



*Setting the Standard for Automation™*

# Technological Advancements in Ethylene Cracking Sample Probes

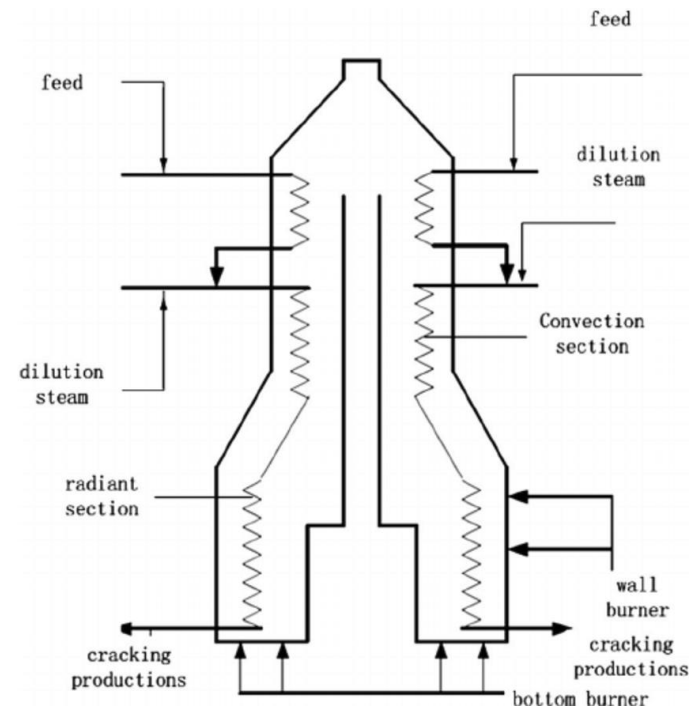
Standards  
Certification  
Education & Training  
Publishing  
Conferences & Exhibits

- Over 25 years of experience in the Analytical Industry including 5 years working exclusively on analyzer integration project in the Middle East. The last 10 years have been with Universal Analyzers, an AMETEK company.



## Distillation Probes – Where are they needed?

- Distillation probes – also known as Transfer Line Samplers, Reflux Samplers, PyGas or Pyrolysis Probes
- Ideal for hot, wet, or dirty process gases
- Current Applications:
  - Ethylene Cracking Furnaces - Light Hydrocarbon Measurement
  - Decoke Operations - CO Measurement
- Possible Applications:
  - Fluidized Catalytic Cracking Units (FCCU) - Standard CEMS Measurements
  - Syngas - Light Hydrocarbon Measurement



## Distillation Probes – What are they designed for?

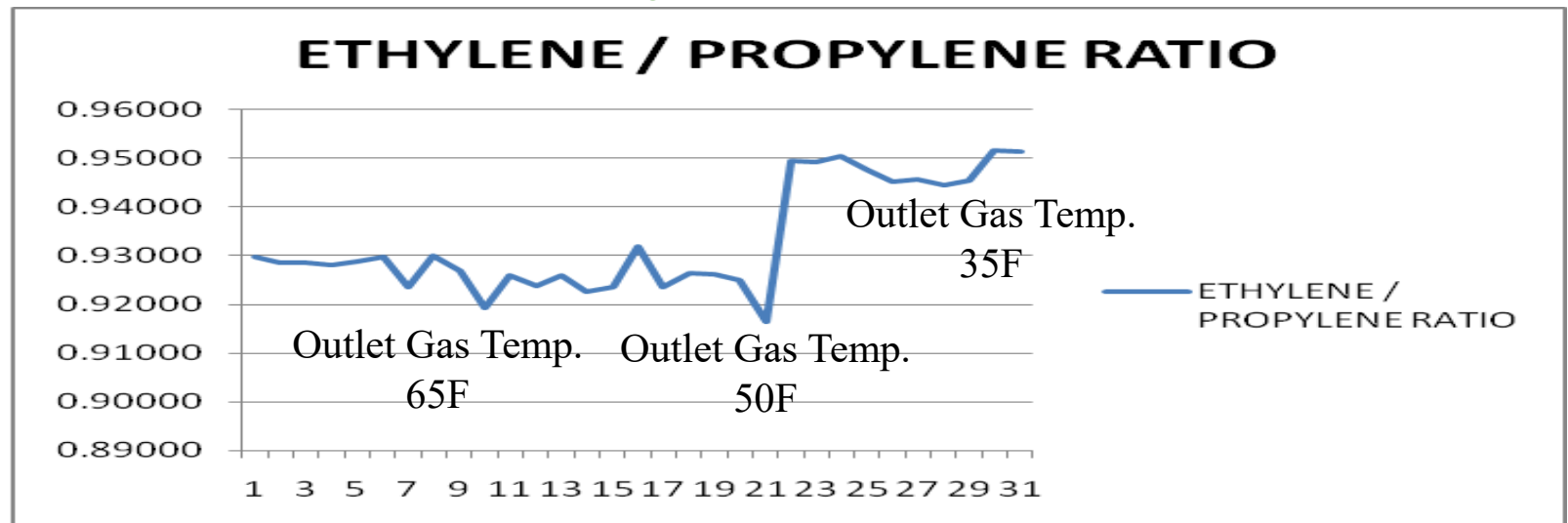
- Process control
  - Measure Ethylene and Propylene ratio after cracking
  - Know when Decoke is complete
    - Overcracking results in coke formation. Undercracking results in reduction of production.



