Refinery and Petrochemical Sample Probes and Sample Systems for Gas Analysis

Cemtek Environmental Emissions Monitoring Seminar and Training Users Group Meeting September 2016

UNIVERSAL Analyzers Inc.

What we manufacture …

Sample Probes

Multi-Point Probe tubes

Heated Sample Line

Gas Coolers

Sample Conditioning Systems

Instrument Enclosures

Accessories

ONE SIZE DOES

NOT FIT ALL

Examples of considerations for an Extractive Sampling System

- Straight Extractive or Dilution Extractive
- What are we measuring & how many analyzers will be used?
- How much dust should we expect at the point of measurement?
- Particle size if it can be determined?
- How much water is present in vol %?

Examples of considerations for an Extractive Sampling System

- Temperature, Pressure, Velocity & other compounds in the measured gas stream
- How long should sample line be?
- Voltage and Area Classification

Sample Probes

Gas Coolers

Heated Sample Line

Sample Conditioning Systems

Accessories

Heated Sample Probes
There 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 Avoiding Pre-Mature Condensate Drop Out
- Provides proper representation of sample with properly engineered and placed probe tube

SAMPLE PROBE CONSIDERATIONS / OPTIONS

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

Class / Division Definitions

Class I **-** Contains flammable gases or vapors in quantities large enough to produce an explosion.

Class II **-** Is hazardous due to the presence of combustible dust in the air.

Class III **-** Contains easily ignitable fibers or flyings in the air. However, the quantities of fibers and flyings suspended in the air are not likely to be large enough to cause an explosion.

Division 1 - There is a high probability of an explosive atmosphere in normal operation. This can be for part of the time, up to all the time.

Division 2 - There is a low probability of an explosive atmosphere being present during normal operation.

*Group designations further define the types of gases, and dusts (A, B, C, D) (E, F, G)

*Example of an American certification would be:

- **Class I, Div 1, Groups A, B and C; Class II, Div 2, Groups F and G**

Common Model 270 Configuration

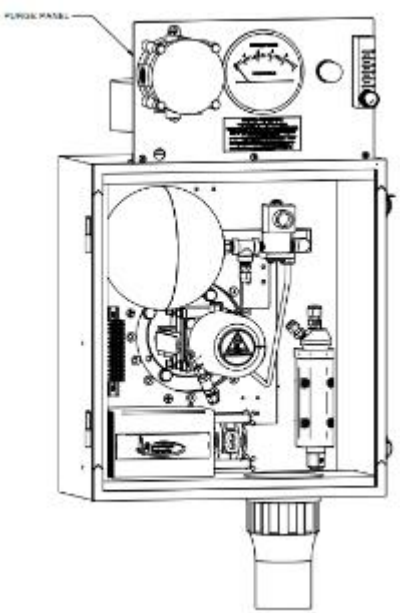
- Used For Low to Moderate Dust Loading Applications with a 3” long, 2-micron filter element
- Fiberglass Enclosure
- Heat Shrink Boot for heated sample line
- Blow Back Option with accumulator tank & solenoid valve
- 340 deg F Temperature Control
- 3, 4 or 6” ANSI Flange
- NEMA 4X Protection

Model 270 Probe for Hazardous Areas

FM APPROVED

FM approved for Class I Division II areas and those suitable for use in Class I Division II areas (purge). We can also provide custom configurations with site specific approval through our approval agency.

AMETEK 5200 CONVAIR DRIVE CARSON CITY, NV 89706	MODEL NO. SERIAL NO. VOLTS Hz WATTS
FM APPROVED	CLASS I DIV 2 GROUP A,B,C,D MAXIMUM AMBIENT TEMPERATURE 93°C TEMPERATURE RATING T3A
WARNING - EXPLOSION HAZARD - SUBSTITUTION OF ALL COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS 1, DIVISION 2 AVERTISSEMENT - RISQUE D' EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE 1, DIVISION 2	
WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS AVERTISSEMENT - RISQUE D' EXPLOSION - AVANT DE CONNECTER L' EQUIPMENT COUPER LE COURANT OU S' ASSURER QUE L' EMPLACEMENT EST DESIGNES NON DANGEREUX	



