

# Micro GC Analysis of Natural Gas and LPG in Seconds Using the Agilent 3000 Natural Gas Analyzer Application

Gas Chromatography

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## Abstract

**Fast and accurate measurement of the composition and heating value of natural gas and LPG is demonstrated using a portable micro GC. The Agilent 3000 Natural Gas Analyzer measures the individual components and calculates physical properties such as specific gravity and heating value in approximately 100 to 160 seconds depending upon the type of natural gas. The entire system is equally suited for laboratories or easy transport to the field for on-site analysis.**

## Introduction

Accurate and timely measurement of the chemical composition and physical properties of natural gas is critical for natural gas producers, and gatherers, gas distribution companies, electrical utilities and independent testing laboratories. The Agilent 3000 Natural Gas Analyzer measures the individual components in natural gas and provides detailed reports of properties including composition, calorific value and density up to 10 times faster than a conventional GC system. This analyzer is applicable to natural gas samples from wellhead to pipeline-quality gas and Liquefied Petroleum Gas (LPG). Additionally, the analyzer can handle Y-Grade Liquefied Natural Gas (LNG). These samples are easily introduced using sample cylinders, Tedlar bags or by direct connection to the pipeline or wellhead sampling points.

The Agilent 3000 Natural Gas Analyzer incorporates micromachined components and high resolution capillary columns to produce the fastest results possible. The complete analysis of natural gas is typically complete in under 160 seconds with precision superior to most conventional laboratory gas chromatographs. This hardware, combined with Agilent's Cerity Networked Data System software and LAN interfacing, provides a powerful, yet easy to use, system complete with calorific value (BTU or Mega Joule/m<sup>3</sup>) calculations and reporting according to Gas Processors Association (GPA), American Society of Testing and Materials (ASTM) and the International Standards Organization (ISO) standards.



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## A Versatile Analyzer for Field and/or Laboratory Analysis of Natural Gas and LPG

Figure 1 shows a typical chromatogram obtained for the analysis of approximately 1000 BTU pipeline-quality gas, complete in under 90 seconds. Pipeline-quality gas, which is one of the most common sample types encountered, typically contains large amounts of methane and small amounts of C<sub>6</sub> plus. The Agilent 3000 Natural Gas Analyzer quickly separates and measures the permanent gases and hydrocarbons present using an optimized, dual-channel micro gas chromatograph.

This powerful, yet easy-to-use configuration is equally applicable to a wide range of sample types including pipeline gas, wellhead gas, LPG and Y-grade liquefied natural gas.

Wellhead samples, or samples taken directly from the gas well, often contain significant amounts of hydrogen sulfide, yet there are no interferences and H<sub>2</sub>S can be measured from 50 PPM to 30 mol%. In addition, the C<sub>6</sub> plus composition in these sample types can be as high as 4 to 5 % and represent hydrocarbons in the C<sub>6</sub> to C<sub>10</sub> range. For these samples and samples containing higher concentrations of C<sub>6</sub> plus, an optional heated sample

