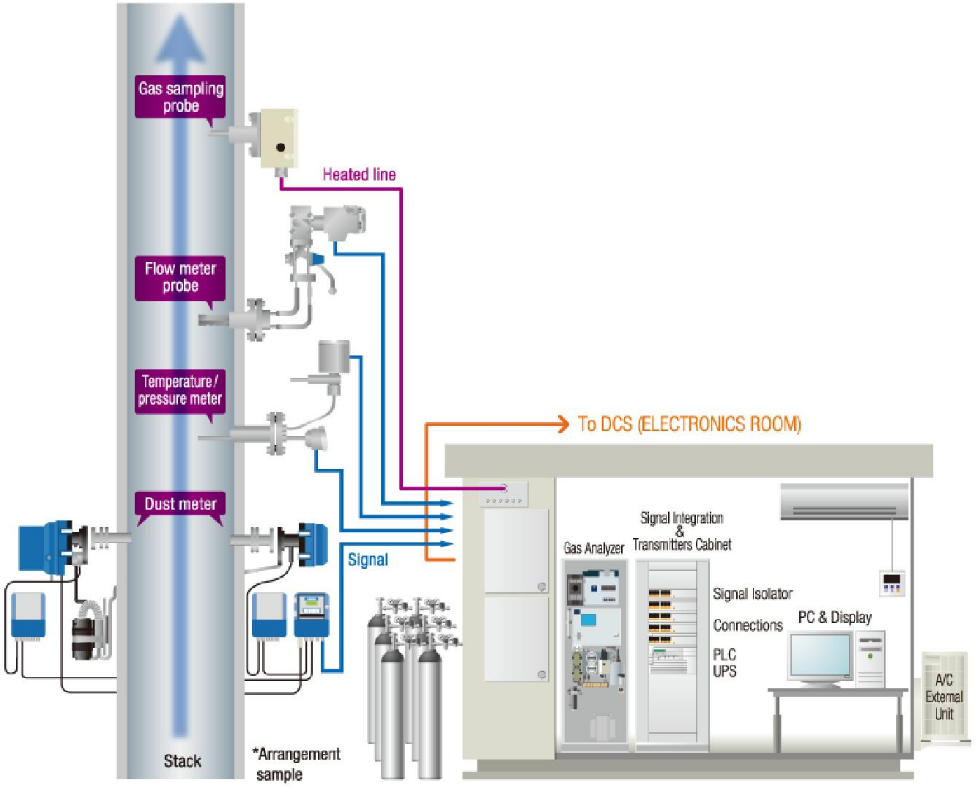
CONTINUOUS EMISSION MONITORING SYSTEM

SOLUTIONS FOR GREEN ENVIRONMENT

WHAT IS CEMS ?



A continuous emission monitoring system (CEMS) is the total equipment necessary for the determination of a gas or particulate matter concentration or emission rate using pollutant analyser measurements and a conversion equation, graph, or computer program to produce results in units of the applicable emission limitation or standard

TYPE OF EMISSION

AAQMS - AMBIENT AIR QUALITY MONITORING SYSTEM

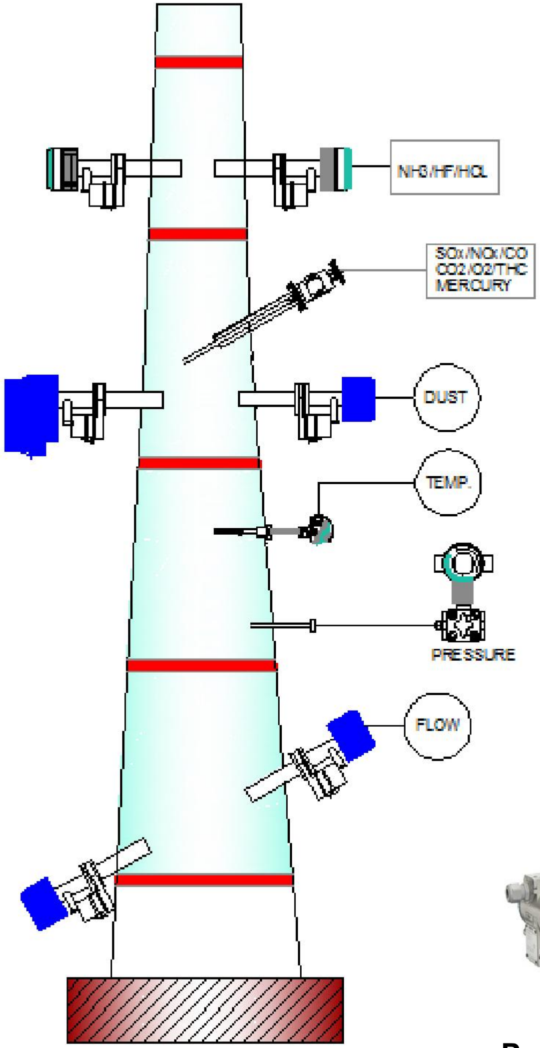
Emission Monitoring of Stationary Source

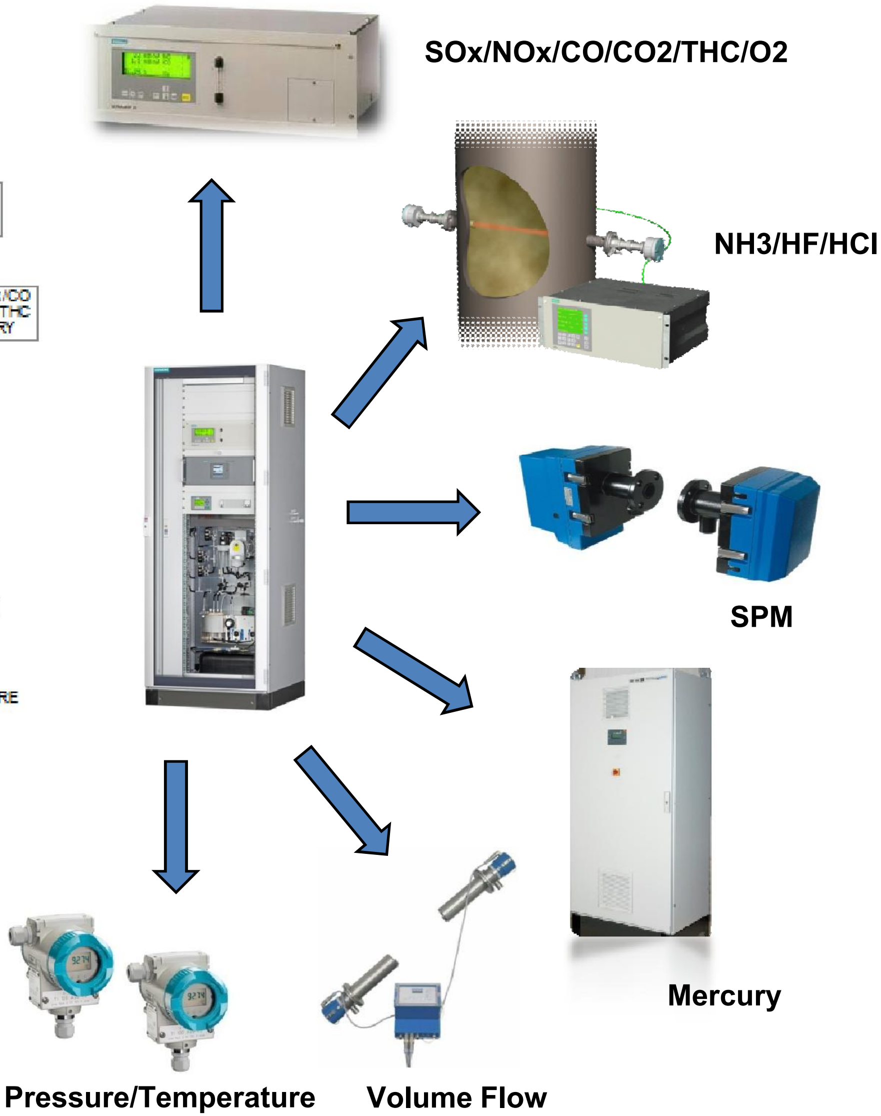
FUGITIVE EMISSION

STACK

EFFLUENT

A COMPLETE CEMS Solution





SOx/NOx/CO/CO2/THC/O2

NH3/HF/HCl

SPM

Mercury

Pressure/Temperature

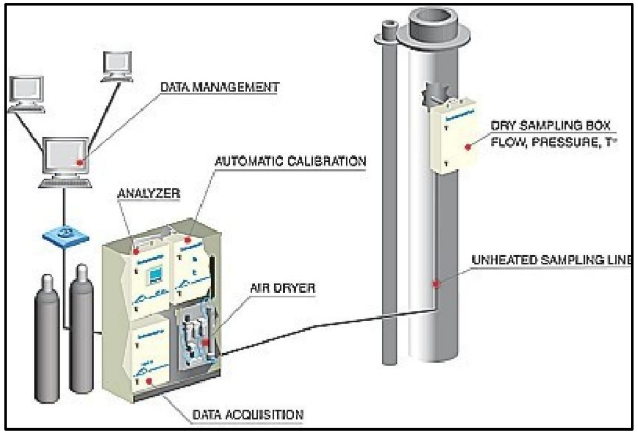
Volume Flow

Overview

- CEMS Methodologies
  - Extractive, In-Situ etc
- Common measurements and analytical approaches
- Common Problems in the different methodologies

CEMS Technologies

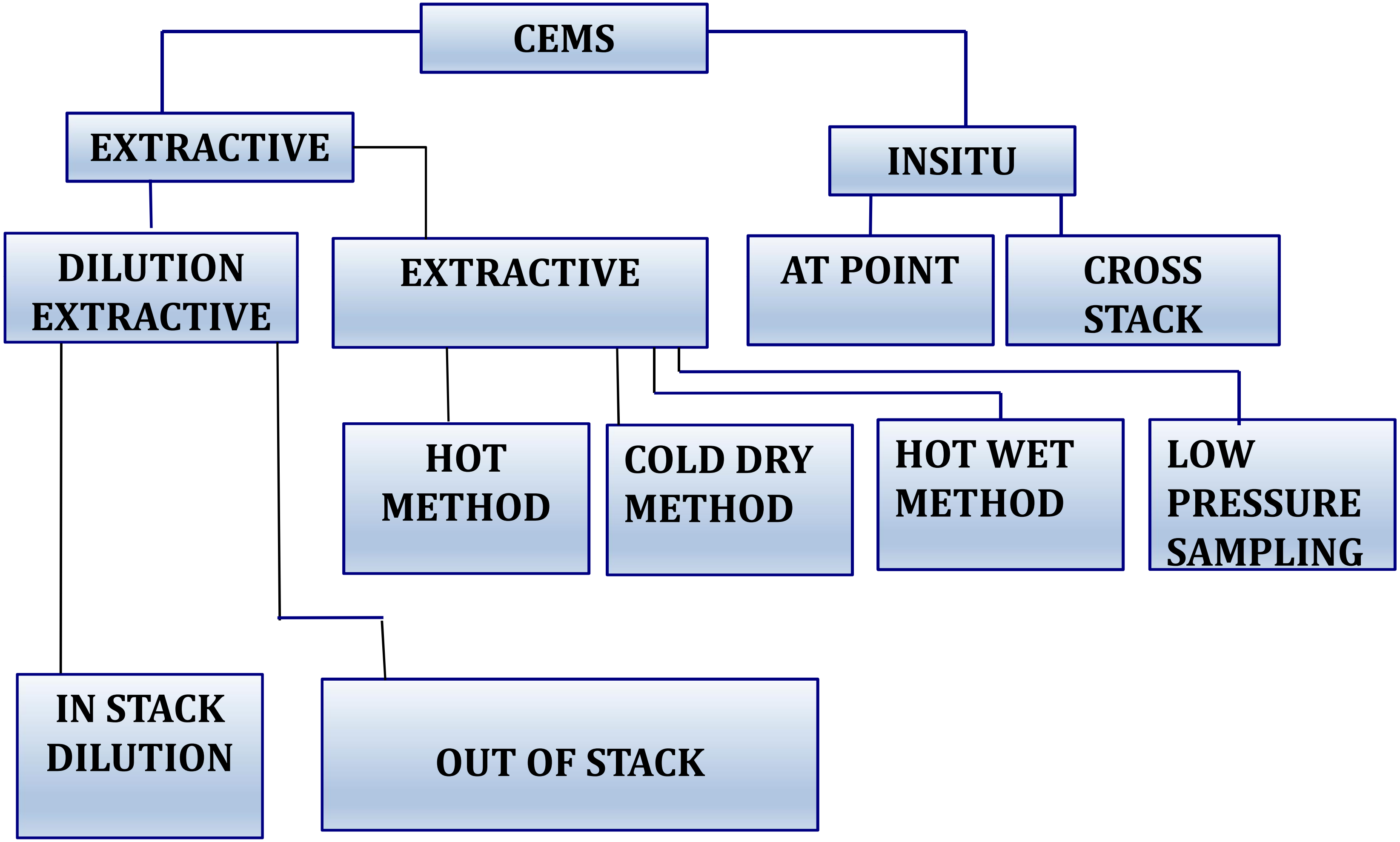
- Continuous emission monitoring or automated measuring systems can be categorised into two types:
  - Type 1: Extractive systems
  - Type 2: *In situ* systems
- Extractive systems withdraw flue gas continuously from stack and transport it to the analyser.
- In situ systems carry out most of their operations in the stack.
  - Point in situ carry out analysis at a single point in the stack.
  - Path monitors carry out analysis usually over the entire stack.



