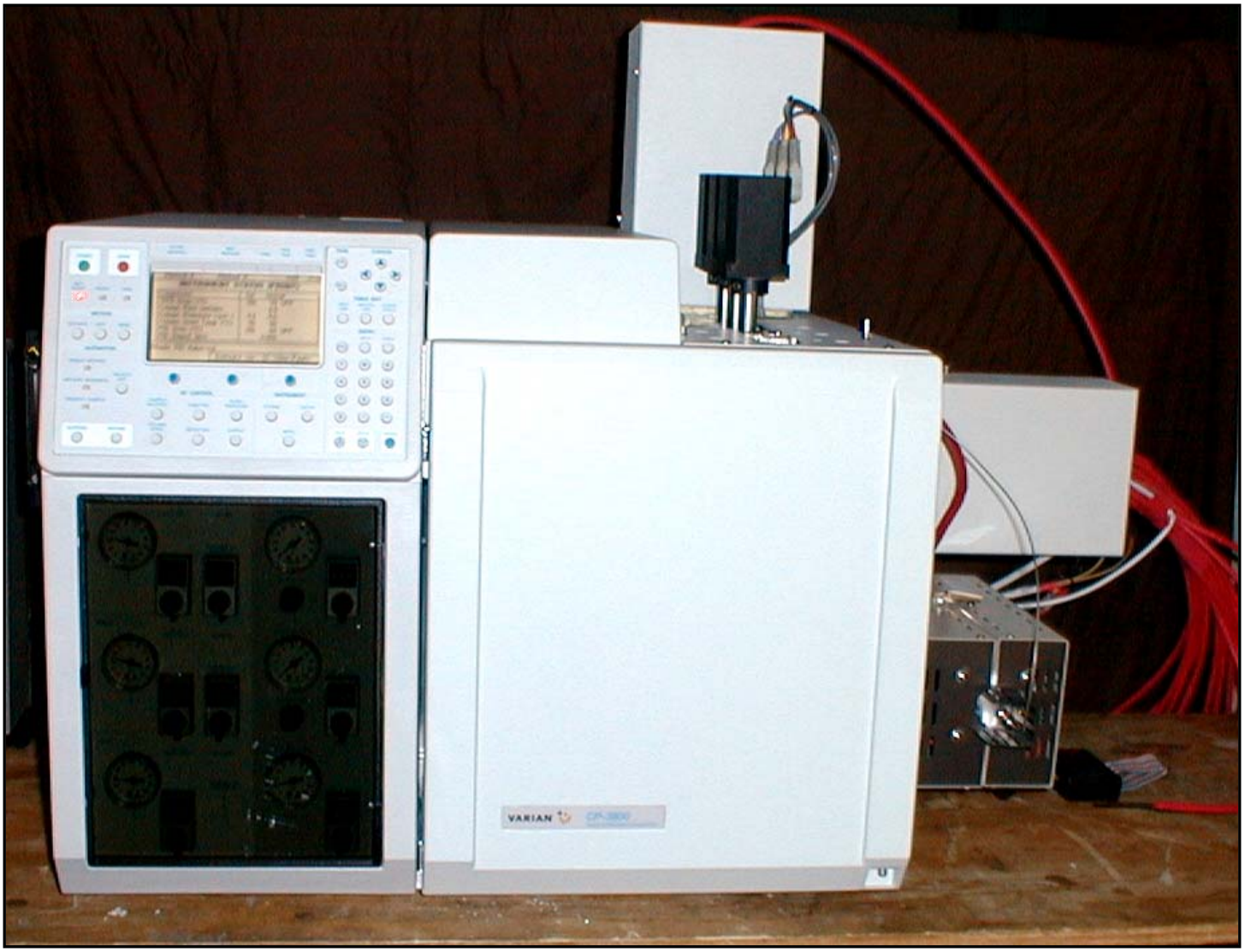
MULTI-PURPOSE GAS ANALYZER (MPGA)

Productivity remains the primary goal of most work environments. Utilizing a gas chromatographic system capable of performing multiple analyses on a series of samples without hardware changes or modifications between runs helps meet that goal. The Multi-Purpose Gas Analyzer (MPGA) from Lotus Consulting is designed to perform six different measurements on the same sample – either concurrently or sequentially. With the standard 16-position automated sampler, these measurements can be switched during the sampling sequence to suit the requirements for each sample.

