Gas-Detection

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AIRMOVOC C6-C12/AIRMOVOC BTEX

WITH INTERNAL PC

Historic

Version N°	Modification nature	Application date	Modified chapters
00	Creation of a user's manual of airmoVOC C6C12 with internal and external calibration	05 June 2013	All
01	Modification	26 February 2014	J.3
02	Addition of airmoVOC BTEX	9. April 2014	All

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Visa :	**Visa :**	**Visa :**

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A. OBJET

User's manual for the analyser airmoVOC C_6-C_{12} or airmoVOC BTEX:

- presentation of the analyser
- operating principle
- installing
- starting and stop of the analyser
- calibration and troubleshooting

B. APPLICATION FIELD

Analysers airmoVOC C6-C12 and airmoVOC BTEX.

C. DEFINITIONS

D. REFERENCE DOCUMENTS

Vistachrom user manual 1.47 (reference: **SMQ 0004-10 GCSV 147 UK**)

Vistachrom user manual 1.49 (reference: **SMQ 0004-11 GCSV 149 UK**)

Installation and starting manual of the airmoVOC C_6-C_{12} (reference: **SMU Installation and Starting manual of an analyser FID**)

Easy start airmoVOC C6C12 with option internal calibration (reference: **easy start airmoVOC.C6-C12 CAL**)

Easy start airmoVOC C6C12 (reference: **easy start airmoVOC.C6-C12_V1_UK**)

Easy calib airmoVOC C6C12 and airmo BTX Internal and External calibration (reference: **EASY CALIB airmoVOC_V1**)

E. AIRMOVOC C6-C12/AIRMOVOC BTEX PRESENTATION

E.1. INTRODUCTION

The airmoVOC is a high performance gas chromatograph with Flame ionisation detector (FID) and an on-line sample preparation. It is designed for the analysis of VOC compounds (For example BTEX: Benzene, Toluene, ethyl-benzene, m&p-xylene and o-xylene) in gaseous samples, in ambient (100 ppt) to emission (ppm) concentration ranges. The miniaturisation, the inertia to chemical compounds, the mobility and flexibility of this analyser have been optimised.

Thanks to an integrated CPU board allowing a dialogue with a PC, this analyser is an automate.

The chromatography software allows:

- A complete automation of the system.
- The signal acquisition, and data treatment.
- Data displayed by Peak Viewer software
- The peak identification thanks to a reference substance table.
- Data saving on the hard disk.
- Trend creation allowing a visualisation of the evolution of selected peak retention times and surface (or concentration of the corresponding compounds).

This compact instrument only requires little space, power and gas. The air for FID can be generated by a compressor (air generator) and hydrogen by a hydrogen generator .Thanks to its high level of automation, it is suitable for continuous pollution monitoring. Therefore, the airmoVOC is suitable for in situ operation.

E.2. GENERAL CHARACTERISTICS

Model: airmoVOC C6-C12 A21022 or airmoVOC BTEX with integrated PC 5U

Pneumatic valve: 6 ports 1/8 " (A 6UWT), pneumatic

Replacement rotor: SSA-6-UWT

Analytical column: Capillary metallic column, id = 0.28 mm, length: 30 m, MXT30 CE, 1 µm

Detector: Flame ionisation detector (FID)

Carrier gas: Hydrogen (quality 5.6)

Trap: L = 8 cm; id = 1.5 mm

Critical orifice: 76 µm (Option: 50 µm or 100 µm)

Supply voltage: 115 VAC or 230 VAC, 24 volts option

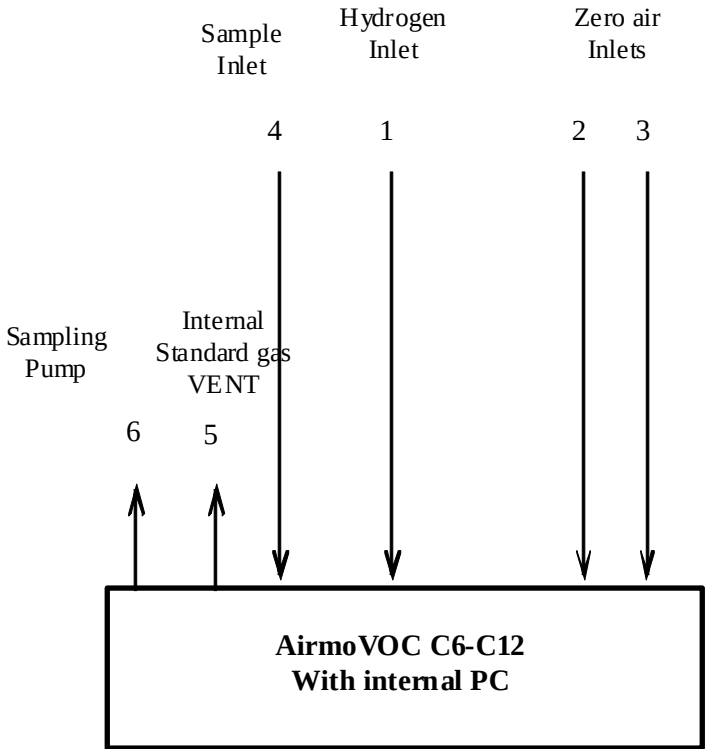
Vistachrom software

Dimension: 19", 5U

Weight: 25kg (packed: 40kg)

Option: -Internal calibration

E.3. FUNCTIONAL DIAGRAM



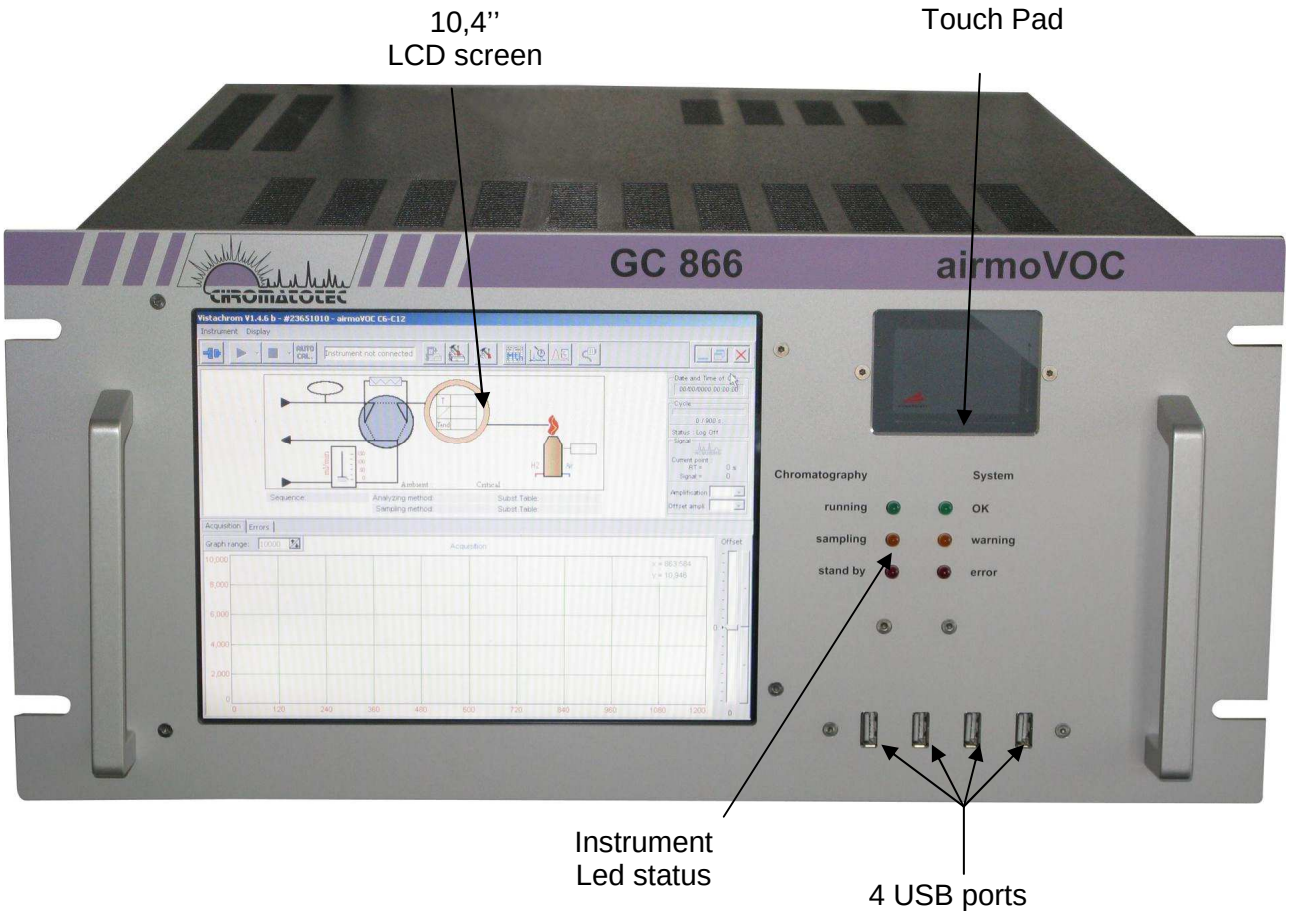
Legend:

1: Hydrogen inlet to connect a Hydroxychrom or a cylinder for carrier gas and flame of FID- 1/16'' fitting
2 : Zero air inlet for the FID and the internal permeation oven – 1/8" fitting

3 : Zero air inlet for the pneumatic valve commutation-1/8" fitting

4: Inlet for Sample (ambient air,...)-1/4" fitting
5: Permeation tube VENT. **(With option Internal calibration (internal permeation oven))**
6: Sampling pump- 1/4" fitting

E.4. FRONT FACE SCHEME



Size 5U:	
Length:	48,0 cm
Height:	22,0 cm
Depth:	73,0 cm

With the USB Port, you can connect a mouse and a keyboard to an easy using of the internal pc.

The front face of the analyser presents:

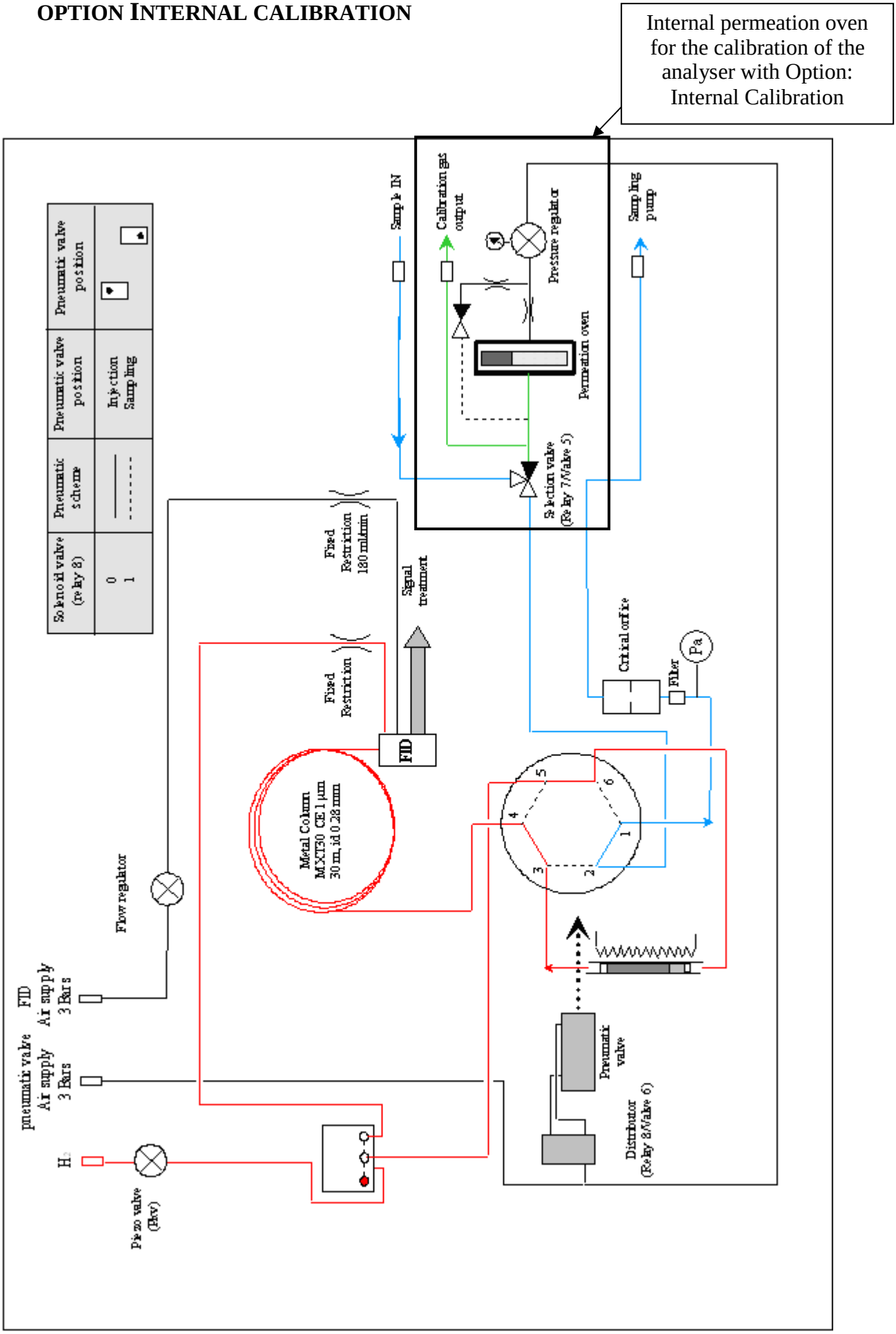
- 6 LEDS indicating the state of the Check. 3 concern the chromatograph, and 3 the communication with the PC.

