

# **Sorbent Trap Monitoring Systems**

## **Lessons Learnt from MATS & PC MACT compliance**

**Presented By**

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A little about me:

- I am from Australia, lived in the USA for 10 years
- Joined Apex in September 2013
- Previous employment was the brewing industry

A tall industrial smokestack emitting a thick plume of white smoke, set against a blue sky with some clouds.


## Outline for today's presentation...

1. Overview of the Apex Instruments Sorbent Trap Monitoring Systems:
  - A. XC-6000 & STM-12B systems for Continuous sampling
  - B. XC-30B system for Method 30B
2. Lessons Learnt
  - A. Technical/Mechanical aspects
  - B. Operational challenges
  - C. Configuration review
  - D. Field repairs & maintenance
  - E. Q & A session


## Apex history of manufacturing Sorbent Trap Monitoring Systems:

- Manufacturing STMS components and systems for over 20 years
- Over 350 APEX STMS in operation throughout the United States



A tall, white industrial smokestack is shown on the left side of the slide, emitting a thick plume of white smoke that rises into the sky. The background is a clear blue sky with some light clouds.


**Sorbent Trap Monitoring Systems capture the total vapor phase Mercury concentration in flue gas and after analysis provide a measurement in micrograms per dry standard meter. ( $\mu\text{g}/\text{dscm}$ )**

A tall, white industrial smokestack emitting a thick plume of white smoke against a blue sky with some clouds.

**Known volumes of flue gas are extracted from a stack or duct through paired, in-stack sorbent media traps at an appropriate flow rate. Collection of mercury on the sorbent media in the stack mitigates potential loss of mercury during transport probe / sample line.**

## PS-12B Overview

### What is Sorbent Trap Measurement?

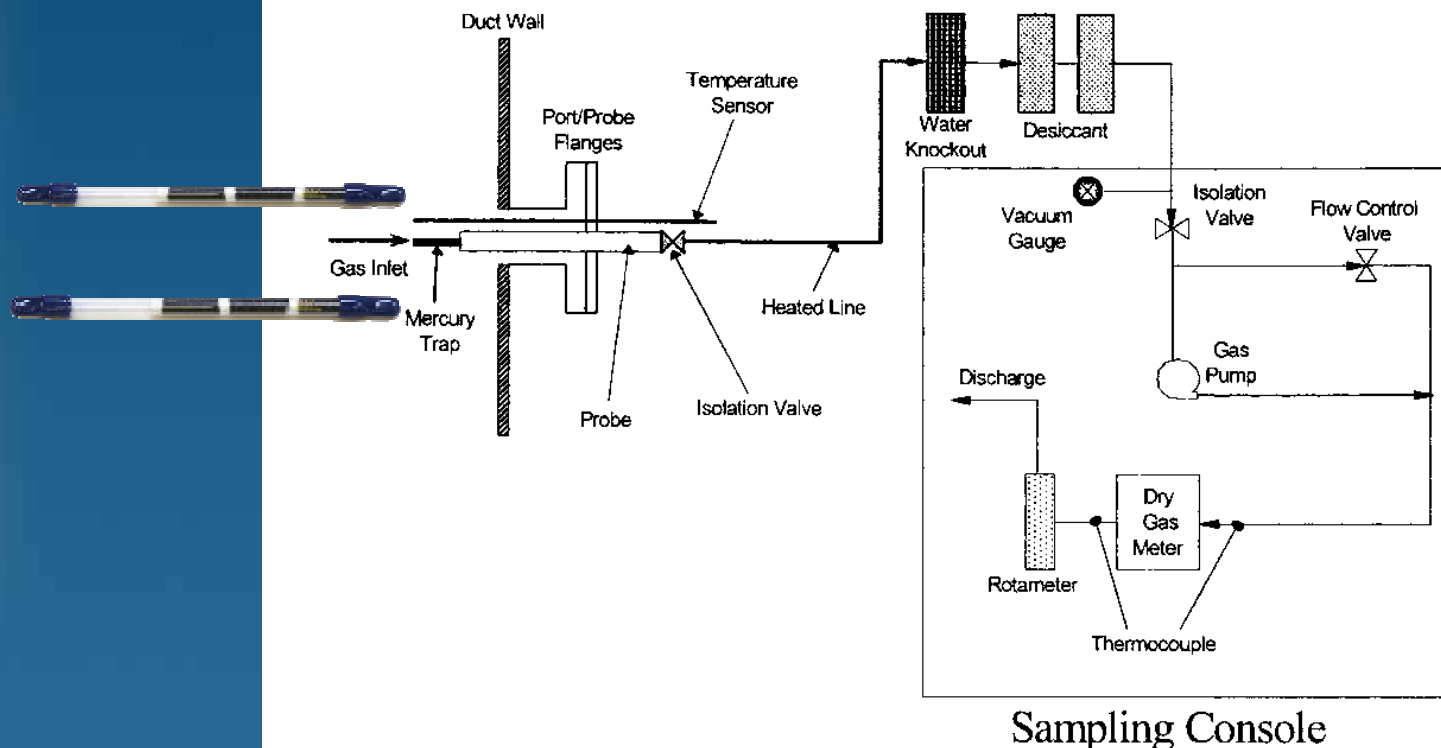
- 
- A tall, white industrial smokestack emitting a thick plume of white smoke against a blue sky with some clouds.
- Simple manual method that makes time-integrated Hg measurements
  - *Sampling time duration is typically 7 days*
  - A vacuum pump pulls stack gas through the sorbent trap at a set rate
  - The sorbent collects Hg, and dry gas meter measures the sample volume
  - Laboratory analyzes traps for the Hg mass collected
  - Concentration = mass of mercury collected / volume

