

REINHOLD ENVIRONMENTAL[®]



2023 Reinhold/PCUG Round Table Presentation

Cohosted by Duke Energy and Vistra in The Westin Hotel,
Cincinnati, OH on June 26-27, 2023

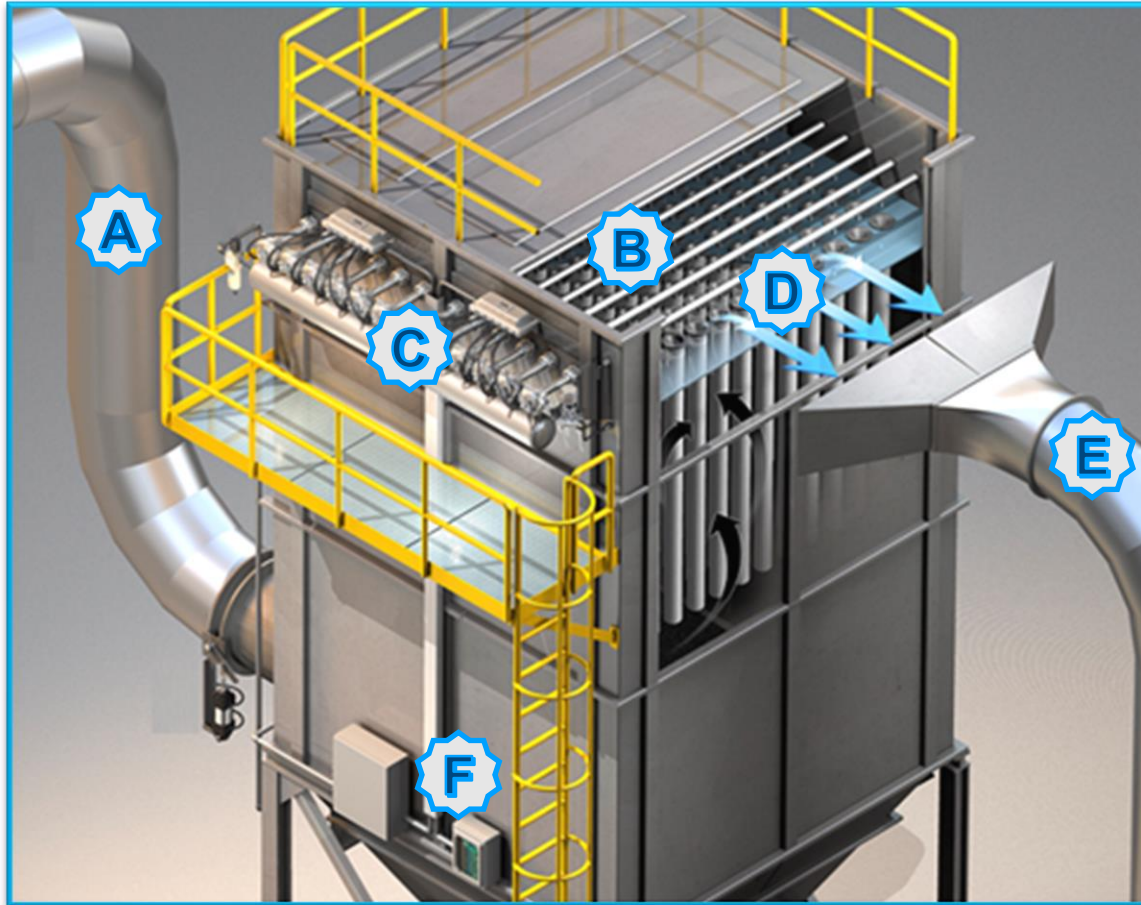
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Reinhold 2023

Fabric Filters: Lessons Learned

We Care for Clean Air.



A- Inlet Duct

B- Blowpipe

C- Cleaning System

D- Tubesheet

E- Outlet Duct

F- Controller

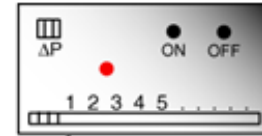
Lesson Learned

Develop a baghouse maintenance strategy

1. **Preventive Maintenance:** Inspections based on the Calendar or Usage
 2. **Predictive Maintenance:** Looking for Trends to determine a Failure
 3. **Troubleshooting:** (AKA – Fire Fighting/It's Broke, Time to write a Work Order)
- **When do you ask the Question?**
 - How does the Pulse Valve Sound?
 - Its Time for a Check Up → Preventive
 - Before the Problem → Predictive
 - After the Problem → Troubleshooting

