



PCF Elettronica's FID 9000

Portable HOT FID
VOC monitor

Particularly suited for
VOC monitoring
at emissions

(Procedure according to CEE CEN 264 # 326
and UNI EN 12619:2013)



INSTALLATION AND OPERATION BASIC INSTRUCTIONS

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**ACCORDING TO CEE CEN 264 # 326
AND UNI EN 12619 AS WELL AS 13526 PROCEDURES**

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1.0 FOREWORDS

The FID detector is generally known as the most linear and stable sensor for detection of organic compounds. Particularly in environmental monitoring, where a mix of hydrocarbons are present in the sample, the measuring equipment requires a detector possibly equally sensitive to all types of compound. For this matter the FID is the detector that mostly meets the needs.

FID 9000 portable VOC monitor has been studied, developed and manufactured to monitor Volatile Organic Carbon (VOC) according to CEE CEN 264 and UNI EN 12619:2013 procedures at emissions.

The whole carbon compounds are detected in a specially developed Flame Ionisation Detector (FID detector).

PCF Elettronica's FID detector is very well known for its stability as well as for its low maintenance in the time.

It's generally known that organic compounds in hydrogen flame ionise. The quantity of carbon ions generated are proportional to the total quantity of carbon passing through the hydrogen flame.

The carbon (methane) equivalent concept.

In the environment as well as in industrial emissions there is very high number of different organic compounds so the response of the instrument detector cannot be referred to a single compound. The measurements must be considered in terms of equivalent response, .i.e. the response of the detector is "normalised" (referred to) to a single compound.

The characteristics of FID detector, i.e approximately proportional to organic carbon concentration in the sample, makes the purpose easy. At first approximation the same concentration in air of compounds with different carbon atom number responds proportionally to the number of atoms in the molecule, so

| Concentration ppm | Species | FID response |
|----------------------|-------------------------------|-----------------|
| 1 | CH ₄ | 1 |
| 1 | C ₂ H ₆ | 2 |
| 1 | C ₃ H ₈ | 3 |
| 1 | C ₆ H ₆ | 6 |

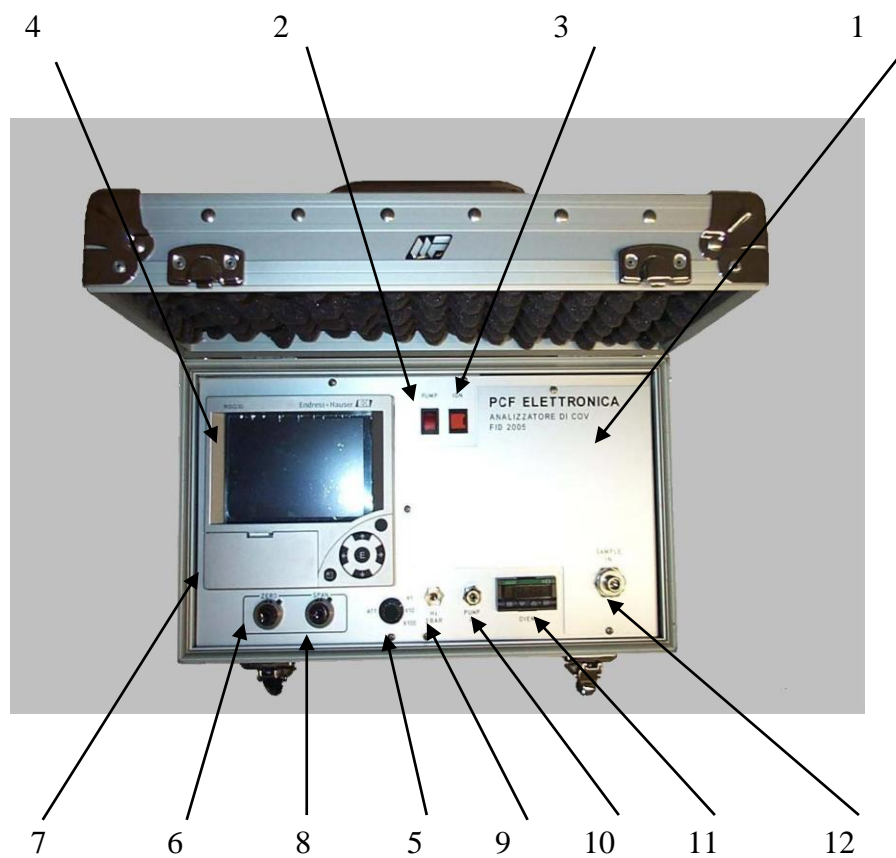
In other words, once the instrument response is normalised to methane, 1 ppm of propane will approximately generate a signal as 3 ppm of methane.

