エネルギーおよび化学製品業界向け
アナライザソリューションガイド

正確で信頼性の高いデータにより
品質と生産性の向上を実現
エネルギーおよび化学製品業界は、石油、天然ガス、バイオ燃料の需要を満たすという形でグローバル経済の発展に大きく貢献しています。そのビジネスの成功は、安全性と信頼性、そして効率を兼ね備えたプロセスを確立し、製品を滞りなく消費者に供給できるかどうかにかかっています。

アジレントは信頼性の高い分析ソリューションを数十年にわたって提供し、研究者、プロセス管理者、ライン分析者の課題の解決を支援してきました。原油や天然ガスの特性解析から、精製化学薬品の生産モニタリング、代替燃料の品質測定まで、アジレントはチャネルパートナーとともに、エネルギーおよび化学製品業界に向けて幅広いアナライザを提供しています。

最新の GC テクノロジーを搭載したアジレントのアナライザ

アジレントのエネルギーおよび化学製品業界向けアナライザは、業界規格に基づき、厳しい品質管理プロセスに従って製造されています。

設置前:

✔ 工場において構成およびチェックアウトによる分析性能の「出荷前テスト」を実施
✔ 培養を受けたアジレントまたはチャネルパートナーのエンジニアがお客様サイトにて据付と性能評価を実施

設置後:

✔ アジレントのアプリケーション開発および設計チームがお客様の分析上の課題解決に向けて継続的にサポート

最新の GC テクノロジーを搭載したアジレントのアナライザ
アジレントのエネルギーおよび化学製品業界向けアナライザには、アジレントの卓越したハードウェアと高い技術力が活かされています。

石油化学ストリーム中の微量汚染物質を定量するシステムで、化学的に不活性な機器や特殊カラムを使用するなどシステムの単純な構成変更から、サンプル中の多様な化合物を特性解析できる複雑なマルチバルブアナライザまで、幅広いソリューションを取り揃えています。

このガイドでは、アジレントのエネルギーおよび化学製品業界向けアナライザをすべてご紹介します。これには、次のものが含まれます。

・ASTM、UOP、EN、GPAなどの業界規格の準拠を目的に開発された、導入後すぐに利用できるテスト済みのGC分析ソリューション*

・お客様のアプリケーションに基づきあらかじめ決められた仕様に従って構成され、テストされたカスタムアナライザシステム

・アジレントのチャネルパートナーが設計、提供、サポートする特定の機器およびツール

標準構成のアナライザとカスタムアナライザのどちらをご希望の場合も、セットアップ時間を短縮し、より多くの時間を優れた成果を生み出すために費やせるよう、アジレントがお客様をサポートします。

*本書に記載されている定量下限は、各システム構成で一般的な数値です。これらの値は、メソッドで要求される検出下限の絶対値とは異なる場合があります。
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インタラクティブファイルをご利用の場合：タイトルをクリックすると、
該当ページに移動できます。11ページ以降の内容は英語です。

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Acrobatの検索ウィンドウが
開きます。

検索

エネルギーおよび化学製品業界向けアナライザソリューションの詳細については、
www.agilent.com/chem/energyをご覧ください。（英語）
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エネルギーおよび化学製品業界向けアナライザソリューションの詳細については、www.agilent.com/chem/energyをご覧ください。
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<td>リファイナリガスアナライザ</td>
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<tr>
<td>外付けオープン付き3チャネル高速リファイナリガスアナライザ、H₂S および O₂ を含む分析用</td>
<td>G3445 #529</td>
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<tr>
<td>リファイナリガスアナライザ、水素キャリアガスによるH₂S およびO₂ の分析に対応</td>
<td>G3445 #530</td>
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<tr>
<td>高容量リファイナリガスアナライザ</td>
<td>G3445 #531</td>
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<td>天然ガスアナライザ</td>
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<td>3 チャネル高速リファイナリガスアナライザ — H₂S および COS</td>
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<td>デュアルチャネルアナライザ、燃料中の含酸素化合物および芳香族化合物分析用</td>
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### DIN メソッド用の構成

