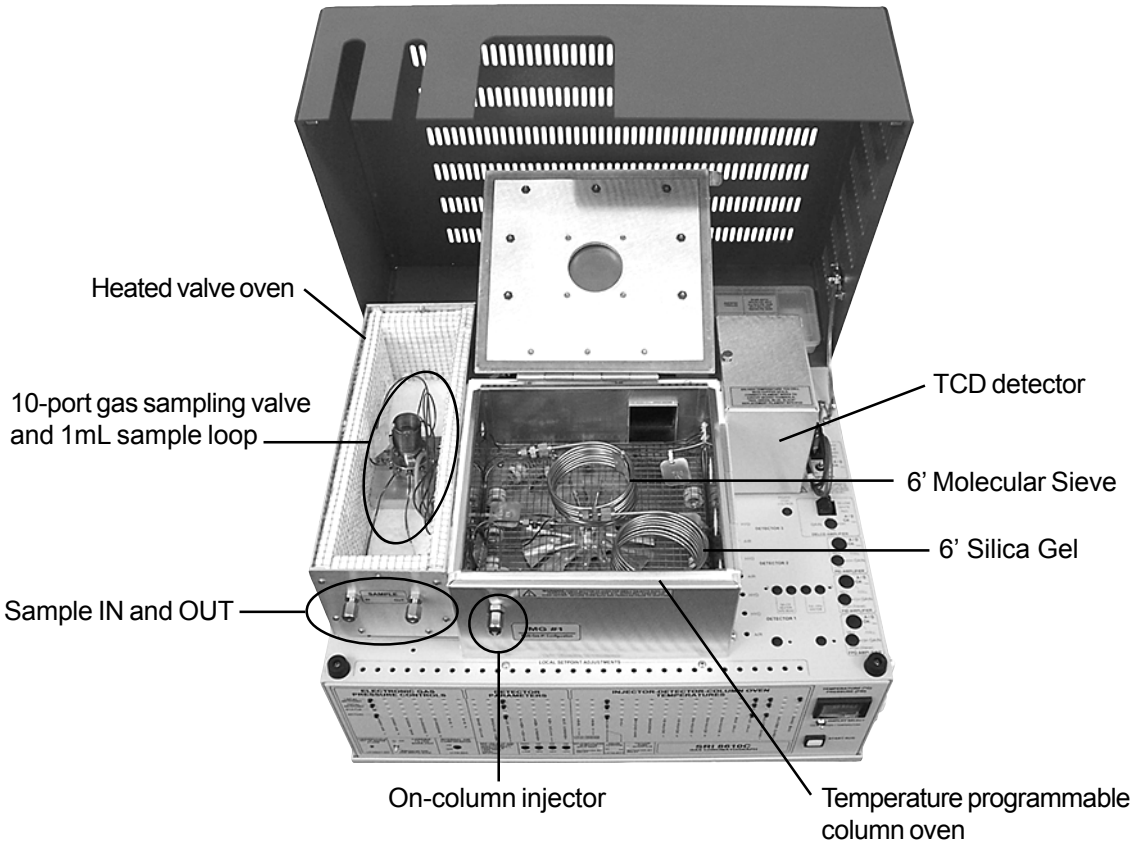
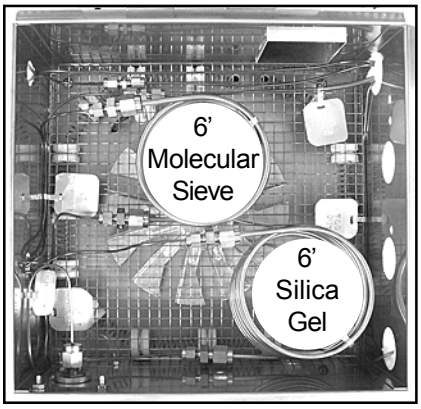
## *System Overview*

Your SRI Multiple Gas Analyzer #1 (MG#1) GC is pre-plumbed and ready to resolve $H_2$, $O_2$, $N_2$, Methane, CO, Ethane, $CO_2$, Ethylene, NOx, Acetylene, Propane, Butanes, Pentanes, and $C_6$ through $C_8$. The basic version of the MG#1 has a TCD detector. An HID detector or an FID with the integrated Methanizer may be added.




