

*Sample Systems Specialists  
For Gas Analysis Systems...*



**A Team for Process & Compliance Solutions!**



# Company Background

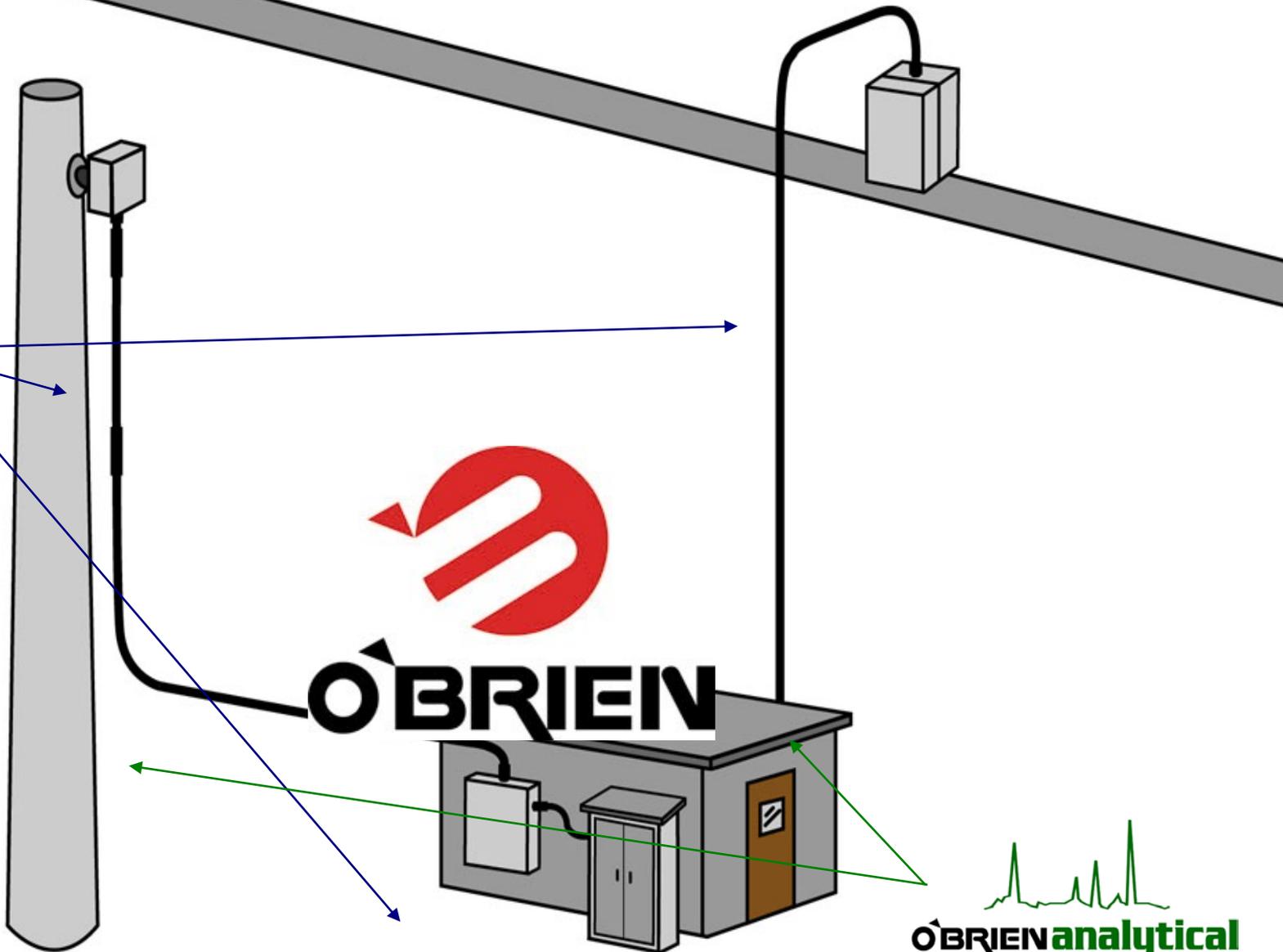


- In Business Since 1990 w/Corporate Offices in Carson City Nevada
- Have 24,000 Sq/ft. Building For Manufacturing & Administration
- Additional Capability - Machine Shop (Lathes, Mills, CNC, Etc.)
- Ship Products Globally
- Made In The USA

