



Dust Control System Design

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Dust Control Systems

Topics for discussion

- Why and Where do we need Dust Control?
- System & Component Overview
- Design of a Dust Control System
- Explosion Protection
- Dust Control Maintenance & Troubleshooting
- Questions

XOL Automation is a leading Engineering Sales & Service Company delivering comprehensive solutions in the DRY material handling and processing sector.



Food



Milling



Oil Seed



Grains

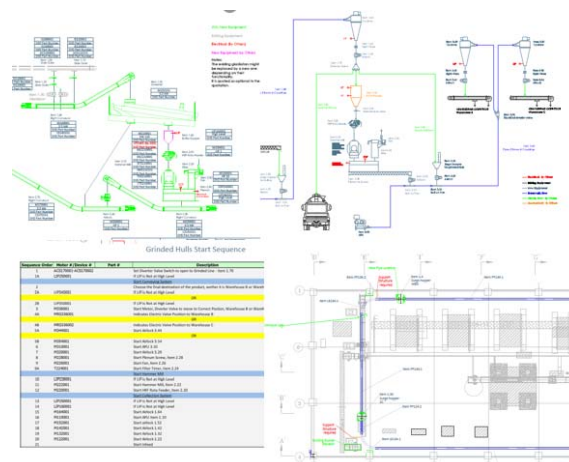


Sugar

Process Equipment & Systems



Engineering & Services



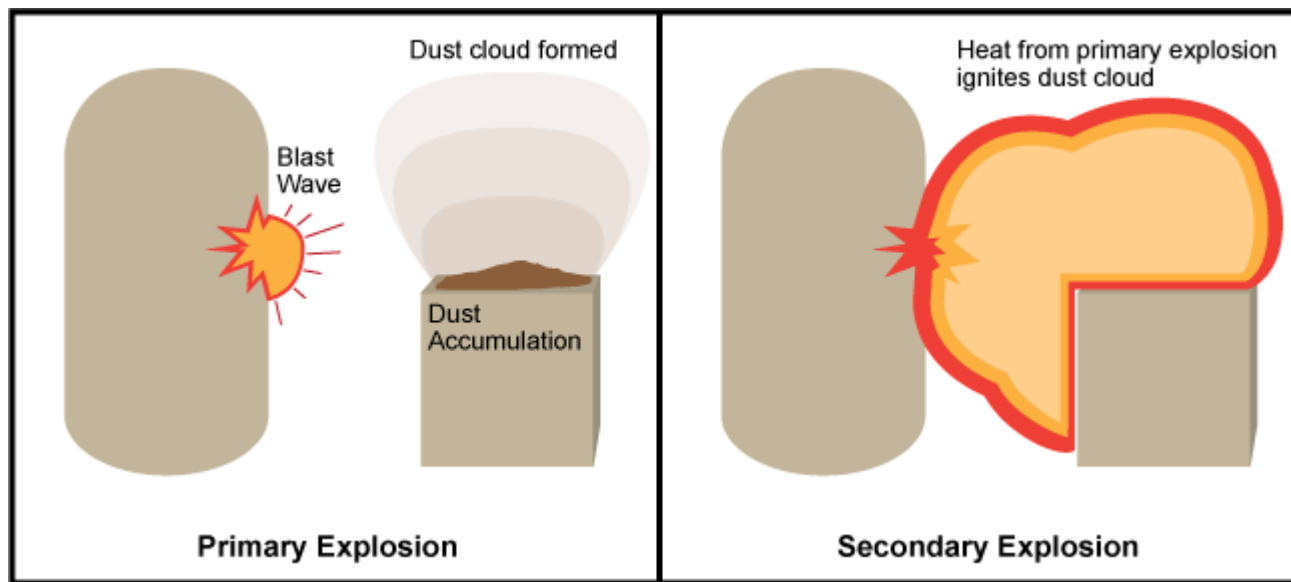
Geographical Coverage



Why is “Dust” an issue?

- Health issue for workers (respiratory, visibility, slip hazard, fire & EXPLOSIONS)
- Safety & Risk issue for assets and facilities
- Sanitation and infestation control
- Maintenance costs
- Equipment life expectancy
- Retention of valuable product (product degradation & waste)