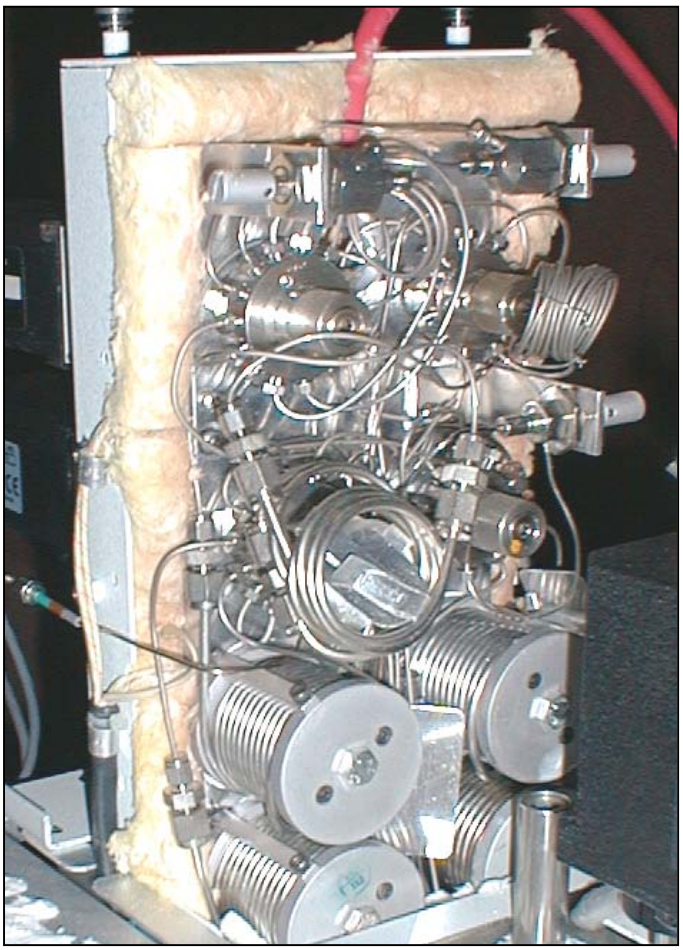
The analyzer is kept fully busy by loading samples with different analytical needs. The appropriate valving is activated, the proper column is selected, the correct detector is turned on and optimized, and full calibrations and control checks are performed for any of the six available methodologies – all automatically.

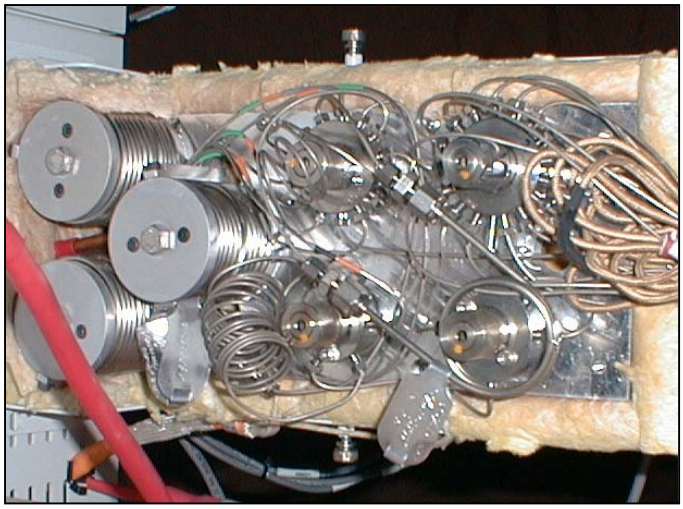
The system is based on the Varian 3800 Gas Chromatograph and takes advantage of virtual every feature available on the instrument. Three detectors are installed and fully operational at all times. Valves are mounted



in three separate valve ovens. All seven external events are employed to activate valves. Three electronic flow controllers and two detector electronic flow controllers are included. All seven thermal zones set temperatures for columns, valves, catalysts and detectors. Additional digital flow controllers and pressure regulators provide extra flows. And three external temperature controllers provide for heated sample lines and other thermal zones. The oxidation catalyst is located within its own oven mounted on the instrument's side.

The automated sampler is controlled through special software with the Varian Star Workstation. The sample position is user-specified in the Star SampleList with each sample line. The order is not mandated; samples can be examined in any order and even repeated later in the sequence. The sampling position is documented in the Star MessageLog and can be listed through a Star Custom Report along with the final results.





Built-in measurements include:

CLASSICAL NATURAL GAS (C_1-C_5, C_6+) – Following GPA methodology, the sample is injected into a valve/column scheme that performs a column sequence reversal with backflush to elute the C_6+ composite as a single peak prior to elution of C_1 through nC_5.

