



EP-DT
Detector Technologies

GC training at GIF++

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CERN

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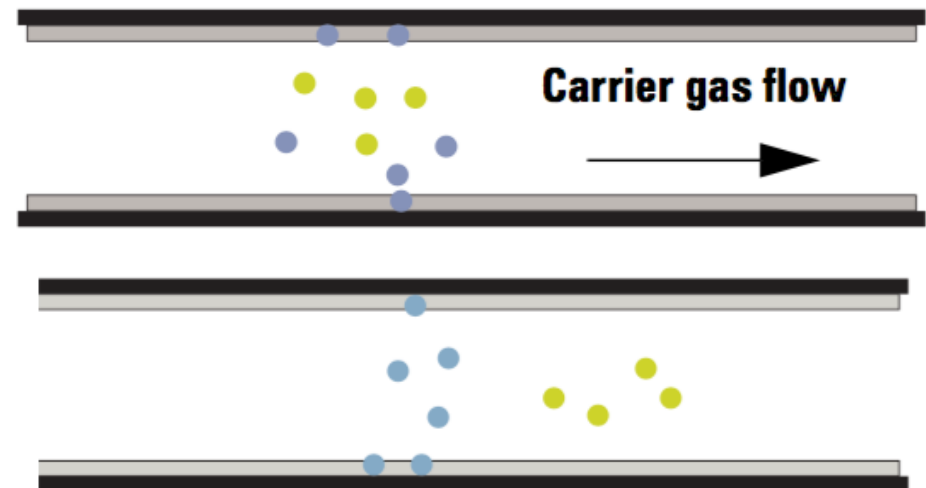
How the GC works

Fundamentals of Gas Chromatography

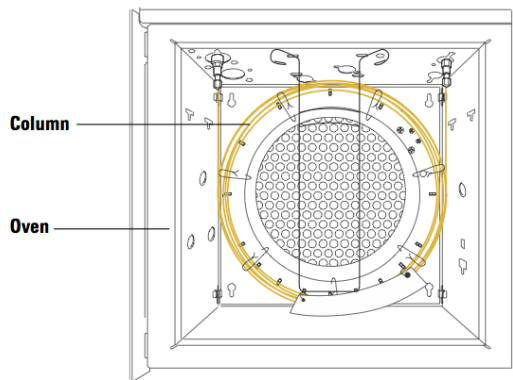
- It separates mixtures into individual components.
- GC creates a time separation.
- The mixture passes through a column containing a material that retards some components more than others → separation.
- The components are detected by the TCD.
- The result is a gas chromatogram (μV versus time).
- The components are identified by the retention time.
- Their concentration is given by the peak area.

The column

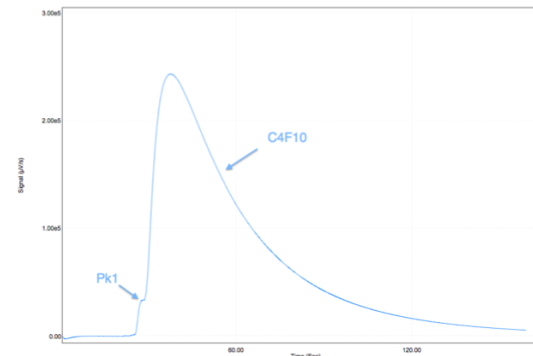
- Different types of column.
- The coating inside the column separates the components.
- Some components are more attracted than others to the coating.



How the GC works

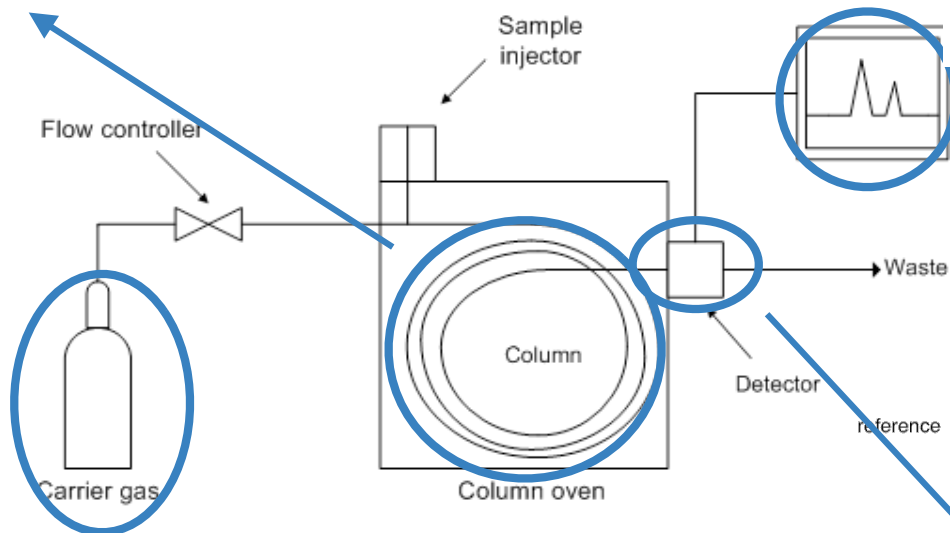


- Choice and thickness of column coating.
- Column length and diameter.
- Choice of carrier gas and flow rate.
- Oven temperature.



