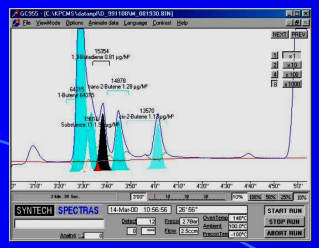
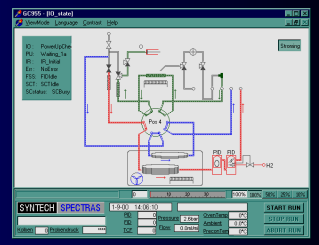
Synspec b.v.

Specialist in Gas chromatography



Synspec b.v.



Gas chromatographs

for ambient air and industrial hazard monitoring

Contents

- Small training in gas chromatography
  - Difference between GC and other ambient air monitors
  - Separation technique
  - Detection technique
  - Trapping techniques

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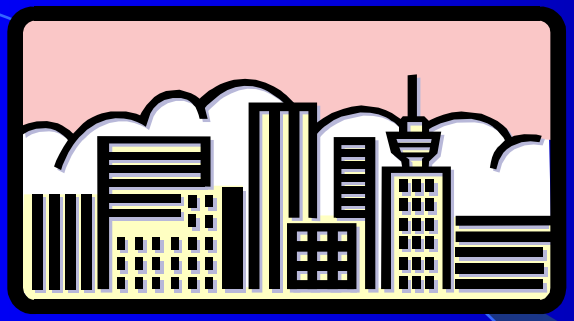
Gas chromatography basics 1:

Of course you would like a measurement instrument to function like a black box



Black box

is of acceptable quality

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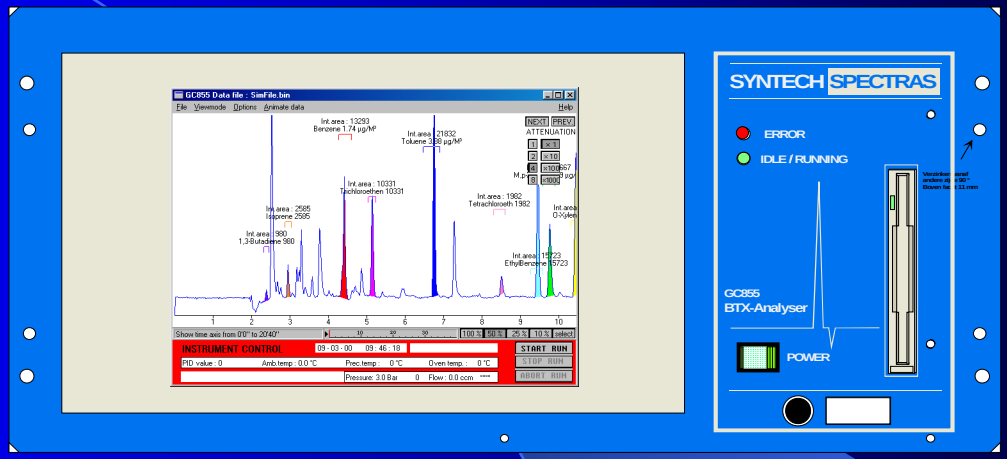
Gas chromatography basics 2

The Black box in reality takes a little more work and understanding....