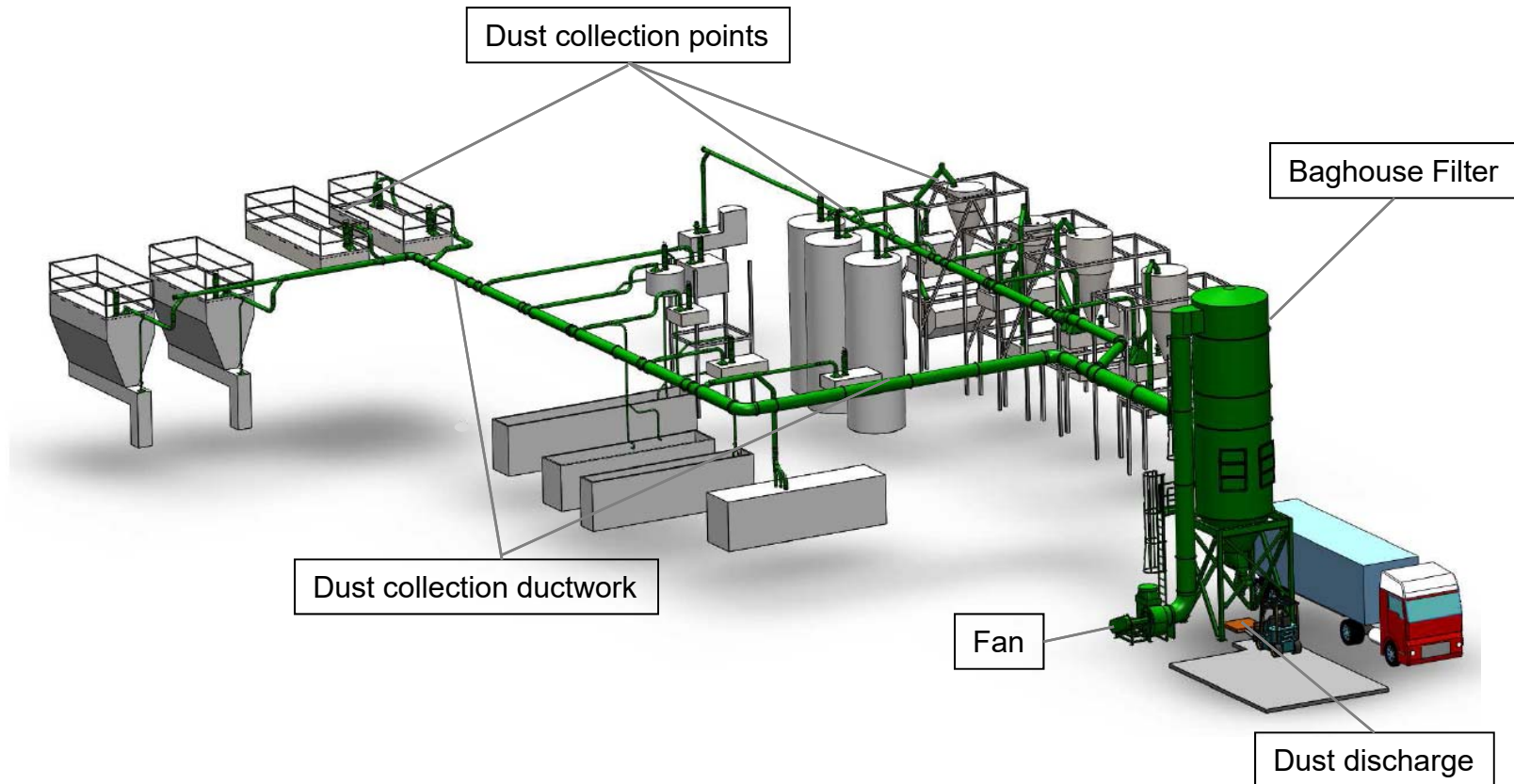
Dust related explosions have a significant risk of major secondary events if there are any significant accumulations of dust within the facility.





Dust control system design considerations

- System overview
- Component selection
- Ductwork design
- Dust control points/hood design



Basic system equipment list: hoods, dampers, ductwork, baghouse and suction fan

Options:

- Replace baghouse filter with a cyclone
- Add a pressure convey system to send dust to a dust bin

Dry-Type Dust Collectors Air Material Separators (AMS)

Baghouse filter



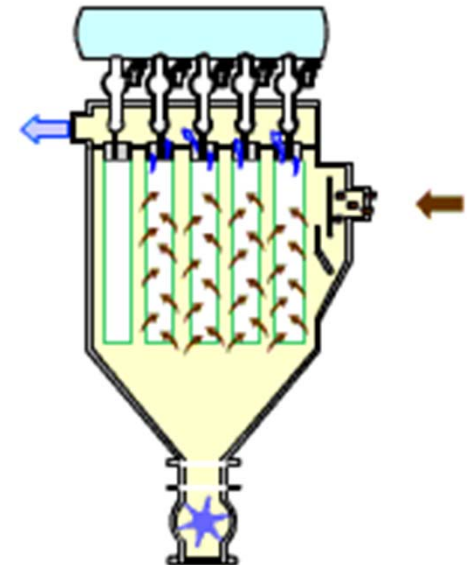
v's

Cyclone



	Baghouse	Cyclone
Efficiency	High (typically >99.5%)	Highly dependent on application
Maintenance	Moderate (if correctly sized/designed)	Minimal
Cost	\$\$\$	\$

- Various styles/designs available
- Utilizes fabric socks/media
- Efficiencies could exceed 99.9% depending on type of filter media and dust characteristics Dust characteristics must be carefully considered during filter selection and system design
- Filter bags and “dust cake” on surface of media act to separate particles from incoming dirty airstream, resulting in clean air exiting baghouse to atmosphere