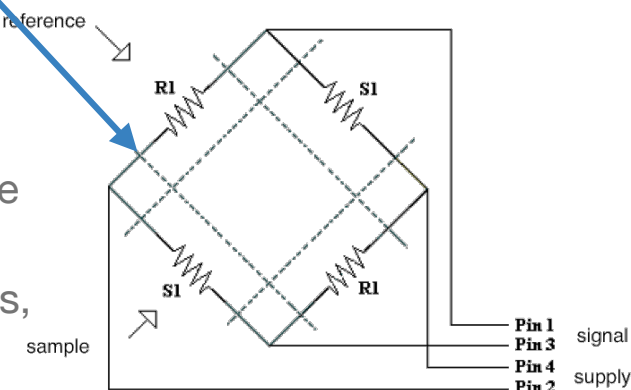
• μV versus time

- Carrier gas used as reference.
- Usually He or Ar (depends on what you want to identify)



- One way for carrier gas, the second for the analytical column flow.
- When the analytical flow is pure carrier gas, bridge is equilibrated and signal is zero.
- The analytical flow causes fluctuation in the filament temperature \rightarrow bridge disequilibrated.

Wheatstone bridge



How to run the GC

- **Connect your gas line at the GC**
 - 6 mm connector -> panel on the top of the GC with label
- **Max pressure around 200 mbar**
 - Pressure regulator on the panel
- **Regulate the gas flow**
 - Rotameter on the panel (about 2-5 l/h)
- **Never touch the two gas lines on the back of the GC!!!**
 - These are the carrier gas
 - In case the two lines are swapped -> GC breaks!!!

PC name: PC-PH-GIF-GC

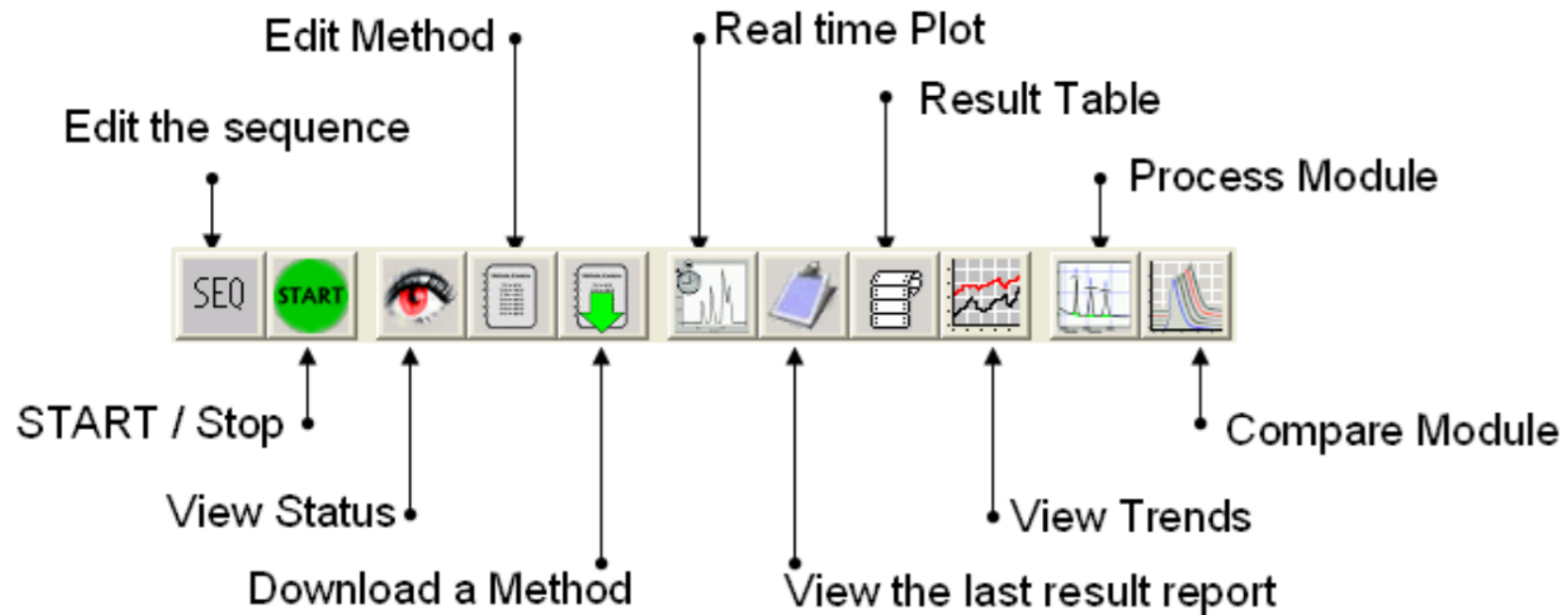
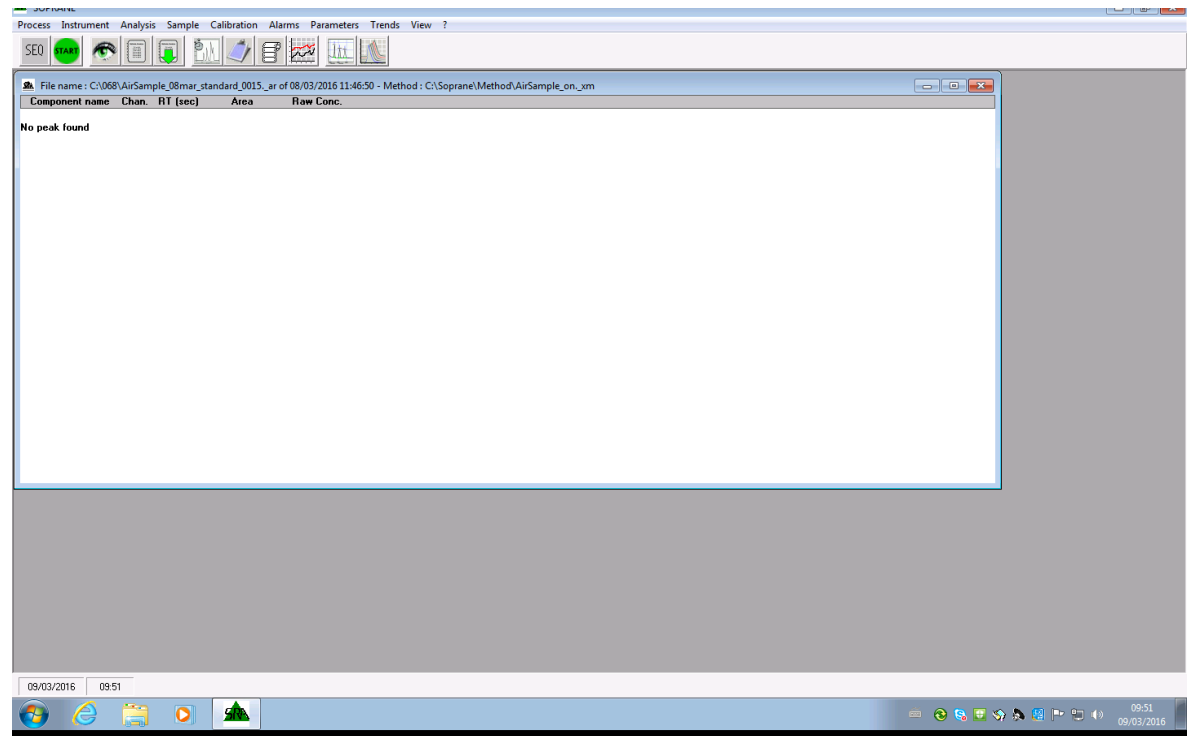
user name: two people for each set-up will be added in the users of the pc

