2019 CHEM SHOW

THE EVENT FOR PROCESSING TECHNOLOGY

OCT 22-24 • JAVITS CENTER • NYC

Troubleshooting Pneumatic Conveying Systems

Presenter: Brad Schultz

MAGNUM SYSTEMS

AGENDA

Part 1 – Dilute Phase System Troubleshooting

Part 2 – Dense Phase System Troubleshooting

PART 1
Dilute Phase System Troubleshooting

MAGNUM SYSTEMS

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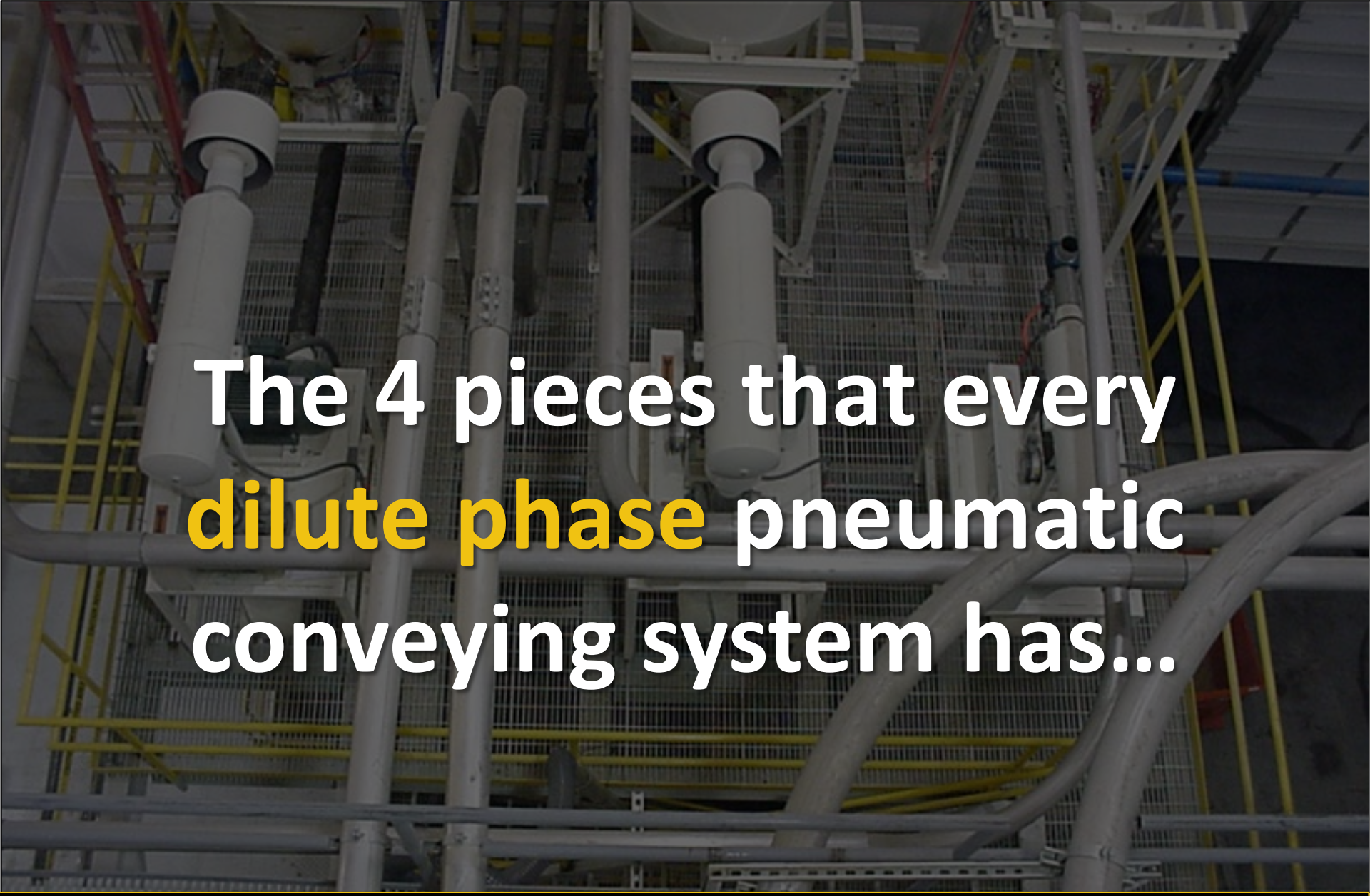
What a Pneumatic Conveying System looks like when its working correctly

What a Pneumatic Conveying System looks like when its **not** working correctly



Blower Package

- The source of “power” in the system

- Blowers only provide 2 things:
  - The correct VOLUME of air needed
  - The PRESSURE required to generate the power needed

Convey Line

- The tie between point “A” and point “B”

Filter Receiver / Bin Vent

- End of the line where the air and material are separated

Filter Receivers/Bin Vents provide two things:

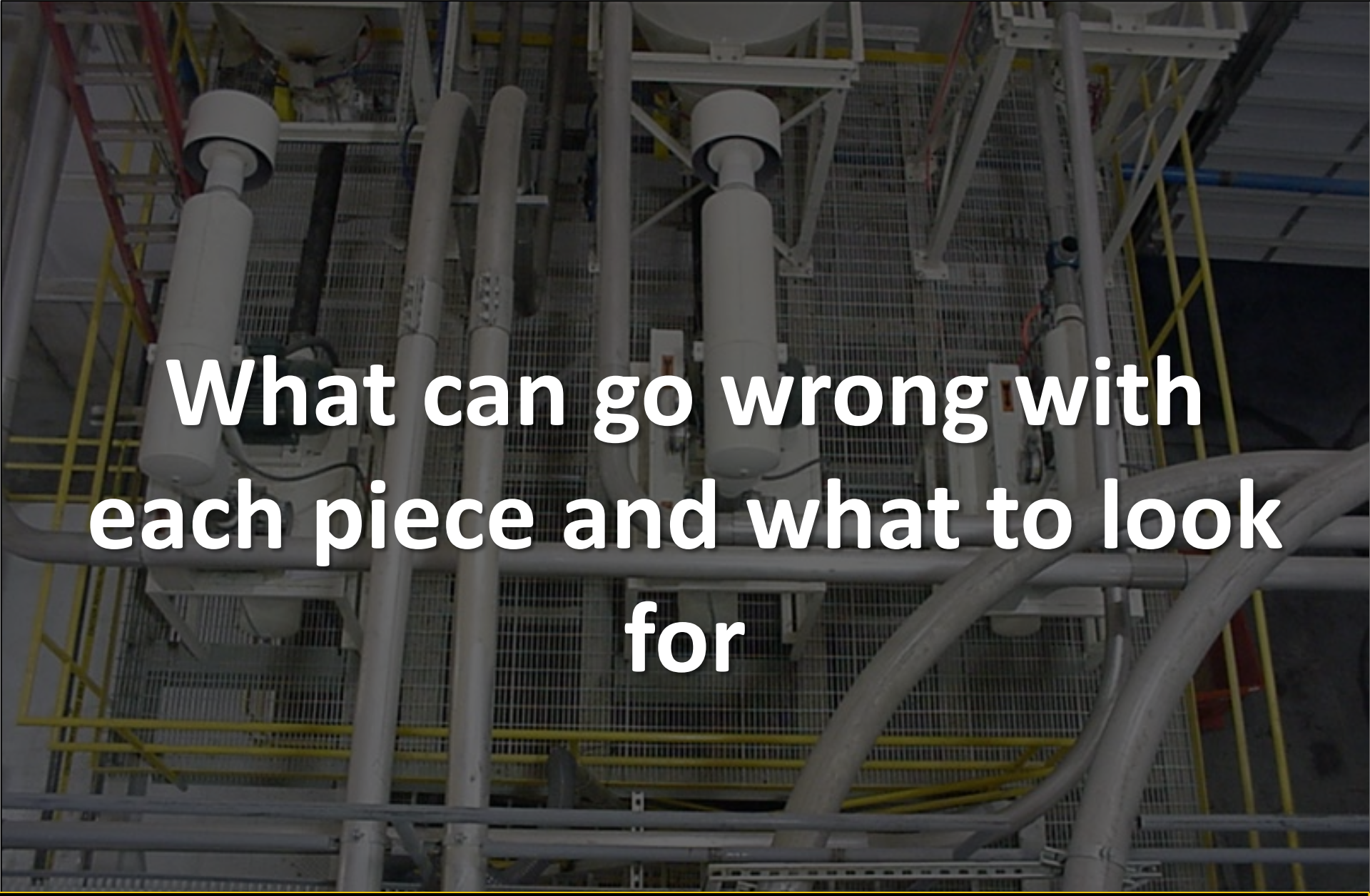
- A wide spot in the river
- A physical barrier to particulate from escaping the system