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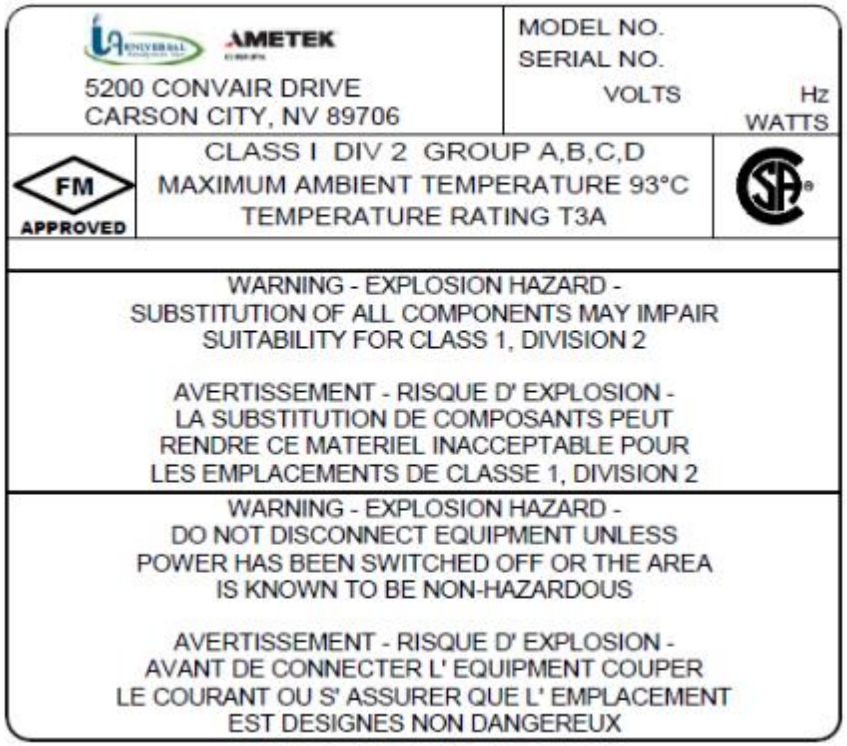
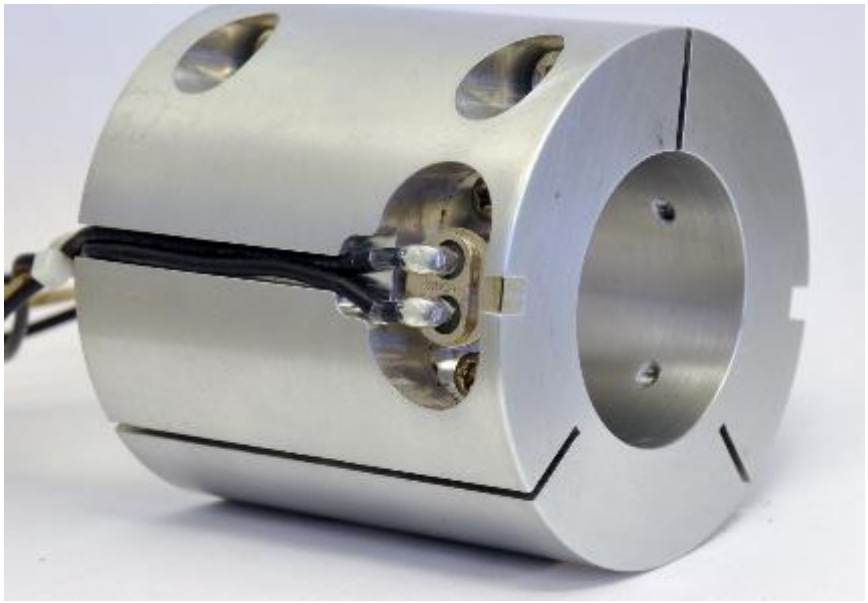
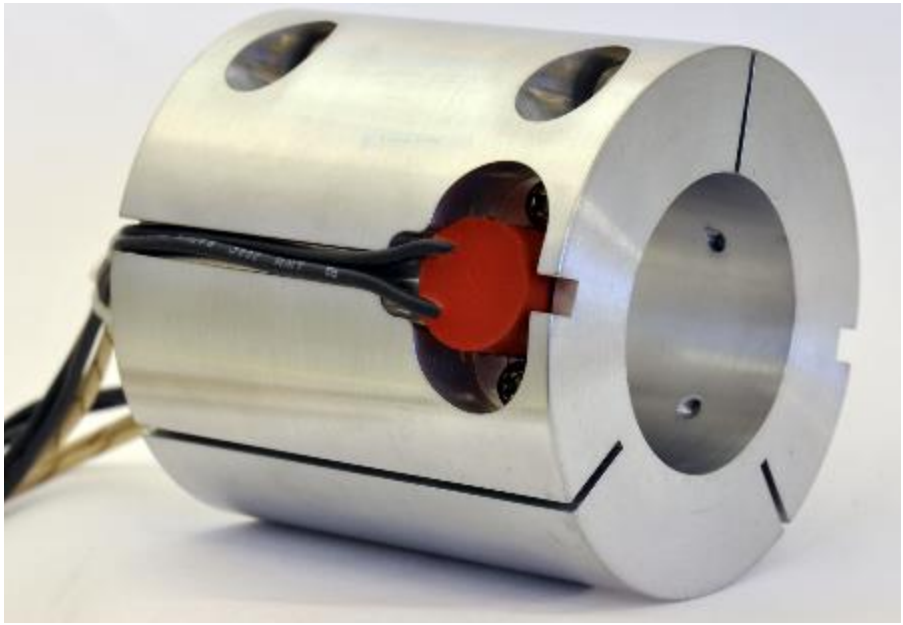
- **Modifications are made to the heater and integrated temperature switch**
- **Removed the possibility of “Spark and Arc”**
- **Factory Mutual certified and approved the modified configuration and requires annual shop inspections and audits allowing us the right to mass build and supply this Div II rated Sample Probe**



