

CHROMATOTEC Group / airmotec	USER MANUAL STANDARD SMU n° 206-3-03	Application date : 5 June 2013
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AIRTOXIC GC 866

Historic

Version N°	Nature of modification	Application date	Chapters modified
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WARNING

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CAUTION for all manipulation HIGH VOLTAGES inside the instrument

Don't open the alimentation box because there is the presence of high voltage until 1500 V.

A. OBJET

User's manual for the analyser airTOXIC: presentation of the analyser, operating principle, installing, starting and stop of the analyser, calibration and troubleshooting.

B. APPLICATION FIELD

Analysers airTOXIC.

C. DEFINITIONS

D. REFERENCE DOCUMENTS

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

Installation and starting manual of an PID analyser (reference: SMU 206-3-220-00-01 Installation and starting Manual PID.pdf)

Easy start airTOXIC with internal calibration (reference: easy start air tox73.UK.pdf)

Easy start airTOXIC Std (reference: easy start airTOXIC-STD-74022-UK)

Easy calib airTOXIC Std (reference: EASY CALIB airTOXIC-STD A74022-UK.pdf)

Easy calib airTOXIC with internal calibration (reference: EASY CALIB airTOXIC Calib A73022-UK.pdf)

E. AIRTOXIC WITH INTERNAL PC 5U - PRESENTATION

E. 1. INTRODUCTION

The airTOXIC is a high performance gas chromatograph with photo ionization detection (PID) and an on-line sample preparation. It is designed for the analysis of BTEX compounds (Benzene, Toluene, ethyl-benzene, m&p-xylenes 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 (Nitrogen) when compared to conventional systems. Thanks to its high level of automation, it is suitable for continuous pollution monitoring. Therefore, the airTOXIC is suitable for in-situ operation.

E. 2. GENERAL CHARACTERISTICS

Model: airTOXIC A73022

Pneumatic valve: 6 ports 1/8" (A 6UWP)

Replacement rotor: SSA-6-UWP

Analytical column: Capillary metallic column, length: 30 m ref.: MXT30CE

Detector: Photo ionisation detector (PID)

Carrier gas: Nitrogen (quality 5.5 minimum)

Lamp cleaning: zero air or nitrogen

Trap: L = 8 cm; id= 1.5 mm

Critical orifice: 50 µm

Supply voltage: 115VAC or 220 VAC

Vistachrom software

Dimension: 19", 5U

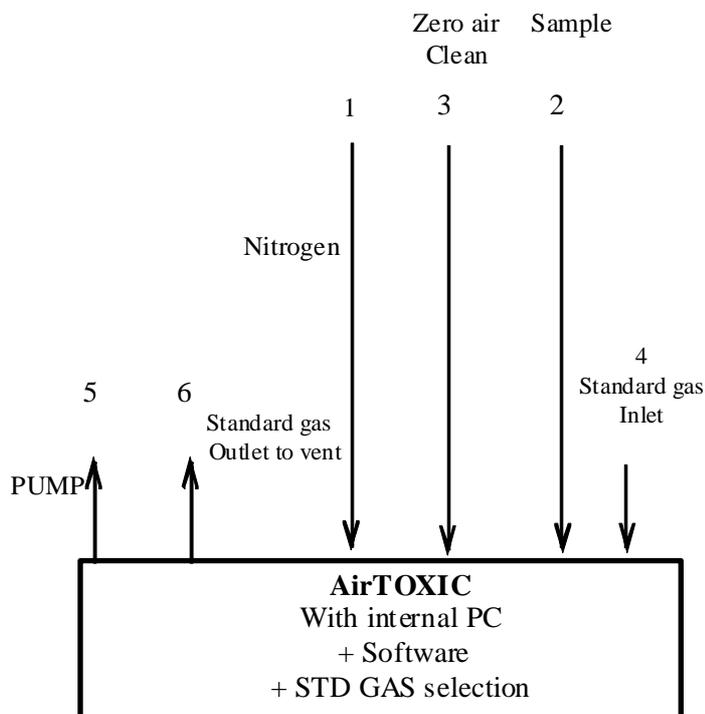
Weight: 25 kg (packed: 45 kg)

Option: Internal permeation oven

ORIGIN COUNTRY: FRANCE

CHROMATOTEC Group / airmotec
 15, Rue d'Artiguelongue
 33240 SAINT -ANTOINE
 FRANCE

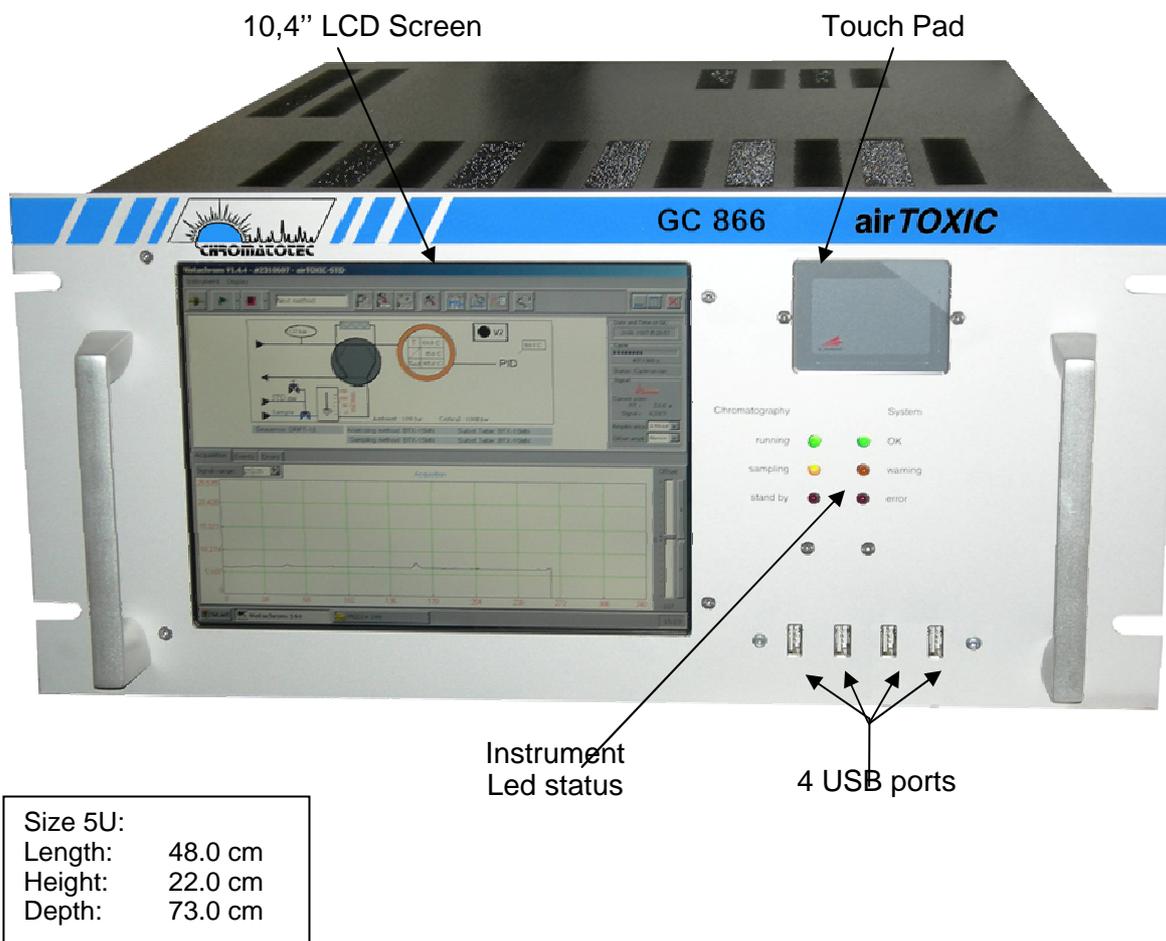
E. 3. FUNCTIONAL DIAGRAM



Legend:

- 1** Nitrogen inlet to connect a cylinder (not included) 1/8" stainless steel, swagelok
- 2** Sample inlet (ambient air...). 1/4" stainless steel, swagelok
- 3** Zero air inlet (for auto cleaning and internal permeation oven) to connect a cylinder or a compressor, 1/8" stainless steel, swagelok
- 4** Standard gas inlet, 1/8" stainless steel, Swagelok for external calibration (to connect a standard gas cylinder or an external permeation oven)
- 5** Sampling pump 1/4" VACUUM, stainless steel, Swagelok
- 6** Standard gas outlet, 1/8" to connect on A VENT, stainless steel, swagelok.

E. 4. FRONT FACE



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.

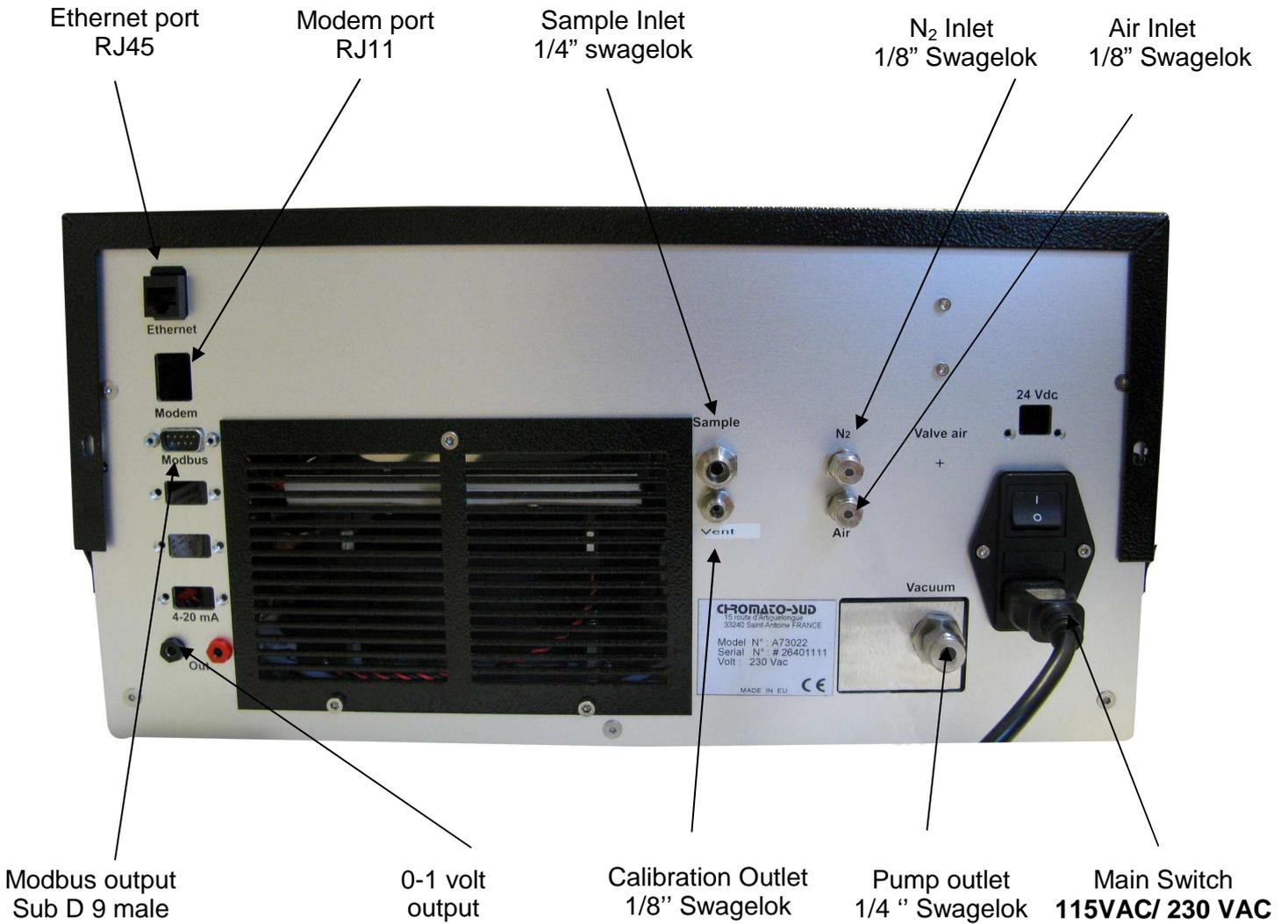
System: A2 communication protocol (when the analyser is connected to Acquisition software and when Acquisition software is in the on-line window)

"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).