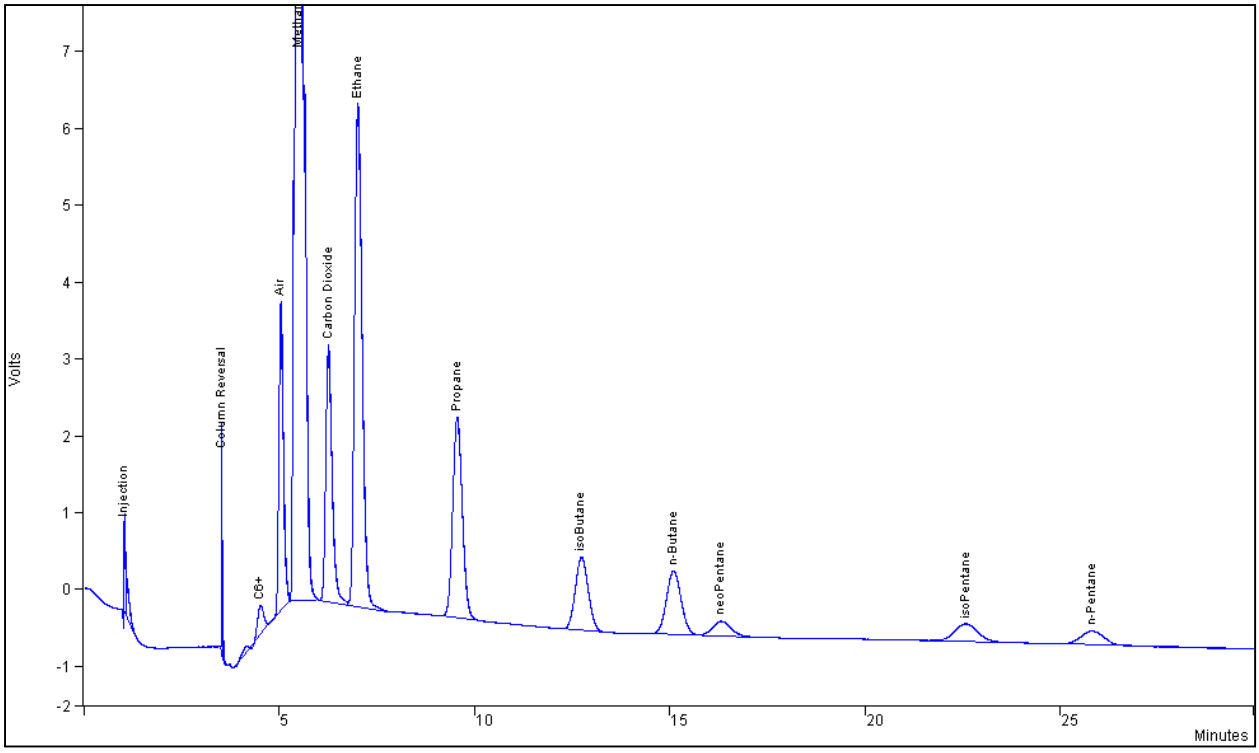
FULL SPECIATION OF NATURAL GAS – For full speciation of the C_6+ peak, the same sample can be injected into a capillary column outfitted with a splitter (to reduce the injection volume for optimum capillary chromatography).

NON-METHANE ORGANIC CARBON (NMOC) – Adapted from EPA Method 25, all organics including propane and heavier are backflushed off the column set and oxidized to CO_2 with a catalyst and then reduced to CH_4 with another catalyst. The total carbon count is accurately measured with an FID.

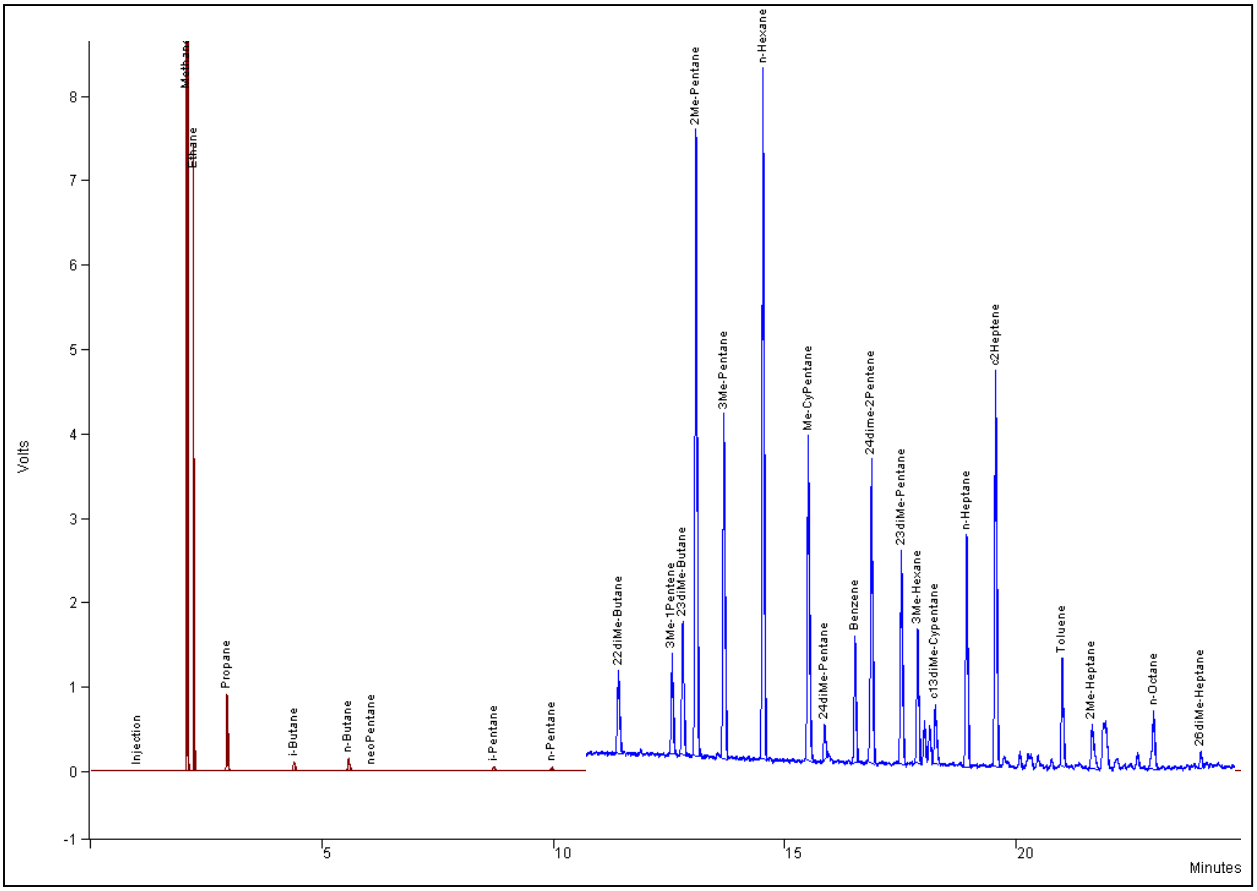
FIXED GASES – The valve/column configuration properly separates Hydrogen, Oxygen, Nitrogen, Carbon Monoxide and Carbon Dioxide. Detection is performed with a Pulsed Discharge Detector.