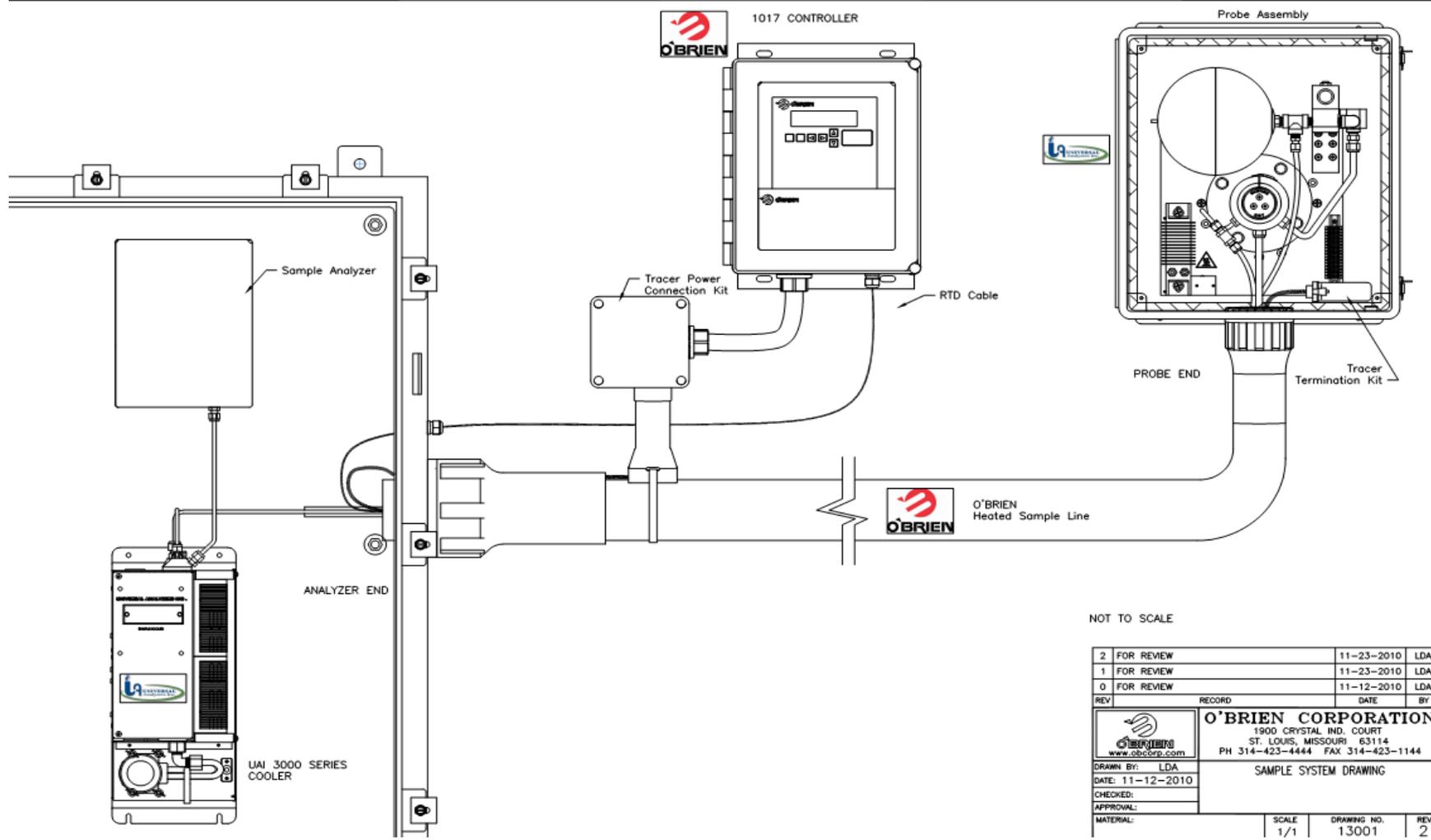


# What we manufacture ...

- Gas Coolers / Chillers
- Gas Sample Probes
- NH<sub>3</sub> Convertors
- Sample Conditioning Systems
- Multi-Point Sequencers
- Heated Sample Line



# One Source: Probe » Sample Line » Sample Conditioning



NOT TO SCALE

2	FOR REVIEW	11-23-2010	LDA
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0	FOR REVIEW	11-12-2010	LDA
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 <b>O'BRIEN CORPORATION</b> 1900 CRYSTAL IND. COURT ST. LOUIS, MISSOURI 63114 PH 314-423-4444 FAX 314-423-1144			
DRAWN BY: LDA			
DATE: 11-12-2010			
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APPROVAL:			
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# We are currently supplying our customers with ...

- Application Assistance and Recommendations
- Proposed Solutions & Engineering Design
- Hardware

# Examples of considerations for an Extractive Sampling System

- Straight Extractive or Dilution Extractive?
  - **Determines the style of probe and analyzers**
- What are we measuring & how many analyzers will be used?
  - **Used to determine flow rate requirement & pump / cooler sizing**
- How much dust should we expect at the point of measurement?
  - **Used to determine filter sizing and blow back feature requirement**
- Particle size if it can be determined?
  - **Used to determine what the porosity size of our filters should be**
- How much water is present in vol %?
  - **Used to determine proper gas cooler sizing**

# Examples of considerations for an Extractive Sampling System

- Temperature, Pressure, Velocity & other compounds in the measured gas stream
  - **Used to determine material types, maintain temperatures & any extra support issues**
- How long should sample line be?
  - **Because we need to know**
- Voltage, Maintain & Ambient temperature for heated sample line bundle
  - **Used for design of heater and insulation requirement**
- Hazardous Area Classification or General Purpose
  - **Used for design of heater and insulation requirement**

# Sample Probes

Gas Coolers

Heated Sample  
Line

Sample  
Conditioning  
Systems

Accessories



# Types of gas sample probes ...

- Extractive - Non-Dilution
- Extractive - Non-Dilution with NH<sub>3</sub> Converter
- Extractive - Non-Dilution for High Dust Loading
- Extractive – Hazardous Area Classifications
- Extractive - Process
- Dilution

# Heated Sample Probes

## What is the real purpose ...

- Junction Between the Process / Point of Measurement and the Heated Sample Line
- Initial Point of Filtration
- Keeps Gas Sample Heated and in a Gas Phase - Avoid Cold Spots
- Designed to Avoid Condensation Drop Out
- Provides Dilution of Gas Sample
  - Dilution CEMS (e.g. Part 75 compliance)

# SAMPLE PROBE CONSIDERATIONS / OPTIONS

- Enclosure
  - Fiberglass
  - Stainless Steel
- Interior Enclosure Heater with insulation
- Filter Temperature (340 or 375 deg F)
- Temperature control (switch or controller)
- Flange Sizes
- Tube length and Material
- Filter Size
- Probe tip filters
- Blow Back
- Hazardous or General Purpose

# 270S Common Configuration



- Used For Low to Moderate Dust Loading Applications
- Fiberglass Enclosure
- Heat Shrink Boot for heated sample line
- Blow Back Option with accumulator tank & solenoid valve
- 340 deg F Temperature Control
- 4" ANSI Flange
- NEMA 4X Protection

