The Impacts of Process Changes on a Dust Collection System

August 17, 2017

Presented by: Afshin Nayeri

kice.com

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

Nature of Contaminant	Examples	Minimum Design Velocity, FPM
Vapors, gases & smoke	All vapors, gases, smoke	1000 - 2000
Fumes	Welding	2000 - 2500
Very fine, light dust	Grain dust, fine rubber dust, bakelite molding powder dust, jute lint, cotton dust, sawdust & shavings (light), soap dust, leather shavings, & plastics regrind dust	3000 - 4000

We make
your job easier. Today.

Tube Data Chart

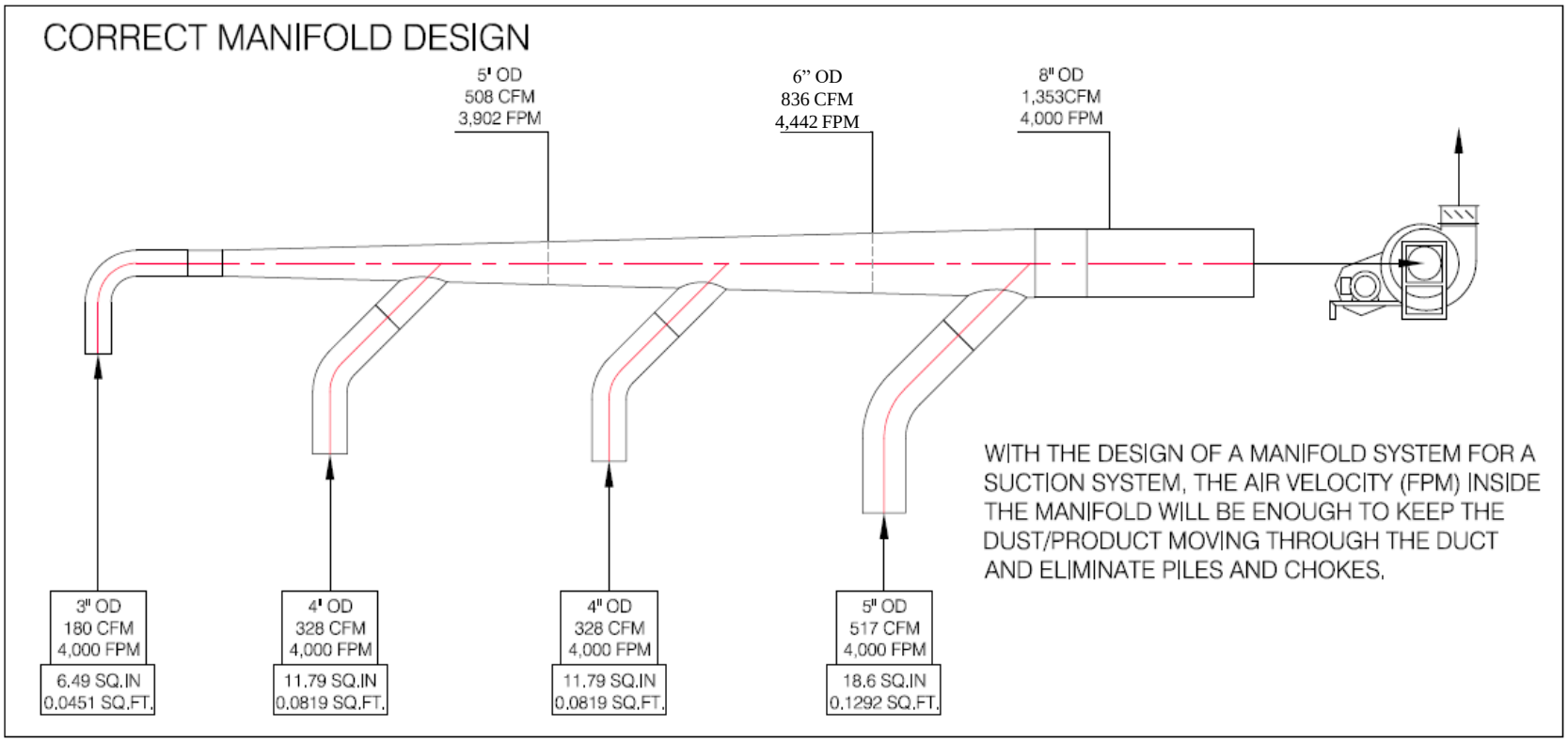
Tube		Area		Velocity — Feet Per Min. 3600 @ .81 wg		4000 @ 1.0 wg		4400 @ 1.21 wg		4800 @1.44 wg		90° EL Equiv. Ft.
O.D.	I.D.	SQ. IN.	SQ. FT.	C.F.M.	IN. PER 100'	C.F.M.	IN. PER 100'	C.F.M.	IN. PER 100'	C.F.M.	IN. PER 100'	
1.5	1.375	1.48	.0103	37	15.0"	41	18.0"	45	22.0"	49	27.0"	4'
2	1.875	2.76	.0192	69	10.5"	77	13.0"	84	15.0"	92	17.5"	5'
2.5	2.375	4.43	.0308	111	7.8"	123	9.5"	136	11.2"	148	13.0"	6'
3	2.875	6.49	.0451	162	6.2"	180	7.5"	198	9.0"	216	10.0"	8'
3.5	3.375	8.95	.0621	224	5.2"	248	6.3"	273	7.5"	298	8.5"	9'
4	3.875	11.79	.0819	295	4.3"	328	5.3"	360	6.4"	393	7.0"	10'
4.5	4.375	15.02	.1043	376	3.7"	418	4.6"	459	5.2"	501	6.3"	11'
5	4.875	18.6	.1292	465	3.2"	517	4.0"	568	4.8"	620	5.2"	12'
5.5	5.375	22.7	.1576	567	3.0"	60	3.7"	693	4.3"	756	4.4"	14'
6	5.875	27.1	.1882	678	2.7"	753	3.3"	829	3.9"	904	4.2"	15'
8	7.875	48.7	.3382	1218	1.9"	1353	2.3"	1488	2.7"	1623	3.0"	20'
10	9.75	74.66	.5185	1867	1.4"	2074	1.7"	2281	2.1"	2489	2.5"	25'
12	11.75	108.43	.7530	2711	1.2"	3012	1.4"	3313	1.7"	3614	2.0"	30'