Extractive monitoring system

In situ monitoring system.

TYPE OF CEMS TECHNIQUE



CEMS

EXTRACTIVE

INSITU

DILUTION EXTRACTIVE

EXTRACTIVE

AT POINT

CROSS STACK

HOT METHOD

COLD DRY METHOD

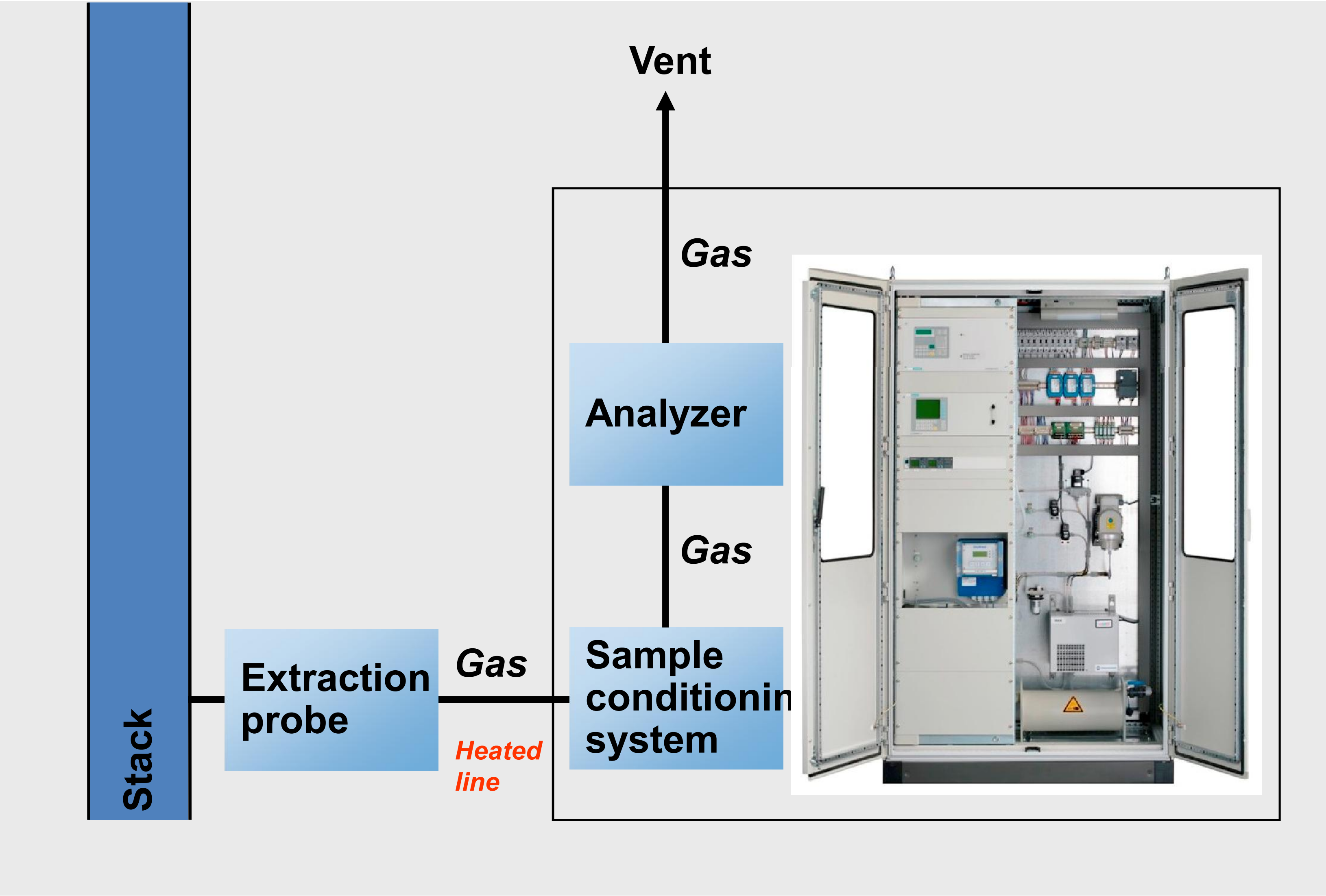
HOT WET METHOD

LOW PRESSURE SAMPLING

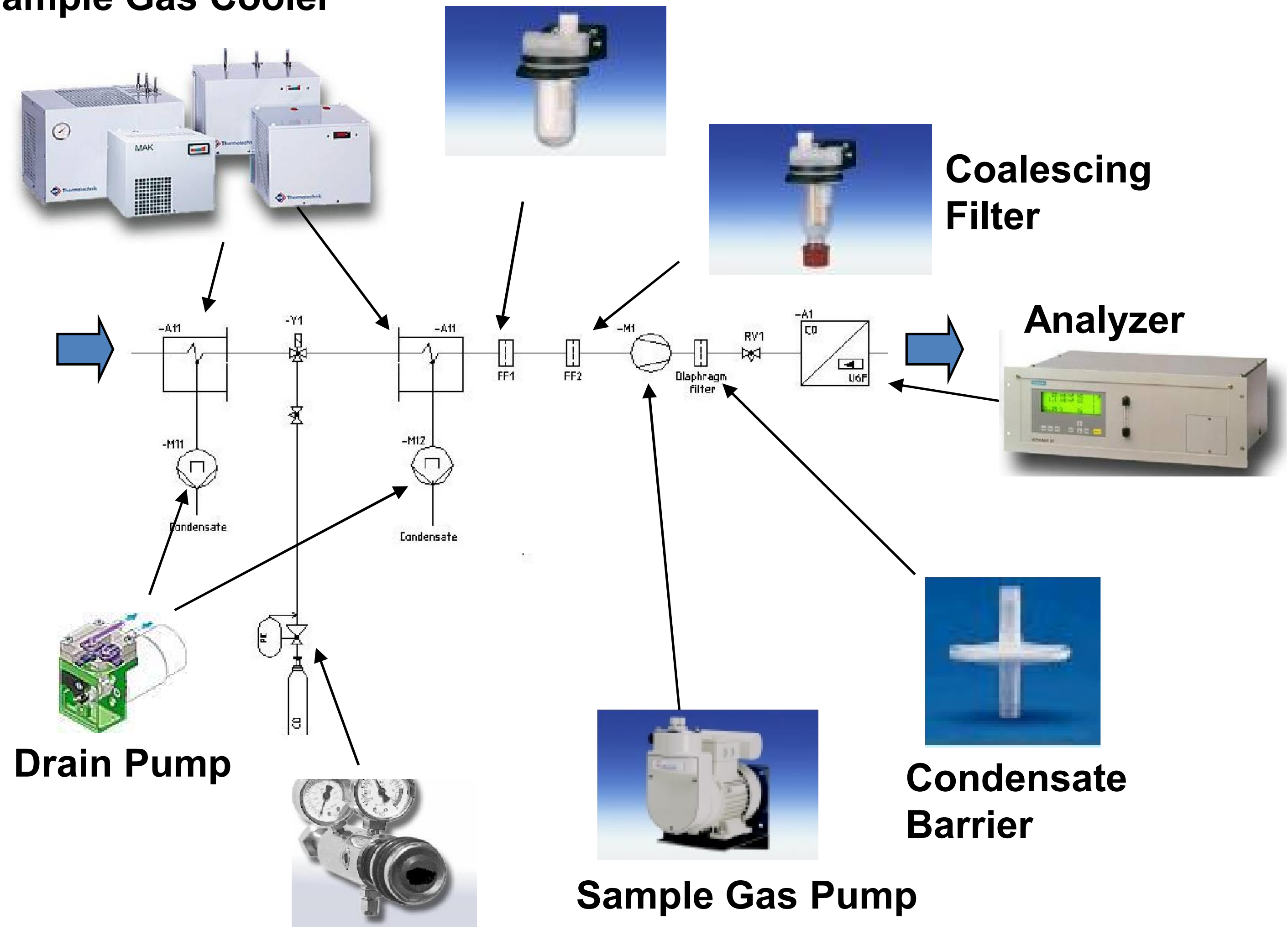
IN STACK DILUTION

OUT OF STACK

EXTRACTIVE ….HOT EXTRACTION METHOD OF SAMPLING



Typical Sample Conditioning System Design for HOT EXTRACTION METHOD CEMS



Sample Gas Cooler

Filter

Coalescing Filter

Analyzer

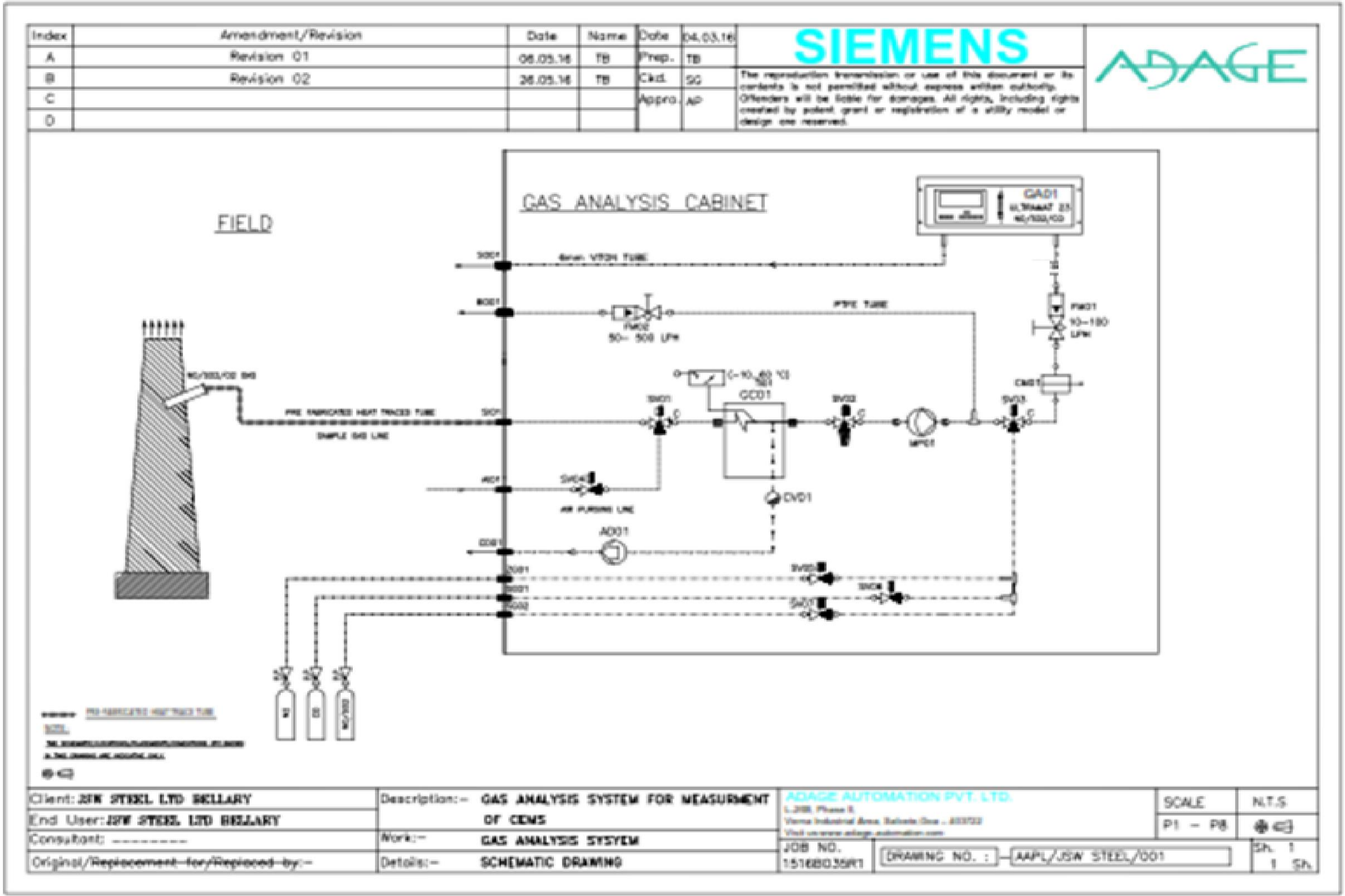
Auto Drain Pump

Pressure Reducer

Sample Gas Pump

Condensate Barrier

Typical SHS Design for Hot Extractive CEMS



Index	Amendment/Revision	Date	Name
A	Revision 01	06.05.16	TB
B	Revision 02	26.05.16	TB
C			
D			

Date	04.03.16
Prep.	TB
Ckd.	SG
Appro.	AP

SIEMENS

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ADAGE

Client: JSW STEEL LTD BELLARY
End User: JSW STEEL LTD BELLARY
Consultant: --------
Original/~~Replacement for/Replaced by~~:-

Description:- GAS ANALYSIS SYSTEM FOR MEASURMENT OF CEMS
Work:- GAS ANALYSIS SYSYEM
Details:- SCHEMATIC DRAWING

ADAGE AUTOMATION PVT. LTD.