1.1 General description

PCF Elettronica FID 9000 portable Hot FID VOC monitor is an extremely simple instrument studied, developed and manufactured for operation at emissions or industrial installations where just the power supply and the hole for the insertion of the probe must be available.

The hydrogen consumption is very low (27 ml/min.) and the zero air generator is built in the instrument

1.2 FID 9000 portable Hot FID VOC monitor



FID 9000

Figure captions

- 1- Heated analysis chamber
- 2- Activation switch of gas sampling heated pump
- 3- IGN push button, to activate FID. A nearby LED shows the condition of flame ON.
- 4- Video graphic display (144 x 144 mm).
- 5- Full range regulation knob.
- 6- Zero signal trimming potentiometer knob.
- 7- Compact flash memory insertion and USB port.
- 8- Span signal adjustment potentiometer knob.
- 9- Pneumatic connection of FID supply hydrogen (from a gas cylinder).
- 10- Pneumatic connection for intake of air supply to FID detector, compression and recirculation is guaranteed by in mounted air compressor.
- 11- Temperature measurement and control of in built heated head sampling pump.
- 12- Pneumatic connection for the insertion of the heat traced sample line.

2.0 WORKING PRINCIPLE

PCF Elettronica FID 9000 portable VOC monitor, along with its SS sampling probe and heat traced sampling line was studied, developed and manufactured for continuous source monitoring of VOC, detection procedure according to CEE CEN 264 # 326 as well as UNI EN 12619 regulations.

The instrument operates fully automatically and unattended, according to intended application fields it works within a wide range of temperatures and water contents of sample (in any case **no condensed water** should be present) with no detectable influence for the measured values. Sample is sucked through a variable SS probe with ceramic filter on the tip (probe is built according to UNI 10263 directive), a heat traced PTFE line kept at fix temperature between 150 – 180 °C and finally an heated head pump. A second heated filter in sintered stainless steel protects sample capillary in front of detector.

Sample is continuously fed to FID detector, therefore response time is very low with no time interval due to the sampling by capillary loop.

Sample route from the ceramic filter inserted into the stack gas through the sampling probe, the Teflon line, the sucking pump and finally FID detector is kept at high controlled temperature to avoid any condensation.

Data are displayed and recorded on a modern video graphic unit in built in the analyser. All information and data may be downloaded either on a flash memory support or through USB port to a PC.

All monitor components are mounted in a small (some 00 x 00 x 0 mm (16” x 12” x 6” WxDxH) reinforced and ventilated aluminium box with carrying strip.

Visualized data on video graphic display are available to be displayed and /or elaborated as follows:

- Recording on strip chart recorder
- Back up memory storage, followed by PC management
- Real time display of concentration curves at emission

The standard configuration for the correct operation at the measuring site includes:

- FID 9000 FID monitor
- SS sampling probe
- 3 m. heat trace sampling line (different lengths are available on request)
- The hydrogen gas cylinder (the zero air, necessary for FID supply is generated within the instrument).

2.1 Description of FID detector measuring principle

consistent quantity of ions proportional to concentration of organic carbon in the sample. The actual structure of FID detector shows the mixing of hydrogen with gas sample; then the combustible mixture is burnt at the extremity of a small nozzle in an oxygenated environment (pure air in a large stoichiometric excess). The electric charges generated by the combustion of the organic matter in the sample are collected by a polarised couple of electrodes and converted into electrical micro current. The ionisation currents through an electrometer generate a voltage drop at the output proportional to the current in the flame.

