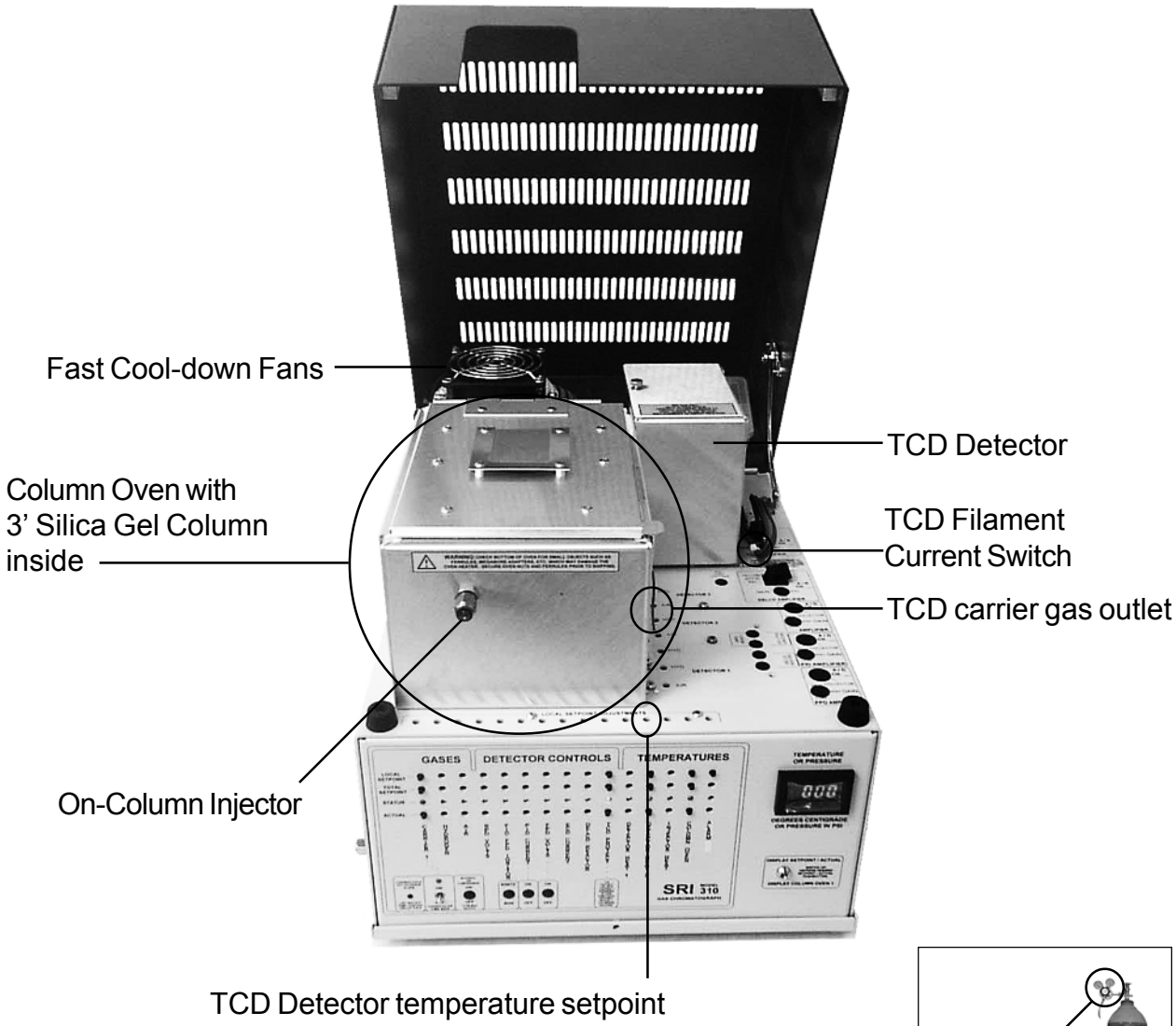
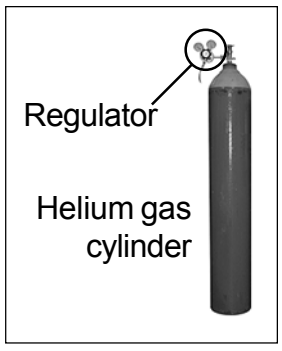
System Overview

Your educational TCD GC is configured on the compact 310 chassis. It is equipped with a TCD Detector, a temperature programmable Column Oven, a 3' Silica Gel packed column, Electronic Pressure Control (EPC) for carrier gas, On-column Injector, and a built-in, single channel PeakSimple Data System. The model shown below is equipped with optional Fast Cool-down fans.