the airprobe **Air**



contains x gram of y per m3

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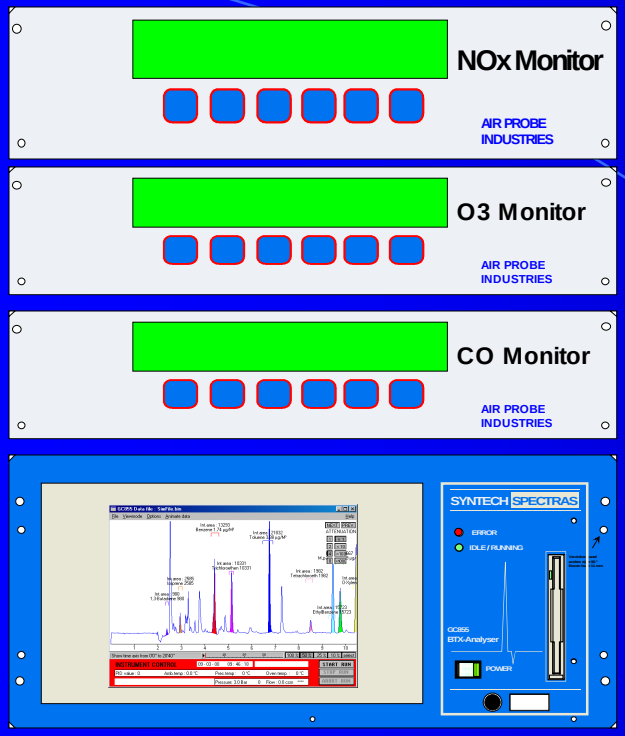
Gas chromatography basics 3

Air-Analyzers are generally:



Single component analyzers

- Inorganic compounds (Nox, Ozone, CO)
- Specific cells
- No separation of sample
- Detection UV or IR
- Higher concentrations (ppb)
- Measurement is normally continuous

But the Syntech Spectras is a: Multi component analyzer (GC)

- Organic components (also some inorganic)
- 4 types of detector (FID, PID, TCD, ECD)
- Complete separation of the sample because detector is not selective
- Low to ultra low concentrations (ppt level)
- Sample is sometimes pre-concentrated
- Measurement is Semi-continuous

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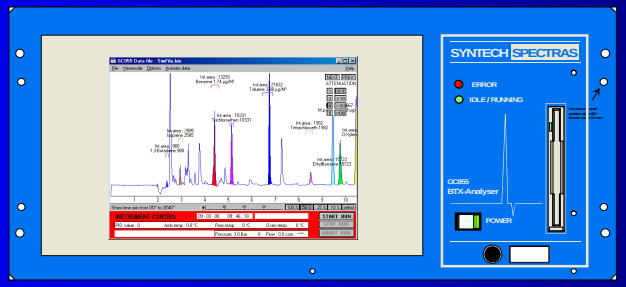
Gas chromatography basics 4



Air

Detecting with GASCHROMATOGRAPHY (G.C.) takes 4 steps:

- Sampling
  - air sample, ***dust free***
- Concentration
  - with immission-samples
- Separation
  - because detector is sensitive to many VOCs
- Detection
  - choose the optimum for sensitivity, selectivity

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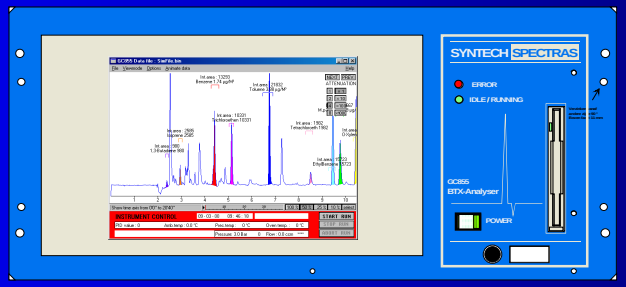
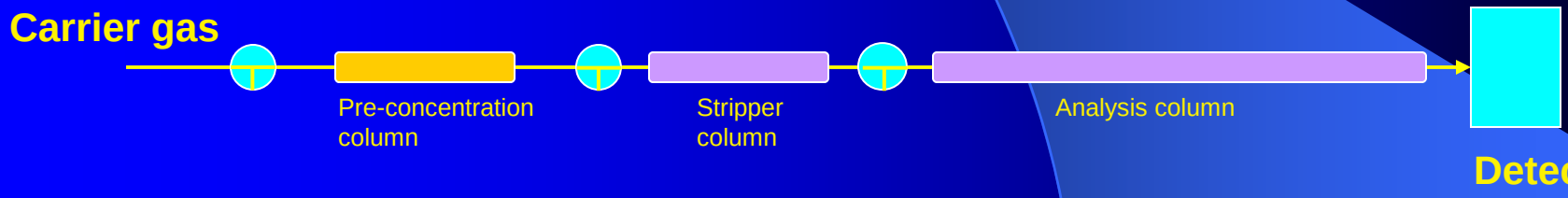
Gas chromatography basics 5