External

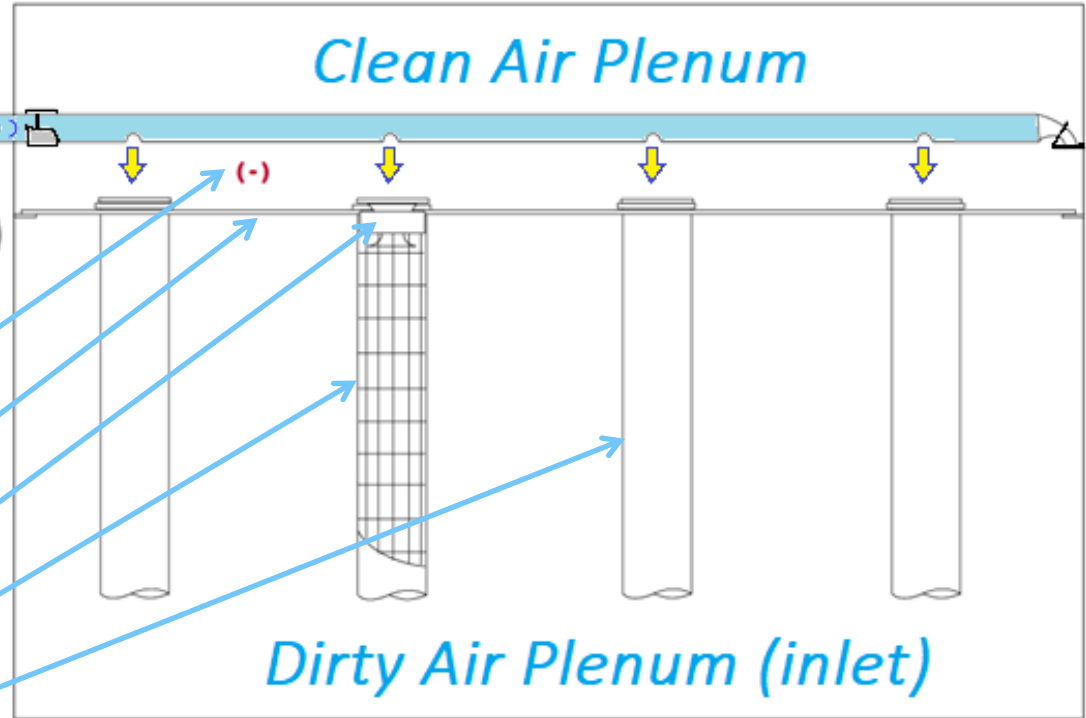
- Solenoid Valve
- Bleeder Tube
- Pulse Valve
- Header/Manifold



*Sequential
Controller*

Internal

- Quick Release Blow Pipe
- Tubesheet
- Venturi
- Cage
- Filter Bag



Lessons Learned – Differential Pressure

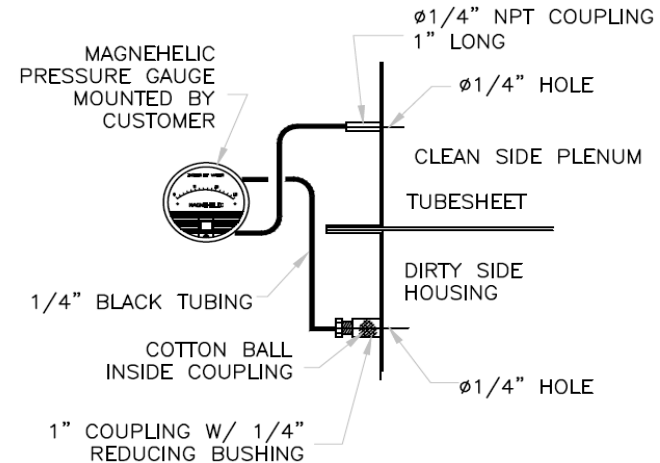
Monitor, Measure, trend differential pressure continuously



Understand Differential Pressure

Every baghouse should have a measuring device that gauges how much differential pressure the unit is experiencing. Too much differential pressure means things are plugged and too little means something is leaking.

