TDLS200 TruePeak

Tunable Diode Laser Spectrometer

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The clear path to operational excellence

Yokogawa Laser Analysis Division

YOKOGAWA

Agenda

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- General LAD Product Overview
- Basic theory overview
  - Brief explanation of operational theory
  - What differentiates Yokogawa from other suppliers of TDL analyzers
- What is required for application review and why
  - Gas composition
  - Gas pressure
  - Gas Temperature
  - Pipe size or duct size (OPL)
- Example of applications
- Why TDL for combustion
  - O2, CO/CH4 for Gas fired furnaces
  - CO for Wall fired Coal combustion

TruePeak TDL – *Solution Highlights*

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Better than conventional techniques
Better than 1st Generation TDL

- In Situ Analysis
  (without sample conditioning)
- Fast Response (1-20 seconds)
- Interference Rejection
  (high and variable light obstruction)
- Process Pressures up to 20 Bar
- Process Temperature up to 1500℃
- Optical Measurement
  (No sensor contact with process)
- Options for Aggressive Processes
  (i.e. - high particulate content, corrosives)
- Flexible Installation Options

ICOS Overview

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- As with TDL, ICOS can be applied to the measurement of a number of gases. Limitation is only the available wavelengths from laser suppliers:
- Measurable gases (ppb-ppm detection limits possible) include:
  - NH_3
  - CO
  - CO_2
  - C_2H_2
  - C_3H_4
  - H_2O
  - O_2
  - Others available

YOKOGAWA "ADVANCED REFLUX SAMPLER"

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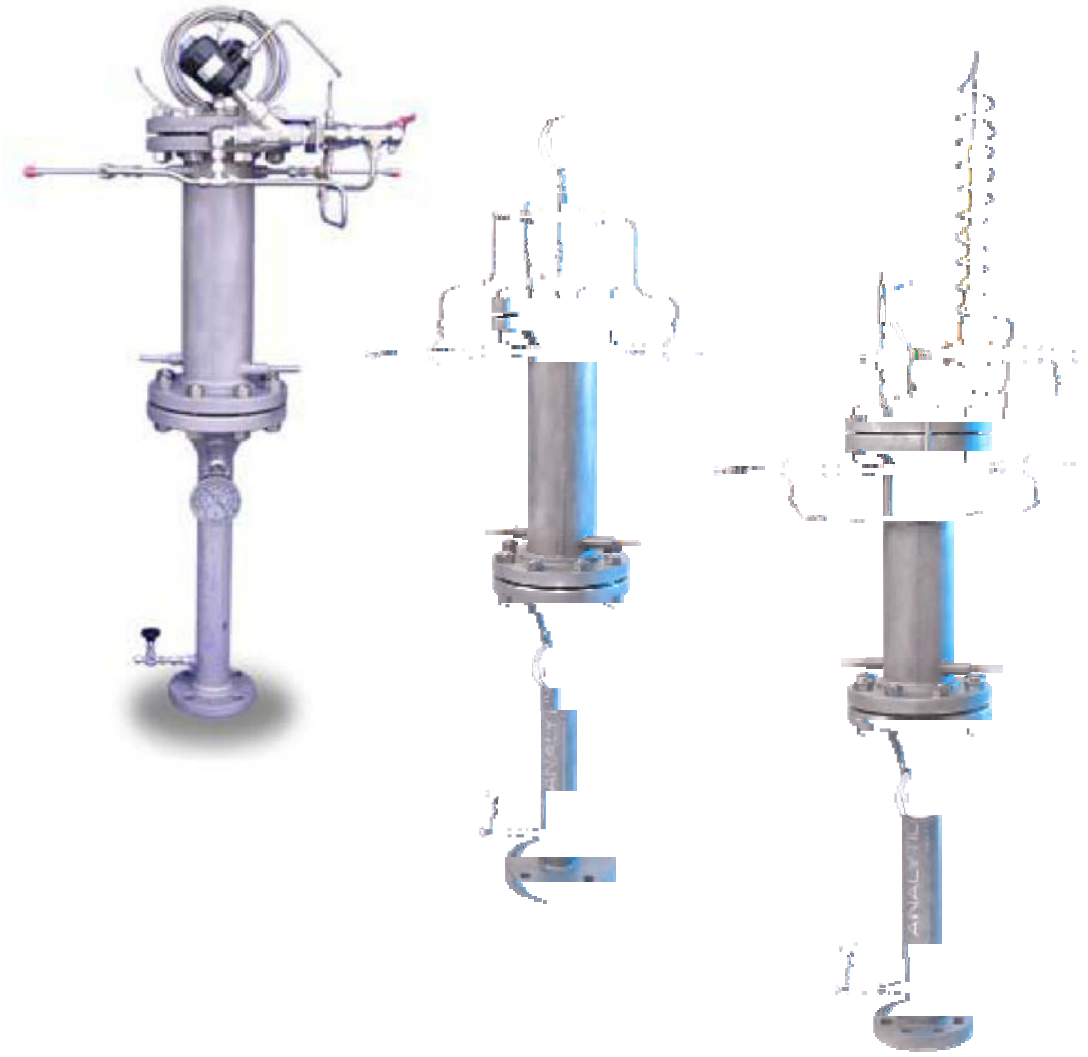
- Tighter Temperature Control for Improved Analysis Accuracy
- Large Cooling Capacity
- Higher Sample Flow for Faster Analysis without liquid carryover
- Reduced Service Requirements and Field Serviceable for lower LTCO
- Custom Designs



Advanced Process and Combustion Analysis

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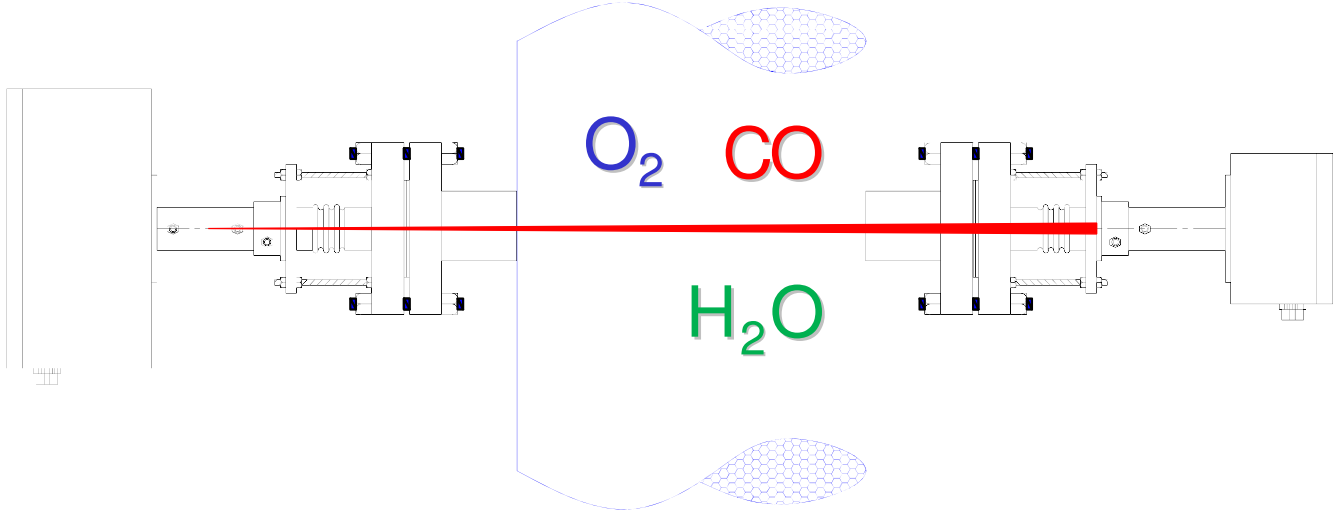
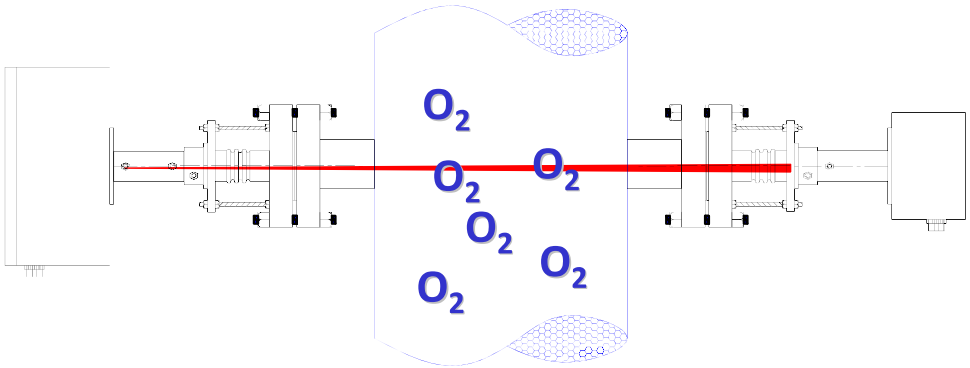