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.

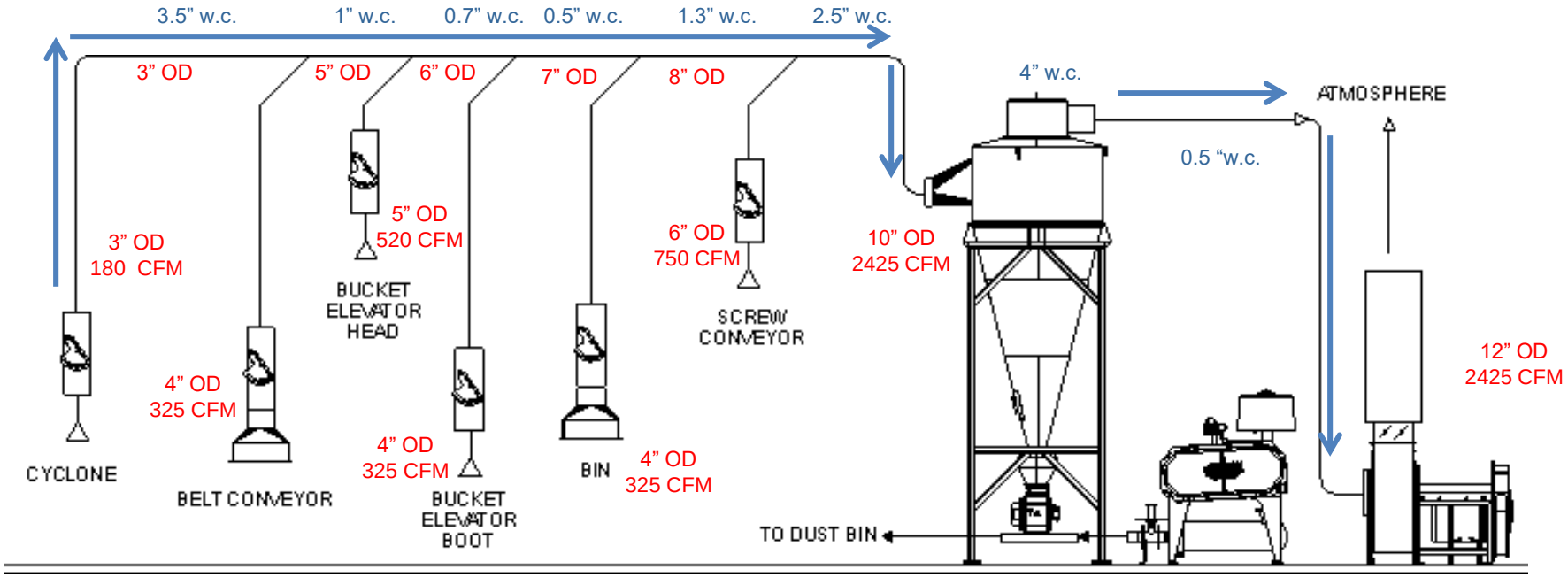
Area of Circle: 3.14 x r^2 (or .7854 x D^2)
Volume (C.F.M.): Velocity (ft./min.) x Area (sq. ft.)