The changes in polarisation of the flame show up as voltage changes of the electrometer output, then are transferred to a display or a pen recorder as measurements of carbon content.

5.0 COMMISSIONING AND STARTING UP THE INSTRUMENT

5.1 Commissioning

- Connect the H₂ adduction gas from the two stages gas reducer of H₂ gas cylinder to the relevant connection located on the cover of analysis chamber and adequately indicated.
- Connect the heat traced line adducting gas sample to the instrument sample connection. The plug of the heating resistance must be connected to relevant socket located at the right bottom side of the instrument.
- Plug in the power supply cable to mains (220 V 50 Hz, 500 VA).

5.2 Starting up

- Move mains switch into ON position, switching ON of the instrument. Green bulb will be lighted.
- Wait some 20 minutes for the heating up and the conditioning of the instrument.
- Check that the manual switch for switching of air supply to FID detector is set to correct position according to the selected supply of combustion air to the monitor, namely whether by UPP air gas cylinder or by in built air compressor and selective scrubber).
- Open the H₂ gas cylinder regulating the hydrogen pressure supply to the correct value indicate in the final test table.
- Switch on the sample pump (**Attention please, do not switch on the sample pump when instrument is cool, its Teflon head works properly only when heated up, working cool could cause its seizing**).
See also foot note at the end of this section.
- Press IGN push button and keep it pressed till IGN “OK” appears on the video graphic display. Wait about 20-30 seconds.
- If flame stays ON, “Fiamma (Flame) OK” should be indicated on video graphic display.
- In case on video graphic display IGN “Off” is shown, it means that FID flame is not correctly switched on. Repeat the above described operations till flame is correctly switched on.
- With the flame switched ON wait some 20-30 minutes for the stabilisation of the electronics of instrument then zero the display with the ZERO potentiometer knob, making sure that the instrument is sampling clean ambient air (see Chap. 6).
- Insert the sampling Probe into the sampling hole.

NOTE

- 1- The sample sucking pump is PC controlled. Therefore the pump can be activated only when the read temperature is higher than 150°C. Then switch on the pump only when the temperature is higher than 150°C. Be very careful in switching on the pump, eventually repeat the operation in sequence different times.
- 2- FID air consumption is about 200 ml/min. Zero air supply is from in built air generator.

In case the heated pump does not start up leave the switch on “OFF” position and contact the service people.

3.3 Switching off the monitor

- Extract the sampling probe from the duct/stack
- Leave the monitor to operate for about ten minutes in ambient air (clean and dry sample).
- Move Pump switch lever on to “OFF” position.
- Close the tap of hydrogen gas cylinder
- Move the mains switch lever to “OFF” position.

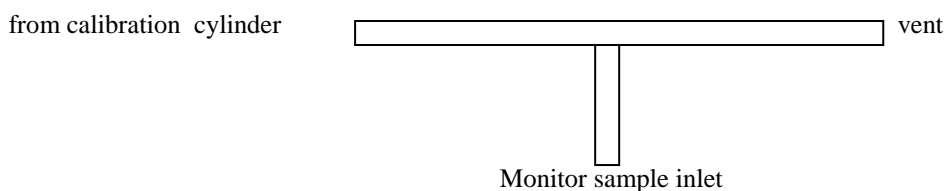
6.0 MONITOR CALIBRATION PROCEDURES (ZERO AND SPAN)

6.1 ZERO calibration

- 1- Make sure that the monitor is sucking clean air at ambient pressure, vent condition, and wait 2-3 minutes for stabilisation.
- 2- Zero the display with the ZERO knob.

