# Natural Gas Analysis: A Simplified Approach for the Analysis of Permanent Gases and Hydrocarbons in Natural Gas by Capillary Chromatography and Deans Switch

Application Note


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## Abstract

A method has been developed for the analysis of permanent gases and hydrocarbons using Agilent Micro-fluidics Capillary Flow Technology (CFT). This has simplified method development and reduced the cost associated with this type of analyzer when compared to using switching valves and packed columns for the analysis of natural gas samples. Capillary columns and CFT allow for improved resolution, more commonly available parts, and allow for increased speed of analysis over packed column methods.


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## Introduction

Many of the standard methods for natural gas analysis were developed at a time when capillary columns and electronic pressure control were not available. With the advent of newer technologies such as capillary columns, capillary flow technology, more sensitive detectors, and improved flow and pressure control technology, these outdated methods should be revisited. This application note explores alternatives that offer improvements in ease of setup, improved resolution, and improved detection limits. With this in mind we should consider the following topics when designing GC methods.

Many older methods require the use of switching valves and multiple packed columns to obtain the chromatographic results needed. By using capillary columns and Micro-fluidics devices, chromatographic design can often be simplified.

Methods using packed columns were written at a time when operating a GC in flow control mode was not possible. With the advent of accurate electronic flow and pressure control (EPC) modules, users can operate the Agilent 7890 GC in flow control mode, allowing for better control over column flow, often resulting in decreased analysis times. Increasing speed of analysis is often important at a time when there is a global helium shortage resulting in an increased use of alternative carrier gases such as nitrogen.

This technique allows both liquid and gas injection, and is flexible with many types of sample matrixes.

## Experimental

Natural gas standard: (p/n 5080-8756)

*Table 1. Samples*

| Compound | Concentration (vol%) |
|---|---|
| Carbon dioxide | 1% |
| Ethane | 9% |
| Hexane | 0.5% |
| Iso-butane | 3% |
| Iso-pentane | 1% |
| Methane | 69% |
| *n*-butane | 3% |
| *n*-pentane | 1% |
| Nitrogen | 6% |
| Oxygen | 0.5% |
| Propane | 6% |

*Table 2. Chromatographic Conditions and Set Points*

| GC conditions | |
|---|---|
| Oven | 40 °C for 1.5 minutes,<br>then 50 °C/min to 250 °C for 1 minute |
| Run time | 6.7 minutes |
| SS inlet | Heater: 250 °C<br>Pressure: 33.119 psi<br>Total flow: 193.2 mL/min<br>Split ratio: 45:1<br>Split flow: 189 mL/min |
| Column 1 | Agilent 19091P-003, HP-Plot Q, 15 m × 320 µm, 20 µm<br>In: Front SS inlet<br>Out: PCM C-1 |
| Column 2 | Agilent Restrictor, 0.37 m × 100 µm<br>In: PCM C-1<br>Out: Front detector TCD |
| Column 3 | Agilent 19091P-MS4, HP-PLOT MoleSieve 5A,<br>30 m × 320 µm, 12 µm<br>In: PCM C-1<br>Out: Back detector TCD |
| Valve | 6-port Gas sample valve, 0.25 mL loop<br>Agilent Deans Switch, (p/n G2855B) |

## Results and Discussion

Traditional configurations for natural gas analysis use packed columns and multiple rotorary valves to perform the analysis. By using a single gas sample inject valve in series with a Micro-fluidics Deans Switch kit (p/n G2855B), a complete natural gas analysis through hexane was obtained in less than 6 minutes with resolution of oxygen and nitrogen. In comparison, the typical single valve GPA 2261 analyzer using packed columns requires 11 minutes to analyze through *n*-pentane, along with reporting a composite air peak instead of resolving oxygen and nitrogen. Other designs such as ASTM D1945 which resolves oxygen and nitrogen, require complex valve configurations and run times longer than 10 minutes.

This system employs a single valve switch for separation of oxygen, nitrogen, and hydrocarbons through hexane. If oxygen and nitrogen resolution is not needed and can be reported as an air composite, this analysis can be accomplished even faster on a single Plot Q column, requiring only an inject valve for introducing sample.

## Conclusions

By using a Micro-fluidics Deans Switch kit, the typical natural gas analysis can be simplified.

Analysis can be accomplished in under 6 minutes, including oxygen and nitrogen resolution.

Packed columns can be replaced with more efficient and readily available capillary columns.

In some cases, method development can be simplified by using capillary columns and CFT devices.

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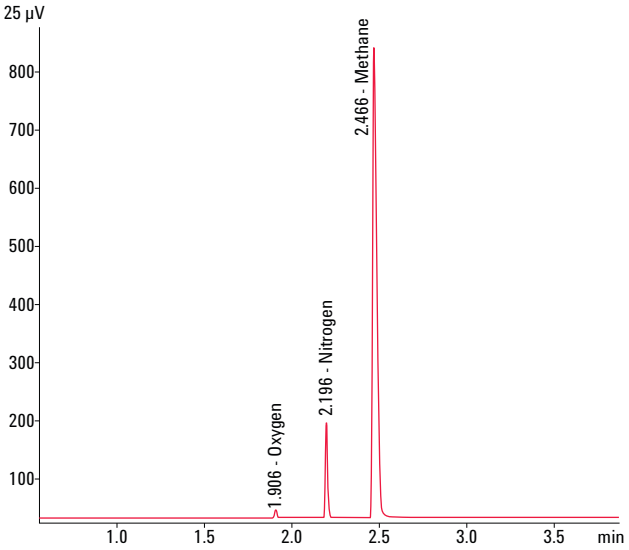


*Figure 1. Back TCD signal.*

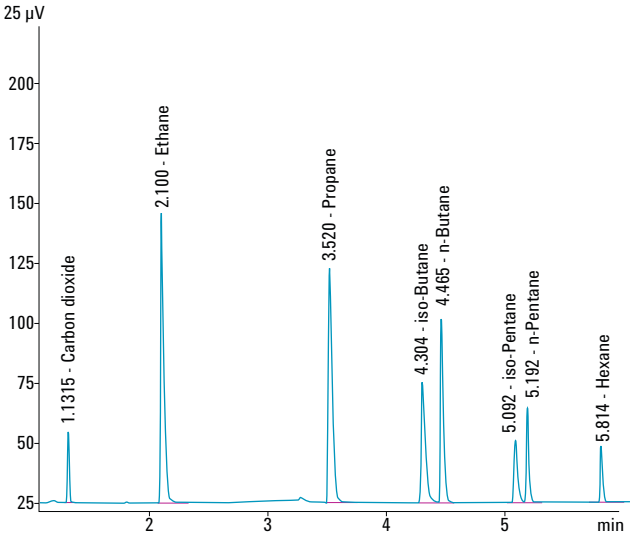


*Figure 2. Front TCD signal.*

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