C_2S – Ethane, Ethene and Ethyne are separated with a custom valve/column setup. Results can be mathematically added to the NMOC for total Non-Methane.

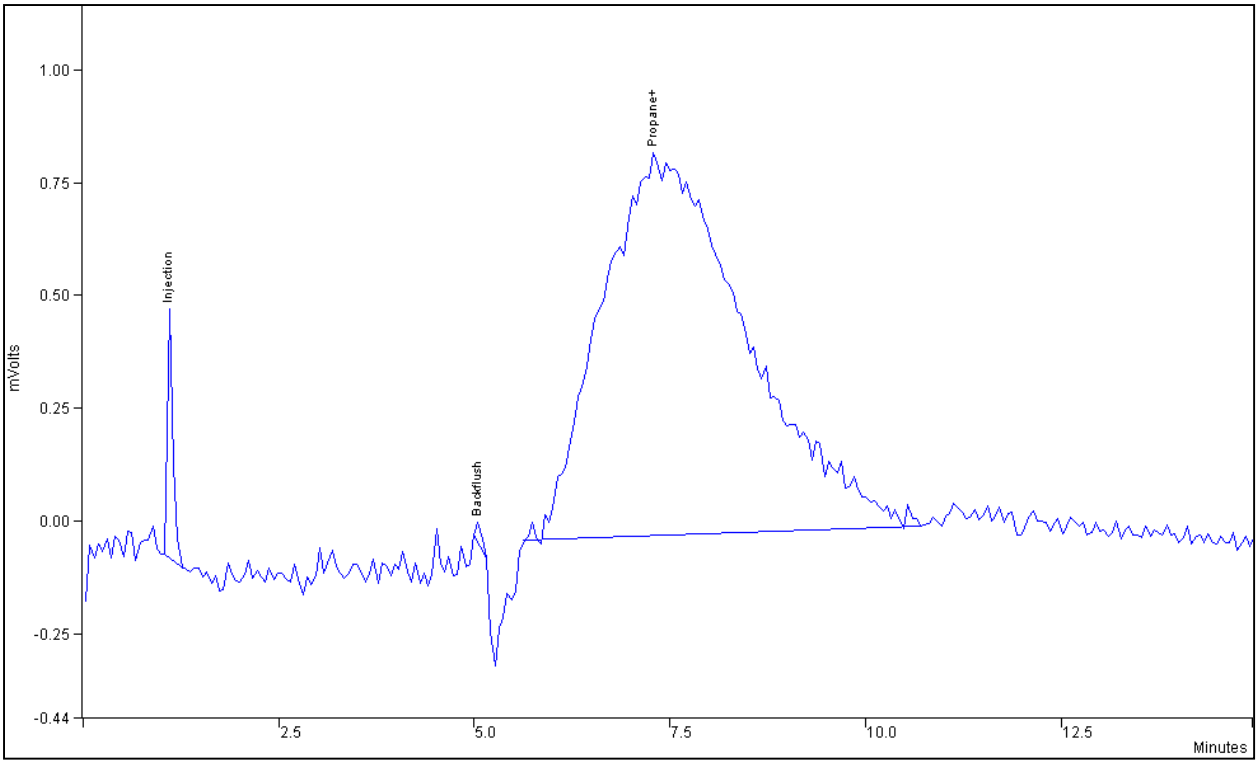
TOTAL HYDROCARBONS – Injecting a sample loop directly to an FID generates a composite peak that represents the total hydrocarbon content of a sample.