# 270SF SAMPLE PROBE FLANGE

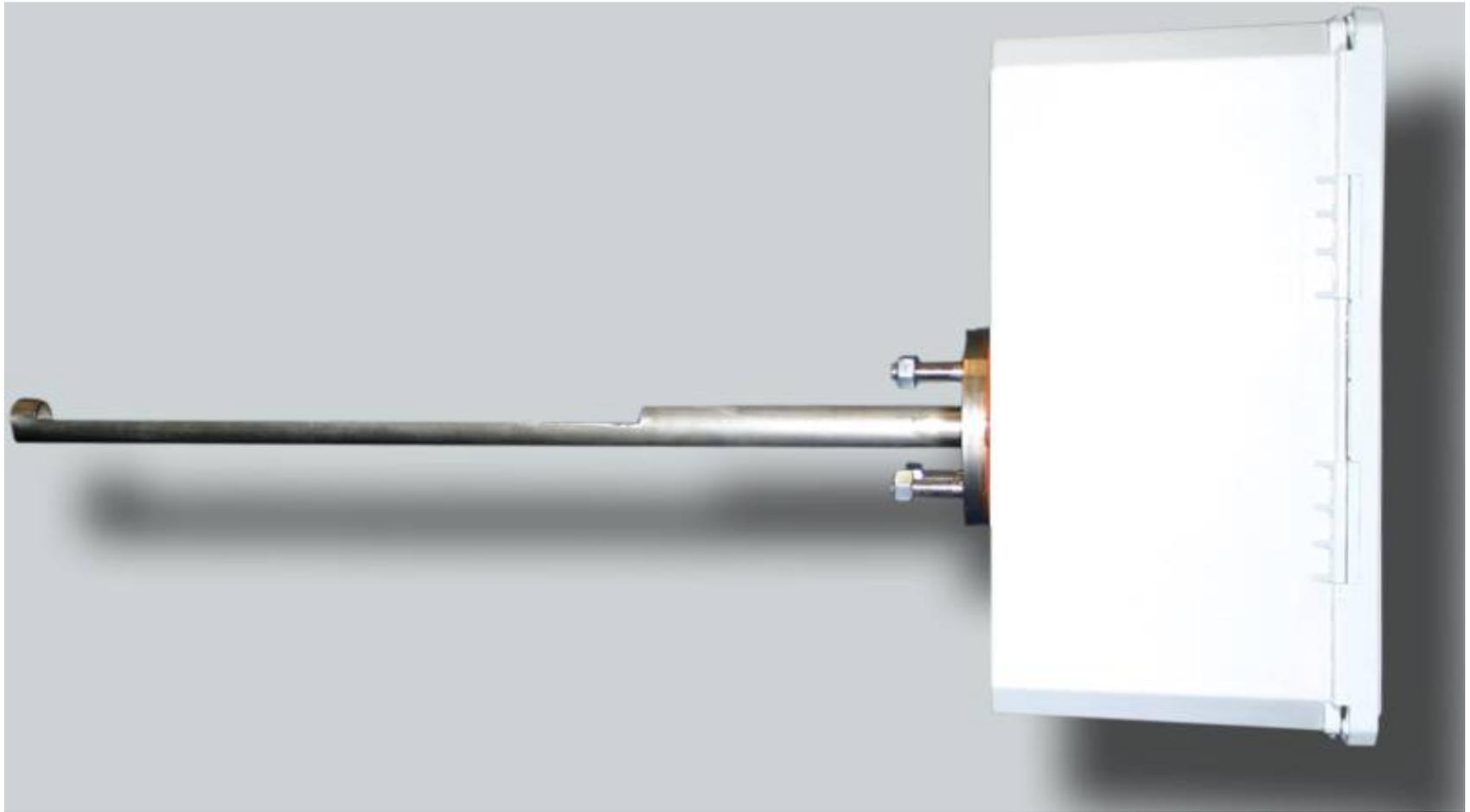


- **Physically Sized to allow for all common flange sizes**
- **Sub-Flange design allows for the removal of filter chamber without removing 270S enclosure from stack**
- **Comes Standard with 3" probe tube support collar as a vertical play reducer –relieves probe tube threads from stress related to probe tube flexing**

# 270 Filter Element



- 3" Ceramic 2-micron standard
- Consumable
- Stainless Steel (optional)
- Can be cleaned in an Ultrasonic bath
- Glass fiber (optional)
- Gas flow path from inside - out



# Universal Analyzers: Making Installation Easy



- Accumulator Tank for Blowback - EXTERNAL
- Electrical connections – EXTERNAL
- Pneumatic connections - EXTERNAL
- Heat Shrink Sample Line - NO
- NEMA 4X enclosure - NO
- Room in enclosure for other components - NO

- Accumulator Tank for Blowback - INTERNAL
  - Electrical connections - INTERNAL
  - Pneumatic connections - INTERNAL
  - Heat Shrink Sample Line Entry – YES
  - NEMA 4X enclosure - YES
  - Room for other components - YES
- All Within Enclosure



# 275E Gas Sample Probe



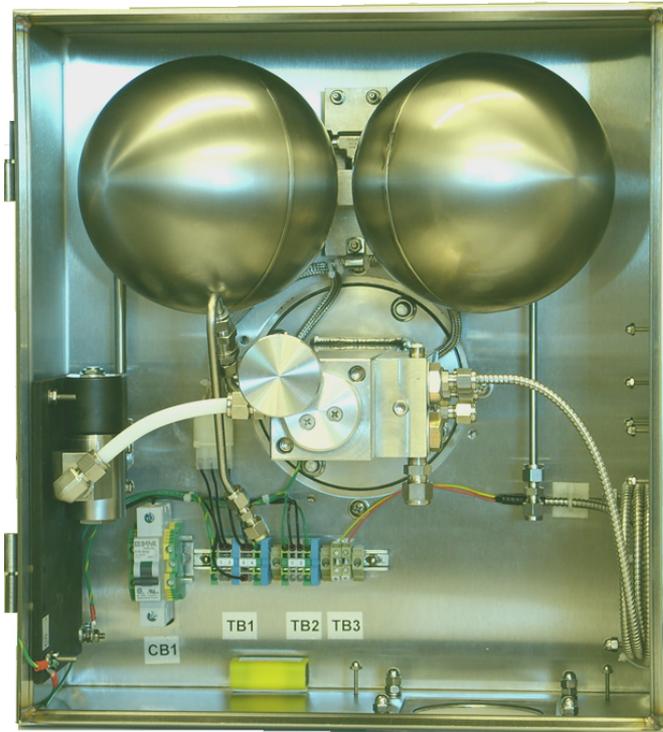
- Used For Higher Dust Loading Applications
- 9" Stainless Steel Filter Element – 2 $\mu$ m
- Dual Accumulator Tanks For High Efficiency Blow-Back
- Incorporates a Pneumatically Controlled Isolation Valve
- Blow-Back Over Filter Element & Inside Out of Tip Filter
- Standard Stainless Steel NEMA Type Enclosure
- Very Easy To Remove Filter Element –No Tools Required

# 275E Filter Element



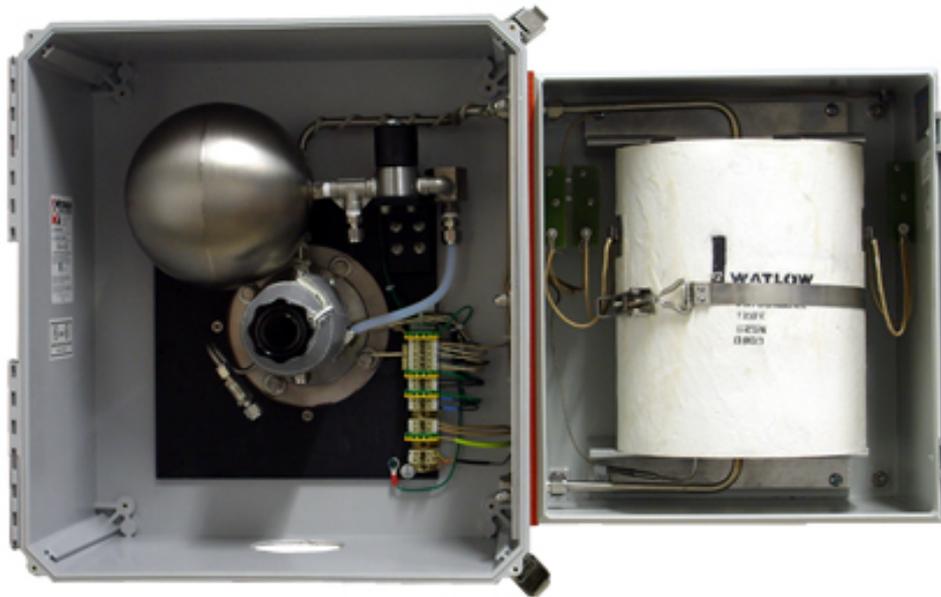
- Woven / Layered Stainless Steel
- Can be cleaned in an Ultrasonic bath
- Gas flow path from inside - out

