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




Agilent Technologies

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

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。

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

✓ 訓練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

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、各システム構成での一般的な数値です。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。

目次

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。

本書に含まれるアプリケーション
ノート内の語句を検索するには、
下の検索ボタンをクリックすると、
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)

目的別アナライザ

リファイナリガス

アナライザモデル	製品	対応している公開メソッド
G3445 #521	3 チャネル高速リファイナリガスアナライザ	ASTM D1945、ASTM D1946、UOP 539
G3445 #522	3 チャネル高速リファイナリガスアナライザ — H_2S および COS	ASTM D1945、ASTM D1946、UOP 539
G3445 #523	拡張リファイナリガスアナライザ	
G3445 #524	ニッケルカラム付きリファイナリガスアナライザ	ASTM D1945、ASTM D1946、UOP 539
G3445 #526	リファイナリガスアナライザ	ASTM D1945、ASTM D1946、UOP 539
G3445 #529	3 チャネル高速リファイナリガスアナライザ、H_2S および O_c を含む分析用	ASTM D1945、ASTM D1946
G3445 #530	リファイナリガスアナライザ、水素キャリアガスによる H_2S および酸素の分析に対応	ASTM D1945、ASTM D1946、UOP 539
G3445 #531	ラージバルブオーブン付き高容量リファイナリガスアナライザ (RGA)、ヘリウムキャリアガスによる硫化水素および酸素の分析に対応	ASTM D1945、ASTM D1946、UOP 539
G3445 #532	ラージバルブオーブン (LVO) およびマイクロパックドカラム付き高速リファイナリガスアナライザ	UOP 539
G3445 #533	ラージバルブオーブン (LVO) 付きリファイナリガスアナライザ、水素キャリアガスによる酸素および H_2S の分析に対応	UOP 539
アジレントへのお問い合わせ	リファイナリガスアナライザ: 4 チャネルマイクロ GC	ASTM D2163、DIN-51666、UOP 59

天然ガス

アナライザモデル	製品	対応している公開メソッド
G3445 #541	拡張天然ガスアナライザ、C-12 までの分析用	GPA 2286 (架橋化合物 iC_5 および nC_5 以外の計算)
G3445 #542	天然ガスアナライザ	ASTM D1945、GPA 2261 (H_2 および He を除く)
G3445 #543	天然ガスアナライザ	ASTM D1945、GPA 2261
G3445 #544	天然ガスアナライザ	ASTM D1945、GPA 2261
G3445 #545	天然ガスアナライザ	GPA 2261 (H_2 および He を除く、O_2 と N_2 の分離なし)
G3445 #547	3 チャネル天然ガスアナライザ、幅広い HC 分析に対応	ASTM D1945、GPA 2261
G3445 #548	拡張天然ガスアナライザ	GPA 2286 (架橋化合物 iC_5 および nC_5 を含む計算)
G3582A #120	天然ガスアナライザ A: 2 チャネルマイクロ GC	ASTM D3588-98、GPA 2172、GPA 2177、ISO 6974-6
G3582A #121	拡張天然ガスアナライザ A : 3 チャネルマイクロ GC	ASTM D3588-98、GPA 2172、GPA 2177、ISO 6974-6
G3582A #122	天然ガスアナライザ B、H_2S を含む分析用: 2 チャネルマイクロ GC	ASTM D3588-98、GPA 2172、GPA 2177、ISO 6974-6
G3582A #123	拡張天然ガスアナライザ B、H_2S を含む分析用: 3 チャネルマイクロ GC	ASTM D1945、ASTM D3588-98、GPA 2172、GPA 2177、ISO 6974-6
7890-0110	液化天然ガスアナライザ	GPA 2177
7890-0610	天然ガスアナライザ: 永久ガスおよび炭化水素	
7890-0611	天然ガスアナライザ: 永久ガスおよび幅広い炭化水素	

改質燃料

アナライザモデル	製品	対応している公開メソッド
G3445 #611	シング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	ASTM D4815、ASTM D5580
G3445 #612	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	ASTM D4815、ASTM D5580
G3445 #615	ガソリン中のベンゼン分析用アナライザ	ASTM D3606
G3445 #616	燃料中の芳香族化合物分析用アナライザ	ASTM D5580
G3445 #617	Deans スイッチによるガソリン中の含酸素化合物および芳香族化合物分析用アナライザ	EN 12177、EN 13132
G3445 #618	キャピラリ・フロー・テクノロジーによる軽質炭化水素中の低濃度含酸素化合物分析用アナライザ	ASTM D7423
G3445 #621	ラージバルブオーブン付き 3-in-1 改質燃料アナライザ	ASTM D3606、ASTM D4815、ASTM D5580
7890-0340	ガソリン中の微量含酸素化合物分析用アナライザ	ASTM D7754

バイオディーゼル/再生可能燃料

アナライザモデル	製品	対応している公開メソッド
G3445 #631	バイオディーゼル中のグリセリン分析用アナライザ	ASTM D6584
G3445 #633	バイオディーゼル中の FAME 含有量分析用アナライザ	EN 14103:2011
G3445 #634	バイオディーゼルアナライザ	EN 14105:2011
G3582A #110	バイオガスアナライザ: 2 チャネルマイクロ GC	
G3582A #111	バイオガスアナライザ: 3 チャネルマイクロ GC	
7890-0295	バイオディーゼルアナライザ、EN 14110:2003 に基づく HSS-GC によるメタノール含有量分析用	EN 14100:2003
M7482A	ジェット燃料中の FAME 分析用アナライザ	IP 585

液化石油ガス (LPG)

アナライザモデル	製品	対応している公開メソッド
7890-0138	アルミナカラム付き LPG 組成アナライザ	ASTM D2163、ASTM D2593、ASTM D2712、ASTM D4424
7890-0188	市販プロパンおよびブタン LPG アナライザ	ISO 7941、EN 27941、IP 405
7890-0397	液化石油ガス中の炭化水素分析用アナライザ	ASTM D2163
アジレントへのお問い合わせ	エタン組成および不純物分析用マイクロ GC アナライザ	
アジレントへのお問い合わせ	プロパンおよびブタンストリーム分析用マイクロ GC アナライザ	

微量不純物

アナライザモデル	製品	対応している公開メソッド
G3445 #646	高濃度 CH_4 を含むプロセスガス中の微量 CO および CO_2 分析用アナライザ	
G3445 #647	プロセスガス中の微量 CO および CO_2 分析用アナライザ	
7890-0191	純塩素中の不活性不純物分析用 2 チャネルアナライザ	
7890-0237	PDHID によるモノマー中の不純物分析用アナライザ	
7890-0355	プロセスガス中の微量 CO および CO_2 分析用ニッケル触媒 (メタナイザ) バイパス付きアナライザ	
7890-0366	水素および軽質炭化水素ガス中の微量 CO および CO_2 分析用アナライザ	UOP 603
7890-0409	PDHID によるエチレン/プロピレン中の不純物分析用アナライザ	
M7484AA または M7474AA	エチレン/プロピレン中の不純物分析用 GC/MS アナライザ	

疑似蒸留 (SIMDIS)

アナライザモデル	製品	対応している公開メソッド
G3440 #653	疑似蒸留アナライザ、沸点範囲 55～538 °C	ASTM D2887
G3445 #654	疑似蒸留アナライザ、沸点範囲 100～615 °C	ASTM D7213 (D2887 より広範囲)
G3445 #655	疑似蒸留アナライザ、沸点範囲 174～700 °C	ASTM D6352

硫黄およびニトロソアミン

アナライザモデル	製品	対応している公開メソッド
G3445 #661	化学発光硫黄検出器による天然ガス/燃料ガス中の硫黄分析用アナライザ	ASTM D5504
G3445 #662	化学発光硫黄検出器による燃料/軽油中の硫黄分析用アナライザ	ASTM D5623、UOP 791
7890-0167	揮発性硫黄アナライザ	ASTM D6228
7890-0460	化学発光窒素検出器による液体中のニトロソアミン分析用アナライザ	

トランスオイルガス

アナライザモデル	製品	対応している公開メソッド
G3445 #571	トランスオイルガスアナライザ (TOGA)	ASTM D3612 メソッド C、ヘッドスペースサンプリング
7890-0552	C_4+ バックラッシュおよび NiCat バイパス付きトランスオイルガスアナライザ (TOGA)	ASTM D3612 メソッド C、ヘッドスペースサンプリング

温室効果ガス

アナライザモデル	製品	対応している公開メソッド
G3445 #561	温室効果ガスアナライザ、ヘッドスペースサンプラ (オプション)、CO 0.4 ppm—0.2 %	
G3445 #562	温室効果ガスアナライザ、CO_2 0.4 ppm—20 %	
G3445 #563	ヘッドスペースサンプラ付き温室効果ガスアナライザ、CO 0.4 ppm—0.2 %	

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。

準拠メソッド別アナライザ

ASTM メソッド用の構成

ASTM D1945	アナライザ番号
3 チャネル高速リファイナリガスアナライザ	G3445 #521
3 チャネル高速リファイナリガスアナライザ — H_2S および COS	G3445 #522
ニッケルカラム付きリファイナリガスアナライザ	G3445 #524
リファイナリガスアナライザ	G3445 #526
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、H_2S および O_2 を含む分析用	G3445 #529
リファイナリガスアナライザ、水素キャリアガスによる H_2S および O_2 の分析に対応	G3445 #530
高容量リファイナリガスアナライザ	G3445 #531
天然ガスアナライザ	G3445 #542
天然ガスアナライザ	G3445 #543
天然ガスアナライザ	G3445 #544
3 チャネル天然ガスアナライザ、幅広い HC 分析に対応	G3445 #547
天然ガスアナライザ B、H_2S を含む分析用: 3 チャネルマイクロ GC	G3582A #123

ASTM D1946	アナライザ番号
3 チャネル高速リファイナリガスアナライザ	G3445 #521
3 チャネル高速リファイナリガスアナライザ — H_2S および COS	G3445 #522
ニッケルカラム付きリファイナリガスアナライザ	G3445 #524
リファイナリガスアナライザ	G3445 #526
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、H_2S および O_2 を含む分析用	G3445 #529
リファイナリガスアナライザ、水素キャリアガスによる H_2S および O_2 の分析に対応	G3445 #530
高容量リファイナリガスアナライザ	G3445 #531

ASTM D2163	アナライザ番号
LPG 組成アナライザ	7890-0138
市販プロパンおよびブタン LPG アナライザ	7890-0188
LPG 中の炭化水素分析用アナライザ	7890-0397
リファイナリガスアナライザ: 4 チャネルマイクロ GC	アジレントへのお問い合わせ

ASTM D2287	アナライザ番号
疑似蒸留 (SIMDIS) アナライザ	G3445 #653

ASTM D3588-98	アナライザ番号
天然ガスアナライザ A: 2 チャネルマイクロ GC	G3582A #120
拡張天然ガスアナライザ A : 3 チャネルマイクロ GC	G3582A #121
天然ガスアナライザ B、H_2S を含む分析用: 2 チャネルマイクロ GC	G3582A #122
拡張天然ガスアナライザ B、H_2S を含む分析用: 3 チャネルマイクロ GC	G3582A #123

ASTM D3606	アナライザ番号
ガソリン中のベンゼン分析用アナライザ	G3445 #615
3-in-1 改質燃料アナライザ	G3445 #621

ASTM D3612-C	アナライザ番号
トランスオイルガスアナライザ	G3445 #571

ASTM D4815	アナライザ番号
シング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	G3445 #611
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	G3445 #612
3-in-1 改質燃料アナライザ	G3445 #621

ASTM D5504	アナライザ番号
SCD による硫黄分析用アナライザ	G3445 #661

ASTM D5580	アナライザ番号
シング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	G3445 #611
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	G3445 #612
燃料中の芳香族化合物分析用アナライザ	G3445 #616
3-in-1 改質燃料アナライザ	G3445 #621

ASTM D5623	アナライザ番号
SCD による硫黄分析用アナライザ	G3445 #662

ASTM D6228	アナライザ番号
揮発性硫黄アナライザ	7890-0167

ASTM D6352	アナライザ番号
疑似蒸留 (SIMDIS) アナライザ	G3445 #655

ASTM メソッド用の構成

ASTM D6584	アナライザ番号
バイオディーゼル中のグリセリン分析用アナライザ	G3445 #631
ASTM D7423	**アナライザ番号**
疑似蒸留 (SIMDIS) アナライザ	G3445 #654
ASTM D7213	**アナライザ番号**
キャピラリ・フロー・テクノロジー (CFT) による軽質炭化水素中の低濃度含酸素化合物分析用アナライザ	G3445 #618
ASTM D7754	**アナライザ番号**
ガソリン中の微量含酸素化合物分析用アナライザ	7890-0340

DIN メソッド用の構成

DIN 51666	アナライザ番号
リファイナリガスアナライザ: 4 チャネルマイクロ GC	アジレントへのお問い合わせ

EN メソッド用の構成

EN 12177	アナライザ番号
ガソリン中の含酸素化合物および芳香族化合物分析用アナライザ	G3445 #617
EN 13132	**アナライザ番号**
ガソリン中の含酸素化合物および芳香族化合物分析用アナライザ	G3445 #617
EN 14103:2011	**アナライザ番号**
バイオディーゼル中の FAME 含有量分析用アナライザ	G3445 #633
EN 14105:2011	**アナライザ番号**
バイオディーゼルアナライザ	G3445 #634
EN 14110:2003	**アナライザ番号**
バイオディーゼル中のメタノール分析用アナライザ	7890-0295
EN 27941	**アナライザ番号**
市販プロパンおよびブタンアナライザ	7890-0188

GPA メソッド用の構成

GPA 2172	アナライザ番号
天然ガスアナライザ A: 2 チャネルマイクロ GC	G3582A #120
天然ガスアナライザ A: 3 チャネルマイクロ GC	G3582A #121
天然ガスアナライザ B: 2 チャネルマイクロ GC	G3582A #122
天然ガスアナライザ B: 3 チャネルマイクロ GC	G3582A #123
GPA 2177	**アナライザ番号**
液化天然ガスアナライザ	7890-0110
天然ガスアナライザ A: 2 チャネルマイクロ GC	G3582A #120
天然ガスアナライザ A: 3 チャネルマイクロ GC	G3582A #121
天然ガスアナライザ B: 2 チャネルマイクロ GC	G3582A #122
天然ガスアナライザ B: 3 チャネルマイクロ GC	G3582A #123
GPA 2261	**アナライザ番号**
天然ガスアナライザ	G3445 #542
天然ガスアナライザ	G3445 #543
天然ガスアナライザ	G3445 #544
天然ガスアナライザ	G3445 #545
天然ガスアナライザ B: 3 チャネルマイクロ GC	G3582A #123
GPA 2286	**アナライザ番号**
拡張天然ガスアナライザ	G3445 #541
拡張天然ガスアナライザ	G3445 #548

IP メソッド用の構成

IP 405	アナライザ番号
市販プロパンおよびブタンアナライザ	7890-0188
IP 585	**アナライザ番号**
ジェット燃料用アナライザ	M7482A

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ISO メソッド用の構成

ISO 6974-6	アナライザ番号
天然ガスアナライザ A: 2 チャネルマイクロ GC	G3582A #120
天然ガスアナライザ A: 3 チャネルマイクロ GC	G3582A #121
天然ガスアナライザ B: 2 チャネルマイクロ GC	G3582A #122
天然ガスアナライザ B: 3 チャネルマイクロ GC	G3582A #123

ISO 7941	アナライザ番号
市販プロパンおよびブタンアナライザ	7890-0188

UOP メソッド用の構成

UOP 539	アナライザ番号
3 チャネル高速リファイナリガスアナライザ	G3445 #521
3 チャネル高速リファイナリガスアナライザ — H_2S および COS	G3445 #522
ニッケルカラム付きリファイナリガスアナライザ	G3445 #524
リファイナリガスアナライザ	G3445 #526
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、H_2S および O_2 を含む分析用	G3445 #529
リファイナリガスアナライザ、水素キャリアガスによる H_2S および O_2 の分析に対応	G3445 #530
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 H_2S および O_2 の分析に対応	G3445 #531
マイクロパックドカラム付き高速リファイナリガスアナライザ	G3445 #532
リファイナリガスアナライザ、水素キャリアガスによる H_2S および O_2 の分析に対応	G3445 #533

UOP 603	アナライザ番号
水素および軽質炭化水素中の微量 CO および CO_2 分析用アナライザ	7890-0366

UOP 59	アナライザ番号
リファイナリガスアナライザ: 4 チャネルマイクロ GC	アジレントへのお問い合わせ

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。

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}.

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

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_2S	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_2S	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.