Model 270 Probe for Hazardous Areas

Filter Chamber with Special Heater and Hermetically Sealed Temperature Switch for Div II Compliance





Heater Oven with Temperature Switch for General Purpose

Model 270 Probe for Hazardous Areas

- Additional components or any modifications to the standard, approved configuration void the pre-approval

Solutions include…

- Providing a Purged Enclosure which declassifies the internal components and makes it “suitable for the area classification…less expensive

- Doing a one-off Inspection and Certification performed by a NRTL such as FM, UL, Metlabs, Intertek, etc….more expensive

- Manufacture with all electrically rated components within the enclosure but no Purge or 3rd party inspection and Certification by a NRTL…less expensive

Purged Enclosures Examples

- Type Z purging systems reduce the classification from Division 2 to unclassified. Power is typically not automatically Shut off!
- Type Y purging systems reduce the classification within a room from Division 1 to Division 2. Power is typically not Automatically Shut off!
- Type X Purging reduce the classification from Division 1 to unclassified. Power IS Automatically Shut off!

Sample Probes

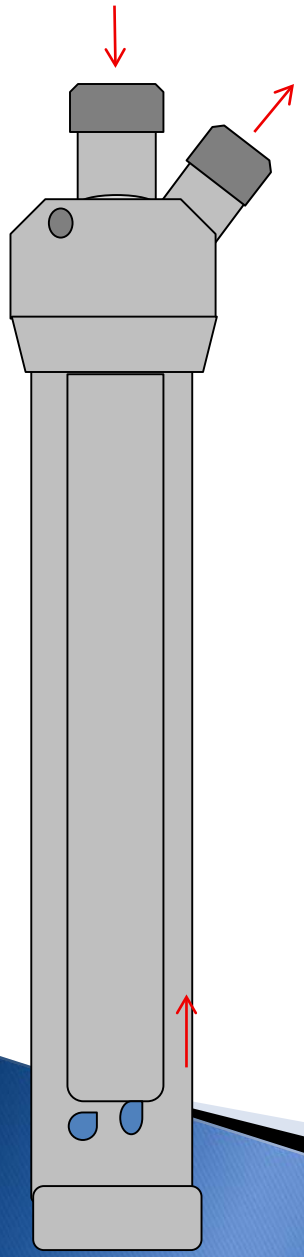
Gas Coolers

Sample Conditioning Systems

Gas Coolers
What is the real purpose …

- Sample must have a dew point no higher than 4 - 5 deg C for most analyzers
- Lower dew point to condense water from a wet gas sample
- Lower dew point to 4 deg C for standard units and -30 deg C for “Freezer Chiller”
- Design should minimize loss of water soluble gasses such as NO_2 and SO_2

