Understanding Air

IAOM – Western Canada District Meeting

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kice.com

Air

- Air is a gas
  - *Nitrogen (78%), Oxygen (20%)*
- Colorless and Odorless
- Essential to plant and animal life
- We can’t see it, but we can feel it and see its effects

“As yet, the wind is an untamed and unharnessed force; and quite possibly one of the greatest discoveries hereafter to be made will be the taming and harnessing of it.”

- Abraham Lincoln, 1860

Harnessing Air

- Humans learned long ago the benefits of capturing and harnessing the power of air movement

Air for Process Systems

Understanding Air

- Air has mass
  - *Weight = 14.7psi at sea level*
  - *Density = 0.0765 lbs/cuft or Approx. 13 cuft/lb at sea level*
- Elevation and temperature affect the density of air
  - *Air is less dense at higher temperatures*
  - *Air is less dense at higher elevations*
- Flows like water; takes the path of least resistance

Pneumatic Conveying

- Air has mass
- Greater mass requires greater horsepower
- Negative Pressure Conveying (centrifugal fan)
  - *Typically higher volumes and lower pressures of air*
  - *Energy requirements affected by increased volume*
- Positive Pressure Conveying (PD blower)
  - *Typically lower volumes and higher pressures of air*
  - *Energy requirements affected by increased pressure*

Pneumatic Conveying

- Calculations are based on moving a specified mass a specified distance at a specified velocity
- All factors are relative and determine air volume and hp requirements

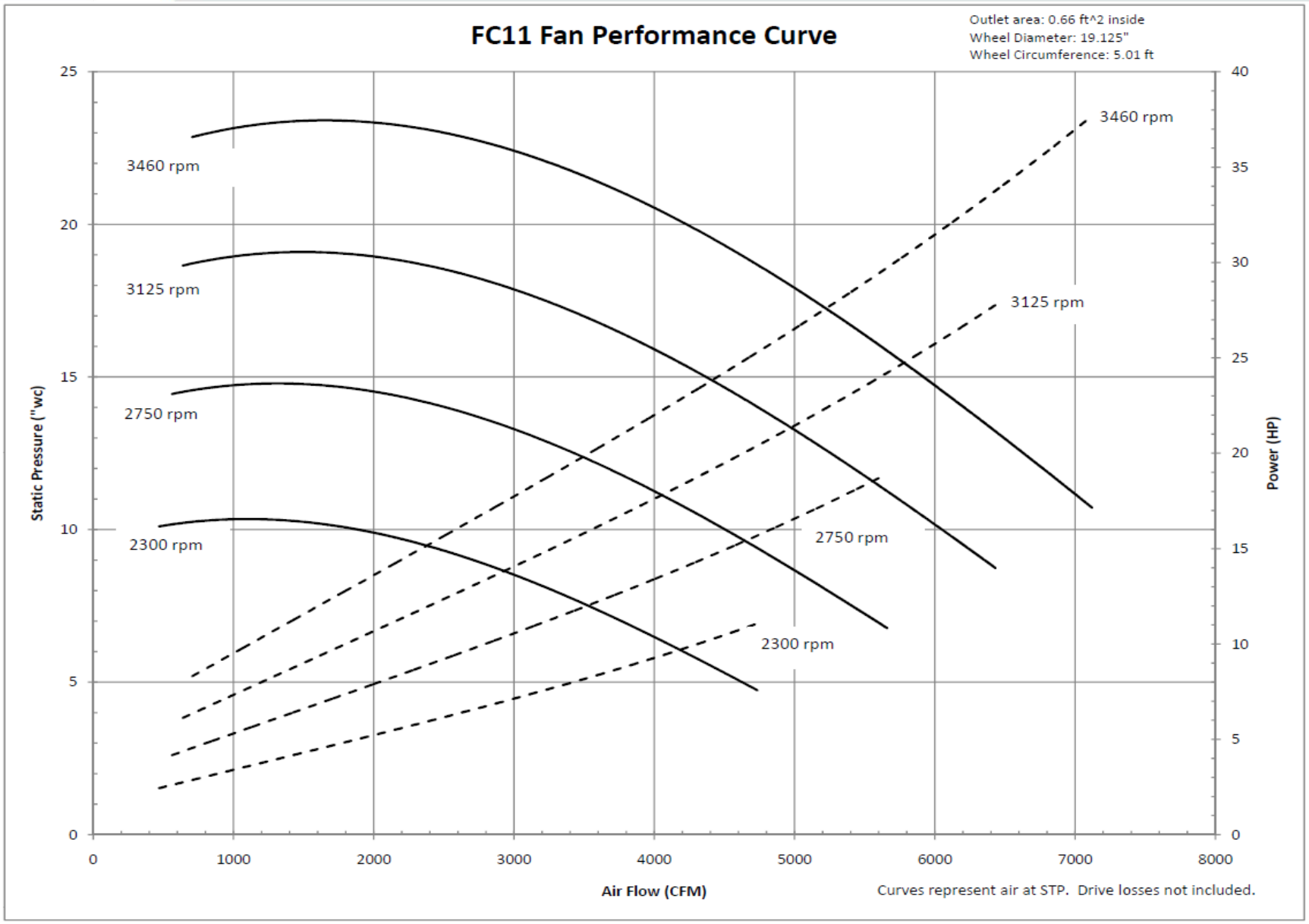
Pneumatic Conveying System Analysis Sheet (v1.0)