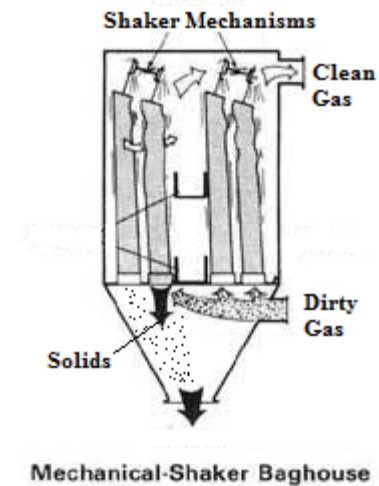
Reverse air cleaning

- High Pressure, Low Volume
- Medium Pressure
- Low Pressure



Bag shaker systems

- Generally not as effective as reverse air



Air-to-Cloth Ratio

- Establishes design capacity of a baghouse
- Term refers to ratio of air quantity (cubic feet per minute or CFM) to the amount of media surface area within filter (square ft.)
- $\text{Air Volume (CFM)} \div \text{Cloth Area (SQ.FT.)} = \text{Air to Cloth Ratio}$

Example: $15,000 \text{ CFM} \div 1,555 \text{ sq ft} = 9.65:1$

(Varies by application and manufacturer but typically in the range of 5:1 to 10:1)

Interstitial-Velocity (Can Velocity)

- Interstitial Velocity is measured in feet per minute (FPM).
- Determined by dividing the total air flow entering the baghouse chamber by the cross sectional area of the filter housing (less bag area)

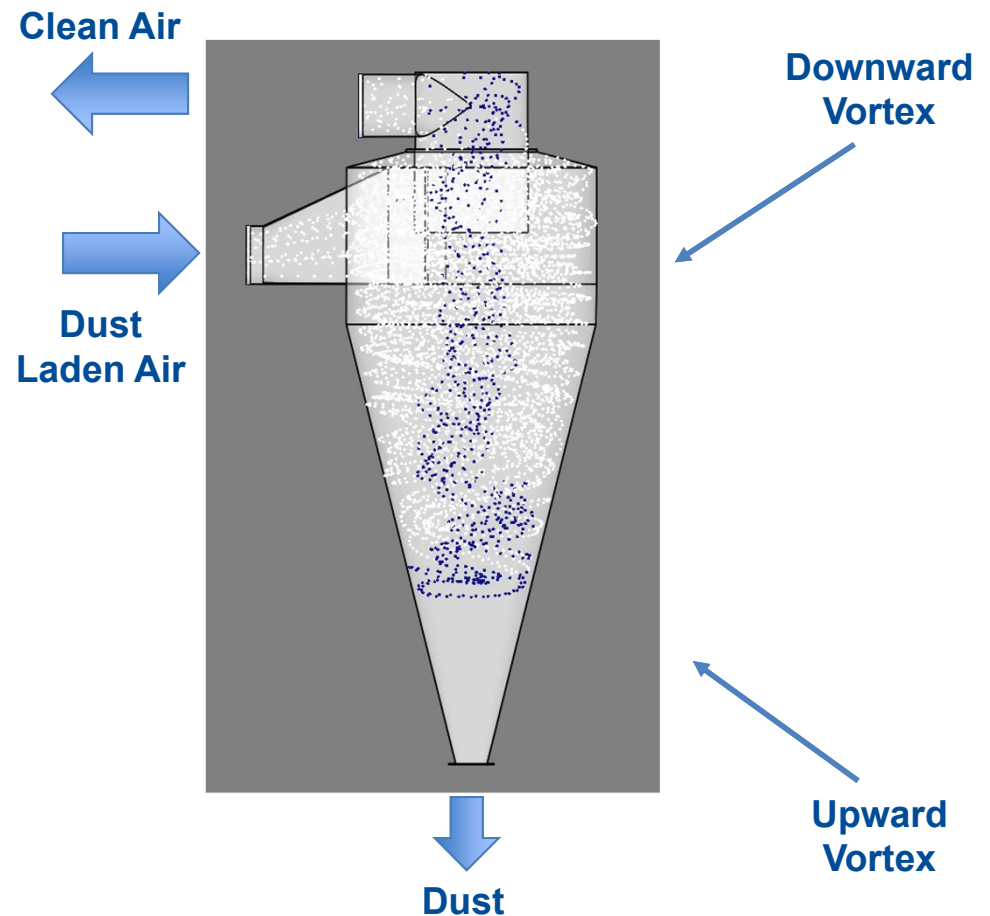
Example:

$15,000 \text{ CFM} \div (77.2 \text{ sq ft} - 20.63 \text{ sq ft}) = 265 \text{ FPM}$