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<td>外付けオーブン付き 3 チャネル高速リファイナリガスアナライザ、 H2S および O2 を含む分析用</td>
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<td>リファイナリガスアナライザ、水素キャリアガスによる H2S および O2 の分析に対応</td>
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<td>高容量リファイナリガスアナライザ、ヘリウムキャリアガスによる H2S および O2 の分析に対応</td>
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エネルギーおよび化学製品業界向けアナライザソリューションの詳細については、www.agilent.com/chem/energy をご覧ください。
Learn more about Analyzer Solutions for the energy and chemical industry at www.agilent.com/chem/energy
## Solutions for Refinery Gas

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<th>Full-range Capacity for H\textsubscript{2}</th>
<th>Separates Air (O\textsubscript{2} and N\textsubscript{2})</th>
<th>High Level of H\textsubscript{2}S</th>
<th>Handles Liquefied Samples</th>
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## Reference Methods for Refinery Gas: Quantitation Ranges for Compounds of Interest

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<td>0.007 to 40</td>
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<td>40 to 100</td>
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<td>0.002 to 0.5</td>
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<td>0.01 to 10</td>
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<td>0.001 to 0.5</td>
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<td>0.1 and above</td>
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<td>C₂ isomers</td>
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<td>0.1 and above</td>
<td>0.001 to 100</td>
<td>0.001 to 10</td>
<td>0.0001 to 1</td>
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<td>C₂ isomers</td>
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<td>0.1 and above</td>
<td>0.001 to 50</td>
<td>0.001 to 5</td>
<td>0.0001 to 0.5</td>
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<td>0.001 to 30</td>
<td>0.001 to 5</td>
<td>0.0001 to 0.5</td>
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<td>—</td>
<td>0.1 to 99.9</td>
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<td>C₅+</td>
<td>0.01 to 1</td>
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<td>—</td>
<td>0.001 to 30</td>
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<td>C₅-C₈</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>0.0001 to 0.5</td>
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<tr>
<td>C₉-C₁₄</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>0.001 to 1</td>
<td>—</td>
</tr>
</tbody>
</table>

* 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.
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-C6, 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

![Graphs showing gas analysis data]

**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
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
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
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-C6 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
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-C6, 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
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)
3-Channel Fast Refinery Gas Analyzer with H$_2$S and O$_2$ 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:**
- C$_1$-C$_6$, C$_6+$ as backflush, H$_2$, O$_2$, N$_2$, CO$_2$, CO, H$_2$S

**Typical quantification range:**
- 0.01 mol% for all above mentioned components except H$_2$S
- 500 ppm for H$_2$S

**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 H$_2$ by third TCD using N$_2$ carrier gas
- Nickel tubing and Hastelloy valve for resistance to sulfur corrosion
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
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
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
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

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

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

(Continued)
**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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> 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](http://www.agilent.com/chem/energy)
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 (C₁–C₄ chain length), as well as small amounts of impurities, such as O₂, N₂, CO₂, H₂, 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 (C₁–C₅ with C₆⁺ as backflush), and perform extended analysis of hydrocarbons in natural gas to C₁₄. 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

<table>
<thead>
<tr>
<th>Analyzer Number</th>
<th>Extended Hydrocarbon Analysis to C₁₂ /C₁₄</th>
<th>Full-range Capacity for H₂</th>
<th>Separates Air (O₂ and N₂)</th>
<th>High Level of H₂S</th>
<th>Handles Liquefied Samples</th>
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<td>No</td>
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### Reference Methods for Natural Gas:
#### Quantitation Ranges for Compounds of Interest

