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DUST COLLECTION

Dust Collection that Positively Impacts Safety, Health and Production Goals

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Tracy Janssen

CAMCORP, INC.

Vice President Air Pollution Control

CAMCORP
A MEMBER OF THE SCHEUCH GROUP

DUST COLLECTION

Dust Collection that Positively Impacts Safety, Health and Production Goals

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Why the Need for Dust Collection?

- Improve safety and health conditions in grain handling facilities.
- Control the loss of grain dust as a valuable grain product.
- Provide aspiration to process machinery for proper function and improved efficiency.
- Reduce dust concentration to a level below the lower explosivity limit.

Emission Sources

- Major process operations at a grain elevator.

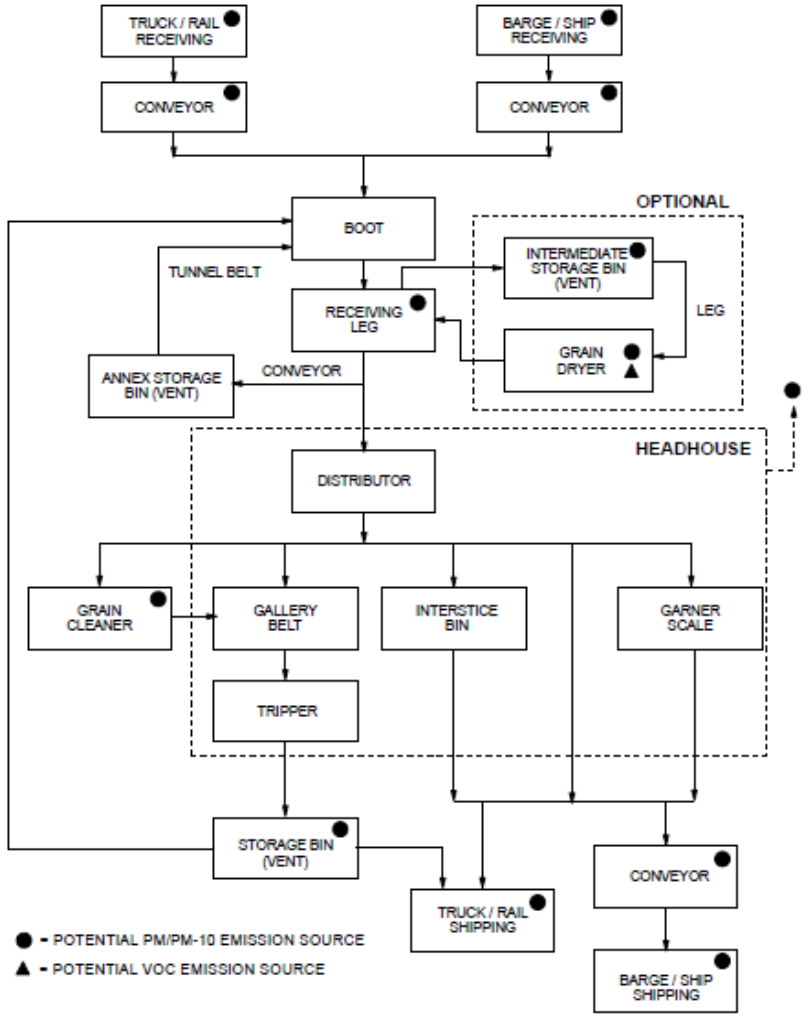


Figure 9.9.1-1. Major process operations at a grain elevator.

Emission Sources

- Simplified process flow diagram of a typical flour mill.

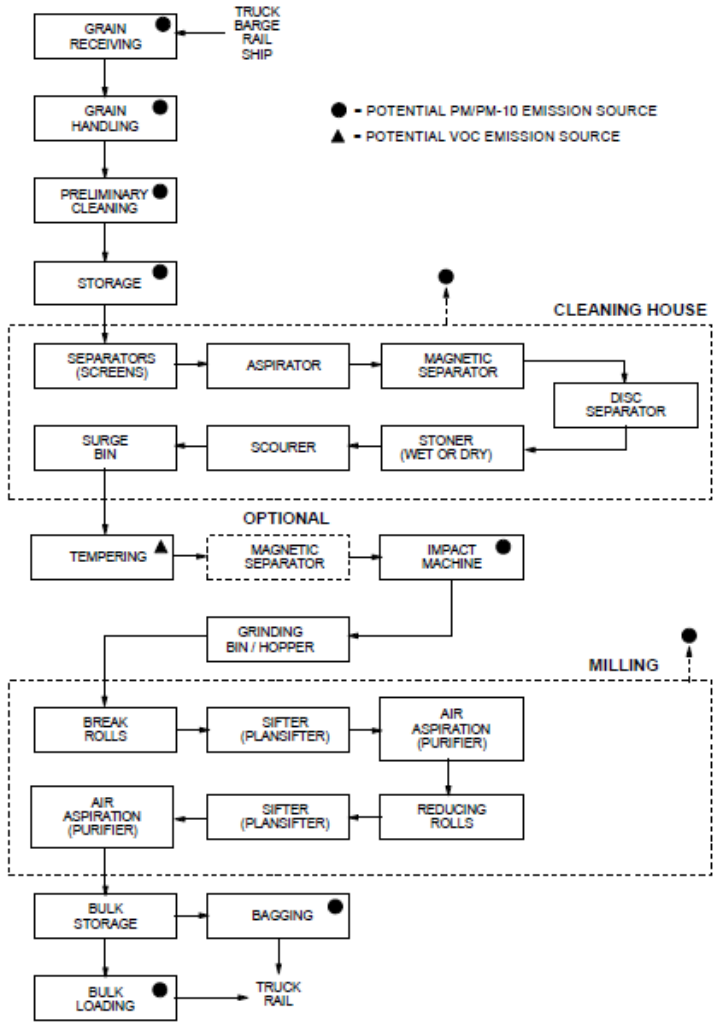


Figure 9.9.1-2. Simplified process flow diagram of a typical flour mill.

Emission Sources

- Flow diagram for oat processing operations.

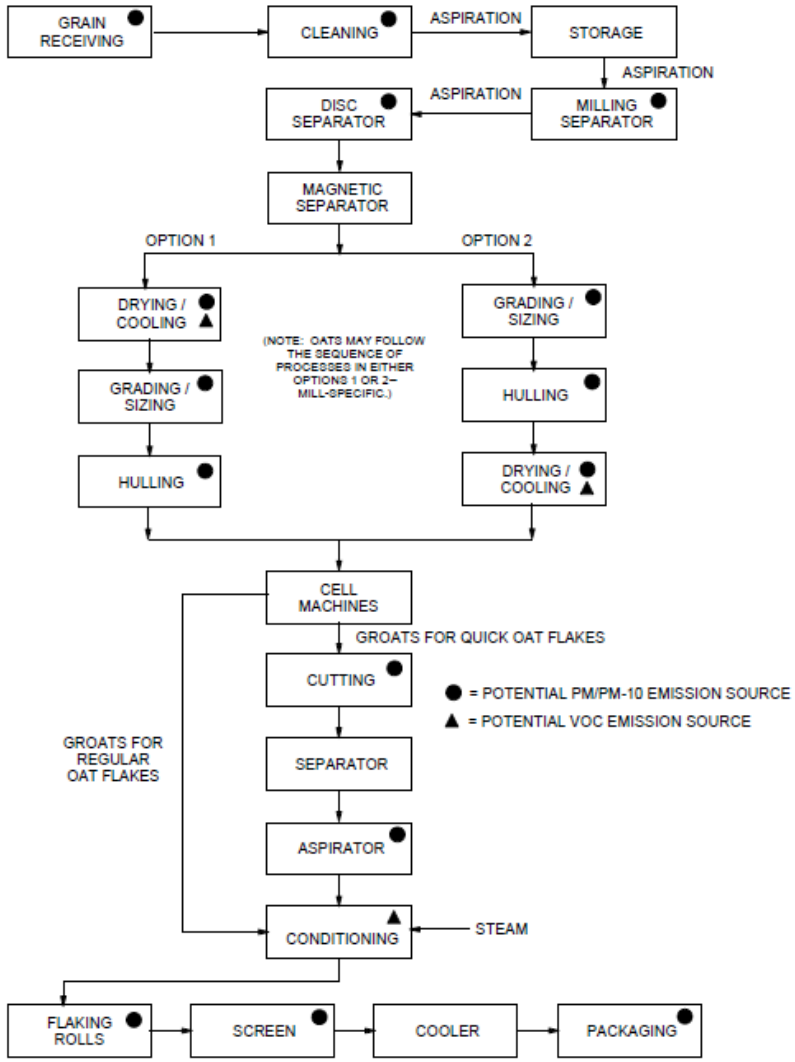


Figure 9.9.1-3. Flow diagram for oat processing operations.[8]

Emission Sources

- Flow diagram for conventional and parboil rice mills.

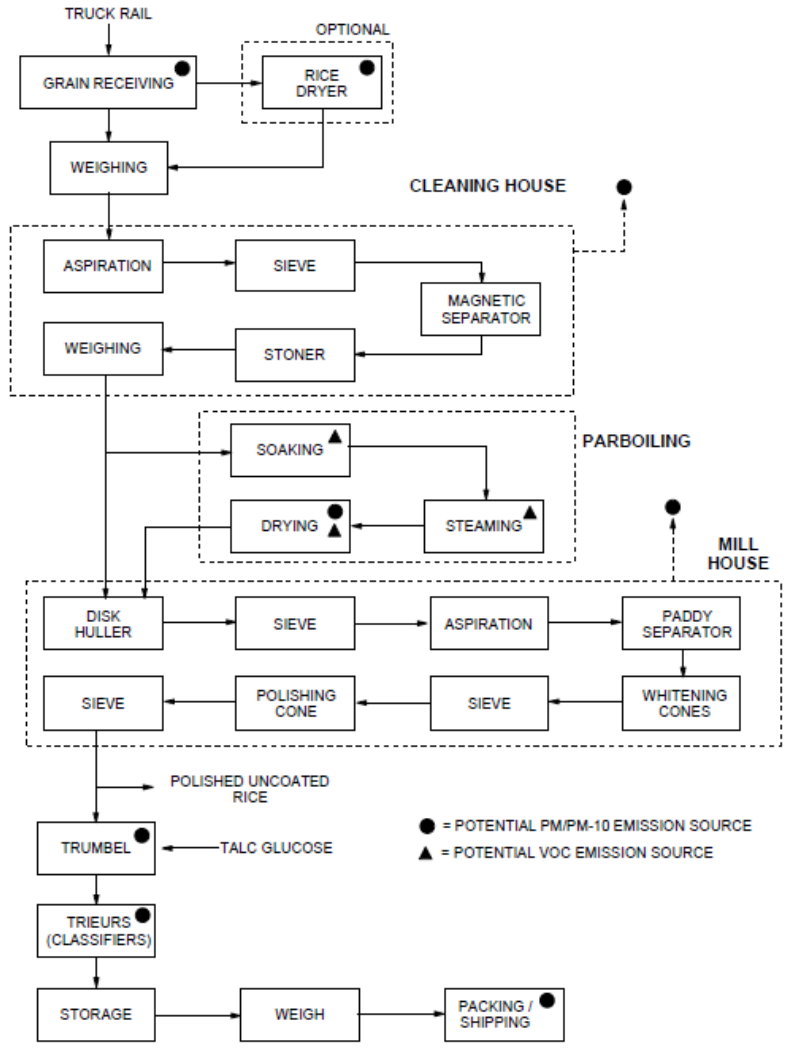


Figure 9.9.1-4. Flow diagram for conventional and parboil rice mills.