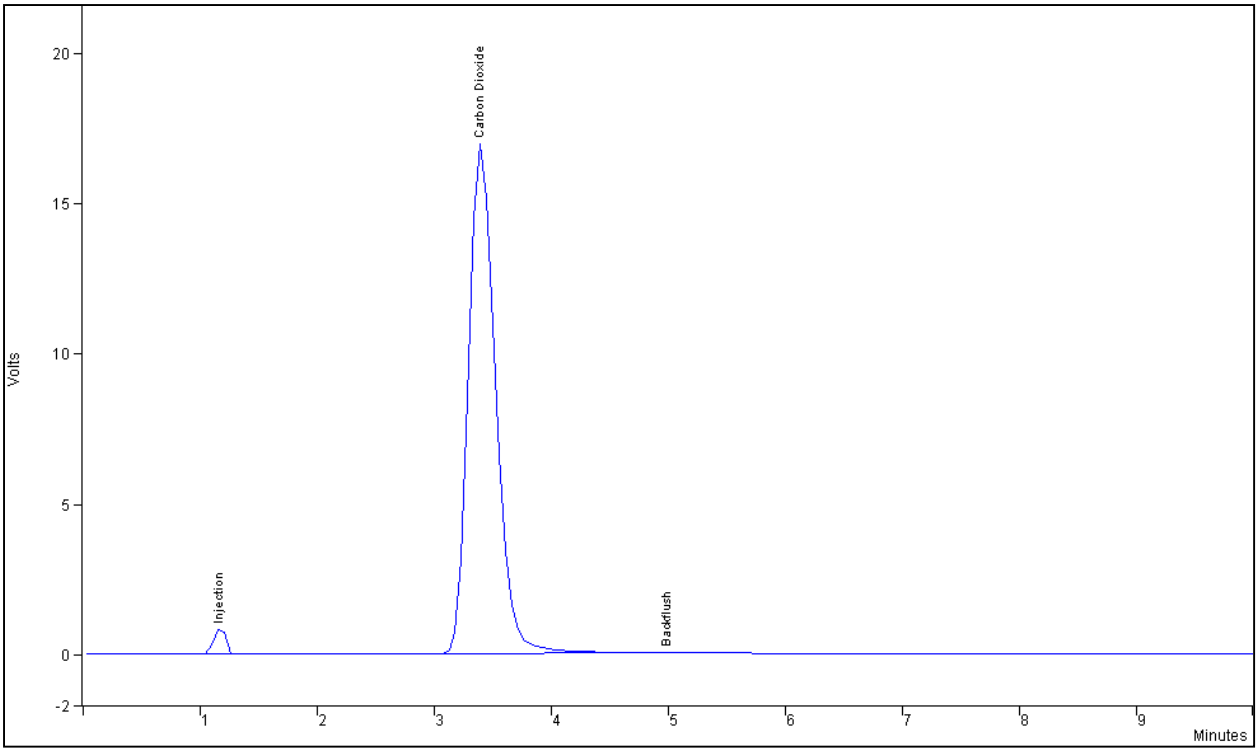
Chromatogram of Natural Gas Sample with Pulsed Discharge Detector.
Column temperature 110 °C; injection volume – 6 μl; pulsed discharge detector detuned.



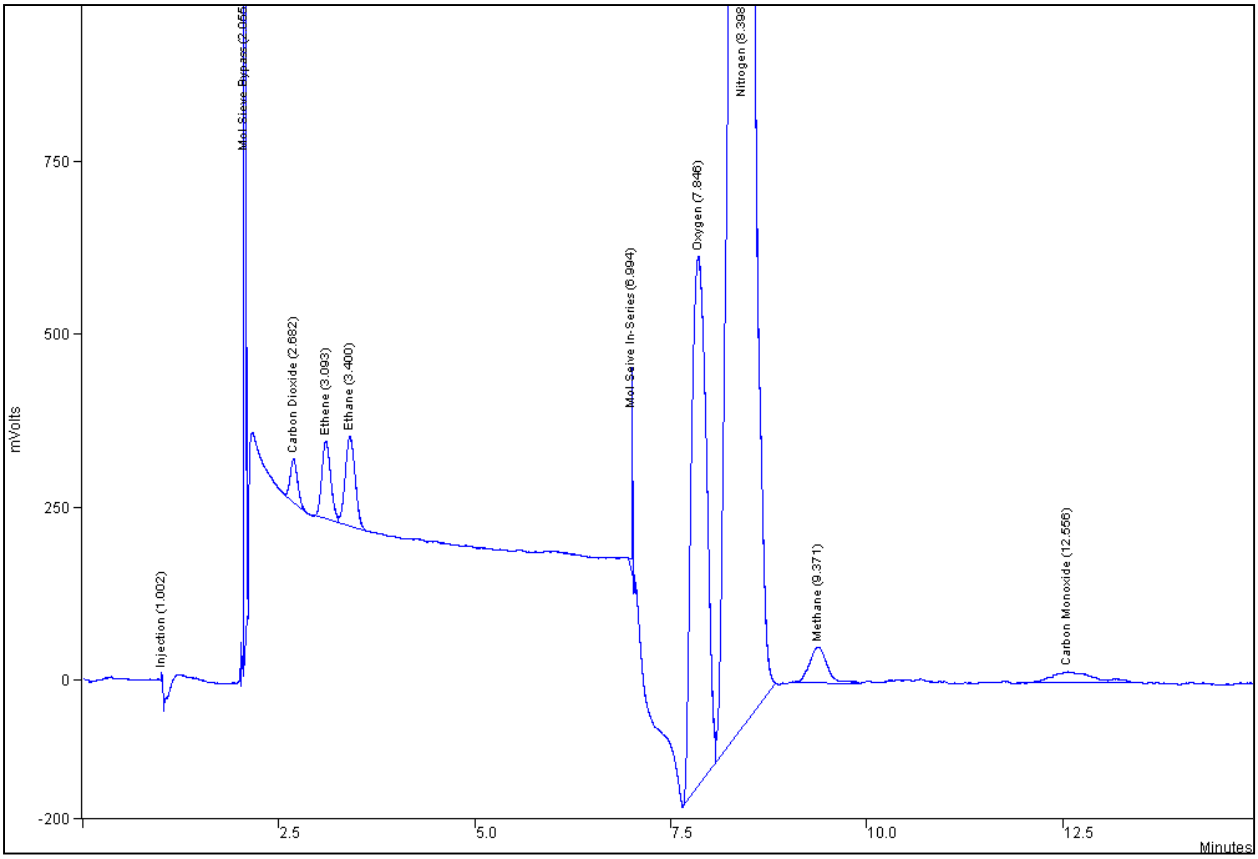
Typical Chromatogram from Full Speciation of Natural Gas Hydrocarbons with Widebore Capillary and Flame Ionization Detector. Methane peak exceeds 220 volts. Amplified portion inserted after n-Pentane. Column temperature: -50 °C, hold 1.00 min., ramp 5 °C/min to +150 °C; injection volume 0.25 ml.; split ratio 5:1