Software: SOPRANE

Never use “Soprane SET-UP” software!!!

- Internal settings of the GC, only for experts

How to run the GC



GC columns and components

The screenshot shows the GC Status window for method c:\soprane\method\stand-by._xm. The status is 'Ready'. Three GC modules are listed:

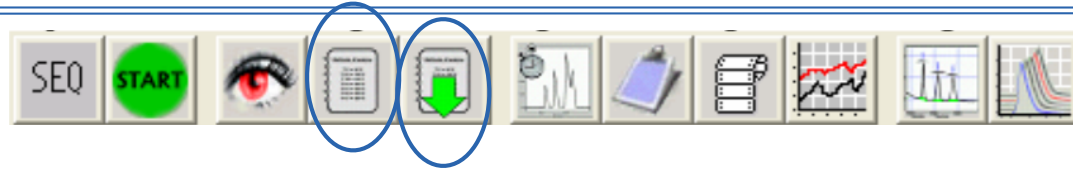
Module Name	Column Type	Temperature 1 (°C)	Temperature 2 (°C)	Temperature 3 (°C)	TCD Status
VAR Molsieve 14m GcModule	Molsieve	25.0	33.0	39.9	Off
VAR PPU 8m GcModule	PPU	24.3	28.0	40.0	Off
VAR OV-1 2.0um 8m GcModule	OV-1	24.3	28.0	40.0	Off

Annotations in the image:

- An eye icon in the top toolbar is circled in blue.
- An arrow points from the text 'Temperature column' to the column icon in the first module.
- An arrow points from the text 'TCD: by default off ON only for analysis' to the 'TCD Off' status in the first module.
- An 'Ok' button is visible at the bottom of the window.

- **Column A (MolSieve):** 5A zeolite molecular sieve. It separates permanent and noble gases: Ne, H₂, O₂, Ar, N₂, CH₄, CO.
- **Column B (PPlotU):** Porous Layer Open Tubular column. Stationary phase is Divinylbenzene/Ethylene glycol dimethacrylate. It separates CR_{1R} to CR_{4R} hydrocarbons, CO₂, CH₄, HR_{2RO}, H₂S, SO₂, N₂O...
- **Column C (OV-1):** polar column. Stationary phase is 100% polydimethylsiloxane. It separates hydrocarbons from CR₄ to C₁₂, BTEX, VOC...