Start reducing the time required to get your analysts running real world samples. Visit **www.agilent.com/chem/energy**

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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:

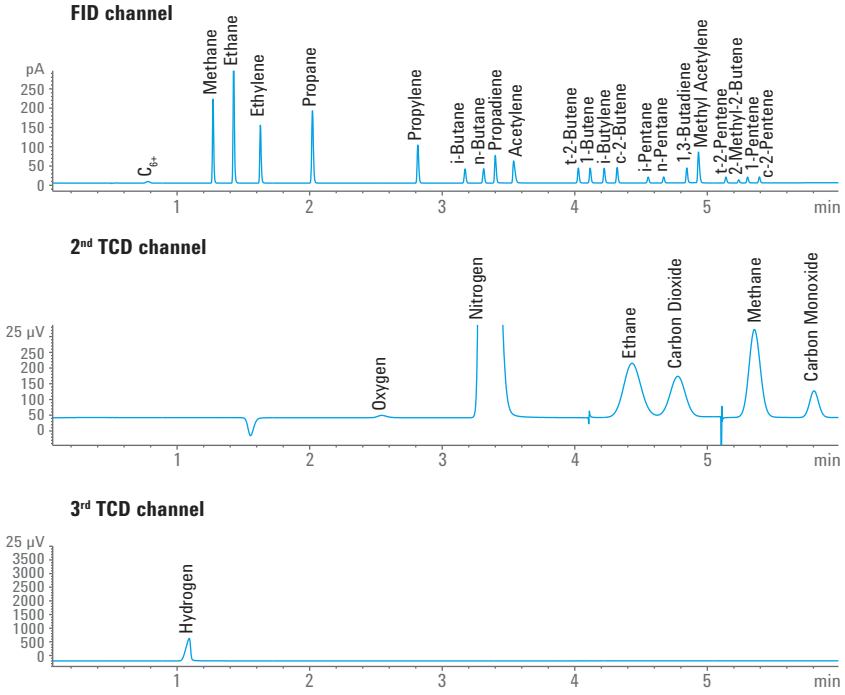
- C_1-C_5, C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO

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 H_2 by third TCD using N_2 or Argon carrier gas
- For H_2S and COS analysis, order G3445A #522

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3-Channel Fast Refinery Gas Analyzer—H_2S 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:

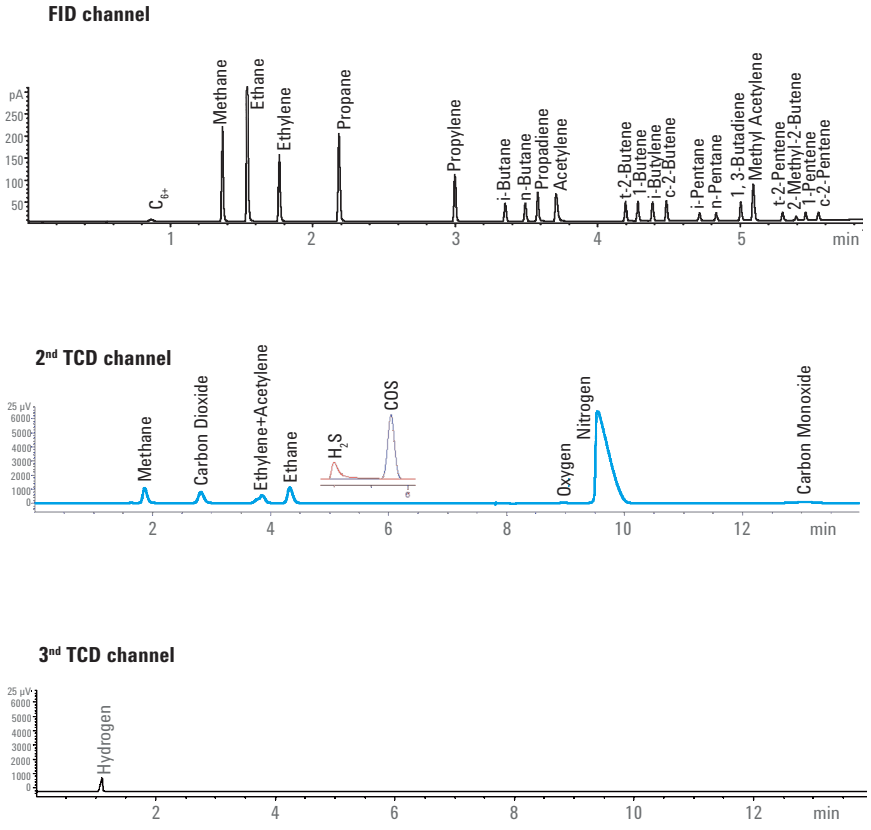
- C_1-C_5 and C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO, H_2S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S and COS
- 500 ppm for H_2S
- 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 H_2 by third TCD using N_2 or Argon carrier gas
- Nickel tubing and Hastelloy valve for high H_2S and COS analysis
- O_2 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:

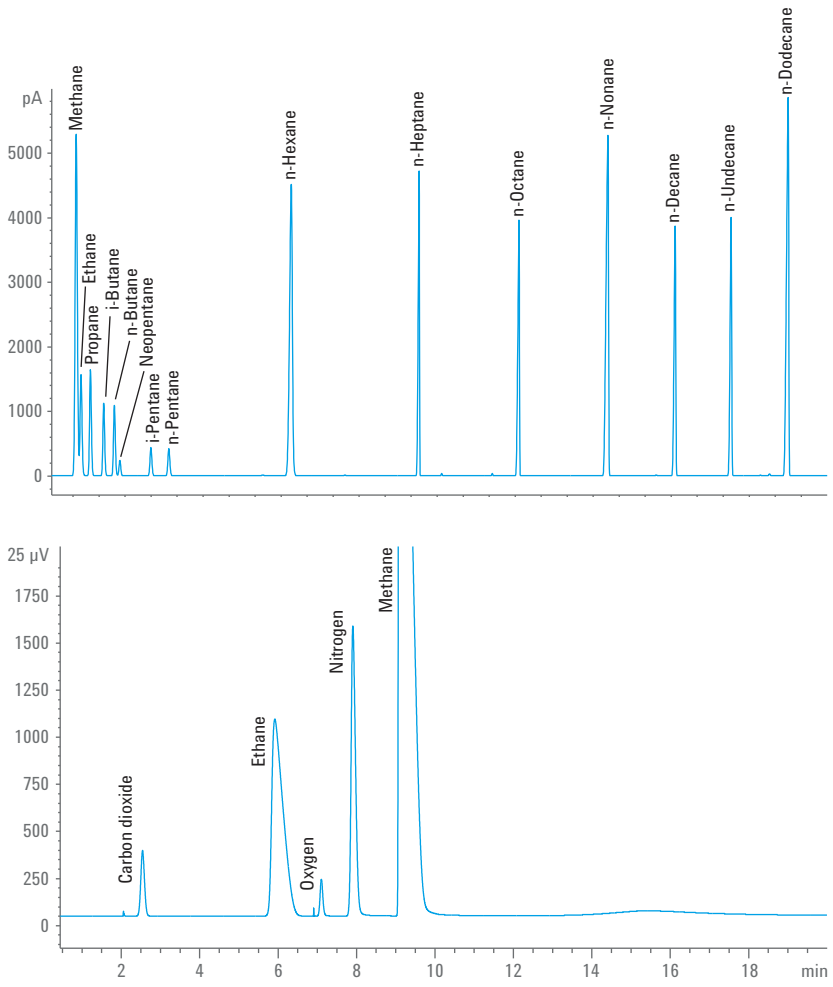
- Refinery gas such as atmospheric overhead, FCC overhead, fuel gas, recycle gas

Compounds analyzed:

- C_1-C_{12}, H_2, He, O_2, N_2, CO_2, and CO

Typical quantification range:

- 0.01 mol% for all components



► KEY BENEFITS AND FEATURES

- PONA column provides extended RGA separation to C_{14}
- Achieve analysis of H_2 and He by switching carrier gases
- Argon or N_2 carrier used for H_2 analysis, use He carrier for remaining compounds
- For hydrocarbons up to C_{12}, 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:

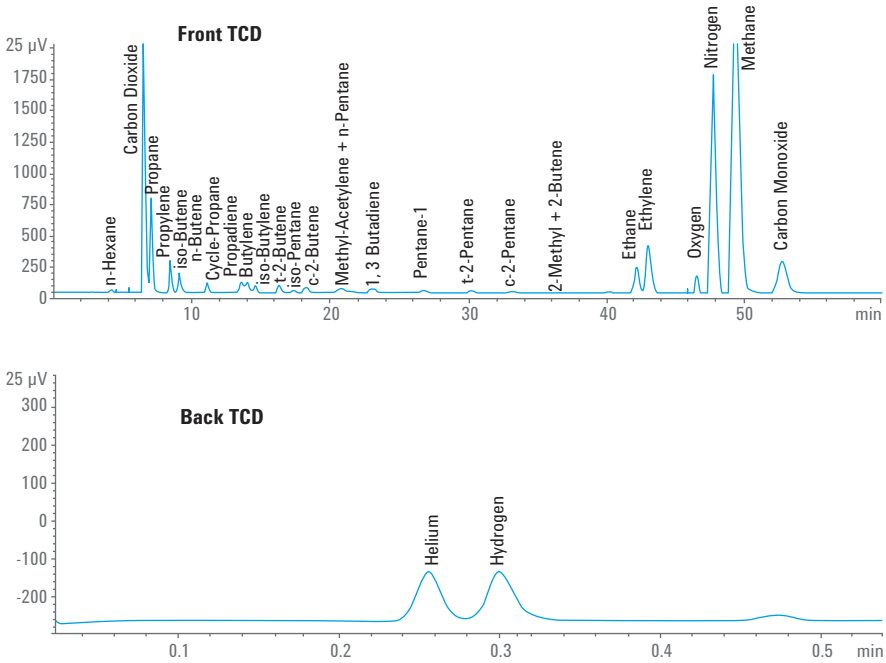
- C_1-C_5 and C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO, H_2S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S
- 500 ppm for H_2S

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 H_2
- 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:

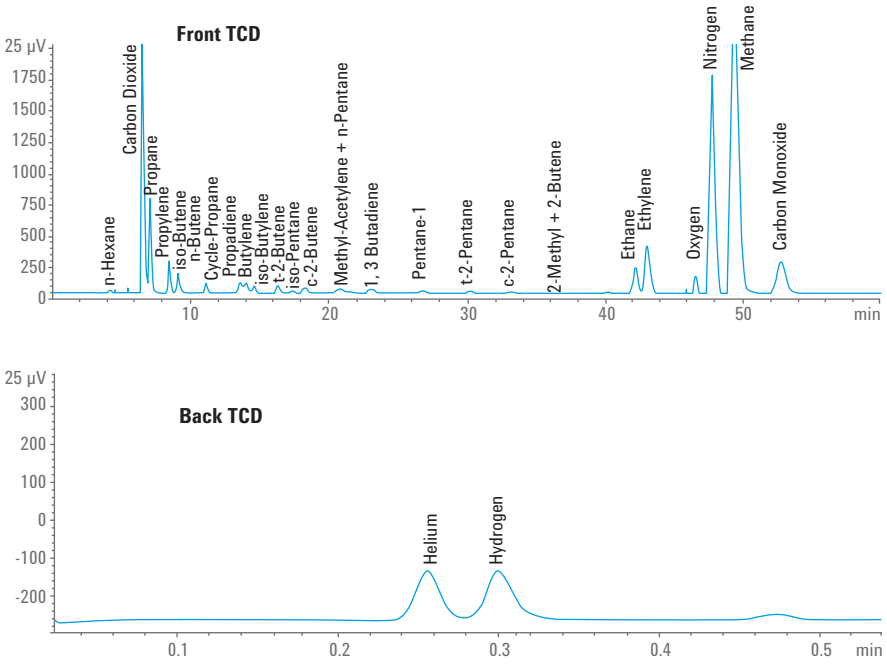
- C_1-C_5, C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO

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 H_2
- 55 minute analysis time
- To analyze samples containing high levels of H_2S, please order G3445 #526

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3-Channel Fast Refinery Gas Analyzer including H_2S and O_2 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:

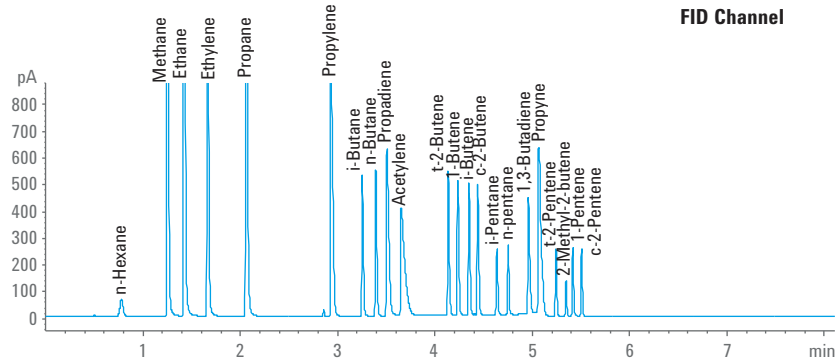
- C_1-C_5, C_{6+}, H_2, He, O_2, N_2, CO_2, CO, H_2S

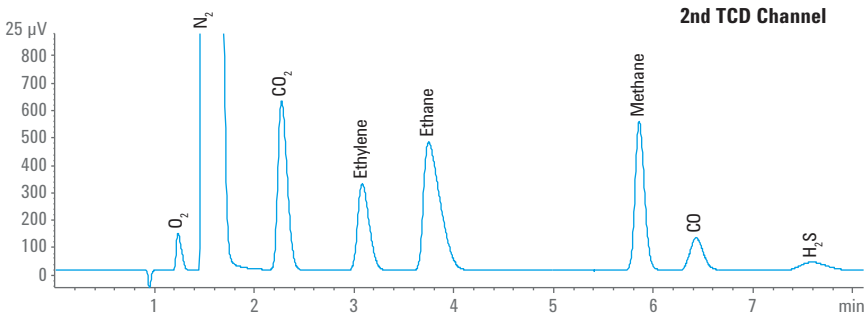
Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S
- 500 ppm for H_2S

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 H_2S and O_2 at isothermal temperature
- Sample shut-off valve (optional)

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3-Channel Fast Refinery Gas Analyzer with H_2S 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:

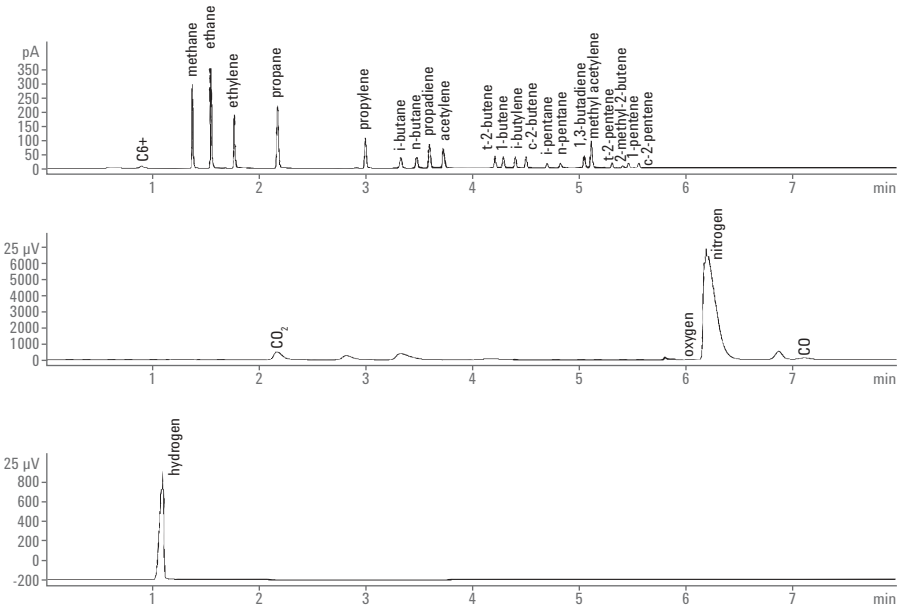
- C_1-C_5, C_{6+} as backflush, H_2, O_2, N_2, CO_2, CO, H_2S

Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S
- 500 ppm for H_2S

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

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3-Channel High Capacity Refinery Gas Analyzer with Large Valve Oven and Helium Carrier for H_2S and O_2 (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:

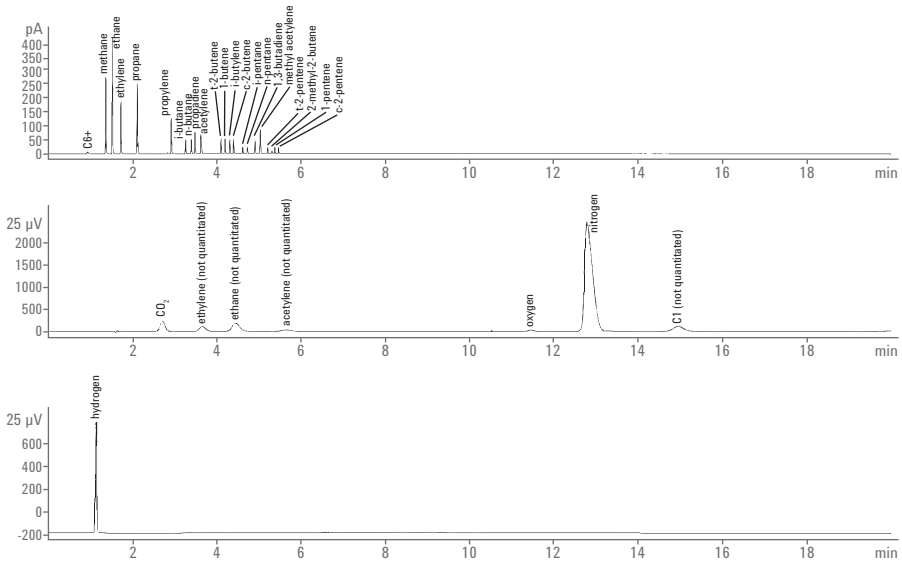
- C_1-C_5, C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO, H_2S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S
- 500 ppm for H_2S
- 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 H_2 by third TCD using N_2 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 H_2S and O_2 (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:

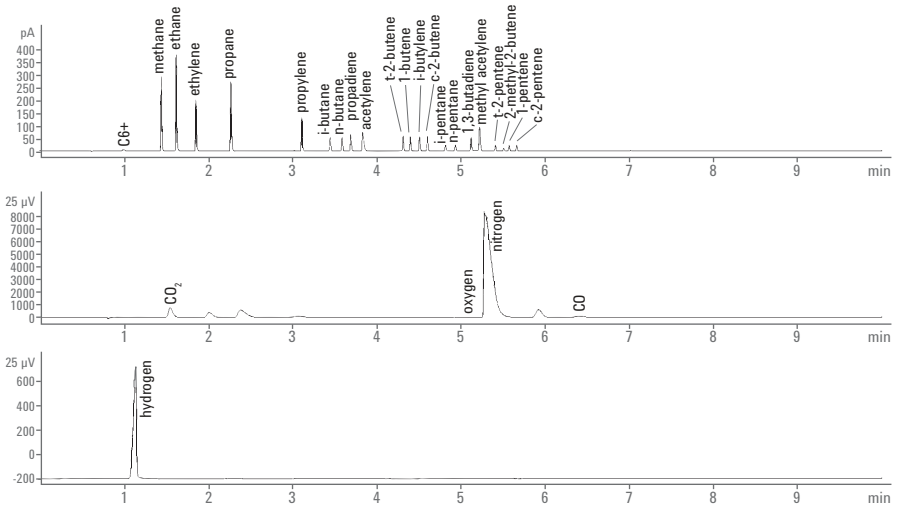
- C_1-C_5, C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO, H_2S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S
- 500 ppm for H_2S
- 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 H_2 by third TCD using N_2 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 H_2S and O_2 (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:

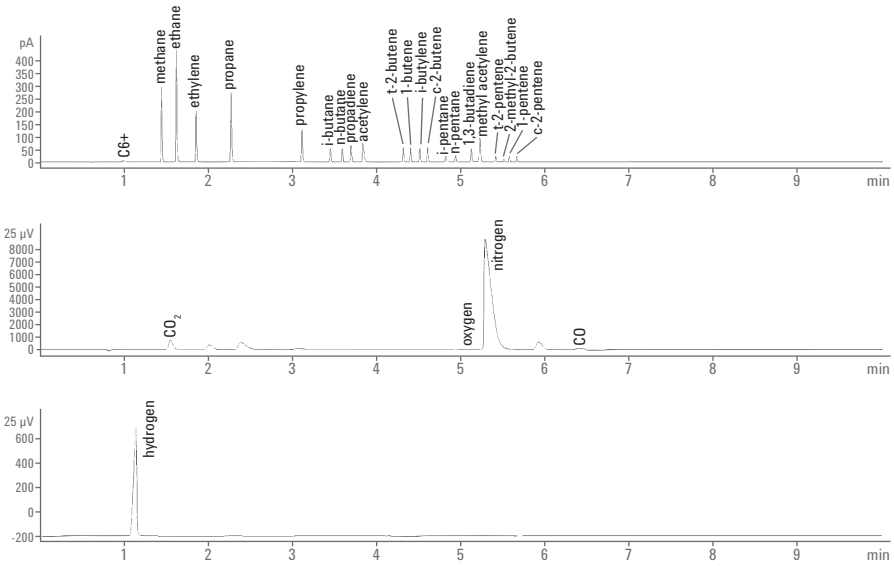
- C_1-C_5, C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO, H_2S, COS

Typical quantification range:

- 0.01 mol% for all above mentioned components except H_2S
- 500 ppm for H_2S
- 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 H_2 by third TCD using N_2 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:

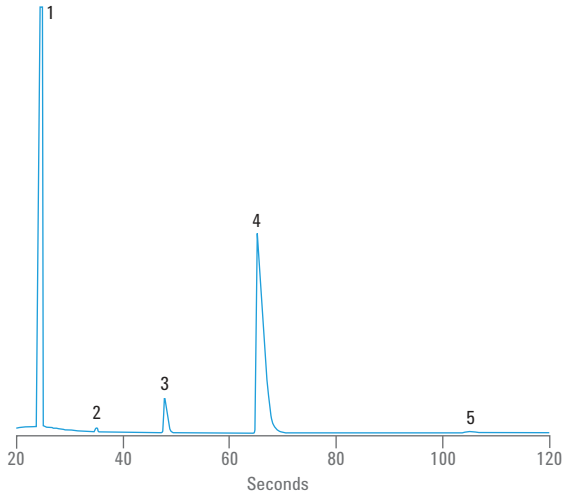
- C_1-C_{5+}
- H_2, He, O_2, N_2, CO_2, CO

Typical quantification range:

- 1-10 ppm

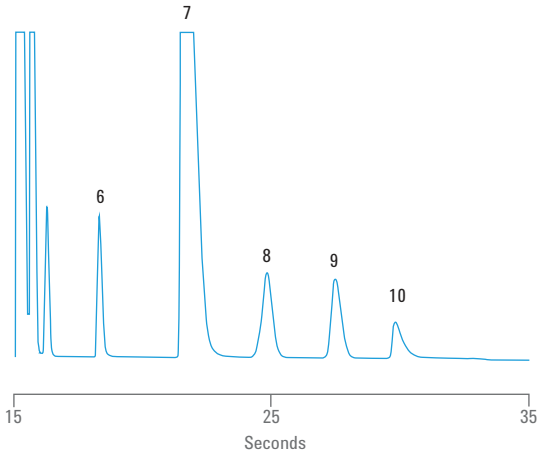
Configured per method:

- UOP 59, DIN-51666, ASTM D2163



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

10 meter molsieve 5Å column with BF



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

10 meter PLOT U column with BF

(Continued)

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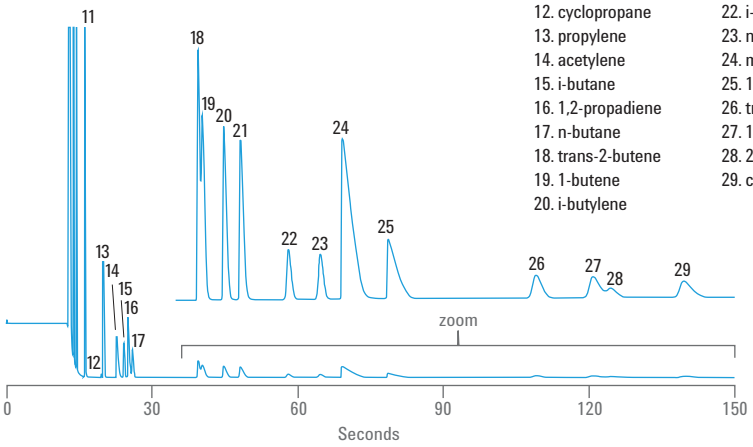
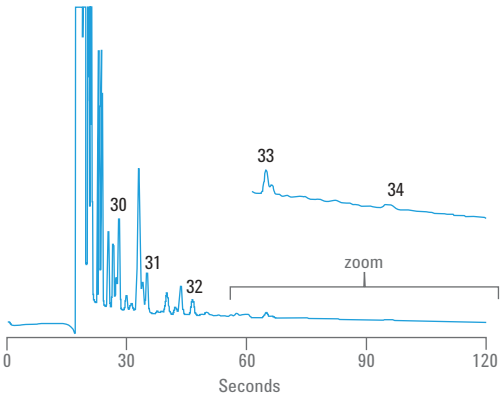


Peak Identification

11. propane
12. cyclopropane
13. propylene
14. acetylene
15. i-butane
16. 1,2-propadiene
17. n-butane
18. trans-2-butene
19. 1-butene
20. i-butylene
21. cis-2-butene
22. i-pentane
23. n-pentane
24. methylacetylene
25. 1,3-butadiene
26. trans-2-pentene
27. 1-pentene
28. 2-methyl-2-butene
29. cis-2-pentene

10 meter Al_2O_3/KCl column (special with short pre-column)



Peak Identification

30. n-hexane
31. n-heptane
32. n-octane
33. n-nonane
34. n-decane

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 C_1-C_{10}, 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_2S	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_2S	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:

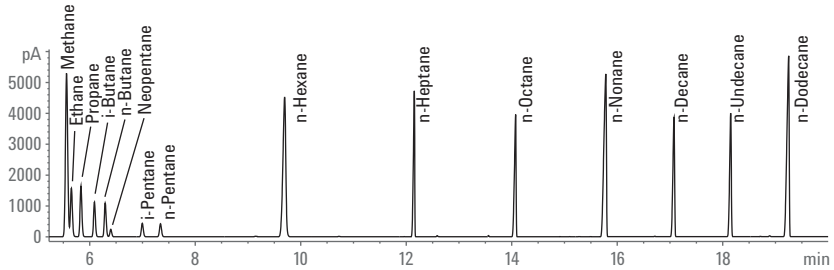
- C_1-C_{12}, O_2, N_2, CO_2, CO

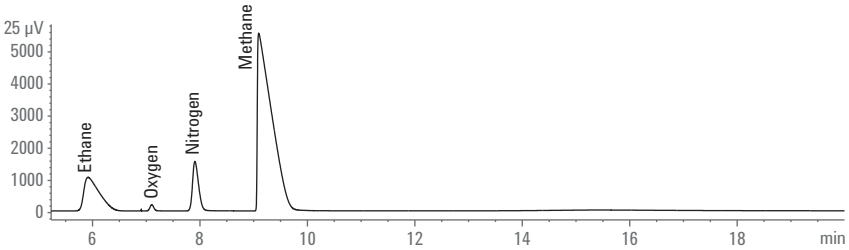
Typical quantification range:

- 50 ppm for permanent gases and C_1-C_2 hydrocarbons on TCD
- 10 ppm for C_3-C_{12} on FID

Configured per method:

- Results per GPA 2286, but calculation without bridge components iC_5 and nC_5





► KEY BENEFITS AND FEATURES

- Dual channels with TCD and FID detectors
- TCD channel with packed column for C_1-C_2, O_2, N_2, CO_2 analysis
- C_3-C_{12} 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

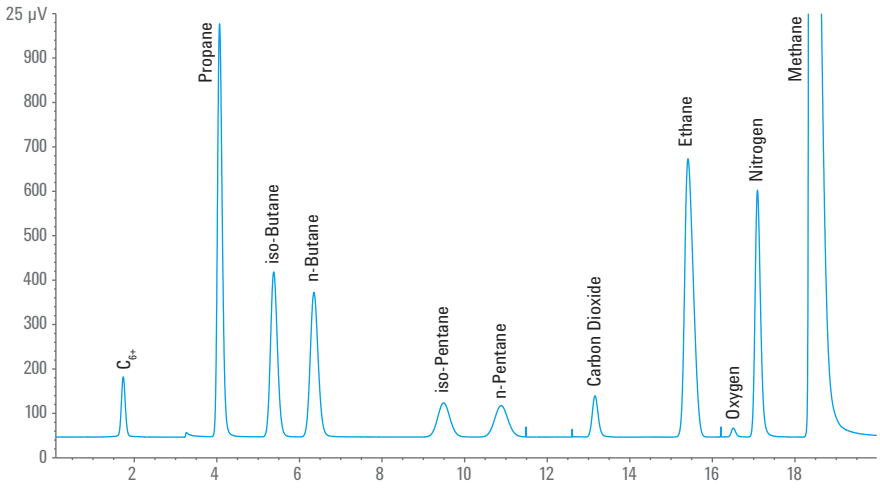
Configuration:
- 3-valve/4-column (packed), TCD

Sample type:
- Natural gas and similar gaseous mixtures

Compounds analyzed*:
- C_1-C_5, C_{6+} as backflush
- O_2, N_2, CO_2, CO

Typical quantification range:
- 0.01 mol% for all components

Configured per method:
- ASTM D1945, GPA 2261 (H_2 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

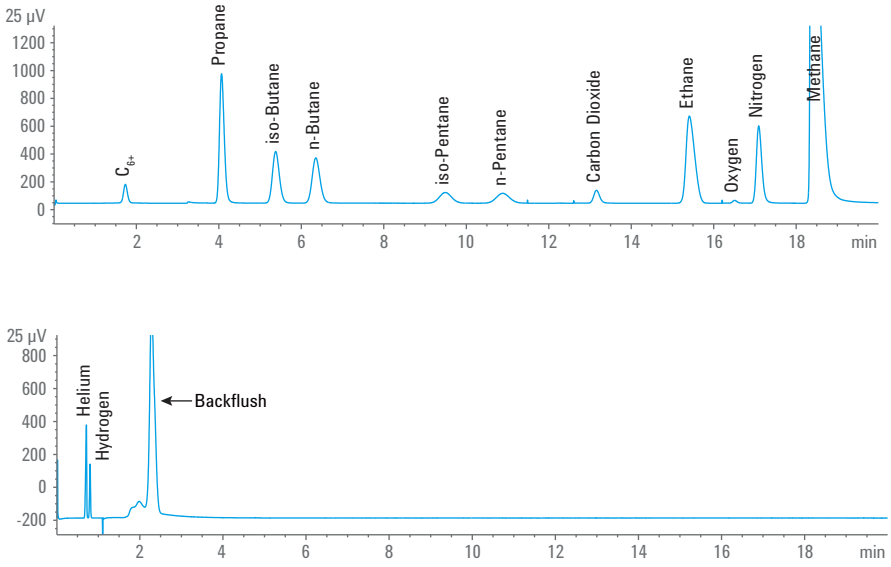
Configuration:
- 4-valve/6-column (packed), 2-TCD

Sample type:
- Natural gas and similar gaseous mixtures

Compounds analyzed:
- C_1-C_5, C_{6+} as backflush
- H_2, He, O_2, N_2, CO_2, 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 H_2 and He analysis

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Natural Gas Analyzer (G3445 #544)

Analyzer Description

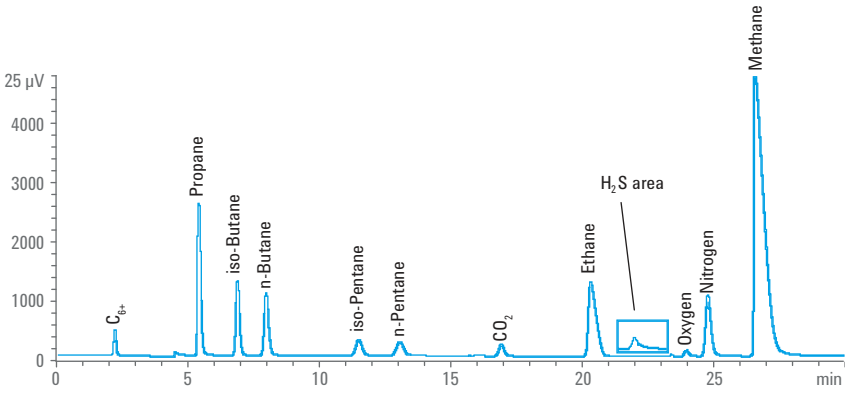
Configuration:
- 3-valve/4-column (packed), TCD

Sample type:
- Natural gas and similar gaseous mixtures

Compounds analyzed:
- C_1-C_5, C_{6+} as backflush
- O_2, N_2, H_2S, CO_2, CO

Typical quantification range:
- 0.01 mol% for all components except H_2S
- 500 ppm for H_2S

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 H_2S analysis
- Dedicated channel for H_2 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:

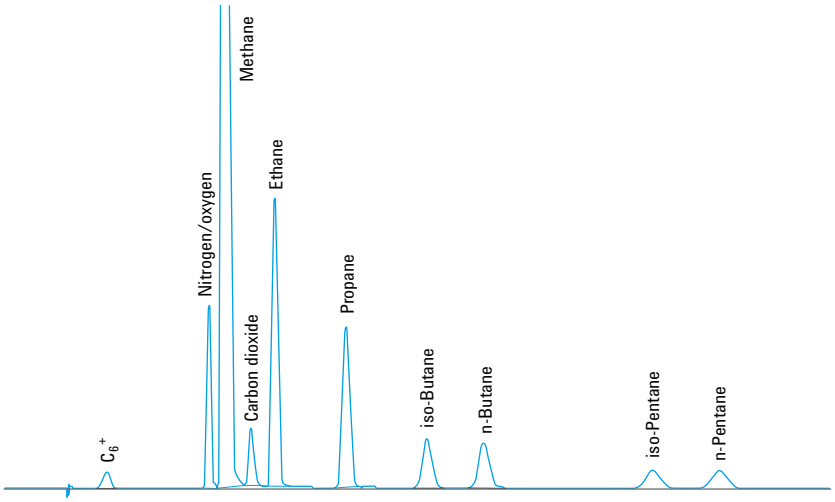
- C_1-C_5, C_{6+} as backflush
- Air composite
- CO_2

Typical quantification range:

- 0.01 mol% for all components

Configured per method:

- GPA 2261 (H_2 and He is not included, without separation of O_2 and N_2)



► 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

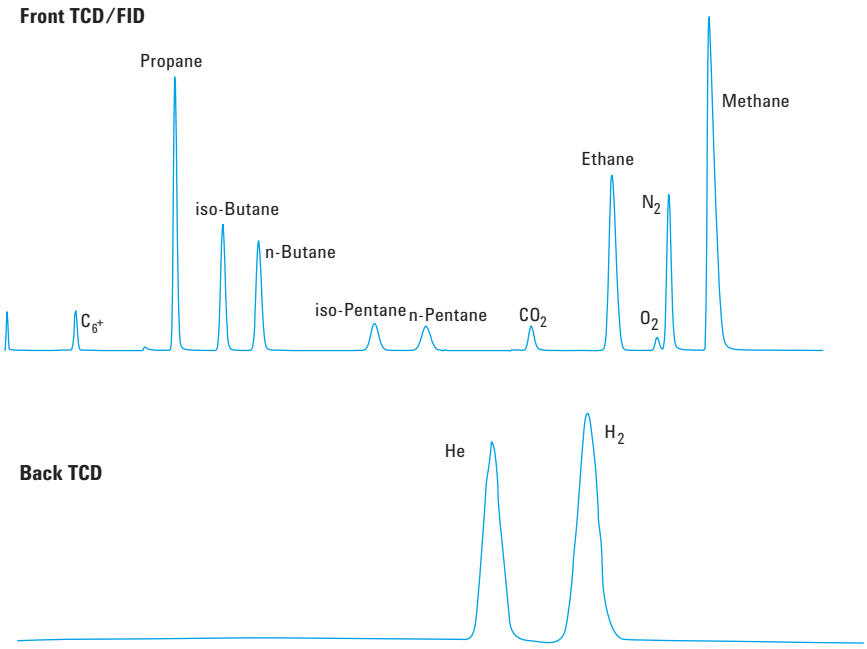
Configuration:
- 4-valve/6-column (packed), 2-TCD/FID

Sample type:
- Natural gas and similar gaseous mixtures

Compounds analyzed:
- C_1-C_5, C_{6+}
- H_2, He, O_2, N_2, CO_2, 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 H_2 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:

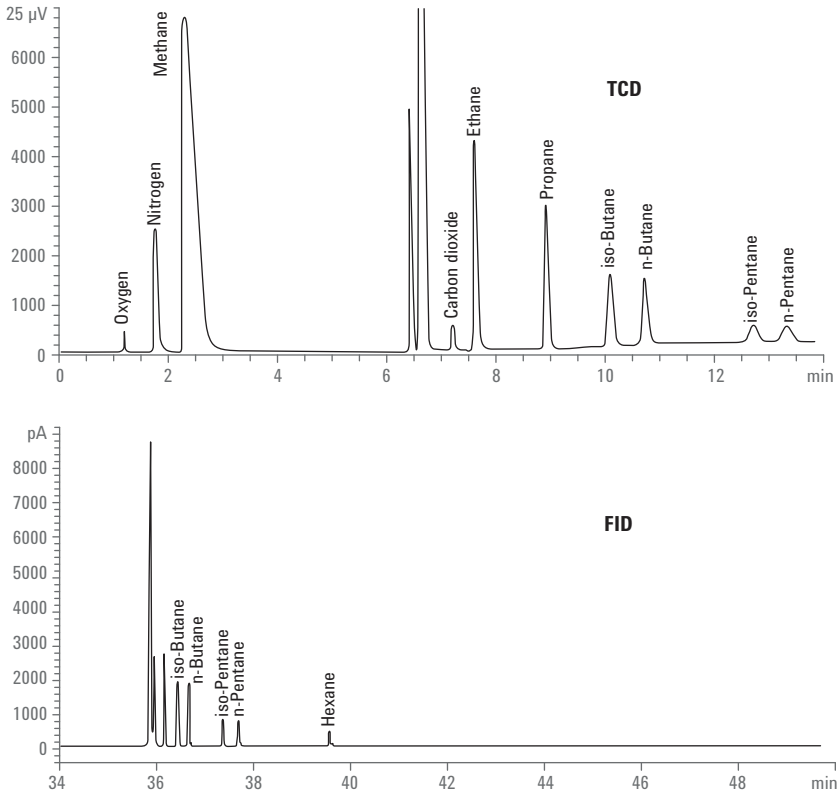
- C_1-C_5
- N_2, O_2, CO_2

Typical quantification range:

- 50 ppm for permanent gases and C_1-C_5 (TCD)
- 10 ppm for C_5-C_6 (FID)

Configured per method:

- GPA 2286



► KEY BENEFITS AND FEATURES

- 2-channel with TCD and FID detectors
- Fixed gases and hydrocarbons up to C_5 on packed columns and thermal conductivity detector
- Hydrocarbons from C_5 to C_{14} 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 C_1-C_9
- Carbon dioxide and Air

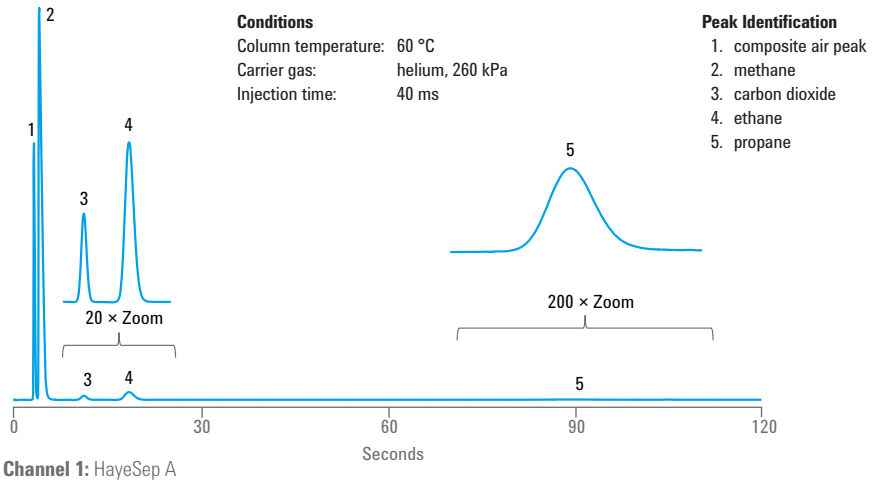
Typical quantification range:

- 1-10 ppm

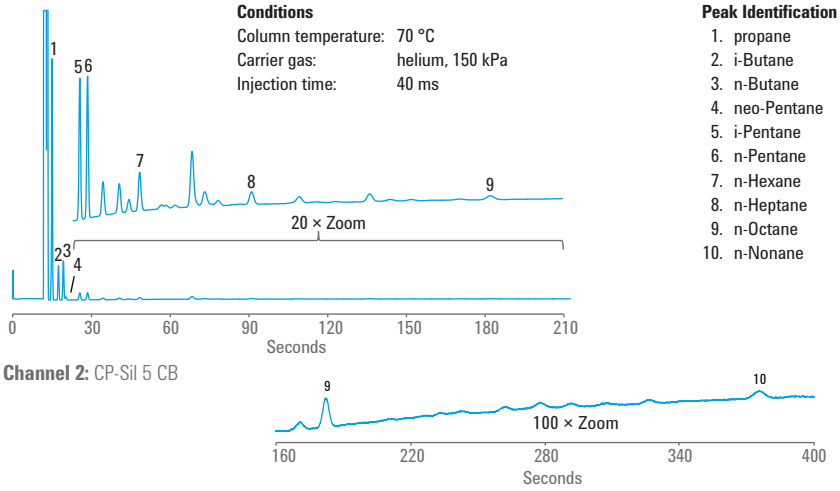
Configured per method:

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

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



Channel 1: HayeSep A



Channel 2: CP-Sil 5 CB

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of natural gas composition in 210 seconds
  - – Characterizes hydrocarbons C_1-C_9, 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:

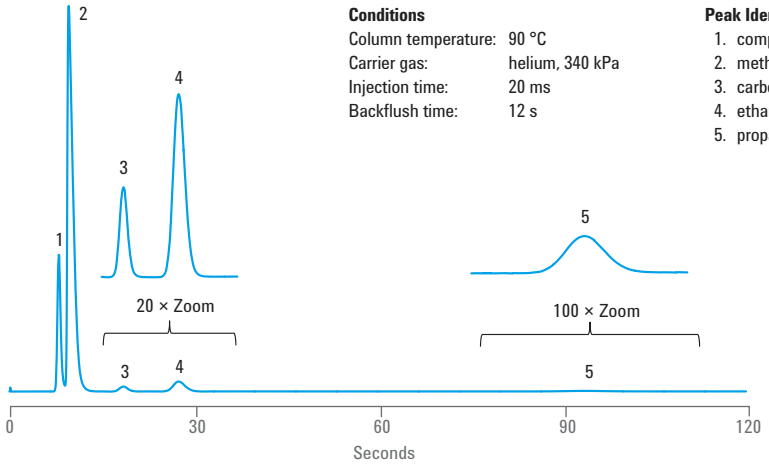
- Hydrocarbons C_1-C_{12}
- Carbon dioxide and air

Typical quantification range:

- 1-10 ppm

Configured per method:

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



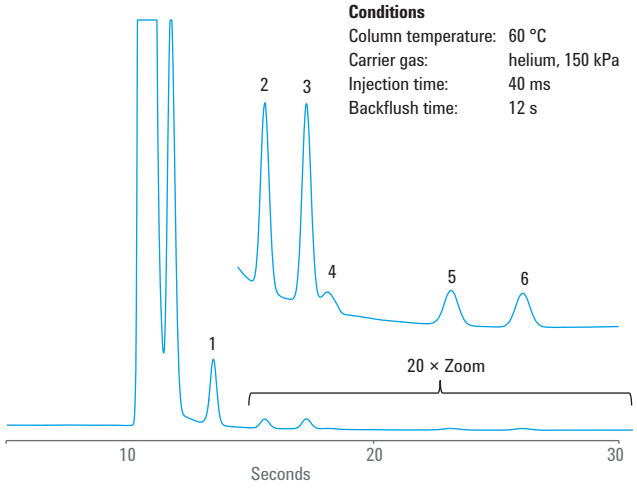
Conditions

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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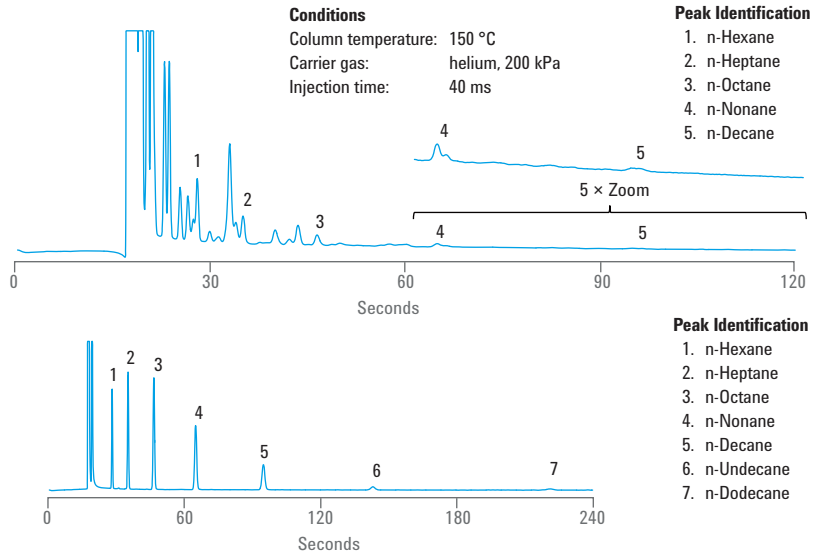

Channel 3: CP-Sil 5 CB

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 C_1-C_{12}, 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 H_2S: 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:

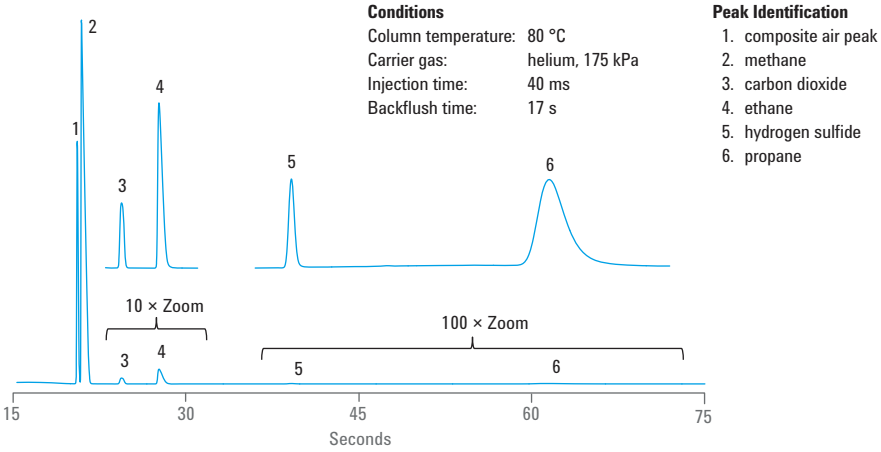
- Hydrocarbons C_1-C_9
- Carbon dioxide and Air
- H_2S

Typical quantification range:

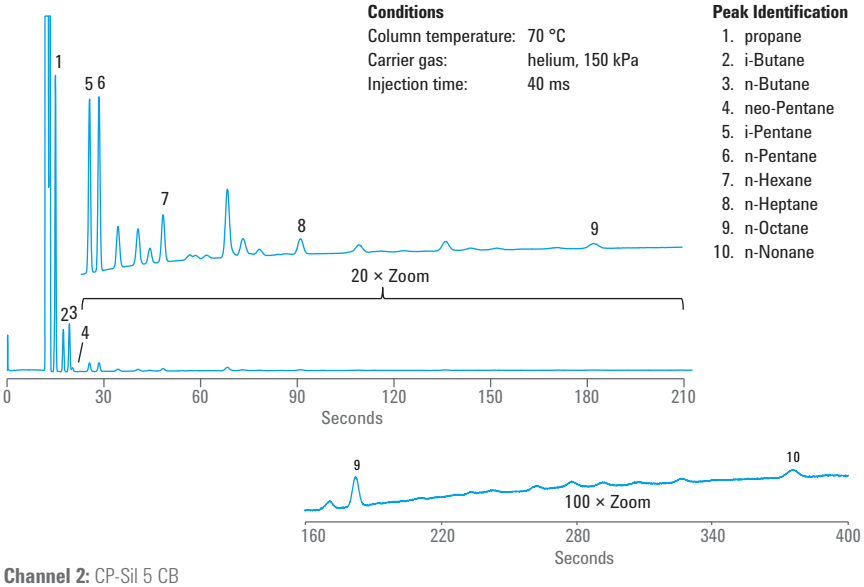
- 1-10 ppm

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 C_1-C_9, 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 H_2S: 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:

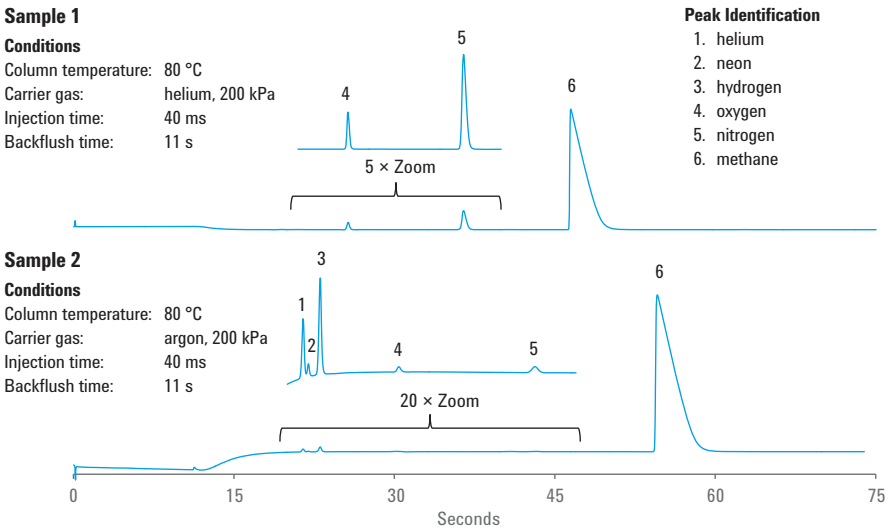
- Hydrocarbons C_1-C_9
- Carbon dioxide and Air
- H_2S
- N_2, O_2, He and H_2

Typical quantification range:

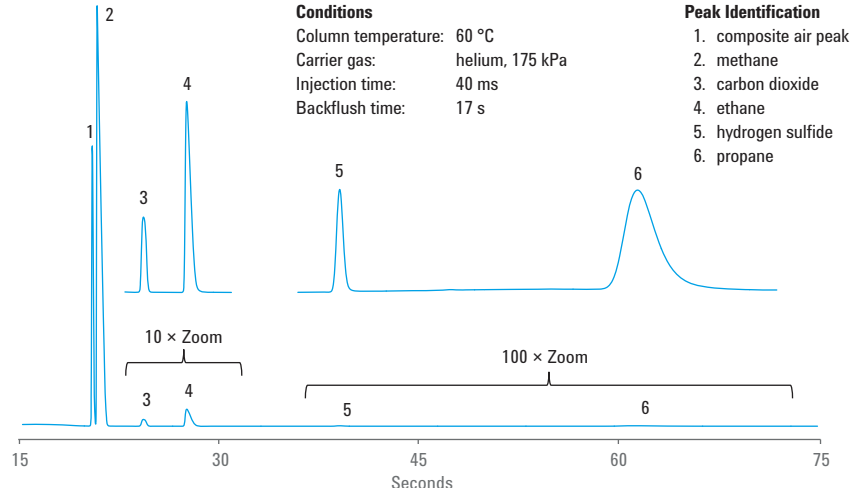
- 1-10 ppm

Configured per method:

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



Channel 1: CP-molsieve 5Å Backflush



Channel 2: PoraPLOT U Backflush

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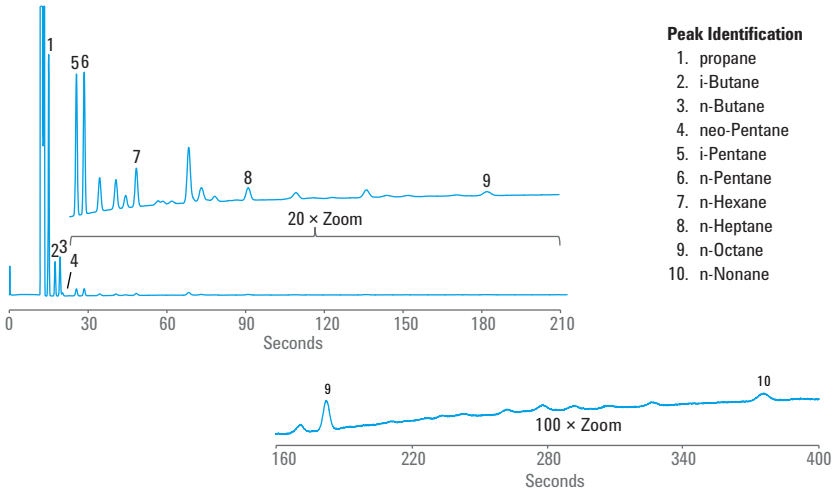

Peak Identification

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

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 C_1-C_9, 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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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:

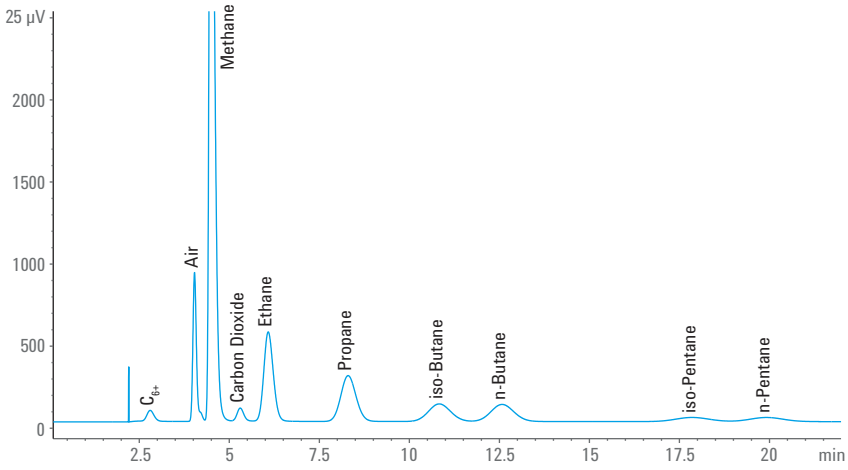
- C_1-C_5
- C_{6+} as backflush
- Air composite, CO_2

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:

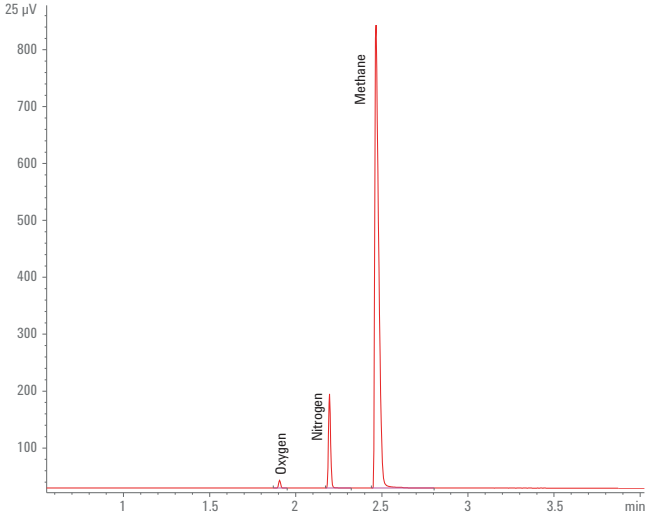
- Natural gas and similar process gas mixtures

Compounds analyzed:

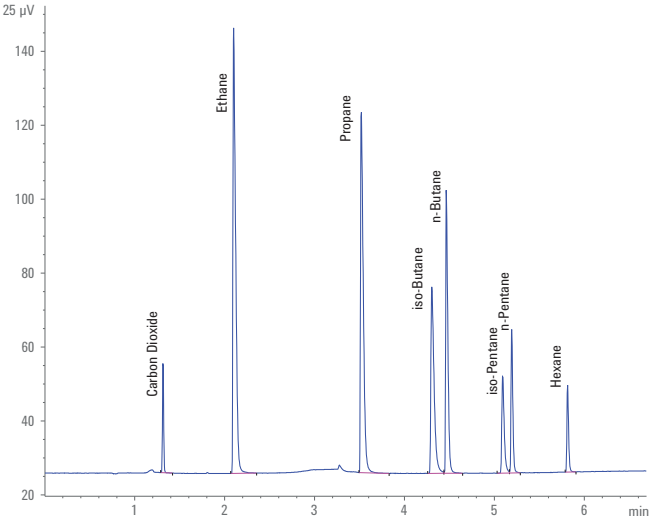
- C_1-C_6
- N_2, O_2, CO, CO_2, H_2S

Typical quantification range:

- 0.01 mol% for all components except H_2S
- 0.05 mol% for H_2S



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
- H_2S analysis
- O_2 and N_2 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:

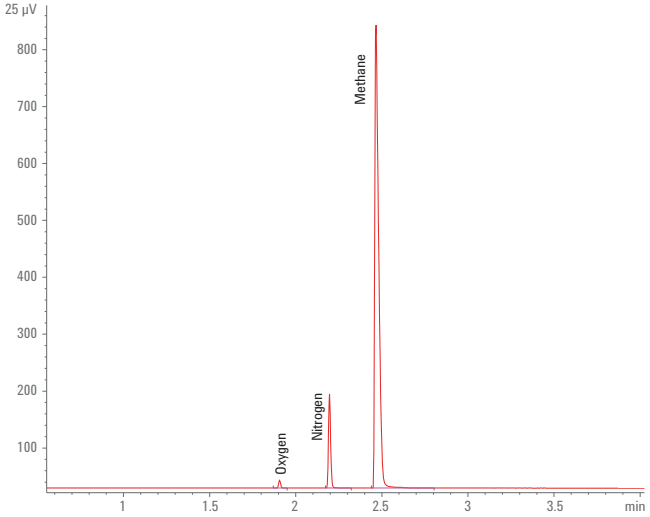
- Natural gas and similar process gas mixtures
- Liquefied Gas with optional LSV

Compounds analyzed:

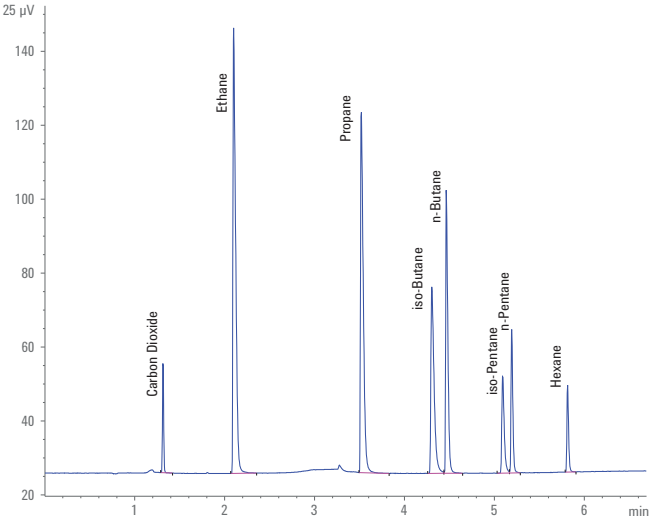
- C_1-C_{15}
- O_2, N_2, CO_2, CO and H_2S

Typical quantification range:

- 0.01 mol% for all components except H_2S
- 0.05 mol% except H_2S

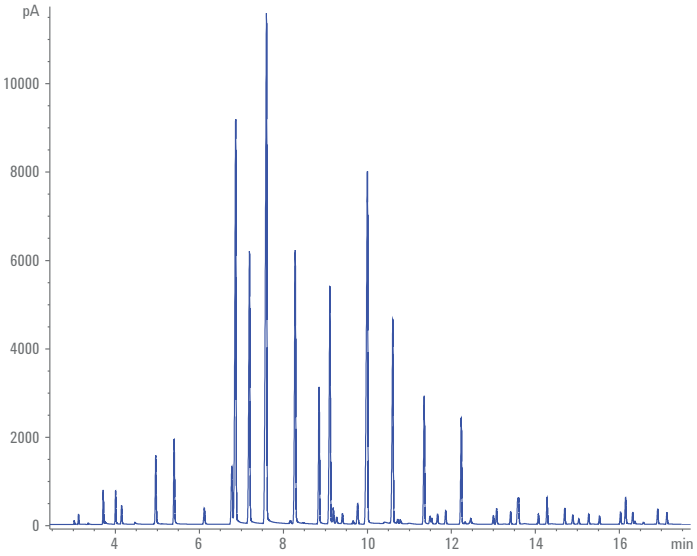


Permanent gases in natural gas



Hydrocarbons (to C6) in natural gas

(Continued)



Extended Hydrocarbons (to C_{15}) 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 C_{15}
- H_2S analysis
- O_2 and N_2 separation
- Handles gas and liquefied gases (with optional LSV)
- For permanent gases and hydrocarbons to C_6 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, 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

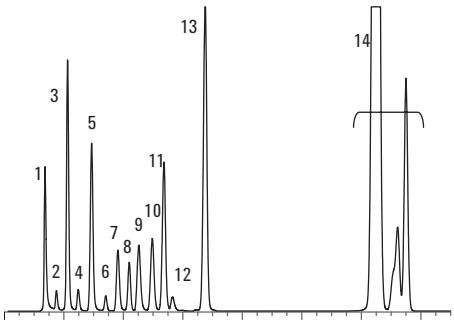
Configured per method:

- ASTM D4815, ASTM D5580

ASTM D4815

Peak Identification

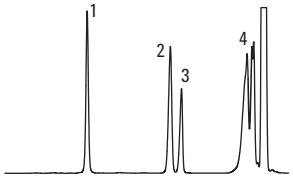
1. methanol
2. ethanol
3. isopropanol
4. *tert*-butanol
5. *n*-propanol
6. MTBE
7. *sec*-butanol
8. DIPE
9. isobutanol
10. *tert*-pentanol
11. DME
12. *n*-butanol
13. TAME
14. heavier hydrocarbon



ASTM D5580 - 1st run

Peak Identification

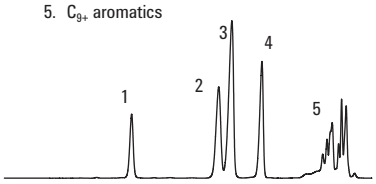
1. benzene
2. toluene
3. 2-hexanone
4. backflush peaks



ASTM D5580 - 2nd run

Peak Identification

1. 2-hexanone
2. ethylbenzene
3. *m/p*-xylene
4. *o*-xylene
5. C_{9+} 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, 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

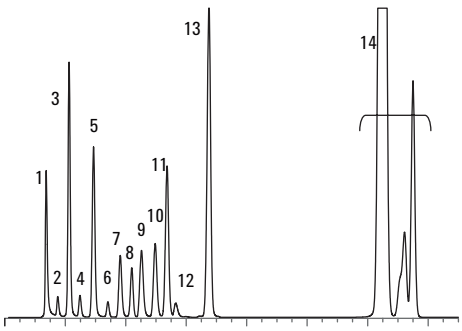
Configured per method:

- ASTM D4815, ASTM D5580

ASTM D4815

Peak Identification

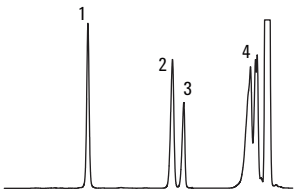
1. methanol
2. ethanol
3. isopropanol
4. *tert*-butanol
5. *n*-propanol
6. MTBE
7. *sec*-butanol
8. DIPE
9. isobutanol
10. *tert*-pentanol
11. DME
12. *n*-butanol
13. TAME
14. heavier hydrocarbon



ASTM D5580 - 1st run

Peak Identification

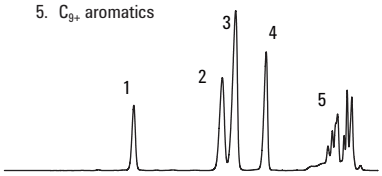
1. benzene
2. toluene
3. 2-hexanone
4. backflush peaks



ASTM D5580 - 2nd run

Peak Identification

1. 2-hexanone
2. ethylbenzene
3. *m*/*p*-xylene
4. *o*-xylene
5. C_{9+} 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

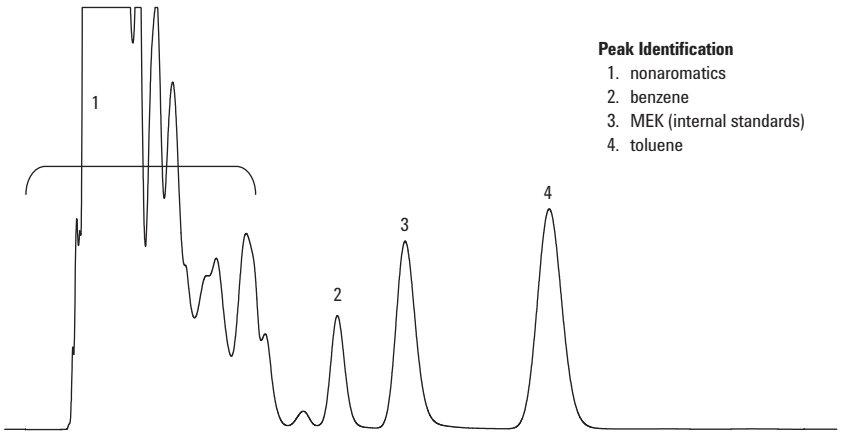
Configuration:
- 1-valve/2-column/TCD or FID

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



► 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, C_9 and heavier aromatics, total aromatics

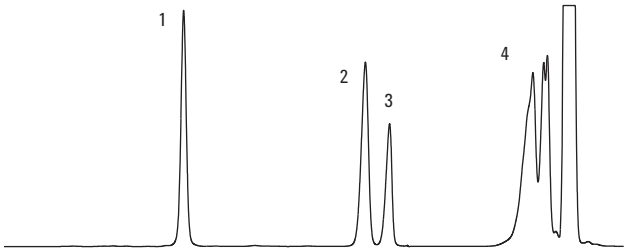
Typical quantification range:

- 0.1 to 5 Vol% for benzene, 1 to 15 Vol% for toluene
- 0.5 to 10 Vol% for individual 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 D5580

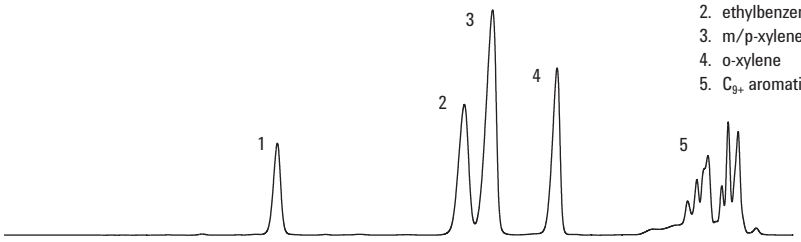
ASTM D5580 - 1st run



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. C_{9+} 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

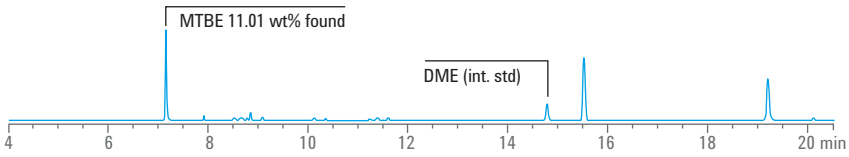
Typical quantification range:

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

Configured per method:

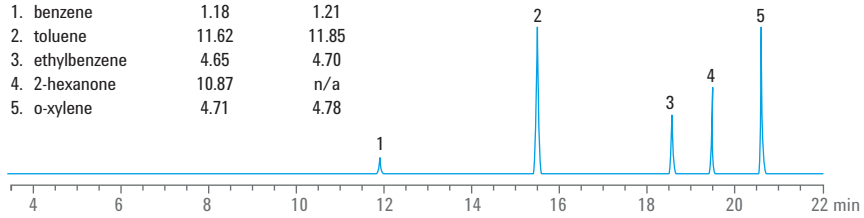
- EN 13132, EN 12177

DB-1 Column (FID B)



DB-1 Column (FID B)

Peak Identification	Ref (wt%)	Found (wt%)
1. benzene	1.18	1.21
2. toluene	11.62	11.85
3. ethylbenzene	4.65	4.70
4. 2-hexanone	10.87	n/a
5. o-xylene	4.71	4.78



► 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:

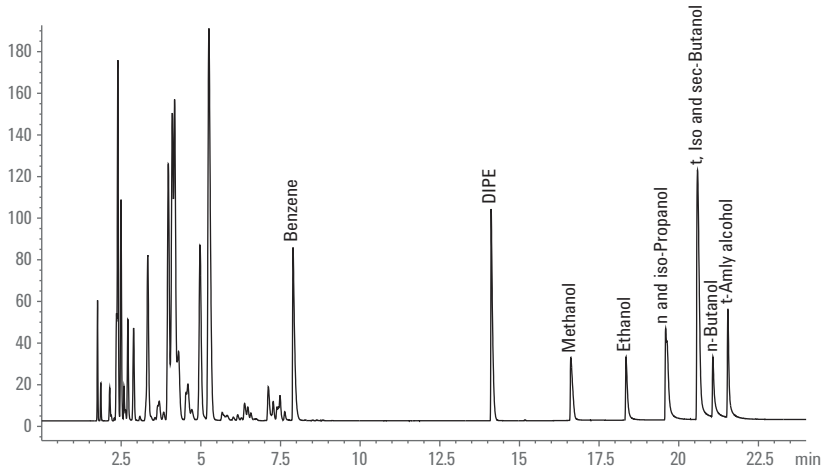
- MTBE, ETBE, DIPE, TAME, methanol, *n*-propanol and *i*-propanol, *n*-butanol, *i*-butanol, *tert*-butyl alcohol, *sec*-butyl alcohol, and *tert*-pentanol

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, C_9 and heavier aromatics, total aromatics

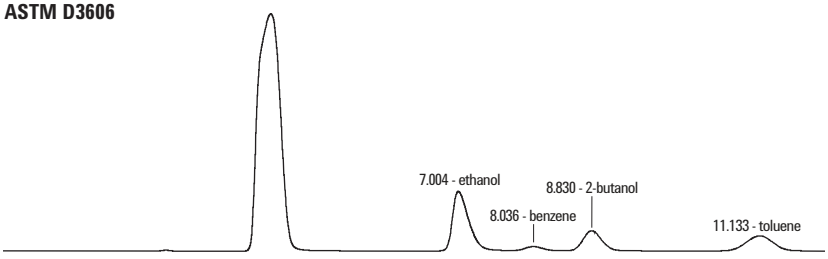
Typical quantification range:

- 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

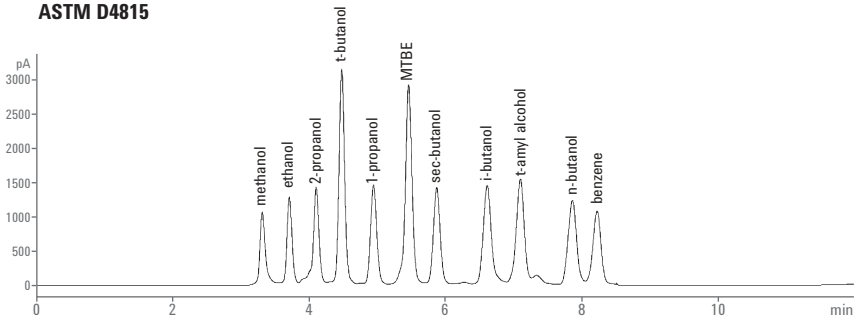
Configured per method:

- ASTM D3606, ASTM D4815, ASTM D5580

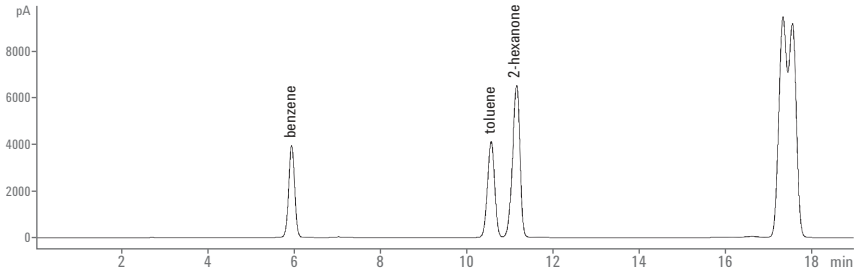
ASTM D3606



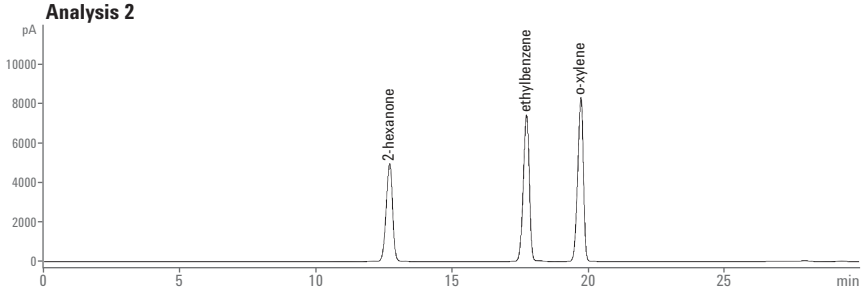
ASTM D4815



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:

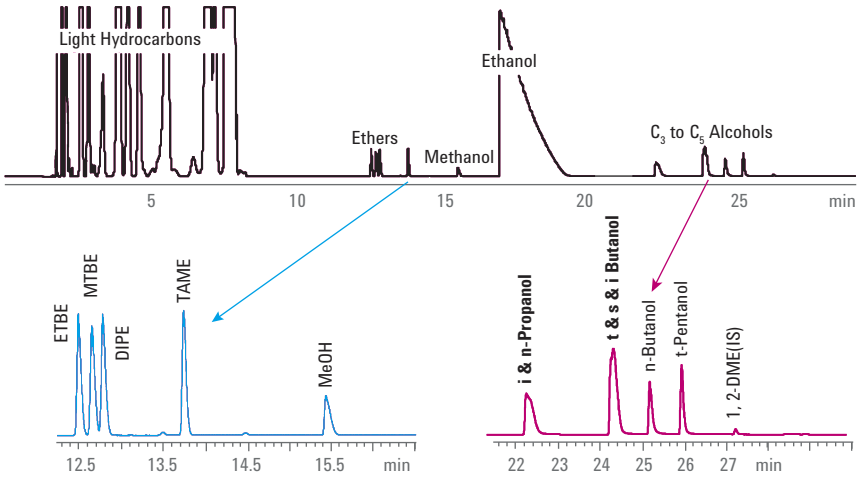
- MTBE, ETBE, DIPE, TAME, methanol, *n*-propanol, *i*-propanol, *n*-butanol, *i*-butanol, *tert*-butyl alcohol, *sec*-butyl alcohol, *tert*-pentanol

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 CO_2 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_2S 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_2S 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

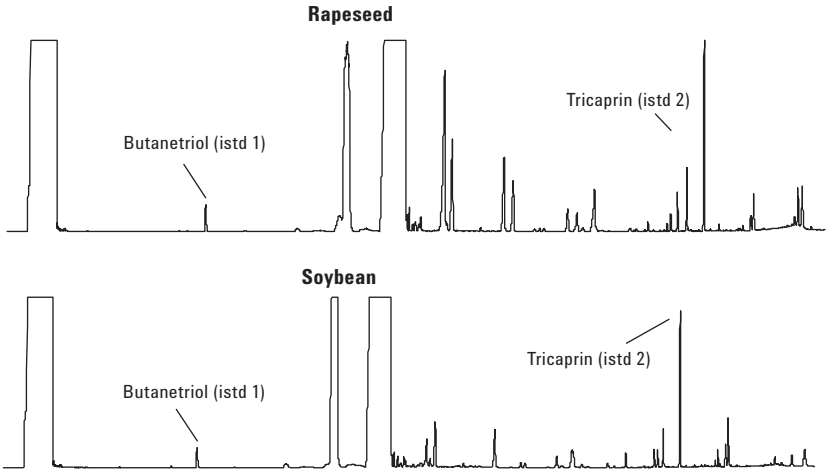
Configuration:
- On-column capillary inlet/FID

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 C_6-C_{24}

Compounds analyzed:

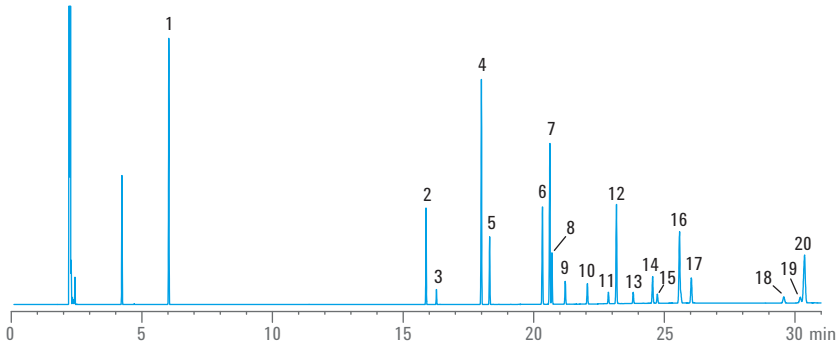
- Methyl esters between C_6-C_{24}

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	C22:0	25.582
7.	methyl oleate (9)	C18:1	20.617		methyl eicosapentaenoate	C20:5	25.582
8.	methyl oleate (11)	C18:1	20.697	17.	methyl erucate	C22:1	26.031
9.	methyl linoleate	C18:2	21.205	18.	methyl lignocerate	C24:0	29.574
10.	methyl linolenate	C18:3	22.052	19.	methyl nervonate	C24:1	30.203
				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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BACK TO BIOFUEL/RENEWABLE FUEL INTRODUCTION

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

Analyzer Description

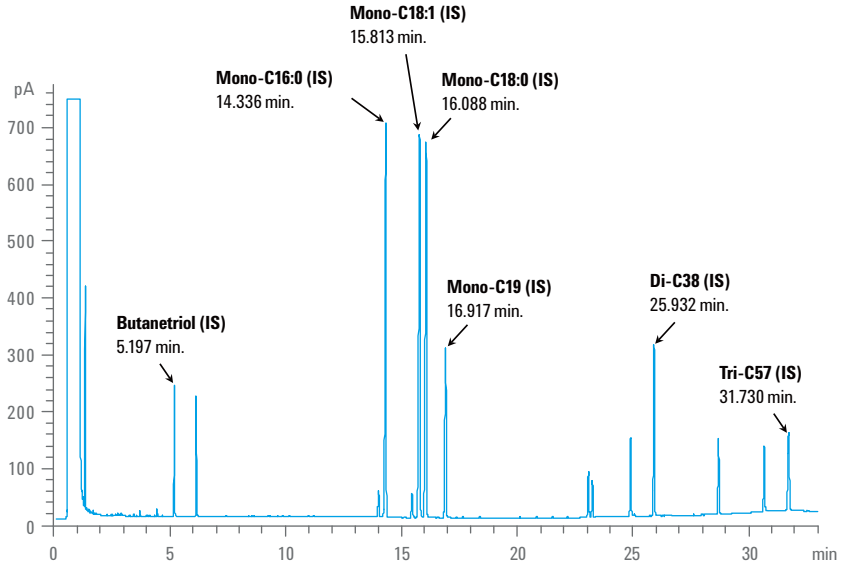
Configuration:
- Split/splitless inlet/FID