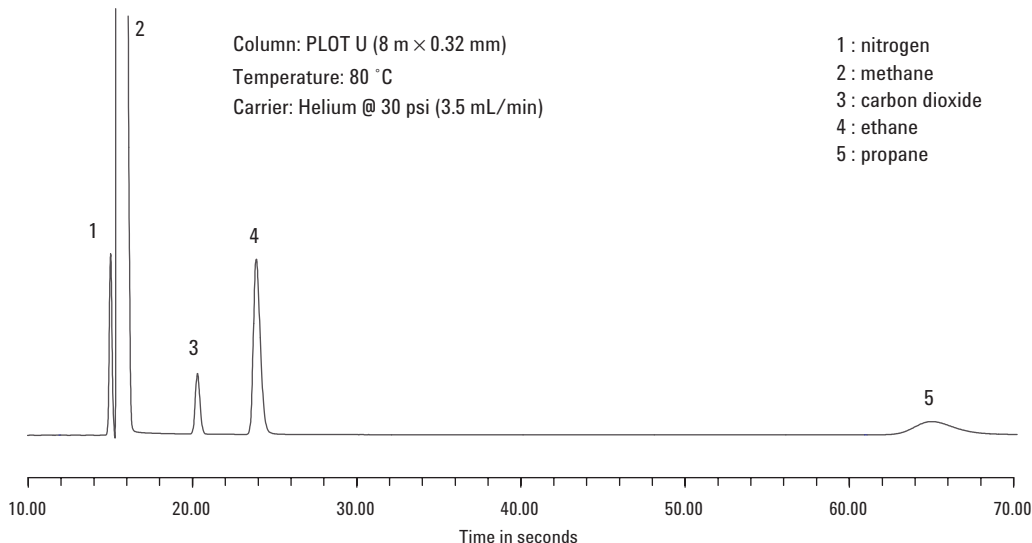
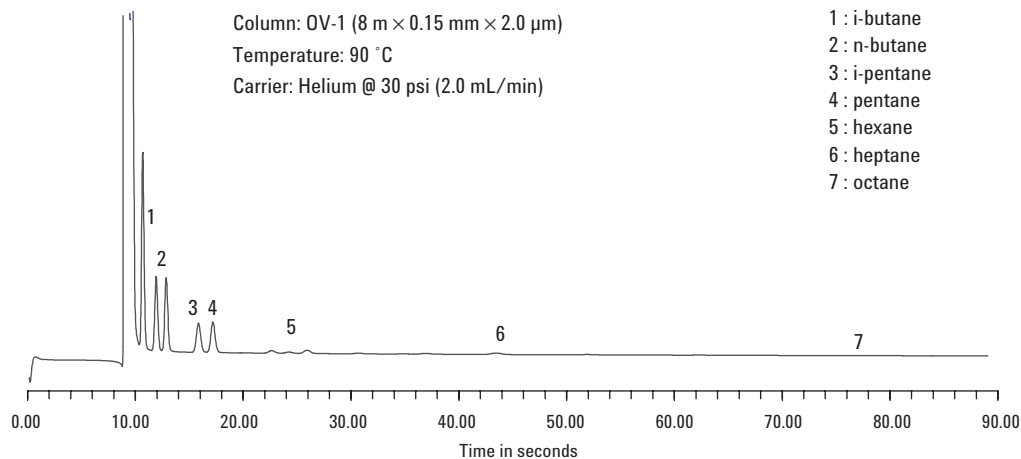
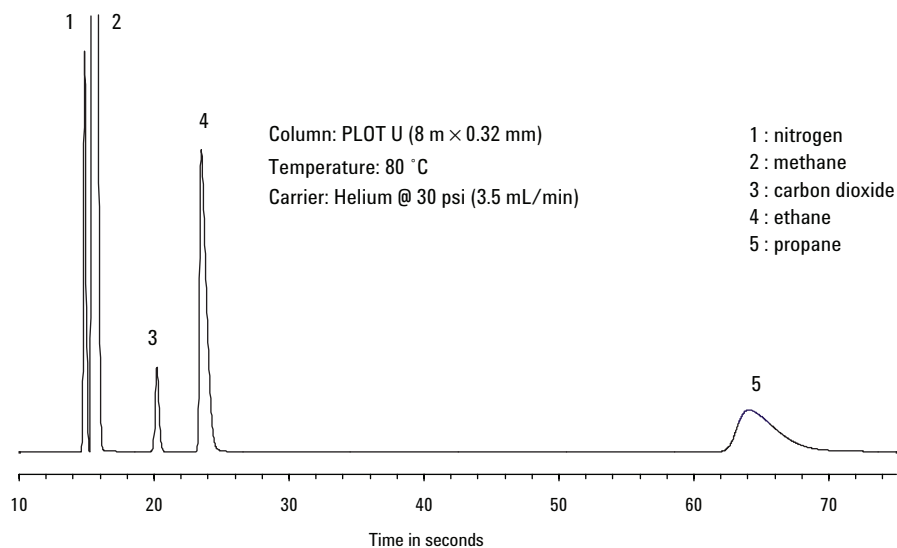
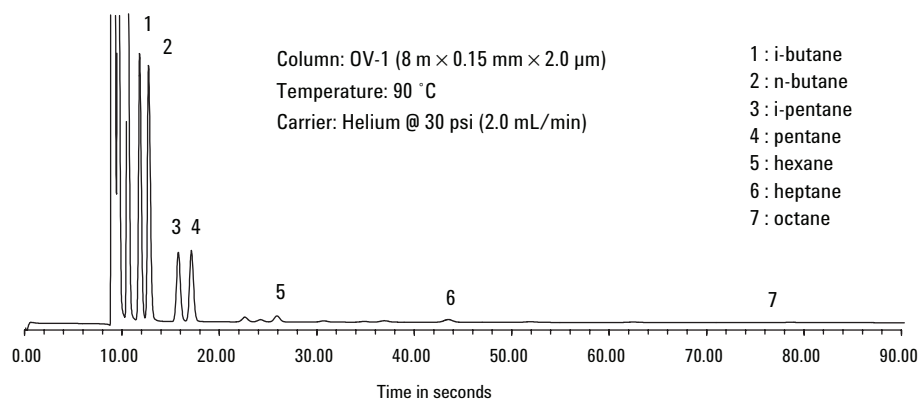