The TCD Detector is located inside its own oven, mounted on the right rear of the Column Oven as shown above. Its temperature is factory preset at 100°C, but it may be heated up to 130°C by adjusting the trimpot with the small blade screwdriver attached to the front right corner of your GC. The trimpot looks like a small brass screw and is located inside the labeled hole on the top edge of the front control panel.

The TCD Detector requires helium to operate, which must be supplied by a gas cylinder and regulator. The helium cylinder pressure is normally set at 30psi, which is 10-20psi higher than the column head pressure.

General Operating Procedure

1. Check to make sure that the TCD filament current is switched OFF. Plug in and turn on your GC. Allow the TCD detector oven to reach temperature (100°C) and stabilize. With the "Display Select" switch in the UP position, press on the TCD Temperature Actual button on the front control panel to read the TCD cell temperature.

2. The carrier gas head pressure is preset at the factory to 10mL/min for the Silica Gel column. Look on the right side of the GC for the carrier pressure that correlates to a flow of 10mL/min. Because different columns require different flow rates, the carrier head pressure may be adjusted by the user with the trimpot above the "CARRIER 1" buttons. For this GC, carrier cylinder pressure is normally set at 30psi, which is 10-20mL higher than the column head pressure. The column head pressure is the pressure developed by the carrier gas as it flows through the analytical column.

3. Make sure that the setpoint and actual pressures are within 1psi.

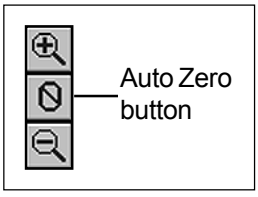
4. Damage or destruction of the TCD filaments will occur if current is applied in the absence of flowing carrier gas. ALWAYS verify that carrier gas can be detected exiting the TCD carrier gas outlet BEFORE energizing the TCD filaments. The carrier gas outlet tube is located on the outside of the Column Oven on the same side as the detector. Place the end of the tube in liquid and observe (a little spit on a finger can suffice). 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 prevents filament damage if carrier gas pressure is not detected at the GC, but it cannot prevent filament damage under all circumstances. Any lack of carrier gas flow should be corrected before proceeding.

5. With the TCD filaments switched OFF, zero the Data System signal. Switch the filaments to LOW. The signal's deflection should not be more than 5-10mV from zero for a brand-new TCD detector. Any more than a 5-10mV deflection indicates partial or complete oxidation of the TCD filaments; more deflection means more oxidation. Therefore, it is a good habit to use the Data System signal to check the working order of the TCD filaments.

6. In PeakSimple, set an isothermal Column Oven temperature ramp program as follows:

Initial Temp.	Hold	Ramp	Final Temp.
80.00	7.00	0.00	80.00

7. Click on the Zero button to the left of the chromatogram window in PeakSimple to zero out the Data System signal. Hit the RUN button on your GC or hit the spacebar on your computer keyboard to begin the run. You may also open the Acquisition pull-down menu and select Run, but this gets difficult unless you have a partner, since your hands are occupied with the sample syringe.