Emission Sources

- Simplified process flow diagram for a corn dry milling operation with degerming.

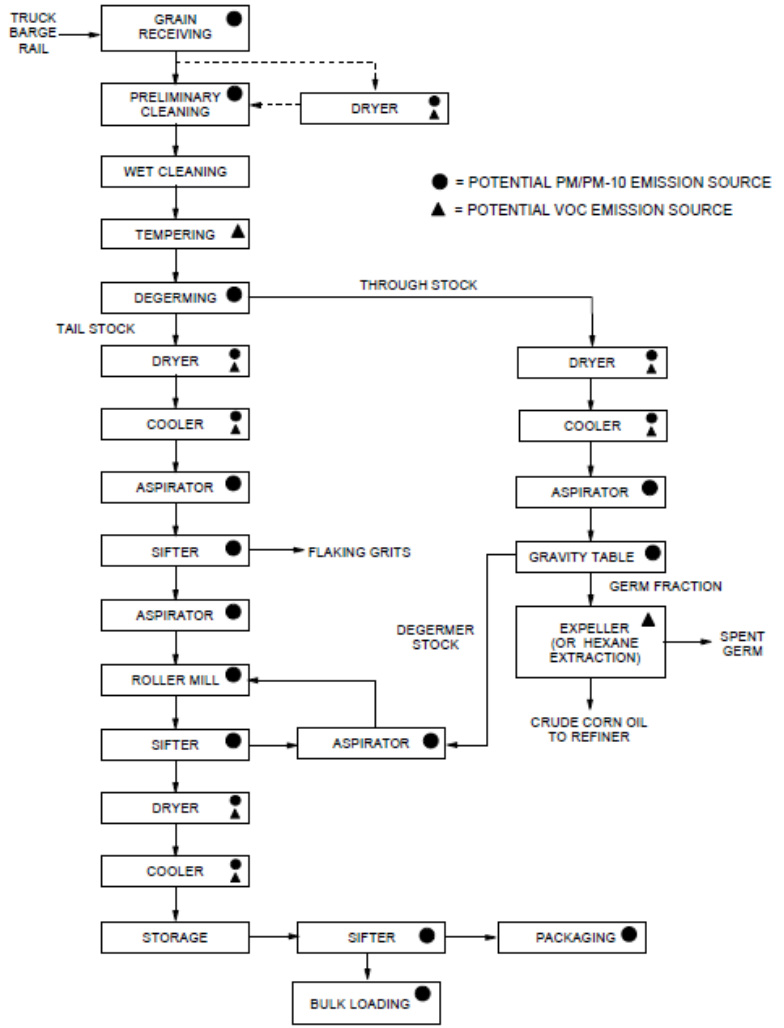


Figure 9.9.1-5. Simplified process flow diagram for a corn dry milling operation with degerming.

Emission Sources

- Typical animal feed milling process flow diagram.

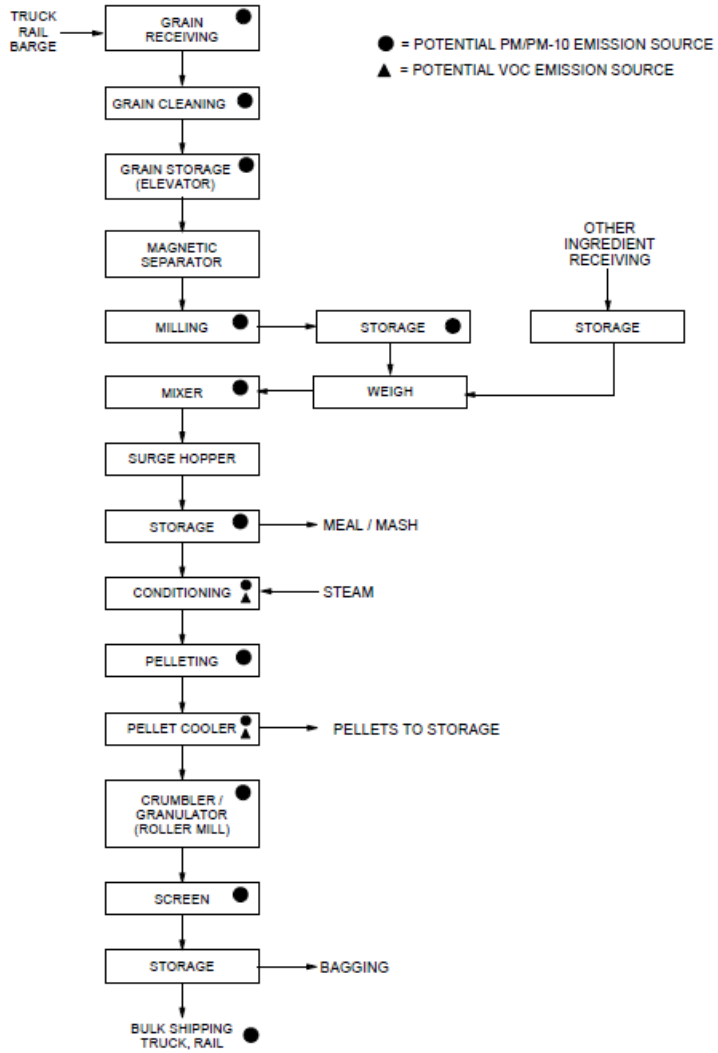
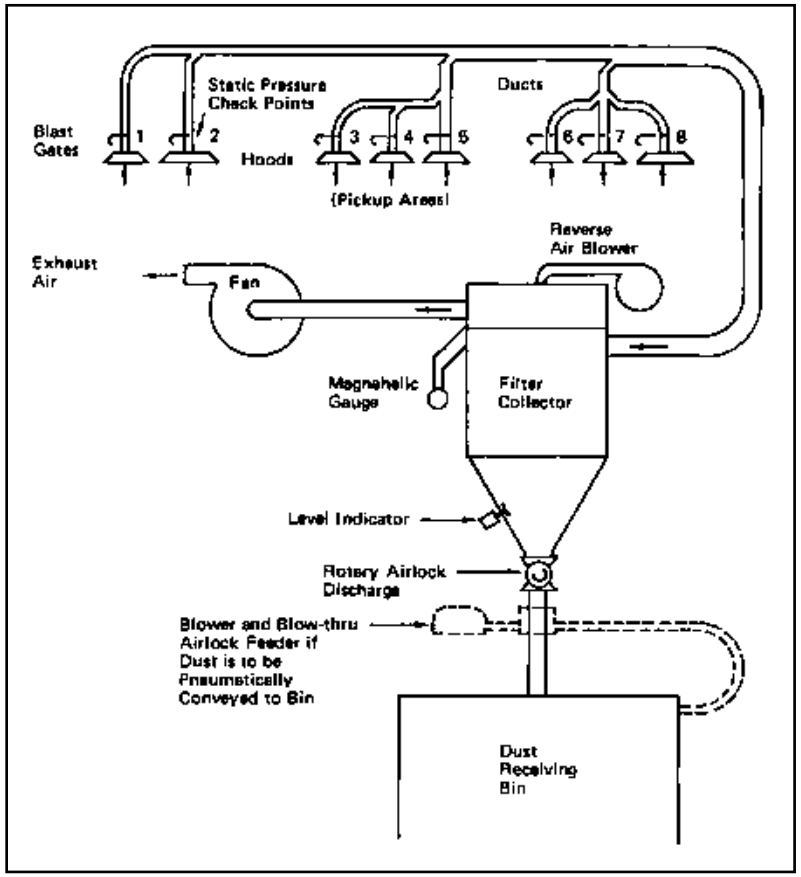
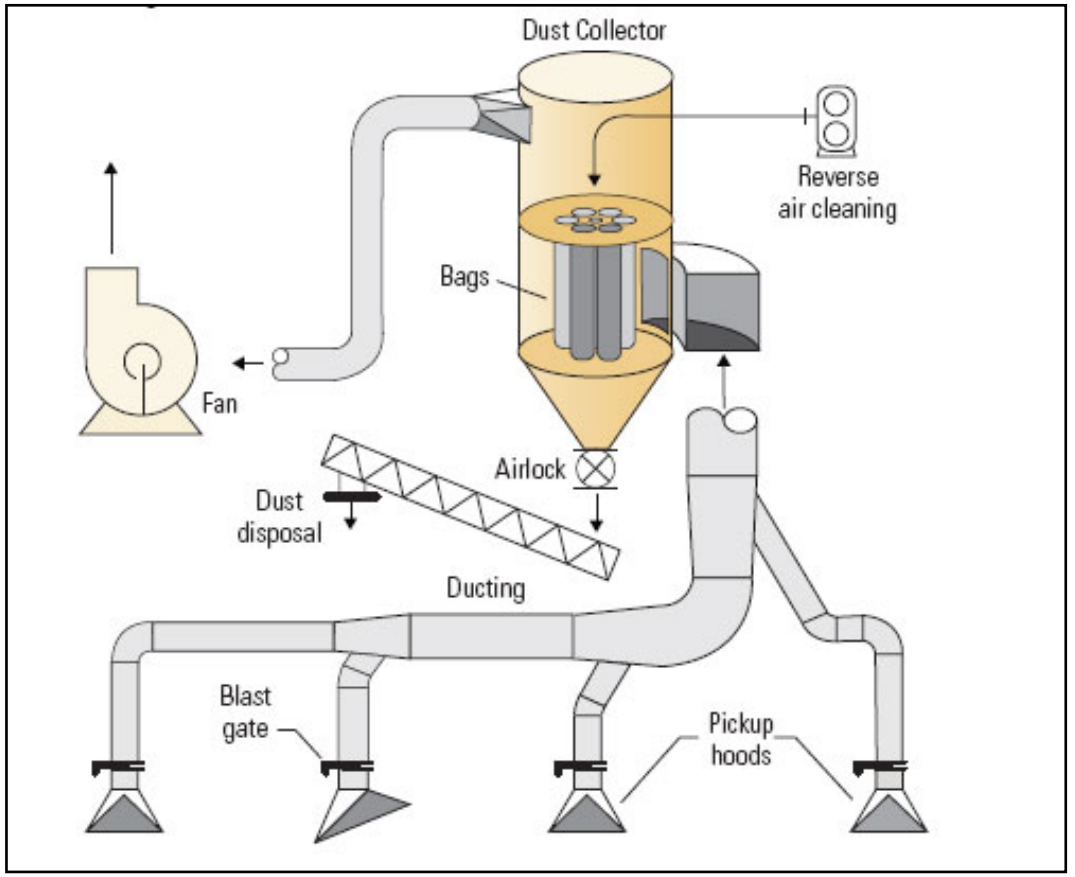


Figure 9.9.1-6. Typical animal feed milling process flow diagram.