The MG#1 allows you obtain complete analyses of the fixed and natural gases listed above with a single injection. The MG#1 achieves this using a 10-port gas sampling valve with a 1mL sample loop in the heated valve oven, and two columns in the temperature programmable column oven.

# POPULAR CONFIGURATION GCs
# Multiple Gas Analyzer #1

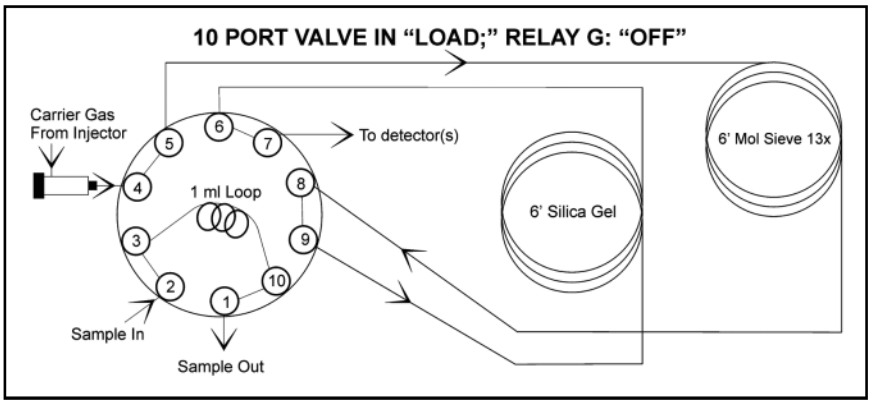
## *Theory of Operation*

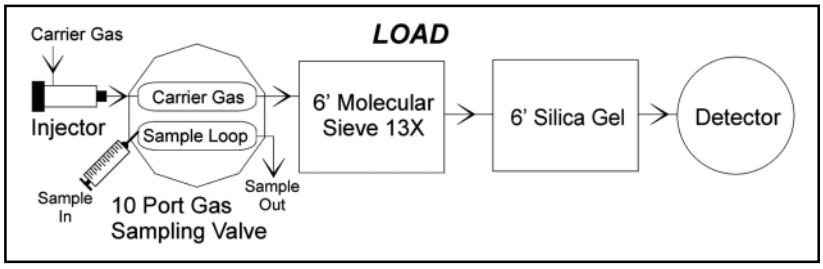
### *10-Port Gas Sampling Valve Plumbing Connections*

The valve, sample loop, and column combination is plumbed in a specific way to allow the MG#1 to separate hydrogen, oxygen, nitrogen, methane, ethane, propanes, butanes, pentanes, carbon monoxide, and carbon dioxide with a single injection.

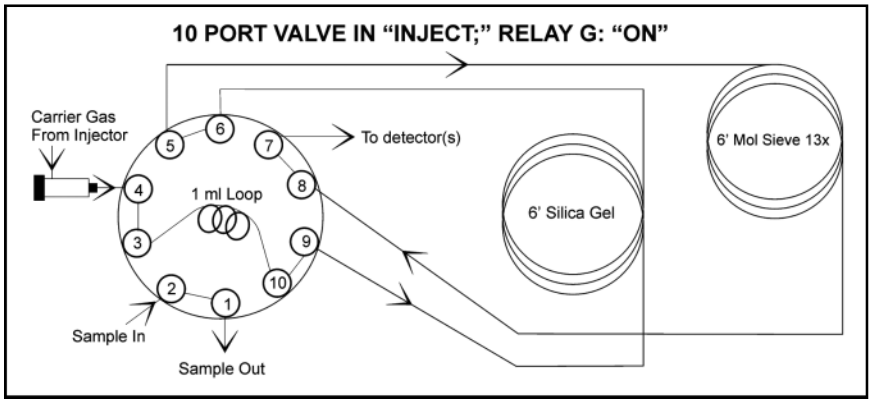
10-Port Gas Sampling Valve in the LOAD Position

A one-milliliter sample loop is connected to the 10-port gas sampling valve. When the valve is in the LOAD position, sample may be flowed through this loop until the moment injection occurs (when the valve switches to the INJECT position).