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 sample output of heat exchanger
- By design we minimize contact of the condensate and the gases being measured (to prevent re-equalization of the liquid into the dry gas)

Heat Exchanger / Impinger

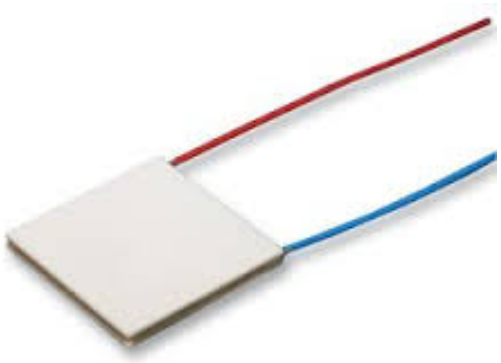
Disassemble for Easy Cleaning

Stainless Steel

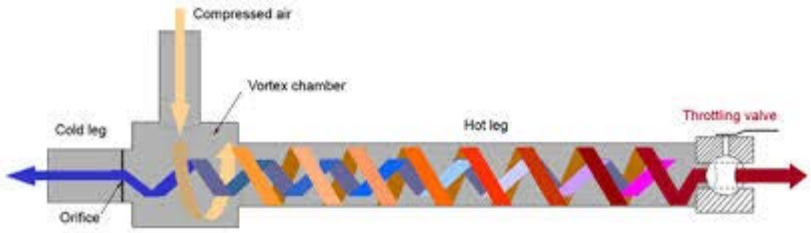
Glass / Kynar
Glass barrel with Kynar top and bottom with drilling for NPT fitting connections

Hazardous Area Gas Coolers from UAI

- **Thermoelectric**
  - **Solid state Peltier effect cooler**
  - **Most common cooler type for UAI**



- **Vortex**
  - **Compressed Air cooler**
  - **No electricity required**
  - **Perfect for Hazardous Areas**



Peltier Advantages

- Small size and light weight when compared to mechanical systems
- Precise Temperature control. Can be controlled to +/- .1 Deg C
- Electrically quiet
- Environmentally Friendly- No Refrigerant or Chlorofluorocarbons
- High Reliability- Mean Time failure of 200,000 hours or 22.8 years

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 Cl I, Div 2, ABCD
- Wall mount with integrated accessories
  - Sample pump
  - Water slip detector
  - Drain pump

Model 3000 Chiller

FM APPROVED

AMETEK
5200 CONVAIR DRIVE
CARSON CITY, NV 89706

MODEL NO. 3080-SS
SERIAL NO. 45261
115 VOLTS 50/60 Hz
700 WATTS

FM APPROVED

CLASS I DIV 2 GROUP A,B,C,D
MAXIMUM AMBIENT TEMPERATURE 41°C
TEMPERATURE RATING T3C

U.S. PATENT NO. 5,465,578

WARNING - EXPLOSION HAZARD -
SUBSTITUTION OF ALL COMPONENTS MAY IMPAIR
SUITABILITY FOR CLASS 1, DIVISION 2

AVERTISSEMENT - RISQUE D' EXPLOSION -
LA SUBSTITUTION DE COMPOSANTS PEUT
RENDRE CE MATERIEL INACCEPTABLE POUR
LES EMPLACEMENTS DE CLASSE 1, DIVISION 2

WARNING - EXPLOSION HAZARD -
DO NOT DISCONNECT EQUIPMENT UNLESS
POWER HAS BEEN SWITCHED OFF OR THE AREA
IS KNOWN TO BE NON-HAZARDOUS

AVERTISSEMENT - RISQUE D' EXPLOSION -
AVANT DE CONNECTER L' EQUIPMENT COUPER
LE COURANT OU S' ASSURER QUE L' EMPLACEMENT
EST DESIGNES NON DANGEREUX