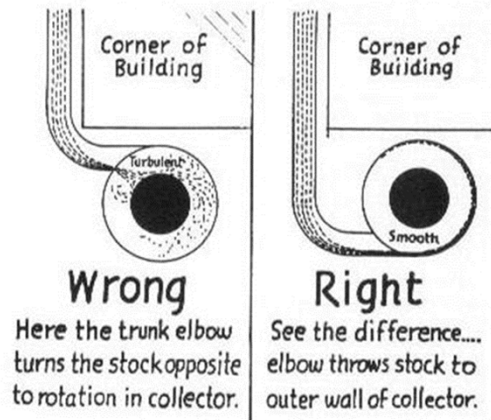
(Increases with bulk density of material but typically below 300FPM)

The dust laden air creates a downward moving vortex in the cyclone and solid particles are thrown to the outside by **Centrifugal Force**.

The dust then drops out of the air flow under **Gravity** as the air vortex reverses and clean air exits at the top of the cyclone.



- Particle Size Distribution
- Particle Density
- Air & material volume entering the cyclone
- Cyclone design and dimensions
- Quality of fabrication
- Quality of installation

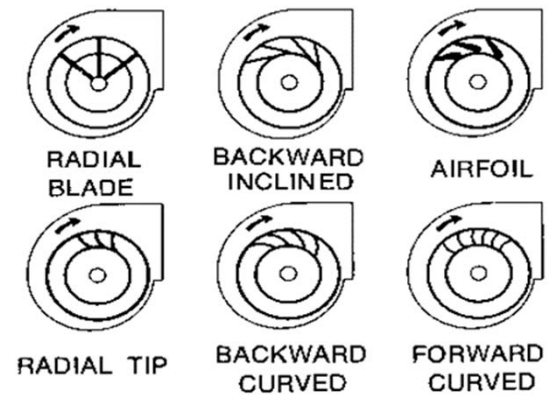


Cyclone efficiencies can vary tremendously based on all of the above parameters

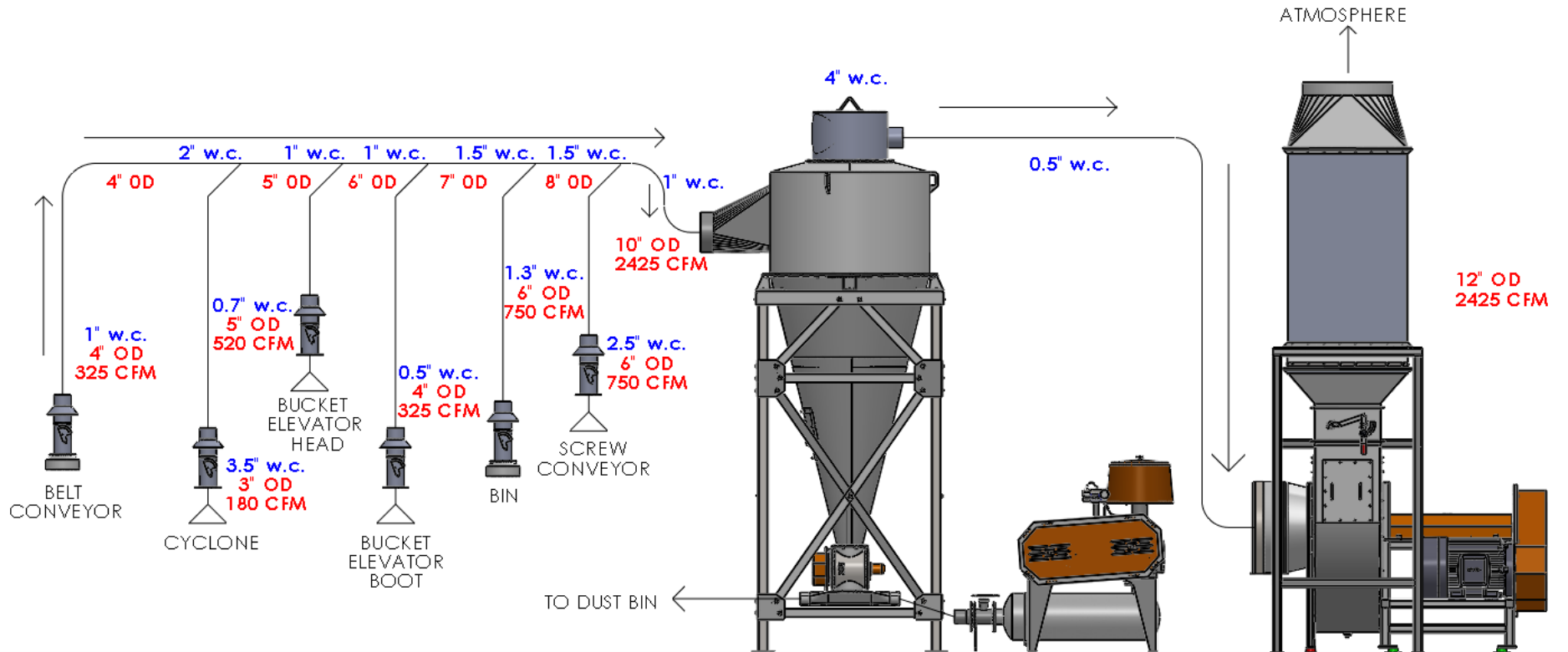


Centrifugal Fan

- Material handling (radial blade) - product or dust in air stream
- Spark resistant construction, as required by NFPA
- General suction/Dust control (normally <20" w.c.)