Cycle:
"**Running**": the green LED is lit during the acquisition.
"**Sampling**": the yellow LED is lit during sampling when the sample flow is set by a critical orifice.
"**Stand by**": the red LED is lit when the system is in stand-by.

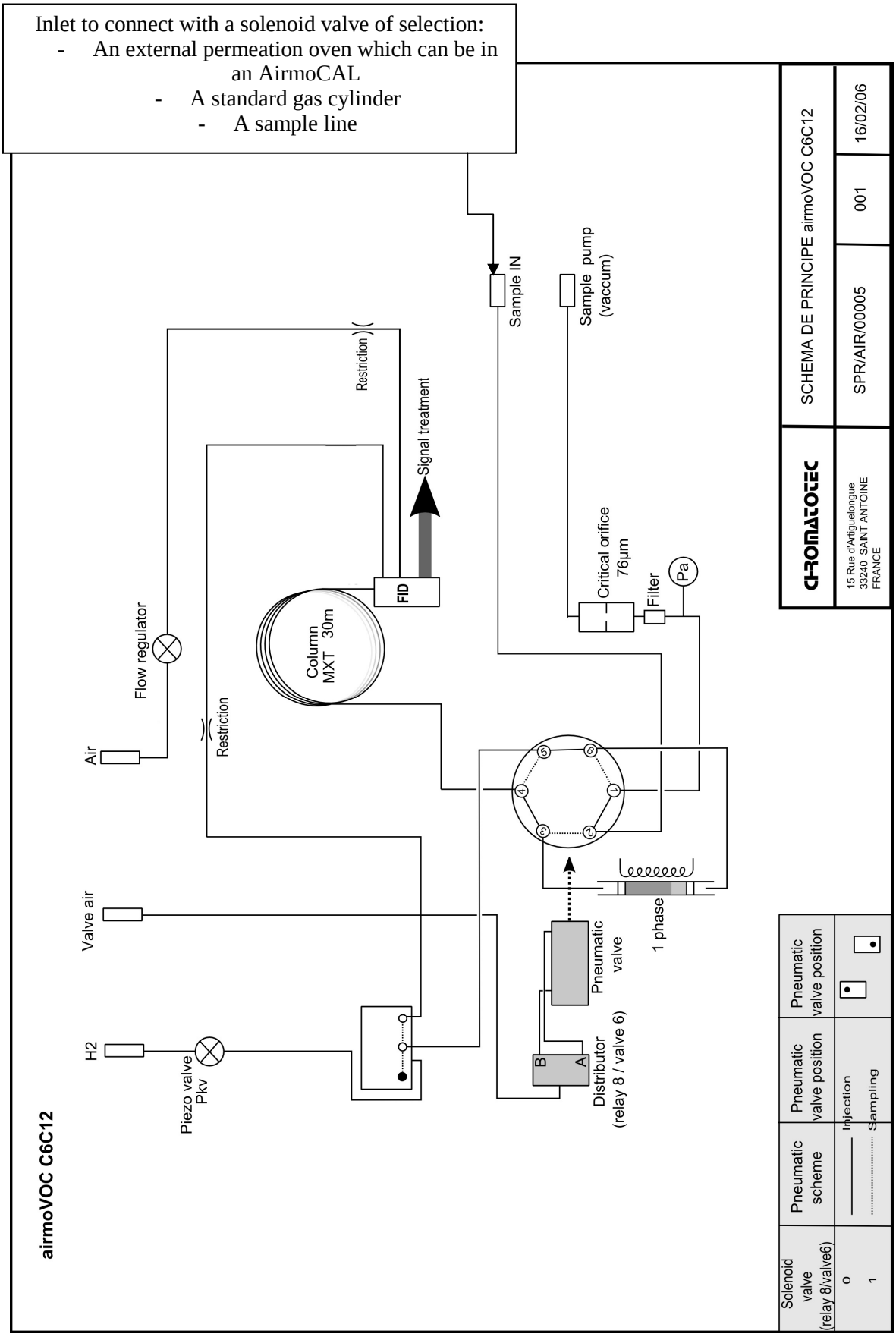
System: A2 communication protocol (when the analyser is connected to Acquisition software and when Acquisition software is in the on-line window)
"**OK**": the green LED is lit when the communication between analyser and PC is correct.

"**Warning**": the yellow LED is lit to indicate something is wrong. For example, if an acquisition is running and if the software is not on the on-line menu (the acquisition is lost) (error number 1xx).
"**Error**": the red LED is lit when an important error has occurred (error number 2xx).

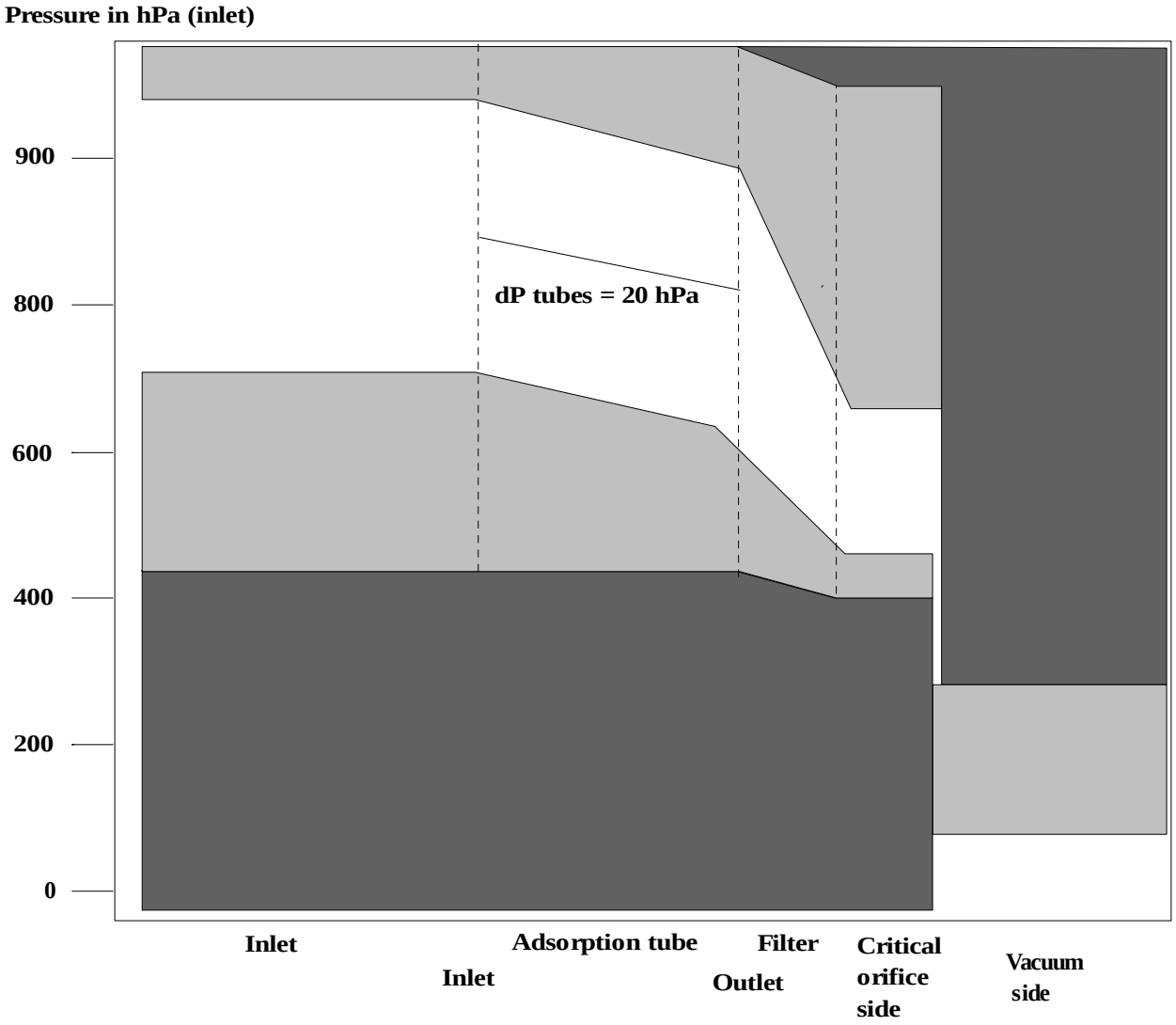
E.5. PNEUMATIC SCHEME OF AIRMOVOC C6C12/AIRMOVOC BTEX WITH OPTION INTERNAL CALIBRATION



E.6. PNEUMATIC SCHEME OF AIRMOVOC C6C12/ AIRMOVOC BTEX



E.7. SAMPLING PUMP CHARACTERISTICS



E.8. BACK FACE

Size 5U:	
Length:	42,5 cm
Height:	21,0 cm

F. OPERATING PRINCIPLE OF THE AIRMOVOC C6-C12/AIRMOVOC BTEX

The analysis cycle comprise 4 steps described here below.

F.1. MEASURING PRINCIPLE

F.1.1. INTRODUCTION

A complete cycle of analysis is done in two successive steps.

- The first stage is the sampling step: it consists to pre-concentrate the VOC contained in the ambient air or in the standard gas.
- The following stage is the analysis step: the trapped VOC are injected in the analytical column by thermal desorption during few minutes (depending on the cycle duration). Then the VOC are separated by the analytical column and detected by the FID.

F.1.2. SAMPLING

The gas sample is drawn by an external pump through a trap, a fine tube containing porous substances, which extracts the gas components according to their affinity with these phases. For example, permanent gases and water vapour are not retained. The trap phase is chosen so as to trap from C6 compounds to C12 compounds.

It is possible, if required, to add to the sample flow an exactly known amount of reference standard compounds.

The volume of gas sample (ambient air or gas standard from internal or external calibration) is measured downstream of the adsorption section, thanks to a critical orifice which set the flow and thanks to the sampling time.

At the end of the sampling, a relay commutes directing the sample flow to the vent. The sampling flow is fixed in the instrument by a critical orifice of 50, 76 or 100 µm. The sampling flow is about 10 to 25 ml/min, 35 to 45 ml/min or 60 to 70 ml/min.

The entrance pressure of the sample must be near atmospheric pressure so that the measurement of the volume sampled by the analyser is correct. This measurement is made thanks to the Pa board and depends on the dimension of the critical orifice. When the analyser is in phase of sampling step, the Pa board must measure the same pressure whatever the sample entering the analyser.

F.1.3. INJECTION OF THE SAMPLE IN THE ANALYTICAL COLUMN (TRAP AND DESORPTION)

The pneumatic valve that was in "sampling" position gets in "injection" position, thereby inserting the sampling tube in the carrier gas circuit in the way opposite to the sampling way. At this time, the trap is heated to desorb the compounds. The gaseous sample is introduced in the analytical column by the carrier gas flow.

F.1.4. CHROMATOGRAPHIC SEPARATION

The analytical column is situated in an oven. The temperature is programmed with a gradient that starts at 60 seconds of the cycle. The sample components elute in the column at a characteristic rate (depending of their boiling point and of their interactions with the column stationary phase). Generally, the retention time of the compounds increases with their molecular weight (boiling point).

F.1.5. DETECTION AND DATA TREATMENT

At the extremity of the column, a flame ionisation detector (FID) generates an electrical signal proportional to the concentration of the sample components as they elute from the column. This electrical signal is digitised to be transferred to the CPU board where the microprocessor processes the data (integration, mass or concentration calculation, peak identification...). All parameters (data results, chromatograms, integration reports...) are then transferred via a RS-232 output where they can be displayed and reprocessed by the software. The digitised signal is also available as an analogue output (0-1V).

The data acquisition starts 6s after the trap thermodesorption end.