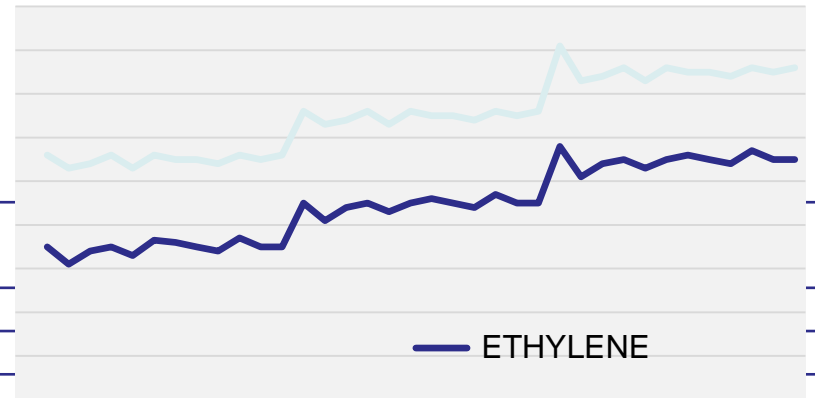
# Case Study – Middle East Chemical Plant Ethylene Furnace

Assumption - Ethylene / Propylene ratio number used in the control of the cracking furnace would be unaffected by the pyrolysis gas sampler.

Results - the Ethylene (C2=) to Propylene (C3=) ratio is clearly affected by the outlet temperature of the sample and use of the outlet sample temperature should be considered in the control algorithm



\$\$\$\$\$ - This shows that change of temperature can have an impact on concentration that will effect process control and yield.