Rotary Valves / Airlock

- The “revolving door” of the system

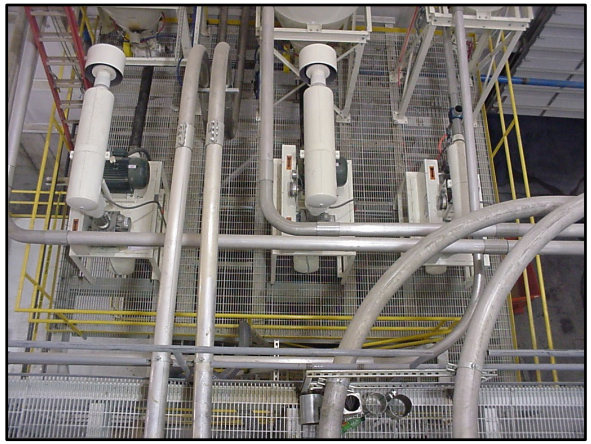
Rotary Airlocks:

- Meters Product into or out of a pneumatic system
- Is the airlock in the system separating the pressure differential
- Not perfect at either, but the only thing that can do both at the same time



Blower Packages

- Represent about 1% of the problems in the field.
- Reality of Blower Packages: if they run for a week, they will run for the next 20 years
- Belts glaze and Belts break, but speeds should never change
- Pressure relief valves should never open



Blower Packages

Have one very important source of information that is the first place you should look at when troubleshooting:

This is your best indicator of what is going on inside the conveying system

Pressure/Vacuum Gauge

- Gauge is “bouncing”
  - Early stages of rotary valve wear or velocity too low
  - Possible controls interaction
- Gauge is “higher than normal”
  - Convey line buildup
  - Bulk density of the material higher than normal
- Gauge is “lower than normal”
  - No feed into system
  - Bridging above feed source

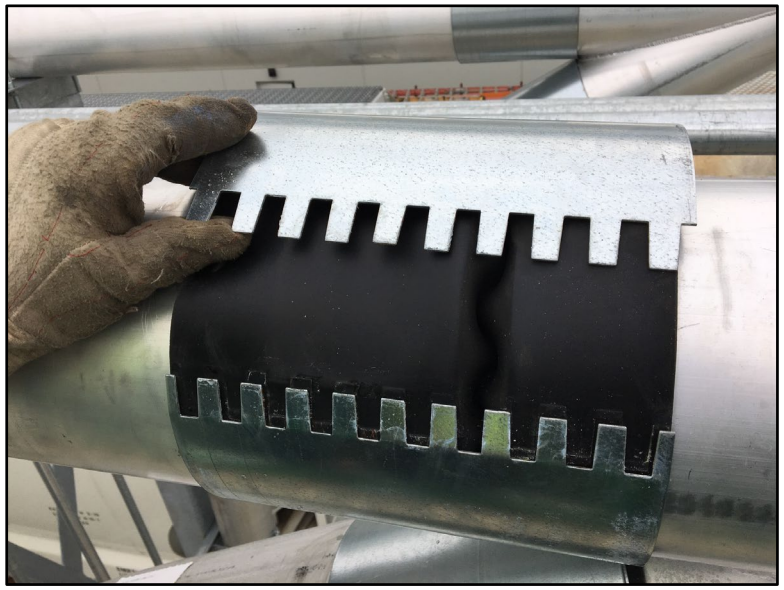
Convey Lines

Represent about 5% of the problems in the field.

- Elbows:
  - The main wear point in a convey line
  - The ONLY place where convey lines “blow apart”
- Adding more line to a convey system will impact performance
- You can “feel” what is going on inside a convey line
- Diverter Valves

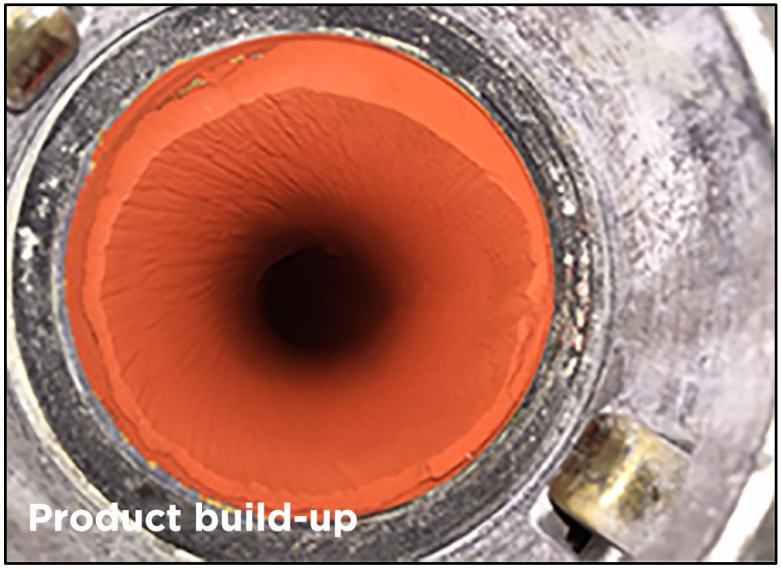
Convey Line - Issues

- Couplings and gaskets. Not as simple as you think
  - Vacuum gasket protectors



Convey Lines

- Product Build-up “hardening of the arteries”



Convey Lines

- Holes

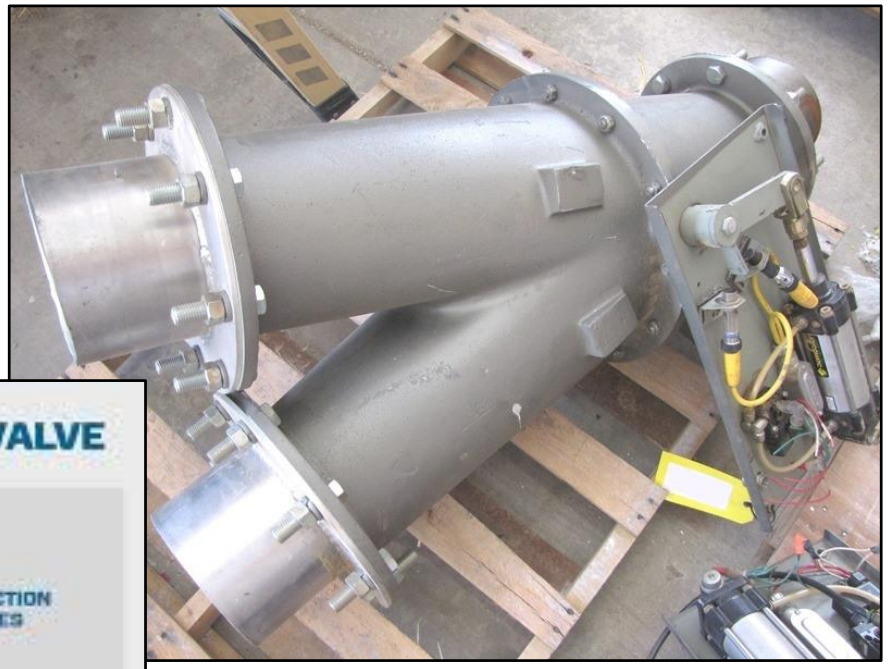
- Obvious in a pressure system
- Little less in a vacuum system

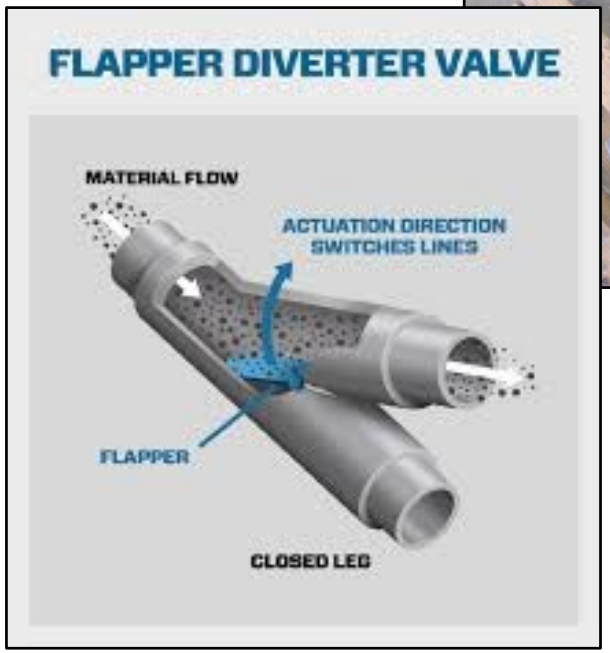
Convey Lines

- Never Convey at a 45 degree angle up
- Horizontal conveying is “harder” than Vertical

