SYSTEC

Process and Emission Measurement

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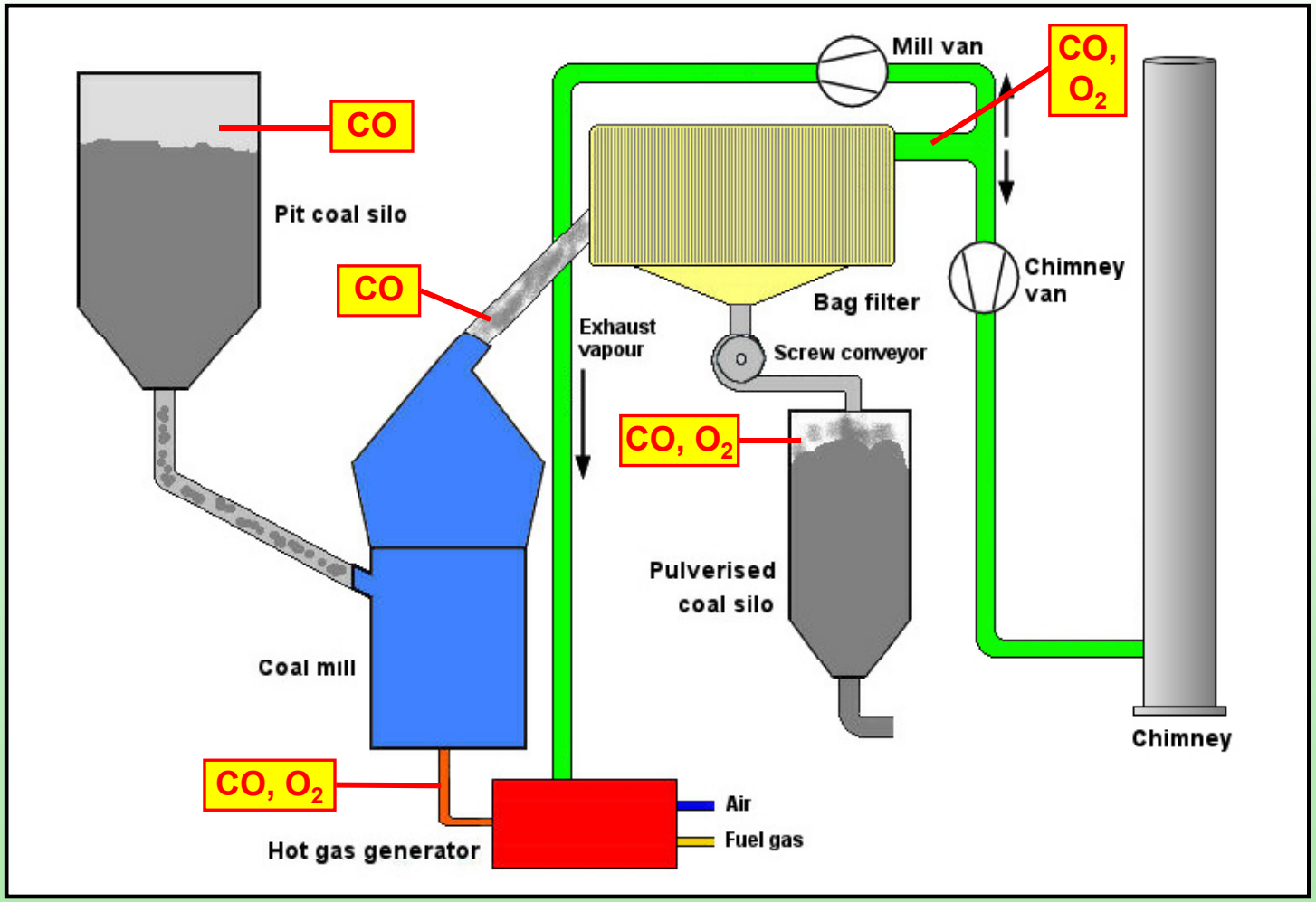
Example 1:

Process measurements in a coal mill



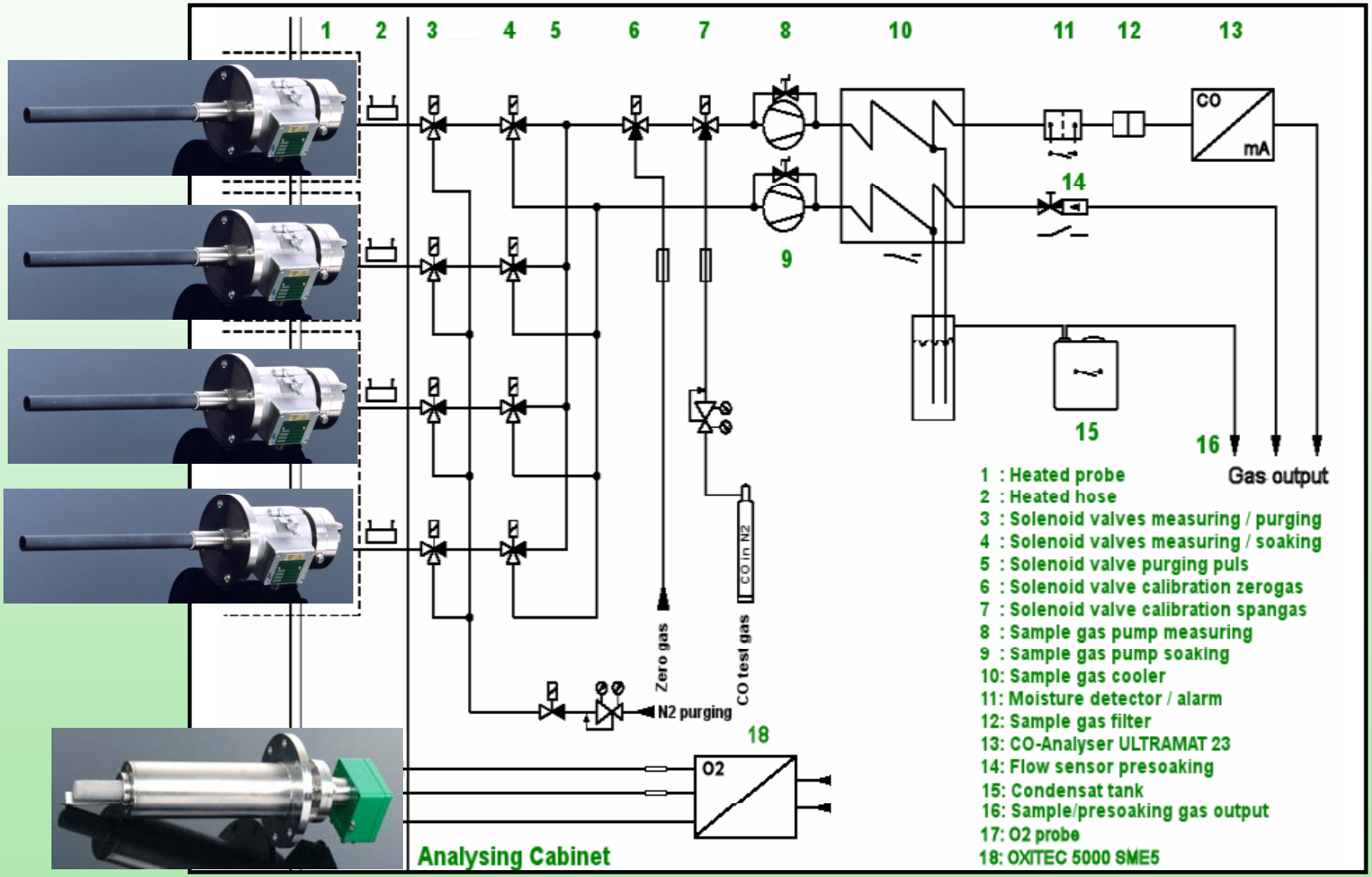
Example 1

CO and O_2 analysing cabinet for a coal mill

In coal milling plants oxygen (O_2) and carbon monoxide (CO) has to be measured, because of the hazard of a coal dust explosion. In ideal case a coal milling plant is been operated in an inert atmosphere with a wet InSitu oxygen concentration of less than 10% (the O_2 limit depends on the type of coal).

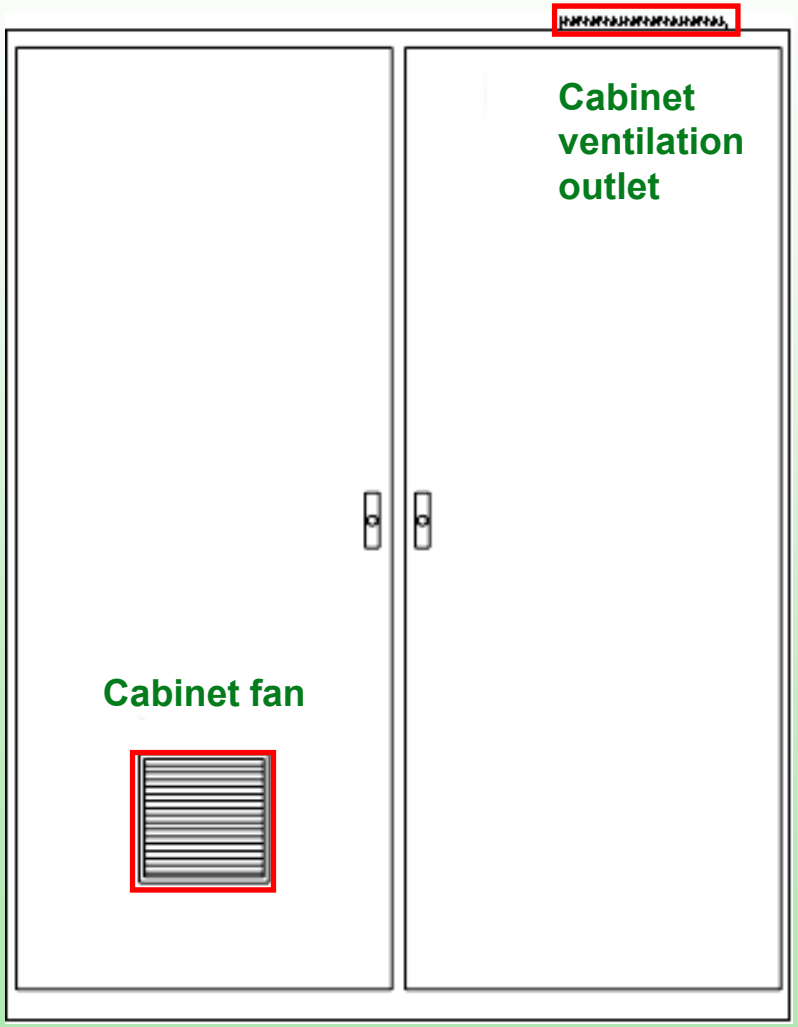
The values of O_2 and CO have to be measured at all measuring points to optimise the coal milling process whereby a dust explosion can be ruled out.