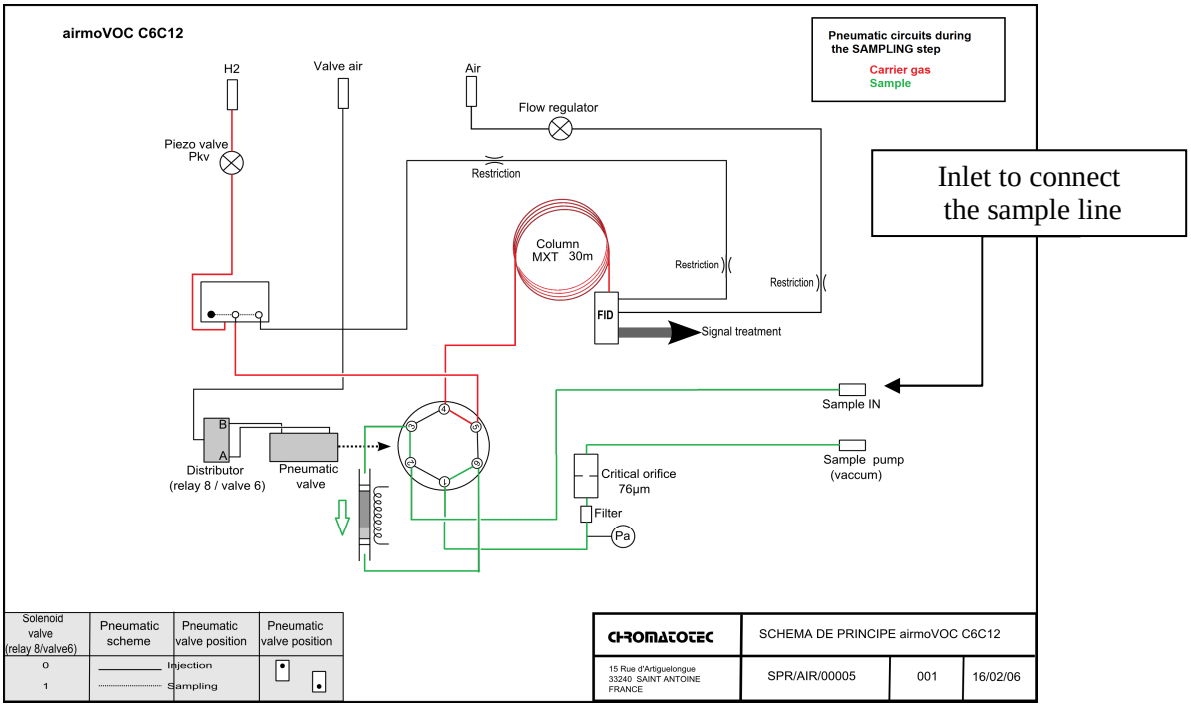
Caution: During this analysis, it is prohibited to exit the ON-LINE menu because the data would be lost. But, it is possible to reduce the software window.

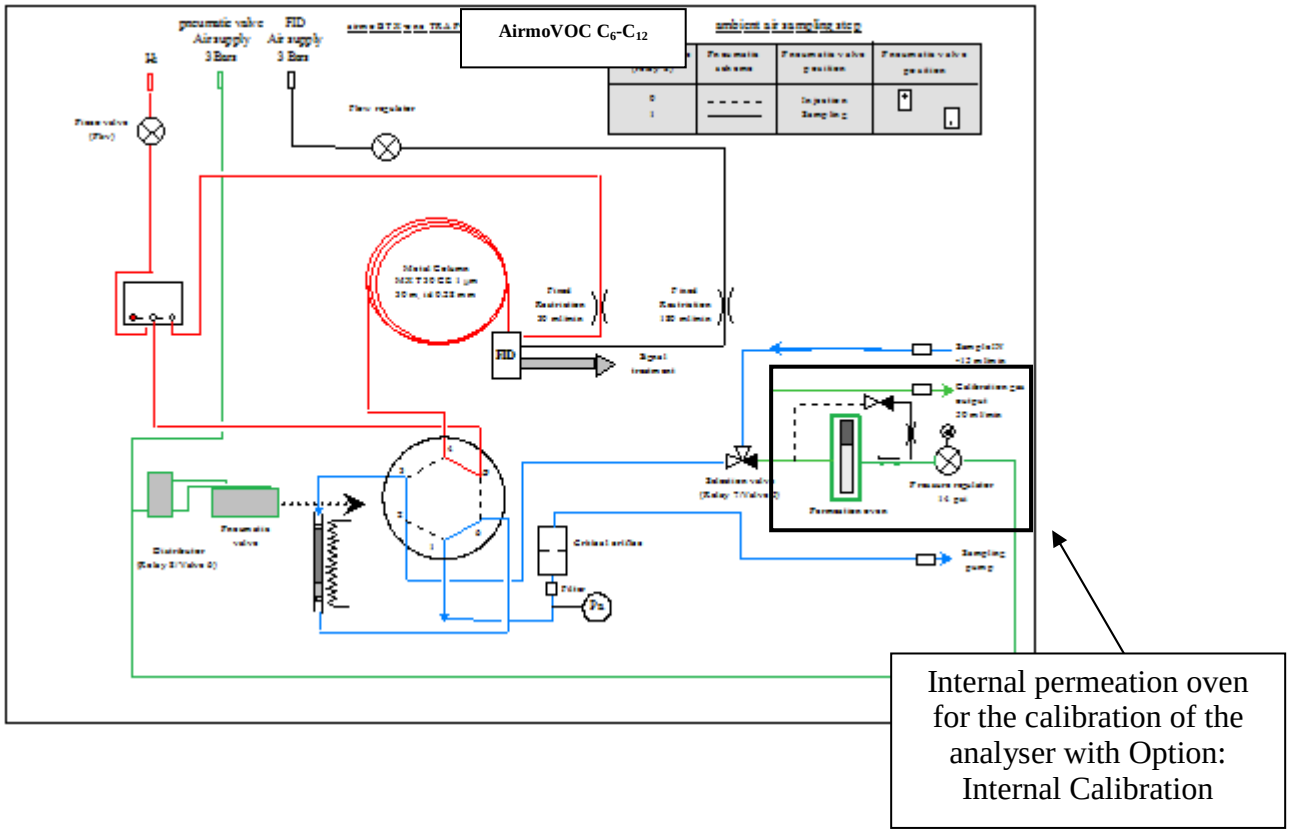
The complete cycle (sampling of the compounds by trapping, injection, chromatographic analysis, and detection) is repeated. The on-board microprocessor stores the data, calculates the selected compound concentrations and stores them. The compounds identification is made on the basis of their retention times, and concentrations are calculated in reference to standard compound analyses.

F.2. SCHEMATIC VISUALISATION OF GAS FLOWS DURING AN ANALYSIS CYCLE

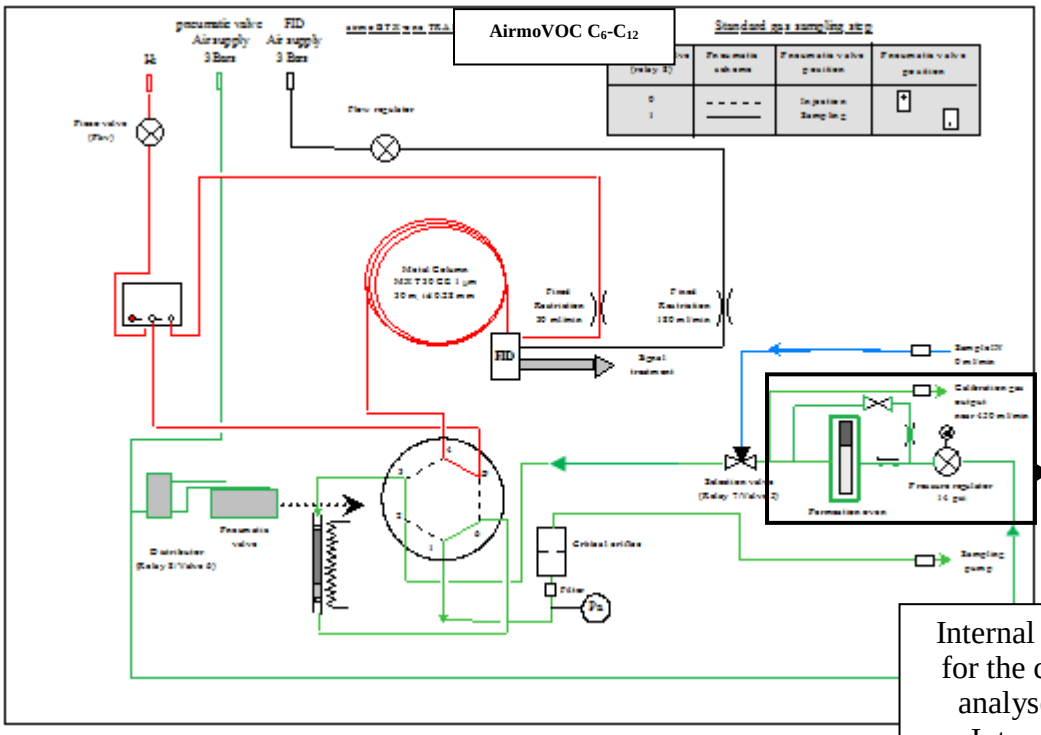
F.2.1. SAMPLING STEP

Ambient air sampling:

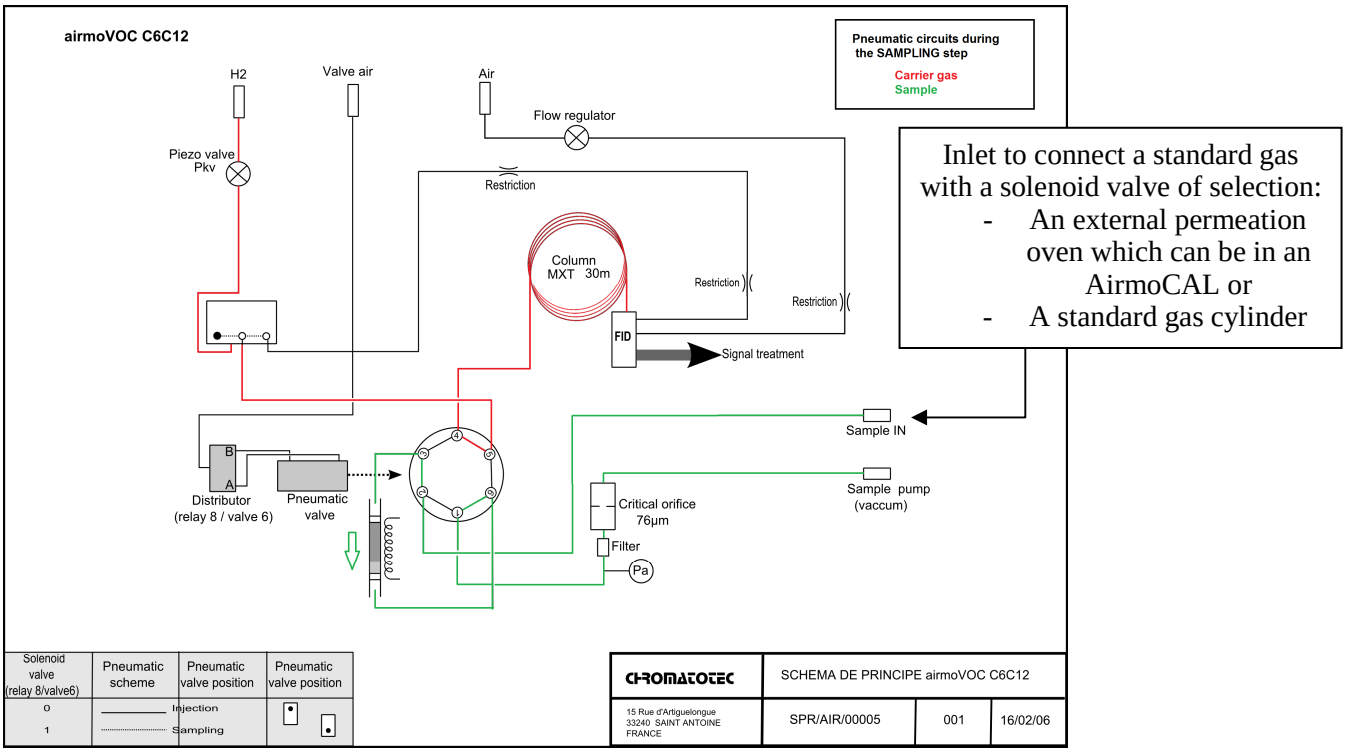




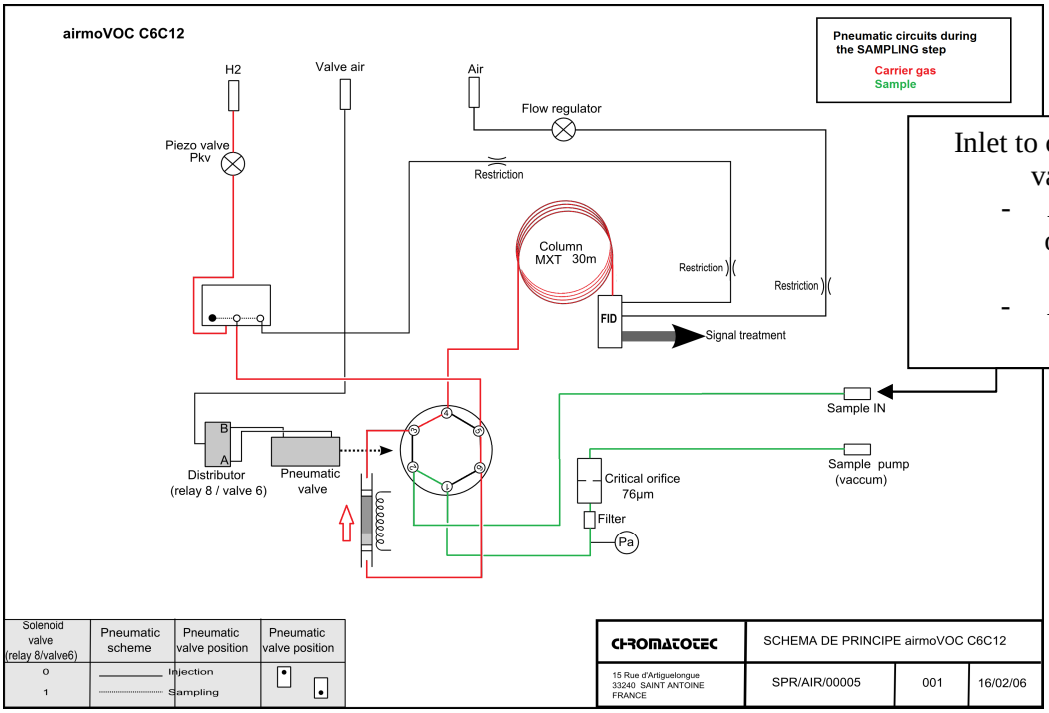
Standard gas sampling from internal calibration device:



Standard gas sampling from an external calibration device:

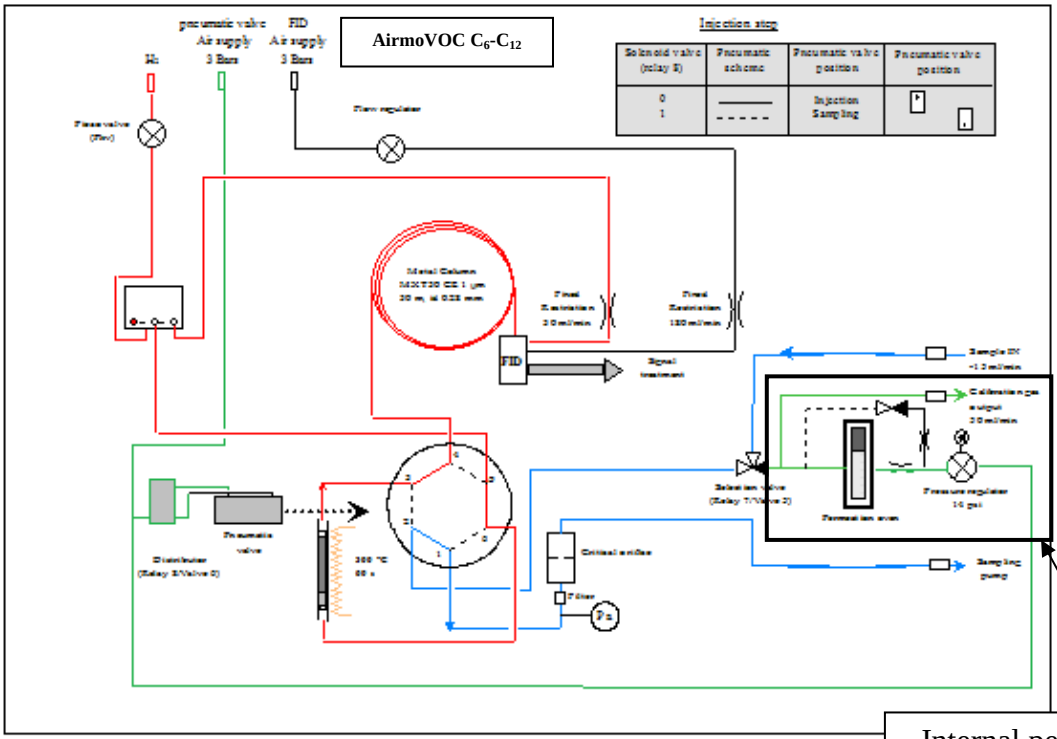


F.2.2. ANALYSIS STEP



Inlet to connect with a solenoid valve of selection:

- An external permeation oven which can be in an AirmoCAL
- A standard gas cylinder
- A sample line



Internal permeation oven for the calibration of the analyser with Option: Internal Calibration

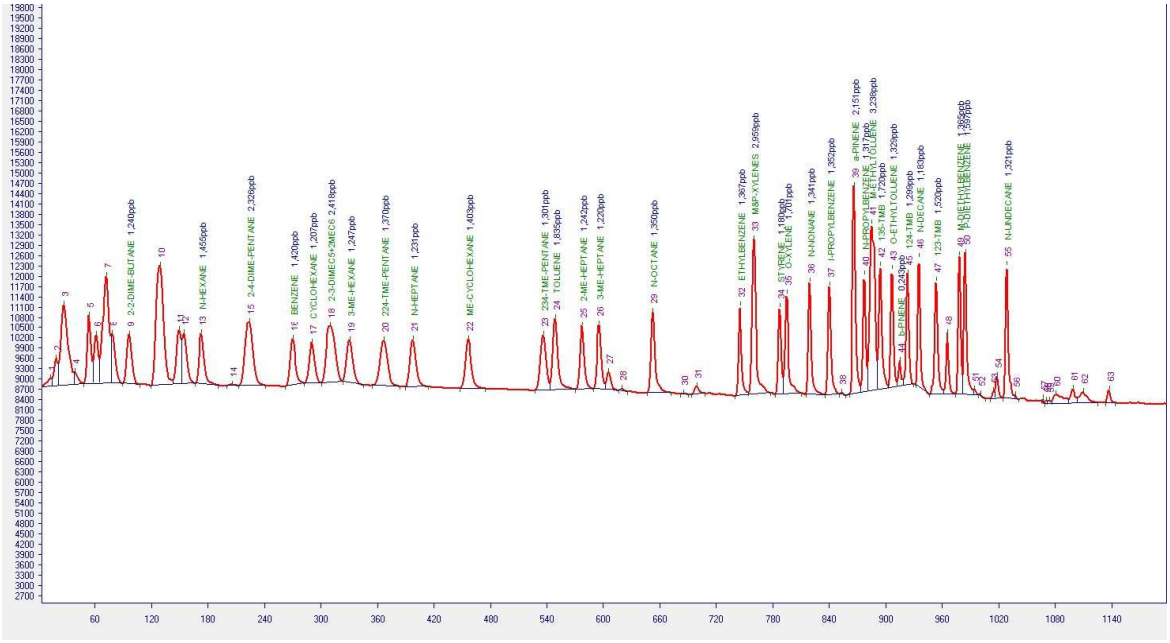
F.3. EXAMPLES OF ANALYSES

Operating conditions for airmoVOC C6C12

Carrier gas: Hydrogen 430 hPa (so around 3 to 4 ml/min)
FID: 170 °C - Flame: Air supply: **3 Bar –** flow **= 180 ml/min –** Hydrogen supply**: 2 Bar** - flow **= 26-27 ml/min**
Thermal desorption: duration 4 minutes with carrier gas
Sampling flow : - 43.5 ml/min – Cycle duration 1800 seconds- Acquisition duration 1200 seconds
Electrometer amplification: High (3)

- External Standard COV analysis

Sample: PAMS 58 VOC contained in sampling bag around 2.5 ppb of each compound without dilution.
Sampling duration: 600 seconds – Acquisition duration : 1200 seconds



Operating conditions :
Description : ExternalSTD 10min-xxxhPa
Method Name : CYLINDER Subtances Table Name : CYLINDER
Sampling :
Tube Number : 3 Duration : 600 s Volume : 434,714 ml Date : 03/05/2013 08:12:48
Detector :
Amplification : 3-High Sample Rate : 15 per second

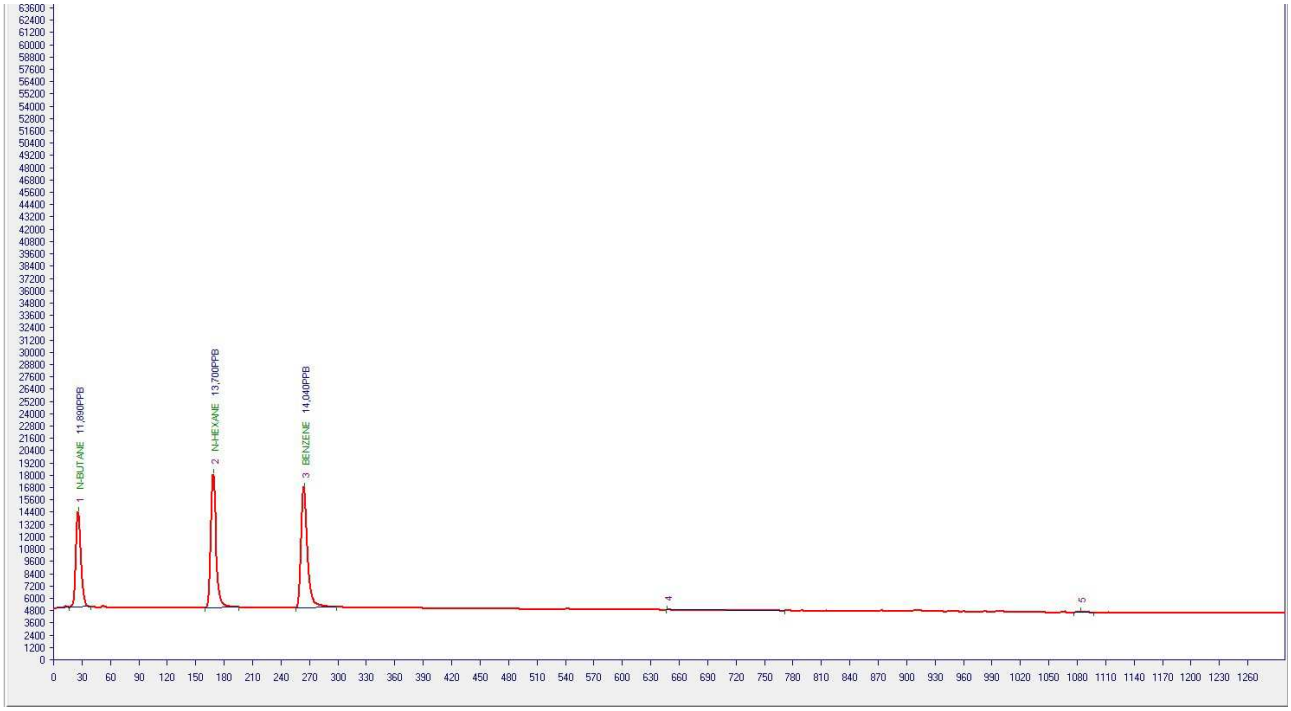
Peak List

Substance	Result	Unit	Start (s)	R.Time (s)	Max	Stop (s)	Area	Type	FWMH
2-2-DIME-BUTA	1,240	ppb	89,40	96,33	10320	107,67	8696,4	ST_E	5,47
N-HEXANE	1,455	ppb	166,33	173,07	10359	190,73	9445,4	ST_E	5,60
2-4-DIME-PENT	2,326	ppb	212,60	223,87	10717	241,20	18967,3	ST_E	9,60
BENZENE	1,420	ppb	262,20	270,07	10202	282,47	9028,5	ST_E	6,20
CYCLOHEXANE	1,207	ppb	282,47	290,60	10087	300,33	8263,6	ST_E	6,53
2-3-DIMEC5+2M	2,418	ppb	300,33	310,07	10586	323,00	17920,9	ST_E	10,67
3-ME-HEXANE	1,247	ppb	323,00	330,53	10156	345,27	9243,4	ST_E	6,73
224-TME-PENT	1,370	ppb	354,40	366,93	10157	384,00	12127,1	ST_E	8,20
N-HEPTANE	1,231	ppb	389,33	397,87	10170	414,07	10035,1	ST_E	6,60
ME-CYCLOHEX	1,403	ppb	447,67	456,67	10185	474,33	10679,2	ST_E	6,60
234-TME-PENT	1,301	ppb	527,20	536,27	10309	543,47	10997,7	ST	6,33
TOLUENE	1,835	ppb	543,47	549,07	10812	570,07	13106,6	E	4,87
2-ME-HEPTANE	1,242	ppb	570,07	577,60	10597	589,13	10496,9	ST_E	5,00
3-ME-HEPTANE	1,220	ppb	589,13	595,80	10633	602,13	10309,1	ST	4,93
N-OCTANE	1,350	ppb	646,67	652,87	11008	671,53	11951,1	ST_E	4,07
ETHYLBENZEN	1,367	ppb	740,13	745,33	11194	754,33	10734,2	ST	3,47
M&P-XYLENES	2,959	ppb	754,33	760,07	13118	777,93	23239,0	E	4,20
STYRENE	1,180	ppb	782,87	787,60	11135	791,20	9088,8	ST	3,20
O-XYLENE	1,701	ppb	791,20	794,87	11539	810,00	13356,7	E	3,00
N-NONANE	1,341	ppb	815,07	819,47	11874	835,53	12276,6	ST_E	3,00
I-PROPYLBENZ	1,352	ppb	835,53	840,33	11765	851,07	12018,6	ST_E	3,20
a-PINENE	2,151	ppb	861,40	866,60	14667	873,60	23848,7	SE	3,47
N-PROPYLBEN	1,317	ppb	873,60	877,33	12082	880,80	11707,5	SE	2,87
M-ETHYLTOLU	3,238	ppb	880,80	885,47	13565	891,33	30450,3	SE	5,60
135-TMB	1,720	ppb	891,33	894,27	12353	903,00	14626,8	SE	2,60
O-ETHYLTOLU	1,329	ppb	903,00	906,93	12257	912,00	11814,1	SE	2,93
b-PINENE	0,243	ppb	912,00	915,13	9561	918,33	2688,7	SE	2,87
124-TMB	1,299	ppb	918,33	923,40	12126	929,40	11046,6	E	2,73
N-DECANE	1,183	ppb	932,07	935,73	12593	946,53	11912,9	ST_E	2,67
123-TMB	1,520	ppb	946,53	954,00	11899	961,67	12927,0	ST	3,13
M-DIETHYLBEN	1,365	ppb	974,40	978,40	12652	981,80	12741,7	ST	2,87
P-DIETHYLBEN	1,597	ppb	981,80	984,87	12727	993,27	14785,7	SE	2,60
N-UNDECANE	1,321	ppb	1024,70	1028,70	12363	1036,90	13437,0	ST	2,73

Filter
(•) Remove unidentified peaks ( ) Display all peaks

- Standard gas analysis (with Internal or external calibration device)

Sampling duration: 600 seconds – Acquisition duration: 1200 seconds - program used: CALIB30MN.mth
External calibration device: AirmoCAL, dilution system with a permeation oven heated at 40°C and swept by total dilution air flow of 243.5 ml/min.