- 0 - 1" W.C. (2.5 millibar) – Too low
- 2 - 6" W.C. (5 – 14 millibar) – Healthy
- 7 - 8" W.C. (17 – 20 millibar) – Starting to age
- 10" W.C. or more (25 millibar or more) – Filters are plugged and need to be replaced

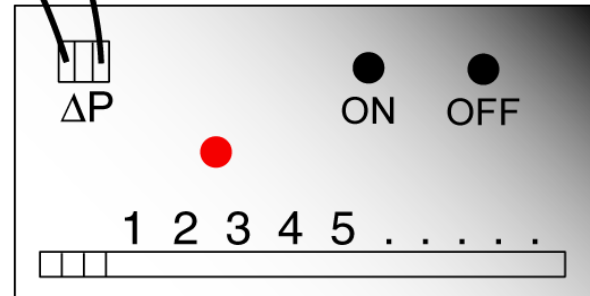
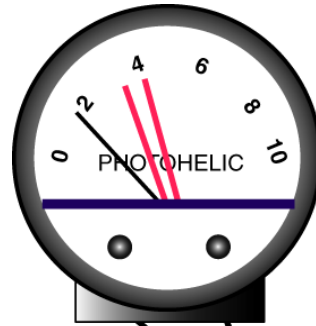


Differential Pressure Integration with Controller

Cleaning On dP:

**4-IWC Start
Cleaning**

**3 ½-IWC Stop
Cleaning**



- Less pulses = longer bag life
- Less pulses = energy savings

Controller Setting Inspection

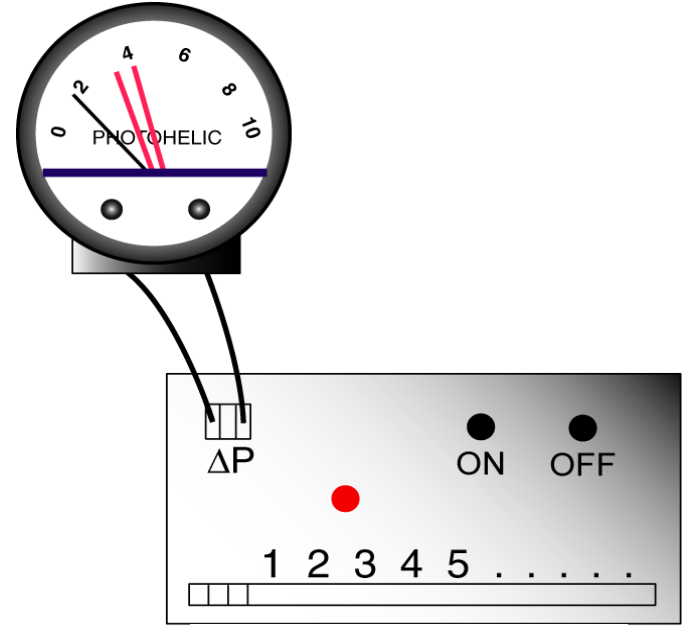


- dP LOW (stop cleaning)
- dP HIGH (start cleaning)
- dP Units (mmwg, inwg, mbar...)
- HIGH dP Alarm (Alarm pressure setting)
- On Time (in milliseconds 100-150)
- Off Time (time between pulses, 6 sec.)
- # Blowdown (current row cleaning)
- Run (in operation)

PROGRAMMING MODE
[ENTER] [UP] [DOWN] [UP] [ENTER]

Row Firing Sequence

- Skip At Least 2 Rows
- Create Distance Between The Previous And Currently Cleaned Filter.
- Move the Dust Down into the Hopper, Not between Filters



1 2 3 4 5 6 7 8 9 10
Cleaning Sequence

Compressed Air Header & Manifold Inspection

- Compressed Air or Compressed Water System?
- Regulators and Compressed Air Filters
- Moisture Blow Down System
- Header Pressure Fluctuation
- Air Leaks (Welds, Connections, Regulators, Other Equipment, etc...)
- **Take Away:** The Filters are cleaned by Compressed Air ONLY.
 - Check Monthly/Quarterly (Compressed Air Savings/Prevent Filter Blinding)