TYPES OF
CENTRIFUGAL FAN IMPELLERS

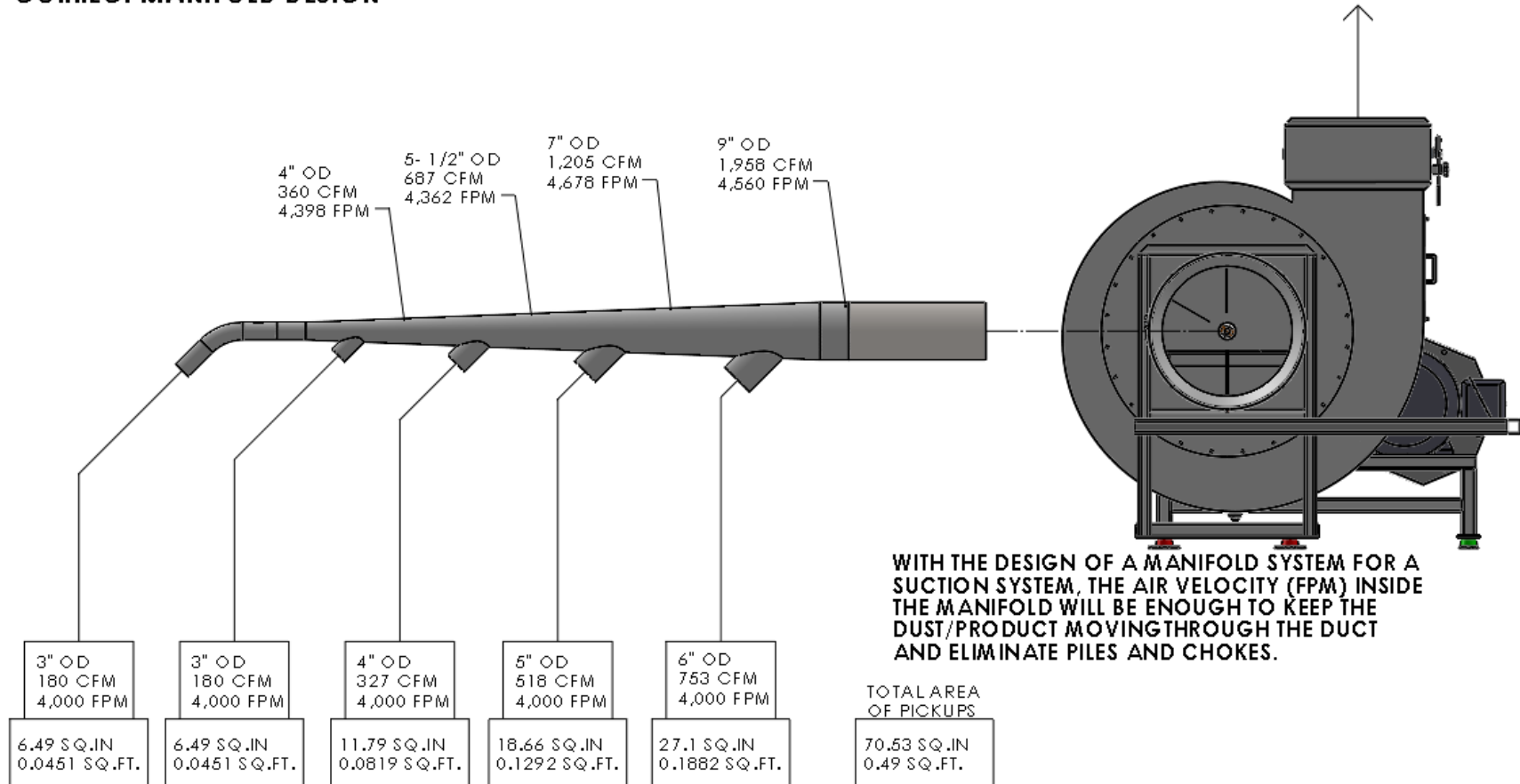


SUM TOTAL OF CFM: 2425 CFM

TOTAL OF HIGHEST STATIC