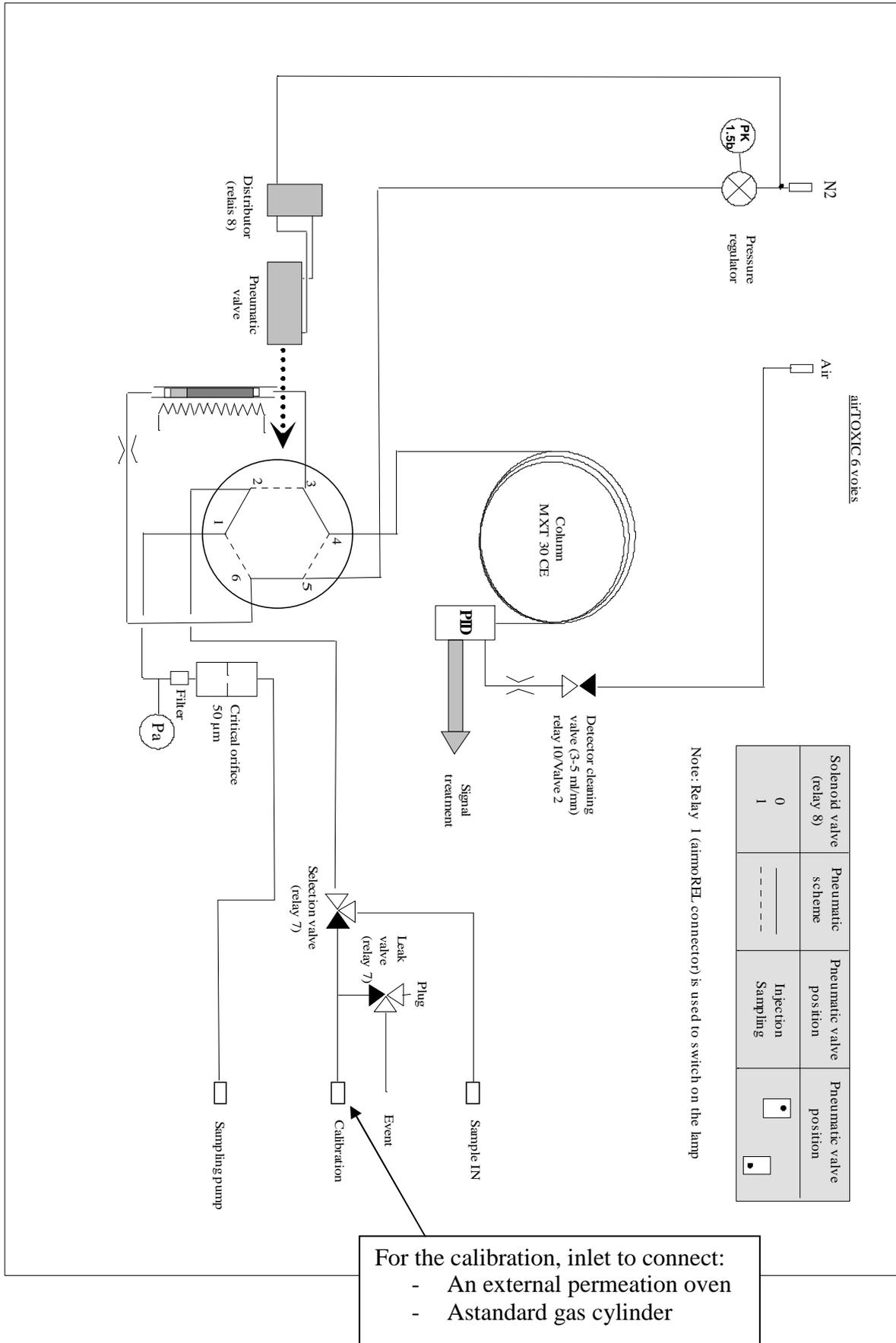
"Error": the red LED is lit when an important error has occurred (Error number 2xx).

E. 5. REAR FACE



Size 5U:	
Length:	42.5 cm
Height:	21.0 cm

E. 6. PNEUMATIC SCHEME OF AIRTOXIC



F. OPERATING PRINCIPLE OF THE AIRTOXIC

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 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 the C6 to C10. 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 standard gas) is measured downstream of the adsorption section, thanks to a critical orifice which fixes 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 set in the instrument by a critical orifice of 50 µm. The sampling flow is about 10 to 25 ml/min.
- 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). Next the VOC are separated by the analytical column and detected by the PID.

F. 2. 1. SAMPLING (CONTROLLED BY RELAY 8/VALVE 6 OF POWER BOARD)

a) Introduction

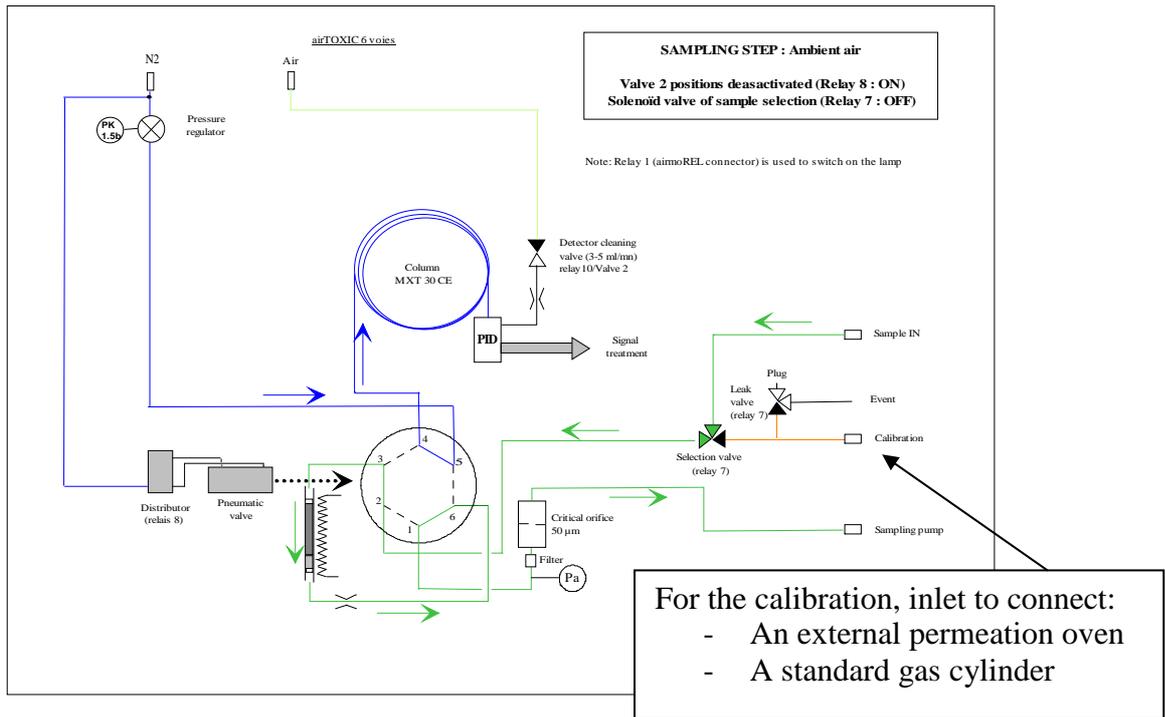
These "transfer line" will have to be as short as possible to avoid a sample condensation. The entrance pressure of the sample must be near the atmospheric pressure so that the measurement of the volume sampled by the analyser is correct. This measurement is made thanks to the Pa board and depends on 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.

b) Ambient air sampling (no selection relay activated)

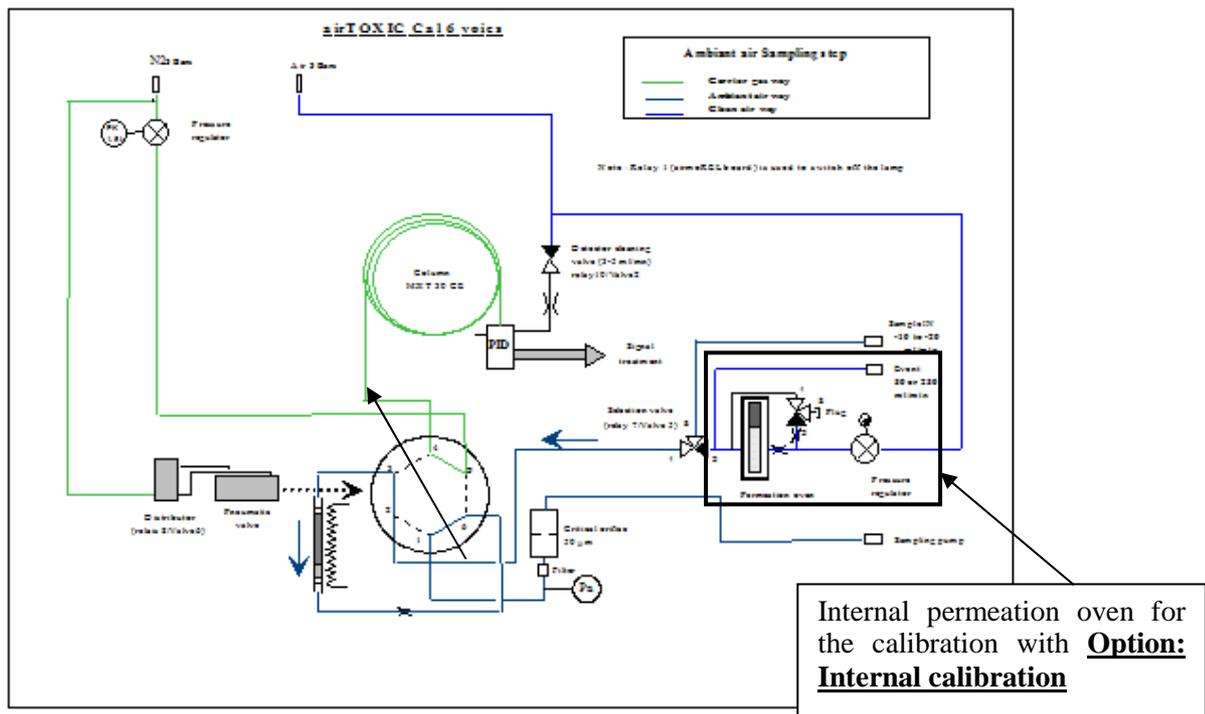
The gas sample to be analyzed must be connected on the connection 1/4", swagelok which is on the rear face and which is named "Sample Inlet". The gas sample must not contain any liquids or dust. It is recommended using a sufficiently dimensioned tube so that the sample remains with atmospheric pressure. The sample volume measured by the analyser is depending on the sample pressure.

A tube of Teflon 1/4" is recommended.

The pneumatic scheme corresponding to the ambient air sampling is:



With option internal calibration, the pneumatic scheme is:



c) Standard gas sampling (controlled by relay 7/valve 5 power board)

There can be 3 types of standard gas:

1. A calibration cylinder containing the BTEX with concentrations ranges similar to the concentration range of compounds contained in ambient air (ppb).
2. A calibration cylinder containing BTEX with much higher concentrations (ppm) than those contained in the ambient air. In this case, it will be necessary to make a dilution of this standard gas before its introduction into the analyser.
3. Permeation tubes of BTEX. The flow of dilution of air zero will be selected according to the permeation rate of the tubes. (Example: for a benzene tube having a permeation rate of 15 ng/min at 45°C, there will be a total dilution flow about of 200 to 300 ml/min).