## PS-12B Overview


### Sampling Apparatus Consists of the following:

- Pair of three section carbon sorbent traps
- Probe, sample pump, heated sample line
- Control Console: Sample moisture removal, Dry gas meters, temperature and pressure sensors, sample duration test data recording.

## A sorbent trap system as defined by Method 30B and PS-12B



## Key Advantages of Sorbent Trap Monitoring

- 
- A tall industrial smokestack emitting a thick plume of white smoke against a blue sky with some clouds.
- Simple to Install, Implement and Operate  
Typically 1 Day to install (1 to 3 Days to Certify RATA)
  - Accurate Method – NIST Traceable SRM  
Very low detection levels, 1 to 3 ng
  - Cost benefit & very reliable compared to Hg CEMs  
Typical STM system around \$50,000
  - Sorbent Method has a long history 10+ years  
Applied widely to Coal-Utility Industry and is the EPA Reference Method
  - Sample captured directly in stack – no Hg transport issues
  - Little or no stack or facility engineering costs
  - No calibration or carrier gases required

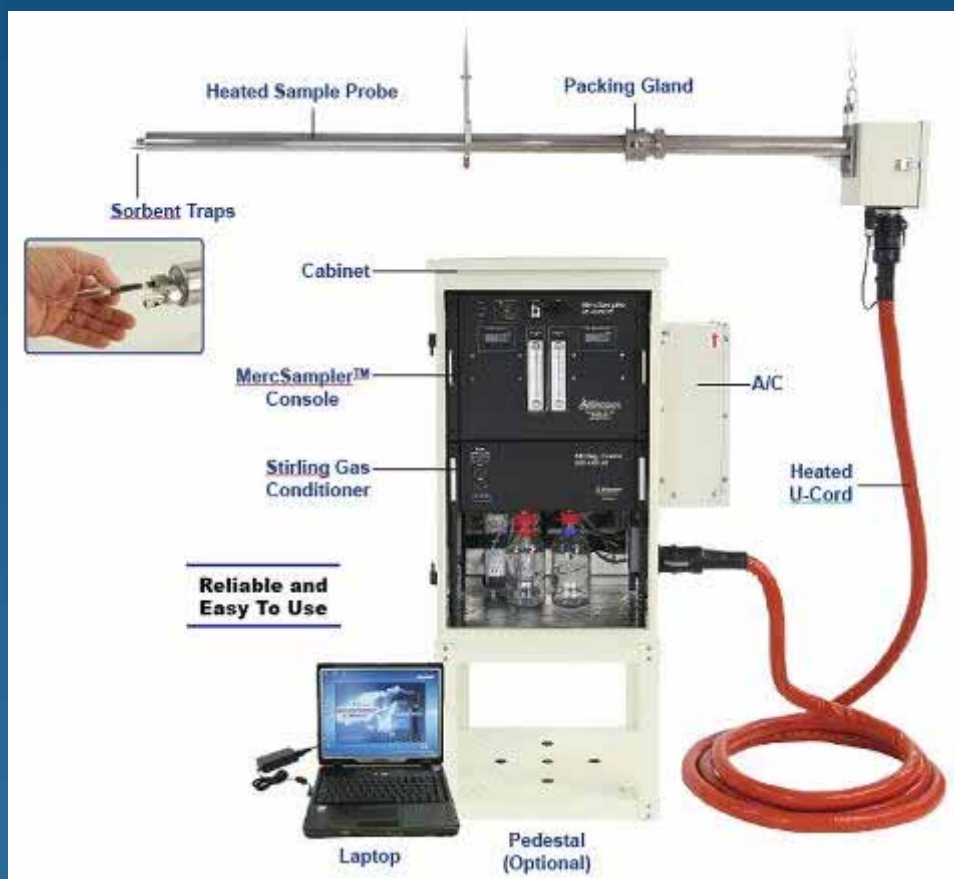
# Sorbent Trap Monitoring System

**For PS-12B**

*Simple, Proven Technology*



# XC-6000 MercSampler™ Sorbent Trap Monitoring System



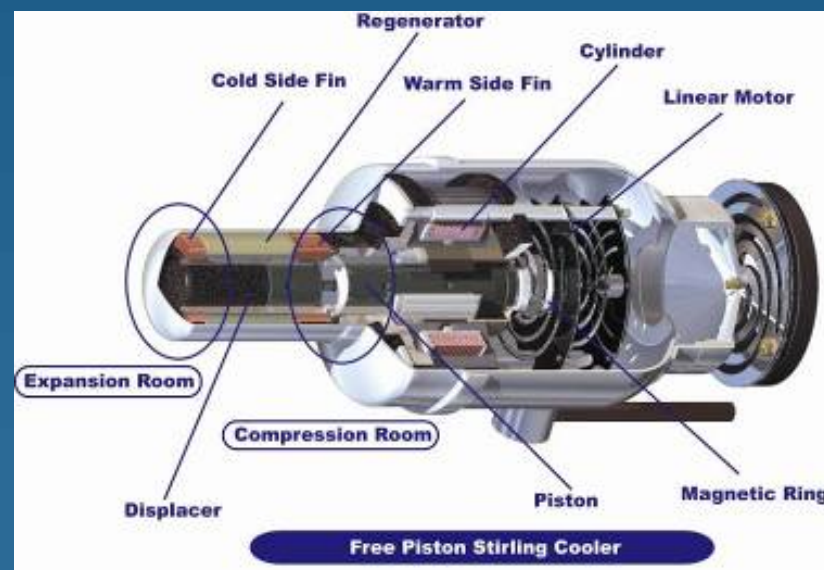
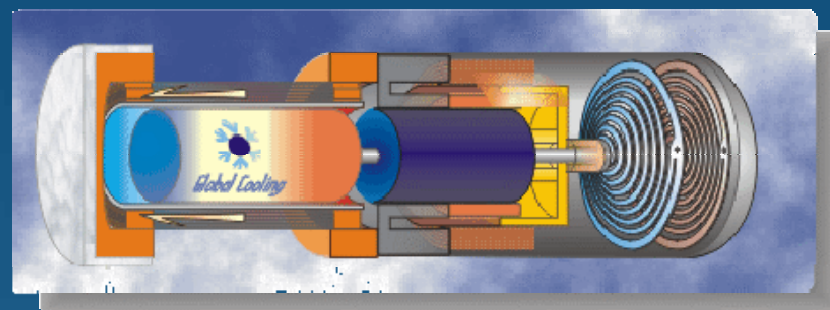
## Includes:

- Probe
- Sample Line
- Chiller
- Control Console
- Laptop/Software
- Simple Proven Technology
- Quick Set-up Time
- Easy to Use
- Low Cost Alternate CEM
- TCP/IP Modbus Interface
- Optional Air cooled Probe  
Flue Gas 320F

# Stirling Cooler Advantage

## Free Piston Stirling Cooler (FPSC)

- Two Moving Parts, Piston and Displacer
- Single Cylinder Compressing and Expanding small quantity of He
- All Hermetically Sealed in Stainless Steel Casing
- Capable of Cooling a Sample within minutes



# STM-12B MercSampler™ Sorbent Trap Monitoring System



## Includes:

- Probe
- Sample Line
- Chiller
- Control Console
- Laptop/Software
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## Sorbent Trap Monitoring Solutions



## Typical 30B Control Console



## MATS & Mercury

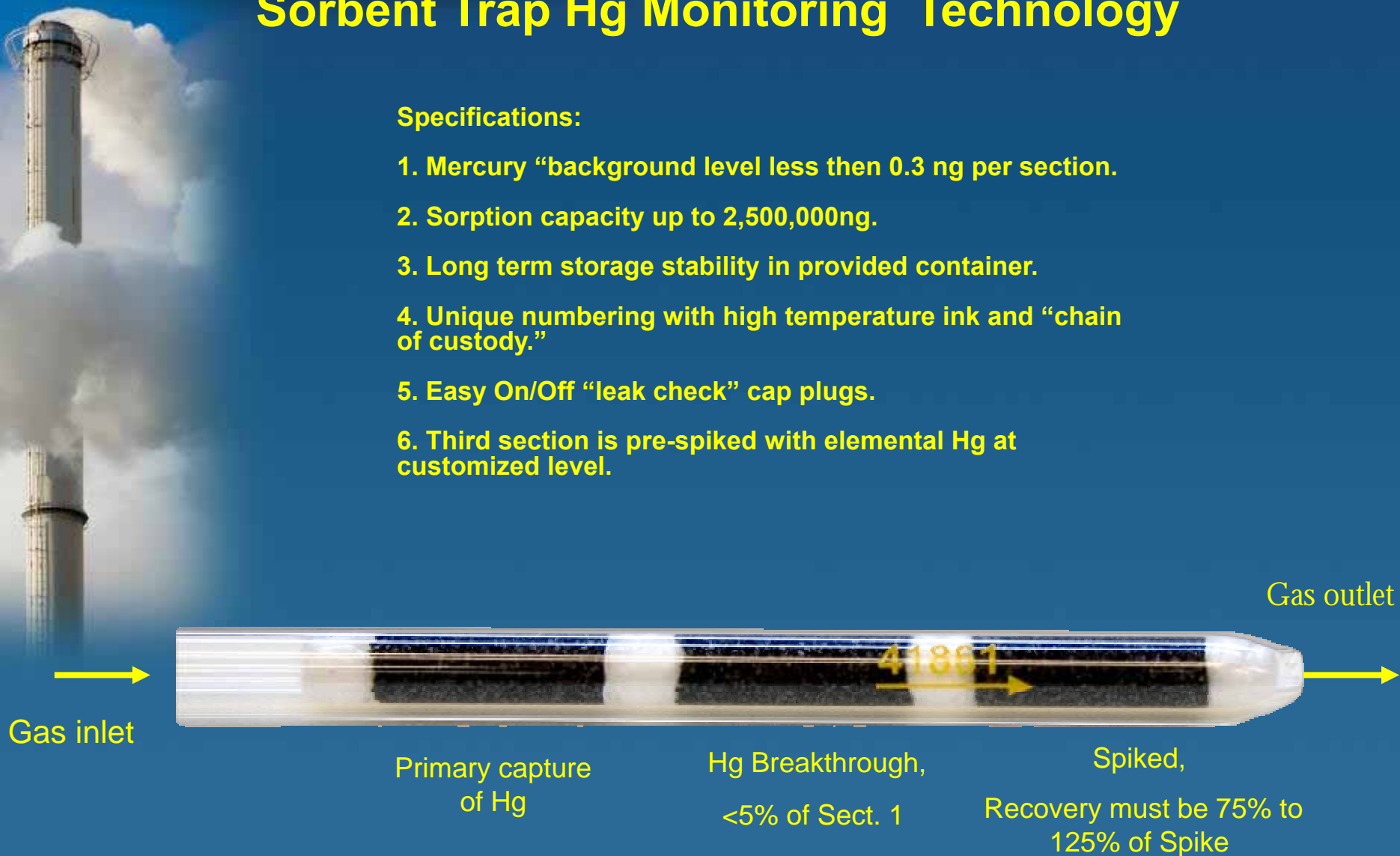
Section 4.1.1.5 states:

- Acceptable Hg reference methods for the RATA include ASTM D6784–02 and Methods 29, 30A, and 30B in appendix A–8 to part 60.
- Perform the RATA of the Hg CEMS at normal load.
- 4.1.1.5.1 *Special Considerations*. A minimum of nine valid test runs must be performed, directly comparing the CEMS measurements to the reference method. More than nine test runs may be performed. If this option is chosen, the results from a maximum of three test runs may be rejected so long as the total number of test results used to determine the relative accuracy is greater than or equal to nine; however, all data must be reported including the rejected data.
- For 30B the time per run must be long enough to collect a sufficient mass of Hg to analyze.
- RATA must be performed annually (Part 63, subpart UUUUU 5.1.2.4)

## Sorbent Trap Hg Monitoring Technology


### Specifications:

1. Mercury “background level less then 0.3 ng per section.
2. Sorption capacity up to 2,500,000ng.
3. Long term storage stability in provided container.
4. Unique numbering with high temperature ink and “chain of custody.”
5. Easy On/Off “leak check” cap plugs.
6. Third section is pre-spiked with elemental Hg at customized level.



# PS-12B Overview

## Sorbent Trap Analysis:

- 
- A tall, white industrial smokestack emitting a thick plume of white smoke against a blue sky with some clouds.
- Each section analyzed separately
  - Total trap mass = Section 1 mass + section 2 mass
  - Section 3 spike must be recovered
  
  - Desorption of Hg from sorbent material:
  - Wet chemistry, leaching or digestion
  - Thermal desorption

# Selection of Monitoring Location

## Pre-Test Leak Check

- $\leq 4\%$  of the target sampling rate @ a vacuum of  $\sim 15''$  Hg

## Proportional Sampling

- Calculate 'Reference Ratio' of stack flow rate to sample flow rate during the first hour of each test period.
- The sample flow rate must be controlled to be proportional to the stack flow rate.