6.2 SPAN calibration

- 1- Disconnect the heat traced line from the inlet connection of monitor.
- 2- Check the zero unless was just performed.
- 3- Set the switch “Pompa Sample” (“Sample Pump”) to “OFF”.
- 4- Connect the output of two stage reducer of gas calibration cylinder. The connection must be performed under vent condition, i.e. at atmospheric pressure:



The suggested calibration mixture is the same used in our laboratories to perform the final checking of the instrument and outlined in the “instrument final check record”

- 5- Move the “Pompa Sample (“Sample Pump”) on to “ON” position, instrument will start sucking the ambient air.
- 6- Open standard gas cylinder tap to guarantee an excess of STD (Standard, calibration, gas) through the vent terminal of “T” tube.
- 7- Wait for about 60 seconds for measurement stabilisation then set, by “SPAN” potentiometer knob, the indicated measured value to the correct STD, calibration, value of gas cylinder.

VOC (Volatile Organic Carbon concept)

As described in chap. 1.0 FID detector response is proportional to the carbon concentration that flows through high temperature flame.

Therefore at the same ppm concentration an organic molecule with 1 carbon atom counts for 1 an organic molecule with 2 carbon atoms counts for 2 etc.

The calibration should be done in term either of Carbon Atom ppm or CH₄ equivalent concentration.

Example (we refer to suggested calibration cylinder concentration in specs)

Suppose the STD, standard or calibration gas mixture, contains 40 ppm of methane (CH₄) and 10 ppm of C₃H₈ (propane).

We must keep in mind that 1 ppm of propane (C₃H₈) corresponds to 3 ppm of methane (CH₄) as having three carbon atoms in each molecule it produces a response three times higher in the FID detector (FID detector response is approximately proportional to the content of carbon atoms independently from chemical bonding)

Therefore 10 ppm of propane (C₃H₈) are approximately equivalent to 30 ppm of methane (CH₄).

In our calibration mixture we will count 40 ppm methane + 30 ppm equivalent of propane = 70 ppm methane (Carbon) equivalent.

The instrument must be set calibrated to Total VOC = 70 ppm

Or as alternative (please note the general formula to convert ppm into mg/Nm³):

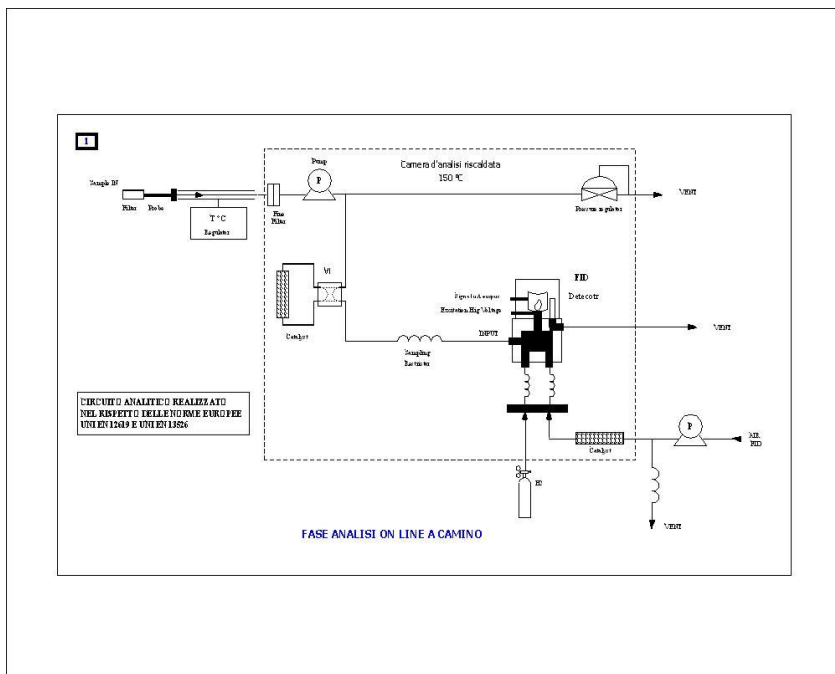
$$70 \text{ ppm} * \frac{12 \text{ (Carbon Molecular Weight)}}{22,414 \text{ (Molecular Volume)}} = 37,45 \text{ mg/Nm}^3 \text{ VOC}$$

NOTE:

- 1- Instead of a mixture of Methane and Propane the calibration gas cylinder could very well contains either only Methane (e.g. 70 ppm) or just propane 15 ppm (for a Methane equivalent of approximately 75 ppm).fd
- 2- The calibration gas cylinder mixture must always be balanced with air, as the nitrogen could produce a lower signal In the FID detector. For emission applications, suggested gas cylinder mixture for calibration is 40 pp of methane (CH₄) + 10 ppm of propane (C₃H₈) with air balance.
- 8- Once set the signal displayed to the correct calibration (standard) value, close the tap of calibration gas cylinder, then move the “Pompa Sample” switch to “OFF” position.
- 9- Wait about two minutes then zero the display with ZERO knob potentiometer.
- 10- Disconnect the T tube for the calibration of monitor from sample inlet and connect to the same inlet the heat traced line carrying the sample gas under measurement.
- 11- Move the “Pompa Sample” switch on to “ON” position.
- 12- Now the monitor is correctly set to perform measurements of Total VOCs.

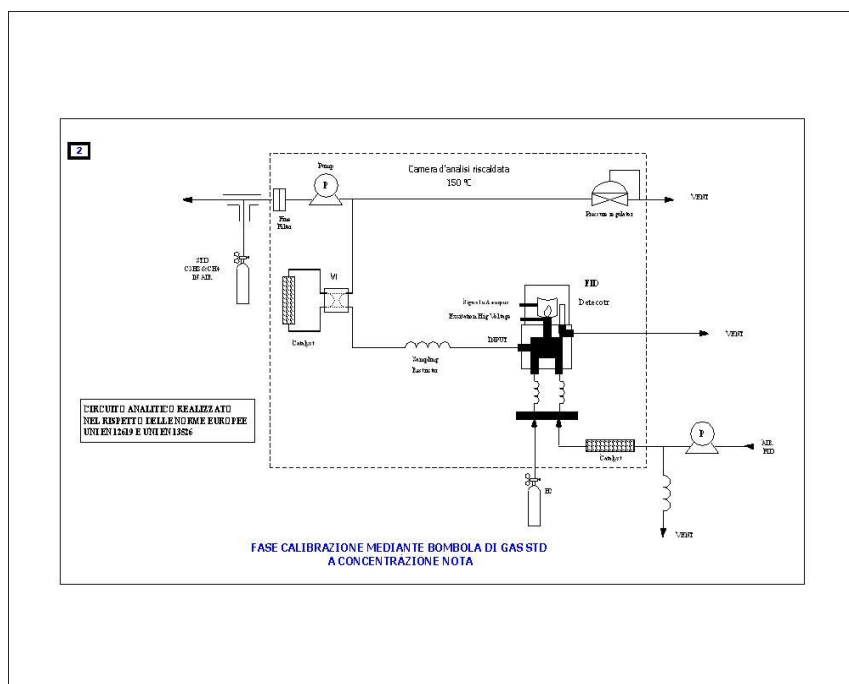
7.0 ANALYTICAL SCHEMATICS ACCORDING TO CEE CEN 264 # 326 AND UNI EN 12619:2013 PROCEDURES

7.1 ANALYSIS PHASE



V

7.2 CALIBRATION PHASE



8.0 MONITOR MAINTENANCE PROCEDURES

All the operations described in the present section must be performed with mains power supply to the instrument OFF (disconnect the mains plug) and with the H₂, Air, Span service gases intercepted by the main manometers on the gas cylinders.

8.1 SUGGESTED MAINTENANCE SCHEDULE

Basically PCF Elettronica's FID 9000 is a very simple VOC monitor with tested parts to last years without maintenance.

For a good performance in the field it is suggested to commission the instrument since the beginning with the correct gas qualities and pressure as well as to check regularly its working conditions.