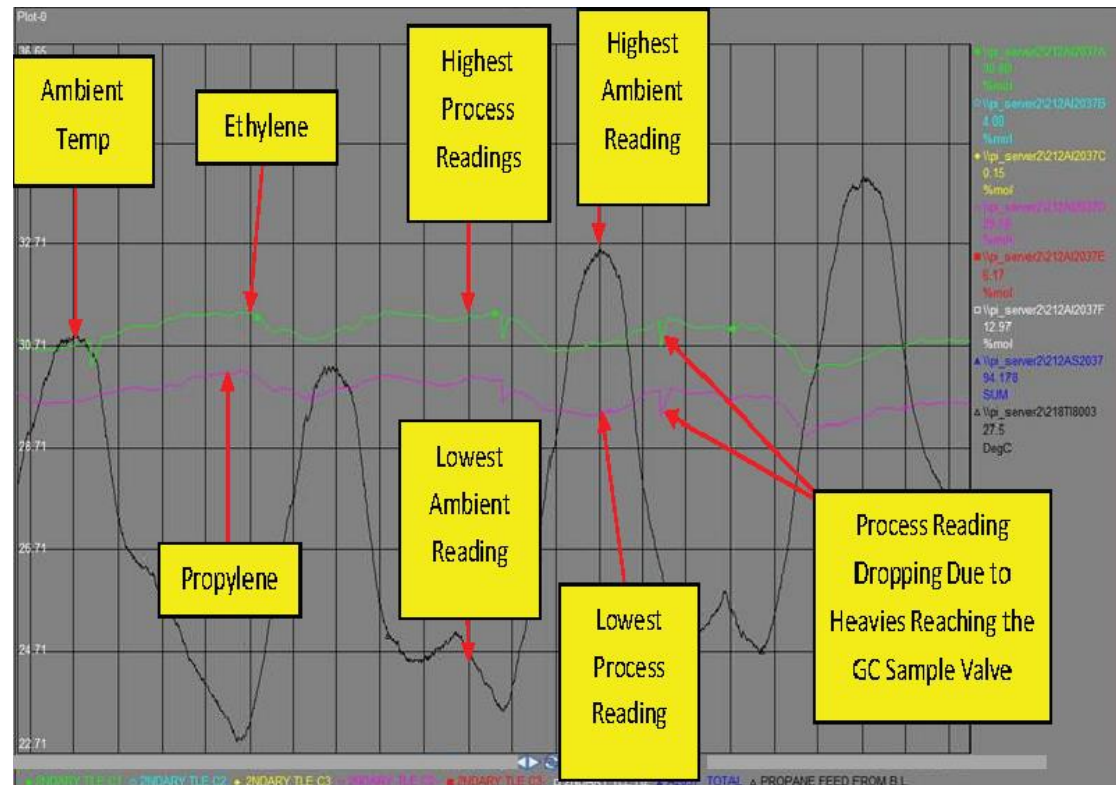


RATE	POUNDS	ANNUAL PRODUCTION (LBS)		
235,000	2,000	470,000,000		
COMPONENT	SAMPLE TEMP	CONCENTRATION	ANNUAL PRODUCTION (LBS)	VALUE (USD)
Ethylene	70F	25.30%	118,910,000	\$35,673,000
Ethylene	60F	26.50%	124,550,000	\$37,365,000
Ethylene	50F	27.60%	129,720,000	\$38,916,000
Propylene	70F	27.30%	128,310,000	\$47,474,700
Propylene	60F	28.60%	134,420,000	\$49,735,400
Propylene	50F	29.60%	139,120,000	\$51,474,400

*SMK™ and USC® M-coil technology for gas feed: these technologies, designed to achieve very large capacities, enable selectivity*

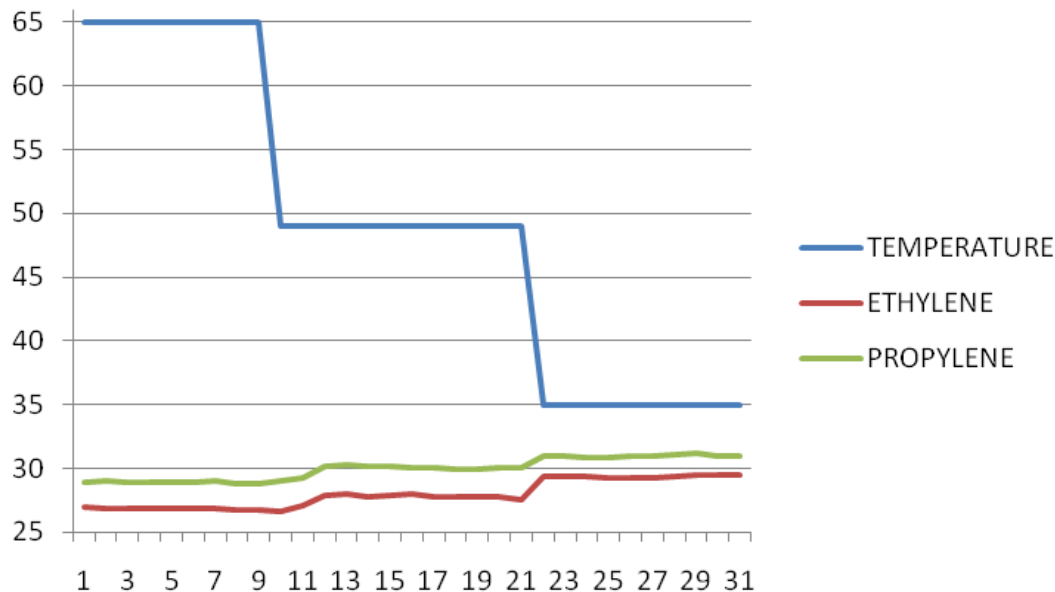
## Typical PYGAS Probes – Common Problems (Sample Temp)