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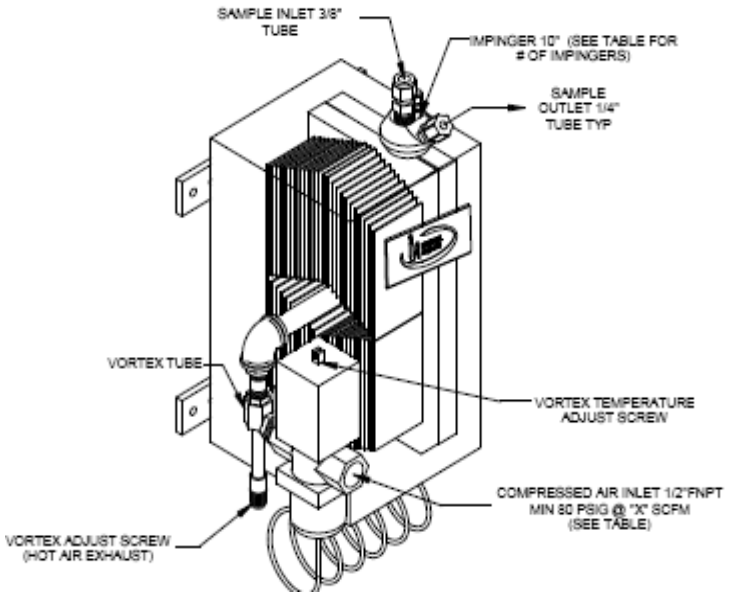
Vortex Gas Cooler

- 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

Vortex Cooler Theory



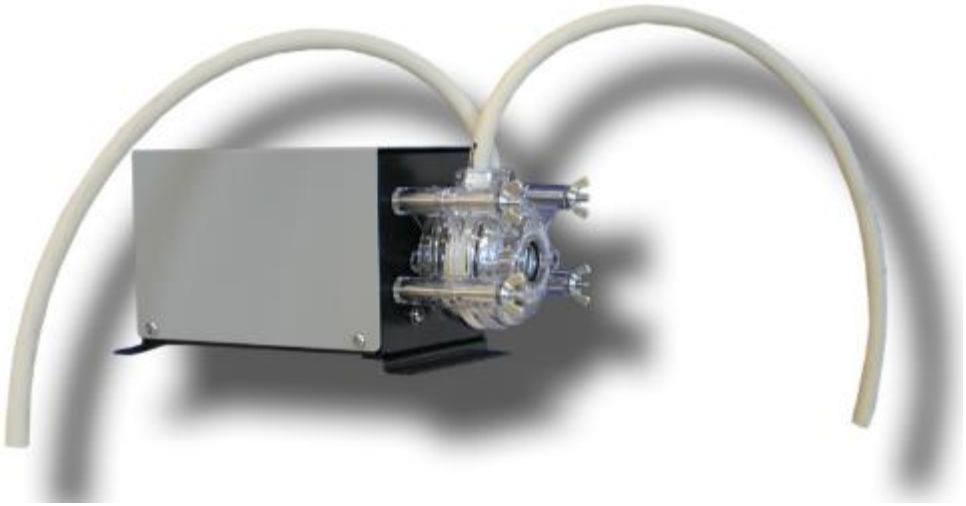
MODEL NO.	# OF IMPINGERS	COMPRESSED AIR REQUIRED "X"	TOTAL COOLING CAPACITY @ 100 PSIG (690 KPa)
1140	1	4CFM (0.06 M^3/MIN)	110 B.T.U. / HR
1160	2	10CFM (0.06 M^3/MIN)	260 B.T.U. / HR
1190	2	15CFM (0.06 M^3/MIN)	400 B.T.U. / HR

Requires Clean Instrument Air (Min 80 PSIG)

- **Separates Compressed Gas into hot and cold streams**
- **Hot Air rotates at a faster rate along the edge of the tube**
- **Cone at end of tube reflects cold air stream, allows hot air stream to exit**

