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Analyzer Solutions Guide
for the Energy and Chemical Industry

**GENERATE ACCURATE, RELIABLE DATA
TO ENSURE QUALITY AND PRODUCTIVITY**



Agilent Technologies

IMPLEMENT NEW GC TECHNOLOGIES WHEN YOUR COMPANY IS READY FOR THEM

Your business helps fuel the global economy by meeting the demand for petroleum, natural gas, and biofuel. Success depends upon safe, reliable, and efficient processes to ensure that consumers receive a consistent flow of these products.

For decades, Agilent has provided reliable analytical solutions to help researchers, process managers, and line analysts meet their measurement challenges. From characterizing raw crude and natural gas... to monitoring the production of refined chemicals... to determining the quality of alternative fuels... Agilent and our Channel Partners supply the most complete portfolio of Analyzers to the energy and chemical industry.

Agilent energy and chemical analyzers reflect industry standards and a stringent quality control process

Before installation:

- ✓ Factory configuration and chemical check-out to “pre-test” analytical performance
- ✓ Field installation and performance verification by factory-trained Agilent or Channel Partner Engineers

Following installation:

- ✓ Continued support by our application development and design teams as you work through your analytical challenges

Customized to get you
on the **FAST TRACK**



Agilent's energy and chemical analyzers build on our reputation for hardware excellence and technical expertise

Our solutions range from basic system modifications—such as using chemically inert materials and specialty columns in systems that quantitate trace contaminants in petrochemical streams—to complex, multi-valve analyzers that let you characterize a sample's diverse components.

On the following pages, you will find Agilent's complete energy and chemical analyzer portfolio, including:

- **Factory tested, ready-to-use GC analytical solutions** developed to meet industry standards such as ASTM, UOP, EN, and GPA*
- **Custom analyzer systems** configured and tested to your application's pre-determined specifications
- **Specific instruments and tools** designed, delivered, and supported by Agilent Channel Partners

Whether you need a ready-to-go configuration or a custom analyzer, Agilent can help you and your team spend less time on analytical setup and more time producing outstanding results!

**This guide reports typical quantitation limits for each system configuration. These values may differ from the absolute reporting limit required by the method.*

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Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

ANALYZER BY REFERENCE

Refinery Gas

Analyzer Model	Description	Configured per Published Method(s)
G3445 #521	3-Channel fast refinery gas analyzer	ASTM D1945, ASTM D1946, UOP 539
G3445 #522	3-Channel fast refinery gas analyzer—H ₂ S and COS	ASTM D1945, ASTM D1946, UOP 539
G3445 #523	Extended refinery gas analyzer	
G3445 #524	Refinery gas analyzer with nickel columns	ASTM D1945, ASTM D1946, UOP 539
G3445 #526	Refinery gas analyzer	ASTM D1945, ASTM D1946, UOP 539
G3445 #529	3-Channel fast refinery gas including H ₂ S and O _c	ASTM D1945, ASTM D1946
G3445 #530	Refinery gas analyzer with H ₂ S and oxygen using hydrogen as a carrier gas	ASTM D1945, ASTM D1946, UOP 539
G3445 #531	High capacity refinery gas analyzer (RGA) with large valve oven and helium carrier gas for hydrogen sulfide and oxygen	ASTM D1945, ASTM D1946, UOP 539
G3445 #532	Fast refinery gas analyzer with large valve oven (LVO) and micropacked columns	UOP 539
G3445 #533	Refinery gas analyzer with large valve oven (LVO) and hydrogen carrier gas for oxygen and H ₂ S	UOP 539
Contact Agilent	Refinery gas analyzer: 4-channel Micro GC	ASTM D2163, DIN-51666, UOP 59

Natural Gas

Analyzer Model	Description	Configured per Published Method(s)
G3445 #541	Extended natural gas analyzer to C-12	GPA 2286 (calculation without bridge compounds iC ₅ and nC ₅)
G3445 #542	Natural gas analyzer	ASTM D1945, GPA 2261 (H ₂ and He not included)
G3445 #543	Natural gas analyzer	ASTM D1945, GPA 2261
G3445 #544	Natural gas analyzer	ASTM D1945, GPA 2261
G3445 #545	Natural gas analyzer	GPA 2261 (H ₂ and He not included, without separation of O ₂ and N ₂)
G3445 #547	3-Channel natural gas analyzer with extended HC analysis	ASTM D1945, GPA 2261
G3445 #548	Extended natural gas analyzer	GPA 2286 (calculation with bridge compounds iC ₅ and nC ₅)
G3582A #120	Natural gas analyzer A: 2-channel Micro GC	ASTM D3588-98, GPA 2172, GPA 2177, ISO 6974-6
G3582A #121	Natural gas analyzer A extended: 3-channel Micro GC	ASTM D3588-98, GPA 2172, GPA 2177, ISO 6974-6
G3582A #122	Natural gas analyzer B with H ₂ S: 2-channel Micro GC	ASTM D3588-98, GPA 2172, GPA 2177, ISO 6974-6
G3582A #123	Natural gas analyzer B extended with H ₂ S: 3-channel Micro GC	ASTM D1945, ASTM D3588-98, GPA 2172, GPA 2177, ISO 6974-6
7890-0110	Liquefied natural gas analyzer	GPA 2177
7890-0610	Natural gas analyzer: permanent gases and hydrocarbons	
7890-0611	Natural gas analyzer: permanent gas and extended hydrocarbons	

Reformulated Fuel

Analyzer Model	Description	Configured per Published Method(s)
G3445 #611	Single channel oxygenates and aromatics in fuel analyzer	ASTM D4815, ASTM D5580
G3445 #612	Dual parallel channel oxygenates and aromatics in fuel analyzer	ASTM D4815, ASTM D5580
G3445 #615	Benzene in gasoline analyzer	ASTM D3606
G3445 #616	Aromatics in fuel analyzer	ASTM D5580
G3445 #617	Oxygenates and aromatics in gasoline by Deans Switch analyzer	EN 12177, EN 13132
G3445 #618	Low level oxygenates in light hydrocarbons by capillary flow technology	ASTM D7423
G3445 #621	3-in-1 reformulated fuel analyzer with large valve oven	ASTM D3606, ASTM D4815, ASTM D5580
7890-0340	Trace oxygenates in gasoline analyzer	ASTM D7754

Biodiesel/Renewable Fuel

Analyzer Model	Description	Configured per Published Method(s)
G3445 #631	Glycerin in biodiesel analyzer	ASTM D6584
G3445 #633	FAME content in biodiesel analyzer	EN 14103:2011
G3445 #634	Biodiesel analyzer	EN 14105:2011
G3582A #110	Biogas analyzer: 2-channel Micro GC	
G3582A #111	Biogas analyzer: 3-channel Micro GC	
7890-0295	Biodiesel analyzer for EN 14110:2003 methanol content by HSS-GC	EN 14100:2003
M7482A	FAMES in Jet Fuel Analyzer	IP 585

Liquefied Petroleum Gas (LPG)

Analyzer Model	Description	Configured per Published Method(s)
7890-0138	LPG composition analyzer with alumina column	ASTM D2163, ASTM D2593, ASTM D2712, ASTM D4424
7890-0188	Commercial propane and butane LPG analyzer	ISO 7941, EN 27941, and IP 405
7890-0397	Hydrocarbons in liquefied petroleum gases	ASTM D2163
Contact Agilent	Ethane composition and impurities by Micro GC	
Contact Agilent	Propane and butane streams by Micro GC	

Trace Impurities

Analyzer Model	Description	Configured per Published Method(s)
G3445 #646	Low CO and CO ₂ in process gases containing high CH ₄ analyzer	
G3445 #647	Low CO and CO ₂ in process gas analyzer	
7890-0191	2-channel inert impurities in pure chlorine analyzer	
7890-0237	Impurities in monomers analyzer by PDHID	
7890-0355	Low CO and CO ₂ in process gases with nickel catalyst (methanizer) bypass	
7890-0366	Trace CO and CO ₂ in hydrogen and light gaseous hydrocarbon analyzer	UOP 603
7890-0409	Impurities in ethylene/propylene analyzer by PDHID	
M7484AA or M7474AA	Impurities in ethylene/propylene by GC/MS	

Simulated Distillation

Analyzer Model	Description	Configured per Published Method(s)
G3440 #653	Simulated distillation analyzer, boiling range from 55 °C to 538 °C	ASTM D2887
G3445 #654	Simulated distillation analyzer, boiling range from 100 °C to 615 °C	ASTM D7213 (D2887 extended)
G3445 #655	Simulated distillation analyzer, boiling range from 174 °C to 700 °C	ASTM D6352

Sulfur and Nitrosamine

Analyzer Model	Description	Configured per Published Method(s)
G3445 #661	Sulfur in natural gas/fuel gas analyzer by sulfur chemiluminescence detector	ASTM D5504
G3445 #662	Sulfur in fuel/petroleum liquids analyzer by sulfur chemiluminescence detector	ASTM D5623, UOP 791
7890-0167	Volatile sulfur analysis	ASTM D6228
7890-0460	Nitrosamine in liquids analyzer by nitrogen chemiluminescence detector	

Transformer Oil Gas

Analyzer Model	Description	Configured per Published Method(s)
G3445 #571	Transformer oil gas analyzer (TOGA)	ASTM D3612 Method C, headspace sampling
7890-0552	Transformer oil gas analyzer (TOGA) with C ₄ + backflush and NiCat bypass	ASTM D3612 Method C, headspace sampling

Greenhouse Gas

Analyzer Model	Description	Configured per Published Method(s)
G3445 #561	Greenhouse gas analyzer, headspace sampler optional, CO 0.4 ppm—0.2%	
G3445 #562	Greenhouse gas analyzer, CO ₂ 0.4 ppm—20%	
G3445 #563	Greenhouse gas analyzer with headspace sampler, CO 0.4 ppm—0.2%	

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ANALYZER BY COMPLIANCE METHOD

ASTM Method Configurations

ASTM D1945	Analyzer Number
3-Channel fast refinery gas analyzer	G3445 #521
3-Channel fast refinery gas analyzer—H ₂ S and COS	G3445 #522
Refinery gas analyzer with nickel columns	G3445 #524
Refinery gas analyzer	G3445 #526
3-Channel fast refinery gas including H ₂ S and O ₂ with external oven	G3445 #529
Refinery gas analyzer with H ₂ S and O ₂ using hydrogen carrier gas	G3445 #530
High capacity refinery gas analyzer	G3445 #531
Natural gas analyzer	G3445 #542
Natural gas analyzer	G3445 #543
Natural gas analyzer	G3445 #544
3-Channel natural gas analyzer with extended HC analysis	G3445 #547
Natural gas analyzer B with H ₂ S: 3-channel Micro GC	G3582A #123
ASTM D1946	Analyzer Number
3-Channel fast refinery gas analyzer	G3445 #521
3-Channel fast refinery gas analyzer—H ₂ S and COS	G3445 #522
Refinery gas analyzer with nickel columns	G3445 #524
Refinery gas analyzer	G3445 #526
3-Channel fast refinery gas including H ₂ S and O ₂ with external oven	G3445 #529
Refinery gas analyzer with H ₂ S and O ₂ using hydrogen carrier gas	G3445 #530
High capacity refinery gas analyzer	G3445 #531
ASTM D2163	Analyzer Number
LPG composition analyzer	7890-0138
Commercial propane and butane LPG analyzer	7890-0188
Hydrocarbons in LPG analyzer	7890-0397
Refinery gas analyzer: 4-channel Micro GC	Contact Agilent
ASTM D2287	Analyzer Number
Simulated distillation analyzer	G3445 #653

ASTM D3588-98	Analyzer Number
Natural gas analyzer A: 2-channel Micro GC	G3582A #120
Natural gas analyzer A extended: 3-channel Micro GC	G3582A #121
Natural gas analyzer B with H ₂ S: 2-channel Micro GC	G3582A #122
Natural gas analyzer B extended with H ₂ S: 3-channel Micro GC	G3582A #123
ASTM D3606	Analyzer Number
Benzene in gasoline analyzer	G3445 #615
3-in-1 reformulated fuel analyzer	G3445 #621
ASTM D3612-C	Analyzer Number
Transformer oil gas analyzer	G3445 #571
ASTM D4815	Analyzer Number
Single channel oxygenates and aromatics in fuel analyzer	G3445 #611
Dual parallel channel oxygenates and aromatics in fuel analyzer	G3445 #612
3-in-1 reformulated fuel analyzer	G3445 #621
ASTM D5504	Analyzer Number
Sulfur analyzer by SCD	G3445 #661
ASTM D5580	Analyzer Number
Single channel oxygenates and aromatics in fuel analyzer	G3445 #611
Dual parallel channel oxygenates and aromatics in fuel analyzer	G3445 #612
Aromatics in fuel analyzer	G3445 #616
3-in-1 reformulated fuel analyzer	G3445 #621
ASTM D5623	Analyzer Number
Sulfur analyzer by SCD	G3445 #662
ASTM D6228	Analyzer Number
Volatile sulfur analyzer	7890-0167
ASTM D6352	Analyzer Number
Simulated distillation analyzer	G3445 #655

ASTM Method Configurations

ASTM D6584	Analyzer Number
Glycerin in biodiesel analyzer	G3445 #631
ASTM D7423	Analyzer Number
Simulated distillation analyzer	G3445 #654
ASTM D7213	Analyzer Number
Low level oxygenates in light hydrocarbons analyzer with capillary flow technology (CFT)	G3445 #618
ASTM D7754	Analyzer Number
Trace oxygenates in gasoline analyzer	7890-0340

DIN Method Configurations

DIN 51666	Analyzer Number
Refinery gas analyzer: 4-channel Micro GC	Contact Agilent

EN Method Configurations

EN 12177	Analyzer Number
Oxygenates and aromatics in gasoline analyzer	G3445 #617
EN 13132	Analyzer Number
Oxygenates and aromatics in gasoline analyzer	G3445 #617
EN 14103:2011	Analyzer Number
FAME content in biodiesel analyzer	G3445 #633
EN 14105:2011	Analyzer Number
Biodiesel analyzer	G3445 #634
EN 14110:2003	Analyzer Number
Methanol in biodiesel analyzer	7890-0295
EN 27941	Analyzer Number
Commercial propane and butane analyzer	7890-0188

GPA Method Configurations

GPA 2172	Analyzer Number
Natural gas analyzer A: 2-channel Micro GC	G3582A #120
Natural gas analyzer A: 3-channel Micro GC	G3582A #121
Natural gas analyzer B: 2-channel Micro GC	G3582A #122
Natural gas analyzer B: 3-channel Micro GC	G3582A #123
GPA 2177	Analyzer Number
Liquefied natural gas analyzer	7890-0110
Natural gas analyzer A: 2-channel Micro GC	G3582A #120
Natural gas analyzer A: 3-channel Micro GC	G3582A #121
Natural gas analyzer B: 2-channel Micro GC	G3582A #122
Natural gas analyzer B: 3-channel Micro GC	G3582A #123
GPA 2261	Analyzer Number
Natural gas analyzer	G3445 #542
Natural gas analyzer	G3445 #543
Natural gas analyzer	G3445 #544
Natural gas analyzer	G3445 #545
Natural gas analyzer B: 3-channel Micro GC	G3582A #123
GPA 2286	Analyzer Number
Extended natural gas analyzer	G3445 #541
Extended natural gas analyzer	G3445 #548

IP Method Configurations

IP 405	Analyzer Number
Commercial propane and butane analyzer	7890-0188
IP 585	Analyzer Number
Jet Fuel Analyzer	M7482A

ISO Method Configurations

ISO 6974-6	Analyzer Number
Natural gas analyzer A: 2-channel Micro GC	G3582A #120
Natural gas analyzer A: 3-channel Micro GC	G3582A #121
Natural gas analyzer B: 2-channel Micro GC	G3582A #122
Natural gas analyzer B: 3-channel Micro GC	G3582A #123
ISO 7941	Analyzer Number
Commercial propane and butane analyzer	7890-0188

UOP Method Configurations

UOP 539	Analyzer Number
3-Channel fast refinery gas analyzer	G3445 #521
3-Channel fast refinery gas analyzer—H ₂ S and COS	G3445 #522
Refinery gas analyzer with nickel columns	G3445 #524
Refinery gas analyzer	G3445 #526
3-Channel fast refinery gas analyzer including H ₂ S and O ₂ with external oven	G3445 #529
Refinery gas analyzer with H ₂ S and O ₂ using hydrogen carrier gas	G3445 #530
High capacity refinery gas analyzer with H ₂ S and O ₂ using helium carrier gas	G3445 #531
Fast refinery gas analyzer with micropacked columns	G3445 #532
Refinery gas analyzer with H ₂ S and O ₂ using hydrogen carrier gas	G3445 #533
UOP 603	Analyzer Number
Trace CO and CO ₂ in hydrogen and light hydrocarbons analyzer	7890-0366
UOP 59	Analyzer Number
Refinery gas analyzer: 4-channel Micro GC	Contact Agilent

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SOLUTIONS FOR REFINERY GAS



Apply the latest GC technologies without disrupting your application workflow

Refineries use distillation and chemical reactions to convert crude oil into fuel, lubricants, and feedstock for downstream processes. In recent years, supply-related performance requirements, together with environmental regulations for emissions and fuel composition, have rapidly driven new plant designs, as well as upgrades to existing refineries.

The composition of refinery gases, which arise from cracking and subsequent distillation, depends on their generating source. Typically, refinery gases contain saturated and unsaturated hydrocarbons (C_1 - C_5), H_2 , O_2 , N_2 , CO , and CO_2 . In some instances, C_6 or higher hydrocarbons and sulfur contaminants such as H_2S may also be present.

Confidently and precisely analyzing refinery gases is challenging, because the source and composition of each gas varies considerably. To succeed, refinery gas analyzers must be able to quickly separate complex mixtures from a broad range of samples found in refinery and petrochemical streams.

Agilent Refinery Gas Analyzers are *complete workflow solutions* that put the latest advances in reproducibility, speed, resolution, and retention into your hands without the hassles of setup, method development, and validation. Each arrives fully pre-configured and tested for applications such as fast and extended refinery gas analysis (RGA) of permanent gases, hydrocarbon content determination (C_1 - C_5 with C_{6+} as backflush), and the extended analysis of hydrocarbons in natural gas to C_{14} .

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Solutions for Refinery Gas

Analyzer Number	Extended Hydrocarbon Analysis to C ₁₂ /C ₁₄	Full-range Capacity for H ₂	Separates Air (O ₂ and N ₂)	High Level of H ₂ S	Handles Liquefied Samples
G3445 #521	Yes	No	Yes	No	No
G3445 #522	Yes	No	Yes	Yes	No
G3445 #523	No	Yes	Yes	No	No
G3445 #524	No	No	Yes	Yes	No
G3445 #526	No	No	Yes	No	No
G3445 #529	Yes	No	Yes	No	No
G3445 #530	No	Yes	Yes	No	No
G3445 #531	No	Yes	Yes	Yes	No
G3445 #532	No	Yes	Yes	No	No
G3445 #533	No	Yes	Yes	No	No
Contact Agilent for configuration details	Yes	No	Yes	Yes	Yes

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Reference Methods for Refinery Gas: Quantitation Ranges for Compounds of Interest

Compound	ASTM D1945 mol %	ASTM D1946 mol %	ASTM D2163 mol %	UOP 539 mol %	GPA 2186	GPA 2286	ISO 6974-6
H ₂ S	0.3 to 30		–	0.1 to 25	–	0.1 to 100	–
O ₂	0.01 to 20		–	0.1 to 99.9	–	0.005 to 20	0.007 to 5
N ₂	0.01 to 100	–	–		0.005 to 5	0.005 to 100	0.007 to 40
CH ₄	0.01 to 100	–	–		0.001 to 5	0.001 to 100	40 to 100
CO		–	–		–	–	0.001 to 1
CO ₂	0.01 to 20	–	–		0.005 to 5	0.005 to 100	0.001 to 10
He	0.01 to 10	–	–		–	–	0.002 to 0.5
H ₂	0.01 to 10	–	–		–	–	0.001 to 0.5
Ethane	0.01 to 100	–	0.1 and above	0.1 to 99.9	0.001 to 95	0.001 to 100	0.002 to 15
Propane	0.01 to 100	–	0.1 and above		0.001 to 100	0.001 to 100	0.001 to 5
C ₄ isomers	0.01 to 10	–	0.1 and above		0.001 to 100	0.001 to 10	0.0001 to 1
C ₅ isomers	0.01 to 2	–	0.1 and above		0.001 to 50	0.001 to 5	0.0001 to 0.5
C ₆ isomers	0.01 to 2	–	–	–	0.001 to 30	0.001 to 5	0.0001 to 0.5
C ₆₊	–	–	–	0.1 to 99.9	–	–	–
C ₇₊	0.01 to 1	–	–	–	0.001 to 30	–	–
C ₇ -C ₈	–	–	–	–	–	0.001 to 2	0.0001 to 0.5
C ₉	–	–	–	–	–	0.001 to 2	–
C ₁₀ -C ₁₄	–	–	–	–	–	0.001 to 1	–

* This guide reports typical quantitation limits for each system configuration. These values may differ from the absolute reporting limit required by the method.

Note: In the table above the symbol “-” indicates that this parameter was not specified.

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your analysts running real world samples.
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3-Channel Fast Refinery Gas Analyzer (G3445 #521)

Analyzer Description

Configuration:

- 5-valve/7-column (capillary and packed), 2-TCD/FID

Sample type:

- Refinery gas such as atmospheric overhead, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

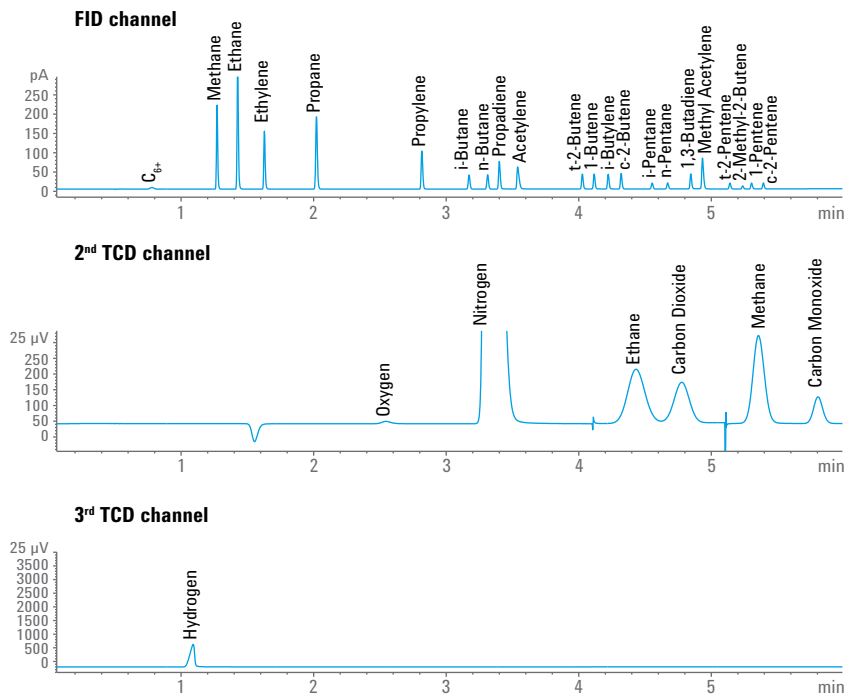
- C₁-C₅, C₆₊ as backflush, H₂, He, O₂, N₂, CO₂, CO

Typical quantification range:

- 0.01 mol% for all above mentioned components

Configured per method:

- ASTM D1945, ASTM D1946, UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection for complete refinery gas analysis within 6 minutes
- Optimized columns to allow for faster hydrocarbon and permanent gas analysis using the same oven temperature program
- Full-range capability for H₂ by third TCD using N₂ or Argon carrier gas
- For H₂S and COS analysis, order G3445A #522

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3-Channel Fast Refinery Gas Analyzer— H₂S and COS (G3445 #522)

Analyzer Description

Configuration:

- 5-valve/7-column (capillary and packed), 2-TCD/FID/nickel tubing, Hastelloy valve

Sample type:

- Refinery gas, such as atmospheric overhead, desulfurizer off gas, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

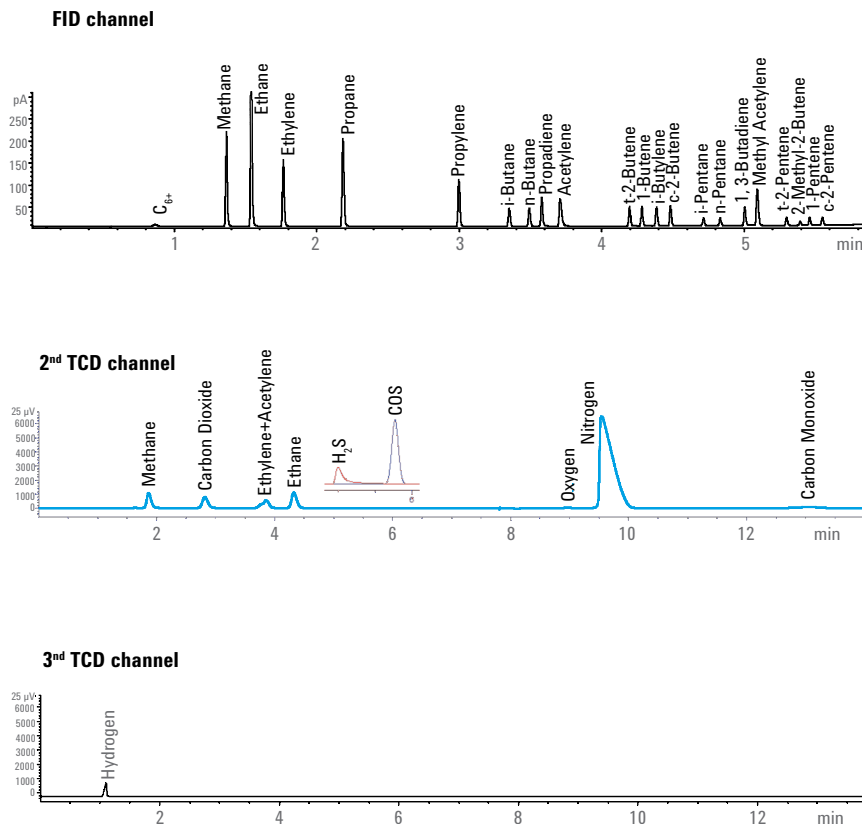
- C₁-C₅ and C₆₊ as backflush, H₂, He, O₂, N₂, CO₂, CO, H₂S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S and COS
- 500 ppm for H₂S
- 300 ppm for COS

Configured per method:

- ASTM D1945, ASTM D1946, UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection for complete refinery gas analysis within 10 minutes
- Optimized columns to allow faster hydrocarbon and permanent gas analysis using the same oven temperature program
- Full-range capability for H₂ by third TCD using N₂ or Argon carrier gas
- Nickel tubing and Hastelloy valve for high H₂S and COS analysis
- O₂ may be present but not for quantitation

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Extended Refinery Gas Analyzer (G3445 #523)

Analyzer Description

Configuration:

- 4-valve/5-column (capillary and packed), TCD/FID

Sample type:

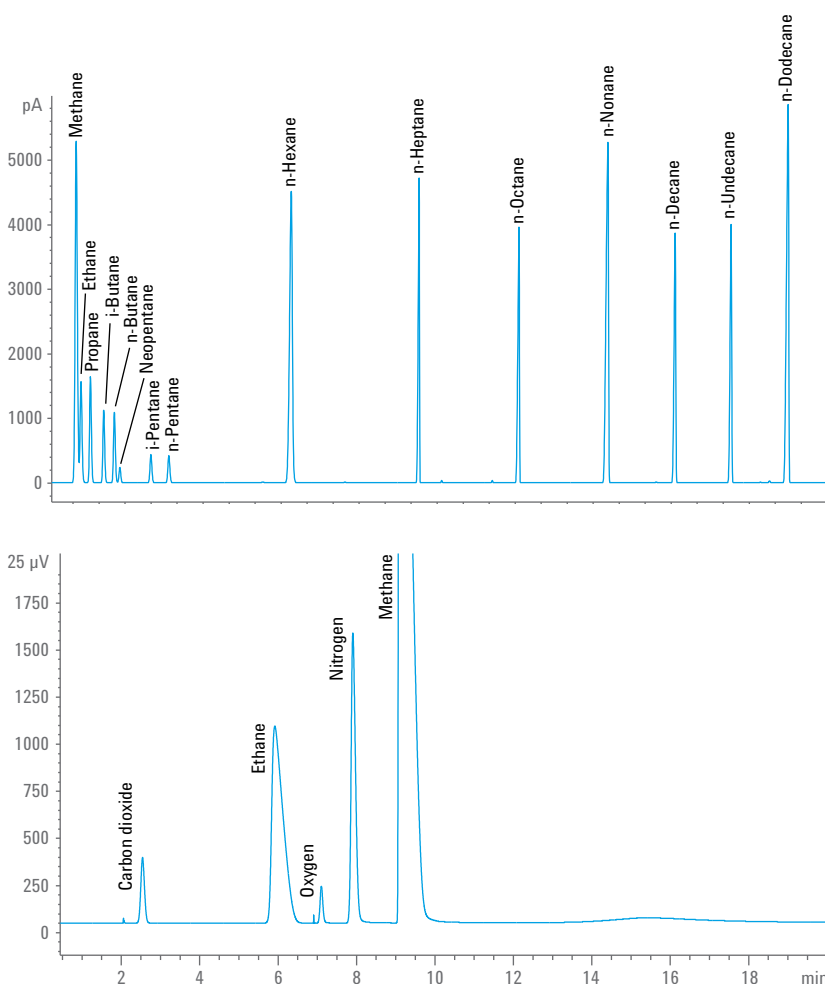
- Refinery gas such as atmospheric overhead, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

- C₁-C₁₂, H₂, He, O₂, N₂, CO₂, and CO

Typical quantification range:

- 0.01 mol% for all components



► KEY BENEFITS AND FEATURES

- PONA column provides extended RGA separation to C₁₄
- Achieve analysis of H₂ and He by switching carrier gases
- Argon or N₂ carrier used for H₂ analysis, use He carrier for remaining compounds
- For hydrocarbons up to C₁₂, approximately 25 minutes analysis time, depends on hydrocarbon range

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Refinery Gas Analyzer with Nickel Columns (G3445 #524)

Analyzer Description

Configuration:

- 4-valve (Hastelloy)/5-column (packed), 2-TCD, plumbed with sulfur-resistant material

Sample type:

- Refinery gas, such as atmospheric overhead, FCC overhead, fuel gas, recycle gas, sour gas

Compounds analyzed:

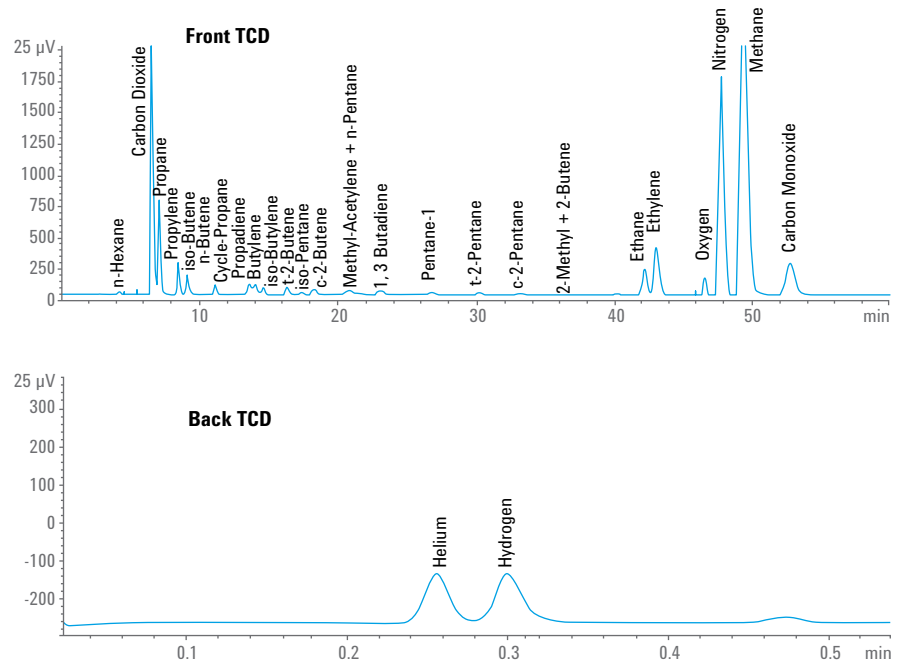
- C₁-C₅ and C₆₊ as backflush, H₂, He, O₂, N₂, CO₂, CO, H₂S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S
- 500 ppm for H₂S

Configured per method:

- ASTM D1945, ASTM D1946, GPA 2231



► KEY BENEFITS AND FEATURES

- Dual TCD channels
- Plumbed with sulfur-resistant material including nickel columns and plumbing and Hastelloy valves for sour gas analysis
- Rugged packed columns
- Dedicated channel for He and H₂
- Approximate 20 minute analysis time
- Hardware configuration same as G3445 #526

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Refinery Gas Analyzer (G3445 #526)

Analyzer Description

Configuration:

- 4-valve/5-column (packed), 2-TCD

Sample type:

- Refinery gas such as atmospheric overhead, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

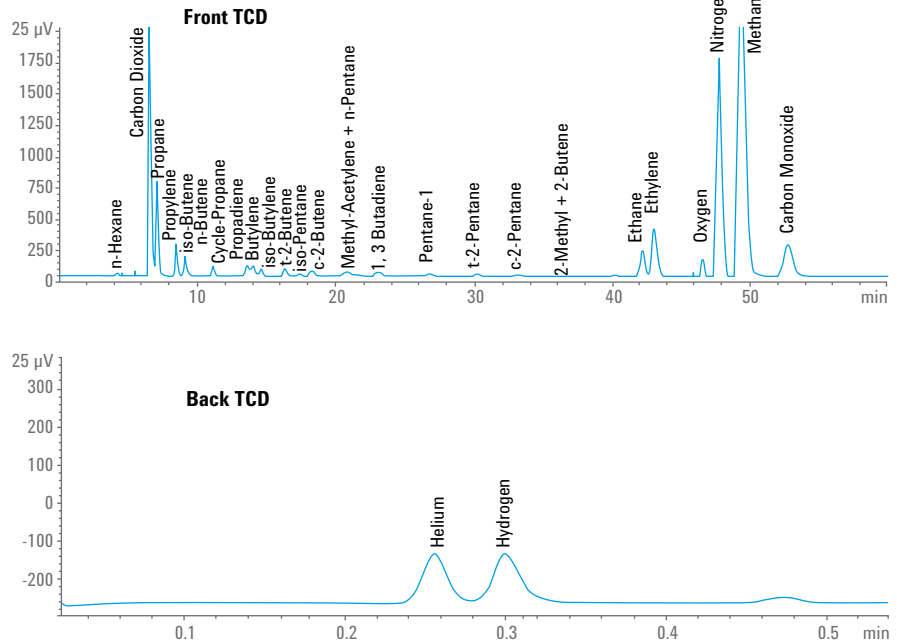
- C₁-C₅, C₆₊ as backflush, H₂, He, O₂, N₂, CO₂, CO

Typical quantification range:

- 0.01 mol% for all components

Configured per method:

- ASTM D1945, ASTM D1946, UOP 539



► KEY BENEFITS AND FEATURES

- Dual TCD channels
- Rugged packed columns
- Full-range capability for He and H₂
- 55 minute analysis time
- To analyze samples containing high levels of H₂S, please order G3445 #526

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3-Channel Fast Refinery Gas Analyzer including H₂S and O₂ with External Oven (G3445 #529)

Analyzer Description

Configuration:

- 5-valve/1-sample shut-off valve (optional)/external oven/7-column (PLOT, packed, micro-packed), 2-TCD/FID

Sample type:

- Refinery gas such as atmospheric overhead, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

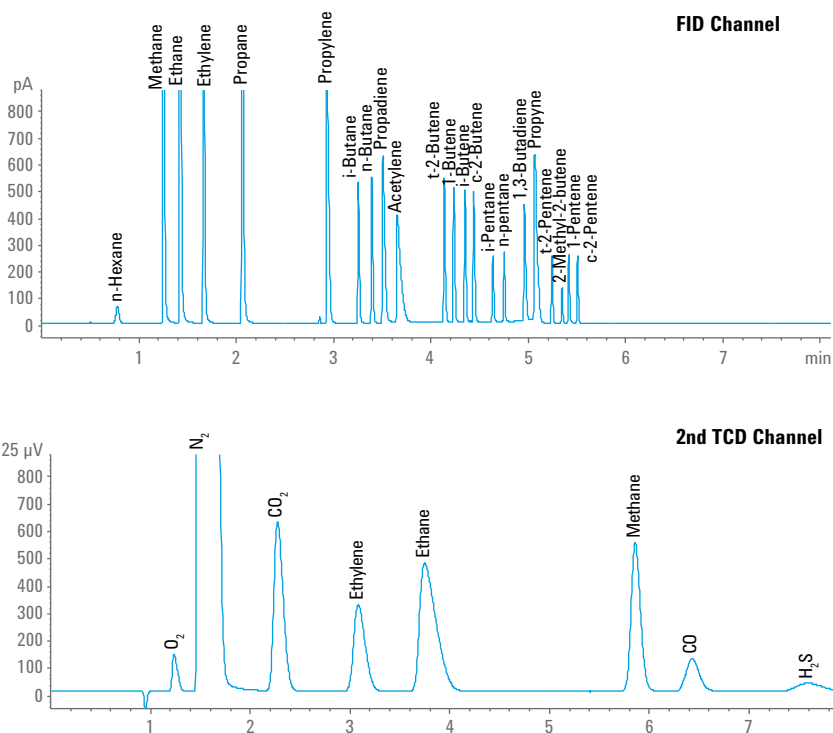
- C₁-C₅, C₆₊, H₂, He, O₂, N₂, CO₂, CO, H₂S

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S
- 500 ppm for H₂S

Configured per method:

- ASTM D1945, ASTM D1946, UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection provides a comprehensive, fast analysis of refinery gas with one injection in 8 minutes
- External oven is used for permanent gas analysis including H₂S and O₂ at isothermal temperature
- Sample shut-off valve (optional)

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3-Channel Fast Refinery Gas Analyzer with H₂S and O₂ using Hydrogen and Nitrogen Carrier Gas (G3445 #530)

Analyzer Description

Configuration:

- 5-valve/external oven/7-column (capillary, packed, micro-packed), 2-TCD/FID, nickel tubing, Hastelloy valve

Sample type:

- Refinery gas such as atmospheric overhead, desulfurizer off gas, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

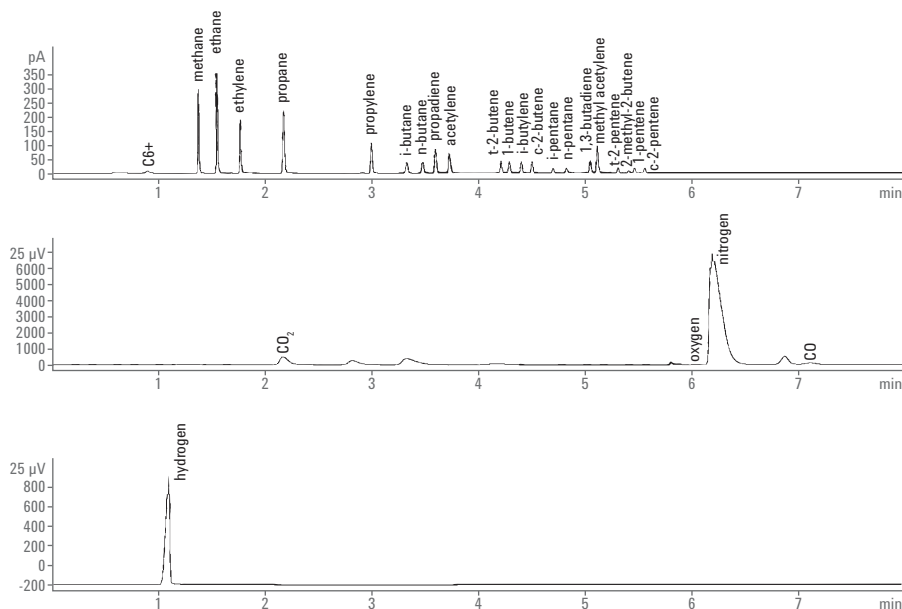
- C₁-C₅, C₆₊ as backflush, H₂, O₂, N₂, CO₂, CO, H₂S

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S
- 500 ppm for H₂S

Configured per method:

- ASTM D1945, ASTM D1946, UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection for complete refinery gas analysis within 13 minutes
- External oven for Micropacked columns allows independent hydrocarbon and permanent gas analysis
- Full-range capability for H₂ by third TCD using N₂ carrier gas
- Nickel tubing and Hastelloy valve for resistance to sulfur corrosion

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3-Channel High Capacity Refinery Gas Analyzer with Large Valve Oven and Helium Carrier for H₂S and O₂ (G3445 #531)

Analyzer Description

Configuration:

- 3-valve/large valve oven/5-column (PLOT, packed), 2-TCD/FID, nickel tubing, Hastelloy valve

Sample type:

- Refinery gas such as atmospheric overhead, desulfurizer off gas, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

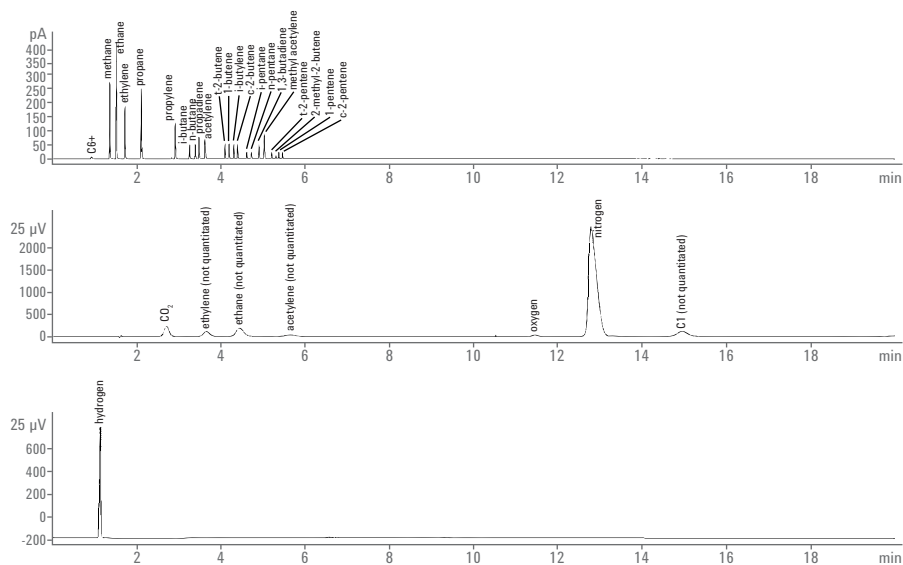
- C₁-C₅, C₆₊ as backflush, H₂, He, O₂, N₂, CO₂, CO, H₂S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S
- 500 ppm for H₂S
- 300 ppm for COS

Configured per method:

- ASTM D1945, ASTM D1946, UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection for complete refinery gas analysis within 17 minutes
- Large valve oven (LVO) for packed columns allows independent hydrogen, hydrocarbon, and permanent gas analysis
- Full-range capability for H₂ by third TCD using N₂ carrier gas
- Nickel tubing and Hastelloy valve for resistance to sulfur corrosion

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3-Channel Fast Refinery Gas Analyzer with Large Valve Oven and Micropacked Columns for H₂S and O₂ (G3445 #532)

Analyzer Description

Configuration:

- 3-valve/large valve oven/
4-column (PLOT, micro-packed),
2-TCD/FID, nickel tubing,
Hastelloy valve

Sample type:

- Refinery gas such as atmospheric overhead, desulfurizer off gas, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

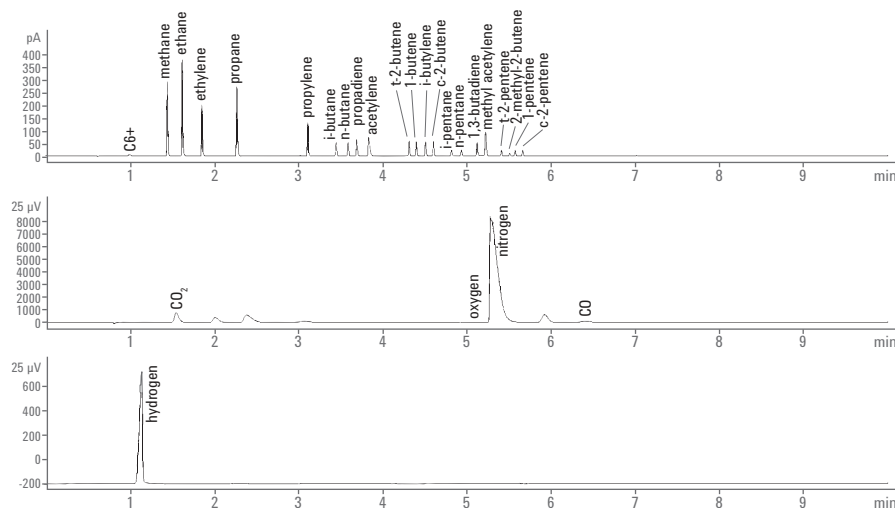
- C₁-C₅, C₆₊ as backflush, H₂, He, O₂, N₂, CO₂, CO, H₂S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S
- 500 ppm for H₂S
- 300 ppm for COS

Configured per method:

- UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection for complete refinery gas analysis within 9 minutes
- Large valve oven (LVO) for Micropacked columns allows independent hydrogen, hydrocarbon, and permanent gas analysis
- Full-range capability for H₂ by third TCD using N₂ carrier gas
- Nickel tubing and Hastelloy valve for resistance to sulfur corrosion

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3-Channel Fast Refinery Gas Analyzer with Large Valve Oven and Hydrogen Carrier Gas for H₂S and O₂ (G3445 #533)

Analyzer Description

Configuration:

- 3-valve/large valve oven/
4-column (PLOT, micro-packed),
2-TCD/FID, nickel tubing,
Hastelloy valve

Sample type:

- Refinery gas such as atmospheric overhead, desulfurizer off gas, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

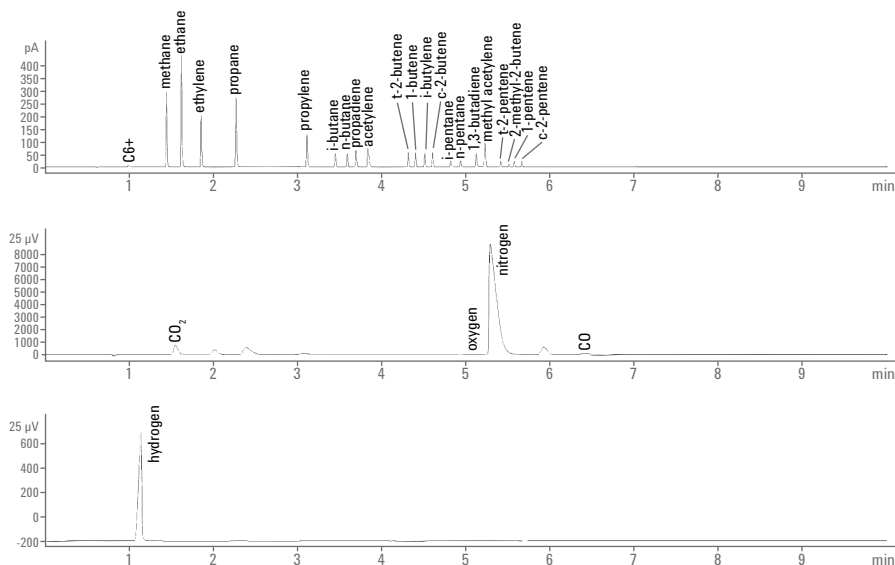
- C₁-C₅, C₆₊ as backflush, H₂, He, O₂,
N₂, CO₂, CO, H₂S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H₂S
- 500 ppm for H₂S
- 300 ppm for COS

Configured per method:

- UOP 539



► KEY BENEFITS AND FEATURES

- Three parallel channels with simultaneous detection for complete refinery gas analysis within 9 minutes
- Large valve oven (LVO) for Micropacked columns allows independent hydrogen, hydrocarbon, and permanent gas analysis
- Hydrogen carrier gas for hydrocarbon and permanent gas analysis
- Full-range capability for H₂ by third TCD using N₂ carrier gas
- Nickel tubing and Hastelloy valve for resistance to sulfur corrosion

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Refinery Gas Analyzer: 4-Channel Micro GC (Contact Agilent)

Analyzer Description

Configuration:

- Four channel Micro GC
 - Channel 1: CP-molsieve 5Å with backflush
 - Channel 2: CP-PoraPLOT U with backflush
 - Channel 3: Alumina oxide with backflush
 - Channel 4: CP-Sil 5 CB

Sample type:

- Refinery, high-pressure refinery, and liquefied refinery gases
 - Fluid coking overheads
 - Ethylene/propylene
 - Fuel gases
 - Stack gases
 - Off gases

Compounds analyzed:

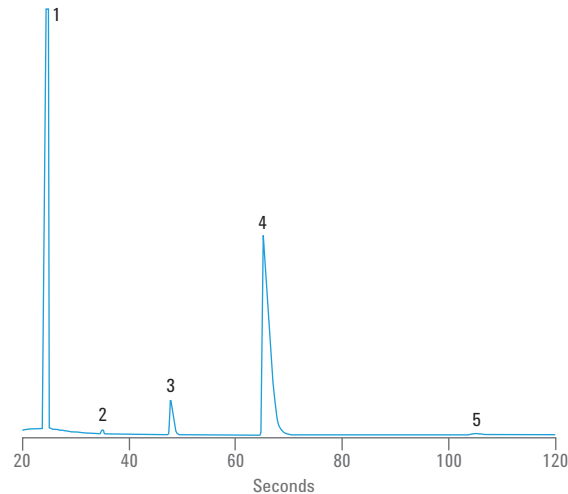
- C₁-C₅₊
- H₂, He, O₂, N₂, CO₂, CO

Typical quantification range:

- 1-10 ppm

Configured per method:

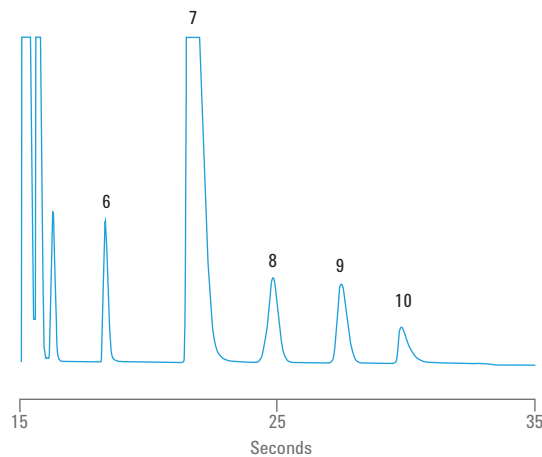
- UOP 59, DIN-51666, ASTM D2163



10 meter molsieve 5Å column with BF

Peak Identification

1. hydrogen
2. oxygen
3. nitrogen
4. methane
5. carbon monoxide



10 meter PLOT U column with BF

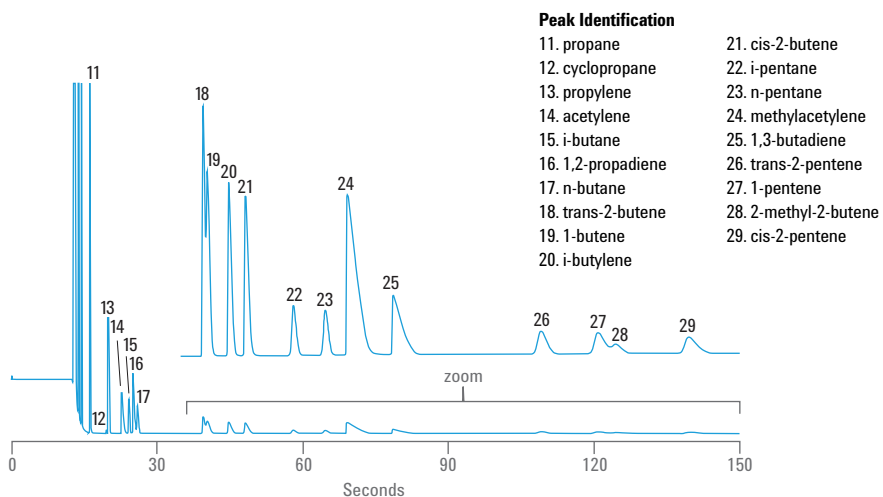
Peak Identification

6. carbon dioxide
7. ethylene
8. ethane
9. acetylene
10. hydrogen sulfide

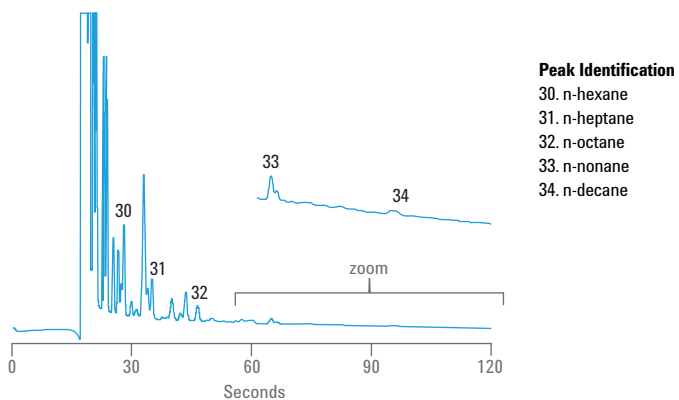
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10 meter Al₂O₃/KCl column (special with short pre-column)



6 meter CP-Sil 5 CB



Our team is ready to work with you to produce a solution for your unique analytical challenges. For more information, visit

www.agilent.com/chem/energy

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of natural gas composition in 150 seconds
 - Characterizes hydrocarbons C₁-C₁₀, carbon dioxide and air concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability: RSD 0.5%

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SOLUTIONS FOR NATURAL GAS



Quickly and reliably determine composition and calorific value

Natural gas is widely used for heating buildings, generating electricity, and providing needed power for industrial processes.

This naturally occurring mixture of gaseous hydrocarbons consists primarily of methane, but can also include other hydrocarbons (C_1 - C_4 chain length), as well as small amounts of impurities, such as O_2 , N_2 , CO_2 , H_2 , He, and sulfur-containing hydrocarbons.

Before it can be sold, natural gas must meet specifications for calorific value and purity; accordingly, collection, processing, transmitting, and distribution demands an array of analytical capabilities. Production by-products—such as ethane, propane, butanes, pentanes and hydrogen sulfide—must also be characterized prior to use in downstream processes.