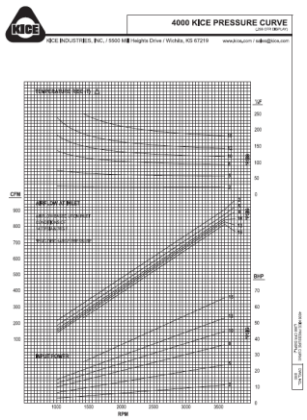
Kice Industries, Inc.
5500 Mill Heights Dr.
Wichita, KS 67219
Ph.: (316) 744-7151
Fax: (316) 744-7355
www.kice.com

By: JW
Customer: ADM
Quote/Order No:
Product to be Conveyed: flour
Product Density (lb/cu. ft.): 32 32

Plant Location:
Elevation: 1565
Temp (°F): 70

Quantity	Units	Calc. 1	Calc. 2	Calc. 3	Calc. 4
Material Feed Rate	Lbs./Min.	200	400	400	
Pipe ID	Inches	5	5	5	
Horizontal Length	Feet	150	150	300	
Vertical Length	Feet	60	60	60	
No. Of Bends	No.	6	6	6	
Bends	Equiv. Ft.	75.0	75.0	75.0	
Air Velocity (3000 to 7000)	Feet/Min.	4200	4200	4800	
Material To Air Velocity	Decimal	0.80	0.80	0.80	0.80
Pressure Loss - Inlet	In. W.G.	16	16	16	
Pressure Loss - Separator	In. W.G.	6	6	6	
Pressure Loss/100 Feet	In. W.G.	4.10	4.10	5.31	
Safety Factor	Decimal	0.01	0.01	0.01	
System Requirements					
Air Flow	CFM	573	573	654	
Pressure Drop	In. W.G.	89.66	145.63	193.96	
Blower Pressure System	PSI	3.24	5.26	7.00	
Blower Vacuum System	In. Hg	6.59	10.70	14.26	
Pressure Drop + Safety	In. W.G.	90.56	147.09	195.90	
Blower Pressure System	PSIG	3.27	5.31	7.07	
Blower Vacuum System	In. Hg	6.66	10.81	14.40	


FC11 Fan Performance Curve
Outlet area: 0.66 ft^2 inside
Wheel Diameter: 19.125"
Wheel Circumference: 5.01 ft
Static Pressure ("wc)
Power (HP)
Air Flow (CFM)
3460 rpm
3125 rpm
2750 rpm
2300 rpm
3460 rpm
3125 rpm
2750 rpm
2300 rpm
0
5
10
15
20
25
0
5
10
15
20
25
30
35
40
0
1000
2000
3000
4000
5000
6000
7000
8000
Curves represent air at STP. Drive losses not included.