TruePeak Tunable Diode Laser Spectrometer

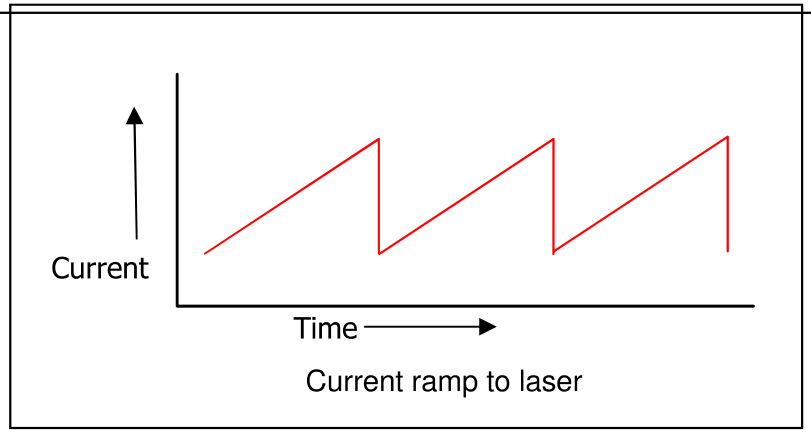
- O_2 concentration in vapor recovery and process applications
- Combustion Gas Analysis of O_2, CO, CH_4, gas temperature, H_2O
- Trace H_2O in Corrosive Processes

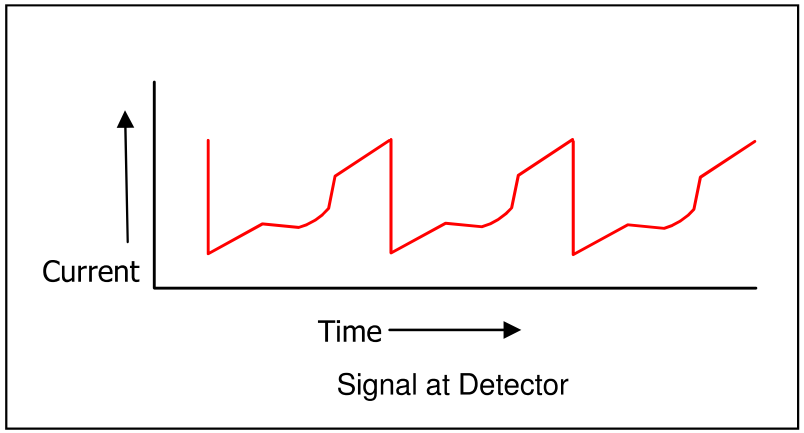
In Situ or Extractive Analysis	Measurements at high pressure and temperature
Fast Response	No direct sensor contact
Accurate	

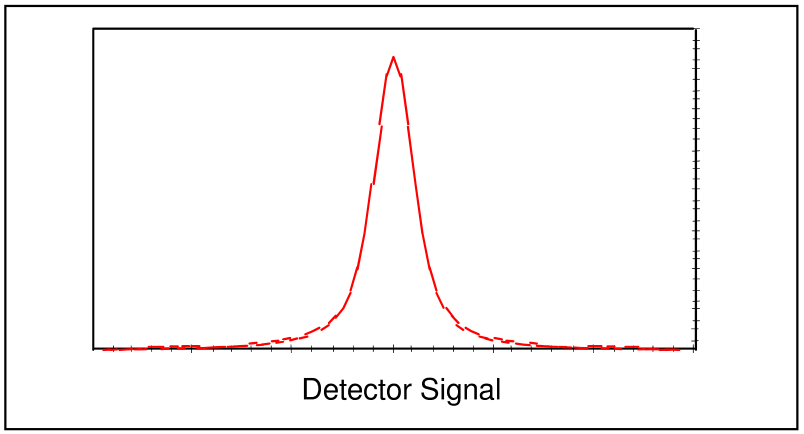
How it Works



- Uses a near infrared laser that travels through the gas being measured
- After travelling through the gas the laser light hits a detector
- Laser is scanned across a wavelength where the gas being measured absorbs the laser light
- The amount of light at the detector tells us:
  - Concentration of gas being measured
  - Diagnostics on the measurement (light delivery, measurement quality)







The TruePeak Advantage

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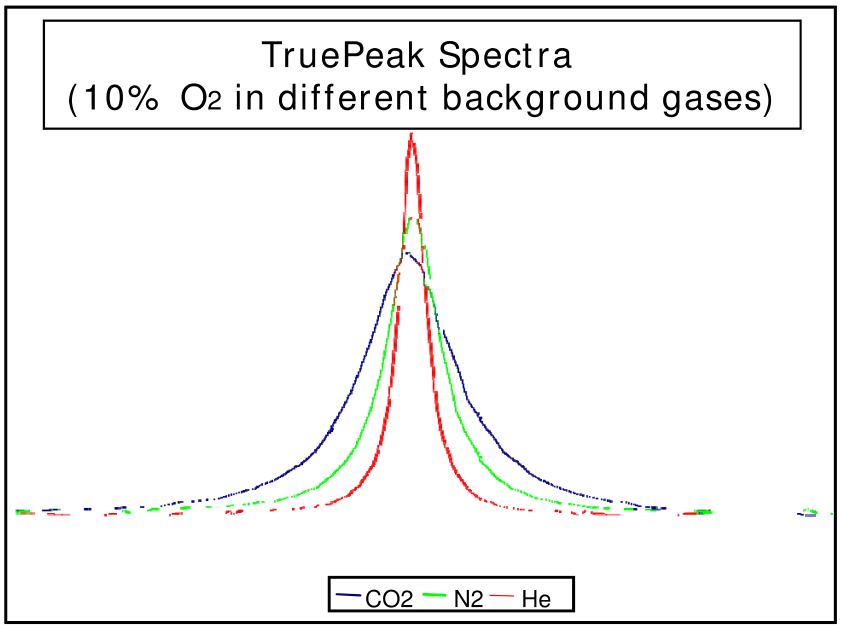
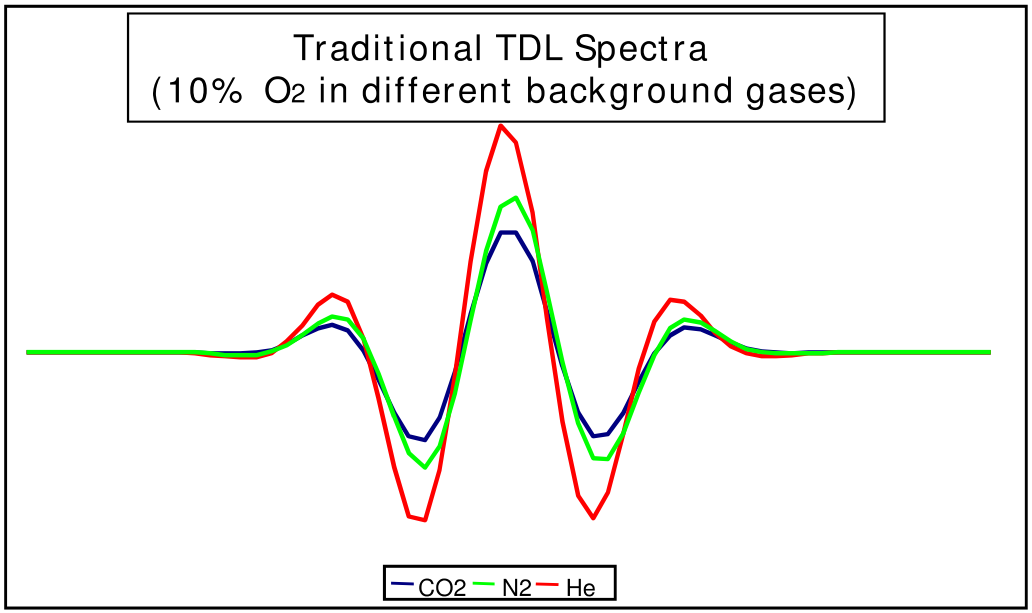
The TruePeak measurement technique is specifically developed for process analysis. It allows measurement in processes where the pressure, temperature and background gases change.

By using the True Peak we can measure the area of the absorbance peak. This eliminates effects from changing background gases, allowing for simple pressure and temperature compensation.

Traditional TDL measurement methods distort the peak, this makes it difficult or impossible to deal with simultaneous pressure, temperature and background gas changes.