*The ratio of stack flow rate to sample flow rate must be within  $\pm 25\%$  of the 'Reference Ratio' every hour throughout the monitoring period.*

# Lessons Learnt

## Technical/Mechanical aspects



# Sampling





## Challenging Sources & Environments



**High Particulate, Wet FGD & Lime Injection  
are some of the sampling challenges for 7 day runs**



# Trap Shield Installation




# **PS-12B Trap analysis issues**

**Breakthrough issues**

**Spike recovery issues**

**Relative Deviation – Paired Trap Agreement**

## **Another Solution is your sampling Profile**

- 
- A tall, white industrial smokestack emitting a thick plume of white smoke or steam, set against a blue sky with some clouds.
- Whether its high particulate or wet stack conditions – Keep your flow rates low typically 250 to 350 ccm or lower if possible.
  - For wet stacks keep your probe temperature hot enough - typically 300 to 350F.
  - Use the right trap for your stack conditions –  
Longer traps,  
Acid gas scrubber section, particulate filter option



## PS-12B Quarterly Audit

### DGM Must be Calibrated Quarterly:

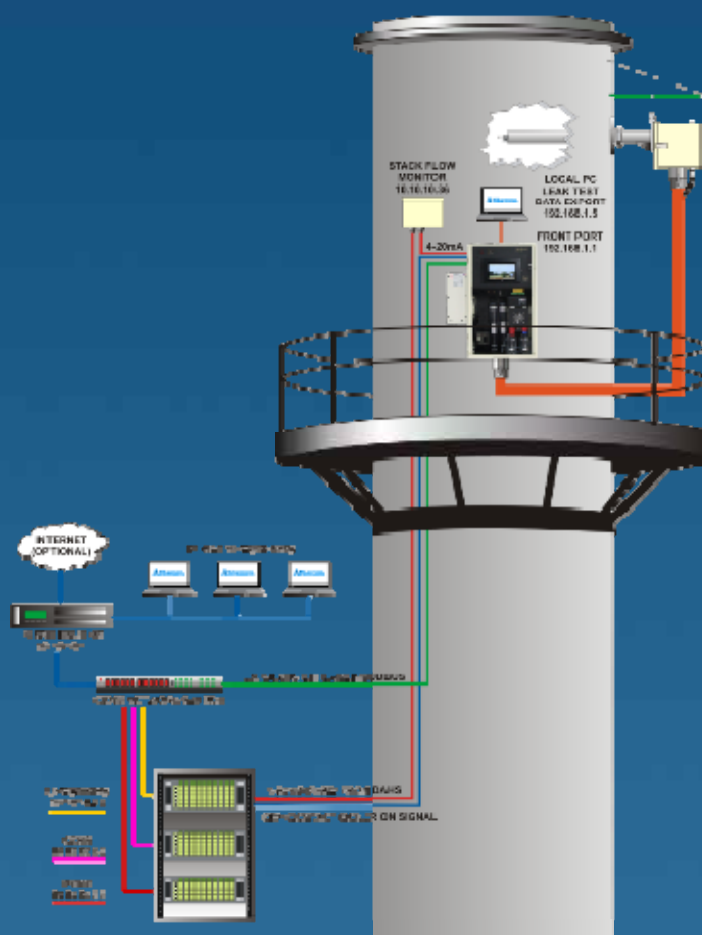
- Single point calibration check
- Calibration coefficient ( $Y$ )  $\leq 5\%$  of average value of  $Y_{\text{ref}}$  derived from the most recent 3 point calibration.
- Temperature Sensor must be calibrated quarterly
- Barometric Pressure Gauge Must be Calibrated Quarterly