Air

Detecting with GASCHROMATOGRAPHY (G.C.):
see here the sample going through the 4 steps:



Gasline

= Switchport

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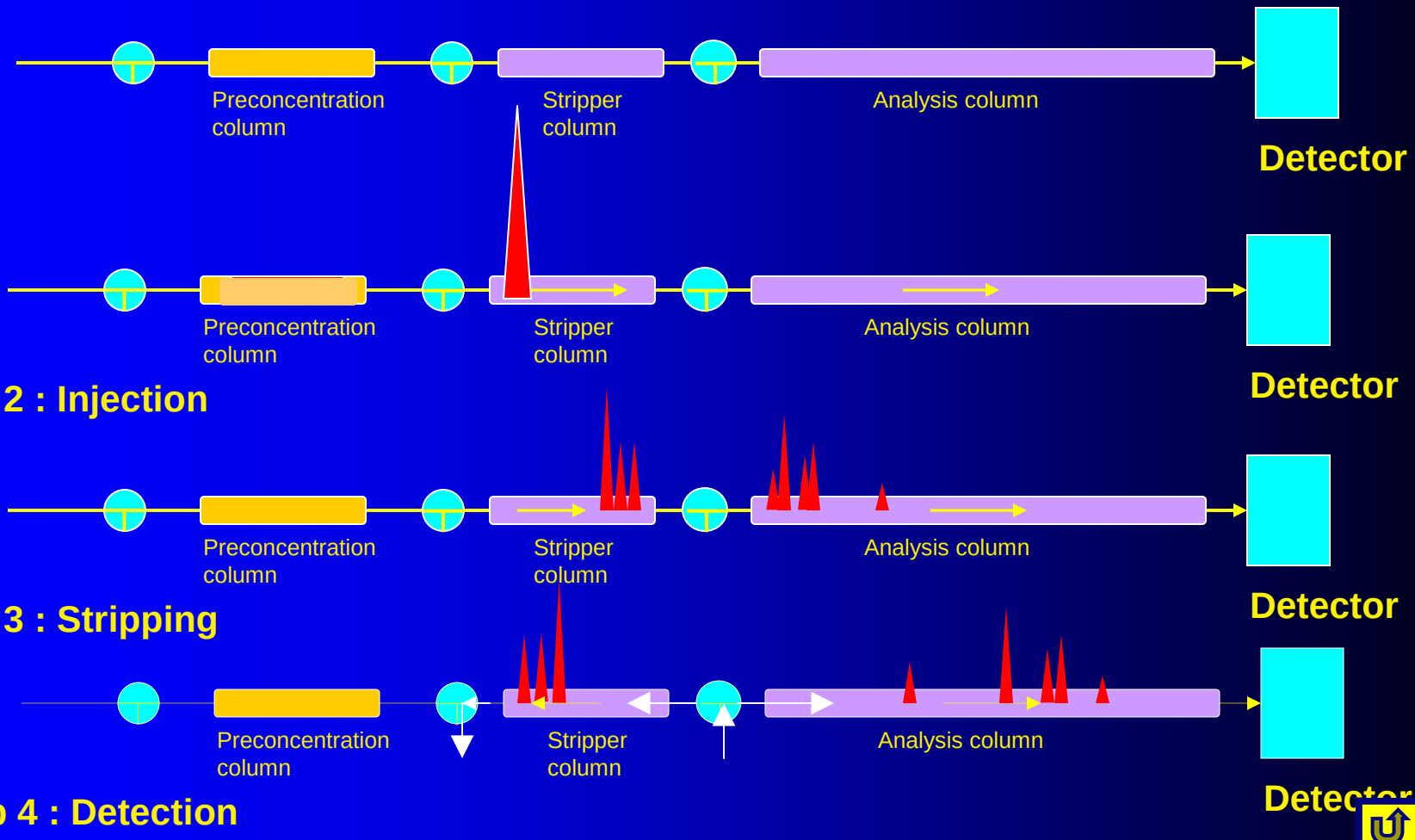
Gas chromatography basics 6

Detecting with GASCHROMATOGRAPHY (G.C.)