PRESSURE OF ANY LINE: 14" w.c. SP

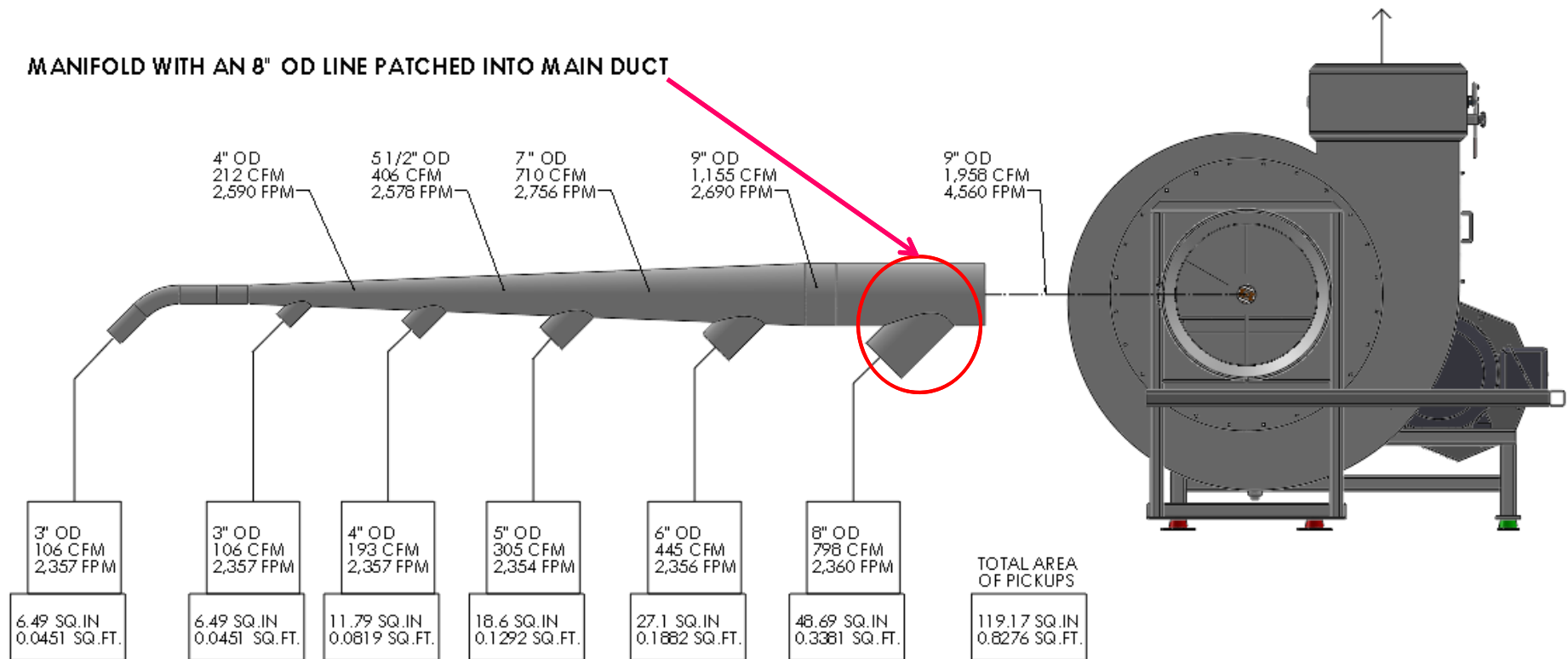
RESULT: Dust control system for 2425 CFM at 14" w.c. SP