Agilent Natural Gas Analyzers measure permanent gases and hydrocarbon content (C_1 - C_5 with C_{6+} as backflush), and perform extended analysis of hydrocarbons in natural gas to C_{14} . These factory-configured, chemically tested GC analyzers help you evaluate the chemical composition of natural gas, natural gas liquids, and by-products that result from processing.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Natural Gas

Analyzer Number	Extended Hydrocarbon Analysis to C ₁₂ / C ₁₄	Full-range Capacity for H ₂	Separates Air (O ₂ and N ₂)	High Level of H ₂ S	Handles Liquefied Samples
G3445 #541	Yes	No	Yes	No	No
G3445 #542	No	No	Yes	No	No
G3445 #543	No	Yes	Yes	No	No
G3445 #544	No	No	Yes	Yes	No
G3445 #545	No	No	No	No	No
G3445 #547	No	Yes	Yes	No	No
G3445 #548	Yes	No	Yes	No	No
G3582A #120	Yes	No	No	No	Optional
G3582A #121	Yes	No	No	No	Optional
G3582A #122	No	No	No	Yes	Optional
G3582A #123	No	No	Yes	Yes	Optional
7890-0110	No	No	No	No	Yes
7890-0610	No	No	Yes	No	Yes
7890-0611	Yes	No	Yes	No	Yes (with optional LSV)

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Reference Methods for Natural Gas: Quantitation Ranges for Compounds of Interest

Compound	ASTM D1945 mol %	ASTM D1946 mol %	ASTM D2163 mol %	UOP 539 mol %	GPA 2186	GPA 2286	ISO 6974-6
H ₂ S	0.3 to 30		–	0.1 to 25	–	0.1 to 100	–
O ₂	0.01 to 20		–	0.1 to 99.9	–	0.005 to 20	0.007 to 5
N ₂	0.01 to 100	–	–		0.005 to 5	0.005 to 100	0.007 to 40
CH ₄	0.01 to 100	–	–		0.001 to 5	0.001 to 100	40 to 100
CO		–	–		–	–	0.001 to 1
CO ₂	0.01 to 20	–	–		0.005 to 5	0.005 to 100	0.001 to 10
He	0.01 to 10	–	–		–	–	0.002 to 0.5
H ₂	0.01 to 10	–	–		–	–	0.001 to 0.5
Ethane	0.01 to 100	–	0.1 and above	0.1 to 99.9	0.001 to 95	0.001 to 100	0.002 to 15
Propane	0.01 to 100	–	0.1 and above		0.001 to 100	0.001 to 100	0.001 to 5
C ₄ isomers	0.01 to 10	–	0.1 and above		0.001 to 100	0.001 to 10	0.0001 to 1
C ₅ isomers	0.01 to 2	–	0.1 and above		0.001 to 50	0.001 to 5	0.0001 to 0.5
C ₆ isomers	0.01 to 2	–	–	–	0.001 to 30	0.001 to 5	0.0001 to 0.5
C ₆₊	–	–	–	0.1 to 99.9	–	–	–
C ₇₊	0.01 to 1	–	–	–	0.001 to 30	–	–
C ₇ -C ₈	–	–	–	–	–	0.001 to 2	0.0001 to 0.5
C ₉	–	–	–	–	–	0.001 to 2	–
C ₁₀ -C ₁₄	–	–	–	–	–	0.001 to 1	–

* This guide reports typical quantitation limits for each system configuration. These values may differ from the absolute reporting limit required by the method.

Note: In the table above the symbol "–" indicates that this parameter was not specified.

Can't find your application?

Agilent Technologies can configure custom solutions to meet your analytical requirements!

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Extended Natural Gas Analyzer to C-12 (G3445 #541)

Analyzer Description

Configuration:

- 3-valve/4-column (capillary and packed), TCD/FID

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed:

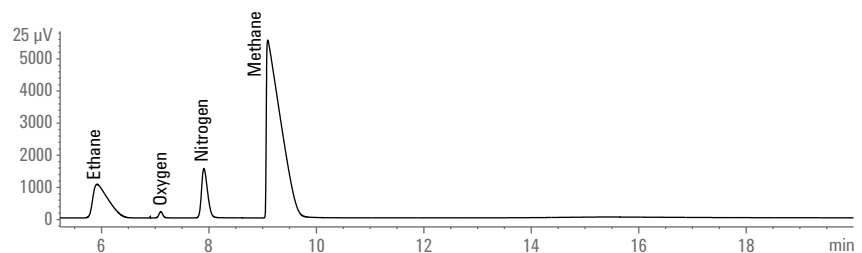
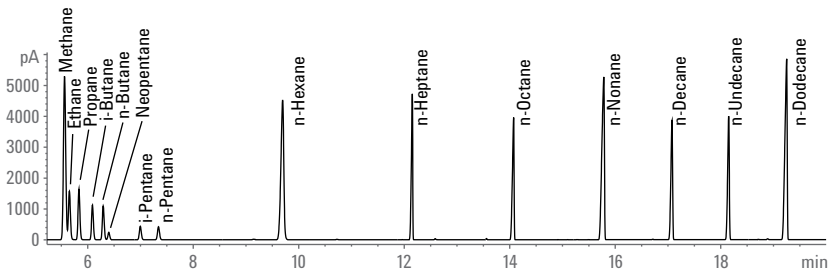
- C₁-C₁₂, O₂, N₂, CO₂, CO

Typical quantification range:

- 50 ppm for permanent gases and C₁-C₂ hydrocarbons on TCD
- 10 ppm for C₃-C₁₂ on FID

Configured per method:

- Results per GPA 2286, but calculation without bridge components iC₅ and nC₅



► KEY BENEFITS AND FEATURES

- Dual channels with TCD and FID detectors
- TCD channel with packed column for C₁-C₂, O₂, N₂, CO₂ analysis
- C₃-C₁₂ hydrocarbons separated on PONA column and measured on FID
- Adapt to liquefied natural gas by adding additional liquid sampling valve

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Natural Gas Analyzer (G3445 #542)

Analyzer Description

Configuration:

- 3-valve/4-column (packed), TCD

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed*:

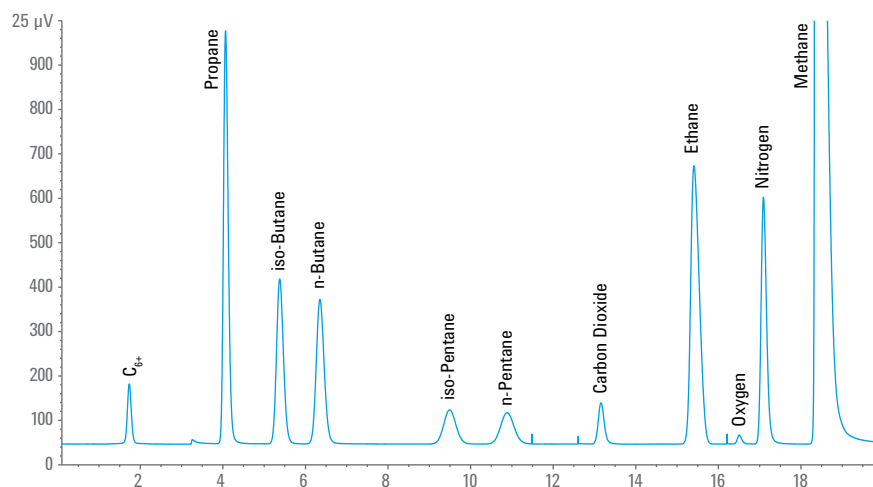
- C₁-C₅, C₆₊ as backflush
- O₂, N₂, CO₂, CO

Typical quantification range:

- 0.01 mol% for all components

Configured per method:

- ASTM D1945, GPA 2261 (H₂ and He are not included)



► KEY BENEFITS AND FEATURES

- Single TCD channel
- Rugged packed columns
- 20 minute analysis time
- Software provided for natural gas calculations per GPA 2261

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Natural Gas Analyzer (G3445 #543)

Analyzer Description

Configuration:

- 4-valve/6-column (packed), 2-TCD

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed:

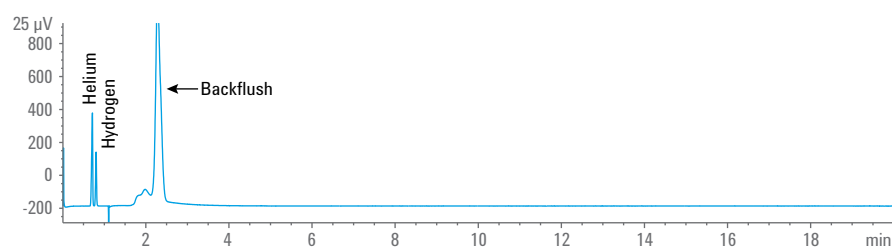
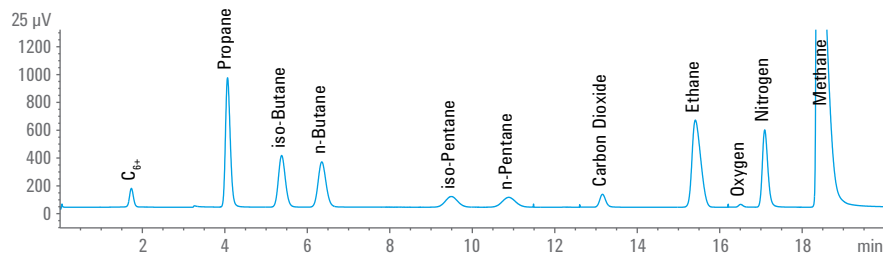
- C₁-C₅, C₆₊ as backflush
- H₂, He, O₂, N₂, CO₂, CO

Typical quantification range:

- 0.01 mol% for all components

Configured per method:

- ASTM D1945, GPA 2261



► KEY BENEFITS AND FEATURES

- Dual TCD channels
- Rugged packed columns
- 20 minute analysis time
- Dedicated channel for H₂ and He analysis

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Natural Gas Analyzer (G3445 #544)

Analyzer Description

Configuration:

- 3-valve/4-column (packed), TCD

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed:

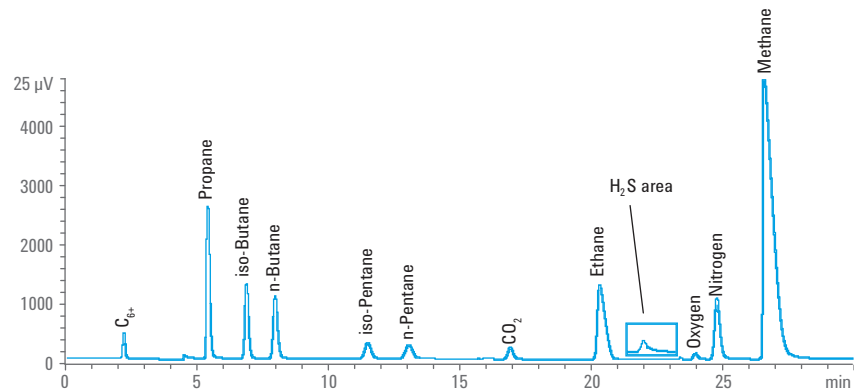
- C₁-C₅, C₆₊ as backflush
- O₂, N₂, H₂S, CO₂, CO

Typical quantification range:

- 0.01 mol% for all components except H₂S
- 500 ppm for H₂S

Configured per method:

- ASTM D1945, GPA 2261



► KEY BENEFITS AND FEATURES

- Single TCD channel
- Rugged packed columns
- 30 minute analysis time
- Software provided for natural gas calculations per GPA 2261
- Similar to G3445 #542 but with hardware to allow H₂S analysis
- Dedicated channel for H₂ and He analysis

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Natural Gas Analyzer (G3445 #545)

Analyzer Description

Configuration:

- 1-valve/2-column (packed), TCD

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed:

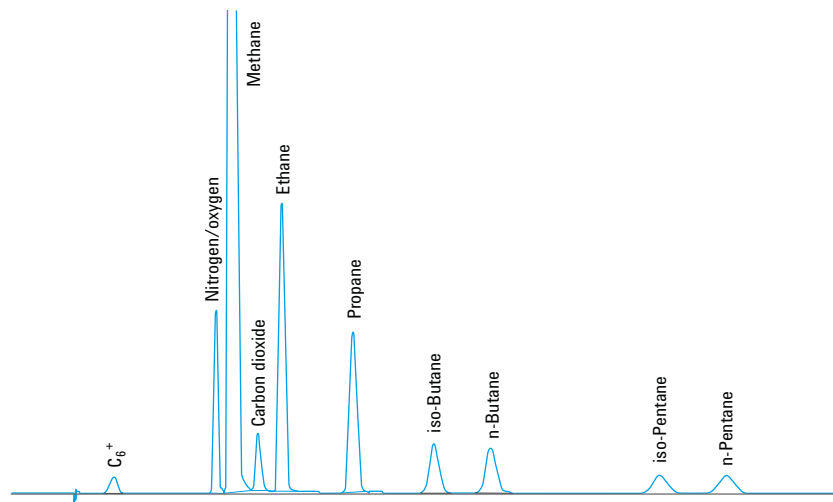
- C₁-C₅, C₆₊ as backflush
- Air composite
- CO₂

Typical quantification range:

- 0.01 mol% for all components

Configured per method:

- GPA 2261 (H₂ and He is not included, without separation of O₂ and N₂)



► KEY BENEFITS AND FEATURES

- Single TCD channel
- Rugged packed columns
- 13 minute analysis time
- Simple and low cost solution for light hydrocarbon analysis

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3-Channel Enhanced Hydrocarbon Natural Gas Analyzer (G3445 #547)

Analyzer Description

Configuration:

- 4-valve/6-column (packed), 2-TCD/FID

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed:

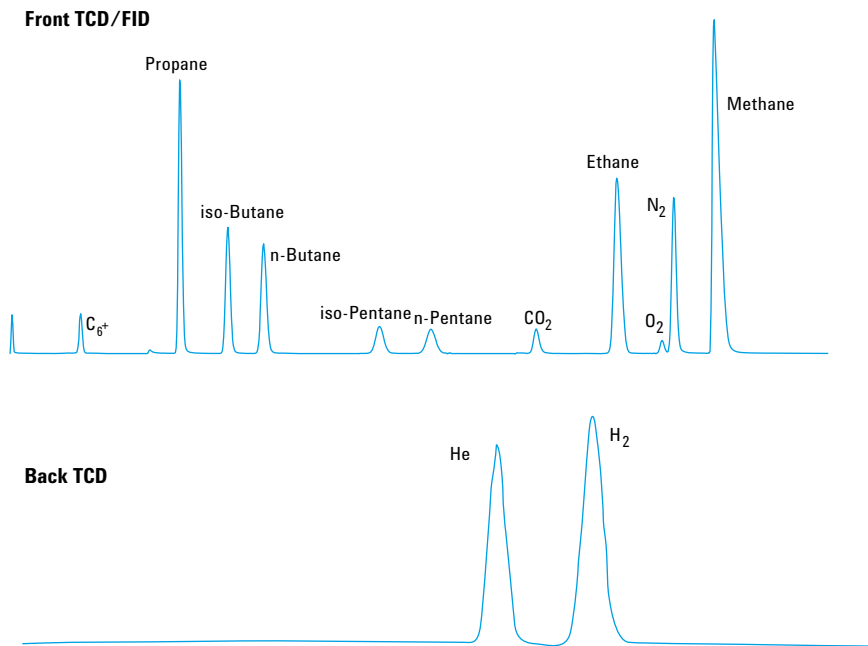
- C₁-C₅, C₆₊
- H₂, He, O₂, N₂, CO₂, CO

Typical quantification range:

- 10 ppm for hydrocarbons (FID)
- 0.01 mol% for all permanent gases

Configured per method:

- ASTM D1945, GPA 2261



► KEY BENEFITS AND FEATURES

- Dual TCD and FID for enhanced hydrocarbon sensitivity
- Rugged packed columns
- Dedicated channel for H₂ and He analysis
- 20 minute analysis time

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Extended Natural Gas Analyzer (G3445 #548)

Analyzer Description

Configuration:

- 4-valve/3-column (packed, capillary), TCD/FID

Sample type:

- Natural gas and similar gaseous mixtures

Compounds analyzed:

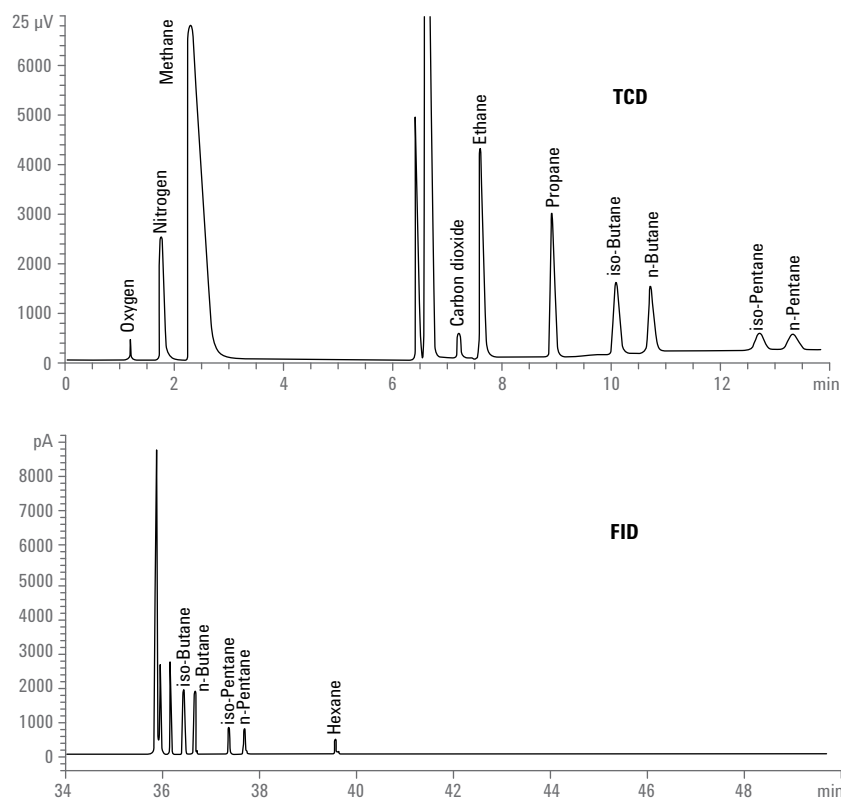
- C₁-C₅
- N₂, O₂, CO₂

Typical quantification range:

- 50 ppm for permanent gases and C₁-C₅ (TCD)
- 10 ppm for C₅-C₆ (FID)

Configured per method:

- GPA 2286



► KEY BENEFITS AND FEATURES

- 2-channel with TCD and FID detectors
- Fixed gases and hydrocarbons up to C₅ on packed columns and thermal conductivity detector
- Hydrocarbons from C₅ to C₁₄ are analyzed on a capillary column and a flame ionization detector
- The pentanes are used as 'bridging' compounds for calculations per GPA 2286
- Software supplied to generate a data report per GPA 2286

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Natural Gas Analyzer A: 2-Channel Micro GC (G3582A #120)

Analyzer Description

Configuration:

- 2-channel Micro GC
 - Channel 1: HayeSep A
 - Channel 2: CP-Sil 5 CB

Sample type:

- Natural gas and liquefied* natural gas

Compounds analyzed:

- Hydrocarbons C₁-C₉
- Carbon dioxide and Air

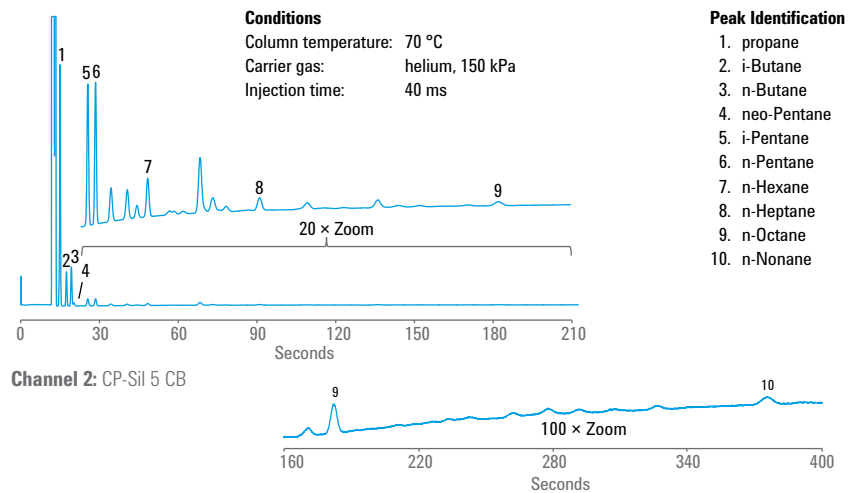
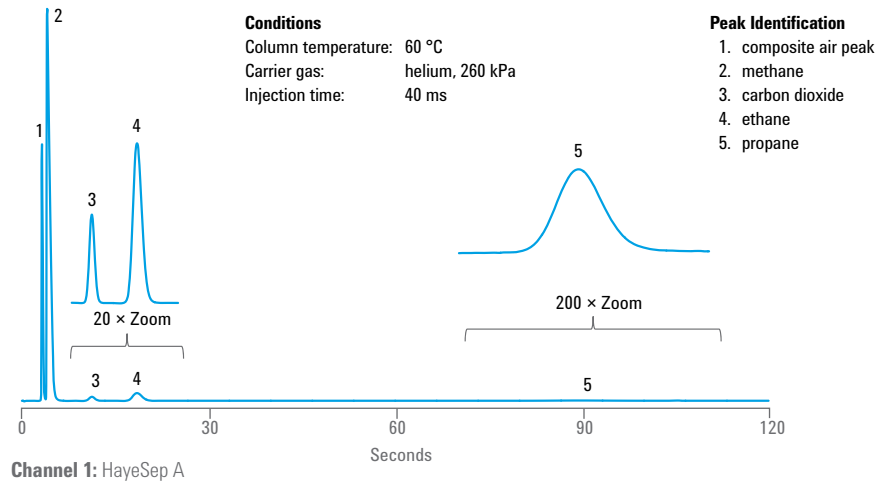
Typical quantification range:

- 1-10 ppm

Configured per method:

- ASTM D3588-98, GPA 2177, GPA 2172, ISO 6974-6

* Injection of liquefied samples, e.g., LPG and LNG, require use of a microgasifier



► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of natural gas composition in 210 seconds
 - Characterizes hydrocarbons C₁-C₉, carbon dioxide and air concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability: RSD 0.5%

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Natural Gas Analyzer A Extended: 3-Channel Micro GC (G3582A #121)

Analyzer Description

Configuration:

- 3-channel Micro GC
 - Channel 1: HayeSep A with Backflush
 - Channel 2: CP-Sil 5 CB with Backflush
 - Channel 3: CP-Sil 5 CB

Sample type:

- Natural gas and liquefied natural gas

Compounds analyzed:

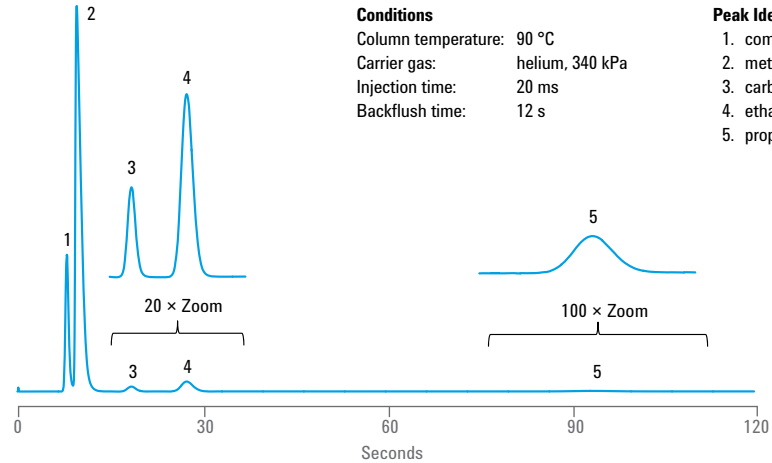
- Hydrocarbons C₁-C₁₂
- Carbon dioxide and air

Typical quantification range:

- 1-10 ppm

Configured per method:

- ASTM D3588-98, GPA 2177, GPA 2172, ISO 6974-6



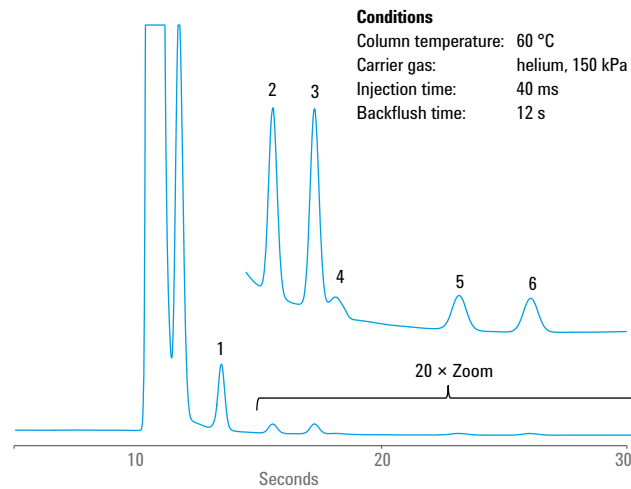
Conditions

Column temperature: 90 °C
 Carrier gas: helium, 340 kPa
 Injection time: 20 ms
 Backflush time: 12 s

Peak Identification

1. composite airpeak
2. methane
3. carbon dioxide
4. ethane
5. propane

Channel 1: HayeSep A with Backflush



Conditions

Column temperature: 60 °C
 Carrier gas: helium, 150 kPa
 Injection time: 40 ms
 Backflush time: 12 s

Peak Identification

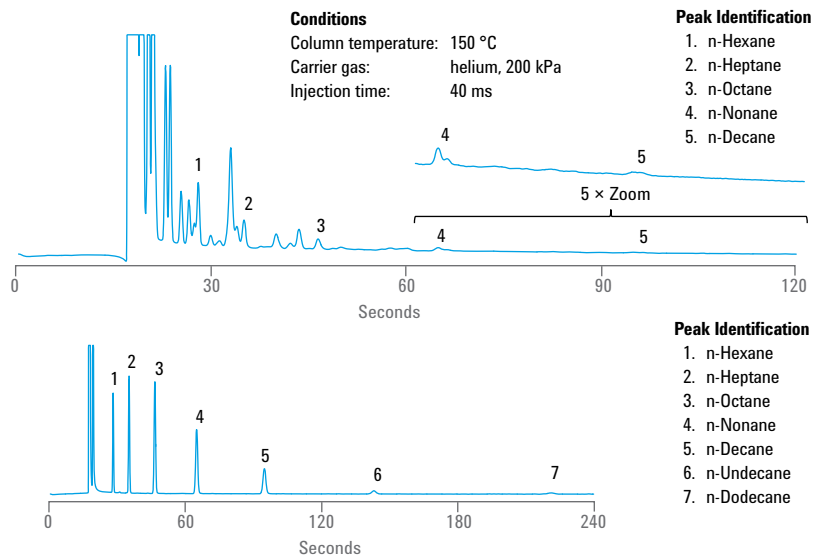
1. propane
2. i-Butane
3. n-Butane
4. neo-Pentane
5. i-Pentane
6. n-Pentane

Channel 2: CP-Sil 5 CB with Backflush

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Channel 3: CP-Sil 5 CB



Robust and reliable:

Agilent lets you choose from more than 100 factory-tested GC instrument configurations and analyzers—all application pre-tested to run according to industry standards such as ISO, ASTM, EPA, USP, CEN, UOP, and GPA.