# 275HD Dilution Probe



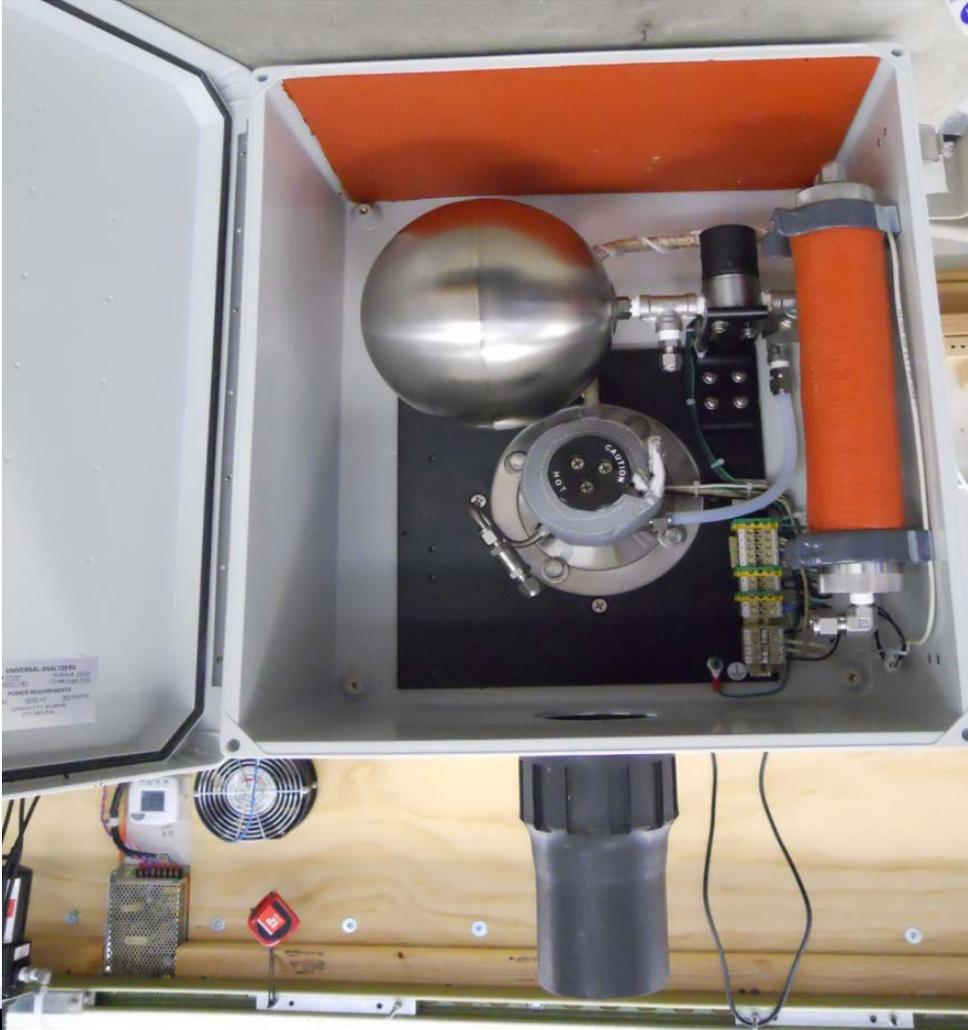
- Standard with NEMA 4X SS Enclosure
- Mechanical filter insert and removal
- Standard With Heat Shrink Boot for Heated Sample Line
- Enclosure Large Enough to Accept All Common Flange Sizes  
–No Adapter Necessary
- Welded Studs on Flange – Customer Does Not Need to Supply
- Orifice/Eductor Manifold with unique bolt design and Sapphire Orifice

# 270 Sample Probe w/ $\text{NH}_3$ Converter



- 270 with 550°F heated filter
- Two sample outlets
- Heated transition between filter chamber and converter
- Stainless Steel catalytic cartridge in separate enclosure
- 1200 watt heater with thermocouple for remote temperature control
- Used primarily in “ $\text{NO}_x$  Differential” gas analyzer systems for measuring  $\text{NH}_3$  slip after an SCR

# Sample Probe w/ Ammonia Scrubber



# Probe Tubes

- 316 Stainless Steel – Good up to 1150°F (most common)
- 310 Stainless Steel – Good to 2000°F (not good for corrosive environments)
- Inconel – Good up to 1600°F
- Hastelloy C276 for temperature and / or corrosion resistance – Good to 1850°F
- Hastelloy X for temperature and / or corrosion resistance – Good up to 2150°F
- Ceramic – Good up to 2500°F

# ... and even more Probe Tubes

- Heated Probe Tubes – used if there is a dew point issue at the point of measurement – the transition from stack to flange
- Probe Tip Demister - use after a wet scrubber – raining in stack
- Other materials available upon request

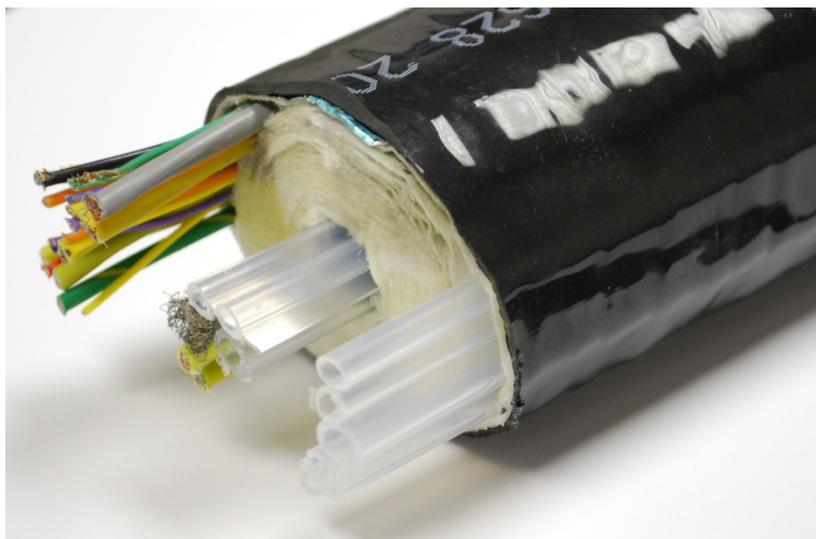
# Temperature Control

- Type K thermocouple temperature sensor provided on orifice / eductor manifold for Dilution Probe
- T/C or RTD can be used on any UAI probe configuration
- Electronic temperature controller required – normally located in probe controller at CEMS shelter
- As retrofit or as an option the electronic temperature controller can be provided in a junction box attached directly to the probe enclosure