1. Calibration with a cylinder containing BTEX < 100 ppb

If the sampling flow is around -15 ml/min, it will be enough to regulate the outlet standard gas at +30 ml/min.

On the reducing valve of the standard gas bottle, put a Teflon tube 1/8 ".

Inside this tube, put a stainless steel tube with a fixed restriction (for example a 1/16" SS tube crimped inside the tube Teflon with the ferrule 1/8 "swagelok). This tube 1/16 "is sufficiently crushed to have a flow of 30 ml/min with a supply pressure of 0.2 to 0.5 Bar.

Then connect the outlet of the bottle (Teflon tube) on the inlet standard gases 1/8" Swagelok situated on the rear face of the analyser (Don't forget to check the leaks). When the analyser is in sampling phase of standard gas, the analyser will take 15 ml/min. The remaining flow will go to the VENT.

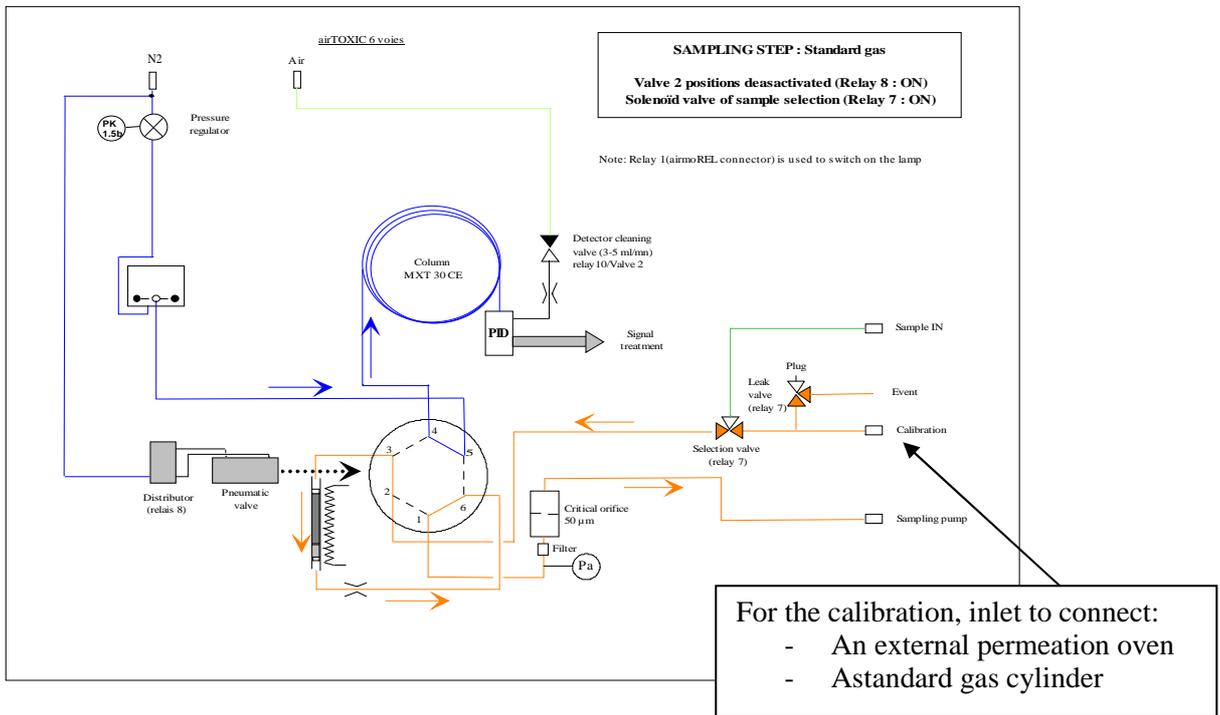
2. Calibration with a cylinder containing 100ppb<BTEX<1ppm or an external permeation oven

The sample must be introduced in the GC at atmospheric pressure. The standard gas has to be diluted (between 1/10 and 1/100).

Put a "T" at the instrument standard gas inlet: it permits the analyser to take the 15 ml/min necessary to atmospheric pressure and to send the remainder to a VENT.

The standard gas flow will be fixed by a restriction (the standard gas flow will be set at: 0.15 ml/min to 1.5 ml/min in function of the standard gas concentration). The dilution can be done with zero air or nitrogen. The dilution flow will be fixed around 30 ml/min. In this case, to prevent pollution of laboratory ambient air, the "VENT" of the external "T" will be connected to the VENT and the internal "VENT" tube of the analyser will be plugged.

The pneumatic scheme of sampling step of external standard gas (cylinder or external permeation oven) is:



3. Calibration with an internal permeation oven (with option internal calibration)

The permeation oven is placed inside the analyser. It's regulated at 45°C or 40°C and it contains a tube of Benzene with a permeation rate around 15 or 32 ng/min at 45°C or 40°C.

The analyser must be supplied with 3 Bar of zero air. In our office, we have adjusted the internal pressure regulator of the permeation oven to have a permanent air flow inside the permeation oven around 50 ml/min for an alimentation pressure around 0.2 to 0.4 Bar. When the standard gas selection solenoid valve is activated, the dilution solenoid valve is activated in the same time so that the zero air flow increases to 250 ml/min. This flow corresponds to the addition of a permanent air flow of 50 ml/min from the permeation oven and air flow 200 ml/min of the dilution.

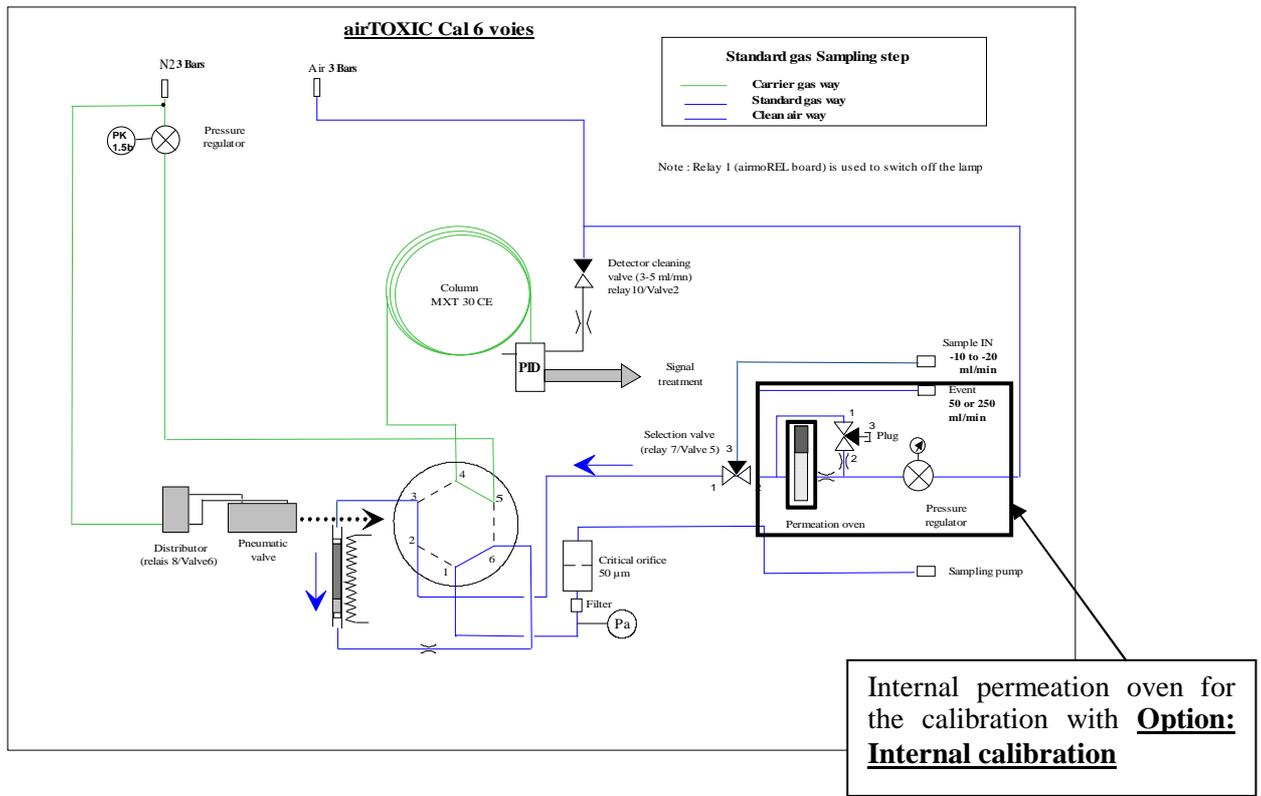
The approximated concentration of internal standard gas becomes:

$$\text{Conc Benzene} = \frac{15}{0.250} = 60.0 \text{ ng/l or } \mu\text{g/m}^3$$

The molecular weight of Benzene is: 78.11 g/mol
 And the molecular volume at 20°C is 24.04 l.mol⁻¹

$$\text{Conc Benzene in ppb} = \frac{60 \times 24.04}{78.11} = 18.5 \text{ ppb}$$

With option internal calibration, the pneumatic scheme of sampling step of the internal standard gas is:



F. 3. 1. INJECTION OF THE SAMPLE IN THE ANALYTICAL COLUMN (TRAP AND DESORPTION)

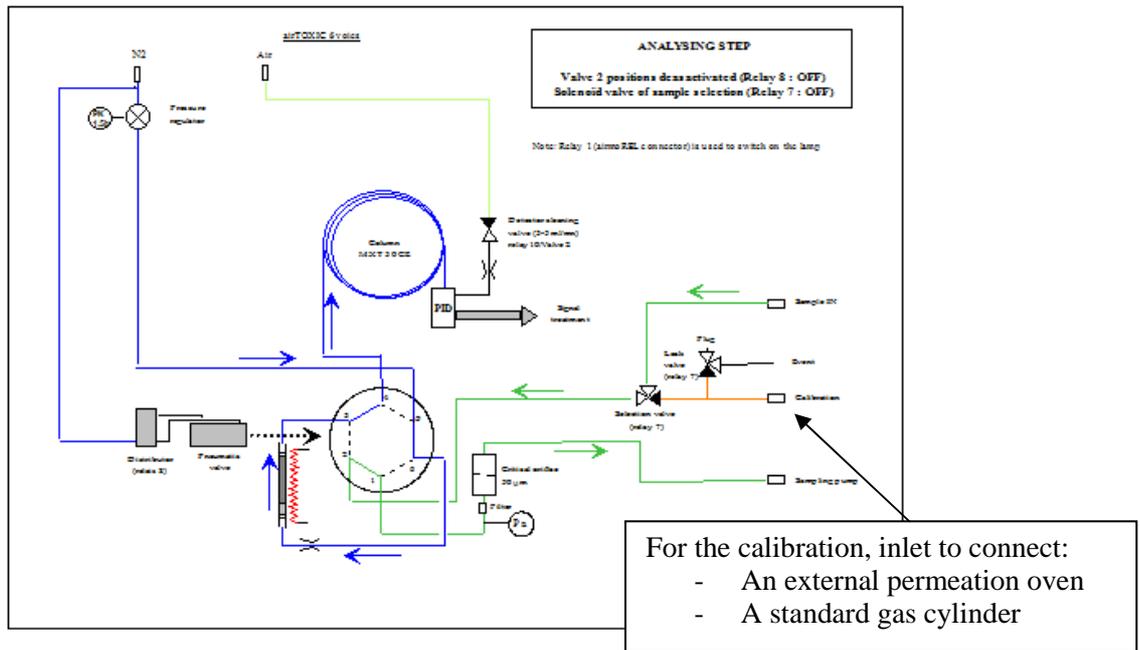
The pneumatic valve that was in "sampling" position gets in "injection" position; thereby the sampling tube is introduced in the carrier gas circuit. The circulation way of carrier gas inside the tube is in the way opposite to the sampling way. At this time, the trap is heated in order to desorb the VOC adsorbed. The time of thermo-desorption is a few minutes (depending on the cycle duration).