CFM

900
800
700
600
500
400
300
200
100

AIRFLOW AT INLET

AIRFLOW BASED UPON INLET
CONDITIONS OF:
14.7 PSIA & 70¼ F

*PSIG DISCHARGE PRESSURE

2
5
8
10
12
15
*PSIG

INPUT POWER

15
12
10
8
5
2
*PSIG

BHP

0
10
20
30
40
50
60
70

1000 1500 2000 2500 3000 3500

RPM

4000 KICE PRESSURE CURVE
(.266 CFR DISPL.)

DWG. NO.
5/00

Air Filtration

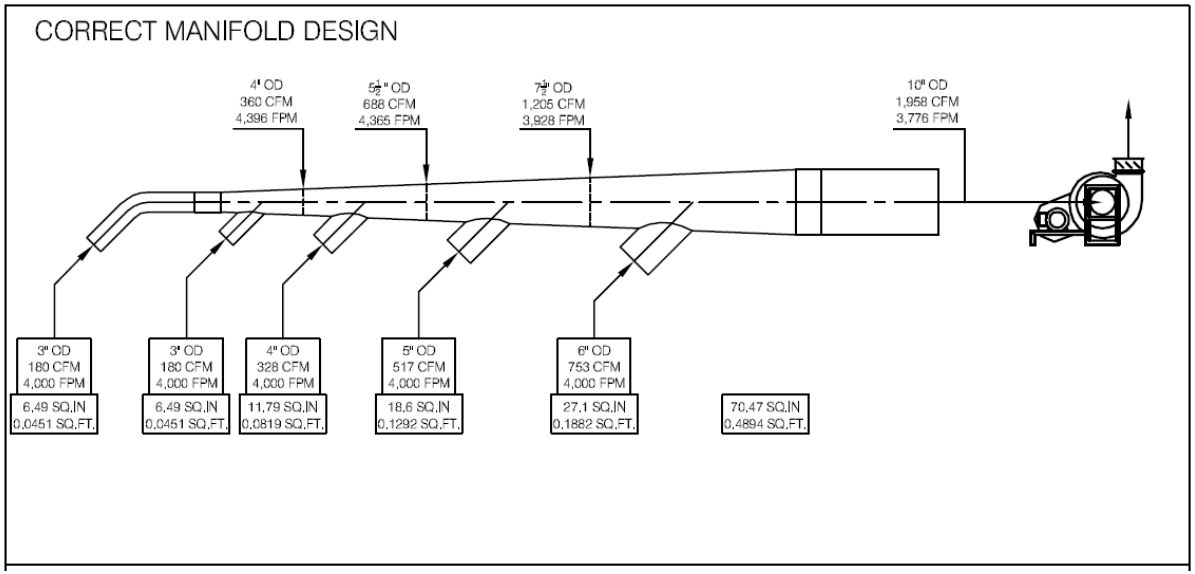
- Effective air filtration is relative to volume
  - *Air to Cloth ratio*
- Velocity also factors into effective filtering
  - *Can velocity*
  - *Interstitial velocity*
- Pressure drop / resistance across dirty bags challenges the air mover and affects the entire air system