CORRECT MANIFOLD DESIGN



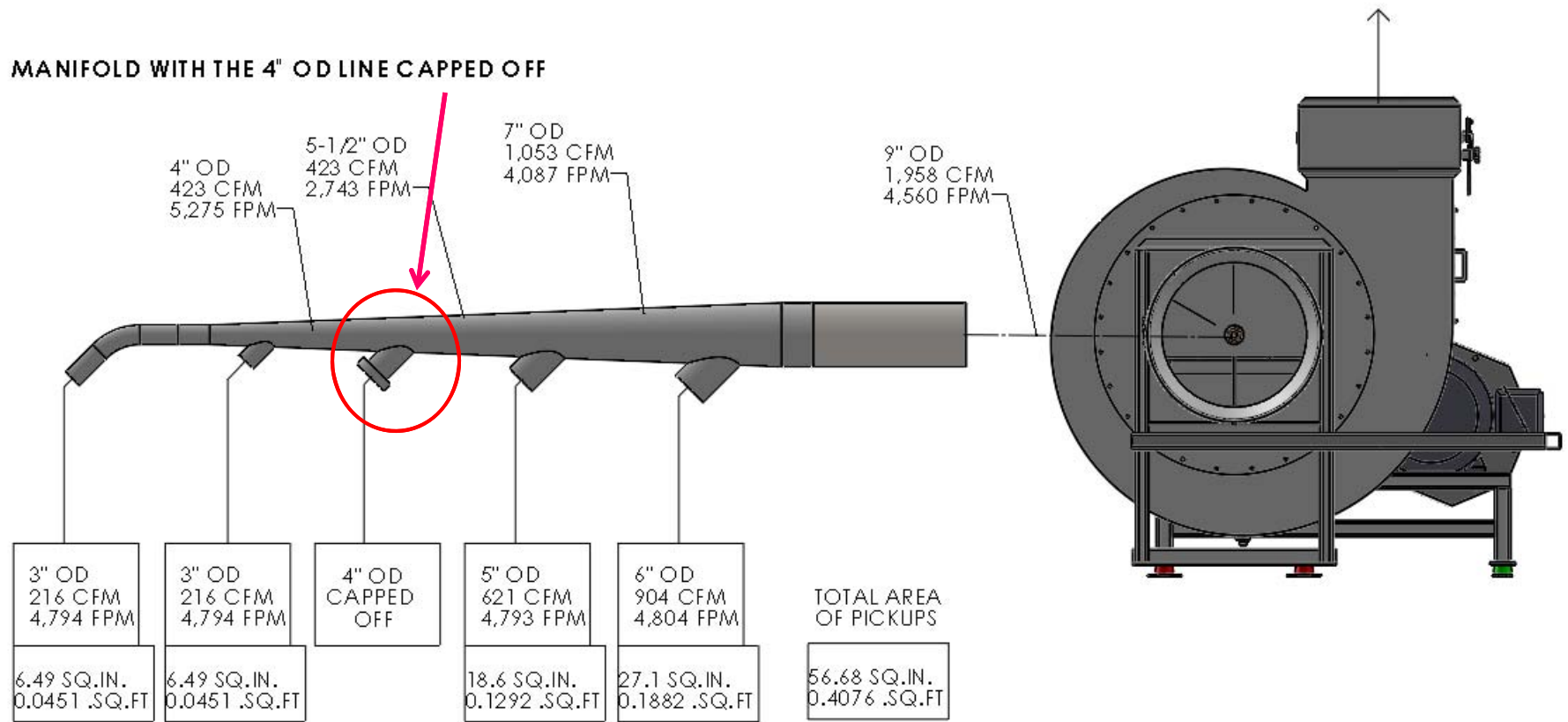
Dust remains in suspension because of correct velocities are maintained throughout system

MANIFOLD WITH AN 8" OD LINE PATCHED INTO MAIN DUCT



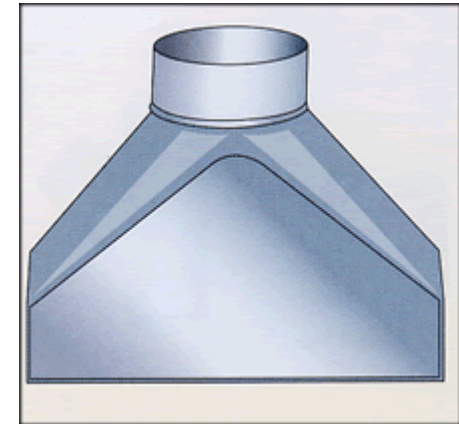
WITH THE ADDITION OF THE 8" LINE, THE AMOUNT OF AIR (CFM) REQUIRED FOR ALL PICKUP POINTS DECREASES.
 42% REDUCTION IN CFM FOR EACH PICKUP POINT.
 PRODUCT WILL FALL OUT OF THE AIR STREAM DUE TO REDUCED AIR VELOCITY IN DUCT.

MANIFOLD WITH THE 4" OD LINE CAPPED OFF



WITH THE CAPPING OFF OF THE 4" LINE, THE AMOUNT OF AIR (CFM) MOVED FOR ALL PICKUP POINTS INCREASES 20% INCREASE IN CFM FOR EACH PICKUP POINT.

- Proper location
 - Close to dust source
 - Take advantage of natural air currents
 - Must not interfere with operation or maintenance
- At each collection point, the system shall be designed to achieve the minimum velocity required for capture, control, and containment of the dust source.
- The hood or pickup point for each dust source shall have a documented minimum air volume flow based upon the system design.



- Size ducts appropriately to keep good velocity in the line back to the filter
- Use lockable dampers or slide gates on each connection point
- Allow “Free Air” into the system as needed to maintain adequate air velocities
- Ensure all connections and fittings are properly sealed to prevent leaks
- Obtain and learn to use an Air Measuring Kit
- During commissioning confirm and document air volumes and velocities meet the design requirements





Dust control system Explosion Protection

- NFPA Code overview
- Technology options
- Technology options and considerations
- Passive isolation devices

Relevant NFPA Codes and Standards



- NFPA 652 - Standard on the Fundamentals of Combustible Dust (2016 –2019)
- NFPA 61 - Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities (2013 –2017)
- NFPA 654 - Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids (2013 – 2017)
- NFPA 68 - Standard on Explosion Protection by Deflagration Venting (2013 –2018)
- NFPA 69 - Standard on Explosion Prevention Systems (2014 –2019)
- NFPA 70 - National Electric Code (2014 –2017)
- NFPA 77 - Recommended Practice on Static Electricity

*Any references to NFPA code in this presentation are not intended to be acted upon and official codes should always be consulted before performing any work