Operating conditions :

Description : Permeation 10mins- xxxhPa
Method Name : CALIB30M — Subtances Table Name : CAL#2077
Sampling : Tube Number : 5 — Duration : 600 s — Volume : 431,793 ml — Date : 16/05/2013 20:49:48
Detector : Amplification : 3-High — Sample Rate : 15 per second
Sensitivity : Base Sensitivity : 4500,0

Peak List

Substance	Result	Unit	Start (s)	R.Time (s)	Max	Stop (s)	Area	Type	FWMH
N-BUTANE	11,886	PPB	16,40	26,27	14630	38,80	55834,8	E	5,33
N-HEXANE	13,705	PPB	160,20	168,60	18366	195,80	88392,3	ST_E	5,80
BENZENE	14,041	PPB	255,20	264,40	16999	298,53	88645,7	ST_E	6,40

Filter
(•) Remove unidentified peaks ( ) Display all peaks

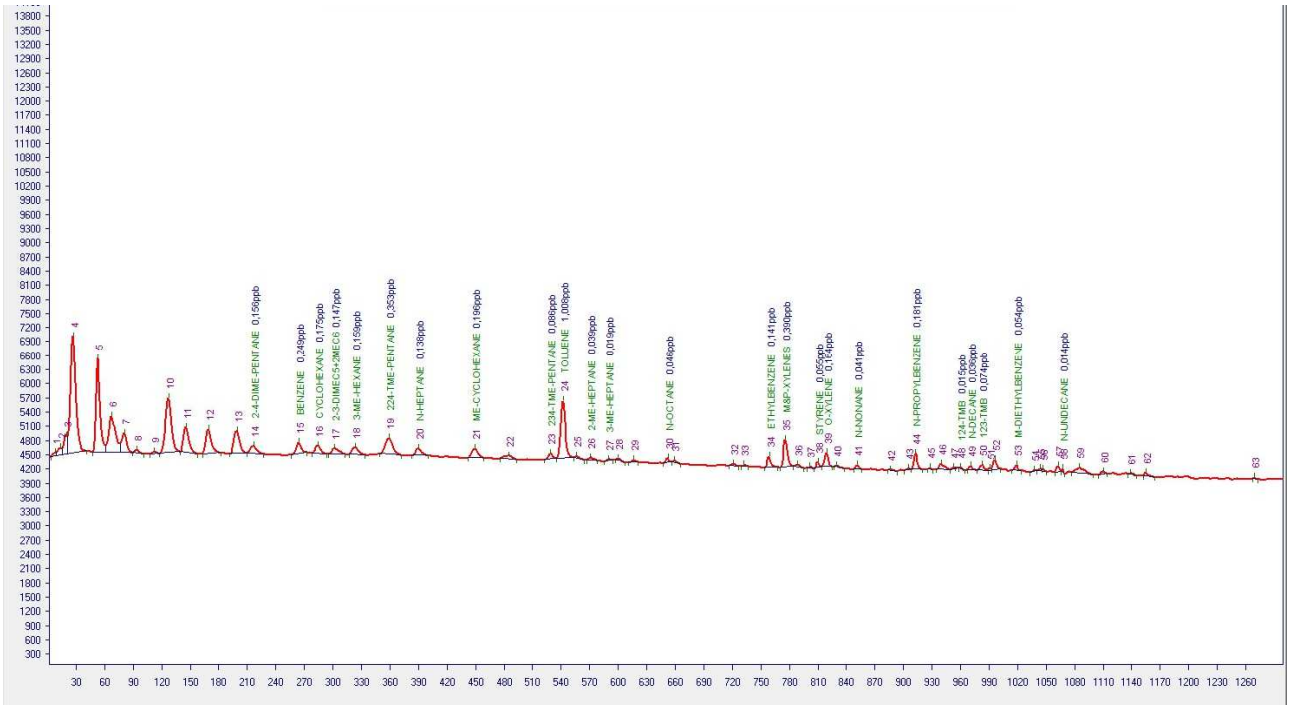
<u>Sample:</u> permeation oven containing:

- **N-BUTANE at 14.22 ppb or 34.38 µg/m^3 (+/-10 %)**
- **BENZENE at 13.98 ppb or 45.42 µg/m^3 (+/-10 %)**
- **N-HEXANE at 13.80 ppb or 49.46 µg/m^3 (+/-10 %)**

(Molecular volume at 20°C = 24.04 l.mol^{-1})

- Ambient air analysis

Sampling duration: 1200 seconds – Cycle duration 1800 seconds – Acquisition : 1200 seconds
Program used : AMB30MN.mth



Operating conditions :

Description : Sampling 10 mins-xxxhPa
Method Name : AMB-30MN — Subtances Table Name : CYLINDER

Sampling :
Tube Number : 5 — Duration : 600 s — Volume : 423,969 ml — Date : 16/05/2013

Detector :
Amplification : 3-High — Sample Rate : 15 per second

Peak List

Substance	Result	Unit	Start (s)	R.Time (s)	Max	Stop (s)	Area	Type	FWMH
2-4-DIME-PENT	0,156	ppb	209,53	216,57	4715	226,60	1239,7	ST_E	6,67
BENZENE	0,249	ppb	256,53	264,53	4791	272,20	1542,2	ST_E	6,53
CYCLOHEXANE	0,175	ppb	278,40	284,63	4723	293,47	1171,3	ST_E	6,20
2-3-DIMEC5+2M	0,147	ppb	295,00	302,00	4660	313,07	1065,1	ST_E	8,60
3-ME-HEXANE	0,159	ppb	316,87	323,80	4688	333,47	1148,2	ST_E	6,80
224-TME-PENT	0,353	ppb	348,87	359,53	4878	372,20	3046,1	ST_E	7,93
N-HEPTANE	0,138	ppb	383,07	390,27	4660	400,47	1095,6	ST_E	6,60
ME-CYCLOHEX	0,196	ppb	441,80	449,47	4663	458,60	1458,1	ST_E	6,80
234-TME-PENT	0,086	ppb	521,93	529,07	4552	535,00	710,2	ST_E	6,20
TOLUENE	1,008	ppb	535,00	542,13	5667	552,93	7022,2	ST_E	5,20
2-ME-HEPTANE	0,039	ppb	566,87	571,07	4465	578,40	319,5	ST_E	5,00
3-ME-HEPTANE	0,019	ppb	585,67	589,93	4434	594,27	153,3	ST_E	6,33
N-OCTANE	0,046	ppb	647,67	652,33	4460	656,13	395,3	ST_E	4,13
ETHYLBENZEN	0,141	ppb	753,80	759,00	4490	767,27	1078,2	ST_E	4,00
M&P-XYLENES	0,390	ppb	770,53	776,20	4851	784,47	2987,0	ST_E	4,80
STYRENE	0,055	ppb	805,60	810,60	4378	814,00	410,4	ST_E	3,80
O-XYLENE	0,164	ppb	814,00	819,47	4567	825,07	1257,8	ST_E	3,87
N-NONANE	0,041	ppb	847,60	851,87	4315	856,20	367,3	ST_E	3,67
N-PROPYLBEN	0,181	ppb	907,87	913,00	4556	920,07	1573,0	ST_E	4,33
124-TMB	0,015	ppb	958,07	960,37	4264	964,20	122,7	ST_E	1,93
N-DECANE	0,036	ppb	967,53	971,07	4295	976,87	358,2	ST_E	3,47
123-TMB	0,074	ppb	976,87	982,63	4314	988,80	614,4	ST_E	4,80
M-DIETHYLBEN	0,054	ppb	1013,90	1019,00	4308	1024,00	490,5	ST_E	3,73
N-UNDECANE	0,014	ppb	1066,10	1067,50	4236	1069,70	137,0	ST_E	1,40

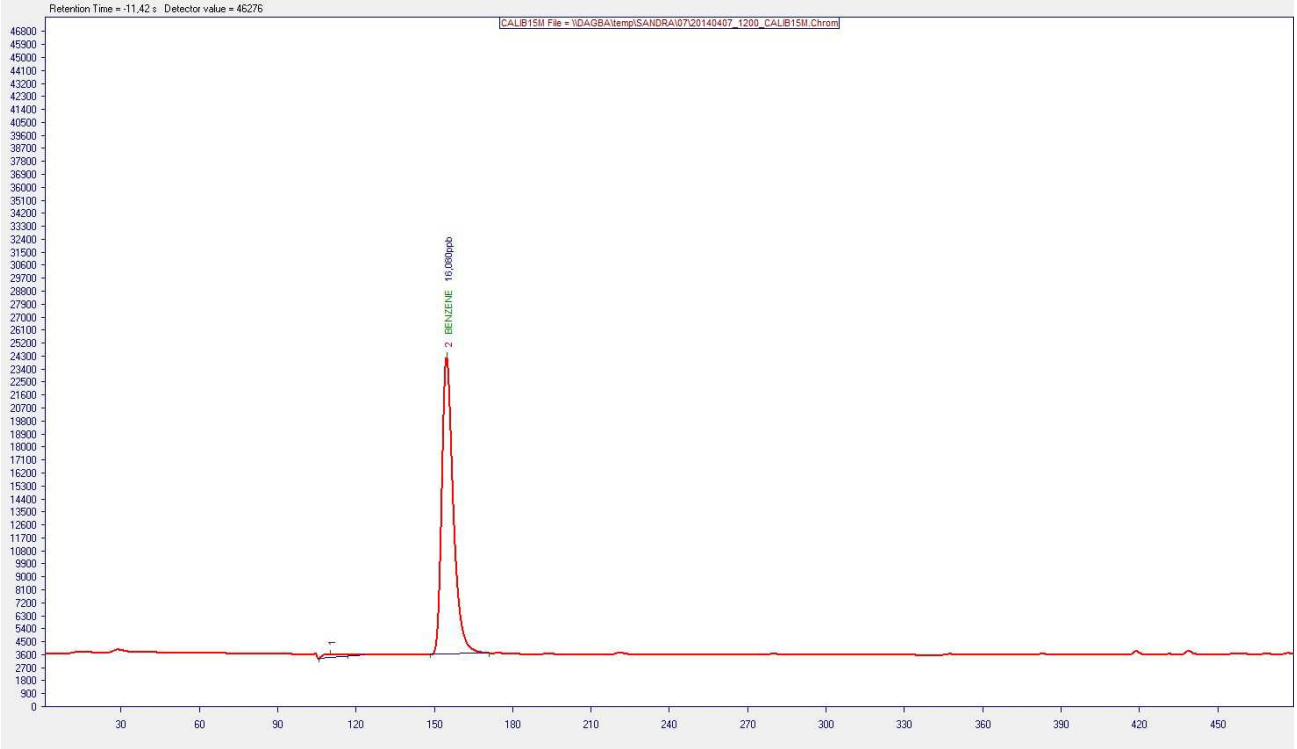
Filter
(•) Remove unidentified peaks ( ) Display all peaks

Operating conditions for airmoVOC BTEX:

Carrier gas: Hydrogen 378 hPa (so around 3 to 4 ml/min)
FID: 150 °C - Flame: Air supply: **3 Bar –** flow **= 180 ml/min –** Hydrogen supply**: 2 Bar -** flow **= 26-27 ml/min**
Thermal desorption: duration 2 minutes with carrier gas
Sampling flow : - 43.1 ml/min – Cycle duration 900 seconds- Acquisition duration 480 seconds
Electrometer amplification: High (3)

- Standard gas analysis (with Internal or external calibration device)

Sampling duration: 660 seconds – Acquisition duration: 480 seconds - program used: CALIB15MN.mth
Internal calibration: permeation oven heated at 40°C and swept by total dilution air flow of 243.5 ml/min.