Condensate Drain Accessories

Peristaltic Pump



Positive Pressure Liquid Drain

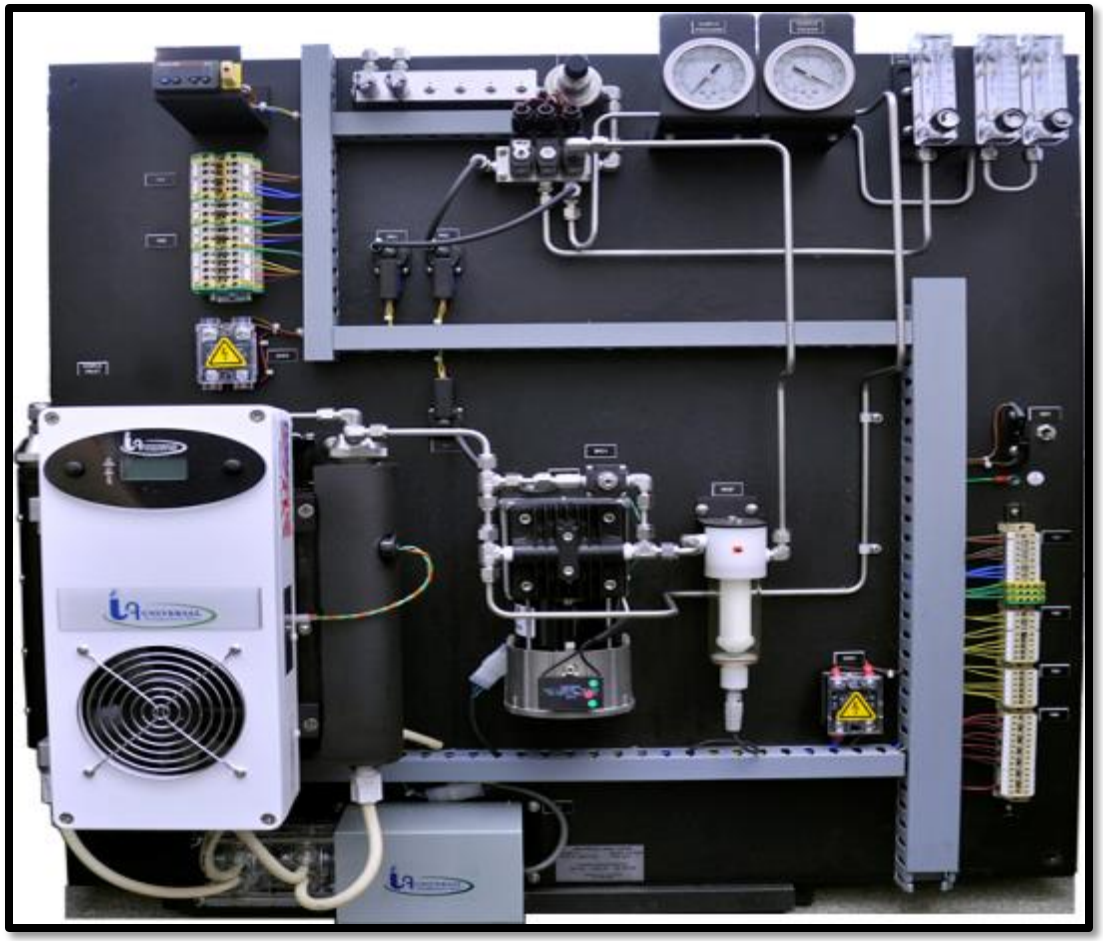
Sample Probes

Gas Coolers

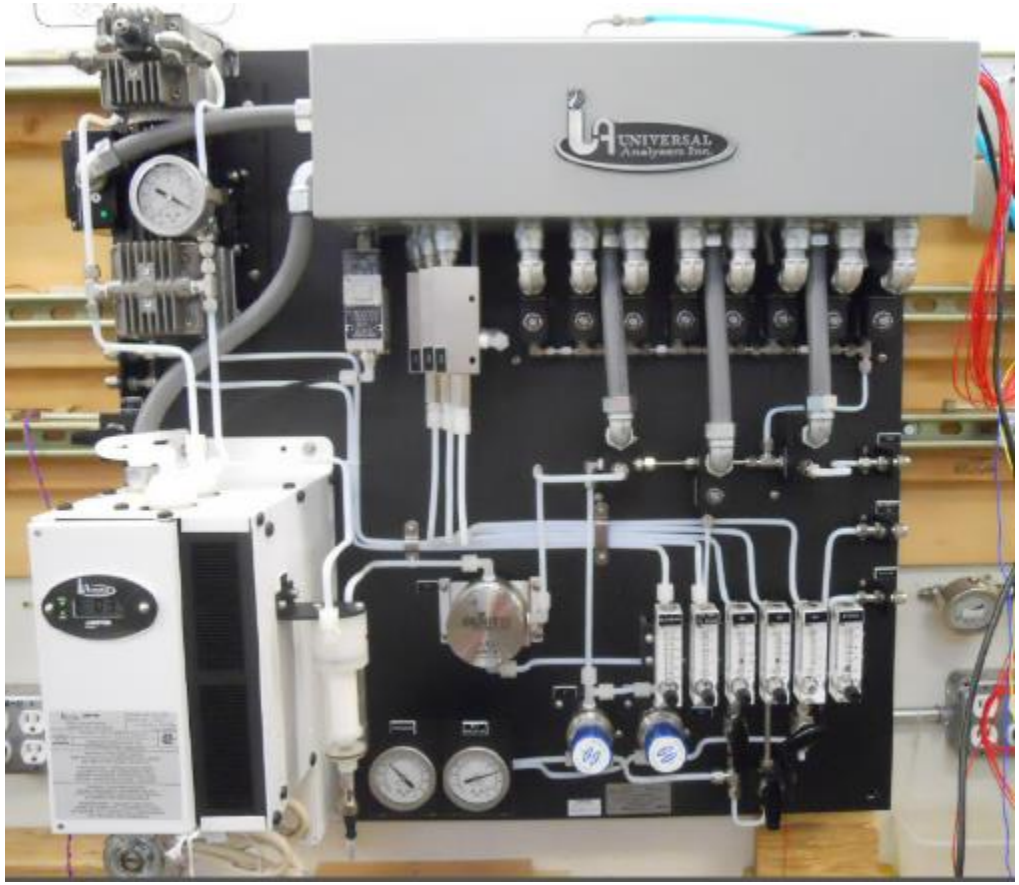
Sample Conditioning Systems

Example Hazardous Area Sample Systems

Sample System on a Wall Mount Panel
Open Architecture for General Purpose Installations