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- What Technical Information is required to evaluate and application
  - Gas and Range to be measured
  - Background Gas Compositions and Ranges
  - Accuracy requirement
  - Process Line or Duct size
  - Process Temperature (Range)
  - Process Pressure (Range)
  - Ambient Temperature
  - Area Classification

Gas and Range to be Measured

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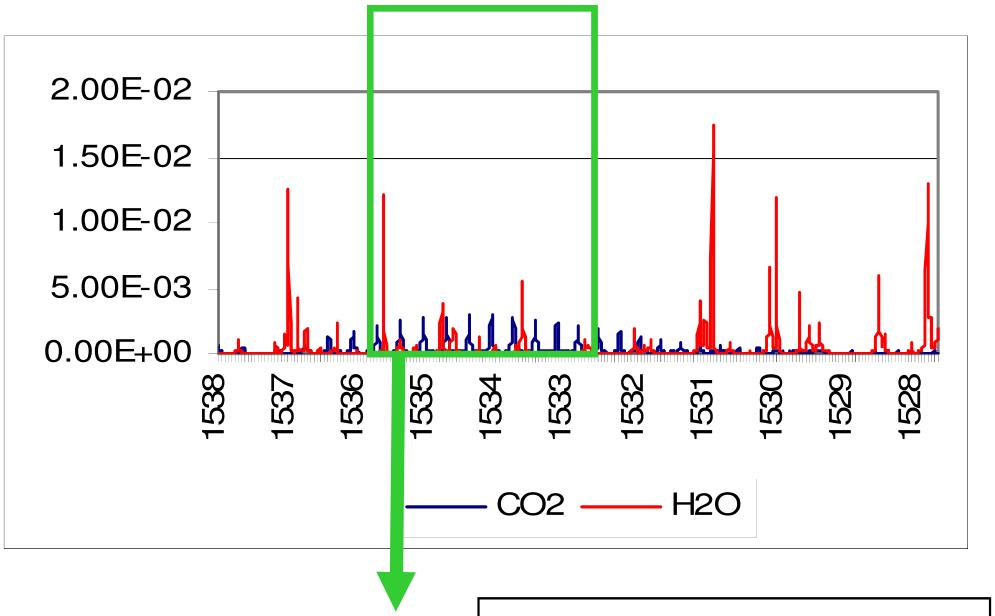
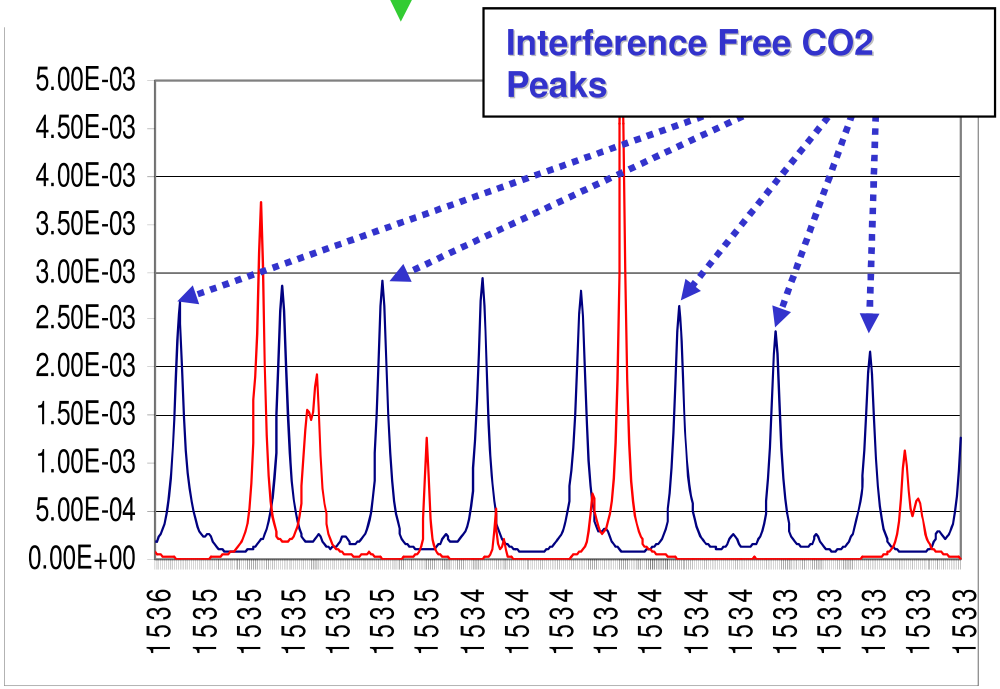
- Is the gas on our current list
  - O2%
  - CO ppm or %
  - H2O ppm or %
  - CH4 ppm or %
  - CO2 ppm or %
  - NH3 ppm or %
  - H2S High ppm or %
  - HCN ppm
  - HCl ppm
- If it is not on the list it will require an R&D project to determine feasibility
- LAD can only measure light gases with high resolution spectra

Background Gas Compositions and Ranges





- There are currently no known spectral interference for O2, but we need to know for our records or as a sales argument
- For all other gases we must verify the there is know spectral overlap from the background gases that are present

Accuracy Requirement

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- Conventional analyzers use sample systems with controlled process conditions
- In-situ TDLS see the sample as it is.
- The following influence Accuracy
  - Process Line or Duct size
  - Process Temperature (Range)
  - Process Pressure (Range)
- All three of these interact and must be know to determine measurement accuracy

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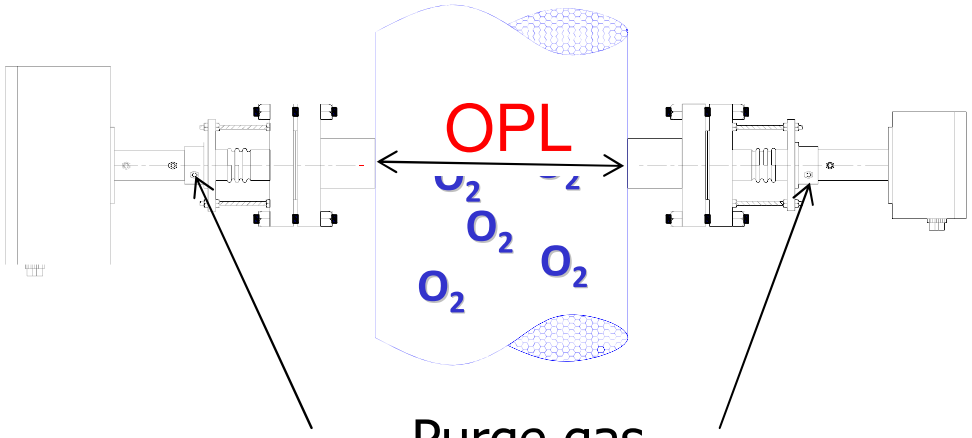
Optical Pathlength (OPL)

- Typically inside wall to inside wall
- If the OPL is increase by 2X the accuracy is increased by 2X, the inverse is also true
- This is a linear relationship



Purge gas
(invisible to the analyzer)

Process Conditions: Temperature and Pressure

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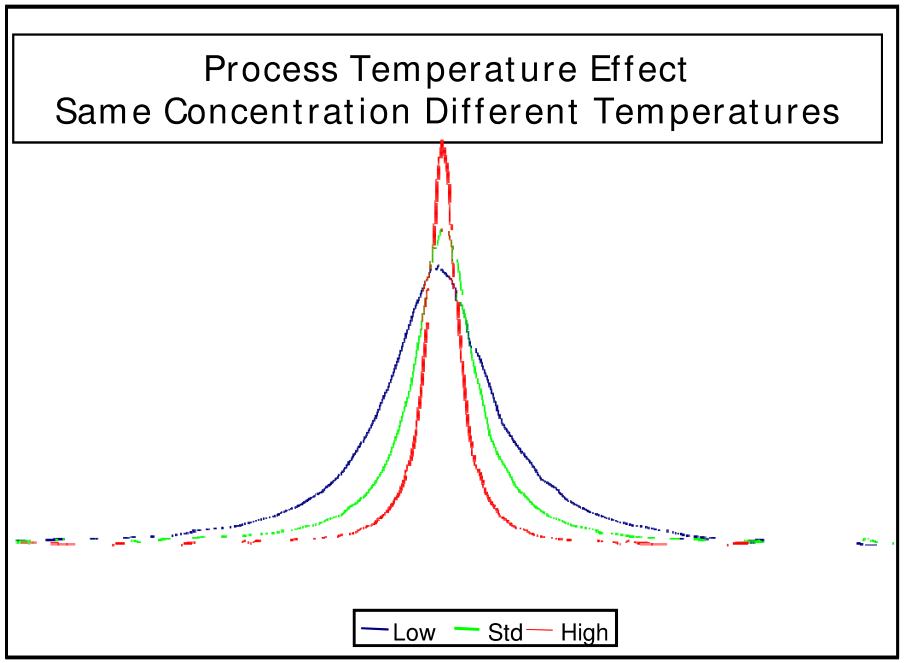
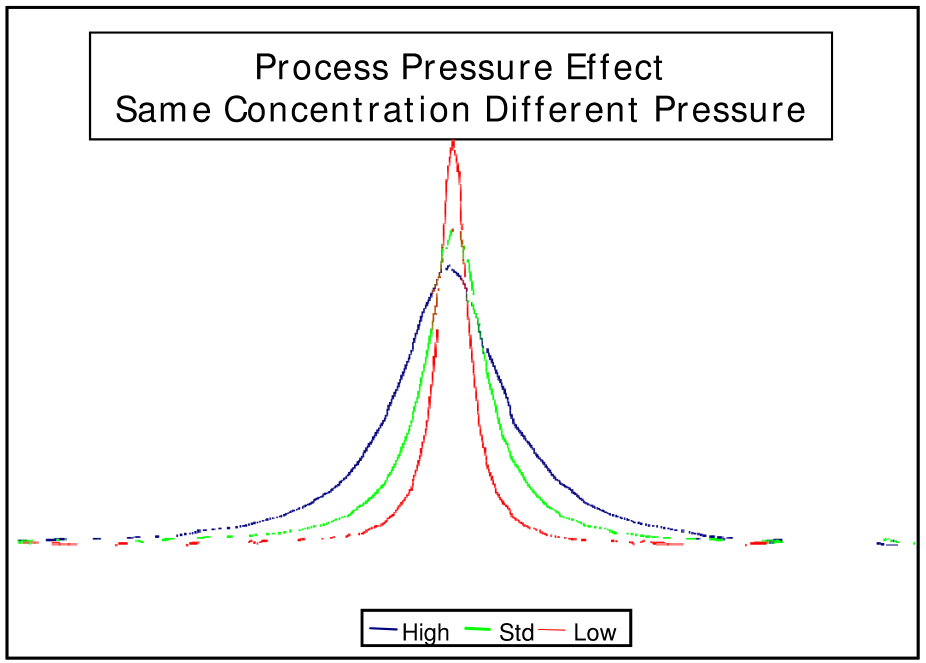
- These diagrams are for demonstration only.
- The temperature effect is non-linear
  - As temperature increases the peak becomes taller and more narrow
  - As temperature decreases the peak becomes wider and shorter
- The pressure effect is typically linear
  - As pressure decreases the peak becomes taller and more narrow
  - As pressure increases the peak becomes wider and shorter