TYPICAL DUST COLLECTION SYSTEM

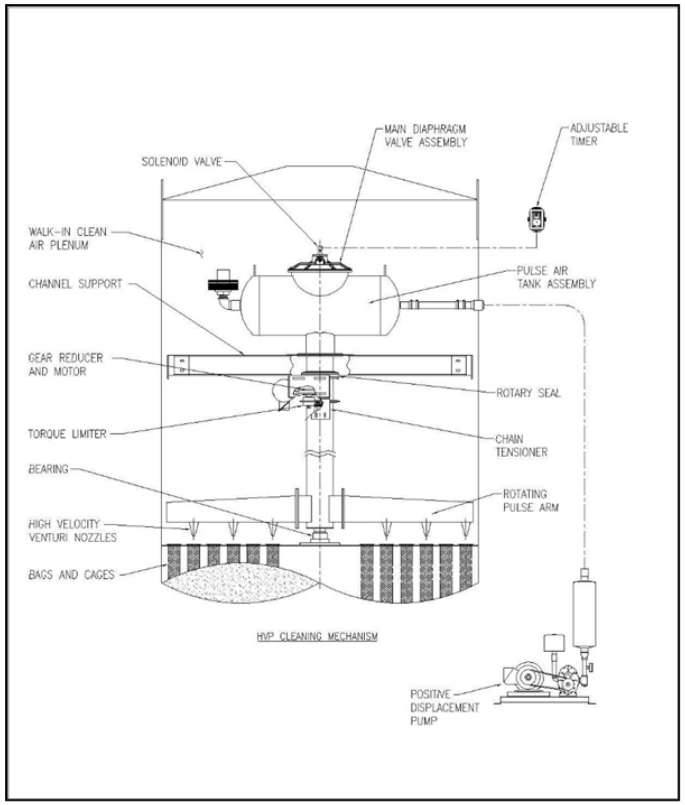




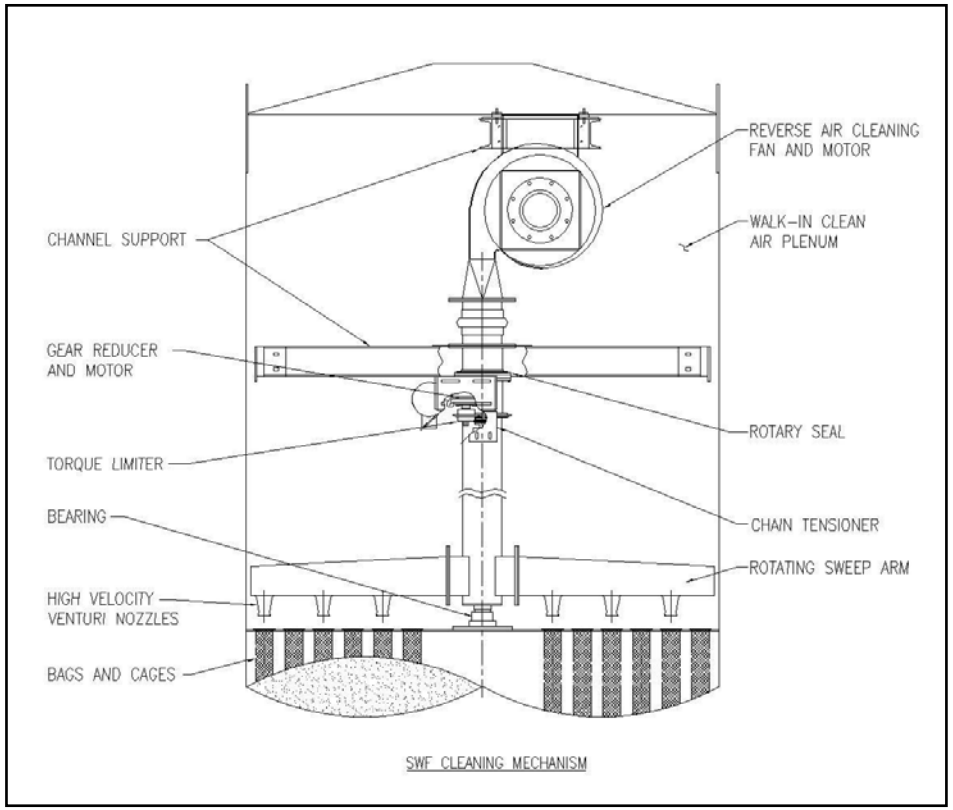
Dust Collection Equipment & Components

- Fabric Filter (Baghouse).
- Cyclone Collector (Alternative to a Baghouse).
- System Fan.
- Rotary Airlock Valve or Rotary Feeder.
- Convey Blower.
- Explosion Isolation.
- Ductwork.

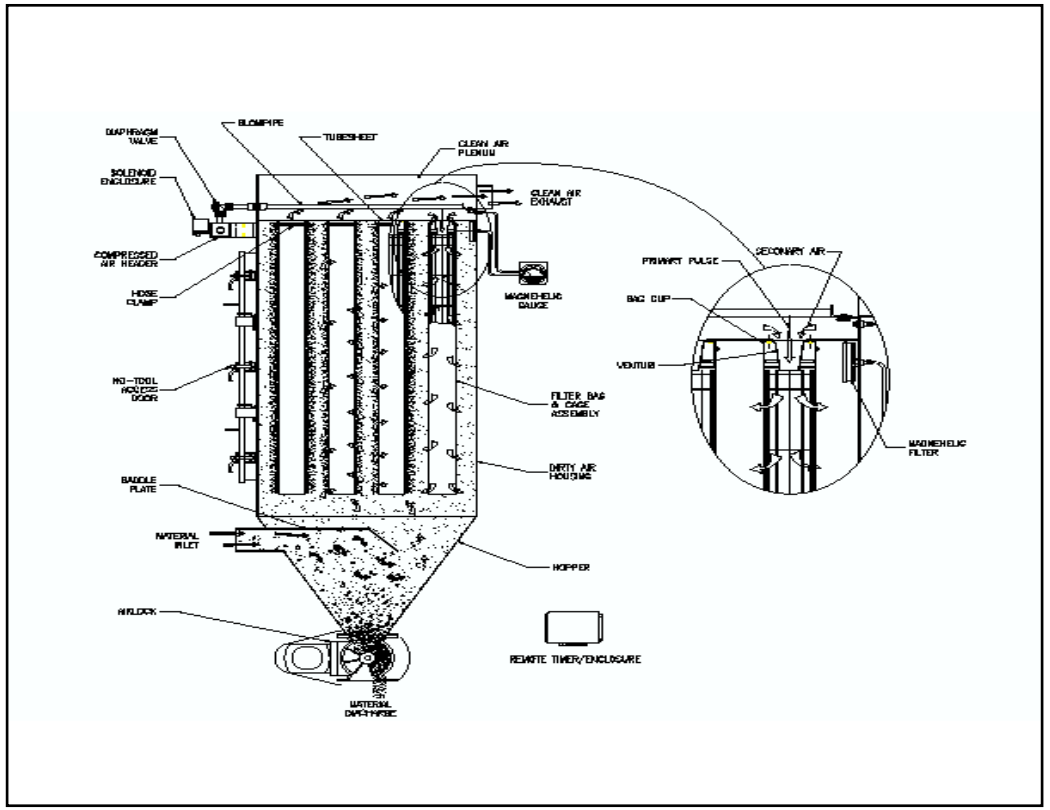
Fabric Filter (Medium-Pressure)



Fabric Filter (Low-Pressure Reverse-Air)



Fabric Filter (Pulse-Jet)



Fabric Filter Cleaning Energy Comparison

Examples: 50,000 CFM Selections at a 7 to 1 Air-to-Media Ratio

Cleaning Technology	Cleaning Horsepower
Medium-Pressure Reverse-Air	10
Low-Pressure Reverse-Air	20
High-Pressure Pulse-Jet	30

Fabric Characteristics & Suitability

	Polyester	Acrylic	Fiberglass	PPE	Ryton	P84
Max Temp.	275° F	265° F	500° F	400° F	375° F	500° F
Abrasion	Excellent	Good	Fair	Excellent	Good	Fair
Filtration Properties	Excellent	Good	Fair	Excellent	Very Good	Excellent
Moist Heat	Poor	Excellent	Excellent	Good	Excellent	Good
Alkalines	Fair	Fair	Fair	Good	Excellent	Fair
Mineral Acids	Fair	Good	Poor	Fair	Excellent	Good
Oxygen (+15%)	Excellent	Excellent	Excellent	Excellent	Poor	Excellent
Relative Cost	X	XX	XXX	XXXX	XXXXXX	XXXXXXX

Fabric Finishes

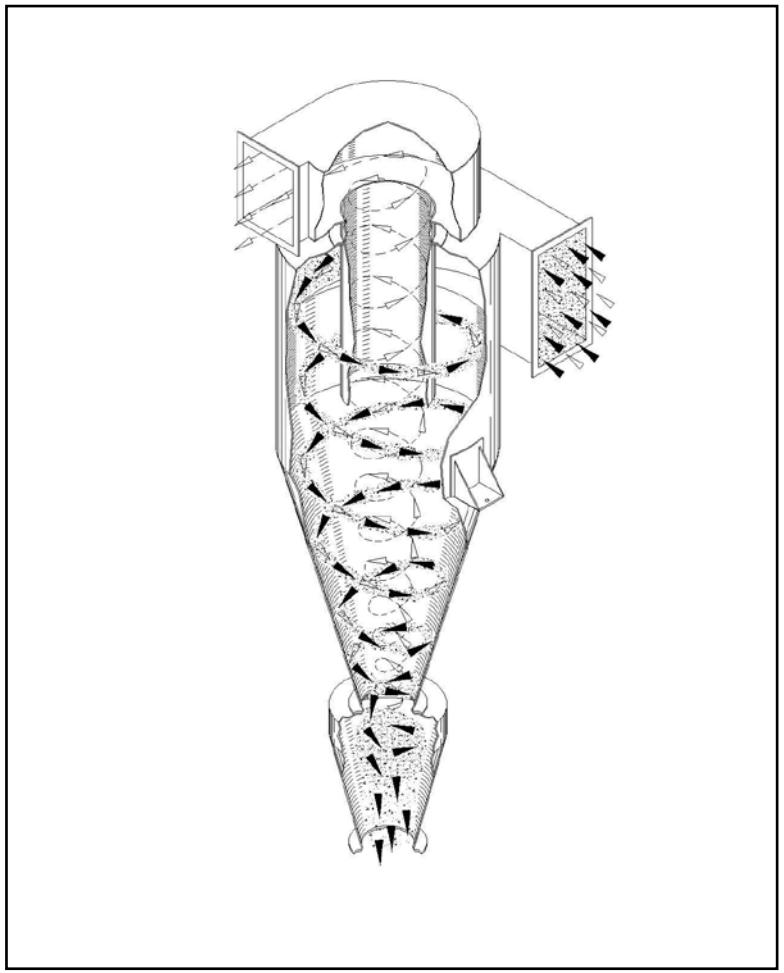
Finish:	Finish Purposes:	Available For:
Singe	Recommend for improved cake release.	Polyester, Polypropylene, Acrylic, PPE, Ryton and P84
Glaze	Provides short-term improvements for cake release. (May impede airflow)	Polyester, Polypropylene
Silicone	Aids initial cake development and provided limited water repellency.	Polyester
Acrylic Coating	Improves filtration efficiency and cake release.	Polyester and Acrylic
PTFE Penetrating Finish	Improved water and oil repellency: Limited cake release	Nomex & Polyester
PTFE Expanded Membrane	For capture of fine particulate, Improved filtration efficiency and cake release.	Nomex, Polyester, Acrylic, Polypropylene, P84, Ryton & Fiberglass.