<table>
<thead>
<tr>
<th>Compound</th>
<th>ASTM D1945 mol %</th>
<th>ASTM D1946 mol %</th>
<th>ASTM D2163 mol %</th>
<th>UOP 539 mol %</th>
<th>GPA 2186</th>
<th>GPA 2286</th>
<th>ISO 6974-6</th>
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<td>H₂S</td>
<td>0.3 to 30</td>
<td>–</td>
<td>0.1 to 25</td>
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<td>0.1 to 100</td>
<td>–</td>
<td>–</td>
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<td>O₂</td>
<td>0.01 to 20</td>
<td>–</td>
<td>0.1 to 99.9</td>
<td>–</td>
<td>0.005 to 20</td>
<td>0.007 to 5</td>
<td>–</td>
</tr>
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<td>N₂</td>
<td>0.01 to 100</td>
<td>–</td>
<td>0.1 to 99.9</td>
<td>0.005 to 5</td>
<td>0.005 to 100</td>
<td>0.007 to 40</td>
<td>–</td>
</tr>
<tr>
<td>CH₄</td>
<td>0.01 to 100</td>
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<td>0.001 to 5</td>
<td>0.001 to 100</td>
<td>40 to 100</td>
<td>–</td>
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<tr>
<td>CO</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 1</td>
<td>–</td>
</tr>
<tr>
<td>CO₂</td>
<td>0.01 to 20</td>
<td>–</td>
<td>0.005 to 5</td>
<td>0.005 to 100</td>
<td>0.001 to 10</td>
<td>–</td>
<td>–</td>
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<tr>
<td>He</td>
<td>0.01 to 10</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.002 to 0.5</td>
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<tr>
<td>H₂</td>
<td>0.01 to 10</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 0.5</td>
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<td>Ethane</td>
<td>0.01 to 100</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.1 to 99.9</td>
<td>0.001 to 95</td>
<td>0.001 to 100</td>
<td>0.002 to 15</td>
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<td>Propane</td>
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<td>0.1 and above</td>
<td>0.001 to 100</td>
<td>0.001 to 100</td>
<td>0.001 to 5</td>
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<tr>
<td>C₂ isomers</td>
<td>0.01 to 10</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.001 to 100</td>
<td>0.001 to 10</td>
<td>0.0001 to 1</td>
<td>–</td>
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<tr>
<td>C₃ isomers</td>
<td>0.01 to 2</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.001 to 50</td>
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<td>0.0001 to 0.5</td>
<td>–</td>
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<tr>
<td>C₄ isomers</td>
<td>0.01 to 2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 30</td>
<td>0.001 to 5</td>
<td>0.0001 to 0.5</td>
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<tr>
<td>C₅ and C₆ isomers</td>
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<td>–</td>
<td>0.1 to 99.9</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>C₇ isomers</td>
<td>0.01 to 1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 30</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C₇-C₈ isomers</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 2</td>
<td>0.0001 to 0.5</td>
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<tr>
<td>C₉ isomers</td>
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<td>–</td>
<td>–</td>
<td>0.001 to 2</td>
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<td>C₁₀-C₁₄ isomers</td>
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<td>–</td>
<td>–</td>
<td>0.001 to 1</td>
<td>–</td>
</tr>
</tbody>
</table>

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

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**Can’t find your application?**
Agilent Technologies can configure custom solutions to meet your analytical requirements!
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:**
- C₂-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
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
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
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-C6, 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
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
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-C6, 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
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
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

Configuration:
- Column temperature: 60 °C
- Carrier gas: helium, 260 kPa
- Injection time: 40 ms
  - Composite air peak
  - Methane
  - Carbon dioxide
  - Ethane
  - Propane

Configuration:
- Column temperature: 70 °C
- Carrier gas: helium, 150 kPa
- Injection time: 40 ms
  - Propane
  - i-Butane
  - n-Butane
  - Neo-Pentane
  - i-Pentane
  - n-Pentane
  - n-Hexane
  - n-Heptane
  - n-Octane
  - n-Nonane

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%
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 C\(_1\)-C\(_{12}\)
- Carbon dioxide and air

**Typical quantification range:**
- 1-10 ppm

**Configured per method:**
- ASTM D3588-98, GPA 2177, GPA 2172, ISO 6974-6

**Conditions**

**Peak Identification**

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

Channel 1: HayeSep A with Backflush

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

Channel 2: CP-Sil 5 CB with Backflush

- 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
**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%
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

Peak Identification
1. Composite air peak
2. Methane
3. Carbon dioxide
4. Ethane
5. Hydrogen sulfide
6. Propane
7. Propane
8. i-Butane
9. n-Butane
10. neo-Pentane
11. i-Pentane
12. n-Pentane
13. n-Hexane
14. n-Heptane
15. n-Octane
16. n-Nonane

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%
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

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. helium
2. neon
3. hydrogen
4. oxygen
5. nitrogen
6. methane
7. composite air peak
8. methane
9. carbon dioxide
10. ethane
11. hydrogen sulfide
12. propane

Analyzer Description (Continued)
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

---

Channel 3: CP-Si 5 CB

Peak Identification
1. propane
2. i-Butane
3. n-Butane
4. neo-Pentane
5. i-Pentane
6. n-Pentane
7. n-Hexane
8. n-Heptane
9. n-Octane
10. n-Nonane
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
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