Environmental Conditions

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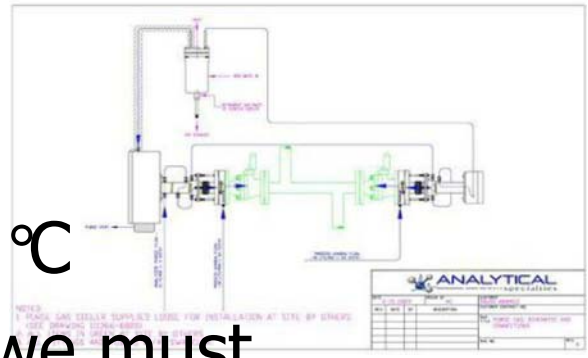

- Ambient Temperature
  - Analyzer Specification is -10℃ to +50℃
  - If we are outside of these conditions we must provide Auxiliary cooling or heating for the Analyzer.
  - Heating can be incorporated into insulated blankets or secondary enclosures
  - Cooling can be as simple as cooling the purge gas
- Area Classification
  - Standard Analyzer is General Purpose
  - An integral Z-purge is used to meet Class 1, Div 2 and ATEX Zone 2

- Process O2%
  - 0-1% to 0-25%
- Small Scale Aggressive Combustion
  - Incineration
- Moisture in Cl2
  - 0-30ppm
- Moisture in COCl2
  - 0-100ppm
- Moisture in HF Alkylation

Process Oxygen Analysis

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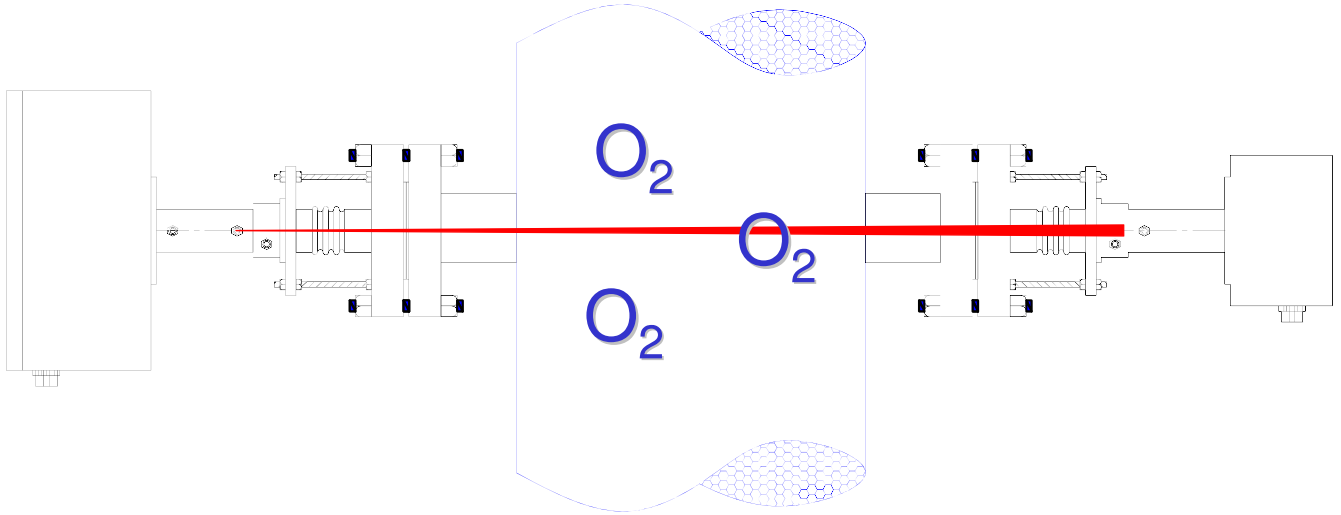
REACTOR CONTROL
VAPOR RECOVERY SYSTEMS
FLARE AND VENT HEADERS



- TruePeak technology provides interference free measurement
- Rapid 5 second analysis
- In process measurement
- No sensor contact = lower ownership costs
- No sample system, no analyzer shelter, no sample lines = lower installed cost

ACCURATE MEASUREMENT for CONTROL IMPROVEMENT

FAST MEASUREMENT for SAFETY IMPROVEMENT

LOW INSTALLED AND OPERATING COST

Traditional

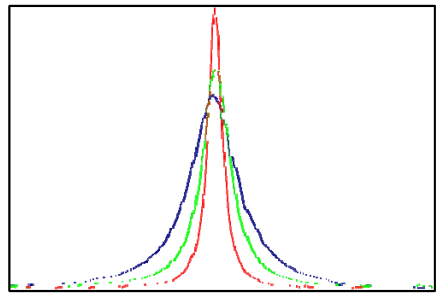
With traditional Process Oxygen measurements the analyzer requires you to:

- Extract and transport the sample
  - Adding Cost and Slowing Response
- Condition the sample to protect the analyzer
  - Adding Cost and Compromising the Accuracy
- Protect the analyzer from the elements
  - Adding Cost
- Often the measurement also suffers from
  - Interferences – Reducing Accuracy
  - Sensor Degradation – Reducing Accuracy and Adding Cost

TDLS200 TruePeak

With TRUEpeak you no longer have to compromise:

- Accuracy
  - TRUEpeak method is interference free
  - TRUEpeak measures the process without changing the composition
  - Rapid 5 second measurement in the process
- Cost and Reliability
  - Installation without sample extraction, transport and conditioning
  - No analyzer shelter required
  - No sensor contact



Jumbo EDC O2 Measurement

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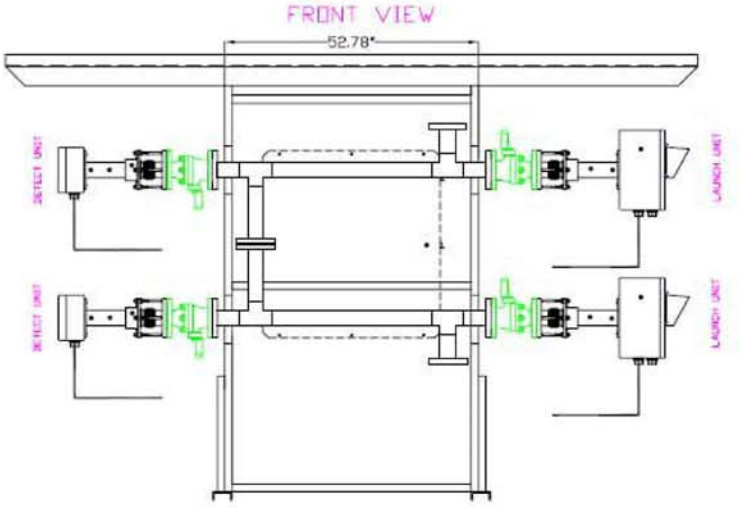
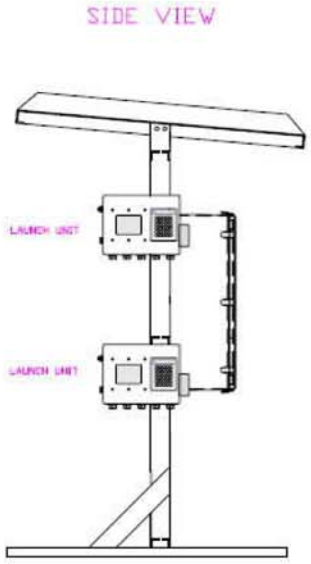
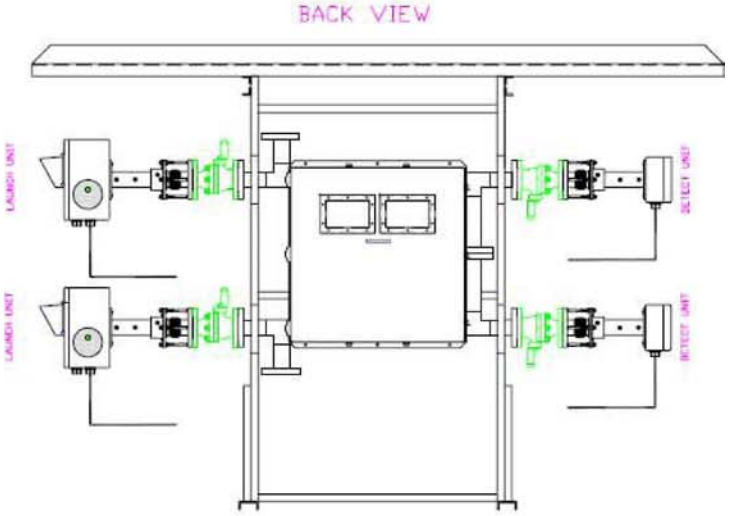
1. 0-21% O2
2. User Interface Keypad and Display
3. Area Classification Class 1 Div2
4. 2"150# Alignment Flanges
5. Dual Utility Panel
6. Free standing galvanized rack
7. 40"OPL 2" flow pipes