The analytical column is situated in an oven of which the temperature is programmed with a gradient that starts at 60 seconds after the beginning of the cycle during the trap thermo-desorption.

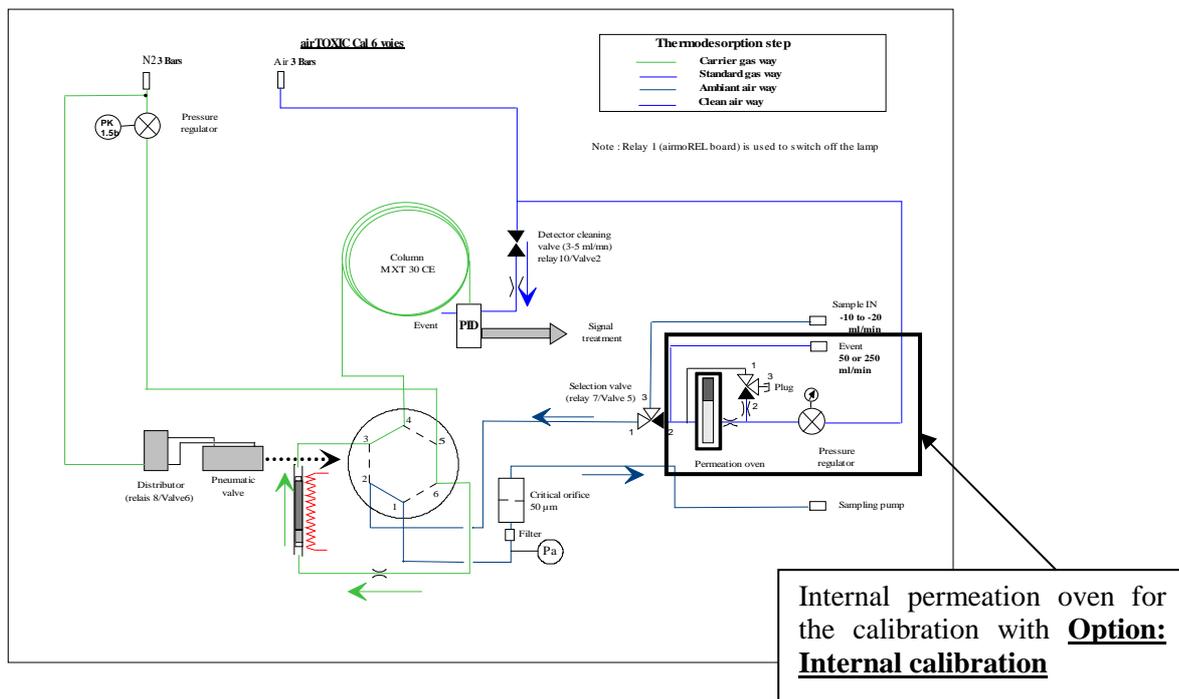
The gaseous sample is introduced in the analytical column by the carrier gas flow. Then, the compounds elute in the column at a characteristic rate (depending on their boiling point and on their interactions with the column stationary phase). Generally, the retention time of the compounds increases with their molecular weight (boiling point).

By default, the 2 positions valve is in position "injection".

The pneumatic scheme of injection step of sample is:



With option internal calibration, the pneumatic scheme of injection step of sample is:



F. 4. 1. DETECTION AND DATA TREATMENT

At the extremity of the column, a photo ionization detector (PID) 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 handles 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 at 191s (cycle in 15 min) or 245s (cycle in 30 min) after the method start (depending of the cycle duration).

Caution: During this analysis, it is advised to not exit the ON-LINE menu because the data would be lost. But, it is possible to reduce the software window.

The complete cycle (sampling, trapping of the compounds, injection, chromatographic analysis and detection) is repeated. The on-board microprocessor stores the data (chromatograms and trends), 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.

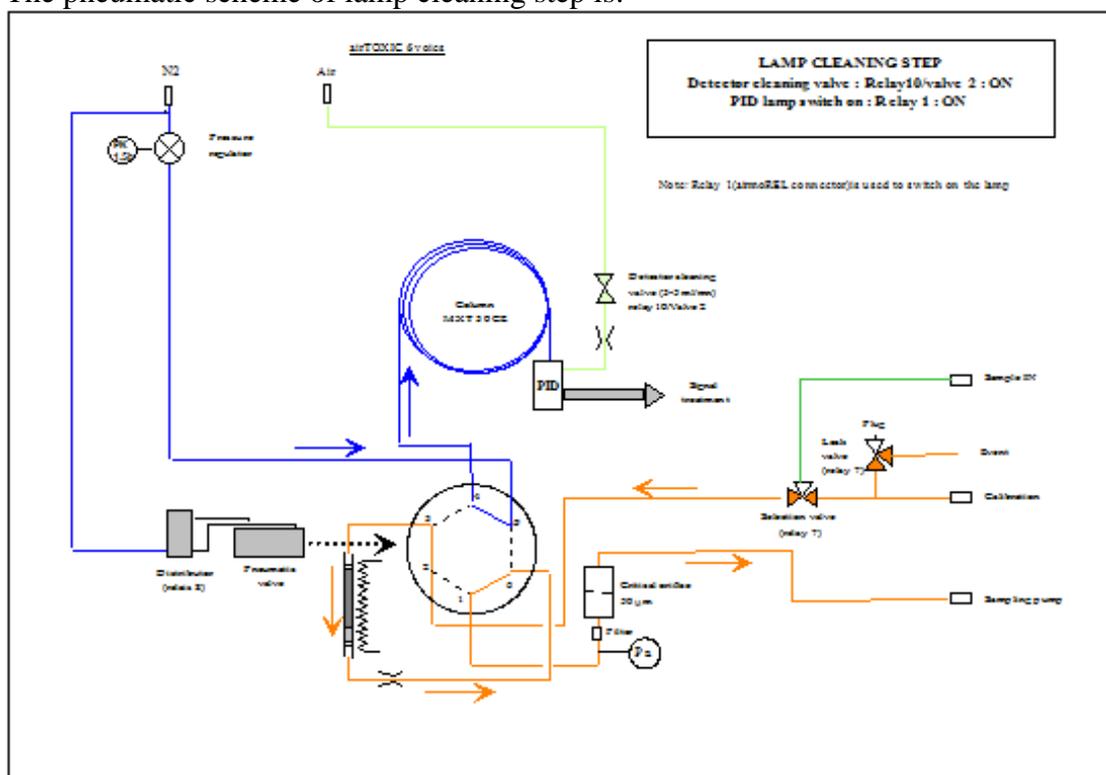
F. 5. 1. SELF CLEANING OF THE LAMP

Detector PID is not a destructive detector and the substances eluted from the analytical column are directly in contact with the lamp area. Thus, to avoid a VOC accumulation on the lamp area, which can cause “less sensitivity of the detector”, a solenoid valve controlled by the relay 10/ valve 2 (of the POWER board) activates the zero air/N₂ for cleaning the lamp area.

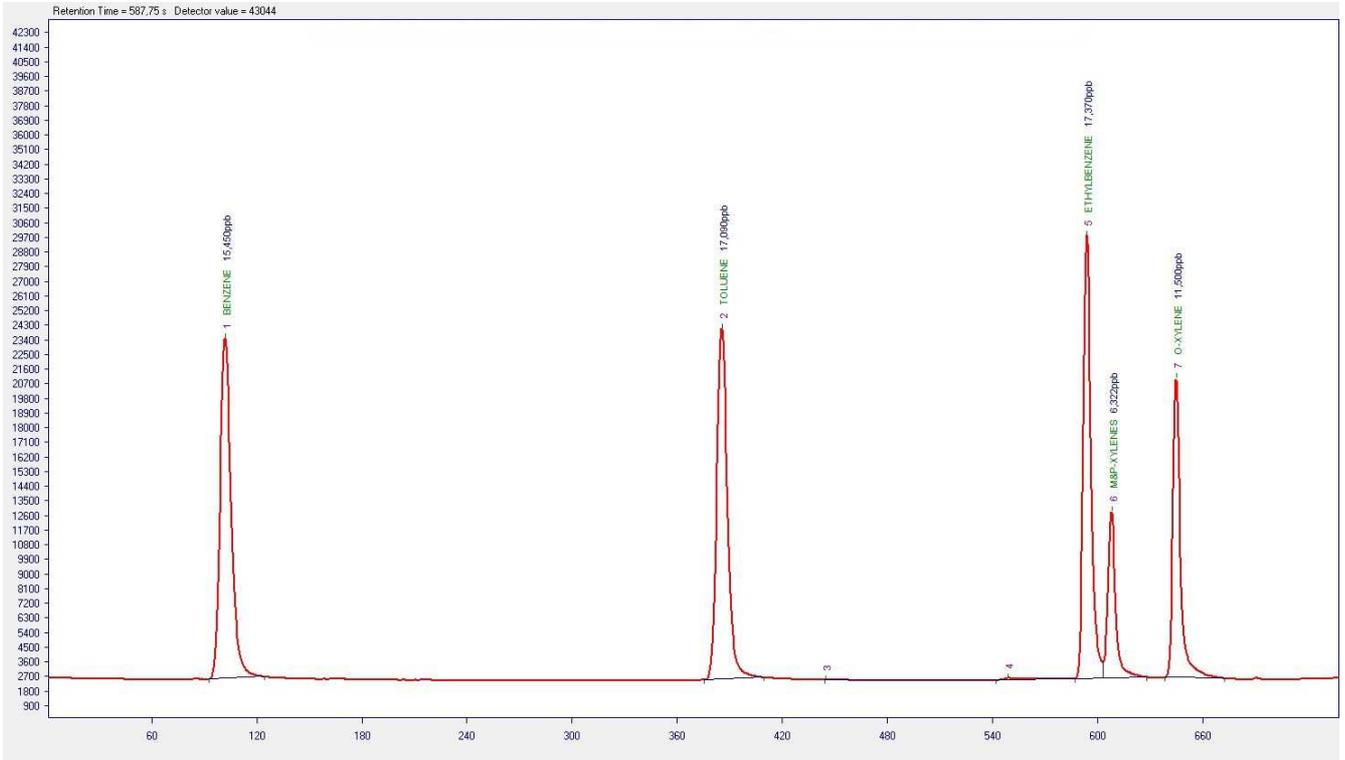
When this relay is active, a flow around 3 to 5 ml/min of zero air (or nitrogen) is sent to the lamp area.

This relay is activated by Vistachrom a few seconds after the end of acquisition. The lamp of the detector is still lit. Next the lamp turns off (by deactivation of the relay: RELAY 1 of the airmoREL board) and the air of cleaning continue to sweep the lamp area during practically all the duration of the cycle.