Preconcentration traps

Preconcentration trap

Cooled preconcentration trap

With our detectors you can choose the desired sensitivity and selectivity

- Photo ionisation detector
- Flame ionisation detector
- Thermal conductivity detector
- Electron capture detector

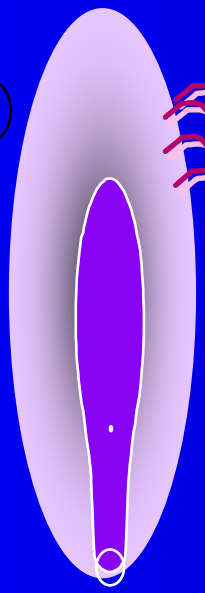
Photo ionisation detector

- An ionising UV-lamp, alternative to standard flame ionisation
- Needs no flame with hydrogen and clean air
- Not destructive
  - combination with other detectors possible
- Sensitive to a range of compounds
  - For aromates 100x more than FID
- Insensitive to a range of compounds
  - Gives a selectivity, but also a limitation

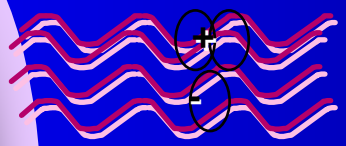
Principle of PID

Gas enters the instrument

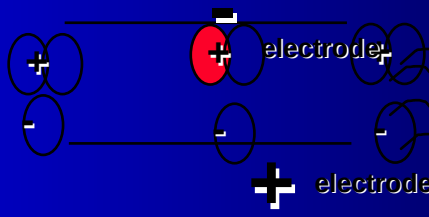
It passes by the UV lamp



It is now "ionized"

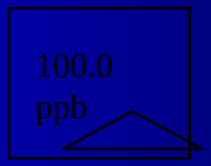


Charged gas ions flow to charged electrodes in the sensor and current is produced



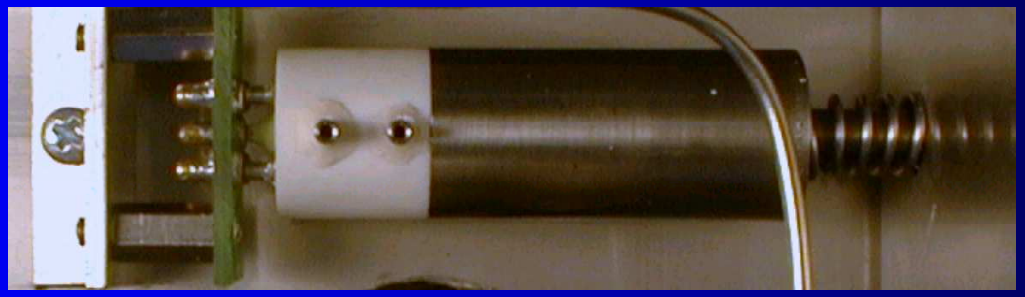
Gas "Reforms" and exits the instrument intact

Current is measured and concentration is displayed on the meter.