Figure 1. Complete analysis of pipeline-quality natural gas in under 100 seconds.

regulator is available to minimize the possibility of sample condensation in the analyzer. Figure 2 demonstrates excellent component resolution of the individual compounds which are easily detected and identified over a wide range of concentration from 50 PPM to 100 mol%. This is possible using a single sample analysis because the

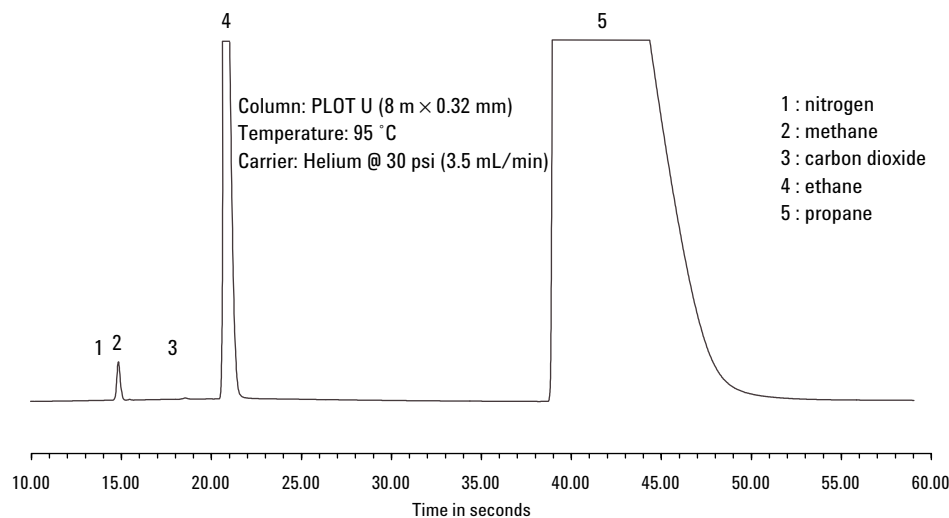
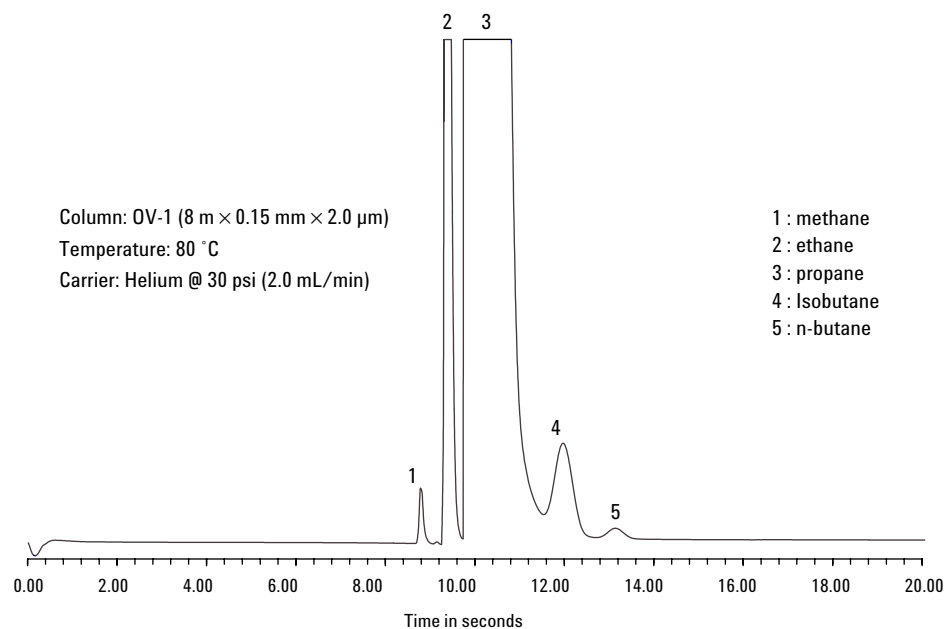
Agilent 3000 Micro GC uses digital signal processing with an expanded dynamic range. There is no need to change the detector range to compensate for wide fluctuations in component concentration normally present in natural gas samples of various sources and types.