Information and operating conditions

Analyser :

Serial Number : #23420414
Owner : Arcelor Mittal
Location : FLORANGE

Operating conditions :

Description : Internal STD 11 Mins-A3
Method Name : CALIB15M — Subtances Table Name : BTX15MN
Sampling :
Tube Number : 1 — Duration : 660 s — Volume : 476,813 ml — Date : 07/04/2014 12:00:48
Detector :
Amplification : 3-High — Sample Rate : 30 per second
Sensitivity :
Base Sensitivity : 4210,0

Peak List

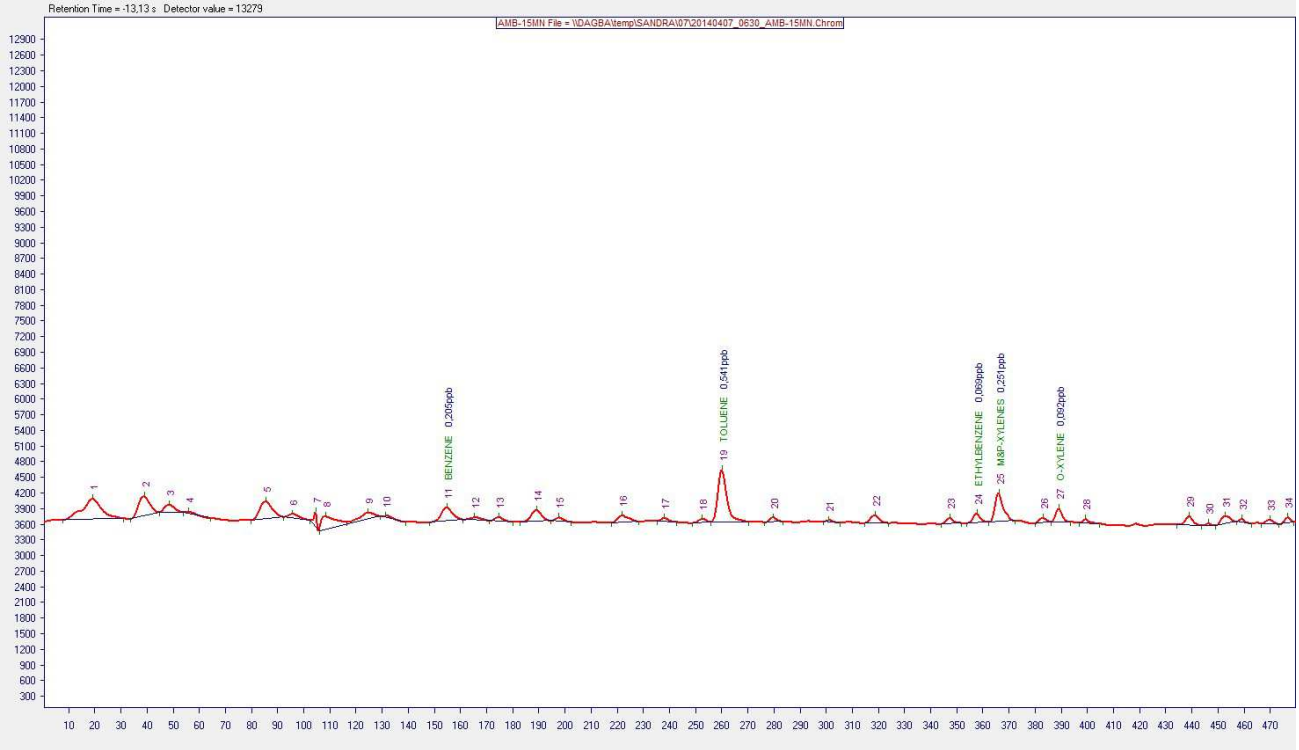
Substance	Result	Unit	Start (s)	R.Time (s)	Max	Stop (s)	Area	Type	FWMH
BENZENE	16,081	ppb	148,57	154,80	24358	171,13	104889,0	ST_E	4,47

Filter

(•) Remove unidentified peaks ( ) Display all peaks

- Ambient air analysis

Sampling duration: 660 seconds – Cycle duration 900 seconds – Acquisition : 480 seconds
Program used : AMB15MN.mth



Information and operating conditions

Analyser :

Serial Number : #23420414
Owner : Arcelor Mittal
Location : FLORANGE

Operating conditions :

Description : Ambient air 11Mins-A3
Method Name : AMB-15MN
Subtances Table Name : BTX15MN

Sampling :
Tube Number : 1
Duration : 660 s
Volume : 471,795 ml
Date : 07/04/2014 06:30:48

Detector :
Amplification : 3-High
Sample Rate : 30 per second

Sensitivity :
Base Sensitivity : 4210,0

Peak List

Substance	Result	Unit	Start (s)	R.Time (s)	Max	Stop (s)	Area	Type	FWMH
BENZENE	0,205	ppb	148,27	154,83	3953	161,03	1320,8	ST_E	4,90
TOLUENE	0,541	ppb	255,80	260,13	4665	270,33	3922,7	ST_E	3,43
ETHYLBENZEN	0,069	ppb	353,77	357,77	3831	362,18	552,7	ST_E	2,90
M&P-XYLENES	0,251	ppb	362,18	366,07	4219	372,20	2003,4	ST_E	3,20
O-XYLENE	0,092	ppb	386,13	389,27	3923	393,53	732,1	ST_E	2,67

Filter

(•) Remove unidentified peaks ( ) Display all peaks

G. INSTALLING THE AIRMOVOC

G.1. RECEIPT OF ANALYSER AND CHECK

Each analyser is inspected and packaged prior to transport with great attention. Immediately after receipt, we recommend to perform a quick visual inspection of the package. If the package is damaged, report it in writing to the carrier at the time of delivery.

The AIRMOVOC is packed in a wood box with protection and maintaining foams placed above and below the analyser.

The AIRMOVOC packaging extraction begins with the opening of the wood box; at this stage, it is possible to check the visual integrity of the analyser.

Any damages must be immediately identified and photographed; it should be reported to the carrier as well as to your local Distributor or to CHROMATOTEC.

For major damages, the AIRMOVOC shall be returned to the manufacturer after synchronization with the service department, which can be reached by e-mail at: support@chromatotec.com.

In case of non-respect of this procedure, CHROMATOTEC cannot be kept in charge of the caused damage and cost will be charged to the customer.

G.2. ELECTRICAL SUPPLY

This instrument is supplied with 115 VAC or 230 VAC. See the identification plate on the rear face to confirm.

The supply must be able to deliver the following power:
230 – 50 Hz VAC (+/- 10 %) or **115VAC – 60 Hz** (+/- 10 %)
Power: 400W
Fuse: 15A

The use of an inverter is strongly recommended.

Power uptake:

- Standby: approximately 80 W
- Normal operation: approximately 140 W
- Short duration peak: approximately 360 W.

These values are for guidance only. The actual power uptake varies with the maximum oven temperature, FID temperature and calibration plug-in unit.

G.3. GAS SUPPLY AND CONNECTIONS

G.3.1. WARNING

Hydrogen is used as carrier gas and as FID combustion gas. Follow safety and security regulation for this gas. Check all connections for tightness and leaks.

The gas supply tubing diameters must be sufficiently large so that the required inlet pressure at the instrument is maintained even under worst-case conditions (such as maximum gas flow rate at maximum ambient air).

All tubing used must be clean, debarred, and free of sward and dust. The use of virgin tubing is recommended. Tubing which has previously been in contact with liquids is not suitable. The following materials have proven themselves suitable:

* Hydrogen 5.6: stainless steel**, 1/16″(in option 1/8”)**, HPLC grade.
* Zero air for FID and permeation tube inlet (with internal calibration): stainless steel**, 1/8″ (in option ¼”)**, HPLC grade.
* Zero air for air actuator of the pneumatic valve: stainless steel**, 1/8″ (in option ¼”)**, HPLC grade.
* EVENT of the standard gas: **1/8″**, grade not important.
* Sample inlet: glass, 10 mm, or PFA, **1/4″**.
* Pump: **1/4″** grade not important.

Before pressurising the tubing for the first time, all connections must be checked for correctness of assembly and leak tightness.

For a better stability of gas flows, it is recommended to put at the gas cylinders outlet double pressure release valves. These pressure regulators must be free of plastic (i.e. GC or ultra-high purity gas quality).

All gas supplies are controlled on the airmoVOC C_6-C_{12}. The use of unsuitable pressure-reducing valves would result in the entry of contaminating hydrocarbons into the measuring system, resulting in incorrect measurement values.

Gas and power supply connectors are on the instrument rear panel.

The following information refers to the values measured at the inlet connectors to the airmoVOC C_6-C_{12}.

G.3.2. HYDROGEN 5.6

Hydrogen is used as carrier gas and for Hydrogen FID Supply.

* Inlet pressure : **2 bar**
* Consumption for carrier gas : ≈ **3 ml/min**
* Consumption for FID Supply : ≈ **27 ml/min**
* Connector: **1/16**, stainless steel, swagelok.

G.3.3. ZERO AIR

Air is used for FID supply and for the pneumatic valve actuator.

* Inlets pressure : **3 bar**
* Consumption for FID Supply : ≈ **180 ml/min**
* Connectors: **1/8 ″ (in option ¼")**, stainless steel, swagelok.

With option internal calibration:
Air is used also for the permeation oven:

* Consumption for permeation oven: ≈ **50 ml/min** when the relay 7/Valve 5 is not activated and ≈ **250 ml/min** when it is activated.

The permeation tube needs to be placed in the oven before making the pneumatic connections.

G.3.4. SAMPLE

a. Sampling system

An adequate vacuum supply is required to suck up the sample into the instrument and for the sample volume measurement.

* Vacuum: **800 hPa** (200 hPa maximum at the vacuum outlet).
* Pump flow: **1 to 2 l/min**.
* Connector: **1/4″**, stainless steel, swagelok.

The gas sample must be made available at the instrument inlet ("Probe", 1/4" stainless steel, swagelok) under certain defined conditions. It must not contain any liquids. It is recommended that the sample be brought to the instrument through enough high dimensioned glass tubing (1/4" PTFE). Metal tubing should be kept as short as possible.

b. Sample

The sample gas must not contain liquids or particles.
If gas at high temperature and of high relative humidity is being sampled, condensation may occur in the instrument. This must be prevented by diluting the sample with dry gas.

In option, if there is a particle pollution of the atmosphere, filters can be used. The choice of the filter is done according to the level of pollution of ambient environment. If there is a lot of dust, you can use a 2 µm filter. If there is not too much dust, you can use a 5 µm filter.

If the ambient air is clean, it is not necessary to use filters to avoid risks of catching compounds into filters. The size of particles is not a problem for the column if some reach to go through.

A filter on the sample must not cause a pressure drop by more than 50 hPa.

The filter must be frequently changed, since the slightest accumulation of dust can lead to the absorption of some compounds in the sample.

All methods of sample filtering have some effect on the measurement. It is essential in all cases to check that sample compounds to be analysed actually get through the filter. (This can be done by making test measurement with standards before and after the filter and comparing the results).
Note: the dust must be removed by using a suitable fine glass wool or glass frit filter in the sample pass.

c. Standard gas (Internal or external calibration device)

An external or internal calibration system is used to monitor the stability of the analyser and so to validate the results. This system may consist in an internal or external permeation oven.

Calibration is generally done with Benzene permeation tube. To follow the stability on heavy compounds, o-xylene permeation tube can be added.

The temperature setting of the permeation oven is: **45°C** or **40°C**.

The permeation tube included:	**32 ng/min at 45°C (+/-10 %) or 15 ng/min at 45°C or 40°C (+/-10 %)**
The permanent air dilution flow:	≈ **50 ml/min** (when the relay 7 / valve 5 is off) ≈ **250 ml/min** (when the relay 7/valve 5 is on)

The solenoid valve controlled by the relay 7/valve 5 is activated 120 seconds (in case where there is an internal permeation oven) or 300 seconds before the sampling start to be sure the total air flow for dilution is stabilized.
A VENT on the rear face permits to measure the permeation flow.

*Connector: **1/8″**, stainless steel, swagelok.

The permeation rate of the calibration tube will be included in the quality control report joined with the analyser.

G.4. SIGNAL AND DATA CABLING

Data cable:	RS 232, 9600 Baud. Maximum permissible cable length: 15 meters 9 pole plug submin. Type D, male / female.
Analogue output:	0-1 V, 500 ohms output impedance Two 4 mm diameter banana plug sockets (black: -; red : +). Short circuits protection.
Switching output:	Isolated relay switch controlled by CPU microprocessor. Switching capacity 100 mA at 24 V Two 4 mm diameter banana plugs.

G.5. MECHANICAL INSTALLATION AND OPERATION POSITION

The usual lack of space in instrumentation cabins, vehicles and measurement stations results necessary in the installation of the various measuring systems in close proximity to each other. Despite this, it is essential to ensure that a sufficient supply of cooling air is available to the instrument at all times. Usually, cooler conditions are found in the lower levels of large systems. In no case an instrument with large power consumption should be placed directly below the airmoVOC.

G.6. ENVIRONMENTAL CONDITIONS

The permitted ambient temperature range for operation of the instrument is **+18°C to +24°C**.

Do not forget that the internal temperature of the instrument is 5 to 8 °C higher than ambient. Therefore the lowest permissible oven temperature lies about 5 °C above ambient, an important point when operating at elevated room temperature, expect extended cooling times.