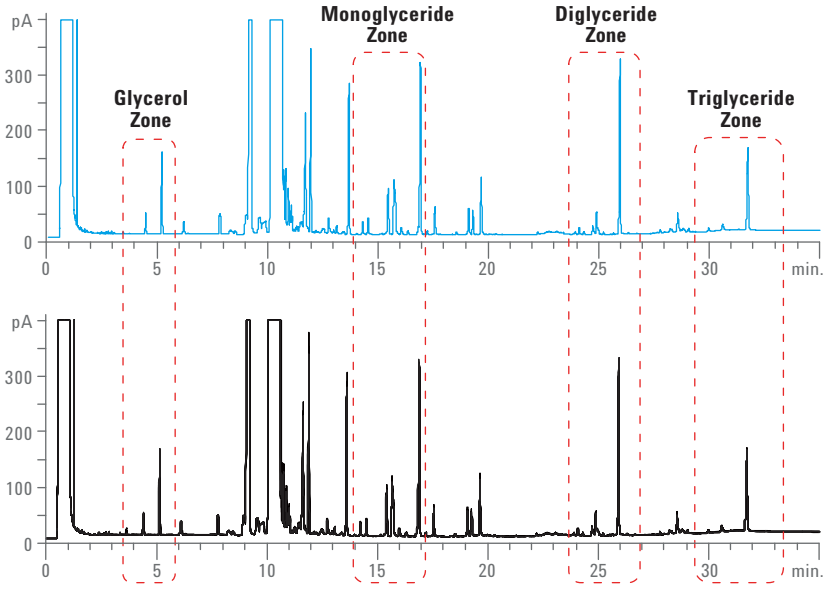
Sample type:
- B100 biodiesel

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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BACK TO BIOFUEL/RENEWABLE FUEL INTRODUCTION

► 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

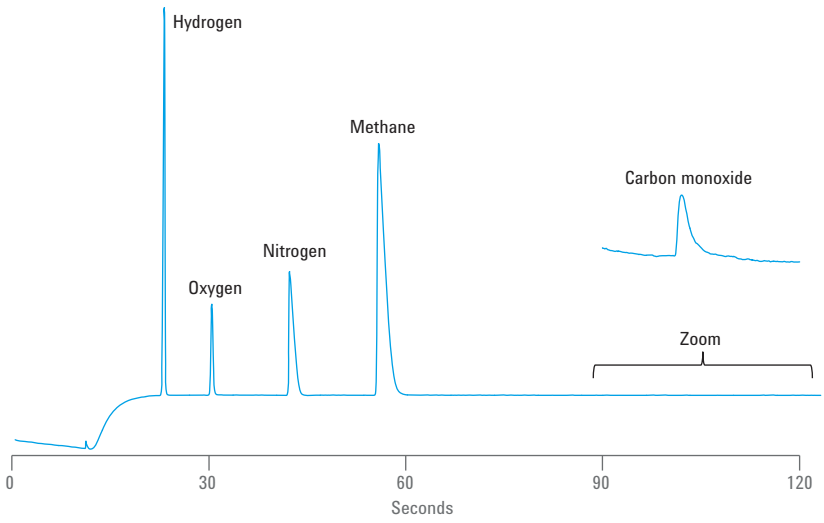
Compounds analyzed:

- Channel 1: C_1, H_2, O_2, N_2 and CO
- Channel 2: C_2-C_3, H_2S and CO_2

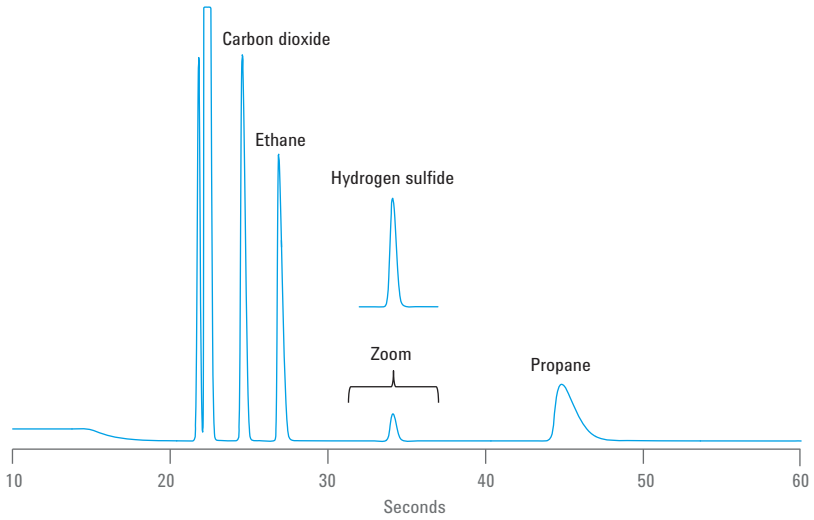
Typical quantification range:

- 1-10 ppm

Channel 1 – Permanent gases



Channel 2 – CO_2, C_2, H_2S, and C_3



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BACK TO BIOFUEL/RENEWABLE FUEL INTRODUCTION

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of biogas composition in 120 seconds
  - – Characterizes permanent gases, hydrocarbons C_1-C_3 and H_2S 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.

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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

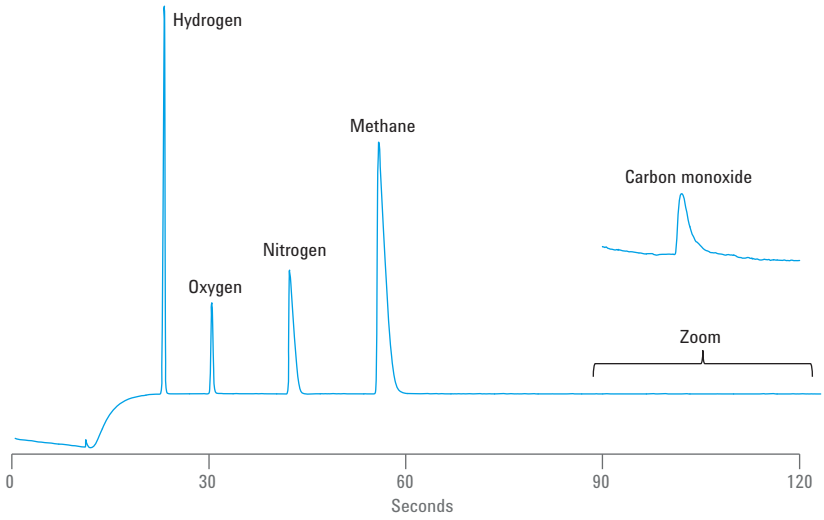
Compounds analyzed:

- Channel 1: C_1, H_2, O_2, N_2 and CO
- Channel 2: C_2-C_3, H_2S and CO_2
- Channel 3: C_4-C_7

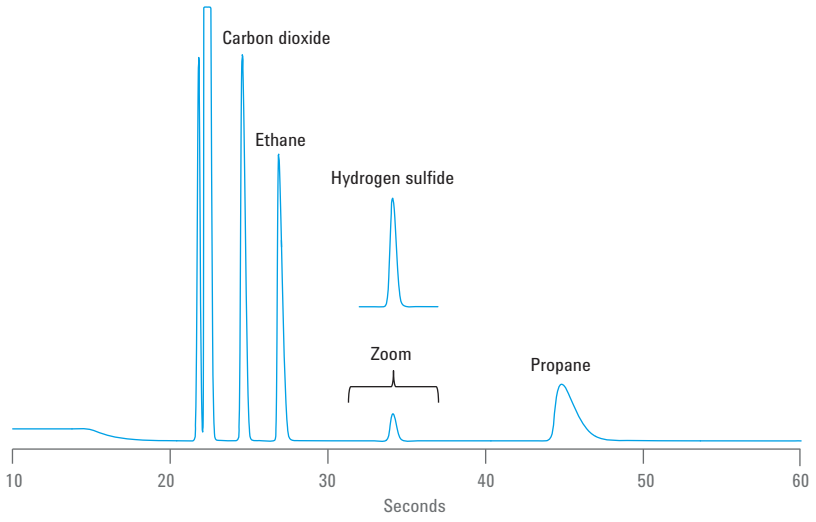
Typical quantification range:

- 1-10 ppm

Channel 1 – Permanent gases



Channel 2 – CO_2, C_2, H_2S, and C_3



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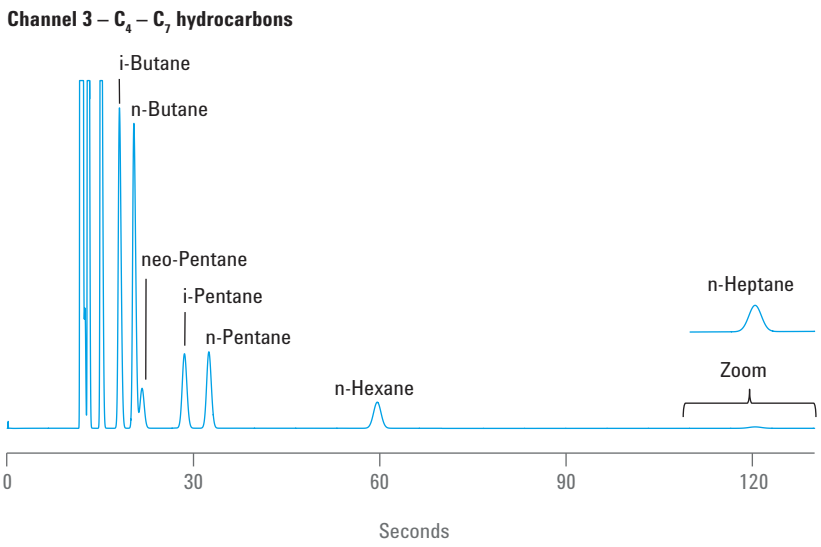

Take the quick, cost-effective path through your toughest challenges. Contact Agilent to discuss an Analyzer or custom GC for your specific need at **www.agilent.com/chem/energy**

► KEY BENEFITS AND FEATURES

- Optimized for the rapid analysis of biogas composition in 120 seconds
  - Characterizes permanent gases, hydrocarbons C_1-C_7 and H_2S 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

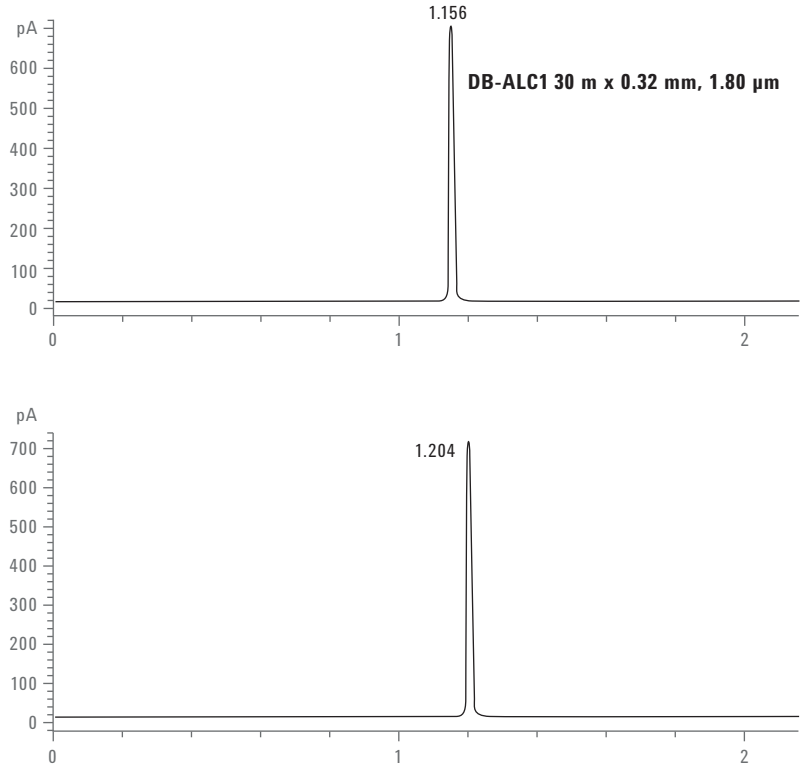
Configuration:
- Headspace/FID

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:

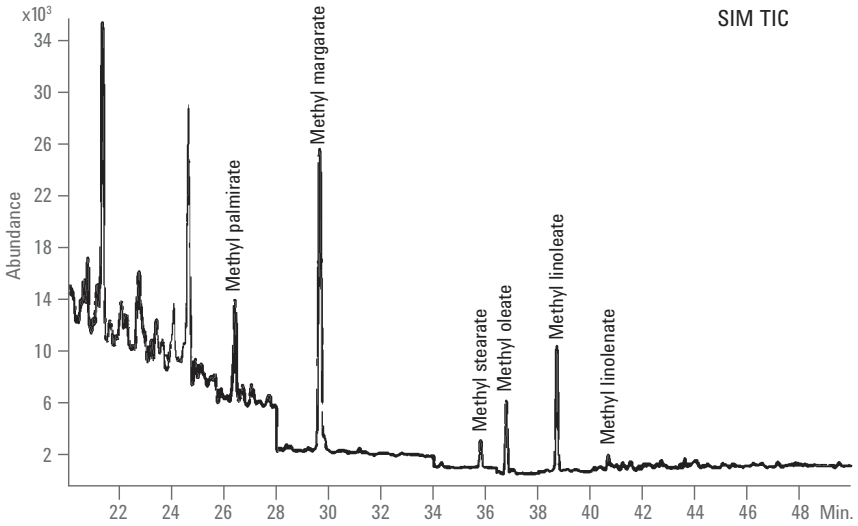
- Trace fatty acid methyl esters

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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BACK TO BIOFUEL/RENEWABLE FUEL INTRODUCTION

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 C_1-C_6 in LPG samples.

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

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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_2S	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:

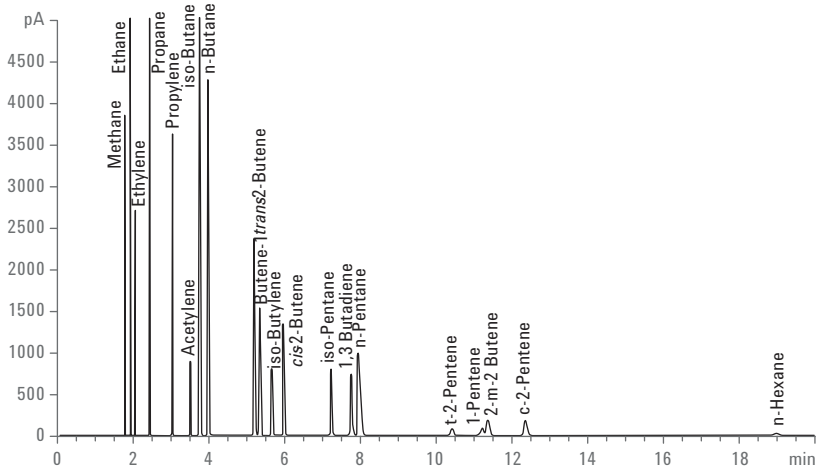
- C_1-C_6

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 C_1 to C_8 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:

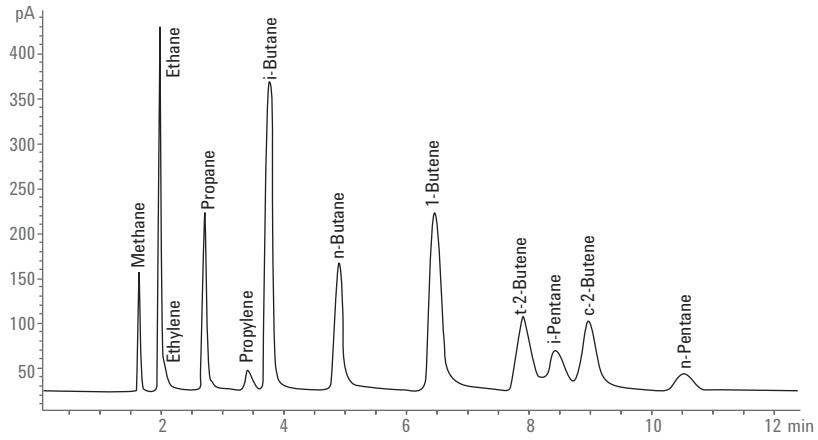
- C_1-C_6

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

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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:

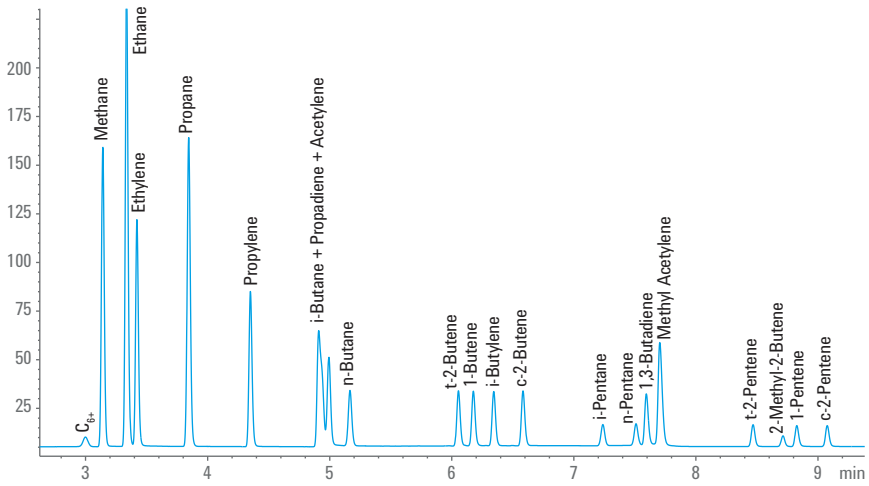
- C_1-C_5
- C_{6+} as backflush

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:

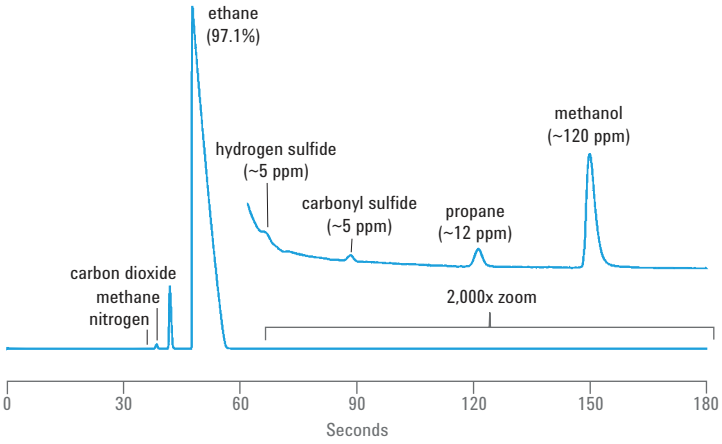
- Ethane

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:

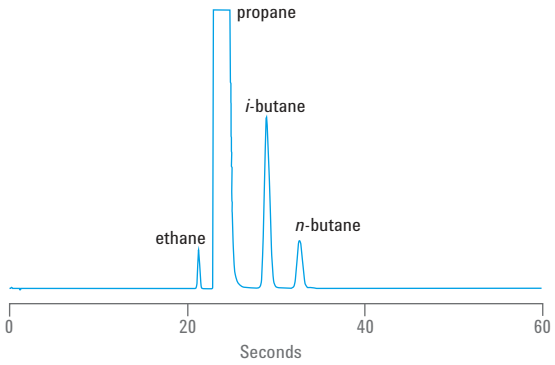
- Propane and Butane streams

Compounds analyzed:

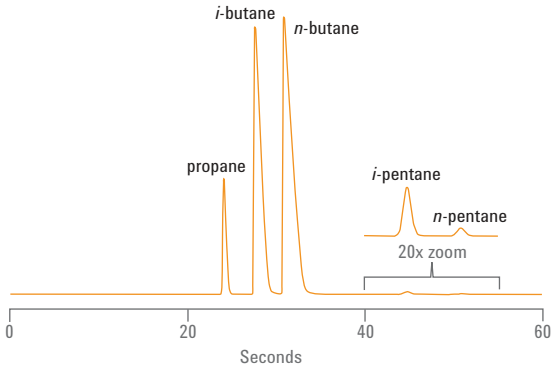
- Ethane, propane, i-butane, n-butane, i-pentane, n-pentane

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, H_2, and CO_2 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 incudes permeation tube dilution block for built-in calibration		

Reference Methods for CO/CO_2 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 CO_2 in Process Gases Containing High CH_4 Analyzer (G3445 #646)

Analyzer Description

Configuration:

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

Sample type:

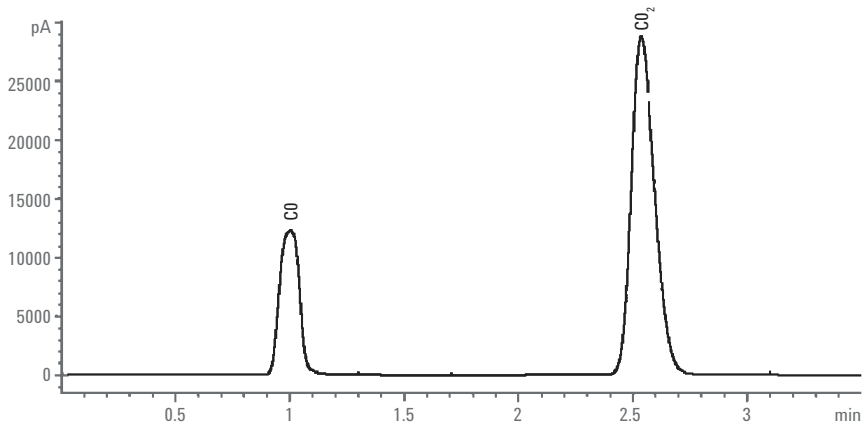
- Process gas containing high levels of methane, natural gas

Compounds analyzed:

- 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
- High concentration hydrocarbons cut on the pre-column; CH_4 vented during the analysis through use of a 4-port valve
- Trace levels of CO and CO_2 can be analyzed by conversion to CH_4 and detection with FID
- 3 minute analysis time

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BACK TO TRACE IMPURITIES INTRODUCTION

Low CO and CO_2 in Process Gas Analyzer (G3445 #647)

Analyzer Description

Configuration:

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

Sample type:

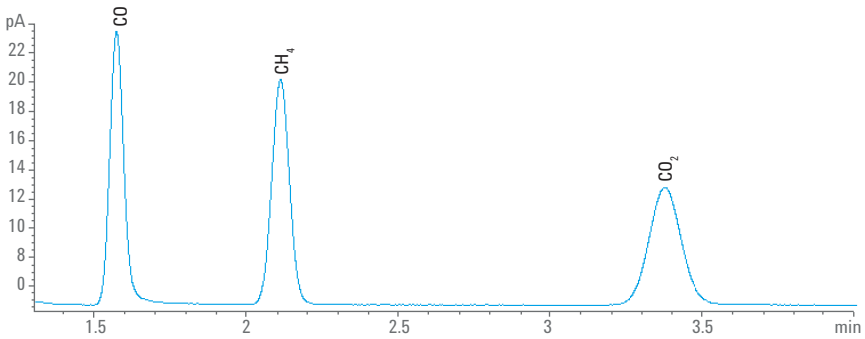
- Ethylene, propylene, or process gas streams containing low concentrations of methane

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

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BACK TO TRACE IMPURITIES INTRODUCTION

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:

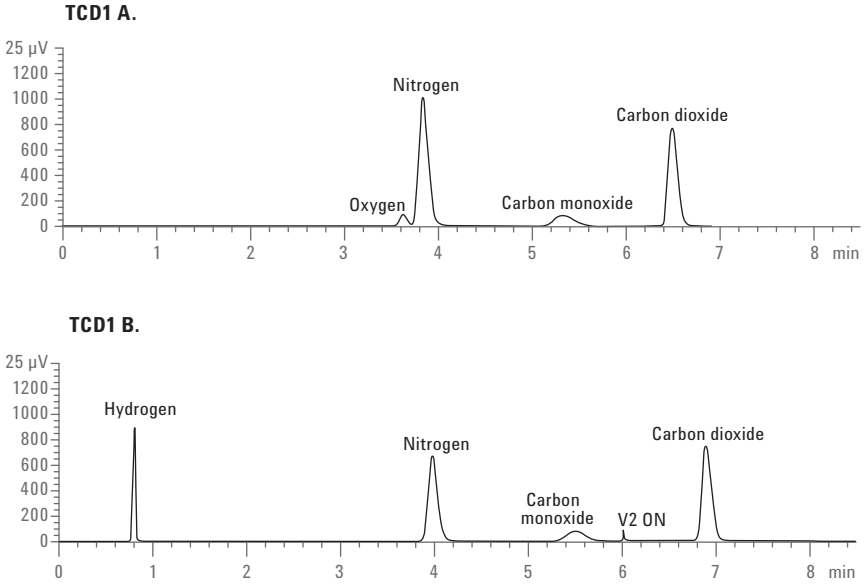
- Pure chlorine gas

Compounds analyzed:

- H_2, O_2, N_2, CH_4, CO_2, 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 H_2 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:

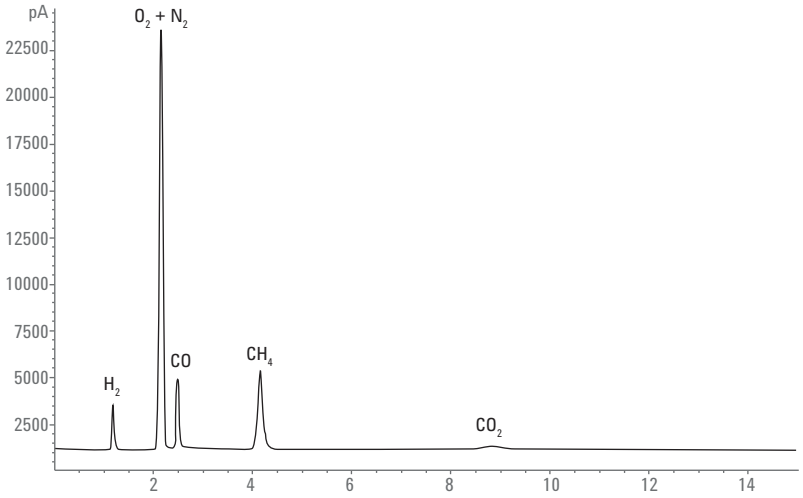
- Monomers (gas)

Compounds analyzed:

- H_2, O_2 + N_2 composite peak, CH_4, CO, CO_2

Typical quantification range:

- 1.5 ppm for O_2 + N_2 composite peak
- 0.1 ppm for H_2, CO and CO_2



► 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 H_2, O_2+N_2, CO, CH_4, and CO_2 are separated on micro-packed column and detected at 0.1 ppm and higher

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Low CO and CO_2 in Process Gases with Nicat Bypass to Detector (7890-0355)

Analyzer Description

Configuration:

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

Sample type:

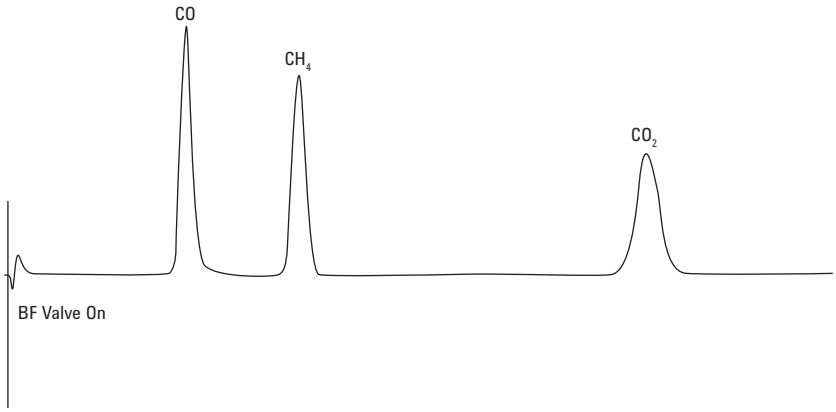
- Process gas containing air

Compounds analyzed:

- CO, CO_2

Typical quantification range:

- 0.2 ppm for CO
- 0.4 ppm for CO_2



► KEY BENEFITS AND FEATURES

- Single channel with packed columns
- Hydrocarbon components heavier than CO_2 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 CO_2 can be analyzed by conversion to CH_4 and detection with FID
- 6 minute analysis time

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Trace CO and CO_2 in Hydrogen and Light Gaseous Hydrocarbons Analyzer (7890-0366)

Analyzer Description

Configuration:

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

Sample type:

- H_2/Light gaseous hydrocarbons

Compounds analyzed:

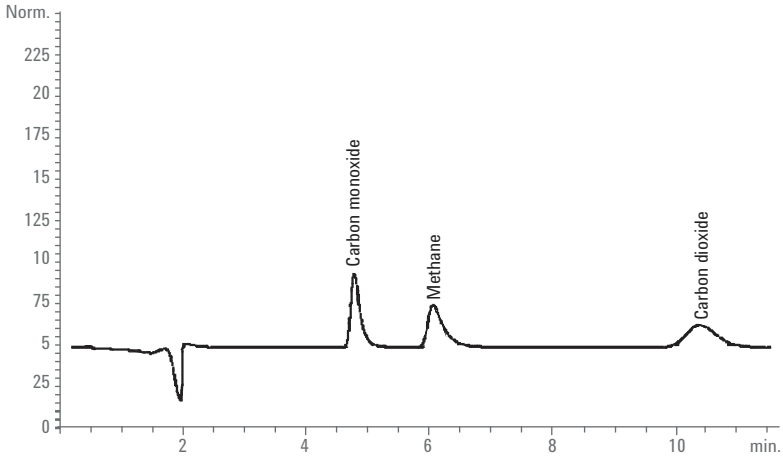
- CO, CO_2, and CH_4

Typical quantification range:

- 0.2 ppm for CO
- 0.4 ppm for CO_2

Configured per method:

- UOP 603



► KEY BENEFITS AND FEATURES

- Single channel with packed columns
- Trace levels of CO and CO_2 can be analyzed by conversion to CH_4 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:

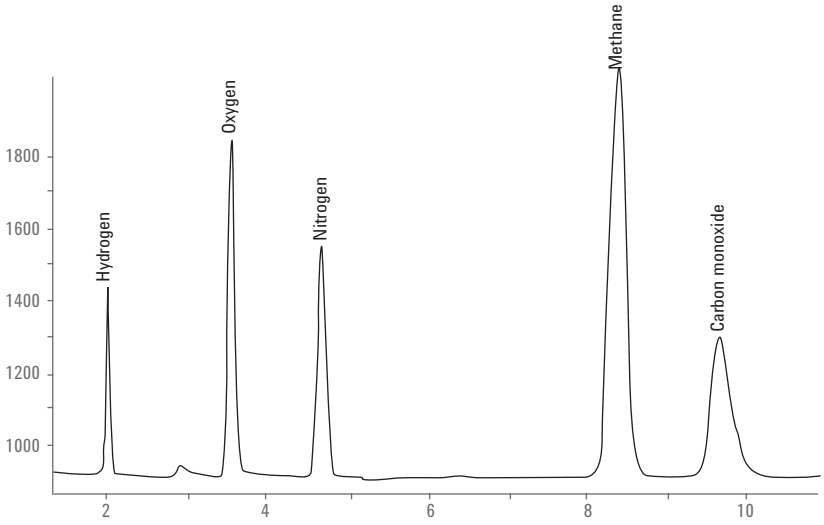
- Ethylene/Propylene

Compounds analyzed:

- H_2, O_2, N_2, CO, CH_4

Typical quantification range:

- H_2: 0.1-40 ppm
- N_2, 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 H_2, O_2, N_2, CO, CH_4 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 incudes permeation tube dilution block for built-in calibration

Sample type:

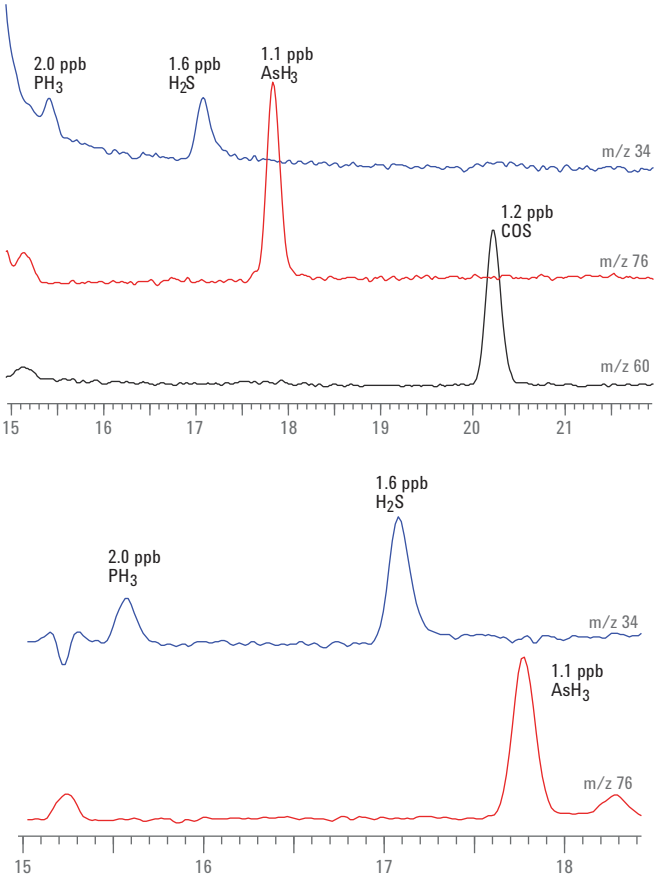
- High purity ethylene and propylene

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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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:

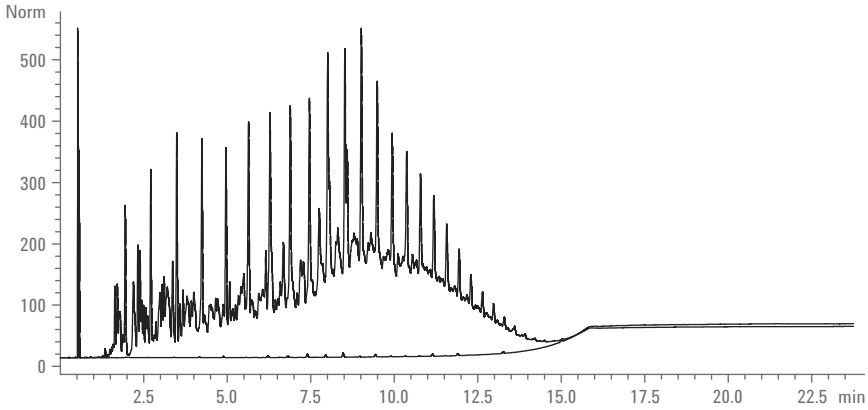
- Multimode inlet/FID/Sim. Dist. software

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 mm, 0.4 µm

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

Analyzer Description

Configuration:

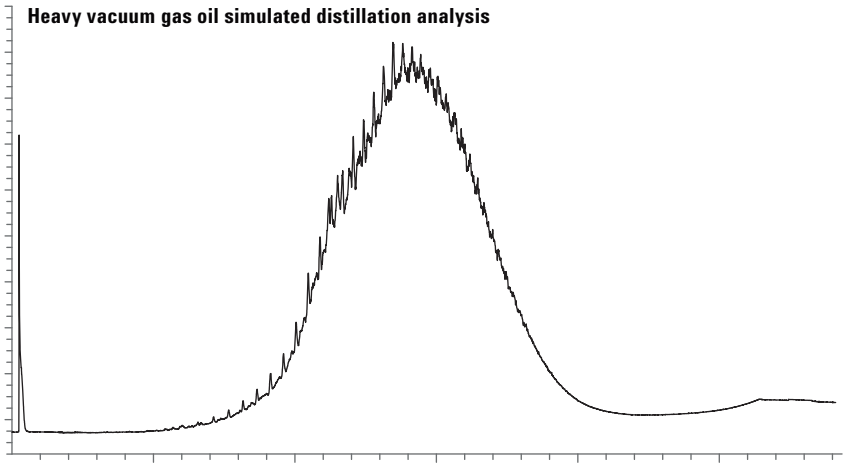
- Multimode Inlet/FID/Sim. Dist. software

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:

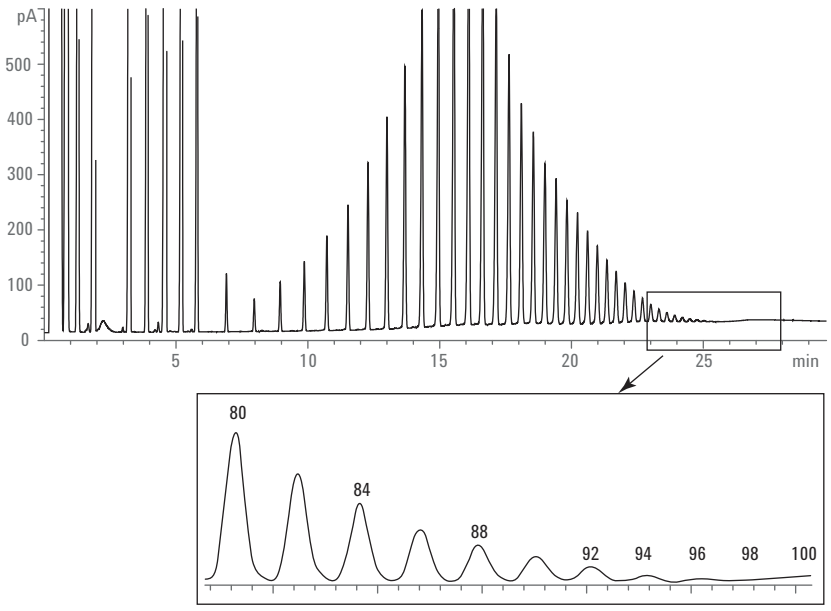
- Multimode Inlet/FID/Sim. Dist. software

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_2S 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_2S, 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:

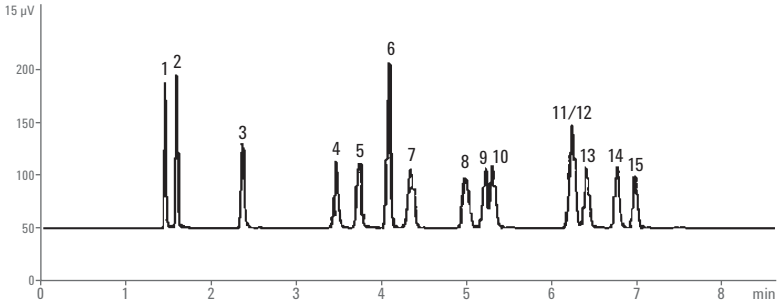
- Sulfur compounds in Natural Gas or Gaseous fuels
- H_2S, CS_2, COS, mercaptans, aromatic sulfur compounds, sulfides

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_3SH	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-propanehiol	$CH_3SHC_2H_5$	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:

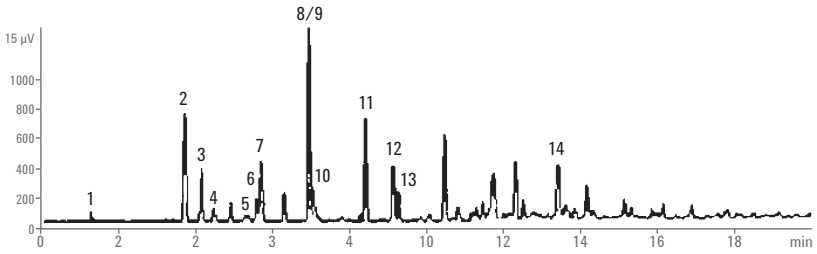
- Volatile sulfur-containing compounds in light petroleum liquids, such as CS_2, COS, mercaptans, aromatic sulfur compounds, sulfides

Typical quantification range:

- 20 ppb of sulfur in gasoline

Configured per method:

- ASTM D5623, UOP 791



Components	Formula	Components	Formula
1. Ethyl mercaptan	CH_3CH_3SH	8. Thiophene	C_4H_4S
2. Dimethyl sulfide	$(CH_3)_2S$	9. Sec-butyl mercaptan	$CH_3CH_2CH(SH)CH_3$
3. Carbondisulfide	C_2S	10. n-Butyl mercaptan	$CH_3(CH_2)_3SH$
4. Isopropyl mercaptan	$(CH_3)_2CHSH$	11. Dimethyl disulfide	CH_3SSCH_3
5. t-Buyyl mercaptan	$(CH_3)_3CSH$	12. 2-Methyl thiophene	C_5H_6S
6. n-Propyl mercaptan	CH_3CH_2SCH	13. 3-Methyl thiophene	C_5H_6S
7. Methylethyl sulfide	$CH_3CH_2SCH_3$	14. Dimthyl disulfide	$(C_2H_5)_2S_2$

► 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: C_2, C_3, C_4 monomers
- 7890-0167: Natural gas and fuel gas streams

Compounds analyzed:

- Volatile sulfur such as H_2S, COS, MeSH, EtSH, DMS, CS_2, t-BuSH and THT

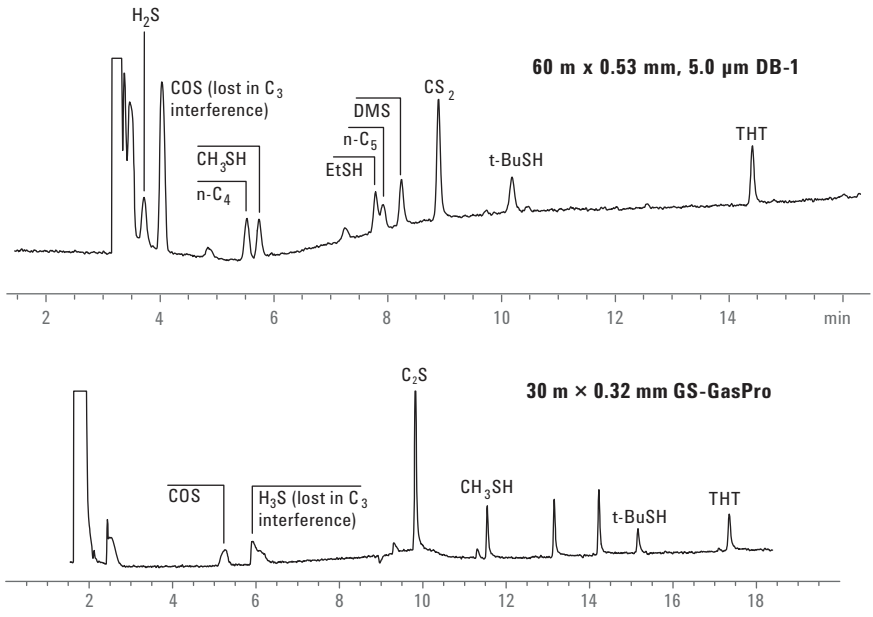
Typical quantification range:

- 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 H_2S in propylene and other light hydrocarbon streams
- Same GC configuration for two methods:
  1. 7890-0167: natural gas, fuel gas streams
  2. 7890-0148: C_2, C_3, C_4 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:

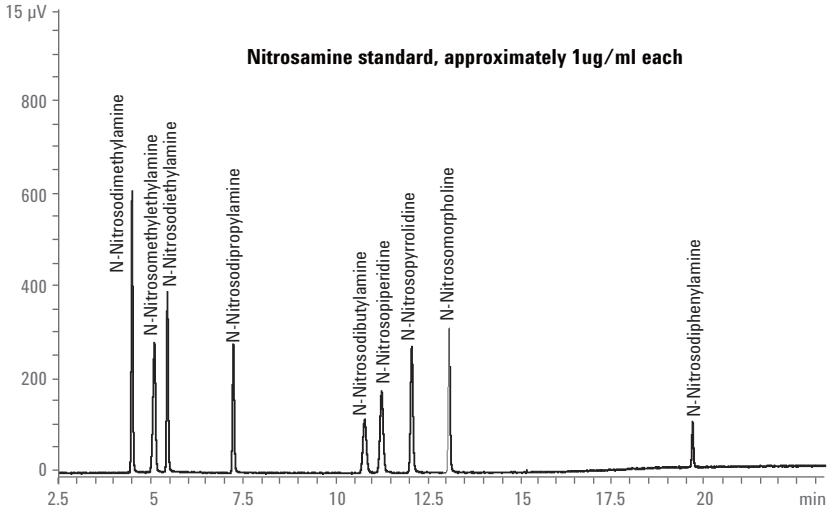
- Liquid samples

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

ASTM D3612-A		ASTM D3612-C	
Component Gas	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_2H_2	0.05
		C_2H_4	0.04
		C_2H_6	0.04
		C_3H_8	0.2

**Estimated from the H_2 response. The detection limits were obtained from the analysis of a dissolved gas standard of 1 ppm for all gases, except for O_2, N_2, CO, and CO_2, 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:

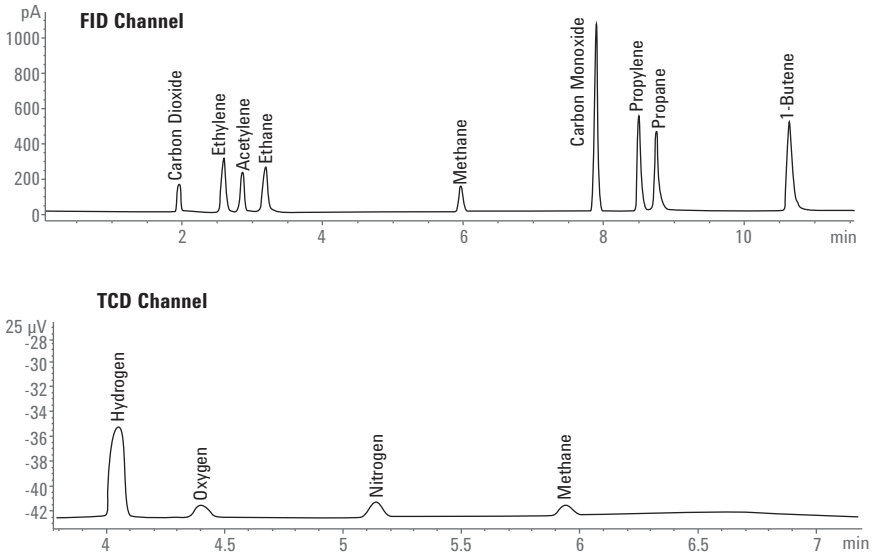
- H_2, O_2, N_2, CH_4, CO and CO_2,
- C_2 (ethane, ethylene, acetylene), C_3 (propane, propylene), C_4 (1-butene)

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 CO_2 can be analyzed by conversion to CH_4 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:

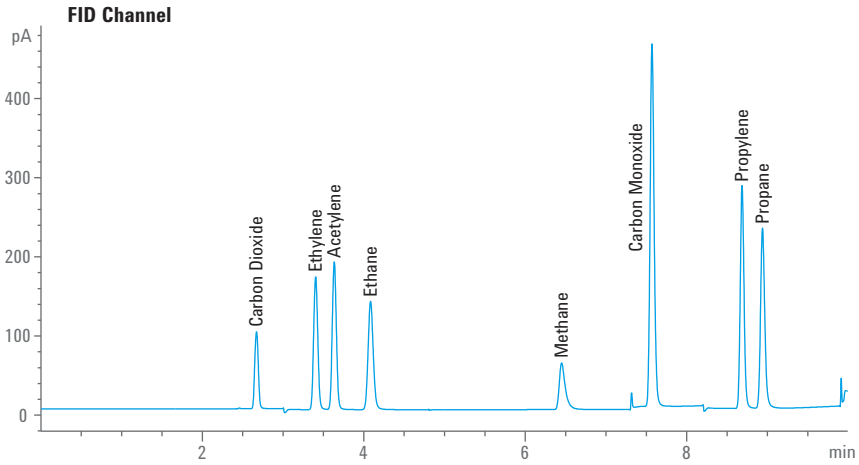
- H_2, O_2, N_2, CH_4, CO and CO_2
- C_2 (ethane, ethylene, acetylene), C_3 (propane, propylene), C_4 (1-butene)

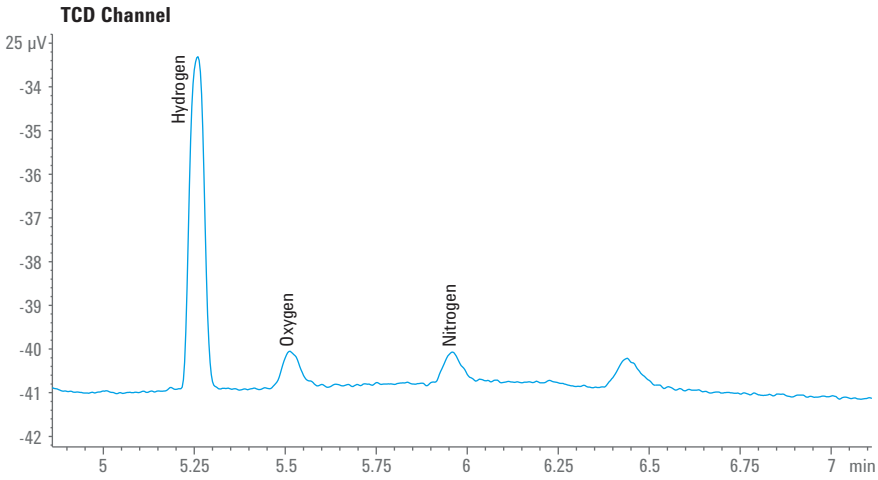
Typical quantification range:

- 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 CO_2 can be analyzed by conversion to CH_4 and detection with FID
- Backflush of C_{4+} hydrocarbons present through pre-column to shorten analysis time
- Through additional valve switching C_2, C_3, C_4 hydrocarbons bypass nickel catalyst for FID detection
- 10 minutes analysis time

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BACK TO TRANSFORMER OIL GAS INTRODUCTION

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 (CO_2), methane (CH_4) and nitrous oxide (N_2O)—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_2O (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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BACK TO GREENHOUSE GAS INTRODUCTION

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 CH_4, N_2O and CO_2

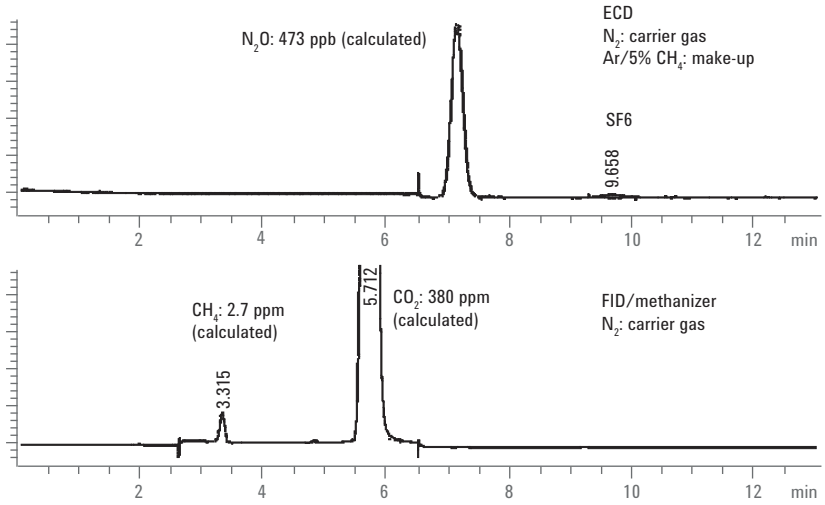
Compound analyzed:

- CH_4, N_2O, CO_2

Typical quantification range:

- 50 ppb for N_2O
- 0.2 ppm-20% for CH_4
- 0.4 ppm-0.2% for CO_2

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 N_2O 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 SF_6
- 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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BACK TO GREENHOUSE GAS INTRODUCTION

Greenhouse Gas Analyzer (G3445 #562)

Analyzer Description

Configuration:

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

Sample type:

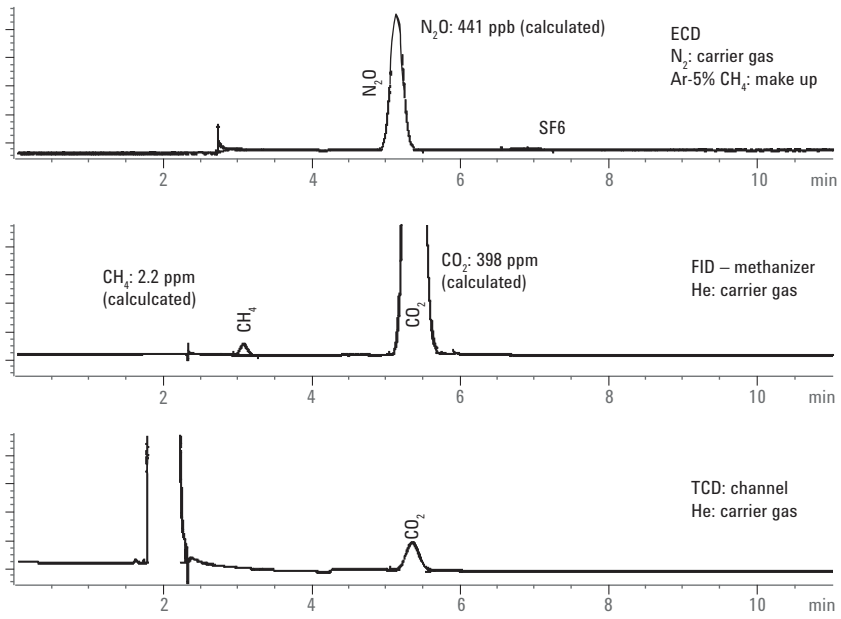
- Greenhouse gases and soil gases with compounds of interest contain gases such as CH_4, N_2O and CO_2

Compound analyzed:

- CH_4, N_2O, CO_2

Typical quantification range:

- 50 ppb for N_2O
- 0.2 ppm-20% for CH_4
- 0.4 ppm-20% for CO_2



► KEY BENEFITS AND FEATURES

- Configured for simultaneous analysis of greenhouse gas with one injection
- Sensitivity of Micro-ECD ensures the detection of N_2O 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 SF_6
- 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 CO_2 determinations

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BACK TO GREENHOUSE GAS INTRODUCTION

Greenhouse Gas Analyzer (G3445 #563)

Analyzer Description

Configuration:

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

Sample type:

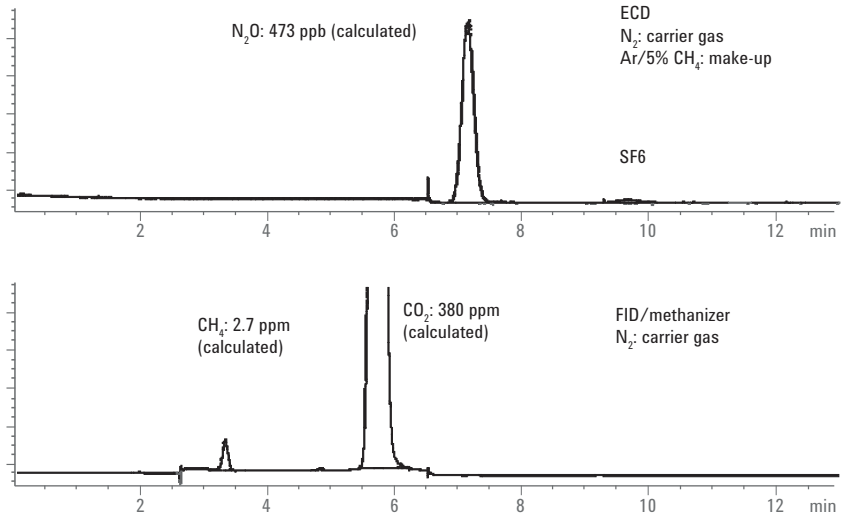
- Greenhouse gases, soil gases where the compounds of interest include gases such as CH_4, N_2O and CO_2

Compound analyzed:

- CH_4, N_2O, CO_2

Typical quantification range:

- 50 ppb for N_2O
- 0.2 ppm-20% for CH_4
- 0.4 ppm-0.2% for CO_2



► KEY BENEFITS AND FEATURES

- Analyzer configured for simultaneous analysis of greenhouse gas with one injection
- Sensitivity of Micro-ECD ensures the detection of N_2O 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 SF_6
- 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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BACK TO GREENHOUSE GAS INTRODUCTION

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 M_3
- ✓ 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

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

システムバリデーションとデータ測定に特化した GC および GC/MS アナライザ

アジレントの GC および GC/MS アナライザは、メソッド要件を満たすことができるように出荷時に構成され、化学的な試験が実施されているため、「直ちに」高品質のデータが測定でき、サンプルを処理することができます。アジレントのアナライザは単なる機器ではなく、キャピラリ・フロー・テクノロジーやターゲット化合物データベースなどの高度な技術を組み込んだトータルなワークフローソリューションです。お客様固有のアプリケーションに合わせてシステムを最適化することができます。

各アナライザには、あらかじめ設定された出荷検査時のクロマトグラムのレポートと確認用サンプルが付属し、分離機能の確認を実施できる状態で届けられます。これにより、設置の完了と同時にシステムバリデーションを開始できるため、メソッド開発コストを大幅に削減できます。もちろん、問題が生じた場合には、アジレントのサポートチームがいつでも対応いたします。

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