# Probe Tip Filter



# High Velocity Probe Tube Duct / Exhaust Flows of over 125 fps



# Sample Probes Heated Sample Line

Gas Coolers

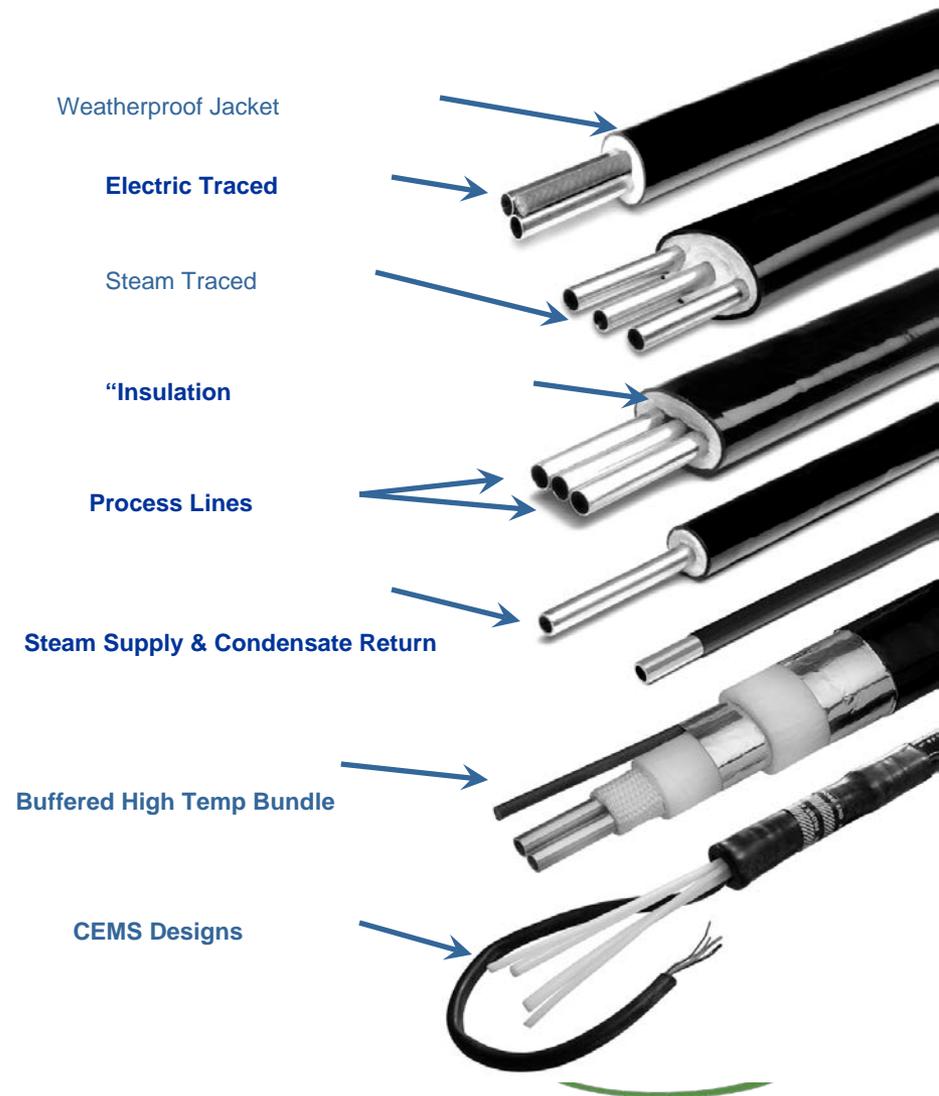
Sample  
Conditioning  
Systems

# Important Heated Sample line Design Re Required Information

- Run Length
- Power Supply
- Dew point / Maintain Temperature/ Control
- Types of Tube Material
- Ambient Conditions
- Circuit Breaker Sizing
- Installation
- Hazardous Area Classification
- Electrical Classification
- Insulation Thickness

# Anatomy of a Tubing Bundle

- A tubing bundle is a small diameter tube or group of tubes packaged in an insulated, weatherproofed jacket. It's steam or electric traced to provide freeze protection or temperature maintenance.
- Piping and installation of flow, level, and pressure transmitters.
- Analyzer sample transport.
- Steam and condensate.

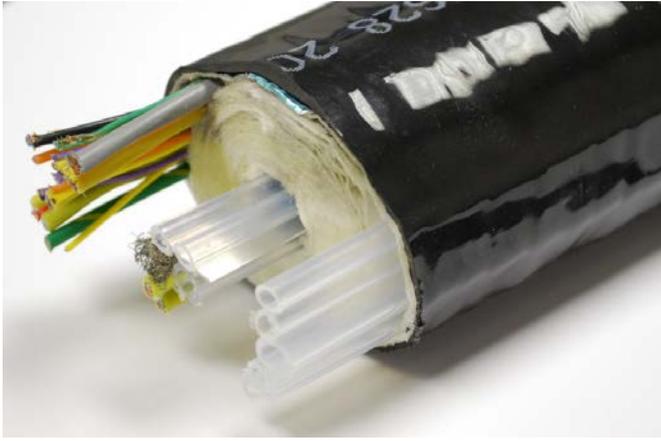


# Tubing Selection for Process Applications



- Teflon: Inert but temperature limitations (dew point temperature), permeation
- Stainless Steel: welded, seamless but cleanliness and adsorption problems with some applications
- Electro Polished: improved surface finish for improved adsorption resistance
- Electro Polished/Coated: for a product that is inert as Teflon but strong as steel

# Two Bundle Approach



## Probe Support Bundle

- Bigger isn't always better
- Two Umbilical's: Heated and Un-Heated Support



# Bending the Bundle

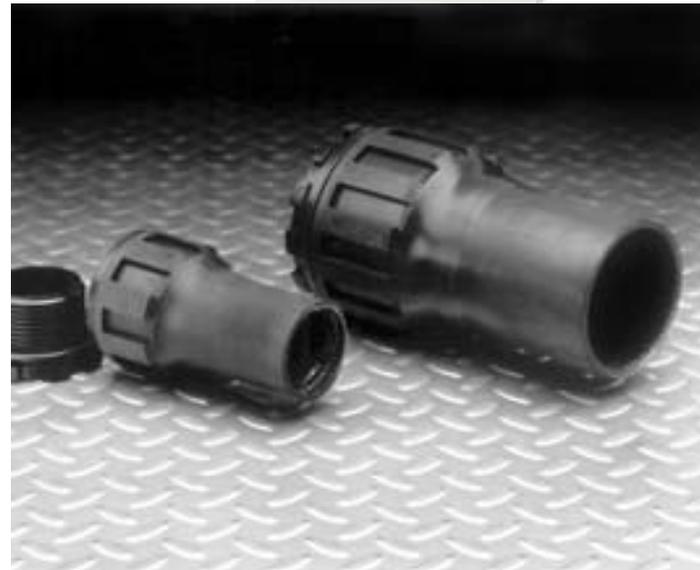
- The jacket will wrinkle when the bundle is bent. This is a normal condition and does not affect the performance or life of the bundle.
- Do not exceed the minimum bending radius of 8" (200mm).
- Use the O'Brien Bundle Bending Tool or a mandrel with the minimum bending radius such as a small spool.
- The bundle will tend to twist and then bend on this dimension naturally.