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

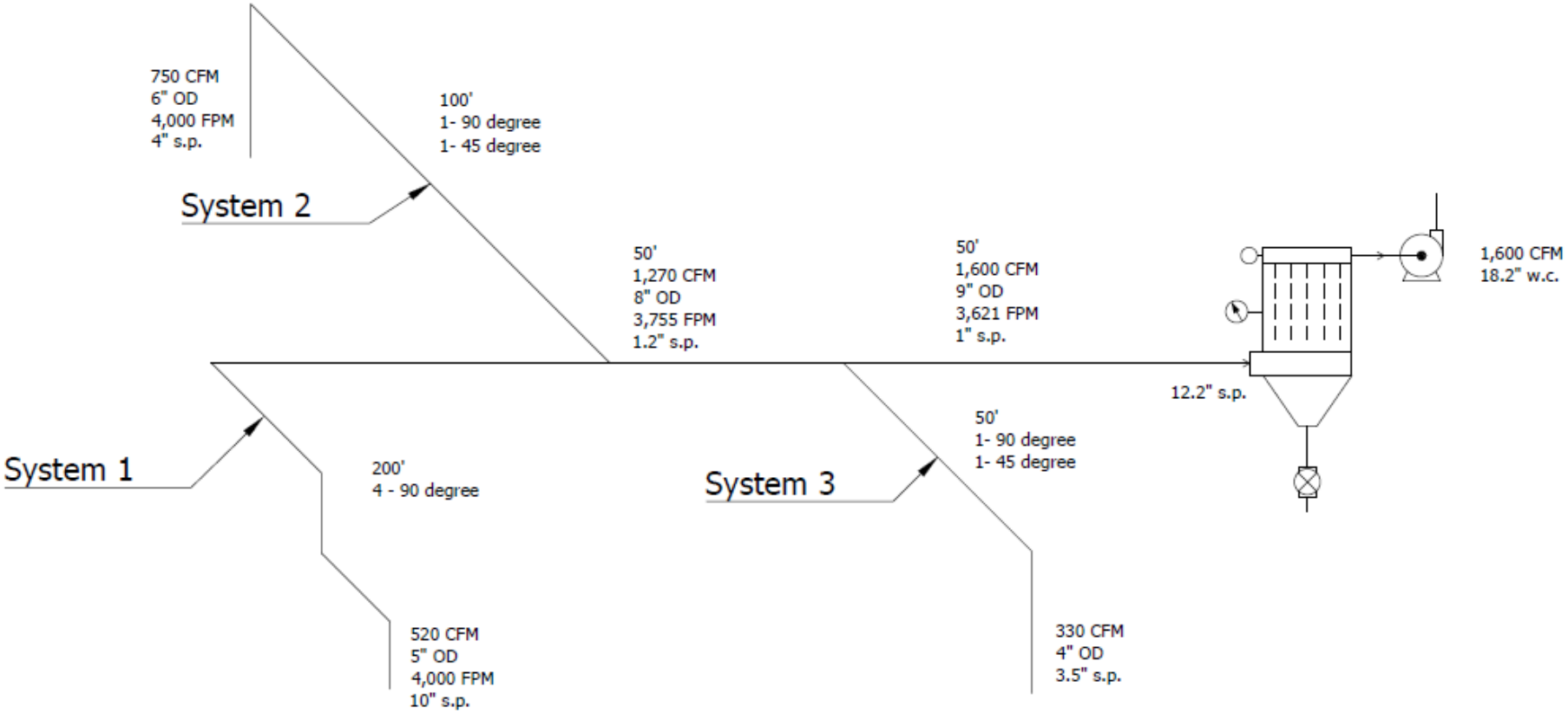


SUM TOTAL OF CFM: 2425 CFM

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



Downsides to Incorrect Duct Sizing & Changes to Systems without Engineering

Downside to Incorrect Ducting Sizing

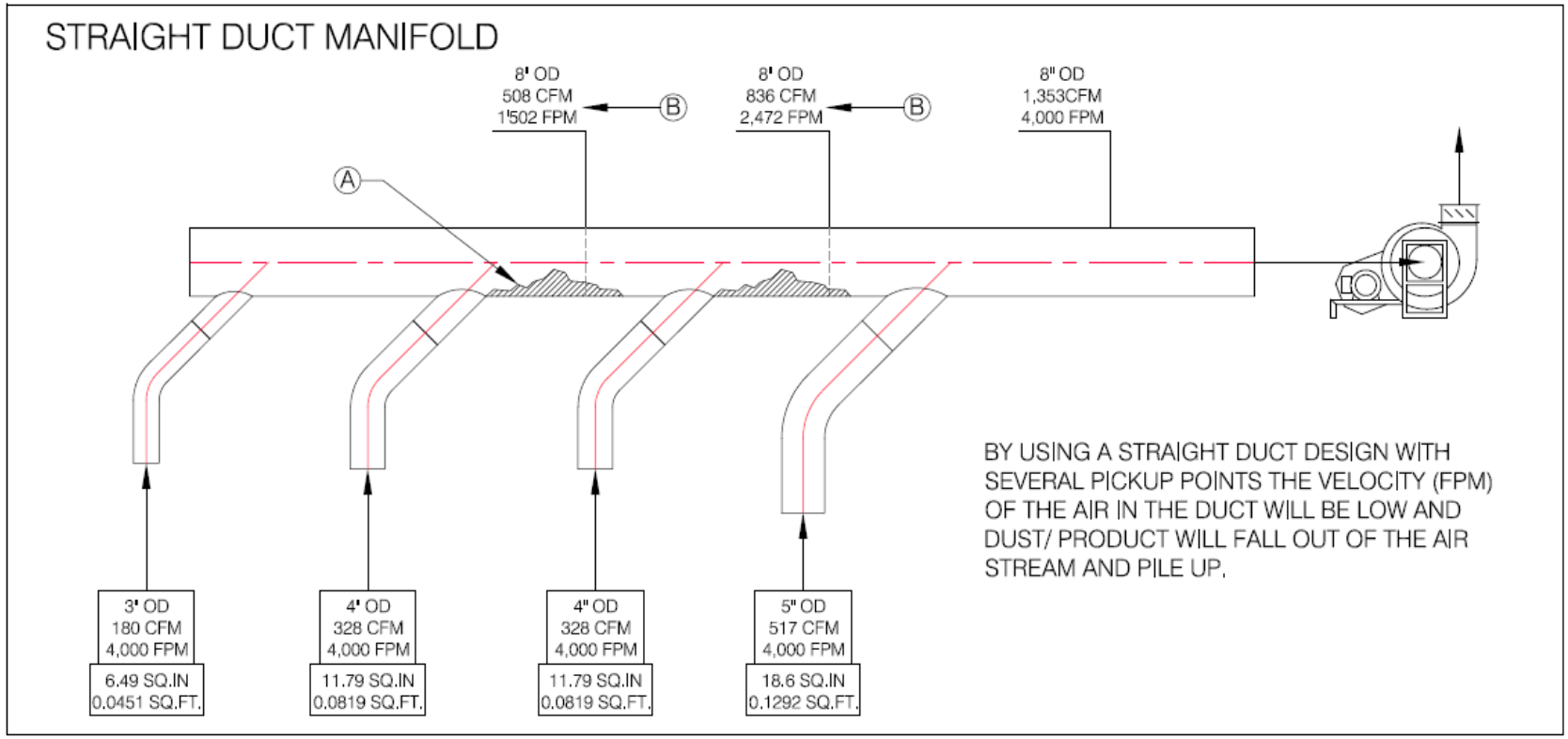
- Dust will build up inside ducting
  - Increasing weight of duct on hangers, concrete, etc…
  - Provide fuel source should an explosion occur.
  - Food source for pests
  - Potential for mold
  - Dust emission into plant
- Perpetuate bad system performance
  - Potential for plugging in ductwork or at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