RHU Vent and Sour Gas Vent O2%

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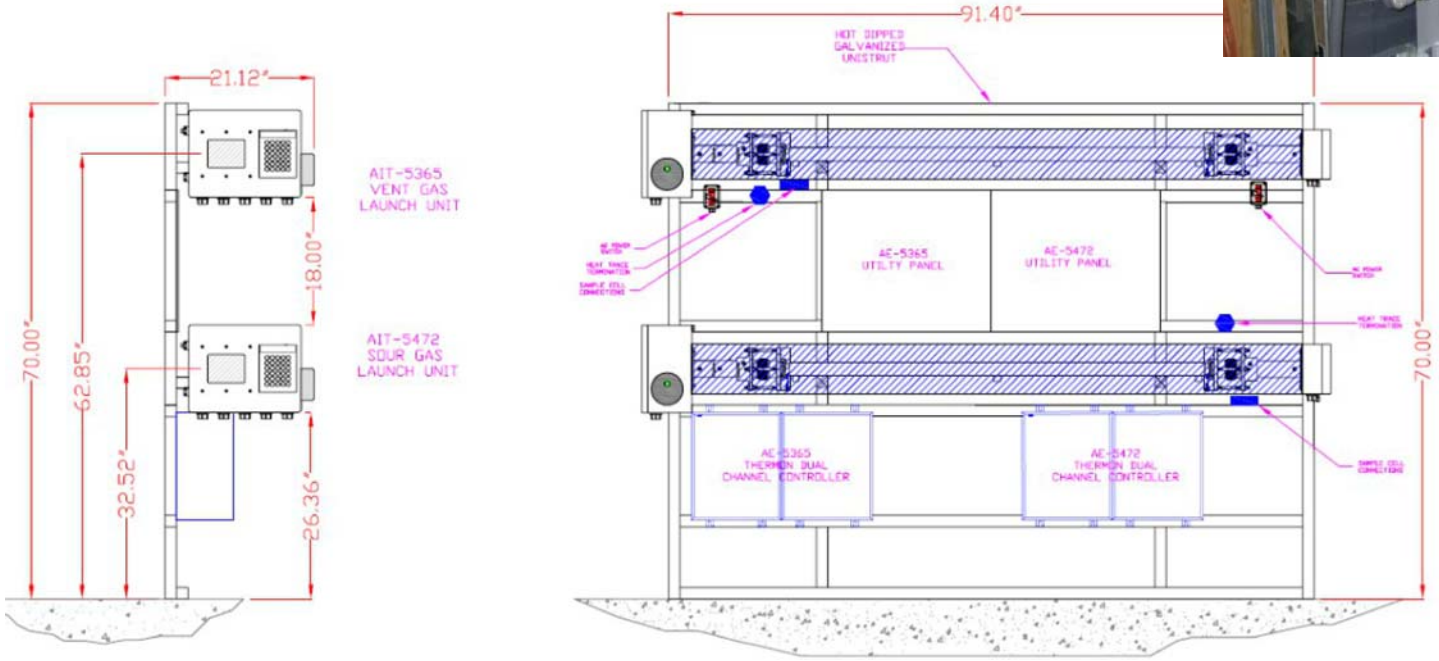
Sour Gas (High H2S)
Vent Gas from RHU
1.0-21% O2
2.60" OPL
3.Process Temperature 65C
4.Process Pressure 5psig
5.Typ 0.4% O2
6.Div 2
7.Screen and Keypad
8.Sample system
9.Heat trace and wall rack

Analyzer System



Sample System

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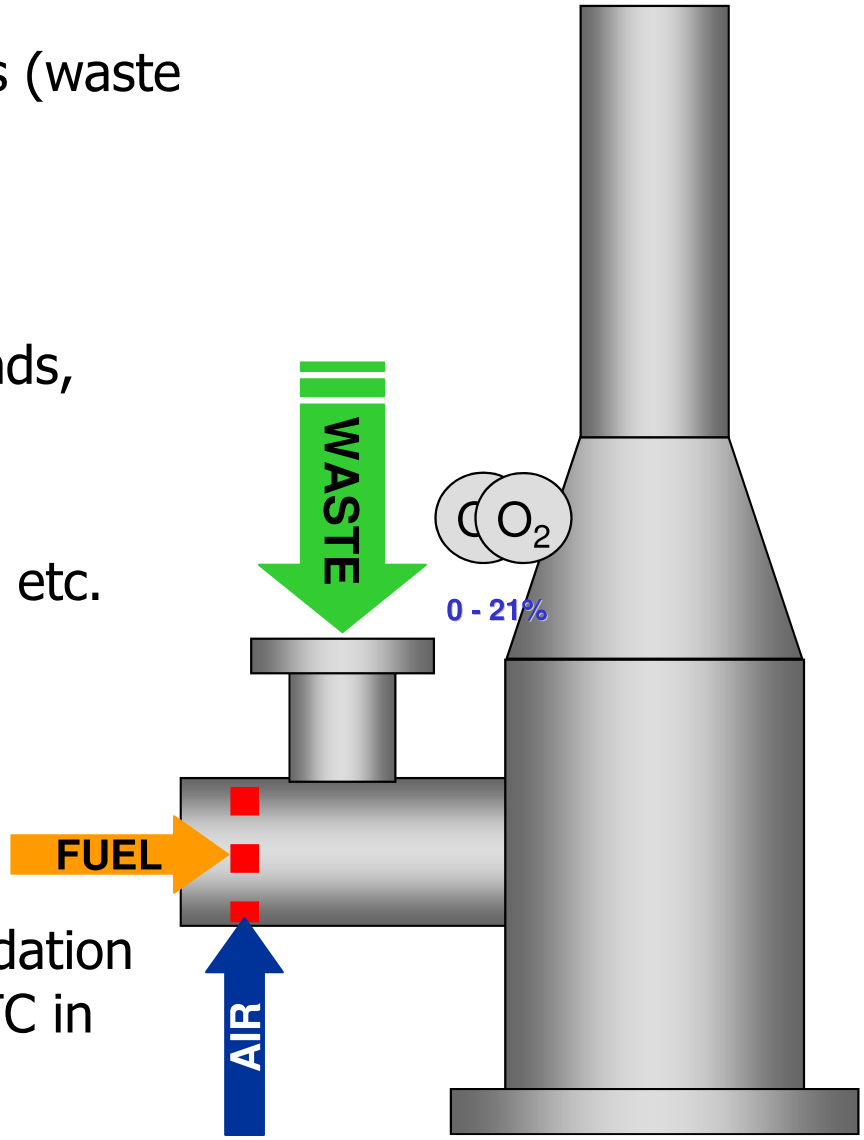
Application Difficulties:

- Changing combustion properties during burns (waste variation)
- High Temperature
- Possible High Particulate
- Interferences / poisons (chlorinated compounds, sulfurs) TDLS not effected
- Speed requirements
- Electrochemical unacceptable due to poisons, etc.
- Paramagnetic O2 Analyzer requires sample extraction, transport, conditioning
  - Speed of response issue
  - Reliability of Extractive, Transportation, Condition
  - Paramagnetic interference of background gases
- ZrO2 suffers from rapid cell poisoning, degradation of sensor response (poisons) also requires ETC in some cases (plugging of filters, flow lines)



