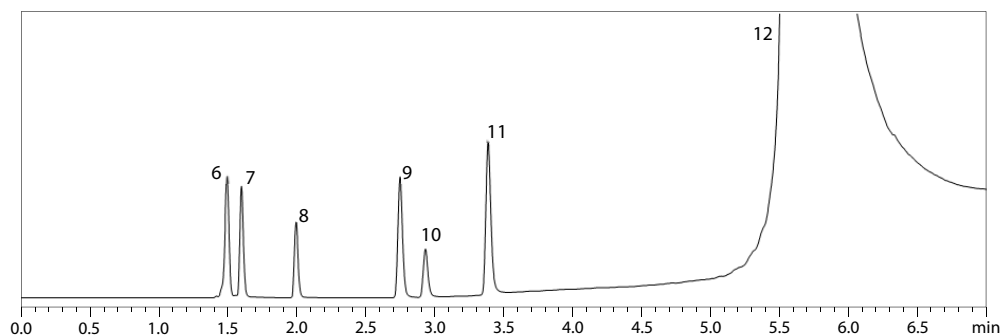


Figure 2. Chromatogram for 5 ppm Mixed Gas* *Helium balance

Table 2. Repeatability of Area Values ($\mu V \times sec$) for Each Component

	1	2	3	4	5	6	Ave.	RSD%
Hydrogen	3996	4010	4040	4052	4096	4105	4050	1.10
Oxygen	15036	14983	15023	14973	15009	15067	15015	0.23
Nitrogen	17021	16490	16510	16472	16566	16589	16608	1.25
Methane	35142	35412	35561	35625	35784	35970	35582	0.81
Carbon monoxide	17143	17237	17330	17371	17441	17499	17337	0.76
Carbon dioxide	25817	25812	25829	25779	25925	26010	25862	0.34
Ethylene	49433	49439	49527	49481	49714	49833	49571	0.33
Acetylene	37416	37436	37446	37440	37604	37717	37510	0.33
Ethane	67092	67187	67263	67357	67579	67701	67363	0.35

APPLICATION NEWS - NO. G291

Analysis of Thiophene in Benzene using Nexis GC-2030

Thiophene and other sulfur compounds are known to be linked to sulfur oxide generation during combustion, and as compounds associated with catalyst poisoning. Even very small quantities can have adverse effects, so the quality control of petroleum products requires trace analysis of sulfur compounds.

In the petroleum refinement process, thiophene is eluted together with benzene. ASTM D 7011 specifies standards for the analysis of thiophene impurities in benzene.

The FPD-2030 flame photometric detector, which is installed in Nexis GC-2030 gas chromatograph, has the world's highest level of sensitivity*, thanks to the optimized nozzle shape and the advanced dual focus system. In the analysis of sulfur content in petroleum products, this detector provides high sensitivity and high stability.

In this Application News, we describe the analysis of thiophene in benzene using Nexis GC-2030 gas chromatograph equipped with the FPD-2030.

E. Kobayashi, T. Murata

* As of May 2017

Instruments and Analytical Conditions

Table 1. GC analytical condition

Model	Nexis GC-2030 / AOC-20i
Software	LabSolutions LC/GC
Injection Unit	WBI direct injection unit
Injection Volume	1 μ L
Injection Temperature	200 °C
Column	SH-Stabiliwax (0.53 mm I.D. x 30 m, d.f. = 2.0 μ m)
Column Temperature	75 °C (7 min) Total 7 min
Purge Gas	3 mL/min (He)
Carrier Gas	He (99.999%)
Carrier Gas Control	Constant flowrate Total flowrate: 10 mL/min(He)
Detector	FPD-2030 (S)
Detector Temperature	230 °C
Detector Gas	H ₂ : 40 mL/min, Air: 60 mL/min

Analysis Results

The results of analyzing 0.1 to 10 ppm of thiophene (in a benzene solution) via the capillary column GC-FPD method are shown below. 0.1 ppm of thiophene in benzene was detected (S/N=16), and favorable linearity was obtained in the range from 0.1 to 10 ppm. (Fig. 2).