The pneumatic scheme of lamp cleaning step is:



F. 6. 1. CHROMATOGRAM EXAMPLE OF PERMEATION TUBES ANALYSIS CONTAINED INTO A PERMEATION OVEN



Operating conditions :

Description : External STD during 360 s
 Method Name : CALIB30M Substances Table Name : CAL-30MN

Sampling :

Tube Number : 3 Duration : 360 s Volume : 102.201 ml Date :

27/03/2013 16:53:48

Detector :

Amplification : 2-Middle Sample Rate : 15 per second

Peak List

Substance	Result	Unit	Start (s)	R.Time (s)	Max	Stop (s)	Area	Type	FWMH
BENZENE	15.450	ppb	92.60	102.13	23626	124.53	154099.0	ST_E	6.53
TOLUENE	17.090	ppb	375.53	385.73	24227	409.60	152404.0	ST_E	6.27
ETHYLBENZENE	17.370	ppb	587.07	594.20	29941	603.33	141523.0	ST	4.53
M&P-XYLENES	6.322	ppb	603.33	608.33	12959	627.93	52839.3	E	3.93
O-XYLENE	11.496	ppb	638.60	645.20	21152	672.47	93145.7	ST_E	4.13

Filter

Remove unidentified peaks Display all peaks

F. 2. PHOTOIONIZATION DETECTOR

F. 1. 1. INTRODUCTION AND SPECIFICATION

The photo ionization detector PID has been designed to detect organic and some inorganic species eluted from gas chromatography columns. The PID shows high sensitivity, wide linear range and simple operation.

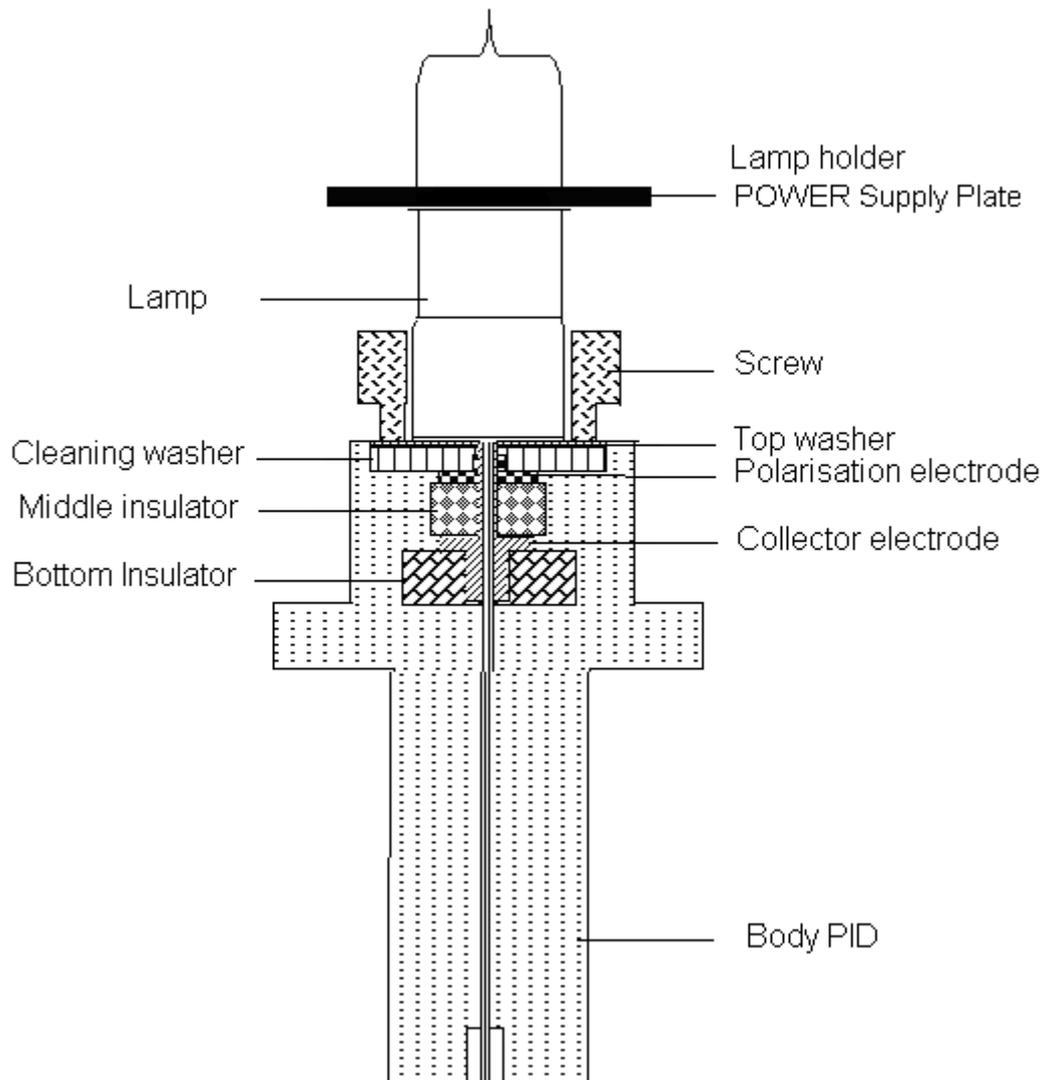
F. 2. 1. DESIGN AND OPERATION

THE PID operation is based on ionization of compounds by means of UV-radiation. Kr, Xe, or H₂ glow discharge lamps are used as the source of such radiation. The lamp emits the photons with characteristic energy levels. The photons go through an ionization chamber, where a part of photons is absorbed by the eluted species. The compounds whose ionization energy is less than photon energy are ionized. The ion current produced in ionization chamber is proportional to the concentration measured of compounds.

The PID assembly is shown in lamp scheme here after. It involved a body with gas inlet, ionization chamber and UV-lamp. Metal spacer is placed between the ionization chamber and the lamp. Lamp housing, spring and Teflon sleeve are used to keep the lamp against the spacer. Lamp housing is connected to detector body by means of lamp holder and power supply plate. The coaxial electrodes in the ionization chamber are separated from each other and metallic parts of the detector by means of ceramic insulators. One of the electrodes is connected to the PID power supply, another –to the electrometer. The electrical leads of UV-lamp are brought out through the hole in the top of housing and connected to the lamp power supply.

The power supply board provides a stable current of 0.2 mA for lamp ignition and operating and a polarizing voltage of 9 V for PID.

F. 3. 1. LAMP SCHEME



G. DETECTOR INSTALLATION

G. 1. PRECAUTIONS

The voltage on the lamp power supply board and on the lamp electrodes reaches -780 VCC.

To assemble or disassemble the detector, turn power off the instrument with the two positions switch placed inside the analyser.

Don't use the main switch on the rear face if the PC is on.

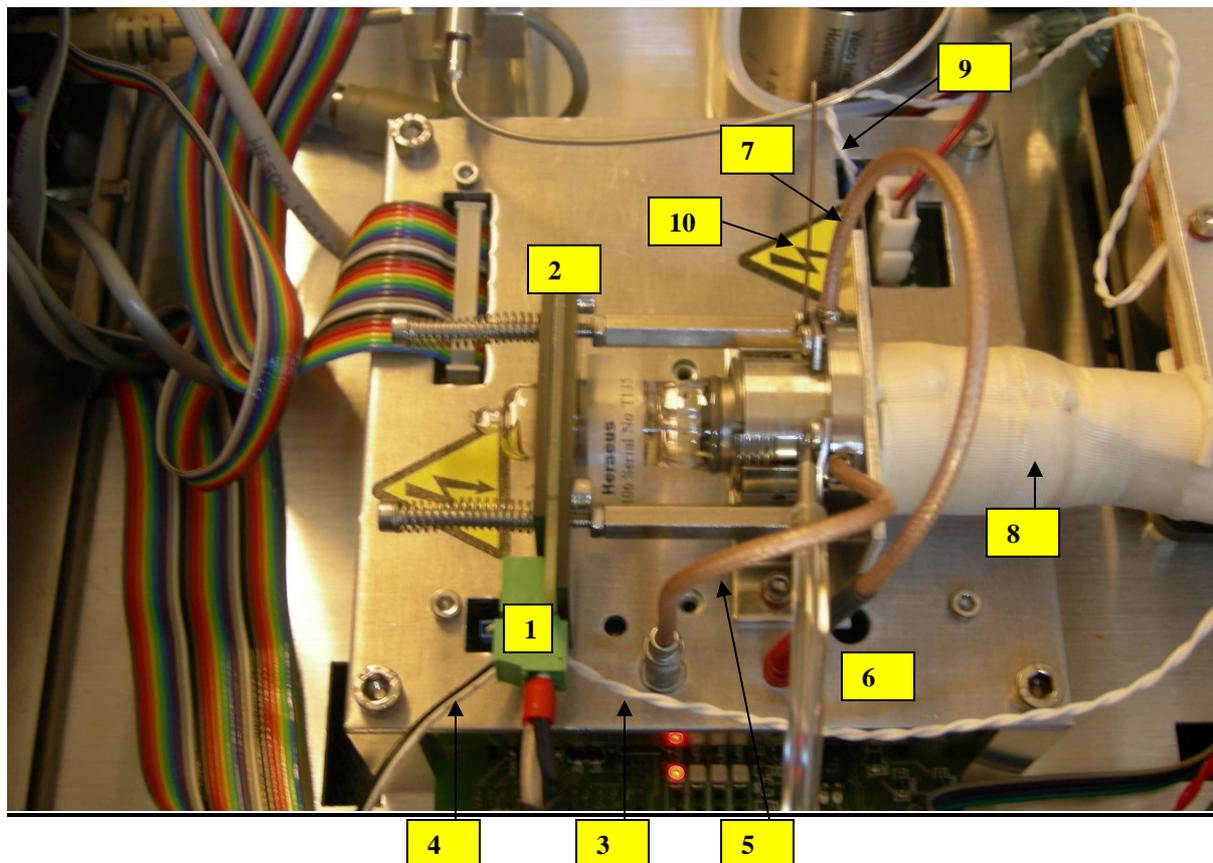
No contact can be tolerated between any element of lamp power supply board and metal parts of chromatograph. Be careful when installing of the board inside the device.

G. 2. DETECTOR MOUNTING

The PID body is mounted on a metallic support fixed with screws. It is heated by a heating resistor. VUV-lamp in housing is located on the detector body with bay-net joint. The lamp current is adjusted near 200 μ A in our laboratories.

CAUTION: Do not slacken the springs which compress the lamp abruptly because the lamp window could be destroyed.

G. 3. DETECTOR CONNECTING



1) High voltage cable

This cable supplies the tube with high voltage around -780V. This voltage can be set on the High Voltage housing.

2) Lamp holder – Power supply plate

Never remove this holder when power on. Before to remove the lamp, switch off the instrument.

3) PID sensor cable

4) Analog output cable

5) Electrode signal

It is connected to the electrode in the detector. The current which goes through this cable is very low (some μV) and it is amplified by the electrometer board.

6) Air cleaning tube

This tube brings 3 to 5 ml/mn of zero air comes to the lamp window to clean it during cycle.