Gas plan of a CO analyser cabinet for a coal mill



Process measurement coal mill

Gas analyser cabinet



Internal mounting plate

Heated hoses entry

Solenoid valves measuring/purging

Solenoid valves measuring/soaking

Gas pumps

left one: measuring pump

right one: presoaking pump

Solenoid valve for calibration zero gas

Solenoid valve for calibration span gas

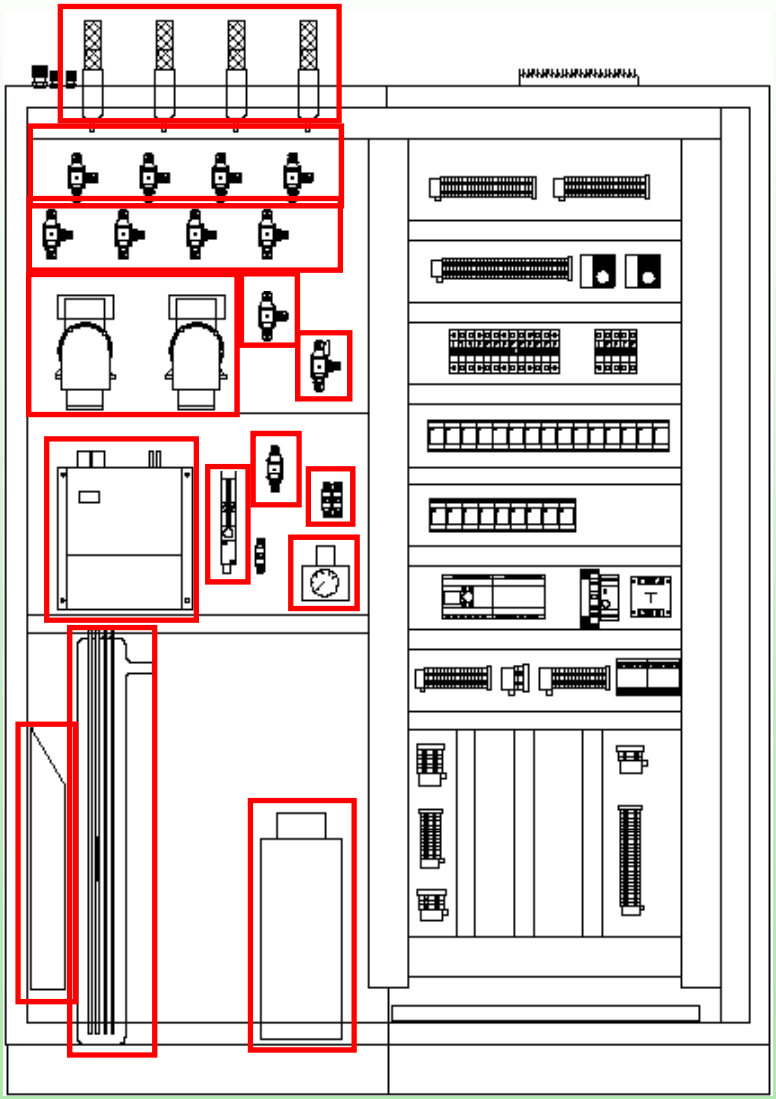
Sample gas cooler

Flow meter with alarm

Cabinet heater

Condensate system

Condensate tank



Solenoid valve for purging

Pressure reducer for purging gas

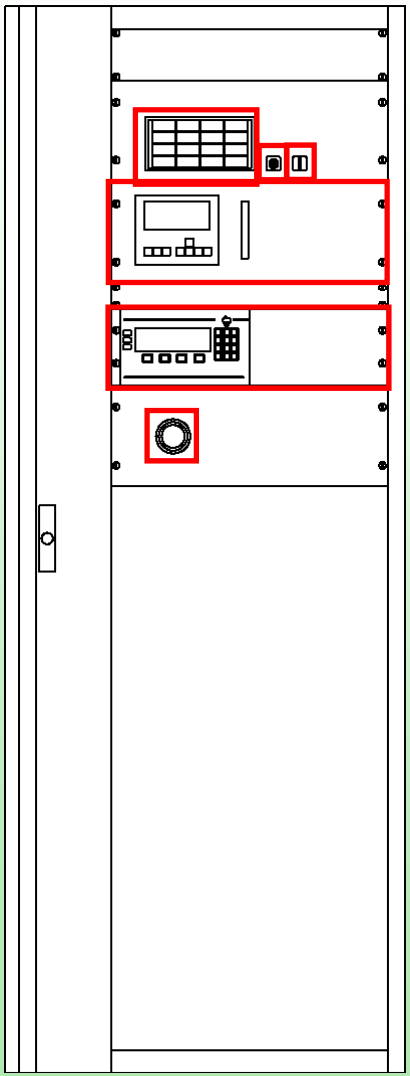
Zero gas and test gas input connection

Process measurement coal mill

Swivel frame

ULTRAMAT 23 CO Analyser

OXITEC 5000 O_2 Analyser



Signal and alarm lamps

Lamp test

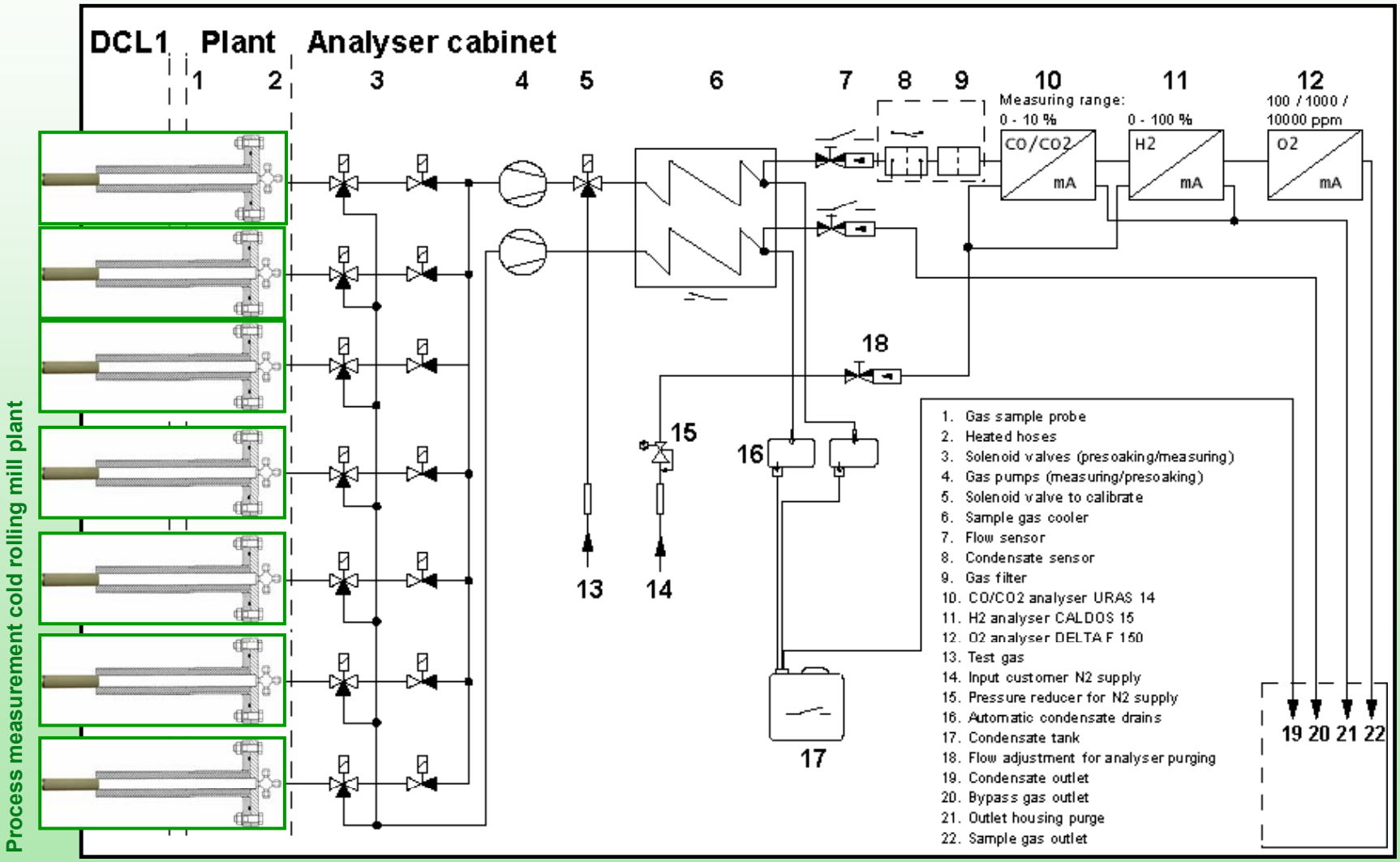
Maintenance switch

Sample gas filter

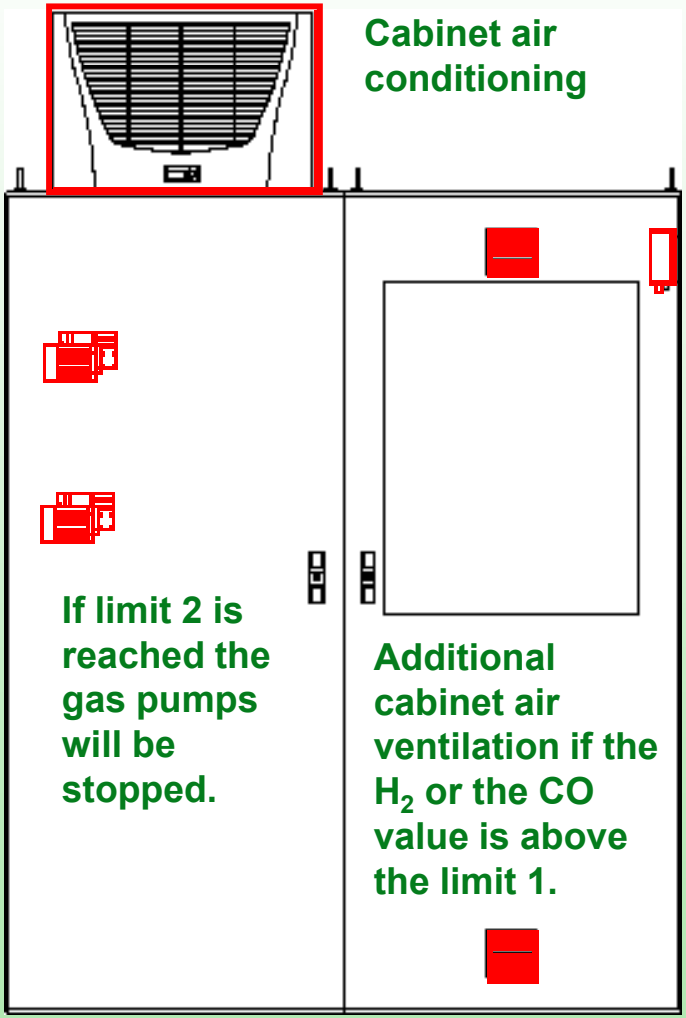
Example 2

Analysis for heat treatment furnaces of a cold rolling mill plant