Diverter Valves

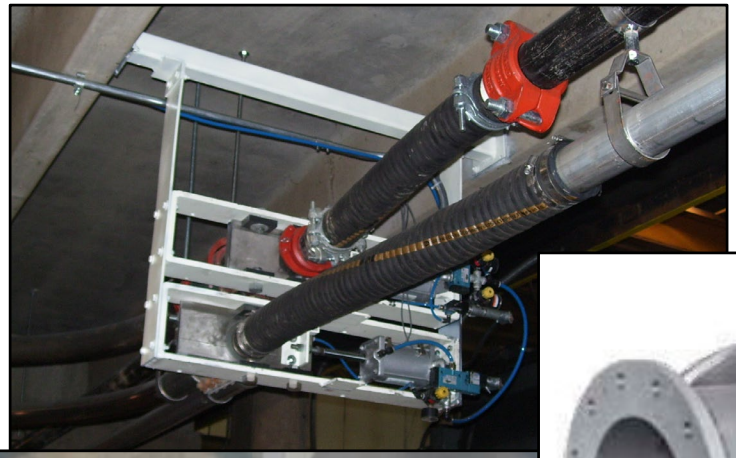
- Internal Leaks can fill dead leg

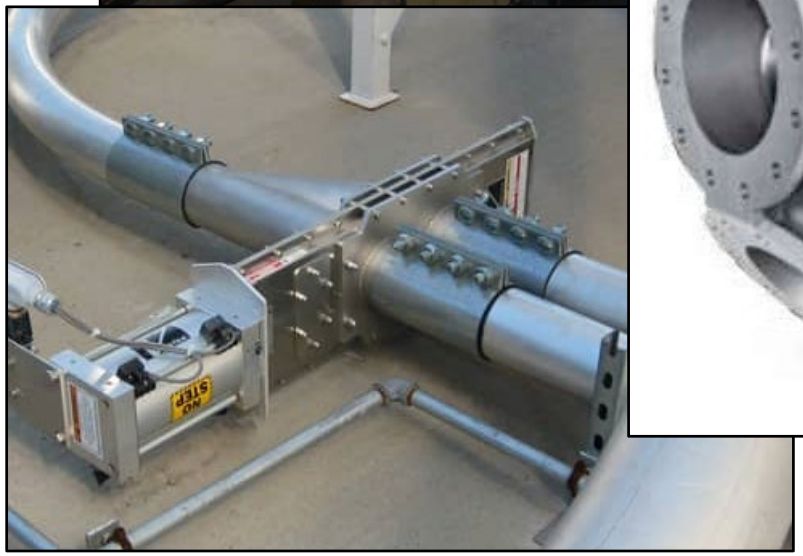




Diverter Valves

- Better design



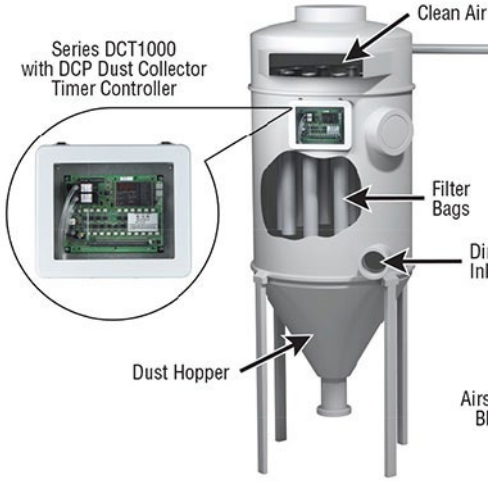


Filter Receivers / Bin Vents

- Represent about 5% of the problems in the field.
- They are not dust collectors
- “dirty bags” are not a bad thing
  - New bags have the worst efficiency they will ever have

Filter Receivers / Bin Vents

Have one very important source of information that is the first place you should look at when troubleshooting:



This is your best indicator of what is going on inside the filter
0 – 6” is fine. Steady is great. Bouncing is bad…

Filter Receivers / Bin Vents

The timer board has many functions

- Controls the duration and delay of the cleaning pulses
- Displays the differential pressure across the bags (how dirty are the bags)
- Can be set for on-demand cleaning
- Has a dry contact switch for high pressure alarm
- Has a 4-20mA output for continuous monitoring

Filter Receivers / Bin Vents

Solenoids and Diaphragm valves

- Electrical signal opens the solenoid, letting the air off the back of the diaphragm
- causing it to release a pulse of compressed air down the inside of the filter bags

- Should sound like a rifle shot…not a “woosh” of air. You are snapping the bag clean not blowing it clean

Filter Receivers / Bin Vents

- Holes in bags
  - Along the wires of the cages
  - On the bottom of the bags
- Leaks (doors are the worst)
  - Pressure systems make a mess
  - Vacuum is hard to diagnose and find.
  - Very detrimental to system performance.
- Can Velocity and Interstitial Velocity
  - Separation is by gravity

Rotary Valves / Airlocks

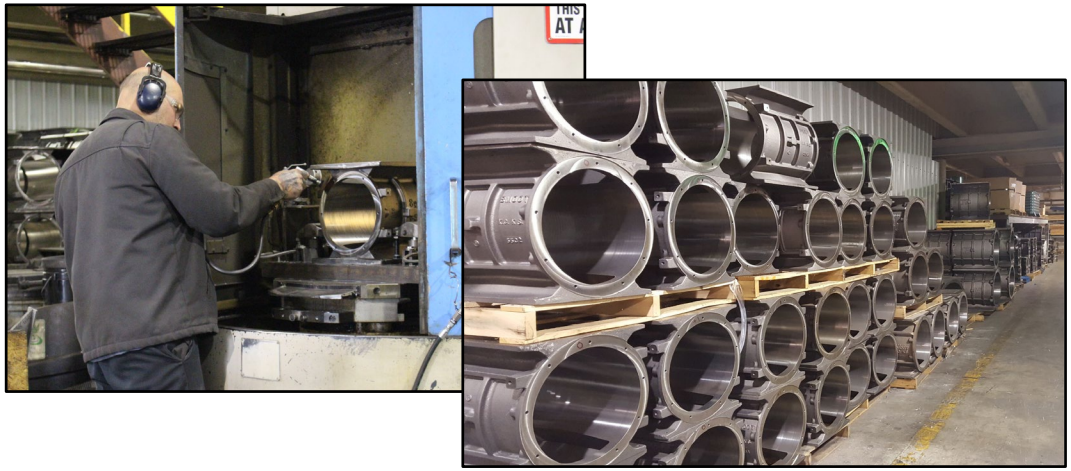
Represent about “the rest”% of the problems in the field.

- Reality of Rotary Valves: They are a very precision device put into a rough environment.

Rotary Valves / Airlocks

Rotary Valves wear out.

- Leave our factory at 0.004” to 0.006” of tolerance
- Are considered “wore out” at 0.015”
- Wear is slow and internal
- Very hard to measure while installed
- It’s a complete business by itself



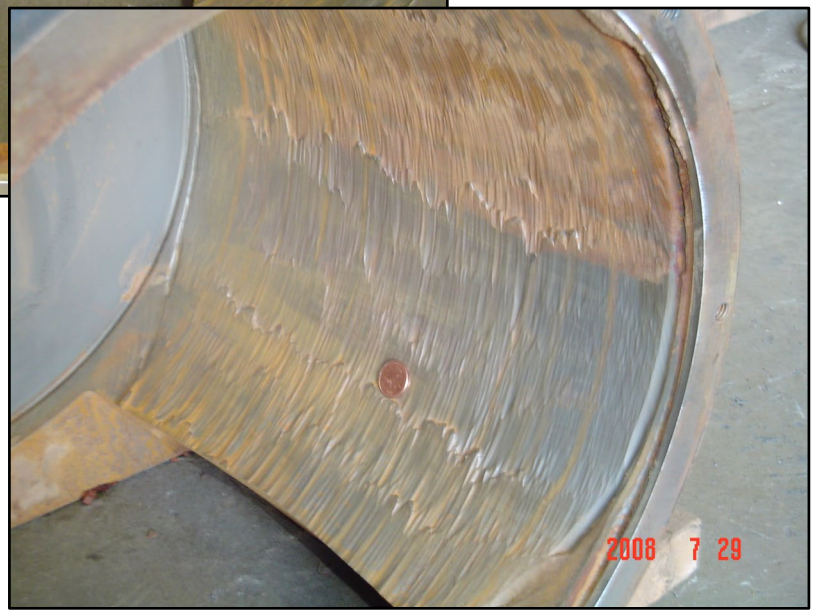
Rotary Valves / Airlocks

Rotary Valve wear is the hardest part of a pneumatic conveying system to diagnose