Example of GC method



Analytical parameters

Method: C:\Soprane\Method\DT_on

Module A Module B Module C Module D

Module MS5A PPU OV1

Inlet temp. (°C) []

Inject temp. (°C) 85.00 75.00 65.00 []

Column temp. (°C) 115.00 65.00 65.00 []

Pump (sampling time) (s) Pump1: 60.00 Pump2: 60.00

Sampling time (s) 60.00 60.00 60.00

Inject time (ms) 100.00 25.00 25.00

Backflush time (s) []

Run time (s) 240.00

Column pressure (psi) 33.00 28.00 28.00 []

Detector ON ON ON OFF

Sensitivity Standard Standard Standard []

Progr. Temp./ Press. Prog A Prog B Prog C Prog D

New method Save as Print Param. OK Cancel

Each user has its method (created by us)

GC method: Stand-by

This method when we don't use the GC:

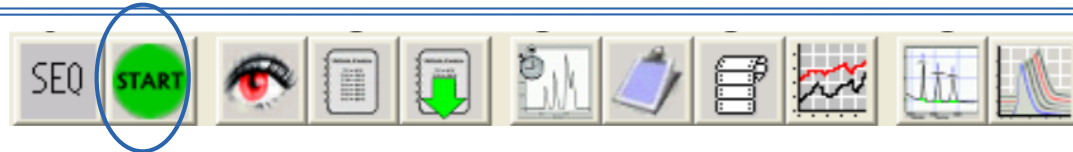
Analytical parameters

Method: C:\Soprane\Method\Stand-by

Module	MS5A	PPU	OV1	
Inlet temp. (°C)	<input type="checkbox"/>			
Inject temp. (°C)	<input type="checkbox"/> 85.00	<input type="checkbox"/> 80.00	<input type="checkbox"/> 80.00	<input type="checkbox"/>
Column temp. (°C)	<input checked="" type="checkbox"/> 40.00	<input checked="" type="checkbox"/> 40.00	<input checked="" type="checkbox"/> 40.00	<input type="checkbox"/>
Pump (sampling time) (s)	Pump1: 60.00		Pump2: 60.00	
Sampling time (s)	60.00	60.00	60.00	
Inject time (ms)	200.00	25.00	25.00	
Backflush time (s)				
Run time (s)	180.00			
Column pressure (psi)	<input checked="" type="checkbox"/> 33.00	<input checked="" type="checkbox"/> 28.00	<input checked="" type="checkbox"/> 28.00	<input type="checkbox"/>
Detector	<input checked="" type="checkbox"/> OFF	<input type="checkbox"/> OFF	<input type="checkbox"/> OFF	<input type="checkbox"/> OFF
Sensitivity	Standard	Standard	Standard	
Progr. Temp./ Press.	Prog A	Prog B	Prog C	Prog D