Media Efficiency

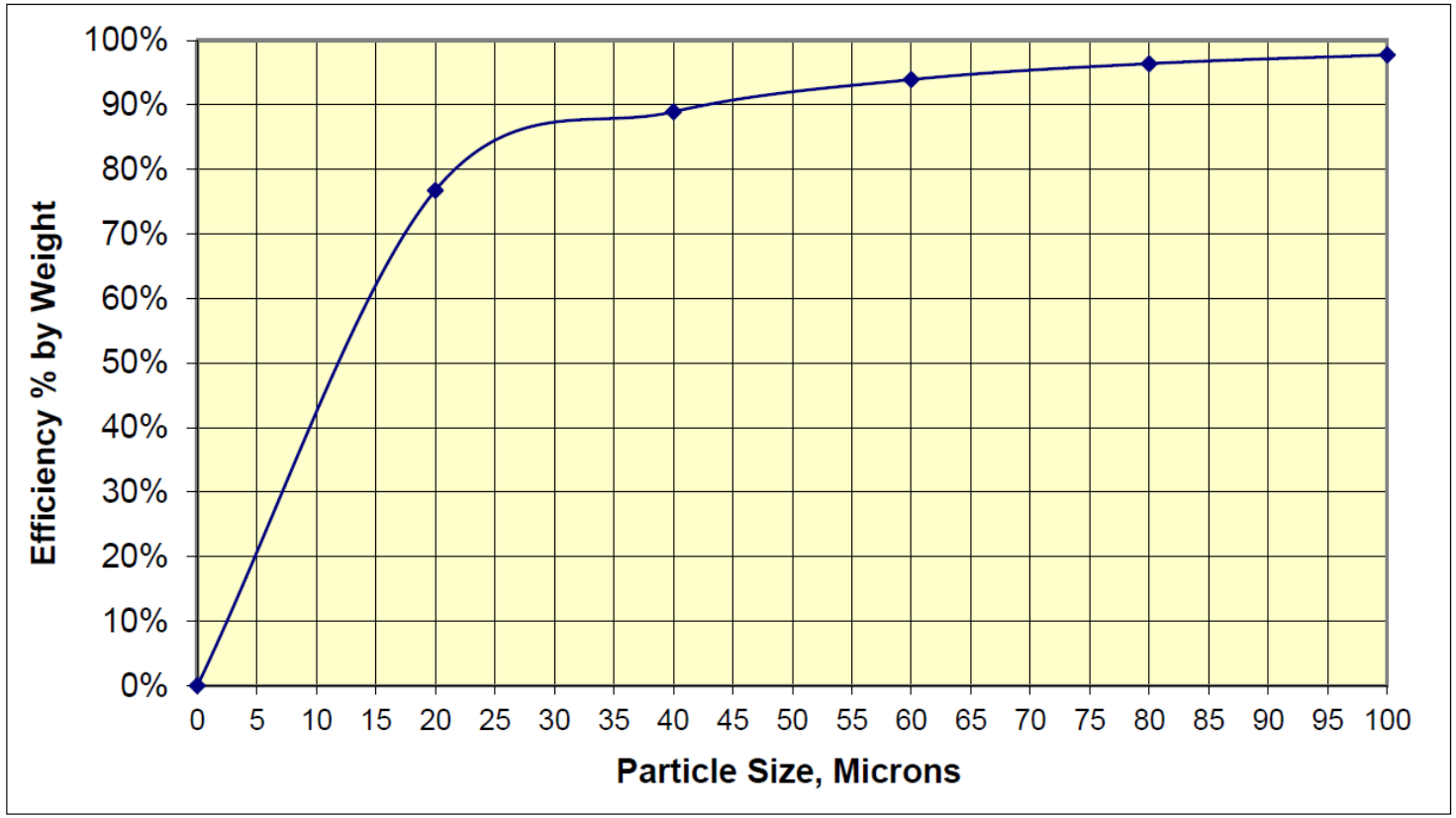
Media	Efficiency	Particle Size
Polyester, PPE, Ryton	0.005 grains/dscf	2.0 Micron
Micro Denier	0.002 grains/dscf	2.0 Micron
P84, PTFE Membrane	0.003 grains/dscf	0.5 Micron

Cyclone Collector

- Uses centrifugal forces to separate particulate matter from an air stream.



Cyclone Collector - Efficiency Curve

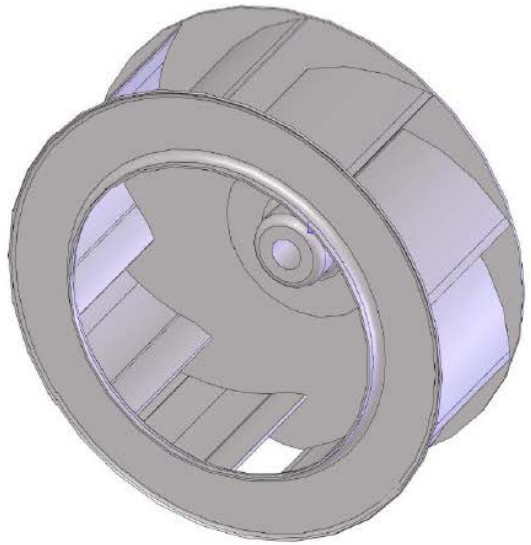


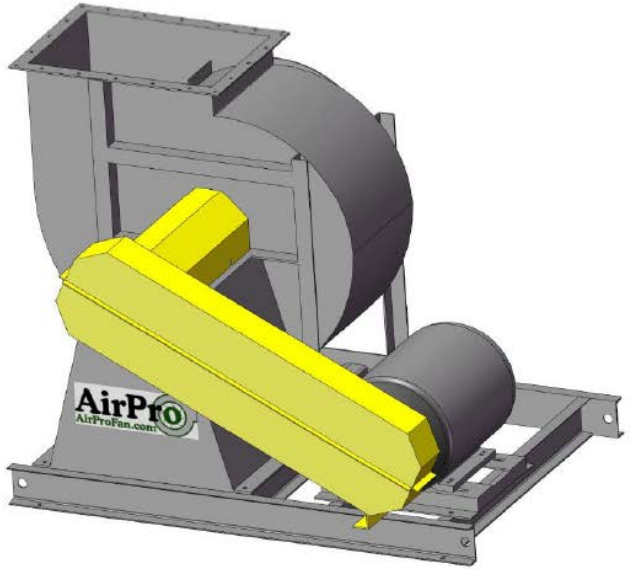
System Fan

- Airfoil wheel.
- Backward inclined wheel.
- Radial bladed air handling wheel.
- Radial bladed material handling wheel.

System Fan - Airfoil Wheel

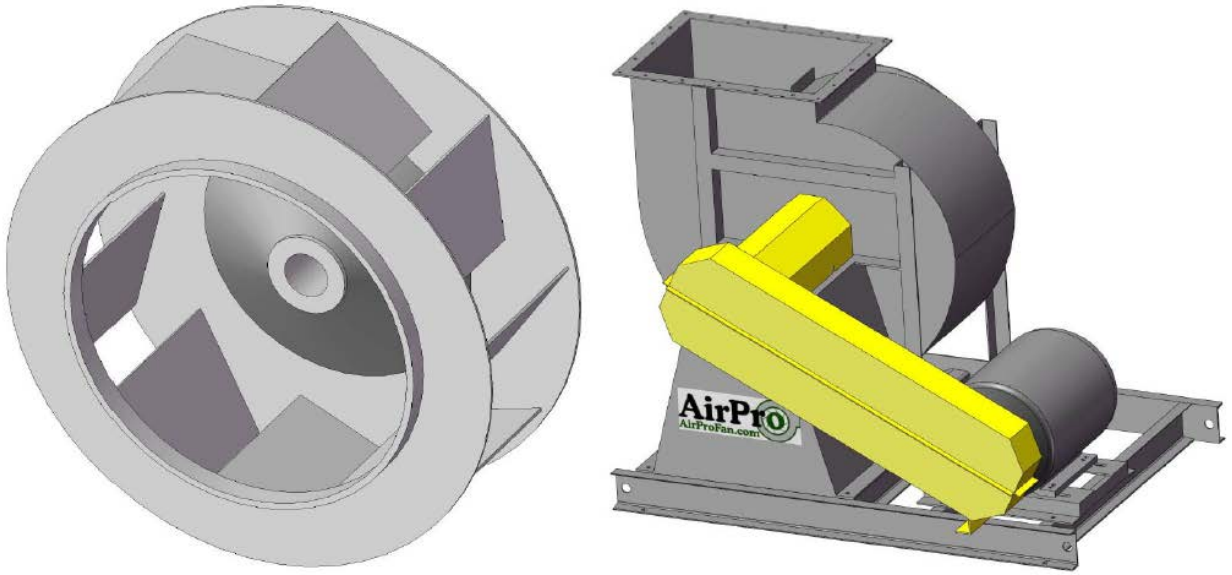
- Clean air only.
- Most efficient fan available.
- Lower operational sound levels.
- Lower energy costs.