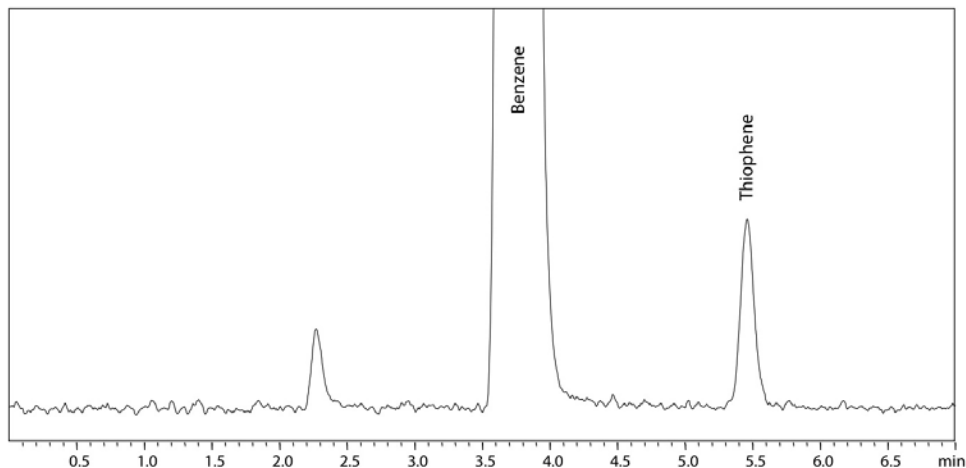
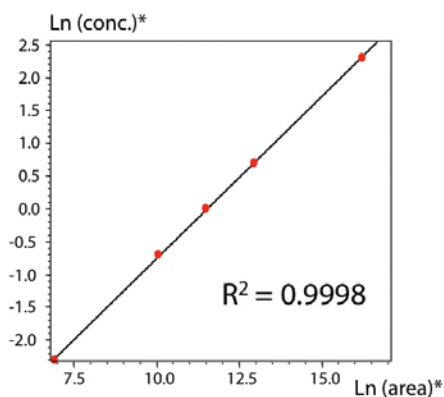


Fig. 1 Chromatogram of 0.1 ppm Thiophene in Benzene



* In the analysis of sulfur compounds using an FPD detector, the output is proportional to the square of the sulfur concentration. Thus the natural logarithm for both concentration and area should be plotted.

Fig. 2 Linearity of Thiophene in Benzene

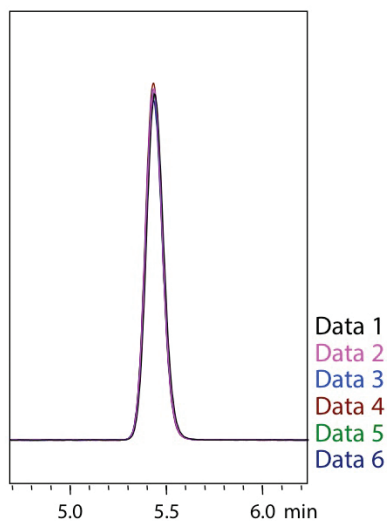


Fig. 3 Chromatogram (Overlap of Six Consecutive Analyses) from the Repeated Analyses of 1 ppm Thiophene in Benzene

Table 2. Repeatability of Area Values ($\mu\text{V} \times \text{sec}$) for 1 ppm

	1	2	3	4	5	6	Ave.	RSD%
Thiophene	97646	98126	97901	99524	97693	96797	97948	0.91

Note: The above are reference values, not guaranteed values.

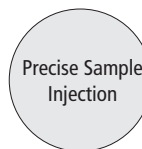
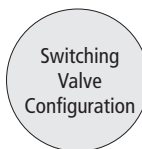
RELATED PRODUCTS FOR PETROCHEMICAL INDUSTRY

Aromatics Analyzer HPLC

Applicable Methods

- ASTM D6591, D6379, D5186, IP 391, 436, 548, Custom Methods Analysis

- Aromatics in fuels



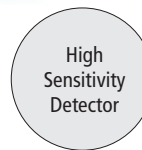
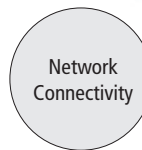
Furan Analysis HPLC

Applicable Methods

- ASTM D5837 Custom Methods

Analysis

- Individual Furanic, Components in Transformer Oil



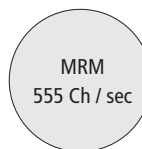
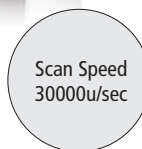
LC/MS/MS