New method Save as Print Param. OK Cancel

How to start analysis



About 15-20 analysis to get good results

Start of analysis

Start analysis

Analysis mode Number of runs 15

Single sequence

Automatic mode

Method : Stand-by._xm

Name : AirSample_08mar_standard

Path : C:\068

Sample name AirSample_08mar_standard

Operator AB

Interval in minutes between injections : 0.00

Ok

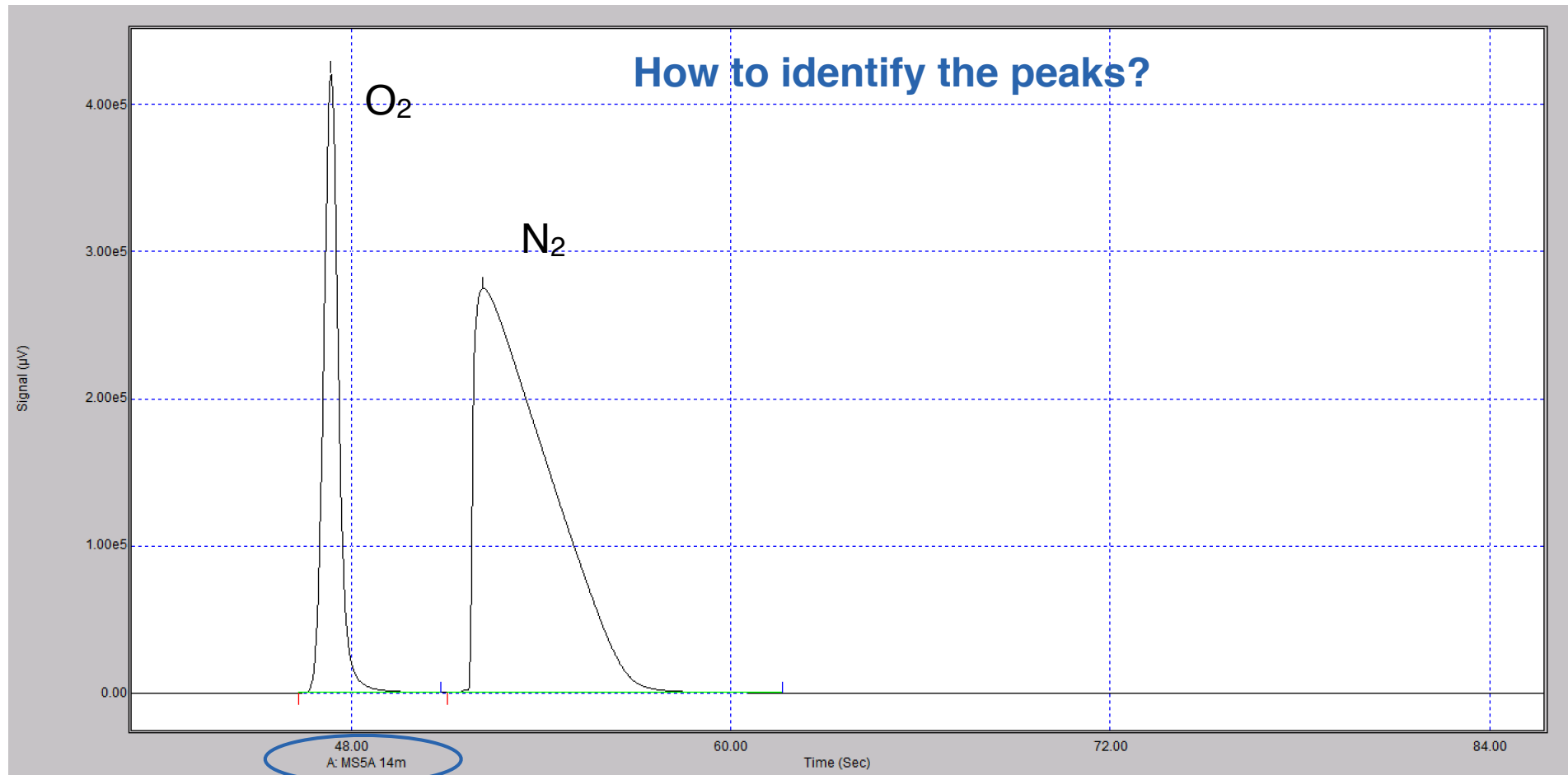
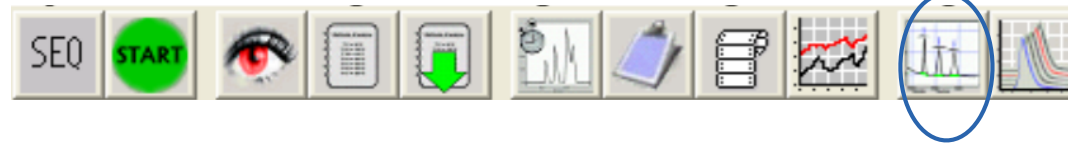
Cancel