H. STARTING THE AIRMOVOC C6C12/AIRMOVOC BTEX

Before turning on the supply gases (hydrogen, air), you must check that the pressure reducing valves are turned off because the piezo valve and the pressure regulator are pre-adjusted and a big pressure variation is very dangerous for the pre-adjustments.
Check that all the tubes are connected correctly and without leaks.

a) Set the Hydrogen pressure at **2 bar**

b) Set the Zero Air pressure at **3 bar**

c) Switch on the sample vacuum pump.

d) Switch on the analyser. The green LED "**OK**" and the red LED "**STAND BY**" light. It is possible that errors occurred before the instrument was last switched off. In which case, the error information have been saved by the system. In this case, the yellow LED "**ALARM**" or the red LED "**FAULT**" will light immediately after the instrument is switched on again. The error number will be send to the computer before or at the end of the first chromatogram. When the airmoVOC C_6-C_{12}- FID is switch on, the initial parameters are charged in the instrument. These parameters are :

* Oven temperature: ≈ **36 °C**
* FID temperature : **170 °C** (**or 150°C for airmoVOC BTEX**)
* Column pressure : ≈ **500 hPa**

These parameters are fixed and should not be modified.

e) In the same time, the PC is switched on. Windows “embedded” starts with **Chromatotec** user “pass word”: **CETOMRIA** or **Administrator** user “pass word”: **1234** and the PC open automatically the Vistachrom software. You select the “**super user**” level and you type **1234** as Password.

f) Log on the instrument with and the PC  .

g) Load the working sequence with  .

h) Start the analysis with the touchpad  . The first cycle permits to initialize the system.

To change the hour in Windows XP embedded of the PC, see the procedure: (reference: **SMO 0012-00 Clock Adjustement in Embedded Computer.pdf**)

I. STOP THE AIRMOVOC C6-C12/AIRMOVOC BTEX

In any case, before SHUT DOWN the power supply with the main SWITCH on the rear panel. It will be necessary to correctly stop the instrument. At the end of the method, wait some minutes until the LEDS "stand by" and "ok" **are lit.**

I.1. CLASSICAL STOP

- Click on the icon  . In this case, the analyser stops at the end of the analysing method. Wait some minutes unil the LEDs "stand by" and "ok" of the RS 232 board light before close Vistachrom software.
  In any case, the LEDs "stand by" and "ok" of the RS 232 board must be lit.
- Wait the end of the cycle and wait for some minutes to obtain the initial parameters of the oven (**36°C**), **sampling off**, **Desorption of the TRAP**, etc. The reason is: the carrier gas is controlled by the piezo valve. If the instrument is shut down during the function, the piezo valve is closed and no carrier gas ways through the analytical column and the TRAP. It is a big cause of damage of these elements.
- LOG OFF the instrument with the icon  .

BE CAREFUL, if the icon is yellow  **, the instrument is in function and doesn't be shut down. When the icon is blue**  **, the instrument can be switch off.**

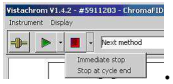
- When the instrument is LOG OFF and in stand by position (the LEDs "stand by" and "ok" of the RS 232 board must be lit), no communication subsists with the software and the instrument can be switched off with the internal POWER SUPPLY
- When the oven temperature is near 36°C-38°C, LOG OFF the instrument with the icon  . **BE CAREFUL, if the icon is yellow, the instrument is in function and doesn't be shut down.**
- When the instrument is LOG OFF and in **stand by** position (the LEDs "**stand by**" and "**ok**" of the RS 232 board must be lit), no communication subsists with the software and the instrument can be switch off.

I.2. EMERGENCY STOP

Sometimes, an error occurs during the functioning of the instrument, caused by the system or by a human manipulation. It is possible to completely loose or not the communication with the instrument. In this case, the only answer will be to make a RESET of the instrument and of the PC.

There are two possibilities:

I.2.1. SOFTWARE RESET

- **STOP THE MEASURE** at the end of the method on the ON LINE window with the icon  .
- Wait some minutes to obtain the initial parameters of the oven (36 **°C**), **sampling off**, **Desorption of the TRAP**, etc.
- **LOG OFF** the instrument with the icon  .
- **CLOSE** the aquisition software **Vistachrom**.
- **START THE "ServiceGC"** Software.
- **Select the serial number of your instrument and the communication port.**
- **Click on the "LOG ON" button.**
- Click on **"RESET"** button (*Service GC*) the leds "**Stand By**", "**Error**" and "**Ok**"on the RS232 Board must be lit.
- When the "**dialog activity"** icon blink, the instrument communicates with the PC and the user can transfer the Setup with the "**Transfert setup"** button**.** The led "**Error**" will be lit off.
- **Stop** the "***ServiceGC"*** utilitary with the "***Close"*** button**.**
- Restart **acquisition software Vistachrom and LOG ON** with  .
- Load the working sequence with  and restart the analyser with  .

Sometimes, software RESET is not sufficient and hardware RESET will be necessary.

I.2.2. HARDWARE RESET

- **STOP THE MEASURE** at the end of the method on the ON LINE window with the icon  .
- Wait some minutes to obtain the initial parameters of the oven (**36 °C**), **sampling off**, **Desorption of the TRAP**, etc. If the communication is impossible with the acquisition software, (use Service GC utility to STOP analyse).
- **SHUT DOWN** the instrument, open the COVER and disconnect the battery from the CPU board.
- **Wait for some minutes** to empty all the memory of the CPU board. **During this manipulation, it will be recommended to make a PC RESTART**.
- **Reconnect** the battery on the CPU board.
- **SWITCH ON** the instrument with the internal two positions switch. The leds "**Stand By**", "**Error**" and "**Ok**"on the RS232 Board must be lit.
- **START** the "**ServiceGC"** Software.
- **Select the serial number of your instrument and the communication port.**
- **Click on "LOG ON" button.**
- The **Transfert setup** is automatic and the led "**Error**" will be lit off.
- **Stop** the "***ServiceGC"*** utility with the "***Close"*** button and **Restart** the acquisition software **Vistachrom**.
- **LOG ON** the instrument with  and Load the working sequence with the icon  and start the measure with the icon  .

After a RESET, the first cycle only permits to initialise the instrument. There is no TRAP desorption, no acquisition during this cycle, etc.

J. ANALYSER CALIBRATION

J.1.BASE SENSITIVITY

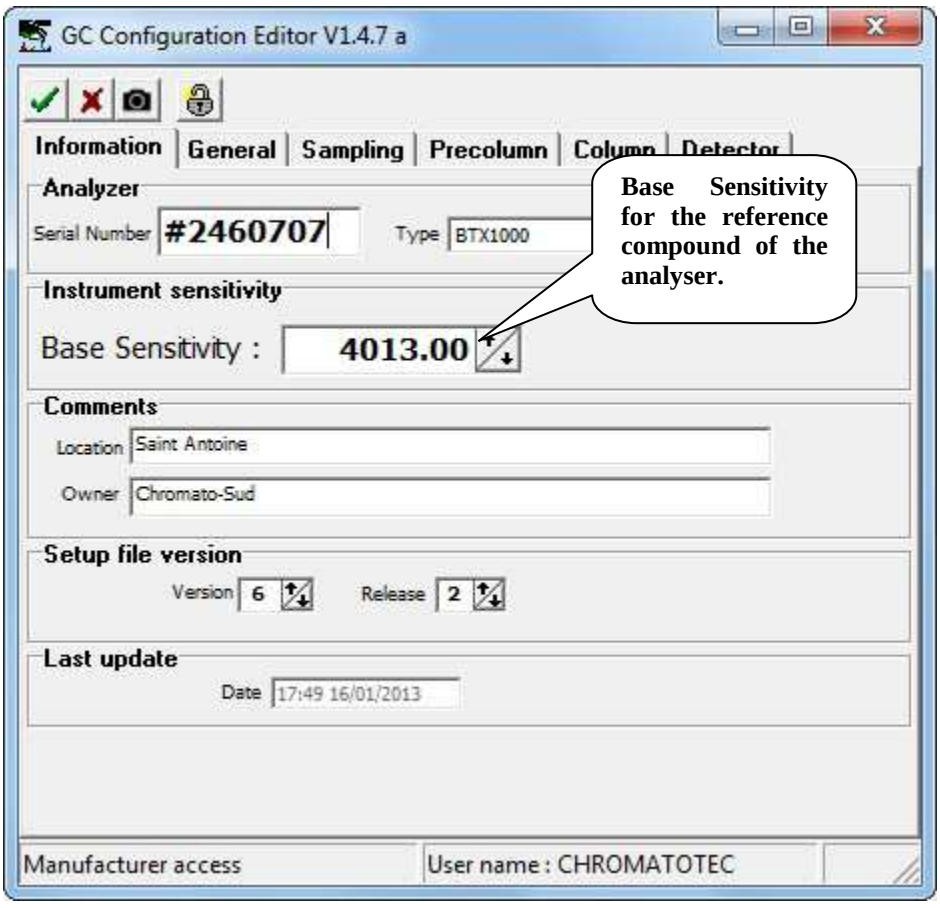
AirmoVOC analysers are calibrated with a sensibility factor called **Base Sensitivity (BS)**.

This factor is calculated in area units per nanogram of a reference compound adsorbed on the TRAP.

The BS is the area of the signal produced by 1 nanogram of Benzene (Reference compounds for an airmoVOC C_6-C_{12}, an airmoVOC BTEX or an airTOXIC).

How to access to the Base Sensitivity:

Click on the "GC parameters setup" icon , select tab "Information". The next window appears:



In this example, the factor BS = 4013 ua/ng $_{Benzene}$

This is the **original value of BS** for this analyser.

With a FID detector, the BS value is around 4500 (+/- 600) ua/ng $_{Benzene}$

J.2.CALIBRATION STABILITY MONITORING

With internal or external calibration device:

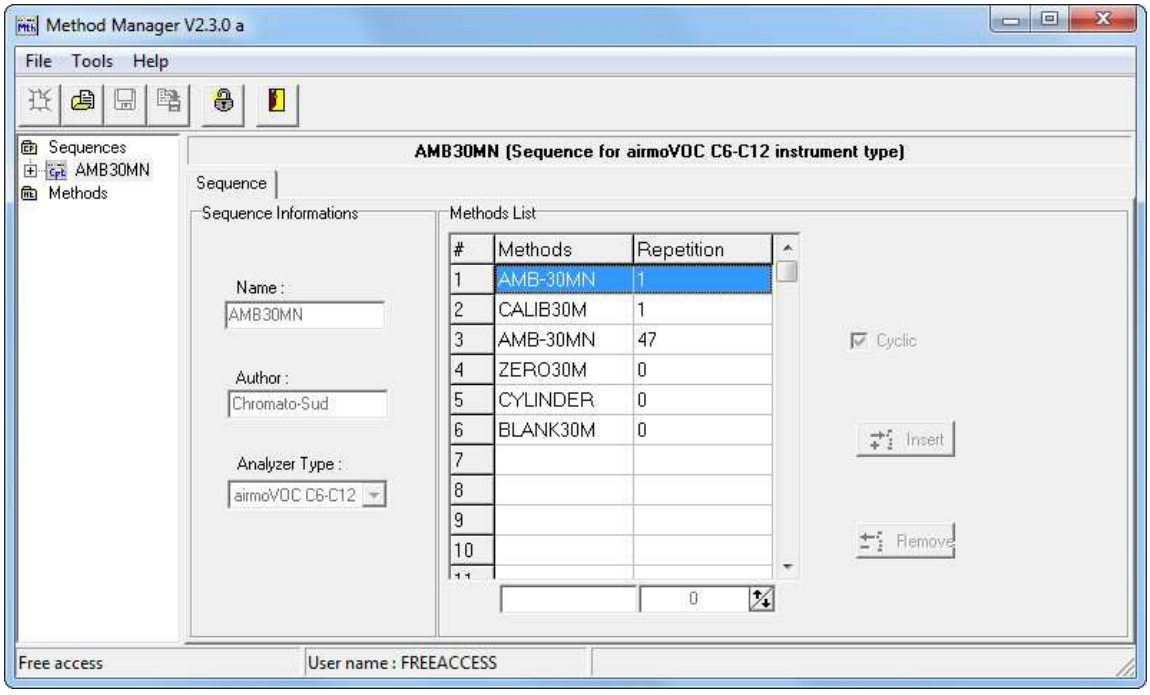
- **Internal permeation oven**
- **External permeation oven, like airmoCAL device for example**

It is possible to follow the stability of the Base Sensitivity.

Calibration analysis is a method included into the analysis sequence.