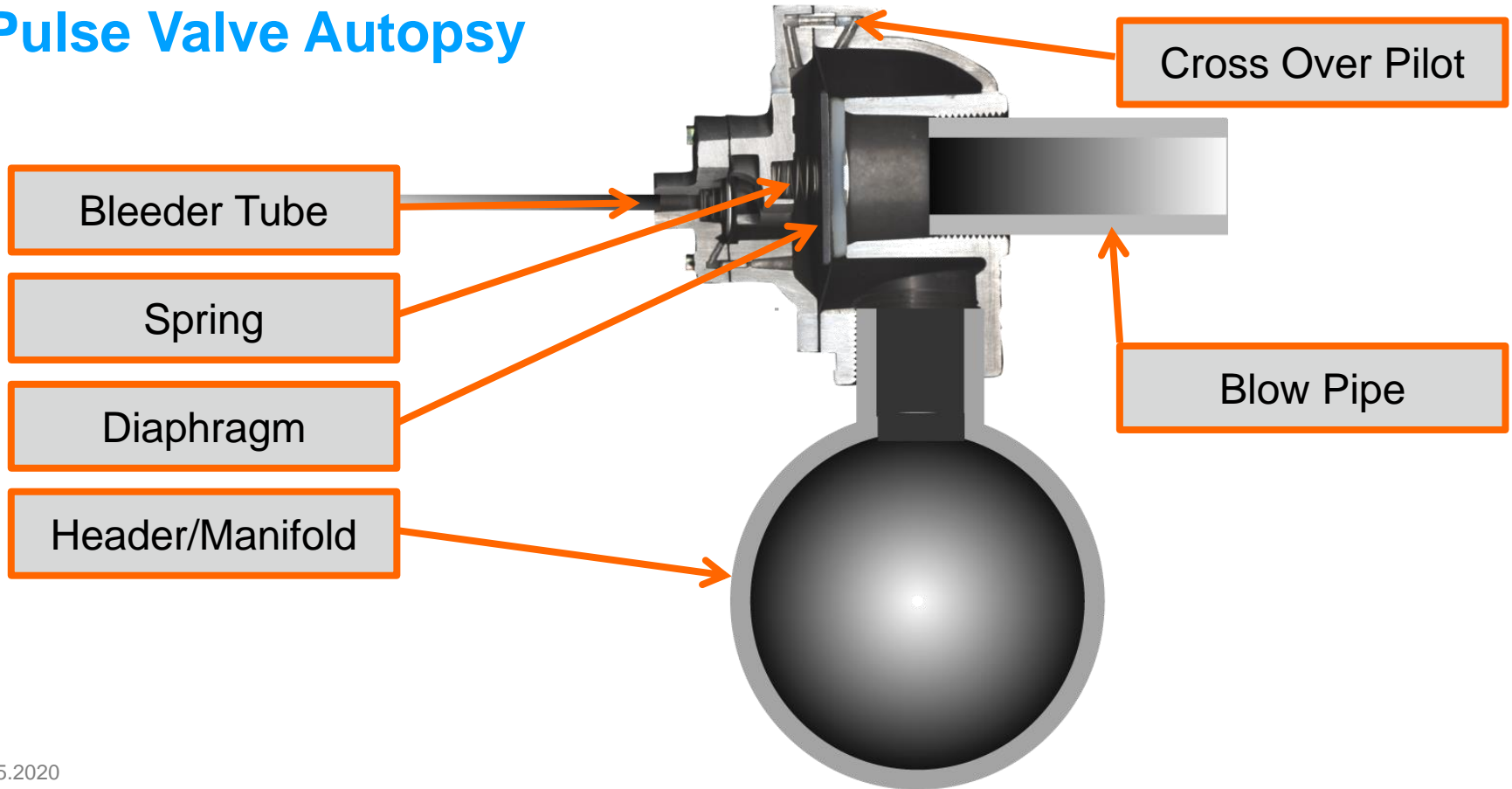


Do you have an air header condensate drain (auto purge system)?



- Periodically open the drain valve on the compressed air header to blow out accumulated moisture
- Include an automatic purge valve, tied into the pulsing sequence
- Include a drip leg with a ball valve
- Not necessary to stop equipment to perform purge

Pulse Valve Autopsy



Pulse Valve & Solenoid Inspection

Tips...

- What Does The Pulse Valve Sound Like?
 - Short Crisp Pop. NOT A Long Fluttering Sound (Wasting Compressed Air)
- Check The Pulse Valves & Solenoids Are All Firing
- Check the remote pilot is operating to drain the header
- Data Collection: Cycle Counts & Pressure Drop Across Baghouse
- **Take Away:** The Pulse Valve & Solenoid controls the cleaning air to the Filter
 - Checked Monthly (Clean Filters, Consistent dp, Compressed Air Savings)



LOOK!