**Figure 2. Wellhead samples containing higher concentrations of C<sub>6</sub> plus hydrocarbons and H<sub>2</sub>S are easily analyzed using the Agilent 3000 Natural Gas Analyzer.**

Analysis of pressurized liquid samples, which are gases under standard temperature and pressure, is possible using optional sample conditioners. For analysis of LPG, a heated vaporizer provides the backpressure necessary to ensure representative sampling and vaporization for gas introduction into the analyzer. A good example of this type of

sample is shown in Figure 3, which demonstrates the analysis of a typical LPG. Notice that the major component is propane and that there are smaller amounts of ethane, iso-butane and n-butane as well as trace amounts of CO<sub>2</sub> and nitrogen. This analyzer would not separate unsaturated hydrocarbons such as propenes and butenes if present.

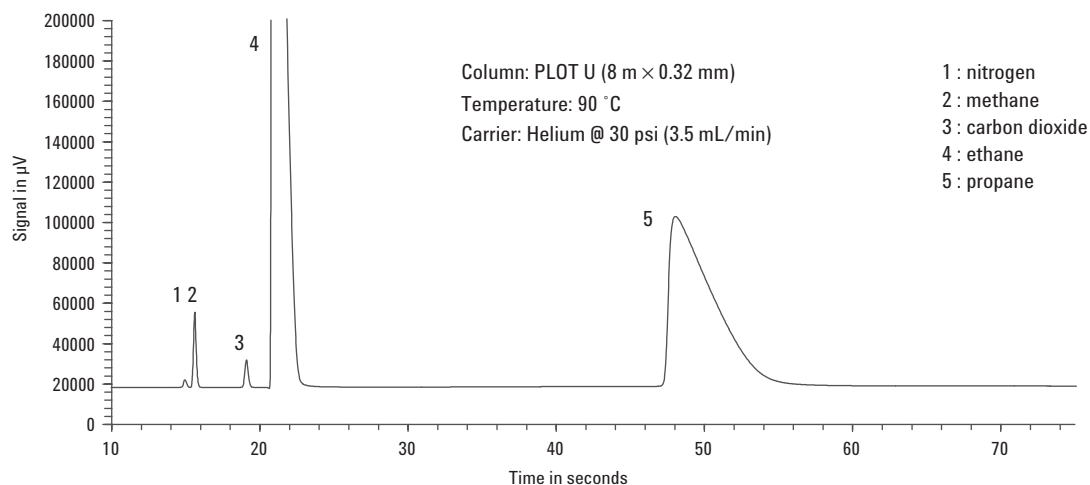
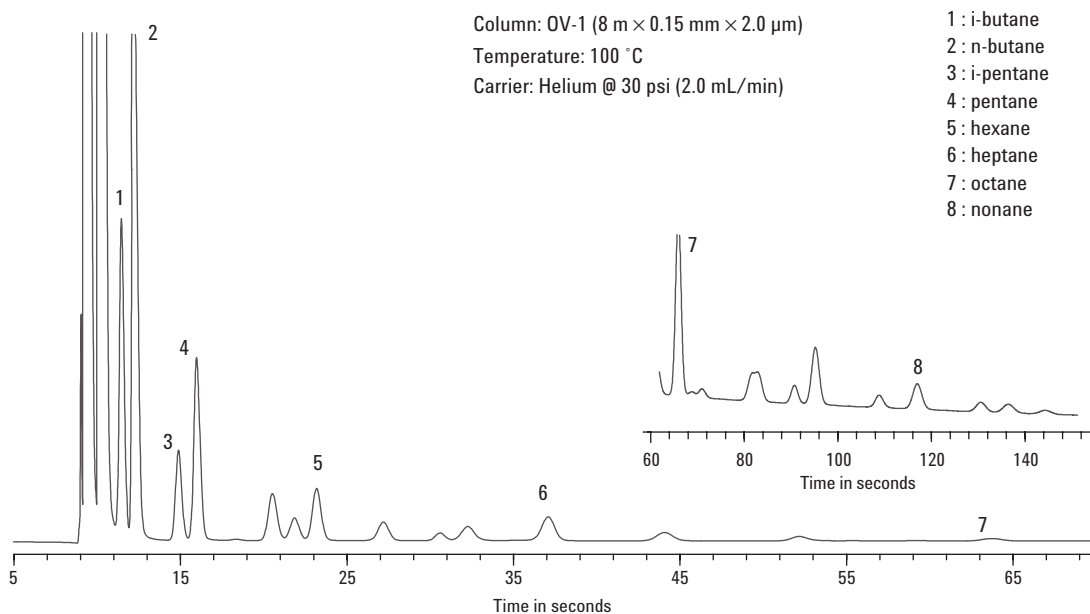