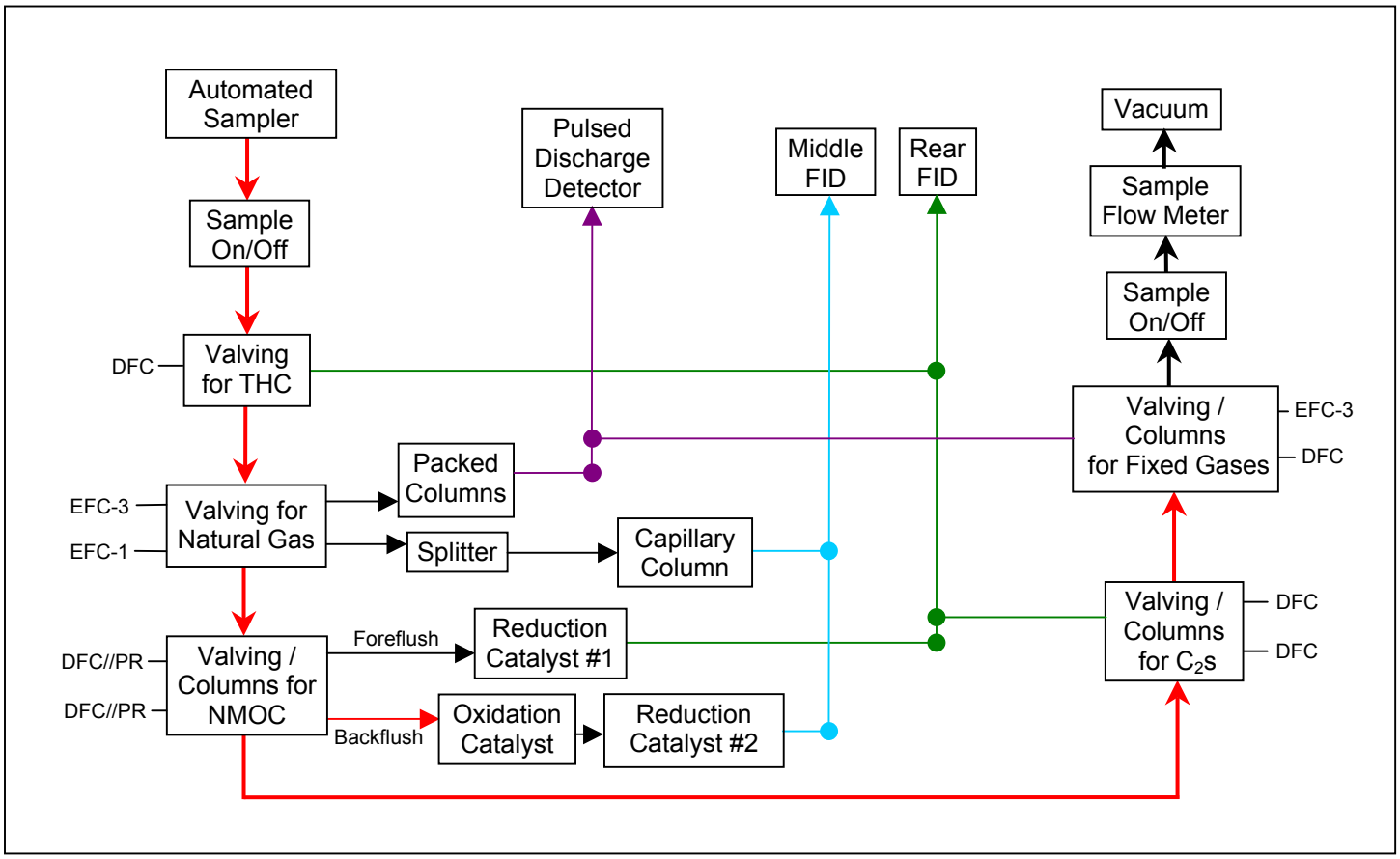
NMOC chromatogram of 62.4 ppm C n-Hexane. Column temperature – 120 ^{o}C; injection volume – 100 μl; blank baseline subtracted.