Name and sample name need to be the same

usually between 0 and 5 min

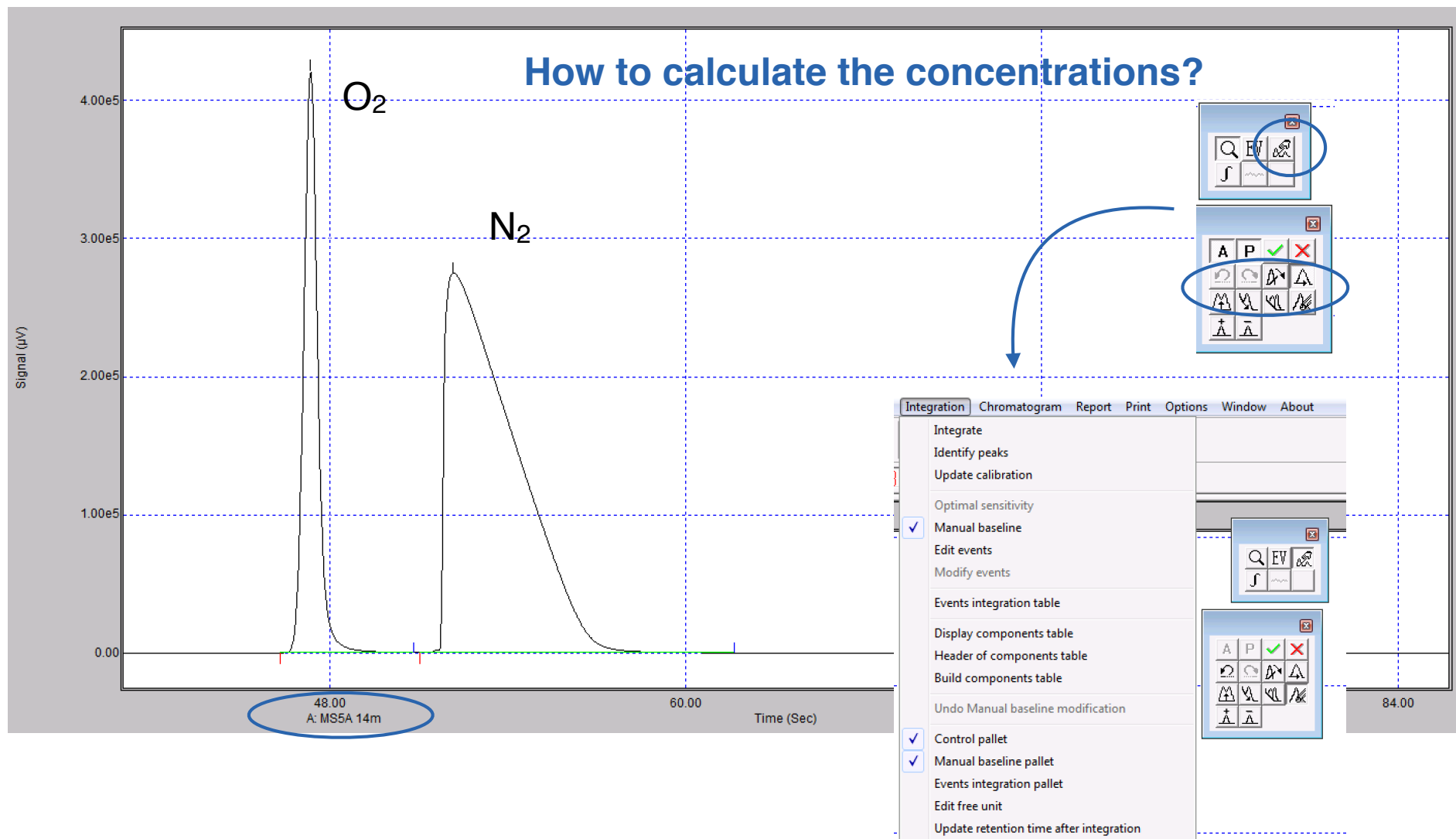
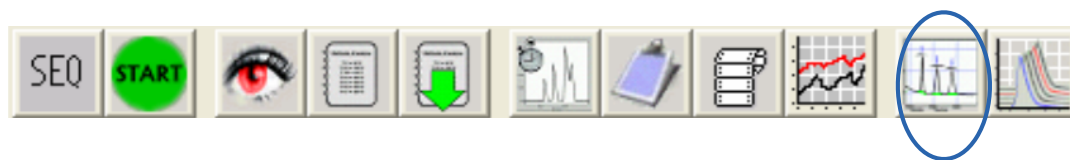
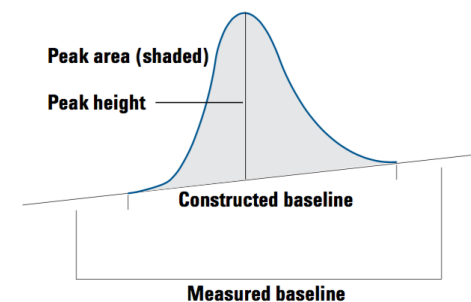
Never change it! It automatically created a folder every day