- There is nothing that can be done to a rotary valve to be able to measure or predict wear.
- All the wear is on the inside
- “where is the wear”…not predictable or even
- Can be a very slow process that takes years
  - “corporate memory”

Rotary Valves / Airlocks

Note that the valve is wore out on only one side



Rotary Valves / Airlocks

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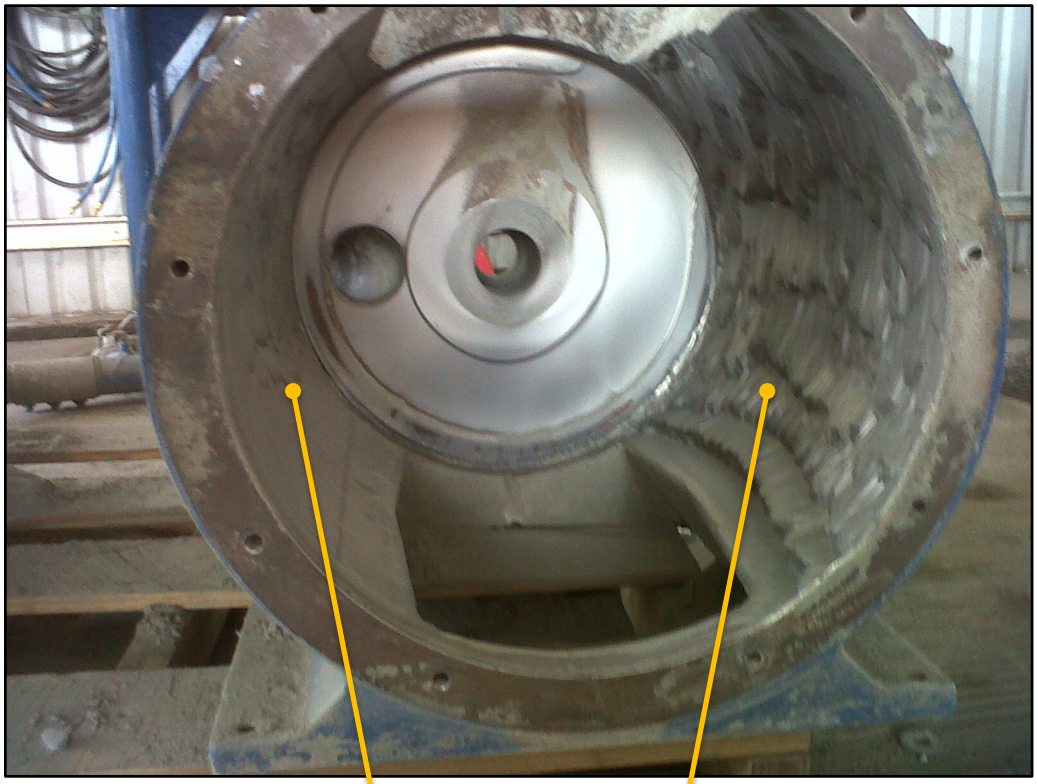
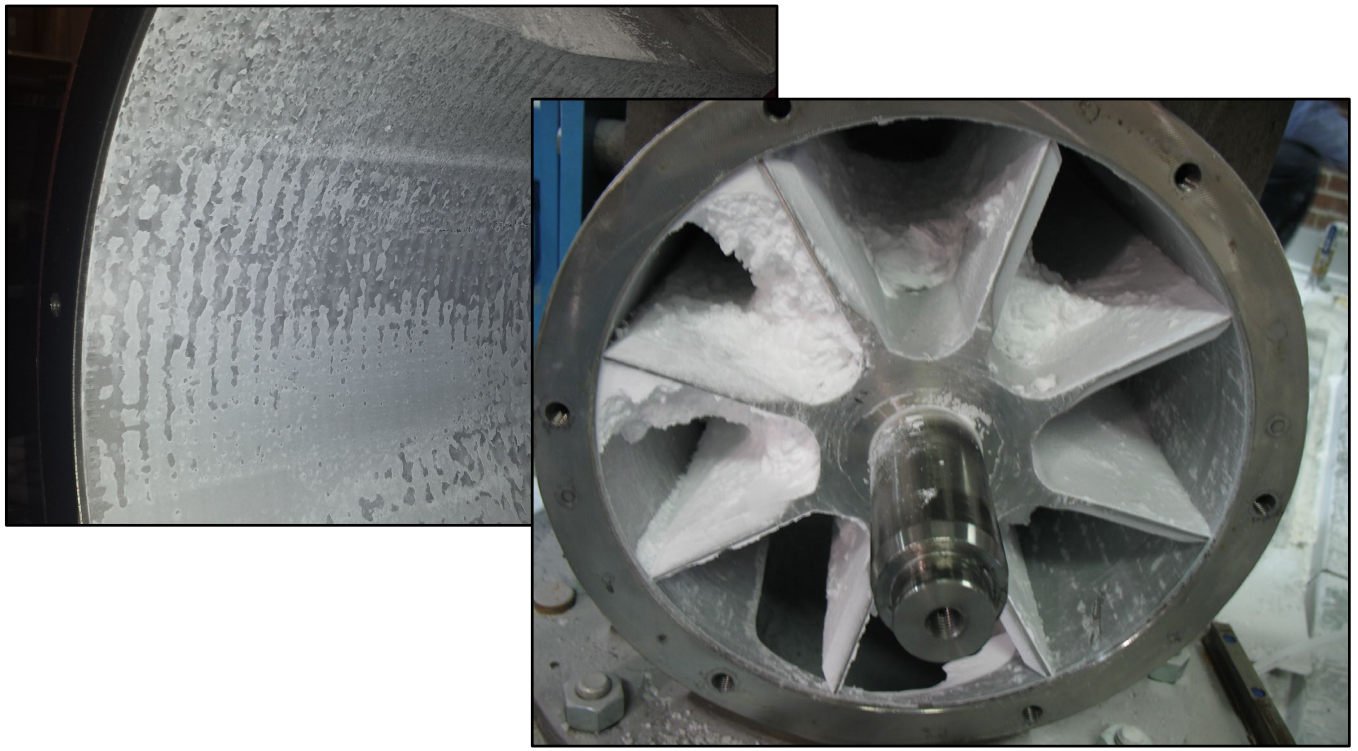


Minimal to No Wear

Severe Wear

Rotary Valves / Airlocks

Product Buildup also causes issues.