**Figure 3. Analysis of Liquefied Petroleum Gas (LPG) using the heated sample regulator.**

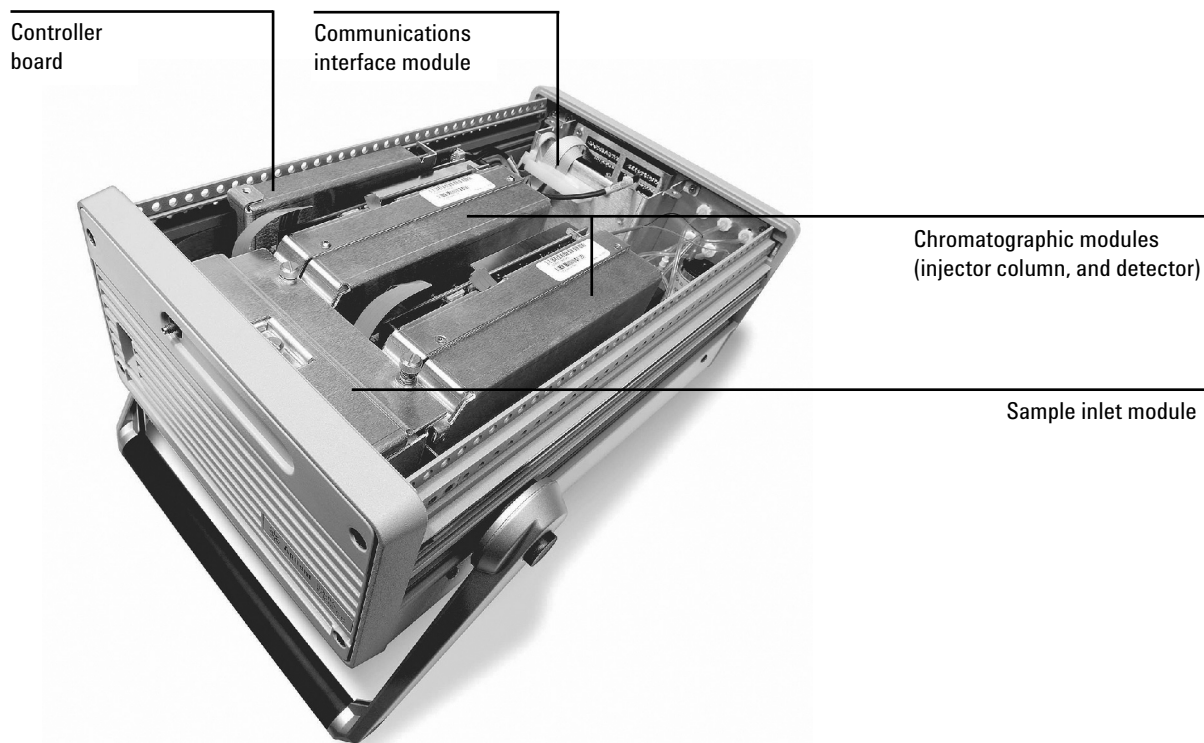
Another important sample in the natural gas industry is Y-Grade LNG, a de-methanized natural gas liquid under pressure. The de-methanized sample contains significant amounts of C<sub>6</sub> plus material, which is apparent in the chromatogram in Figure 4. These sample types use an optional Heated Vaporizer interface to maintain sample integrity and provide the heat necessary to ensure complete sample vaporization.