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)
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:**
- C\textsubscript{1}-C\textsubscript{15}
- O\textsubscript{2}, N\textsubscript{2}, CO\textsubscript{2}, CO and H\textsubscript{2}S

**Typical quantification range:**
- 0.01 mol% for all components except H\textsubscript{2}S
- 0.05 mol% except H\textsubscript{2}S

(Continued)
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 C\textsubscript{15}
• H\textsubscript{2}S analysis
• O\textsubscript{2} and N\textsubscript{2} separation
• Handles gas and liquefied gases (with optional LSV)
• For permanent gases and hydrocarbons to C\textsubscript{6} in natural gas, please consider 7890-0610
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.
Solutions for Oxygenates and Aromatics in Fuel

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<tr>
<td>7890-0340</td>
<td>1-valve/2-column/FID</td>
<td>Trace oxygenates in reformulated gasoline per ASTM D7754</td>
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Reference Methods for Oxygenates: Quantitation Ranges for Compounds of Interest

<table>
<thead>
<tr>
<th>ASTM D7423</th>
<th>Analyte</th>
<th>The linear working range</th>
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<tr>
<td></td>
<td>Oxygenate compounds</td>
<td>0.50 mg/kg to 100 mg/kg</td>
</tr>
</tbody>
</table>
Single Channel Oxygenates and Aromatics in Fuel Analyzer (G3445 #611)

**Configurations:**
- 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, \( C_9 \) 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 \( C_8 \) aromatics, 5 to 30 Vol% for total \( C_9 \) and heavier aromatics, 10 to 80 Vol% for total aromatics

**Configured per method:**
- ASTM D4815, ASTM D5580

**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
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

**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
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
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

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
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

![Graph showing chromatogram of analytes](image)

**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
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
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, t-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

KEY BENEFITS AND FEATURES

- Solution for 3 ASTM methods for oxygenates and aromatics in gasoline
- Capable of running one method at a time
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
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](http://www.agilent.com/chem/energy)
Solutions for Biofuel/Renewable Fuel

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<td>Free glycerin, monoglycerides, diglycerides, triglycerides, bound glycerin, and total glycerin in B100 biodiesel per ASTM D6584</td>
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<tr>
<td>G3445 #633</td>
<td>Split/splitless inlet/FID with optional liquid autosampler</td>
<td>FAME content between C6-C24 in B100 biodiesel per EN 14103:2011</td>
</tr>
<tr>
<td>G3445 #634</td>
<td>Split/splitless inlet/FID with optional methods for automated sample preparation</td>
<td>Glycerol, monoglycerides, diglycerides, triglycerides in B100 biodiesel per EN14105:2011</td>
</tr>
<tr>
<td>G3582A #110</td>
<td>2-channel Micro GC</td>
<td>Compounds analyzed in biogas:</td>
</tr>
<tr>
<td></td>
<td>- Channel 1: CP-molsieve 5Å</td>
<td>- Channel 1: C1, H2, O2, N2, and CO</td>
</tr>
<tr>
<td></td>
<td>- Channel 2: CP PoraPLOT U</td>
<td>- Channel 2: C2-C9, H2S and CO2</td>
</tr>
<tr>
<td>G3582A #111</td>
<td>3-channel Micro GC</td>
<td>Compounds analyzed in biogas:</td>
</tr>
<tr>
<td></td>
<td>- Channel 1: CP-molsieve 5Å</td>
<td>- Channel 1: C1, H2, O2, N2, and CO</td>
</tr>
<tr>
<td></td>
<td>- Channel 2: CP PoraPLOT U</td>
<td>- Channel 2: C2-C9, H2S and CO2</td>
</tr>
<tr>
<td></td>
<td>- Channel 3: CP-Sil 5 CB</td>
<td>- Channel 3: C4-C7</td>
</tr>
<tr>
<td>7890-0295</td>
<td>Headspace/FID with optional liquid autosampler</td>
<td>Methanol in B100 biodiesel per EN 14110:2003</td>
</tr>
<tr>
<td>M7482A</td>
<td>GC/MSD operating in Scan/SIM mode with optional 7896A WorkBench for fully automated analysis</td>
<td>Trace fatty acid methyl esters per IP 585</td>
</tr>
</tbody>
</table>