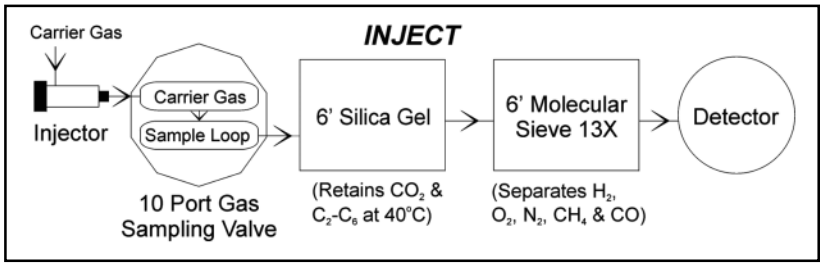




10-Port Gas Sampling Valve in the INJECT Position



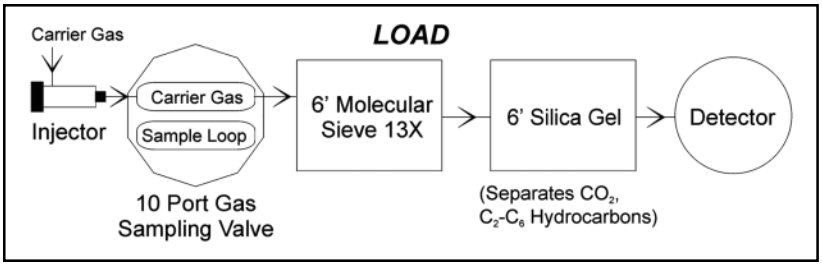

At the beginning of the chromatographic run, the valve is actuated to the INJECT position, depositing the sample loop contents into the carrier gas stream and directing it to the two analytical columns, which are connected in series through the 10-port valve.

*The column sequence is reversed while the flow direction remains the same.*



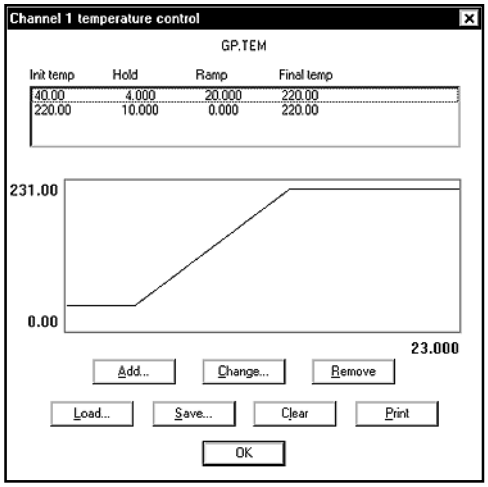
## *Theory of Operation*
### *10-Port Gas Sampling Valve Plumbing Connections*

The sample is deposited by the carrier gas stream first into the Silica Gel column, with the column oven holding at 40°C, where the ethane, propane, butanes, pentanes, and carbon dioxide are retained. The remainder of the sample containing $H_2$ (or helium, whichever is not being used as a carrier), $O_2$, $N_2$, methane, and CO, continues on to the Molecular Sieve column. During a chromatographic run with the sampling valve in the INJECT position, the $H_2$ or helium, $O_2$, $N_2$, and methane components are the first to elute through the columns and into the detector. This is due to the Silica Gel's long retention of $C_2$, $CO_2$ and higher hydrocarbons at 40°C. The sampling valve is actuated back into the LOAD position immediately following the elution of the CO peak. This reverses the sequence of the columns prior to the detector, and sends the components preparing to elute from the Silica Gel packed column (ethane, propane, etc.) to the detector without passing them through the Molecular Sieve packed column. At the same time, the Silica Gel packed column is temperature ramped to promote the rapid elution of the remaining components.