Poor insulation  
which can lead to  
failure



# IMPORTANT: Sealing the Ends



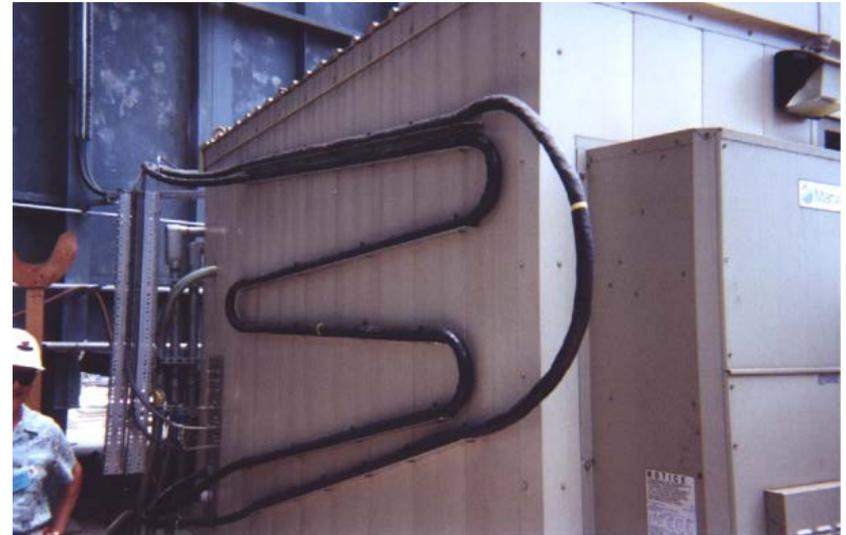
# Common Umbilical Failures



- **Over temperature causing bundle component damage (tracer, tube, jacket)**
  - **Could result in electrical short or fire**
  - **Bundle no longer maintains temperature**
  - **Tube plug or leak**
- **Bundle won't maintain desired temperature**

# Improper Installations

- Measure Twice
- Poor Routing
- Improper Supports





## Installation Best Practices

Proper Installation IS  
CRITICAL.

**Bundles require 1/2" gap between them to give up their heat and should not be clamped tight as it causes hot spots in the bundle.**

**CORRECT**



The bundle should not be compressed when installed properly. (see above)



**NEEDS SPACING**

**TOO TIGHT**

# Sample Probes

## Gas Coolers

### Sample

### Conditioning

### Systems



# Gas Coolers

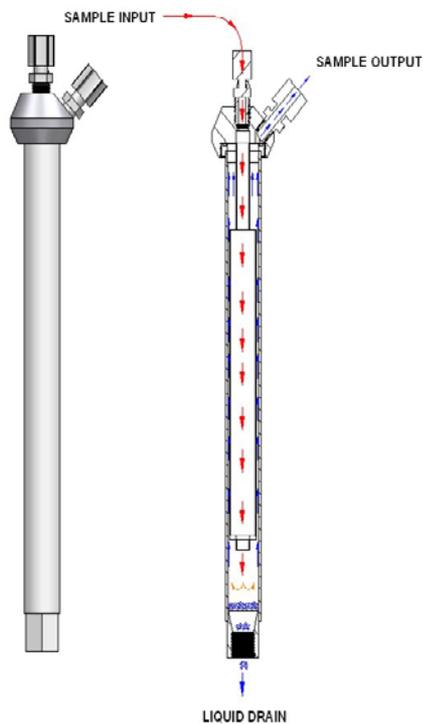
## What is the real purpose ...

- Sample must have a dew point no higher than 5 - 7 deg C for most analyzers
- Lower dew point to condense water from a wet gas sample
- Universal Analyzer coolers lower dew point to 4 deg C for standard units and -30 deg C for “Freezer Chiller”
- Universal Analyzer coolers minimize loss of water soluble gasses such as NO<sub>2</sub> and SO<sub>2</sub>

# Types of Gas Coolers

- **Thermoelectric**
  - Solid state Peltier effect cooler
  - Most common cooler type for UAI
- **Compressor**
  - Refrigeration type gas cooler
  - Adjustable temperature set point
- **Vortex**
  - Compressed Air cooler
  - No electricity required
  - Perfect for Hazardous Areas

# Gas Cooler Flow Path



- Tube within a tube design
- Inner tube insulated / isolated from outside chilled walls of heat exchanger
- Gas stays hot until it exits bottom of inner tube and flash dries
- Condensate forms and is continuously drained
- Dry gas travels up annular space to exit of heat exchanger
- By design we minimize contact of the condensate and the gases being measured

# Heat Exchanger / Impinger



**Stainless Steel**



**Glass / Kynar  
Glass barrel with  
Kynar top and  
bottom with  
drilling for fitting  
connections**

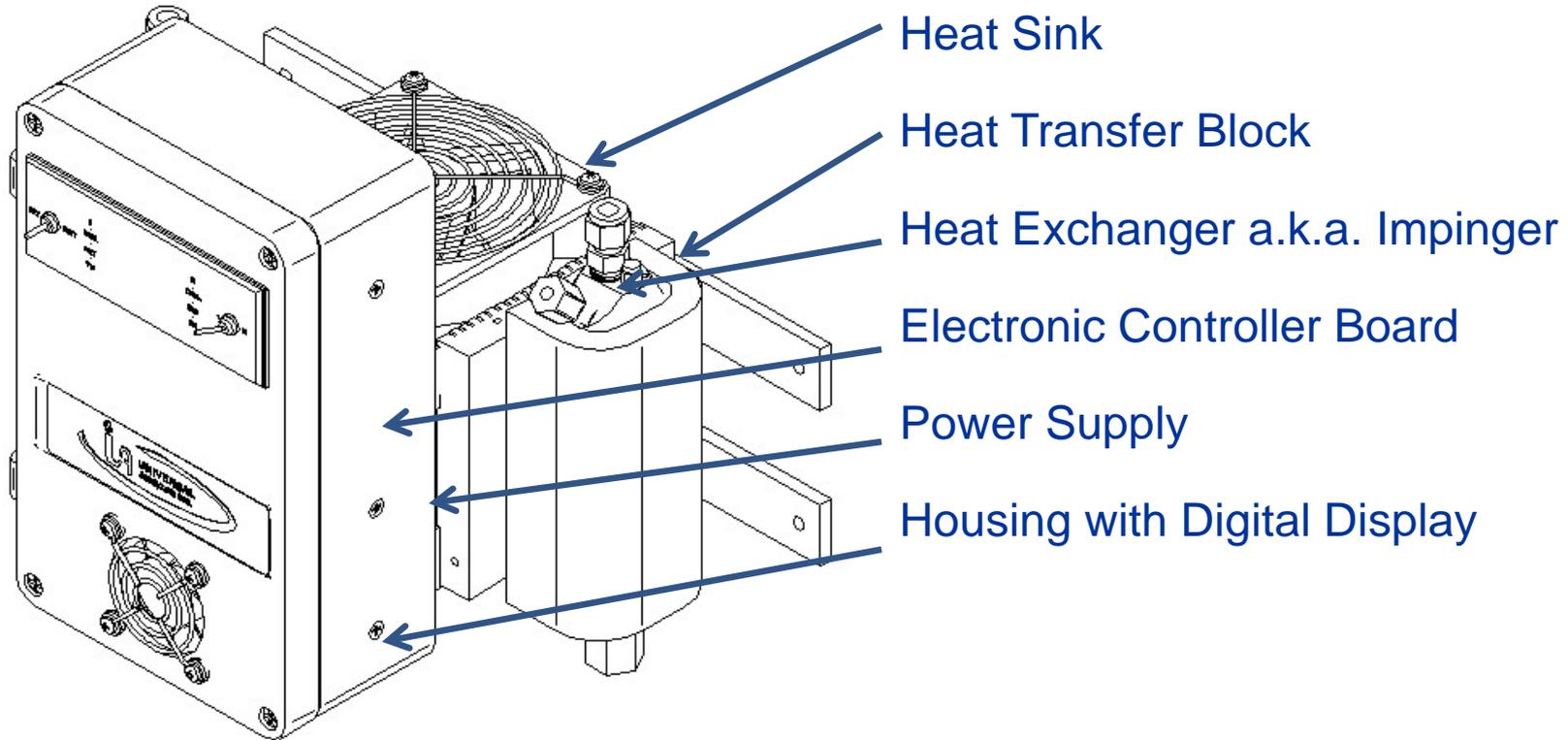
# Gas Cooler Selection Chart

- Aid to help determine model number based on ...
  - Flow rate
  - Ambient temperature
  - Percentage water content