► **KEY BENEFITS AND FEATURES**

- Optimized for the rapid analysis of natural gas composition in 240 seconds
 - Characterizes hydrocarbons C₁-C₁₂, carbon dioxide and air concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability: RSD 0.5%

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Natural Gas Analyzer B with H₂S: 2-Channel Micro GC (G3582A #122)

Analyzer Description

Configuration:

- 2-channel Micro GC
 - Channel 1: PoraPLOT U Backflush
 - Channel 2: CP-Sil 5 CB

Sample type:

- Natural gas and liquefied natural gas

Compounds analyzed:

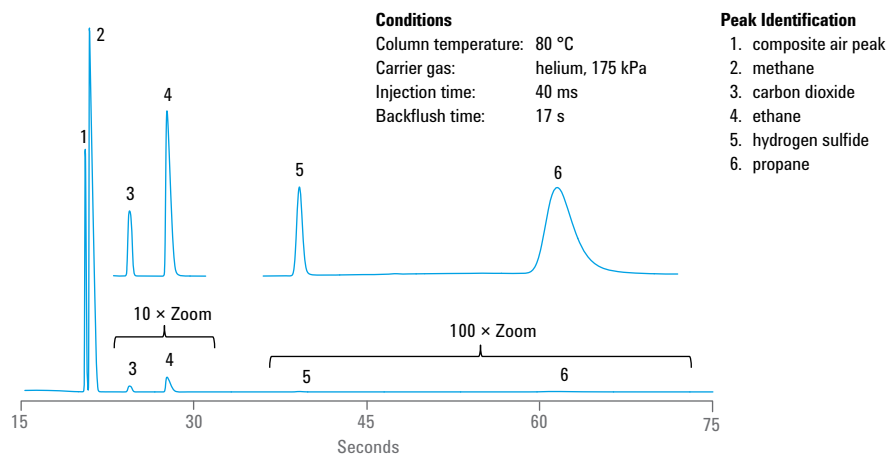
- Hydrocarbons C₁-C₉
- Carbon dioxide and Air
- H₂S

Typical quantification range:

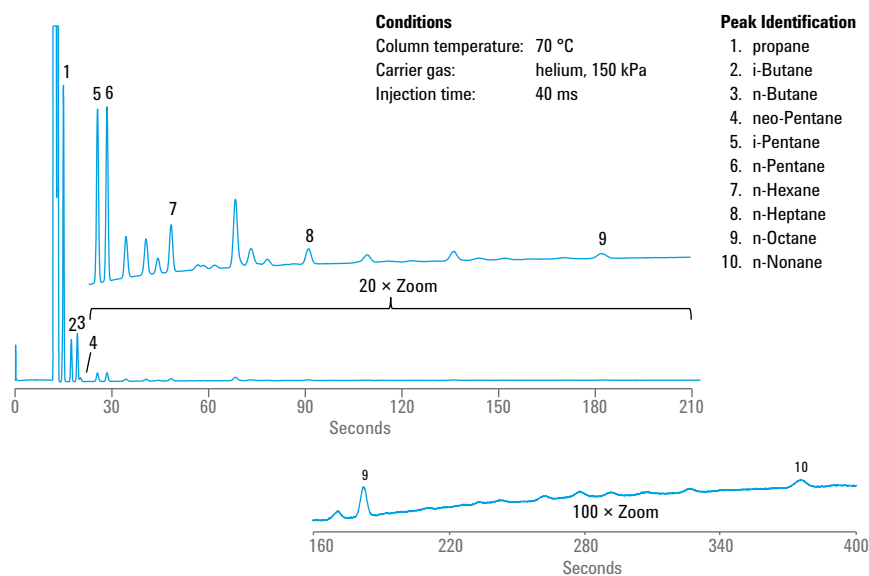
- 1-10 ppm

Configured per method:

- ASTM D3588-98, GPA 2177, GPA 2172, ISO 6974-6



Channel 1: PoraPLOT U Backflush



Channel 2: CP-Sil 5 CB

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of natural gas composition in 210 seconds
 - Characterizes hydrocarbons C₁-C₉, carbon dioxide and air concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability: RSD 0.5%

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Natural Gas Analyzer B Extended with H₂S: 3-Channel Micro GC (G3582A #123)

Analyzer Description

Configuration:

- 3-channel Micro GC
 - Channel 1: CP-molsieve 5Å Backflush
 - Channel 2: PoraPLOT U Backflush
 - Channel 3: CP-Sil 5 CB

Sample type:

- Natural gas and liquefied natural gas

Compounds analyzed:

- Hydrocarbons C₁-C₉
- Carbon dioxide and Air
- H₂S
- N₂, O₂, He and H₂

Typical quantification range:

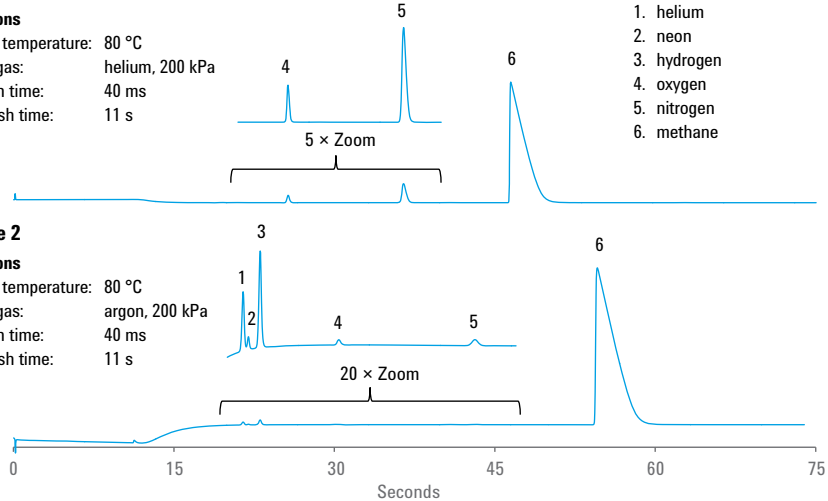
- 1-10 ppm

Configured per method:

- ASTM D3588-98, GPA 2261, GPA 2177, GPA 2172, ISO 6974-6, ASTM D1945

Sample 1

Conditions
 Column temperature: 80 °C
 Carrier gas: helium, 200 kPa
 Injection time: 40 ms
 Backflush time: 11 s

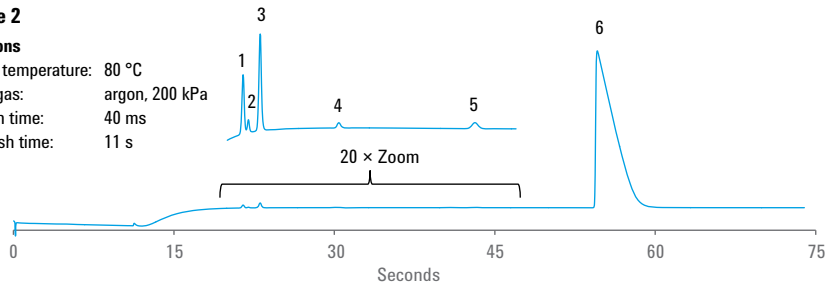


Peak Identification

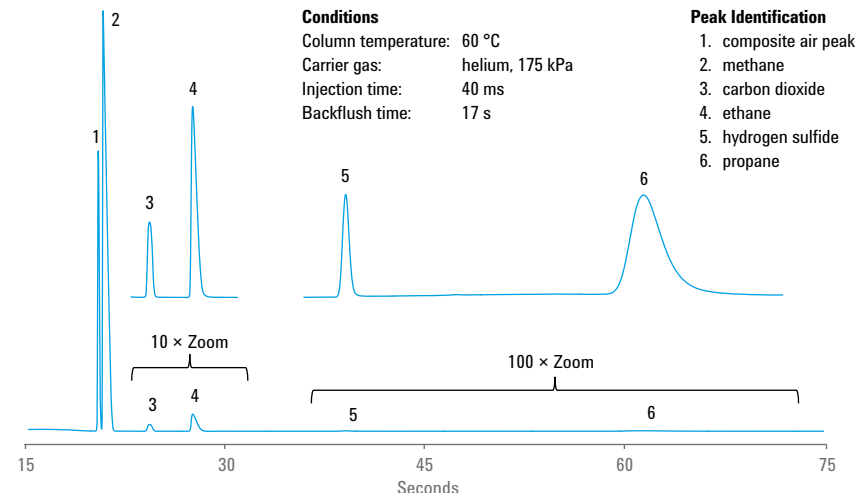
1. helium
2. neon
3. hydrogen
4. oxygen
5. nitrogen
6. methane

Sample 2

Conditions
 Column temperature: 80 °C
 Carrier gas: argon, 200 kPa
 Injection time: 40 ms
 Backflush time: 11 s



Channel 1: CP-molsieve 5Å Backflush



Conditions
 Column temperature: 60 °C
 Carrier gas: helium, 175 kPa
 Injection time: 40 ms
 Backflush time: 17 s

Peak Identification

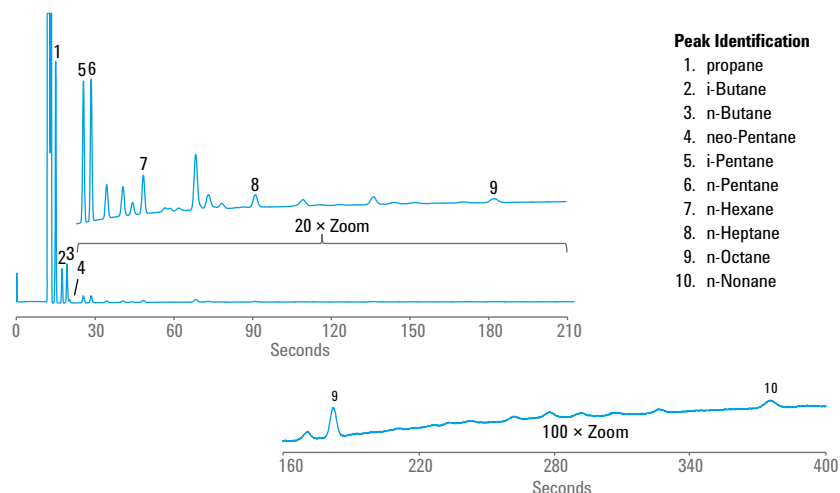
1. composite air peak
2. methane
3. carbon dioxide
4. ethane
5. hydrogen sulfide
6. propane

Channel 2: PoraPLOT U Backflush

(Continued)

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Channel 3: CP-Sil 5 CB



Agilent solutions significantly reduce your time from system arrival to final validation. With pre-configured hardware and method-specific separation tools, your analysts can focus on calibration and validation per your laboratory's SOPs.

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of natural gas composition in 210 seconds
 - Characterizes hydrocarbons C₁-C₉, carbon dioxide and air concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability: RSD 0.5%
- Optional report for calorific value
- Dual carrier gas for optimal detection

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INTRODUCTION

Liquefied Natural Gas Analyzer (7890-0110)

Analyzer Description

Configuration:

- 1-valve/1-liquid valve/2-column (packed)/TCD

Sample type:

- Natural gas and similar gaseous mixtures; liquefied natural gas

Compounds analyzed:

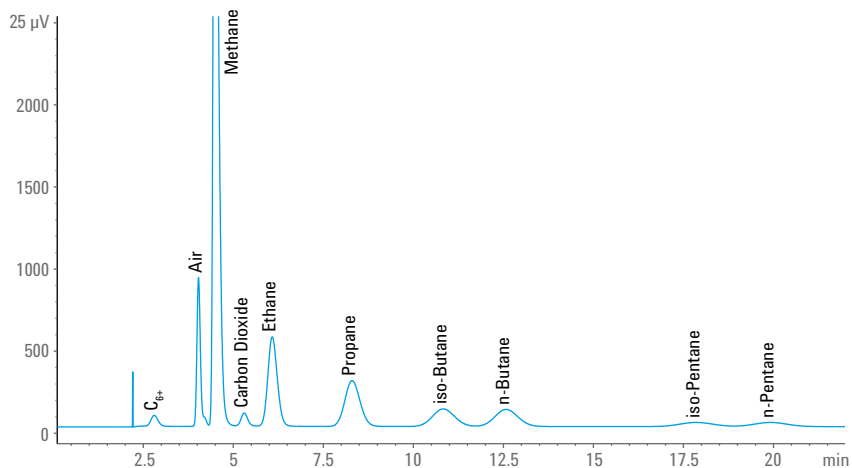
- C₁-C₅
- C₆₊ as backflush
- Air composite, CO₂

Typical quantification range:

- 0.01 mol% for all components

Configured per method:

- GPA 2177



► KEY BENEFITS AND FEATURES

- Single TCD channel
- Rugged packed columns
- Simple and lowest cost
- Liquid sample valve for liquefied natural gas
- 22 minute analysis time

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Permanent Gas and Hydrocarbons in Natural Gas Analyzer (7890-0610)

Analyzer Description

Configuration:

- 1-valve/2-column (capillary), 2-TCD

Sample type:

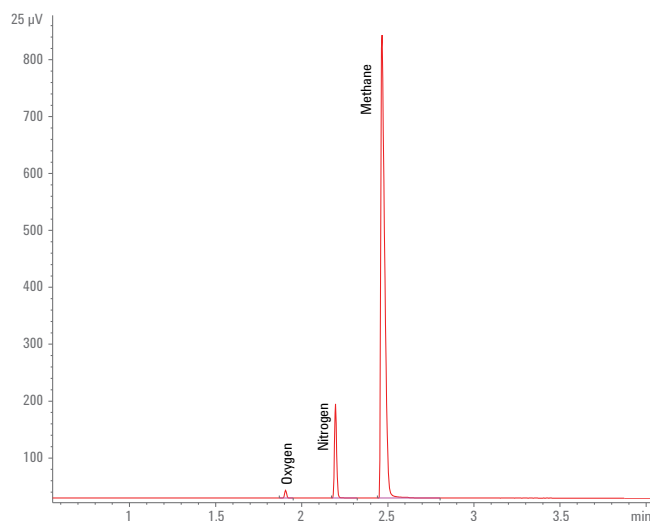
- Natural gas and similar process gas mixtures

Compounds analyzed:

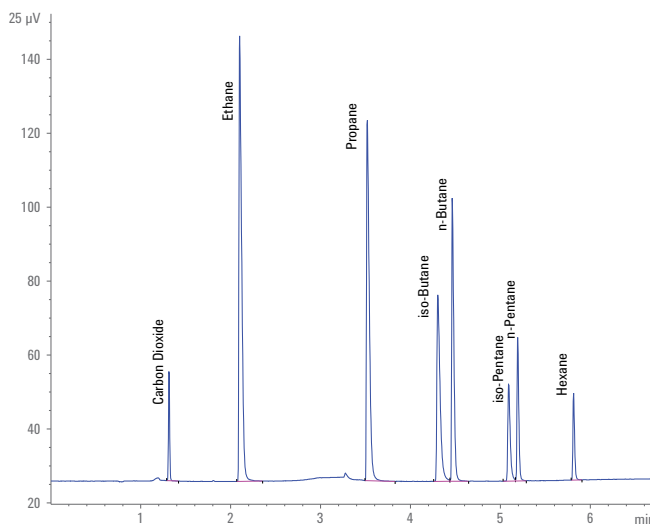
- C₁-C₆
- N₂, O₂, CO, CO₂, H₂S

Typical quantification range:

- 0.01 mol% for all components except H₂S
- 0.05 mol% for H₂S



Permanent gases in natural gas



Hydrocarbons (to C6) in natural gas

► KEY BENEFITS AND FEATURES

- Capillary columns with Deans Switch and dual TCD
- Easy maintenance
- 5 minute analysis time
- H₂S analysis
- O₂ and N₂ separation
- Handles gas and liquefied gases (with optional LSV)

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Natural Gas Analyzer: Permanent Gas and Extended Hydrocarbons (7890-0611)

Analyzer Description

Configuration:

- 1-valve/3-column (packed)/TCD (2)/FID

Sample type:

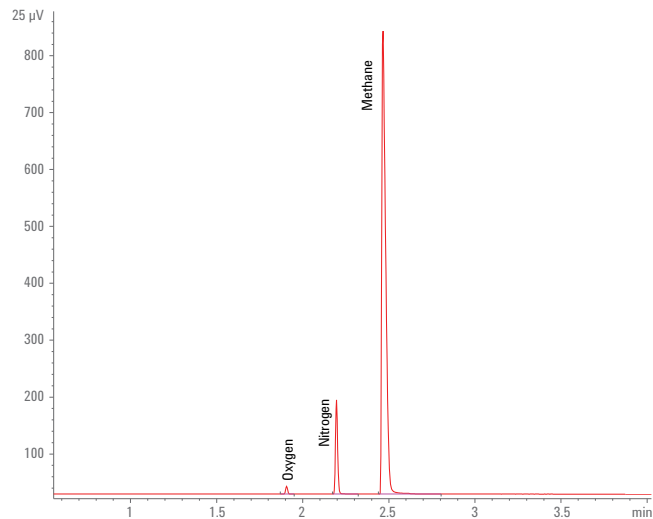
- Natural gas and similar process gas mixtures
- Liquefied Gas with optional LSV

Compounds analyzed:

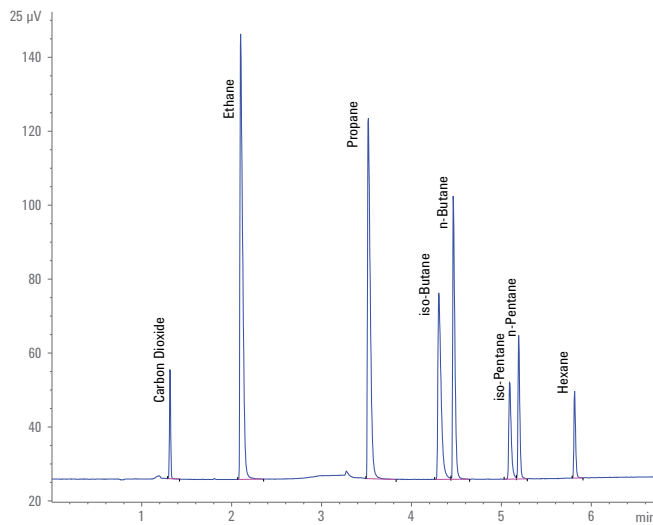
- C₁-C₁₅
- O₂, N₂, CO₂, CO and H₂S

Typical quantification range:

- 0.01 mol% for all components except H₂S
- 0.05 mol% except H₂S



Permanent gases in natural gas

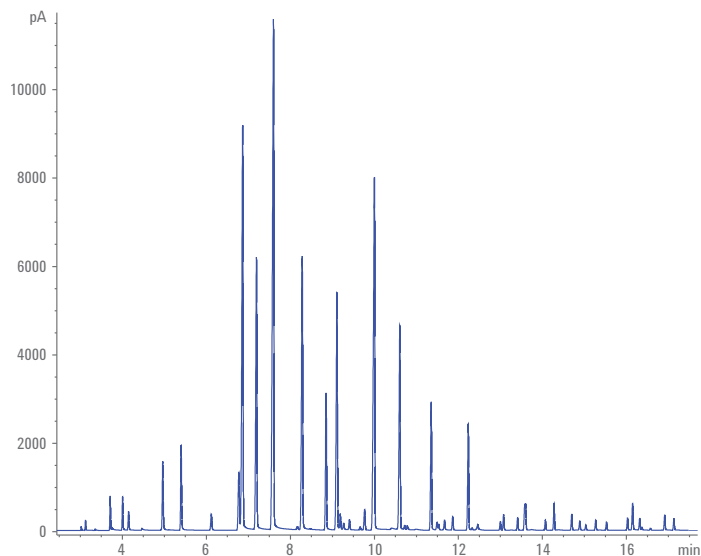


Hydrocarbons (to C6) in natural gas

(Continued)

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Extended Hydrocarbons (to C₁₅) in real world liquefied gas sampled, peaks unlabelled



Agilent analyzers help extend the analytical capabilities of your laboratory. Customization through the addition of a liquid sampling valve has expanded natural gas analyzers to include liquefied gas samples. To find out more, visit www.agilent.com/chem/energy

► KEY BENEFITS AND FEATURES

- Capillary columns with Deans Switch/dual TCD/FID
- Easy maintenance
- 5 minute analysis time for permanent gases
- 20 minute analysis time for hydrocarbons to C₁₅
- H₂S analysis
- O₂ and N₂ separation
- Handles gas and liquefied gases (with optional LSV)
- For permanent gases and hydrocarbons to C₆ in natural gas, please consider 7890-0610

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SOLUTIONS FOR REFORMULATED FUEL



Conform to strict octane and emissions regulations

The 1990 US EPA Clean Air Act sets strict limits on volatile organic compounds (VOCs) and other toxic chemicals that emit from gasoline engine exhaust.

To reach these target levels, fuel producers must reformulate their gasoline to increase octane levels. This is accomplished through catalytic restructuring of hydrocarbon molecules in naphtha feedstock to produce a more complex structure and increase oxygen content through oxygenate blending. The resulting fuels have higher octane ratings, and combust more efficiently and thoroughly.

Agilent, together with our Channel Partners, offer a portfolio of **Reformulated Gasoline (RFG) Analyzers** that are factory configured to meet standards such as ASTM and CEN—and are chemically tested for analyzing oxygenate concentrations, benzene, and heavier aromatic content in RFG.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Oxygenates and Aromatics in Fuel

Analyzer Number	Configuration	Capability
G3445 #611	1-valve, 2-column (micro-packed and capillary), and FID/TCD	Oxygenates and aromatics in finished gasoline per ASTM D4815 and ASTM D5580
G3445 #612	2-valve, 4-column (micro-packed and capillary) and dual FID	Parallel channel oxygenates and aromatics per ASTM D4815 and ASTM D5580
G3445 #615	1-valve, 2-column (packed column), TCD or FID	Benzene in finished motor and aviation fuels per ASTM D3606
G3445 #616	1-valve, 2-column (micro-packed and capillary), 2-FID (or FID/TCD)	Aromatics in finished gasoline per ASTM D5580
G3445 #617	Deans Switching/2-column/dual FID	Oxygenates and aromatics in commercial and raw gasoline per EN 13132 and EN 12177
G3445 #618	Capillary flow technology micro volume tee/2-column/FID/autosampler (for liquid samples), gas sampling valve (for gas samples), LSV (for liquefied gases)	Low level oxygenates in light hydrocarbons per ASTM D7423
G3445 #621	3-in-1 reformulated fuel analyzer with large valve oven (LVO)	ASTM D3606, ASTM D4815, and ASTM D5580
7890-0340	1-valve/2-column/FID	Trace oxygenates in reformulated gasoline per ASTM D7754

Reference Methods for Oxygenates: Quantitation Ranges for Compounds of Interest

ASTM D7423	
Analyte	The linear working range
Oxygenate compounds	0.50 mg/kg to 100 mg/kg

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Single Channel Oxygenates and Aromatics in Fuel Analyzer (G3445 #611)

Analyzer Description

Configuration:

- 1-valve/2-column (micro-packed and capillary)/FID/TCD

Sample type:

- Finished gasoline

Compounds analyzed:

- ASTM D4815: MTBE, ETBE, TAME, DIPE, methanol, ethanol, isopropanol, *n*-propanol, isobutanol, *tert*-butanol, *sec*-butanol, *n*-butanol, *tert*-pentanol
- ASTM D5580: benzene, toluene, ethylbenzene, xylene, C₉ and heavier aromatics, total aromatics

Typical quantification range:

- 0.1 to 20 Wt% for individual ethers, 0.1 to 12 Wt% for individual alcohols
- 0.1 to 5 Vol% for benzene, 1 to 15 Vol% for toluene
- 0.5 to 10 Vol% for individual C₈ aromatics, 5 to 30 Vol% for total C₉ and heavier aromatics, 10 to 80 Vol% for total aromatics

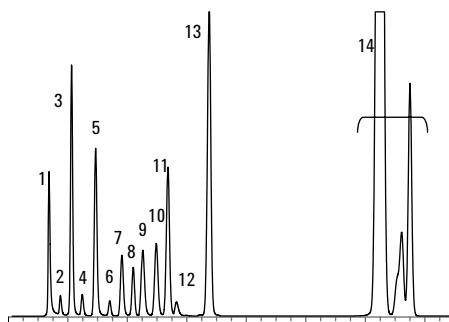
Configured per method:

- ASTM D4815, ASTM D5580

ASTM D4815

Peak Identification

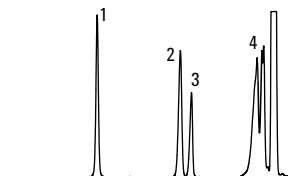
- | | |
|-------------------------|---------------------------|
| 1. methanol | 8. DIPE |
| 2. ethanol | 9. isobutanol |
| 3. isopropanol | 10. <i>tert</i> -pentanol |
| 4. <i>tert</i> -butanol | 11. DME |
| 5. <i>n</i> -propanol | 12. <i>n</i> -butanol |
| 6. MTBE | 13. TAME |
| 7. <i>sec</i> -butanol | 14. heavier hydrocarbon |



ASTM D5580 - 1st run

Peak Identification

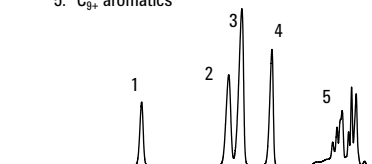
1. benzene
2. toluene
3. 2-hexanone
4. backflush peaks



ASTM D5580 - 2nd run

Peak Identification

1. 2-hexanone
2. ethylbenzene
3. *m/p*-xylene
4. *o*-xylene
5. C₉, aromatics



► KEY BENEFITS AND FEATURES

- Designed for both ASTM D4815 and ASTM D5580 methods, uses same hardware configuration
- Configured to determine oxygenates (ASTM D4815) and aromatics (ASTM D5580) in gasoline by using either helium or nitrogen (which is lower cost) carrier gas

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Dual Parallel Channel Oxygenates and Aromatics in Fuel Analyzer (G3445 #612)

Analyzer Description

Configuration:

- 2-valve/4-column (micro-packed and capillary)/2-FID

Sample type:

- Finished gasoline

Compounds analyzed:

- ASTM D4815: MTBE, ETBE, TAME, DIPE, methanol, ethanol, isopropanol, *n*-propanol, isobutanol, *tert*-butanol, *sec*-butanol, *n*-butanol, *tert*-pentanol
- ASTM D5580: benzene, toluene, ethylbenzene, xylene, C₉ and heavier aromatics, total aromatics

Typical quantification range:

- 0.1 to 20 Wt% for individual ethers, 0.1 to 12 Wt% for individual alcohols
- 0.1 to 5 Vol% for benzene, 1 to 15 Vol% for toluene
- 0.5 to 10 Vol% for individual C₈ aromatics, 5 to 30 Vol% for total C₉ and heavier aromatics, 10 to 80 Vol% for total aromatics

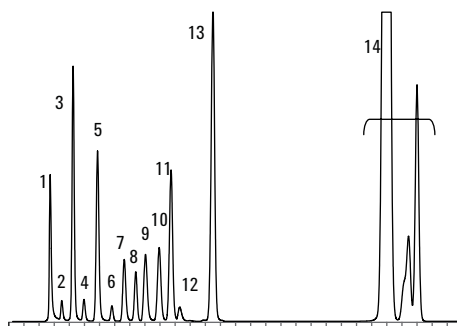
Configured per method:

- ASTM D4815, ASTM D5580

ASTM D4815

Peak Identification

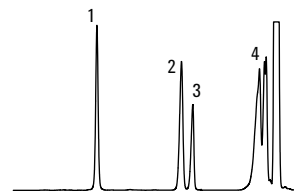
- | | |
|-------------------------|---------------------------|
| 1. methanol | 8. DIPE |
| 2. ethanol | 9. isobutanol |
| 3. isopropanol | 10. <i>tert</i> -pentanol |
| 4. <i>tert</i> -butanol | 11. DME |
| 5. <i>n</i> -propanol | 12. <i>n</i> -butanol |
| 6. MTBE | 13. TAME |
| 7. <i>sec</i> -butanol | 14. heavier hydrocarbon |



ASTM D5580 - 1st run

Peak Identification

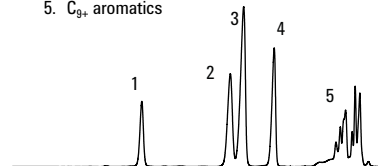
1. benzene
2. toluene
3. 2-hexanone
4. backflush peaks



ASTM D5580 - 2nd run

Peak Identification

1. 2-hexanone
2. ethylbenzene
3. *m/p*-xylene
4. *o*-xylene
5. C₉, aromatics



► KEY BENEFITS AND FEATURES

- Dual parallel channels are configured on one GC system; one channel for ASTM D4815 and one for ASTM D5580
- Analyzer has the capability to determine oxygenates (ASTM D4815) and aromatics (ASTM D5580) in gasoline

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Benzene in Gasoline Analyzer (G3445 #615)

Analyzer Description

Configuration:

- 1-valve/2-column/TCD or FID

Sample type:

- Finished motor and aviation gasoline

Compounds analyzed:

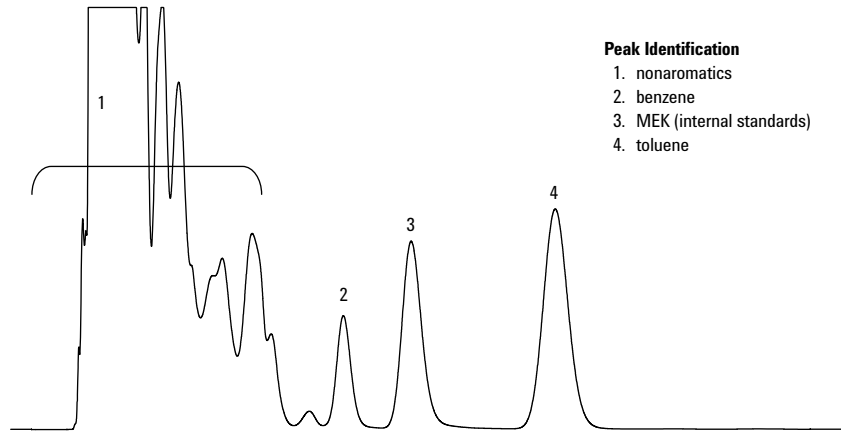
- Benzene, toluene

Typical quantification range:

- 0.1 to 5 Vol% for benzene
- 2 to 20 Vol% for toluene

Configured per method:

- ASTM D3606



Peak Identification

1. nonaromatics
2. benzene
3. MEK (internal standards)
4. toluene

► KEY BENEFITS AND FEATURES

- Single channel with dual packed-column configured to determine benzene and toluene in finished motor and aviation gasoline
- Independently heated valve system prevents condensation of heavy components in the sample

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Aromatics in Fuel Analyzer (G3445 #616)

Analyzer Description

Configuration:

- 1-valve/2-column (micro-packed and capillary), 2-FID (or FID/TCD)

Sample type:

- Finished gasoline

Compounds analyzed:

- Benzene, toluene, ethylbenzene, xylene, C₉ and heavier aromatics, total aromatics

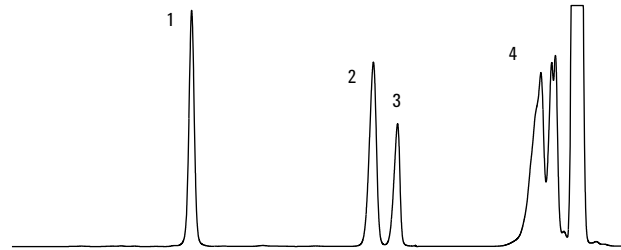
Typical quantification range:

- 0.1 to 5 Vol% for benzene, 1 to 15 Vol% for toluene
- 0.5 to 10 Vol% for individual C₈ aromatics
- 5 to 30 Vol% for total C₉ and heavier aromatics
- 10 to 80 Vol% for total aromatics

Configured per method:

- ASTM D5580

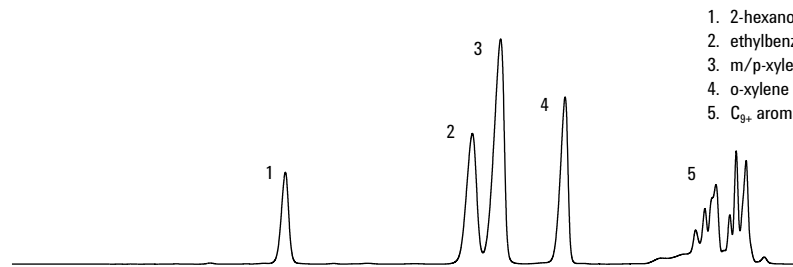
ASTM D5580 - 1st run



Peak Identification

1. benzene
2. toluene
3. 2-hexanone
4. backflush peaks

ASTM D5580 - 2nd run



Peak Identification

1. 2-hexanone
2. ethylbenzene
3. m/p-xylene
4. o-xylene
5. C₉, aromatics

► KEY BENEFITS AND FEATURES

- Dual-column system configured to determine benzene, toluene, ethylbenzene, and xylene in finished gasoline
- System configuration uses improved TCEP column mounting to greatly improve method stability

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Oxygenates and Aromatics in Gasoline by Deans Switch Analyzer (G3445 #617)

Analyzer Description

Configuration:

- Deans Switching/2-column/2-FID

Sample type:

- Commercial or raw gasoline

Compounds analyzed:

- Benzene, toluene, ethylbenzene, and oxygenates: MTBE, ETBE, TAME, DIPE, ethanol, isopropanol, *n*-propanol, isobutanol, *tert*-butanol, *sec*-butanol, *n*-butanol, and *tert*-pentanol

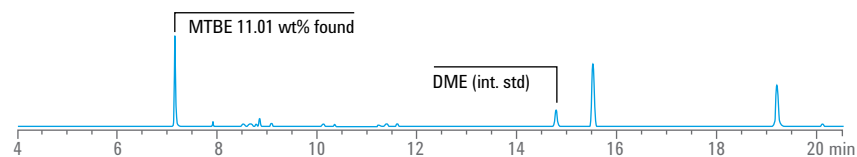
Typical quantification range:

- 0.05 to 6 Vol% for benzene, 0.17 to 15 Vol% for individual organic oxygenates

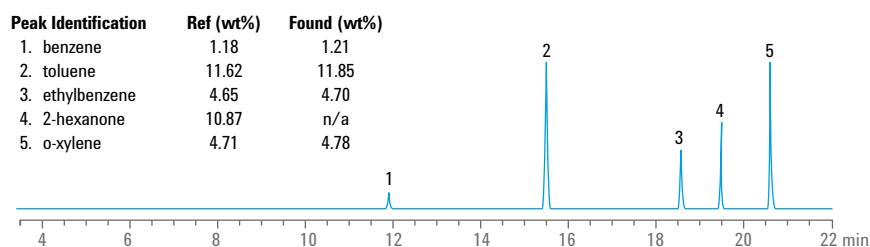
Configured per method:

- EN 13132, EN 12177

DB-1 Column (FID B)



DB-1 Column (FID B)



► KEY BENEFITS AND FEATURES

- Configured to determine the oxygenates (EN 13132) and benzene (EN 12177) in gasoline
- Capillary Flow Technology (CFT) Deans Switch provides easier method setup and reliable performance by eliminating carry-over and minimizing peak tailing for very polar compounds
- Uses backflush to reduce analysis time

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Low Level Oxygenates in Light Hydrocarbons Analyzer by Capillary Flow Technology Micro Volume Tee (G3445 #618)

Analyzer Description

Configuration:

- Capillary Flow Technology micro-volume tee/2-column/FID/Autosampler (for liquid samples), gas sampling valve (for gas samples), LSV (for liquefied gases)

Sample type:

- Ethene, propene, hydrocarbon matrices that do not have a final boiling point greater than 200 °C

Compounds analyzed:

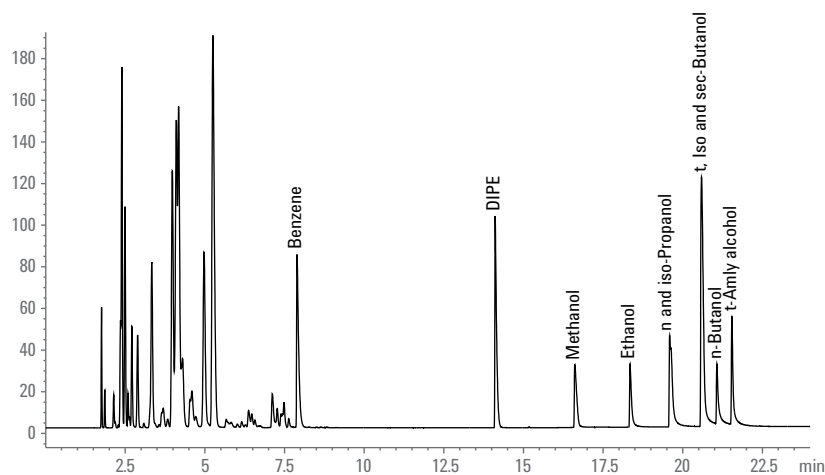
- MTBE, ETBE, DIPE, TAME, methanol, *n*-propanol and *i*-propanol, *n*-butanol, *i*-butanol, *tert*-butyl alcohol, *sec*-butyl alcohol, and *tert*-pentanol

Typical quantification range:

- 0.5 ppm for MTBE

Configured per method:

- ASTM D7423



► KEY BENEFITS AND FEATURES

- Analyzer configured to determine low level oxygenates in any hydrocarbon matrix with final boiling point <200 °C
- Capillary Flow Technology (CFT) fluidic switch with backflush used to remove hydrocarbons with higher boiling points
- Agilent GS-OxyPLOT column separates light hydrocarbons from oxygenates
- GS-OxyPLOT is surprisingly inert to polar compounds and is an excellent column for quantitative analysis of oxygenates at low concentrations

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3-in-1 Reformulated Fuel Analyzer with Large Valve Oven (LVO) (G3445 #621)

Analyzer Description

Configuration:

- 3-valves/5-columns (capillary, packed), and micro-packed), TCD/FID

Sample type:

- Finished gasoline

Compounds analyzed:

- ASTM D4815: MTBE, ETBE, TAME, DIPE, methanol, ethanol, isopropanol, *n*-propanol, isobutanol, *tert*-butanol, *sec*-butanol, *n*-butanol, *tert*-pentanol
- ASTM D3606/D5580: benzene, toluene, ethylbenzene, xylene, C₉ and heavier aromatics, total aromatics

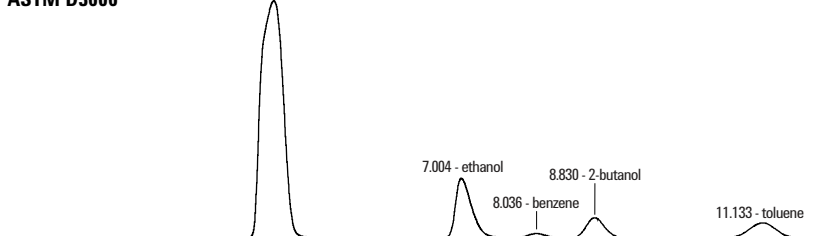
Typical quantification range:

- ASTM D3606
 - 0.1-5.0 Vol% benzene
 - 2-20 Vol% toluene
- ASTM D4815
 - 0.1-15 Wt% ethers and alcohols
- ASTM D5580
 - 0.1-5% benzene
 - 1-15% toluene
 - 0.5-10% C8 aromatics
 - 5-30% C9 plus aromatics
 - 10-80% total aromatics

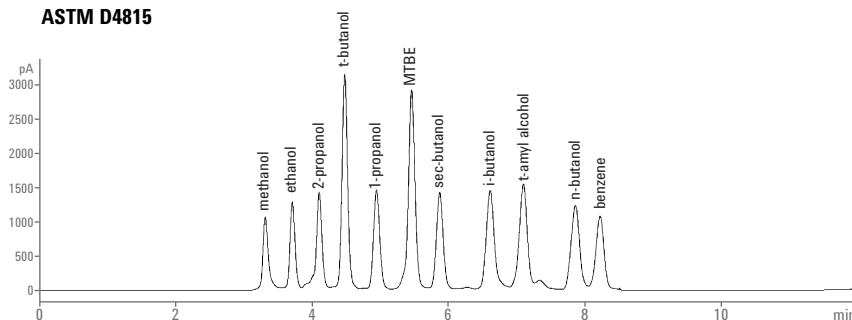
Configured per method:

- ASTM D3606, ASTM D4815, ASTM D5580

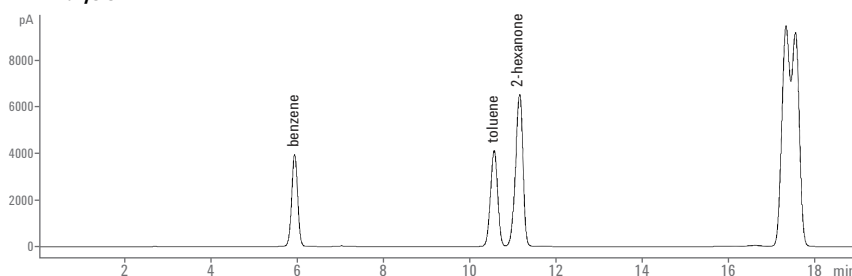
ASTM D3606



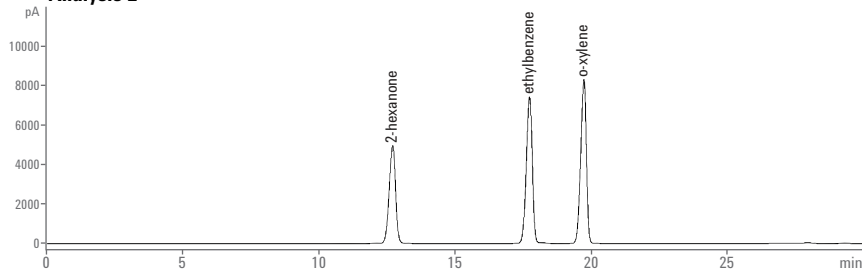
ASTM D4815



ASTM D5580
Analysis 1



ASTM D5580
Analysis 2



► KEY BENEFITS AND FEATURES

- Solution for 3 ASTM methods for oxygenates and aromatics in gasoline
- Capable of running one method at a time

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Trace Oxygenates in Reformulated Gasoline Analyzer (7890-0340)

Analyzer Description

Configuration:

- 1-valve/2-column/FID

Sample type:

- Reformulated gasoline, ethanol/gasoline blends, naphtha

Compounds analyzed:

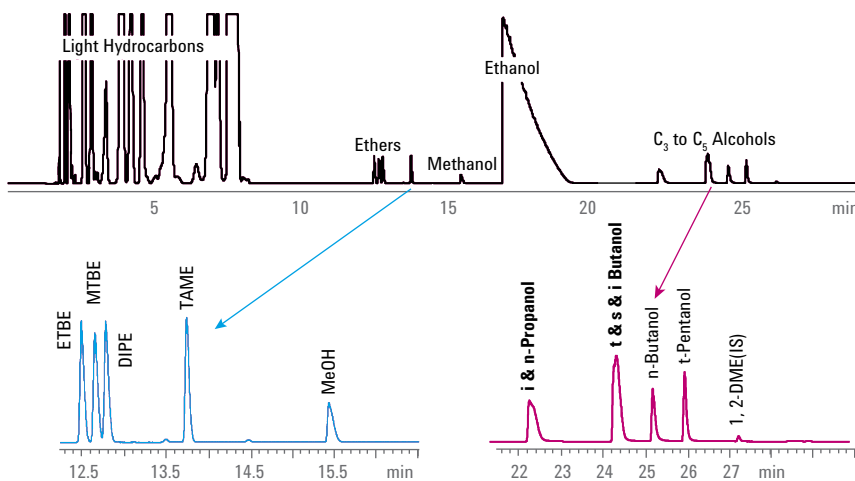
- MTBE, ETBE, DIPE, TAME, methanol, *n*-propanol, *i*-propanol, *n*-butanol, *i*-butanol, *tert*-butyl alcohol, *sec*-butyl alcohol, *tert*-pentanol

Typical quantification range:

- 10 to 1,000 ppm (wt/wt) for oxygenates
- 1 to 15 Vol% for ethanol

Configured per method:

- ASTM D7754



► KEY BENEFITS AND FEATURES

- Analyzer configured to analyze oxygenates (at the 10 to 1,000 ppm level) in gasoline containing 1 to 15 Wt% ethanol additive
- Excellent separation of oxygenates from light hydrocarbons
- Resolves all ethers (ETBE, MTBE, DIPE, and TAME)
- High quantitative precision for high and low ether concentrations in the presence of 1 to 15 Wt% ethanol

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SOLUTIONS FOR BIOFUEL/RENEWABLE FUEL



Ensure the highest quality standards from feedstock to final product

Global pressure to reduce our dependence on fossil fuels is driving the demand for sustainable, reliable, and clean alternative energy sources. It has also fueled a steady increase in research involving the conversion of biomass to biofuels.

In recent years, vegetable oil derivatives (*biodiesel*) have successfully powered automobiles, public transportation systems, and long-haul trucking fleets, while providing a fuel source—*produced from locally available feedstock*—that reduces engine wear and generates lower sulfur and CO₂ emissions.

While there is no question that biodiesel benefits our environment, producing biodiesel from many different oils does create product quality and uniformity challenges. Success depends upon characterizing raw materials, monitoring chemical conversions, ensuring process efficiency, and validating product quality.

To help you meet these challenges, Agilent has expanded our Alternative Energy Analyzer Portfolio to include **Biofuel GC Analyzers and Renewable Energy GC Analyzers**. These “ready-to-go” systems include proven analytical methods and advanced features that enable your lab to quickly validate methods that conform to ASTM and CEN standards for FAMES, glycerin/glyceride, and trace methanol measurements.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Biofuel/Renewable Fuel

Analyzer Number	Configuration	Capability
G3445 #631	On-column capillary inlet/FID with optional liquid autosampler	Free glycerin, monoglycerides, diglycerides, triglycerides, bound glycerin, and total glycerin in B100 biodiesel per ASTM D6584
G3445 #633	Split/splitless inlet/FID with optional liquid autosampler	FAME content between C ₆ -C ₂₄ in B100 biodiesel per EN 14103:2011
G3445 #634	Split/splitless inlet/FID with optional methods for automated sample preparation	Glycerol, monoglycerides, diglycerides, triglycerides in B100 biodiesel per EN14105:2011
G3582A #110	2-channel Micro GC - Channel 1: CP-molsieve 5Å - Channel 2: CP PoraPLOT U	Compounds analyzed in biogas: - Channel 1: C ₁ , H ₂ , O ₂ , N ₂ and CO - Channel 2: C ₂ -C ₃ , H ₂ S and CO ₂
G3582A #111	3-channel Micro GC - Channel 1: CP-molsieve 5Å - Channel 2: CP PoraPLOT U - Channel 3: CP-Sil 5 CB	Compounds analyzed in biogas: - Channel 1: C ₁ , H ₂ , O ₂ , N ₂ and CO - Channel 2: C ₂ -C ₃ , H ₂ S and CO ₂ - Channel 3: C ₄ -C ₇
7890-0295	Headspace/FID with optional liquid autosampler	Methanol in B100 biodiesel per EN 14110:2003
M7482A	GC/MSD operating in Scan/SIM mode with optional 7896A WorkBench for fully automated analysis	Trace fatty acid methyl esters per IP 585

From the laboratory to the field, Agilent Technologies can provide analytical solutions to address your requirements for Renewable Energy Research.

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Glycerin in Biodiesel Analyzer (G3445 #631)

Analyzer Description

Configuration:

- On-column capillary inlet/FID

Sample type:

- B100 biodiesel
- Not applicable to vegetable oil methyl esters obtained from lauric oils, such as coconut oil and palm kernel oil

Compounds analyzed:

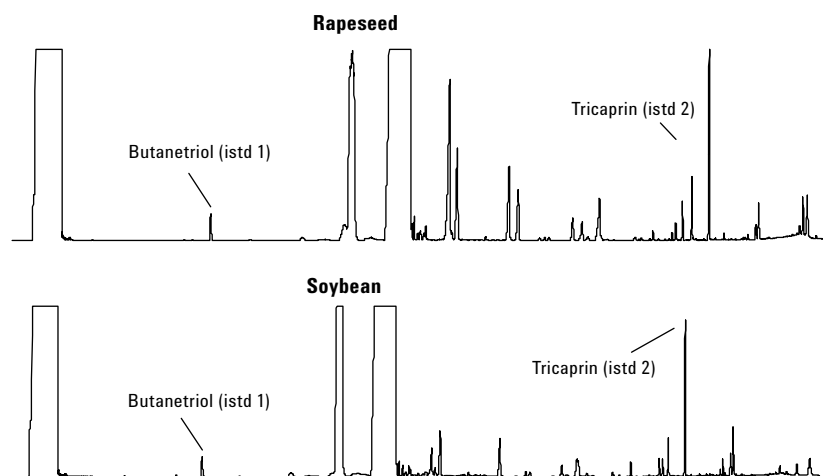
- Free glycerin, monoglycerides, diglycerides, triglycerides, bound glycerin, total glycerin

Typical quantification range:

- 0.005 to 0.05 Wt% for free glycerin, 0.05 to 0.5 Wt% for total glycerin

Configured per method:

- ASTM D6584



► KEY BENEFITS AND FEATURES

- Configured with COC inlet with a retention gap column in front of the analytical column
 - Significantly improves peak shape for better accuracy and reproducibility
 - Use of standard syringes instead of special narrow-bore syringes
- Uses Agilent “Ultimate Union” to connect retention gap to column
 - Reliable, leak-free, high-temperature connection
- Exceeds ASTM and CEN specifications for calibration and precision

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FAME Content in Biodiesel Analyzer (G3445 #633)

Analyzer Description

Configuration:

- Split/splitless inlet/FID

Sample type:

- B100 biodiesel, which contains methyl esters between C₆-C₂₄

Compounds analyzed:

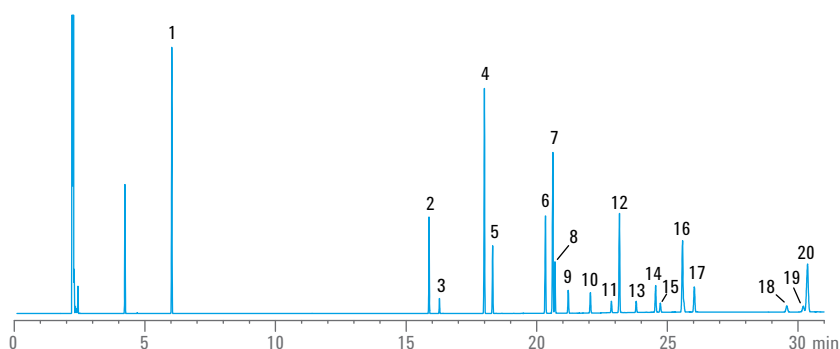
- Methyl esters between C₆-C₂₄

Typical quantification range:

- > 90 Wt% for esters, 1 to 15 Wt% for linoleic acid content

Configured per method:

- EN 14103:2011



Peak No.	Name	RT (min)	Peak no.	Name	RT (min.)
1.	methyl hexanoate	C6:0 6.031	11.	methyl arachidate	C20:0 22.857
2.	methyl myristate	C14:0 15.878	12.	methyl eicosonate	C20:1 23.166
3.	methyl myristoleate	C14:1 16.275	13.	methyl eicosadienoate	C20:2 23.808
4.	methyl palmitate	C16:0 17.996	14.	methyl arachidonate	C20:4 24.551
5.	methyl palmitoleate	C16:1 18.311	15.	methyl eicosatrienoate	C20:3 24.730
6.	methyl stearate	C18:0 20.332	16.	methylbehenate and methyl eicosapentaenoate	C22:0 25.582 C20:5 25.582
7.	methyl oleate (9)	C18:1 20.617	17.	methyl erucate	C22:1 26.031
8.	methyl oleate (11)	C18:1 20.697	18.	methyl lignocerate	C24:0 29.574
9.	methyl linoleate	C18:2 21.205	19.	methyl nervonate	C24:1 30.203
10.	methyl linolenate	C18:3 22.052	20.	methyl docosahexaenoate	C22:6 30.365

► KEY BENEFITS AND FEATURES

- Excellent precision with a very simple, easy-to-use method
- Esters separated on wax-type column
- Internal standard (methyl nonadecanoate) used for quantification
- Analysis time about 35 minutes

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Biodiesel Analyzer per EN 14105:2011 (G3445 #634)

Analyzer Description

Configuration:

- Split/splitless inlet/FID

Sample type:

- B100 biodiesel

Compounds analyzed:

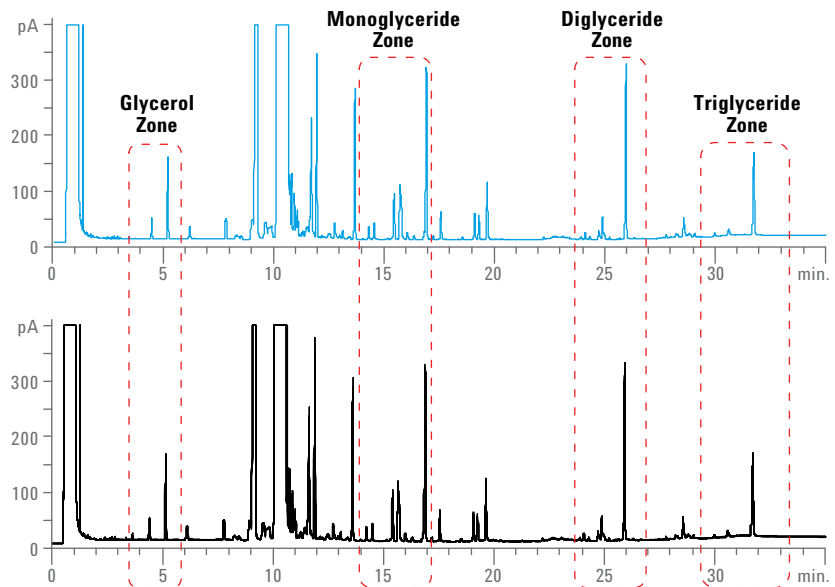
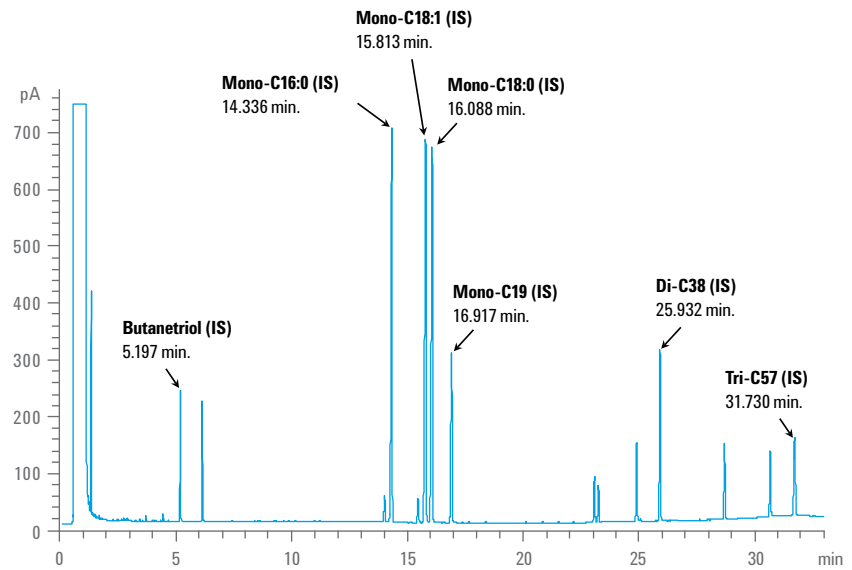
- Glycerol, monoglycerides, diglycerides, triglycerides

Typical quantification range:

- 0.001 to 0.05 Wt% for free glycerin, 0.1 to 0.5 Wt% for all glycerides

Configured per method:

- EN 14105:2011



Automated preparation of B100 Biodiesel sample with Agilent WorkBench (Upper chromatogram: Single run, Lower chromatogram: Overlay of 10 separate samples preparations)

(Continued)

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► KEY BENEFITS AND FEATURES

- Configured for automated sample preparation with Agilent 7696A Sample Prep WorkBench
 - Automation reduces reagent consumption by up to 10x
 - WorkBench not included with system, must be purchased separately
- Exceeds CEN specifications for calibration and precision for method EN 14105:2011
 - Automated prep of calibration standard sample prep exceeds method performance criteria
 - Automated prep of B100 samples exceeds method precision requirement
- Includes macro for data calculation and reporting per method EN 14105:2011, requires Microsoft Excel®



Are your analysts manually preparing samples and standards?

Automate workflow using the Agilent 7696A Sample Prep WorkBench—precise sample prep per compliance method requirements.

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Biogas Analyzer: 2-Channel Micro GC (G3582A #110)

Analyzer Description

Configuration:

- 2-Channel Micro GC
 - Channel 1: CP-molsieve 5Å
 - Channel 2: CP PoraPLOT U

Sample type:

- Biogas

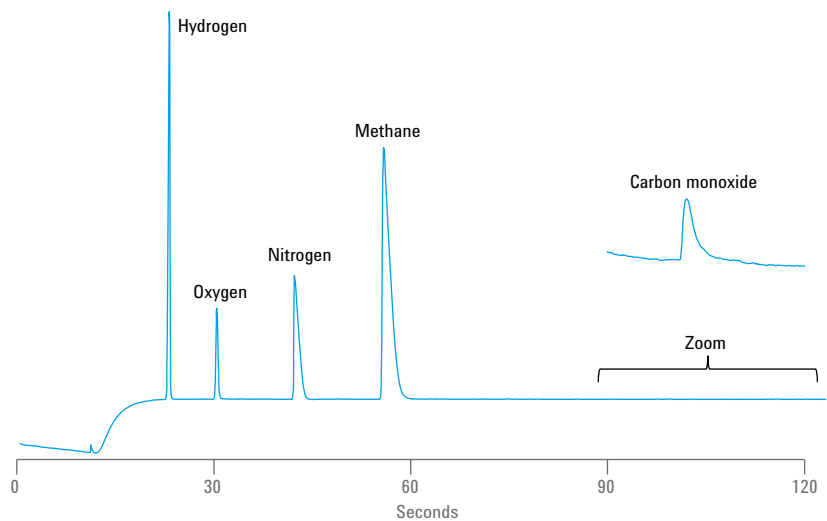
Compounds analyzed:

- Channel 1: C₁, H₂, O₂, N₂ and CO
- Channel 2: C₂-C₃, H₂S and CO₂

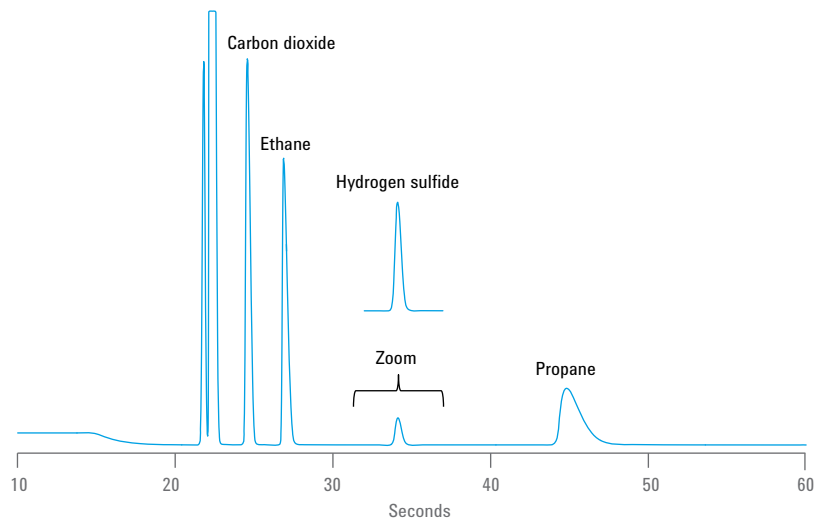
Typical quantification range:

- 1-10 ppm

Channel 1 – Permanent gases



Channel 2 – CO₂, C₂, H₂S, and C₃



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► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of biogas composition in 120 seconds
 - Characterizes permanent gases, hydrocarbons C₁-C₃ and H₂S concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability:
 - Retention time: RSD 0.1%
 - Peak area: RSD 0.5%
- Dual carrier gas for optimal detection



Rapid, reliable results for laboratory, process, or field analysis. Micro GC analyzers provide chromatographic results in seconds instead of minutes.