JOB NO.
1516BD35R1

DRAWING NO. : AAPL/JSW STEEL/001

SCALE N.T.S
P1 - P8

Sh. 1
1 Sh.

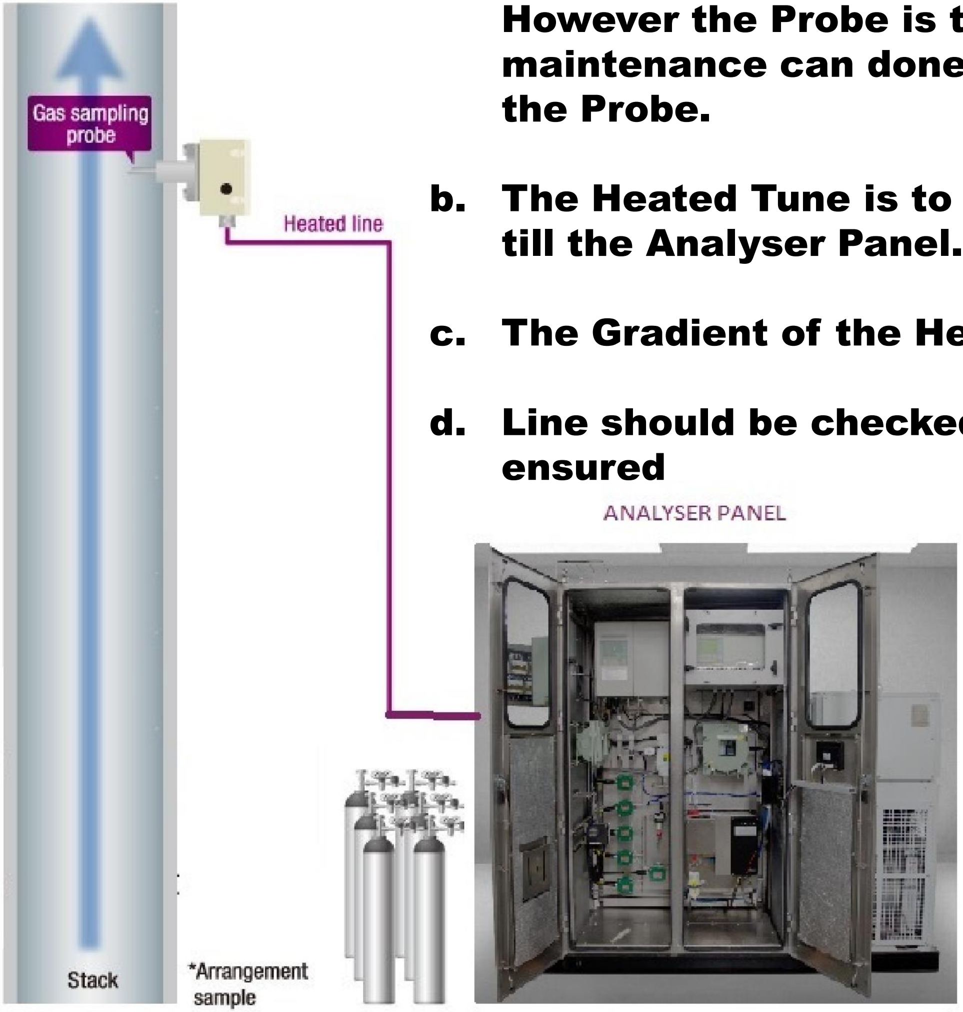
MAIN POINTS IN A HOT EXTRACTION METHOD

a. The Heated Probe should be located as per the guidelines. Which should 2 times the stack diameter downstream and 1/2 times stack diameter upstream. However the Probe is to be located at a location where maintenance can done and there is proper approach to the Probe.

b. The Heated Tune is to start from the Probe and continue till the Analyser Panel. There should be no Cold Spots.

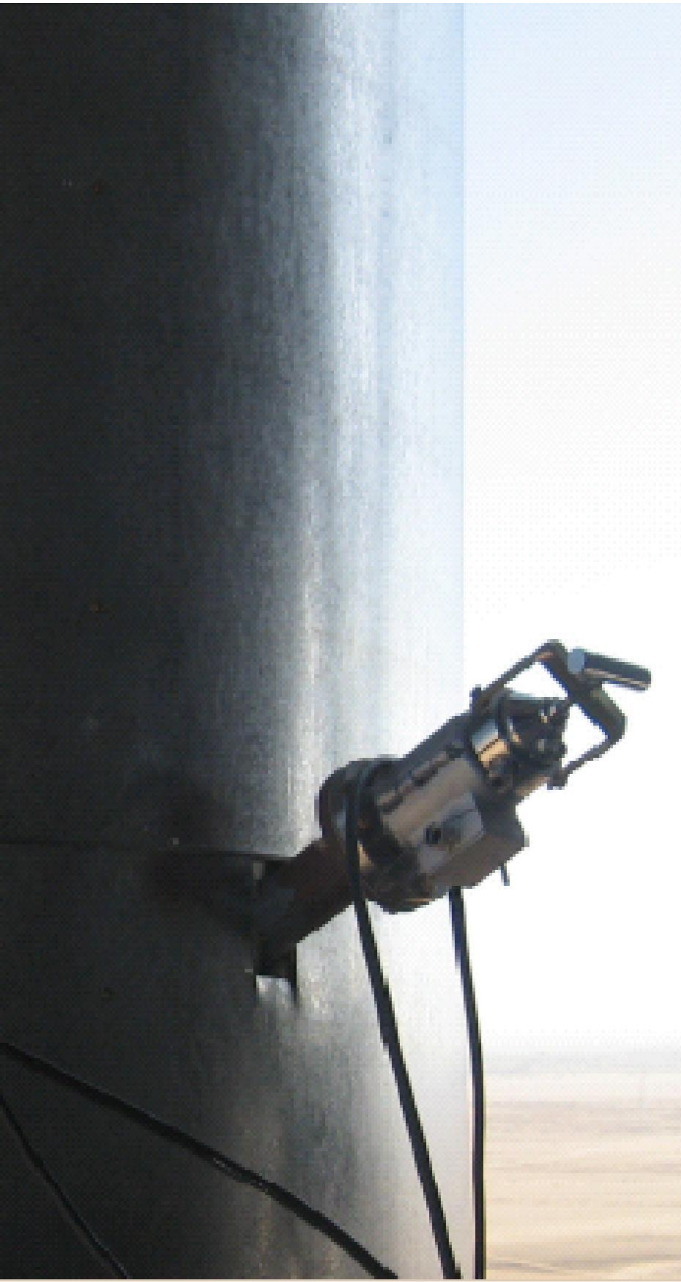
c. The Gradient of the Heated line should be downwards.

d. Line should be checked and Leakage free Line should be ensured

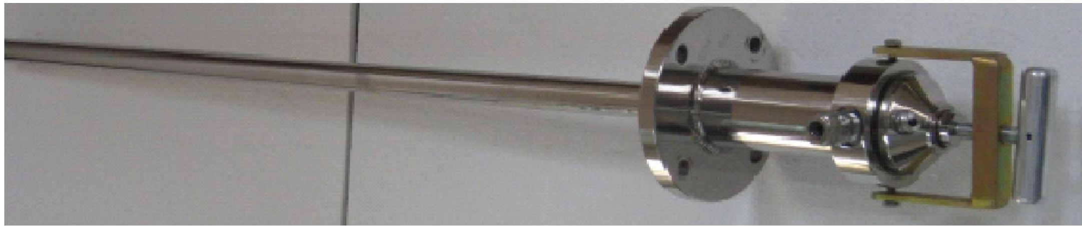


The Probe Head

The picture along side shows the Probe Head. The Tube Assembly (Picture shown below) is to be screwed on to the Probe Head



The Assembled Probe Head along with the Tube Assembly is to be inserted through the Bushing Tube. Please note the angle of the Probe should be towards the ground.



EXAMPLE OF SOME CEMS SYSTEMS

Cool-Dry Extractive Systems

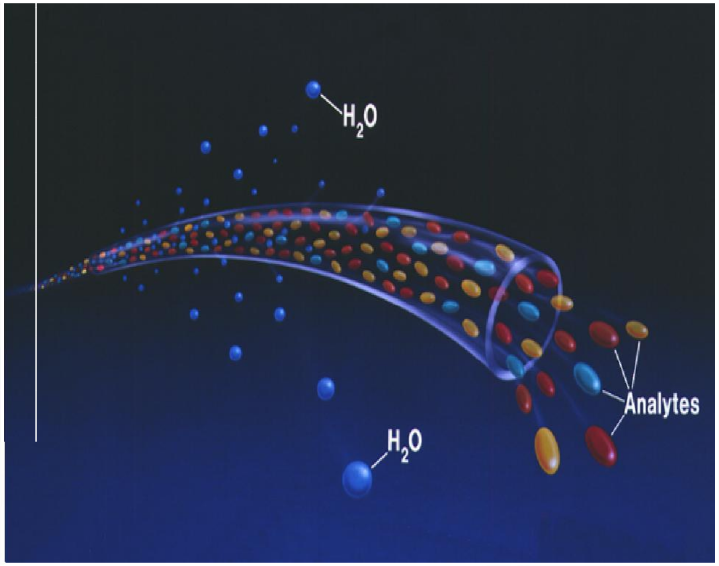
Sample gas is extracted and conditioned to remove moisture prior to analysis. Options:

- Conditioning at the CEM shelter

  Heated sample line is required to keep the wet sample above its dew point until it reaches the water removal system
- Conditioning at the stack

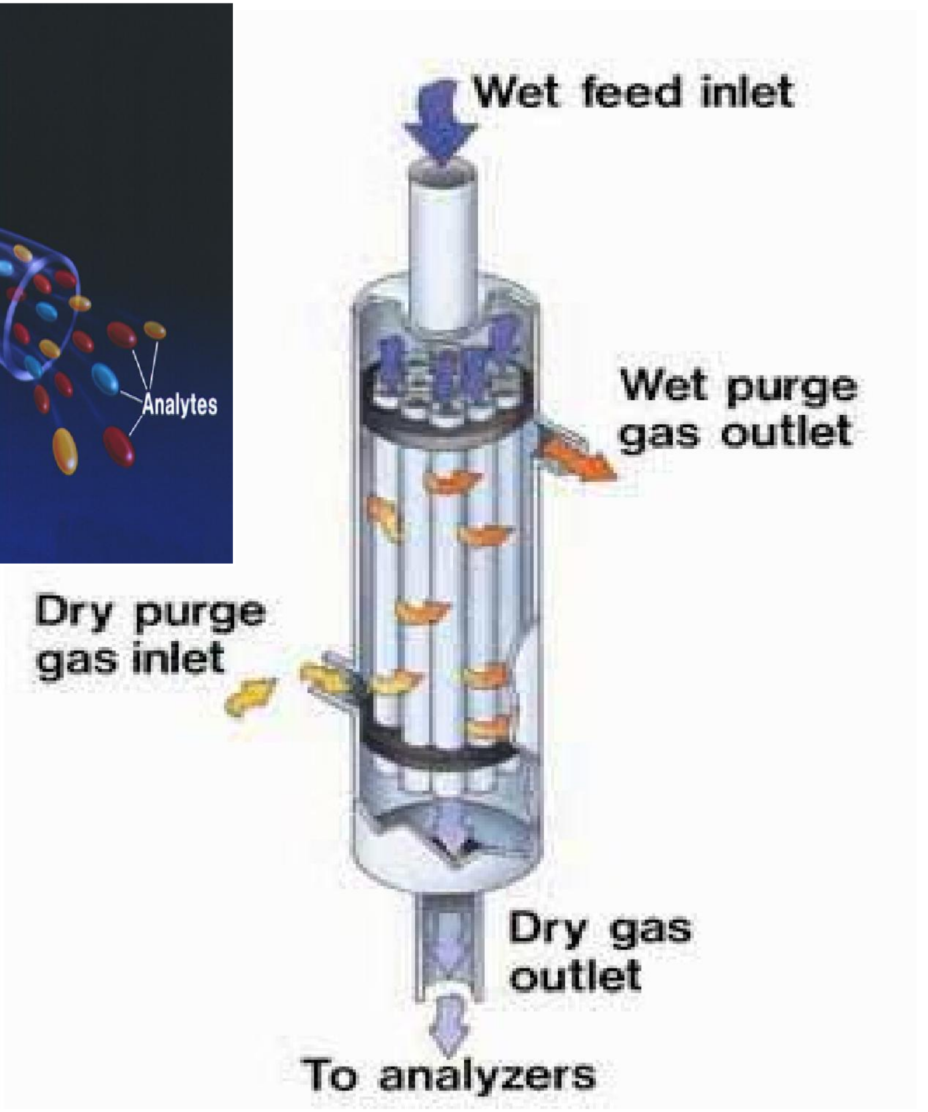
  Water is removed at the stack - no heated line - commonly used by source testers for short-term sampling