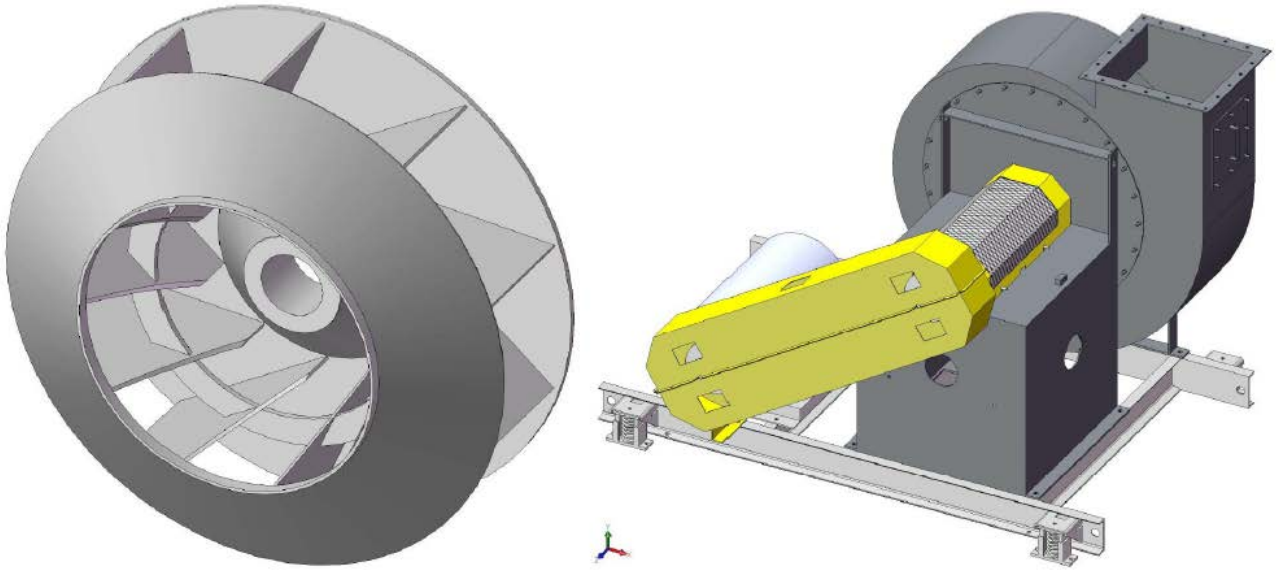
System Fan - Backward Inclined Wheel

- Clean air only.
- High efficiency.



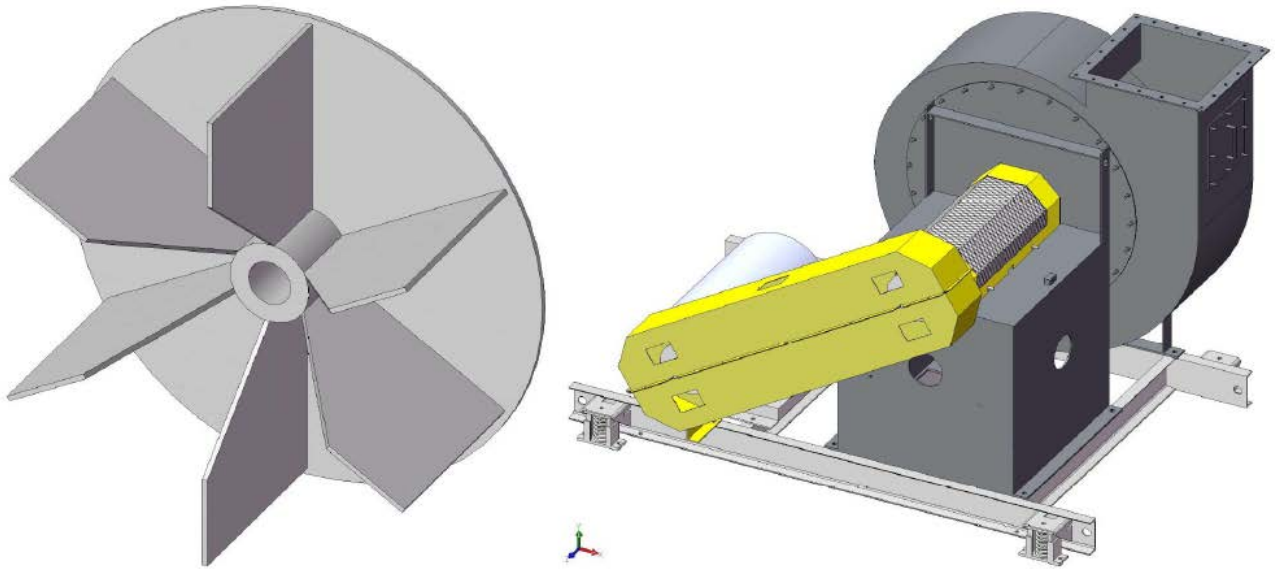
System Fan - Radial Bladed Air Handling

- Light dust / clean air applications.
- Most efficient radial bladed exhauster.



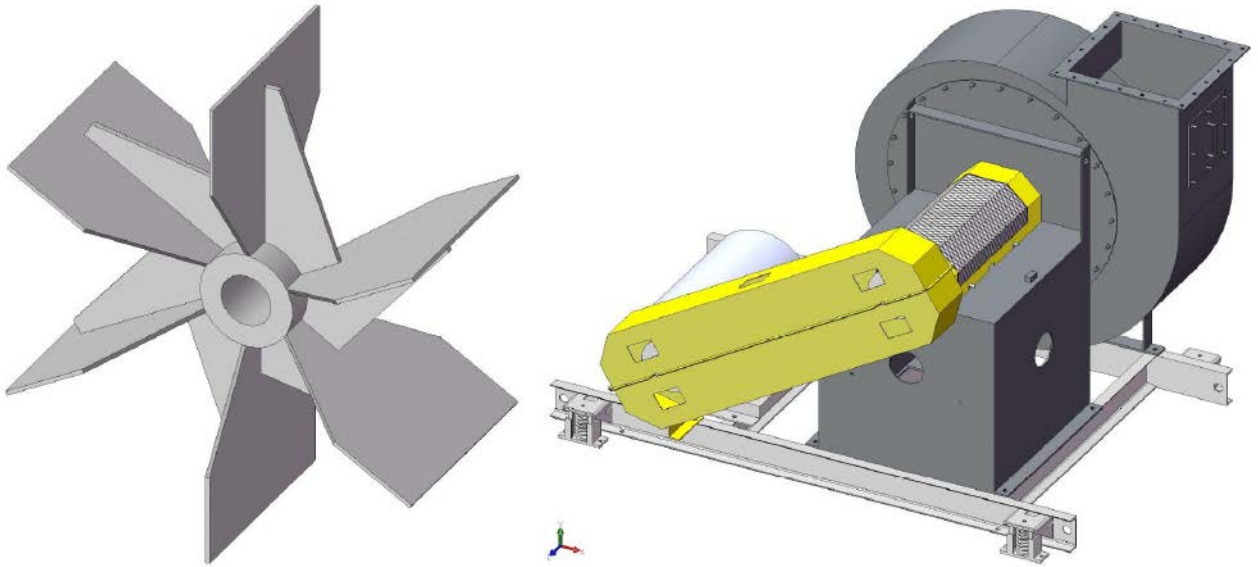
System Fan - Radial Bladed Material Handling

- Flat backplate.
- General material handling.
- Open radial blade design.



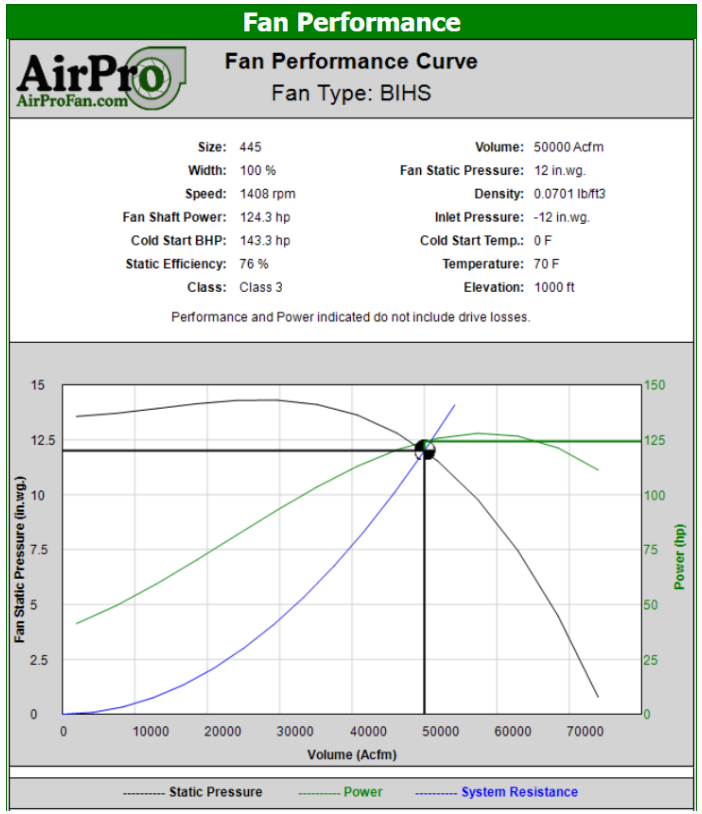
System Fan - Radial Bladed Material Handling

- Paddle wheel.
- General material handling.
- Open radial blade design.