- Ethylene and Propylene levels measured throughout a four day period.
- Existing probe could not maintain outlet set point temperature
- Readings varied with ambient temperature
- This graph is 4 day trend-spike due to heavies with 4 to 5 hour duration.
- Do you have a trend showing analysis varying with ambient condition?



## Typical PYGAS Probes – Common Problems (Sample Temp)

- **Sample outlet temperature not controlled well**
  - Analyzer measurements vary greatly with sample gas temperature
    - Ideal Gas Law dictates if pressure is constant, a decrease in temperature will cause the concentration to go up



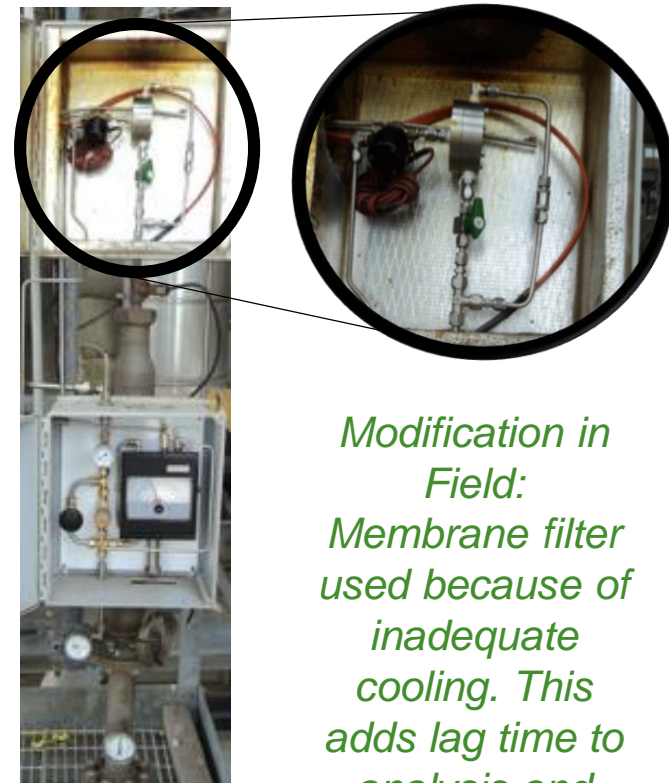
- Testing shows how sample outlet temperature affects the measured Ethylene and Propylene
  - Testing was done with a GC over four days
  - As the outlet temperature of the Model 1221 was lowered the analyzer value for Ethylene and Propylene increased
  - Testing should be completed to determine if your current measurements are faulty.

*Universal Analyzers can develop optimum temperature profile for you.*



## Typical PYGAS Probes – Common Problems

- Difficult to service probes while installed
- Probe functionality cannot be monitored
- Insufficient cooling capacity causing water carry over
  - Small sample contact surface area
  - Poor heat transfer to separator
  - Improper probe insulation
  - Unable to expel condensate
  - External components added – decreasing response time
- Probes plug
  - Inefficient filtration of particulate
- Mesh Pad filtration is maintenance intensive



*Modification in Field:  
Membrane filter used because of inadequate cooling. This adds lag time to analysis and creates maintenance item.*

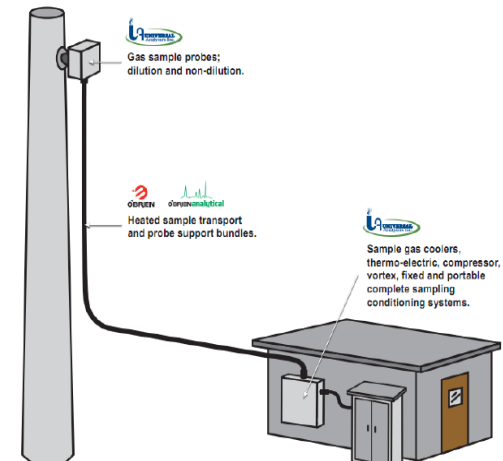
## Smith Analytical – PyGas Sample Conditioner (1221)