# Lessons Learnt

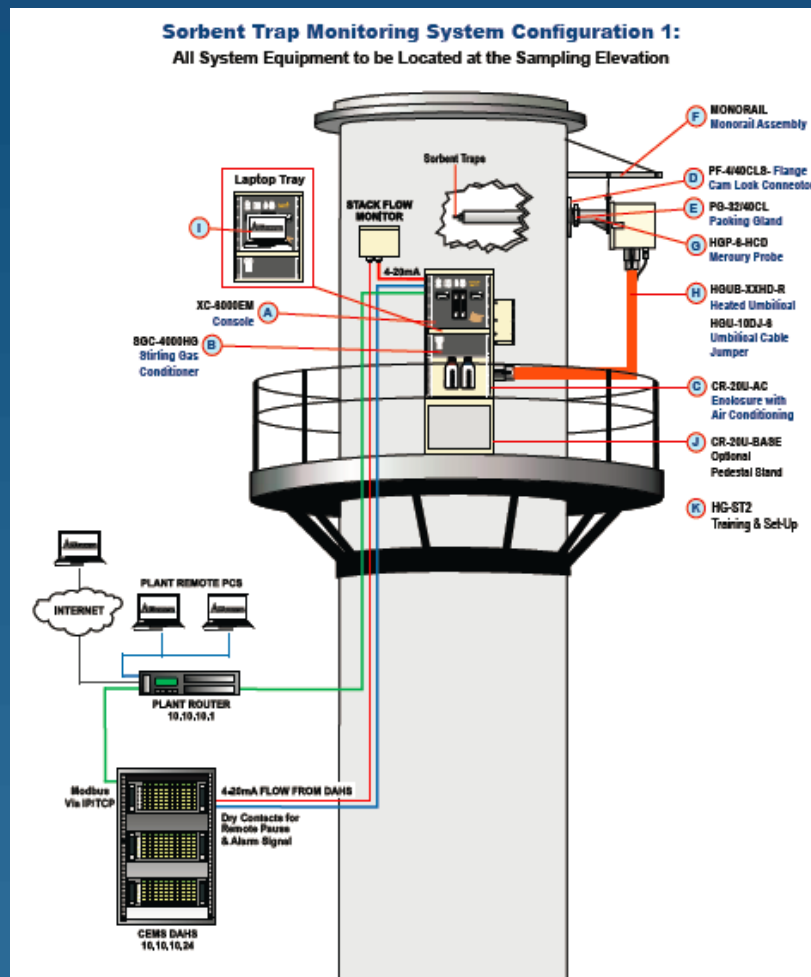
## Configuration review



# STM-12B Configuration



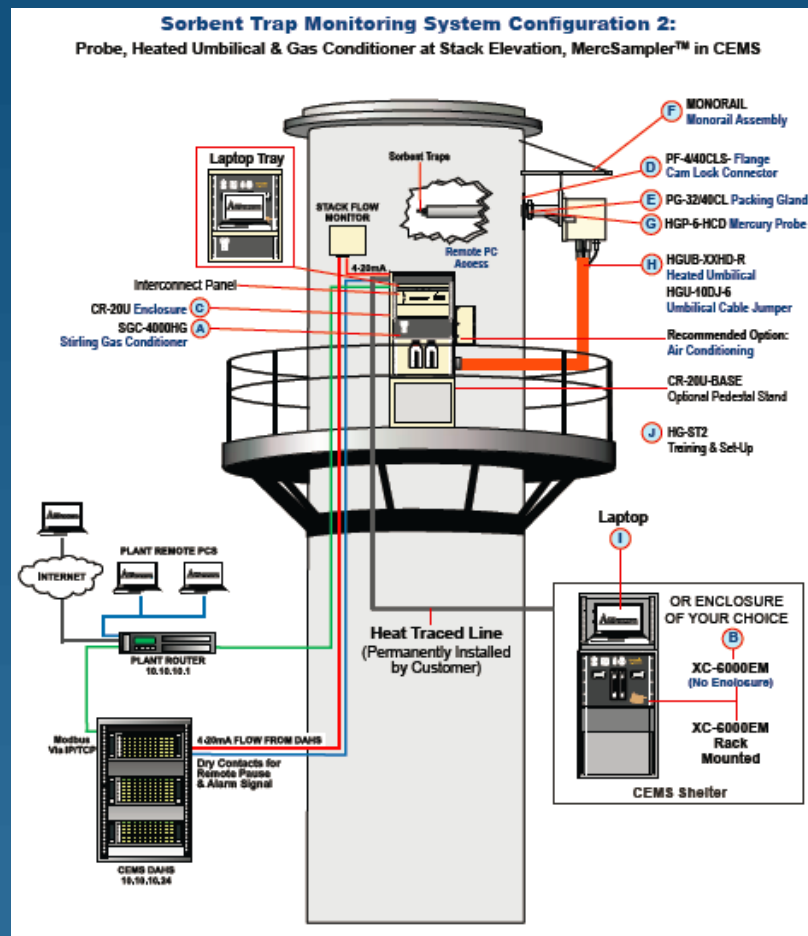
# XC-6000 Configuration 1 (typical)