Requirements for FID

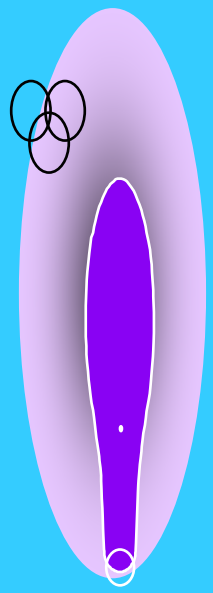
- For a background signal hydrogen is burned
- The flame needs clean air
- The hydrogen supply and the flame must be monitored
- Sensitivity is relative to on carbon content



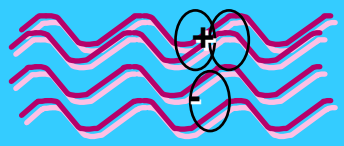
Principle of FID

Gas enters the instrument

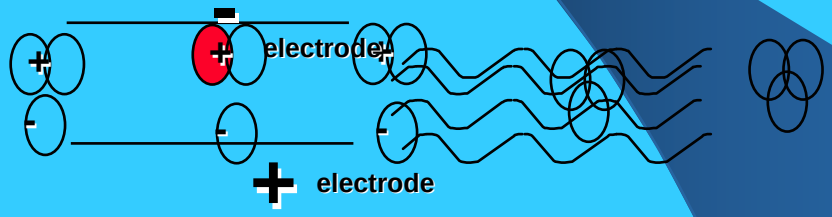
It passes by the flame and the hydrocarbons burn



Ions are formed in the flame

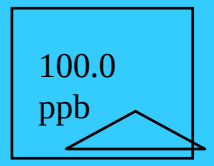


Charged gas ions flow to charged electrodes in the sensor and current is produced



The original compound has been burned: carbondioxide leaves the instrument

Current is measured and concentration is displayed on the meter.

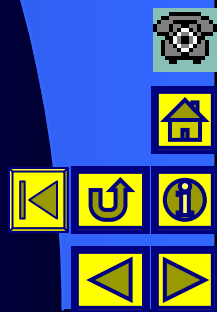


Thermal conductivity detector

- Oldest gaschromatographical detector
- Universal for organic and anorganic compounds
- Based on changes in thermal conductivity of gases

Requirements for TCD

- Pure gas with low conductivity: helium or hydrogen
  - most hydrocarbons have a higher conductivity
  - for some anorganic compounds the opposite can be used:
    - you can measure helium in nitrogen
    - but you can also measure nitrogen in helium
- Sensitive electronics
  - it is still the least sensitive detector
  - it is the one you propose if other detectors are too sensitive
  - or if you must measure anorganic compounds



Electron Capture detector

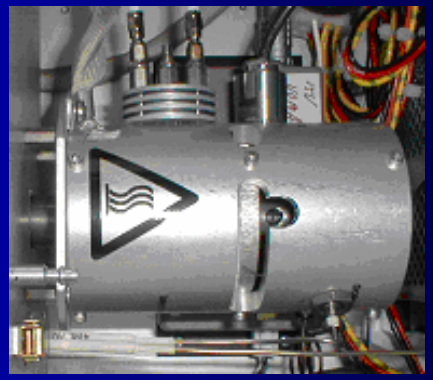
- The opposite of the PID and FID
- Electrons are generated by a source
- This gives a "big" background current
- Some molecules capture the electrons
- This gives a change in current
- The process is very sensitive,
  - mostly for chlorinated hydrocarbons
  - also for other halogenated hydrocarbons

Detecting:4 detectors available:

PID

TCD

FID



PDECD

Summary of detectors

- PID: easy, very sensitive, not universal
- FID: universal, hydrogen and clean air required problems with identification
- TCD: easy, needs helium, not sensitive, but universal
- ECD: very sensitive, not universal, complicated

Gaschromatography basics 18

Combinations of detectors: some work well, some are not possible due to the working of the detector all sample is destructed

	PID	FID	TCD	ECD
PID		+	+	+
FID	-		-	-
TCD	+	+		+
ECD	-	-	-	

GC955 flow diagram

- We always use the stripper principle
- This enables us to split off and flush back high boiling hydrocarbons
- It also makes it possible to sample already a new sample during the analysis of the previous one
- The elements can be seen in the instrument