Nafion Dryer based Measurements

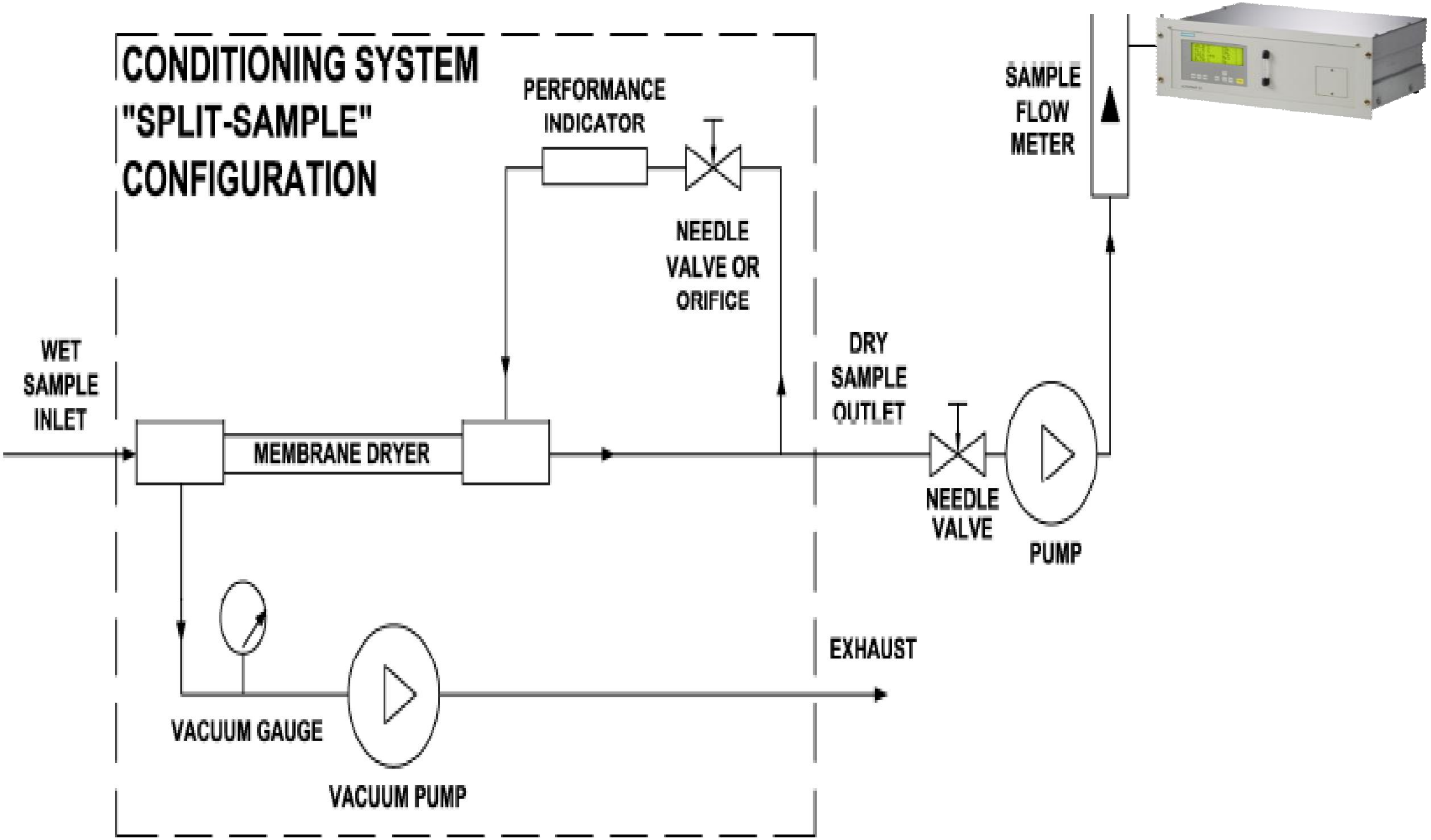


Tube-in-shell, heat and moisture exchanger

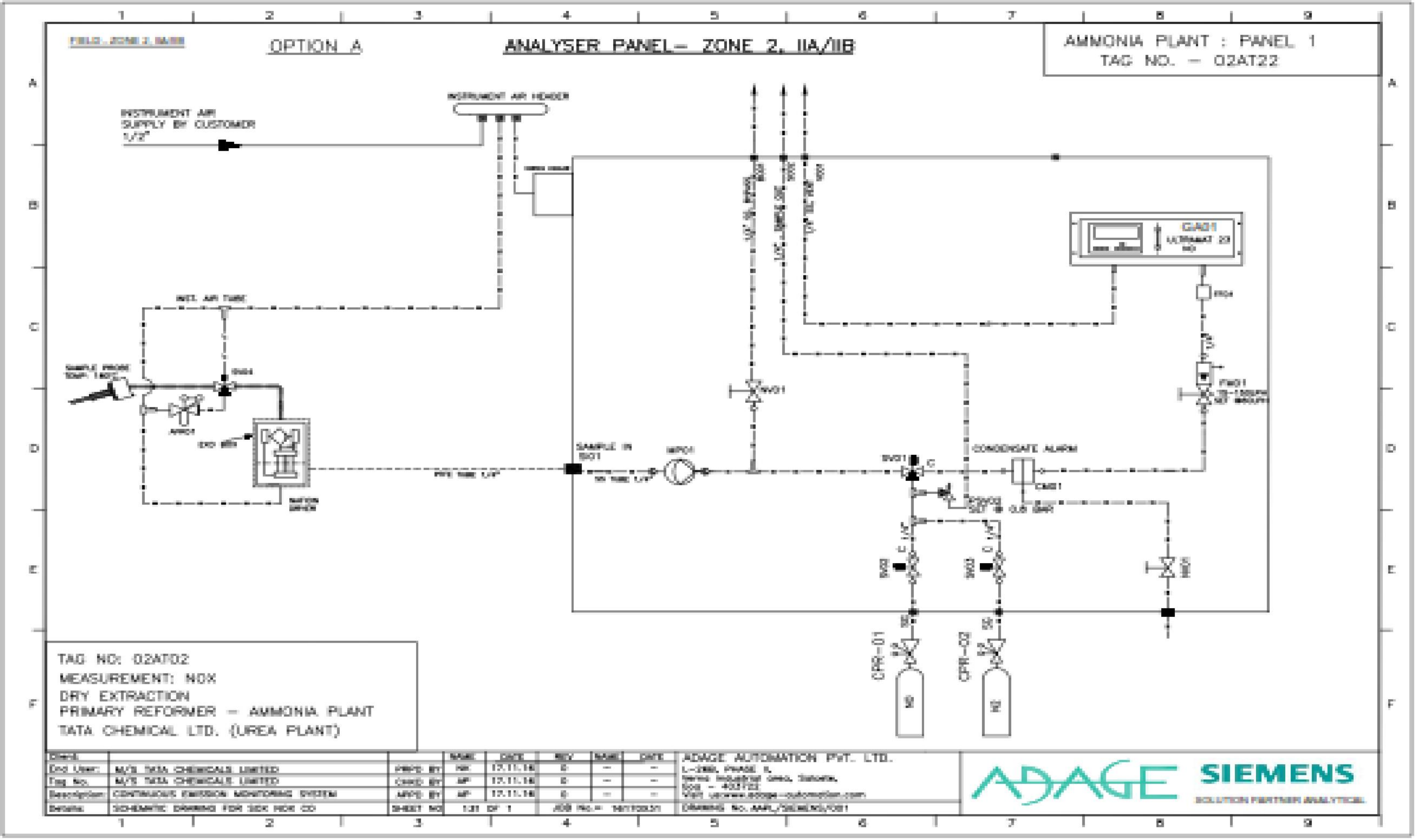
To increase drying capacity, simply increase the surface area (wider, longer or more tubes)



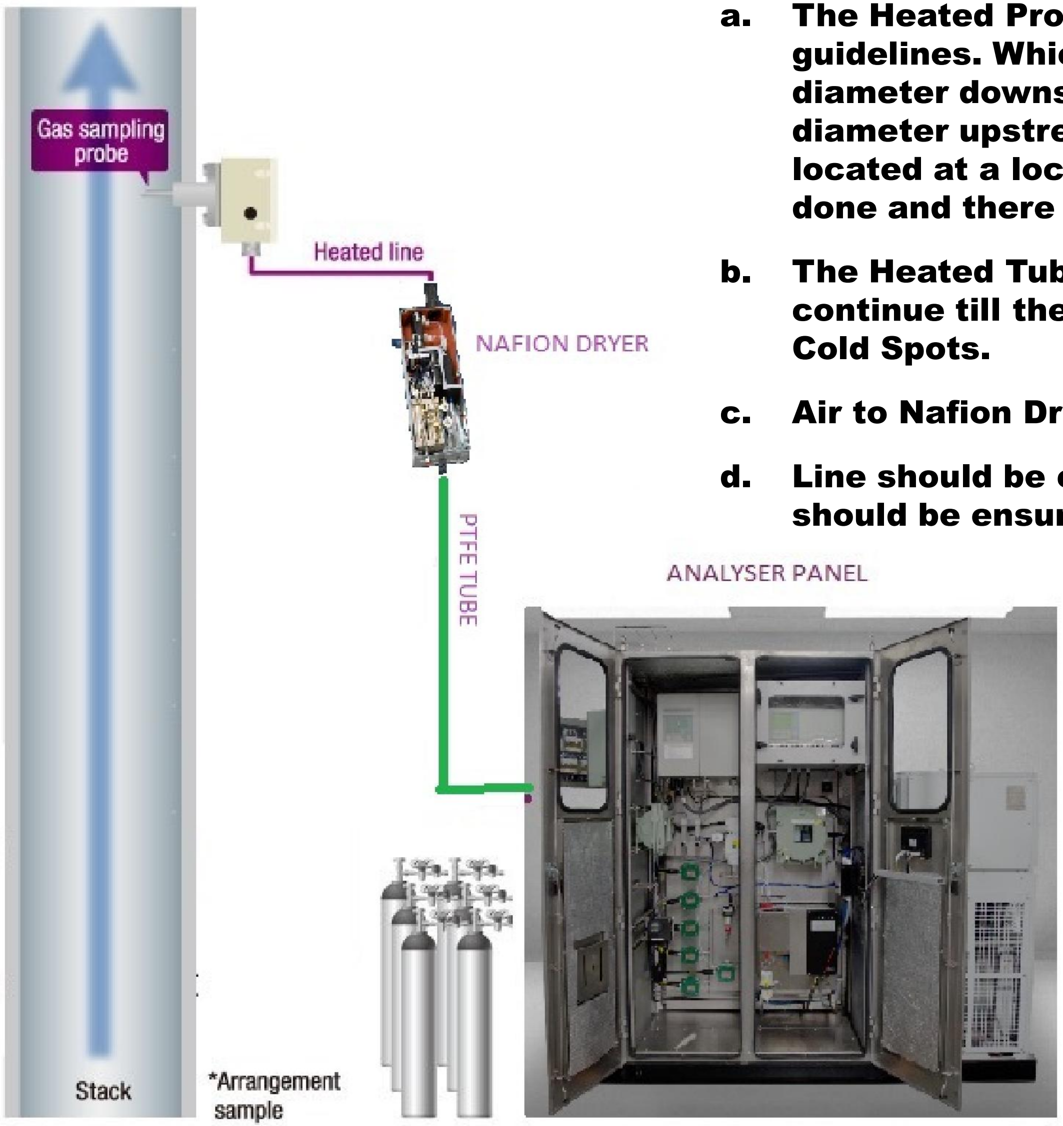
Extractive based on COLD DRY METHOD



Typical SHS Design for COLD DRY METHOD



MAIN POINTS IN A COLD DRY EXTRACTION METHOD



a. **The Heated Probe should be located as per the guidelines. Which should 2 times the stack diameter downstream and 1/2 times stack diameter upstream. However the Probe is to be located at a location where maintenance can done and there is proper approach to the Probe.**

b. **The Heated Tube is to start from the Probe and continue till the Nafion Dryer. There should be no Cold Spots.**