- A large number of pulse valves can be checked for proper operation via covering the exhaust port, then checking back to determine which ports are not discharging air and marking those for repair. (**Ear Plug Test**)
- Corrosion on ANY metal surface or component is an indication of moisture in the system.
- Moving parts should be...well MOVING
- Material handling system should be moving material



LISTEN!



- Pulses Should Sound Short And Crisp
- The Sound Of Whistling Air Is An Indication That There Is A Leak
- Fan Should Run Steady
- Rattling Is Not A Good Sign

Understand Pulse Pressure Basics

- Stick with the OEM guideline.
- Consult an expert if you are making changes.
- More pulse pressure is not better.
- Check pulse pressure routinely and do make changes unless reviewed with an expert.



Lessons Learned

- Inspect blowpipes and replace any that have elongated orifice holes.
- Bad blowpipes = ineffective cleaning
- There is available technology to confirm best cleaning!

Blowpipe hole integrity

Once the cleaning mechanism pulses, the blowpipe has no air left inside and being void of air the blowpipe area will fill with air from the clean air plenum.

If dust is in the air the dust is pulled into the blowpipe and once the pressures equalize the dust settles to the bottom of the blowpipe



Lessons Learned

Hopper equipment must continuously move dust away from the baghouse

- **Hoppers Contain And Direct The Captured Dust To The Airlock**
 - Check the level sensors are functional
 - Check for Bridging/Rat Holes/Build-Up
 - DO NOT HIT THE HOPPER WITH A SLEDGEHAMMER!!!!
- **Airlocks Allow Material Out And Prevent Air leakage**
 - Freely Moving, Quiet, and Sealing
 - No Air Inleakage / No Metal on Metal Sound
 - Parts That Should Move are Moving, and Not Positioned to be held Open Or Closed

Leak Powder Testing

Find the Failed Filter FASTER!!!

- A Fine UV Pigment introduced to the Baghouse to Trace a Filter's Failure
- Faster than using dust on the Tubesheet
- Find Cracked Welds, Improperly Installed Filters, & Failed Bags
- **Take Away:** Find the Failure Quickly
- Less Down Time for Filter Replacement



Injecting Leak Powder

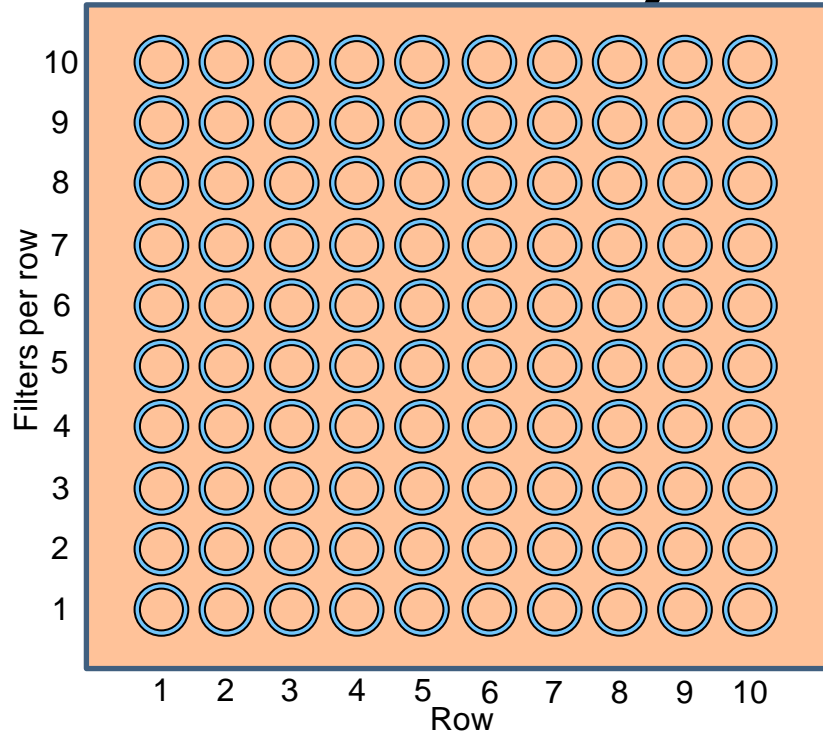


Lessons Learned

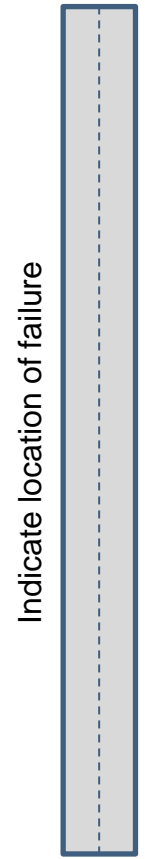
Map and record all filter bag failures and make note of filter failure location and type of failure mode.