From the laboratory to the field, Agilent Technologies can provide analytical solutions to address your requirements for Renewable Energy Research.
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
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 eicosadinoate C20:2    23.808
4.  methyl palmitate C16:0         17.996     14. methyl arachidonate C20:4      24.951
5.  methyl palmitoleate C16:1      18.311     15. methyl eicosatrienoate C20:3   24.730
6.  methyl stearate C18:0          20.332     16. methylbehenate and C22:0       25.582
7.  methyl oleate (9) C18:1        20.817     17. methyl eicosapentaenoate C22:5  26.582
9.  methyl linoleate C18:2         21.205     19. methyl lignocerate C24:0        29.574
10. methyl linolenate C18:3        22.052     20. methyl nervonate C24:1         30.203

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
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)
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®
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

(Continued)
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

(Continued)
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
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

Analyzer Description

DB-ALC1 30 m x 0.32 mm, 1.80 μm

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
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
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)

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

### Reference Methods for LPG:
Quantitation Ranges for Compounds of Interest

<table>
<thead>
<tr>
<th>Compound</th>
<th>ASTM D1945 mol %</th>
<th>ASTM D1946 mol %</th>
<th>ASTM D2163 mol %</th>
<th>UOP 539 mol %</th>
<th>GPA 2186 mol %</th>
<th>GPA 2286 mol %</th>
<th>ISO 6974-6 mol %</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂S</td>
<td>0.3 to 30</td>
<td>–</td>
<td>0.1 to 25</td>
<td>–</td>
<td>–</td>
<td>0.1 to 100</td>
<td>–</td>
</tr>
<tr>
<td>O₂</td>
<td>0.01 to 20</td>
<td>–</td>
<td>0.1 to 99.9</td>
<td>–</td>
<td>0.005 to 20</td>
<td>0.007 to 5</td>
<td>–</td>
</tr>
<tr>
<td>N₂</td>
<td>0.01 to 100</td>
<td>–</td>
<td>–</td>
<td>0.005 to 5</td>
<td>0.005 to 100</td>
<td>0.007 to 40</td>
<td>–</td>
</tr>
<tr>
<td>CH₄</td>
<td>0.01 to 100</td>
<td>–</td>
<td>–</td>
<td>0.001 to 5</td>
<td>0.001 to 100</td>
<td>40 to 100</td>
<td>–</td>
</tr>
<tr>
<td>CO</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 1</td>
</tr>
<tr>
<td>CO₂</td>
<td>0.01 to 20</td>
<td>–</td>
<td>–</td>
<td>0.005 to 5</td>
<td>0.005 to 100</td>
<td>0.007 to 10</td>
<td>–</td>
</tr>
<tr>
<td>He</td>
<td>0.01 to 10</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.002 to 0.5</td>
</tr>
<tr>
<td>H₂</td>
<td>0.01 to 10</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 0.5</td>
</tr>
<tr>
<td>Ethane</td>
<td>0.01 to 100</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.1 to 99.9</td>
<td>0.001 to 95</td>
<td>0.001 to 100</td>
<td>0.002 to 15</td>
</tr>
<tr>
<td>Propane</td>
<td>0.01 to 100</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.001 to 100</td>
<td>0.001 to 100</td>
<td>0.001 to 100</td>
<td>0.001 to 1</td>
</tr>
<tr>
<td>C₄ isomers</td>
<td>0.01 to 10</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.001 to 100</td>
<td>0.001 to 100</td>
<td>0.0001 to 10</td>
<td>0.0001 to 1</td>
</tr>
<tr>
<td>C₅ isomers</td>
<td>0.01 to 2</td>
<td>–</td>
<td>0.1 and above</td>
<td>0.001 to 50</td>
<td>0.001 to 5</td>
<td>0.0001 to 0.5</td>
<td>–</td>
</tr>
<tr>
<td>C₆ isomers</td>
<td>0.01 to 2</td>
<td>–</td>
<td>–</td>
<td>0.001 to 30</td>
<td>0.001 to 5</td>
<td>0.0001 to 0.5</td>
<td>–</td>
</tr>
<tr>
<td>C₆⁺</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.1 to 99.9</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C₇⁺</td>
<td>0.01 to 1</td>
<td>–</td>
<td>–</td>
<td>0.001 to 30</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C₇-C₈</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 2</td>
<td>0.0001 to 0.5</td>
<td>–</td>
</tr>
<tr>
<td>C₉</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 2</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C₁₁-C₁₄</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.001 to 1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*Note: In the table above the symbol “—” indicates that this parameter was not specified.*
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
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:
• C₁₋₆