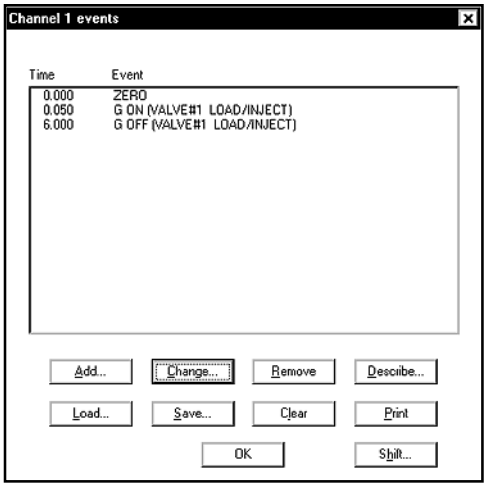

After the elution of the CO peak, the valve is switched back into the LOAD position, and the $C_2$, $CO_2$, and higher hydrocarbons come off the Silica Gel column.

The built-in data system automates the process: the column oven temperature is controlled through a PeakSimple temperature program, and the sampling valve is controlled through a PeakSimple event table.




Temperature program:

| Initial | Hold | Ramp | Final |
|---|---|---|---|
| 40°C | 4.00 | 20.00 | 220°C |
| 220°C | 10.00 | 0.00 | 220°C |



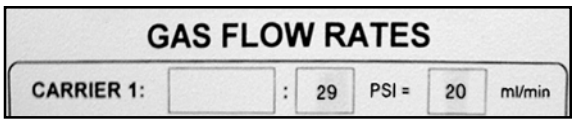

Event table:

| Time | Event |
|---|---|
| 0.000 | ZERO |
| 0.050 | G ON (valve in INJECT) |
| 6.000 | G OFF (valve in LOAD) |

## POPULAR CONFIGURATION GCs
## Multiple Gas Analyzer #1

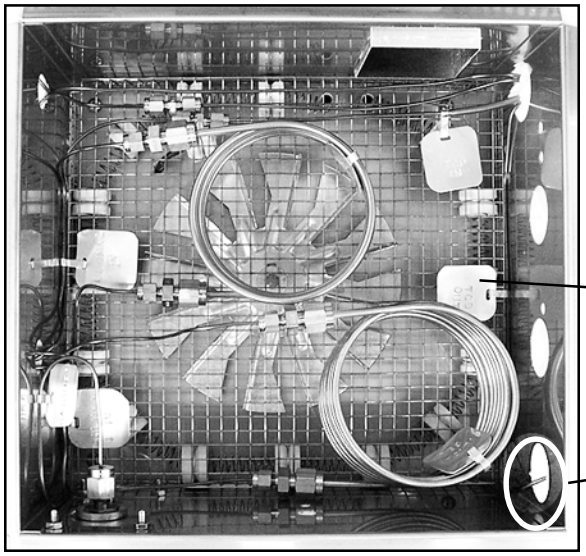
### *General Operating Procedures*

1. Set the cylinder head pressure 15-20psi higher than the head pressure. The carrier head pressure used to generate the test chromatograms at the factory is printed on the right side of your GC.




For this particular TCD-equipped MG#1, the head pressure required for a 20mL/min flow is 29psi.