Gas plan for a CO, CO_2, H_2 and O_2 analyser cabinet for a heat treatment furnace



Gas analysing cabinet



Process measurement cold rolling mill plant

Gas analyser cabinet

Internal mounting plate

Heated hoses entry

Flowmeter

Condensate sensor

Gas filter

Gas pumps

upper one: measuring pump

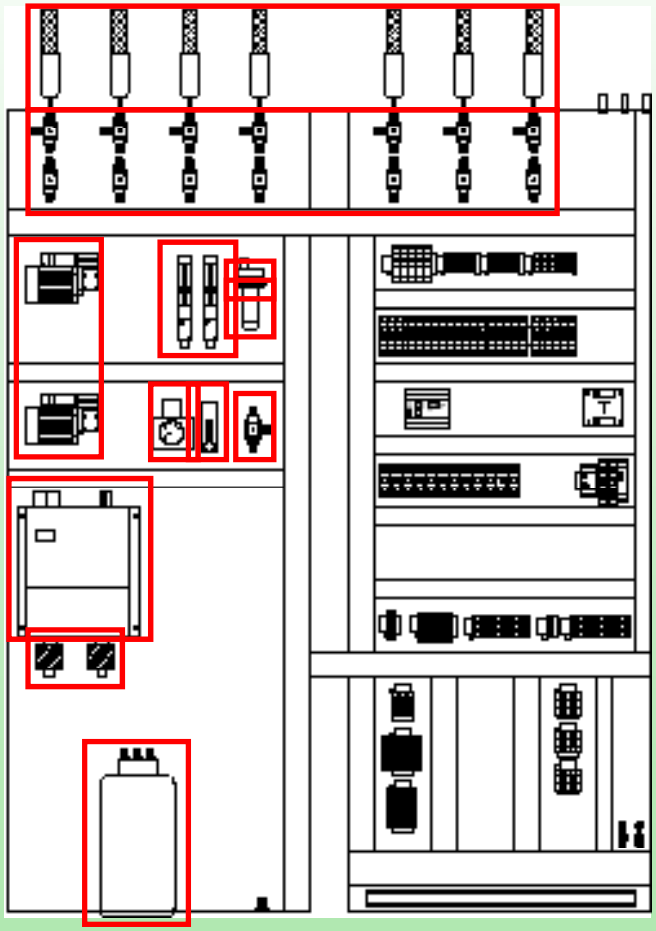
lower one: presoaking pump

Solenoid valve for calibration

Sample gas cooler

Condensate drain

Condensate tank



Solenoid valves

Flow adjustment for N_2 analyser purge

Pressure reducer for N_2 purging of the analysers

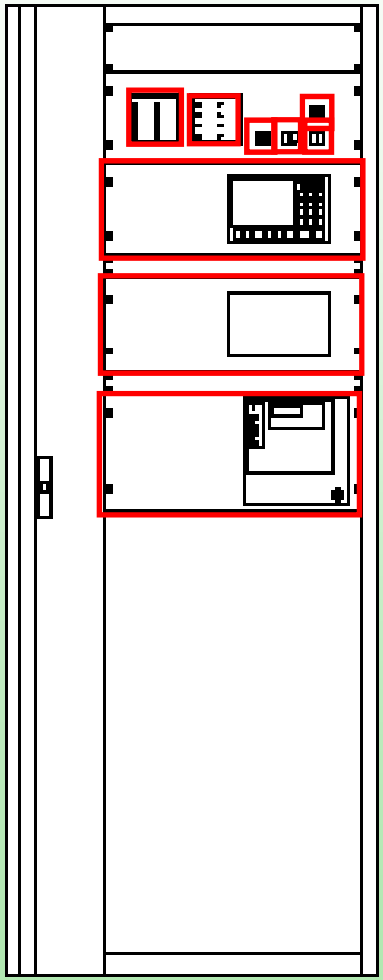
Process measurement cold rolling mill plant

Gas analyser cabinet

Internal swivel frame

Display status messages

Display sampling points



Lamp test

Maintenance switch

Manual calibration Delta F

Start Delta F Analyser*

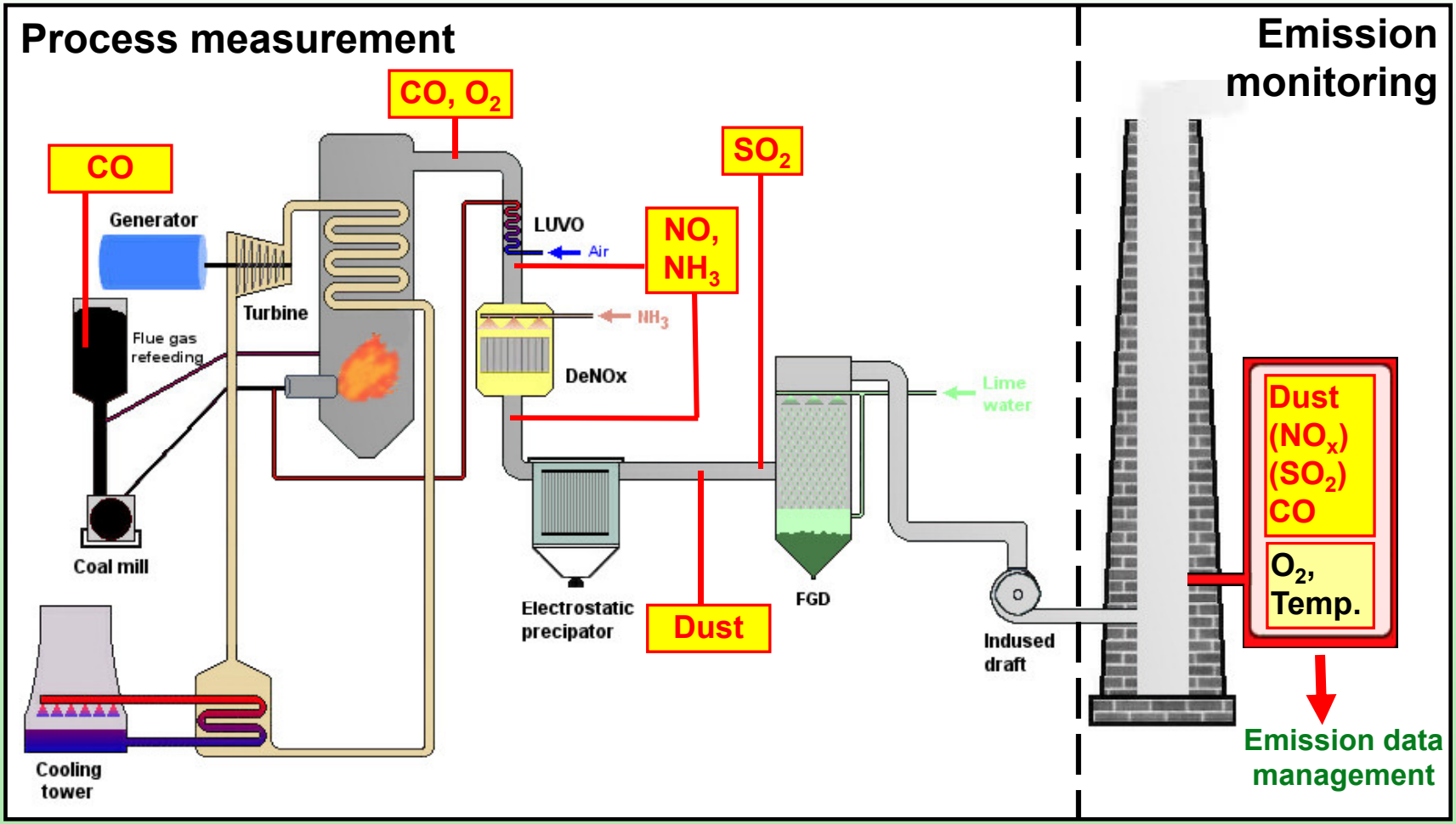
URAS 14 CO/CO_2 Analyser

CALDOS H_2 Analyser

DELTA F O_2 Analyser

Example 3:

Emission monitoring in a coal-fired power plant



Emission measurement according to 13.BImSchV

(German environmental protection act)

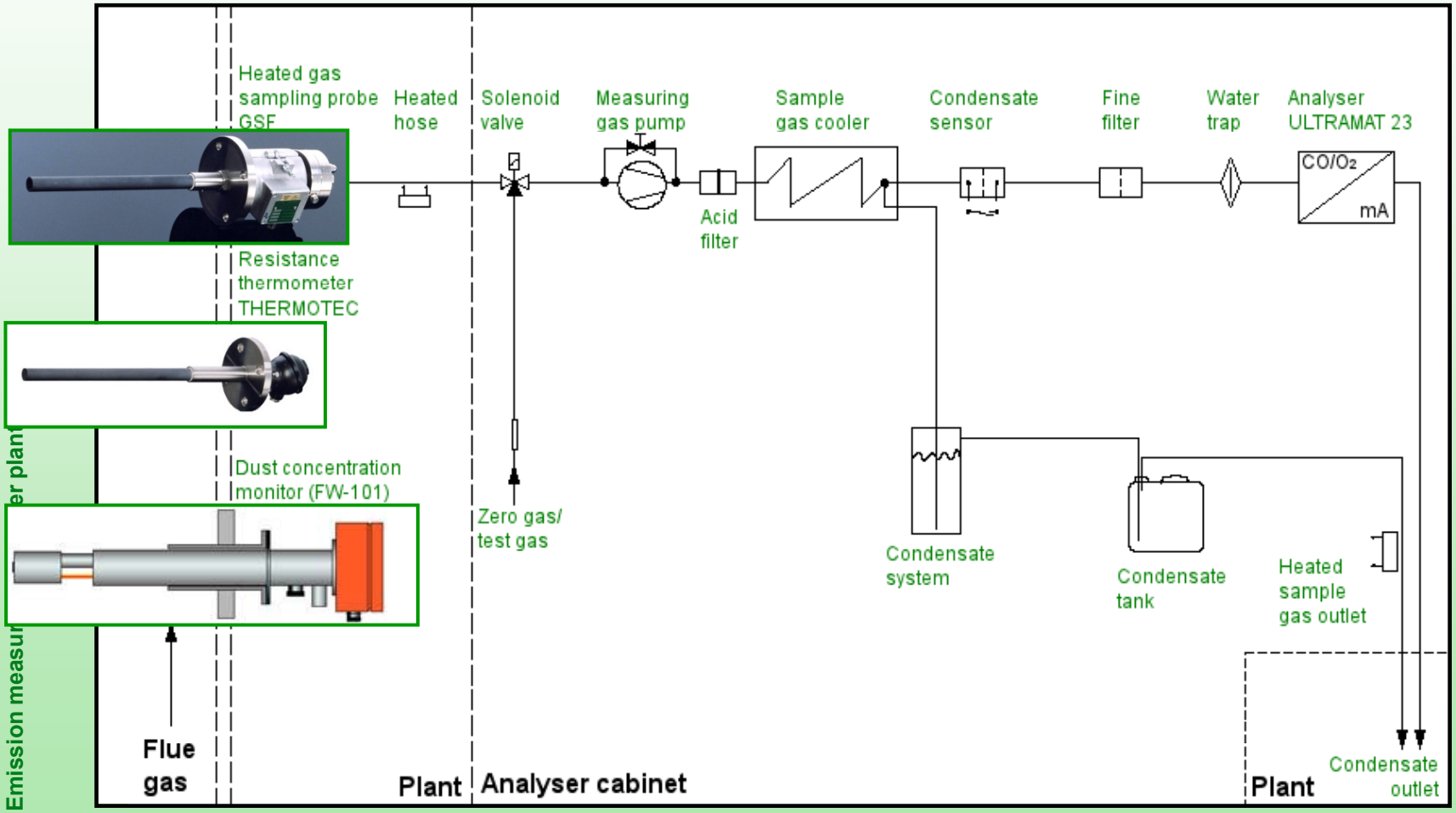
This is a regulation by law concerning the combustion of coal, gas and oil and determines the limits for up to 4 pollutants:

- Dust
- (NO_x)
- (SO2)
- CO

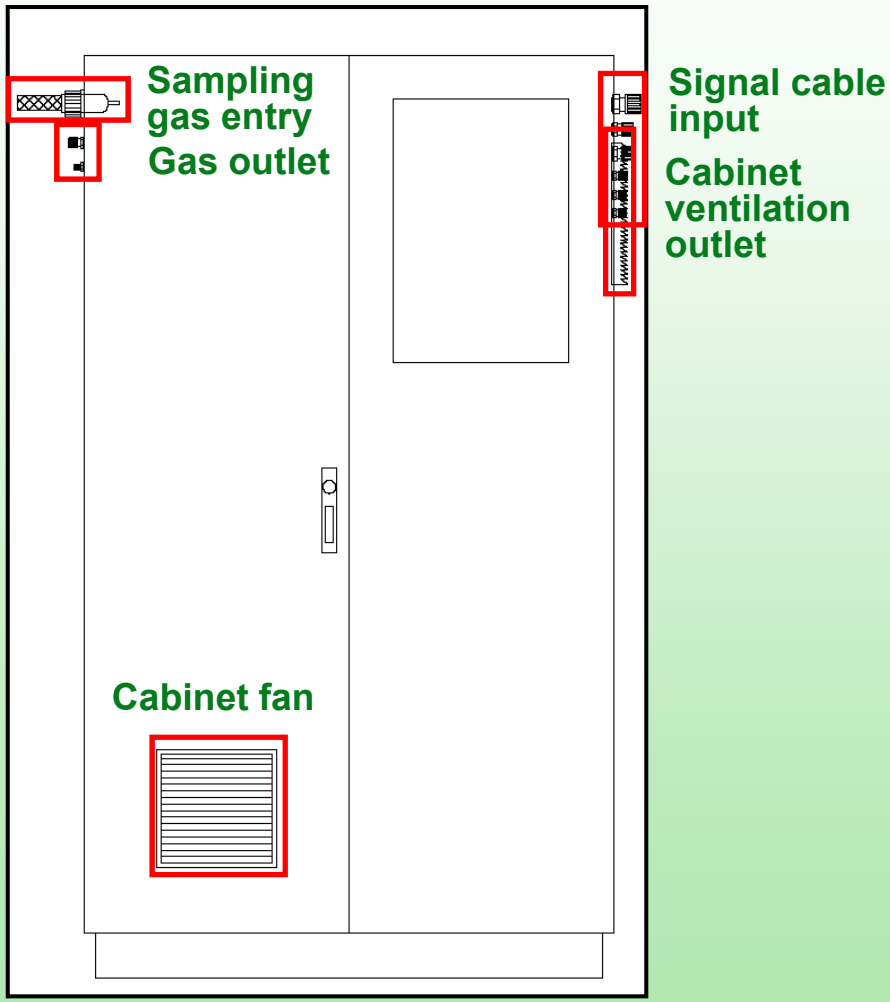
For the calculation of emission O_2 and Temperature are necessary.

In the following example just Dust, CO, O_2 and the Temperature has to be measured.

Gas plan for a Emission analysing cabinet for a coal-fired power plant according to 13. BImSchV