## Accurate and Reproducible Results in Under 160 Seconds

The Agilent 3000 Natural Gas Analyzer combines modular micromachined injectors and detectors and high resolution capillary columns into a compact gas chromatograph. This modular design is illustrated in Figure 5, where the individual components are easily identified. Two chromatographic



**Figure 4.** The Agilent Micro GC Natural Gas Analyzer is applicable to liquid samples such as Y Grade LNG using a heated vaporizer option.



**Figure 5. The Agilent 3000 Natural Gas Analyzer incorporates a compact, modular design.**

modules are optimized and integrated to quickly separate and measure the individual components in natural gas. Critical performance parameters such as sample volume, temperature and carrier gas pressure are precisely controlled to produce accurate and reliable measurements independent of ambient temperature and pressure. The result is unmatched precision as illustrated in Table 1, which represents typical results produced for a

series of 60 natural gas analyses. Precise retention times and component areas translate into accurate component identification and quantification of the individual components present in natural gas.

### Industry Standard Reporting Options and LAN Interfacing Provide the Results You Need and Communicate to the Systems You Use

**Table 1. Excellent Retention Time and Quantitative Precision Over 60 Analysis of Natural Gas**

Component	Conc. (%)	Mean RT sec.	RT RSD %	Area count thousands	Area RSD %
Nitrogen	2.51	14.923	0.032	657	0.161
Methane	88.75	15.399	0.139	56700	0.121
Carbon dioxide	3.01	20.215	0.032	381	1.625
Ethane	3.52	23.786	0.046	1600	0.040
Propane	1.00	64.939	0.008	724	0.225
iso-butane	0.40	11.801	0.046	622	0.044
n-butane	0.40	12.732	0.042	638	0.055
iso-pentane	0.15	15.724	0.041	354	0.049
n-pentane	0.15	17.063	0.037	366	0.064
Hexane	0.05	25.792	0.027	56.3	0.280
Heptane	0.02	43.282	0.058	39.3	0.778

From the composition of natural gas it is possible to calculate a wide range of physical properties such as heating value, specific gravity (or density), compressibility, and WOBBE index. These values are of critical importance in determining the commercial value of the natural gas either purchased or sold, especially in custody transfer situations. For large volume end users, even small differences in the calculated values can have a significant financial impact. The natural gas analyzer software automatically calculates these physical properties after each sample analysis and generates a standard report using industry specific methods from either

the Gas Processors Association 2172 as illustrated in Figure 6, the American Society of Testing and Materials D3588 or the International Standards Organization 6976. These reports can be printed locally or transmitted via LAN (or modem) to

laboratory information systems (LIMS) and corporate enterprise systems (ERP). The integrated LAN interface supports TCP/IP or DHCP for easy connection to your corporate systems.