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
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
**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)
**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

**► 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)
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

<table>
<thead>
<tr>
<th>Analyzer Number</th>
<th>Configuration</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Suitable for process gas containing high levels of CH₄</td>
</tr>
<tr>
<td>G3445 #646</td>
<td>2-valve/2-column/methanizer/FID</td>
<td>Yes</td>
</tr>
<tr>
<td>G3445 #647</td>
<td>1-valve/2-column/methanizer/FID</td>
<td>No</td>
</tr>
<tr>
<td>7890-0191</td>
<td>3-valve/5-column (packed)/2-TCD/Hastelloy valve, inlet tubing, sample filter and nickel stripper</td>
<td>H₂, O₂, N₂, CH₄, CO₂, and CO in pure chlorine gas</td>
</tr>
<tr>
<td>7890-0237</td>
<td>1-valve/2-column (packed column)/PDHID</td>
<td>H₂, O₂ + N₂ composite peak, CH₄, CO, CO₂ in monomer gas</td>
</tr>
<tr>
<td>7890-0355</td>
<td>2-valve/2-column/methanizer/FID</td>
<td>No</td>
</tr>
<tr>
<td>7890-0366</td>
<td>2-valve/2-column/methanizer/FID</td>
<td>No</td>
</tr>
<tr>
<td>7890-0409</td>
<td>1-valve/2-column (packed column)/PDHID</td>
<td></td>
</tr>
<tr>
<td>M7484AA or M7474AA</td>
<td>2-valve/1-column GC/MSD with high efficiency source using self cleaning ion source option</td>
<td>H₂, O₂, N₂, CO, CH₄ in ethylene/propylene</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Component Gas</th>
<th>Concentration Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO/CO₂</td>
<td>0.5 to 500 mol-ppm</td>
</tr>
</tbody>
</table>
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
Low CO and CO$_2$ 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:**
- CO$_2$ and CO

**Typical quantification range:**
- 0.2 ppm for CO
- 0.4 ppm for CO$_2$

**KEY BENEFITS AND FEATURES**

- Single channel with packed columns
- Hydrocarbons cut on the pre-column while trace levels of CO and CO$_2$ pass through Methanizer for conversion to CH$_4$ and detection with FID
- 4 minute analysis time
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
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
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
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
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
**SOLUTIONS FOR TRACE IMPURITIES**

**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 μL sample loop
- Integrated permeation tube dilution block (M7484AA only) enables fully automated calibration for improved efficiencies

---

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- Back to Trace Impurities
- Back to Introduction
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

<table>
<thead>
<tr>
<th>Analyzer Number</th>
<th>ASTM Method</th>
<th>Carbon Number</th>
<th>Sample Range</th>
<th>Boiling Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3440 #653</td>
<td>ASTM D2887</td>
<td>C_{44}</td>
<td>Jet fuel diesel</td>
<td>55-538 °C</td>
</tr>
<tr>
<td>G3445 #654</td>
<td>ASTM D7213</td>
<td>C_{60}</td>
<td>Lube oil base stocks</td>
<td>100-615 °C</td>
</tr>
<tr>
<td>(D2887 extended)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3445 #655</td>
<td>ASTM D6352</td>
<td>C_{100}</td>
<td>Lube oil base stock</td>
<td>174-700 °C</td>
</tr>
</tbody>
</table>

Agilent’s Multimode Inlet expands the range of applications for your laboratory GC; including suitability for Simulated Distillation.
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 mm, 0.4 μm
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
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
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 SO₂. 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.
## Solutions for Sulfur and Nitrosamine