Airlock Leakage

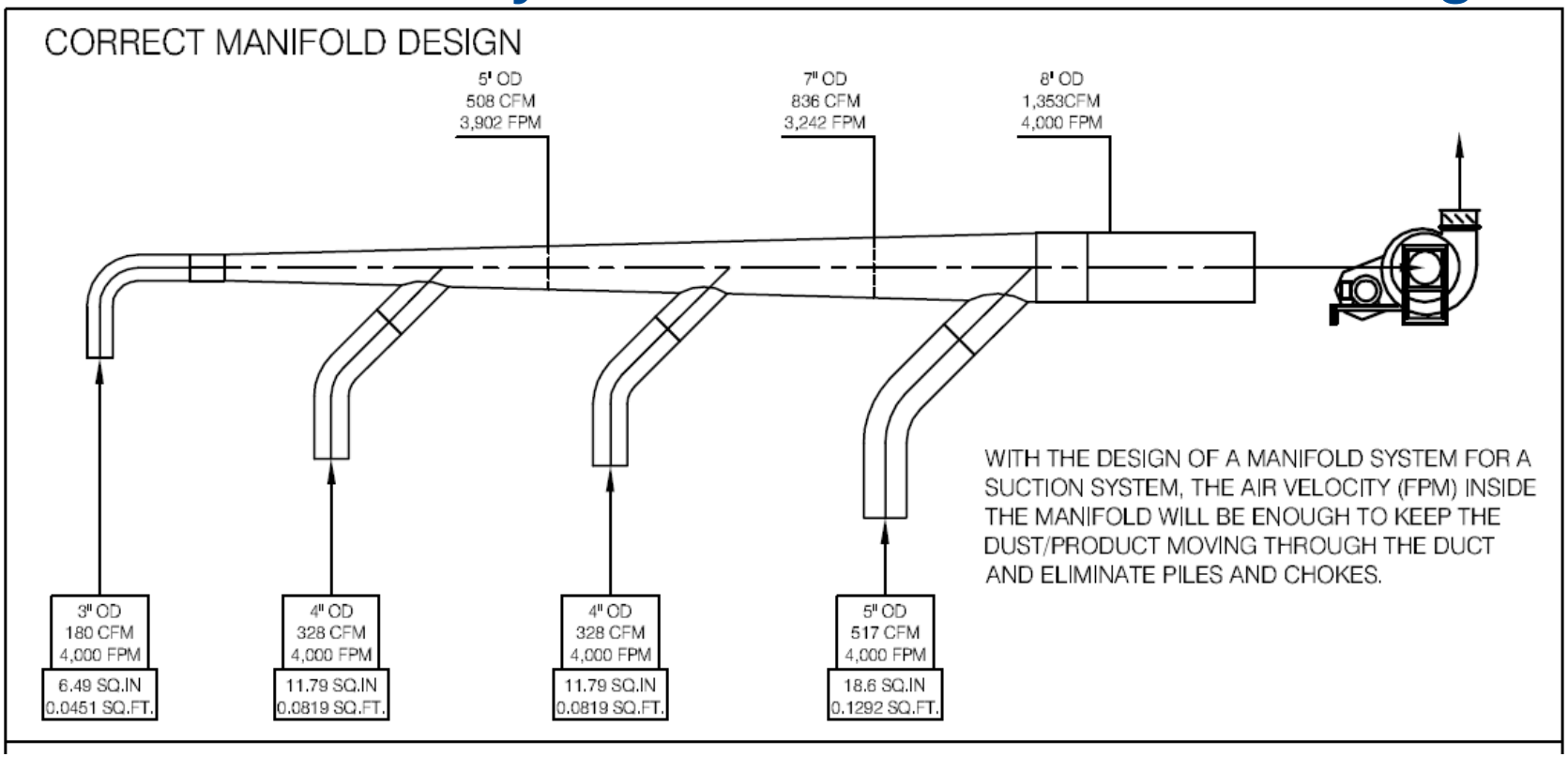
- Static air leakage
  - *Air movement through valve due to open clearances*
  - *Worn clearances increase leakage*
- Dynamic air leakage
  - *Air loss from convey line taken away by “empty” pocket*

Proper Duct Design

- Good design requires appropriate air volume at effective velocity
- Any change to original design will impact the efficiency of the system