H2O in Cl2 Chlorine 3

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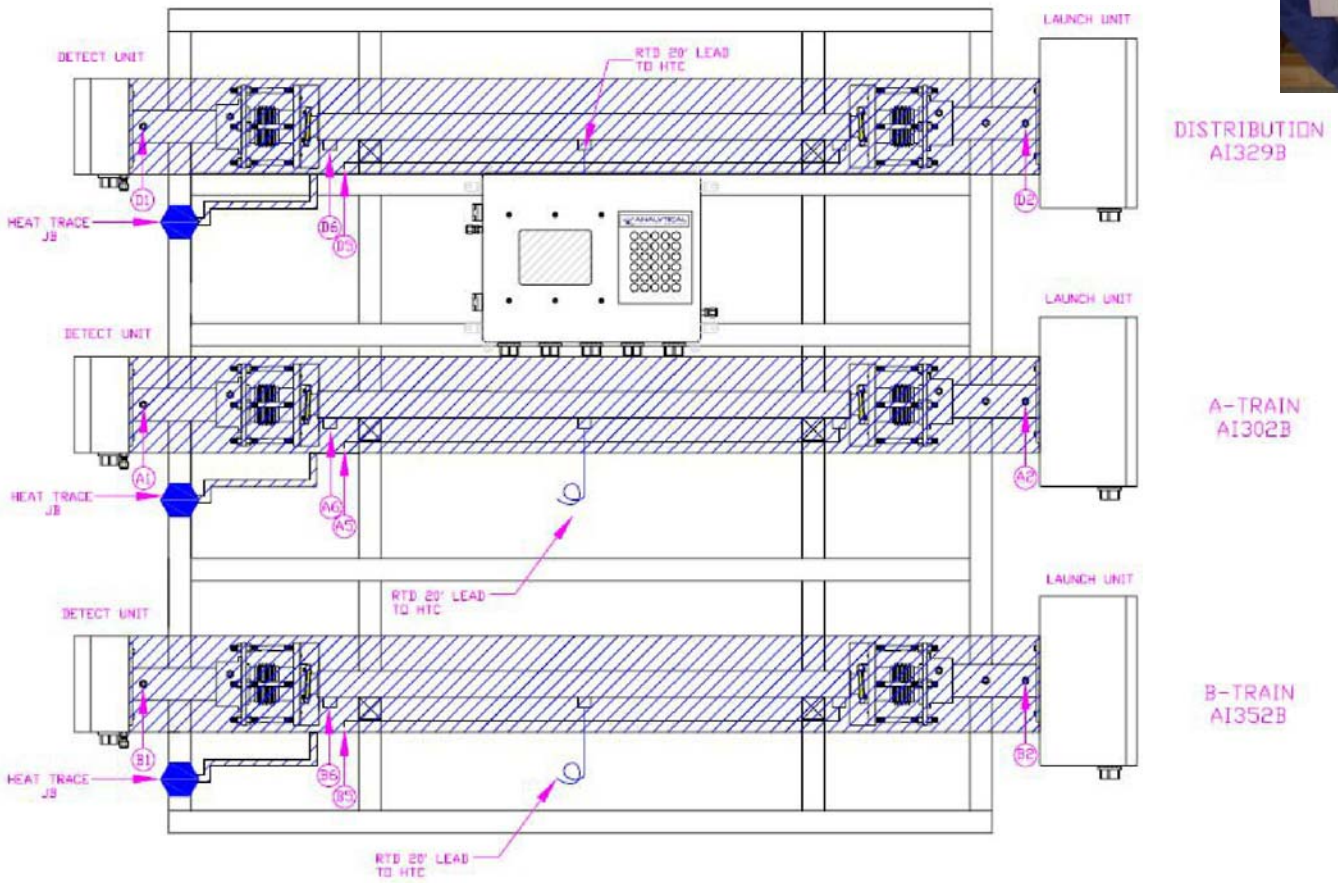
1. Quantity 3 Analyzers
2. 0-30ppm H2O in Cl2
3. 40" OPL Monel cell
4. Dryer
5. Manual system
6. Heating
7. RIU - mounted in house



H2O in Cl2 B-28

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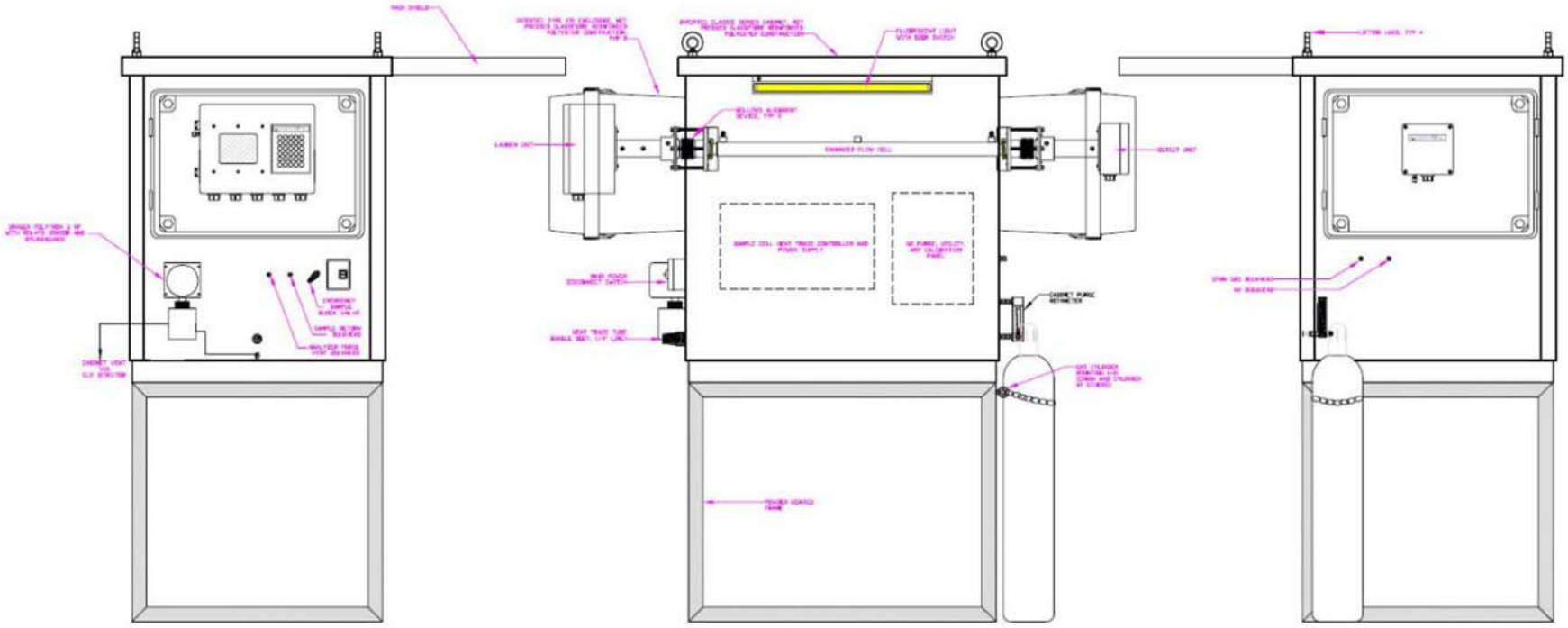
1. 0-30ppm H2O in Cl2
2. 40" OPL Monel cell
3. Dryer,
4. Manual system
5. Heating
6. RIU - mounted in house



Scope of Supply to Bayer Baytown

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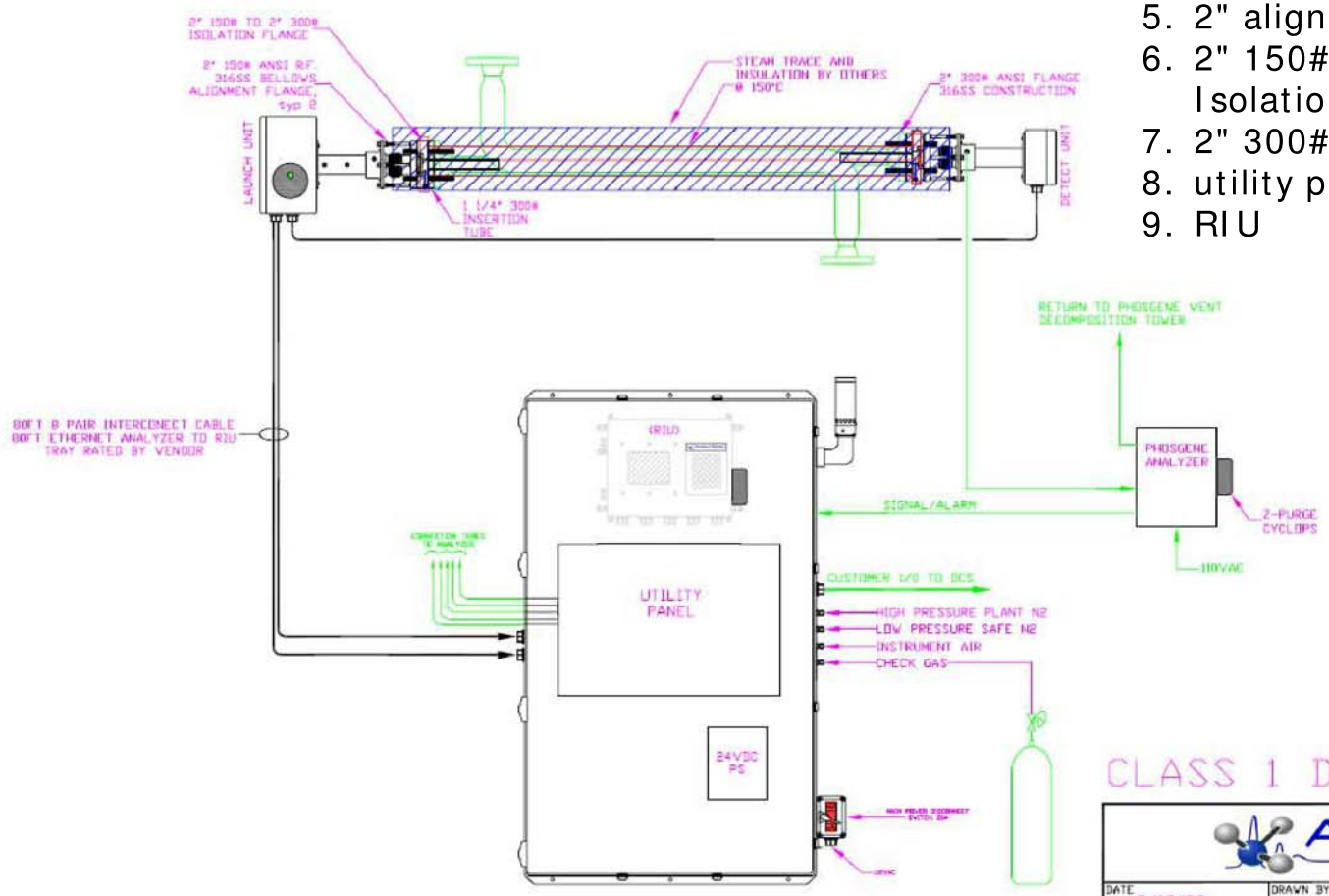
1. Measurement Range 0-30ppm H2O
2. 1m OPL by-pass
3. Process Temp120C
4. Process pressure 1-2 Barg
5. 2" alignment flanges,
6. 2" 150# to 2" 300# Hastelloy C276 Isolation studded flange,
7. 2" 300# Insertion Tubes,
8. utility panel
9. RIU