<table>
<thead>
<tr>
<th>Analyzer Number</th>
<th>Configuration</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3445 #661</td>
<td>1-valve/capillary column/SCD</td>
<td>Sulfur compounds in natural gas or gaseous fuels; H₂S, CS₂, COS, mercaptans, aromatic sulfur compounds, sulfides per ASTM D5504</td>
</tr>
<tr>
<td>G3445 #662</td>
<td>Capillary inlet/capillary column/SCD (requires additional automatic liquid sampler for handling liquid sample analysis)</td>
<td>Volatile sulfur-containing compounds in light petroleum liquids, such as CS₂, COS, mercaptans, aromatic sulfur compounds, sulfides per ASTM D5623 and UOP 791</td>
</tr>
<tr>
<td>7890-0167</td>
<td>3-valve/2-column/2-VI (volatile inlets)/2-FPD</td>
<td>Volatile sulfur such as H₂S, COS, MeSH, EtSH, DMS, CS₂, t-BuSH and THT per ASTM D6228</td>
</tr>
<tr>
<td>7890-0460</td>
<td>On-column capillary inlet/capillary column/NCD</td>
<td>N-Nitrosodimethylamine, N-Nitrosopyrrolidine, N-Nitrosodibutylamine, N-Nitrosopiperidine, N-Nitrosodibutylamine, N-Nitrosopiperidine, N-Nitrosomorpholine, N-Nitrosomethylisethyamine, N-Nitrosodiethylamine, N-Nitrosodipropylamine, N-Nitrosodiethylamine, N-Nitrosodipropylamine, N-Nitrosodiphenylamine in liquids</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Method</th>
<th>Detection Range for Sulfur Compounds</th>
<th>Detection Range for Individual Sulfur Species</th>
<th>Detection Range for Sulfur Compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D5504 (SCD)</td>
<td>10-1,000,000 pg of sulfur equivalent 0.01 to 1000 mg/m³</td>
<td>0.1 to 100 mg/kg</td>
<td>20-20,000 pg of sulfur equivalent 0.02 to 20 mg/m³</td>
</tr>
<tr>
<td>ASTM D5623 (SCD)</td>
<td>Detection range for individual sulfur species</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM D6228 (FPD)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inert treatment of sample pathways and detector components used in Agilent analyzers ensure your laboratory’s success with trace impurity analysis.
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
  • H₂S, CS₂, COS, mercaptans, aromatic sulfur compounds, sulfides

Typical quantification range:
• 100 ppb of H₂S
• 20-40 ppb for other S components (depends on different compounds)

Configured per method:
• ASTM D5504

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

Components | Formula | Components | Formula
--- | --- | --- | ---
1. Hydrogen sulfide | H₂S | 8. Tert-butyl mercaptan | (CH₃)₃CSH
2. Carbonyl sulfide | COS | 9. 1-propanethiol | CH₃(CH₂)₂SH
3. Methyl mercaptan | CH₂SH | 10. Thiophene | C₄H₄S
4. Ethyl mercaptan | CH₃SH | 11. n-butanethiol | CH₃(CH₂)₃SH
5. Dimethyl sulfide | CH₂SCH₂ | 12. Diethyl sulfide | CH₃CH₂SCH₂CH₃
6. Carbon disulfide | CS₂ | 13. Methyl ethyl sulfide | CH₃SCH₂CH₃
7. 2-propanethiol | CH₃SCH₂H₂ | 14. 2-methyl-1-propanethiol | (CH₃)₂CHCH₂SH
15. 1-methyl-1-propanethiol | CH₃CH₂CHSHCH₃

Components | Formula
--- | ---
8. Tert-butyl mercaptan | (CH₃)₃CSH
9. 1-propanethiol | CH₃(CH₂)₂SH
10. Thiophene | C₄H₄S
11. n-butanethiol | CH₃(CH₂)₃SH
12. Diethyl sulfide | CH₃CH₂SCH₂CH₃
13. Methyl ethyl sulfide | CH₃SCH₂CH₃
14. 2-methyl-1-propanethiol | (CH₃)₂CHCH₂SH
15. 1-methyl-1-propanethiol | CH₃CH₂CHSHCH₃

---

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BACK TO SULFUR AND NITROSAMINE INTRODUCTION
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