- **AirmoVOC C6C12**

Example of working sequence:

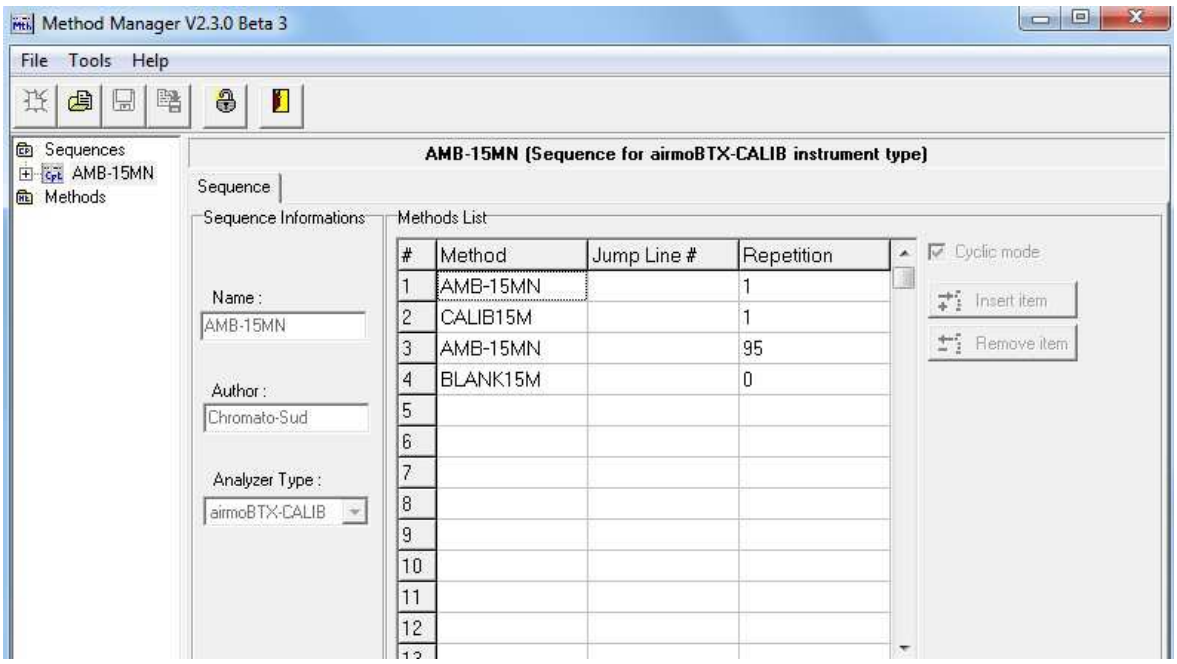


This routine working sequence is cyclic and it's composed of:
-1 ambient air measurement
-1 internal calibration measurement
-47 ambient air measurements.

Each working method has a total duration of 30 minutes. Each analysis method gives a chromatogram.
In this case (with 30 minutes cycle), the standard gas is analysed once a day.

- **AirmoVOC BTEX**

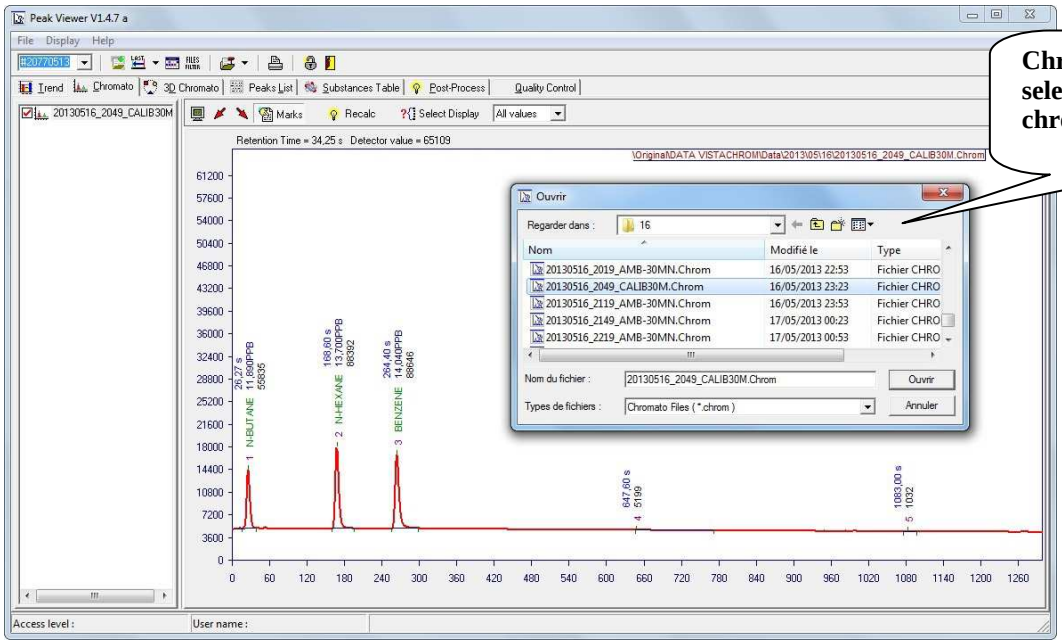
Example of working sequence:



This routine working sequence is cyclic and it's composed of:
-1 ambient air measurement
-1 internal calibration measurement
-95 ambient air measurements.

Each working method has a total duration of 15 minutes. Each analysis method gives a chromatogram.
In this case (with 15 minutes cycle), the standard gas is analysed once a day.

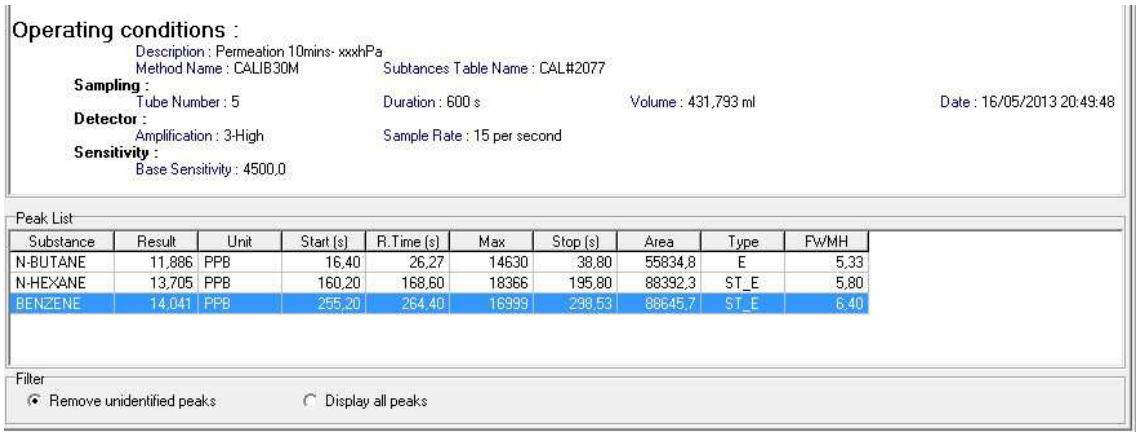
You can read the results in Peak Viewer Software (refer to *Easy Start*)



To calcul the new BS "Base Sentitivity":

In Peak Viewer software, open the last calibration chromatogram; in this example, it is called 20130516_2049_CALIB30M.Chrom

Select the TAB Peak List:



In this example, the concentration measured for the Benzene standard is 14.04 ppb or 45.62 µg/m^3 (**with a molecular volume of 24.04 l.mol^{-1} at 20 °C**) (C_C) and the area of peak is 88645.7 ua. The BS used to calculate this concentration was 4500 ua/ng$_{Benzene}$ and the volume of the sample is 431.793 ml.

$BS = [Area / (C_C \times V)] \times 10^{-3}$

C_C : concentration calculated in µg/m^3
V : volume of the sample in m^3

N.A:

New BS = [88645.7 / ((45.62 x (431.793 10^{-6}))] x 10^{-3} = 4500.15 rounded to **4500 ua/ng**
The BS of the analyser didn't change: the calibration is stable.

J.3.USING AN EXTERNAL STANDARD GAS FOR CALIBRATION IF NO AIRMOCAL DEVICE

Calibration with a standard gas cylinder 10 ppb to 100ppb.

The different steps are:

1) **Stop the analyser at the end of cycle**

2) **Purge 3 times (minimum) the manometer of your cylinder**

3) **Connect the solenoid valve to the analyser power board (5th position, Valve 3, Fig 2)**

Fig 2: Control relay of the power board

Connect the external solenoid valve to the connector #5 (valve 3) of the analyser power board. This external solenoid valve permits to select the standard gas from the cylinder as sample.

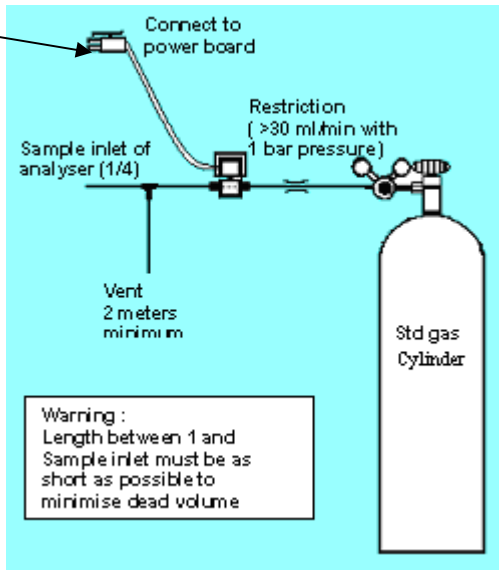


Fig 3: diagram of XXvalveCAL device

4) **Measure the flow of standard gas before the external solenoid valve (30ml/min see Fig 3) and connect the device to the sample inlet of the analyser.**

WARNING**: you must respect the diagram (vent, flows...)**

5) **Select and load the calibration sequence in VISTACHROM (Ex : Calibrat.CPT)**

This working sequence permits in a first time to calibrate with precision the analyser and in a second time to certify the permeation tube. This sequence is not cyclic so the analyser will stop at the end of the sequence.

6) **Start the analysis and wait for the analysis results.**

Go in Peak Viewer software and compare calculated concentrations with expected concentrations. (see next part K.*READJUSTMENT OF CALIBRATION*).

K. READJUSTMENT OF CALIBRATION (PARAMETER BS)

How to calculate the New Base Sensitivity:

As it is mentioned before (J.2 *CALIBRATION STABILITY MONITORING*)

$BS = [Area / (C_C \times V)] \times 10^{-3}$ **C_C : concentration calculated in µg/m^3**
V : volume of the sample in m^3

If the concentration calculated is not equal (± X %) to the concentration expected (C_E), you have to change the value of the base sensitivity:

$$\text{New BS} = BS \times (C_C / C_E)$$

For internal or external calibration analysis (permeation tube of standard gases analysis), the concentration expected is in the Quality Control document (permeation rate and dilution flow).

Example: Expected concentration is 110 µg/m^3 (**C_E**) and you have measured 119.72 (**C_C**) with a BS of 4244 (ua/ng).

New BS = 4244 x (119.72 / 110) = 4619.0 rounded 4620 (ua/ng)

How to change the Base Sensitivity value:

1) You must be identified by Vistachrom with Super User name (Password: 1234)

2) Stop the analyser **at the end of cycle.**
3) Click on the "**GC parameters setup**" icon  , Tab "Information" (See Fig1)
4) Change BS by the New BS and click on OK to validate the configuration.
5) Start the analysis.
6) Check if the New BS is taken into account to calculate the new concentrations at the end of analysis.

L. PERMEATION TUBE REPLACEMENT (WITH INTERNAL OR EXTERNAL CALIBRATION DEVICE)

When the user has to replace the permeation tube, the procedure is:

- The used permeation tube will have a permeation rate around 32 ng/min at 45 °C or 15 ng/min at 45°C or 40°C (precision +/- 10 %).
- Stop the analyser and stop the sampling pump.
- Insert the new permeation tube in the oven installed inside the analyser.
- Test the gastight of the permeation oven by plugging the VENT.
- Measure the air dilution flow with a flowmeter on the VENT.
- Switch on the analyser but don't start the measurement. Leds STAND BY and OK light.
- Log on the analyser with the "service GC", and activate the relay 7/valve 5 to have a measurement of the total air dilution flow on the vent.
- Calculate coarsely the concentration of the permeation tube.
  For example: Tube of Benzene with a permeation rate of **32** ng/min at 45°C and a total dilution flow of **250** ml/min.

  The benzene concentration will be:

$$\frac{32}{0{,}250} = 128 \text{ ng/l or } \mu g/m3$$

The molecular weight of benzene is **78, 11** g/mol and the molecular volume at 20°C is **24, 04** $l.mol^{-1}$

The concentration of the permeation tube in ppb will be:

$$\frac{128 \times 24.04}{78{,}11} = 39.4 \text{ ppb}$$

- **Log off Service GC and log the GC on Vistachrom.**
- **The user will wait for some hours before using the calibration method to have a stabilized permeation tube.**
- **Switch on the sampling pump.**
- Load the working sequence and start the analysis without activation the auto-calibration option. A new base sensitivity will be calculated but not updated in the GC Configuration.
- Open the viewer and reprocess the 4 stabilized calibration chromatograms obtained with the substances table of the ambient air method.
- With the viewer, select the RECALC button to have the concentration measured by the analyser.
- If the reprocessed calibration analyses give for example 39.5 ppb, 40.1 ppb, 40.2 ppb and 40.0 ppb, the mean concentration is 39.95 ppb rounded to 40.0 ppb.
- Open the Configuration Setup and note the original base sensitivity and make the next calculation :

Mean concentration obtained after chromatograms re-identification: 40.0 ppb
Theoretical concentration: 39.4 ppb
Original "Base sensitivity": 4000 (ua by ng)

The new base sensitivity is:

$$\frac{40.0 \times 4000}{39.4} = 4060.91$$

The new Base sensitivity will be updated in the Setup GC configuration. In this example, the value will be: 4060.

M. TROUBLE SHOOTING GUIDE

For any problems, please look at our customer service website http://support.chromatotec.com using your password.

If you don't have the password, contact our customer service:
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