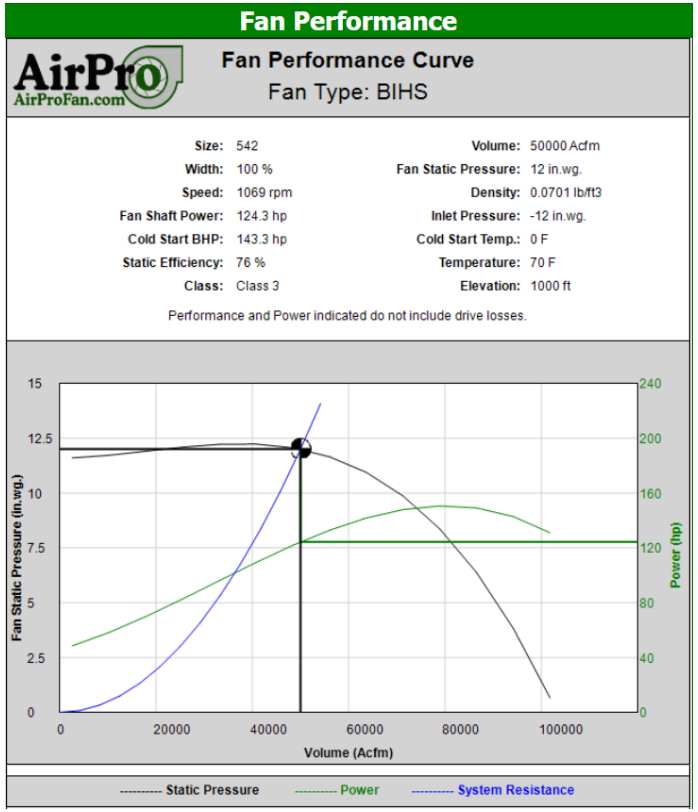


System Fan - Performance Curves

Good Fan Selection



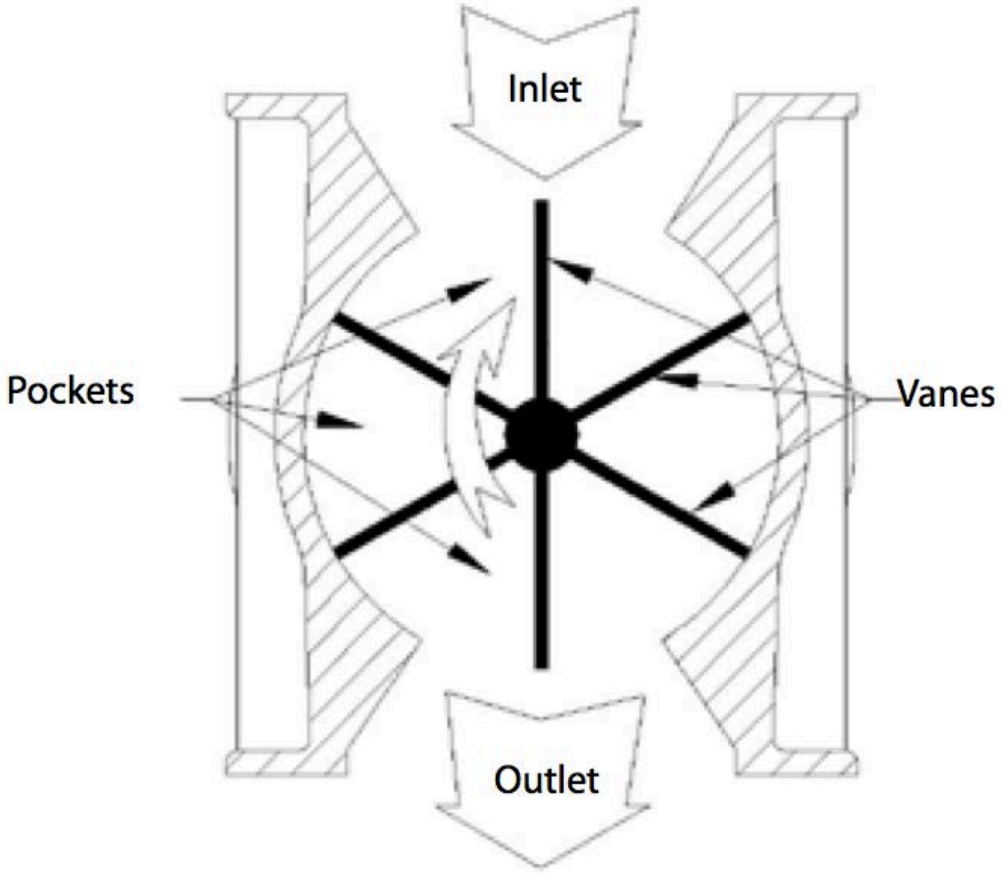
Poor Fan Selection



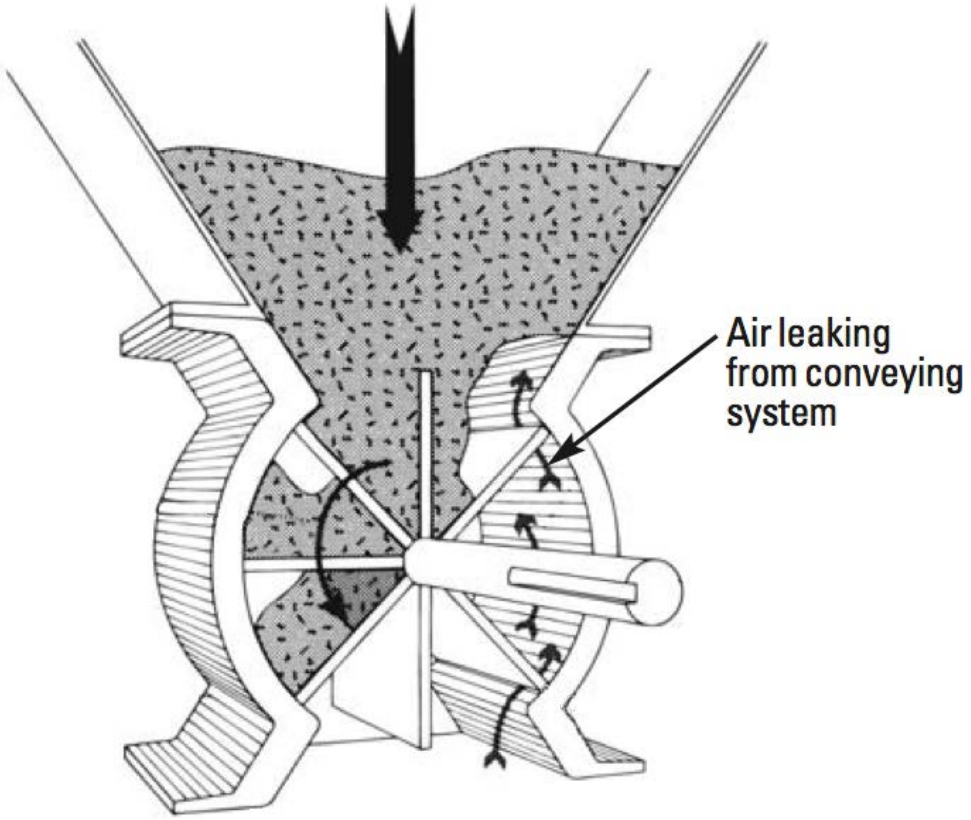
Rotary Airlock Valve or Rotary Feeder

Rotary Airlock Valve

- Airlocks are designed to:
  - Seal air between inlet and outlet ports.
  - Prevent air from travelling down with the material, or back up into the hopper.
  - Move material efficiently and predictably.
  - Maintain constant air pressure.

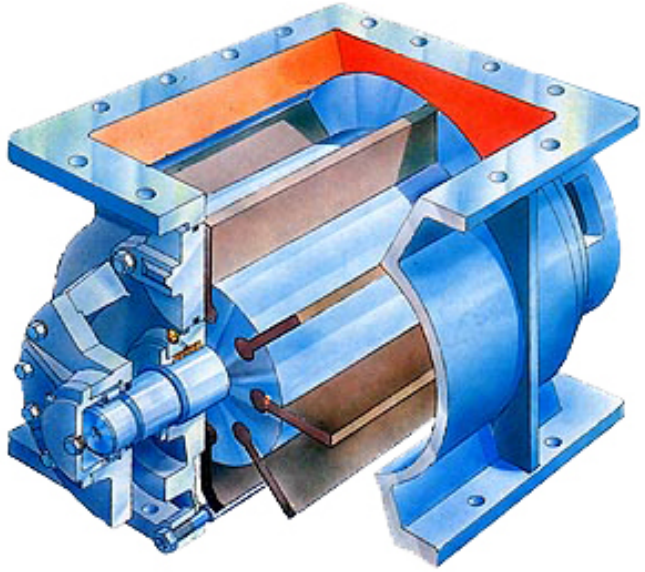


Airlocks - Are not Perfect Seals



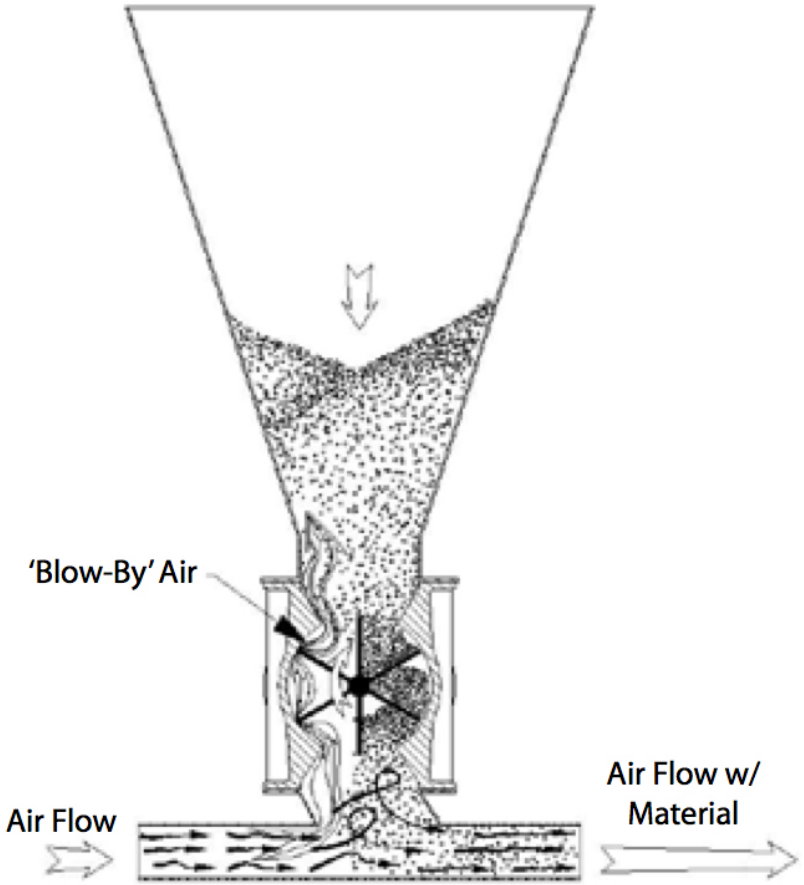
Types of Leakage - Clearance Leakage

- Rotor blades and housing cannot touch, need gap.
  - Source of leakage.
- Clearances calculated based on:
  - Speed.
  - High temperatures.
  - Displacement of the housing under the material load.



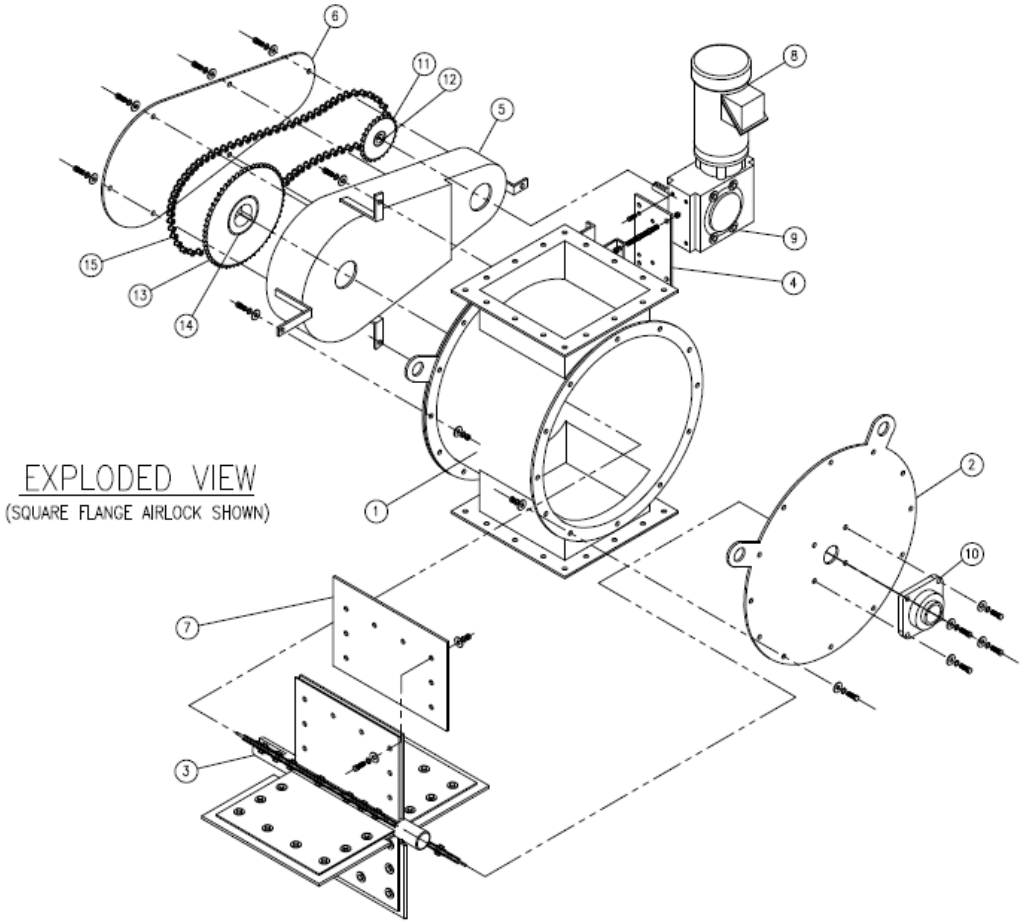
Types of Leakage - Pocket Leakage

- Material enters rotor pockets and displaces gas.
- Gas impedes material flow.
- Leakage determined by pressure differential across:
  - Valve.
  - Rotor pocket volume.
  - Product feed rate.
  - Valve shaft speed.



