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
- NH3 Convertors
- Sample Conditioning Systems
- Multi-Point Sequencers
- Heated Sample Line
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
  o Used to determine material types, maintain temperatures & any extra support issues

• How long should sample line be?
  o Because we need to know

• Voltage, Maintain & Ambient temperature for heated sample line bundle
  o Used for design of heater and insulation requirement

• Hazardous Area Classification or General Purpose
  o 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 NH3 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
  o 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 - 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

• 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
275E Gas Sample Probe

- Used For Higher Dust Loading Applications
- 9” Stainless Steel Filter Element – 2µm
- 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/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 “NO$_x$ Differential” gas analyzer systems for measuring NH3 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
quired 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 $\frac{1}{2}$” gap between them to give up their heat and should not be clamped tight as it causes hot spots in the bundle.

The bundle should not be compressed when installed properly. (see above)
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 NO₂ and SO₂
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

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<th>% Water</th>
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Components of Thermoelectric Cooler

- Heat Sink
- Heat Transfer Block
- Heat Exchanger a.k.a. Impinger
- Electronic Controller Board
- Power Supply
- Housing with Digital Display
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 ≈ 0.8% H₂O by volume.
- Freezer chiller @ -25 deg C dew point removes H₂O down to ≈ 0.03% H₂O by volume
- SO₃ & H₂O combine to form H₂SO₄.
- Do not know of an SO₃ only scrubber.
- Must remove as much H₂O as possible to minimize formation of H₂SO₄ which forms in gas cooler as acidic aerosol.
Freezer Chiller

- Special configuration for SO2/SO3 (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
Sample Conditioning Systems
Accessories
Accessories

Peristaltic Pump

Positive Pressure Liquid Drain
Accessories

Filter with Liquid Sensor Port

Filter

Liquid Sensor
WE THANK YOU FOR YOUR TIME!!!

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