For a good commissioning of the instrument we recommend:

- standard tool case
- digital multi meter and

| Time | Operations | Actions (if necessary) |
|----------------|---|--|
| Commissioning | Check: Power Supply Gas Supplies (quality and pressure) Service gas pressure | |
| Monthly | Sample flow | Replace or clean filters Front filter and/or Sintered filter |
| Every 3 months | Sample flow Membrane pump | Rebuild pump |
| Every 6 months | Calibration check | Change coefficients |
| Every year | Scrubbing efficiency Check H ₂ capillary Air capillary Carrier capillary | Replace catalyst Replace |

8.1 TROUBLE SHOOTING

Events

Actions

Completely dead display:

- Check the mains power supply
- Check the fuse on the power supply socket
- Check display lamps
- Micro processor PCB not working

- Connect power supply
- Eventually replace the fuse
- Replace lamps if necessary
- Replace micro processor PCB

FID flame does not ignite

LED always on

- Wrong hydrogen and air pressures
- Lack of hydrogen supply
- Clogged H₂ or Air capillaries
- FID air compressor not working
- Ignition spiral is broken
- FID thermocouple broken
- Transformer not working
- Auxiliary services PCB is not working

- Check hydrogen and air supply and set the correct hydrogen and air pressures
- Check hydrogen cylinder, opening tap and pressure
- Check flow rate and replace if necessary
- Either maintain or replace air compressor
- Replace FID
- Replace FID
- Replace transformer
- Replace auxiliary services PCB

Dead output signals

- FID detector not working
- Electrometer board not working
- Auxiliary services PCB not working

- Replace FID detector
- Replace electrometer board
- Replace auxiliary services PCB

RS 232 signal working , 0-10 Vdc signal not present

- Check external connection
- Electrometer PCB not working

- Restore external connection
- Replace electrometer PCB

Lack of FID air gas pressure

- Supply air cylinder (if present) empty or with closed interception valve
- FID air compressor not working
- Leakage in the relevant circuit
- Pressure regulator not working
- Manometer not working

- Open the gas cylinder or replace it
- Either maintain or replace FID air compressor
- Find and mend the leakage
- Replace pressure regulator
- Replace manometer

Lack of FID Air pressure

- | | |
|--|-------------------------------------|
| - Supply air cylinder either empty or with closed interception valve | Open the gas cylinder or replace it |
| - Leakage in the relevant circuit | Find and mend the leakage |
| - Pressure regulator not working | Replace pressure regulator |
| - Manometer not working | Replace manometer |
| - Auxiliary services PCB not working | Replace auxiliary services PCB |

No circulation of sample gas

- | | |
|---|---|
| - Sample adduction line either interrupted or clogged | Maintain heat trace sample line and/or probe ceramic filter |
| - Sampling pump not working | Either maintain or replace sampling pump |
| - Auxiliary services card not working | Replace auxiliary services PCB |

9.0 SPARE PARTS

| Code Number | Description |
|-------------|--|
| 095020114 | Sample capillary |
| 095020115 | Hydrogen capillary |
| 095020116 | Air capillary |
| 095020120 | Catalytic scrubber (HC into CO ₂) |
| 095020121 | Scrubber sub assembly |
| 095020125 | FID detector sub assembly |
| 095020127 | Air compressor oil less pump |
| 095020128 | Sample sucking heated head pump |
| 095020130 | Red LED |
| 095020132 | Return push button |
| 095020133 | Lever switch |
| 095020134 | Zero and Span potentiometer |
| 095020135 | Display micro processor PCB |
| 095020136 | Power supply transformer |
| 095020137 | Mains power supply socket |
| 095020138 | Cooling fan |
| 095020141 | Electrometer PCB |
| 095020144 | Auxiliary services PCB |
| 095020146 | Stabilised Power Supply PCB |
| 095020147 | Display micro processor PCB |
| 095020150 | PT 100 temperature detector |
| 095020152 | FID detector heating resistance |
| 095020153 | Catalytic converter heating resistance |
| 095020155 | Sintered filter |
| 095020156 | Sampling probe ceramic filter |
| 095020157 | Ceramic filter gasket |
| 095020163 | ZERO – SPAN potentiometer |
| 095020164 | Multi turn potentiometer knob |
| 095020170 | SS sampling probe |
| 095020180 | Heat traced sampling line (standard length 3 m) |

- 41-6021 **Suggested consumables set (including)**
n.2 ceramic filter for sampling probe
n.1 heated pump rebuild kit
n.1 air pump rebuild kit
n.1 fuse set
- 41-6022 **Suggested spare parts set (including)**
n.1 sample capillary
n.1 hydrogen capillary
n.1 pressure regulator
n.1 catalyst replacement
n.1 Seal set
n.1 Flame ON temperature sensor

PCF ELETTRONICA

FID 9000 N° matr. _____

Portable HOT FID VOC MONITOR

FINAL CHECK RECORD

H2 Gas cylinder pressure..... Bar
To FID, flow rate..... ml/min.