Gas analyser cabinet



Gas analyser cabinet

Interior view

Heated hoses entry

Solenoid valve

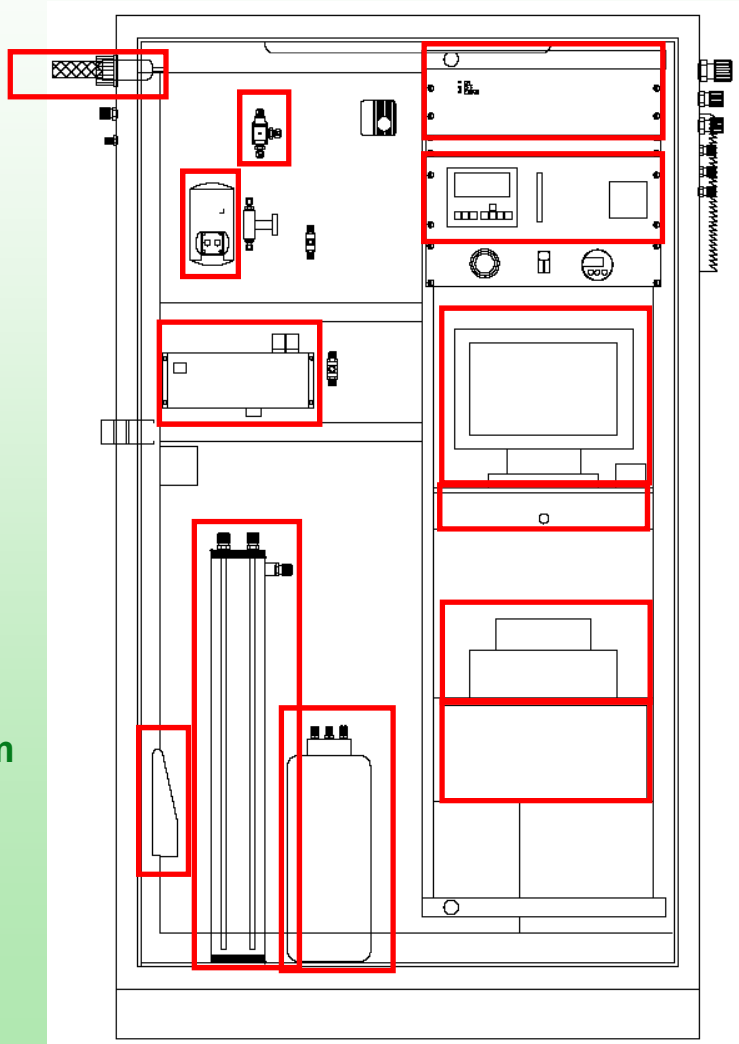
Gas pump

Sample gas cooler

Condensate system

Cabinet heater

Condensate tank



Communication unit

ULTRAMAT 23
CO/O_2 Analyser

Monitor

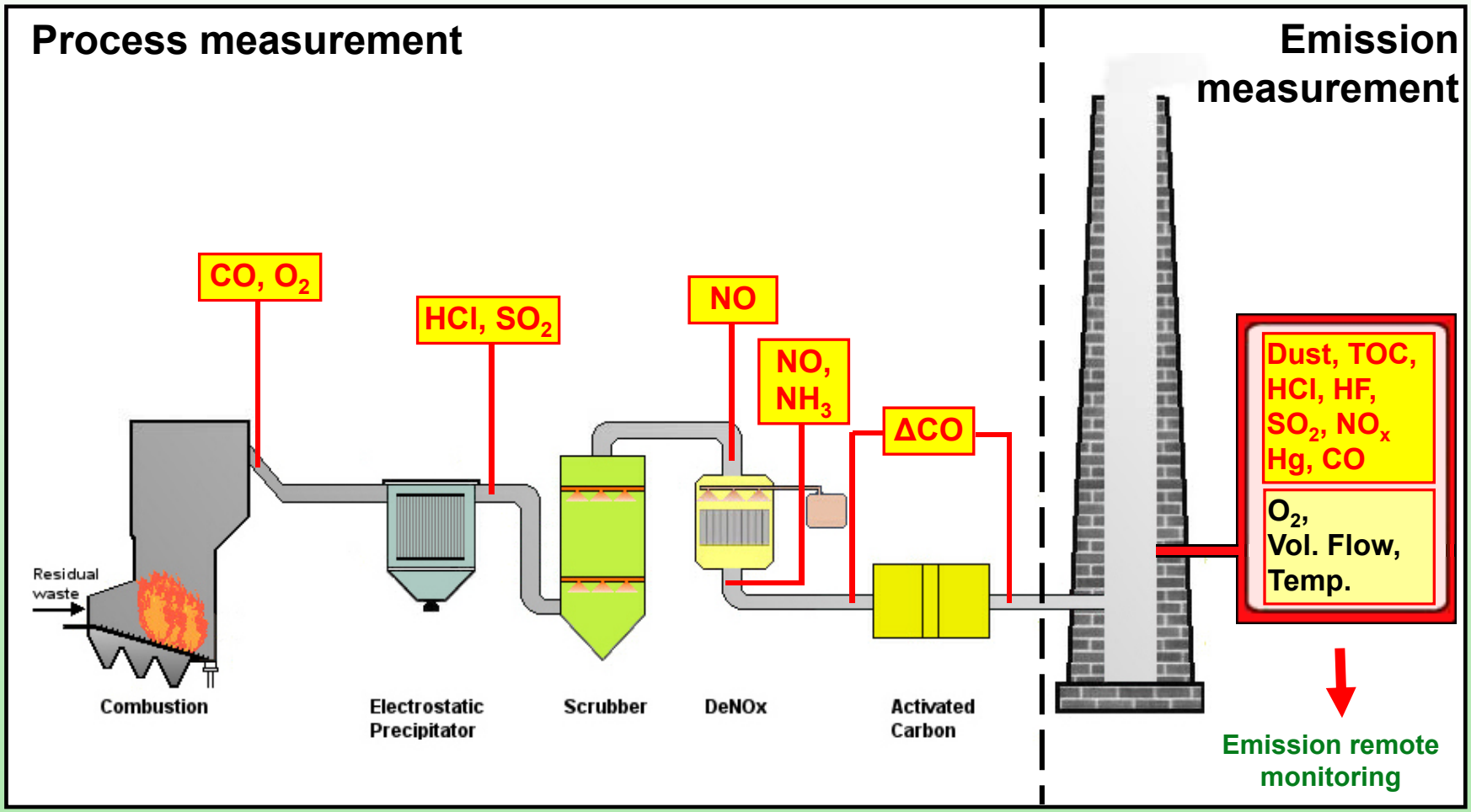
Keyboard and mouse

Printer

Industrial personal computer

Example 4

Emission monitoring in a waste incineration



Emission measurement waste incineration

Emission measurement

according to 17. BImSchV German environmental protection act)

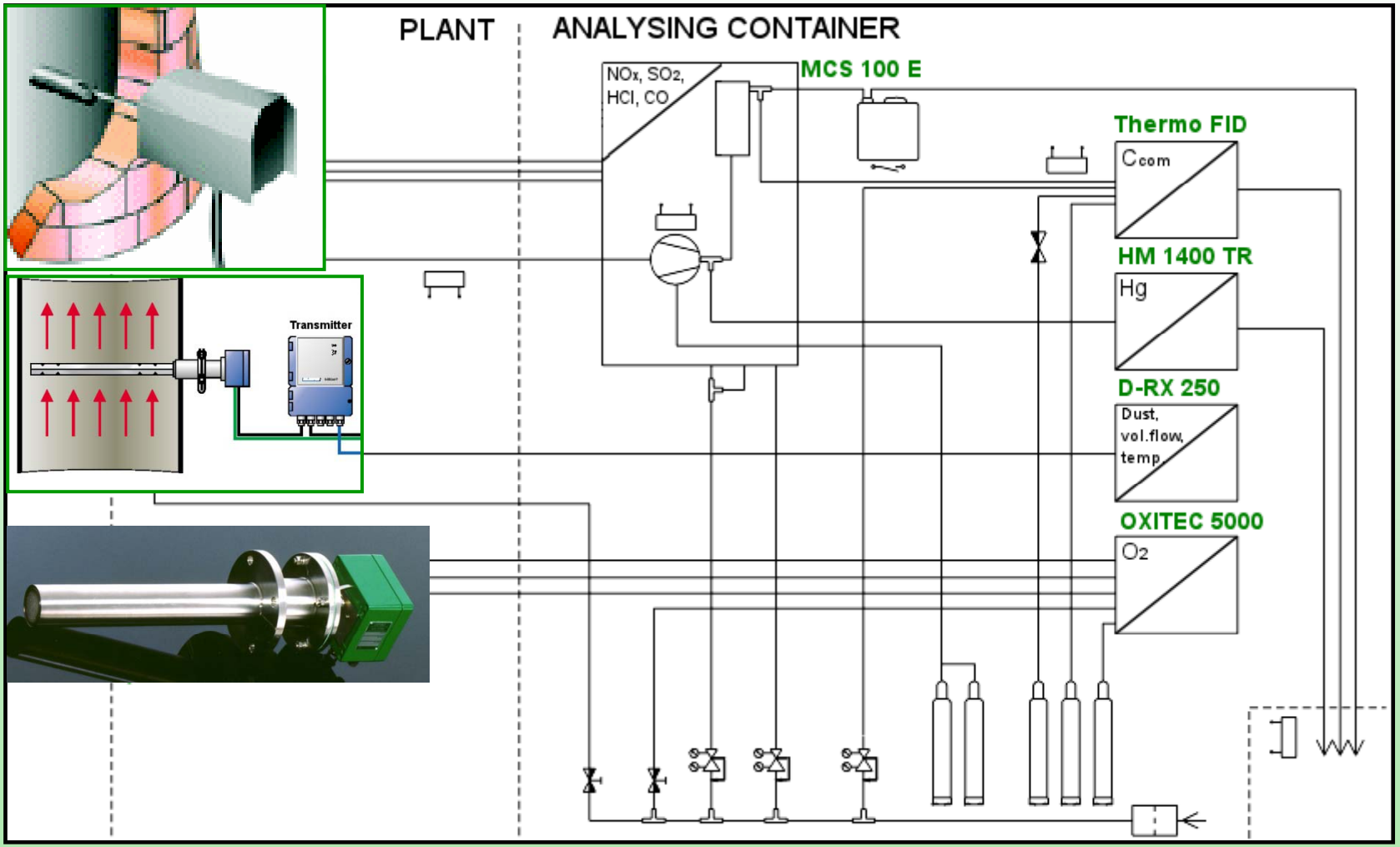
This is a regulation by law concerning the combustion of waste and determines the limits for up to 9 pollutants:

- Dust
- TOC
- HCl
- HF
- SO_2
- NO_x
- Hg
- CO
- Temperature in the afterburning zone

For the calculation of emission, O_2 and Volume Flow also the measurement of Temperature is necessary.

In the following example just Dust, TOC, HCl, SO_2, NO_x, Hg, CO and the Temperature in the afterburning zone has to be measured.