NFPA 652 Overview and Implications



- New for 2016 - Standard on the Fundamentals of Combustible Dust
- Gives the general requirements for managing fire and explosion hazards for combustible dusts. Applies to all facilities and operations that contain combustible dust or combustible particulate solids.
- Directs users to other industry specific NFPA standards but does not supersede those standards (NFPA 61, 654 etc.).
- Dust Hazard Analysis (DHA): Retroactive requirement. Existing facilities are allowed 3 years from the effective date of the standard (9/7/2015) to complete a DHA. (Reasonable progress each year!)
- Provides requirements and exceptions for Explosion Protection, Isolation & Fire Protection

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- Direct Venting (with or without ducting)
- Flameless Venting
- Suppression
- Passive Isolation
- Active Isolation
- Spark Detection & Extinguishing

Most applications usually require a combination of technologies. The choice of one technology over the other is dependent upon the overall risk management plan and the preferences of the owner/operator.

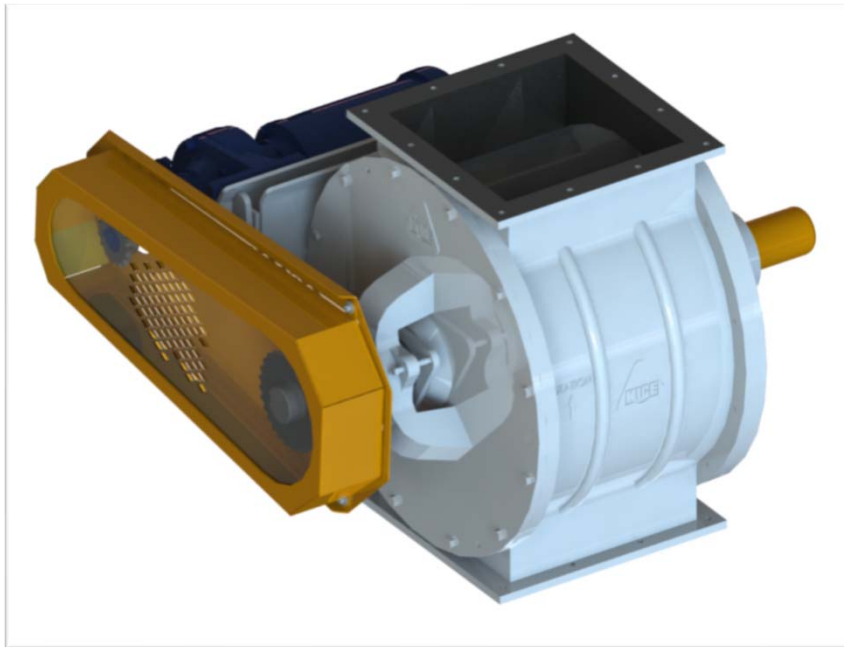
Explosion Protection Considerations



- Is the filter located inside or outside? If inside how close to outside wall?
- Is the fan on the dirty side of the filter? Spark detection, prevention, spark resistant construction?
- Calculation of the filter specifications, K_{st} , and P_{max} determine the explosion vent size. Length of duct to outside wall also affects vent size.
- Is suppression the best alternative? Cost, maintenance?
- Is isolation needed?
- Control of static electricity and other possible ignition sources.

Requirements of Airlocks used as Passive Isolation Devices

- In order for a Rotary Valve or Airlock to be able to be used as a Passive Isolation Device it needs to meet the requirements of NFPA 69: Chapter 12.2.4, and have sufficient strength to withstand the maximum anticipated explosion pressure (P_{red}) for the application.



Some (but not all) of the requirements of this section are;

- At least six vanes on the rotor, diametrically opposed
- At least two vanes on each side of the housing in a position of minimum clearance at all times
- Close clearance valves to have clearances of ≤ 0.0079 "
- Clearances measured prior to installation and as part of a predictive maintenance program
- Bearings mounted externally

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Dust Control System Troubleshooting and Maintenance

Where to start

- What were the original system design specifications?
- What system changes or modifications have been made?
- Check damper settings
- Check fan speed/performance (measure don't guess)
- Duct work for leaks/blockages
- Filter pressure drop/bags/cleaning

- Filter Bag changing when differential pressure is too high.
- Routine checking/changing of solenoids, diaphragms, springs.
- Duct cleaning if buildup due to condensation.
- Airlock bearings, seals, and check clearances.
- Fan bearing lubrication, check sheaves, belts, vibration monitoring.
- Bag Cleaning Air Power Unit inlet filter check, lubrication, check sheaves, belts, relief valve.

- Fugitive dust can result in a wide range of issues in all facilities
- Effective dust control systems require careful design, installation and maintenance
- Various explosion protection measures are laid out in the latest NFPA codes
- Work with a reputable system designer to ensure you are installing a safe and cost effective solution



Thank you for the opportunity to speak with you today – be safe!



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