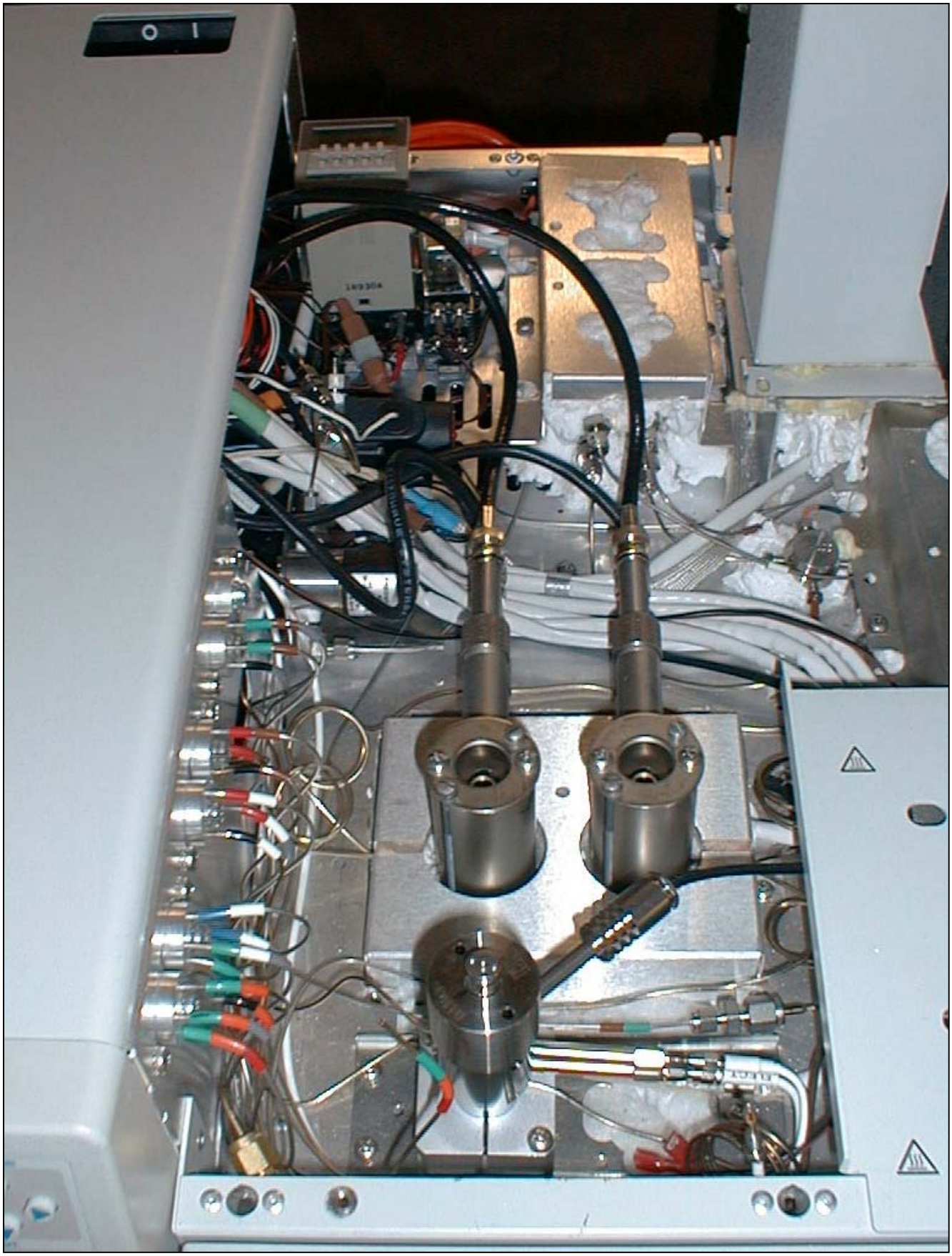


Foreflush chromatogram of 15% Carbon Dioxide. Column temperature – 120 ^{o}C; injection volume – 100 μl; blank baseline subtracted.



Chromatogram of 1000 ppm levels for Carbon Dioxide, Ethene, Ethane, Methane and Carbon Monoxide in Nitrogen. Column temperature – 120 °C; injection volume – 6 µl. Elution of Ethyne is expected at approximately 4.0 minutes. Baseline is not subtracted.





View of detector compartment with cover removed. Pulsed Discharge Detector is in front with the two Flame Ionization Detectors mounted on a common detector oven. The dual Reduction Catalysts are inside the oven in rear of picture.

Specifications

NATURAL GAS – C_1-C_5, C_6+ -

Injection volume – 6 µl
Detection limit – < 0.01 % V/V
Linear Range – < 0.01 % to 100% with pulsed discharge detector detuned

NATURAL GAS SPECIATION -

Injection volume – 0.25 ml
Detection Limit – < 0.4 ppm C with split ratio 10:1
Linear Range – < 0.4 ppm C to > 10,000 ppm C with split ratio 5:1

TOTAL HYDROCARBONS -

Injection volume – 0.25 ml
Detection Limit – < 0.4 ppm C
Linear Range – < 0.4 ppm C to > 10 % V/V

NON-METHANE ORGANIC CARBON -

Injection Volume – 100 µl
Detection limit – < 20 ppm C
Linear range – < 20 ppm C to > 50,000 ppm C (within +/- 5% of linearity)
Area Reproducibility – typically < 2% RSD (>10X detection limit)
Calibration Reproducibility – < ±3%
Oxidation Catalyst Efficiency – > 99%
Reduction Catalyst Efficiency – > 95%