Rotary Feeder

NOT NFPA Compliant



Convey Blower

Convey Blower

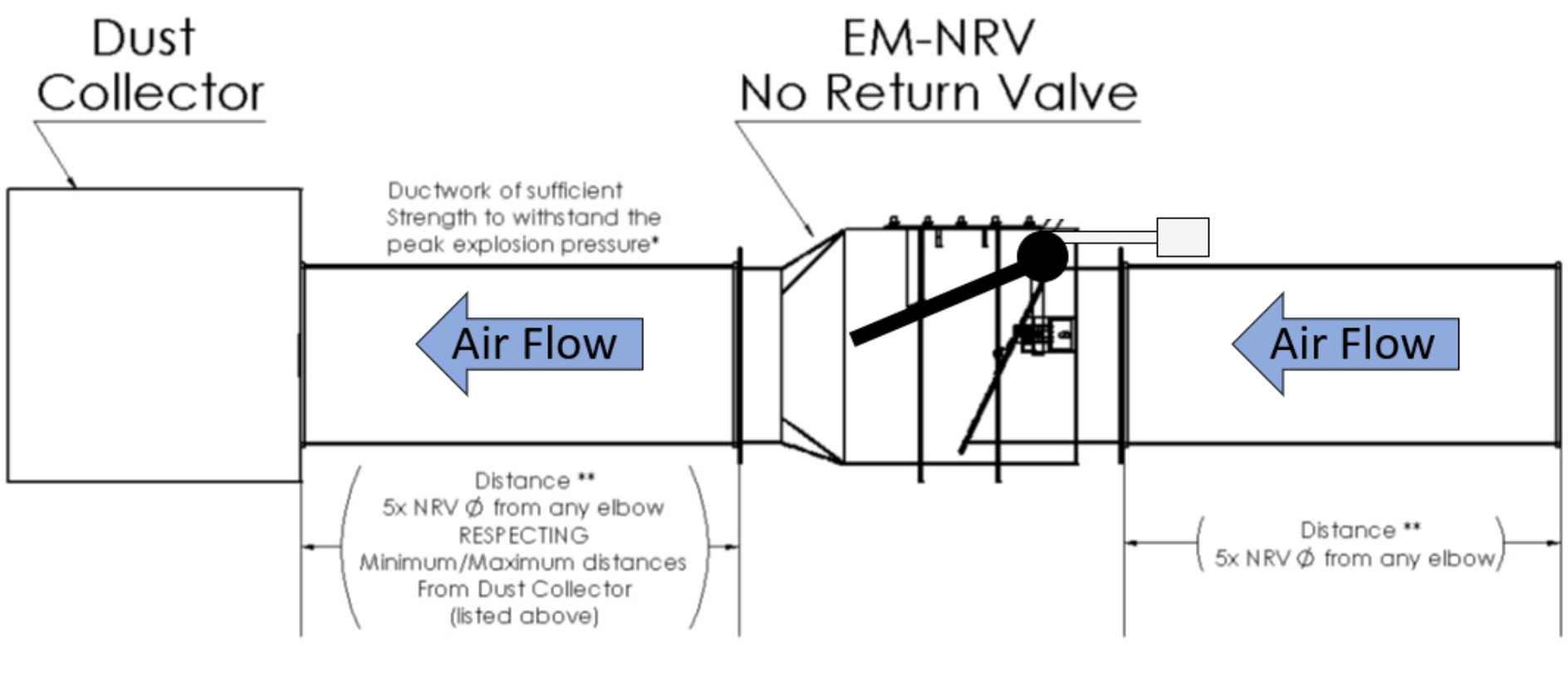
Proper Sizing and Selection

- Size 47 URAI is the Preferred Selection.

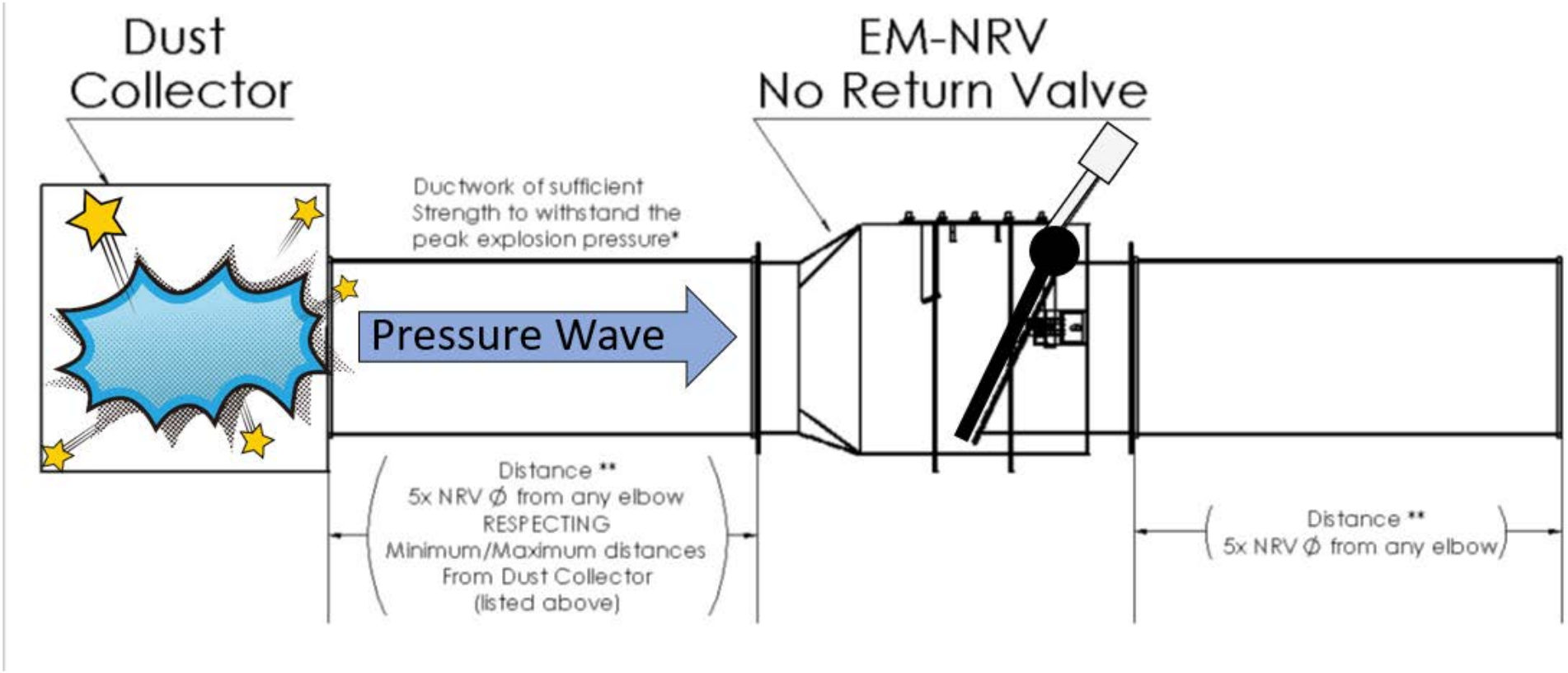
```
AMBIENT CONDITIONS:
    Gas                         AIR
    Relative Humidity           36%
    Molecular Weight            28.877
    k-Value                     1.396
    Specific Gravity            .997
    Ambient Temperature         68          deg F
    Ambient Pressure            14.3        PSIA
    Elevation                   750         feet
STANDARD CONDITIONS:
    Pressure                    14.7        PSIA
    Temperature                 68          deg F
    Relative Humidity           36          %

SELECTED UNIT DETAIL:  Model  47 URAI
                                            Design    Des/Max
    Speed, RPM                              2287      63.5%
    System Inlet Volume, ICFM               300
    Actual Blower Inlet Volume, ICFM        300       +/-5 %
    Standard Volume, SCFM                   292
    Mass/Weight Flow, #/min                 21.87     +/-5 %
    System Inlet Temperature, deg F         68.0
    System Inlet Pressure, PSIA             14.300
    Inlet Pressure Loss, PSI                0.000
    Blower Inlet Pressure, PSIA             14.300
    Blower Discharge Pressure, PSIA         18.300
    Discharge Press. Loss, PSI              0.000
    System Discharge Pressure, PSIG         4.000
    Blower Diff. Press., PSI                4.000     54.5%
    Power, BHP                              6.87      +/-4%
    Temperature Rise, deg F                 49.5      22.0%
    Discharge Temperature, deg F            117.5
    System Discharge Volume, ACFM           256
    Relief Valve Setting, PSIG              6.0       76.5%
    Power @ RV Setting, BHP                 10.06
    Temp. Rise @ Relief Setting, deg F      76.2      33.9%
    Disch. Temp @ Relief Setting, deg F     144.2
    V-Belt: Est. B10 Brg Life, hours        4099808
    Coupling: Est. B10 Brg Life, hours      4099808
    Est. Free Field Noise, dBa              83.6
     Measured as sound press. level per ISO 2151:2004E with +/-3 dBA tol.


SELECTION SUMMARY (OTHER AVAILABLE UNITS)
Size Unit Description      RPM          %RPM  %Pr.   BHP  Noise  %dT  VolEffic
  47 URAI                  2287  2397   64%   54%   6.87  83.6   22%   82.2%
  45 URAI                  2904  3044   81%   40%   6.91  87.2   22%   85.4%
  36 URAI                  3404  3122   95%   54%   7.16  87.6   22%   86.4%
```

Explosion Isolation

Explosion Isolation



Explosion Isolation



Ductwork

Ductwork

Ductwork and Hoods

Recommended Velocities

- Hood Face Velocity: Minimum capture velocity is 200 fpm with an optimum (typical) range of 300 - 500 fpm.
- Ductwork Transport Velocity: An acceptable range of 3,500 - 4,500 fpm with an optimum preferred velocity of 4,000 fpm.

Maintenance

- Safety.
- Safety.
- Safety.

Sample Maintenance Schedule

Daily:

- Check Magnehelic gauge readings on all filters.
- Check for dust in clean-air outlet from filter.
- Check filter hoppers for continuous discharge of dust.