Gas plan of an emission measurement



Gas analysis container

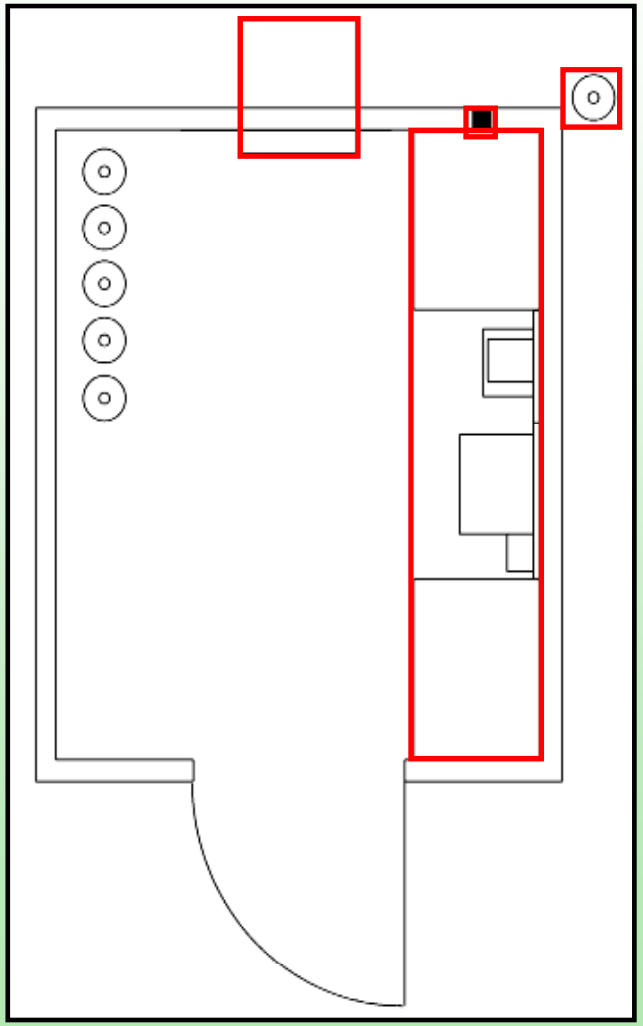
Cabinet air conditioning

H_2 bottle (burning gas for FID)

Measuring gas outlet

Power supply and analysis systems

Test gas bottles



Analyser configuration inside the container

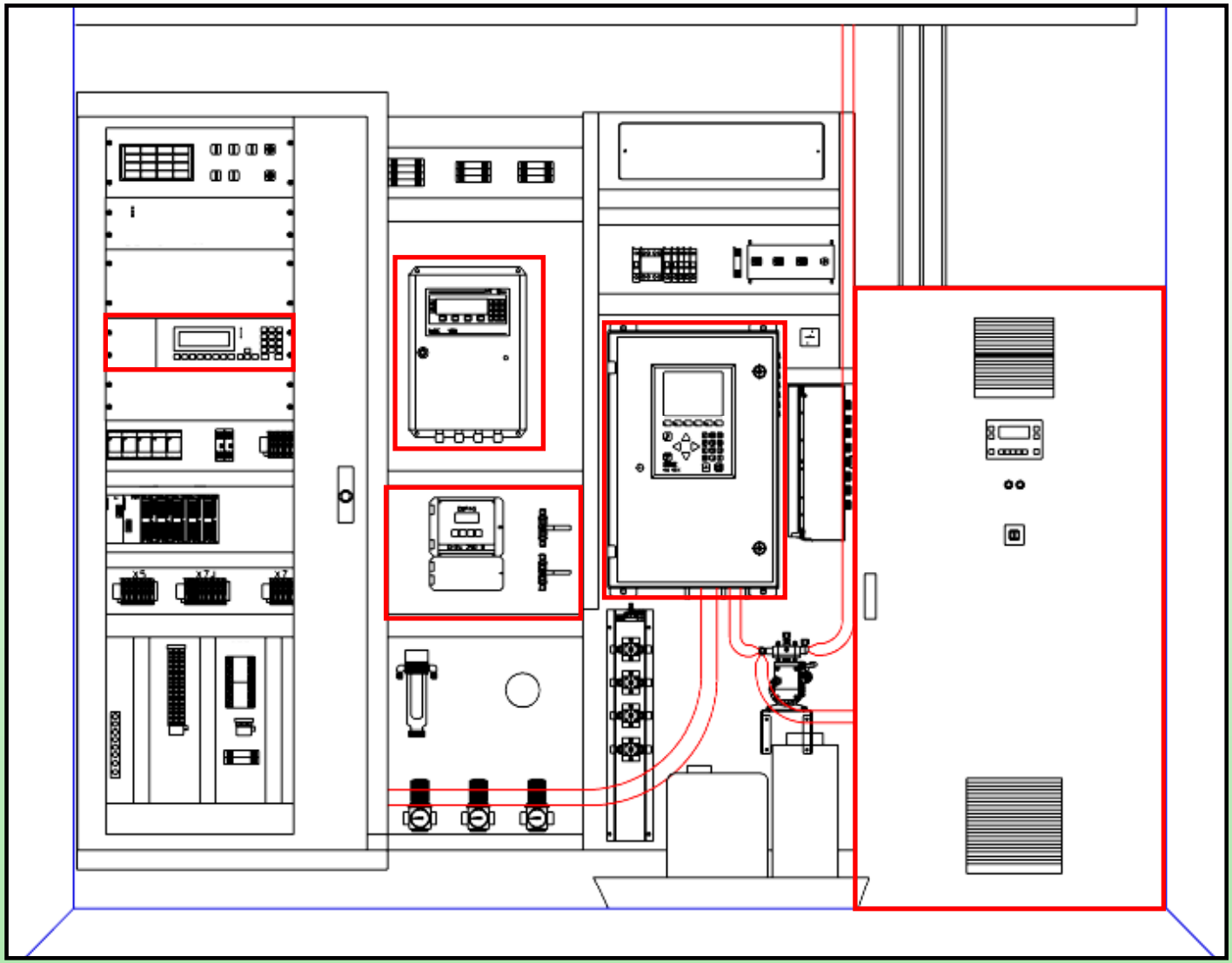
Thermo FID
(TOC)

OXITEC® 5000
(O2)

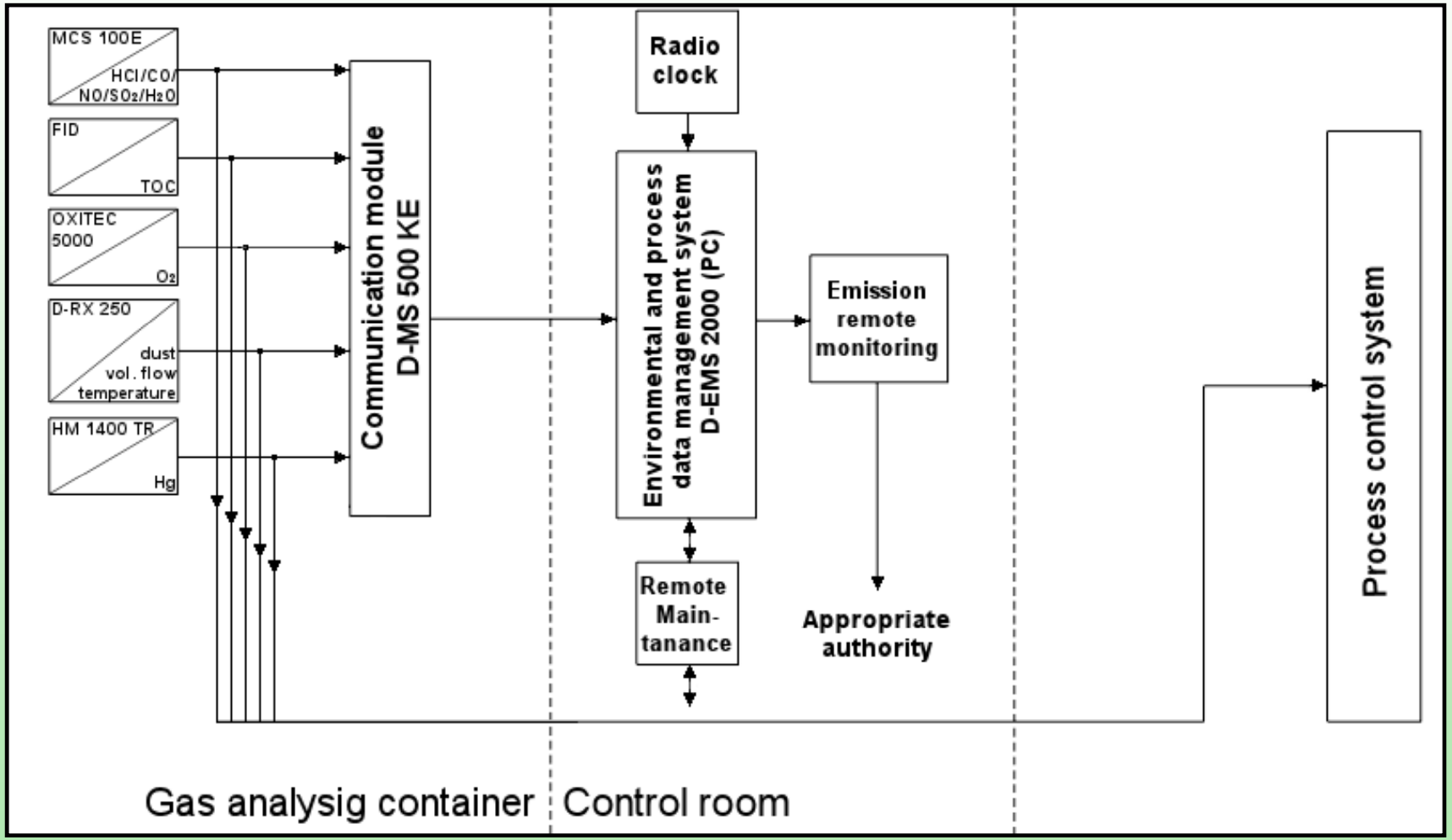
MCS 100 E
(NOx, SO2, HCl, CO)

D-RX 250 (Dust, Vol.Flow, Temp.)