c. **Air to Nafion Drier should be moisture free – Dry.**

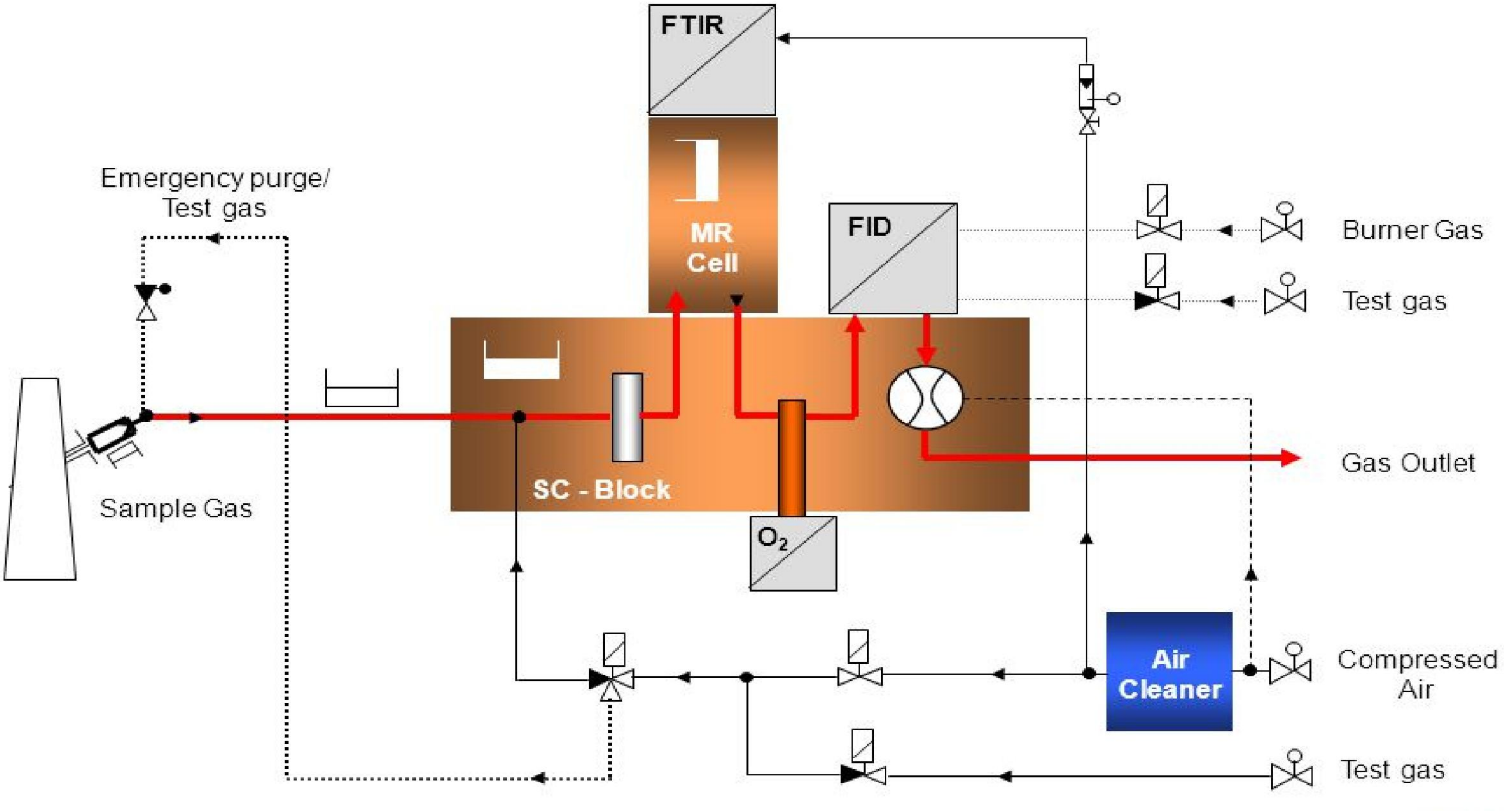
d. **Line should be checked and Leakage free Line should be ensured**

Hot-Wet Extractive Systems

No moisture removal - Moisture remains in the system throughout the sampling and measurement process.

Sampling line, pump, and analytical chamber are heated to keep wet sample gas above its dew point. Sample is analyzed hot and wet.

ACF - System design



FTIR

MR Cell

FID

Emergency purge/ Test gas

Burner Gas

Test gas

SC - Block

Gas Outlet

Sample Gas

O_2

Air Cleaner

Compressed Air

Test gas

□ Enter filename via "View - Header and Footer...". Apply to all. | 6

In-Stack Dilution Systems

Flue gas sample is diluted with clean/dry air using a "dilution probe" inside the stack

- Sample gas is diluted (typically at ratios of 15 to 300 to 1) with dry gas at dew points

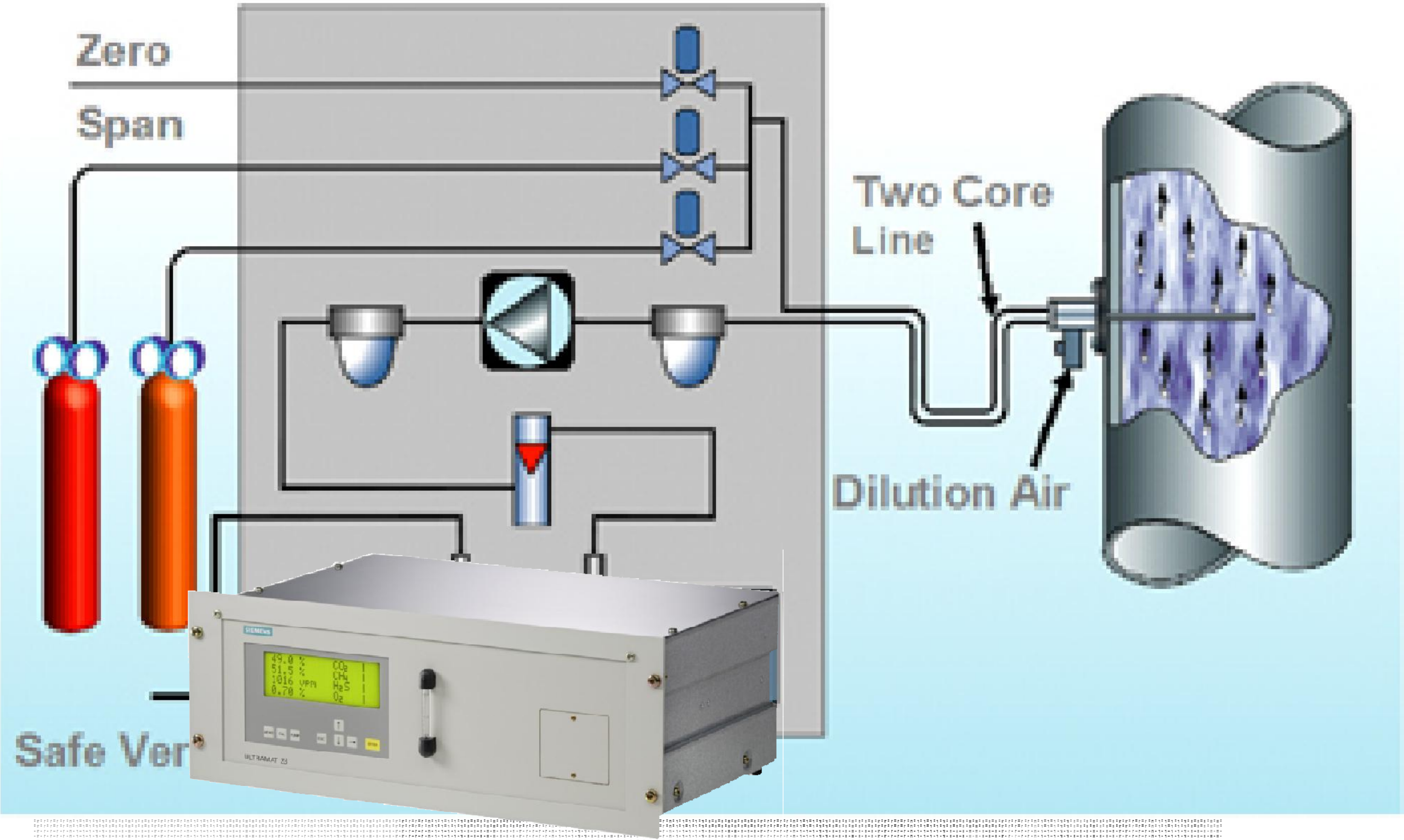
- Dilution ratio controlled by using a critical orifice in the probe - critical flow maintained by achieving a set pressure drop across orifice
- Flow through orifice is dependent on Ts, Ps, Ms, and dilution air pressure and temperature.
- A "wet" gas measurement is made

Out-of-Stack Dilution Systems

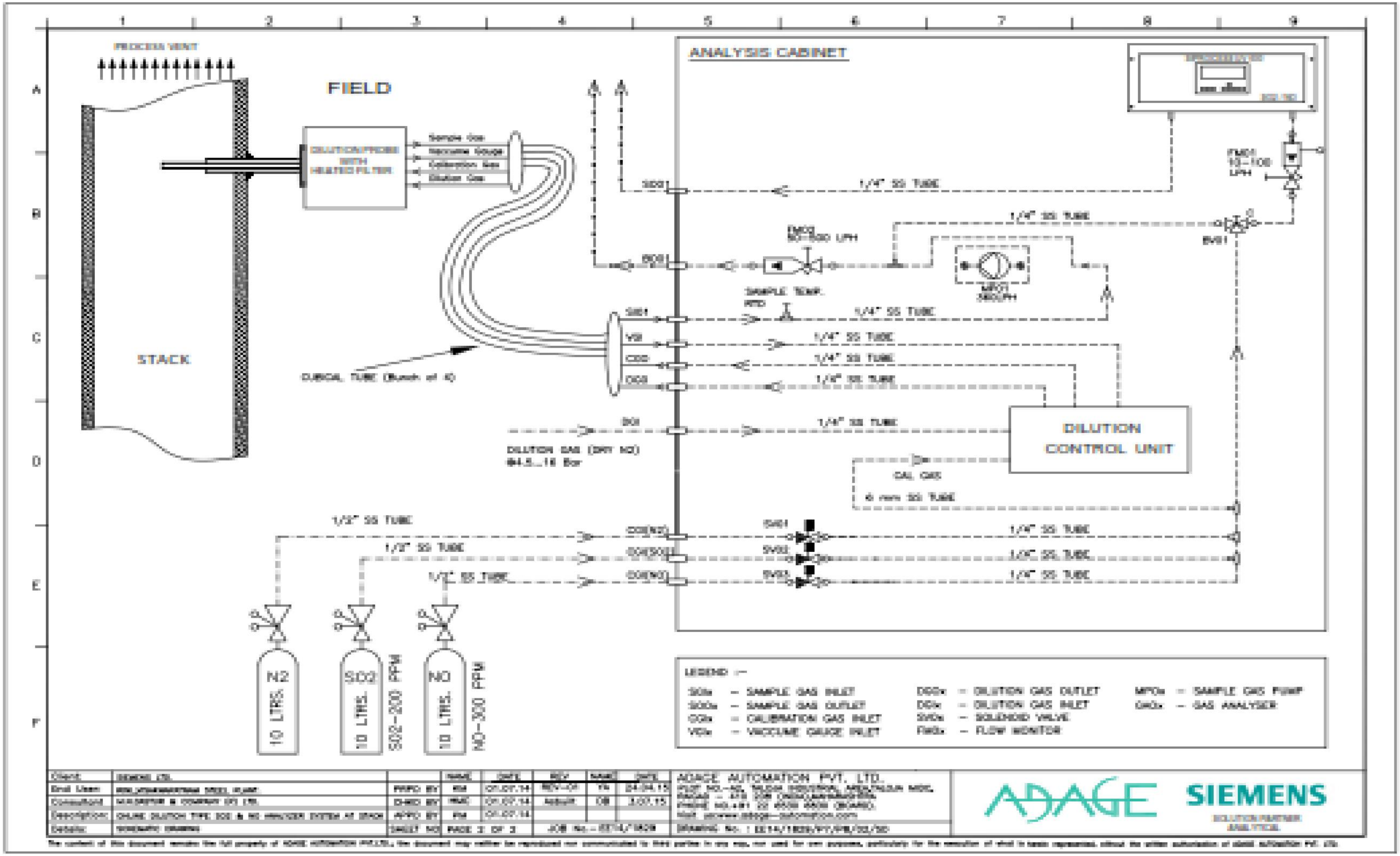
Flue gas sample is diluted with clean/dry air using dilution "box" close-coupled or otherwise outside of the stack

- Dilution ratio controlled by using a critical orifice in the box - critical flow maintained by achieving a set pressure drop across orifice
- Sample gas is diluted (typically at ratios of 15 to 300 to 1) with dry gas at dew points typically at - 40° C
- Flow through orifice is dependent on Ps, Ms, and dilution air pressure and temperature.
- A "wet" gas measurement is made

MEASUREMENT BASED ON DILUTION TECHNIQUE



Typical SHS Design for Dilution based CEMS



Low Pressure Sampling

- The measuring principle works on a low pressure sample (LPS). The sampling system consists of a SONIC NOZZLE. It is an original system which can collect and convey the sample from 50 to 200 mbar abs from the sampling point to the analyzer.