## THERMO-ELECTRIC 41°F (5°C) OUTLET DEWPOINT

% WATER	520	530	540	560	570	620	630	640	1040	1050	1060	1080	1090	3040	3050	3080
<b>77°F (25°C)</b>																
<b>12%</b>	2.5 l/m	4 l/m	5 l/m	5 l/m	8 l/m	2.5 l/m	4 l/m	5 l/m	5 l/m	8 l/m	8 l/m	10 l/m	15 l/m	6 l/m	8 l/m	10 l/m
<b>15%</b>	2 l/m	4 l/m	4 l/m	4 l/m	8 l/m	2 l/m	4 l/m	4 l/m	4 l/m	8 l/m	8 l/m	9 l/m	15 l/m	5 l/m	8 l/m	8 l/m
<b>30%</b>	1 l/m	4 l/m	2 l/m	2 l/m	8 l/m	1 l/m	4 l/m	2 l/m	2 l/m	8 l/m	5 l/m	5 l/m	15 l/m	2.8 l/m	7 l/m	4 l/m
<b>50%</b>	0.6 l/m	4 l/m	1 l/m	1 l/m	8 l/m	.6 l/m	4 l/m	1 l/m	1 l/m	8 l/m	3 l/m	3 l/m	15 l/m	1.4 l/m	6 l/m	2 l/m
<b>90°F (32°C)</b>																
<b>12%</b>	2 l/m	3 l/m	4 l/m	4 l/m	7 l/m	2 l/m	3 l/m	4 l/m	4 l/m	7 l/m	8 l/m	9 l/m	11 l/m	5 l/m	6 l/m	8 l/m
<b>15%</b>	1.8 l/m	3 l/m	3.5 l/m	3.5 l/m	7 l/m	1.8 l/m	3 l/m	3.5 l/m	3.5 l/m	7 l/m	8 l/m	8 l/m	11 l/m	4 l/m	6 l/m	7 l/m
<b>30%</b>	0.9 l/m	3 l/m	1.8 l/m	1.8 l/m	7 l/m	0.9 l/m	3 l/m	1.8 l/m	1.8 l/m	7 l/m	4 l/m	4 l/m	11 l/m	2 l/m	5.5 l/m	3.5 l/m
<b>50%</b>	0.5 l/m	3 l/m	0.9 l/m	0.9 l/m	7 l/m	0.5 l/m	3 l/m	0.9 l/m	0.9 l/m	7 l/m	2 l/m	2 l/m	11 l/m	1 l/m	4.5 l/m	1.8 l/m
<b>105°F (41°C)</b>																
<b>12%</b>	1.5 l/m	2 l/m	3 l/m	3 l/m	4 l/m	1.5 l/m	2 l/m	3 l/m	3 l/m	4 l/m	8 l/m	7 l/m	6 l/m	2.8 l/m	3 l/m	4.6 l/m
<b>15%</b>	1.2 l/m	2 l/m	2.5 l/m	2.5 l/m	4 l/m	1.2 l/m	2 l/m	2.5 l/m	2.5 l/m	4 l/m	6 l/m	5 l/m	6 l/m	2.4 l/m	3 l/m	4 l/m
<b>30%</b>	0.6 l/m	2 l/m	1.3 l/m	1.3 l/m	4 l/m	0.6 l/m	2 l/m	1.3 l/m	1.3 l/m	4 l/m	3 l/m	3 l/m	6 l/m	1.2 l/m	2.5 l/m	2.2 l/m
<b>50%</b>	0.3 l/m	2 l/m	0.7 l/m	0.7 l/m	4 l/m	0.3 l/m	2 l/m	0.7 l/m	0.7 l/m	4 l/m	1.5 l/m	1.5 l/m	6 l/m	0.6 l/m	2 l/m	1.1 l/m

# Components of Thermoelectric Cooler



# 500 Series Gas Cooler



- One to four 5" heat exchangers
- One or two gas streams
- Flow rates from 1 – 5 l/m STP
- Digital display
- Adjustable temperature set point
- Stable dew point
- On-board electronics for liquid sensor

# 600 Series Gas Cooler



- Ideal for OEM & system integrators
- External power supply required – usually provided by OEM
- One or two 5” heat exchangers
- Flow rates from 2.5 – 5 l/m STP
- Small footprint
- One or two gas streams
- Adjustable temperature set point
- Stable dew point
- On-board electronics for liquid sensor

# 1000 Series Gas Cooler



- One to four 10" heat exchangers
- One or two gas streams
- Flow rates from 4 – 16 l/m STP
- Digital display
- Adjustable temperature set point
- Stable dew point
- On-board electronics for liquid sensor

# 3000 Series Gas Cooler



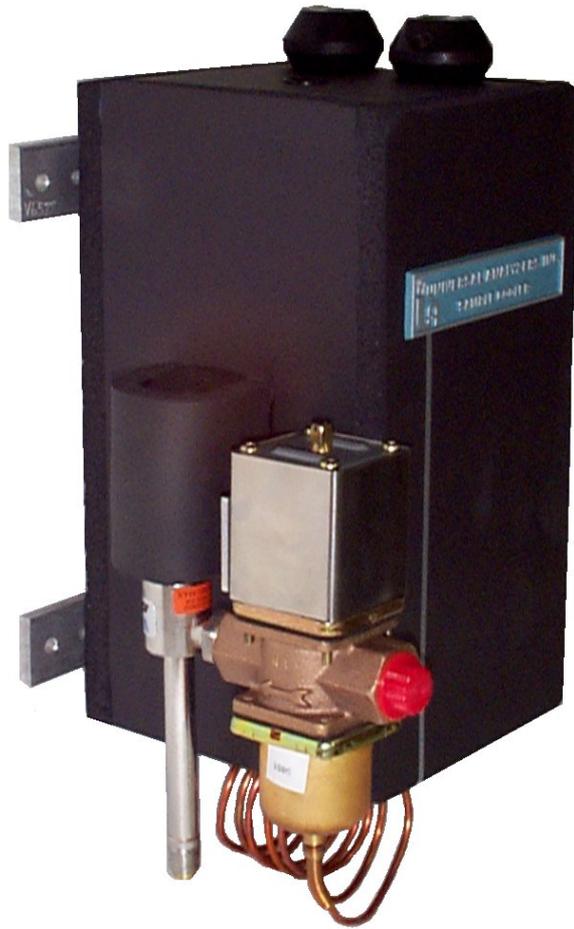
- One or two 10" heat exchangers
- One or two gas streams
- Flow rates from 4 – 8 l/m STP
- Digital display
- Adjustable temperature set point
- Stable dew point
- On-board electronics for liquid sensor
- FM approved CI I, Div 2, ABCD
- Wall mount with integrated accessories
  - Sample pump
  - Water slip detector
  - Drain pump