Rotary Valves / Airlocks

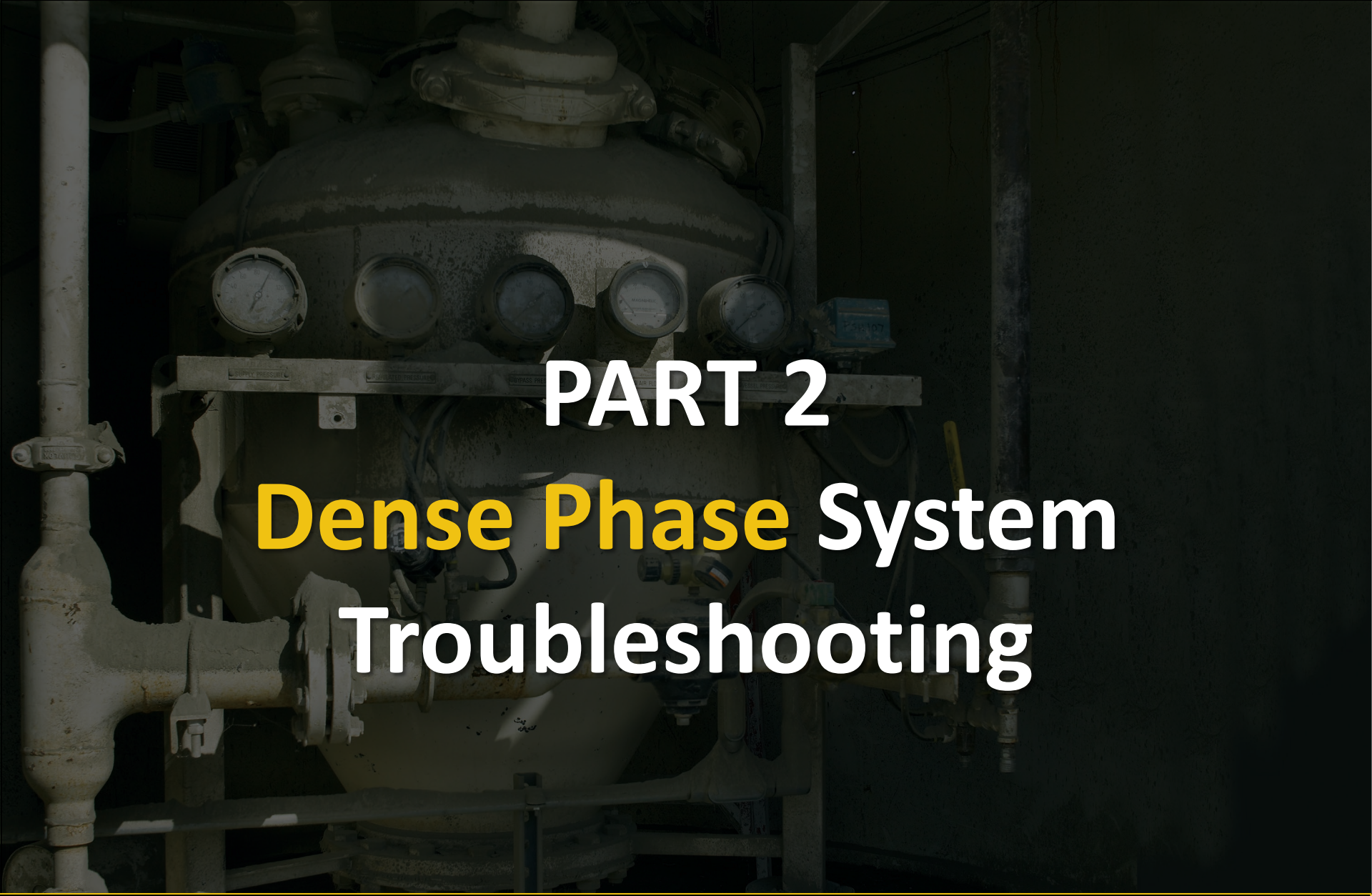
What you **can see** with rotary valve wear

- Rate has dropped in the system
  - Blow by air increase causing fill efficiency to go down
- Frequency of line plugging going up
- Blower Pressure “bouncing”

SUMMARY – Dilute Phase Troubleshooting

Remember 3 things

- There are 4 main components
- Start with the Rotary Valves
- Determine the frequency of the problem



PART 2
Dense Phase System Troubleshooting

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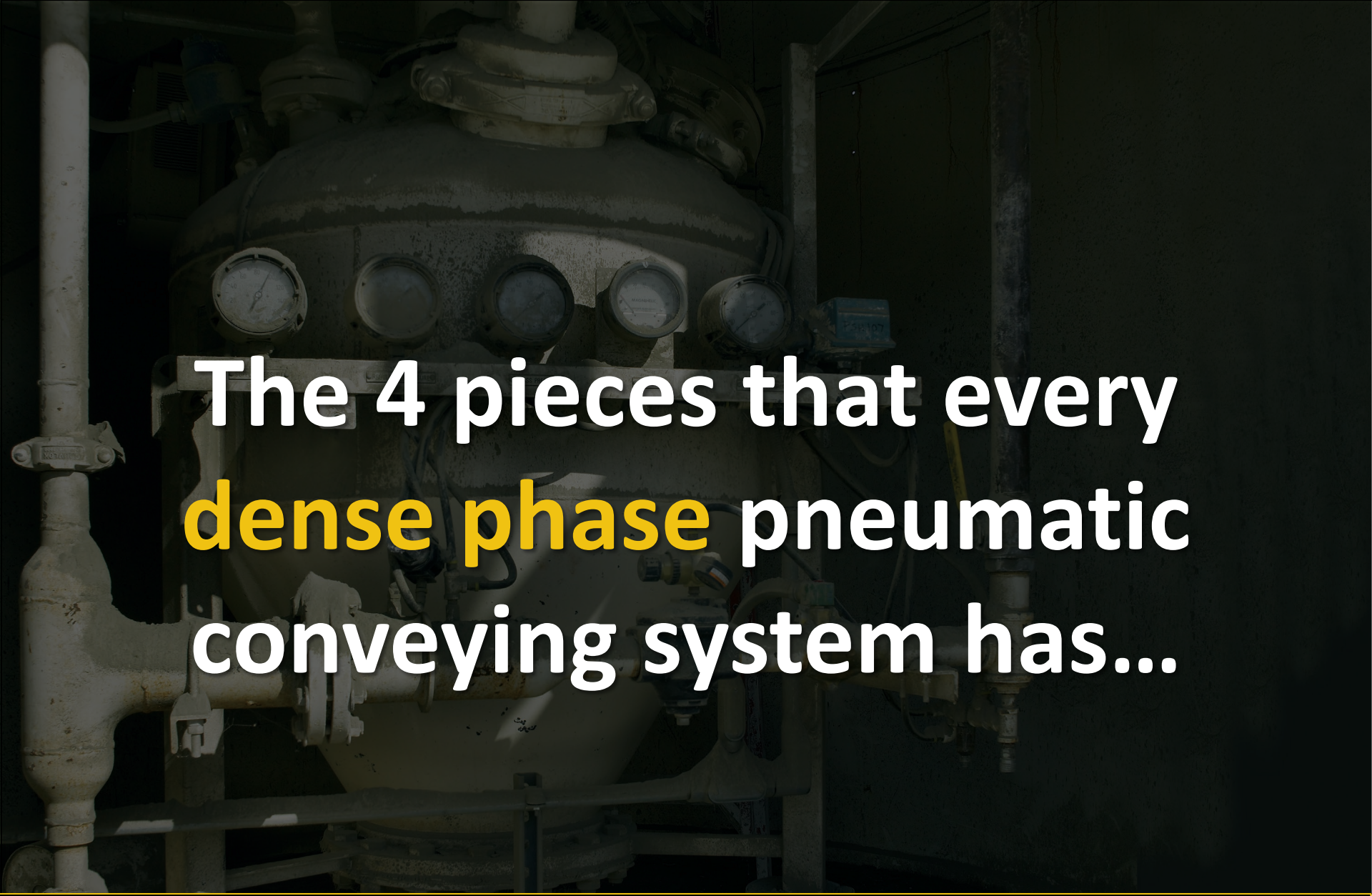


Air Compressor

- The source of “power” in the system

- Air Compressors tend to fall into 2 categories:
  - Dedicated to and only for the Dense Phase system
  - Part of the plant air system