7) Polarisation

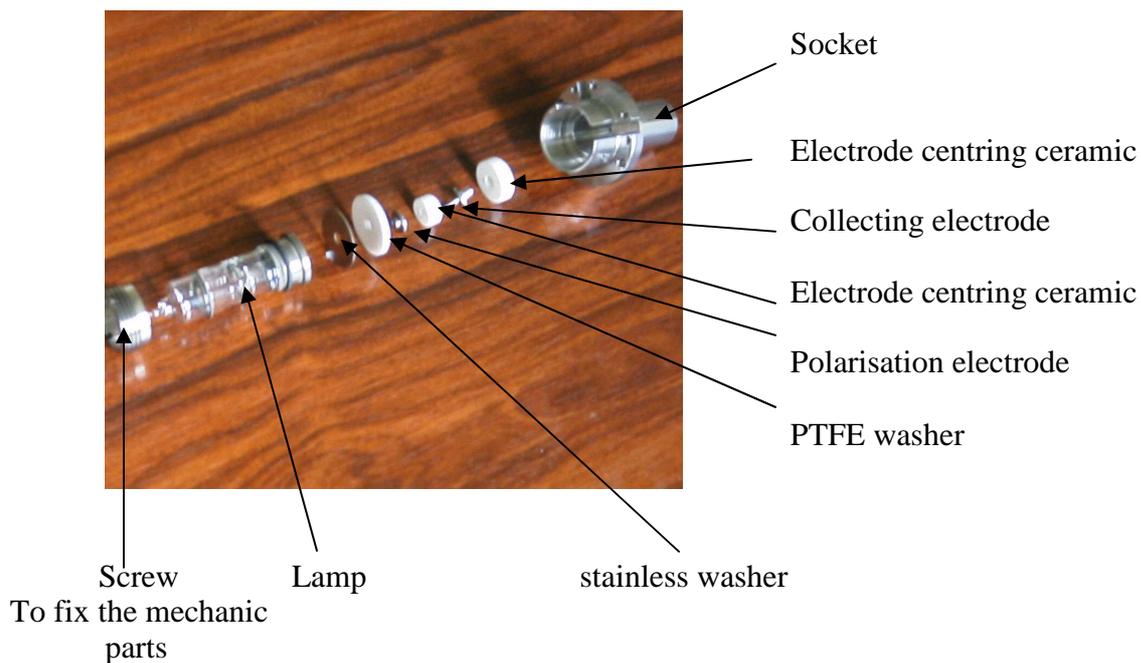
This electrode polarises the detector with voltage of 9,3V. This voltage comes from the High voltage housing and it cannot be adjusted.

8) Insulated Socket of the detector. Its function is to heat the detector at 150°C. Its resistor is around 10 Ω and it is supplied by the Power Board Pwm signal.

9) Oven sensor cable

10) VENT of the cleaning zero air (or Nitrogen) when the Valve 2 of POWER Board is active.

Detector assembly



G. 4. DETECTOR SWITCHING

By default, the PID lamp is switched off. Lighting is programmed in the working method of the analyser. The duration varies according to the duration of the selected cycle (15 or 30 minutes).

The detector lamp ignition is controlled by the relay "RELAY 1" of the airmoREL Board. When the lamp is lit, a purple blue light appears inside the lamp.

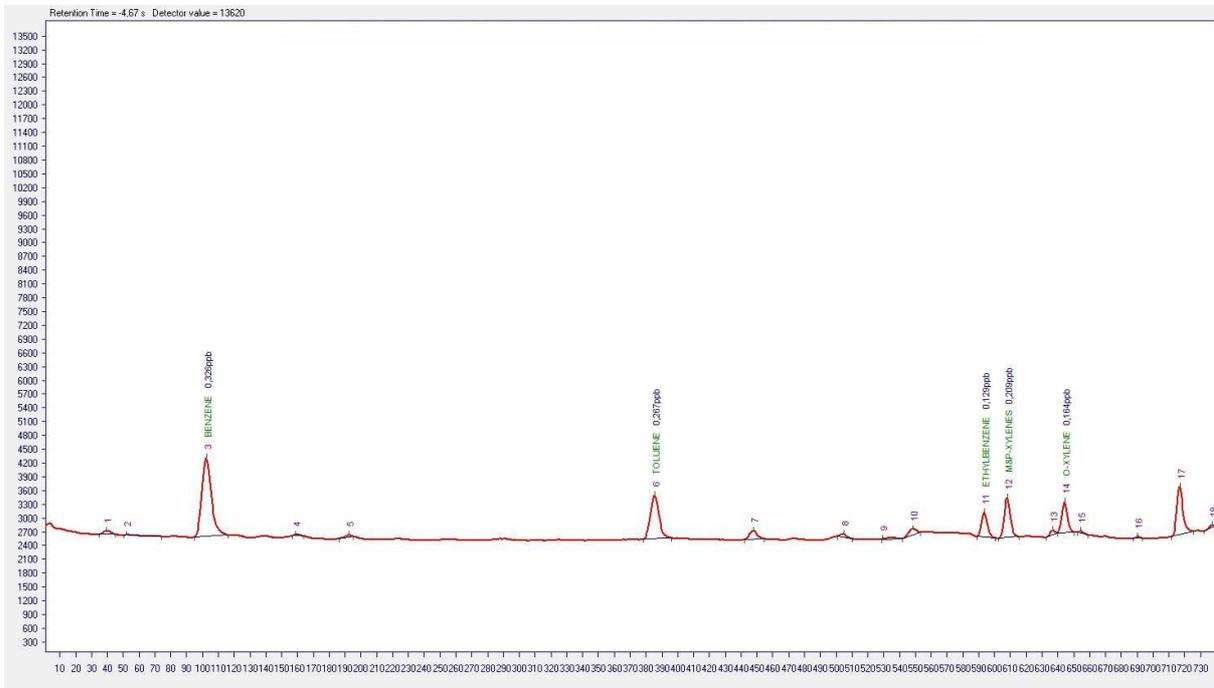
H. CHROMATOGRAM EXAMPLE

1. Ambient air analysis

Analytical conditions:

- Cycle duration: 30 minutes
- Trapping at ambient temperature during 22.5 minutes
- Trap desorption: duration 240 seconds
- Carrier gas: Nitrogen 5.5 at 3 to 4 ml/min. Head column pressure 1.00 (+/-0.15) Bar.
- Oven temperature: 36 to 38°C at 2 °C/min- 38°C to 50°C at 2°C/min - 50 to 80°C at 10°C/min- 80°C to 190°C at 15°C/min – isothermal 190°C (hold 240s)
- Acquisition duration: 740 seconds.

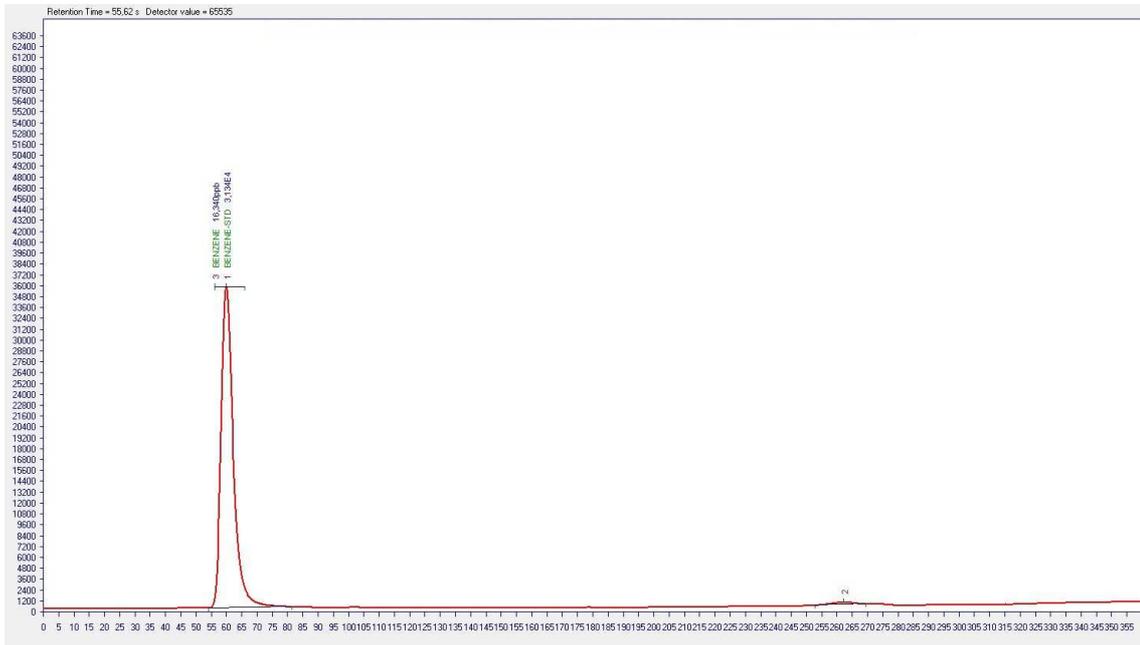
➤ Sample : 382.3 ml of ambient air



Operating conditions :		Description : Ambient air 22.5 mins		Substances Table Name : BTX-30MN					
Method Name : BTX-30MN		Sampling :		Duration : 1350 s					
Tube Number : 3		Date :		Volume : 382.296 ml					
27/03/2013 18:07:18		Detector :		Sample Rate : 15 per second					
Amplification : 2-Middle									
Peak List									
Substance	Result	Unit	Start (s)	R. Time (s)	Max	Stop (s)	Area	Type	FWMH
BENZENE	0,326	ppb	94,73	102,67	4341	116,13	12066,5	ST_E	6,33
TOLUENE	0,267	ppb	378,33	385,73	3522	395,80	5994,3	ST_E	5,87
ETHYLBENZENE	0,129	ppb	589,13	593,80	3161	600,33	2400,0	ST_E	3,87
M&P-XYLENES	0,209	ppb	602,73	608,20	3470	615,40	3964,1	ST_E	4,20
O-XYLENE	0,164	ppb	639,60	644,53	3381	650,47	2814,0	ST_E	3,80
Filter									
<input checked="" type="radio"/> Remove unidentified peaks <input type="radio"/> Display all peaks									

2. Standard gas analysis

Sample: Benzene (internal standard gas)



Operating conditions :
 Description : Internal STD during 360 s
 Method Name : CALIB15M Substances Table Name : CAL-15MN
Sampling : Tube Number : 3 Duration : 360 s Volume : 100,342 ml Date :
 05/04/2013 05:59:48
Detector : Amplification : 2-Middle Sample Rate : 25 per second
Sensitivity : Base Sensitivity : 31151,0

Substance	Result	Unit	Start (s)	R. Time (s)	Max	Stop (s)	Area	Type	FWMH
BENZENE-STD	31342,900	---	54,12	60,04	36002	61,40	164170,0	ST_E	4,00
BENZENE	16,340	ppb	56,00	56,00	36002	66,00	164170,0	Peaks sum	---

Filter
 Remove unidentified peaks Display all peaks

Sample used: internal permeation oven containing a benzene tube.

The permeation oven temperature setting is: 45 °C.

The total dilution flow is around 180 ml/min to 250 ml/min (depending of the analyser configuration).

Permeation rate of the tube around: 15 ng/min at 45°C (+/- 10 %).

The concentration awaited is between:

$$\frac{15}{0.250} = 60.0 \mu\text{g}/\text{m}^3$$

and

$$\frac{15}{0.180} = 83.3 \mu\text{g}/\text{m}^3$$

I. INSTALLING THE AIRTOXIC

I. 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 AIRTOXIC A73022 is packed in a wood box with protection and maintaining foams placed above and below the analyser.

The AIRTOXIC A73022 packaging extraction begins with the opening of the wood box; at this stage, it is possible to verify 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 AIRTOXIC A73022 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.

I. 2. ELECTRICAL SUPPLY

This instrument is supplied with 115VAC or 220 VAC.

The supply must be able to deliver the following power:

115 VAC or 220 VAC (+/- 10 %)

Power: 400W

Fuse: 15A

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, PID temperature and calibration plug-in unit.

I. 3. GAS SUPPLY AND CONNECTIONS

See the rear panel scheme to visualize the pneumatic connections of the instrument.

I. 1. 1. WARNING

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:

- Nitrogen: stainless steel, **1/8"**, HPLC grade.
- Zero air: stainless steel, **1/8"**, HPLC grade.
- Sample inlet: glass, 10 mm, or PFA, **1/4"**.
- Standard gas inlet: glass, 10mm, or PFA, **1/4"**.
- Standard gas outlet: **1/8"**(grade not important). **To connect on A VENT.**
- 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 that double pressure release valves are used with gas bottles. These pressure regulators must be free of plastic (i.e. GC or ultra-high purity gas quality).

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

See on § I-6 Gas and power supply connectors on the instrument rear panel.

The following information refers to the values measured at the inlet connectors to the airTOXIC.