Typical elements for the sampling and stripper principles

- Double column
- 10-port valve
- Loop or preconcentration

System with cooled preconcentration and capillary column

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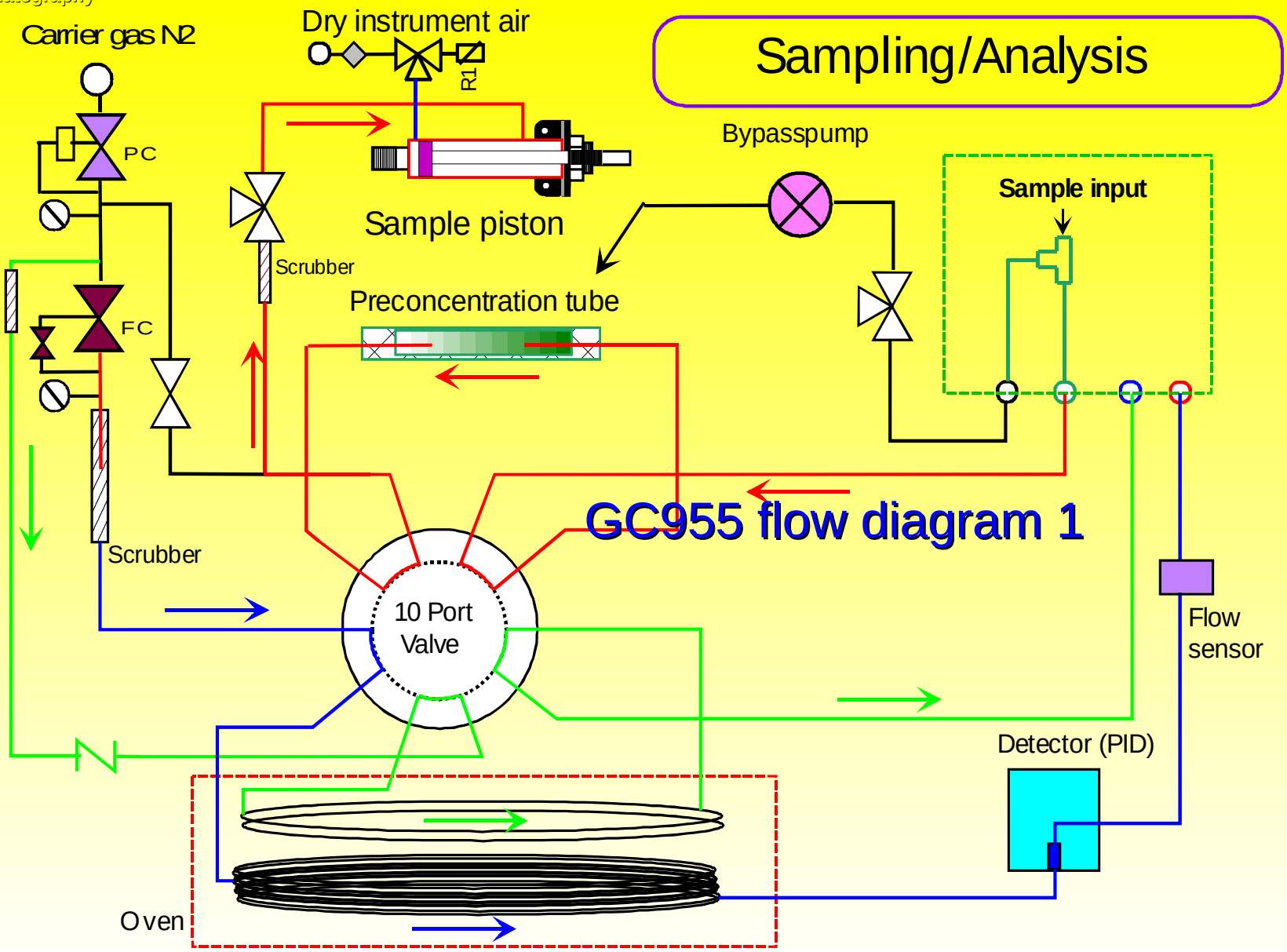
Sampling/Analysis