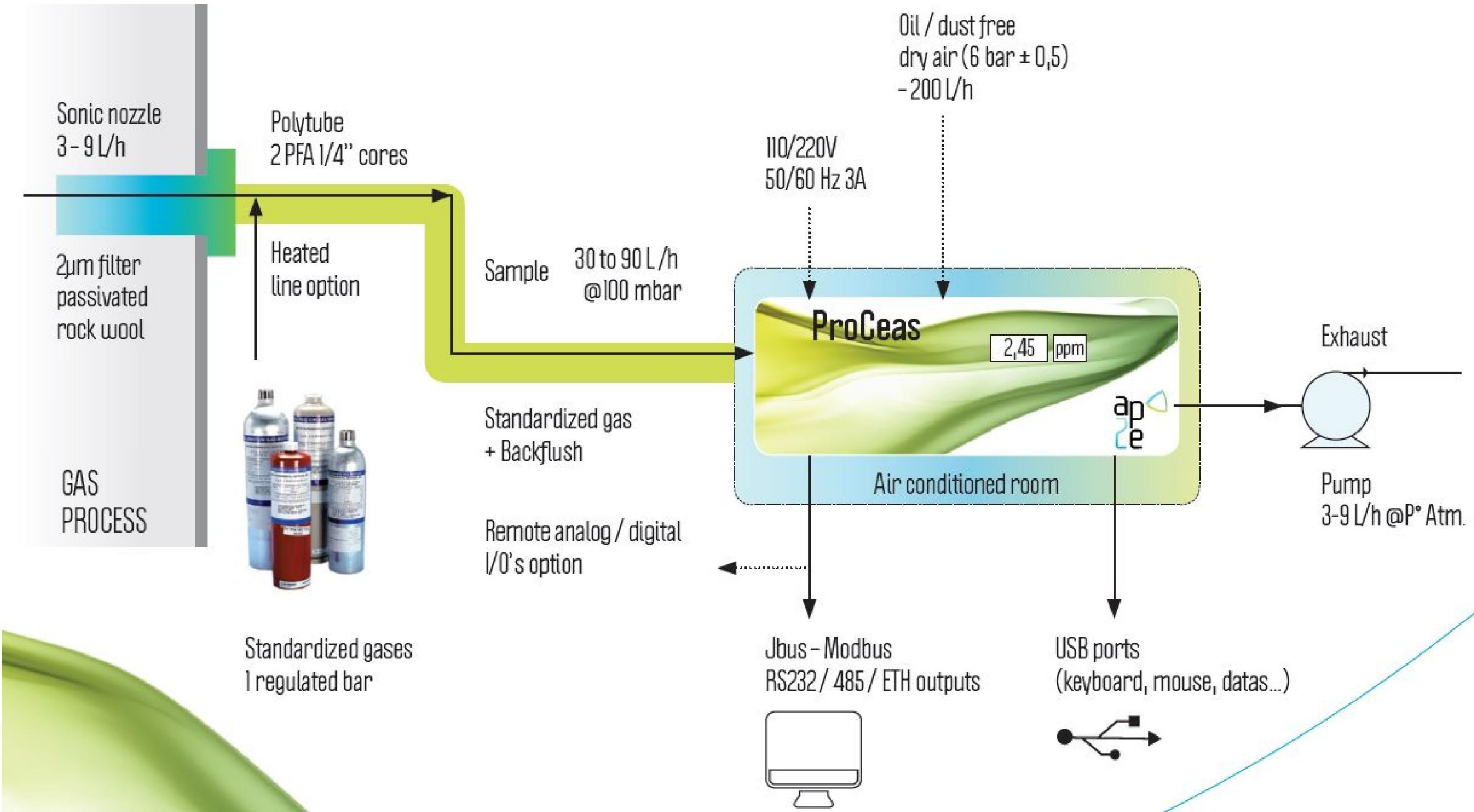
- The sample is taken at a very low pressure (50 to 200 mbar absolute). This feature enables us to reduce the vapor pressure of the sample at the level of the sampling point. At the pressure of the sampling, the ambient temperature is almost always above the dew point. There is no risk of condensation, which eliminates the need for a heated line and a cooler. Thanks to this technique, we do not distort the sample.

- The sample is taken with a flow rate of 1 to 24 l/h. However, since the pressure of the sample in the duct is 10 times lower than the atmospheric pressure (100 mbar abs), the transfer speed is multiplied by 10. The transfer rate of the sample ranges therefore between 10 to 240 l/h.

- Since only a little flow amount is collected, the system hardly gets dirty, requiring limited maintenance of the analysis chain.

MEASUREMENT BASED ON LOW PRESSURE SAMPLING

LAYOUT FROM SONIC NOZZLE TO ProCeas ANALYZER



Sonic nozzle
3 - 9 L/h

2µm filter
passivated
rock wool

GAS
PROCESS

Polytube
2 PFA 1/4'' cores

Heated
line option

Standardized gases
1 regulated bar

Sample

30 to 90 L/h
@100 mbar

Standardized gas
+ Backflush

Remote analog / digital
I/O's option

Oil / dust free
dry air (6 bar ± 0,5)
- 200 L/h

110/220V
50/60 Hz 3A

Air conditioned room

Exhaust

Pump
3-9 L/h @P° Atm.

Jbus - Modbus
RS232 / 485 / ETH outputs

USB ports
(keyboard, mouse, datas...)

In-Situ Systems

Measure gases, flow, or particulate matter in the duct or stack without gas extraction

- **Path Systems**

  Transmit light or sound across the duct or stack to make the measurement.

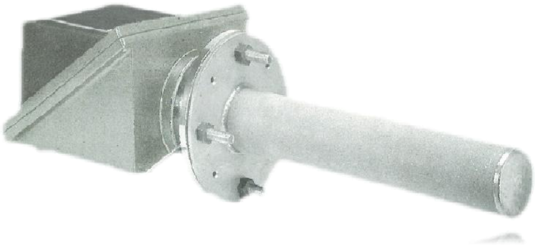
- **Point Systems**

  Make measurements at a point or short sensing volume (cm to m) in the stack or duct.

OVERVIEW OF INSITU CEMS :

CEMS:
(Analyzer Used: IR/UV Based)

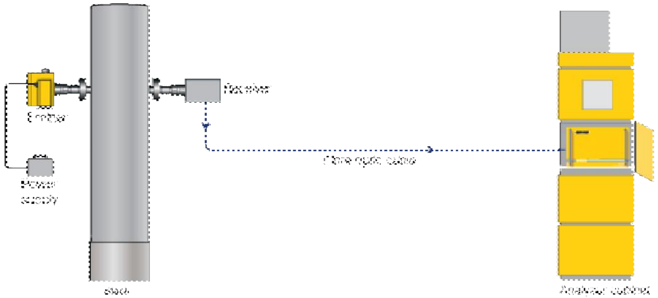
POINT SYSTEM



SO2/NOx/CO/CO2/O2

CEMS:
(Analyzer Used: DOAS)

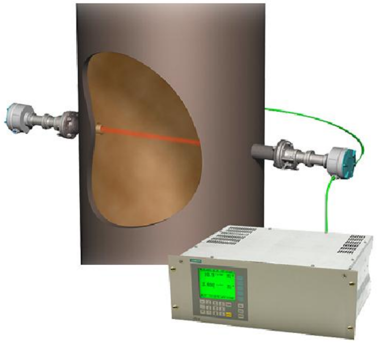
PATH SYSTEM



SO2/ NOx/ CO/CO2/NH3

CEMS:
(Analyzer Used: TDLS)

PATH SYSTEM

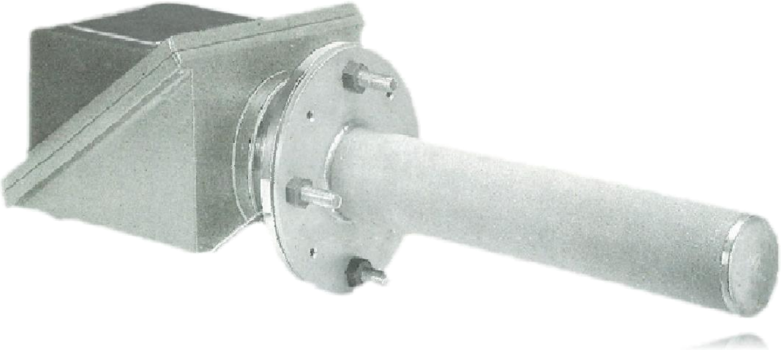


NH3 / HCL / HF /CO/CO2

PROBE TYPE INSITU CEMS :

An infra-red (IR) or UV, duct or stack-mounted gas analyser designed to provide in-stack analysis of, gas-phase emission components.

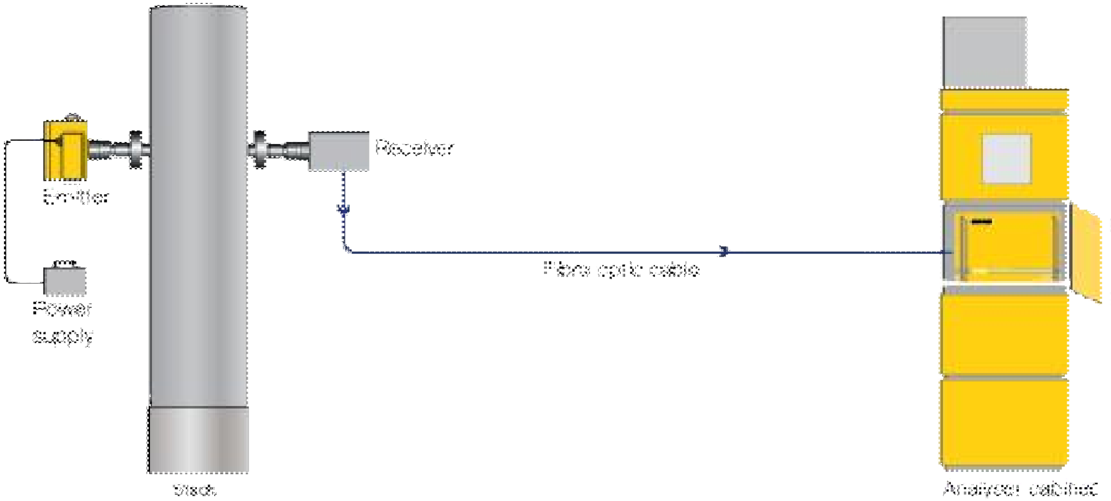
A typical system comprises an in-situ mounted analyser, an integral calibration function and a Control Unit with options which include a powerful in-situ Heater and calibration gas cyinders



PATH TYPE INSITU CEMS :

CEM systems measure multiple emissions or process gases in real time in situ. Using the UV / FTIR DOAS (Differential Optical Absorption Spectroscopy) technique, the system is non-contact, with fast response.

A basic system includes an analyser spectrometer, an emitter/receiver set, and an optical fibre cable & calibration gas cylinders.

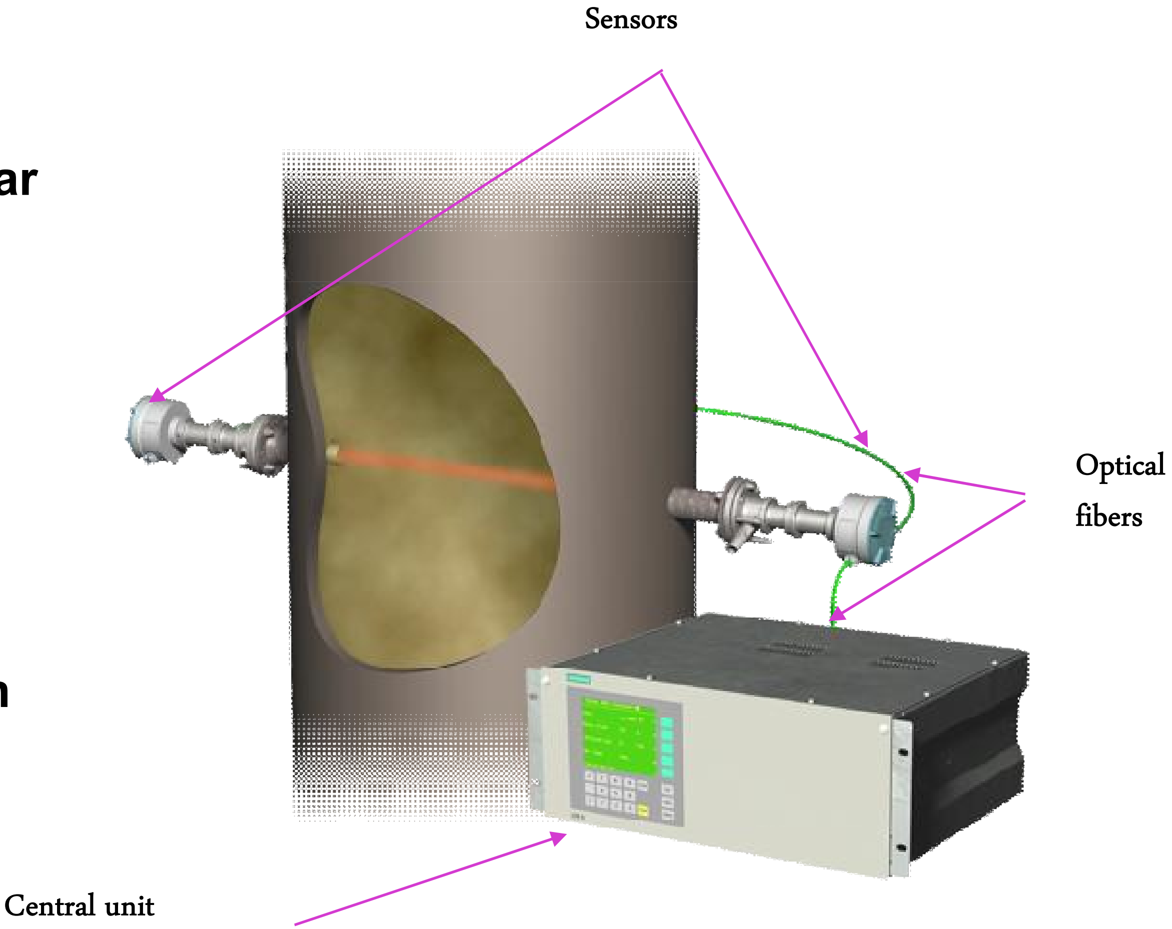


PATH TYPE INSITU CEMS :

