The Impacts of Process Changes on a Dust Collection System

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Why is “Dust” a Problem?

- Product degradation or loss
- Health issue for workers
- Safety issue for assets and facilities
- Sanitation and infestation control
- Maintenance
- Equipment life expectancy
- Retention of valuable product
Where is “Dust” a Problem?

- Anywhere in a facility
  - Product transfer
  - Pit dumping
  - Loadout
  - Tunnels
  - Head house
  - Aeration
**Typical Dust Control Points in Other Systems**

Dust hoods and other pick up points that go back to general dust collector. Basically it takes “walking” the system to see where the dust issues are

- Bucket Elevator (boot and/or head)
- Horizontal drag, belt, and/or screw conveyors
- Scales
- Garner Bins
- Distributors
- Trippers

- Bins
- Belts
- Cleaners
- Truck and Rail Dumps
- Truck and Rail Loading
- Inlets and Discharges

**Generalization:**
- Dust is released anytime product is handled
- The more violently it is handled, the more dust is released
- Discharge to another piece of equipment generates dust
- We will never get it all
Dust Collection System Design
Approximate air volumes in grain elevators for dust control points

- **Belt Loaders**: 4”- 5” depending on belt width
- **Tail Pulleys**: 5”- 6” depending on width
- **Elevator Boots**: 4”- 8” depending on leg width
- **Elevator Heads**: 5”- 10” depending on leg width
- **Scale Hoppers**: 5”- 8” depending on hopper size
- **Dump Pits**: 100-150 CFM per square foot of open area
- **Rail Pits**: 100-150 CFM per square foot of open area
- **Screw Conveyors (covered)**: 3”- 4” on 20’-to-30’ centers and depending on screw size
- **Drag Conveyors**: 3”- 4” on 20’-to-30’ centers and depending on screw size
- **Turnheads (Distributors)**: 5”- 8” depending on number of positions
- **Tripper Suction**: 8”- 10” branch depending on width
- **Bin Suction**: 3”- 6” depending on bin diameter
- **Floor Sweeps**: Typically 6” and normally closed

*REF: Kice Industries, Inc., 2012*
# Duct Design Velocities

<table>
<thead>
<tr>
<th>Nature of Contaminant</th>
<th>Examples</th>
<th>Minimum Design Velocity, FPM</th>
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</thead>
<tbody>
<tr>
<td>Vapors, gases &amp; smoke</td>
<td>All vapors, gases, smoke</td>
<td>1000 - 2000</td>
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<tr>
<td>Fumes</td>
<td>Welding</td>
<td>2000 - 2500</td>
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<tr>
<td>Very fine, light dust</td>
<td>Grain dust, fine rubber dust, bakelite molding powder dust, jute lint, cotton dust, sawdust &amp; shavings (light), soap dust, leather shavings, &amp; plastics regrind dust</td>
<td>3000 - 4000</td>
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### Tube Data Chart

<table>
<thead>
<tr>
<th>Tube</th>
<th>Area</th>
<th>Velocity</th>
<th>Feet Per Min.</th>
<th>90° EL Equiv. Ft.</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>3600 @ .81 wg</td>
<td>4000 @ 1.0 wg</td>
<td>4400 @ 1.21 wg</td>
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<tr>
<td>O.D.</td>
<td>I.D.</td>
<td>SQ. IN.</td>
<td>SQ. FT.</td>
<td>C.F.M.</td>
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<td>1.48</td>
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<td>2</td>
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<td>2.76</td>
<td>.0192</td>
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</table>

Tube I.D. and area based on .063 wall thickness, except 10" or 12" O.D. are indicated.

Based on standard air at .075 lb./cu.ft.

**Area of Circle:** $3.14 \times r^2$ (or $.7854 \times D^2)$

**Volume (C.F.M.):** Velocity (ft./min.) x Area (sq. ft.)
Correct manifold design

Designed to keep air velocity inside the duct high enough to keep product moving and eliminate product laying in the line.
System Sizing

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
Example Design

System 2
- 750 CFM
- 6" OD
- 4,000 FPM
- 4" s.p.
- 100'
- 1- 90 degree
- 1- 45 degree

System 1
- 520 CFM
- 5" OD
- 4,000 FPM
- 10" s.p.
- 200'
- 4 - 90 degree

System 3
- 330 CFM
- 4" OD
- 3.5" s.p.
- 50'
- 1- 90 degree
- 1- 45 degree

1,600 CFM
18.2" w.c.

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Downsides to Incorrect Duct Sizing & Changes to Systems without Engineering
Downside to Incorrect Ducting Sizing

- Dust will build up inside ducting
  - Increasing weight of duct on hangers, concrete, etc…
  - Provide fuel source should an explosion occur.
  - Food source for pests
  - Potential for mold
  - Dust emission into plant
- Perpetuate bad system performance
  - Potential for plugging in ductwork or at pickup points
  - Wear in elbows and ductwork

KEY REASONS:
- Loss of good product
- Safety
- Health
- Sanitation
- Cost
Examples of What Not to Do
Easier, simpler, and less expensive to install but allows for several points along the line for product to drop out due to velocity.
Manifold with 4” OD Line Capped Off

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

20% increase in CFM at each pickup point. May not be an issue, but will increase velocity and may pick up good product (i.e. good grain going to feed).
Manifold with 8” OD line patched into the main duct

42% reduction in CFM at each pickup point and allows product to drop out of the line
Results of Increasing Fan Speed to Accommodate Additional Pickup Points

- Could Resolve the Duct Velocity Issues
- Filter Could Get Overloaded
Overloaded Filter – Symptoms

- High Air to Cloth Ratios
- High Can Velocities

- Premature increase in pressure drop as dust migrates into bags.
- Reduced air flow in dust collection system - dusting out at pickup points in system
- Stack emissions
- Short bag life
Thank You For Your Time

Questions?