Sample System
on a Wall Mount Panel for Div II Areas



Div II Pump, Gas Cooler, Solenoids and Alarm Switches

Explosion Proof Solenoids and Rated Conduit in / out of NEMA 4 enclosure. This was built suitable for a Div II Area classification

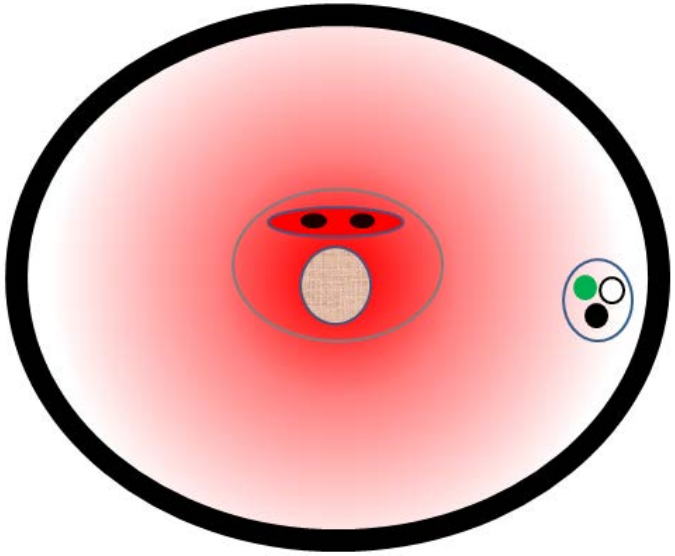
Sample system with Vortex Gas Cooler and , Div I rated sample pump