CLASS 1 DIV 2 C&D

ANALYTICAL specialties

DATE	DRAWN BY	CUSTOMER
8/18/08	JM	Bayer Material Sciences

REV.	DATE	BY	DESCRIPTION
A	8/26/08	JM	Issue For Approval
B	9/25/08	JM	Revised Drawing
C	10/13/08	JM	Revised Drawing
D	11/17/08	JM	Revised Drawing
E	12/15/08	JM	As Built

CUSTOMER CONTRACT NO. 260336380

DWG TITLE GENERAL INSTALLATION OVERVIEW

DWG NO. 112303-1501 REV. E

ALL ITEMS IN GREEN SUPPLIED BY CUSTOMER AT SITE

Alky 3 Trace H2O in Butane Recycle

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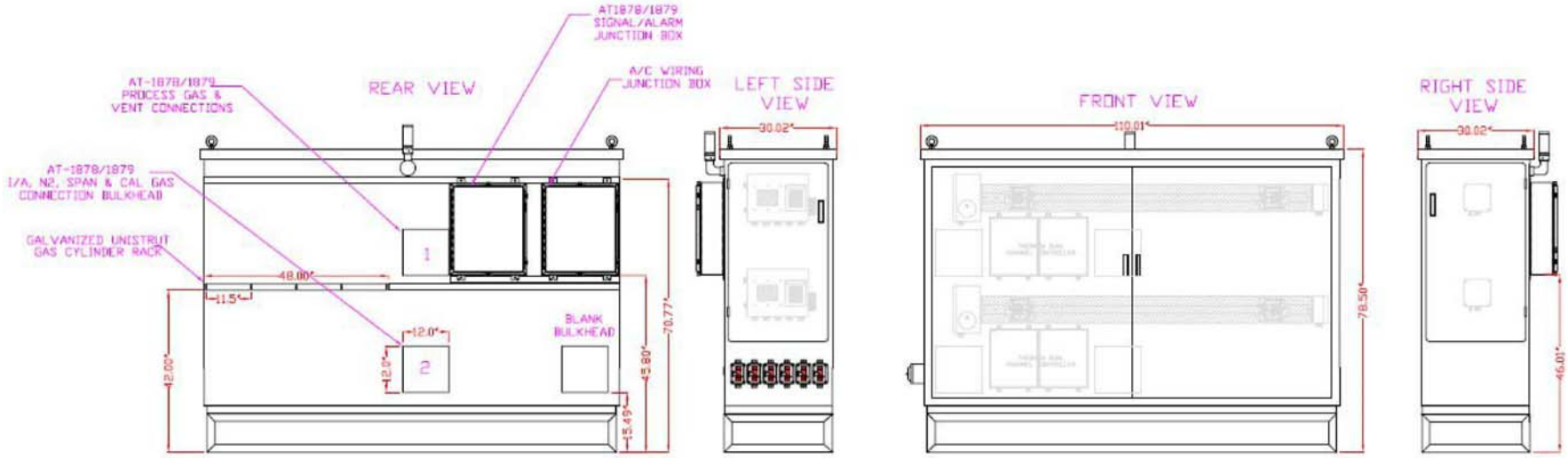
Defluorinator Inlet
Debutanizer Overhead
1.0-30ppm H2O (typ < 5ppm)
2.60" Monel Flow Cell @ 90degC
3. Monel wetted Sample Handling System
4.Keypad and Display Div 2 C&D
5.Full SS enclosure



Other Measurements

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- Trace Moisture
  - Rapid measurement of H2O in corrosive and aggressive processes
- Ammonia Slip
  - In situ measurement of NH3 in de-NOx process
- Impurities
  - Part per million measurements of Acetylene, Ammonia, Moisture and other product impurities

Combustion Analysis

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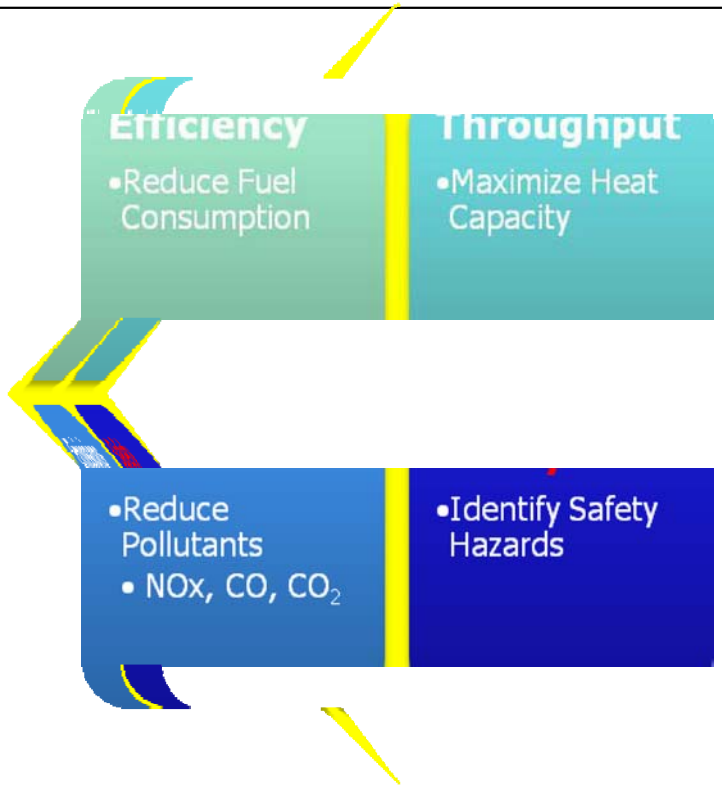
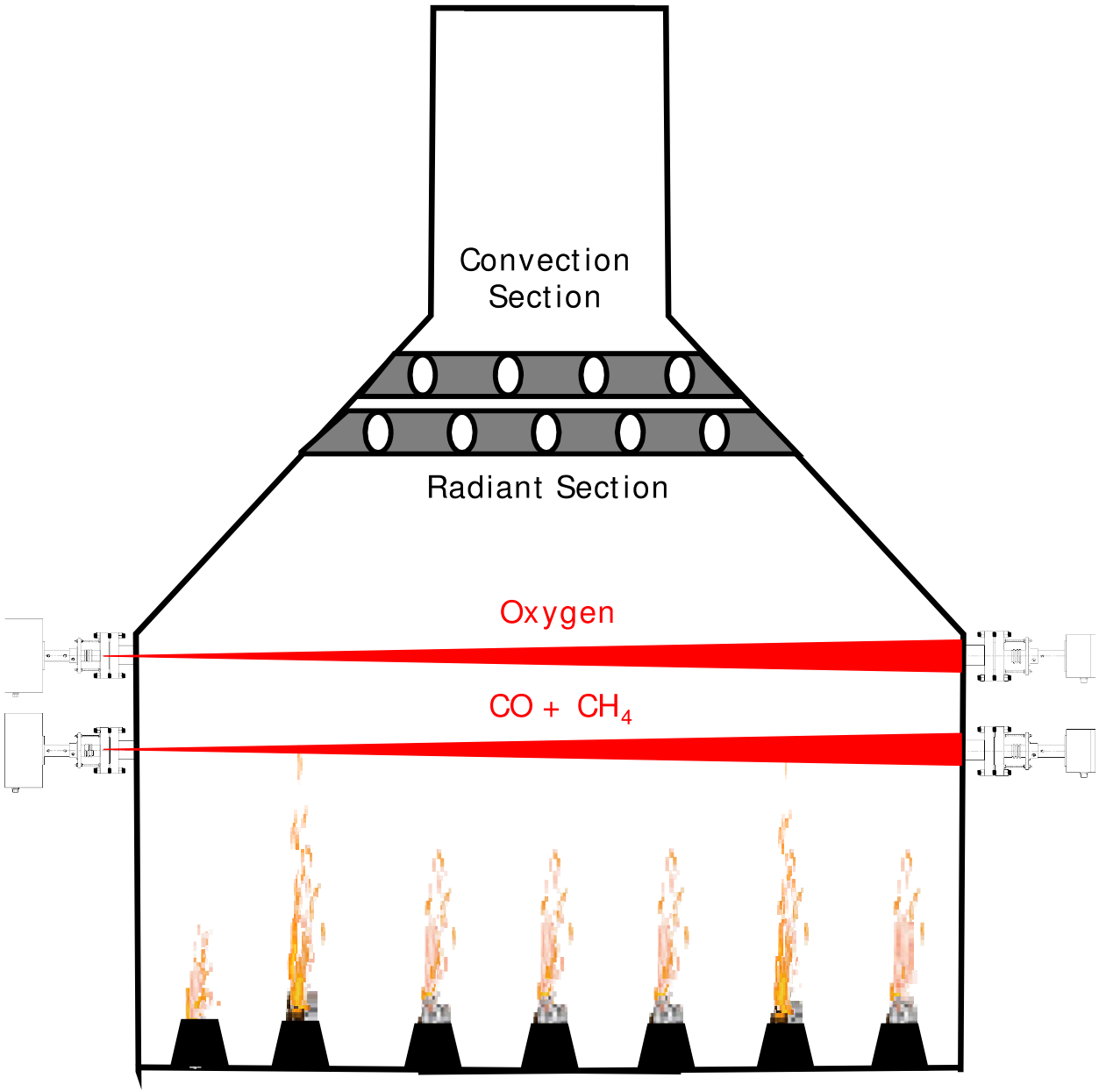