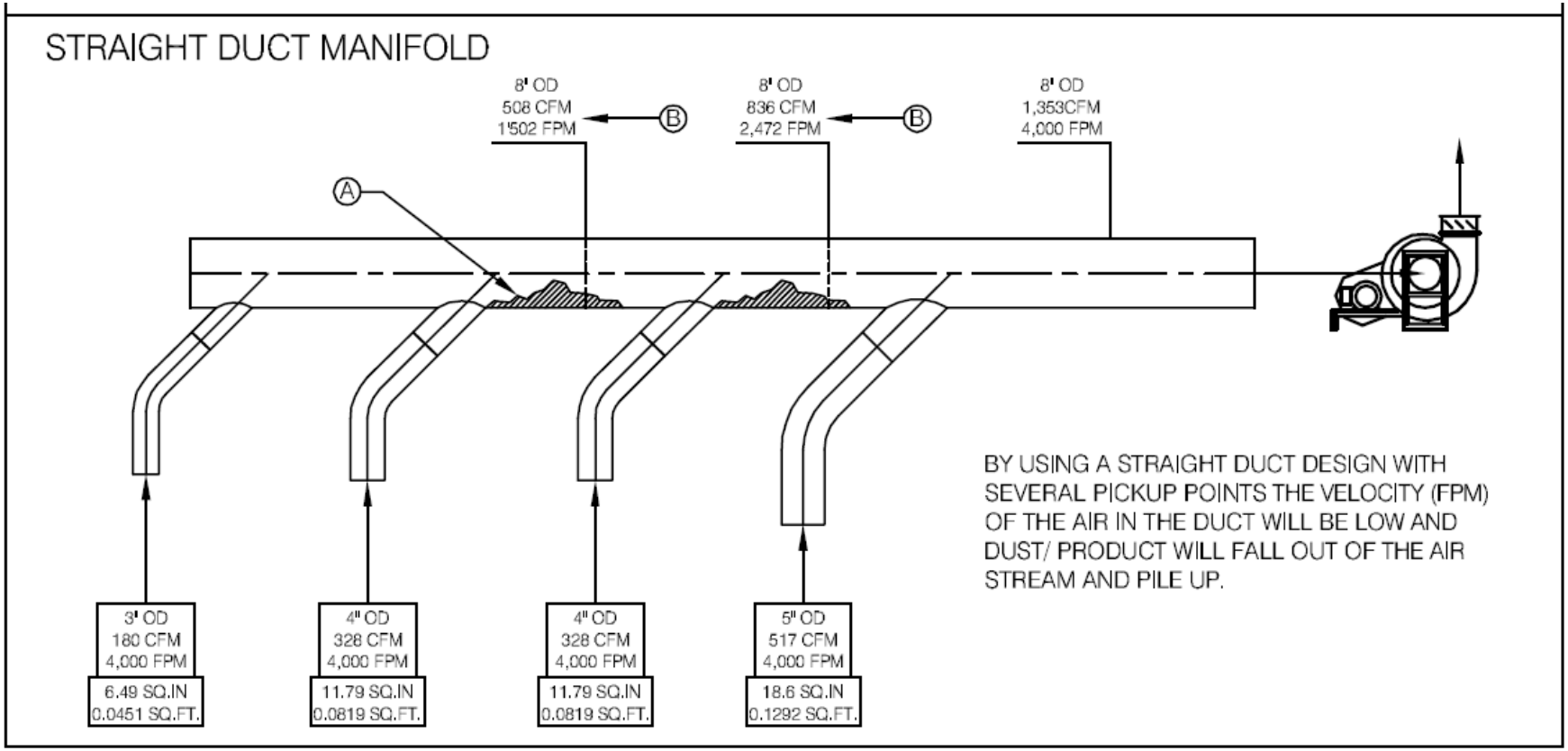


Good Velocity, Good Volume, Good Design



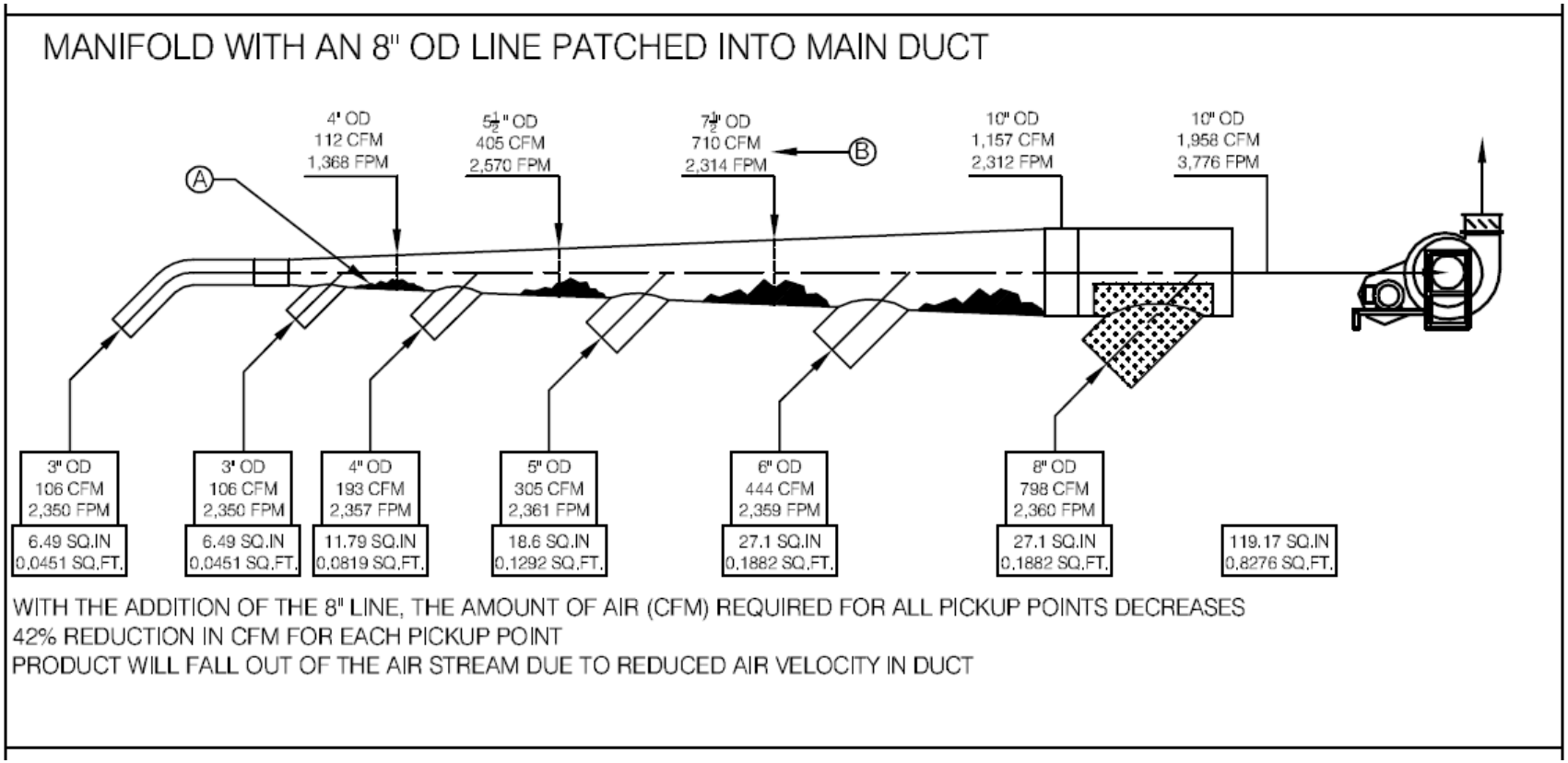
Dust is in suspension; System is balanced.