# 5000 Series Gas Cooler



- One or two 5" heat exchangers
- One or two gas streams
- Flow rates from 1 – 8 l/m STP
- Compressor controlled
- Digital display
- Adjustable temperature set point
- Stable dew point
- On-board electronics for liquid sensor

# Vortex Gas Cooler



- One or two 10" heat exchangers
- One or two gas streams
- Flow rates from 1 – 6 l/m STP
- No electricity required
- Can be installed in CL I, Div. 1 areas
- Adjustable temperature set point
- Stable dew point

# Freezer Chiller - why?

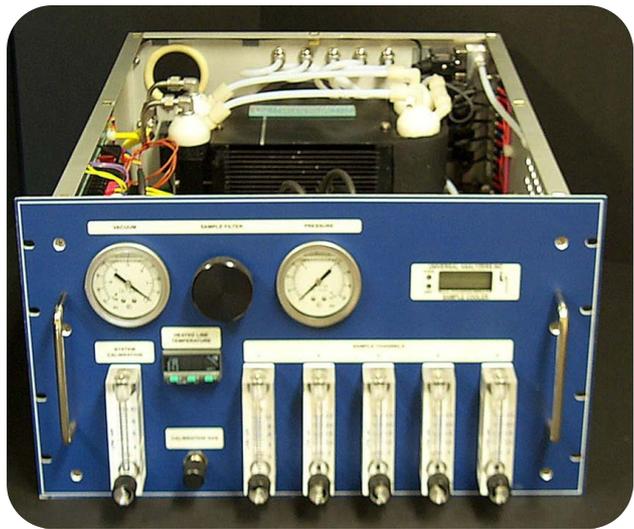
- Standard gas cooler @ 5 deg C dew point still has  $\approx 0.8\%$  H<sub>2</sub>O by volume.
- Freezer chiller @ -25 deg C dew point removes H<sub>2</sub>O down to  $\approx 0.03\%$  H<sub>2</sub>O by volume
- SO<sub>3</sub> & H<sub>2</sub>O combine to form H<sub>2</sub>SO<sub>4</sub>.
- Do not know of an SO<sub>3</sub> only scrubber.
- Must remove as much H<sub>2</sub>O as possible to minimize formation of H<sub>2</sub>SO<sub>4</sub> which forms in gas cooler as acidic aerosol.

# Freezer Chiller



- Special configuration for SO<sub>2</sub>/SO<sub>3</sub> (acidic) aerosols
- Dew point -25 deg C
- Flow rates from 2.5 – 5 l/m STP
- Digital display
- PLC controlled – “Smart” cooler
  - Automatic switching
  - Pre-cooling of next up freezer heat exchanger
- Complete system including:
  - Sample pump
  - Peristaltic pump
  - Filter with liquid sensor
  - Pressure and flow switches

Sample Probes  
Gas Coolers  
**Sample  
Conditioning  
Systems**  
Accessories



# Sample Conditioning Systems

## What is the real purpose ...

- Analyzer may not be compatible with pressure, temperature or moisture content of extracted sample.
- Prepare the sample for analysis without affecting relative concentration of components.
- Typically include some or all of the following:
  - Cooler
  - Pump (sample and / or peristaltic)
  - Flow meter
  - Pressure regulator
  - Solenoid valves
  - Alarms

# Sample Conditioner Drawer



# Universal Analyzer Capabilities



# Sample Conditioning System 19" U-Bracket



# Portable Sample Systems



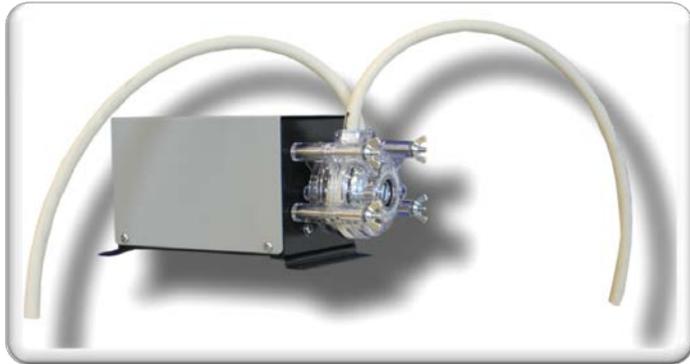
- One or two 5" heat exchangers
- One gas stream
- Flow rate options of 2.5 or 5 l/m STP
- Includes:
  - Gas cooler
  - Sample pump
  - Peristaltic pump
  - Flow meter
  - Water carry-over sensor
  - Digital temperature display
  - Stainless steel case
  - Carrying handle and feet
  - Approx: 16 kg

# Portable Sample System



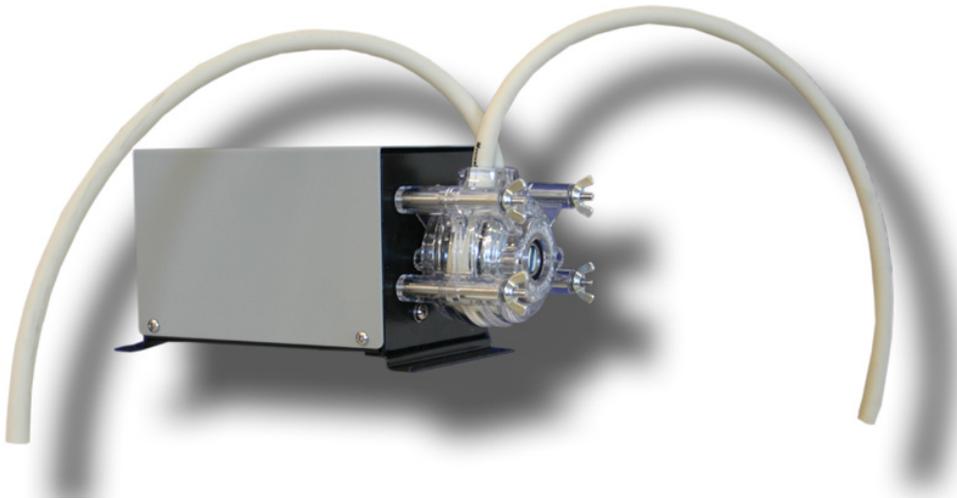
- One or two 10" heat exchangers
- One or Two gas streams
- Flow rate options of 4 or 8 l/m STP
- Includes:
  - Gas cooler
  - Sample pump
  - Peristaltic pump
  - Flow meter
  - Water carry-over sensor
  - Digital temperature display
  - Stainless steel case
  - Carrying handles and feet
  - Approx: 36 kg

Sample Probes  
Gas Coolers  
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# Accessories

Peristaltic Pump



Positive Pressure Liquid Drain



# Accessories



**Filter with Liquid  
Sensor Port**



**Filter**



**Liquid Sensor**

**WE THANK YOU FOR YOUR TIME!!!**

**BOB BERTIK  
UNIVERSAL ANALYZERS / O'BRIEN ANALYTICAL  
(805) 218-2746**