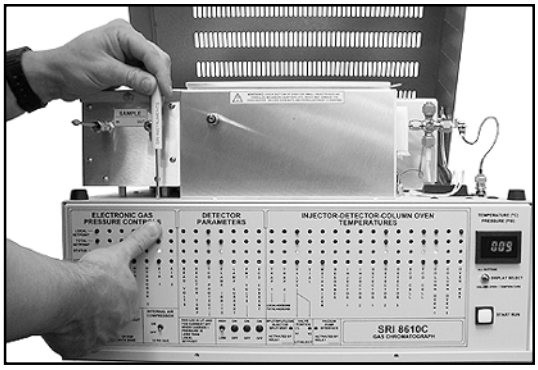
2. *IMPORTANT:* Damage or destruction of the TCD filaments will occur if current is applied in the absence of flowing carrier gas. ALWAYS verify that carrier gas can be detected exiting the TCD carrier gas outlet BEFORE turning the TCD current ON. Tagged for identification, the TCD outlet tubing is located in the column oven. The end of this tubing will be protruding from the column oven wall on the detector side, unless there is also an FID or HID installed. In this case, the TCD outlet tubing will be connected to the FID or HID detector bulkhead fitting in the column oven wall. Place the end of the TCD outlet tubing in some liquid and observe. If there are no bubbles exiting the tube, there is a flow problem. DO NOT turn ON the TCD current if carrier gas flow is not detectable. A filament protection circuit shuts OFF the TCD current if the column head pressure drops below 3psi, but it cannot prevent filament damage under all circumstances. Any lack of carrier gas flow should be corrected before proceeding. If necessary, reconnect the TCD outlet tubing to the FID or HID when you are finished testing the carrier flow.



The TCD carrier outlet tubing is tagged inside the column oven.

Unless connected to another detector, the end of the TCD outlet tubing will be on the outside of the column oven wall.

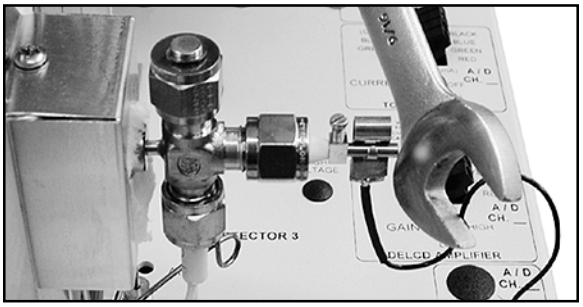
3. If your MG#1 has an FID/Methanizer, set the FID hydrogen flow to 25mL/minute, and the FID combustion air to 250mL/minute. If your MG#1 has an HID, set the helium make-up flow to 40mL/minute and the helium carrier to 10mL/minute. Again, check the "GAS FLOW RATES" printed on the right-hand side of your GC for its flows and the approximate required pressures. Gas flows are adjusted using the trimpots on the top edge of your GC's front control panel. Turn each trimpot while pressing its LOCAL SETPOINT button until the LED display shows the same pressure (in psi) as that printed under GAS FLOW RATES.




4. Set the valve oven temperature to 90°C. If present: set the FID/Methanizer temperature to 380°C; set the HID temperature to 200°C.

## *General Operating Procedures continued*

5. Turn the TCD current ON to LOW. Ignite the FID, if present, by holding up the ignitor switch (labeled "FLAME IGNITE") for a couple of seconds until you hear a small POP. The ignitor switch is located on your GC's front control panel under the heading "DETECTOR PARAMETERS." Verify that the FID flame is lit by holding the shiny side of a chromed wrench directly in front of the FID exhaust vent. The flame is lit when condensation is visible on the wrench surface.




If present, switch on the HID current and set it to 100 using the trimpot and LOCAL SETPOINT button. You should be able to see a purple arc between the two HID electrodes.

Please see the DETECTORS section in your SRI manual for more information.