Biogas Analyzer: 3-Channel Micro GC (G3582A #111)

Analyzer Description

Configuration:

- 3-Channel Micro GC
 - Channel 1: CP-molsieve 5Å
 - Channel 2: CP-PoraPLOT U
 - Channel 3: CP-Sil 5 CB

Sample type:

- Biogas mixed with hydrocarbon streams, e.g., LPG, Natural Gas

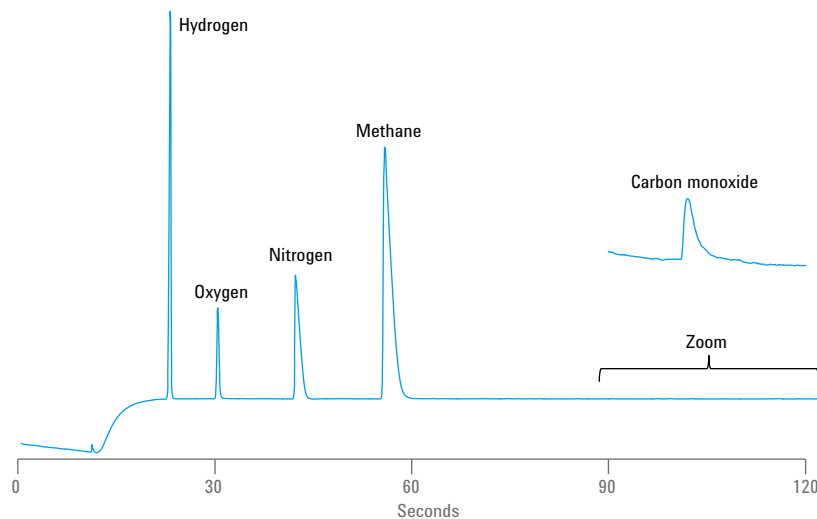
Compounds analyzed:

- Channel 1: C₁, H₂, O₂, N₂ and CO
- Channel 2: C₂-C₃, H₂S and CO₂
- Channel 3: C₄-C₇

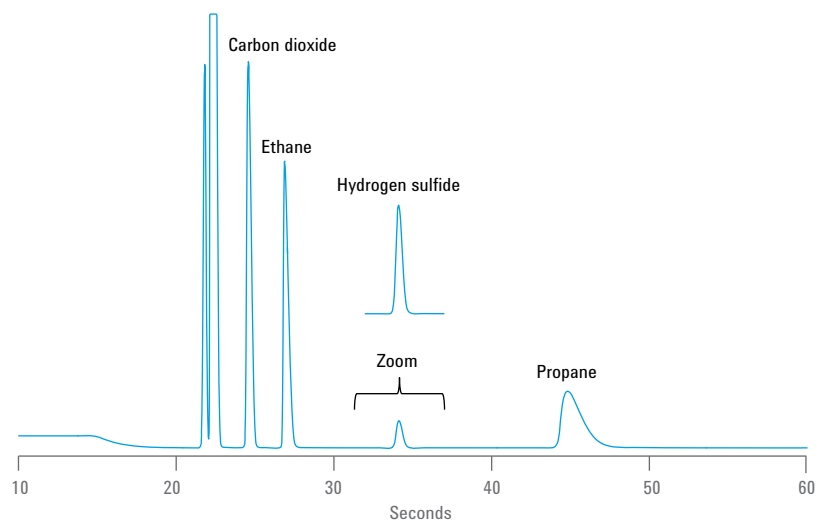
Typical quantification range:

- 1-10 ppm

Channel 1 – Permanent gases



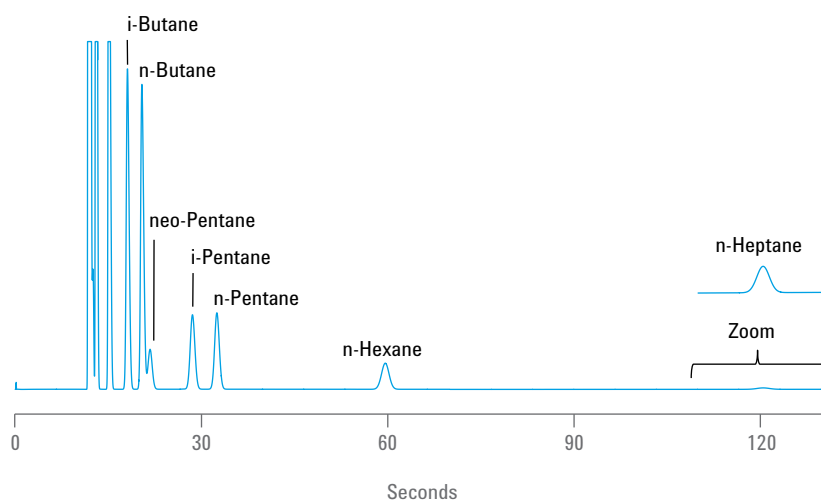
Channel 2 – CO₂, C₂, H₂S, and C₃



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Channel 3 – C₄ – C₇ hydrocarbons

Take the quick, cost-effective path through your toughest challenges. Contact Agilent to discuss an Analyzer or custom GC for your specific need at www.agilent.com/chem/energy

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of biogas composition in 120 seconds
 - Characterizes permanent gases, hydrocarbons C₁-C₇ and H₂S concentrations
- Preconfigured with analytical method
 - Injection parameters
 - Analytical parameters
- Excellent repeatability:
 - Retention time: RSD 0.1%
 - Peak area: RSD 0.5%
- Dual carrier gas for optimal detection

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Methanol in Biodiesel Analyzer (7890-0295)

Analyzer Description

Configuration:

- Headspace/FID

Sample type:

- B100 biodiesel

Compounds analyzed:

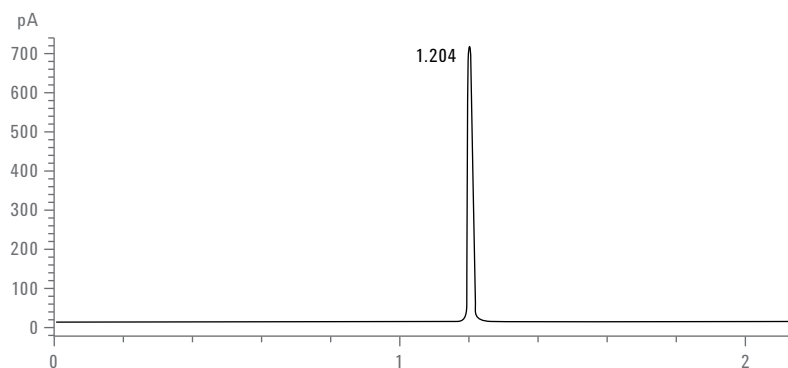
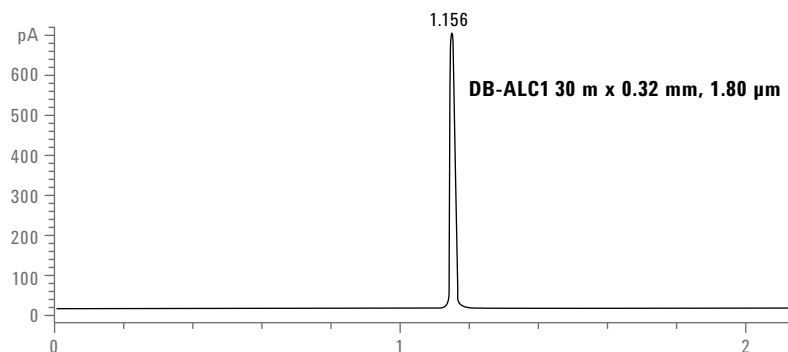
- Methanol

Typical quantification range:

- 0.01 to 0.5 Wt% for methanol

Configured per method:

- EN 14110:2003



► KEY BENEFITS AND FEATURES

- Uses Agilent 7697A headspace sampler for automated sample preparation
- Enhanced precision through backpressure regulation of headspace gas sampling valve loop
- Increased sensitivity for low concentration methanol through pressurization of the headspace sample loop
- Quantitative analysis using external calibration, no internal standard required
- Agilent J&W DB-ALC columns optimized for alcohol analysis by headspace GC
- Improved peak shape for easy quantification

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FAMEs in Jet Fuel Analyzer (M7482A)

Analyzer Description

Configuration:

- GC/MSD operating in Scan/SIM mode
- Optional 7896A WorkBench for fully automated analysis

Sample type:

- Jet fuel

Compounds analyzed:

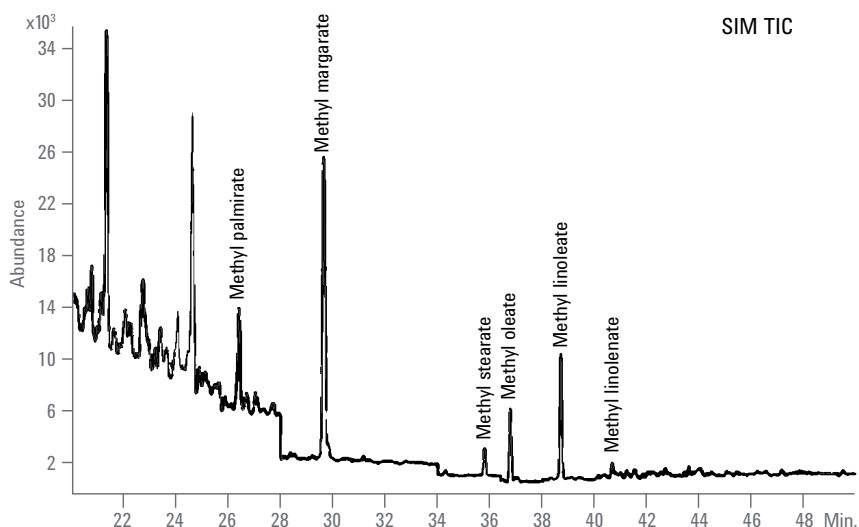
- Trace fatty acid methyl esters

Typical quantification range:

- 4.5 mg/kg to 150 mg/kg of selected FAME species

Configured per method:

- IP 535



► KEY BENEFITS AND FEATURES

- Helps to control adherence to limit of 5 mg/kg of total FAME content established by the Joint Inspection Group
- Optimized simultaneous SCAN/SIM maximizes sensitivity and selectivity
- Optional 7896A WorkBench reduces chemical resource need by 10x and improves calibration performance and sample precision

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SOLUTIONS FOR LIQUEFIED PETROLEUM GAS



Accurately measure calorific value and cleanliness during consumption

Synthesized by refining petroleum (or natural gas) derived from fossil fuels, Liquefied Petroleum Gas (LPG) is used to power vehicles and heat appliances.

LPG contains a flammable mixture of hydrocarbon gases—primarily propane, butane, or a mixture of the two. However, because LPG is usually odorless, low concentrations of sulfur are also added to facilitate leak detection.

Gas composition directly affects both the calorific value and burning cleanliness of LPG. **Agilent LPG Analyzers** conform to strict industry standards for determining LPG composition and performing fast analysis of hydrocarbon content from C₁-C₆ in LPG samples.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Liquefied Petroleum Gas (LPG)

Analyzer Number	Configuration	Factory checkout per method
7890-0138	LPG composition analyzer	ASTM D2163, ASTM D2593, ASTM D2712, ASTM D4424
7890-0188	Commercial propane and butane LPG analyzer	ISO 7941, EN 27941, and IP 405
7890-0397	Hydrocarbons in LPG analyzer	ASTM D2163
Contact Agilent	Ethane composition and impurities by Micro GC	
Contact Agilent	Propane and butane streams by Micro GC	

Reference Methods for LPG: Quantitation Ranges for Compounds of Interest

Compound	ASTM D1945 mol %	ASTM D1946 mol %	ASTM D2163 mol %	UOP 539 mol %	GPA 2186	GPA 2286	ISO 6974-6
H ₂ S	0.3 to 30		–	0.1 to 25	–	0.1 to 100	–
O ₂	0.01 to 20		–	0.1 to 99.9	–	0.005 to 20	0.007 to 5
N ₂	0.01 to 100	–	–		0.005 to 5	0.005 to 100	0.007 to 40
CH ₄	0.01 to 100	–	–		0.001 to 5	0.001 to 100	40 to 100
CO	–	–	–		–	–	0.001 to 1
CO ₂	0.01 to 20	–	–		0.005 to 5	0.005 to 100	0.001 to 10
He	0.01 to 10	–	–		–	–	0.002 to 0.5
H ₂	0.01 to 10	–	–		–	–	0.001 to 0.5
Ethane	0.01 to 100	–	0.1 and above	0.1 to 99.9	0.001 to 95	0.001 to 100	0.002 to 15
Propane	0.01 to 100	–	0.1 and above		0.001 to 100	0.001 to 100	0.001 to 5
C ₄ isomers	0.01 to 10	–	0.1 and above		0.001 to 100	0.001 to 10	0.0001 to 1
C ₅ isomers	0.01 to 2	–	0.1 and above		0.001 to 50	0.001 to 5	0.0001 to 0.5
C ₆ isomers	0.01 to 2	–	–	–	0.001 to 30	0.001 to 5	0.0001 to 0.5
C ₆₊	–	–	–	0.1 to 99.9	–	–	–
C ₇₊	0.01 to 1	–	–	–	0.001 to 30	–	–
C ₇ -C ₈	–	–	–	–	–	0.001 to 2	0.0001 to 0.5
C ₉	–	–	–	–	–	0.001 to 2	–
C ₁₀ -C ₁₄	–	–	–	–	–	0.001 to 1	–

Note: In the table above the symbol "–" indicates that this parameter was not specified.

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LPG Composition Analyzer (7890-0138)

Analyzer Description

Configuration:

- Liquid valve/1-column (PLOT Alumina)/FID

Sample type:

- LPG

Compounds analyzed:

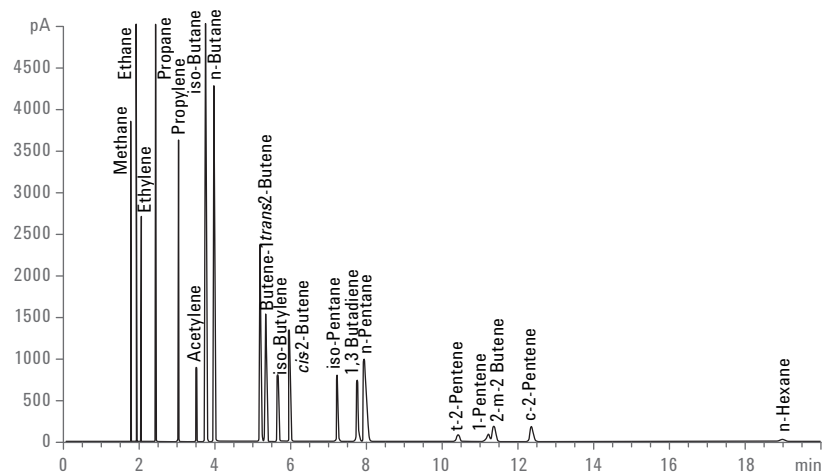
- C₁-C₆

Typical quantification range:

- 10 ppm for hydrocarbons

Configured per method:

- ASTM D2163, ASTM D2593, ASTM D2712, ASTM D4424



► KEY BENEFITS AND FEATURES

- Single channel with single LSV
- PLOT Alumina is ideal for separation of the C₁ to C₈ isomers; especially for separation of cyclopropane and propylene

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Commercial Propane and Butane LPG Analyzer (7890-0188)

Analyzer Description

Configuration:

- Liquid valve/1-column (packed column)/FID

Sample type:

- LPG, commercial propane and butane

Compounds analyzed:

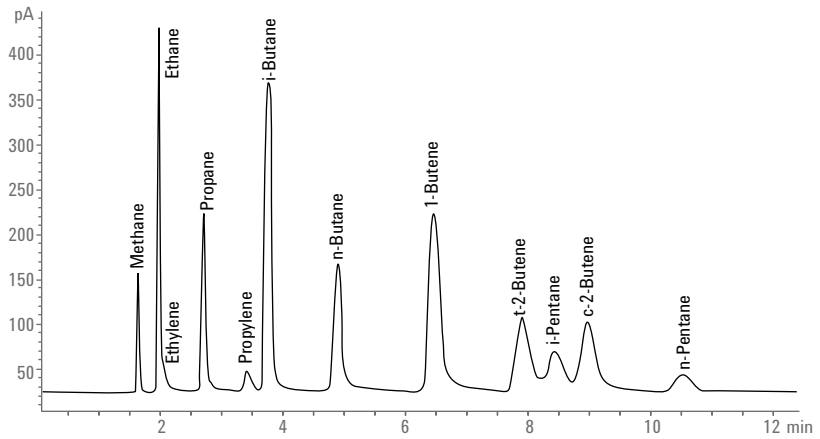
- C₁-C₆

Typical quantification range:

- 10 ppm for hydrocarbons

Configured per method:

- ISO 7941, EN 27941, and IP 405



► KEY BENEFITS AND FEATURES

- Single channel with single LSV
- Rugged packed column
- Configured to analyze liquefied petroleum gas, specifically propane and butane for commercial use

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Hydrocarbons in LPG Analyzer (7890-0397)

Analyzer Description

Configuration:

- 1-liquid valve/2-valve/
2-column/FID

Sample type:

- LPG (liquefied petroleum gases),
propane/propylene mixture

Compounds analyzed:

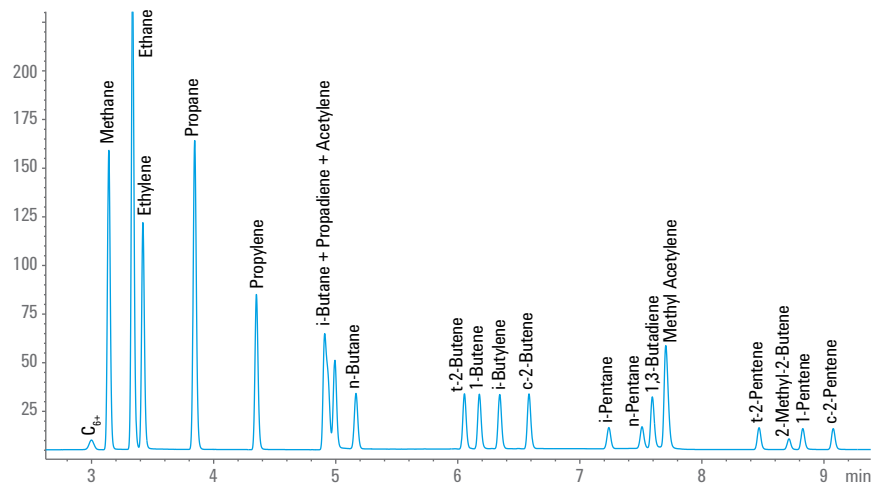
- C₁-C₅
- C₆₊ as backflush

Typical quantification range:

- 10 ppm for hydrocarbons

Configured per method:

- ASTM D2163



► KEY BENEFITS AND FEATURES

- Single channel with single LSV valve
- Configured to analyze liquefied petroleum gas, specifically propane and butane for commercial use

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Liquefied Petroleum Micro GC Analyzer: Ethane Composition and Impurities (Contact Agilent)

Analyzer Description

Configuration:

- Single channel Micro GC
- Agilent J&W PoraPLOT Q column

Sample type:

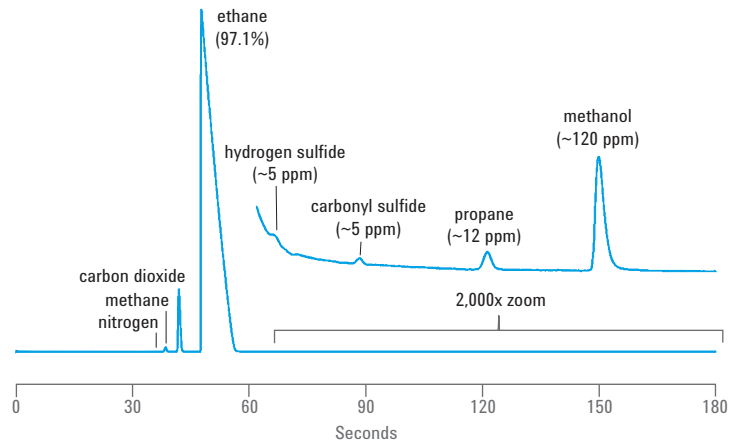
- Ethane

Compounds analyzed:

- Nitrogen, methane, ethane, propane, hydrogen sulfide, carbonyl sulfide, methanol

Typical quantification range:

- 5 ppm to % for impurities
- Up to 100% for bulk



► KEY BENEFITS AND FEATURES

- Sample preparation is done via a Micro Gasifier
 - Heated pressure reducer to turn LPG liquid into gas of the required sample pressure
- Very fast analysis
 - Typically 3 minute analysis time
 - Isothermal analysis ensures very fast run-to-run times
- Compositional and impurity analysis in a single run
- Very good detection limits (typically low ppm range)

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Liquefied Petroleum Micro GC Analyzer: Propane and Butane Streams (Contact Agilent)

Analyzer Description

Configuration:

- Single channel Micro GC
- Agilent J&W CP-Sil 5 CB column

Sample type:

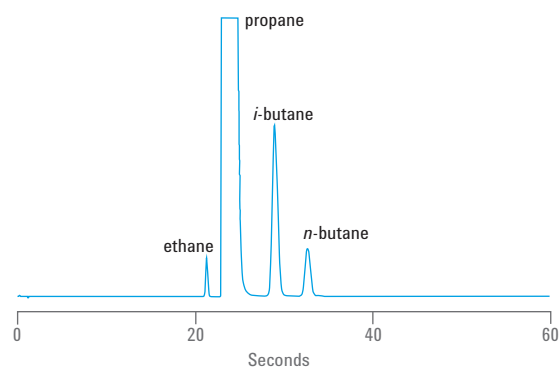
- Propane and Butane streams

Compounds analyzed:

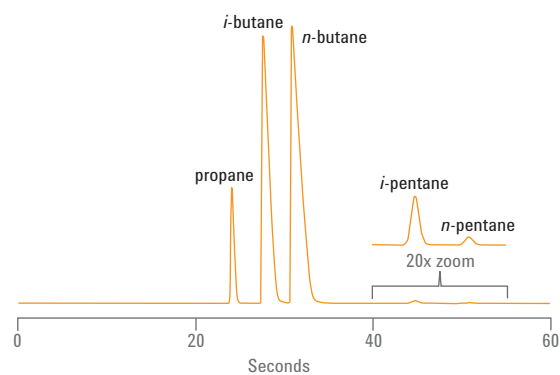
- Ethane, propane, *i*-butane, *n*-butane, *i*-pentane, *n*-pentane

Typical quantification range:

- 5 ppm to % for impurities
- Up to 100% for bulk



Propane stream



Butane stream

► KEY BENEFITS AND FEATURES

- Sample preparation is done via a Micro Gasifier
 - Heated pressure reducer to turn LPG liquid into gas of the required sample pressure
- Very fast analysis
 - Typically 60 seconds analysis time
 - Isothermal analysis ensures very fast run-to-run times
- Compositional and impurity analysis in a single run
- Very good detection limits (typically low ppm range)

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SOLUTIONS FOR TRACE IMPURITIES



Meet the stringent demands of both regulators and customers

Accurately measuring feedstock impurities at increasingly lower concentrations is critical to process efficiency and profitability. For example, producers of high-purity monomers (such as ethylene and propylene) face stiff competition and tight customer specifications.

Purity is also a must for researchers and production operations in the food, pharmaceutical, chemical, and semi-conductor industries. Failure to fully characterize the impurity content of N, Ar, H₂, and CO₂ can render the gas unfit for a given application.

Trace contaminants also contribute to equipment corrosion and reduced polymer yields. Even worse, they can cause catalyst degradation, poisoning, and contamination, which can lead to costly, time-consuming catalyst bed replacement.