- Oxygen, Carbon Monoxide and Methane measurement IN THE PROCESS at HIGH TEMPERATURE
- Measures across multiple burners to improve accuracy and safety coverage
- Rapid 5 second measurement for improved control and safety

IMPROVED CONTROL, LOWER FUEL COSTS, REDUCED EMISSIONS, IMPROVED SAFETY



Improving Combustion Analysis

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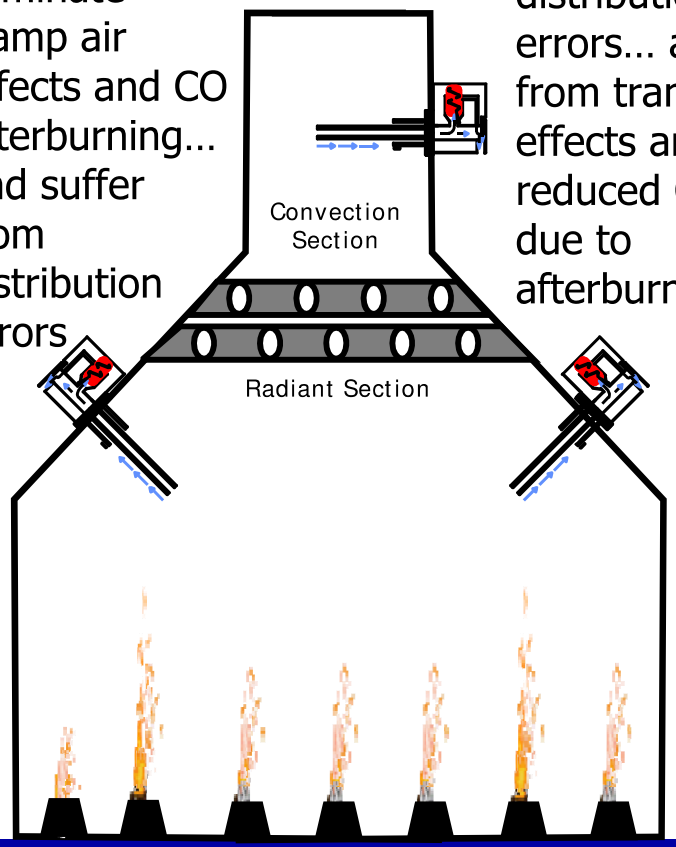
Traditional

With traditional combustion measurements you had to make a difficult choice

Measure in the combustion zone to eliminate tramp air effects and CO afterburning… and suffer from distribution errors

OR

Measure past the combustion zone to reduce distribution errors… and suffer from tramp air effects and reduced CO levels due to afterburning



TDLS200 TruePeak

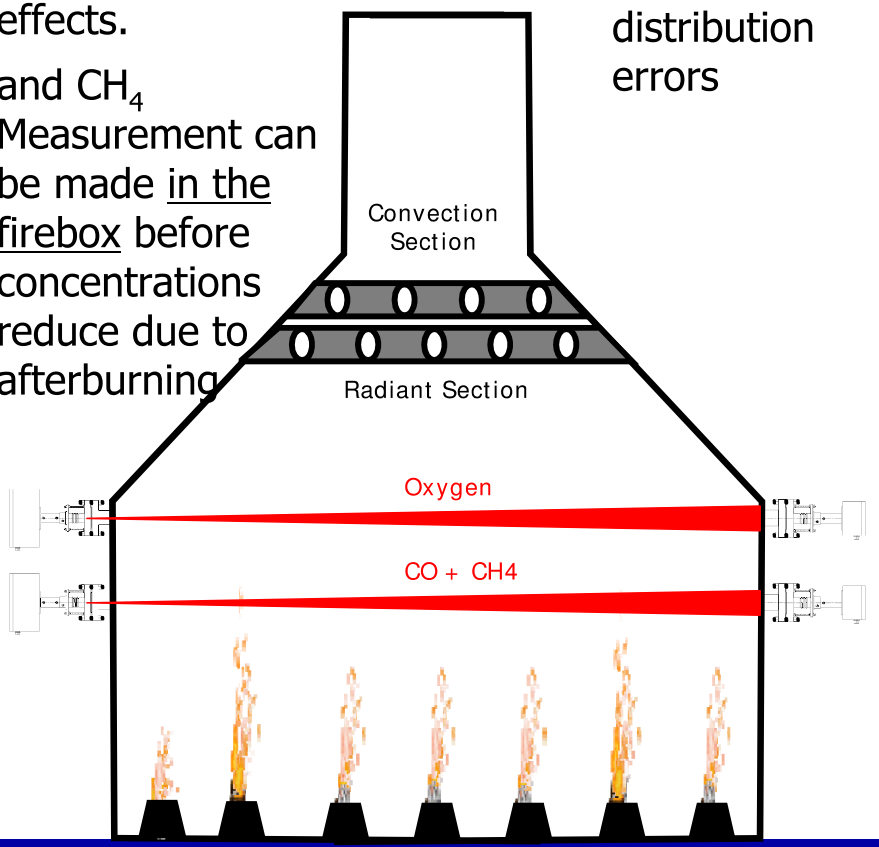
With TRUEpeak you no longer have to compromise

O_2 Measurement can be made <u>in the firebox</u> to eliminate tramp air effects.

CO and CH_4 Measurement can be made <u>in the firebox</u> before concentrations reduce due to afterburning

AND

<u>Across the firebox</u> to minimize distribution errors



Designed for the Most Demanding Applications

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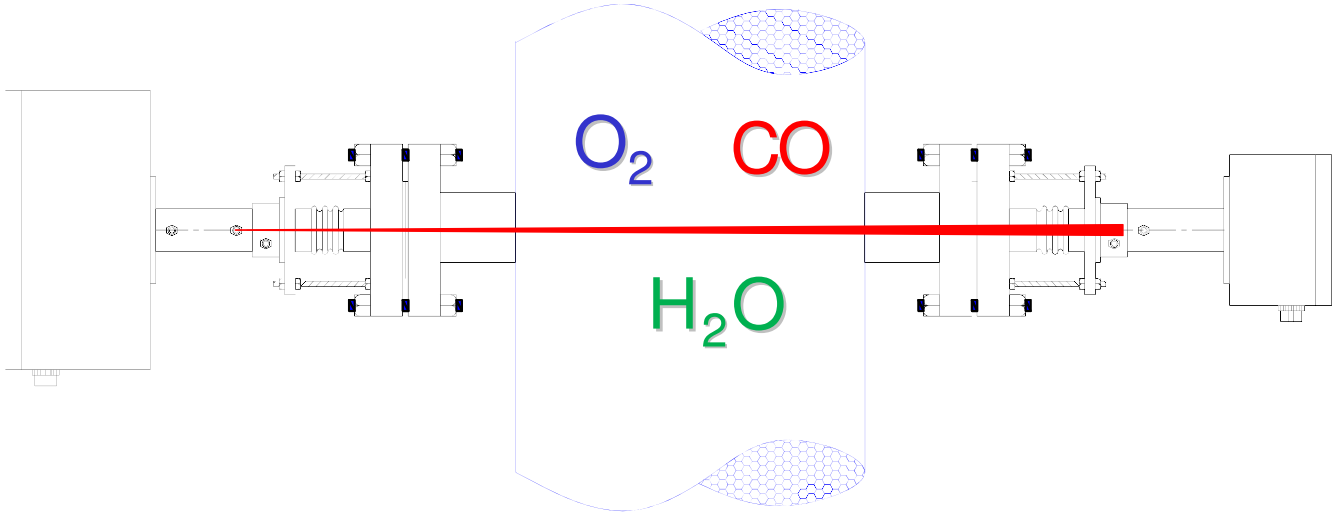
TDLS200 TruePeak



- In Process Measurement
  - No sample extraction
  - No sample conditioning
  - No analyzer shelter
- Accurate and Reliable
  - No interferences for most applications
  - Measurement across the process
  - Fast 1 second response
  - No sensor contact with the process
  - High diagnostic coverage