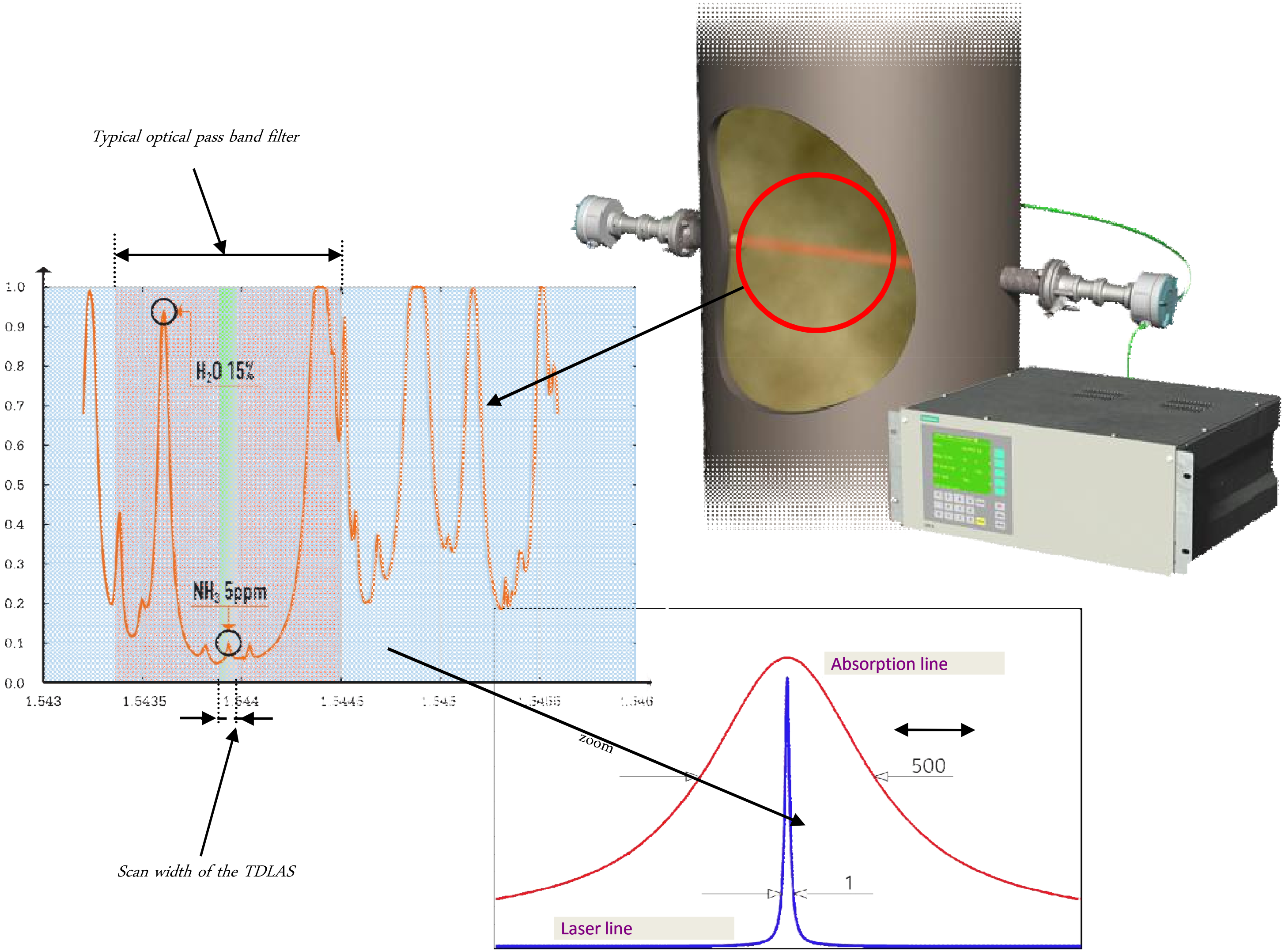
TDLS System Design for NH3, HF, HCL

A basic system includes an analyser spectrometer, an emitter/receiver set, and an optical fibre cable.

- **Insitu Single-line molecular absorption spectroscopy**
- **Absorption Technology – Wavelength Modulation Spectroscopy**
- **Fast Response time**
- **Zero Drift – No Calibration**



In-Situ Single Line Absorption Spectroscopy

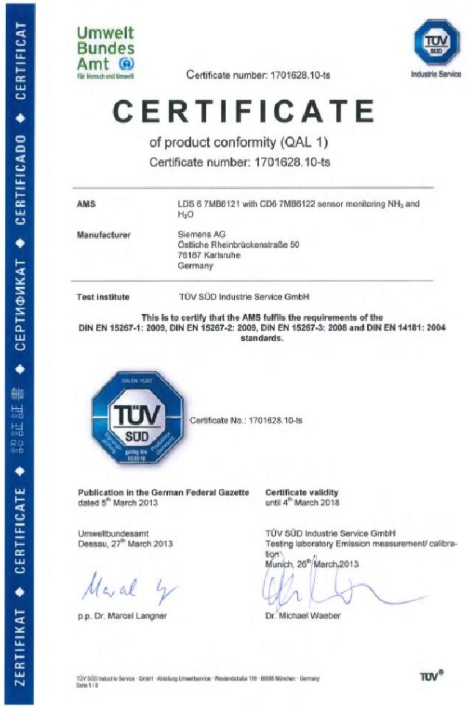


Typical optical pass band filter

Scan width of the TDLAS

CERTIFICATION OF ANALYZERS

- ☐ Analyzers should be Certified according to EN 14181/ EN 15267 by TUV.
- ☐ Analyzers should be Certified according to MCERTS, UK
- ☐ Analyzers should be compliant to US EPA



Umwelt Bundes Amt
Für Mensch und Umwelt

Certificate number: 1701628.10-ts

TÜV SÜD Industrie Service

CERTIFICATE

of product conformity (QAL 1)
Certificate number: 1701628.10-ts

AMS	LDS 6 7MB6121 with CD6 7MB6122 sensor monitoring NH_3 and H_2O
Manufacturer	Siemens AG Östliche Rheinbrückenstraße 50 76187 Karlsruhe Germany
Test institute	TÜV SÜD Industrie Service GmbH

This is to certify that the AMS fulfils the requirements of the DIN EN 15267-1: 2009, DIN EN 15267-2: 2009, DIN EN 15267-3: 2008 and DIN EN 14181: 2004 standards.

Certificate No.: 1701628.10-ts

Publication in the German Federal Gazette
dated 5th March 2013

Certificate validity
until 4th March 2018

Umweltbundesamt
Dessau, 27th March 2013

p.p. Dr. Marcel Langner

TÜV SÜD Industrie Service GmbH
Testing laboratory Emission measurement/ calibration
Munich, 26th March 2013

Dr. Michael Waeber

TÜV SÜD Industrie Service · GmbH · Abteilung Umweltservice · Westendstraße 199 · 80686 München · Germany
Seite 1 / 8

TÜV®

sira CERTIFICATION · CSA Group · mCERTS · Environment Agency

PRODUCT CONFORMITY CERTIFICATE

This is to certify that the

LDS 6 Ammonia Analyser

Manufactured by:

Siemens SAS
Division Production Sensors & Communication
Usine de Haguenau
1, Chemin de la Sandlach
67506 Haguenau Cedex
France

Has been assessed by Sira Certification Service
And for the conditions stated on this certificate complies with:

MCERTS Performance Standards for Continuous Emission Monitoring Systems, Version 3.4 dated July 2012
EN15267-3:2007,
& QAL 1 as defined in EN 14181: 2004

Certification Ranges*:

NH_3	0 to 20 mg/m^3	(0 to 25 mg/m^3*m)
	0 to 76 mg/m^3	(0 to 95 mg/m^3*m)
	0 to 380 mg/m^3	(0 to 475 mg/m^3*m)
H_2O	0 to 30 %vol.	(0 to 37.5 %vol.*m)
	0 to 40 %vol.	(0 to 50 %vol.*m)

*Valid for a path length of 1.25m or higher

Project No. : 16A26521
Certificate No : Sira MC 060088/04
Initial Certification 29 November 2006
This Certificate Issued 03 October 2013
Renewal Date 28 November 2016

R Cooper I Eng MInst MC
Technical Director

MCERTS is operated on behalf of the Environment Agency by

Sira Certification Service
12 Acorn Industrial Park, Crayford Road, Crayford
Dartford, Kent, UK DA1 4AL
Tel: +44 (0)1322 520500 Fax: +44 (0)1322 520501

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Analytical Methods

- Common Species
  - SO2
  - NOx
  - CO
  - Oxygen
  - Ammonia / HF / HCL
  - Mercury
  - H2S
  - CO2

    VOC’s / THC

Overview of Technologies

Method	Technique	Technology	Gases Measured
Non-Dispersive Infrared (NDIR)	Hot Extraction Cold dry Extraction In-situ	Beer Lambert Law Filter photometer	SO2, NOx, CO, CO2
Non-Dispersive Ultraviolet	Hot Extraction Cold dry Extraction In-situ	Beer Lambert Law Filter Photometer	H2S, SO2,
UV Fluorescence	Cold Dry Extractive Dilution Extractive	Excitation (214nm) and Fluorescence (300 nm)	H2S, SO2
Chemiluminescence	Dilution Extractive	Converter	Oxides of Nitrogen
Dispersive Ultraviolet	In-Situ	Beer Lambert Dispersive	SO2, NH3, H2S
Enhanced Laser	Extractive	OFCEAS (Optical feedback cavity-enhanced absorption spectroscopy)	H2S, HF, NH3, HCl, HCN, SO2, SO3, NO,NO2,CO, CO2, O2
TDLS	Insitu	Wavelength Modulation Spectroscopy	H2S, HF, NH3, HCl, O2, CO,CO2, H2O
Flame Ionization Detector (FID)	Hot Wet Extractive	Hydrogen flame and measure hydrocarbon	THC, VOC

Method	Technique	Technology	Gases Measured
Fourier Transform Infra Red (FTIR)	Hot Wet Extractive	Beer Lambert Law Filter photometer	H_2S, HF, NH_3, HCl, HCN, SO_2, NO,NO_2,CO, CO_2, O_2, H_2O
Gas Chromatography	Hot Wet Extractive Hot Extraction Cold Dry Extraction	GC separation and FID detection	VOC, THC, H_2S, HF, NH_3, HCl, HCN, SO_2, NO,NO_2,CO, CO_2, O_2, H_2O
Mass Spectrometry	Hot Wet Extractive Hot Extraction Cold Dry Extraction	Ionisation	VOC, THC, H_2S, HF, NH_3, HCl, HCN, SO_2, NO,NO_2,CO, CO_2, O_2, H_2O
Atomic Absorption	Hot Wet ex-situ Cold Dry ex-situ	Resonance Mercury emission/absorption	Hg
Atomic Fluorescence	Hot Wet ex-situ	fluorescence analyzer	Hg
Paramagnetic	Hot Extraction Cold dry Extraction	Measures unique magnetic effect of oxygen	O_2
Zirconium Oxide	Hot Extraction Cold dry Extraction In-Situ	Transport of oxygen ions (Nernst Eqn)	O_2
Electrochemical	Hot Extraction Cold dry Extraction	Chemical reaction	O_2

THE BEST SOLUTION

AIM :-
We are to measure Pollutants which are emitted out from the Stacks.