Trending your failures will be the most effective way of finding a long-term solution.

Tubesheet layout drawing



Date	Filter Location	Filter Failure Type



Indicate location of failure

Filter bag

Filter Bag Lab Testing

Why Test a Filter Bag

- Root Cause Failure Analysis
 - What is causing my bags to fail prematurely?
 - What actions do I need to take?
- Estimate of Life Remaining, Based on Previous and Current Results
 - Lab testing is Most Effective when done on a set time interval to establish a Trend
- **Take Away:** Use bag testing as a key part of the bag performance evaluation.
 - Check Bi-Annually/Annually(Filter Life/Maintain Capacity/Schedule Maintenance)



What is the best bag media for my process?

It depends

- Temperature
- Airflow
- Total available cloth area
- Moisture
- Dust size
- Process conditions
- Chemistry/acid/dew point
- Changes and potential upset possibilities
- Baghouse design and how it cleans the bags

Lessons Learned: Filter Media

Take the guess work out and rely on your process conditions

- Attain specific data on your process. No such thing as too much information.
- Simulate performance using available technology.
- Stay on top of the latest changes in filter media advancement.
- Consult experts that are developing the latest technology.

Lessons Learned:

Typically, the filter bags are not the hero or villain...



The Filter bags are usually the victim of a process or baghouse operating change/flaw

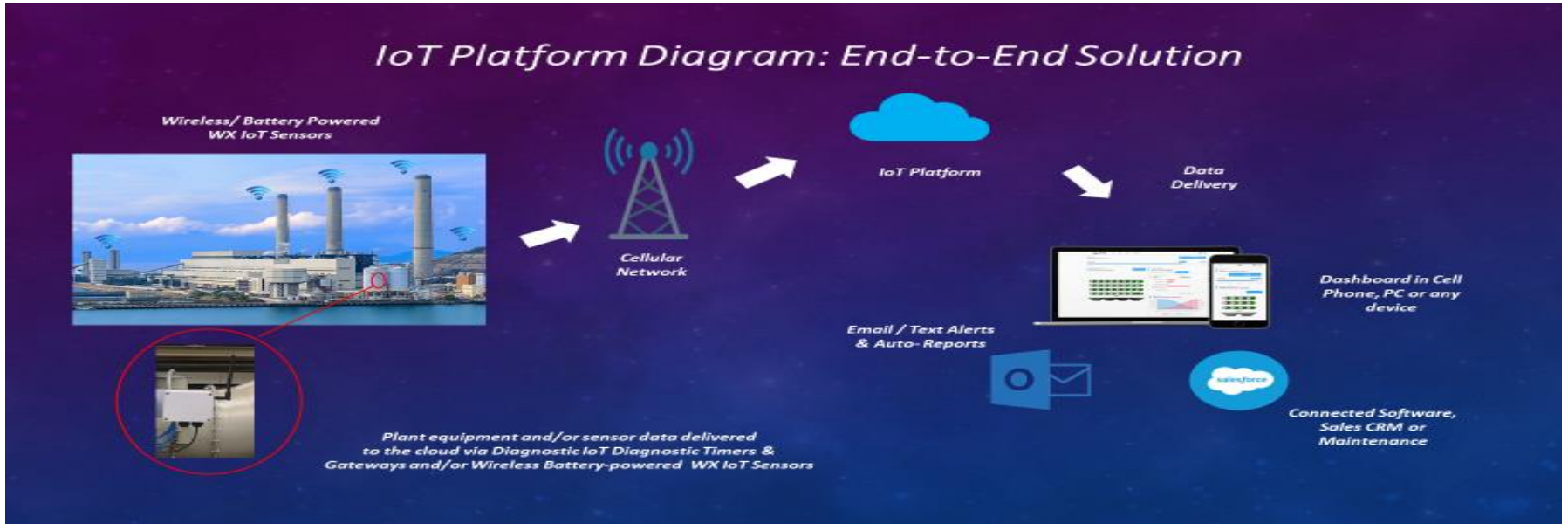
Fabric Filter Tips

- Test power supply to timer board/controller
- Test differential pressure taps (clean pressure lines)
- Measure compressed air pressure in the header
- Test filters periodically
- Test dust for a deeper dive
- Measure fan for vibration
- Measure airflow for confirmation
- Measure Cleaning Cycles Daily (keep count of the pulses).