HM 1400 TR
(Hg)

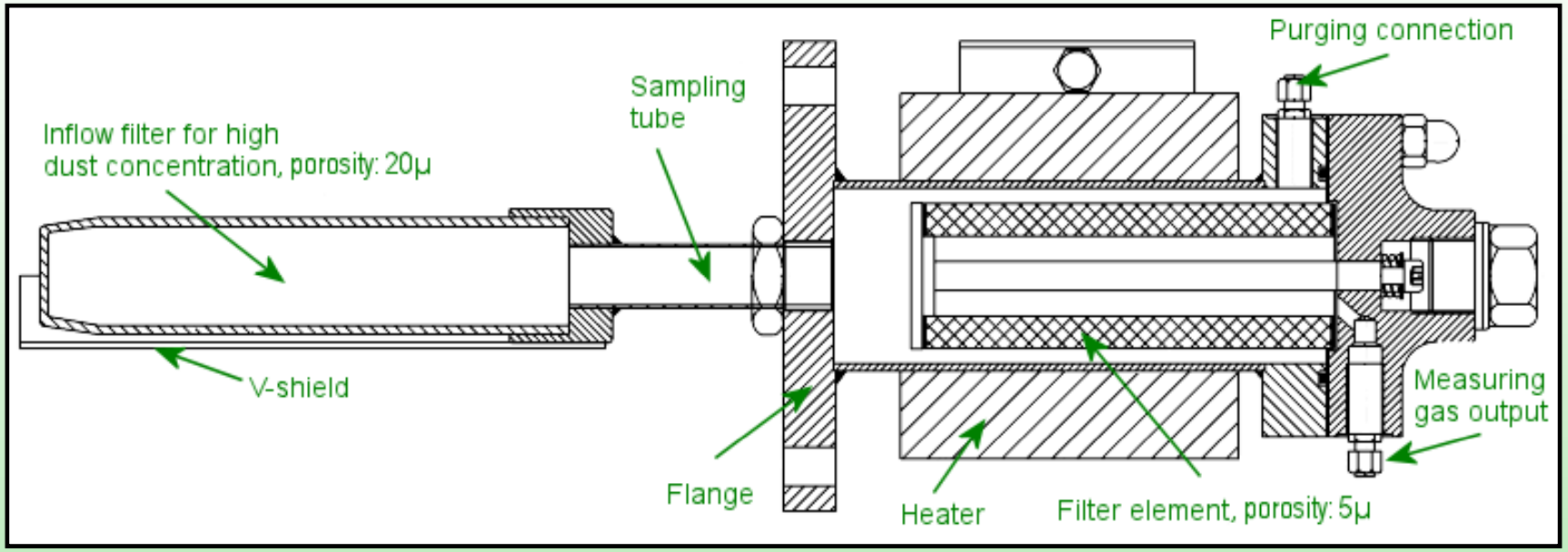


Measured values evaluation



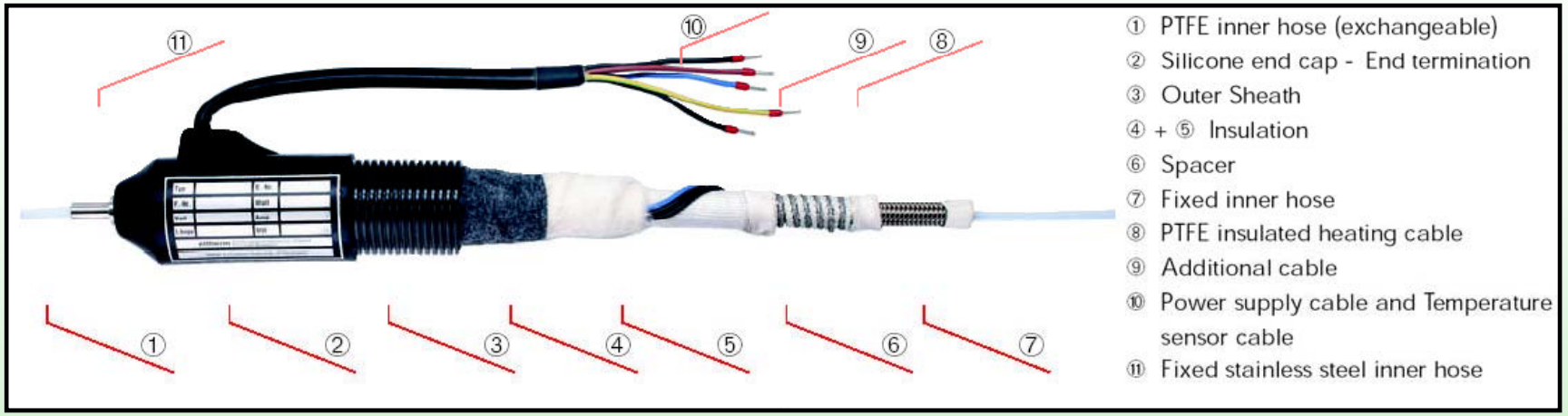
Components of measuring gas extraction and conditioning

Details of the gas sampling probe GSF-…



The measuring gas output must be connected directly to the heated hose in order to avoid dew point problems.

Self-regulating heated hose



With the self regulating heating cables inside, the heating power is controlled according to the ambient temperature. The bus wires of the self regulating cable provide an infinite amount of parallel switched resistances that makes it possible to cut the heating tape in any desired position without developing dead or cold zones in the heating tape.

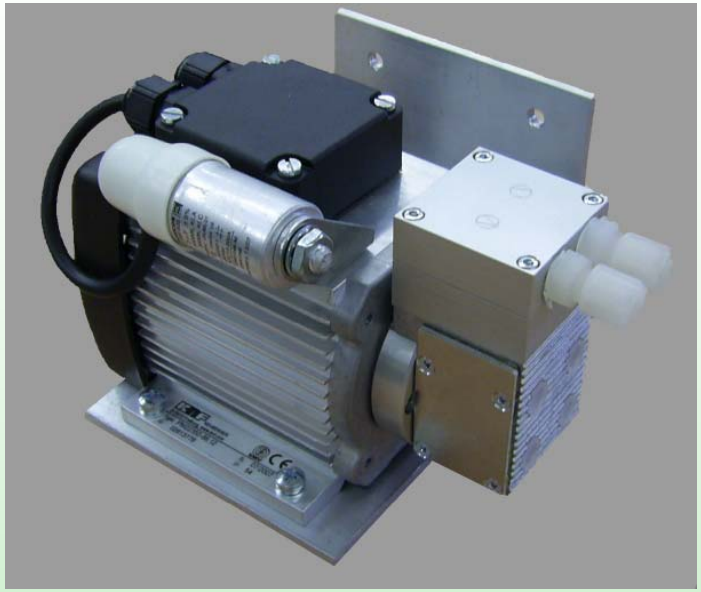
When the operating temperature rises, the plastic molecular structure expands and lowers the connection between the carbon particles. The resistance rises, and the power decreases. Thus, the heating tape adjusts to every individual heating application.

This options enable the customer to terminate and cut the heated hoses to length by himself at site and fix the hose to the assembly requirements.

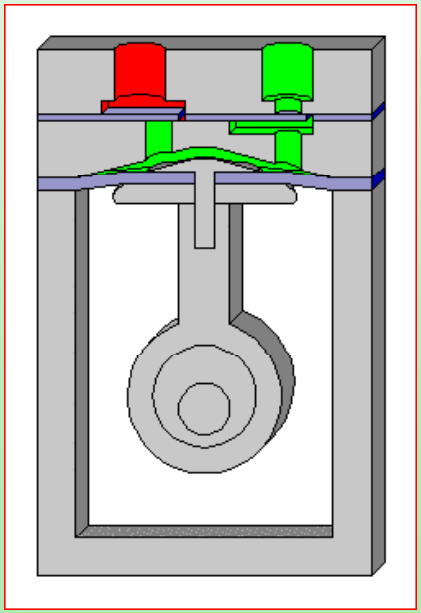
Solenoid valves (Example: stainless steel)

- **Pivoted armature solenoid valve with a wide range of circuit functions**
- **The magnetic system and the medium are separated by a diaphragm system.**
- **The valve is fast-acting and has a long service life, even in non-lube conditions.**
- **Insensitive to contaminated fluids**

Measuring gas pumps



The pumps are switched of if condensate or cooler alarm occurs.



Picture from KFN Neuberger

Functional principle of the pump:

An elastomer diaphragm (see illustration) is moved up and down by an eccentric. On the down-stroke it draws the air or gas being handled through the inlet valve. On the up-stroke the diaphragm forces the medium through the exhaust valve and out of the head. The compression chamber is hermetically sealed from the drive mechanism by the diaphragm. The pumps transfer, evacuate, and compress completely oil-free.

Sample gas cooler

Function:

Removing of the residual moisture

The cooler reduces the dew point of sample gas to about +5°C (for a maximum gas inlet temperature of +200°C). This is equivalent to approx. 0.86 Vol.% residual moisture.

In the case of a temperature rise error of the gas cooler the measuring system may not receive measuring gas, in order to prevent condensation in the gas ways. For this reason the measuring gas pump switched off automatically.

The gas cooler works free of maintenance, but the heat exchanger may be replaced in case of damage, leakage or when clogged.