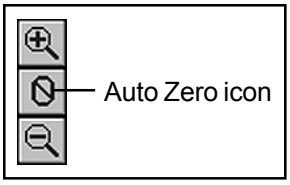
6. Ethane is the first peak to elute from the Silica Gel column after the $H_2$, $O_2$, $N_2$, $CH_4$, and CO, which are separated by the Molecular Sieve column. The ethane and $CO_2$ will get stuck in the Molecular Sieve column if the gas sampling valve is not rotated back into the LOAD position (by turning Relay G OFF) prior to the ethane elution. Therefore, you must determine the elution time of ethane, so that you can set an event program that will rotate the valve at the right time during the run. Type in an event program as follows:

| Time | Event |
|---|---|
| 0.00 | Zero |
| 0.1 | G ON |
| 0.3 | G OFF |

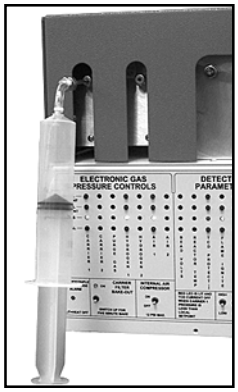
This event program will inject the sample loop contents into the Silica Gel column, then immediately reverse the columns so the sample will not enter the Molecular Sieve column. Since ethane is the first peak off the column, it is easy to determine its elution time.

7. Set the column oven temperature program as follows:

| Initial | Hold | Ramp | Final |
|---|---|---|---|
| 40°C | 6.00 | 10.00 | 200°C |




8. Zero the data system signal by clicking on the Auto Zero icon on the left side of the chromatogram window. Inject a sample containing ethane into the gas sampling valve through the sample inlet on the front of the valve oven. Start the run by pressing the computer keyboard spacebar, or by pressing the START button on the front of your GC. Note the elution time of ethane.




Injection by syringe of gas sample into valve

9. Revise the event program so that Relay G turns OFF just before the ethane peak begins to rise from the baseline. A typical event table for the MG#1 GC system is shown at right.

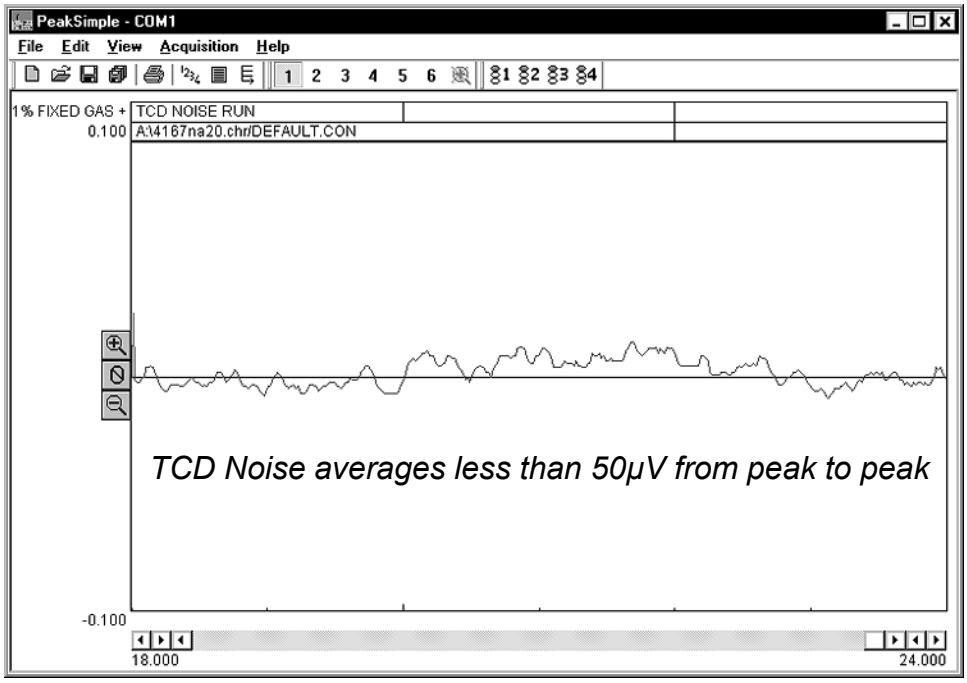
| Time | Event |
|---|---|
| 0.00 | Zero |
| 0.1 | G ON |
| 6.0 | G OFF |

10. Revise the temperature program if necessary. The temperature program used for the test chromatogram on the Expected Performance page works well with the above event program.