KEY REASONS:

- Loss of good product
- Safety
- Health
- Sanitation
- Cost

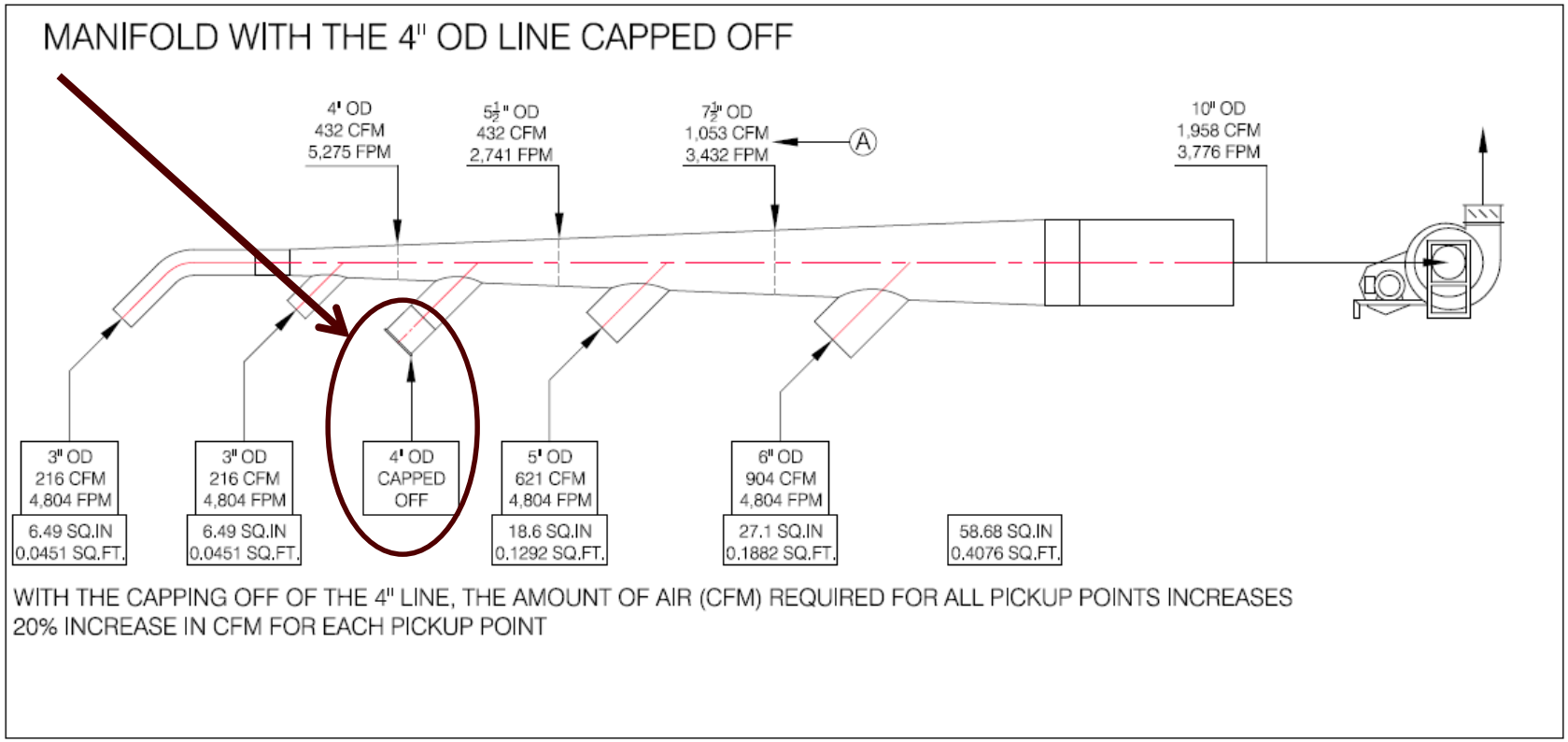
Examples of What Not to Do

Straight Duct Manifold



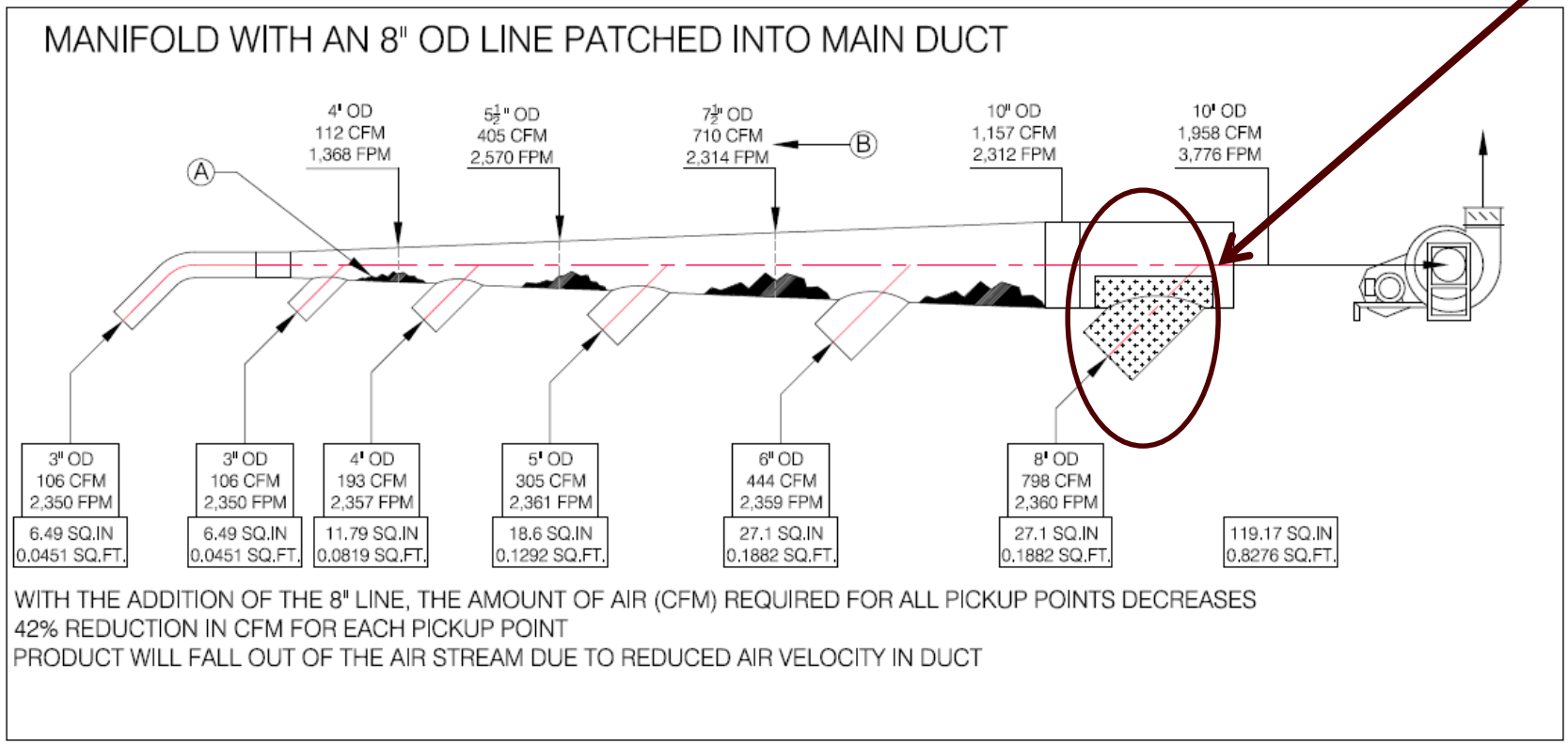
Easier, simpler, and less expensive to install but allows for several points along the line for product to drop out due to velocity.

Manifold with 4” OD Line Capped Off



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 ?