With their innovative hardware configurations, **Agilent Trace Impurities Analyzers** reliably confirm the purity of raw materials provided by your suppliers, so you can detect contaminants with confidence at trace (ppb) levels.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Trace Impurities

Analyzer Number	Configuration	Capability	
		Suitable for process gas containing high levels of CH ₄	Suitable for process gas containing O ₂
G3445 #646	2-valve/2-column/methanizer/FID	Yes	No
G3445 #647	1-valve/2-column/methanizer/FID	No	No
7890-0191	3-valve/5-column (packed)/ 2-TCD/Hastelloy valve, inlet tubing, sample filter and nickel stripper	H ₂ , O ₂ , N ₂ , CH ₄ , CO ₂ , and CO in pure chlorine gas	
7890-0237	1-valve/2-column (packed column)/PDHID	H ₂ , O ₂ + N ₂ composite peak, CH ₄ , CO, CO ₂ in monomer gas	
7890-0355	2-valve/2-column/methanizer/FID	No	Yes • Separates O ₂ from CO with backflush • High level of O ₂ will not impact CO
7890-0366	2-valve/2-column/methanizer/FID	No	Yes • Separates O ₂ from CO
7890-0409	1-valve/2-column (packed column)/PDHID	H ₂ , O ₂ , N ₂ , CO, CH ₄ in ethylene/ propylene	
M7484AA or M7474AA	2-valve/1-column GC/MSD with high efficiency source using self cleaning ion source option - M7484AA includes permeation tube dilution block for built-in calibration		

Reference Methods for CO/CO₂ Analysis: Quantitation Ranges for Compounds of Interest

UOP 603	
Component Gas	Concentration Range
CO/CO ₂	0.5 to 500 mol-ppm

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Low CO and CO₂ in Process Gases Containing High CH₄ Analyzer (G3445 #646)

Analyzer Description

Configuration:

- 2-valve/2-column (packed column)/Methanizer/FID

Sample type:

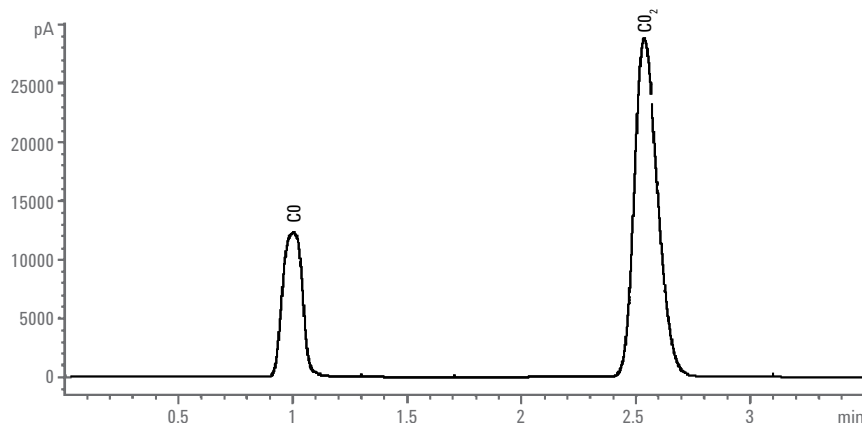
- Process gas containing high levels of methane, natural gas

Compounds analyzed:

- CO₂ and CO

Typical quantification range:

- 0.2 ppm for CO
- 0.4 ppm for CO₂



► KEY BENEFITS AND FEATURES

- Single channel with packed columns
- High concentration hydrocarbons cut on the pre-column; CH₄ vented during the analysis through use of a 4-port valve
- Trace levels of CO and CO₂ can be analyzed by conversion to CH₄ and detection with FID
- 3 minute analysis time

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Low CO and CO₂ in Process Gas Analyzer (G3445 #647)

Analyzer Description

Configuration:

- 1-valve/2-column (packed column)/Methanizer/FID

Sample type:

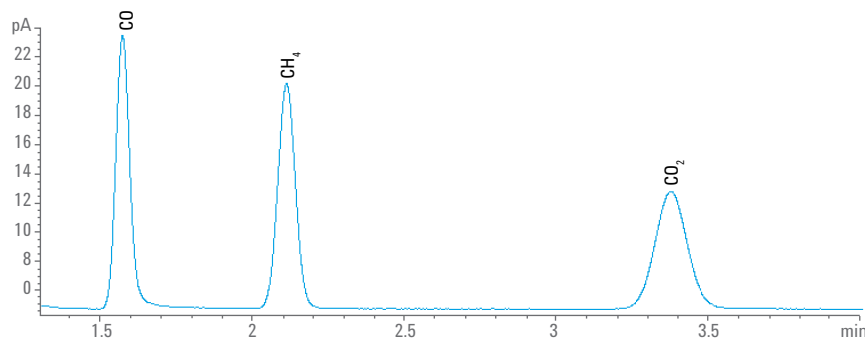
- Ethylene, propylene, or process gas streams containing low concentrations of methane

Compounds analyzed:

- CO₂ and CO

Typical quantification range:

- 0.2 ppm for CO
- 0.4 ppm for CO₂



► KEY BENEFITS AND FEATURES

- Single channel with packed columns
- Hydrocarbons cut on the pre-column while trace levels of CO and CO₂ pass through Methanizer for conversion to CH₄ and detection with FID
- 4 minute analysis time

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2-Channel Inert Impurities in Pure Chlorine Analyzer (7890-0191)

Analyzer Description

Configuration:

- 3-valve/5-column (packed column)/2-TCD/Hastelloy valve, inlet tubing, sample filter, nickel stripper

Sample type:

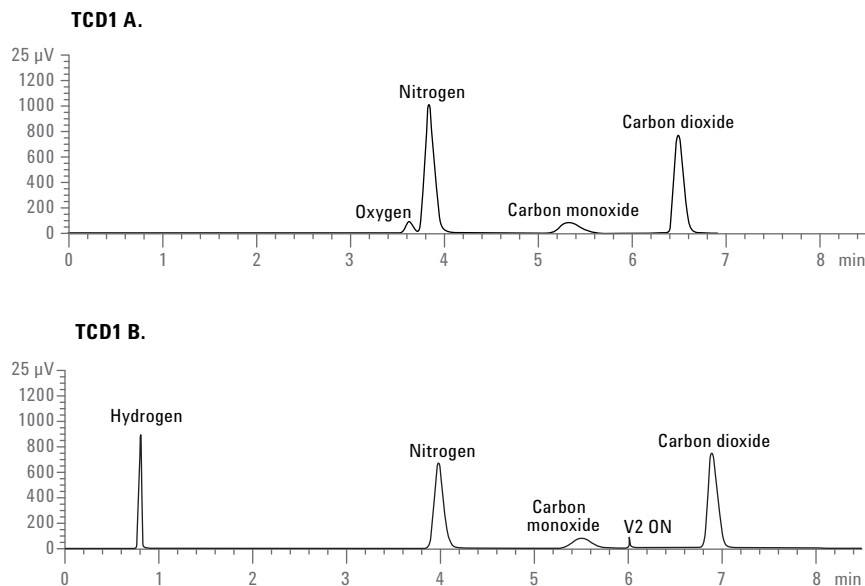
- Pure chlorine gas

Compounds analyzed:

- H₂, O₂, N₂, CH₄, CO₂, and CO

Typical quantification range:

- 50 ppm for fixed gases



► KEY BENEFITS AND FEATURES

- Dual TCD channels with packed column system measures low levels of inert impurities in pure chlorine
- Chlorine is cut to the vent at the sampling
- Hastelloy valve, inlet tubing, sample filter, nickel stripper to avoid corrosion
- Full-range capability, including H₂ by the use of second TCD with argon carrier gas

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Impurities in Monomers Analyzer by PDHID (7890-0237)

Analyzer Description

Configuration:

- 1-valve/2-column (packed column)/PDHID

Sample type:

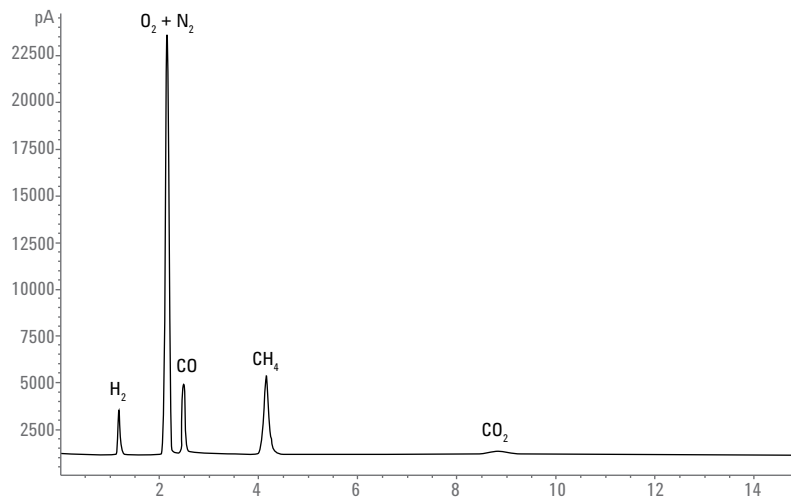
- Monomers (gas)

Compounds analyzed:

- H₂, O₂ + N₂ composite peak, CH₄, CO, CO₂

Typical quantification range:

- 1.5 ppm for O₂ + N₂ composite peak
- 0.1 ppm for H₂, CO and CO₂



► KEY BENEFITS AND FEATURES

- Single-valve, dual-column system using PDHID in helium ionization mode allows determination of impurities at 0.1 ppm level
- Uses a 10-port, low-leakage valve
- Matrix effects are eliminated by “cutting out” the light components on a packed pre-column
- Inert impurities including H₂, O₂+N₂, CO, CH₄, and CO₂ are separated on micro-packed column and detected at 0.1 ppm and higher

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Low CO and CO₂ in Process Gases with Nicat Bypass to Detector (7890-0355)

Analyzer Description

Configuration:

- 2-valve/2-column (packed column)/Methanizer/FID

Sample type:

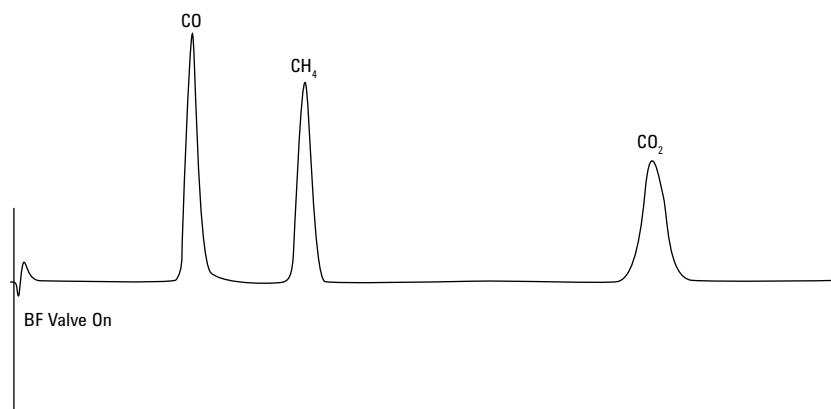
- Process gas containing air

Compounds analyzed:

- CO, CO₂

Typical quantification range:

- 0.2 ppm for CO
- 0.4 ppm for CO₂



► KEY BENEFITS AND FEATURES

- Single channel with packed columns
- Hydrocarbon components heavier than CO₂ are backflushed to vent
- Air or other non-backflushed gases can be by-passed to the FID without flowing through the nickel catalyst
- Trace levels of CO and CO₂ can be analyzed by conversion to CH₄ and detection with FID
- 6 minute analysis time

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Trace CO and CO₂ in Hydrogen and Light Gaseous Hydrocarbons Analyzer (7890-0366)

Analyzer Description

Configuration:

- 2-valve/2-column (packed column)/Methanizer/FID

Sample type:

- H₂/Light gaseous hydrocarbons

Compounds analyzed:

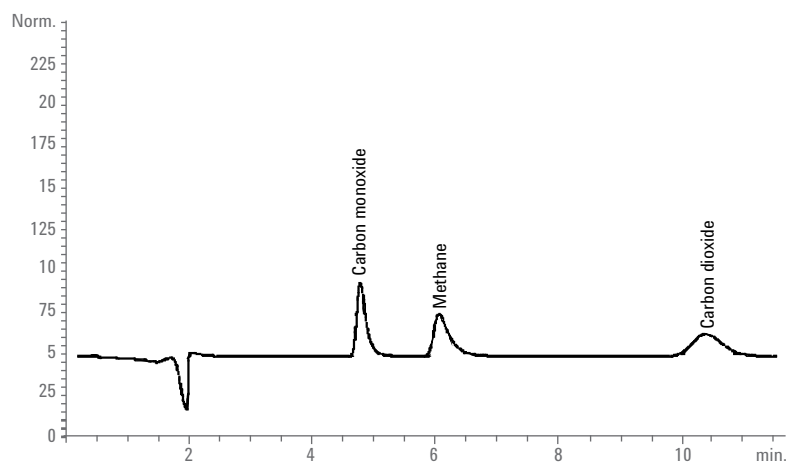
- CO, CO₂, and CH₄

Typical quantification range:

- 0.2 ppm for CO
- 0.4 ppm for CO₂

Configured per method:

- UOP 603



► KEY BENEFITS AND FEATURES

- Single channel with packed columns
- Trace levels of CO and CO₂ can be analyzed by conversion to CH₄ and detection with FID
- 12 minute analysis time

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Impurities in Ethylene/Propylene Analyzer by PDHID (7890-0409)

Analyzer Description

Configuration:

- Valve/2-column (packed column)/PDHID

Sample type:

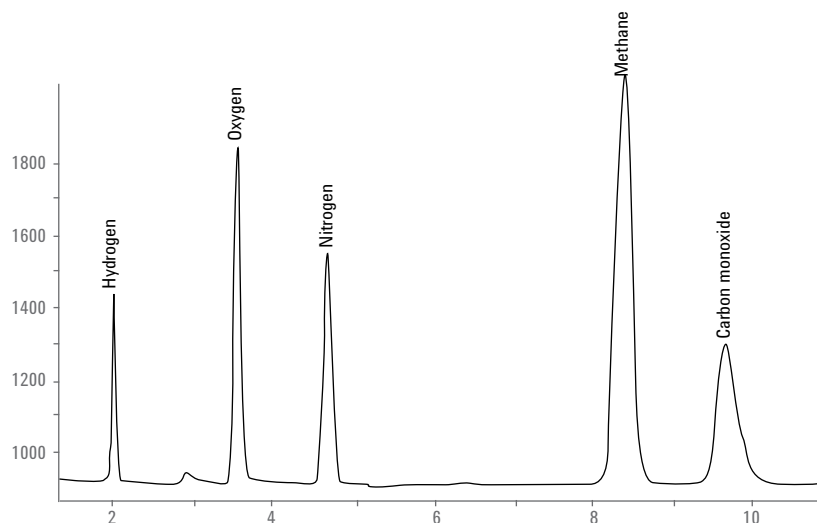
- Ethylene/Propylene

Compounds analyzed:

- H₂, O₂, N₂, CO, CH₄

Typical quantification range:

- H₂: 0.1-40 ppm
- N₂, CO: 0.1-10 ppm



► KEY BENEFITS AND FEATURES

- Single-valve, dual-column system using PDHID in helium ionization mode allows determination of impurities at 0.1 ppm level
- Use a 10-port, low-leakage valve
- Matrix effects are eliminated by “cutting out” the matrix on a packed pre-column
- Inert impurities including H₂, O₂, N₂, CO, CH₄ are separated on packed column and detected at 0.1 ppm and higher

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Impurities in ethylene/propylene by GC/MS (M7484AA or M7474AA)

Analyzer Description

Configuration:

- 2-valve/1-column GC/MSD with high efficiency source using self cleaning ion source option
- M7484AA includes permeation tube dilution block for built-in calibration

Sample type:

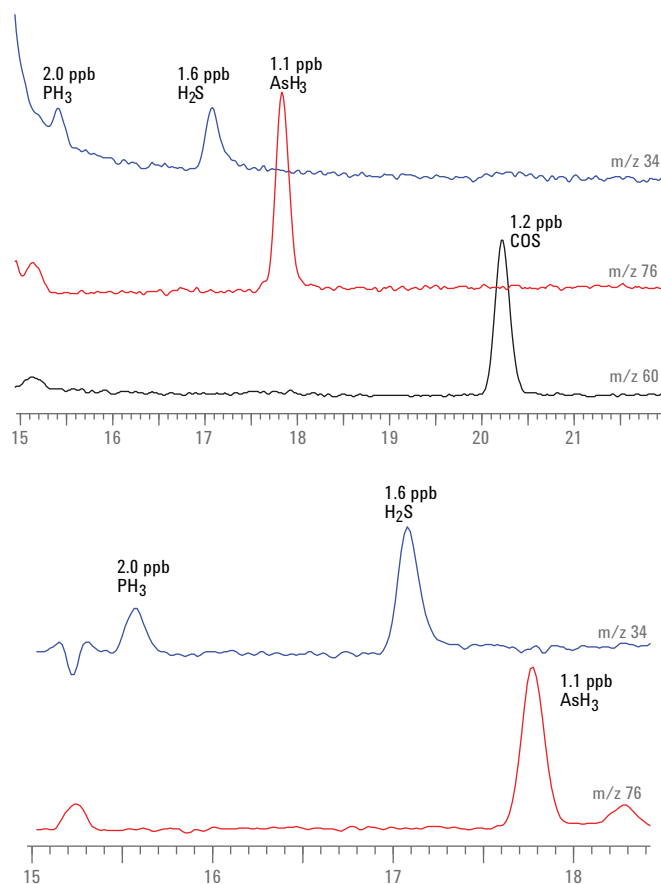
- High purity ethylene and propylene

Compounds analyzed:

- Arsine, phosphine, hydrogen sulfide, and carbonyl sulfide in ethylene matrix
- Arsine, phosphine, and hydrogen sulfide in propylene matrix

Typical quantification range:

- ~5-50 ppb



► KEY BENEFITS AND FEATURES

- Automated analyzer with simplified usability enables in-house analysis of impurities for quicker decisions and less reliance on external contract labs
- High efficiency source with self cleaning ion source for highest sensitivity, low maintenance, and long-term precision
- Uses a 4-port stream selector valve to choose between calibrants or sample and connects to a 6-port gas sampling valve with 50 μ L sample loop
- Integrated permeation tube dilution block (M7484AA only) enables fully automated calibration for improved efficiencies

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SOLUTIONS FOR SIMULATED DISTILLATION



Perform fast, accurate calculations that conform to ASTM methods

Hydrocarbon processors use distillation as their primary separation technique in crude oil refining. Understanding the boiling point distribution of hydrocarbon fractions and crude oil improves production efficiency, quality control, and commercialization of petroleum streams.

Simulated Distillation (Sim. Dist.), which is far less labor intensive than physical distillation, is the preferred method for characterizing boiling point distributions. Built around a GC analyzer equipped with a temperature-programmable inlet and FID, Sim. Dist. determines quantitative mass yield based on the boiling points for the components in hydrocarbon samples. Based on these results, producers can make informed decisions about process optimization and efficiency.

Agilent was one of the first companies to provide Sim. Dist. as a commercially available tool for hydrocarbon analysis. Our current **Simulated Distillation Analyzer** portfolio leverages cutting-edge technologies, such as a high-performance Multimode Inlet and user-friendly software for fast analysis, quick calculations, and detailed presentation of sample profiles. These complete, ready-to-use systems address ASTM methods D2887, D7213 (extended D2887), D6352, and D7169.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Simulated Distillation

Analyzer Number	ASTM Method	Carbon Number	Sample Range	Boiling Range
G3440 #653	ASTM D2887	C ₄₄	Jet fuel diesel	55-538 °C
G3445 #654 (D2887 extended)	ASTM D7213	C ₆₀	Lube oil base stocks	100-615 °C
G3445 #655	ASTM D6352	C ₁₀₀	Lube oil base stock	174-700 °C

Agilent's Multimode Inlet expands the range of applications for your laboratory GC; including suitability for Simulated Distillation.



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Simulated Distillation Analyzer: Boiling Range from 55 to 538 °C (G3445 #653)

Analyzer Description

Configuration:

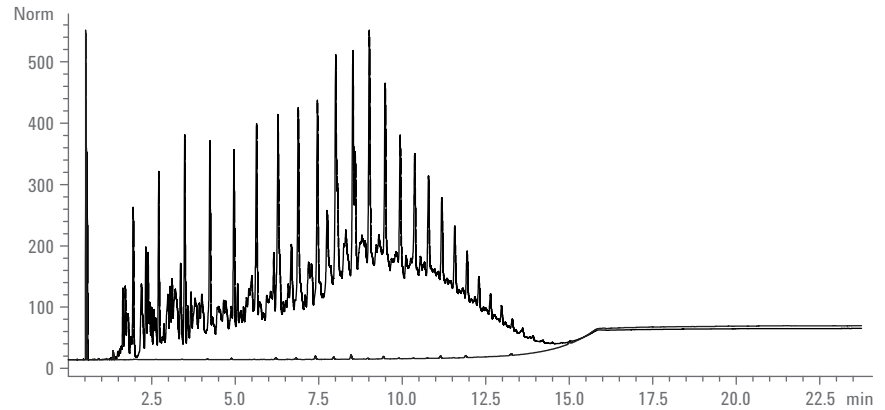
- Multimode inlet/FID/Sim. Dist. software

Sample type:

- Jet fuel, diesel, petroleum fraction with boiling range from 55 to 538 °C

Configured per method:

- ASTM D2887



► KEY BENEFITS AND FEATURES

- Easy-to-use software
- Flexible reporting options allow the user to customize reports to meet laboratory requirements
- Cost effective
- 6 minute fast Sim. Dist. can be achieved by use of short, small-diameter capillary column, 5 m × 180 µm, 0.4 µm

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Simulated Distillation Analyzer: Boiling Range from 100 to 615 °C (G3445 #654)

Analyzer Description

Configuration:

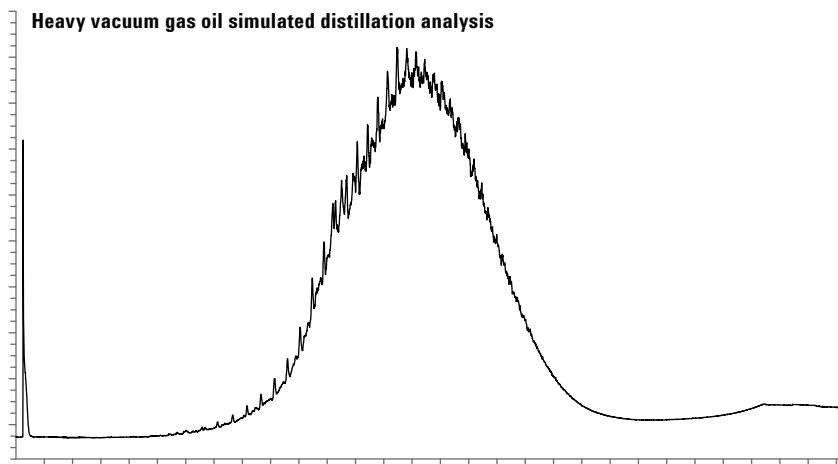
- Multimode Inlet/FID/Sim. Dist. software

Sample type:

- Lube oil, base stocks and petroleum distillate fractions having a boiling range from 100 to 615 °C

Configured per method:

- ASTM D7213 (D2887 extended)



► KEY BENEFITS AND FEATURES

- Configured with Multimode Inlet
 - No syringe-needle discrimination
 - Minimizes inlet discrimination
 - Solvent vent/matrix vent decreases interference and maintenance
 - Flexible modes of operation: hot/cold, split/splitless, and temperature programmed vaporization
 - Cold trapping in liner improves chromatographic peak shape, resolution
- Easy-to-use software
- User defined reporting options allow you to generate reports that meet the requirements for your laboratory

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Simulated Distillation Analyzer: Boiling Range from 174 to 700 °C (G3445 #655)

Analyzer Description

Configuration:

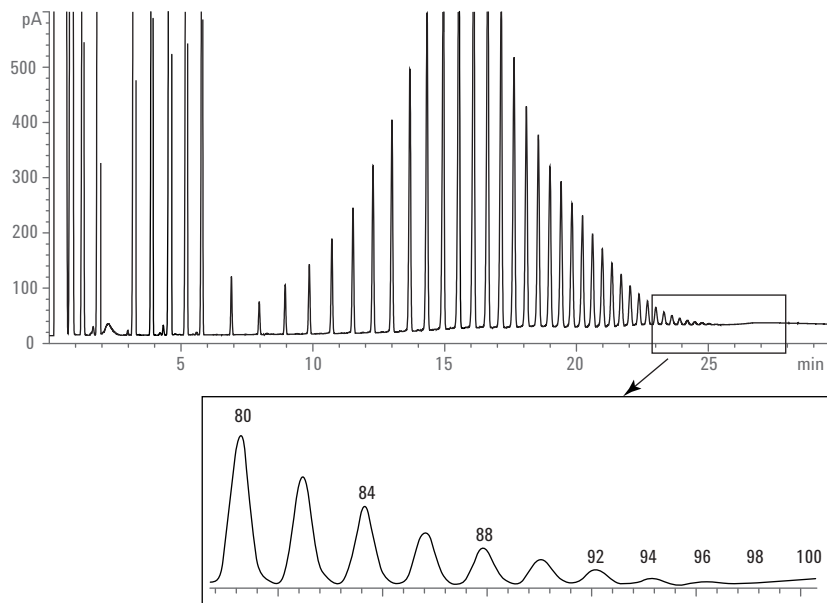
- Multimode Inlet/FID/Sim. Dist. software

Sample type:

- Lube oil, base stocks and petroleum distillate fractions having a boiling range from 174 to 700 °C

Configured per method:

- ASTM D6352



► KEY BENEFITS AND FEATURES

- Complete solution for extended ASTM D2887 (ASTM D7213), and ASTM D6352 on one GC
- High-performance Multimode Inlet
- Columns designed and perfected for Sim. Dist.
- Sim. Dist. software partially integrated with ChemStation
- Multiple reporting options

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SOLUTIONS FOR SULFUR AND NITROSAMINE



Optimize product quality and promote good environmental stewardship

The analysis of sulfur-containing compounds, usually at low concentrations, is a critical step in quality control and assurance throughout the energy and chemical industry. Sulfur occurs naturally in crude oil and natural gas; therefore, sulfur-containing hydrocarbons are ubiquitous in refinery and petrochemical products.

Because sulfur species are small, polar and reactive, sulfur contaminants in concentrations as low as parts-per-billion (ppb) can corrode process hardware, and permanently poison expensive catalysts used to refine and downstream processes. Failure to quickly detect and accurately quantify a “sulfur event” could cause significant financial loss due to contamination and production downtime.

Increased sulfur emissions from hydrocarbon products also contribute to “acid rain,” which can corrode vegetation, building materials, and structures with its high concentrations of SO_2 . Accordingly, regulatory bodies such as the EPA and CEN have imposed legislation to reduce the presence of sulfur contaminants in hydrocarbon products.

Based on our most selective, sensitive detectors, **Agilent Sulfur Analyzers** are factory configured and chemically tested to reliably quantify trace-level sulfur compounds in a wide range of matrices.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Sulfur and Nitrosamine

Analyzer Number	Configuration	Capability
G3445 #661	1-valve/capillary column/SCD	Sulfur compounds in natural gas or gaseous fuels; H ₂ S, CS ₂ , COS, mercaptans, aromatic sulfur compounds, sulfides per ASTM D5504
G3445 #662	Capillary inlet/capillary column/SCD (requires additional automatic liquid sampler for handling liquid sample analysis)	Volatile sulfur-containing compounds in light petroleum liquids, such as CS ₂ , COS, mercaptans, aromatic sulfur compounds, sulfides per ASTM D5623 and UOP 791
7890-0167	3-valve/2-column/2-VI (volatile inlets)/2-FPD	Volatile sulfur such as H ₂ S, COS, MeSH, EtSH, DMS, CS ₂ , t-BuSH and THT per ASTM D6228
7890-0460	On-column capillary inlet/capillary column/NCD	N-Nitrosodimethylamine, N-Nitrosopyrrolidine, N-Nitrosodibutylamine, N-Nitrosopiperidine, N-Nitrosomorpholine, N-Nitrosomethylethylamine, N-Nitrosodiethylamine, N-Nitrosodipropylamine, N-Nitrosodiphenylamine in liquids

Reference Methods for Sulfur and Nitrosamine: Quantitation Ranges for Compounds of Interest

ASTM D5504 (SCD)	ASTM D5623 (SCD)	ASTM D6228 (FPD)
Detection range for sulfur compounds 10-1,000,000 pg of sulfur equivalent 0.01 to 1000 mg/m ³	Detection range for individual sulfur species 0.1 to 100 mg/kg	Detection range for sulfur compounds 20-20,000 pg of sulfur equivalent 0.02 to 20 mg/m ³

Inert treatment of sample pathways and detector components used in Agilent analyzers ensure your laboratory's success with trace impurity analysis.