GC955 flow diagram 1

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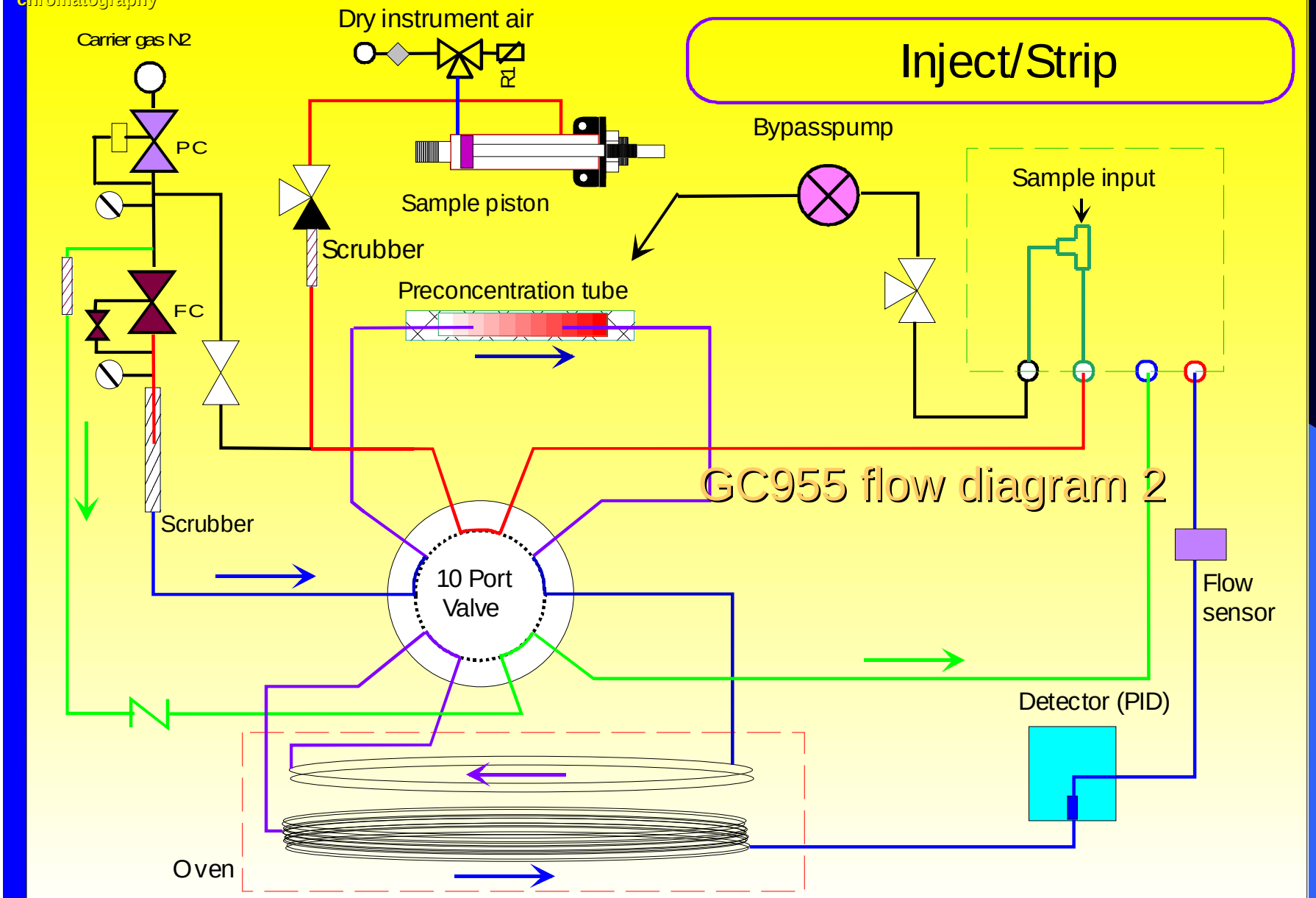

GC955 flow diagram 2

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Conformity tests for the gas chromatograph:

DIN-norm 33963-1 and 2:

Umweltbundesamt, Pilotstation Frankfurt, Offenbach: Frau A. Medem and HerrW. Rudolf, Paul-Ehrlicher-Str.29, D-63225 Langen. Test finished December 1997.