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

Components
1. Ethyl mercaptan CH₃CH₂SH
2. Dimethyl sulfide (CH₃)₂S
3. Carbondisulfide C₄S
4. Isopropyl mercaptan (CH₃)₂CHSH
5. t-Butyl mercaptan (CH₃)₃CSH
6. n-Propyl mercaptan CH₃CH₂SCH
7. Methylene sulfide CH₂=CH₂SCH₂
8. Thiophene C₄H₄S
9. Sec-butyl mercaptan CH₃CH(CH₃)CH₂SH
10. n-Butyl mercaptan CH₃(CH₂)₃SH
11. Dimethyl disulfide CH₃SSCH₃
12. 2-Methyl thiophene C₅H₆S
13. 3-Methyl thiophene C₅H₆S
14. Dimethyl disulfide (C₂H₅)₂S₂
Volatile Sulfur Analyzer (7890-0167)

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

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
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
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)

<table>
<thead>
<tr>
<th>Analyzer Number</th>
<th>Configuration</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3445 #571</td>
<td>1-valve/2-column/TCD/FID/methanizer/headspace</td>
<td>H₂, O₂, N₂, CH₄, CO and CO₂, C₂ (ethane, ethylene, acetylene), C₃ (propane, propylene), and C₄ (1-butene) per ASTM D3612-C</td>
</tr>
<tr>
<td>7890-0552</td>
<td>3-valve/3-column/TCD/FID/methanizer/headspace</td>
<td>H₂, O₂, N₂, CH₄, CO, CO₂, C₂ (ethane, ethylene, acetylene), C₃ (propane, propylene), and C₄ (1-butene) per ASTM D3612-C</td>
</tr>
</tbody>
</table>

Reference Methods for TOGA: Quantitation Ranges for Compounds of Interest

<table>
<thead>
<tr>
<th>Component Gas</th>
<th>Minimum Detection Limits for Gases Dissolved in Oil, ppm</th>
<th>Compound</th>
<th>Detection Limits, ppm (signal/noise = 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H₂, O₂, N₂, CH₄, CO, CO₂, C₂ (ethane, ethylene, acetylene), C₃ (propane, propylene), and C₄ (1-butene) per ASTM D3612-C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₂</td>
<td>5</td>
<td>H₂</td>
<td>0.6</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>1</td>
<td>O₂</td>
<td>11.0*</td>
</tr>
<tr>
<td>CO₂</td>
<td>25</td>
<td>N₂</td>
<td>11.2</td>
</tr>
<tr>
<td>Atmospheric gases</td>
<td>50</td>
<td>CH₄</td>
<td>0.06</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>CO</td>
<td>0.09</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>CO₂</td>
<td>0.1</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>C₂H₂</td>
<td>0.05</td>
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<tr>
<td>50</td>
<td></td>
<td>C₂H₄</td>
<td>0.04</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>C₂H₆</td>
<td>0.04</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>C₃H₆</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*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.
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
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
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

<table>
<thead>
<tr>
<th>Analyzer Number</th>
<th>Valve/Column</th>
<th>Detector</th>
<th>Methanizer</th>
<th>Autosampler</th>
<th>Fast Analysis</th>
<th>O₂/N₂ Separation</th>
<th>N₂O (Lowest Detection Limit)</th>
<th>CH₄</th>
<th>CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3445 #561</td>
<td>3/2</td>
<td>FID/Micro-ECD</td>
<td>YES</td>
<td>HSS (optional)</td>
<td>NO</td>
<td>NO</td>
<td>50 ppb</td>
<td>0.2 ppm-20%</td>
<td>0.4 ppm-0.2%</td>
</tr>
<tr>
<td>G3445 #562</td>
<td>4/4</td>
<td>FID/Micro-ECD/TCD</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>50 ppb</td>
<td>0.2 ppm-20%</td>
<td>0.4 ppm-20%</td>
</tr>
<tr>
<td>G3445 #563</td>
<td>3/2</td>
<td>FID/Micro-ECD</td>
<td>YES</td>
<td>HSS</td>
<td>NO</td>
<td>NO</td>
<td>50 ppb</td>
<td>0.2 ppm-20%</td>
<td>0.4 ppm-0.2%</td>
</tr>
</tbody>
</table>

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

ECD
N₂: carrier gas
Ar/5% CH₄: make-up

SF₆

CH₄: 2.7 ppm
(calculated)

CO₂: 380 ppm
(calculated)

FID/methanizer
N₂: carrier gas

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)
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
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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- PIONA/Reformulyzer M₃
- Olefins Analyzer
- DHA Analyzer
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- Aromatics Analyzer
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