I. 2. 1. NITROGEN

Nitrogen is used as carrier gas and for the pneumatic actuator. It can also be used for the cleaning of the lamp area and for the internal or external permeation oven when there is no zero air available.

- Nitrogen (5.5 quality recommended).
- Inlet pressure: **3 bars**
- Consumption for carrier gas: **3 to 4 ml/min**
- Consumption for the air actuator: **near 2.6 liters by day** (depending of the cycle duration).
- Connector: **1/8"**, stainless steel, swagelok.

I. 3. 1. AIR

Zero air is used for the clean air of PID lamp and for the internal or external permeation oven.

- Air (Zero).
- Inlet pressure: **3 bar**
- Consumption for the self cleaning of the PID Lamp: **3 to 5 ml/min**

- Consumption for the permeation oven: **50 ml/min (250 ml/min when relay 7 is activated)**.
- Connector: **1/8"**, stainless steel, Swagelok.

I. 4. 1. SAMPLE

a) Sampling system

An adequate vacuum supply is required to aspirate 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 ("Sample", 1/4" stainless steel, Swagelok) under some 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. Metal tubing should be kept as short as possible.

In order to carry out the sample volume measurement, some conditions must be fulfilled. The lower the inlet pressure the less the sample gas flows is into the instrument. The pressure at the inlet connector must be at least 800 hPa.

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 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 certain components in the sample.

All methods of sample filtering have some effect on the measurement. It is essential in all cases to check that the compound to be analysed actually goes through the filter. (This can be done by making test measurement with reference samples 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.

- The flow is fixed by a critical orifice of 50 µm. The sampling flow is around **10 to 25 ml/min**.

c) Standard Gas (Internal or external calibration device)

An external (permeation oven or gas cylinder) or internal calibration device is used to do the “Autocalibration” of the analyser, that is to calculate and adjust the sensitivity of the analyser and so to validate the results.

Internal permeation oven:

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

For example, the permeation tube included: **15 ng/min à 45°C or 40°C (certified +/- 10%)**. The permanent air dilution flow is \approx **50 ml/min** (when the relay 7 / valve 5 is off)
 \approx **250 ml/min** (when the relay 7/valve 5 is on)

The solenoid valve controlled by the relay 7/valve 5 is activated 120 second before the sampling start to be sure the total air flow for dilution is stabilized.

An EVENT on the rear face permits to measure the permeation flow.

- Connector: **1/8"**, stainless steel, Swagelok.

External calibration:

In the case where the calibration gas would be diluted before its introduction into the analyser, it is necessary to use a “T” at the instrument inlet to have a correct pressure measurement (when the standard gas used is too much concentrated and has to be diluted).

- Inlet Connector : 1/8'' swagelok stainless steel
- Sampling flow is fixed by the critical orifice of 50 μ m.
- Outlet external standard gas : **1/16'' OD tube**, stainless steel

The instrument measure the sample volume introduced in the analyser with the PA Board. This volume depends on the critical orifice pressure. This pressure will be always near ambient pressure. The analyser takes the needed volume and **the additional internal standard gas output is sent towards the VENT.**

I. 4. SIGNAL AND DATA CABLING

- Data cable: RS 232, 9600 Baud. Maximum permissible cable length: 15 meters
Connector 9 pole submin. Type D, male / female.
Inside the instrument.
- 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 plug.

I. 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. Under no circumstances should an instrument with large power consumption be placed directly below the AIRTOXIC.

I. 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.

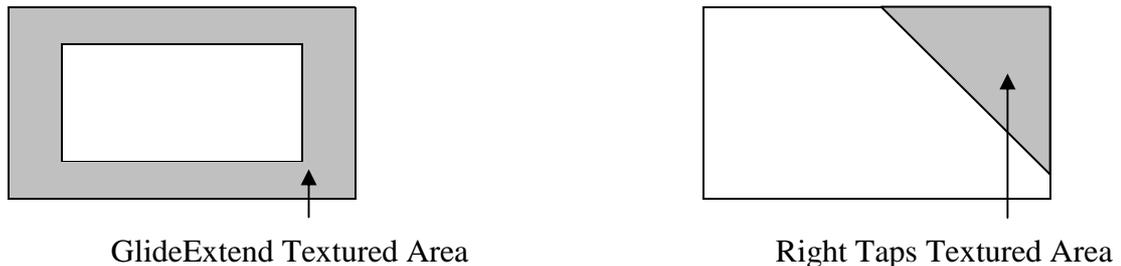
J. TOUCH PAD USING

No finger pressure is required. To move the cursor you simply move your finger across the touchpad. Tap once on the pad to “click” twice to “double-click”, and tap and hold to drag, and highlight.

When the user’s finger encounters the edge of the pad during a drag, draw, or highlight operation, the user may lift and reposition their finger (similar to repositioning a mouse on a mousepad). Thus, the user is always in control and is never required to “steer” as the cursor begins to coast in the direction of the finger.

The overlay incorporates two distinct levels of texturing. This dual textured surface is used to define the areas on the touchpad where the GlideExtend and Right Taps features may be activated during typical user operations (see figure 1). The GlideExtend region provides valuable tactile feedback during drag, draw, and highlight operations, signalling to the user they may now lift and reposition their finger away from the edge of the touchpad while GlideExtend is engaged. Similarly, the coarser texture of the Right Taps area alerts the user that tapping in this area will result in a secondary button input (right “click”). The Right Taps area is also visually delineated by a change in color.

Figure 1:



K. STARTING THE AIRTOXIC

**Before turning on the supply gas (Nitrogen), you must verify that the pressure reducing valve is turned off because the pressure regulator inside the instrument is pre-adjusted and a big pressure variation is very dangerous for the pre-adjustments.
Check that all the tubes are connected correctly and gas tight.**

- a) Set the Nitrogen pressure at **3 bar**. Switch on the sample vacuum pump. Connect to the VENT the outlet of the sampling pump and the outlet of the Standard T.
- b) Switch on the Main Power Supply (Back Face)
- c) When the airTOXIC is on 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 this case, the error information will have been saved by the system. If this is case, the yellow LED "**WARNING**" or the red LED "**ERROR**" will light immediately after the instrument is switched on again. The error number will be sent to the computer before or by latest the end of the first chromatogram. When the airTOXIC is switch on, the initial parameters are charged in the instrument. These parameters are :
 - Column oven temperature: **36°C** (30 minutes cycle) / **43 °C** (15 minutes cycle)
 - PID temperature: **150 °C**
 - Head column pressure: $\approx 1,0 (+/-0,15)$ Bar

These parameters are fixed and should not be modified.

- d) 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.
- e) You log on the instrument with and the PC .
- f) Load the working sequence with .
- g) Start the analysis with the touchpad . The first cycle permits to initialize the system and to start a sampling step.

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

L. STOP THE AIRTOXIC

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, and stop correctly the internal PC.

L. 1. CLASSICAL STOP

- Click on the icon . In this case, the analyser stops at the end of the analysing method. Wait some minutes until 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 and any other.
- When the oven temperature is near 36°C or 43°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 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.
- You will have stopped the software before SHUTTING DOWN the GC and PC.

L. 2. EMERGENCY STOP

Sometimes, an error occurs caused by the system or by a human manipulation during communication between the instrument and the PC. It is possible to completely loose or not the communication with the instrument. In any case, the alone response will be to make a RESET of the instrument and of the PC. Two possibilities:

L. 1. 1. SOFTWARE RESET

- **STOP THE MEASURE** at the end of the method on the ON LINE window with the



- Wait some minutes to obtain the initial parameters of the oven (36°C or 43°C), **sampling off, Desorption of the TRAP**, etc.
- **LOG OFF** the instrument with the icon .
- **CLOSE** the acquisition 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*” utility 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.

L. 2. 1. HARDWARE RESET

- Stop the measure with . Wait some minutes to obtain the initial parameters of the oven (**36°C or 43°C**), **sampling off, Desorption of the TRAP**. If the communication is impossible with the acquisition software, (use Service GC utility to STOP analyse).
- **SHUT DOWN** only the instrument. For this manipulation, you have to open the cover and use the 2 positions switch inside the instrument and disconnect the battery on the CPU Board.

CAUTION: UNDER THE COVER THERE IS A HIGH VOLTAGE POWER. TAKE GUARD WITH VARIOUS ELECTRIC CONNECTIONS.

- **Wait some minutes** to clean all the memory of the CPU board. **During this manipulation, it will be recommended to restart the PC.**
- **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 .

In any case, the first cycle only permits to initialise the instrument. It will have no TRAP desorption, no acquisition during this cycle, etc.

M. AUTOMATIC CALIBRATION

M. 1. GENERAL

What is the Auto-calibration: It is the action of the analyser to adjust automatically the base sensitivity factor from known and stable reference gas measurements.

This option is possible if you have inside the analyser:

- An integrated oven containing one permeation tube (reference)
- Or a solenoid valve permitting to make a standard gas selection, with a standard gas cylinder or an external permeation oven connected on Inlet standard gas.
- Vistachrom software version 1.43 (minimum) to 1.47
- Microprocessor 5.8 (minimum) to 6.2 on the instrument CPU board.

This option permits to validate in continuous the ambient BTEX measurements because the standard gas analysis is automatically repeated like indicated in the working sequence.

M. 2. BASE SENSITIVITY

With an airTOXIC, the base sensitivity is:

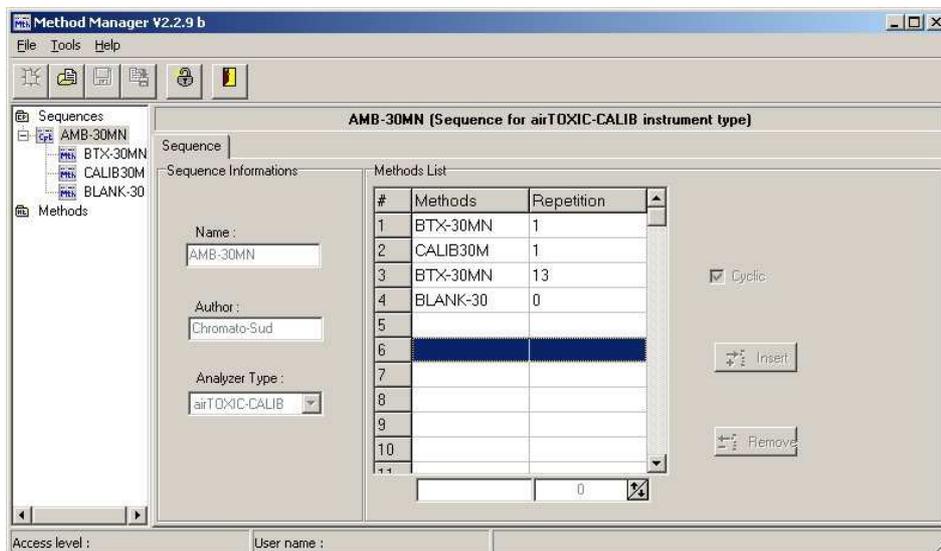
$\text{Base Sensitivity} = \frac{\text{reference compound PeakArea}}{\text{reference compound weight}}$

The instrument is calibrated in our office and a configuration and control quality report is edited and included in the user manual's folder.

The airTOXIC uses a PA board (to have an atmospheric pressure measurement) and a critical orifice (to control the sample flow). The real volume sampled through the TRAP is calculated by Vistachrom.

Be careful, the sample volume measured by the analyser is in ml. This unit cannot be modified by the user.

M. 3. EXAMPLE OF WORKING SEQUENCE WITH AUTOCALIBRATION USING



This routine working sequence is cyclic.

Each working method has a total duration of 30 minutes. Each analysis method gives a chromatogram.

So we have $24 \times 2 = 48$ chromatograms by 24 hours.