Italian Benzene and Toluene norm:

C.N.R. in Rome, by prof. I. Allegrini and Dr. A. Febo. May 1997.

French requirements for measurement of Benzene, Toluene, Xylenes and Ethylbenzene:

at INERIS, Verneuil-en-Halatte, France, by Ir. Y. Godet, September 1997; and at Ecole des Mines de Douai, Dr. Galloo, test finished December 1997.

EMC-conformity:

By the NMI (Nederlands Meet Instituut), January 1996.

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References

Examples for environmental applications:

In Germany: **over 30 instruments**, **BTX and M/TNMHC, ozone precursors: Hannover 3 x Goettingen, Hamburg, Berlin, Mecklenburg Vorpommern 10x, Sachsen Anhalt, Brandenburg, Potzdam, Frankfurt, Karlsruhe**

In the European Community: EC-JRC in Ispra, Italy, **BTX**

In the UK: **over 20 instruments**, **BTX and Benzene, butadiene: Edinburg, Doncaster, Margate, Dublin 3 x, Cork,**

In Italy : **over 80 instruments BTX and BTX, Terpenes**

In France**: 16 instruments, BTX and M/TNMHC**

In Switzerland**: 6 instruments, BTX: Luzern, Zug, Uri, Tessin, Geneva,**

In Austria**: 10 instruments, BTX**

In Tschechia: **12 instruments, BTX: all around**

In Taiwan**: 2 instruments, BTX**

In Slowakia**: 4 instruments, BTX**

In Poland**: 10 instruments, BTX**

In Spain: **25 instruments BTX: Madrid, Andalusia, Arragon,**

In Belgium: **8 instruments BTX: Antwerp, Liege, Charleroi, Bruxxelles, Mol**

In Portugal: **2 instruments BTX**

In Hungary: **24 instruments BTX: half Budapest, half all over the country**

In the Netherlands: **17 instruments**, **BTX, light boiling hydrocarbons, chlorinated compounds, Methylmercaptan, ethylmercaptan, Vinylchloride and other chlorinated compounds: Amsterdam, Haarlem, Rotterdam, Maastricht, Apeldoorn**

In the following countries **: 1 instrument, BTX: Malta, Lituania, Estonia, Iceland**

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References

Examples for industrial applications:

Germany:

- -Vinylchloride, methylmercaptan, dimethylsulfide, benzene, dimethyldisulfide at a waste dump to ensure workers safety
- -BTEX, cresols, naphta at a tar see to measure during covering this see to have a record against possible health effects to nearby village
- -BTEX, Dichloroethene, Trichloroethene, Perchloroethene in soil-decontamination plant as process monitoring
- -Methylmercaptane in ppm-concentrations in an exhaust

Belgium:

- -Vinylchloride at an upscaling laboratory to ensure workers safety

Nederland:

- -Vinylchloride at an upscaling laboratory to ensure workers safety
- -Ethyleneoxide and propyleneoxide at a test plant to ensure workers safety
- -Methylmercaptan, ethylmercaptan and benzene near oil wells to study possible stench effects on nearby inhabitants
- -Vinylchloride and other chlorinated compounds at a waste dump monitoring project
- -Ethyleneoxide in a sterilising unit
- -Ethene in greenhouse safety
- -benzene in a plant to ensure workers safety

Taiwan:

- -Methylmercaptan and ethylmercaptan to have a record of measurements against stench complaints of city inhabitants
- -methane and total hydro carbon

Poland:

- -Methylmercaptane and Ethylmercaptane in paper pulp

Norway:

- -N2, O2, CO, CO2, CH4, NMTHC in a diving habitat to ensure workers' safety