Convey Line

- The tie between point “A” and point “B”
- Usually pipe not tube

Filter Receiver / Bin Vent

- End of the line where the air and material are separated

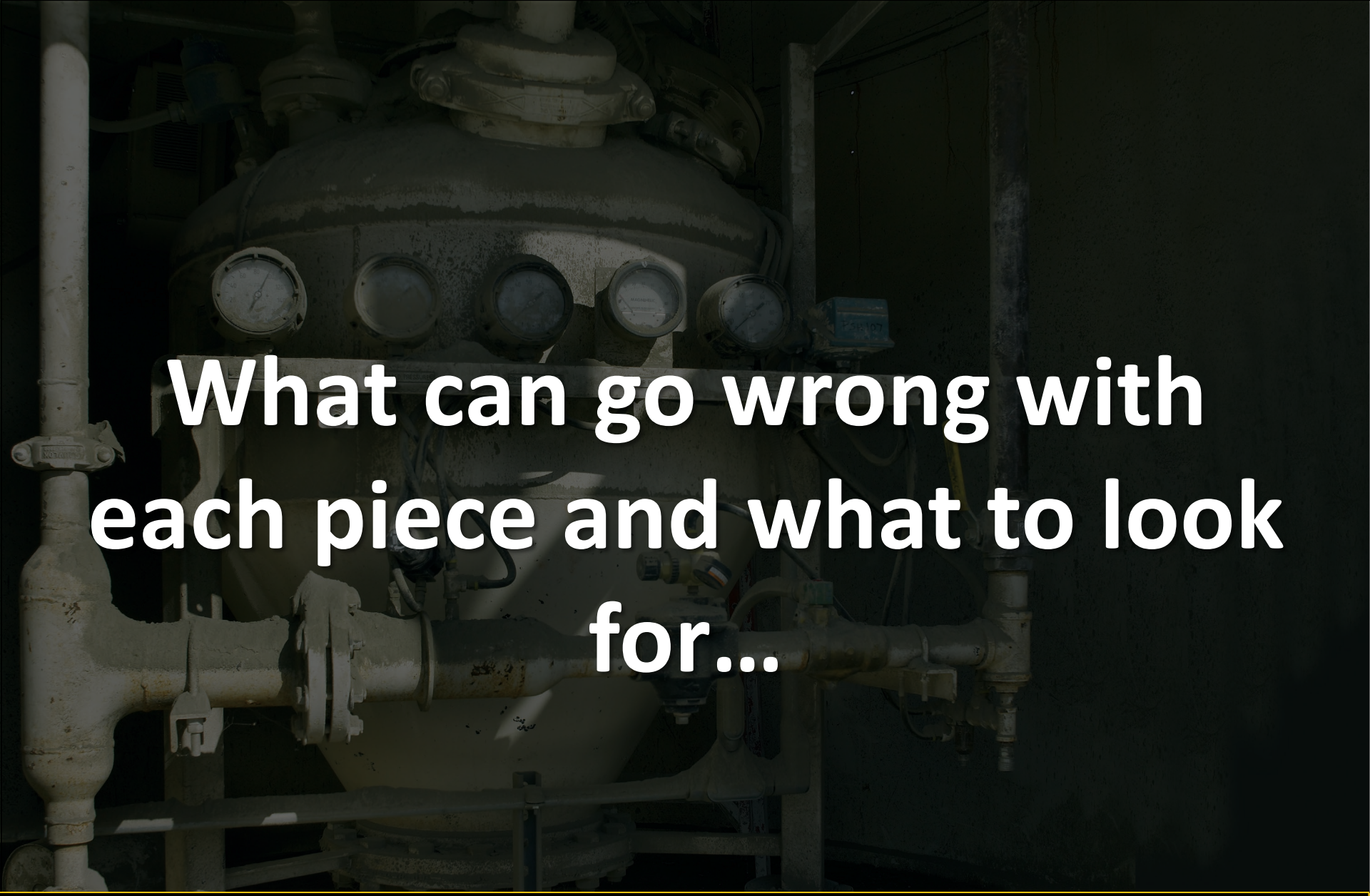
Filter Receivers/Bin Vents provide two things:

- A wide spot in the river
- A physical barrier to particulate from escaping the system

ASME Code Pressure Vessel

Pressure Vessels:

- Normally rated to 100 PSIG
- Top or Bottom Discharge
- Normally cycle about 10-13 times per hour



What can go wrong with each piece and what to look for…

Air Compressor

- The source of “power” in the system

- Air Compressors tend to fall into 2 categories:
  - Dedicated to and only for the Dense Phase system
  - Part of the plant air system

Air Compressors

- Oil- Compressed air generates oil mist
  - Oil/Mist separator

Air Compressors

- Water- Compressed air generates a lot of water
  - Desiccant drier

  - Refrigerant drier

Air Compressors

- Accumulator
  - Storage of Compressed Air
  - Should always pump back up to full pressure prior to next convey cycle
  - Keeps the pressure constant on the system air volume controls

Convey Line

- The tie between point “A” and point “B”
- Usually pipe not tube

Convey Lines- Ditto Dilute Phase issues except:

Pipe not tube

- Due to compressed air codes, usually Schedule 40 or 80 pipe

- Couplings are made for pipe.

Convey Lines- Ditto Dilute Phase issues

You can feel what is going on inside the pipe. Great way to “see” what is going on.

Convey Lines- Boosters

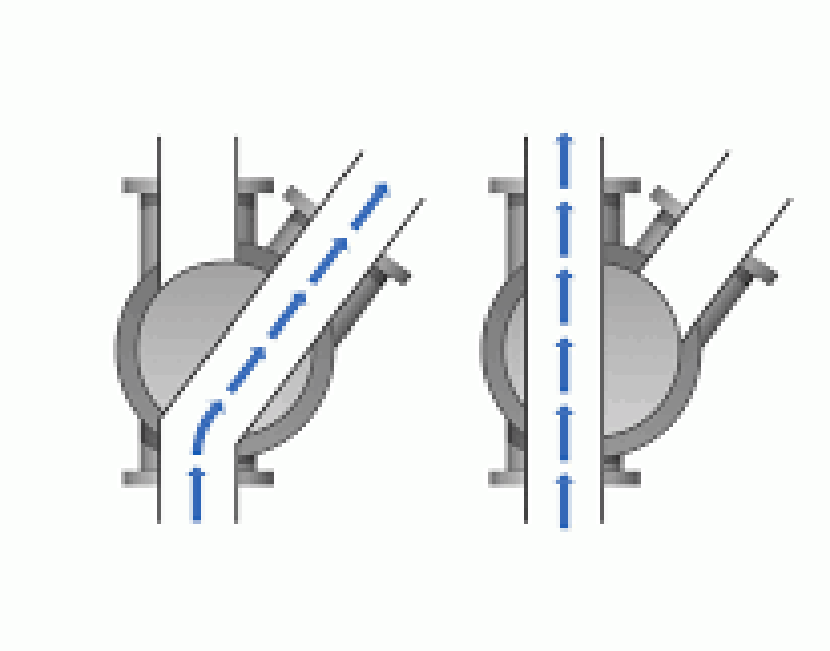
- Used to “stir up” materials that have de-aerated or have become solid plugs.
  - Normally just prior to an elbow

Convey Lines- Elbow Support

- Dense phase slugs have mass…
- Big lines = large slugs = large forces pushing line in direction of travel
- Amplified by materials that tend to de-aerate

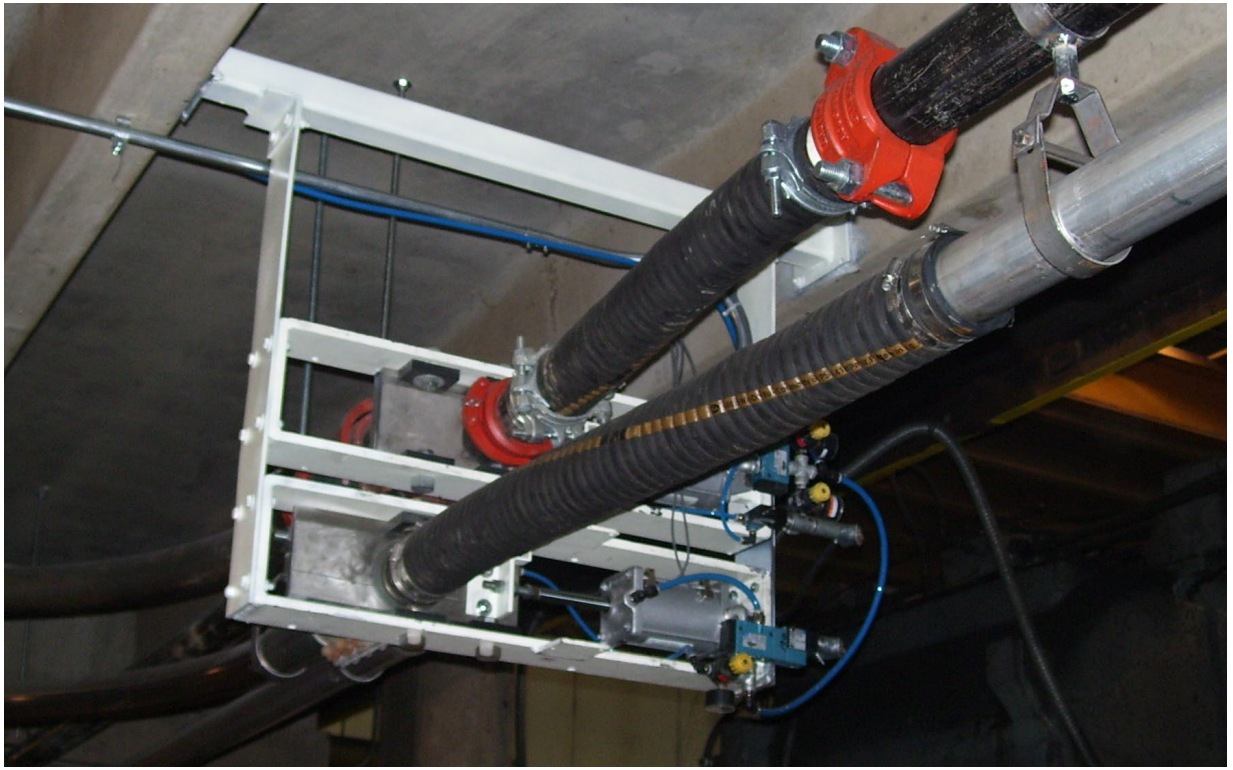
Diverter Valves

- Divert Angle and slugs of material



Diverter Valves

- Better design



What is Dilute Phase or Dense Phase Conveying?