FIXED GASES -

Injection volume – 6 µl
Detection Limit – O_2, N_2, H_2, CO_2, CO, CH_4 – < 300 ppm V/V
Linear Range – < 300 ppm V/V to 100 % V/V

C_2S -

Injection volume – 1.0 ml
Detection Limit – CH4, C2H6, C2H4 – < 0.1 ppm C
Linear Range – < 0.1 ppm C to > 10 %V/V

MISCELLANEOUS:

Detectors – Flame Ionization Detector, 2 each; Pulsed Discharge Detector

Electrometers – Three each included each with single range from 100 µVolts full scale to 1000 Volts full scale (10^7 dynamic range) with Star Workstation

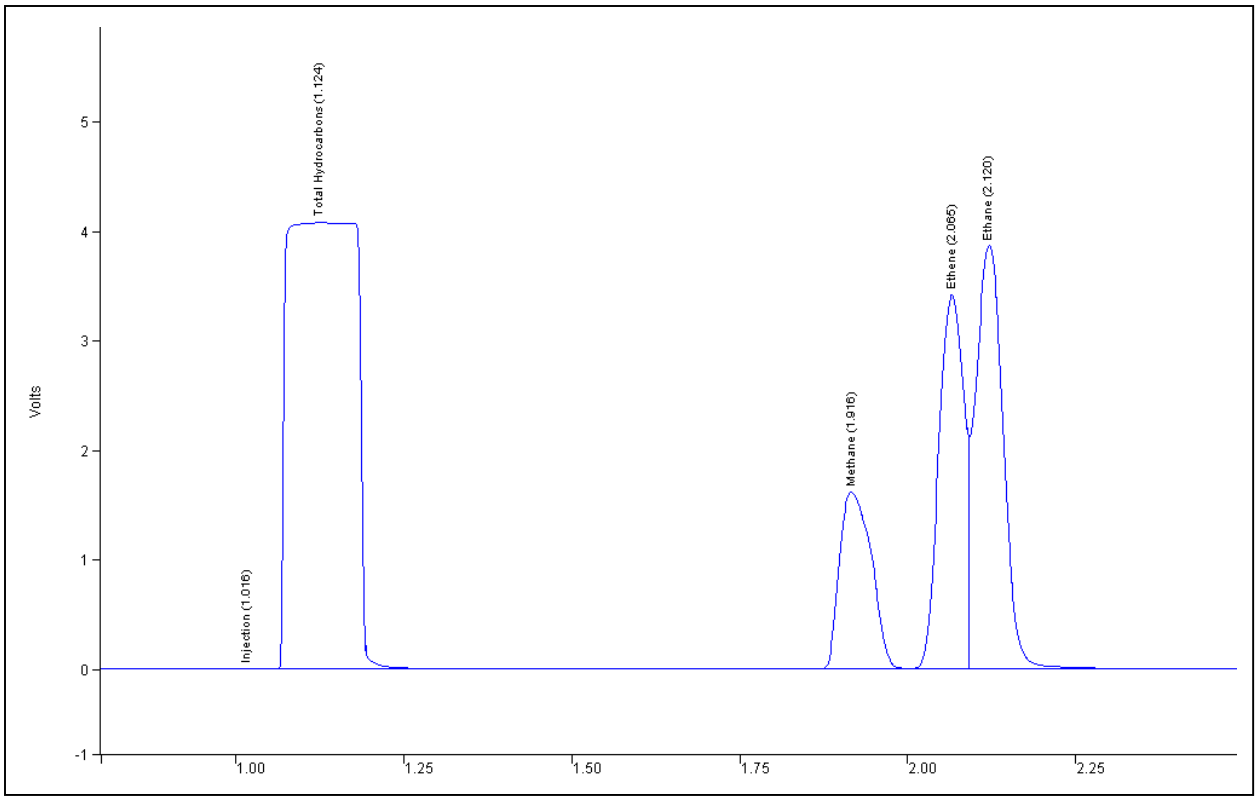
Carrier Gas Flows –Electronic Flow Controller Type 1 for Natural Gas Speciation with full control over spilt ratios; two Electronic Flow Controllers Type 3 for Natural Gas C_1-C_5, C_6+ and Fixed Gases. Flows for other analyses set with Digital Flow Controllers. Most pressures displayed on gauges visible from front of instrument

Detector Gases Controls – Two Detector Electronic Flow Controllers for air, hydrogen and catalyst hydrogen

Sample Introduction – Tedlar™ bag, pressurized canister or gas-tight syringe (for fixed gases only) all standard and fully operational with no hardware changes; Multi-position Automated Sampler (up to 16 positions) with micro-electric actuation and control through Star Workstation included

Valving – All valves are high performance, low volume design by Valco Instruments and all valves involved in chromatography are heated; all valves are fully automated with micro-electric actuation

Temperature Probes – All temperature zones within the gas chromatograph monitored with self-calibrating Platinum Probes and controlled with Fully Proportional Heating



Total Hydrocarbon content of a sample can be represented as a peak generated by injecting a fixed volume sample directly to an FID. Methane, Ethane and Ethene peaks are generated from concurrent injection to the same detector. Column temperature – 120 ^{o}C; injection volume – 0.25 ml THC, 1.00 ml C_2s.

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