Applicable Methods

- Custom Methods

Analysis

- Additives in Polymers



VOCs with GC/MS

GCMS-QP2020

Applicable Methods

- EPA 8270B, TO-14, Custom Methods

Analysis

- Volatile Organic Compounds, Arsine Phosphine in Ethylene



FTIR Spectrophotometers

Applicable Methods

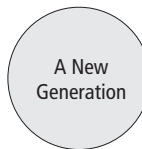
- ASTM D7371, EN 14078, Custom Methods

Analysis

- FAME in Biodiesel

Components in Transformer Oil, Total Petroleum Hydrocarbons

- Additives in Polymers



UV-VIS Spectrophotometer

UV-1800

Applicable Methods

- ASTM D1840, D2008, Custom Methods

Analysis

- Petroleum Products, Turbine Fuels, Mineral Oils



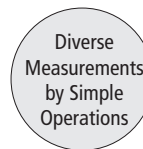
Thermal Analyzers

Applicable Methods

- ASTM D3417, D3418, D4419, D4591, D5483, D3850, D6370, D6375, Custom Methods

Analysis

- Thermal Properties of Polymers, DSC, TGA, TG/DTA, TMA



Spectrofluorophotometer

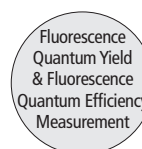
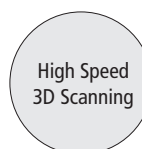
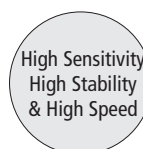
RF-6000

Applicable Methods

- ASTM D5412, Custom Methods

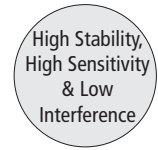
Analysis

- Measuring Oil in water



**Inductively Coupled Plasma Mass Spectrometer
ICPMS-2030**

Applicable Methods
- Custom Methods
Analysis
- Trace Elements in Naphtha



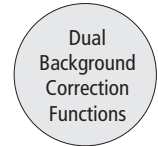
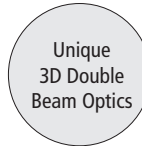
**Simultaneous ICP Atomic Emission Spectrometer
ICP-9820**

Applicable Methods
- ASTM D4951, D5184, UOP 389, 303, 714, APHA 3120, IFP 9507 Analysis
Analysis
- All Elements, Lubricating Oils, Petroleum Naphtha, Gasoline



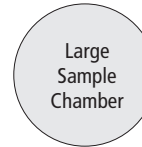
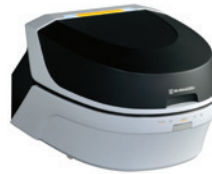
**Atomic Absorption Spectrometer
AA-7000**

Applicable Methods
- ASTM D6595, D3237, D3567, D3605, D3635, D3831, D3919, D4628
Analysis
- Additives in Polymers, All Elements, Lubricating Oil, Petroleum Oils



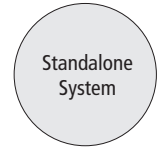
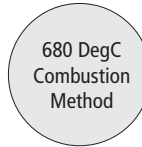
**Energy Dispersive X-ray Fluorescence Spectrometer
EDX-7000/8000**

Applicable Methods
- ASTM D5839, D4294, C 114, ISO 8754
Analysis
- Sulfur in Oil, All element



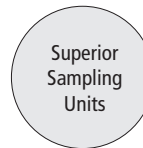
Total Organic Carbon Analyzer, TOC

Applicable Methods
- ASTM D7573, EN 1484, EPA 415.1, APHA 5310B
Analysis
- TOC in Various Type of Water, High Salt Content Water



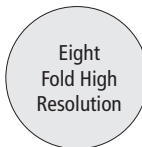
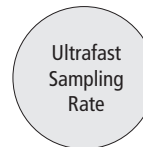
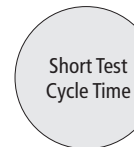
Online TOC

Applicable Methods
- Custom Methods
Analysis
- TOC in Various Type of Water



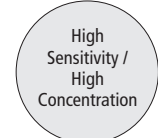
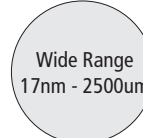
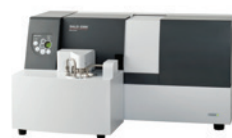
Testing Machines

Applicable Methods
- ISO 6892, ISO 527, ASTM D638
Analysis
- Tensile Properties of Metals, Tensile properties of Plastics



Particle Size Analyzer

Applicable Methods
- Custom Methods
Analysis
- Various Petrochemical Stream



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