Technical data:

- **Cooling temperature monitoring**
- **Dew point stability: +/- 0.1 °C**

Flowmeter

Measuring principle

Variable area flowmeters feature an upright tapered tube, wider end up, in which a specially shaped float moves freely up and down.
The gas flows upwards through the tube, causing the float to lift a certain distance and form a gap between tube wall and float, so that the forces acting on the float are in equilibrium.

The higher the float is in the tube, the larger the gap between the float and the wall. As the gas flows through the tube it pushes the float upwards and streams past the float. The faster the flow, the more gas flows into the tapered tube, and the more it has to pass by the float. Thus the float is pushed upwards until the gap is wide enough for the gas to pass. This gap is equivalent to a respective flow, which can be read from the top edge of the float.

To signal specific flow values, the flowmeters are equipped with a min limit switch that initiate an electrical signal when the preset value has been reached.

Condensate guard and gas filter for measuring gas (example)

The condensate guard is screwed in the filter element and measures the condensate content of the sample gas via resistance measurement. This condensate guard will switch off the measuring gas pump if moisture is detected.

It is essential that gas analysers are protected against accumulations of dust and moisture. The sample gas filter must provide particulate free gas to enter the analyser. It is mounted in front of the analysers.

The filter is to be controlled regularly and renewed if necessary!!!

Recommended Analyser Applications

	OXITEC/COMTEC ENOTEC	ULTRAMAT 6 SIEMENS	OXYMAT 6/61 SIEMENS	CALOMAT 6 SIEMENS	ULTRAMAT 23 SIEMENS	MCS 100E SICK Maihak	Thermo FID M+A	HM1400 TR DURAG	D-RX-250 DURAG	FW-101 SICK MAIHAK	ITARBAR Intra
O_2	x		x		x	x					
H_2				x							
CO	x (combust.)	x			x	x					
CO2		x			x	x					
NO		x			x	x					
SO2		x			x	x					
NH3		x				x					
HCl						x					
H2O	(x)	x				x					
Hg								x			
TOC							x				
Dust									x	x	
Temperature									x		x
Volume Flow									x		x

Measuring principles for gas analysers to measure the following components

ULTRAMAT 6

Figure by SIEMENS AG

Measurement item:
CO, CO_2, NO, SO_2, NH_3, H_2O, CH_4 and other hydrocarbons

Method of measurement:
non-dispersive infrared absorption (NDIR)

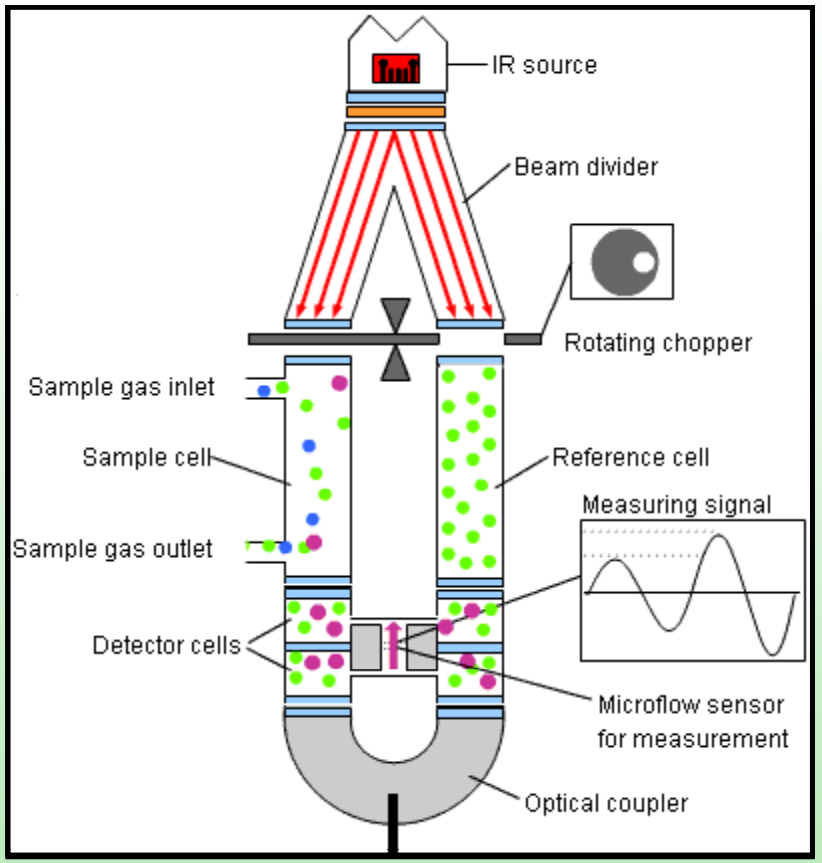
The measuring principle of ULTRAMAT 6 measurement:

The reference cell is filled with nitrogen, a non-IR-active gas (green).

The detector cells are filled with a defined concentration of the measured component (purple). The sample gas flows continuously through the sample cell.

The IR source emits light which is divided by the beam divider into two equal beams. The chopper rotates between the beam divider and the sample cell and interrupts the two beams alternately and periodically.

The infrared light is absorbed by infrared-active gases in the sample cell and the detector cells. The optical coupler extends the detector cells optically. Due to the different absorption in both levels, a low is generated from the upper to the lower detector cell. The flow is converted by the microflow sensor into an electric signal.



Figures by SIEMENS AG

When the beam is interrupted cue to the chopper rotation, the ressure difference is equalized, resulting in a flow from the lower to the upper detector cells.

When the beam passes through the reference cell, it reaches the detector cells practically unattenuated.

The interplay of all phases results in a pulsating flow which gives the electric signal.

CALOMAT 6

Figure by SIEMENS AG

Measuring item:
Primarily the gas analysing system CALOMAT 6 is used for the quantitative analysis of H_2 and He in binary or quasi binary noncorrosive gas mixtures.
It is also possible to measure the concentration of other gases, if their thermal conductivities differ considerably from the thermal conductivity of the carrier gas as Ar, CO_2, CH_4, NH_3.

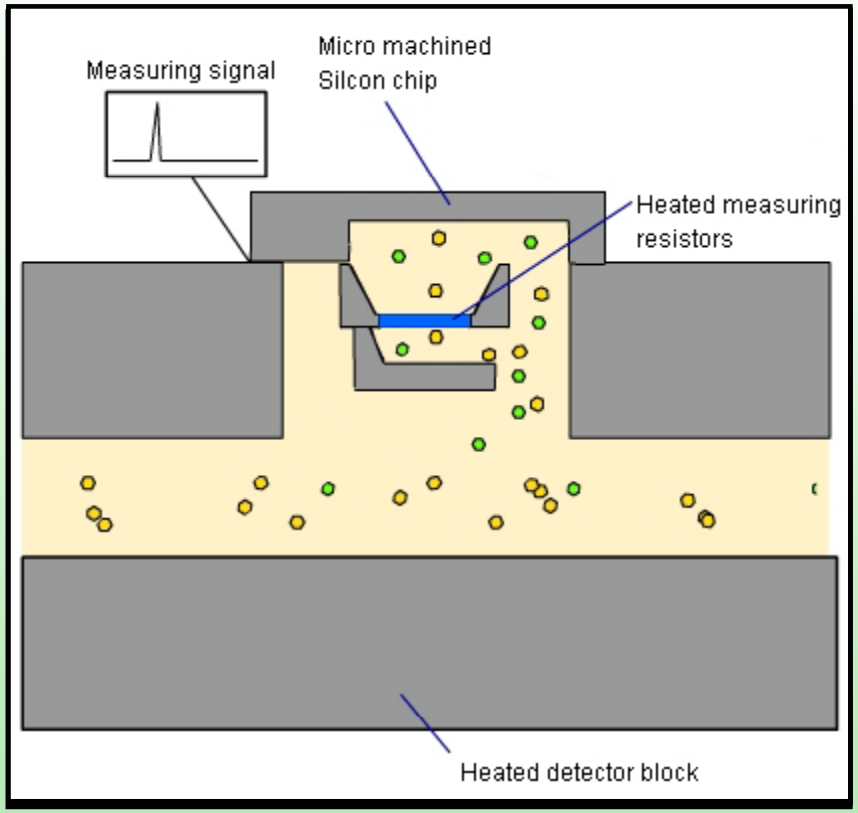
Method of measurement:
Measurement of the specific thermal conductivity

Principle measuring method of the CALOMAT 6 module H_2 measurement:

The sample gas flows through the sample cell with the sensor inside. The sensor is a silicon chip with a measuring membrane and heated thin-film resistors.

The measured component (green) is a gas with a high thermal conductivity (e.g. H_2 or He), the residual gas (yellow) shows very little thermal conductivity (e.g. N_2 or Ar).

When the measured component (green) passes the sensor, the current flow through the heated resistors is changed in order to maintain a predetermined constant temperature. The change of the current through the sensors is measured and converted into the concentration value.



Figures by SIEMENS AG

Maintenance

Before any maintenance at the analyser cabinet should be done, put the maintenance switch in the position „Maintenance“.

Visual checks (sample gas pump, sample probe, sample gas filter, flow meter, valves, fittings, tubes)	**weekly**
Operation control (heated hose, sample gas cooler, gas condensate guard, analysers)	**weekly**
Check the condensate collection tank	**weekly**
Empty the condensate collection tank	**weekly or if necessary**
Removing of dirt if necessary	**Whenever visible**
Changing of membranes (solenoid valves, pumps)	**¼ or ½-yearly**
Changing of filters, gaskets, valves, membranes (sample probe, sample gas pump, sample gas filter, solenoid valves)	**¼- or ½-yearly**
Leak proof test (with N_2 bottle beginning at the sampling point)	**¼-yearly**
Calibration analyser	**¼ or ½-yearly**

Questionnaire for SYSTEC (PDF)

please click here