| Initial | Hold | Ramp | Final |
|---|---|---|---|
| 40°C | 4.00 | 20.00 | 220°C |

# POPULAR CONFIGURATION GCs
# Multiple Gas Analyzer #1

## *Expected Performance*




### TCD Noise Run

Columns: 6' Silica Gel, 6' Molecular Sieve
Carrier: Helium @ 20mL/min
TCD gain: LOW
TCD temperature: 150°C
Valve temperature: 90°C

Temperature program:

| Initial | Hold | Ramp | Final |
|---|---|---|---|
| 80°C | 24.00 | 0.00 | 80°C |

### Factory Test Analysis of 1% Fixed Gas Standard + Ethane

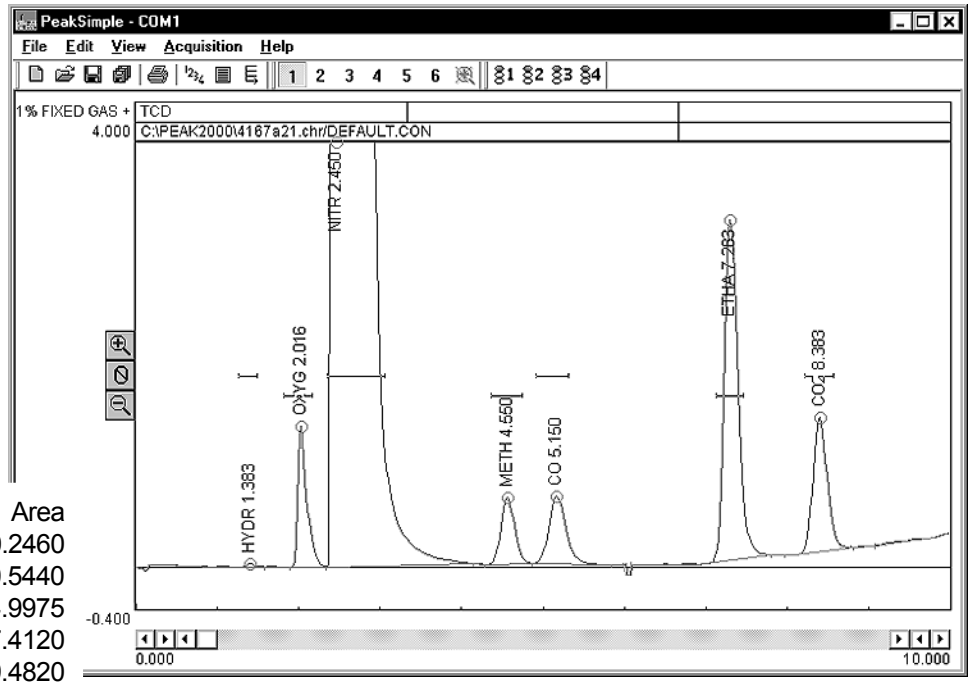
Sample: 1mL 100% ethane + 49mL 1% Fixed Gas Mix
Columns: 6' Silica Gel, 6' Molecular Sieve
Carrier: helium at 20mL/min
TCD gain: LOW
TCD temperature: 150°C
Valve temperature: 90°C

Temperature program:

| Initial | Hold | Ramp | Final |
|---|---|---|---|
| 40°C | 4.00 | 20.00 | 220°C |

Events:

| Time | Event |
|---|---|
| 0.00 | Zero |
| 0.050 | G ON (valve INJECT) |
| 6.000 | G OFF (valve LOAD) |




Results:

| Component | Retention | Area |
|---|---|---|
| Hydrogen | 1.383 | 0.2460 |
| Oxygen | 2.016 | 10.5440 |
| Nitrogen | 2.450 | 924.9975 |
| Methane | 4.550 | 7.4120 |
| CO | 5.510 | 9.4820 |
| Ethane | 7.283 | 38.2725 |
| $CO_2$ | 8.383 | 15.4100 |
| | TOTAL | 1006.3640 |