- Developed because of need to improve this important measurement
- Proven Technology
- Large Installed Base Worldwide
- Proven Solutions
- New Generation Developed with Universal Analyzers  
Patent Pending EFSID 28697688



## UA Model 1221 Product Enhancements

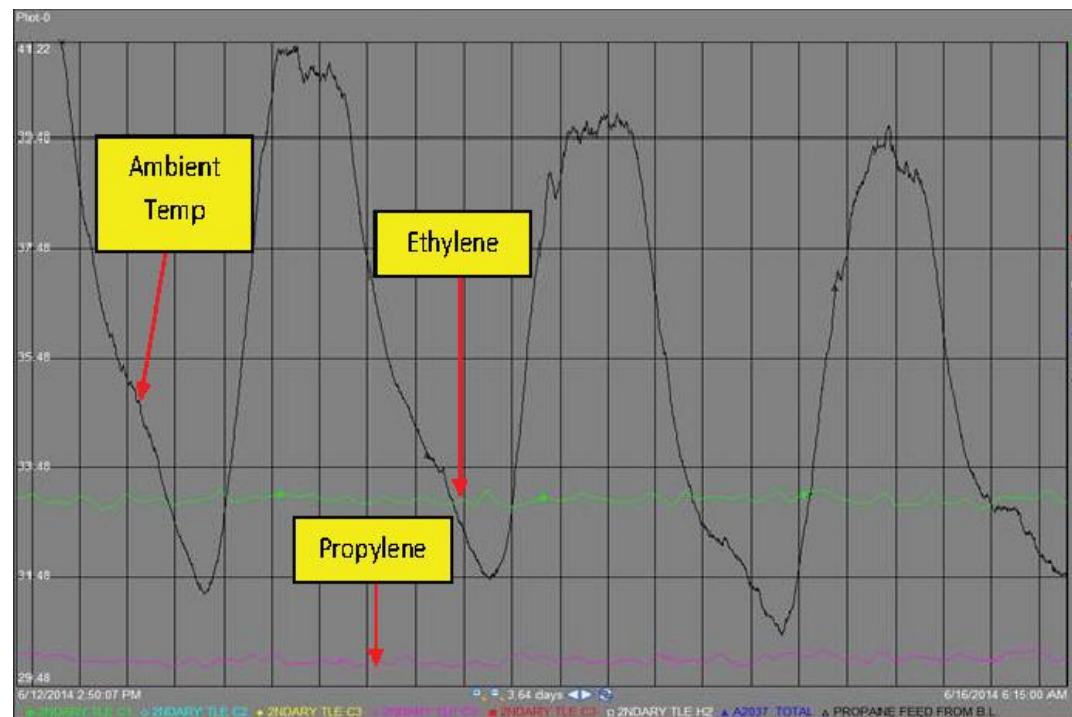
- TraceBoost
- Disc Extraction
- Disc Arrangement
- Control Options
- Control Features



## 1221 SOLUTION

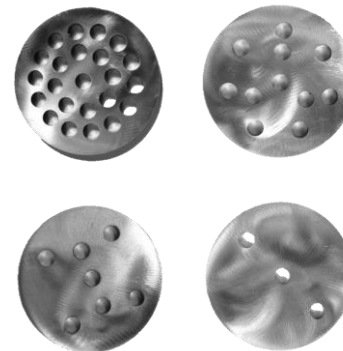
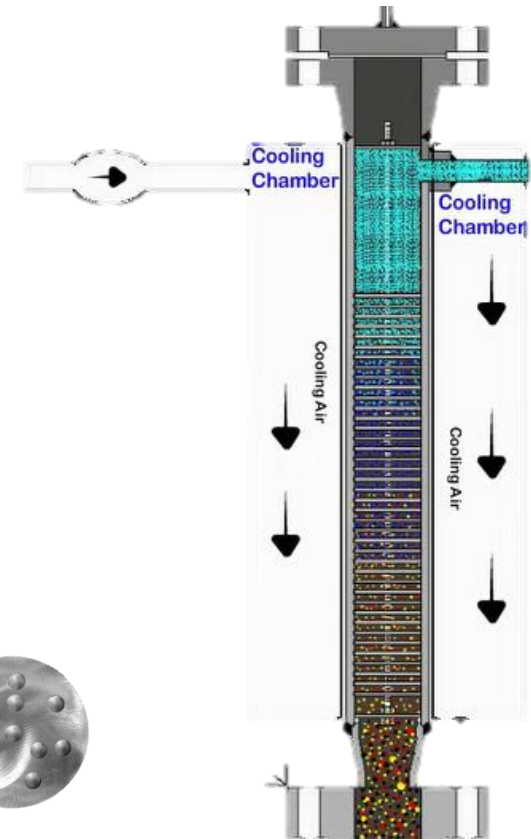
## CRACKING FURNANCE ANALYSIS TREND WITH 1221 PROBE