8. Using the 1mL syringe supplied with your GC, inject sample into column through the On-Column Injector.

Expected Performance

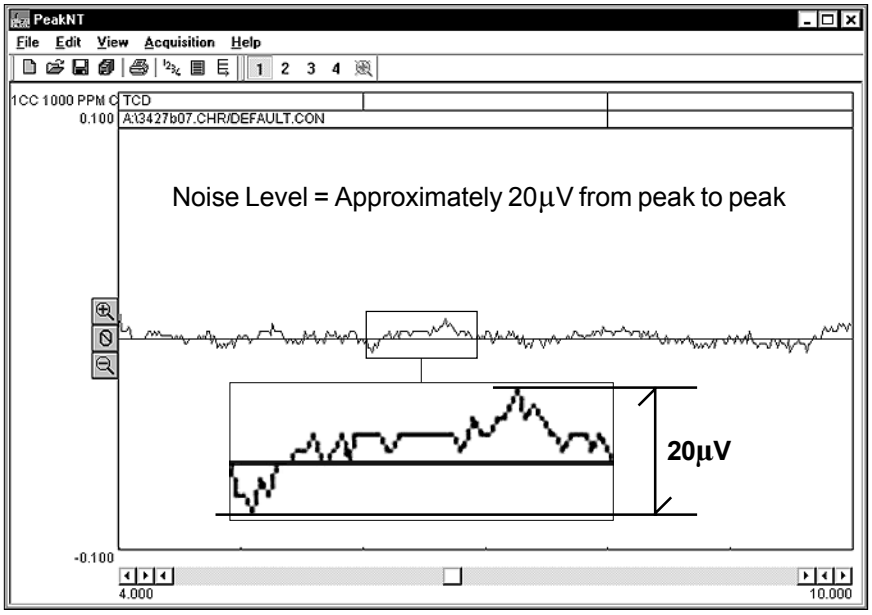
Every compound possesses some degree of thermal conductivity and therefore may be measured with a TCD detector. TCD detectors are most often used with helium as a carrier gas because of helium's high thermal conductivity, but other gases such as nitrogen, argon, or hydrogen may also be used as a carrier gas. A TCD detects all molecules in concentrations from 100% down to around 100ppm, and is especially useful for measuring inorganic gases like O_2, N_2, CO & CO_2.

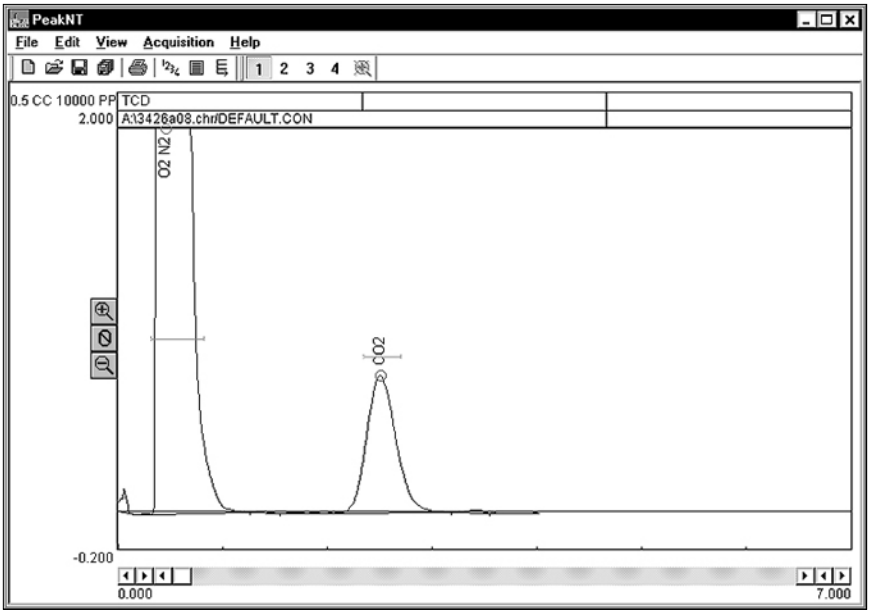
TCD Detector Noise

Column = 1m Silica Gel
Carrier = Helium at 10mL/min
TCD current = LOW
TCD Temp = 100°C

Temperature Program:

Initial	Hold	Ramp	Final
80°C	10.00	0.00	80°C





Factory test run of an Educational TCD GC

Column = 1m Silica Gel
Carrier = Helium at 10mL/min
Sample = 0.5cc 10,000ppm CO_2
TCD current = LOW
TCD Temp = 100°C

Temperature Program:

Initial	Hold	Ramp	Final
80°C	7.00	0.00	80°C

RESULTS:

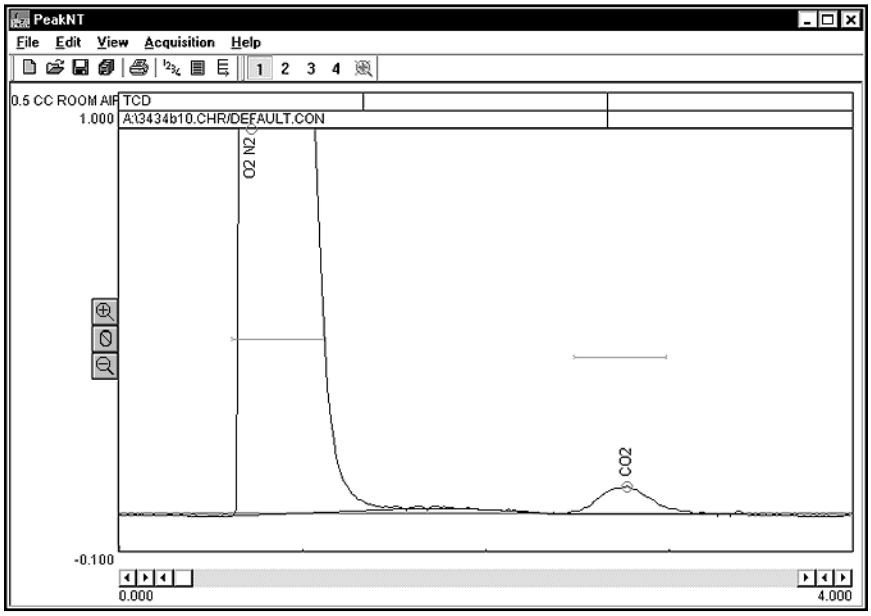
Component	Retention	Area
O2 N2	0.450	1252.9980
CO2	2.500	13.6460
Total		1266.6440

POPULAR CONFIGURATION GCs
Educational TCD

Expected Performance

TCD Room Air Analysis

Column: 3' Silica Gel
Carrier: Helium at 10mL/min
Sample: 0.5cc room air,
direct injection
TCD current: LOW
TCD temperature: 100°C



Temperature Program:

Initial	Hold	Ramp	Final
80°C	4.00	0.00	80°C

Results:

Component	Retention		Area
O_2 N_2	0.716		1021.3830
CO_2	2.766		1.5060
		Total	1022.8890

The CO_2 content of the room air analyzed is approximately 350ppm.

Suggested Class Experiment: "Waiting to Exhale"

CO_2 is a natural by-product of human respiration. Our lungs get oxygen when we inhale and release CO_2 when we exhale. When we hold our breath, the concentration of CO_2 increases. In this experimental gas chromatography analysis of human breath, the students will supply the samples. They will exhale into and trap their breath in the syringe, then it will be injected into the Educational TCD system and analyzed for CO_2 concentration. Have a contest for the highest CO_2 concentration: the student with the most CO_2 in his or her breath will win. Whomever passes out is disqualified!

1. Follow steps 1-4 of the ***General Operating Procedure***.

2. In PeakSimple, set an isothermal Column Oven temperature ramp program as follows:

Initial Temp.	Hold	Ramp	Final Temp.
80.00	4.00	0.00	80.00

3. Locate the 3mL (3cc) syringe supplied with your GC, remove its needle, and give both parts to a student. Instruct the student to exhale into the tip of the syringe while pulling back on the plunger. Students need not touch the syringe with their mouths for it to work. Fill the syringe completely, then replace the needle. Depress the plunger until the syringe contains 0.5mL of breath.

NOTE: For sanitation concerns, it may be prudent to have one new, sterile syringe for each participating student. Sterile 3mL syringes complete with needles may be acquired for about $0.18 each from:

VWR (800-932-5000):
BD-309587 Syringe-Needle, 3mL Sub-Q 26G 5/8 Luer-lok™

4. Click the Auto Zero button in PeakSimple, then press the RUN button on your GC or the spacebar on your PC keyboard to begin the run.

5. Inject sample into the On-Column injector.

6. Save and print the resulting PeakSimple chromatogram with the student's name for the sample identification. Typical results are about 12-14 area counts per 1% of CO_2.

7. Repeat steps 2-5 for each student. Compare chromatograms to find the winner.

Example TCD Breath Analysis

Column: 3' Silica Gel
Carrier: Helium at 10mL/min
Sample: 0.5cc human breath,
direct injection
TCD current: LOW
TCD temperature: 100°C

Temperature Program:

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

Results:

Component	Retention		Area
O_2 N_2	0.700		1379.4740
CO_2	2.700		61.9540
		Total	1441.4280