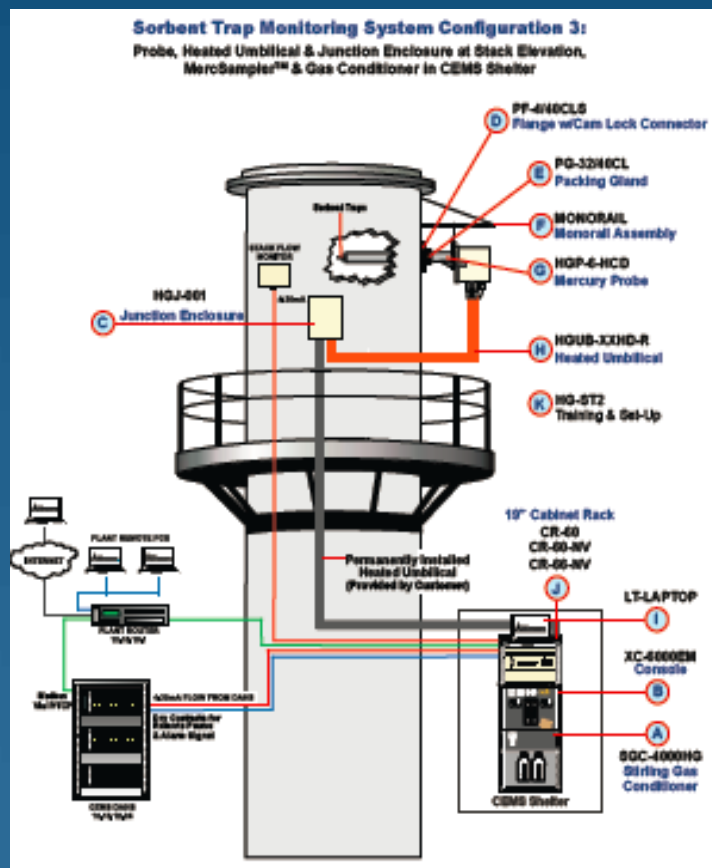
## Typical XC-6000 Installation



# XC-6000 Configuration 2



# XC-6000 Configuration 3





## Mercury Sampler XC-6000D



### Alarm Actions

		Delay (Sec.)	Auto Reset (Sec.)	Action
Proportional / Constant Flow Tolerance	15 (nn 5-25%)	20	10	End Test
High Vacuum Level	14 (nn Inches)	20	10	Alert
Modbus Idle Timeout (if applicable)		60		Pause Test
Flow / Moisture - Current Loops < 4mA (if applicable)		8	10	Alert

### Thermocouples °F

		Valid Range	Delay (Sec.)	Auto Reset (Sec.)	Action
Trap and Probe	+/- 25		20	10	DISABLE
Chiller	+/- 4		20	10	Alert
Sample Line (Aux.)	Low 285 High 335		20	10	Alert

Return From Power Failure Action >>>

10

Pause Test

Alarm Delay During Startup or Resume 60 (nnnn - mimum 60 Sec.)

Disable All

Main Menu

< Prev

Cancel

Next >

# **Lessons Learnt**

## **Field repairs & maintenance**

**Field replacement of DGM's**

**Acid gas scrubber sorbent replacement**



**QUESTIONS?**

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