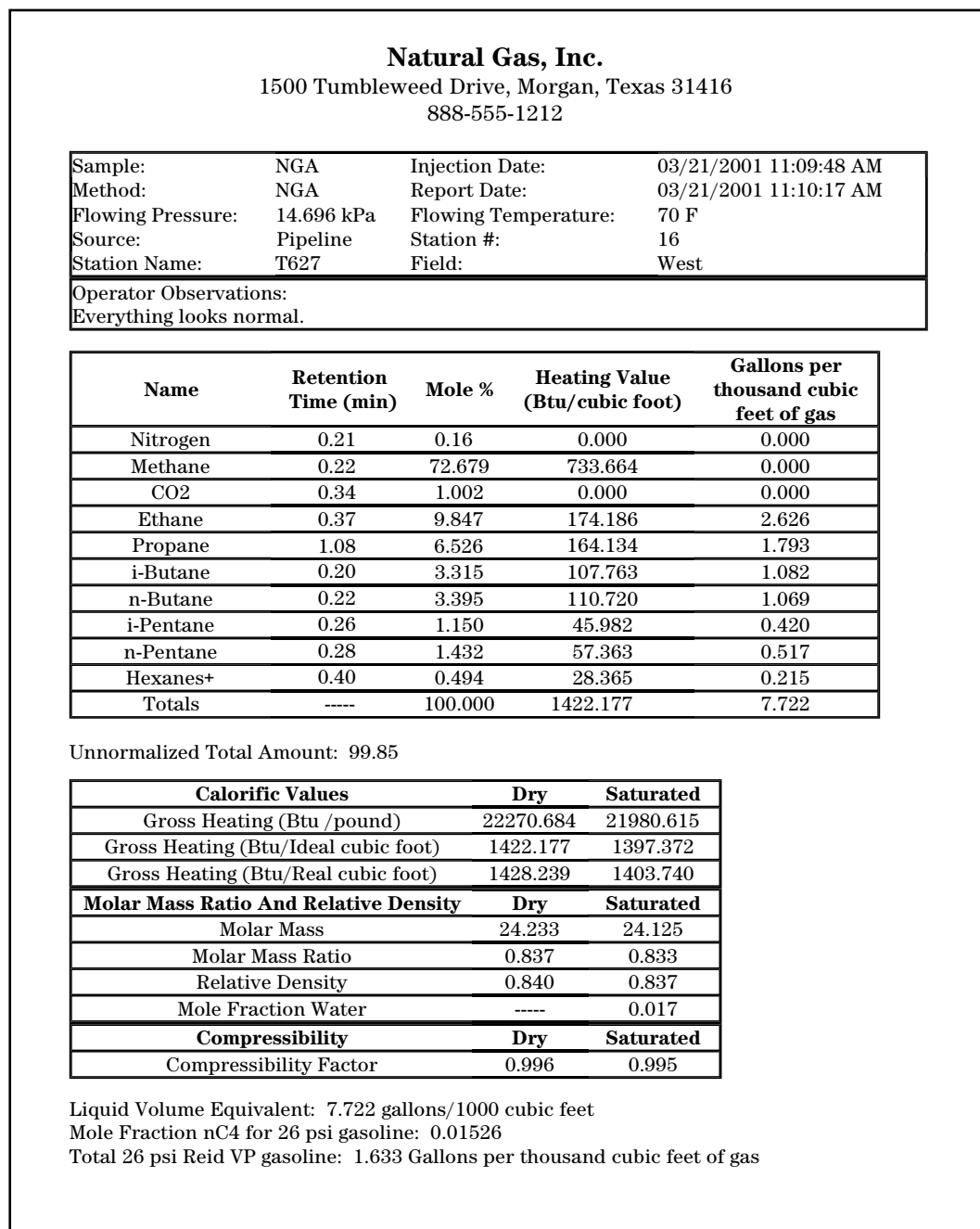


Figure 6. Standard report of composition and physical properties of natural gas using the GPA format.

## Summary

Agilent provides a family of gas chromatographic (GC) analyzers for natural gas and natural gas liquids. These analyzers include all software, supplies, methods, and support to help you address your specific measurement and technical business needs.

Whether you select from one of our turnkey configurations or require a custom analyzer, *Agilent will consult with you* to define the solution that is right for you. For more information on natural gas analysis or other Agilent solutions go to **[www.agilent.com/chem](http://www.agilent.com/chem)**

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