Example of gas chromatogram

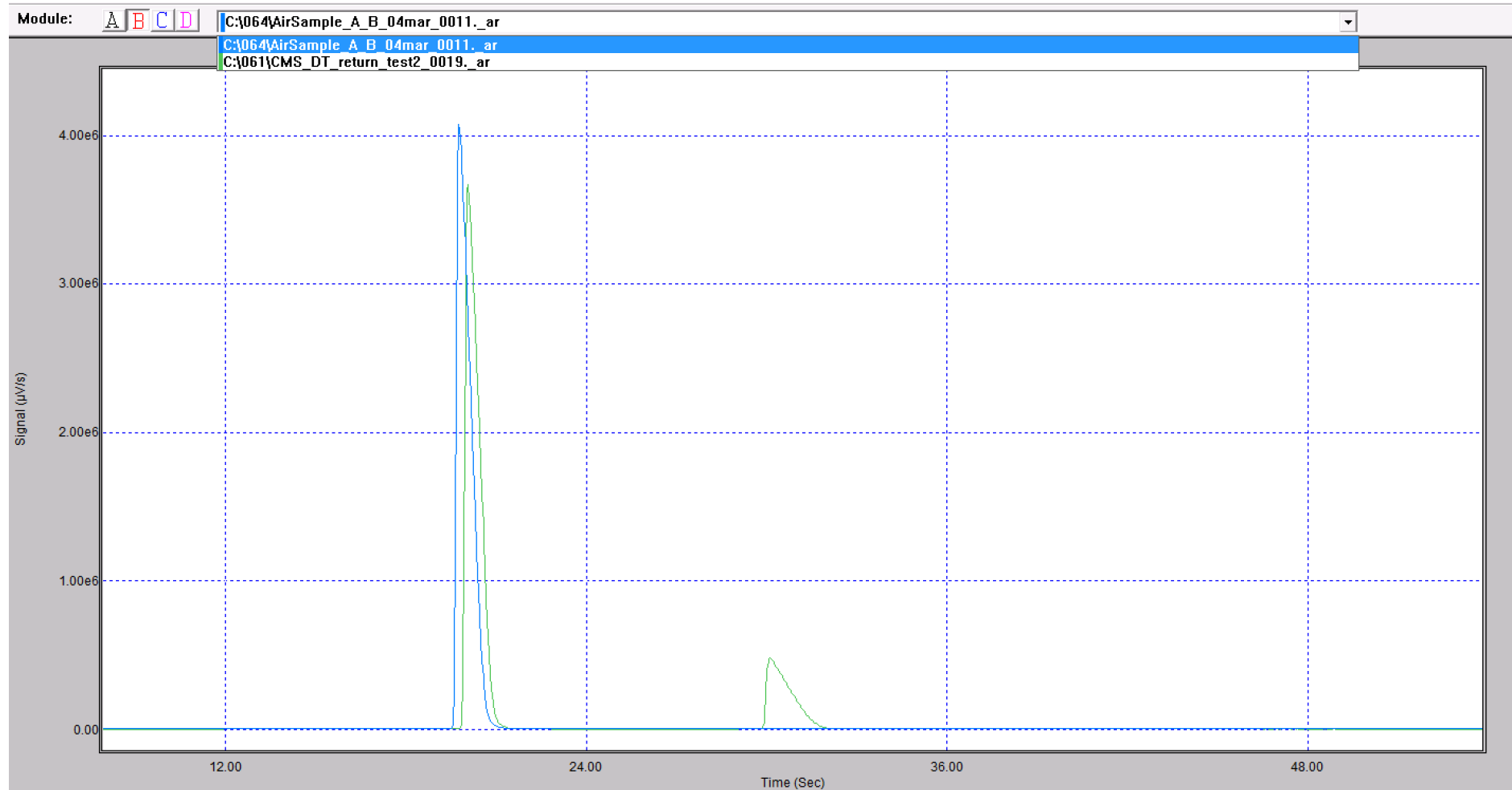


How to calculate the concentrations?