Lessons Learned:

Take Advantage of available technologies



Lessons Learned Summary

1. Understand, monitor, measure, trend differential baghouse differential pressure.
2. Filter media choice is based your process conditions..
3. Inspect all baghouse cleaning components.
4. Listen for irregular valves sounds.
5. Map your bag failures.
6. Send failed bags to a bag laboratory for root cause analysis
7. Keep your hoppers empty.
8. Observe stack for opacity.
9. Consider remote monitoring. Take advantage of the available technology

And Finally

Train your employees annually:

- ✓ Baghouse Basics
- ✓ Best Practices
- ✓ New Technology
- ✓ Network with experts and other users
- ✓ Youtube.com is an excellent source information

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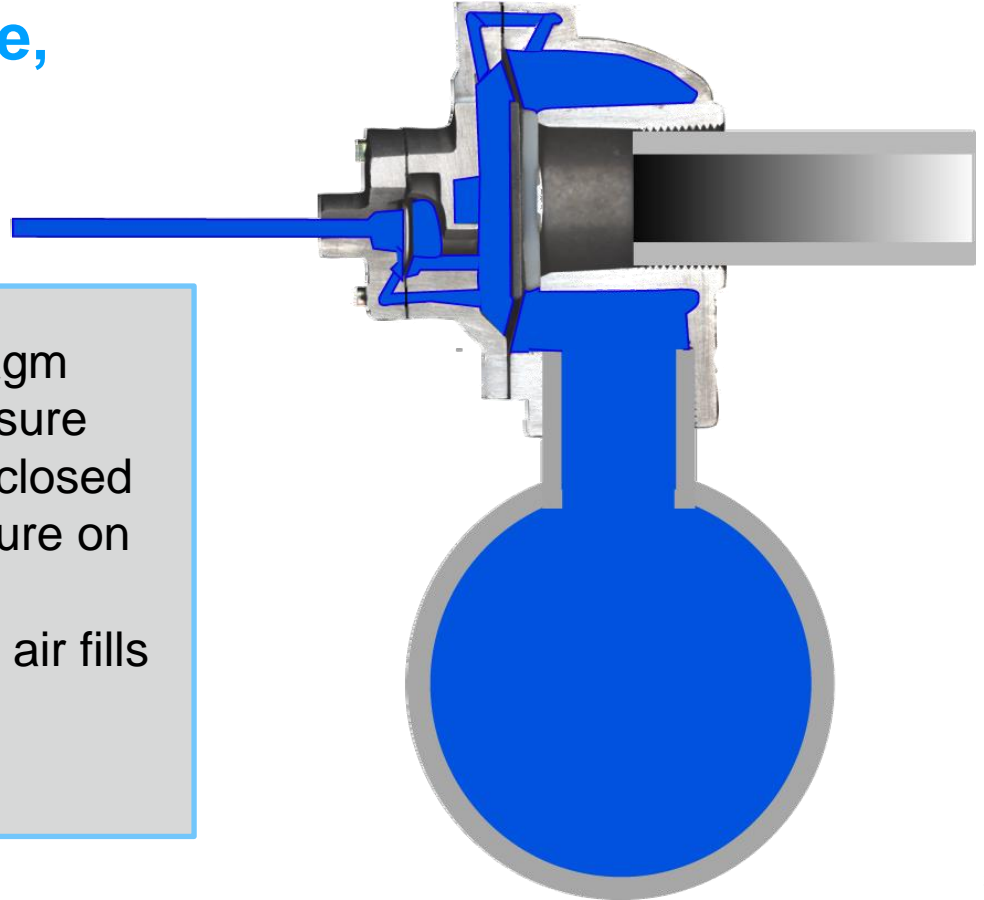
Leak Powder Testing

How to Use the Power

- Use 1-2 Lbs per 1000 SqFt of Filter in the Baghouse
- Have the Baghouse Operating at Normal Conditions Before Testing
- Inject the Powder (Hopper Door, Inlet Duct, Vacuum Into the System)
- When ~80% of the powder has been Injected, Start Isolating the Compartment
 - This prevents from drafting the powder out, making detection more difficult
- Enter the Compartment. Use a Bright UV Flashlight to find the Powder
 - The person injecting the powder should not go into the compartment
- Have 2-3 different colors for easy retesting after the failed filter is replaced.