- No water carryover
  - Stable outlet temperature with change in ambient conditions.
  - This allows operations to optimize process.
- Overcracking results in coke formation.
- Undercracking results in reduction of production.



## Model 1221 – How does it work?

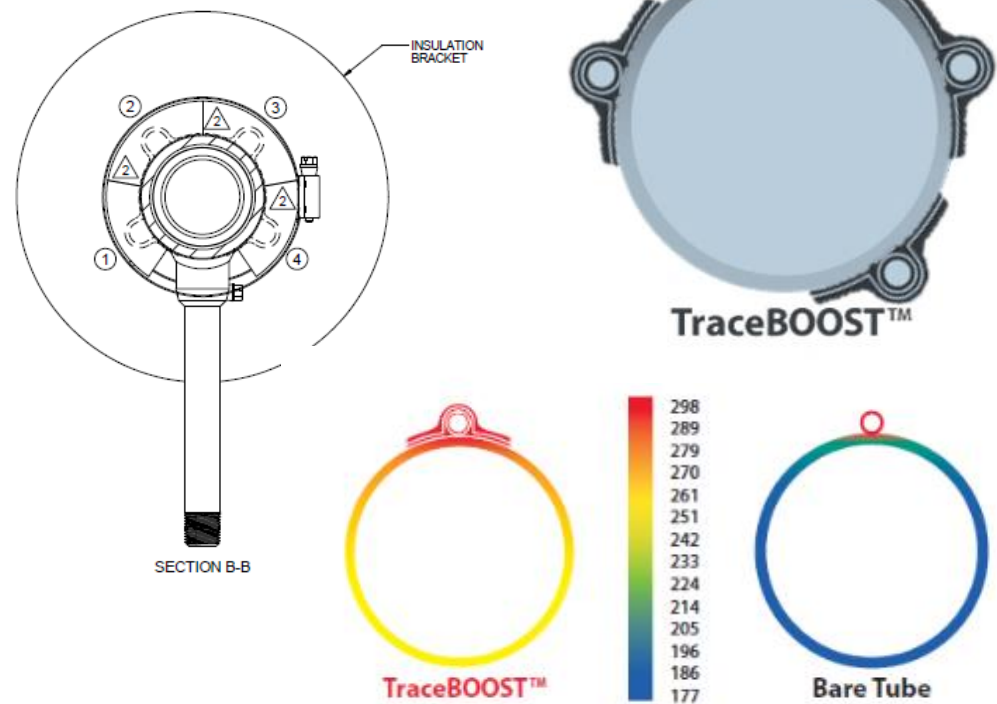
- The separation chamber is cooled to 40-65 °F (4-18 °C) via a Vortex tube
- Hot, wet sample passes through the chilled chamber
- Distillation discs in chamber cool the sample
- Water and heavy hydrocarbons condense
- They drop back into process stream – process commonly called “Reflux Action”



## Model 1221 – (Cooling Capabilities)

### ■ TraceBoost™ Technology

- Technology developed by Control Southeast Inc. for optimizing heat transfer and temperature profile.
- Transfers uniform cooling via conductive heat transfer
- Causes more even distribution of cooling
- Helps minimize Vortex air consumption
- No risk of cooling media leaking into process