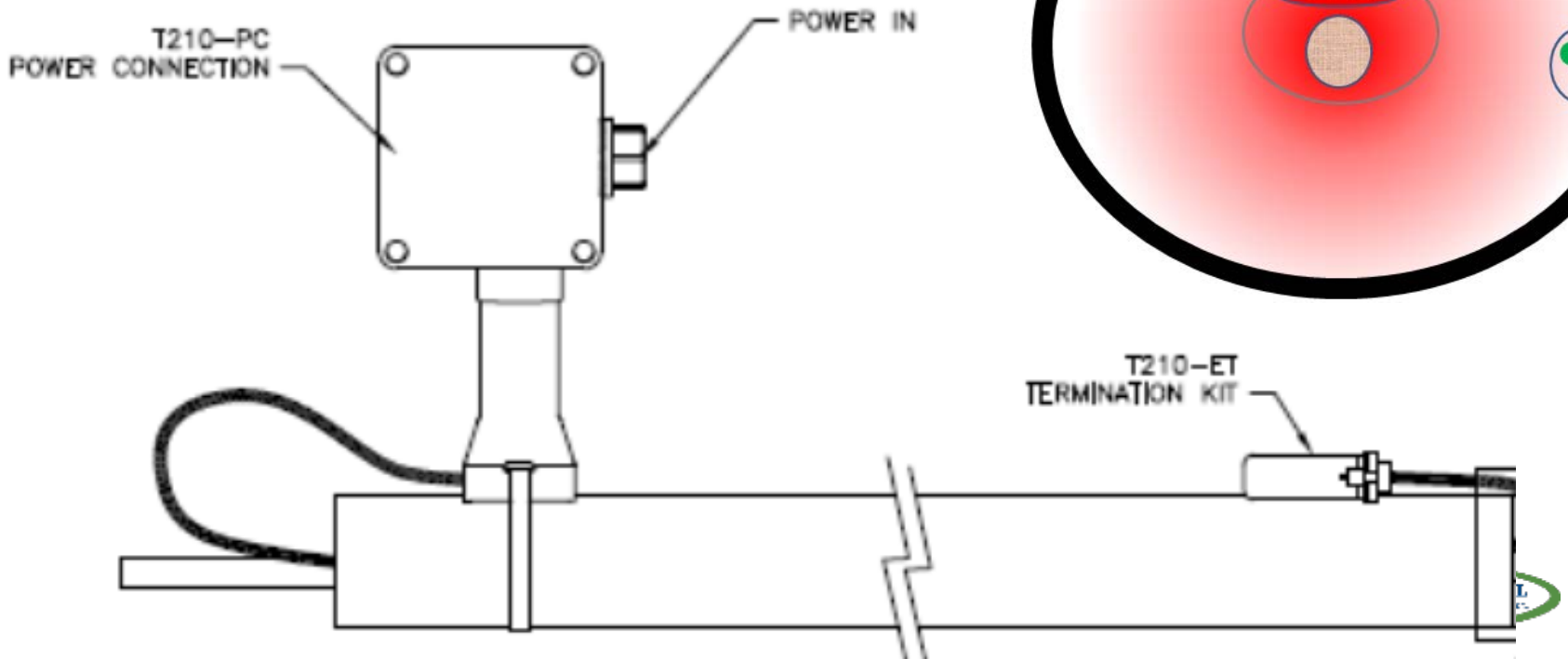
Div II Rated Gas Cooler and Sample Pump

Small Oxygen Analyzer within a Purged Enclosure

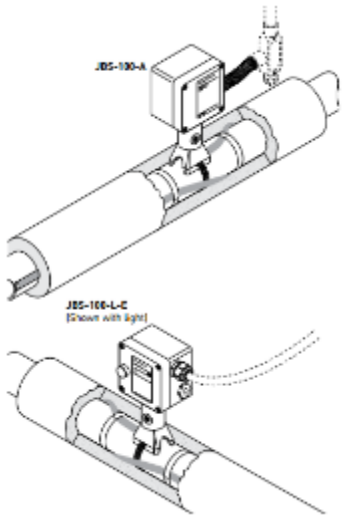
Heated Sample Line

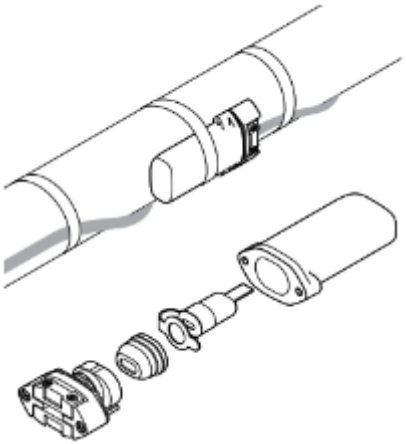
Entire system including power connection and end termination are required for hazardous area locations.





Heated Sample Line – End Connection Kits





Power End

Probe End

NEMA 4X Polymer Enclosure

FM, CSA Approved for Hazardous Areas

Must be used with Div II rated cables to maintain protection

Now lets talk Sample pumps

THANK YOU FOR YOUR TIME!!!

BOB BERTIK
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