What Makes A Pulse Valve, Pulse?

- Spring Used to Seat the Diaphragm
- Cross Over Pilot Equalizes Pressure
- Pressure Keeps the Diaphragm closed
- Solenoid Opens, reducing pressure on one side.
- Diaphragm moves, Compressed air fills the Blow Pipe



PM100 Probe – Stack Particulate Detection

Description: Particulate Monitor HART DTM
 Model: PM 1 PRO
 Tag: STACK

Auburn FilterSense
 Particulate Monitoring and Control Solutions

Measured Values

Process Variables

Alarms and Status

Alarms and Status

NAMUR Status

- Maintenance Required
- Out of Specification
- Function Check
- Failure
- Diagnostic State

Device Diagnostic Status 0

- DV Simulation Active
- Non-Volatile Memory Failure
- Volatile Memory Error
- Watchdog Reset Executed
- Voltage Conditions Out of Range
- Environmental Conditions Out of Range
- Electronic Failure
- Device Config Locked

Alarm Status

- Alarm 1 (HI/Hi Particulate)
- Alarm 2 (HI Particulate)
- Self-Check Overall Status
- Fatal Device Error: Auto Reset After 5 Min
- System Error: In HW/FW: Reset Recommended
- Configuration Error HW/Config: Reset Recommended

Device Diagnostic Status 1

- Status Simulation Active

Apply All Apply Close

Description: Particulate Monitor HART DTM
 Model: PM 1 PRO
 Tag: STACK

Auburn FilterSense
 Particulate Monitoring and Control Solutions

Trending

Trend

PV SV

■ PV (Particulate) ■ SV (Avg Particulate) ■ TV (Peak Particulate) ■ Loop Current

Settings

Parameter Selection

PV

SV

TV

Loop Current

Archive to CSV

Archive Trend

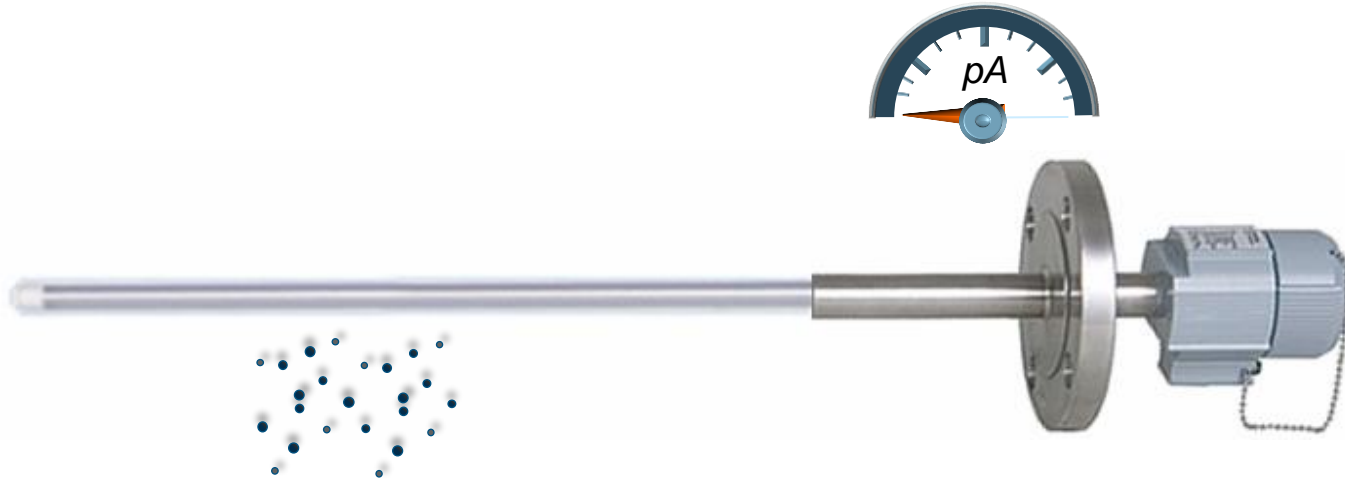
Refresh

Cycle Refresh

1 Sec

Apply All Apply Close

Charge-Induction Principle



Preventative...

Predictive...

OR

Troubleshooting

What is Your Method of Maintenance?