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Sulfur Analyzer by SCD (G3445 #661)

Analyzer Description

Configuration:

- 1-valve/Capillary column/SCD

Sample type:

- Natural gas and other gaseous fuels

Compounds analyzed:

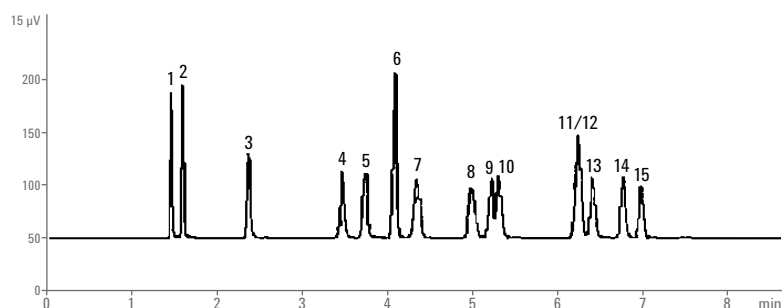
- Sulfur compounds in Natural Gas or Gaseous fuels
- H_2S , CS_2 , COS, mercaptans, aromatic sulfur compounds, sulfides

Typical quantification range:

- 100 ppb of H_2S
- 20-40 ppb for other S components (depends on different compounds)

Configured per method:

- ASTM D5504



Components	Formula	Components	Formula
1. Hydrogen sulfide	H_2S	8. Tert-butyl mercaptan	$(CH_3)_3CSH$
2. Carbonyl sulfide	COS	9. 1-propanethiol	$CH_3(CH_2)_2SH$
3. Methyl mercaptan	CH_3SH	10. Thiophene	C_4H_4S
4. Ethyl mercaptan	CH_3CH_2SH	11. n-butanethiol	$CH_3(CH_2)_3SH$
5. Dimethyl sulfide	CH_3SCH_3	12. Diethyl sulfide	$CH_3CH_2SCH_2CH_3$
6. Carbon disulfide	CS_2	13. Methyl ethyl sulfide	$CH_3SCH_2CH_3$
7. 2-propanethiol	$CH_3SHC_2H_5$	14. 2-methyl-1-propanethiol	$(CH_3)_2CHCH_2SH$
		15. 1-methyl-1-propanethiol	$CH_3CH_2CHSHCH_3$

► KEY BENEFITS AND FEATURES

- 7890 GC with Sulfur Chemiluminescence Detector-SCD for sulfur analysis in natural gas and gaseous fuels
- High Selectivity: higher selectivity for sulfur over carbon
- Equimolar: simplifies quantification of unknowns
- Linear: simplifies calibration
- UltiMetal hardware to enhance sulfur analysis without corrosion
- Dynamic detection range with GC-integrated 8355 SCD

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Sulfur Analyzer by SCD (G3445 #662)

Analyzer Description

Configuration:

- Capillary inlet/Capillary column/SCD (Requires additional Automatic Liquid Sampler for liquid sample analysis)

Sample type:

- Gasoline motor fuels, petroleum liquids with a final boiling point of approximately 230 °C or lower at atmospheric pressure

Compounds analyzed:

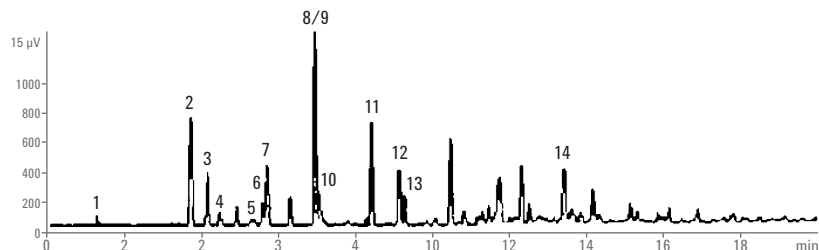
- Volatile sulfur-containing compounds in light petroleum liquids, such as CS₂, COS, mercaptans, aromatic sulfur compounds, sulfides

Typical quantification range:

- 20 ppb of sulfur in gasoline

Configured per method:

- ASTM D5623, UOP 791



Components	Formula	Components	Formula
1. Ethyl mercaptan	CH ₃ CH ₂ SH	8. Thiophene	C ₄ H ₄ S
2. Dimethyl sulfide	(CH ₃) ₂ S	9. Sec-butyl mercaptan	CH ₃ CH ₂ CH(SH)CH ₃
3. Carbondisulfide	C ₂ S	10. n-Butyl mercaptan	CH ₃ (CH ₂) ₃ SH
4. Isopropyl mercaptan	(CH ₃) ₂ CHSH	11. Dimethyl disulfide	CH ₃ SSCH ₃
5. t-Butyl mercaptan	(CH ₃) ₃ CSH	12. 2-Methyl thiophene	C ₅ H ₆ S
6. n-Propyl mercaptan	CH ₃ CH ₂ SCH ₃	13. 3-Methyl thiophene	C ₅ H ₆ S
7. Methyleneethyl sulfide	CH ₃ CH ₂ SCH ₃	14. Dimethyl disulfide	(C ₂ H ₅) ₂ S ₂

► KEY BENEFITS AND FEATURES

- 7890 GC with Sulfur Chemiluminescence Detector (SCD) for sulfur analysis in natural gas and gaseous fuels
- High Selectivity: higher selectivity for sulfur over carbon
- Equimolar: simplifies quantification of unknowns
- Linear: simplifies calibration
- UltiMetal hardware to enhance sulfur analysis without corrosion
- Dynamic detection range with GC-integrated 8355 SCD

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Volatile Sulfur Analyzer (7890-0167)

Analyzer Description

Configuration:

- 3-valve/2-column/2-VI (volatile inlets)/2-FPD

Sample type:

- 7890-0148: C₂, C₃, C₄ monomers
- 7890-0167: Natural gas and fuel gas streams

Compounds analyzed:

- Volatile sulfur such as H₂S, COS, MeSH, EtSH, DMS, CS₂, t-BuSH and THT

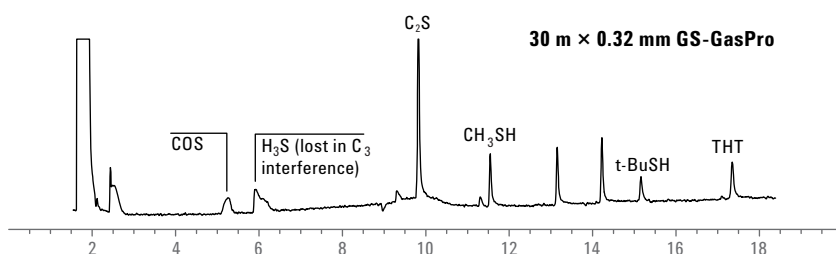
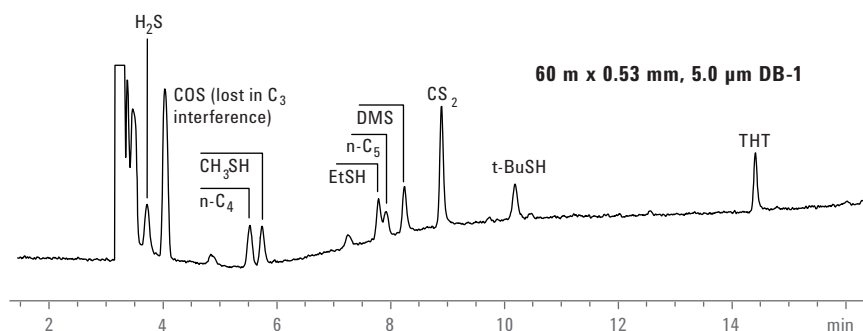
Typical quantification range:

- 50 ppb for sulfur compounds

Configured per method:

- ASTM D6228

45 ppb (v/v) each of the eight sulfur compounds in natural gas, split ratio: 0.5:1



► KEY BENEFITS AND FEATURES

- Dual-channel FPD system utilizing DB1 and GasPro column allows simultaneous determination of COS and H₂S in propylene and other light hydrocarbon streams
- Same GC configuration for two methods:
 1. 7890-0167: natural gas, fuel gas streams
 2. 7890-0148: C₂, C₃, C₄ monomers (uses a longer column)
- Can also be used to measure S and P
- Dynamic blending system (7890-0130) provides easy calibration and assists with method development
- System passivation with UltiMetal® for enhanced sulfur analysis
- Excellent alternative to more expensive specialty detectors SCD, PFPD, MSD

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Nitrosamine in Liquids Analyzer by NCD (7890-0460)

Analyzer Description

Configuration:

- On-column capillary inlet/Capillary column/NCD

Sample type:

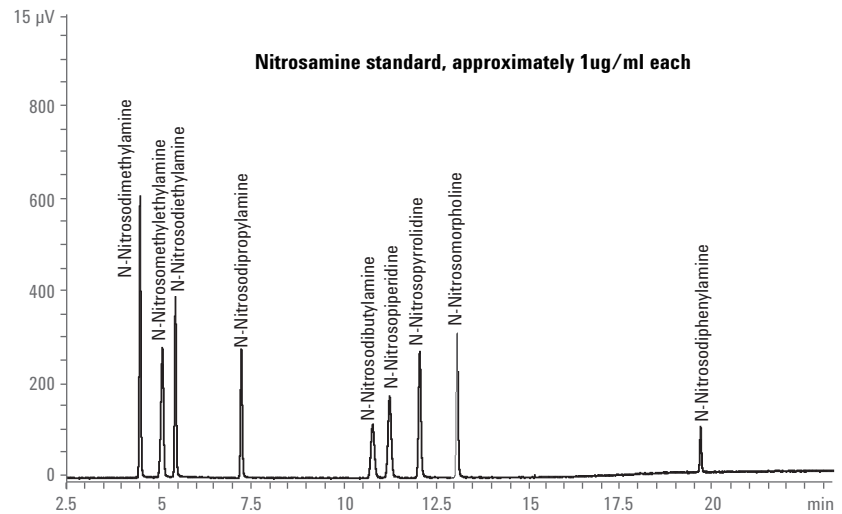
- Liquid samples

Compounds analyzed:

- N-Nitrosodimethylamine
- N-Nitrosomethylethylamine
- N-Nitrosodiethylamine
- N-Nitrosodipropylamine
- N-Nitrosodibutylamine
- N-Nitrosopiperidine
- N-Nitrosopyrrolidine
- N-Nitrosomorpholine
- N-Nitrosodiphenylamine

Typical quantification range:

- 10 ppb for N-Nitrosodimethylamine



► KEY BENEFITS AND FEATURES

- 7890 GC with Nitrogen Chemiluminescence Detector (NCD) in nitrosamine mode for nitrosamine analysis in liquids
- High Selectivity: higher selectivity for nitrosamine to low ppb level
- Equimolar: simplifies quantification of unknowns
- Linear: simplifies calibration

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SOLUTIONS FOR TRANSFORMER OIL GAS



Confirm oil integrity and prevent catastrophic failure

Electrical transformers, which literally *transform* voltage from one level to another, use oil as both an insulator and a coolant for internal components. Because transformer operation subjects the oil to electrical and mechanical stresses, the oil must be able to maintain its stability at high temperatures for extended periods of time.

Factors such as aging, oxidation, vaporization, electrolytic action, and decomposition can change the oil's chemical properties, resulting in gas formation. Information derived by analyzing these dissolved gases provides considerable diagnostic information about the transformer's current and future stability—helping operators determine whether a transformer should be decommissioned.

The following pages give you an in-depth look at **Agilent Transformer Oil Gas (TOGA) Analyzers**. Configured per ASTM standards, these analyzers harness advanced technologies such as headspace sampling, traditional packed columns, capillary columns, and TCD/FID detectors (following methanization) to deliver rugged, reliable TOGA analysis.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Transformer Oil Gas (TOGA)

Analyzer Number	Configuration	Capability
G3445 #571	1-valve/2-column/TCD/FID/methanizer/headspace	H ₂ , O ₂ , N ₂ , CH ₄ , CO and CO ₂ , C ₂ (ethane, ethylene, acetylene), C ₃ (propane, propylene), and C ₄ (1-butene) per ASTM D3612-C
7890-0552	3-valve/3-column/TCD/FID/methanizer/headspace	H ₂ , O ₂ , N ₂ , CH ₄ , CO, CO ₂ , C ₂ (ethane, ethylene, acetylene), C ₃ (propane, propylene), and C ₄ (1-butene) per ASTM D3612-C

Reference Methods for TOGA: Quantitation Ranges for Compounds of Interest

Component Gas	ASTM D3612-A	ASTM D3612-C	
	Minimum Detection Limits for Gases Dissolved in Oil, ppm	Compound	Detection Limits, ppm (signal/noise = 3)
H ₂	5	H ₂	0.6
Hydrocarbons	1	O ₂	11.0*
CO ₂	25	N ₂	11.2
Atmospheric gases	50	CH ₄	0.06
		CO	0.09
		CO ₂	0.1
		C ₂ H ₂	0.05
		C ₂ H ₄	0.04
		C ₂ H ₆	0.04
		C ₃ H ₈	0.2

*Estimated from the H₂ response. The detection limits were obtained from the analysis of a dissolved gas standard of 1 ppm for all gases, except for O₂, N₂, CO, and CO₂, where the concentration was 17, 24, 1.6, and 8.8 ppm, respectively. These results were obtained with a headspace sampler coupled with a gas chromatograph of one commercial source; other devices can be used but the analytical performance may be somewhat different than that specified in Method C.

Why spend time configuring hardware and developing methods? Let Agilent implement the latest advances in GC to provide your team with the tools it requires to quickly analyze trace target compounds in complex matrices.

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Transformer Oil Gas Analyzer (G3445 #571)

Analyzer Description

Configuration:

- 1-valve/2-column/TCD/FID/methanizer/headspace

Sample type:

- Gas

Compounds analyzed:

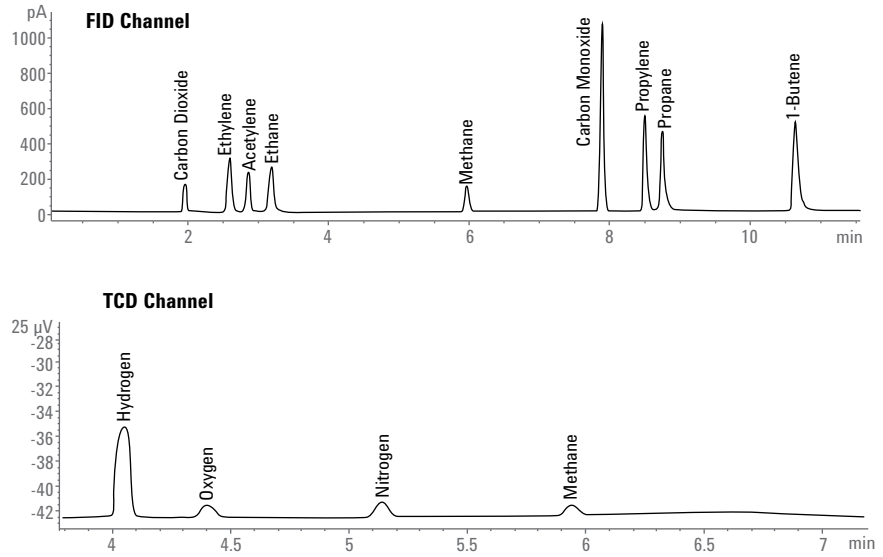
- H₂, O₂, N₂, CH₄, CO and CO₂,
- C₂ (ethane, ethylene, acetylene),
- C₃ (propane, propylene),
- C₄ (1-butene)

Typical quantification range:

- Meet the specifications listed in table 3 in ASTM D3612-C

Configured per method:

- ASTM D3612-C



► KEY BENEFITS AND FEATURES

- Single channel with PLOT columns
- Use direct transfer line to column connection
- Trace levels of CO and CO₂ can be analyzed by conversion to CH₄ and detection with FID
- 10 minute analysis time
- Improved precision through 7890 PCM backpressure regulation of headspace gas sampling valve loop

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Transformer Oil Gas Analyzer (7890-0552)

Analyzer Description

Configuration:

- 3-valve/3-column/TCD/FID/methanizer/headspace

Sample type:

- Gas

Compounds analyzed:

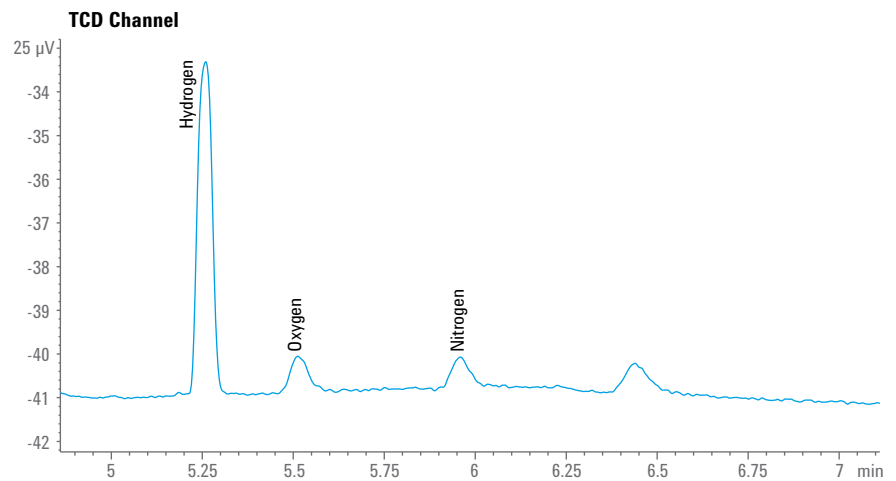
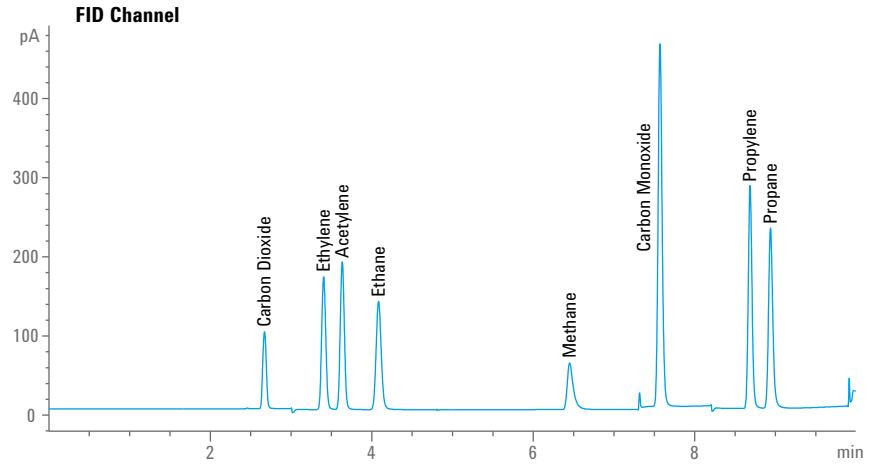
- H₂, O₂, N₂, CH₄, CO and CO₂
- C₂ (ethane, ethylene, acetylene), C₃ (propane, propylene), C₄ (1-butene)

Typical quantification range:

- Meet the specifications listed in table 3 in ASTM D3612-C

Configured per method:

- ASTM D3612-C



► KEY BENEFITS AND FEATURES

- Trace levels of CO and CO₂ can be analyzed by conversion to CH₄ and detection with FID
- Backflush of C₄₊ hydrocarbons present through pre-column to shorten analysis time
- Through additional valve switching C₂, C₃, C₄ hydrocarbons bypass nickel catalyst for FID detection
- 10 minutes analysis time

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SOLUTIONS FOR GREENHOUSE GAS



Monitor and measure gases that contribute to climate change

Fossil fuel consumption increases the concentration of Greenhouse Gases (GHGs)—such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)—in Earth's atmosphere. These gases trap heat, thereby affecting our planet's temperature.

To help fight climate change caused by increased concentrations of atmospheric GHGs, regulatory institutions (such as the EPA and CEN) have initiated programs to inventory GHG emissions through continuous measurement.

Agilent can help you track GHG emissions with our comprehensive portfolio of factory-configured, chemically tested **Greenhouse Gas (GHG) Analyzers**.

Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy

Solutions for Greenhouse Gas Analysis with Quantitation Ranges for Compounds of Interest

Configuration				Capability					
Analyzer Number	Valve/ Column	Detector	Methanizer	Autosampler HSS/CTC	Fast Analysis	O ₂ /N ₂ Separation	N ₂ O (Lowest Detection Limit)	CH ₄	CO ₂
G3445 #561	3/2	FID/Micro-ECD	YES	HSS (optional)	NO	NO	50 ppb	0.2 ppm-20%	0.4 ppm-0.2%
G3445 #562	4/4	FID/Micro-ECD/TCD	YES	NO	YES	NO	50 ppb	0.2 ppm-20%	0.4 ppm-20%
G3445 #563	3/2	FID/Micro-ECD	YES	HSS	NO	NO	50 ppb	0.2 ppm-20%	0.4 ppm-0.2%

Don't stretch your resources for method development. Agilent energy and chemical solutions let you quickly implement new technologies for analyzing difficult matrices!

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Greenhouse Gas Analyzer (G3445 #561)

Analyzer Description

Configuration:

- 3-valve/2-packed column/
Micro-ECD/FID/methanizer

Sample type:

- Greenhouse gases and soil gases with compounds of interest contain gases such as CH₄, N₂O and CO₂

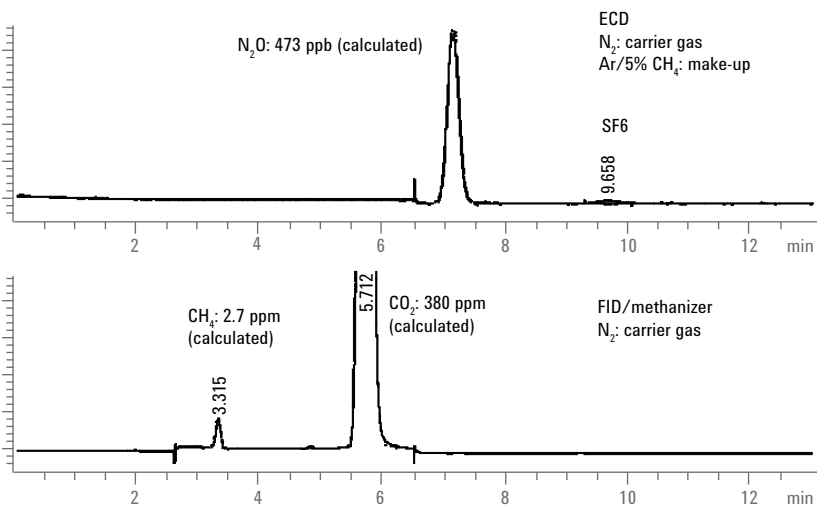
Compound analyzed:

- CH₄, N₂O, CO₂

Typical quantification range:

- 50 ppb for N₂O
- 0.2 ppm-20% for CH₄
- 0.4 ppm-0.2% for CO₂

Chromatogram for real sample (laboratory air)



► KEY BENEFITS AND FEATURES

- Configured for simultaneous analysis of greenhouse gas with one injection
- Sensitivity of Micro-ECD ensures the detection of N₂O at ppb level
- An easy-to-use union based on Capillary Flow Technology connects valves and Micro-ECD to improve chromatographic performance, including the peak shape
- Easily expanded to include the determination of SF₆
- Single channel with a simple valve configuration
 - Possible to use 6-port valve instead of a 10-port for automated headspace sampling (see G3445 #563)

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Greenhouse Gas Analyzer (G3445 #562)

Analyzer Description

Configuration:

- 4-valve/4-packed column/
Micro-ECD/TCD/FID/methanizer

Sample type:

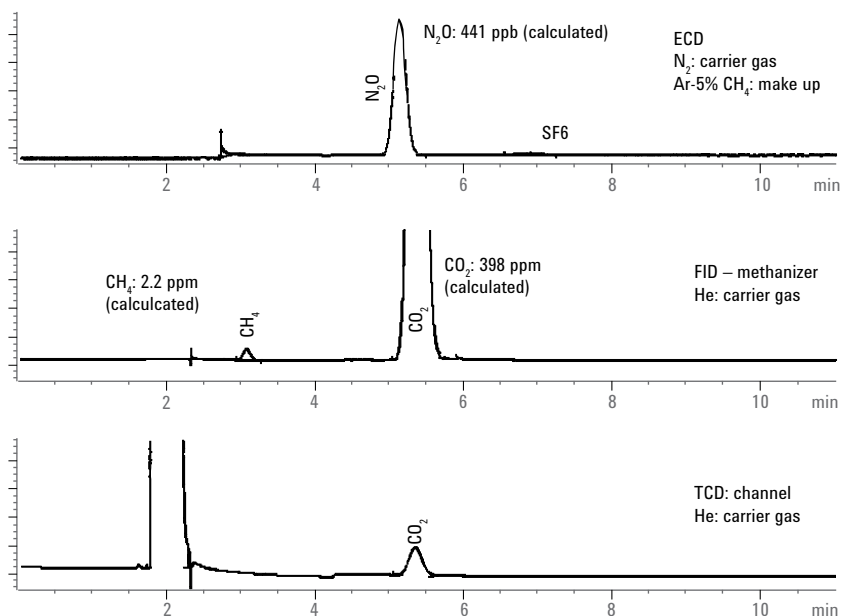
- Greenhouse gases and soil gases with compounds of interest contain gases such as CH₄, N₂O and CO₂

Compound analyzed:

- CH₄, N₂O, CO₂

Typical quantification range:

- 50 ppb for N₂O
- 0.2 ppm-20% for CH₄
- 0.4 ppm-20% for CO₂



► KEY BENEFITS AND FEATURES

- Configured for simultaneous analysis of greenhouse gas with one injection
- Sensitivity of Micro-ECD ensures the detection of N₂O at ppb level
- An easy-to-use union based on Capillary Flow Technology connects valves and Micro-ECD to improve chromatographic performance, including the peak shape
- Easily expanded to include the determination of SF₆
- Uses 2 separate channels with three detectors
 - Achieve faster results
 - Increases flexibility reducing critical nature timing for valve switching
 - Facilitates method setup
 - Uses third TCD to expand concentration range for CO₂ determinations

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Greenhouse Gas Analyzer (G3445 #563)

Analyzer Description

Configuration:

- 3-valve/2-packed column/Micro-ECD/FID/methanizer

Sample type:

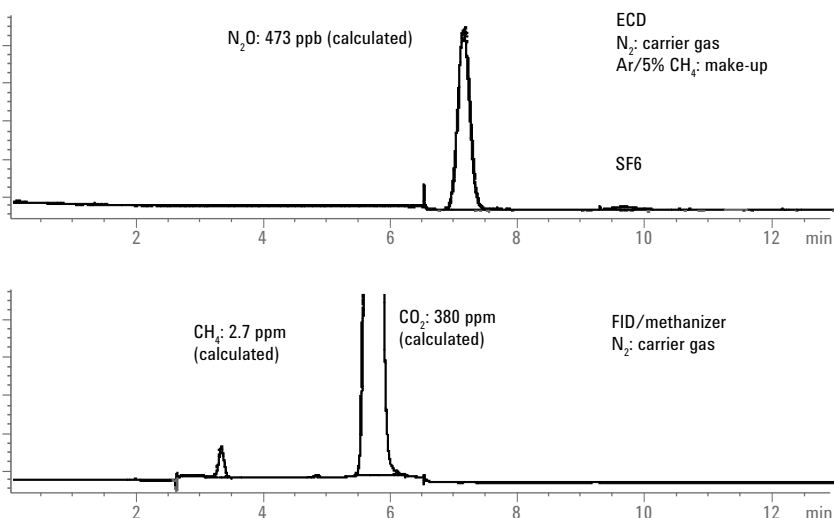
- Greenhouse gases, soil gases where the compounds of interest include gases such as CH₄, N₂O and CO₂

Compound analyzed:

- CH₄, N₂O, CO₂

Typical quantification range:

- 50 ppb for N₂O
- 0.2 ppm-20% for CH₄
- 0.4 ppm-0.2% for CO₂



► KEY BENEFITS AND FEATURES

- Analyzer configured for simultaneous analysis of greenhouse gas with one injection
- Sensitivity of Micro-ECD ensures the detection of N₂O at ppb level
- An easy-to-use union based on Capillary Flow Technology connects valves and Micro-ECD to improve chromatographic performance, including the peak shape
- Single channel with a simplified valve configuration
- Easily expanded to include the determination of SF₆
- Modification to G3445 #561 that allows for automated headspace sampling
 - Headspace sampler and Interface not included: HSS must be ordered separately

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SOLUTIONS FROM OUR CHANNEL PARTNERS



Enriching our expertise with specialized technologies and experience

Helping you meet your analytical challenges does not end with our own technological developments. Agilent's industry leadership has enabled us to nurture valuable partnerships that complement our energy and chemical analysis capabilities with solutions such as:

- ✓ Refinery Gas Analyzers /Fast RGA (UOP 539)
 - High-Speed RGA (ASTM D2163 /ISO 7941/DIN 51666)
 - Micro GC
 - Sulfur in LPG
- ✓ Natural Gas Analyzers
- ✓ Petrochemical Analyzers
 - Trace sulfur in ethylene and propylene
- ✓ PIONA/Reformulyzer M₃
- ✓ Olefins Analyzer
- ✓ DHA Analyzer
- ✓ Oxygenates Analyzer
- ✓ Aromatics Analyzer
- ✓ 8634 Analyzer for ASTM D86 (equivalent for groups 3 and 4)
- ✓ Sim. Dist. Analyzer/HT Sim. Dist. Analyzer
- ✓ DHA front end
- ✓ Apply lab GC on-line
- ✓ HPLC-based solutions

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Customized to get you
on the **FAST TRACK**



GC and GC/MS Analyzers let you focus on system validation and data generation... not method development

Agilent GC and GC/MS Analyzers are factory configured and chemically tested to meet method requirements, and get you on the "Fast Track" to producing quality data and processing backlogs. More than just instruments, Agilent Analyzers are complete workflow solutions that incorporate advanced technologies, such as Capillary Flow Technology and target compound databases that allow us to optimize your system for your unique application.

Each Analyzer arrives ready to perform with pre-set chromatography and checkout samples to verify separation capabilities. That means your team can work toward system validation as soon as installation is complete—and significantly reduce your method development costs. And as always, our support team is available, should any problems arise.

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