Bad Velocity, Good Volume, Bad Design



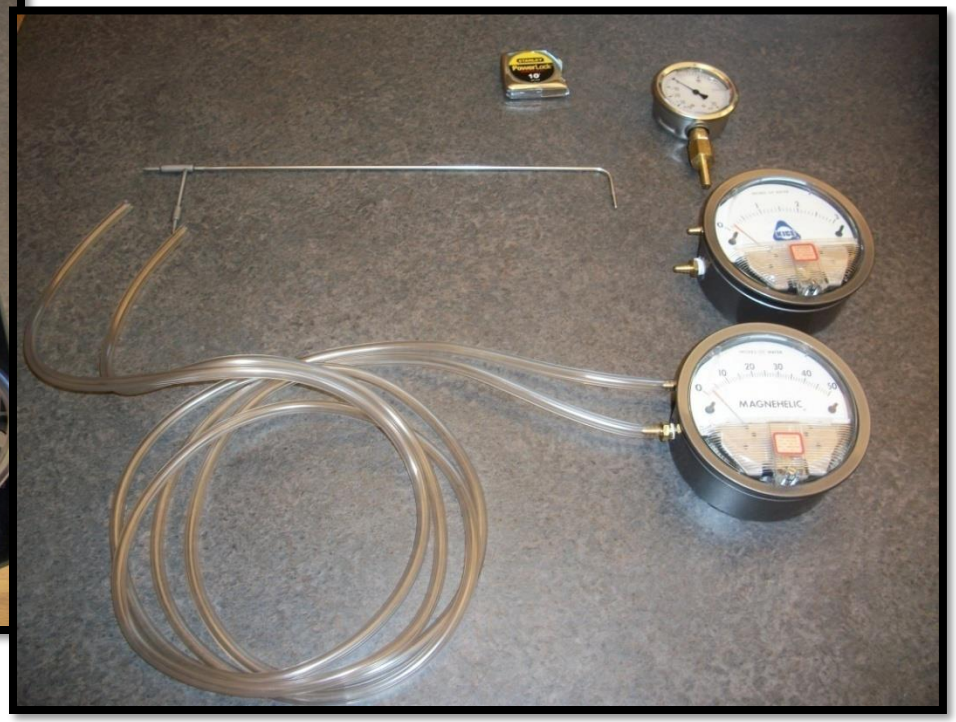
Dust is dropping out (in locations); System is balanced (at end of system).

Additions without Rebalancing



Dust is NOT in suspension; System is NOT balanced. Air taking path of least resistance.

Air Measuring Kit



In Closing…….

- Understand the equipment and processes that you have in operation
  - *Understand system behavior in both optimal and upset conditions*
- If in doubt or confused, rely on the manufacturer or system designer for advice
- Learn to identify and resolve issues before failures occur
- Regular and effective maintenance pays off
- BE SMART / BE SAFE

Always work smartly and practice safety!!


Thank you for the opportunity to speak with you today
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EST 1946