- They are different modes of how the material being conveyed flows through a convey line.

- It is 100% the Material not the equipment that determines the difference

Dilute Phase VS Dense Phase

Dense Phase	Dilute Phase
3 MPH	40 MPH

Dilute Phase VS Dense Phase

40 MPH

Dilute Phase VS Dense Phase

3 MPH

Filter Receiver / Bin Vent

- Exactly the same filters as used on Dilute Phase Systems

Filter Receivers / Bin Vents

- Dense Phase air volumes change
  - Zero flow….vessel filling
  - Average flow….vessel conveying
  - Peak flow….vessel blowdown
- DP reading are going to fluctuate
- Alarm setpoints are almost impossible to set

ASME Code Pressure Vessel

Pressure Vessels:

- Normally rated to 100 PSIG
- Top or Bottom Discharge
- Normally cycle about 10-13 times per hour

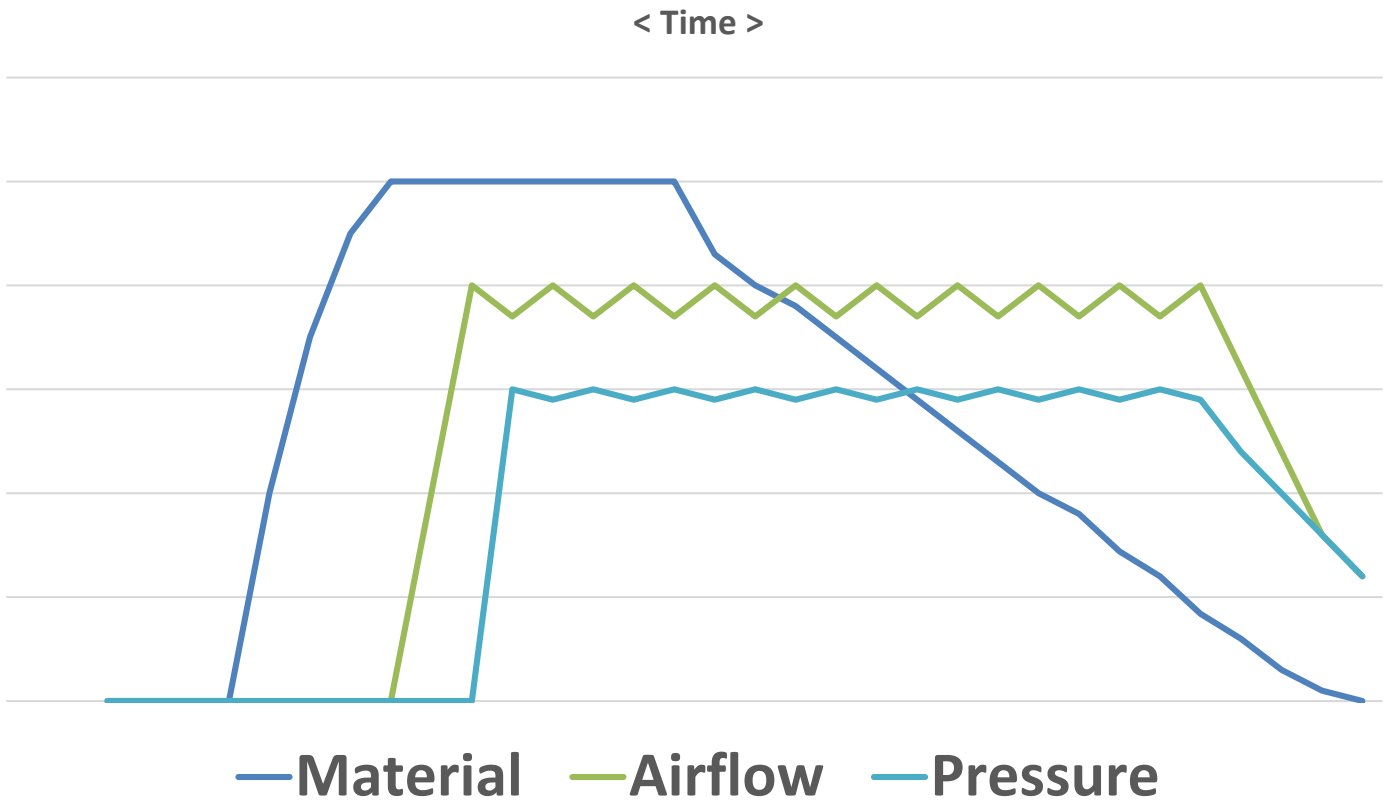
Pressure Vessel

Where the “magic” is

- Black Box of Magic
  - Air Control
    - » CFM constant
    - » PSIG constant

Dense Phase Cycle

Normal



Pressure Vessel

Two Reasons for Dense Phase

- Abrasive material
  Sand, Cement, alumina, perlite ore

- Friable material
  Popcorn, glass spheres, sugar

Pressure Vessel

- For a material to work well in a dense phase system, it has to be either:

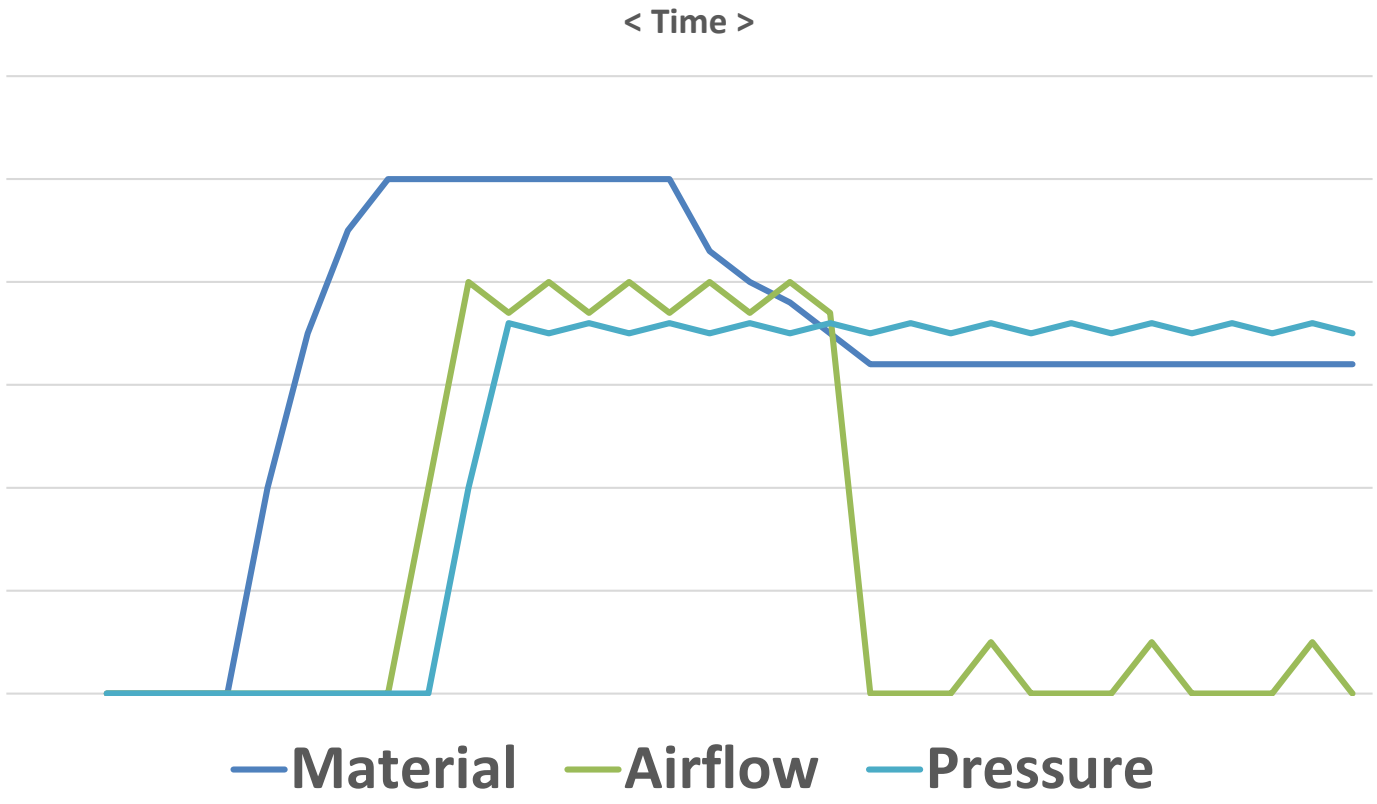
- Permeable…..air can get through it
- (Popcorn, plastic pellets,sand)