To have a shift date all 24 hours, we have introduced in this sequence 1 ambient air measurement, 1 internal standard gas measurement and 13 ambient air analyses. In this case, the standard gas analyses are executed each 7.5 hours. The “BS” of the analyser is calculated and **updated each 7.5 hours (if the auto-cal function is activated)**.

But we can also manage different cases. For example, only 2 standard gas analyses per day, which corresponds into the sequence: 1 ambient air measurement, 1 internal standard gas measurement and 22 ambient air analysis.

M. 4. WORKING METHODS

The VOC contained in the ambient air are measured during the analysis method named **BTX-30MN.mth**.

The reference compound(s) is (are) measured during the analysis method named **CALIB30M.mth**.

Many parameters are similar between the ambient air and the standard gas measurement methods.

The differences are:

- A specific substances table for each method
- A relay control for the standard gas selection (activation of the calibration)

M. 5. SUBSTANCES TABLE EXAMPLE

The substances table enables the VC software to do the identification of peaks according to the retention time of compounds. With precise analytic conditions (head column pressure, oven gradient...), the retention time is characteristic for each compound.

M. 1. 1. AMBIENT AIR SUBSTANCES TABLE

#	Name	RT Min	RT Max	Select Peak	GC Result formula	With X=
1	BENZENE	131	141	Middle	X	Area/BS
2	TOLUENE	251	261	Middle	1.6 * X ^{0.88}	Area/BS
3	ETHYLBENZENE	360	370	Middle	2 * X ^{0.88}	Area/BS
4	M&P-XYLENES	370	380	Middle	1.8 * X ^{0.81}	Area/BS
5	O-XYLENE	395	405	Middle	2 * X ^{0.84}	Area/BS

In the substances table of the ambient air:

- The **benzene** is the **reference linear compound** with a factor = **1.00**
- The others substances have a corrective linearisation curve in comparison with the reference linear compound **BENZENE**.

Example: the corrective linearisation curve of the Toluene (in comparison of the Benzene) is: **1.6 x (area/BS)^{0.88}**

- The mass for the toluene will be: 1.6 x (real area peak of toluene / BS)^{0.88}.
- The "Select peak" corresponds to the peak integration mode
 - MIDDLE: the best centred in the time window,
 - MAX: the more important peak in the time window,
 - SUM: the sum of all peaks in the time window (not used in this table).

M. 2. 1. STANDARD GAS SUBSTANCES TABLE

Minima BS and Maxima BS

Internal standard gas Benzene Concentration Expressed in mg/m³

#	Name	RT Min	RT Max	Select Peak	GC Result formula	With X=
1	BENZENE-STD	131	141	Middle	X/(0,0602*[SampleVol])	Area
2	TOLUENE	251	261	Middle	1.6 * X^0.88	Area/BS
3	ETHYLBENZENE	360	370	Middle	2 * X^0.88	Area/BS
4	M&P-XYLENES	370	380	Middle	1.8 * X^0.81	Area/BS
5	O-XYLENE	395	405	Middle	2 * X^0.84	Area/BS
6	BENZENE	131	141	Sum	X	Area/BS

Compound name

Retention time window in seconds

Peak integration mode

Corrective factor or Corrective linearisation formula in comparison with the reference compound

Calibration curve: Linear Auto-Calibration

X / Conc.

With X = Area + AreaOfs

Name	Value
Conc.	0,0602
AreaOfs	0
Average point N=	1
Min BS	3000
Max BS	50000

In the standard gas substances table, some parameters are different in comparison with the ambient air substances table:

The reference compound will be placed on the first line.

- The “**Min BS**” corresponds to the **smallest acceptable value for the “BS” with MIDDLE amplification of the electrometer (amplification 2).**
- The “**Max BS**” corresponds to the **largest acceptable value for the “BS” with MIDDLE amplification of the electrometer (amplification 2).**
- In the “**Conc.**”: we introduce the reference compound concentration expressed in **mg by m³** (the volume unit is programmed in the microprocessor and cannot be modified).
 - In this example : the internal standard gas concentration is : 18.5 ppb at 20 °C (mol. volume : 24,04 l), the concentration will be :

$$(18.5 \times 78.11) / 24.04 = 0.0602 \text{ mg/m}^3$$

- This value (0.0602) is introduced in the “**Conc.**” field for the reference compound. The other corrective factors are not changed.
- In the “**Calibration curve**” field, we introduce “**Linear Auto-Calibration**” to indicate that the **reference compound is BENZENE.**

In the “**Average point N=**” field, we select the number **1**. This number permits to calculate the BS on one point de calibration (if the value is included between the window created by “**Min BS**” and “**Max BS**”). For more information, see **SMQ 0016-05 AutoCalibration 147 UK.pdf** manual.

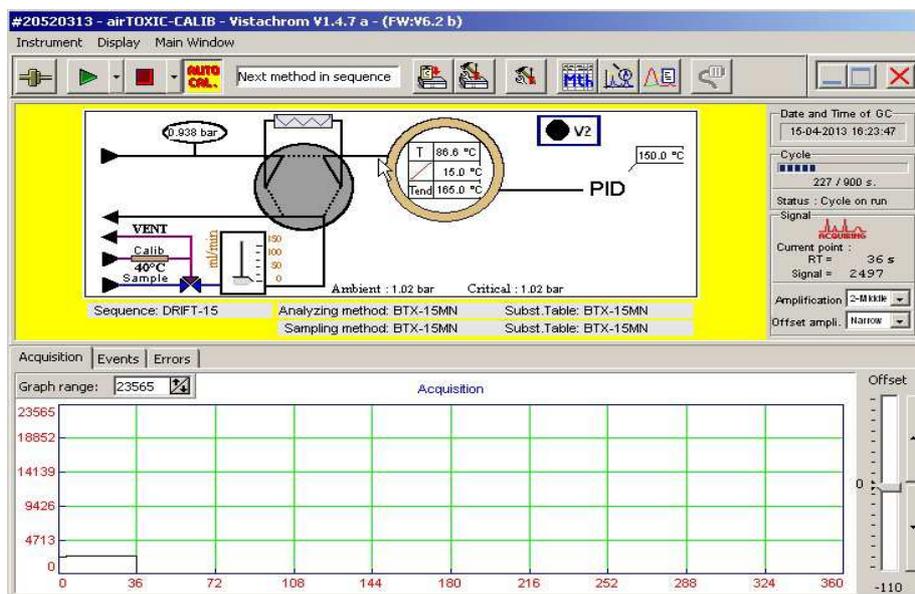
In the case of the standard gas replacement (from a permeation tube in an internal or external oven or from a gas cylinder), the parameters of the first line of the substances table of the calibration method will have to be updated by the user with the new concentration of BENZENE.

M. 6. AUTO-CALIBRATION ACTIVATION

To use the auto-calibration function, the analyser has to work with the routine working sequence.

In this sequence, CHROMATOTEC Group / airmotec advises to program 4 standard gas analyses by day to validate in continuous the ambient air measurements. The substances table must be configured as indicated in the previous.

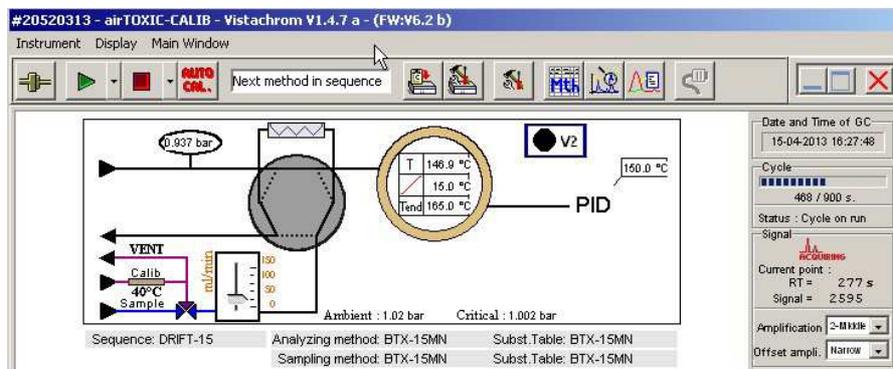
To activate the auto-calibration, the user will have to click on the  icon. The on-line window indicates to the user that the auto-calibration is activated by the Vistachrom screen colour: Yellow like:



Auto-calibration option activated

To stop the auto-calibration option, you have to click on the  icon.

The Vistachrom on-line window becomes white like:



Auto-calibration option deactivated

N. PID CLEANING

The cleaning of the lamp window can be necessary when there is a great loss of sensitivity of the analyser due to pollution on the surface of lamp area by condensation of high boiling points compounds.

CAUTION: Do not disassemble detector when hot or when line power is on.

N. 1. LAMP WINDOW CLEANING WITH SOLVENTS

- Switch off the analyser when it is in stand by status. LED “Stand By” and “OK” lit. Let the detector cool down to ambient temperature.
- Turn off the lamp and oven if necessary. Allow time to the detector to cool down to ambient temperature.
- Remove carefully lamp housing from the lamp holder.
- Add a drop of acetone to window and wipe it with a clean cotton material for 2-3 minutes, then add a drop of ethanol and wipe for 2-3 minutes.
- When the lamp window is contaminated too strongly (no response or it is reduced dramatically) clean it with PID lens polishing powder then rinse with water. Next use acetone and ethanol as presciently indicated.

CAUTION: Lamp window can be also cleaned by conditioning the detector in oxygen flow when the lamp is on.

- Dry the window with air.
- Carefully place the lamp housing and delicately set up the plate of maintenance and power supply of the lamp.

N. 2. CLEANING OF PID INTERNAL COMPONENTS

The parts to be cleaned are those which are in contact with analyst:

- Ionization chamber
- VUV Lamp
- Gas inlet

CAUTION: PID internal components requires in cleaning just when the baseline noise and drift cannot be decreased by any other ways.

- Before disassembling the detector, try to clean it by conditioning in the carrier gas flow at 190 °C for 24 hours.
- Do not wash the ceramic insulators (when highly contaminating they must be replaced).
- To delicately draw the plate from maintenance and power supply the lamp by supporting the lamp so that it did not leave its site brutally and remove the lamp housing with lamp.
- Remove the nut and remove screws which fixed electrodes and take the spacer, insulators and electrodes out of the detector body.

CAUTION: Use the tweezers for handling ceramic internal component to avoid contamination.

- Clean the electrodes and gas inlet using acetone, chloroform and ethanol.
- Install the insulators, electrodes into the detector body and drive by the screws, install metal spacer and lock with nut.
- Install the lamp in housing with precaution.
- Delicately replace the power supply and fixing plate of the lamp.

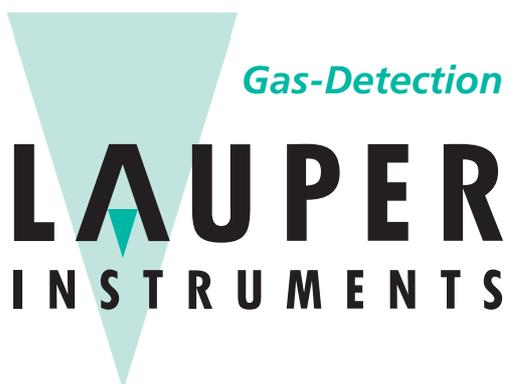
O. LAMP REPLACEMENT

- Stop the analyser and let the lamp cool down to ambient temperature.
- Remove the lamp housing with the lamp.
- Disconnect the lamp leads from the lamp and remove it from the housing.
- Install the other lamp to housing, bring its wires out through the hole in the top of housing and connect them to the power supply leads.

Place the lamp housing with lamp to detector body and connect it.

P. TROUBLE SHOOTING GUIDE

For any problem, please look at our customer service website: <http://support.chromatotec.com> using your access code.



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