## Model 1221 – (Cooling Capabilities)

### ■ Insulation

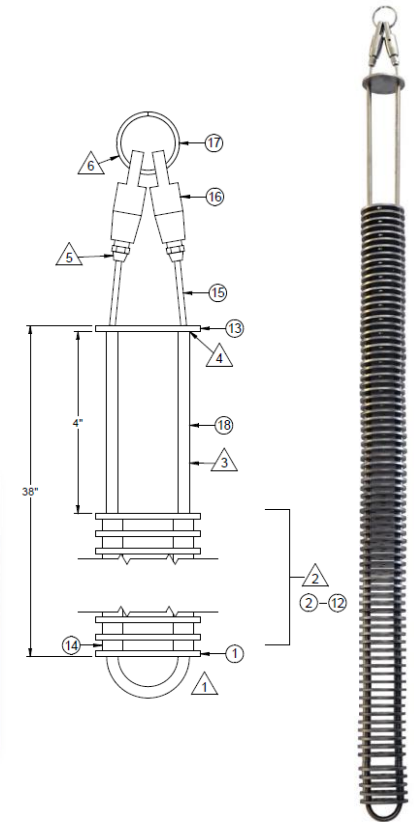
- Encapsulated thermal insulation is used to prevent ambient air temperature bias
- The robust PVC based coating on the cooling chamber provides a barrier to protect the thermal insulation and prevents damage during maintenance or collateral activities





## Model 1221 – (Maintenance)

- Distillation Discs Assembly
  - Easy to maintain
    - Cable Lift Design - can remove internals, clean, and reinsert into probe
  - Easy to install
    - Eyelet allows easy installation onto process valve.
  - Internals can be removed without removing entire probe
    - **Safety Solution - entire probe pipe does not have to be removed for cleaning of internals**
    - Options steam clean port for internals
- Wire prevents discs from rotating
  - Ensures tortuous path through discs



## Typical Air Consumption (SCMH)

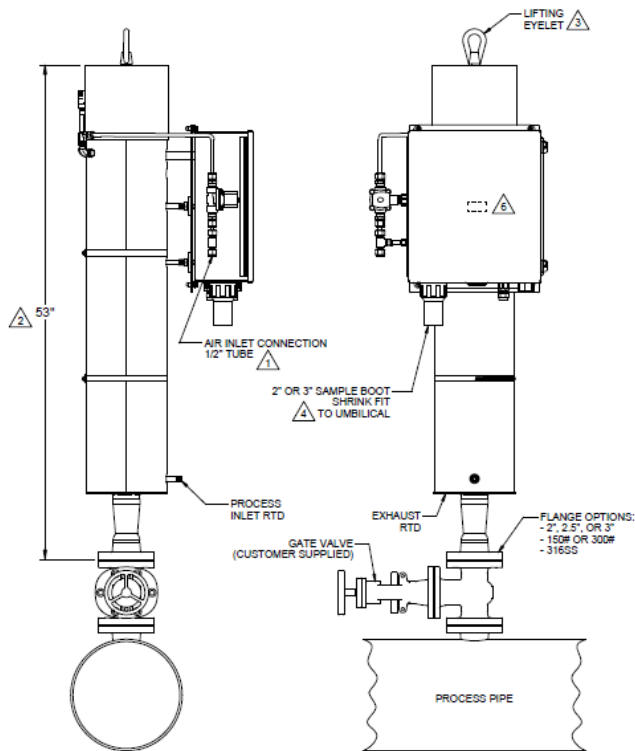
		Duty Cycle					
		5.00%	10.00 %	20.00 %	30.00 %	40.00%	50.00%
Instrument Air Pressure [barg]	5.5	2.8	5.6	11.2	16.8	22.4	28.1
	6.2	3.1	6.2	12.4	18.6	24.8	31.0
	6.9	3.4	6.8	13.6	20.4	27.2	34
	7.6	3.7	10.2	14.8	22.2	29.6	36.9
	8.6	4.1	8.3	16.6	24.8	33.1	41.4



Recommended Instrument Air Pressure 6.9 – 8.6 barg  
 Typical Duty Cycle 8 – 10%  
 Sample Inlet Temperature 121°C, Flow Rate 5L/min  
**Air Consumption 5.1 – 6.8 SCMh**







# THANK YOU FOR YOUR TIME

## Questions?