- Fluidizable….air turns it to “water”
- (talc, cement, clay)

- Air is always moving down the line through the material…if not….you have a plug

Dense Phase Cycle

Plugged line



Pressure Vessel

- Bottom Discharge
- More common and simpler design. But only work on materials that flow without a lot of assistance out of a hopper

Pressure Vessel

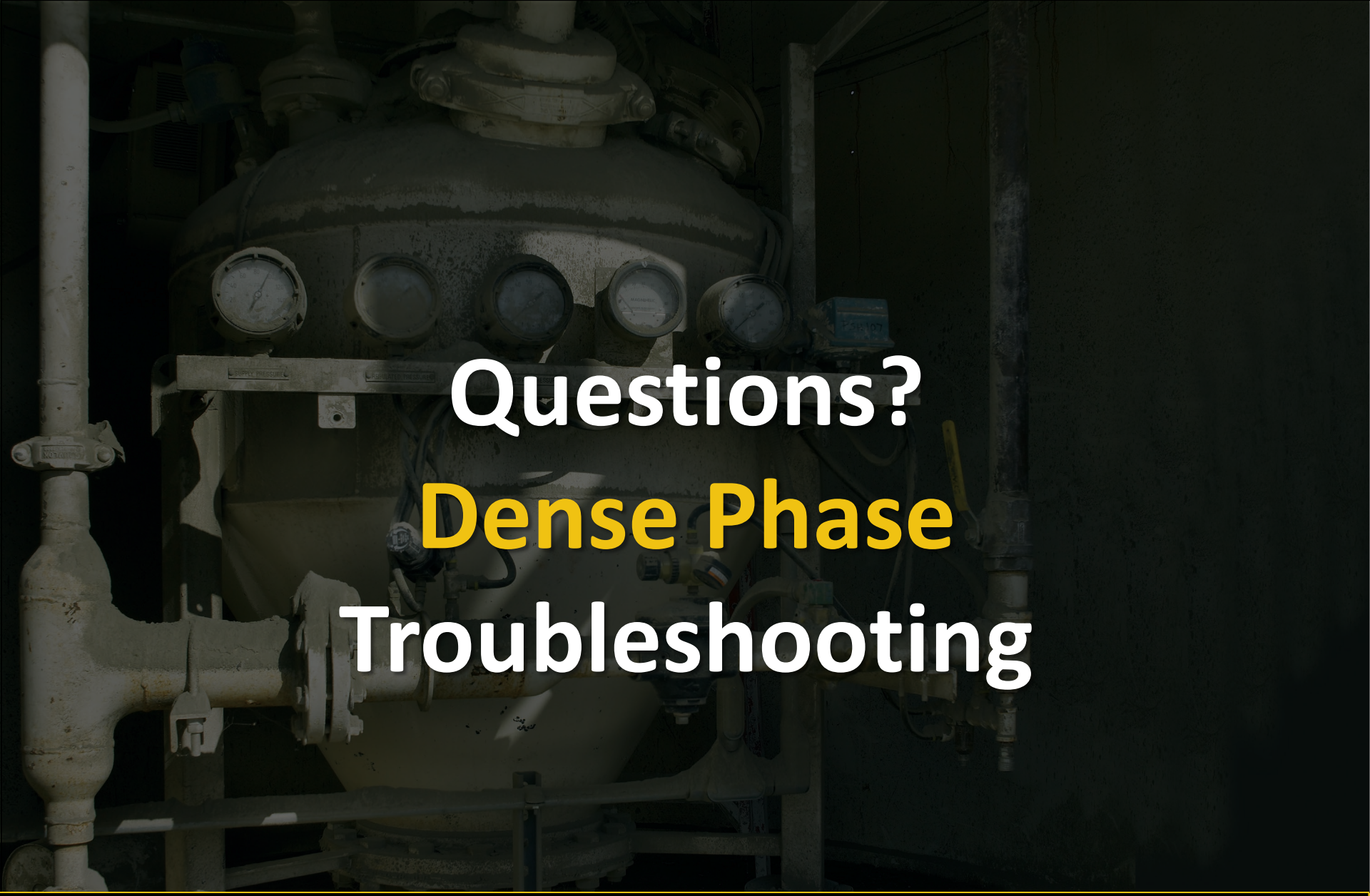
- Top Discharge
- Highly fluidizable powders that tend to flush down the line if you used bottom discharge
- Fluidizing disk can be a high maintenance item

Pressure Vessel – Mark your gauges and lock out your “tweekers”

Dense Phase Problems

Most dense phase problems are in two areas:

- The material has changed
- “Tweekers” increasing the airflow in a system



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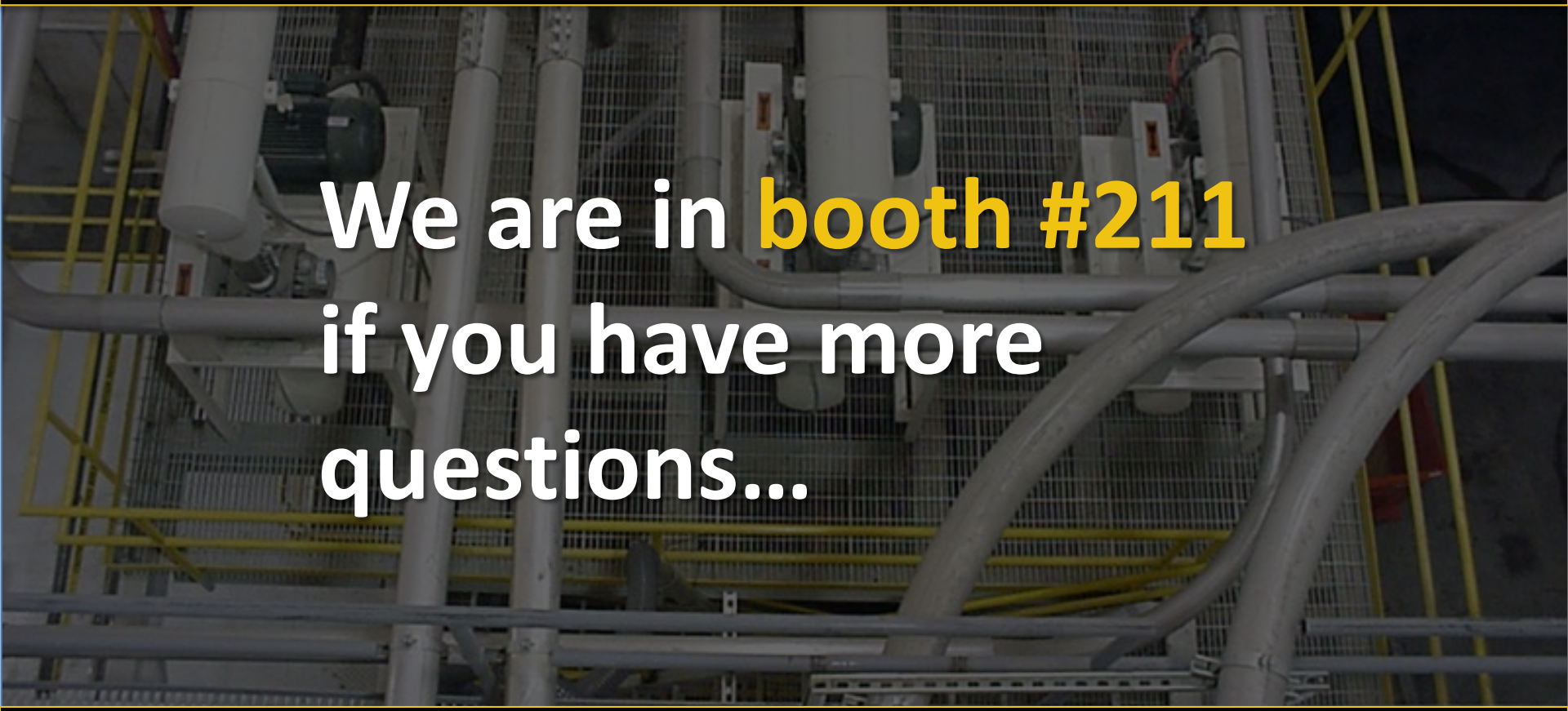

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