Sample Maintenance Schedule

Weekly:

- Check and record Magnehelic gauge readings on all filters.
- Check fan and motor bearings for excessive heat or vibration.
- If high-pressure pneumatic conveying equipment is used to dispose of dust, check the positive-displacement pump for vibration, overheating and proper lubrication. Also compare reading on pressure gauge with previous readings. Clean air inlet filter or replace, as necessary. It is important to follow the manufacturer's recommendation on this piece of equipment.

Sample Maintenance Schedule

Monthly (or at manufacturer's recommended intervals):

- Check oil in all gearmotors - do not overfill.

Sample Maintenance Schedule

Six Months:

- Check explosion vents on all filters.
- Check belt tension on all v-belt drives.
- Check collector wall thickness (Ultrasonic Thickness Gauge is an accurate, non-destructive tool for this).

Do Not Let This Happen to You!

Regulatory / Compliance

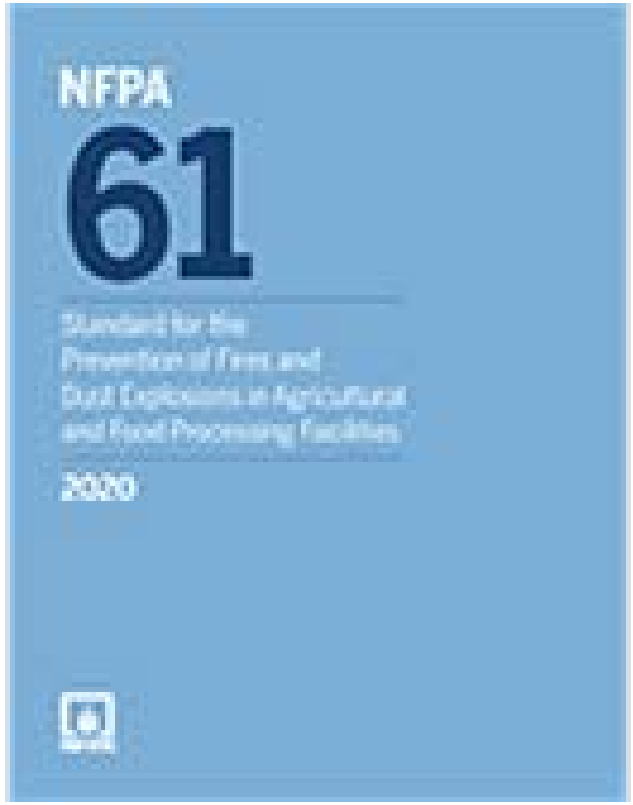
NFPA Official Definition. Authority Having Jurisdiction.

The Authority Having Jurisdiction or AHJ is an organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

- OSHA.
- Factory Mutual.
- Fire Marshal.
- Company Official.

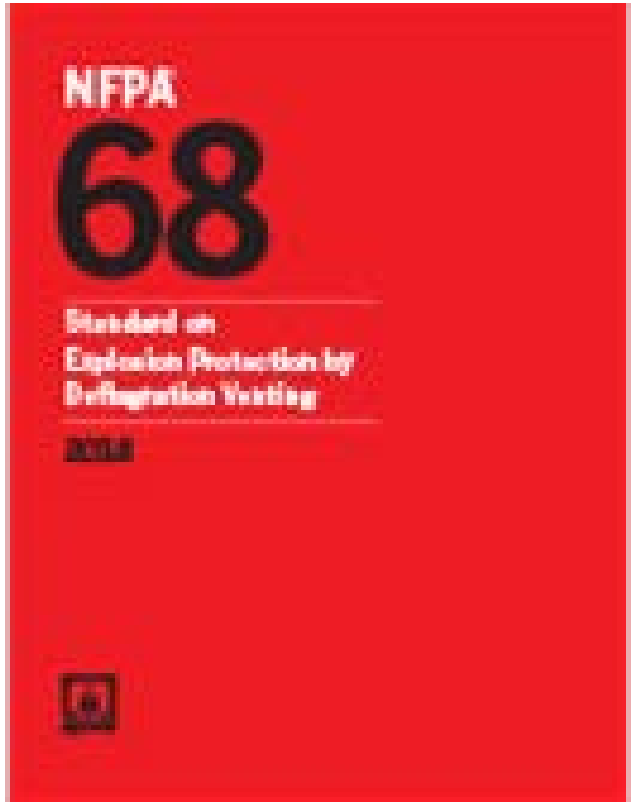
Regulatory / Compliance

- NFPA 61, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities.



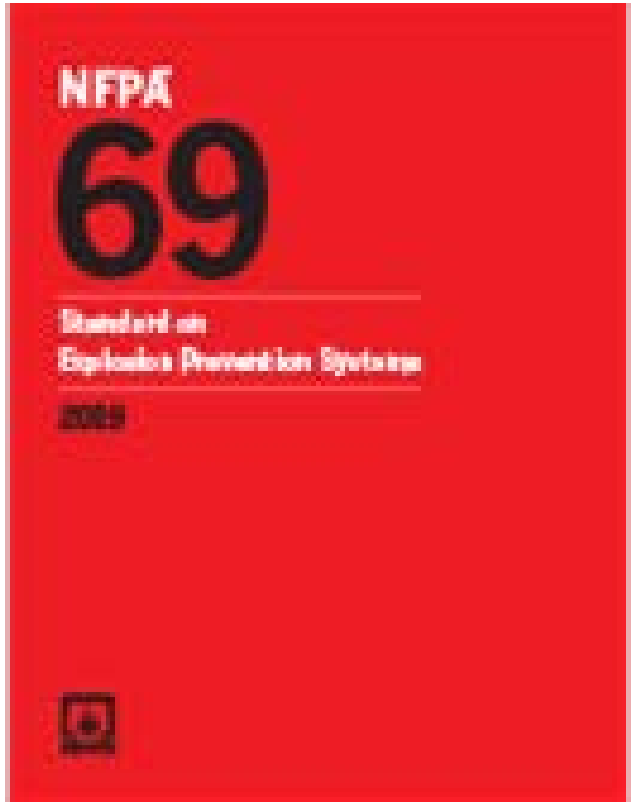
Regulatory / Compliance

- NFPA 68, Standard on Explosion Protection by Deflagration Venting.



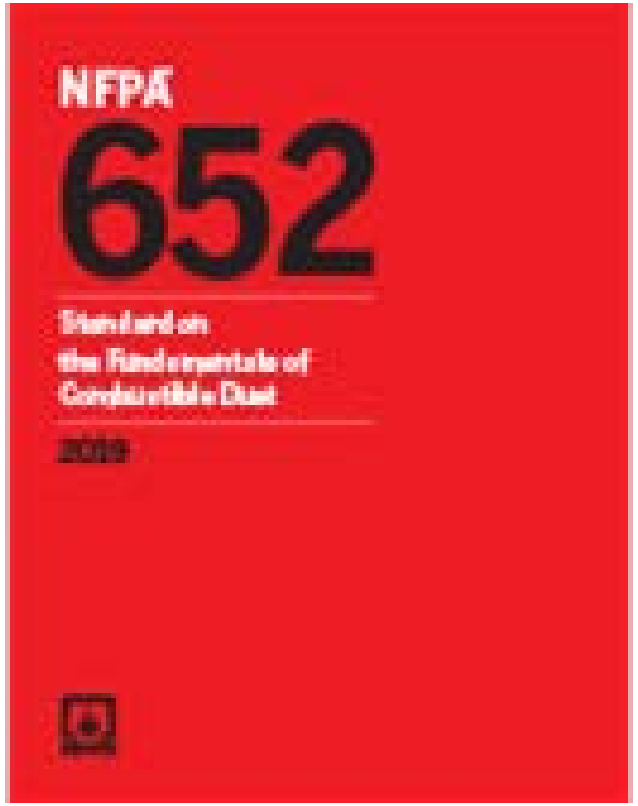
Regulatory / Compliance

- NFPA 69, Standard on Explosion Prevention Systems.



Regulatory / Compliance

- NFPA 652, Standard on the Fundamentals of Combustible Dust.



Questions?

<u>Contact</u>

E-mail us at:

tracyj@camcorpinc.com

References

- AP 42, Fifth Edition, Volume I
  Chapter 9: Food and Agricultural Industries
  http://www.epa.gov/ttn/chief/ap42/ch09/final/c9s0909-1.pdf.
- Pneumatic Dust Control in Grain Elevators: Guidelines For Design Operation and Maintenance – Publication NMAB 367-3.

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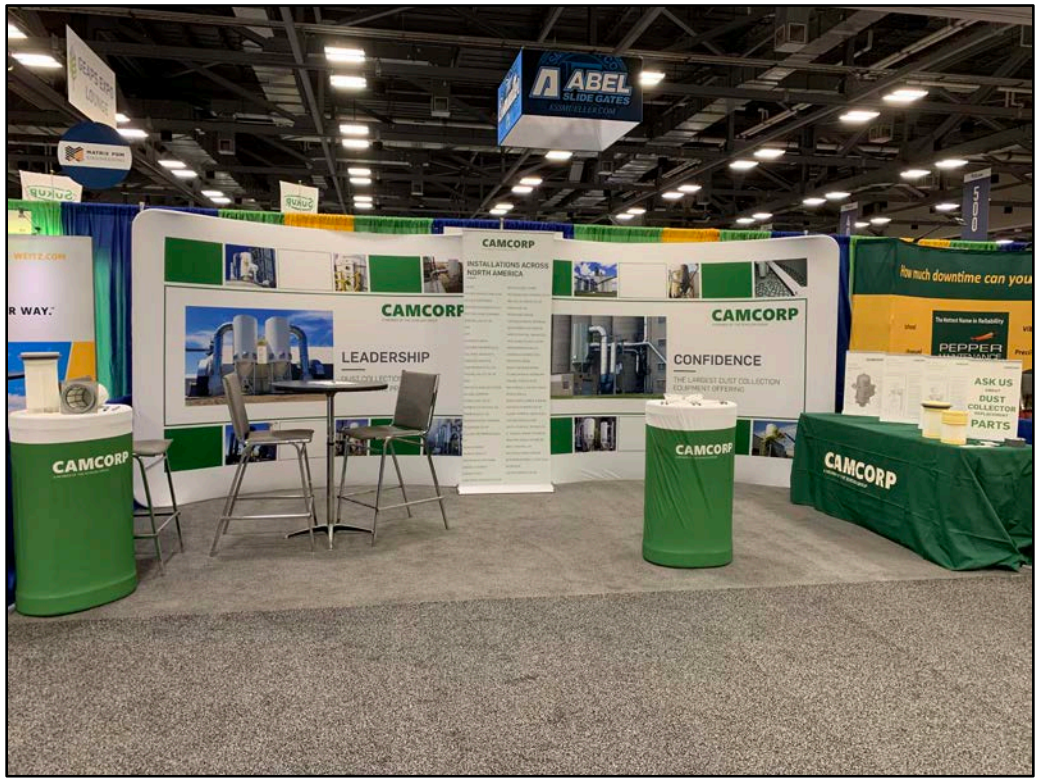

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