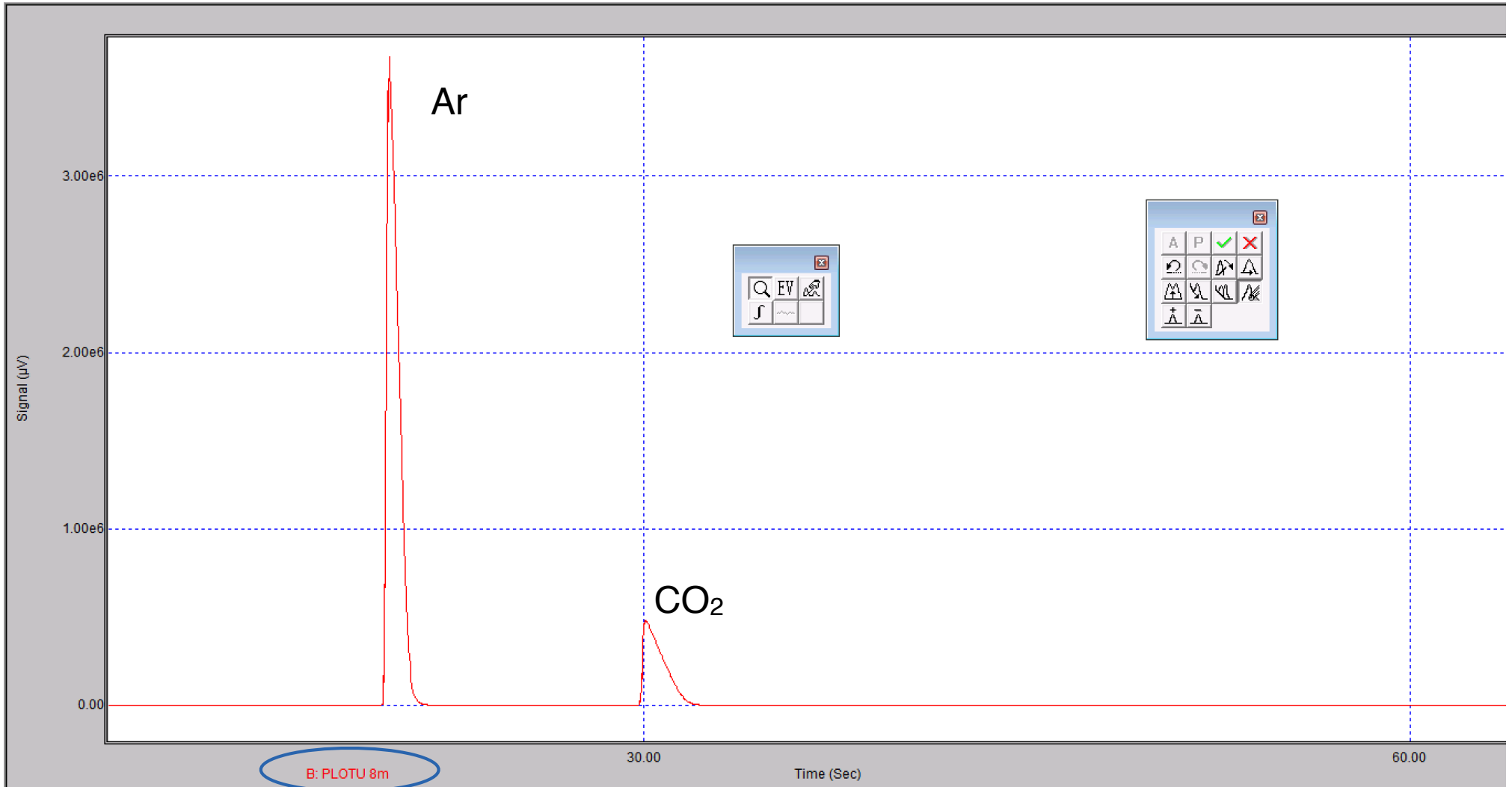
Example of gas chromatogram



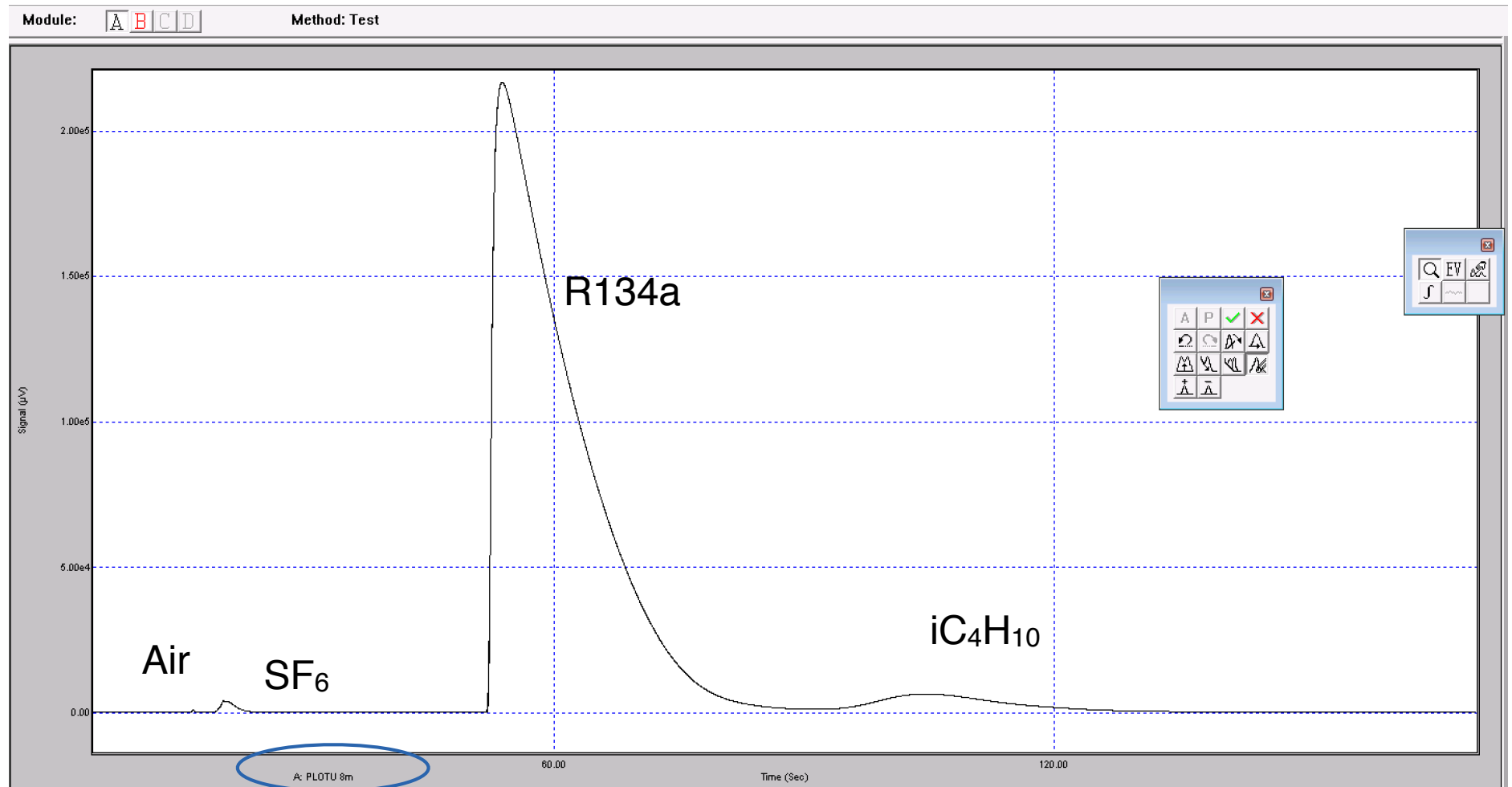
Comparison of gas chromatograms



Ar - CO2



RPC gas mixture



Ar-CF4-CO2