Air To FID, flow rate..... ml/min.
Sample To FID, flow rate..... ml/min.

Test of FID detector: Switching ON/OFF three times **O.K.**

Test of sampling pump: Three start checks **O.K.**

Test of Zero Air pump: Three tests of switching ON/OFF **O.K.**

Hydrogen leaks check: Checked overnight **O.K.**

CALIBRATION PARAMETERS

Calibration mixture used to calibrate the monitor: CH₄ + C₃H₈, air balance

Gas cylinder : _____ certification N# _____

Concentration of traceable gas mixture : CH₄ _____ ppmV C₃H₈ _____ ppmV

Dilution device: THERMO ELECTRON mod. 146 Dilution System

Theoretical gas mixture Total C.O.V. _____ ppmV CH₄

Measure gas mixture Total C.O.V. _____ ppmV CH₄

Set point SPAN RANGE : _____ DIV

Set point ZERO RANGE : _____ DIV

Service Engineer : _____

Data : _____

APPENDIX 1

GAS CONNECTIONS

1- CAUTION WITH THE HYDROGEN SOURCE (VERY IMPORTANT !)

ATTENTION! DO NOT APPLY A PRESSURE HIGHER THAN THE INDICATED ONE:

H₂ = 3,0 Bar max.

Air (optional) = 5,0 Bar max.

When wiring the hydrogen supply pipe to the analyzer it is necessary to be very careful. The connection **must be manually scewed** and only at the end, when you are sure that the fitting is screwed to the end, it must be blocked with the key (8 mm) provided.

You do not have to force for any reason the connection plug to avoid damaging the screw of the same and necessitate its replacement with the consequent impossibility to use the instrument as well as to avoid hydrogen losses.

The customer must make sure that all the hydrogen cylinders used are in compliance with the safety standards laid down for the accommodation of the same.

AN INSTRUMENT INCORRECTLY INSTALLED IS UNABLE TO PROPERLY OPERATE AND MAY BE A DANGER FOR THE OPERATOR

- 2- **THE HYDRIDE CARTRIDGE (Option)**, in built in the instrument
The hydride cartridge is foreseen as option as constitution of the compressed H₂ mini cylinder-

Manometer Connector for refilling



Pressure Regulator
Hydride cylinder/tank

APPENDIX 2 (optional)

HYDRIDE CYLINDER WITH HYDROGEN RELEASE AT LOW PRESSURE (Option)

QUICK START MANUAL

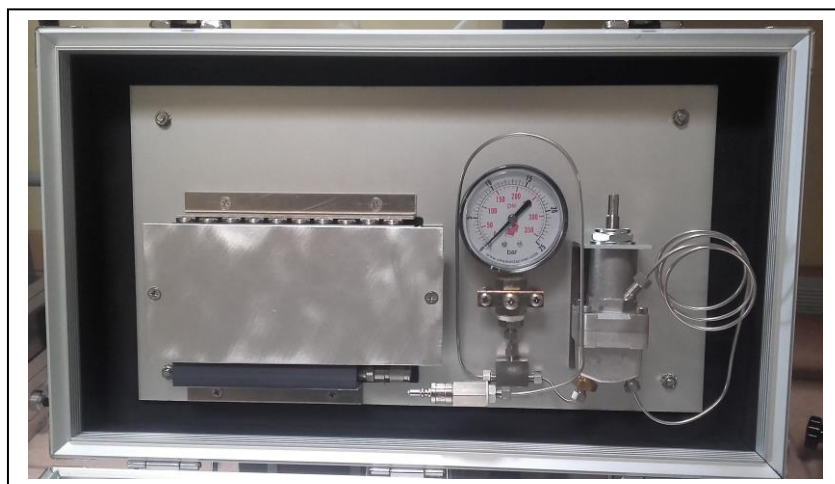
[Note: as the hydride cylinder is not of our production it could slightly change in dimensions and/or specifications]