Points to Note :

1. All Stacks are different, as the nature of the industries are different.
2. Some Stacks are of Steel, some Cement, Power Plants, Petrochemicals, Fertilizers etc.
3. Though the ultimate measurement components are the same, the background gas composition are different.
4. Technology should be chosen keeping the Application and the Gas components in mind.

POINTS TO CONSIDER

1. The Temperature of the Stack.
2. The Moisture Content in the Stack.
3. Dew Point Of Sample Gas
4. The Dust Content in the Stack.
5. The Presence of Corrosive Components in the Gas.
6. The Range of the Analyser.
7. The Area Classification, (Safe Area or in Zone)
8. What is the maintenance requirement of the Analyser.

CALIBRATION

Calibration Of an Analyser ensures that the Analyser is reading the Certified Gas Correctly. Hence it can be concluded when the Stack gas is fed in the Analyser after calibration the concentration displayed would be correct.

WHAT ARE THE MAJOR ITEMS NEEDED FOR CALIBRATION

1. Certified Calibration Gas Cylinders.
2. The Calibration Cylinders should have a valid Certificate. In case dates have expired the Cylinder needs to be refilled and revalidated.
3. There should be a Zero Gas Cylinder.
4. There Should be a Span Gas Cylinder. (The Value of the Span Gas Cylinder should be around 80% of the measuring Range of the Analyser.
5. The Gas Analysis System should have facility to allow the possibility of passing Calibration Gas in the Analyser and performing calibration.

TYPES OF CALIBRATION

Manual Calibration :-

This means that a person is in front of the Analyser System, he opens the Calibration Cylinders and lets the gasses pass through the Analyser, and once the readings in the Analyser has stabilised, He performs calibration.

Automatic Calibration :-

This is termed so that the calibration is performed by the Analyser Automatically.

Now this Automatic Calibration can be triggered in Two ways :

1. The Calibration can be time based
2. The Calibration can be triggered by external input.

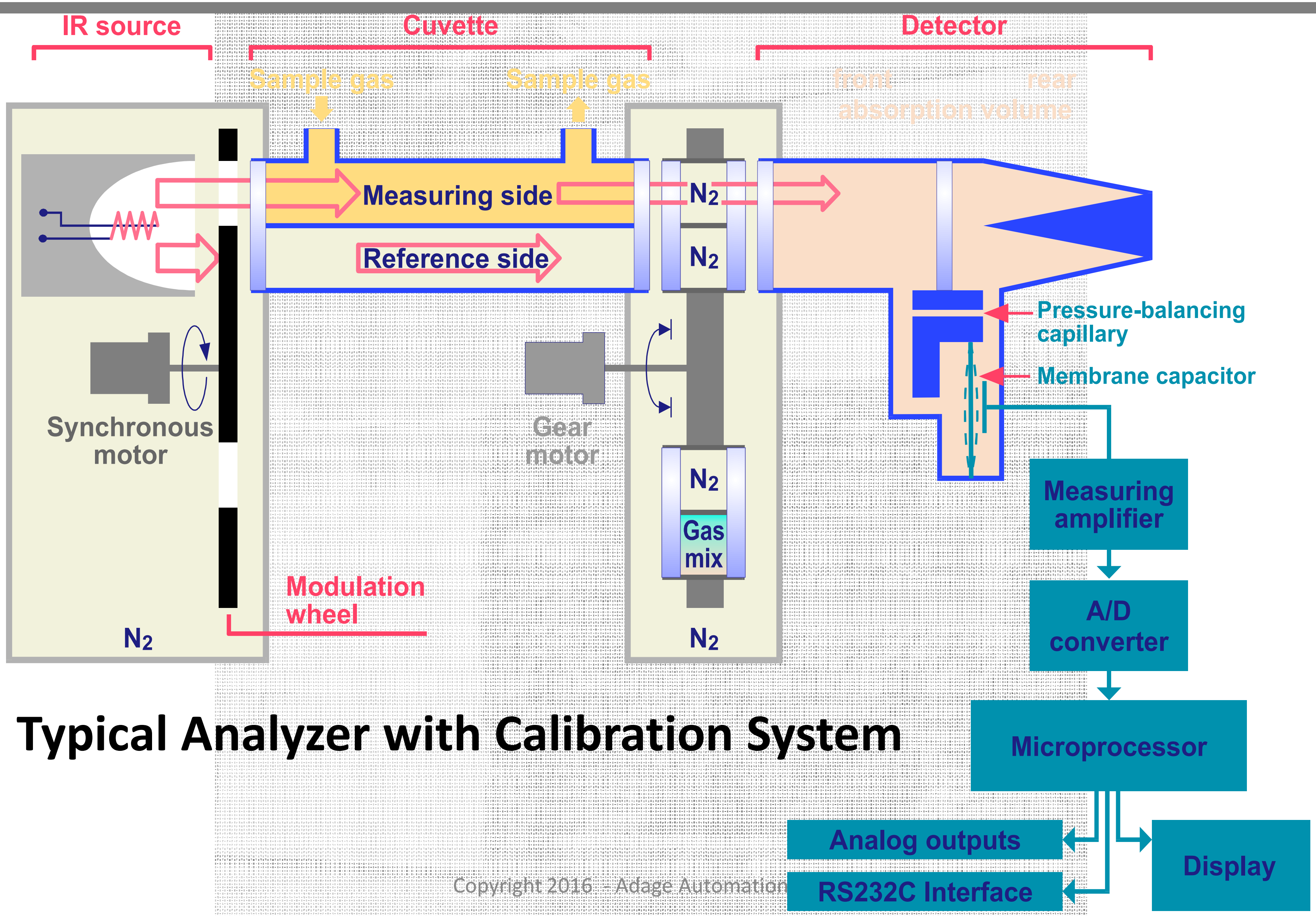
AUTOMATIC CALIBRATION

Some Analysers are equipped with calibration Cuvette.

These Cuvettes are pre filled in the Factory with the zero and Span Gases.

During Automatic Calibration, these cuvette come in line with the IR beam. The Analyser Response in the Zero Gas and Span gas in measured, and in case there is drift the Analyser Automatically corrects the drift.

Typical Analyzer with Calibration System

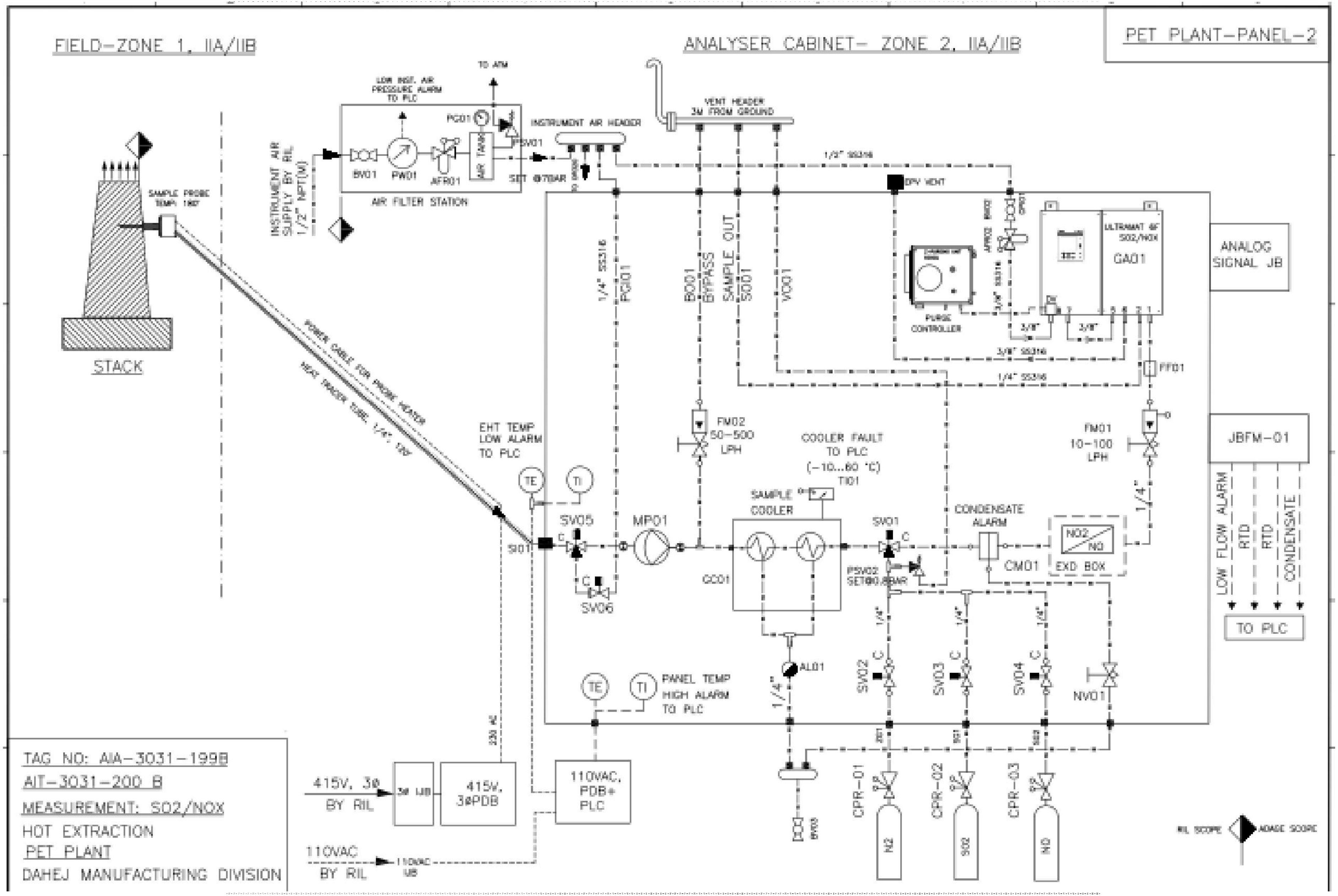


AUTOMATIC CALIBRATION

In Analysers which don’t have the Calibration Cuvette, the Analyser Goes into the Automatic Calibration Mode. And Goes to Zero Cal.

During Zero Cal the Analyser Activates a Relay. With the help of this relay a solenoid valve is energised, which allows zero Gas t flow in the Analyser. The Analyser then calibrates itself for Zero.

Then The Analyser Goes to Span Cal. During Span Cal another Relay is energised. This Relay allows the Span Gas to enter the Analyser. The Analyser then calibrates itself for Span.


PET PLANT–PANEL–2
FIELD–ZONE 1, IIA/IIB
ANALYSER CABINET– ZONE 2, IIA/IIB
STACK
SAMPLE PROBE TEMP: 180°
POWER CABLE FOR PROBE HEATER
HEAT TRACER TUBE, 1/4", 120°
INSTRUMENT AIR SUPPLY BY RIL 1/2" NPT(M)
LOW INST. AIR PRESSURE ALARM TO PLC
TO ATM
PG01
PSV01
BV01
PW01
AFR01
AIR TANK
SET @7BAR
AIR FILTER STATION
INSTRUMENT AIR HEADER
VENT HEADER 3M FROM GROUND
1/2" SS316
DPV VENT
1/4" SS316
PG01
BO01
BYPASS
SAMPLE OUT
SO01
VO01
PURGE CONTROLLER
ULTRAMAT 6F SO2/NOX
GA01
3/8"
3/8"
3/8" SS316
1/4" SS316
FF01
ANALOG SIGNAL JB
FM02 50–500 LPH
FM01 10–100 LPH
1/4"
COOLER FAULT TO PLC (–10...60 °C) TI01
SAMPLE COOLER
EHT TEMP LOW ALARM TO PLC
TE
TI
SV05
C
MP01
SI01
SV06
CC01
SV01
C
PSV02 SET@0.8BAR
CONDENSATE ALARM
CM01
NO2 / NO
EXD BOX
JBFM–01
LOW FLOW ALARM
RTD
RTD
CONDENSATE
TO PLC
AL01
1/4"
1/4"
1/4"
1/4"
SV02
SV03
SV04
NV01
CPR–01
CPR–02
CPR–03
N2
SO2
NO
TE
TI
PANEL TEMP HIGH ALARM TO PLC
230 AC
415V, 3Ø BY RIL
3Ø IJB
415V, 3ØPDB
110VAC, PDB+ PLC
110VAC BY RIL
110VAC IJB
RIL SCOPE
ADAGE SCOPE
TAG NO: AIA–3031–199B
AIT–3031–200 B
MEASUREMENT: SO2/NOX
HOT EXTRACTION
PET PLANT
DAHEJ MANUFACTURING DIVISION

HOW DO WE DETERMINE THE FREQUENCY OF CALIBRATION FOR ANALYSERS

1. The Analyser will have a drift value as mentioned in the Data Sheet.
2. Calibration Gas is to be passed in the Analyser every month and drift to be noted. If the Drift is within the limits the Analyser is to be calibrated once in three months.
3. In case the drift is outside the limits, the frequency of calibration is to be increased and drift checking Frequency is also to be increased.

Thank you for your attention