A) Hydrogen refilling procedure

1. Place the hydrides cartridge as to facilitate connection to a hydrogen source such as pressurized cylinders or electrolyzers compatible (hydrogen generators).
Avoid working in awkward positions with short tubes.
2. Open the black knob of the hydride cartridge safety valve by turning it clockwise.
3. Purge a small amount of air/hydrogen mixture from the **special pipe** connected to the source of hydrogen, by the use of the supplied interception valve, or by a short pressure applied to the end supplied male connector, **before connecting it to the hydride cylinder**. This should eliminate polluting gases such as nitrogen or oxygen present in the air.
4. Connect the hydrogen source through the appropriate pipe and a provided pressure regulator, ensuring that the chosen source (cylinder or H₂ generator) has a minimum pressure of 10-15 bars. Use a pressure regulator with dual-stage secondary stage that reaches at least 30 bar.
Never exceed 25 bar pressure, this could cause irreparable damage to the device.
5. If possible, gently place the hydride cylinder in a bath of cold water (10-15 °C), preferably in a horizontal position, ensuring that the filling hose is not choked and that the quick connector at the connection point is not under water.
6. If applicable, gradually increase the pressure up to a maximum of 20 bar (keep still around 16 bar). The cartridge should start to heat to effect the adsorption of hydrogen and for the increase of pressure.
7. When immersed in a water bath, as to completely fill the cylinder, keep the water temperature the more possibly also constant with the progress of charging. The walls of the cylinder will heat up and consequently also the water will warm.
8. If the refilling is via industry standard cylinders at pressures of 20 bar, after about 30 minutes the cartridge will be charged. Otherwise the cartridge will be charged after about 50 minutes, if the process is carried out with pressures of 15 bar. In the case of charging with H₂ generators, wait until the hydrogen flow toward the cartridge falls in the neighbourhood of 10-20 cc/min; at that point you will have the certainty of the filled cartridge.
9. Disconnect the quick coupler from the cylinder by pulling out the female attack ring on the cartridge. Do not force in any way the connector; eventually in the event of difficulty in extracting, pull out at the same time the male connector or, even better, contact our Technical Support.
Always close, when not in use, the cartridge black knob, turning it clockwise.

B) Hydrogen desorption procedure

1. Connect the quick coupling kit by connecting an end of the same to the quick connection of the cylinder and the other to the device you want to cater.
2. Open the black knob of the hydride cartridge safety valve by turning it counter clock wise.
3. Turn on the device to cater, in our case FID detector, to begin to use the stored hydrogen.
4. After use close the hydride cartridge safety valve black knob by turning it clockwise and disconnect it as in step 9 of the charging.



The Hydride Device mounted on the aluminium cover inside the VOC portable monitor



The Hydride Device with the special supplied pipe for the connection to primary H₂ source (H₂ Gas Cylinder or H₂ Generator)

C) Description of an hydride cylinder

The technical characteristic of supplied cylinder may change without notice. The definitive specifications of the installed hydride cylinder will be described in the enclosed operating manual to the instrument.



Model: MyH2 80
Normal capacity: 7 g (0,08 Nm³) Hydrogen gas
Hydrides powder: AB₂
External volume: 0,17 liters
Internal volume 0,15 liters
Diameter: 5 cm
Height: 18 cm
Weight of product: 1,3 kg
Maximum refilling pressure: 30 bar
Maximum tested pressure: 100 bar
Suggested maximum refilling pressure: 20bar
Cooling minimum temperature for refill: > 5° C
Maximum operative temperature: < 65° C
Recommended hydrogen purity grade 5.0 (99.999%)
Minimum hydrogen purity grade 4.5 (99.995%)
Flow: < 500ml/min
Certification: CE, compliant ISO 16111